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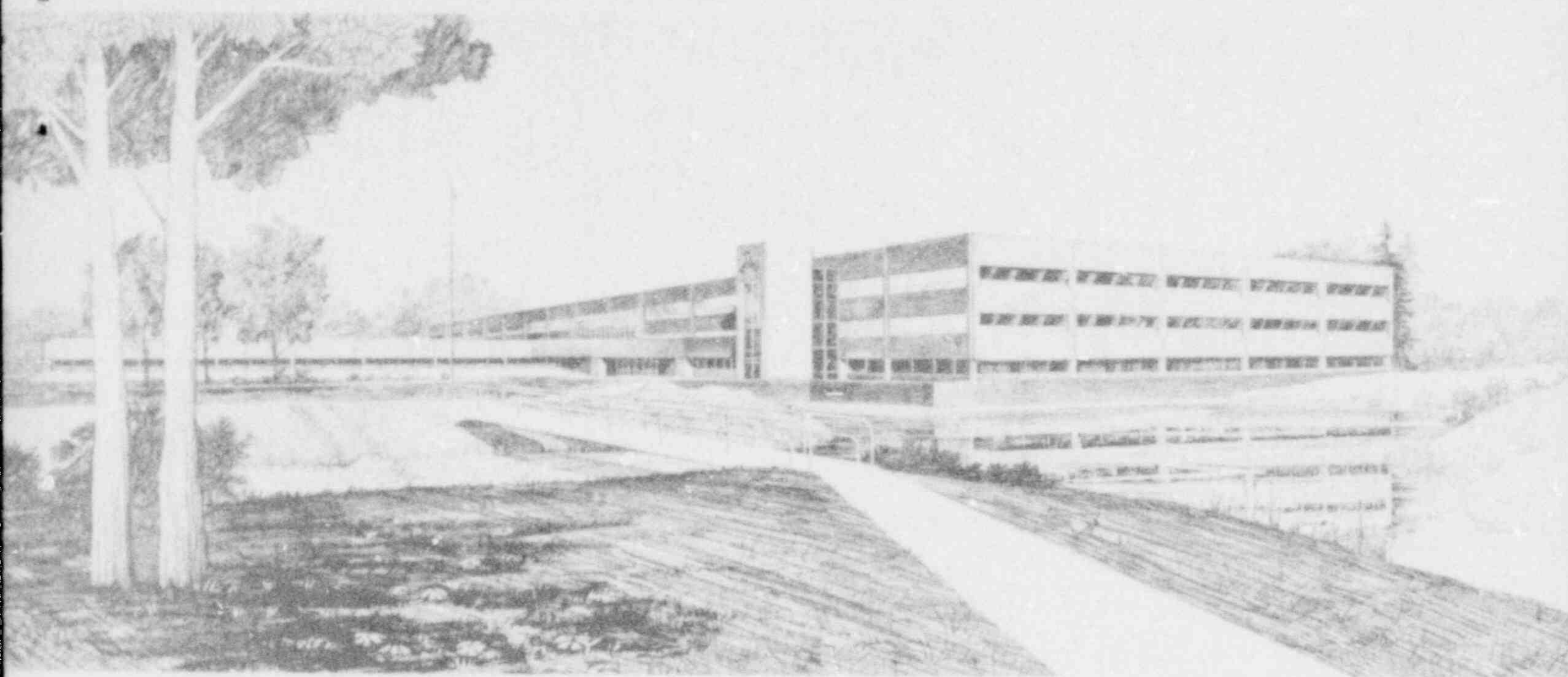
EGG-2021



U.S. Department of Energy
Idaho Operations Office • Idaho National Engineering Laboratory

Experiment Data Report for Semiscale Mod-3 Small Break Test Series (Tests S-SB-4 and S-SB-4A)

Manuel N. Arevalo
Kenneth E. Sackett

April 1980

Prepared for the
U.S. Nuclear Regulatory Commission
Under DOE Contract No. DE-AC07-76IDO1570

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and

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NUREG/CR-1293
EGG-2021
Distribution Category: R2

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FIN No. A6038

ABSTRACT

Recorded test data are presented for Tests S-SB-4 and S-SB-4A of the Semiscale Mod-3 Small Break Test Series. These are two of several Semiscale tests conducted to investigate the thermal-hydraulic phenomena resulting from a small break loss-of-coolant accident (LOCA) in a pressurized water reactor (PWR) system and to provide experimental data that can be used to assess the analytical capability of computer codes used in LOCA analysis. The primary objective of these tests is to determine the effect of Loss-of-Fluid Test (LOFT) initial conditions and configuration on system behavior during a small break loss-of-coolant experiment. Other objectives are to provide data for comparison with similar tests to be run in the LOFT facility and to investigate scaling effects pertinent to LOFT. Tests S-SB-4 and S-SB-4A were conducted from initial conditions of closely approximating the specified initial conditions of 14.86 MPa and 557 K core inlet temperature with a core power level of 1.2 MW. This report's purpose is to make the uninterpreted data from Tests S-SB-4 and S-SB-4A available for future data analysis. The data, presented in the form of graphs in engineering units, have been analyzed only to the extent necessary to ensure that they are reasonable and consistent.

SUMMARY

Tests S-SB-4 and S-SB-4A were performed as part of the Semiscale Mod-3 portion of the Semiscale Program conducted by EG&G Idaho, Inc., for the United States Government. These tests were part of the Mod-3 Small Break Test Series performed to investigate the thermal-hydraulic phenomena resulting from a small break loss-of-coolant accident (LOCA) in a pressurized water reactor (PWR) system and to provide experimental data that can be used to assess the analytical capability of computer codes used in LOCA analysis. The primary objective of Tests S-SB-4 and S-SB-4A is to identify the effect of Loss-of-Fluid Test (LOFT) initial conditions and configuration on system behavior during a small break loss-of-coolant experiment (LOCE). Other objectives are to provide data for comparison with results from similar tests to be run in the LOFT facility, and to investigate scaling effects pertinent to LOFT.

The Mod-3 system was equipped with a pressure vessel which contained an electrically heated core and other simulated reactor internals, and an external downcomer assembly; an intact loop with steam generator, pump, and pressurizer; a broken loop with steam generator, pump, and rupture assembly; and a pressure suppression system with header, suppression tank, and steam supply system. High-pressure and low-pressure coolant injection pumps and a coolant injection accumulator were provided for the intact loop.

The specified initial conditions for Tests S-SB-4 and S-SB-4A were a system pressure of 14.86 MPa and a core inlet temperature of 557 K, with a core differential temperature of 20 K. Semiscale pumps are not large enough to produce the volume scaled LOFT flow rate, so the pumps were run with the maximum flow rate attainable and a lower core power level (1.2 MW) was used to maintain the desired fluid temperatures. The decay power, however, was volume scaled to the LOFT decay power to achieve the desired volume to power ratio. The simulated (2.5%) small break was located on the centerline of the broken loop cold leg and was volume scaled to represent an 11-cm break in a PWR. After initiation of blowdown, power to the electrically heated core was reduced to simulate the predicted heat flux response of nuclear fuel rods during a LOCE.

Tests S-SB-4 and S-SB-4A were generally conducted as specified. Conditions which did not conform to the specified test configuration were considered acceptable for analysis purposes within the test objectives. Of 217 and 215 measurements taken for Tests S-SB-4 and S-SB-4A, respectively, 211 and 204 produced usable data.

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EXPERIMENT DATA REPORT FOR SEMISCALE MOD-3 SMALL BREAK TEST SERIES (TESTS S-SB-4 AND S-SB-4A)

I. INTRODUCTION

The Semiscale Mod-3 experiments represent the current phase of the Semiscale Program conducted by EG&G Idaho, Inc., for the United States Government. The program, which is sponsored by the Nuclear Regulatory Commission through the Department of Energy, is part of the overall NRC program designed to investigate the response of a pressurized water reactor (PWR) system to a hypothesized loss-of-coolant accident (LOCA). The underlying objectives of the Semiscale Program are to quantify the physical processes controlling system behavior during a LOCA and to provide an experimental data base for assessing reactor safety evaluation models. The Semiscale Mod-3 Program has the further objective of providing support to other experimental programs in the form of instrumentation assessment, optimization of test series, selection of test parameters, and evaluation of test results.

Tests S-SB-4 and S-SB-4A were conducted November 6 and 8, 1979, in the Semiscale Mod-3 System as part of the Small Break Test Series (Test Series SB). This series was designed to investigate the thermal-hydraulic phenomena resulting from a small break LOCA in a PWR system and to provide experimental data with which to assess the analytical capability of computer codes to predict PWR system behavior during a small break LOCA. The primary objective of Tests S-SB-4 and S-SB-4A was to determine the effect of LOFT initial conditions and configuration on system behavior during a small break loss-of-coolant experiment. Other objectives are to provide data for comparisons with results from similar tests to be conducted in the LOFT facility and to investigate scaling effects pertinent to LOFT. Hardware configuration and test parameters were selected to simulate conditions and response of the LOFT system.

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. The following section briefly describes the system configuration, procedures, and initial test conditions, and events that are applicable to Tests S-SB-4 and S-SB-4A; the Data Presentation section consists of the data graphs and provides comments and supporting information necessary for interpretation of the data. A description of the overall Semiscale Program and test series and a more detailed description of the Semiscale Mod-3 system, are given in References 1 and 2. Additional information describing the data acquisition system capabilities, posttest adjustments made to the data, and the methodology used to establish uncertaintly limits for the data are given in the three appendixes.

II. SYSTEM, PROCEDURES, CONDITIONS, AND EVENTS FOR TESTS S-SB-4 AND S-SB-4A

The following system configuration, procedures, initial test conditions and events are specific to Tests S-SB-4 and S-SB-4A as indicated.

1. System Configuration and Test Procedures

The Semiscale Mod-3 system used for these tests consisted of a pressure vessel with simulated reactor internals, including a 25-rod core with 22 electrically heated rods and an external downcomer assembly; an intact loop with pressurizer, steam generator, and pump; and a broken loop with a steam generator, pump, and rupture assembly. A valve was installed between the break and the broken loop pump to simulate the noncommunicative break in the inactive broken loop hot leg of the LOFT configuration. The system also had high- and low-pressure coolant injection pumps and coolant injection accumulator for the intact loop and a pressure suppression system with header, suppression tank, and steam supply system. Reference 2 further describes the Semiscale Mod-3 system. The system configuration for these tests is shown in Figures 1 and 2.

Twenty-two rods of the 25-rod core were operated at a rod peak power density of 23.1 kW/m. The total core power was 1.2 MW. Two rods were unpowered, and another rod was replaced by a liquid level probe.

In preparation for the tests, the system was filled with treated demineralized water and vented at strategic points to ensure a liquid-full system. Treated demineralized water in the steam generator feedwater tank was heated to 495 K, and the required liquid levels were established in the steam generator secondary sides. Prior to warmup the system was checked for leakage and system instrumentation checkout was performed. Warmup to initial test conditions was accomplished with the heaters in the core. During warmup, the purification and sampling systems were valved into the primary system to maintain water chemistry requirements and to provide a water sample at system conditions for subsequent analysis. At 50-K temperature intervals during warmup, detector readings were sampled to allow the integrity of the measurement instrumentation and the performance of the data acquisition system to be checked.

Prior to the establishment of the initial core power level, the accumulator for the intact loop was filled with treated demineralized water, drained to specified levels, and pressurized to 4.14 MPa[a] with nitrogen; and the pressure suppression system was pressurized to 0.65 MPa with saturated steam from the steam supply system. After the core power was increased to 1.2 MW, initial test conditions were held for approximately 600 s to establish system equilibrium. At the end of this period all auxiliary systems were isolated to prevent blowdown through those systems.

A successful simulated small cold leg break, through a rupture assembly and blowdown nozzle having a total break area of 0.0613 cm^2, was accomplished. Pressure to operate the rupture assembly and initiate blowdown was taken from an accumulator system filled with water and pressurized with gaseous nitrogen to 15.6 MPa. Immediately (within 0.02 s) after initiation of pressure to operate the rupture assembly, the lines to the accumulator were again isolated. During blowdown the effluent was ejected from the primary system to the pressure suppression system which was vented to maintain a constant pressure of 0.650 MPa for 300 s after blowdown, ramped down to 0.30 MPa during the next 30 s, and maintained at 0.30 MPa until the primary system pressure reached 12.0 MPa. At this time the suppression system pressure was reduced to 0.10 MPa for the remainder of the test. At blowdown the intact loop circulation pump speed followed a predetermined curve for 40 s, at which time power was tripped and the pump allowed to coast down. The broken loop circulation pump power was tripped 1.5 s before rupture initiation. During the blowdown, transient power to the electrically heated core was automatically controlled to simulate the thermal response of nuclear fuel rods. The core power decay curve for Test S-SB-4A was different from that of Test S-SB-4 in that control was manual, and core power was kept sufficiently high to overcome previously calculated heat

a. All pressures are presented in absolute values.

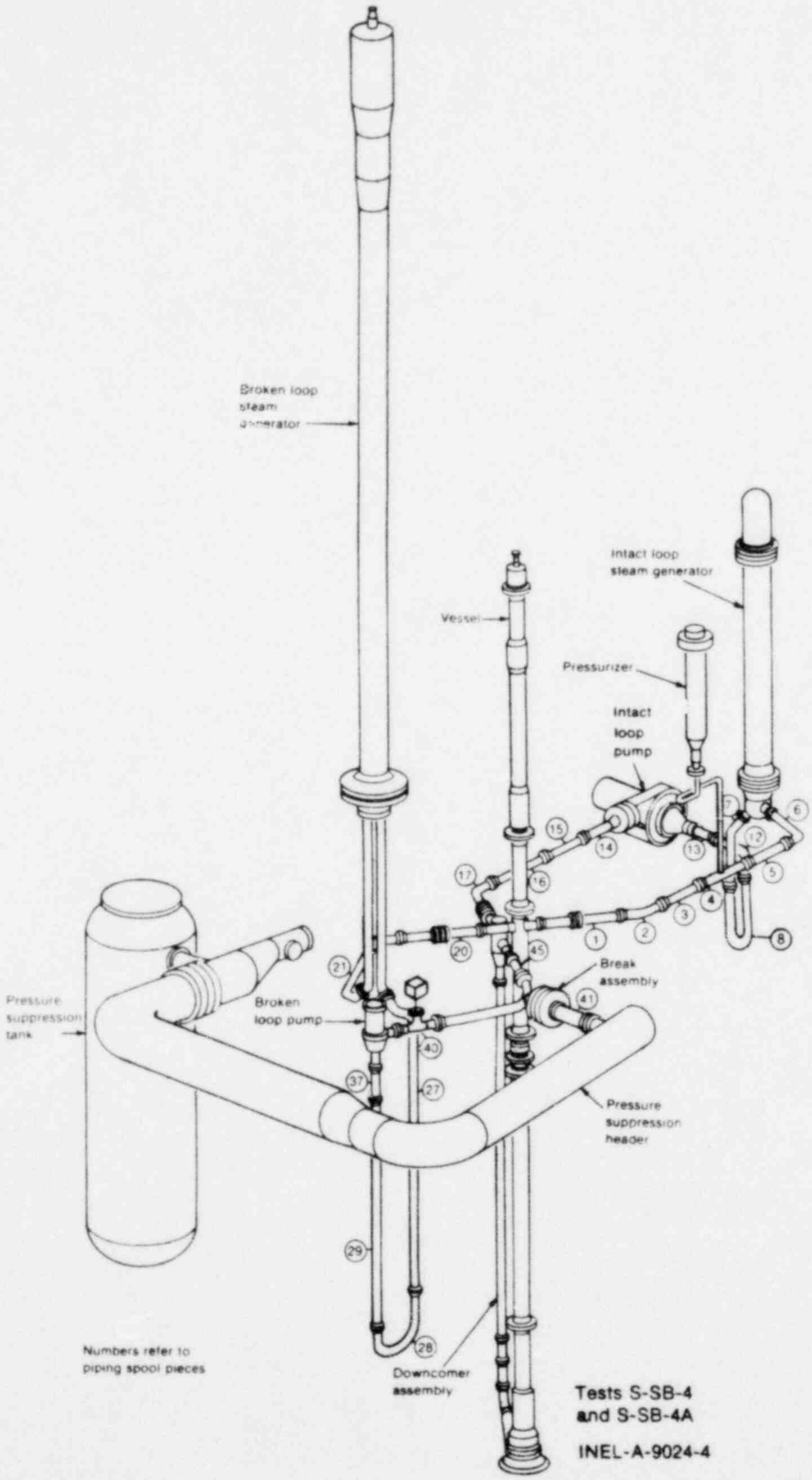


Figure 1. Semiscale Mod-3 system for cold leg break configuration—isometric.

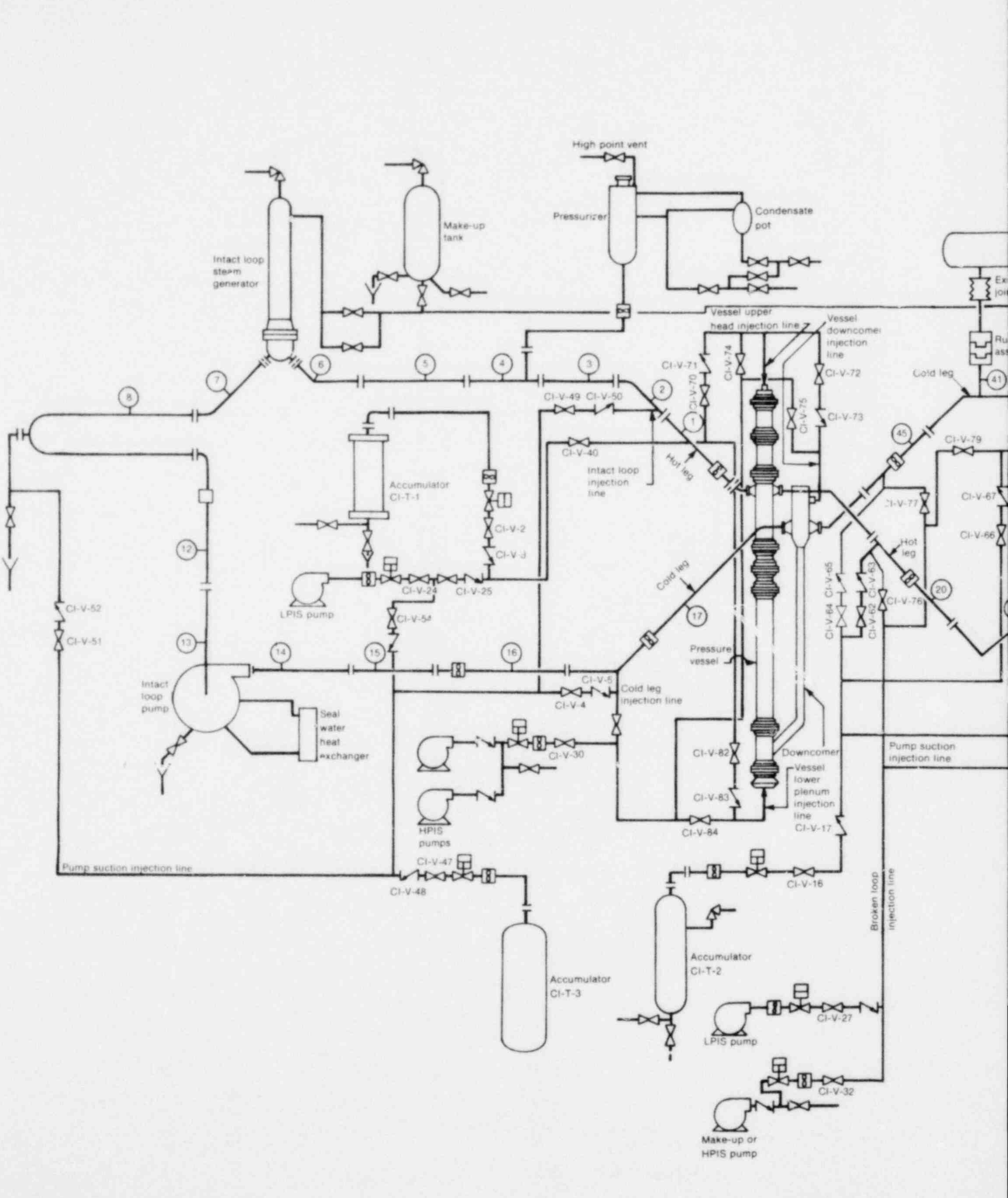
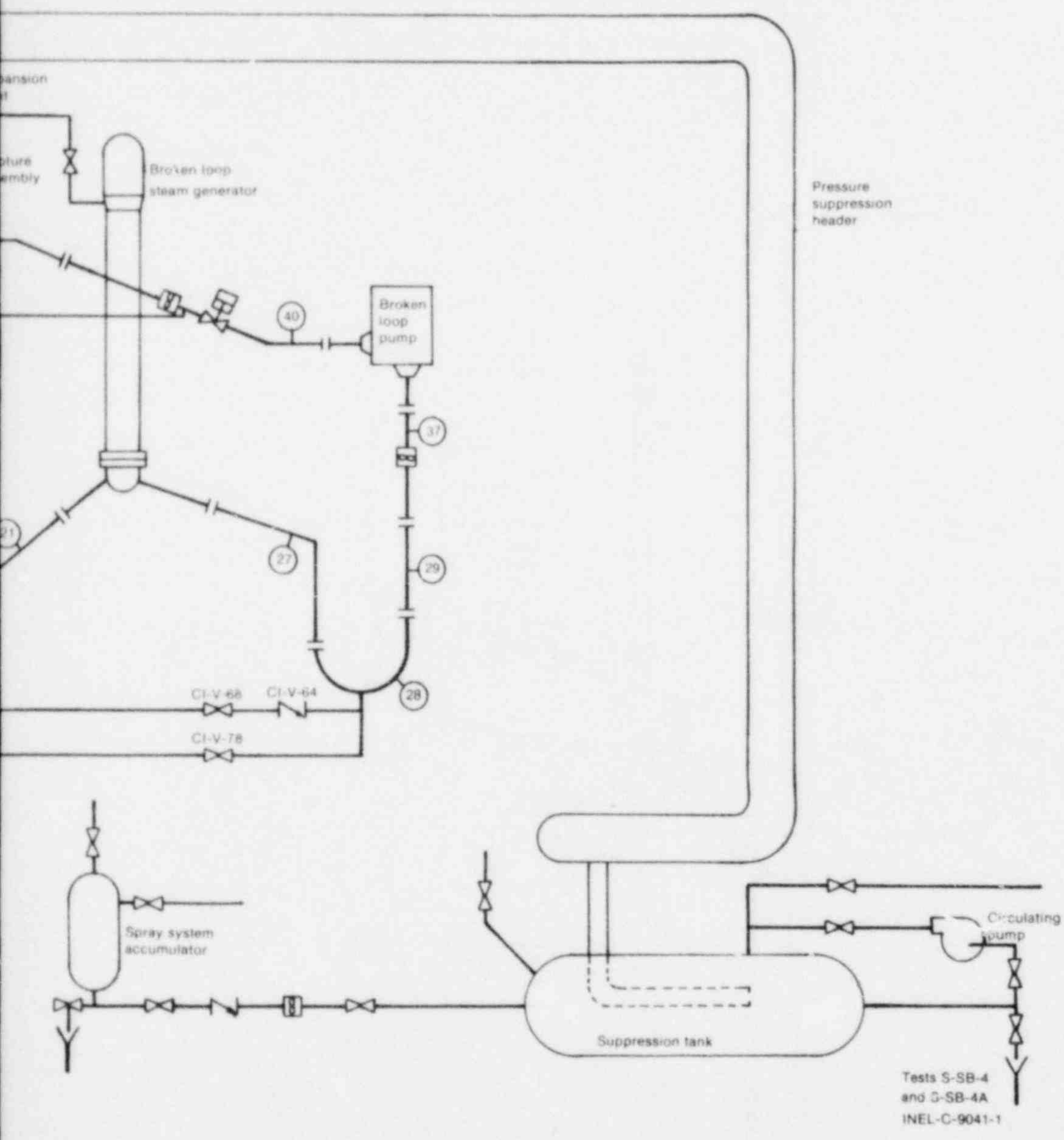


Figure 2. **Semiscale Mod-3 system for cold leg break configuration—sc**


Broken loop steam generator
Pressure suppression header
Broken loop pump
40
37
29
27
28
CI-V-68
CI-V-64
CI-V-78
Spray system accumulator
Suppression tank
Circulating pump
Tests S-SB-4 and S-SB-4A
INEL-C-9041-1

hematic.

losses. This difference is reflected in the core power[a] as well as step functions in the output of other detectors. At 2592 s into Test S-SB-4 the power to the low-power bus was lost and remained off for 198 s. The high-power bus attempted to make up this power loss resulting in temperature and pressure increases in much of the system.

For both tests the coolant injection systems were arranged to discharge into the cold leg of the intact loop. The high-pressure injection pumps were started at blowdown initiation, with coolant injection starting at a system pressure of 13.1 MPa. The injection rate varied with decreasing system pressure, according to a specified curve, to the end of the test. Low-pressure coolant injection was initiated at 3500 s and 2244 s for Tests S-SB-4 and S-SB-4A, respectively, after blowdown initiation at a system pressure of 0.98 MPa and continued to the end of the test. Intact loop accumulator coolant injection started 564 s and 764 s, respectively, after blowdown and continued until test termination. Total volume of coolant injected into the system from the accumulator was 0.064 m^3. Nitrogen was discharged into the system.

a. Core power is shown in Figures 637 and 639.

2. Initial Test Conditions and Sequence Of Events

Conditions in the Semiscale Mod-3 System at initiation of blowdown are given in Tables 1 and 2; the primary system water chemistry prior to blowdown is given in Table 3; and the sequence of events relative to rupture is given in Table 4.

TABLE 1. CONDITIONS AT BLOWDOWN INITIATION

	Measured[a]		Specified
	Test S-SB-4	Test S-SB-4A	Tests S-SB-4 2nd S-SB-4A
Core power (MW)	1.18	1.19	1.2 $\pm$ 0.05
System pressure (MPa)	14.65	15.10	14.86 $\pm$ 0.035
Intact loop cold leg fluid temperature (K)	558.2	558.7	557 $\pm$ 1
Broken loop cold leg fluid temperature (K)	558.2	560.5	557 $\pm$ 1
Intact loop hot leg to cold leg temperature differential (K)	19.86	19.81	20 $\pm$ 1
Broken loop hot leg to cold leg temperature differential (K)	20.40	17.42	20 $\pm$ 1
Intact loop cold leg flow (l/s)	10.32	12.78	b
Broken loop cold leg flow (l/s)	2.41	3.67	b
Steam generator feedwater temperature[c] (K)	483.9	486.2	495 $\pm$ 6
Intact loop steam generator liquid level (cm) (above top of tube sheet)	296	296	295 $\pm$ 5
Pressure suppression tank pressure (MPa)	0.65	0.65	0.65
Pressure suppression tank water level (cm)	empty	empty	empty

a. Measured initial conditions are taken from digital acquisition system just prior to blowdown initiation.

b. Flow is not specified since it must be adjusted to achieve the required differential temperature across the core.

c. One source of feedwater was used for both intact and broken loops.

TABLE 2. PRIMARY COOLANT TEMPERATURE DISTRIBUTION PRIOR TO RUPTURE[a]

	Detector	Test S-SB-4 Temperature (K)	Test S-SB-4A Temperature (K)
Intact loop hot leg (near vessel)	RFI-2	578.0	578.5
Intact loop cold leg	TFI-8	557.8	559.3
Intact loop cold leg (near downcomer)	RFI-17	558.2	558.7
Broken loop hot leg (near vessel)	RFB-20	578.6	577.9
Broken loop cold leg (near downcomer)	RFB-45	558.2	560.5
Downcomer (near top)	TFD-83	557.4	559.7
Downcomer (middle)	TFD-269	558.0	560.4
Downcomer (near bottom)	TFD-347	557.8	560.2
Core (top of heated length)	TFG-10DE-12	590.9	588.9
Core (middle of heated length)	TFG-5AB-45	569.1	569.8
Core (bottom of heated length)	TFG-1AB-12	558.6	561.1
Vessel lower plenum	TFV-572W	558.1	560.5

a. Average of data taken from 5 s to 0.5 s prior to blowdown initiation.

TABLE 3. SEQUENCE OF EVENTS DURING TESTS S-SB-4 AND S-SB-4A[a]

Event	Time Relative to Rupture (s)	
	Test S-SB-4	Test S-SB-4A
Core power level established	-879	-514
Makeup pump and pressurizer heaters off	-2.5	-2.5
Core power decay transient started	-1.5	-1.5
Broken loop pump power terminated	-1.5	-1.5
Intact loop pump control initiated	0	0
Broken loop hot leg isolation valve closed	0	0
Steam generators feedwater valves closed	0	0
Steam generators steam valves closed	0	0
Broken loop steam generator drained	0	0
High-pressure injection system flow started	16	12
Intact loop pump power terminated	40	40
Auxiliary feedwater into intact loop steam generator started manually	60	60
Pressure suppression tank pressure ramped down to 300 kPa	300	300
ECC accumulator intact loop cold leg flow started	564	764
Auxiliary feedwater shut off	1860	1860
Low-pressure injection system flow started	3508	2245
Core power terminated	3935	2740

a. A time controlled sequence was used to control critical events during the test.

TABLE 4. WATER CHEMISTRY PRIOR TO BLOWDOWN[a]

	Test S-SB-4	Test S-SB-4A
pH	9.93	7.49
Conductivity (μmho/cm)	34.2	7.9
Lithium (μg/ml)	16.4	3.7
Chlorides (μg/ml)	<0.10	<0.10
Fluorides (μg/ml)	<0.37	<0.37
Oxygen (ml/l)	0.04	19.8
Total gas (ml/l)	136.1	139.8
Suspended solids (μg/ml)	2.62	0.30

a. Water sample taken at system pressure and temperature of approximately 15.0 MPa and 558 K (cold leg).

III. DATA PRESENTATION

The data from Semiscale Mod-3 Tests S-SB-4 and S-SB-4A are presented with brief comment. Processing analysis has been performed only to the extent necessary to obtain appropriate engineering units and to ensure that data are reasonable and consistent. In all cases, in converting transducer output to engineering units a homogeneous fluid was assumed. Further interpretation and analysis should consider that sudden decompression processes such as those occurring during blowdown may have subjected the measurement device to nonhomogeneous fluid conditions.

The performance of the system during Tests S-SB-4 and S-SB-4A was monitored by 217 and 215 detectors, respectively. The data obtained were recorded on a digital data acquisition system with selected channels recorded on analog tape. The analog system was used to provide redundant data. The long-term data -20 to 4396 s for Test S-SB-4 and (-20 to 2740 s) for Test S-SB-4A presented in this report were recorded at an effective sample rate of 0.208 and 0.356 points per second, respectively. Short-term data (-20 to 256 s) were recorded at an effective sample rate of 3.33 points per second.

The data are presented in some instances in the form of composite graphs to facilitate comparison of the values of given variables at several locations. The scales selected for the graphs do not reflect the obtainable resolution of the data. (The data processing techniques are described further in Reference 2 and Appendix A.)

Figures 3 through 10 provide supporting 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; provides brief comments regarding the data; and references the detector and comments to the corresponding figure. Figures 11 through 650 (data graphs) present all the blowdown data obtained. Time zero on the graphs is the time of rupture initiation. Appendix A provides information explaining the data acquisition system capabilities. Appendix B explains posttest data adjustments. Appendix C presents an analysis of selected data which provide a guide to the uncertainty associated with data measurements in the Semiscale Mod-3 system.

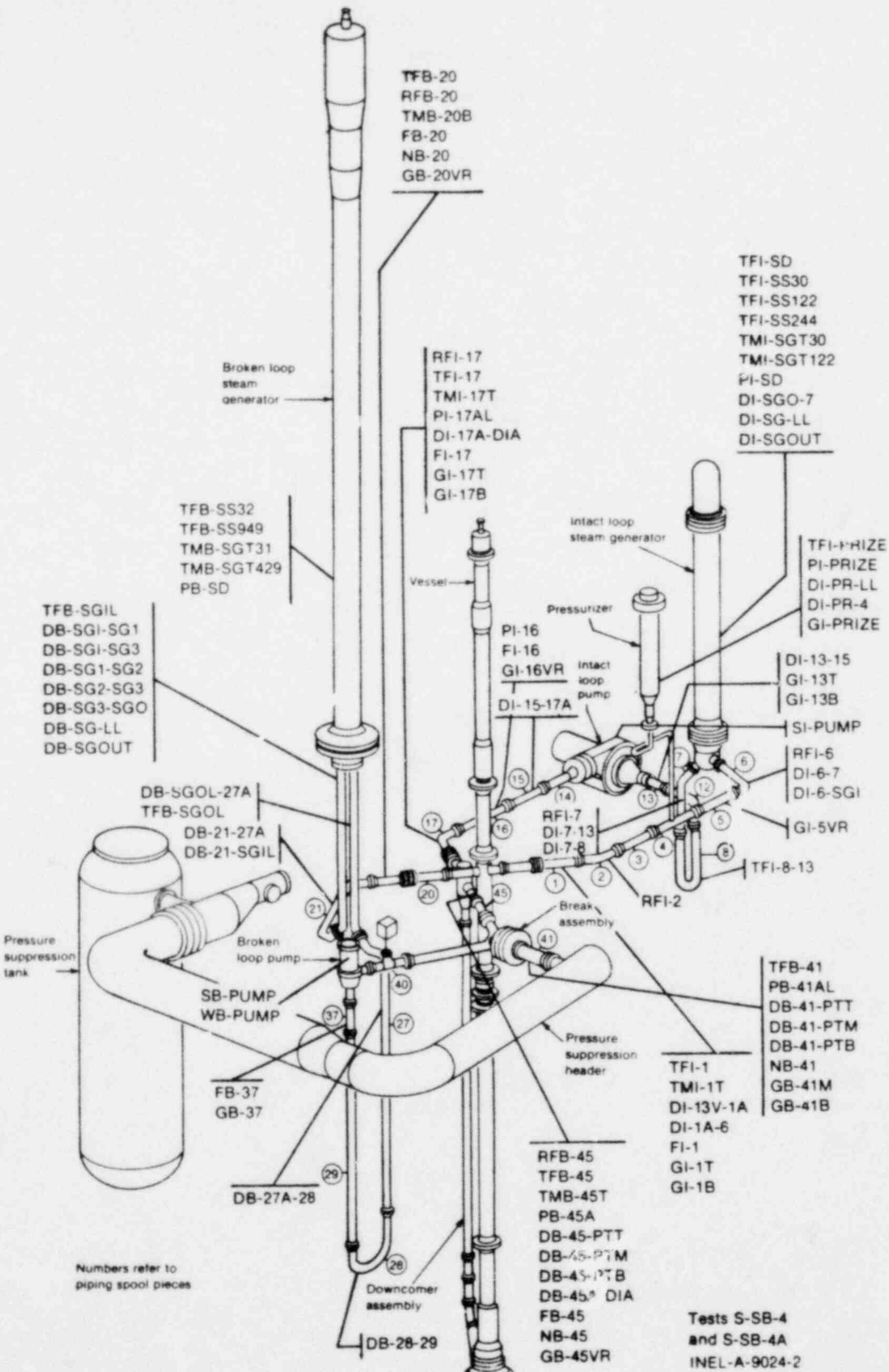


Figure 3. Semiscale Mod-3 system and instrumentation for cold leg break configuration—isometric.

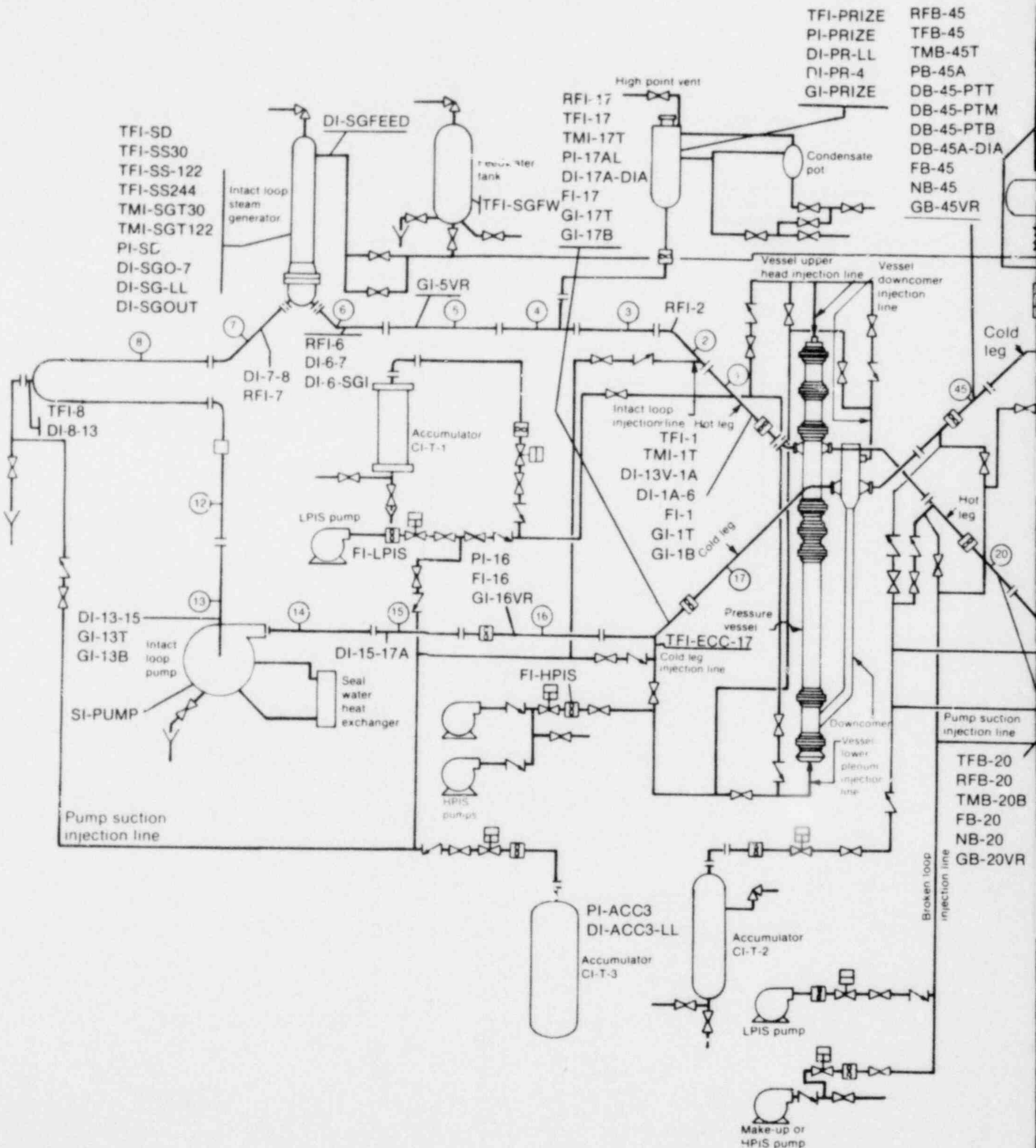
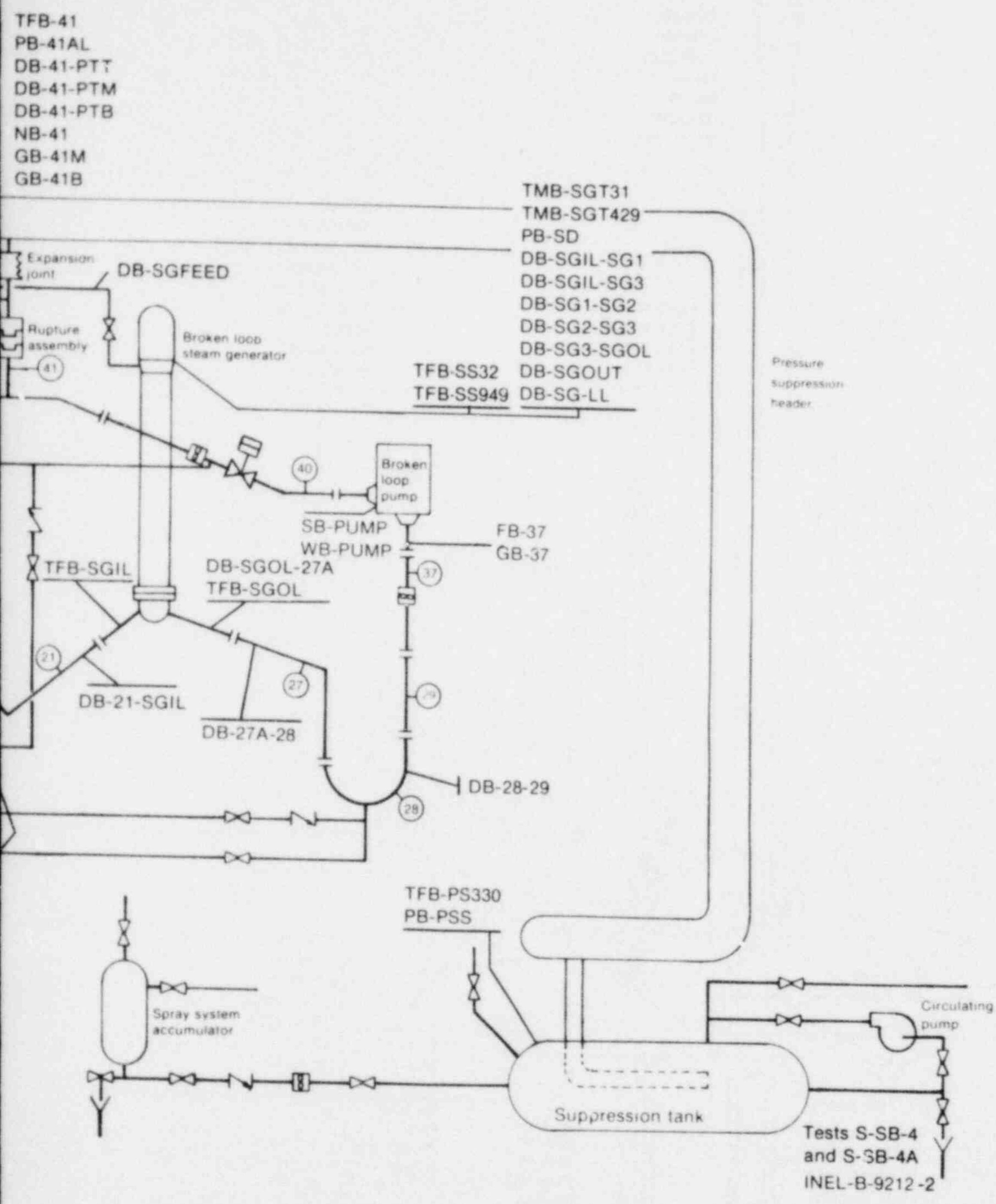
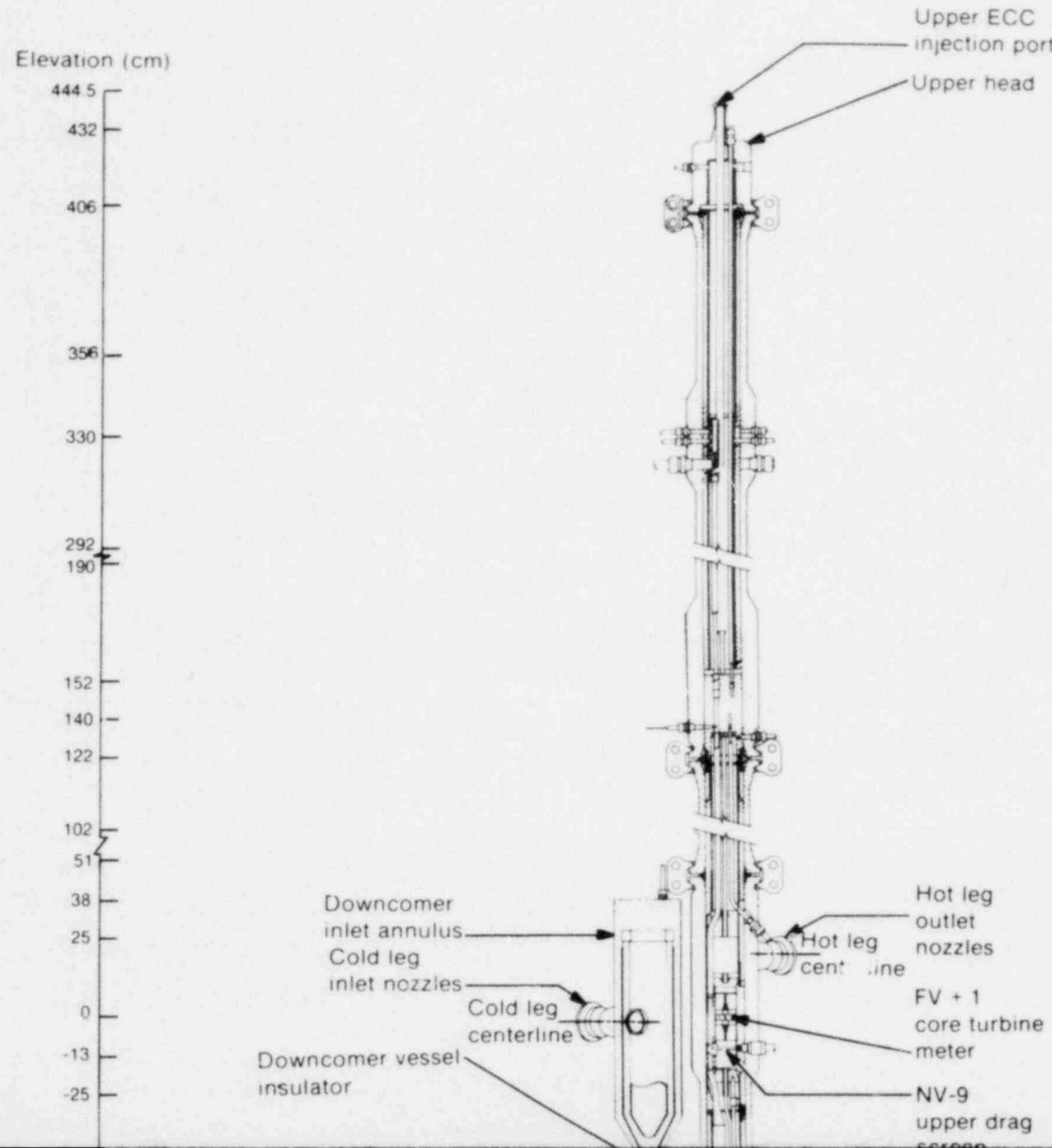


Figure 4. Semiscale Mod-3 system and instrumentation for cold leg bre



k configuration—schematic.



Elevation (cm)
444.5
432
406
356
330
292
190
152
140
122
102
51
38
25
0
-13
-25
Upper ECC injection port
Upper head
Downcomer inlet annulus
Cold leg inlet nozzles
Cold leg centerline
Downcomer vessel insulator
Hot leg outlet nozzles
FV + 1 core turbine meter
NV-9 upper drag

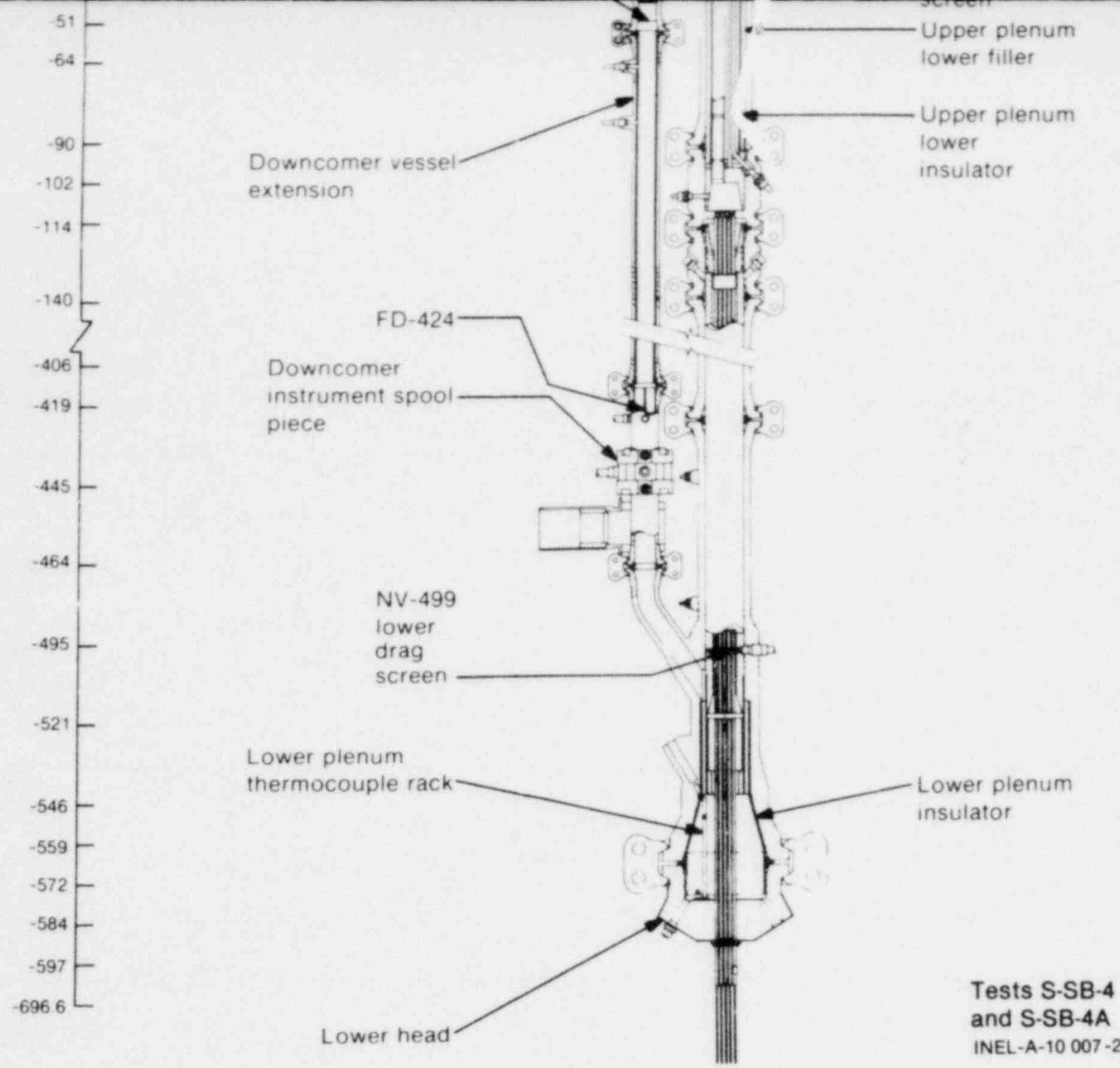


Figure 5. **Semiscale Mod-3 pressure vessel and downcomer—cross section showing instrumentation.**

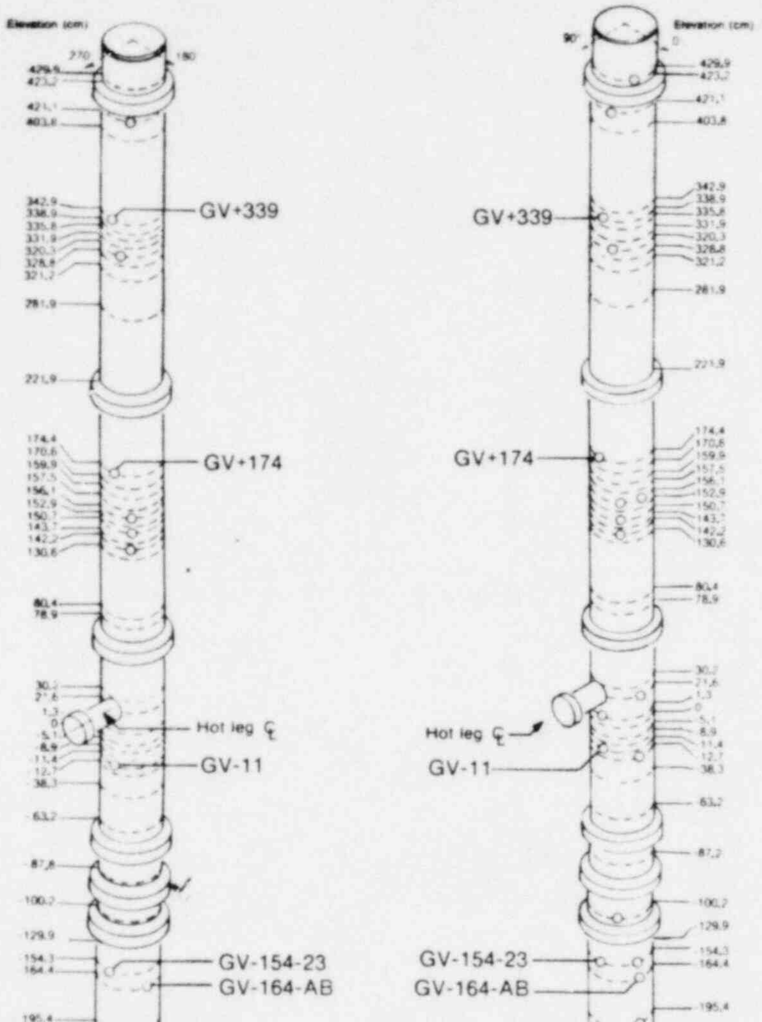


Figure 6. Semiscale Mod-3 pressure vessel—isometric showing instrumentation.

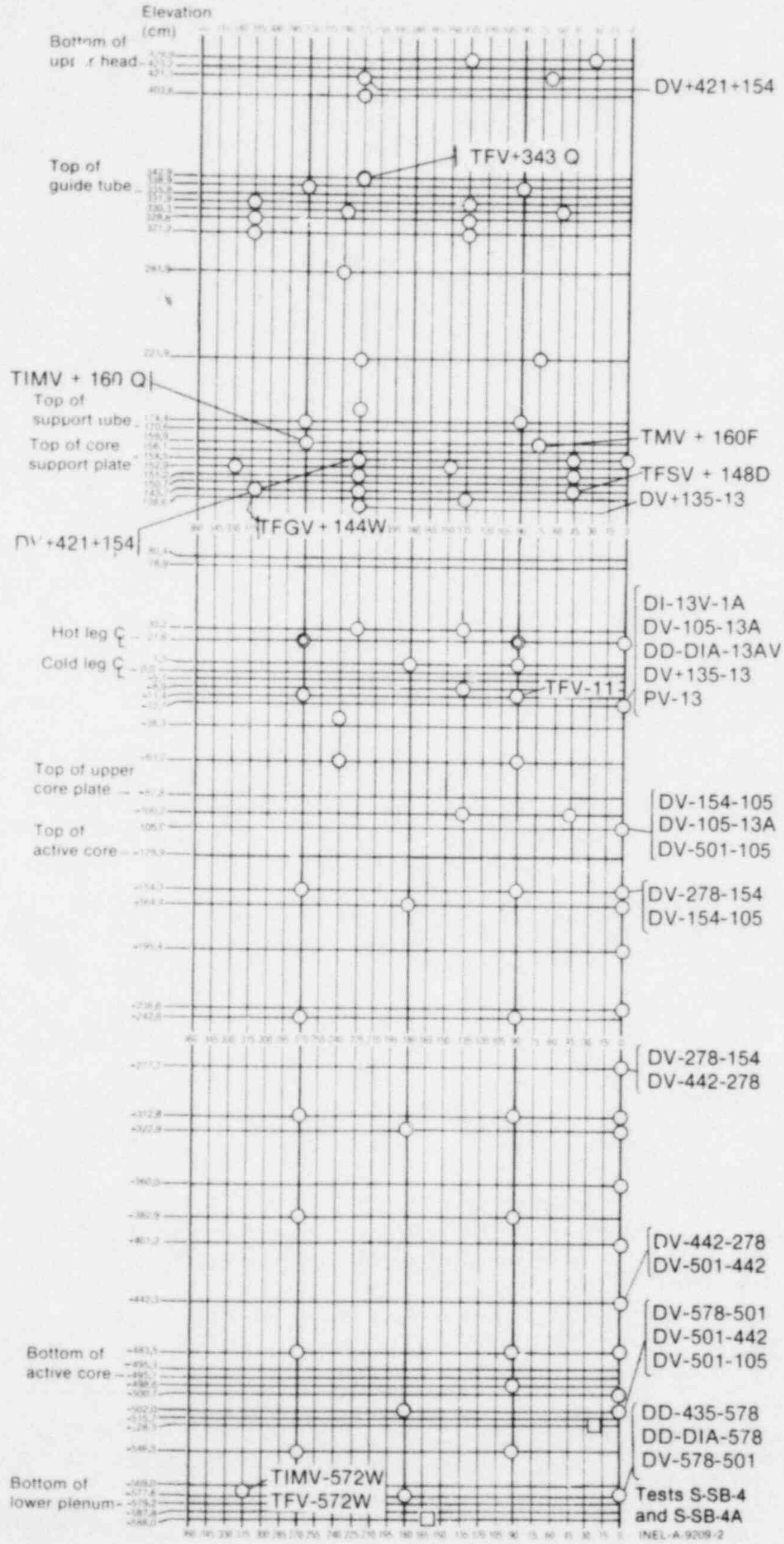


Figure 7. Semiscale Mod-3 pressure vessel—penetrations and instrumentation.

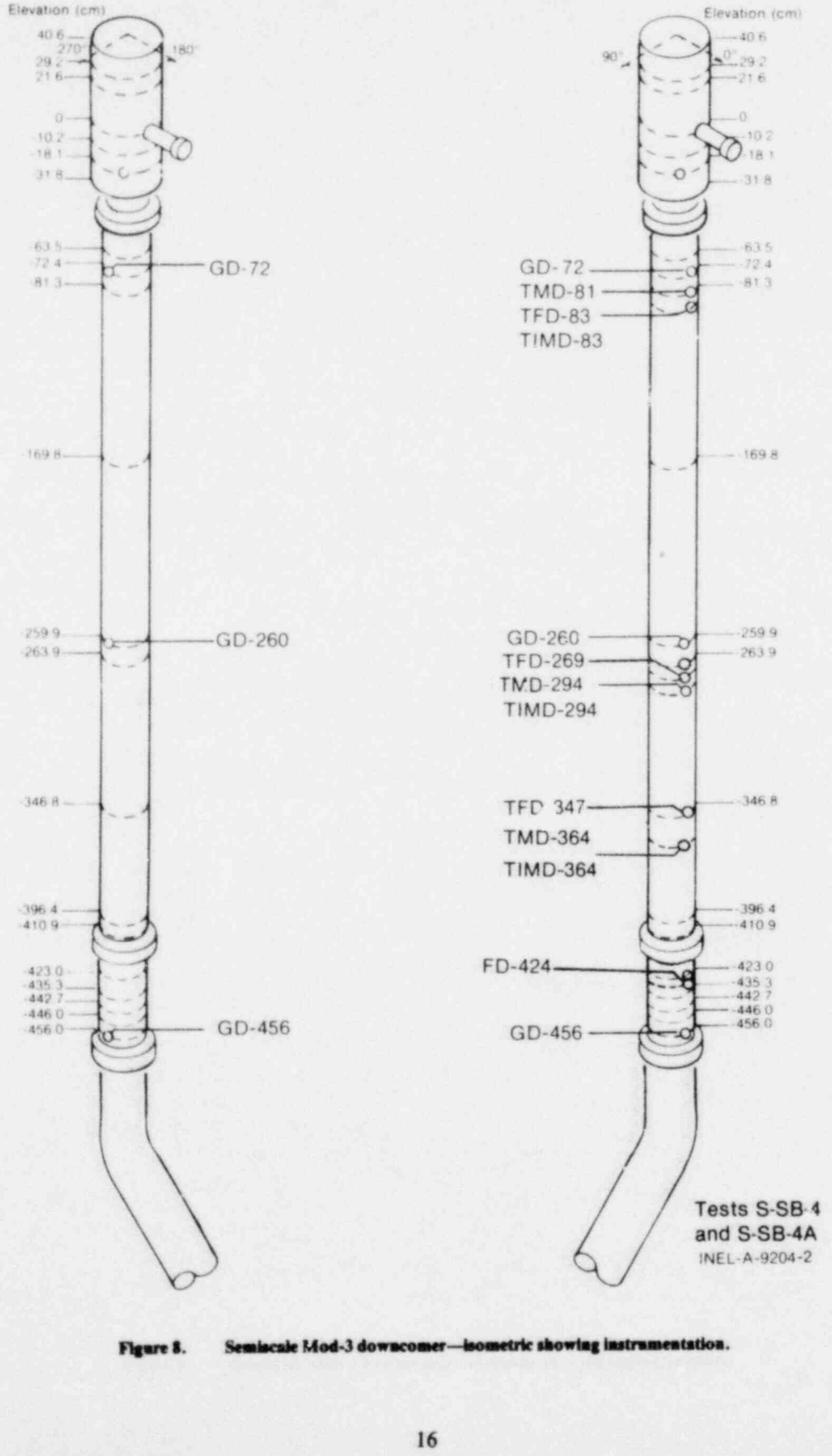


Figure 8. Semiscale Mod-3 downcomer—isometric showing instrumentation.

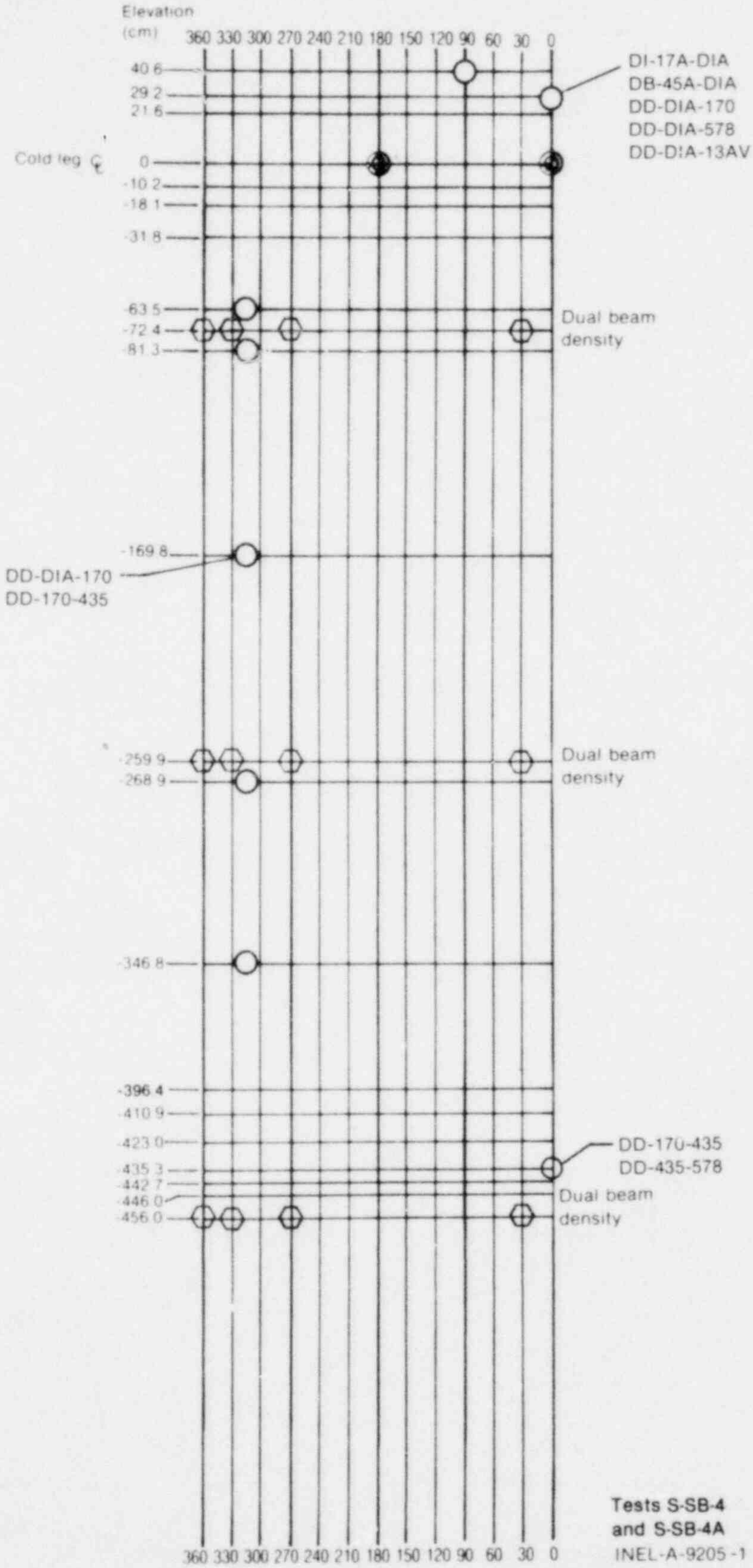


Figure 9. Semiscale Mod-3 downcomer—penetrations and instrumentation.

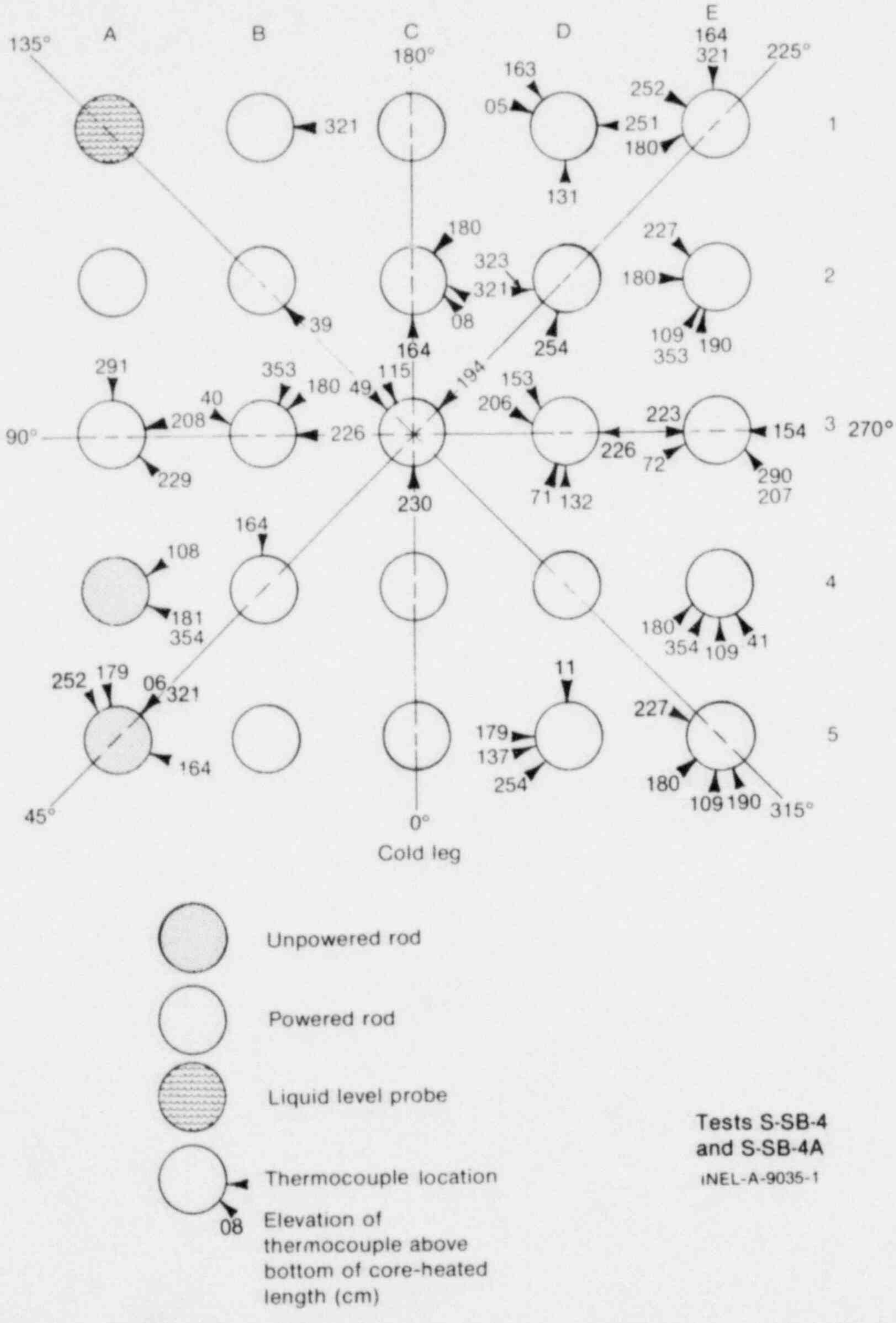


Figure 10. Semiscale Mod-3 heater core—plan view.

TABLE 5. DATA PRESENTATION FOR SEMISCALE MOD-3 TESTS S-SB-4 AND S-SB-4A

Measurement	Location and Comments[a]	Data Acquisition Range[a] Detector	System	Figure[a]	Measurement Comments[b]
FLUID TEMPERATURE	Chrome-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.			11, 12	
RFI-2	Hot leg, Spool 2, 99 cm from vessel center, 10 cm upstream of hot leg injection port (platinum resistance bulb).	0 to 811 K	0 to 811 K	13, 14	
RFI-6	Hot leg, Spool 6, 300 cm from vessel center (platinum resistance bulb).	0 to 811 K	0 to 811 K	15, 16	Test S-SB-4A only.
RFI-7	Cold, leg, Spool 7, 964 cm from downcomer center (platinum resistance bulb).	0 to 811 K	0 to 811 K	17, 18	Test S-SB-4A only.
TFI-8	Cold leg, Spool 8, 481 cm from downcomer center.			19, 20	
RFI-17	Cold leg, Spool 17, 92 cm from downcomer center, 7 cm upstream of cold leg injection port (platinum resistance bulb).	0 to 811 K	0 to 811 K	21, 22	
TFI-17	Cold leg, Spool 17, 60 cm from downcomer center.			23, 24	
Broken Loop		0 to 1533 K	0 to 820 K		
RFB-20	Hot leg, Spool 20, 73 cm from vessel center, 14 cm downstream of hot leg injection port (platinum resistance bulb).	0 to 811 K	0 to 811 K	25, 26	
TFB-20	Hot leg, Spool 20, 84 cm from vessel center, 25 cm downstream of hot leg injection port.			27, 28	
TFB-SGIL	Steam generator inlet leg, 382 cm from vessel center.			29, 30	
TFB-SGOL	Steam generator outlet leg, 943 cm from downcomer center.			31, 32	Test S-SB-4A only.
TFB-41	Cold leg, Spool 41, 6 cm upstream of rupture disc assembly 191 cm from downcomer center.			33, 34	
RFB-45	Cold leg, Spool 45, 89 cm from downcomer center (platinum resistance bulb).	0 to 811 K	0 to 811 K	35, 36	
TFB-45	Cold leg, Spool 45, 78 cm from downcomer center.			37, 38	
Downcomer		0 to 1533 K	0 to 820 K		
TFD-83	In downcomer extension, 83 cm below cold leg centerline.			39, 40	
TFD-269	In downcomer extension, 269 cm below cold leg centerline.			41, 42	
TFD-347	In downcomer extension, 347 cm below cold leg centerline.			43, 44	
Vessel		0 to 1533 K	0 to 820 K		
Vessel Upper Plenum					
TFV-572W	In vessel lower plenum, 572 cm below cold leg centerline at 315°.			45, 46	
Vessel Lower Plenum					
TFV-11	In vessel, 11 cm below cold leg centerline.			47, 48	
Vessel Upper Head					
TFV+343Q	In vessel upper head filler, 343 cm above cold leg centerline at 325°.			49, 50	
Vessel Guide Tube					
TFGV+144W	In vessel guide tube, 144 cm above cold leg centerline at 315°.			51, 52	Test S-SB-4A only.
Vessel Support Tube					
TFSV+148D	In vessel support tube, 148 cm above cold leg centerline at 45°.			53, 54	

TABLE 5 (continued)

Measurement	Location and Comments[a]	Data Acquisition Range[a] Detector	System	Figure[a]	Measurement Comments[b]
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.				
TFG-1AB-12	Thermocouple in space defined by Columns A and B, Rows 1 and 2.			55, 56	
Grid Spacer 2	450 cm below cold leg centerline, 46 cm above bottom of heated length.				
TFG-2AB-23	Thermocouple in space defined by Columns A and B, Rows 2 and 3.			57, 58	
Grid Spacer 4	370 cm below cold leg centerline, 126 cm above bottom of heated length.				
TFG-4AB-23	Thermocouple in space defined by Columns A and B, Rows 2 and 3.			59, 60	
Grid Spacer 5	330 cm below cold leg centerline, 166 cm above bottom of heated length.				
TFG-5AB-45	Thermocouple in space defined by Columns A and B, Rows 4 and 5.			61, 62	
Grid Spacer 6	290 cm below cold leg centerline, 206 cm above bottom of heated length.				
TFG-6DE-34	Thermocouple in space defined by Columns D and E, Rows 3 and 4.			63, 64	
Grid Spacer 7	250 cm below cold leg centerline, 246 cm above bottom of heated length.				
TFG-7AB-34	Thermocouple in space defined by Columns A and B, Rows 3 and 4.			65, 66	
Grid Spacer 8	210 cm below cold leg centerline, 286 cm above bottom of heated length.				
TFG-8DE-23	Thermocouple in space defined by Columns D and E, Rows 2 and 3.			67, 68	
Grid Spacer 9	170 cm below cold leg centerline, 326 cm above bottom of heated length.				
TFG-9DE-12	Thermocouple in space defined by Columns D and E, Rows 1 and 2.			69, 70	
Grid Spacer 10	130 cm below cold leg centerline, 366 cm above bottom of heated length.				
TFG-10DE-12	Thermocouple in space defined by Columns D and E, Rows 1 and 2.			71, 72	
ECC System		0 to 1533 K	0 to 820 K		
TFI-ECC-17	On centerline of ECC line, 72 cm from junction with Spool 17.			73, 74	Higher initial temperature for test S-SB-4 caused by leaking check value in ECC line.
Steam Generator		0 to 1533 K	0 to 820 K		
Intact Loop					
TFI-SGFW	In feedwater line leading to steam generator.			75, 76	
TFI-SD	In steam generator steam dome, 320 cm above top of tube sheet.			77, 78	
TFI-SS30	Secondary side, 30 cm above top of tube sheet.			79, 80	
TFI-SS122	Secondary side, 122 cm above top of tube sheet.			81, 82	
TFI-SS244	Secondary side, 244 cm above top of tube sheet.			83, 84	
Broken Loop					
TFB-SS32	Secondary side, 32 cm above top of tube sheet.			85, 86	
TFB-SS949	Secondary side, 949 cm above bottom of tube sheet.			87, 88	
Pressurizer		0 to 1533K	0 to 820 K		
TFI-PRIZE	In surge line near pressurizer exit, between turbine flowmeter and pressurizer.			89, 90	

TABLE 5 (continued)

Measurement	Location and Comments[a]	Data Acquisition Range[a]		Figure[a]	Measurement Comments[b]
		Detector	System		
MATERIAL TEMPERATURE	Chromel-Alumel thermocouples unless specified otherwise.				
Intact Loop		0 to 1533 K	0 to 820 K		
TMI-1T	Hot leg, Spool 1, top, 1.6 mm from pipe inside diameter (ID), 68 cm from vessel center.			91, 92	
TMI-17T	Cold leg, Spool 17, top, 1.6 mm from pipe ID, 68 cm from downcomer center.			93, 94	
Broken loop		0 to 1533 K	0 to 820 K		
TMB-20B	Hot leg, Spool 20, bottom, 1.6 mm from pipe ID, 91 cm from vessel center.			95, 96	Test S-SB-4 only.
TMB-45T	Cold leg, Spool 45, top, 1.6 mm from pipe ID, 98 cm from downcomer center.			97, 98	
Downcomer		0 to 1533 K	0 to 820 K		
TMD-81	On downcomer extension, 81 cm below cold leg centerline.			99, 100	
TMD-294	On downcomer extension, 294 cm below cold leg centerline.			101, 102	
TMD-364	On downcomer extension, 364 cm below cold leg centerline.			103, 104	
Downcomer Insulator		0 to 1533 K	0 to 820 K		
TIMD-83	On downcomer extension insulator, 83 cm below cold leg centerline.			105, 106	
TIMD-294	On downcomer extension insulator, 294 cm below cold leg centerline.			107, 108	
TIMD-364	On downcomer extension insulator, 364 cm below cold leg centerline.			109, 110	
Vessel		0 to 1533 K	0 to 820 K		
TMV+160F	In vessel on upper head filler, 160 cm above cold leg centerline at 75°.			111, 112	
Vessel Insulator		0 to 1533 K	0 to 820 K		
TIMV+160Q	In vessel on upper plenum insulator, 160 cm above cold leg centerline at 225°.			113, 114	
TIMV-572W	In vessel on lower head insulator 572 cm below cold leg centerline at 315°.			115, 116	Test S-SB-4A only.
Steam Generator		0 to 1533 K	0 to 820 K		
Intact Loop					
TMI-SGT30	On a steam generator tube, 30 cm above top of tube sheet on outside diameter (OD) tube.			117, 118	
TMI-SGT122	On a steam generator tube, 122 cm above top of tube sheet on OD of tube.			119, 120	
Broken Loop		0 to 1533 K	0 to 820 K		
TMB-SGT31	On a steam generator tube, 31 cm above top of tube sheet on OD of tube.			121, 122	
TMB-SGT429	On a steam generator tube, 420 cm above top of tube sheet on OD of tube.			123, 124	
CORE HEATER CLADDING TEMPERATURE	Chromel-Alumel thermocouples.				Test S-SB-4 Temperature spike at 2592 s on high-power heater rods caused by 198 s loss of power to low-power bus; high-power bus attempted to compensate. Test S-SB-4A Temperature spiked at 550 s and 800 s caused by manual control of power to compensate for heat loss.

TABLE 5 (continued)

Measurement	Location and Comments[a]	Data Acquisition Range[a] Detector	Data Acquisition Range[a] System	Figure[a]	Measurement Comments[b]
High-Power Heaters		0 to 1533 K	0 to 1580 K		
TH-B2-39	Heat at Column B, Row 2. Thermocouple 39 cm (315°) above bottom of heated length.			125, 126	
TH-B3-40 TH-B3-180 TH-B3-226 TH-B3-353	Heater at Column B, Row 3. Thermocouples 40 cm (120°), 180 cm (225°), 226 cm (270°), and 353 cm (210°) above bottom of heated length.			127, 128 129, 130 131, 132 133, 134	Detectors TH-B3-40 failed Test S-SB-4A.
TH-C2-08 TH-C2-164 TH-C2-180 TH-C2-321	Heater at Column C, Row 2. Thermocouples 8 cm (285°), 164 cm (0°), 180 cm (225°), and 321 cm (270°) above bottom of heated length.			135, 136 137, 138 139, 140 141, 142	Detectors TH-C2-164 and TH-C2-180 Test S-SB-4 only.
TH-C3-49 TH-C3-115 TH-C3-194 TH-C3-230	Heater at Column C, Row 3. Thermocouples 49 cm (135°), 115 cm (165°), 194 cm (225°), and 230 cm (0°) above bottom of heated length.			143, 144 145, 146 147, 148 149, 150	
TH-D2-254 TH-D2-323	Heater at Column D, Row 2. Thermocouples 254 cm (15°) and 323 cm (60°) above bottom of heated length.			151, 152 153, 154	
TH-D3-71 TH-D3-132 TH-D3-153 TH-D3-206 TH-D3-226	Heater at Column D, Row 3. Thermocouples 71 cm (15°), 132 cm (0°), 153 cm (135°), 206 cm (120°), and 226 cm (270°) above bottom of heated length.			155, 156 157, 158 159, 160 161, 162 163, 164	Detector TH-D3-132 Test S-SB-4 data questionable, use for trend only.
Low-Power Heaters		0 to 1533 K	0 to 1580 K		
TH-A5-06 TH-A5-164 TH-A5-179 TH-A5-252 TH-A5-321	Heater at Column A, Row 5. Thermocouples 6 cm (225°), 164 cm (300°), 179 cm (180°), 252 cm (165°), and 321 cm (225°) above bottom of heated length.			165, 166 167, 168 169, 170 171, 172 173, 174	
TH-B1-321	Heater at Column B, Row 1. Thermocouple 321 cm (270°) above bottom of heated length.			175, 176	
TH-D1-05 TH-D1-131 TH-D1-163 TH-D1-251	Heater at Column D, Row 1. Thermocouples 5 cm (105°), 131 cm (0°), 163 cm (120°), and 251 cm (270°) above bottom of heated length.			177, 178 179, 180 181, 182 183, 184	
TH-D5-11 TH-D5-137 TH-D5-179 TH-D5-254	Heater at Column D, Row 5. Thermocouples 11 cm (80°), 137 cm (75°), 179 cm (90°), and 254 cm (45°) above bottom of heated length.			185, 186 187, 188 189, 190 191, 192	
TH-E1-164 TH-E1-180 TH-E1-252 TH-E1-321	Heater at Column E, Row 1. Thermocouples 164 cm (180°), 180 cm (60°), 252 cm (120°), and 321 cm (180°) above bottom of heated length.			193, 194 195, 196 197, 198 199, 200	
TH-E2-109 TH-E2-180 TH-E2-190 TH-E2-227 TH-E2-353	Heater at Column E, Row 2. Thermocouples 109 cm (30°), 180 cm (90°), 190 cm (15°), 227 cm (120°), and 353 cm (30°) above bottom of heated length.			201, 202 203, 204 205, 206 207, 208 209, 210	
TH-E3-72 TH-E3-154 TH-E3-207 TH-E3-223 TH-E3-290	Heater at Column E, Row 3. Thermocouples 72 cm (60°) 154 cm (270°), 207 cm (300°), 223 (90°), and 290 cm (300°) above bottom of heated length.			211, 212 213, 214 215, 216 217, 218 219, 220	
TH-E4-41 TH-E4-109 TH-E4-180 TH-E4-354	Heater at Column E, Row 4. Thermocouples 41 cm (345°), 109 cm (0°), 180 cm (60°), and 354 cm (45°) above bottom of heated length.			221, 222 223, 224 225, 226 227, 228	
TH-E5-109 TH-E5-180 TH-E5-190 TH-E5-227 TH-E5-353	Heater at Column E, Row 5. Thermocouples 109 cm (0°), 180 cm (60°), 190 cm (34[illegible]°), 227 cm (120°), and 353 cm (75°) above bottom of heated length.			229, 230 231, 232 233, 234 235, 236 237, 238	
PRESSURE					
Intact Loop					
PI-16	Cold leg, Spool 16, 144 cm from downcomer center.	0 to 17.237 MPa	0 to 20.29 MPa	239, 240	
PI-17AL	Cold leg, Spool 17, 60 cm from downcomer center (low range).	0 to 3.477 MPa	0 to 3.45 MPa	241, 242	

TABLE 5 (continued)

Measurement	Location and Comments[a]	Data Acquisition Range[a] Detector	System	Figure[a]	Measurement Comments[b]
Broken Loop					
PB-41AL	Cold leg, Spool 41, 163 cm from downcomer center (low range).	0 to 3.477 MPa	0 to 3.48 MPa	243, 244	
PB-45A	Cold leg, Spool 45, 90 cm from downcomer center, 0°.	0 to 17.237	0 to 20.77 MPa	245, 246	
Vessel		0 to 17.237 MPa			
PV-13	In vessel hot leg extension, 13 cm below cold leg centerline (tee off DP tap).		0 to 21.49 MPa	247, 248	
ECC System					
PI-ACC3	In accumulator for intact loop.	0 to 6.895 MPa	0 to 7.893 MPa	249, 250	
Steam Generator		0 to 17.237 MPa			
Intact Loop					
PI-SD	Intact loop steam generator, secondary side steam dome.		0 to 21.02 MPa	251, 252	
Broken Loop					
PB-SD	Broken loop steam generator, secondary side steam dome.		0 to 21.55 MPa	253, 254	
Pressurizer		0 to 17.237 MPa			
PI-PRIZE	Pressurizer steam dome.		0 to 22.83 MPa	255, 256	
DIFFERENTIAL PRESSURE	Elevation difference between transducer taps is zero unless specified otherwise.				
Intact Loop					
DI-13V-1A	From vessel lower section of upper plenum, 13 cm below cold leg centerline to hot leg, Spool 1, 60 cm from vessel center. Lower upper plenum tap is 35 cm below Spool 1 tap.	±127 cm water	±17.25 kPa	257, 258, 259, 260	
DI-1A-6	Hot leg, Spool 1, 60 cm from vessel center to hot leg, Spool 6, 271 cm from vessel center.	±127 cm water	±17.44 kPa	261, 262, 263, 264	
DI-6-7	Hot leg, Spool 6, 271 cm from vessel center across steam generator to cold leg, Spool 7, 574 cm from downcomer center. Spool 6 tap is 47 cm above Spool 7 tap.	±345 kPa	±353 kPa	265, 266, 267, 268	
DI-6-SGI	Hot leg, Spool 6, 271 cm from vessel center to intact loop steam generator inlet, 349 cm from vessel center. Spool 6 tap is 41 cm below SGI tap.	±127 cm	±16.8 kPa	269, 270, 271, 272	
DI-SGO-7	Intact loop steam generator outlet plenum, 670 cm from downcomer center to cold leg, Spool 7, 574 cm from downcomer center. SGO tap is 79 cm above Spool 7 tap.	±127 cm water	±16.1 kPa	273, 274, 275, 276	
DI-7-8	Cold leg, Spool 7, 574 cm from downcomer center to cold leg, Spool 8, 487 cm from downcomer center. Spool 7 tap is 136 cm above Spool 9 tap.	±762 cm water	±102.3 kPa	277, 278, 279, 280	
DI-8-13	Cold leg, Spool 8, 487 cm from downcomer center to cold leg. Spool 13, 332 cm from downcomer center. Spool 9 tap is 136 cm below Spool 13 tap.	±254 cm water	±33.65 kPa	281, 282, 283, 284	
DI-13-15	Cold leg, Spool 13, 332 cm from downcomer center, across primary pump to cold leg, Spool 15, 175 cm from downcomer center. Spool 13 tap is 25 cm below Spool 15 tap.	±690 kPa	±690 kPa	285, 286, 287, 288	
DI-15-17A	Cold leg, Spool 15, 175 cm from downcomer center, across cold leg injection port to cold leg, Spool 17, 60 cm from downcomer center.	±254 cm water	±33.85 kPa	289, 290, 291, 292	
DI-17A-DIA	Cold leg, Spool 17, 60 cm from downcomer center, to downcomer inlet annulus, 30 cm above cold leg centerline. Spool 17 tap is 30 cm below DIA tap.	±127 cm water	±17.06 kPa	293, 294, 295, 296	

TABLE 5 (continued)

Measurement	Location and Comments[a]	Data Acquisition Range[a] Detector	System	Figure[a]	Measurement Comments[b]
Broken Loop					
DB-21-SGIL	Hot leg, Spool 21, 220 cm from vessel center to steam generator inlet leg, 382 cm from vessel center. Spool 21 tap is 134 cm below SGI tap.	±254 cm water	±37.13 kPa	297, 298, 299, 300	
DB-SGIL-SGI	Steam generator inlet leg, 382 cm from vessel center across primary side tube 91 cm above top of tube sheet. SGI tap is 166 cm below SGI tap.	±1270 cm water	±168.7 kPa	301, 302, 303, 304	
DB-SGIL-SG3	Steam generator inlet leg, 382 cm from vessel center across primary side tube 838 cm above top of tube sheet. SGI tap is 913 cm below SG3 tap.	±2032 cm water	±266.8 kPa	305, 306, 307, 308	
DB-SG1-SG2	Across steam generator primary side tube 91 cm to 465 cm above top of tube sheet. Elevation difference between taps is 374 cm.	±1270 cm water	±169.0 kPa	309, 310, 311, 312	
DB-SG2-SG3	Across steam generator primary side tube 465 cm to 838 cm above top of tube sheet. Elevation difference between taps is 373 cm.	±1270 cm water	±169.4 kPa	313, 314, 315, 316	
DB-SG3-SGO	Across steam generator primary side tube 838 cm above top of tube sheet to steam generator outlet leg, 946 cm from downcomer center. SG3 tap is 985 cm above SGO tap.	±20[illegible]2 cm water	±2[illegible]5.2 kPa	317, 318, 319, 320	
DB-SGO-27A	Steam generator outlet leg, 946 cm from downcomer center to cold leg, Spool 27A, 87 cm from downcomer center. SGO tap is 65 cm above Spool 27A tap.	±254 cm water	±34.01 kPa	321, 322, 323, 324	
DB-27A-28	Cold leg, Spool 27, 872 cm from downcomer center to cold leg Spool 28, 565 cm from downcomer center. Spool 27A tap is 304 cm above Spool 28 tap.	±762 cm water	±102.0 kPa	325, 326, 327, 328	
DB-28-29	Cold leg, Spool 28, 565 cm from downcomer center to cold leg Spool 29, 505 cm from downcomer center. Spool 28 tap is 62 cm below Spool 29 tap.	±762 water	±102.8 kPa	329, 330, 331, 332	
DB-41-PTT	Cold leg, Spool 41, upstream of rupture assembly, 209 cm from downcomer center. PTT (pitot tube, top) located +0.5 r (radius).	±762 cm water	±100.9 kPa	333, 334, 335, 336	
DB-41-PTM	Cold leg, Spool 41, upstream of rupture assembly 209 cm from downcomer center. PTM (pitot tube, middle) located on pipe centerline.	±762 cm water	±109.9 kPa	337, 338, 339, 340	
DB-41 PTB	Cold leg, Spool 41, upstream of rupture assembly, 209 cm from downcomer center. PTB (pitot tube, bottom) located -0.5 r (radius).	±762 cm water	±105.4 kPa	341, 342, 343, 344	
DB-45-PTT	Cold leg, Spool 45, 89 cm from downcomer center. PTT (pitot tube, top) located 0.5 r (radius).	±51 cm water	±6.569 kPa	345, 346, 347, 348	
DB-45-PTM	Cold leg, Spool 45, 89 cm from downcomer center. PTM (pitot tube, middle) located on pipe centerline.	±51 cm water	±6.626 kPa	349, 350, 351, 352	
DB-45-PTB	Cold leg, Spool 45, 89 cm from downcomer center. PTB (pitot tube, bottom) located -0.5 r (radius).	±51 cm water	±6.558 kPa	353, 354, 355, 356	
DB-45A-DIA	Cold leg, Spool 45, 89 cm from downcomer center to downcomer inlet annulus, 30 cm above cold leg centerline. Spool 45 tap is 30 cm below DIA tap.	±127 cm water	±17.18 kPa	357, 358, 359, 360	
Downcomer					
DD-DIA-13V	Downcomer inlet annulus, 30 cm above cold leg centerline to vessel lower upper plenum, 13 cm below cold leg centerline. Elevation difference between taps is 43 cm.	±345 kPa	±347 kPa	361, 362, 363, 364	

TABLE 5 (continued)

Measurement	Location and Comments[a]	Data Acquisition Range[a]		Figure[a]	Measurement Comments[b]
		Detector	System		
Downcomer (continued)					
DD-DIA-170	Downcomer inlet annulus, 30 cm above cold leg centerline to downcomer extension, 170 cm below cold leg centerline. Elevation difference between taps is 200 cm.	±762 cm water	±102 kPa	365, 366, 367, 368	
DD-DIA-578	Downcomer inlet annulus, 30 cm above cold leg centerline to vessel lower head, 578 cm below cold leg centerline. Elevation difference between taps is 608 cm.	±1270 cm water	±170 kPa	369, 370, 371, 372	
DD-170-435	Downcomer extension, 170 cm below cold leg centerline to downcomer instrumented spool piece, 435 cm below cold leg centerline. Elevation difference between taps is 265 cm.	±762 cm water	±109 kPa	373, 374, 375, 376	
DD-435-578	Downcomer instrumented spool piece, 435 cm below cold leg centerline to vessel lower head, 578 cm below cold leg centerline. Elevation difference between taps is 143 cm.	±254 cm water	±33.5 kPa	377, 378, 379, 380	
Vessel					
DV-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.	±254 cm water	±33.8 kPa	381, 382, 383, 384	
DV-501-442	Vessel lower core region, 501 cm below cold leg centerline to lower core region, 442 cm below cold leg centerline. Elevation difference between taps is 59 cm.	±254 cm water	±34.0 kPa	385, 386 387, 388	
DV-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.	±1270 cm water	±172 kPa	389, 390, 391, 392	
DV-442-278	Vessel lower core region, 442 cm below cold leg centerline, to mid-core region, 278 cm below cold leg centerline. Elevation difference between taps is 164 cm.	±762 cm water	±100 kPa	393, 394, 395, 396	Detector failed for Test S-SB-4A after 765 s.
DV-278-154	Vessel midcore region, 278 cm below cold leg centerline to upper core region 154 cm below cold leg centerline. Elevation difference between taps is 124 cm.	±762 cm water	±99.7 kPa	397, 398, 399, 400	
DV-154-105	Vessel upper core region 154 cm below cold leg centerline to heater rod ground hub, 105 cm below cold leg centerline. Elevation difference between taps is 49 cm.	±752 cm water	±99.8 kPa	401, 402 403, 404	
DV-105-13	Heater rod ground hub, 105 cm below cold leg centerline to lower section of upper plenum, 13 cm below cold leg centerline elevation difference between taps is 92 cm.	±254 cm water	±33.58 kPa	405, 406, 407, 408	
DV+421+154	Vessel top head, 421 cm above cold leg centerline to core support tube, 154 cm above cold leg centerline. Elevation difference between taps is 267 cm.	±1270 cm water	± 168 kPa	409, 410, 411, 412	
DV+135-13	Bottom of vessel lower head, 154 cm above cold leg centerline to lower sect on upper plenum, 13 cm below cold leg centerline. Elevation difference between taps is 148 cm.	±762 cm water	±101 kPa	413, 414, 415, 416	
ECC System					
DI-ACC3-LL	Top to bottom of accumulator for intact loop. Elevation difference between taps is 279 cm.	±127 cm water	±34.46 kPa	417, 418, 419, 420	
Steam Generator					
Intact Loop					
DI-SG-LL	Liquid level for intact loop steam generator. Elevation difference between taps is 206 cm.	±1270 cm water	±169 kPa	421, 422, 423, 424	Data questionable, sense lines entrapped air. Use for trend only. Tests S-SB-4 and S-SB-4A.

TABLE 5 (continued)

		Data Acquisition Range[a]			
Measurement	Location and Comments[a]	Detector	System	Figure[a]	Measurement Comments[b]
Intact Loop (continued)					
DI-SGFEED	Across orifice plate in feedwater line to steam generator for intact loop.	0 to 890 cm water	0 to 153 kPa		Detector failed both tests.
DI-SGOUT	Across venturi tube in discharge line from steam generator for intact loop.	0 to 2865 cm water	0 to 492 kPa	425, 426, 427, 428	
Broken Loop					
DB-SG-LL	Liquid level for broken loop steam generator. Elevation difference between taps is 1067 cm.	±1270 cm water	±166 kPa	429, 430, 431, 432	
DB-SGFEED	Across orifice plate in feedwater line to steam generator for intact loop.	0 to 63[illegible] cm water	0 to 109 kPa		Detector failed both tests.
DB-SGOUT	Across venturi tube in discharge line from steam generator for broken loop.	0 to 208 cm water	0 to 35.8 kPa	433, 434 435, 436	
Pressurizer					
DI-PR-LL	Liquid level for pressurizer. Elevation difference between taps is 127 cm.	±127 cm water	±18.47 kPa	437, 438, 439, 440	
DI-PR-4	Pressurizer bottom to Spool 4. Elevation difference between taps is 157 cm. Spool 4 tap is 140 cm below pressurizer exit.	±762 cm water	±100 kPa	441, 442, 443, 444	
VOLUMETRIC FLOW RATE	Turbine flowmeter, bidirectional.				Data acquisition system range may exceed rated detection range; however, turbine response is linear to flow rates well beyond the rated range.
Intact Loop	3-in. Schedule 160 pipe.				
FI-1	Hot leg, Spool 1, 38 cm from vessel center.	±1.26 to ±12.6 l/s	±19 l/s	445, 446, 447, 448	
FI-16	Cold leg, Spool 16, 145 cm from downcomer center.	±5.05 to ±50.5 l/s	±15 l/s	449, 450, 451, 452	Turbine flowmeter ranged too high for accurate measurement after 1253 and 220 s for tests S-SB-4 and S-SB-4A, respectively.
Broken Loop					
FI-17	Cold leg, Spool 17, 38 cm from downcomer center.	±1.26 to ±12.6 l/s	±19 l/s	453, 454,	Detector failed for Test S-SB-4A.
FB-20	Hot leg, Spool 20, 100 cm from vessel center.	±1.26 to ±12.6 l/s	±5 l/s	455, 456, 457, 458	
FB-37	Cold leg, Spool 37, 309 cm from downcomer center.	±1.26 to ±12.6 l/s	±5.5 l/s	459, 460 461, 462	
FB-45	Cold leg, Spool 45, 110 cm from downcomer center.	±0.63 to ±6.31 l/s	±5.5 l/s	463, 464	Detector failed for Test S-SB-4.
Downcomer					
FD-424	In downcomer, upstream of instrumented spool piece, 424 cm below cold leg centerline.	±0.126 to ±12.6 l/s	±20 l/s		Detector failed.
Vessel					
FV+1	Core exit, 1 cm above cold leg centerline.	±2.52 to ±25.2 l/s	±20 l/s	465, 466, 467, 468	
ECC System					
Intact Loop					
FI-HPIS	In line immediately after HPIS pump for intact loop; 1/2-in. line.	±0.0316 to ±0.316 l/s	±0.15 l/s	469, 470, 471, 472	
FI-LPIS	In line leading from LPIS pump for intact loop, 3/4-in. line.	±0.047 to ±0.473 l/s	±0.20 l/s	473, 474, 475, 476	

TABLE 5 (continued)

Measurement	Location and Comments[a]	Data Acquisition Range[a] Detector	System	Figure[a]	Measurement Comments[b]
MOMENTUM FLUX	Drag-screen, bidirectional.				
Broken Loop					
NB-20	Hot leg, Spool 20, 79 cm from vessel center.	±0.05 to ±10.7 N	±2.5 N	477, 478, 479, 480	
NB-41	Cold leg, Spool 41, 198 cm from downcomer center.	±0.22 to ±44.5 N	±35.61 N	481, 482, 483, 484	
NB-45	Cold leg, Spool 45, 84 cm from downcomer center.	±0.05 to ±10.7 N	±2.5 N	485, 486, 487, 488	
Vessel					
NV-9	In vessel lower upper plenum region, 9 cm below cold leg centerline.	±0.11 to ±22.2 N	±9.0 N	489, 490, 491, 492	
NV-499	In vessel at entrance to heated core, 499 cm below cold leg centerline.	±0.08 to ±15.1 N	±15.0 N	493, 494, 495, 496	
DENSITY					
Intact Loop		1.6 to 1600 kg/m^3	0 to 1600 kg/m^3		
GI-1T GI-1B GI-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.			497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508	
GI-5VR	Hot leg, Spool 5, 228 cm from vessel center, vertical.			509, 510, 511, 512	
GI-13T GI-13B GI-13C	Cold leg, Spool 13, 342 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.			513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524	
GI-16VR	Cold leg, Spool 16, 131 cm from downcomer center.			525, 526, 527, 528	
GI-17T GI-17B GI-17C	Cold leg, Spool 17, 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.			529, 530 531, 532, 533, 534, 535, 536, 537, 538, 539, 540	
Broken Loop		1.6 to 1600 kg/m^3	0 to 1600 kg/m^3		
GB-20VR	Hot leg, Spool 20, 64 cm from vessel center, vertical.			541, 542, 543, 544	
GB-37	Cold leg, Spool 37, 360 cm from downcomer center.			545, 546	Test S-SB-4 only.
GB-41M GB-41B GB-41C	Cold leg, Spool 41, 1700 cm from downcomer center.			547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558	
GB-45VR	Cold leg, Spool 45, 66 cm from downcomer vertical.			559, 560, 561, 562	
Downcomer		1.6 to 1600 kg/m^3	0 to 1600 kg/m^3		
GD-72B	Downcomer, 72 cm below cold leg centerline. B (body) ranges 30° to 330°.			563, 564, 565, 566	
GD-260B	Downcomer, 260 cm below cold leg centerline. B (body) ranges 30° to 330°.			567, 568, 569, 570	
GD-456B	Downcomer, 456 cm below cold leg centerline. B (body) ranges 30° to 330°.			571, 572, 573, 574	
Vessel		1.6 to 1600 kg/m^3	0 to 1600 kg/m^3		
GV-528-588	Vessel lower head, 528 cm below cold leg centerline, at 15° to 588 cm below cold leg centerline at 165°.				Detector failed Tests S-SB-4 an S-SB-4A.

TABLE 5 (continued)

Measurement	Location and Comments[a]	Data Acquisition Range[a] Detector	System	Figure[a]	Measurement Comments[b]
Vessel (continued)					
GV-502-AB	At bottom of core heated length, 502 cm below cold leg centerline between heater rod Columns A and B.			575, 576, 577, 578	
GV-383-23	Lower part of core heated length, 383 cm below cold leg centerline between heater rod Rows 2 and 3.				Detector failed Tests S-SB-4 and S-SB-4A.
GV-323-AB	Near center of core heated length, 323 cm below cold leg centerline between heater rod Columns A and B.			579, 580, 581, 582	
GV-313-23	Near center of core heated length, 313 cm below cold leg centerline between heater rod Rows 2 and 3.			583, 584, 585, 586	
GV-243-23	Upper part of core heated length, 243 cm below cold leg centerline between heater rod Rows 2 and 3.			587, 588	Detector failed Test S-SB-4A.
GV-164-AB	Near top of core heated length, 164 cm below cold leg centerline between heater rod Columns A and B.			589, 590 591, 592	
GV-154-23	Near top of core heated length, 154 cm below cold leg centerline between heater rod Rows 2 and 3.			593, 594, 595, 596	
GV-11	Vessel at base of core flow instrument housing, 11 cm below cold leg centerline.			597, 598, 599, 600	Detector failed Tests S-SB-4 and S-SB-4A.
GV+339	Vessel at top of control rod guide tube, 339 cm above cold leg centerline.				
GV+174	Vessel at top of core support tube, 174 cm above cold leg centerline.			601, 602, 603, 604	
Pressurizer		1.6 to 1600 kg/m^3	0 to 1600 kg/m^3		
GI-PRIZE	Pressurizer surge line.				Detector failed Tests S-SB-4 and S-SB-4A.
MASS FLOW RATE	Mass flow rate obtained by combining density (gamma attenuation technique) with volumetric flow rate (turbine flowmeter) or momentum flux (drag screen).	Range for mass flow is determined from ranges of individual detectors used in calculation.			
Intact Loop					
FI-1, GI-1C	Hot leg, Spool 1.			605, 606, 607, 608	
Broken Loop					
FB-20, GB-20VR	Hot leg, Spool 20.			609, 610, 611, 612	
NB-20, GB-20VR				613, 614, 615, 616	
FB-37, GB-37	Cold leg, Spool 37.			617, 618	Test S-SB-4 only.
NB-41, GB-41C	Cold leg, Spool 41.			619, 620, 621, 622	
FB-45, GB-45VR	Cold leg, Spool 45.			623, 624	Test S-SB-4 only.
NB-45, GB-46VR				625, 626, 627, 628	
Vessel					
FV+1, GV-154-23	Top of core heated length.			629, 630, 631, 632	
NV-499, GV-502-AB	Core inlet.			633, 634, 635, 636	
CORE CHARACTERISTICS					
High-Power Bus					
AH-HI	Core amperage.	0 to 10 000 A	0 to 10 030 A	637, 638	
VH-HI	Core voltage.	0 to 400 V	0 to 402 V	639, 640	

TABLE 5 (continued)

Measurement	Location and Comments[a]	Data Acquisition Range[a] Detector	System	Figure[a]	Measurement Comments[b]
Low-Power Bus					
AH-LO	Core amperage.	0 to 10 000 A	0 to 9330 A	641, 642	
VH-LO	Core voltage.	0 to 400 V	0 to 402 V	643, 644	
PUMP CHARACTERISTICS					
Intact Loop					
SI-PUMP	Pump speed.	377 rad/s	377 rad/s	645, 646	
Broken Loop					
SB-PUMP	Pump speed.	3770 rad/s	3770 rad/s	647, 648	
WB-PUMP	Pump power.	82 kW	20 kW	649, 650	

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

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

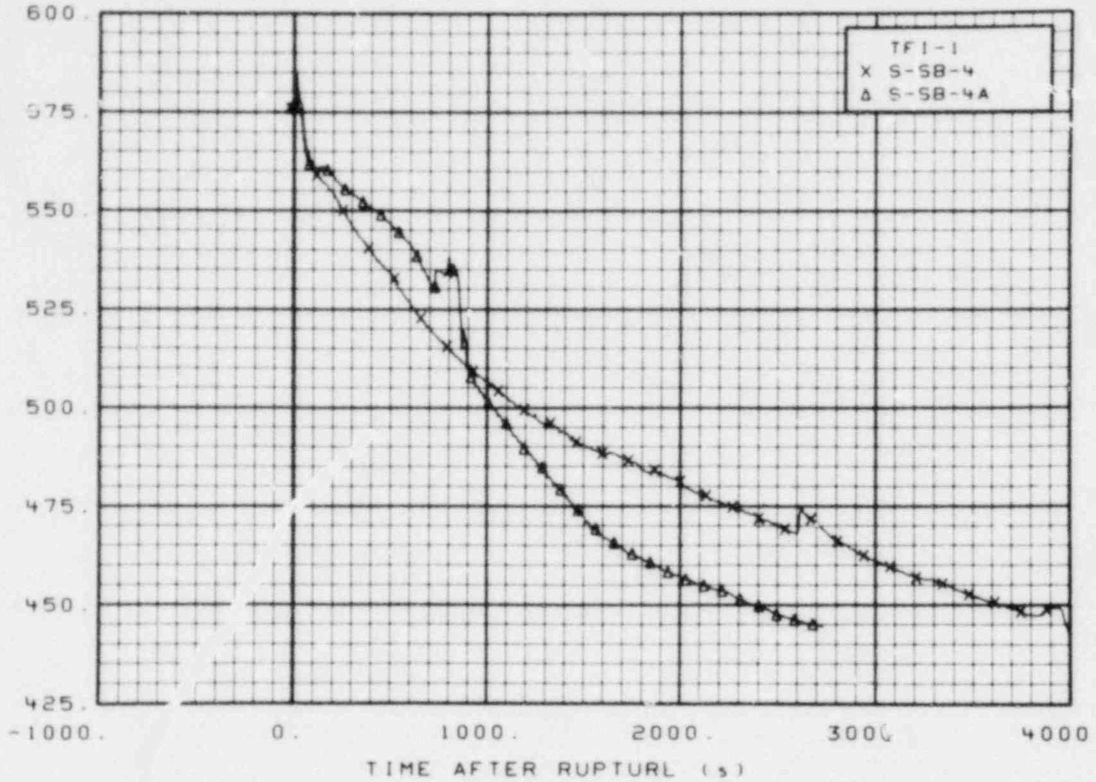


Figure 11. Fluid temperature in intact loop hot leg (TFI-1), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

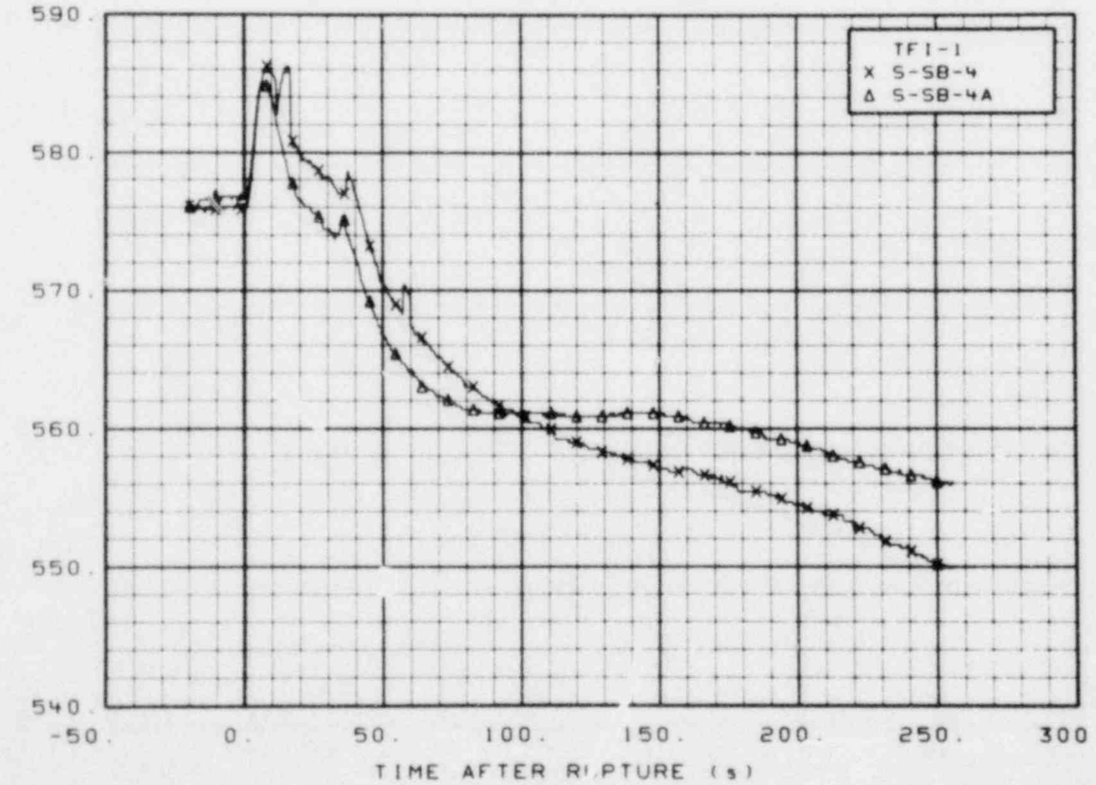


Figure 12. Fluid temperature in intact loop hot leg (TFI-1), from -20 to 256 s.

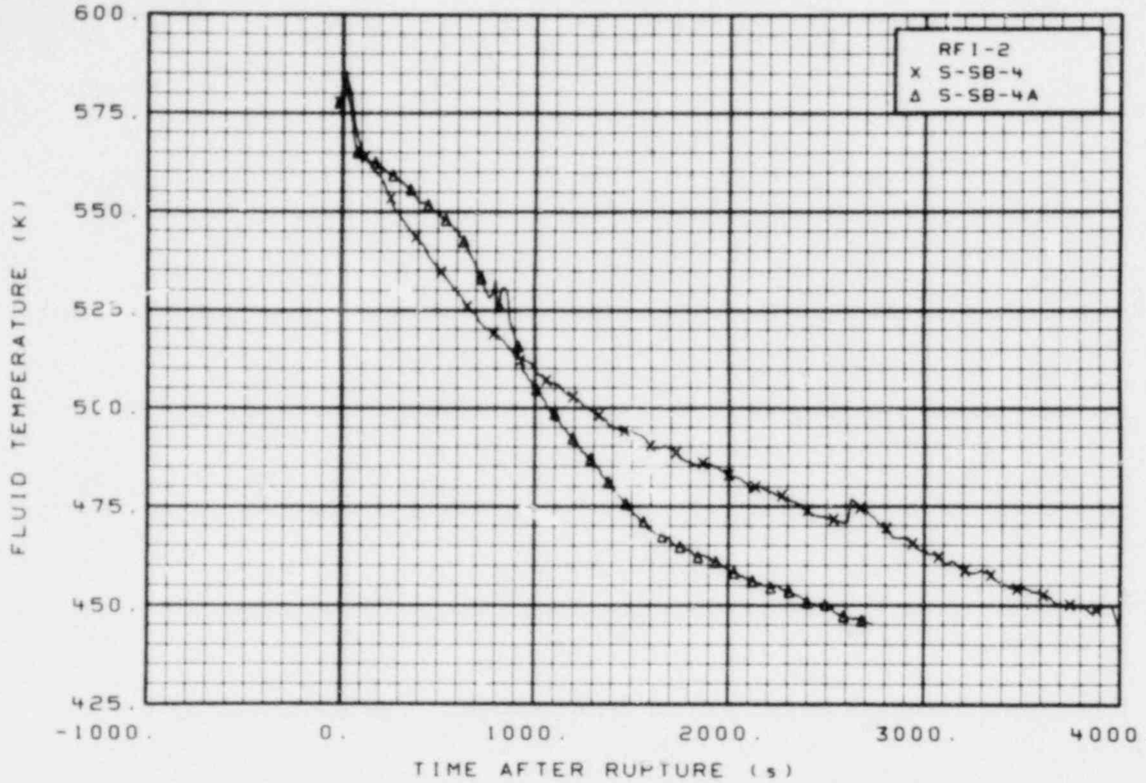


Figure 13. Fluid temperature in intact loop hot leg (RFI-2), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

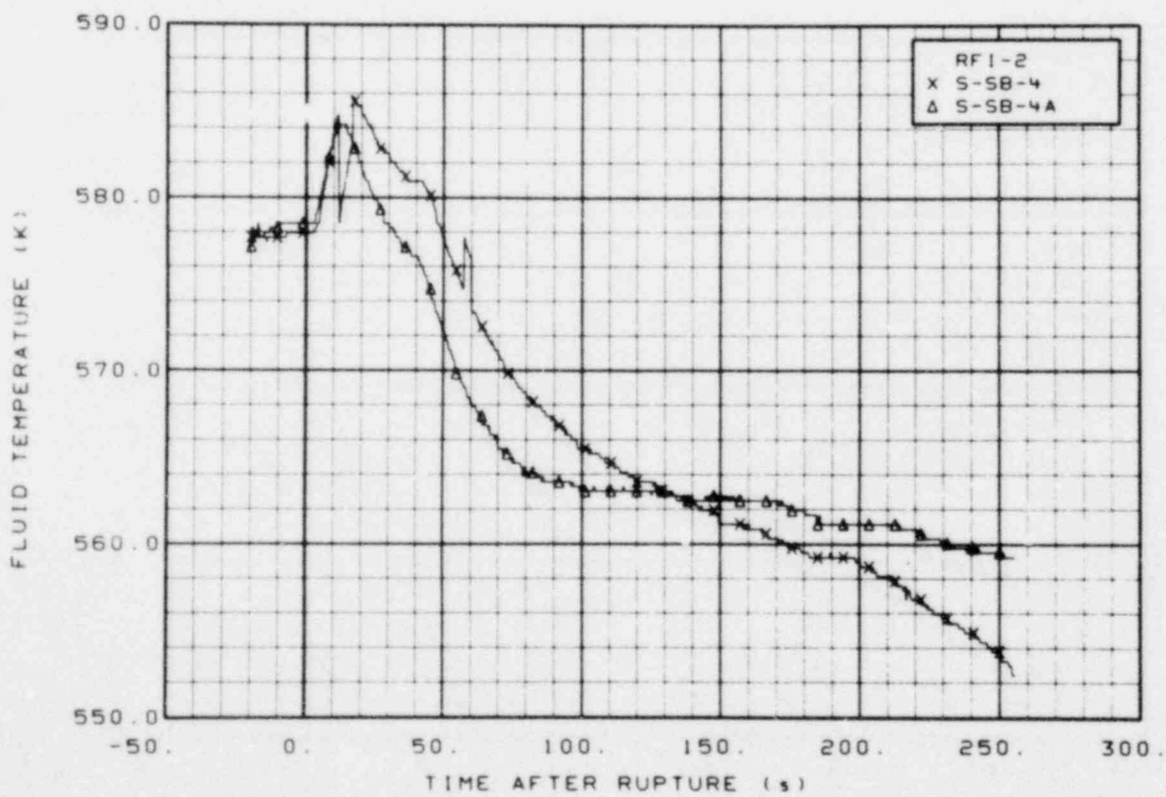


Figure 14. Fluid temperature in intact loop hot leg (RFI-2), from -20 to 256 s.

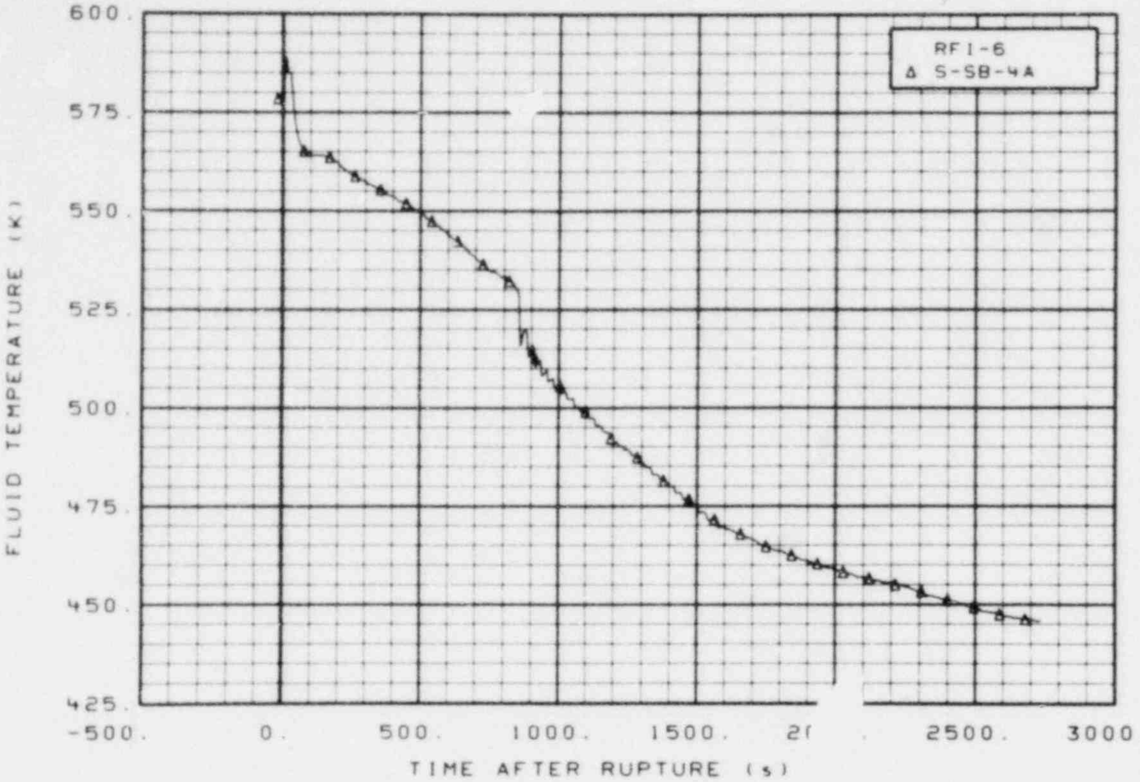


Figure 15. Fluid temperature in intact loop hot leg, Test S-SB-4A (RFI-6), from -20 to 2740 s.

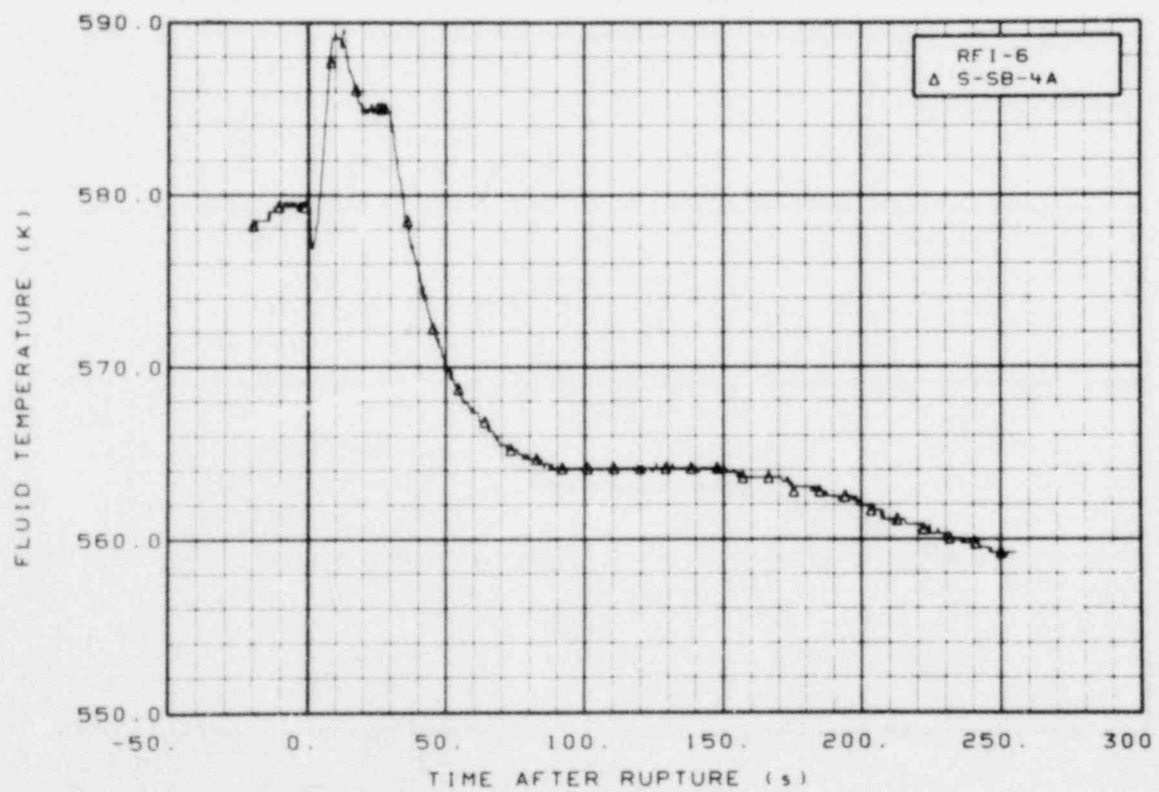


Figure 16. Fluid temperature in intact loop hot leg, Test S-SB-4A (RFI-6), from -20 to 256 s.

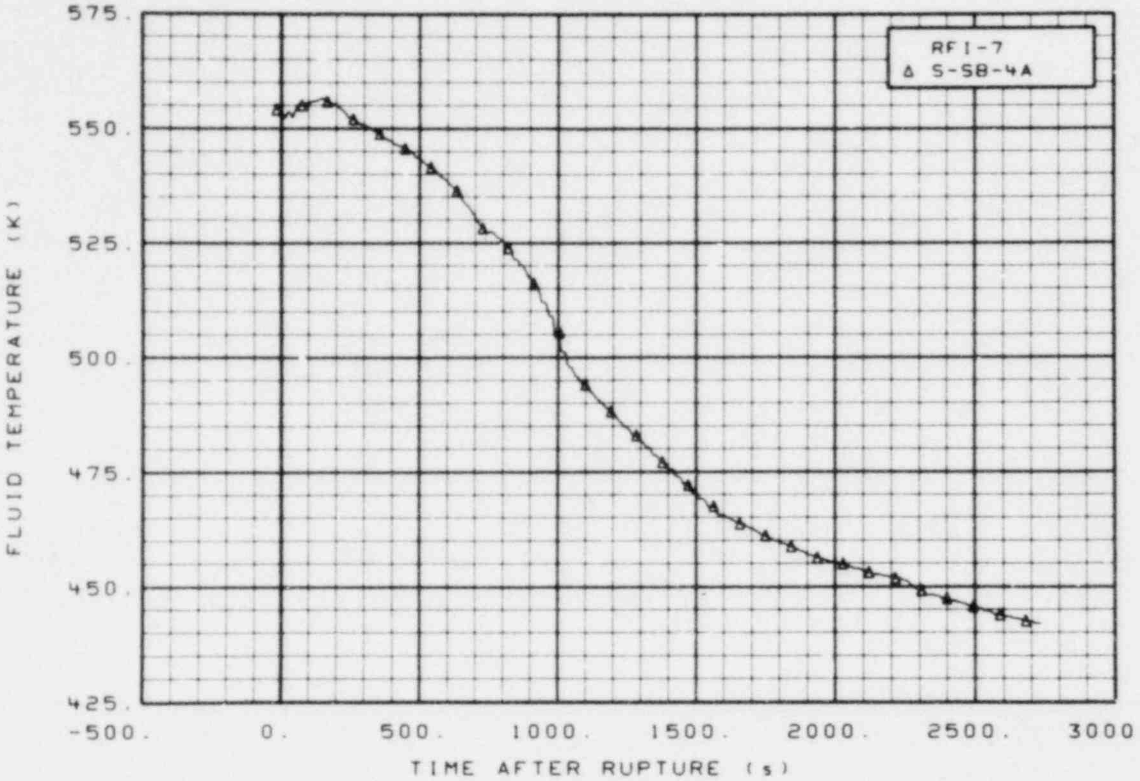


Figure 17. Fluid temperature in intact loop cold leg, Test S-SB-4A (RFI-7), from -20 to 2740 s.

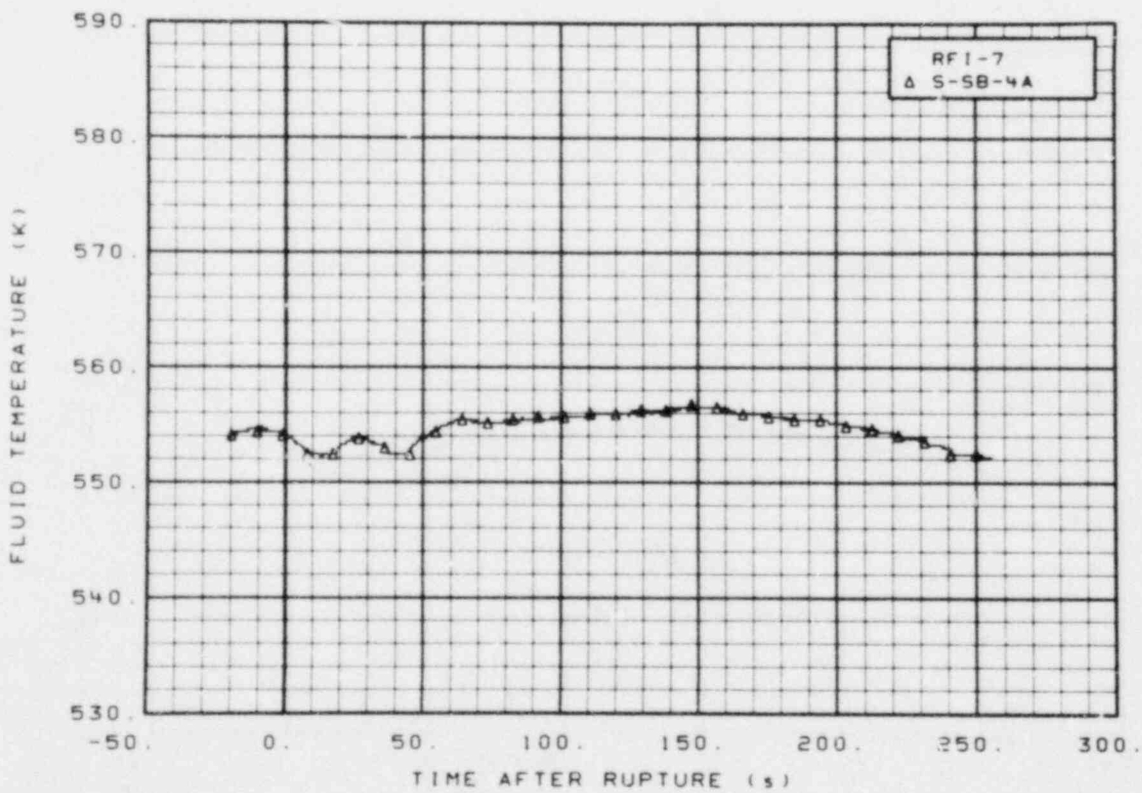


Figure 18. Fluid temperature in intact loop cold leg, Test S-SB-4A (RFI-7), from -20 to 256 s.

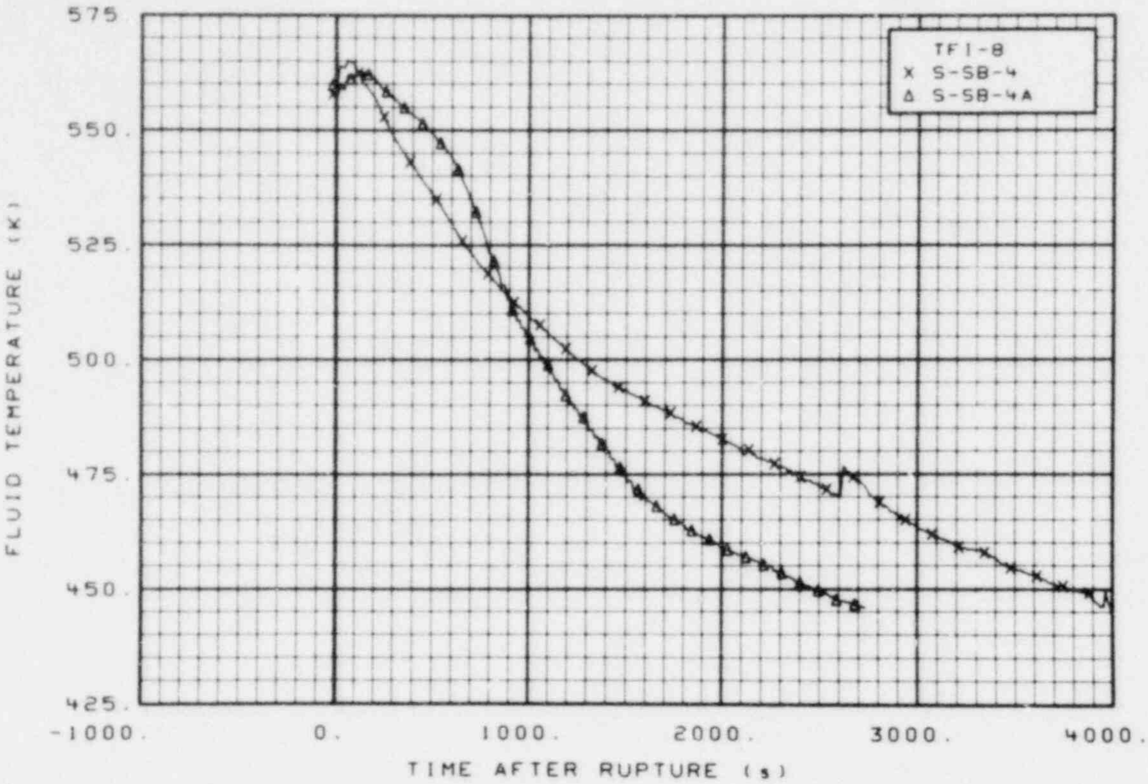


Figure 19. Fluid temperature in intact loop cold leg (TFI-8), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

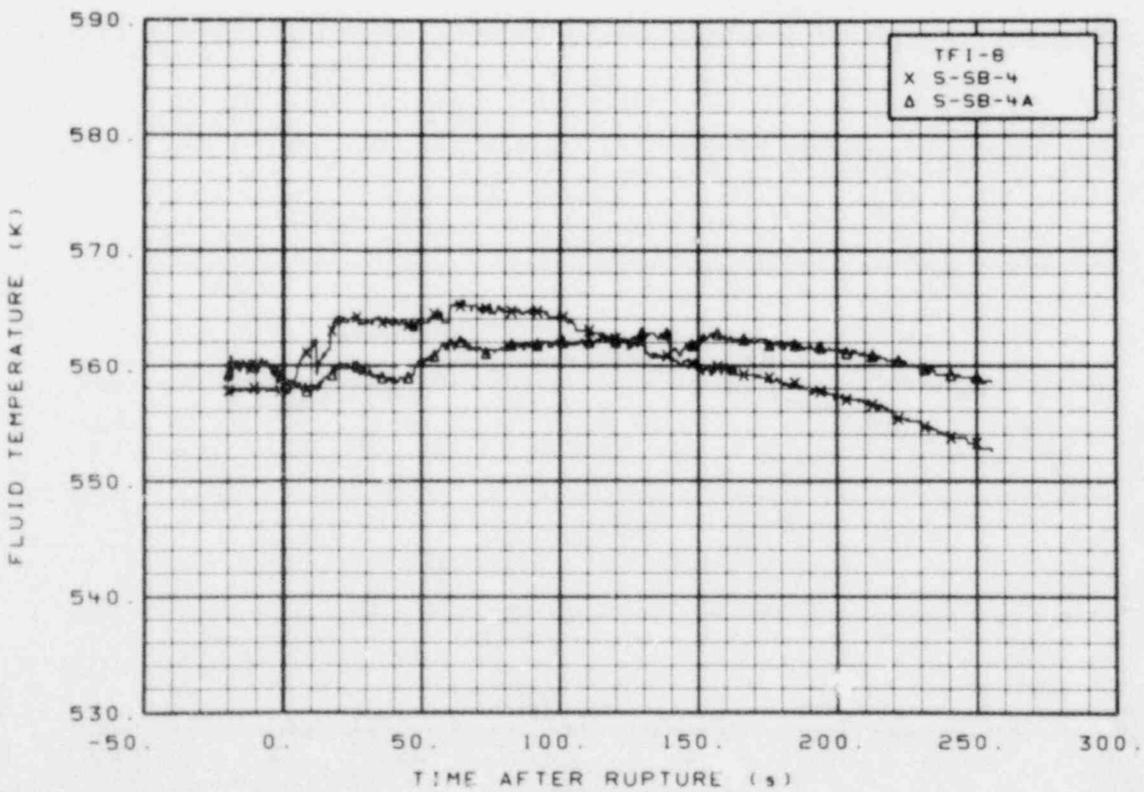


Figure 20. Fluid temperature in intact loop cold leg (TFI-8), from -20 to 256 s.

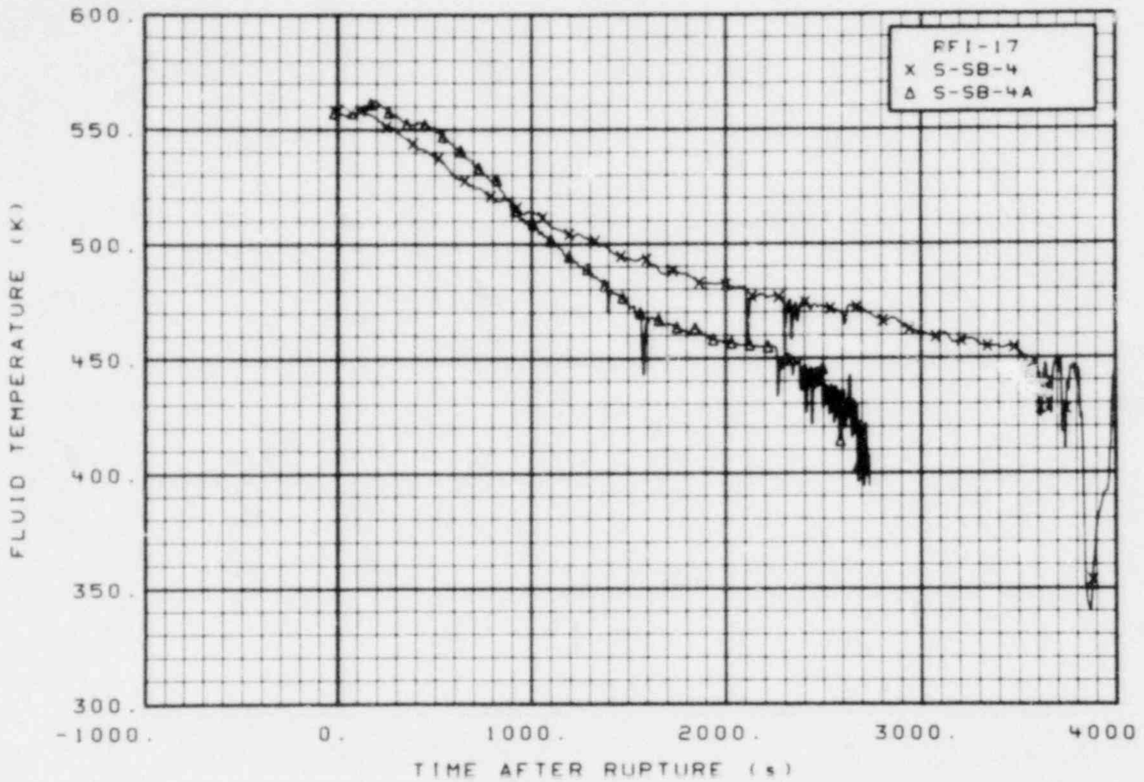


Figure 21. Fluid temperature in intact loop cold leg (RFI-17), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

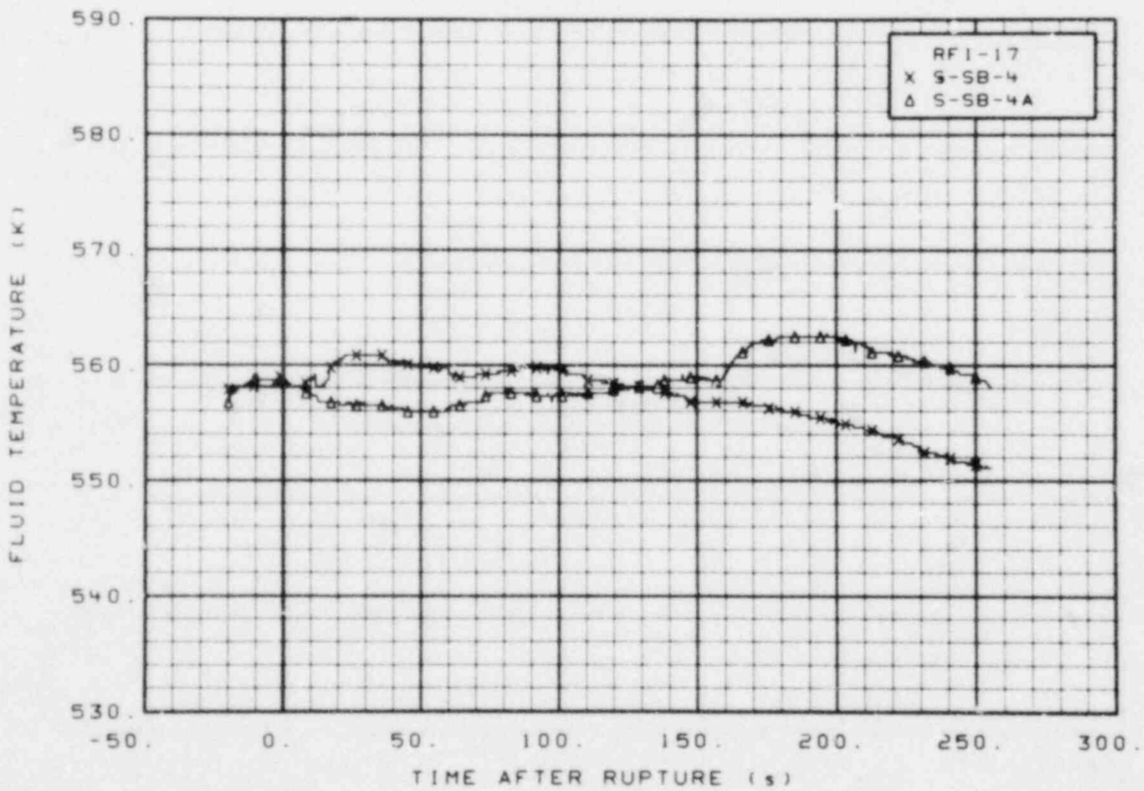


Figure 22. Fluid temperature in intact loop cold leg (RFI-17), from -20 to 256 s.

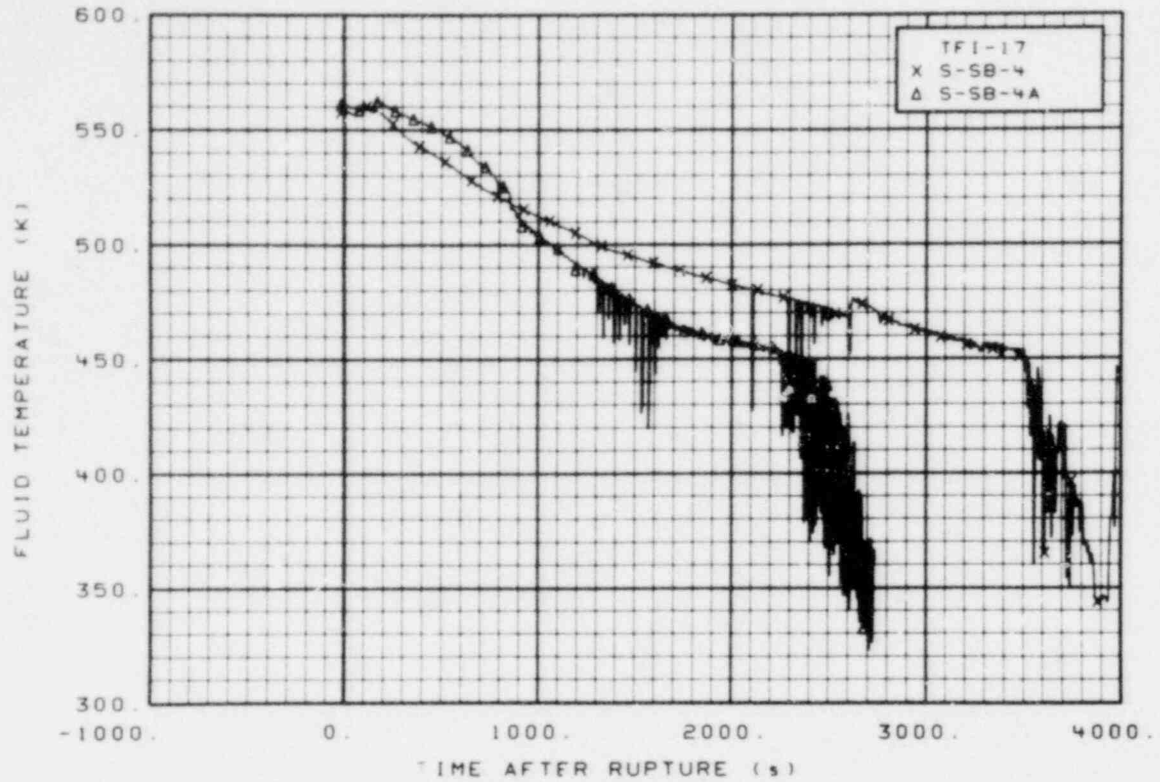


Figure 23. Fluid temperature in intact loop cold leg (TFI-17), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

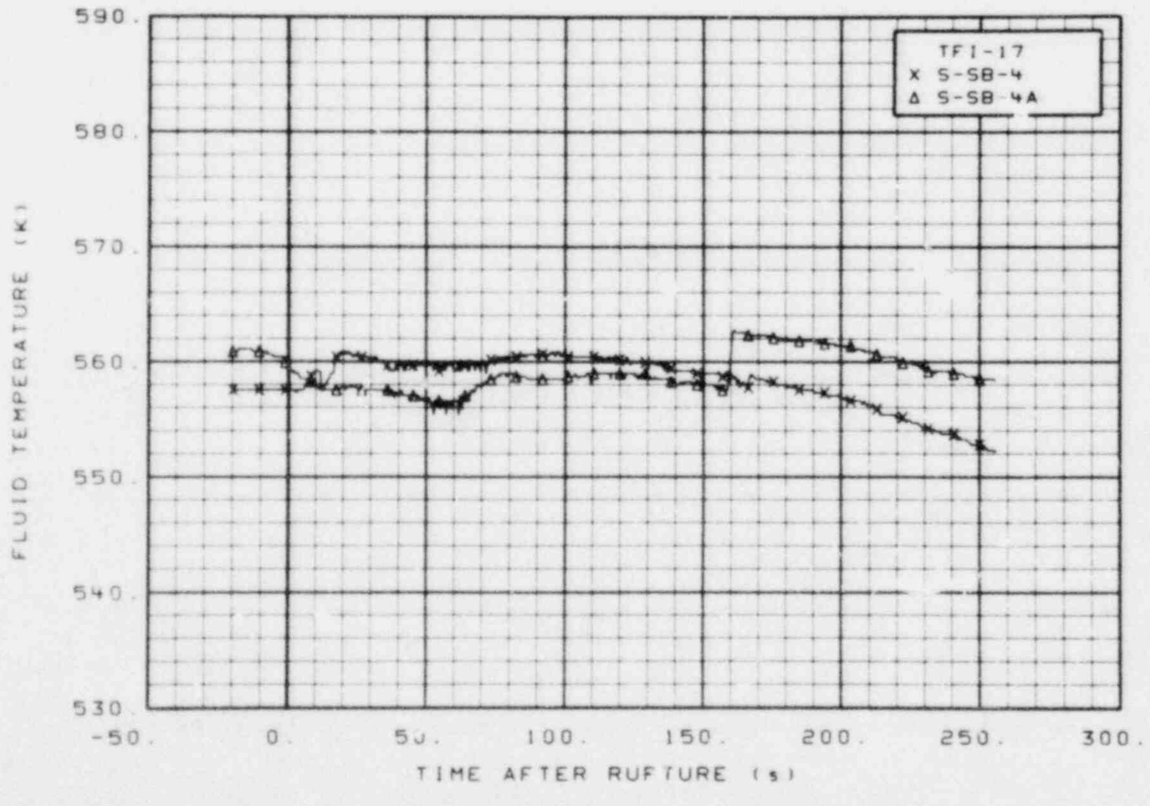


Figure 24. Fluid temperature in intact loop cold leg (TFI-17), from -20 to 256 s.

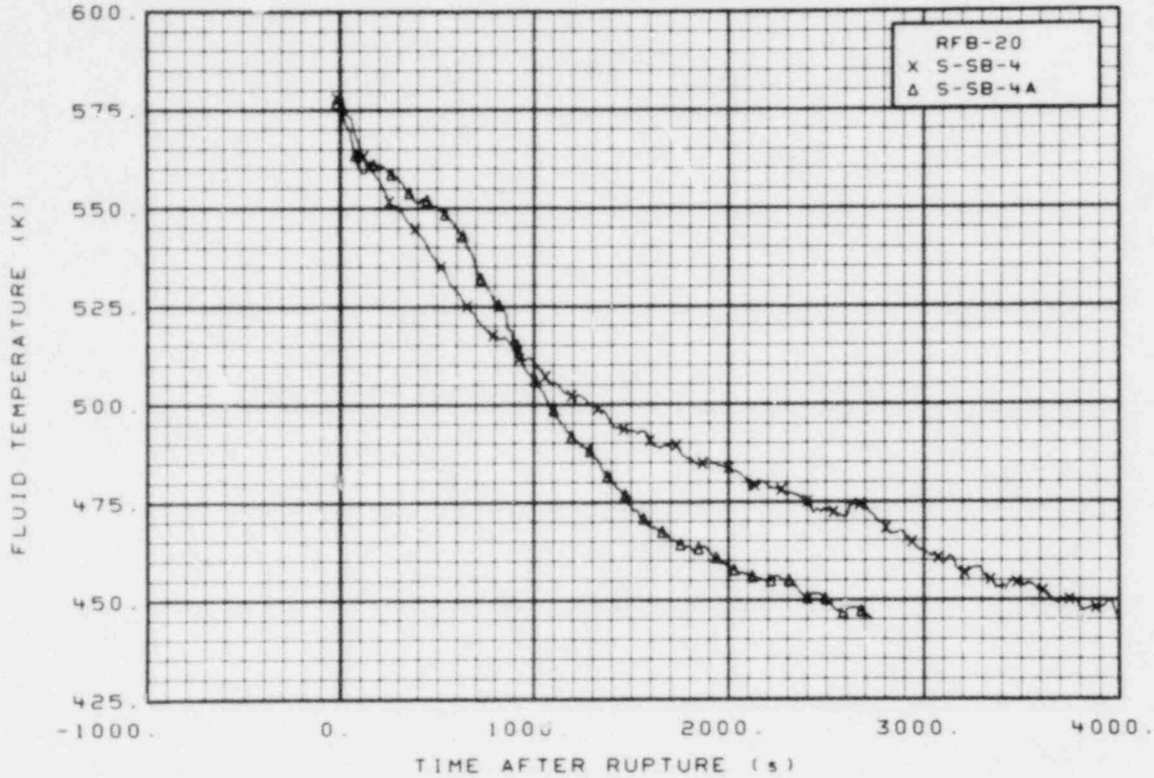


Figure 25. Fluid temperature in broken loop hot leg (RFB-20), from -20 to 4000 s (to 27 s for Test S-SB-4A).

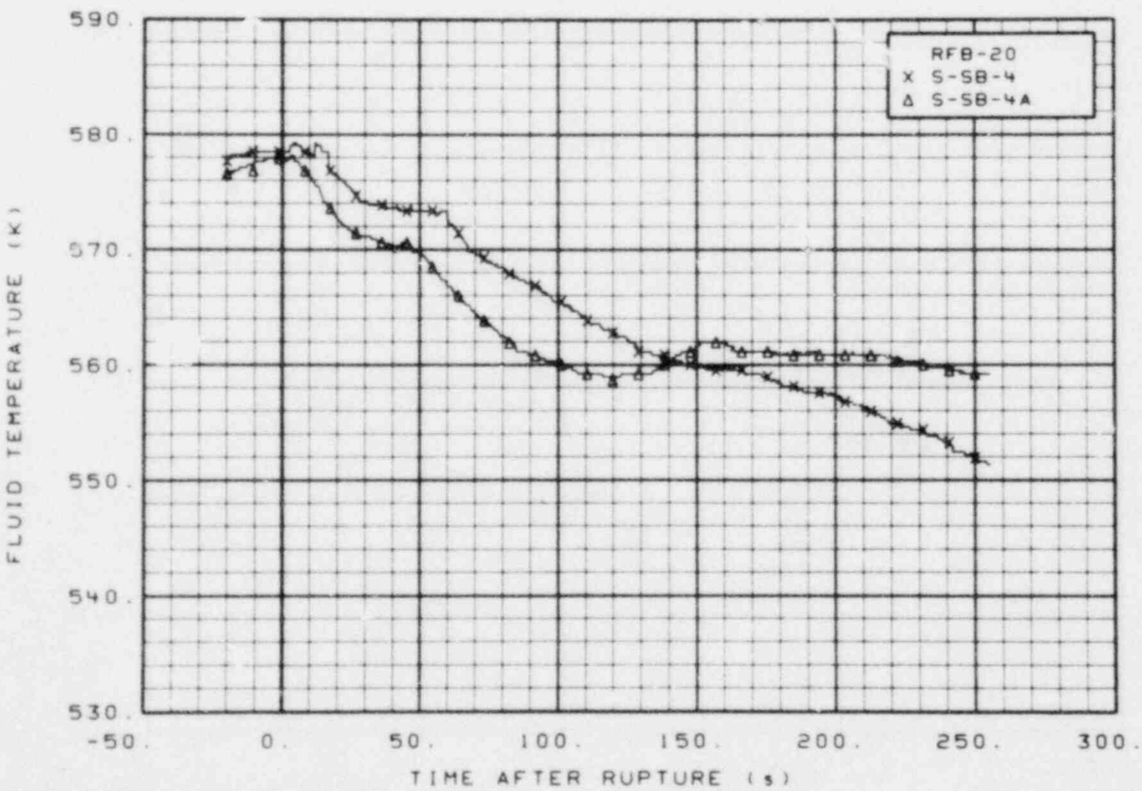


Figure 26. Fluid temperature in broken loop hot leg (RFB-20), from -20 to 256 s.

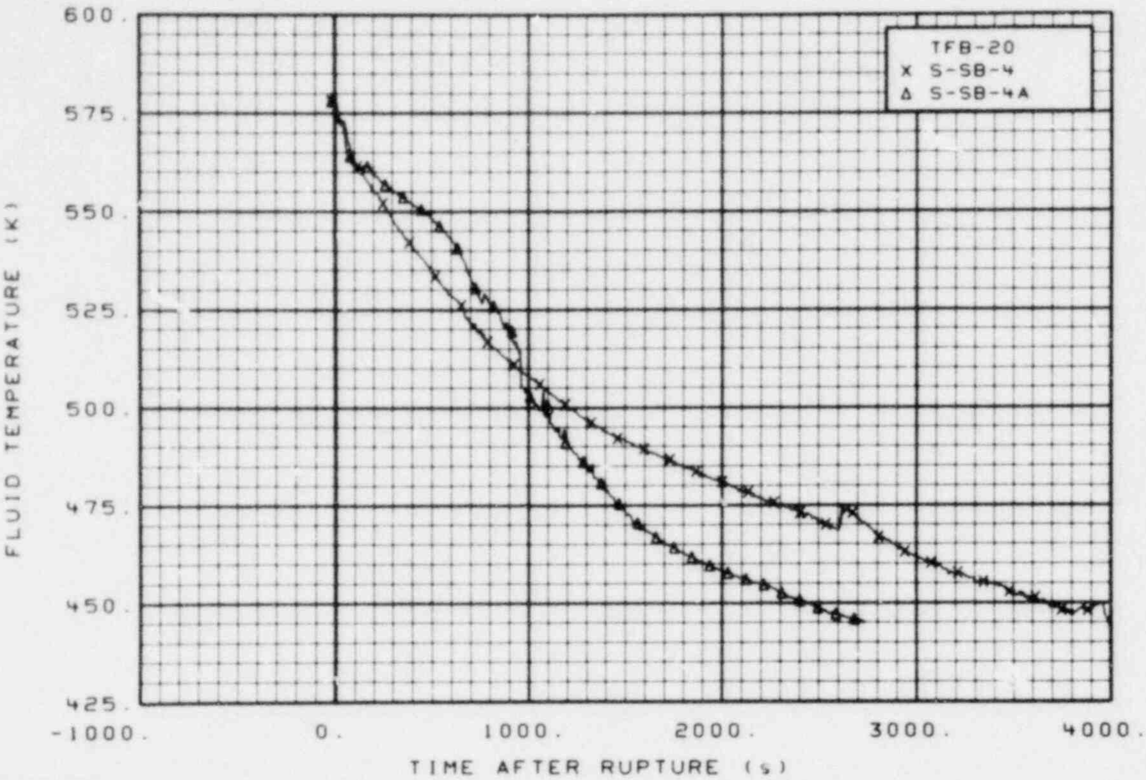


Figure 27. Fluid temperature in broken loop hot leg (TFB-20), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

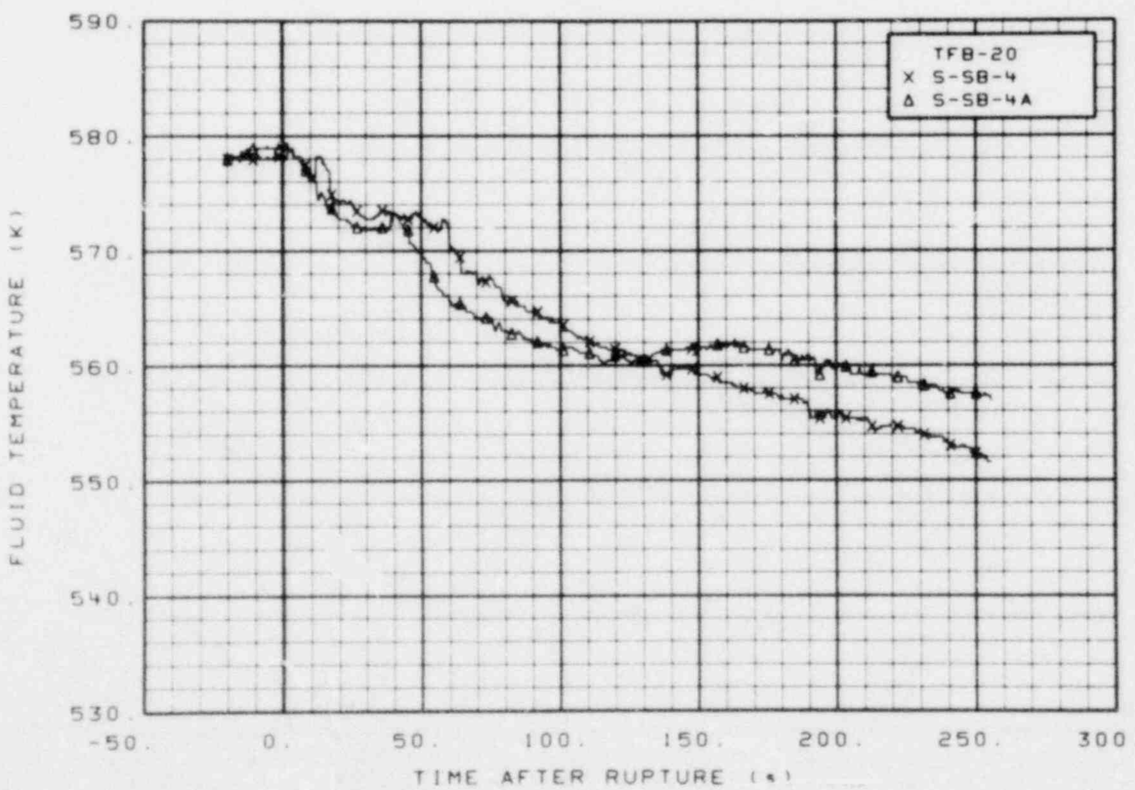


Figure 28. Fluid temperature in broken loop hot leg (TFB-20), from -20 to 256 s.

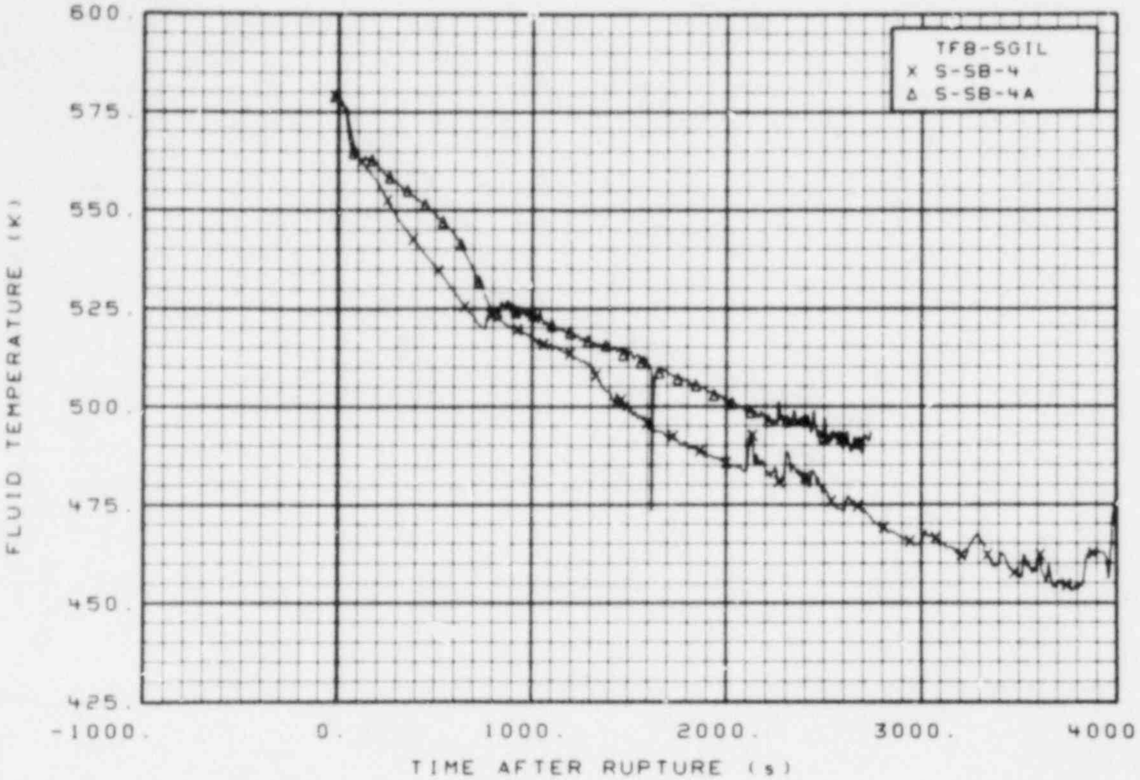


Figure 29. Fluid temperature in broken loop steam generator, inlet leg (TFB-SGIL), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

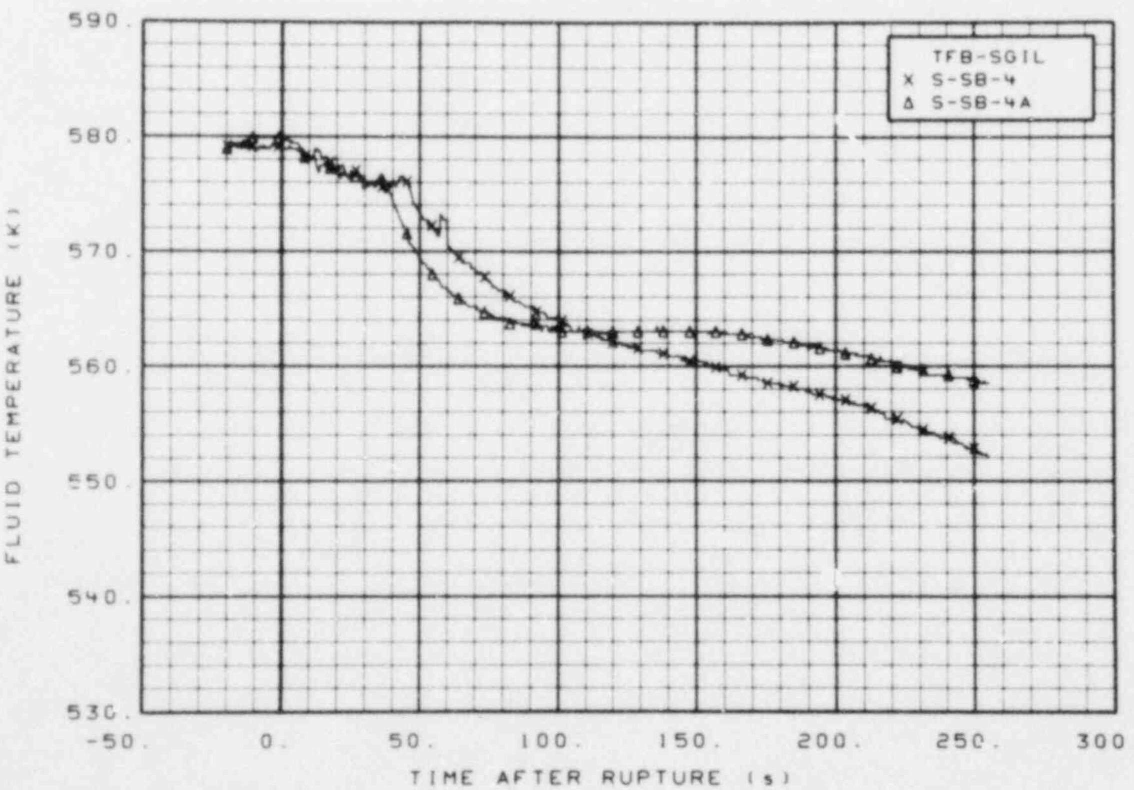


Figure 30. Fluid temperature in broken loop steam generator, inlet leg (TFB-SGIL), from -20 to 256 s.

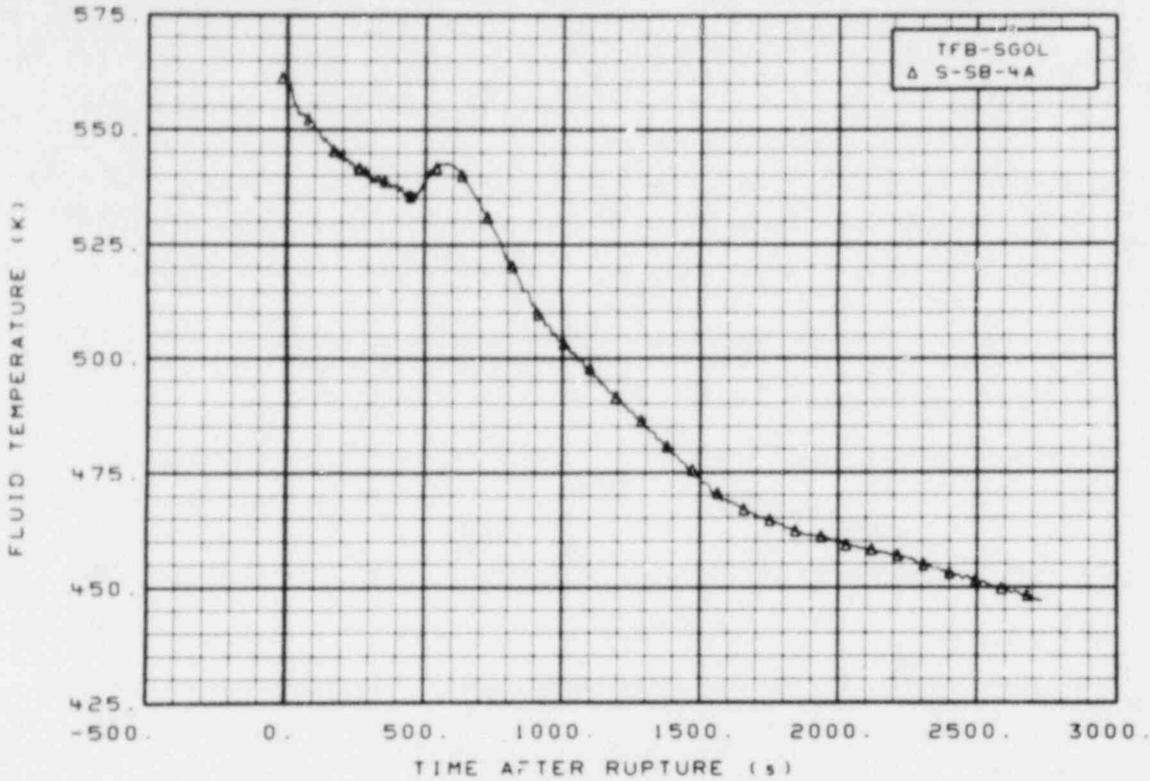


Figure 31. **Fluid temperature in broken loop steam generator, outlet leg, Test S-SB-4A (TFB-SGOL), from -20 to 2740 s.**

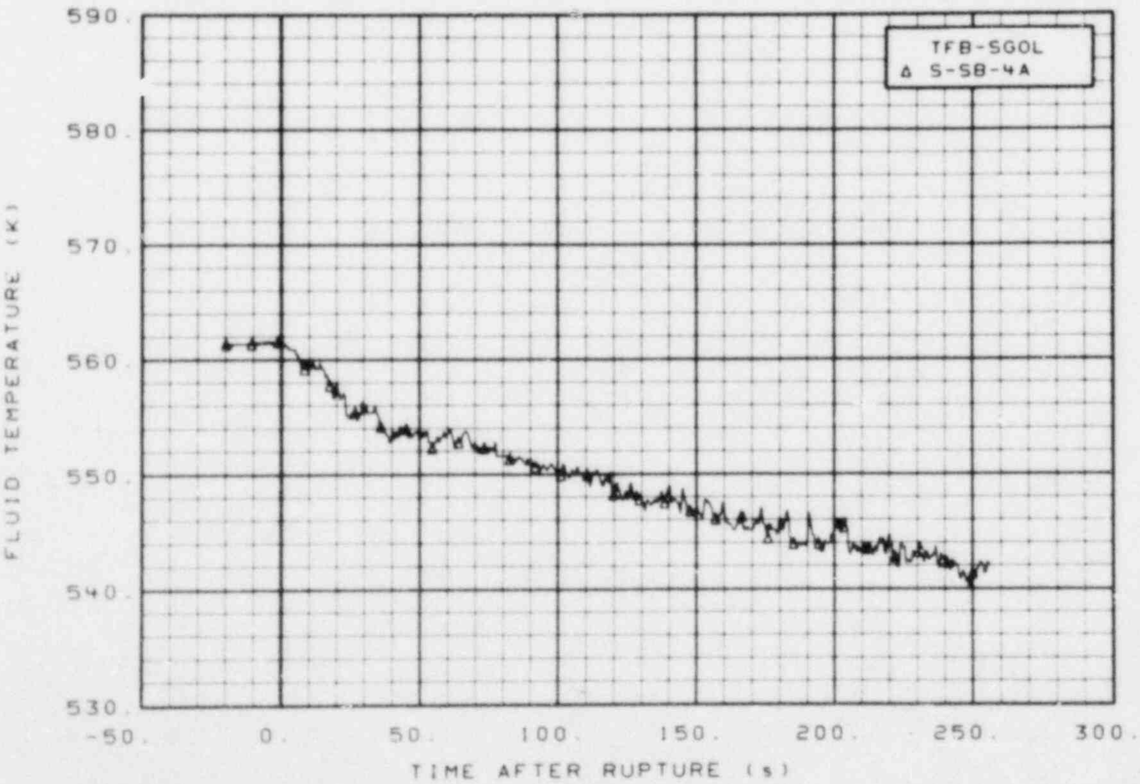


Figure 32. **Fluid temperature in broken loop steam generator, outlet leg, Test S-SB-4A (TFB-SGOL), from -20 to 256 s.**

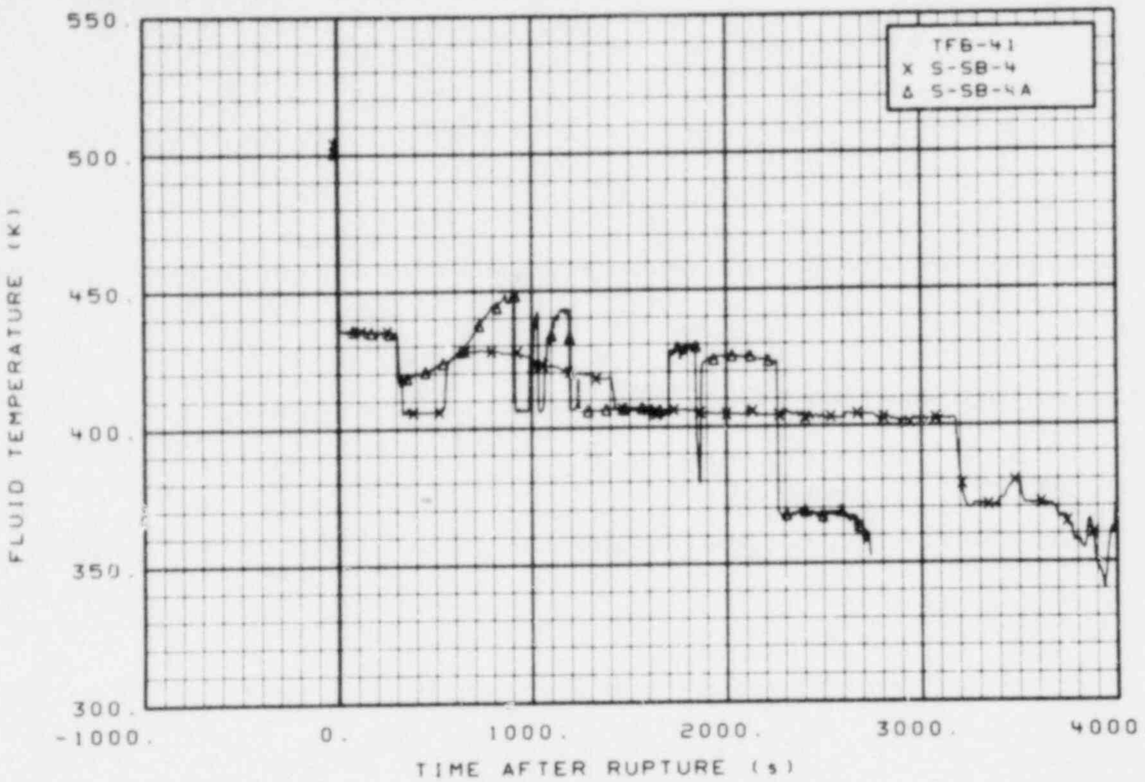


Figure 33. Fluid temperature in broken loop cold leg (TFB-41), from -20 to 4000 s (to 2740 s for S-SB-4A).

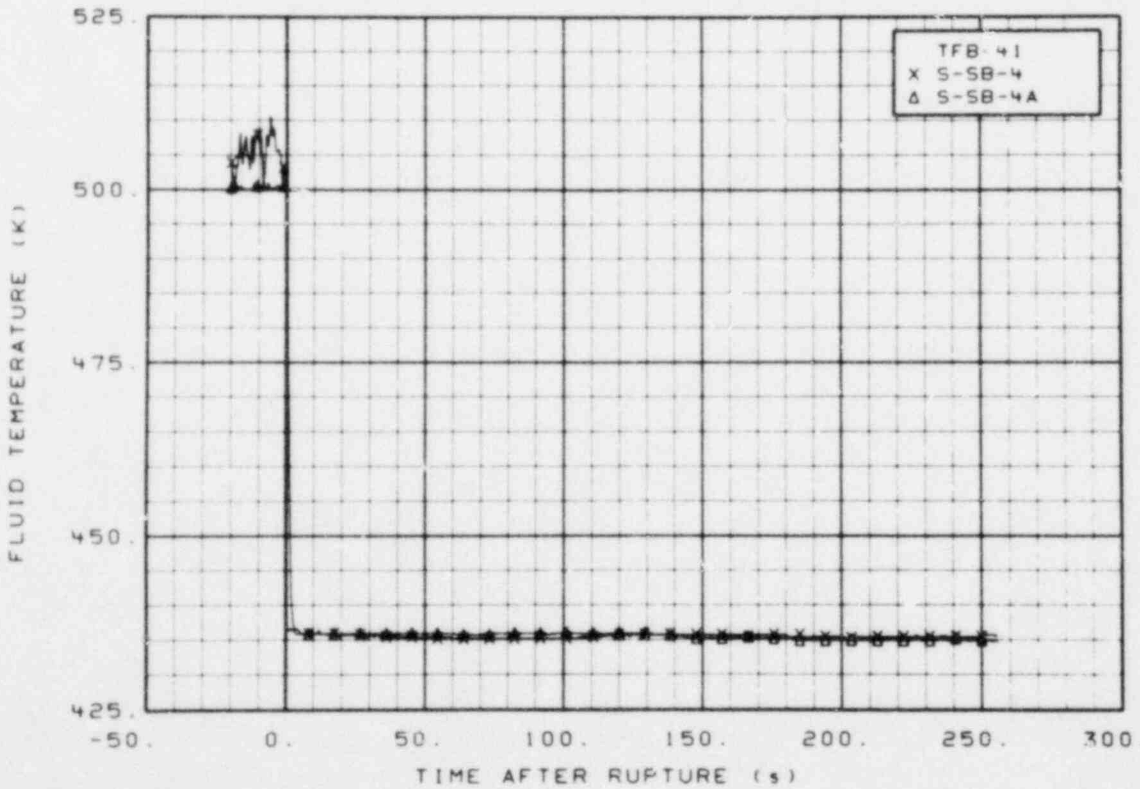


Figure 34. Fluid temperature in broken loop cold leg (TFB-41), from -20 to 256 s.

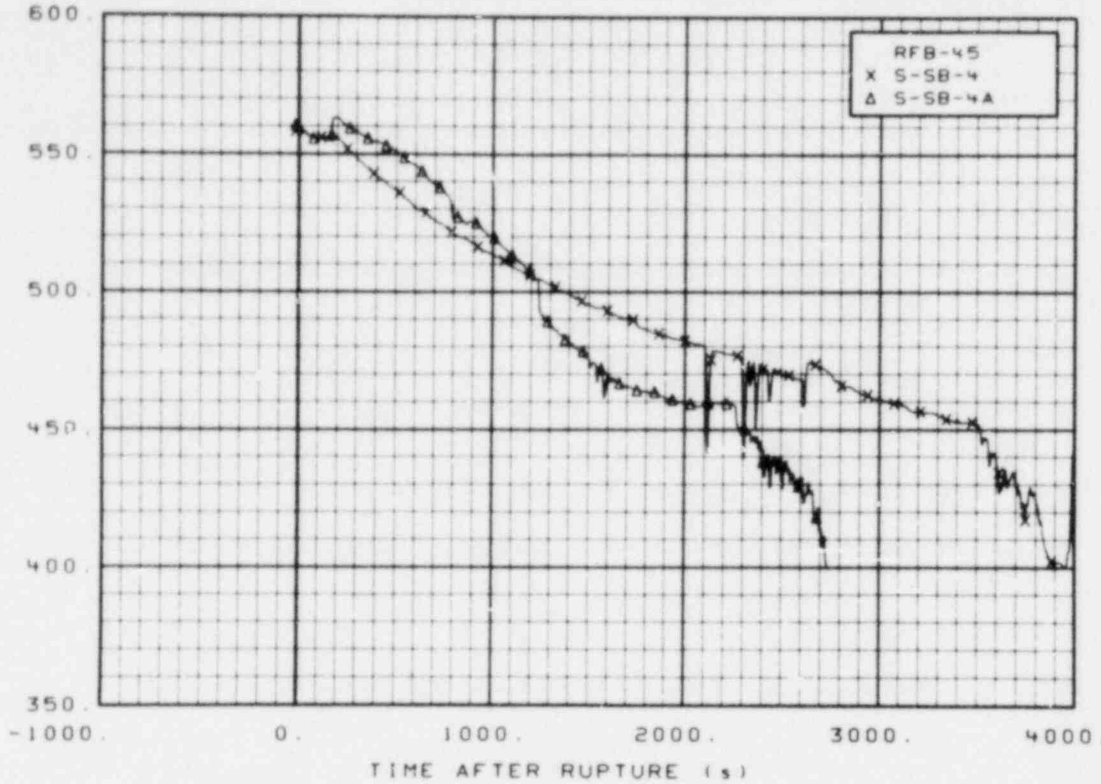


Figure 35. Fluid temperature in broken loop cold leg (RFB-45), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

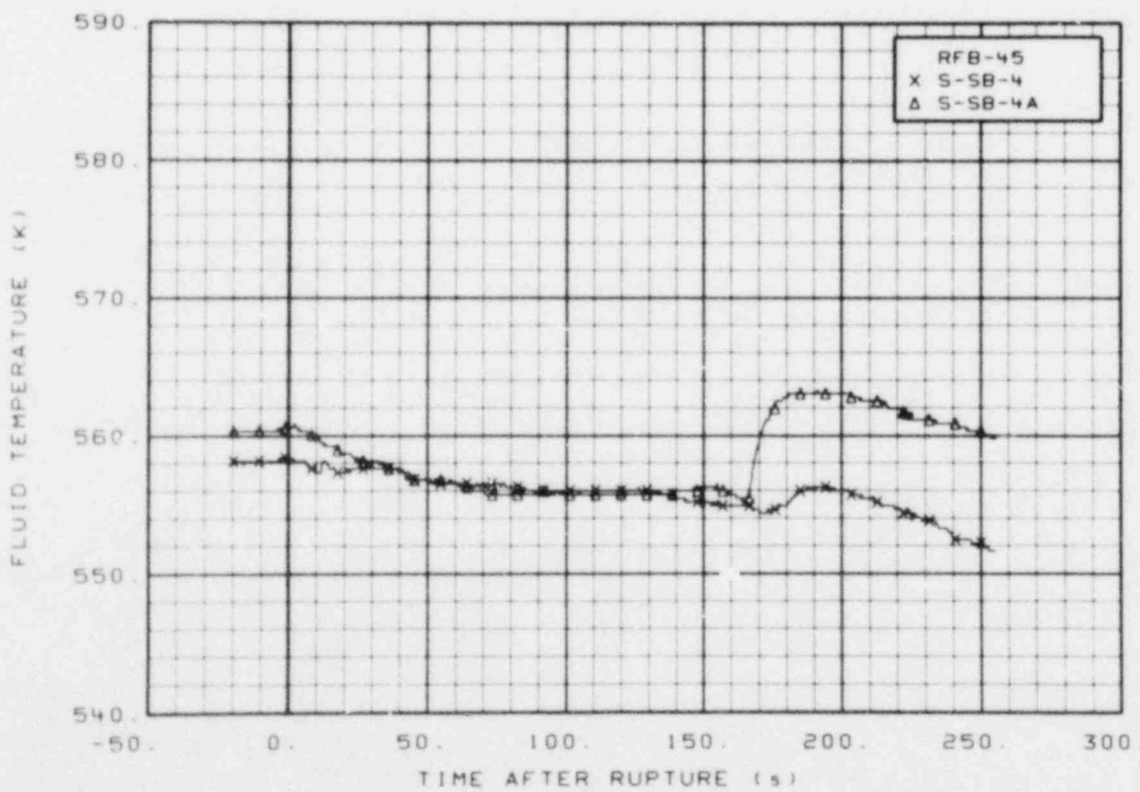


Figure 36. Fluid temperature in broken loop cold leg (RFB-45), from -20 to 256 s.

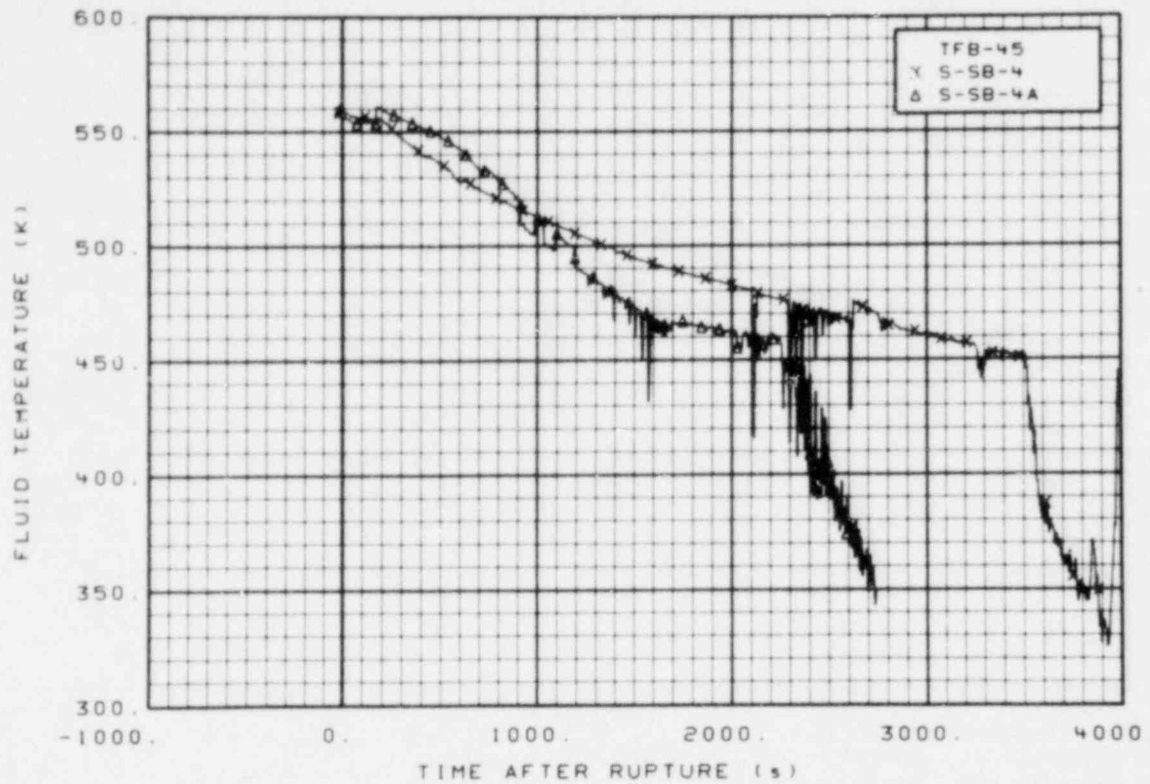


Figure 37. Fluid temperature in broken loop cold leg (TFB-45), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

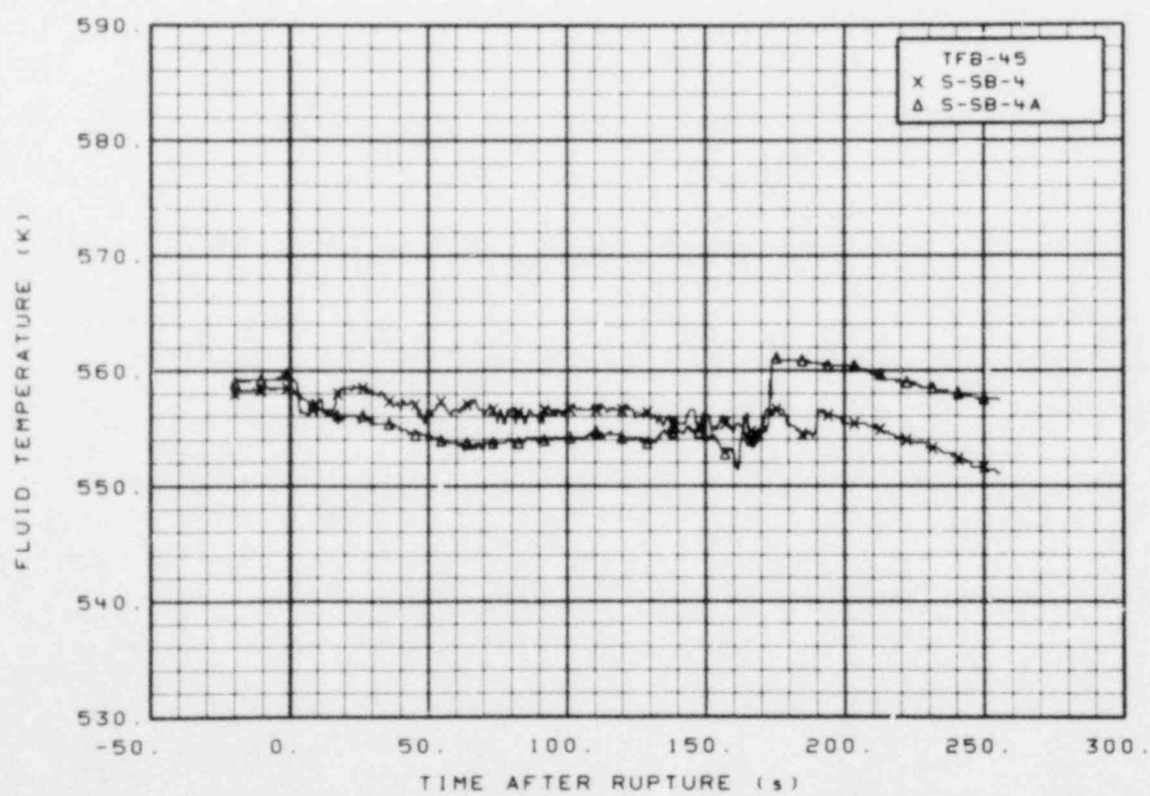


Figure 38. Fluid temperature in broken loop cold leg (TFB-45), from -20 to 256 s.

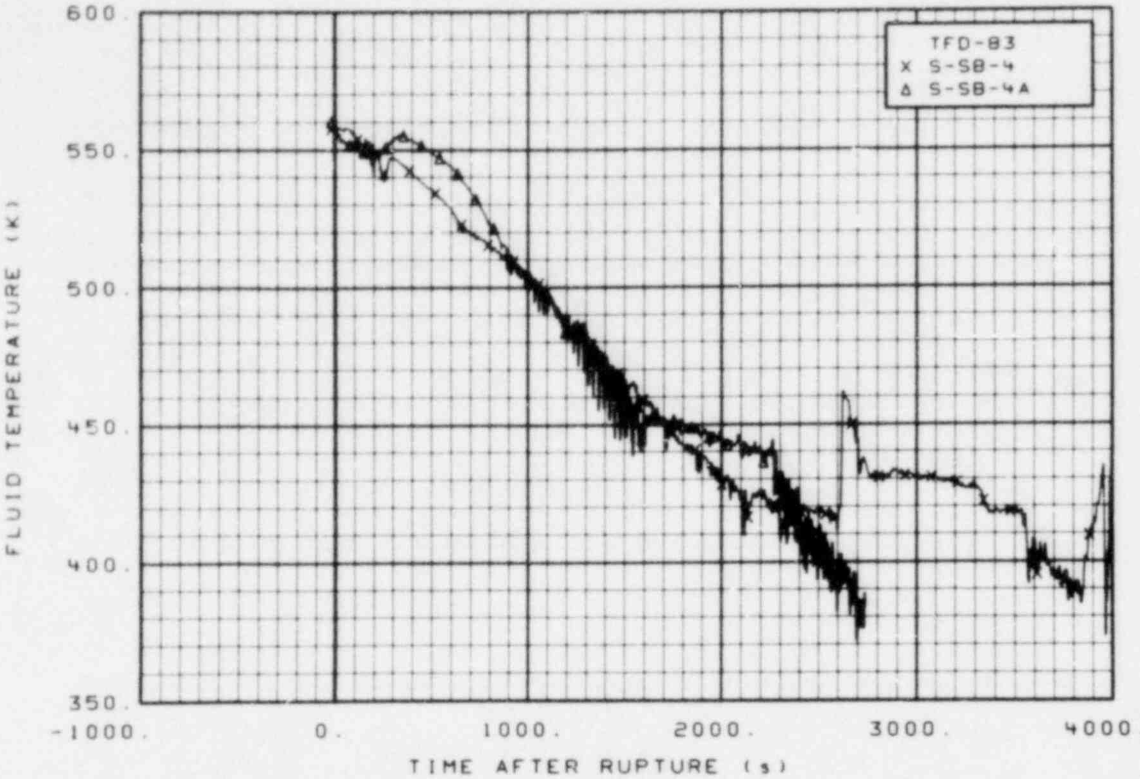


Figure 39. Fluid temperature in downcomer (TFD-83), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

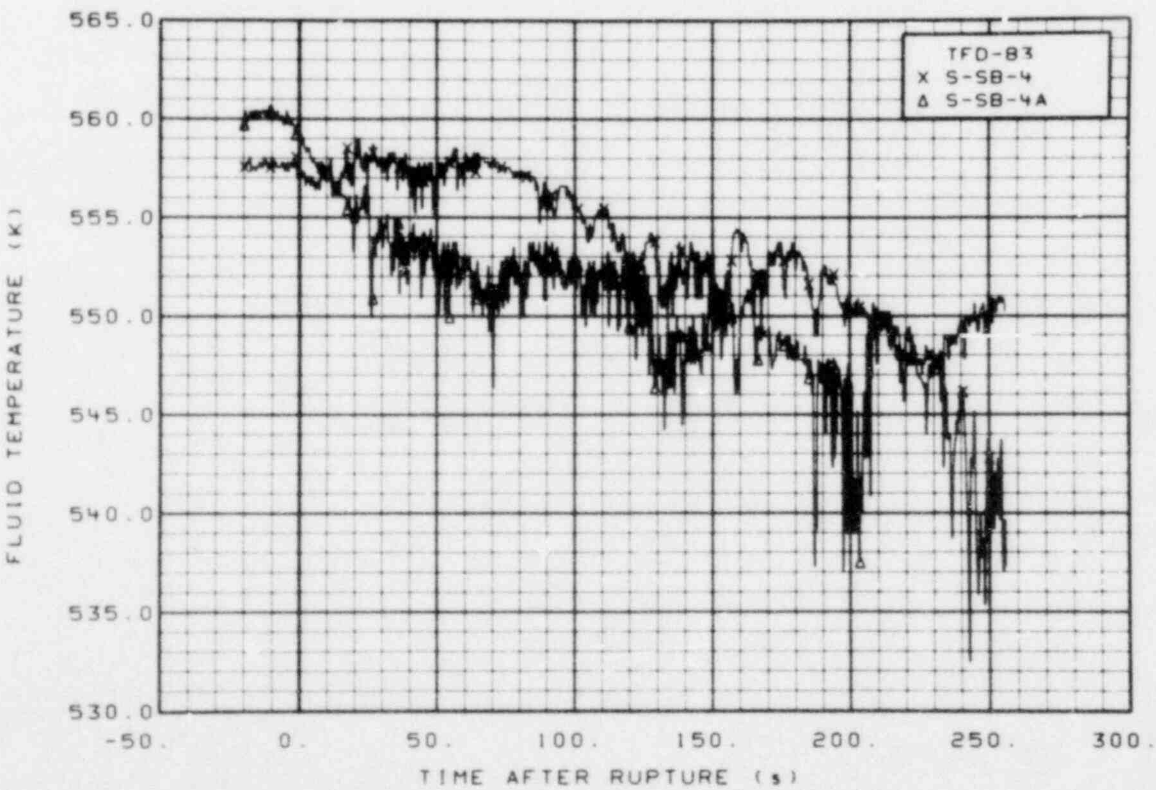


Figure 40. Fluid temperature in downcomer (TFD-83), from -20 to 256 s.

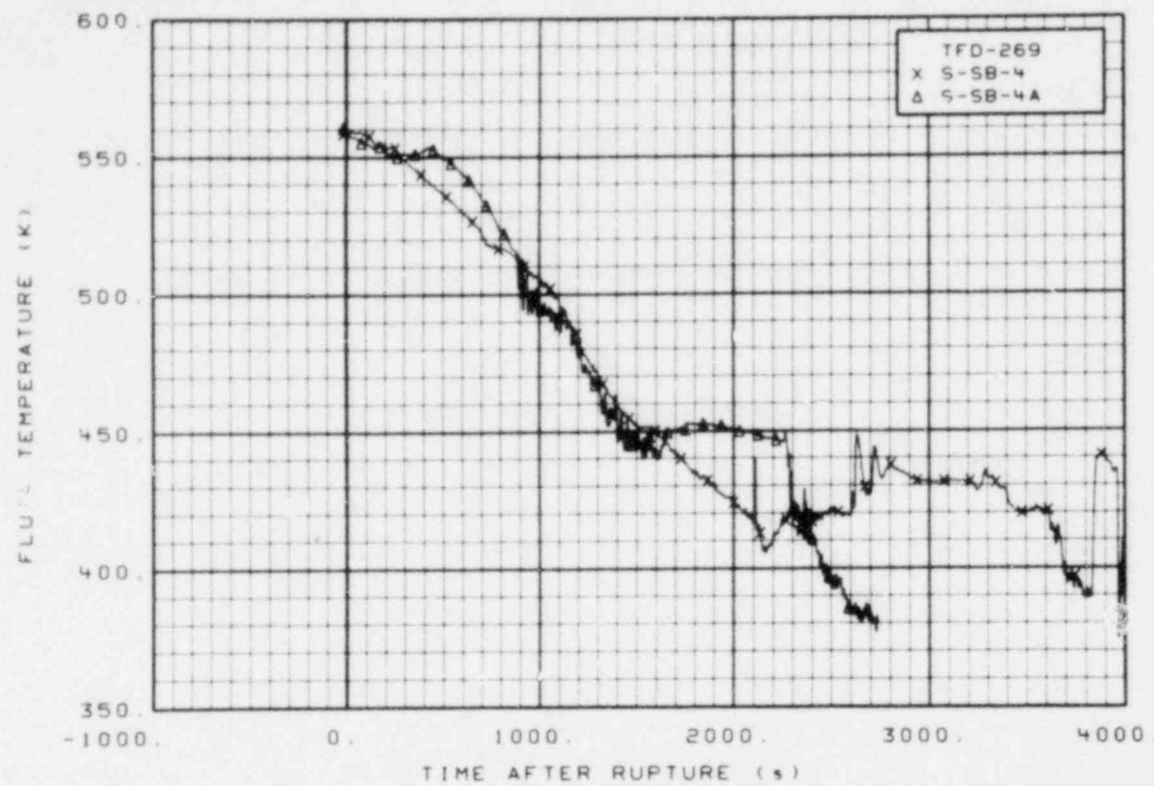


Figure 41. Fluid temperature in downcomer (TFD-269), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

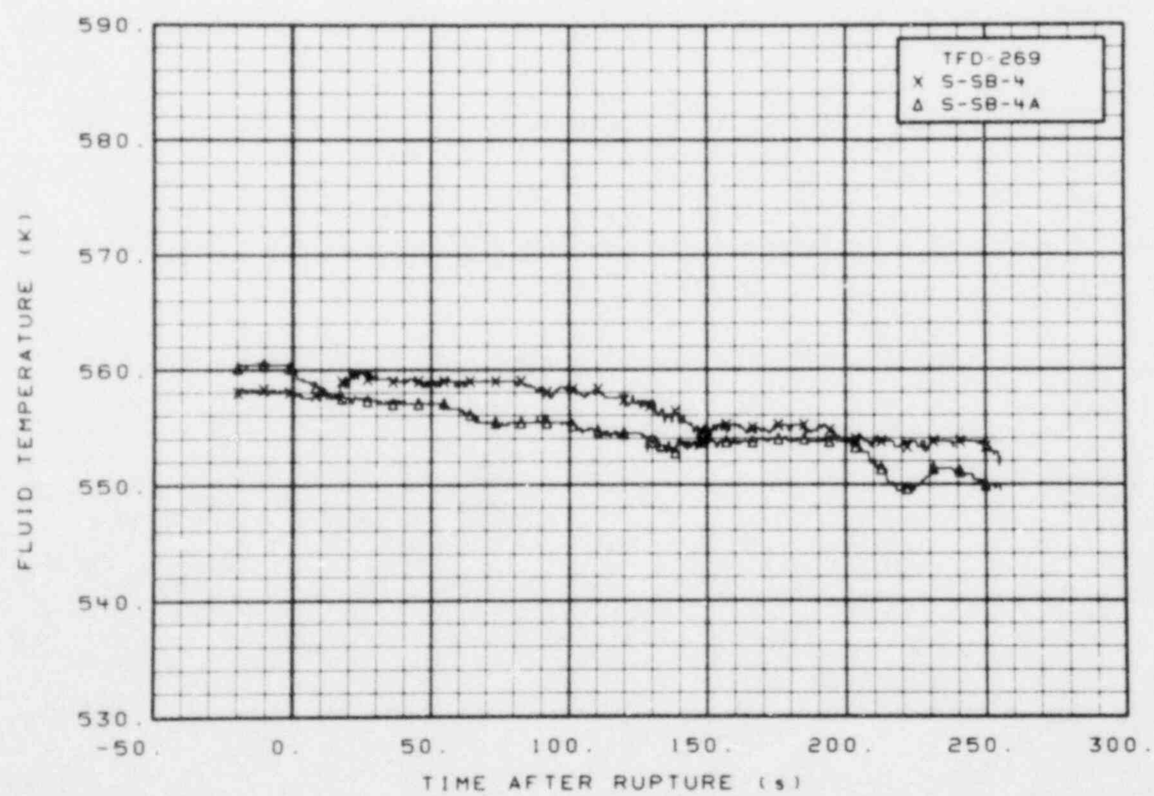


Figure 42. Fluid temperature in downcomer (TFD-269), from -20 to 256 s.

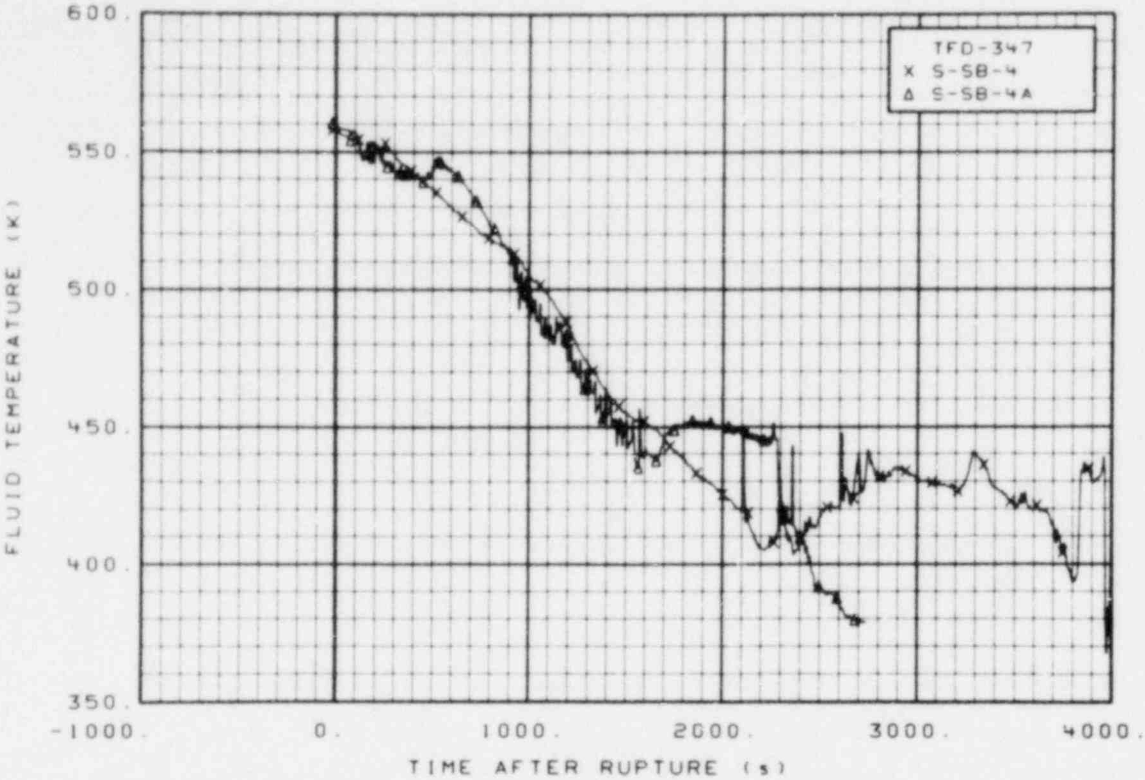


Figure 43. Fluid temperature in downcomer (TFD-347), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

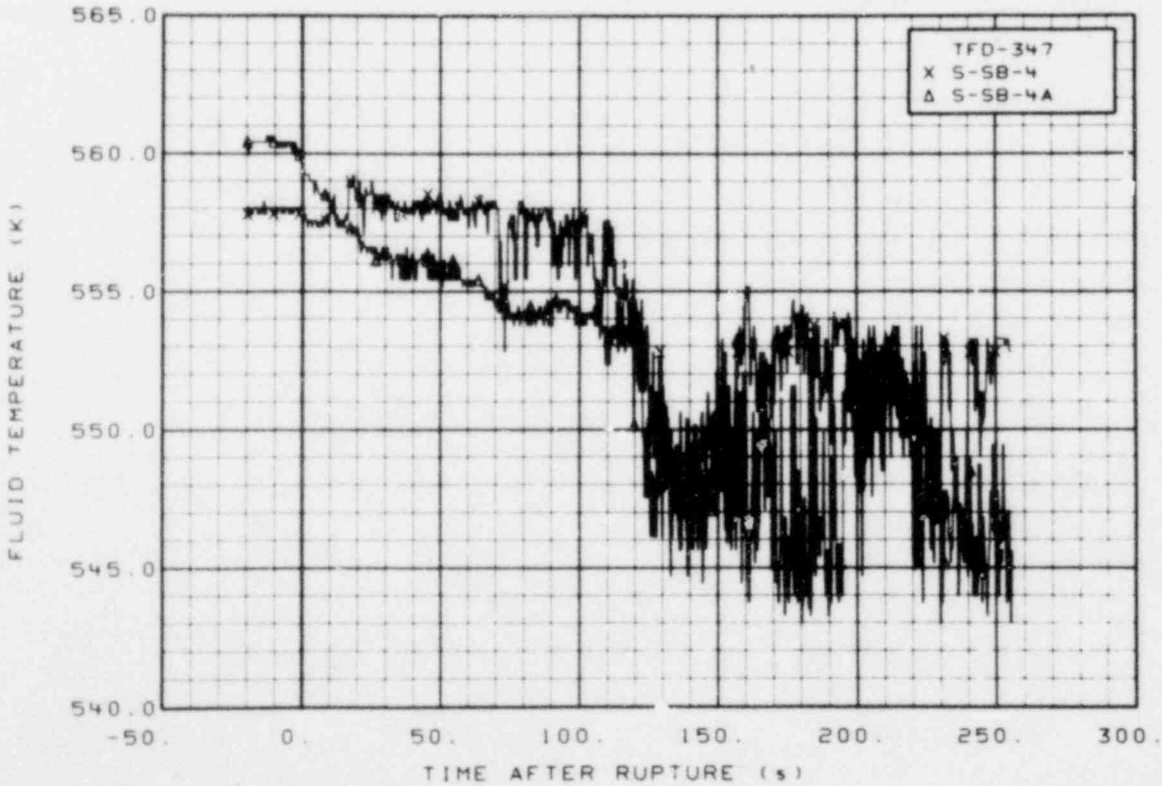


Figure 44. Fluid temperature in downcomer (TFD-347), from -20 to 256 s.

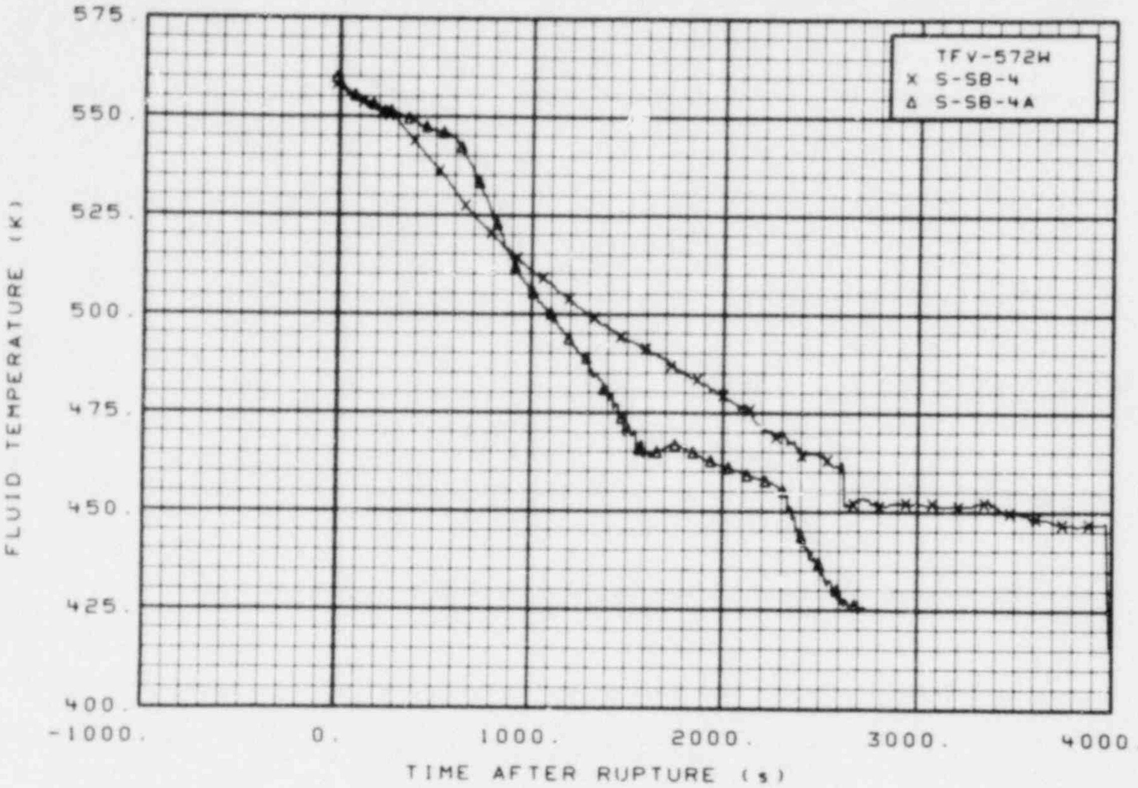


Figure 45. Fluid temperature in vessel (TFV-572W), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

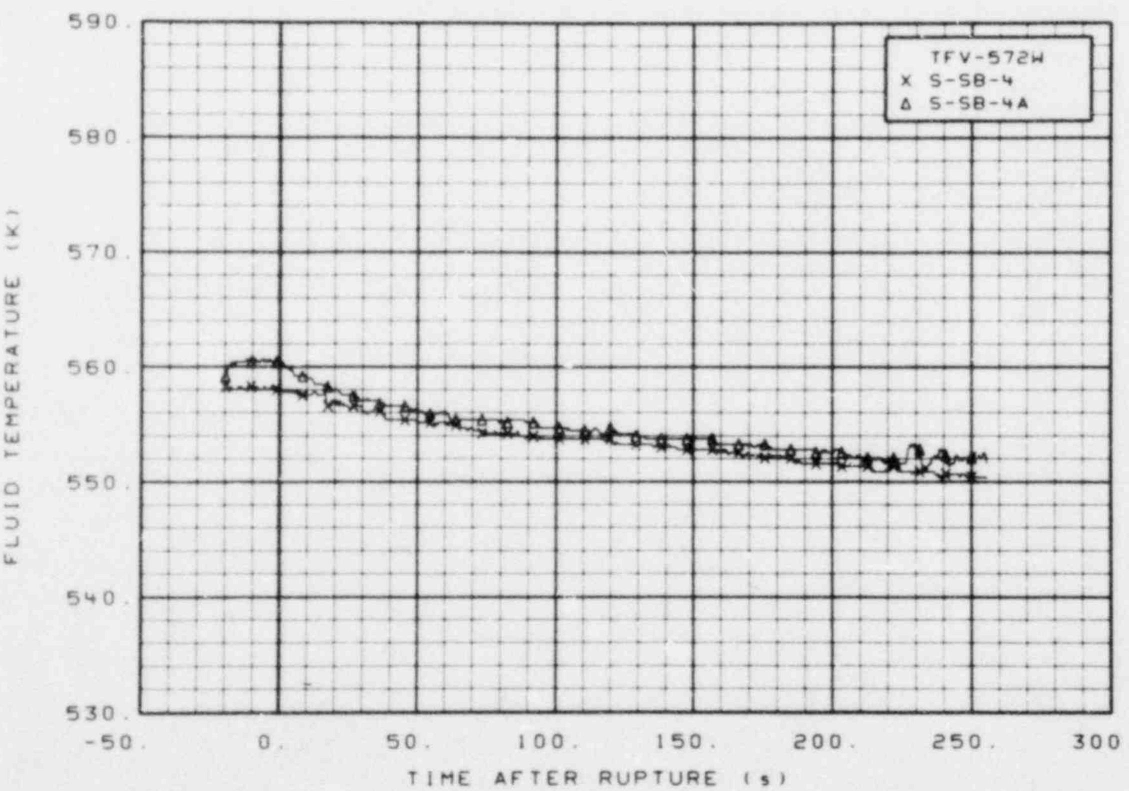


Figure 46. Fluid temperature in vessel (TFV-572W), from -20 to 256 s.

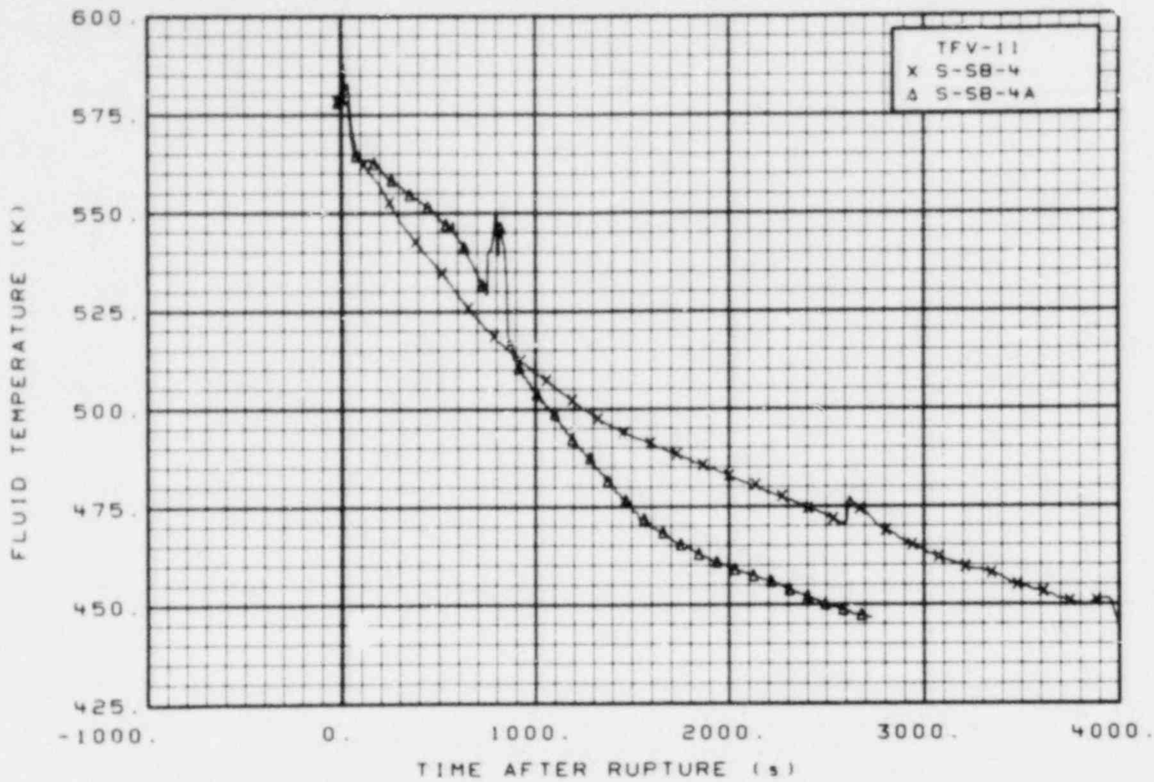


Figure 47. Fluid temperature in vessel (TFV-11), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

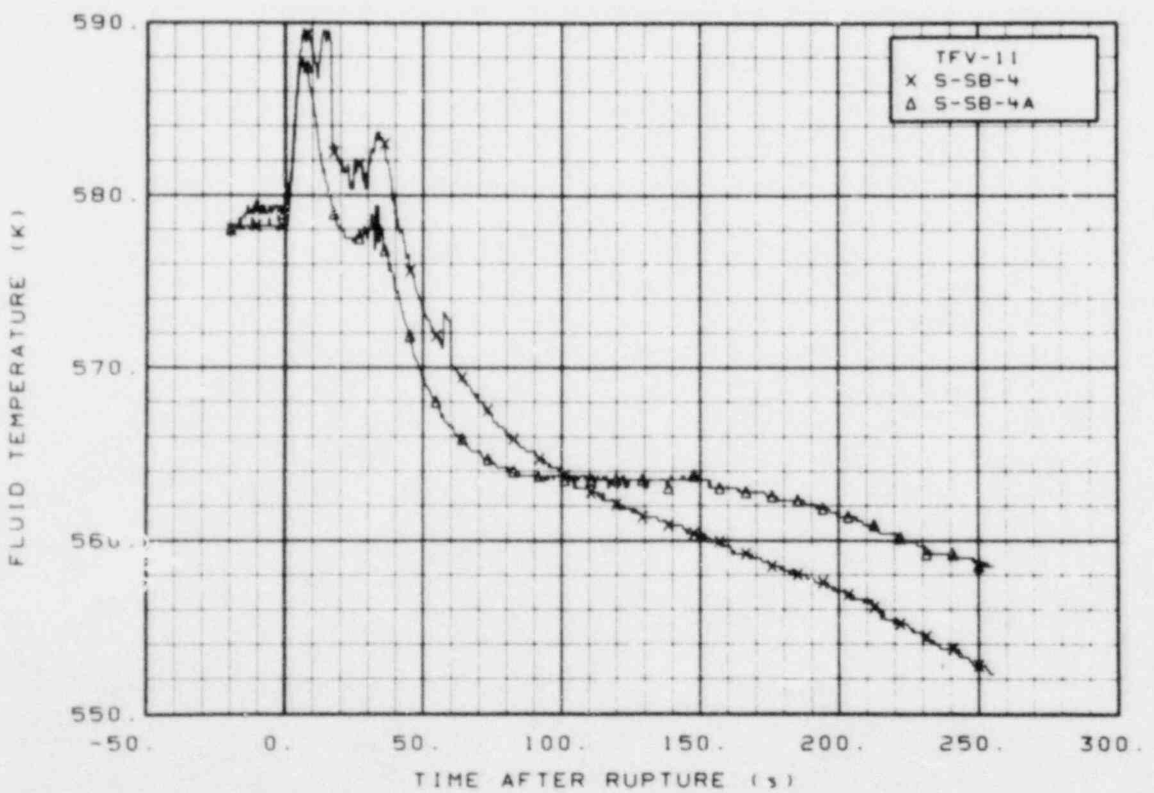


Figure 48. Fluid temperature in vessel (TFV-11), from -20 to 256 s.

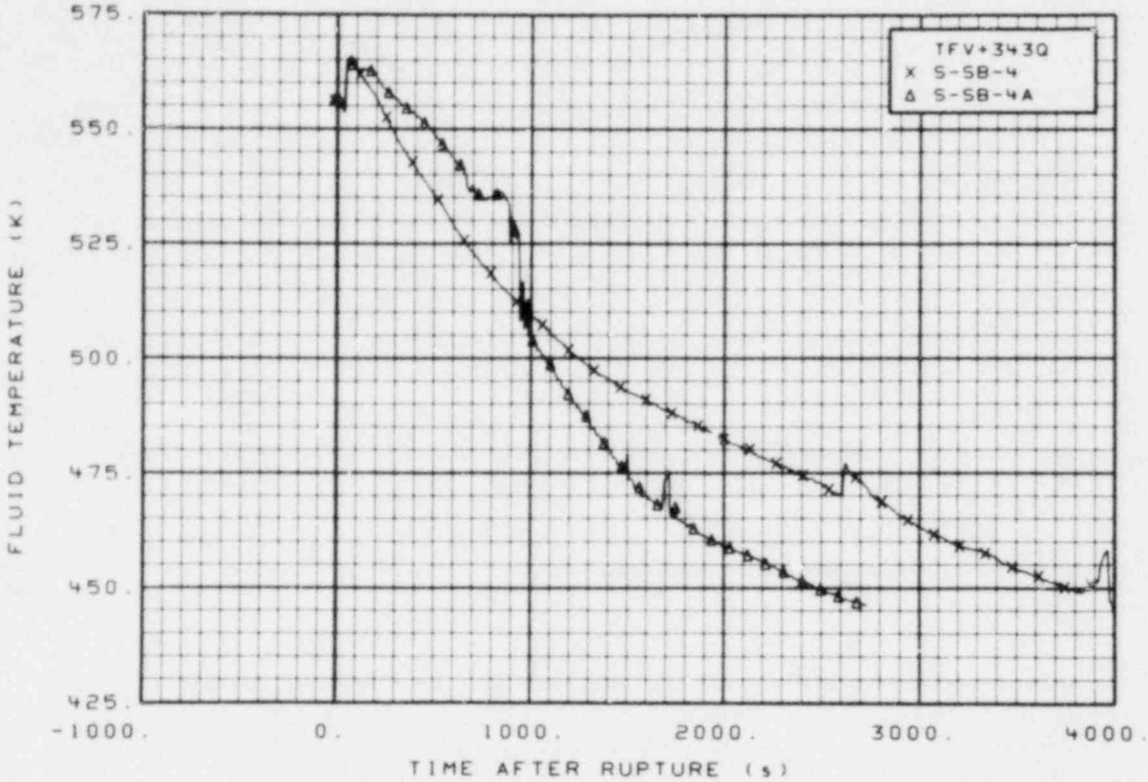


Figure 49. Fluid temperature in vessel (TFV + 343Q), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

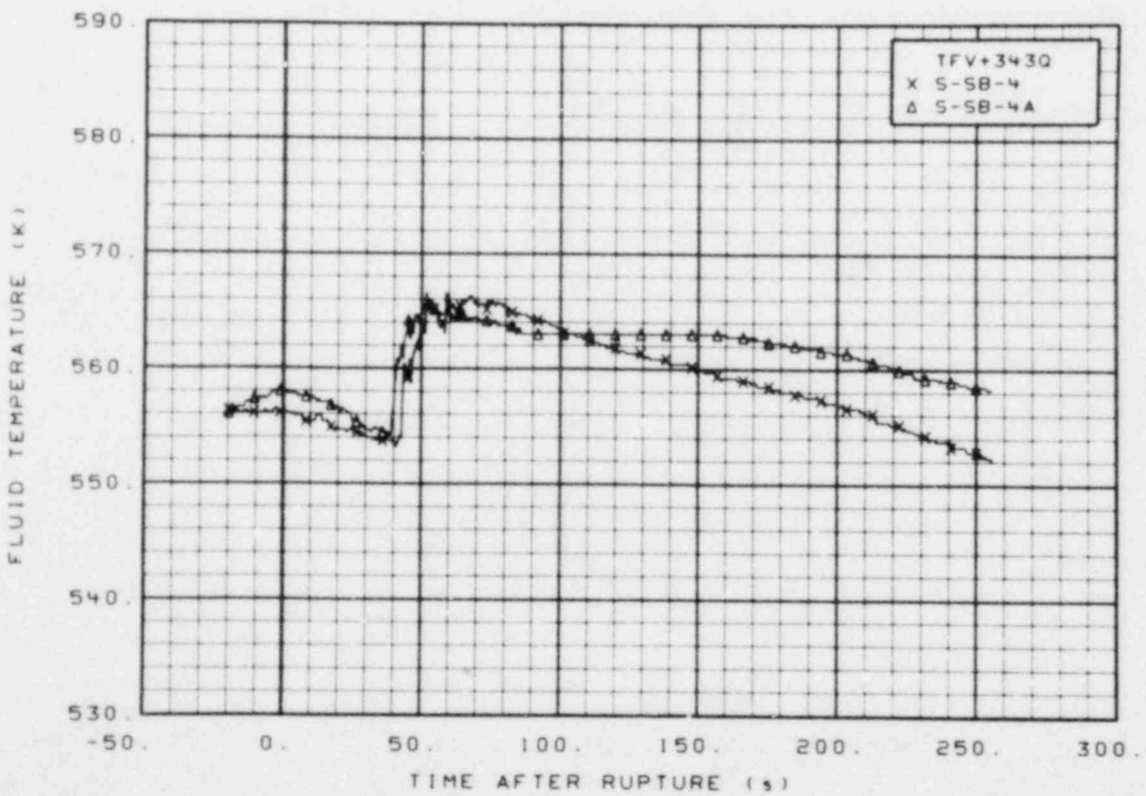


Figure 50. Fluid temperature in vessel (TFV + 343Q), from -20 to 256 s.

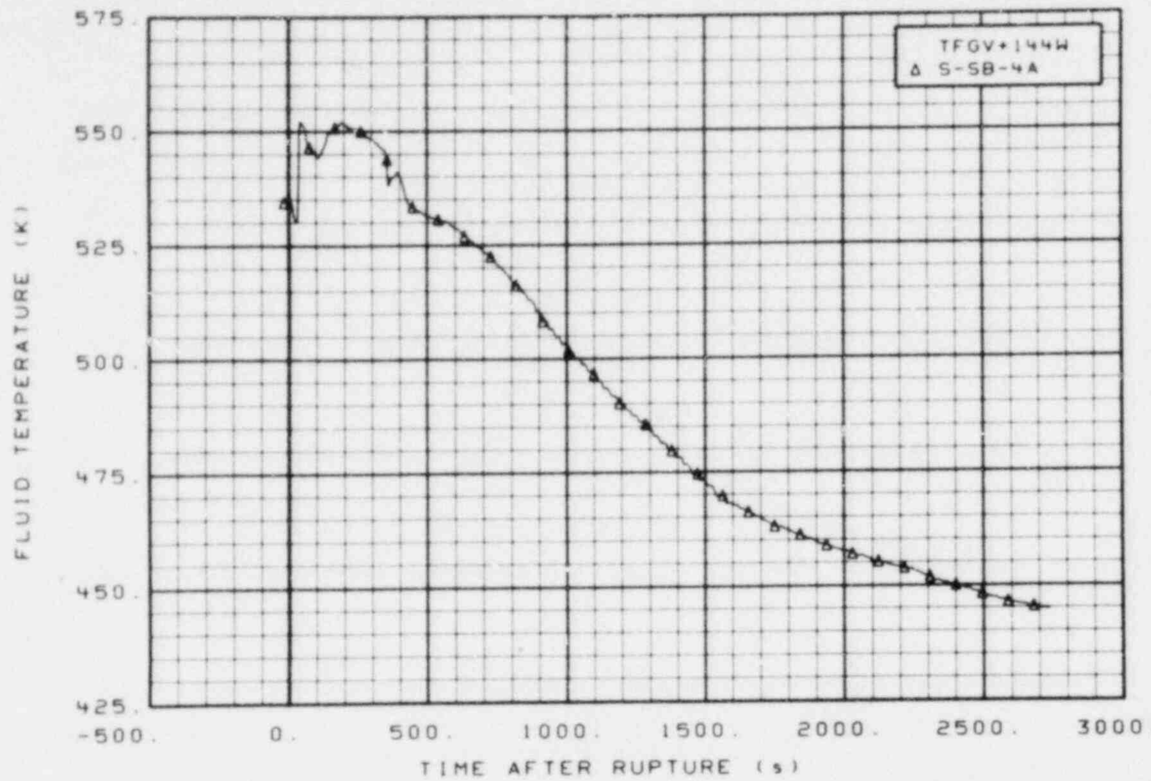


Figure 51. Fluid temperature in vessel core guide tube, Test S-SB-4A (TFGV + 144W), from -20 to 2740 s.

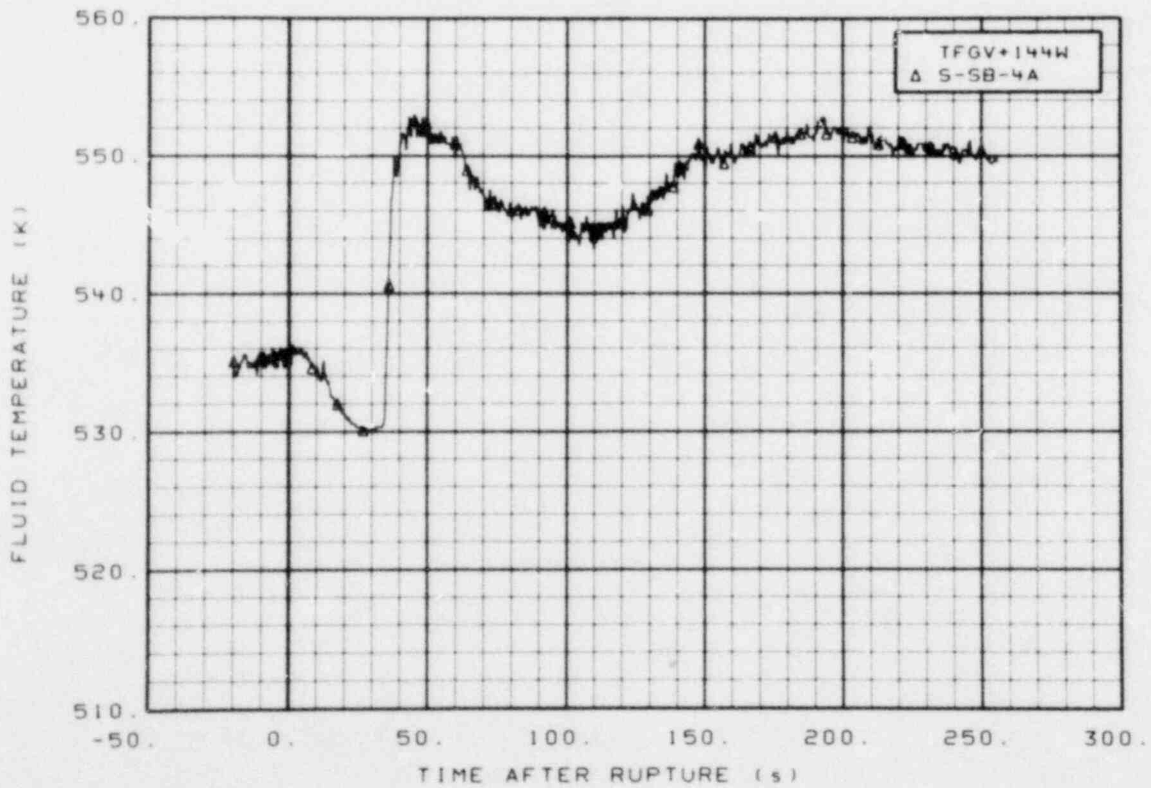


Figure 52. Fluid temperature in vessel core guide tube, Test S-SB-4A (TFGV + 144W), from -20 to 256 s.

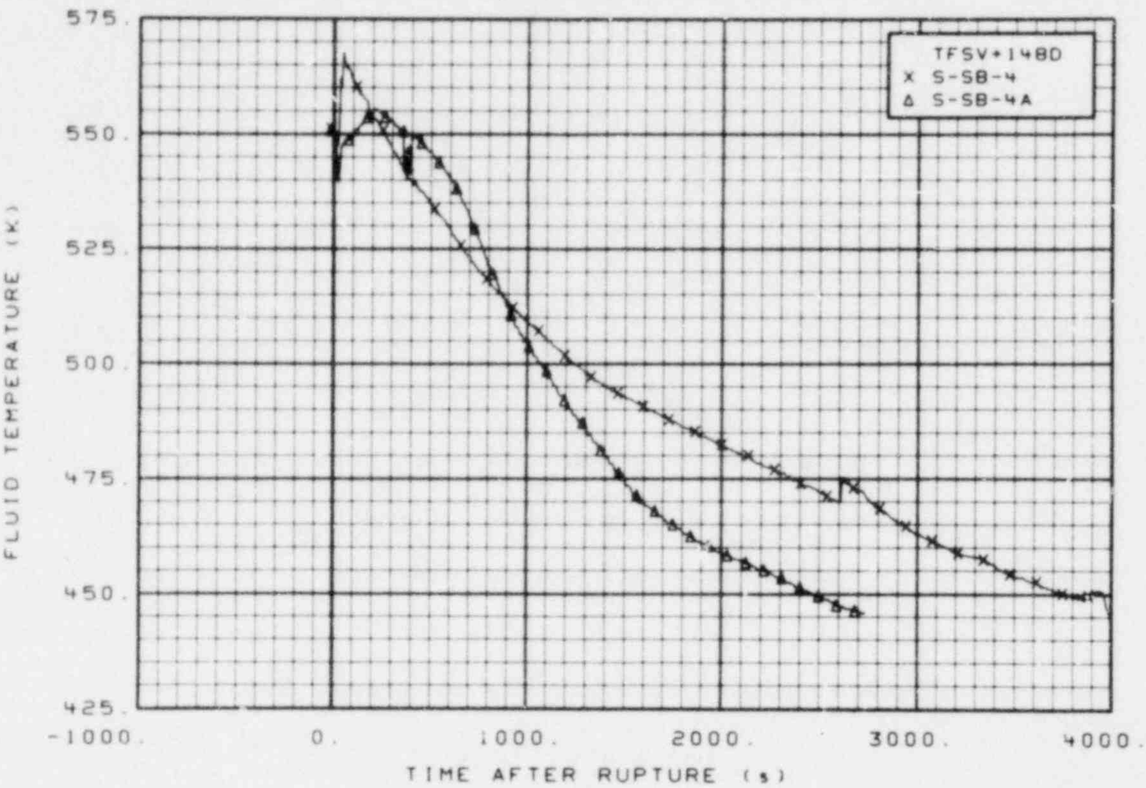


Figure 53. Fluid temperature in vessel support tube (TFSV + 148D), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

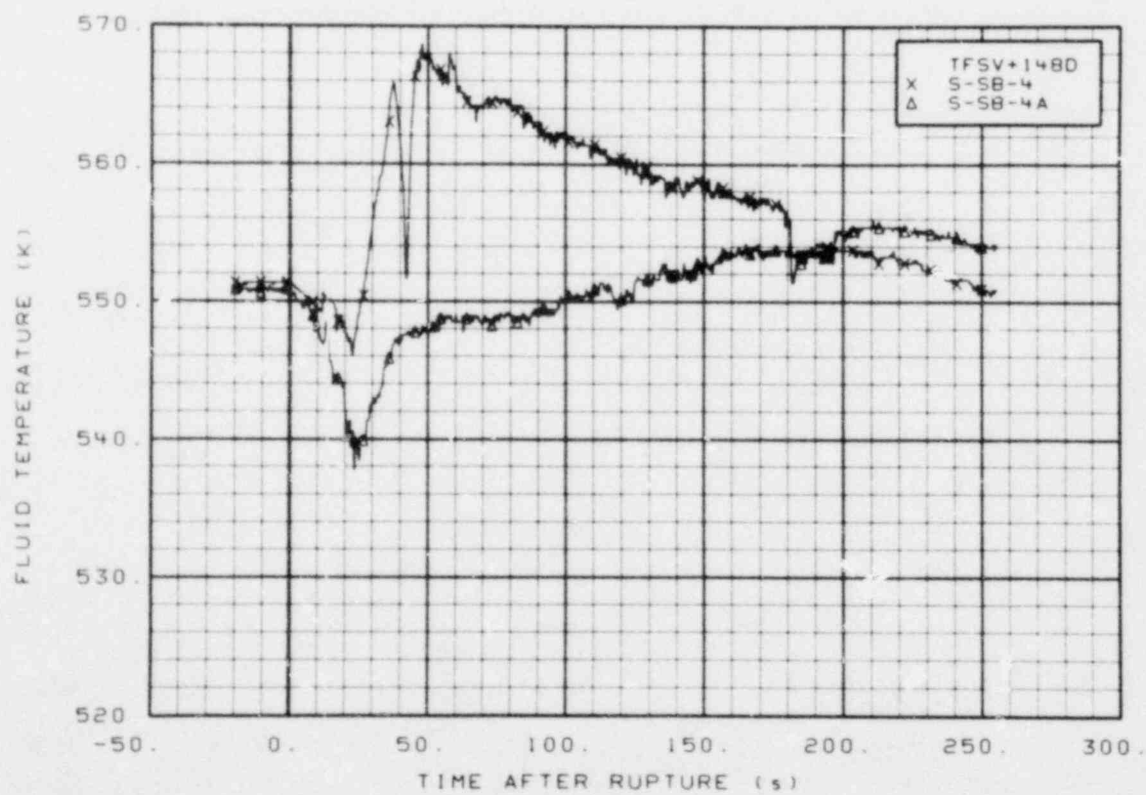


Figure 54. Fluid temperature in vessel support tube (TFSV + 148D), from -20 to 256 s.

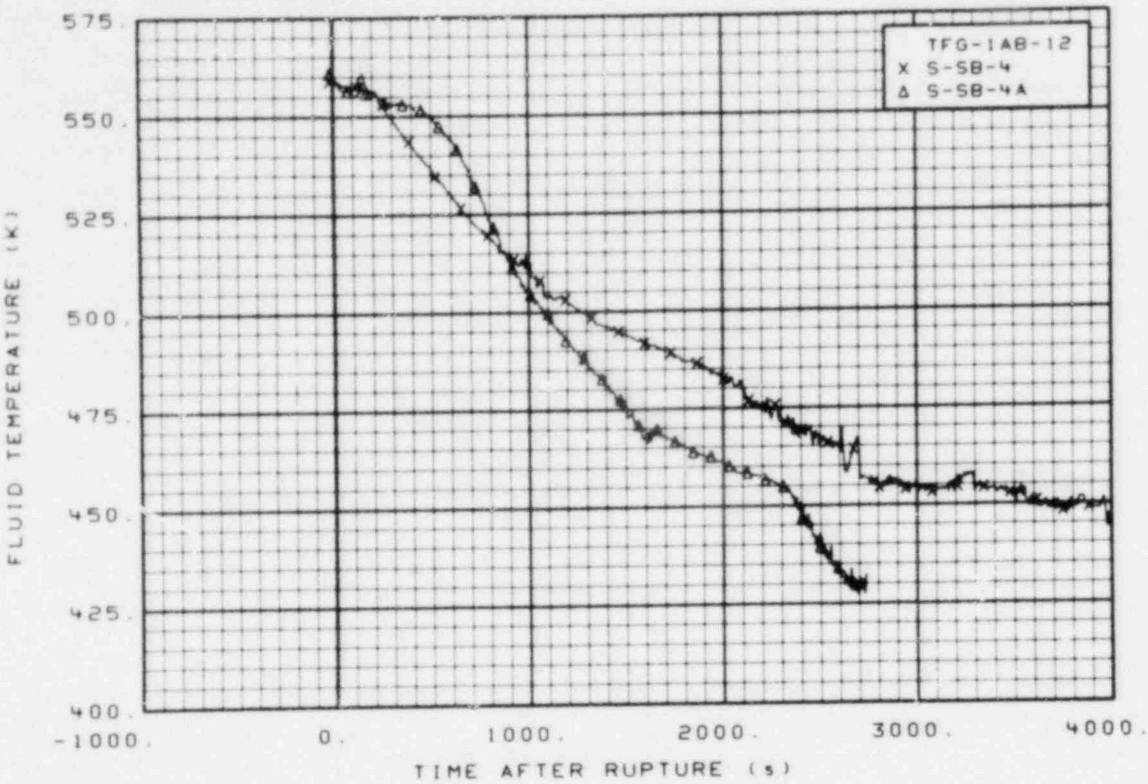


Figure 55. Fluid temperature in core, Grid Spacer 1 (TFG-1AB-12), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

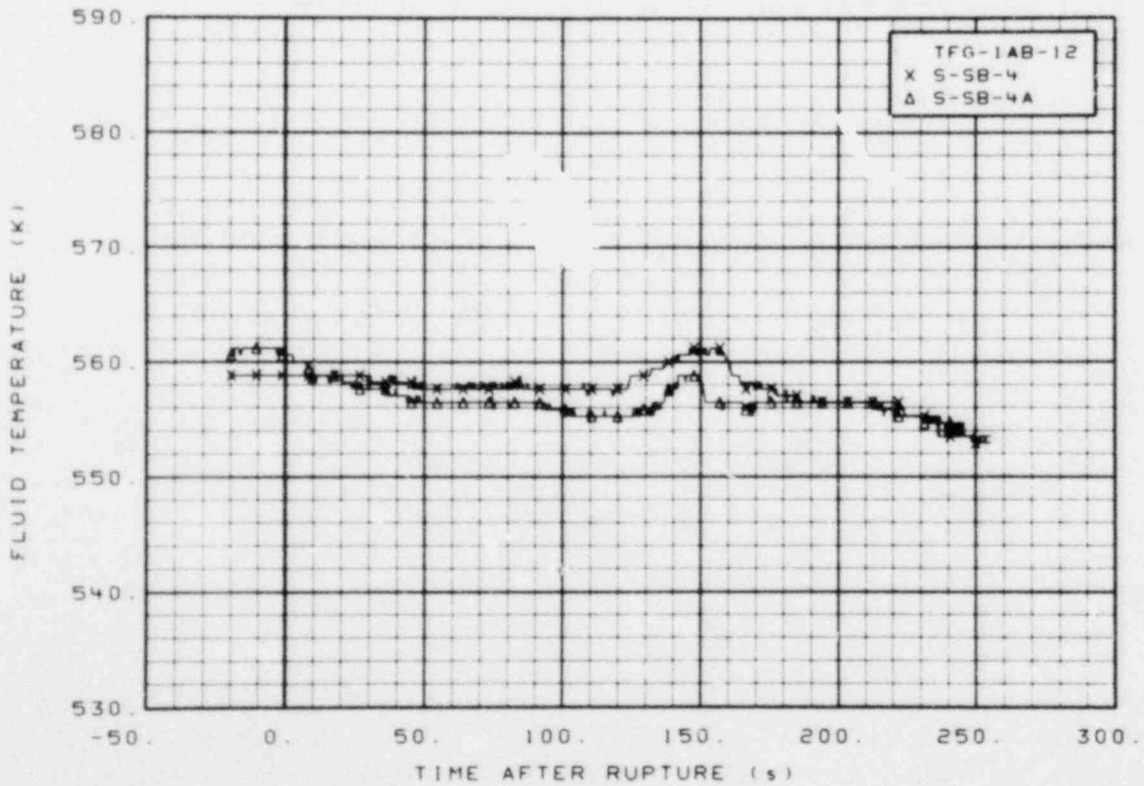


Figure 56. Fluid temperature in core, Grid Spacer 1 (TFG-1AB-12), from -20 to 256 s.

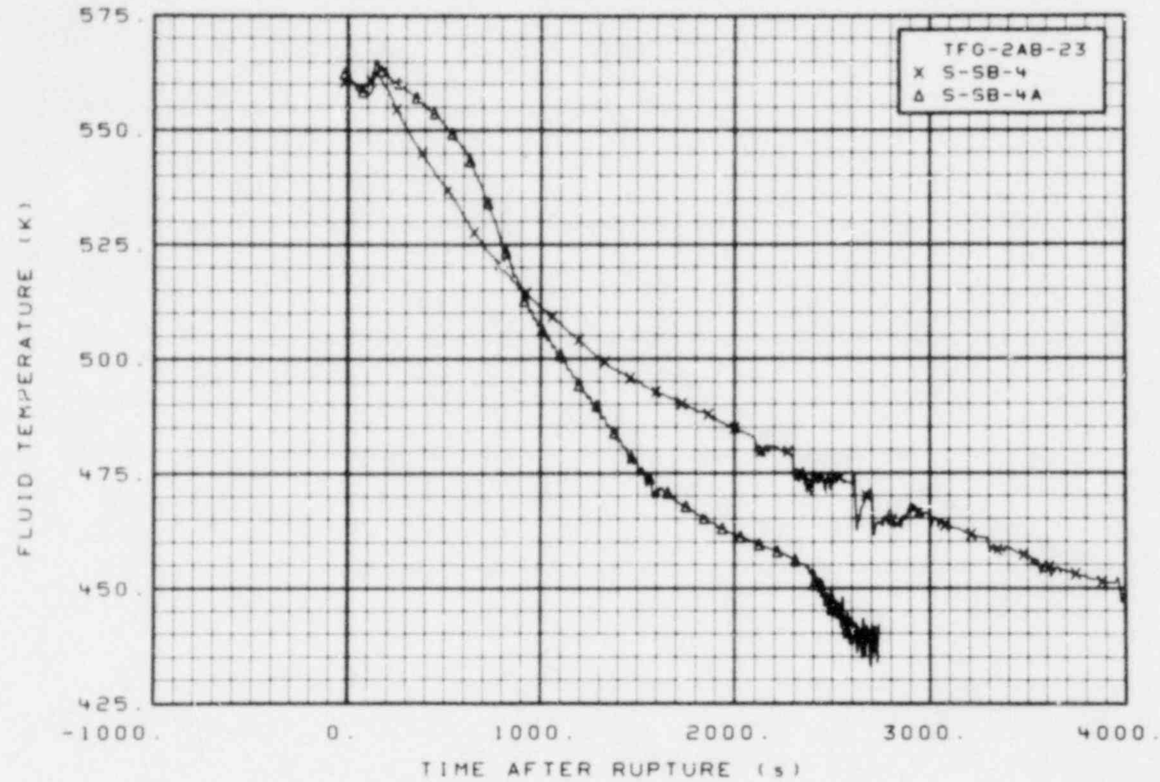


Figure 57. Fluid temperature in core, Grid Spacer 2 (TFG-2AB-23), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

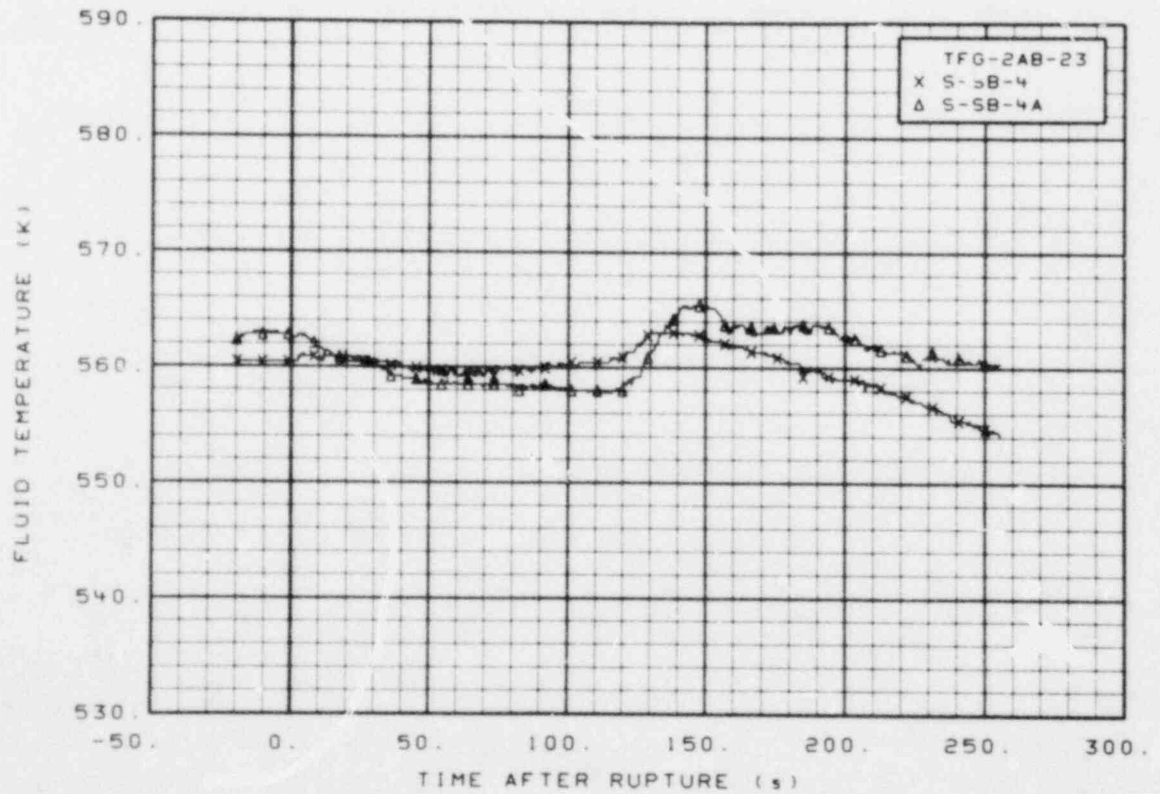


Figure 58. Fluid temperature in core, Grid Spacer 2 (TFG-2AB-23), from -20 to 256 s.

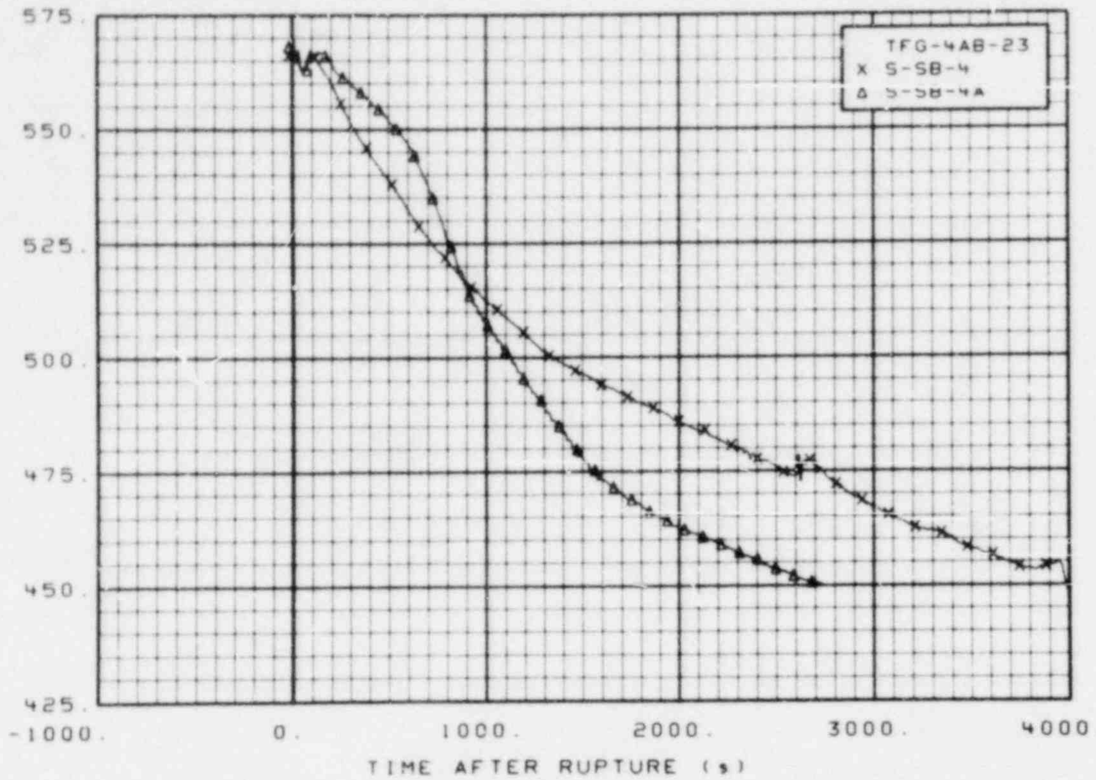


Figure 59. Fluid temperature in core, Grid Spacer 4 (TFG-4AB-23), from -20 to 4000 s (to 2740 s for S-SB-4A).

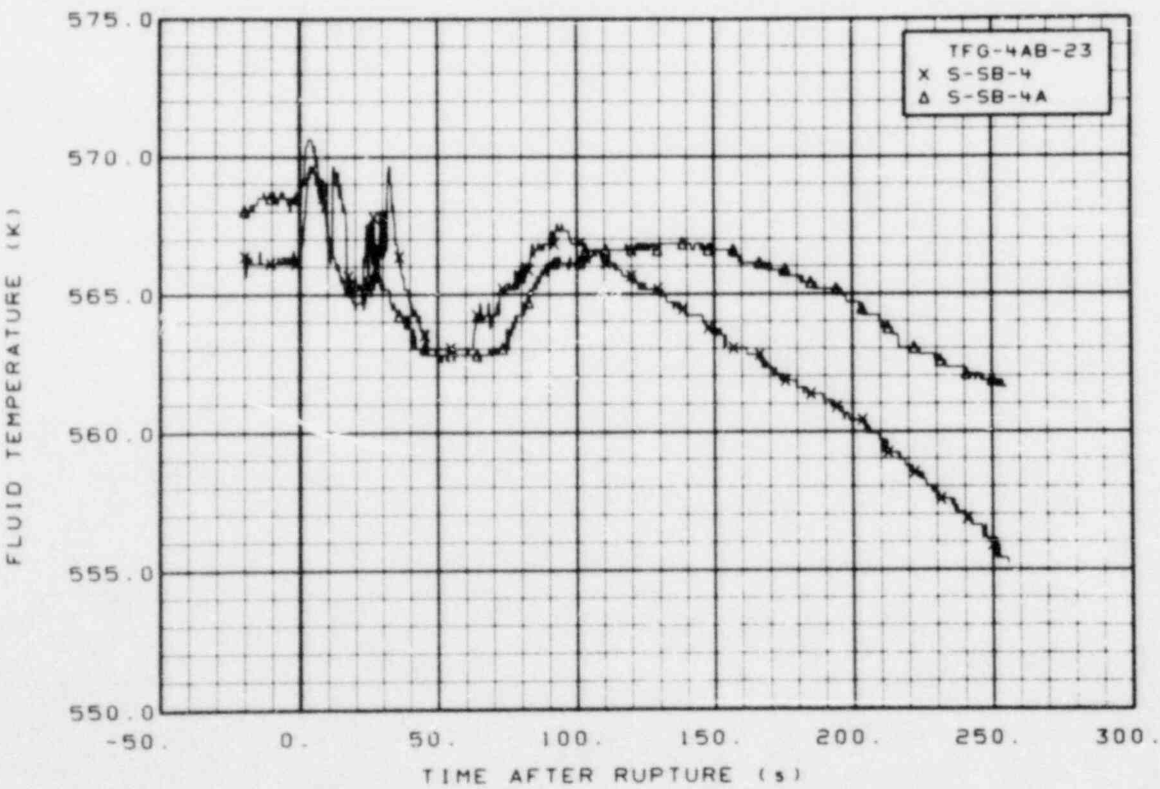


Figure 60. Fluid temperature in core, Grid Spacer 4 (TFG-4AB-23), from -20 to 256.

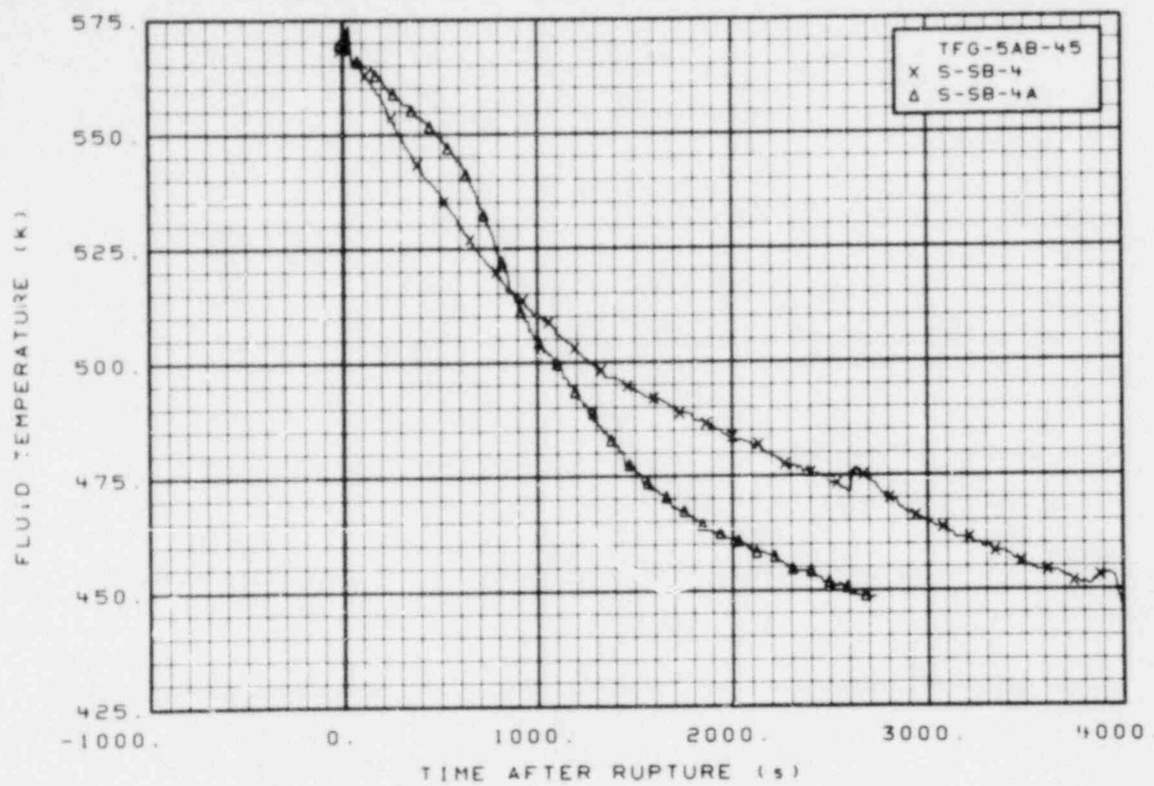


Figure 61. Fluid temperature in core, Grid Spacer 5 (TFG-5AB-45), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

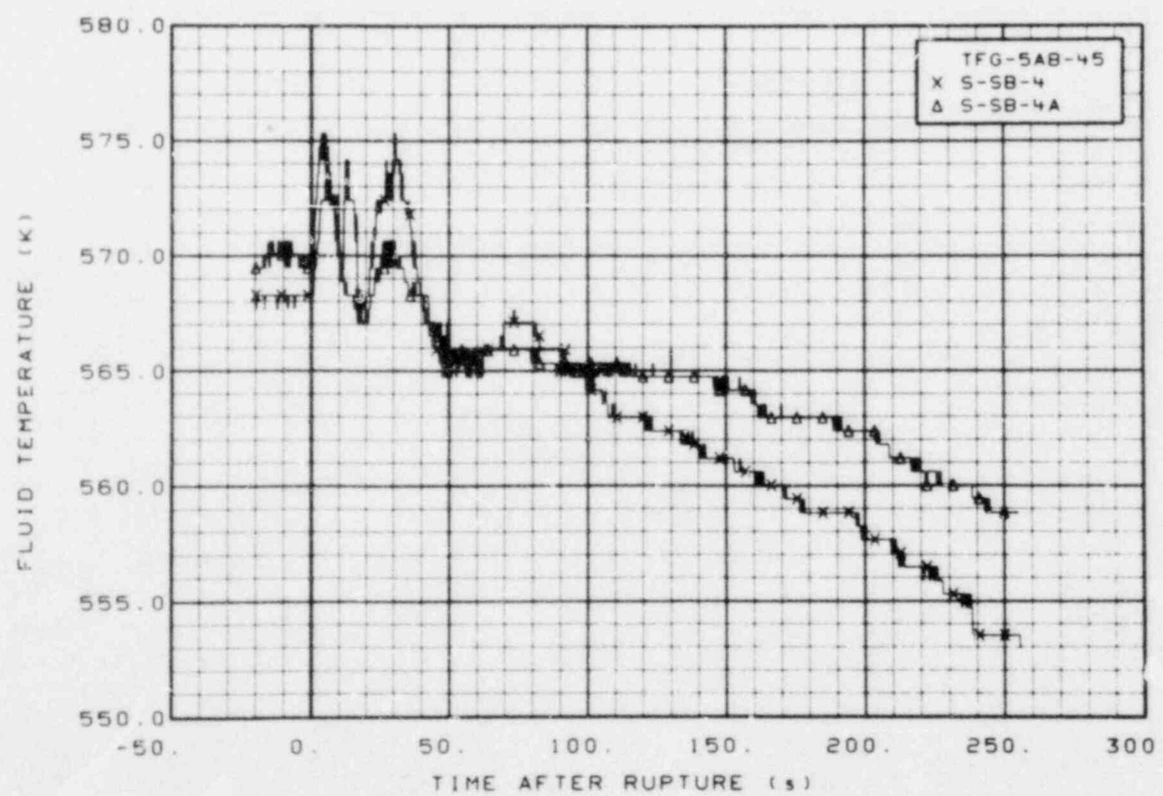


Figure 62. Fluid temperature in core, Grid Spacer 5 (TFG-5AB-45), from -20 to 256 s.

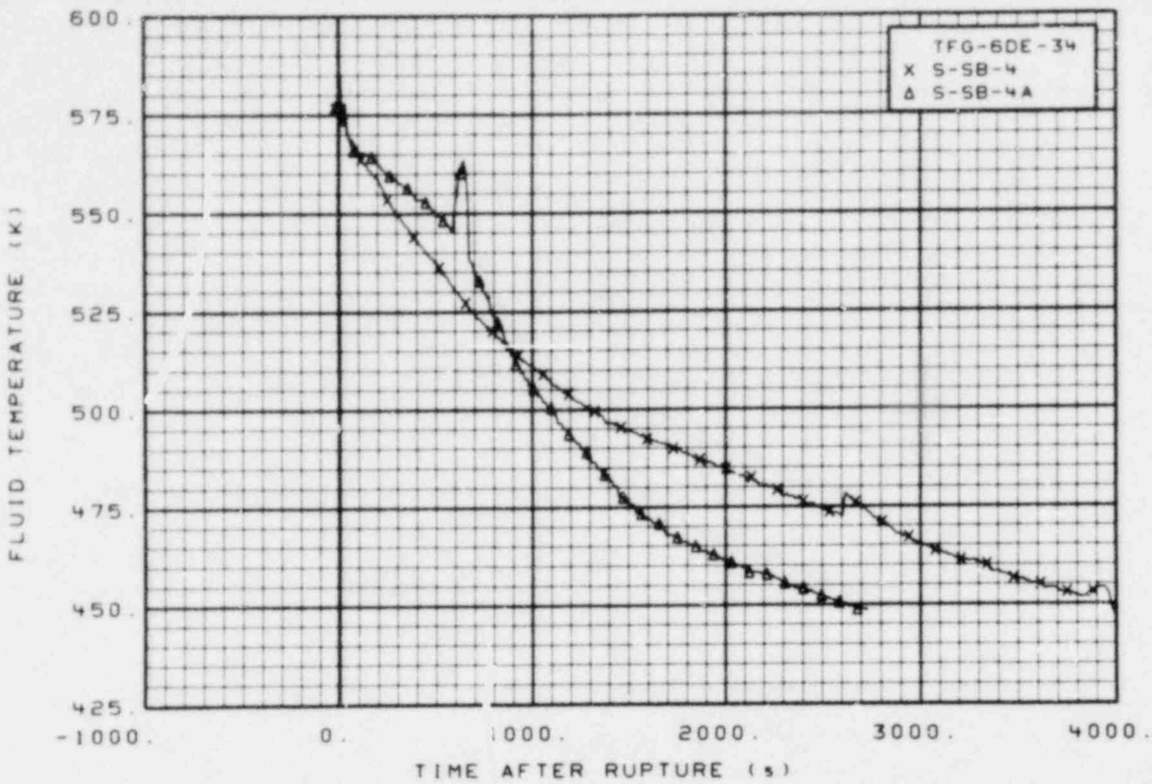


Figure 63. Fluid temperature in core, Grid Spacer 6 (TFG-6DE-34), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

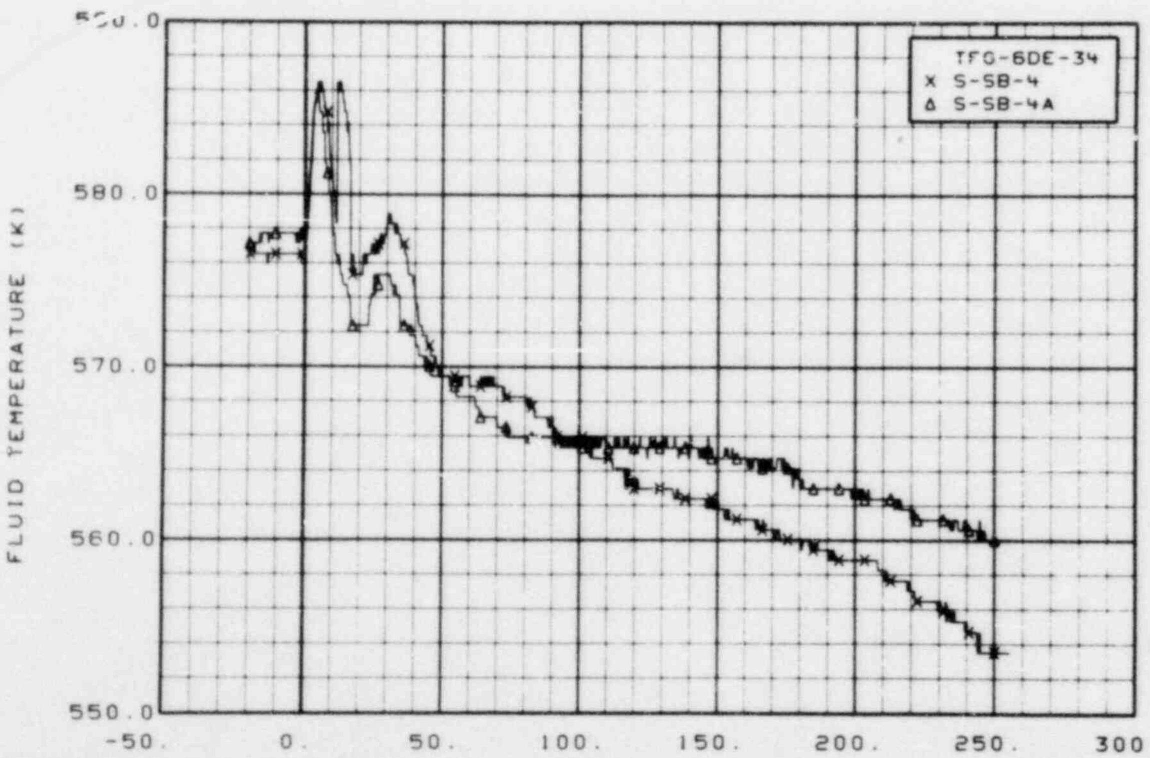


Figure 64. Fluid temperature in core, Grid Spacer 6 (TFG-6DE-34), from -20 to 256 s.

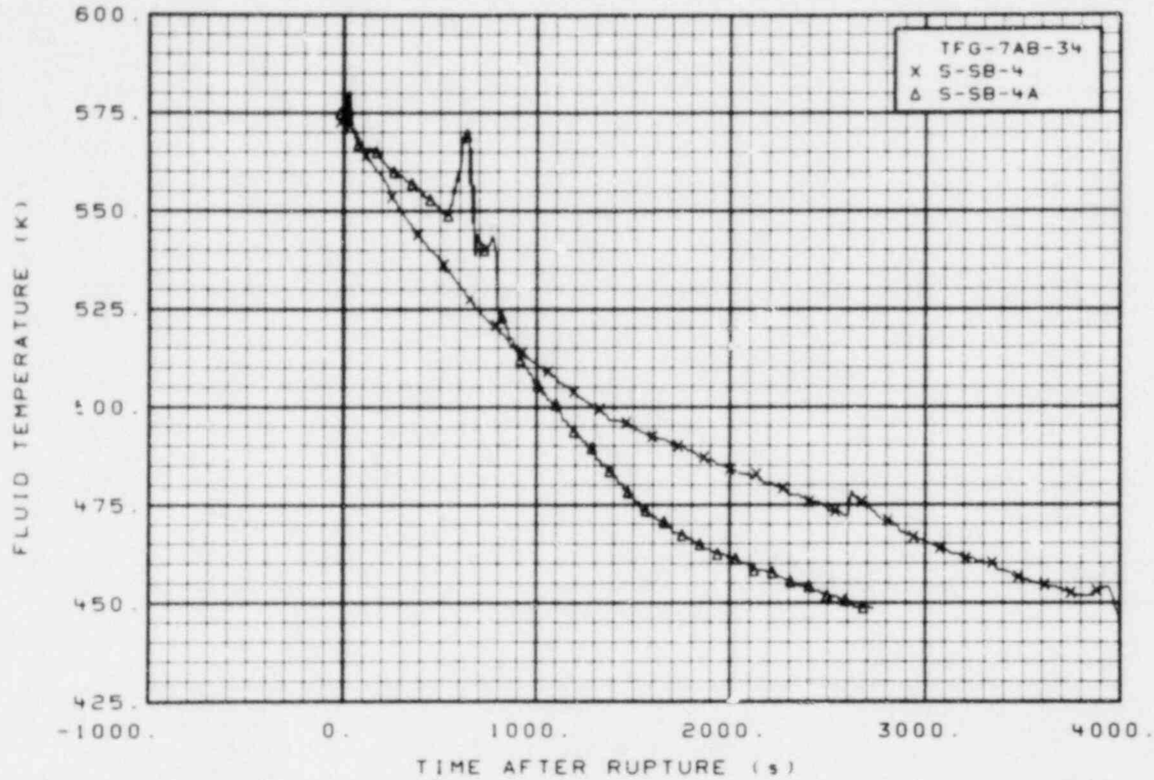


Figure 65. Fluid temperature in core, Grid Spacer 7 (TFG-7AB-34), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

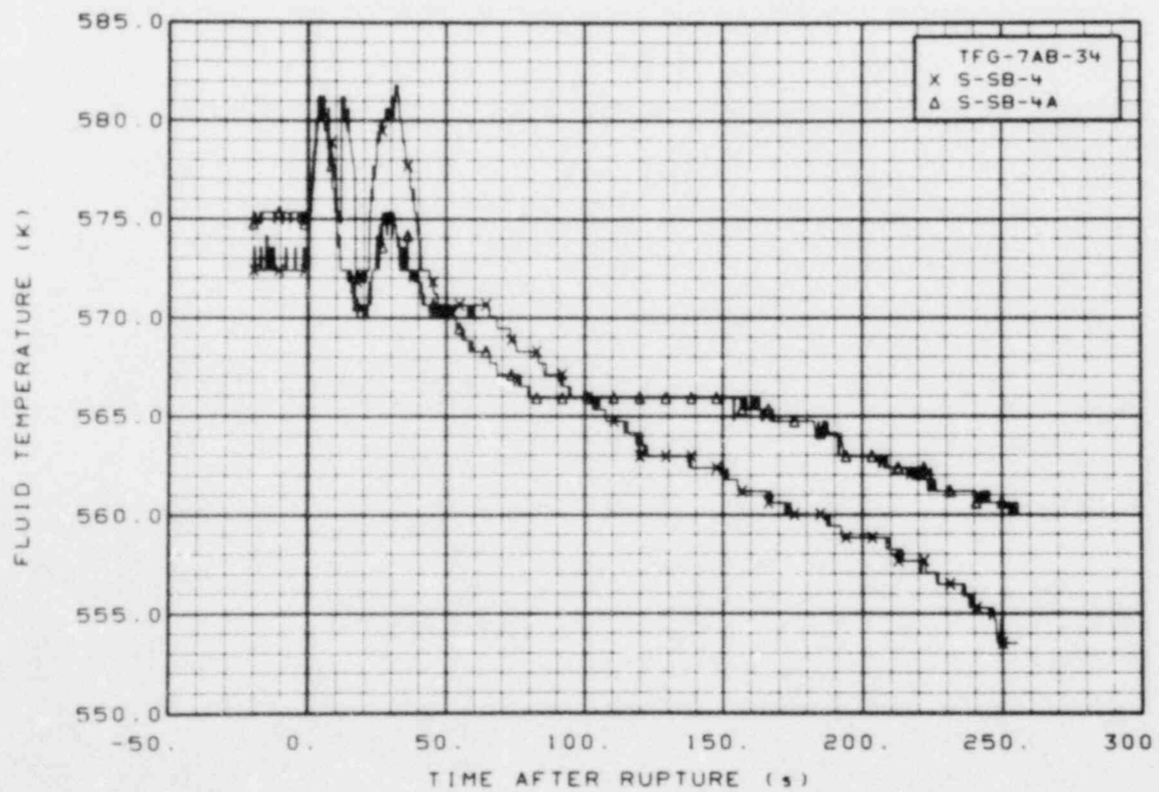


Figure 66. Fluid temperature in core, Grid Spacer 7 (TFG-7AB-34), from -20 to 256 s.

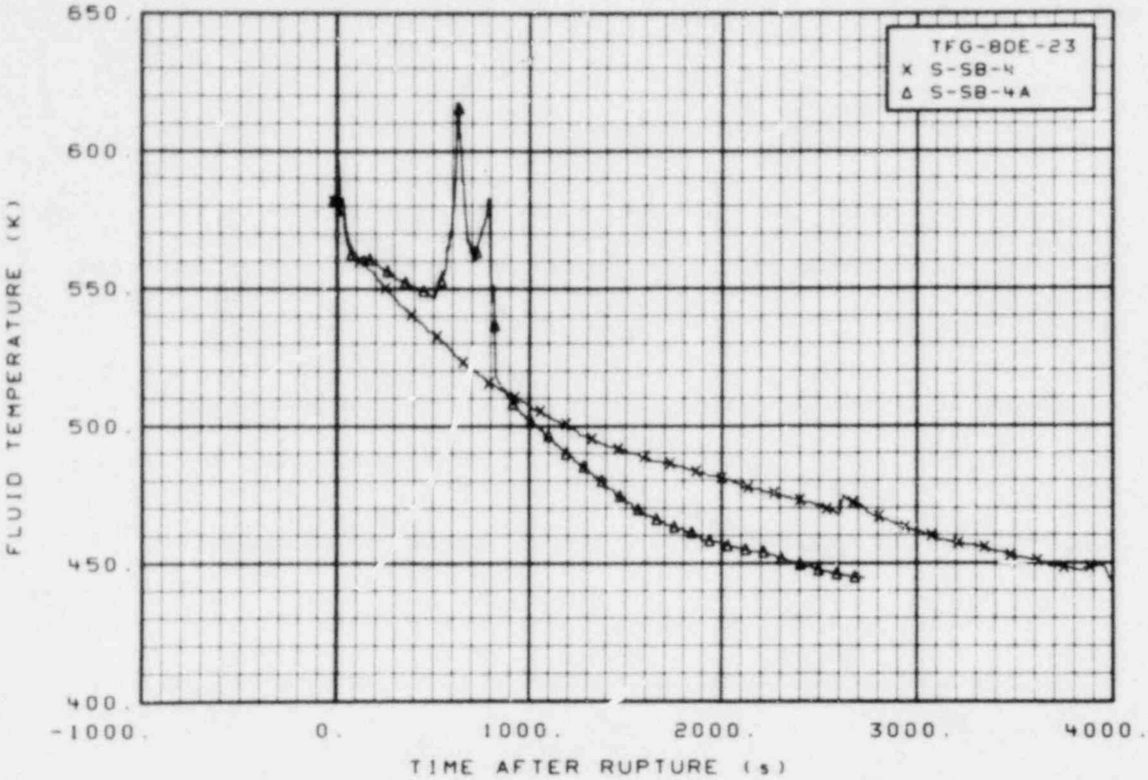


Figure 67. Fluid temperature in core, Grid Spacer 8 (TFG-8DE-23), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

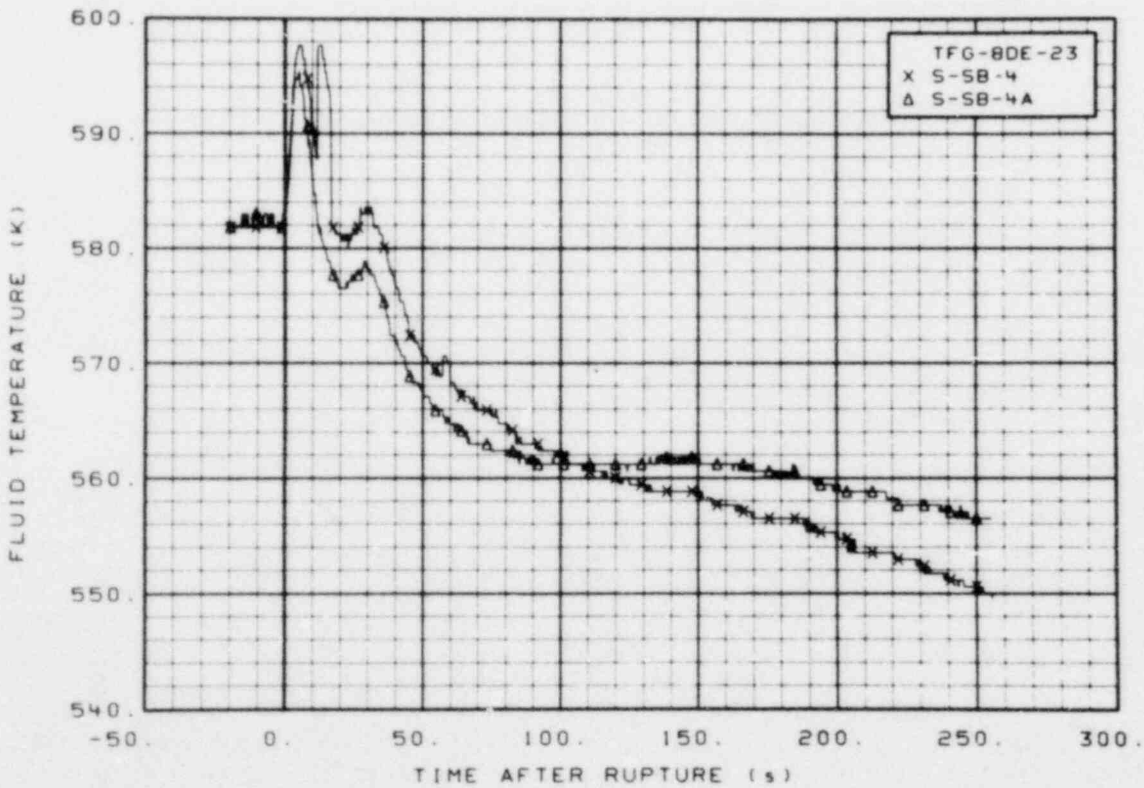


Figure 68. Fluid temperature in core, Grid Spacer 8 (TFG-8DE-23), from -20 to 256 s.

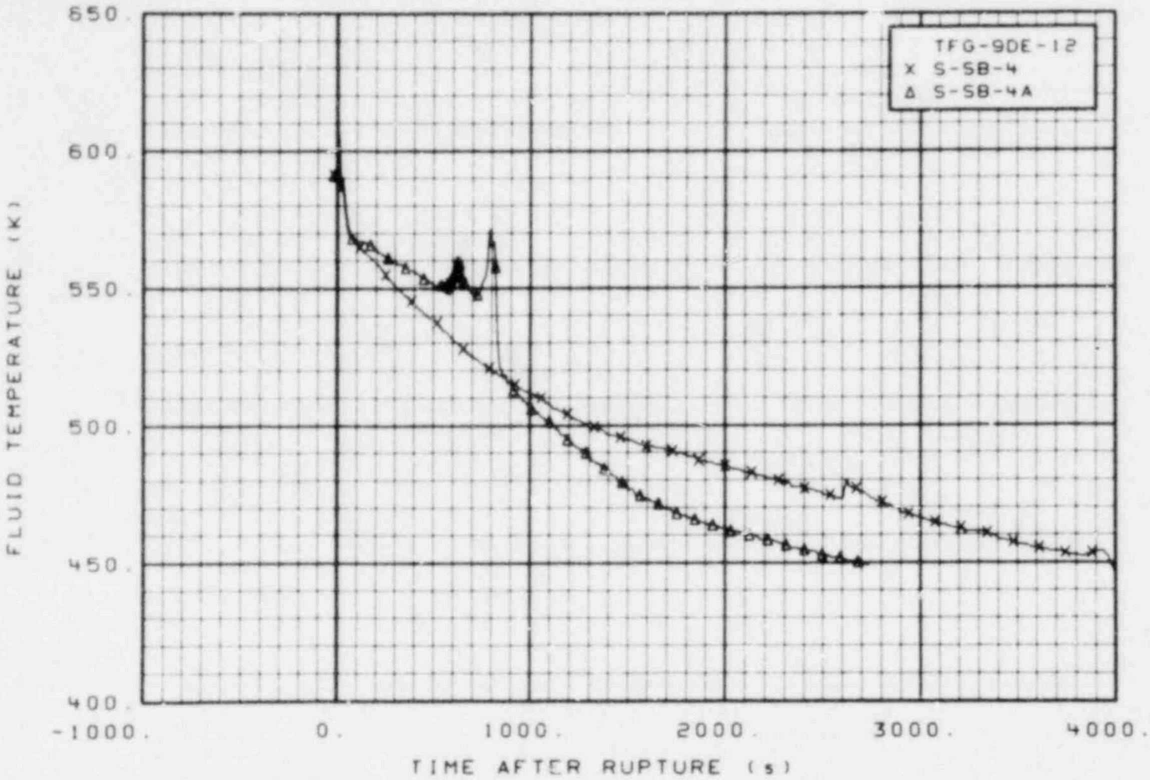


Figure 69. Fluid temperature in core, Grid Spacer 9 (TFG-9DE-12), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

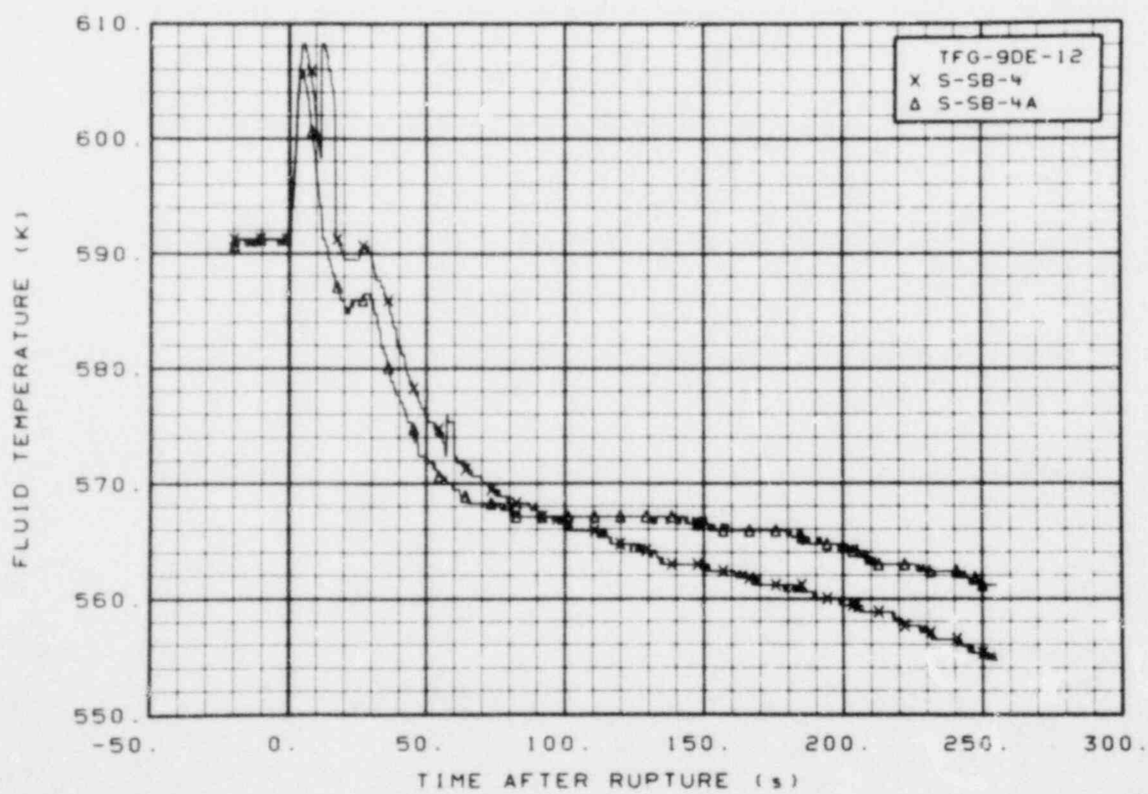


Figure 70. Fluid tempera ıre in core, Grid Spacer 9 (TFG-9DE-12), from -20 to 256 s.

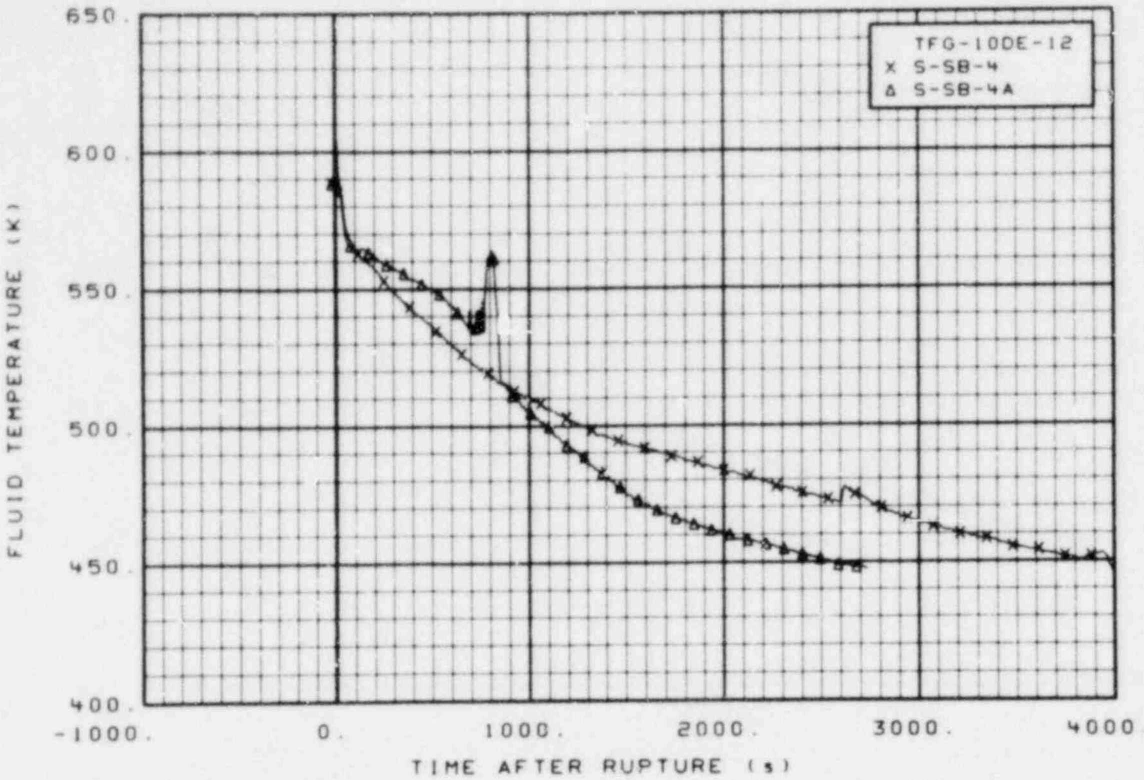


Figure 71. Fluid temperature in core, Grid Spacer 10 (TFG-10DE-12), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

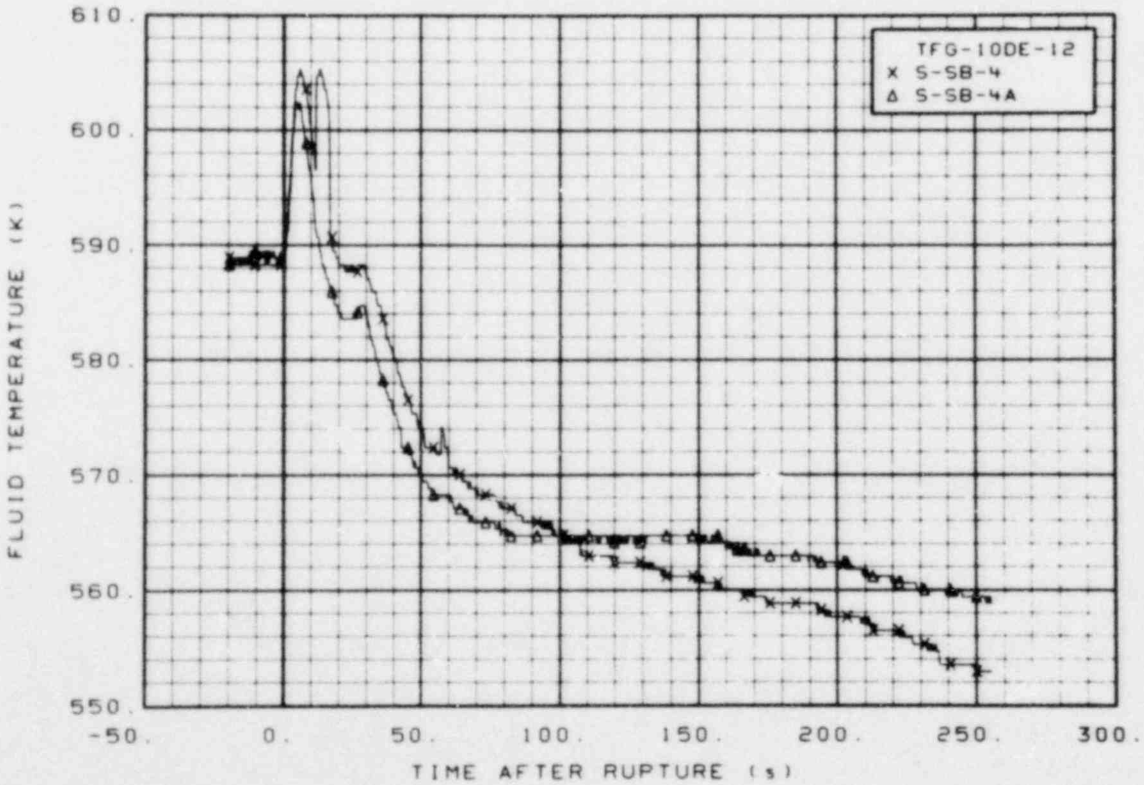
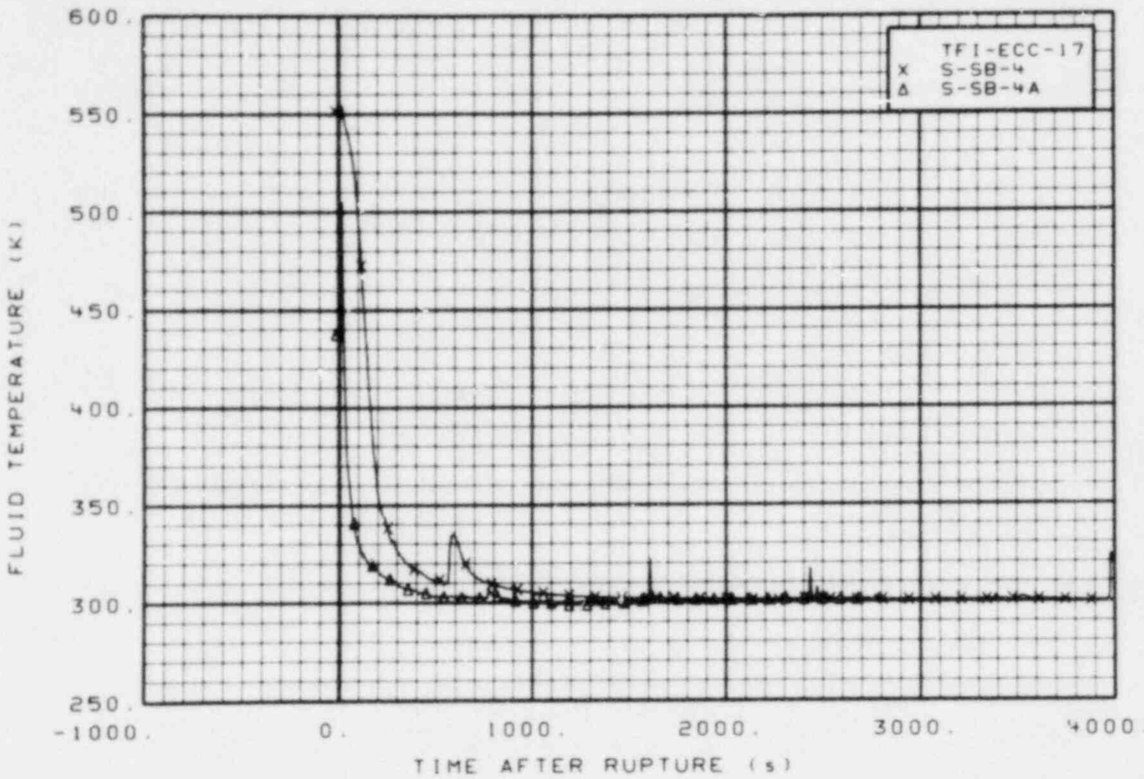


Figure 72. Fluid temperature in core, Grid Spacer 10 (TFG-10DE-12), from -20 to 256 s.



igure 73. Fluid temperature in vessel accumulator, coolant injection line (TFI-ECC-17), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

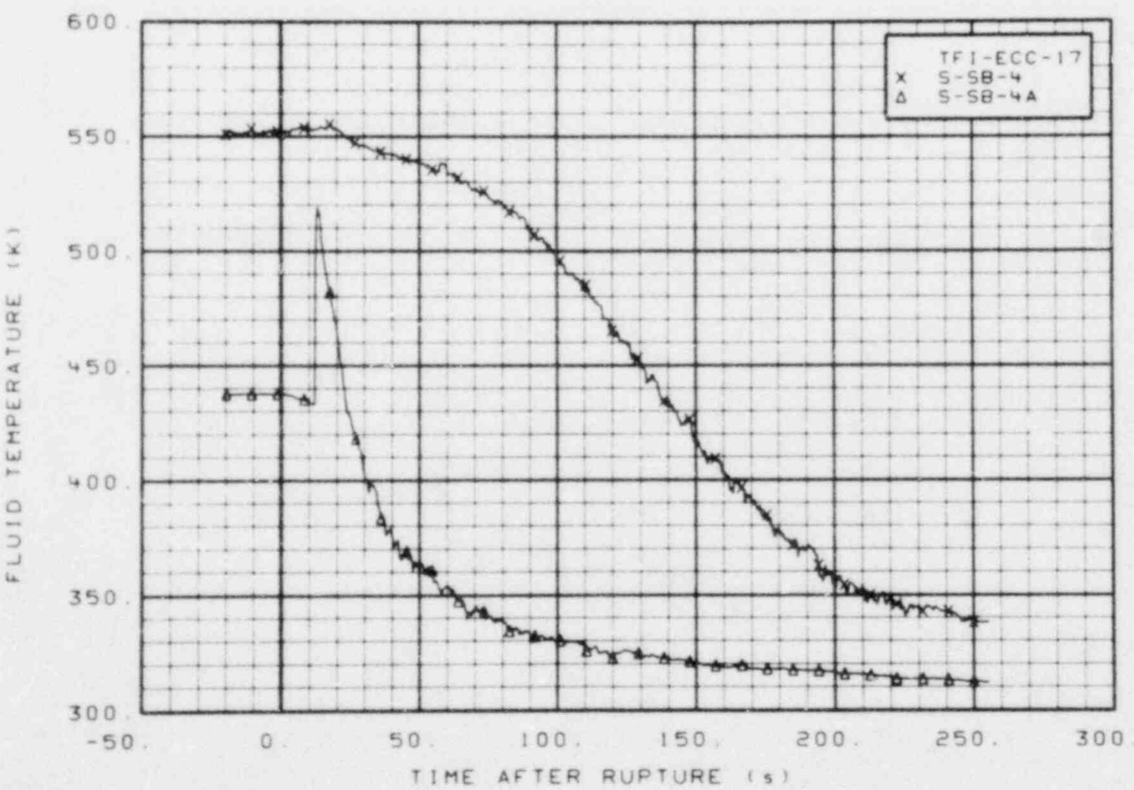


Figure 74. Fluid temperature in vessel accumulator, coolant injection line (TFI-ECC-17), from -20 to 256 s.

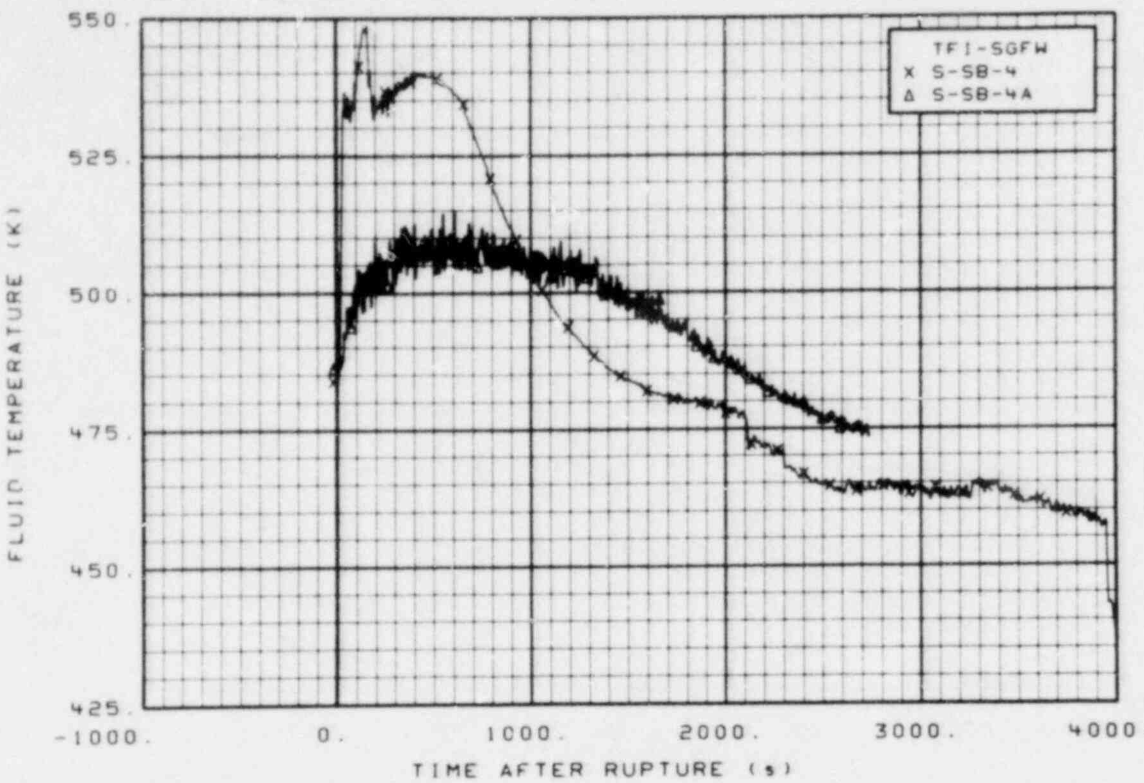


Figure 75. Fluid temperature in intact loop feedwater (TFI-SGFW), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

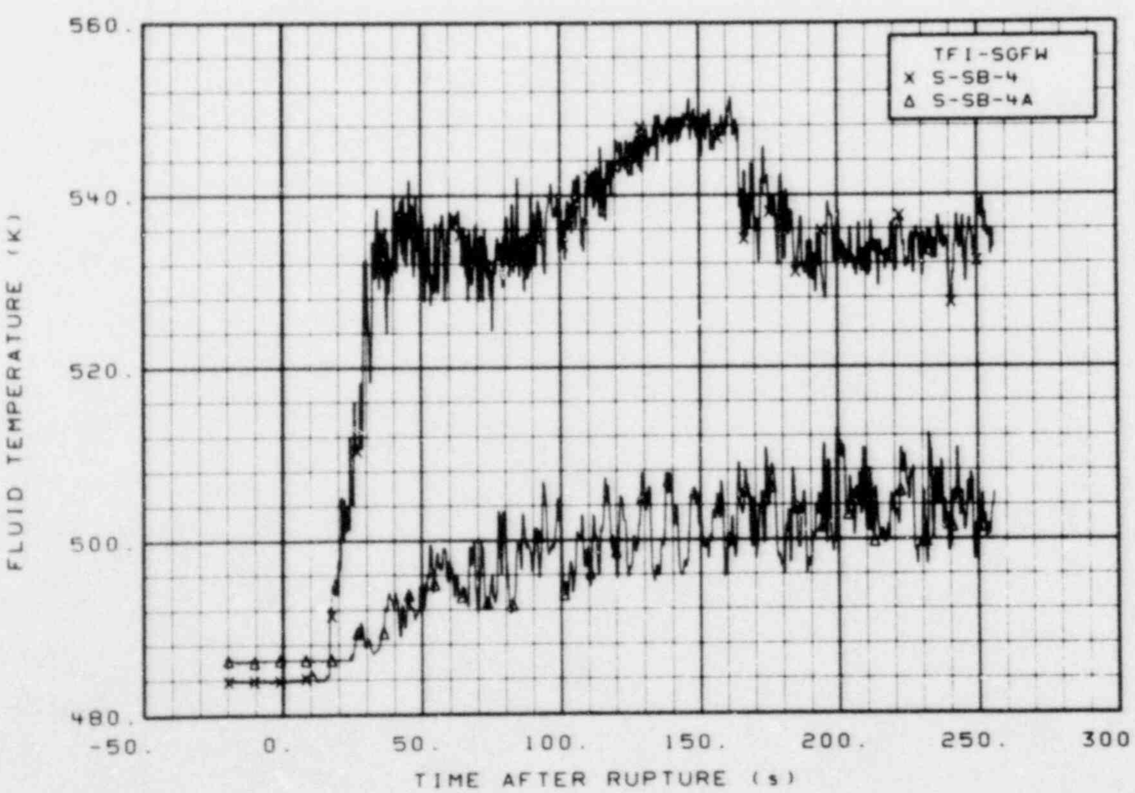


Figure 76. Fluid temperature in intact loop feedwater (TFI-SGFW), from -20 to 256 s.

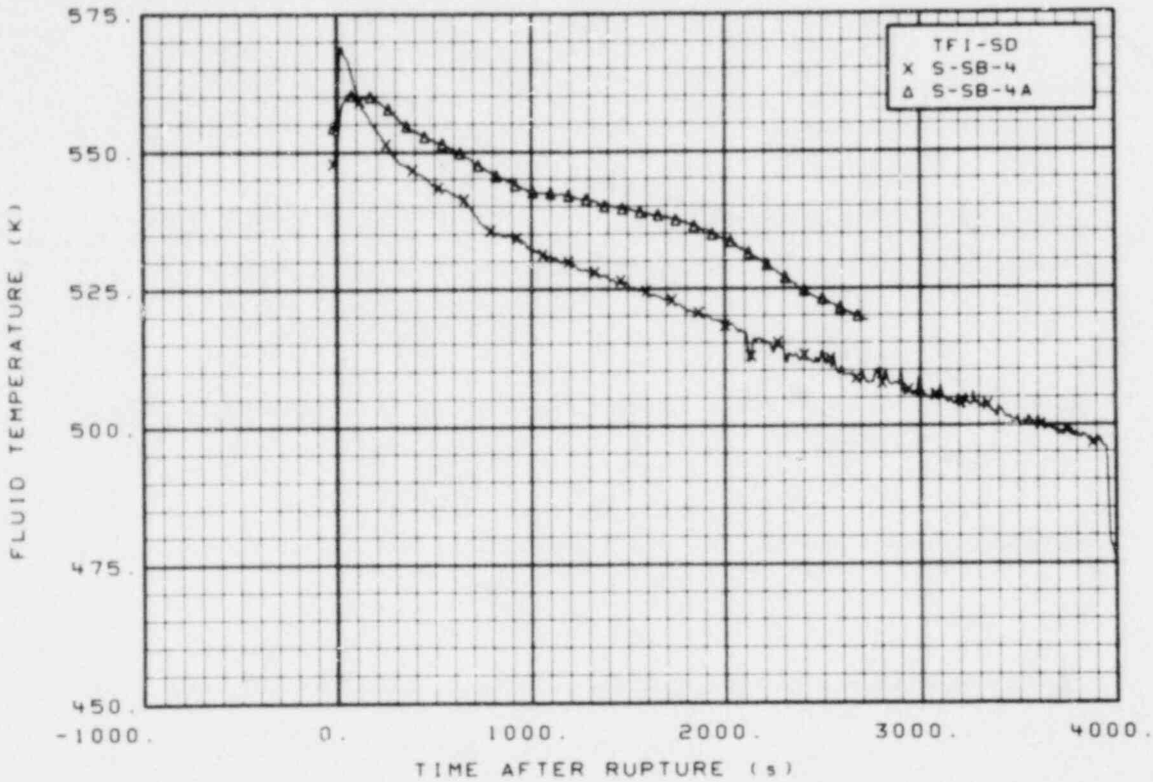


Figure 77. Fluid temperature in intact loop steam generator steam dome, secondary side (TFI-SD), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

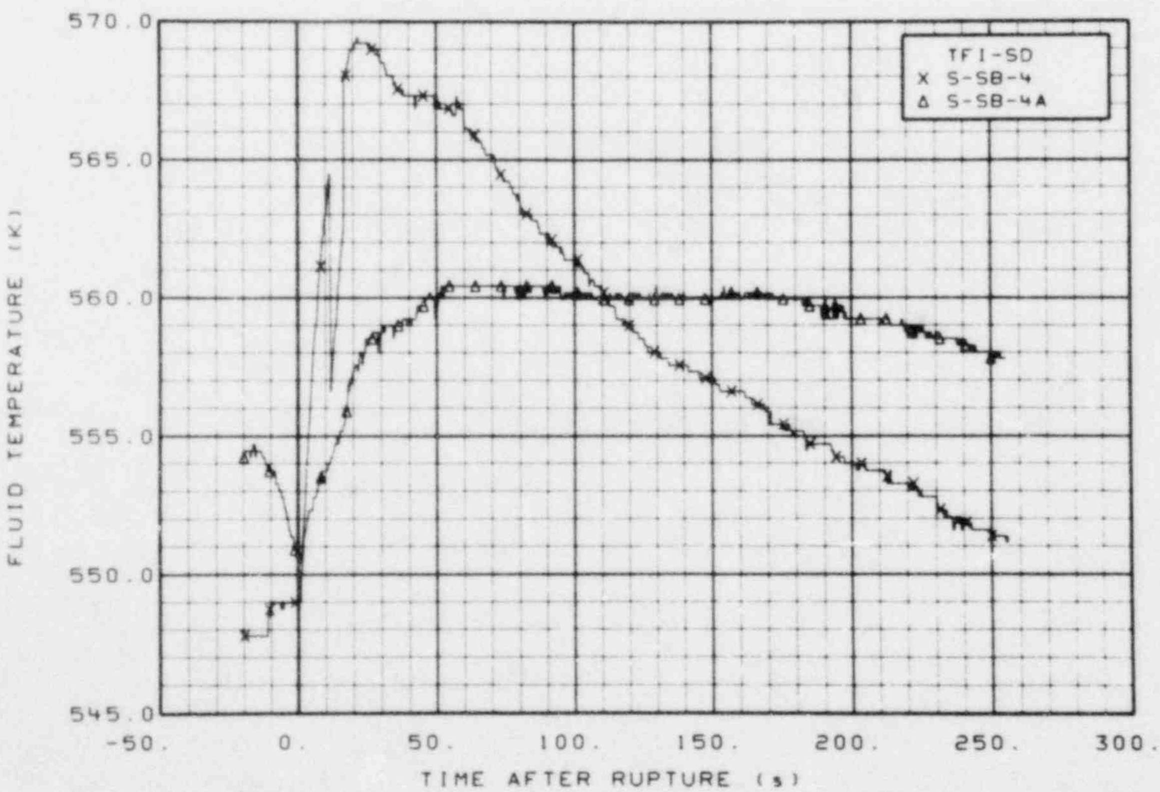


Figure 78. Fluid temperature in intact loop steam generator steam dome, secondary side (TFI-SD), from -20 to 256 s.

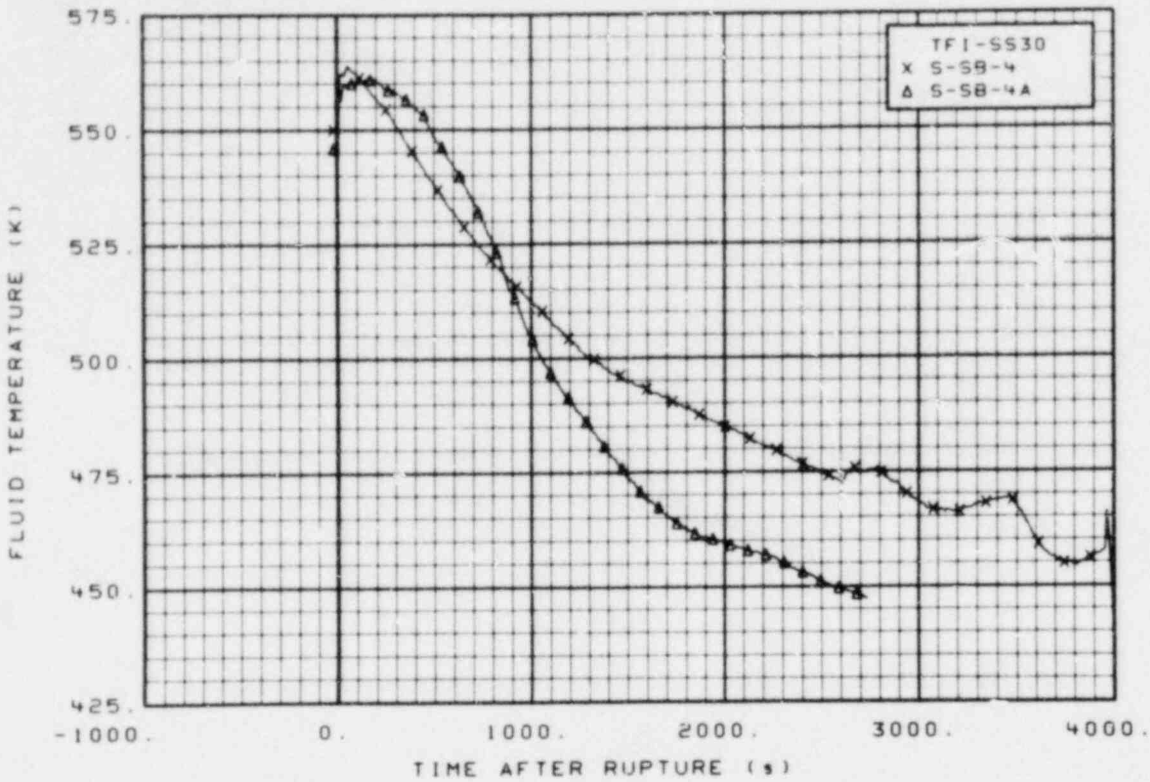


Figure 79. Fluid temperature in intact loop steam generator, secondary side (TFI-SS30), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

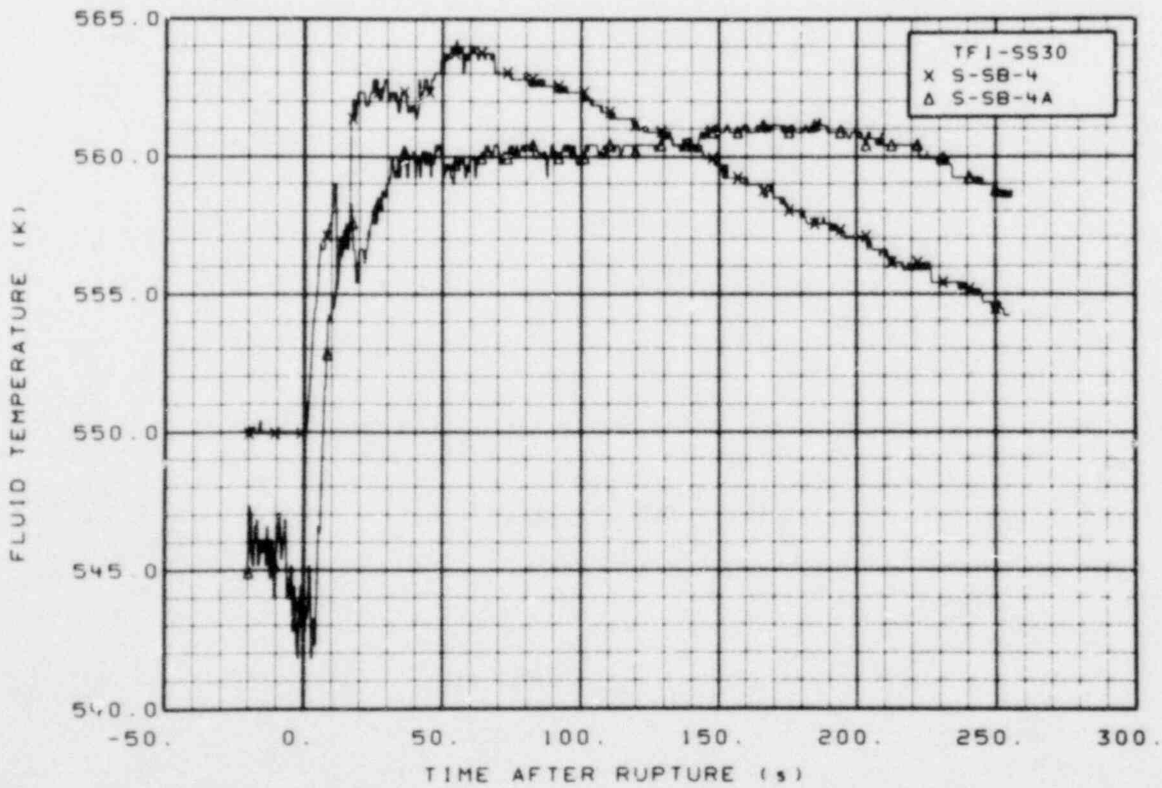


Figure 80. Fluid temperature in intact loop steam generator, secondary side (TFI-SS30), from -20 to 256 s.

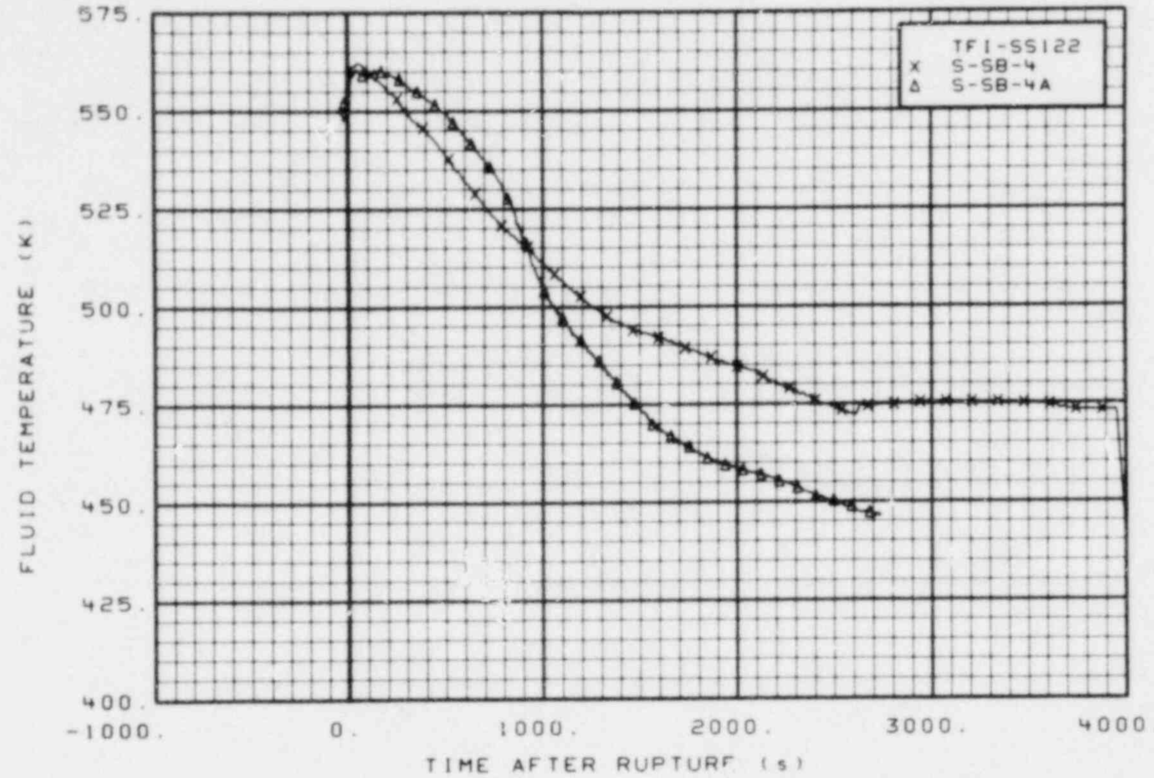


Figure 81. Fluid temperature in intact loop steam generator, secondary side (TFI-SS122), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

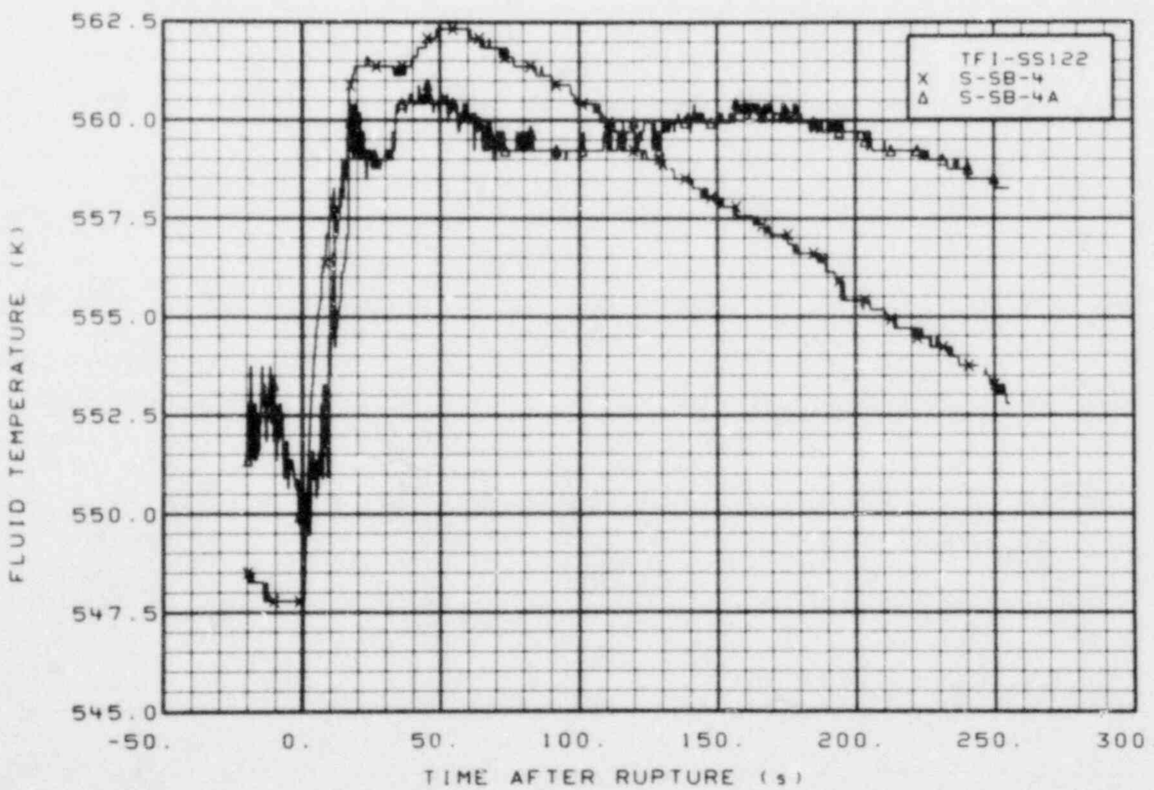


Figure 82. Fluid temperature in intact loop steam generator, secondary side (TFI-SS122), from -20 to 256 s.

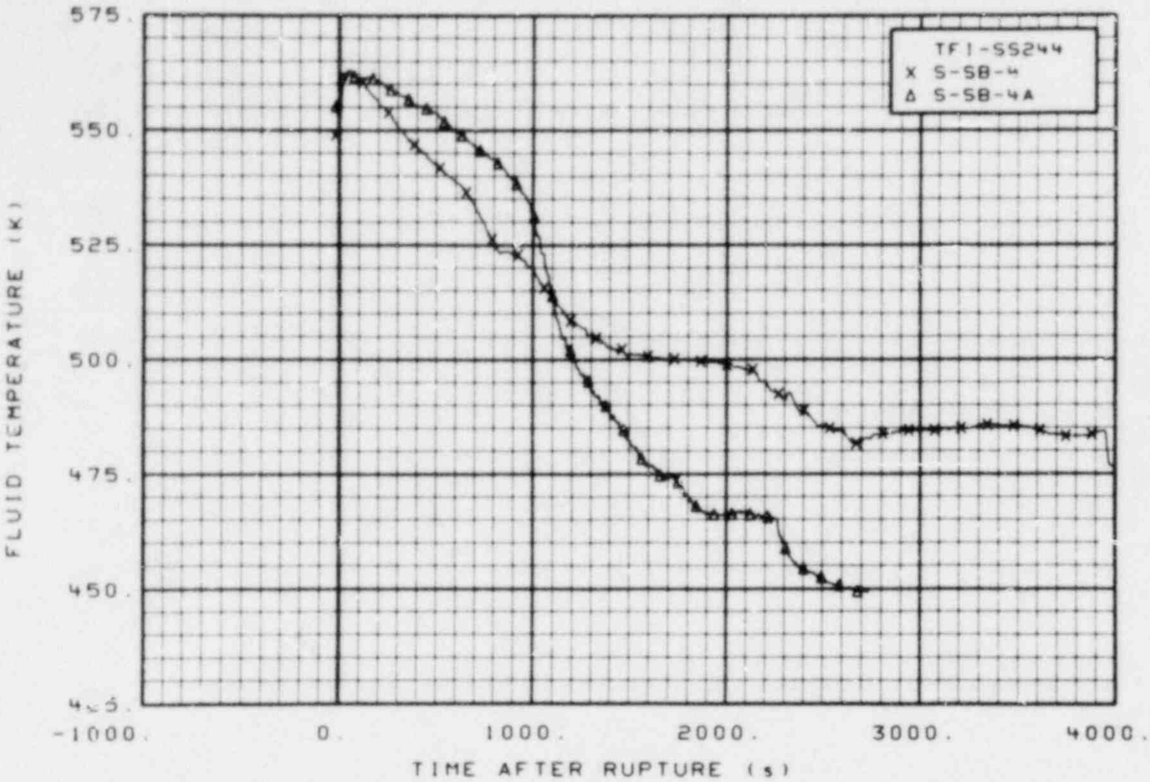


Figure 83. Fluid temperature in intact loop steam generator, secondary side (TFI-SS244), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

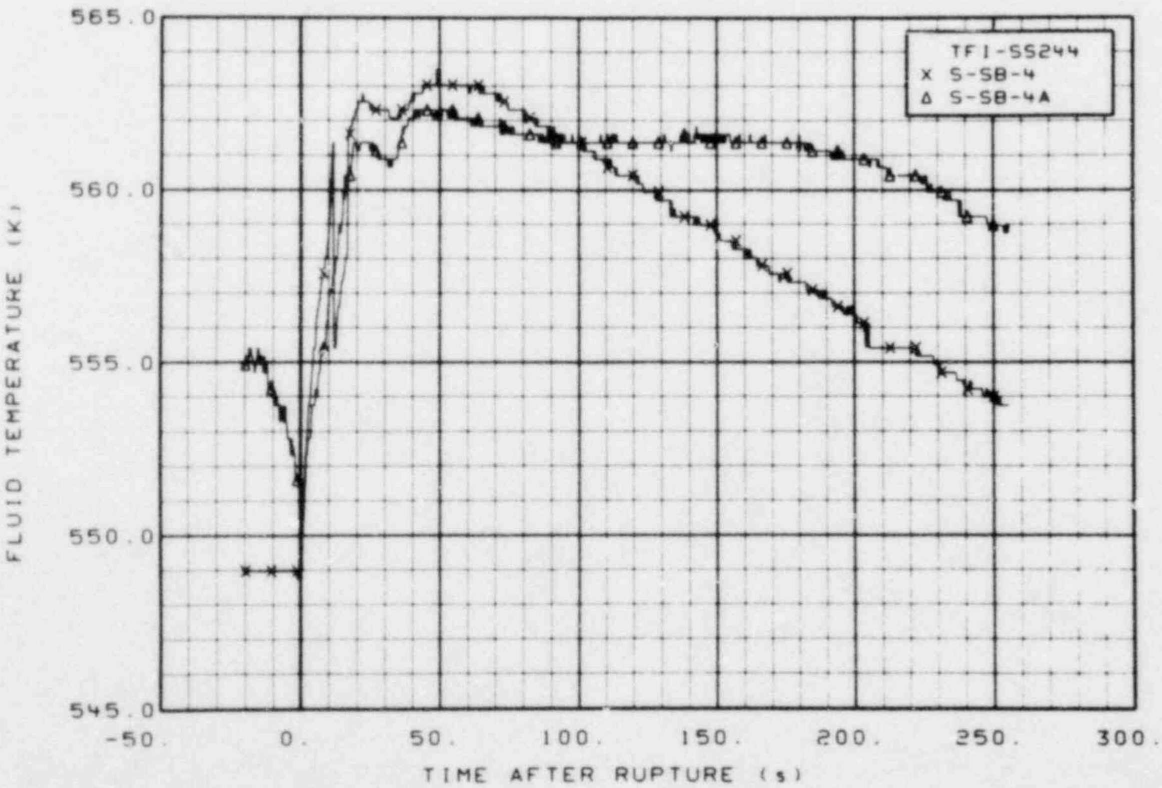


Figure 84. Fluid temperature in intact loop steam generator, secondary side (TFI-SS244), from -20 to 256 s.

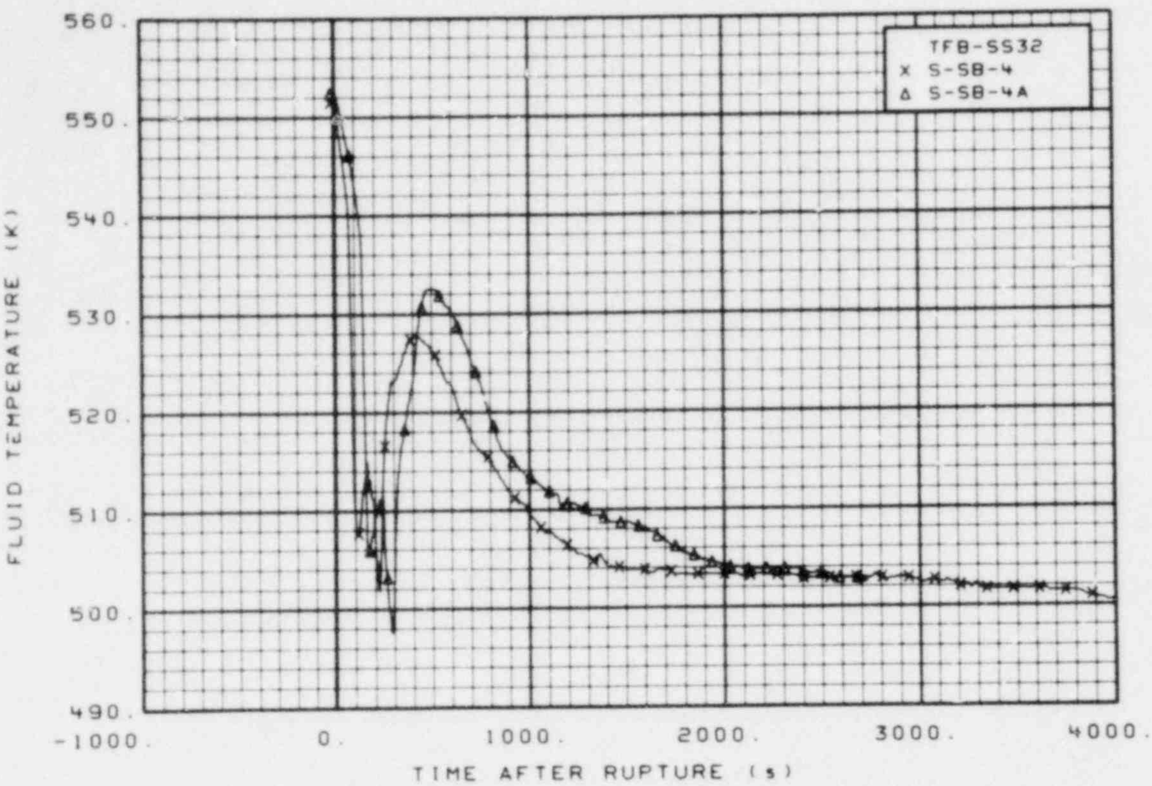


Figure 85. Fluid temperature in broken loop steam generator, secondary side (TFB-SS32), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

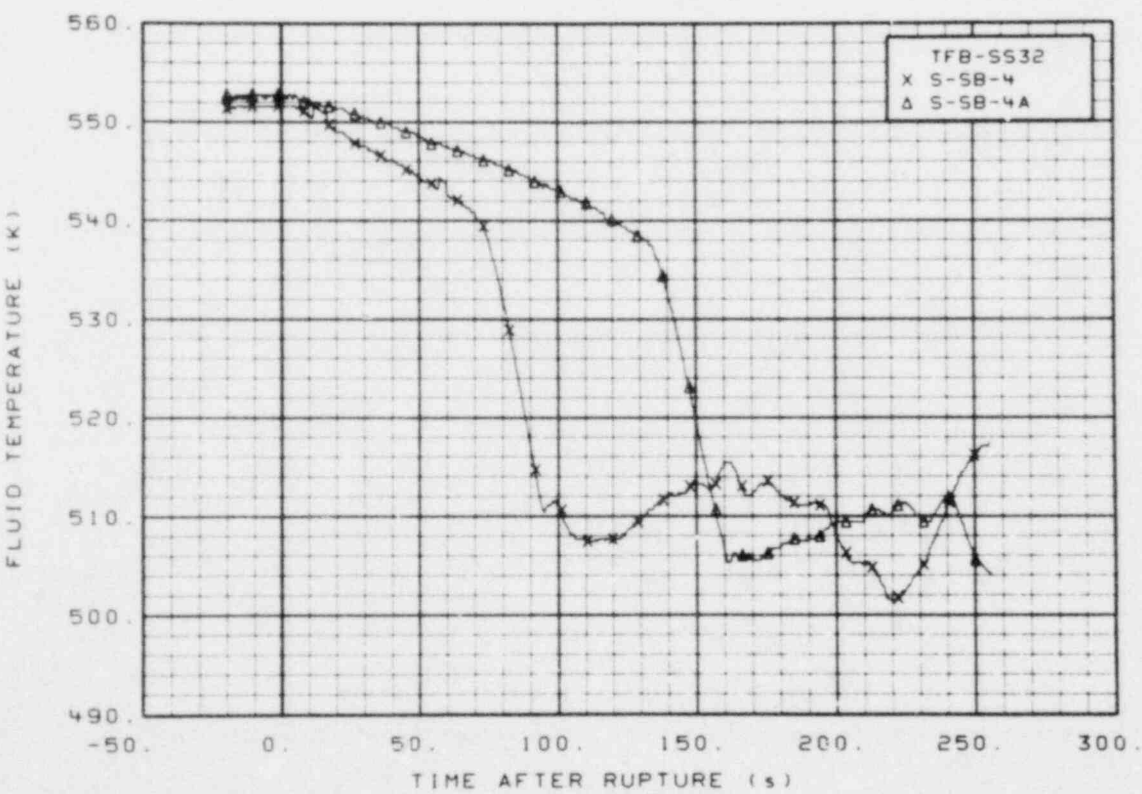


Figure 86. Fluid temperature in broken loop steam generator, secondary side (TFB-SS32), from -20 to 256 s.

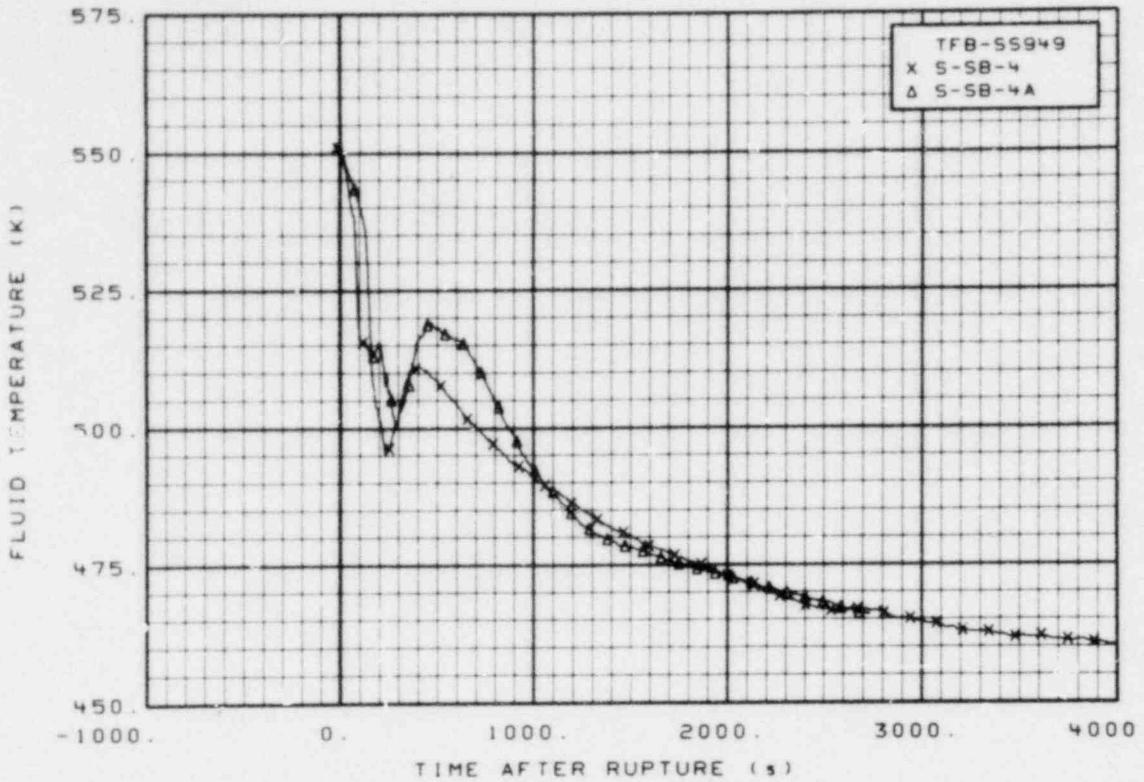


Figure 87. Fluid temperature in broken loop steam generator, secondary side (TFB-SS949), from -20 to 4000 s (to 2740 s for S-SB-4A).

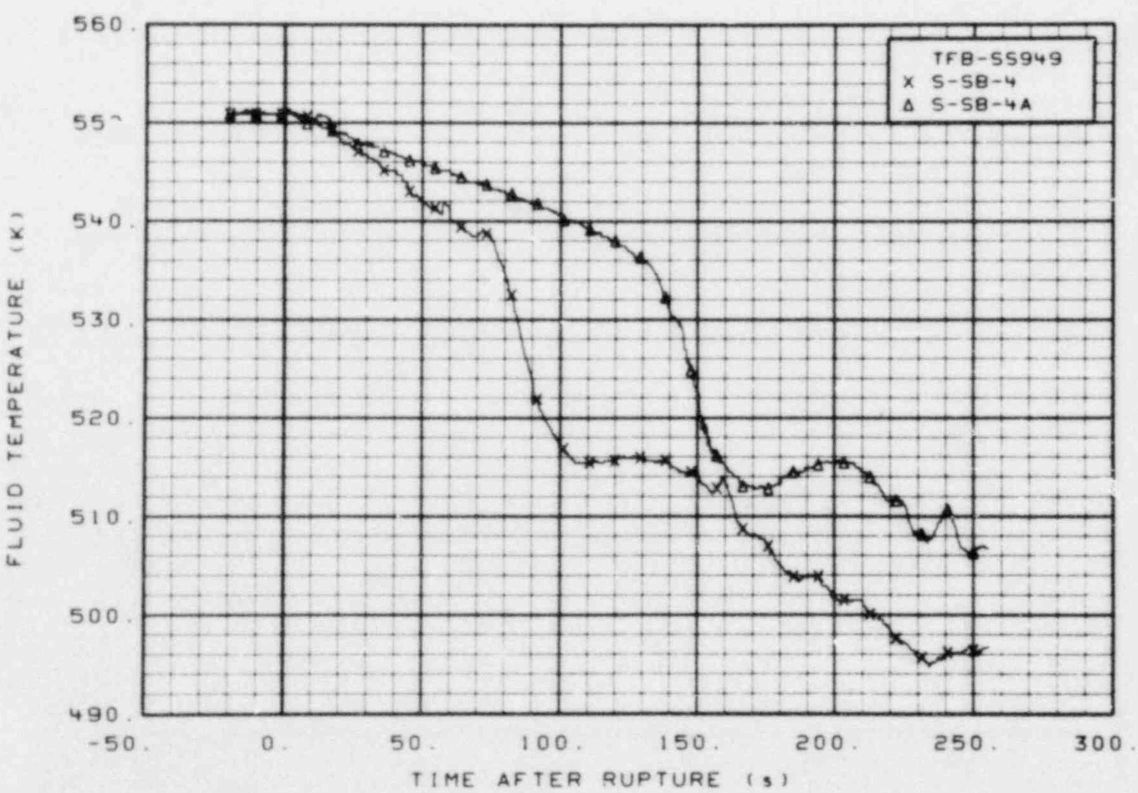


Figure 88. Flui temperature in broken loop steam generator, secondary side (TFB-SS949), from -20 to 256 s.

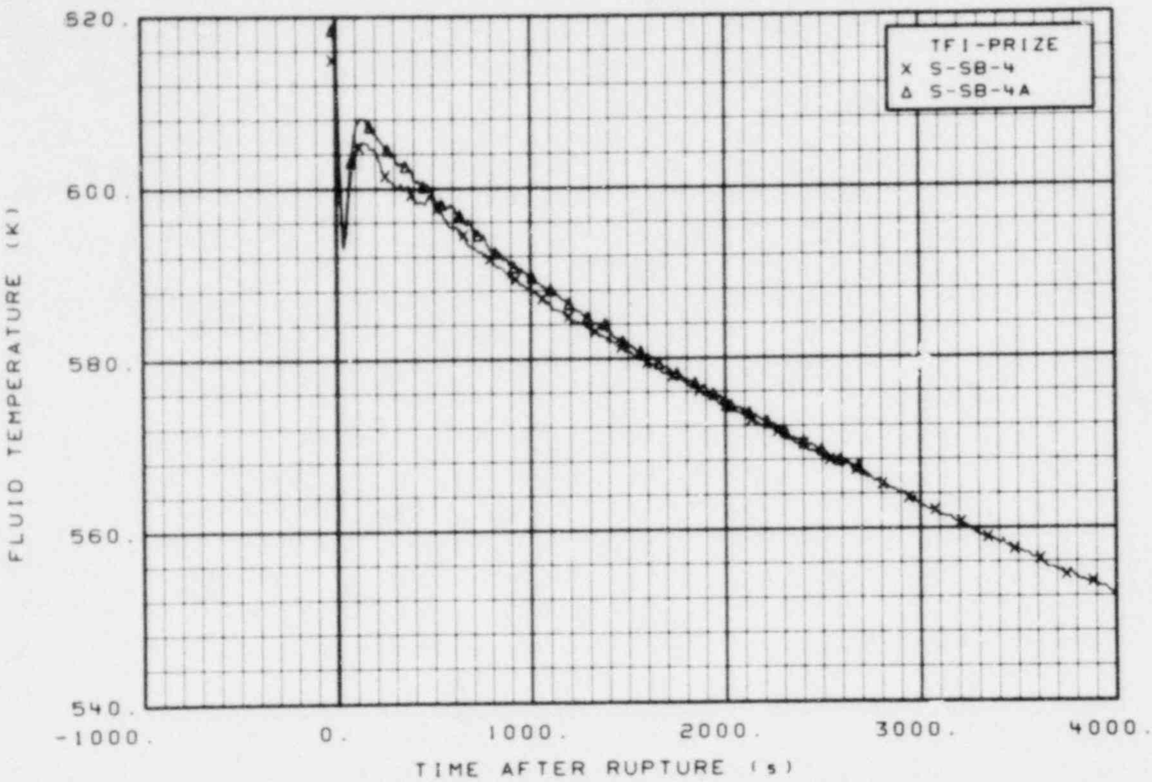


Figure 89. Fluid temperature in intact loop, pressurizer (TFI-PRIZE), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

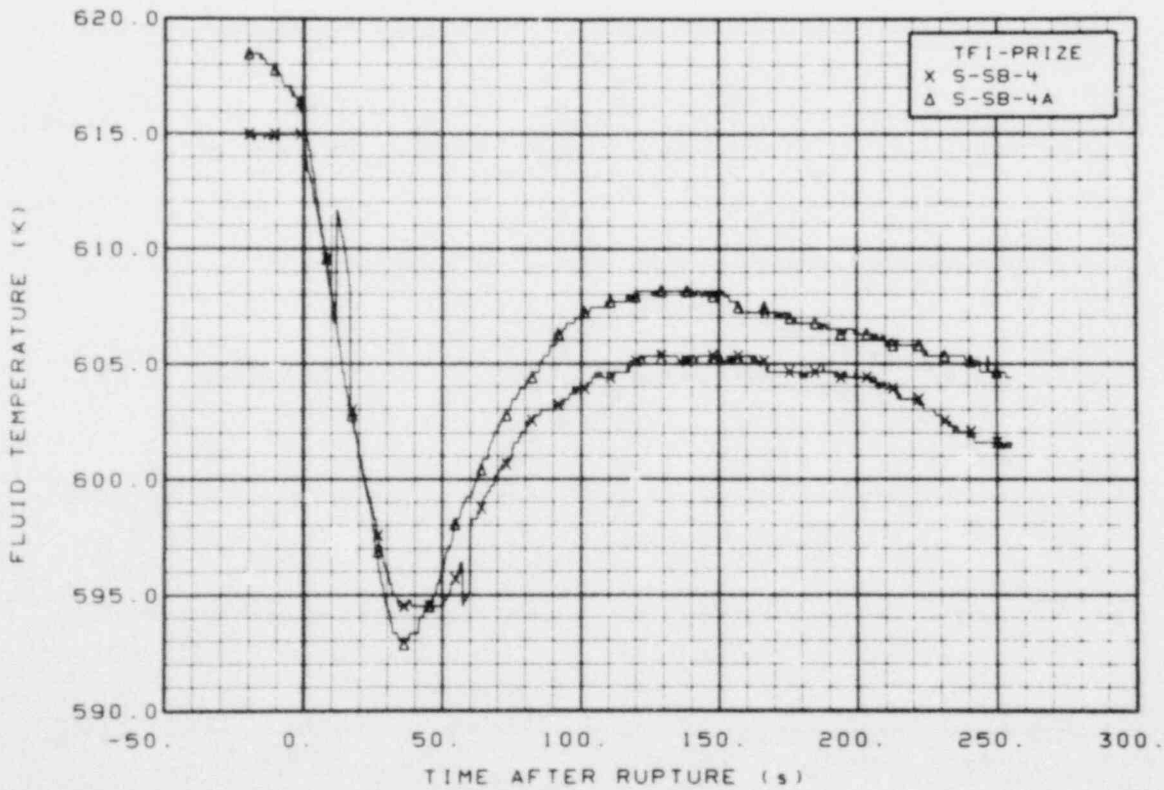


Figure 90. Fluid temperature in intact loop, pressurizer (TFI-PRIZE), from -20 to 256 s.

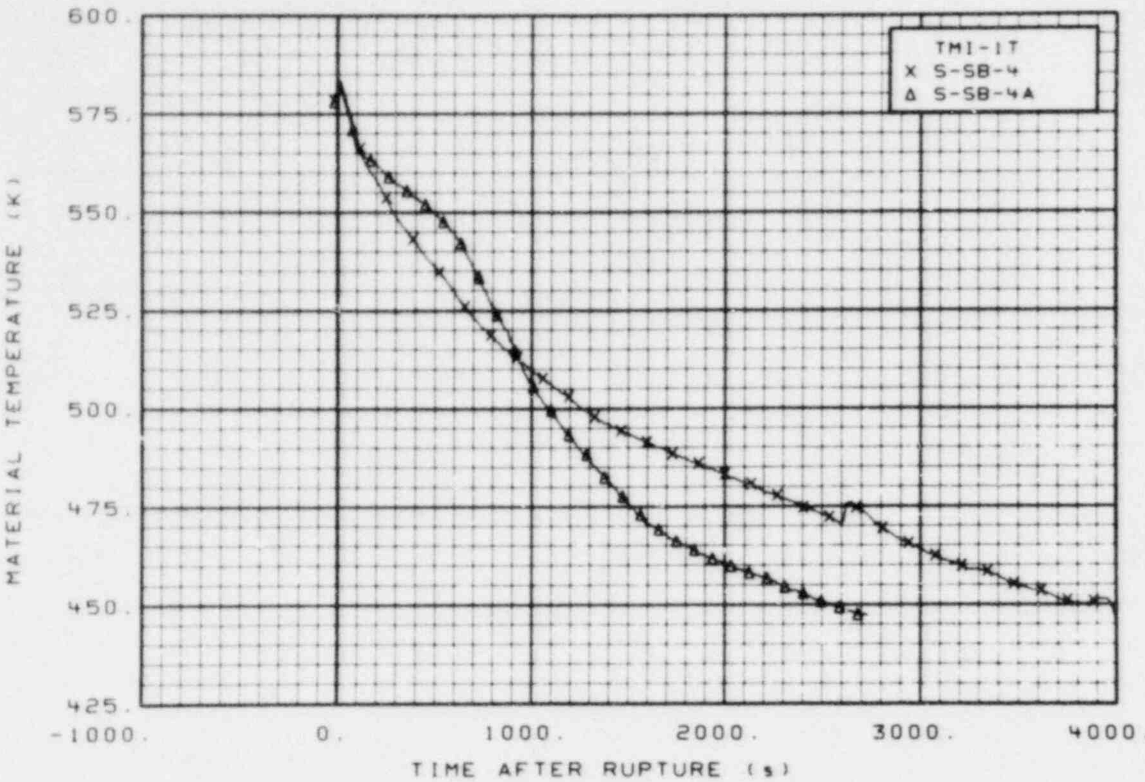


Figure 91. Material temperature in intact loop cold leg (TMI-1T), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

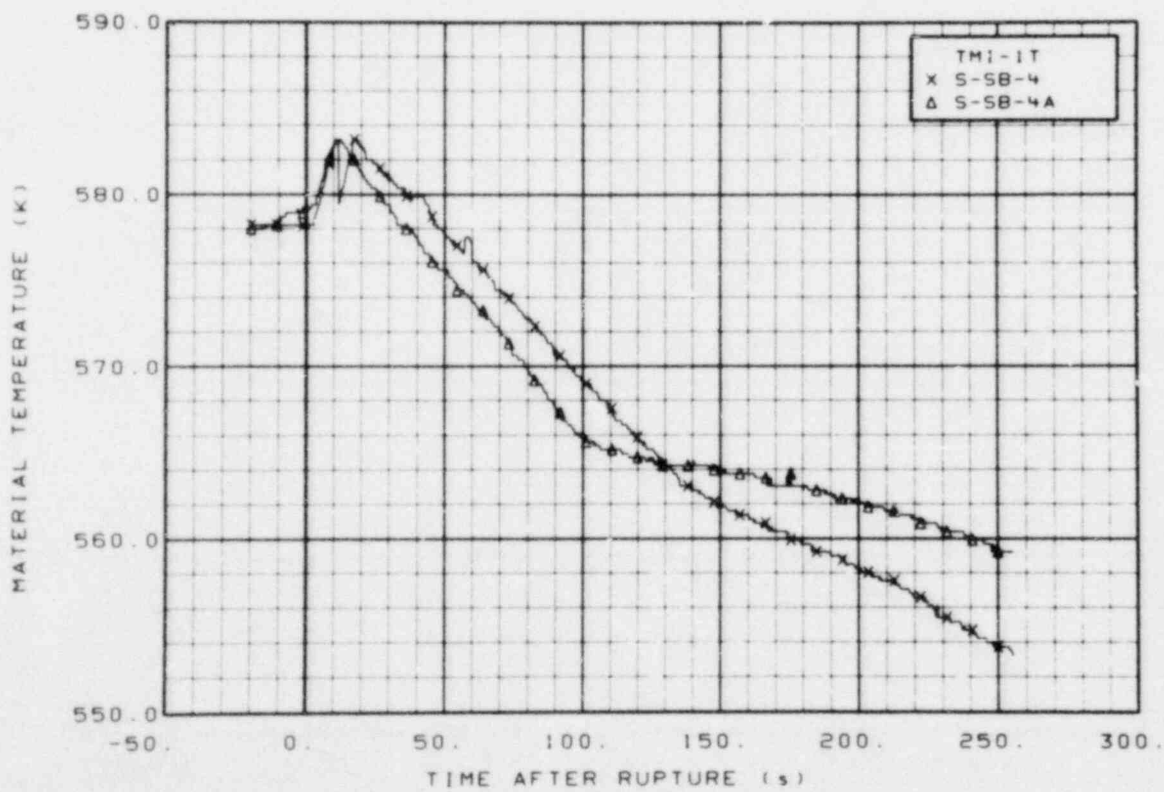


Figure 92. Material temperature in intact loop cold leg (TMI-1T), from -20 to 256 s.

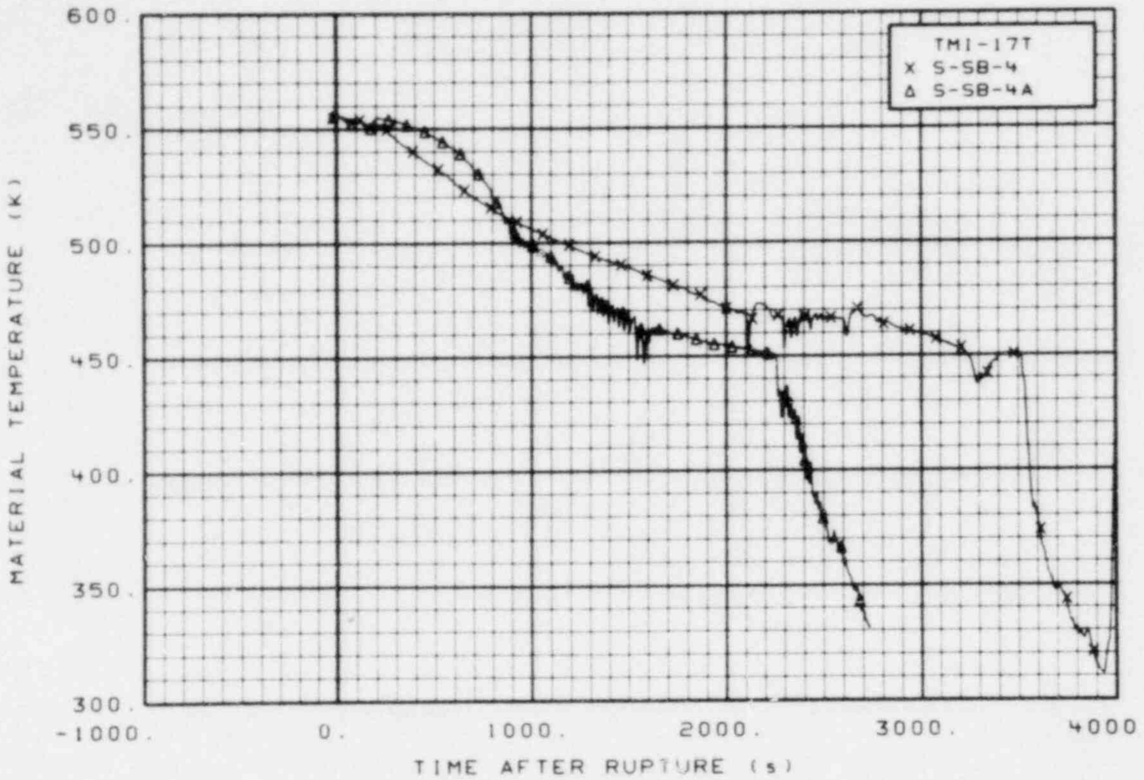


Figure 93. Material temperature in intact loop cold leg (TMI-17T), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

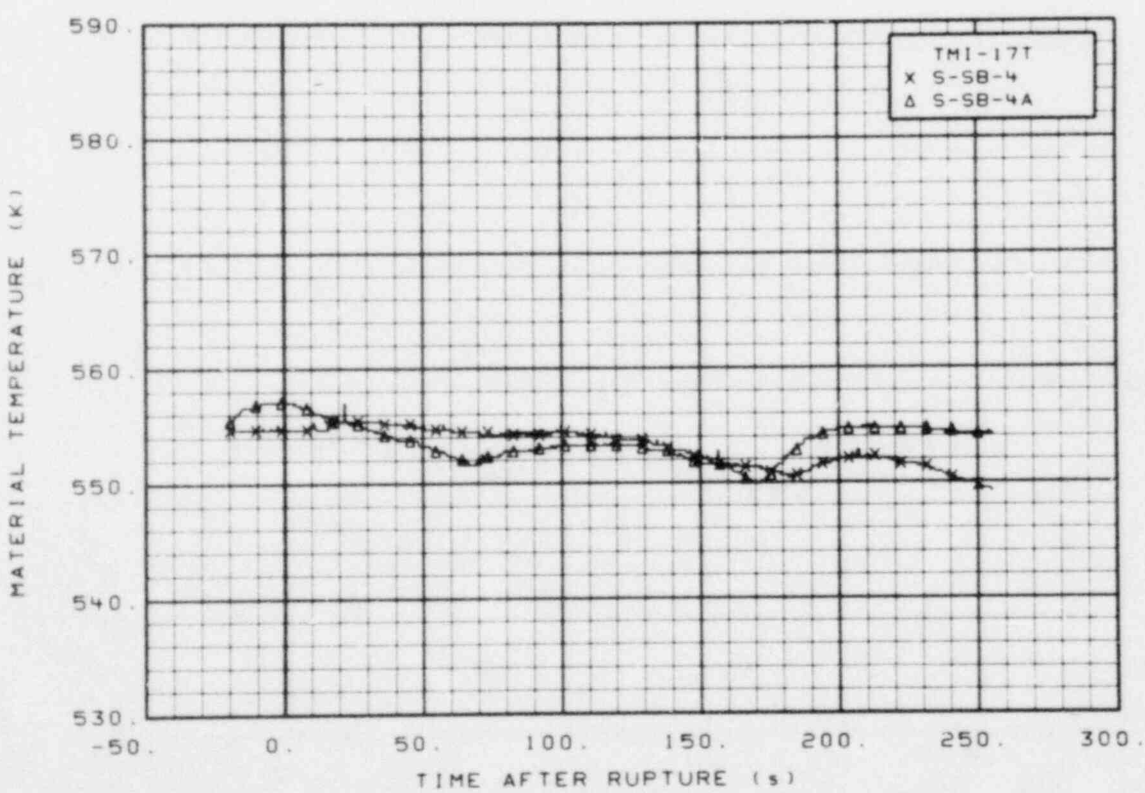


Figure 94. Material temperature in intact loop cold leg (TMI-17T), from -20 to 256 s.

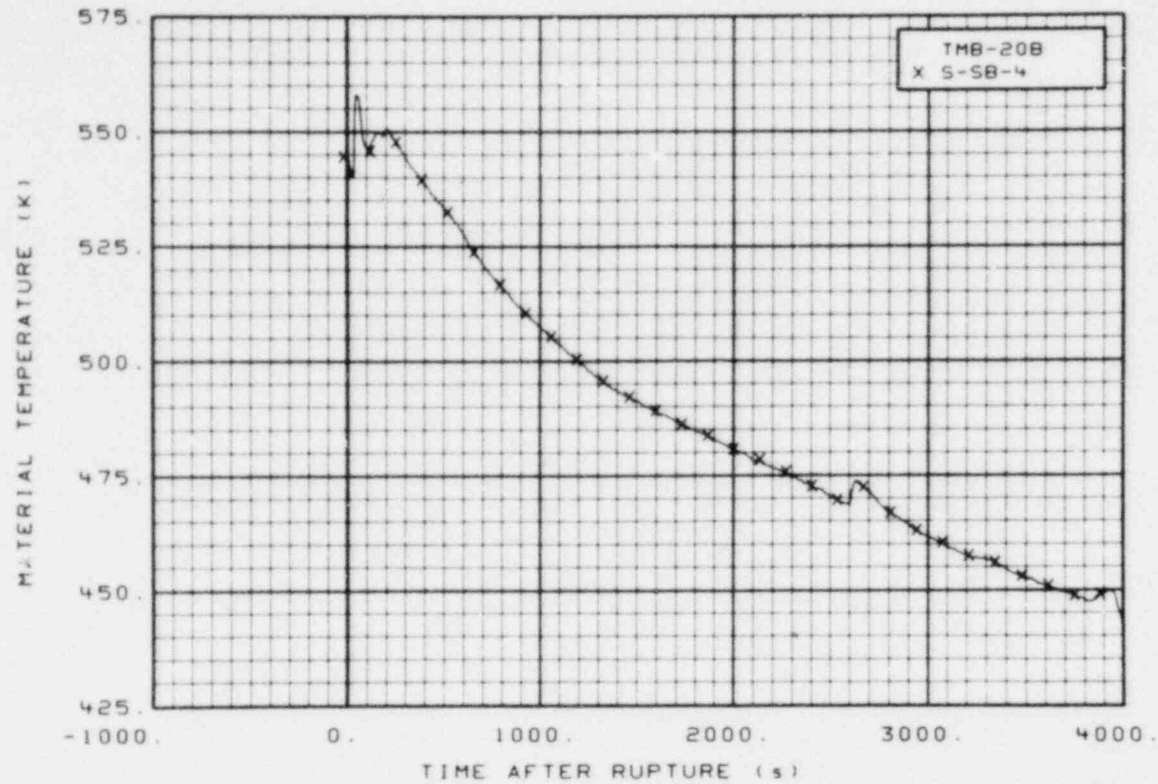


Figure 95. Material temperature in broken loop hot leg, Test S-SB-4 (TMB-20B), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

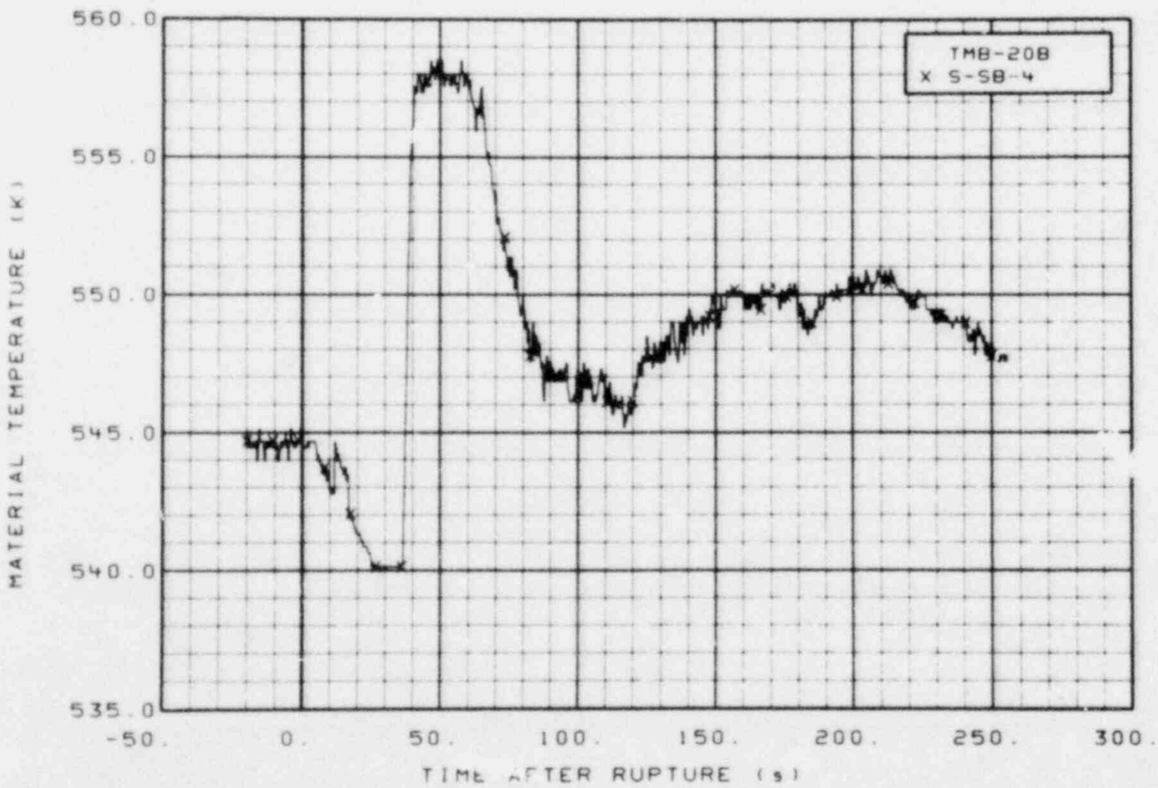


Figure 96. Material temperature in broken loop hot leg, Test S-SB-4 (TMB-20B), from -20 to 256 s.

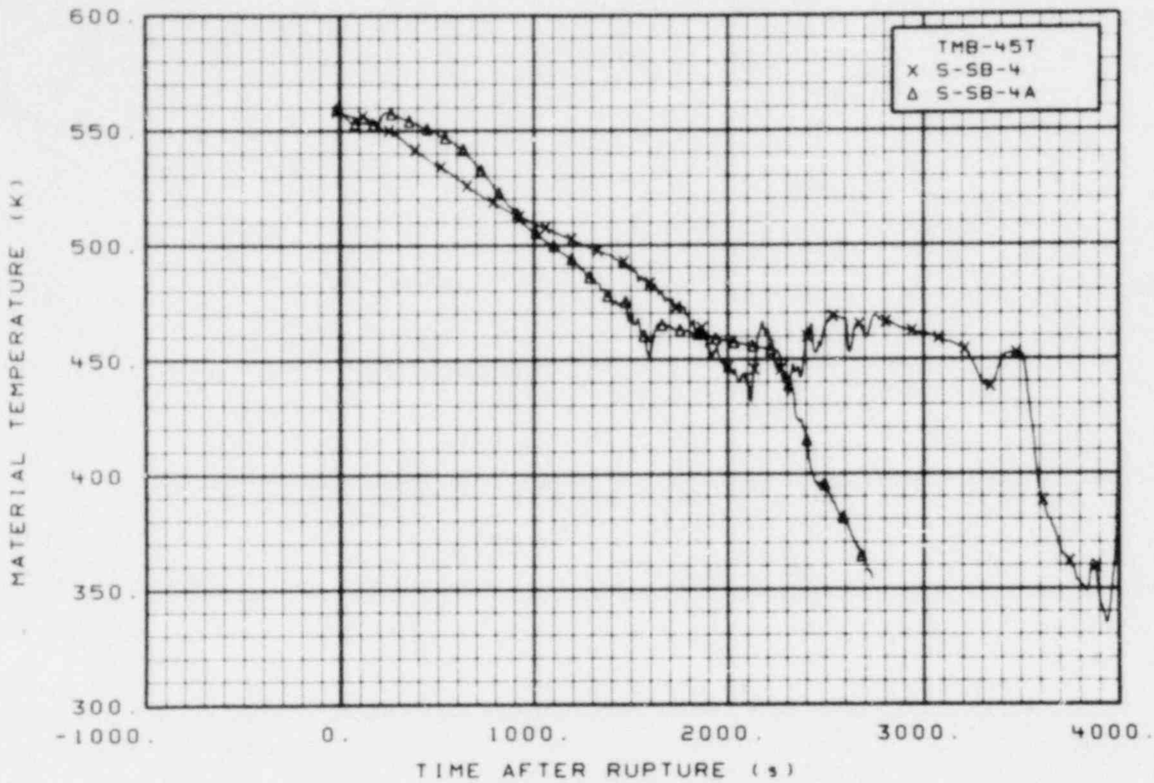


Figure 97. Material temperature in broken loop cold leg, (TMB-45T), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

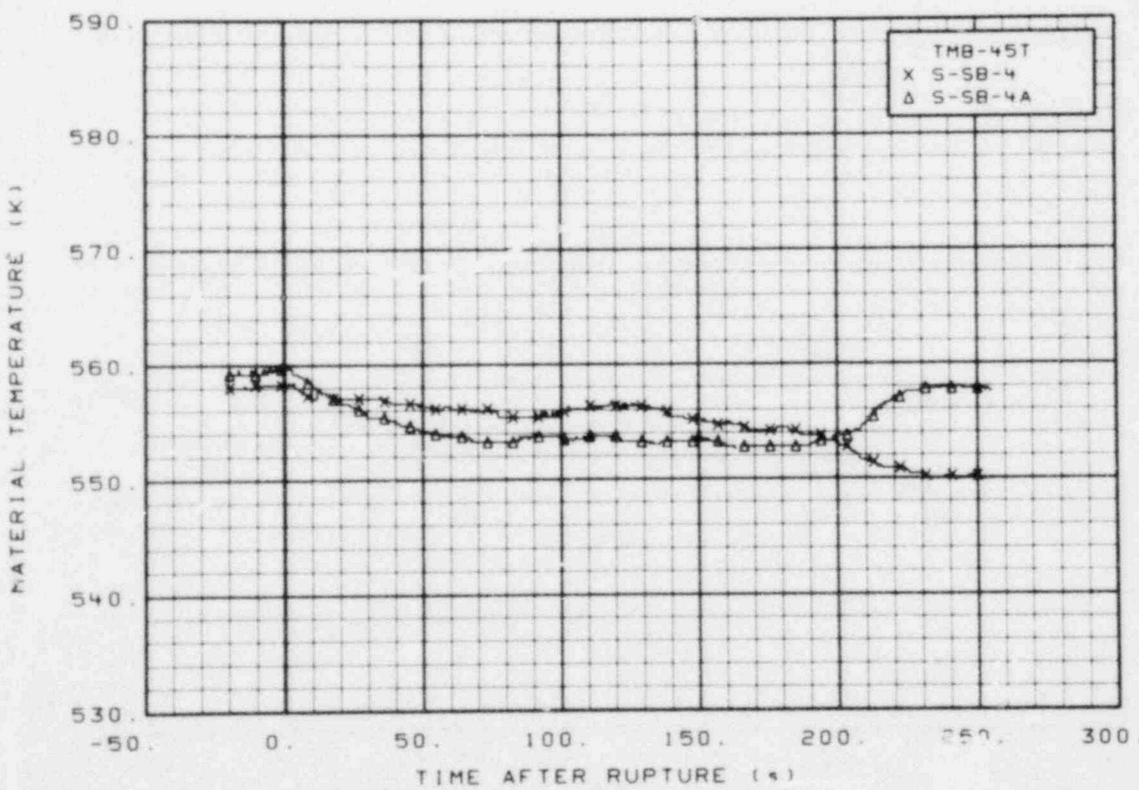


Figure 98. Material temperature in broken loop cold leg, (TMB-45T), from -20 to 256 s.

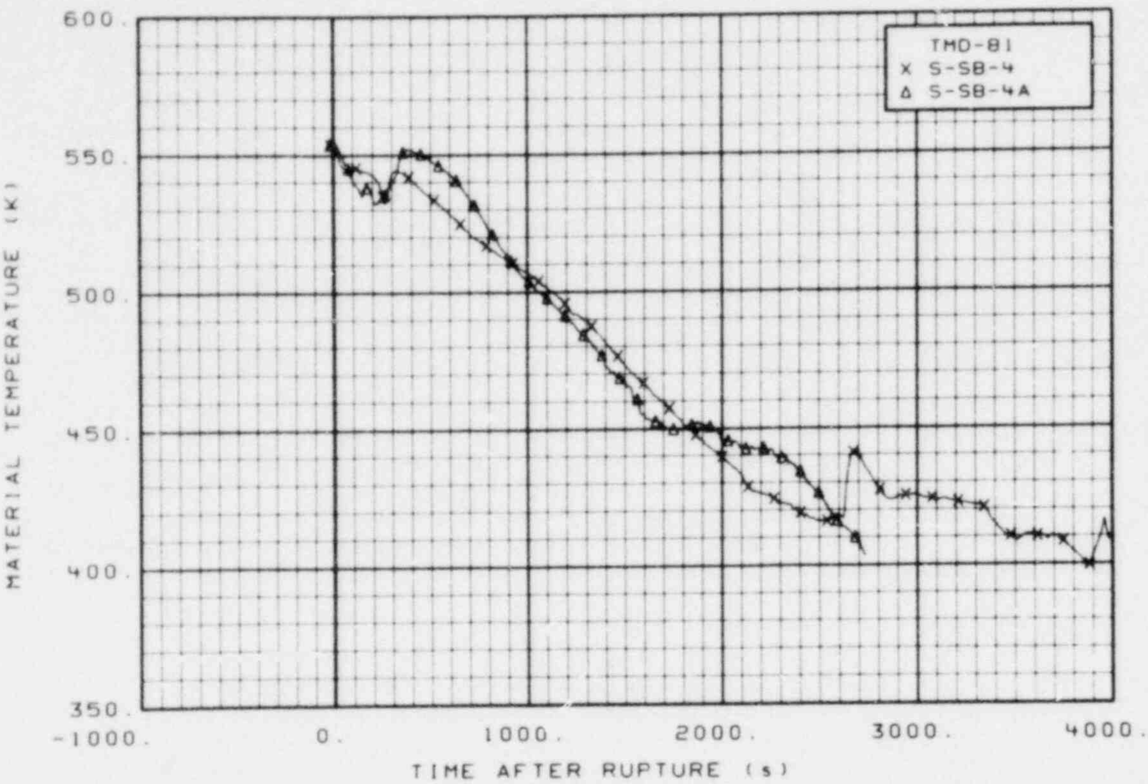


Figure 99. Material temperature in downcomer (TMD-81), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

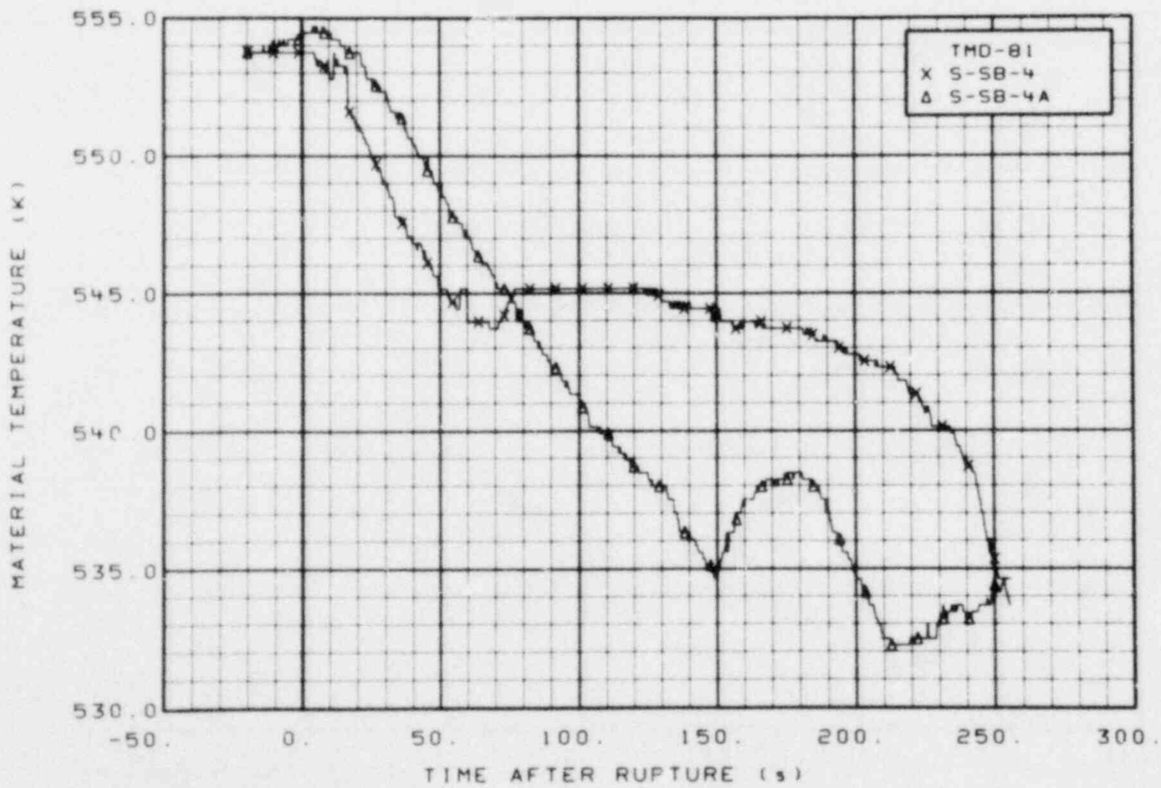


Figure 100. Material temperature in downcomer (TMD-81), from -20 to 256 s.

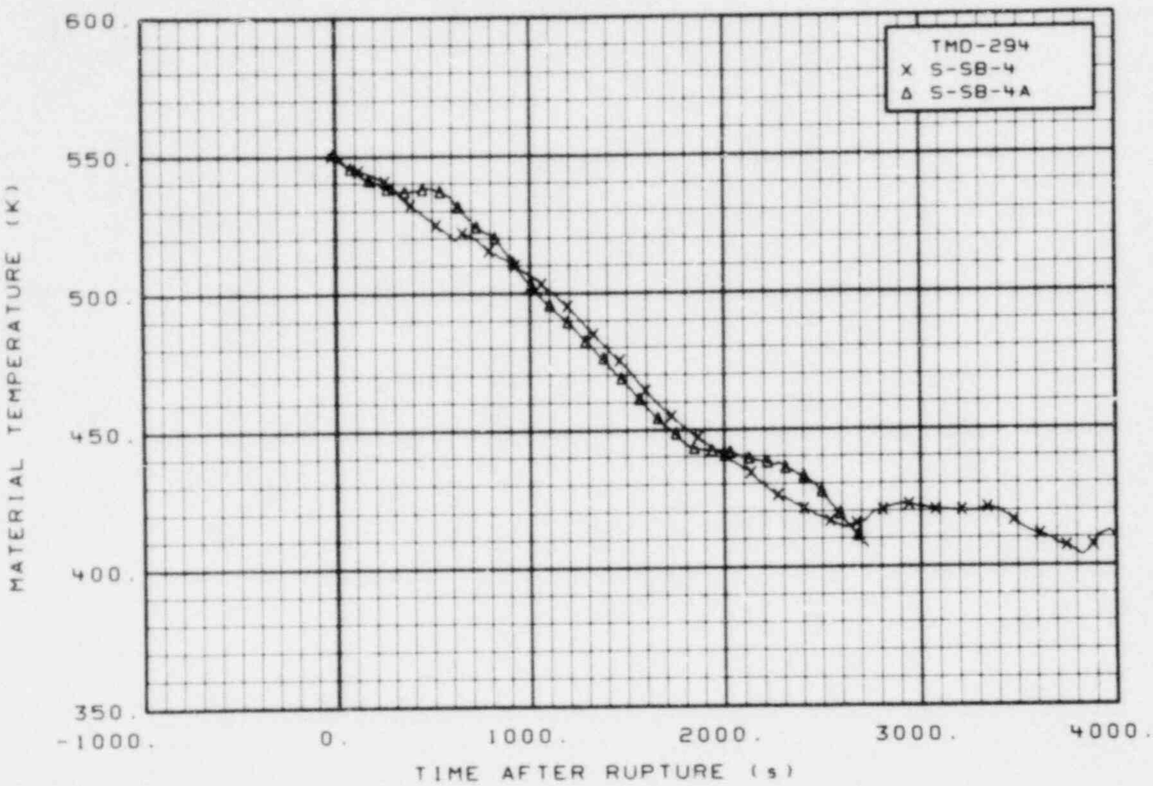


Figure 101. Material temperature in downcomer (TMD-294), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

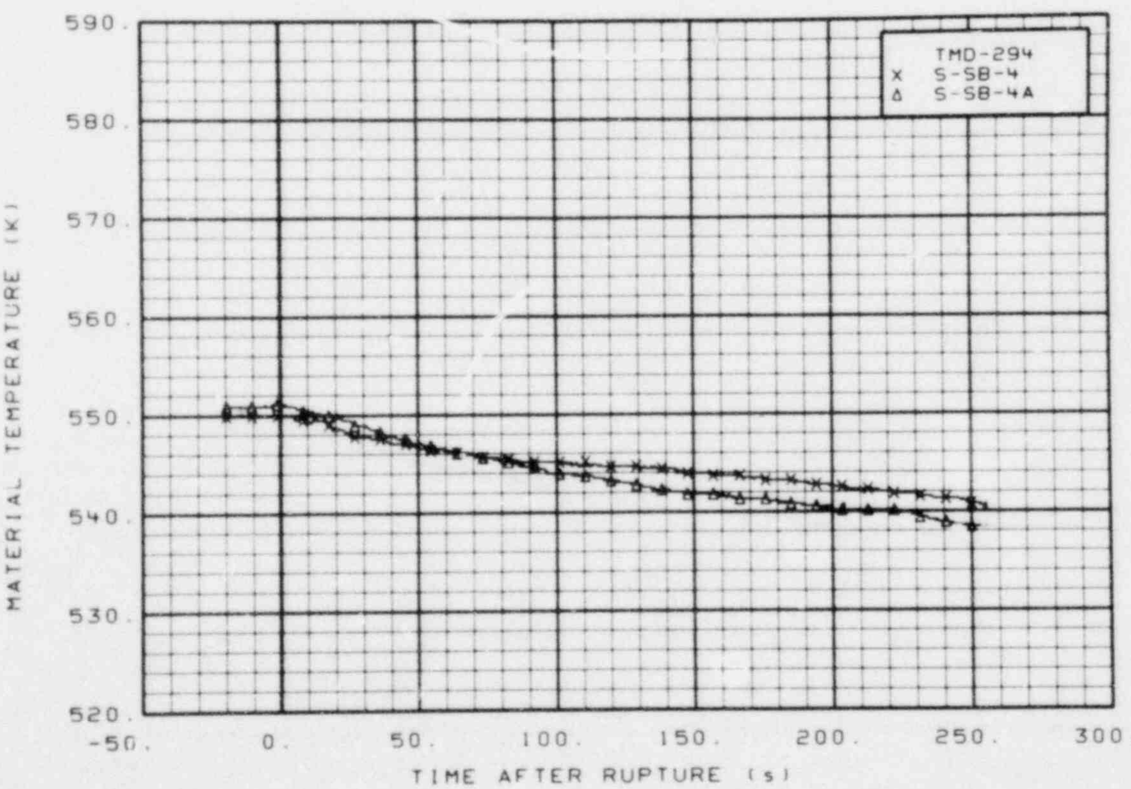


Figure 102. Material temperature in downcomer (TMD-294), from -20 to 256 s.

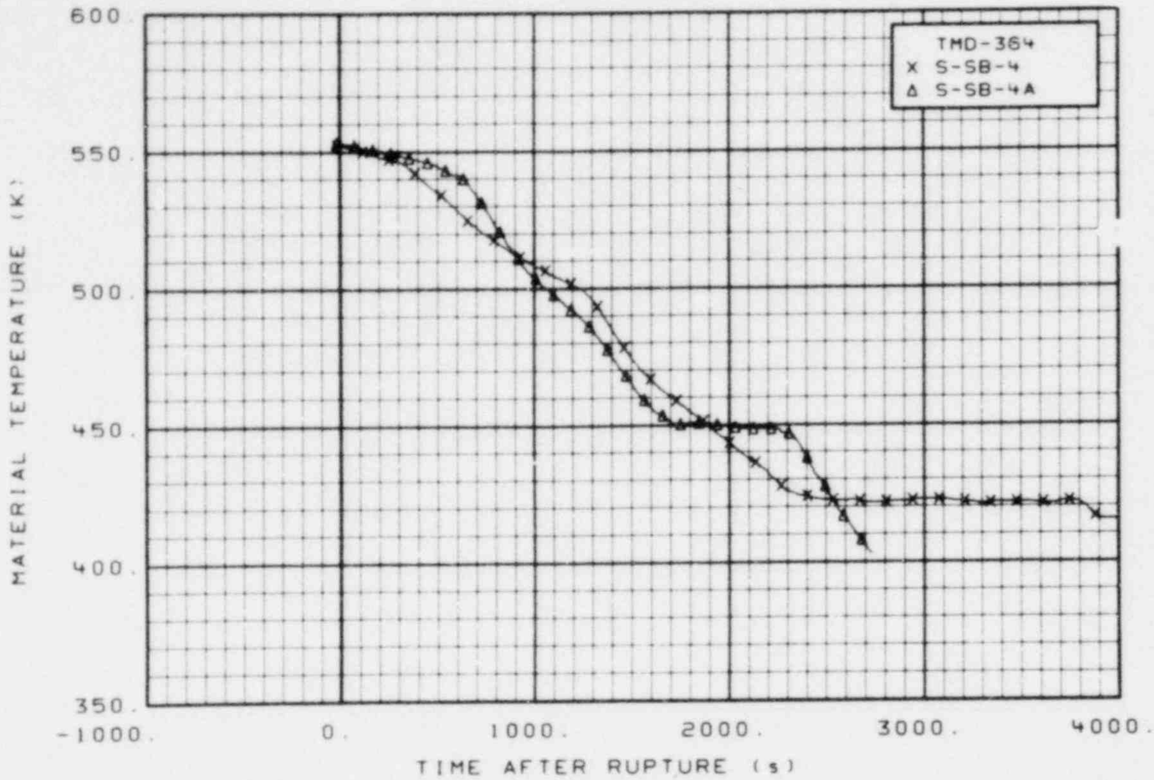


Figure 103. Material temperature in downcomer (TMD-364), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

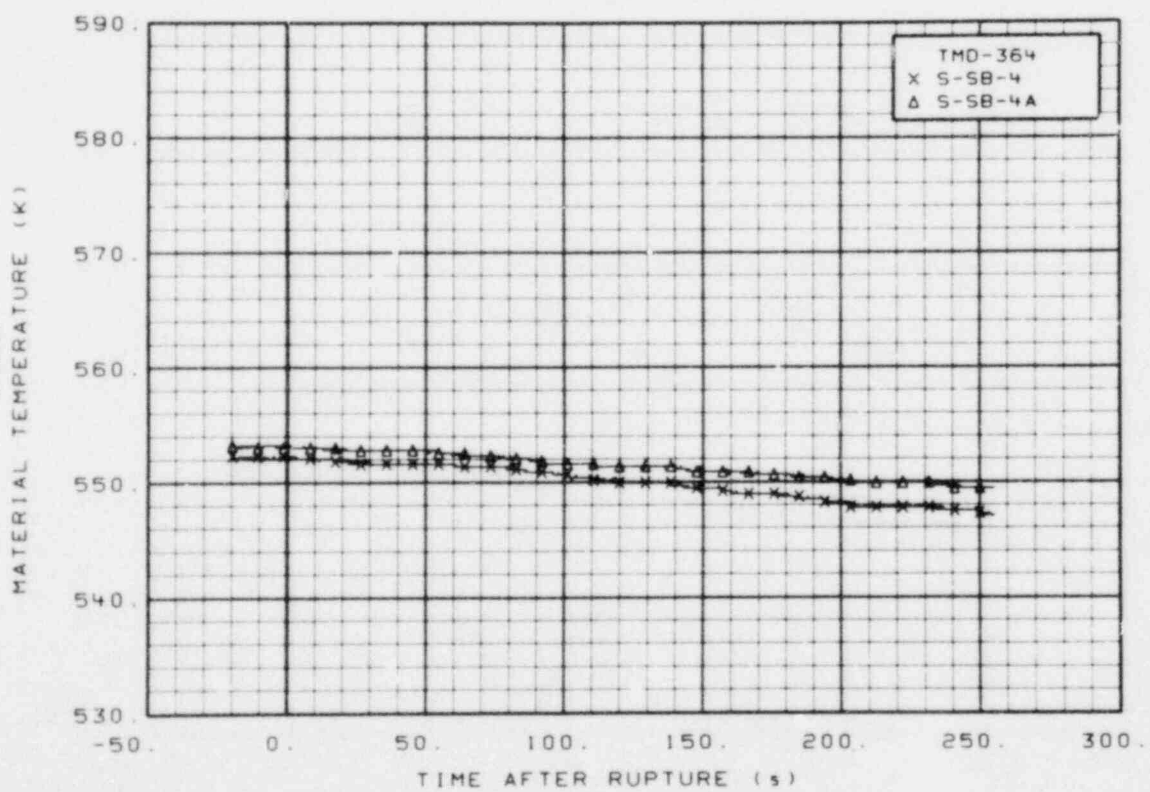


Figure 104. Material temperature in downcomer (TMD-364), from -20 to 256 s.

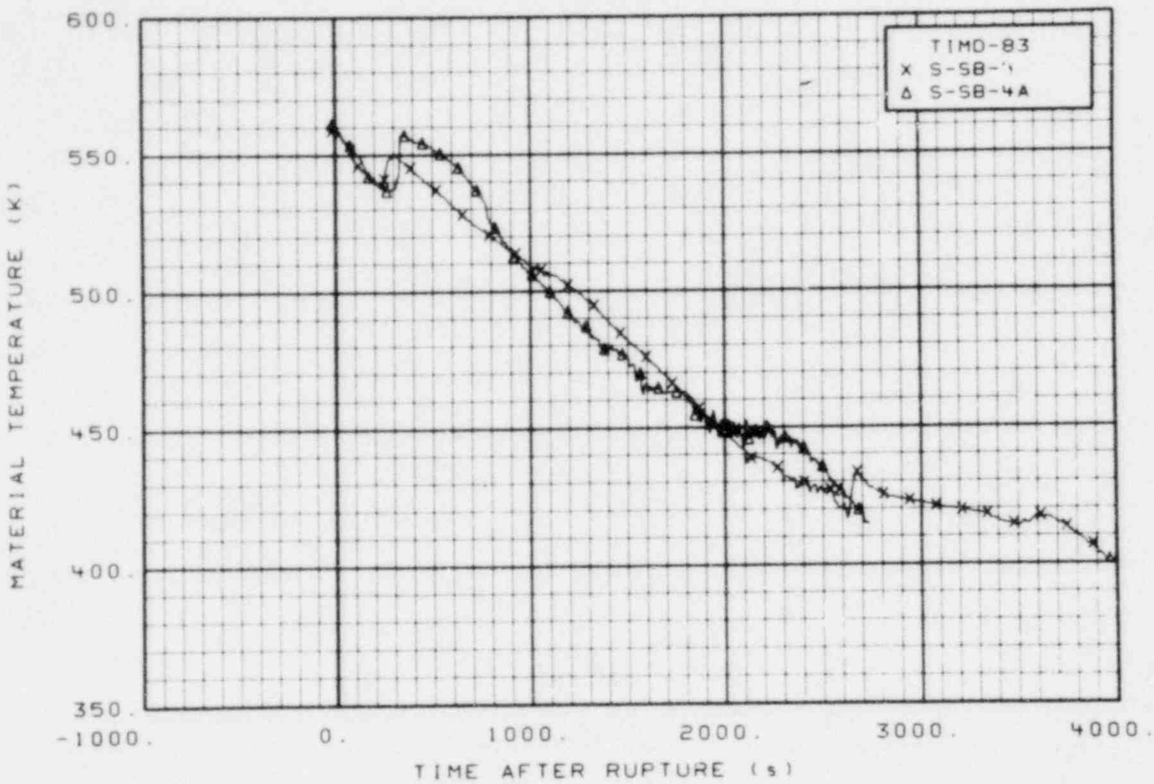


Figure 105. Material temperature in downcomer insulator (TIMD-83), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

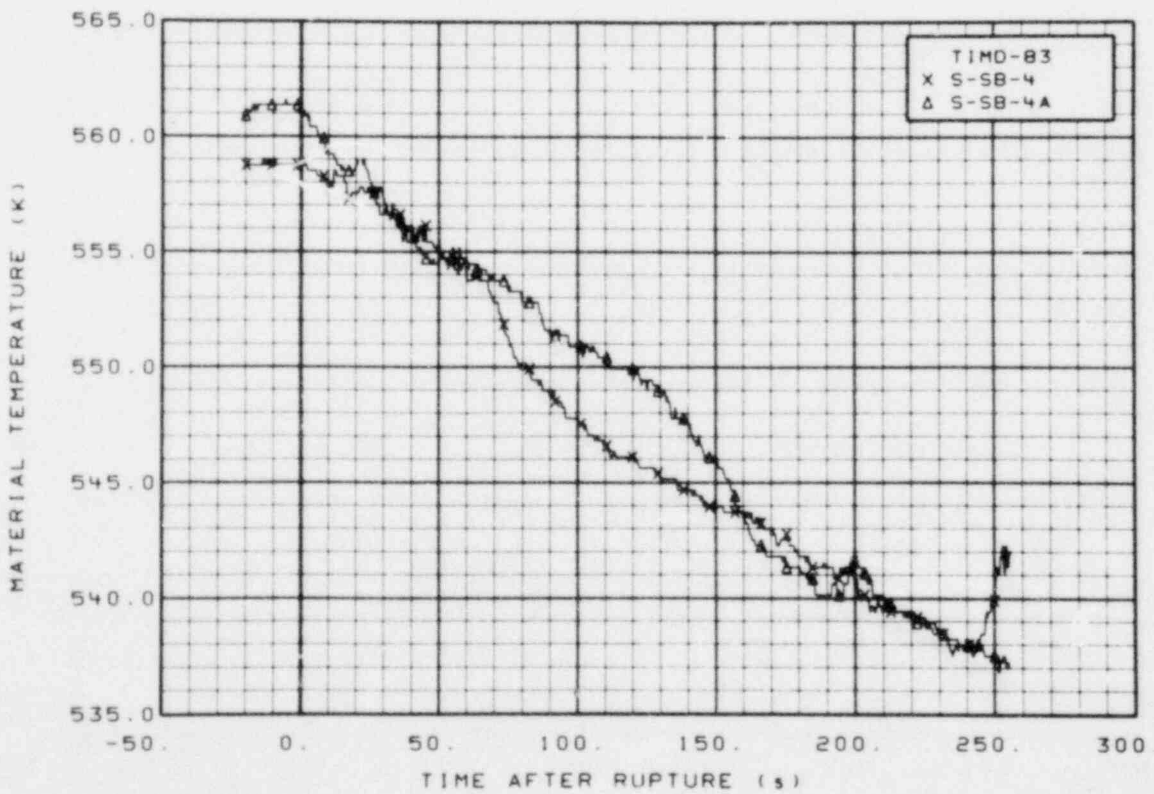


Figure 106. Material temperature in downcomer insulator (TIMD-83), from -20 to 256 s.

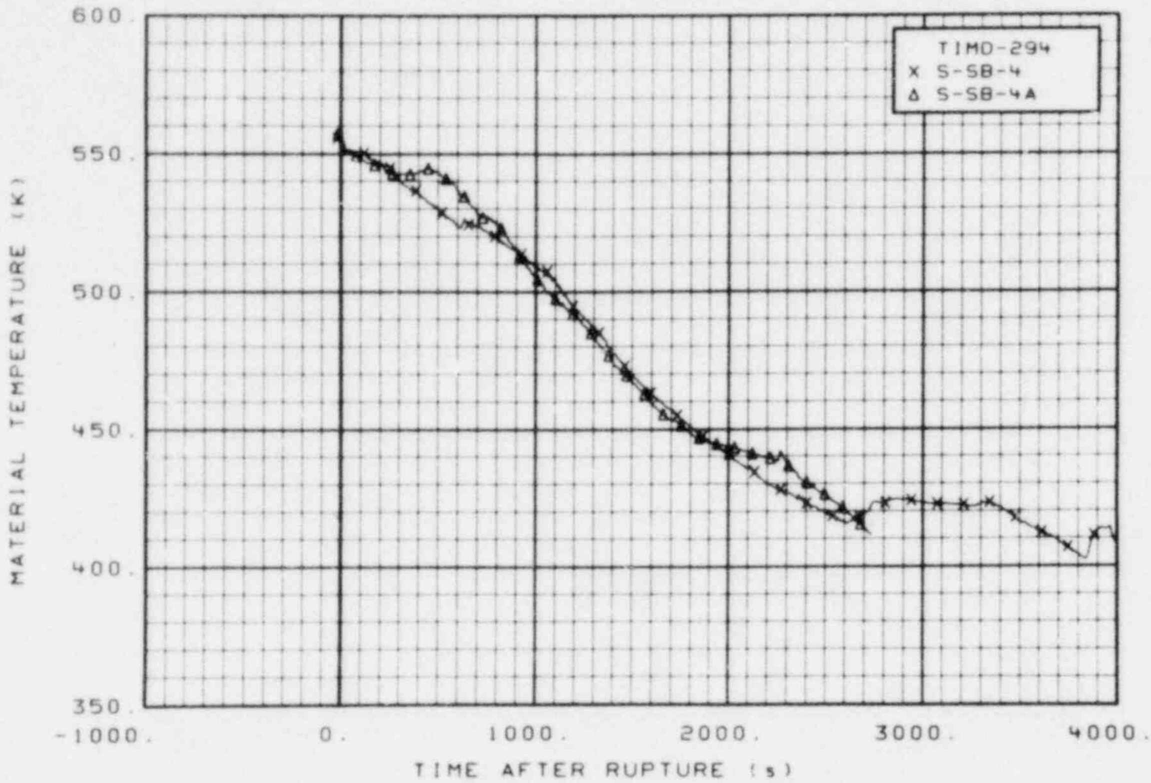


Figure 107. Material temperature in downcomer insulator (TIMD-294), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

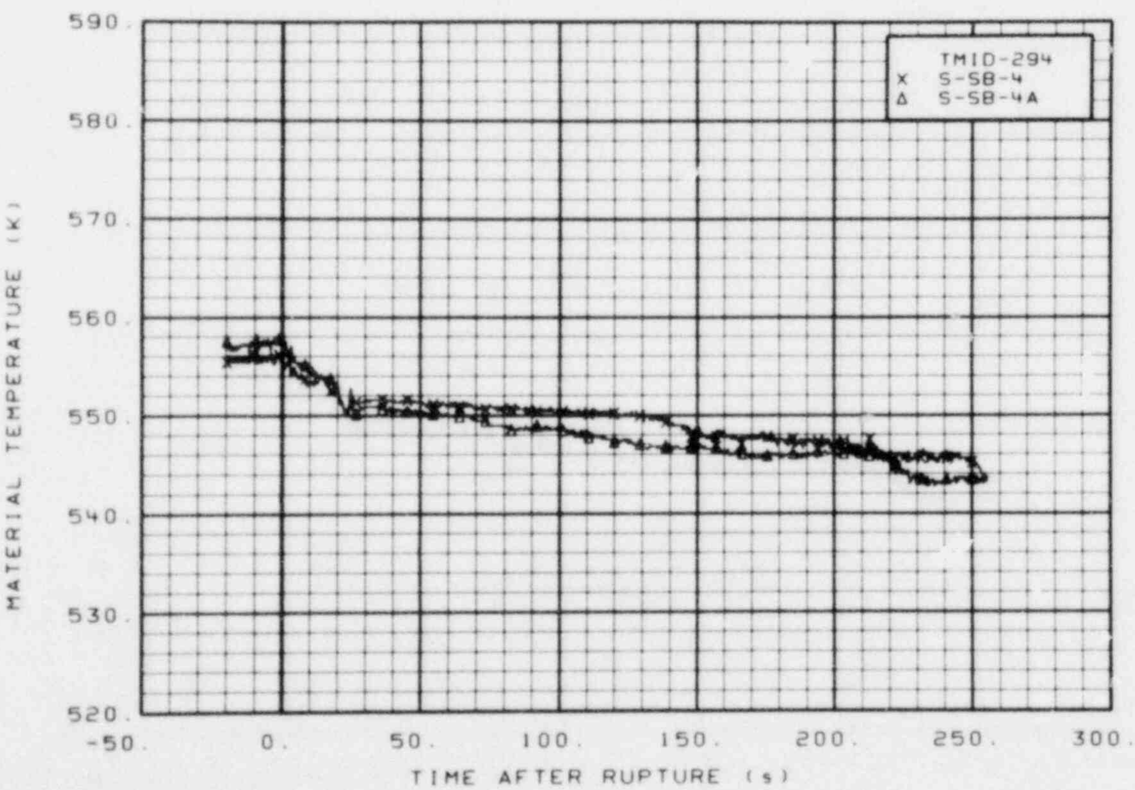


Figure 108. Material temperature in downcomer insulator (TIMD-294), from -20 to 256 s.

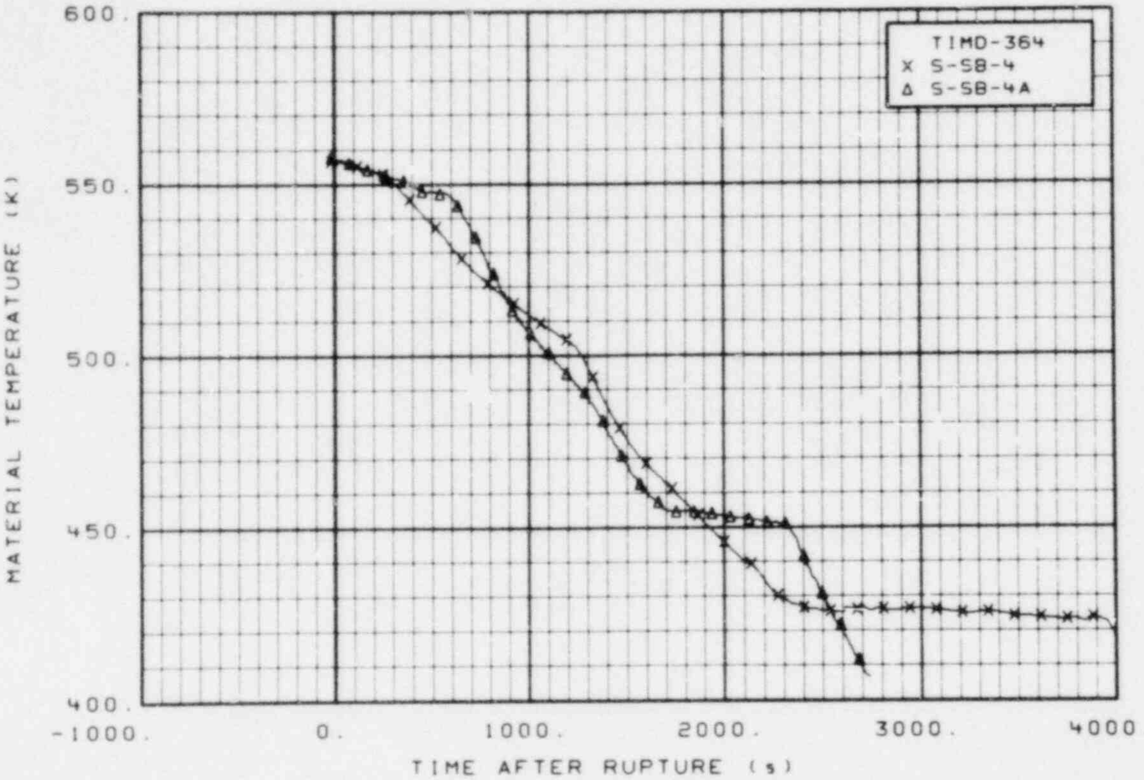


Figure 109. Material temperature in downcomer insulator (TIMD-364), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

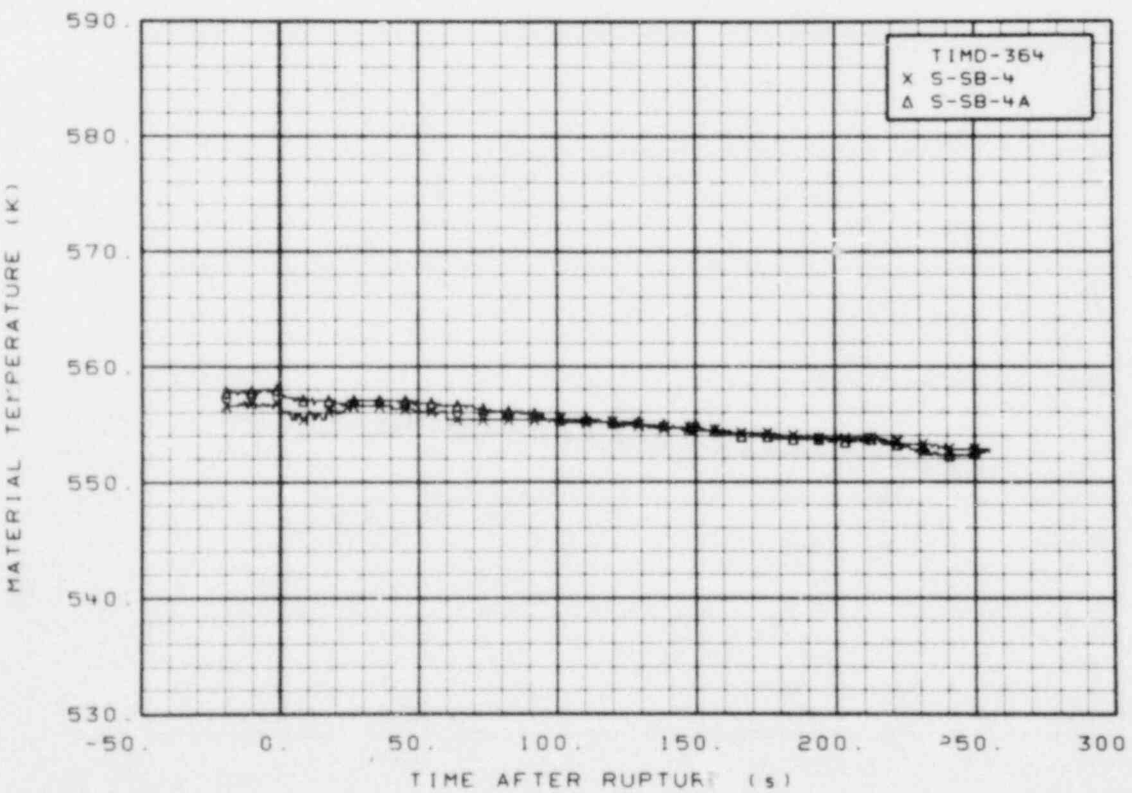


Figure 110. Material temperature in downcomer insulator (TIMD-364), from -20 to 256 s.

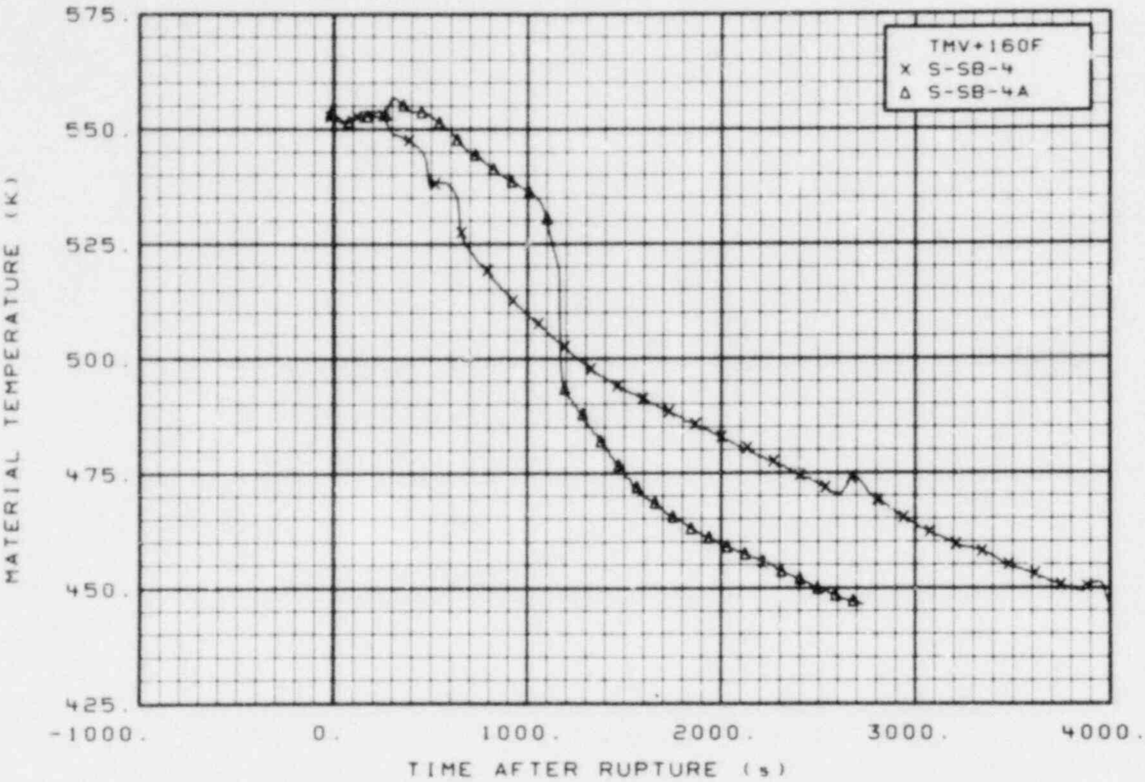


Figure 111. Material temperature on vessel upper head filler (TMV + 160F), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

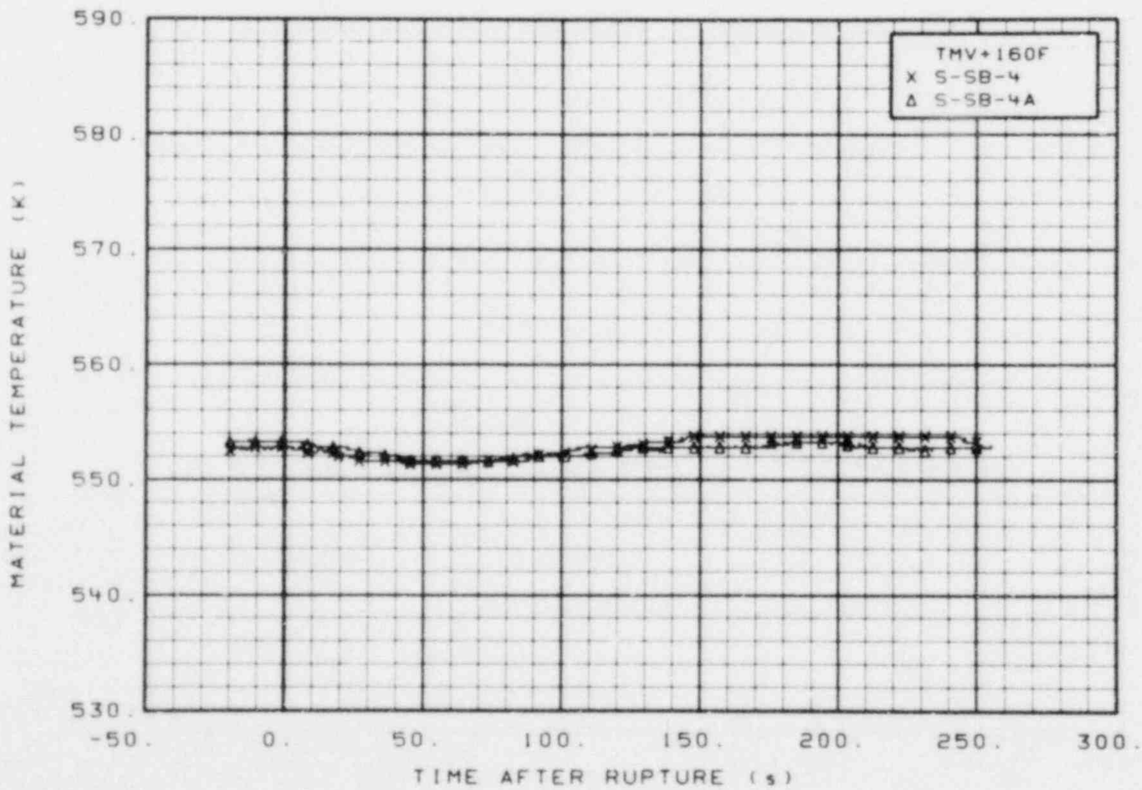


Figure 112. Material temperature on vessel upper head filler (TMV + 160F), from -20 to 256 s.

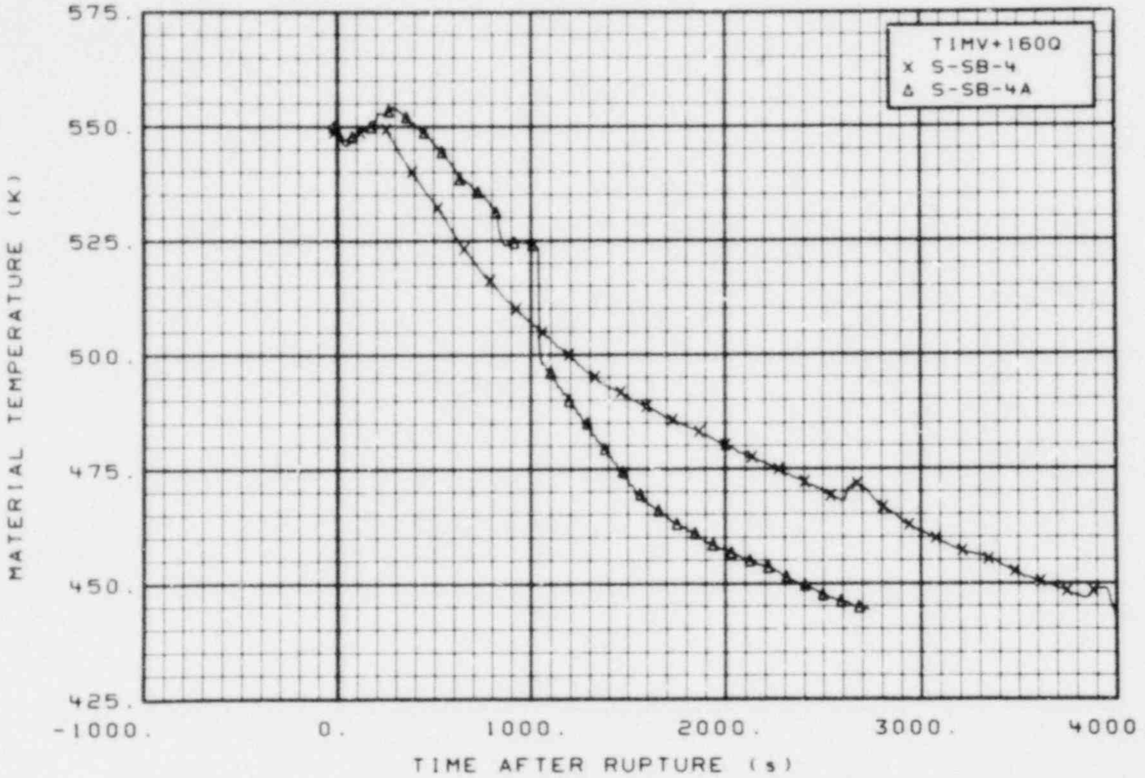


Figure 113. Material temperature on vessel insulator (TIMV + 160Q), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

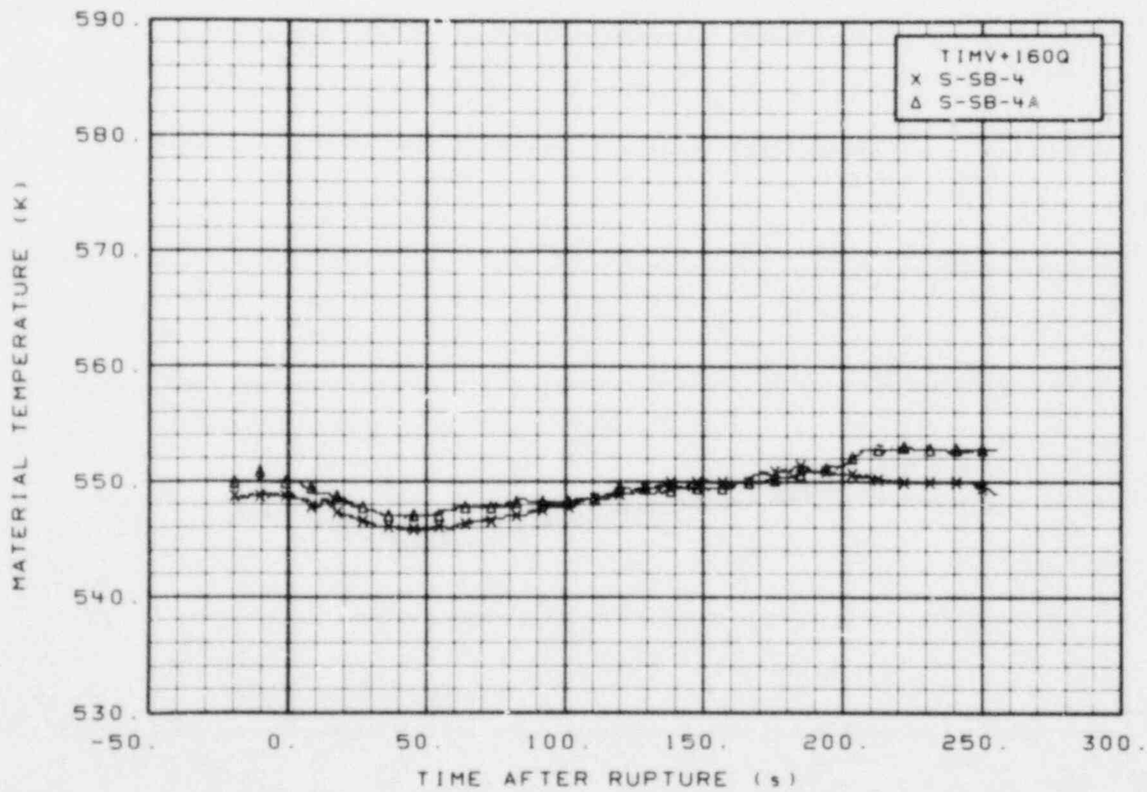


Figure 114. Material temperature on vessel insulator (TIMV + 160Q), from -20 to 256 s.

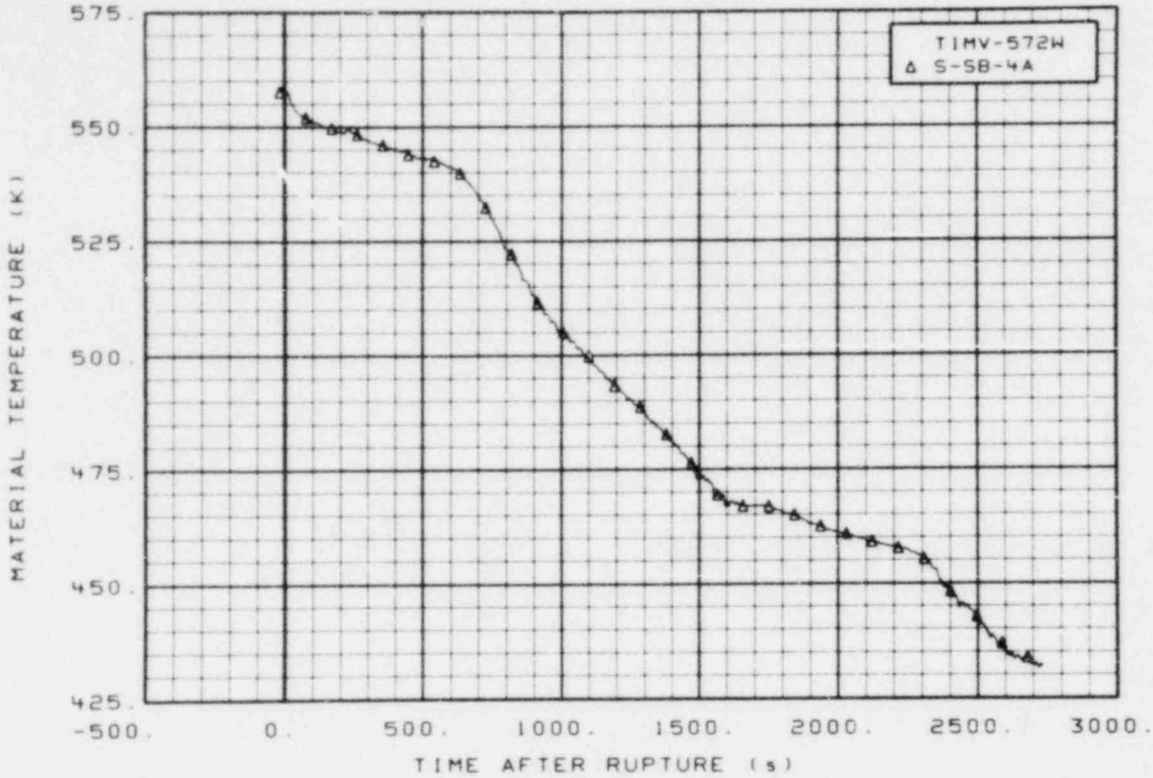


Figure 115. Material temperature on vessel insulator, Test S-SB-4A (TIMV + 572W), from -20 to 2740 s.

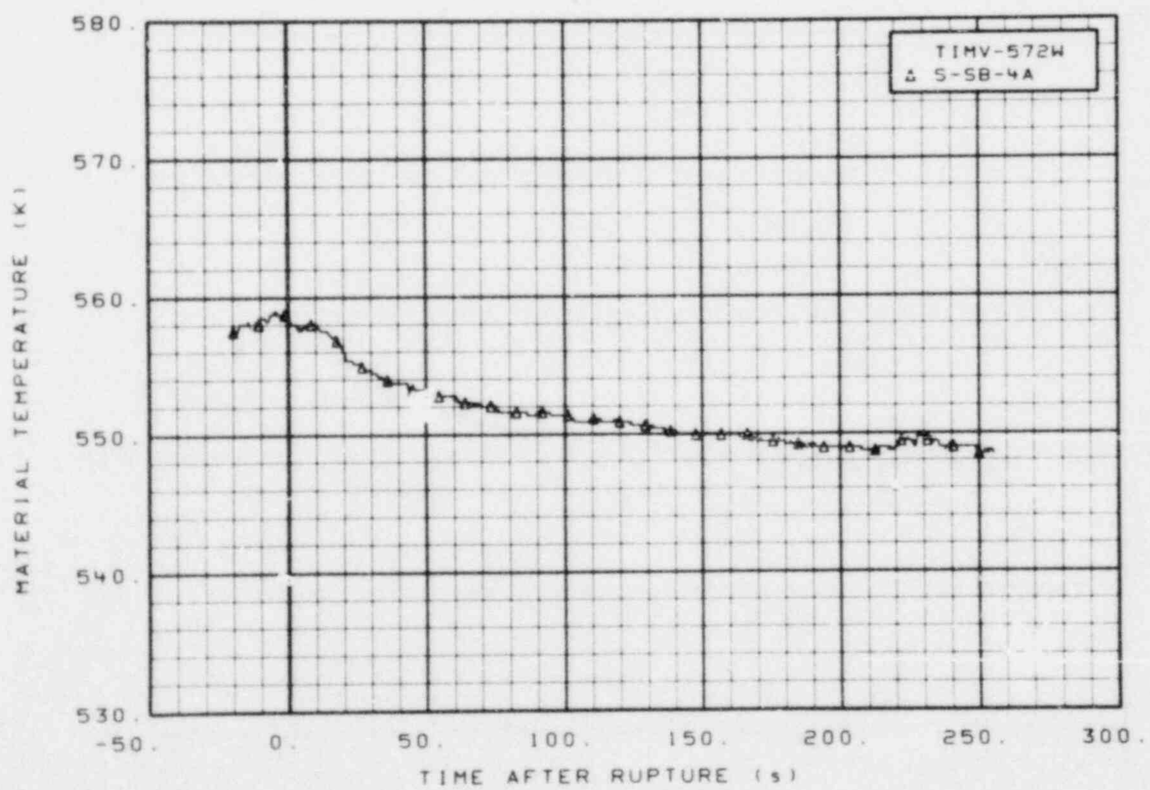


Figure 116. Material temperature on vessel insulator, Test S-SB-4A (TIMV + 572W), from -20 to 256 s.

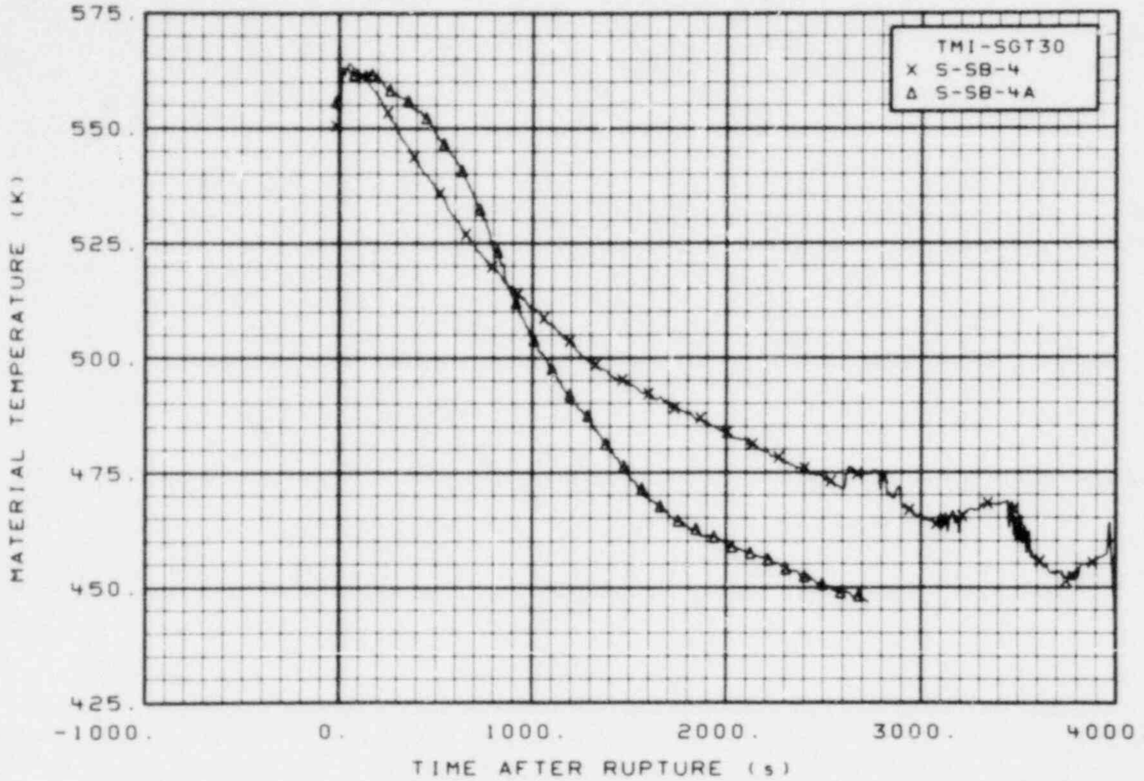


Figure 117. Material temperature in intact loop steam generator tube (TMI-SGT30), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

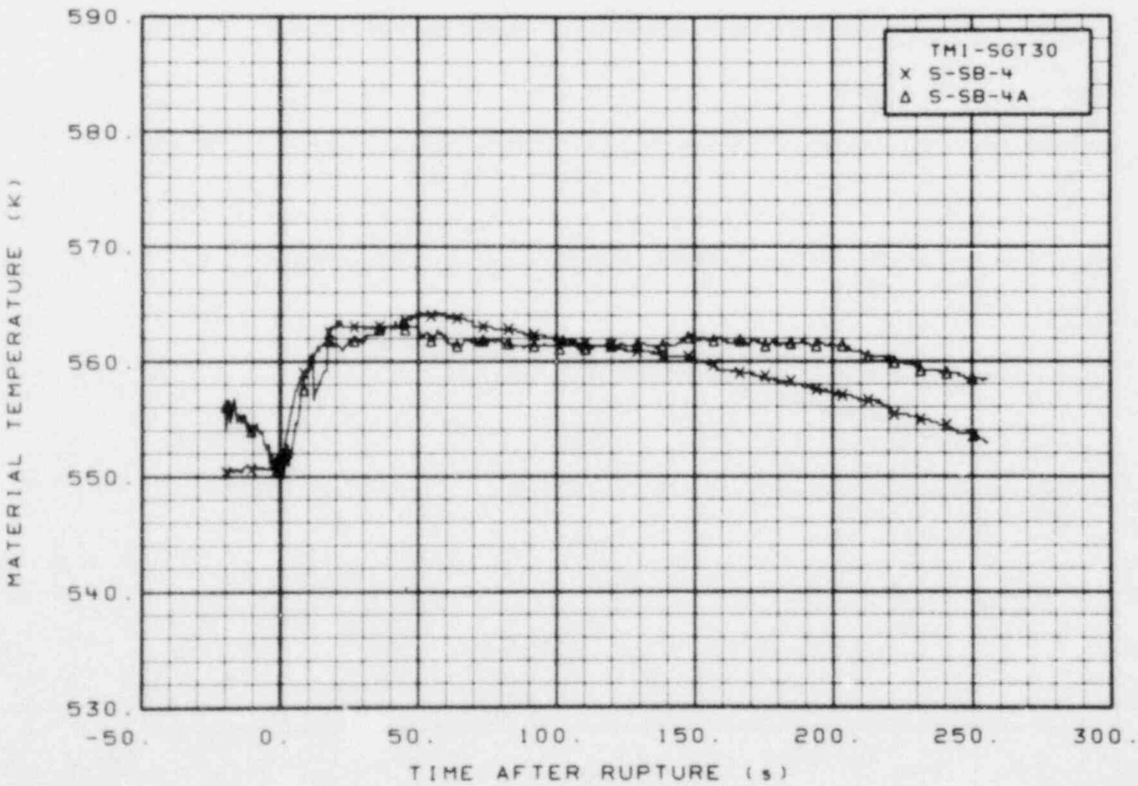


Figure 118. Material temperature in intact loop steam generator tube (TMI-SGT30), from -20 to 256 s.

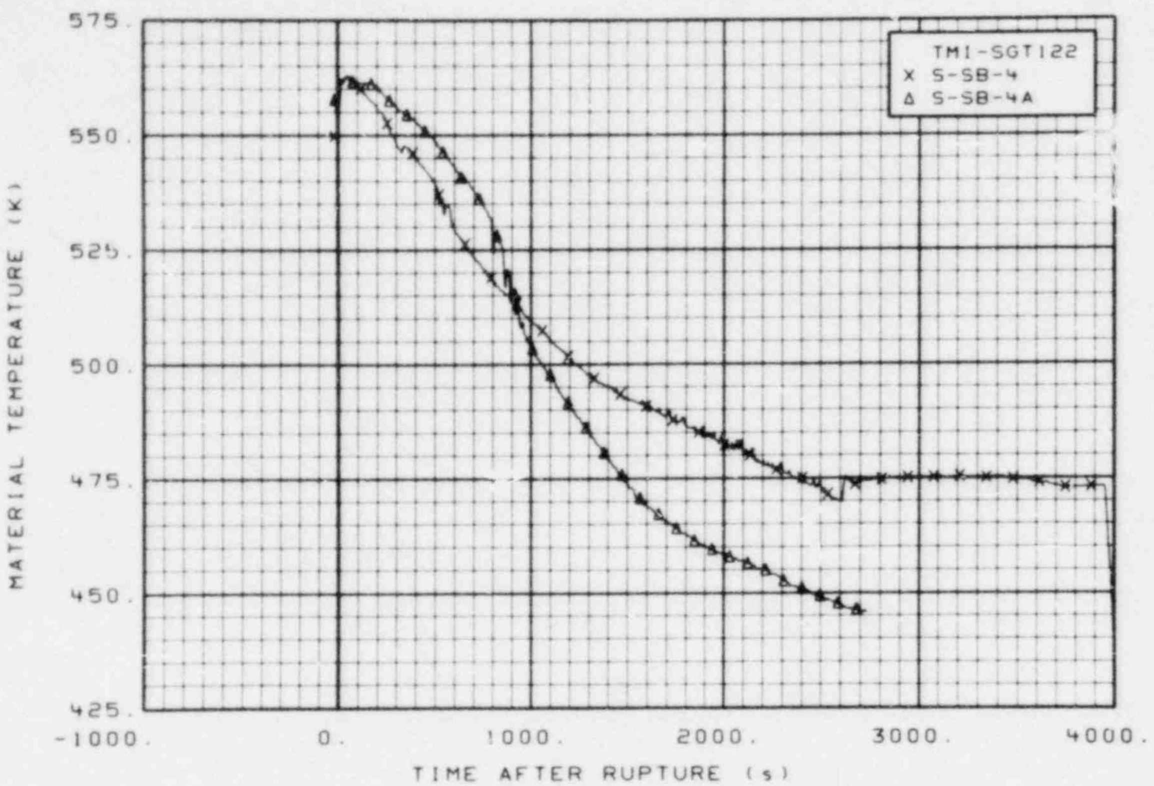


Figure 119. Material temperature in intact loop steam generator tube (TMI-SGT122), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

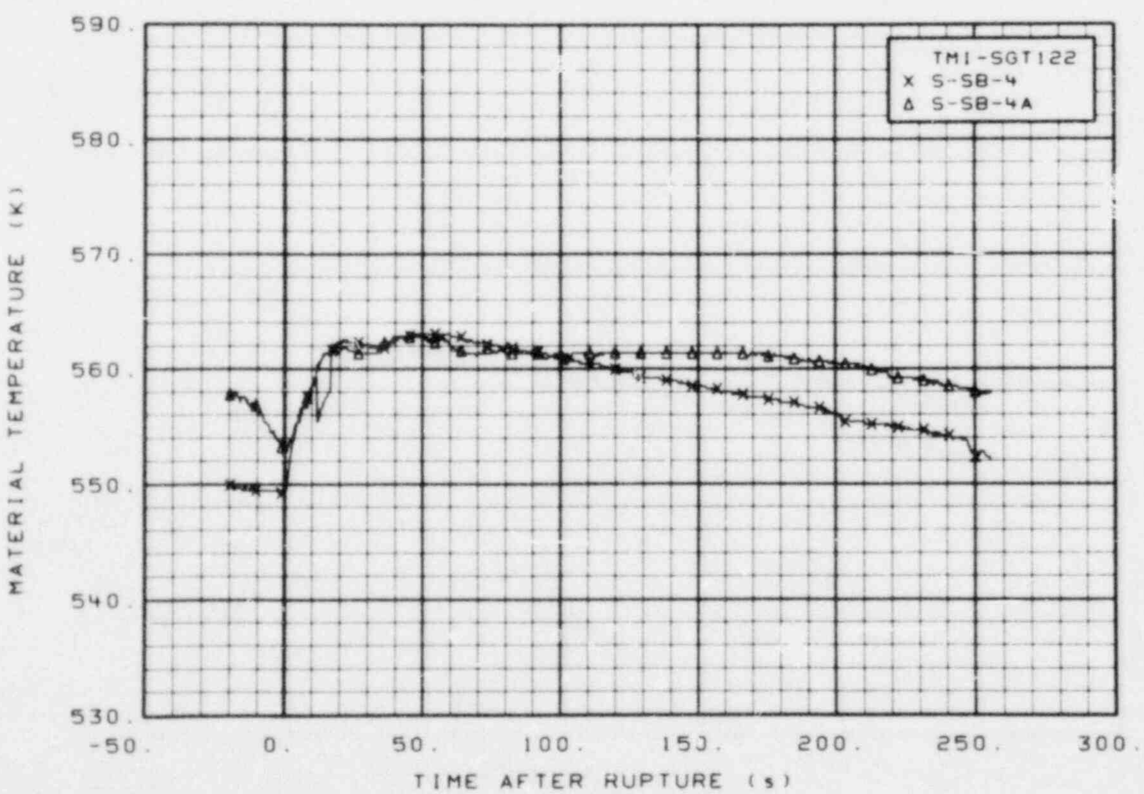


Figure 120. Material temperature in intact loop steam generator tube (TMI-SGT122), from -20 to 256 s.

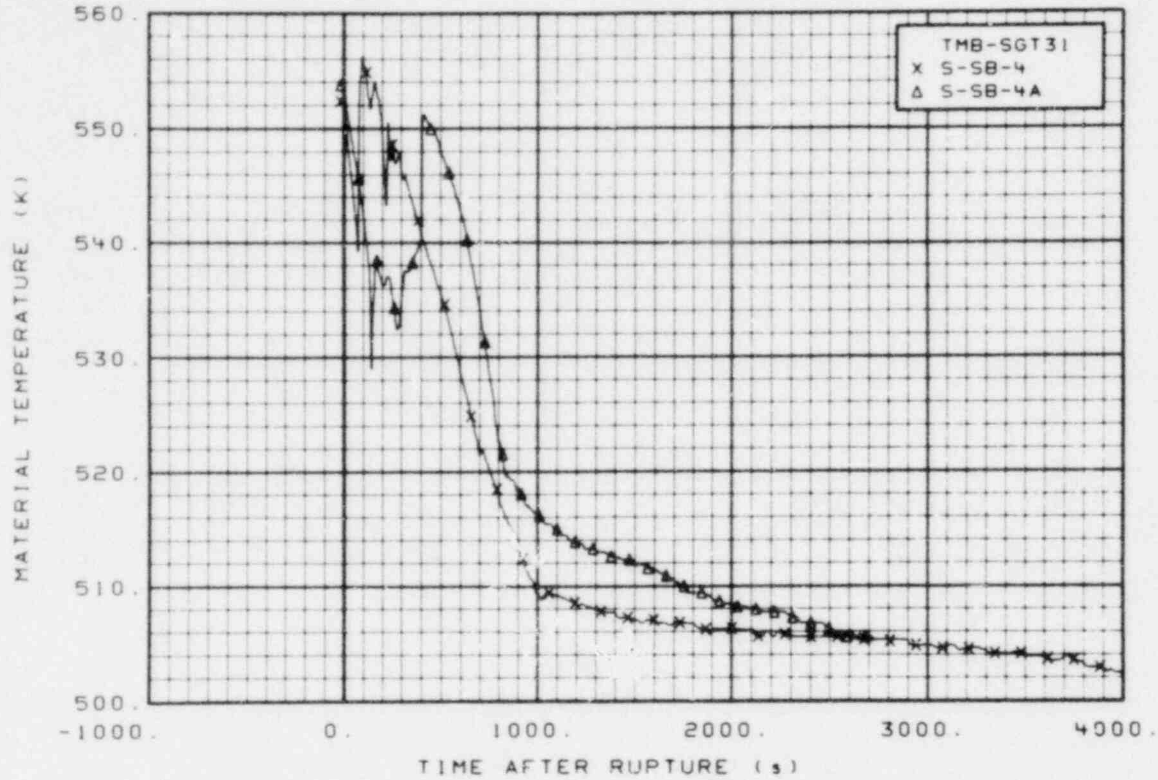


Figure 121. Material temperature in broken loop steam generator tube (TMB-SGT31), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

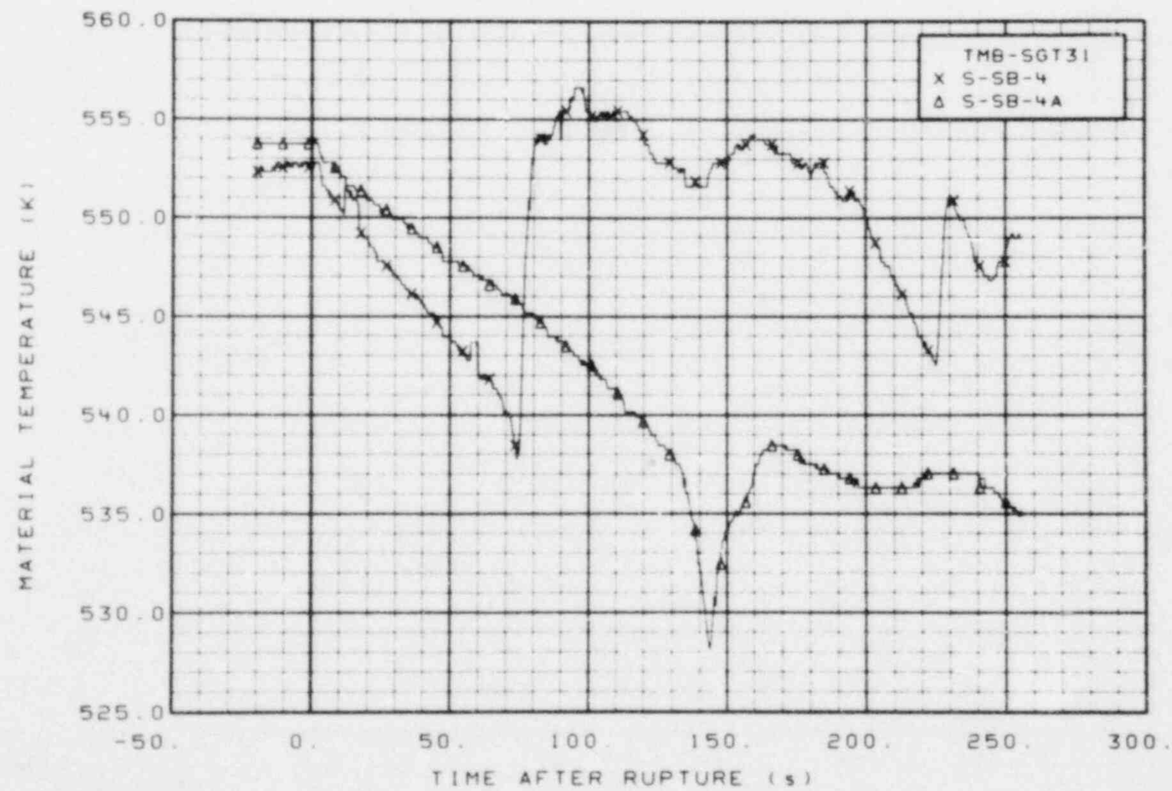


Figure 122. Material temperature in broken loop steam generator tube (TMB-SGT31), from -20 to 256 s.

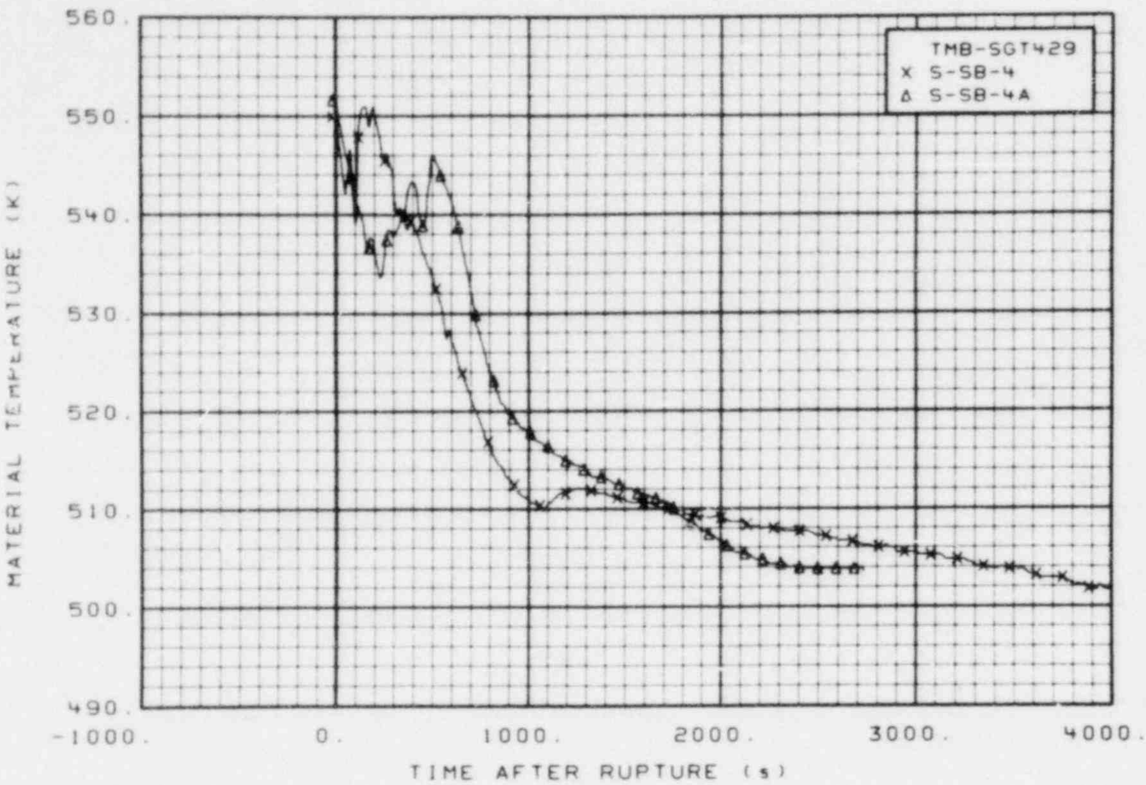


Figure 123. Material temperature in broken loop steam generator tube (TMB-SGT429), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

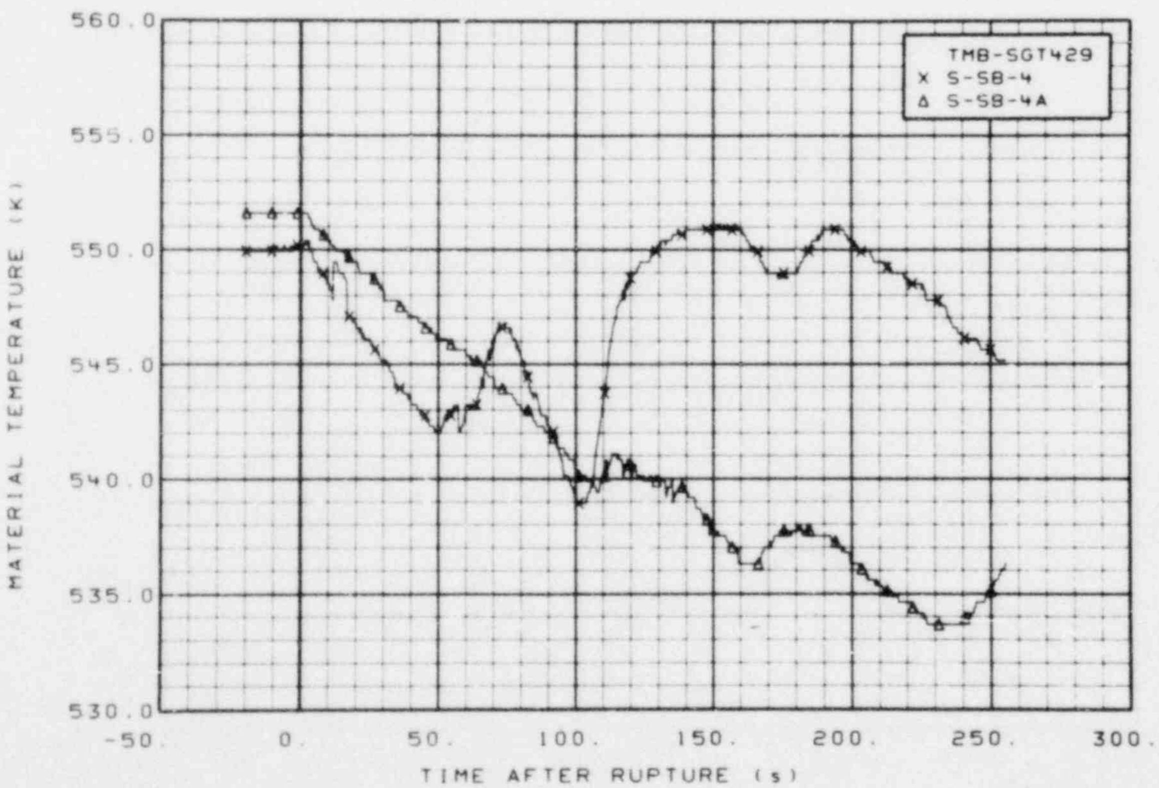


Figure 124. Material temperature in intact loop steam generator tube (TMI-SGT429), from -20 to 256 s.

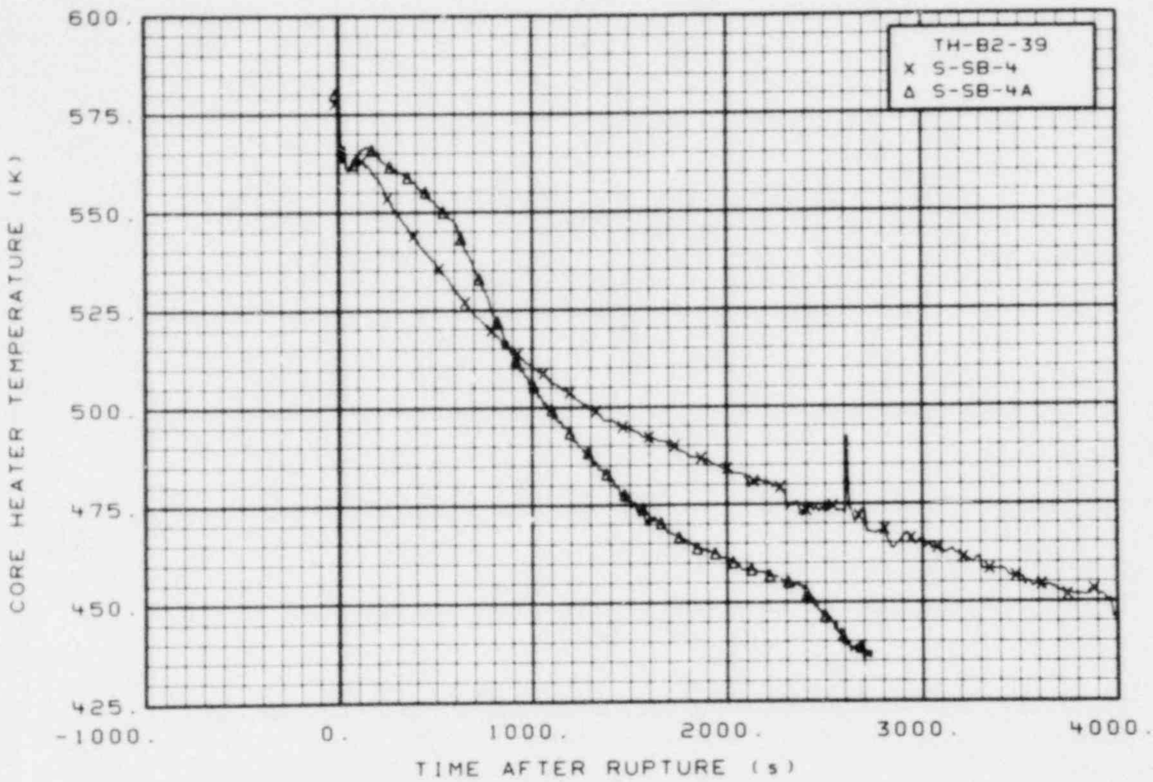


Figure 125. Core heater temperature, Rod B-2 (TH-B2-39), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

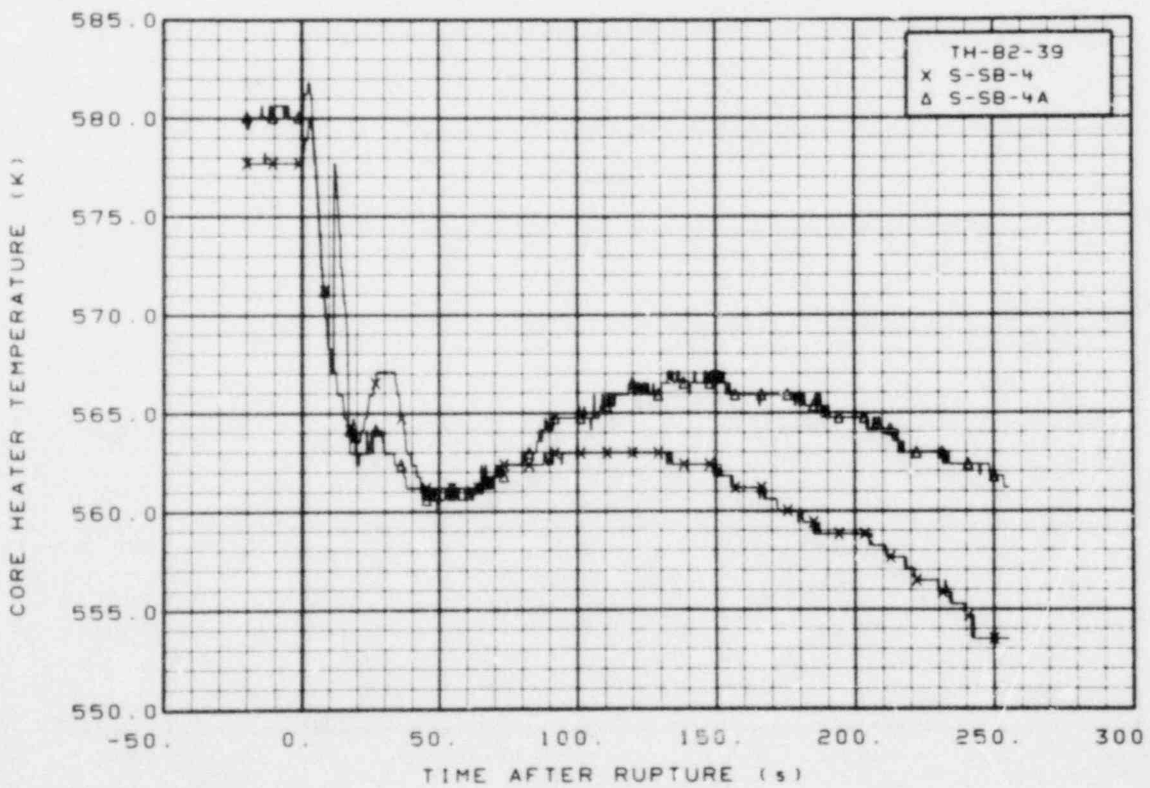


Figure 126. Core heater temperature, Rod B-2 (TH-B2-39), from -20 to 256 s.

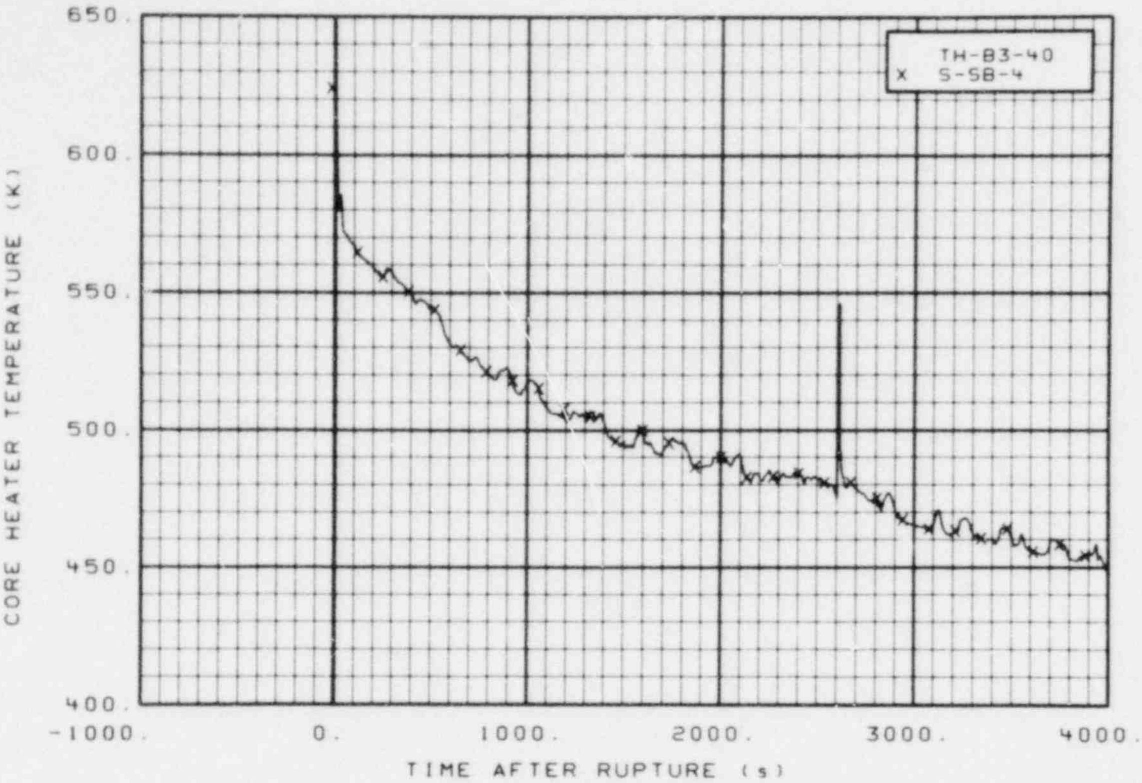


Figure 127. Core heater temperature, Test S-SB-4, Rod B-3 (TH-B3-40), from -20 to 4000 s.

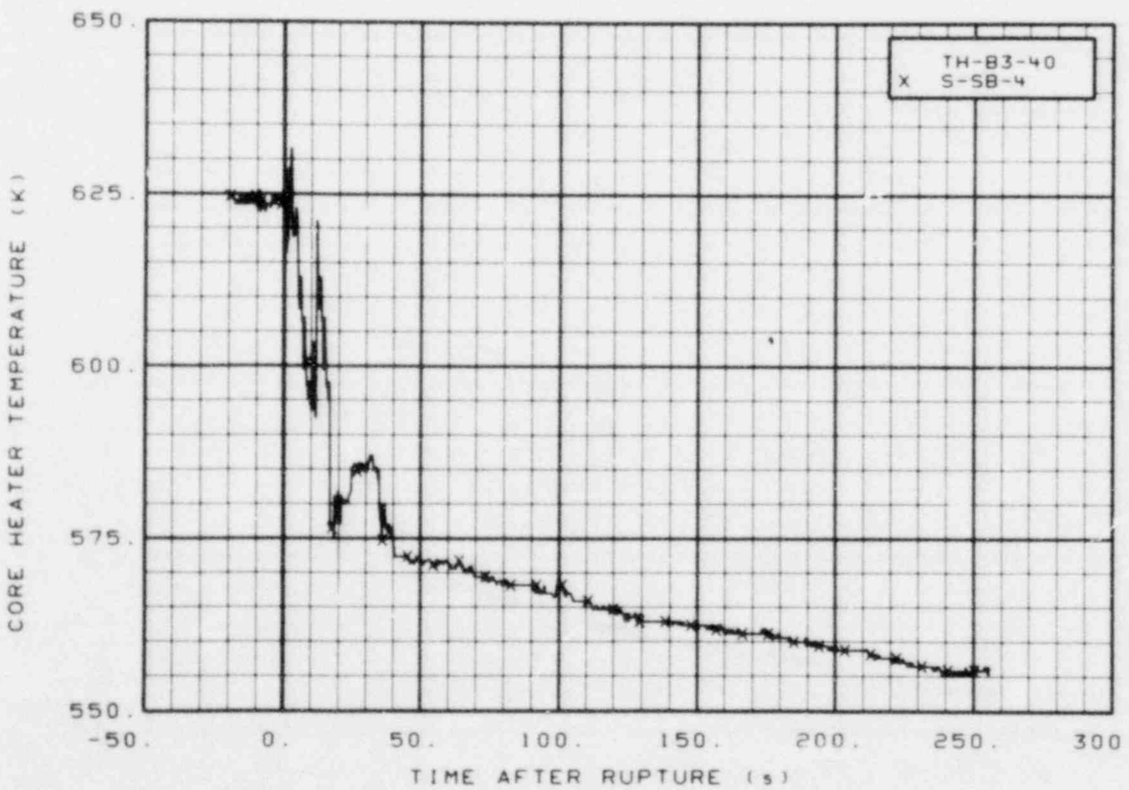


Figure 128. Core heater temperature, Test S-SB-4, Rod B-3 (TH-B3-40), from -20 to 256 s.

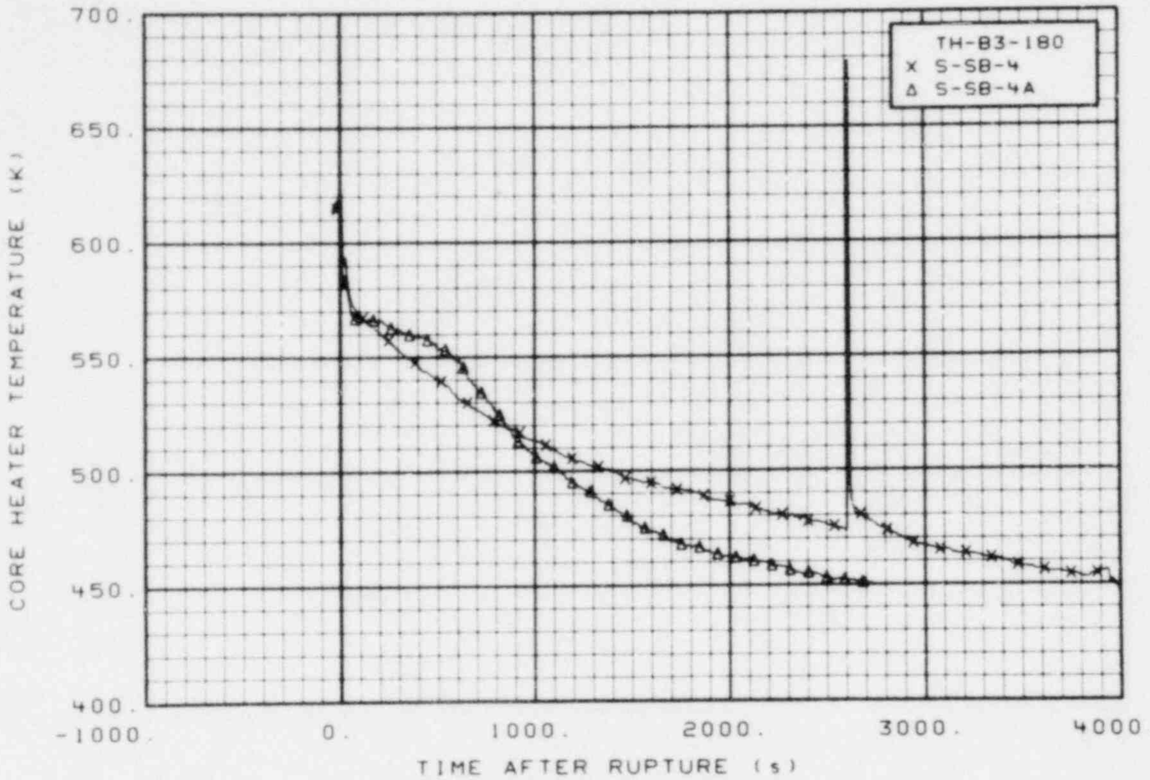


Figure 129. Core heater temperature, Rod B-3 (TH-B3-180), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

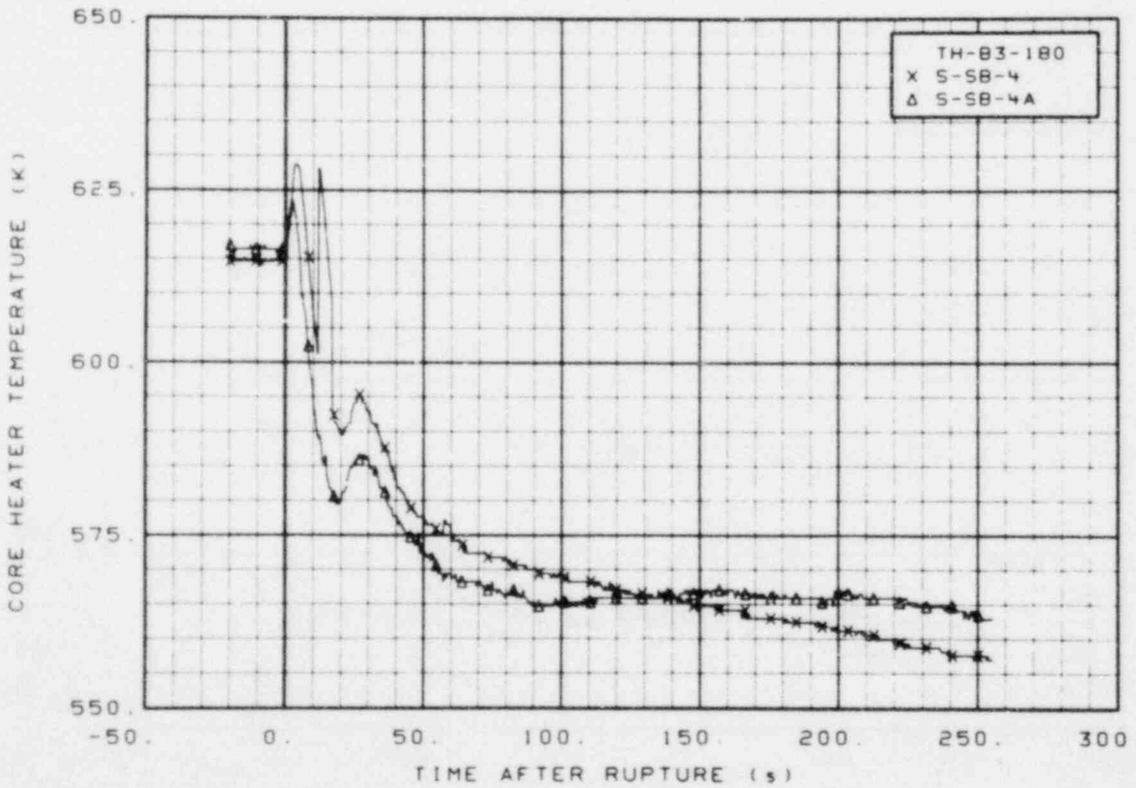


Figure 130. Core heater temperature, Rod B-3 (TH-B3-180), from -20 to 256 s.

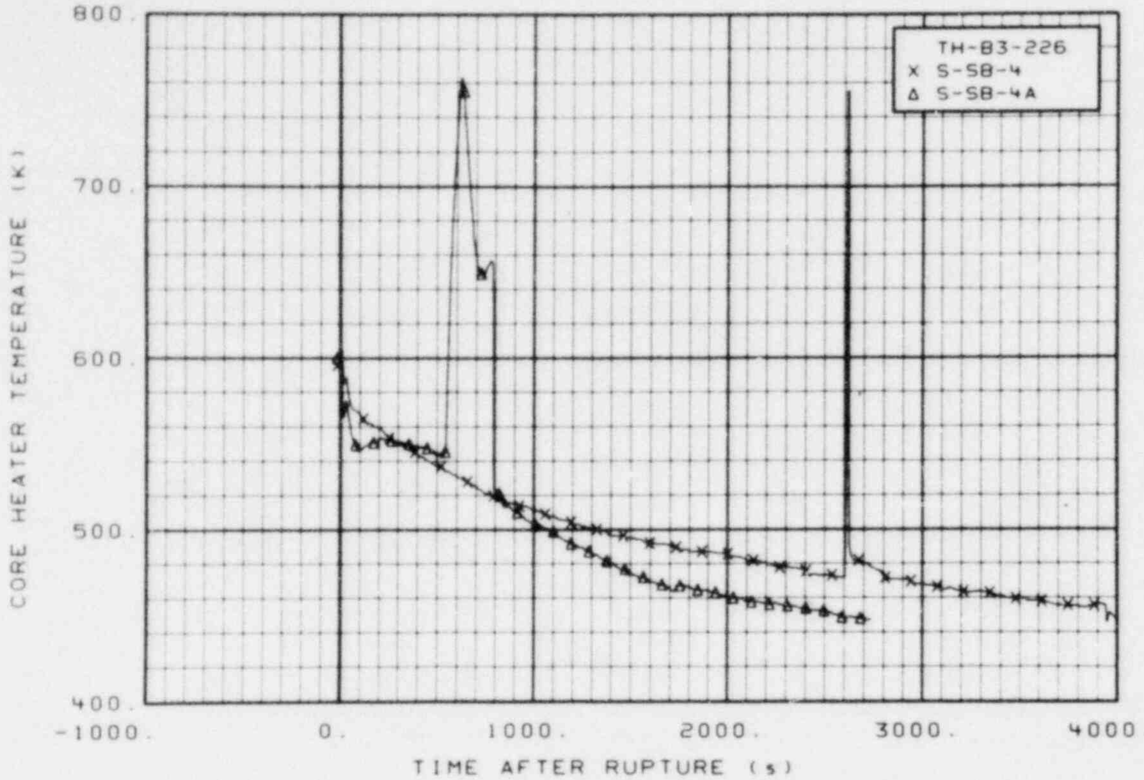


Figure 131. Core heater temperature, Rod B-3 (TH-B3-226), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

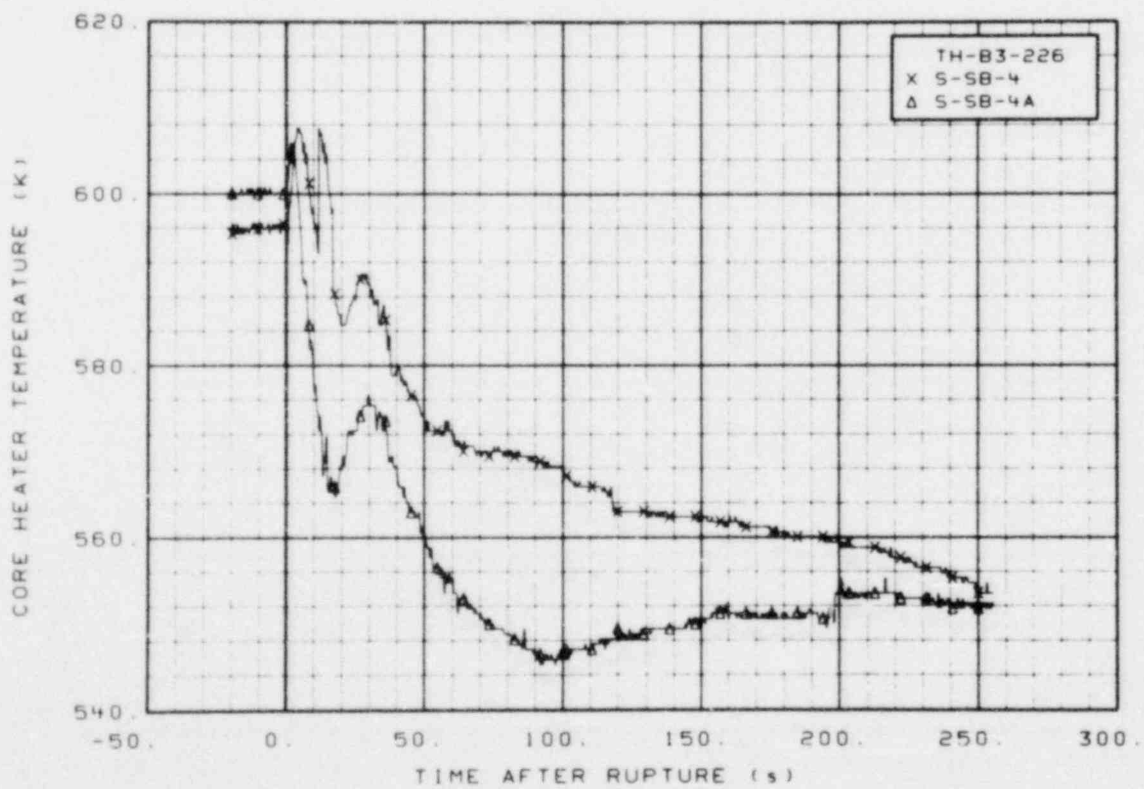


Figure 132. Core heater temperature, Rod B-3 (TH-B3-226), from -20 to 256 s.

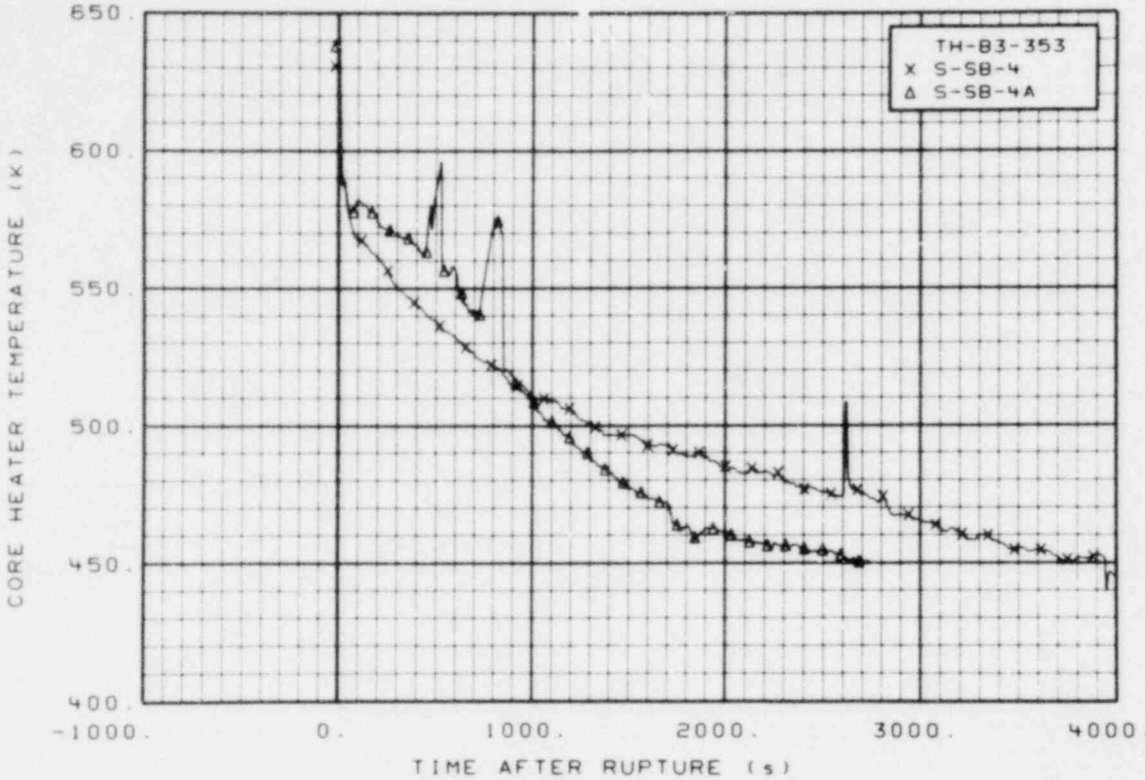


Figure 133. Core heater temperature, Rod B-3 (TH-B3-353), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

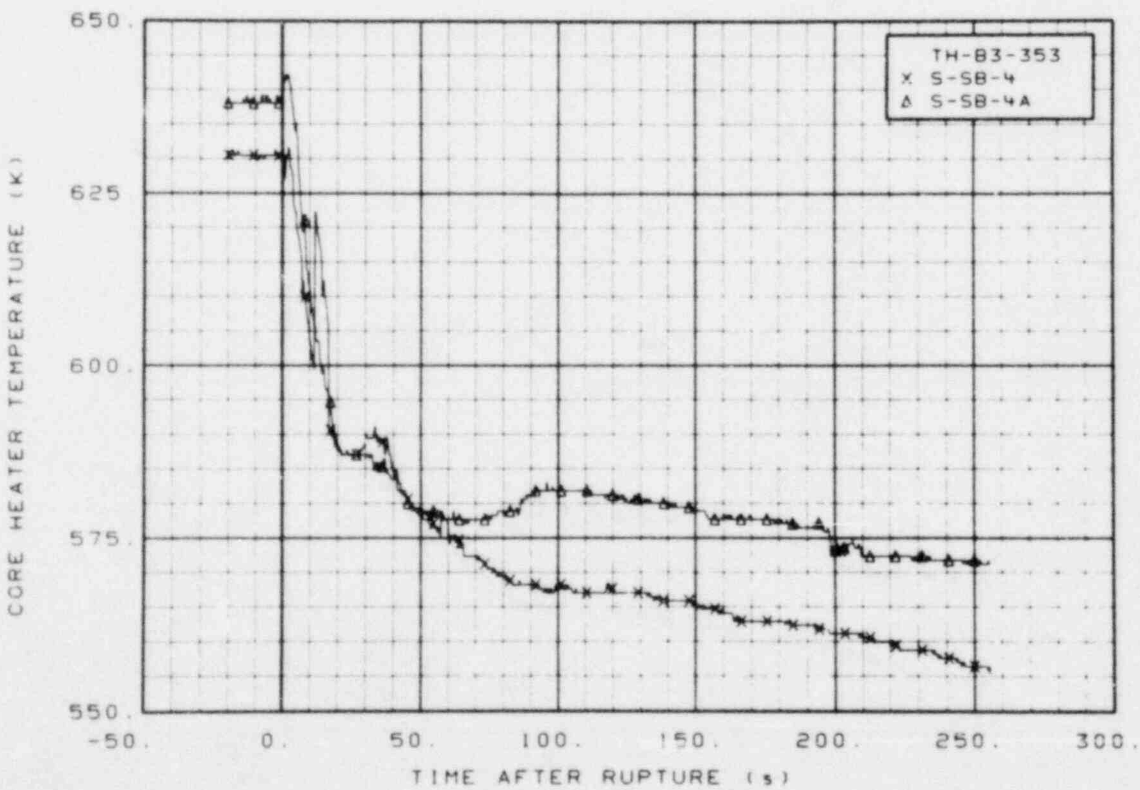


Figure 134. Core heater temperature, Rod B-3 (TH-B3-353), from -20 to 256 s.

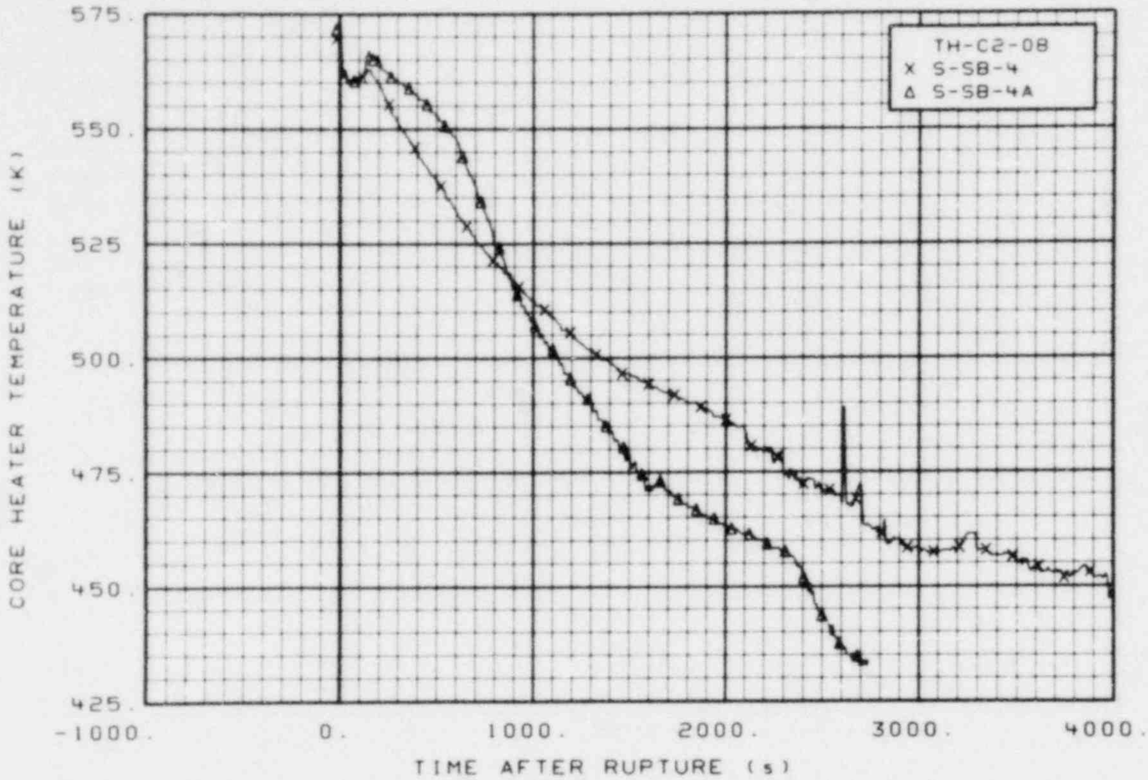


Figure 135. Core heater temperature, Rod C-2 (TH-C2-08), from -20 to 4000 s (to 2740 6 for Test S-SB-4A).

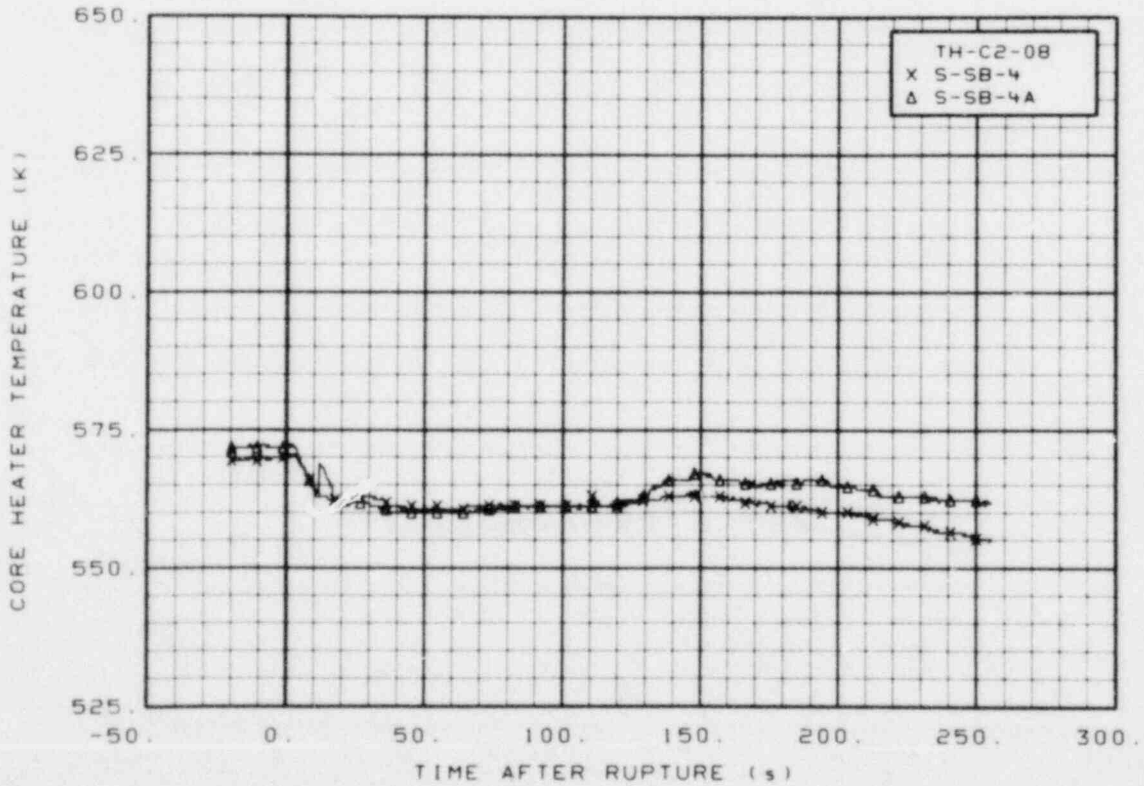


Figure 136. Core heater temperature, Rod C-2 (TH-C2-08), from -20 to 256 s.

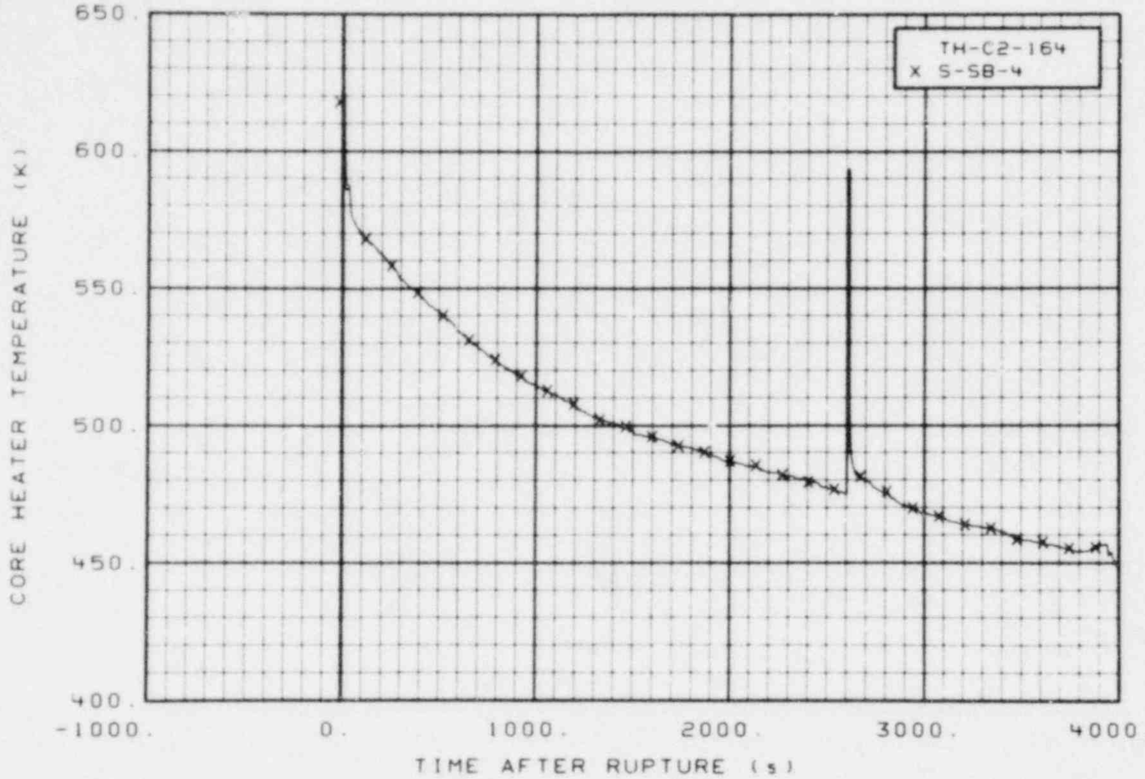


Figure 137. Core heater temperature, Test S-SB-4, Rod C-2 (TH-C2-164), from -20 to 4000 s.

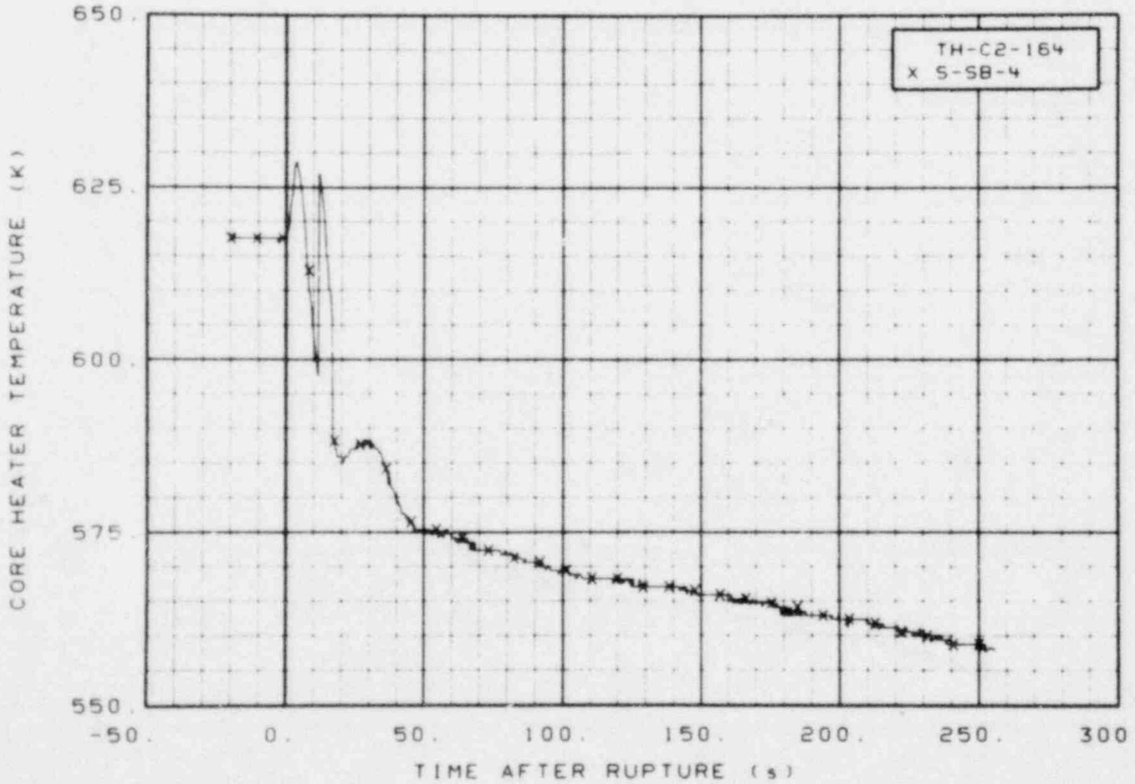


Figure 138. Core heater temperature, Test S-SB-4, Rod C-2 (TH-C2-164), from -20 to 256 s.

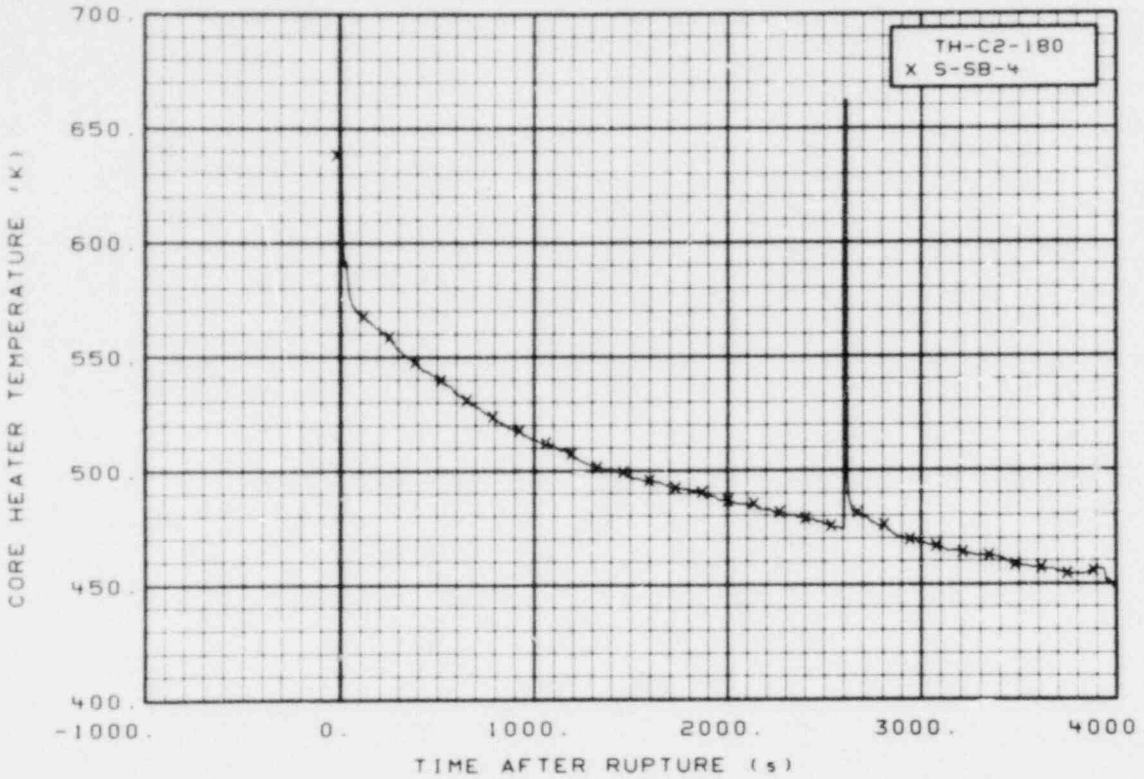


Figure 139. Core heater temperature, Test S-SB-4, Rod C-2 (TH-C2-180), from -20 to 4000 s.

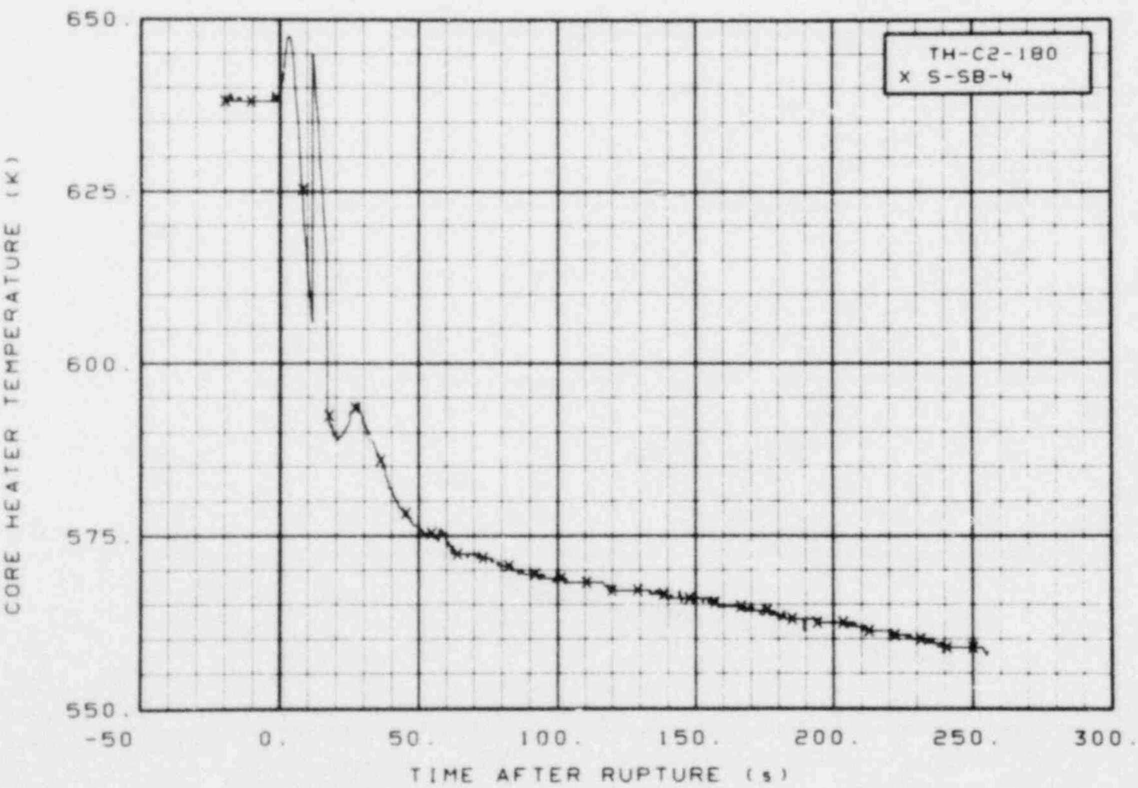


Figure 140. Core heater temperature, Test S-SB-4, Rod C-2 (TH-C2-180), from -20 to 256 s.

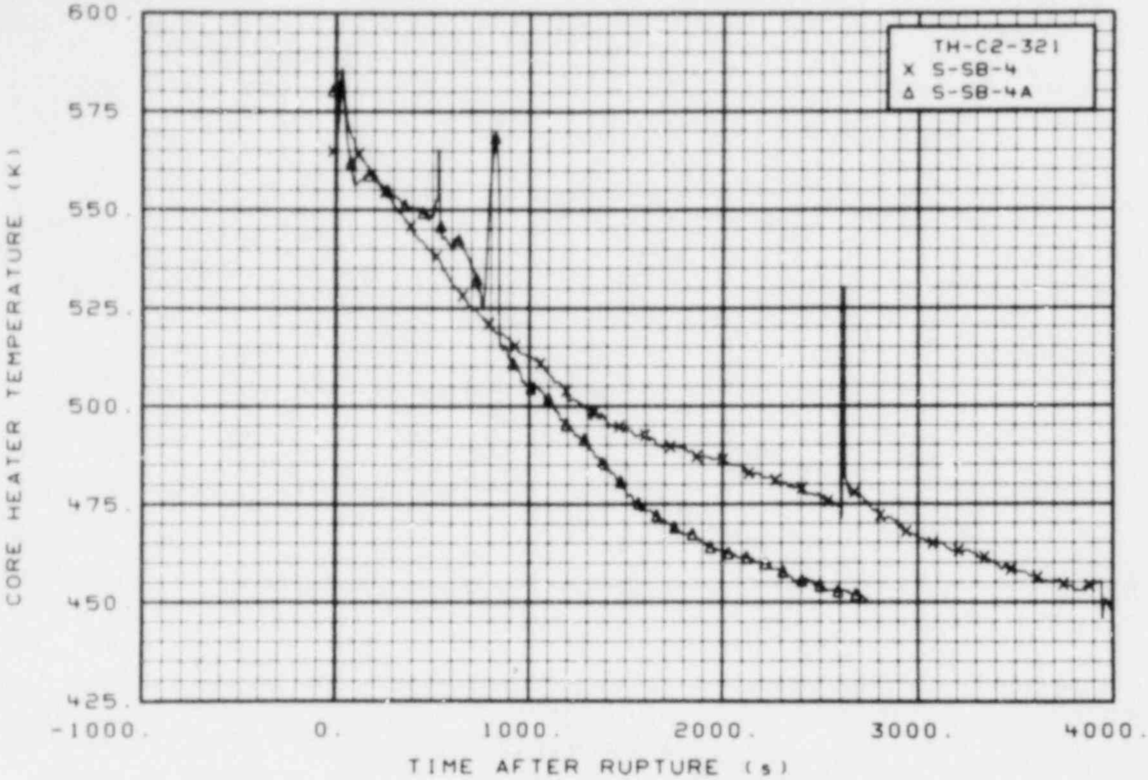


Figure 141. Core heater temperature, Rod C-2 (TH-C2-321), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

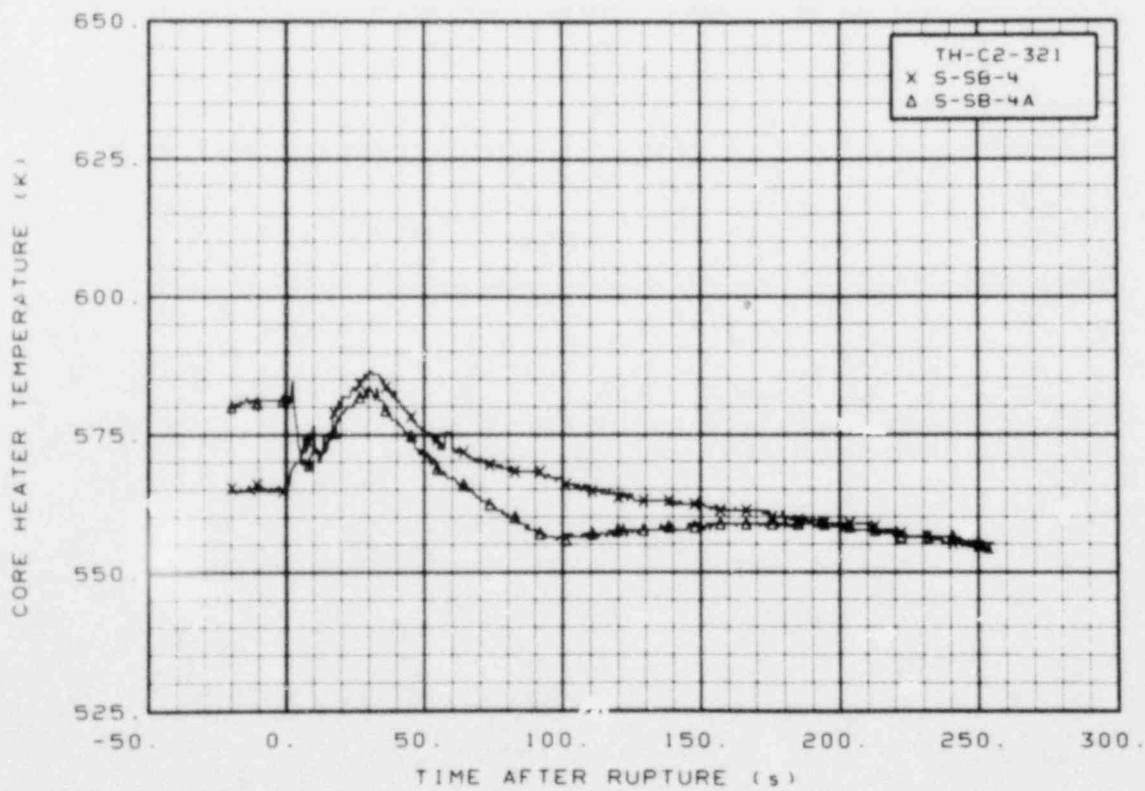


Figure 142. Core heater temperature, Rod C-2 (TH-C2-321), from -20 to 256 s.

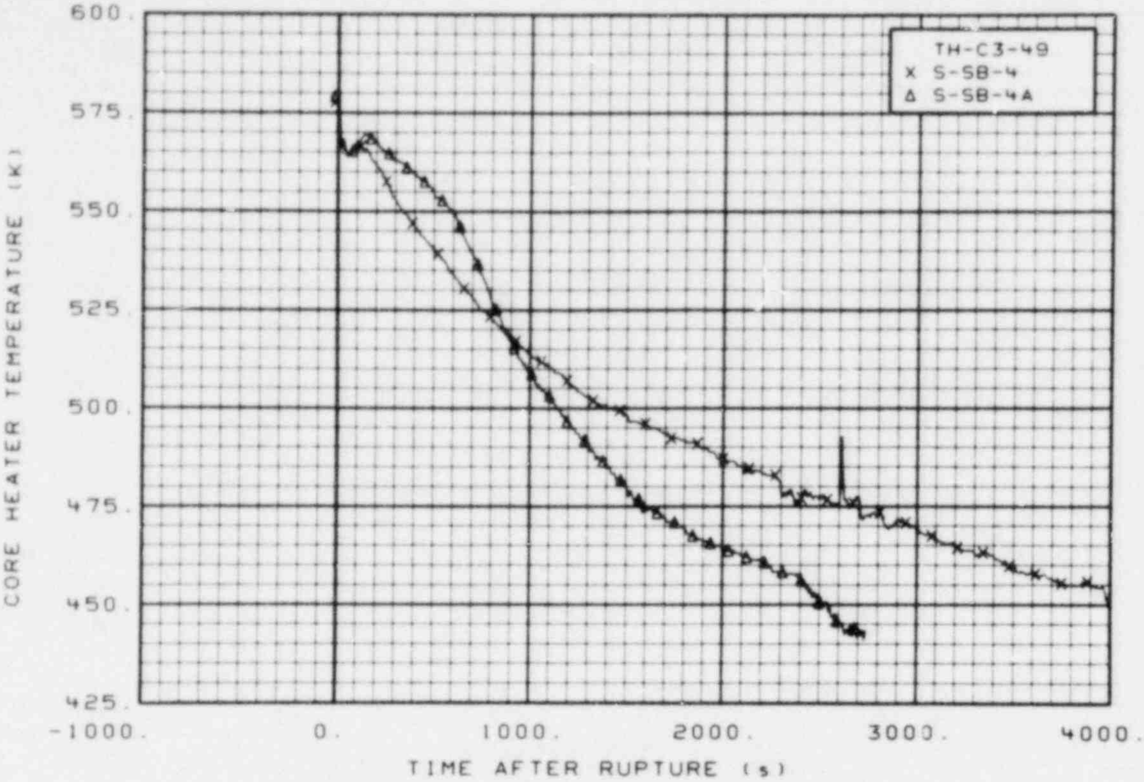


Figure 143. Core heater temperature, Rod C-3 (TH-C3-49), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

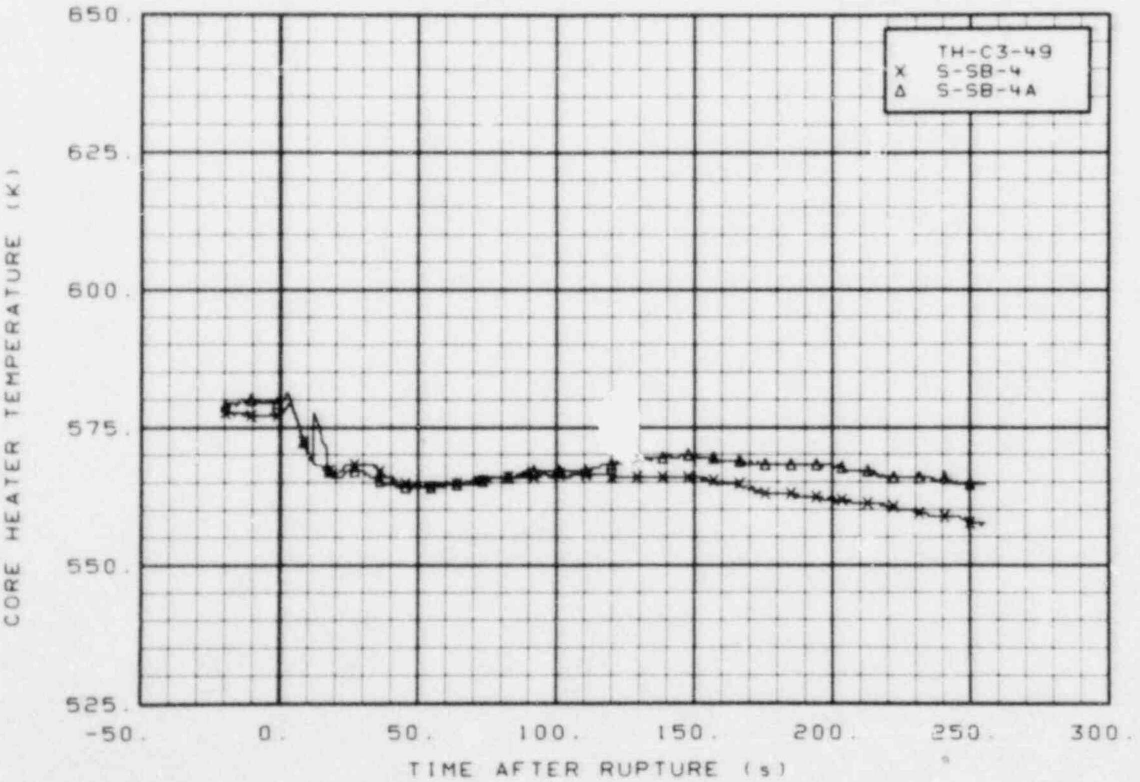


Figure 144. Core heater temperature, Rod C-3 (TH-C3-49), from -20 to 256 s.

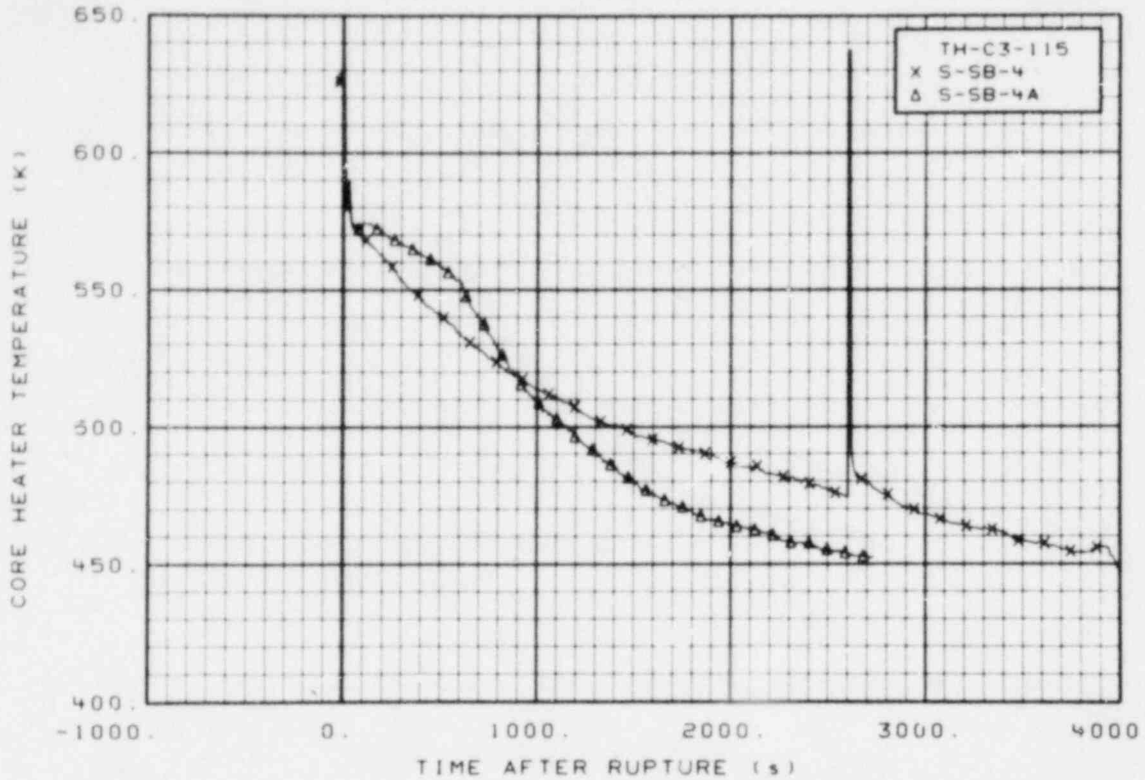


Figure 145. Core heater temperature, Rod C-3 (TH-C3-115), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

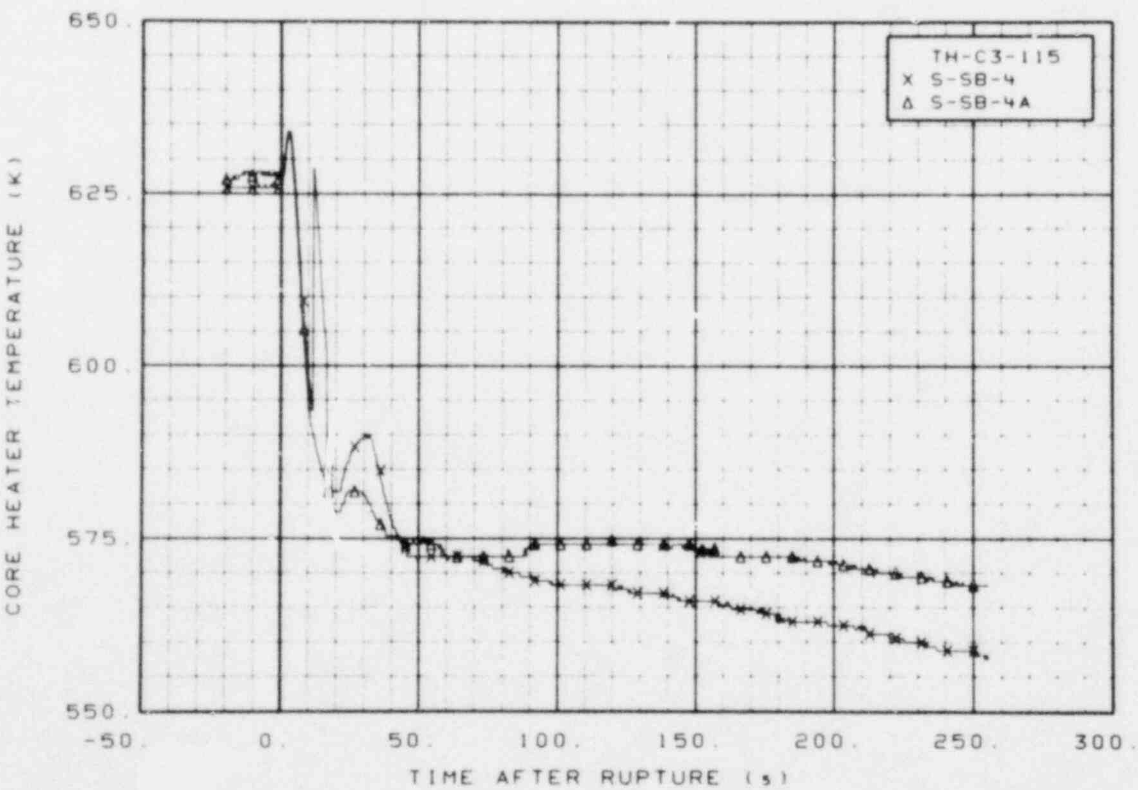


Figure 146. Core heater temperature, Rod C-3 (TH-C3-115), from -20 to 256 s.

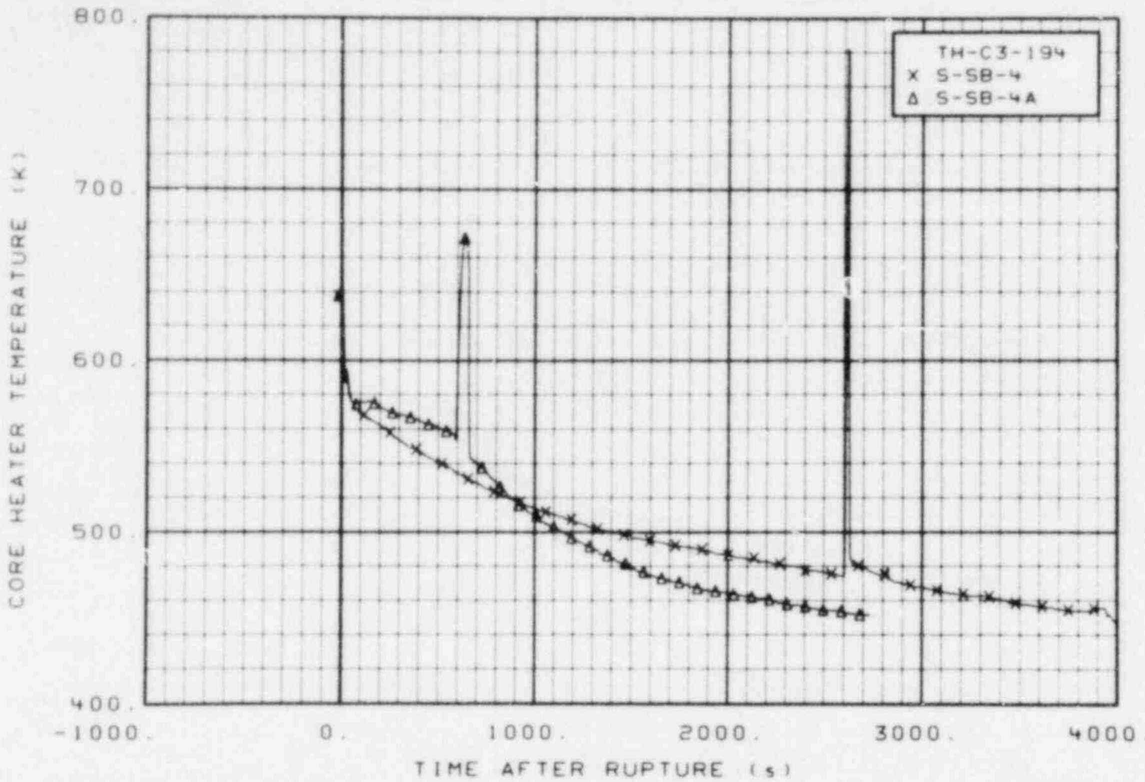


Figure 147. Core heater temperature, Rod C-3 (TH-C3-194), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

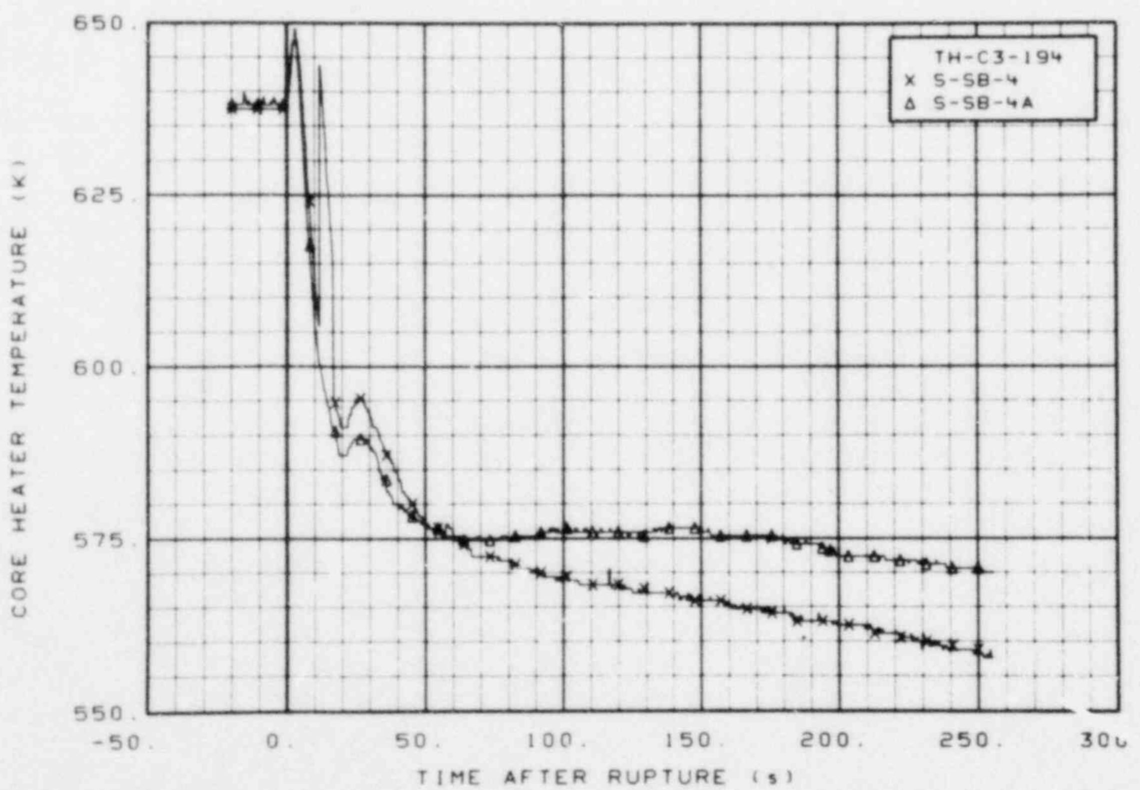


Figure 148. Core heater temperature, Rod C-3 (TH-C3-194), from -20 to 256 s.

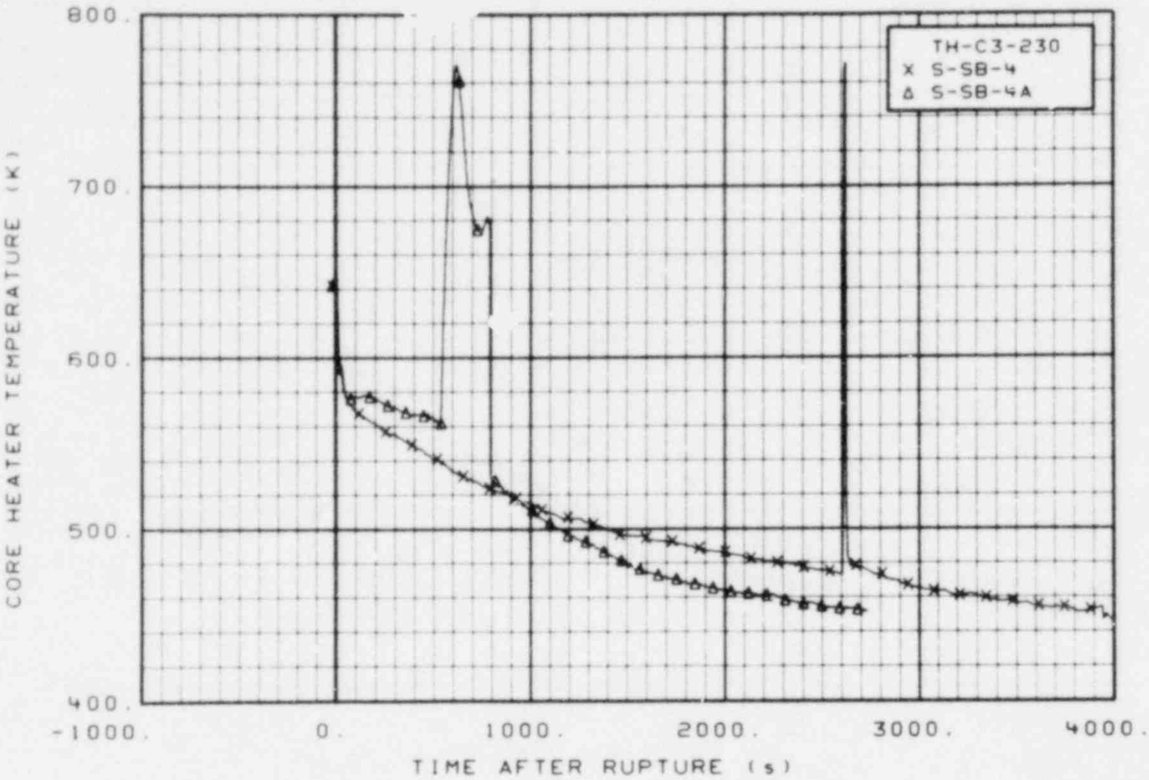


Figure 149. Core heater temperature, Rod C-3 (TH-C3-230), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

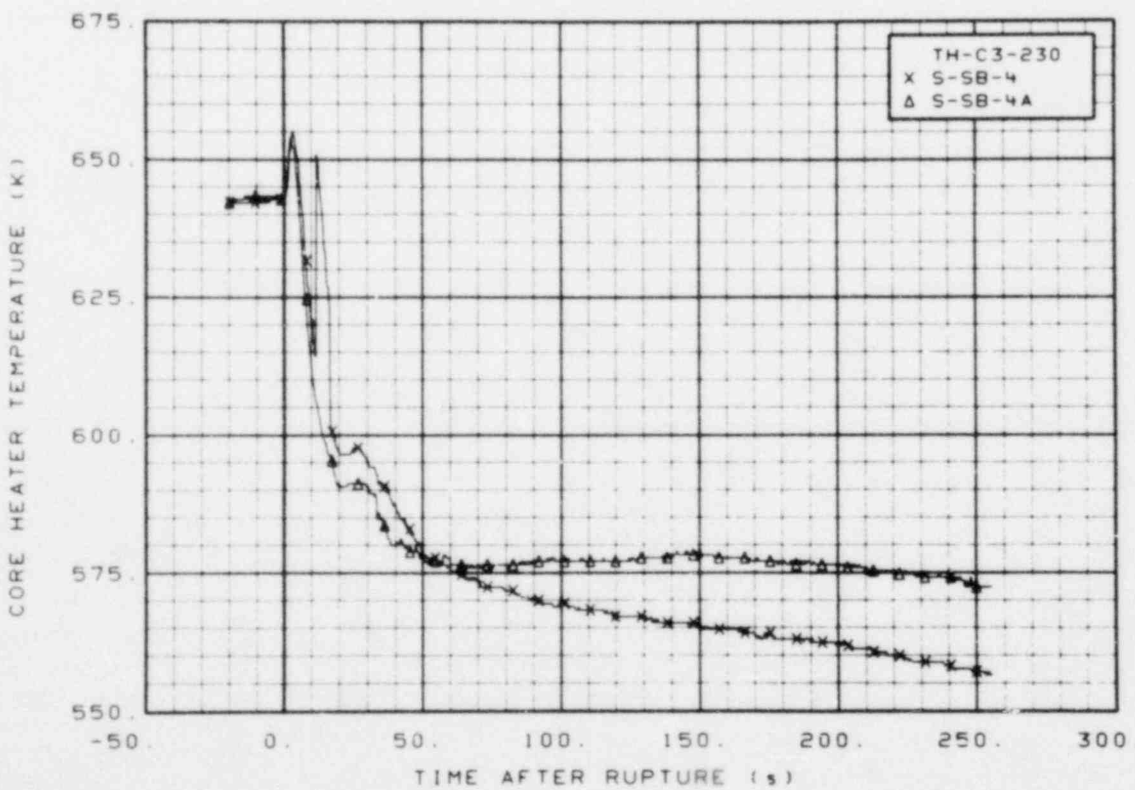


Figure 150. Core heater temperature, Rod C-3 (TH-C3-230), from -20 to 256 s.

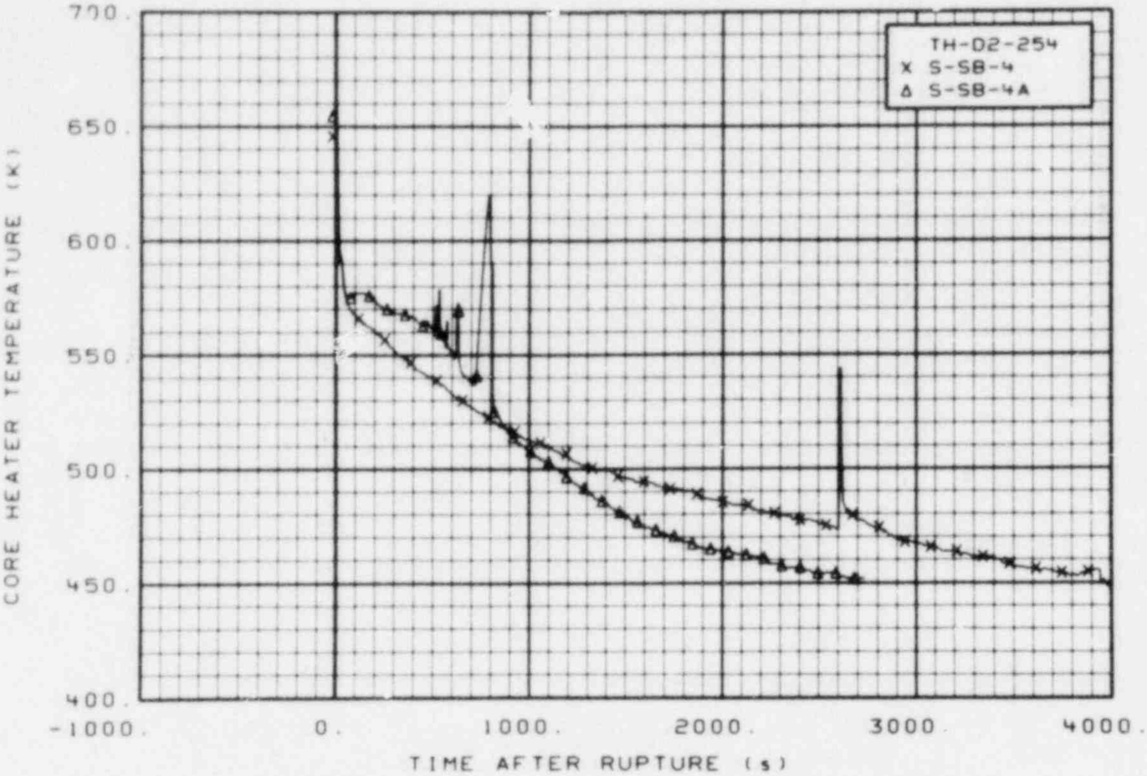


Figure 151. Core heater temperature, Rod D-2 (TH-D2-254), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

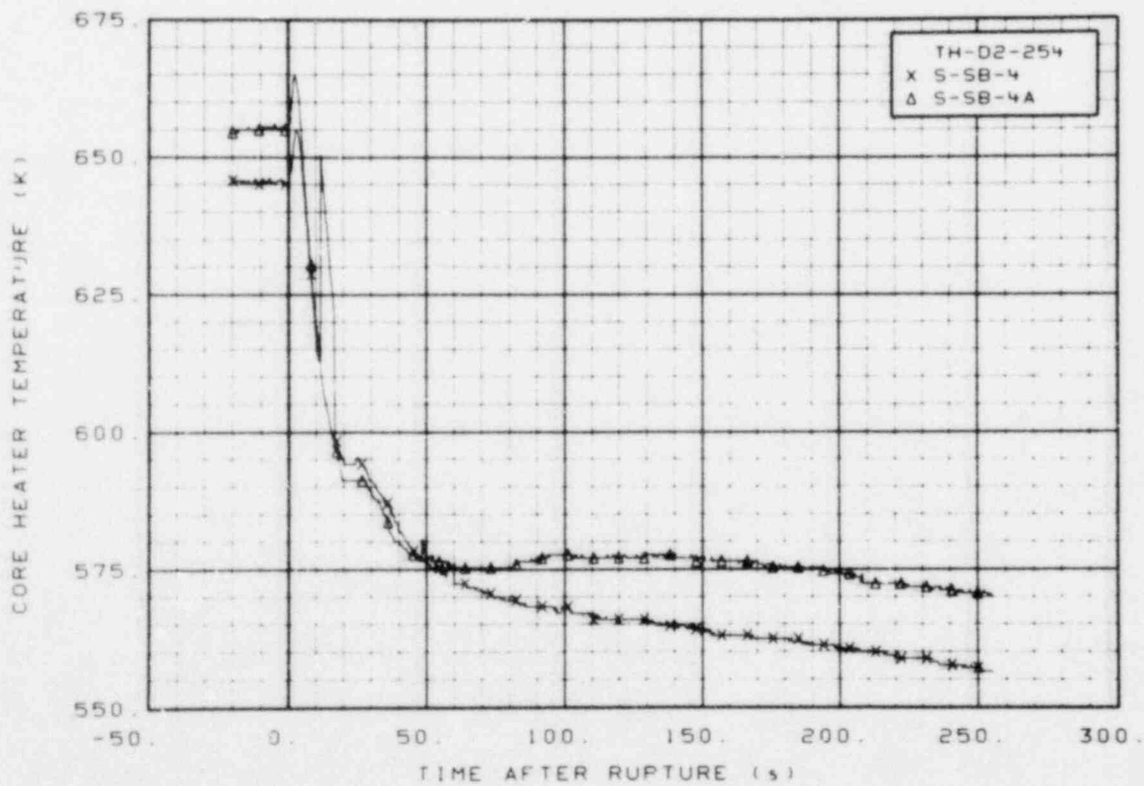


Figure 152. Core heater temperature, Rod D-2 (TH-D2-254), from -20 to 256 s.

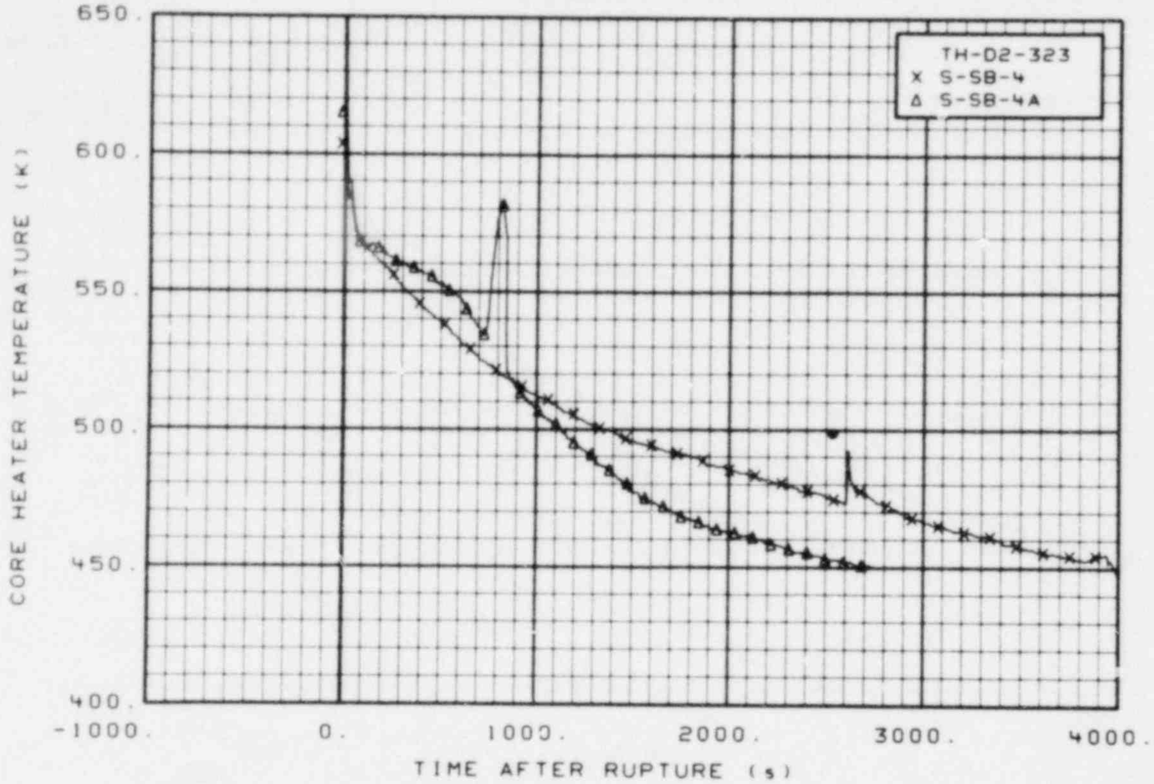


Figure 153. Core heater temperature, Rod D-2 (TH-D2-323), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

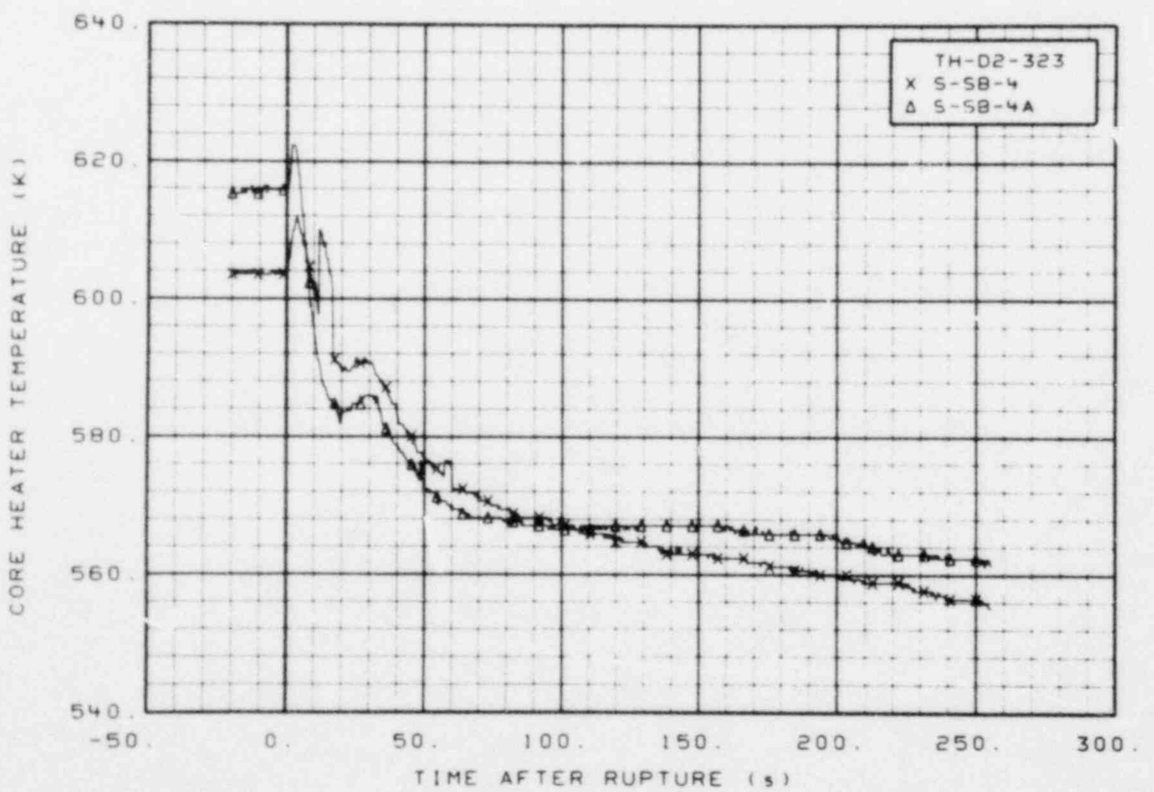


Figure 154. Core heater temperature, Rod D-2 (TH-D2-323), from -20 to 256 s.

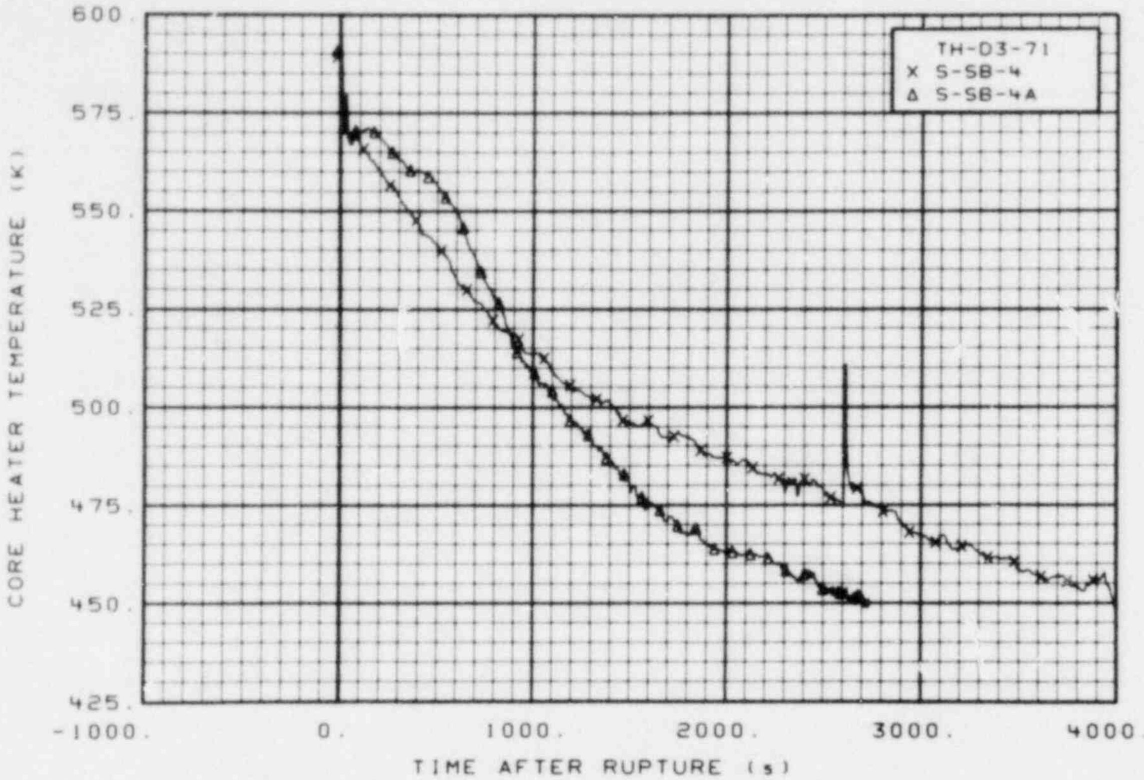


Figure 155. Core heater temperature, Rod D-3 (TH-D3-71), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

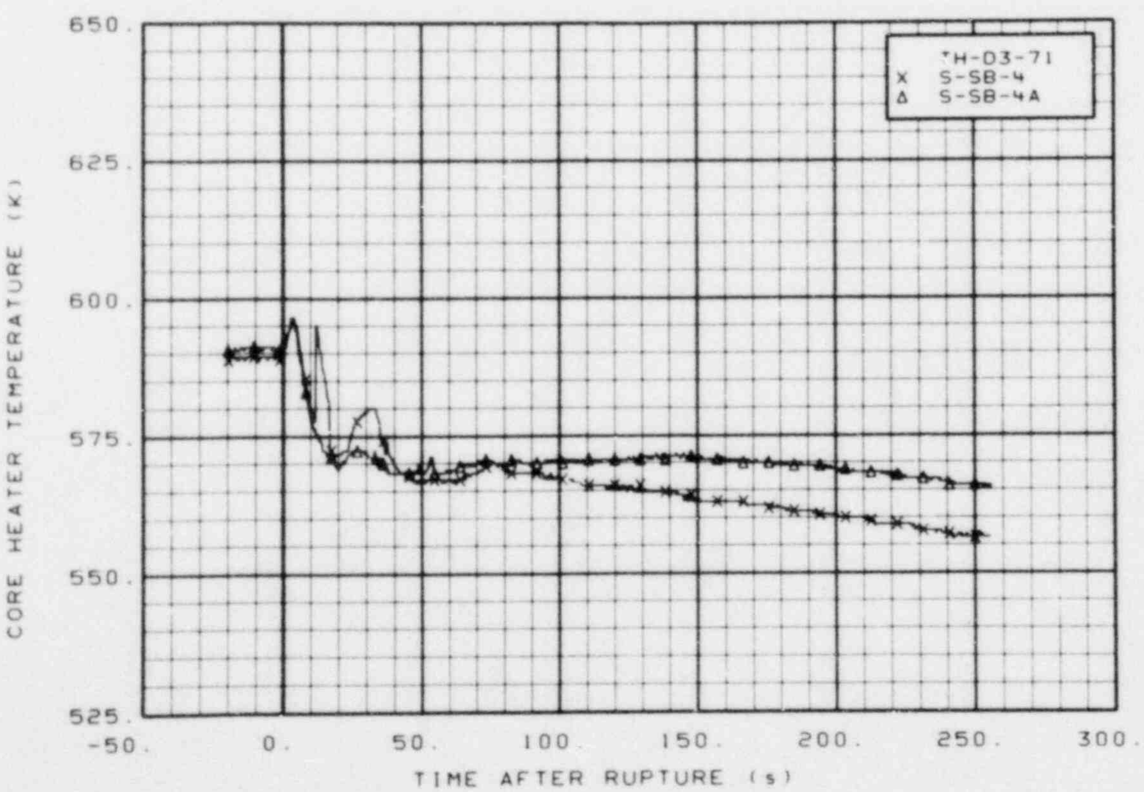


Figure 156. Core heater temperature, Rod D-3 (TH-D3-71), from -20 to 256 s.

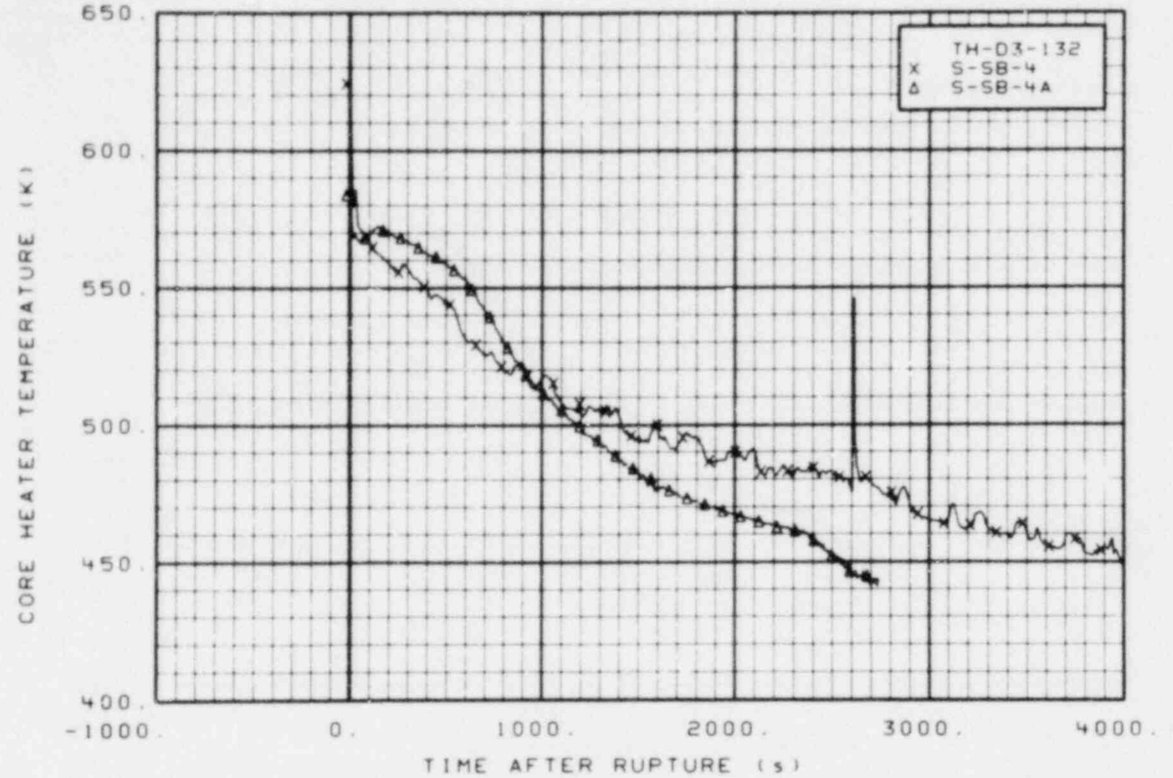


Figure 157. Core heater temperature, Rod D-3 (TH-D3-132), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

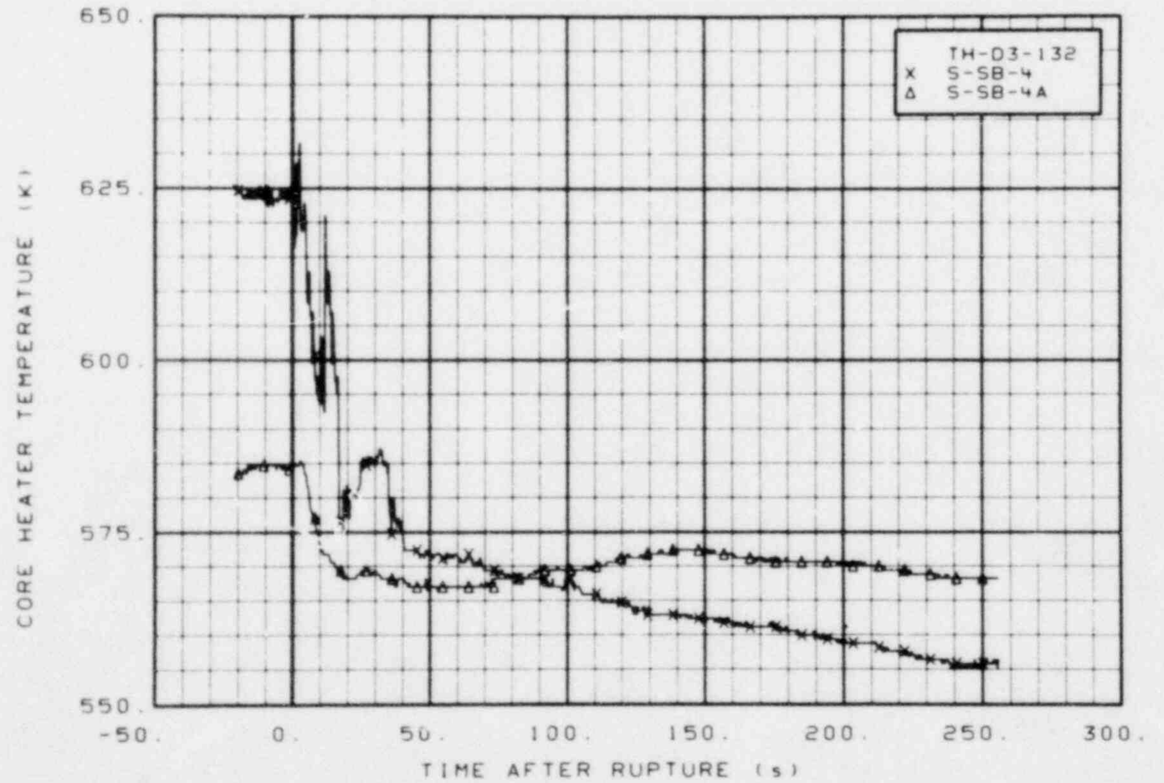


Figure 158. Core heater temperature, Rod D-3 (TH-D3-132), from -20 to 256 s.

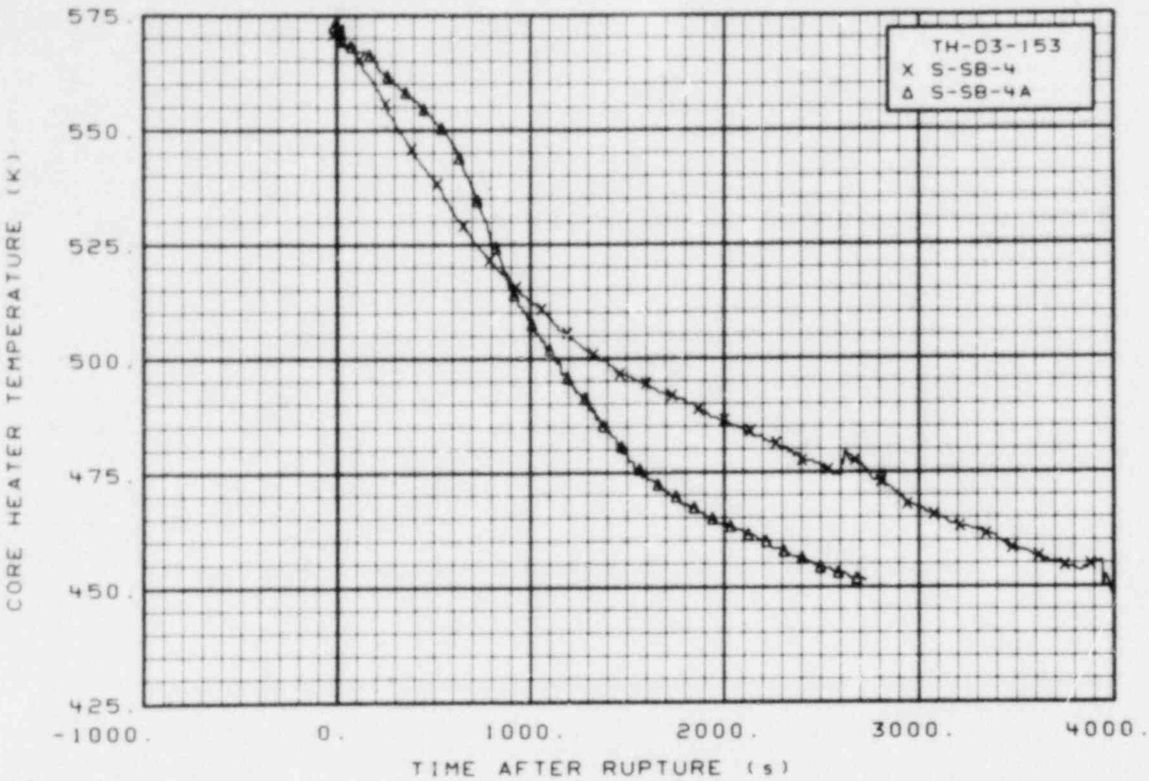


Figure 159. Core heater temperature, Rod D-3 (TH-D3-153), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

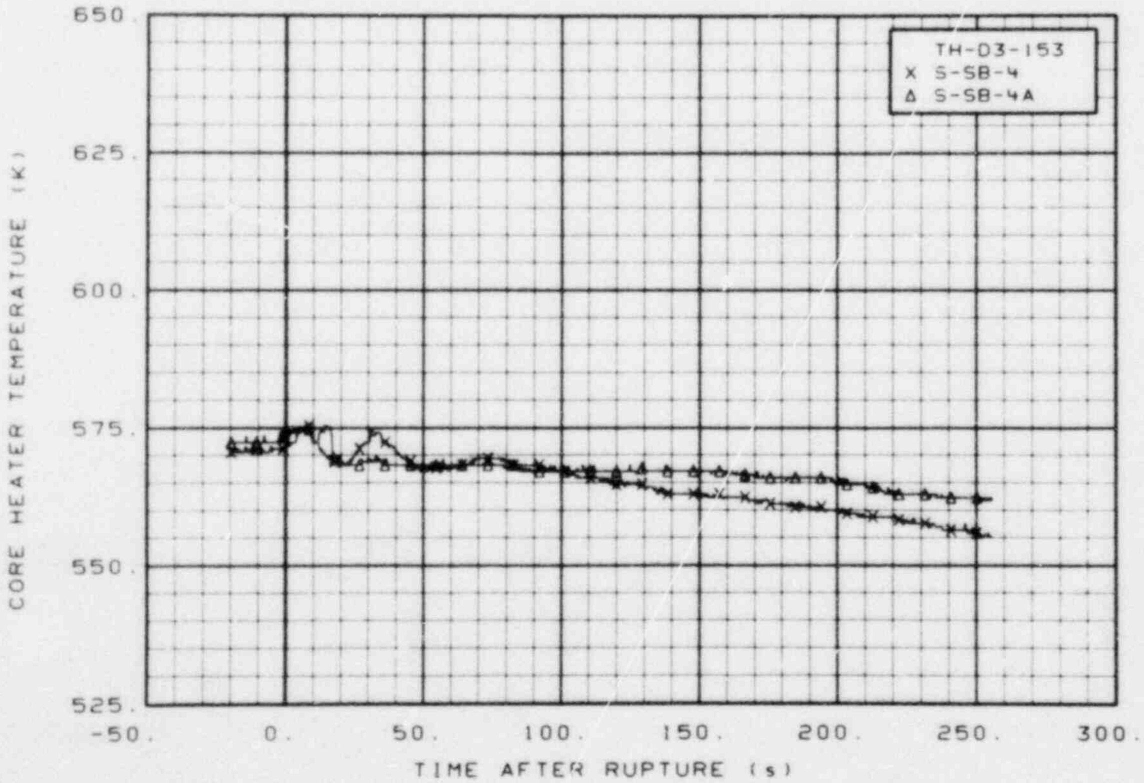


Figure 160. Core heater temperature, Rod D-3 (TH-D3-153), from -20 to 256 s.

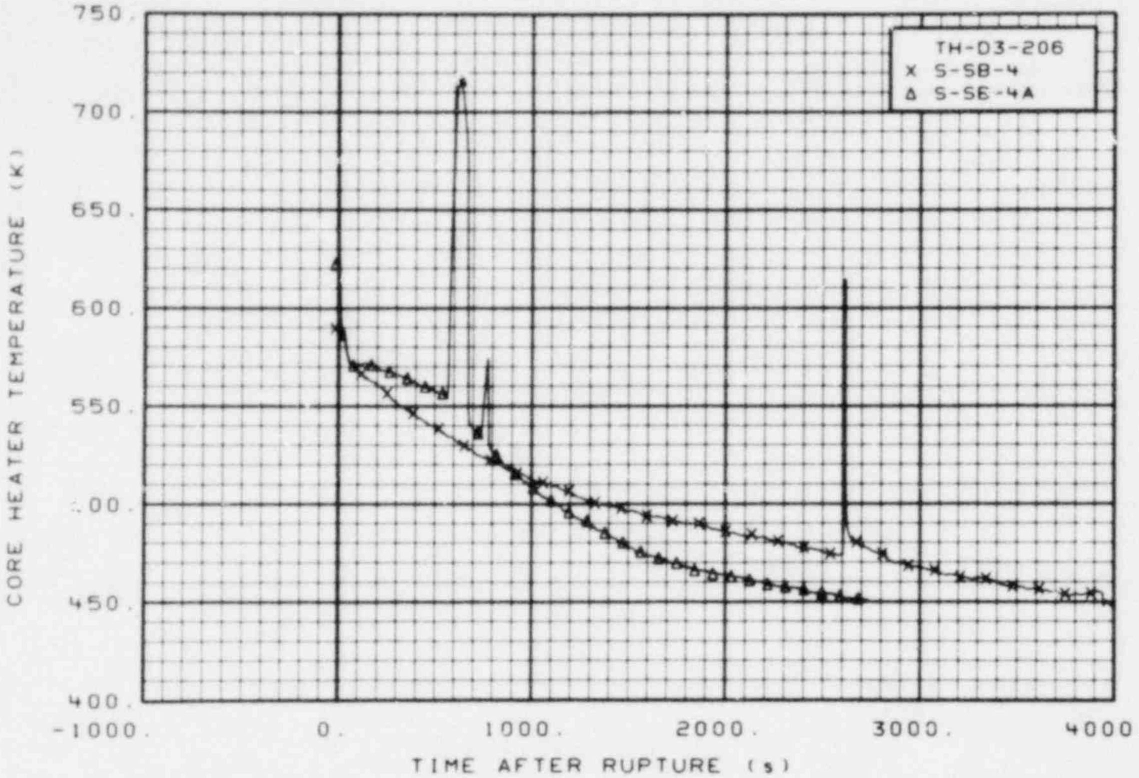


Figure 161. Core heater temperature, Rod D-3 (TH-D3-206), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

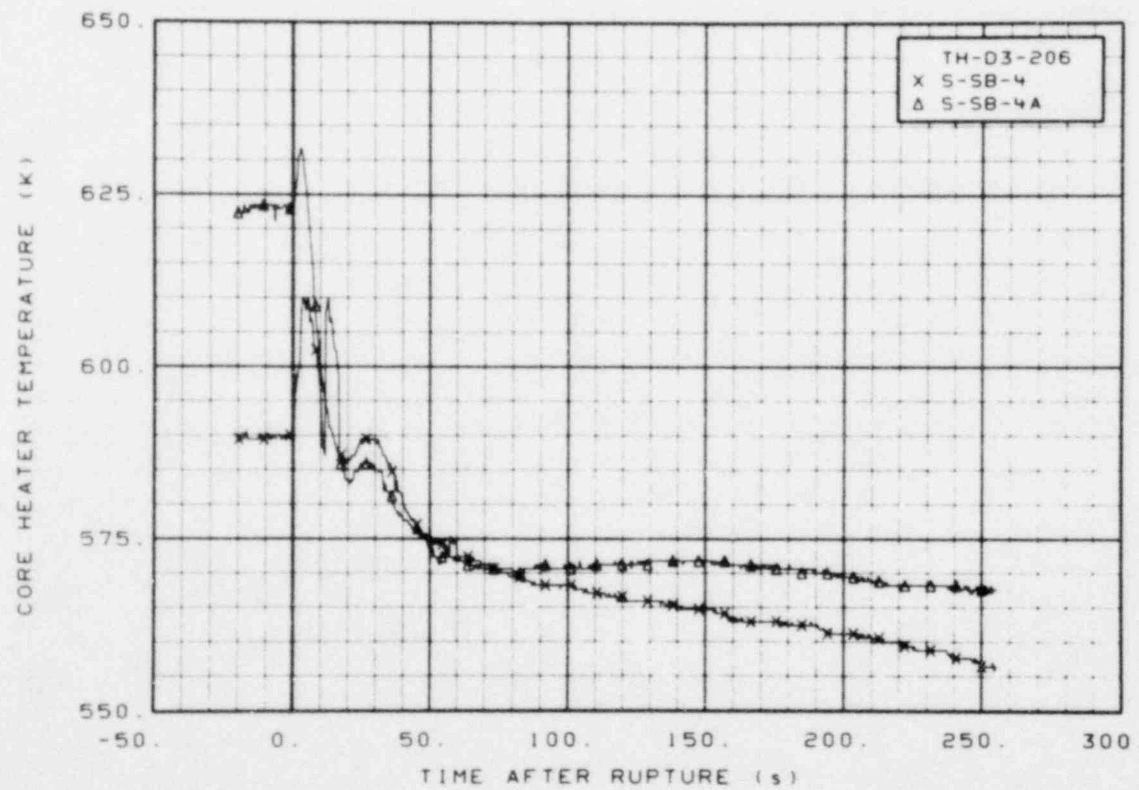


Figure 162. Core heater temperature, Rod D-3 (TH-D3-206), from -20 to 256 s.

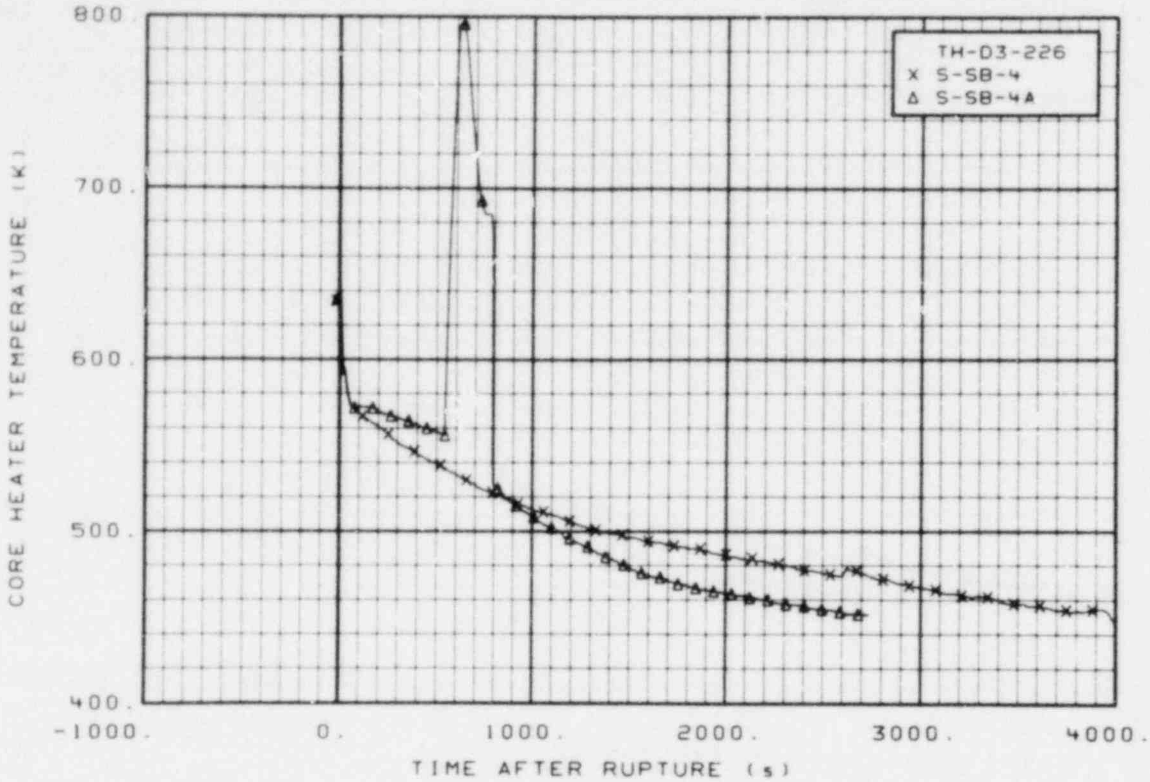


Figure 163. Core heater temperature, Rod D-3 (TH-D3-226), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

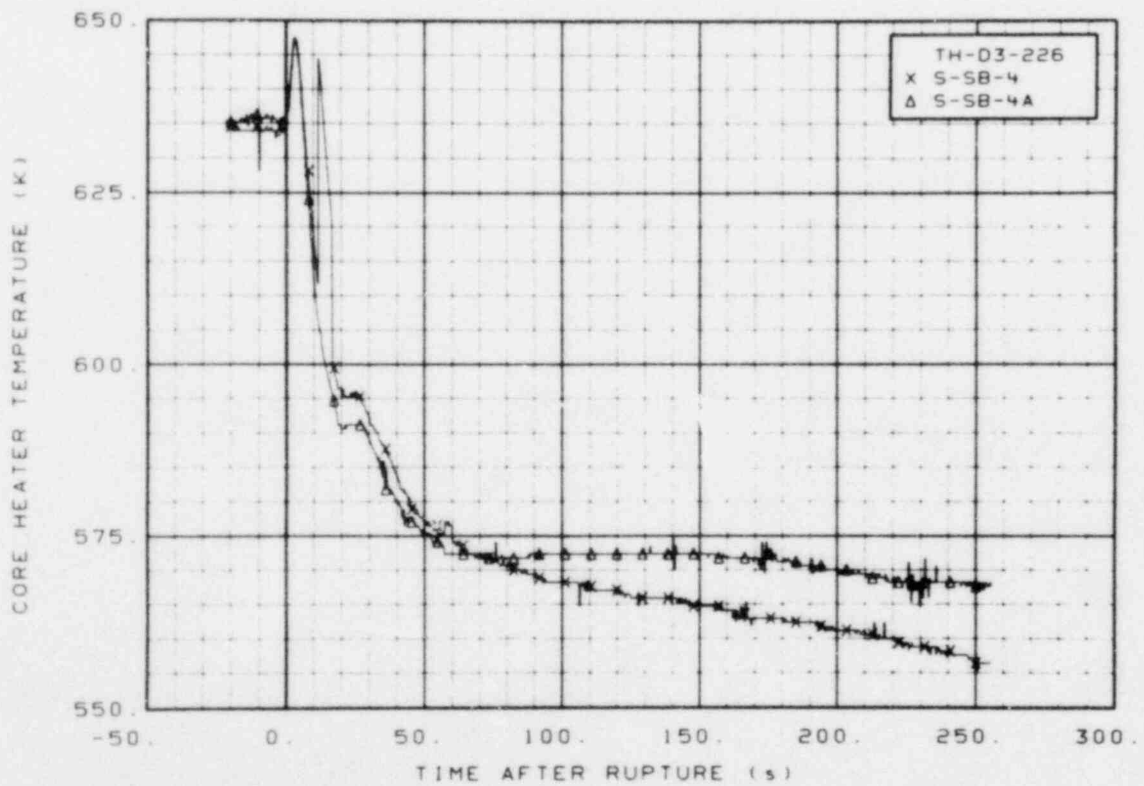


Figure 164. Core heater temperature, Rod D-3 (TH-D3-226), from -20 to 256 s.

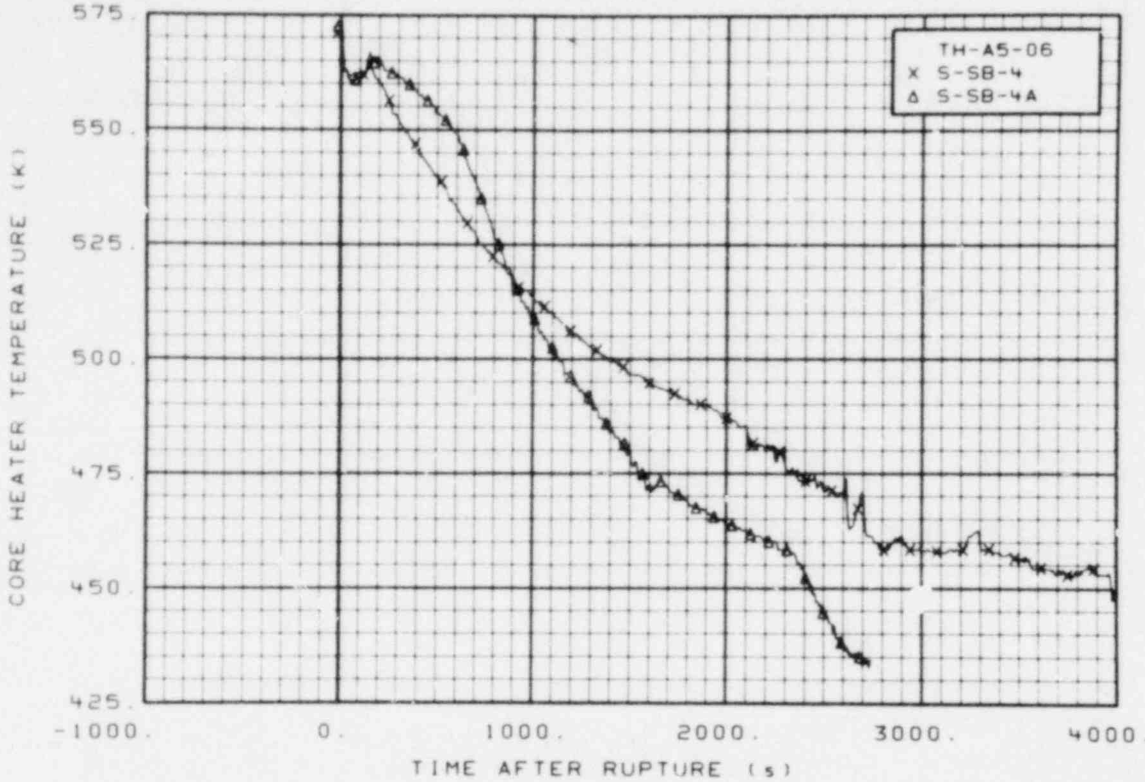


Figure 165. Core heater temperature, Rod A-5 (TH-A5-06), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

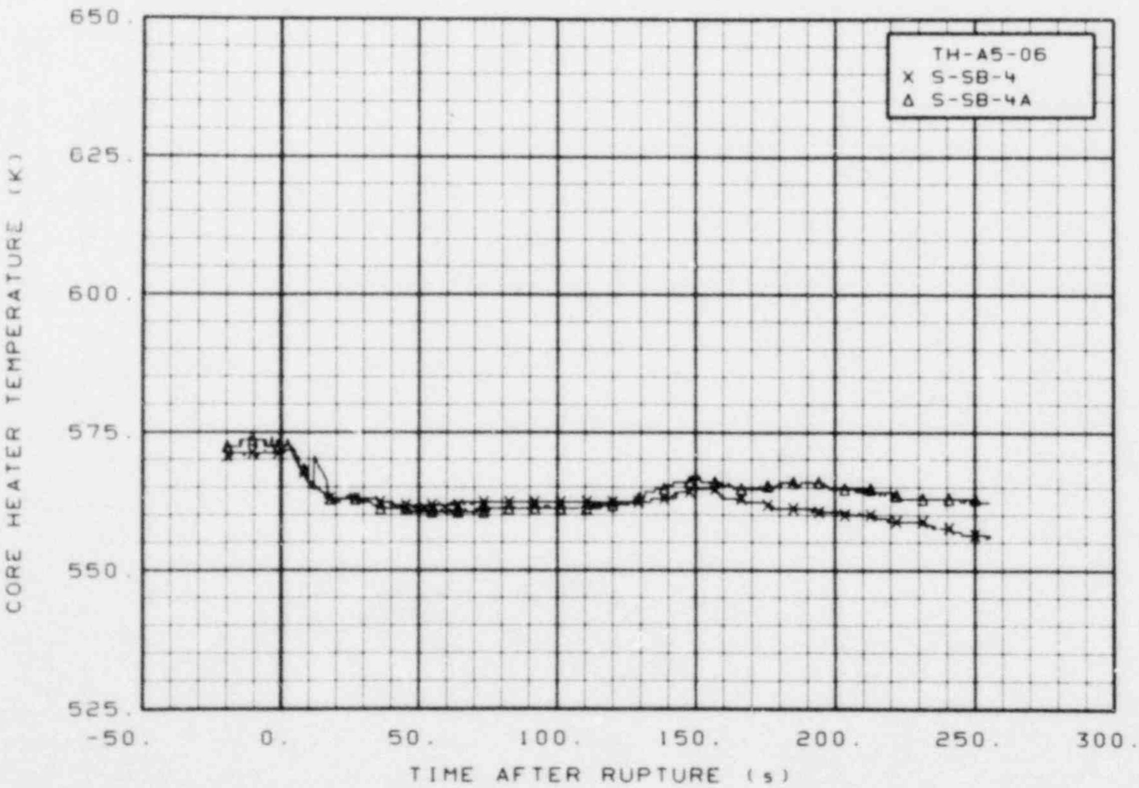


Figure 166. Core heater temperature, Rod A-5 (TH-A5-06), from -20 to 256 s.

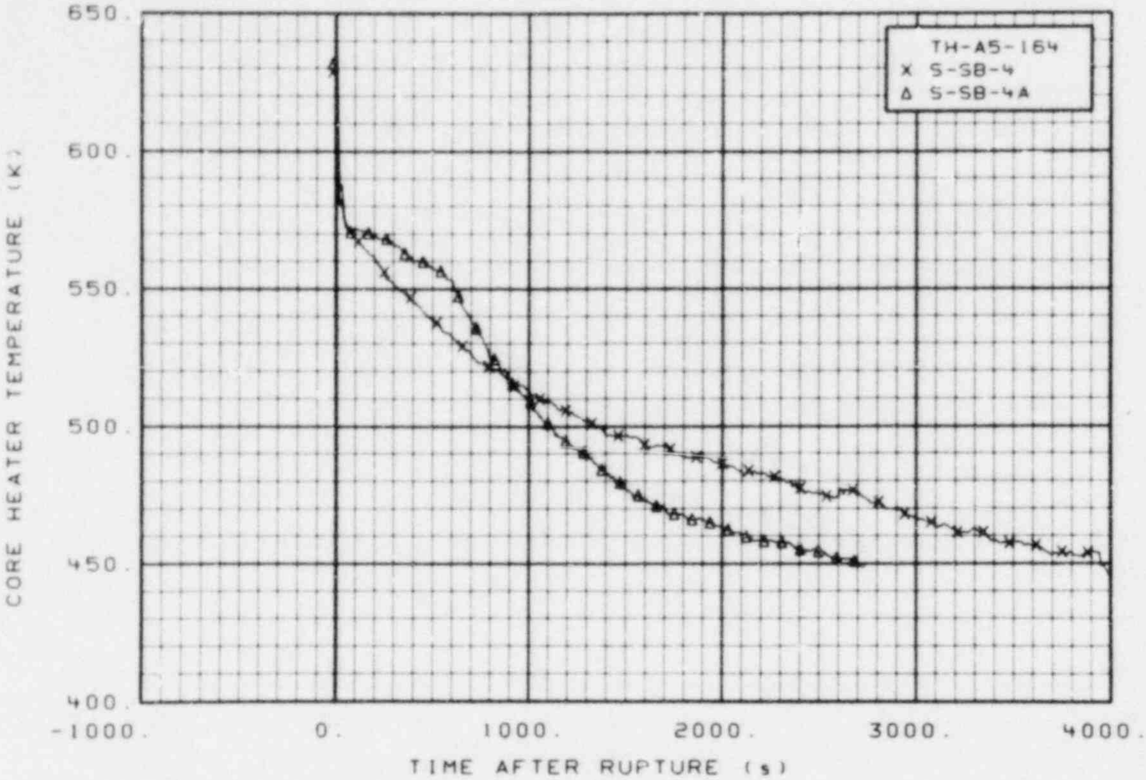


Figure 167. Core heater temperature, Rod A-5 (TH-A5-164), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

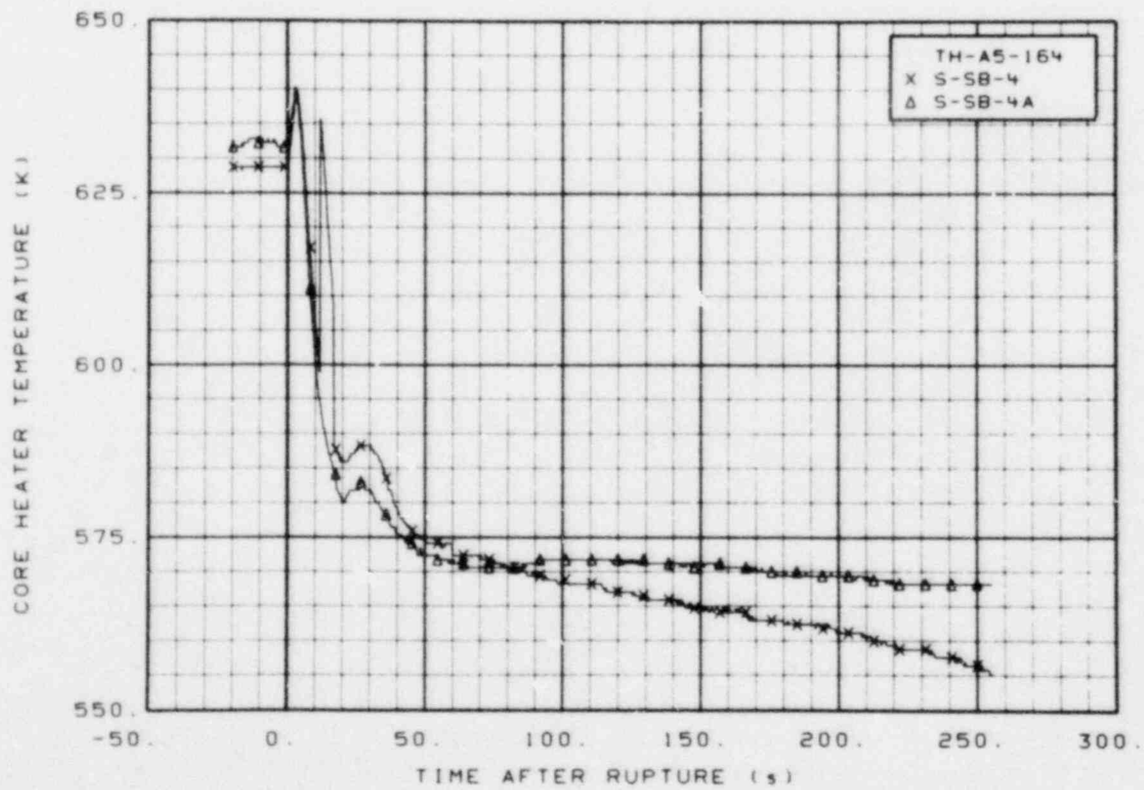


Figure 168. Core heater temperature, Rod A-5 (TH-A5-164), from -20 to 256 s.

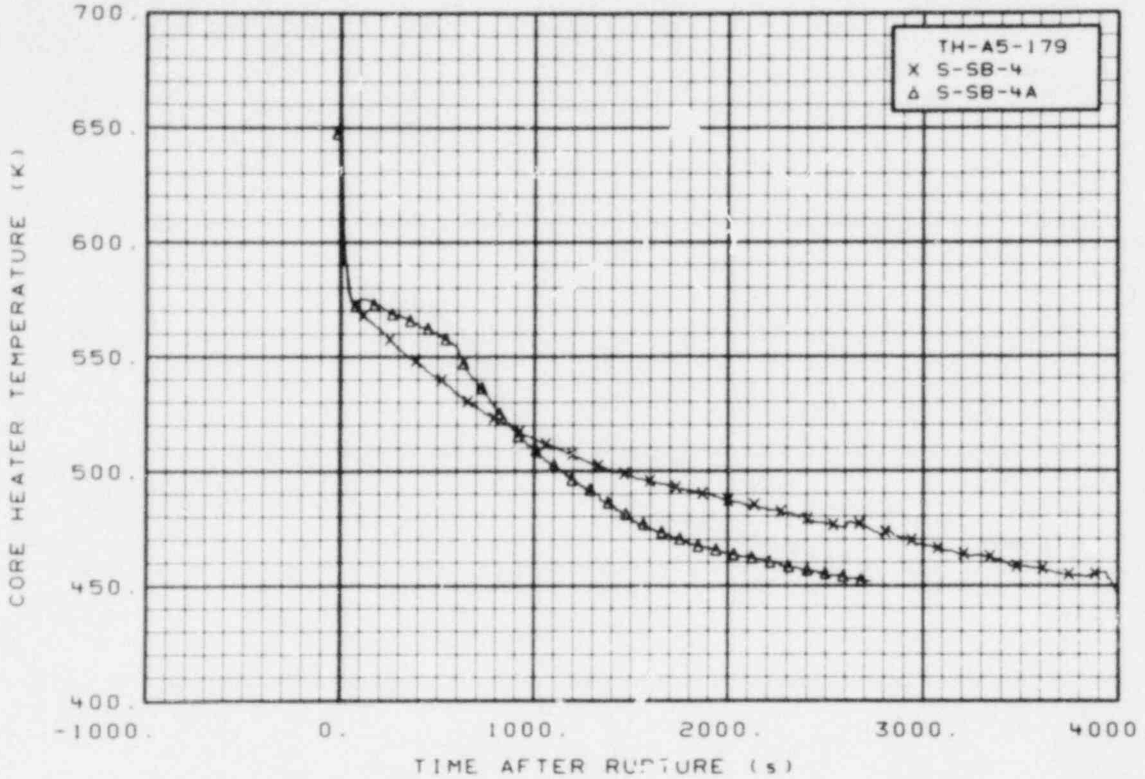


Figure 169. Core heater temperature, Rod A-5 (TH-A5-179), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

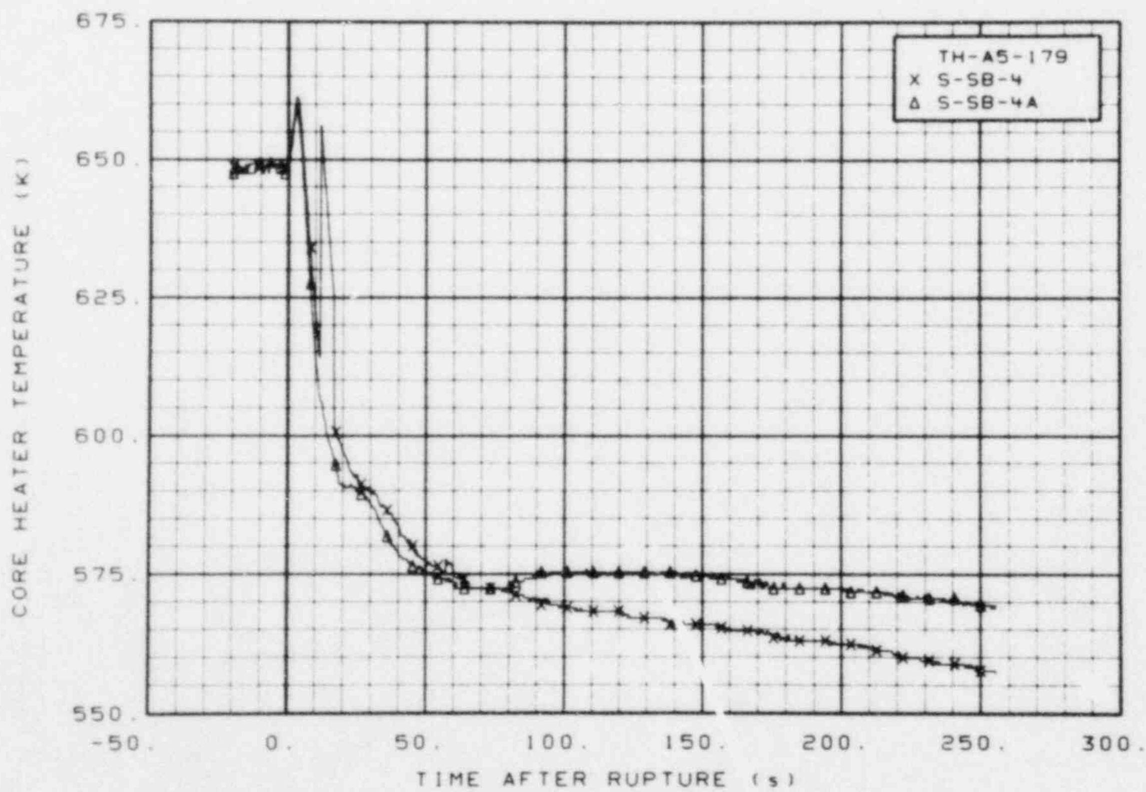


Figure 170. Core heater temperature, Rod A-5 (TH-A5-179), from -20 to 256 s.

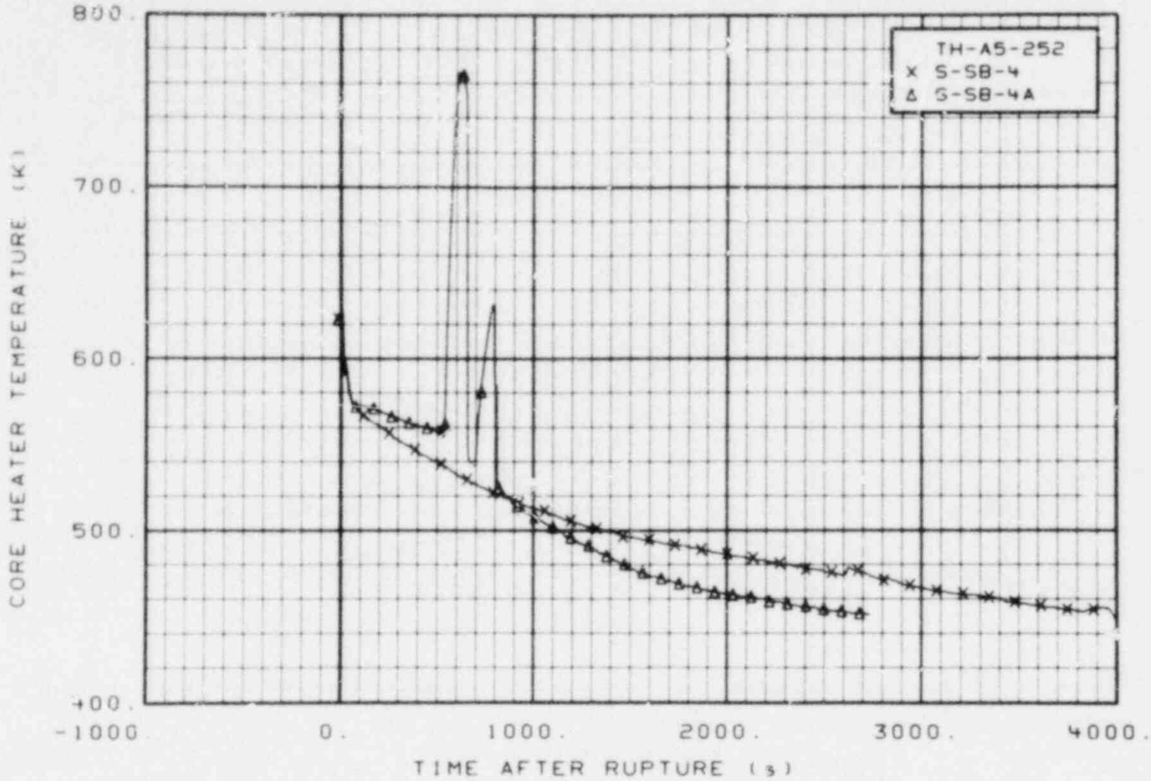


Figure 171. Core heater temperature, Rod A-5 (TH-A5-252), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

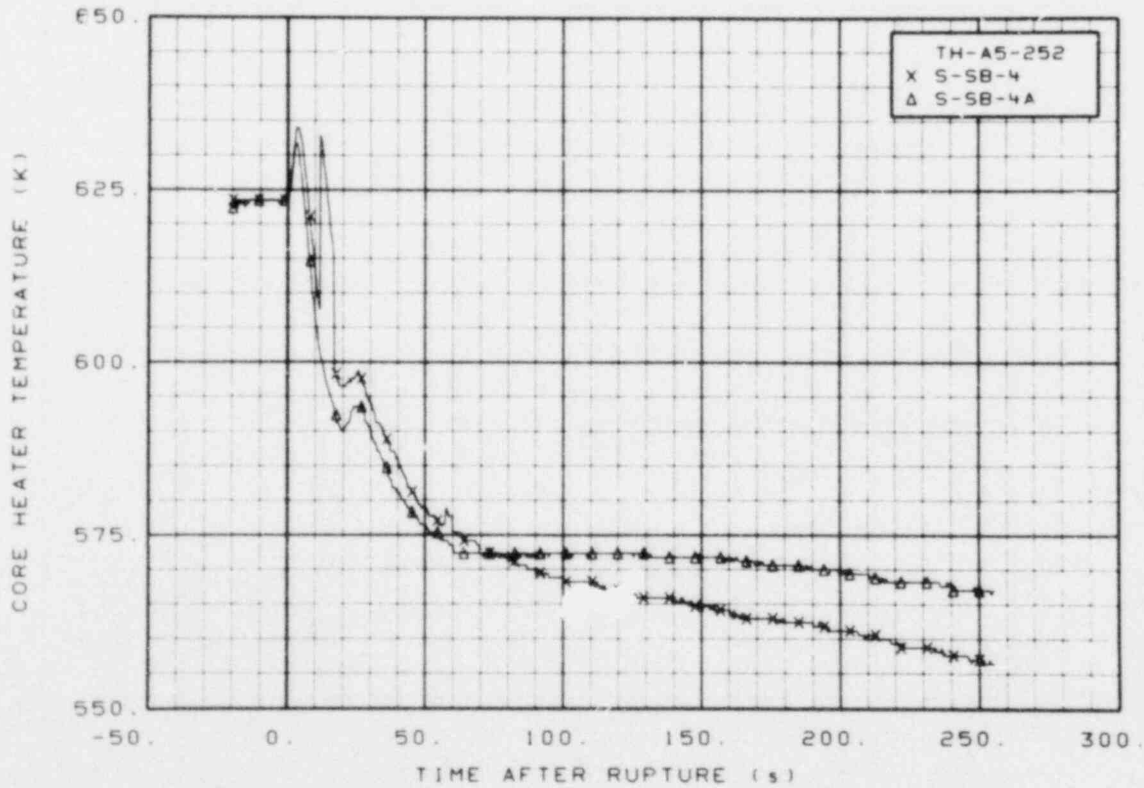


Figure 172. Core heater temperature, Rod A-5 (TH-A5-252), from -20 to 256 s.

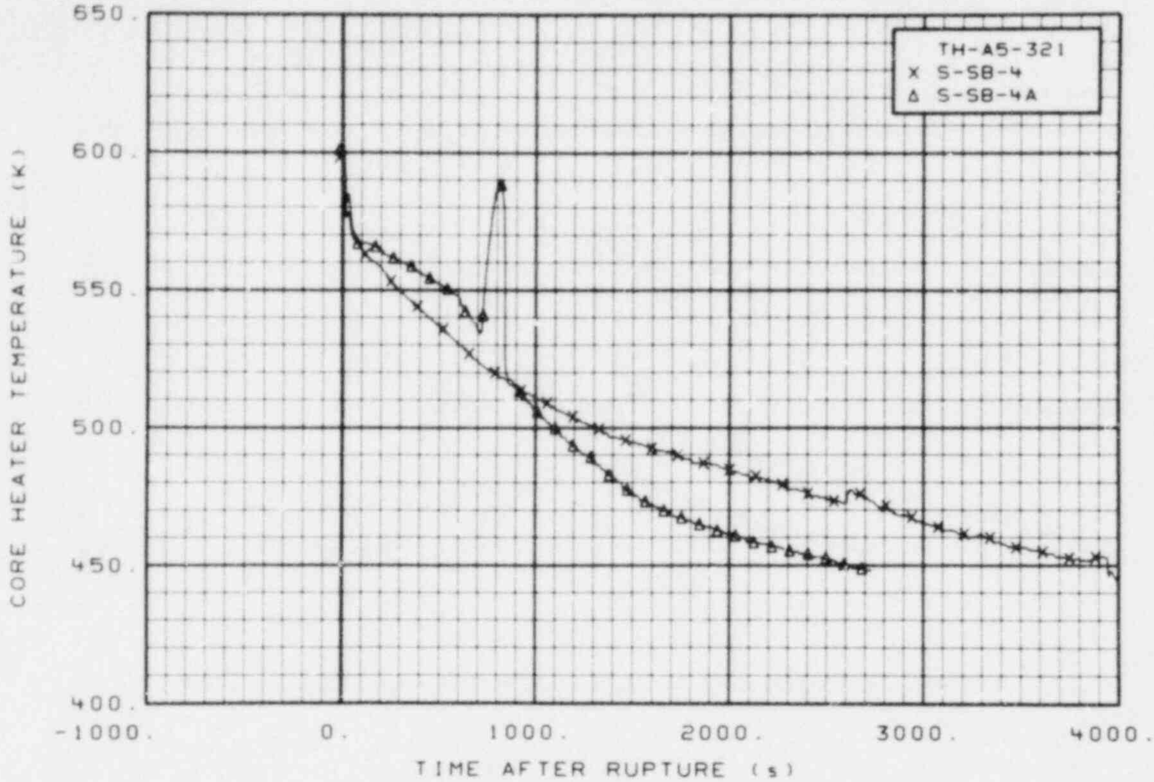


Figure 173. Core heater temperature, Rod A-5 (TH-A5-321), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

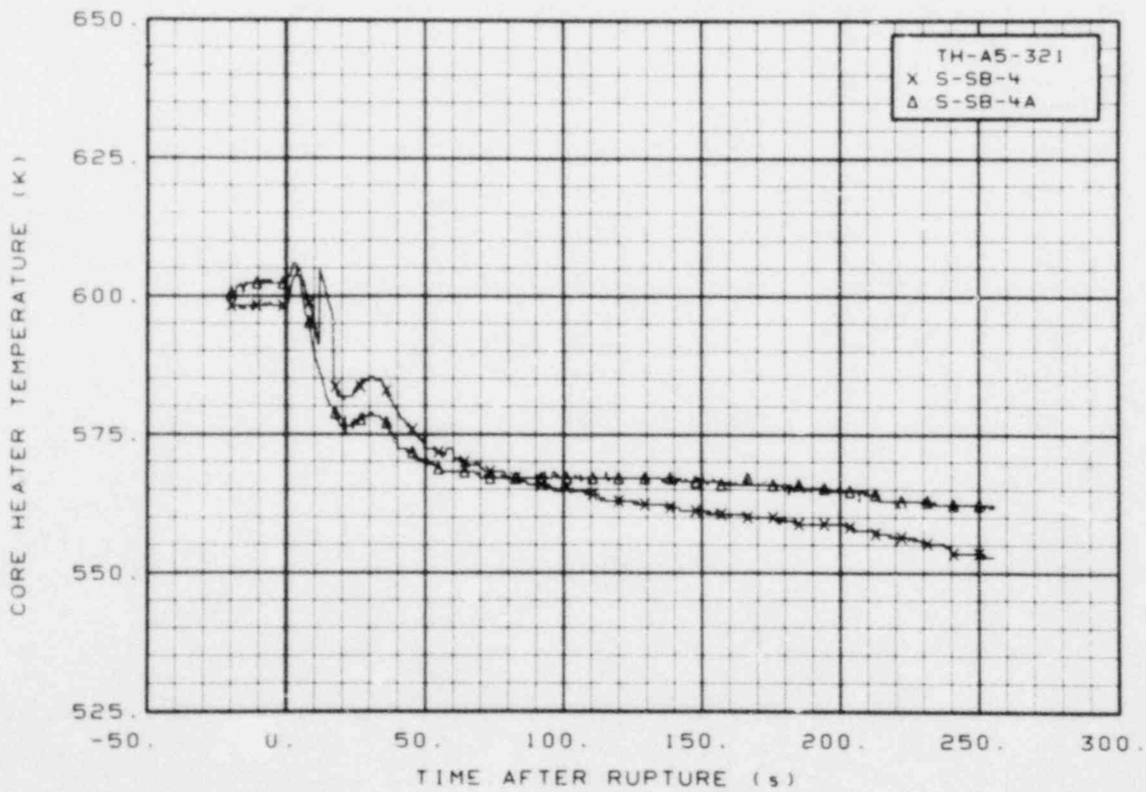


Figure 174. Core heater temperature, Rod A-5 (TH-A5-321), from -20 to 256 s.

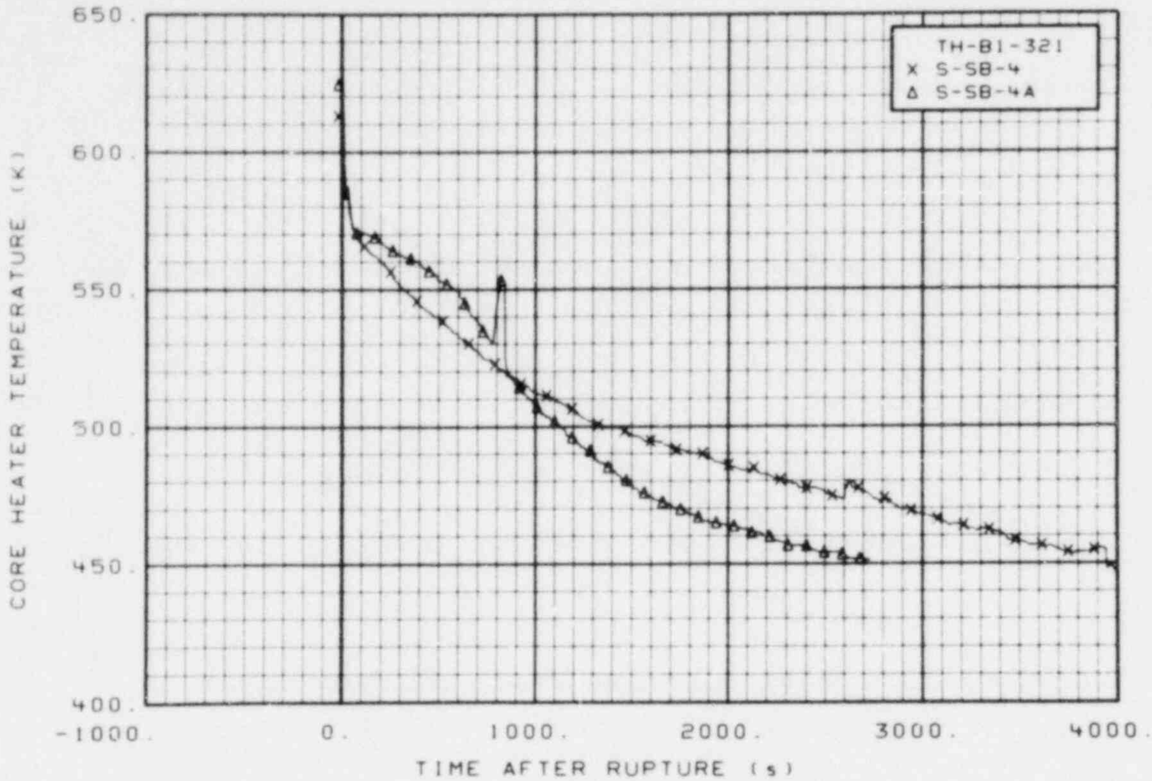


Figure 175. Core heater temperature, Rod B-1 (TH-B1-321), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

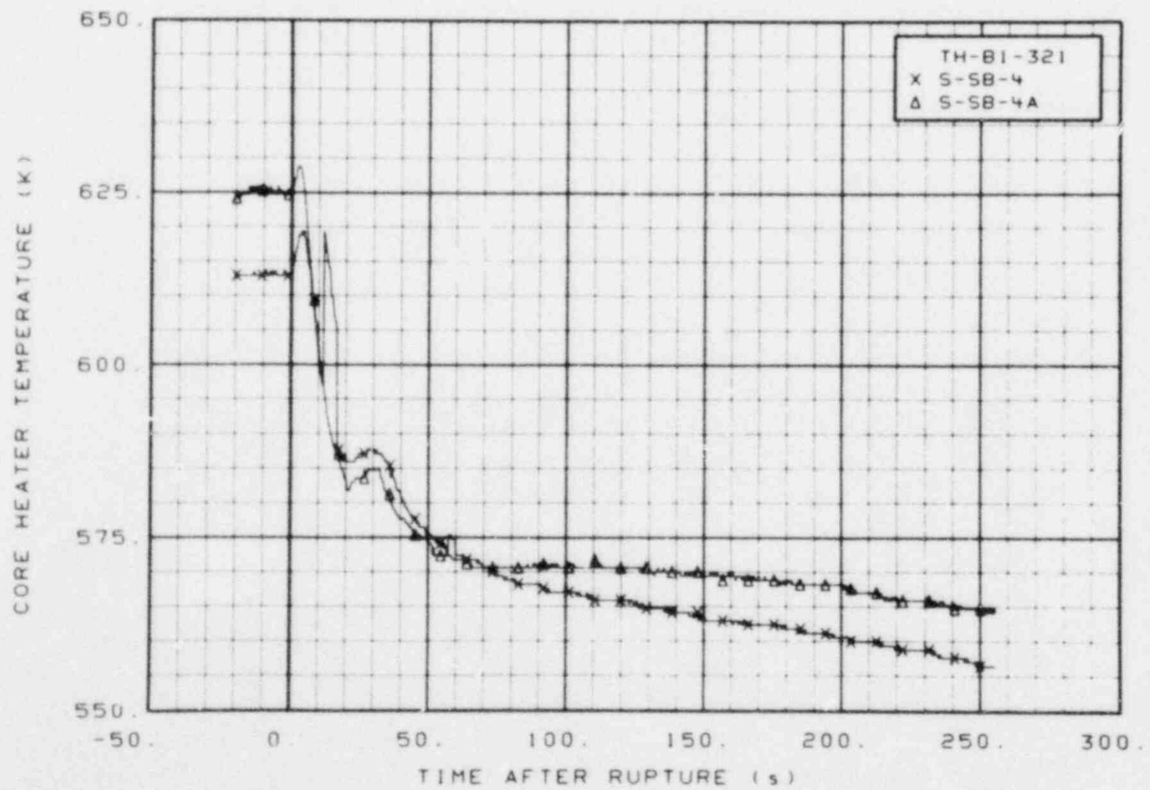


Figure 176. Core heater temperature, Rod B-1 (TH-B1-321), from -20 to 256 s.

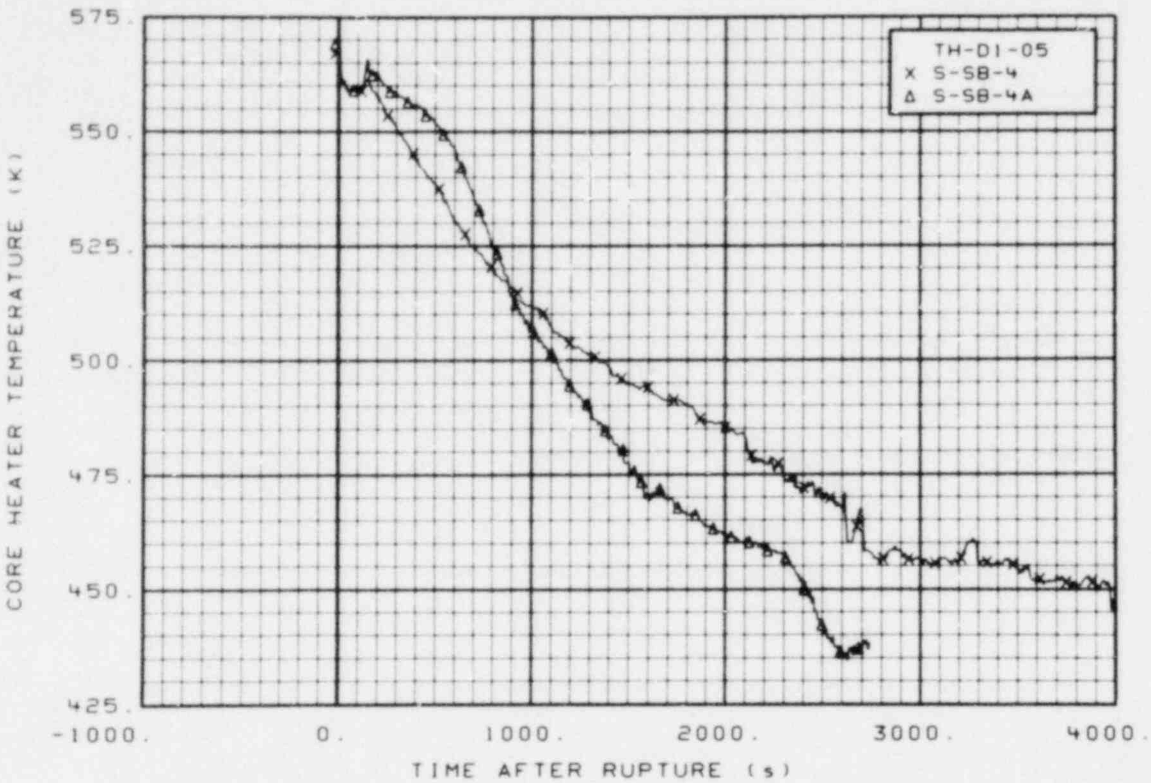


Figure 177. Core heater temperature, Rod D-1 (TH-D1-05), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

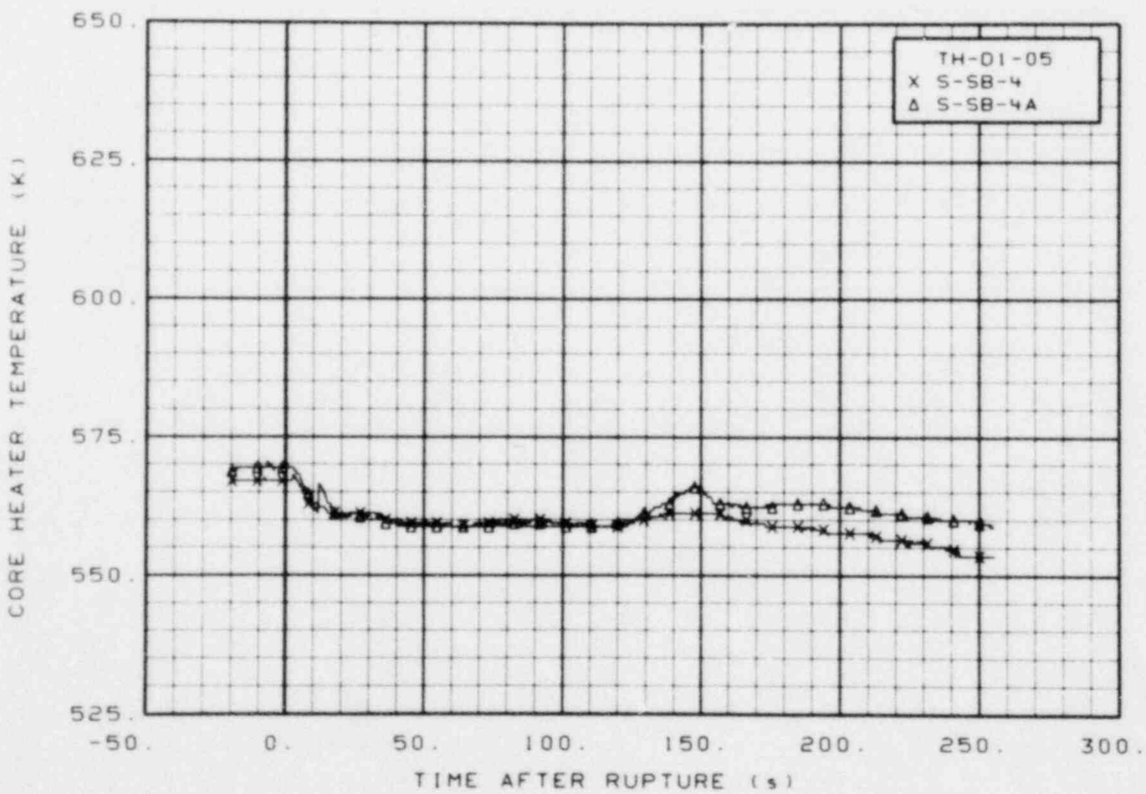


Figure 178. Core heater temperature, Rod D-1 (TH-D1-05), from -20 to 256 s.

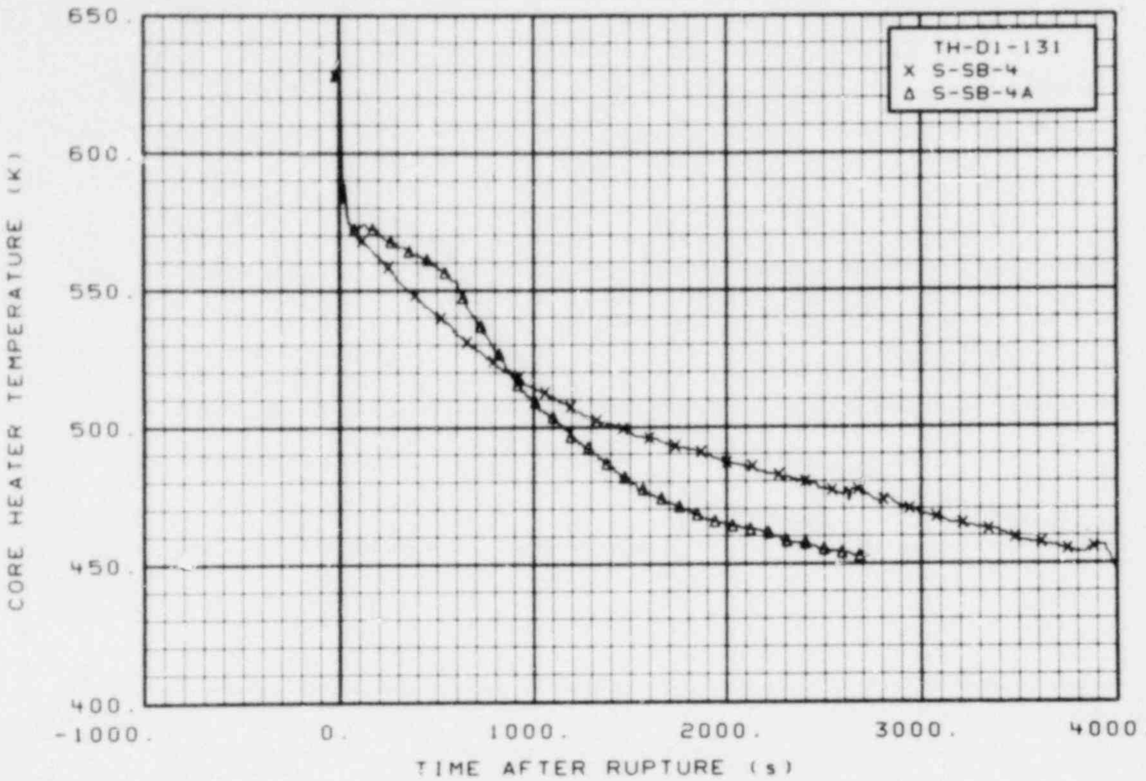


Figure 179. Core heater temperature, Rod D-1 (TH-D1-131), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

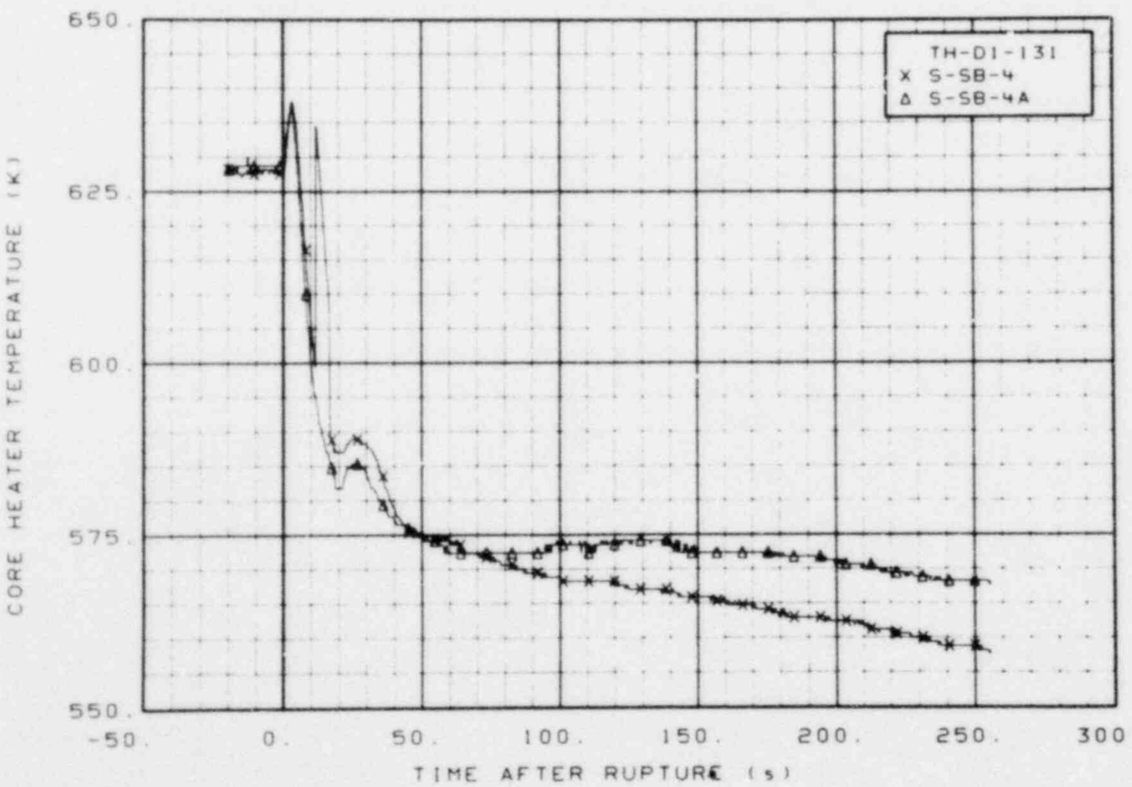


Figure 180. Core heater temperature, Rod D-1 (TH-D1-131), from -20 to 256 s.

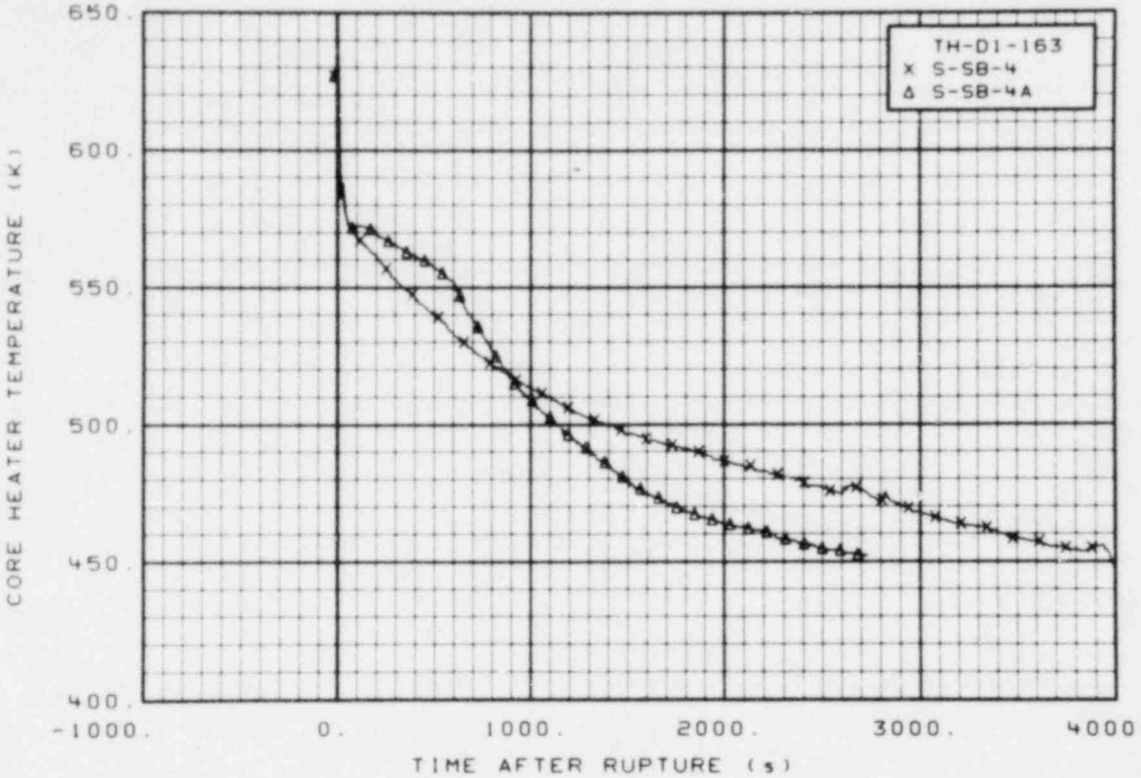


Figure 181. Core heater temperature, R/ d D-1 (TH-D1-163), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

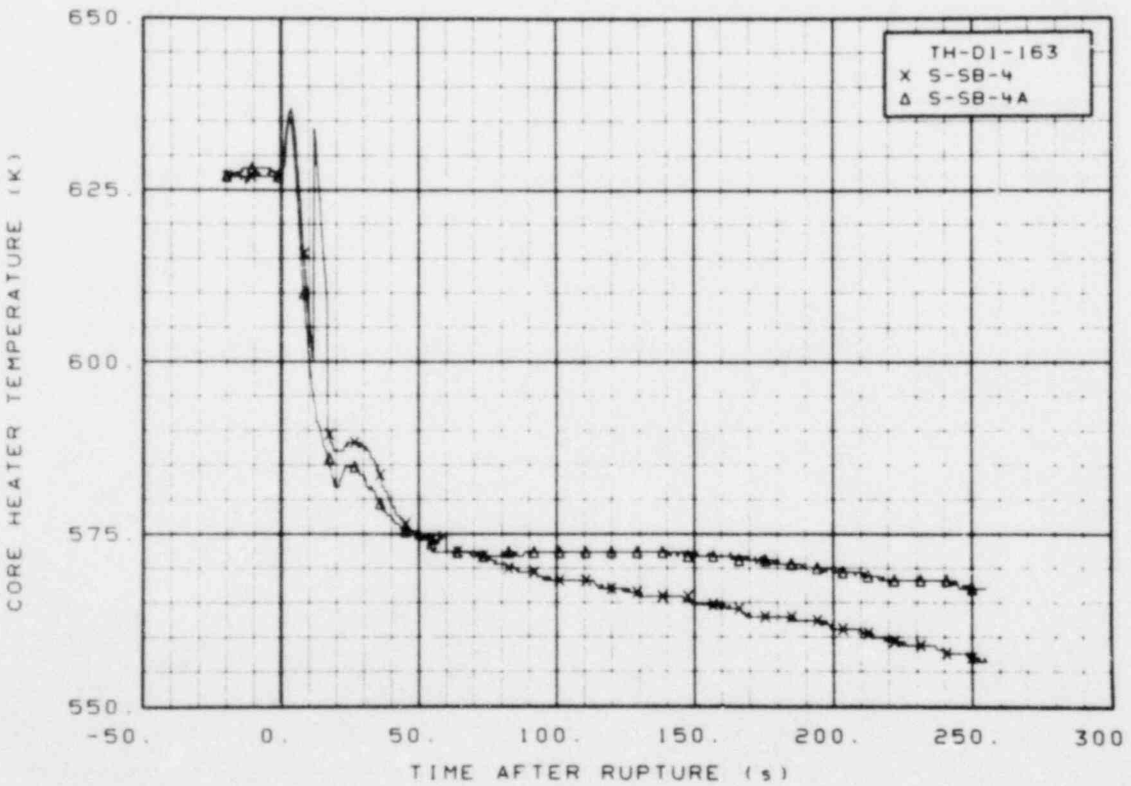


Figure 182. Core heater temperature, Rod D-1 (TH-D1-163), from -20 to 256 s.

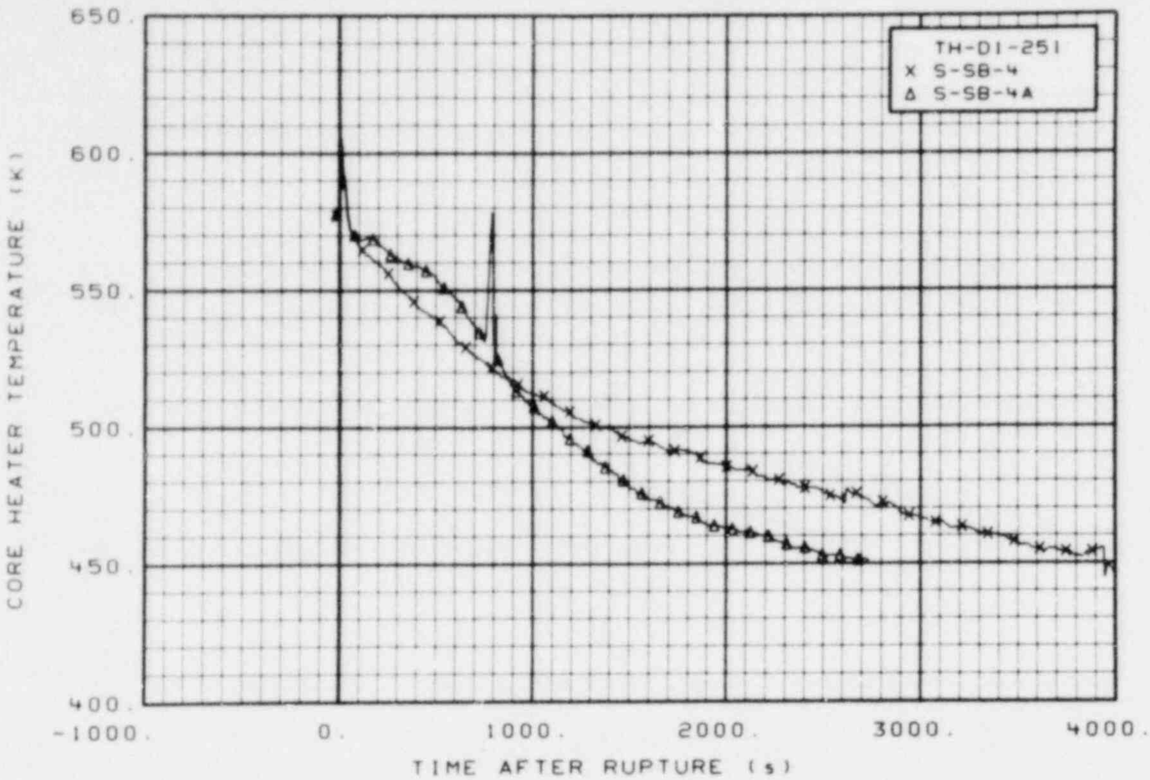


Figure 183. Core heater temperature, Rod D-1 (TH-D1-251), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

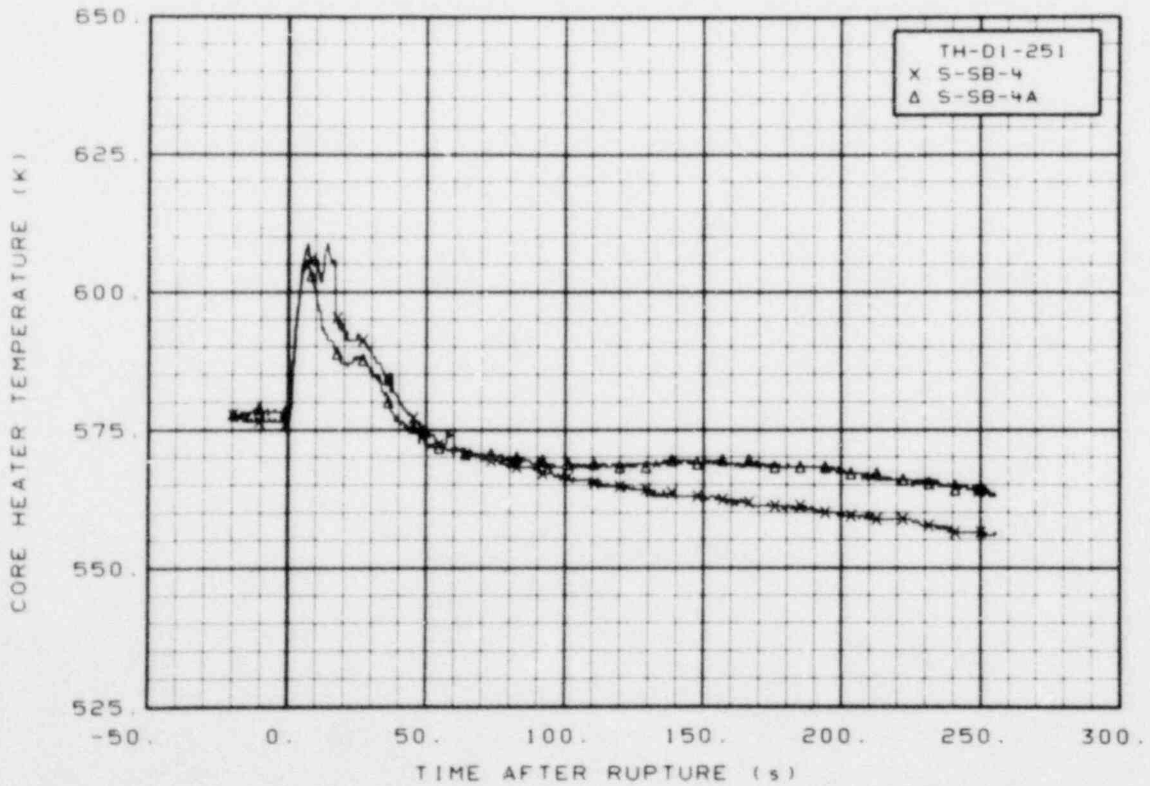


Figure 184. Core heater temperature, Rod D-1 (TH-D1-251), from -20 to 256 s.

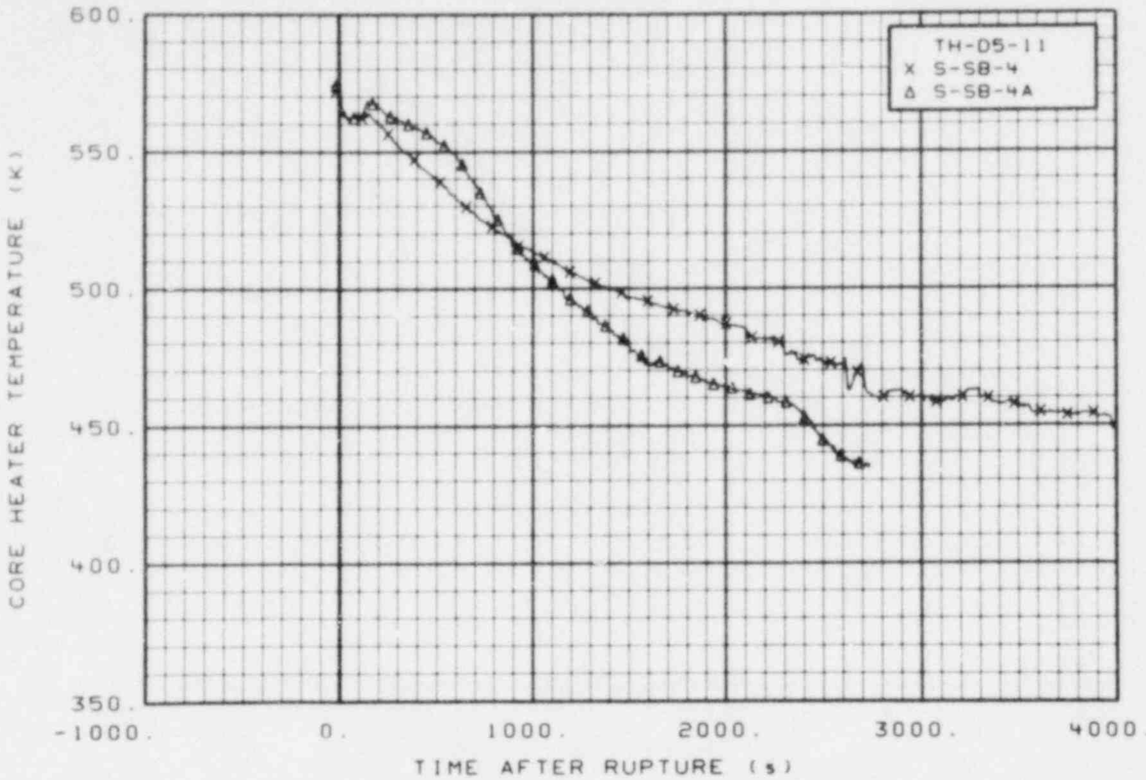


Figure 185. Core heater temperature, Rod D-5 (TH-D5-11), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

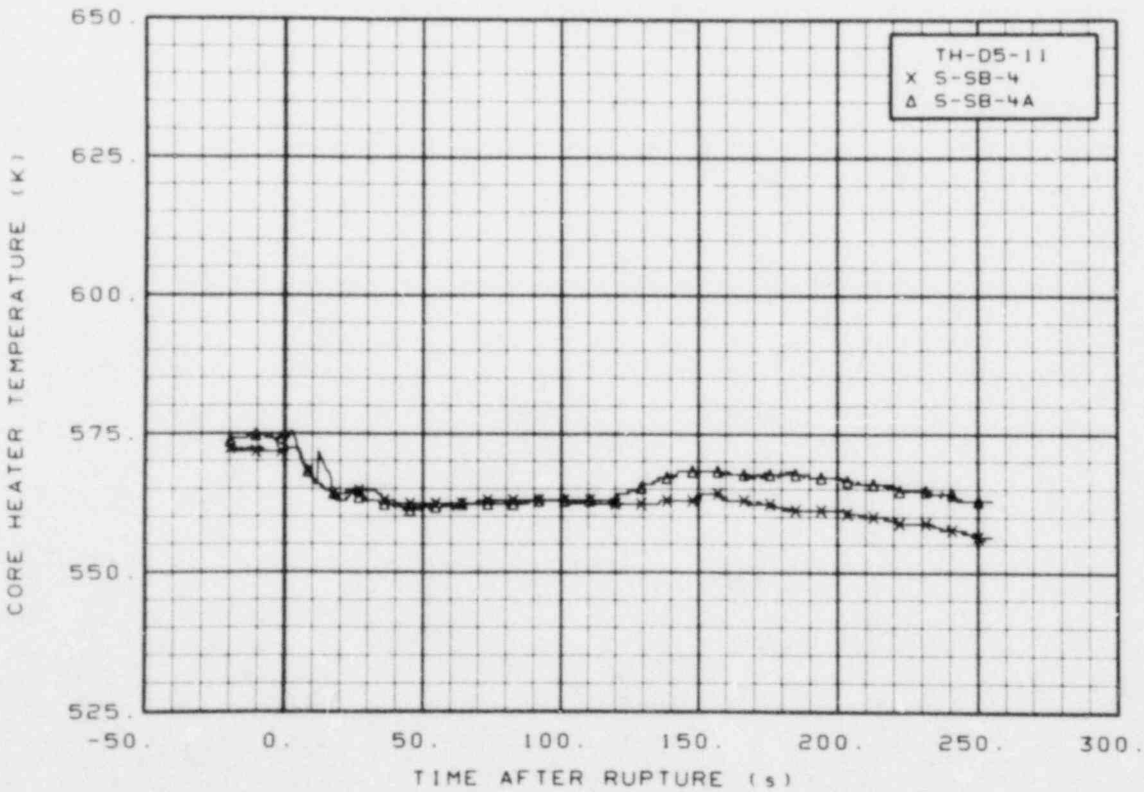


Figure 186. Core heater temperature, Rod D-5 (TH-D5-11), from -20 to 256 s.

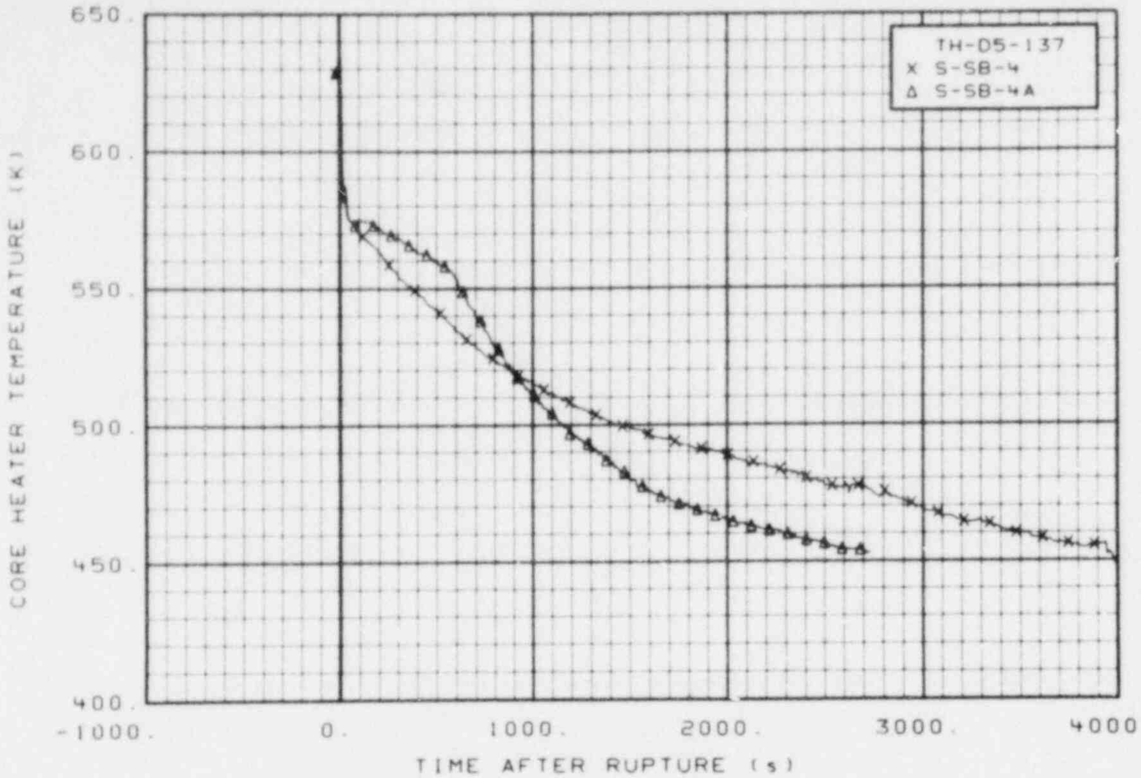


Figure 187. Core heater temperature, Rod D-5 (TH-D5-137), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

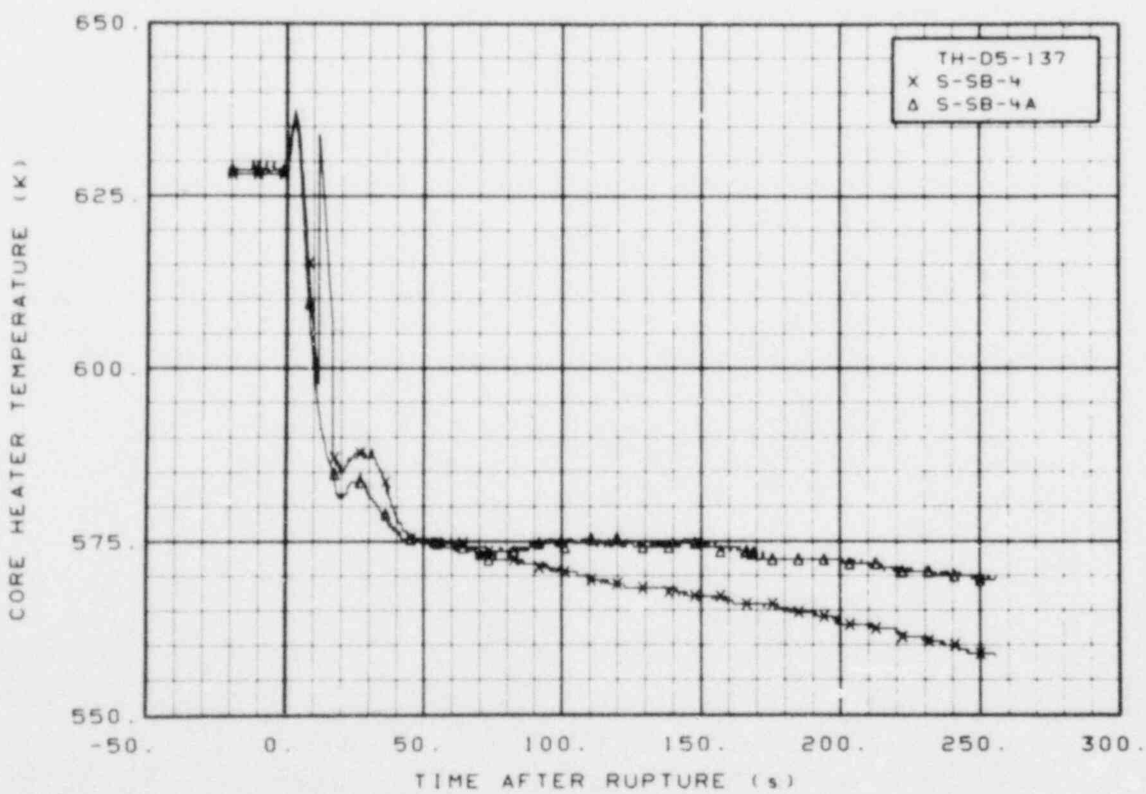


Figure 188. Core heater temperature, Rod D-5 (TH-D5-137), from -20 to 256 s.

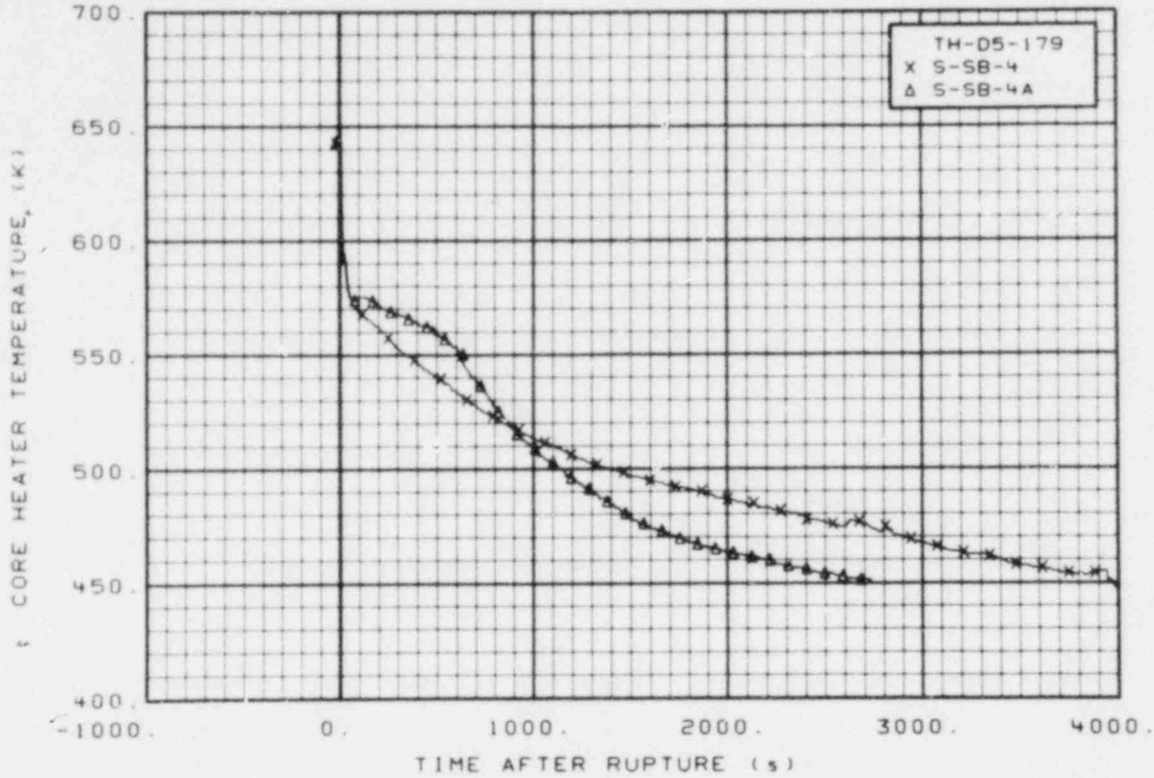


Figure 189. Core heater temperature, Rod D-5 (TH-D5-179), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

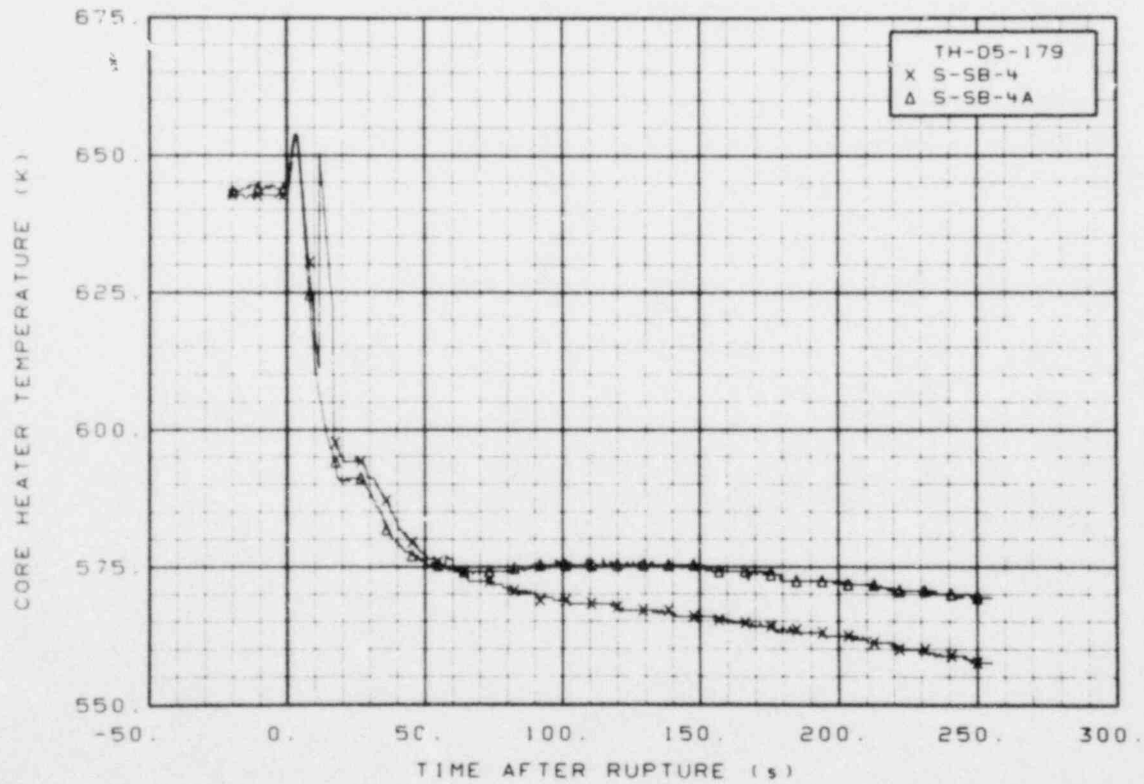


Figure 190. Core heater temperature, Rod D-5 (TH-D5-179), from -20 to 256 s.

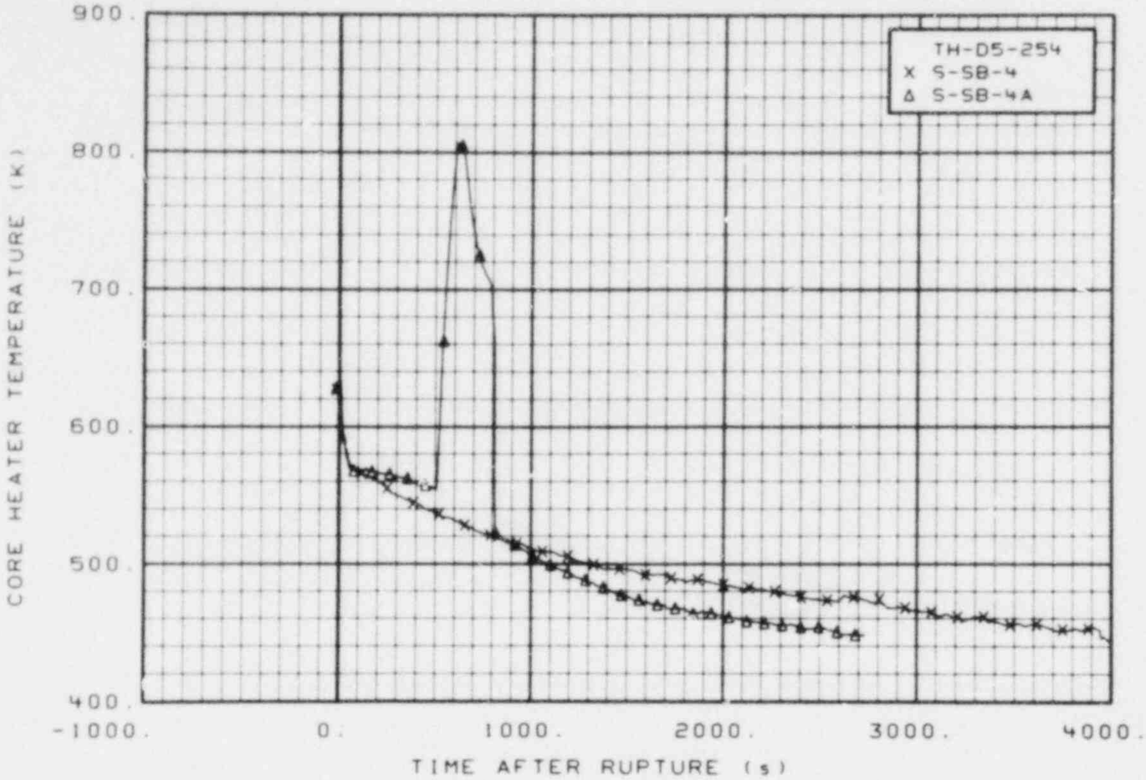


Figure 191. Core heater temperature, Rod D-5 (TH-D5-254), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

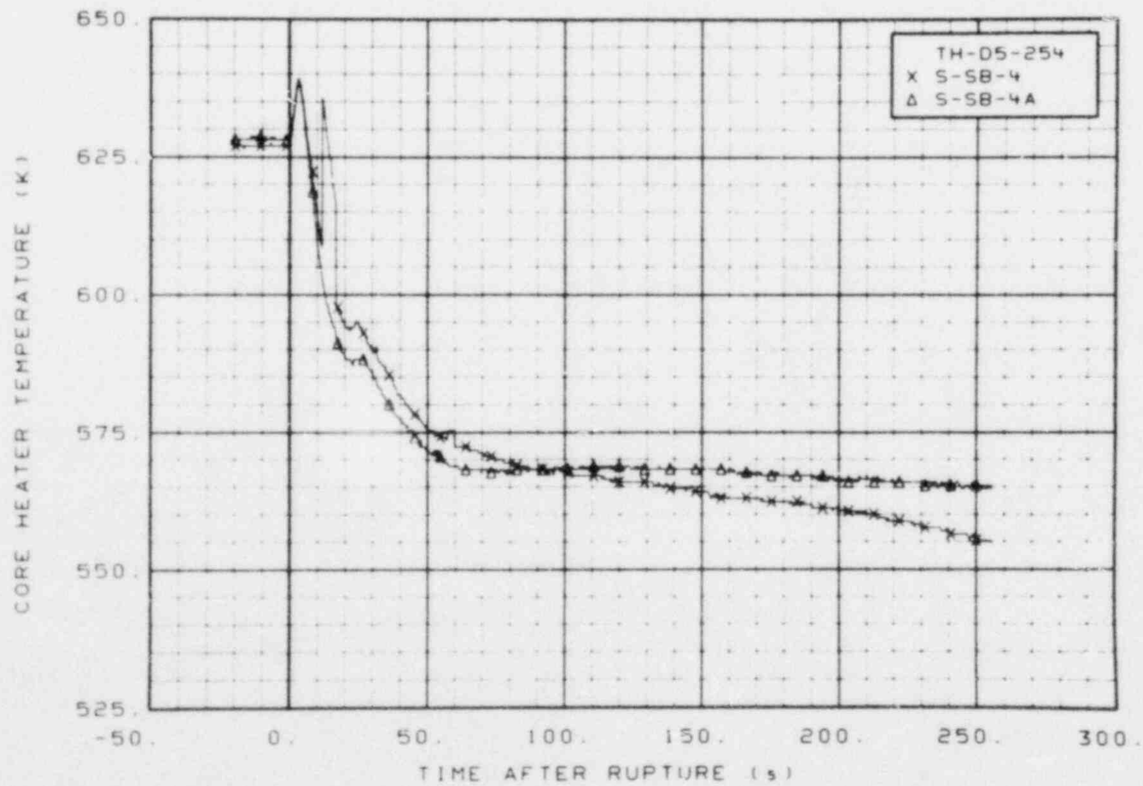


Figure 192. Core heater temperature, Rod D-5 (TH-D5-254), from -20 to 256 s.

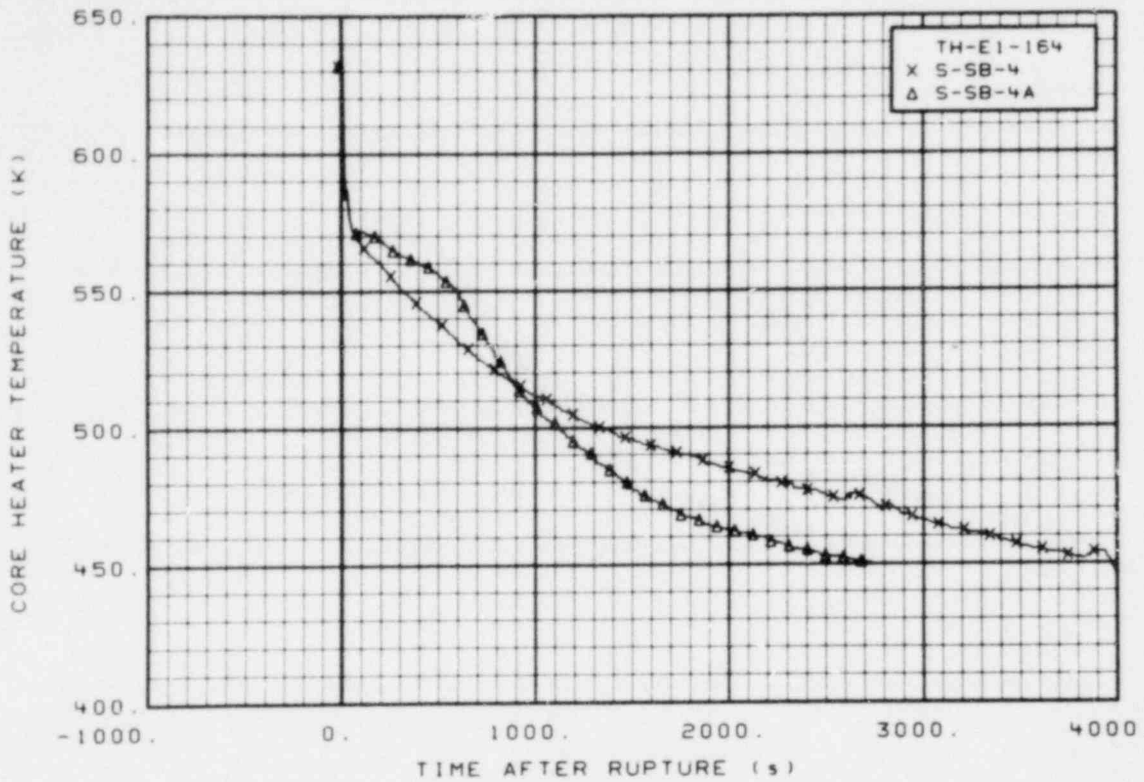


Figure 193. Core heater temperature, Rod E-1 (TH-E1-164), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

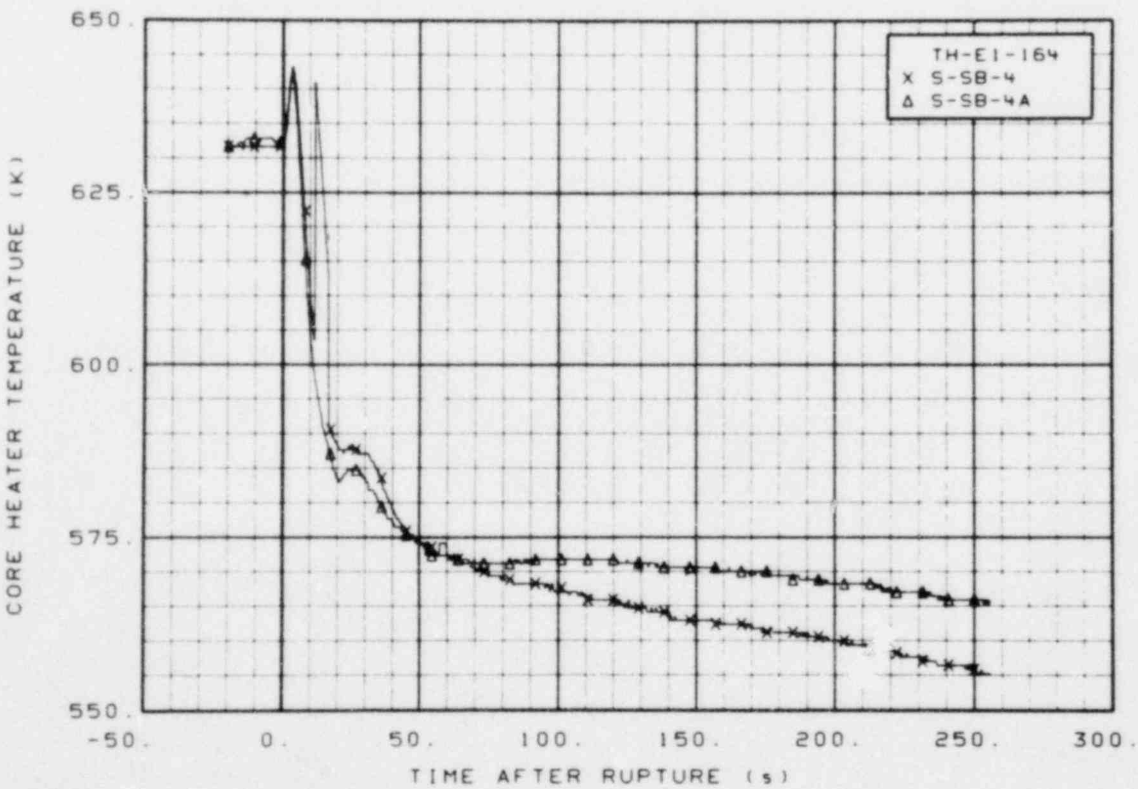


Figure 194. Core heater temperature, Rod E-1 (TH-E1-164), from -20 to 256 s.

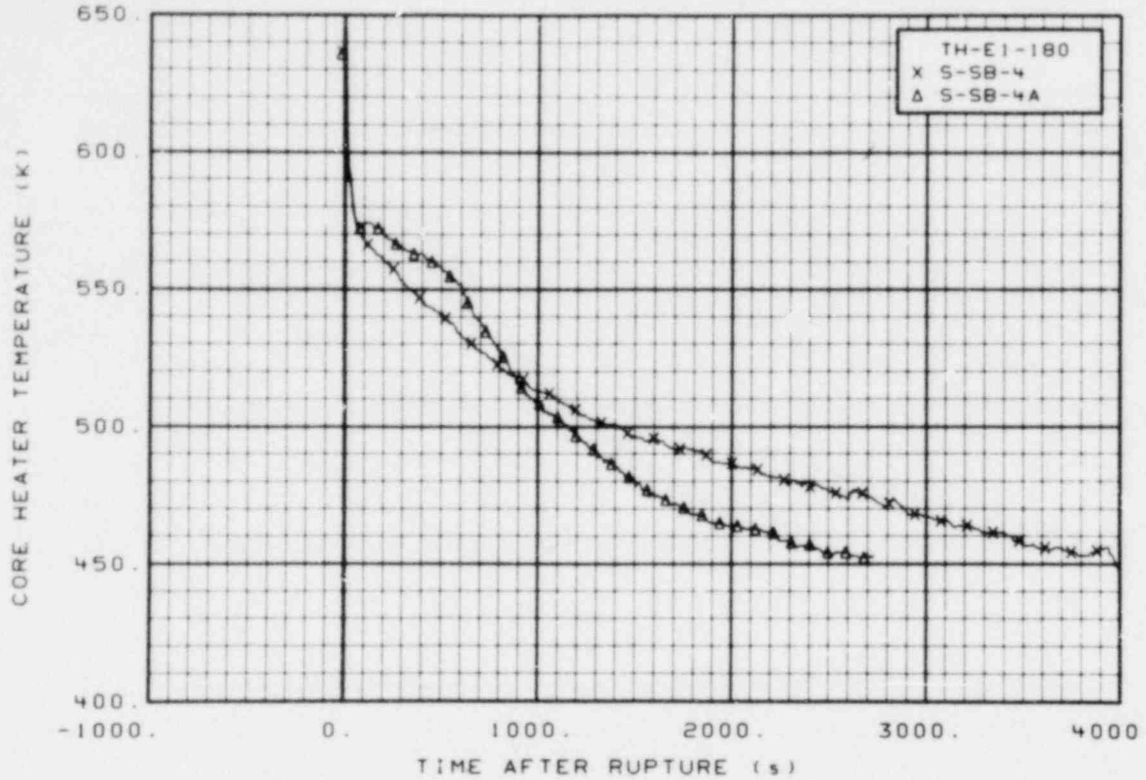


Figure 195. Core heater temperature, Rod E-1 (TH-E1-180), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

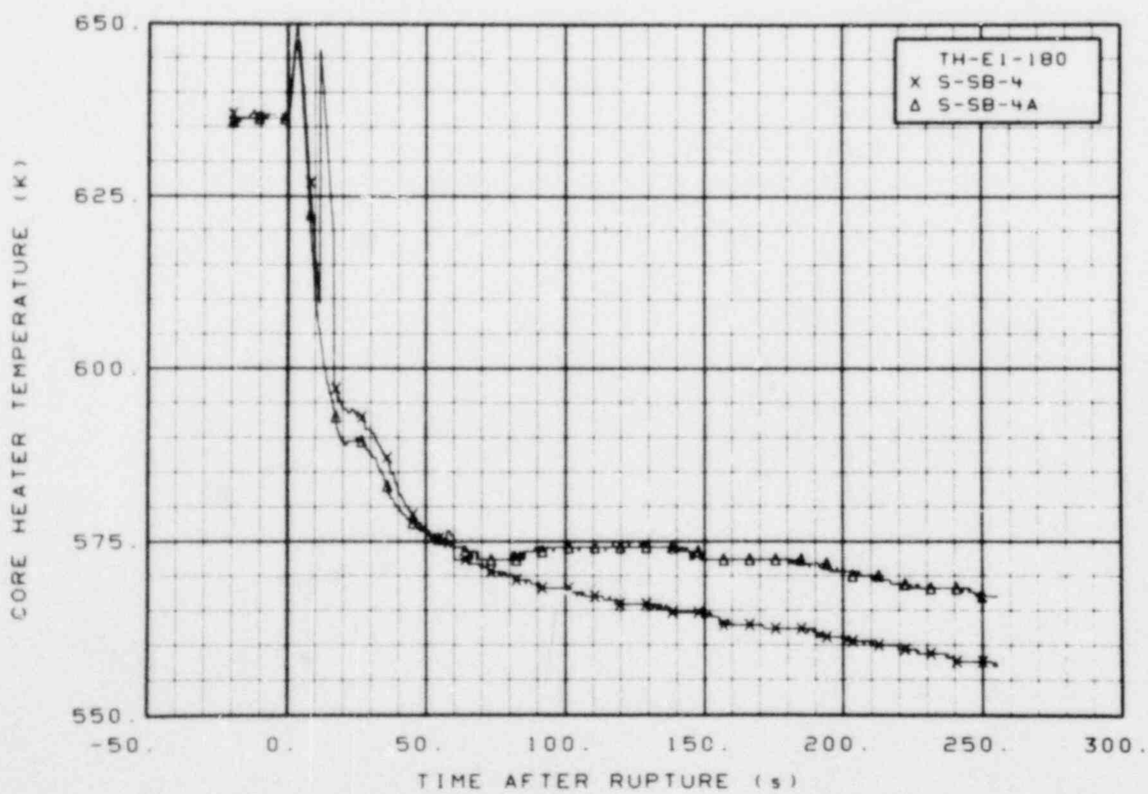


Figure 196. Core heater temperature, Rod E-1 (TH-E1-180), from -20 to 256 s.

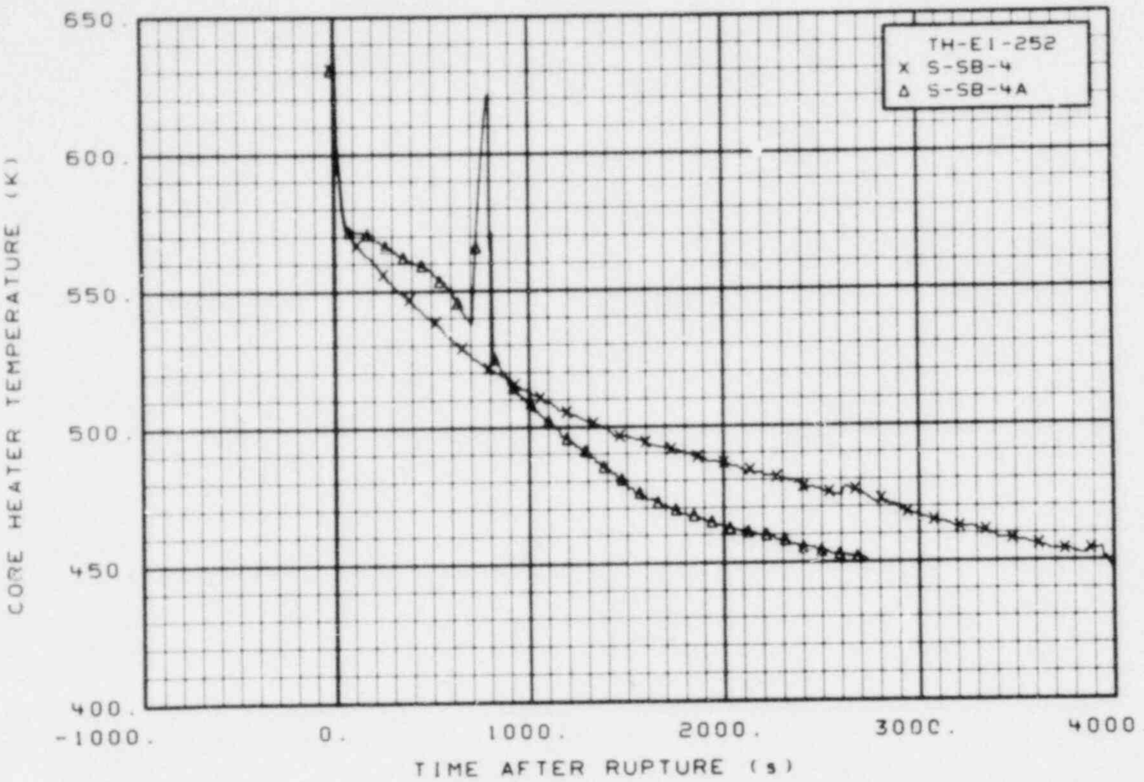


Figure 197. Core heater temperature, Rod E-1 (TH-E1-252), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

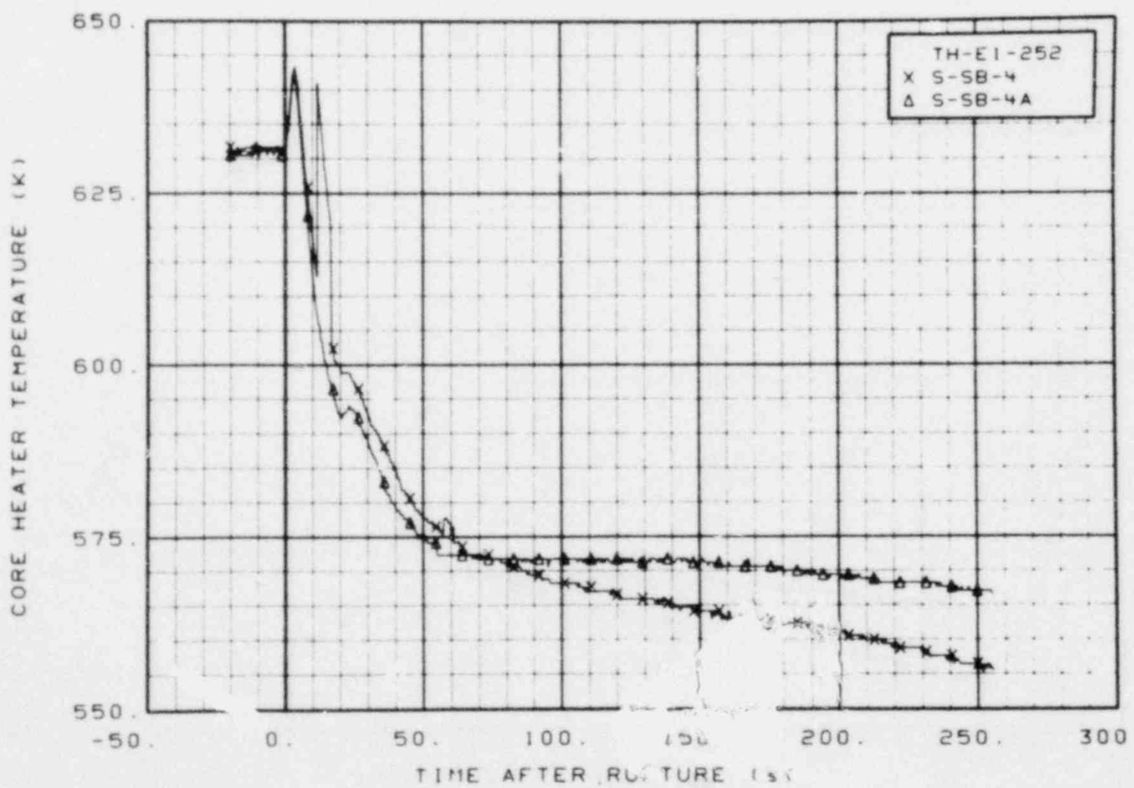


Figure 198. Core heater temperature, Rod E-1 (TH-E1-252), from -20 to 256 s.

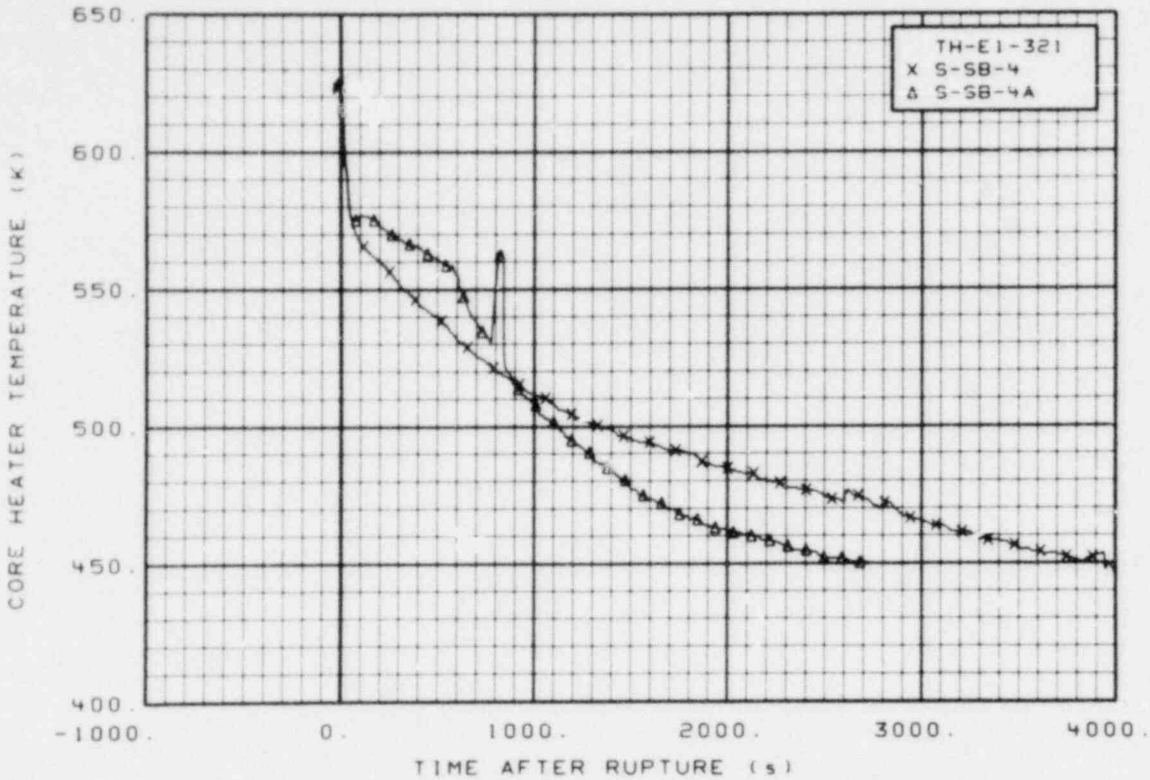


Figure 199. Core heater temperature, Rod E-1 (TH-E1-321), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

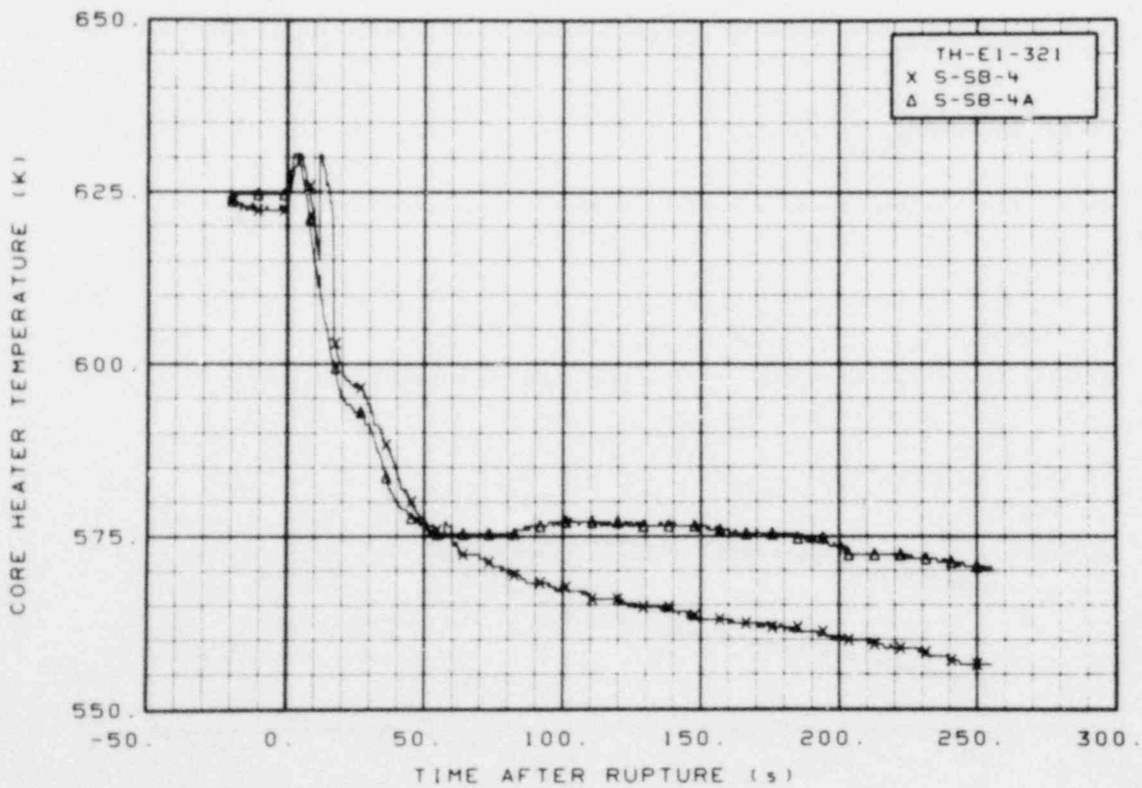


Figure 200. Core heater temperature, Rod E-1 (TH-E1-321), from -20 to 256 s.

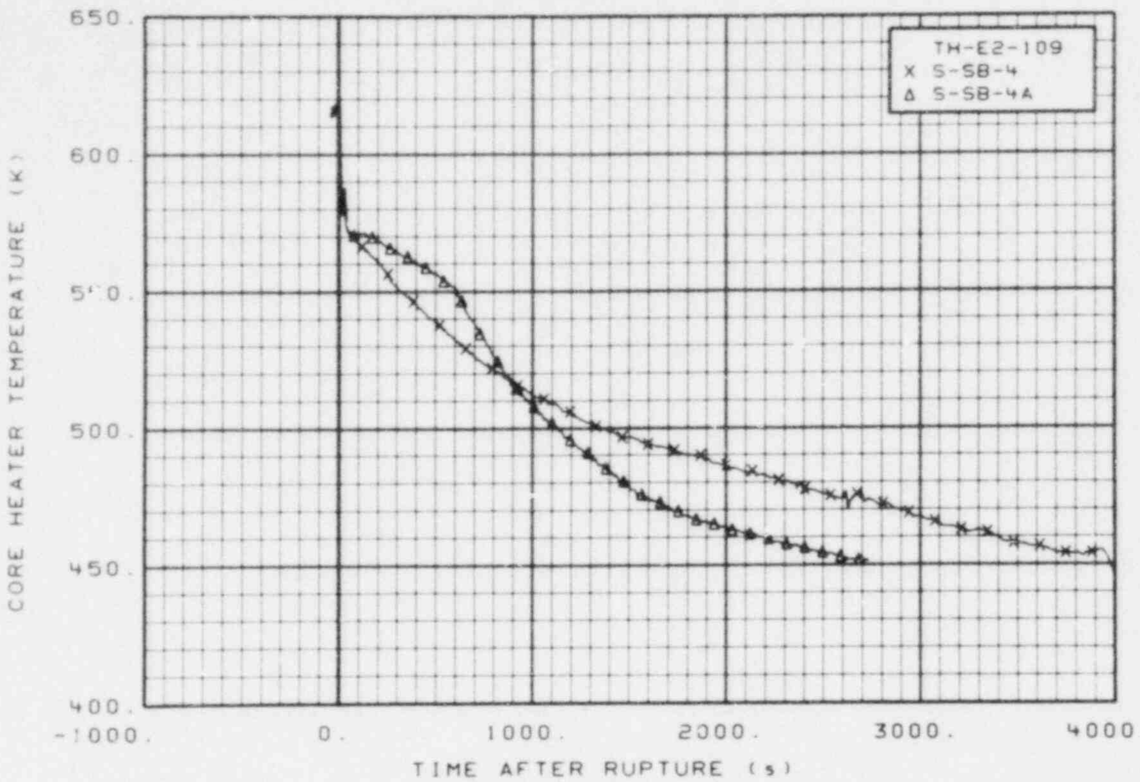


Figure 201. Core heater temperature, Rod E-2 (TH-E2-109), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

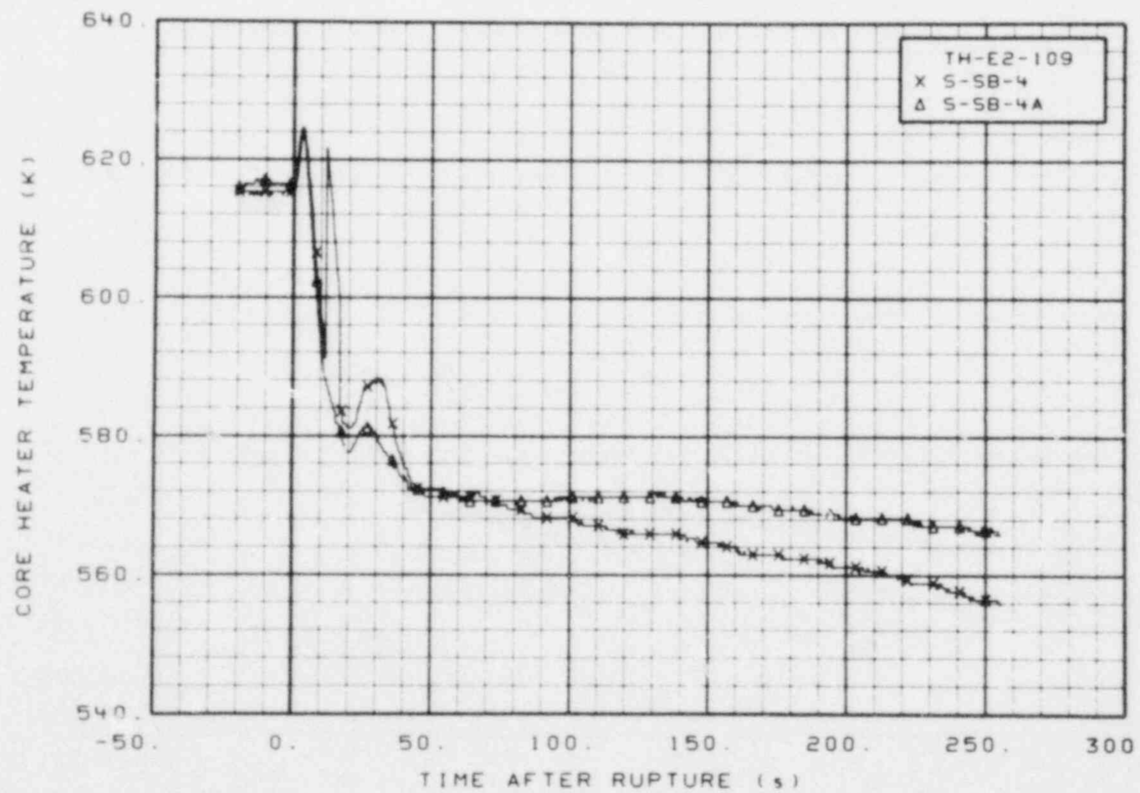


Figure 202. Core heater temperature, Rod E-2 (TH-E2-109), from -20 to 256 s.

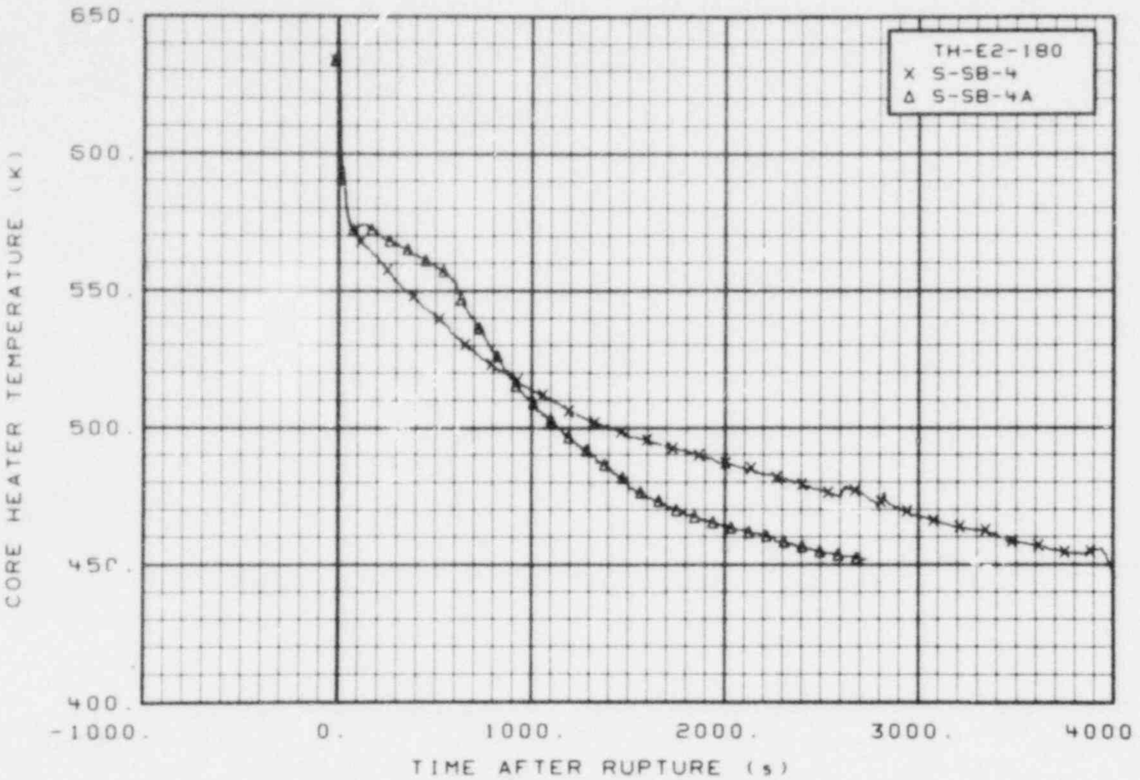


Figure 203. Core heater temperature, Rod E-2 (TH-E2-180), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

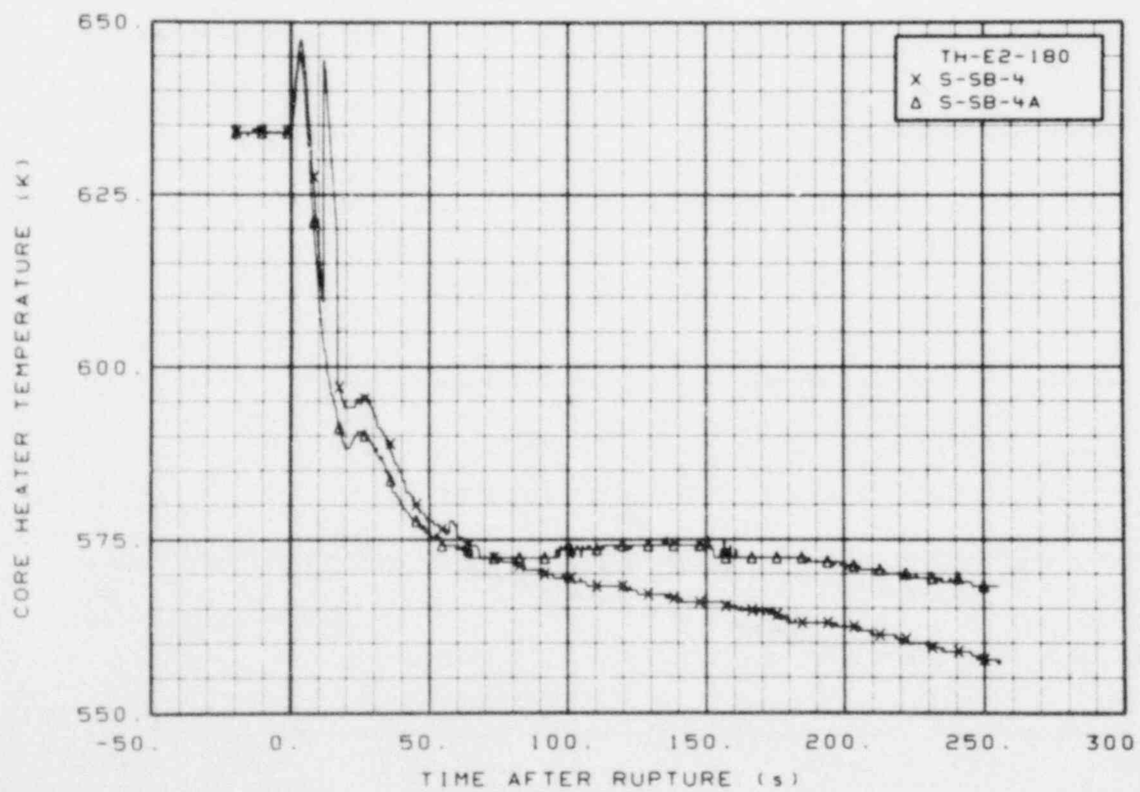


Figure 204. Core heater temperature, Rod E-2 (TH-E2-180), from -20 to 256 s.

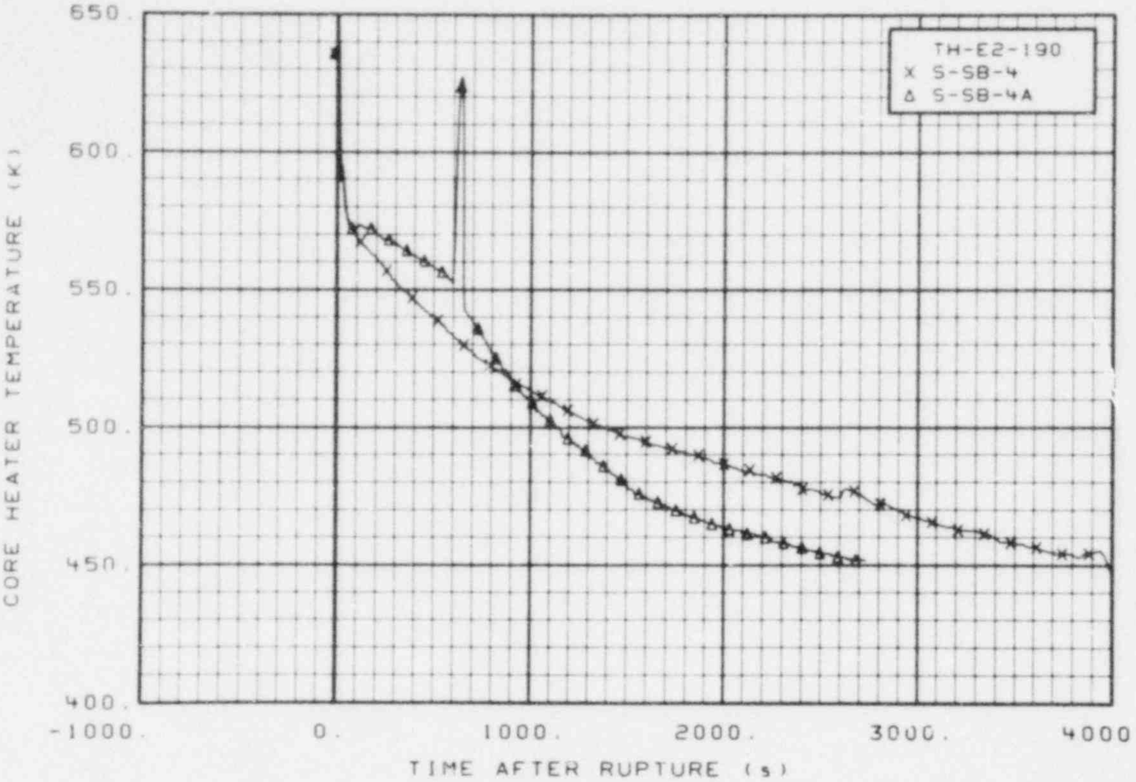


Figure 205. Core heater temperature, Rod E-2 (TH-E2-190), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

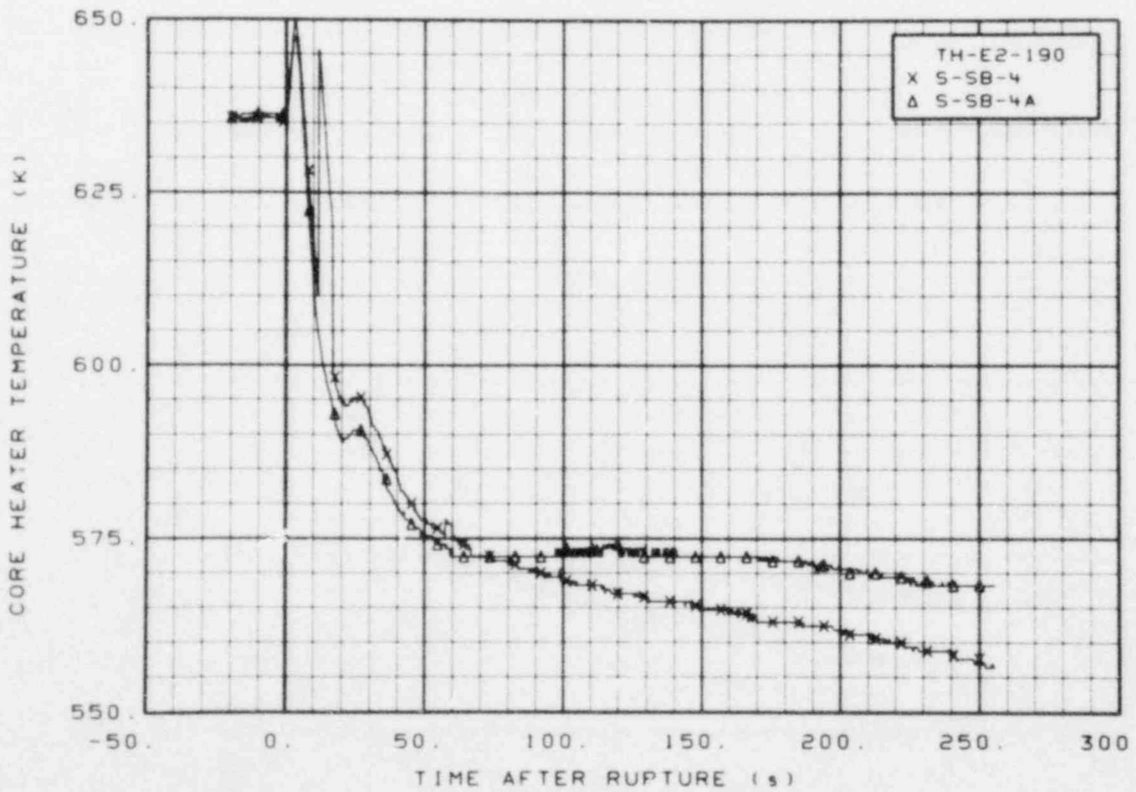


Figure 206. Core heater temperature, Rod E-2 (TH-E2-190), from -20 to 256 s.

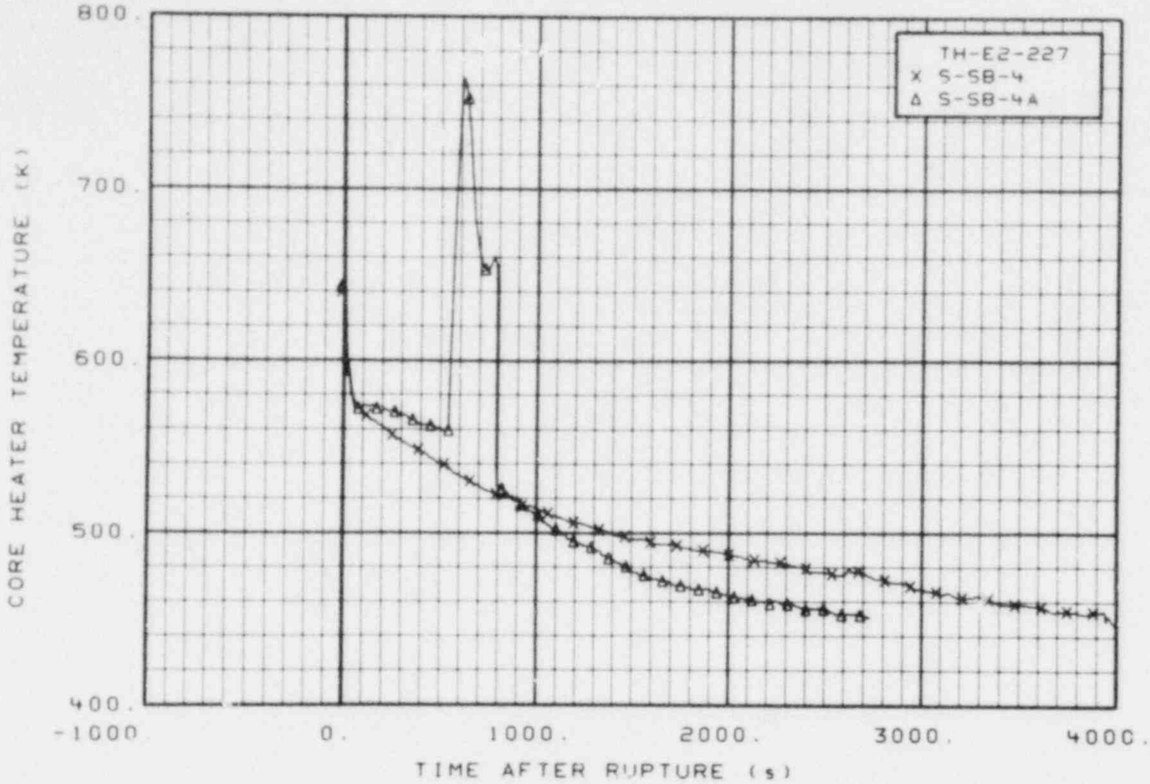


Figure 207. Core heater temperature, Rod E-2 (TH-E2-227), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

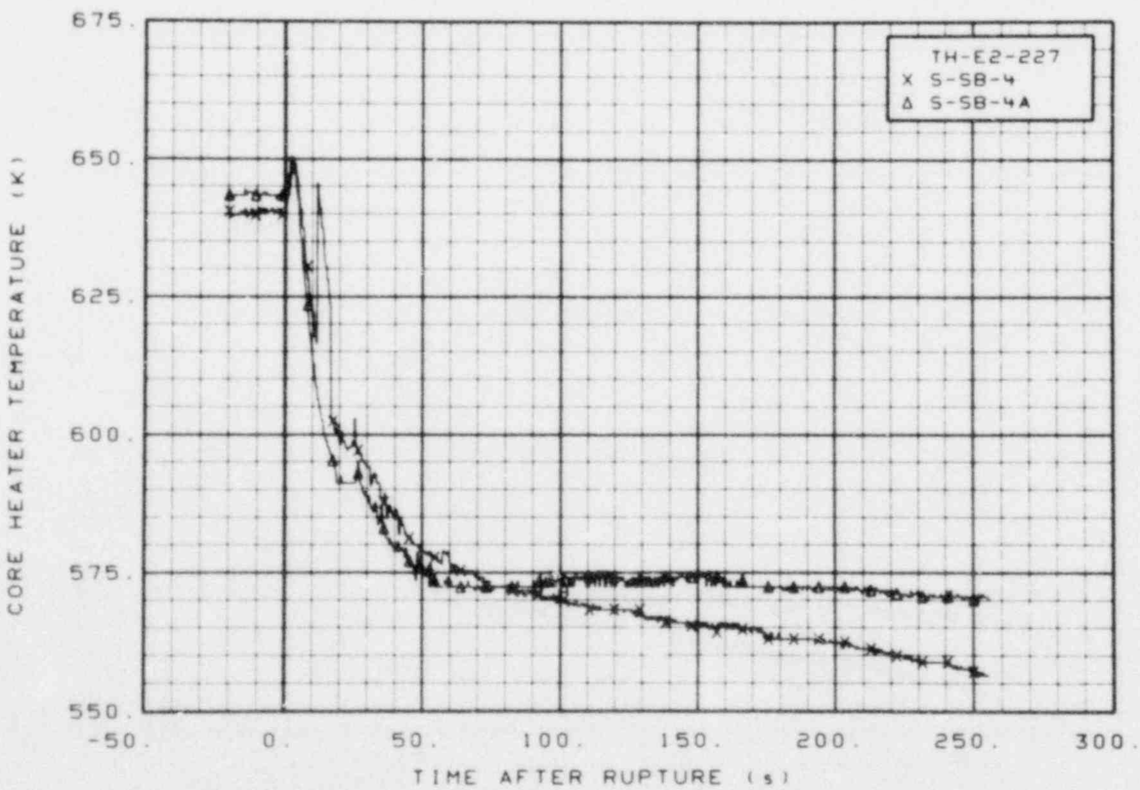


Figure 208. Core heater temperature, Rod E-2 (TH-E2-227), from -20 to 256 s.

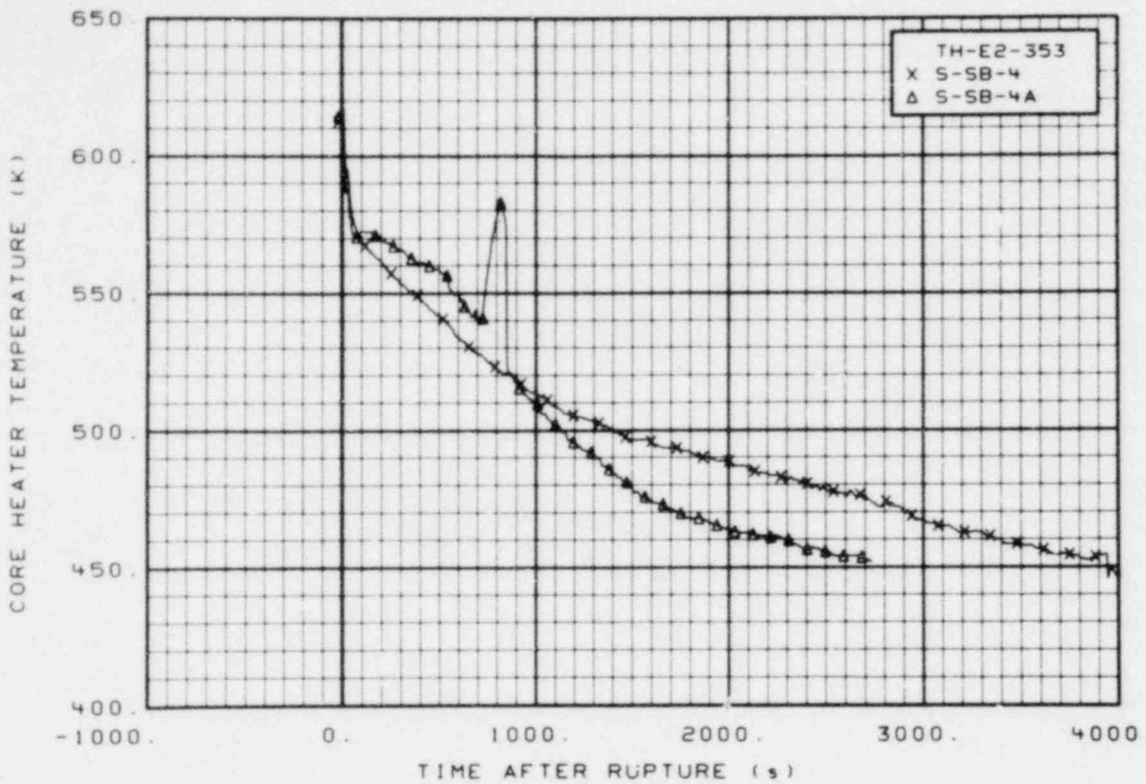


Figure 209. Core heater temperature, Rod E-2 (TH-E2-353), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

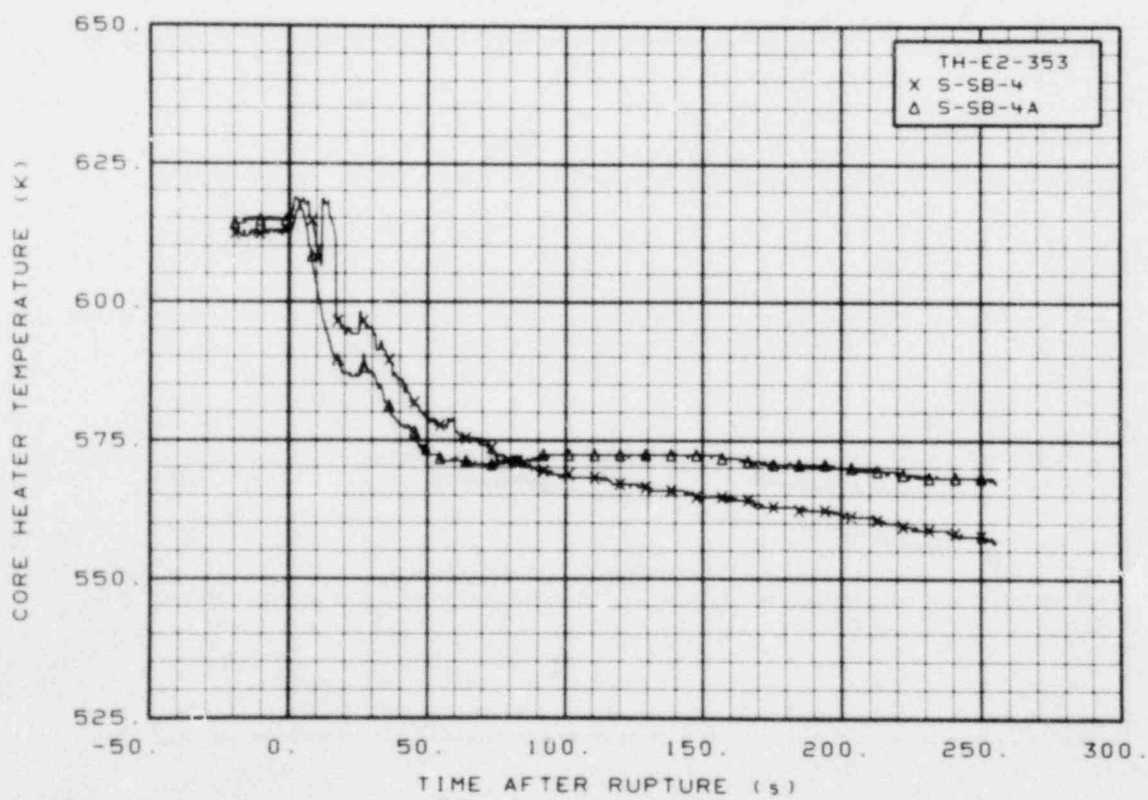


Figure 210. Core heater temperature, Rod E-2 (TH-E2-353), from -20 to 256 s.

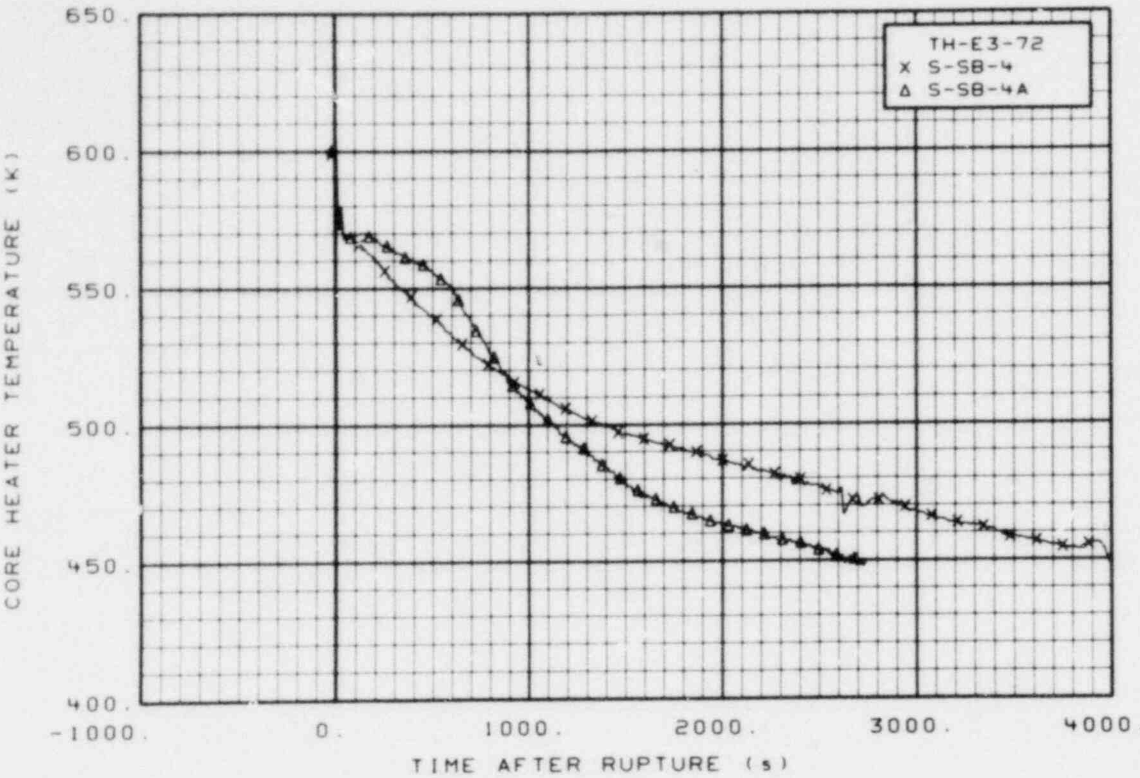


Figure 211. Core heater tempe:ature, Rod E-3 (TH-E3-72), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

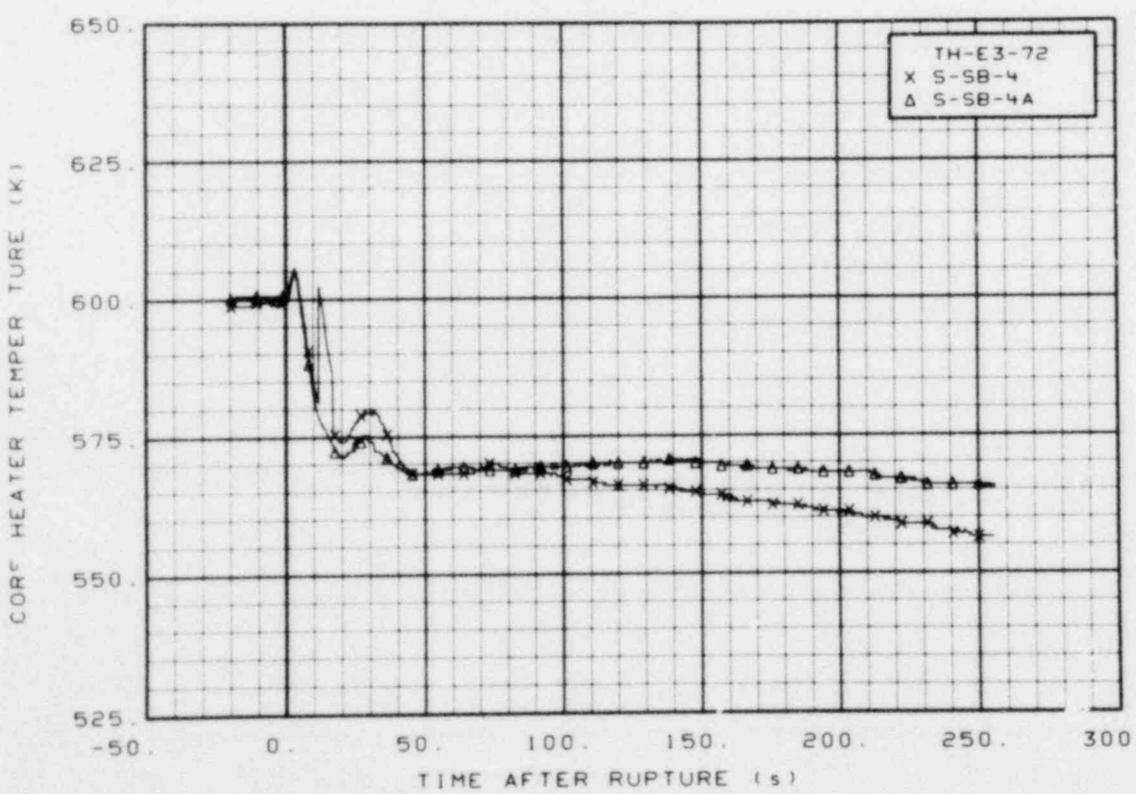


Figure 212. Core heater temperature, Rod E-3 (TH-E3-72), from -20 to 256 s.

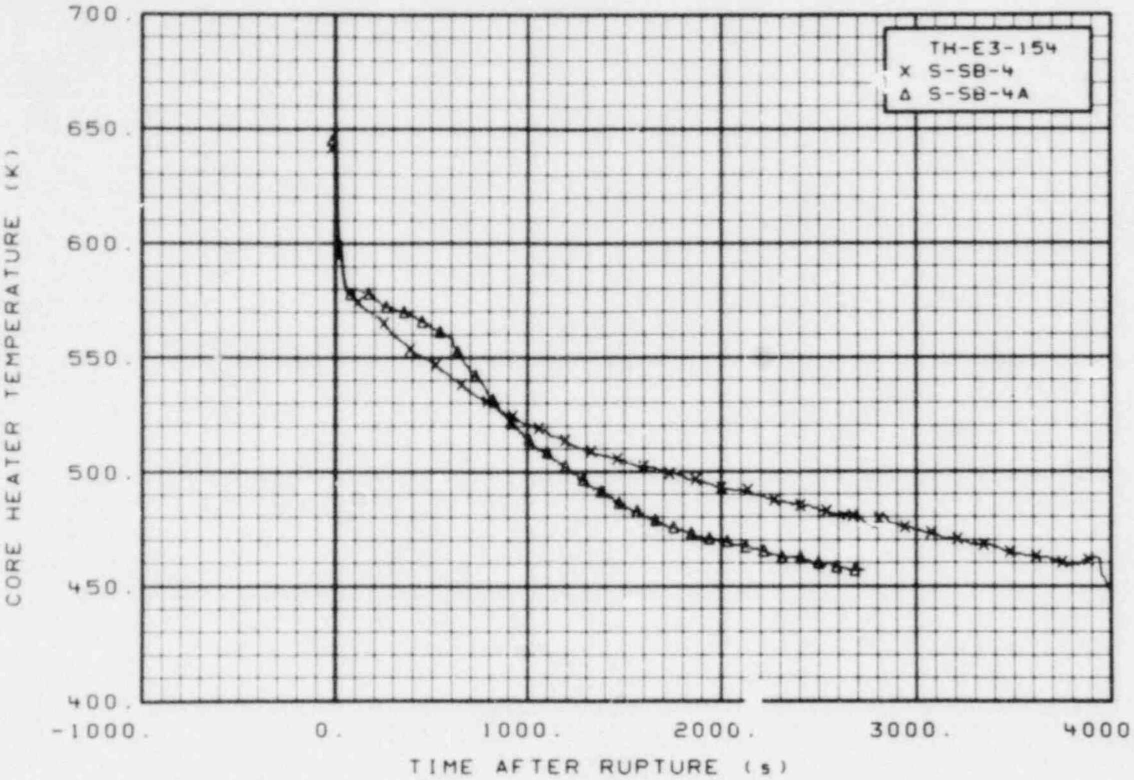


Figure 213. Core heater temperature, Rod E-3 (TH-E3-154), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

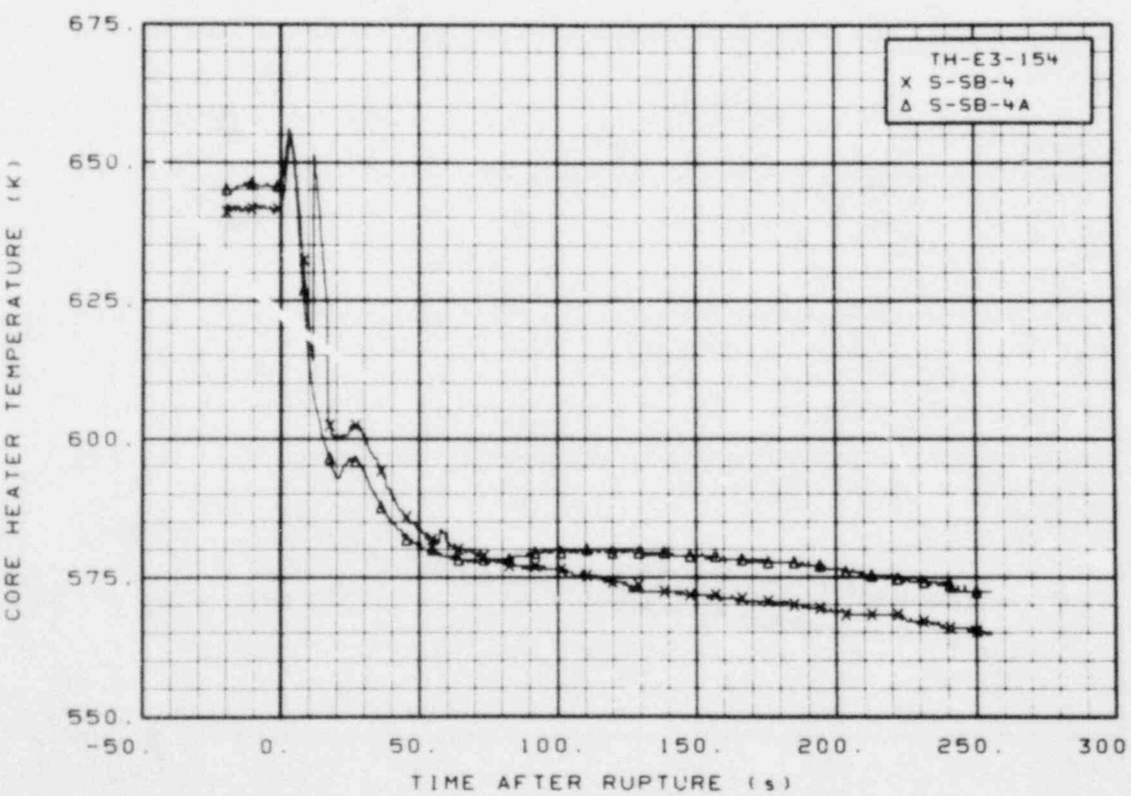


Figure 214. Core heate: emperature, Rod E-3 (TH-E3-154), from -2ª to 256 s.

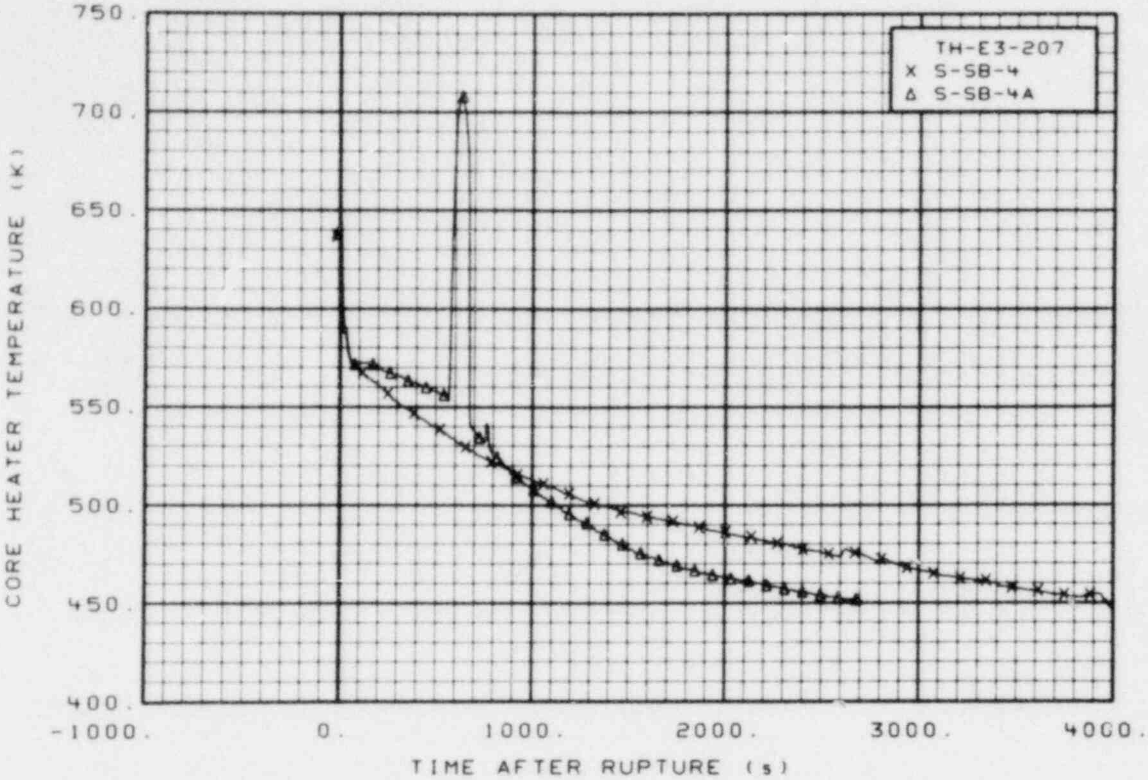


Figure 215. Core heater temperature, Rod E-3 (TH-E3-207), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

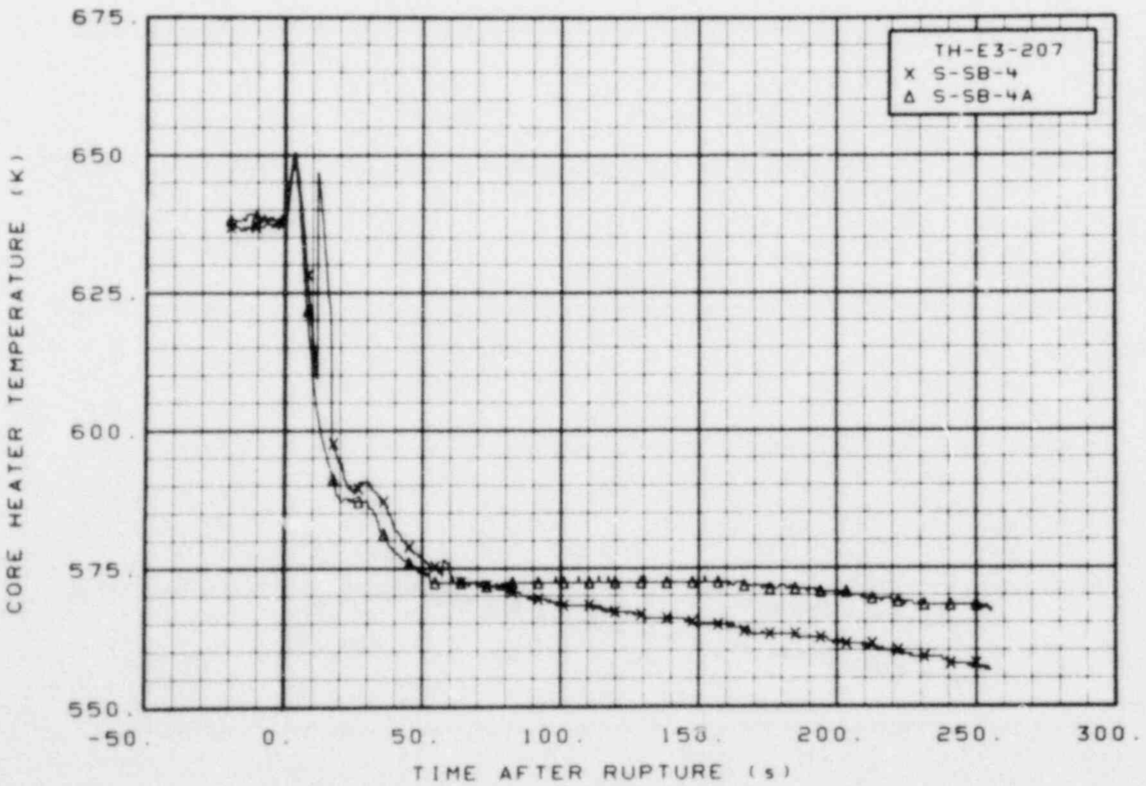


Figure 216. Core heater temperature, Rod E-3 (TH-E3-207), from -20 to 256 s.

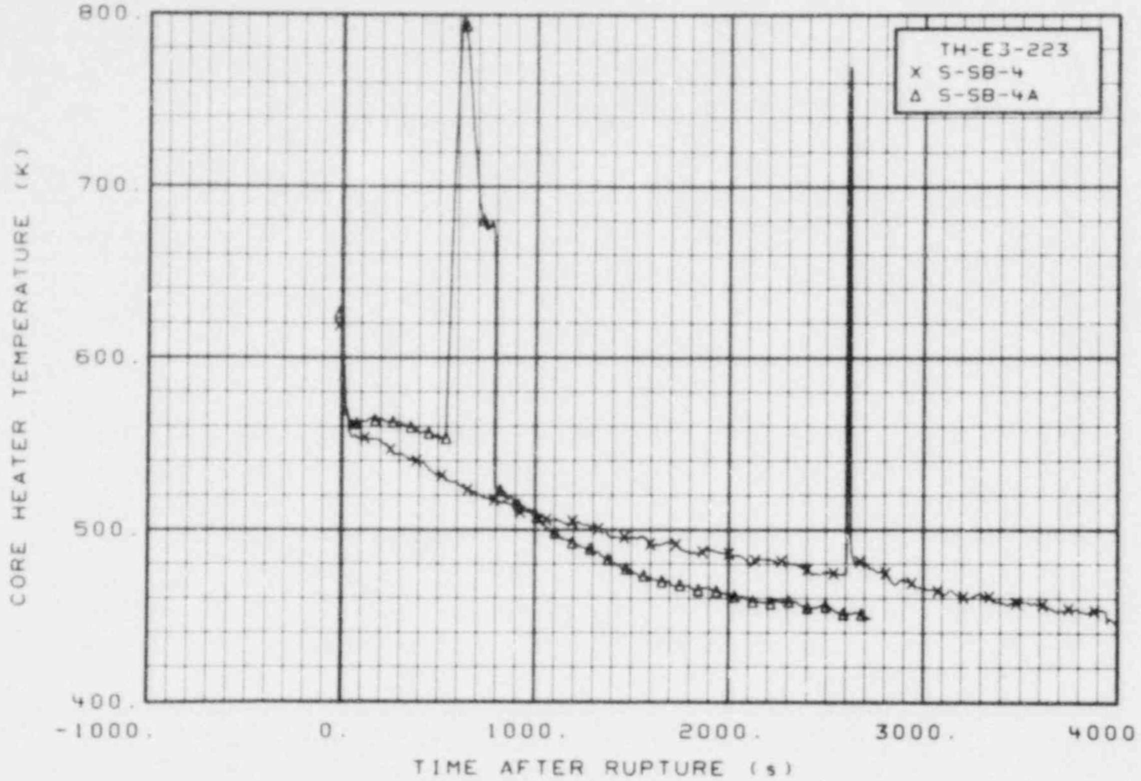


Figure 217. Core heater temperature, Rod E-3 (TH-E3-223), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

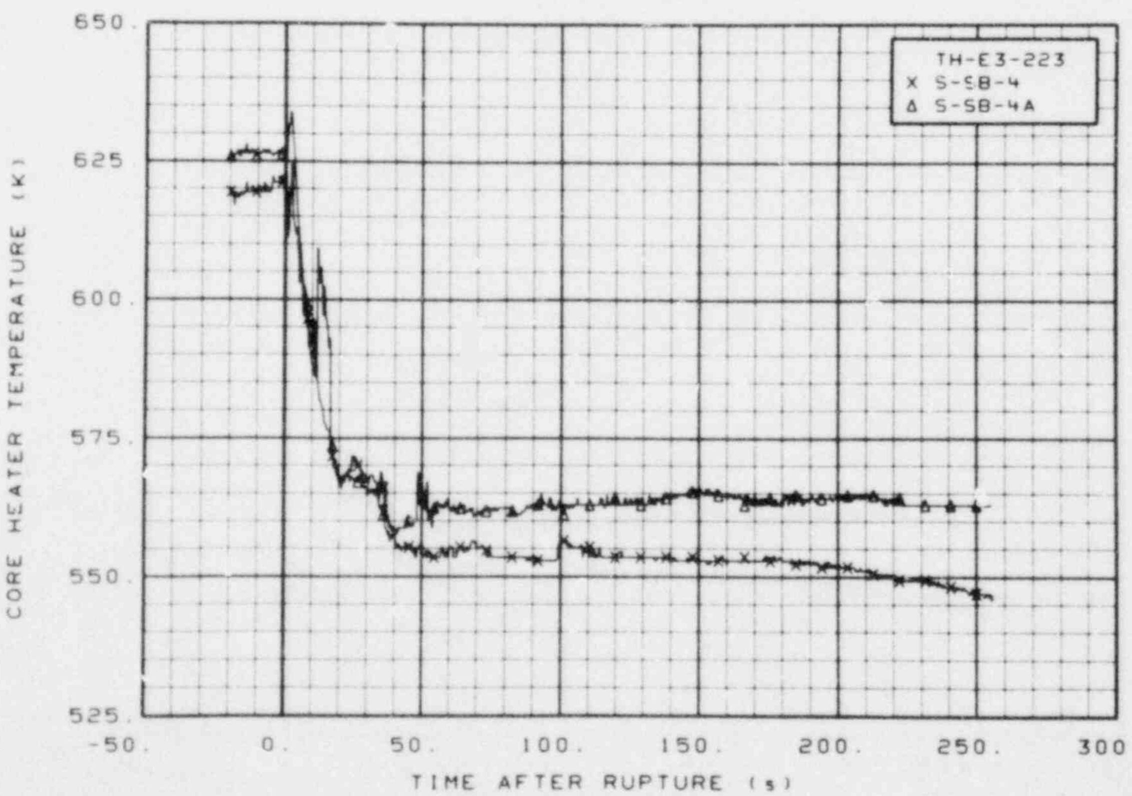


Figure 218. Core heater temperature, Rod E-3 (TH-E3-223), from -20 to 256 s.

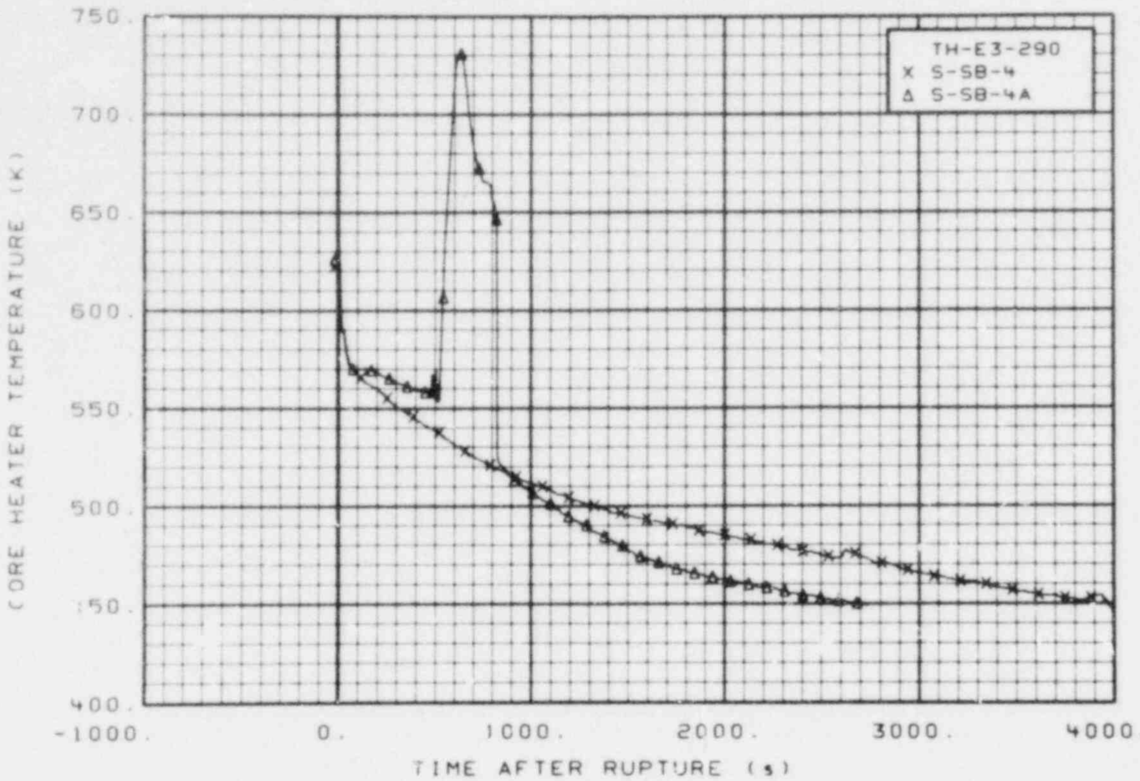


Figure 219. Core heater temperature, Rod E-3 (TH-E3-290), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

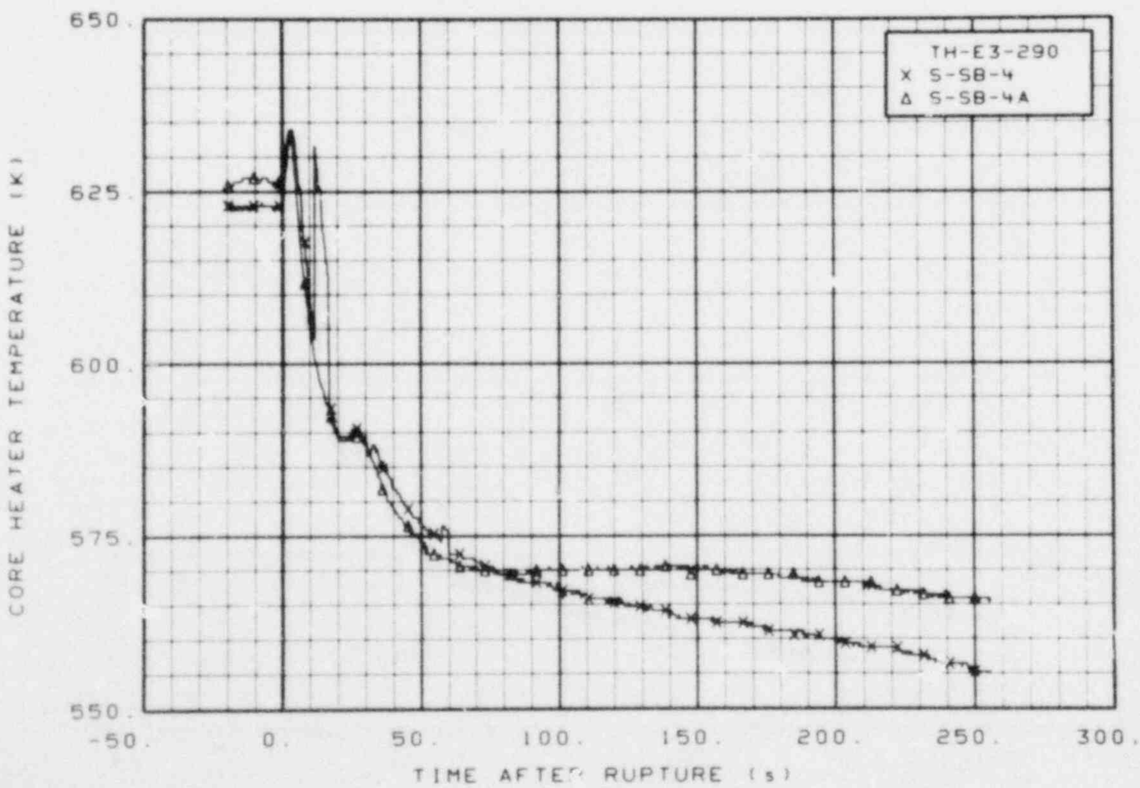


Figure 220. Core heater temperature, Rod E-3 (TH-E3-290), from -20 to 256 s.

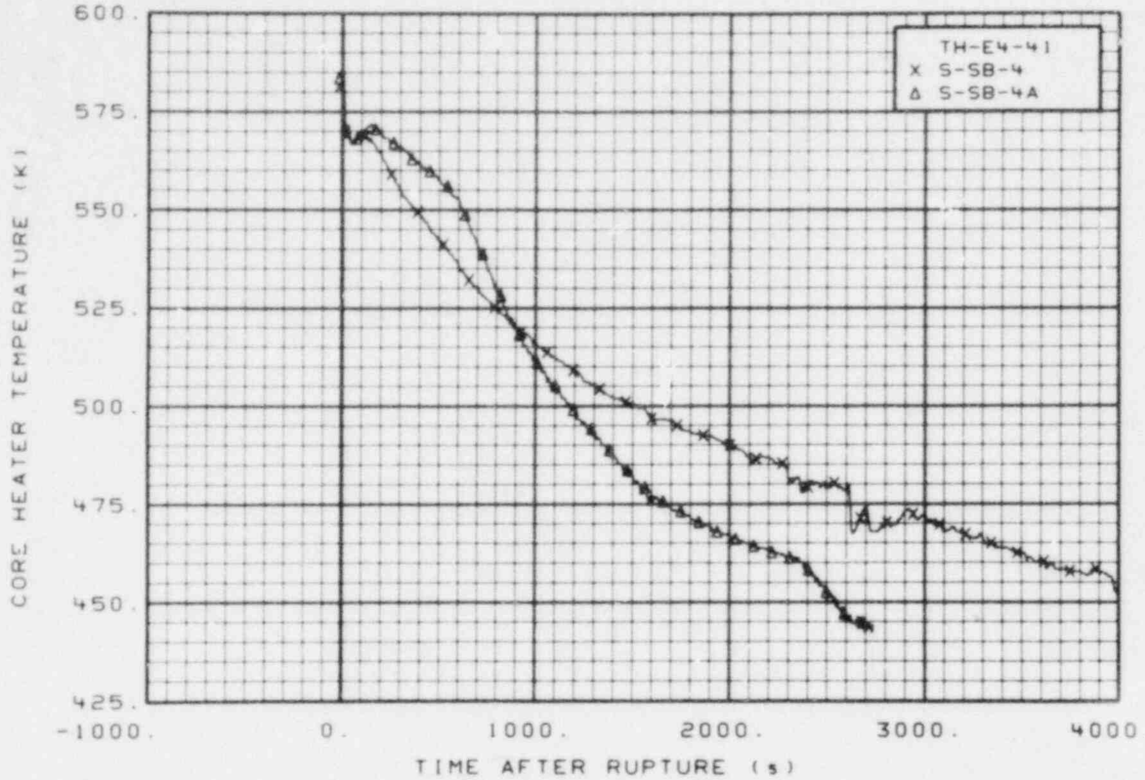


Figure 221. Core heater temperature, Rod E-4 (TH-E4-41), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

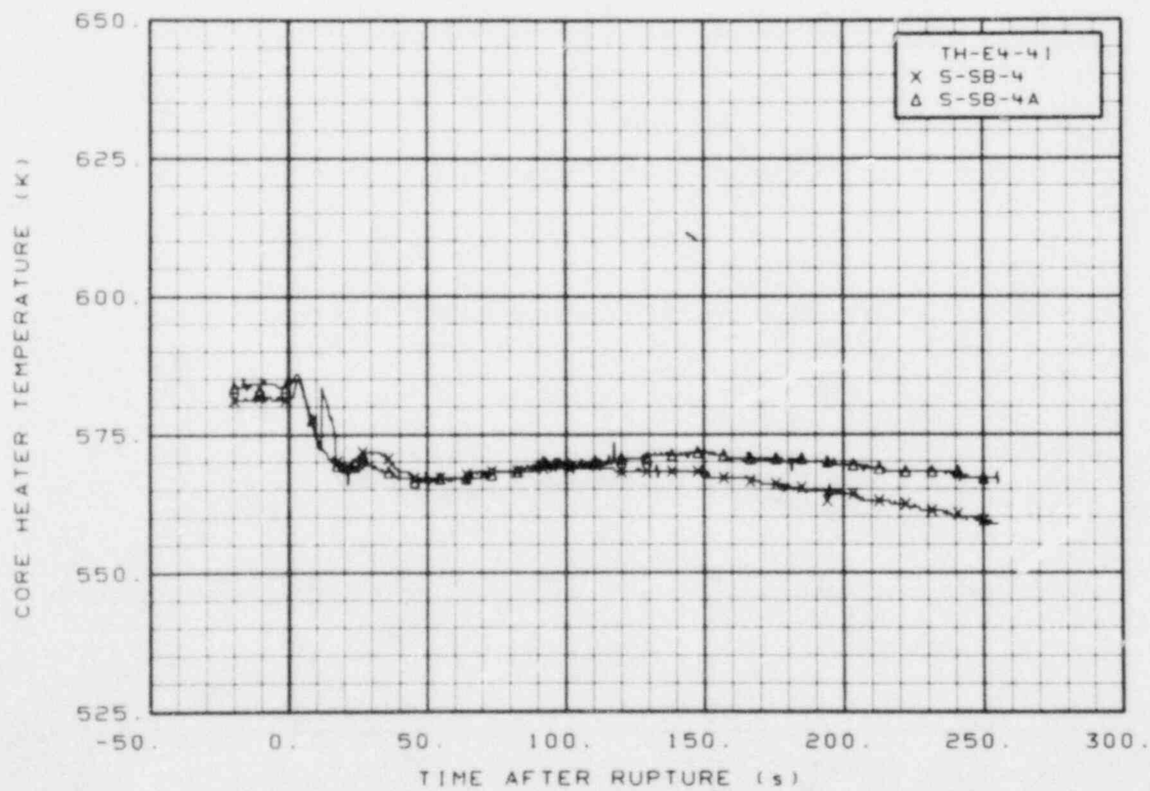


Figure 222. Core heater temperature, Rod E-4 (TH-E4-41), from -20 to 256 s.

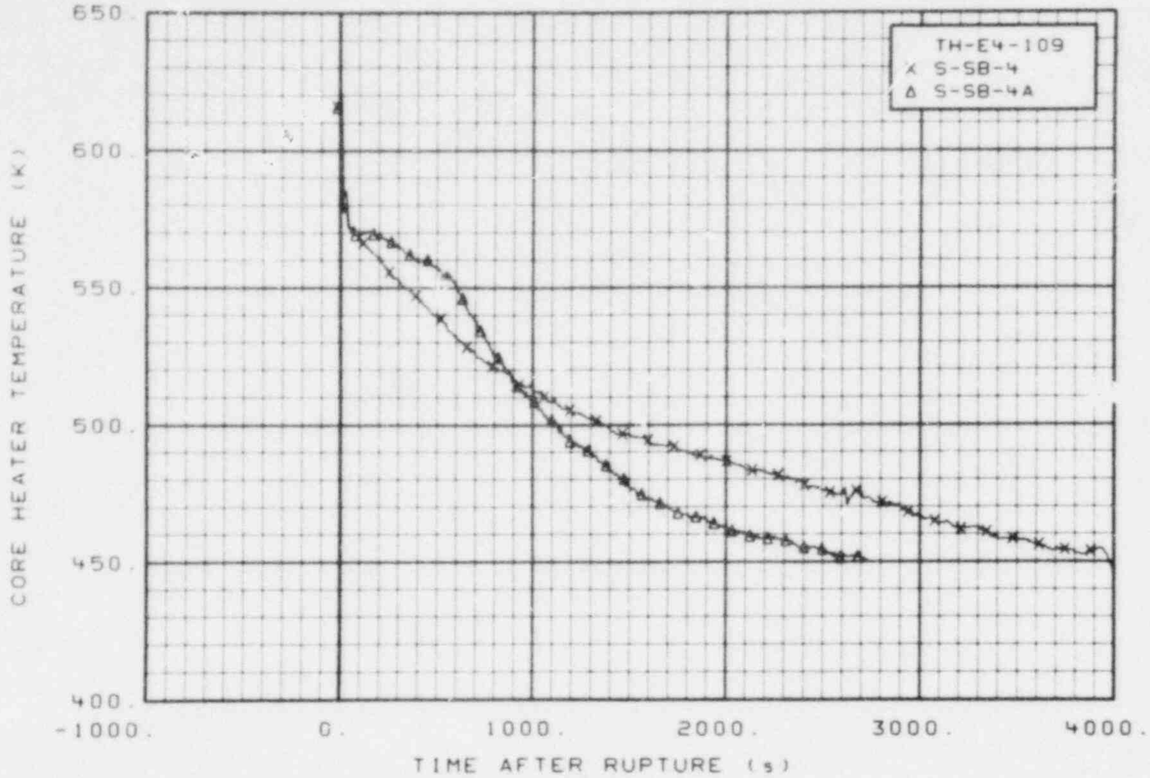


Figure 223. Core heater temperature, Rod E-4 (TH-E4-109), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

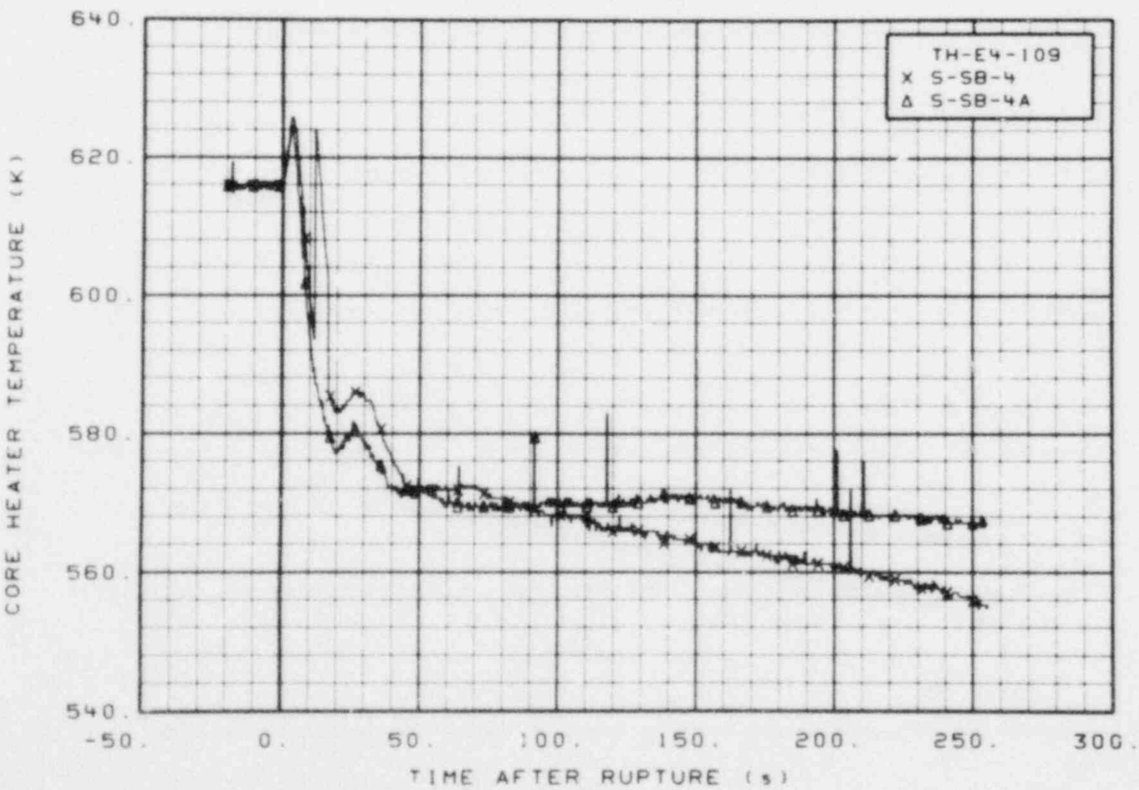


Figure 224. Core heater temperature, Rod E-4 (TH-E4-109), from -20 to 256 s.

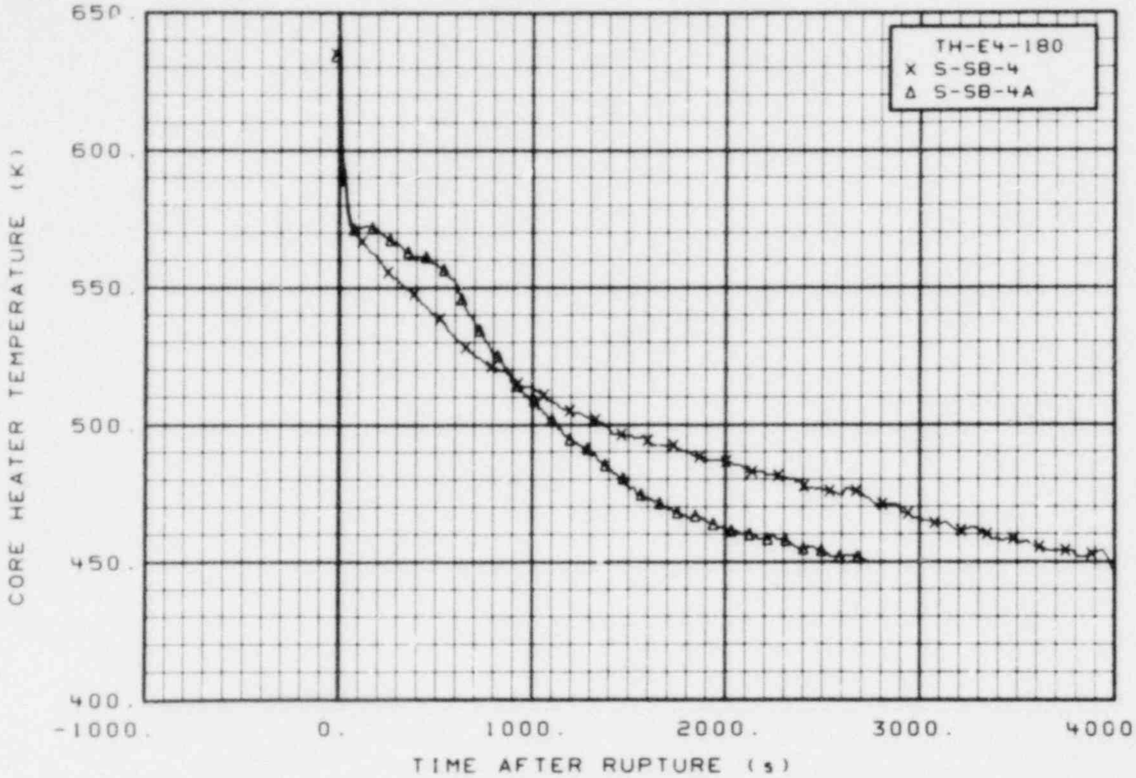


Figure 225. Core heater temperature, Rod E-4 (TH-E4-180), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

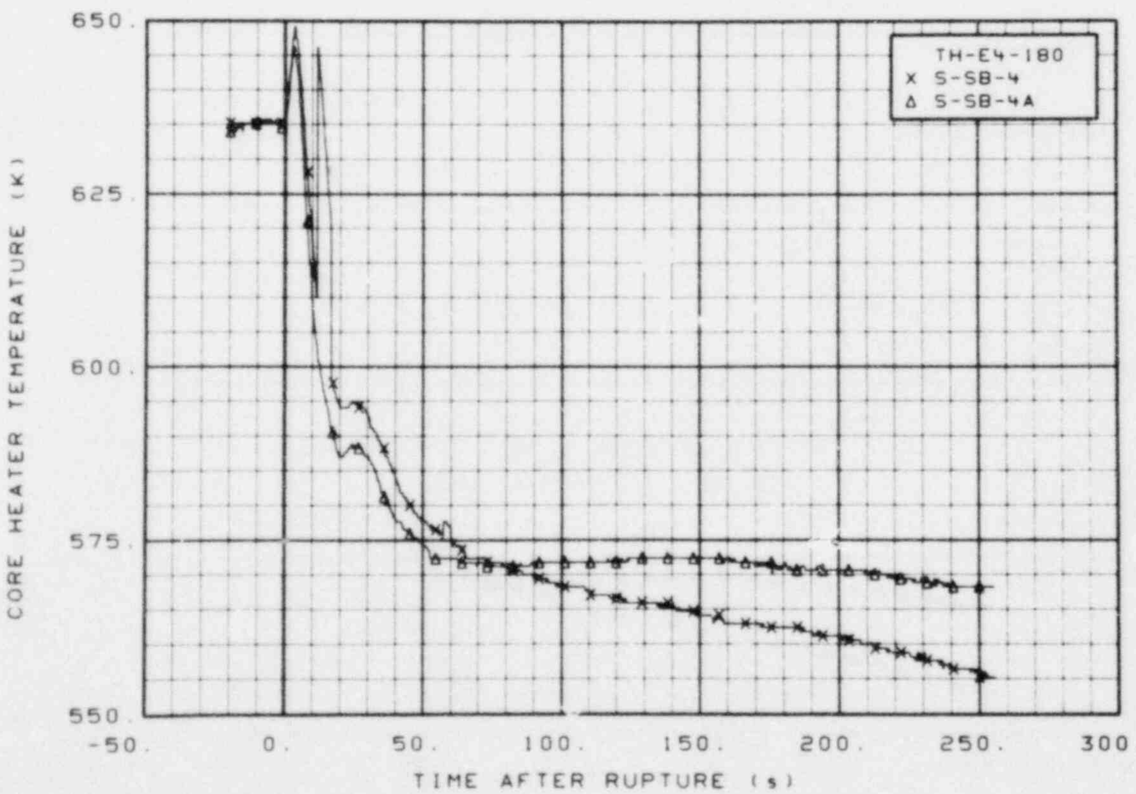


Figure 226. Core heater temperature, Rod E-4 (TH-E4-180), from -20 to 256 s.

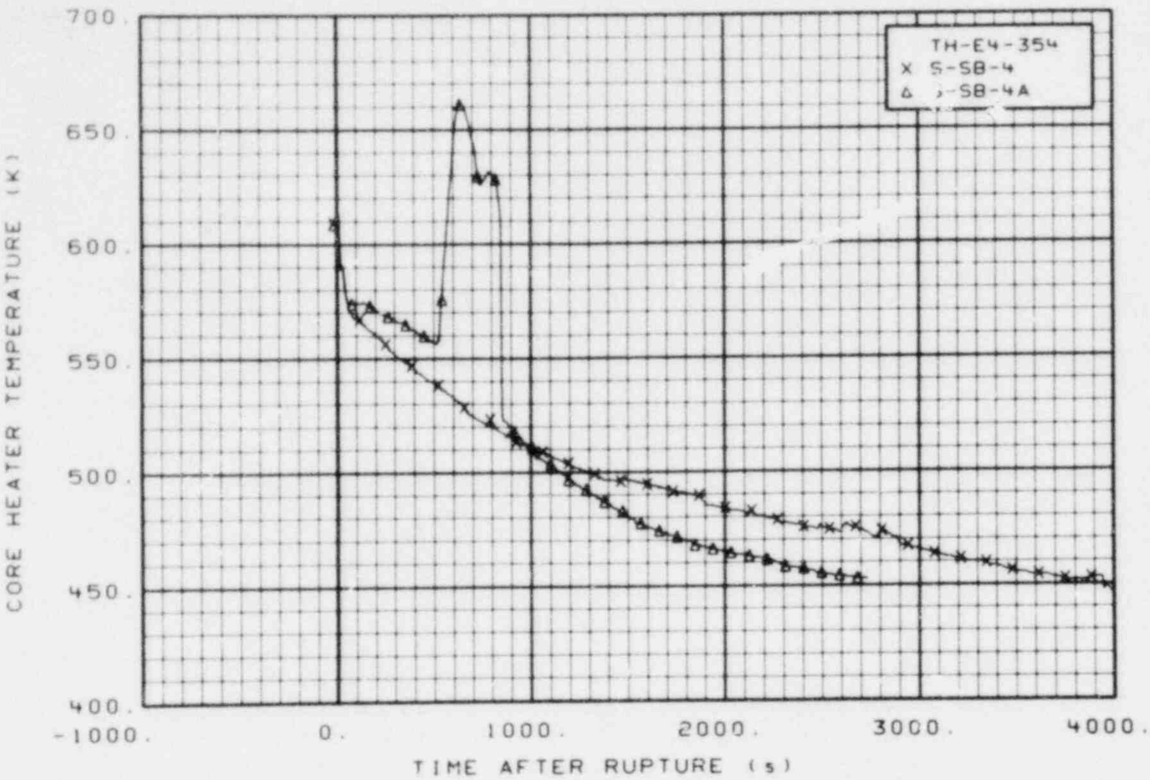


Figure 227. Core heater temperature, Rod E-4 (TH-E4-354), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

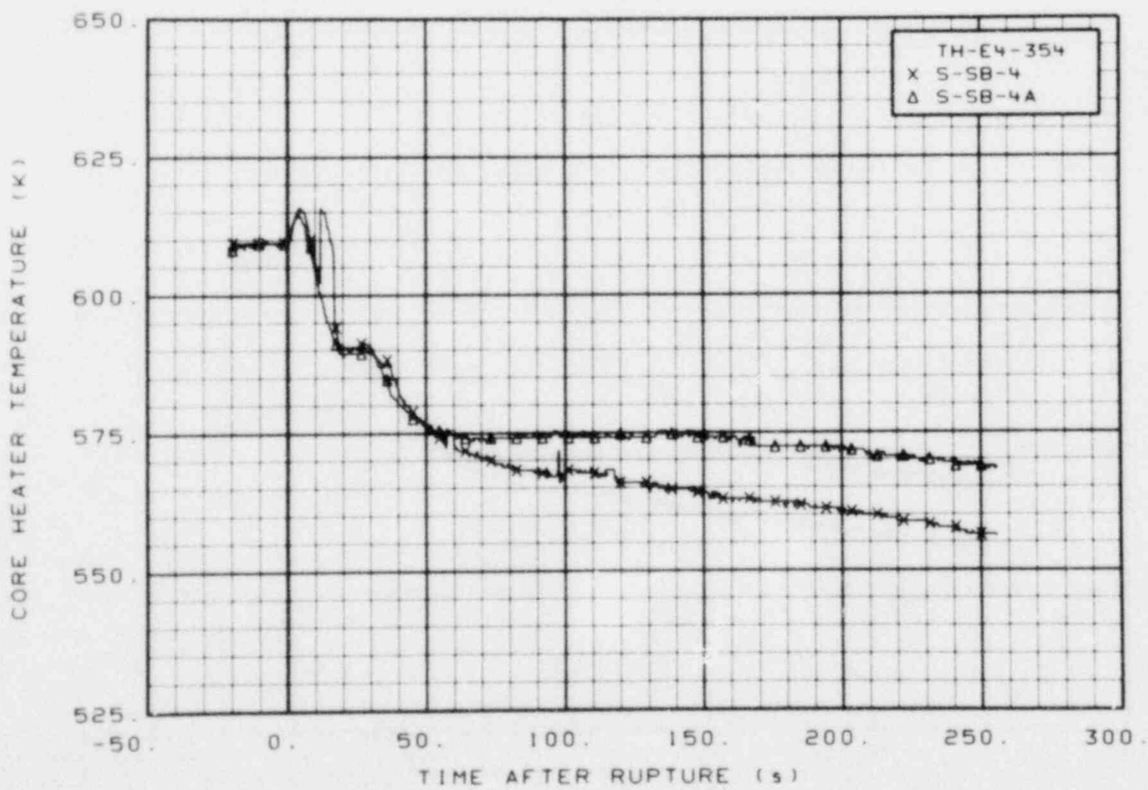


Figure 228. Core heater temperature, Rod E-4 (TH-E4-354), from -20 to 256 s.

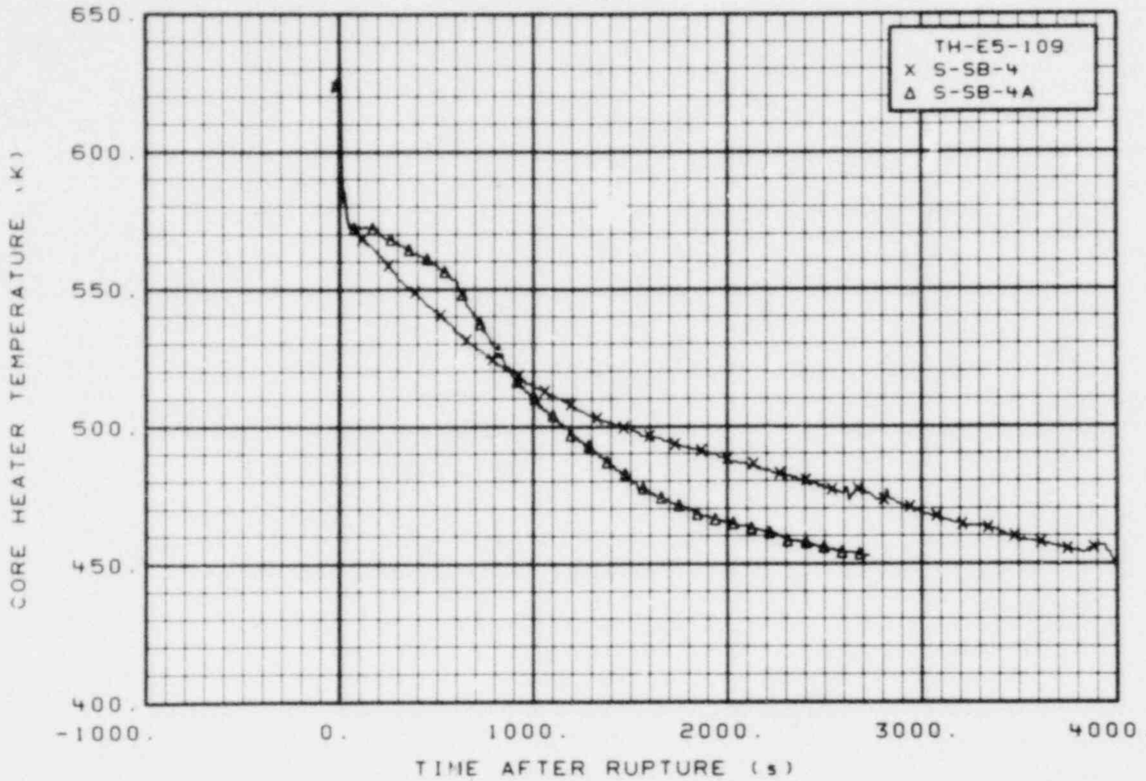


Figure 229. Core heater temperature, Rod E-5 (TH-E5-109), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

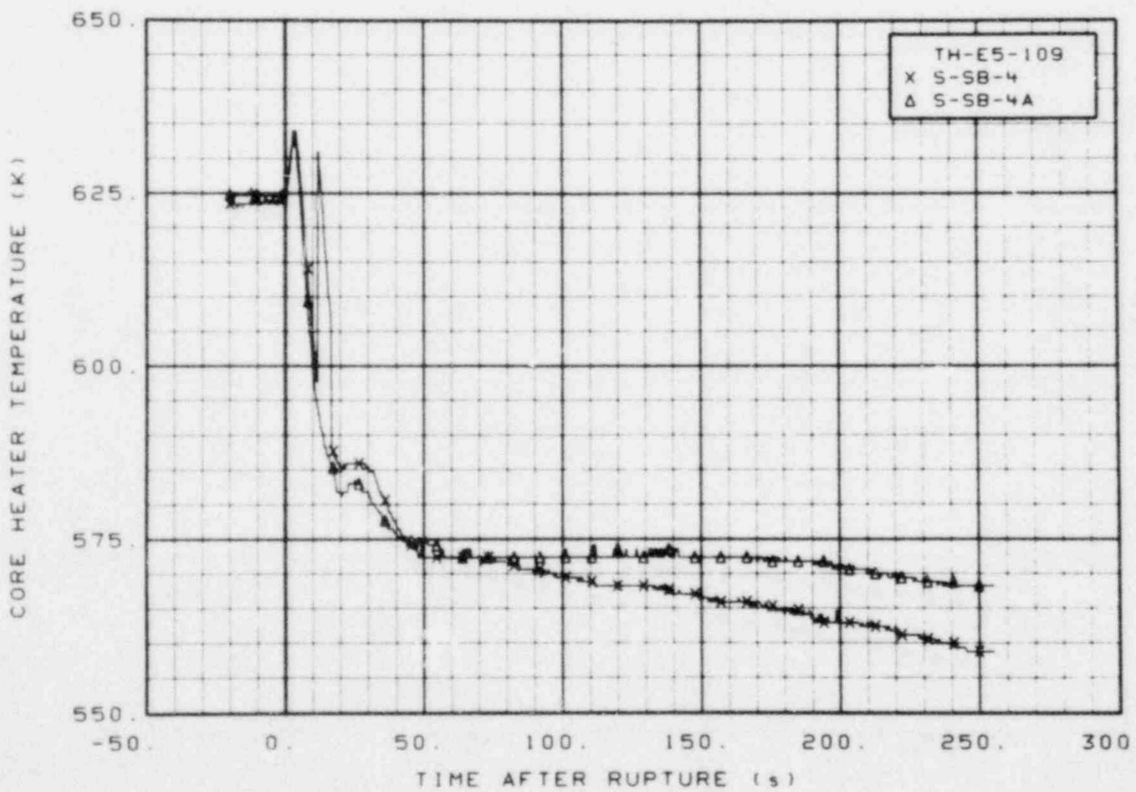


Figure 230. Core heater temperature, Rod E-5 (TH-E5-109), from -20 to 256 s.

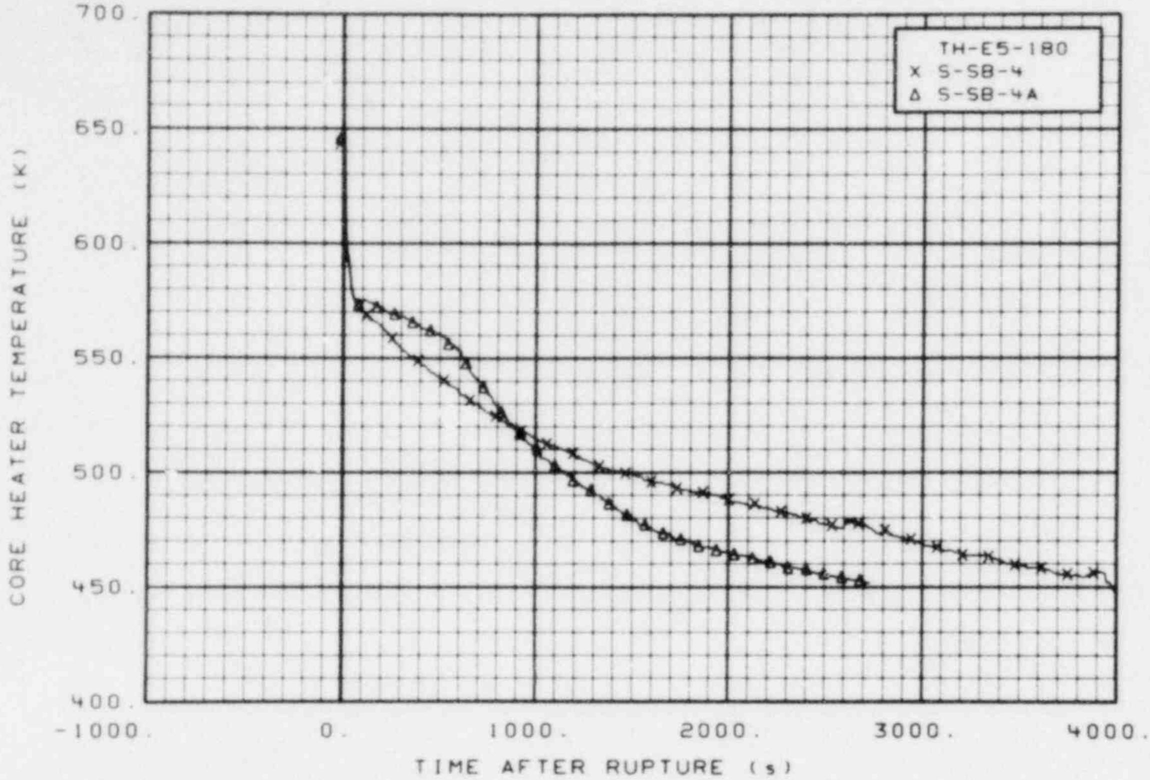


Figure 231. Core heater temperature, Rod E-5 (TH-E5-180), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

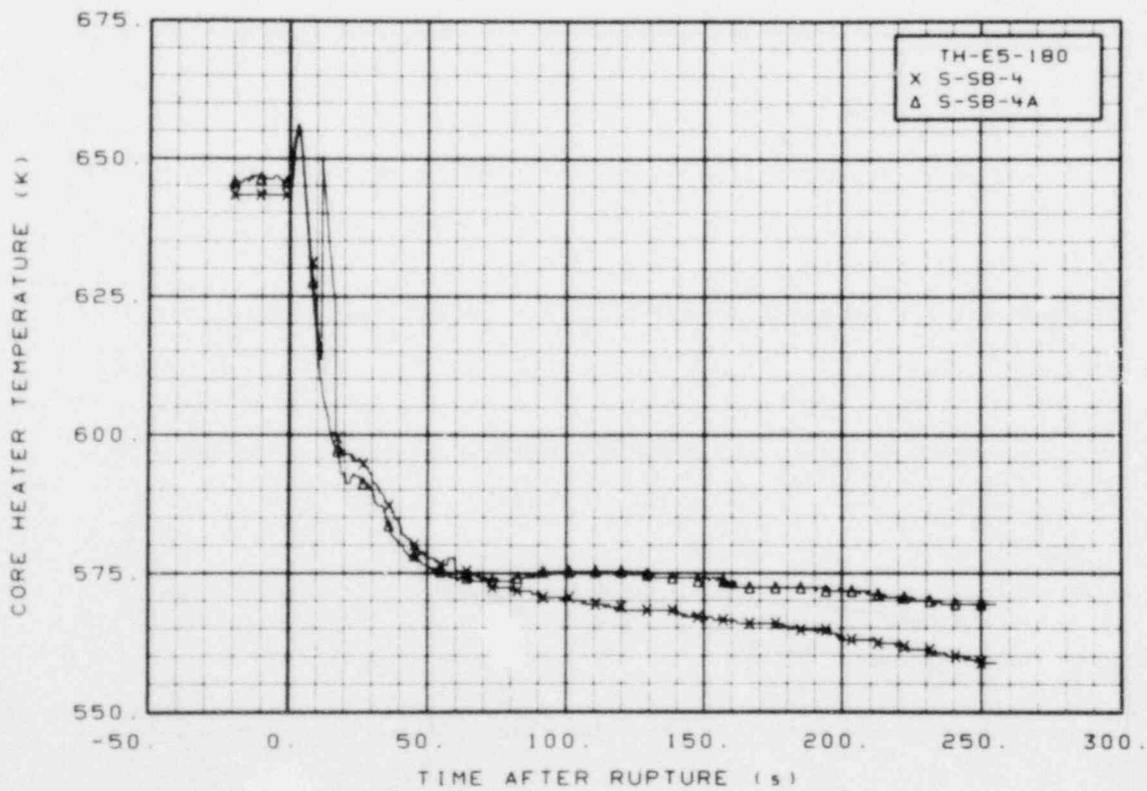


Figure 232. Core heater temperature, Rod E-5 (TH-E5-180), from -20 to 256 s.

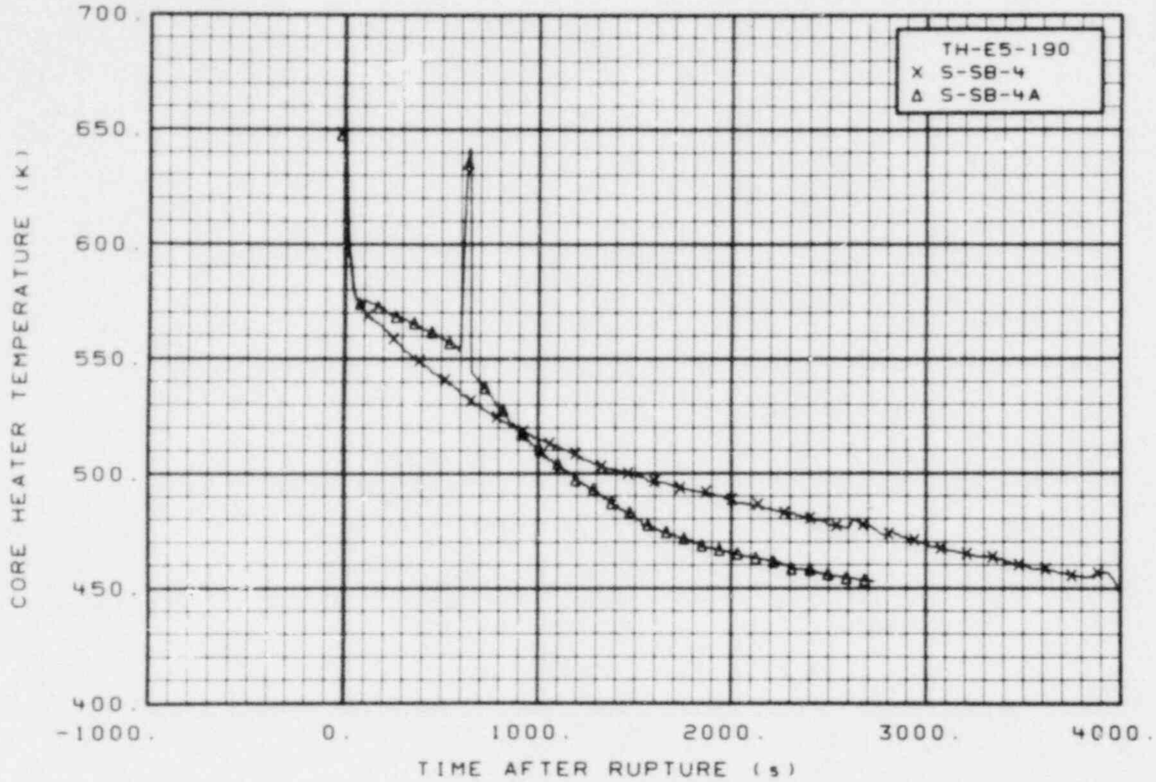


Figure 233. Core heater temperature, Rod E-5 (TH-E5-190), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

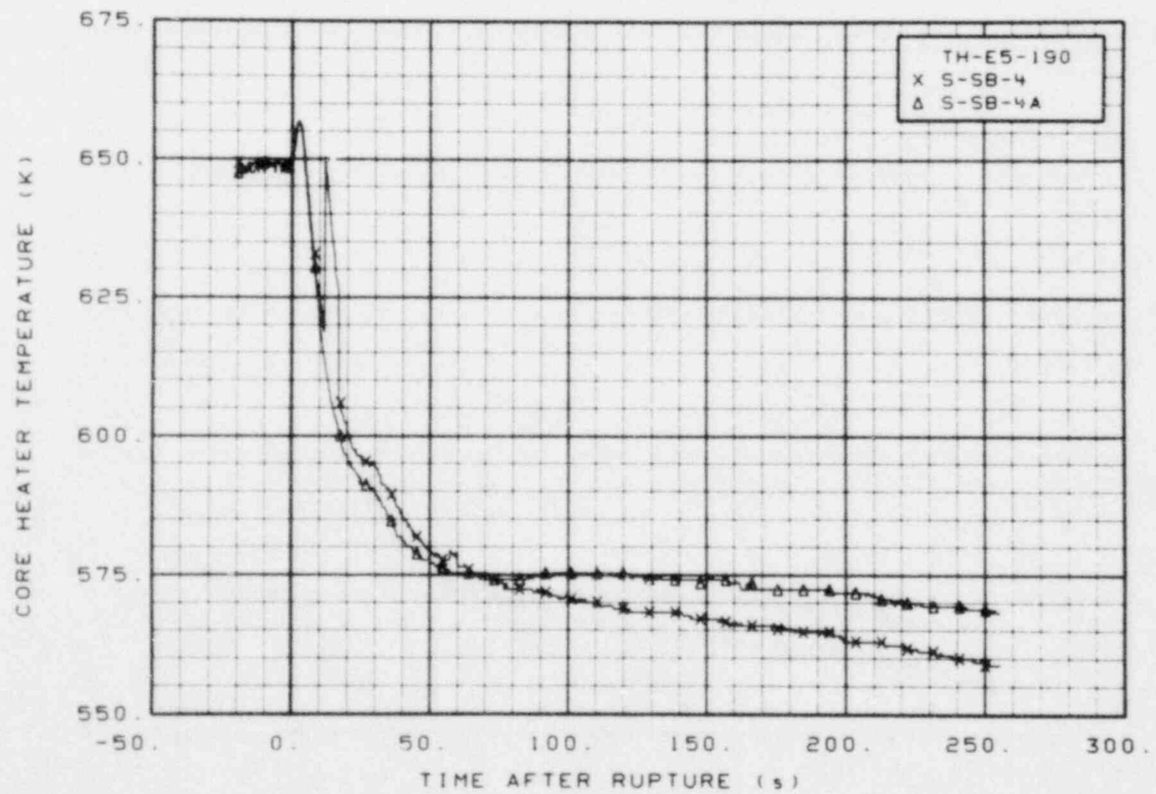


Figure 234. Core heater temperature, Rod E-5 (TH-E5-190), from -20 to 256 s.

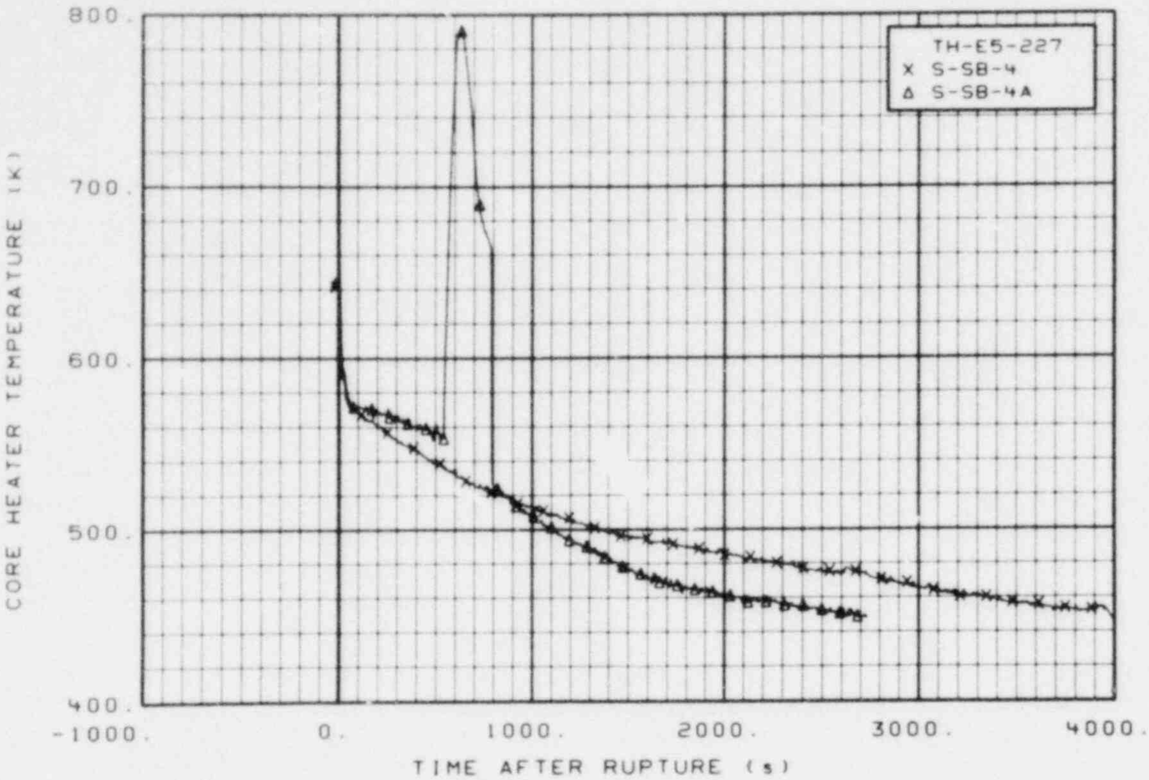


Figure 235. Core heater temperature, Rod E-5 (TH-E5-227), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

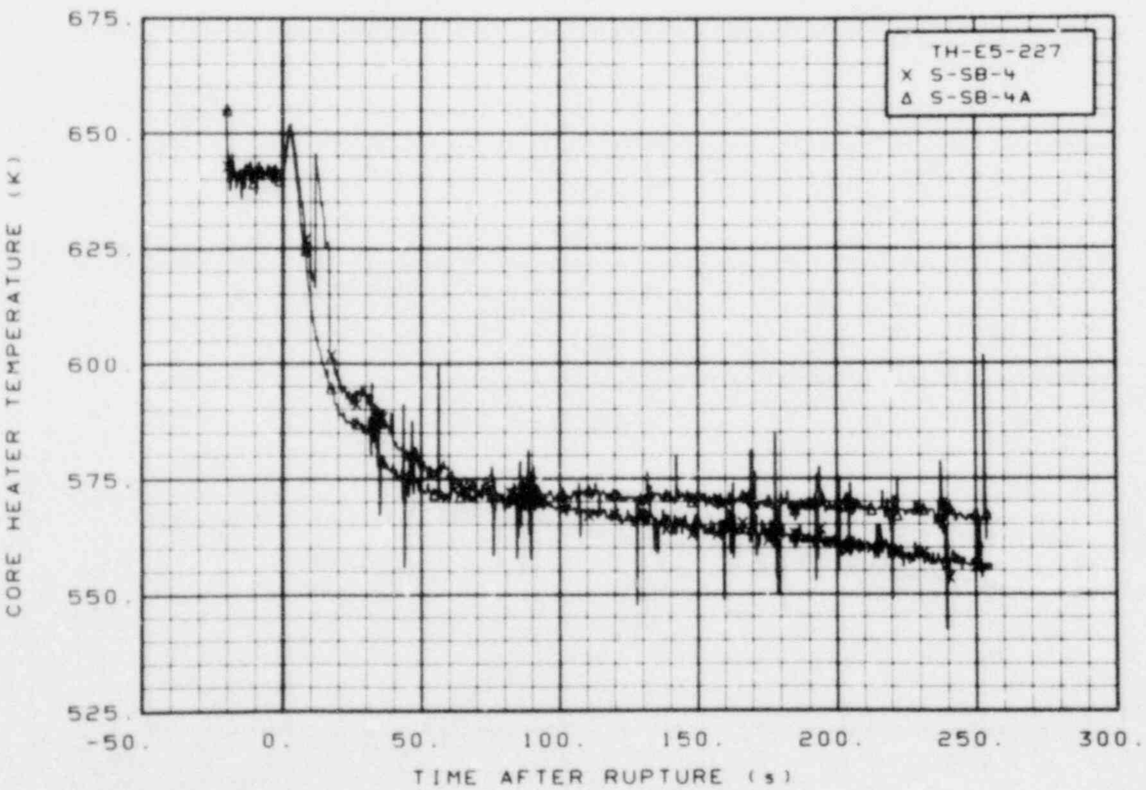


Figure 236. Core heater temperature, Rod E-5 (TH-E5-227), from -20 to 256 s.

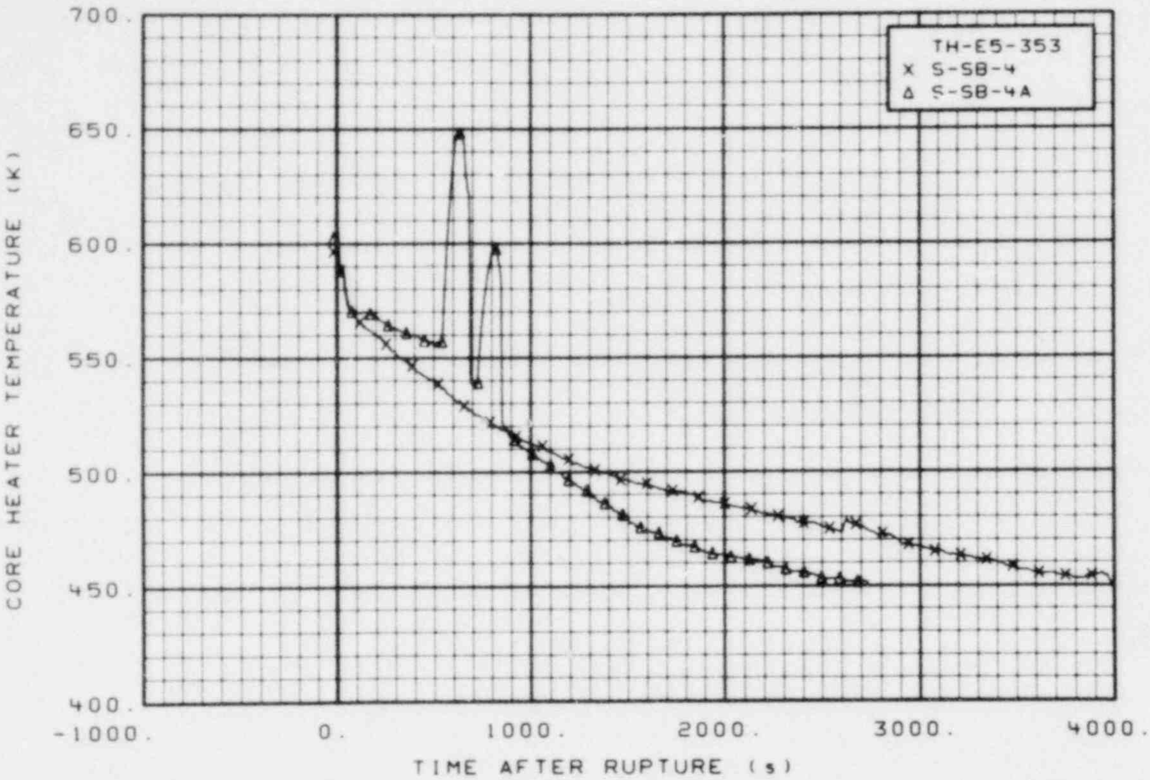


Figure 237. Core heater temperature, Rod E-5 (TH-E5-353), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

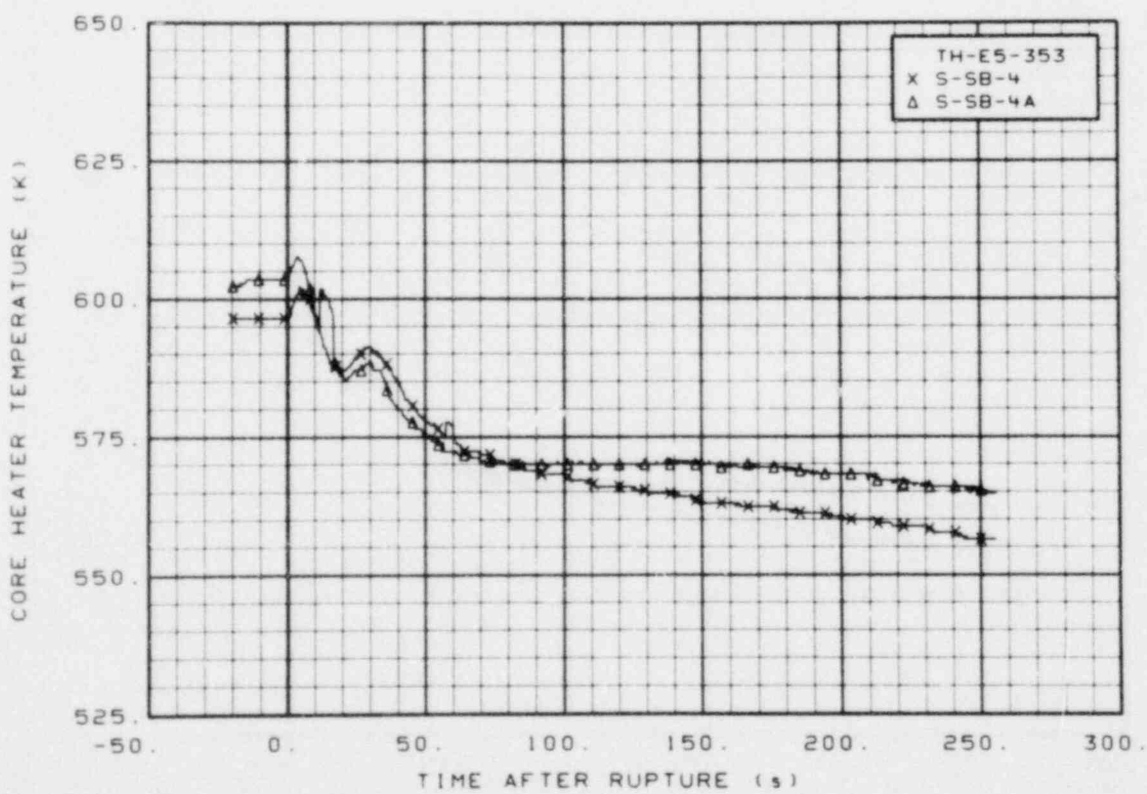


Figure 238. Core heater temperature, Rod E-5 (TH-E5-353), from -20 to 256 s.

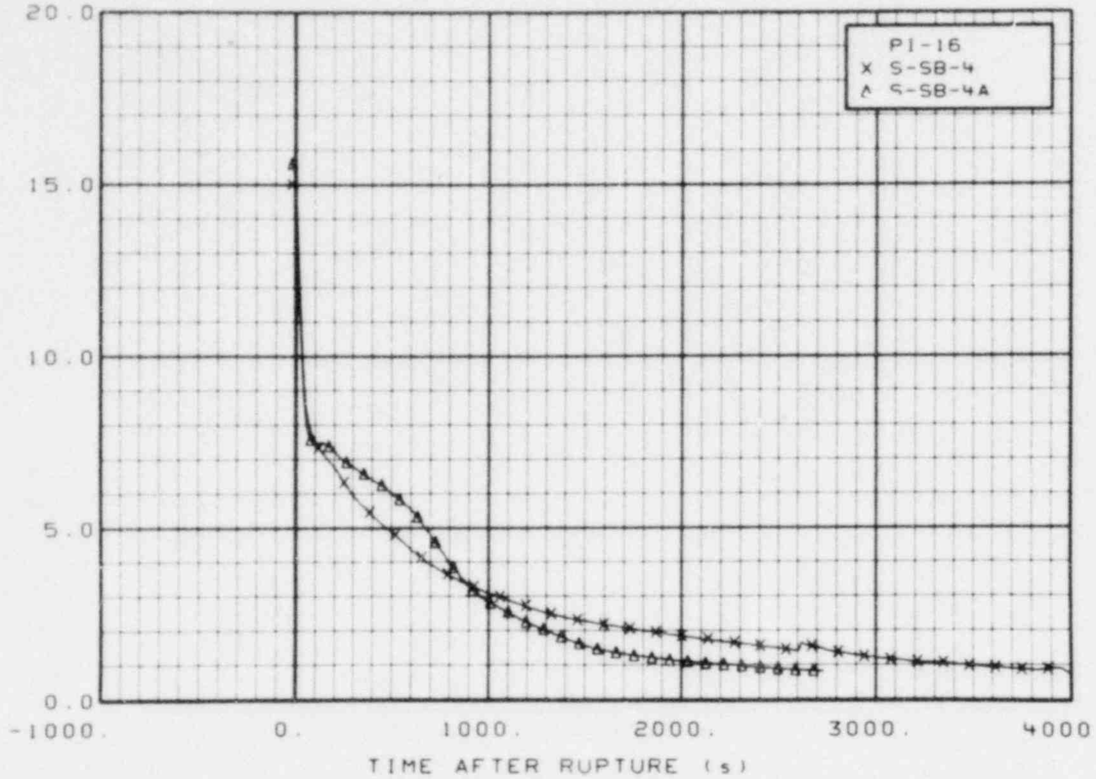


Figure 239. Pressure in intact loop cold leg (PI-16), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

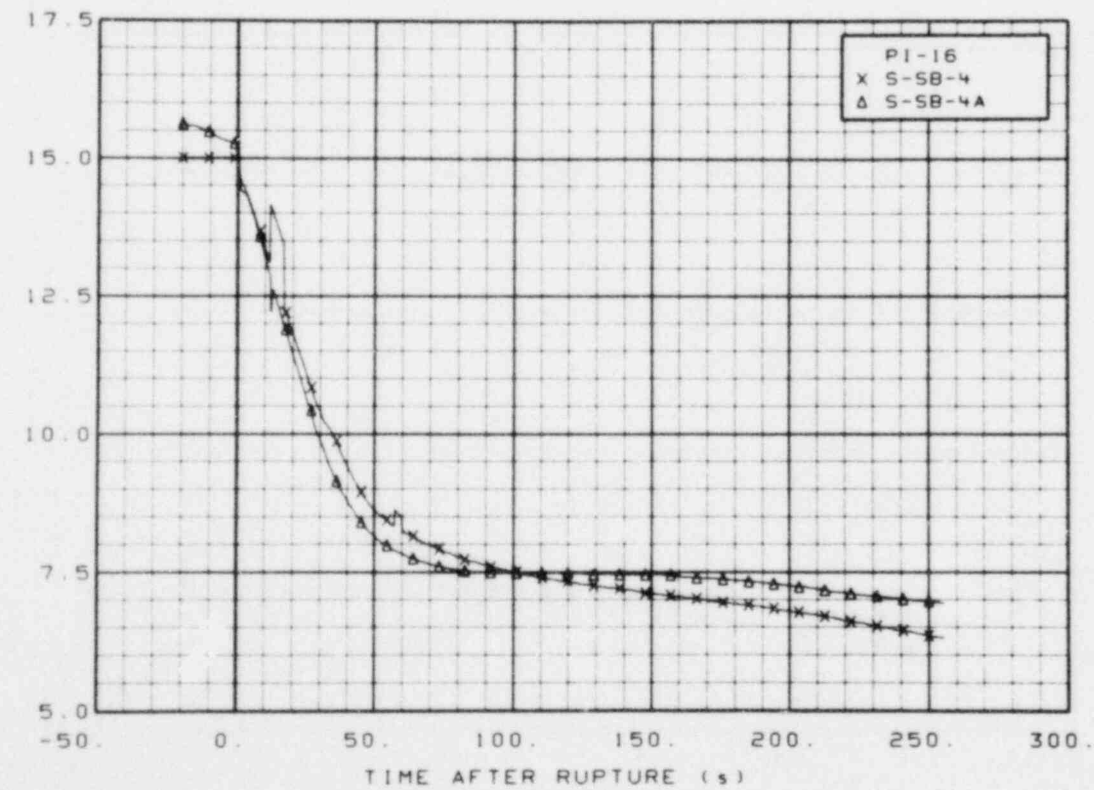


Figure 240. Pressure in intact loop cold leg (PI-16), from -20 to 256 s.

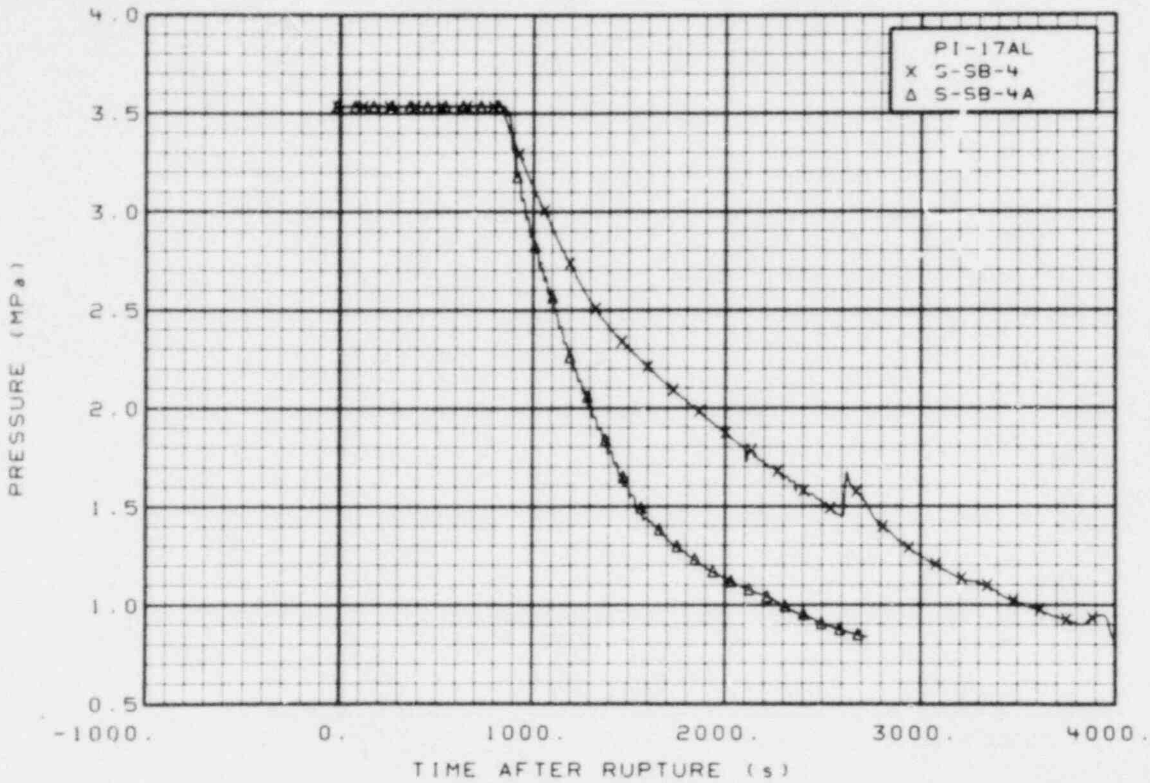


Figure 241. Pressure in intact loop cold leg (PI-17AL), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

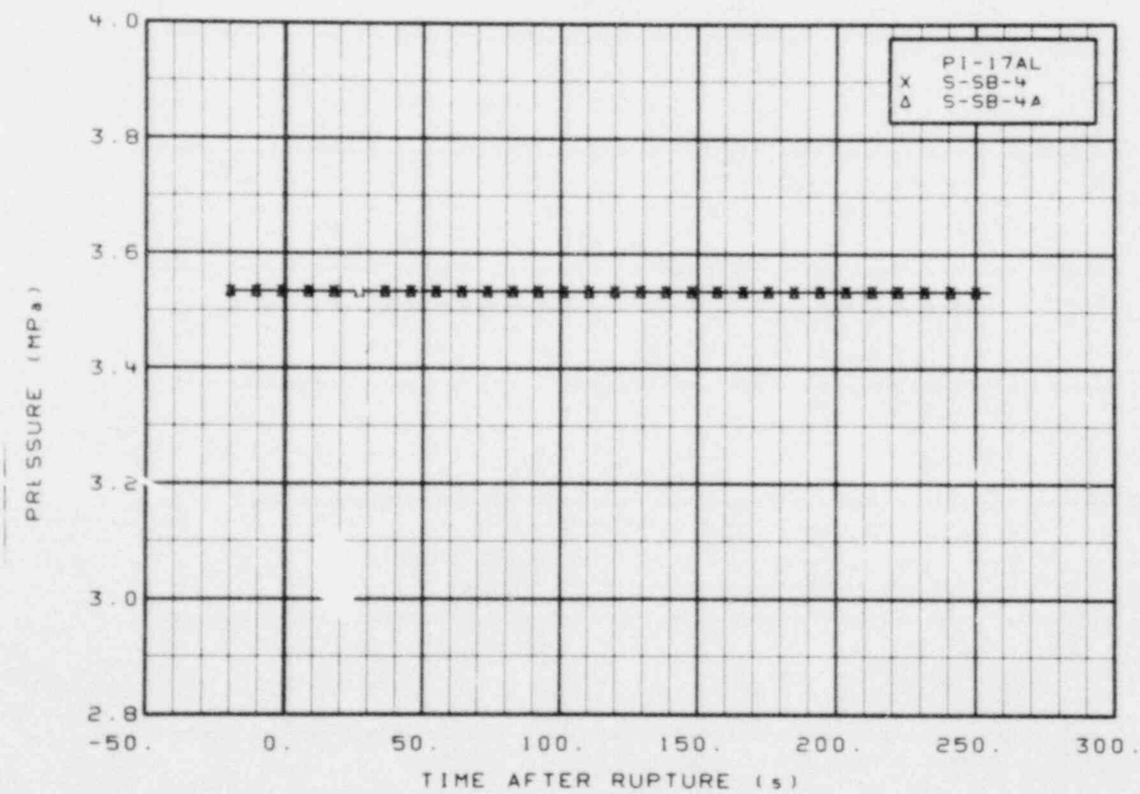


Figure 242. Pressure in intact loop cold leg (PI-17AL), from -20 to 256 s.

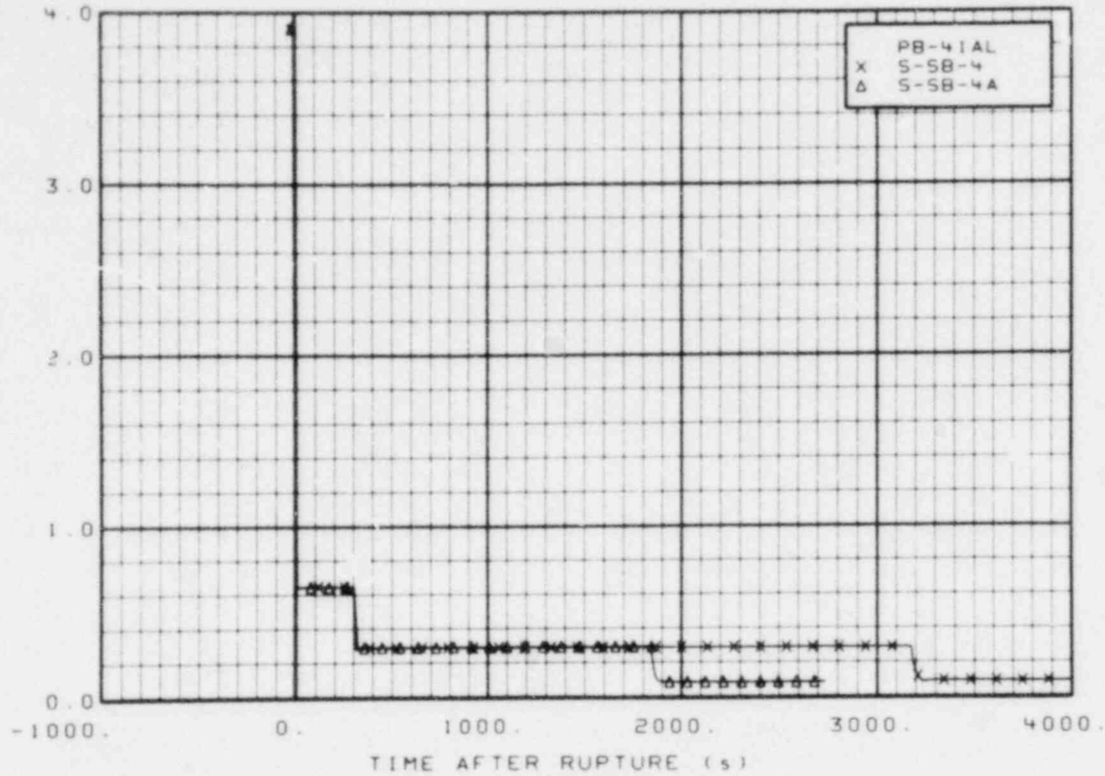


Figure 243. Pressure in broken loop cold leg (PB-41AL), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

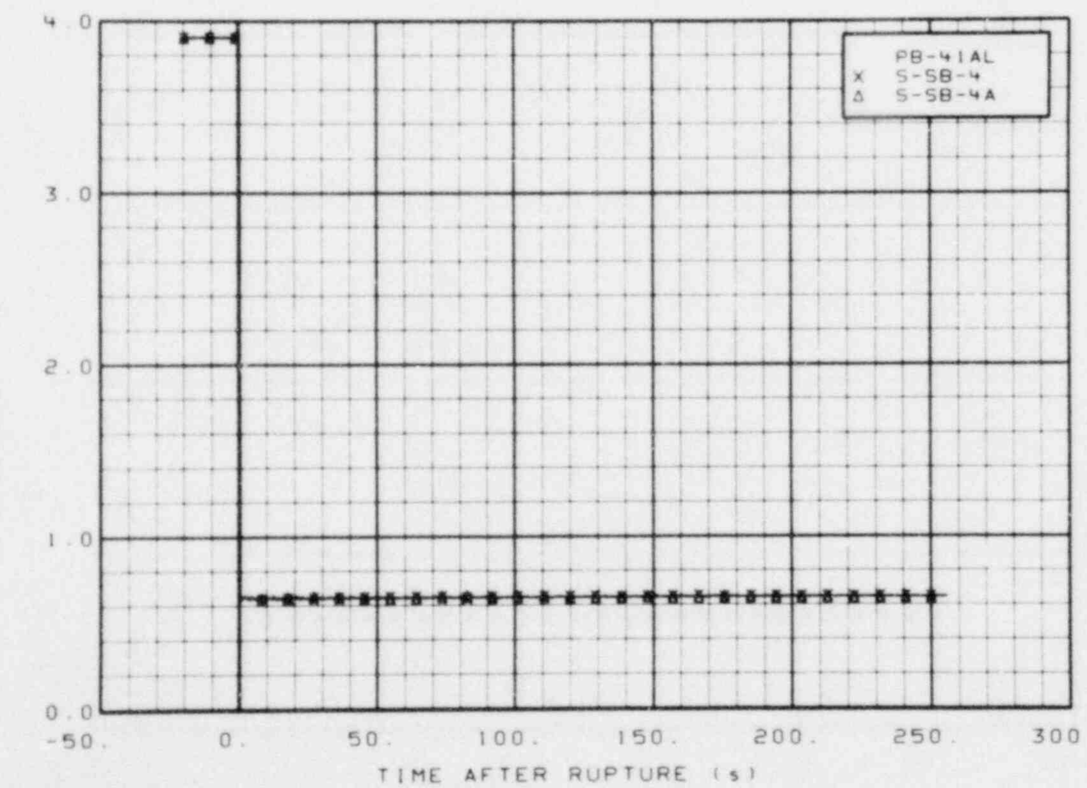


Figure 244. Pressure in broken loop cold leg (PB-41AL), from -20 to 256 s.

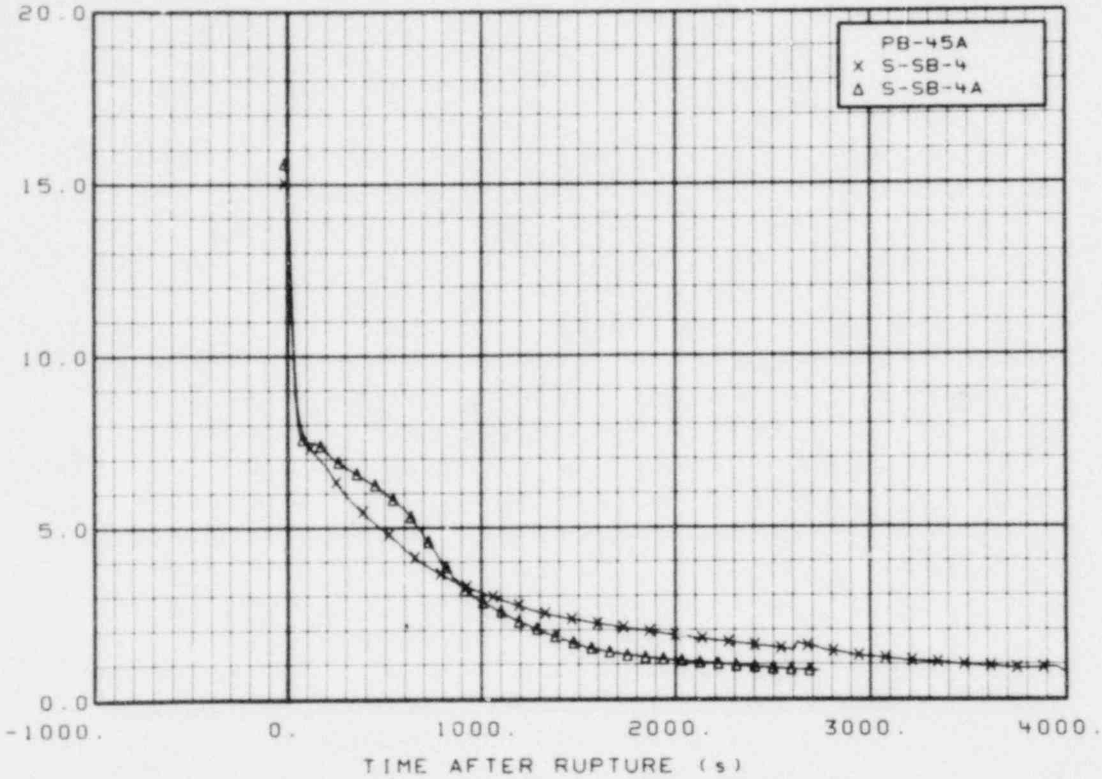


Figure 245. Pressure in broken loop cold leg (PB-45A), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

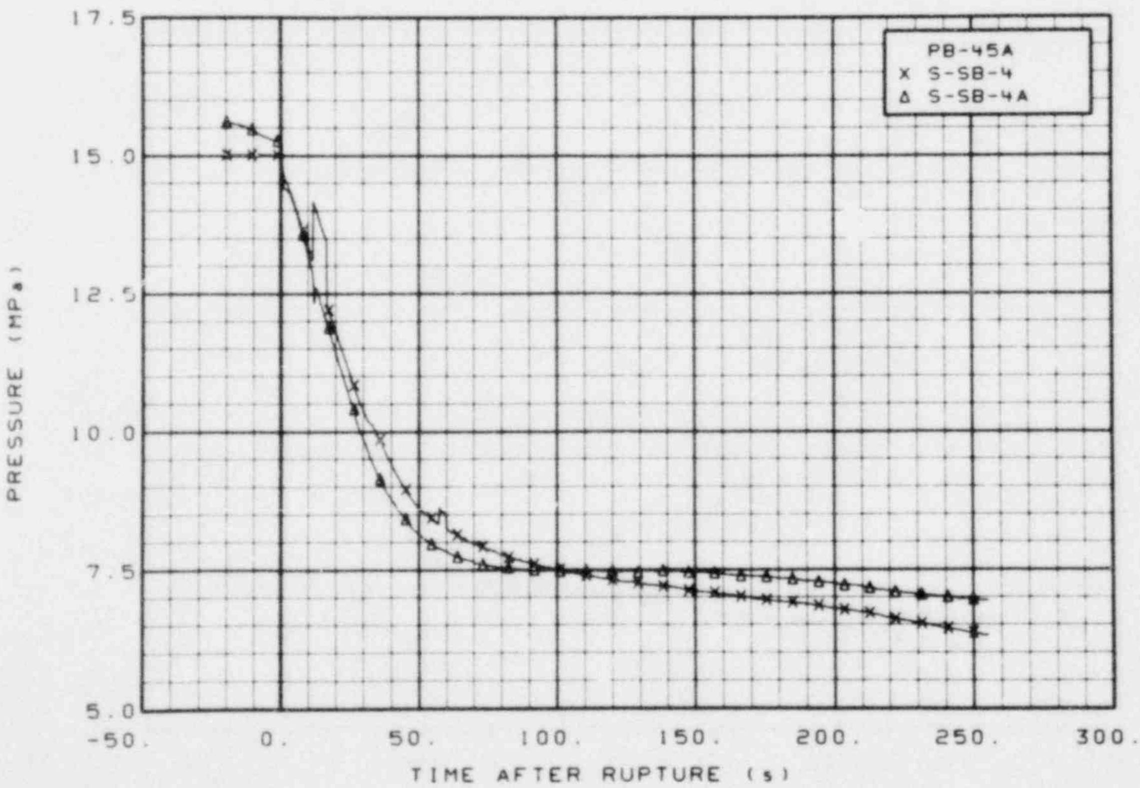


Figure 246. Pressure in broken loop cold leg (PB-45A), from -20 to 256 s.

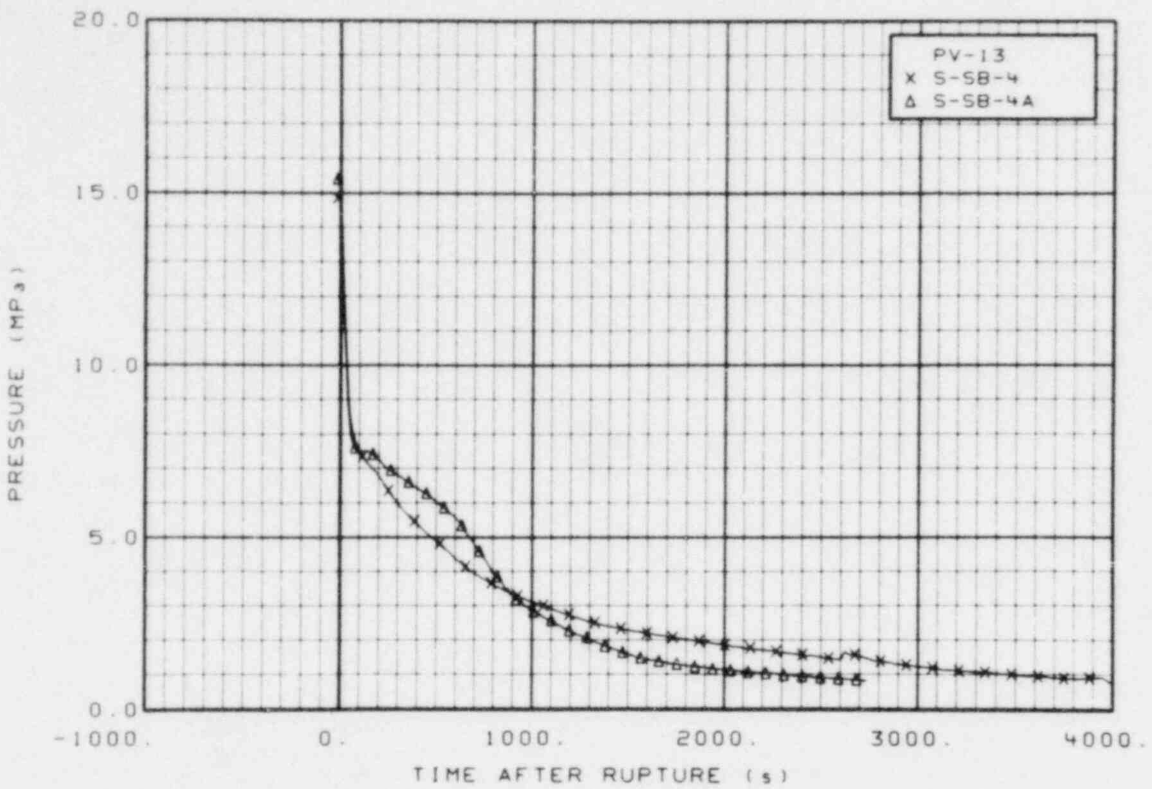


Figure 247. Pressure in vessel upper plenum (PV-13), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

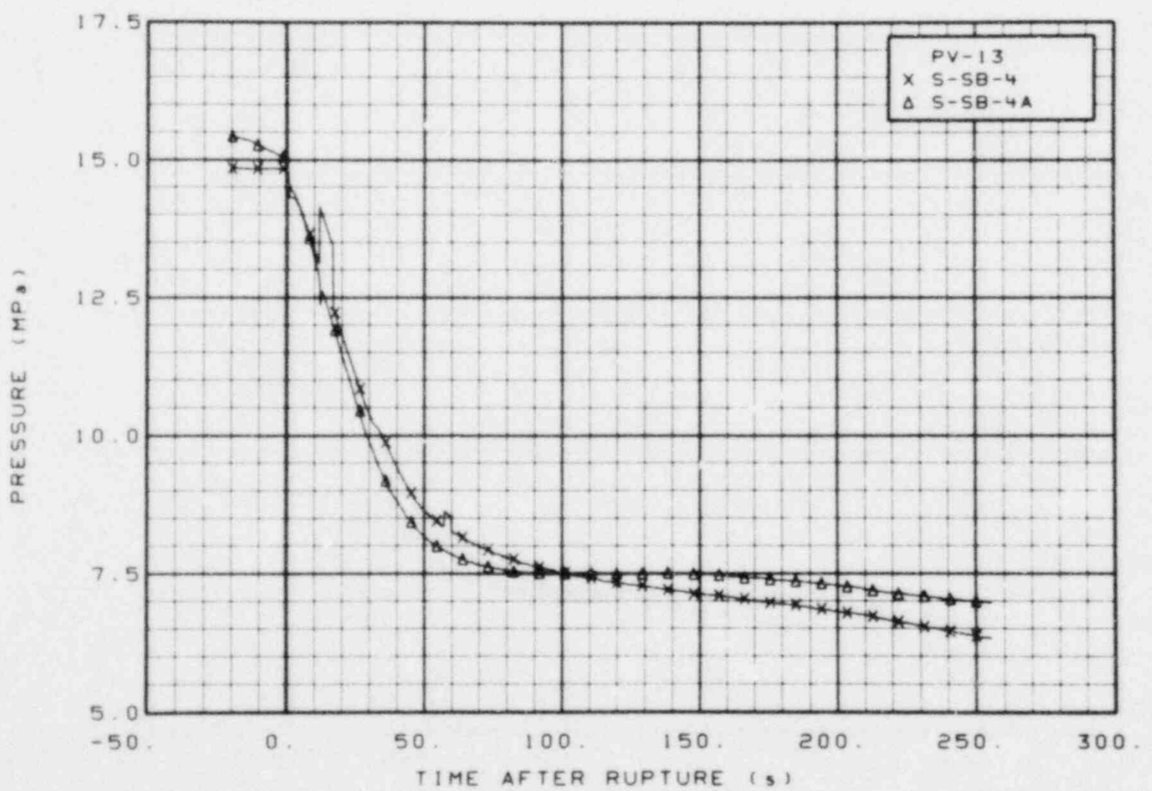


Figure 248. Pressure in vessel upper plenum (PV-13), from -20 to 256 s.

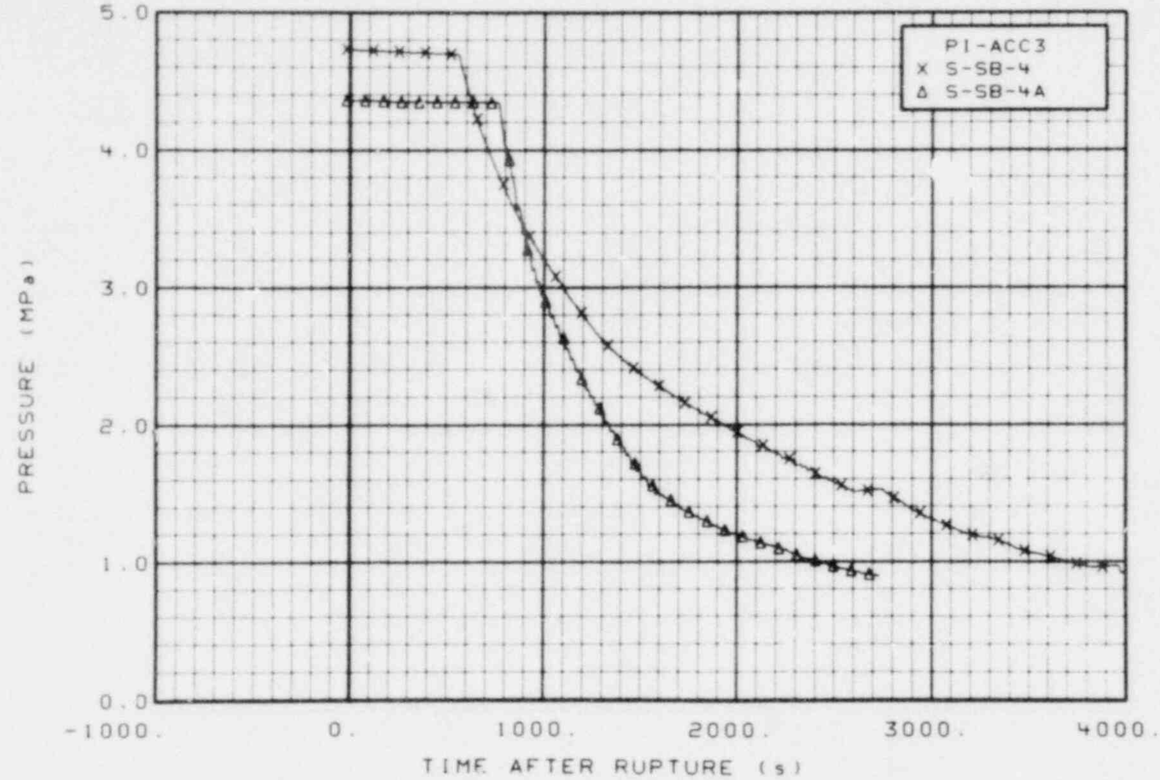


Figure 249. Pressure in intact loop ECC injection accumulator (PI-ACC3), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

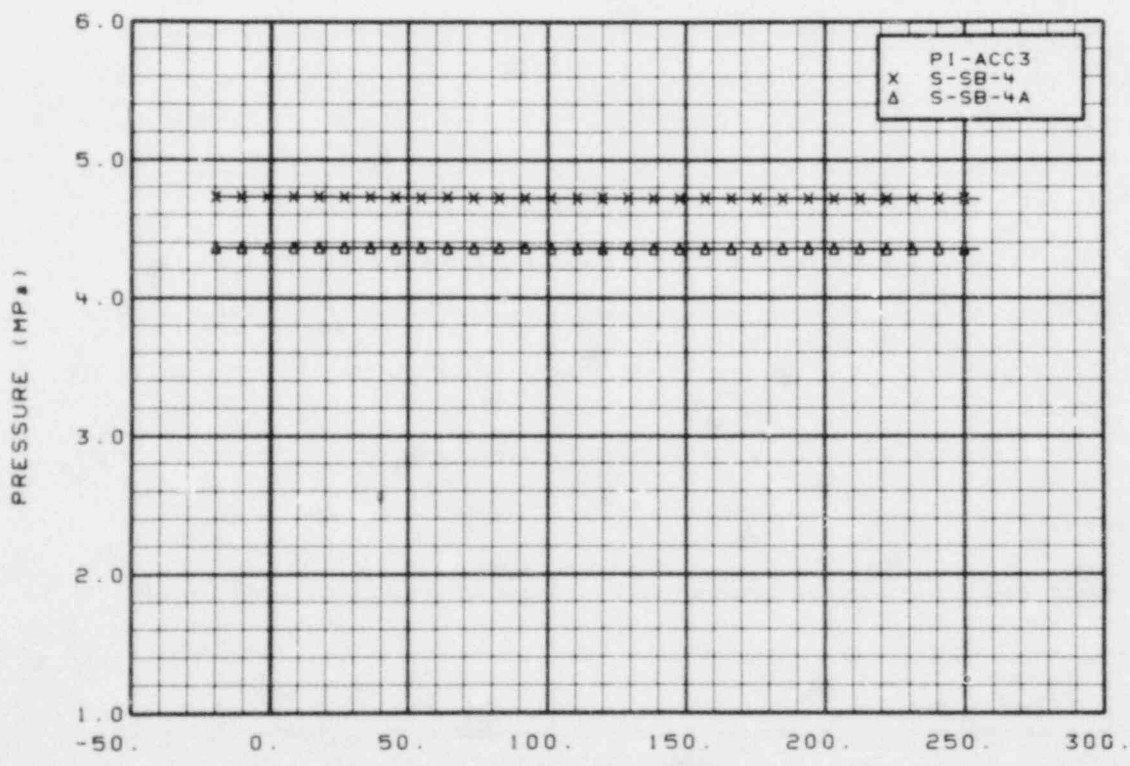


Figure 250. Pressure in intact loop ECC injection accumulator (PI-ACC3), from -20 to 256 s.

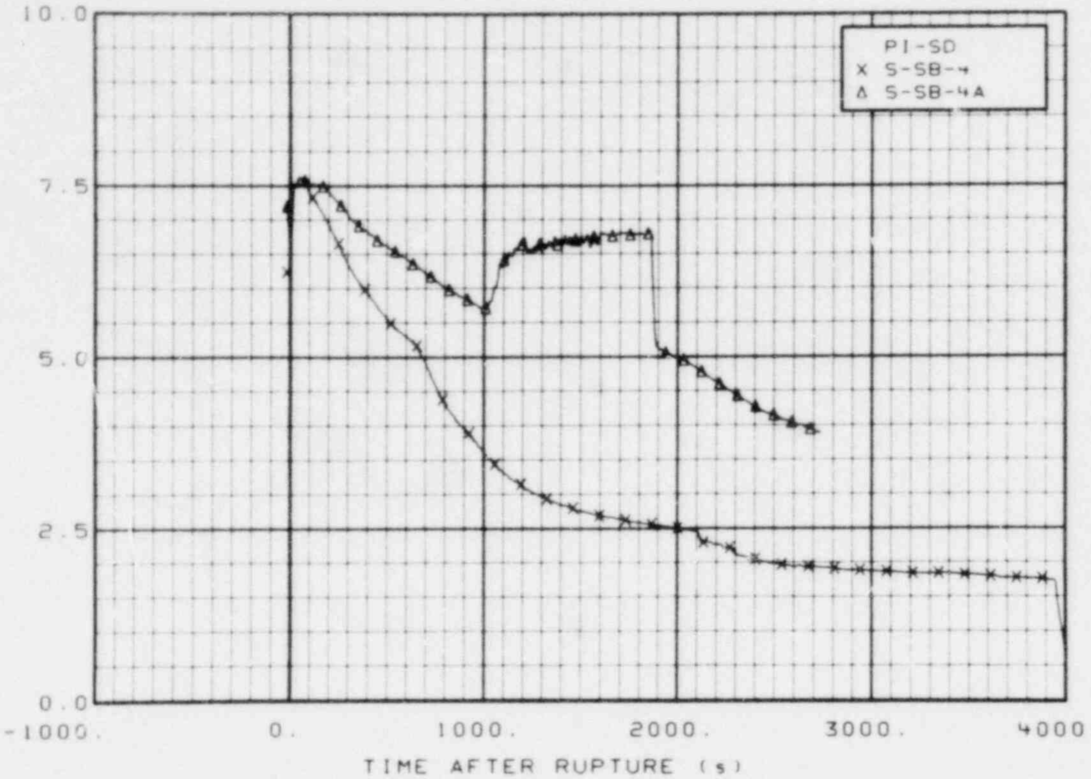


Figure 251. Pressure in intact loop steam generator, secondary side steam dome (PI-SD), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

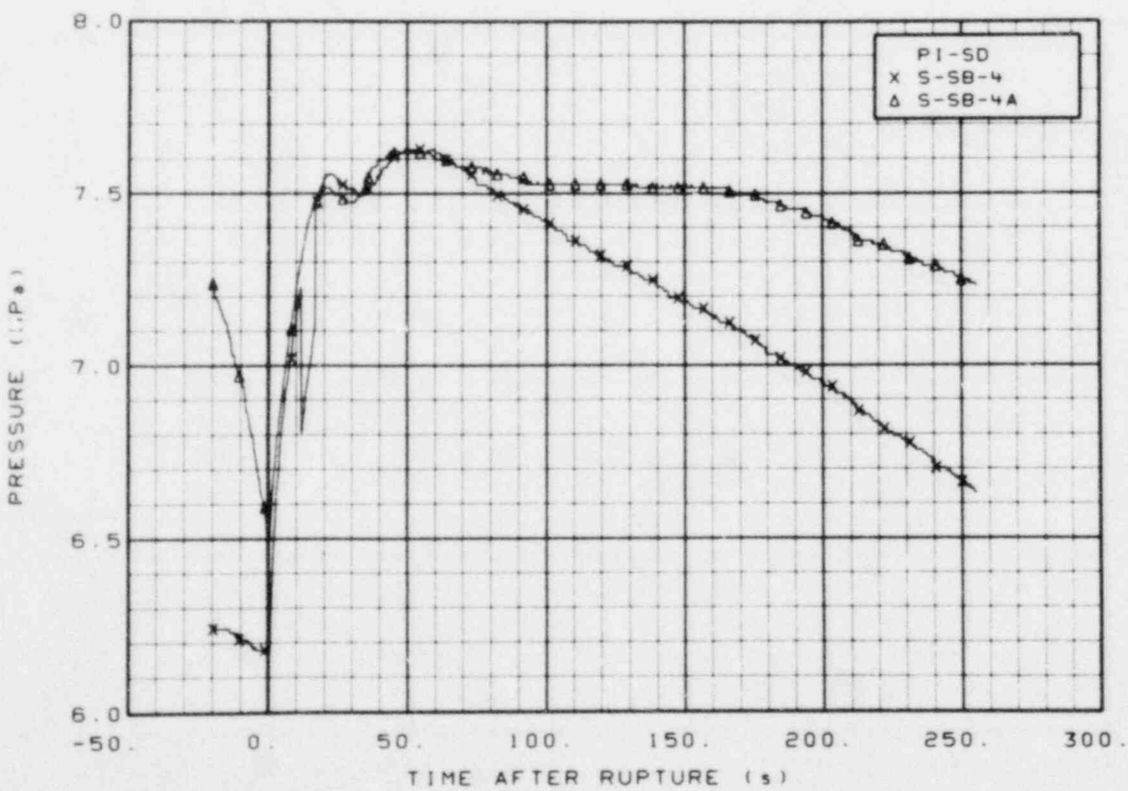


Figure 252. Pressure in intact loop steam generator, secondary side steam dome (PI-SD), from -20 to 256 s.

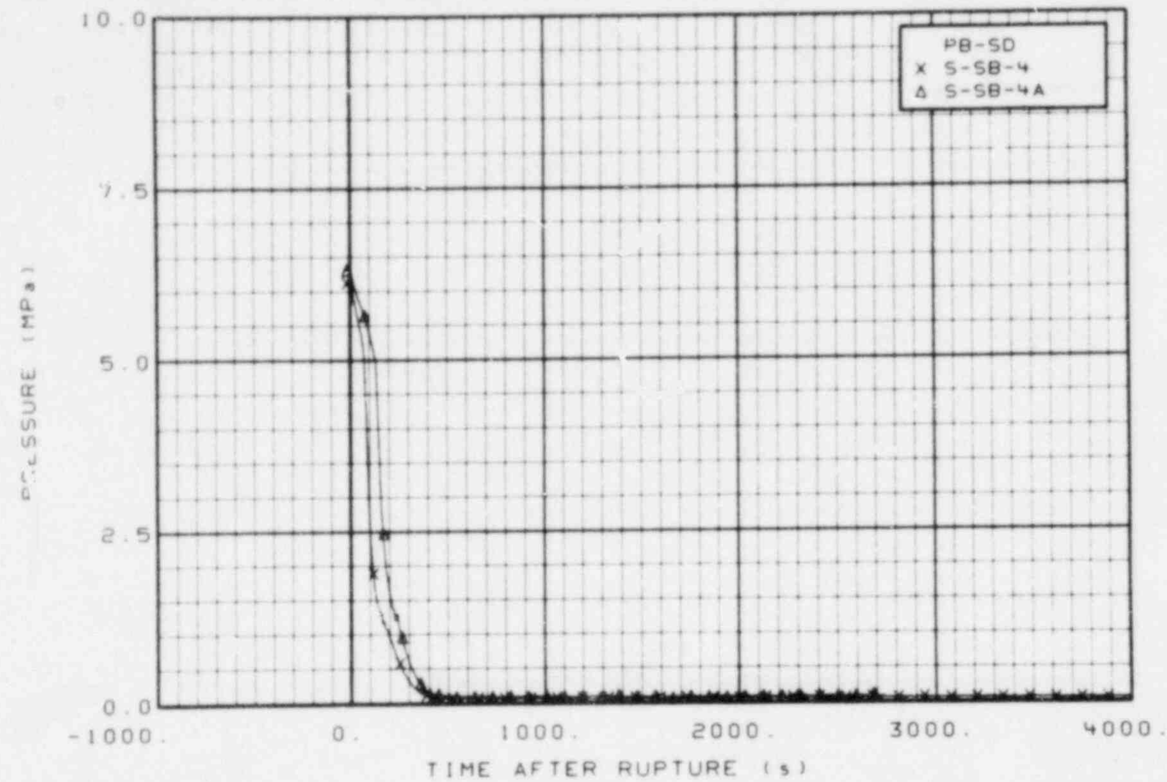


Figure 253. Pressure in broken loop steam generator, secondary side steam dome (PB-SD), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

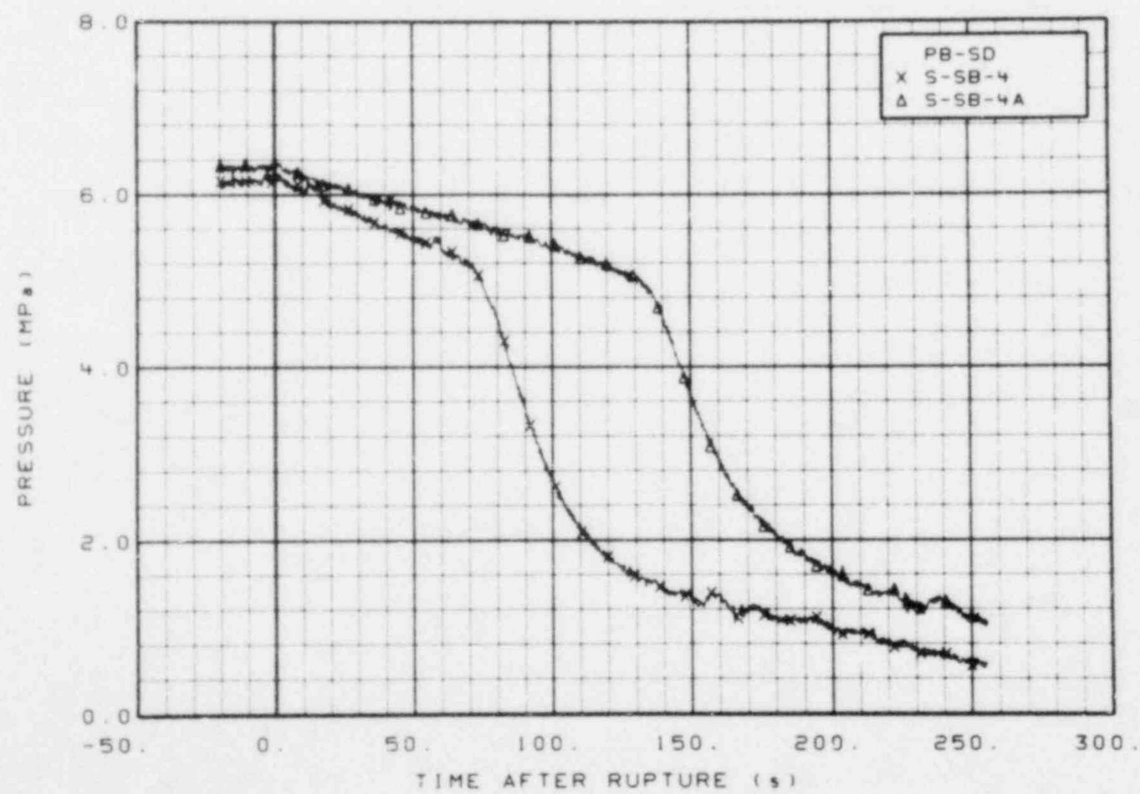


Figure 254. Pressure in broken loop steam generator, secondary side steam dome (PB-SD), from -20 to 256 s.

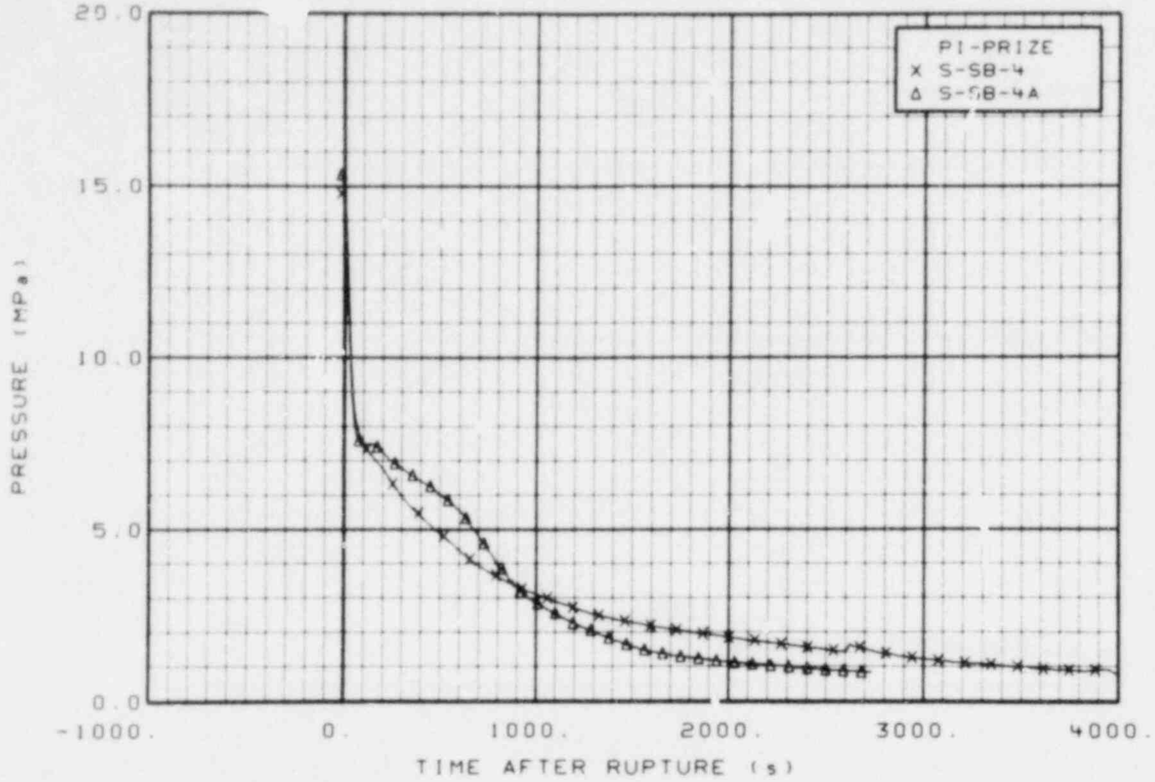


Figure 255. Pressure in pressurizer steam dome (PI-PRIZE), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

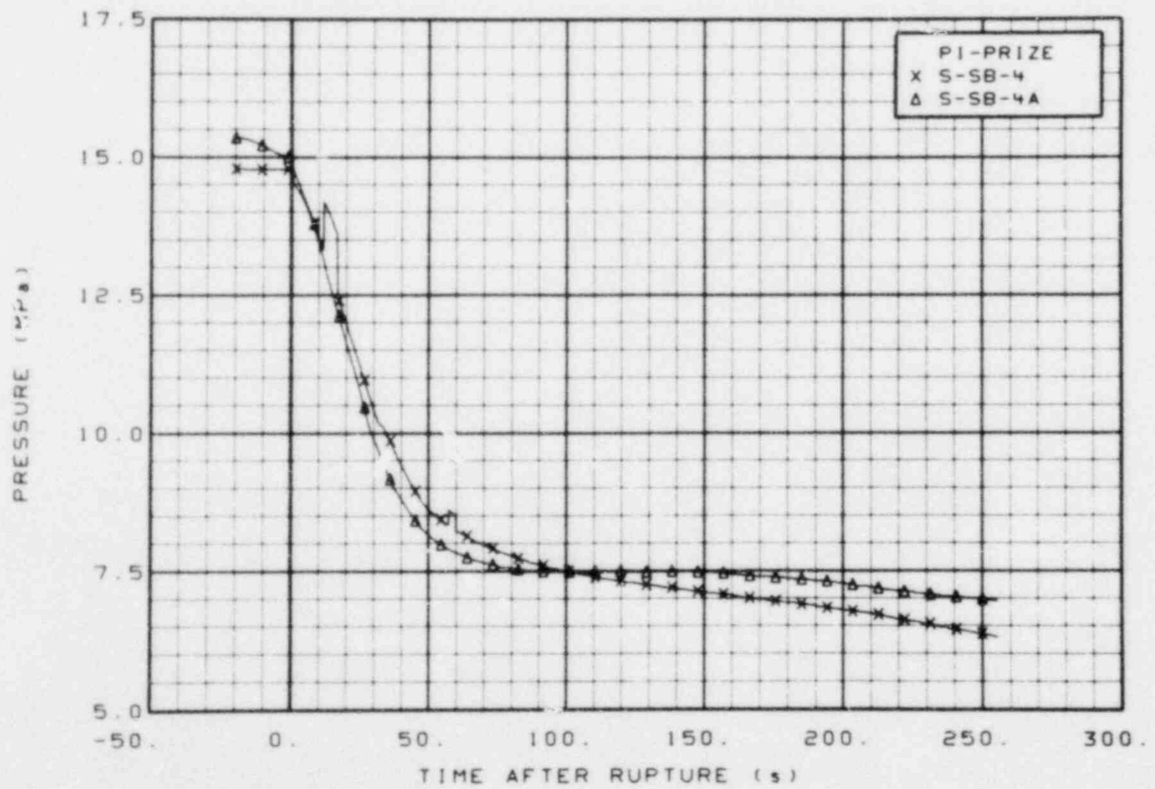


Figure 256. Pressure in pressurizer steam dome (PI-PRIZE), from -20 to 256 s.

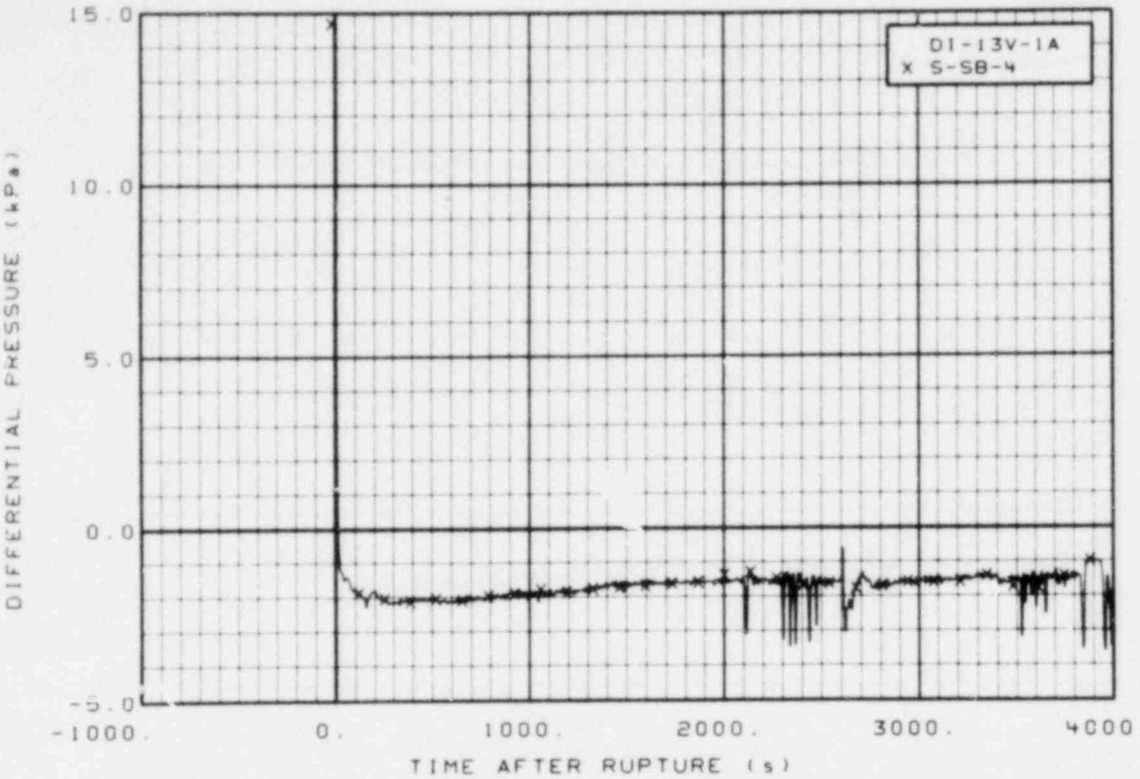


Figure 257. Differential pressure in intact loop hot leg, Test S-SB-4 (DI-13V-1A), from -20 to 4000 s.

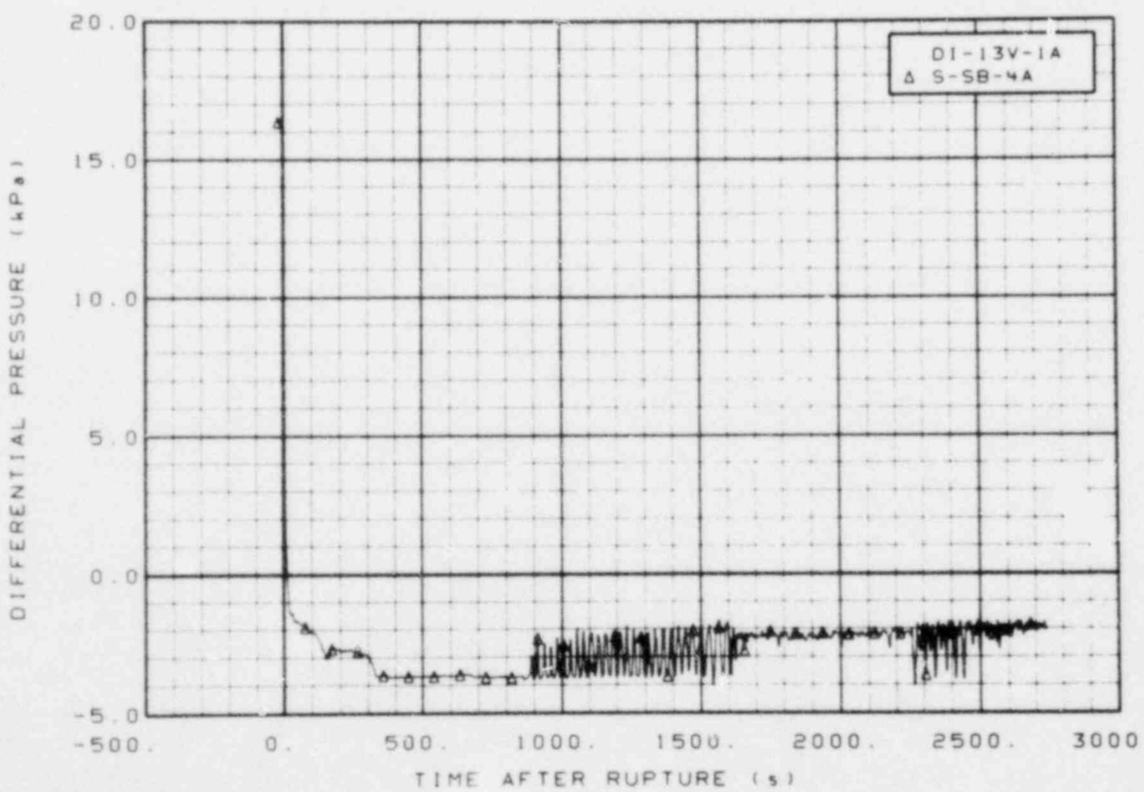


Figure 258. Differential pressure in intact loop hot leg, Test S-SB-4A (DI-13V-1A), from -20 to 2740 s.

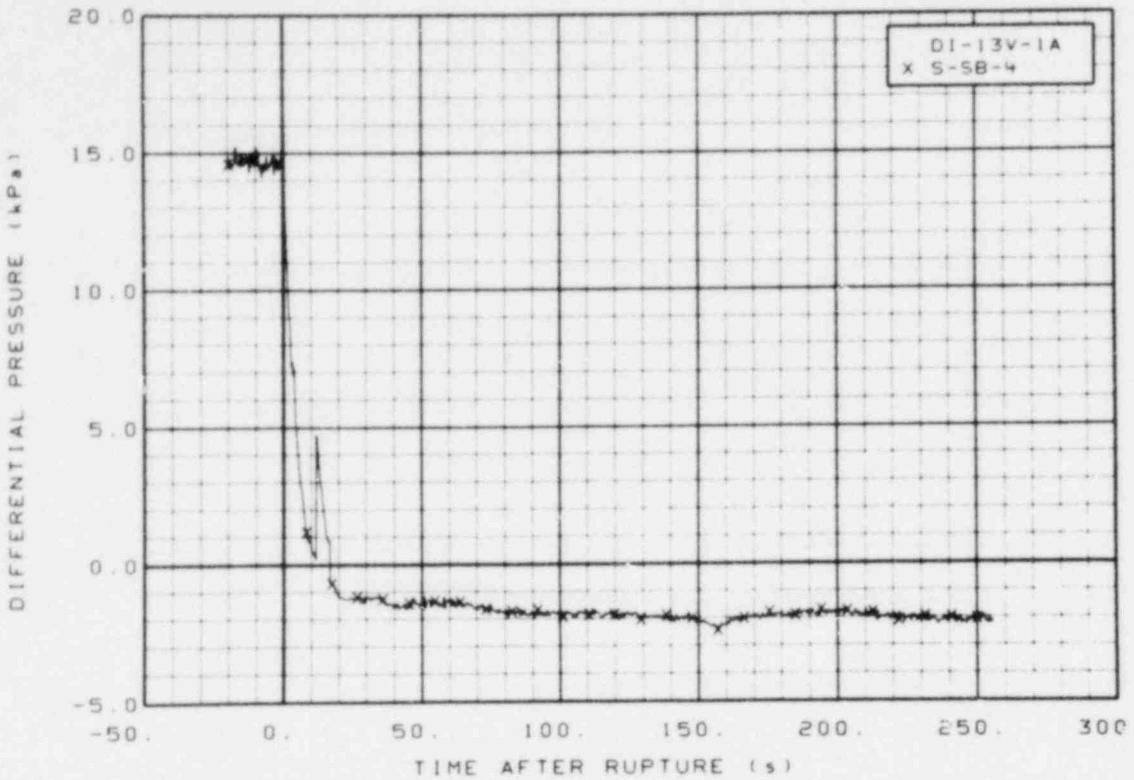


Figure 259. Differential pressure in intact loop hot leg, Test S-SB-4 (DI-13V-1A), from -20 to 256 s.

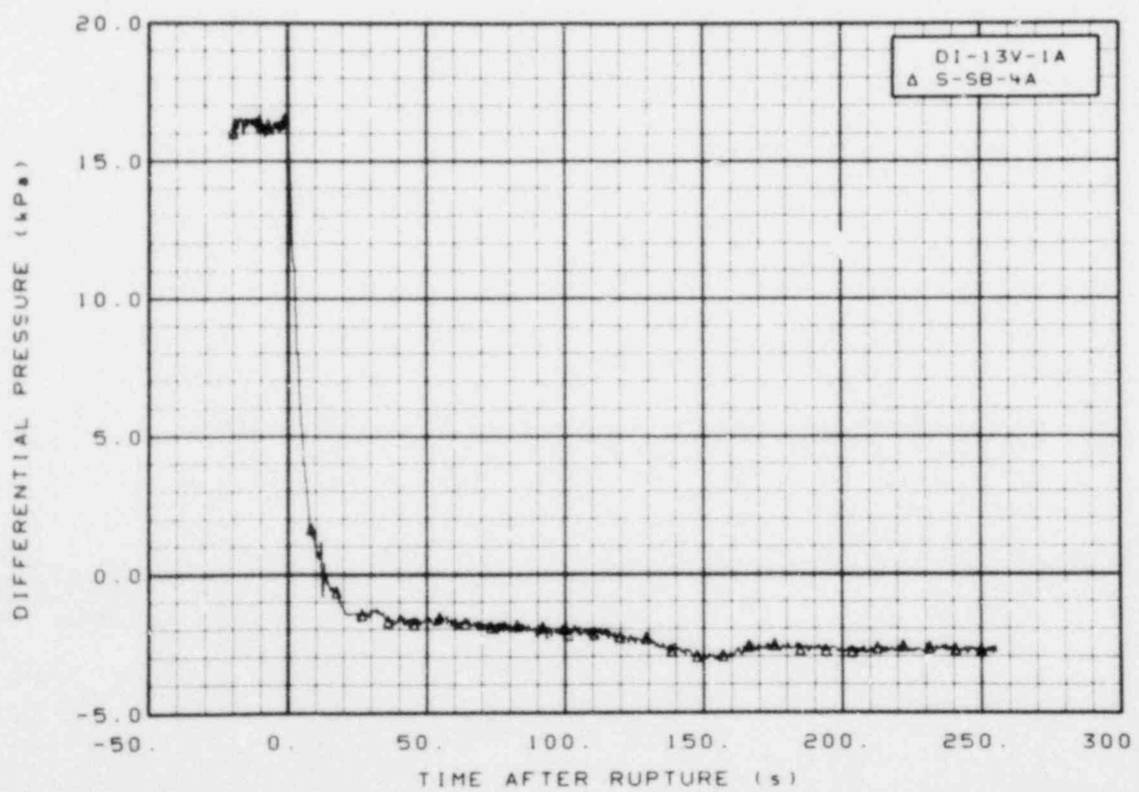


Figure 260. Differential pressure in intact loop hot leg, Test S-SB-4A (DI-13V-1A), from -20 to 256 s.

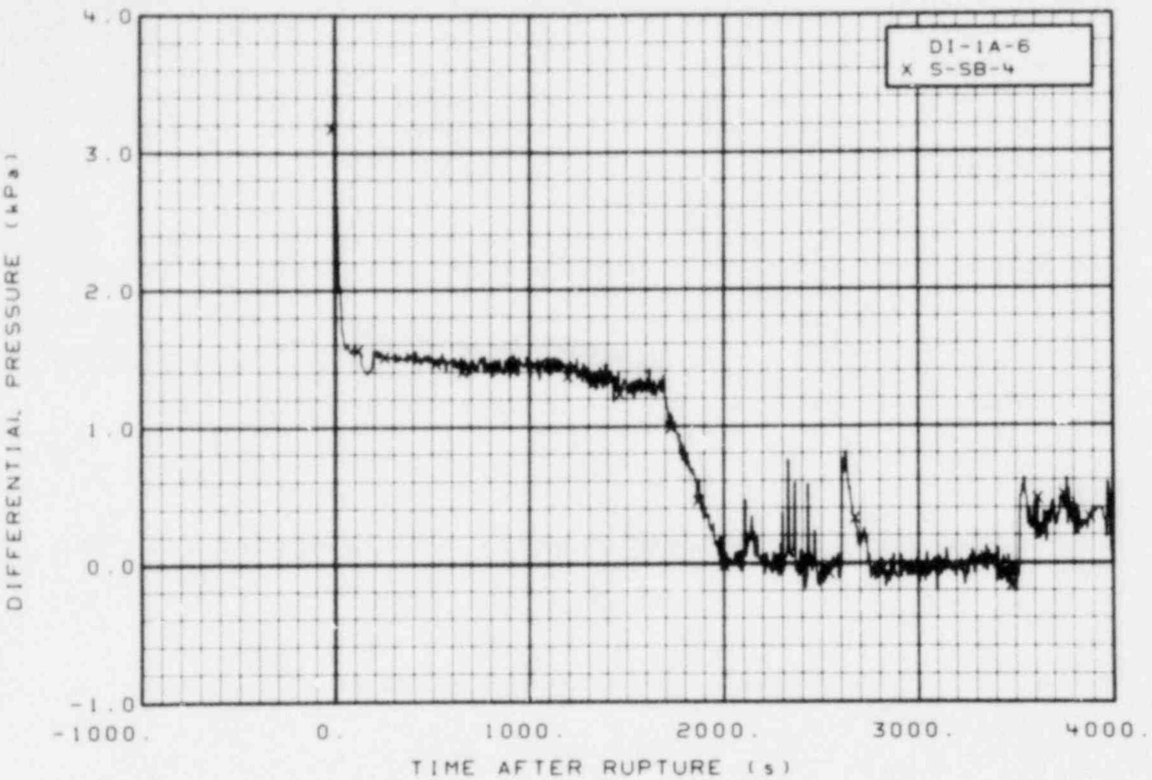


Figure 261. Differential pressure in intact loop hot leg, Test S-SB-4 (DI-1A-6), from -20 to 4000 s.

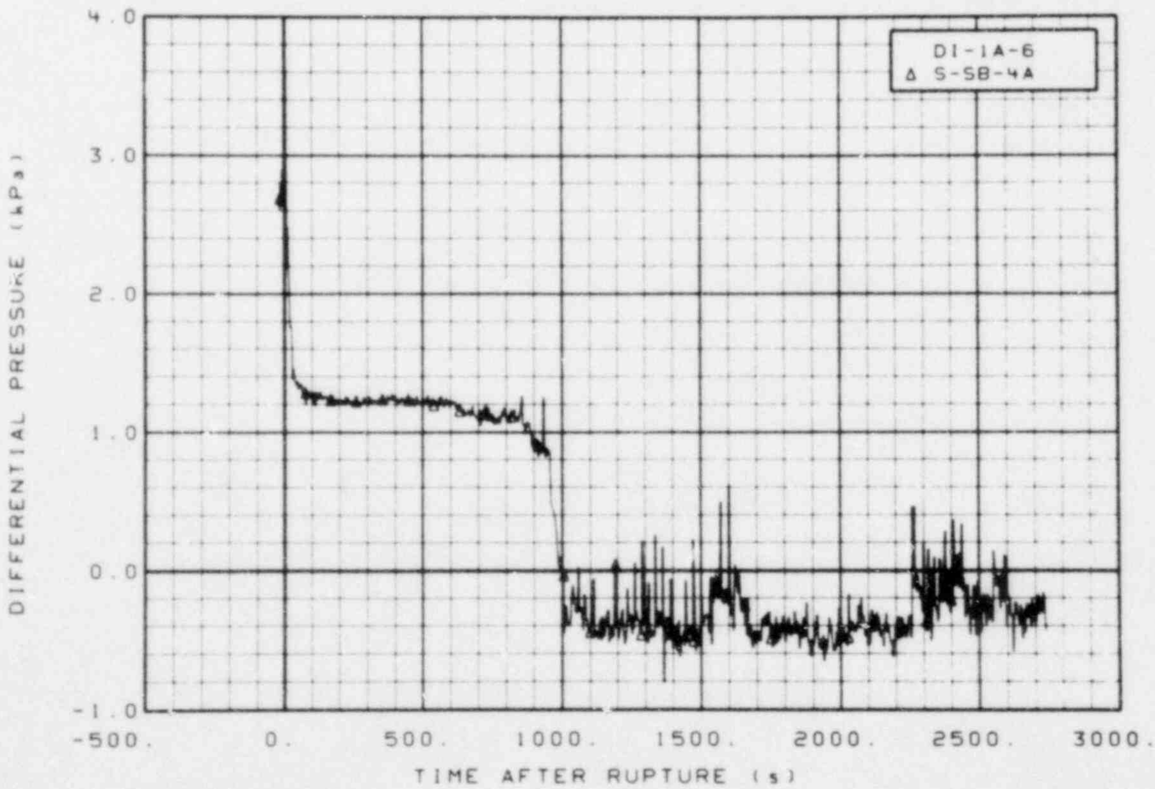


Figure 262. Differential pressure in intact loop hot leg, Test S-SB-4A (DI-1A-6), from -20 to 2740 s.

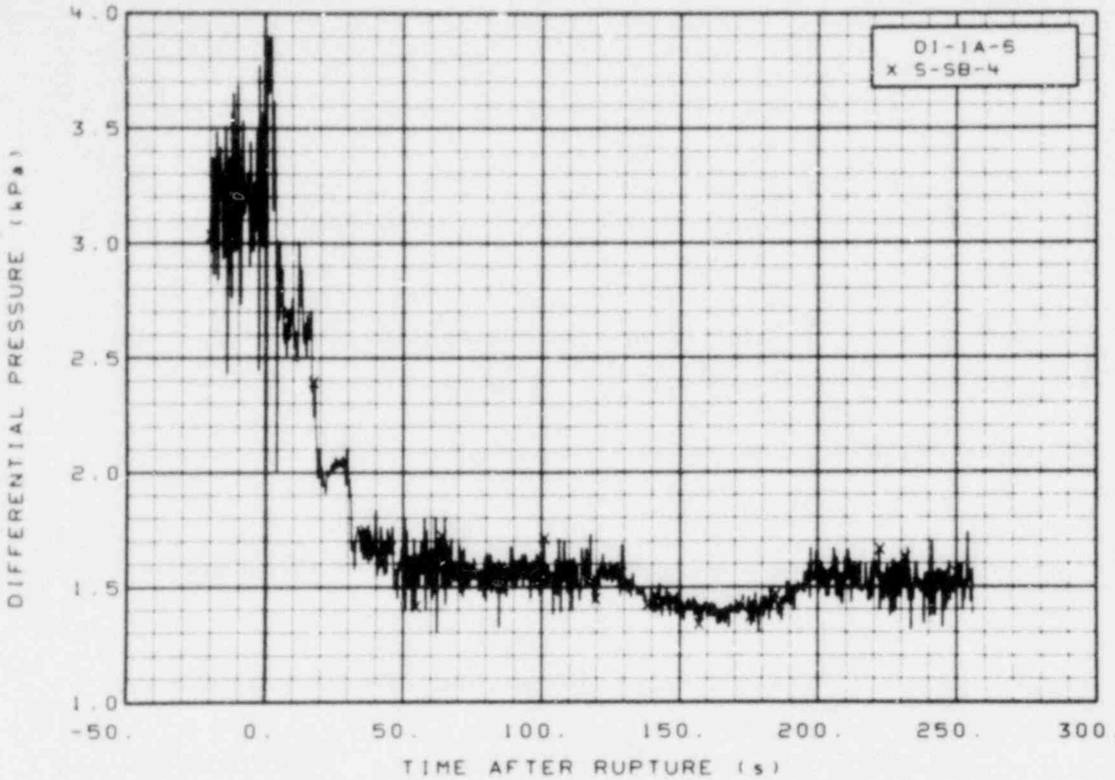


Figure 263. Differential pressure in intact loop hot leg, Test S-SB-4 (DI-1A-6), from -20 to 256 s.

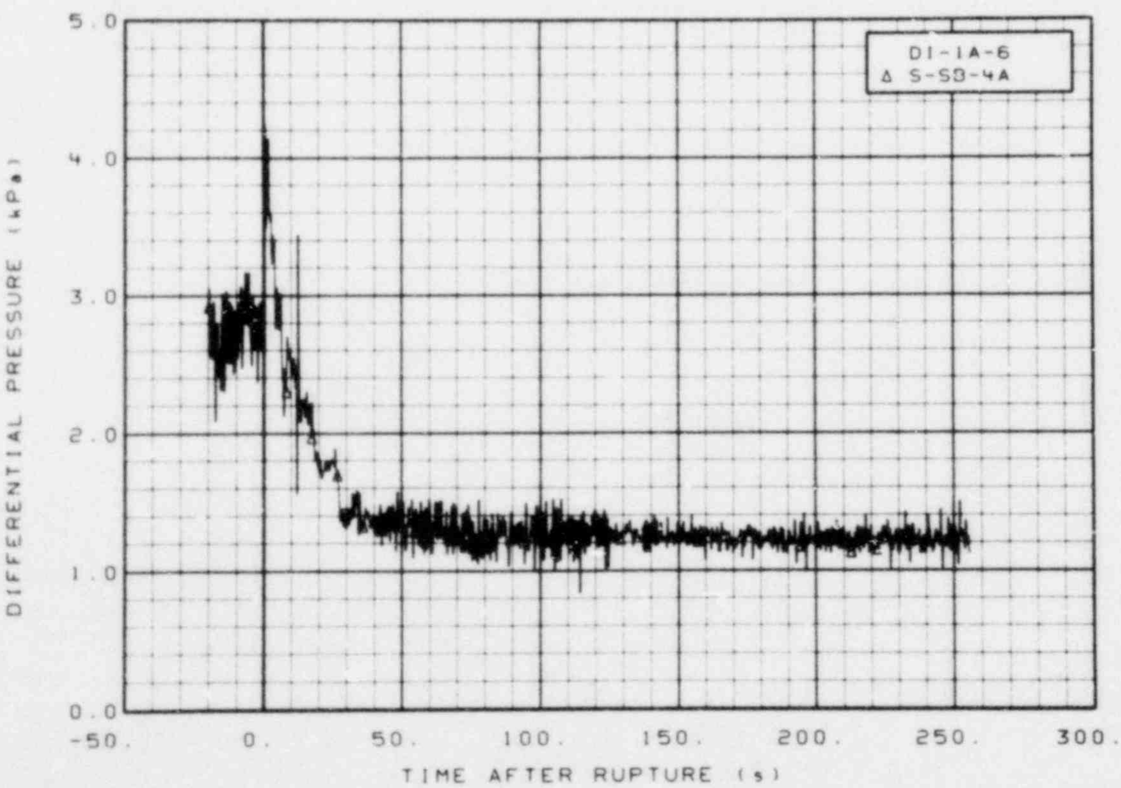


Figure 264. Differential pressure in intact loop hot leg, Test S-SB-4A (DI-1A-6), from -20 to 256 s.

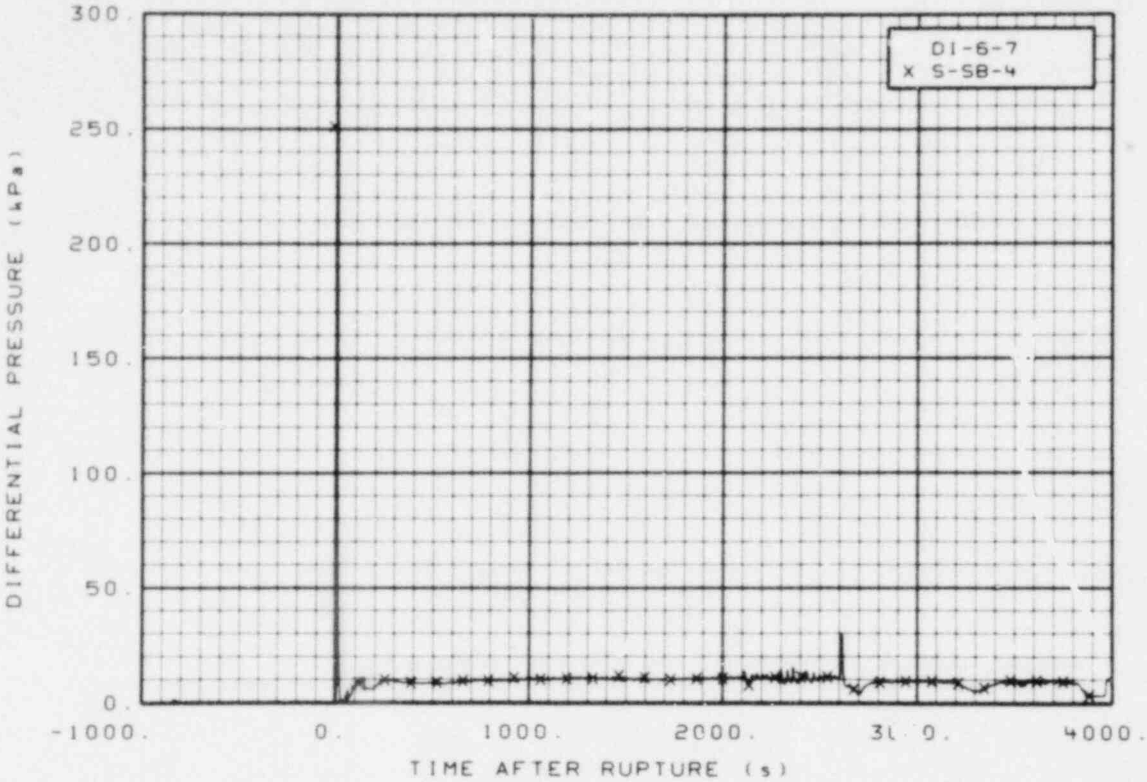


Figure 265. Differential pressure in intact loop hot leg, Test S-SB-4 (DI-6-7), from -20 to 4000 s.

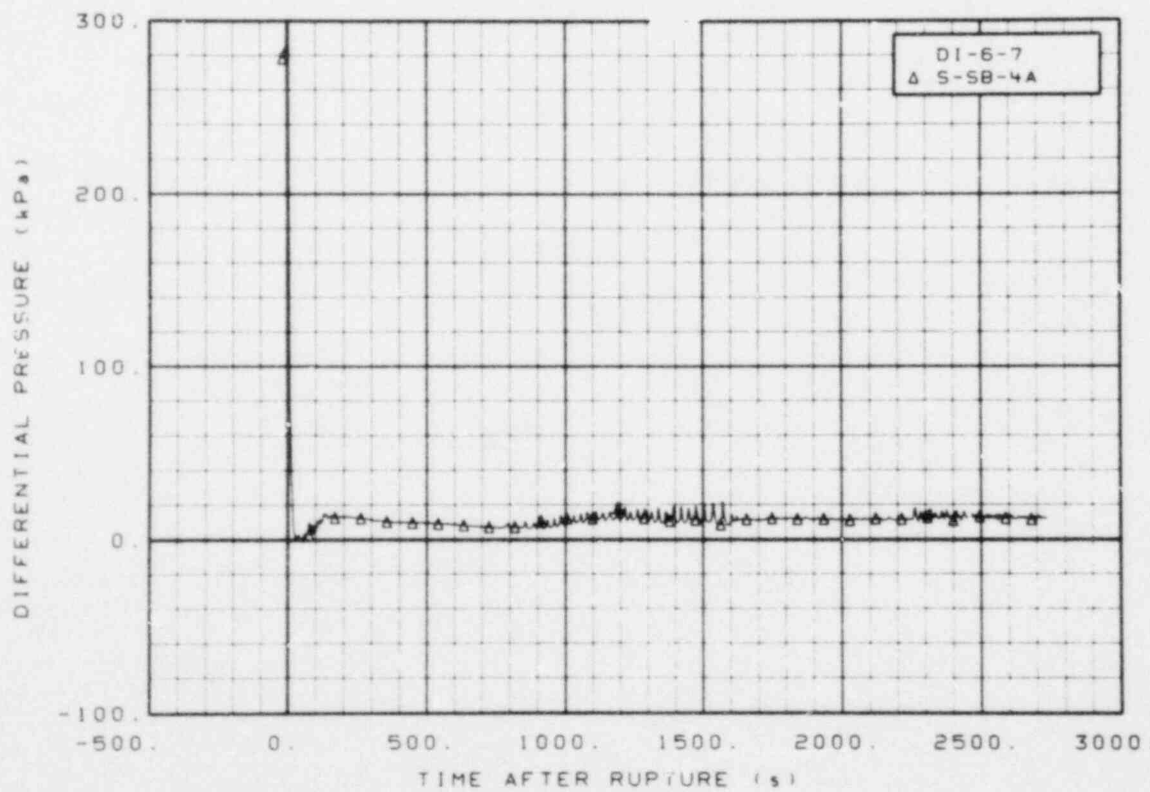


Figure 266. Differential pressure in intact loop hot leg, Test S-SB-4A (DI-6-7), from -20 to 2746 s.

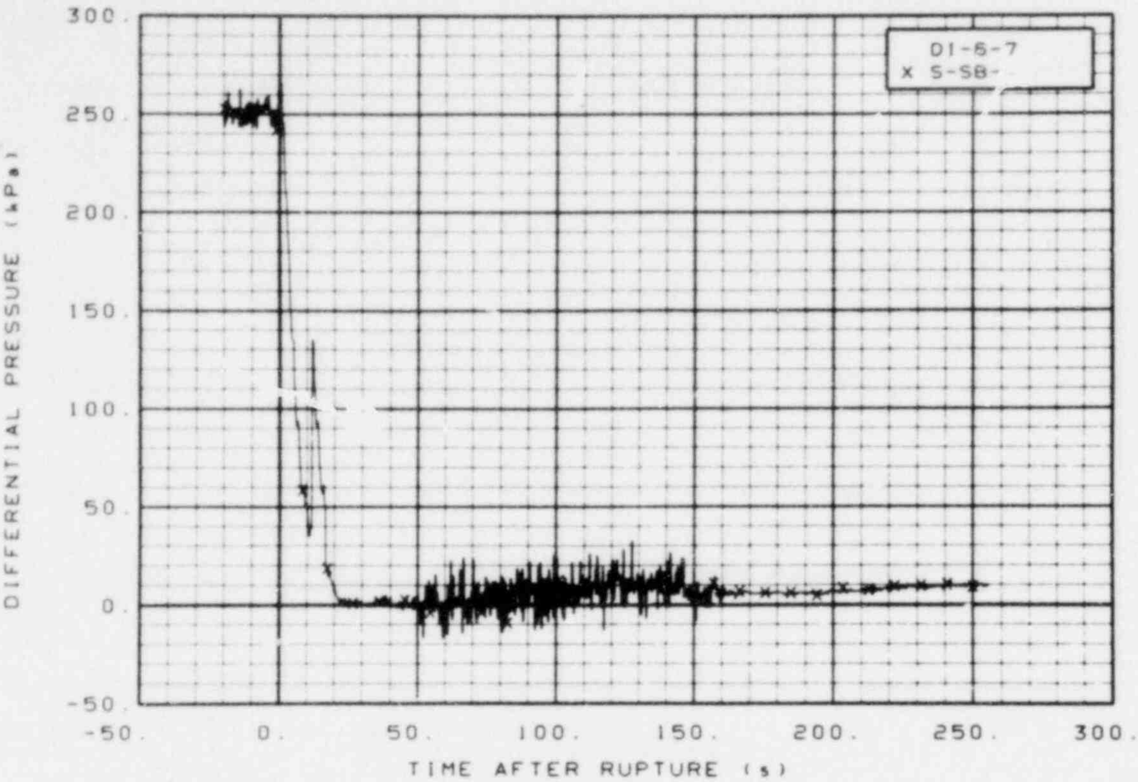


Figure 267. Differential pressure in intact loop hot leg, Test S-SB-4 (DI-6-7), from -20 to 256 s.

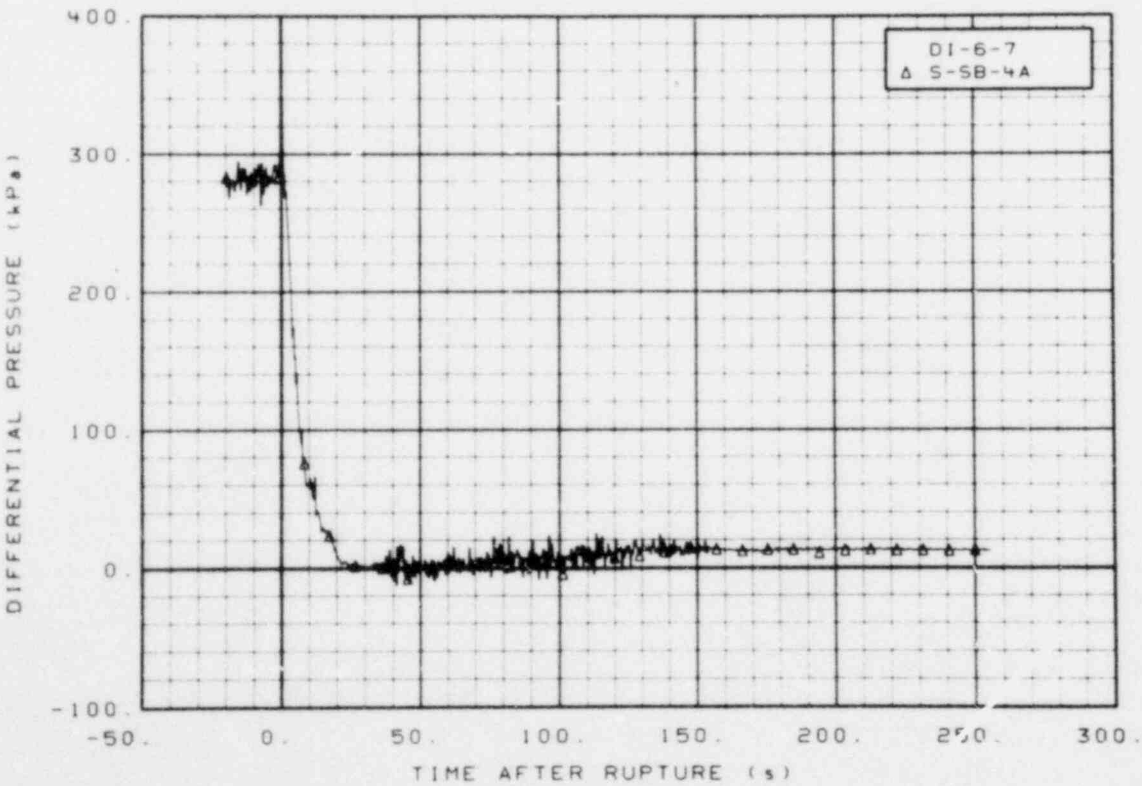


Figure 268. Differential pressure in intact loop hot leg, Test S-SB-4A (DI-6-7), from -20 to 256 s.

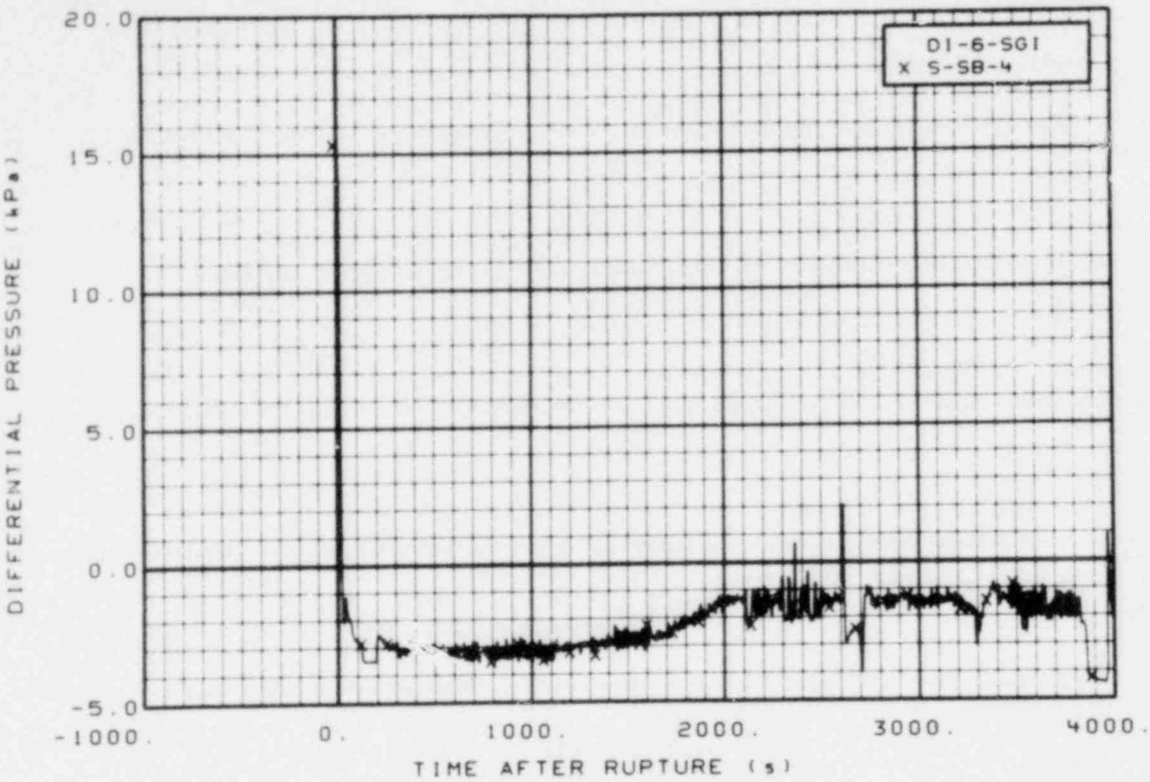


Figure 269. Differential pressure in intact loop hot leg, Test S-SB-4 (DI-6-SGI), from -20 to 4000 s.

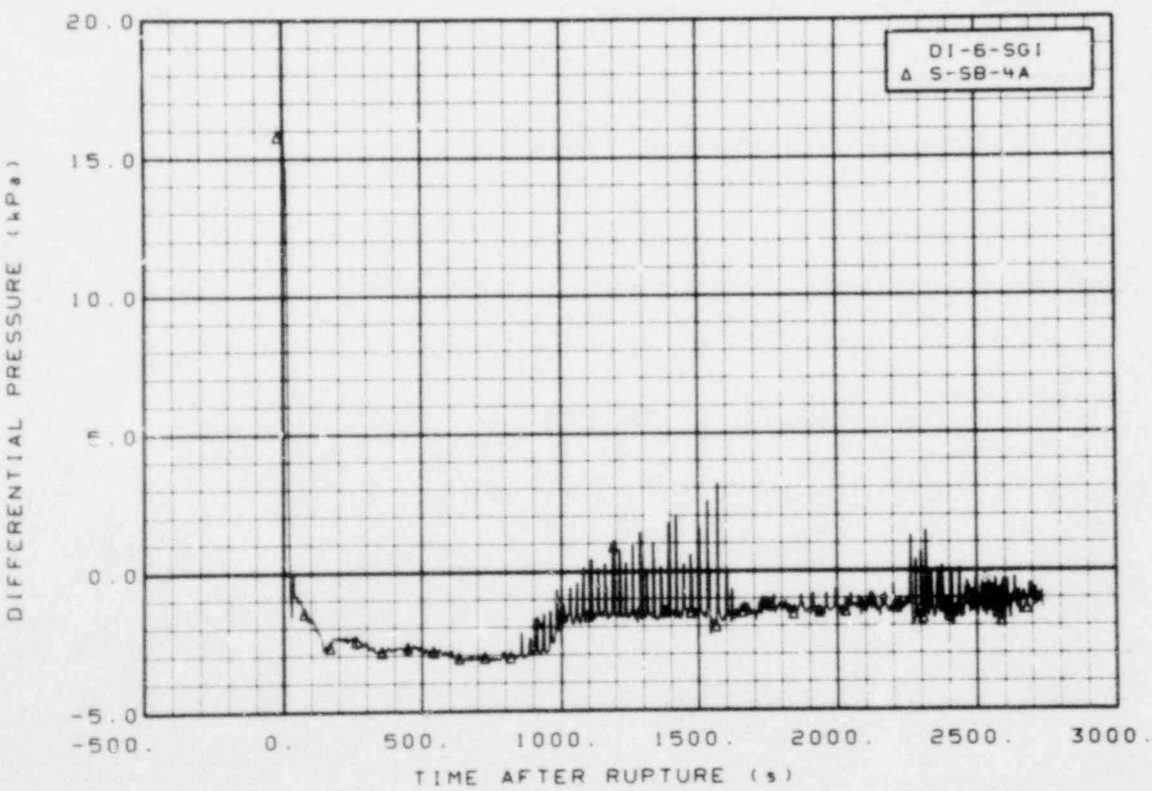


Figure 270. Differential pressure in intact loop hot leg, Test S-SB-4A (DI-6-SGI), from -20 to 2740 s.

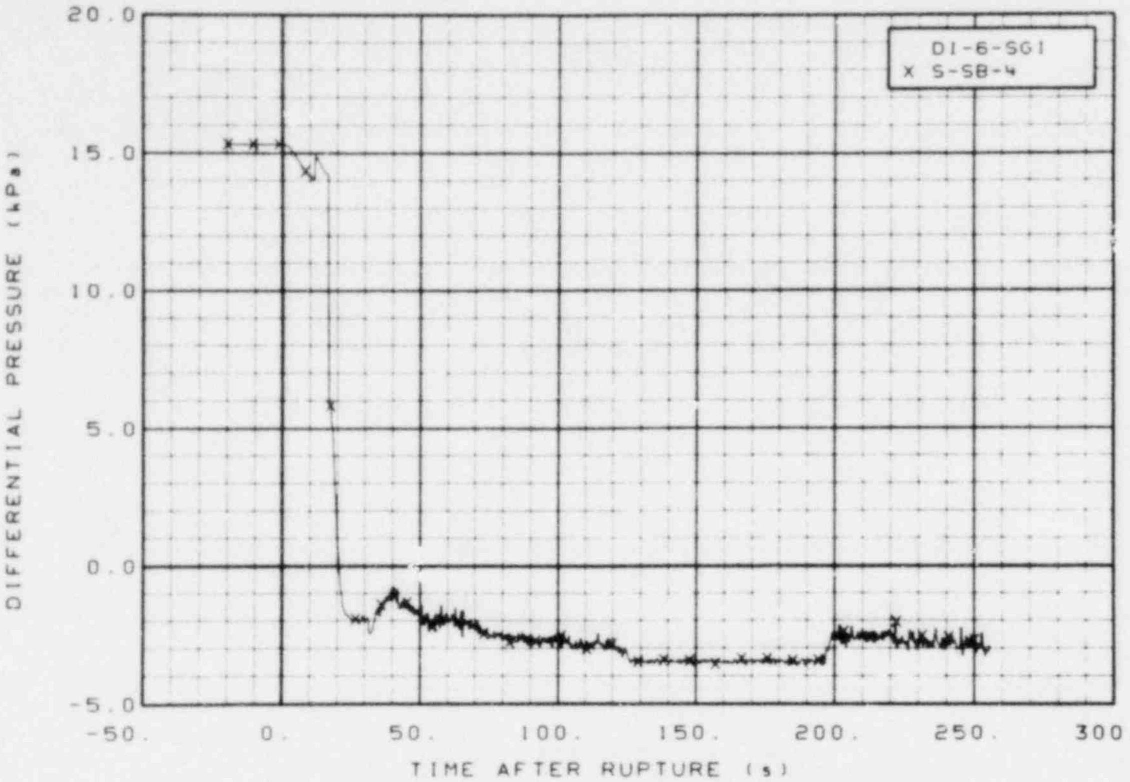


Figure 271. Differential pressure in intact loop hot leg, Test S-SB-4 (DI-6-SGI), from -20 to 256 s.

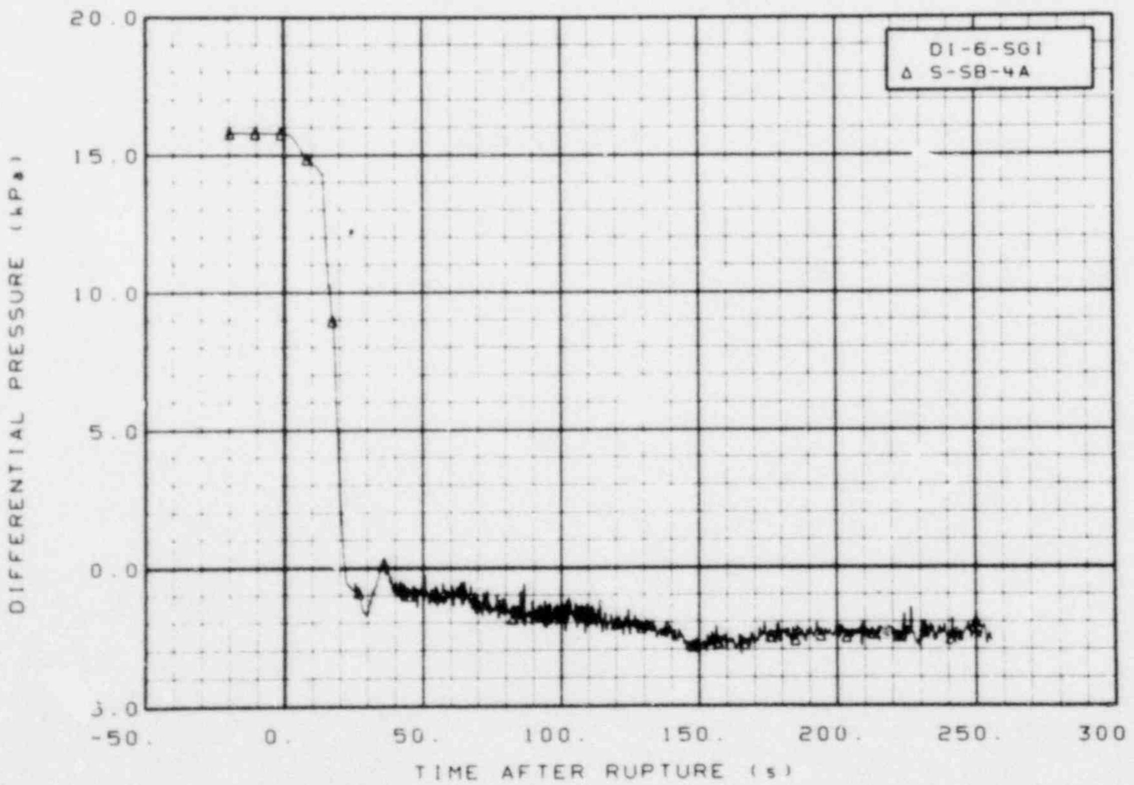


Figure 272. Differential pressure in intact loop hot leg, Test S-SB-4A (DI-6-SGI), from -20 to 256 s.

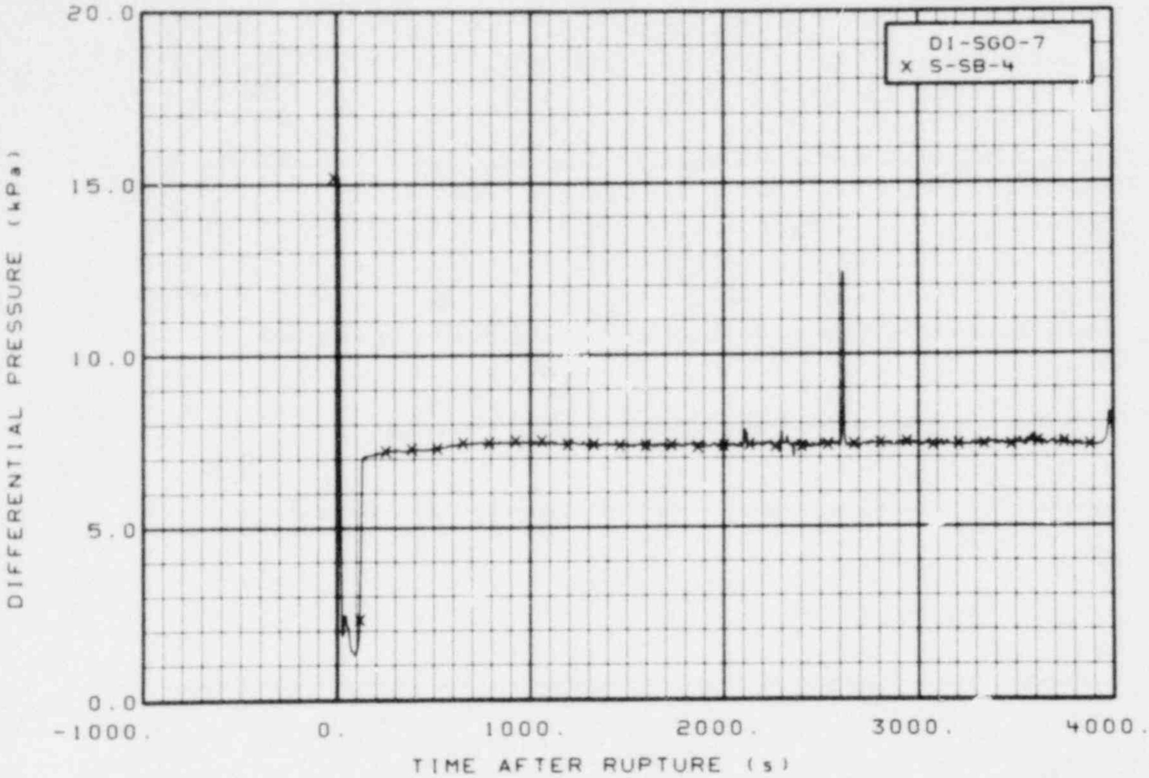


Figure 273. Differential pressure in intact loop cold leg, Test S-SB-4 (DI-SGO-7), from -20 to 4000 s.

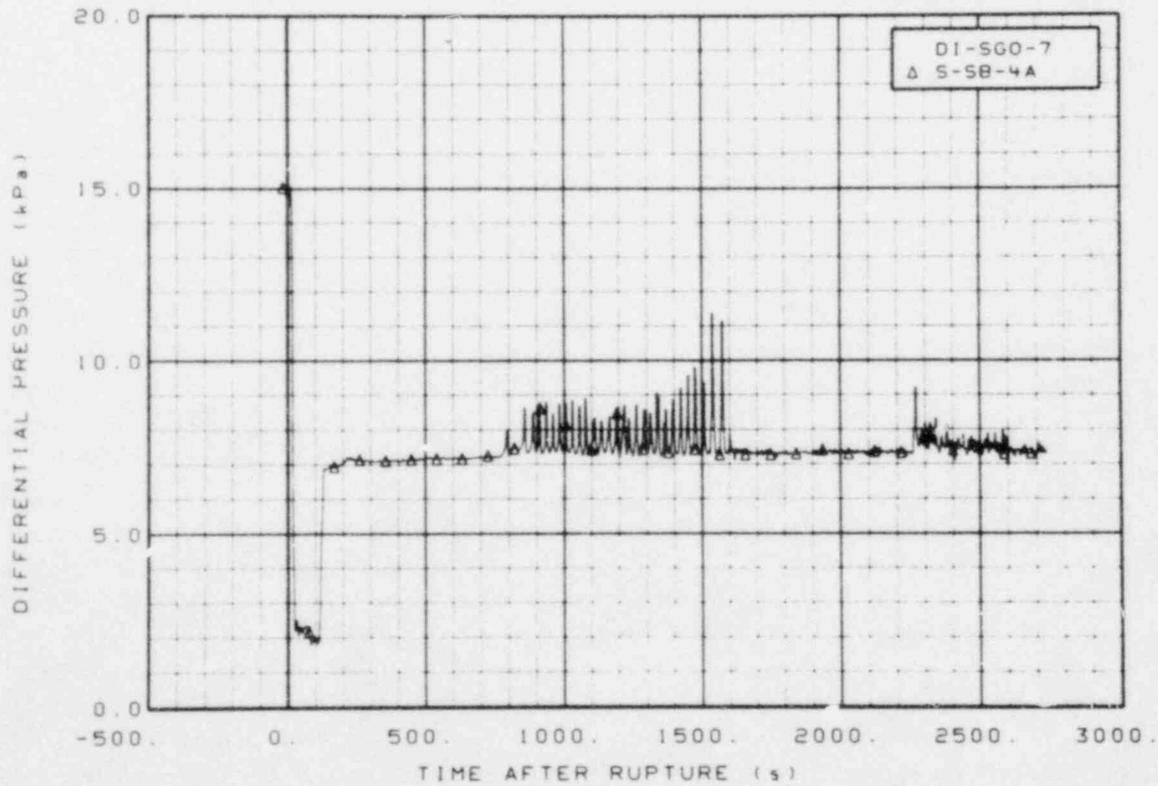


Figure 274. Differential pressure in intact loop co'd leg, Test S-SB-4A (DI-SGO-7), from -20 to 2740 s.

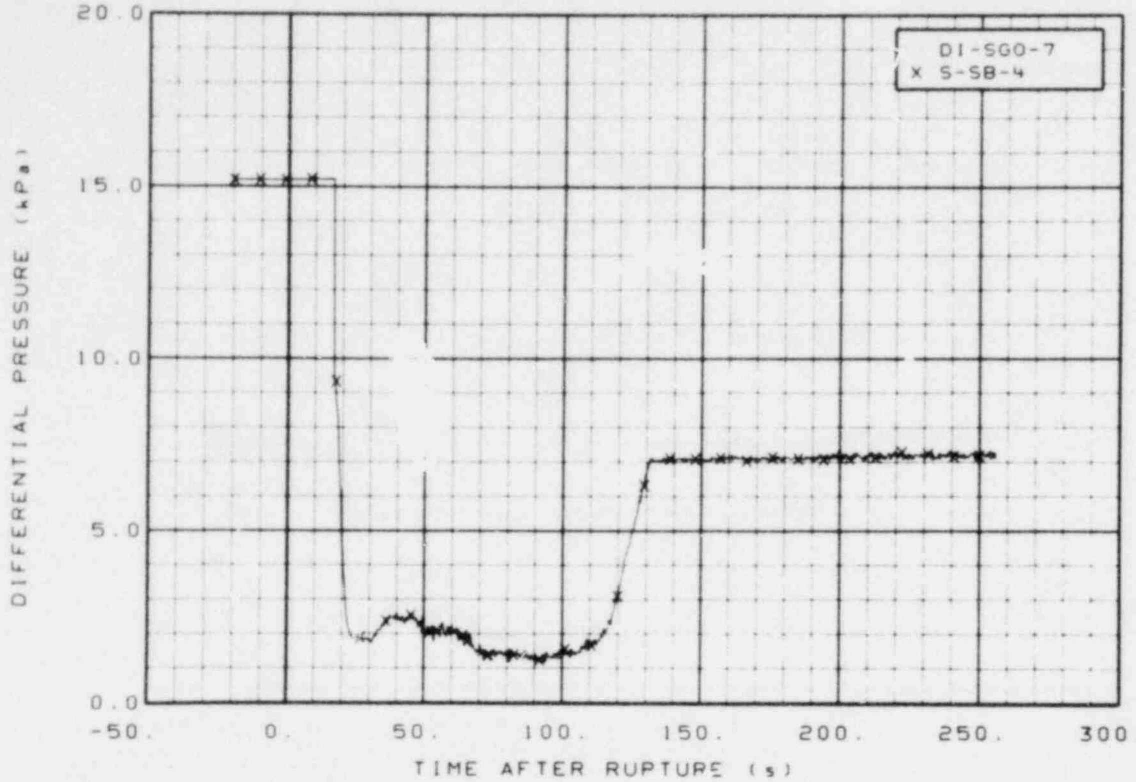


Figure 275. Differential pressure in intact loop cold leg, Test S-SB-4 (DI-SGO-7), from -20 to 256 s.

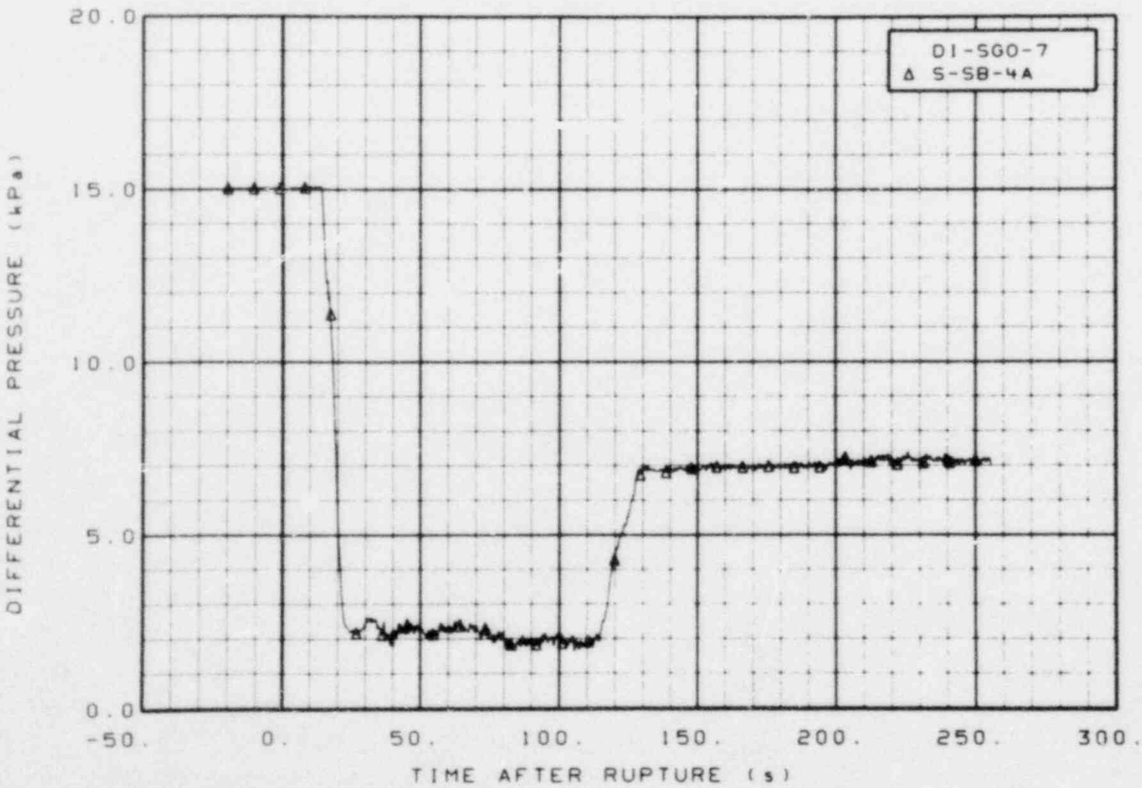


Figure 276. Differential pressure in intact loop cold leg, Test S-SB-4A (DI-SGO-7), from -20 to 256 s.

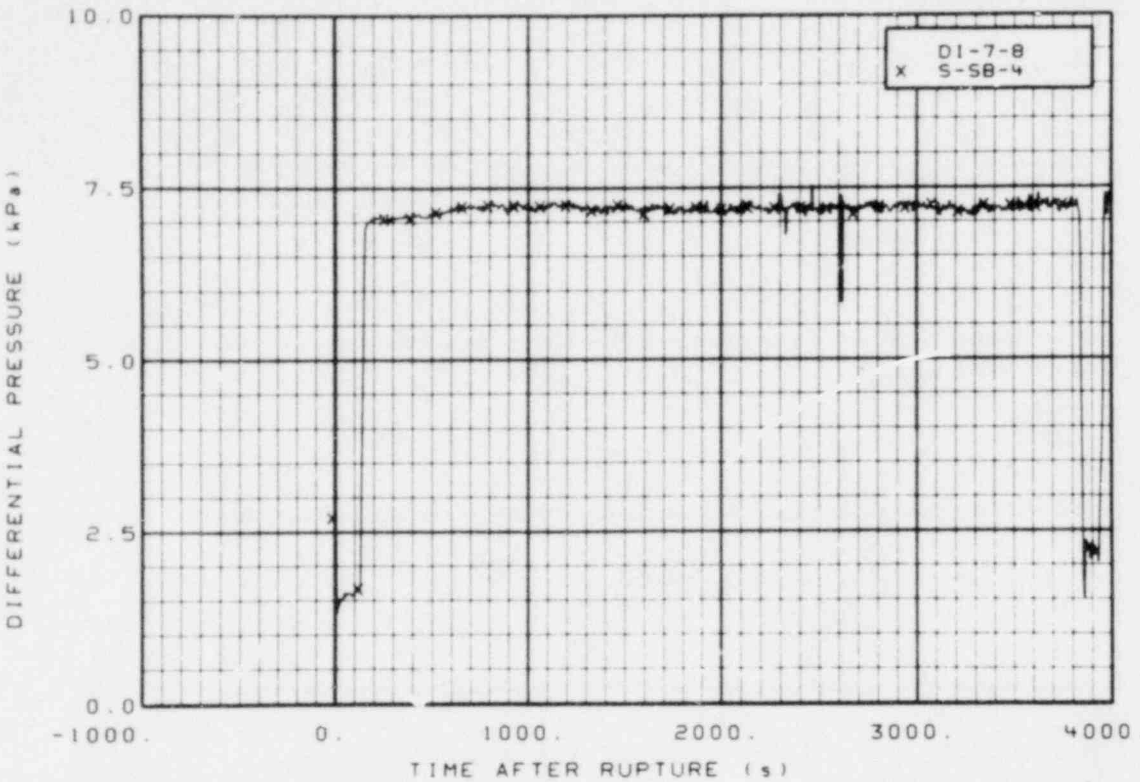


Figure 277. Differential pressure in intact loop cold leg, Test S-SB-4 (DI-7-8), from -20 to 4000 s.

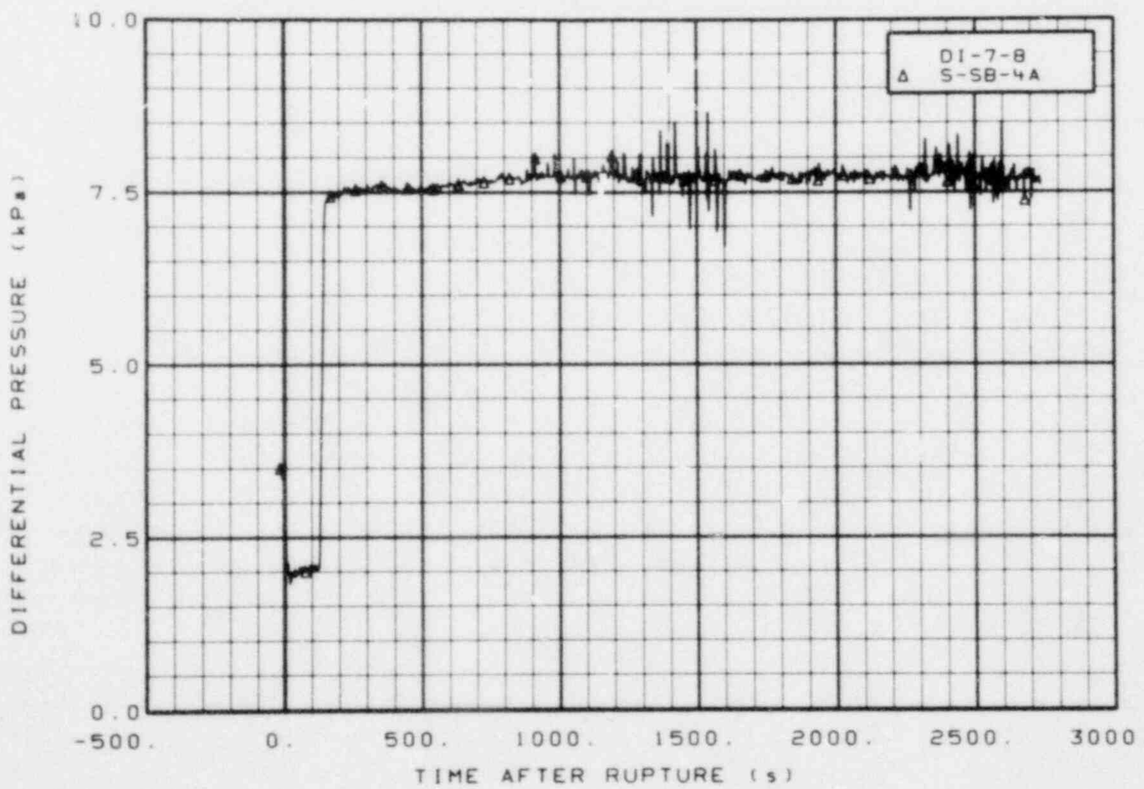


Figure 278. Differential pressure in intact loop cold leg, Test S-SB-4A (DI-7-8), from -20 to 2740 s.

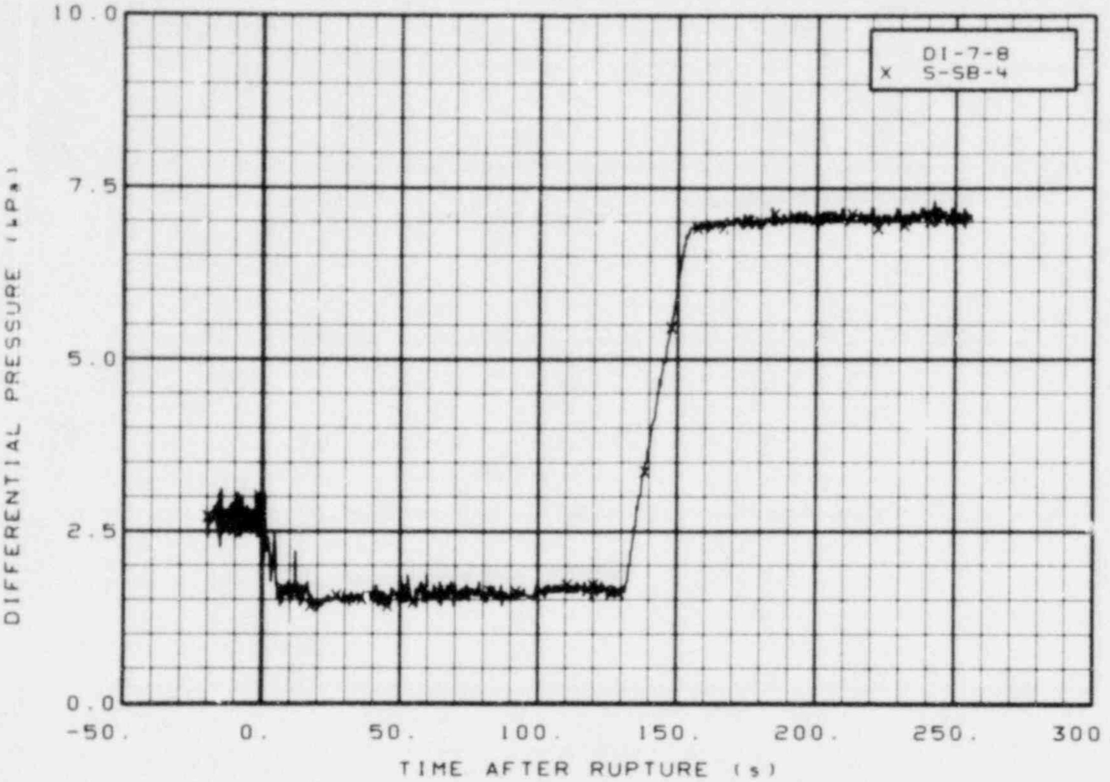


Figure 279. Differential pressure in intact loop cold leg, Test S-SB-4 (DI-7-8), from -20 to 256 s.

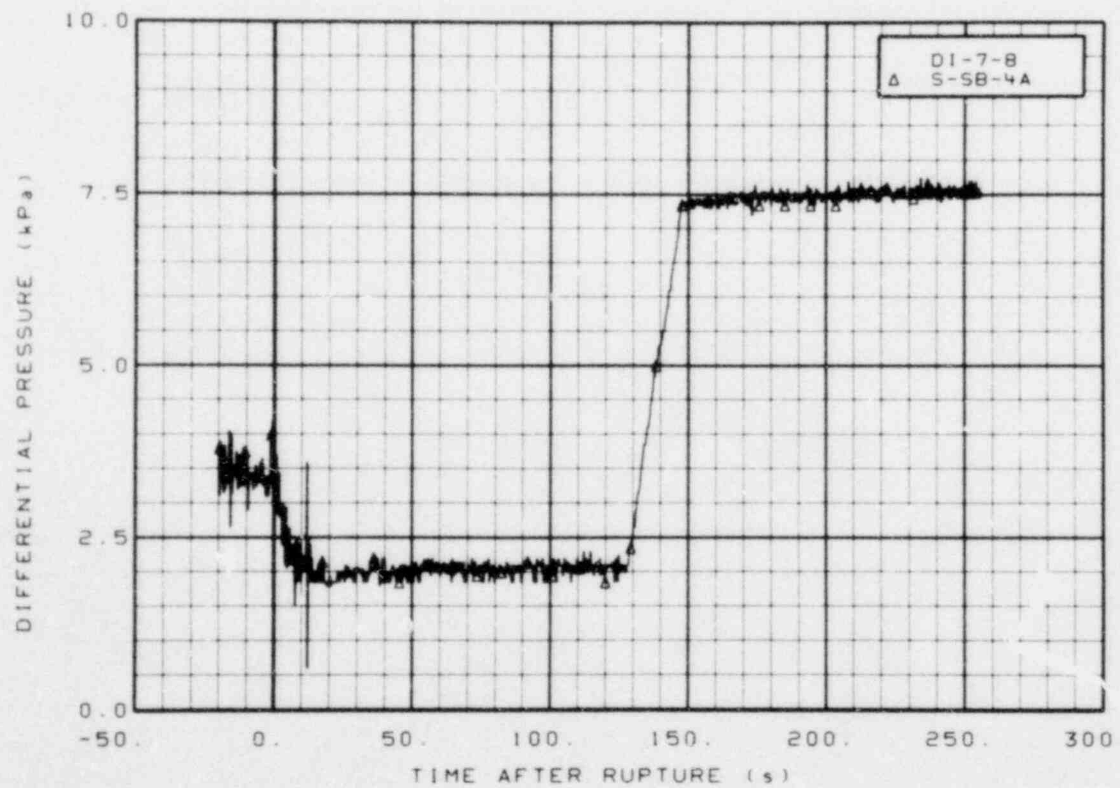


Figure 280. Differential pressure in intact loop cold leg, Test S-SB-4A (DI-7-8), from -20 to 256 s.

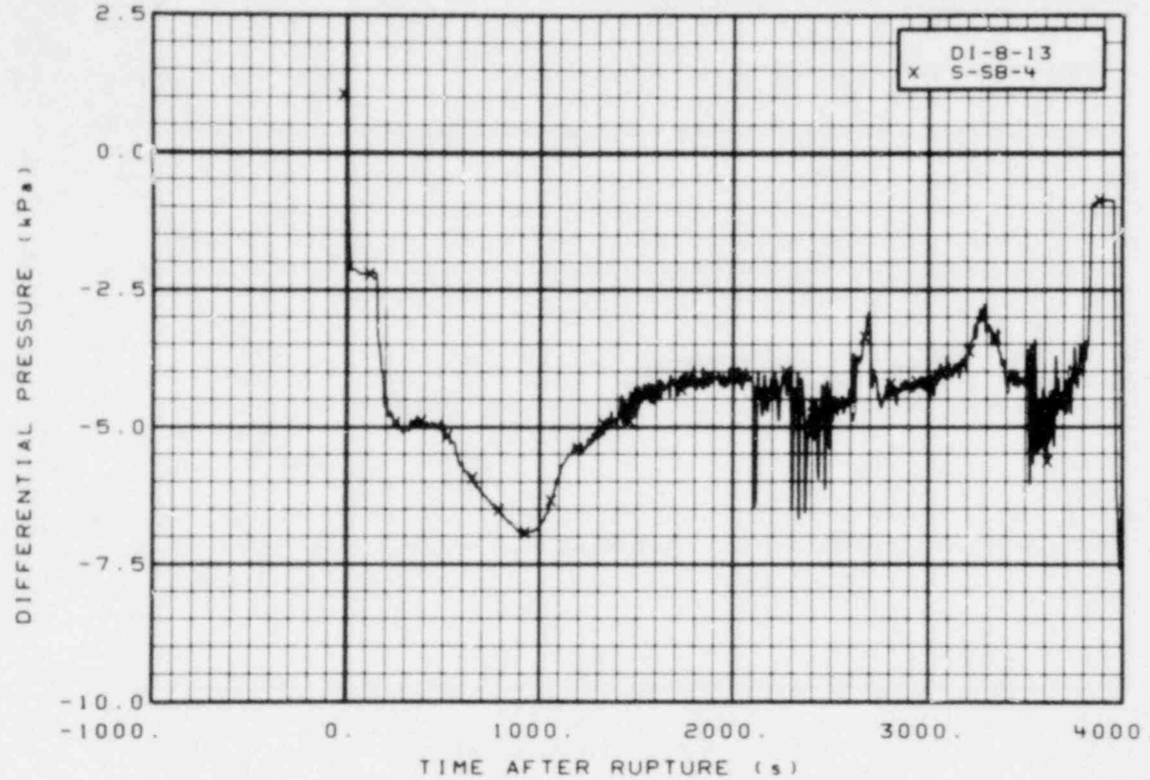


Figure 281. Differential pressure in intact loop cold leg, Test S-SB-4 (DI-8-13), from -20 to 4000 s.

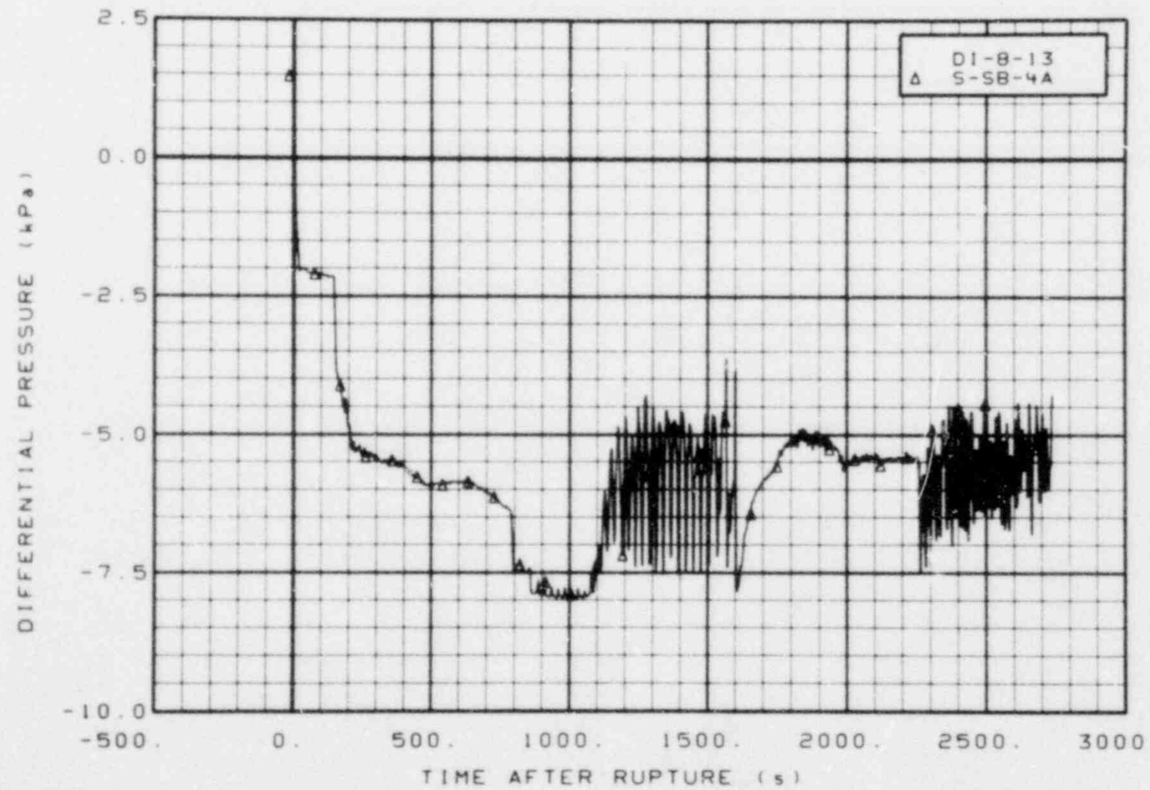


Figure 282. Differential pressure in intact loop cold leg, Test S-SB-4A (DI-8-13), from -20 to 2740 s.

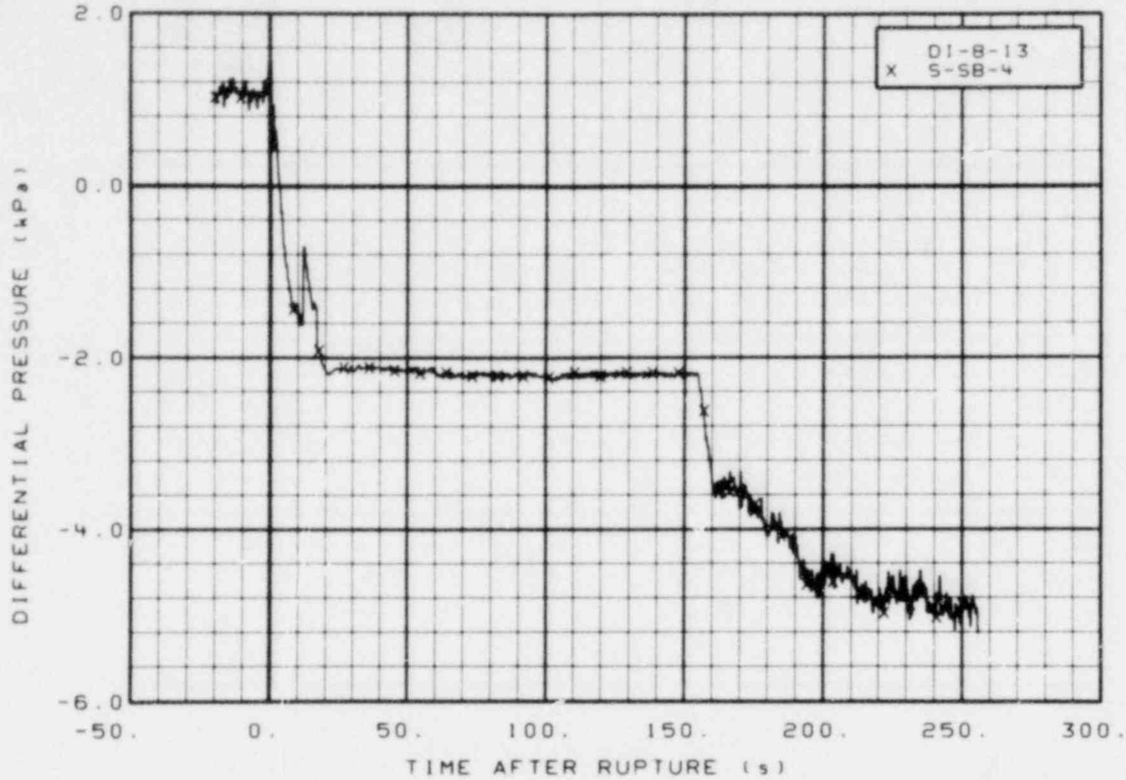


Figure 283. Differential pressure in intact loop cold leg, Test S-SB-4 (DI-8-13), from -20 to 256 s.

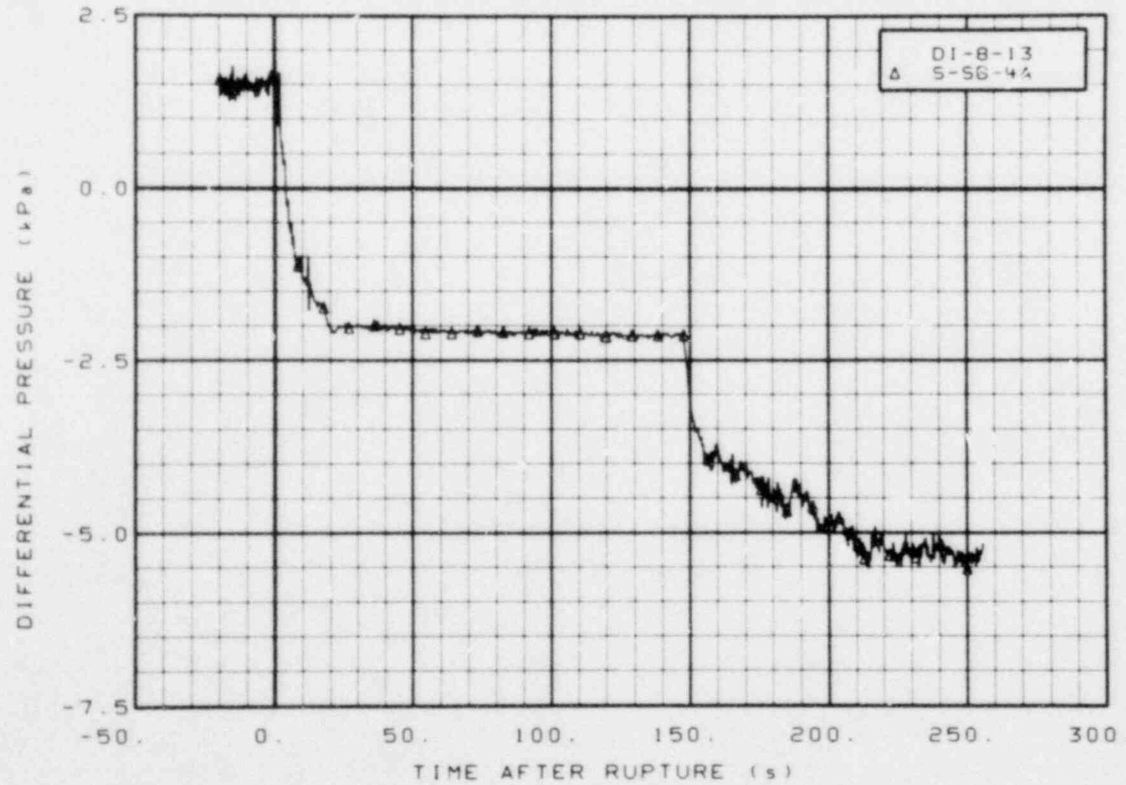


Figure 284. Differential pressure in intact loop cold leg, Test S-SB-4A (DI-8-13), from -20 to 256 s.

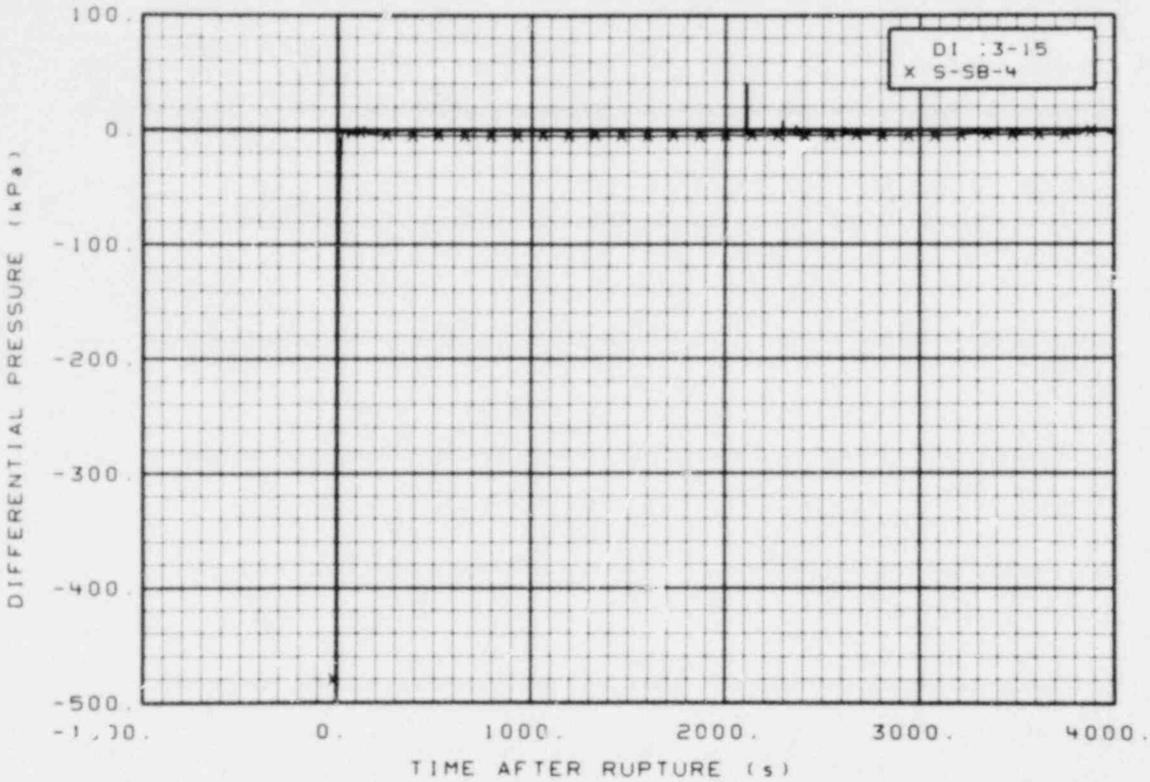


Figure 285. Differential pressure in intact loop cold leg, Test S-SB-4 (DI-13-15), from -20 to 4000 s.

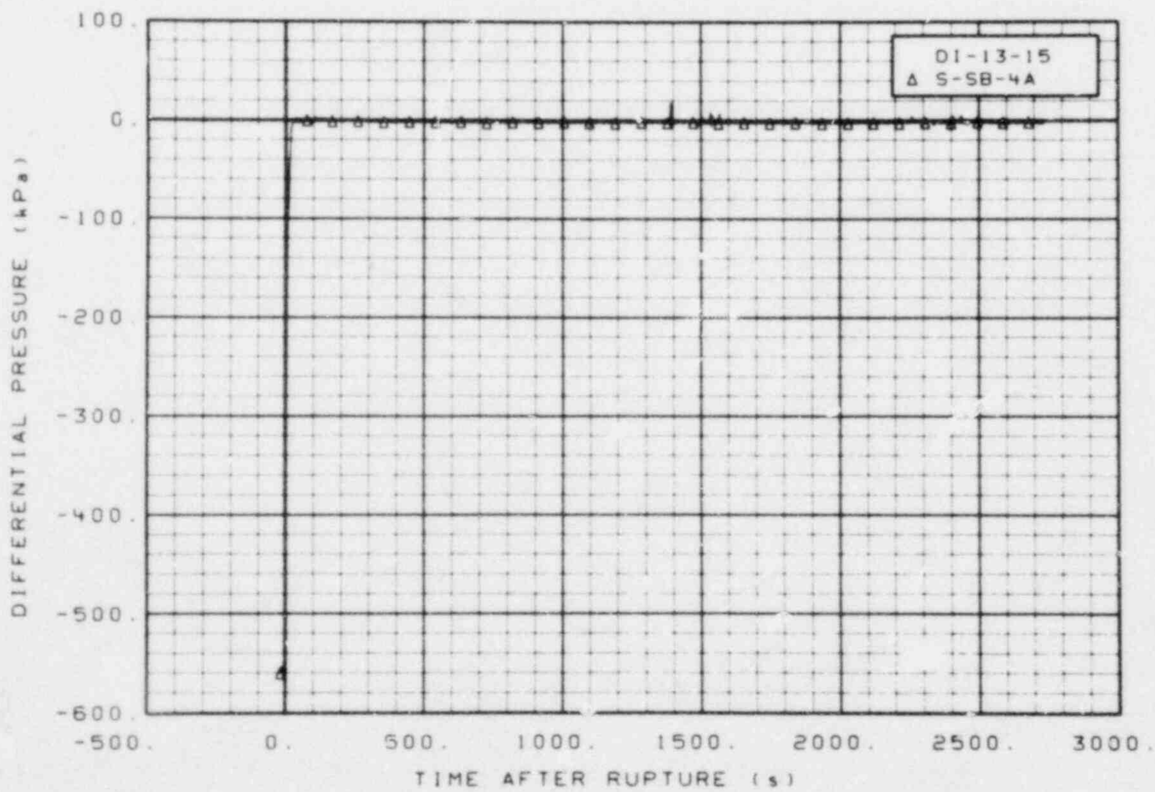


Figure 286. Differential pressure in intact loop cold leg, Test S-SB-4A (DI-13-15), from -20 to 2740 s.

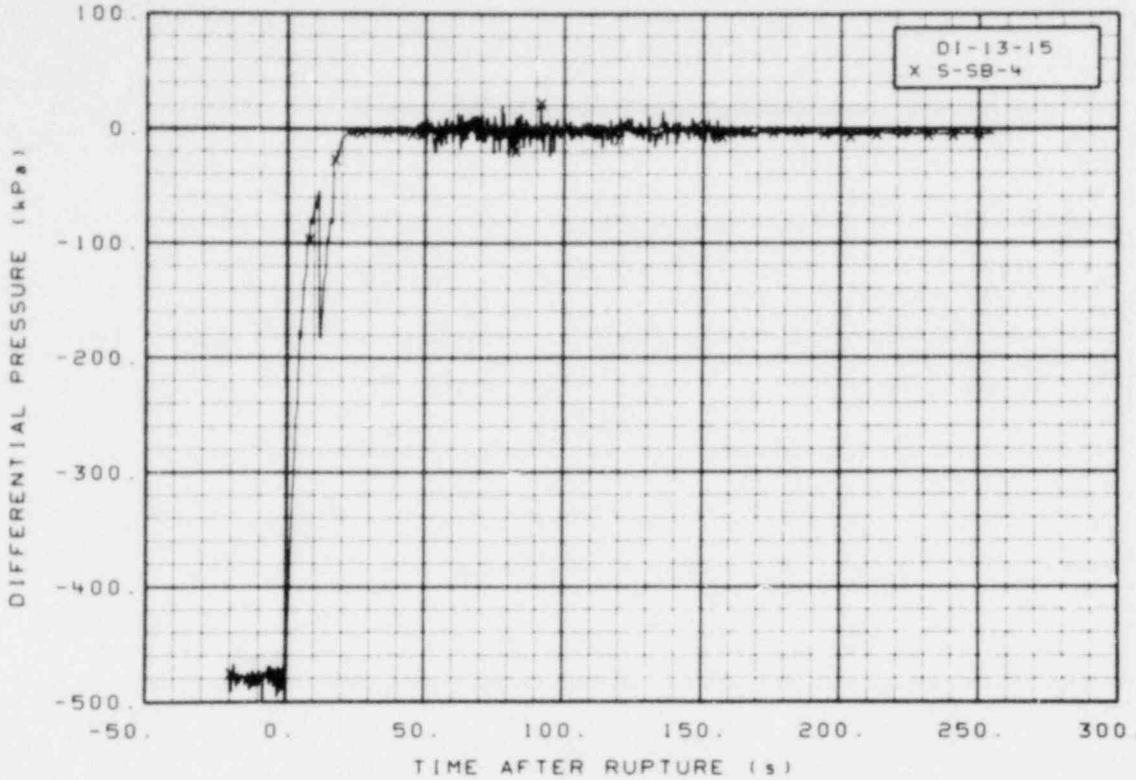


Figure 287. Differential pressure in intact loop cold leg, Test S-SB-4A (DI-13-15), from -20 to 256 s.

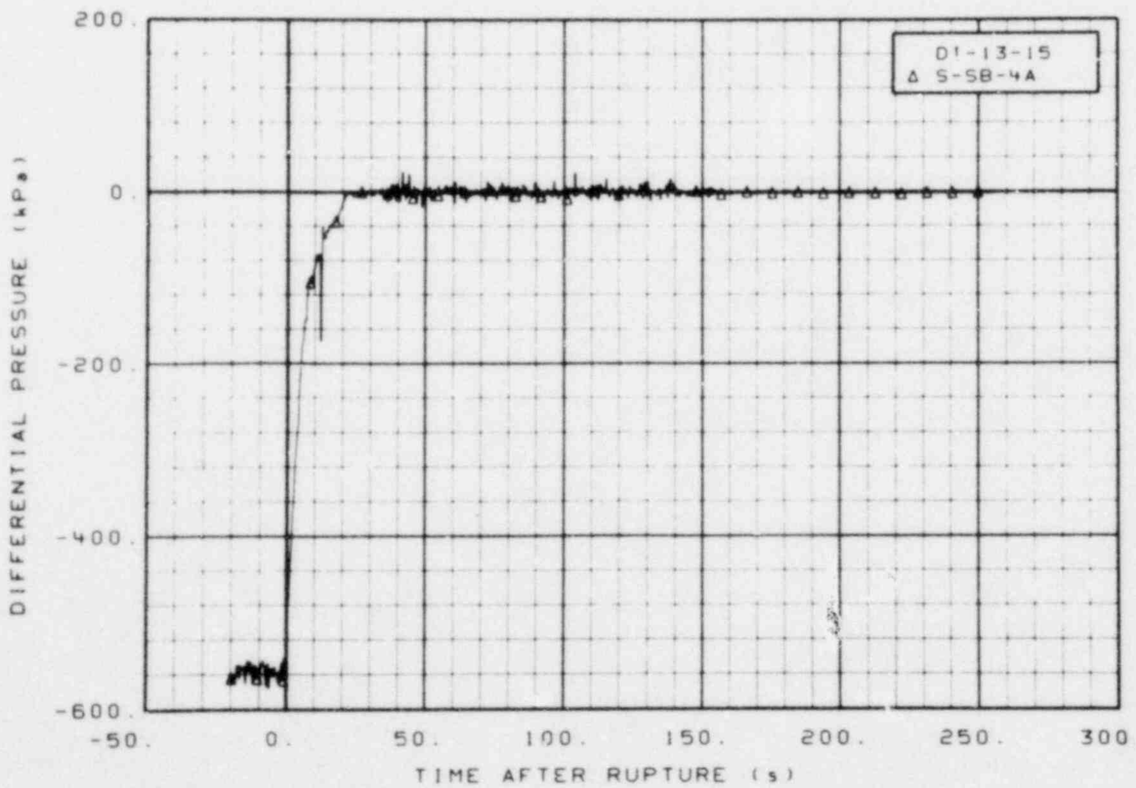


Figure 288. Differential pressure in intact loop cold leg, Test S-SB-4A (DI-13-15), from -20 to 256 s.

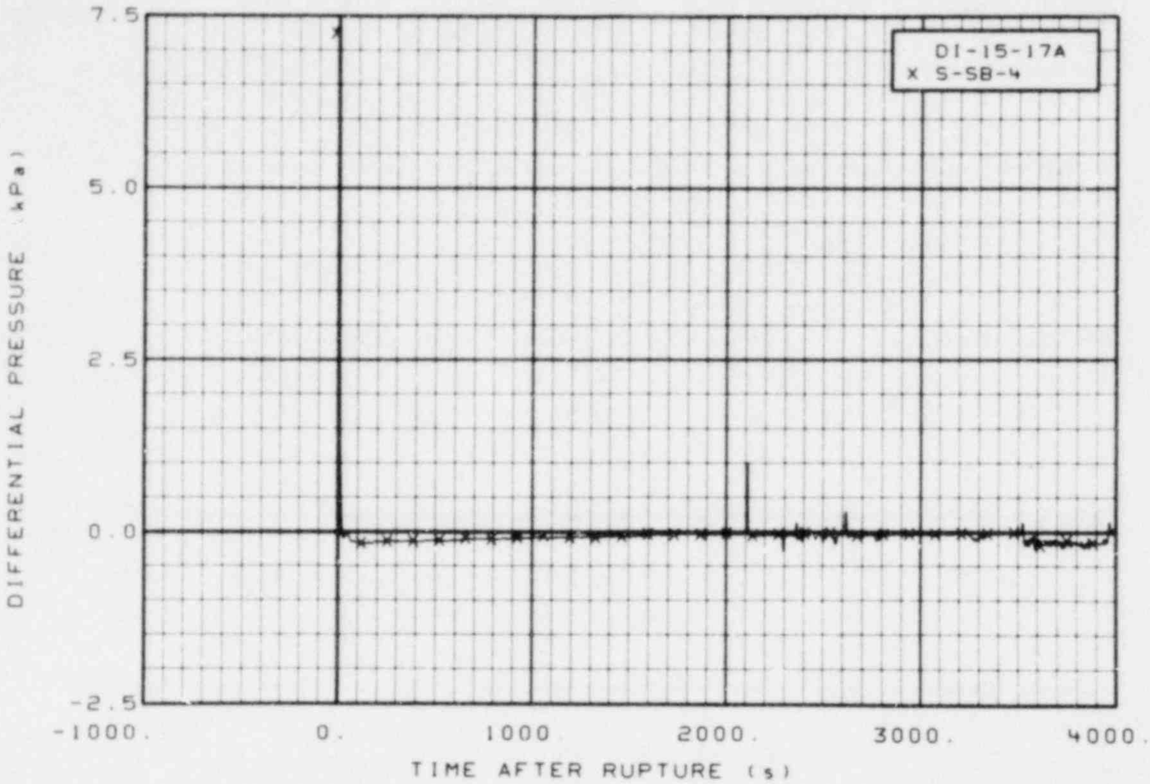


Figure 289. Differential pressure in intact loop cold leg, Test S-SB-4 (DI-15-17A), from -20 to 4000 s.

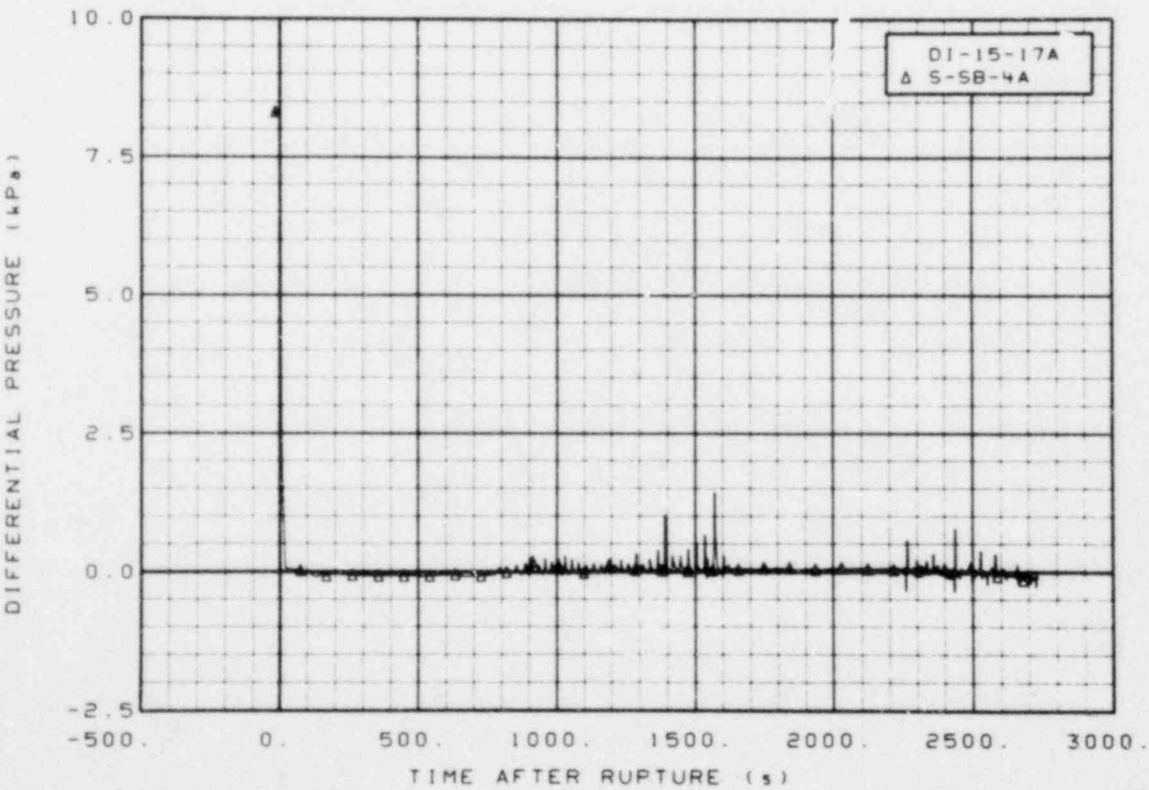


Figure 290. Differential pressure in intact loop cold leg, Test S-SB-4A (DI-15-17A), from -20 to 274

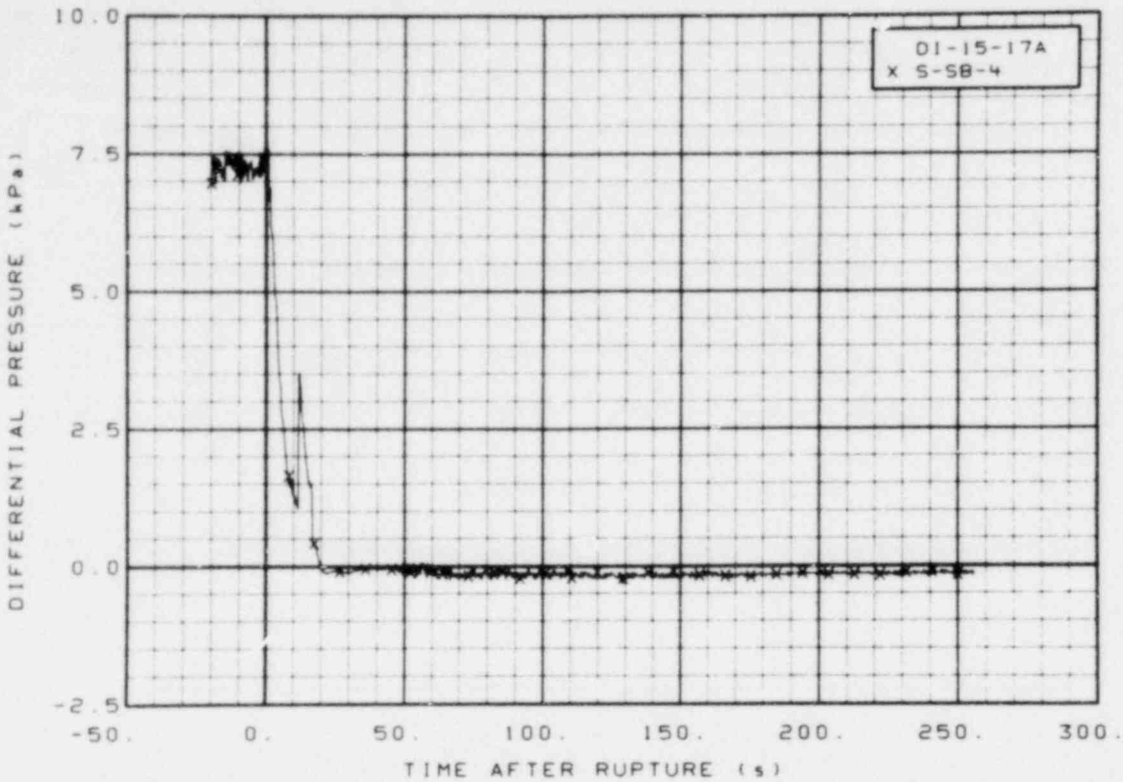


Figure 291. **Differential pressure in intact loop cold leg, Test S-SB-4 (DI-15-17A), from -20 to 256 s.**

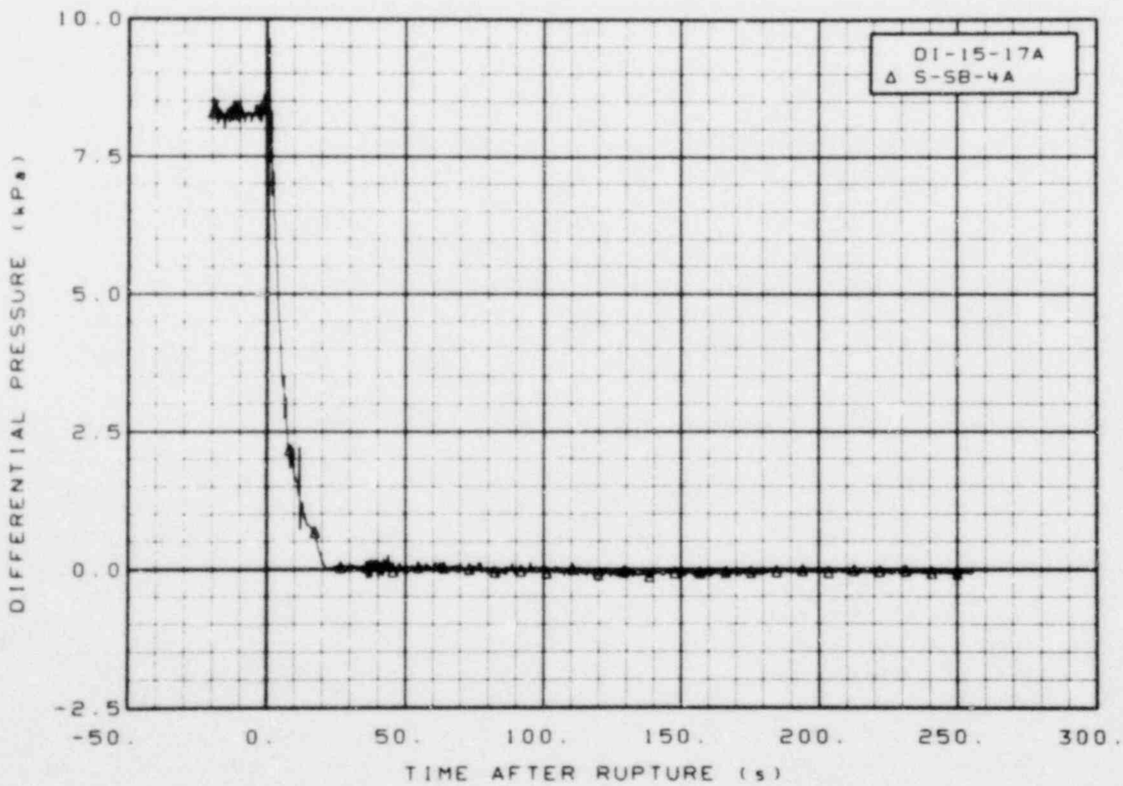


Figure 292. **Differential pressure in intact loop cold leg, Test S-SB-4A (DI-15-17A), from -20 to 256 s.**

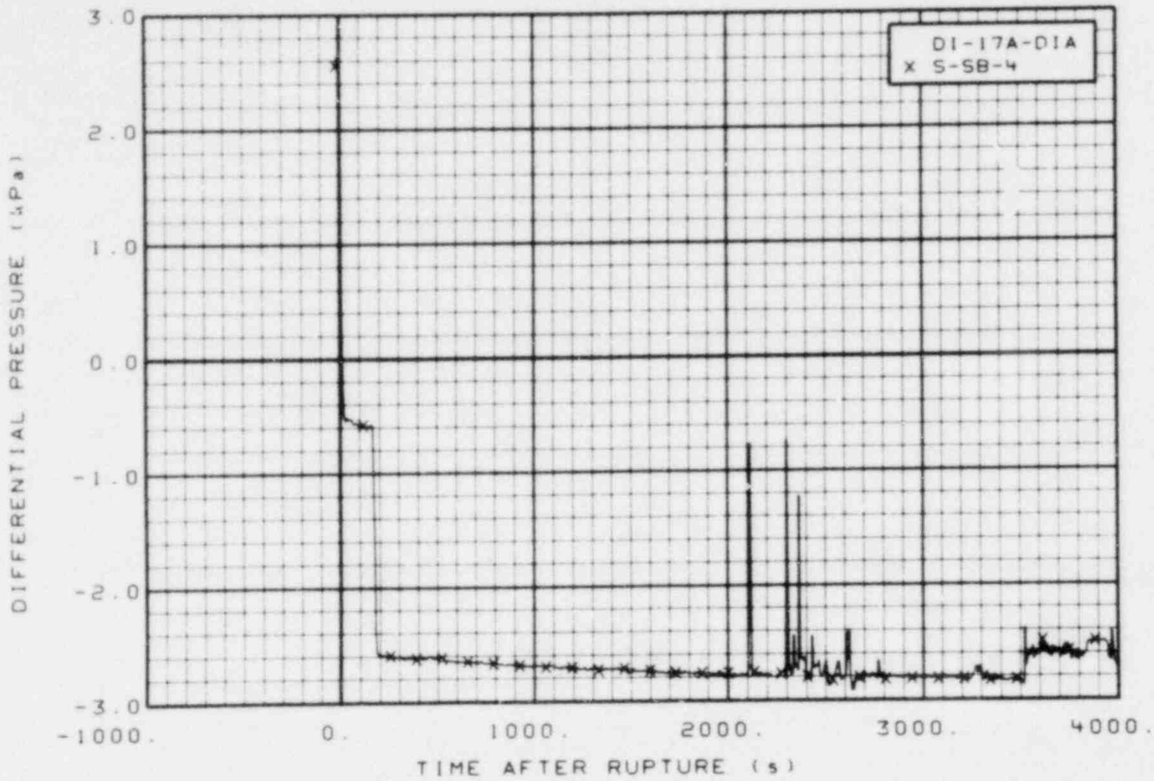


Figure 293. Differential pressure in intact loop cold leg, Test S-SB-4 (DI-17A-DIA), from -20 to 4000 s.

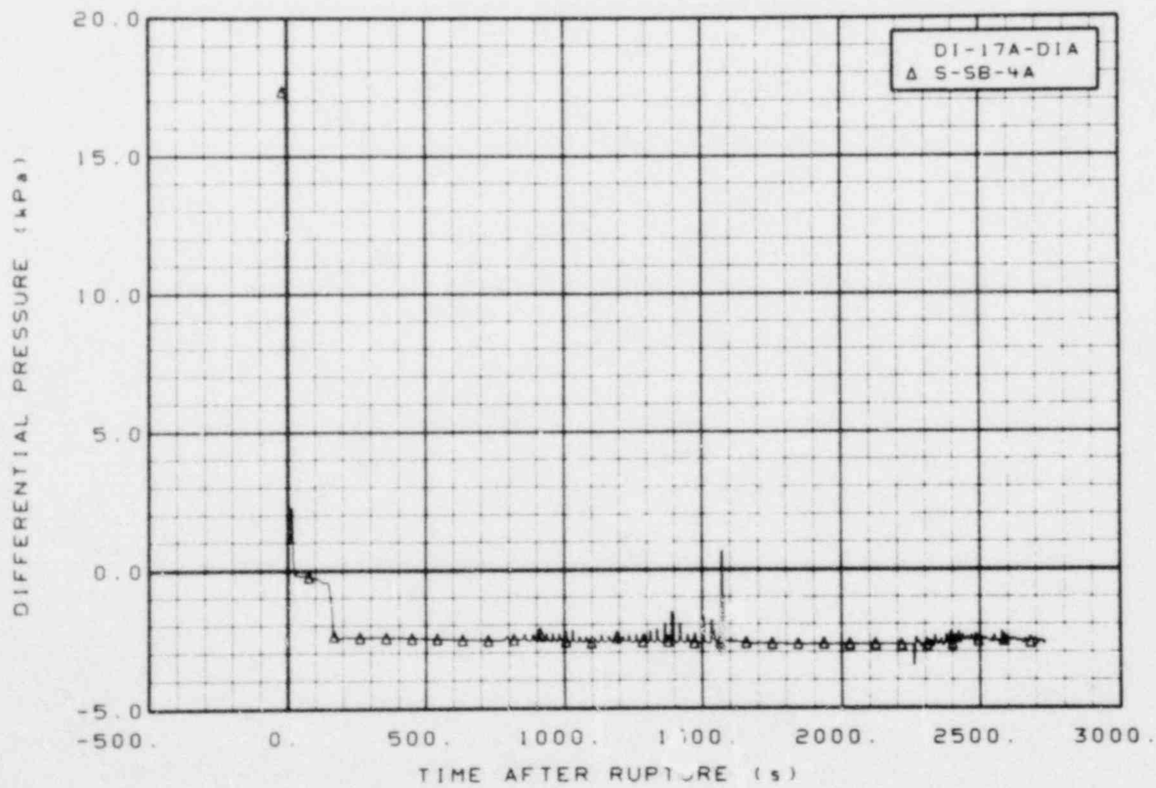


Figure 294. Differential pressure in intact loop cold leg, Test S-SB-4A (DI-17A-DIA), from -20 to 2740 s.

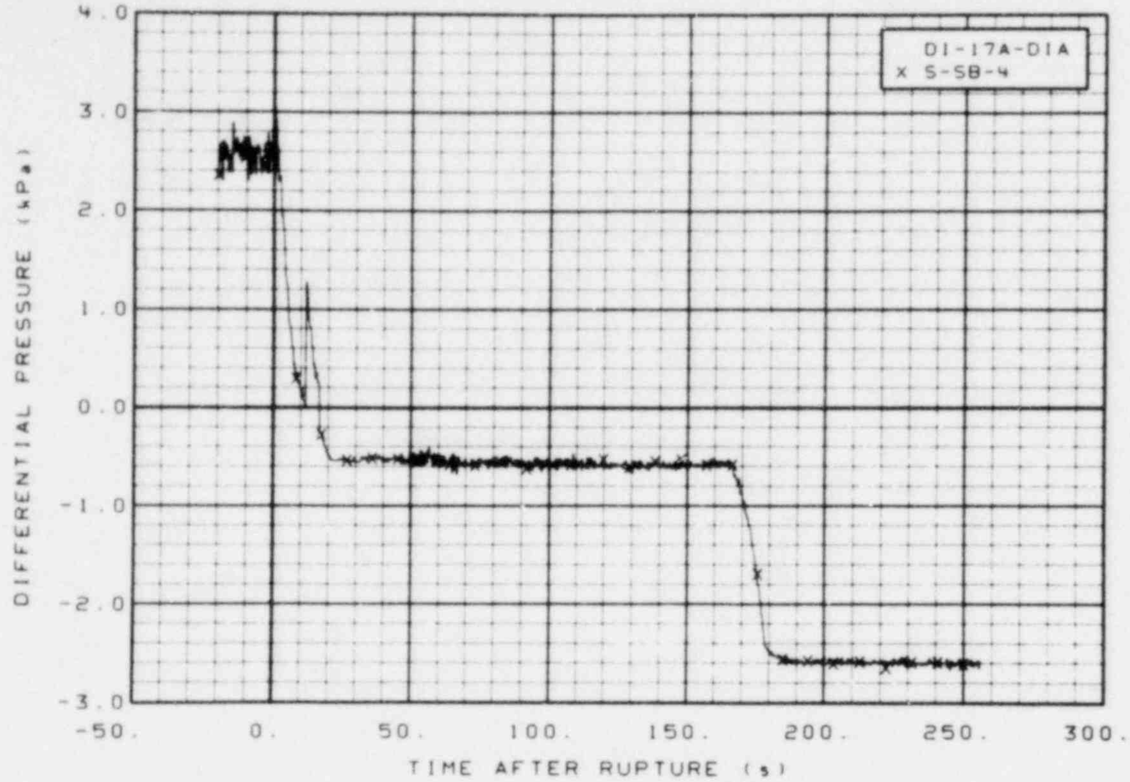


Figure 295. Differential pressure in intact loop cold leg, Test S-SB-4 (DI-17A-DIA), from -20 to 256 s.

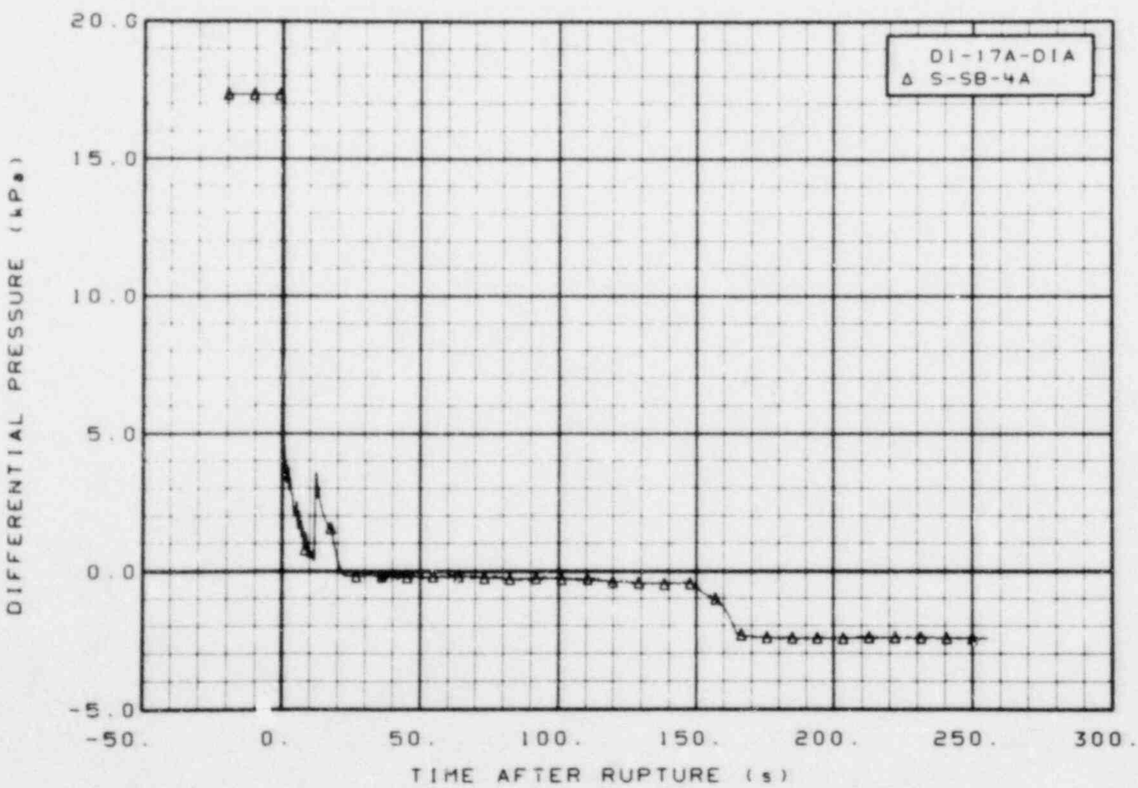


Figure 296. Differential pressure in intact loop cold leg, Test S-SB-4A (DI-17A-DIA), from -20 to 256 s.

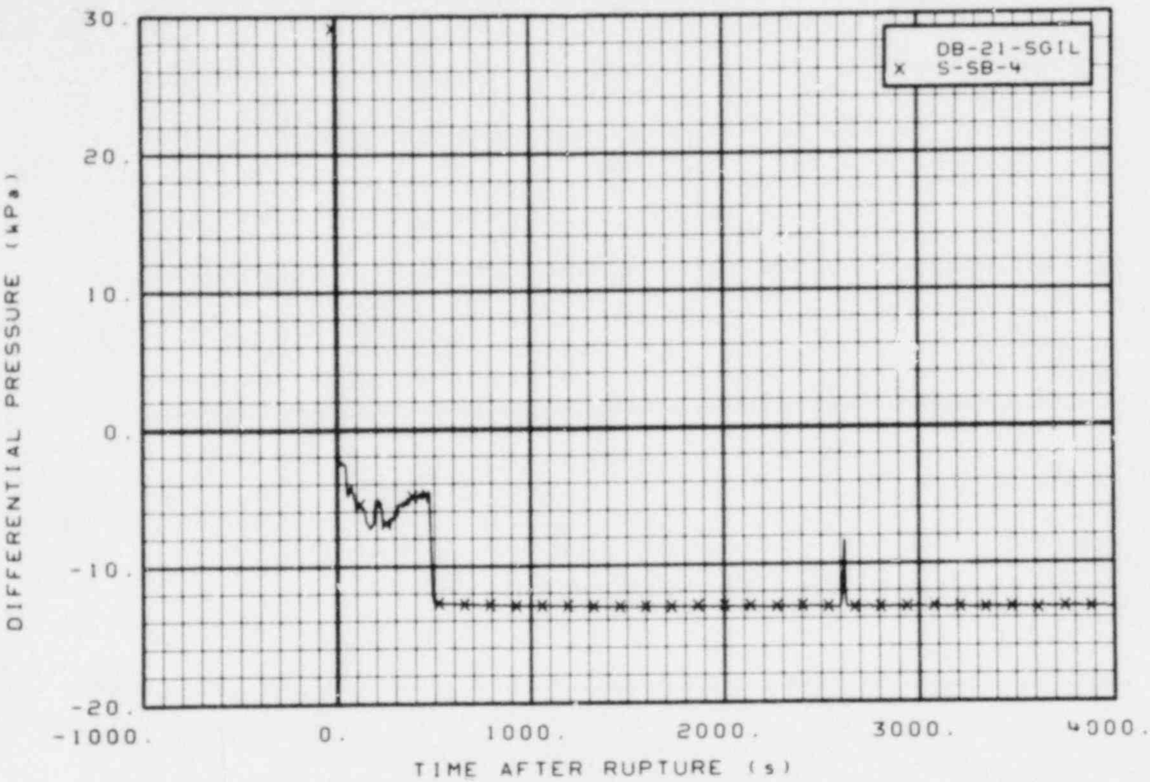


Figure 297. Differential pressure in broken loop hot leg, Test S-SB-4 (DB-21-SGIL), from -20 to 4000 s.

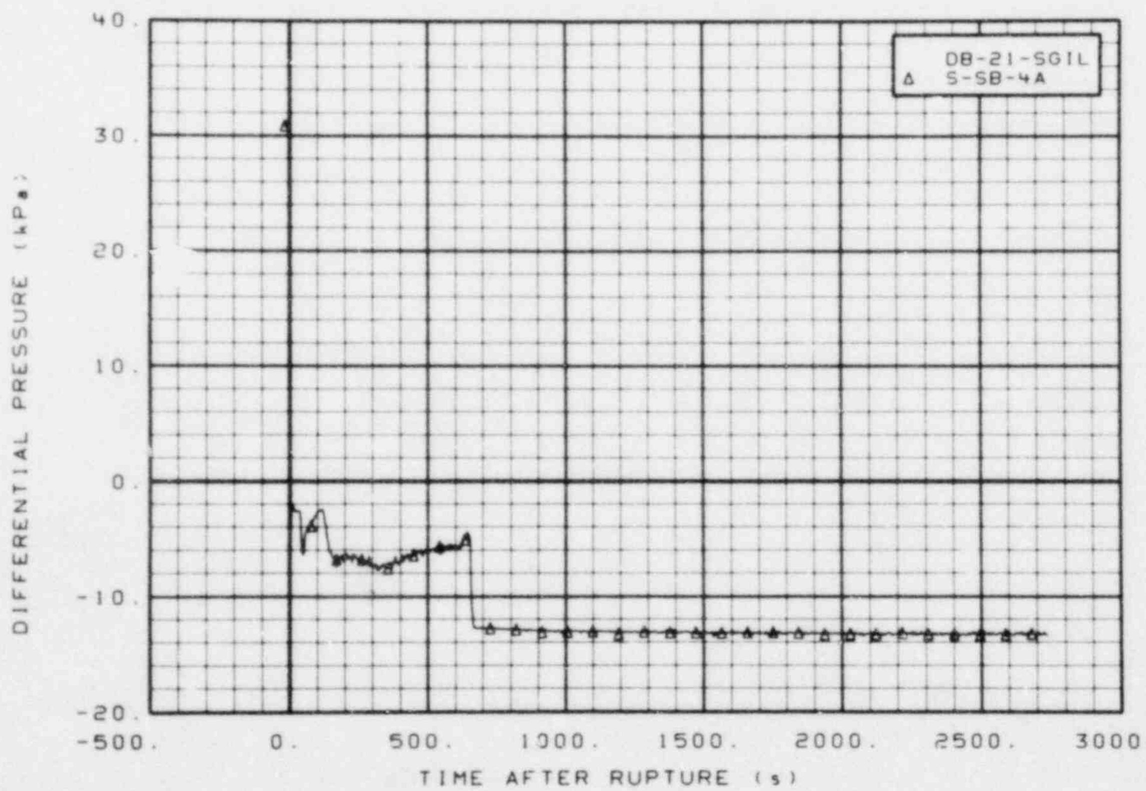


Figure 298. Differential pressure in broken loop hot leg, Test S-SB-4A (DB-21-SGIL), from -20 to 2740 s.

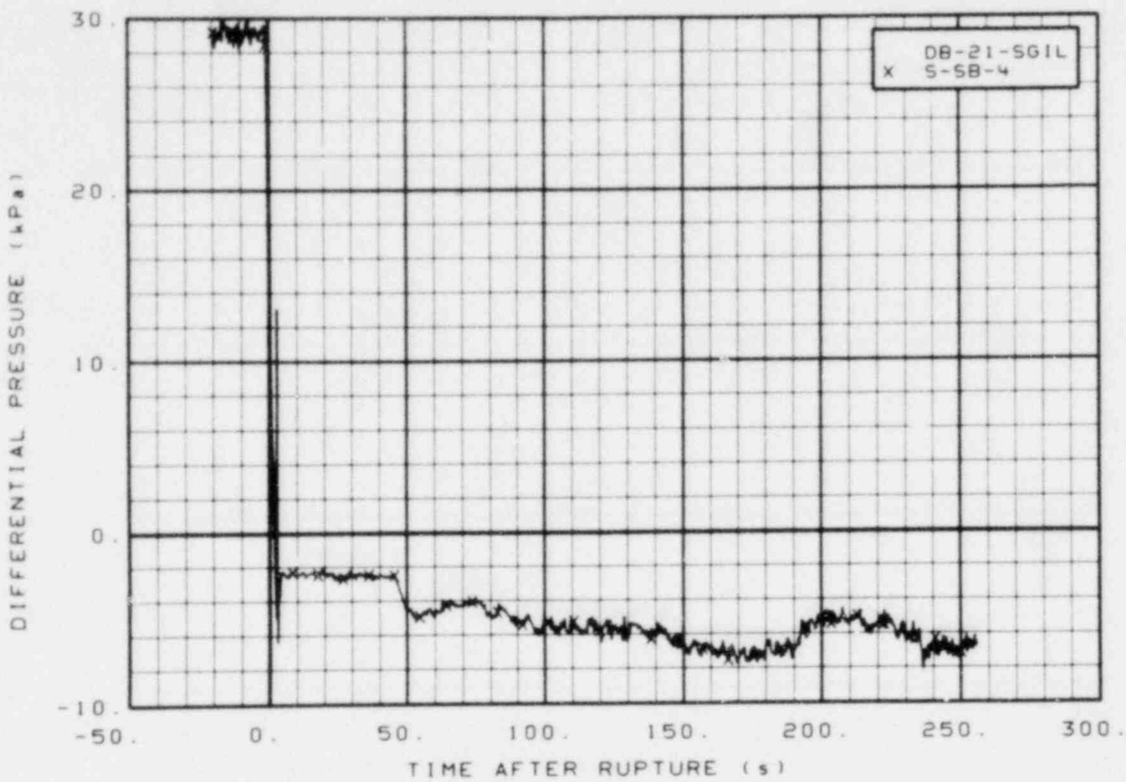


Figure 299. Differential pressure in broken loop hot leg, Test S-SB-4 (DB-21-SGIL), from -20 to 256 s.

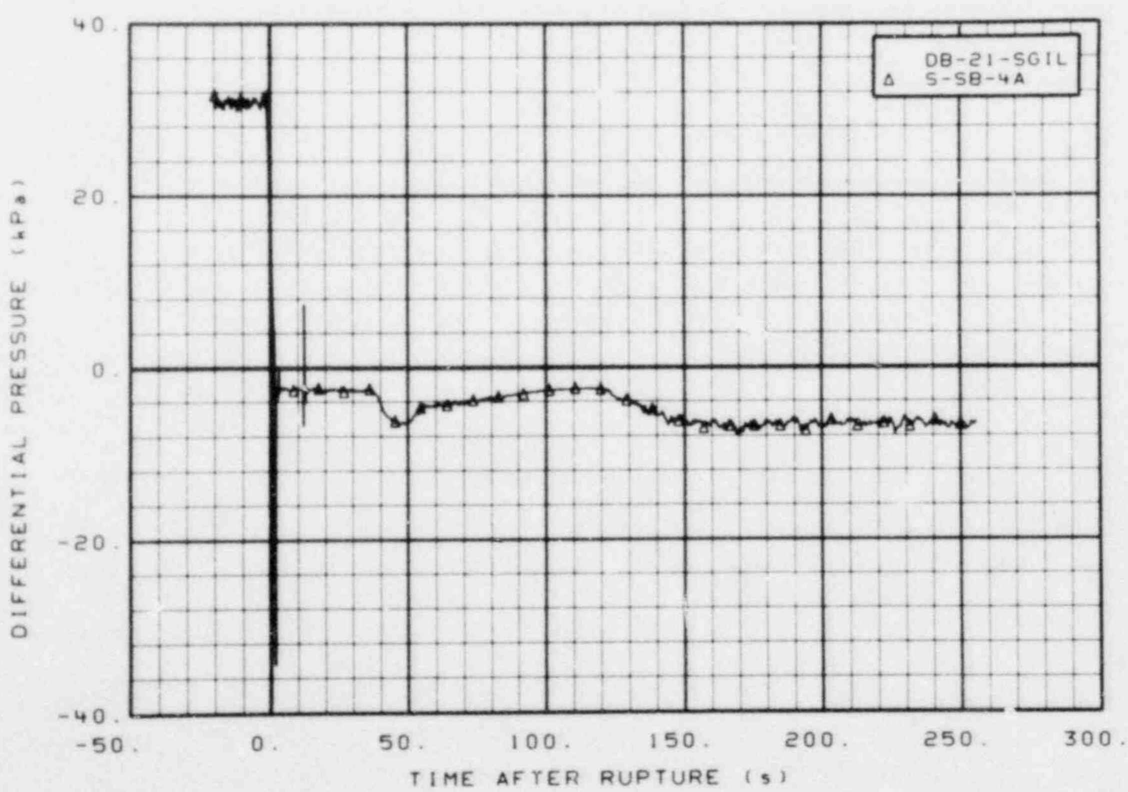


Figure 300. Differential pressure in broken loop hot leg, Test S-SB-4A (DB-21-SGIL), from -20 to 256 s.

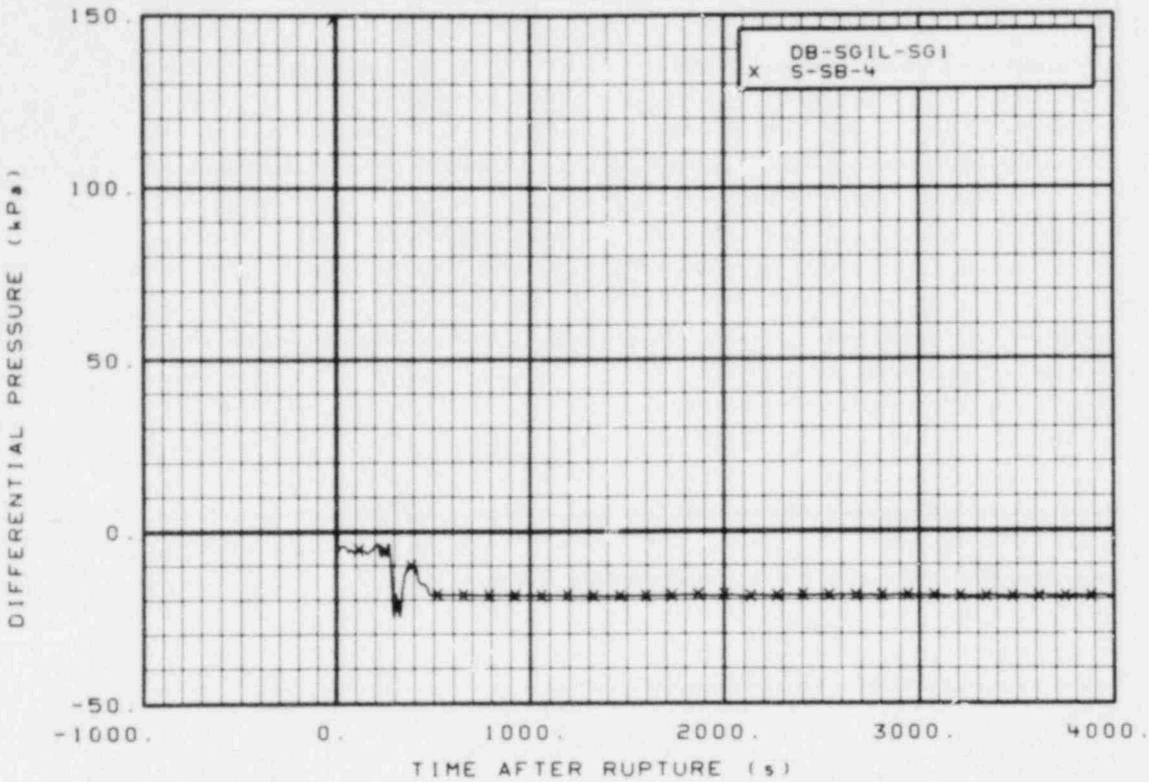


Figure 301. Differential pressure in broken loop hot leg, Test S-SB-4 (DB-SGIL-SG1), from -20 to 4000 s.

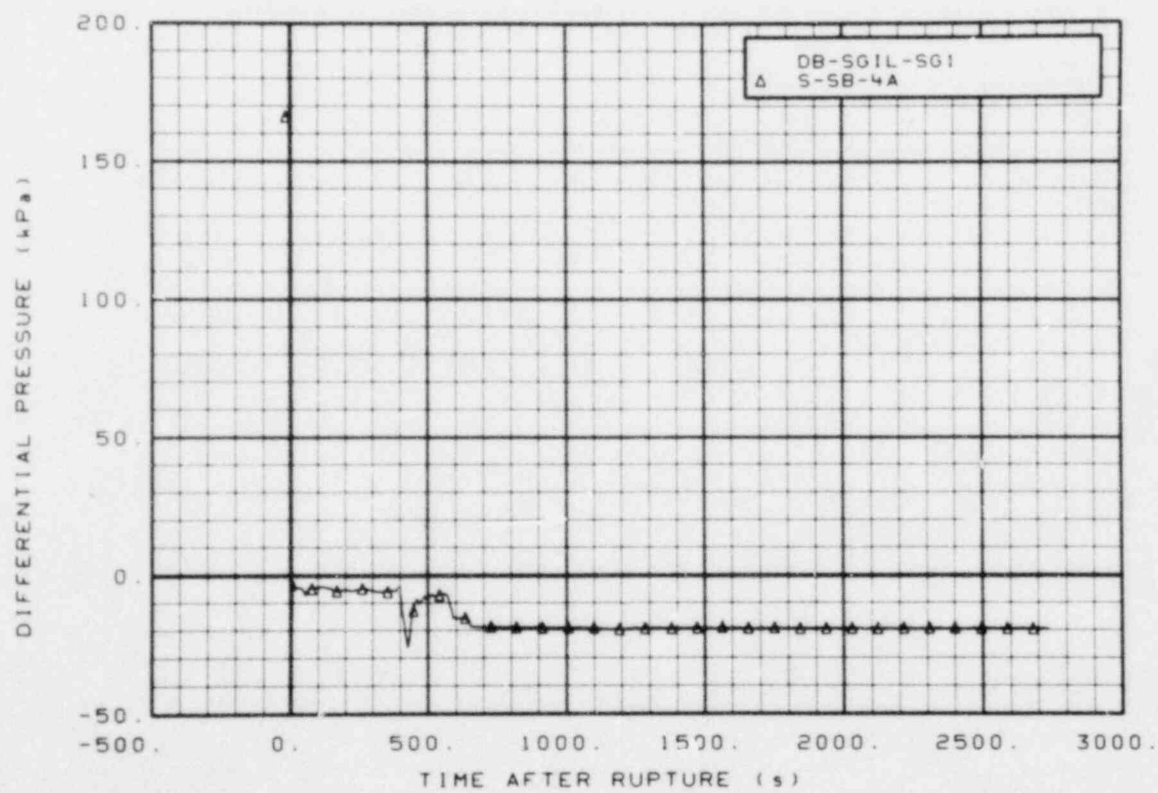


Figure 302. Differential pressure in broken loop hot leg, Test S-SB-4A (DB-SGIL-SG1), from -20 to 2740 s.

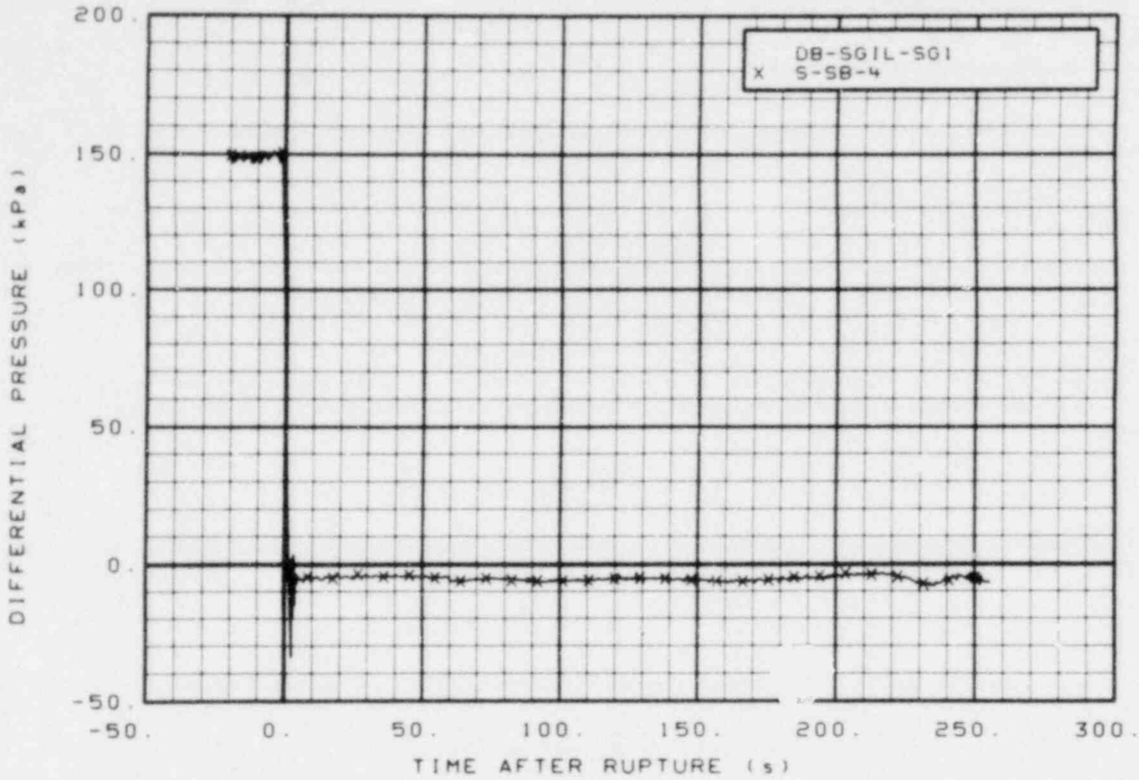


Figure 303. Differential pressure in broken loop hot leg, Test S-SB-4 (DB-SGIL-SG1), from -20 to 256 s.

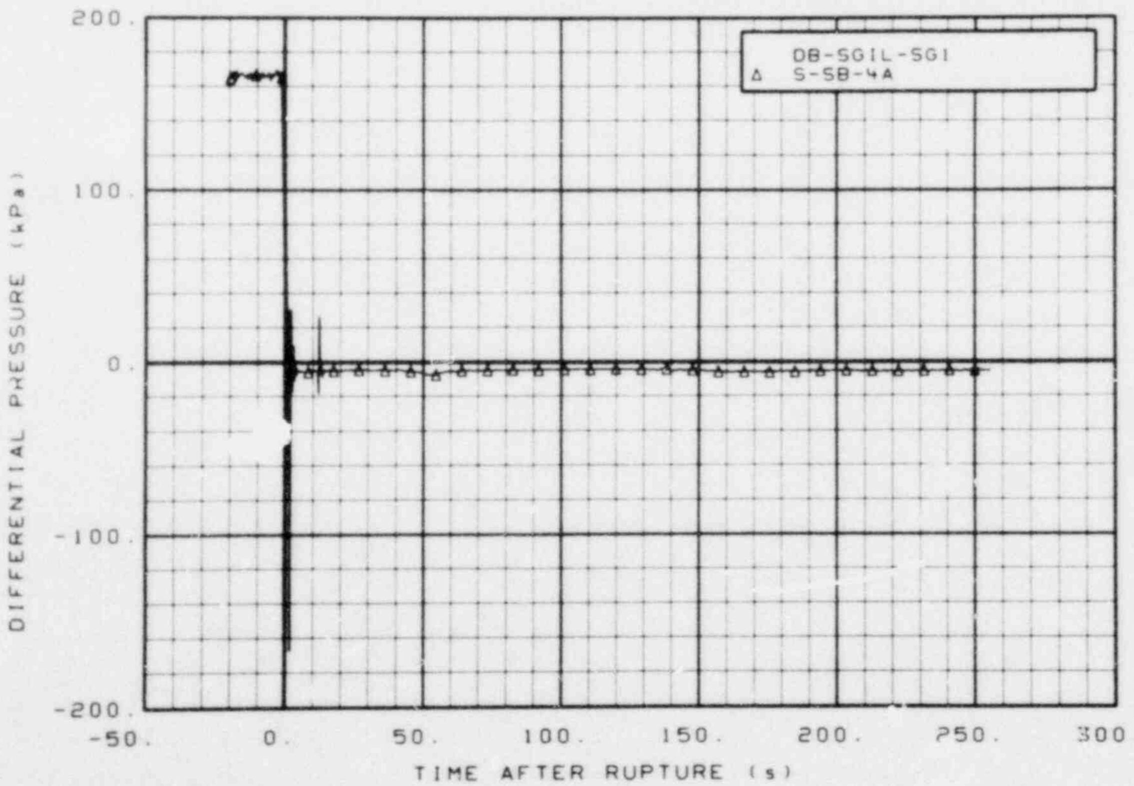


Figure 304. Differential pressure in broken loop ho: leg, Test S-SB-4A (DB-SGIL-SG1), from -20 to 256 s.

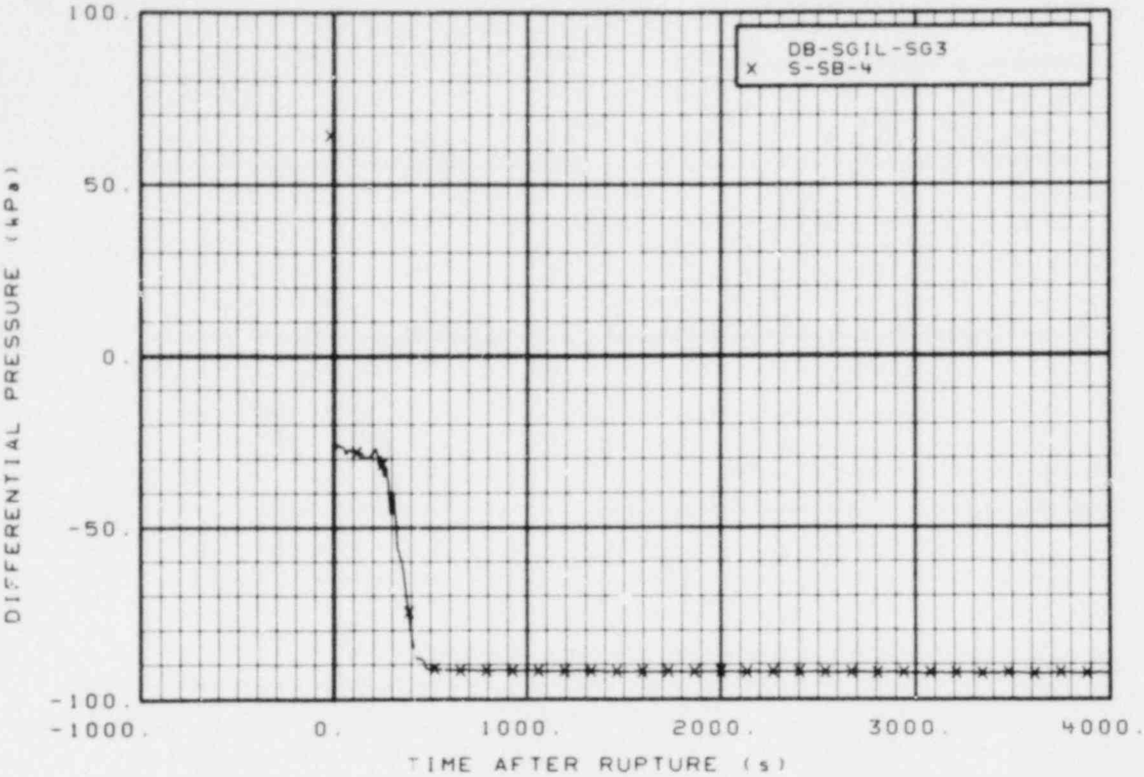


Figure 305. Differential pressure in broken loop hot leg, Test S-SB-4 (DB-SGIL-SG3), from -20 to 4000 s.

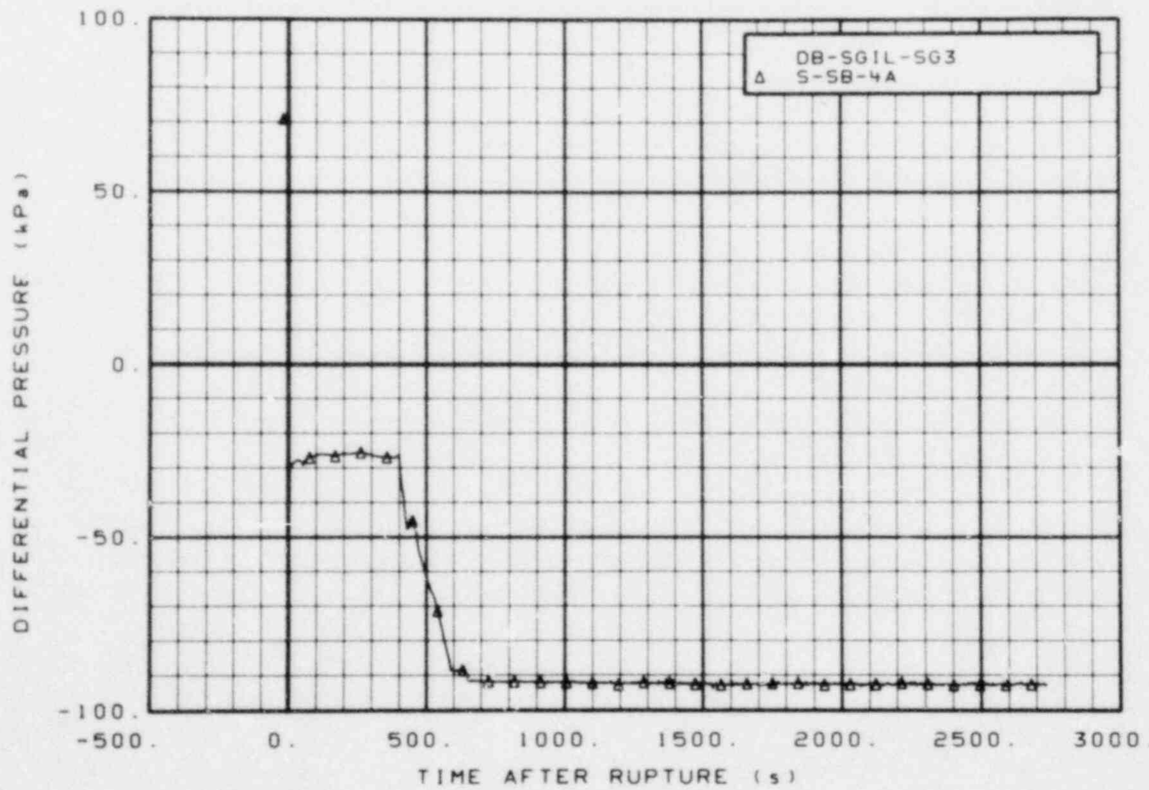


Figure 306. Differential pressure in broken loop hot leg, Test S-SB-4A (DB-SGIL-SG3), from -20 to 2740 s.

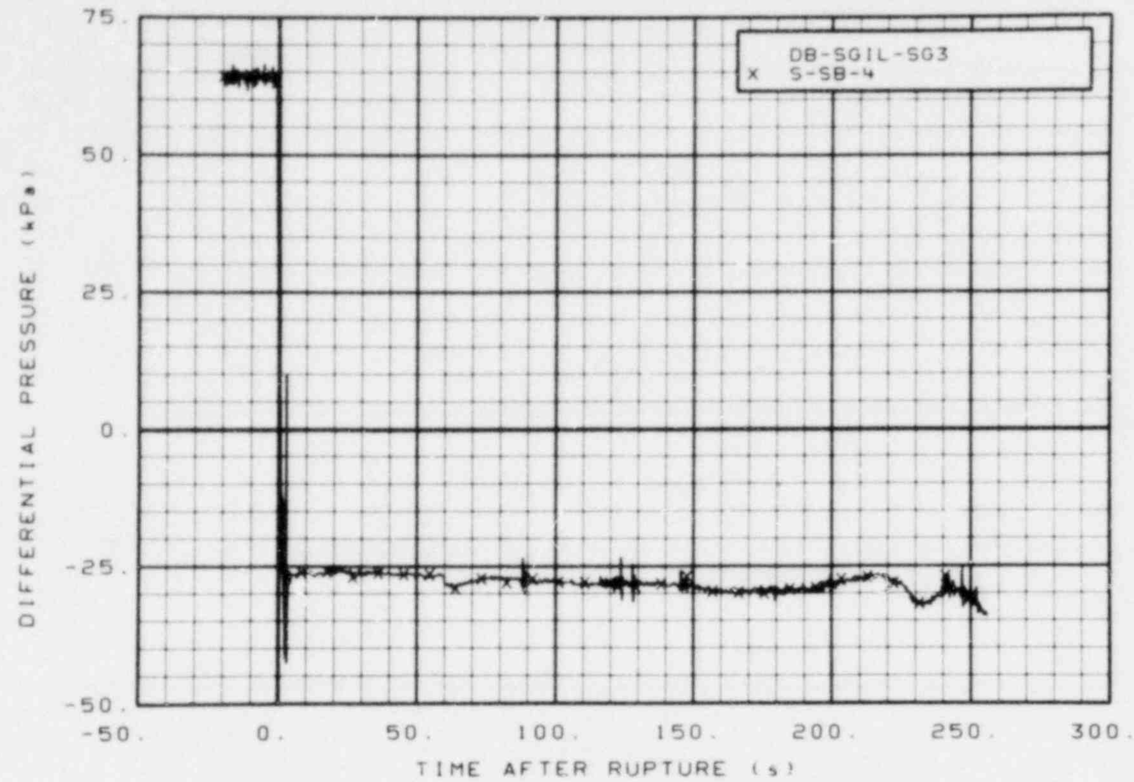


Figure 307. Differential pressure in broken loop hot leg, Test S-SB-4 (DB-SGIL-SG3), from -20 to 256 s.

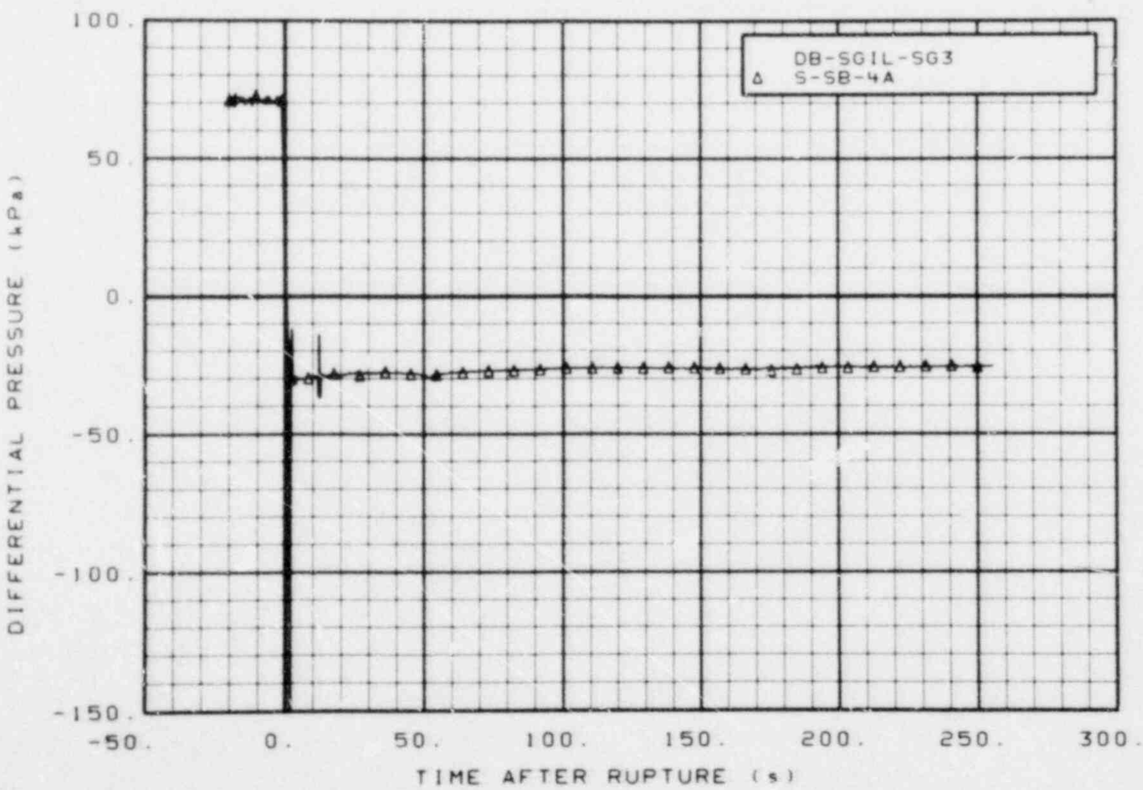


Figure 308. Differential pressure in broken loop hot leg, Test S-SB-4A (DB-SGIL-SG3), from -20 to 256 s.

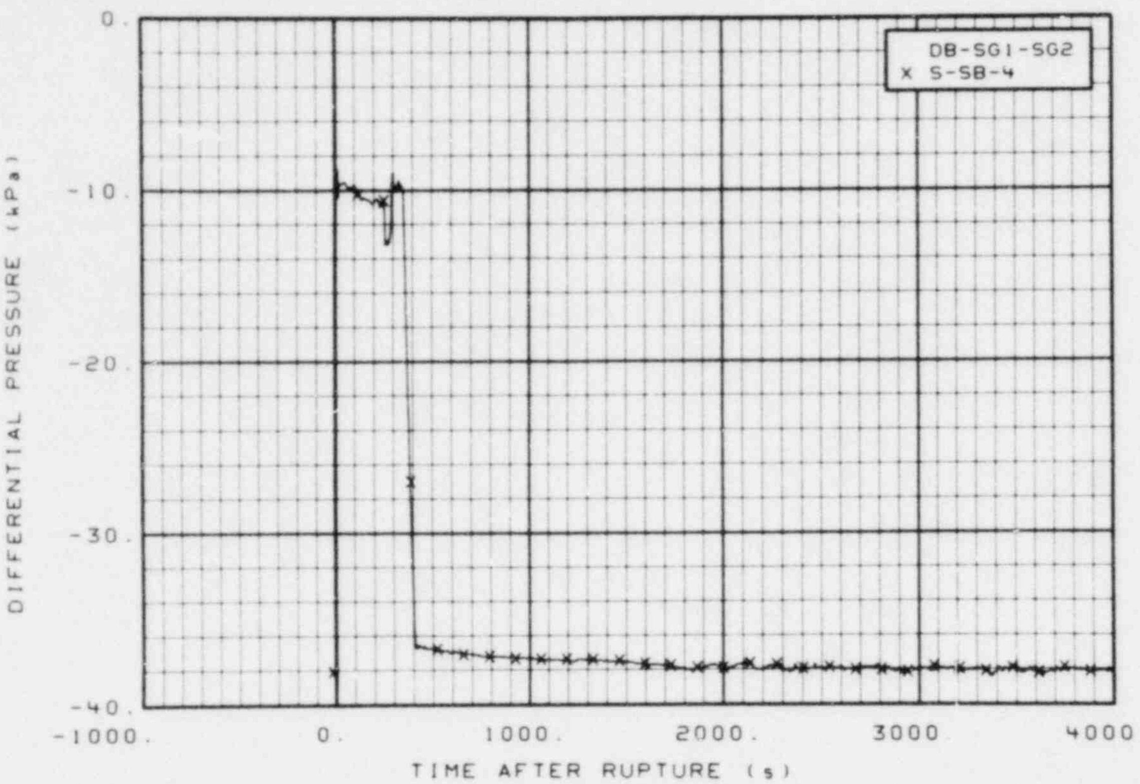


Figure 309. Differential pressure in broken loop hot leg, Test S-SB-4 (DB-SG1-SG2), from -20 to 4000 s.

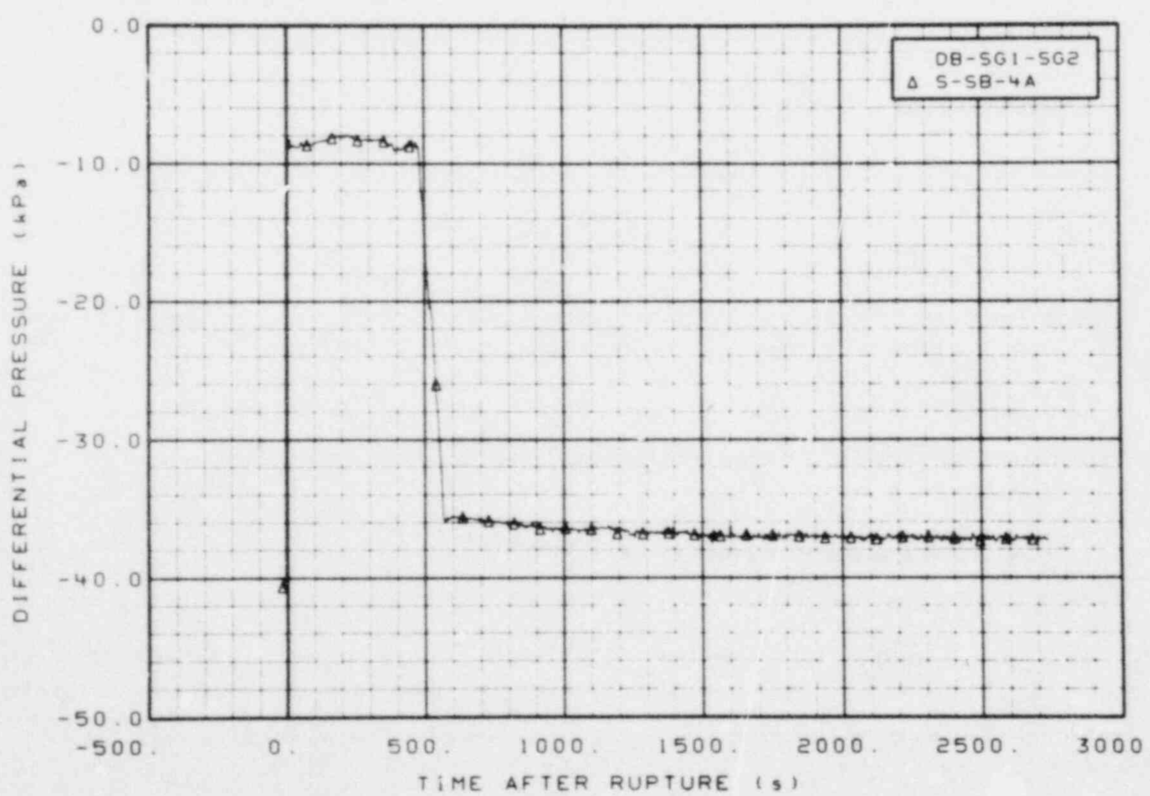


Figure 310. Differential pressure in broken loop hot leg, Test S-SB-4A (DB-SG1-SG2), from -20 to 2740 s.

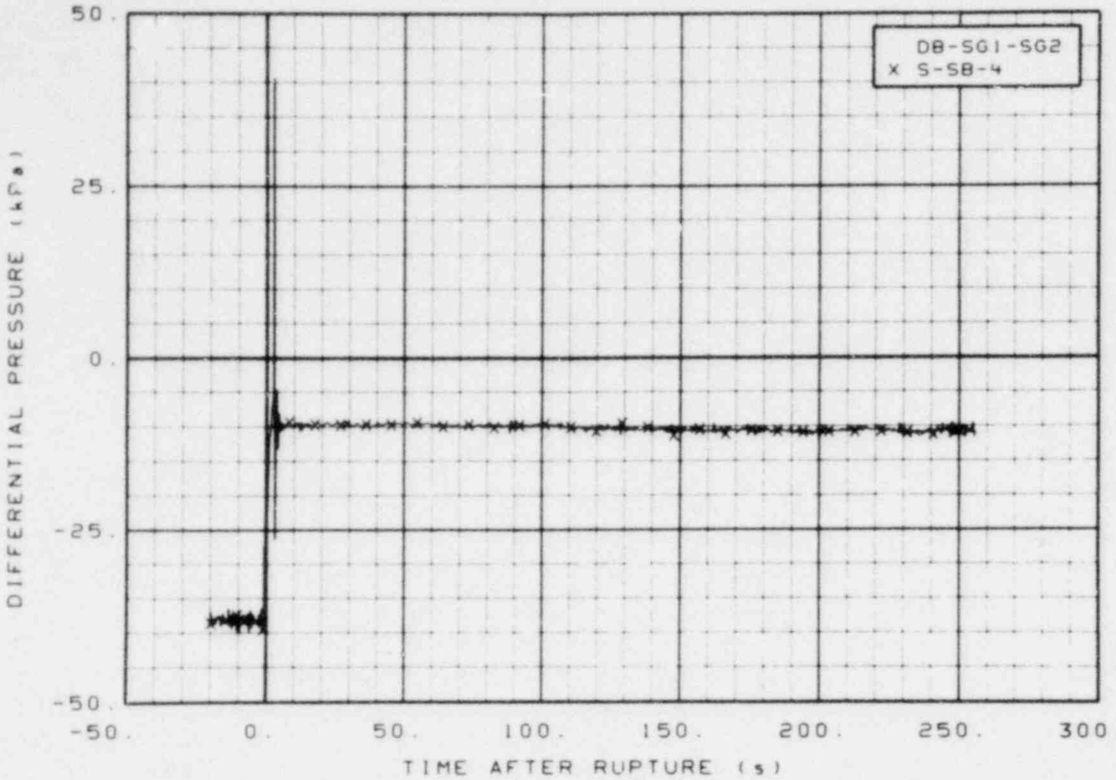


Figure 311. Differential pressure in broken loop hot leg, Test S-SB-4 (DB-SG1-SG2), from -20 to 256 s.

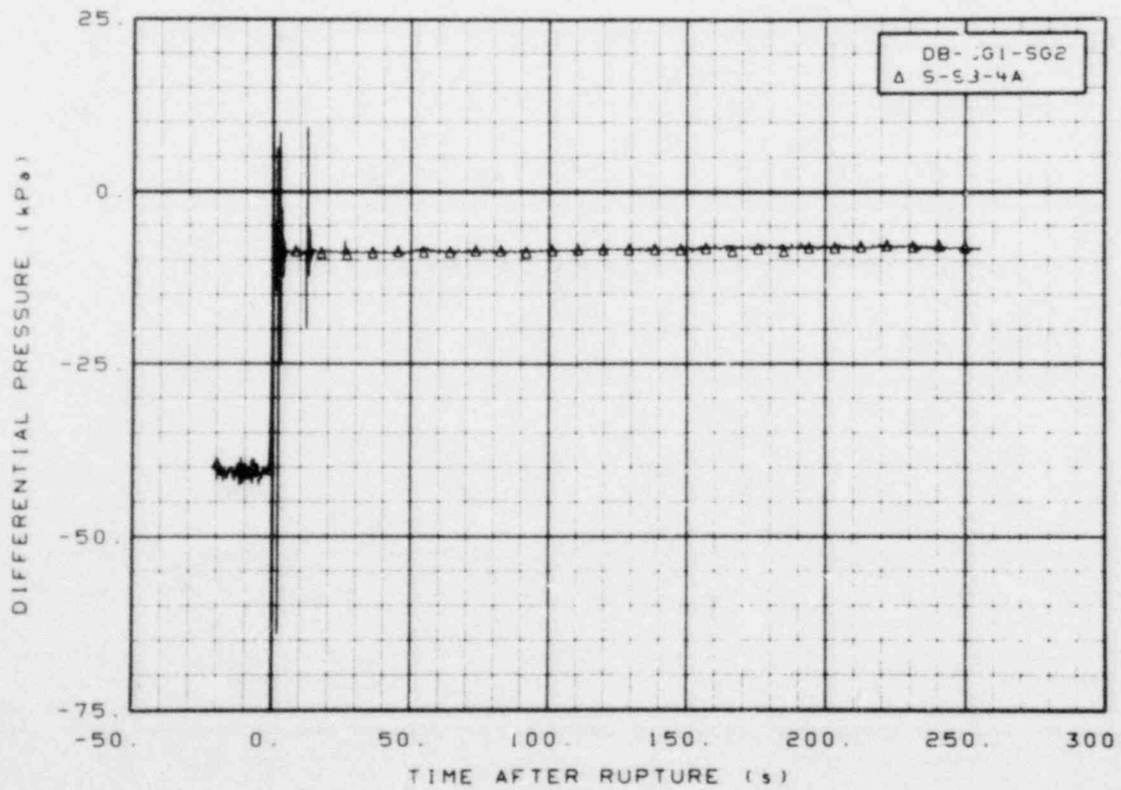


Figure 312. Differential pressure in broken loop hot leg, Test S-SB-4A (DB-SG1-SG2), from -20 to 256 s.

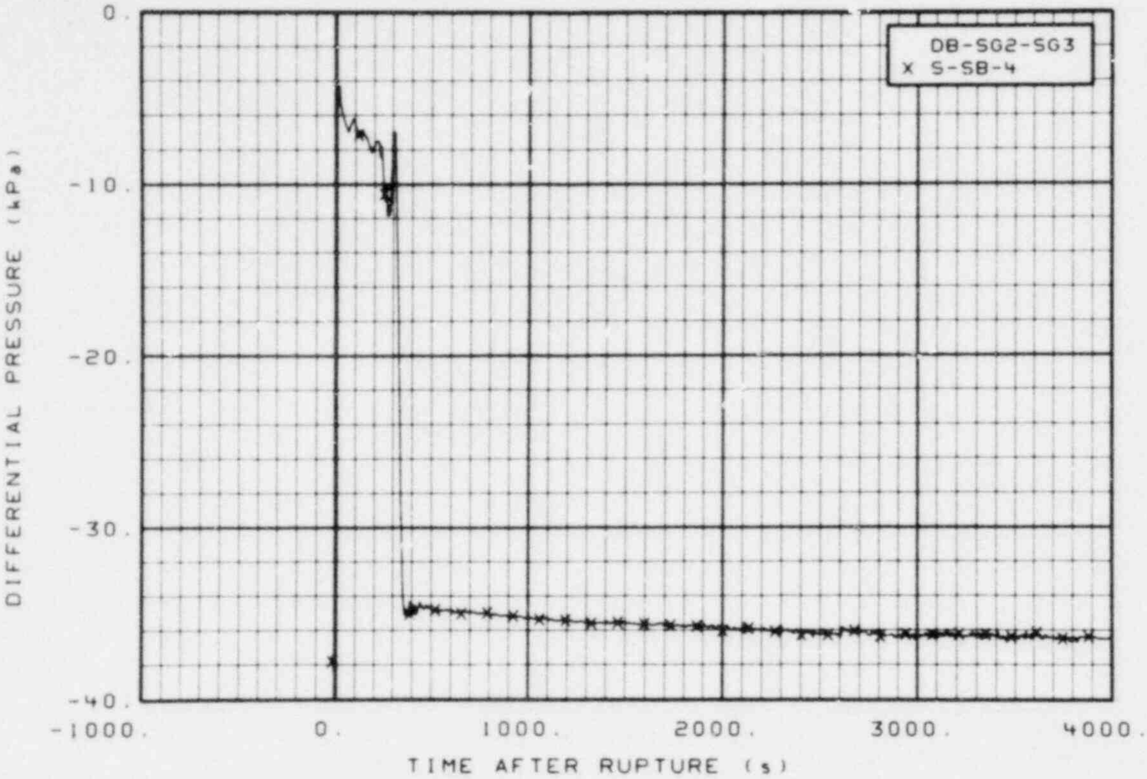


Figure 313. Differential pressure in broken loop hot leg, Test S-SB-4 (DB-SG2-SG3), from -20 to 4000 s.

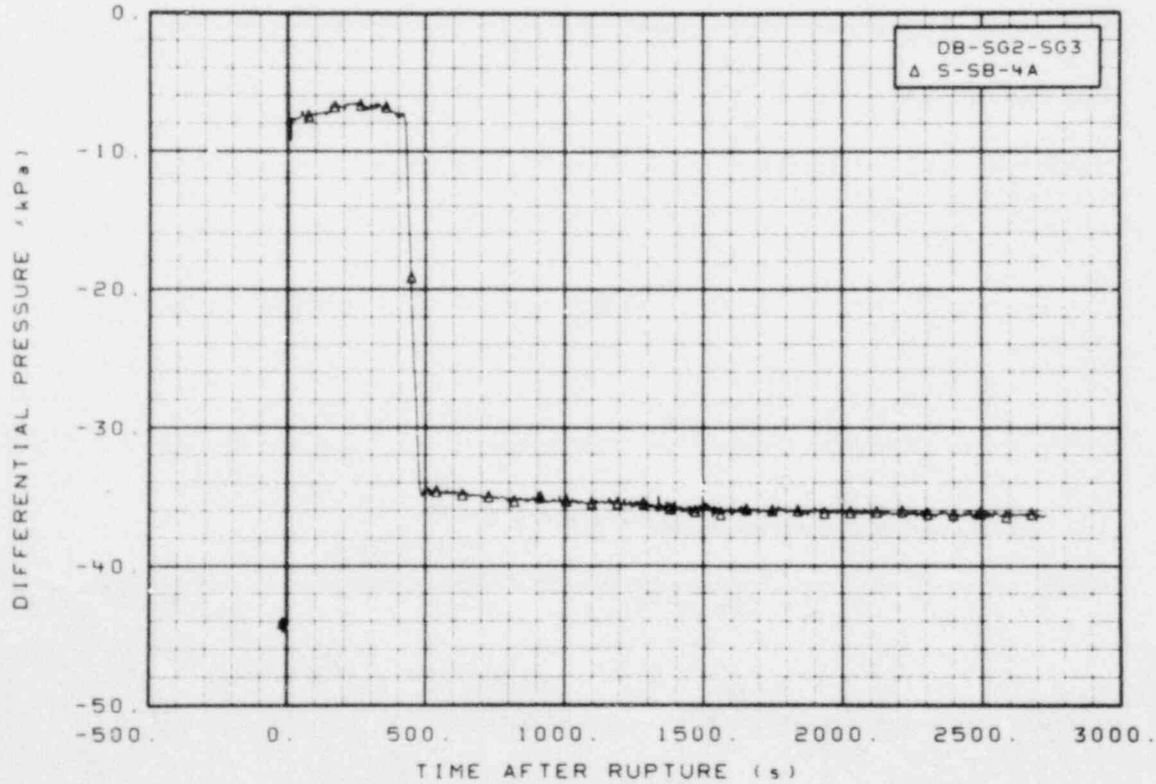


Figure 314. Differential pressure in broken loop hot leg, Test S-SB-4A (DB-SG2-SG3), from -20 to 2740 s.

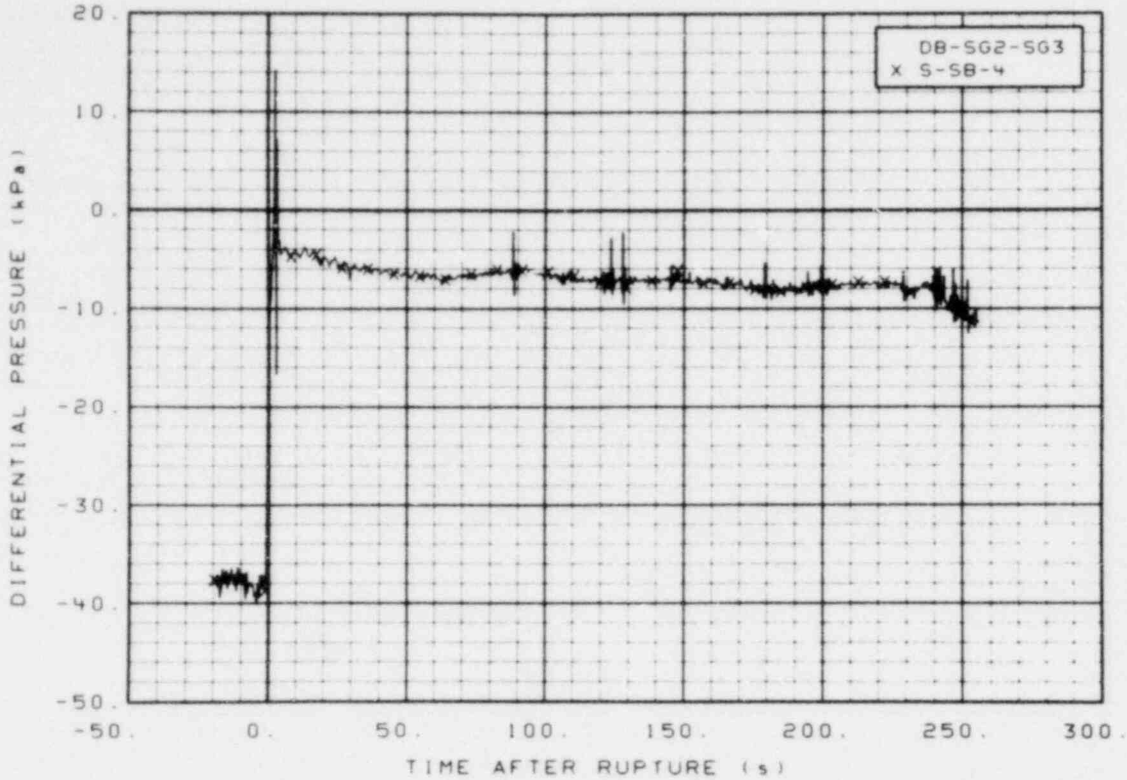


Figure 315. Differential pressure in broken loop hot leg, Test S-SB-4 (DB-SG2-SG3), from -20 to 256 s.

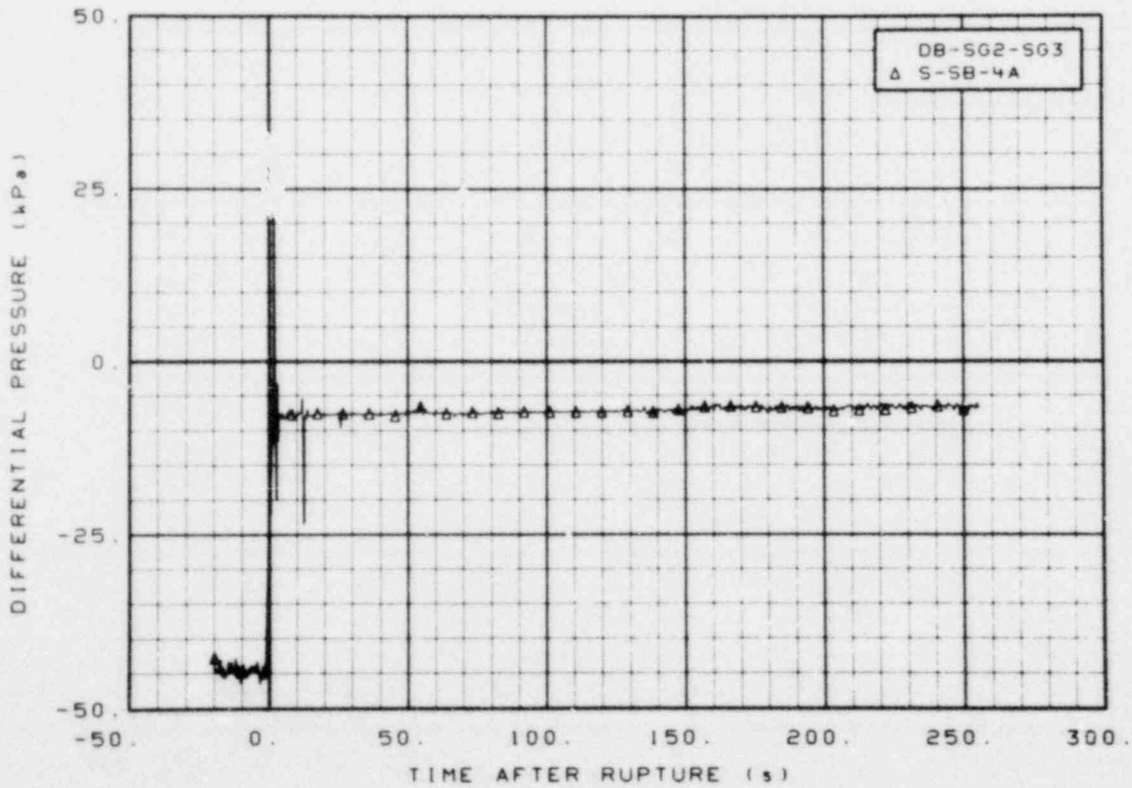


Figure 316. Differential pressure in broken loop hot leg, Test S-SB-4A (DB-SG2-SG3), from -20 to 256 s.

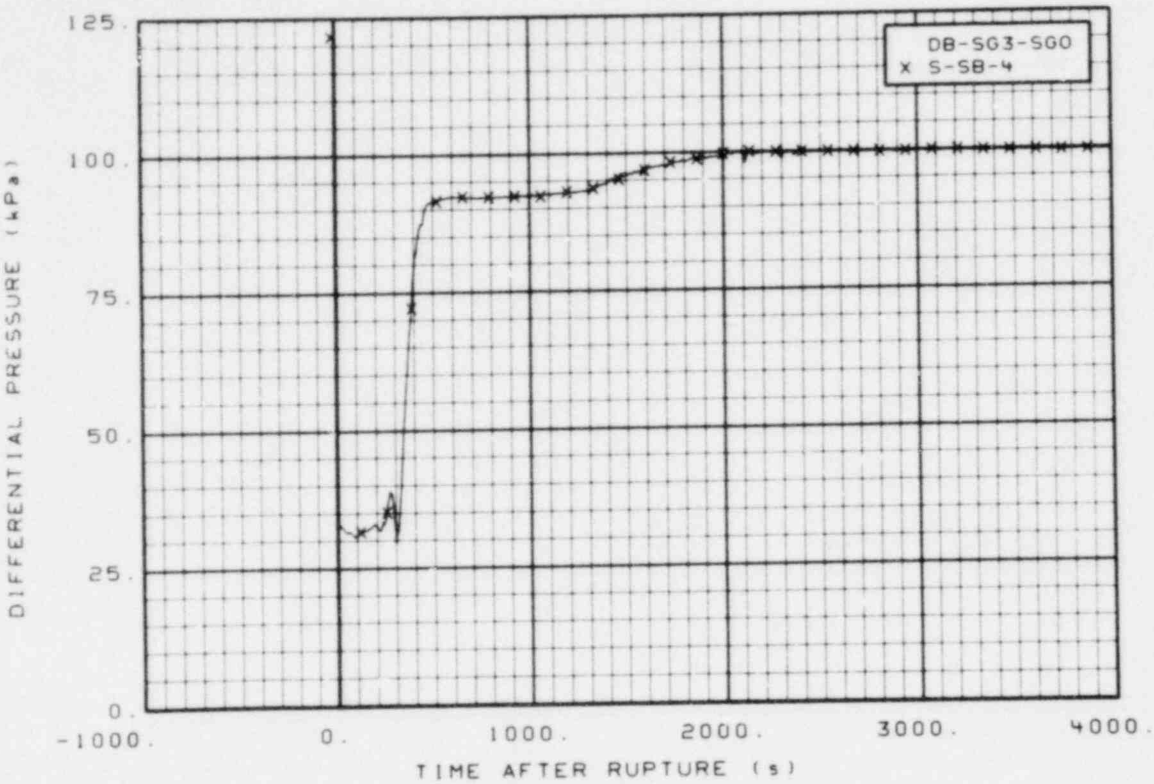


Figure 317. Differential pressure in broken loop hot leg, Test S-SB-4 (DB-SG3-SGO), from -20 to 4000 s.

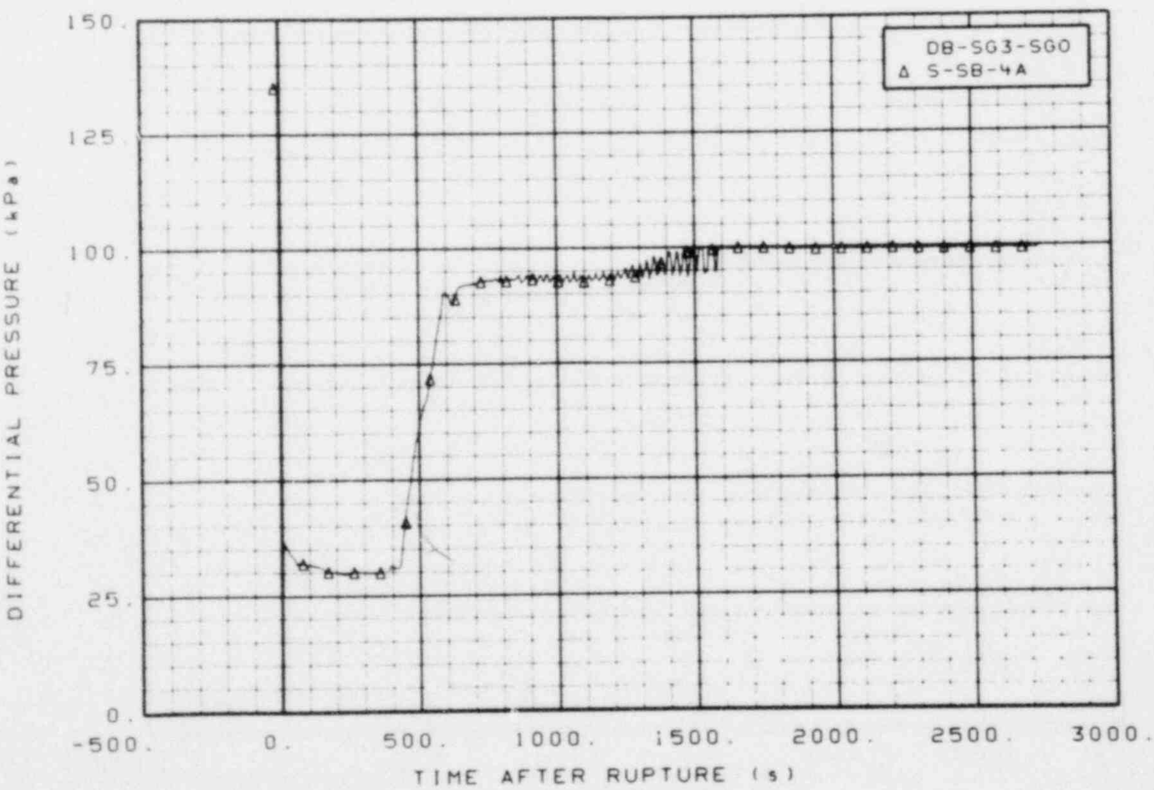


Figure 318. Differential pressure in broken loop hot leg, Test S-SB-4A (DB-SG3-SGO), from -20 to 2740 s.

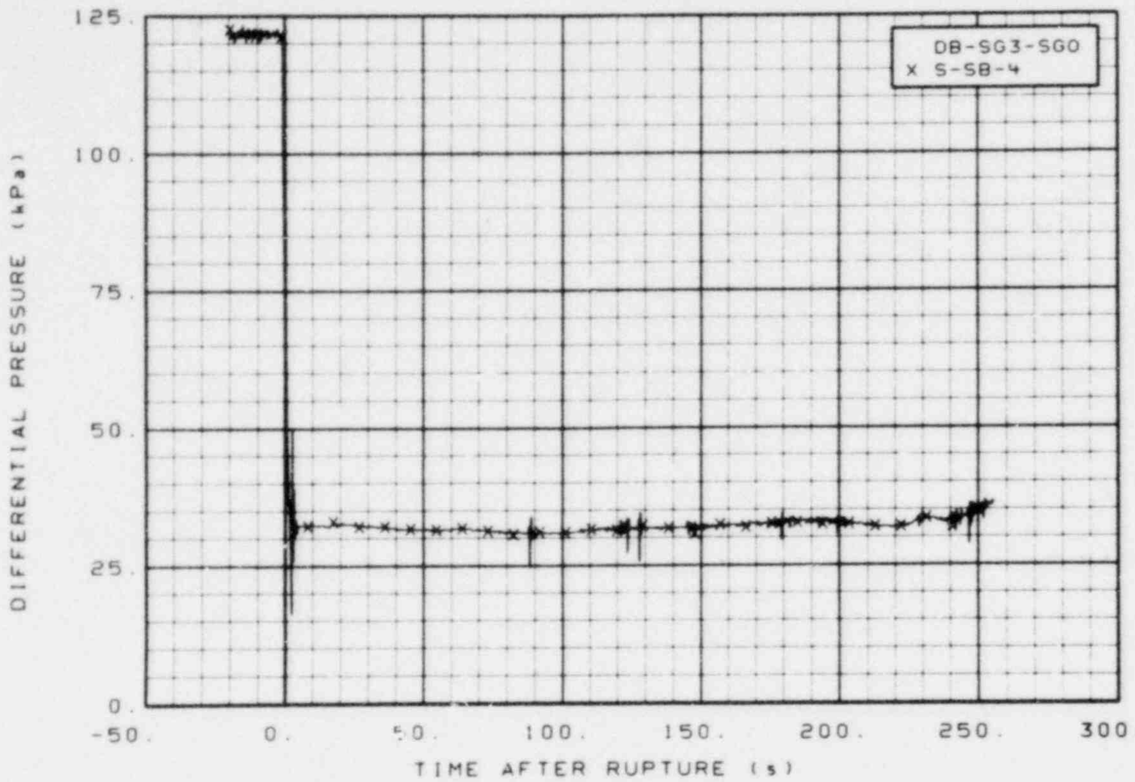


Figure 319. Differential pressure in broken loop hot leg, Test S-SB-4 (DB-SG3-SGO), from -20 to 256 s.

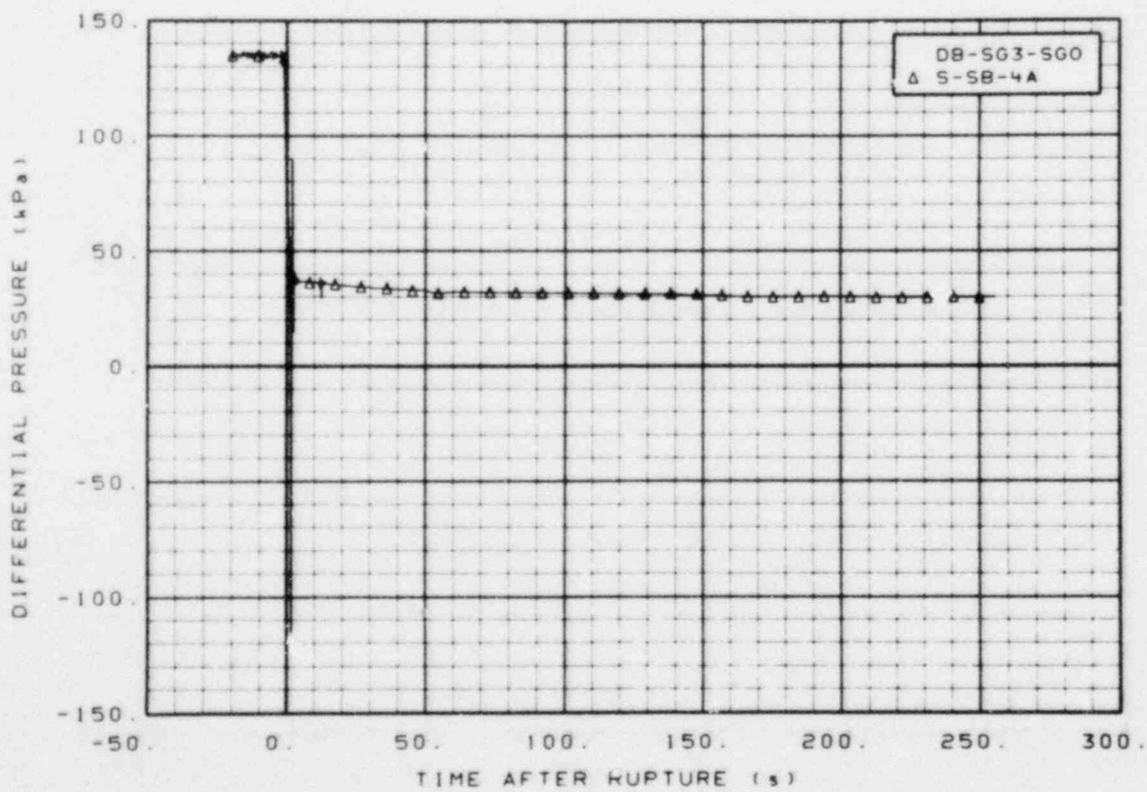


Figure 320. Differential pressure in broken loop hot leg, Test S-SB-4A (DB-SG3-SGO), from -20 to 256 s.

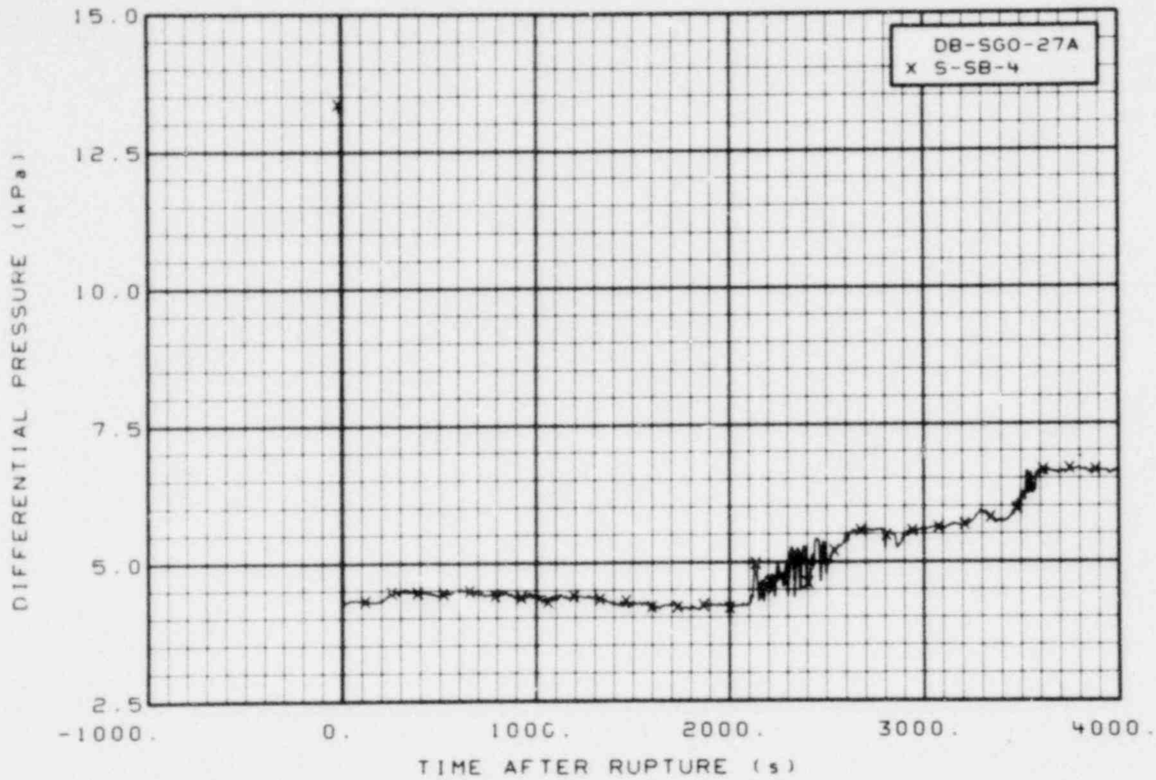


Figure 321. Differential pressure in broken loop cold leg, Test S-SB-4 (DB-SGO-27A), from -20 to 4000 s.

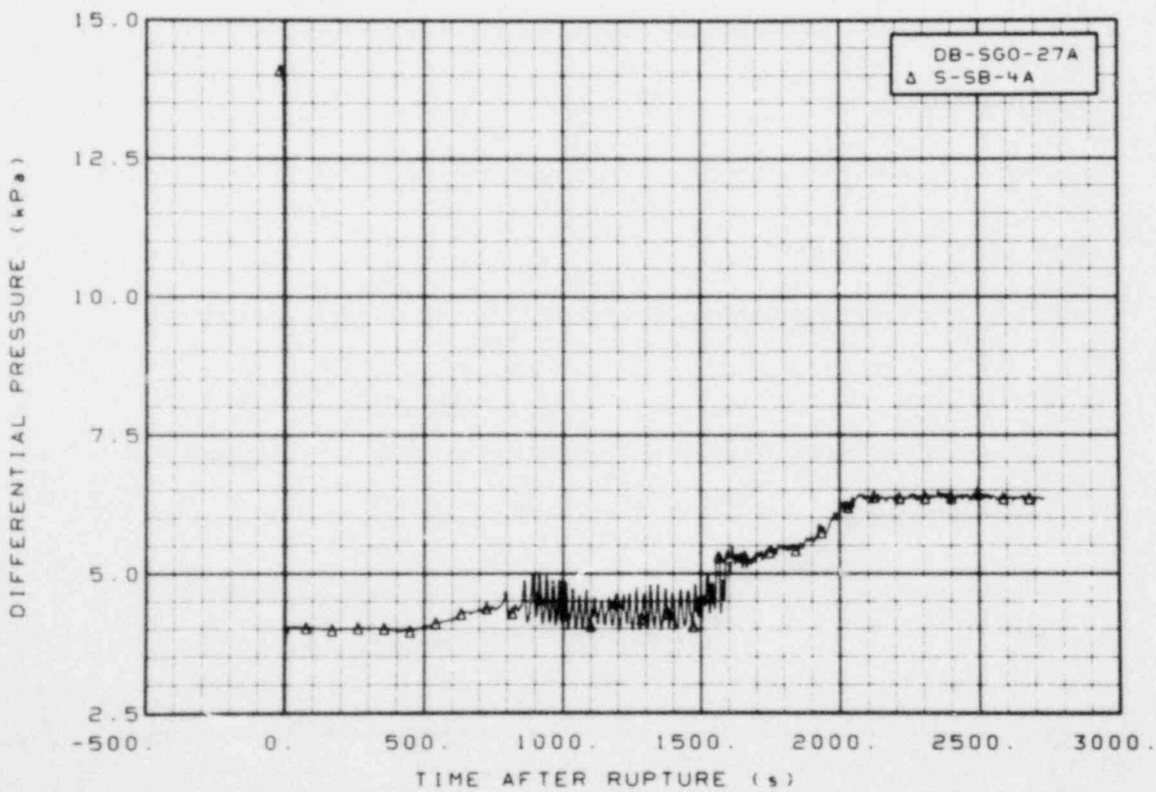


Figure 322. Differential pressure in broken loop cold leg, Test S-SB-4A (DB-SGO-27A), from -20 to 2740 s.

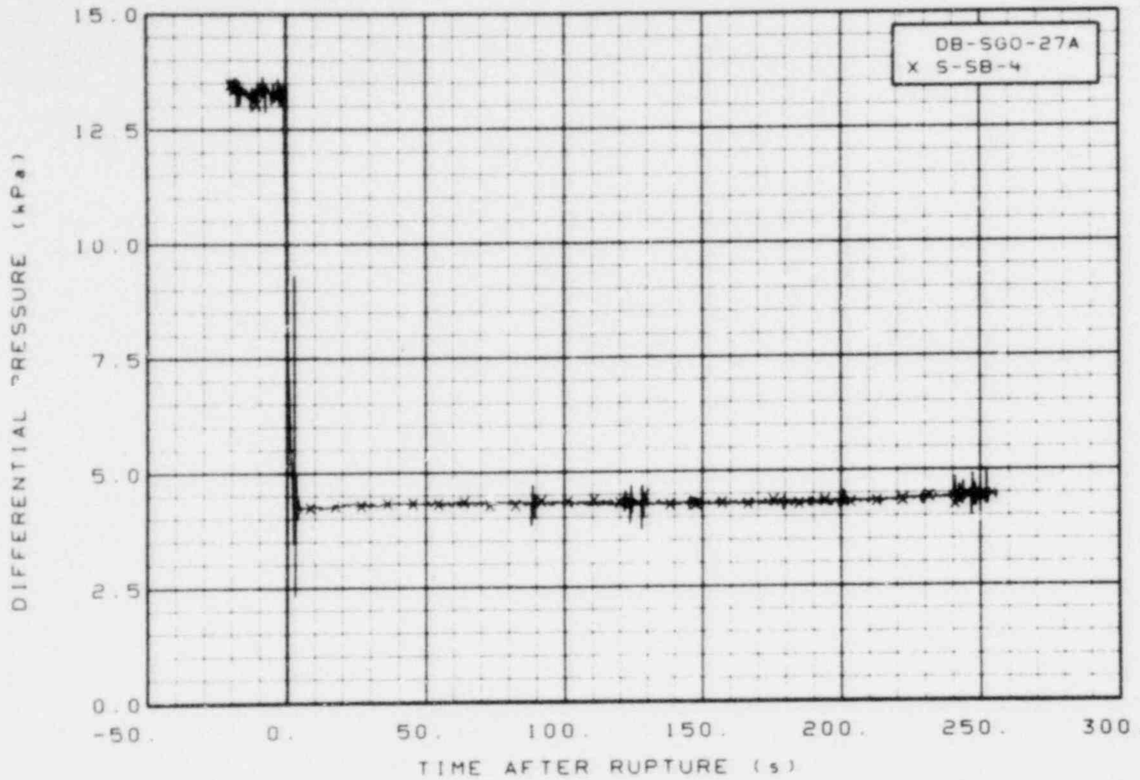


Figure 323. Differential pressure in broken loop cold leg, Test S-SB-4 (DB-SGO-27A), from -20 to 256 s.

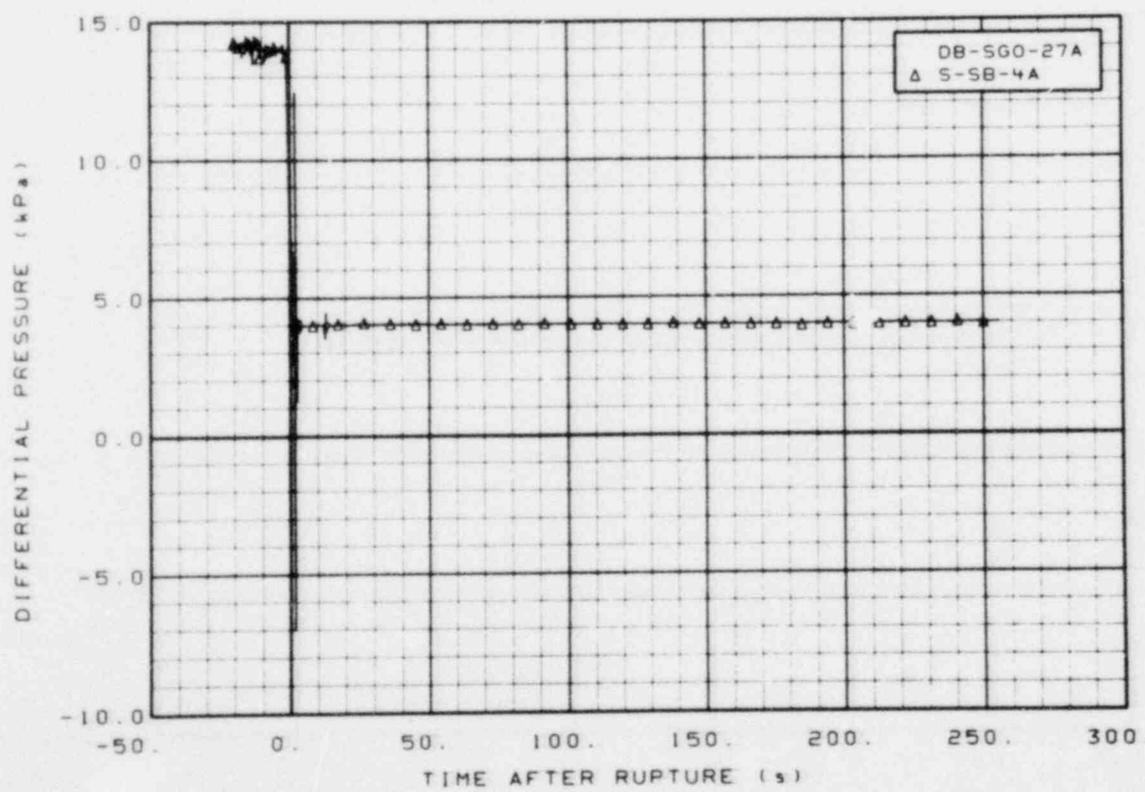


Figure 324. Differential pressure in broken loop cold leg, Test S-SB-4A (DB-SGO-27A), from -20 to 256 s.

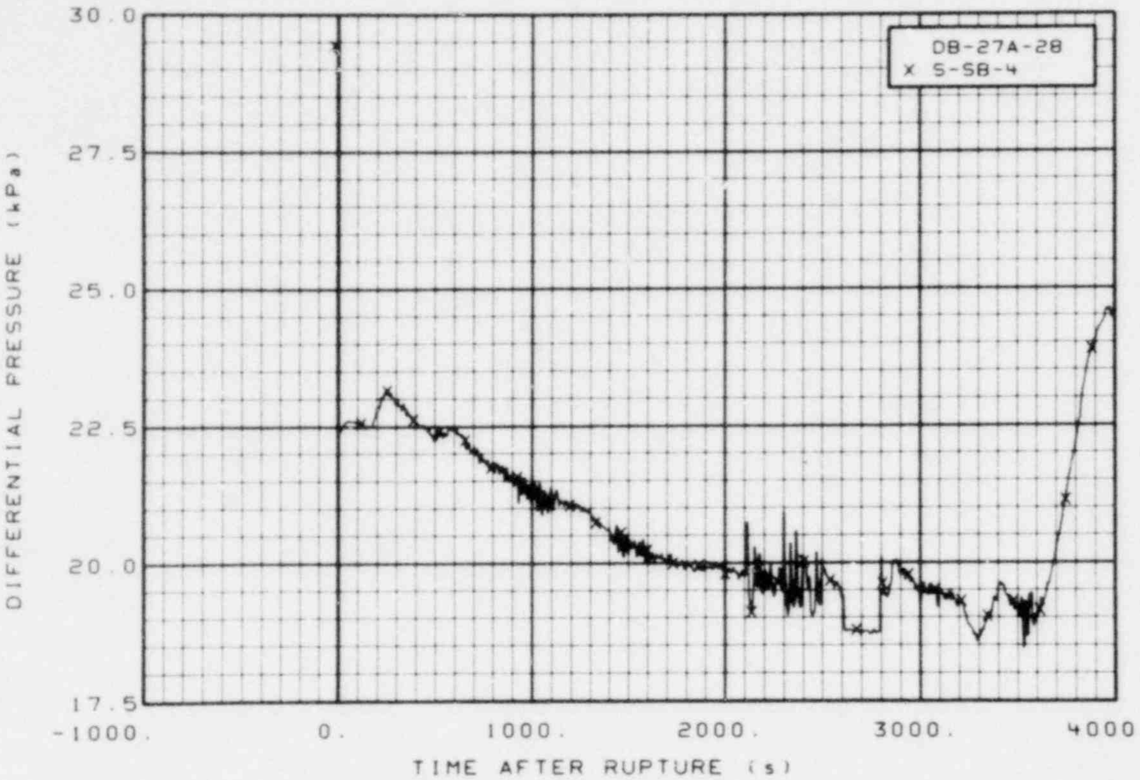


Figure 325. Differential pressure in broken loop cold leg, Test S-SB-4 (DB-27A-28), from -20 to 4000 s.

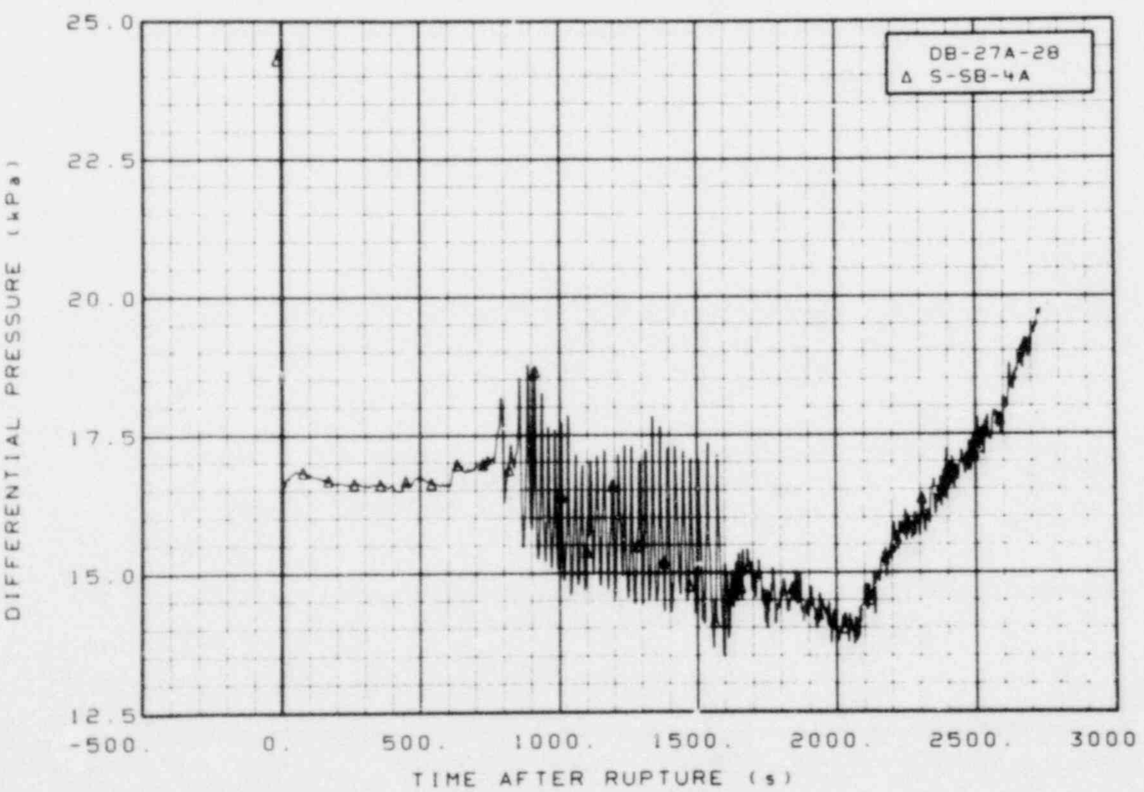


Figure 326. Differential pressure in broken loop cold leg, Test S-SB-4A (DB-27A-28), from -20 to 2740 s.

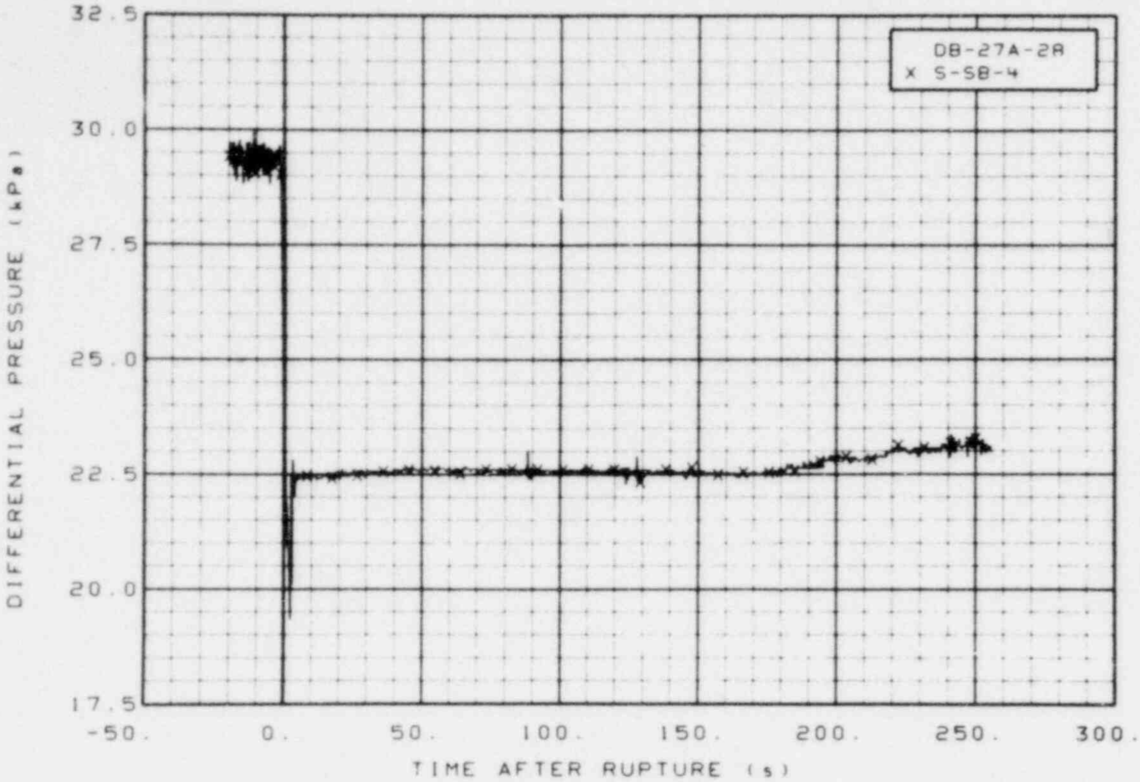


Figure 327. Differential pressure in broken loop cold leg, Test S-SB-4 (DB-27A-28), from -20 to 256 s.

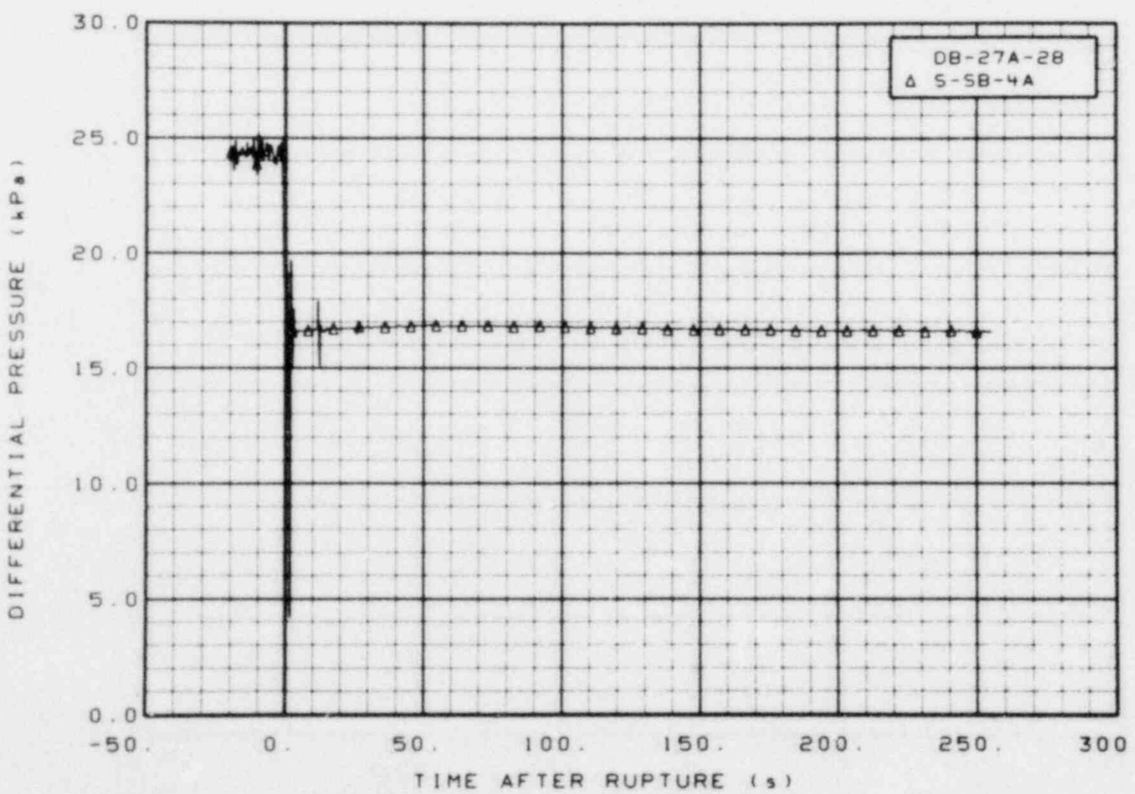


Figure 328. Differential pressure in broken loop cold leg, Test S-SB-4A (DB-27A-28), from -20 to 256 s.

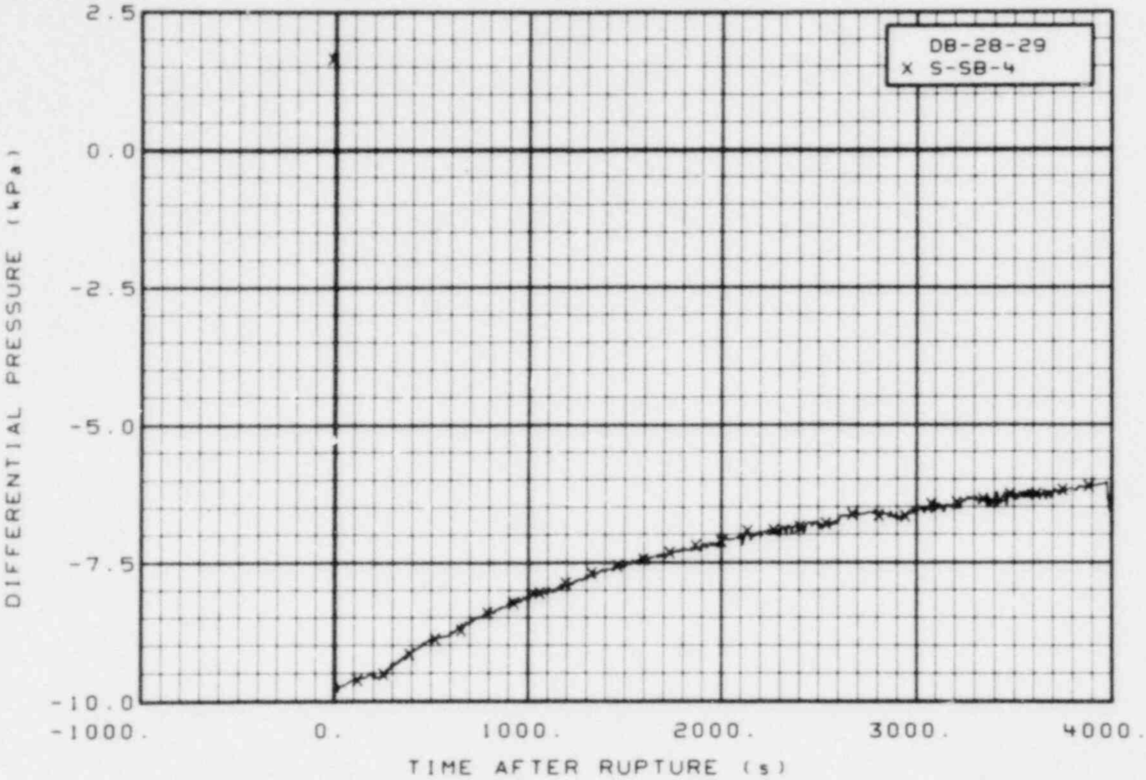


Figure 329. Differential pressure in broken loop cold leg, Test S-SB-4 (DB-28-29), from -20 to 4000 s.

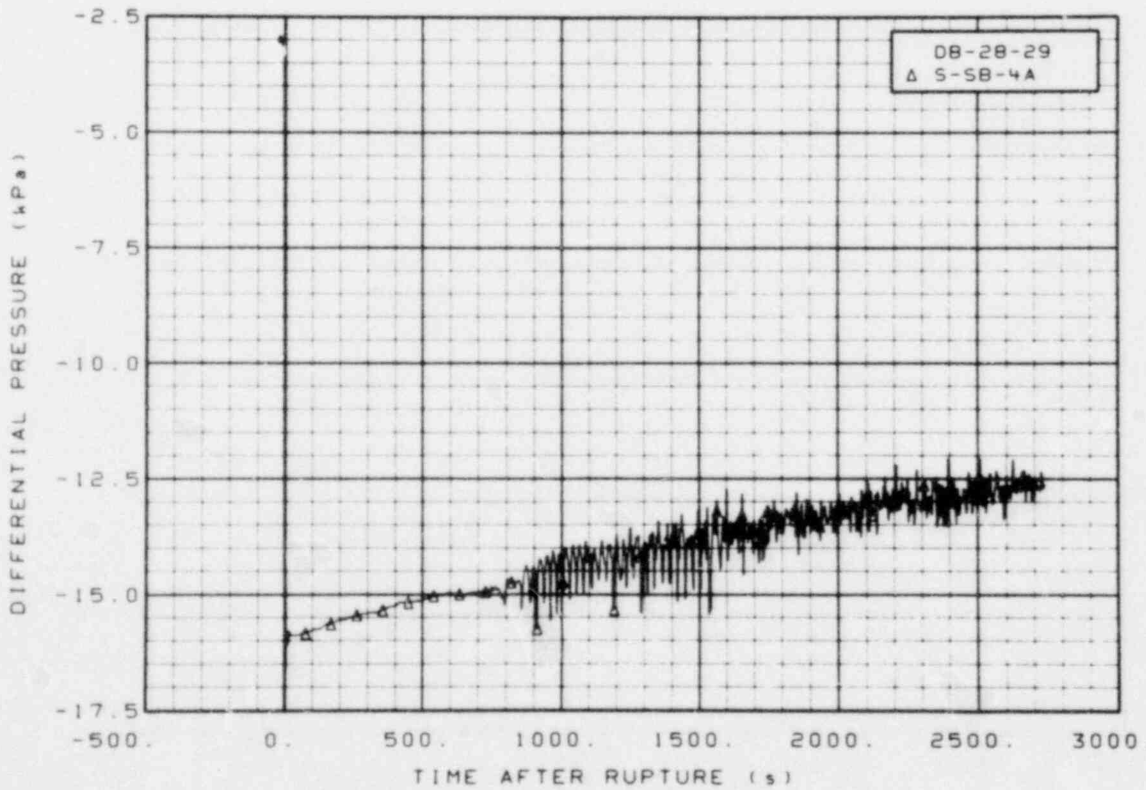


Figure 330. Differential pressure in broken loop cold leg, Test S-SB-4A (DB-28-29), from -20 to 2740 s.

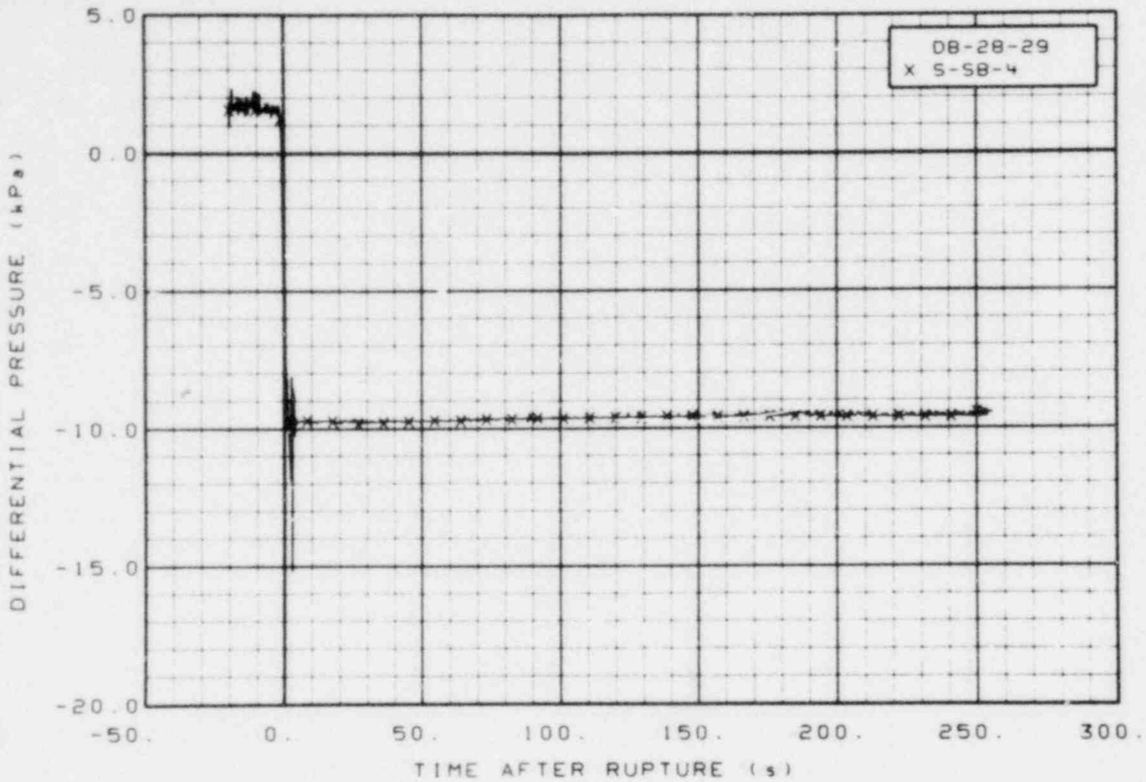


Figure 331. **Differential pressure in broken loop cold leg, Test S-SB-4 (DB-28-29), from -20 to 256 s.**

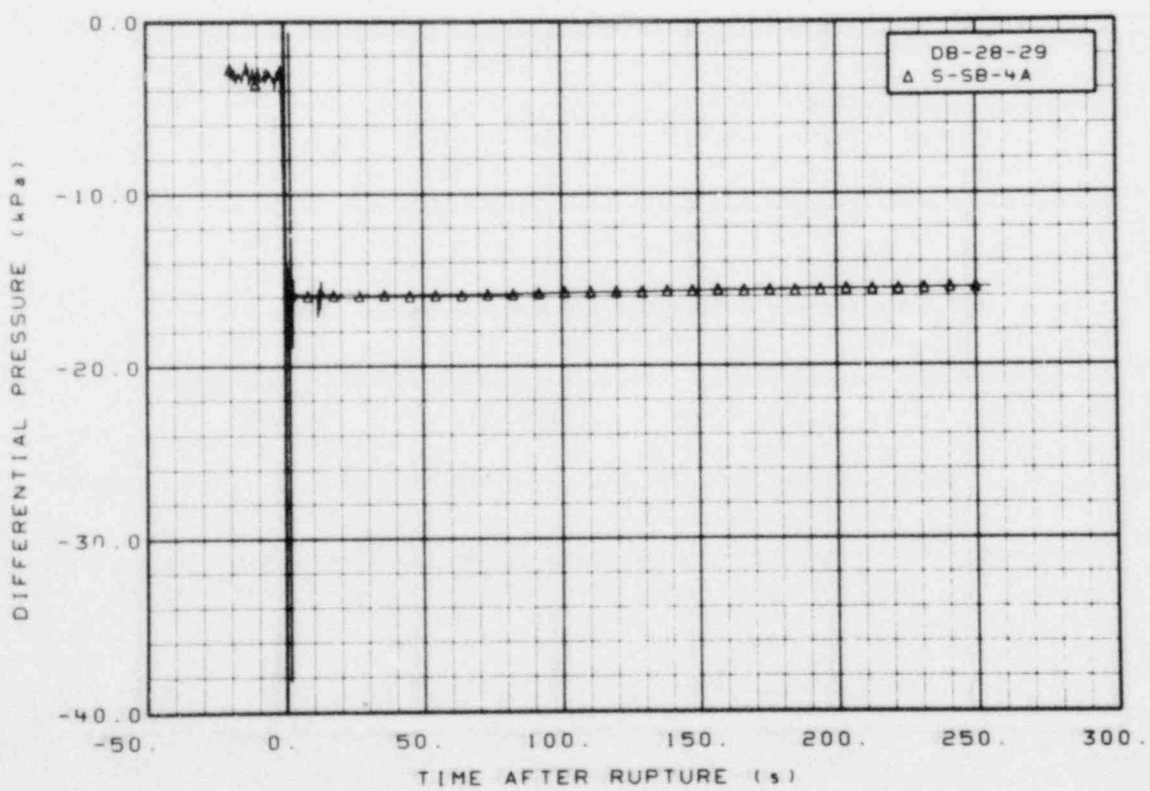


Figure 332. **Differential pressure in broken loop cold leg, Test S-SB-4A (DB-28-29), from -20 to 256 s.**

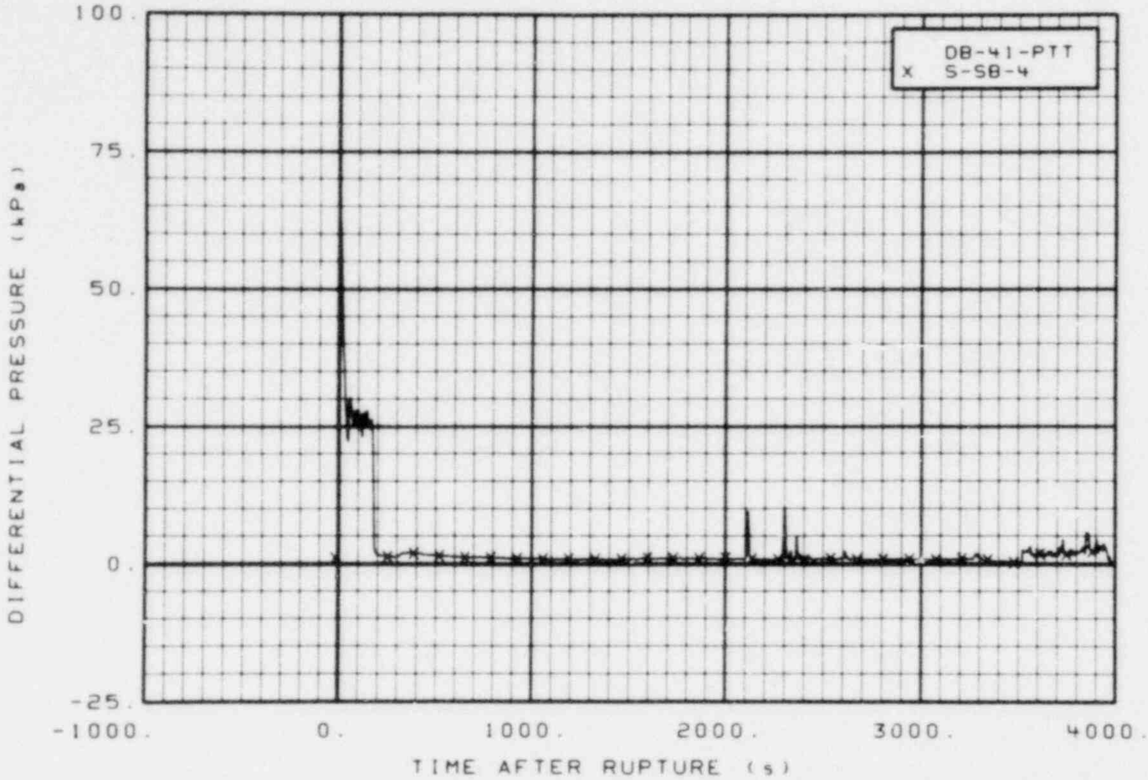


Figure 333. Differential pressure in broken loop cold leg, Test S-SB-4 (DB-41-PTT), from -20 to 4000 s.

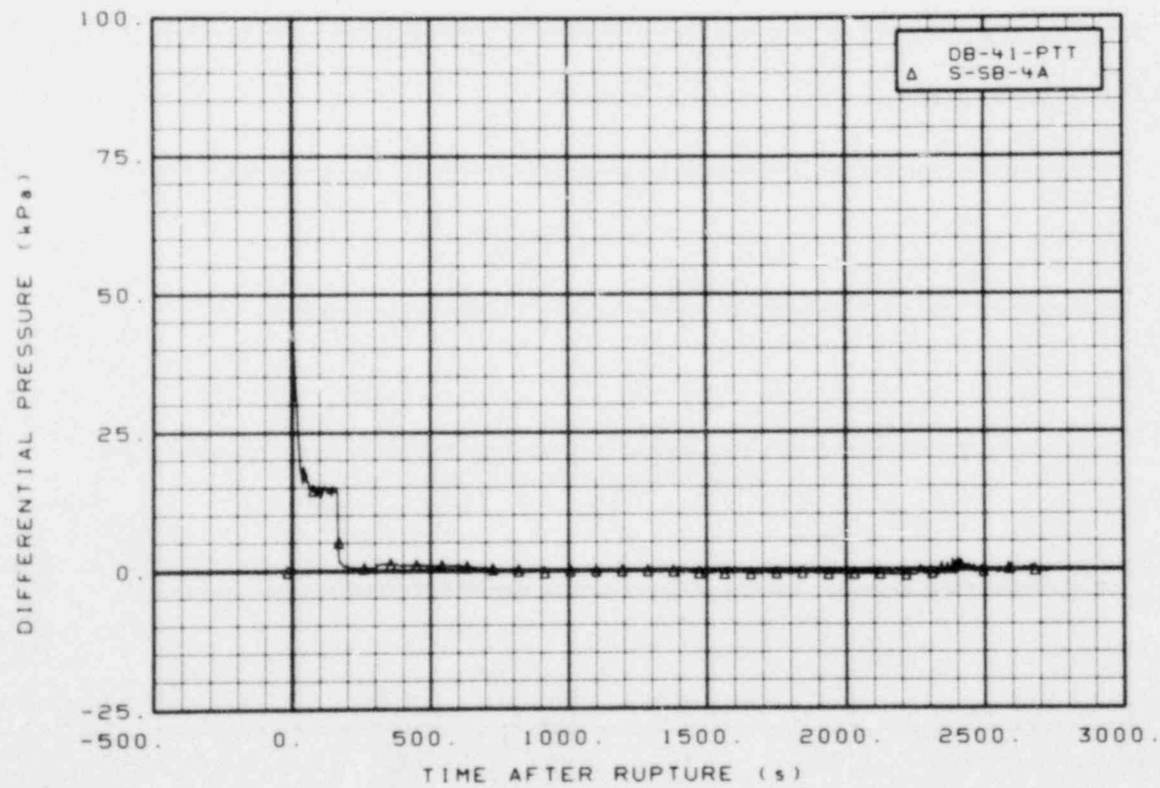


Figure 334. Differential pressure in broken loop cold leg, Test S-SB-4A (DB-41-PTT), from -20 to 2740 s.

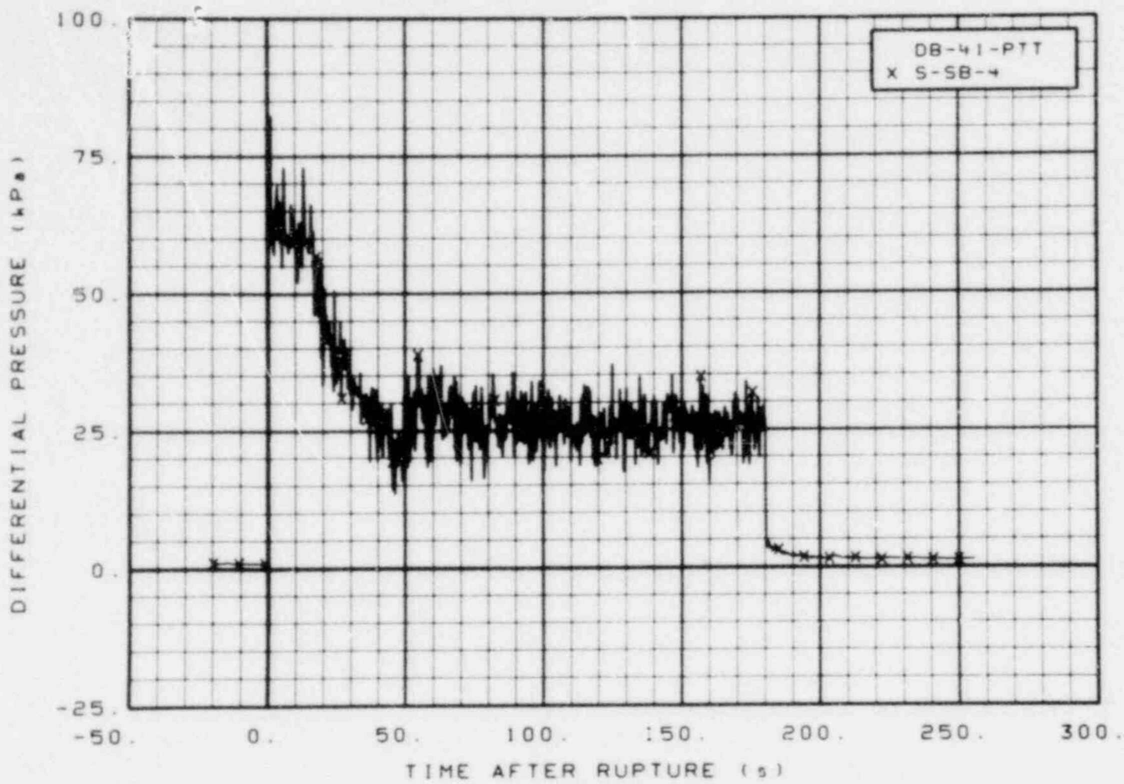


Figure 335. Differential pressure in broken loop cold leg, Test S-SB-4 (DB-41-PTT), from -20 to 256 s.

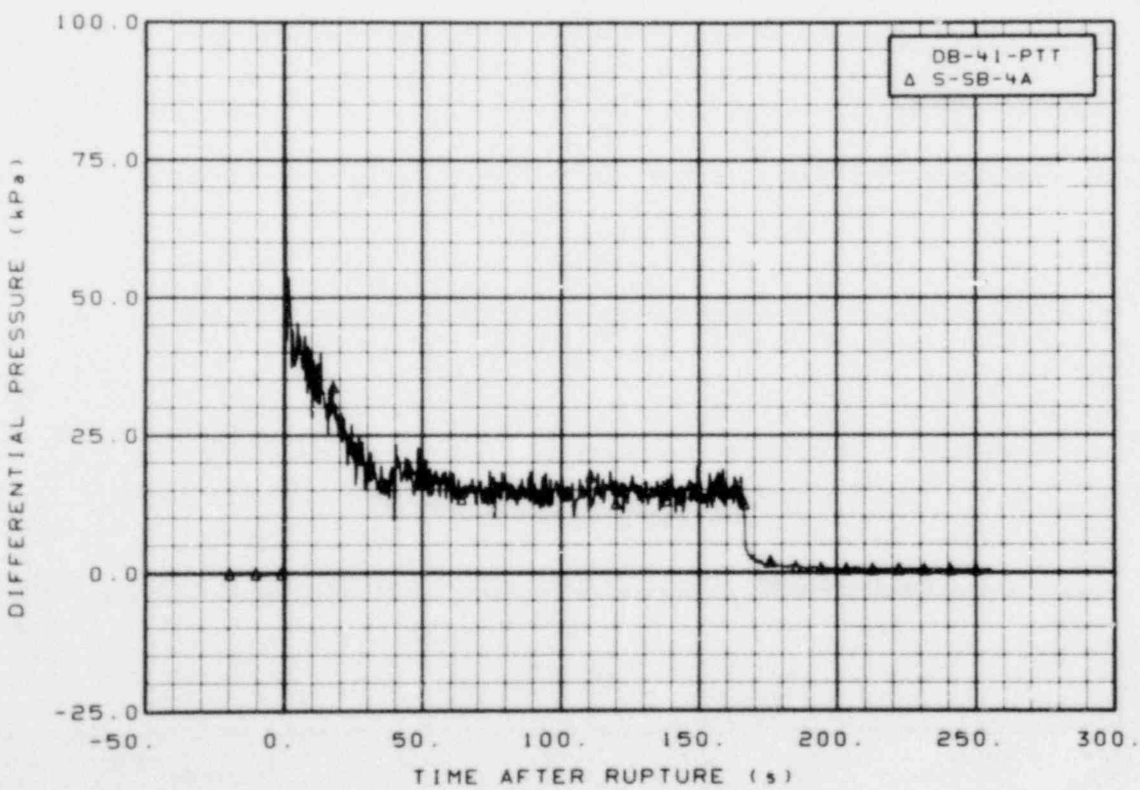


Figure 336. Differential pressure in broken loop cold leg, Test S-SB-4A (DB-41-PTT), from -20 to 256 s.

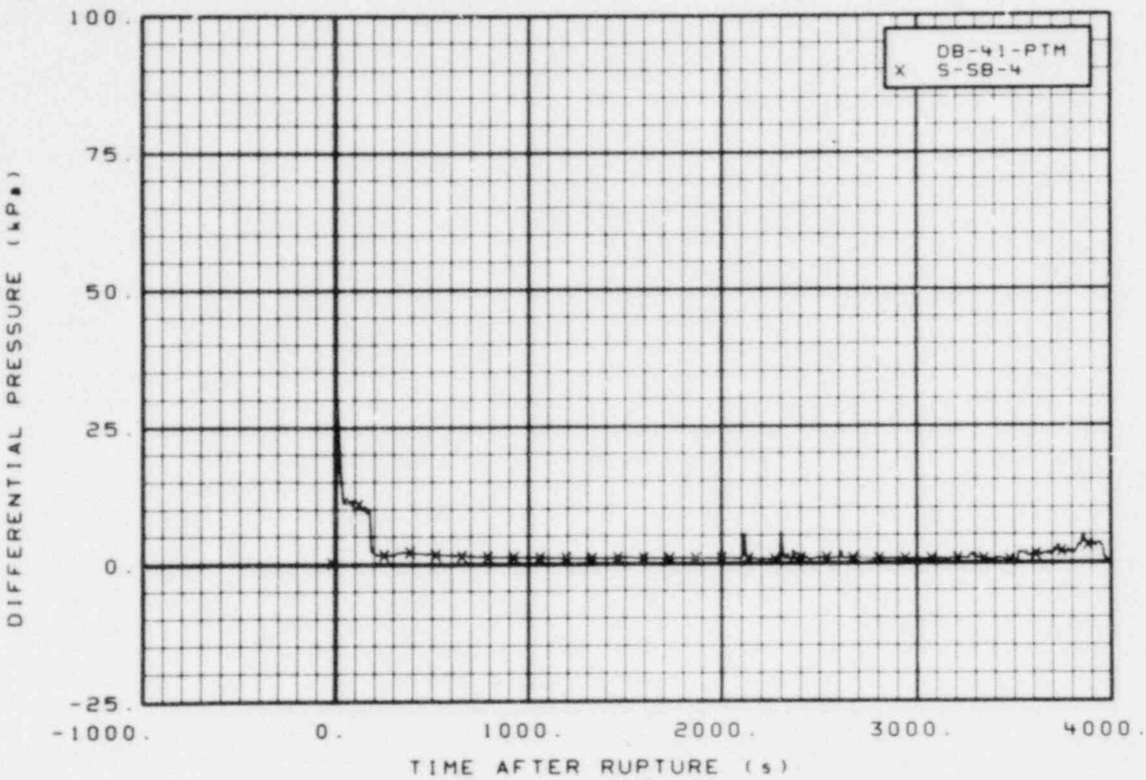


Figure 337. Differential pressure in broken loop cold leg, Test S-SB-4 (DB-41-PTM), from -20 to 4000 s.

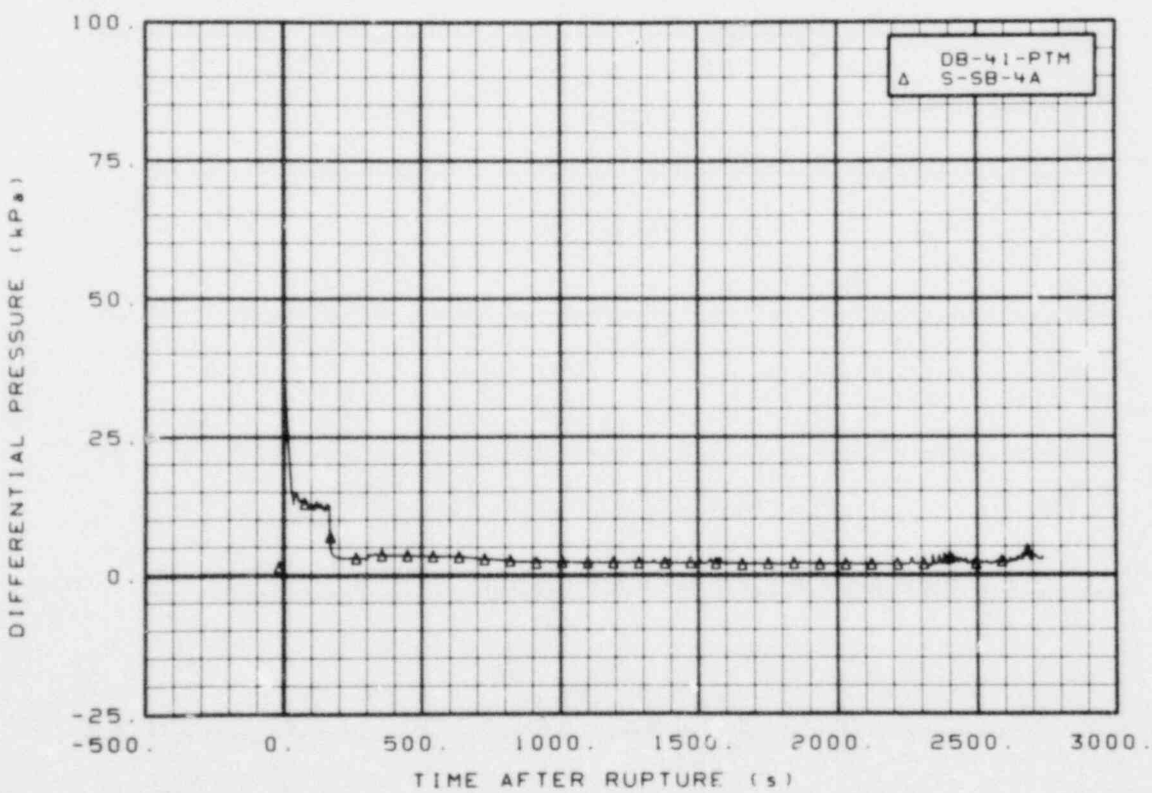


Figure 338. Differential pressure in broken loop cold leg, Test S-SB-4A (DB-41-PTM), from -20 to 2740 s.

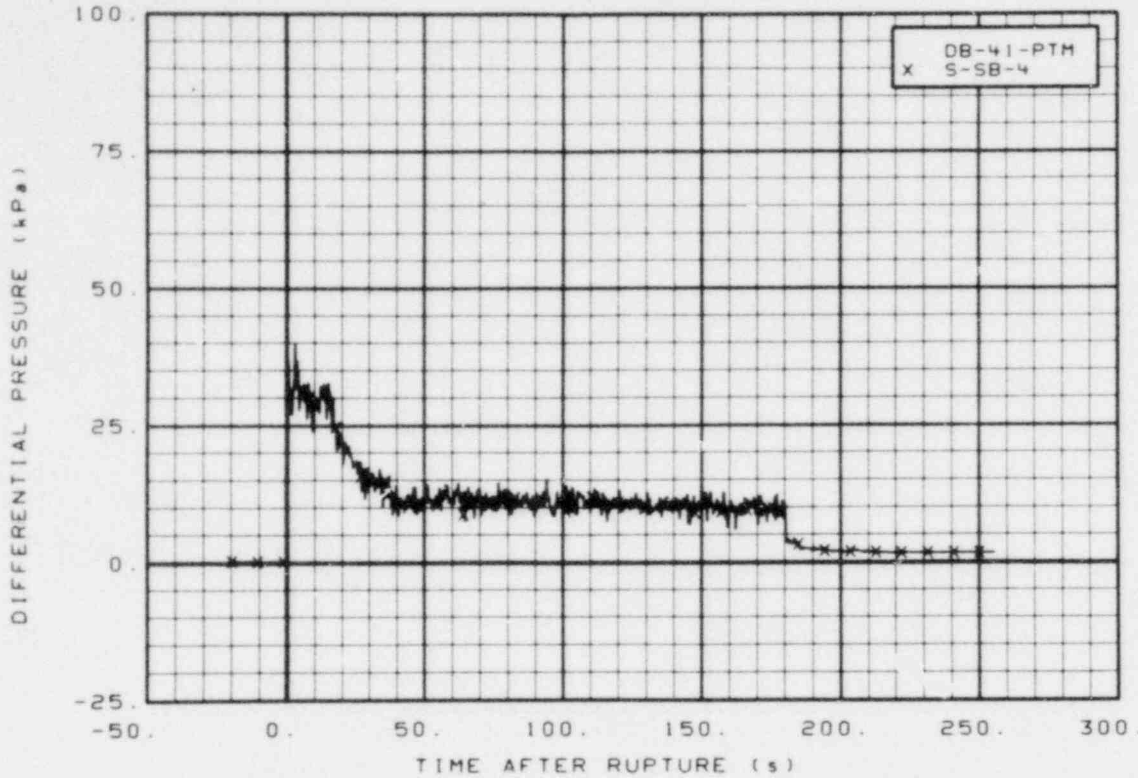


Figure 339. Differential pressure in broken loop cold leg, Test S-SB-4 (DB-41-PTM), from -20 to 256 s.

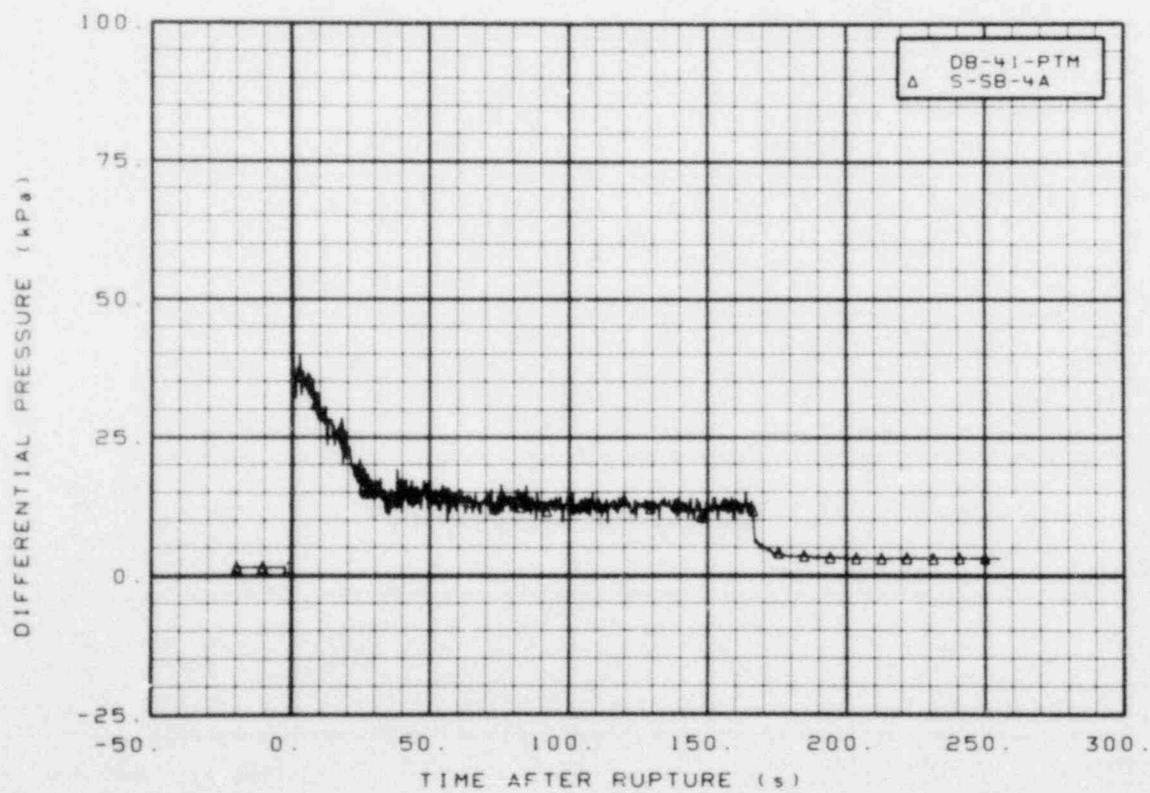


Figure 340. Differential pressure in broken loop cold leg, Test S-SB-4A (DB-41-PTM), from -20 to 256 s.

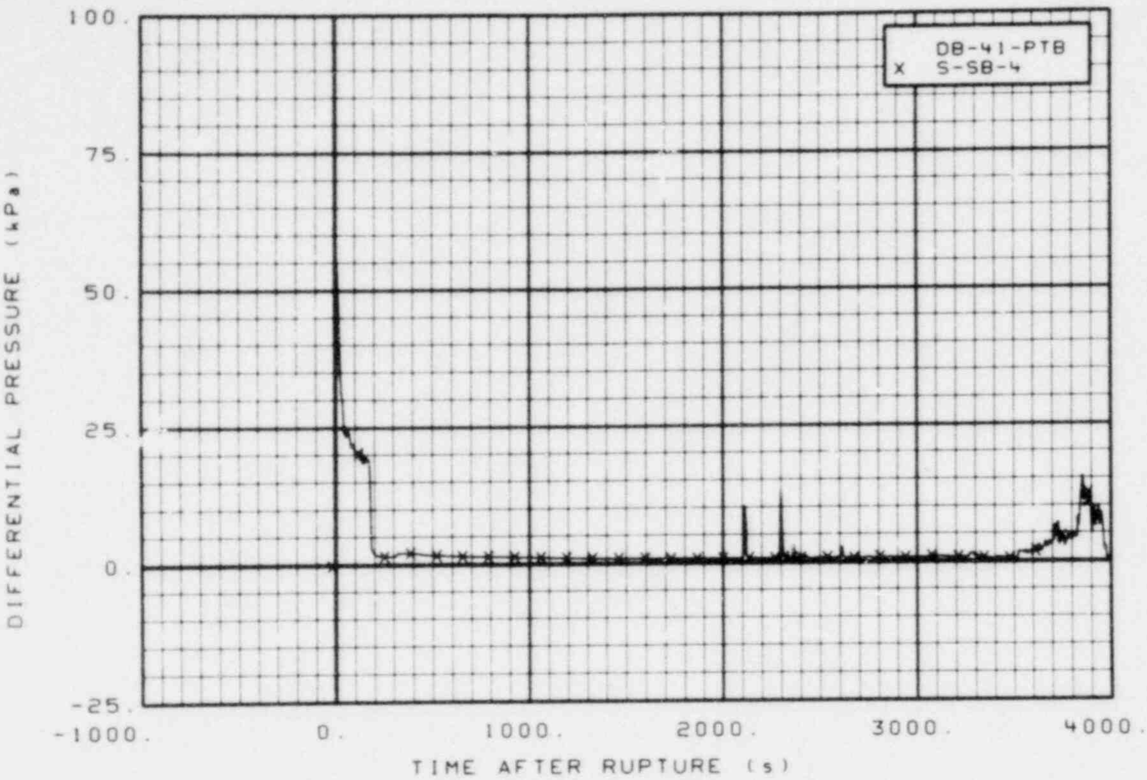


Figure 341. Differential pressure in broken loop cold leg, Test S-SB-4 (DB-41-PTB), from -20 to 4000 s.

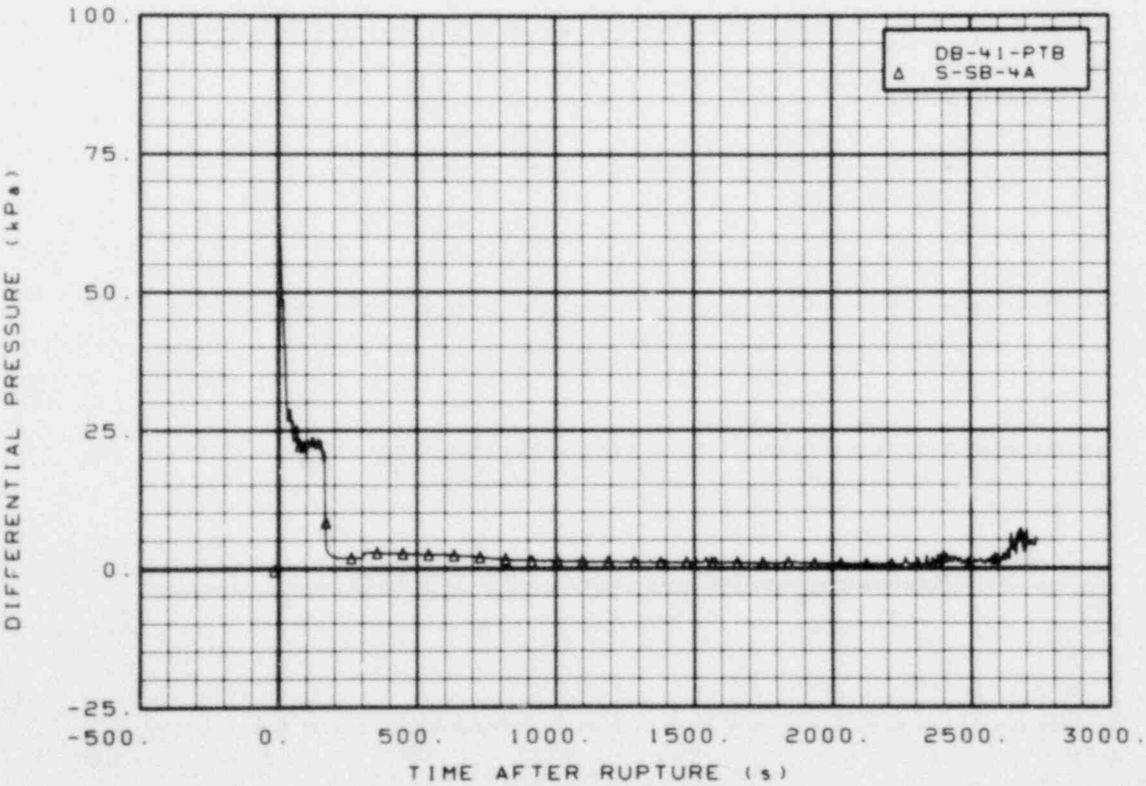


Figure 342. Differential pressure in broken loop cold leg, Test S-SB-4A (DB-41-PTB), from -20 to 2740 s.

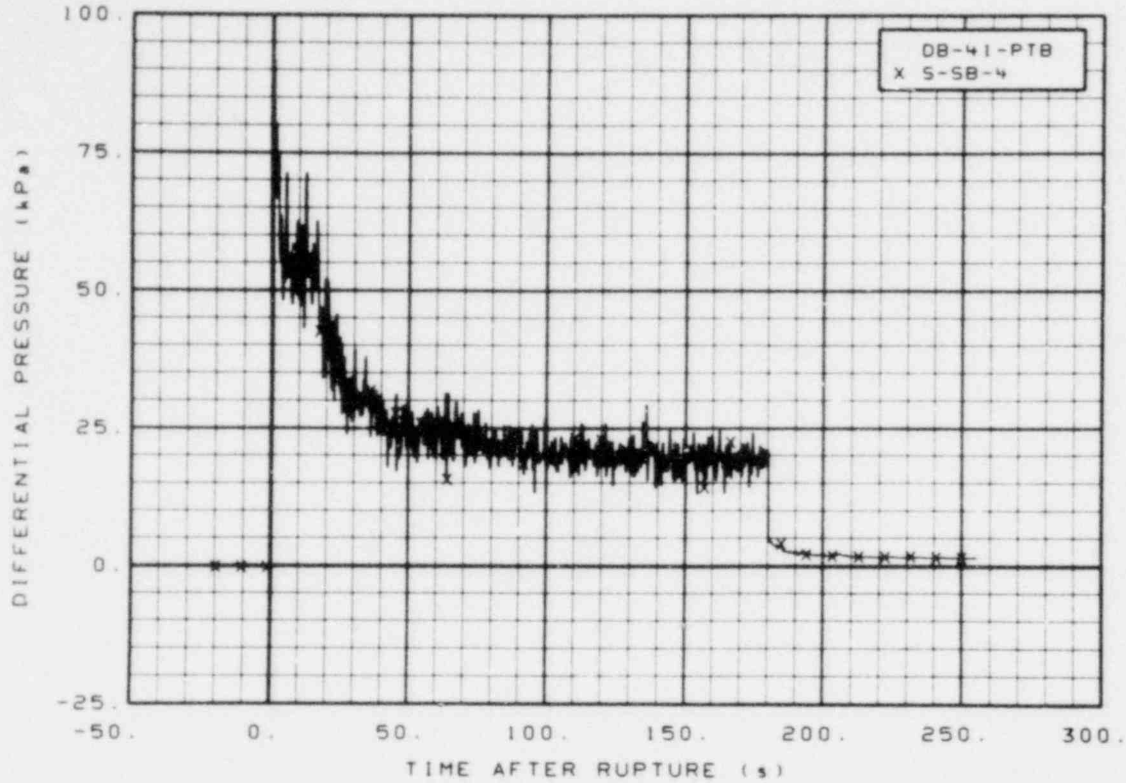


Figure 343. Differential pressure in broken loop cold leg, Test S-SB-4 (DB-41-PTB), from -20 to 256 s.

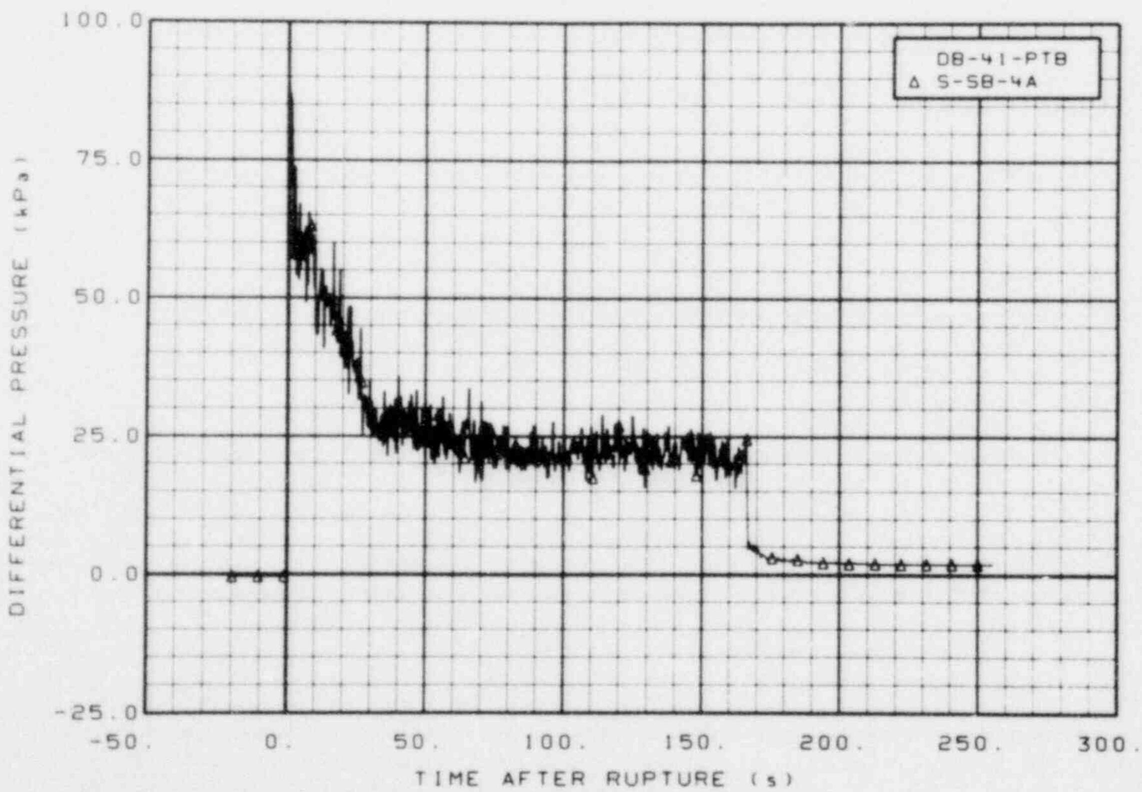


Figure 344. Differential pressure in broken loop cold leg, Test S-SB-4A (DB-41-PTB), from -20 to 256 s.

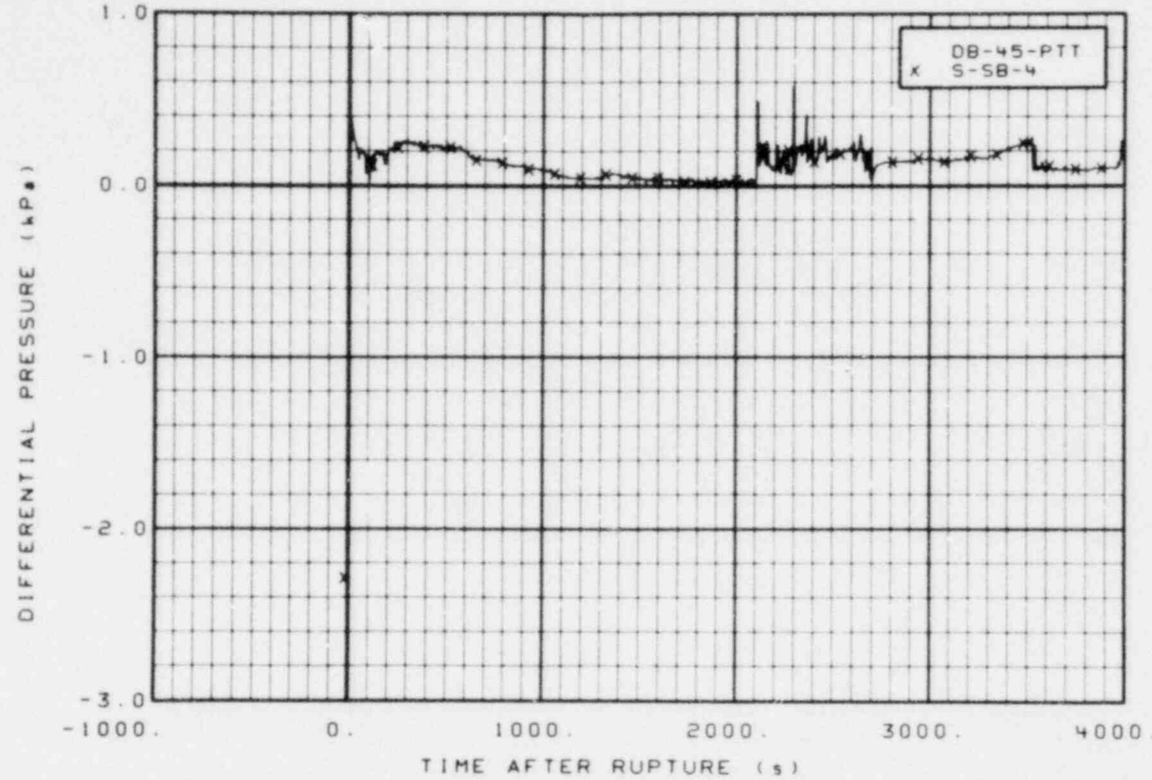


Figure 345. Differential pressure in broken loop cold leg, Test S-SB-4 (DB-45-PTT), from -20 to 4000 s.

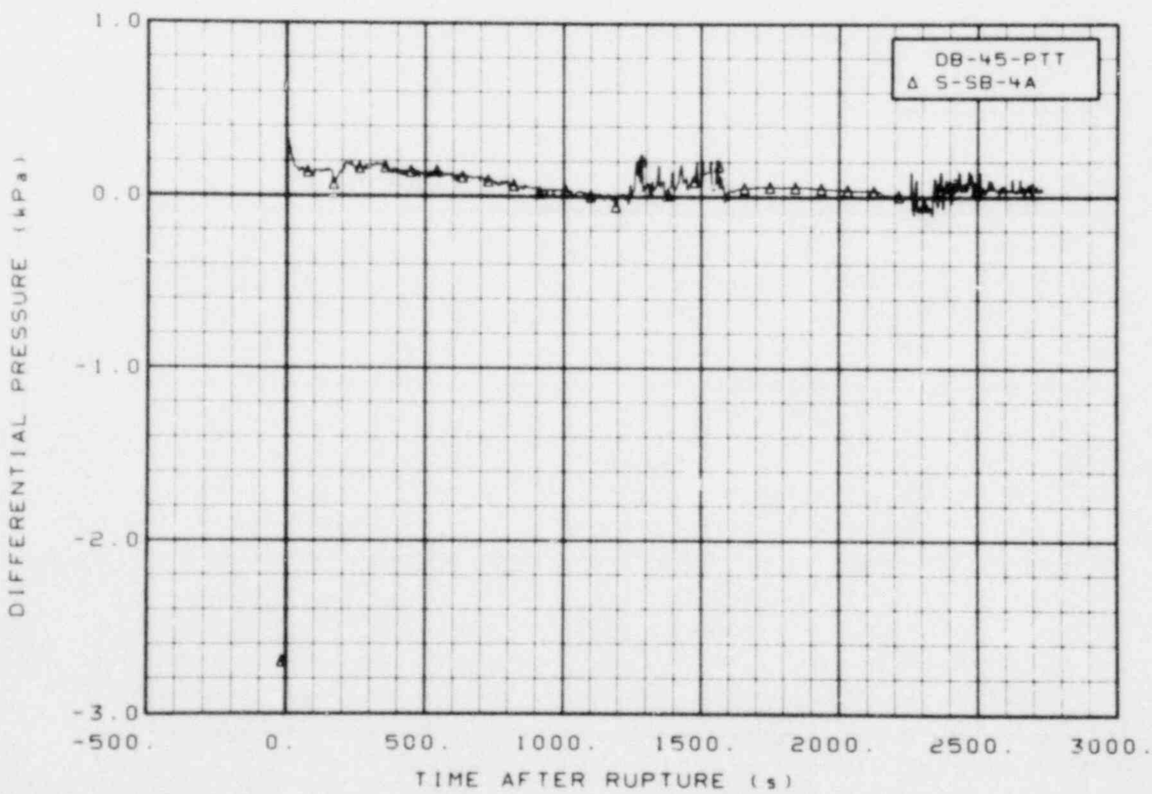


Figure 346. Differential pressure in broken loop cold leg, Test S-SB-4A (DB-45-PTT), from -20 to 2740 s.

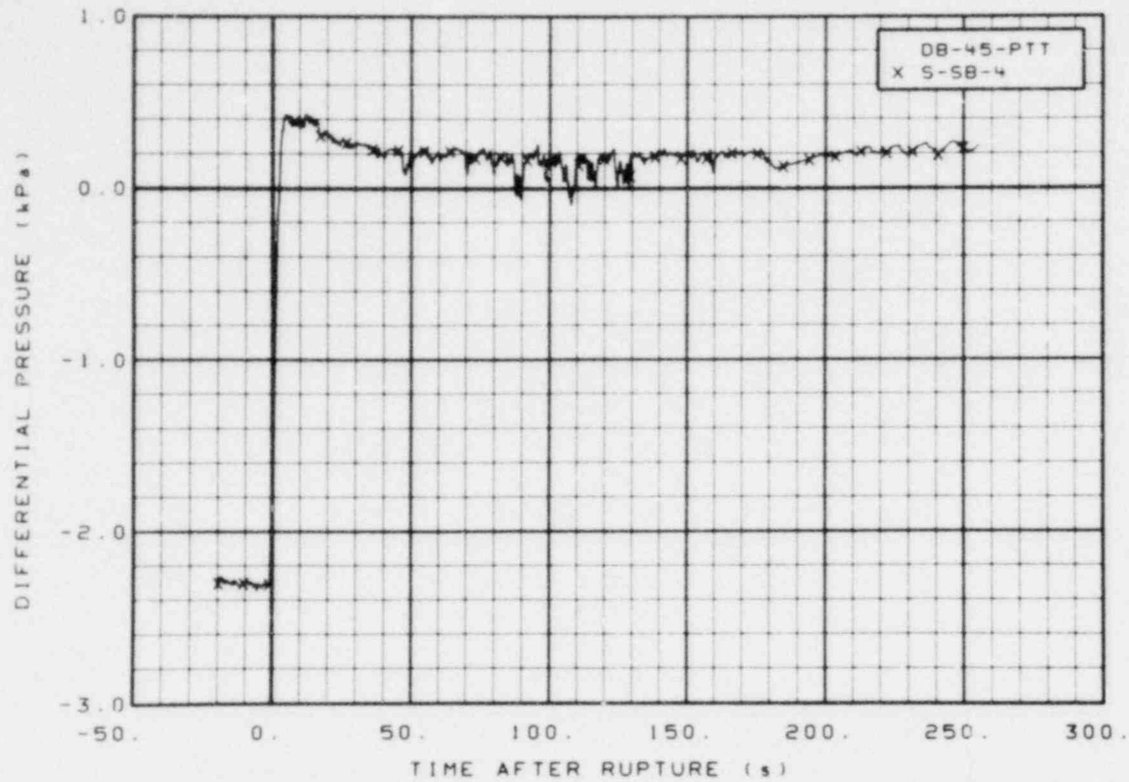


Figure 347. Differential pressure in broken loop cold leg, Test S-SB-4 (DB-45-PTT), from -20 to 256 s.

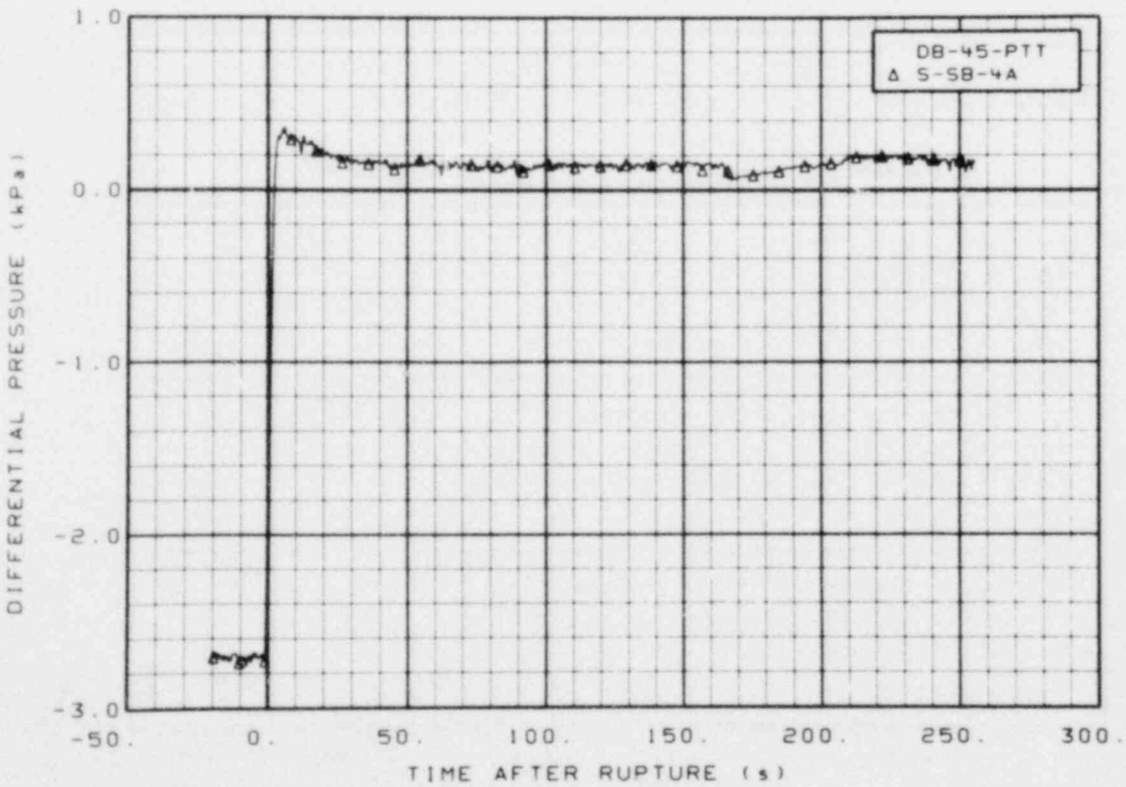


Figure 348. Differential pressure in broken loop cold leg, Test S-SB-4A (DB-45-PTT), from -20 to 256 s.

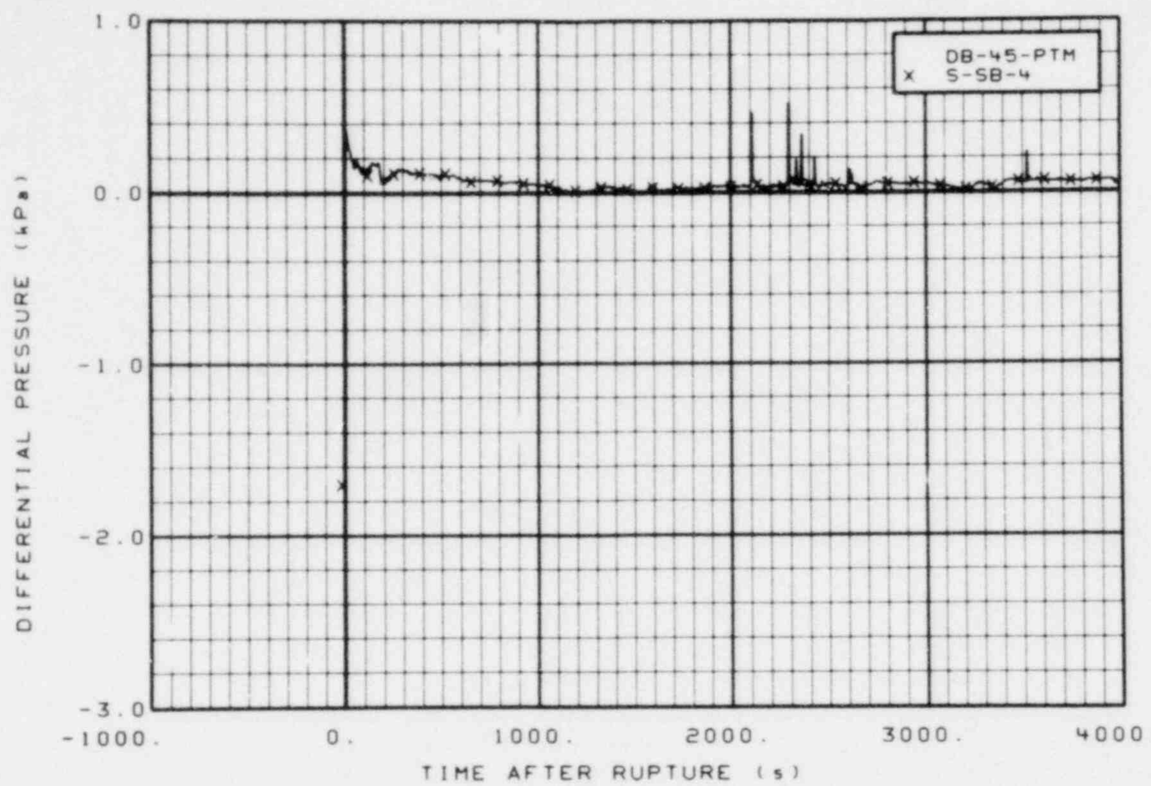


Figure 349. Differential pressure in broken loop cold leg, Test S-SB-4 (DB-45-PTM), from -20 to 4000 s.

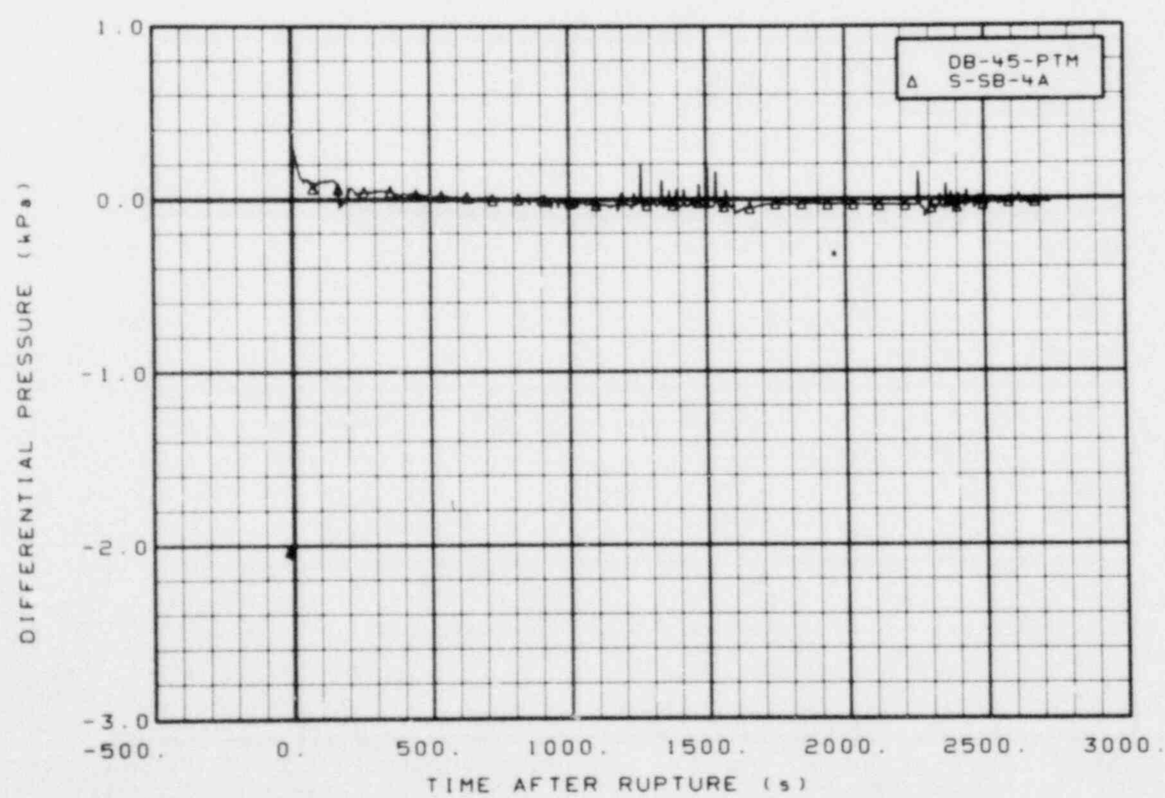


Figure 350. Differential pressure in broken loop cold leg, Test S-SB-4A (DB-45-PTM), from -20 to 2740 s.

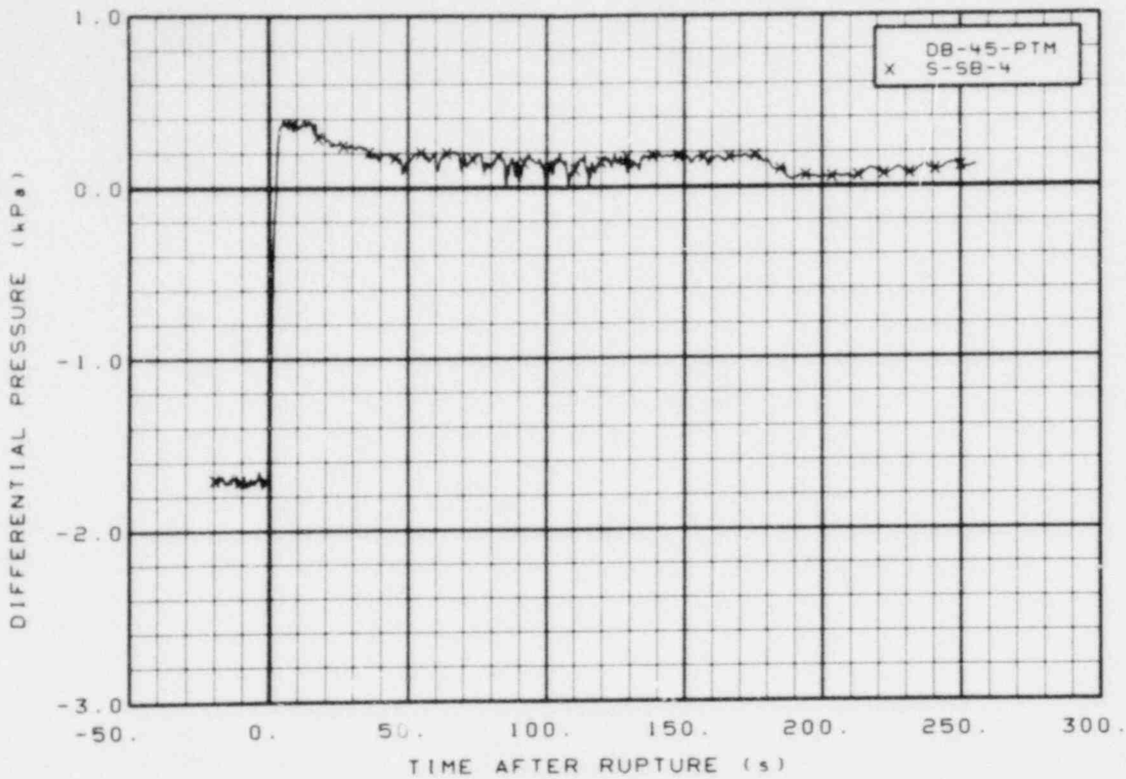


Figure 351. Differential pressure in broken loop cold leg, Test S-SB-4 (DB-45-PTM), from -20 to 256 s.

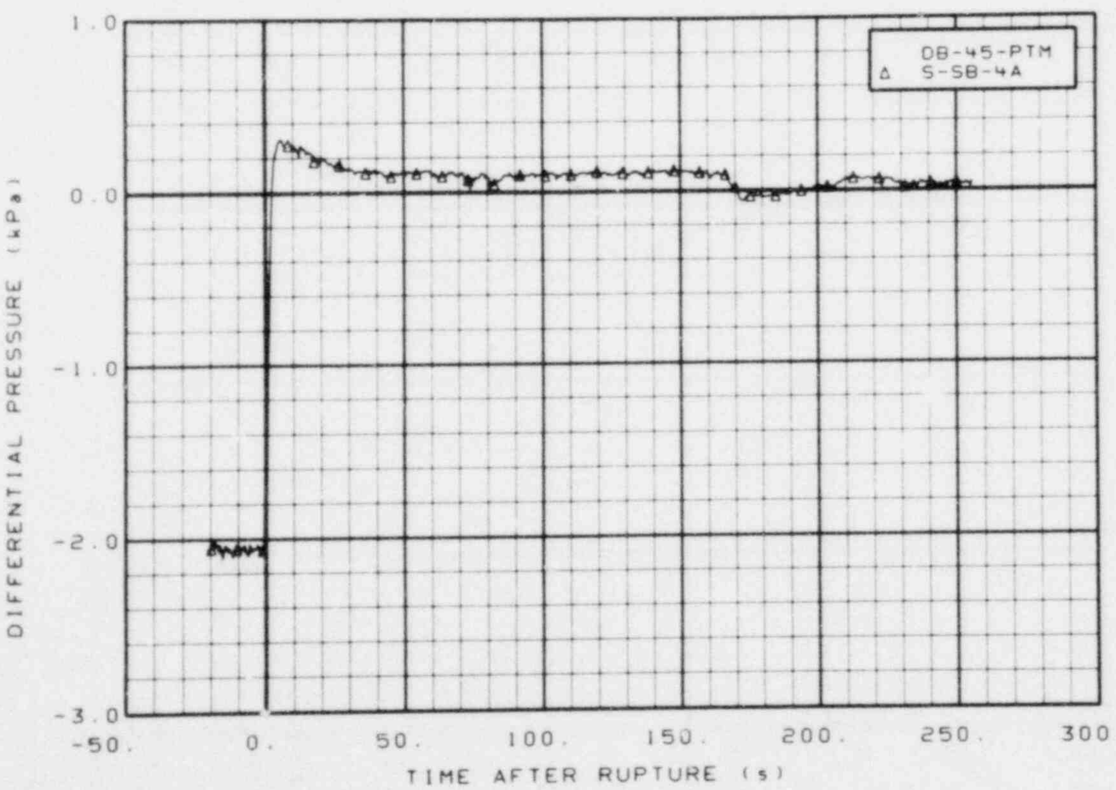


Figure 352. Differential pressure in broken loop cold leg, Test S-SB-4A (DB-45-PTM), from -20 to 256 s.

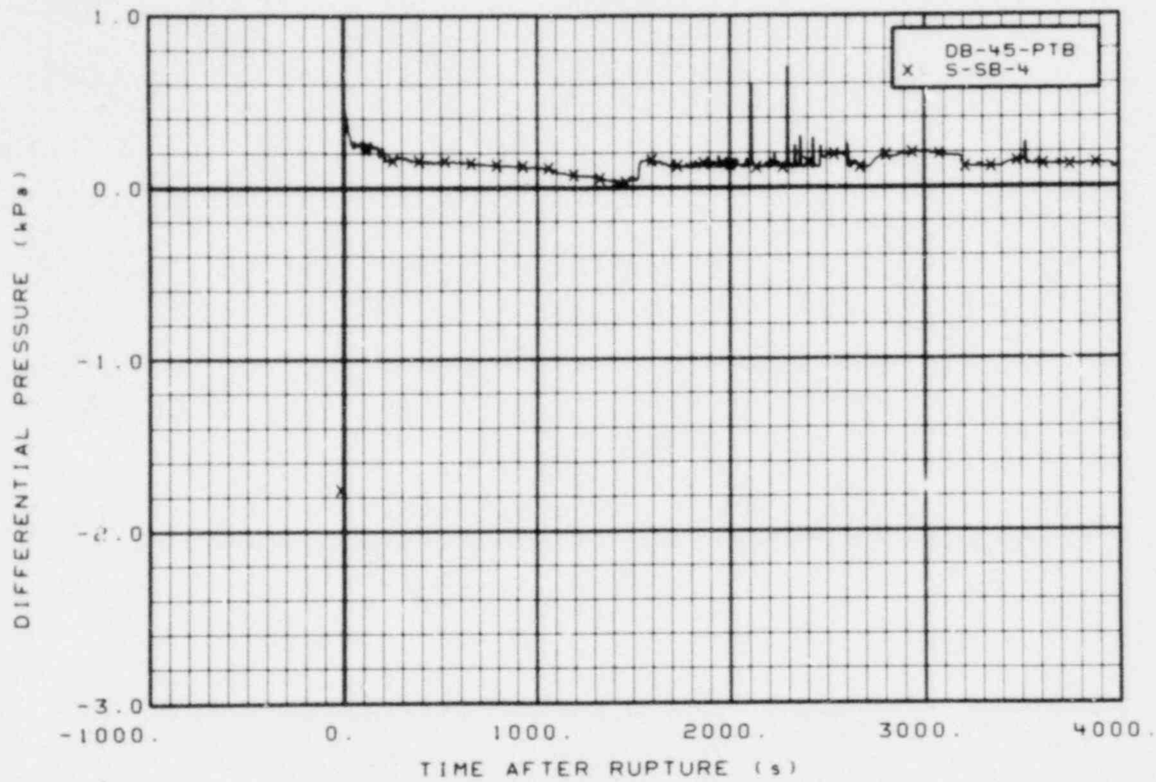


Figure 353. Differential pressure in broken loop cold leg, Test S-SB-4 (DB-45-PTB), from -20 to 4000 s.

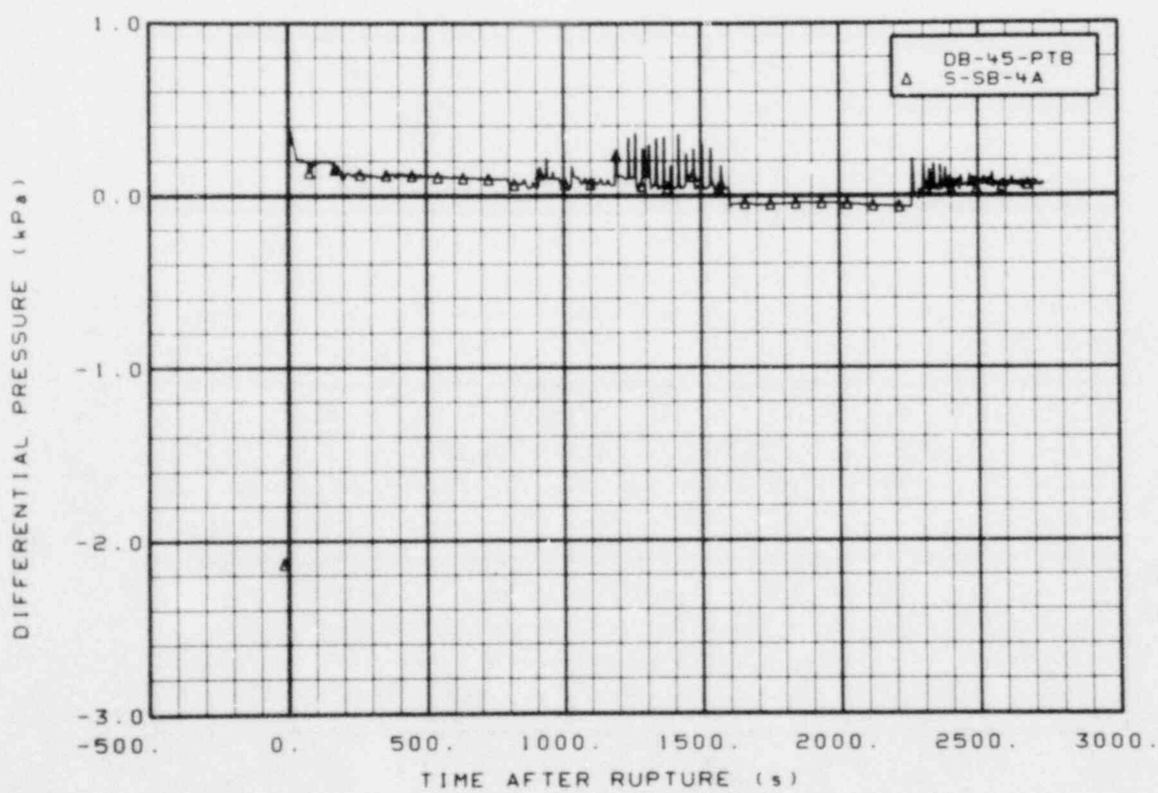


Figure 354. Differential pressure in broken loop cold leg, Test S-SB-4A (DB-45-PTB), from -20 to 2740 s.

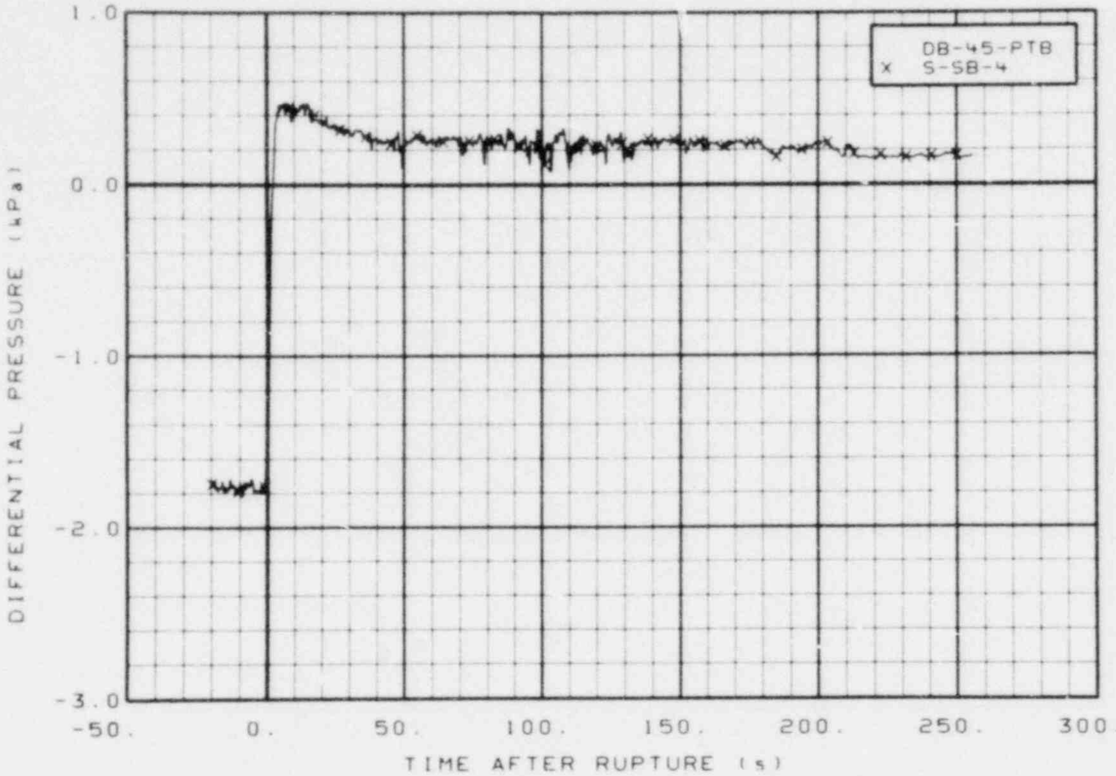


Figure 355. Differential pressure in broken loop cold leg, Test S-SB-4 (DB-45-PTB), from -20 to 256 s.

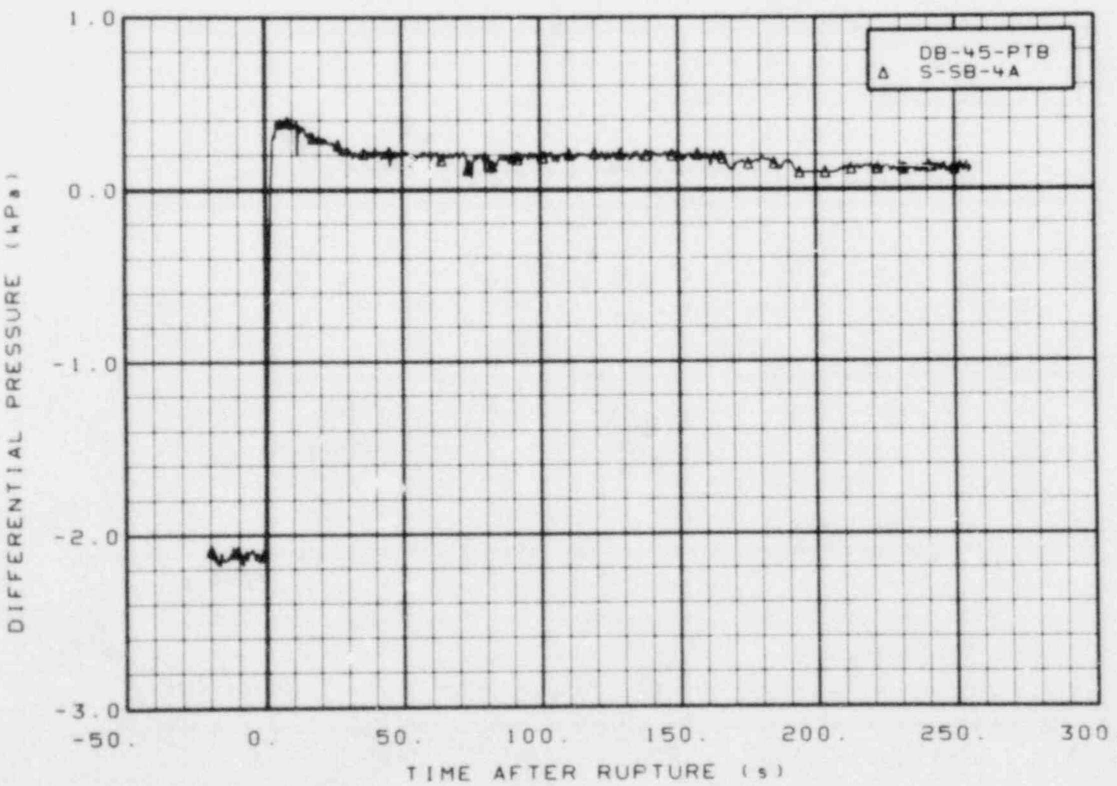


Figure 356. Differential pressure in broken loop cold leg, Test S-SB-4A (DB-45-PTB), from -20 to 256 s.

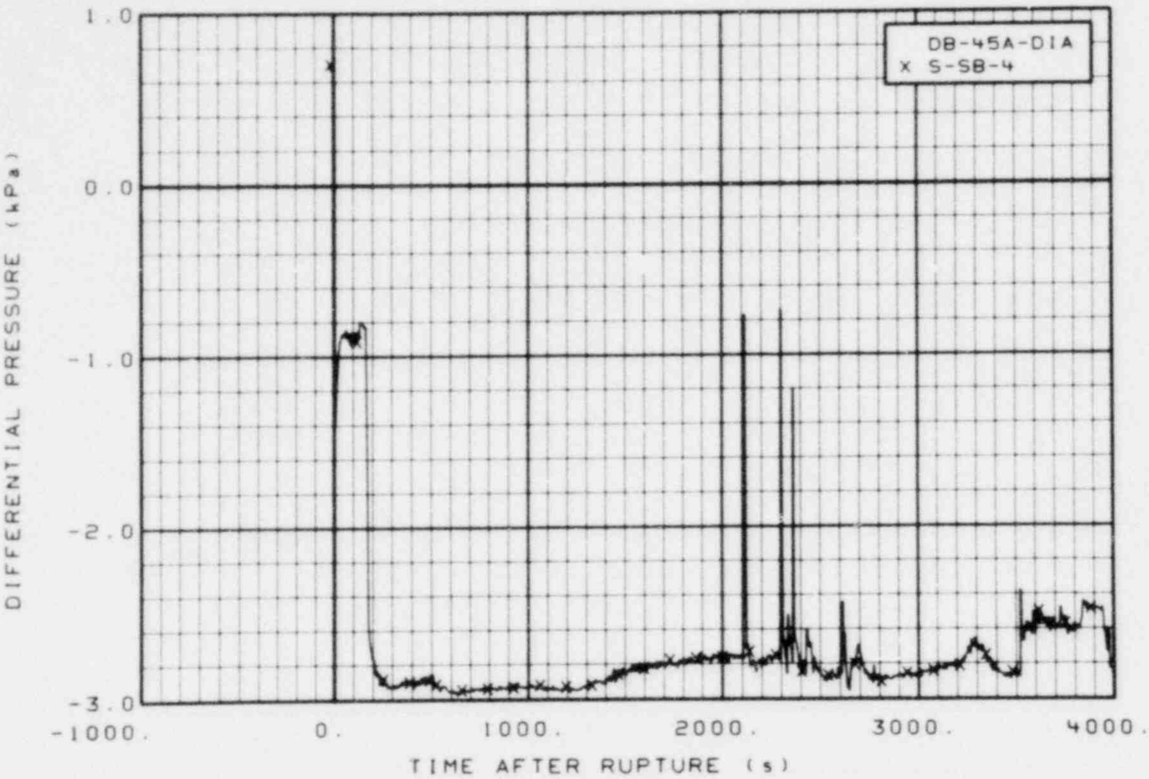


Figure 357. Differential pressure in broken loop cold leg, Test S-SB-4 (DB-45A-DIA), from -20 to 4000 s.

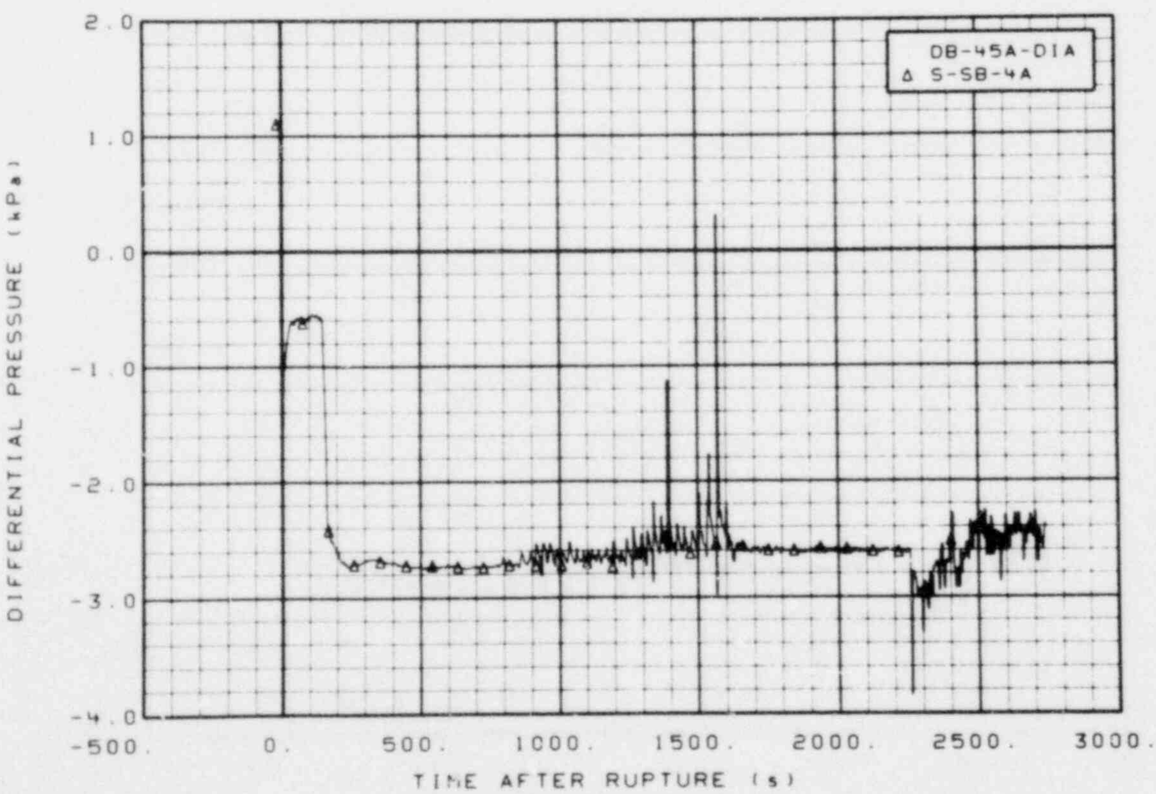


Figure 358. Differential pressure in broken loop cold leg, Test S-SB-4A (DB-45A-DIA), from -20 to 2740 s.

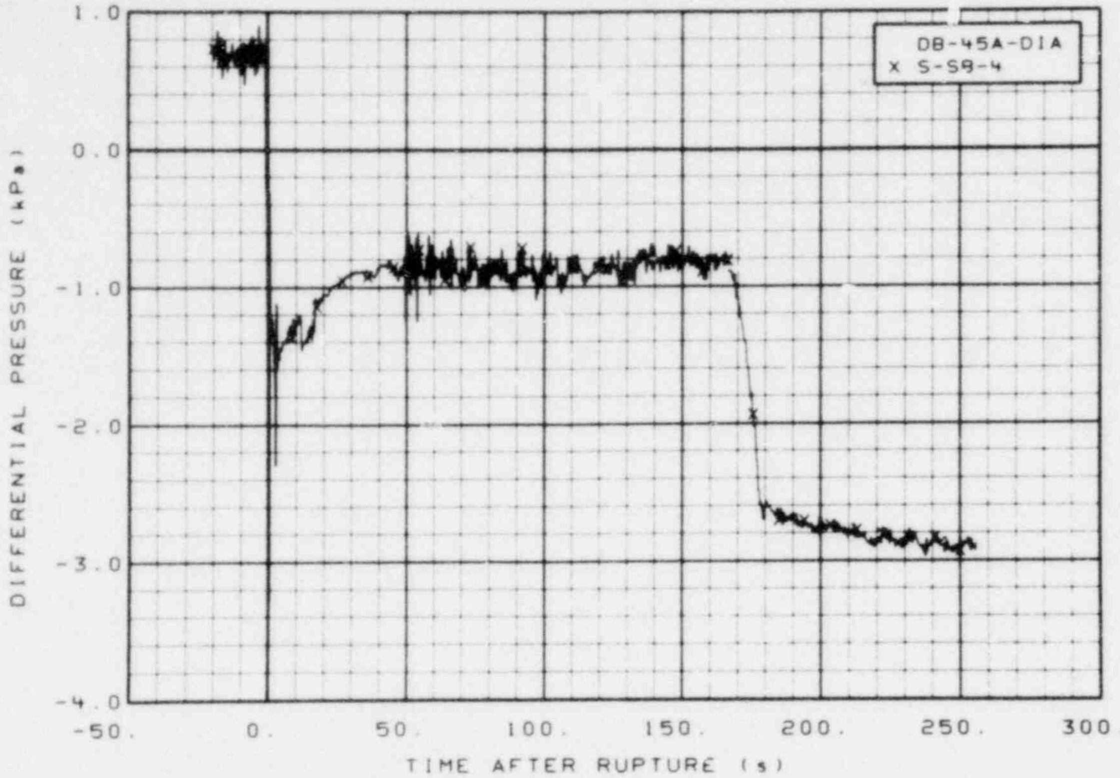


Figure 359. Differential pressure in broken loop cold leg, Test S-SB-4 (DB-45A-DIA), from -20 to 256 s.

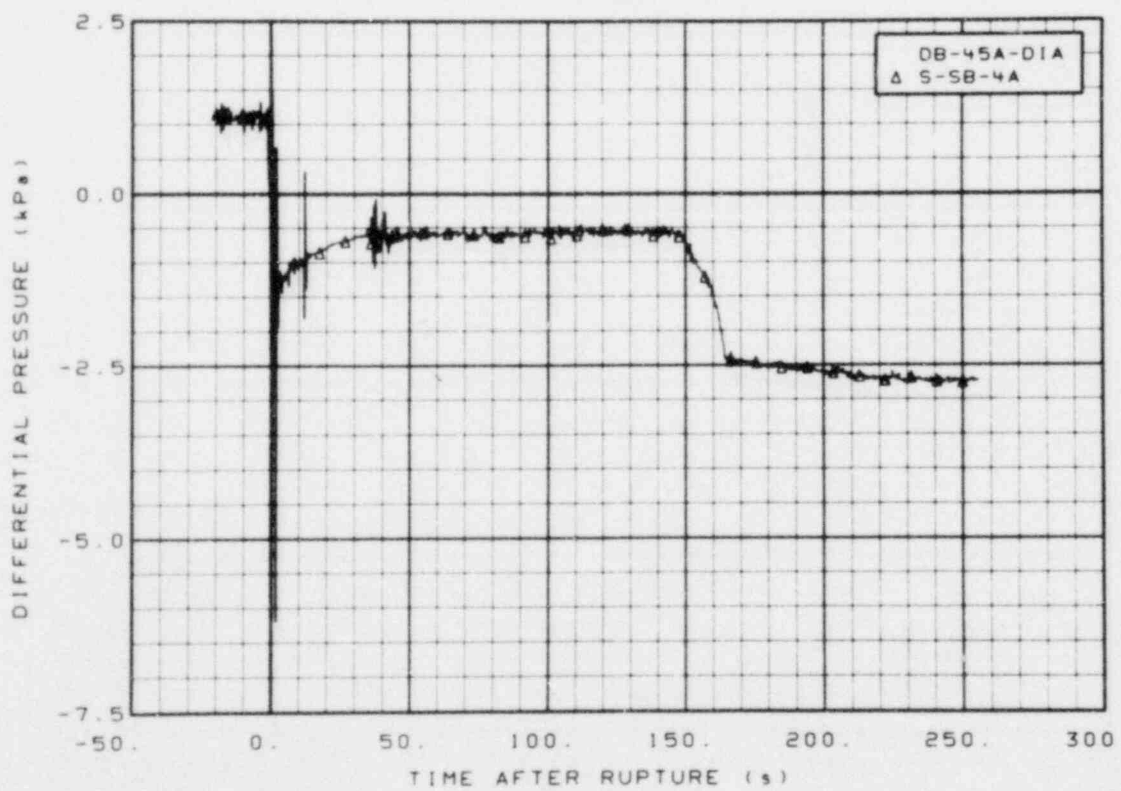


Figure 360. Differential pressure in broken loop cold leg, Test S-SB-4A (DB-45A-DIA), from -20 to 256 s.

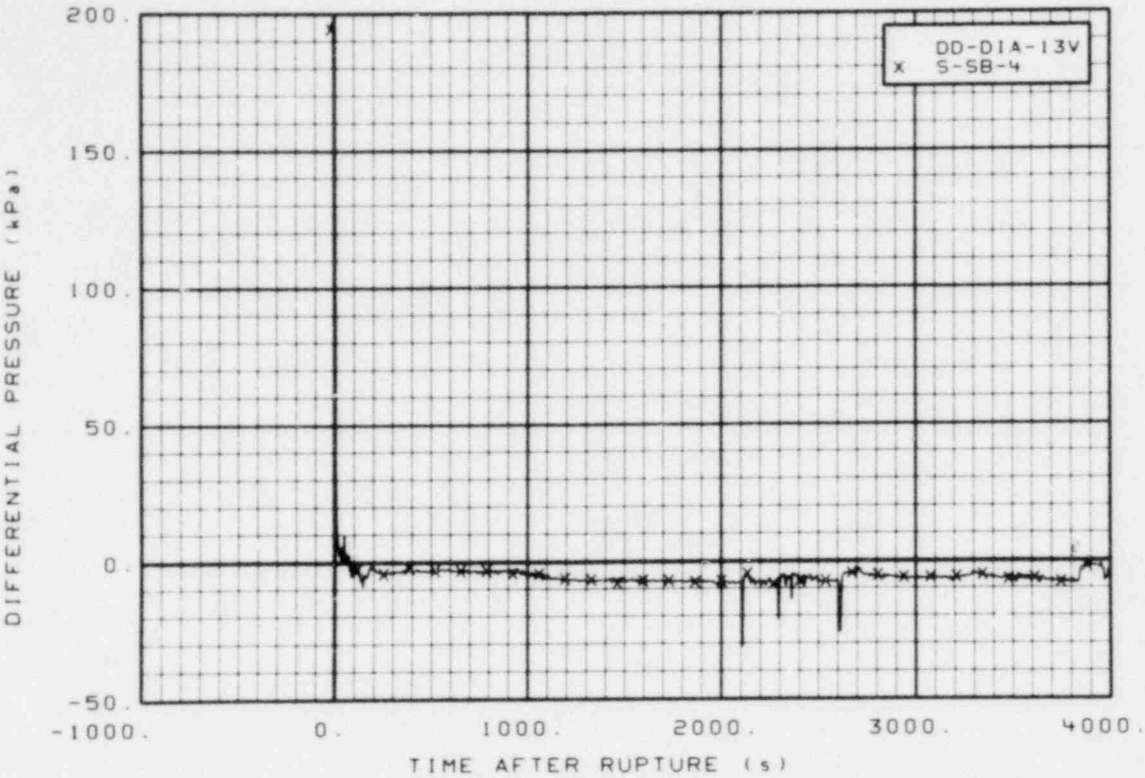


Figure 361. Differential pressure in downcomer, Test S-SB-4 (DD-DIA-13V), from -20 to 4000 s.

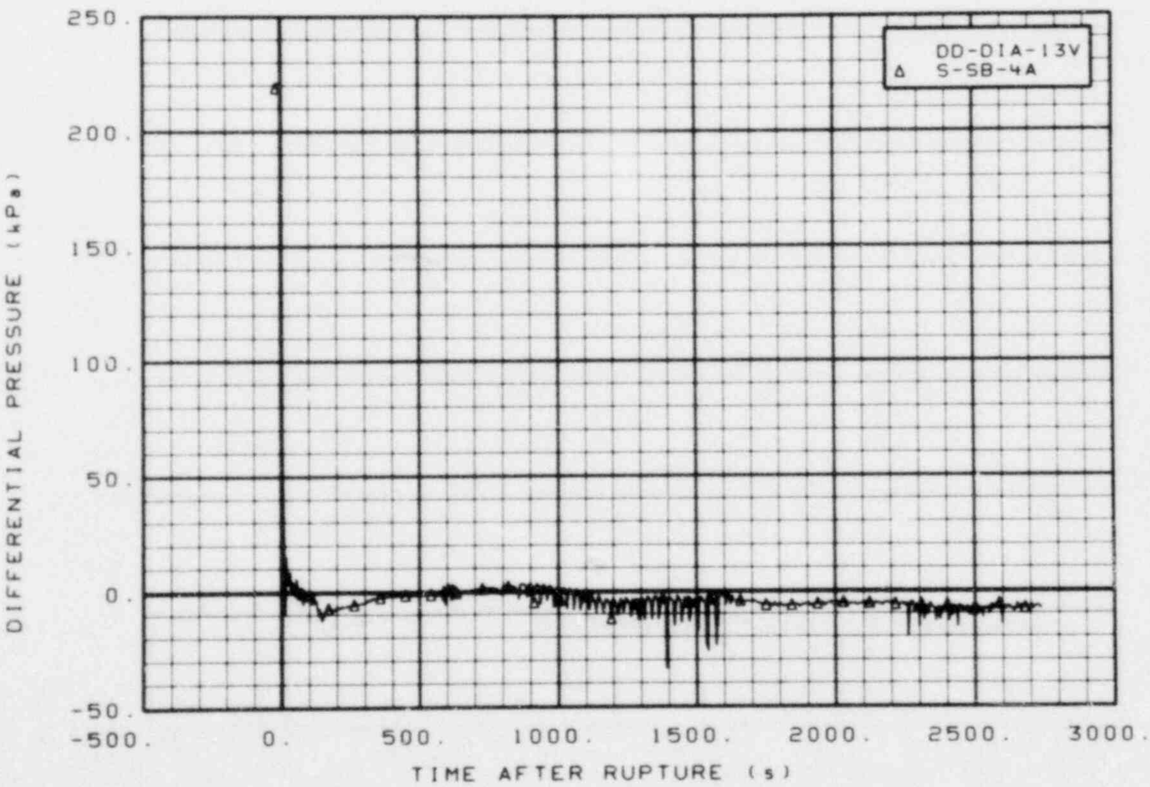


Figure 362. Differential pressure in downcomer, Test S-SB-4A (DD-DIA-13V), from -20 to 2740 s.

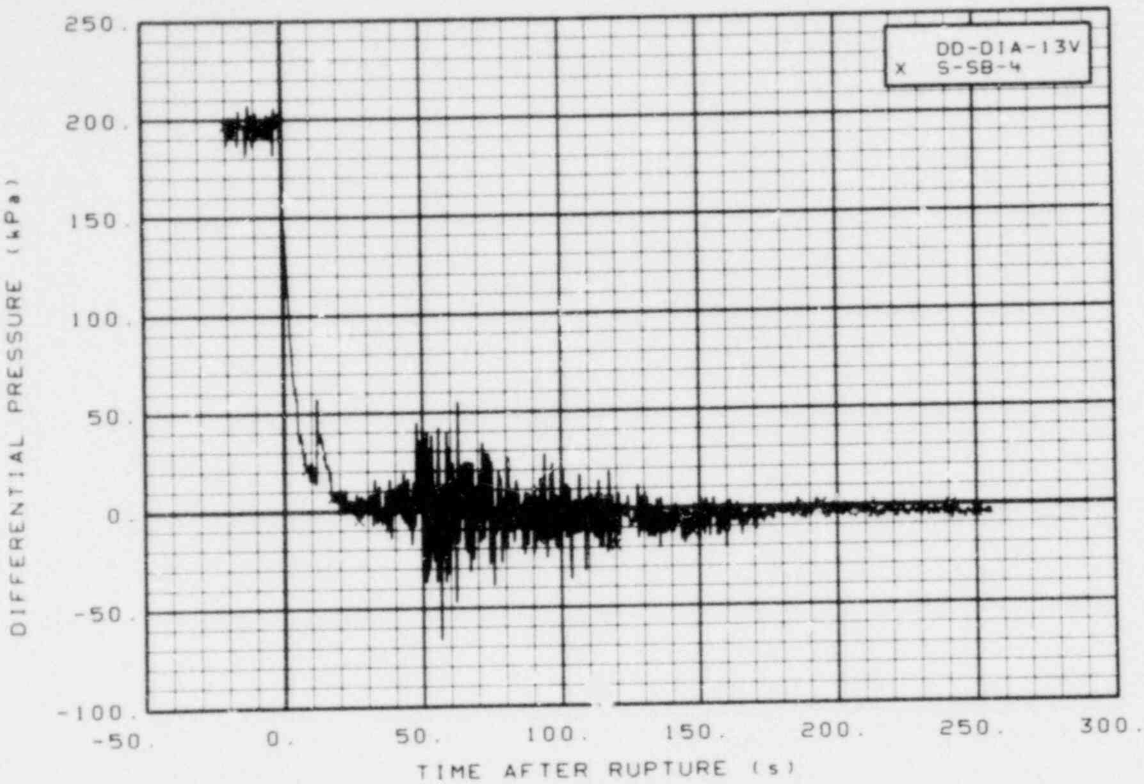


Figure 363. Differential pressure in downcomer, Test S-SB-4 (DD-DIA-13V), from -20 to 256 s.

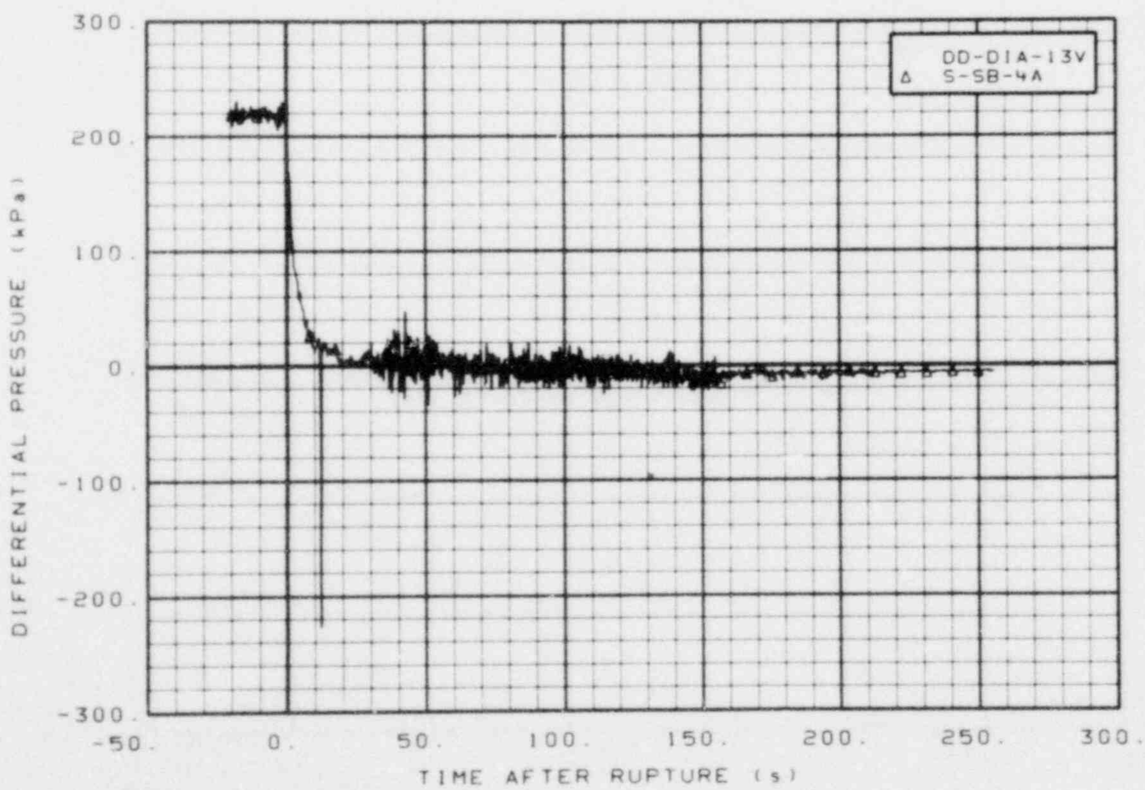


Figure 364. Differential pressure in downcomer, Test S-SB-4A (DD-DIA-13V), from -20 to 256 s.

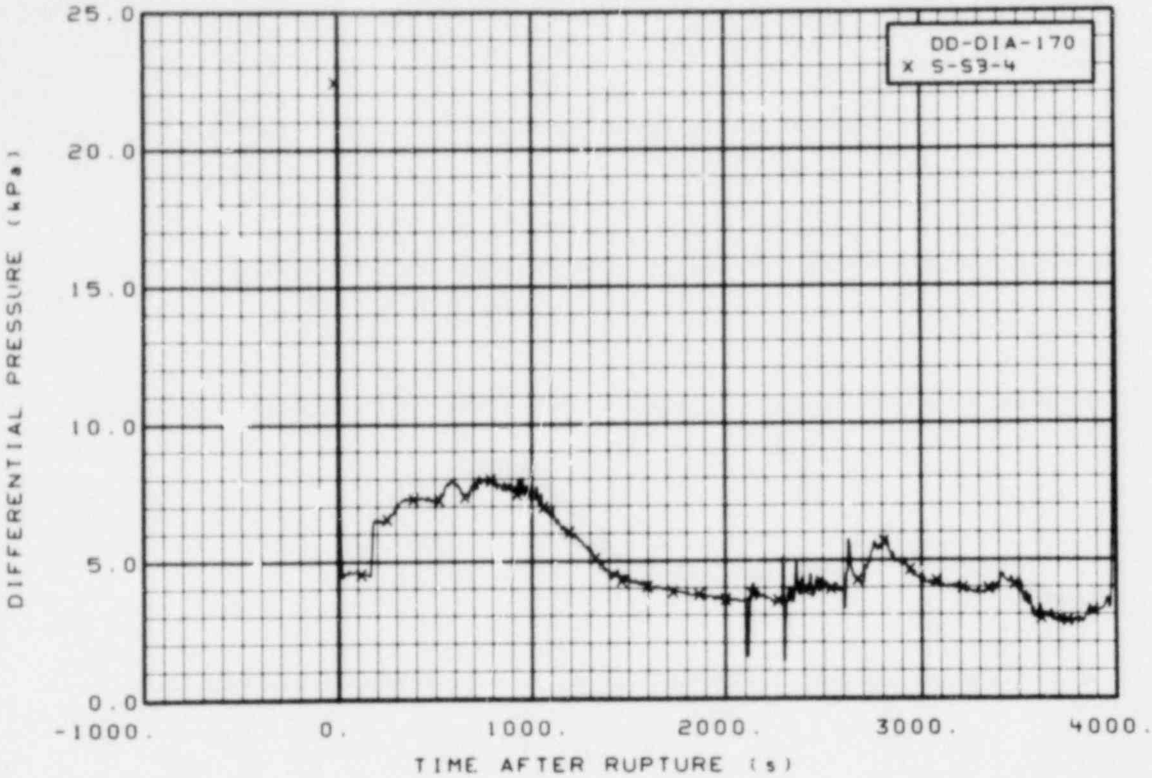


Figure 365. Differential pressure in downcomer, Test S-SB-4 (DD-DIA-170), from -20 to 4000 s.

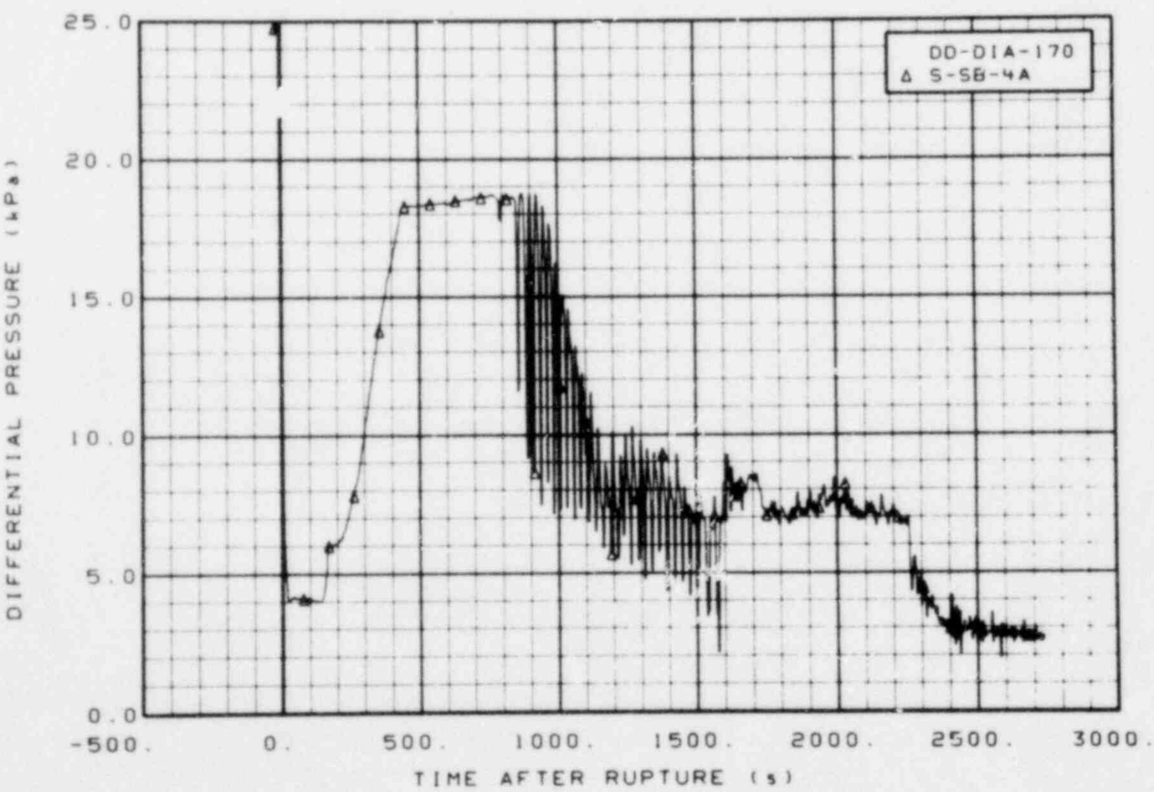


Figure 366. Differential pressure in downcomer, Test S-SB-4A (DD-DIA-170), from -20 to 2740 s.

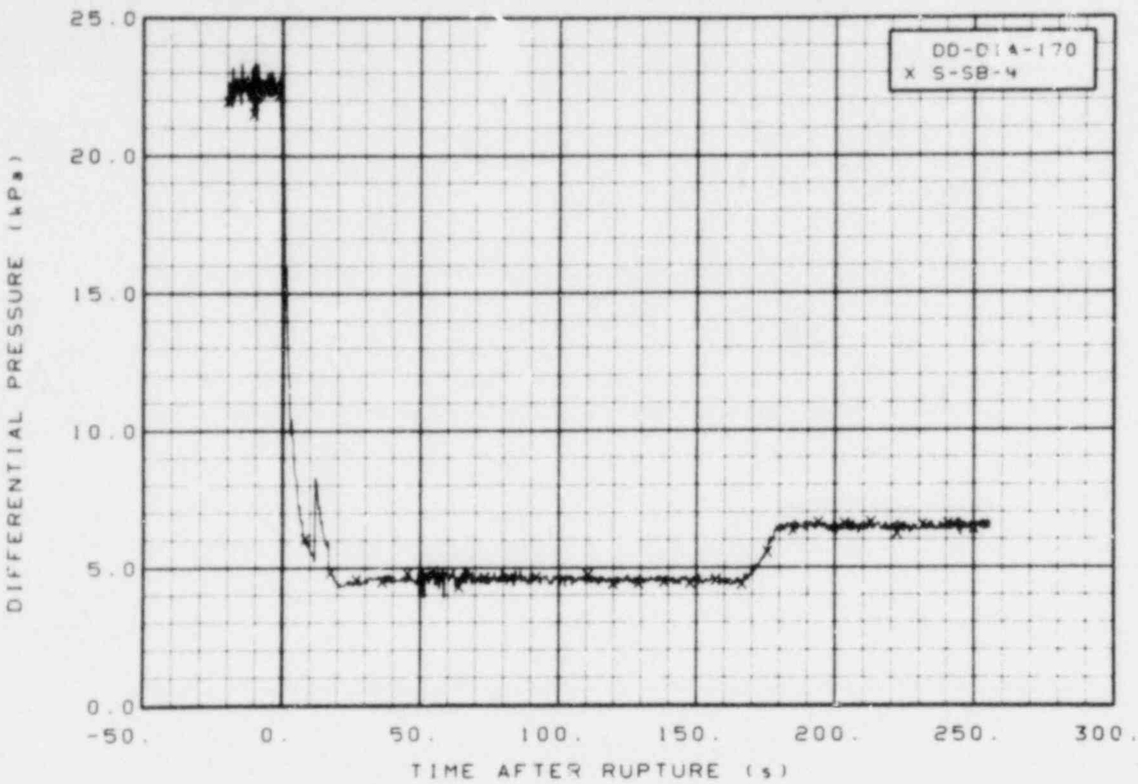


Figure 367. Differential pressure in downcomer, Test S-SB-4 (DD-DIA-170), from -20 to 256 s.

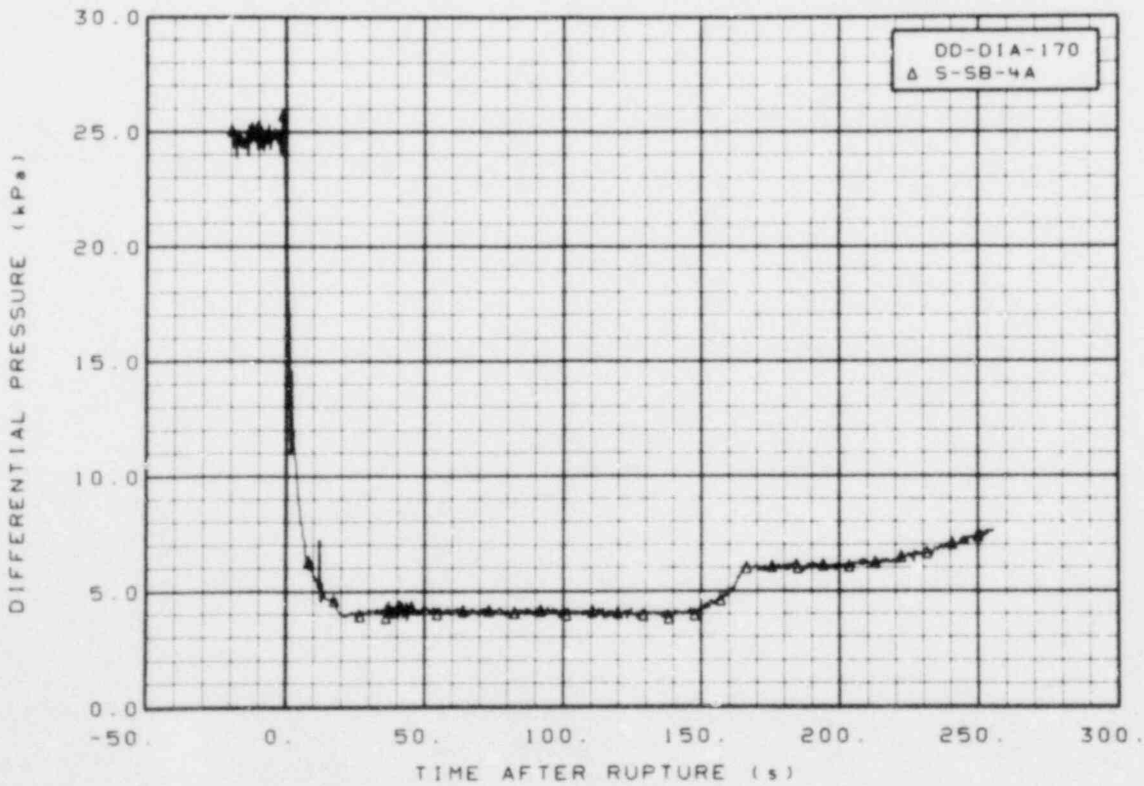


Figure 368. Differential pressure in downcomer, Test S-SB-4A (DD-DIA-170), from -20 to 256 s.

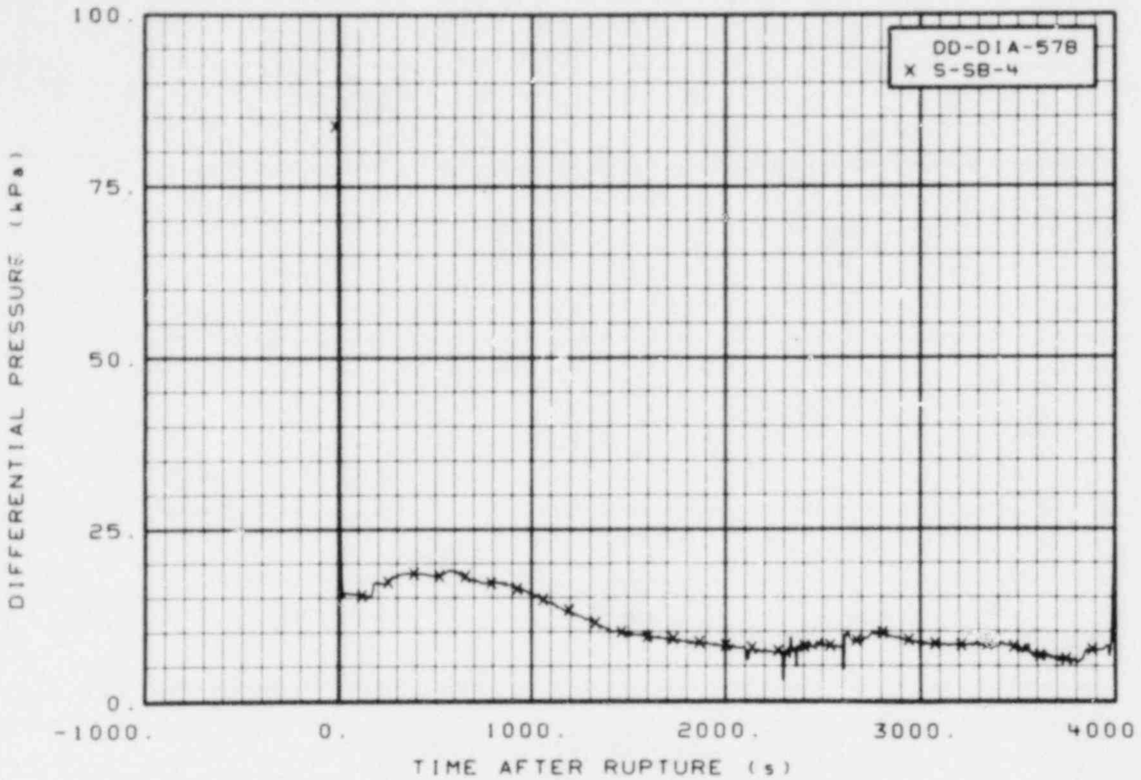


Figure 369. Differential pressure in downcomer, Test S-SB-4 (DD-DIA-578), from -20 to 4000 s.

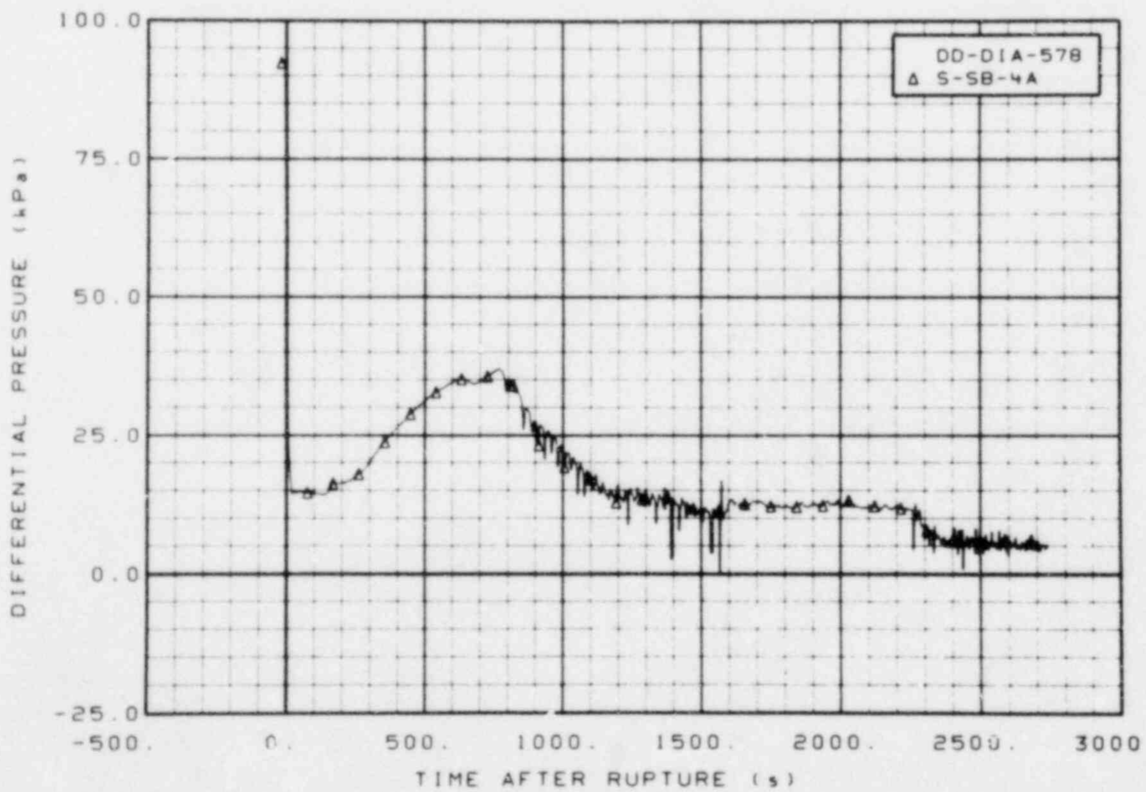


Figure 370. Differential pressure in downcomer, Test S-SB-4A (DD-DIA-578), from -20 to 2740.

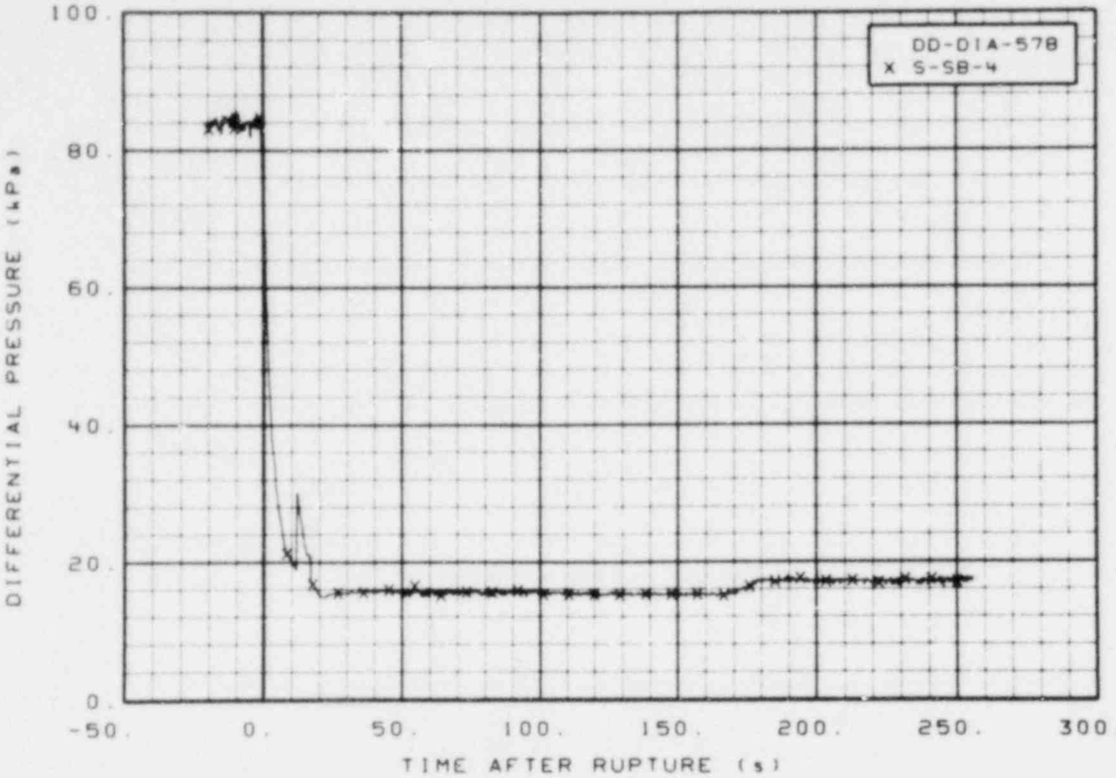


Figure 371. Differential pressure in downcomer, Test S-SB-4 (DD-DIA-578), from -20 to 256 s.

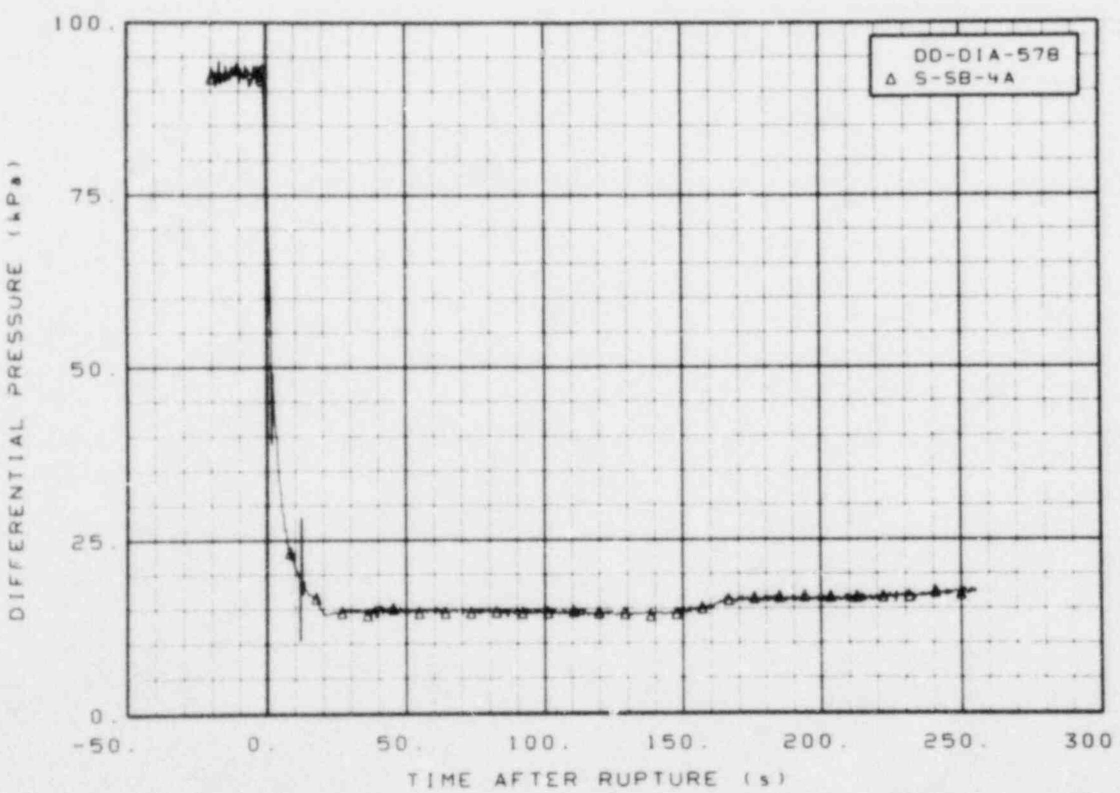


Figure 372. Differential pressure in downcomer, Test S-SB-4A (DD-DIA-578), from -20 to 256 s.

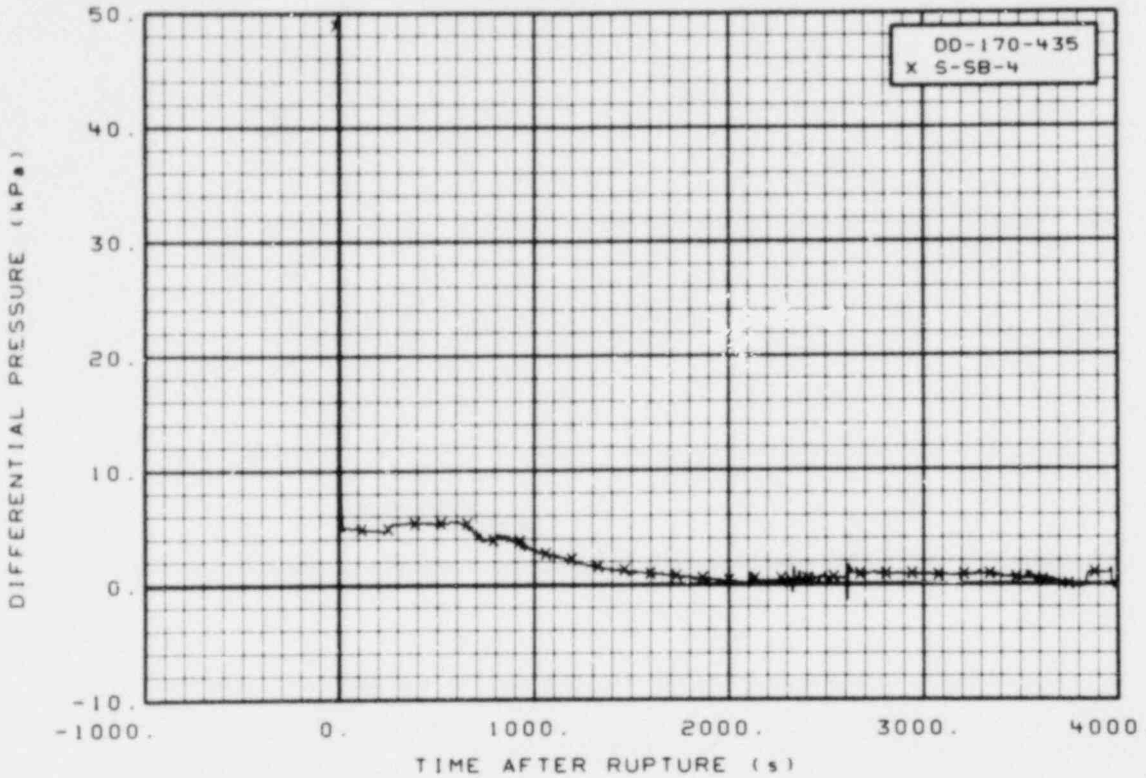


Figure 373. Differential pressure in downcomer, Test S-SB-4 (DD-170-435), from -20 to 4000 s.

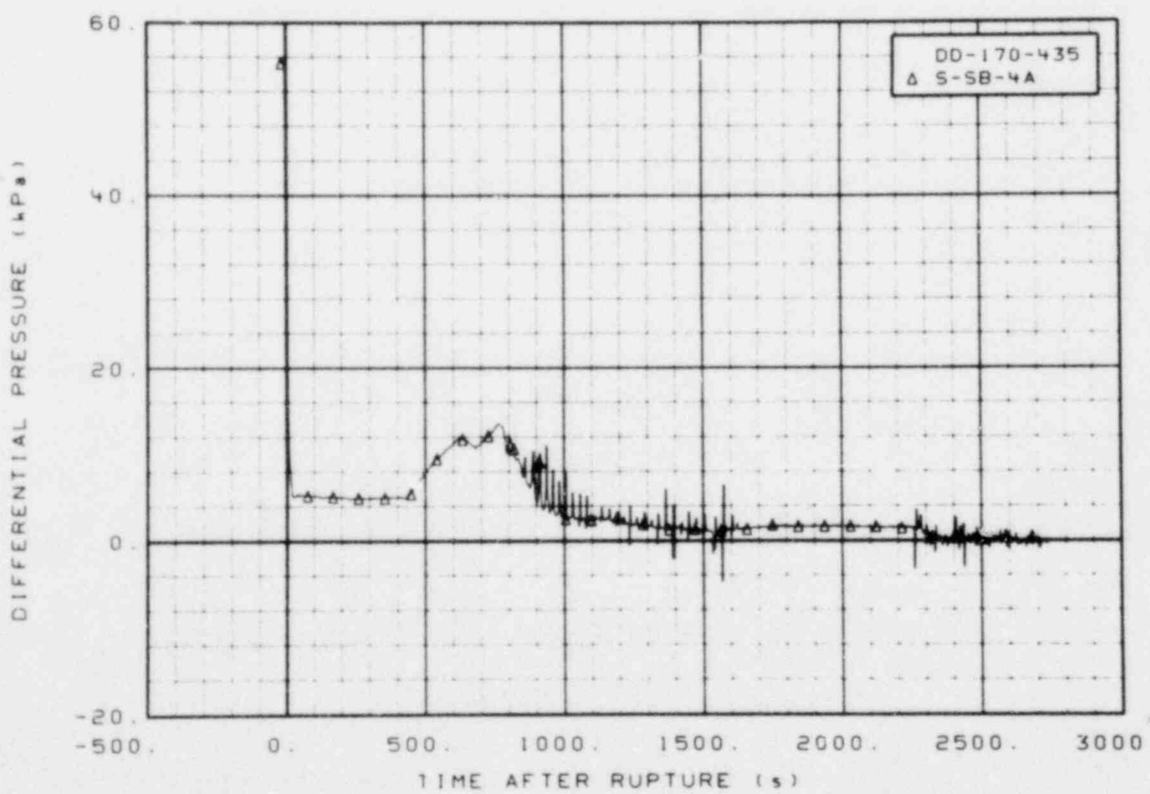


Figure 374. Differential pressure in downcomer, Test S-SB-4A (DD-170-435), from -20 to 2740 s.

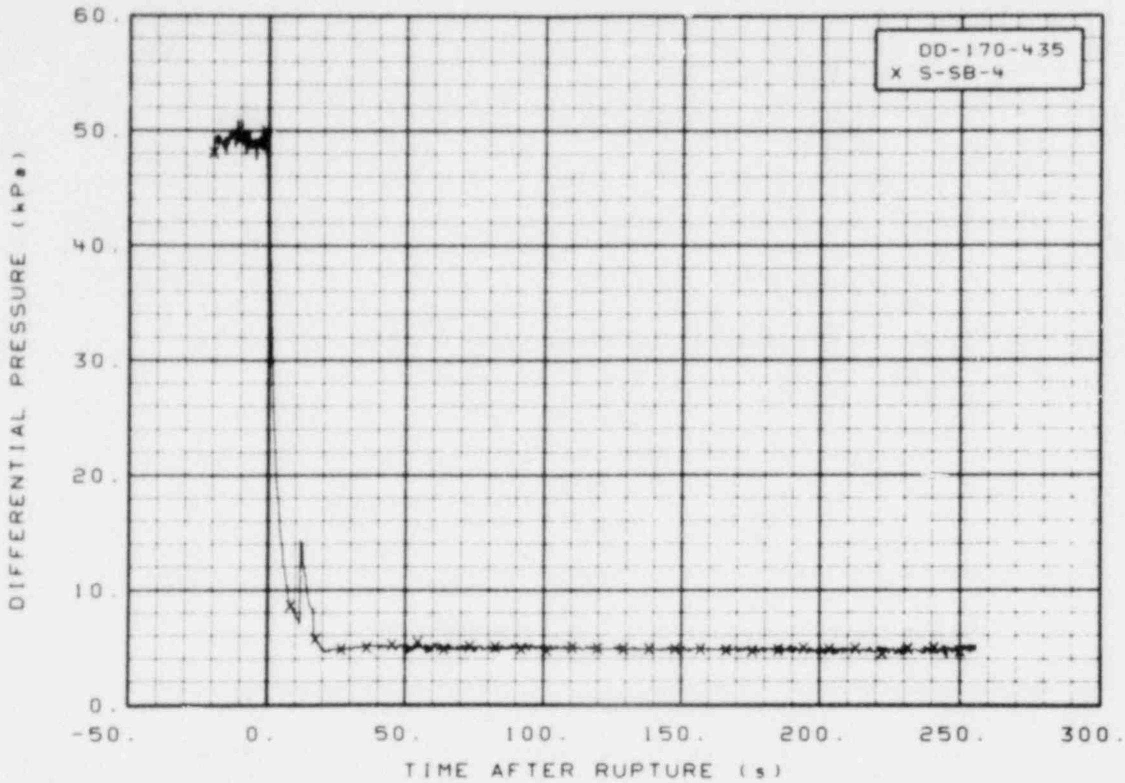


Figure 375. Differential pressure in downcomer, Test S-SB-4 (DD-170-435), from -20 to 256 s.

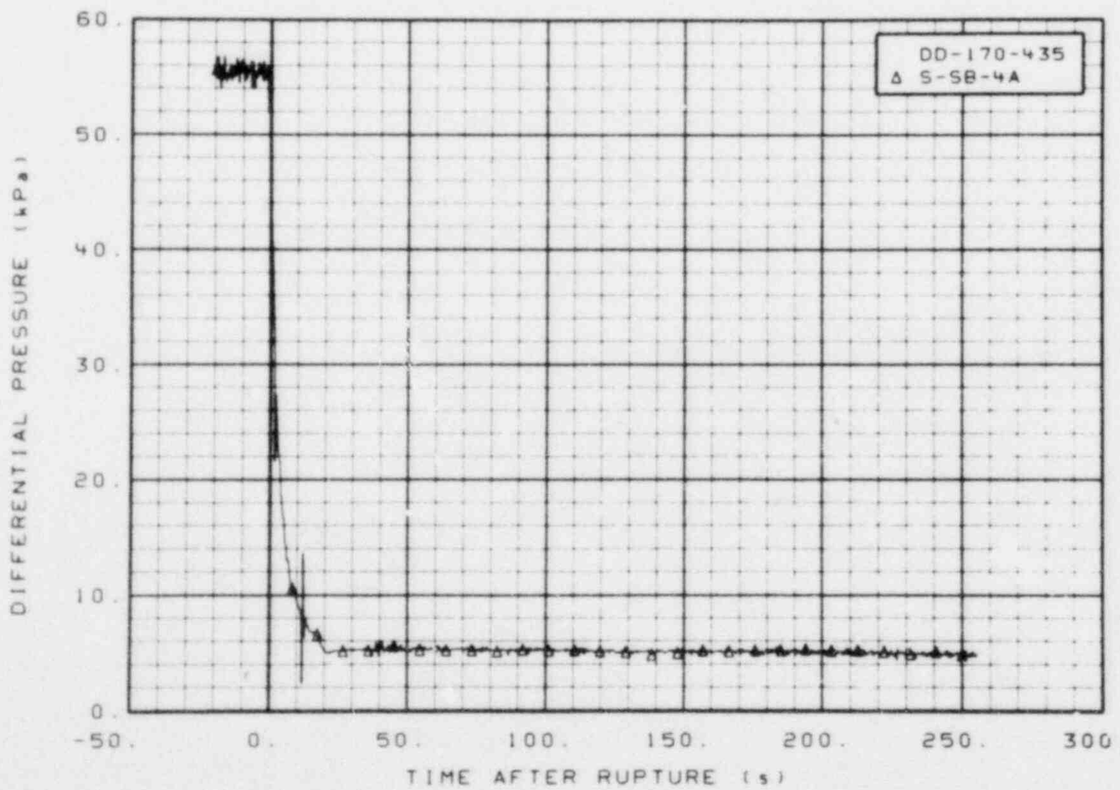


Figure 376. Differential pressure in downcomer, Test S-SB-4A (DD-170-435), from -20 to 256 s.

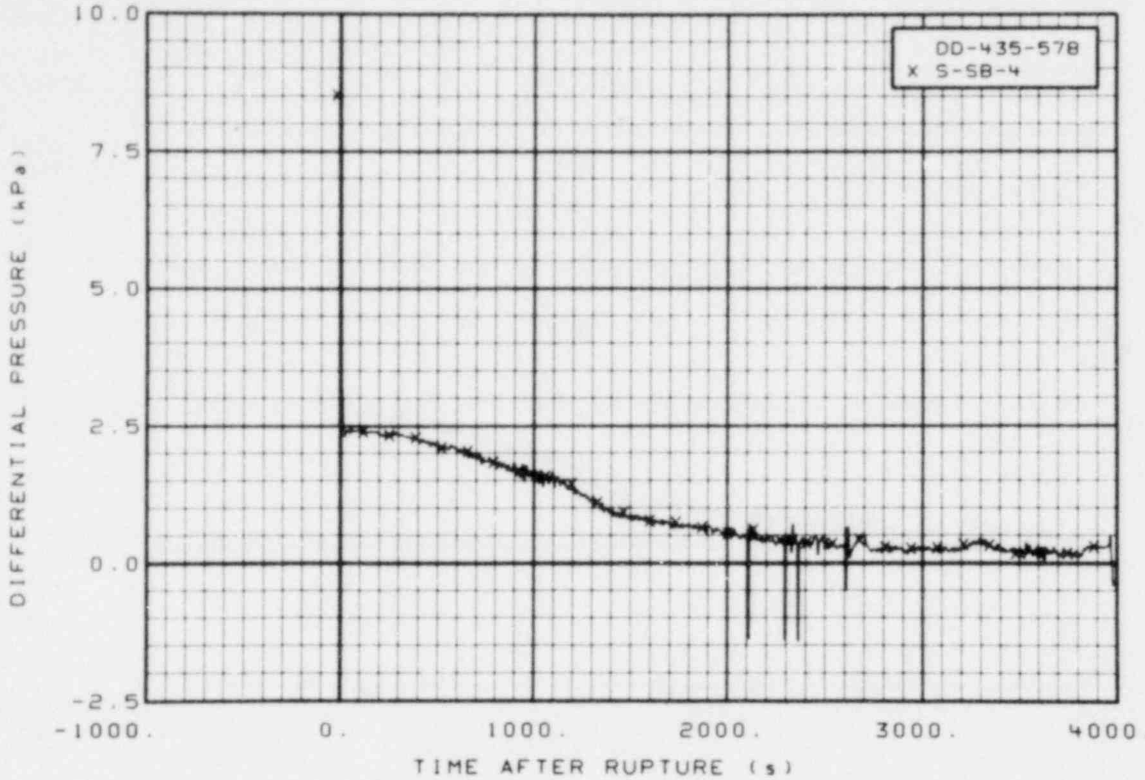


Figure 377. Differential pressure in downcomer, Test S-SB-4 (DD-435-578), from -20 to 4000 s.

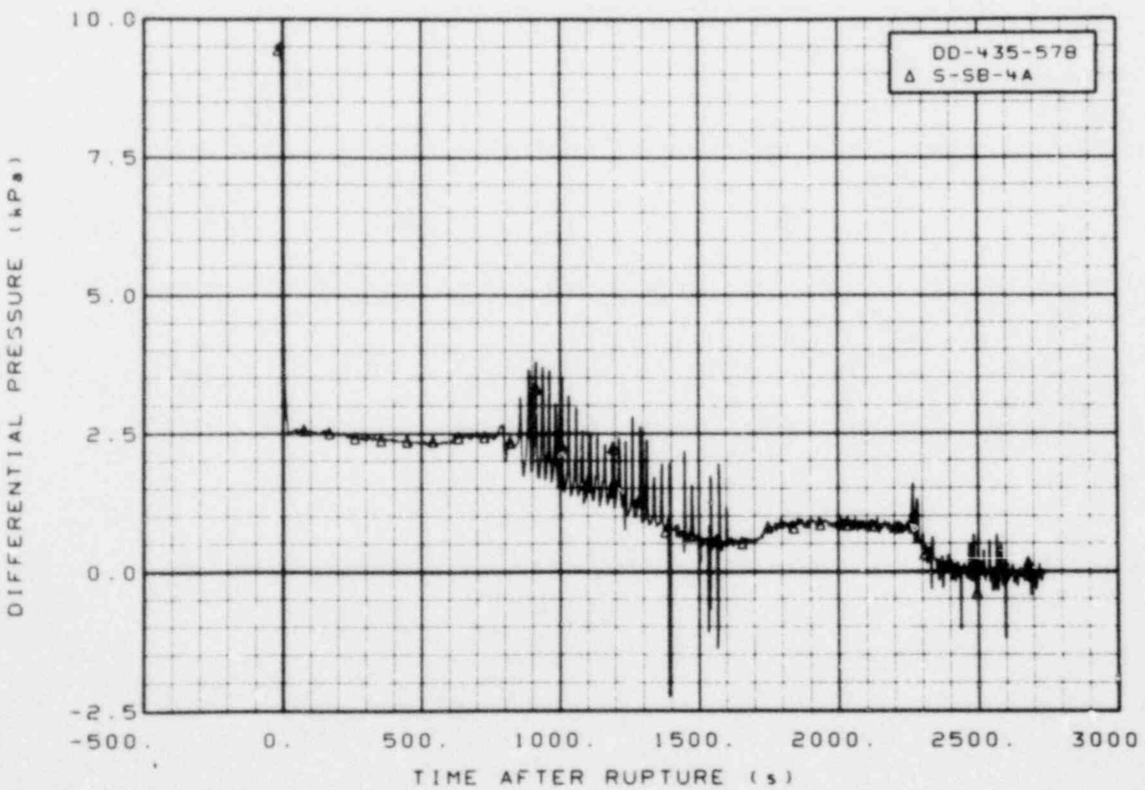


Figure 378. Differential pressure in downcomer, Test S-SB-4A (DD-435-578), from -20 to 2740 s.

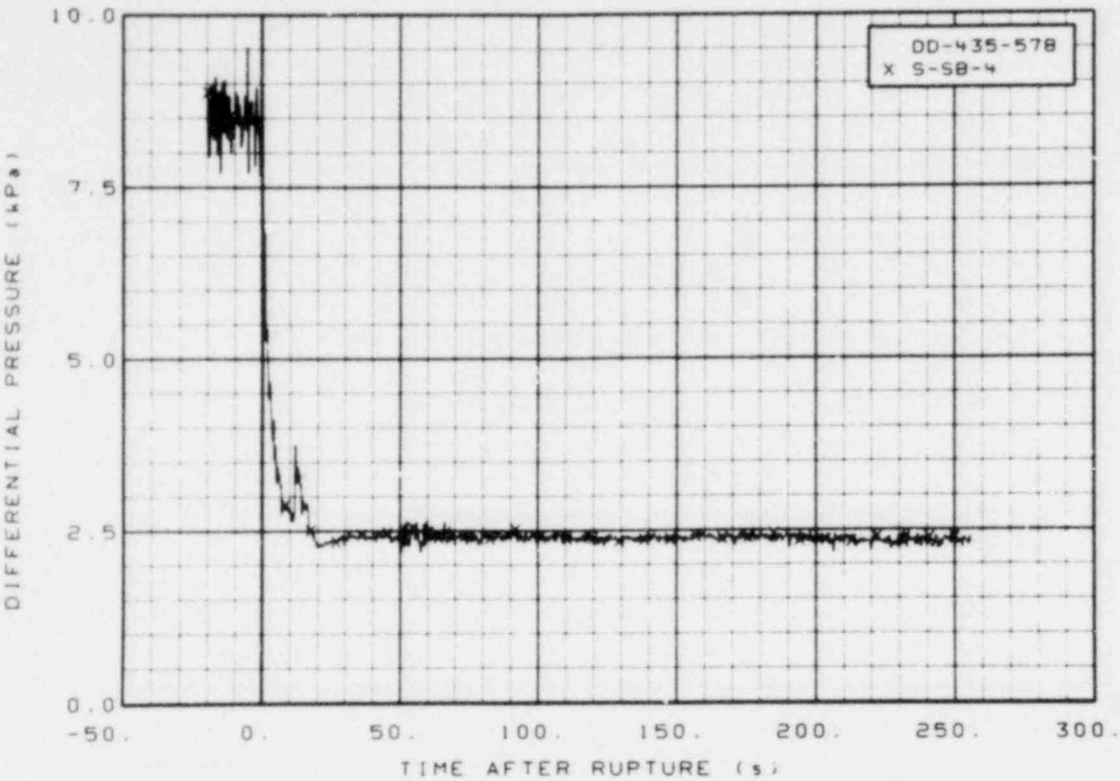


Figure 379. Differential pressure in downcomer, Test S-SB-4 (DD-435-578), from -20 to 256 s.

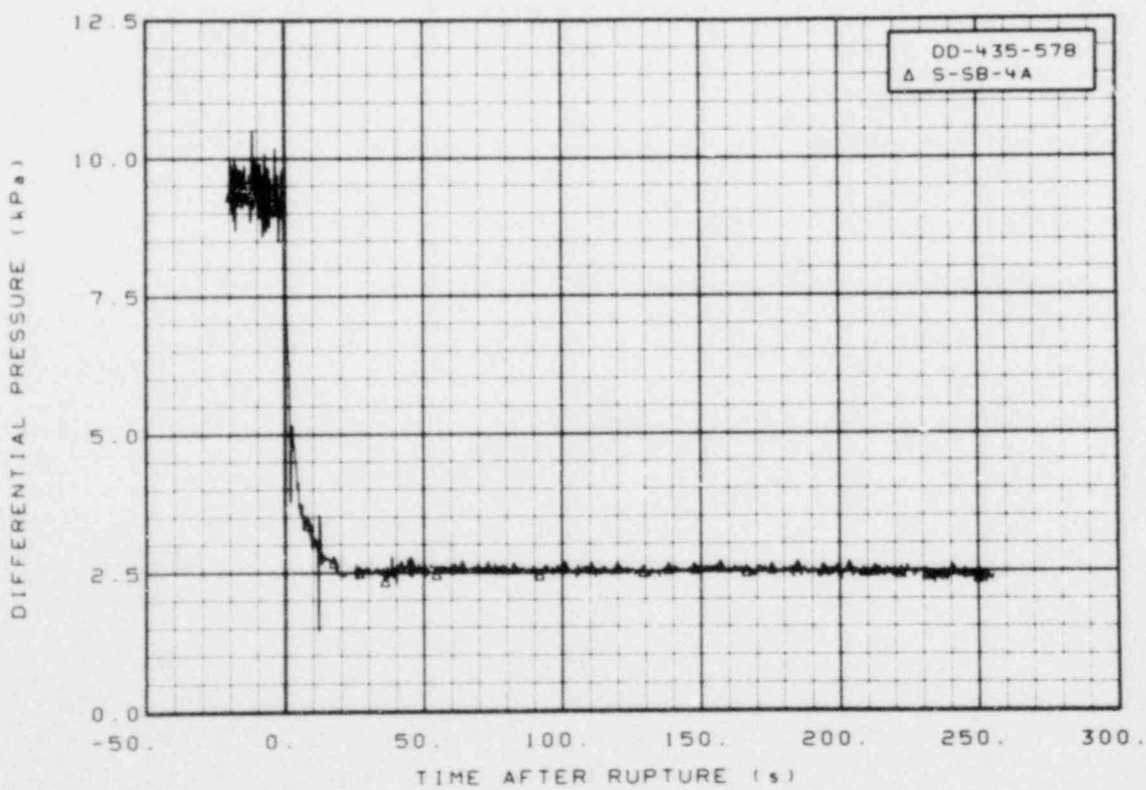


Figure 380. Differential pressure in downcomer, Test S-SB-4A (DD-435-578), from -20 to 256 s.

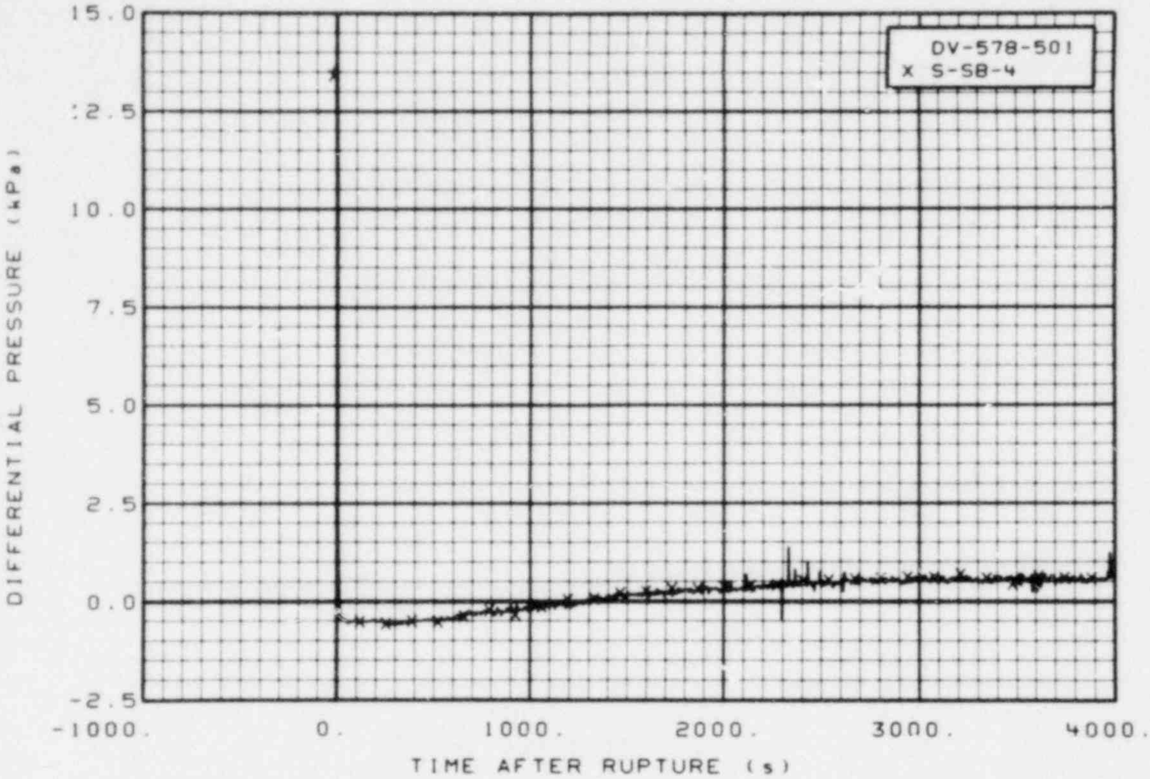


Figure 381. Differential pressure in downcomer, Test S-SB-4 (DV-578-501), from -20 to 4000 s.

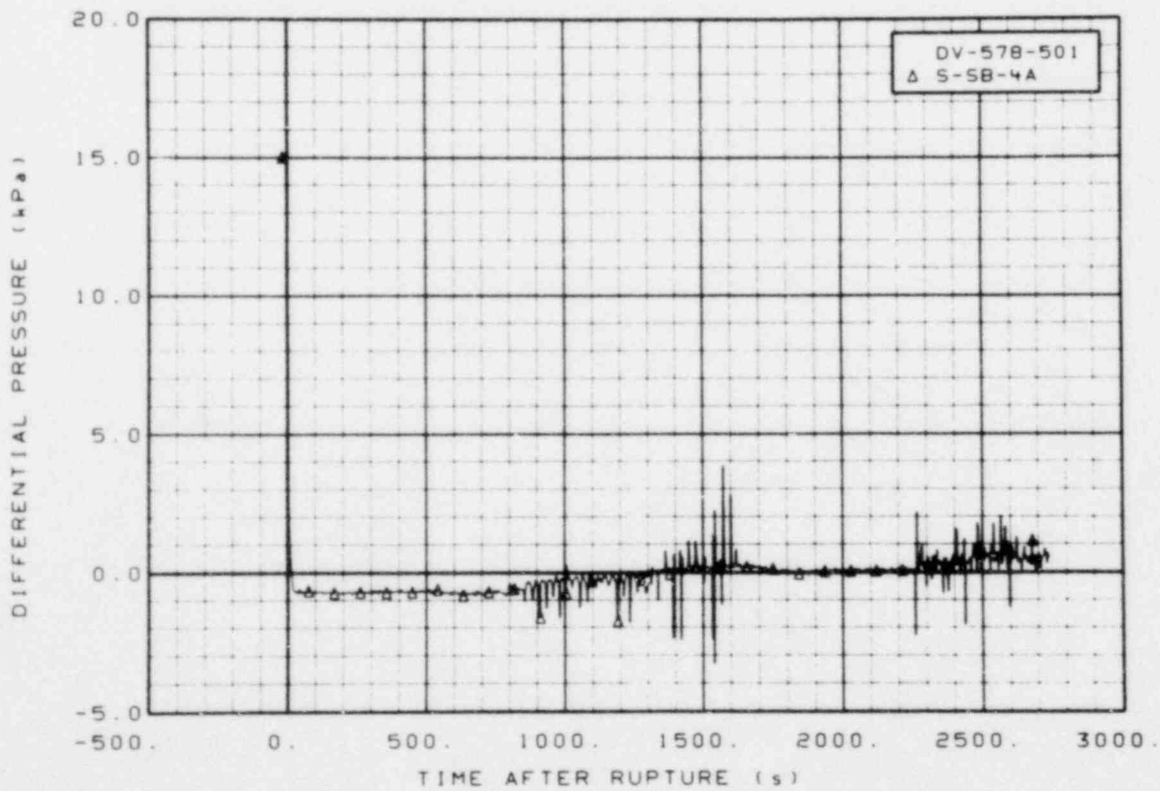


Figure 382. Differential pressure in downcomer, Test S-SB-4A (DV-578-501), from -20 to 2740 s.

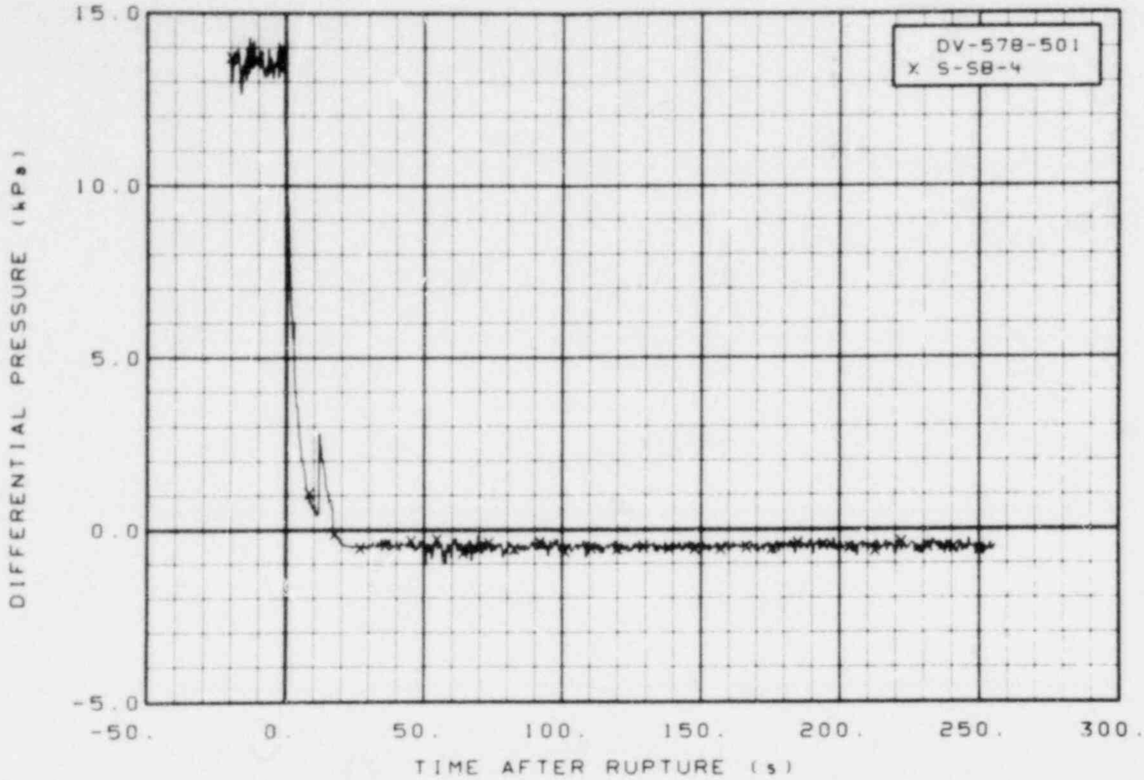


Figure 383. Differential pressure in downcomer, Test S-SB-4 (DV-578-501), from -20 to 256 s.

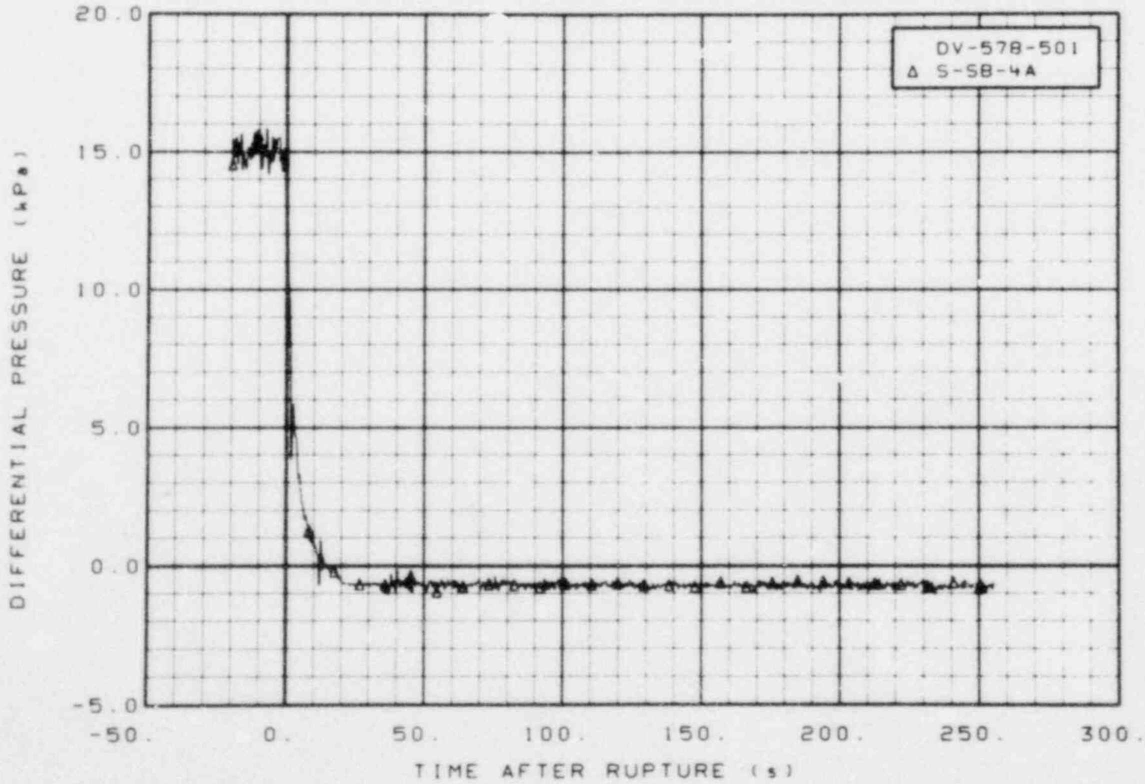


Figure 384. Differential pressure in downcomer, Test S-SB-4A (DV-578-501), from -20 to 256 s.

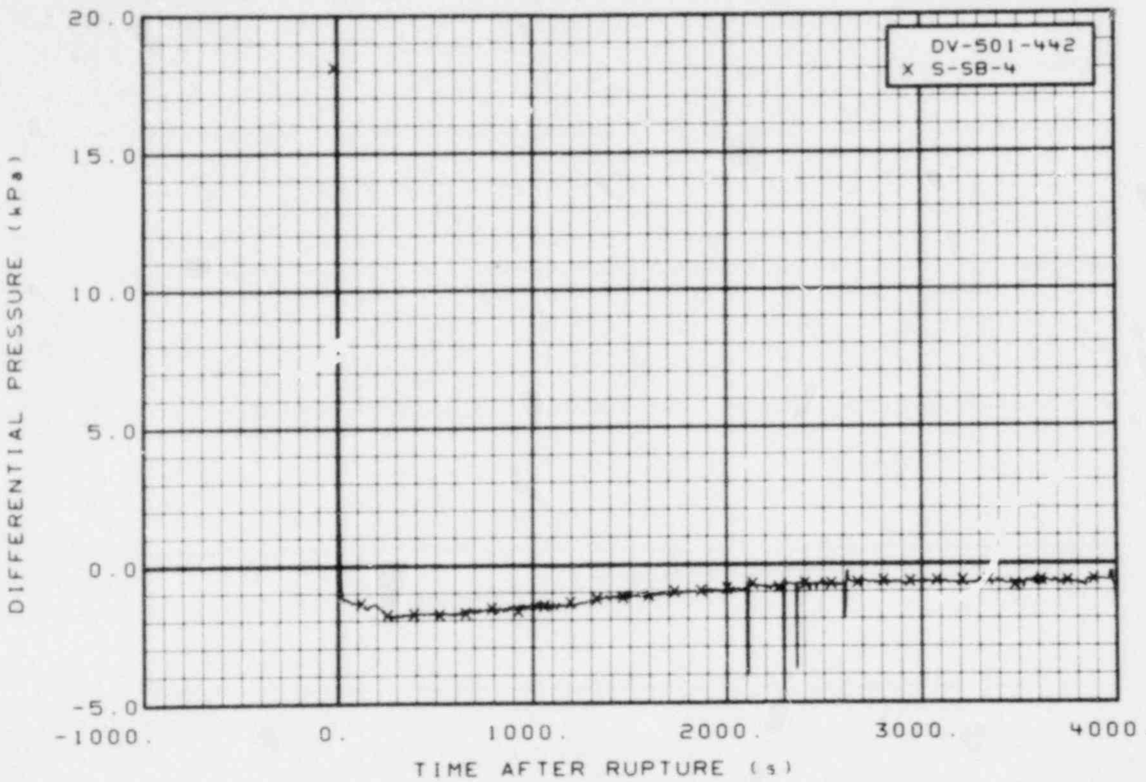


Figure 385. Differential pressure in vessel, Test S-SB-4 (DV-501-442), from -20 to 4000 s.

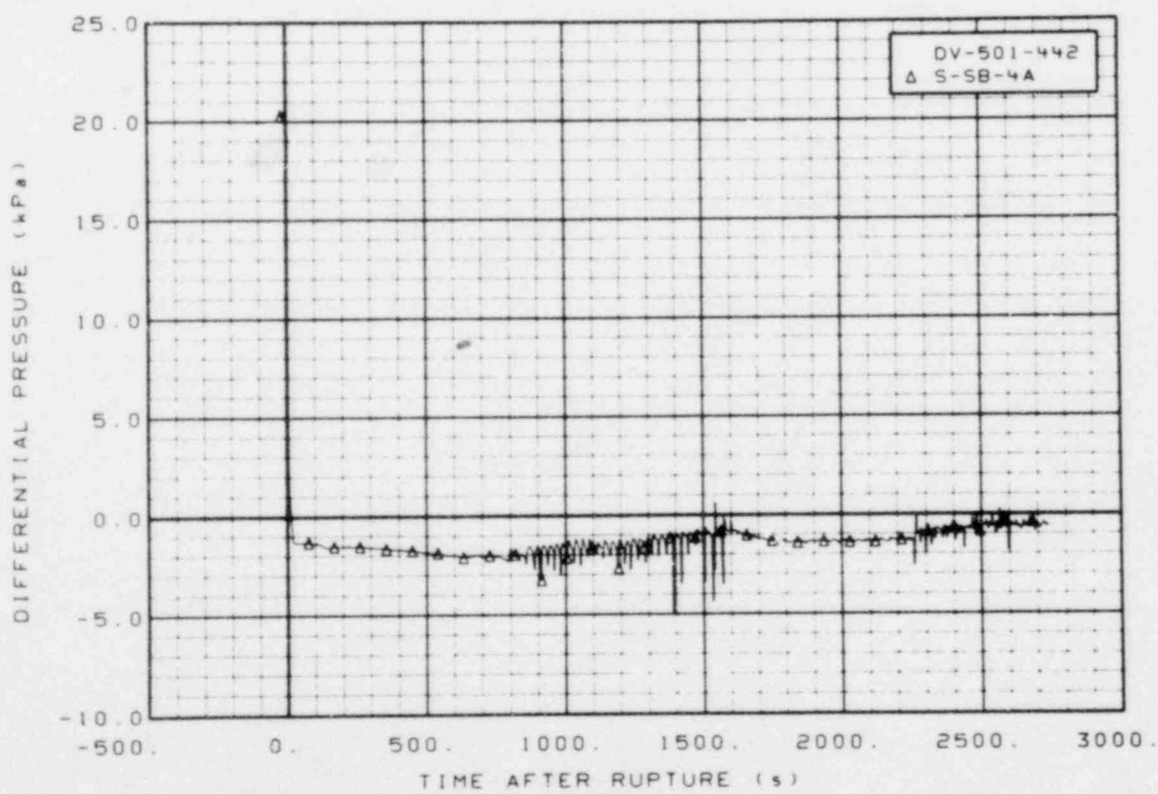


Figure 386. Differential pressure in vessel, Test S-SB-4A (DV-501-442), from -20 to 2740 s.

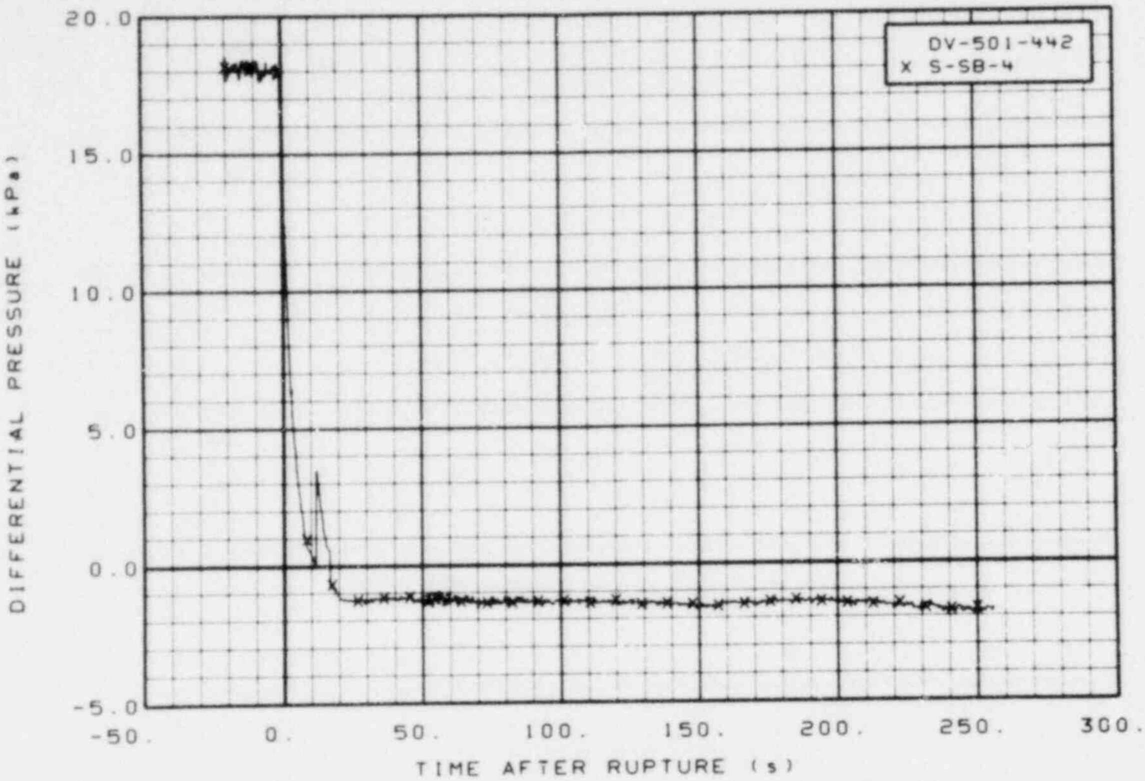


Figure 387. Differential pressure in vessel, Test S-SB-4 (DV-501-442), from -20 to 256 s.

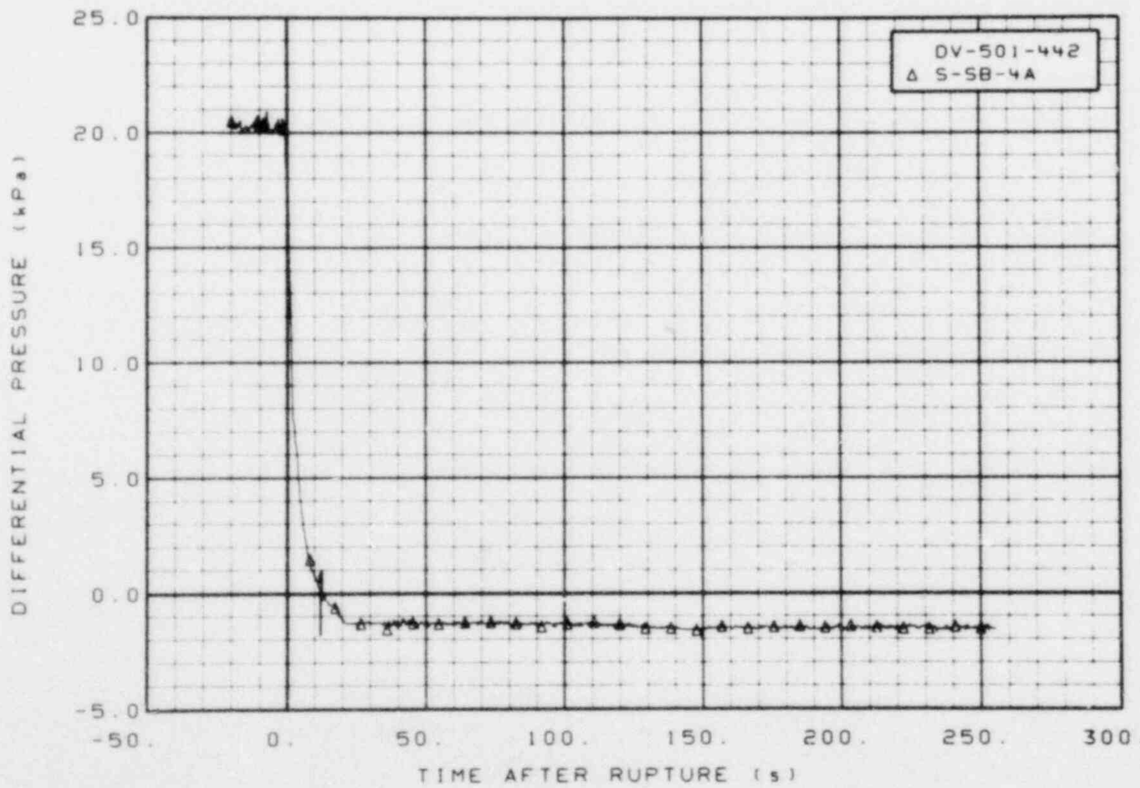


Figure 388. Differential pressure in vessel, Test S-SB-4A (DV-501-442), from -20 to 256 s.

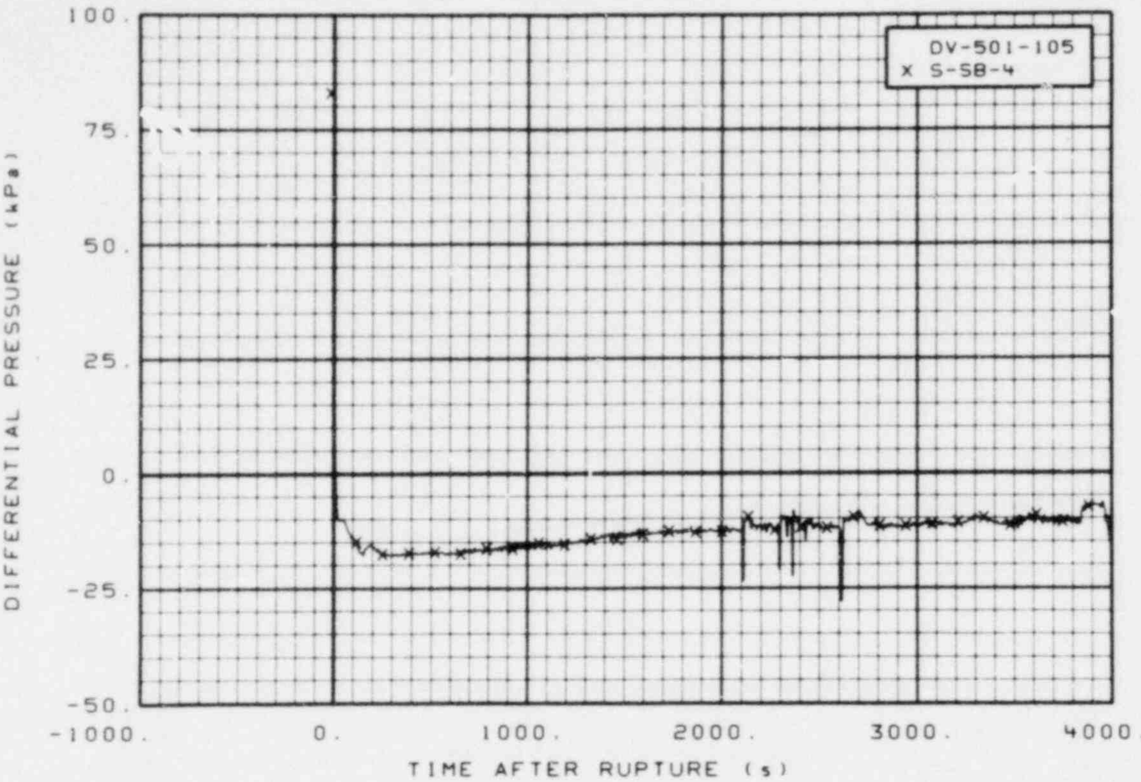


Figure 389. Differential pressure in vessel, Test S-SB-4 (DV-501-105), from -20 to 4000 s.

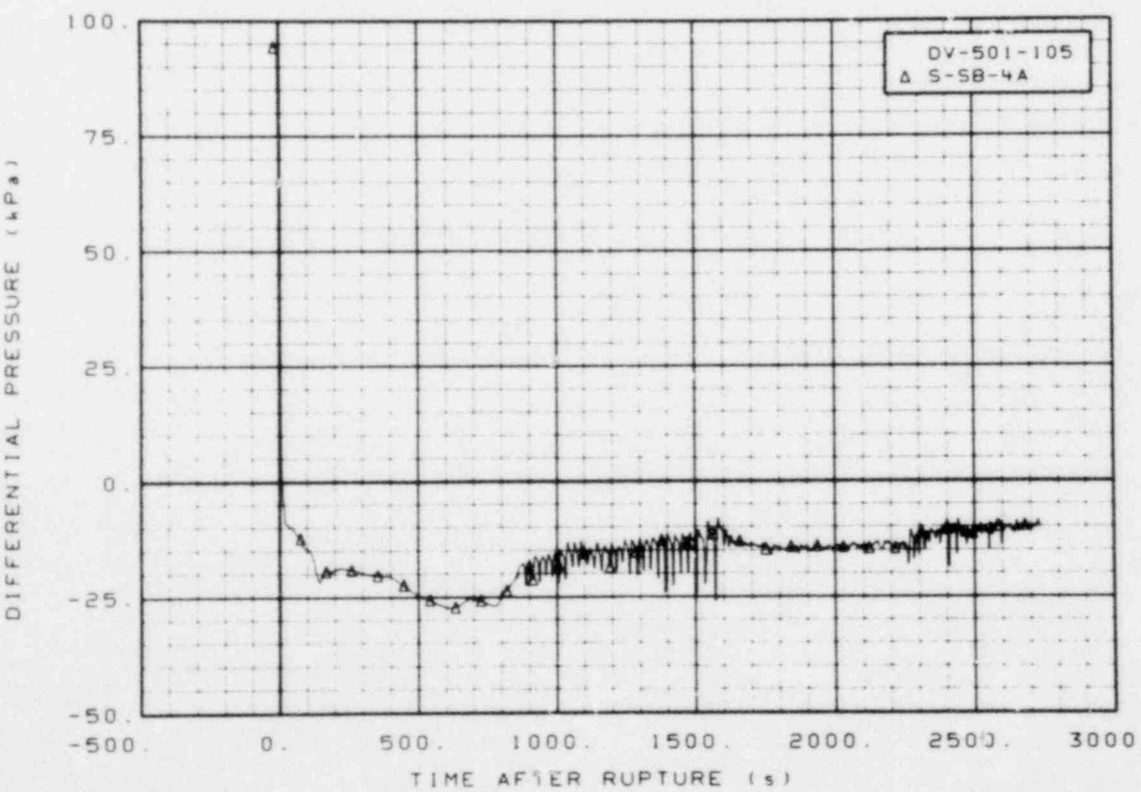


Figure 390. Differential pressure in vessel, Test S-SB-4A (DV-501-105), from -20 to 2740 s.

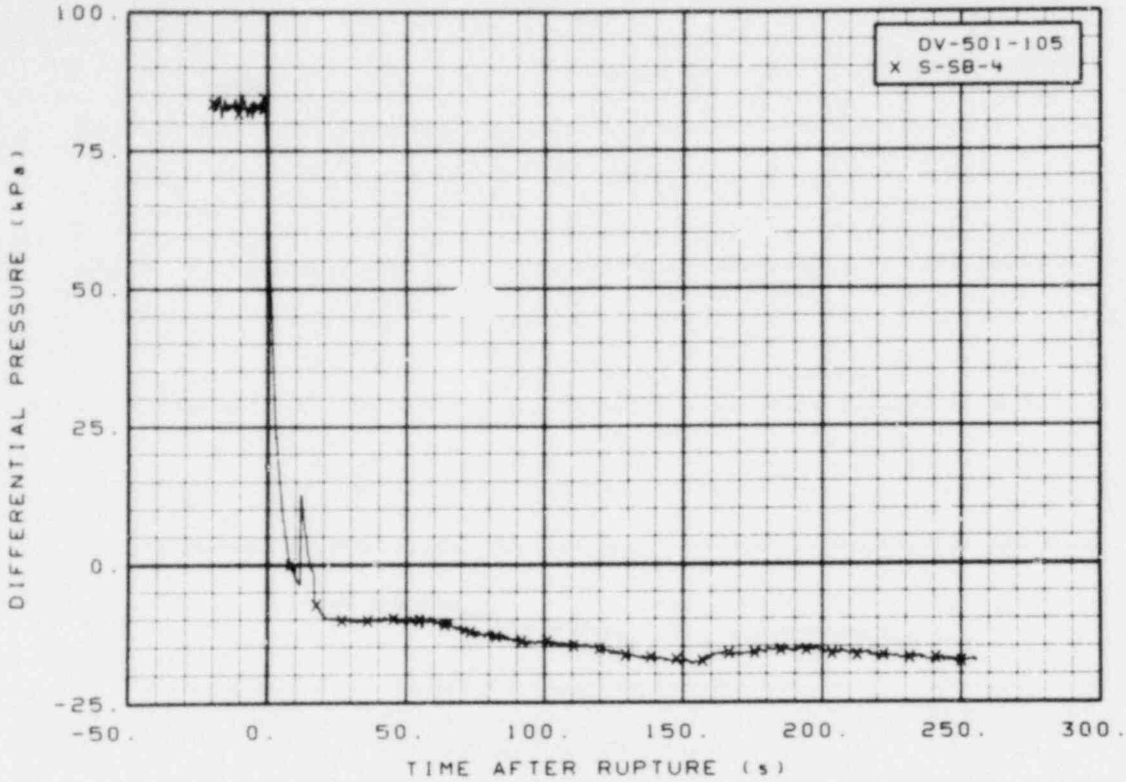


Figure 391. Differential pressure in vessel, Test S-SB-4 (DV-501-105), from -20 to 256 s.

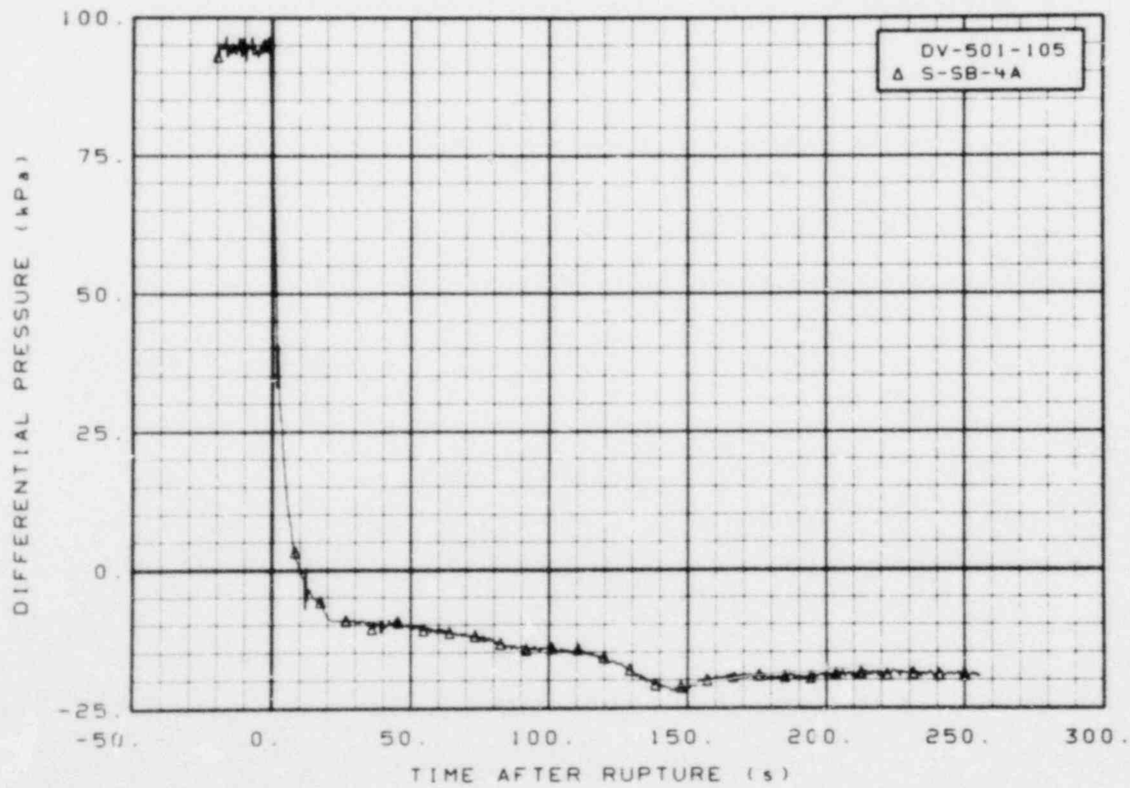


Figure 392. Differential pressure in vessel, Test S-SB-4A (DV-501-105), from -20 to 256 s.

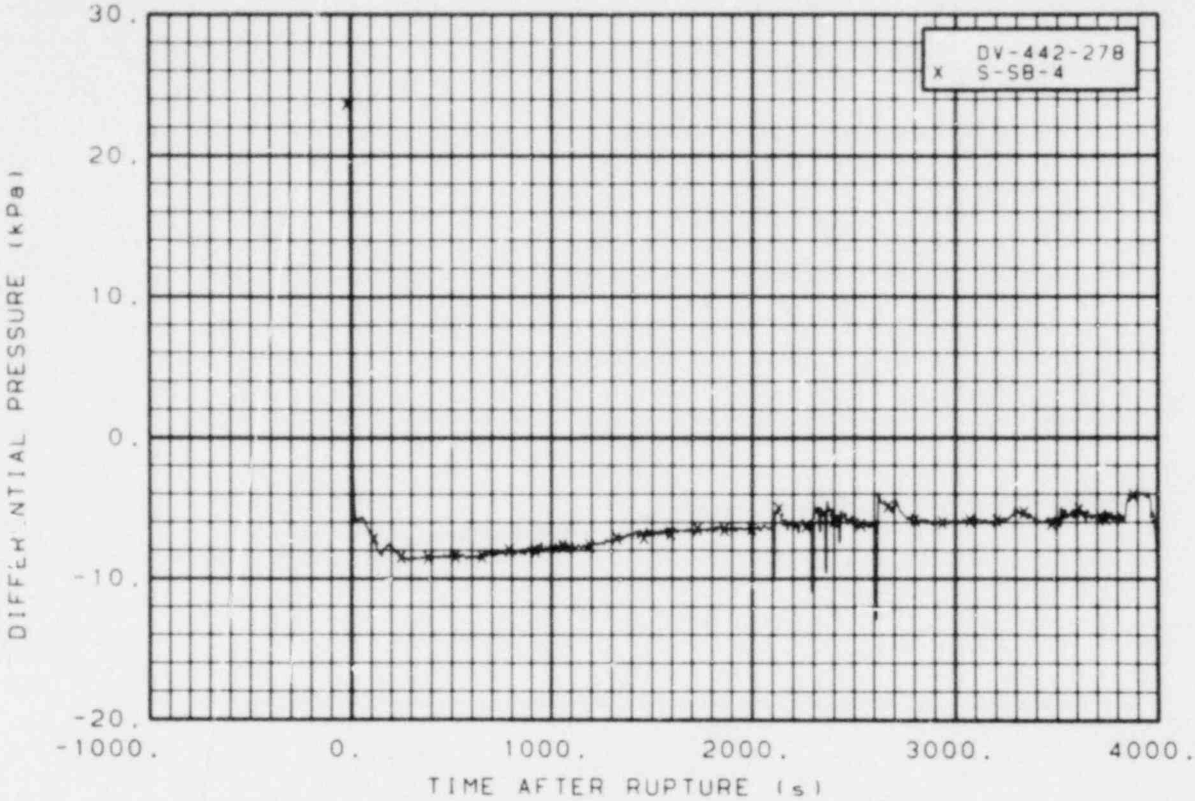


Figure 393. Differential pressure in vessel, Test S-SB-4 (DV-442-278), from -20 to 4000 s.

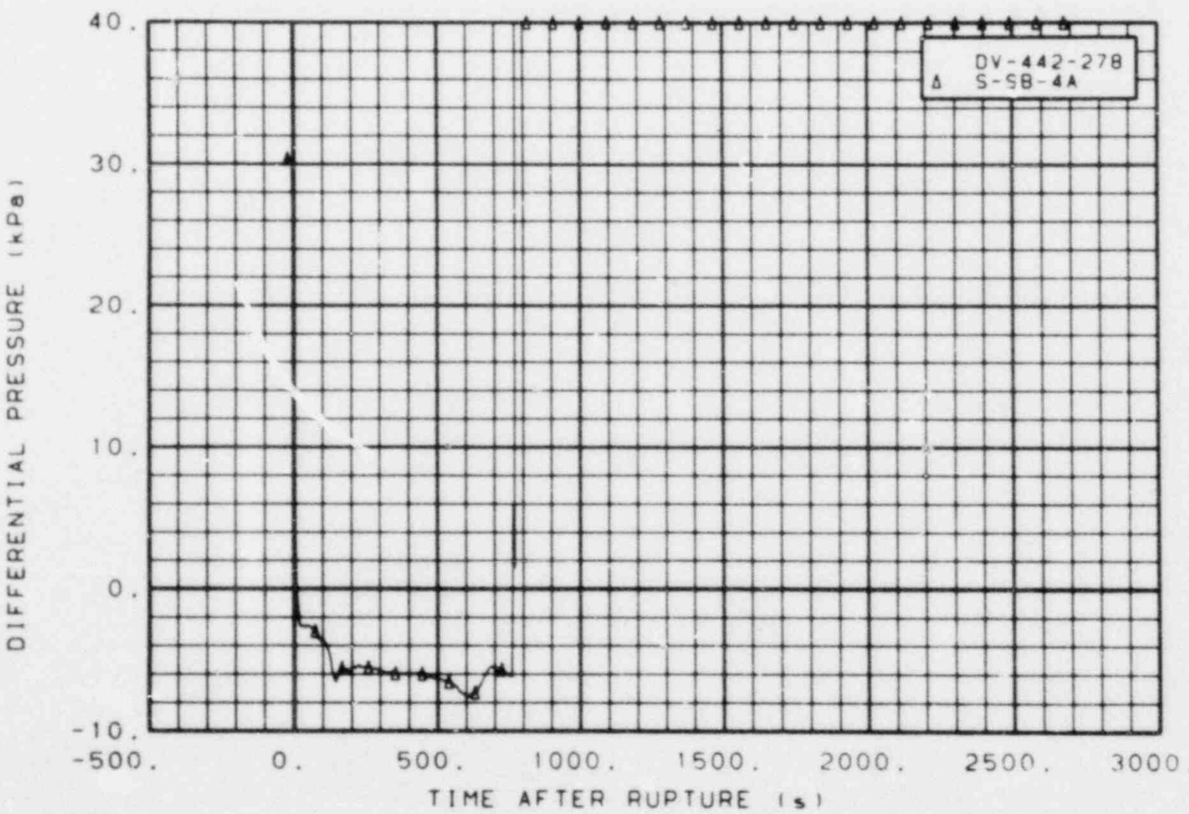


Figure 394. Differential pressure in vessel, Test S-SB-4A (DV-442-278), from -20 to 2740 s.

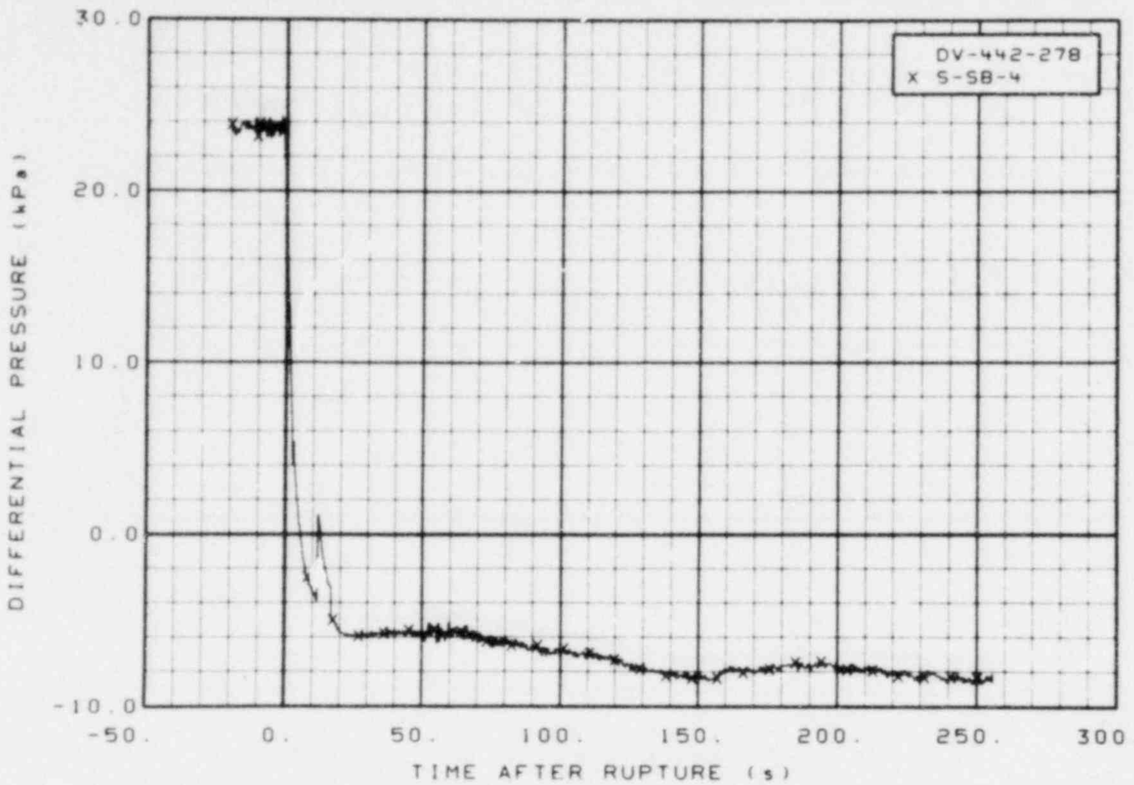
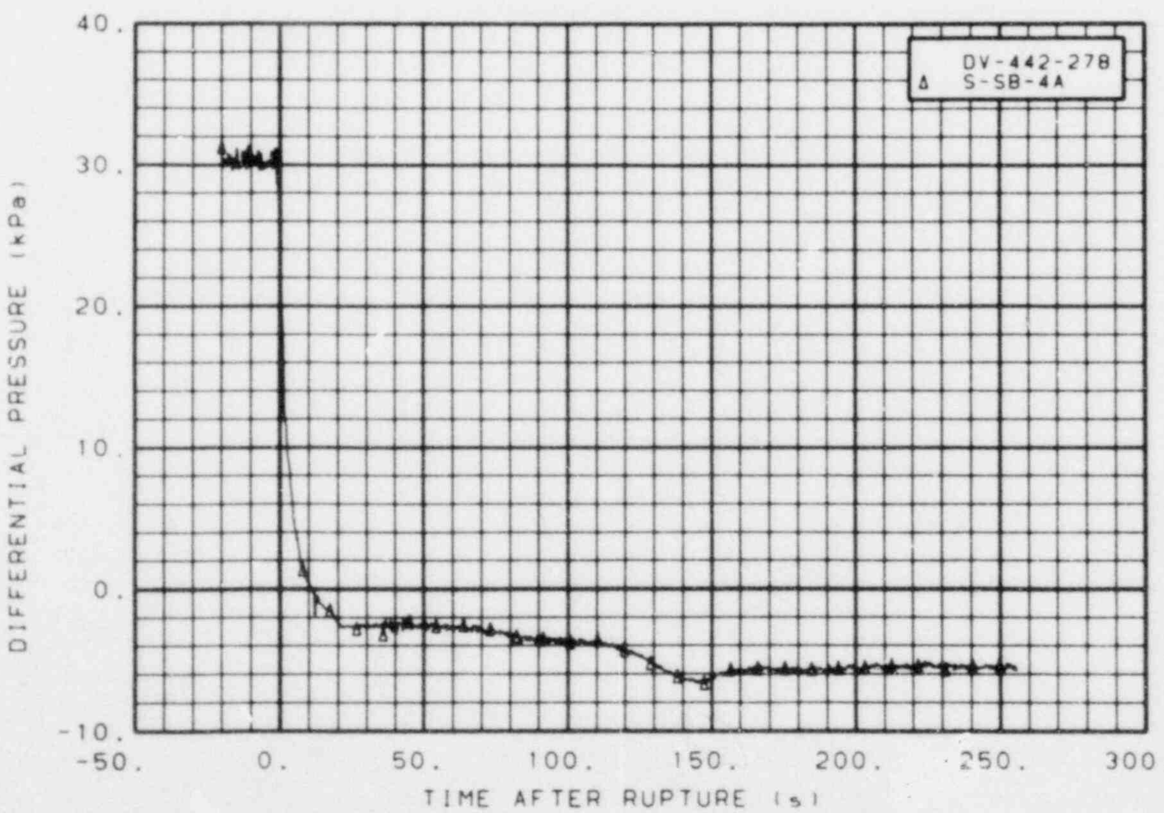


Figure 395. Differential pressure in vessel, Test S-SB-4 (DV-442-278), from -20 to 256 s.



Figu 396. Differential pressure in vessel, Test S-SB-4A (DV-442-278), from -20 to 256 s.

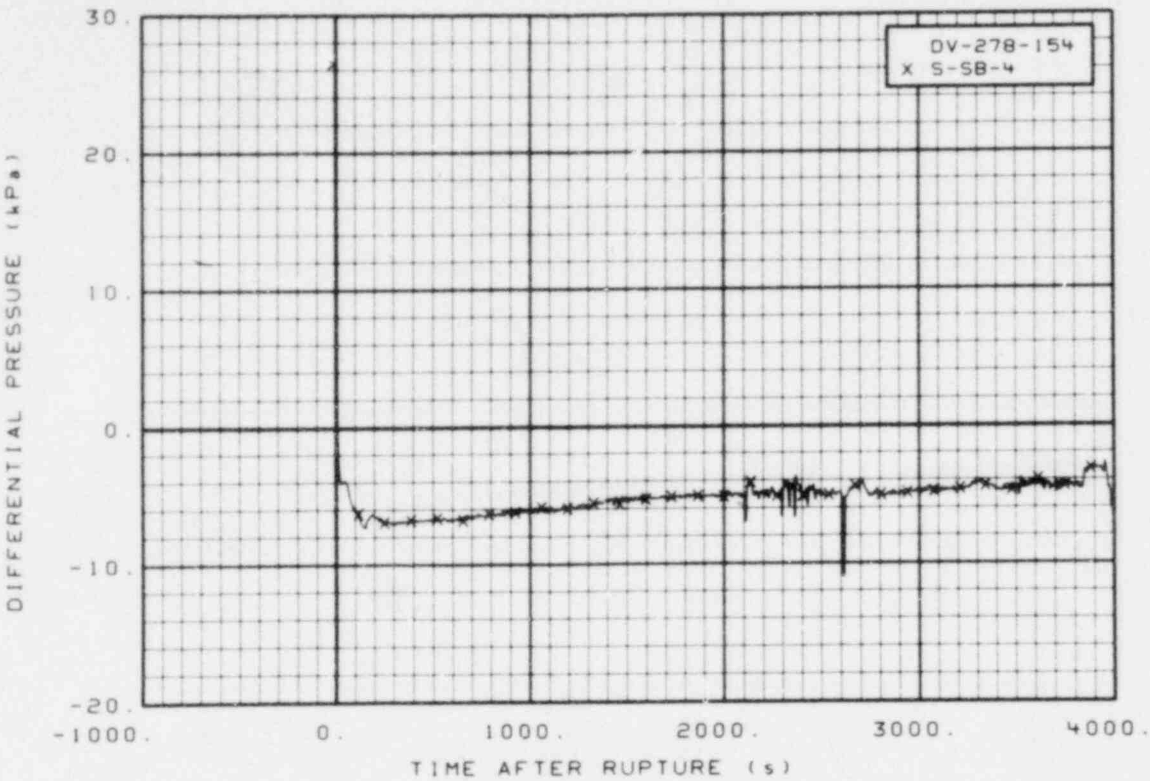


Figure 397. Differential pressure in vessel, Test S-SB-4 (DV-278-154), from -20 to 4000 s.

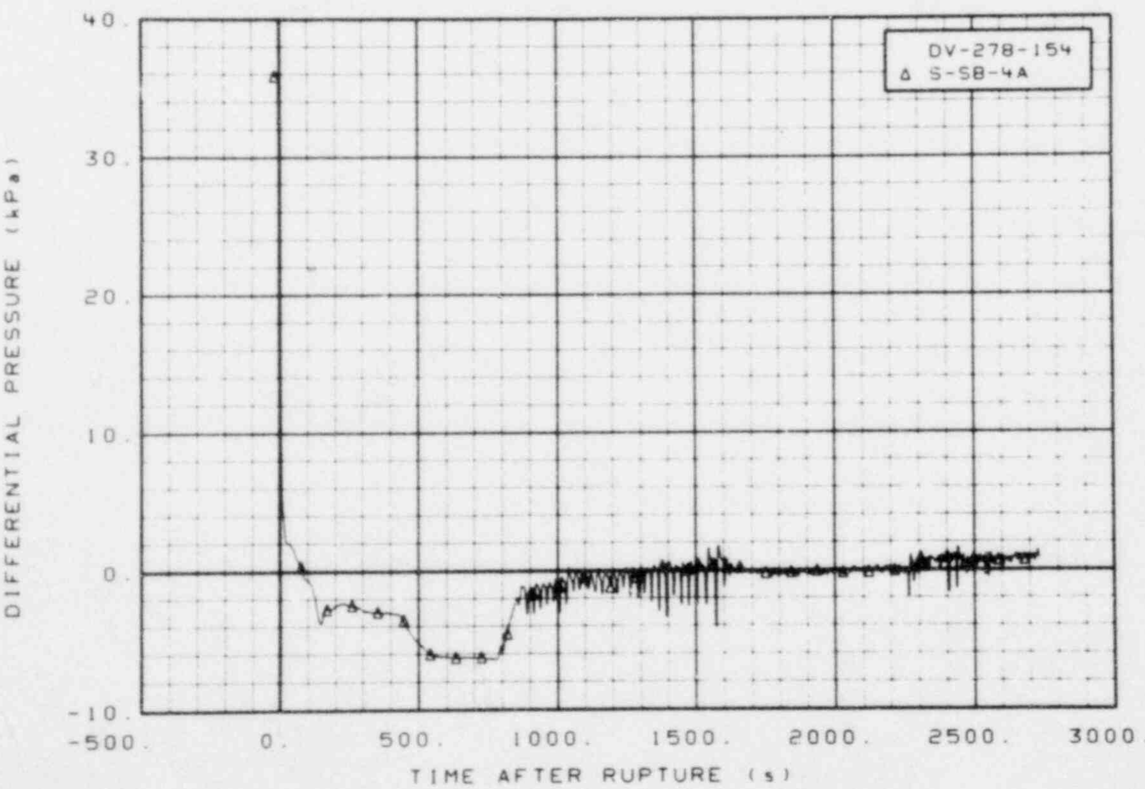


Figure 398. Differential pressure in vessel, Test S-SB-4A (DV-278-154), from -20 to 2740 s.

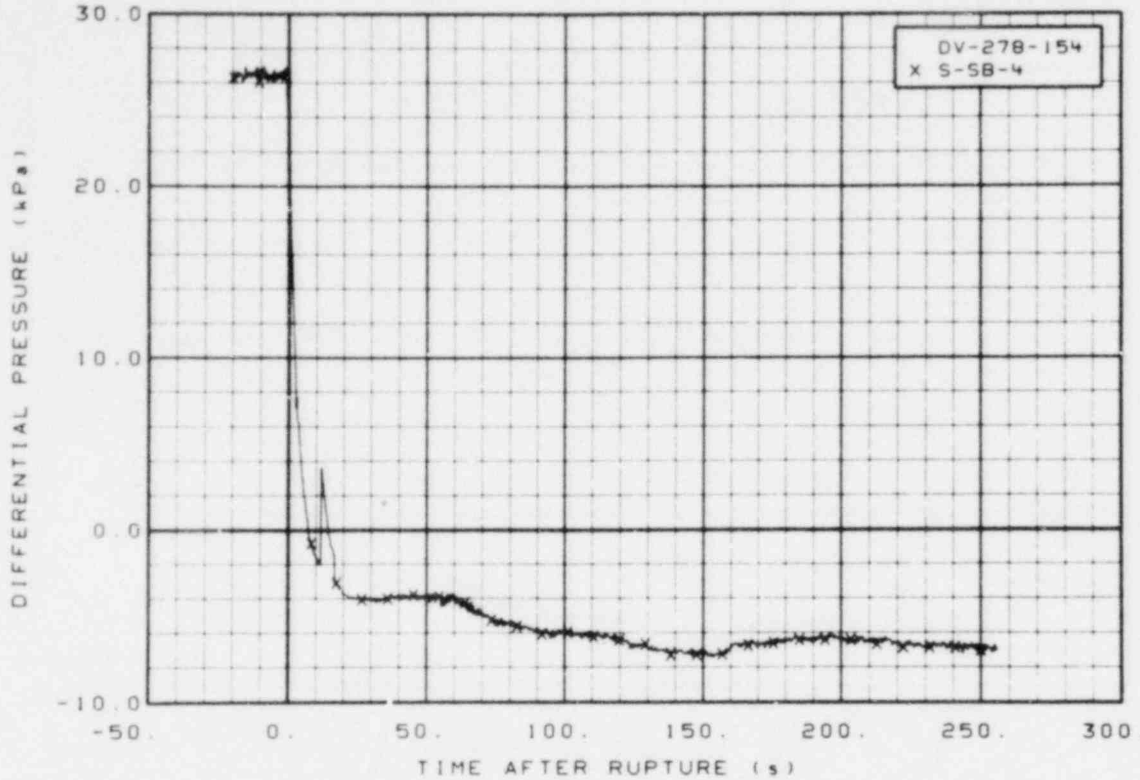


Figure 399. Differential pressure in vessel, Test S-SB-4 (DV-278-154), from -20 to 256 s.

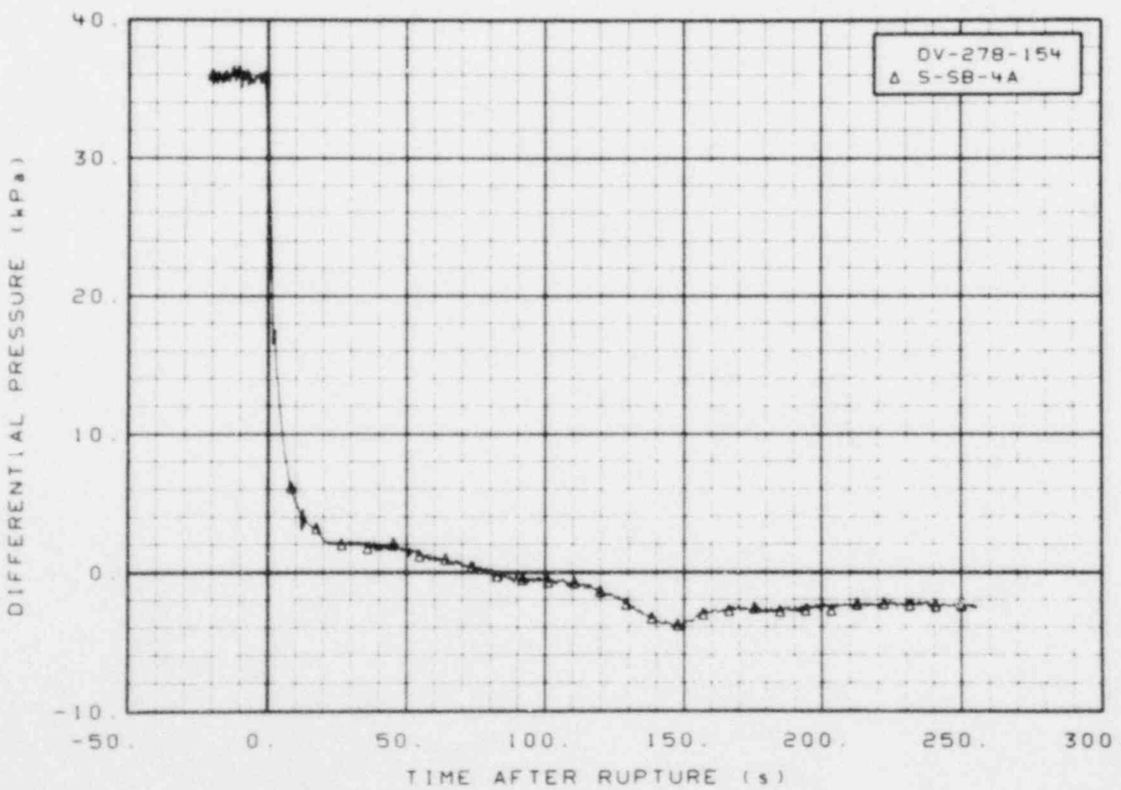


Figure 400. Differential pressure in vessel, Test S-SB-4A (DV-278-154), from -20 to 256 s.

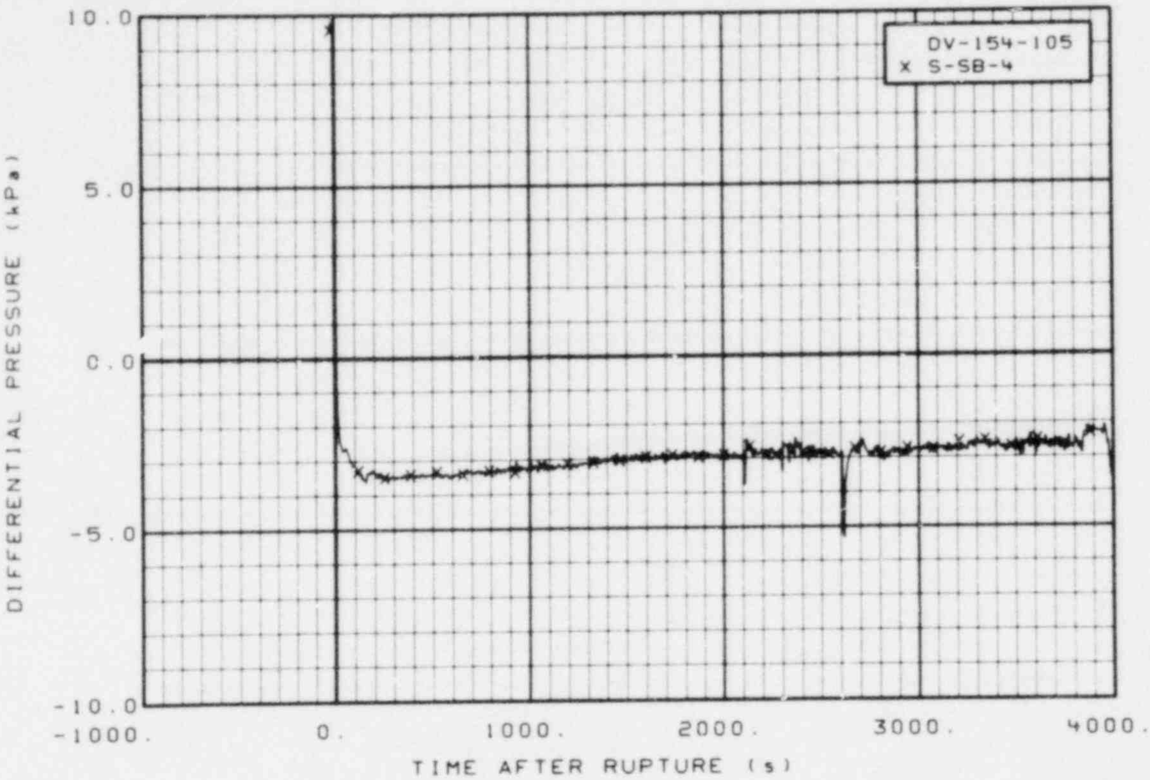


Figure 401. Differential pressure in vessel, Test S-SB-4 (DV-154-105), from -20 to 4000 s.

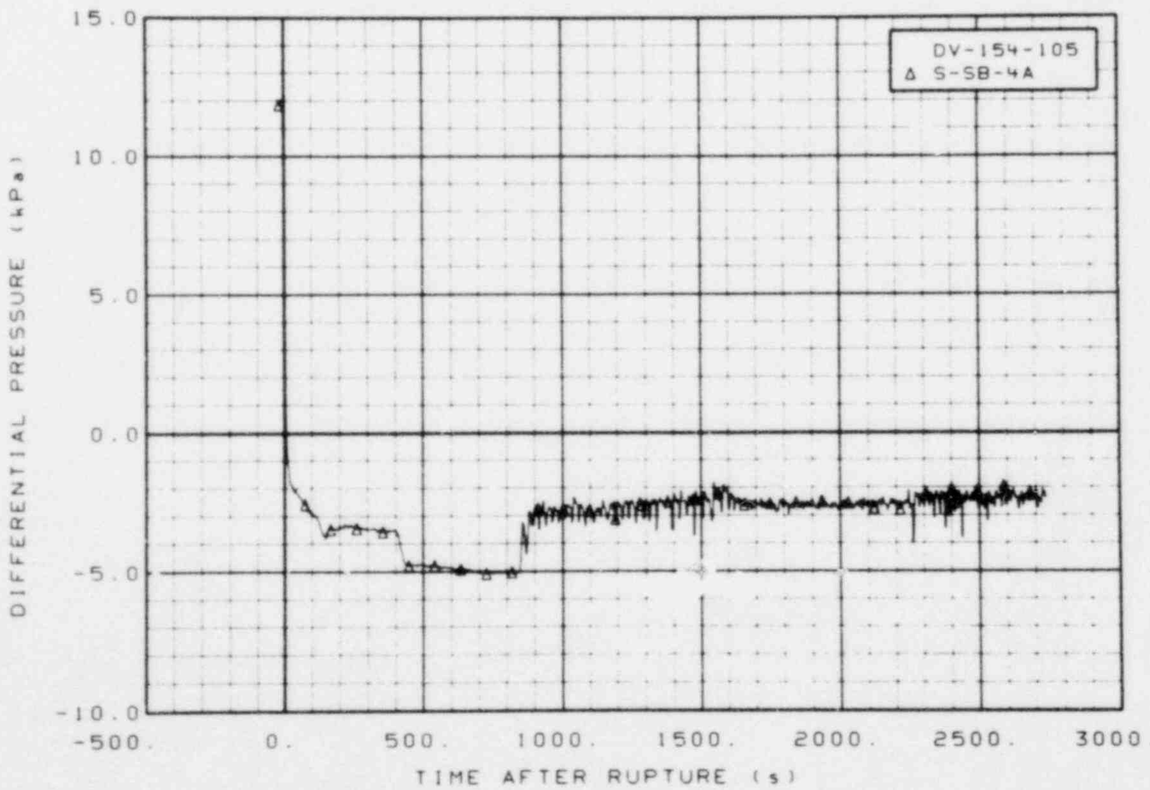


Figure 402. Differential pressure in vessel, Test S-SB-4A (DV-154-105), from -20 to 2740 s.

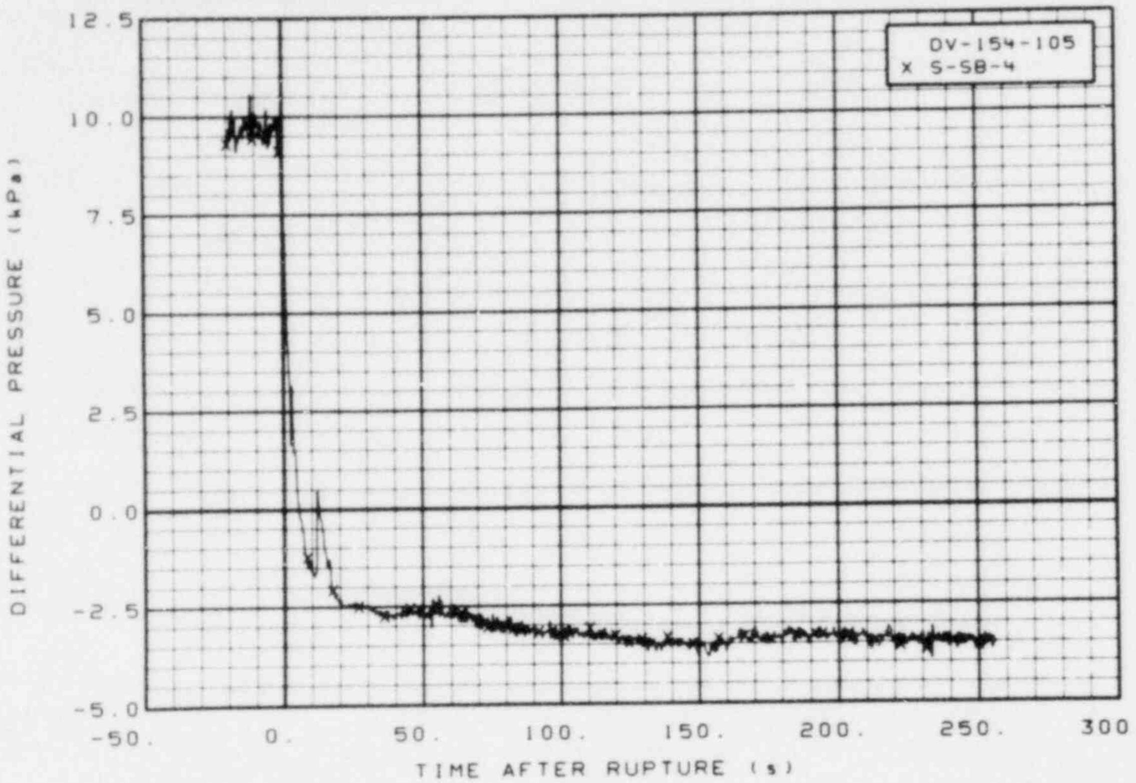


Figure 403. Differential pressure in vessel, Test S-SB-4 (DV-154-105), from -20 to 256 s.

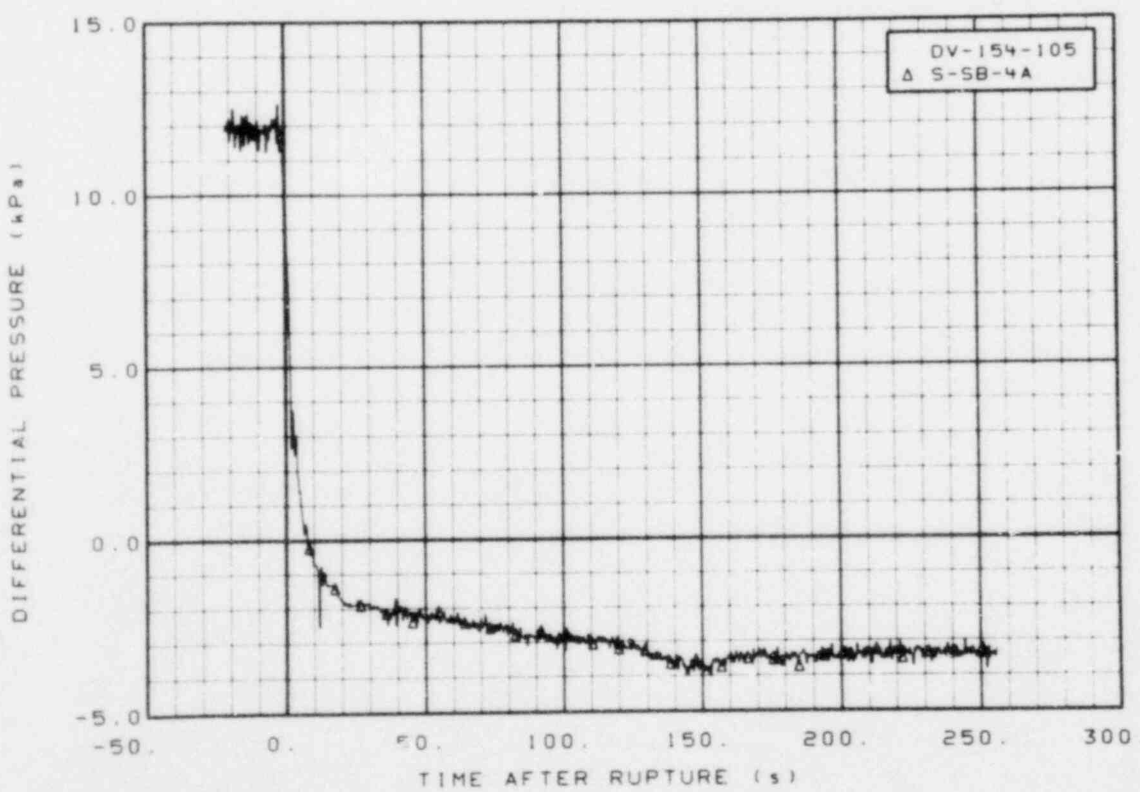


Figure 404. Differential pressure in vessel, Test S-SB-4A (DV-154-105), from -20 to 256 s.

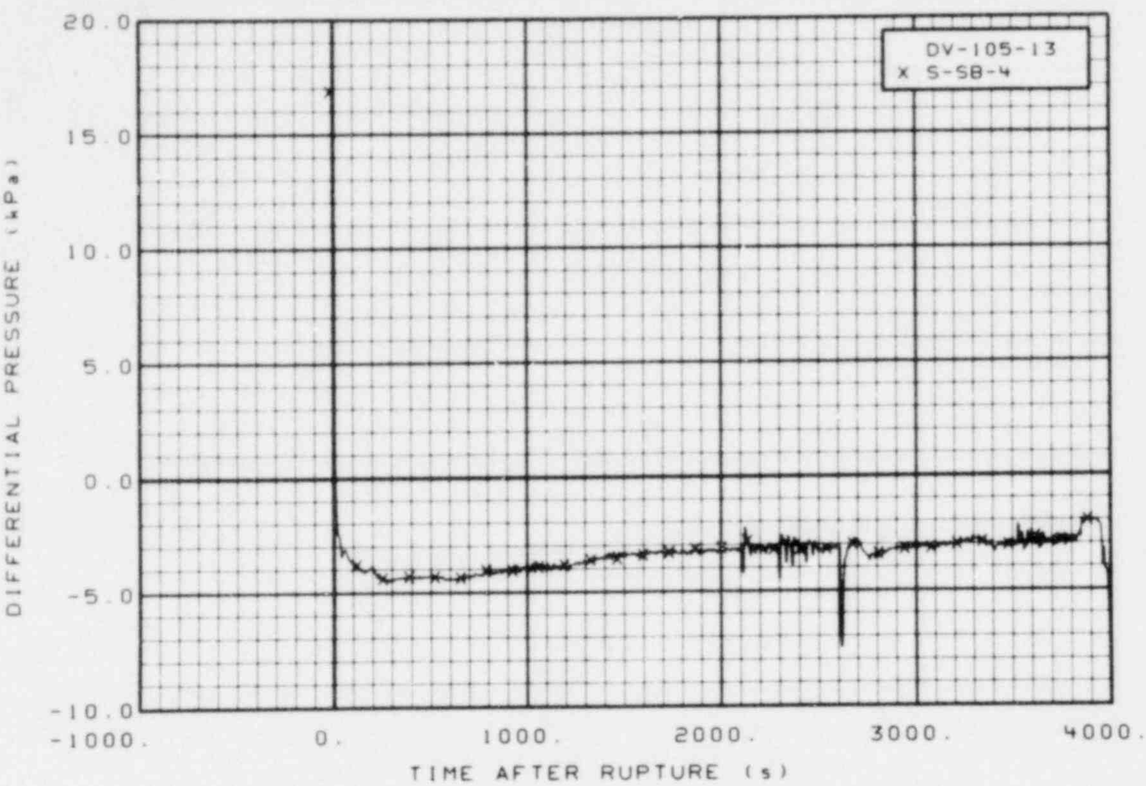


Figure 405. Differential pressure in vessel, Test S-SB-4 (DV-105-13), from -20 to 4000 s.

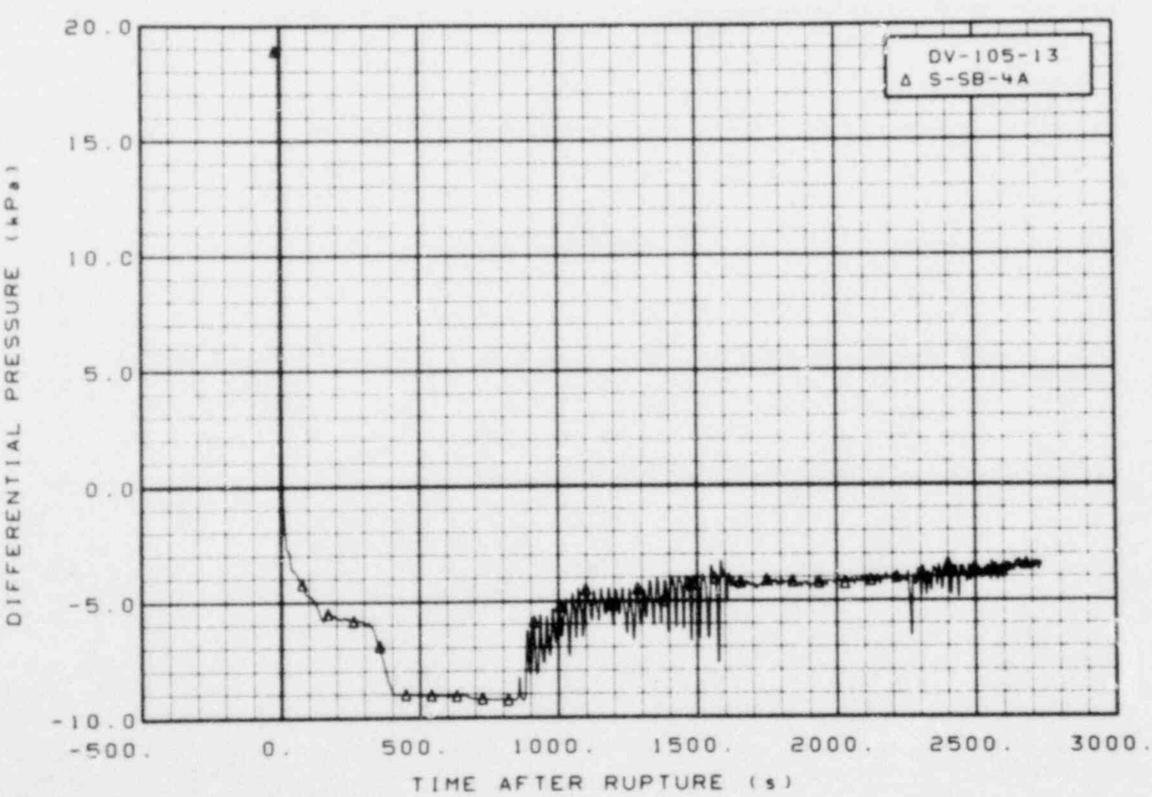


Figure 406. Differential pressure in vessel, Test S-SB-4A (DV-105-13), from -20 to 2740 s.

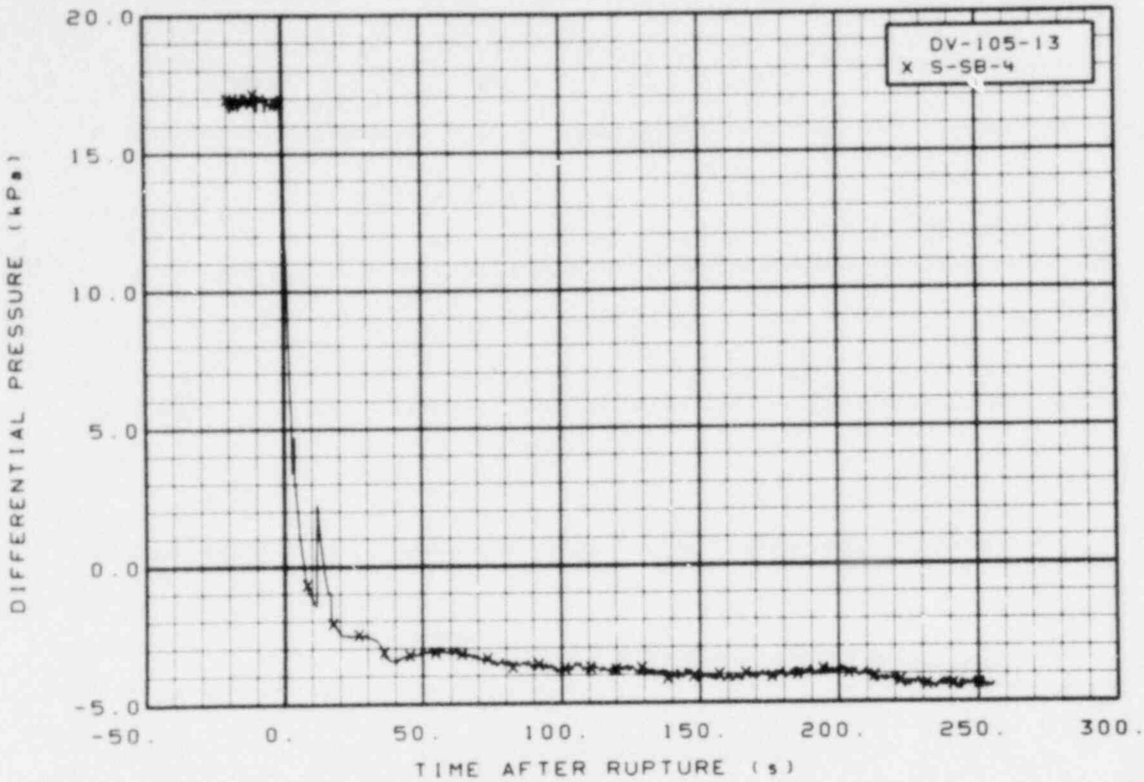


Figure 407. Differential pressure in vessel, Test S-SB-4 (DV-105-13), from -20 to 256 s.

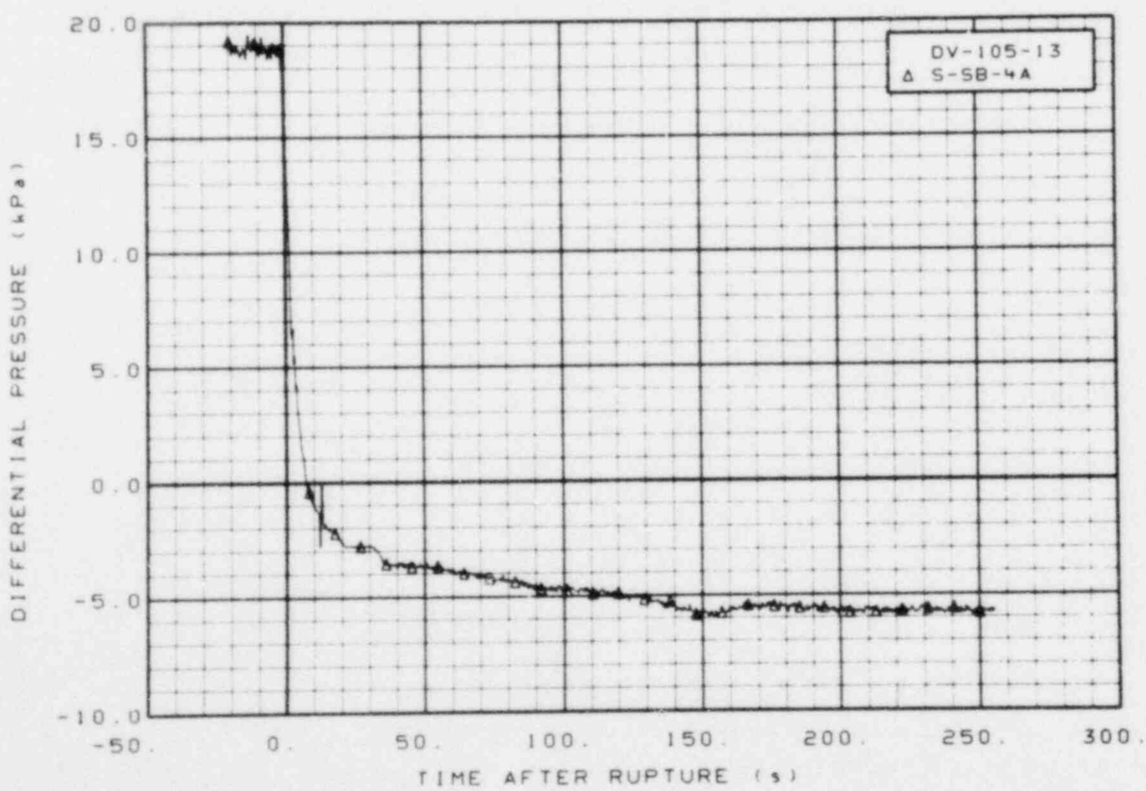


Figure 408. Differential pressure in vessel, Test S-SB-4A (DV-105-13), from -20 to 256 s.

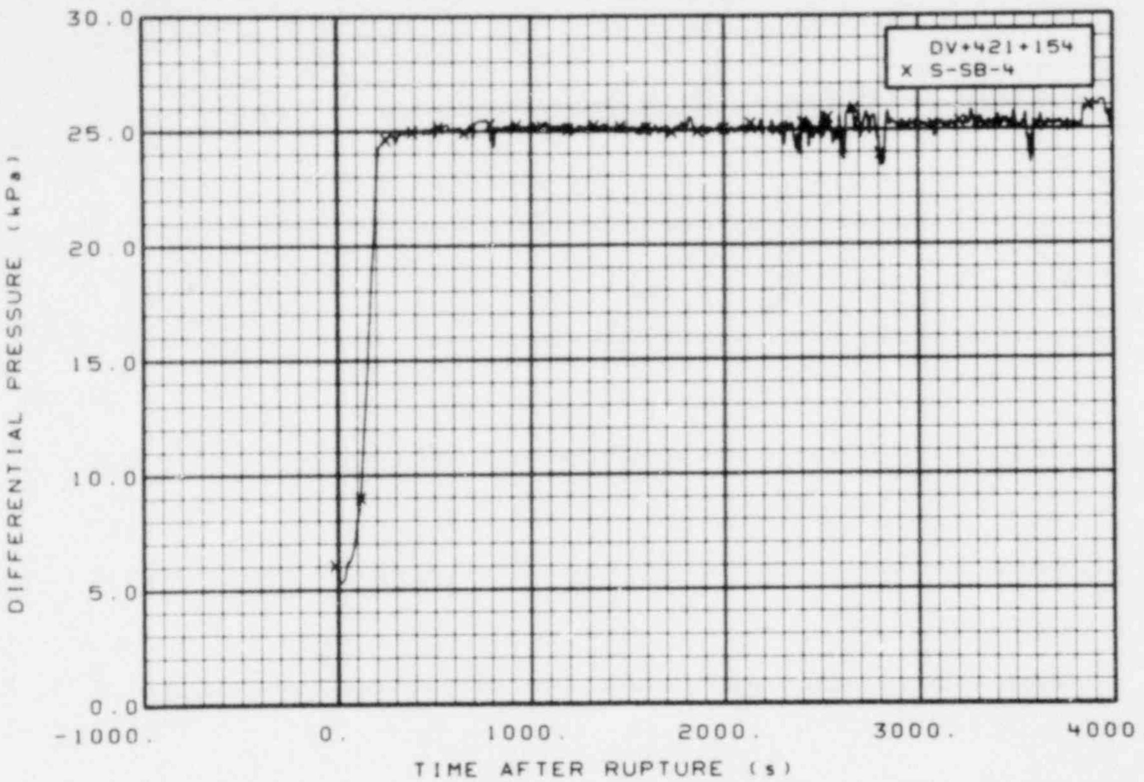


Figure 409. Differential pressure in vessel, Test S-SB-4 (DV + 421 + 154), from -20 to 4000 s.

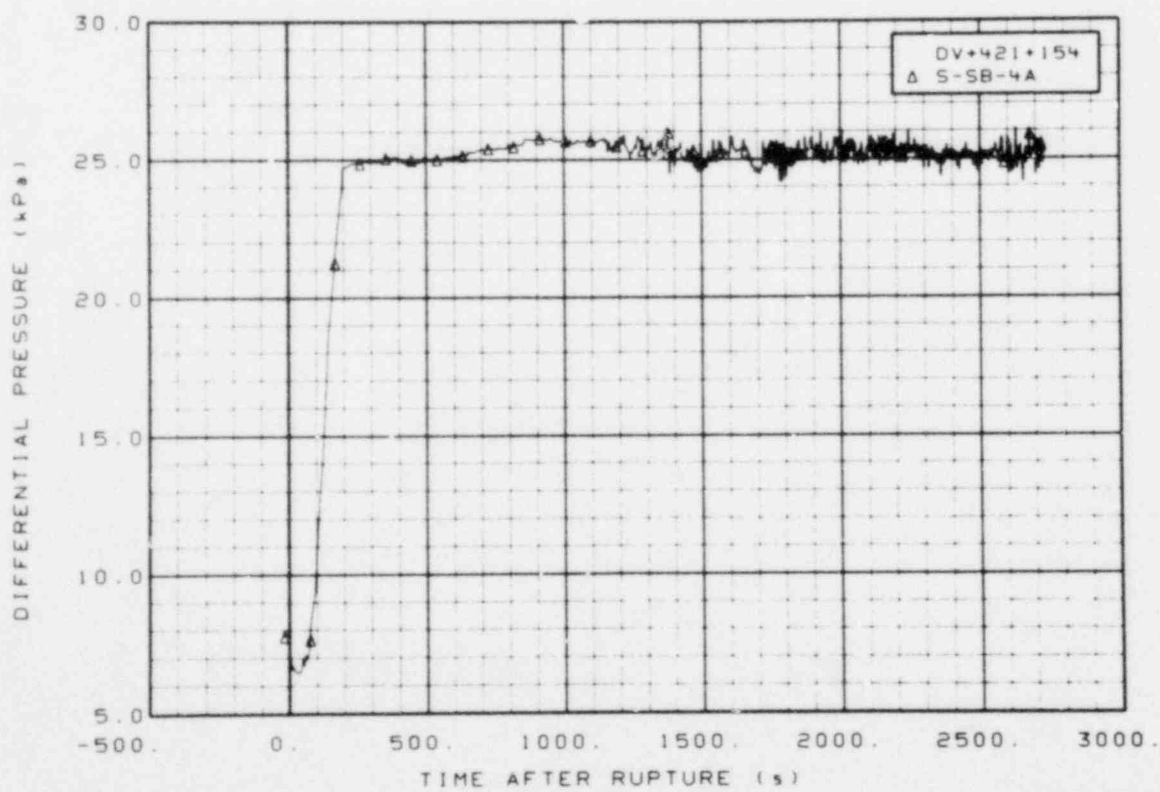


Figure 410. Differential pressure in vessel, Test S-SB-4A (DV + 421 + 154), from -20 to 2740 s.

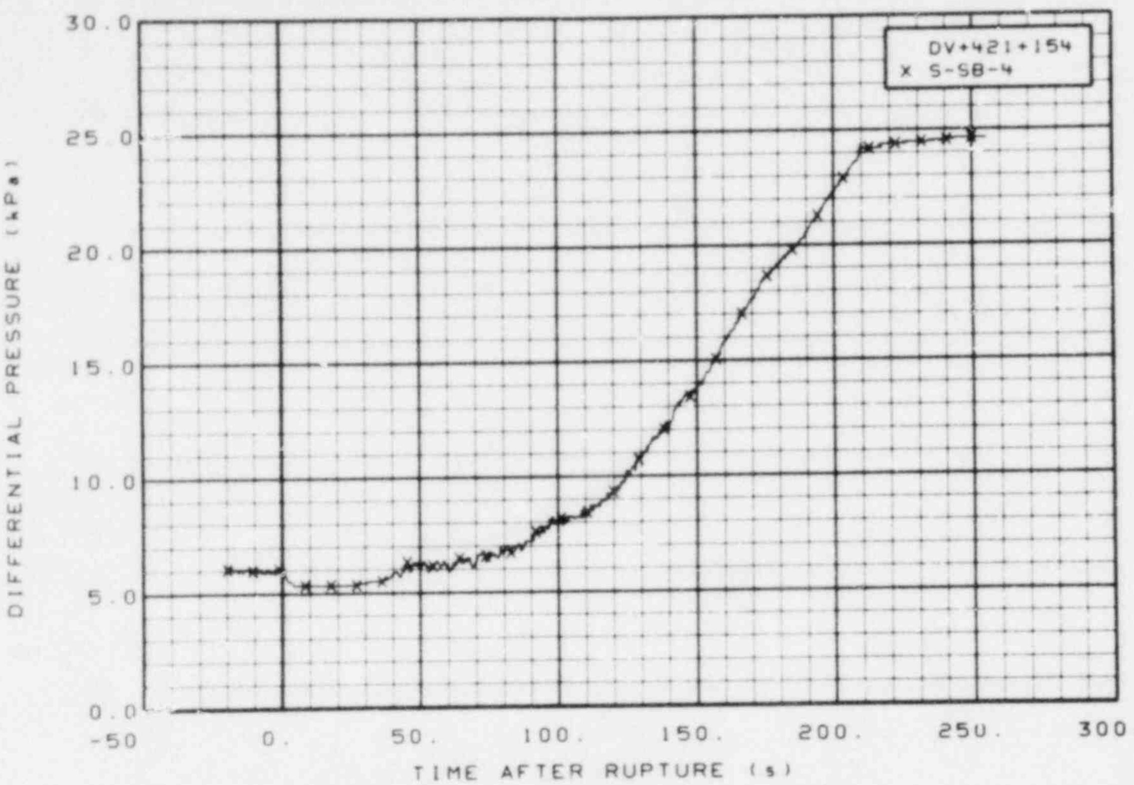


Figure 411. **Differential pressure in vessel, Test S-SB-4 (DV + 421 + 154), from -20 to 256 s.**

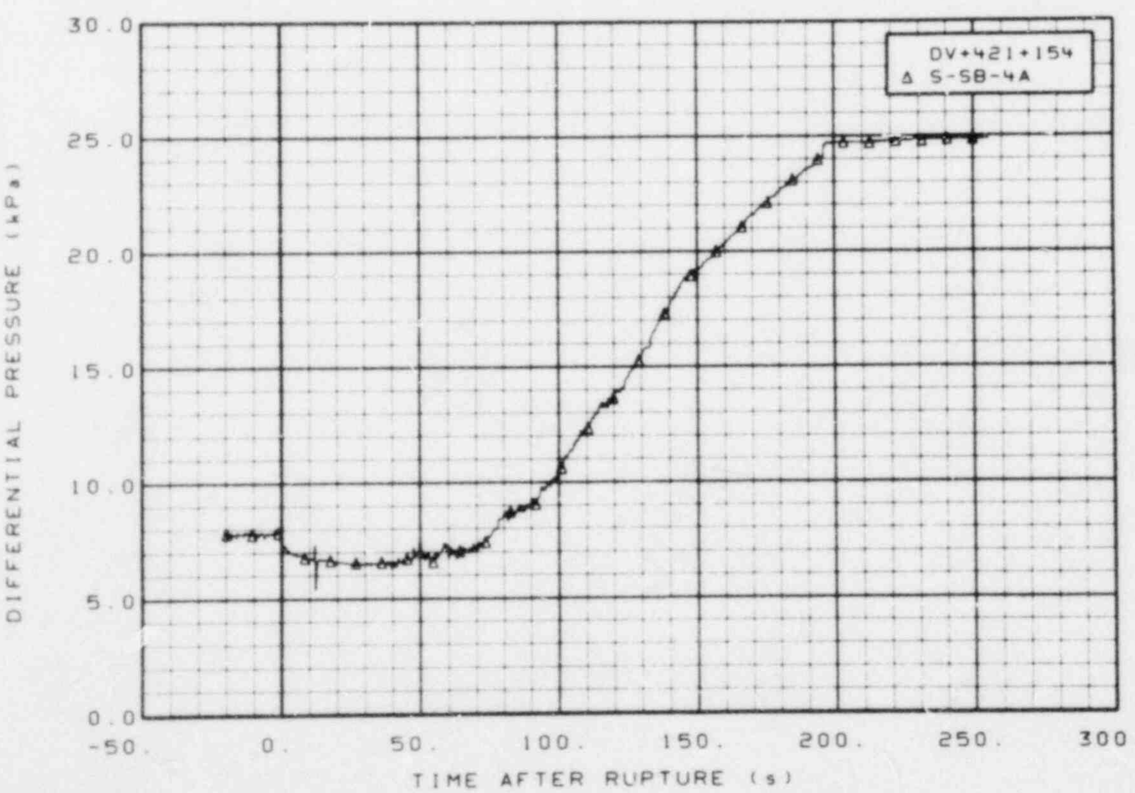


Figure 412. **Differential pressure in vessel, Test S-SB-4A (DV + 421 + 154), from -20 to 256 s.**

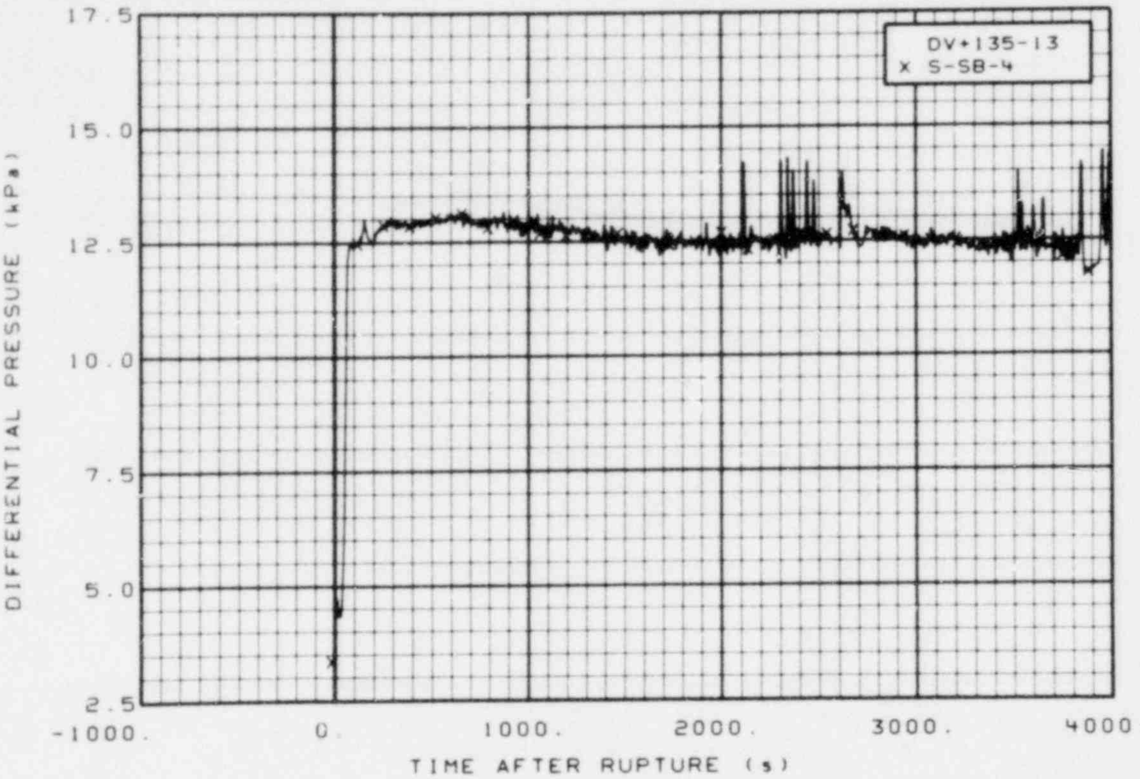


Figure 413. Differential pressure in vessel, Test S-SB-4 (DV + 135-13), from -20 to 4000 s.

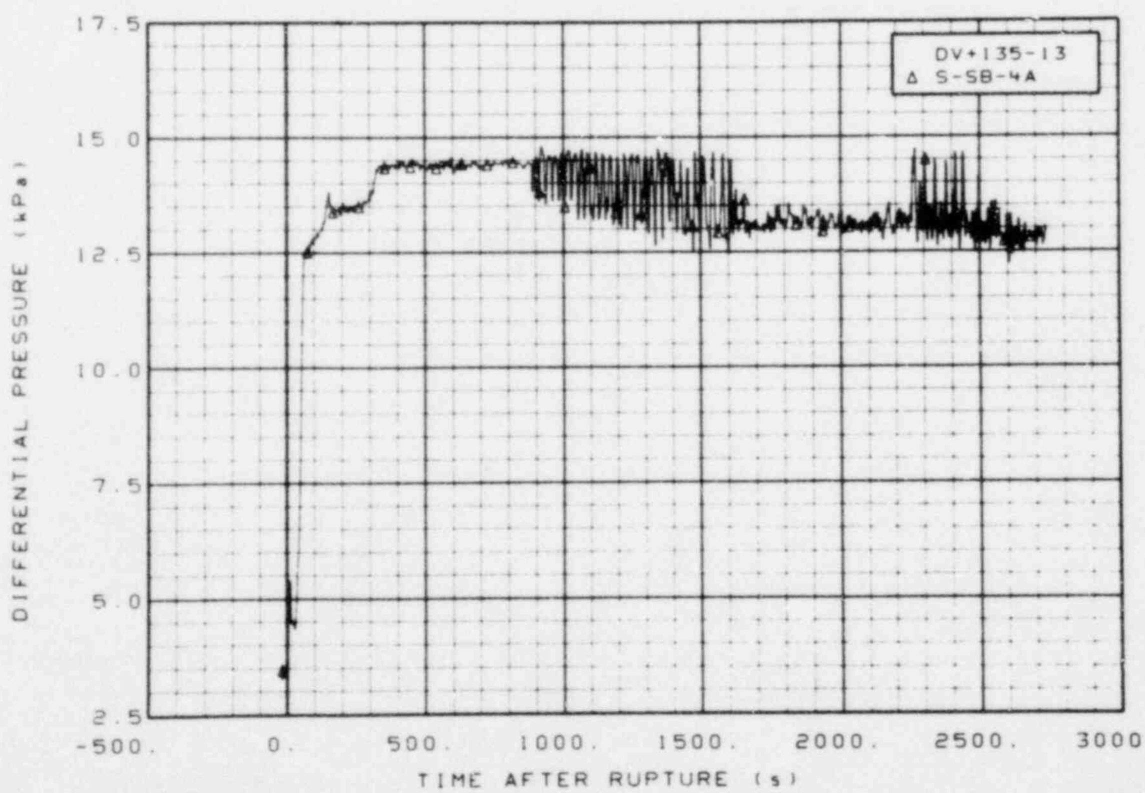


Figure 414. Differential pressure in vessel, Test S-SB-4A (DV + 135-13), from -20 to 2740 s.

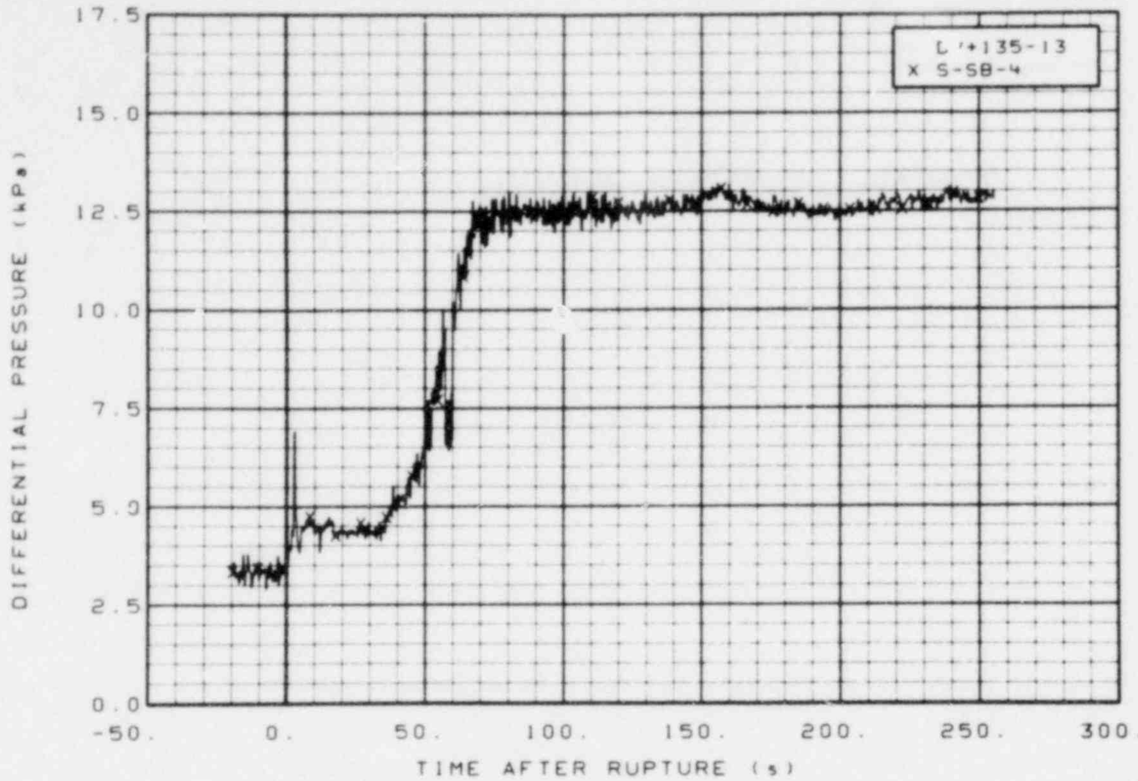


Figure 415. Differential pressure in vessel, Test S-SB-4 (DV + 135-13), from -20 to 256 s.

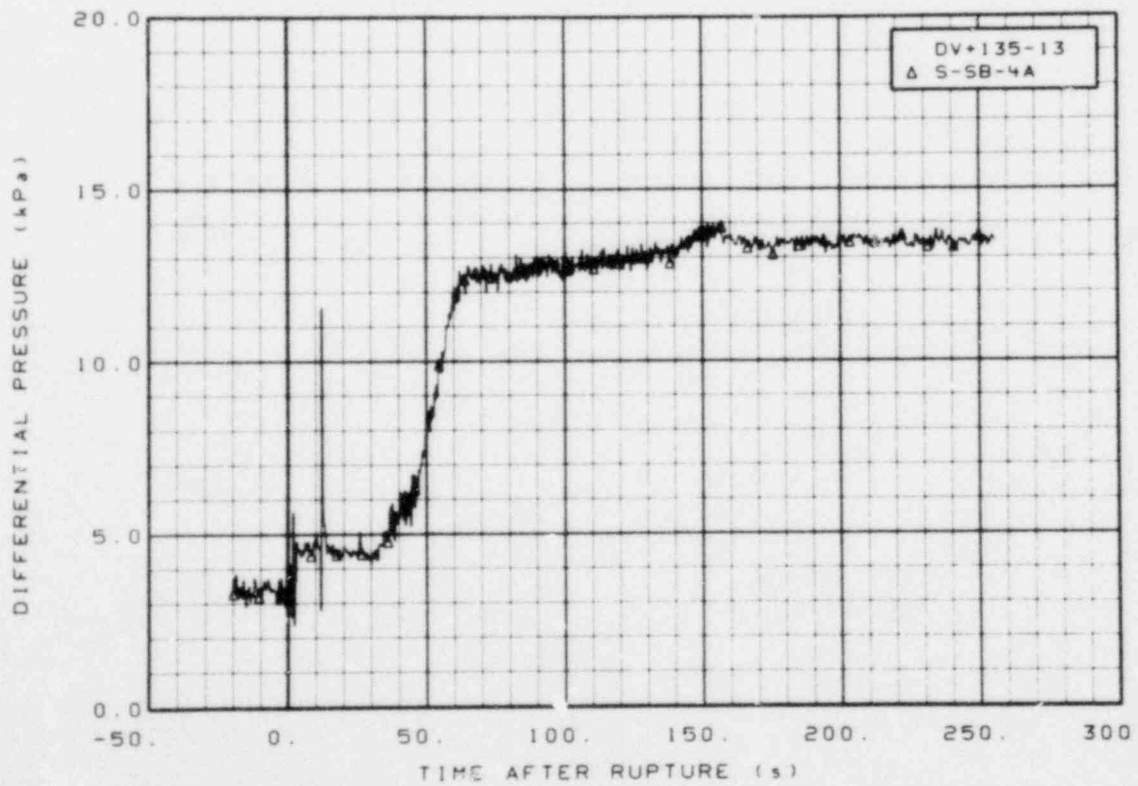


Figure 416. Differential pressure in vessel, Test S-SB-4A (DV + 135-13), from -20 to 256 s.

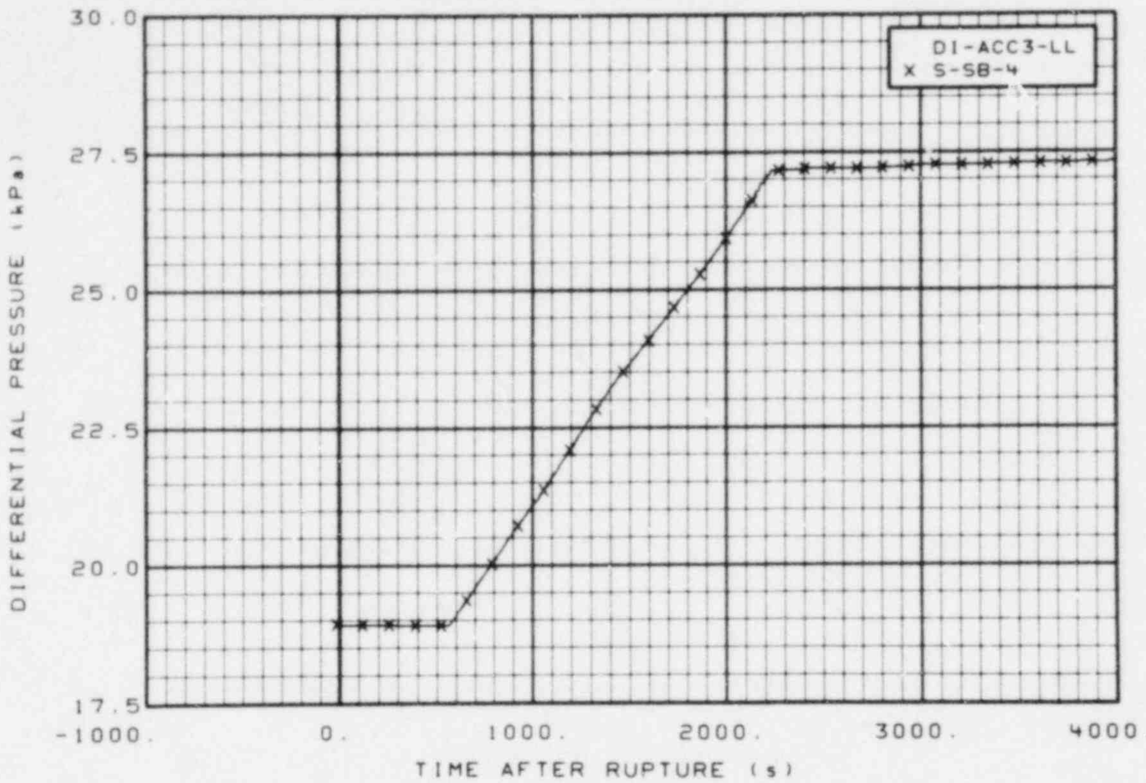


Figure 417. Differential pressure in intact loop ECC injection accumulator, Test S-SB-4 (DI-ACC3-LL), from -20 to 4000 s.

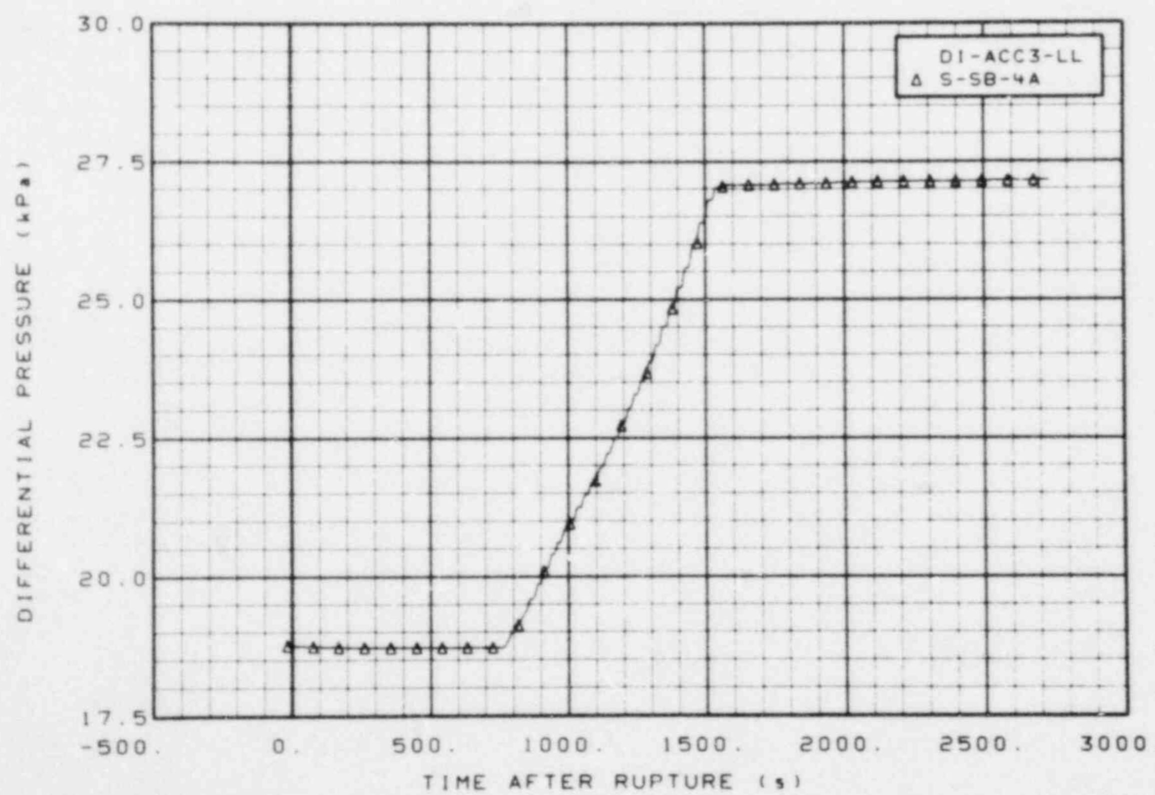


Figure 418. Differential pressure in intact loop ECC injection accumulator, Test S-SB-4A (DI-ACC3-LL), from -20 to 2740.

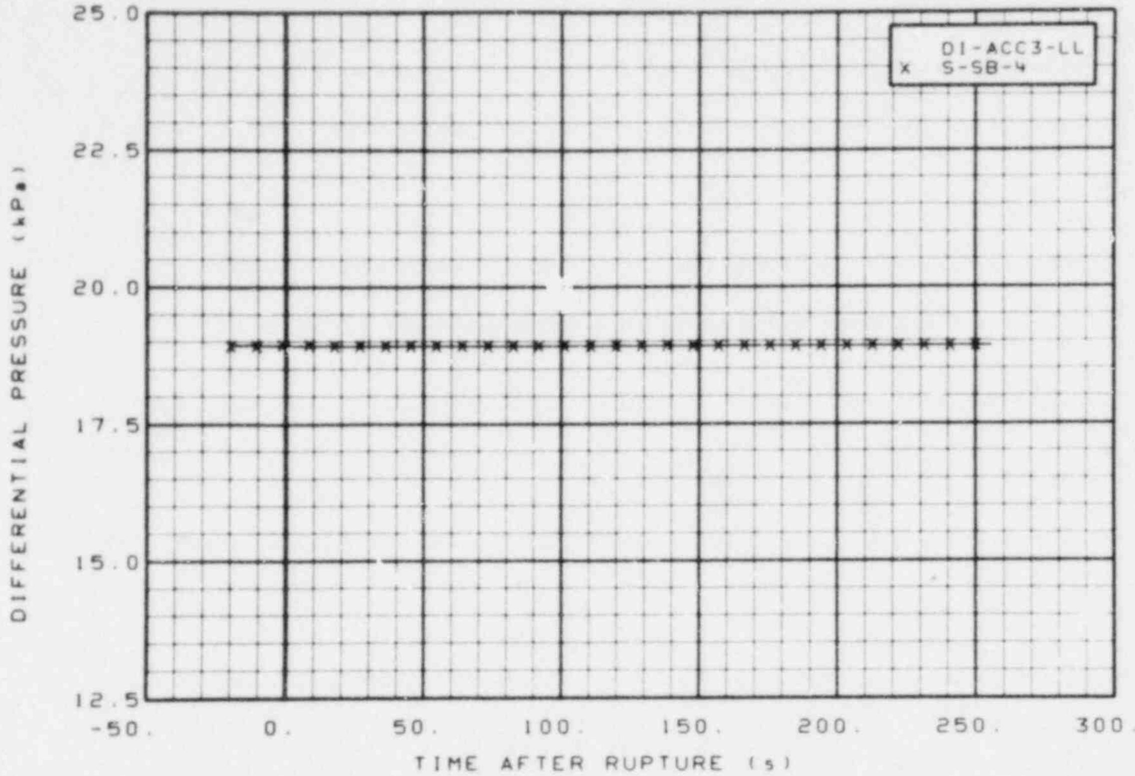


Figure 419. Differential pressure in intact loop ECC injection accumulator, Test S-SB-4 (DI-ACC3-LL), from -20 to 256 s.

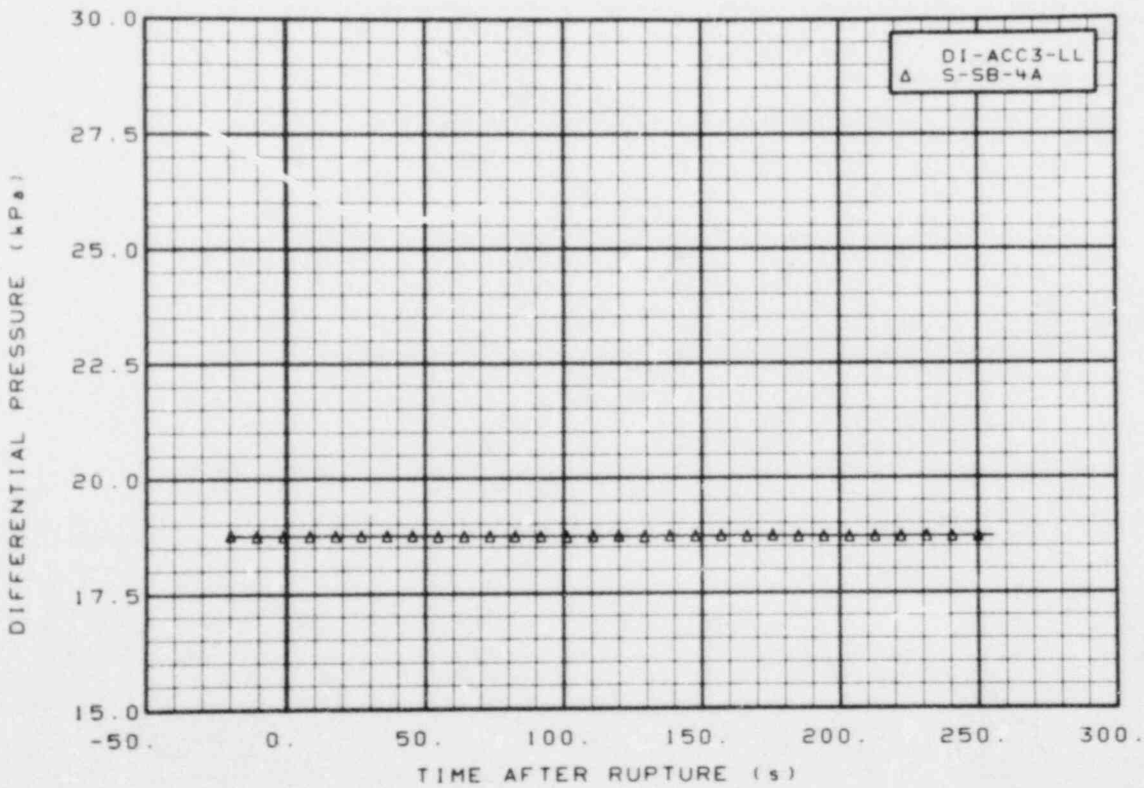


Figure 420. Differential pressure in intact loop ECC injection accumulator, Test S-SB-4A (DI-ACC3-LL), from -20 to 256 s.

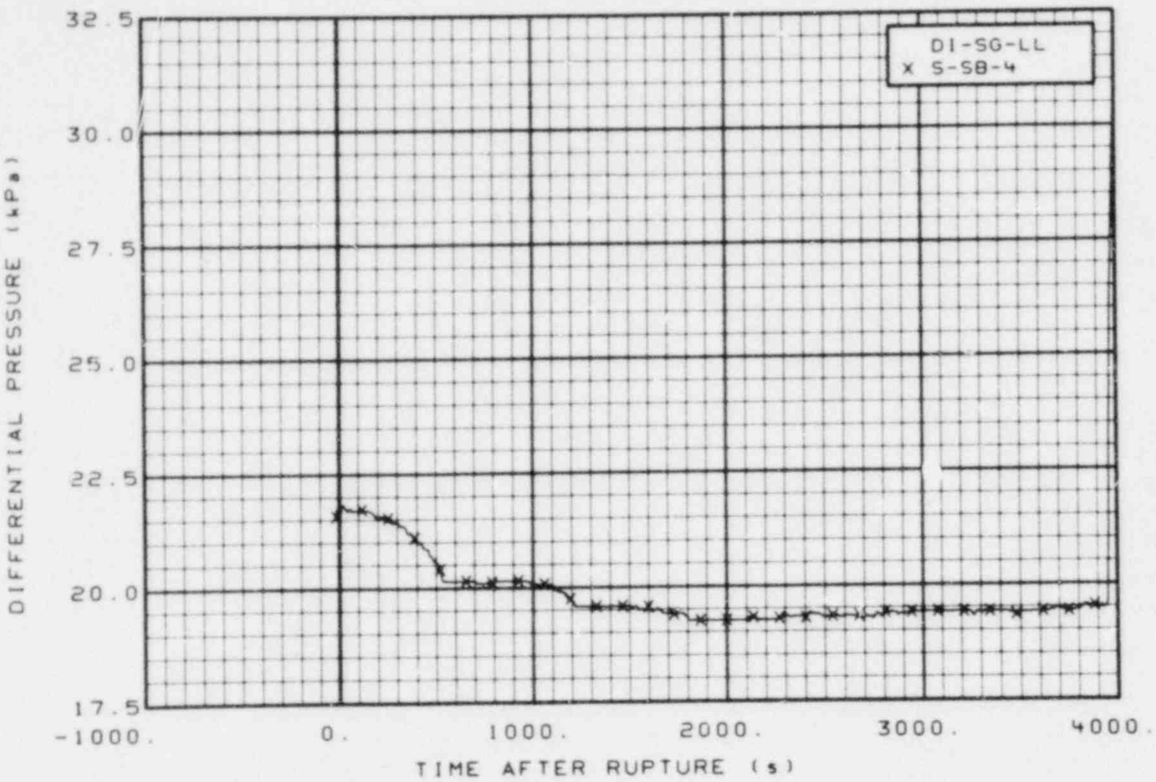


Figure 421. Differential pressure in intact loop steam generator, secondary side liquid level, Test S-SB-4 (DI-SG-LL), from -20 to 4000 s.

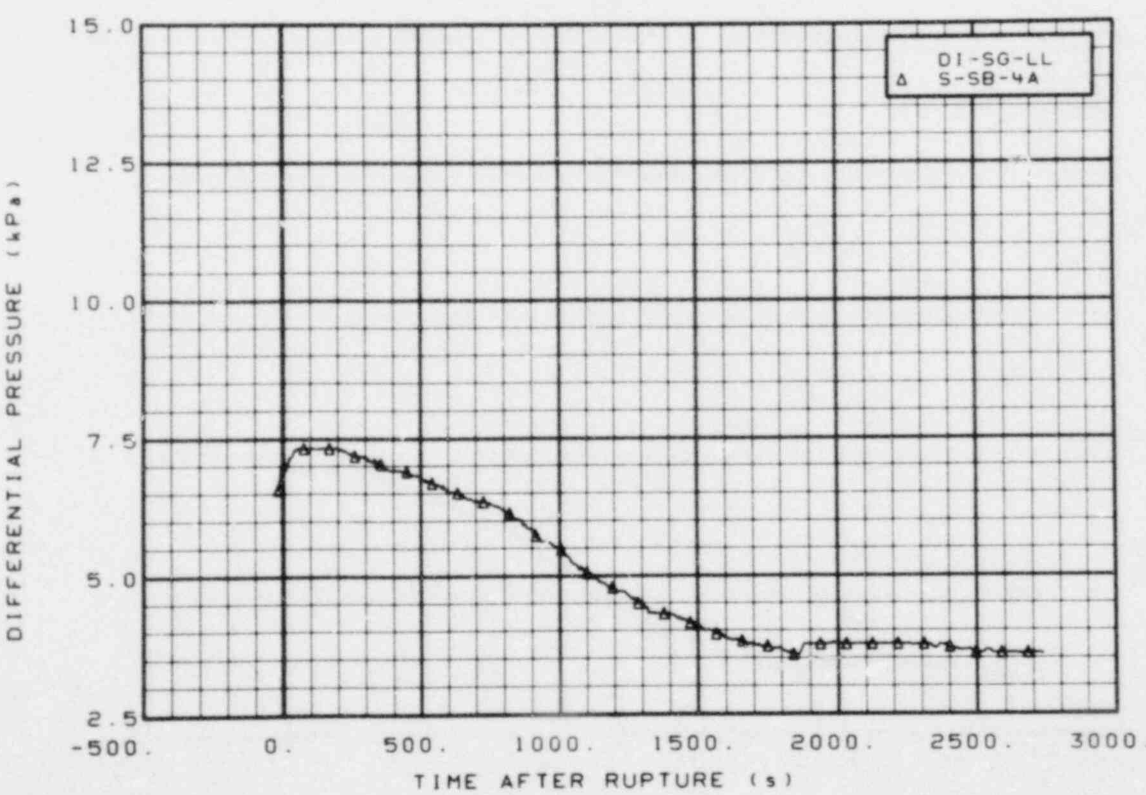


Figure 422. Differential pressure in intact loop steam generator, secondary side liquid level, Test S-SB-4A (DI-SG-LL), from -20 to 2740 s.

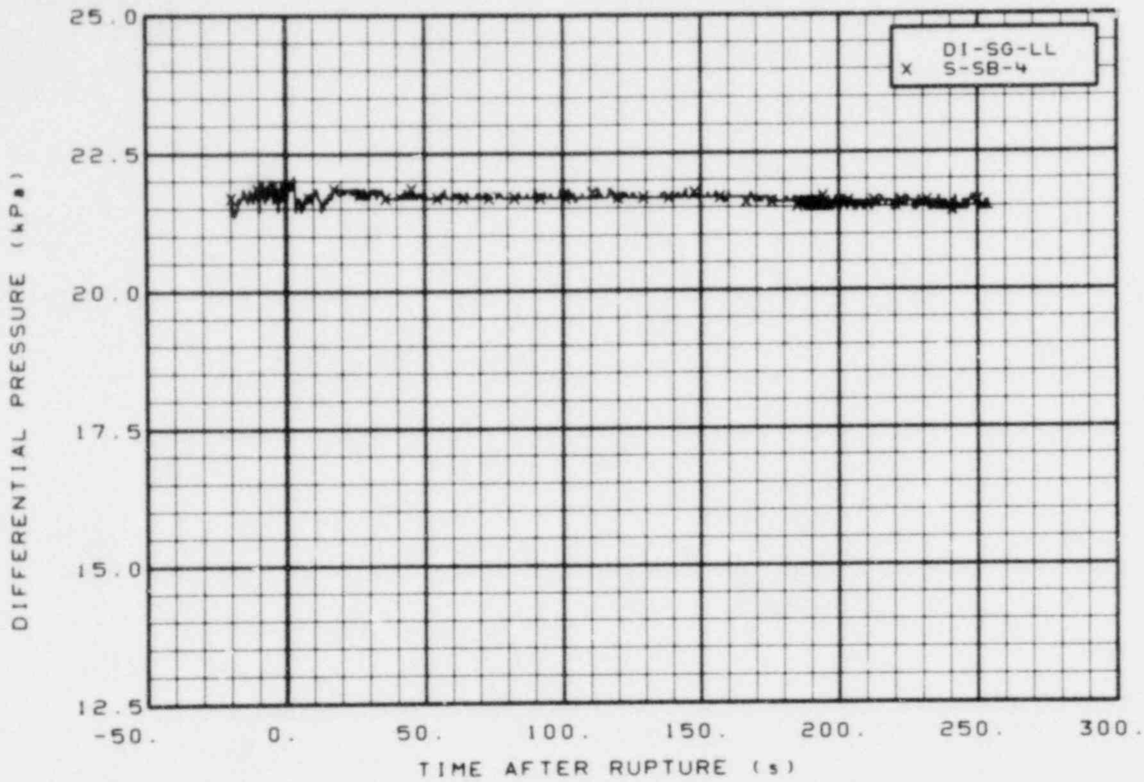


Figure 423. **Differential pressure in intact loop steam generator, secondary side liquid level, Test S-SB-4 (DI-SG-LL), from -20 to 256 s.**

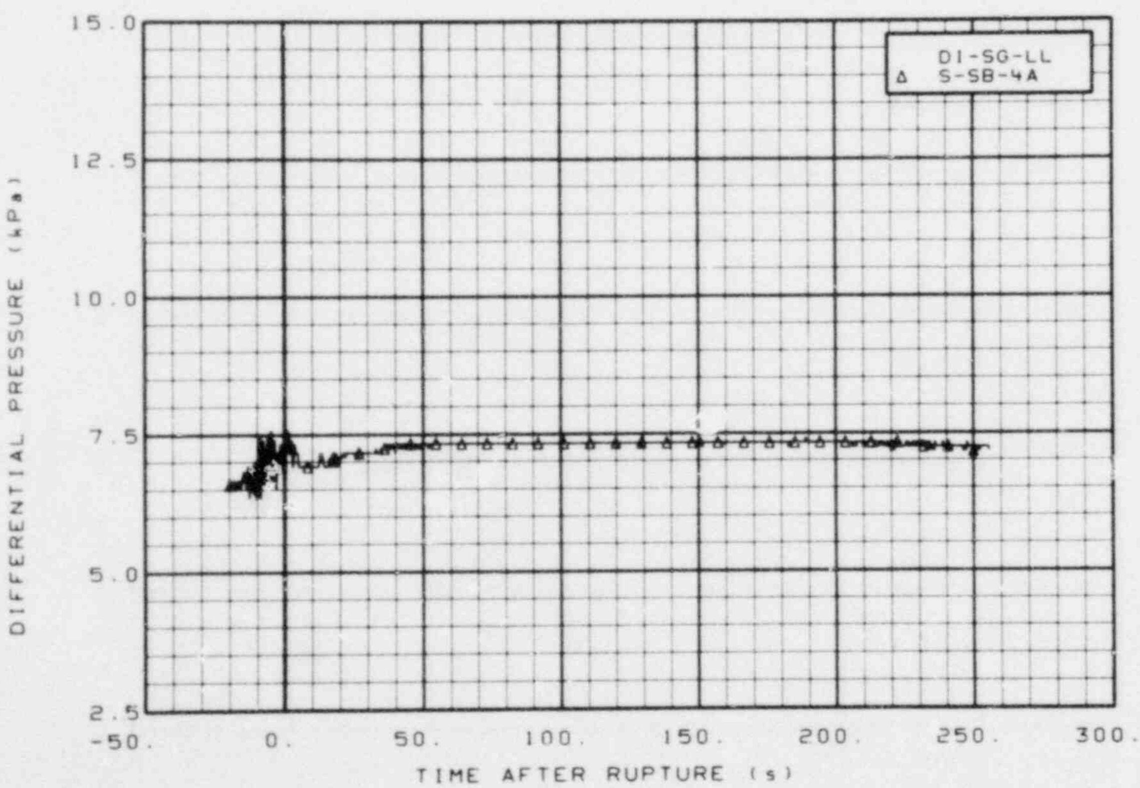


Figure 424. **Differential pressure in intact loop steam generator, secondary side liquid level, Test S-SB-4A (DI-SG-LL), from -20 to 256 s.**

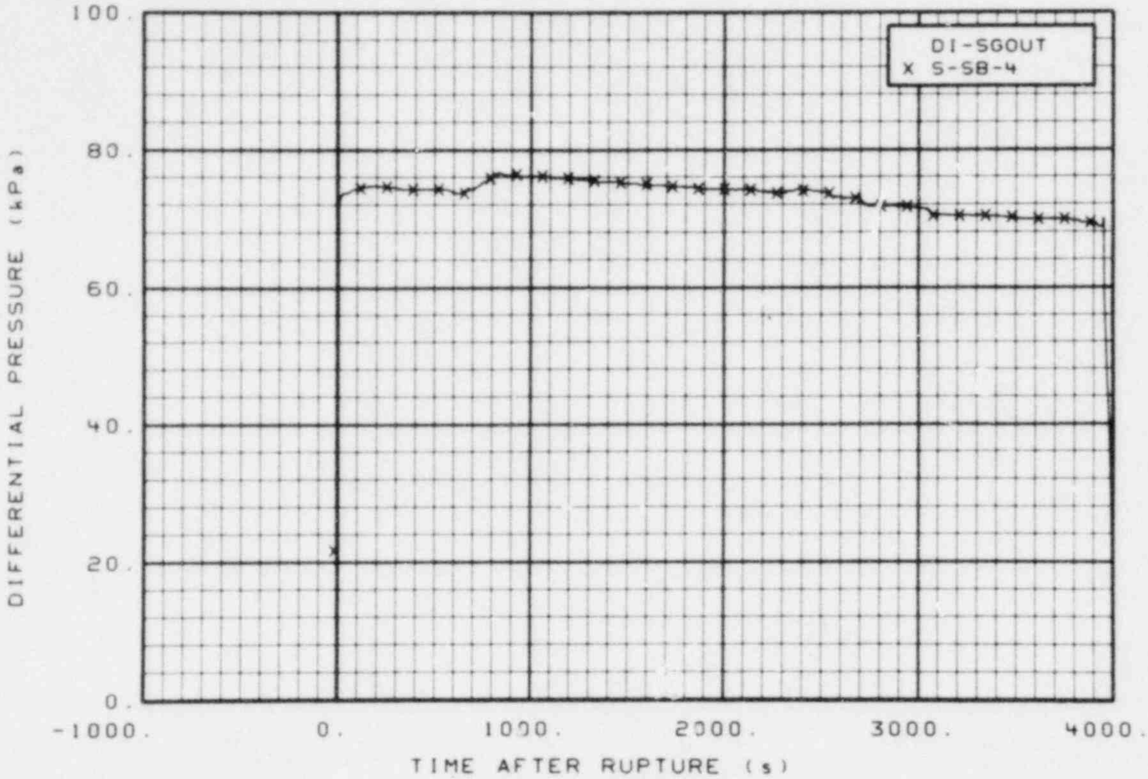


Figure 425. Differential pressure in intact loop steam generator, discharge line, Test S-SB-4 (DI-SGOUT), from -20 to 4000 s.

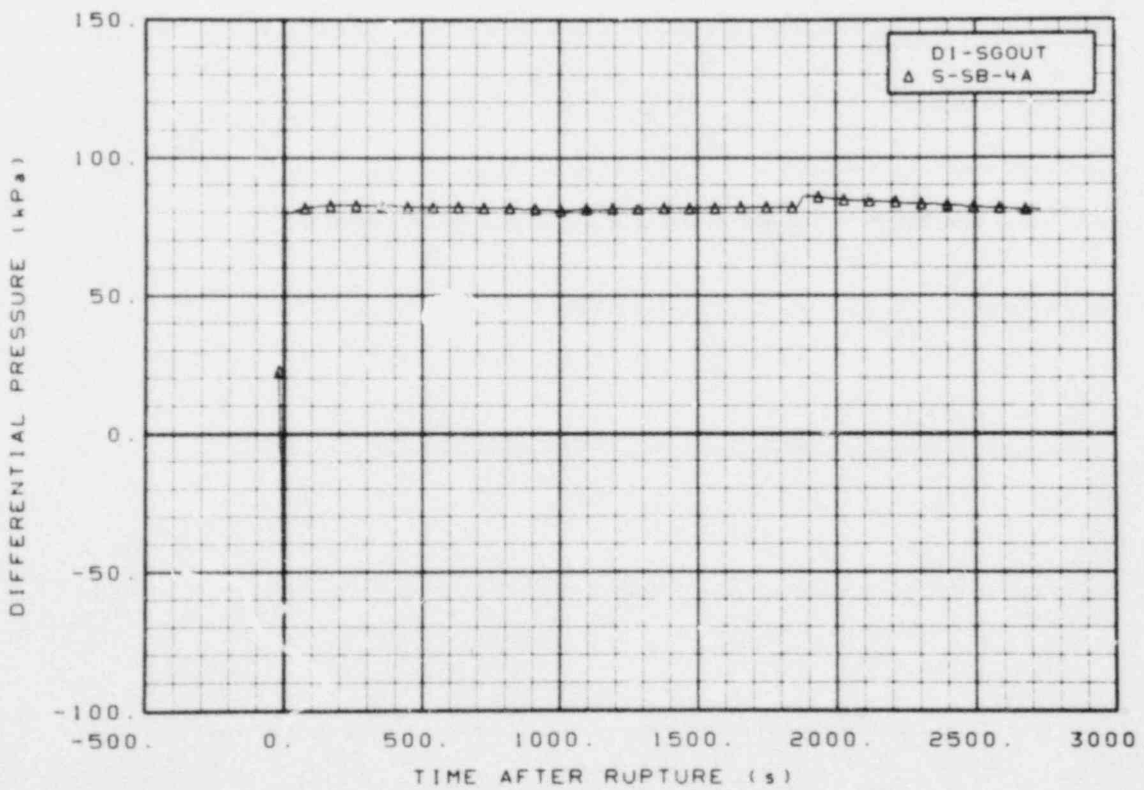


Figure 426. Differential pressure in intact loop steam generator, discharge line, Test S-SB-4A (DI-SGOUT), from -20 to 2740 s.

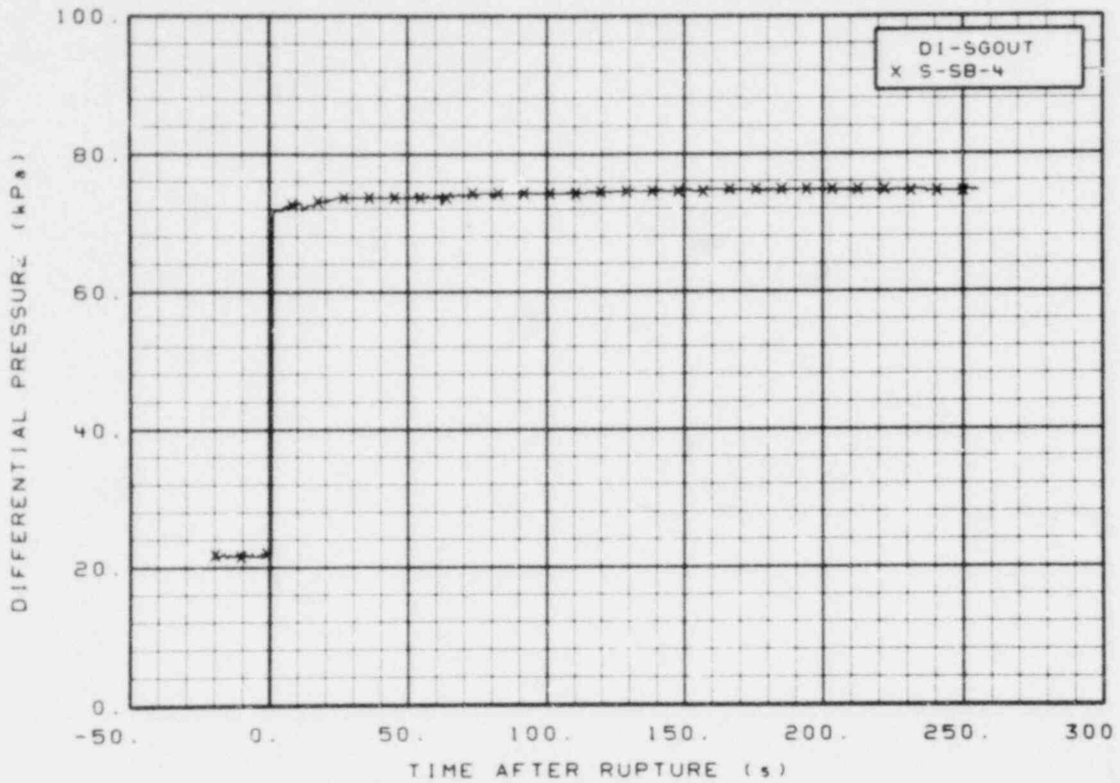


Figure 427. **Differential pressure in intact loop steam generator, discharge line, Test S-SB-4 (DI-SGOUT), from -20 to 256 s.**

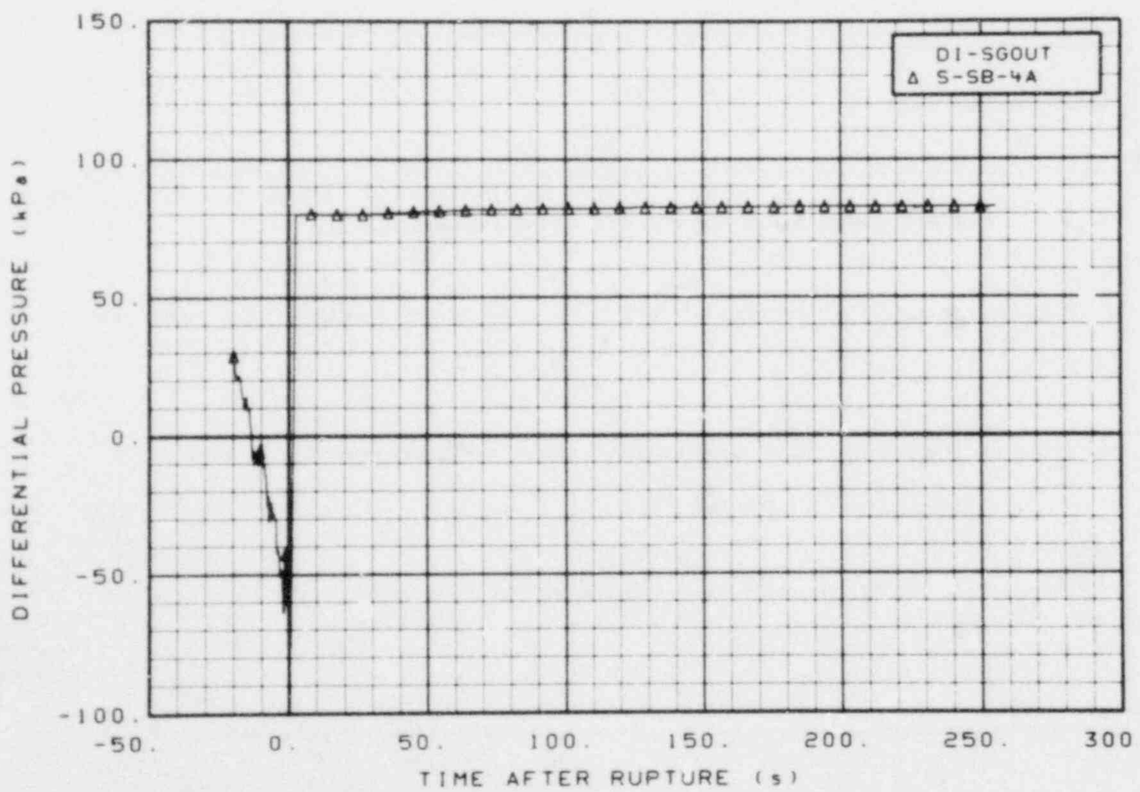


Figure 428. **Differential pressure in intact loop steam generator, discharge line, Test S-SB-4A (DI-SGOUT), from -20 to 256 s.**

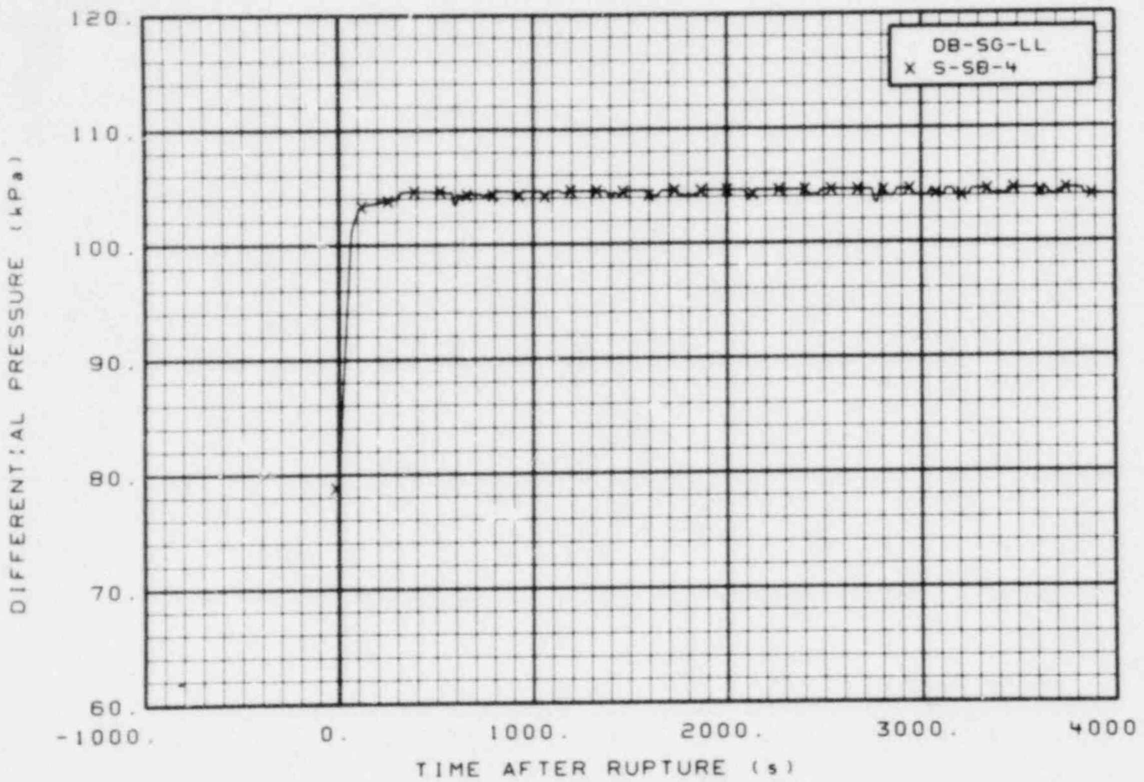


Figure 429. Differential pressure in broken loop steam generator, secondary side liquid level, Test S-SB-4 (DB-SG-LL), from -20 to 4000 s.

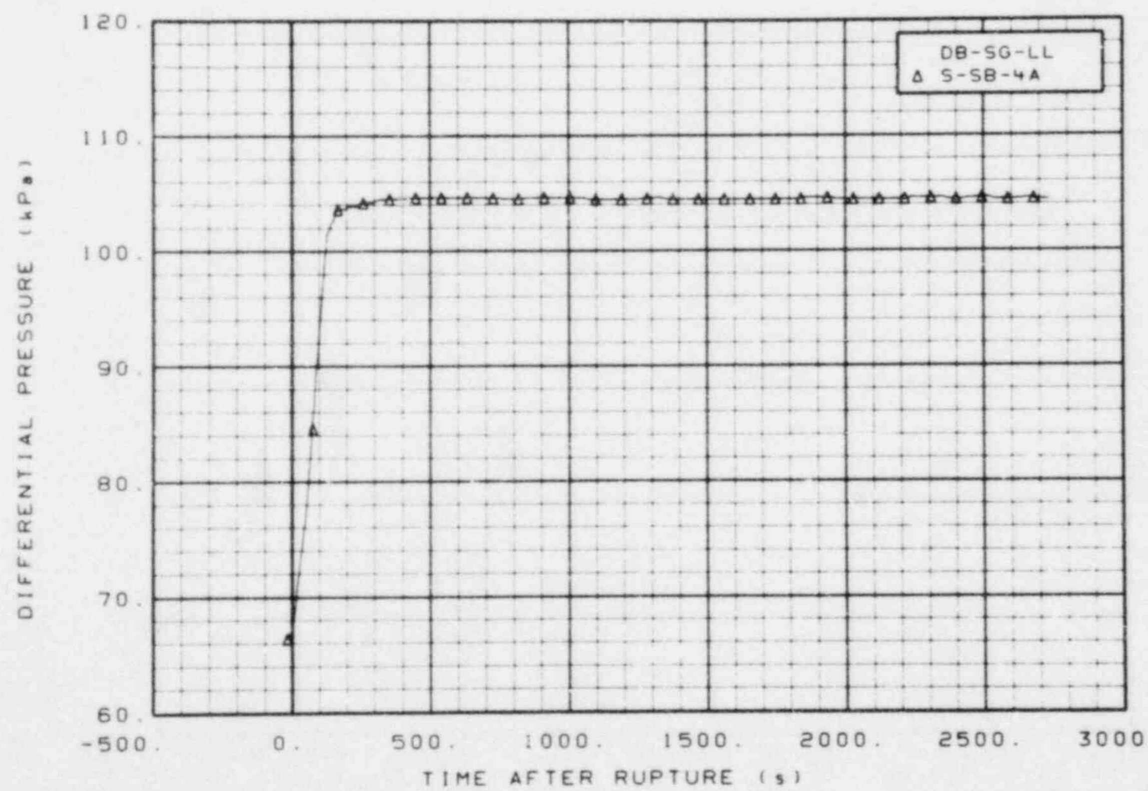


Figure 430. Differential pressure in broken loop steam generator, secondary side liquid level, Test S-SB-4A (DB-SG-LL), from -20 to 2740 s.

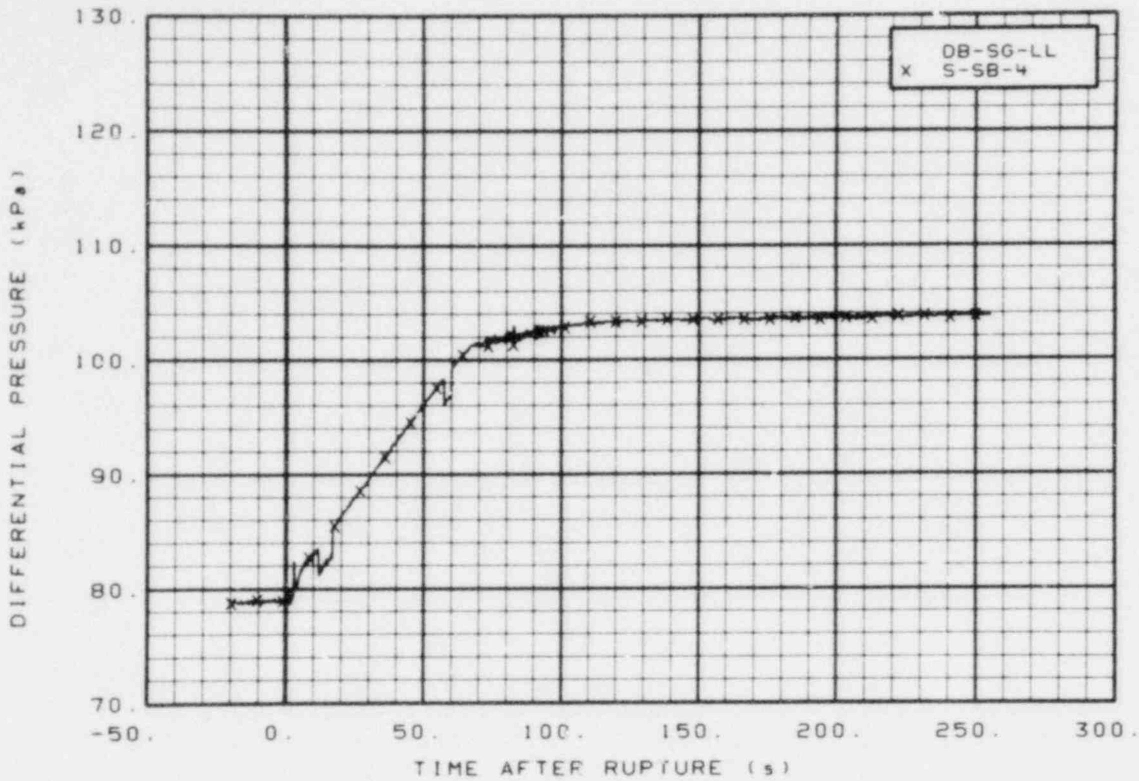


Figure 431. Differential pressure in broken loop steam generator, secondary side liquid level, Test S-SB-4 (DB-SG-LL), from -20 to 256 s.

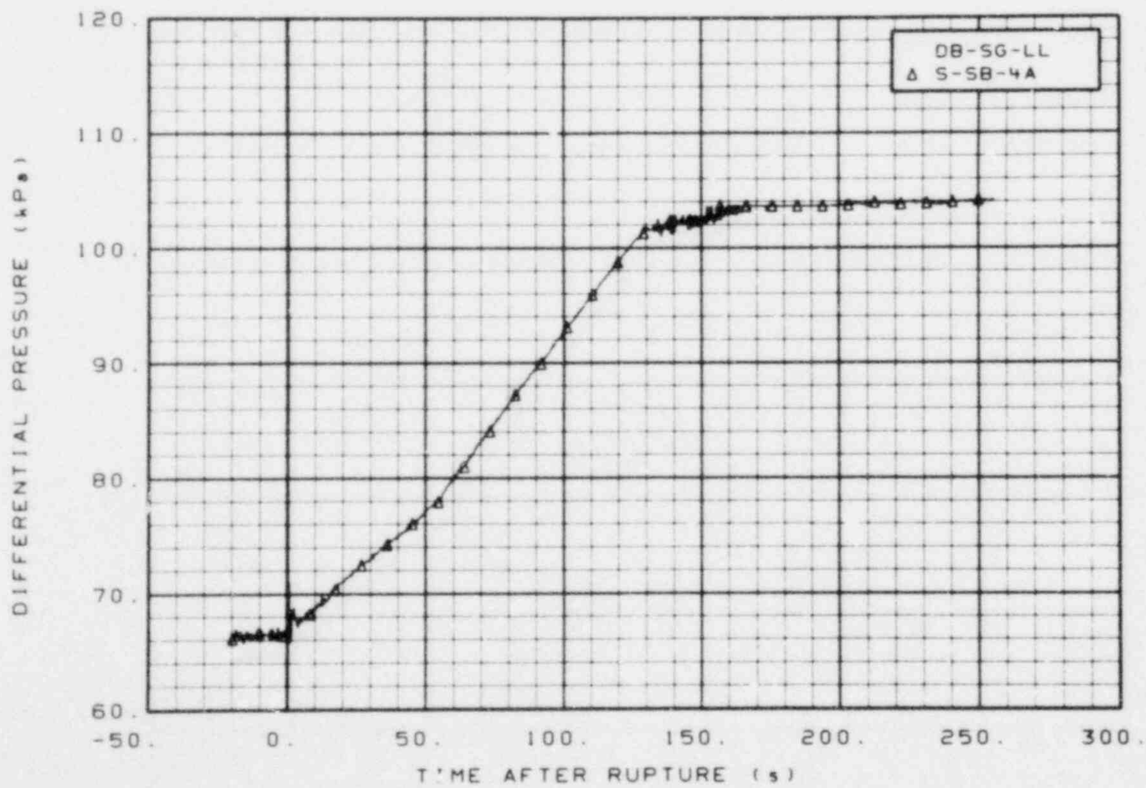


Figure 432. Differential pressure in broken loop steam generator, secondary side liquid level, Test S-SB-4A (DB-SG-LL), from -20 to 256 s.

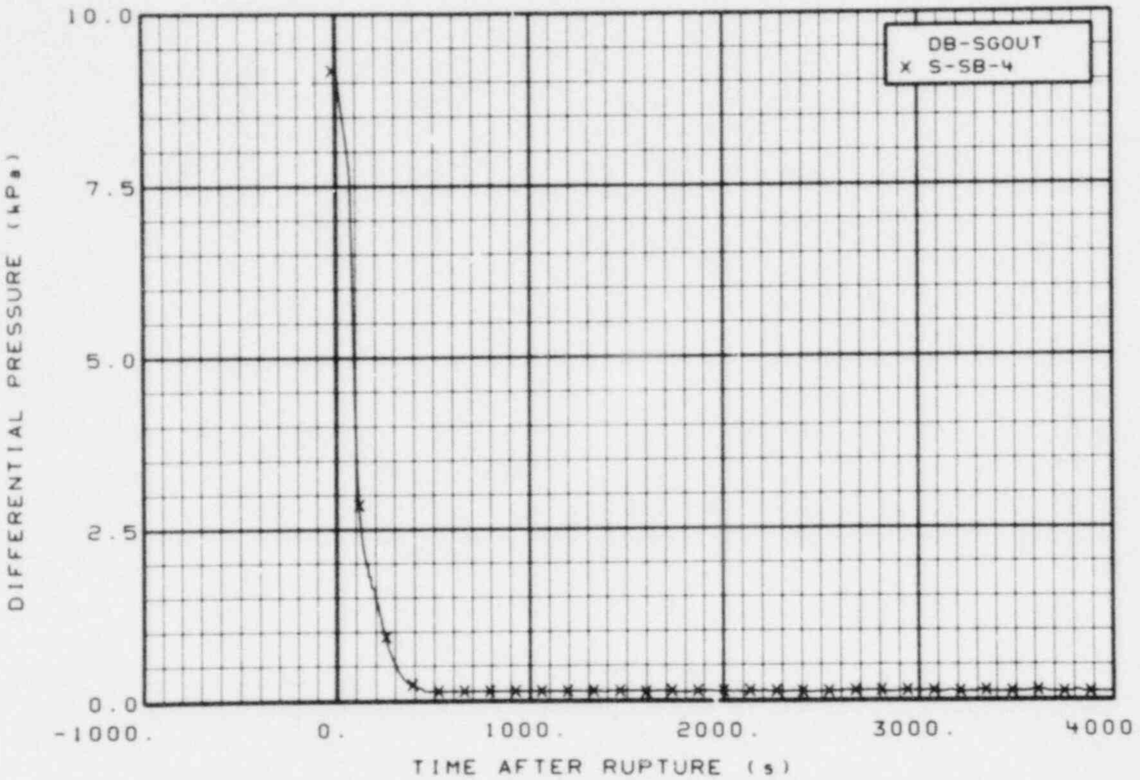


Figure 433. Differential pressure in broken loop steam generator discharge line, Test S-SB-4 (DB-SGOUT), from -20 to 4000 s.

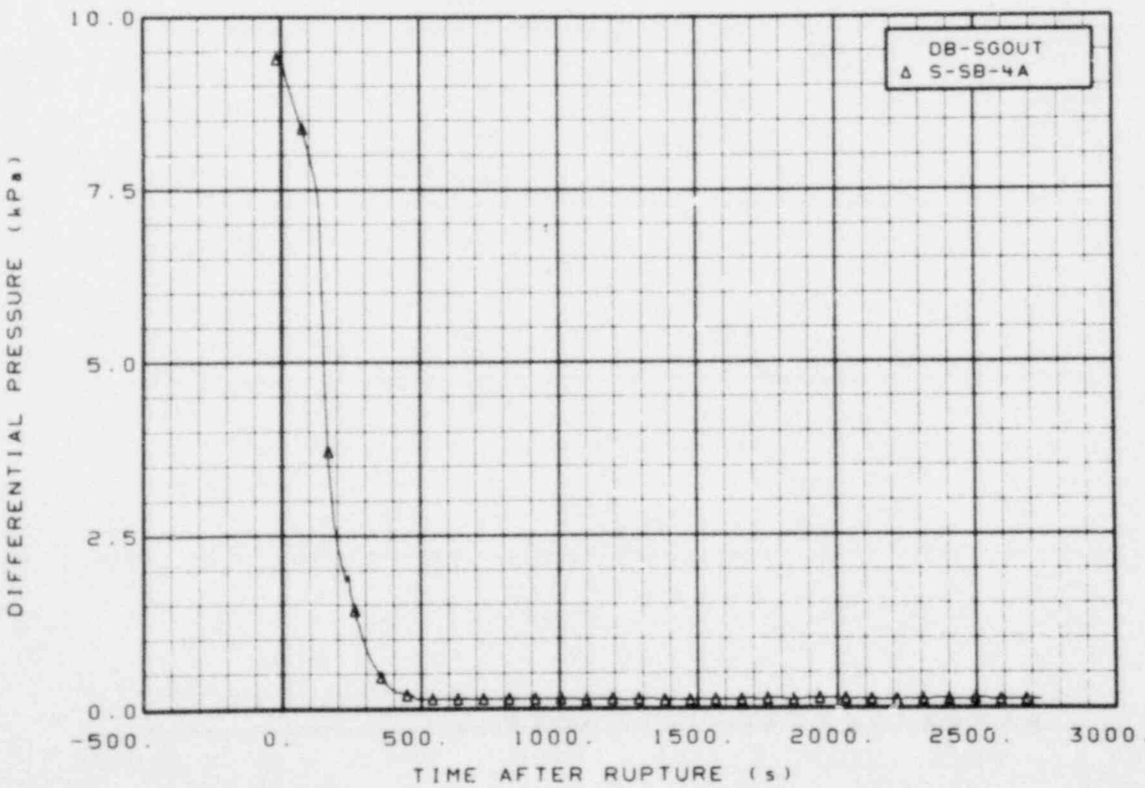


Figure 434. Differential pressure in broken loop steam generator discharge line, Test S-SB-4A (DB-SGOUT), from -20 to 2740 s.

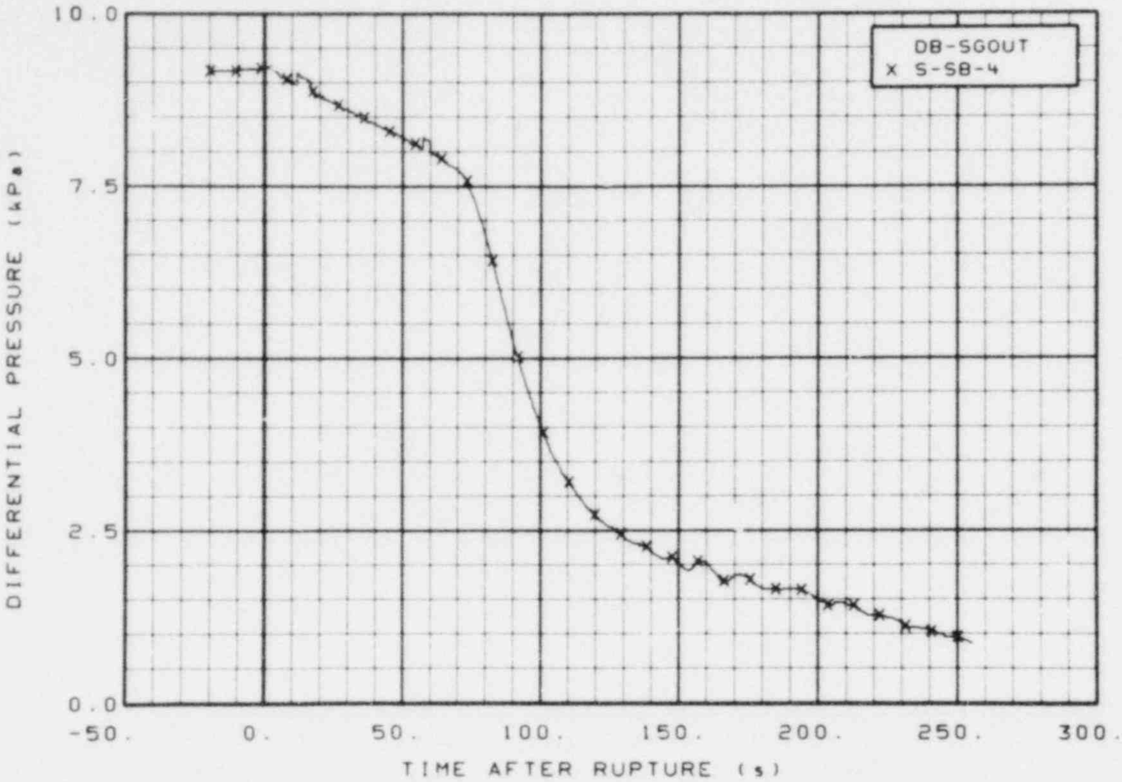


Figure 435. Differential pressure in broken loop steam generator discharge line, Test S-SB-4 (DB-SGOUT), from -20 to 256 s.

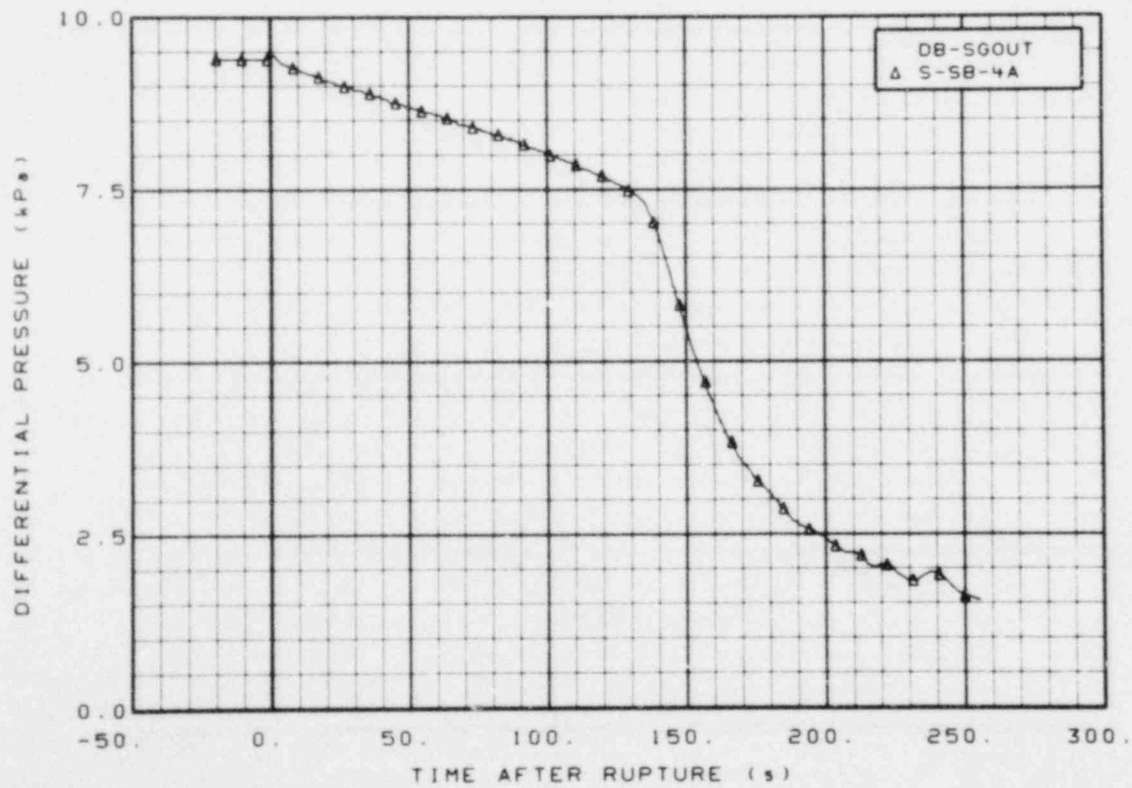


Figure 436. Differential pressure in broken loop steam generator discharge line, Test S-SB-4A (DB-SGOUT), from -20 to 256 s.

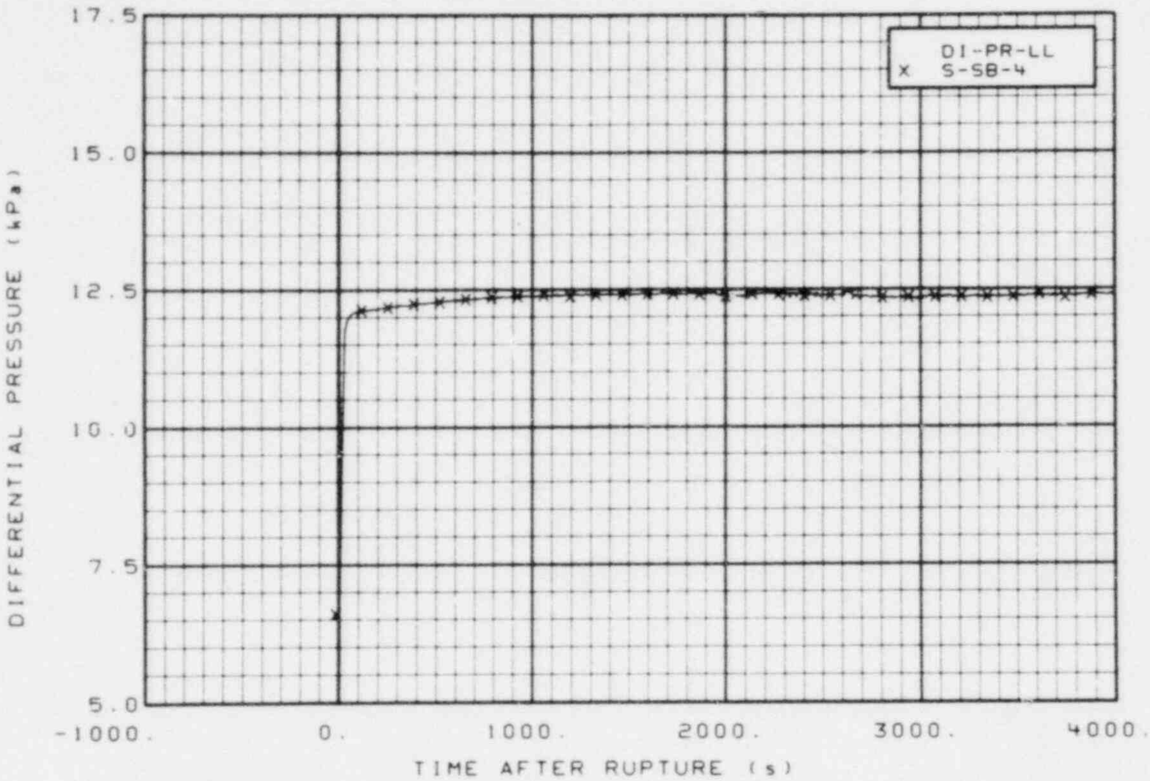


Figure 437. Differential pressure in pressurizer, liquid level, Test S-SB-4 (DI-PR-LL), from -20 to 4000 s.

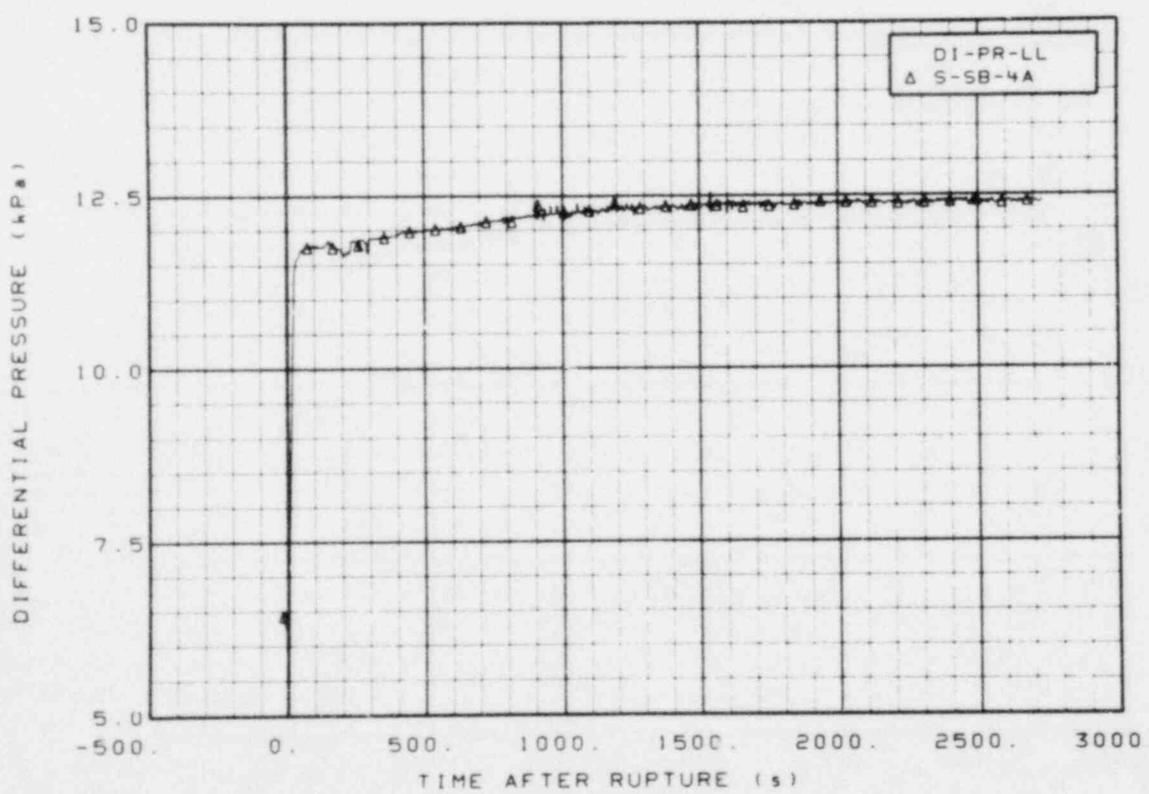


Figure 438. Differential pressure in pressurizer, liquid level, Test S-SB-4A (DI-PR-LL), from -20 to 2740 s.

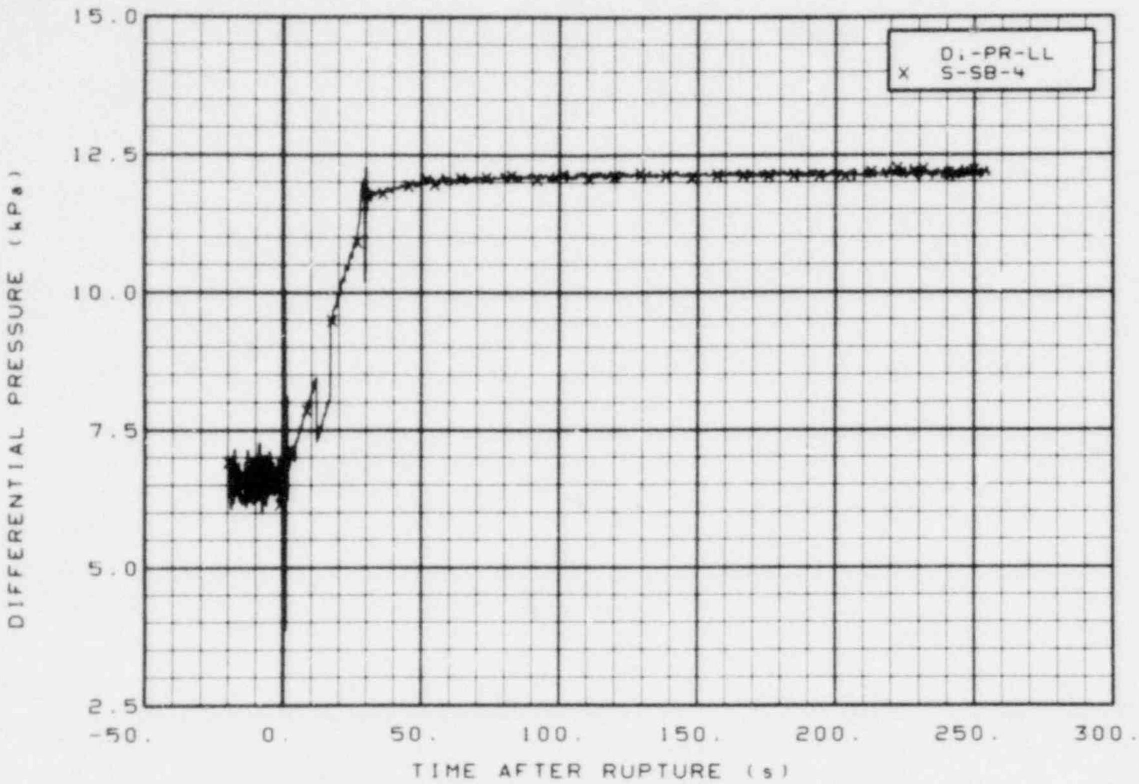


Figure 439. Differential pressure in pressurizer, liquid level, Test S-SB-4 (DI-PR-LL), from -20 to 256 s.

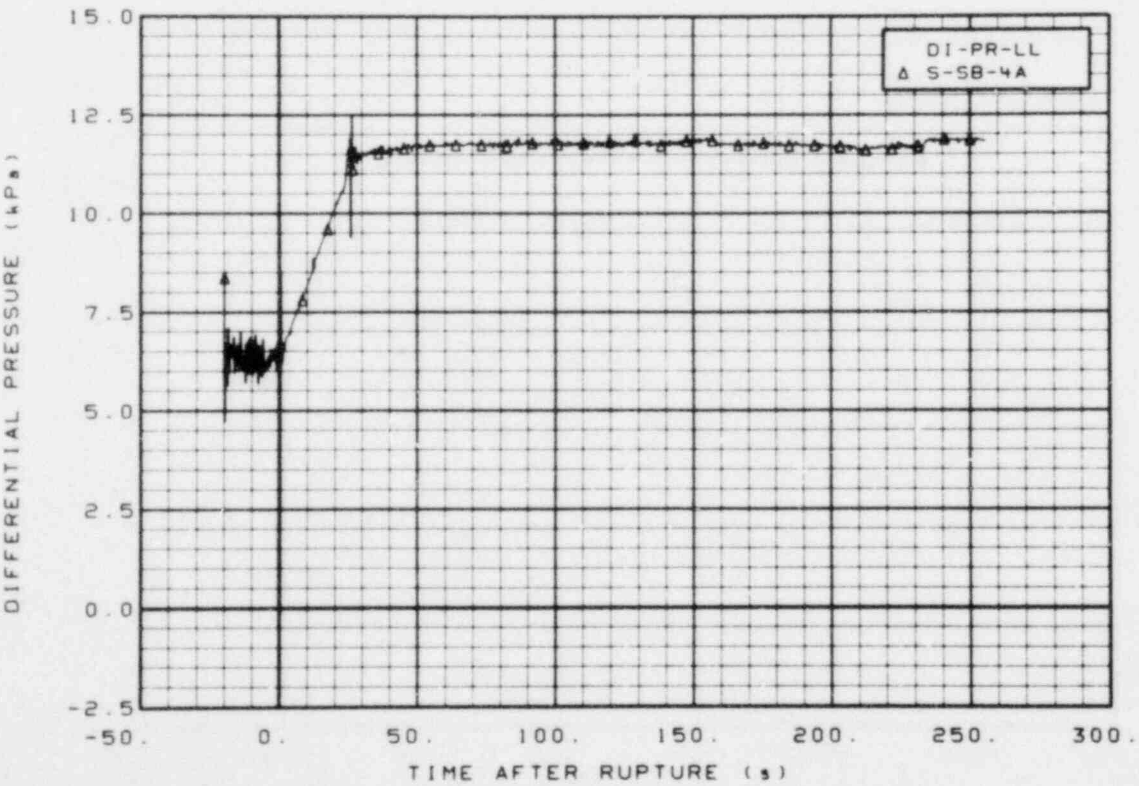


Figure 440. Differential pressure in pressurizer, liquid level, Test S-SB-4A (DI-PR-LL), from -20 to 256 s.

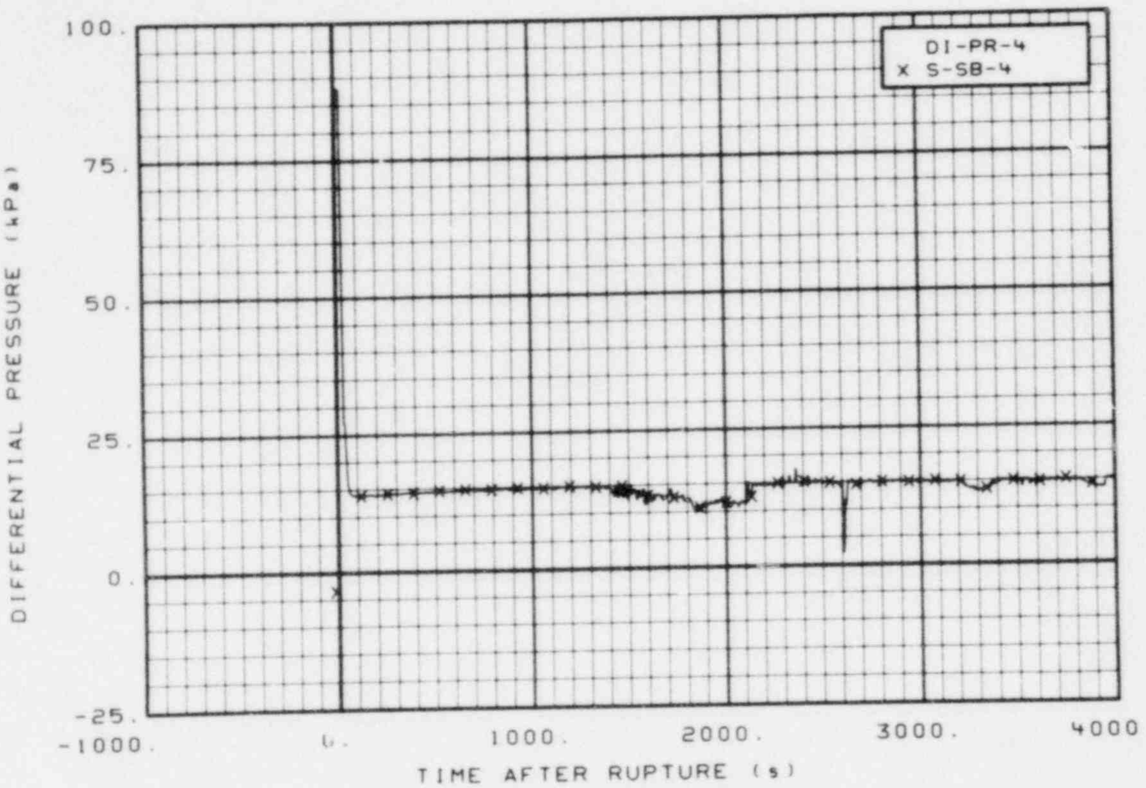


Figure 441. Differential pressure in pressurizer, Test S-SB-4 (DI-PR-4), from -20 to 4000 s.

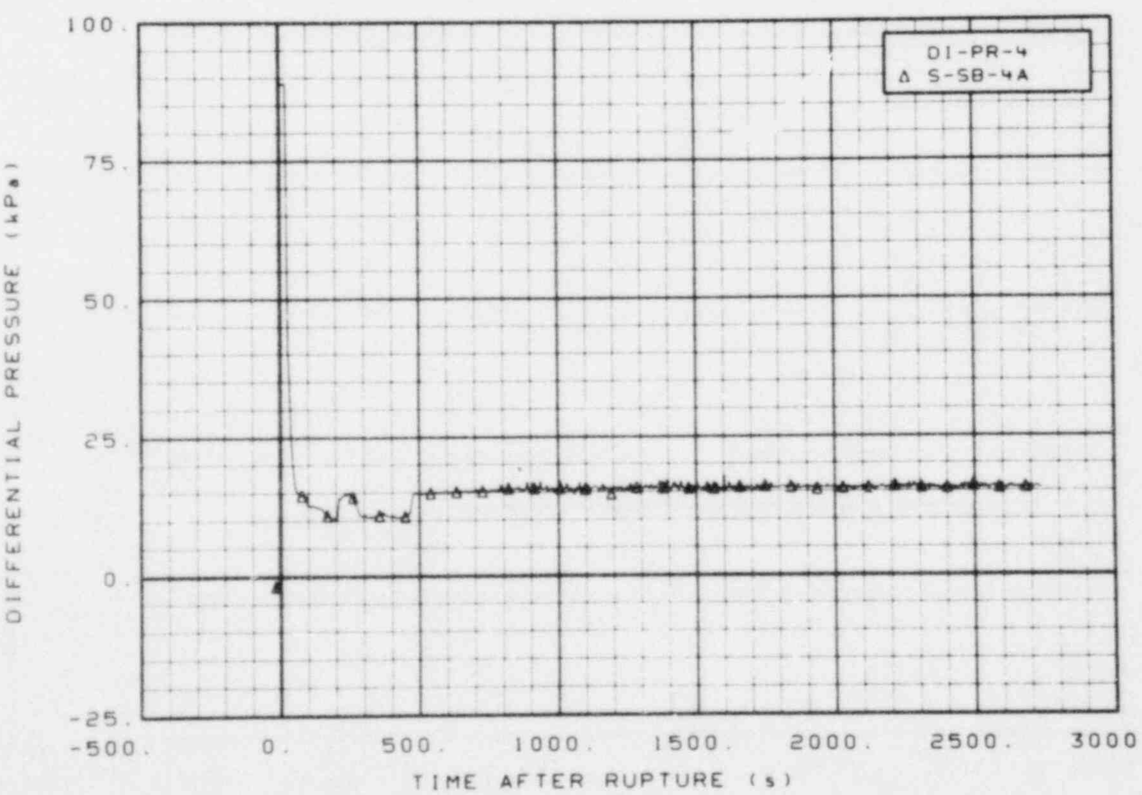


Figure 442. Differential pressure in pressurizer, Test S-SB-4A (DI-PR-4), from -20 to 2740 s.

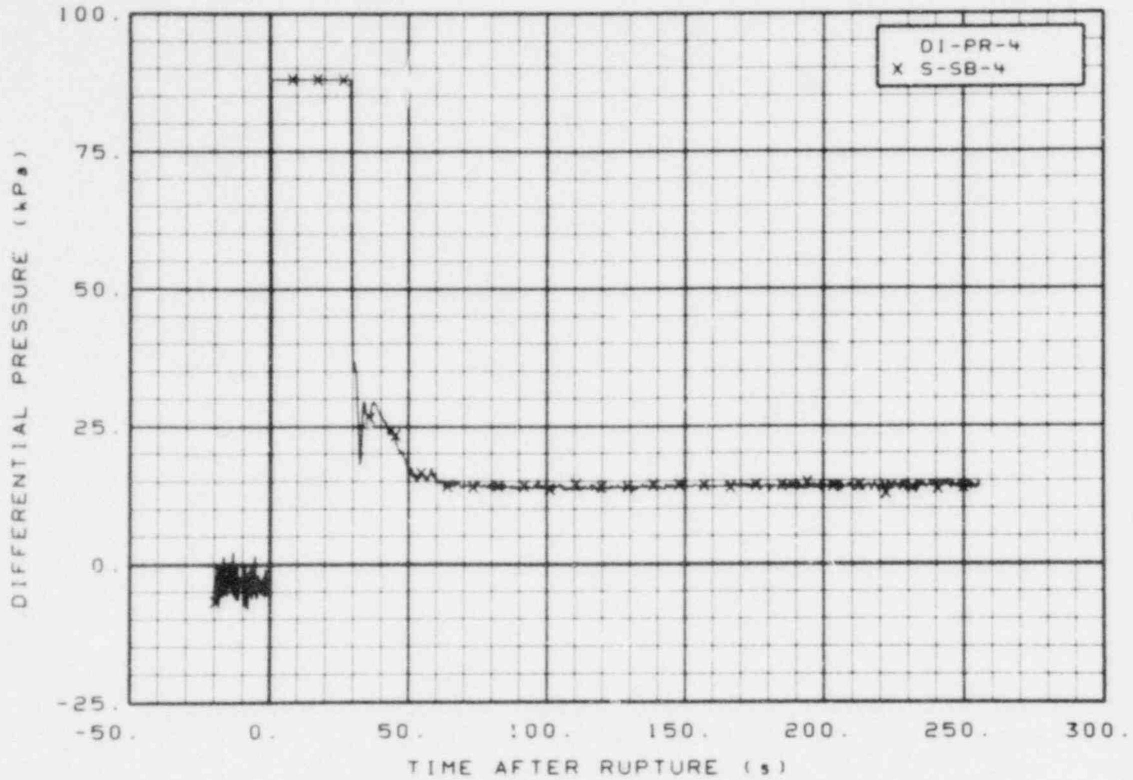


Figure 443. Differential pressure in pressurizer, Test S-SB-4 (DI-PR-4), from -20 to 256 s.

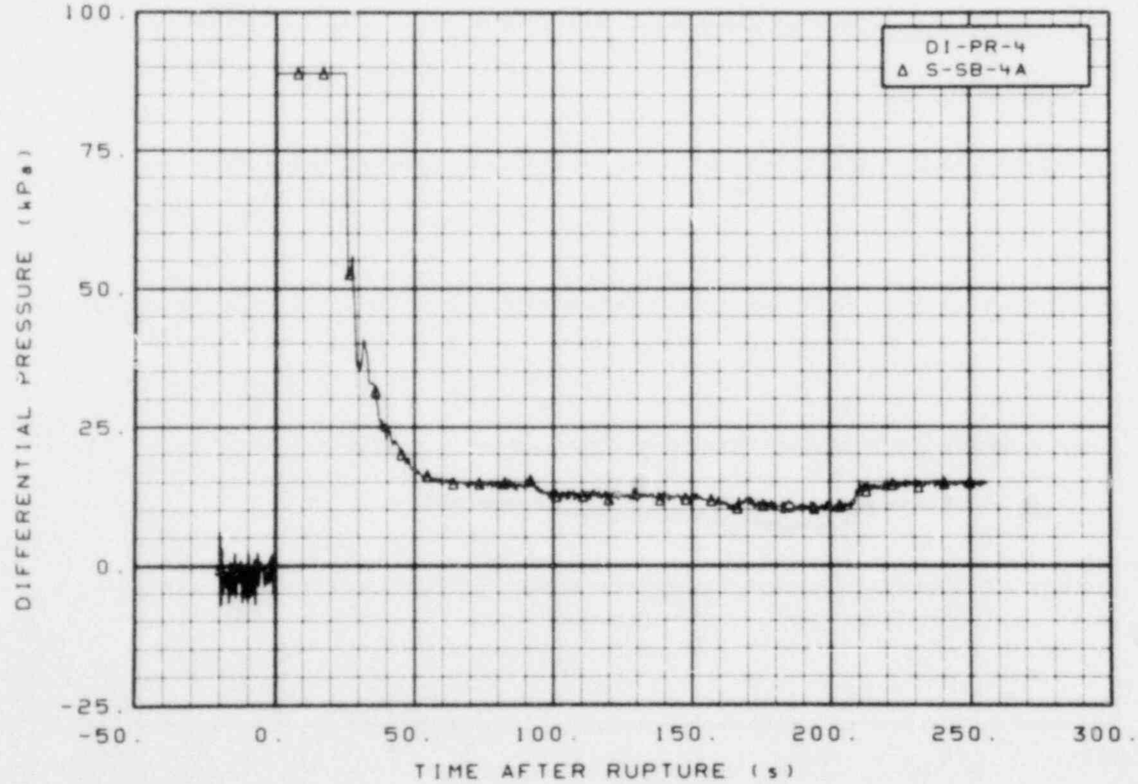


Figure 444. Differential pressure in pressurizer, Test S-SB-4A (DI-PR-4), from -20 to 256 s.

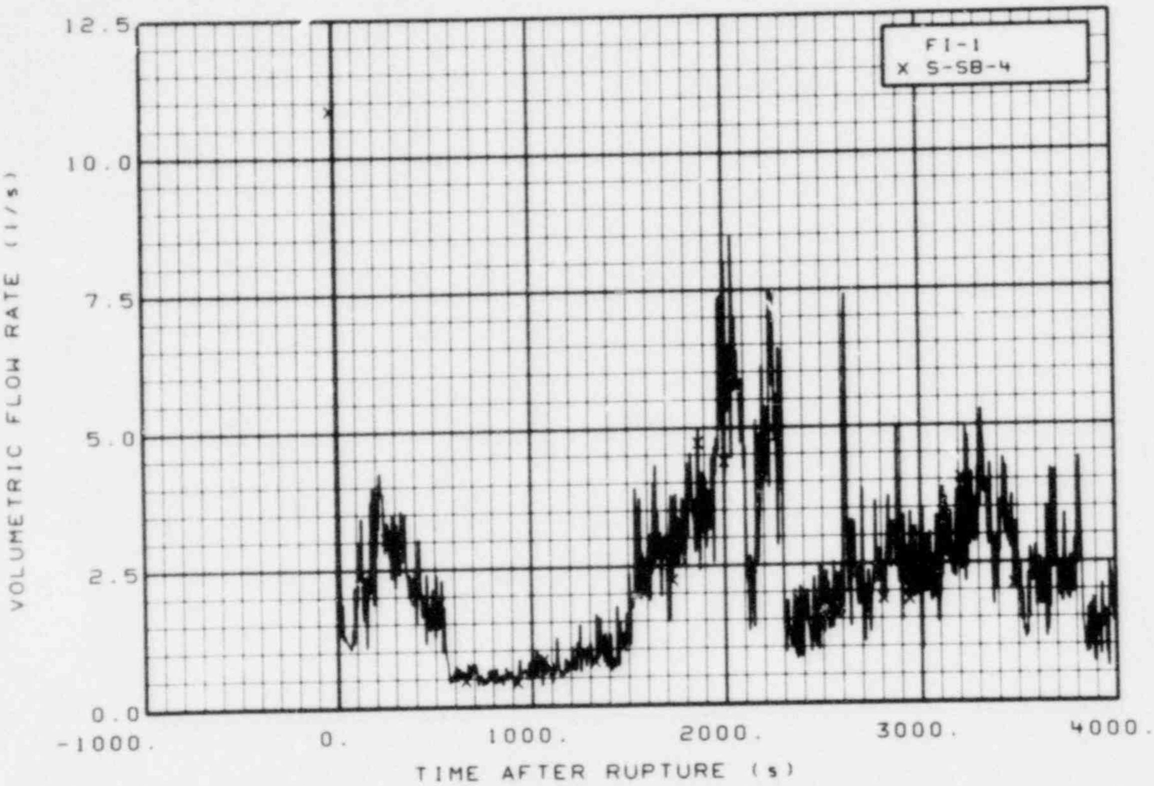


Figure 445. Volumetric flow rate in intact loop hot leg, Test S-SB-4 (FI-1), from -20 to 4000 s.

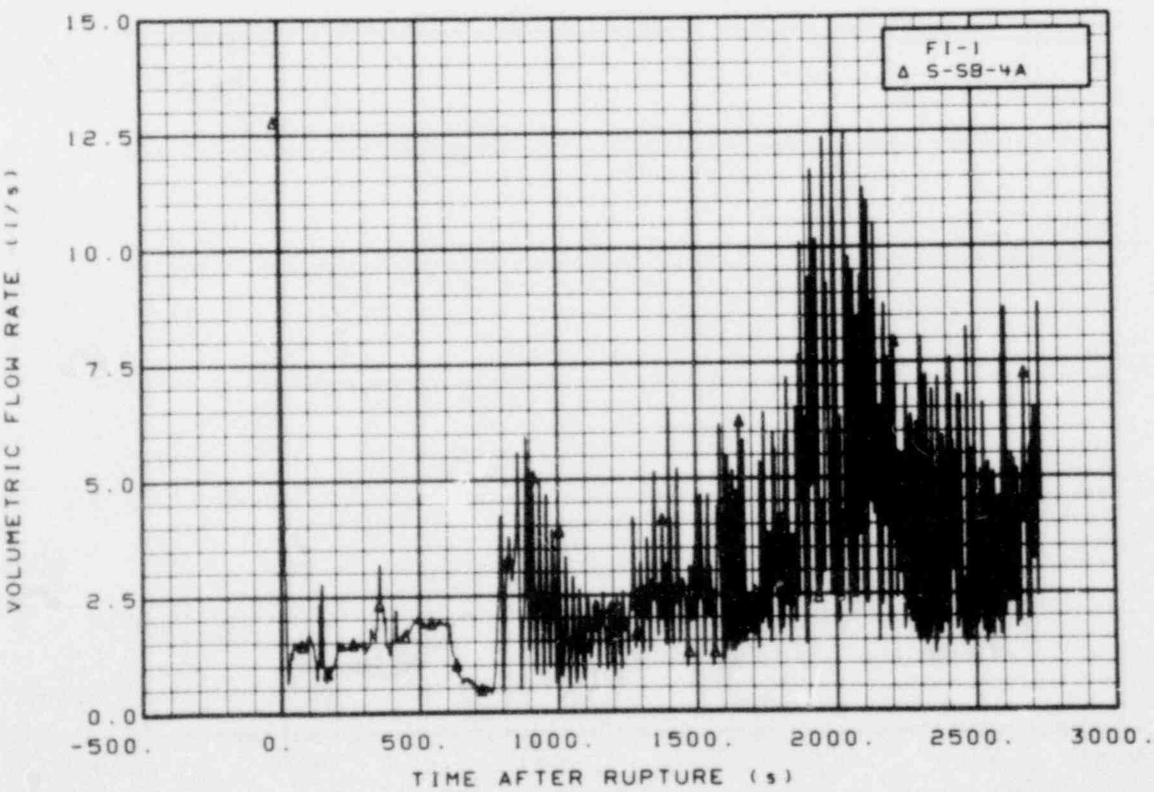


Figure 446. Volumetric flow rate in intact loop hot leg, Test S-SB-4A (FI-1), from -20 to 2740 s.

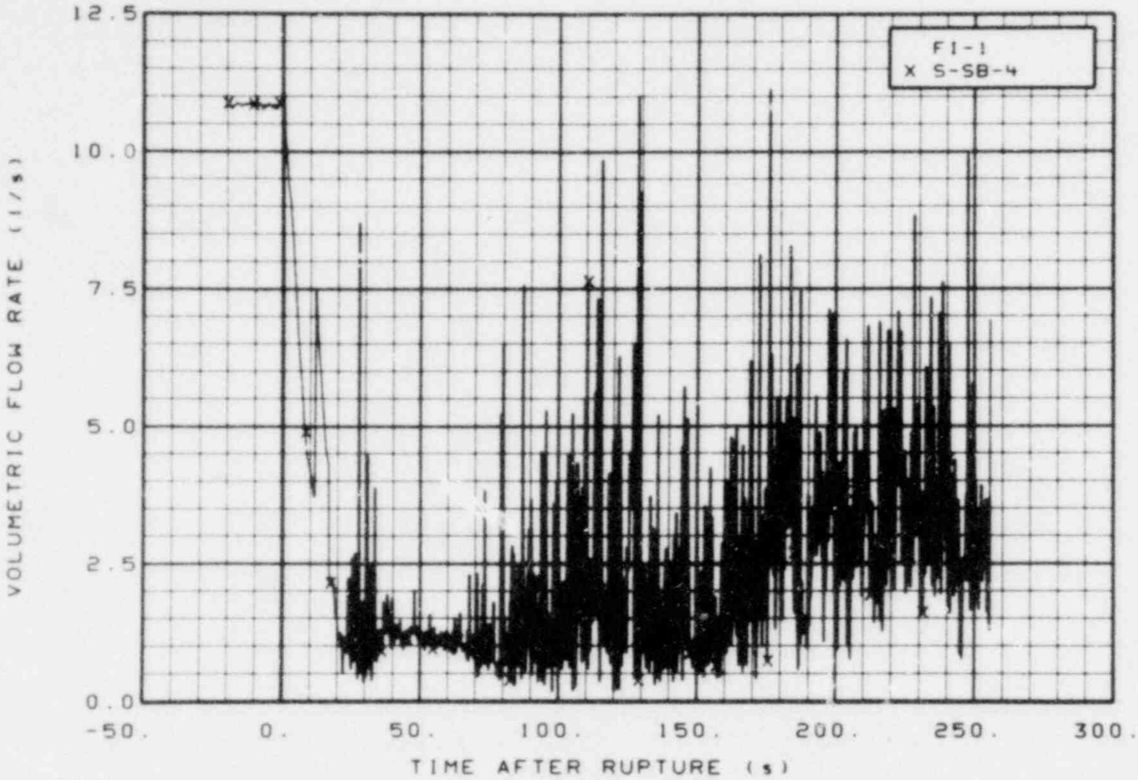


Figure 447. Volumetric flow rate in intact loop hot leg, Test S-SB-4 (FI-1), from -20 to 256 s.

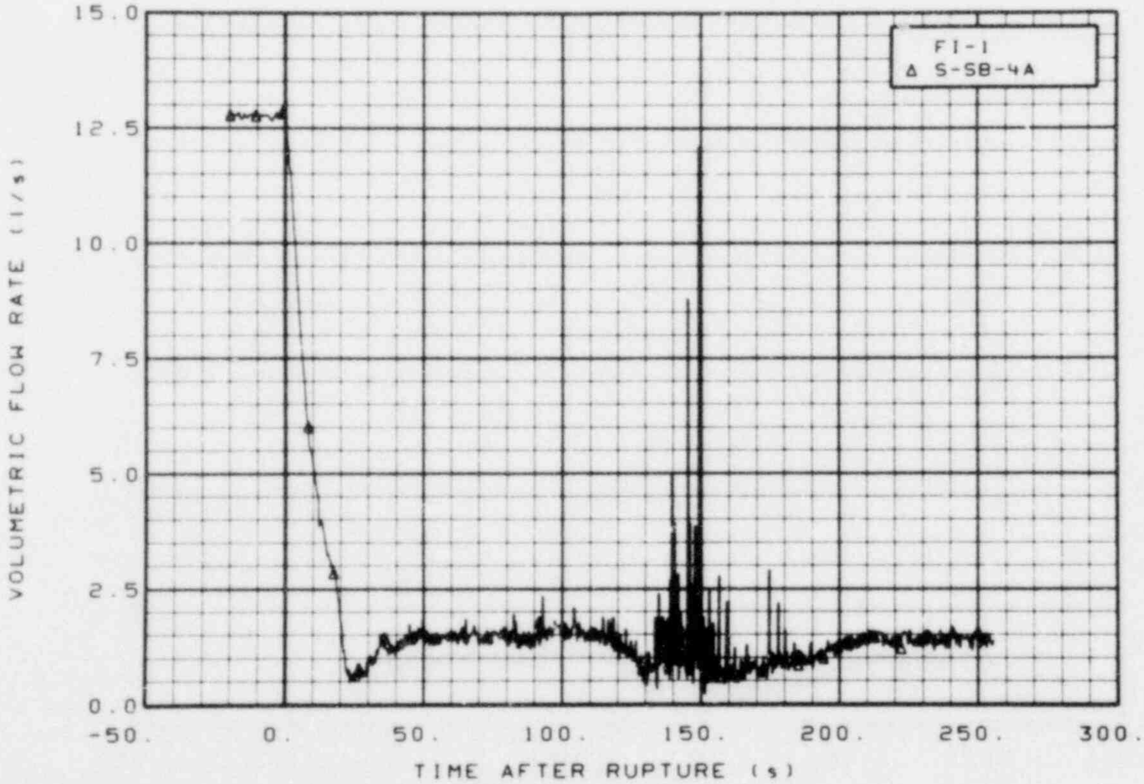


Figure 448. Volumetric flow rate in intact loop hot leg, Test S-SB-4A (FI-1), from -20 to 256 s.

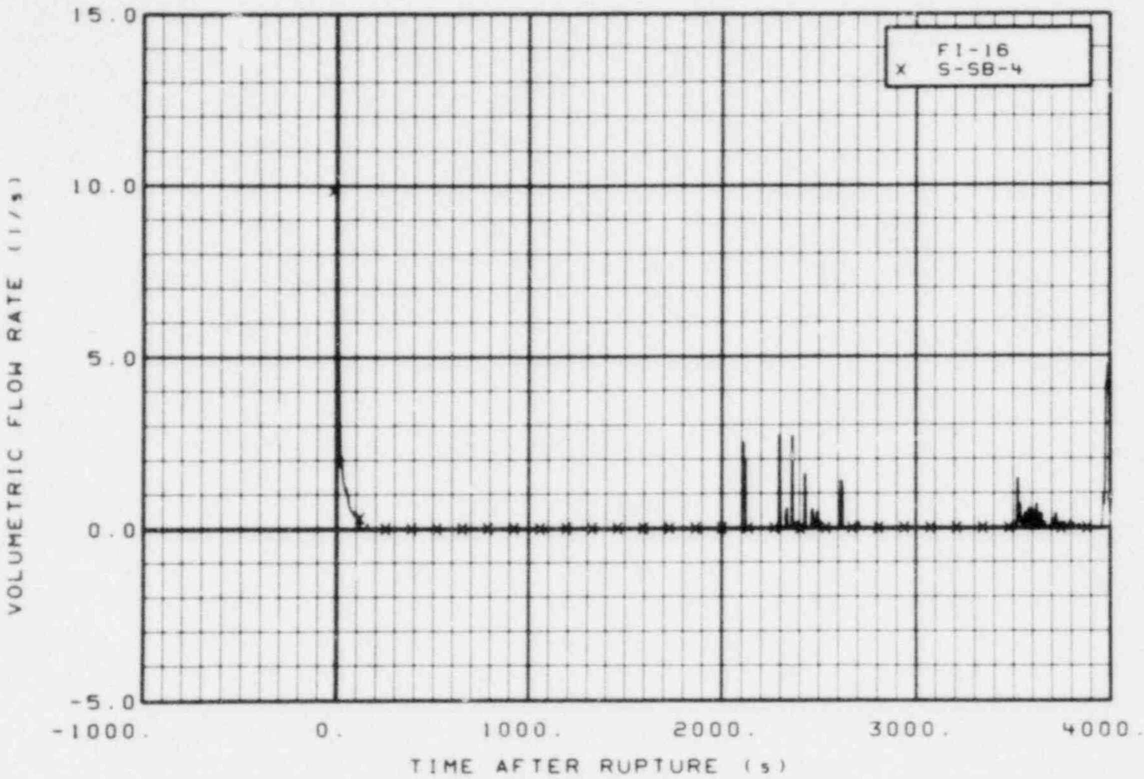


Figure 449. Volumetric flow rate in intact loop cold leg, Test S-SB-4 (FI-16), from -20 to 4000 s.

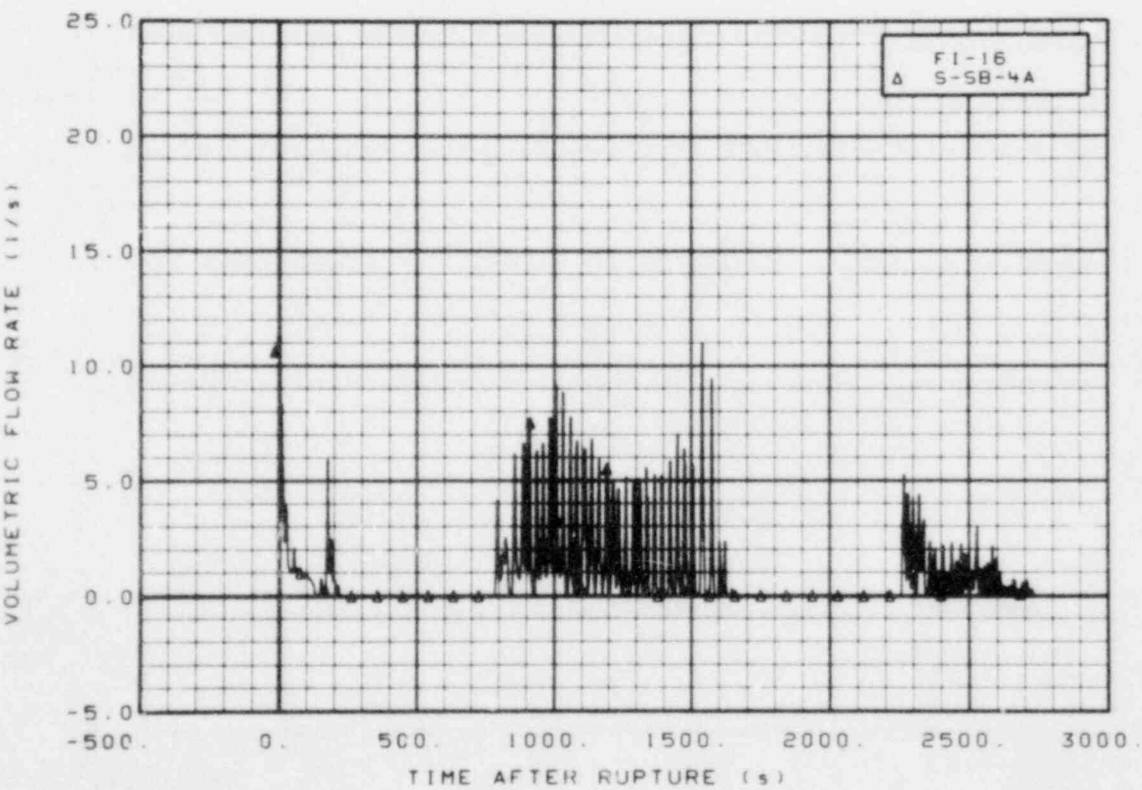


Figure 450. Volumetric flow rate in intact loop cold leg, Test S-SB-4A (FI-16), from -20 to 2740 s.

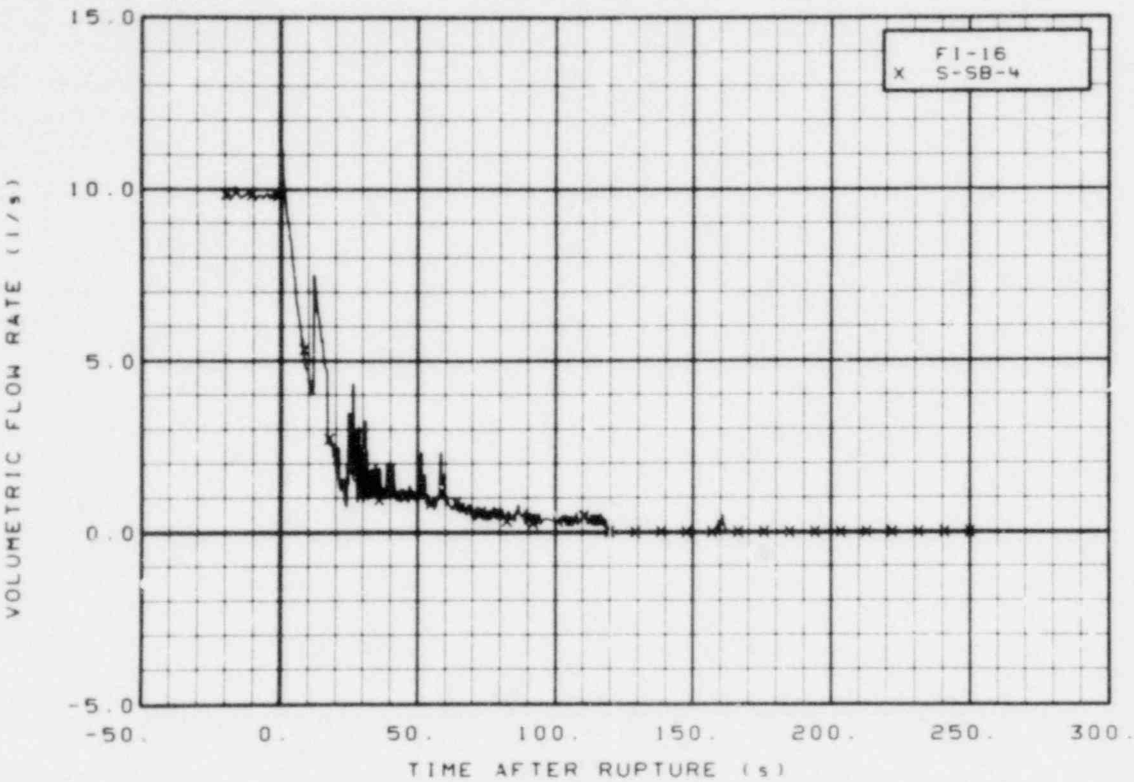


Figure 451. Volumetric flow rate in intact loop cold leg, Test S-SB-4 (FI-16), from -20 to 256 s.

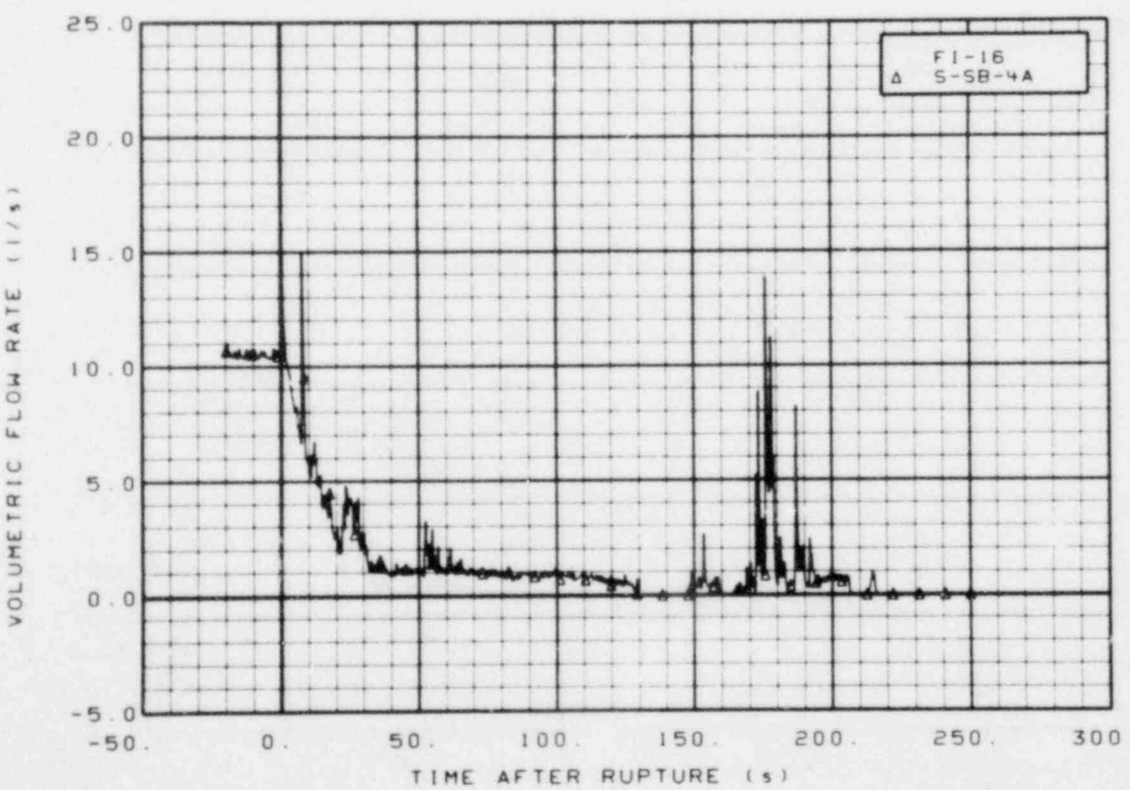


Figure 452. Volumetric flow rate in intact loop cold leg, Test S-SB-4A (FI-16), from -20 to 256 s.

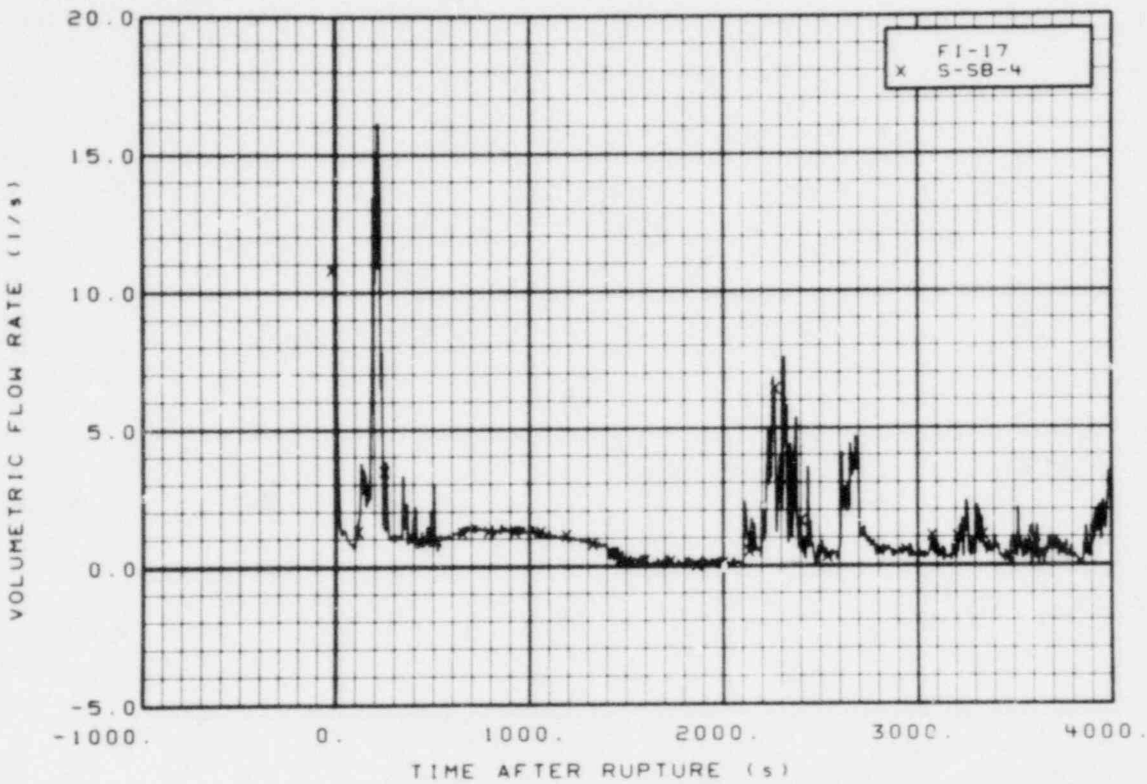


Figure 453. Volumetric flow rate in intact loop cold leg, Test S-SB-4 (FI-17), from -20 to 4000 s.

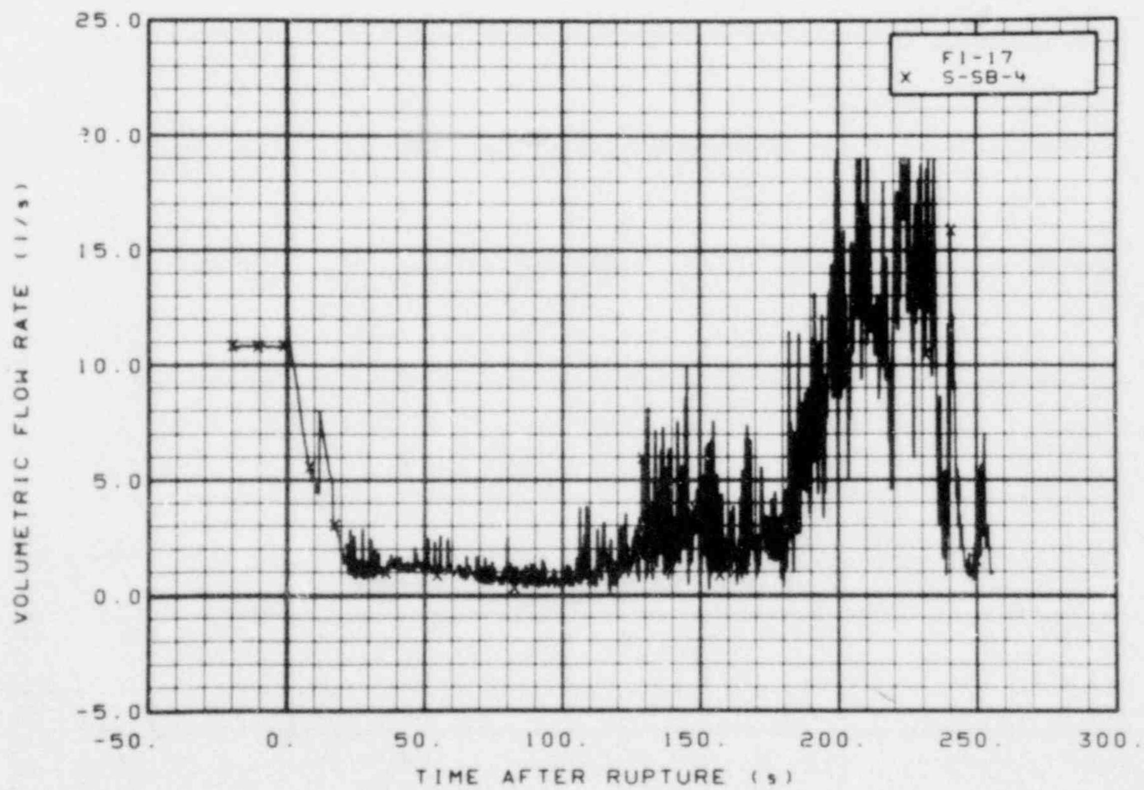


Figure 454. Volumetric flow rate in intact loop cold leg, Test S-SB-4 (FI-17), from -20 to 256 s.

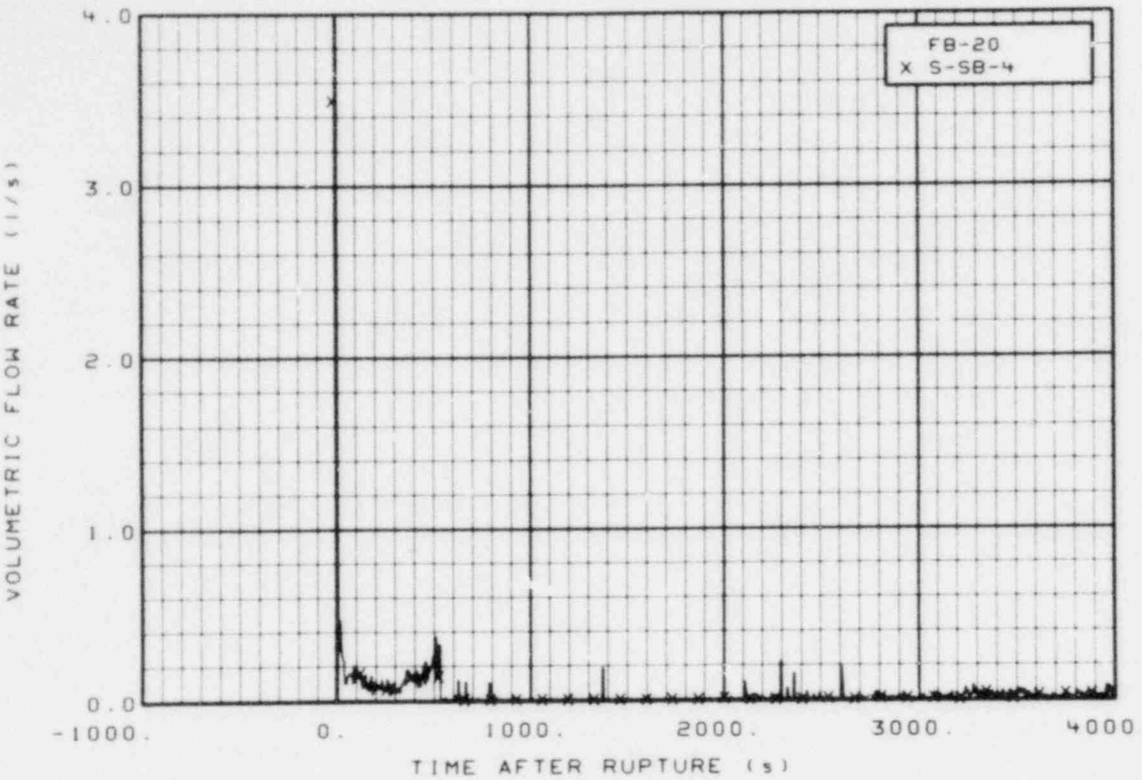


Figure 455. **Volumetric flow rate in broken loop hot leg, Test S-SB-4 (FB-20), from -20 to 4000 s.**

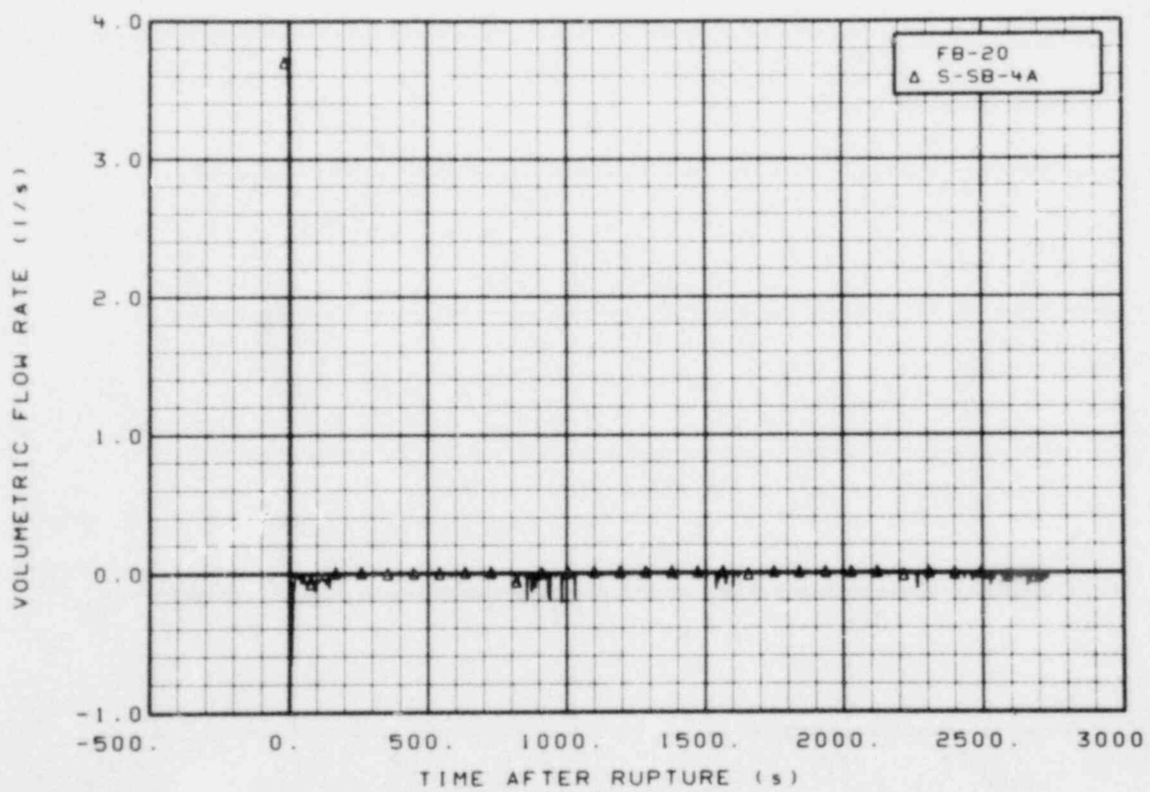


Figure 456. **Volumetric flow rate in broken loop hot leg, Test S-SB-4A (FB-20), from -20 to 2740 s.**

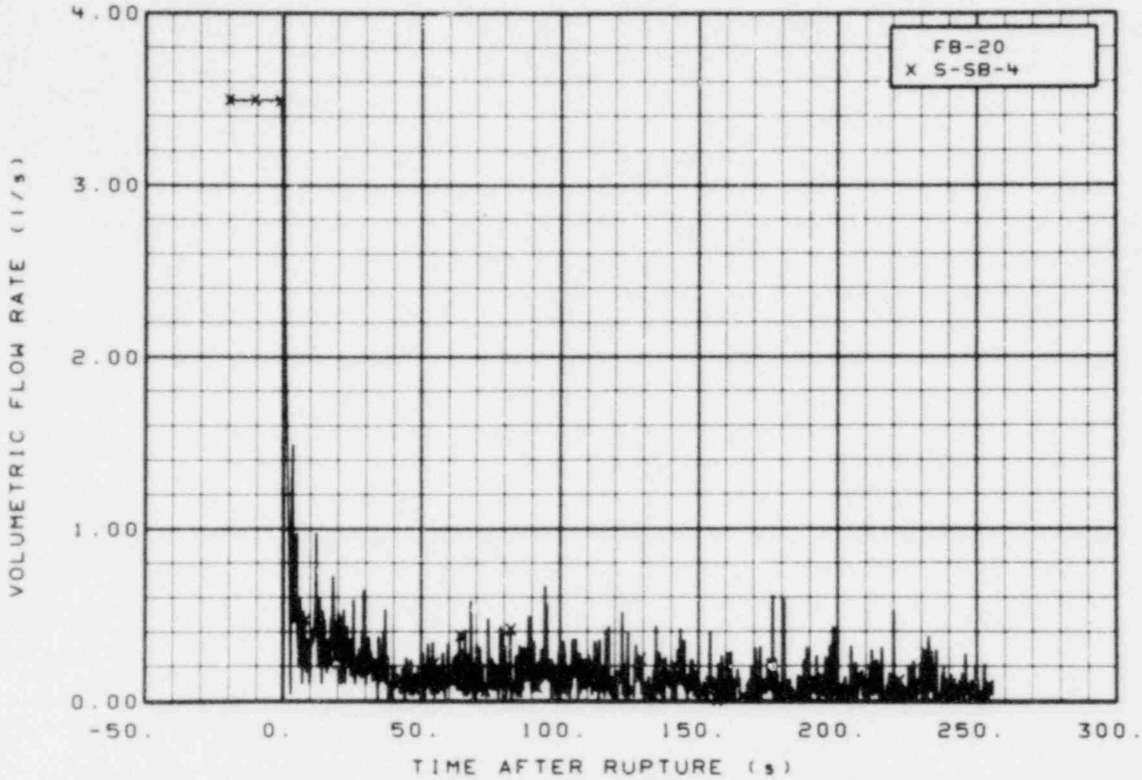


Figure 457. Volumetric flow rate in broken loop hot leg, Test S-SB-4 (FB-20), from -20 to 256 s.

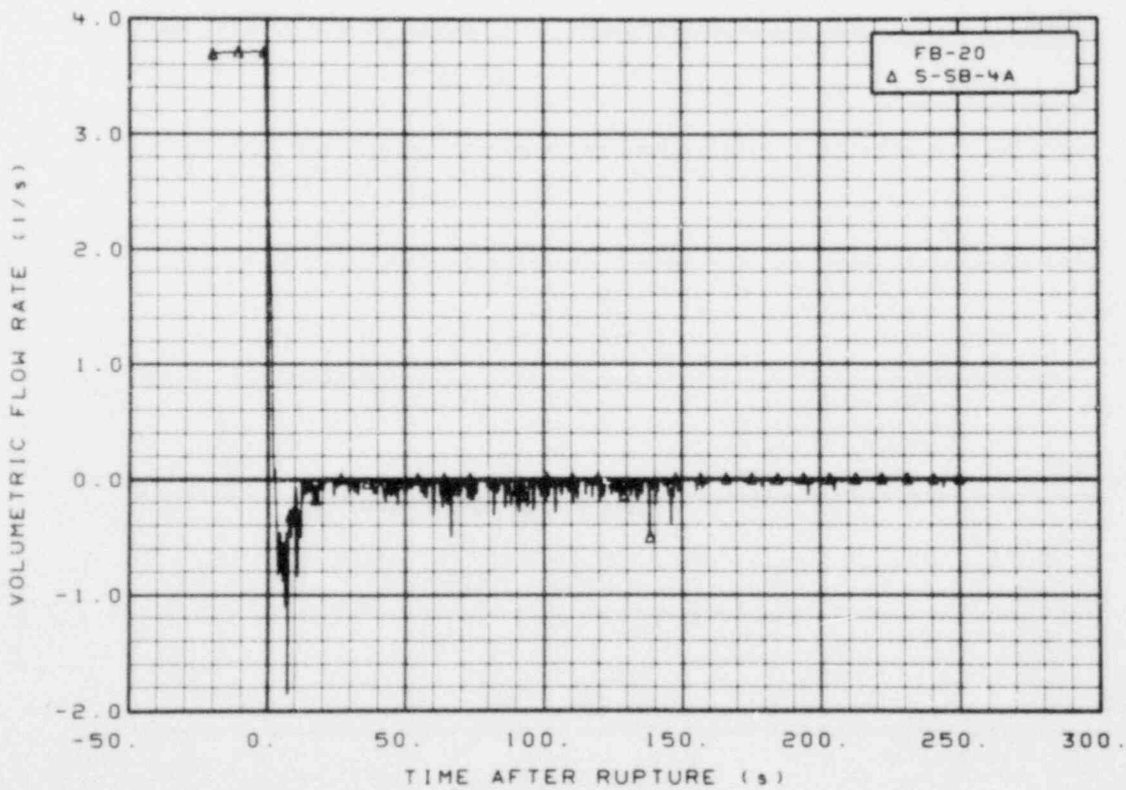


Figure 458. Volumetric flow rate in broken loop hot leg, Test S-SB-4A (FB-20), from -20 to 256 s.

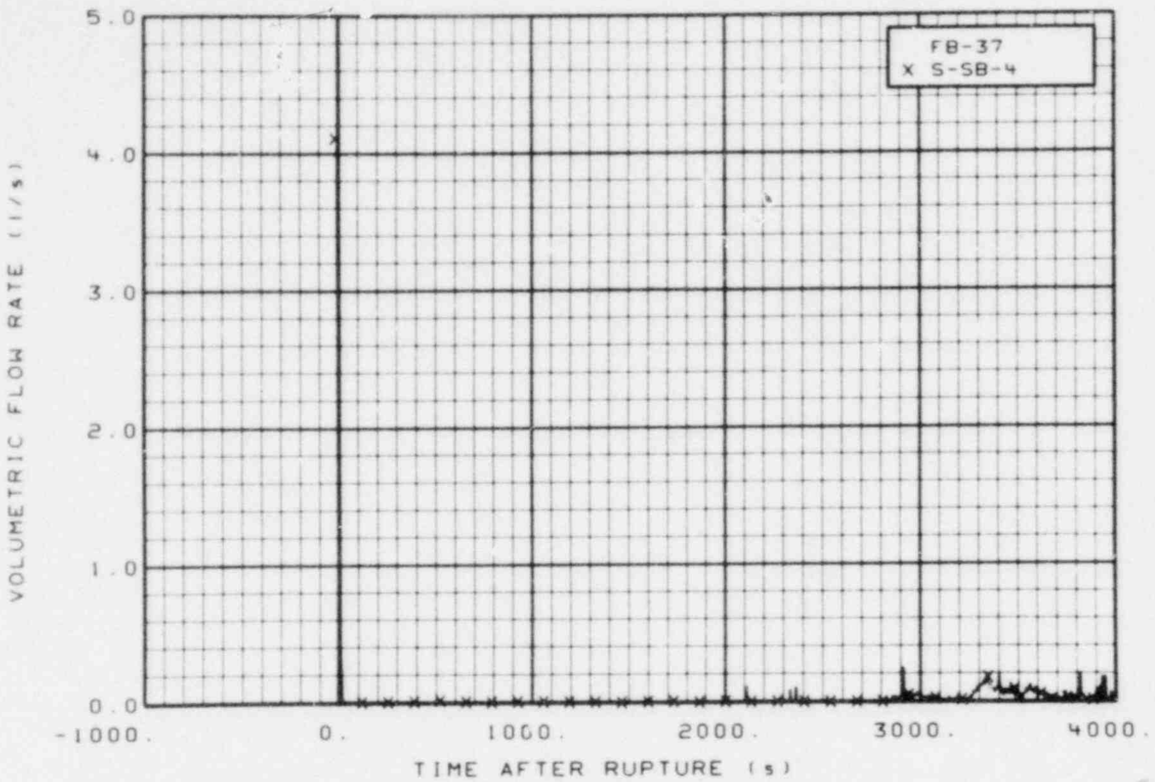


Figure 459. Volumetric flow rate in broken loop cold leg, Test S-SB-4 (FB-37), from -20 to 4000 s.

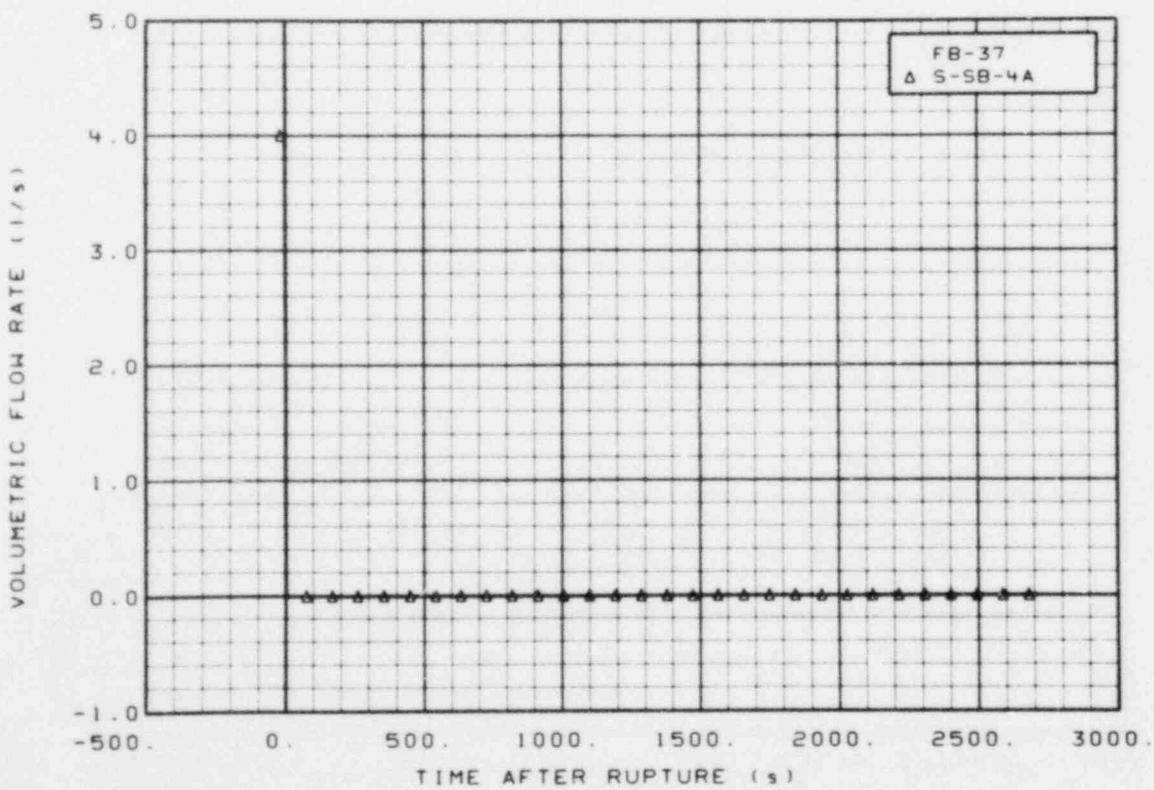


Figure 460. Volumetric flow rate in broken loop cold leg, Test S-SB-4A (FB-37), from -20 to 2740 s.

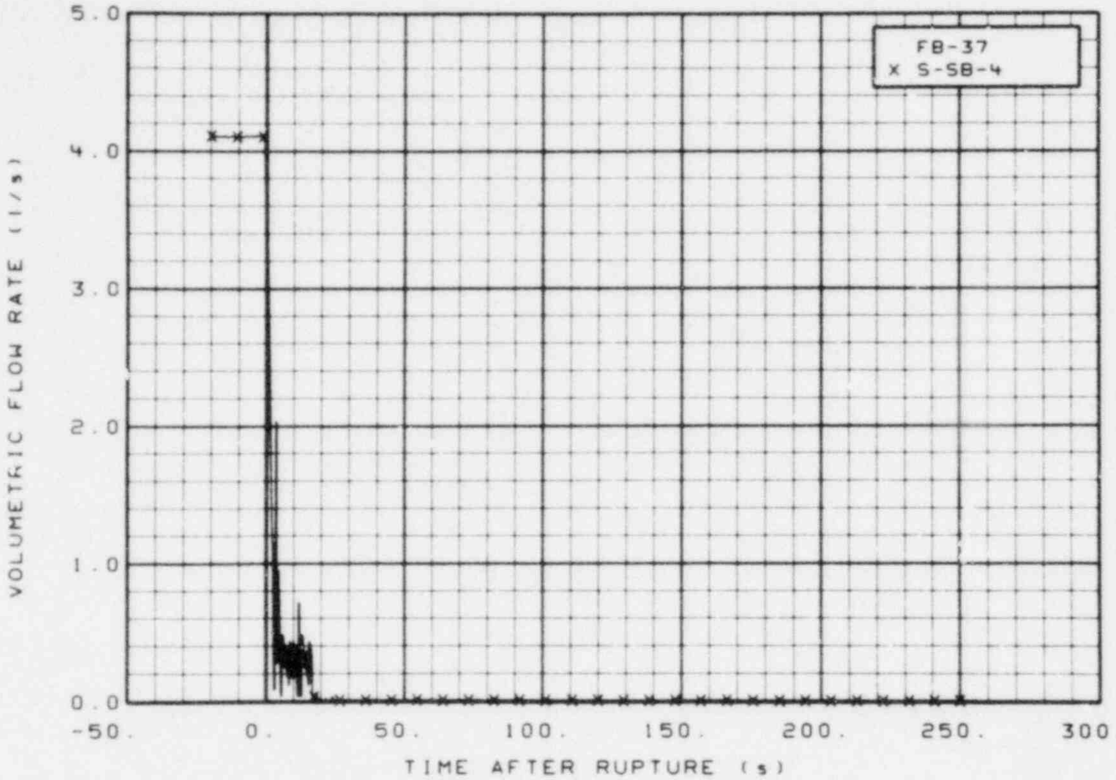


Figure 461. Volumetric flow rate in broken loop cold leg, Test S-SB-4 (FB-37), from -20 to 256 s.

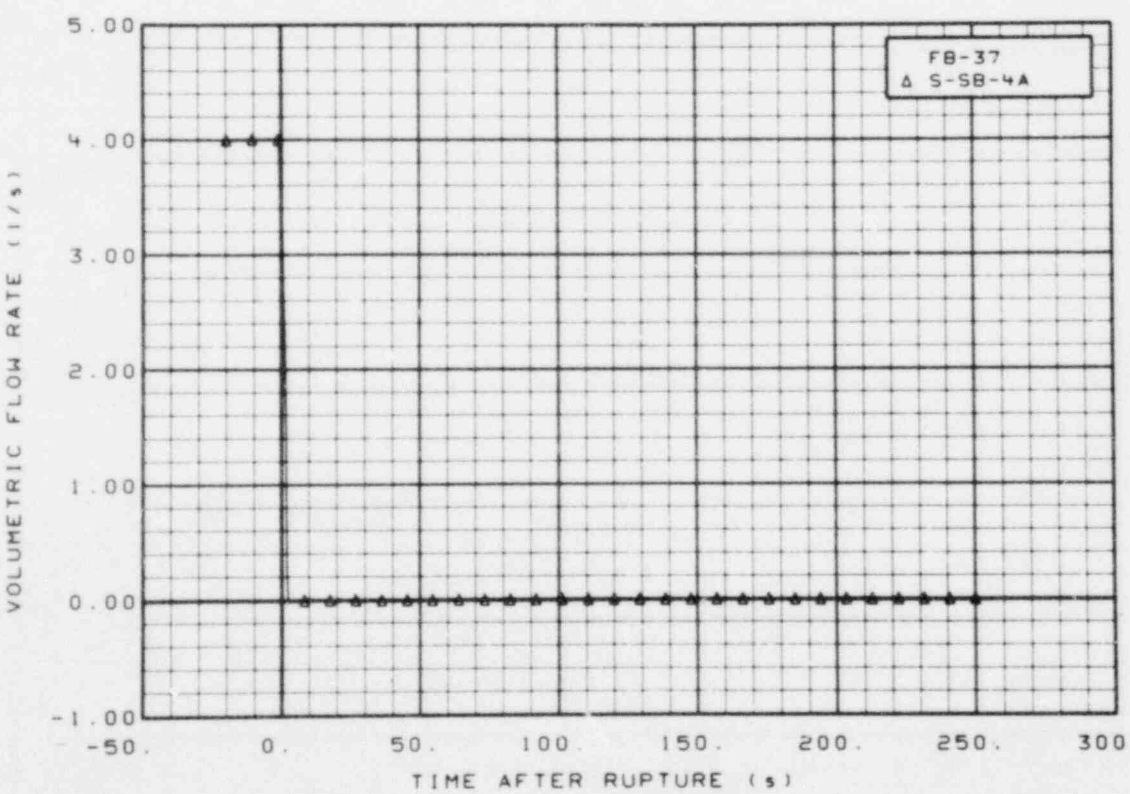


Figure 462. Volumetric flow rate in broken loop cold leg, Test S-SB-4A (FB-37), from -20 to 256 s.

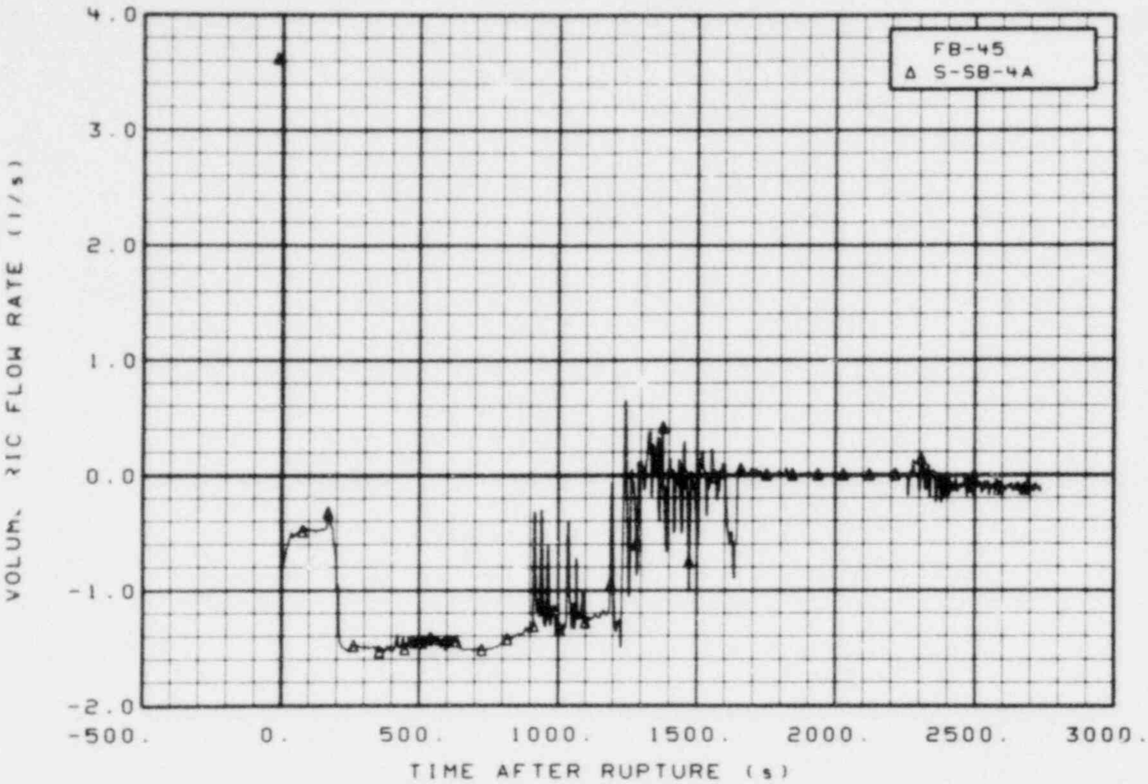


Figure 463. Volumetric flow rate in broken loop cold leg, Test S-SB-4A (FB-45), from -20 to 2740 s.

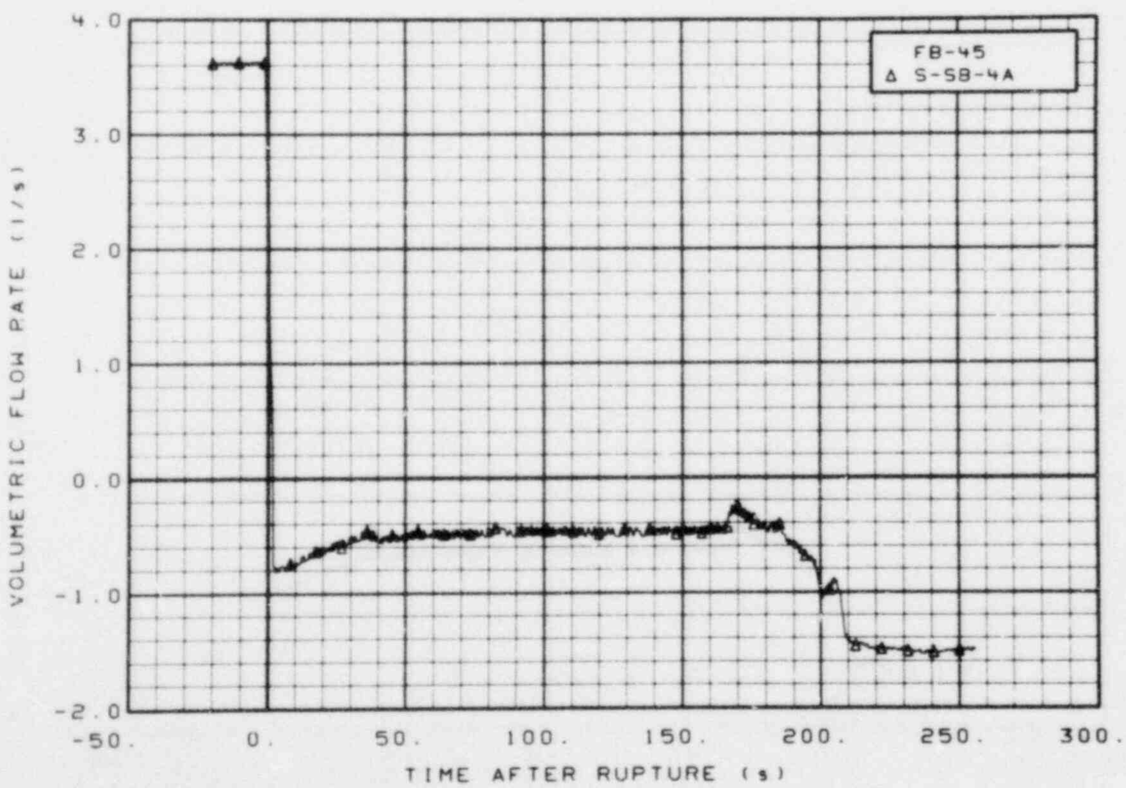


Figure 464. Volumetric flow rate in broken loop cold leg, Test S-SB-4A (FB-45), from -20 to 256 s.

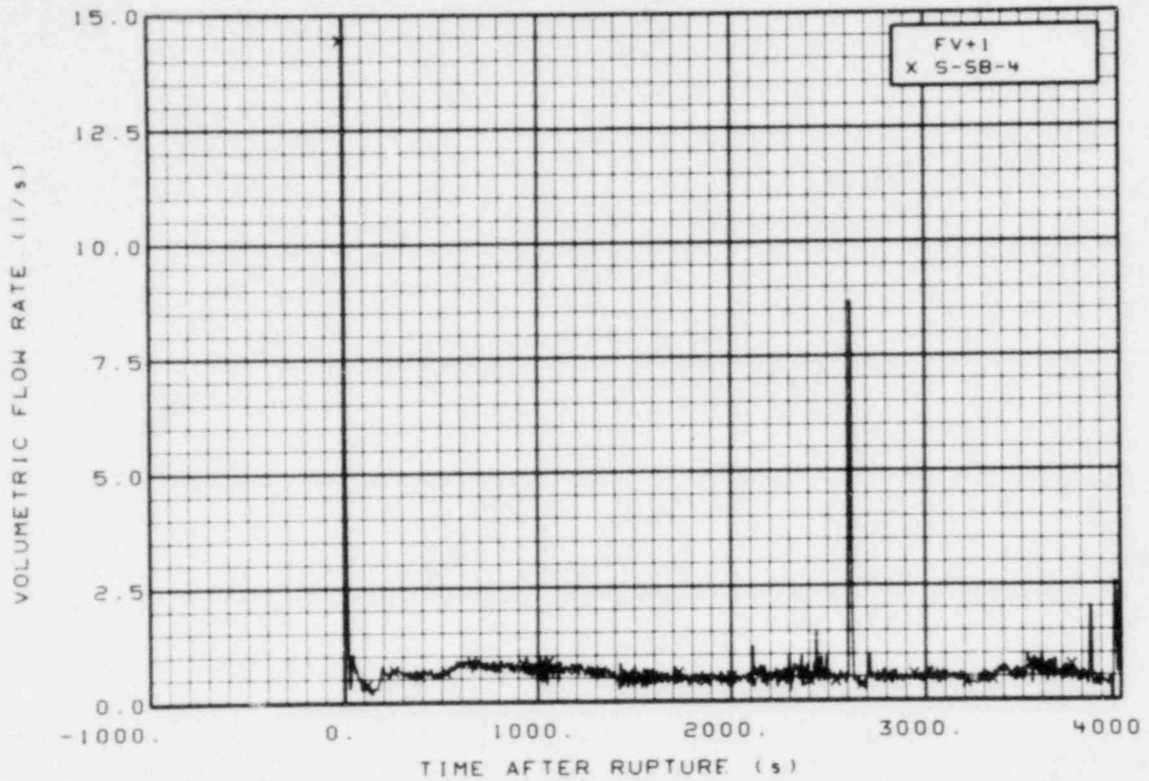


Figure 465. Volumetric flow rate in vessel upper plenum, Tes' S-SB-4 (FV + 1), from -20 to 4000 s.

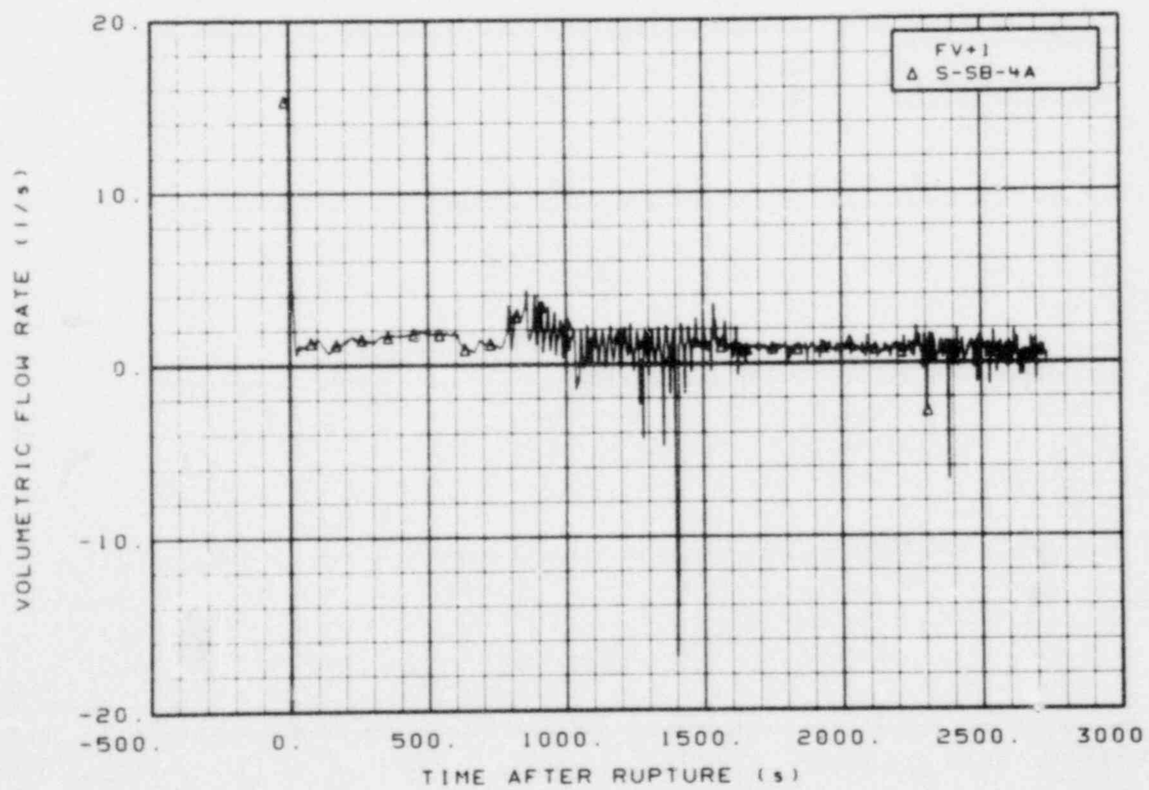


Figure 466. Volumetric flow rate in vessel upper plenum, Test S-SB-4A (FV + 1), from -20 to 2740 s.

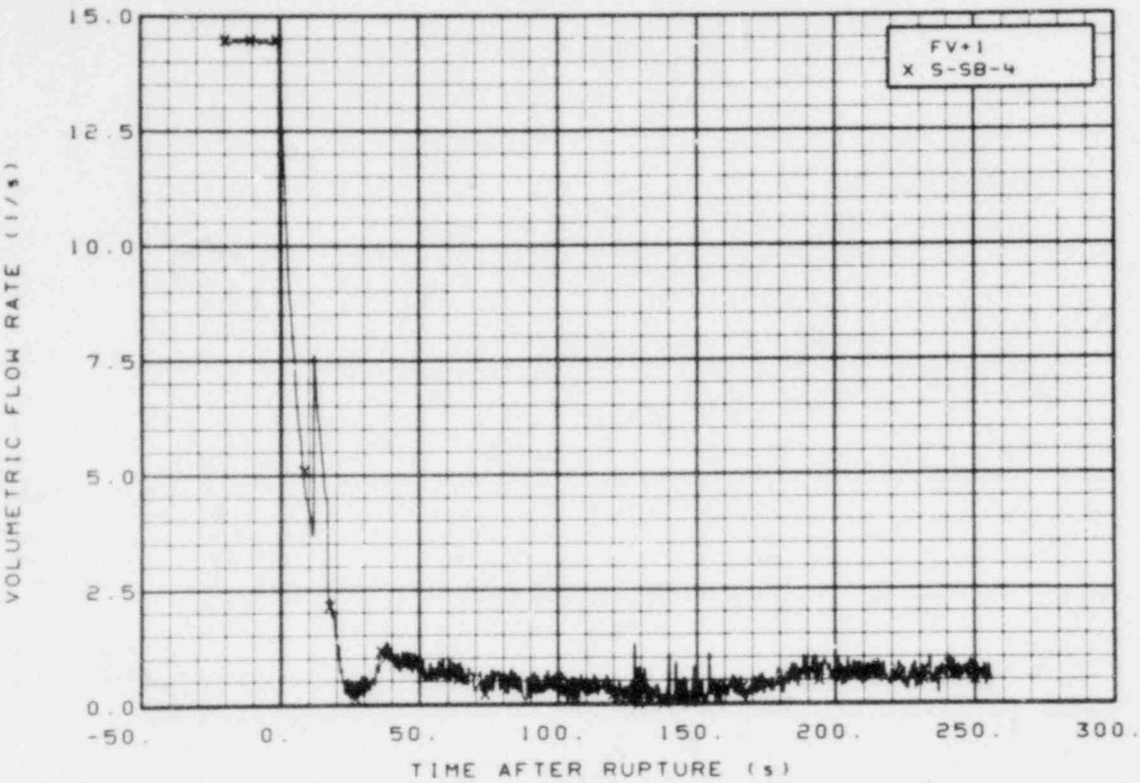


Figure 467. Volumetric flow rate in vessel upper plenum, Test S-SB-4 (FV + 1), from -20 to 256 s.

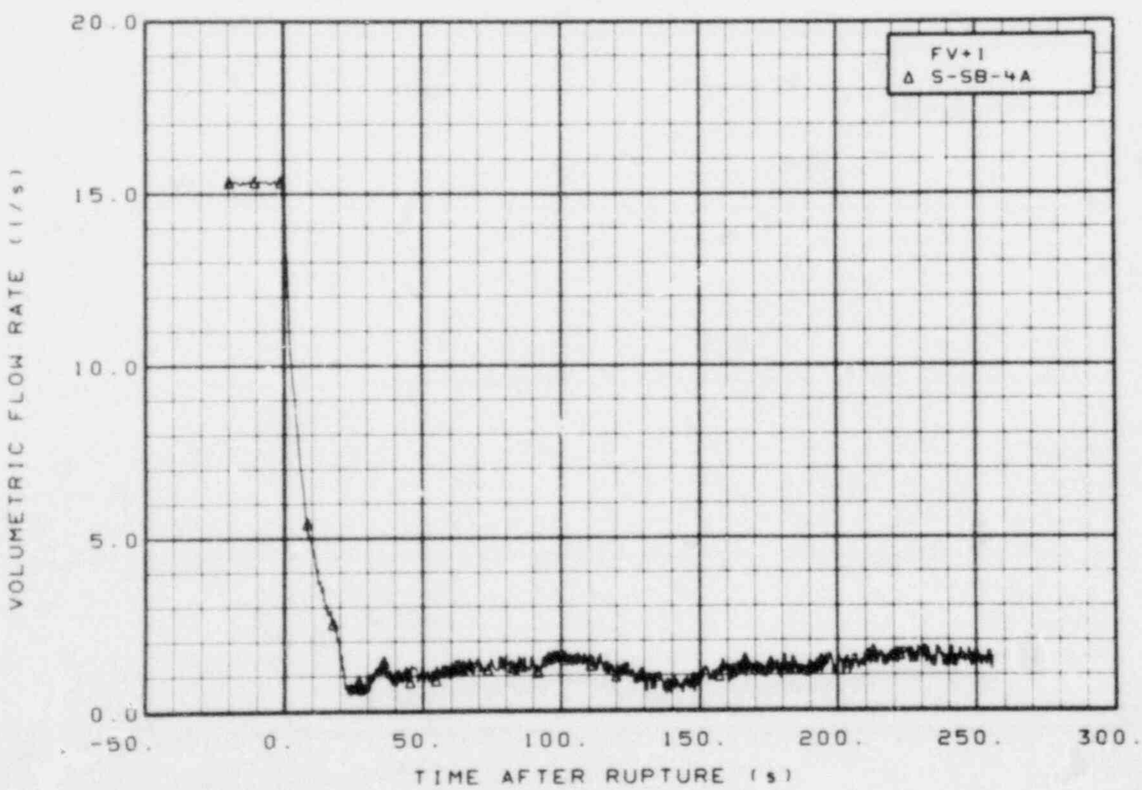


Figure 468. Volumetric flow rate in vessel upper plenum, Test S-SB-4A (FV + 1), from -20 to 256 s.

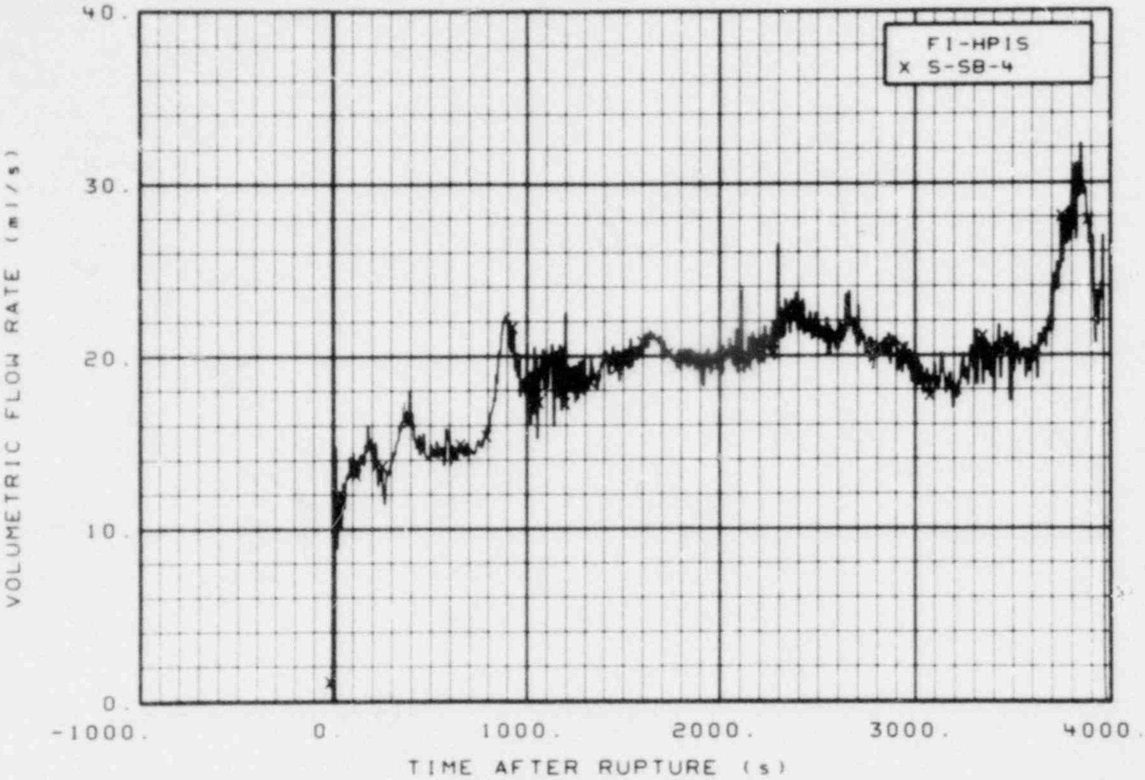


Figure 469. Volumetric flow rate in intact loop high pressure injectionsystem, Test S-SB-4 (FI-HPIS), from -20 to 4000 s.

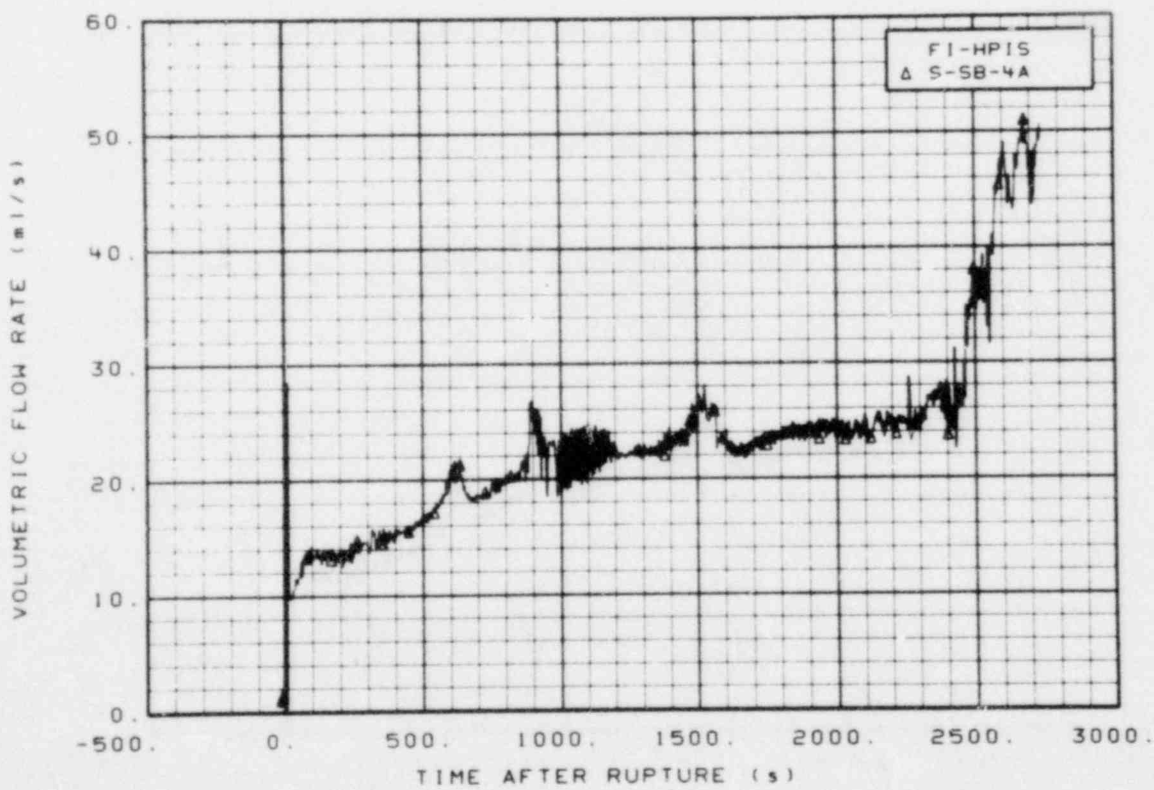


Figure 470. Volumetric flow rate in intact loop high pressure injection system. Test S-SB-4A (FI-HPIS), from -20 to 2740 s.

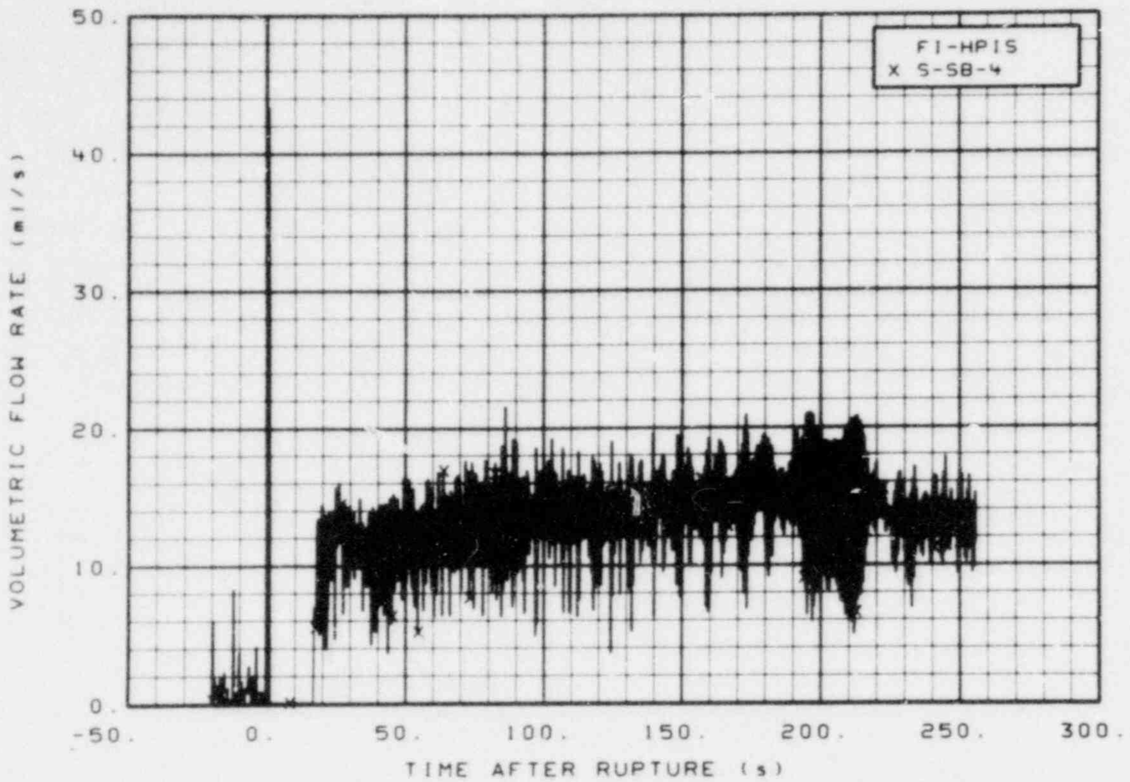


Figure 471. Volumetric flow rate in intact loop high pressure injection system, Test S-SB-4 (FI-HP!S), from -20 to 256 s.

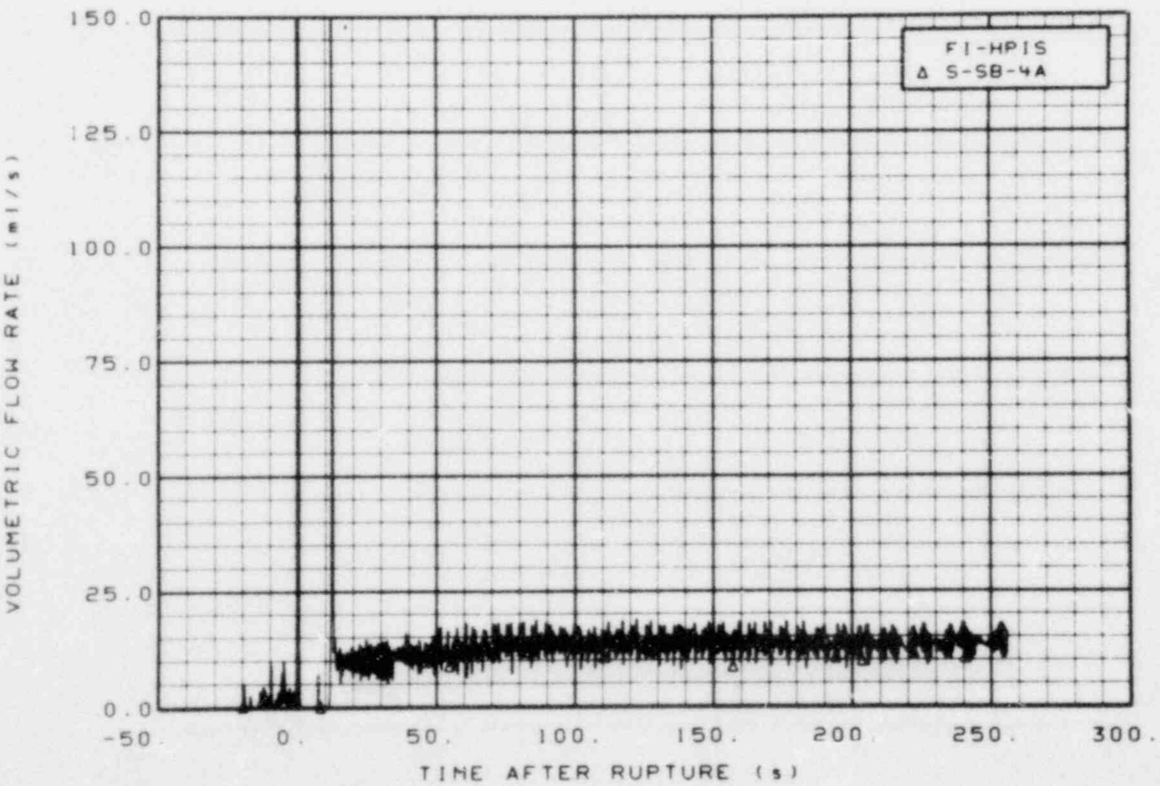


Figure 472. Volumetric flow rate in intact loop high pressure injection system, Test S-SB-4A (FI-HPIS), from -20 to 256 s.

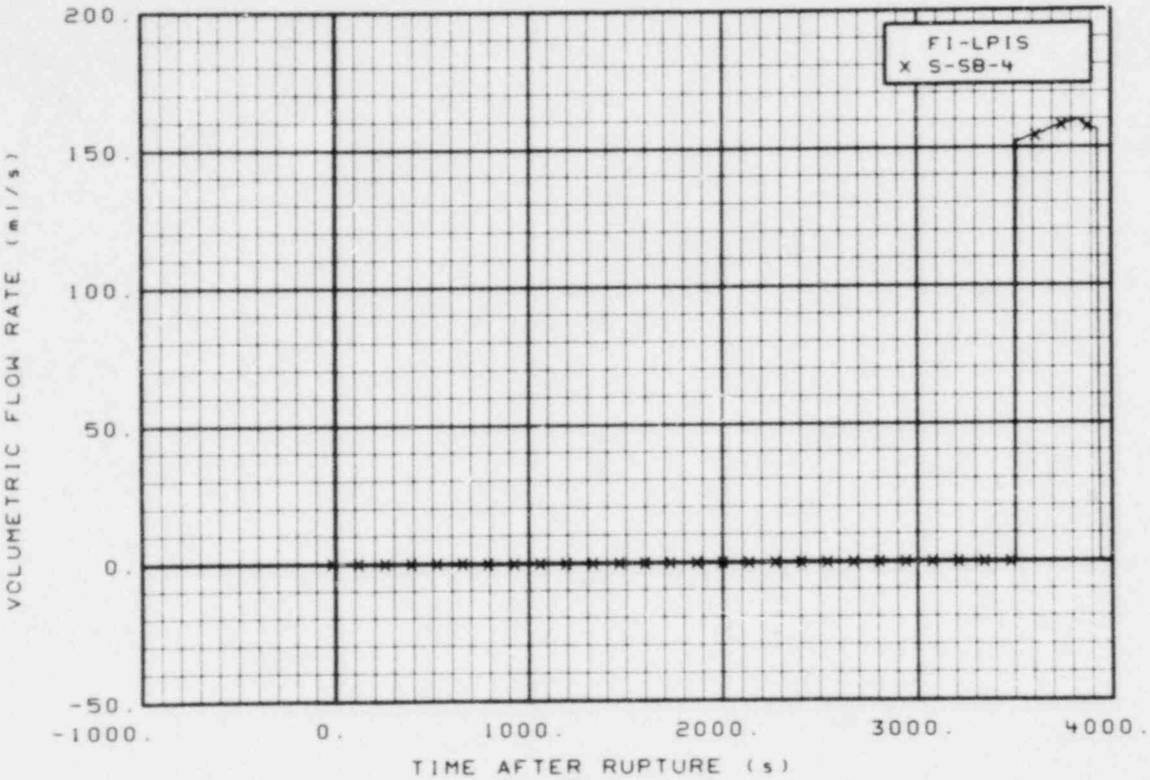


Figure 473. Volumetric flow rate in intact loop low pressure injection system, Test S-SB-4 (FI-LPIS), from -20 to 4000 s.

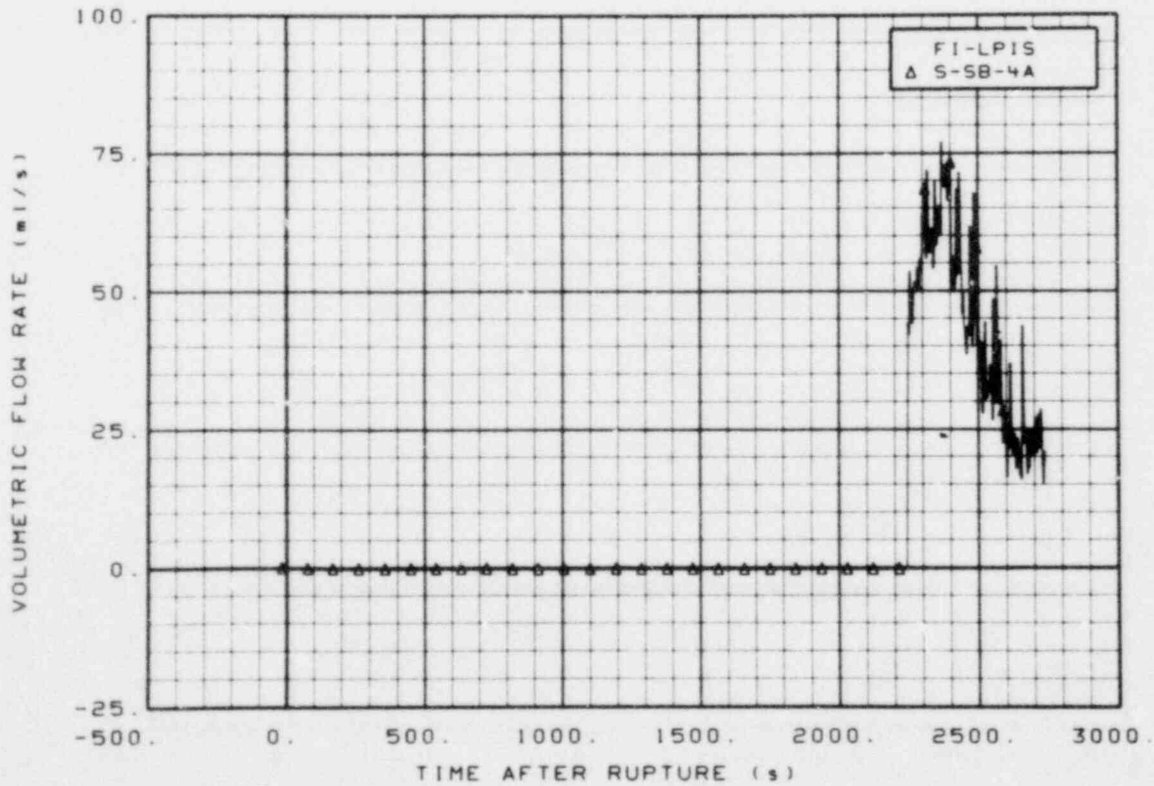


Figure 474. Volumetric flow rate in intact loop low pressure injection system, Test S-SB-4A (FI-LPIS), from -20 to 2740 s.

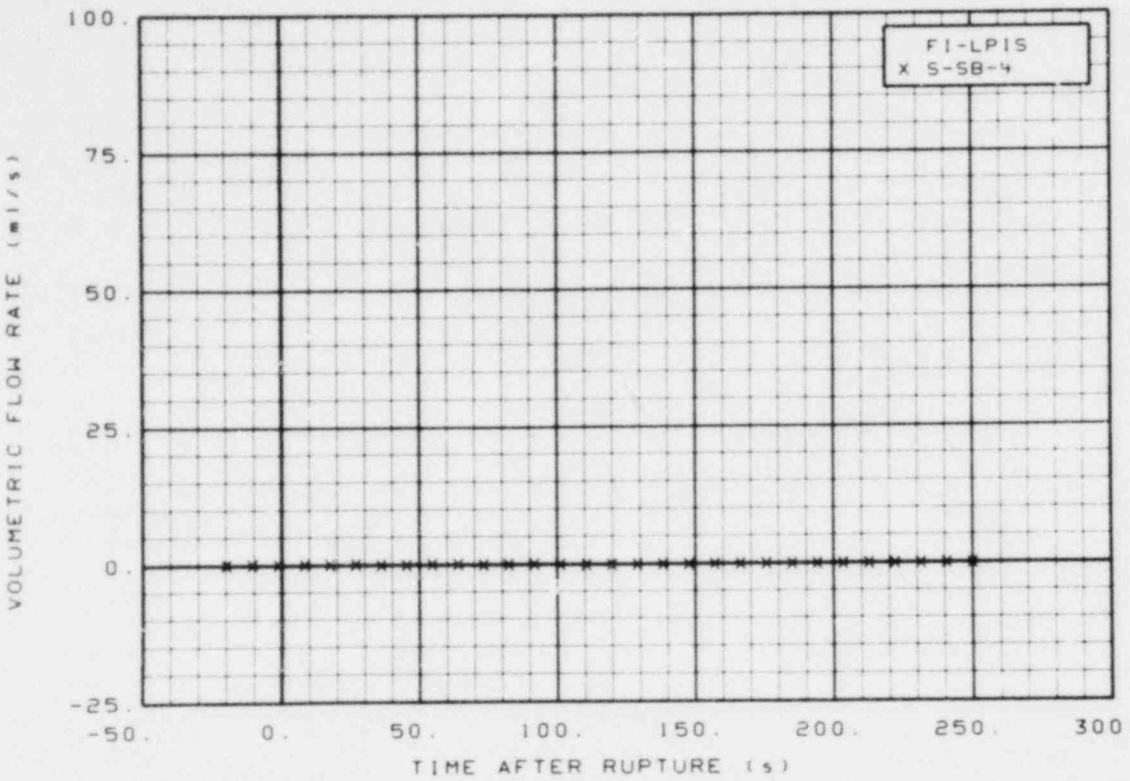


Figure 475. Volumetric flow rate in intact loop low pressure injection system, Test S-SB-4 (FI-LPIS), from -20 to 256 s.

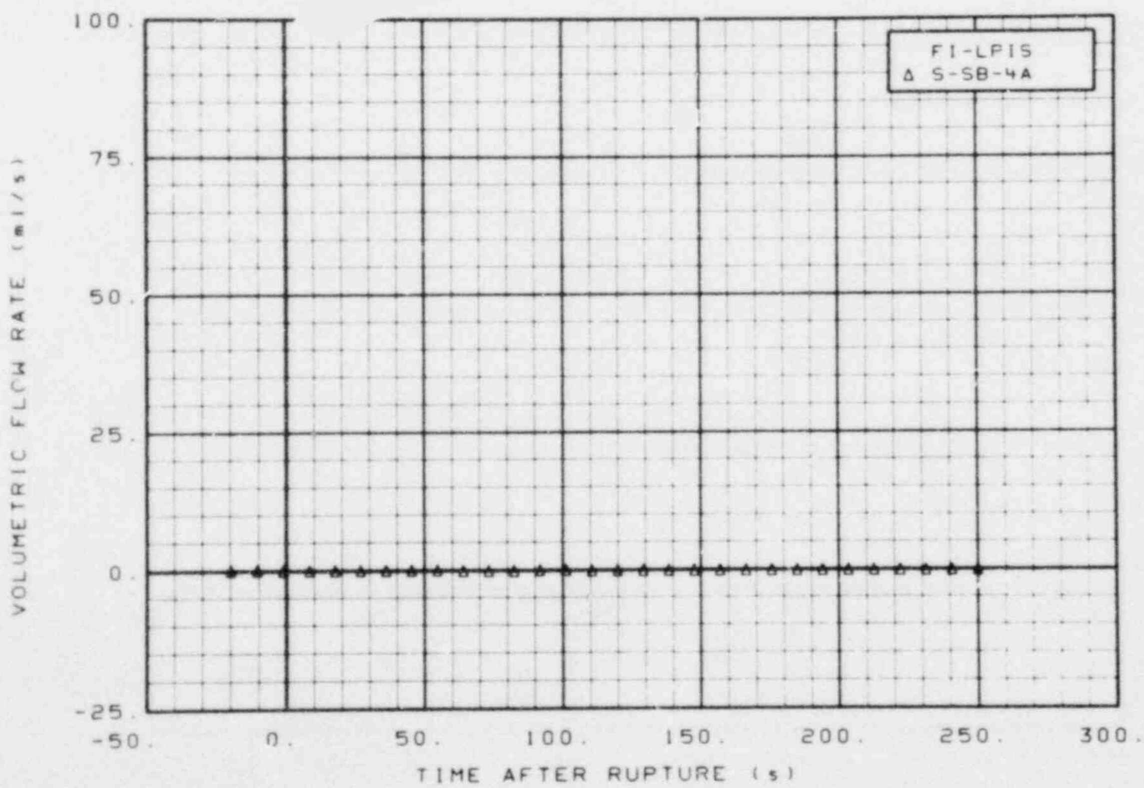


Figure 476. Volumetric flow rate in intact loop low pressure injection system, Test S-SB-4A (FI-LPIS), from -20 to 256 s.

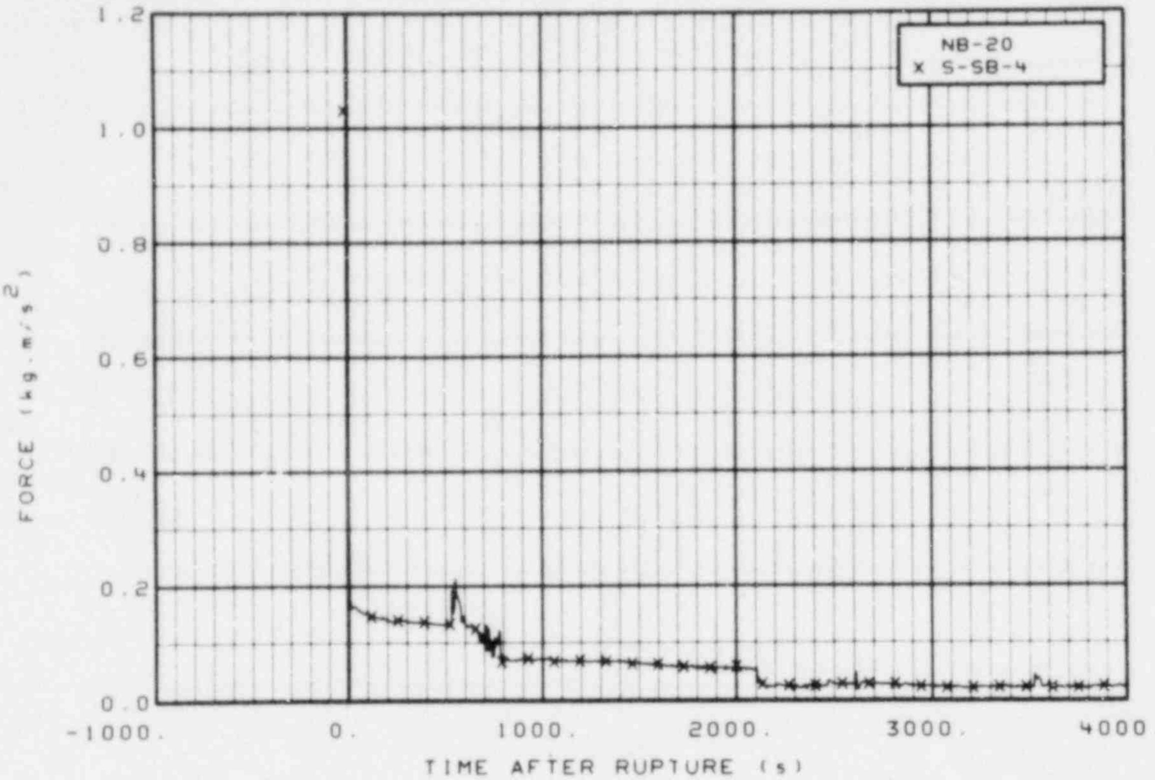


Figure 477. Momentum flux in broken loop hot leg, Test S-SB-4 (NB-20), from -20 to 4000 s.

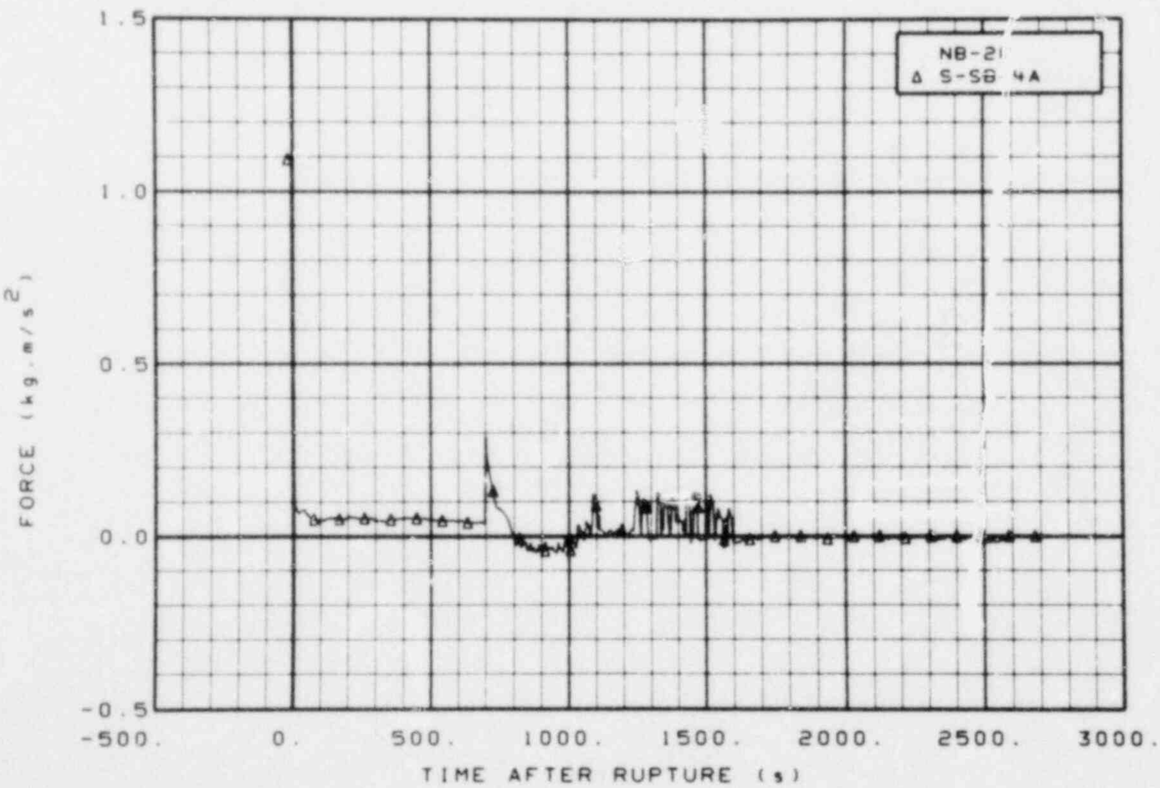


Figure 478. Momentum flux in broken loop hot leg, Test S-SB-4A (NB-20), from -20 to 2740 s.

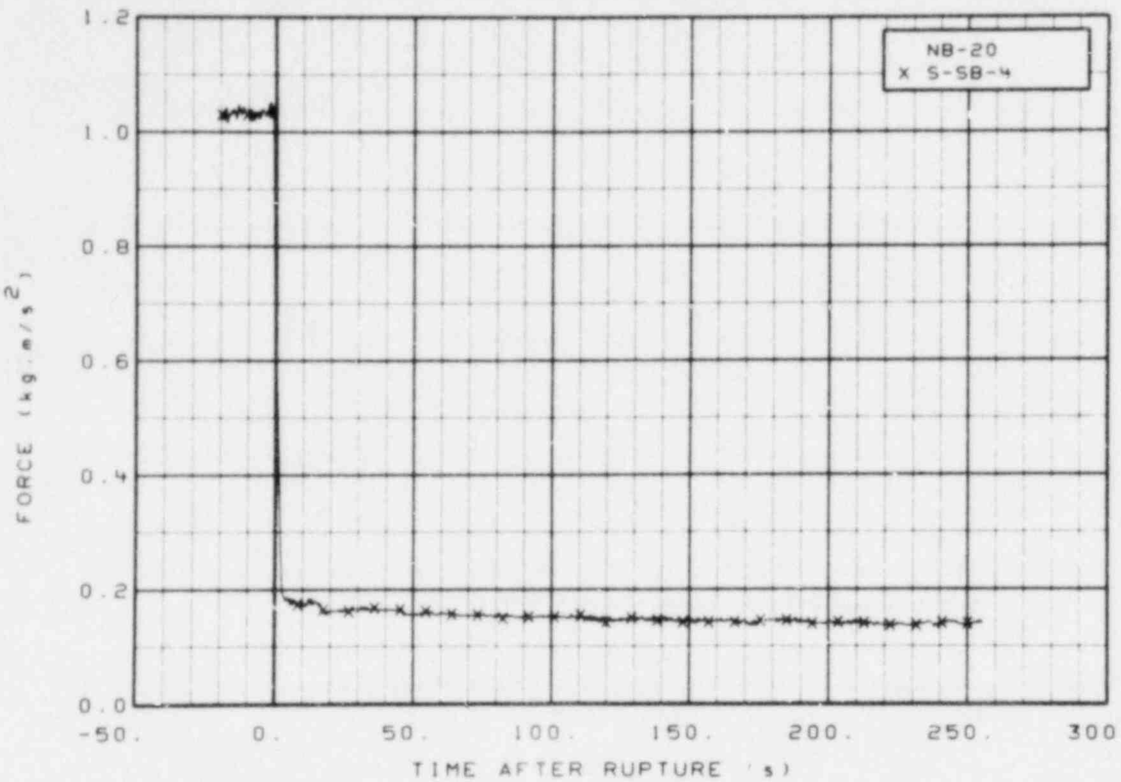


Figure 479. Momentum flux in broken loop hot leg, Test S-SB-4 (NB-20), from -20 to 256 s.

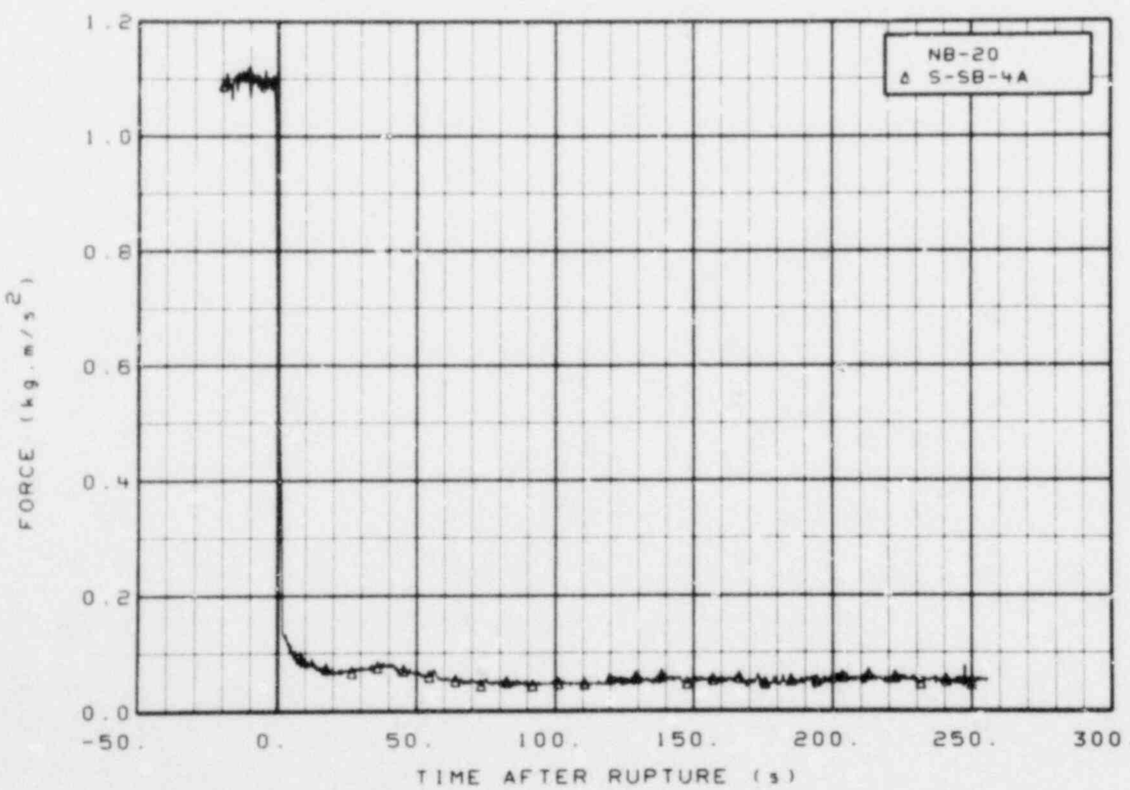


Figure 480. Momentum flux in broken loop hot leg, Test S-SB-4A (NB-20), from -20 to 256 s.

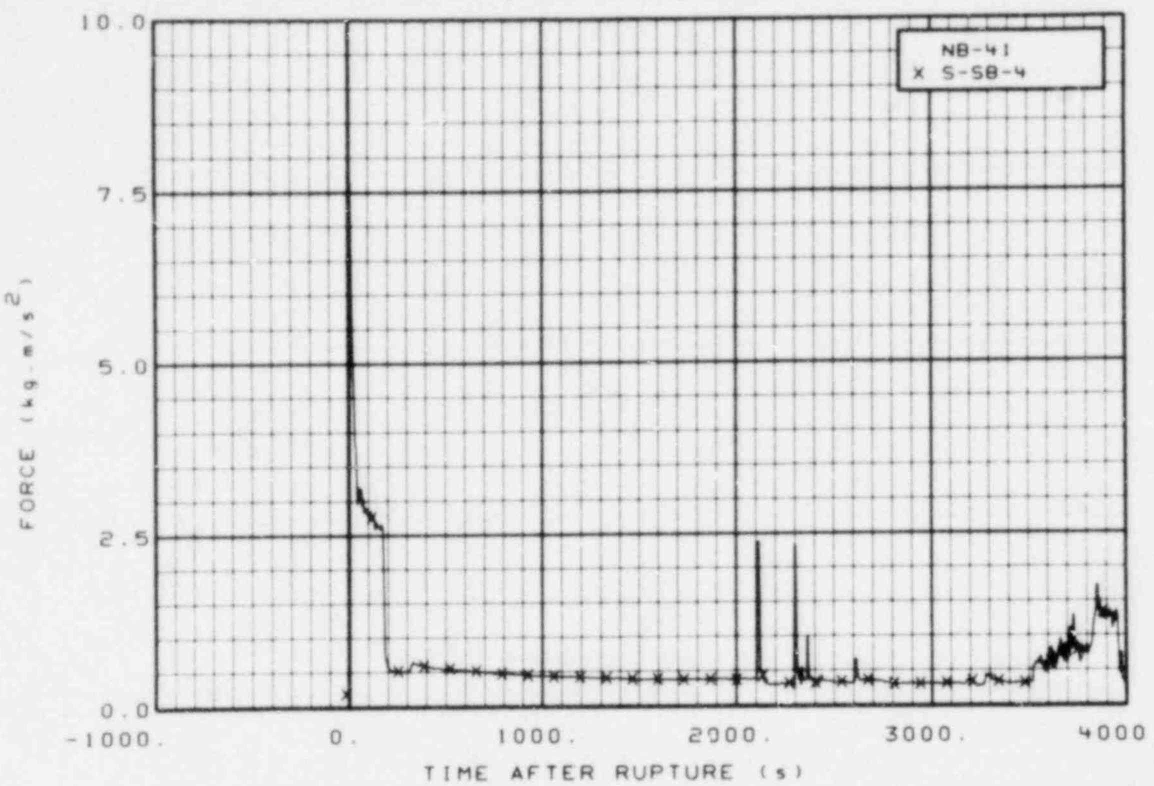


Figure 481. Momentum flux in broken loop cold leg, Test S-SB-4 (NB-41), from -20 to 4000 s.

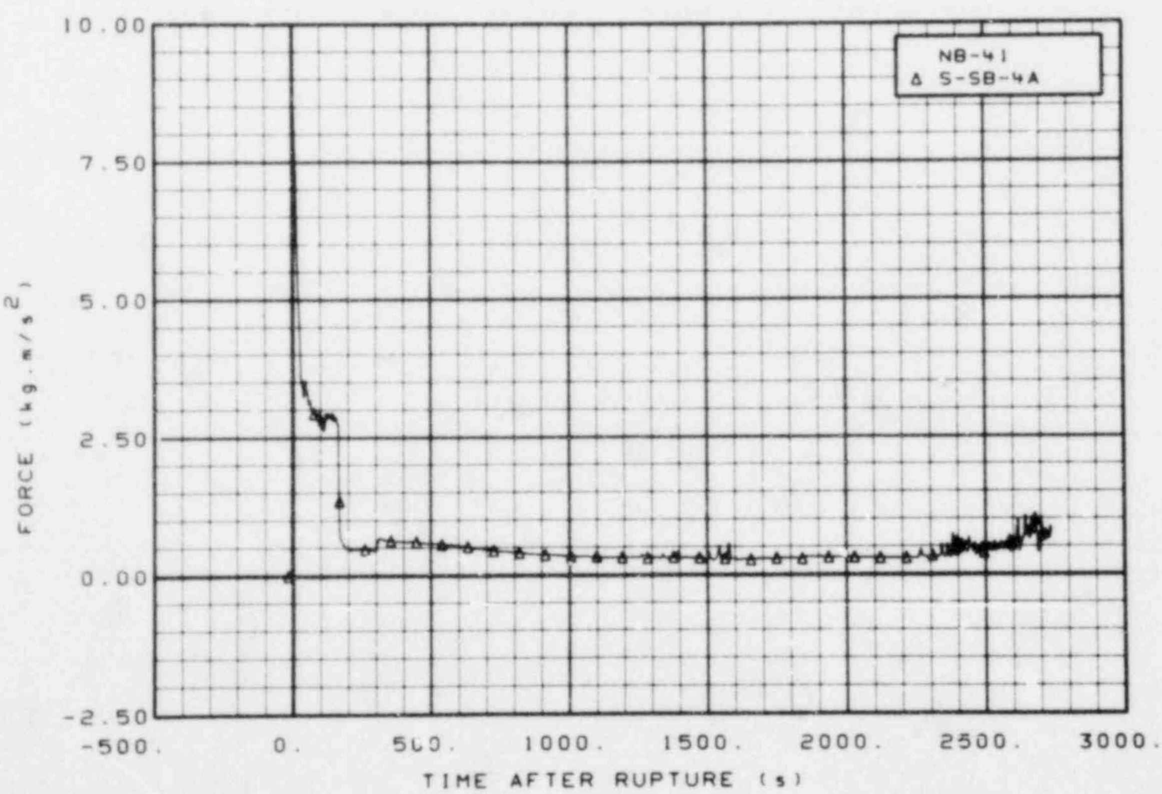


Figure 482. Momentum flux in broken loop cold leg, Test S-SB-4A (NB-41), from -20 to 2740 s.

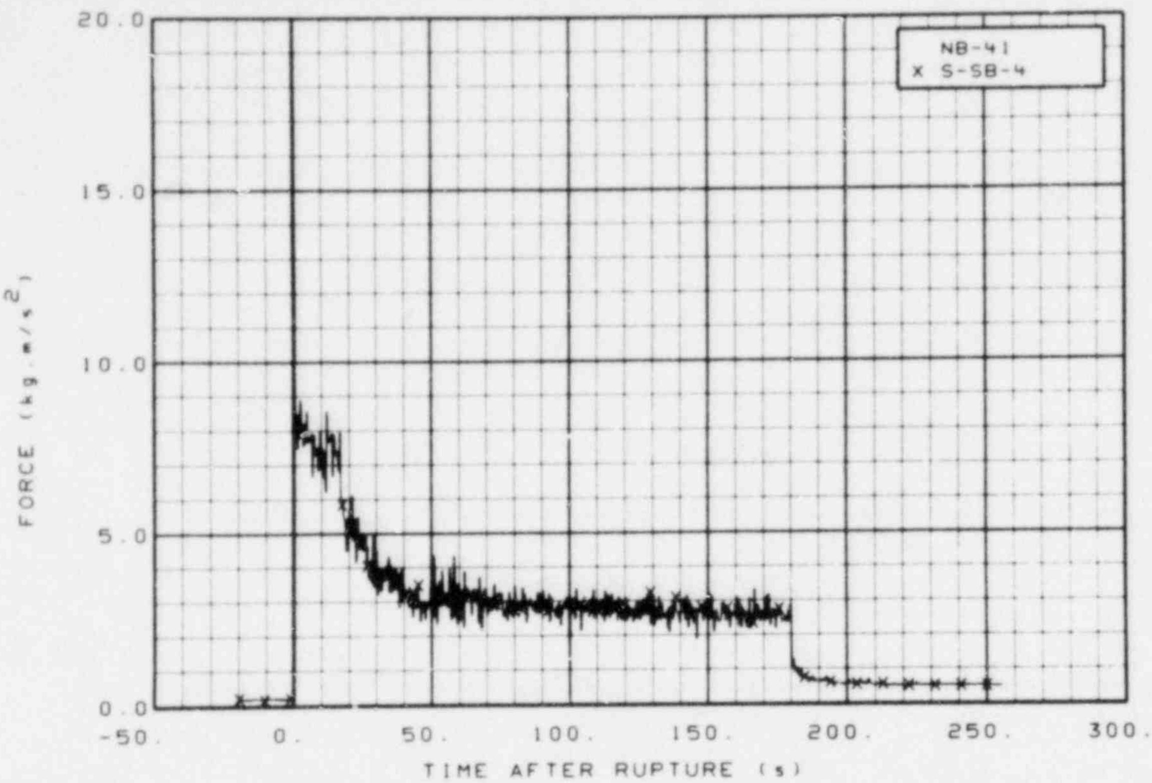


Figure 483. Momentum flux in broken loop cold leg, Test S-SB-4 (NB-41), from -20 to 256 s.

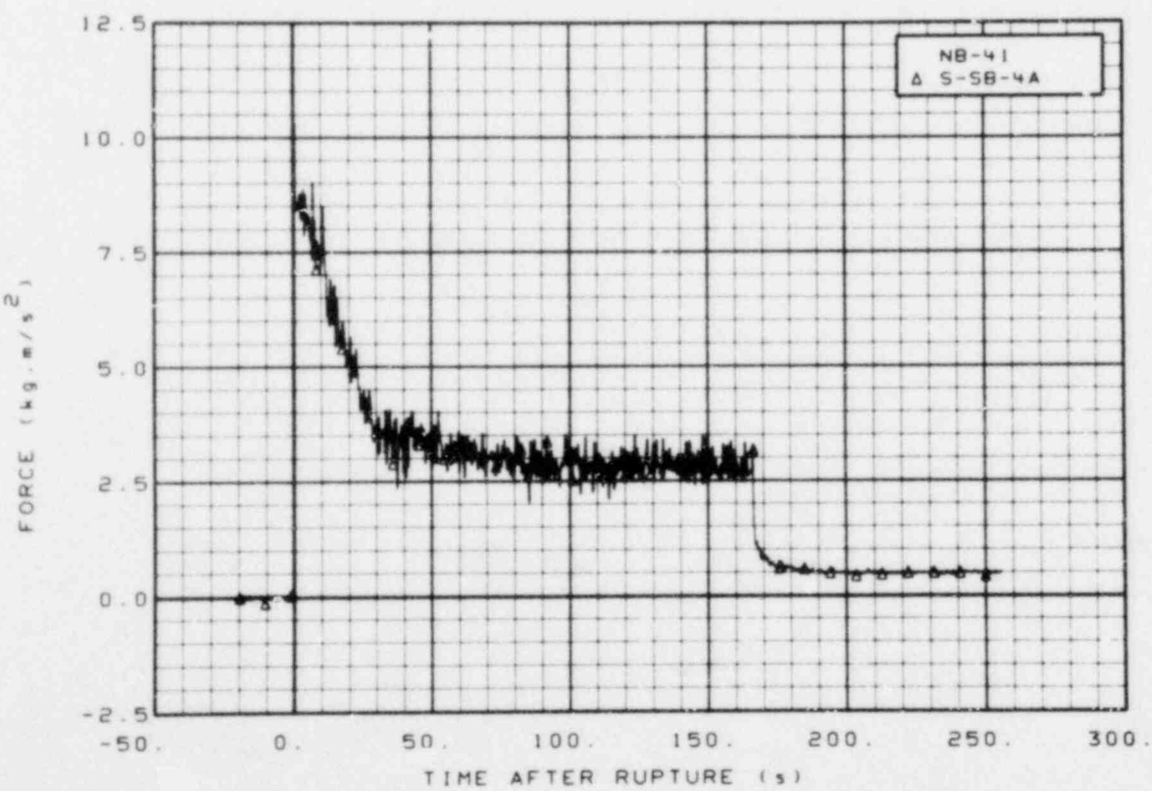


Figure 484. Momentum flux in broken loop cold leg, Test S-SB-4A (NB-41), from -20 to 256 s.

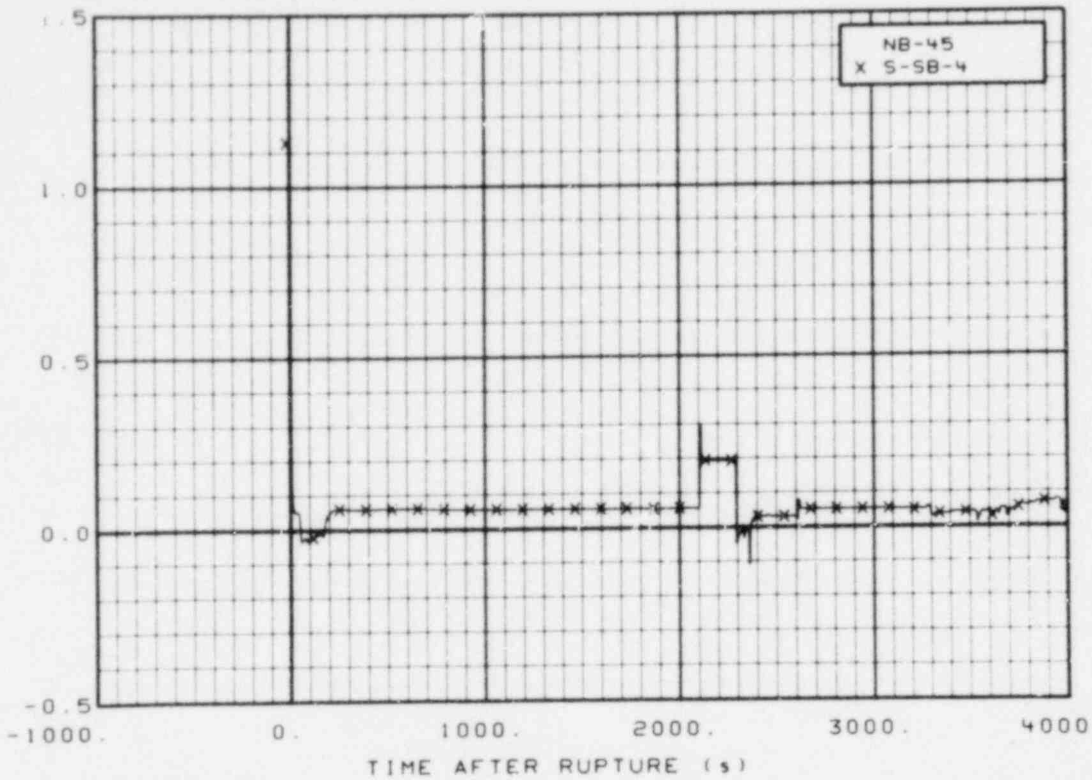


Figure 485. Momentum flux in broken loop cold leg, Test S-SB-4 (NB-45), from -20 to 4000 s.

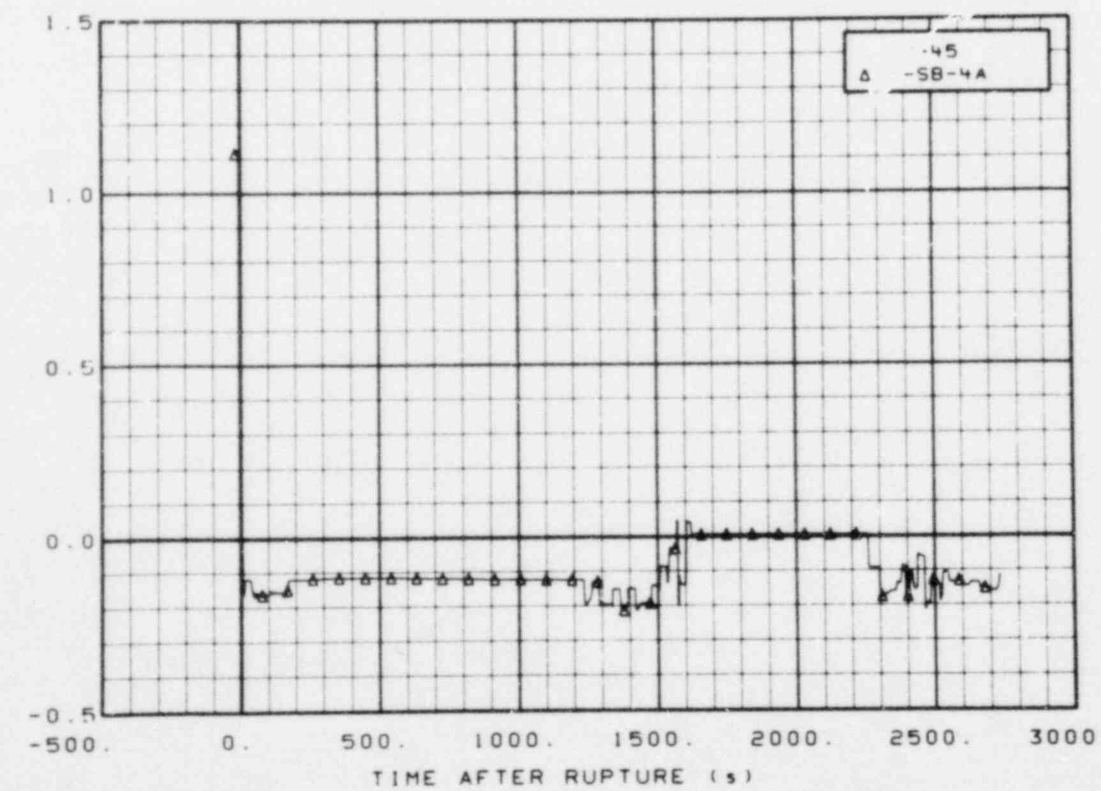


Figure 486. Momentum flux in broken loop cold leg, Test S-SB-4A (NB-45), from -20 to 2740 s.

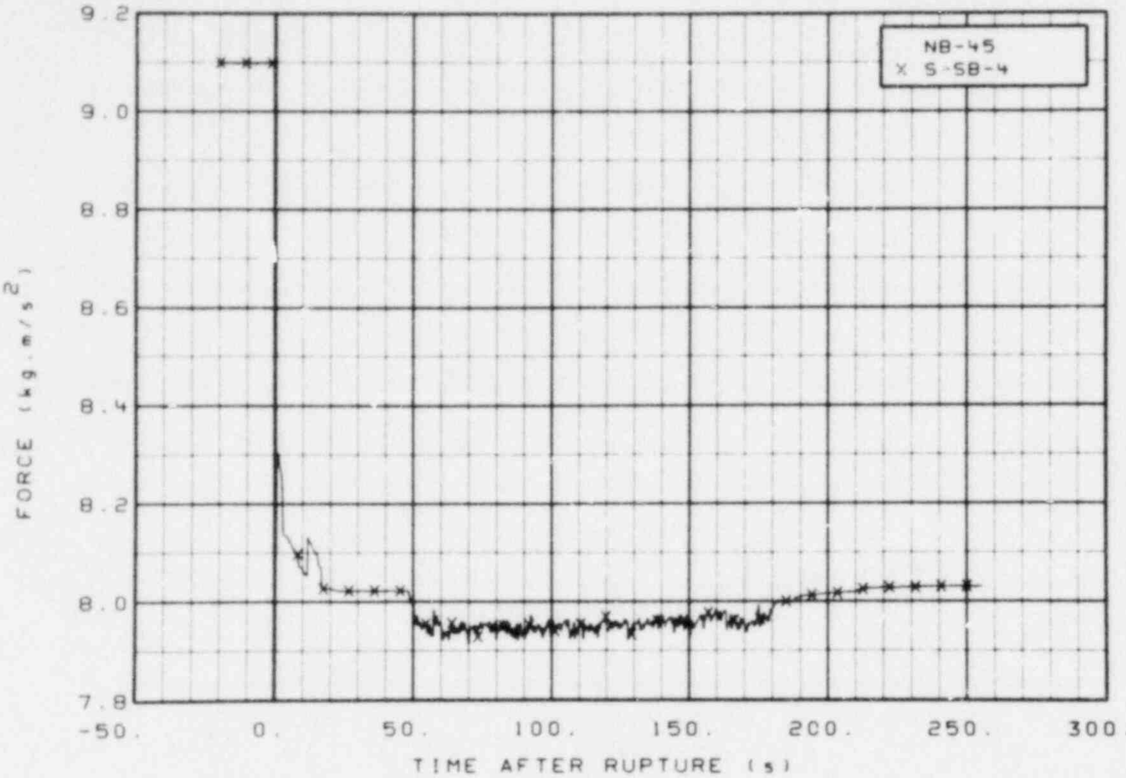


Figure 487. Momentum flux in broken loop cold leg, Test S-SB-4 (NB-45), from -20 to 256 s.

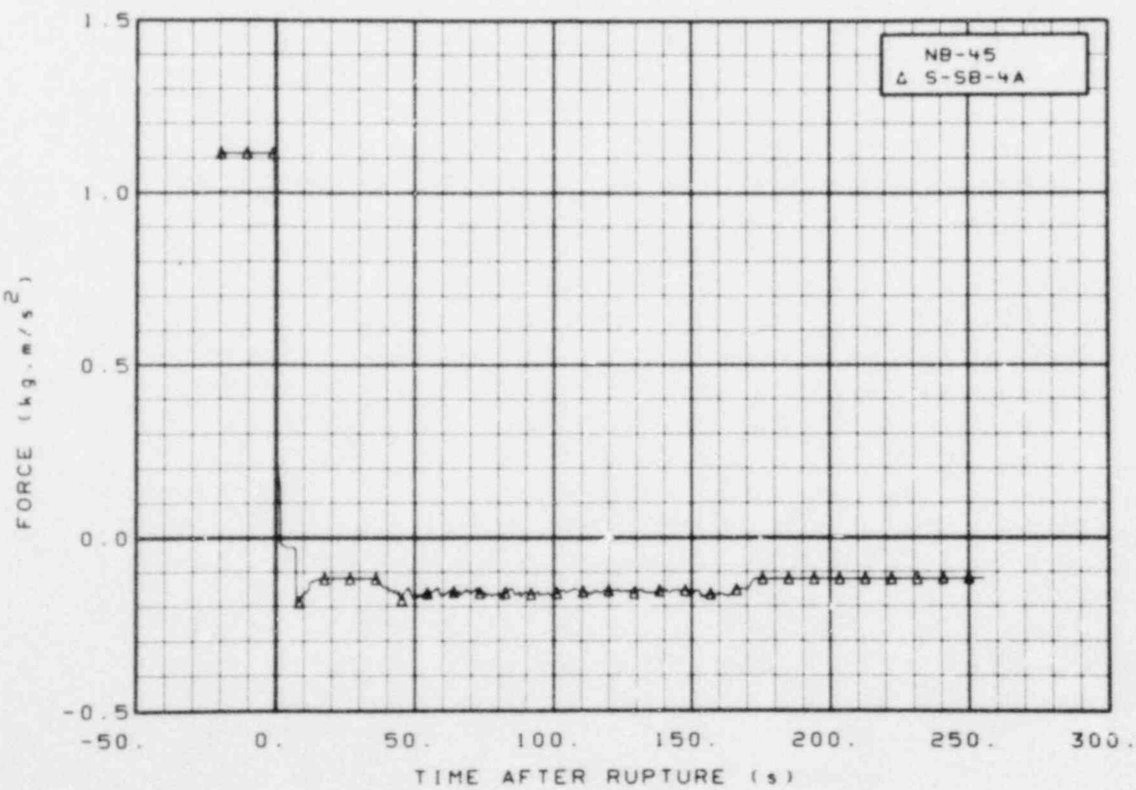


Figure 488. Momentum flux in broken loop cold leg, Test S-SB-4A (NB-45), from -20 to 256 s.

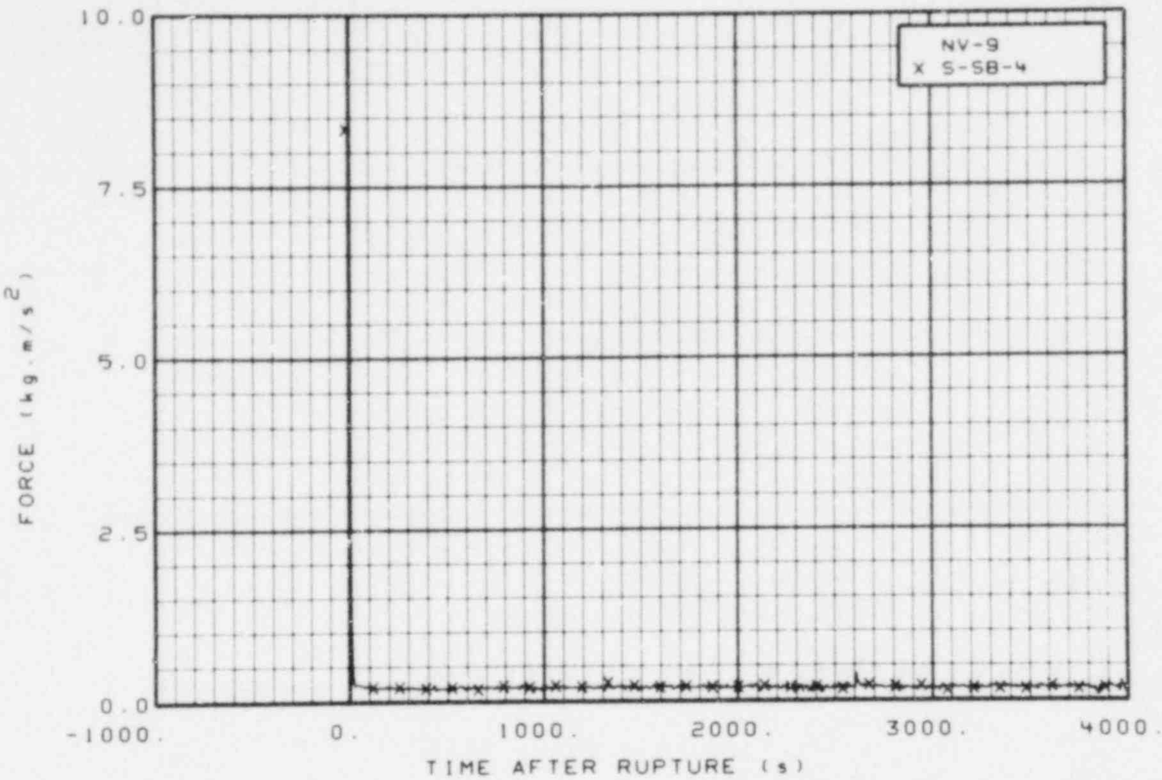


Figure 489. Momentum flux in core outlet, Test S-SB-4 (NV-9), from -20 to 4000 s.

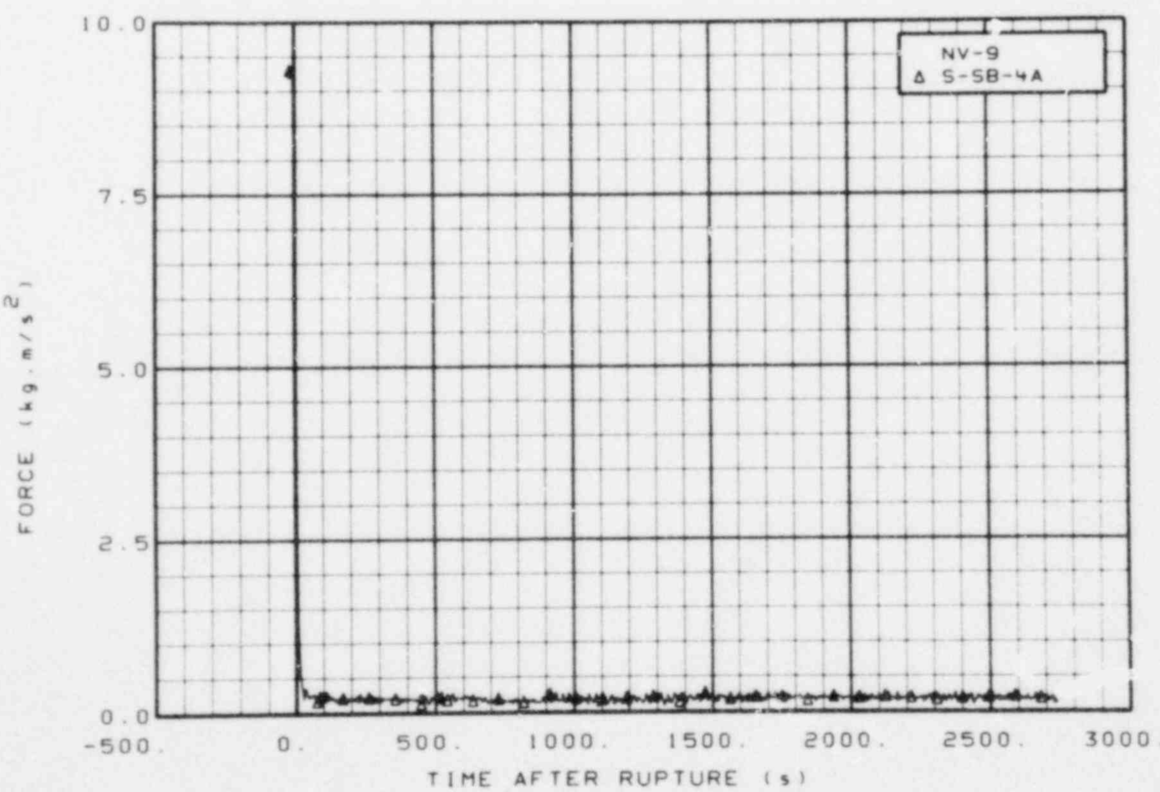


Figure 490. Momentum flux in core outlet, Test S-SB-4A (NV-9), from -20 to 2740 s.

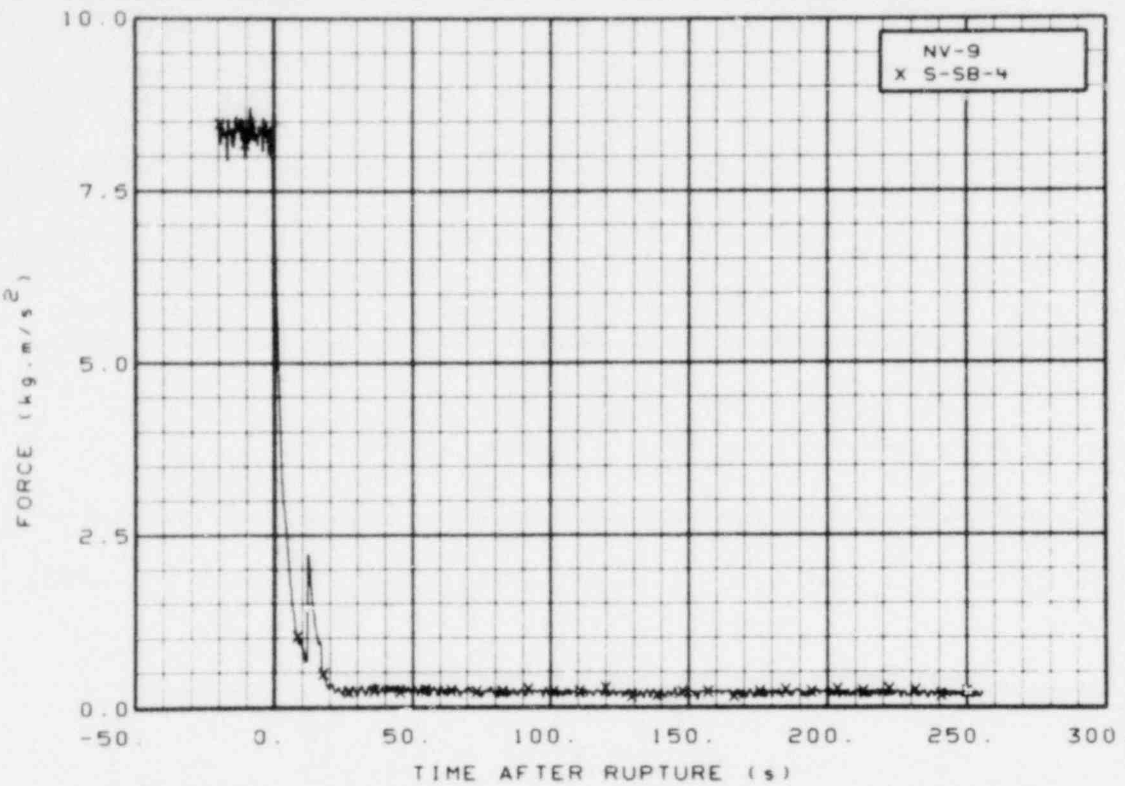


Figure 491. Momentum flux in core outlet, Test S-SB-4 (NV-9), from -20 to 256 s.

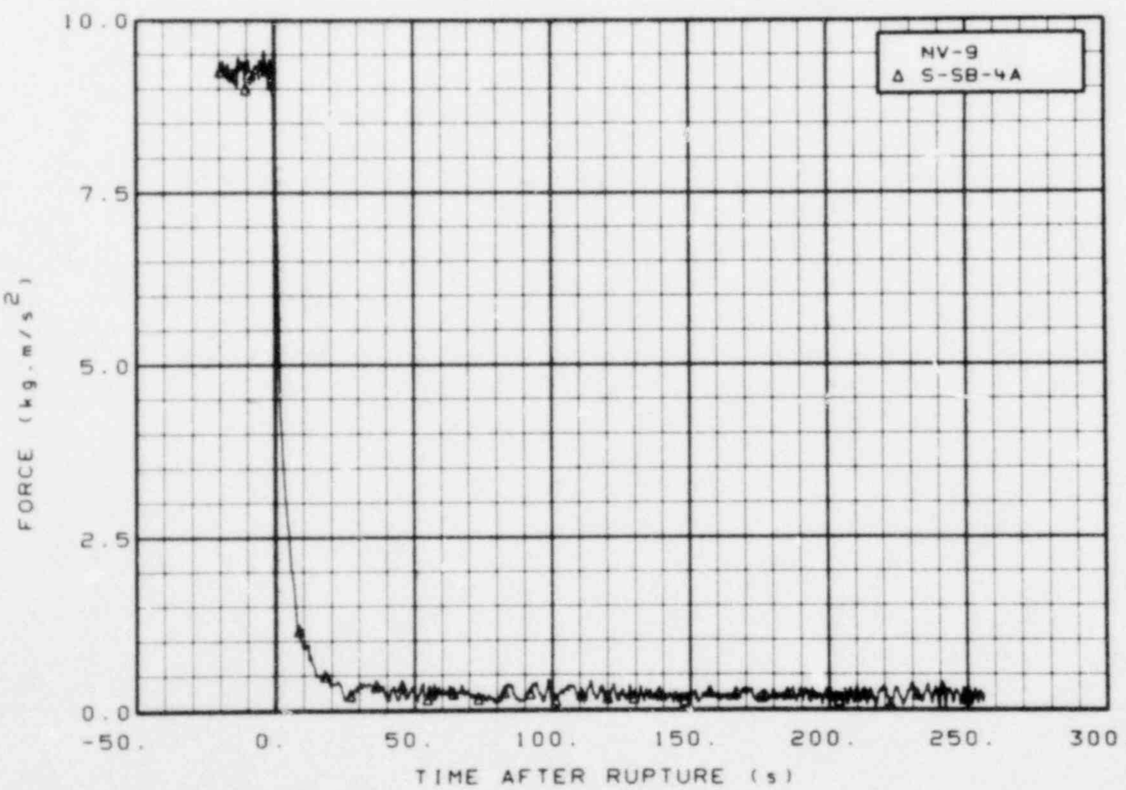


Figure 492. Momentum flux in core outlet, Test S-SB-4A (NV-9), from -20 to 256 s.

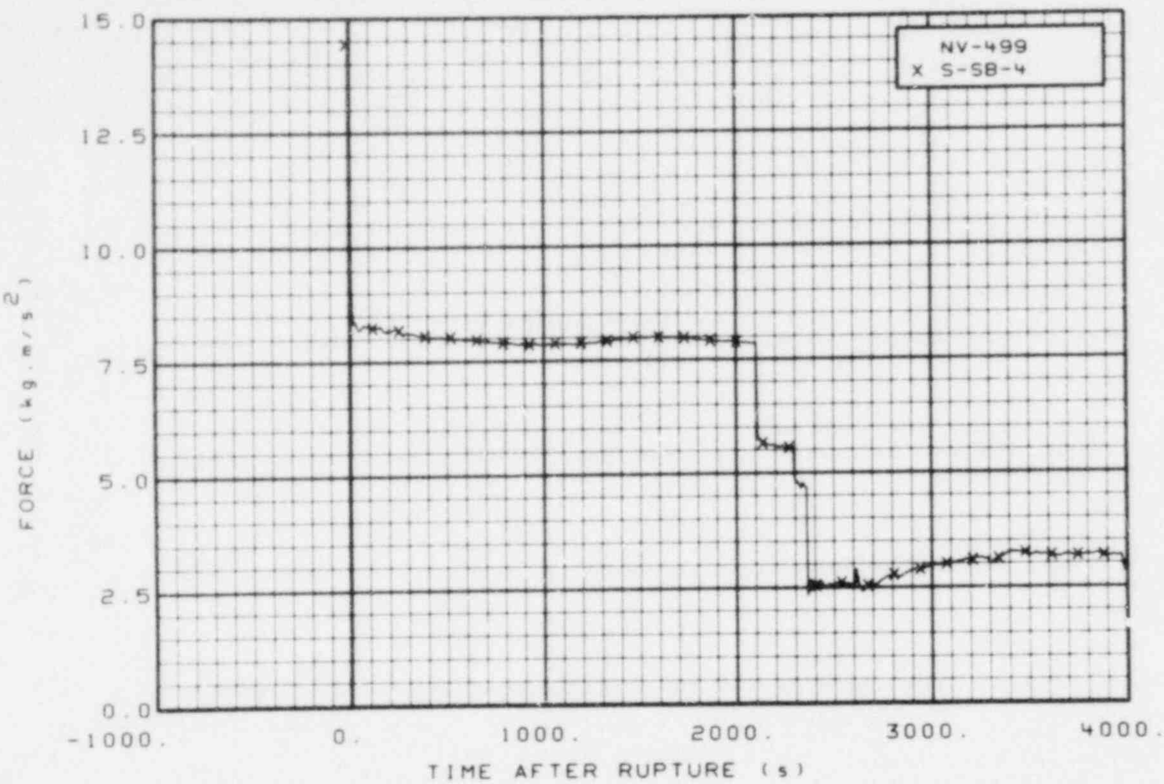


Figure 493. Momentum flux in core inlet, Test S-SB-4 (NV-499), from -20 to 4000 s.

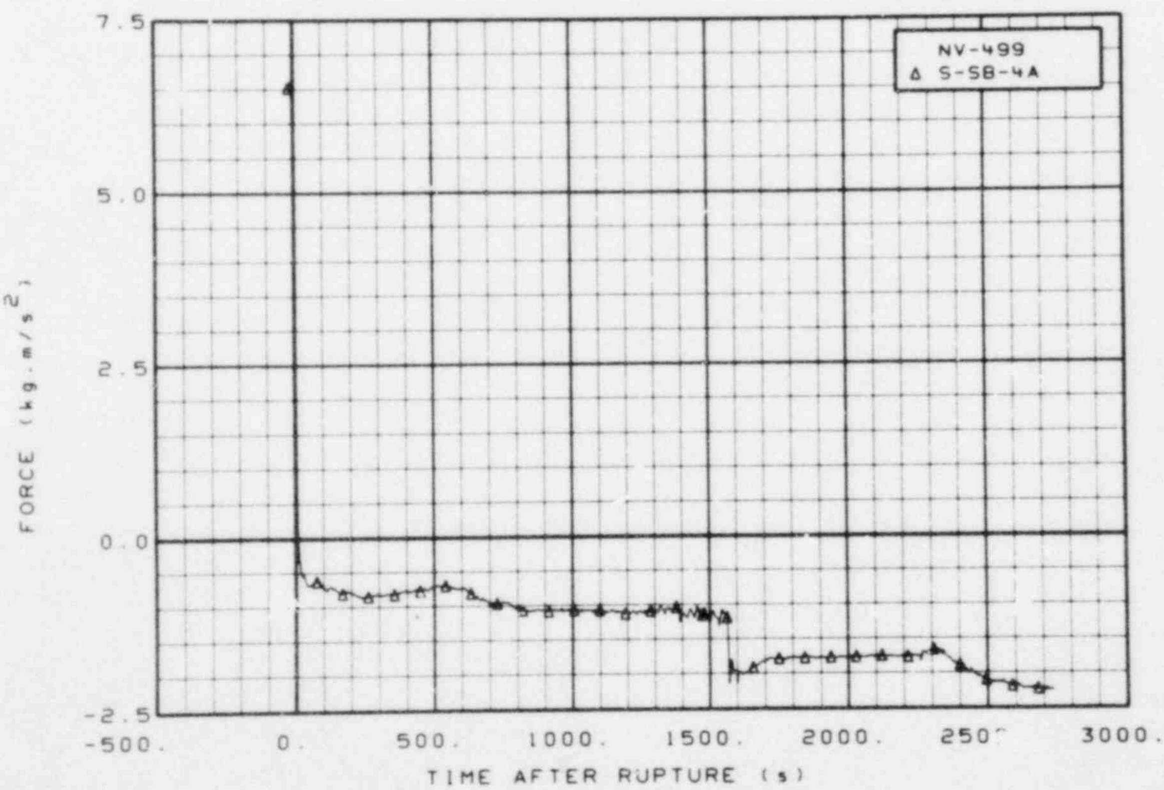


Figure 494. Momentum flux in core inlet, Test S-SB-4A (NV-499), from -20 to 2740 s.

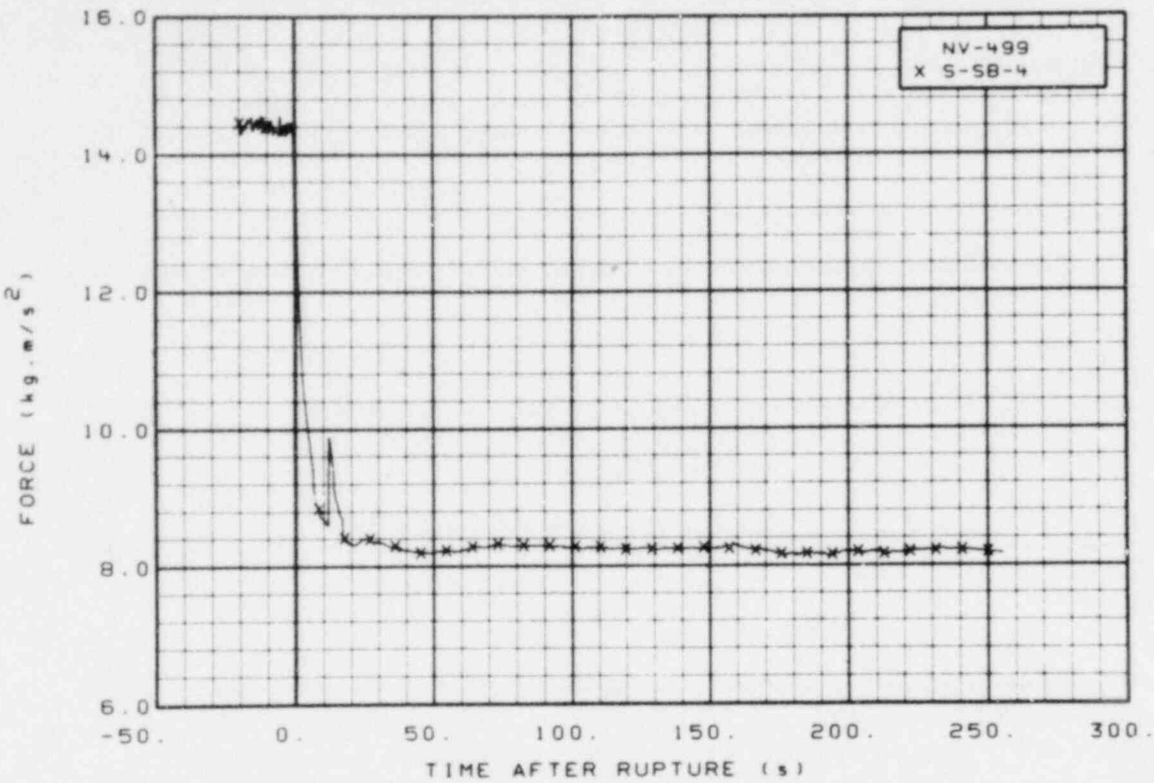


Figure 495. Momentum flux in core inlet, Test S-SB-4 (NV-499), from -20 to 256 s.

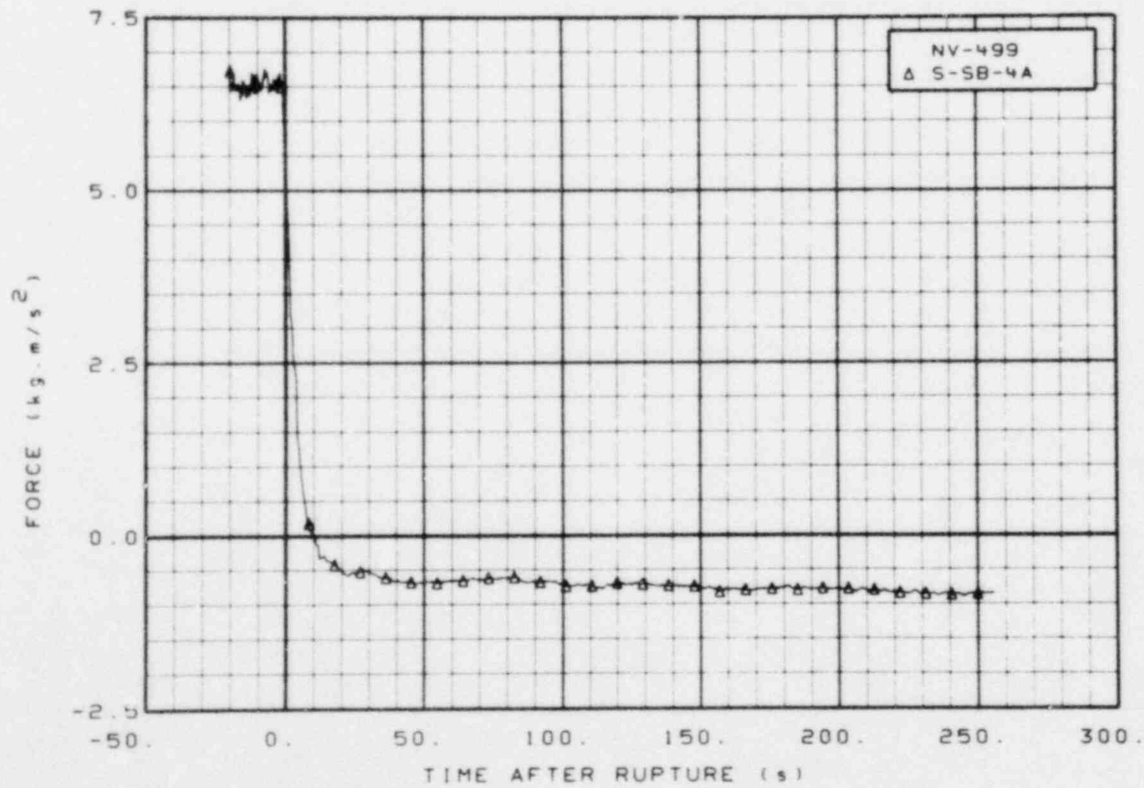


Figure 496. Momentum flux in core inlet, Test S-SB-4A (NV-499), from -20 to 256 s.

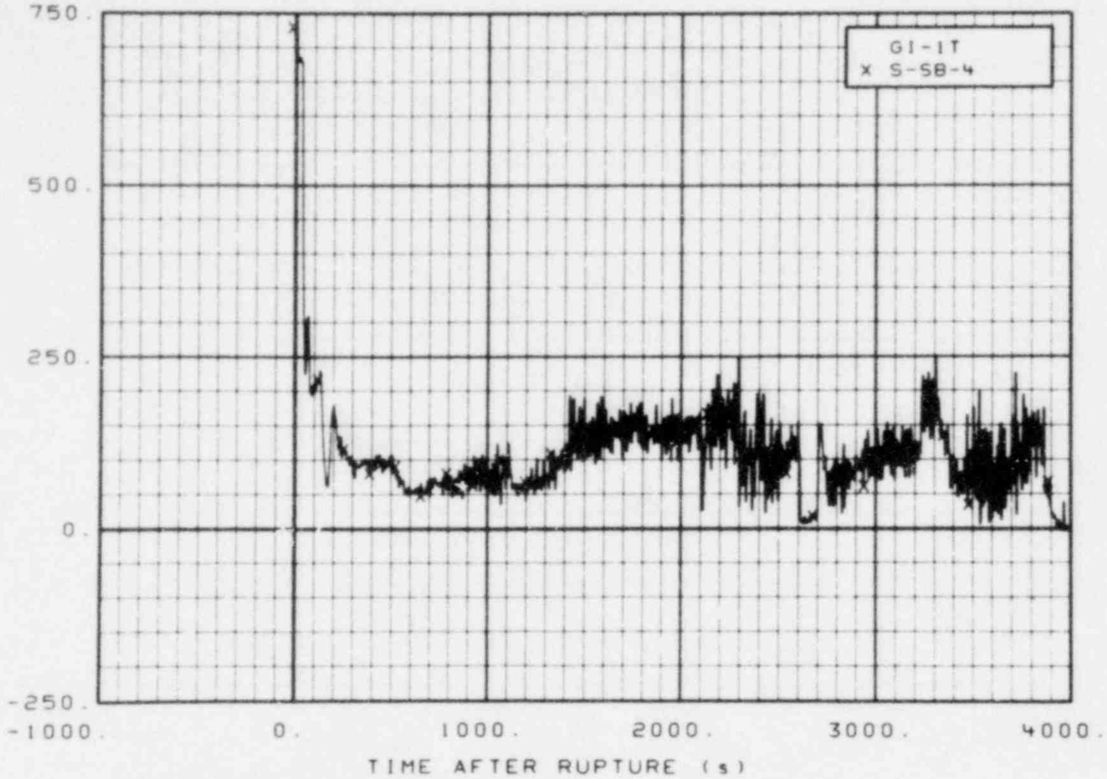


Figure 497. Density in intact loop hot leg, Test S-SB-4 (GI-1T), from -20 to 4000 s.

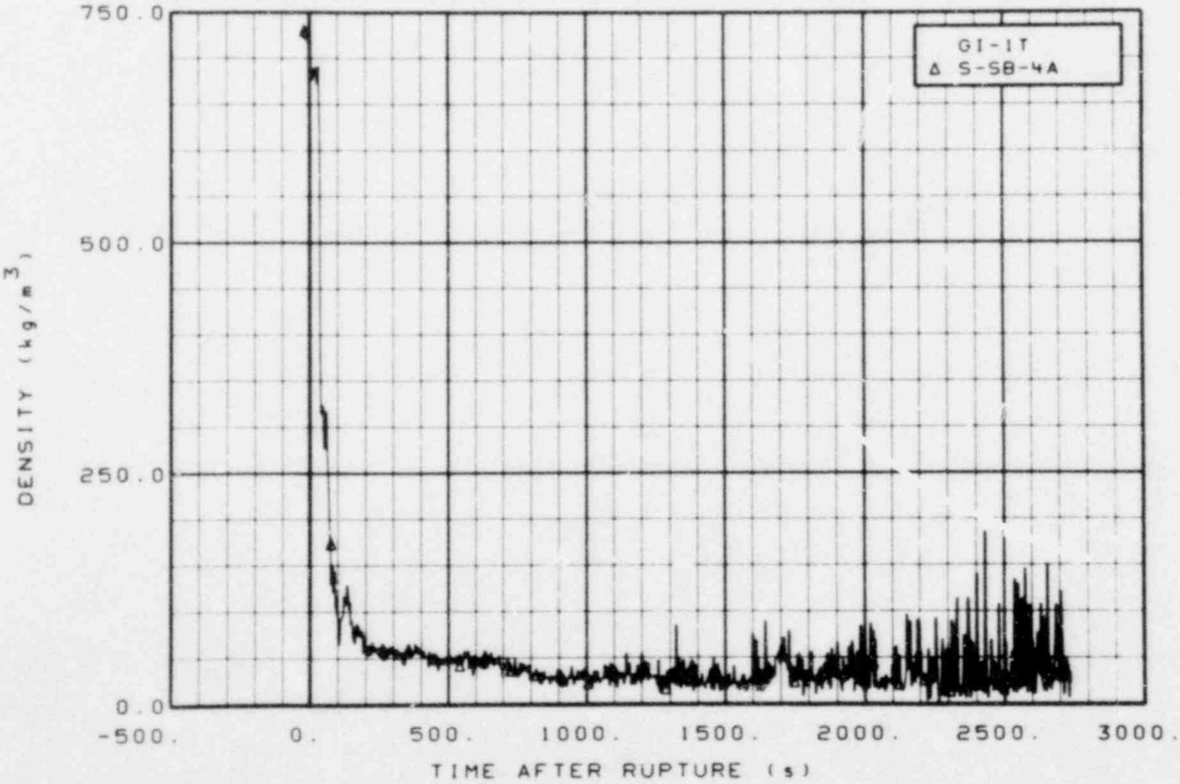


Figure 498. Density in intact loop hot leg, Test S-SB-4A (GI-1T), from -20 to 2740 s.

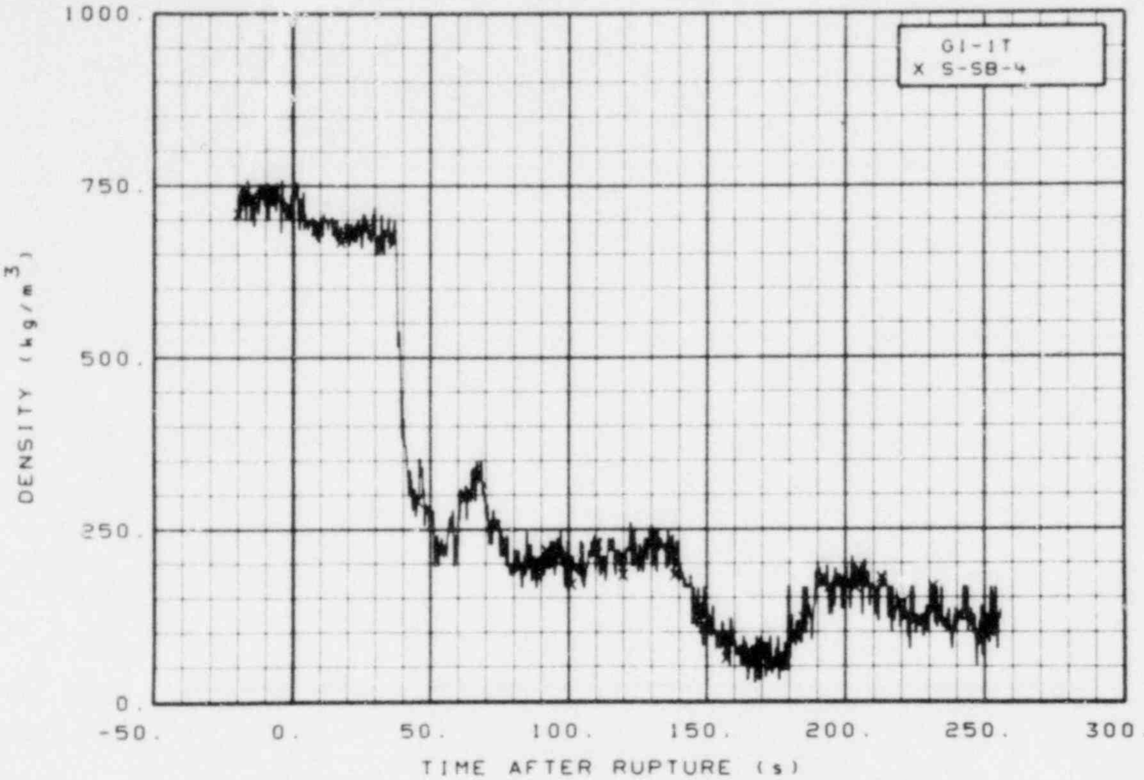


Figure 499. Density in intact loop hot leg, Test S-SB-4 (GI-1T), from -20 to 256 s.

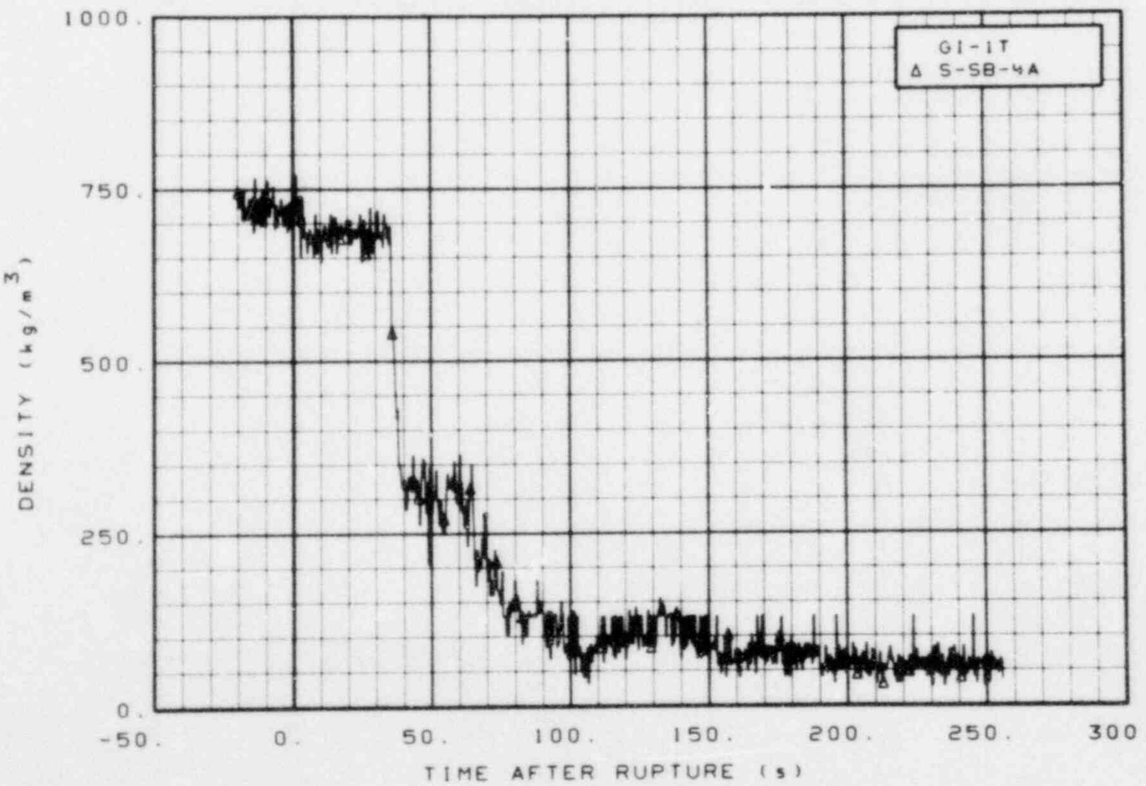


Figure 500. Density in intact loop hot leg, Test S-SB-4A (GI-1T), from -20 to 256 s.

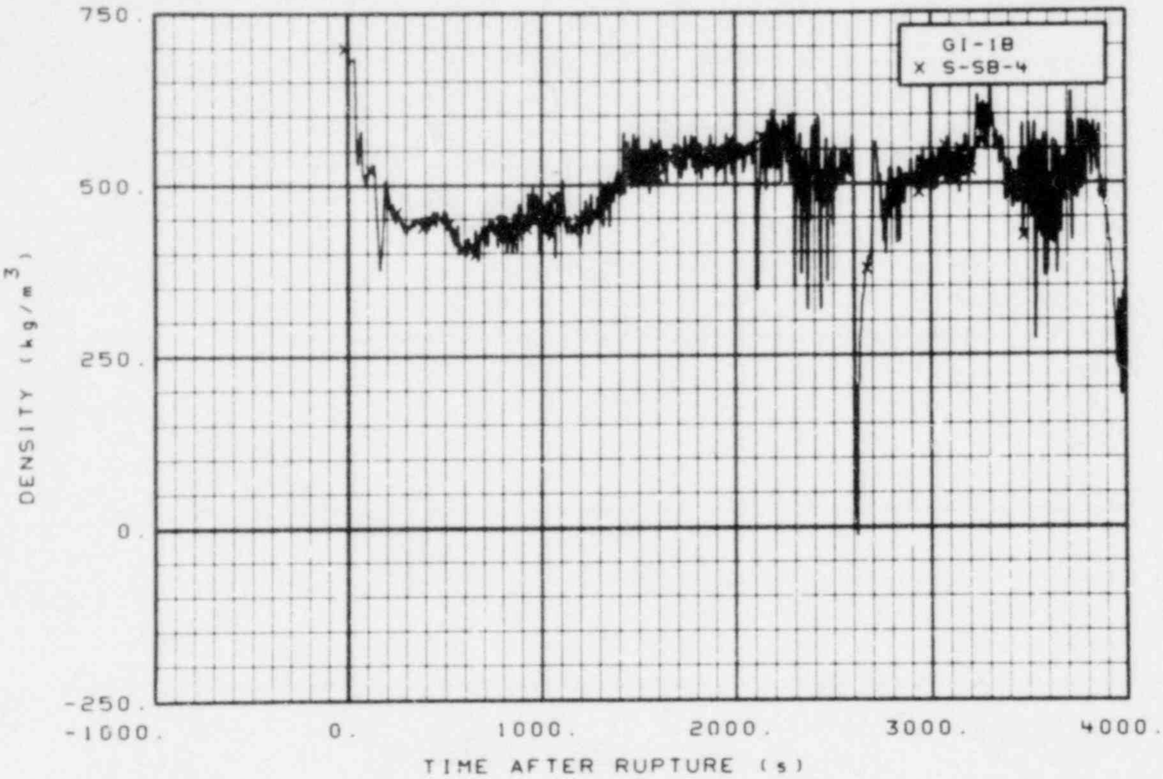


Figure 501. Density in intact loop hot leg, Test S-SB-4 (GI-1B), from -20 to 4000 s.

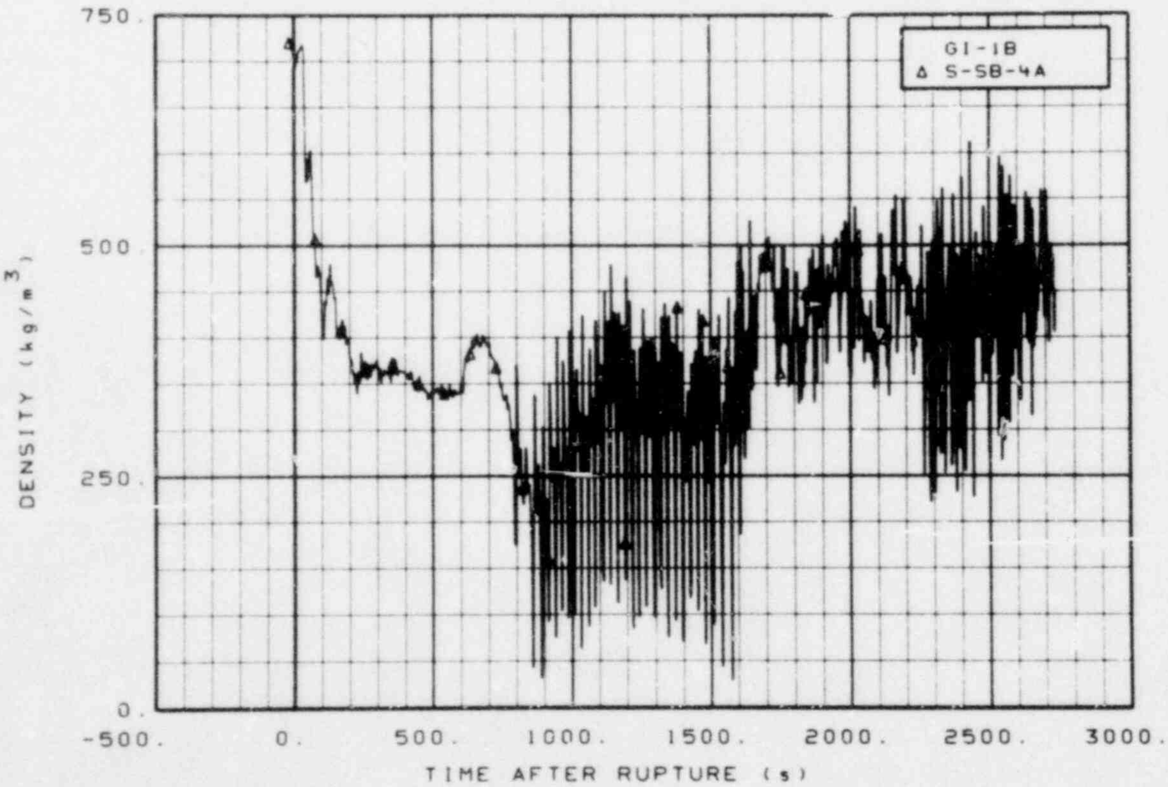


Figure 502. Density in intact loop hot leg, Test S-SB-4A (GI-1T), from -20 to 2740 s.

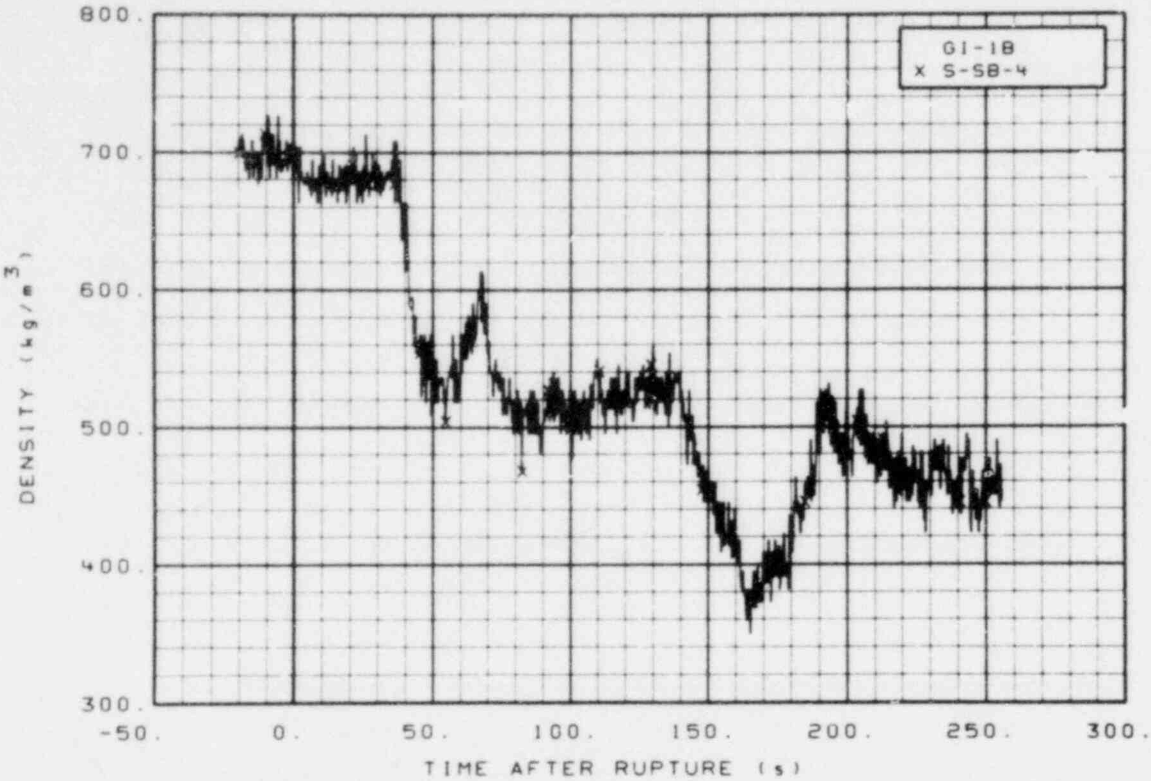


Figure 503. Density in intact loop hot leg, Test S-SB-4 (GI-1T), from -20 to 256 s.

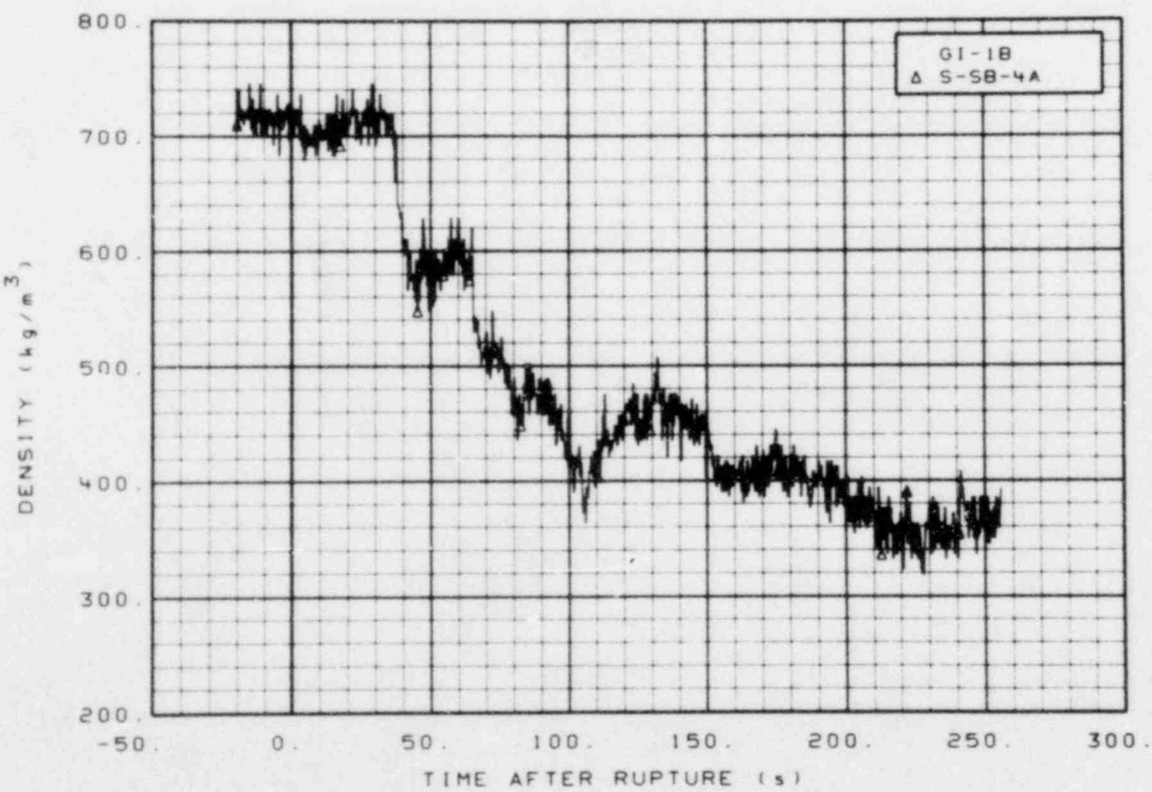


Figure 504. Density in intact loop hot leg, Test S-SB-4A (GI-1T), from -20 to 256 s.

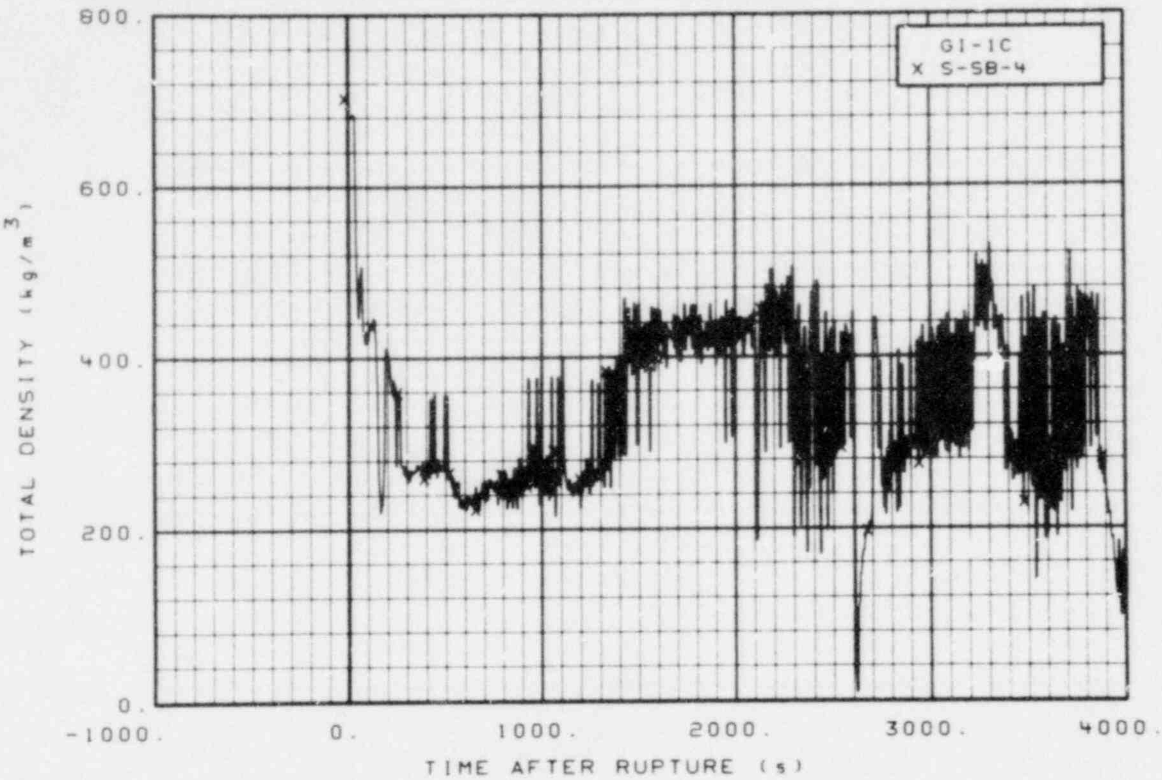


Figure 505. Density in intact loop hot leg, Test S-SB-4 (GI-1C), from -20 to 4000 s.

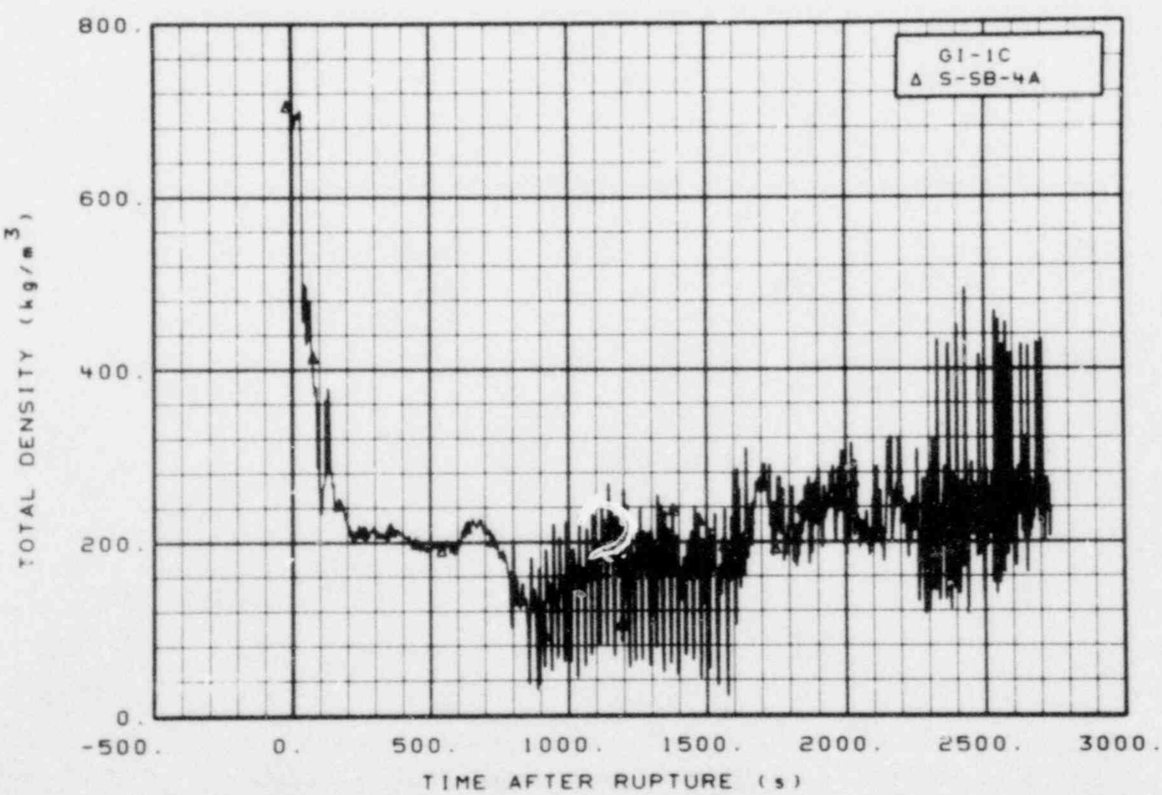


Figure 506. Density in intact loop hot leg, Test S-SB-4A (GI-1C), from -20 to 2740 s.

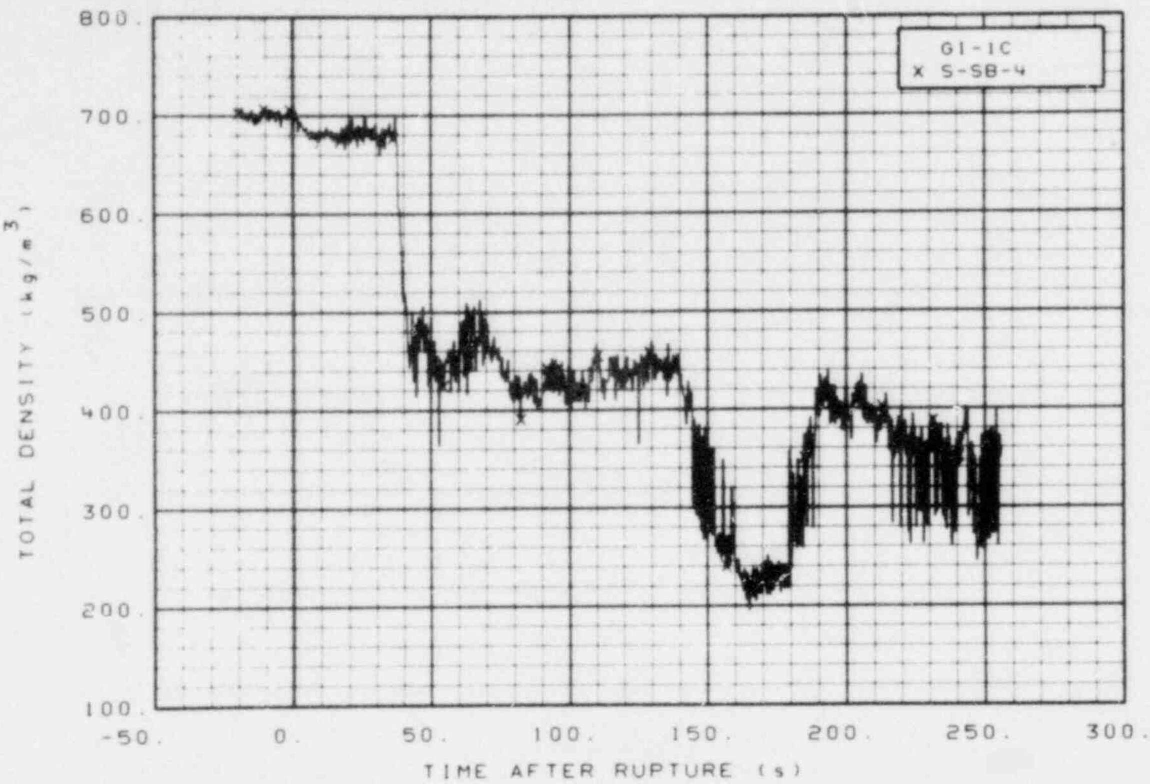


Figure 507. Density in intact loop hot leg, Test S-SB-4 (GI-1C), from -20 to 256 s.

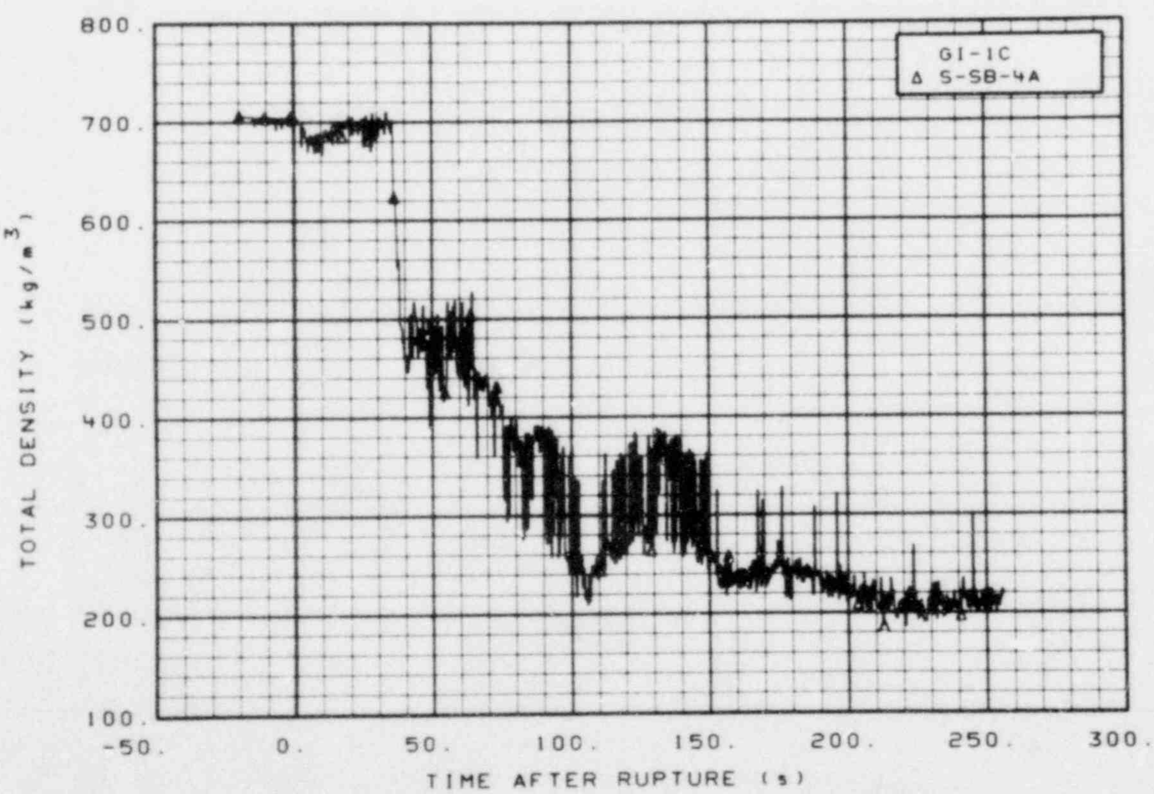


Figure 508. Density in intact loop hot leg, Test S-SB-4A (GI-1C), from -20 to 256 s.

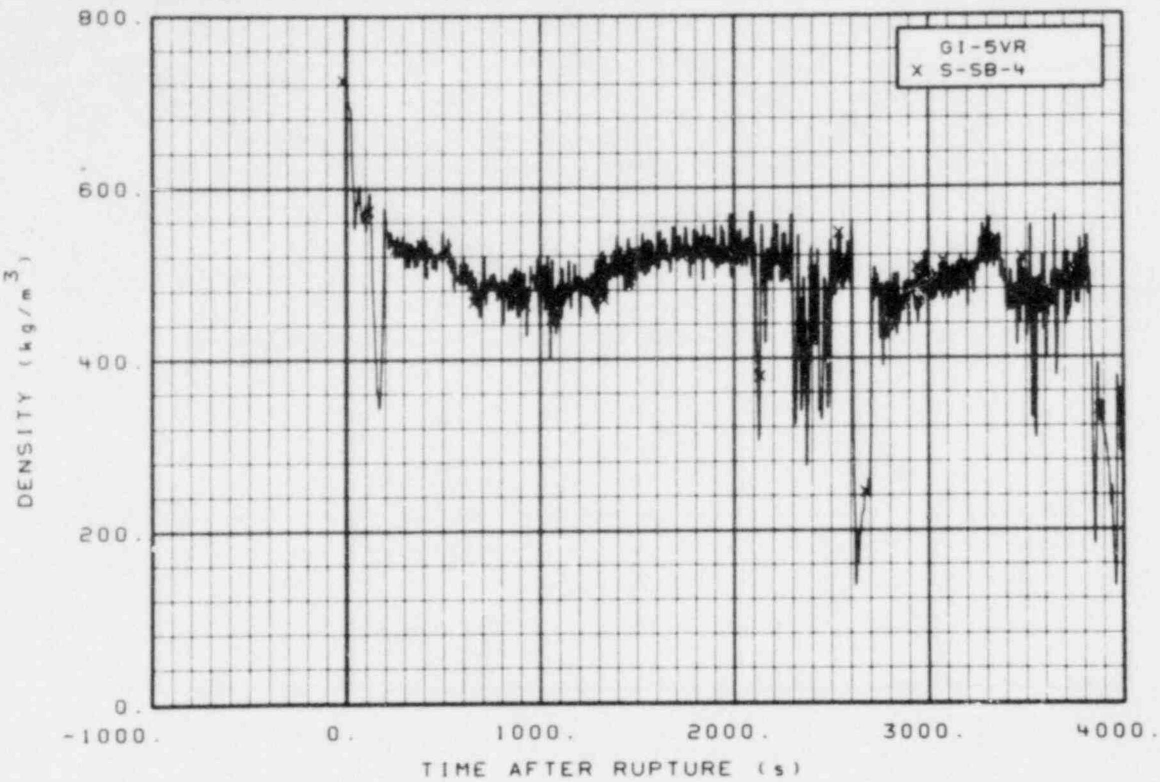


Figure 509. Density in intact loop hot leg, Test S-SB-4 (GI-5VR), from -20 to 4000 s.

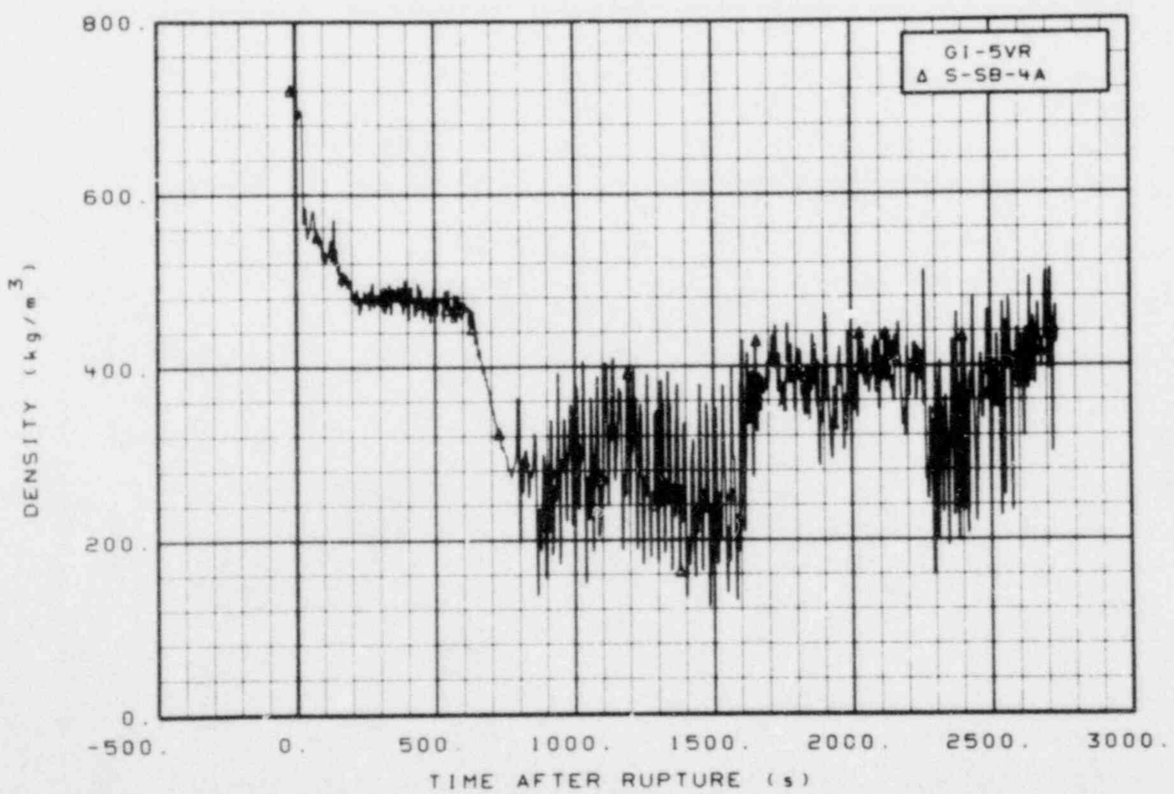


Figure 510. Density in intact loop hot leg, Test S-SB-4A (GI-5VR), from -20 to 2740 s.

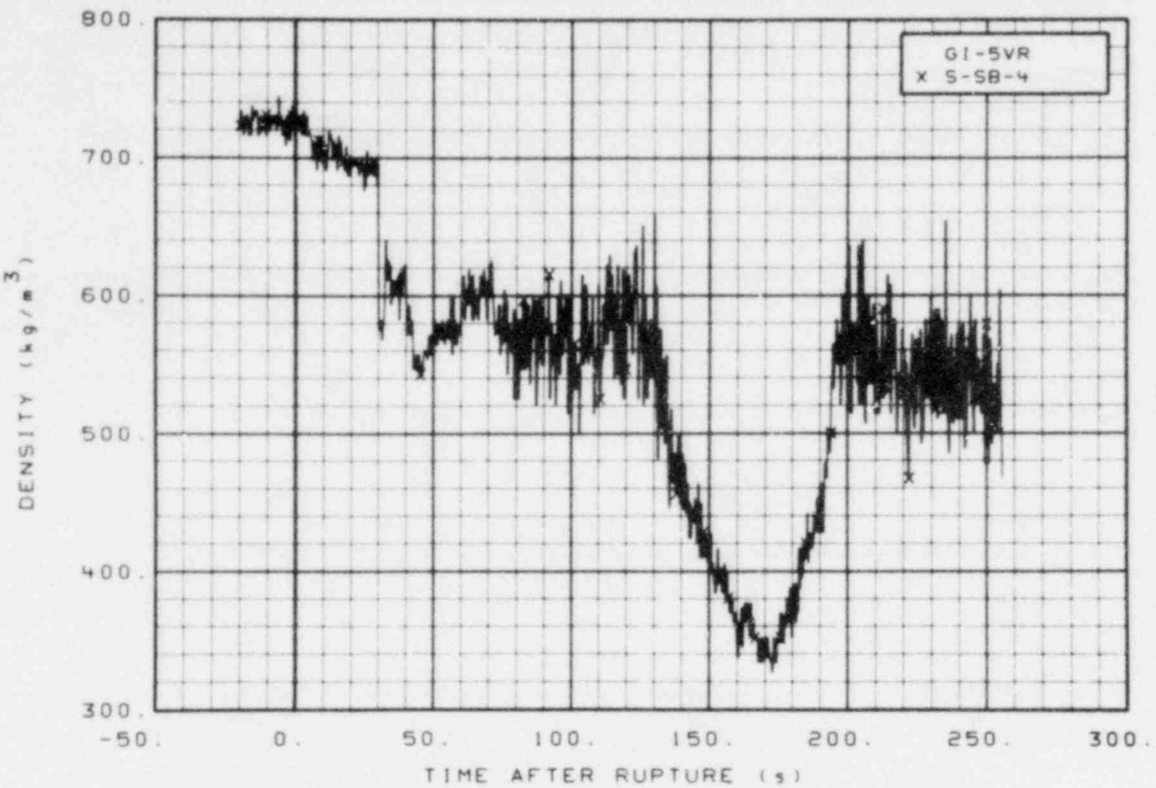


Figure 511. Density in intact loop hot leg, Test S-SB-4 (GI-5VR), from -20 to 256 s.

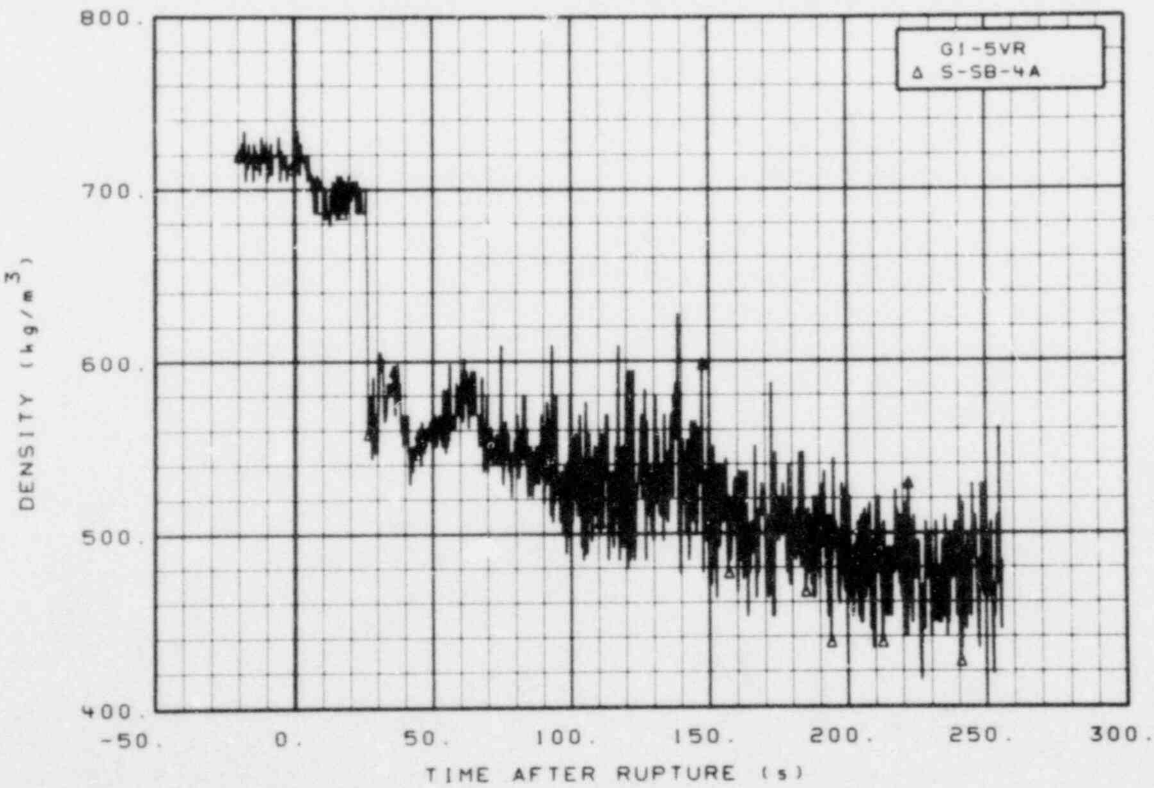


Figure 512. Density in intact loop hot leg, Test S-SB-4A (GI-5VR), from -20 to 256 s.

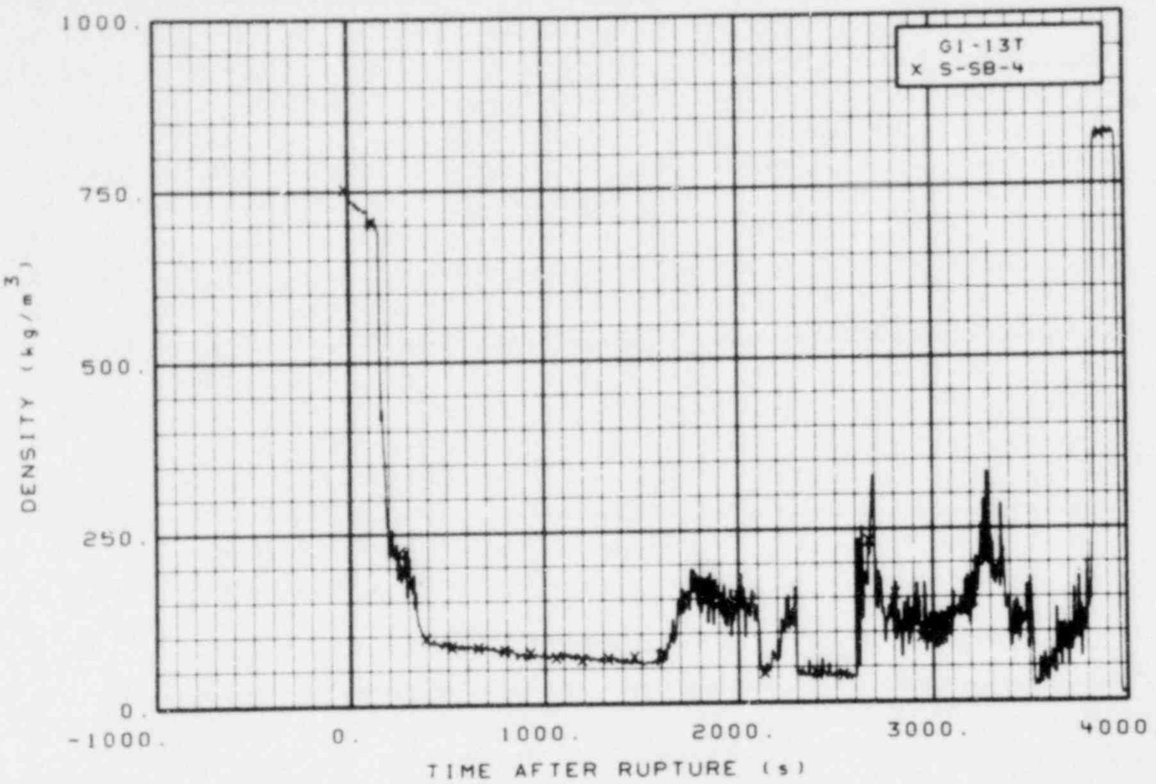


Figure 513. Density in intact loop cold leg, Test S-SB-4 (GI-13T), from -20 to 4000 s.

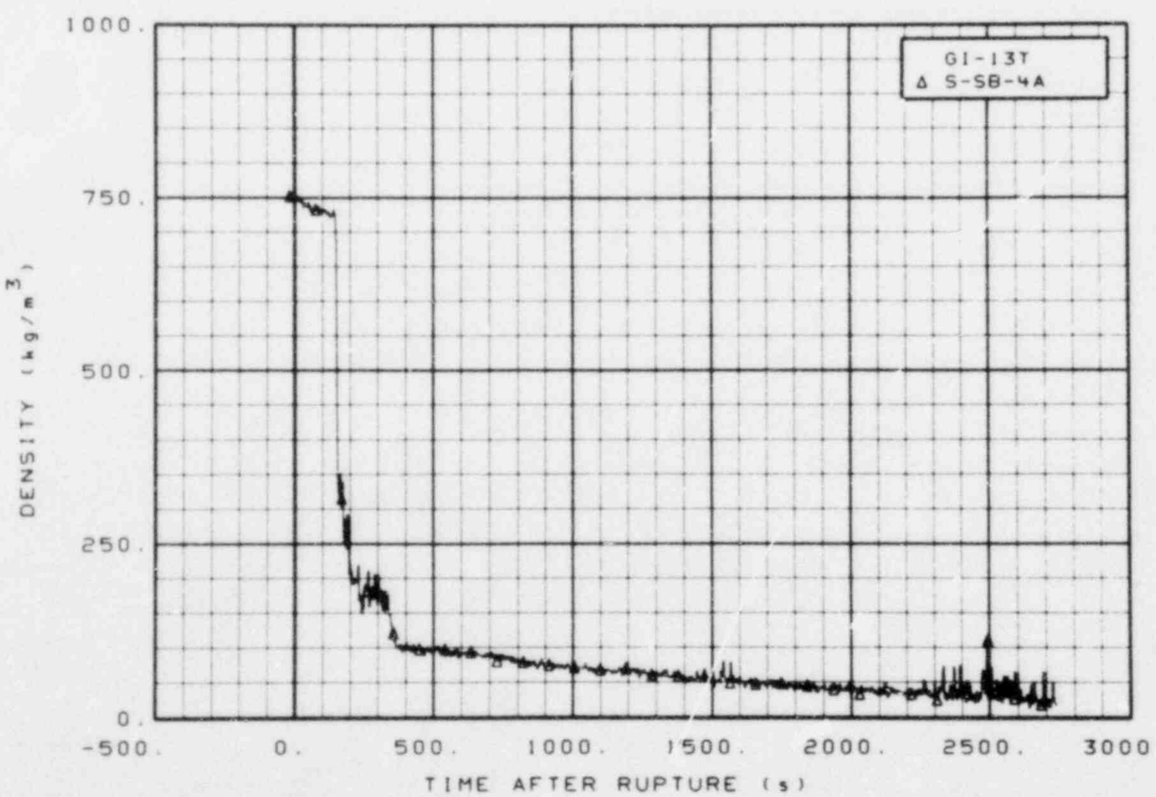


Figure 514. Density in intact loop cold leg, Test S-SB-4A (GI-13T), from -20 to 2740 s.

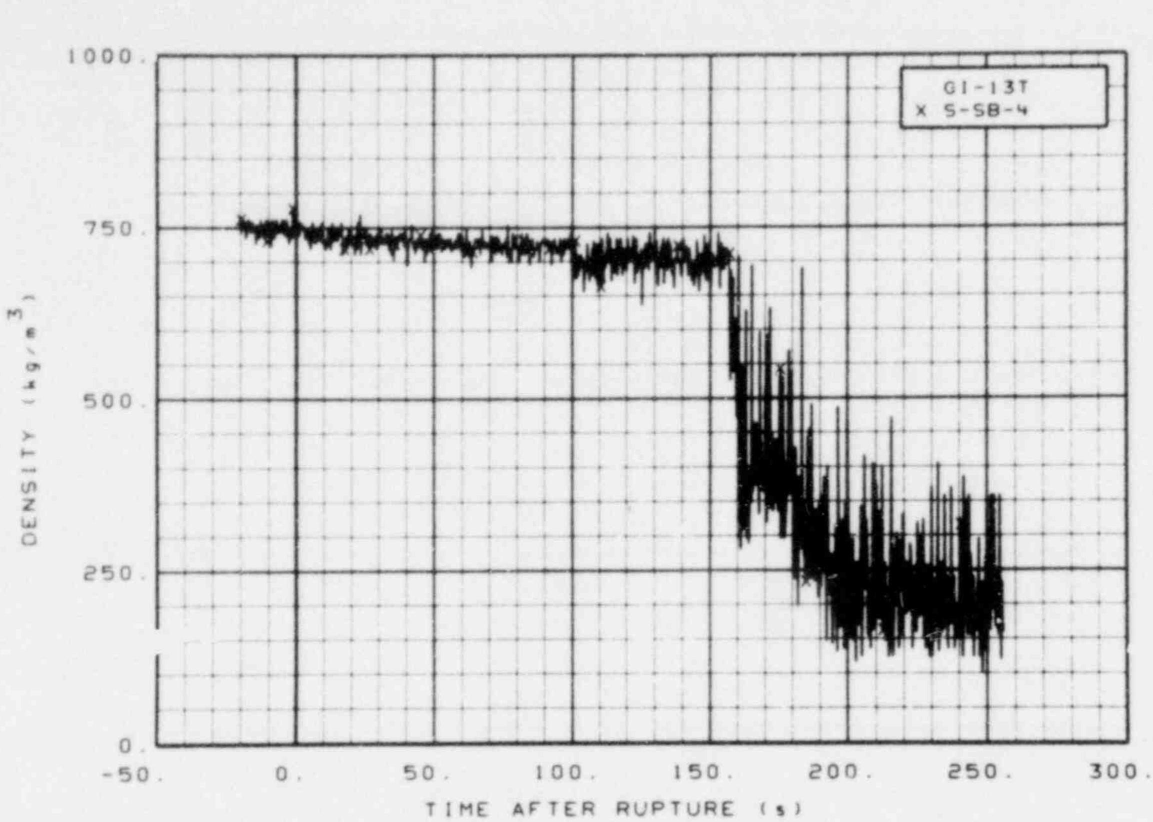


Figure 515. Density in intact loop cold leg, Test S-SB-4 (GI-13T), from -20 to 256 s.

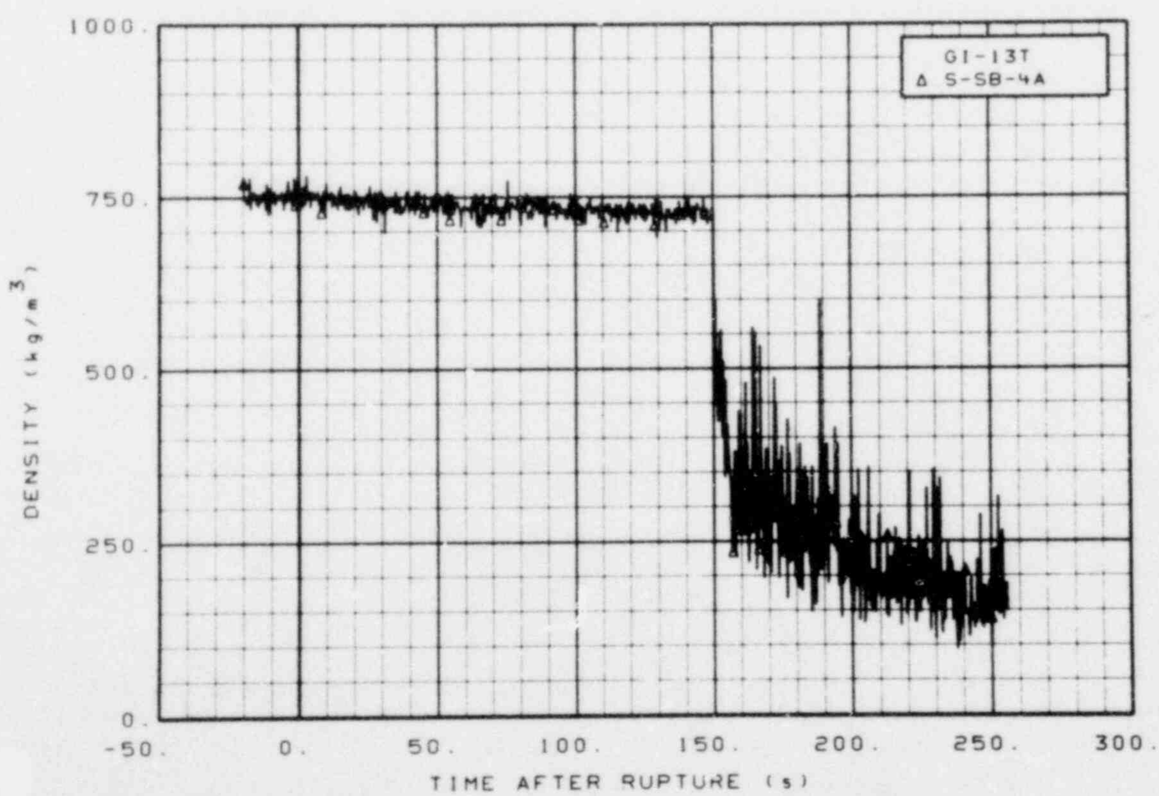


Figure 516. Density in intact loop cold leg, Test S-SB-4A (GI-13T), from -20 to 256 s.

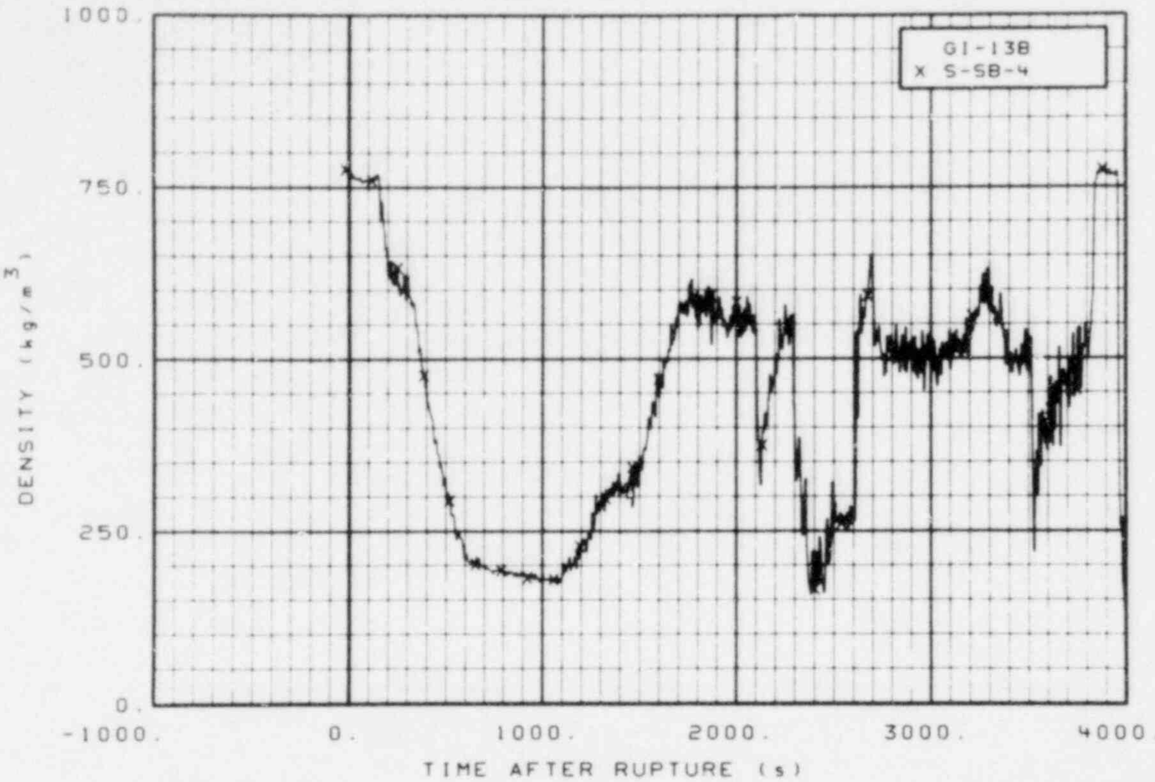


Figure 517. Density in intact loop cold leg, Test S-SB-4 (GI-13B), from -20 to 4000 s.

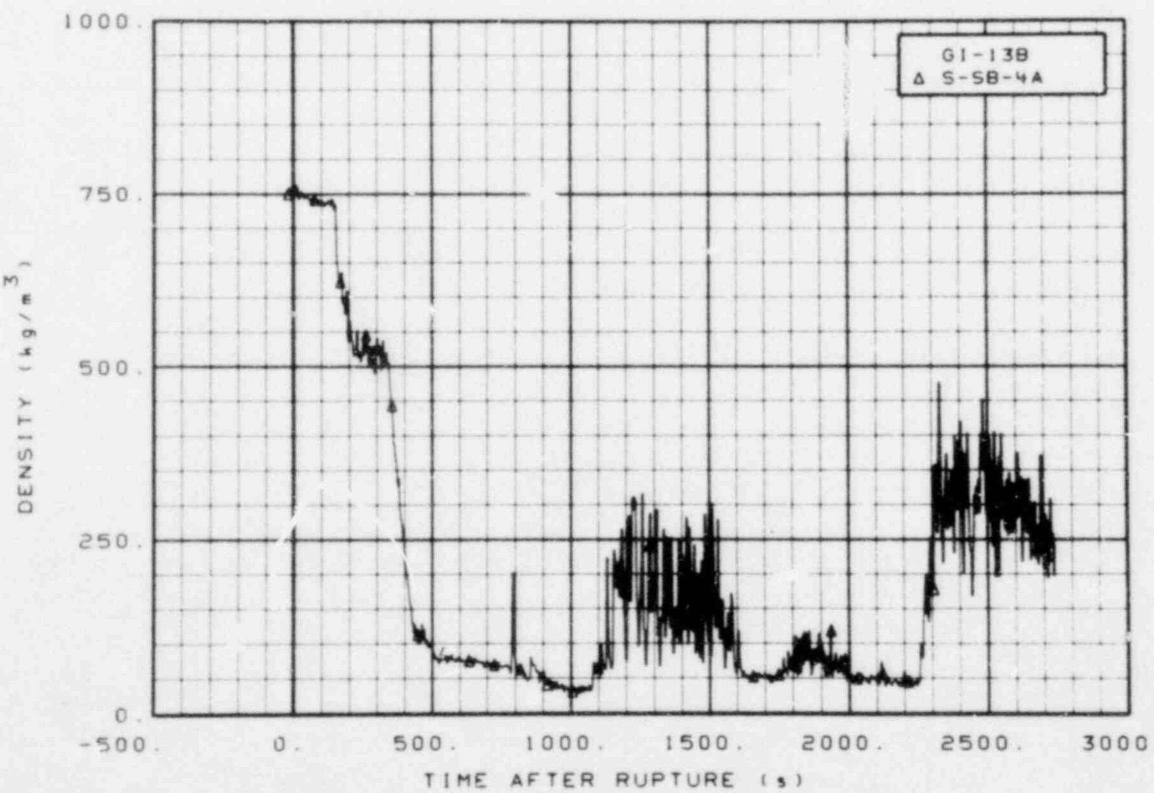


Figure 518. Density in intact loop cold leg, Test S-SB-4A (GI-13B), from -20 to 2740 s.

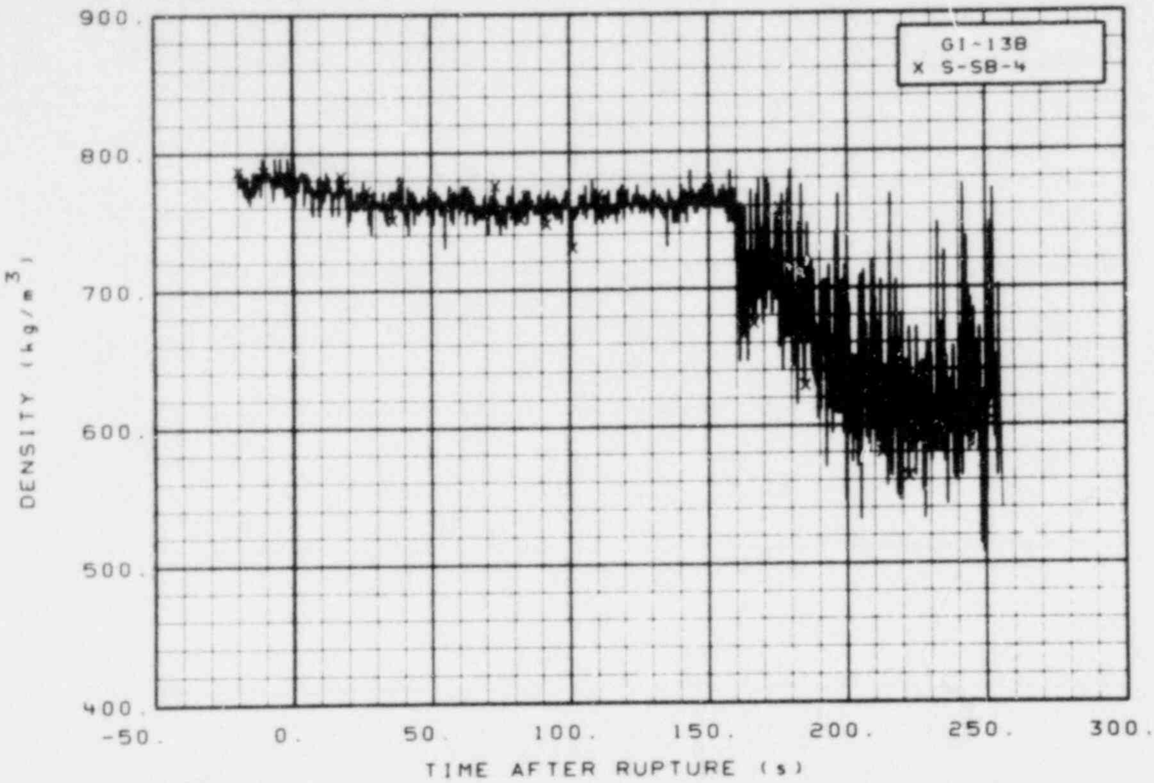


Figure 519. Density in intact loop cold leg, Test S-SB-4 (GI-13B), from -20 to 256 s.

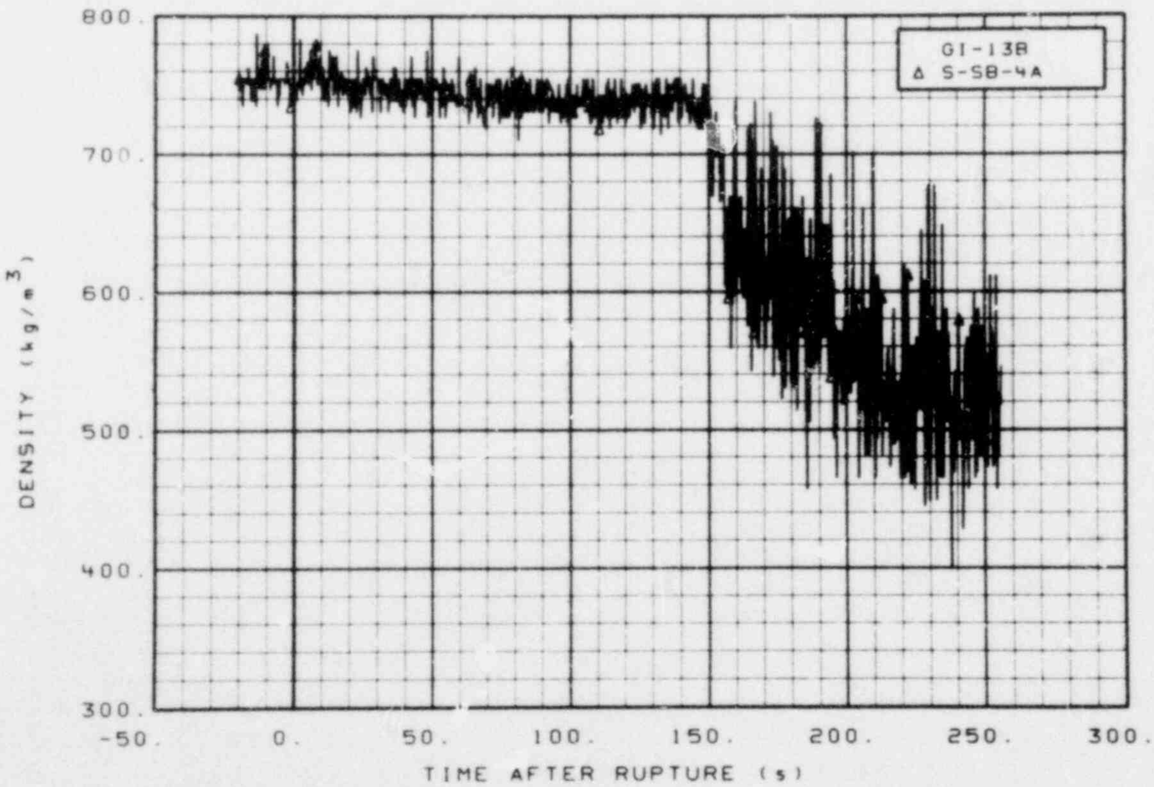


Figure 520. Density in intact loop cold leg, Test S-SB-4A (GI-13B), from -20 to 256 s.

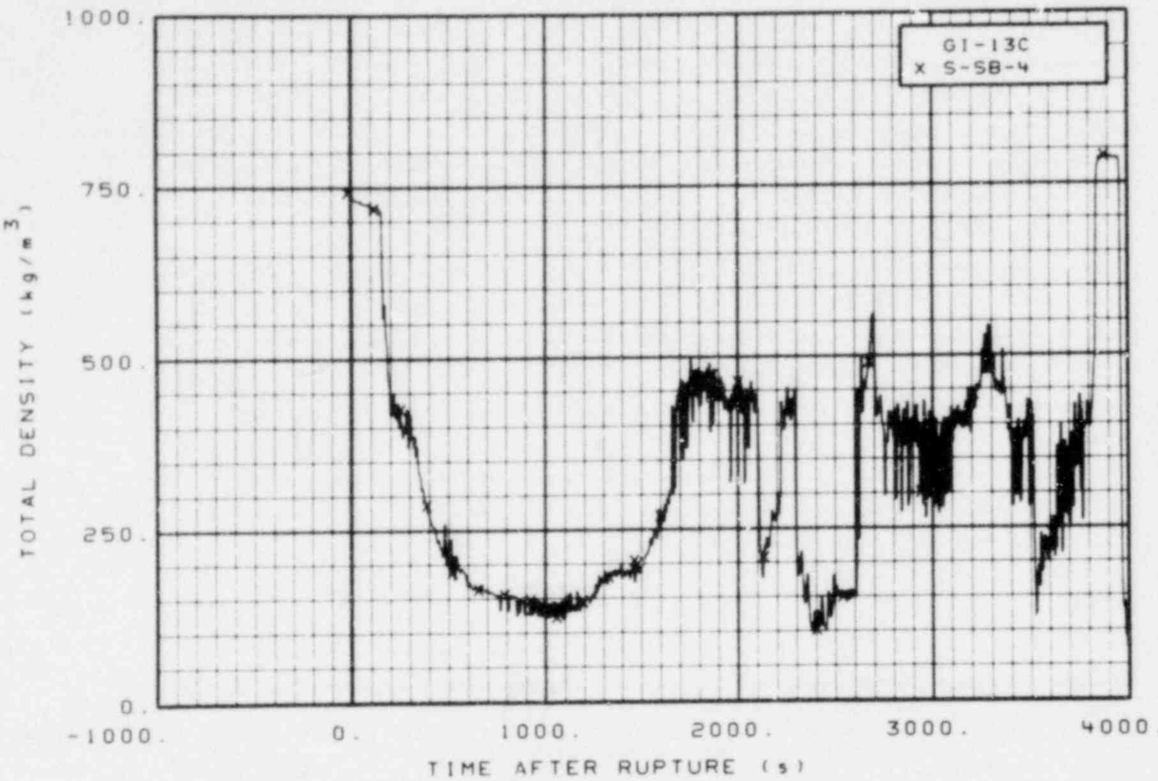


Figure 521. Density in intact loop cold leg, Test S-SB-4 (GI-13C), from -20 to 4000 s.

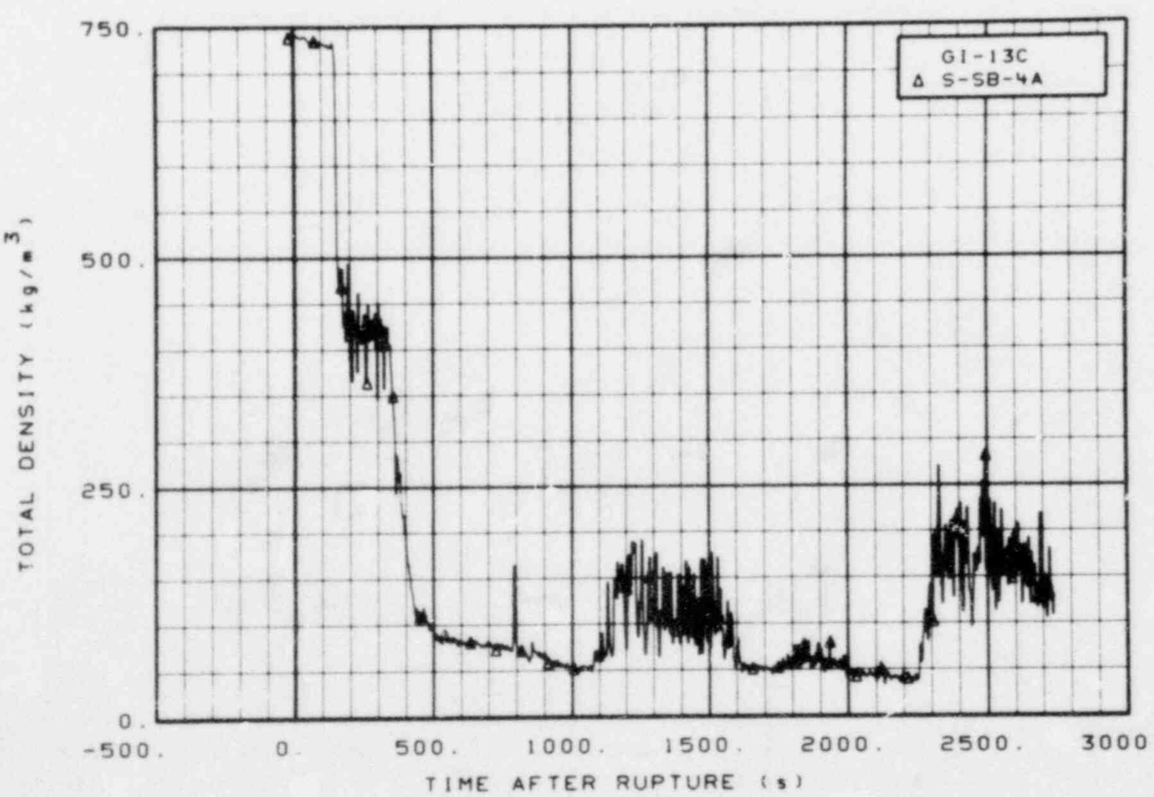


Figure 522. Density in intact loop cold leg, Test S-SB-4A (GI-13C), from -20 to 2740 s.

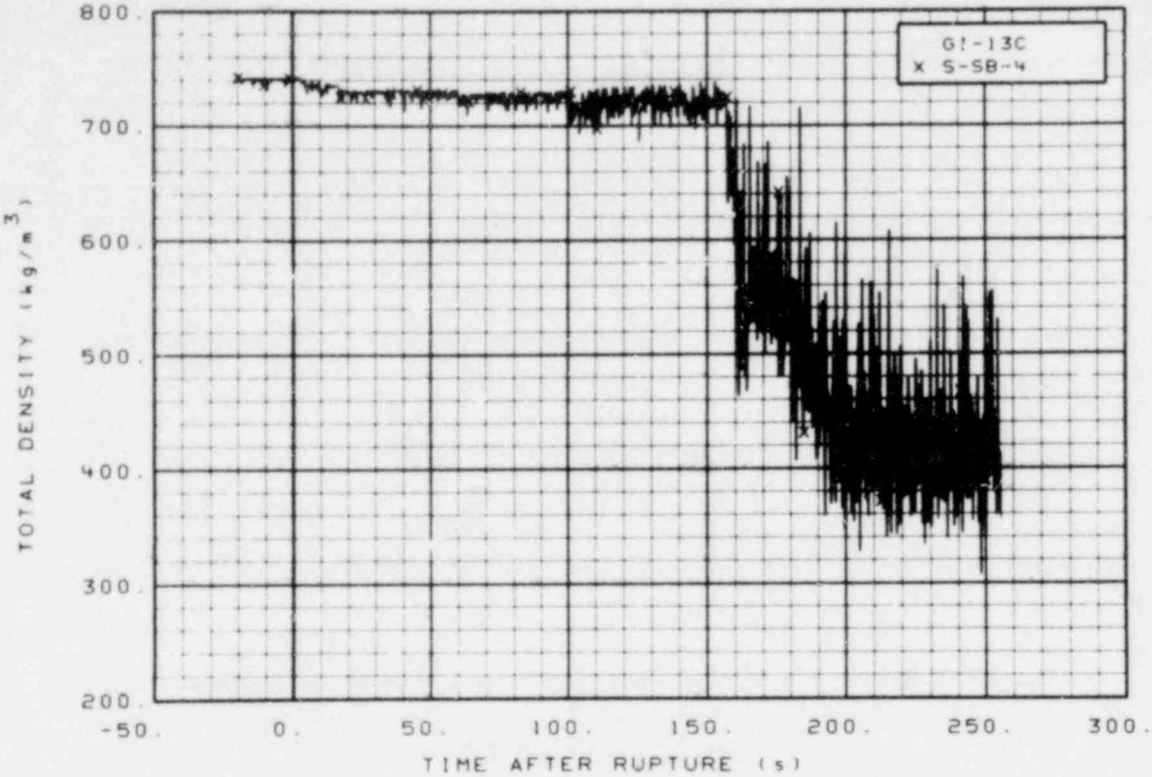


Figure 523. Density in intact loop cold leg, Test S-SB-4 (GI-13C), from -20 to 256 s.

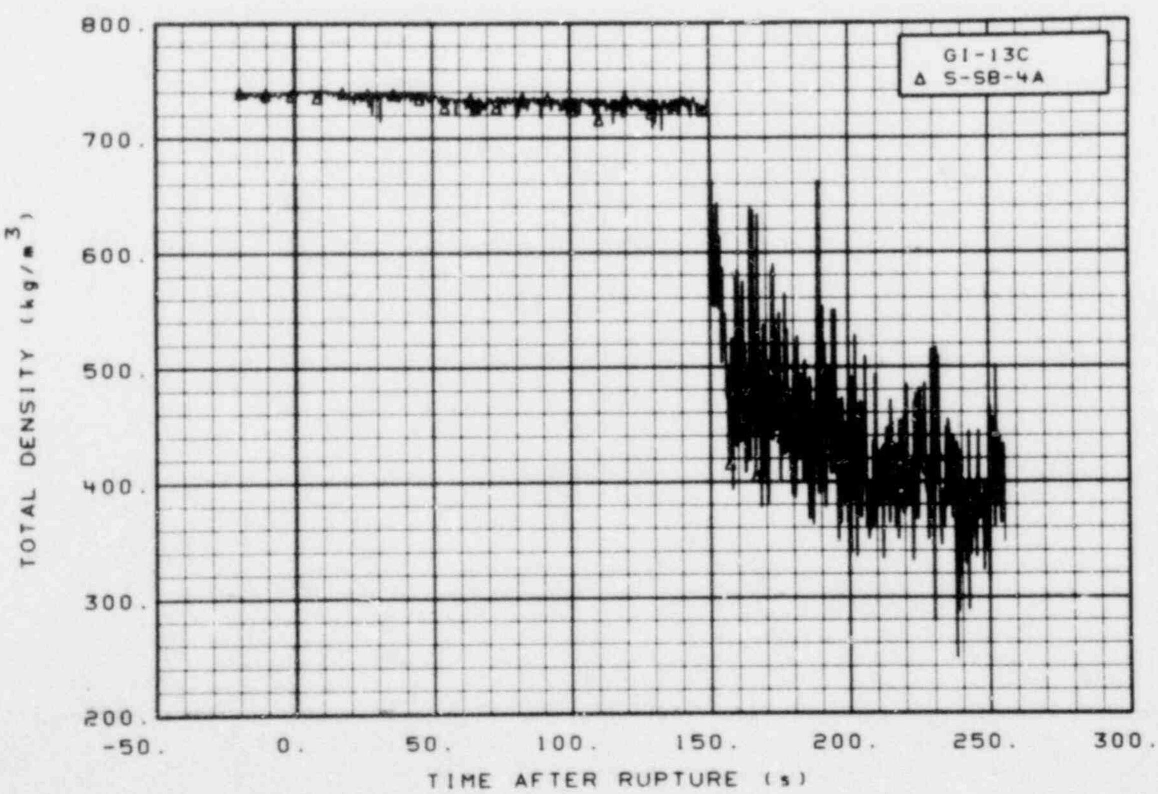


Figure 524. Density in intact loop cold leg, Test S-SB-4A (GI-13C), from -20 to 256 s.

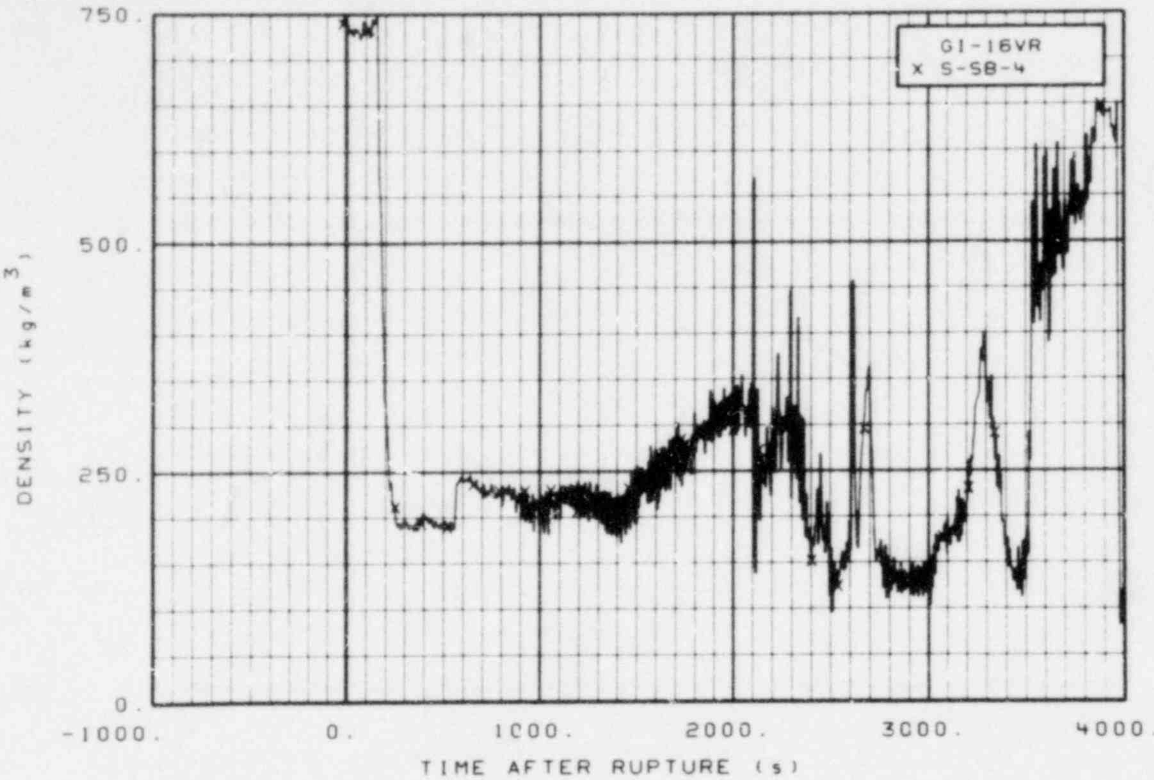


Figure 525. Density in intact loop cold leg, Test S-SB-4 (GI-16VR), from -20 to 4000 s.

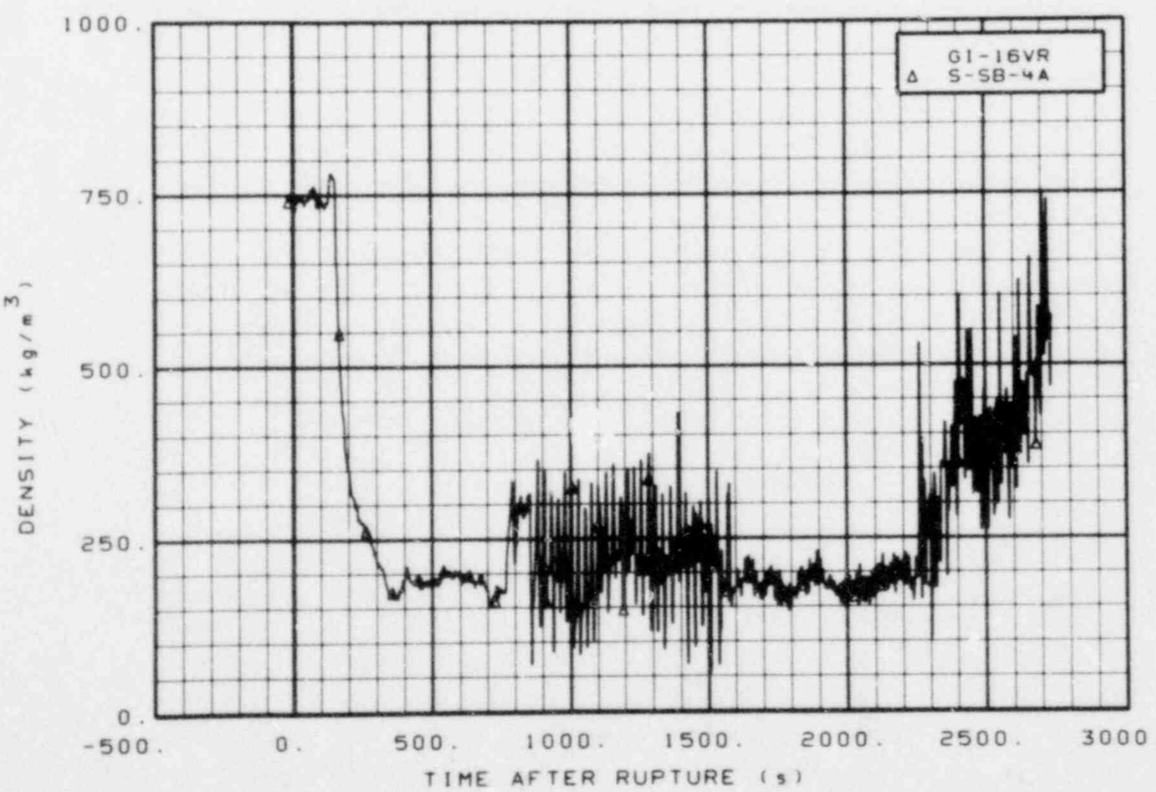


Figure 526. Density in intact loop cold leg, Test S-SB-4A (GI-16VR), from -20 to 2740 s.

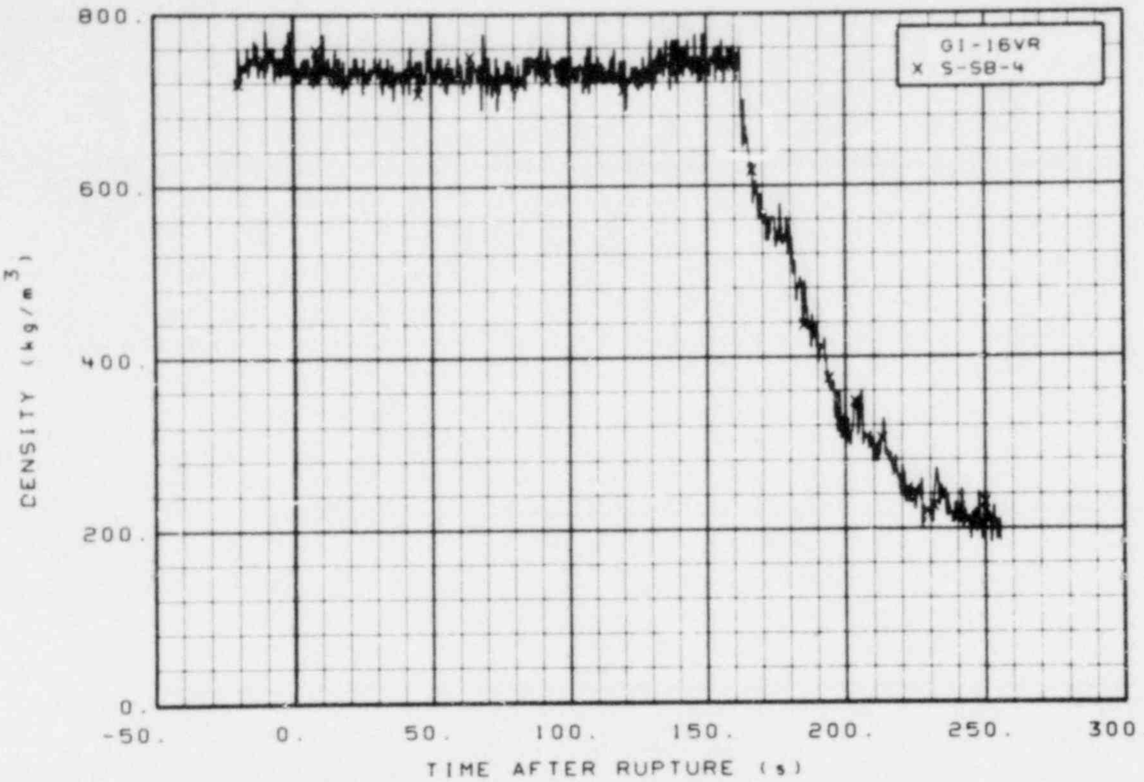


Figure 527. Density in intact loop cold leg, Test S-SB-4 (GI-16VR), from -20 to 256 s.

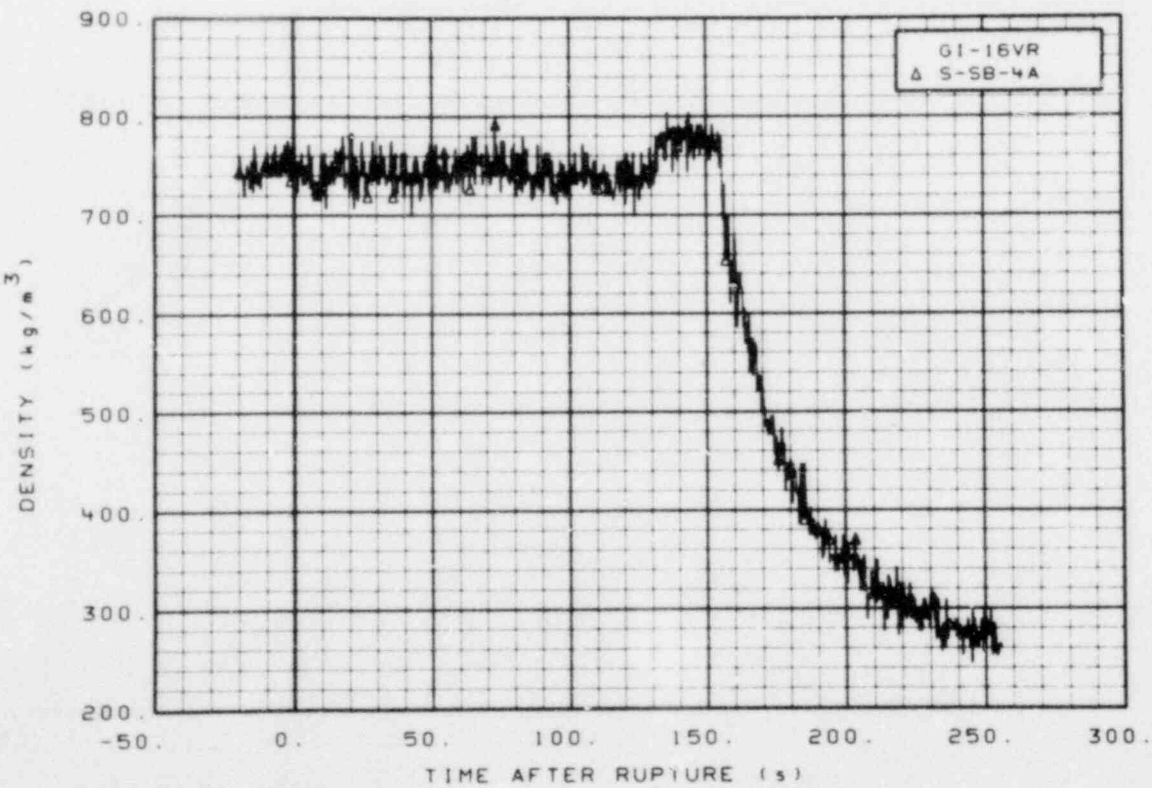


Figure 528. Density in intact loop cold leg, Test S-SB-4A (GI-16VR), from -20 to 256 s.

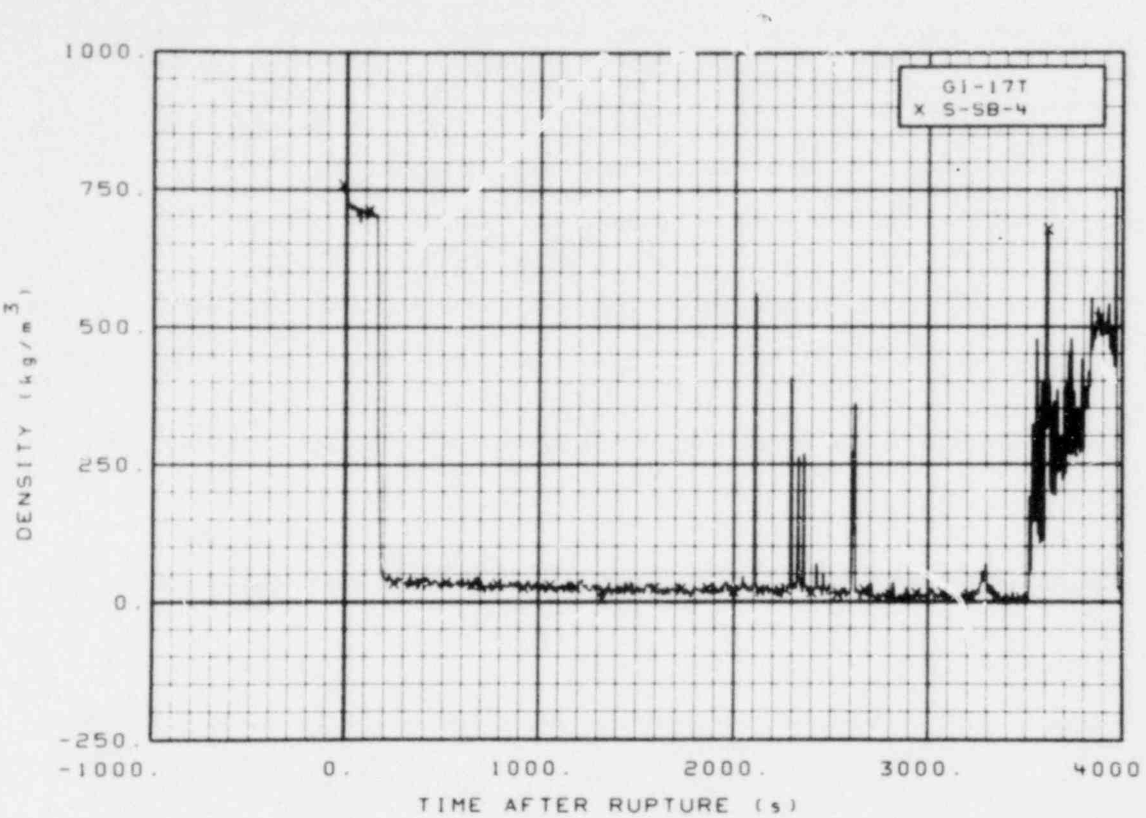


Figure 529. Density in intact loop cold leg, Test S-SB-4 (GI-17T), from -20 to 4000 s.

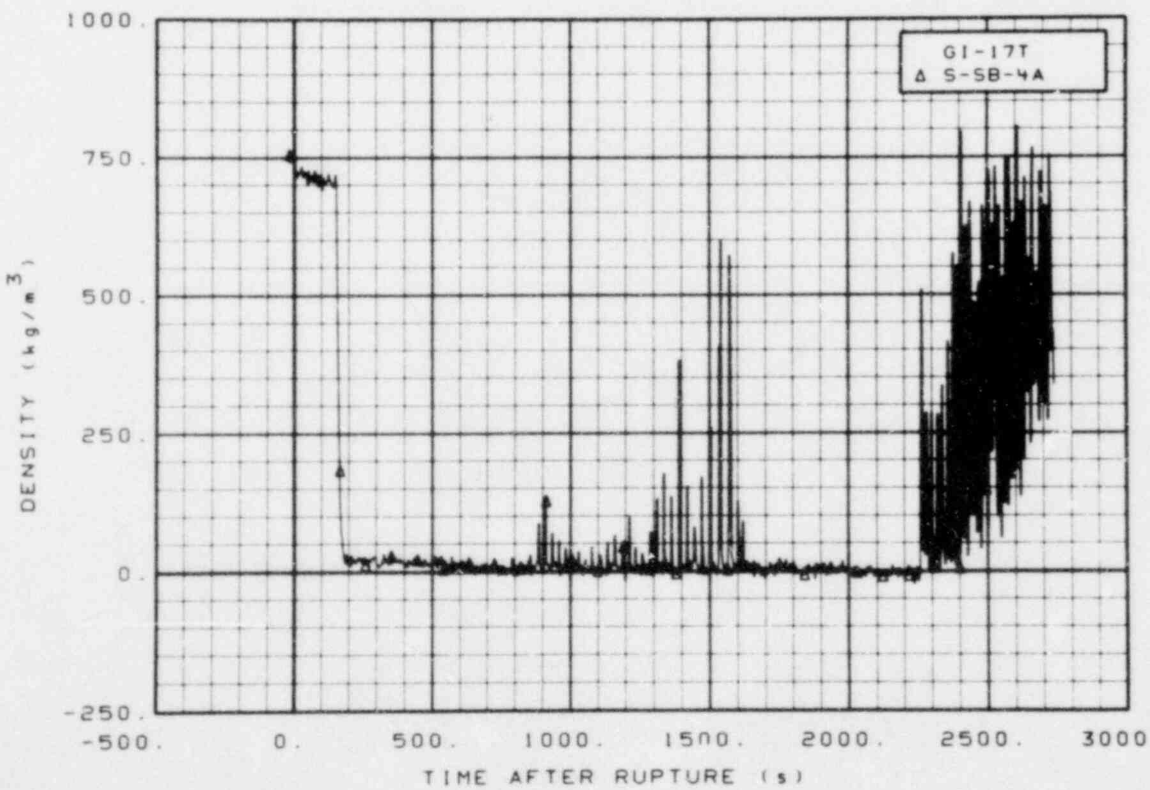


Figure 530. Density in intact loop cold leg, Test S-SB-4A (GI-17T), from -20 to 2740 s.

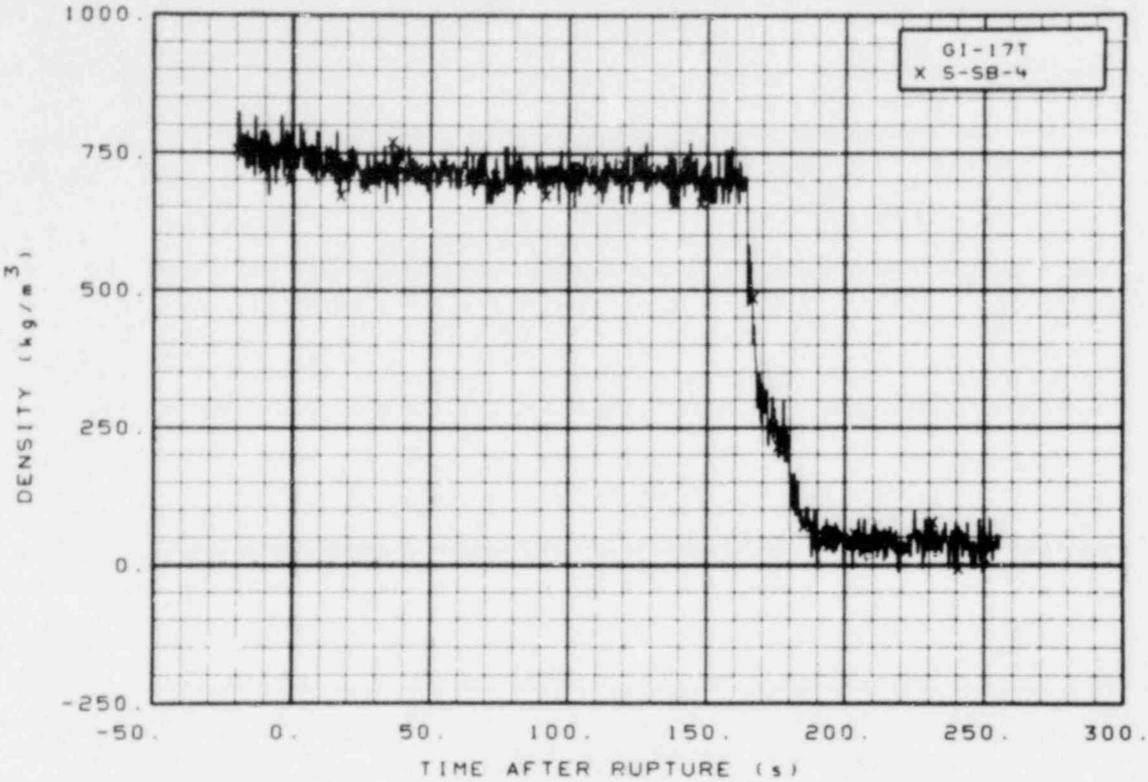


Figure 531. Density in intact loop cold leg, Test S-SB-4 (GI-17T), from -20 to 256 s.

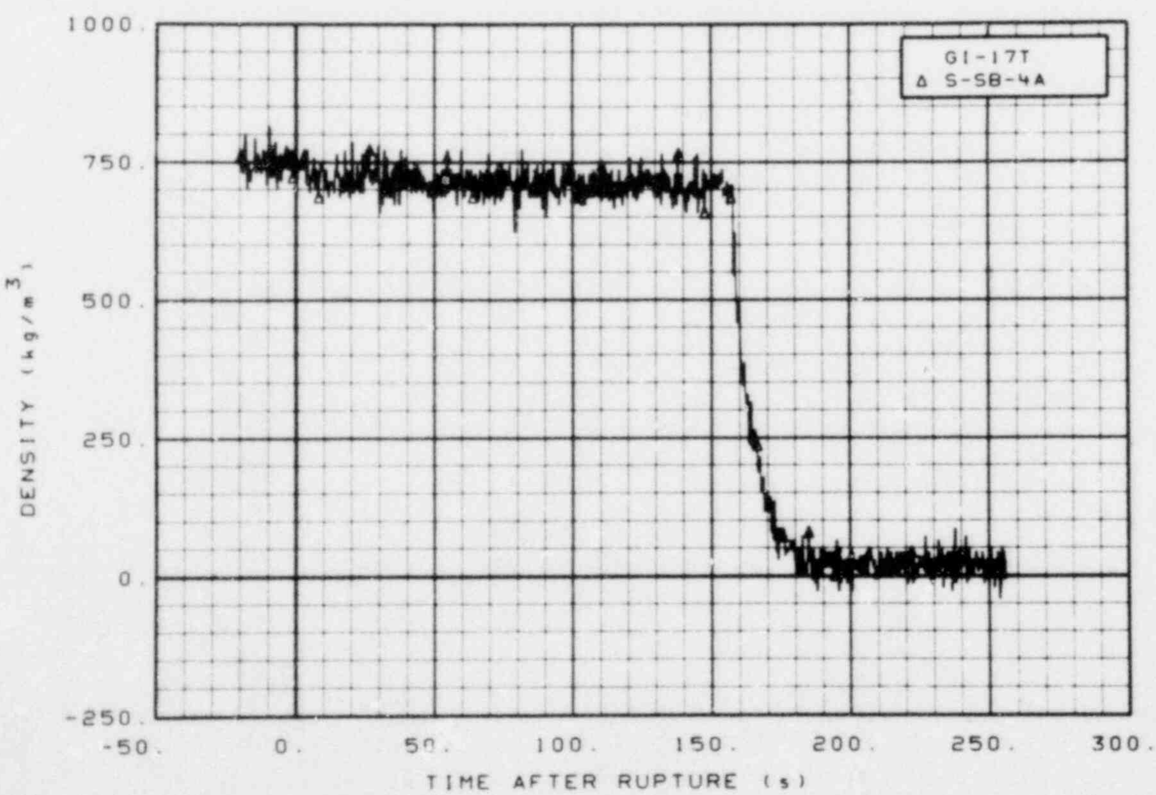


Figure 532. Density in intact loop cold leg, Test S-SB-4A (GI-17T), from -20 to 256 s.

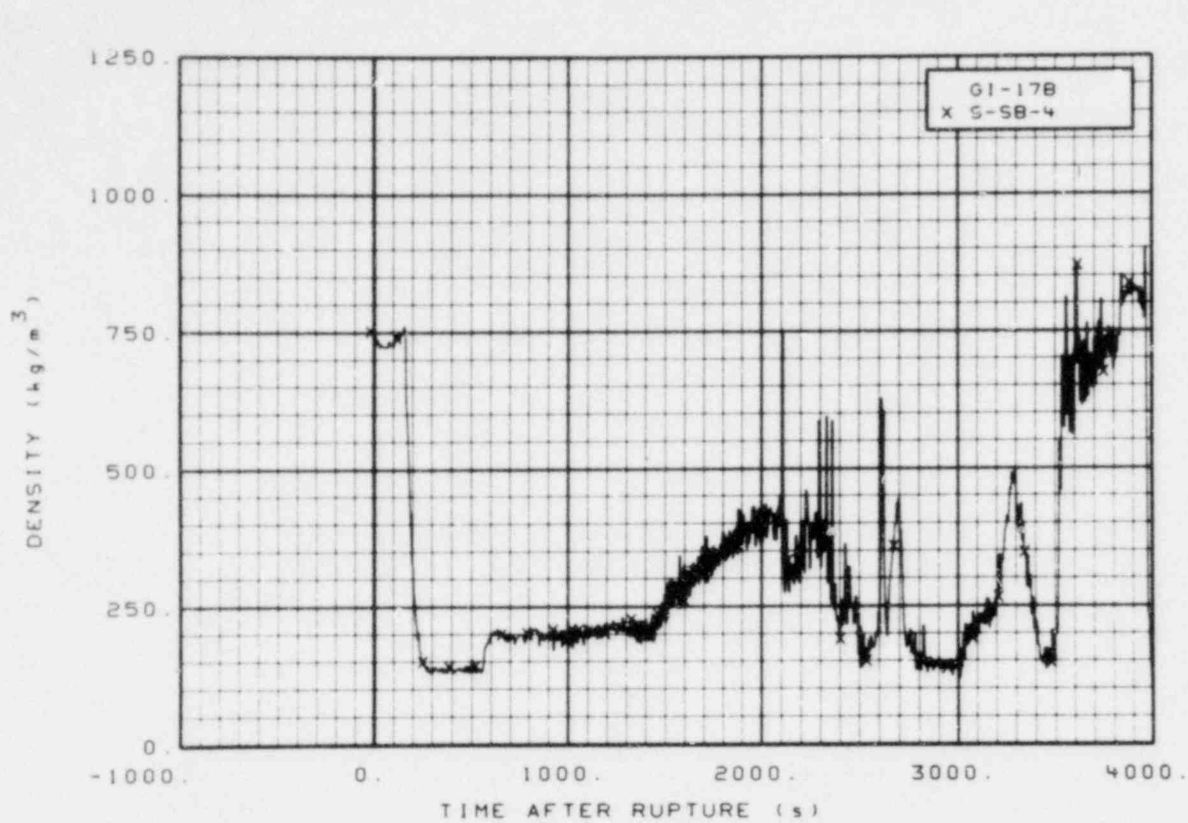


Figure 533. Density in intact loop cold leg, Test S-SB-4 (GI-17B), from -20 to 4000 s.

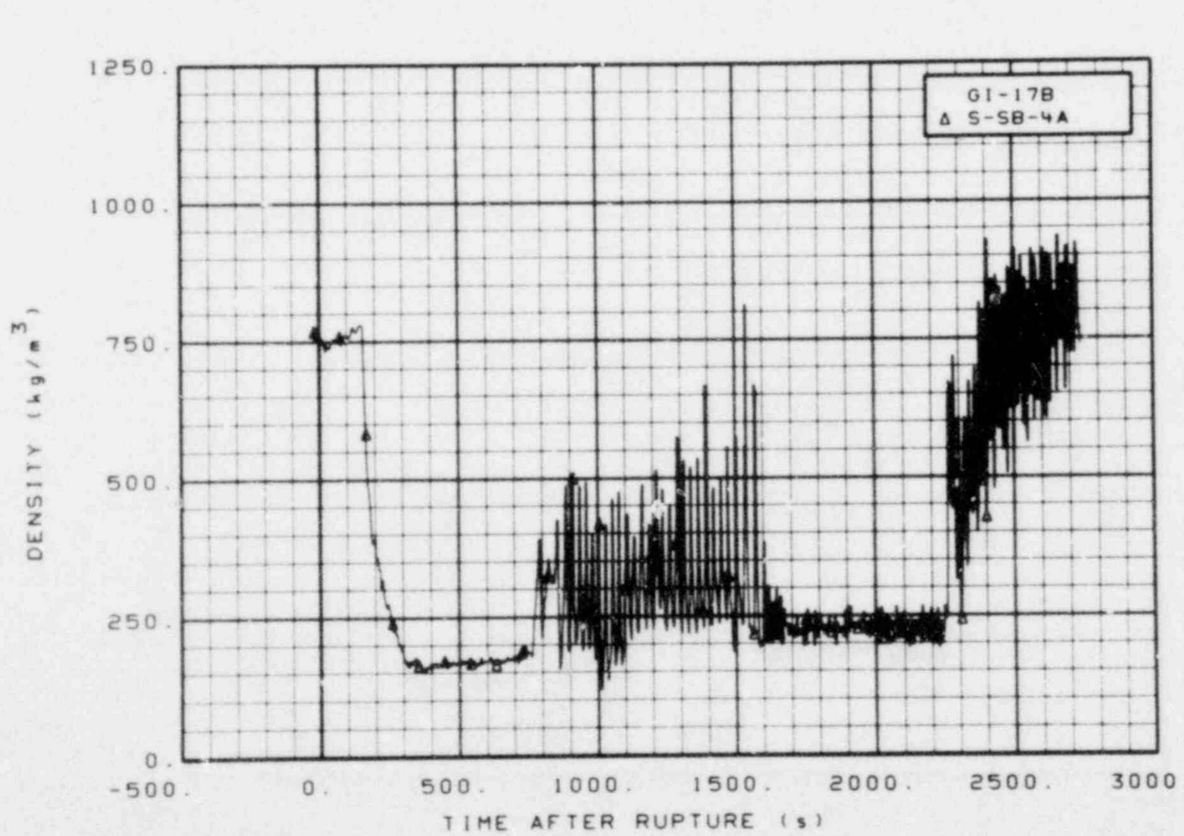


Figure 534. Density in intact loop cold leg, Test S-SB-4A (GI-17B), from -20 to 2740 s.

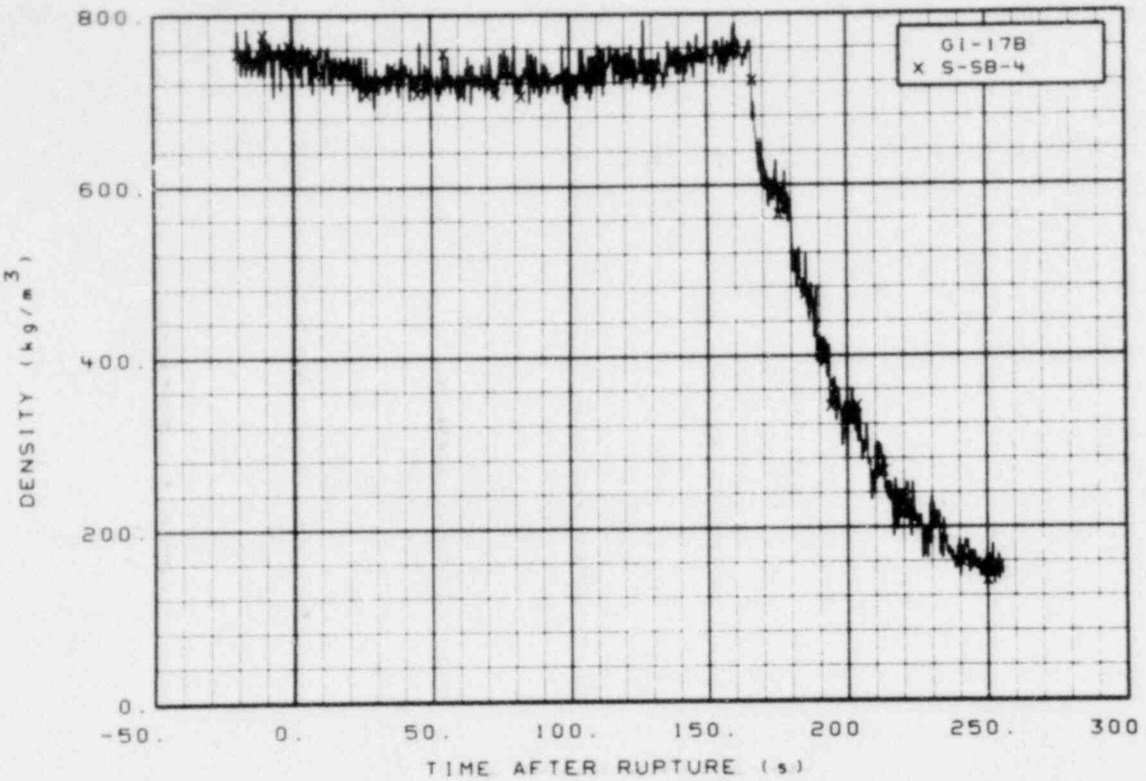


Figure 535. Density in intact loop cold leg, Test S-SB-4 (GI-17B), from -20 to 256 s.

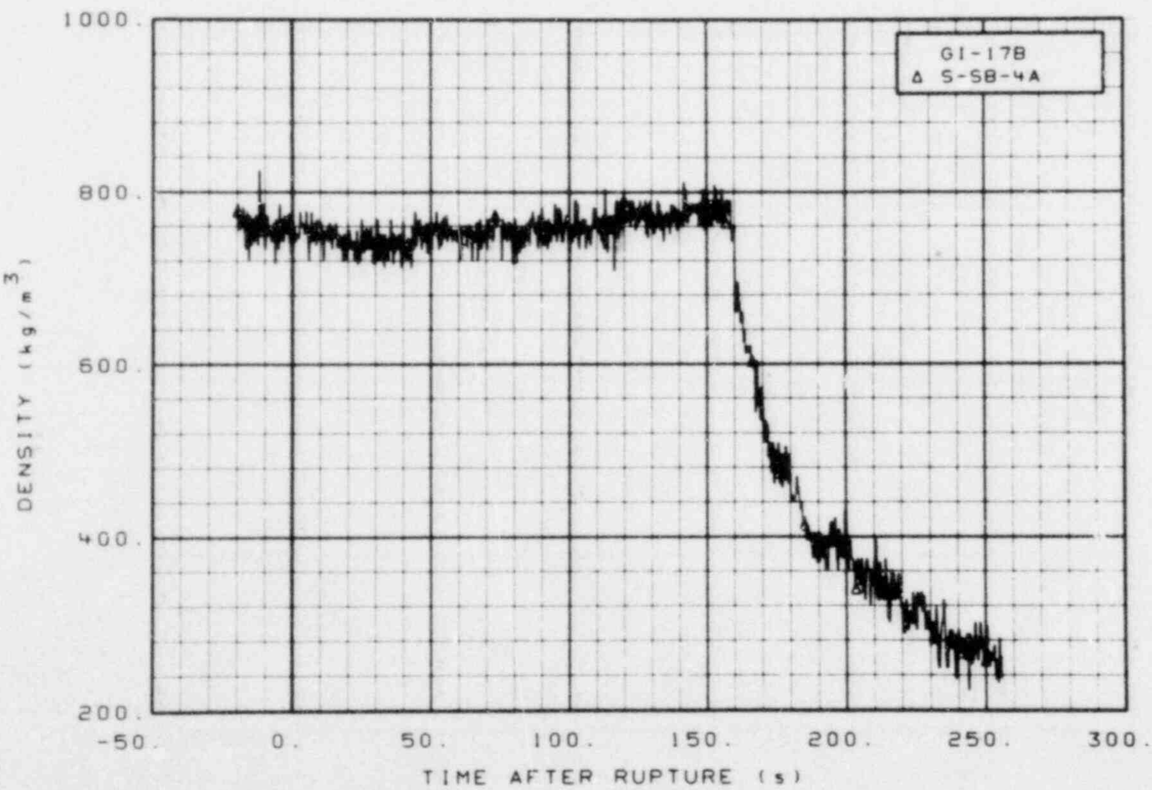


Figure 536. Density in intact loop cold leg, Test S-SB-4A (GI-17B), from -20 to 256 s.

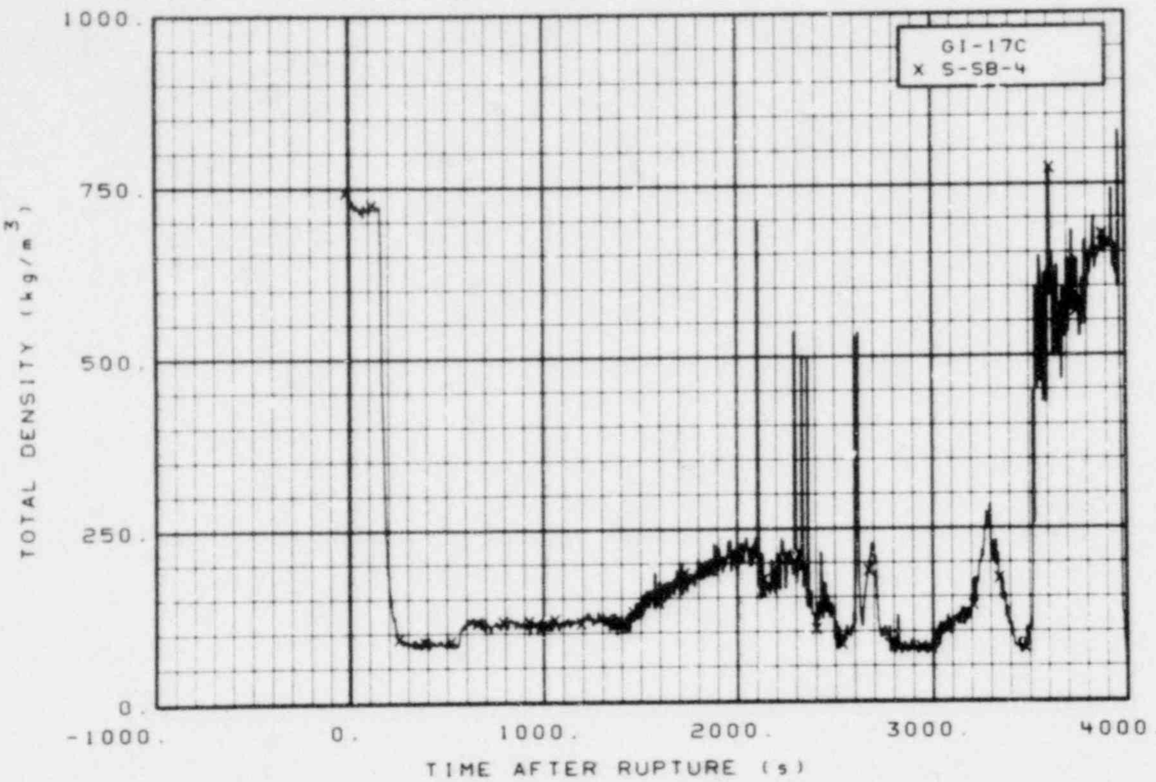


Figure 537. Density in intact loop cold leg, Test S-SB-4 (GI-17C), from -20 to 4000 s.

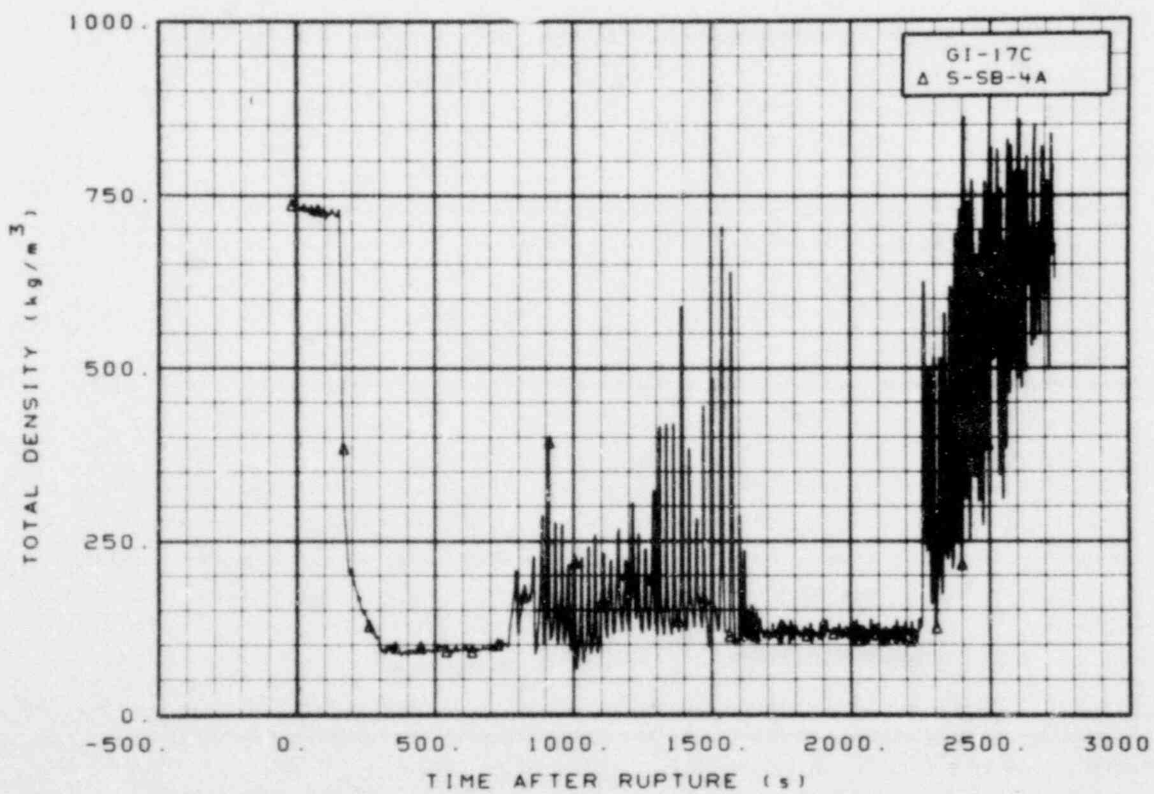


Figure 538. Density in intact loop cold leg, Test S-SB-4A (GI-17C), from -20 to 2740 s.

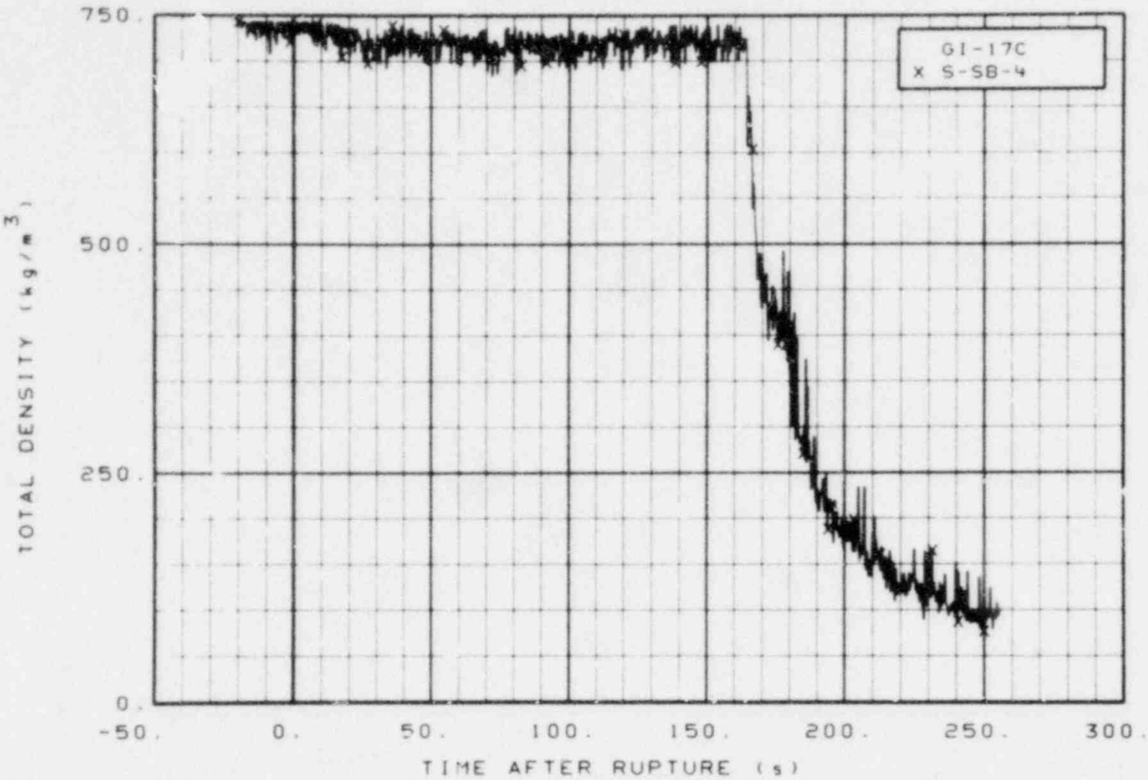


Figure 539. Density in intact loop cold leg, Test S-SB-4 (GI-17C), from -20 to 256 s.

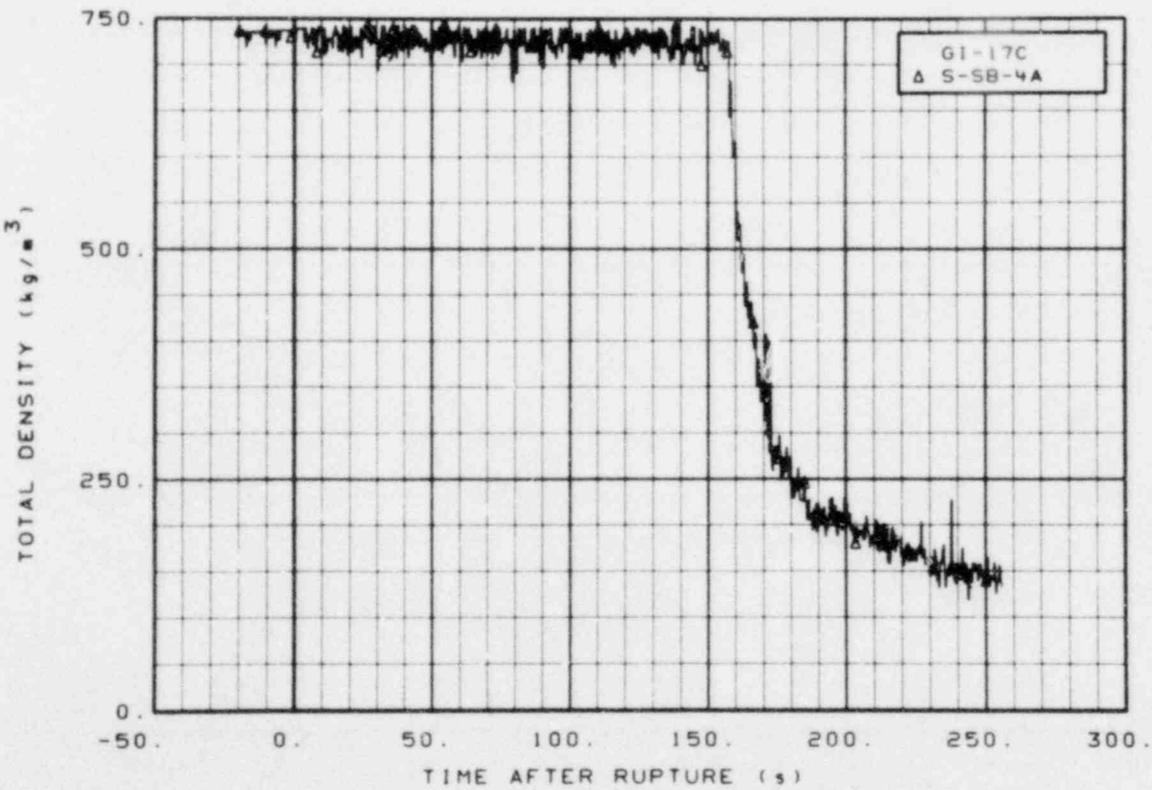


Figure 540. Density in intact loop cold leg, Test S-SB-4A (GI-17C), from -20 to 256 s.

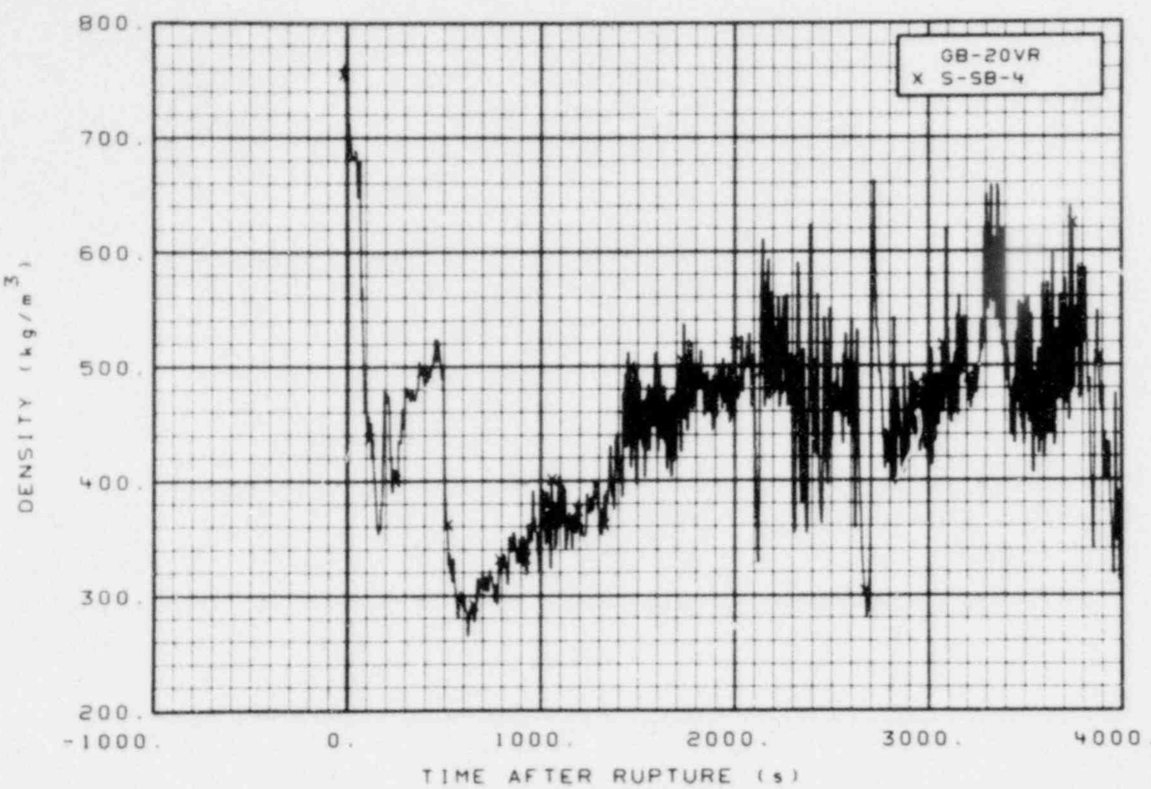


Figure 541. Density in broken loop hot leg, Test S-SB-4 (GB-20VR), from -20 to 4000 s.

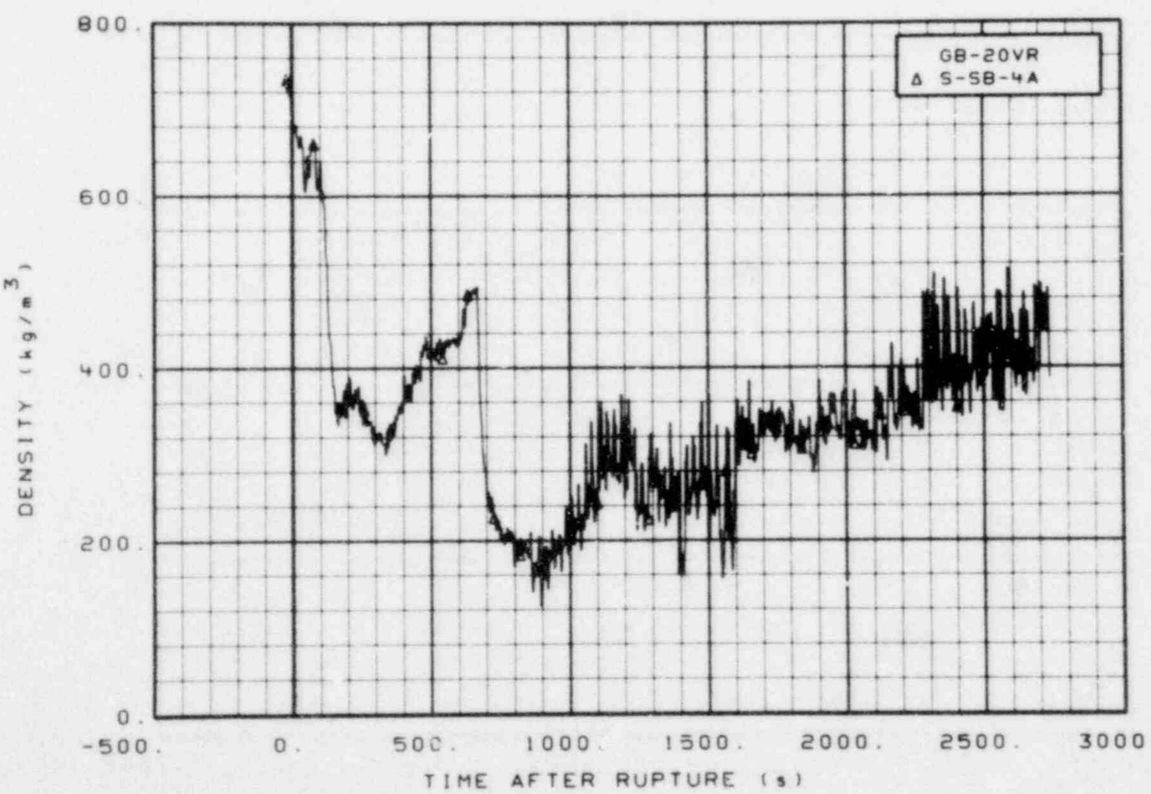


Figure 542. Density in broken loop hot leg, Test S-SB-4A (GB-20VR), from -20 to 2740 s.

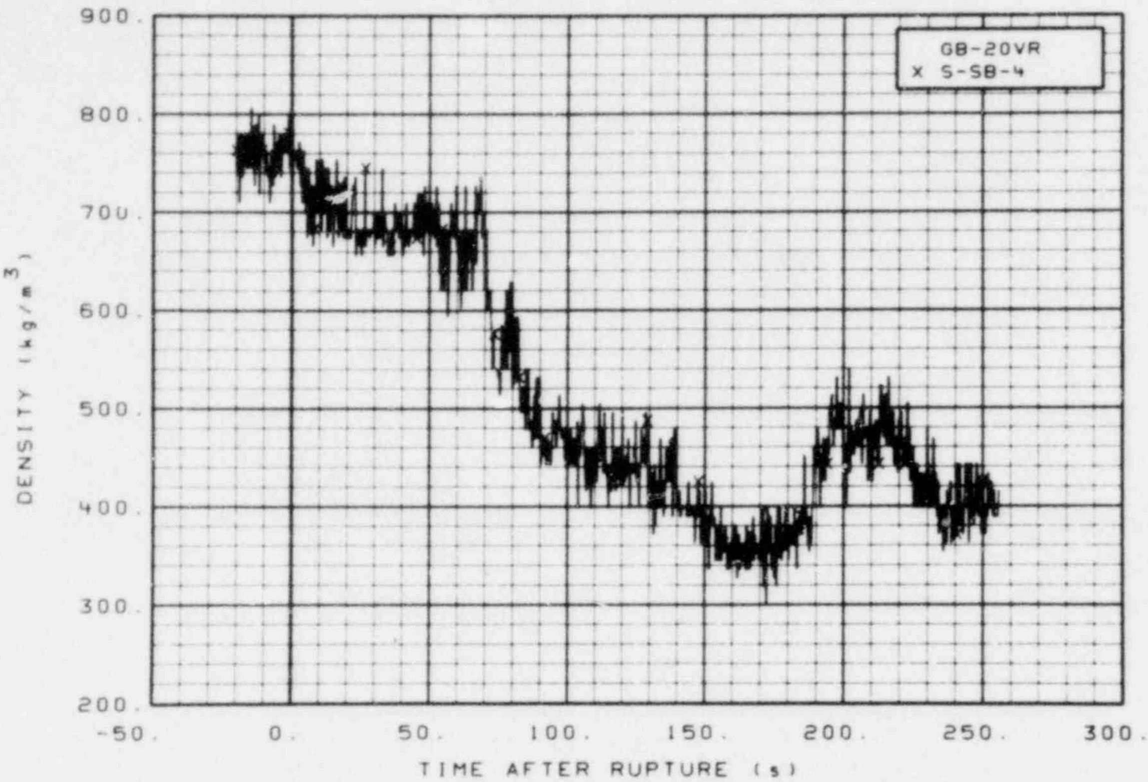


Figure 543. Density in broken loop hot leg, Test S-SB-4 (GB-20VR), from -20 to 256 s.

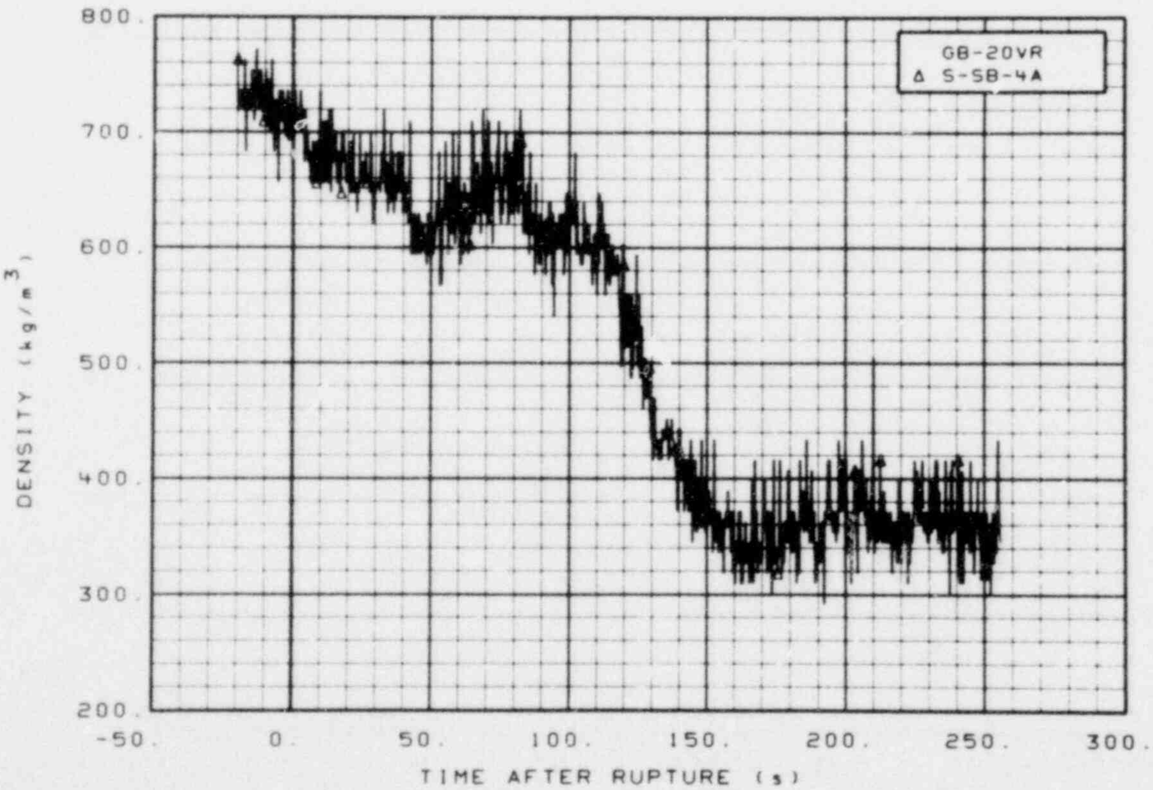


Figure 544. Density in broken loop hot leg, Test S-SB-4A (GB-20VR), from -20 to 256 s.

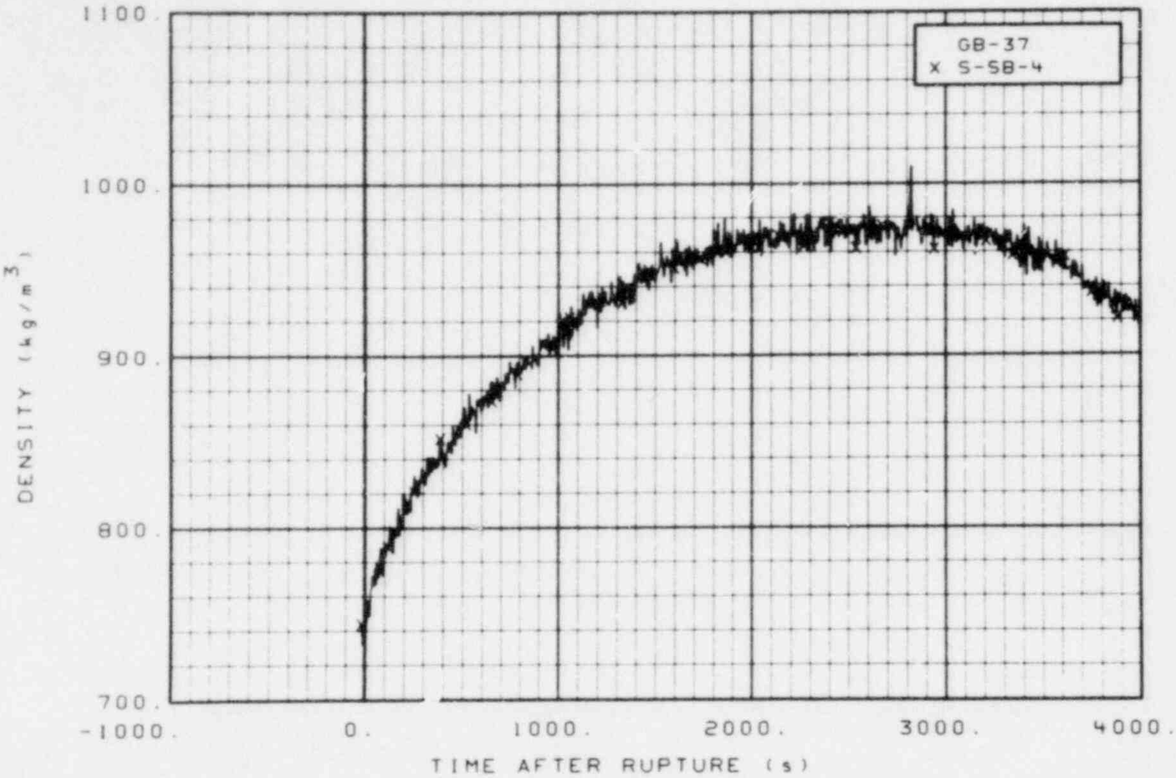


Figure 545. Density in broken loop cold leg, Test S-SB-4 (GB-37), from -20 to 4000 s.

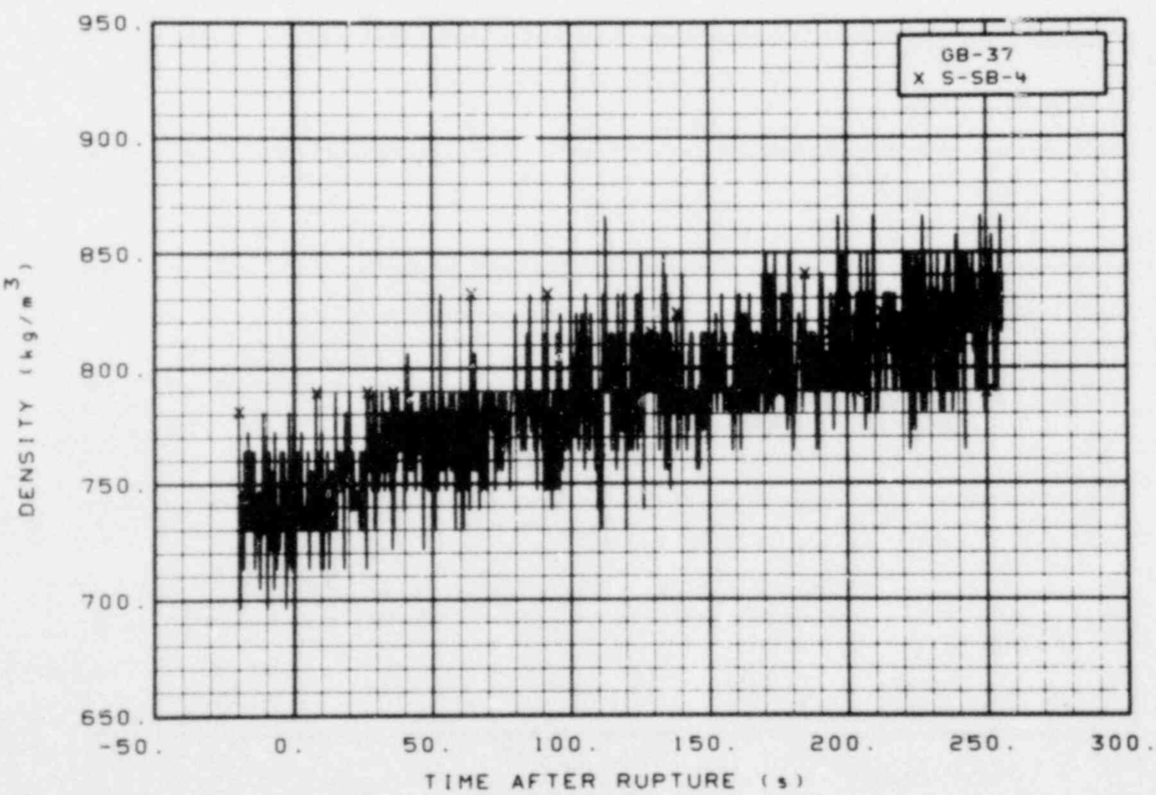


Figure 546. Density in broken loop cold leg, Test S-SB-4 (GB-37), from -20 to 256 s.

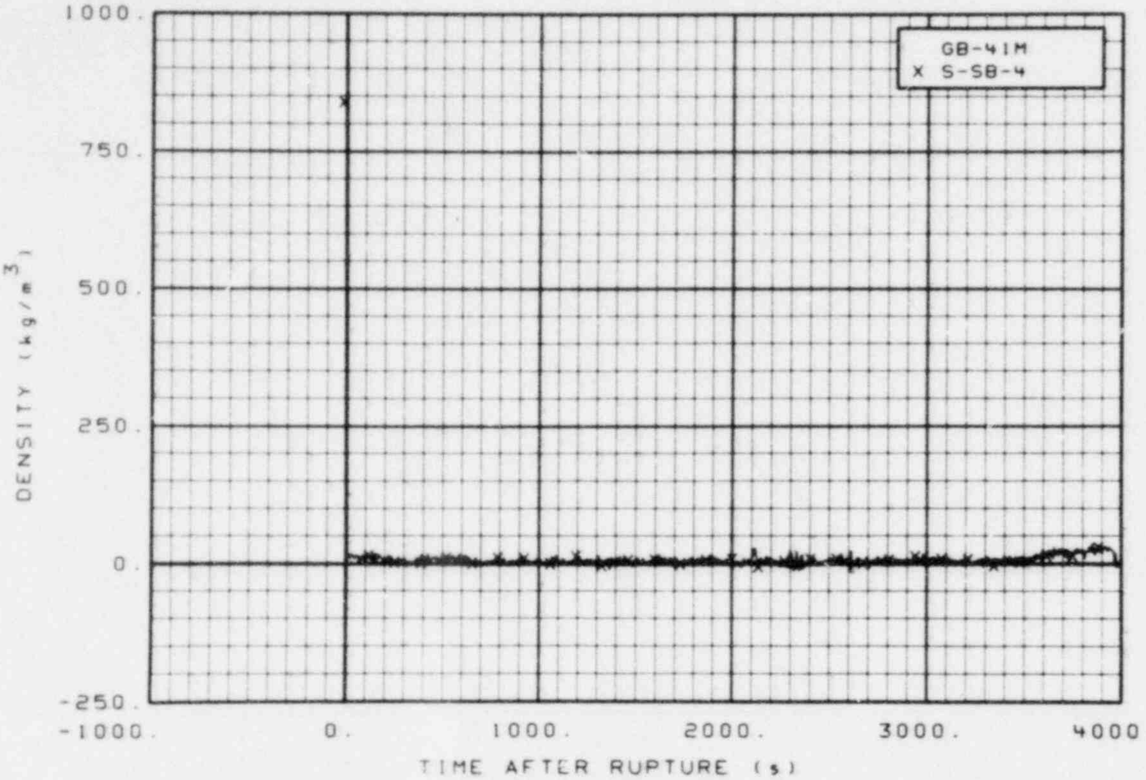


Figure 547. Density in broken loop cold leg, Test S-SB-4 (GB-41M), from -20 to 4000 s.

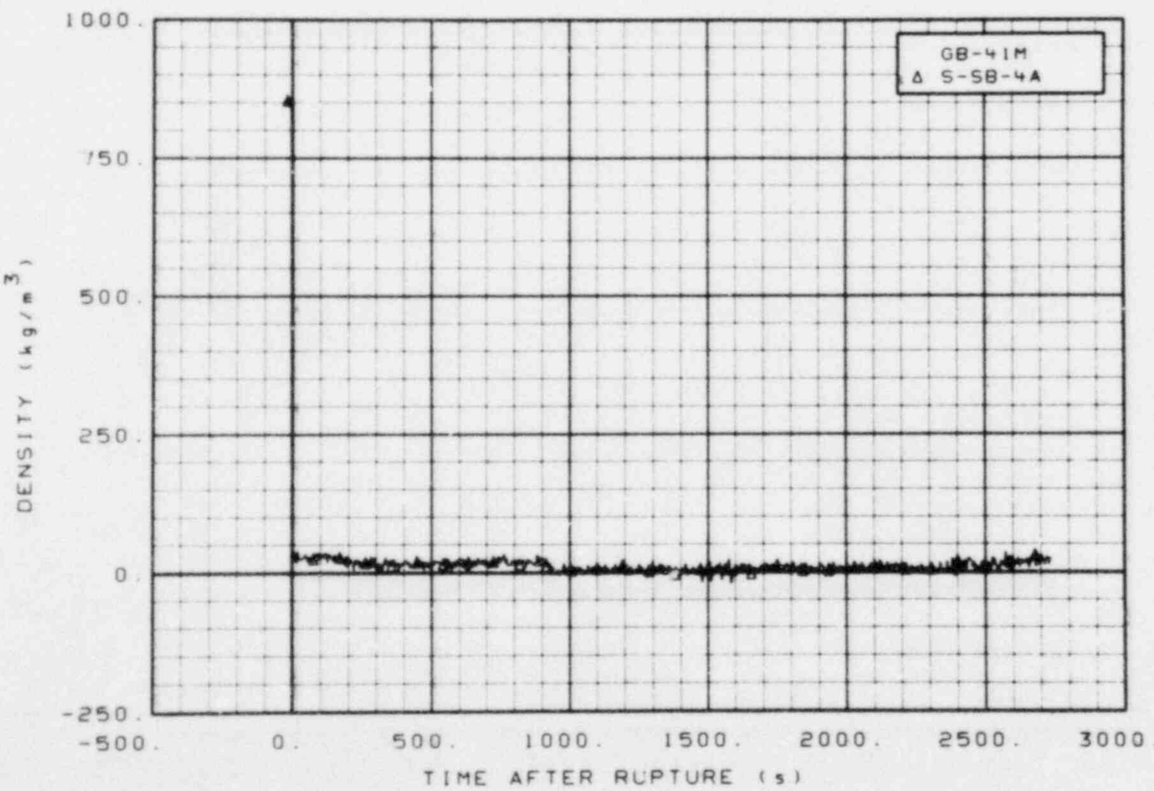


Figure 548. Density in broken loop cold leg, Test S-SB-4A (GB-41M), from -20 to 2740 s.

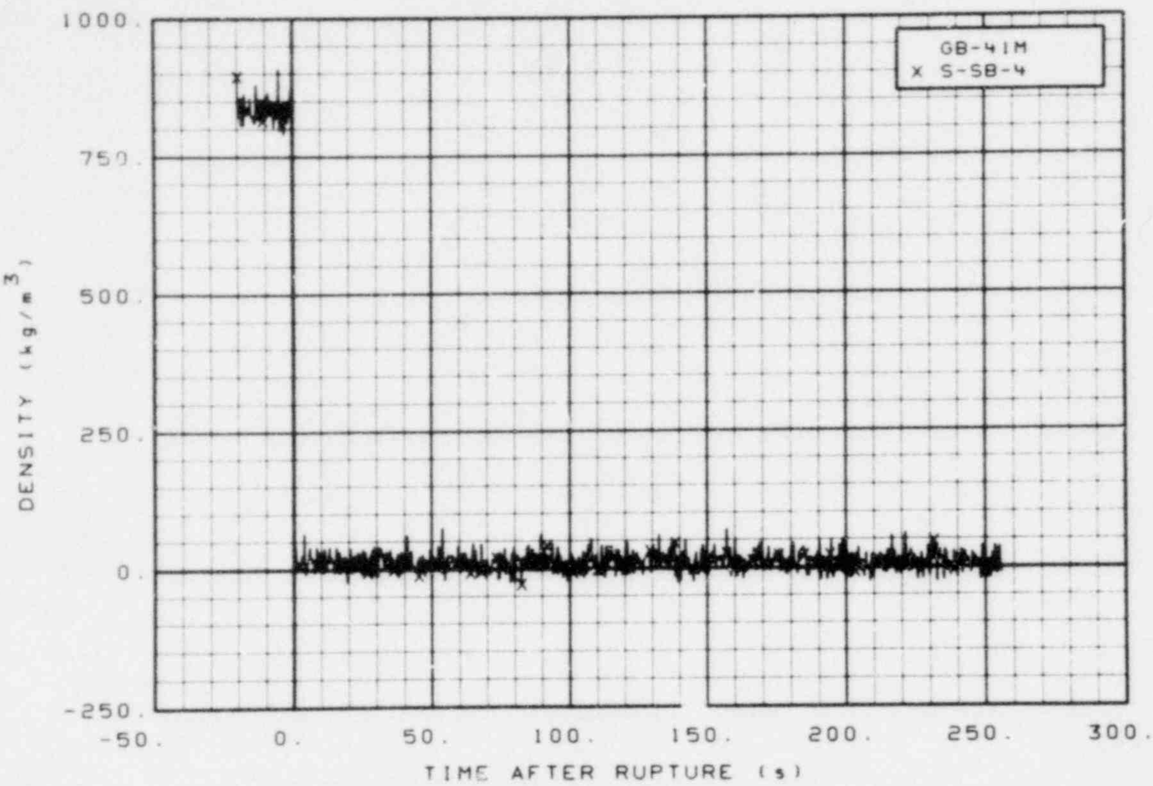


Figure 549. Density in broken loop cold leg, Test S-SB-4 (GB-41M), from -20 to 256 s.

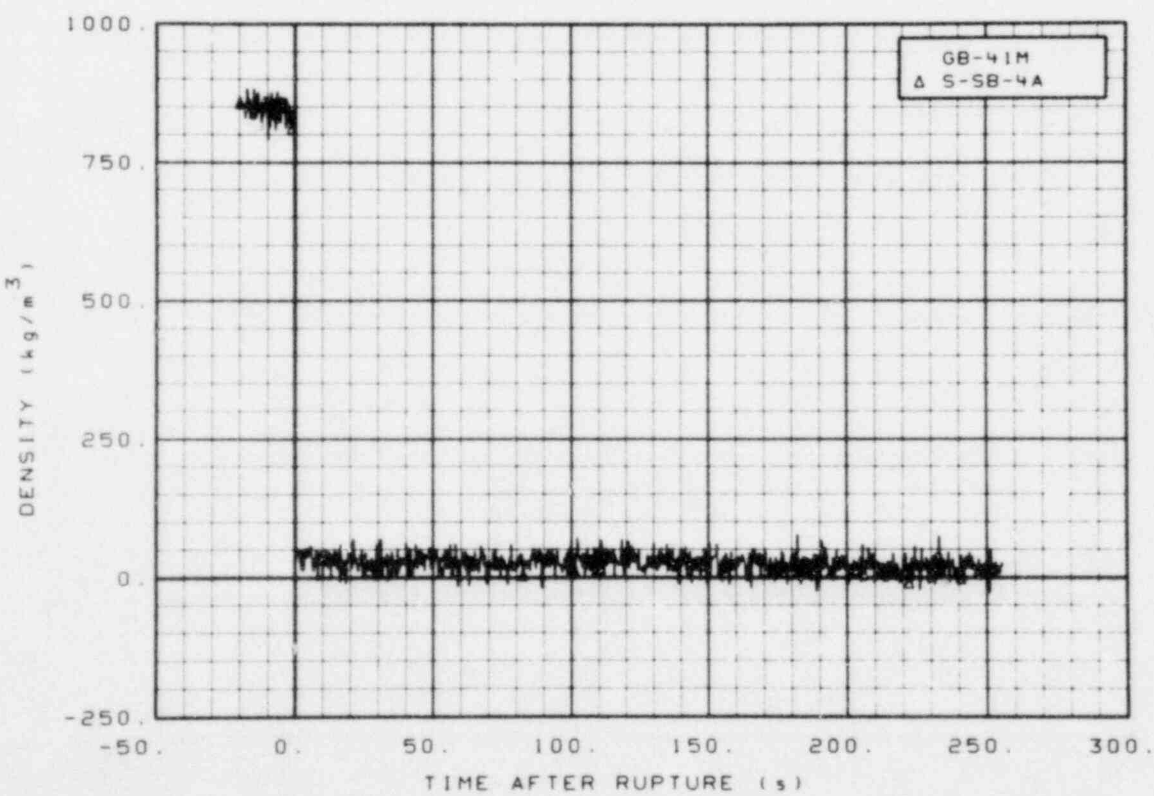


Figure 550. Density in broken loop cold leg, Test S-SB-4A (GB-41M), from -20 to 256 s.

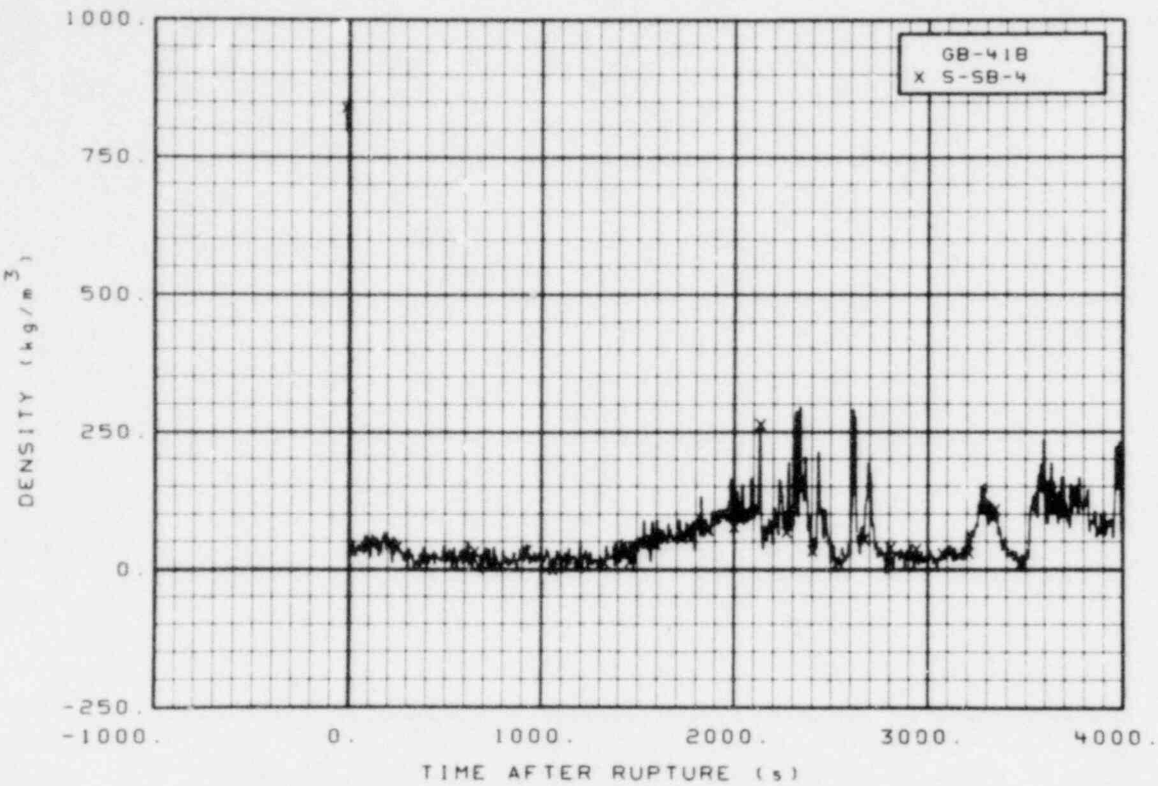


Figure 551. Density in broken loop cold leg, Test S-SB-4 (GB-41B), from -20 to 4000 s.

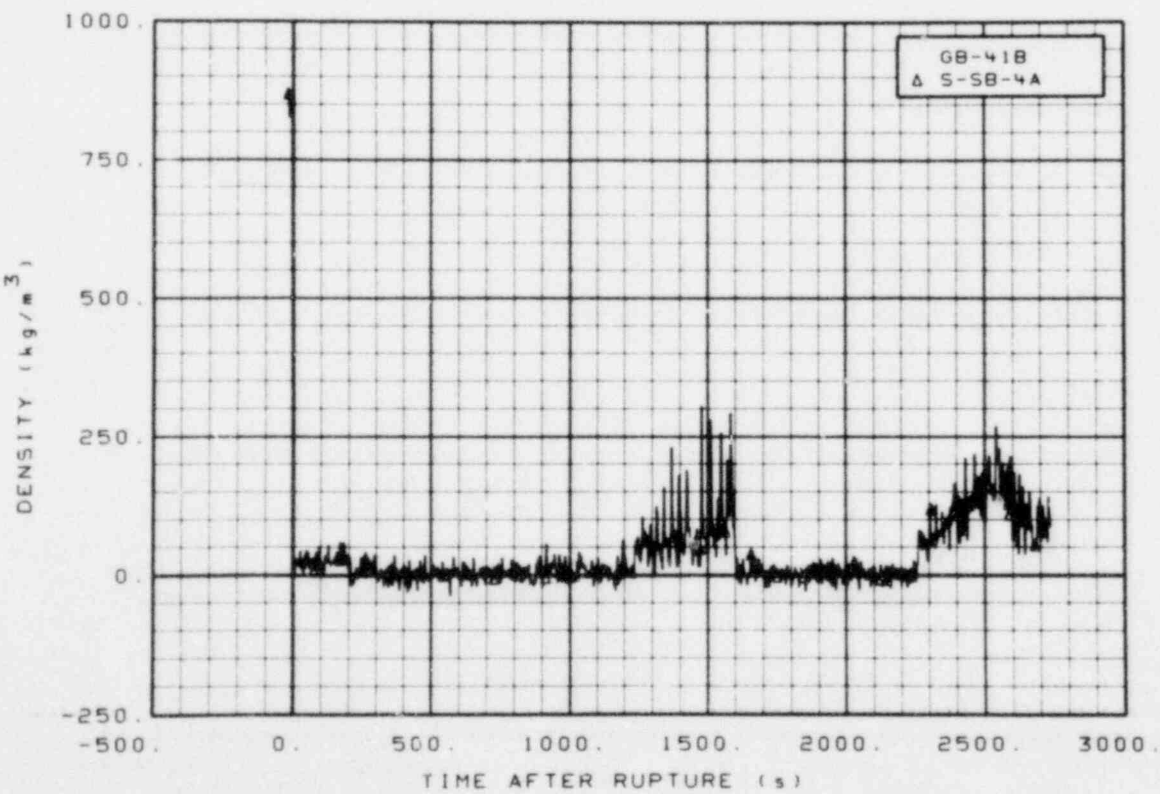


Figure 552. Density in broken loop cold leg, Test S-SB-4A (GB-41B), from -20 to 2740 s.

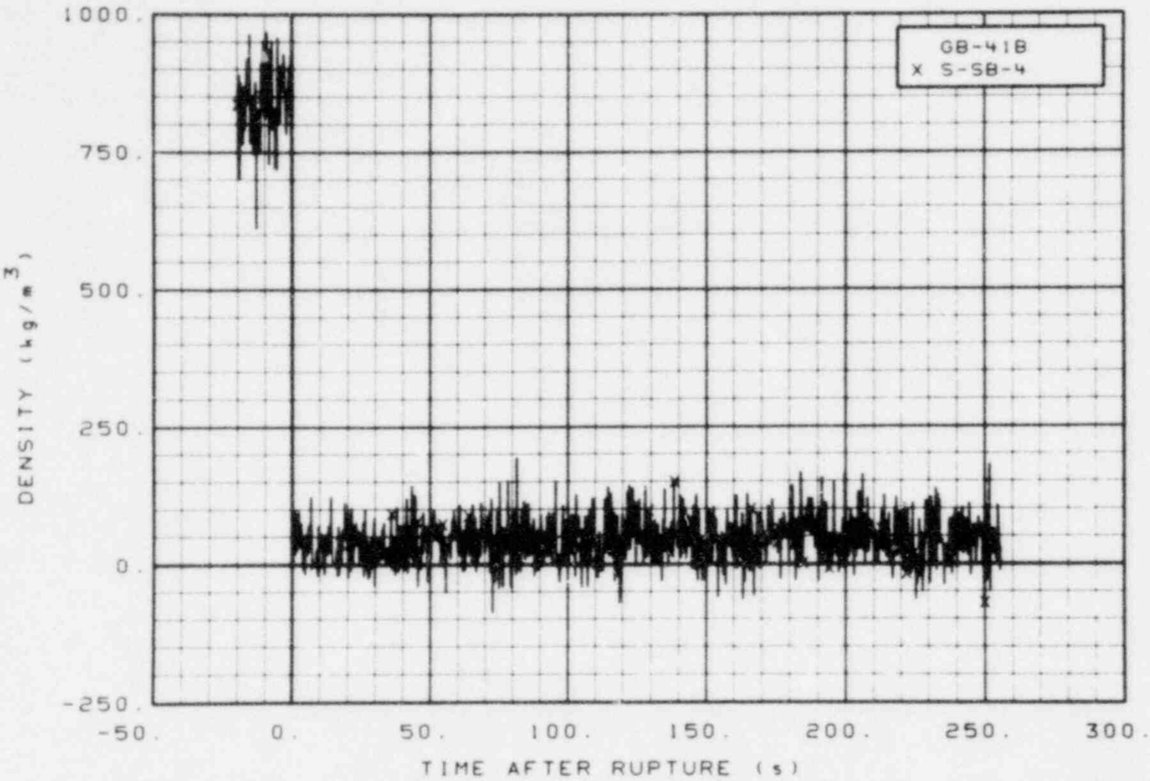


Figure 553. Density in broken loop cold leg, Test S-SB-4 (GB-41B), from -20 to 256 s.

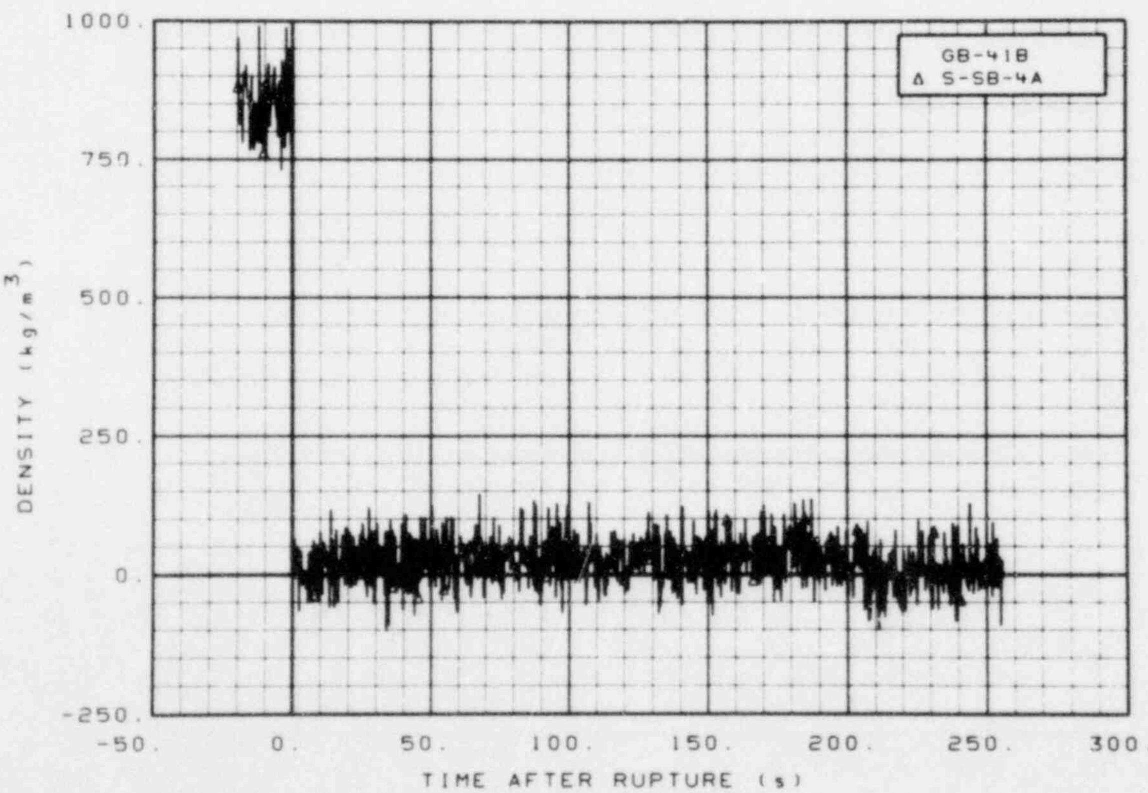


Figure 554. Density in broken loop cold leg, Test S-SB-4A (GB-41B), from -20 to 256 s.

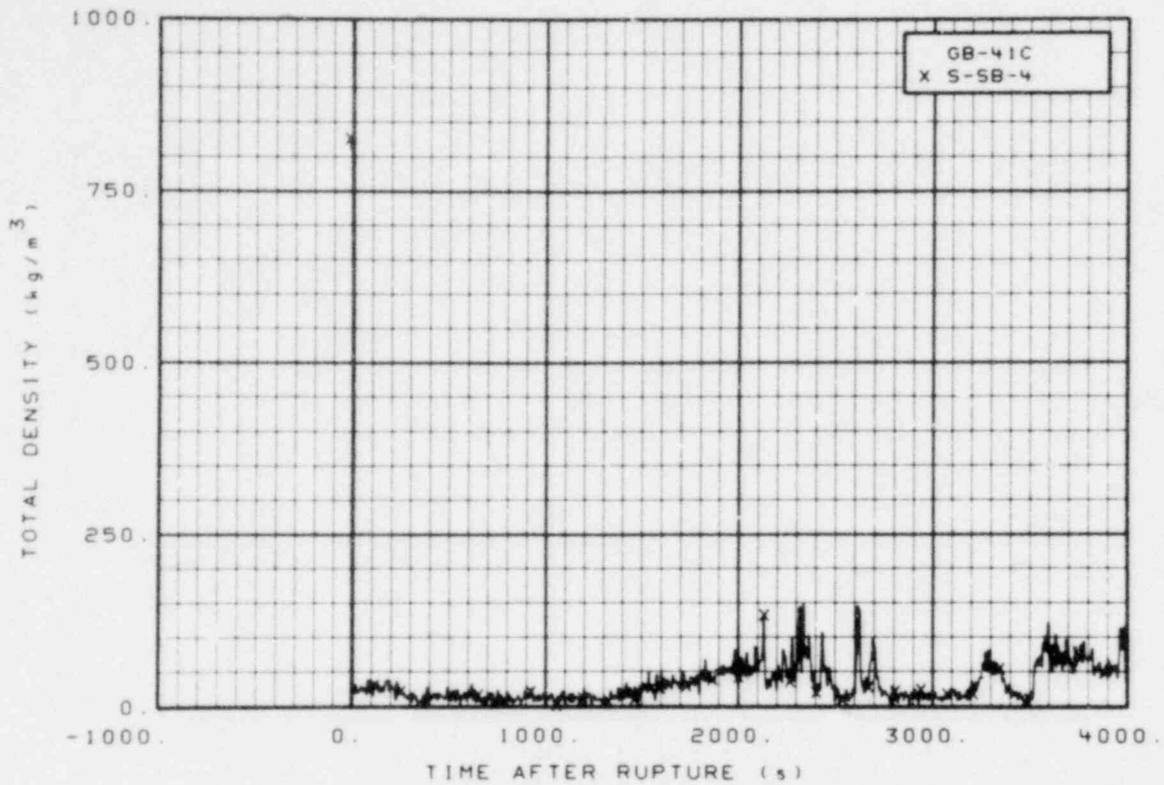


Figure 555. Density in broken loop cold leg, Test S-SB-4 (GB-41C), from -20 to 4000 s.

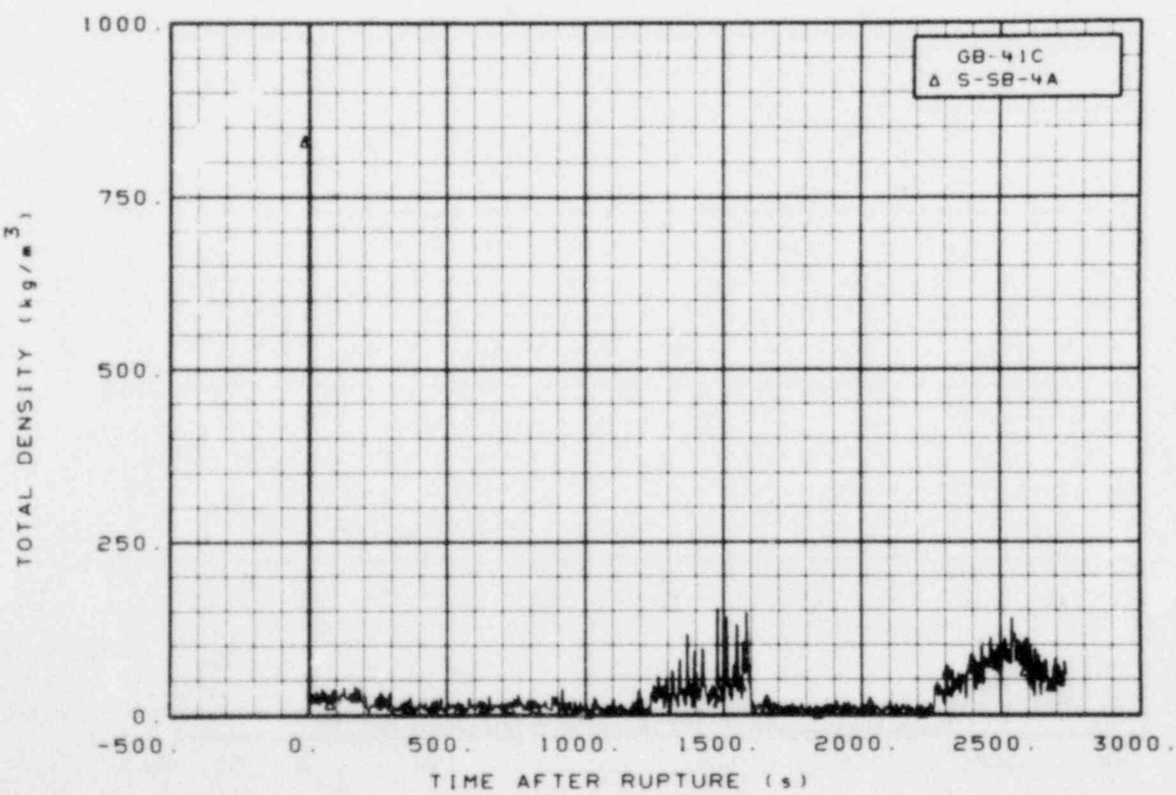


Figure 556. Density in broken loop cold leg, Test S-SB-4A (GB-41C), from -20 to 2740 s.

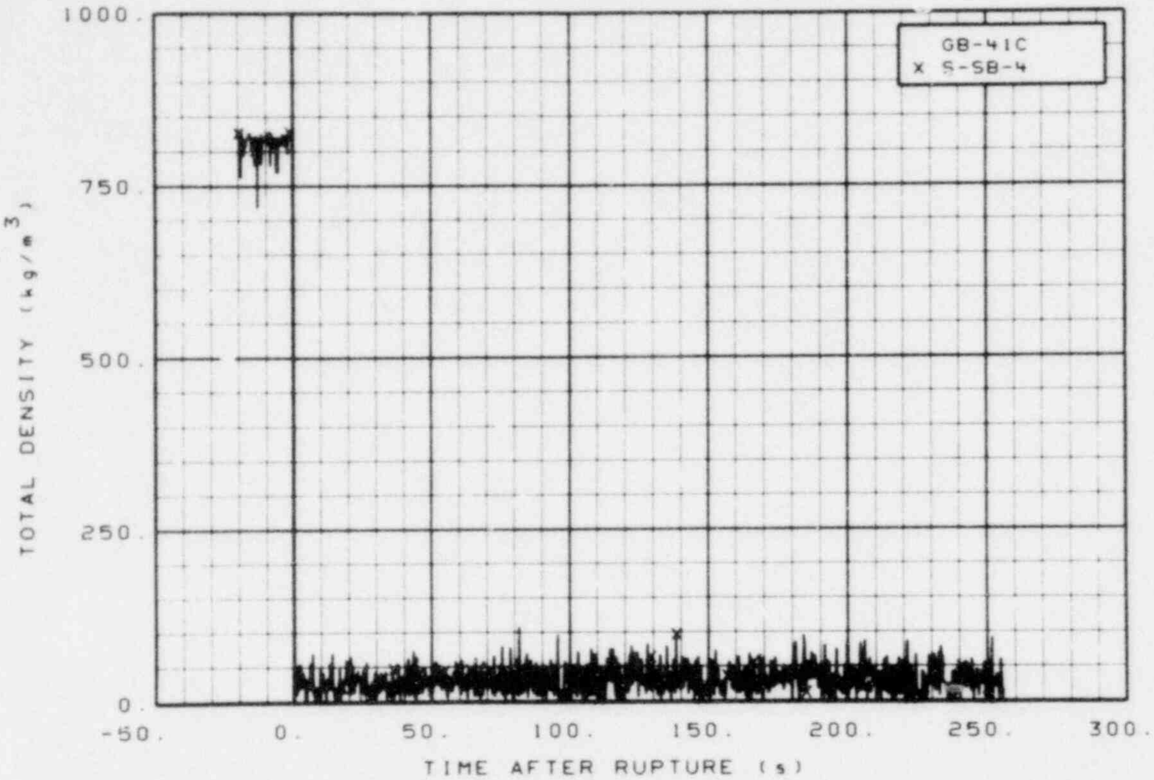


Figure 557. Density in broken loop cold leg, Test S-SB-4 (GB-41C), from -20 to 256 s.

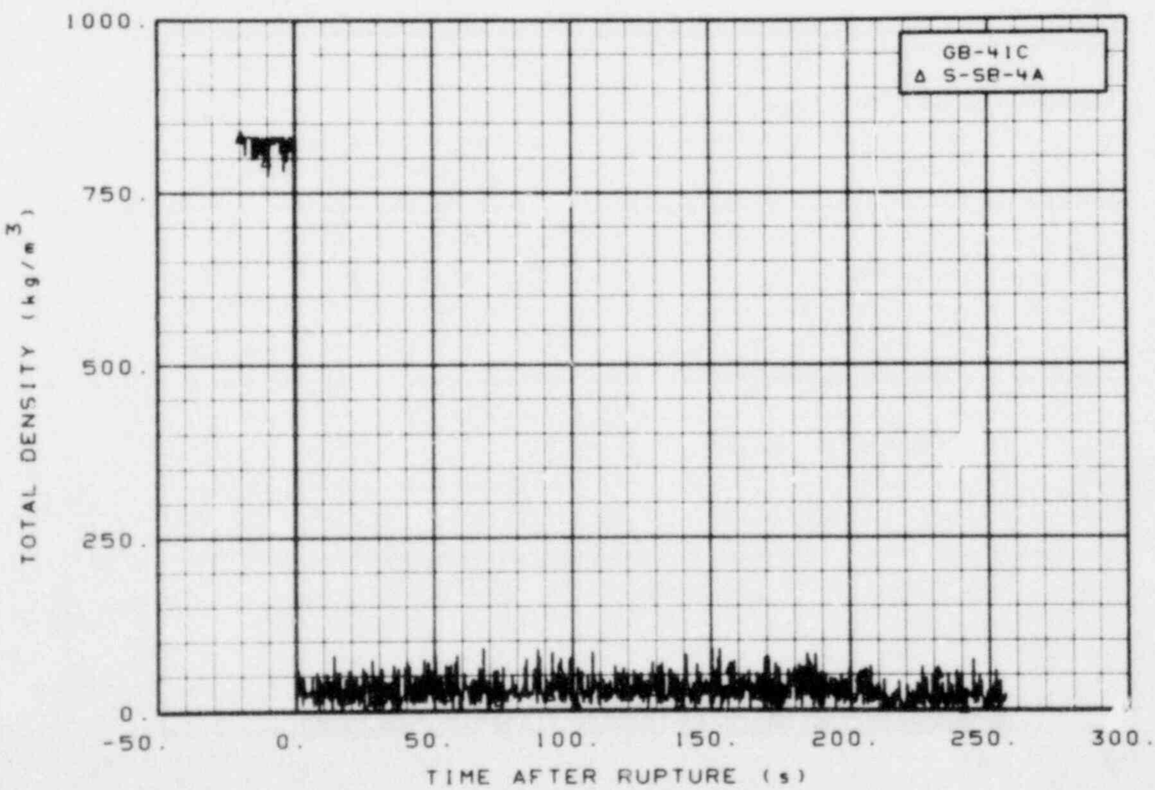


Figure 558. Density in broken loop cold leg, Test S-SB-4A (GB-41C), from -20 to 256 s.

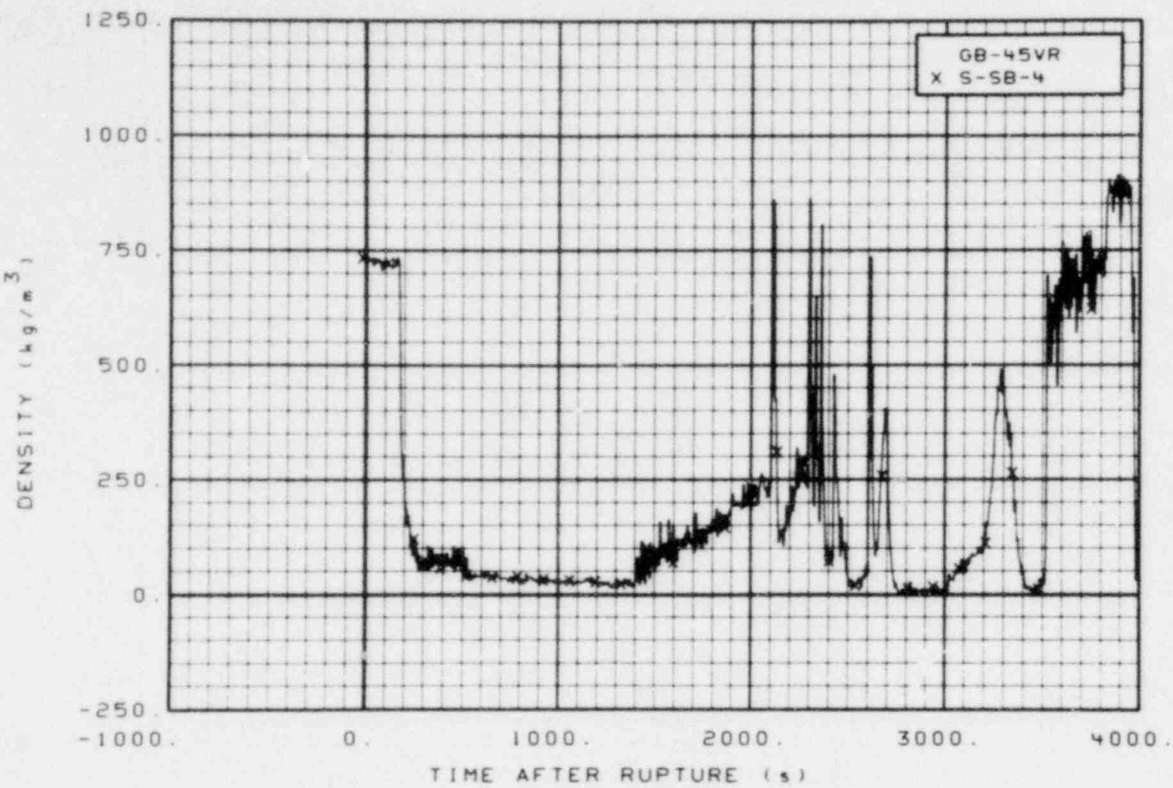


Figure 559. Density in broken loop cold leg, Test S-SB-4 (GB-45VR), from -20 to 4000 s.

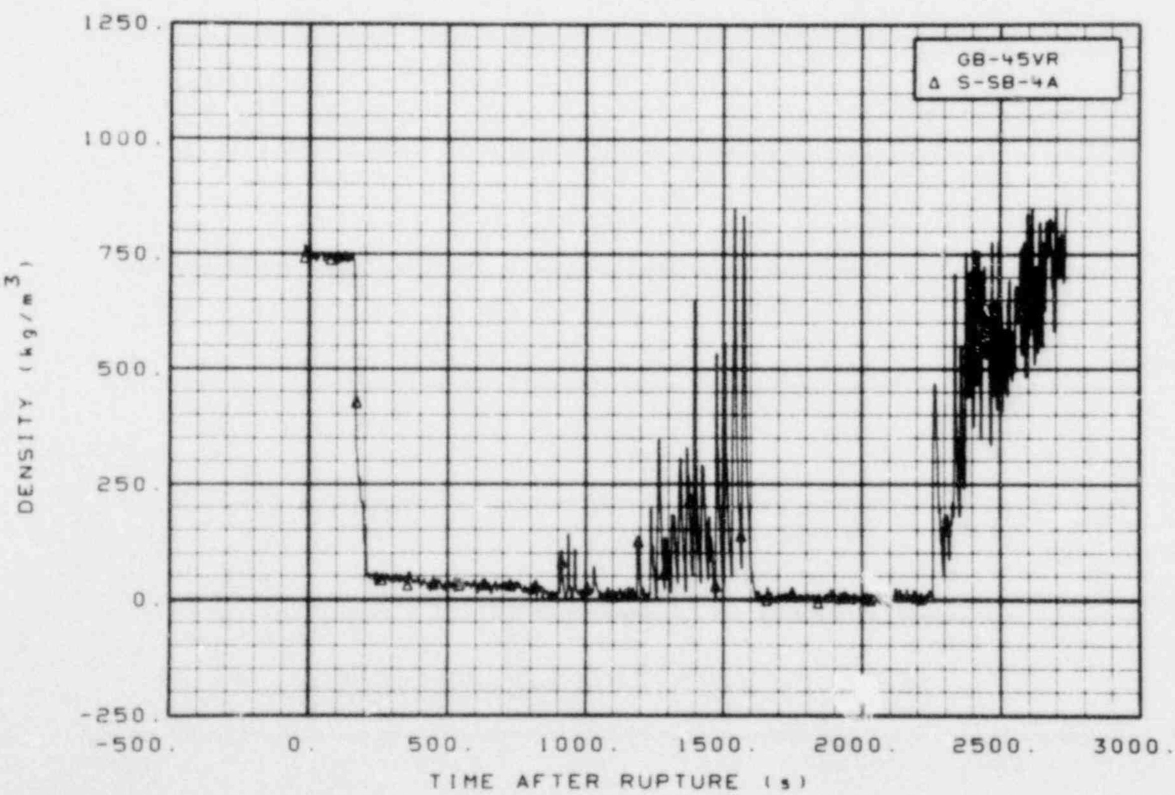


Figure 560. Density in broken loop cold leg, Test S-SB-4A (GB-45VR), from -20 to 2740 s.

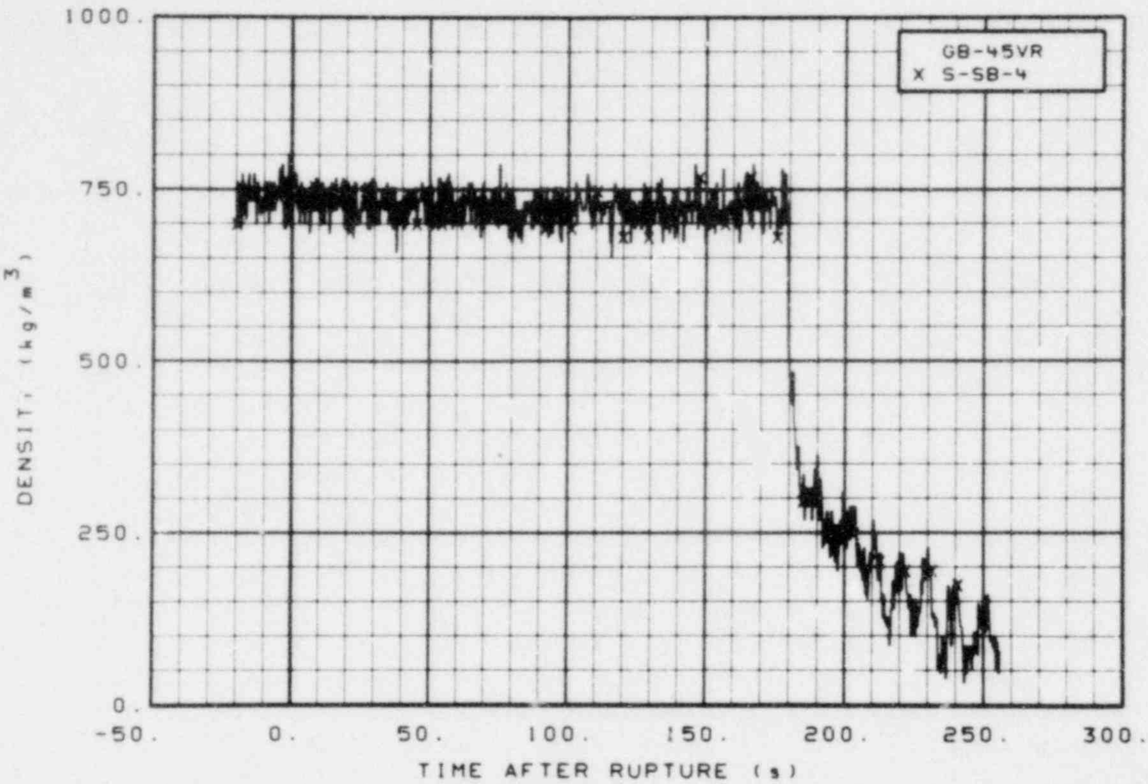


Figure 561. Density in broken loop cold leg, Test S-SB-4 (GB-45VR), from -20 to 256 s.

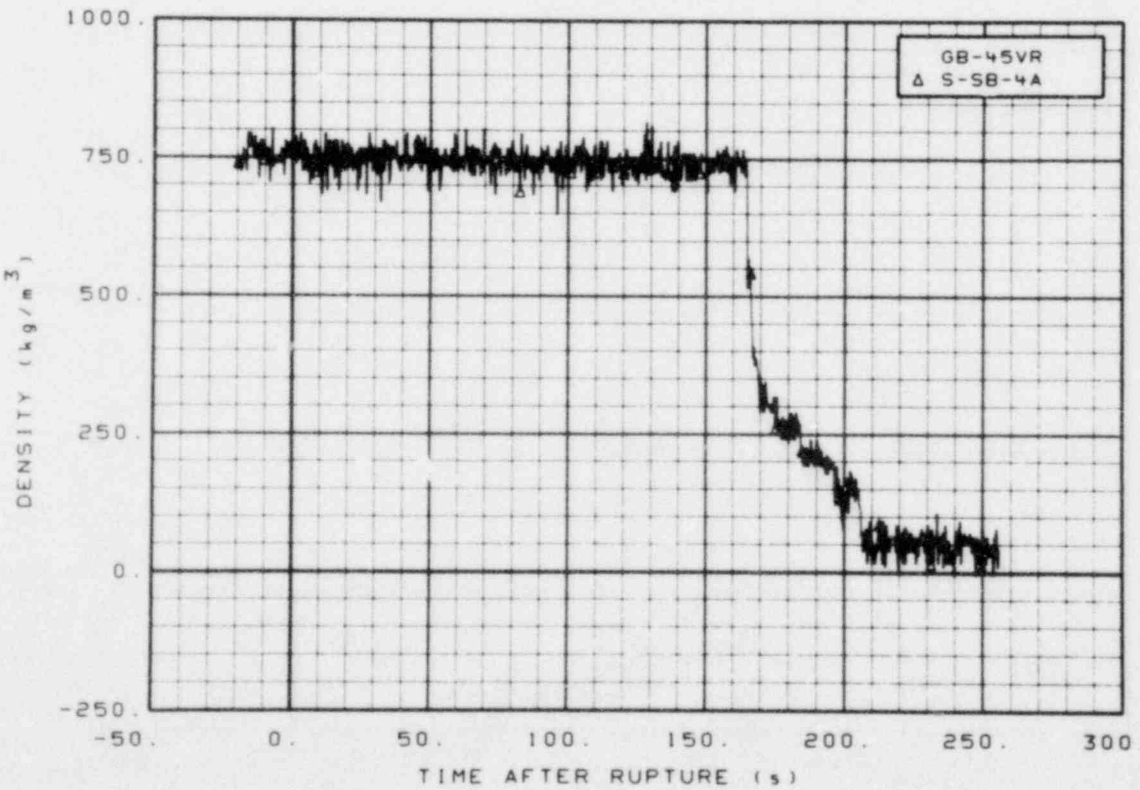


Figure 562. Density in broken loop cold leg, Test S-SB-4A (GB-45VR), from -20 to 256 s.

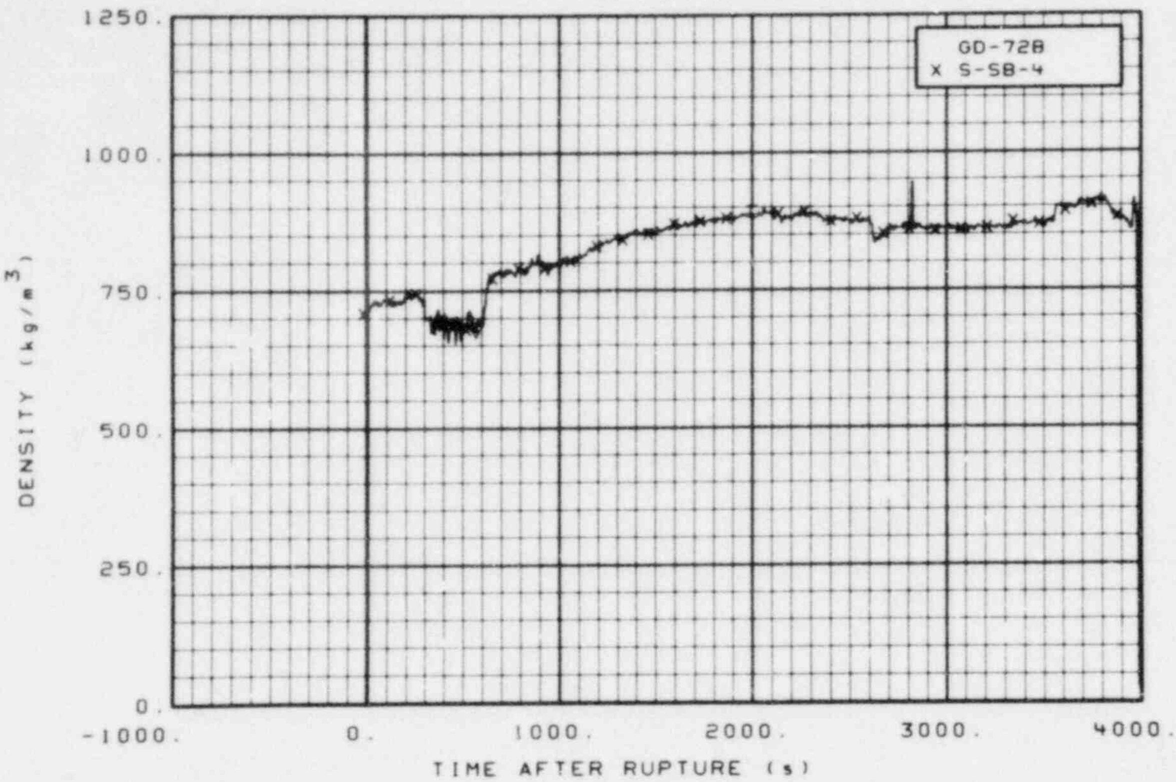


Figure 563. Density in downcomer, Test S-SB-4 (GD-72B), from -20 to 4000 s.

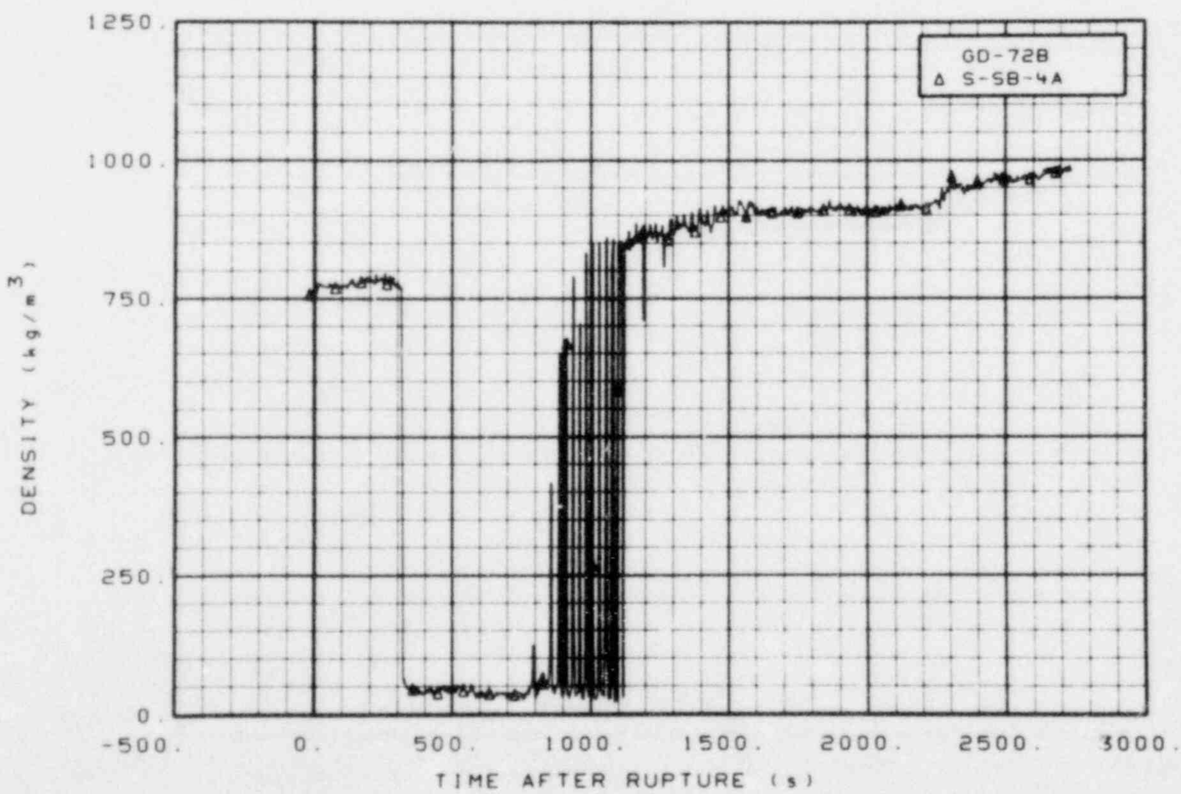


Figure 564. Density in downcomer, Test S-SB-4A (GD-72B), from -20 to 2740 s.

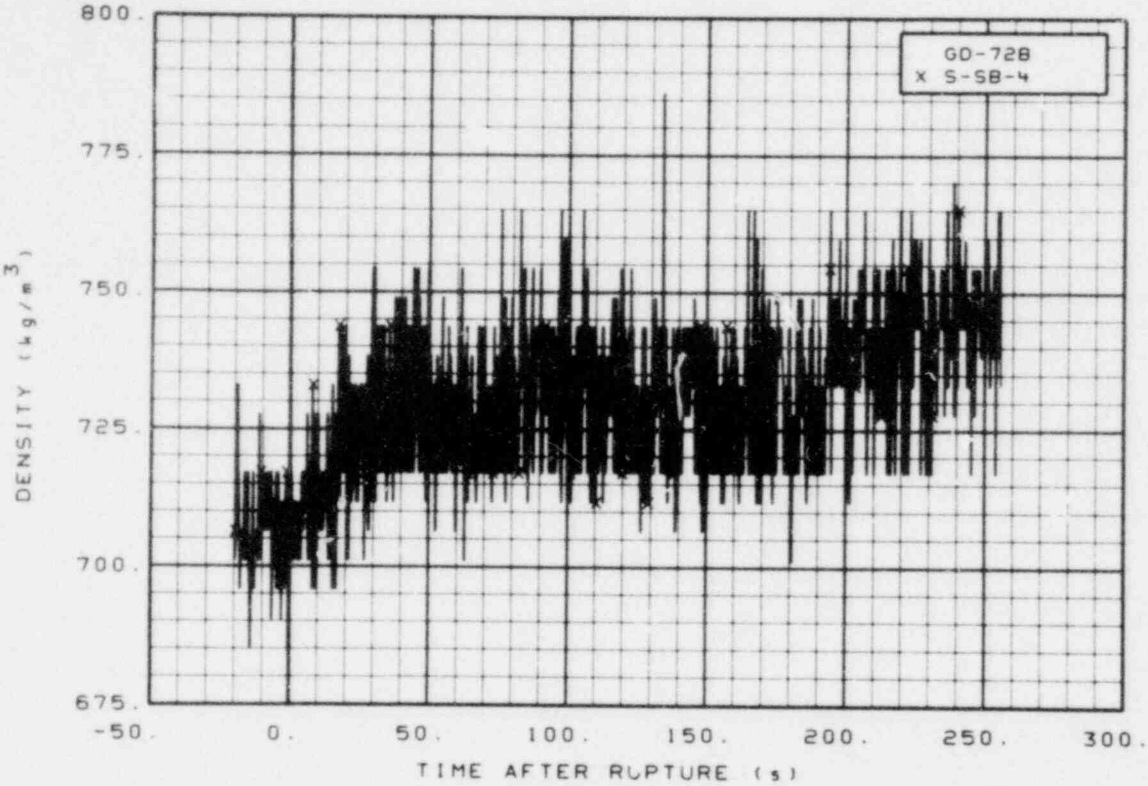


Figure 565. Density in downcomer, Test S-SB-4 (GD-72B), from -20 to 256 s.

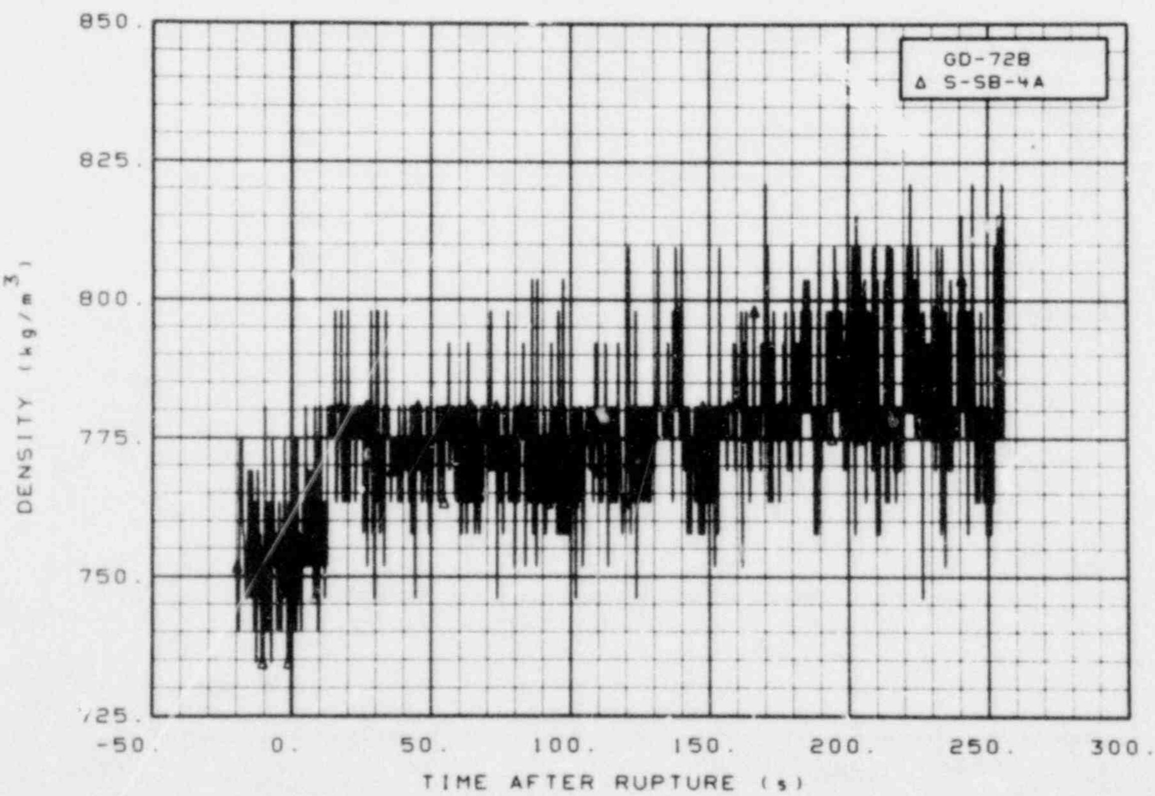


Figure 566. Density in downcomer, Test S-SB-4A (GD-72B), from -20 to 256 s.

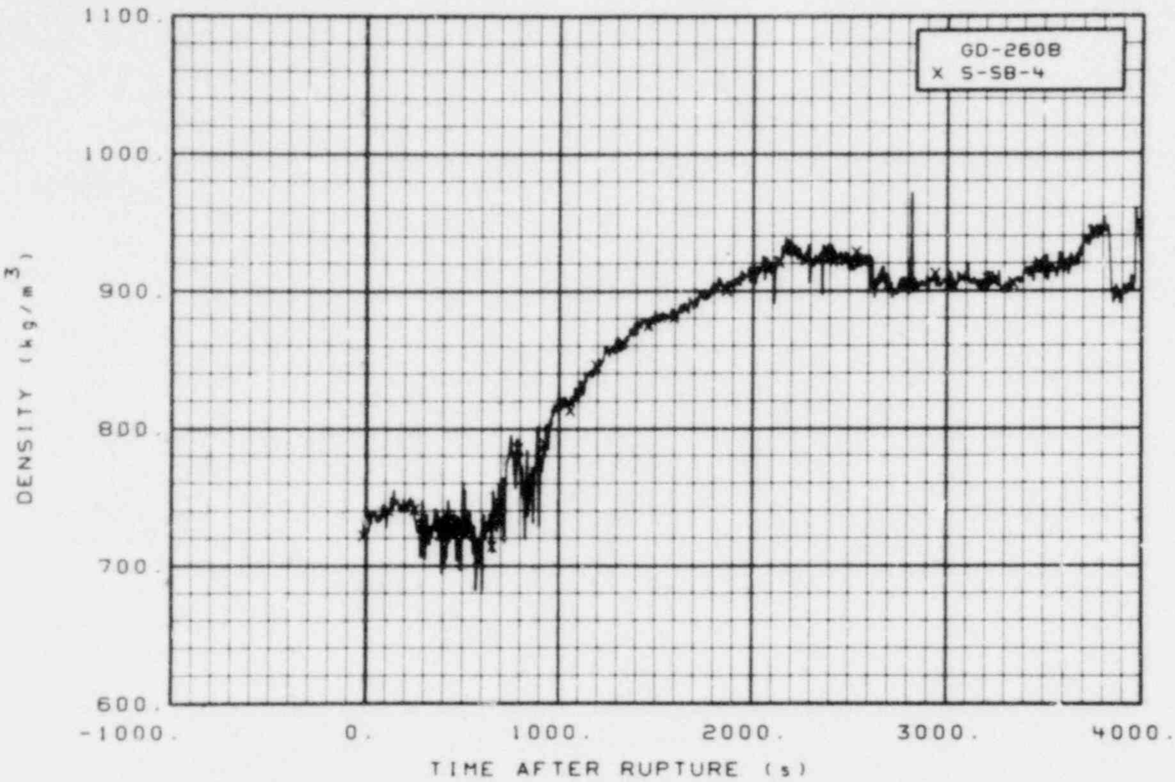


Figure 567. Density in downcomer, Test S-SB-4 (GD-260B), from -20 to 4000 s.

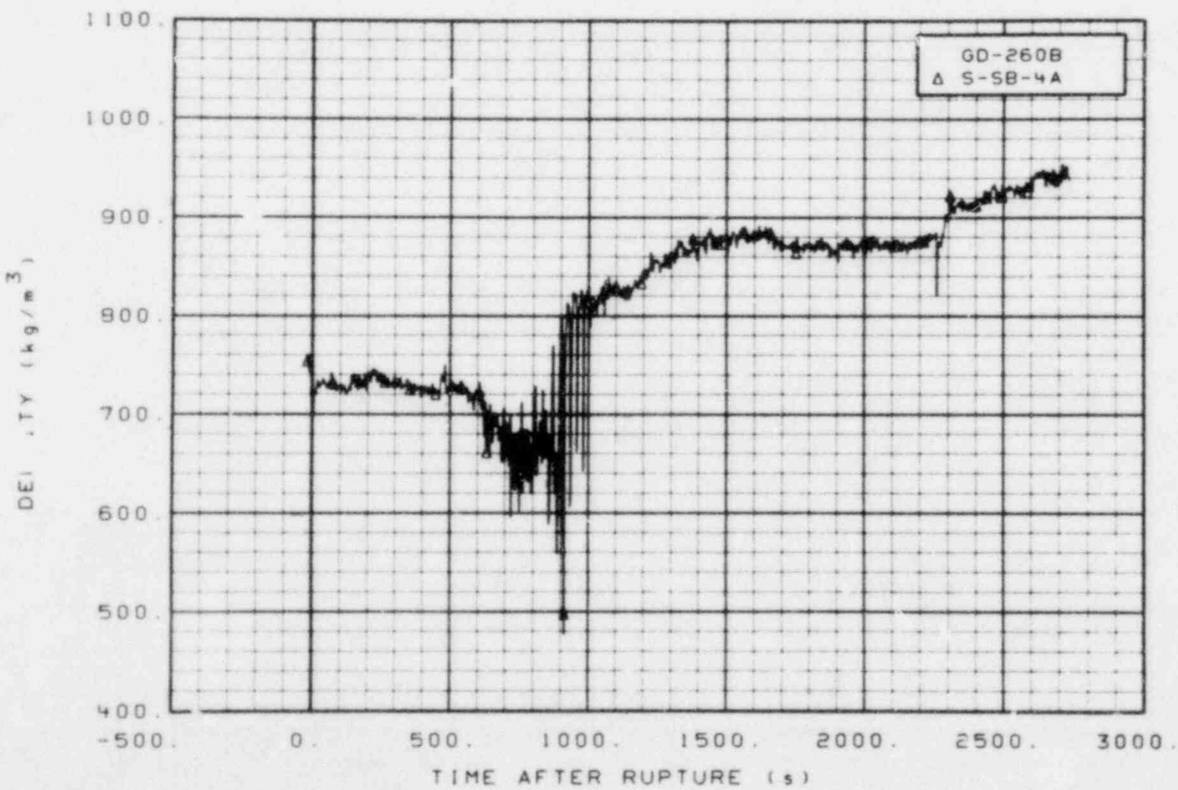


Figure 568. Density in downcomer, Test S-SB-4A (GD-260B), from -20 to 2740 s.

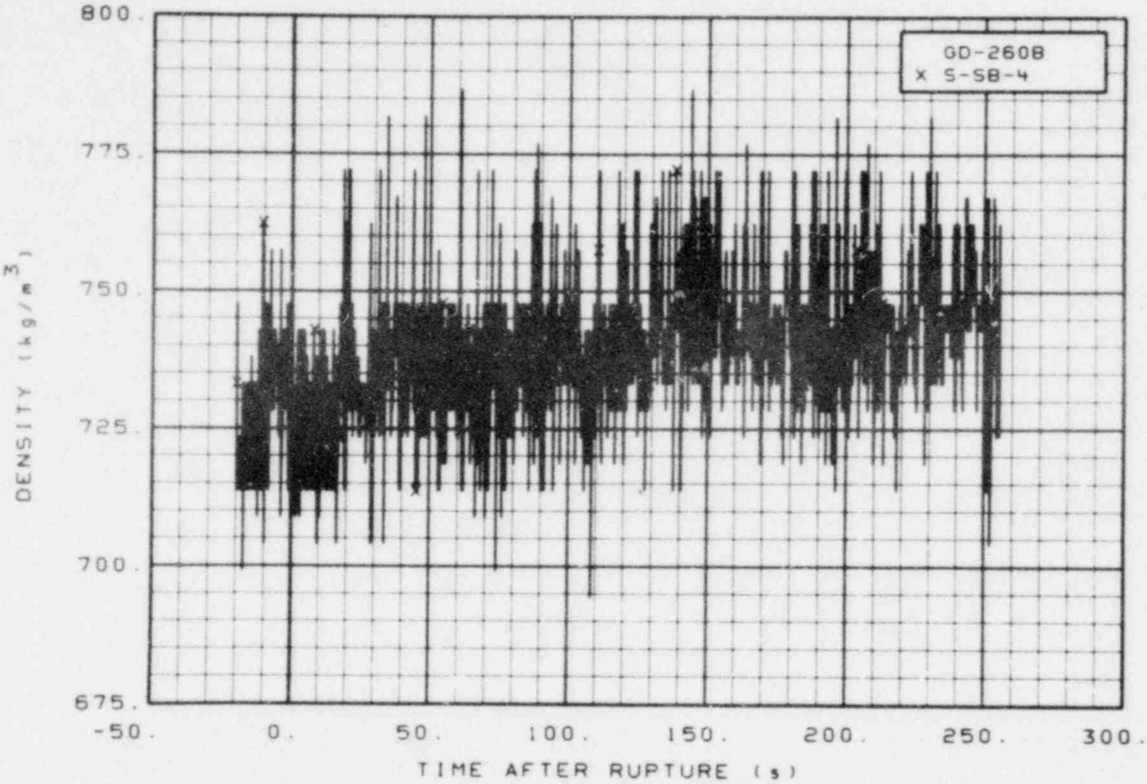


Figure 569. Density in downcomer, Test S-SB-4 (GD-260B), from -20 to 256 s.

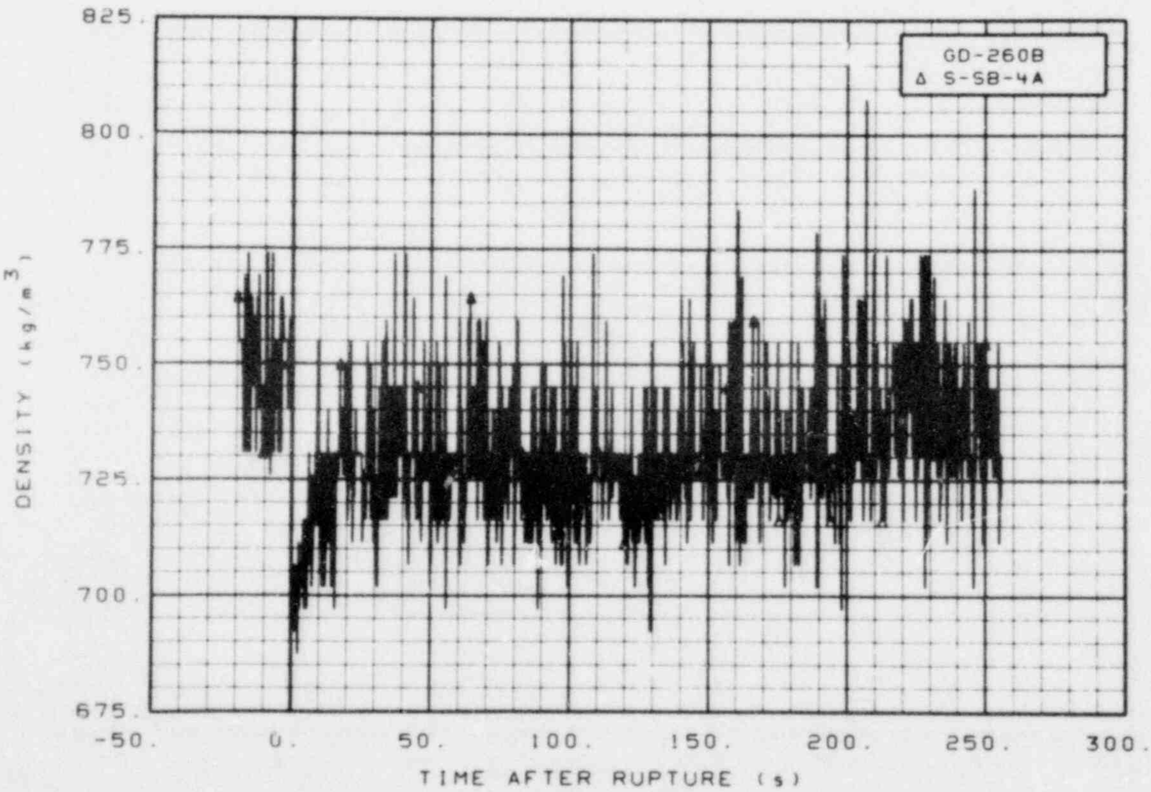


Figure 570. Density in downcomer, Test S-SB-4A (GD-260B), from -20 to 256 s.

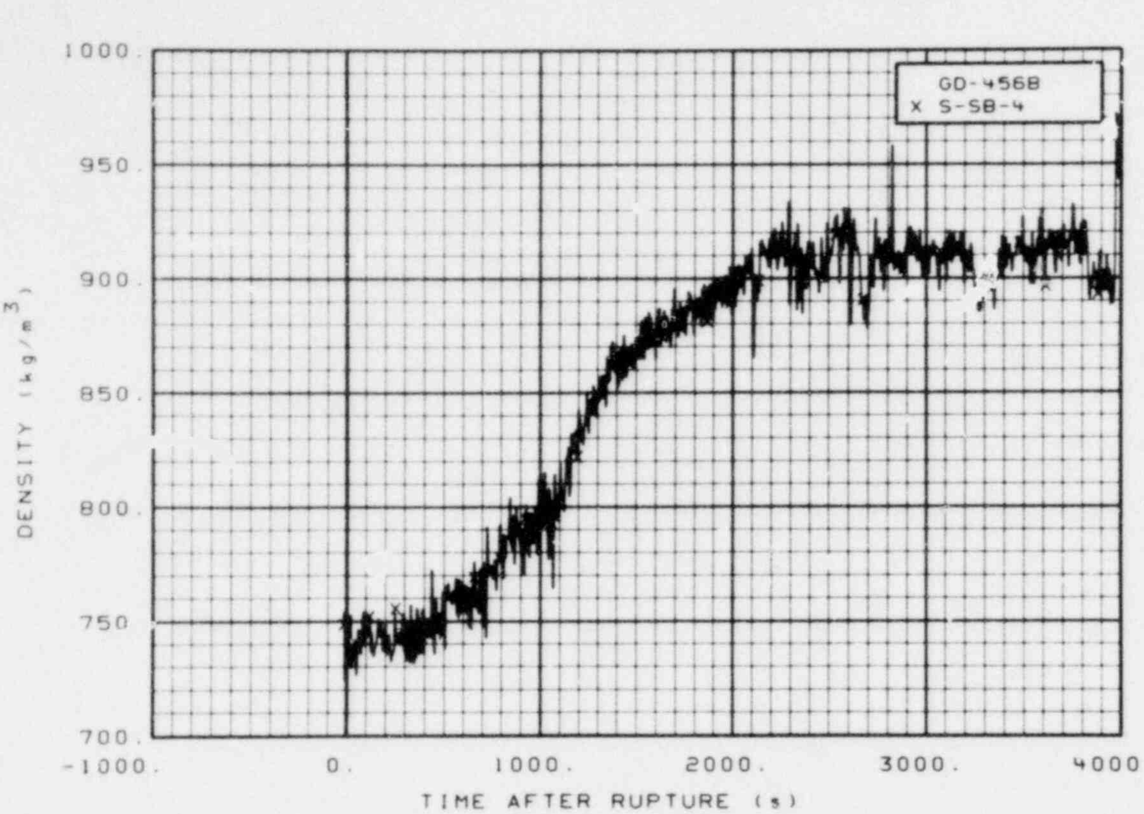


Figure 571. Density in downcomer, Test S-SB-4 (GD-456B), from -20 to 4000 s.

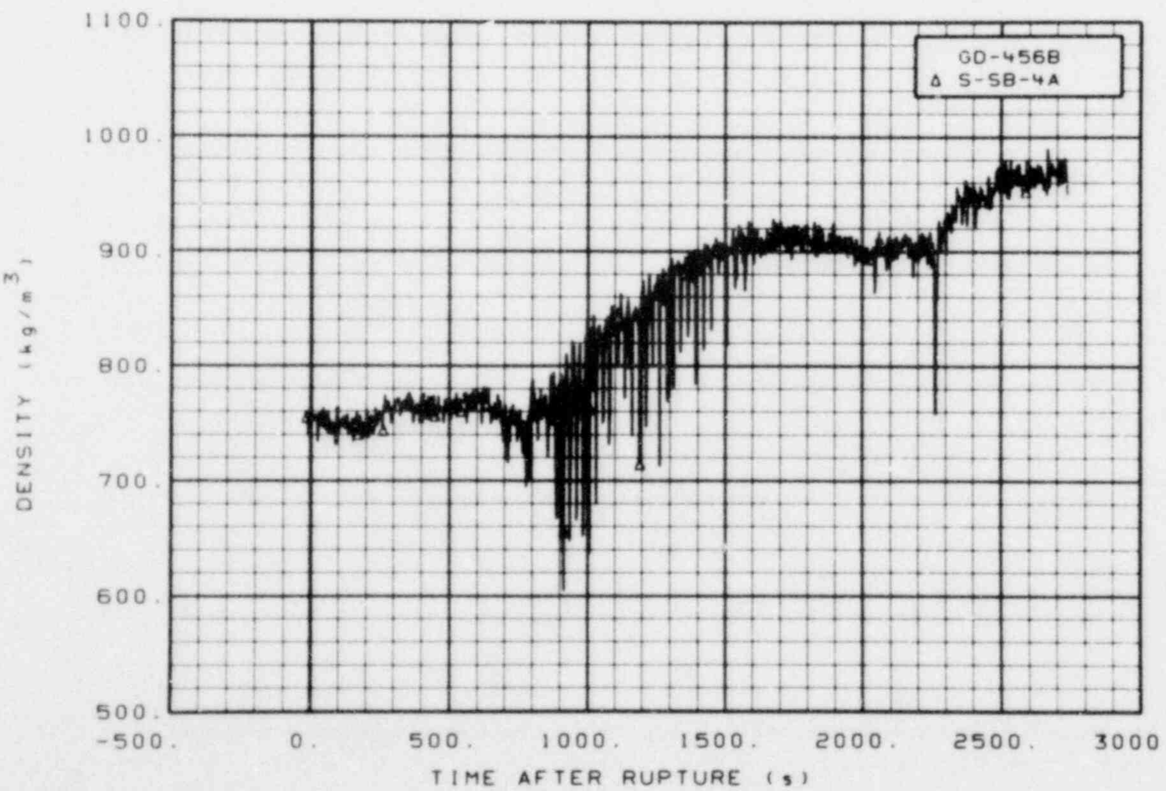


Figure 572. Density in downcomer, Test S-SB-4A (GD-456B), from -20 to 2740 s.

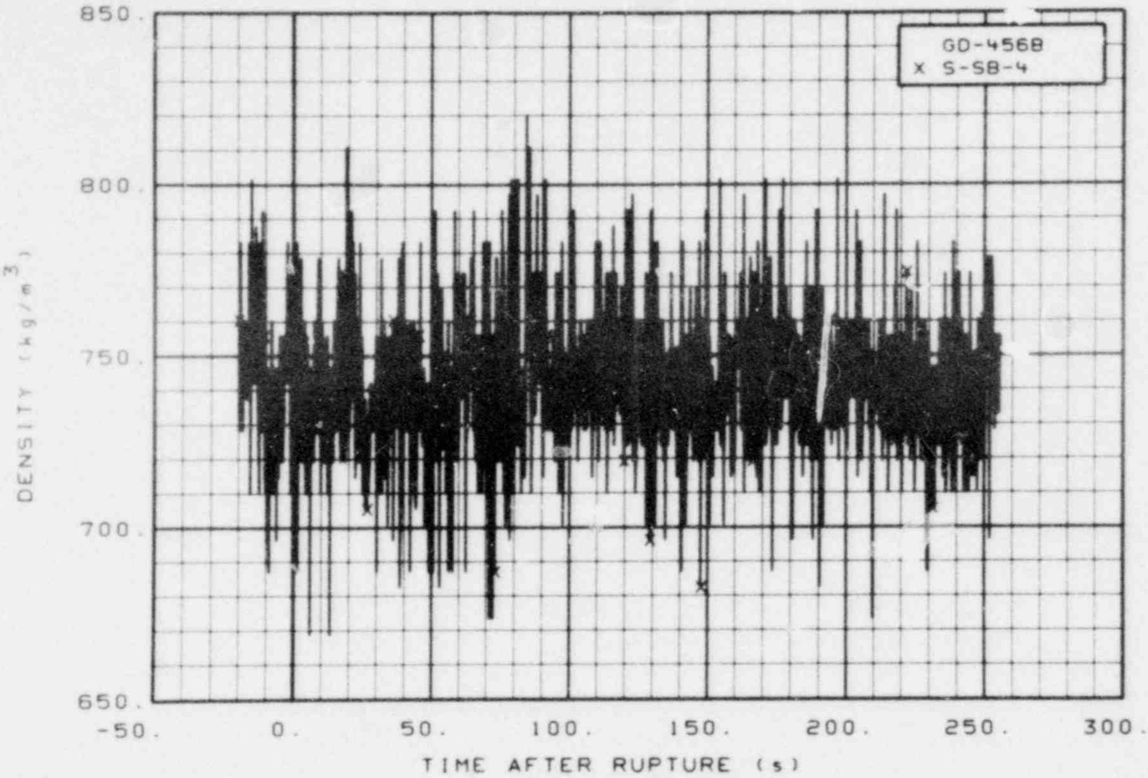


Figure 573. Density in downcomer, Test S-SB-4 (GD-456B), from -20 to 256 s.

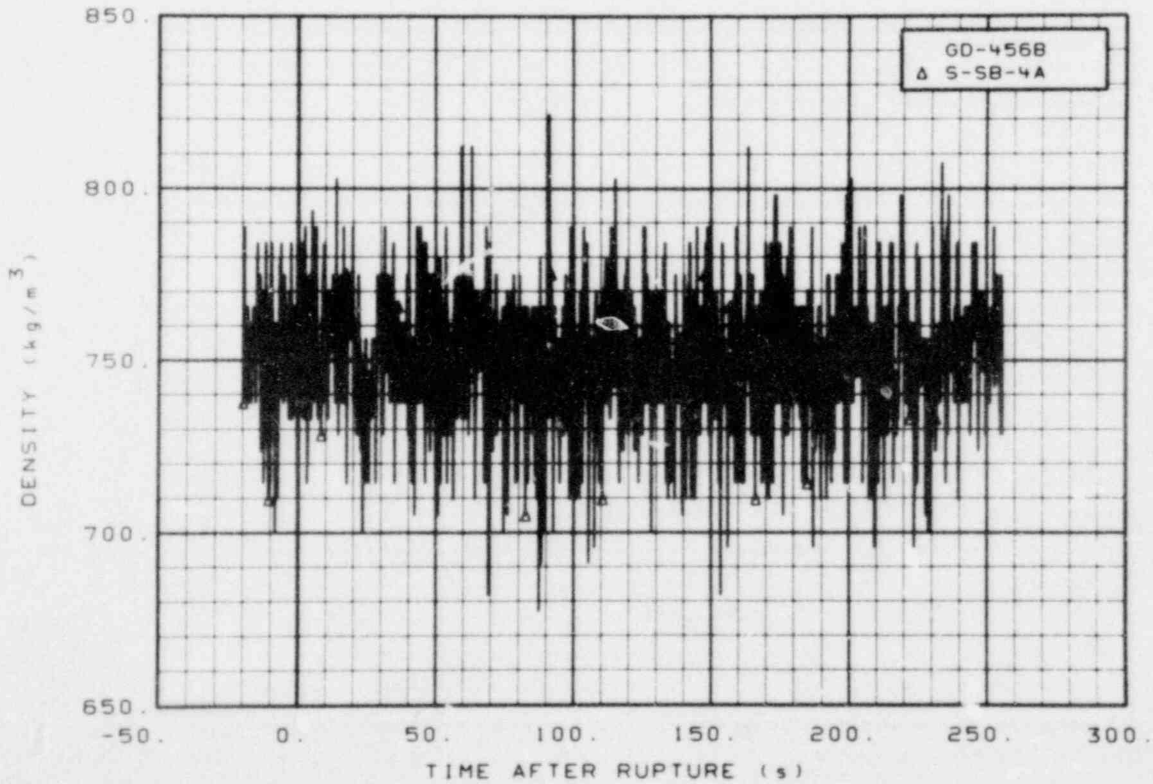


Figure 574. Density in downcomer, Test S-SB-4A (GD-456B), from -20 to 256 s.

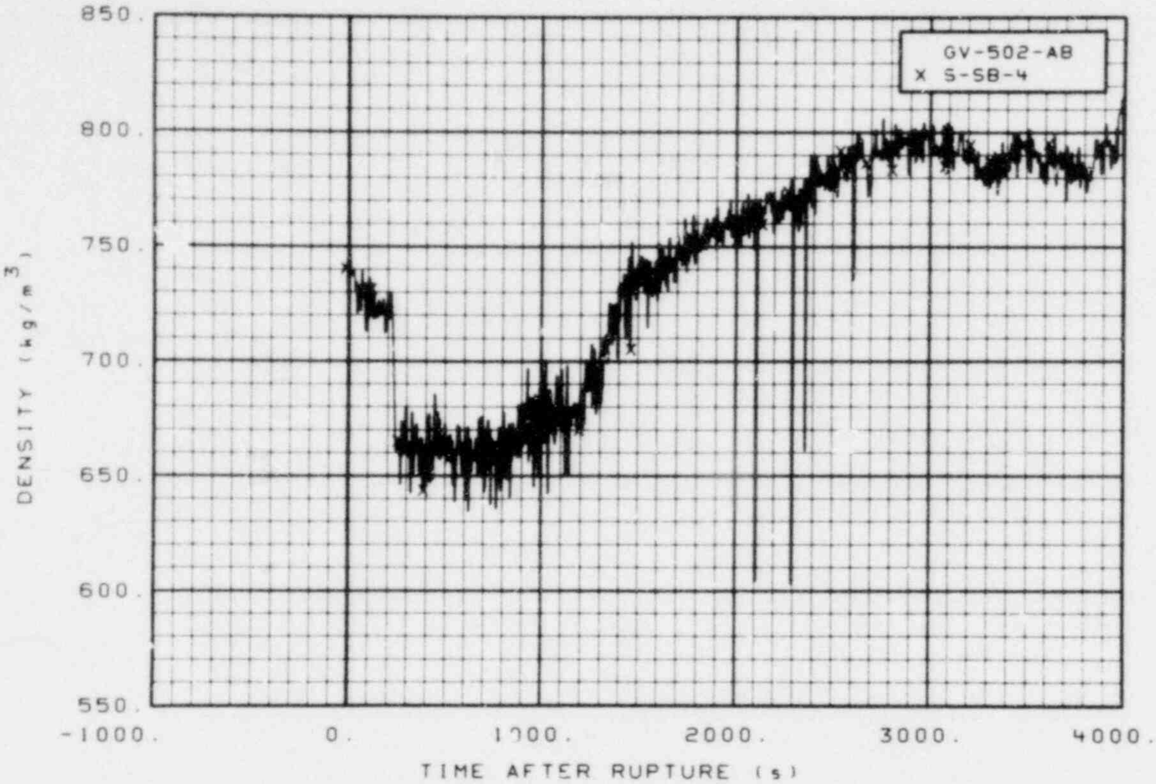


Figure 575. **Density in vessel, Test S-SB-4 (GV-502-AB), from -20 to 4000 s.**

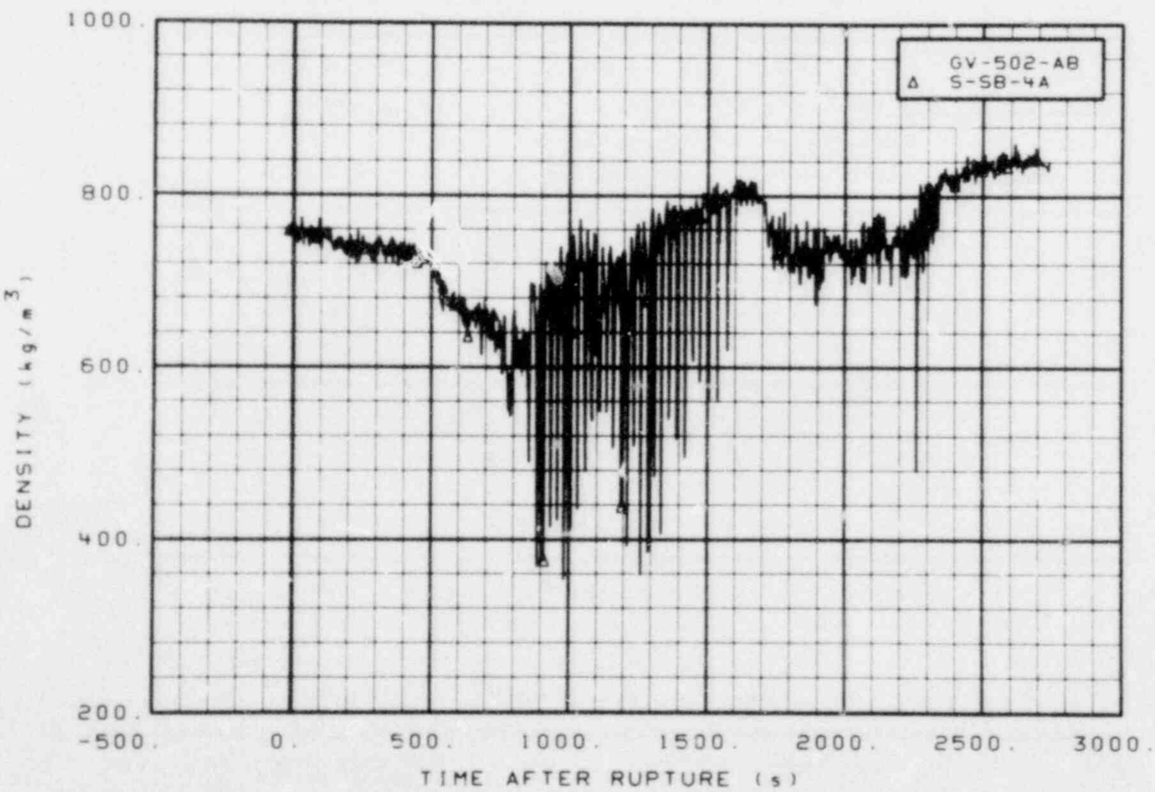


Figure 576. **Density in vessel, Test S-SB-4A (GV-502-AB), from -20 to 2740 s.**

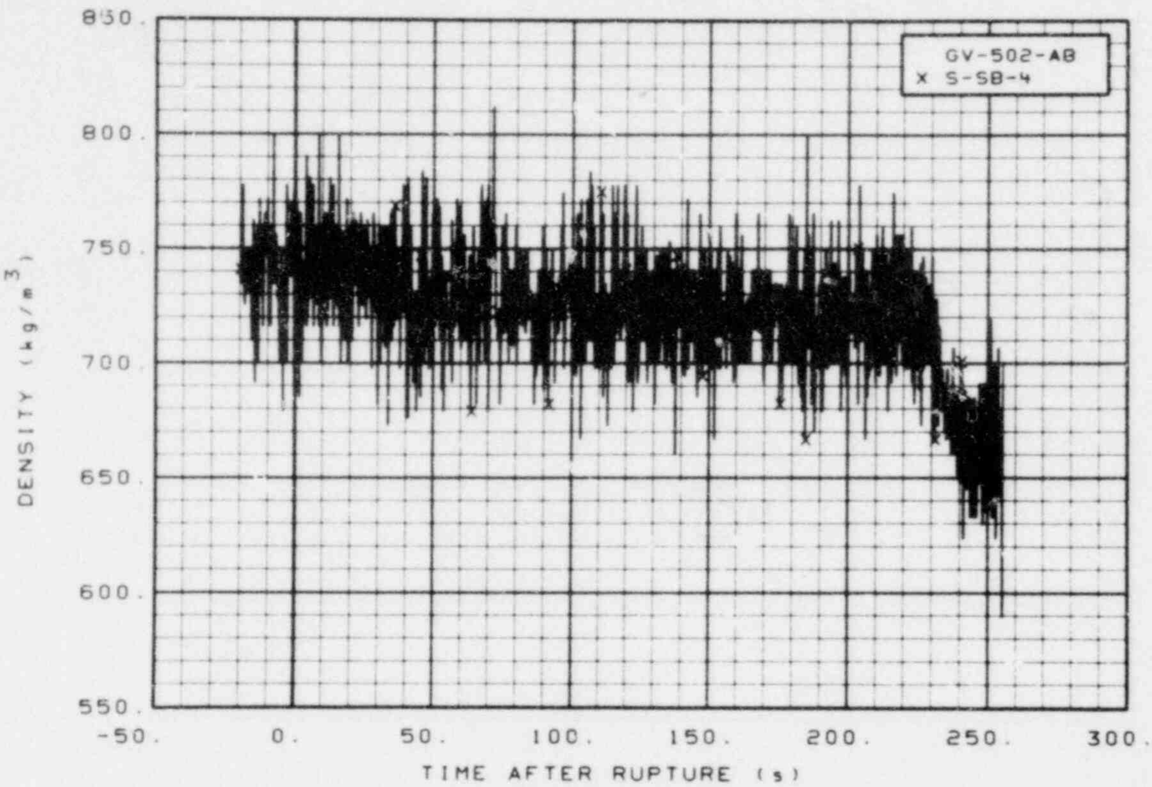


Figure 577. Density in vessel, Test S-SB-4 (GV-502-AB), from -20 to 256 s.

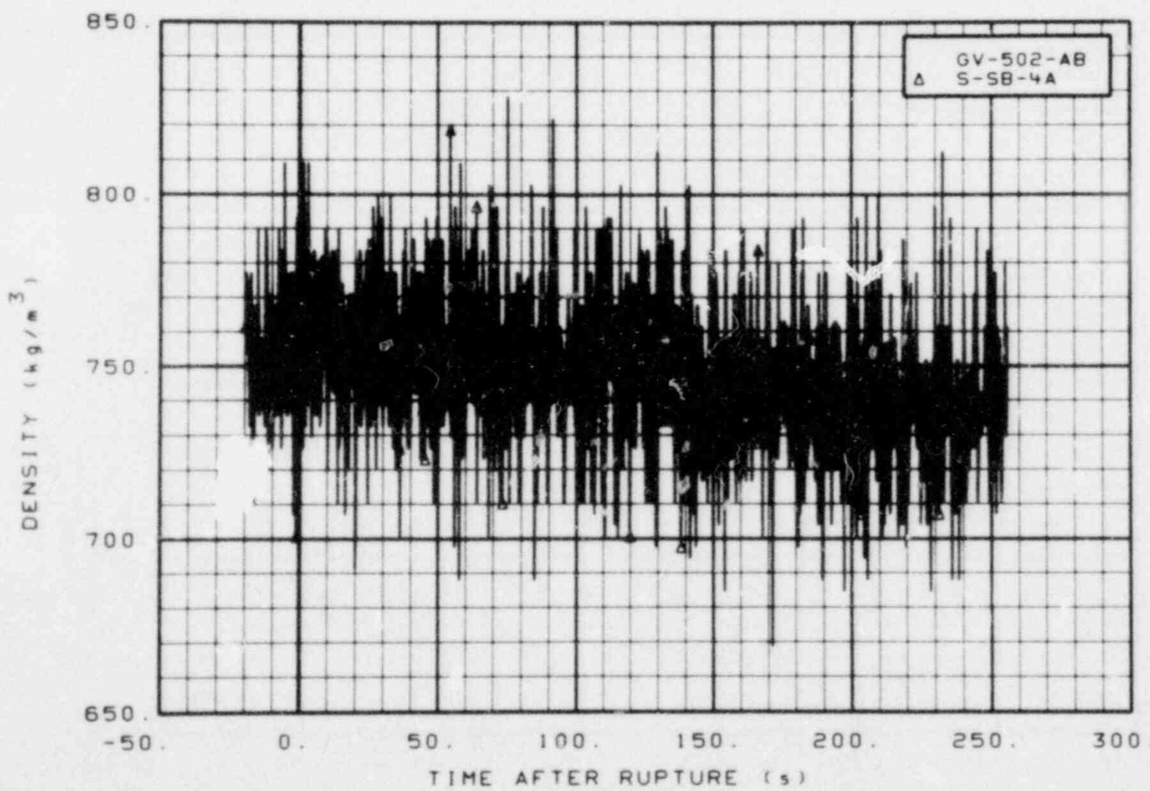


Figure 578. Density in vessel, Test S-SB-4A (GV-502-AB), from -20 to 256 s.

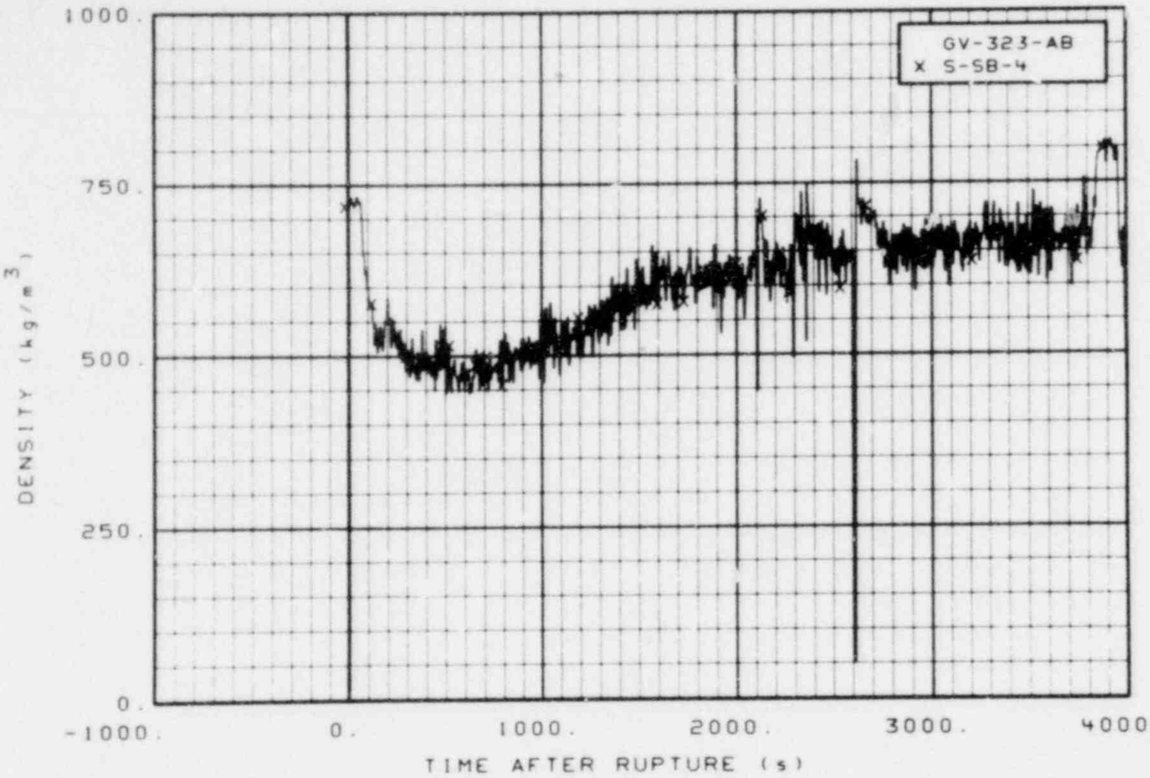


Figure 579. Density in vessel, Test S-SB-4 (GV-323-AB), from -20 to 4000 s.

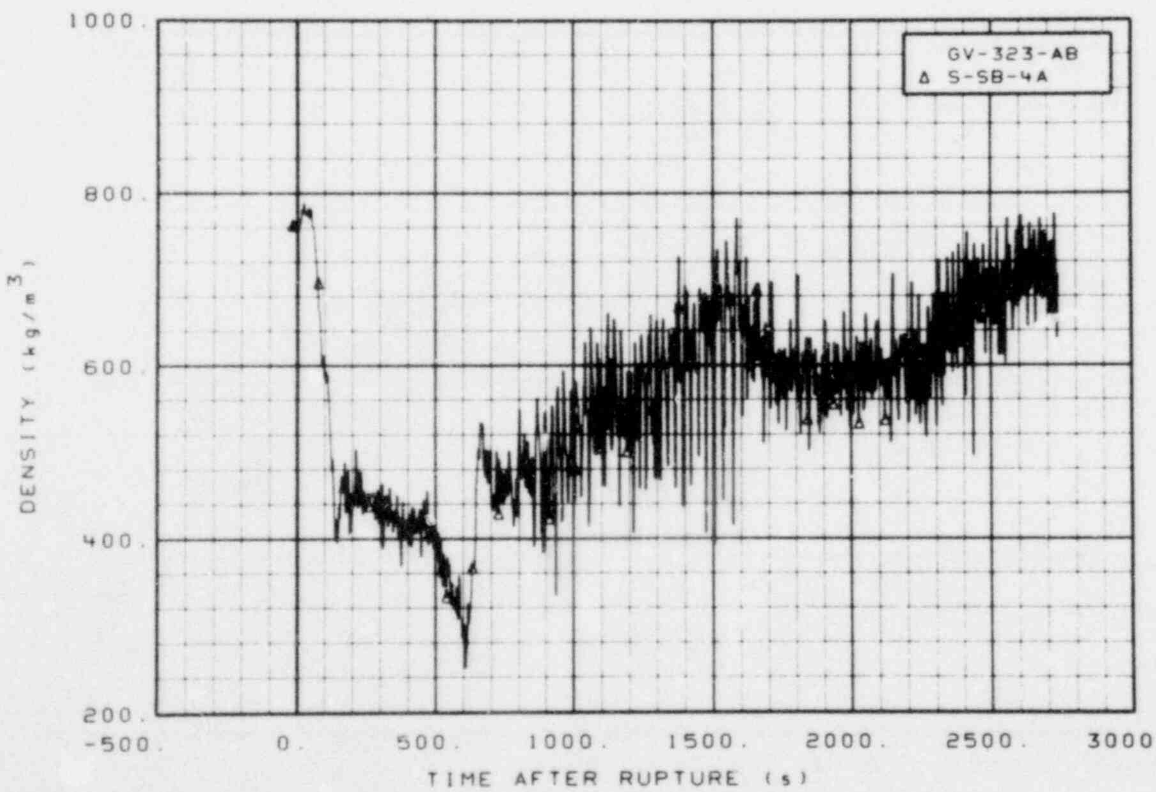


Figure 580. Density in vessel, Test S-SB-4A (GV-323-AB), from -20 to 2740 s.

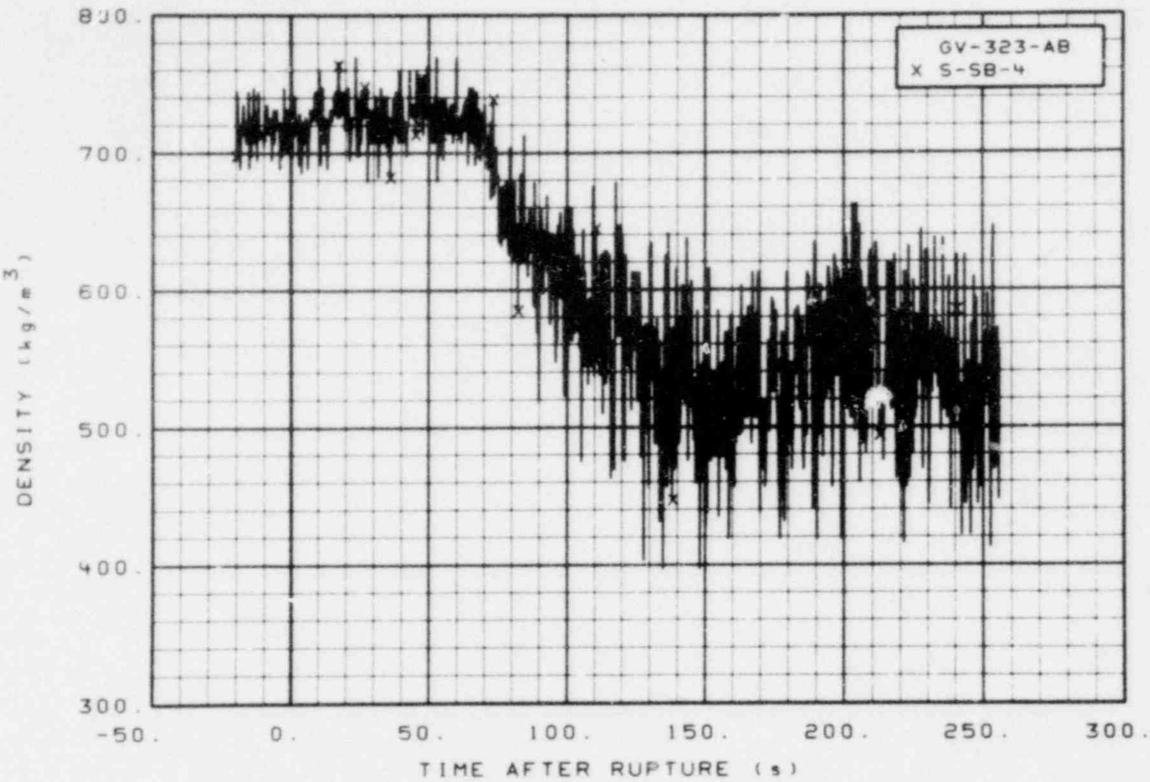


Figure 581. **Density in vessel, Test S-SB-4 (GV-323-AB), from -20 to 256 s.**

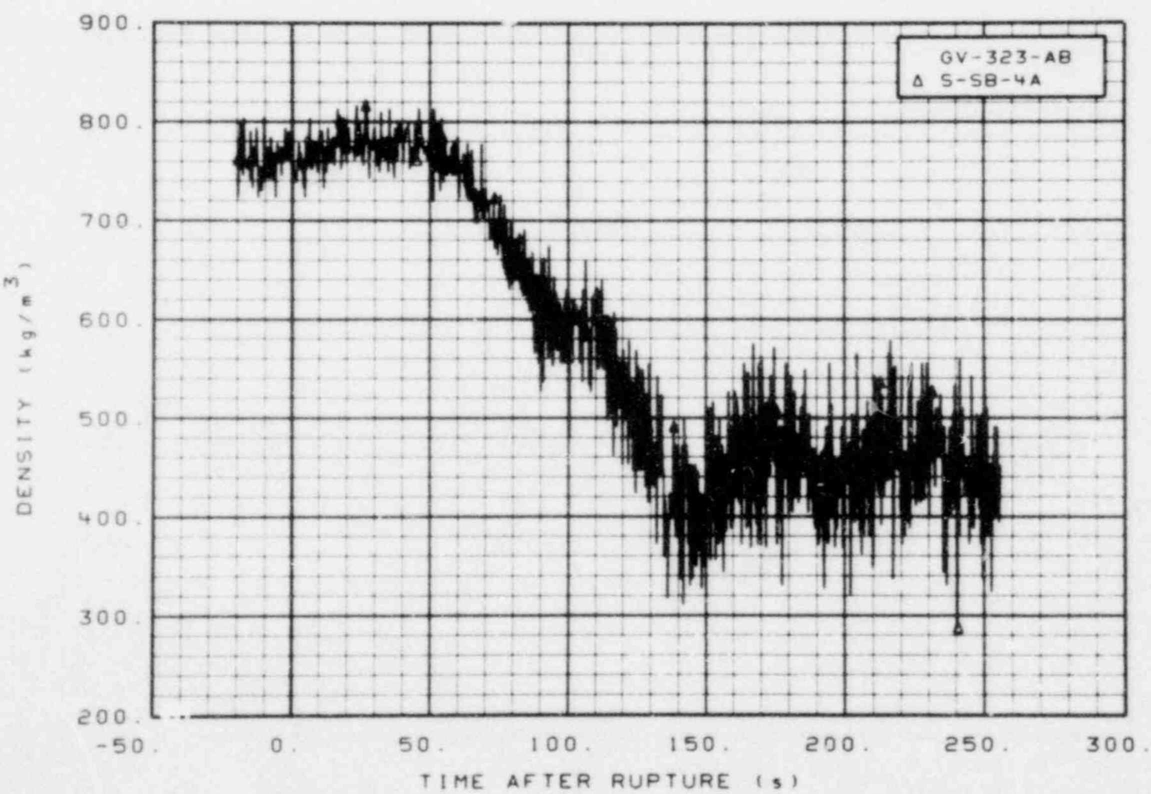


Figure 582. **Density in vessel, Test S-SB-4A (GV-323-AB), from -20 to 256 s.**

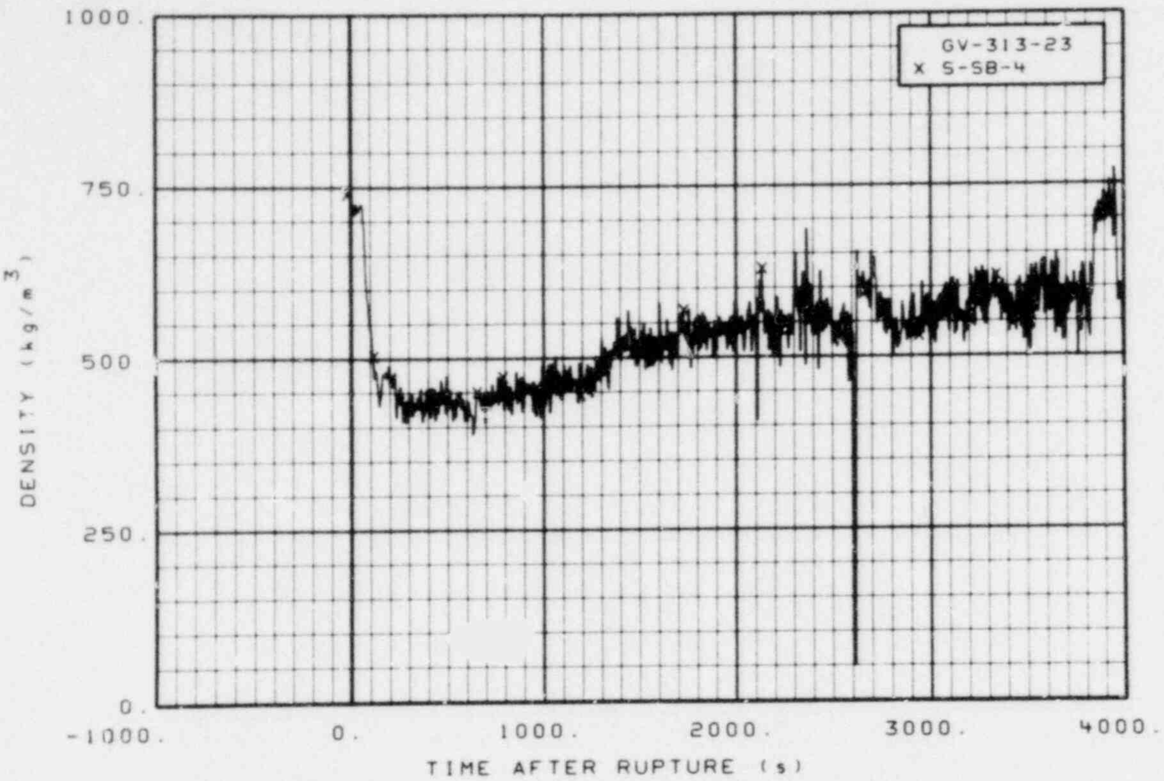


Figure 583. Density in vessel, Test S-SB-4 (GV-313-23), from -20 to 4000 s.

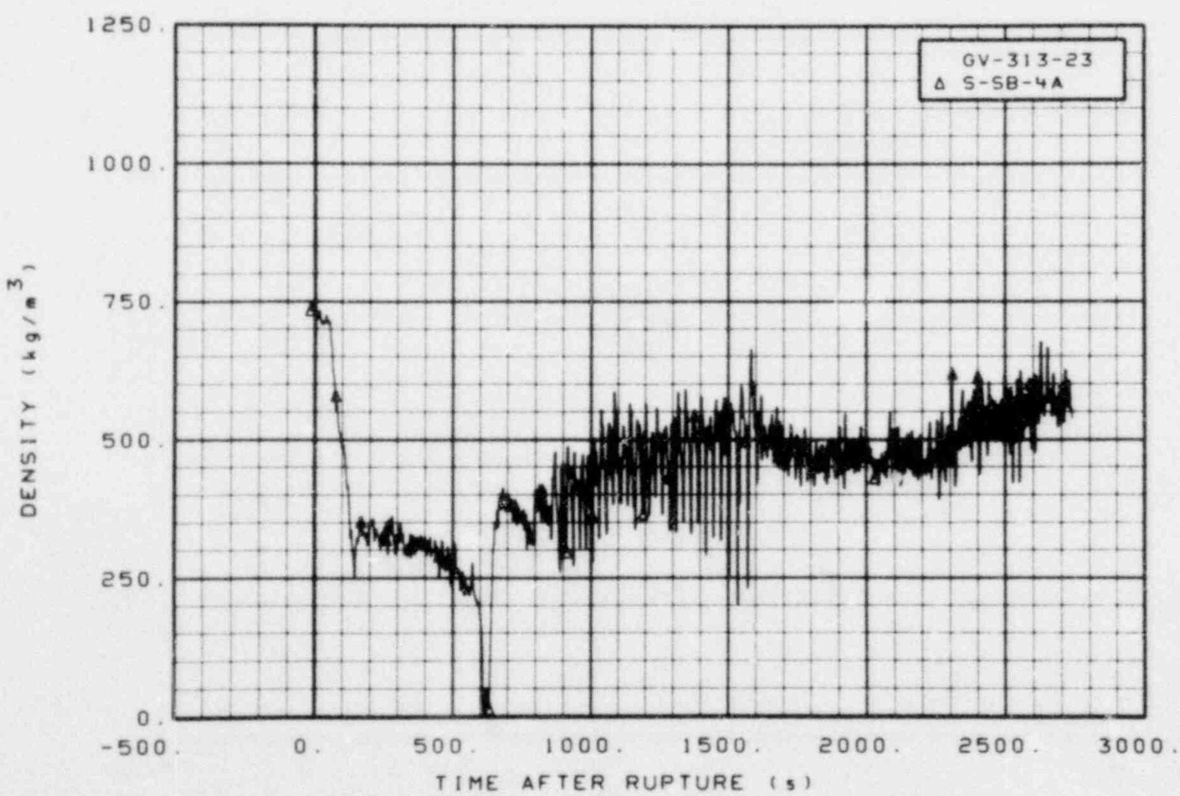


Figure 584. Density in vessel, Test S-SB-4A (GV-313-23), from -20 to 2730 s.

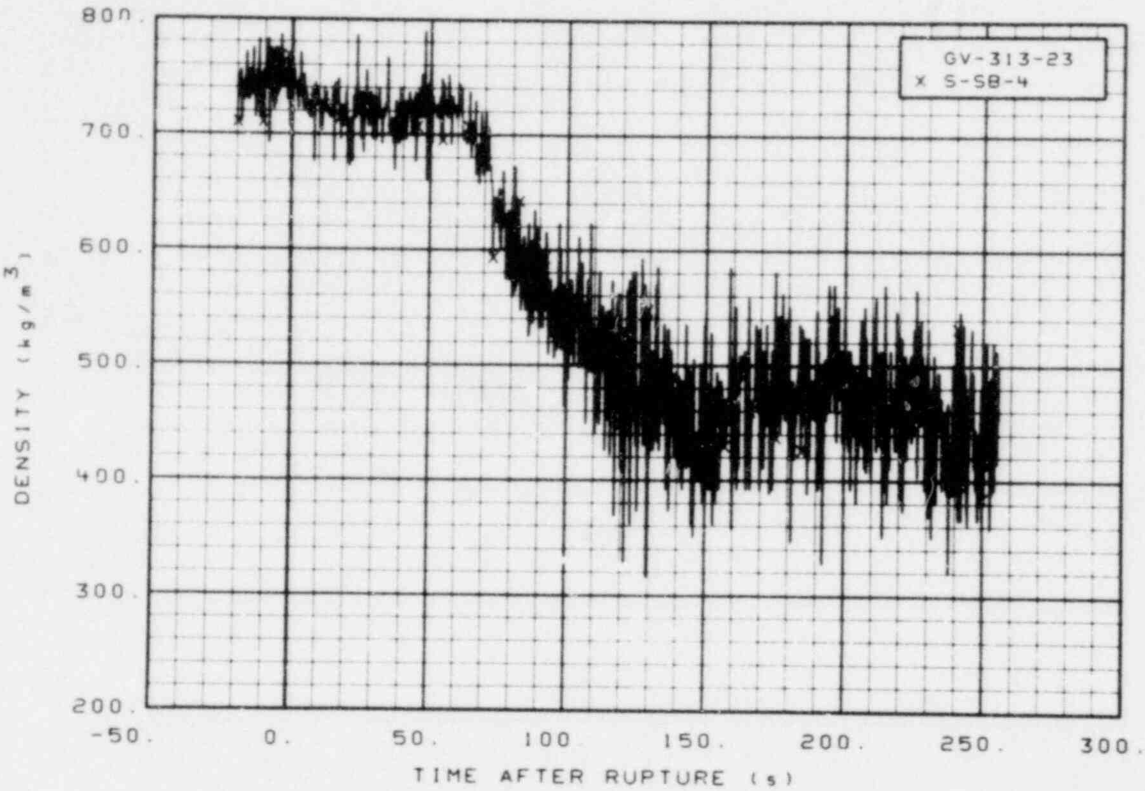


Figure 585. Density in vessel, Test S-SB-4 (GV-313-23), from -20 to 256 s.

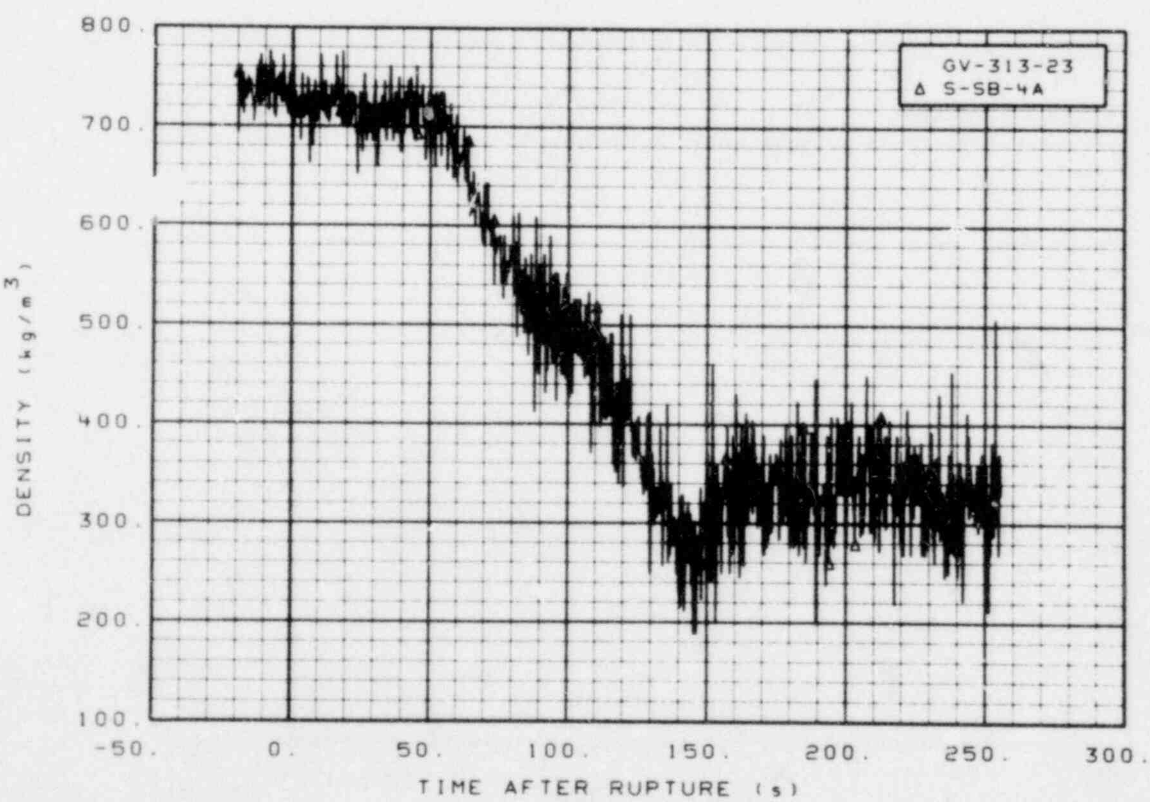


Figure 586. Density in vessel, Test S-SB-4A (GV-313-23), from -20 to 256 s.

IMAGE EVALUATION
TEST TARGET (MT-3)

6″

MICROCOPY RESOLUTION TEST CHART

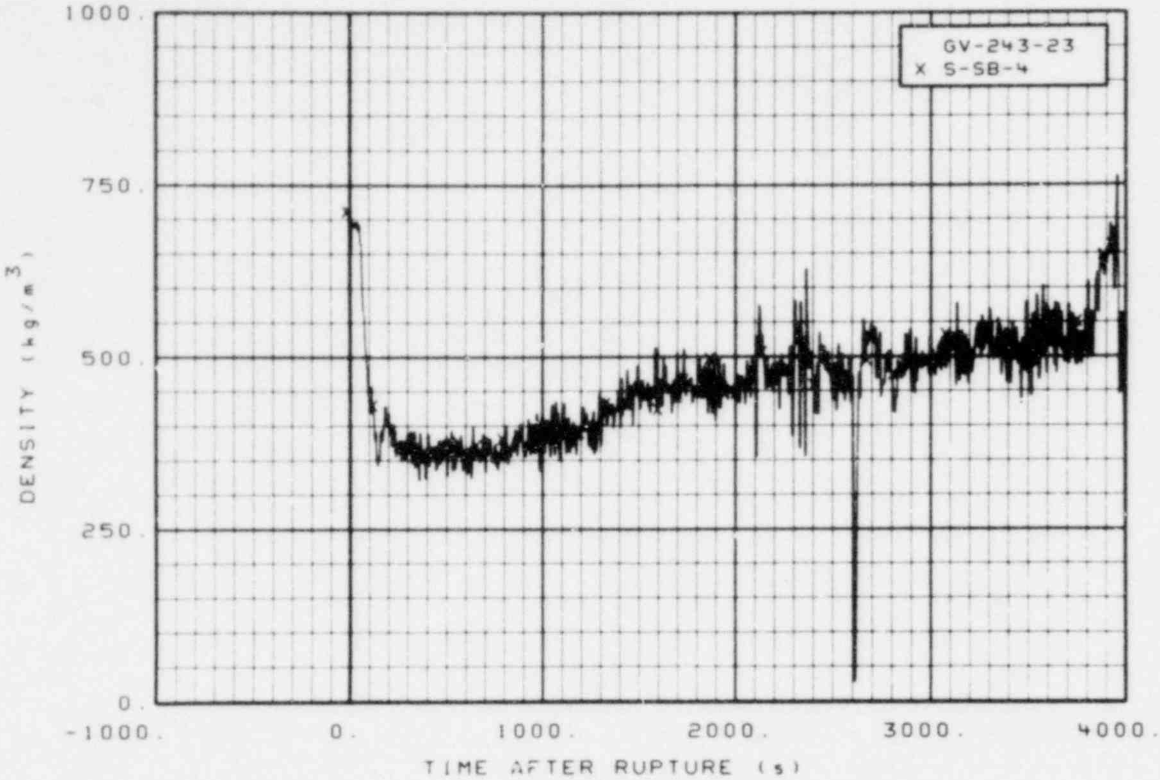


Figure 587. Density in vessel, Test S-SB-4 (GV-243-23), fr -20 to 4000 s.

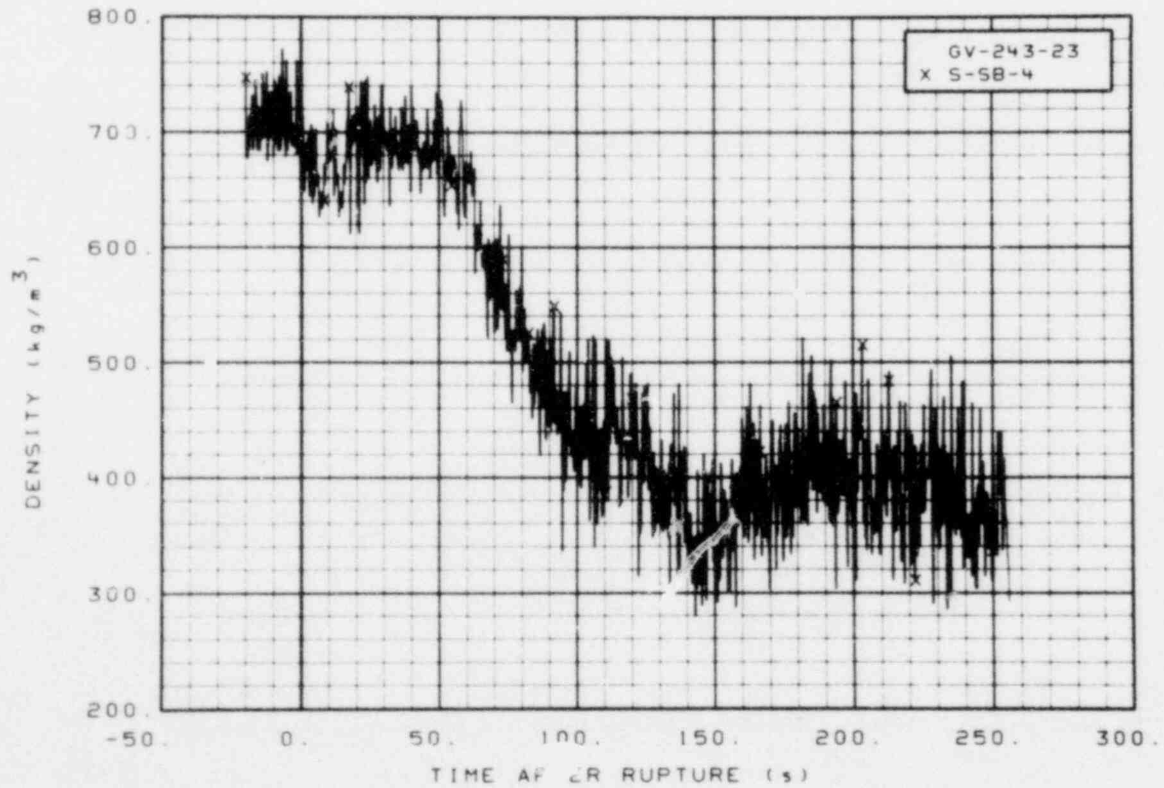


Figure 588. Density in vessel, Test S-SB-4 (GV-243-23), from -20 to 256 s.

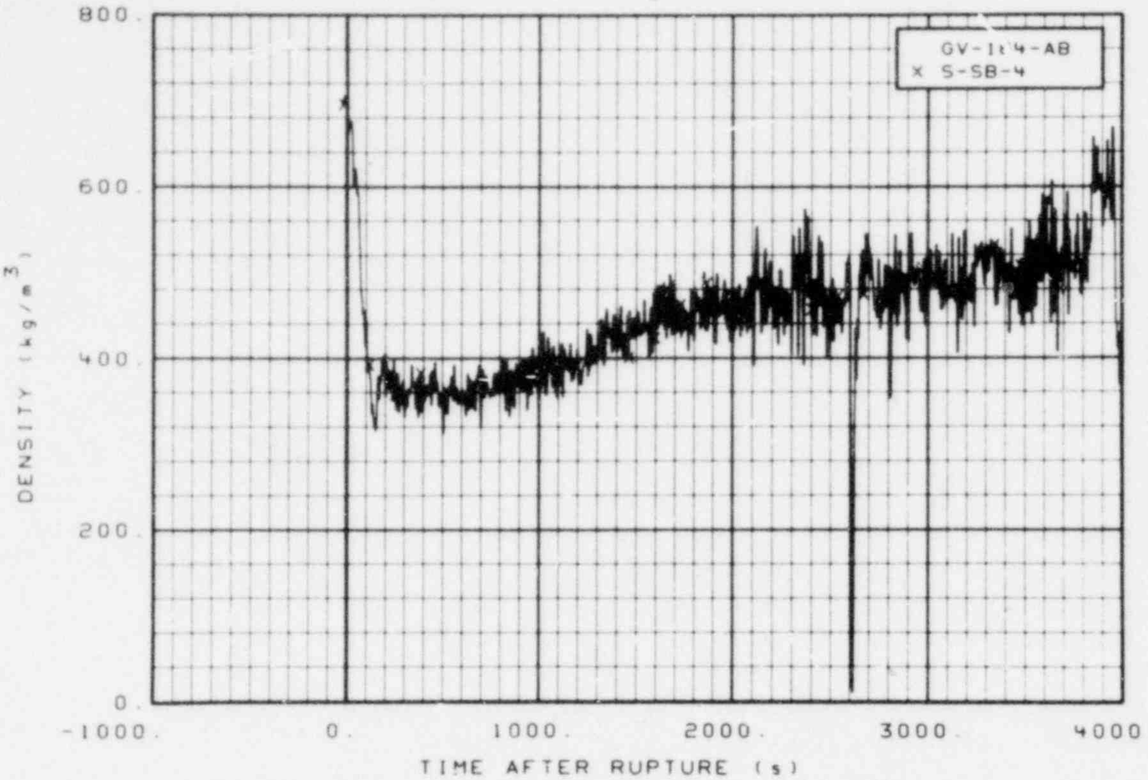


Figure 589. Density in vessel, Test S-SB-4 (GV-164-AB), from -20 to 4000 s.

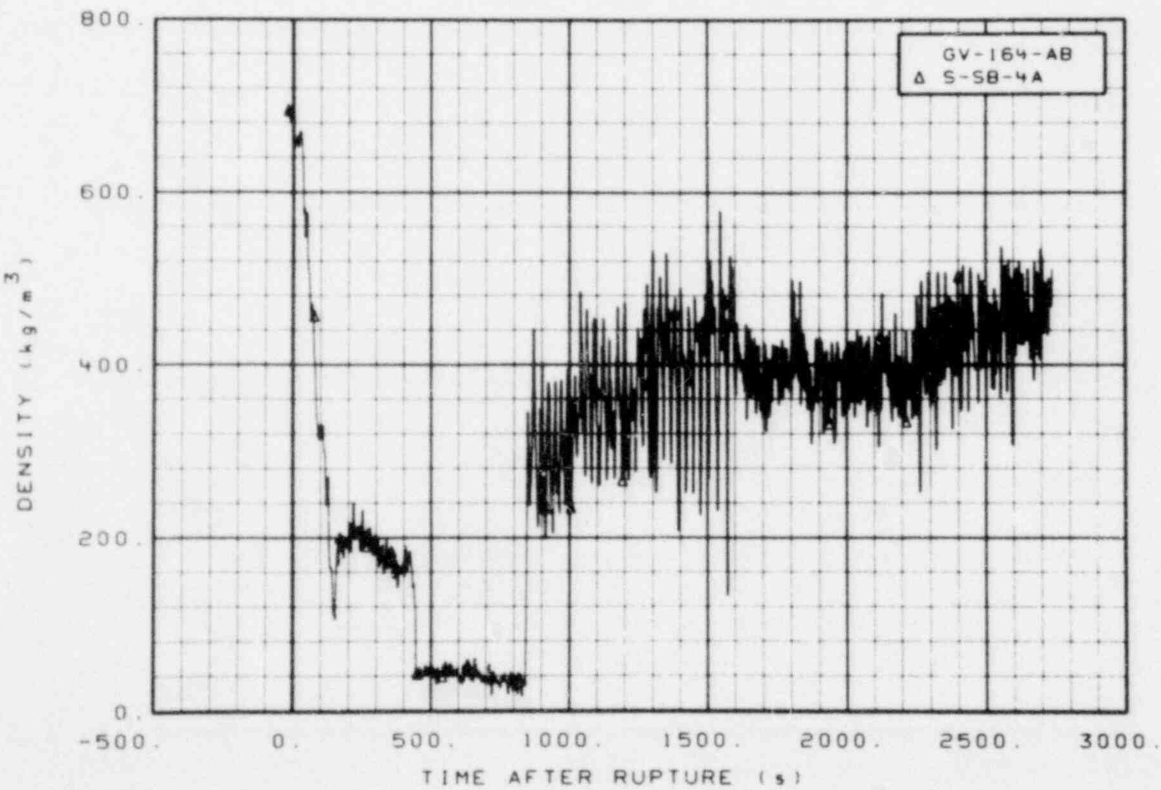


Figure 590. Density in vessel, Test S-SB-4A (GV-164-AB), from -20 to 2740 s.

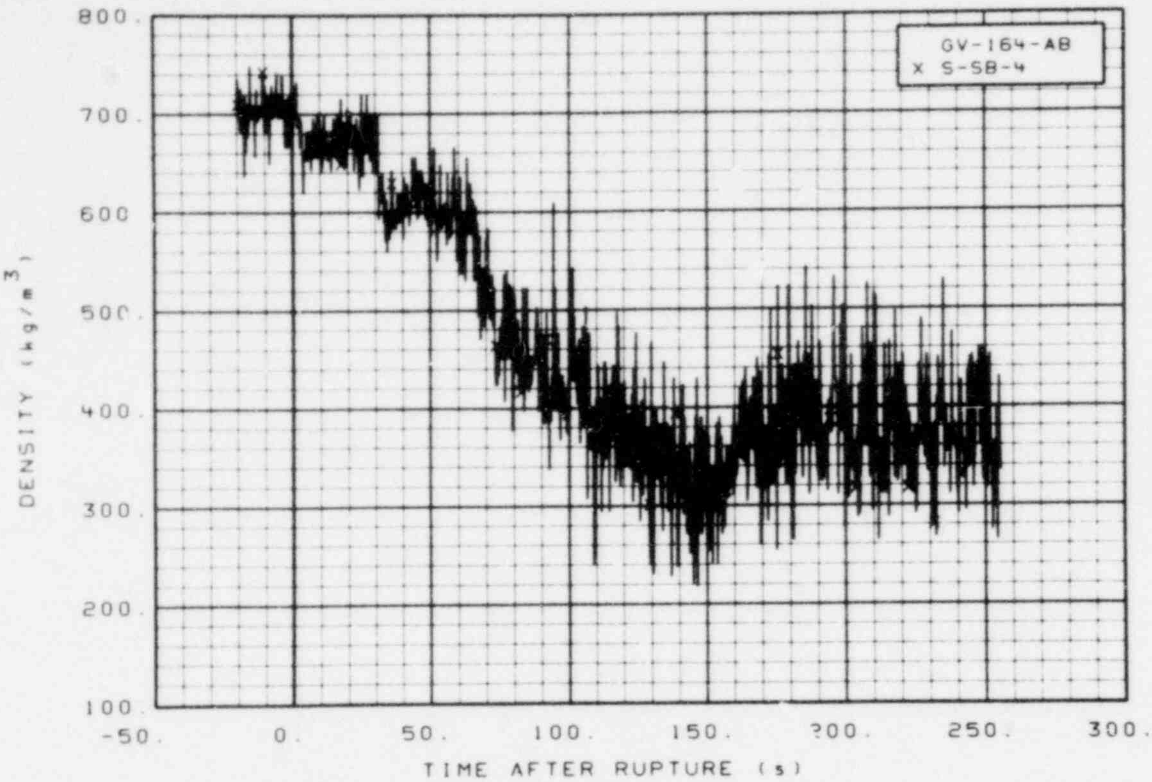


Figure 591. Density in vessel, Test S-SB-4 (GV-164-AB), from -20 to 256 s.

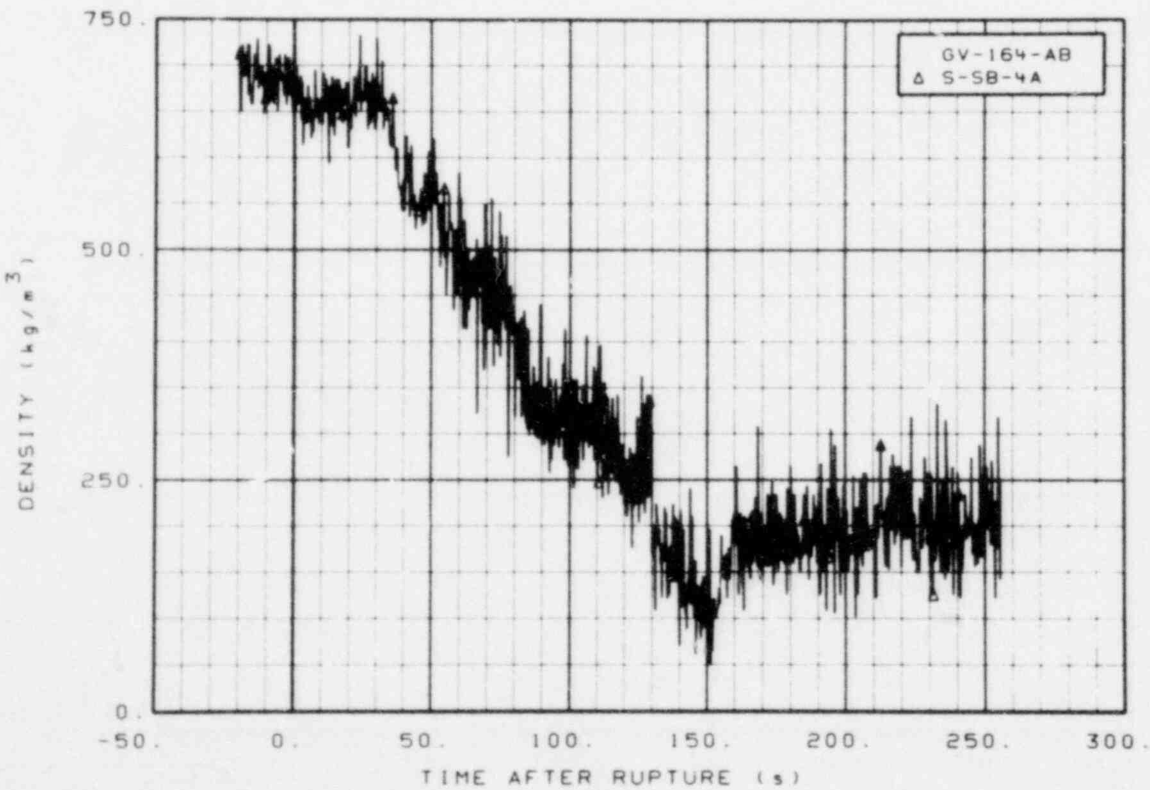


Figure 592. Density in vessel, Test S-SB-4A (GV-164-AB), from -20 to 256 s.

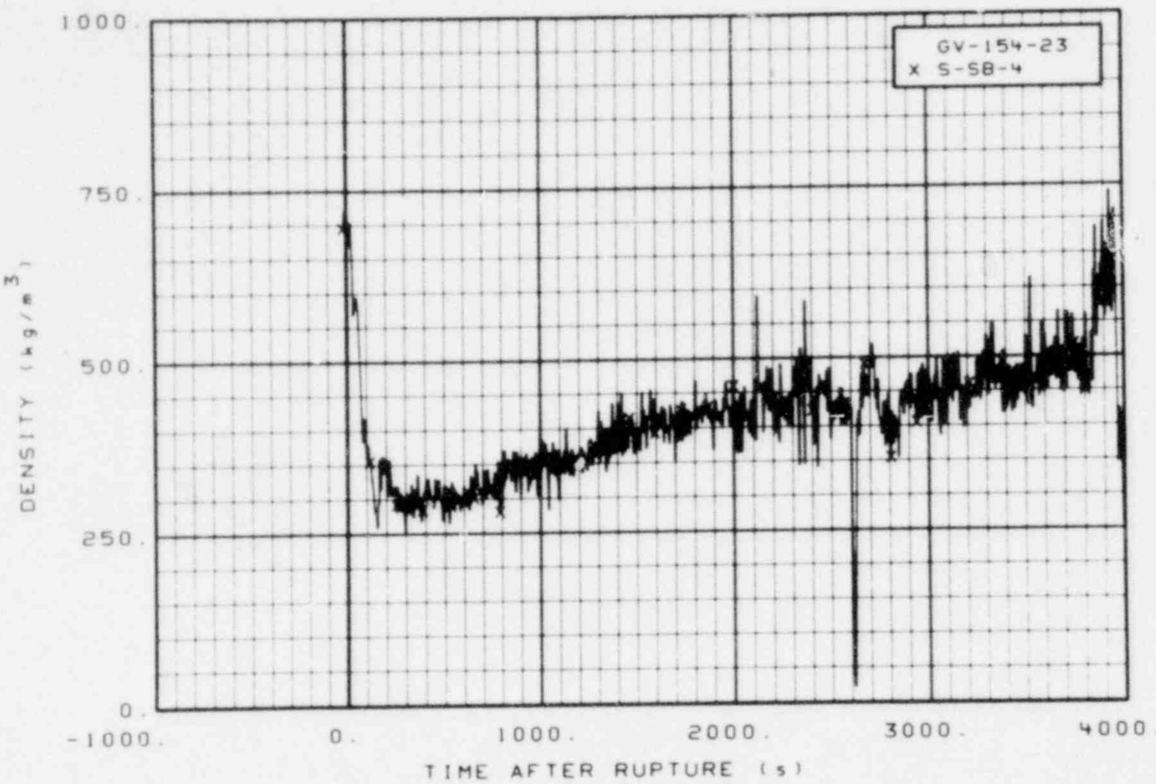


Figure 593. Density in vessel, Test S-SB-4 (GV-154-23), from -20 to 4000 s.

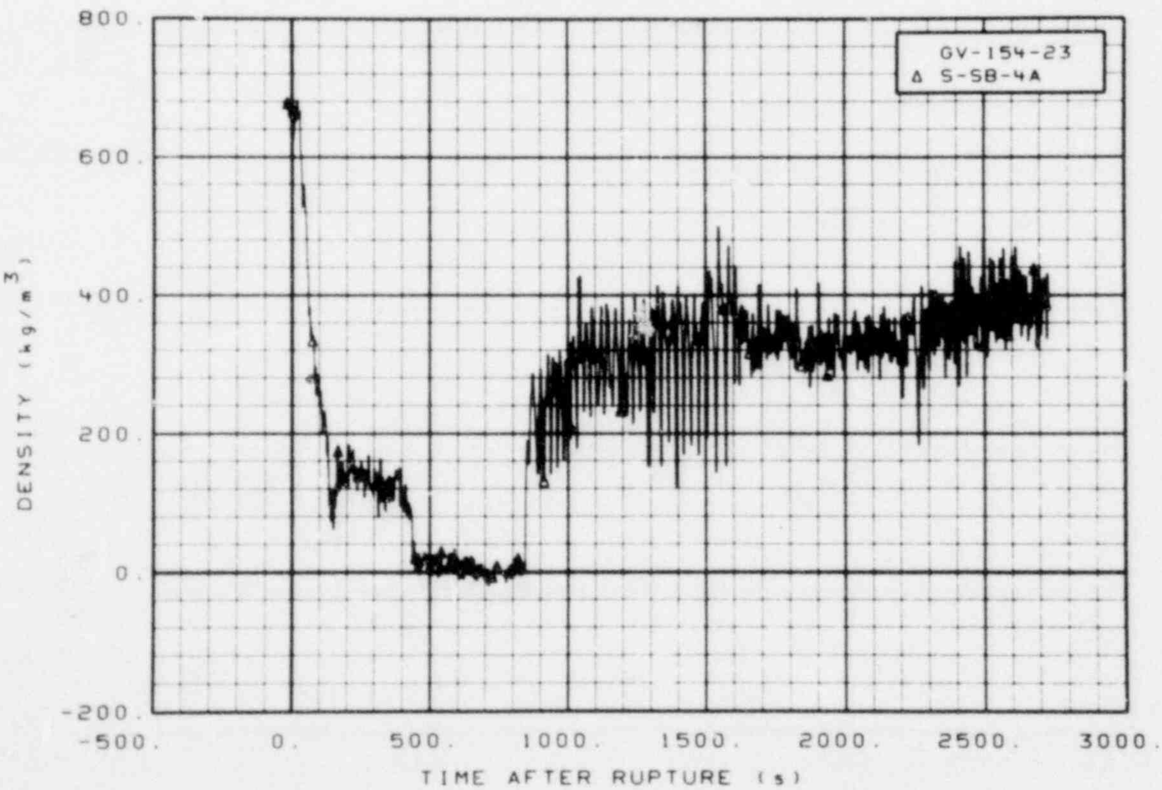


Figure 594. Density in vessel, Test S-SB-4A (GV-154-23), from -20 to 2740 s.

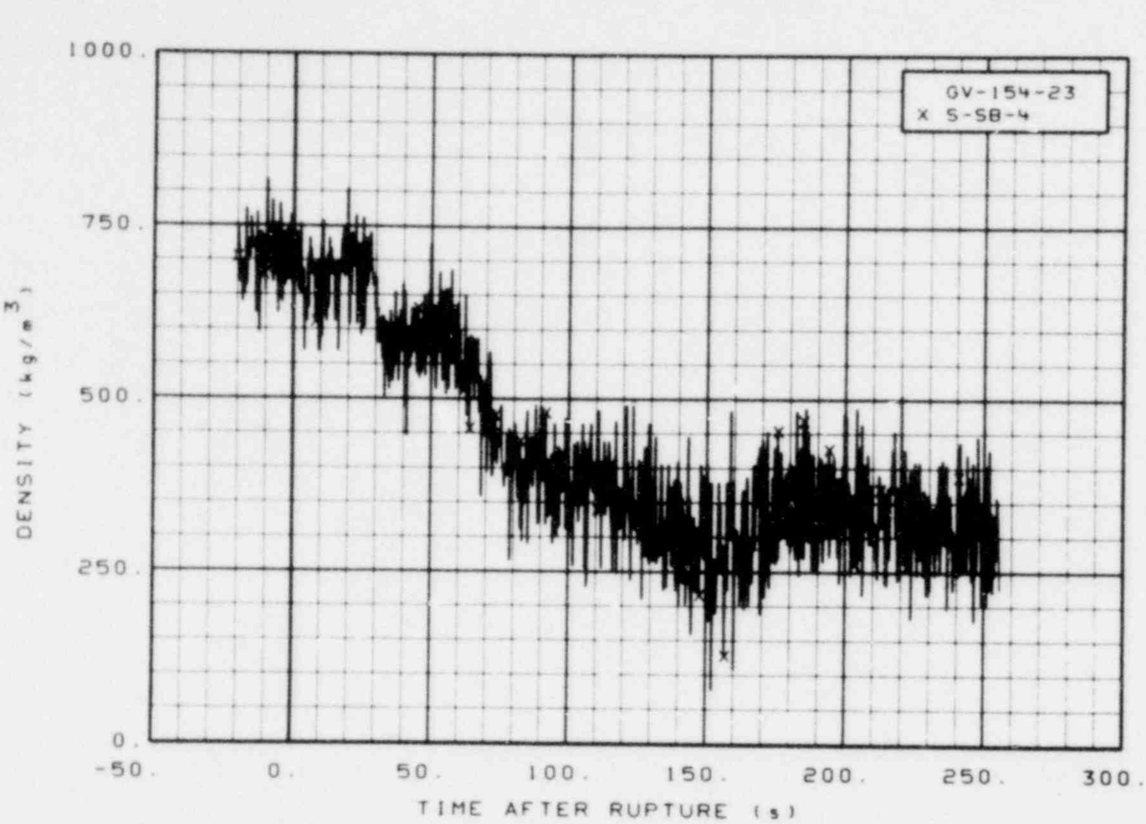


Figure 595. Density in vessel, Test S-SB-4 (GV-154-23), from -20 to 256 s.

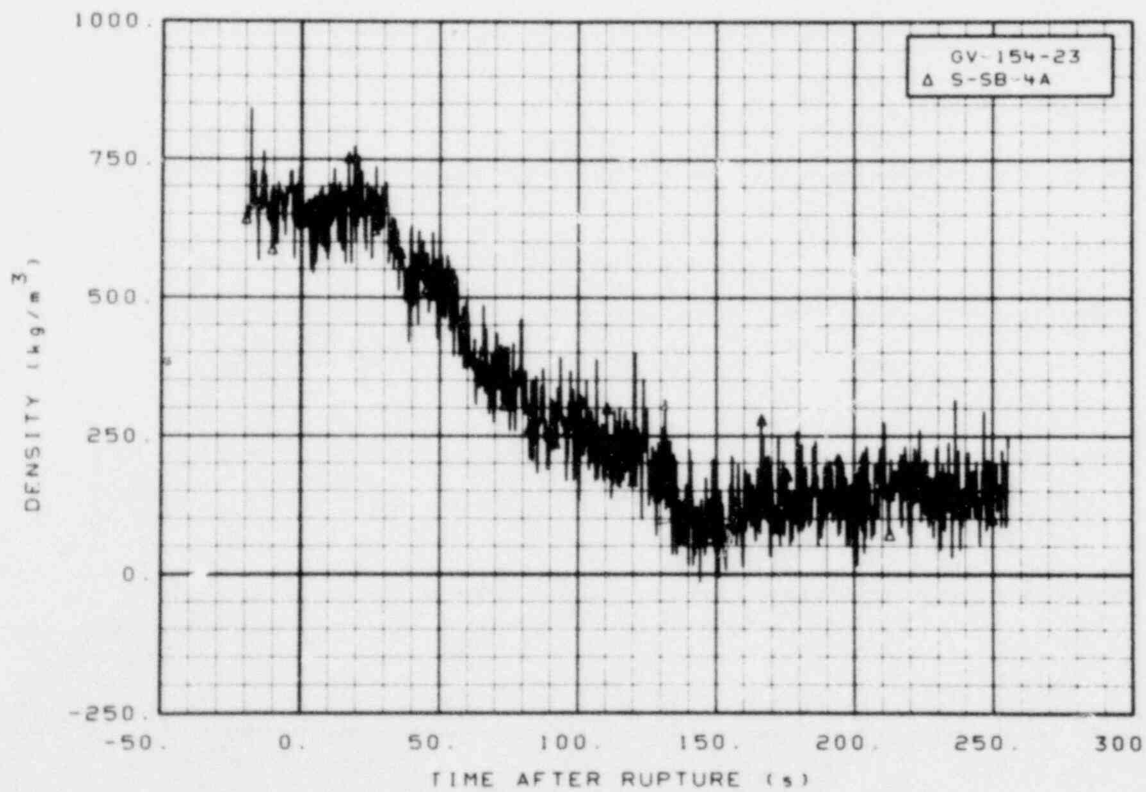


Figure 596. Density in vessel, Test S-SB-4A (GV-154-23), from -20 to 256 s.

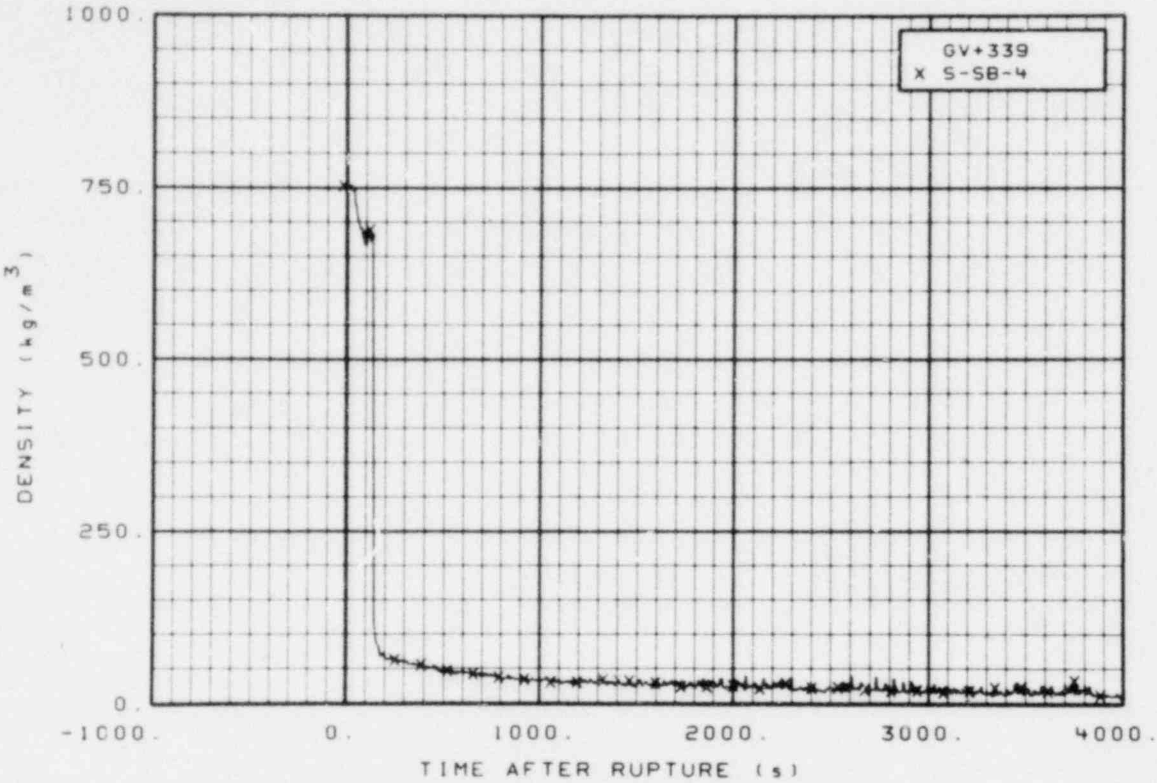


Figure 597. Density in vessel, Test S-SB-4 (GV + 339), from -20 to 4000 s.

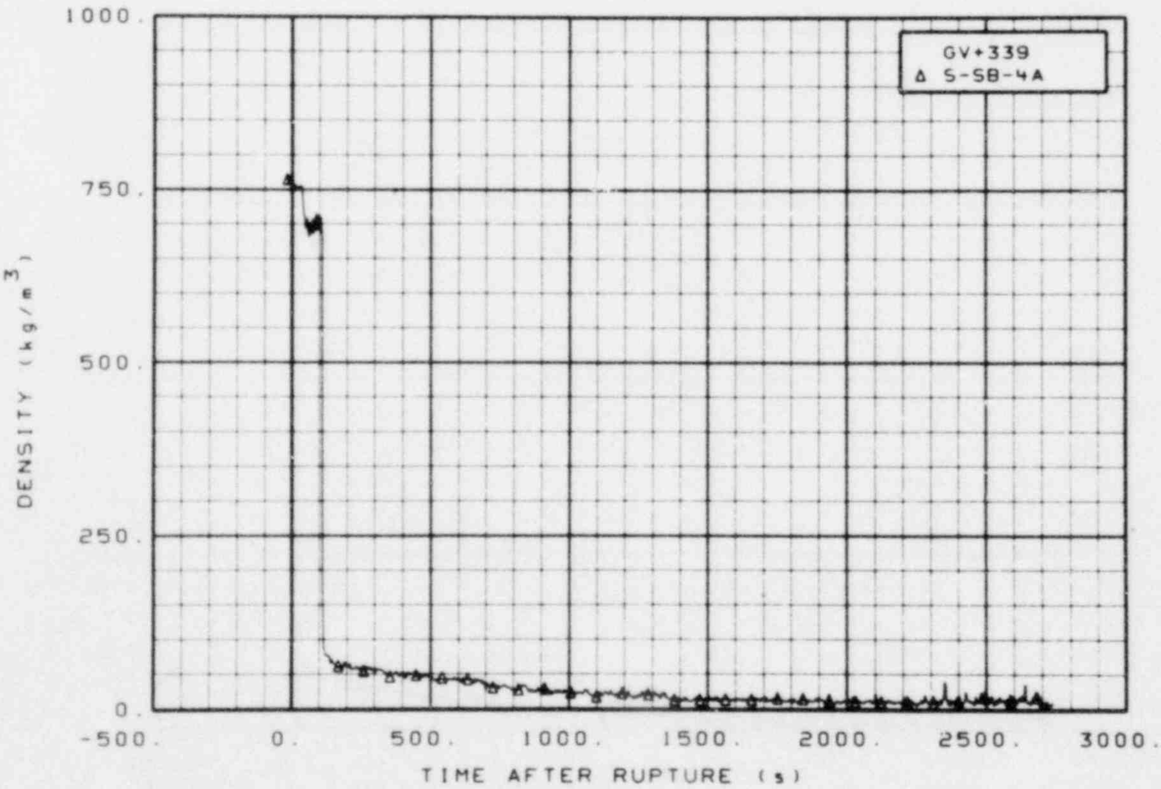


Figure 598. Density in vessel, Test S-SB-4A (GV + 339), from -20 to 2740 s.

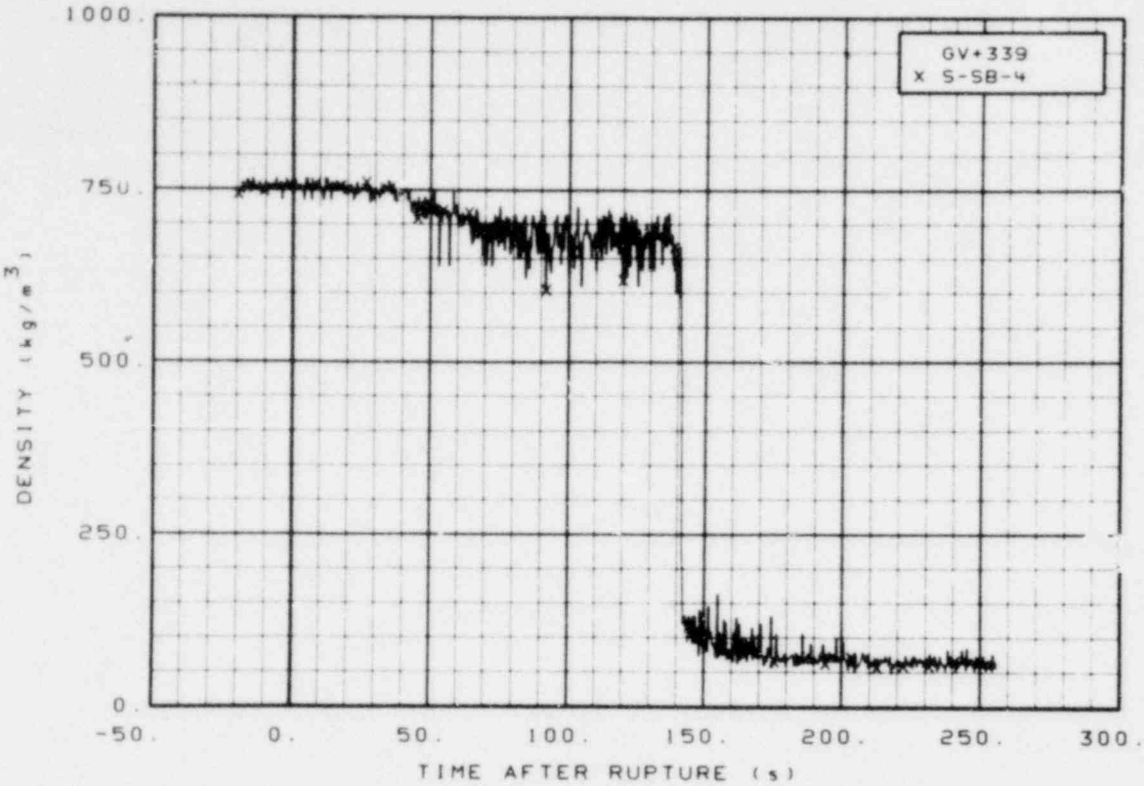


Figure 599. Density in vessel, Test S-SB-4 (GV + 339), from -20 to 256 s.

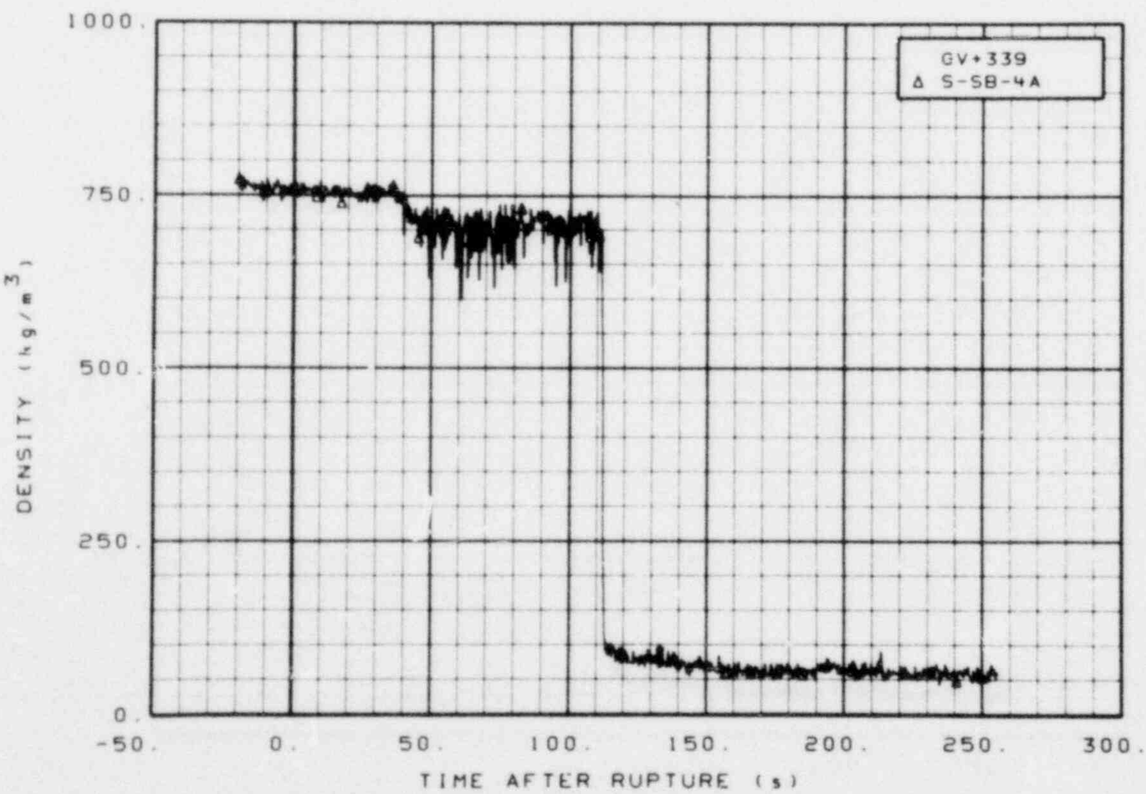


Figure 600. Density in vessel, Test S-SB-4A (GV + 339), from -20 to 256 s.

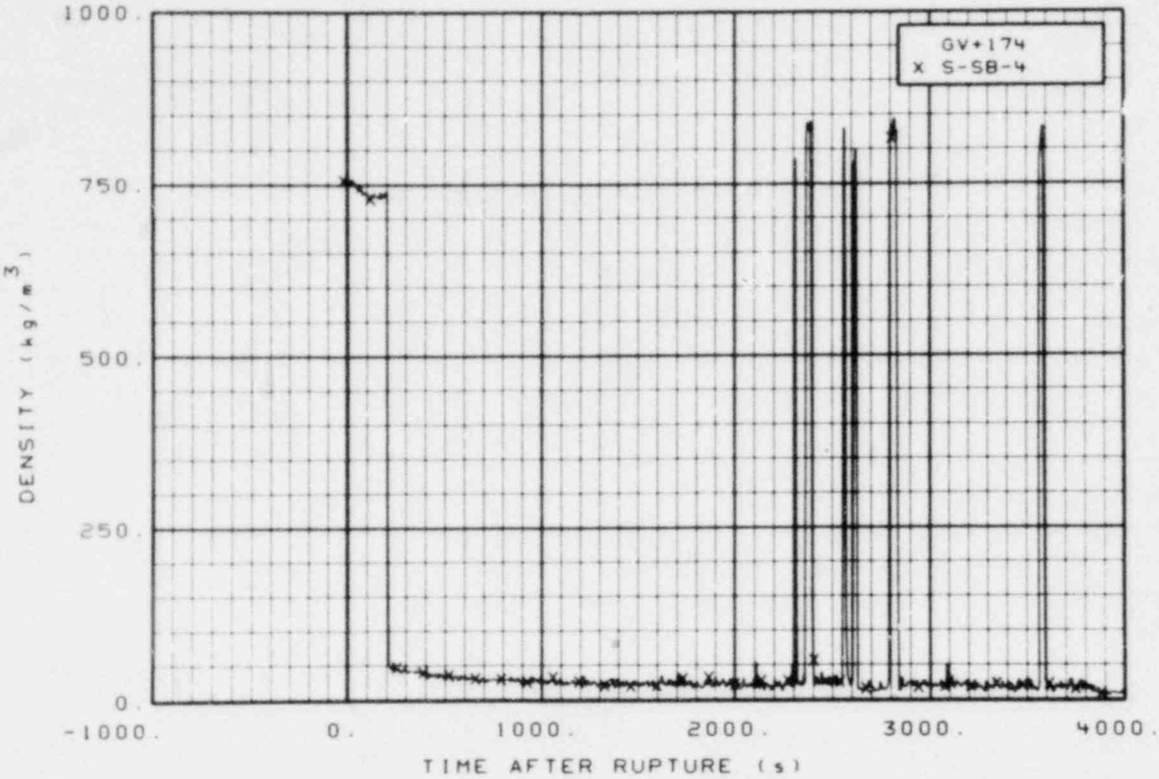


Figure 601. Density in vessel, Test S-SB-4 (GV + 174), from -20 to 4000 s.

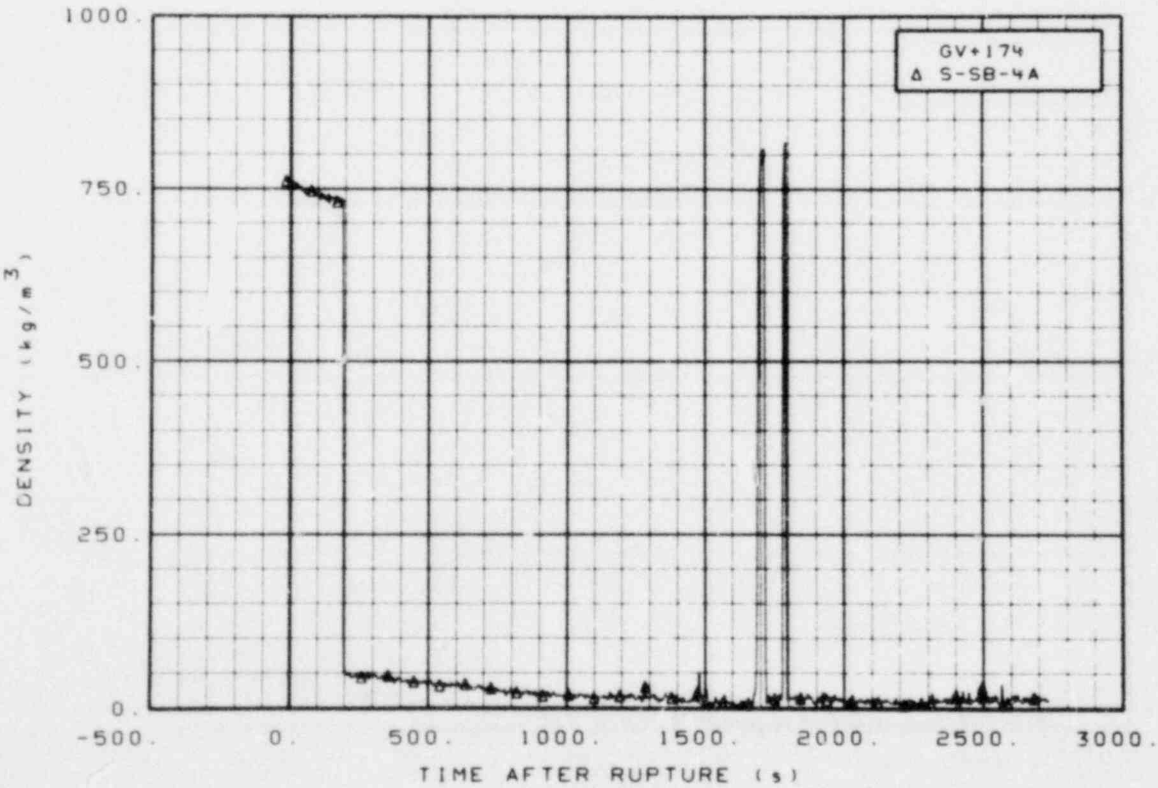


Figure 602. Density in vessel, Test S-SB-4A (GV + 174), from -20 to 2740 s.

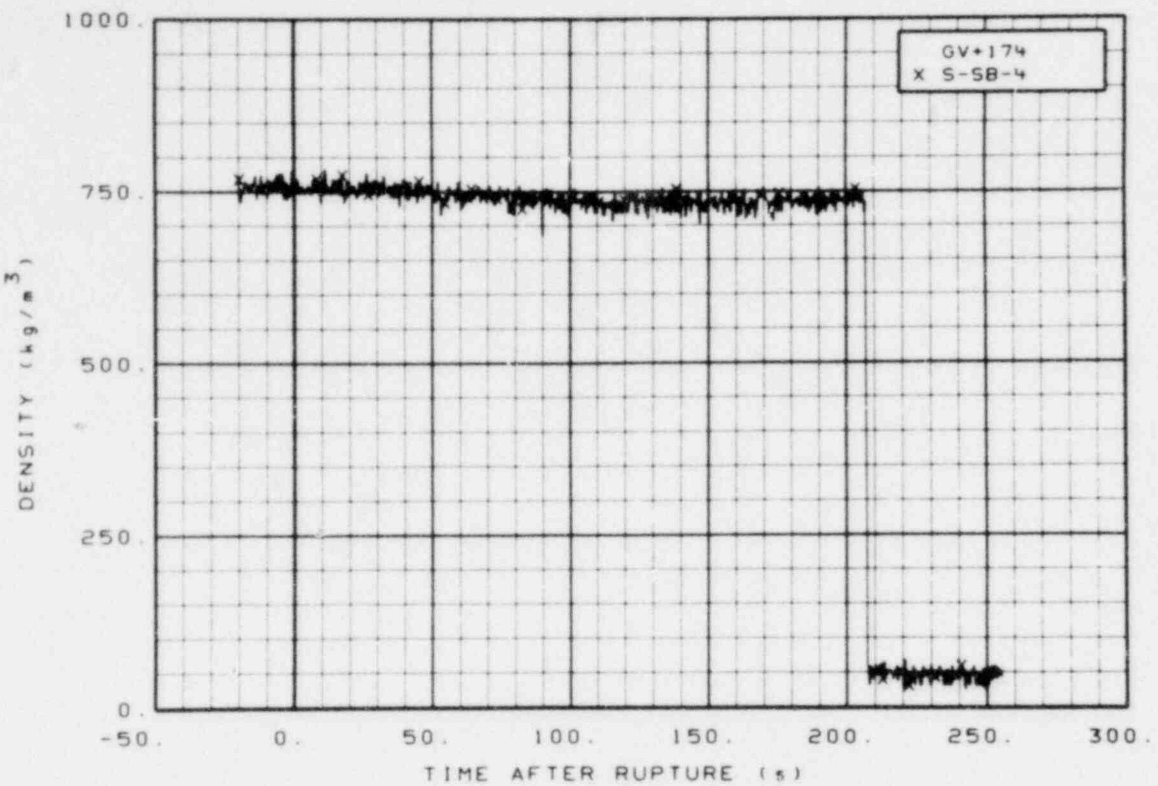


Figure 603. Density in vessel, Test S-SB-4 (GV + 174), from -20 to 256 s.

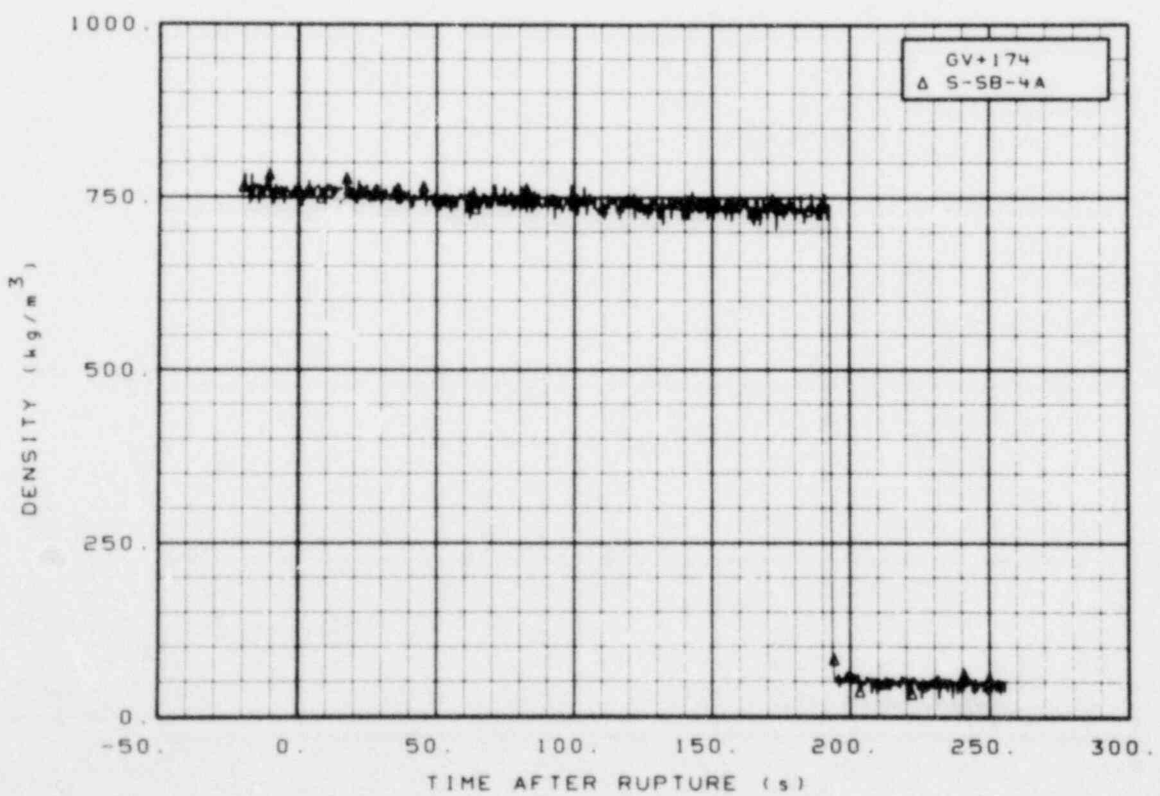


Figure 604. Density in vessel, Test S-SB-4A (GV + 174), from -20 to 256 s.

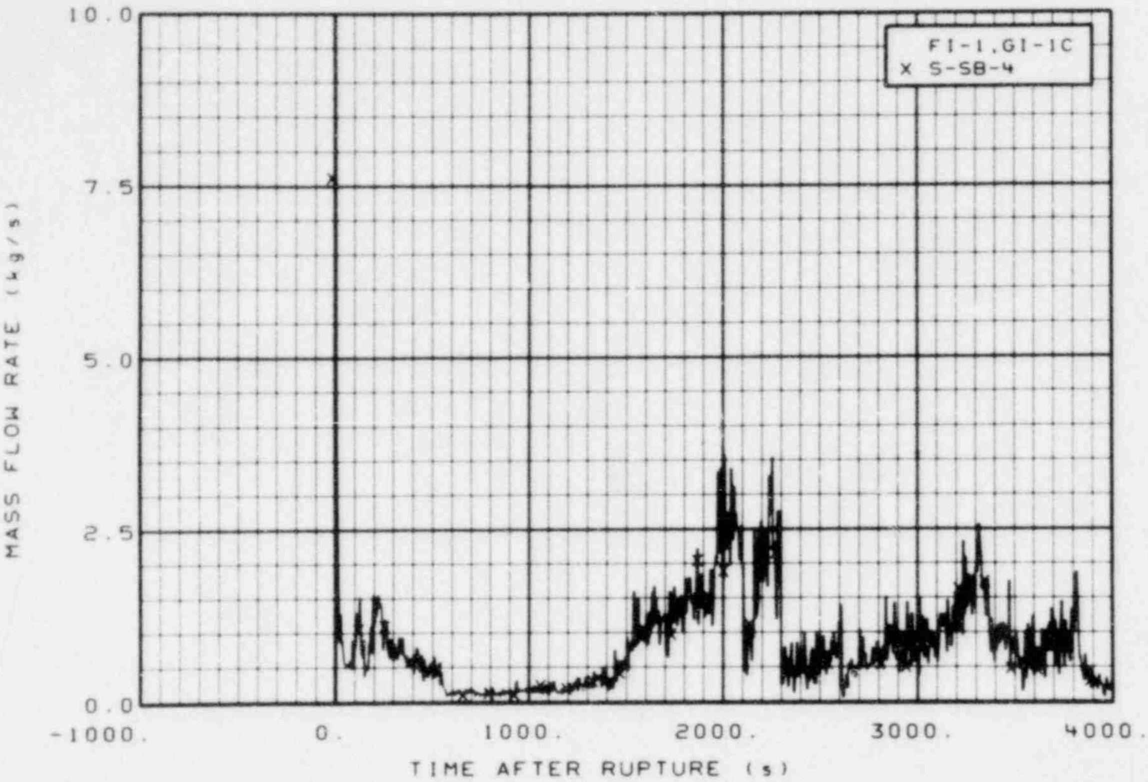


Figure 605. Mass flow intact loop hot leg, Test S-SB-4 (FI-1 and GI-1C), from -20 to 4000 s.

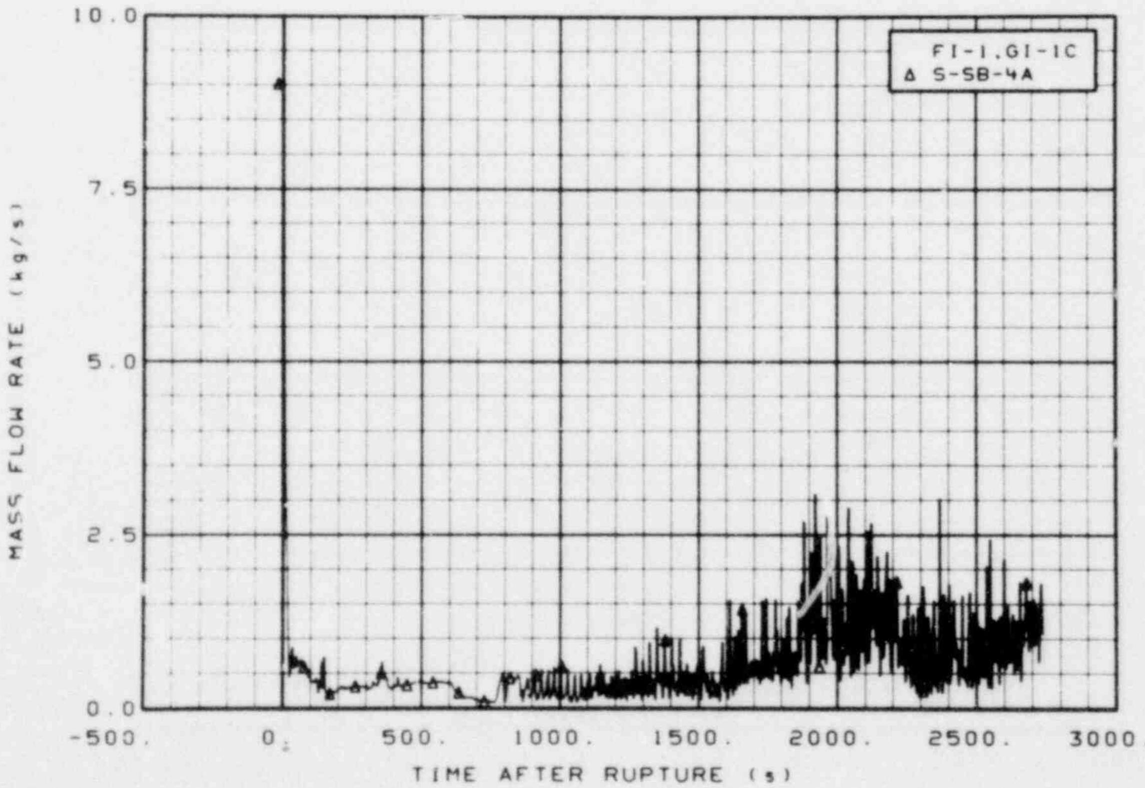


Figure 606. Mass flow intact loop hot leg, Test S-SB-4A (FI-1 and GI-1C), from -20 to 2740 s.

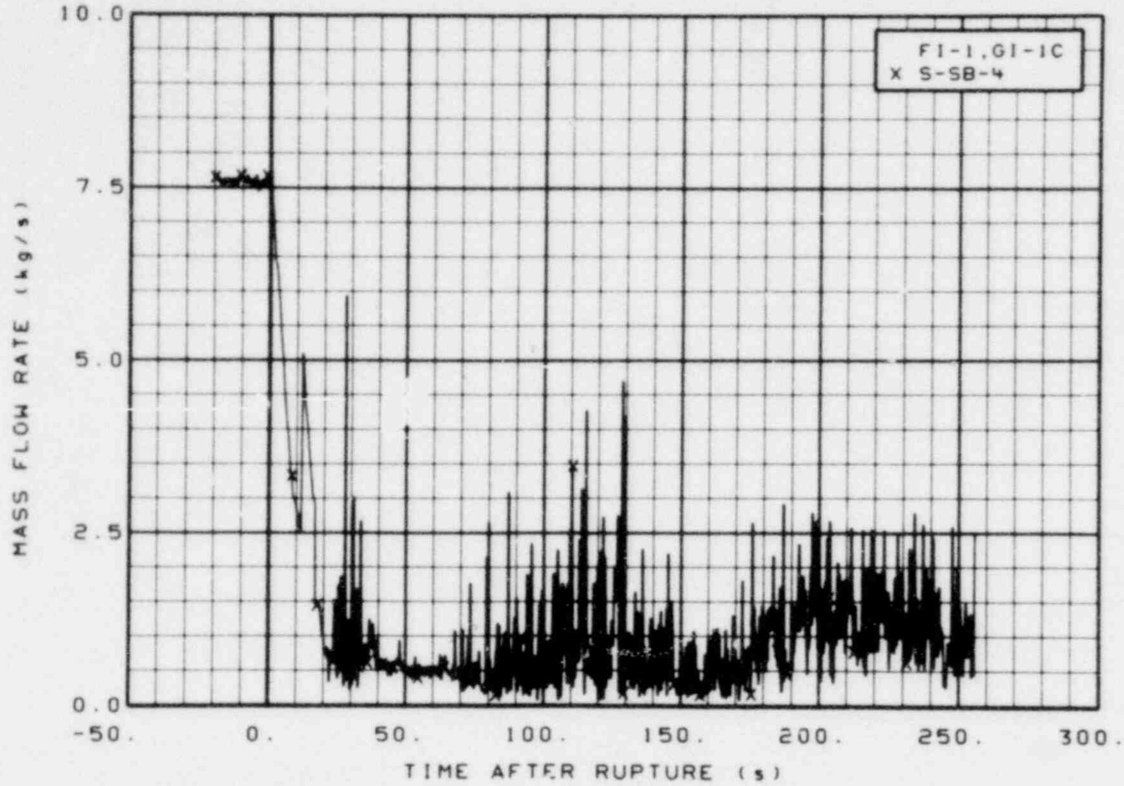


Figure 607. Mass flow intact loop hot leg, Test S-SB-4 (FI-1 and GI-1C), from -20 to 256 s.

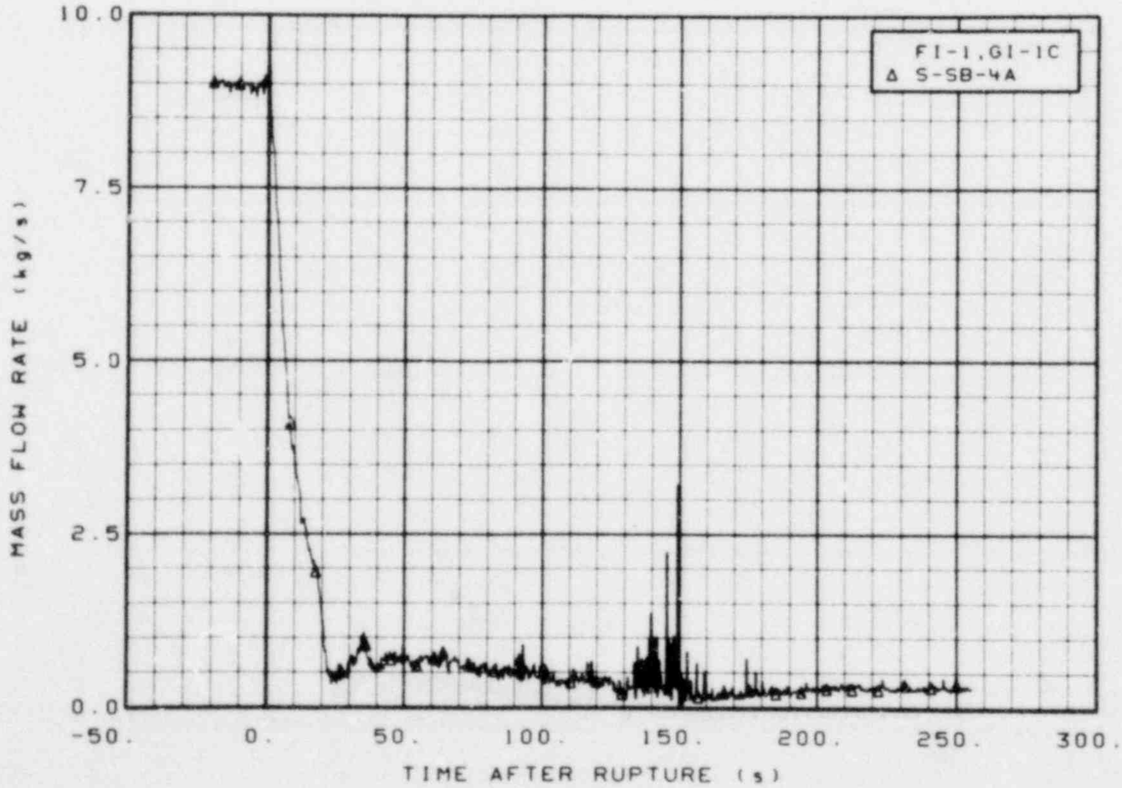


Figure 608. Mass flow intact loop hot leg, Test S-SB-4A (FI-1 and GI-1C), from -20 to 256 s.

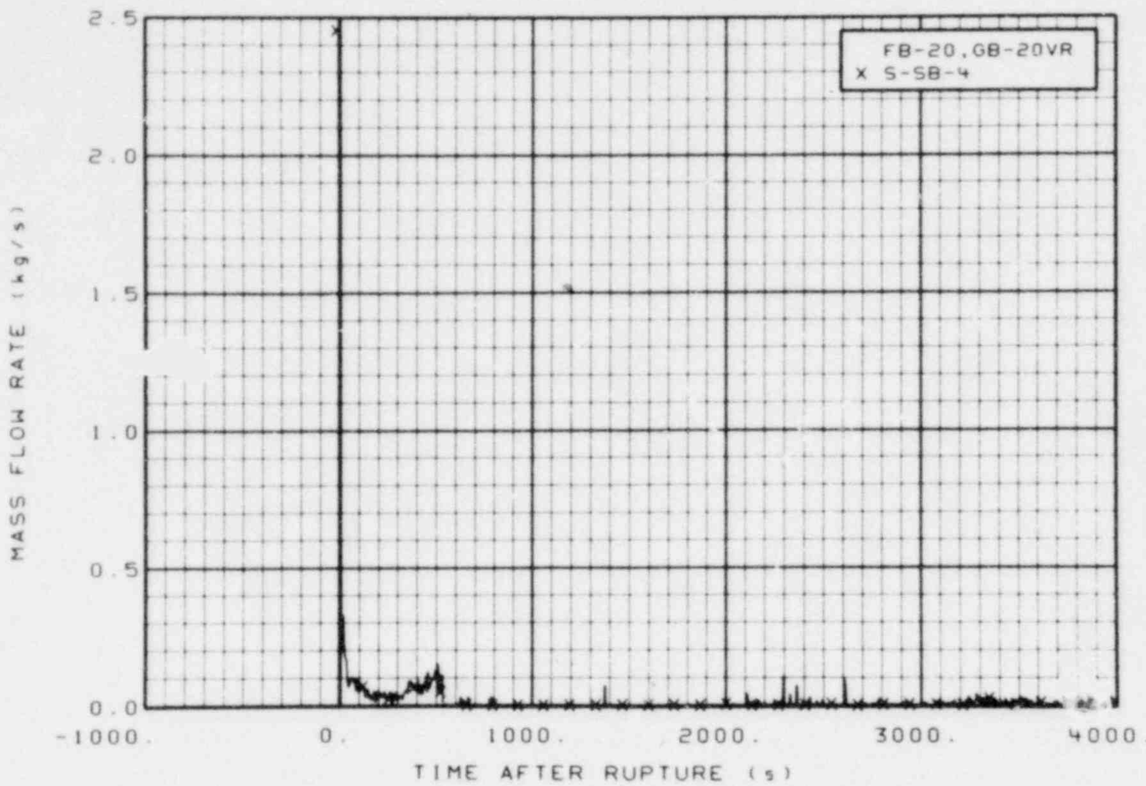


Figure 609. Mass flow intact loop hot leg, Test S-SB-4 (FB-20 and GB-20VR), from -20 to 4000 s.

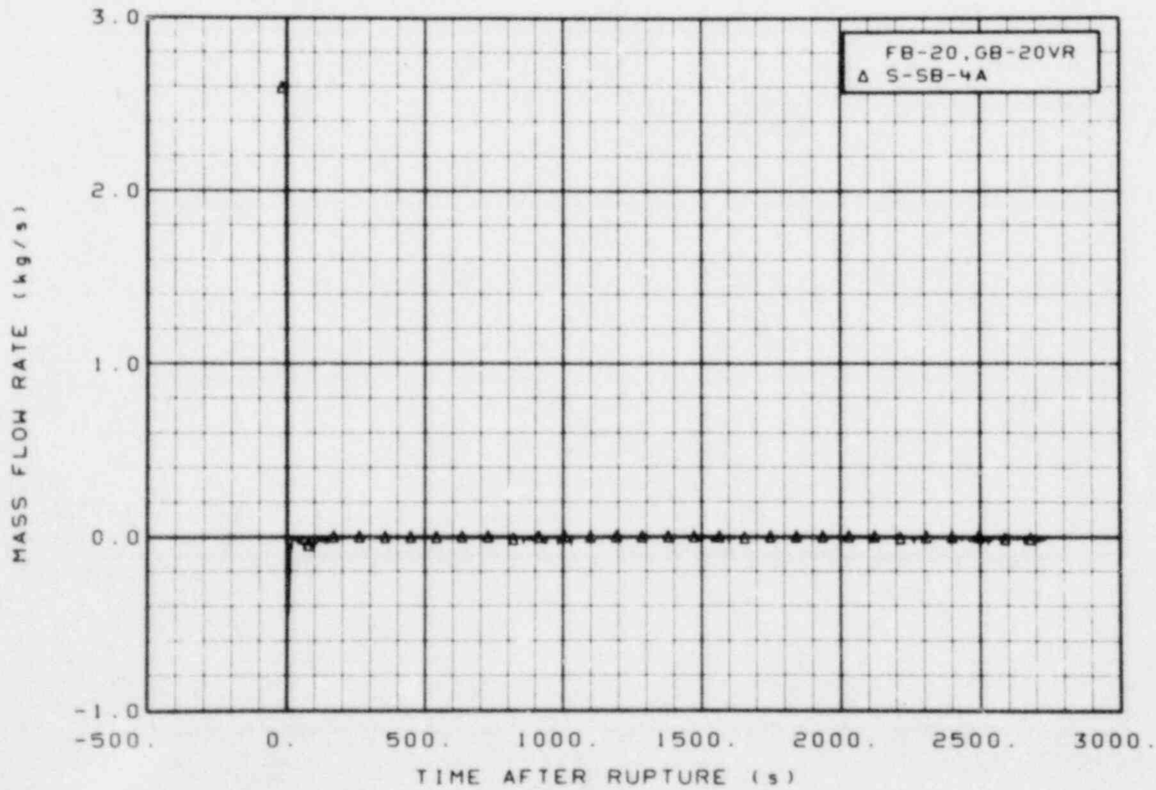


Figure 610. Mass flow intact loop hot leg, Test S-SB-4A (FB-20 and GB-20VR), from -20 to 2740 s.

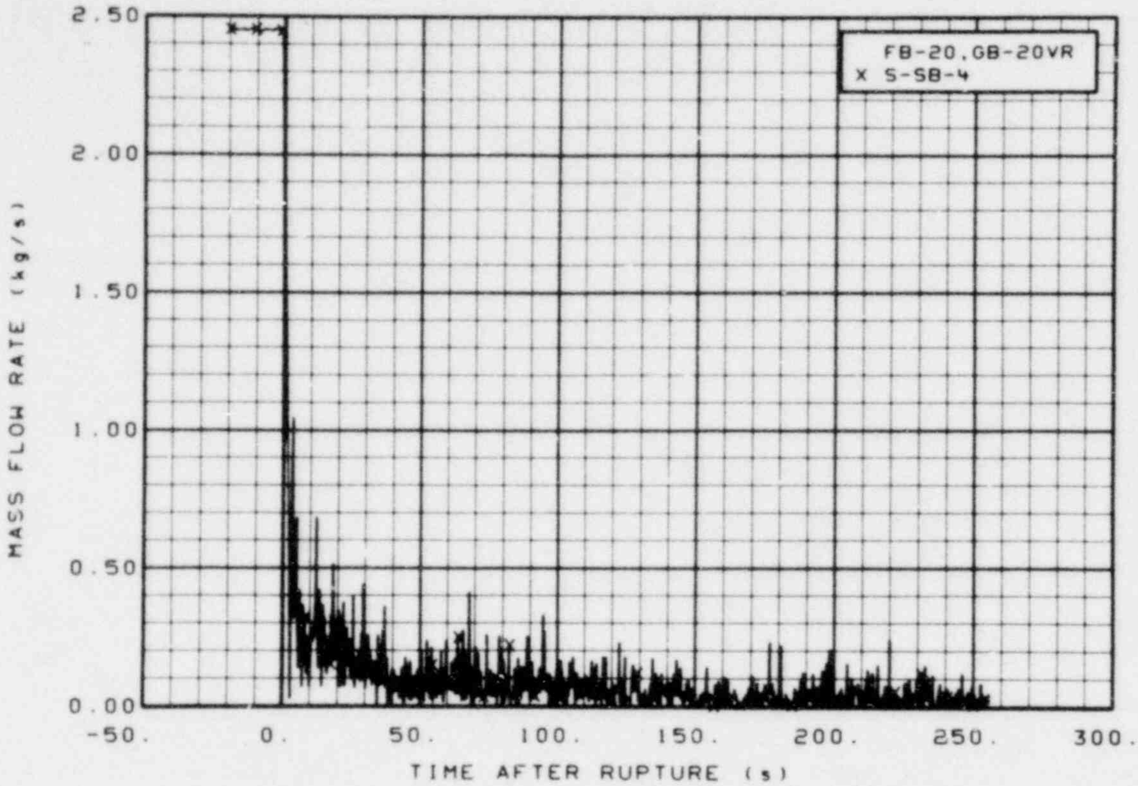


Figure 611. Mass flow intact loop hot leg, Test S-SB-4 (FB-20 and GB-20VR), from -20 to 256 s.

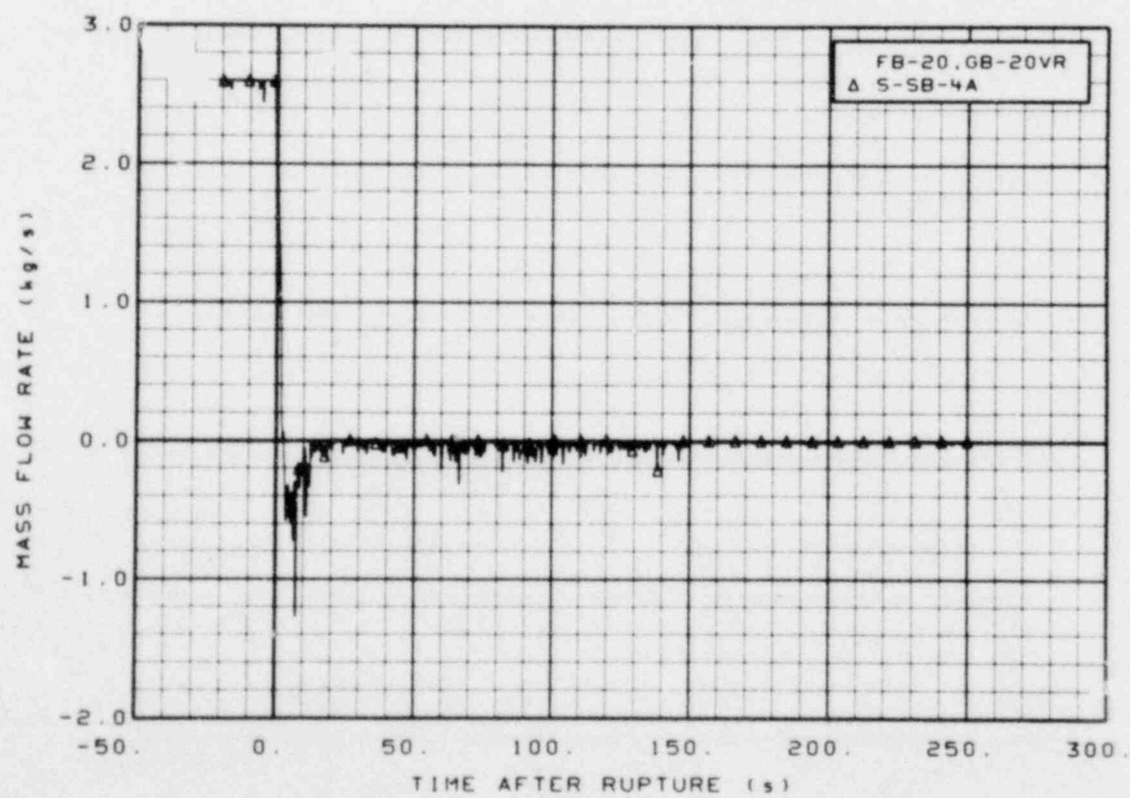


Figure 612. Mass flow intact loop hot leg, Test S-SB-4A (FB-20 and GB-20VR), from -20 to 256 s.

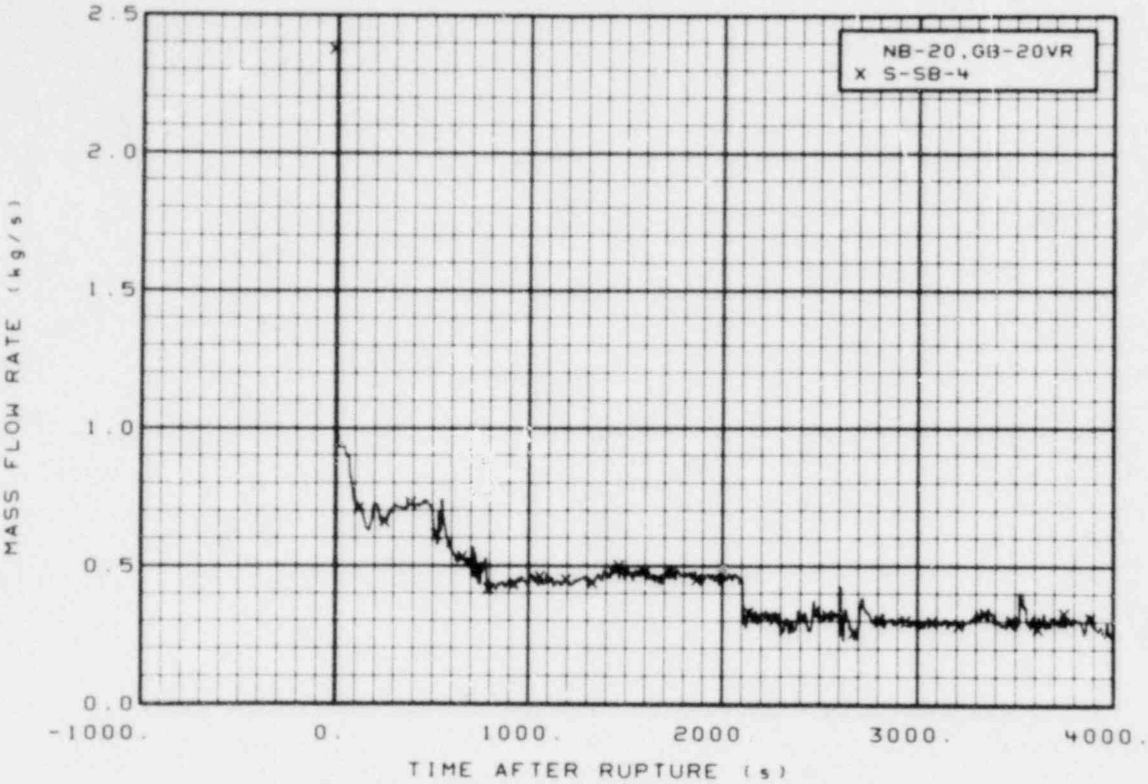


Figure 613. Mass flow intact loop hot leg, Test S-SB-4 (NB-20 and GB-20VR), from -20 to 4000 s.

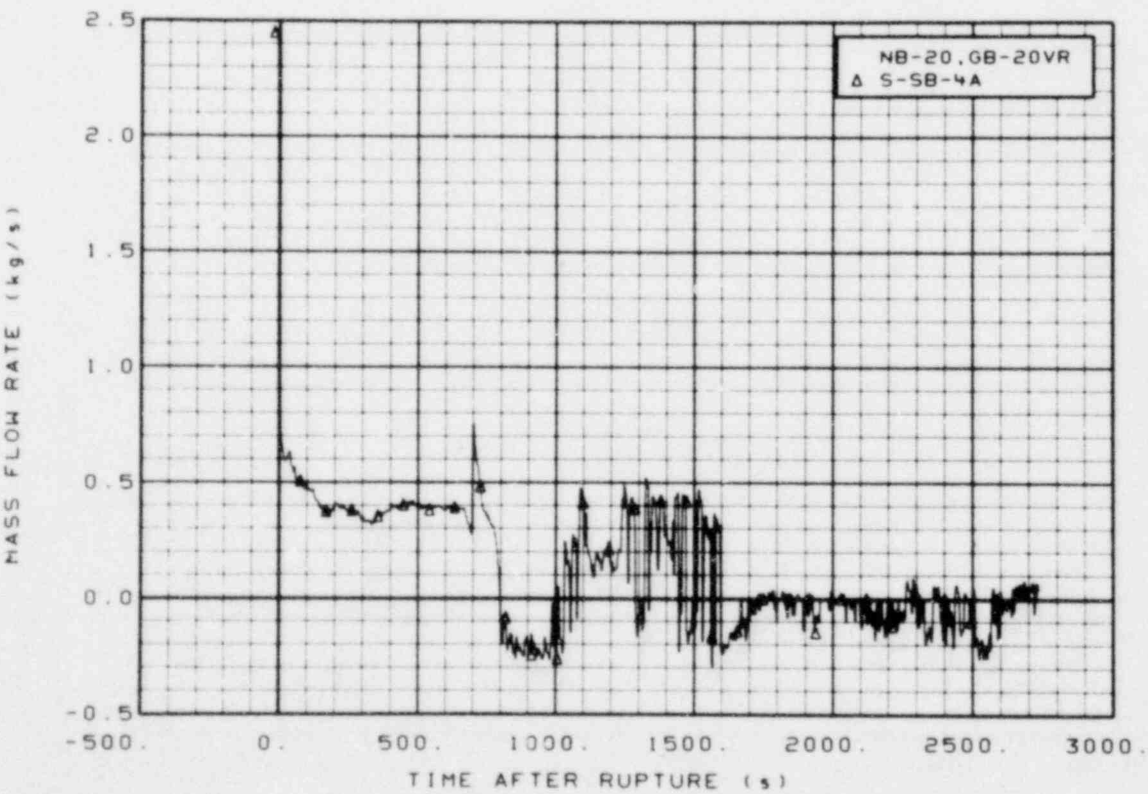


Figure 614. Mass flow intact loop hot leg, Test S-SB-4A (NB-20 and GB-20VR), from -20 to 2740 s.

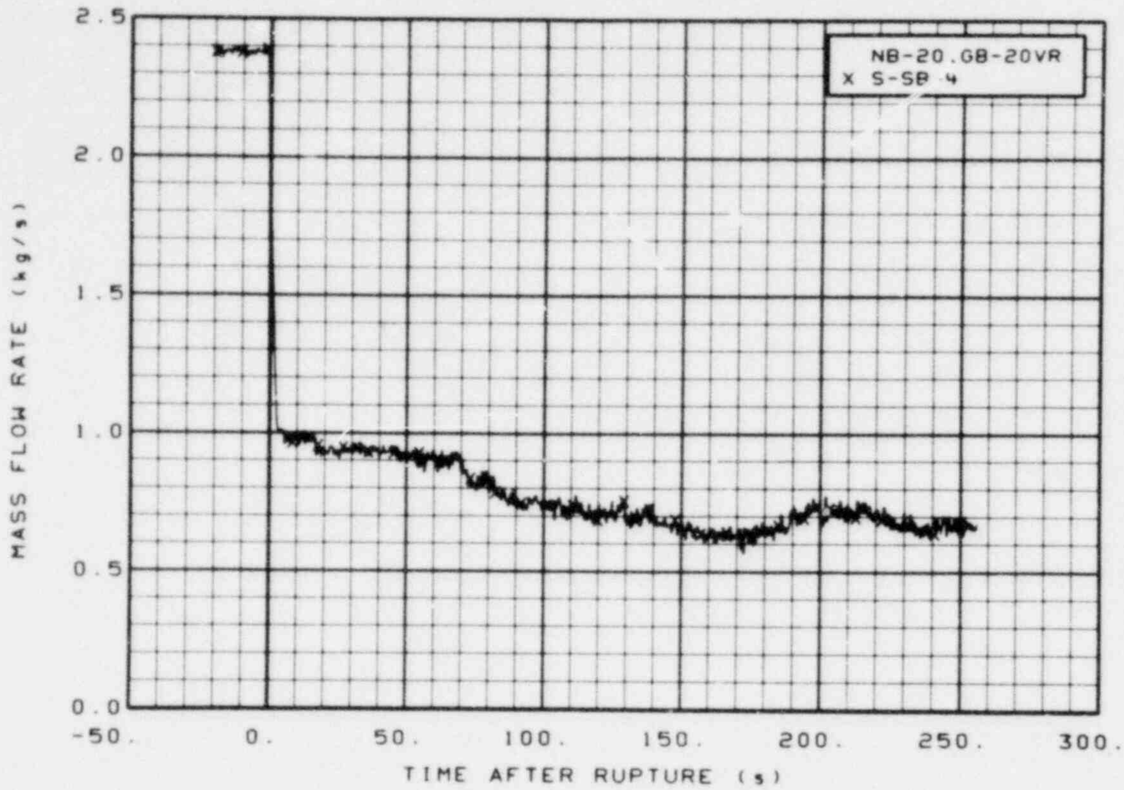


Figure 615. Mass flow intact loop hot leg, Test S-SB-4 (NB-20 and GB-20VR), from -20 to 256 s.

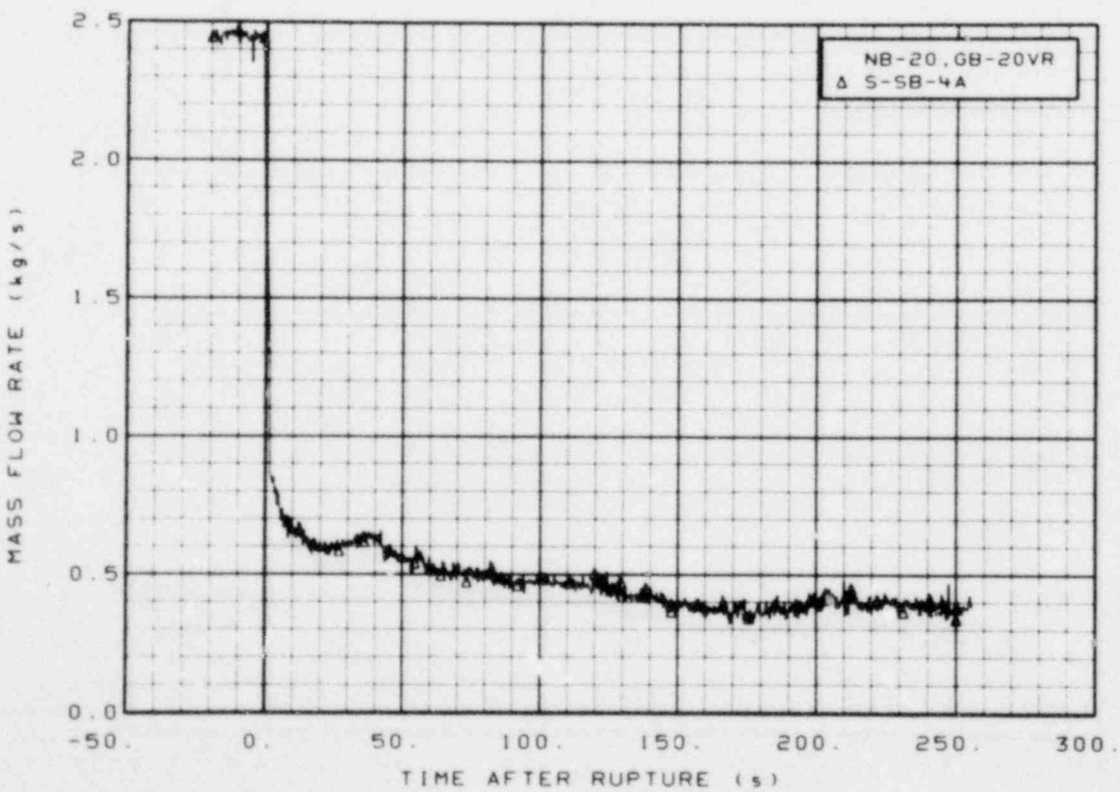


Figure 616. Mass flow intact loop hot leg, Test S-SB-4A (NB-20 and GB-20VR), from -20 to 256 s.

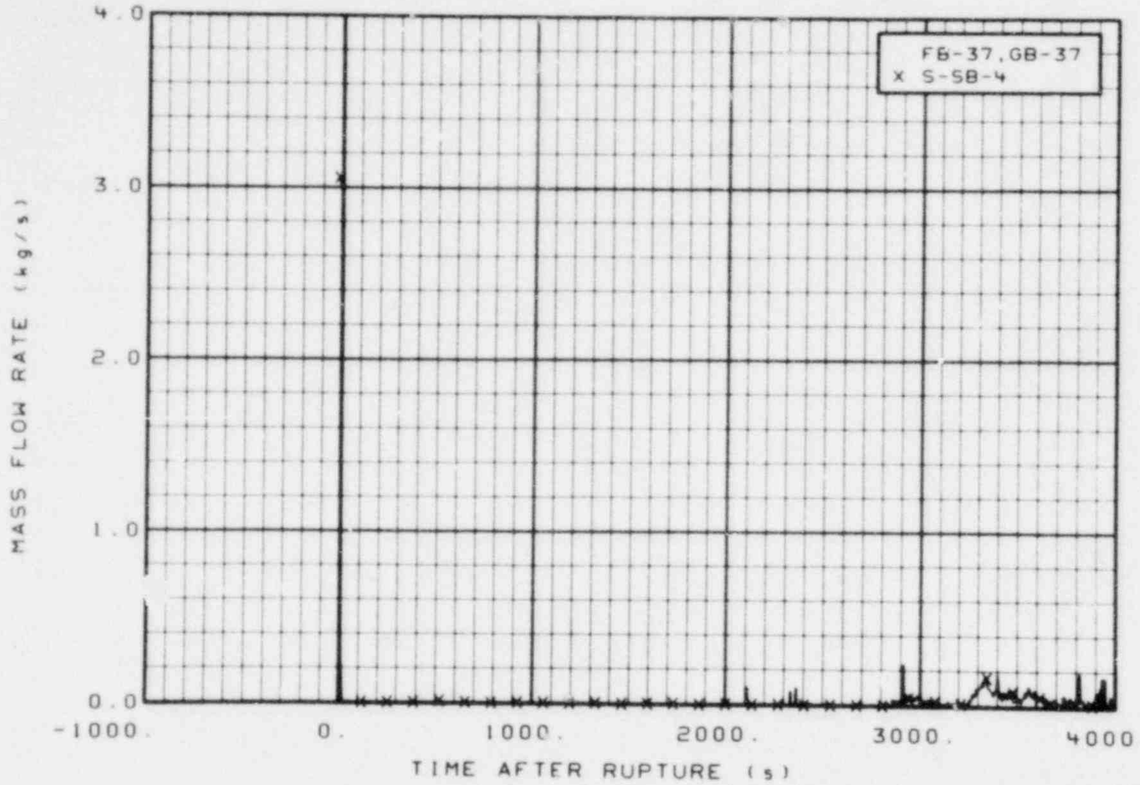


Figure 617. Mass flow in broken loop cold leg, Test S-SB-4 (FB-37 and GB-37), from -20 to 4000 s.

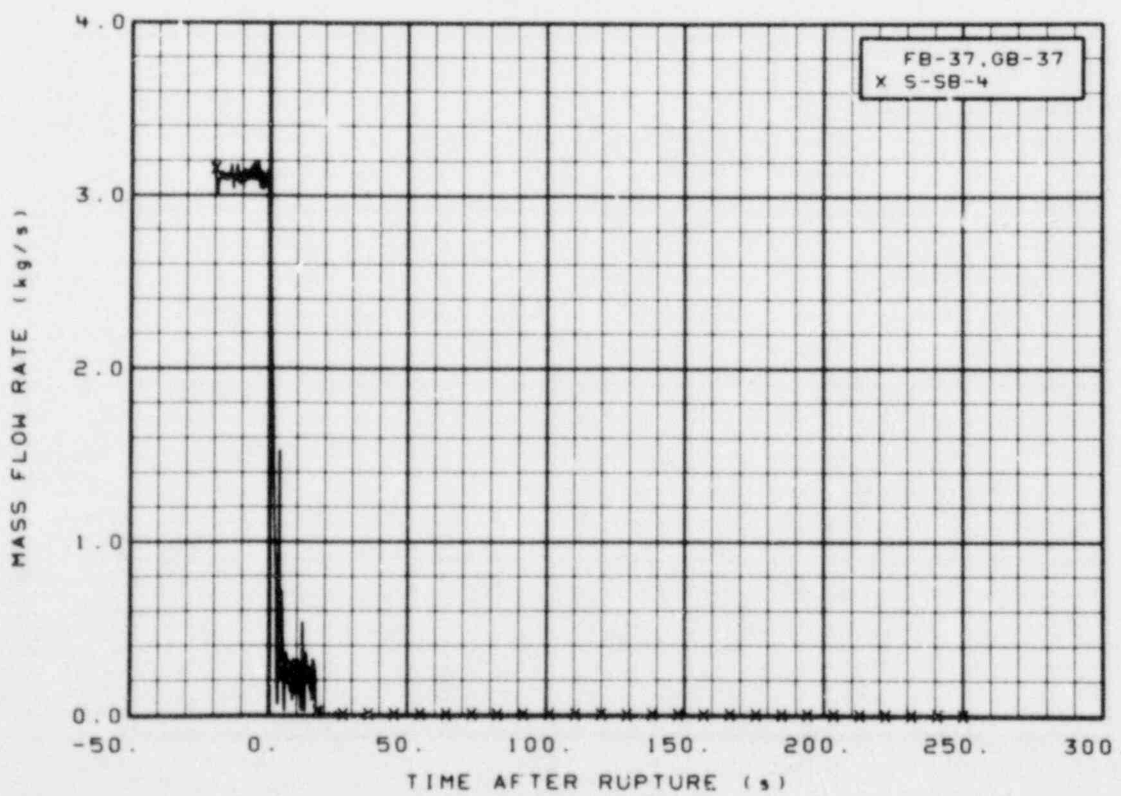


Figure 618. Mass flow in broken loop cold leg, Test S-SB-4 (FB-37 and GB-37), from -20 to 256 s.

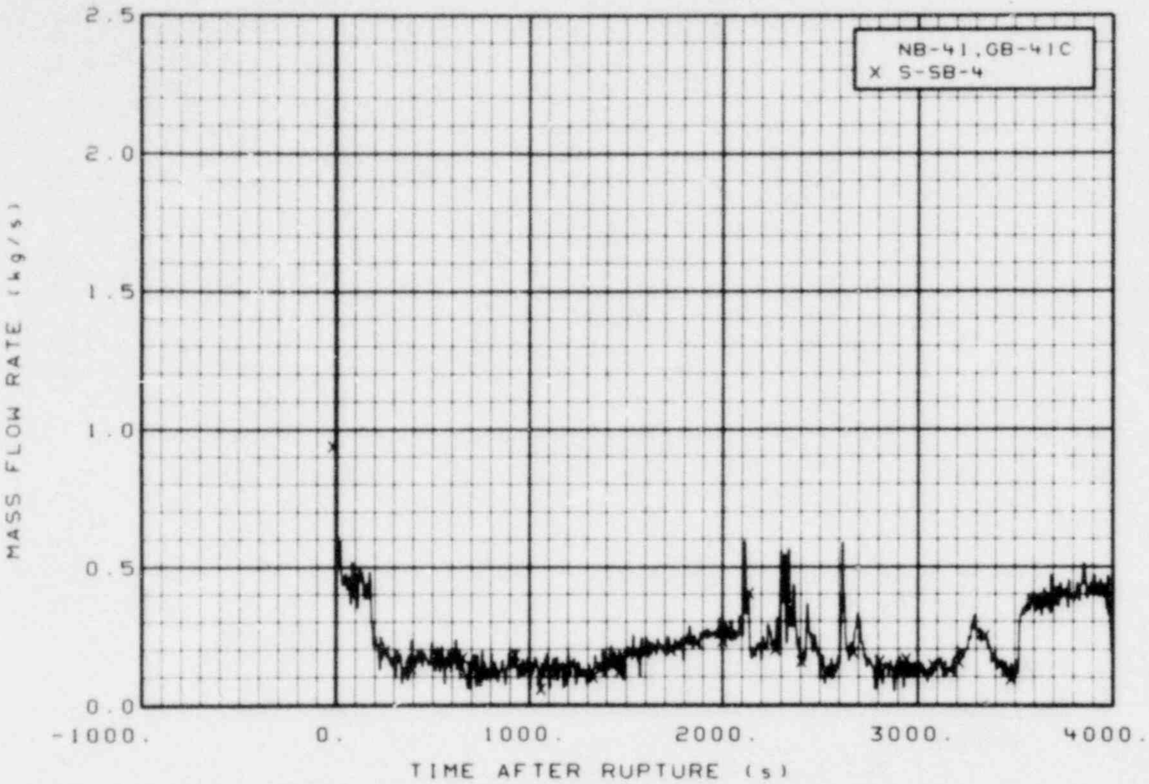


Figure 619. Mass flow in broken loop cold leg, Test S-SB-4 (NB-41 and GB-41C), from -20 to 4000 s.

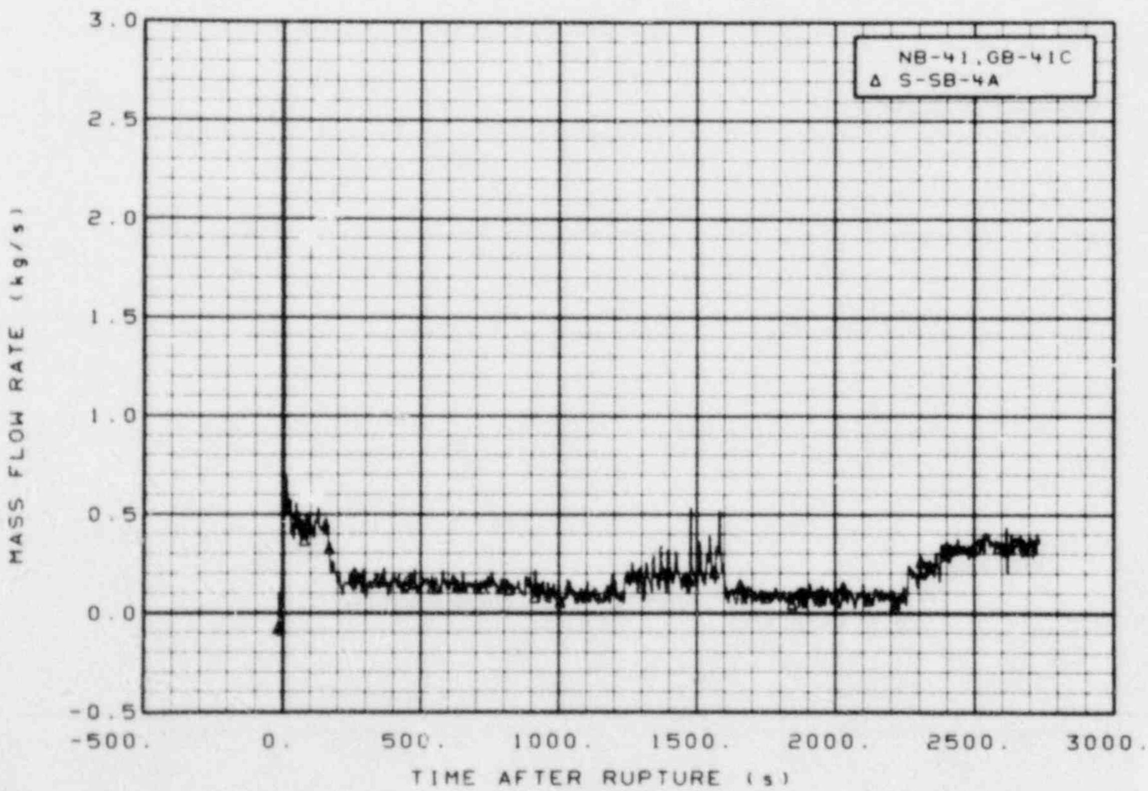


Figure 620. Mass flow in broken loop cold leg, Test S-SB-4A (NB-41 and GB-41C), from -20 to 2740 s.

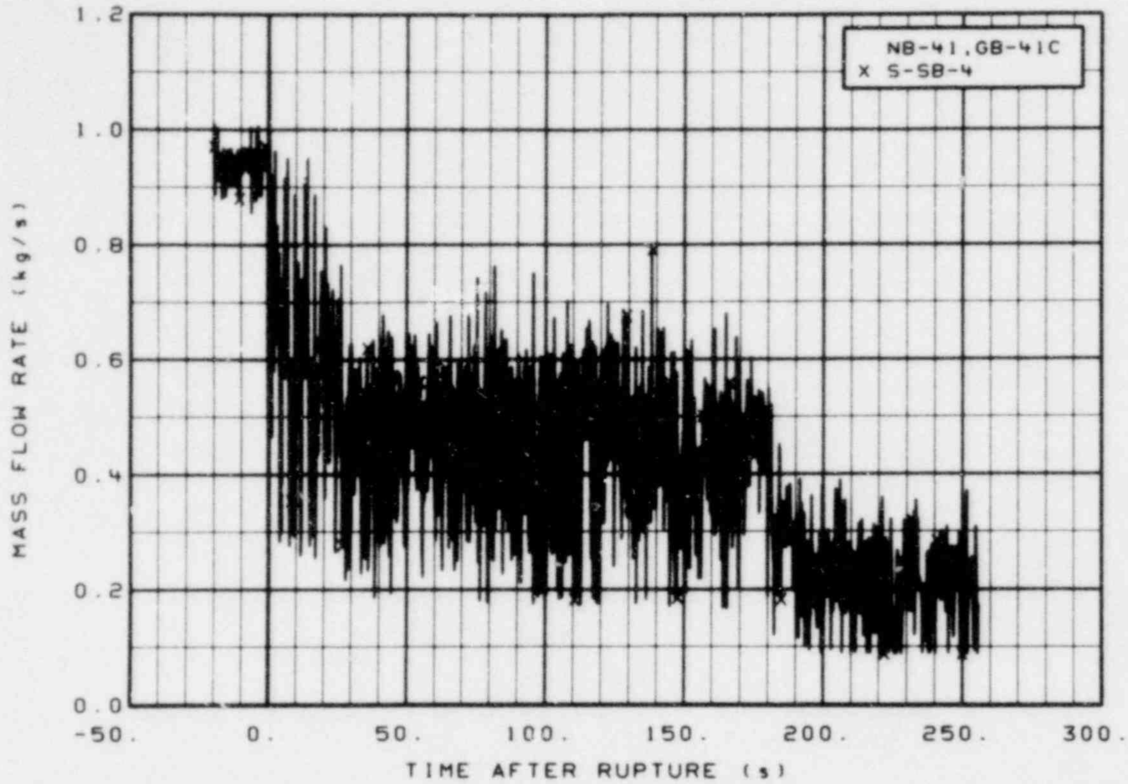


Figure 621. Mass flow in broken loop cold leg, Test S-SB-4 (NB-41 and GB-41C), from -20 to 256 s.

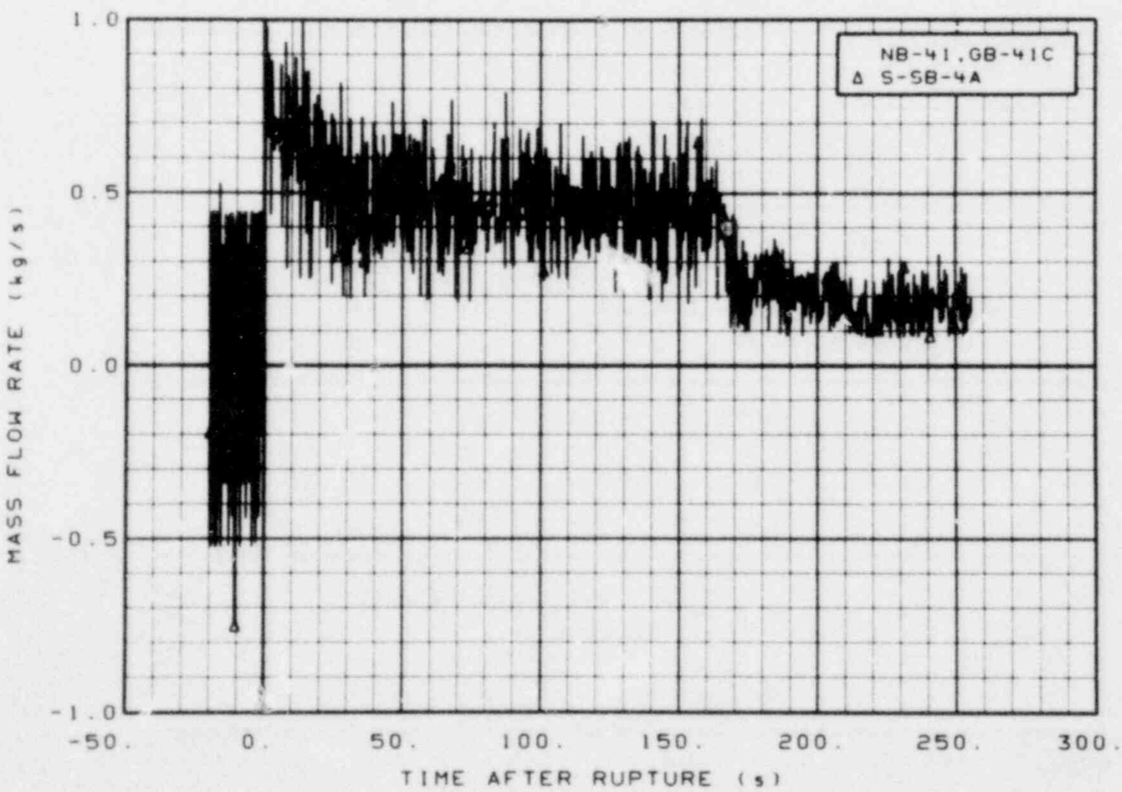


Figure 622. Mass flow in broken loop cold leg, Test S-SB-4A (NB-41 and GB-41C), from -20 to 256 s.

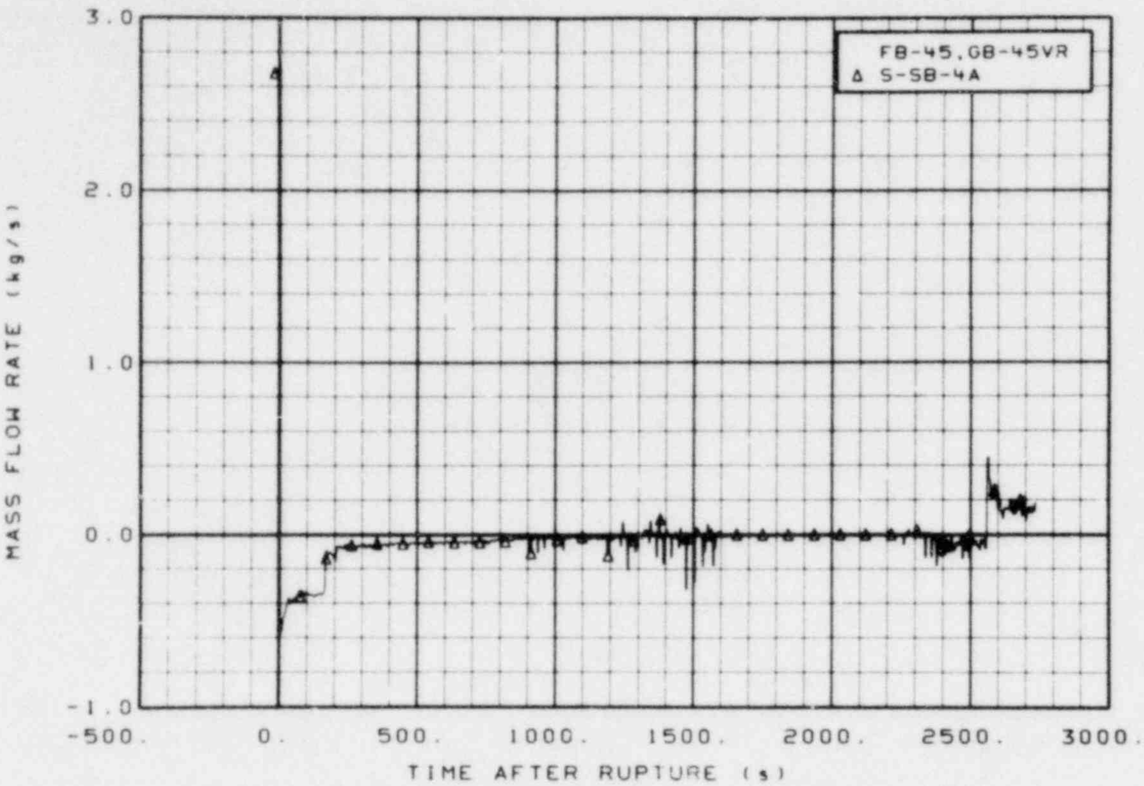


Figure 623. Mass flow in broken loop cold leg, Test S-SB A (FB-45 and GB-45VR), from -20 to 2740 s.

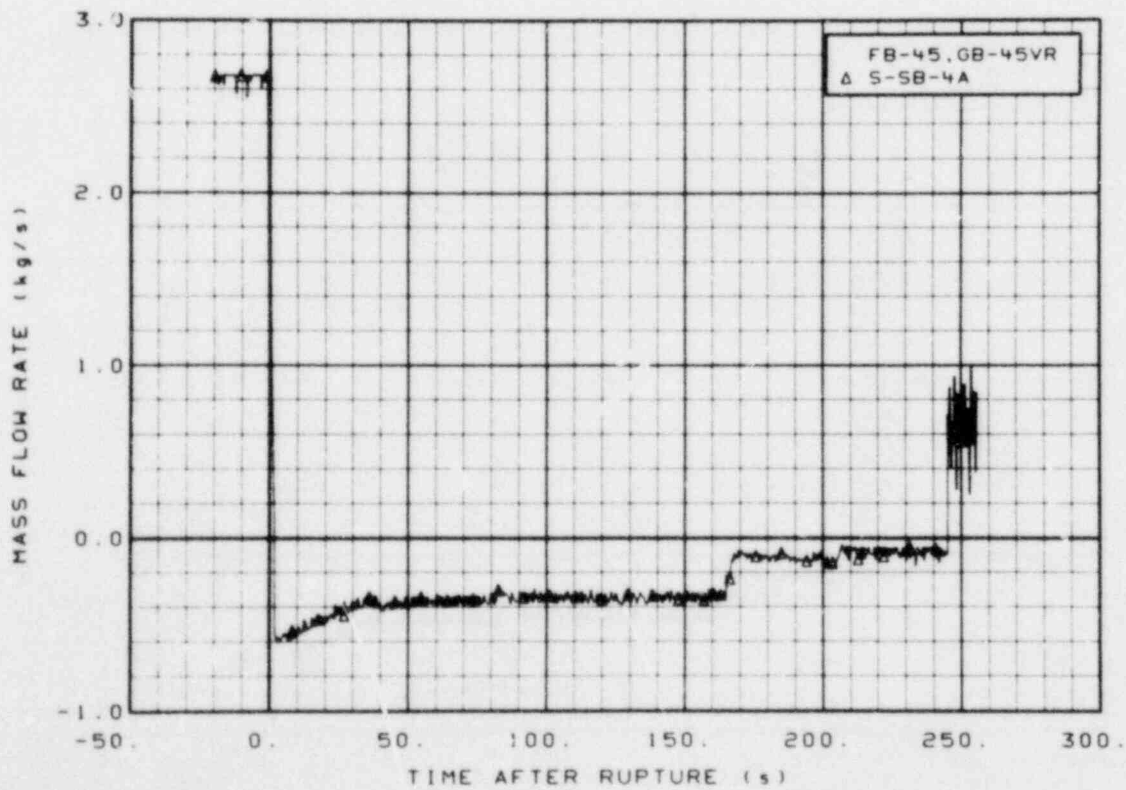


Figure 624. Mass flow in broken loop cold leg, Test S-SB-4A (FB-45 and GB-45VR), from -20 to 256 s.

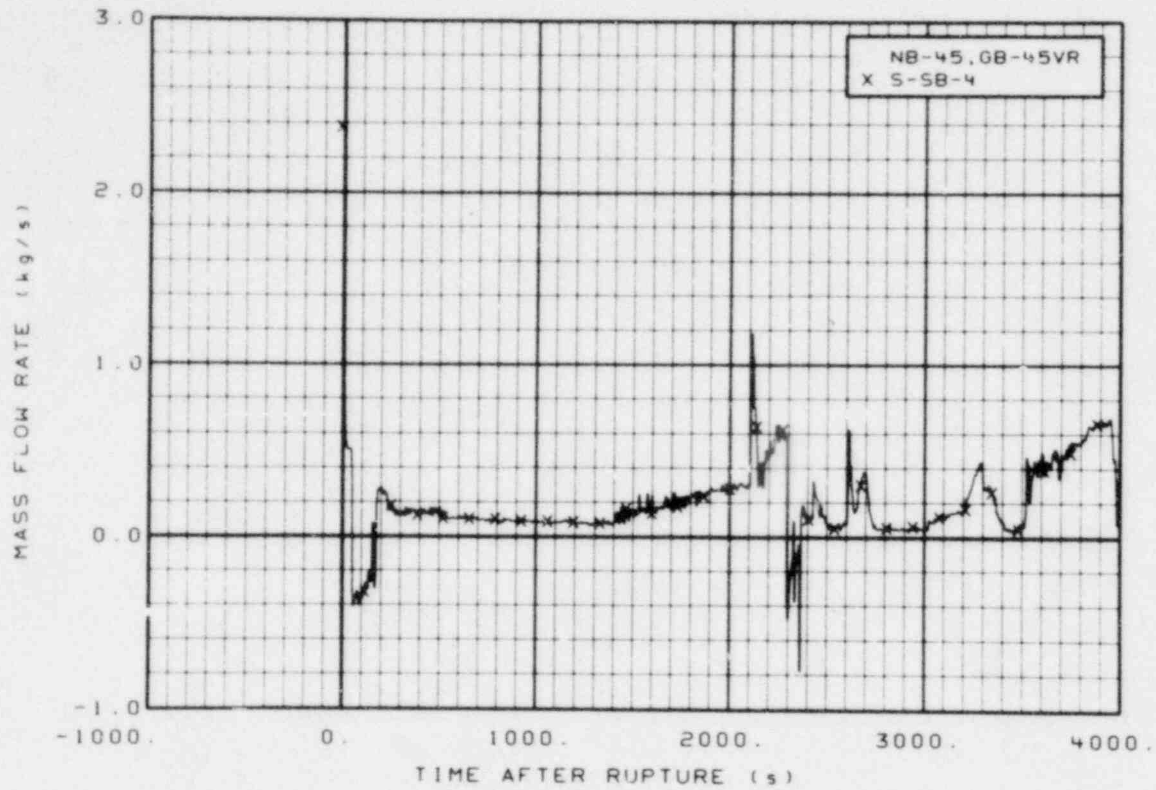


Figure 625. Mass flow in broken loop cold leg, Test S-SB-4 (NB-45 and GB-45VR), from -20 to 4000 s.

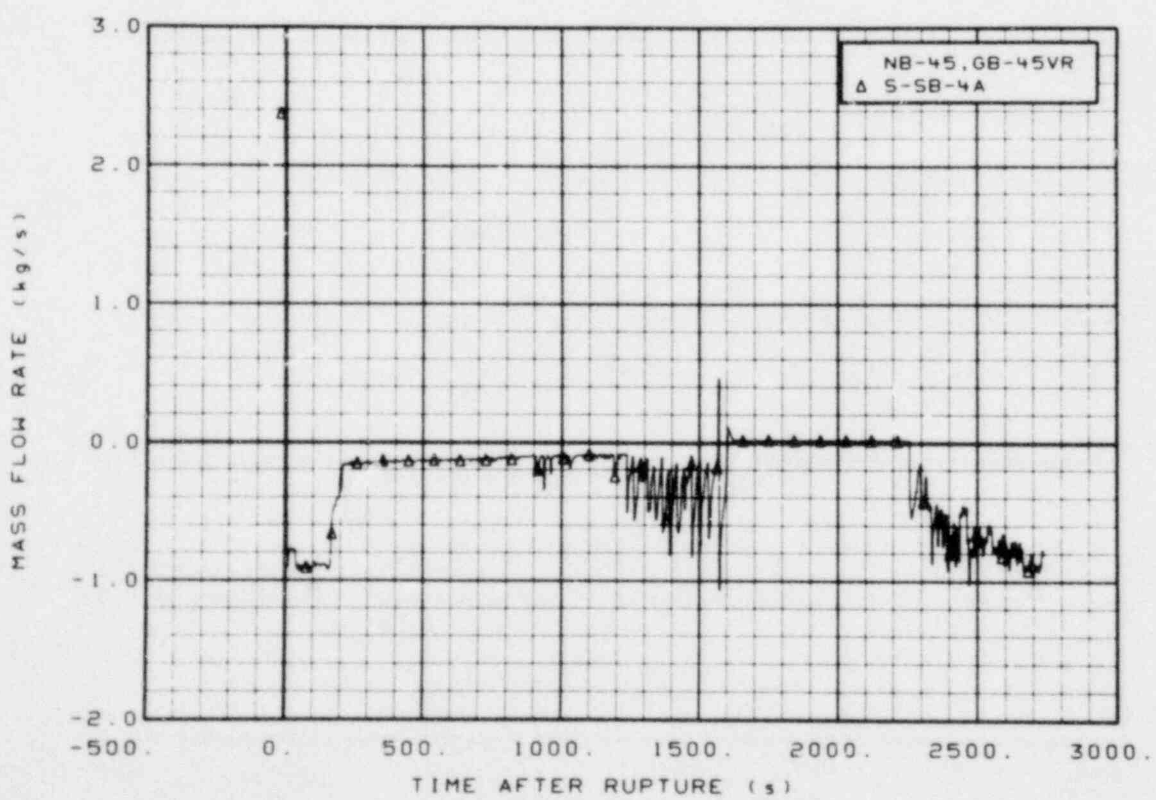


Figure 626. Mass flow in broken loop cold leg, Test S-SB-4A (NB-45 and GB-45VR), from -20 to 2740 s.

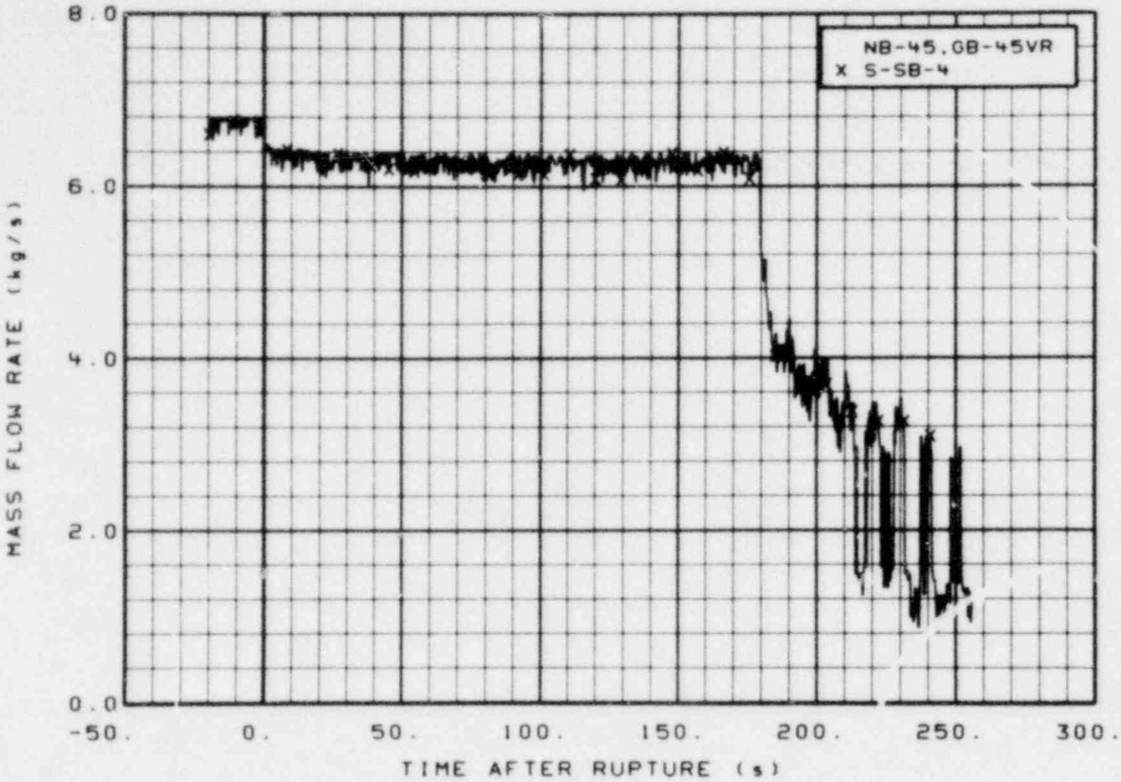


Figure 627. Mass flow in broken loop cold leg, Test S-SB-4 (NB-45 and GB-45VR), from -20 to 256 s.

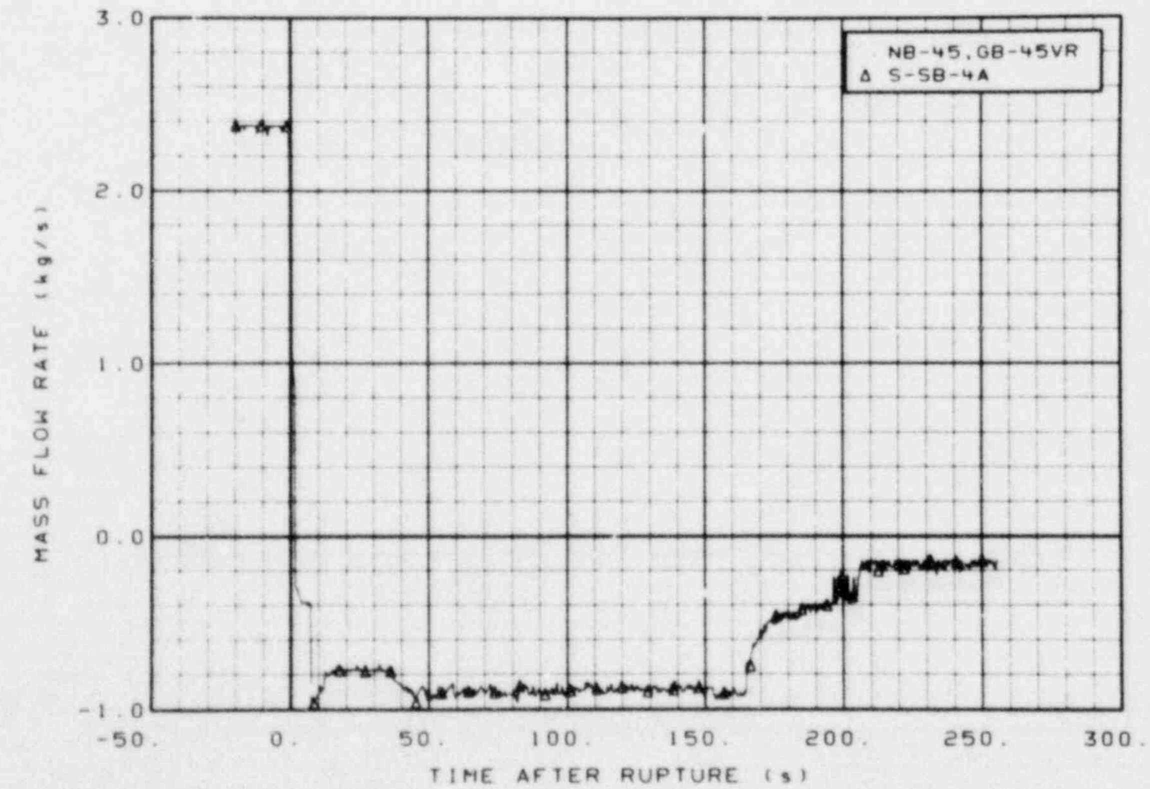


Figure 628. Mass flow in broken loop cold leg, Test S-SB-4A (NB-45 and GB-45VR), from -20 to 256 s.

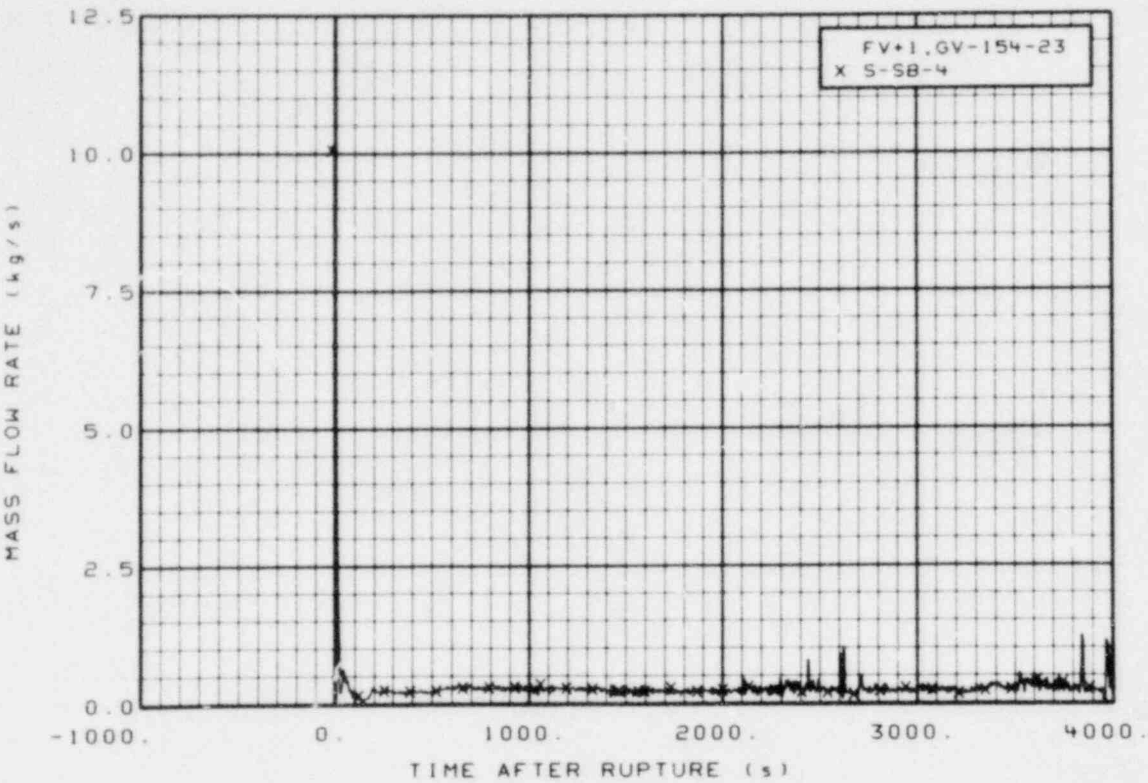


Figure 629. Mass flow in vessel, Test S-SB-4 (FV + 1 and GV-154-23), from -20 to 4000 s.

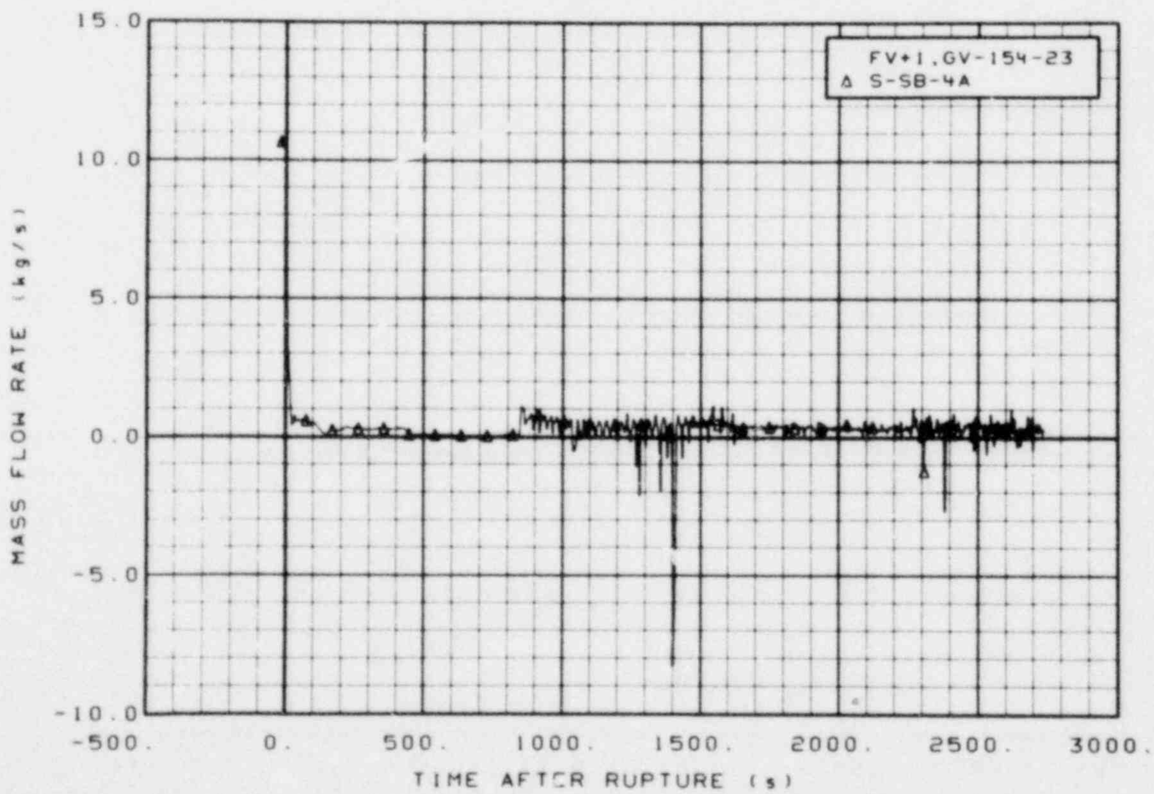


Figure 630. Mass flow in vessel, Test S-SB-4A (FV + 1 and GV-154-23), from -20 to 2740 s.

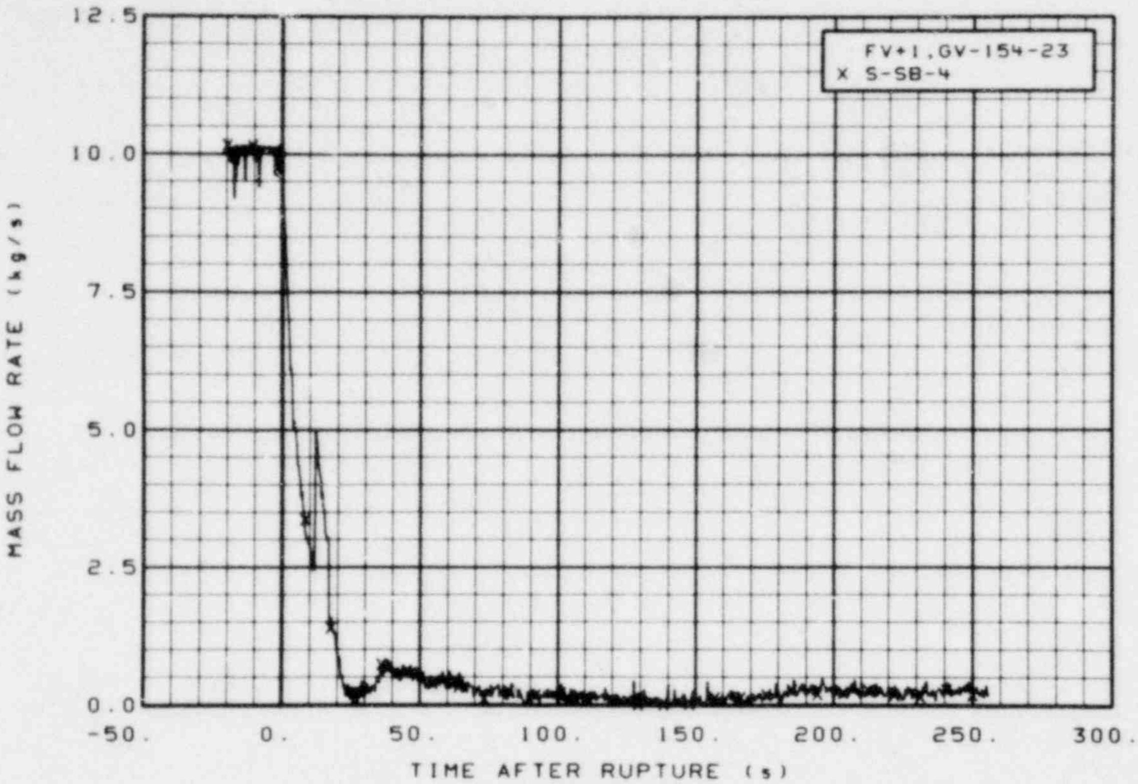


Figure 631. Mass flow in vessel, Test S-SB-4 (FV + 1 and GV-154-23), from -20 to 256 s.

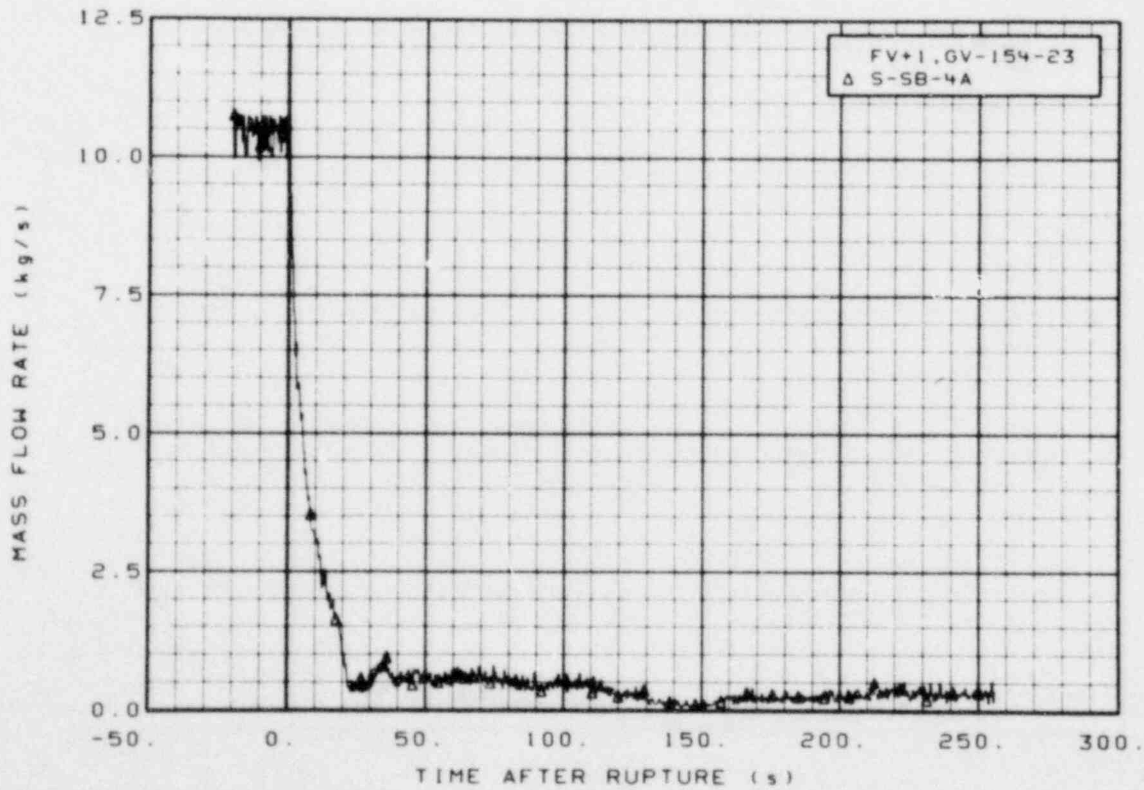


Figure 632. Mass flow in vessel, Test S-SB-4A (FV + 1 and GV-154-23), from -20 to 256 s.

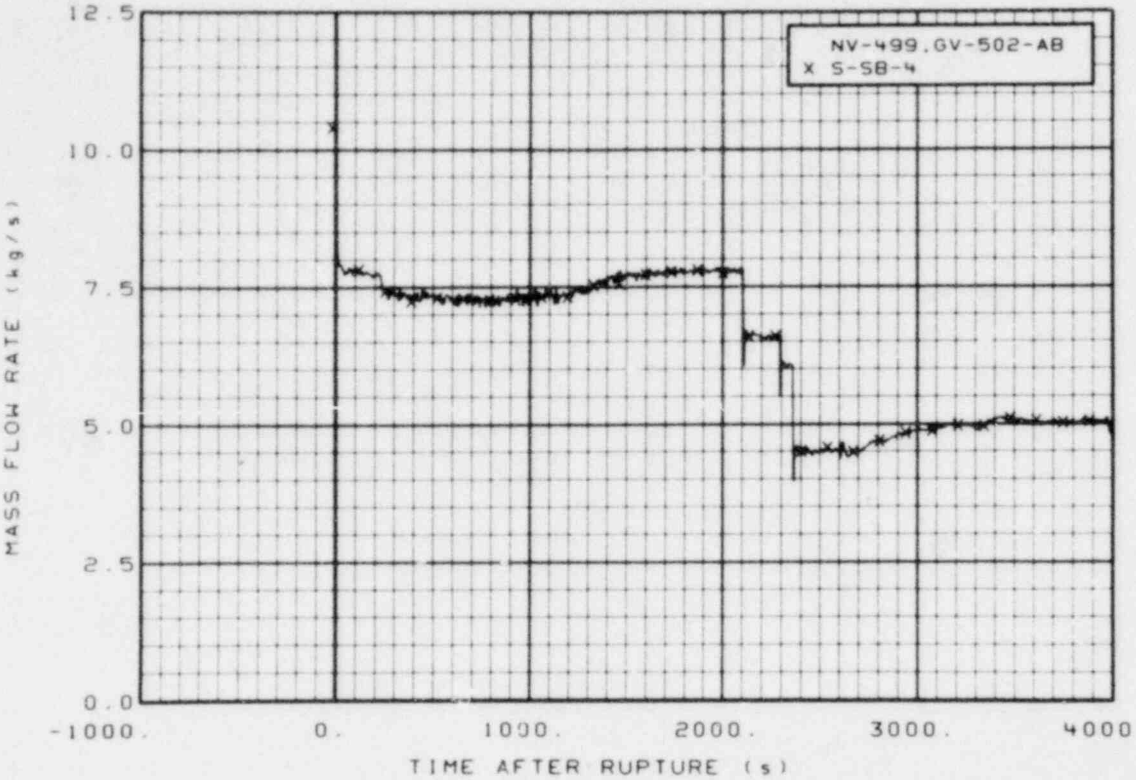


Figure 633. Mass flow in vessel, Test S-SB-4 (NV-499 and GV-502-AB), from -20 to 4000 s.

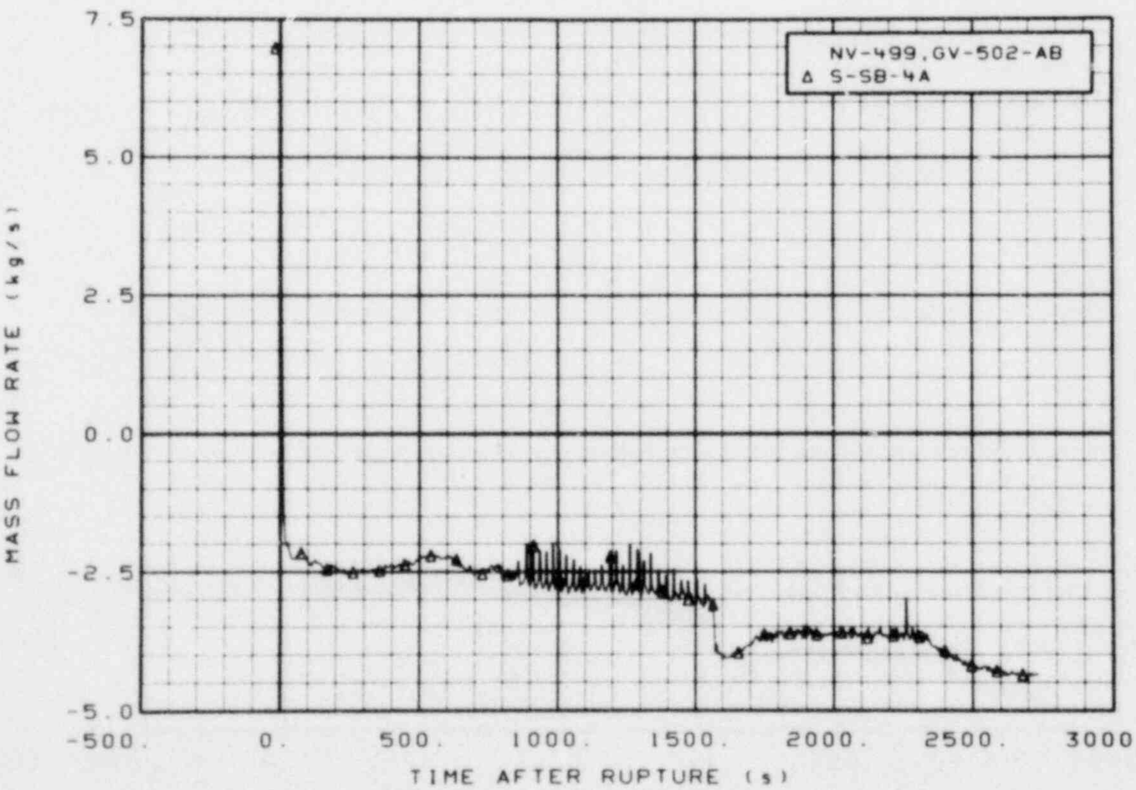


Figure 634. Mass flow in vessel, Test S-SB-4A (NV-499 and GV-502-AB), from -20 to 2740 s.

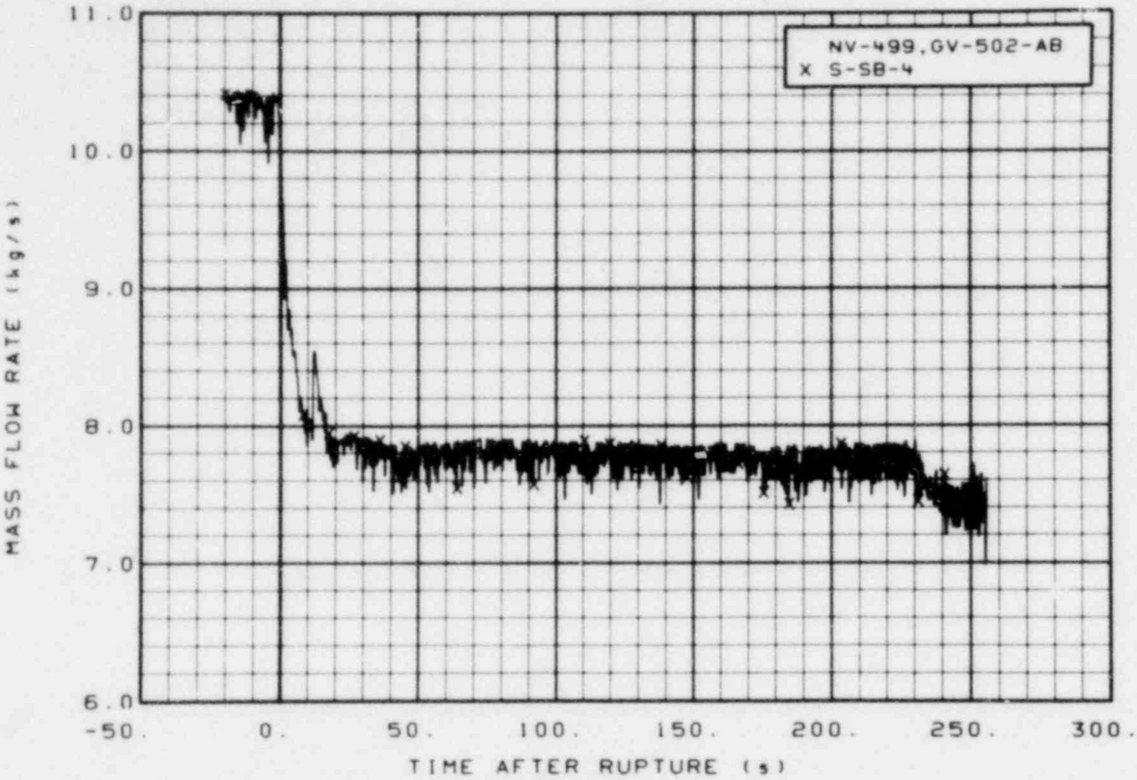


Figure 635. Mass flow in vessel, Test S-SB-4 (NV-499 and GV-502-AB), from -20 to 256 s.

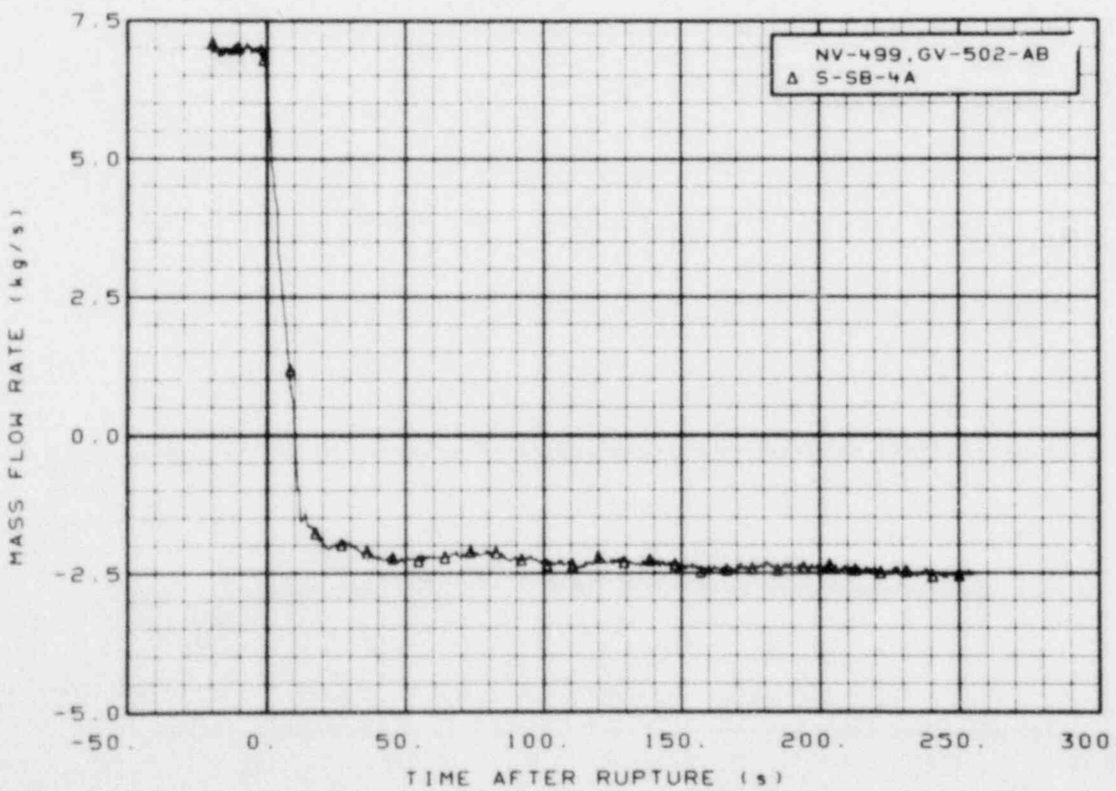


Figure 636. Mass flow in vessel, Test S-SB-4A (NV-499 and GV-502-AB), from -20 to 256 s.

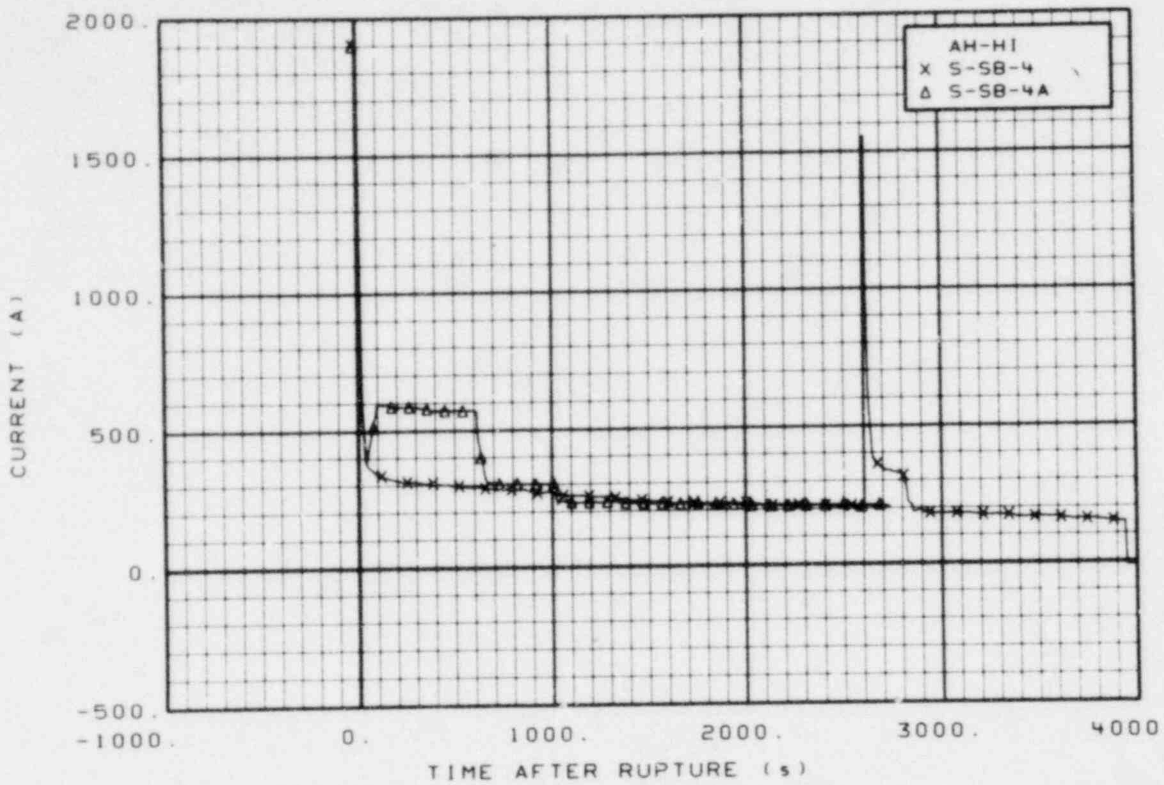


Figure 637. Core heater high power bus amperage (AH-HI), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

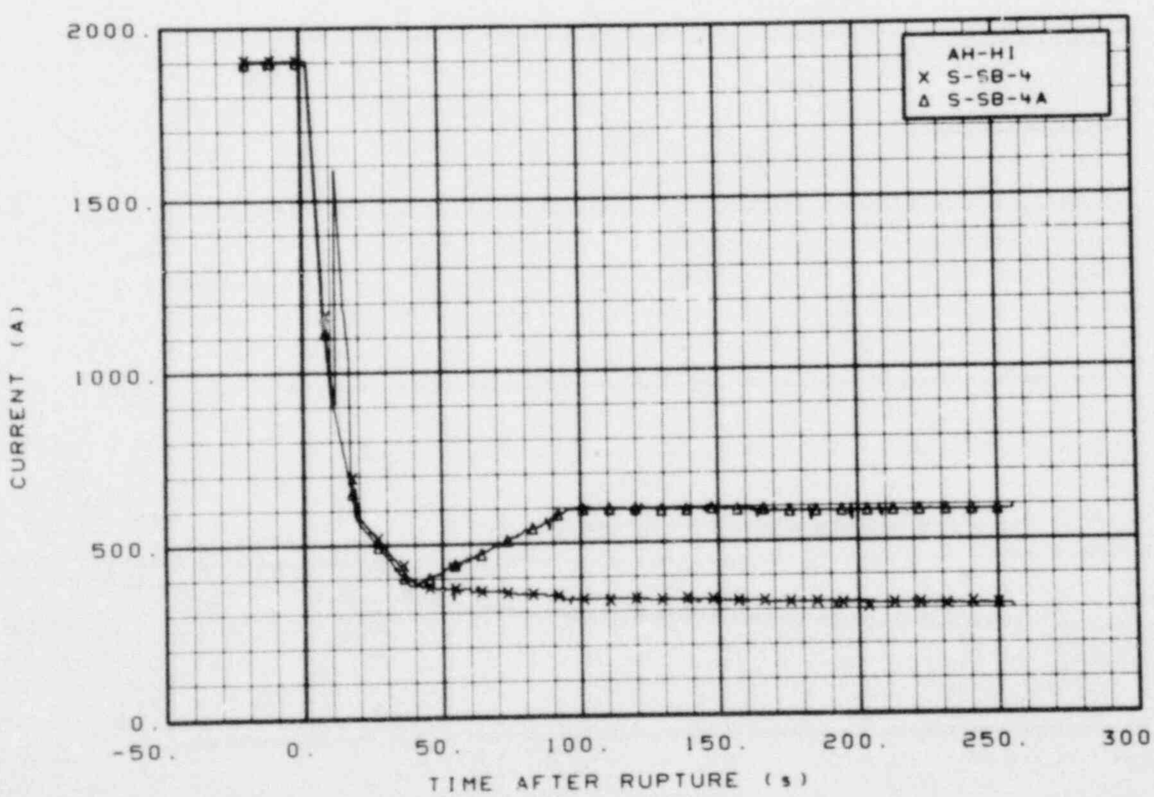


Figure 638. Core heater high power bus amperage (AH-HI), from -20 to 256 s.

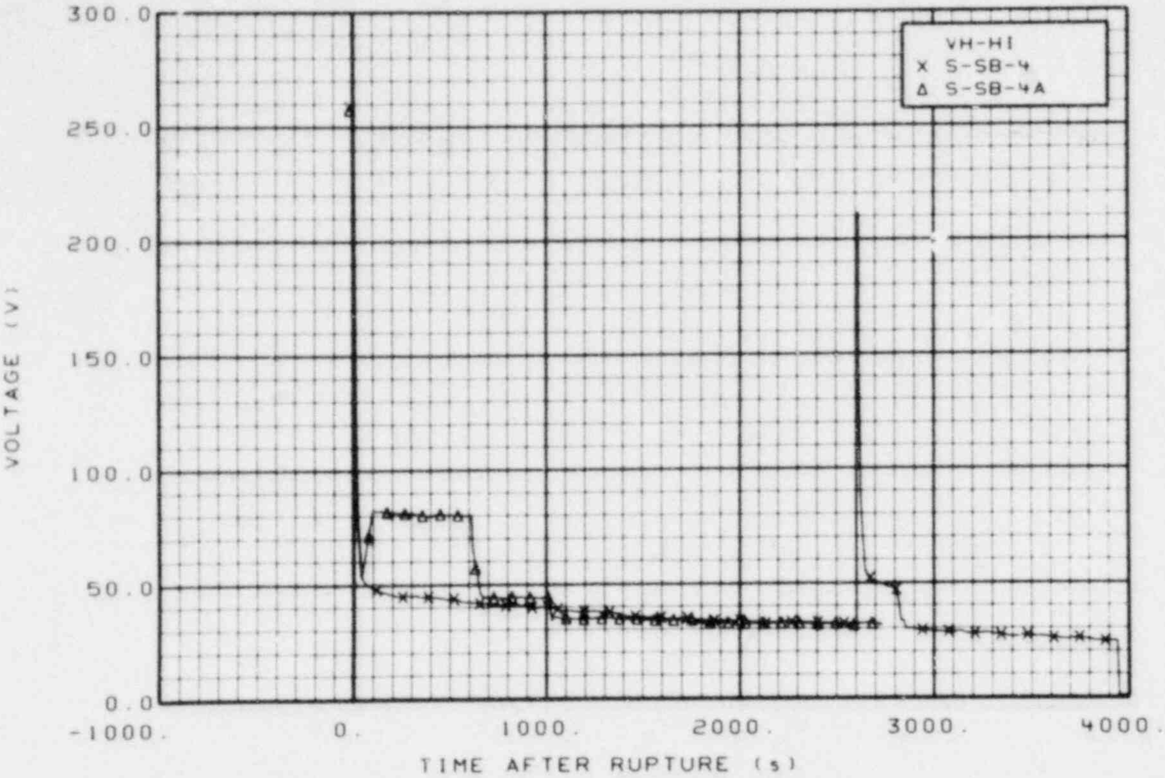


Figure 639. Core heater high power bus voltage (VH-HI), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

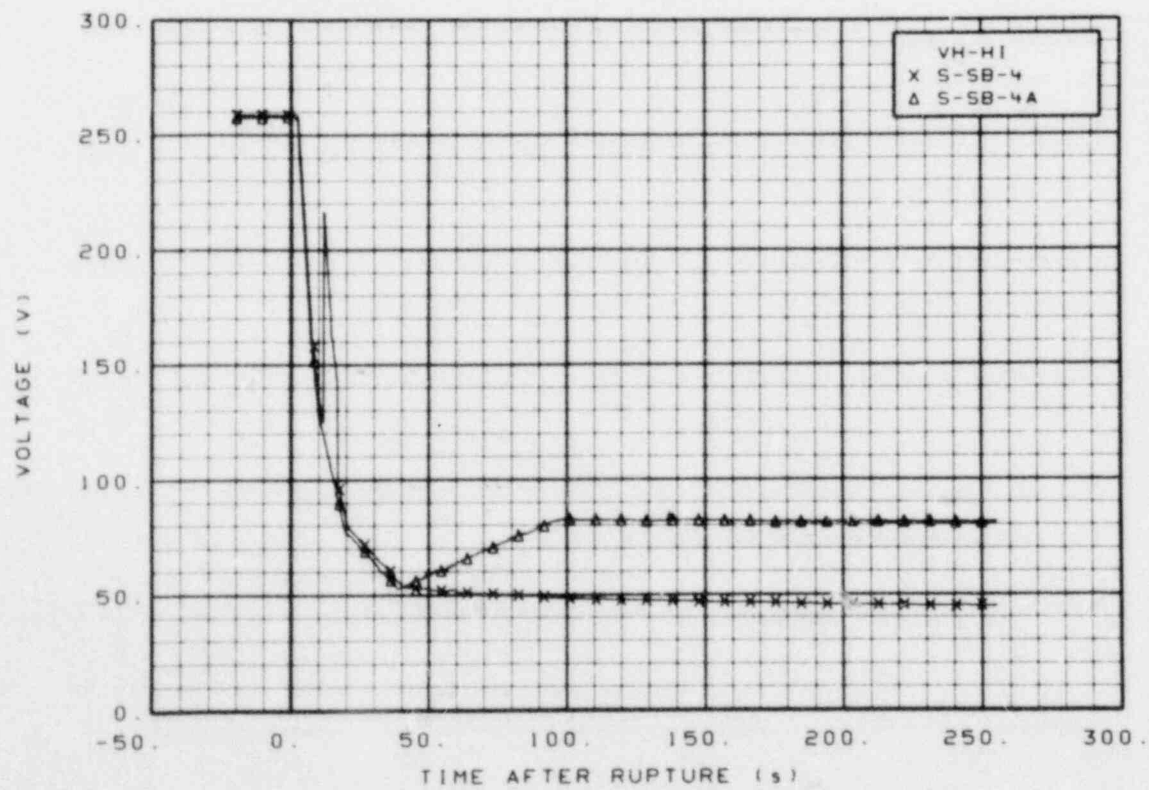


Figure 640. Core heater high power bus voltage (VH-HI), from -20 to 256 s.

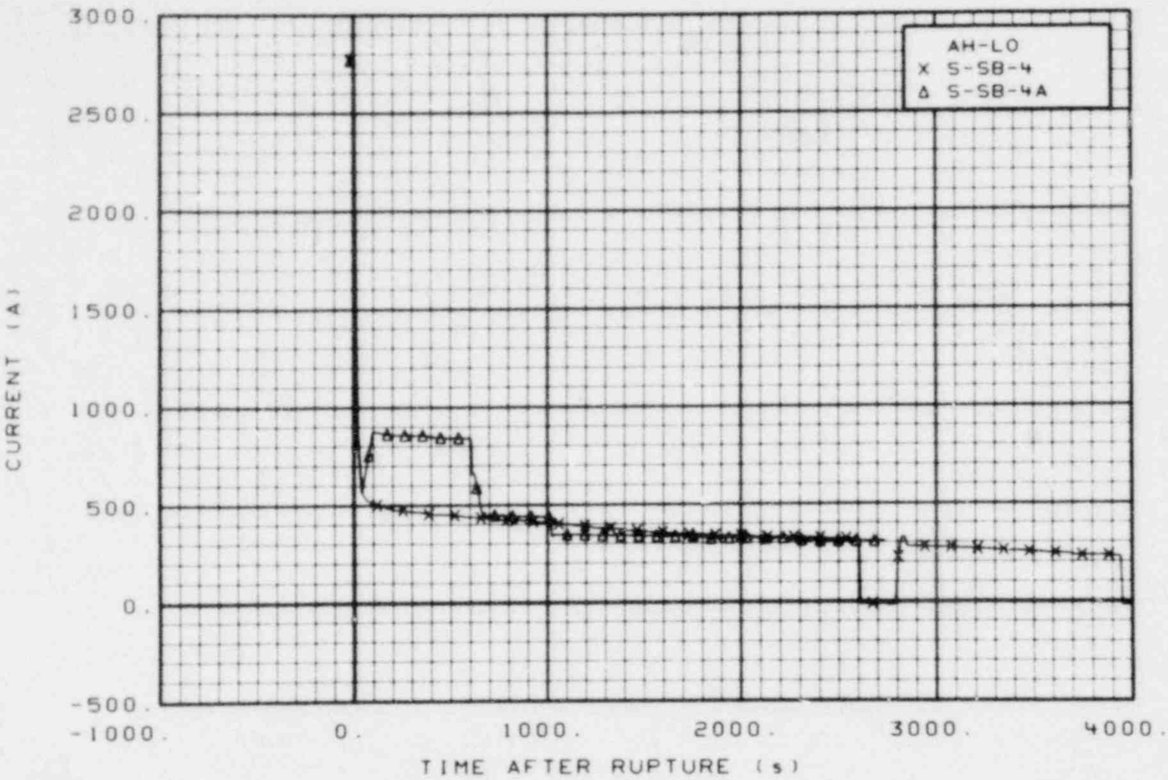


Figure 641. Core heater low power bus amperage (AH-LO), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

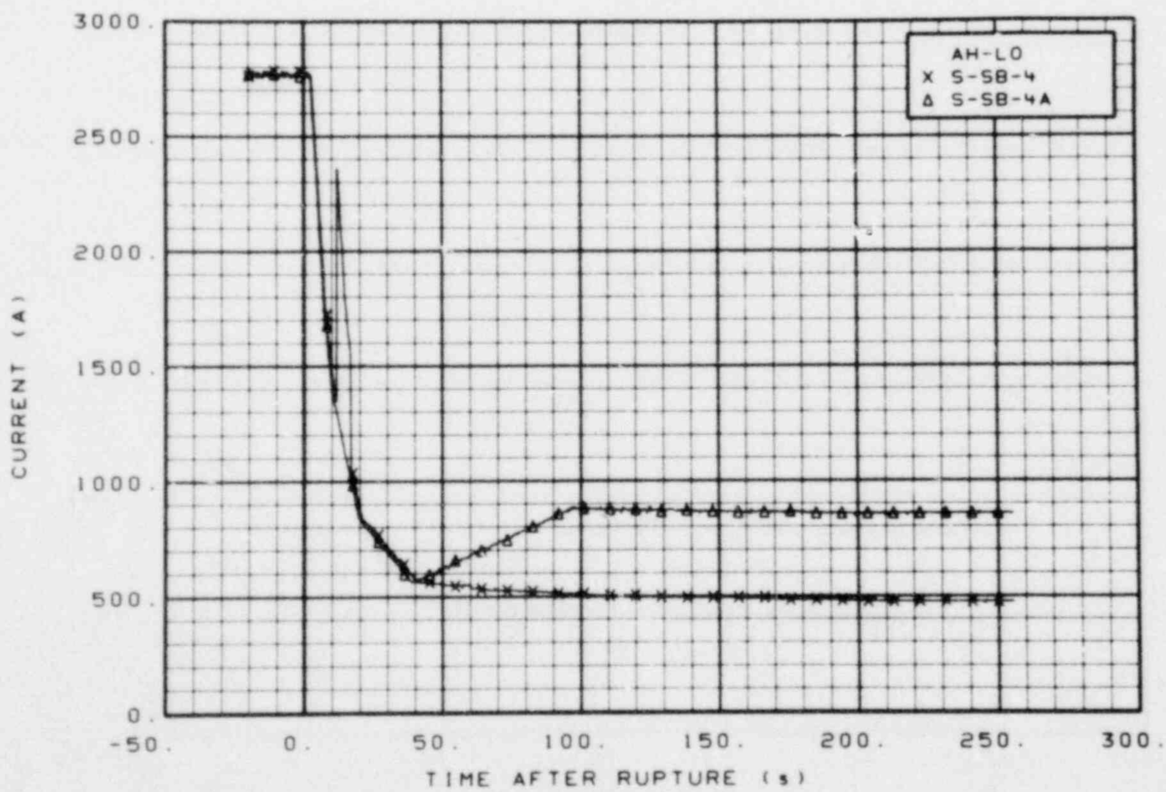


Figure 642. Core heater low power bus amperage (AH-LO), from -20 to 256 s.

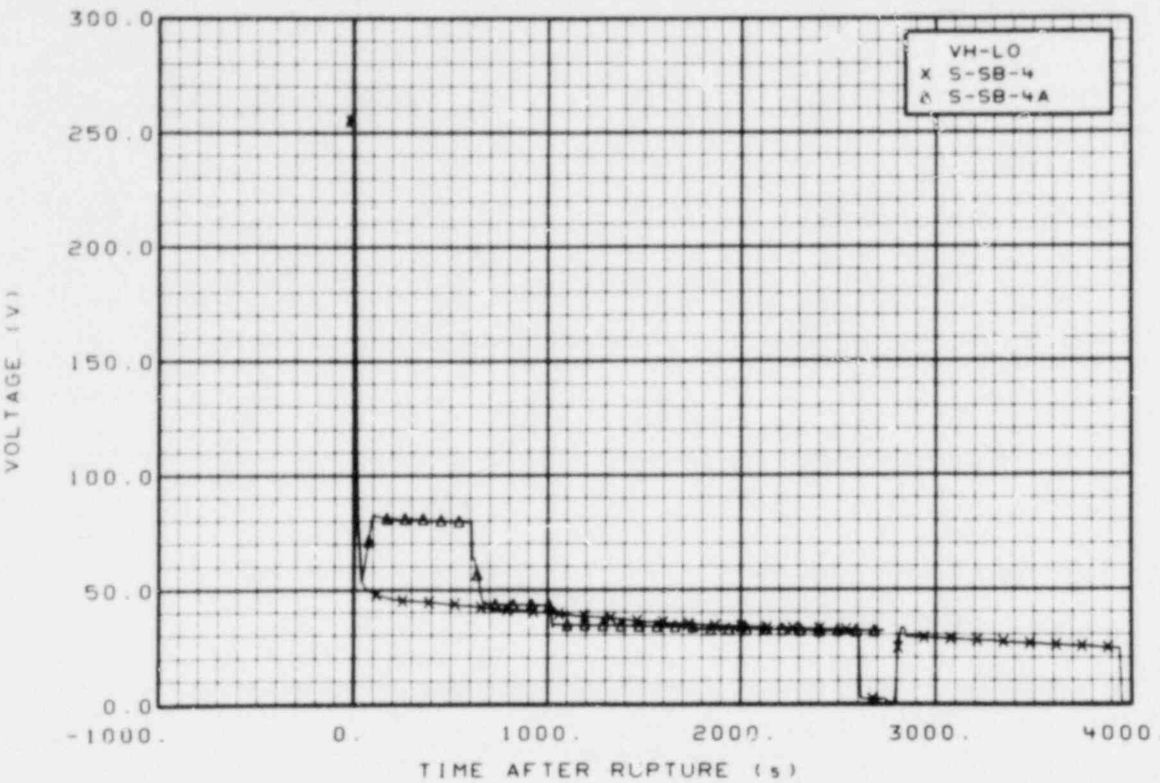


Figure 643. Core heater low power bus voltage (VH-LO), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

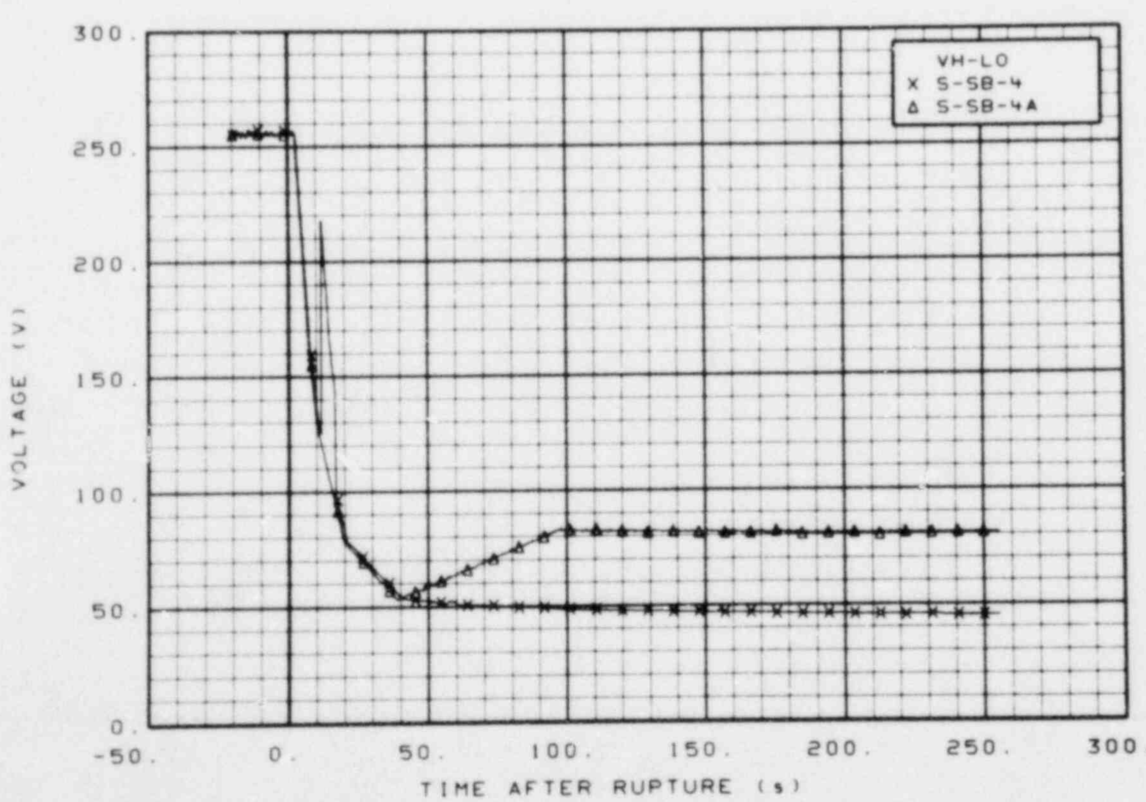


Figure 644. Core heater low power bus voltage (VH-LO), from -20 to 256 s.

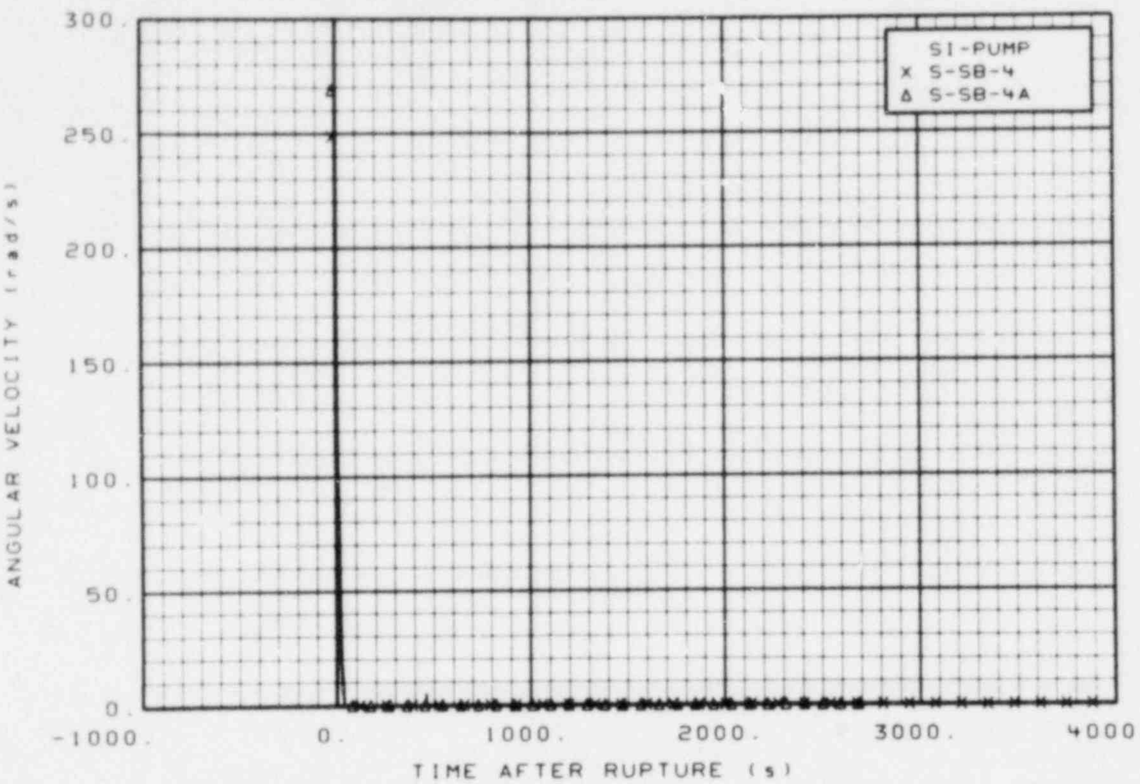


Figure 645. Intact loop pump speed (SI-PUMP), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

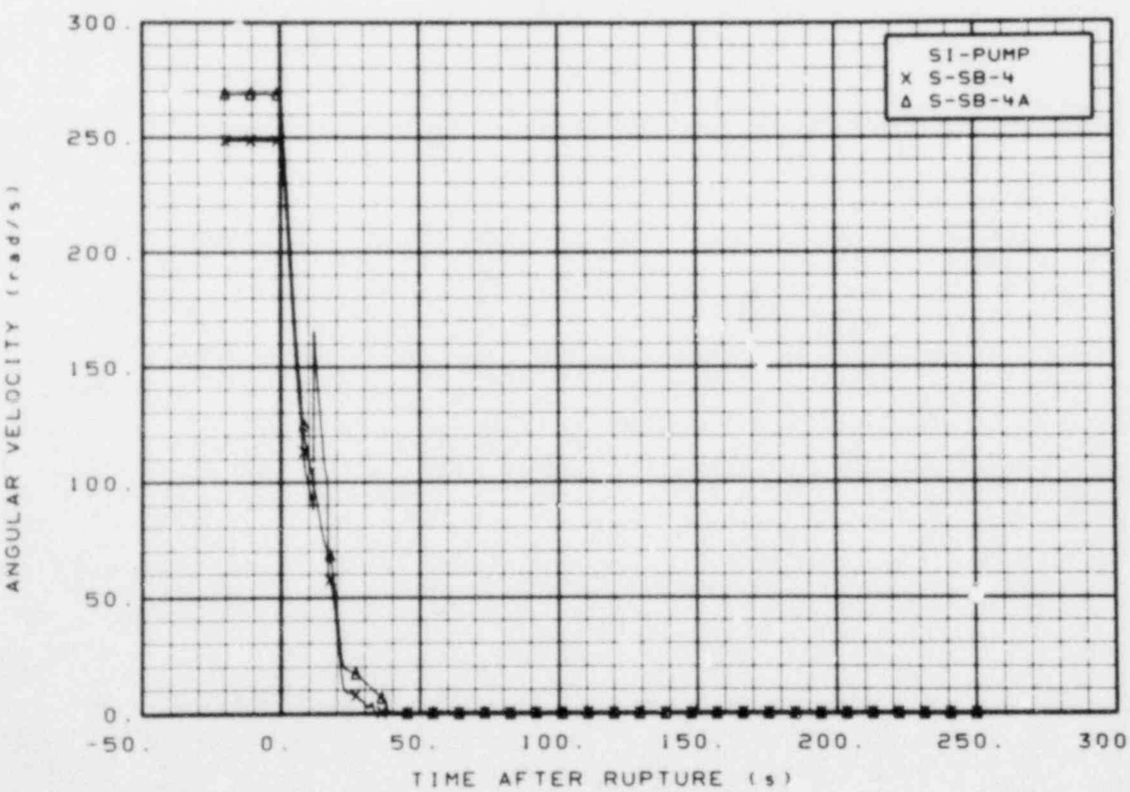


Figure 646. Intact loop pump speed (SI-PUMP), from -20 to 256 s.

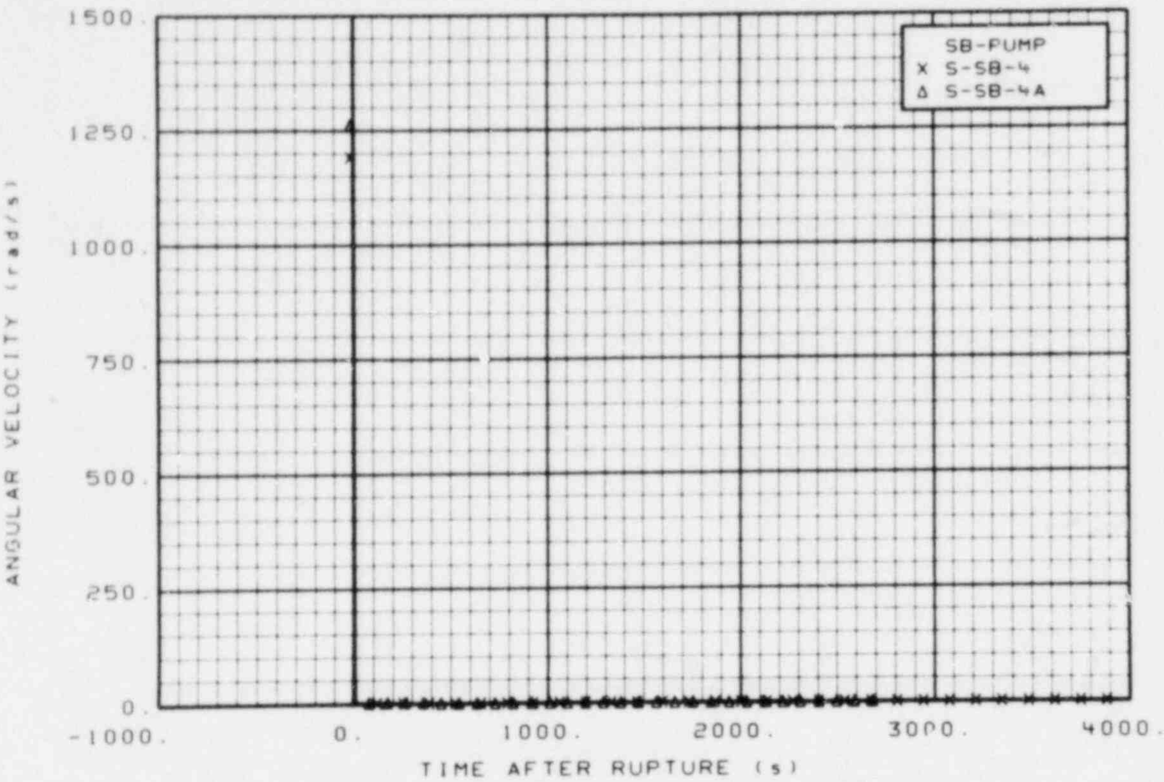


Figure 647. Broken loop pump speed (SB-PUMP), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

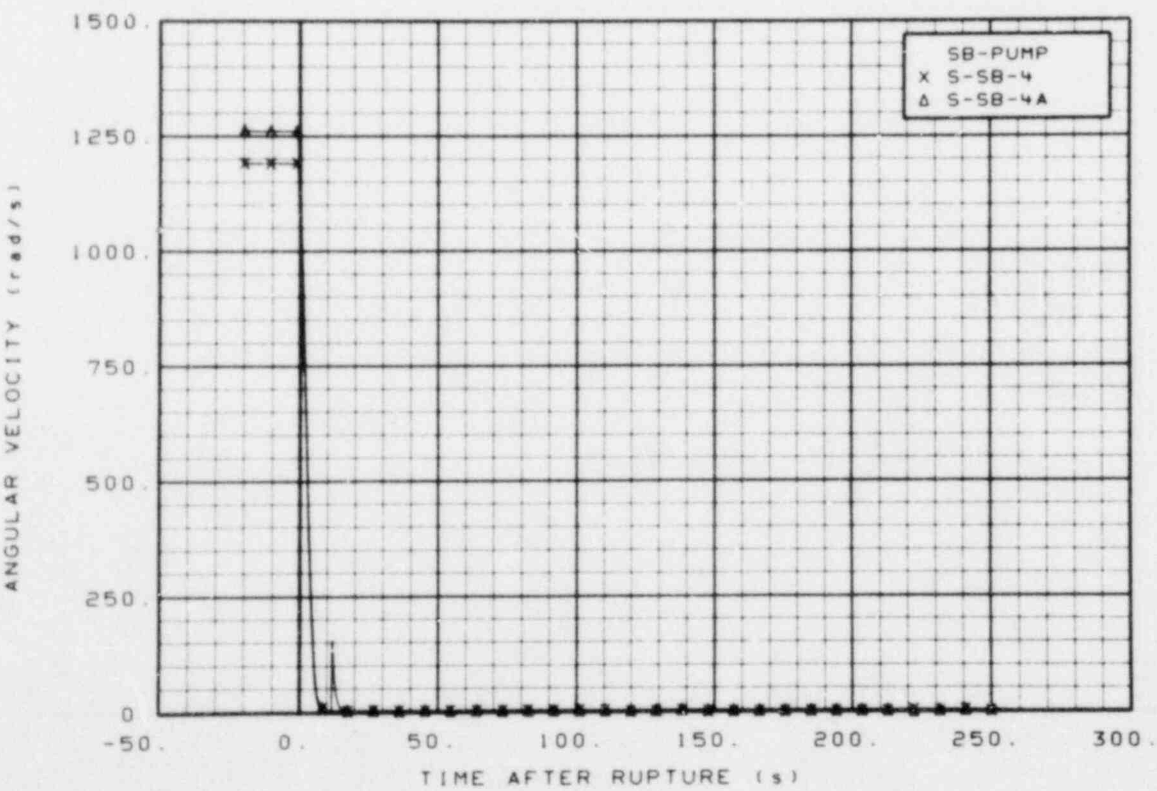


Figure 648. Broken loop pump speed (SB-PUMP), from -20 to 256 s.

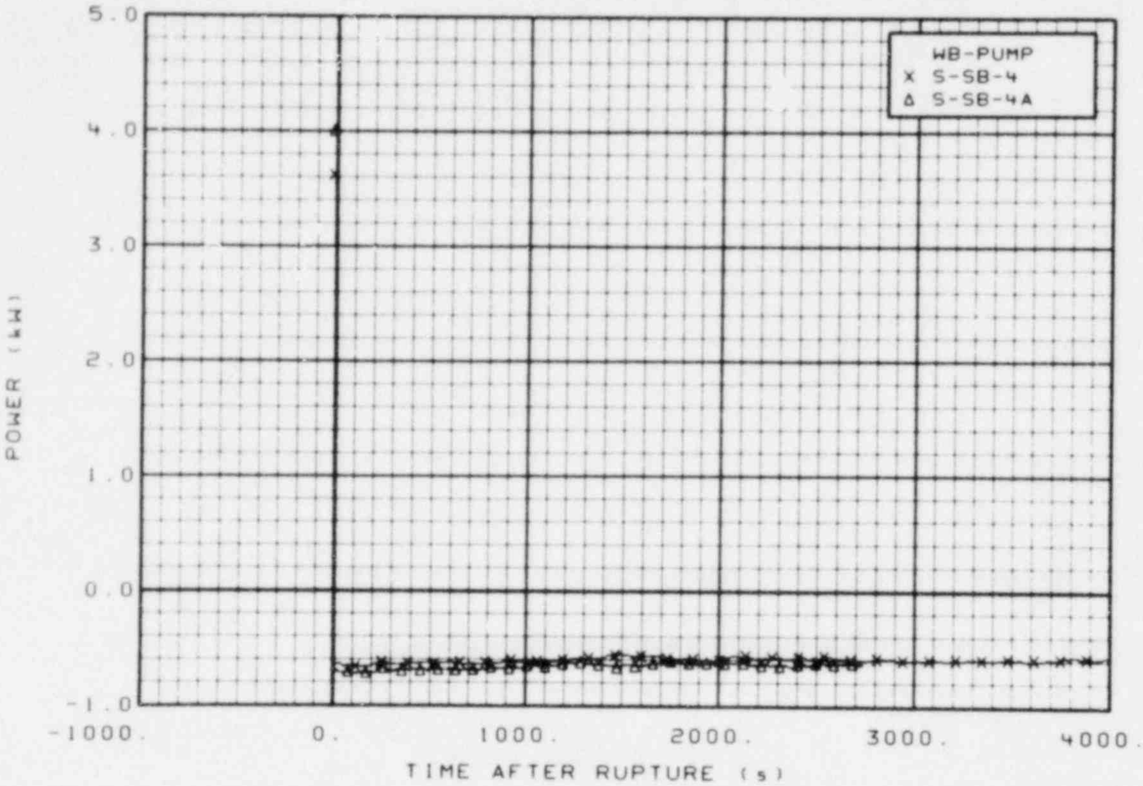


Figure 649. Broken loop pump power (WB-PUMP), from -20 to 4000 s (to 2740 s for Test S-SB-4A).

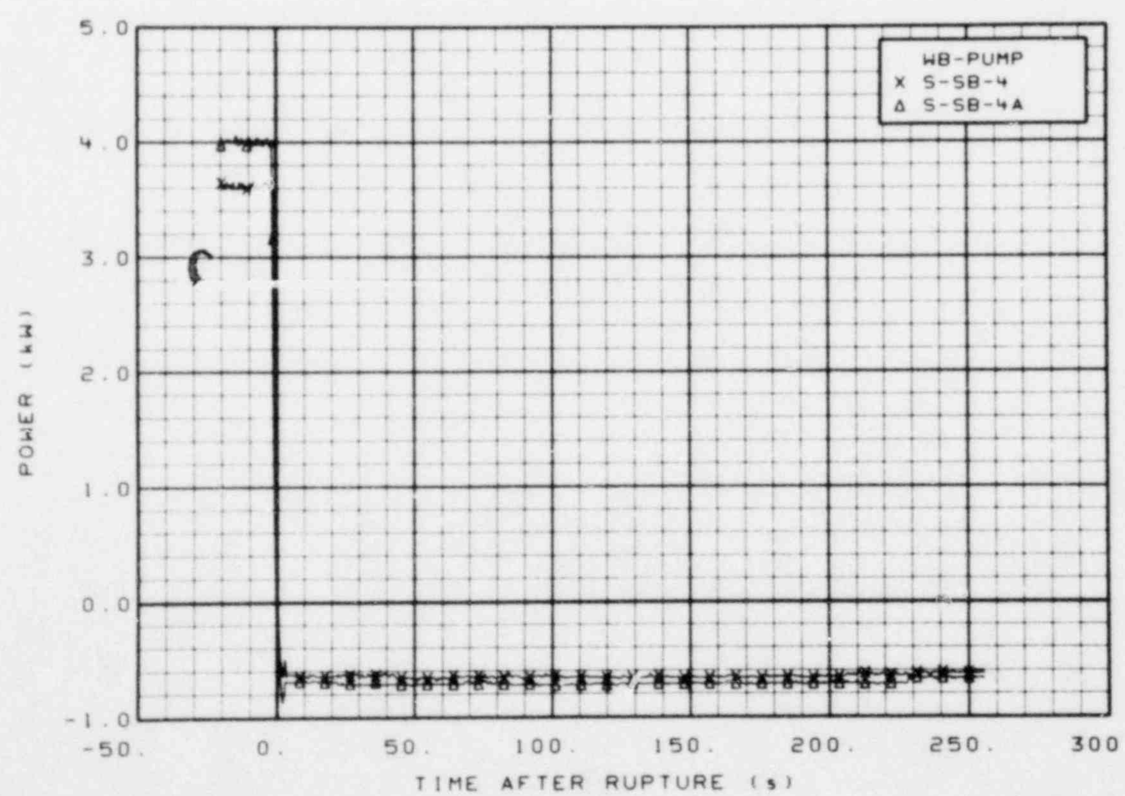


Figure 650. Broken loop pump power (WB-PUMP), from -20 to 256 s.

IV. REFERENCES

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

2. M. L. Patton, *Semiscale Mod-3 Test Program and System Description*, NUREG/CR-0239, TREE-NUREG-1212, July 1978.

APPENDIX A

DATA ACQUISITION SYSTEM CAPABILITIES

APPENDIX A

DATA ACQUISITION SYSTEM CAPABILITIES

The Semiscale Mod-3 system provides for the acquisition, processing, and presentation of test data. The test data system comprises detectors, signal conditioners, signal processors, and recording and display equipment. The data obtained are principally recorded on an on-line digital system. Selected data channels are also recorded on an analog system.

The on-line digital system is called the digital data acquisition and processing system (DDAPS). The DDAPS has dual and single speed capabilities with identical storage and data output limitations. The dual speed mode is used to extend the recording time when obtaining high-frequency data.

From each of up to 240 data channels, the test data system stores 20 blocks of data. Each block of data contains 920 words (each word is the abscissa and ordinate of a data point) of digital information. These 920 words represent a fixed storage display.

The maximum measured throughput rate for the system is 24 000 words per second. This throughput rate can be reduced in increments of 100 words per second. The throughput rate, the number of data channels recorded, and the fixed display of 920 points per block determine the time base for displaying the data.

After the data have been stored, data reduction can be made for presentation and analysis purposes. Because of hardware limitations and aesthetic considerations of data presentation, only certain time bases are used when the data are reduced. For data displayed from -20 to 4396 s, the recorded data are made to occupy a 4416-s span yielding an uncompressed time base of 276 s.

Generally, 920 points from a given data channel are displayed in the nominal time base of 276 s. Integral (1 to 20) multiples of 276 s may be used as variations on the nominal time base. Because the output is fixed at 920 points, data compression is accomplished by averaging adjacent data points to give the desired compression.

APPENDIX B

POSTTEST ADJUSTMENTS TO DATA FROM SEMISCALE MOD-3 TESTS S-SB-4 AND S-SB-4A

APPENDIX B

POSTTEST ADJUSTMENTS TO DATA FROM SEMISCALE MOD-3 TESTS S-SB-4 AND S-SB-4A

Many of the transducers used in the Semiscale Mod-3 system exhibit significant sensitivity to one or more spurious inputs. Strain gage bridge circuits used in pressure transducers, differential pressure transducers, and drag discs are sensitive to changes in ambient temperature. Differential pressure cells are also sensitive to changes in system pressure. Photomultiplier tubes used as gamma-ray detectors in the density transducers are sensitive to temperature changes, as well as to random variations in the locations of the radiation sources. Core power measurements depend on a calibrated resistor, whose resistance changes in value as a function of time and power level as it heats up.

Although the uncertainties introduced into the data by spurious secondary inputs generally do not exceed the specified uncertainty ranges of the transducers, significant improvement in measurement accuracy can be achieved if the secondary sensitivity can be identified and removed. Since the exact values of the spurious inputs to which different transducers might be sensitive cannot often be easily predicted and are sometimes inconvenient to measure, secondary effects have been accounted for by correcting the data after the test rather than by using elaborate real time programs in the data acquisition system computer. The methods and results of the posttest data correction analysis for Tests S-SB-4 and S-SB-4A are presented in the following paragraphs and tables.

Differential Pressure Measurements

Pressure sensitivity in the differential pressure cells in the main system loop is determined from the pretest system pressure check. Digital data are recorded for all measurements at ambient temperature, with no flow, and a continually increasing system pressure from 0.7 to 15.5 MPa. The output of the differential pressure cell is plotted against system pressure, with the resulting plots used to describe the pressure response of the transducer.

Corrections to differential pressure data were made using the following equation:

$$F'(t) = F(t) + P_1\, P(t) \qquad \text{(B-1)}$$

where

$F'(t)$ = corrected data, kPa

$F(t)$ = raw data (kPa)

P_1 = pressure sensitivity (kPa/MPa)

$P(t)$ = pressure data from indicated transducer used for pressure correction sensitivity (MPa).

Density Measurements

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

$$\rho = C_o + C_1\, F(t) \qquad \text{(B-2)}$$

where

ρ = the density (kg/m^3)

C_o = offset (kg/m^3)

C_1 = conversion factor (kg/m^3)/v

$F(t)$ = transducer output (v).

Constants C_o and C_1 are adjusted to match the final data to density values calculated from measured pressure and temperature values at the preblowdown and postdrain conditions, effectively giving the data an in-place calibration. These calculations are made in the Mod-3 system prior to initial data release and are not considered posttest adjustments.

Some density measurements are obtained using a two-beam gamma densitometer which operates on the same basic principle of gamma attenuation as does the single-beam gamma densitometer. Each beam originates from the same gamma source and is allowed to pass through separate portions of the piping cross-sectional flow area to obtain an average density measurement in that particular region. The geometrical relationship of the gamma beam path through the piping and geometrically related variables used for processing of data from a two-beam gamma densitometer are shown in Figure B-1. The average density measured by each individual gamma beam is obtained using the same equation as is used for the single-beam densitometers.

In the Semiscale Mod-3 system, two-beam gamma densitometers provide information which allows the calculation of a better average density than that obtained from a single beam in a horizontal pipe. A mathematical model is used for processing the two-beam data to obtain the improved average density information. The processing method used is based on a froth-water model coupled with information from the two individual gamma beams and related beam path and piping cross-sectional geometry. The resulting information is recorded and reported under the density measurement identification ending with a "C", for example, GI-17C.

The use of the froth-water model for obtaining average density from a two-beam gamma densitometer in a horizontal pipe is based on observations indicating that flow regimes in the Semiscale Mod-3 system can be modeled by a layer of water on the bottom of the pipe with a degree of froth on the surface. For homogeneous flow conditions, such as all froth or all liquid, the model remains valid. At any point in time slug flow is also modeled. The froth-water model does not model annular or inverted annular flows very well. However, these flows are not expected to exist for significant portions of a Semiscale Mod-3 system blowdown in horizontal piping. Density gradients from the top to the bottom of the pipe may exist showing no distinct location change from water to froth. This flow is neither totally homogeneous nor stratified, but the froth-water model does provide an adequate approximation of the average density characteristic of this flow pattern.

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

$$\bar{\rho} = \alpha_f \rho_1 + (1 - \alpha_f) \rho_w \text{ kg/m}^3 \qquad \text{(B-3)}$$

where

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

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

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

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

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

$$\beta = 2 \cos^{-1} (1 - 2h) \qquad \text{(B-4)}$$

where

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

where

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

D = piping inside diameter

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

Average density is not calculated using the two-beam froth-water model when the angle is not favorable due to system hardware restrictions in positioning the source. The froth-water model requires separate density sampling in both the upper and lower portions of the piping cross section.

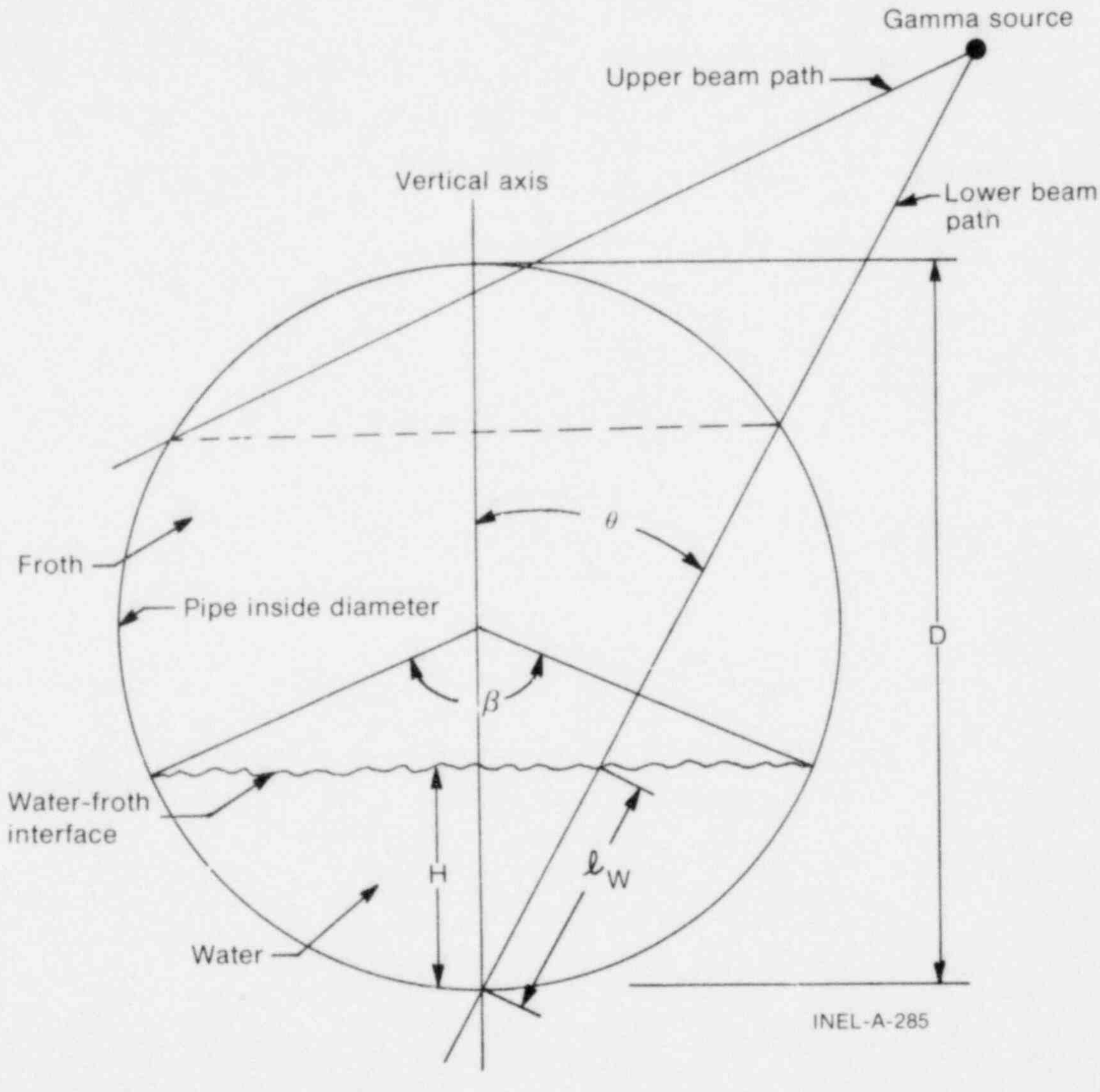


Figure B-1. Geometry used for processing of density data obtained from two-beam gamma densitometers.

APPENDIX C

SELECTED DATA WITH ESTIMATED TOTAL UNCERTAINTY BANDS FROM SEMISCALE MOD-3 TESTS S-SB-4 AND S-SB-4A

APPENDIX C

SELECTED DATA WITH ESTIMATED TOTAL UNCERTAINTY BANDS FROM SEMISCALE MOD-3 TESTS S-SB-4 AND S-SB-4A

Analysis has been performed on selected data from tests to provide a guide to the uncertainty associated with data measurements in the Semiscale Mod-3 system. The end result of the analysis is presented as uncertainty bands about the measured data which represent a 95% confidence level.

The uncertainty bands are obtained by combining uncertainties obtained from analysis of the data itself (random uncertainty) and engineering analysis of the measurement system (engineering uncertainty). The procedure by which uncertainty bands were established for the data presented in this appendix is described in the following paragraphs.

The data trace under analysis was empirically fitted with a linear difference equation, which was subject to a white noise input at each sampling time point. The objective of the empirical fitting procedure was to characterize the white noise, which was taken to represent the random uncertainty. The procedures for fitting the difference equation are discussed in depth in Reference C-1. A data trace was often segmented, and different equations were fitted to each segment with statistical correlations between successive observations accounted for by the fitting procedure. The white noise input was assumed to arise from a normally distributed population. The standard deviation of the white noise, as found during the fitting procedures, was taken as an estimate of the random uncertainty standard deviation and is shown in Table C-1 in appropriate engineering units. (Tables are presented consecutively starting on page 365.) The traces of the uncertainty band analysis are shown in Figures C-1 through C-66. (Figures are presented consecutively starting on page 377.)

Other uncertainties in the data exist because of such factors as variability in installation procedures and techniques, calibration uncertainties, variability in materials, and temperature and pressure sensitivities. These uncertainties and the procedures for estimating them are discussed in Reference C-2. They are referred to as engineering uncertainties, and the estimates are largely subjective. Because of the continuing effort to improve the accuracy of the measured data, such as through the use of better transducers, better signal conditioning and processing equipment, and better calibration and installation techniques, the engineering uncertainties for data from most of the transducer systems have changed from those published in Reference C-2. Table C-2 provides a summary of engineering uncertainty values obtained from current analysis techniques as applied to the data presented herein.

In addition to the normal hardware and installation related sources of engineering uncertainty, a significant measurement uncertainty results when the current transducer systems are subjected to separated two-phase flow regimes during the course of the blowdown transient. Accordingly, for those data affected (fluid density, volumetric flow, and mass flow), which are presented in this appendix, a more extensive assessment was conducted of additional engineering uncertainty due to flow regime effects. Table C-3 identifies the data analyzed and the period in the blowdown process for which flow regime uncertainties were included as a part of the total engineering uncertainty. The time of occurrence of separated two-phase flow and the resulting effect on the uncertainty of the data were evaluated by considering, on an individual basis, each detector output with reference to indications by other auxiliary measurements.

The gamma densitometer density measurement data are affected by two-phase separated flow regimes. The resulting transducer output is a measurement of the average attenuation of the gamma beam through the measured medium. The beam attenuation, in turn, is interpreted through physical relationship to be a measure of the average density along the beam path. When stratified type flow was considered present, the gamma beam attenuation was considered to be a result of a liquid layer and steam at system conditions.

The flow regime uncertainties of the turbine flowmeter were estimated by calculating a void fraction and the cross-sectional liquid and steam flow area for stratified flow. This calculation was accomplished using methods similar to those used to calculate the average density for stratified flows. A simple model was used to equate the forces on the turbine with the assumption of a known void fraction, stratified flow, known component densities, and slip ratio greater than unity. This process provided phase velocities. With the phase densities, velocities, and void fraction, a volumetric flow rate could be calculated. The difference between this value and the measured value was considered to be the uncertainty.

The overall standard deviation of a data point is taken as the root of the sum of the random uncertainty variance and the total engineering uncertainty variance; that is,

$$\sigma_o = \sqrt{\sigma_R^2 + \sigma_E^2} \qquad \text{(C-1)}$$

where

σ_o = overall standard deviation of a data point

σ_R^2 = random uncertainty variance

σ_E^2 = engineering uncertainty variance.

The uncertainty bands for the data are computed about the value given by the fitted difference equation y_i at time point i; that is,

$$\text{uncertainty band} = y_i \pm 1.96\sigma_o. \qquad \text{(C-2)}$$

With due regard to the fact that σ_E has been estimated subjectively, the uncertainty band may be interpreted as an approximate 95% confidence interval within which any true value of the measured variable is consistent with the data.

On certain occasions, the symmetrical uncertainty band given by Equation (C-2) is not appropriate. On those occasions, asymmetrical uncertainty bands were computed; that is, with the width being greater on one side of y_i than on the other.

Finally, the original data trace, along with its uncertainty band from Equation (C-2), was input to a computer plot package. The resulting plot contained the actual data trace surrounded by an uncertainty band derived both from random uncertainty and engineering uncertainty considerations. If thermocouple dryout occurred, the indicated uncertainty bands for the fluid temperature measurements are invalid and should be ignored.

TABLE C-1. RANDOM UNCERTAINTY STANDARD DEVIATION (Tests S-SB-4 and S-SB-4A)

Measurement	Random Uncertainty Standard Deviation	Period Application (s)	Figure	Comments
TFI-1	0.14	-20 to 0	C-1	Test S-SB-4
	0.67	0 to 20		
	0.17	20 to 256		
	0.12	-20 to 0	C-2	Test S-SB-4A
	0.17	0 to 20		
	0.11	20 to 256		
TFB-45	0.085	-20 to 0	C-3	Test S-SB-4
	0.22	0 to 256		
	0.12	-20 to 0	C-4	Test S-SB-4A
	0.18	0 to 155		
	0.71	155 to 180		
	0.25	180 to 256		
TFD-269	0.12	-20 to 0	C-5	Test S-SB-4
	0.20	0 to 256		
	0.088	-20 to 0	C-6	Test S-SB-4A
	0.18	0 to 256		
TFV-572W	0.11	-20 to 0	C-7	Test S-SB-4
	0.10	0 to 256		
	0.17	-20 to 0	C-8	Test S-SB-4A
	0.12	0 to 256		
TFG-7AB-34	0.50	-20 to 0	C-9	Test S-SB-4
	0.89	0 to 40		
	0.21	40 to 256		
	0.25	-20 to 0	C-10	Test S-SB-4A
	0.69	0 to 40		
	0.30	40 to 256		
TMI-1T	0.35	-20 to 0	C-11	Test S-sB-4
	0.13	0 to 256		
	0.096	-20 to 0	C-12	Test S-SB-4A
	0.13	0 to 256		
TMB-45T	0.076	-20 to 0	C-13	Test S-SB-4
	0.11	0 to 60		
	0.12	60 to 190		
	0.087	190 to 256		

TABLE C-1. (continued)

Measurement	Random Uncertainty Standard Deviation	Period Application (s)	Figure	Comments
TMB-45T	0.15	-20 to 0	C-14	Test S-SB-4A
	0.12	0 to 25		
	0.10	25 to 140		
	0.10	140 to 256		
TMD-294	0.10	-20 to 256	C-15	Test S-SB-4
	0.097	-20 to 256	C-16	Test S-SB-4A
TIMD-294	0.36	-20 to 0	C-17	Test S-SB-4
	0.28	0 to 256		
	0.32	-20 to 0	C-18	Test S-SB-4A
	0.27	0 to 256		
TMV + 160 F	0.12	-20 to 0	C-19	Test S-SB-4
	0.092	0 to 256		
	0.028	-20 to 0	C-20	Test S-SB-4A
	0.090	0 to 256		
TIMV-572W	0.13	-20 to 0	C-21	Test S-SB-4A
	0.11	0 to 256		
TH-C2-08	0.27	-20 to 0	C-22	Test S-SB-4
	0.83	0 to 20		
	0.27	20 to 256		
	0.24	-20 to 0	C-23	Test S-SB-4A
	0.37	0 to 20		
	0.23	20 to 256		
TH-C2-321	0.39	-20 to 0	C-24	Test S-SB-4
	0.47	0 to 256		
	0.28	-20 to 0	C-25	Test S-SB-4A
	0.62	0 to 95		
	0.29	95 to 256		
PI-16	0.0046	-20 to 0	C-26	Test S-SB-4
	0.19	0 to 20		
	0.016	20 to 256		
	0.0094	-20 to 0	C-27	Test S-SB-4A
	0.027	0 to 256		

TABLE C-1. (continued)

Measurement	Random Uncertainty Standard Deviation	Period Application (s)	Figure	Comments
PV-13	0.0094	-20 to 0	C-28	Test S-SB-4
	0.18	0 to 20		
	0.017	20 to 256		
	0.010	-20 to 0	C-29	Test S-SB-4A
	0.021	0 to 256		
DI-6-7	5.0	029 to 0	C-30	Test S-SB-4
	9.1	0 to 7		
	19.0	7 to 20		
	3.2	20 tc 165		
	0.65	165 to 256		
	7.0	-20 to 0	C-31	Test S-SB-4A
	8.0	0 to 30		
	5.4	30 to 155		
	[illegible]	155 to 26		
DI-13-15	6.9	-20 to 0	C-32	Test S-SB-4
	16.0	0 to 20		
	2.1	20 to 45		
	6.9	45 to 160		
	1.3	160 to 256		
	8.1	-20 to 0	C-33	Test S-SB-4A
	24.0	0 to 10		
	7.7	10 to 15		
	21.0	15 to 20		
	4.9	20 to 155		
	0.90	155 to 256		
DD-DIA-578	1.4	-20 to 0	C-34	Test S-SB-4
	2.3	0 to 10		
	1.8	10 to 20		
	0.24	20 to 256		
	1.9	-20 to 0	C-35	Test S-SB-4A
	4.5	0 to 10		
	1.7	10 to 18		
	0.52	18 to 256		
DV-501-105	1.4	-20 to 0	C-36	Test S-SB-4
	2.3	0 to 10		
	1.8	10 to 20		
	0.24	20 to 256		

TABLE C-1. (continued)

Measurement	Random Uncertainty Standard Deviation	Period Application (s)	Figure	Comments
DV-501-105	1.5	-20 to 0	C-37	Test S-SB-4A
	2.8	0 to 20		
	0.28	20 to 256		
DI-SG-LL	0.12	-20 to 0	C-38	Test S-SB-4
	0.067	0 to 256		
	0.27	-20 to 0	C-39	Test S-SB-4A
	0.10	0 to 50		
	0.024	50 to 256		
FI-1	0.038	-20 to 0	C-40	Test S-SB-4
	0.050	0 to 20		
	1.3	20 to 35		
	0.45	35 to 65		
	1.7	65 to 256		
	0.044	-20 to 0	C-41	Test S-SB-4A
	0.15	0 to 25		
	0.16	25 to 130		
	1.2	130 to 185		
	0.13	185 to 256		
FI-16	0.069	-20 to 0	C-42	Test S-SB-4
	0.52	0 to 20		
	0.52	20 to 62		
	0.13	62 to 120		
	0.032	120 to 256		
	0.14	-20 to 0	C-43	Test S-SB-4A
	1.7	0 to 10		
	0.85	10 to 65		
	0.12	65 to 150		
	1.3	150 to 220		
	0.046	220 to 256		
FD-424	0.79	-20 to 0	C-44	Test S-SB-4
	1.6	0 to 20		
	0.12	20 to 256		
	0.88	-20 to 0	C-45	Test S-SB-4A
	2.2	0 to 7		
	1.7	7 to 15		
	0.96	15 to 95		
	1.2	95 to 256		

TABLE C-1. (continued)

Measurement	Random Uncertainty Standard Deviation	Period Application (s)	Figure	Comments
FV-1	0.043	-20 to 0	C-46	Test S-SB-4
	0.11	0 to 10		
	0.78	10 to 20		
	0.21	20 to 256		
	0.048	-20 to 0	C-47	Test S-SB-4A
	0.17	0 to 25		
	0.16	25 to 256		
FI-HPIS	1.5	-20 to 0	C-48	Test S-SB-4
	10.5	0 to 7		
	1.0	7 to 18		
	4.3	18 to 25		
	3.0	25 to 185		
	1.3	185 to 215		
	1.3	215 to 256		
	2.15	-20 to 0	C-49	Test S-SB-4A
	27.0	0 to 5		
	3.9	5 to 10		
	26.0	10 to 15		
	2.5	15 to 256		
GI-1T	17.0	-20 to 0	C-50	Test S-SB-4
	29.0	0 to 35		
	22.0	35 to 256		
	18.0	-20 to 0	C-51	Test S-SB-4A
	20.0	0 to 30		
	33.0	30 to 40		
	22.0	40 to 256		
GI-1B	11.0	-20 to 0	C-52	Test S-SB-4
	11.0	0 to 35		
	15.0	35 to 256		
	11.0	-20 to 0	C-53	Test S-SB-4A
	13.0	0 to 35		
	19.0	35 to 42		
	16.6	42 to 256		
GI-1C	4.6	-20 to 0	C-54	Test S-SB-4
	7.2	0 to 35		
	19.0	35 to 45		
	29.0	45 to 256		

TABLE C-1. (continued)

Measurement	Random Uncertainty Standard Deviation	Period Application (s)	Figure	Comments
GI-1C	3.0	-20 to 0	C-55	Test S-SB-4A
	3.5	0 to 30		
	10.0	30 to 40		
	16.6	40 to 256		
GI-17T	31.0	-20 to 0	C-56	Test S-SB-4
	24.0	0 to 160		
	30.0	160 to 256		
	24.0	-20 to 0	C-57	Test S-SB-4A
	24.0	0 to 150		
	28.0	150 to 256		
GI-17B	15.0	-20 to 0	C-58	Test S-SB-4
	14.0	0 to 160		
	21.0	160 to 185		
	19.0	185 to 256		
	17.0	-20 to 0	C-59	Test S-SB-4A
	14.0	0 to 150		
	22.0	150 to 180		
	18.0	180 to 256		
GI-17C	7.8	-20 to 0	C-60	Test S-SB-4
	11.0	0 to 160		
	20.0	160 to 256		
	4.3	-20 to 0	C-61	Test S-SB-4A
	11.0	0 to 155		
	24.0	155 to 165		
	16.0	165 to 256		
GB-45VR	24.0	-20 to 0	C-62	Test S-SB-4
	24.0	0 to 175		
	40.0	175 to 185		
	27.0	185 to 256		
	20.0	-20 to 0	C-63	Test S-SB-4A
	23.0	0 to 160		
	40.0	160 to 175		
	25.0	175 to 256		
FI-1, GI-1C	0.056	-20 to 0	C-64	Test S-SB-4
	0.34	0 to 20		
	0.55	20 to 50		
	0.62	50 to 256		

TABLE C-1. (continued)

Measurement	Random Uncertainty Standard Deviation	Period Application (s)	Figure	Comments
FI-1, GI-1C	0.052	-20 to 0	C-65	Test S-SB-4A
	0.15	0 to 25		
	0.090	25 to 130		
	0.36	130 to 170		
	0.058	170 to 256		
FB-45, GB-45 VR	0.052	-20 to 0	C-66	Test S-SB-4A
	0.18	0 to 7		
	0.025	7 to 240		
	0.15	240 to 247		
	0.23	247 to 256		

TABLE C-2. GENERAL MEASUREMENT ENGINEERING UNCERTAINTY SOURCES AND UNCERTAINTY VALUES (Tests S-SB-4 and S-SB-4A)

Measurement Category	Uncertainty Sources	Uncertainty Value	Expected Uncertainty Values
Fluid Temperature	Changes in homogeneity of the thermocouple wire due to cold working	± 1.11 K	± 1.66 K, $R \leq 550$ K[a]
	Data interpretation from standard reference tables	± 1.11 K, $R \leq 550$ K ± 0.0021 R, $\bar{R} > 550$ K	$\pm \left[1.42 + (0.0021\ R)^2\right]^{1/2}$, $R > 550$ K[a]
	General data acquisition processing	± 0.42 K	where R = transducer reading (K)
	Thermal aging of the thermocouples	± 0.28	
Material Temperature	Changes in homogeneity of the thermocouple wire due to cold working	± 1.11 K	
	Thermocouple radial position	± 2.78 K	± 3.33 K, $R \leq 550$ K
	Data interpretation from standard reference tables	± 1.11 K, $R \leq 550$ K ± 0.0021, R, $\bar{R} > 550$ K	$\pm \left[9.75 + (0.0021\ R)^2\right]^{1/2}$, $R > 550$ K
	General data acquisition and processing	± 0.42 K	where R = transducer reading (K)
	Thermal aging of the thermocouples	± 0.28	

TABLE C-2. (continued)

Measurement Category	Uncertainty Sources	Uncertainty Value	Expected Uncertainty Values
Pressure	Entrance effects	±0.3% of transducer full scale	±0.44% of transducer full scale
	Calibration	±0.26% of transducer full scale	
	Temperature sensitivity	±0.13% of transducer full scale	
	General data acquisition and processing	±0.15% of system full scale	
Differential Pressure	Installation	±.03% of transducer full scale	±2% of transducer full scale[b] where R = transducer reading (kPa) FS = transducer range full scale (kPa)
	Calibration Transducer ranges ±4.96 through ±199.26 kPa	$\pm\left[(0.05) + (0.5\ R/FS)^2\right]^{1/2}$ % of transducer of full scale	
	Transducer ranges ±344.74, ±689.47, ±3447 kPa	$\pm\left[(0.03) + (0.5\ R/FS)^2\right]^{1/2}$ % of transducer full scale	
	Transducer ranges ±6894, ±10 342 kPa	$\pm\left[(0.02) + (0.5\ R/FS)^2\right]^{1/2}$ % of transducer full scale	
	Temperature sensitivity	±0.5% of transducer full scale	
	General data acquisition and processing	±0.15% of system full scale	
	Air entrapment	±0.069 kPa	

TABLE C-2. (continued)

Measurement Category	Uncertainty Sources	Uncertainty Value	Expected Uncertainty Values
Density	Calibration	±1.0 of reading (kg/m^3)	
	Detector system uncertainty	±2.1 kg/m^3	c
	General data acquisition and processing	±0.15 of system full scale (kg/m^3)	
	Flow regime	c	
Volumetric Flow (turbine flowmeter)	Calibration instrument reading	±0.25 of transducer full scale	
	Calibration standards	±19.56 x 10^{-2} ℓ/s	
	Velocity profile	±2.9% of reading	
	Frequency-to-voltage conversion	±0.25% of transducer full scale	c
	General data acquisition and processing	±0.15% of system full scale	
	Dead bands	±5% of transducer full scale	
	Flow regimes	c	

TABLE C-2. (continued)

Measurement Category	Uncertainty Sources	Uncertainty Value	Expected Uncertainty Values
Mass Flow Rate (from volumetric flow and density data)	Combined Results from individual uncertainty sources for volumetric flow and density data[d]	c	c

a. This value is no longer valid if thermocouple dryout occurs.

b. Value is based on observed system performance. It is more conservative than that obtained from the statistical summation of the identified engineering uncertainties.

c. Uncertainty value is time and flow regime dependent.

d. The general method for combining volumetric flow with density data to obtain mass flow rate and the resulting uncertainties in the data are explained in Reference C-2.

TABLE C-3. TIME PERIODS WHEN FLOW REGIME UNCERTAINTIES WERE APPLIED (Tests S-SB-4 and S-SB-4A)

Detector Identification	Time During Which Flow Regime Uncertainties Were Applied (s)	Figure	Comments
FI-1	8 to 256	C-40	S-SB-4
	8 to 256	C-41	S-SB-4A
FI-16	4 to 225	C-42	S-SB-4
	4 to 220	C-43	S-SB-4A
GI-1C	8 to 256	C-54	S-SB-4
	8 to 256	C-55	S-SB-4A
GI-17C	4 to 256	C-60	S-SB-4
	4 to 256	C-61	S-SB-4A
FB-45, GB-45 VR	8 to 256	C-66	S-SB-4A

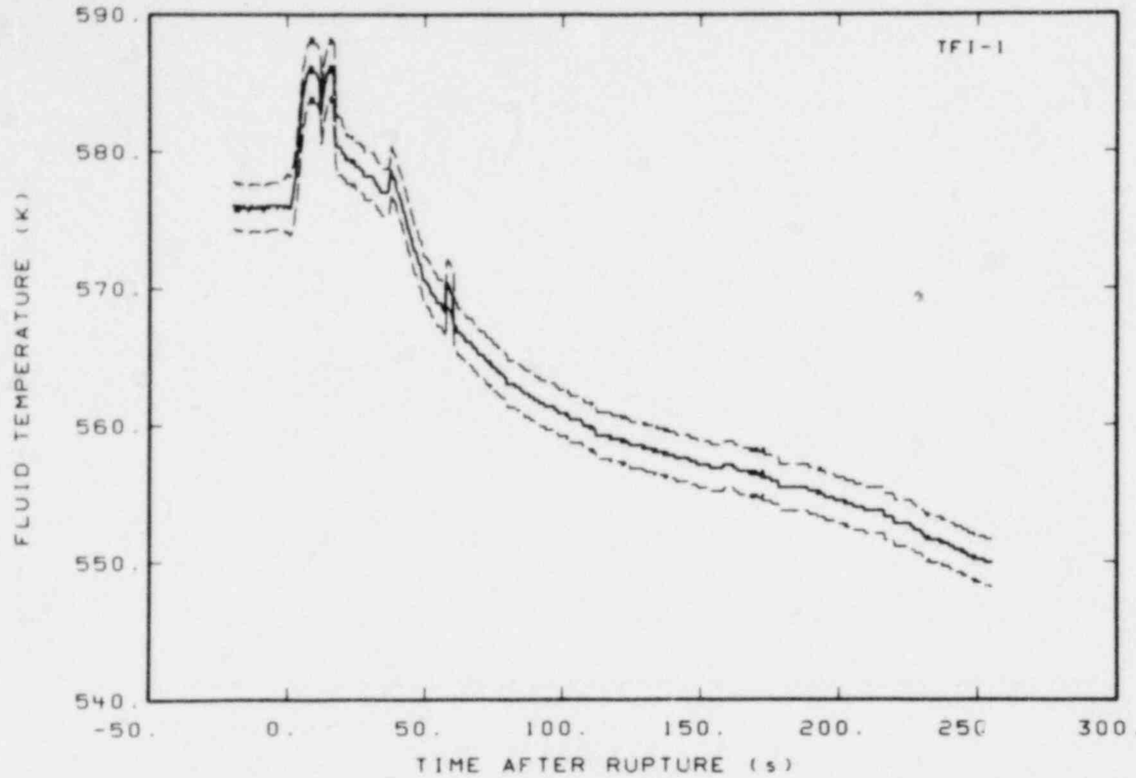


Figure C-1. Fluid temperature in intact loop hot leg, Test S-SB-4 (TFI-1).

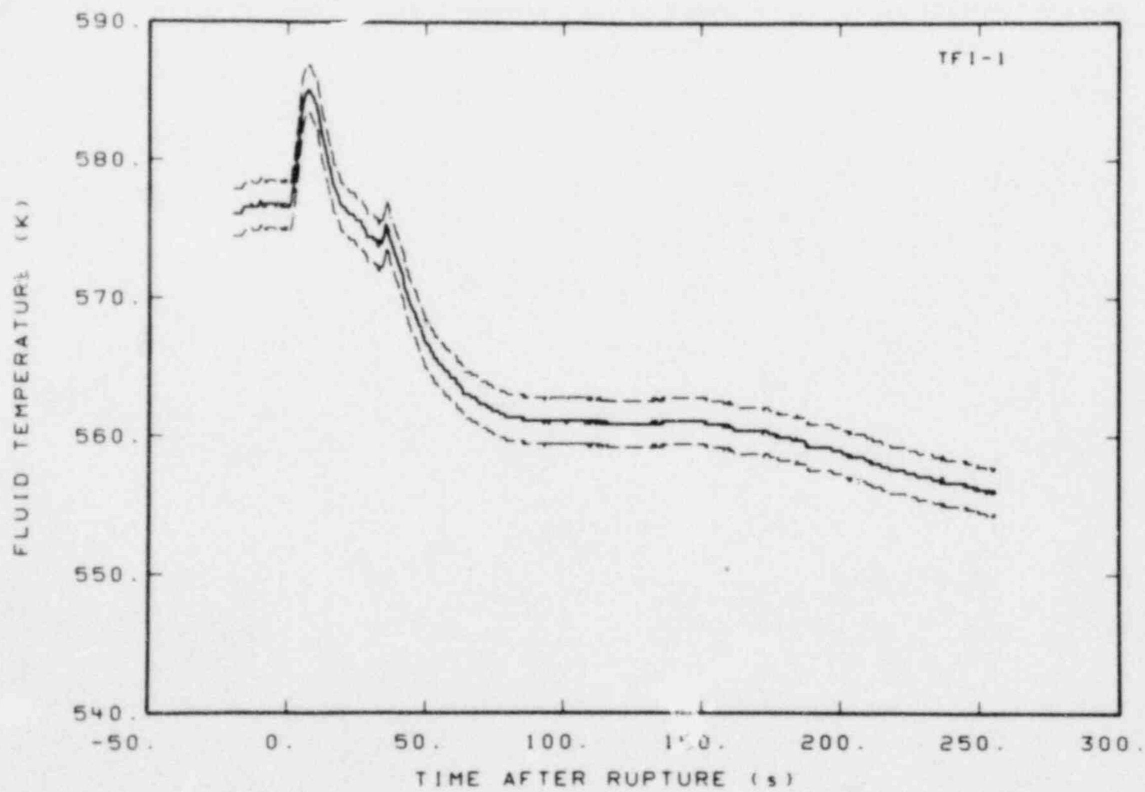


Figure C-2. Fluid temperature in intact loop hot leg, Test S-SB-4A (TFI-1).

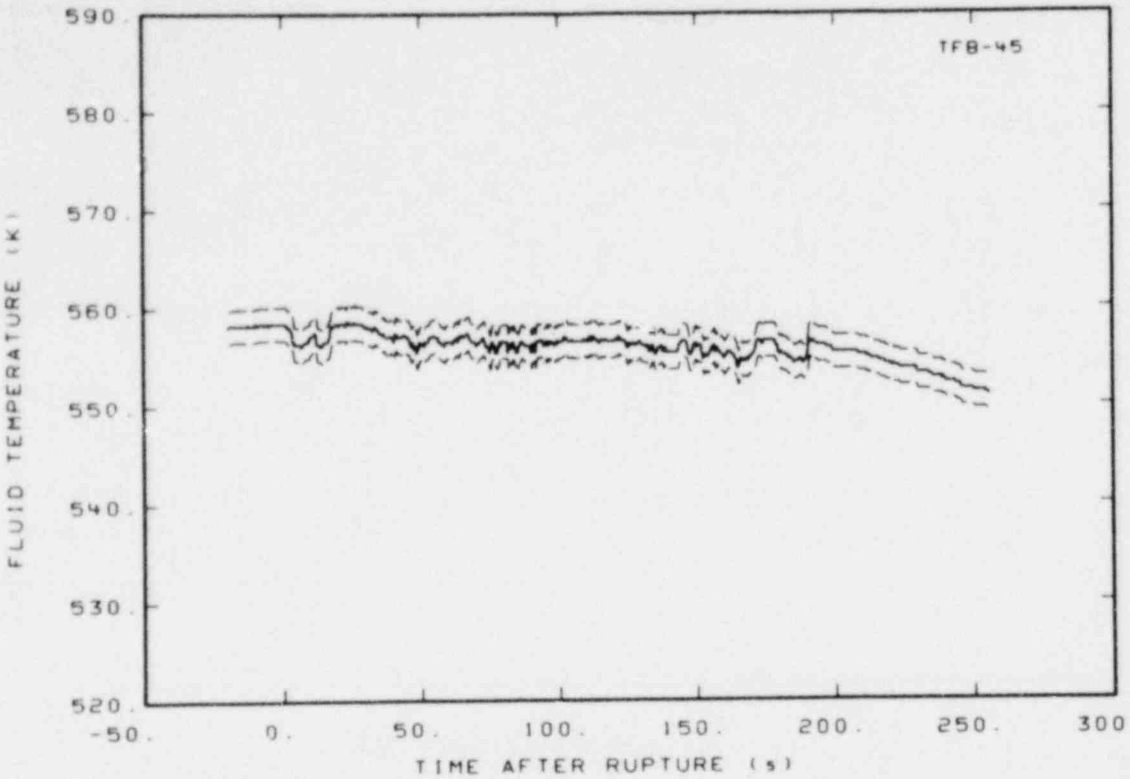


Figure C-3. Fluid temperature in broken loop cold leg, Test S-SB-4 (TFB-45).

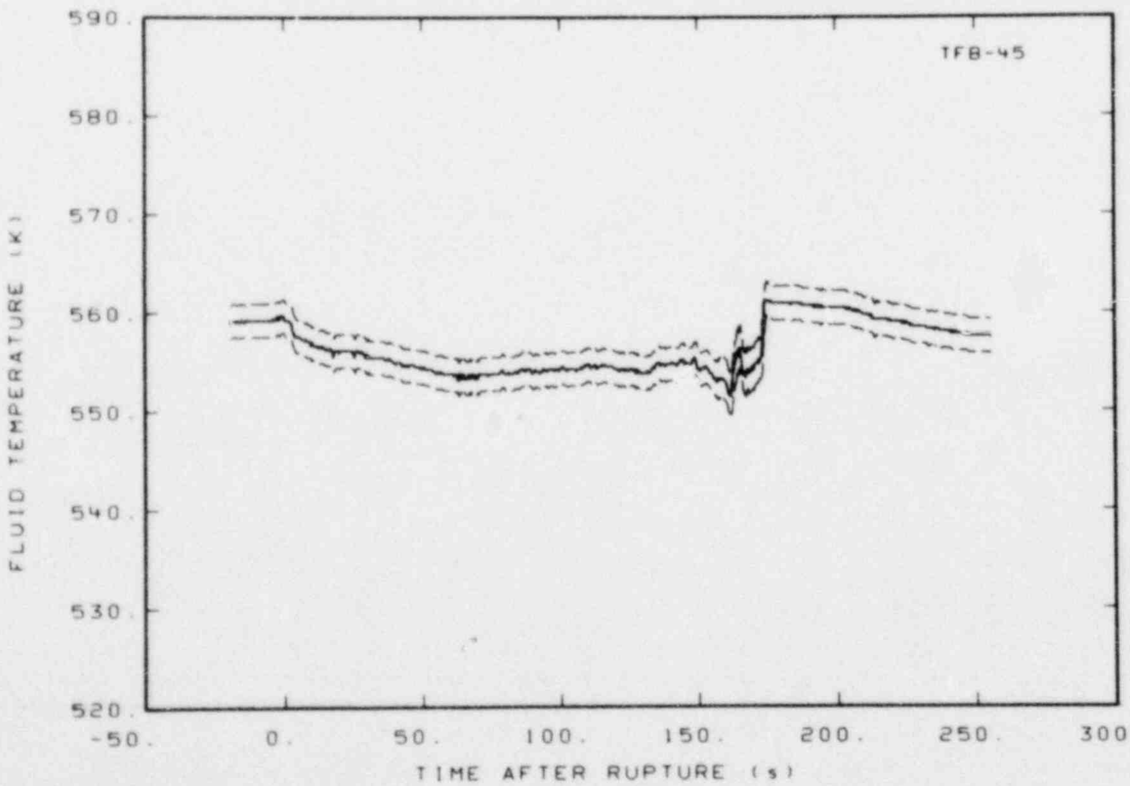


Figure C-4. Fluid temperature in broken loop cold leg, Test S-SB-4A (TFB-45).

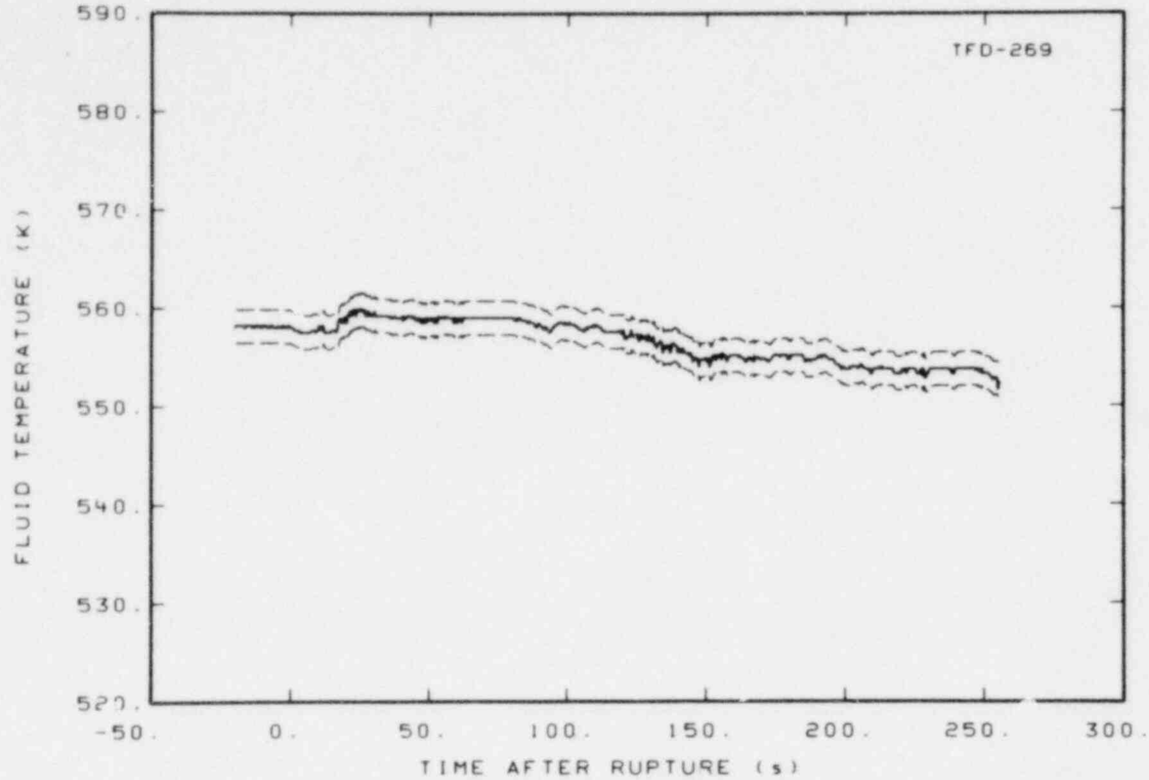


Figure C-5. Fluid temperature in downcomer, Test S-SB-4 (TFD-269).

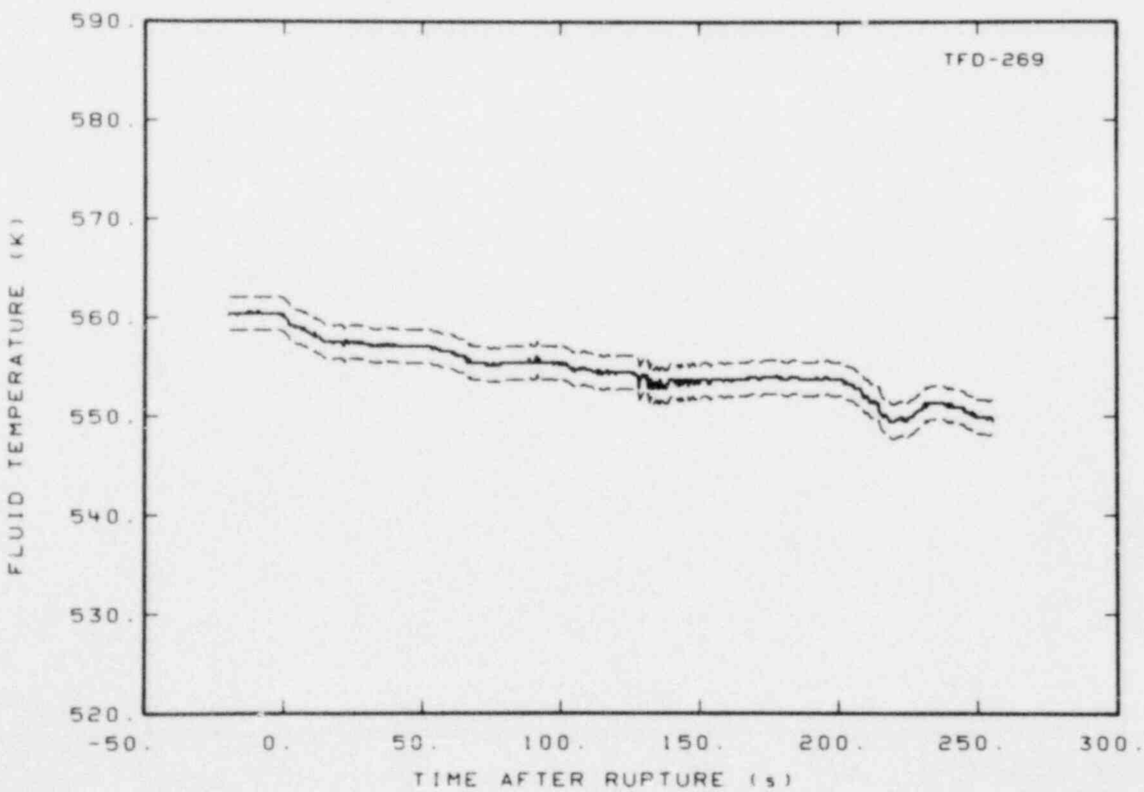


Figure C-6. Fluid temperature in downcomer, Test S-SB-4A (TFD-269).

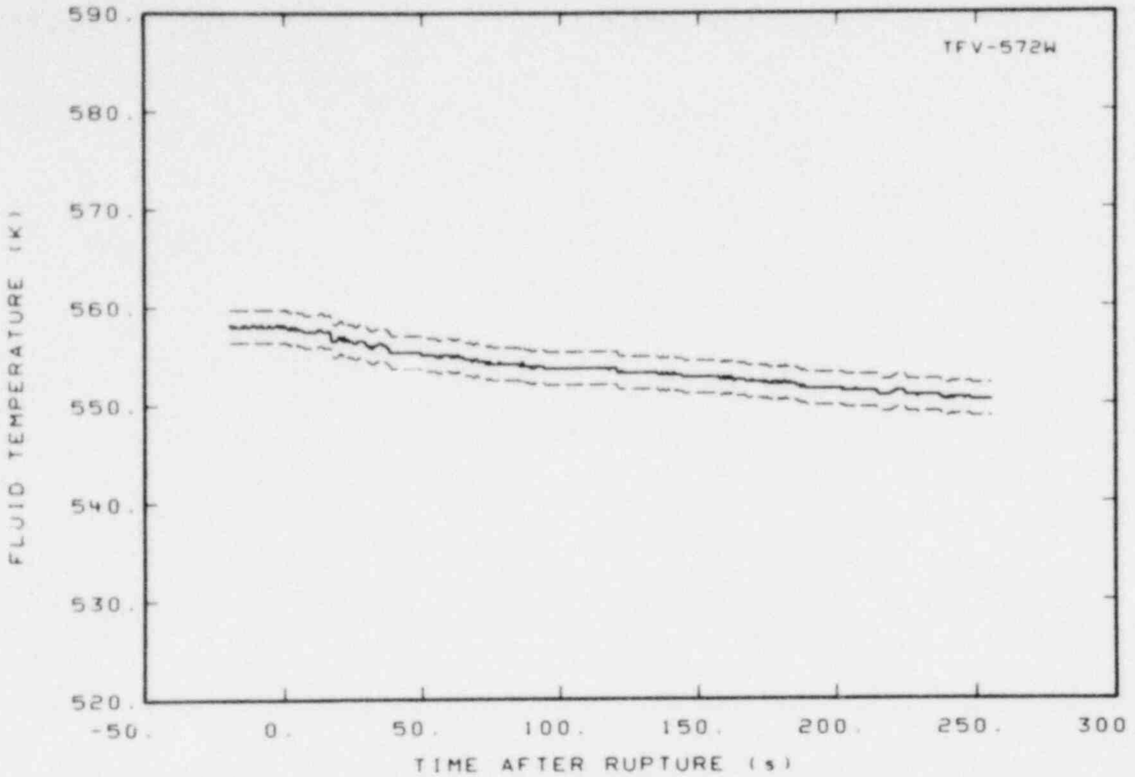


Figure C-7. **Fluid temperature in vessel, Test S-SB-4 (TFV-572W).**

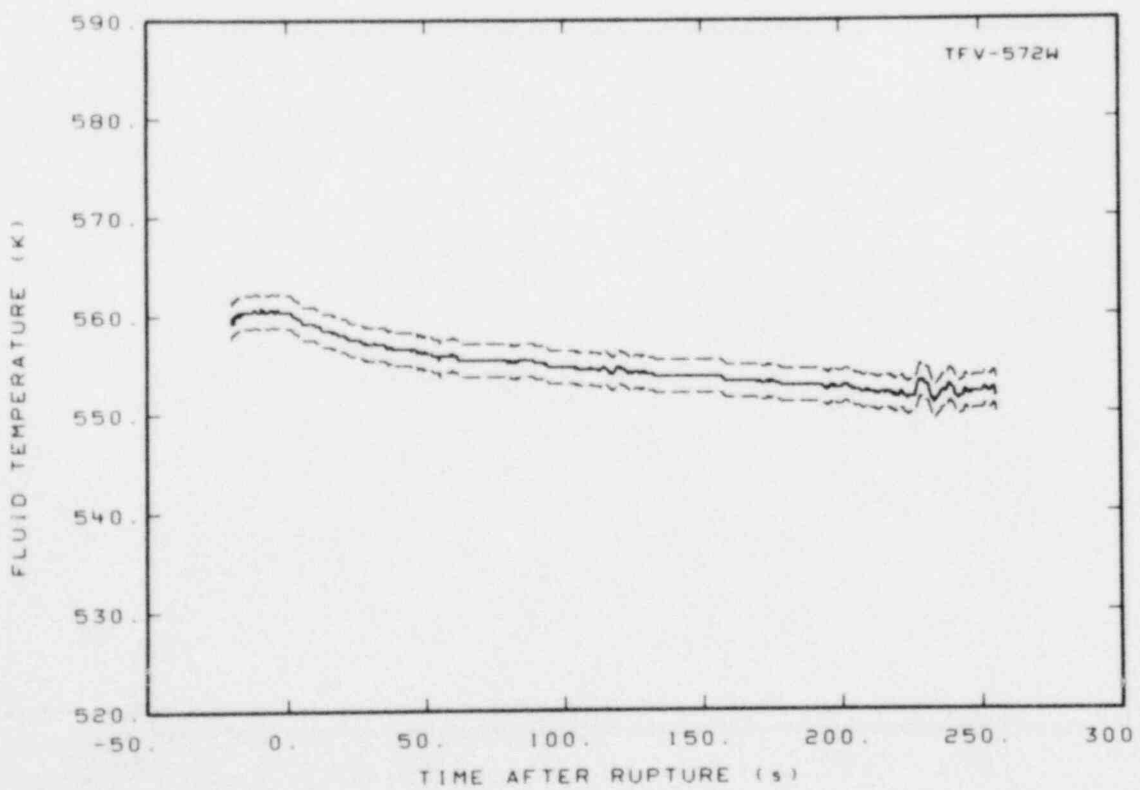


Figure C-8. **Fluid temperature in vessel, Test S-SB-4A (TFV-572W).**

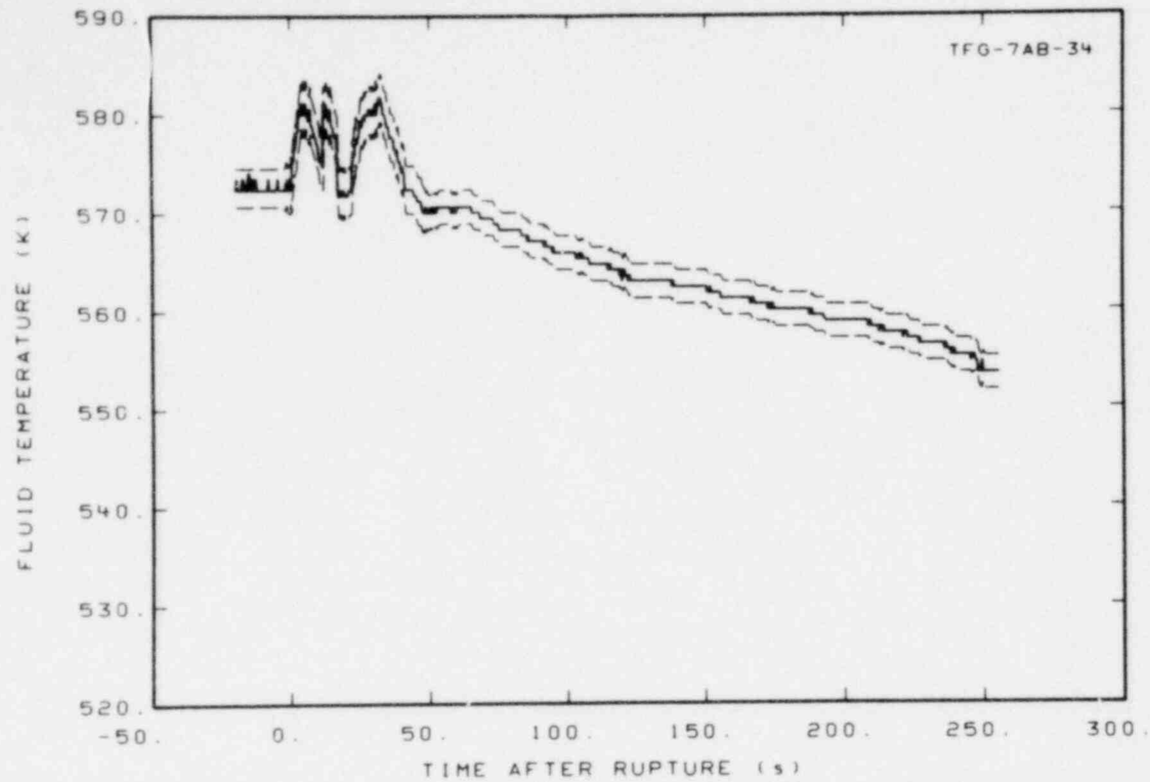


Figure C-9. Fluid temperature in core, Grid Spacer 7 Test S-SB-4 (TFG-7AB-34).

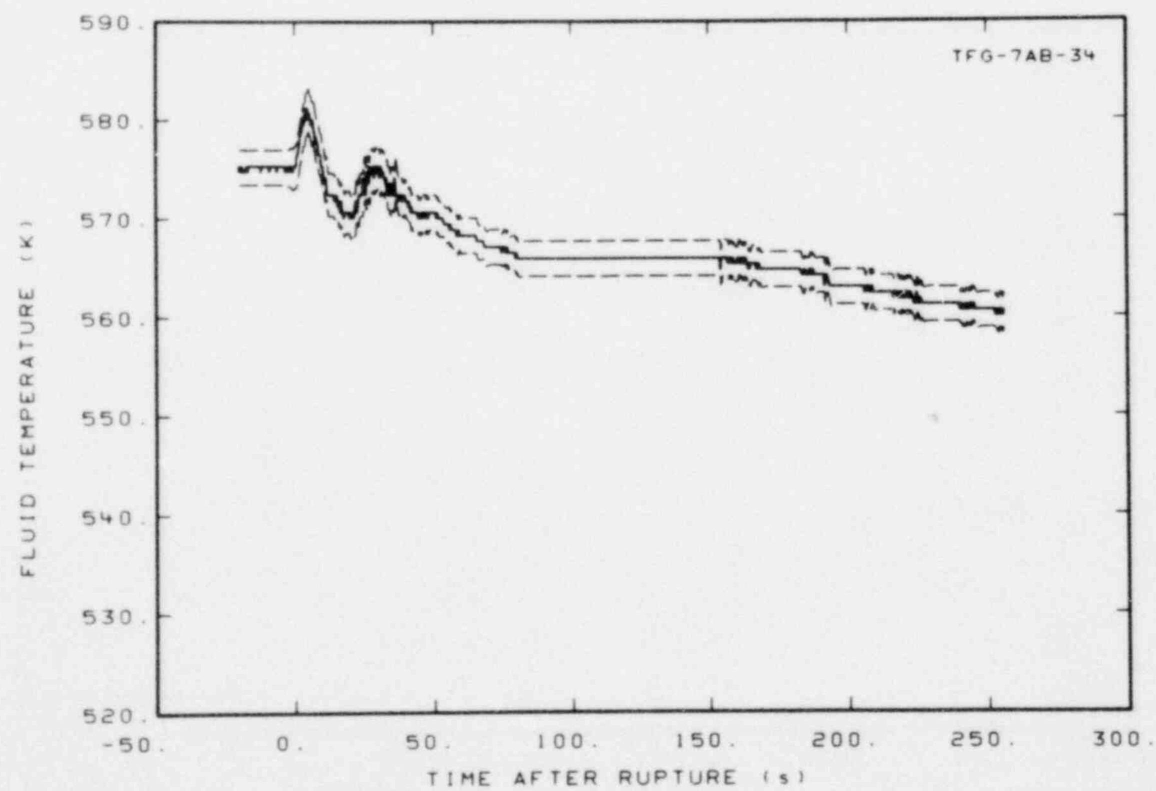


Figure C-10. Fluid temperature in core, Grid Spacer 7 Test S-SB-4A (TFG-7AB-34).

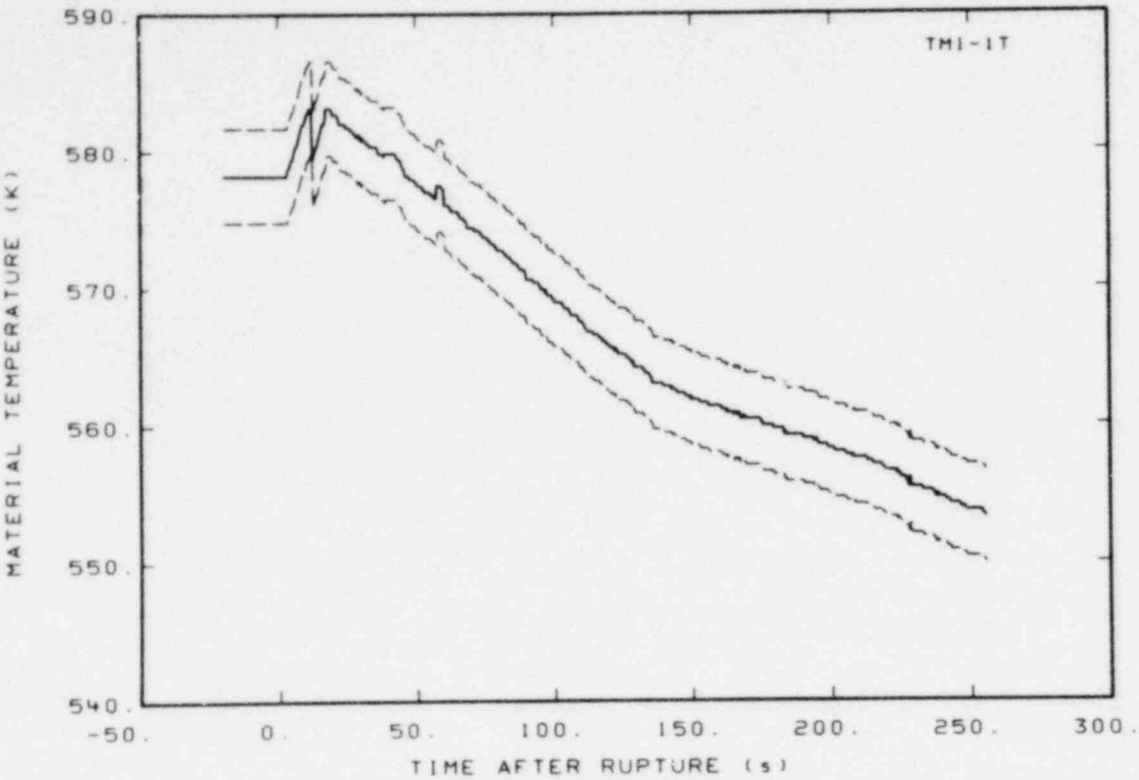


Figure C-11. Material temperature in intact loop, hot leg, Test S-SB-4 (TMI-1T).

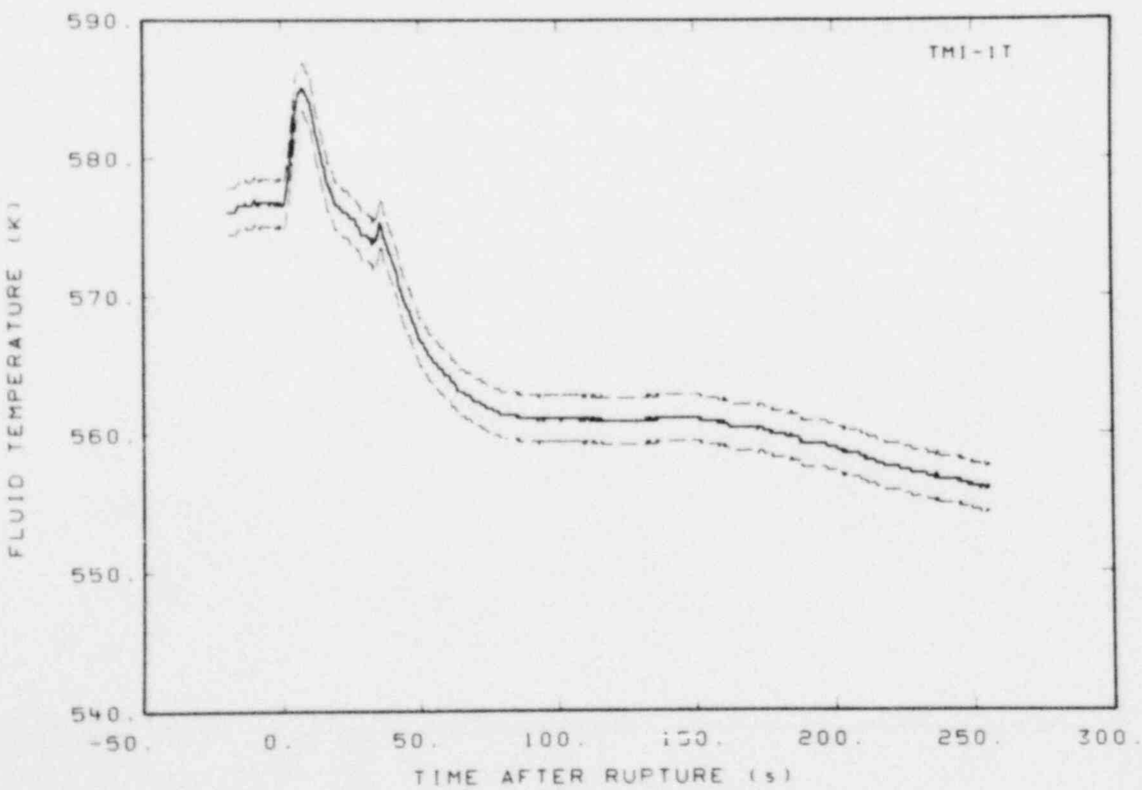


Figure C-12. Material temperature in intact loop, hot leg, Test S-SB-4A (TMI-1T).

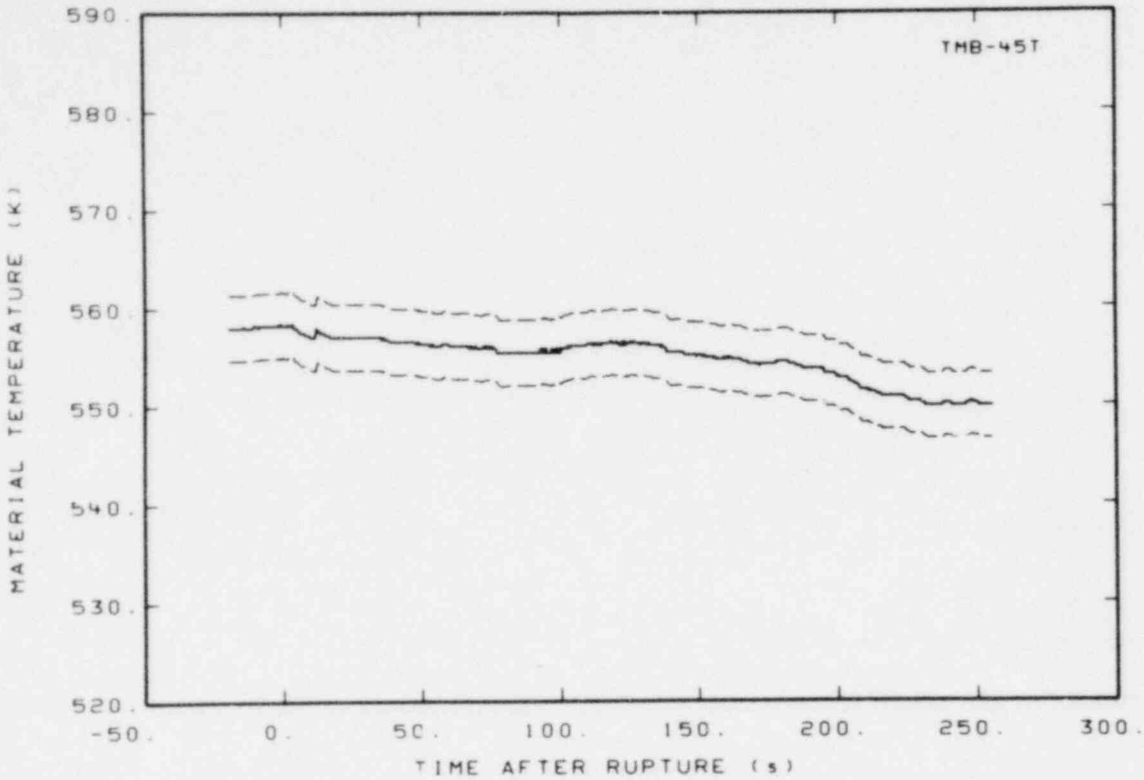


Figure C-13. Material temperature in broken loop cold leg, Test S-SB-4 (TMB-45T).

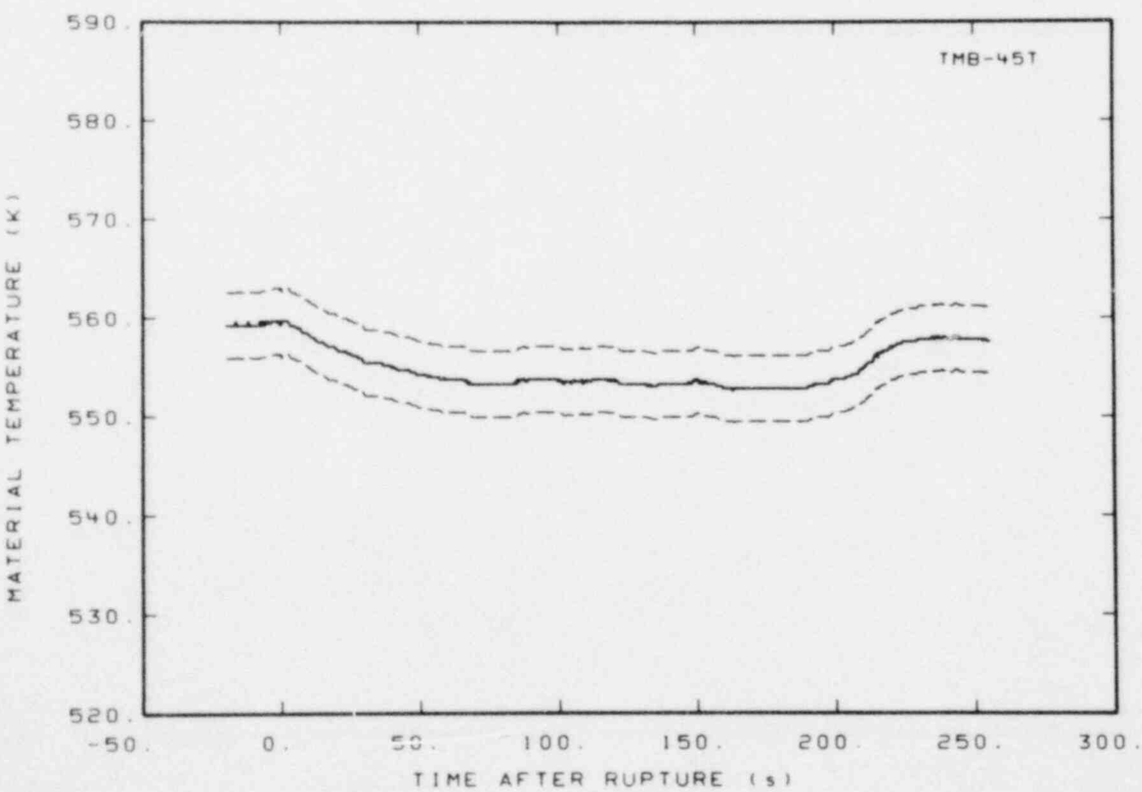


Figure C-14. Material temperature in broken loop cold leg, Test S-SB-4A (TMB-45T).

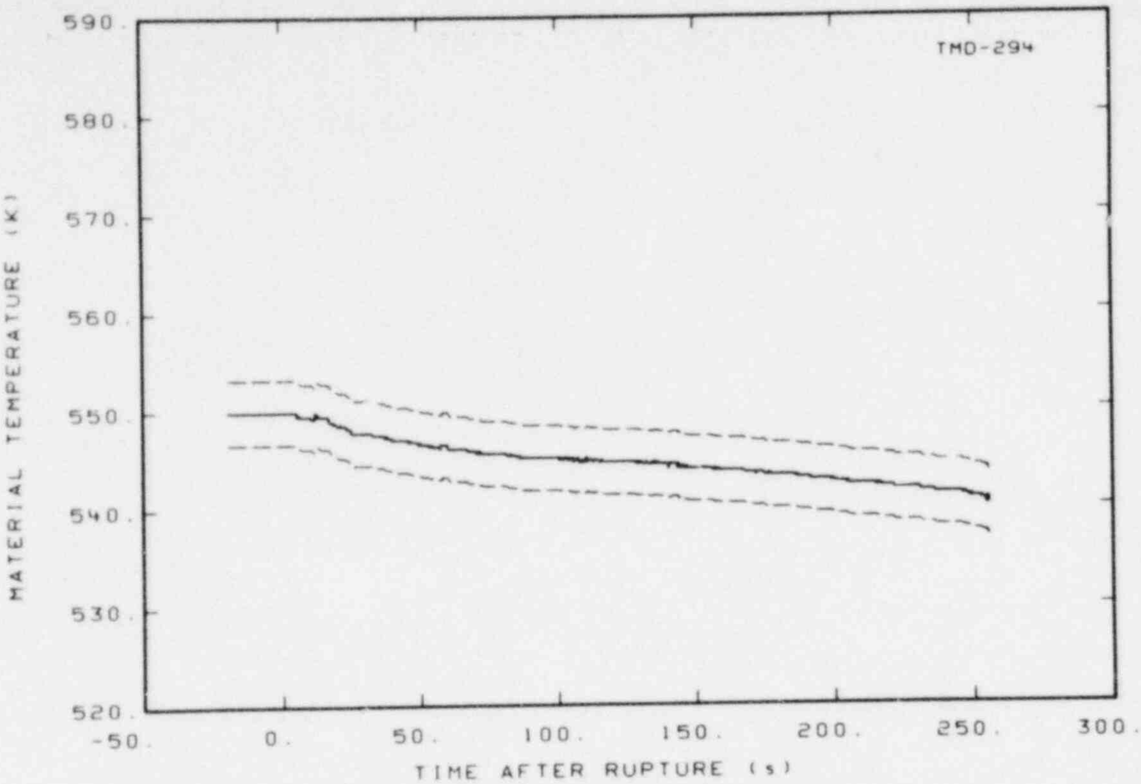


Figure C-15. Material temperature in downcomer, Test S-SB-4 (TMD-294).

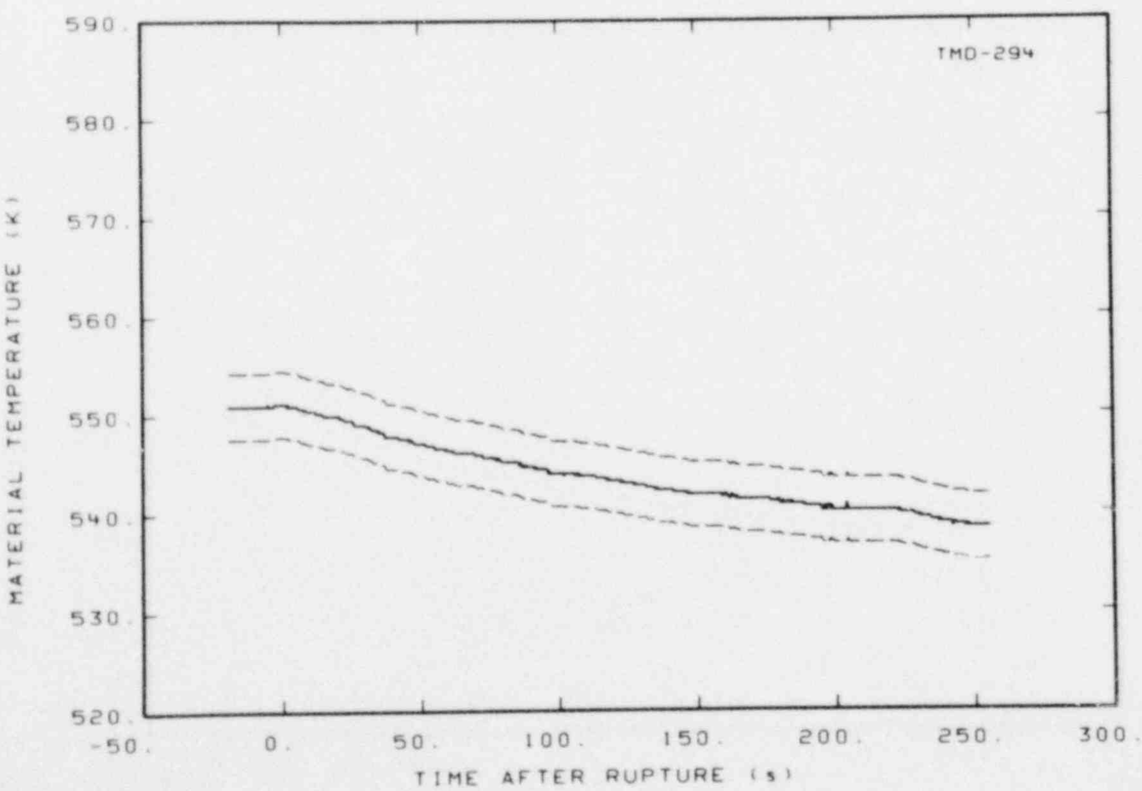


Figure C-16. Material temperature in downcomer, Test S-SB-4A (TMD-294).

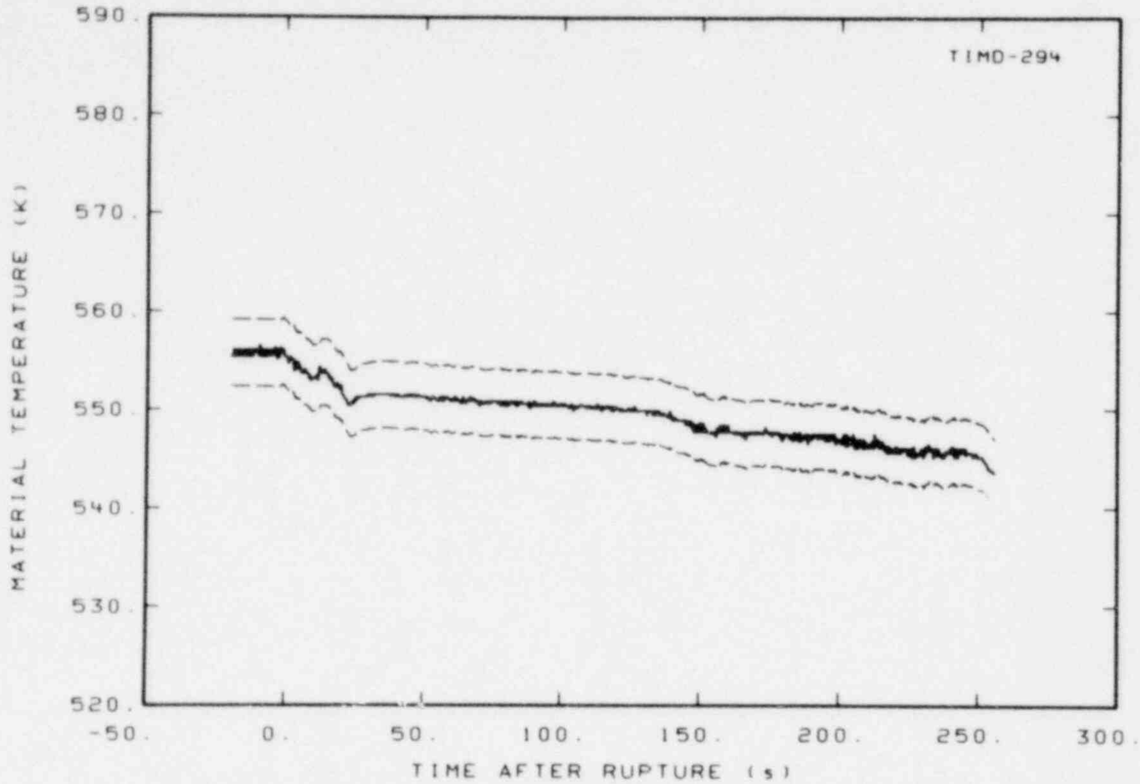


Figure C-17. Material temperature in downcomer insulator, Test S-SB-4 (TIMD-294).

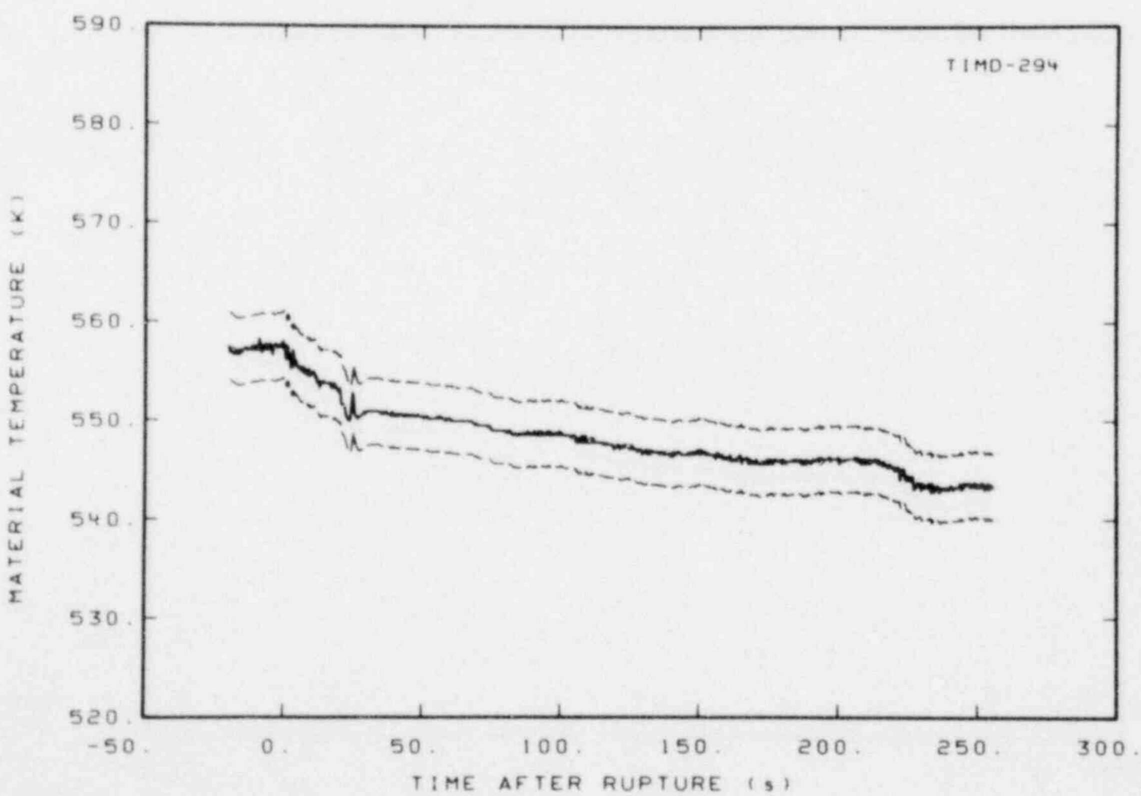


Figure C-18. Material temperature in downcomer insulator, Test S-SB-4A (TIMD-294).

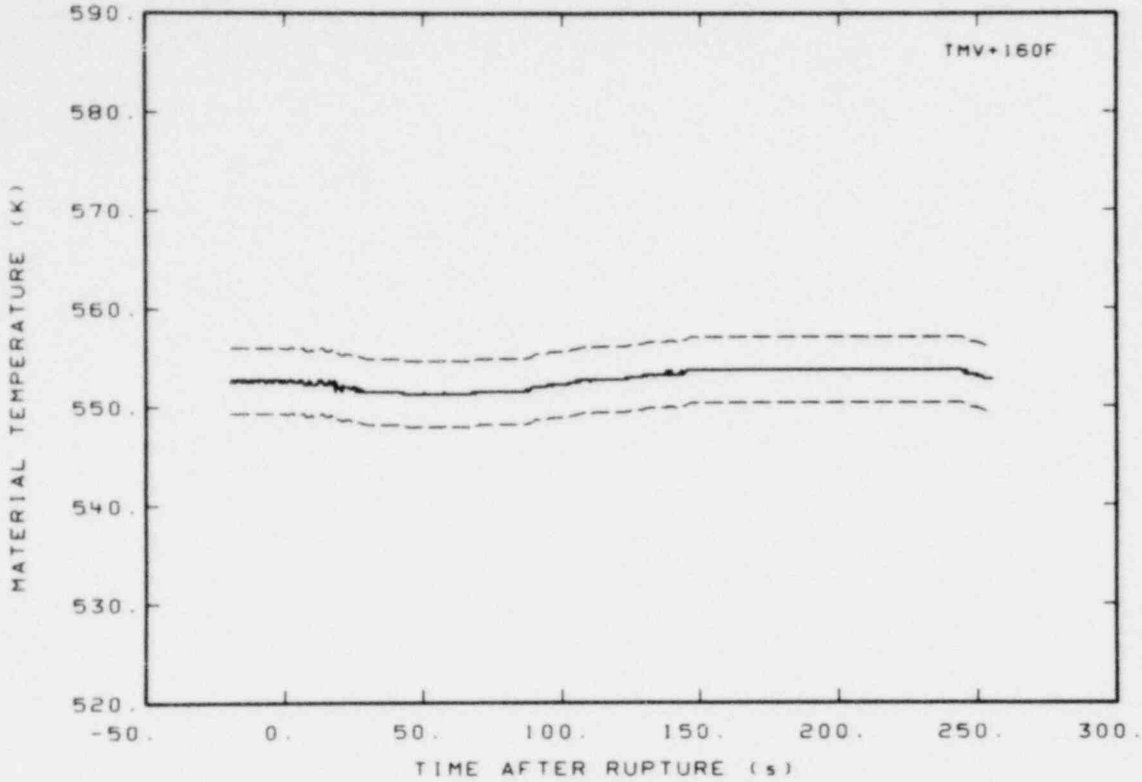


Figure C-19. Material temperature in downcomer insulator, Test S-SB-4 (TMV + 160F).

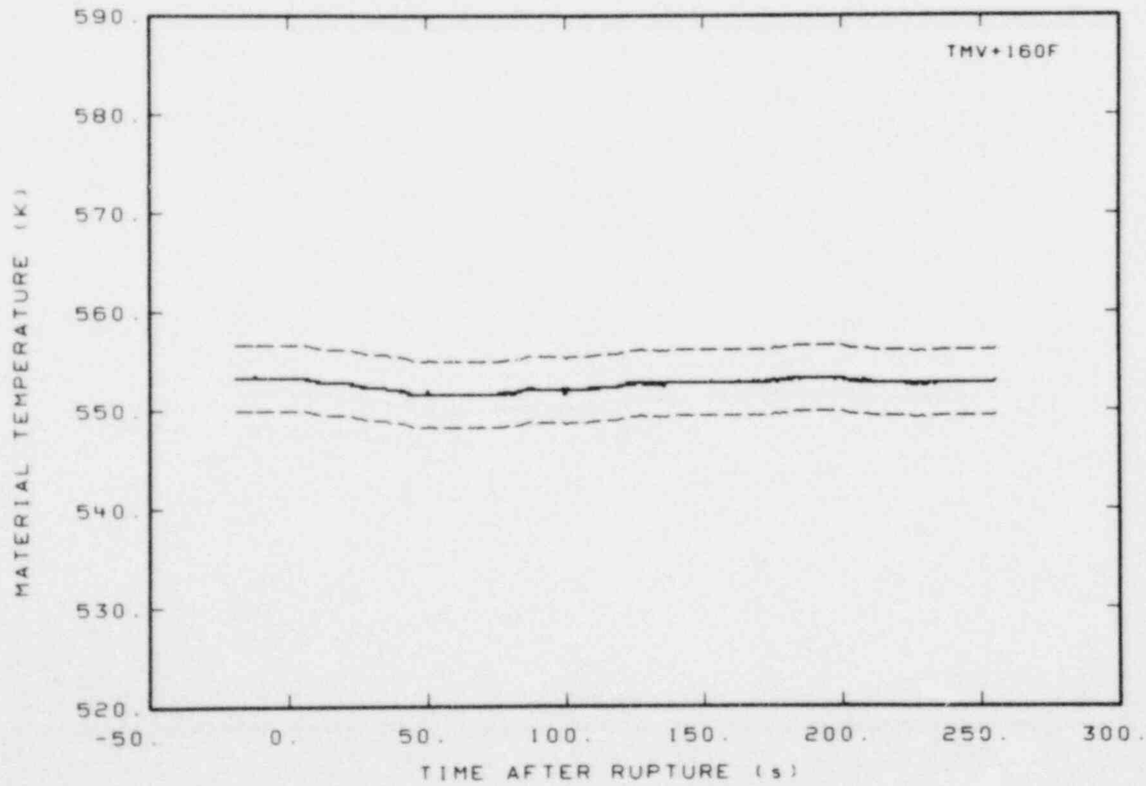


Figure C-20. Material temperature in vessel, Test S-SB-4A (TMV + 160F).

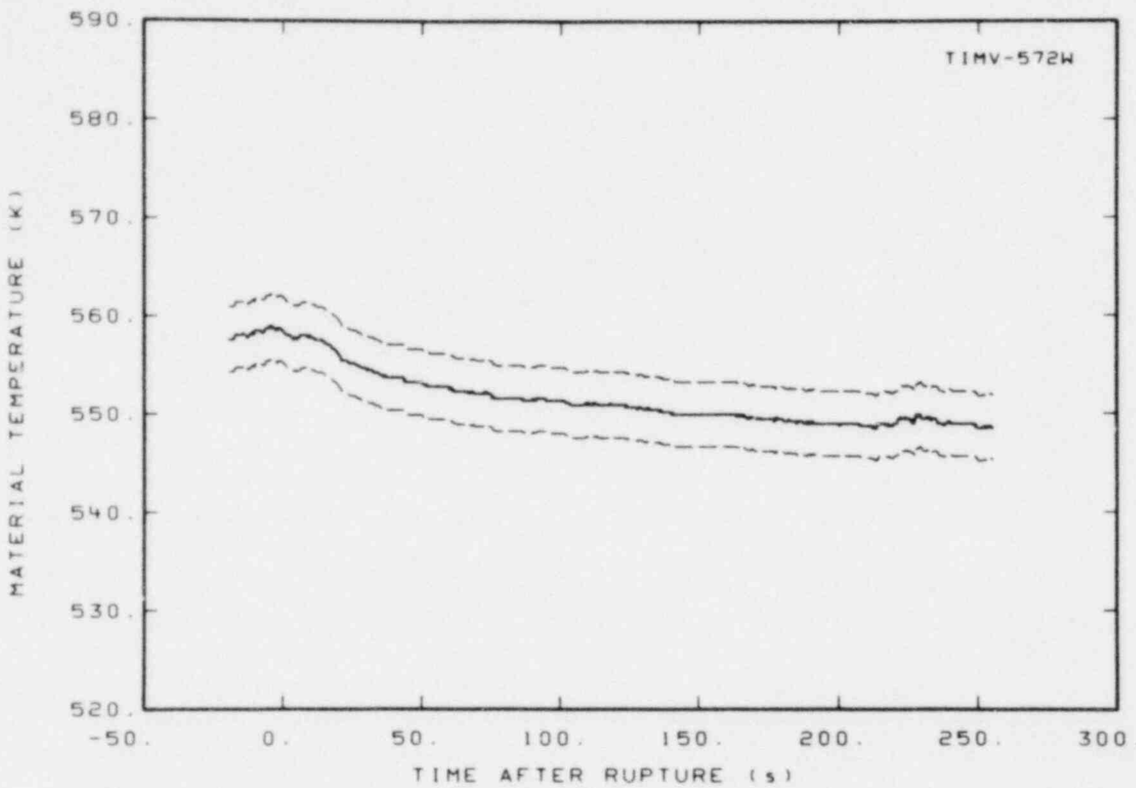


Figure C-21. Material temperature in vessel, Test S-SB-4A (TIMV-572W).

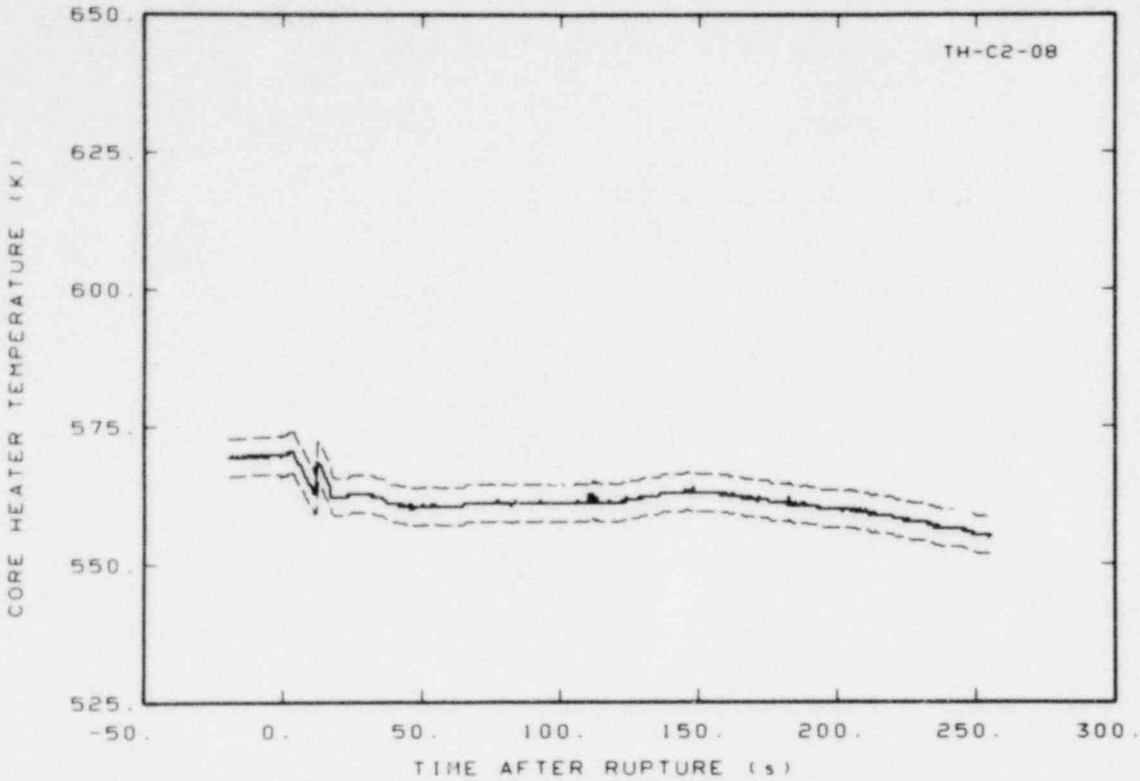


Figure C-22. Material temperature in vessel insulator, Test S-SB-4 (TH-C2-08).

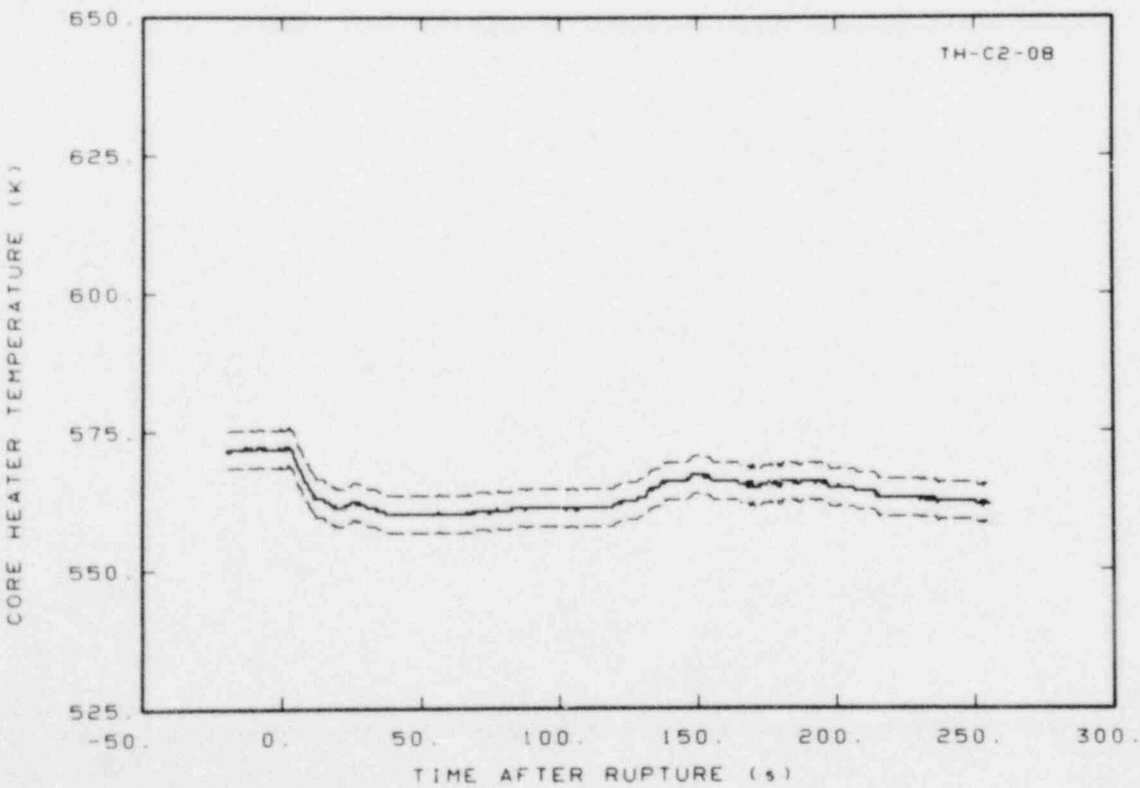


Figure C-23. Core heater temperature, Rod C-2, Test S-SB-4A (TH-C2-08).

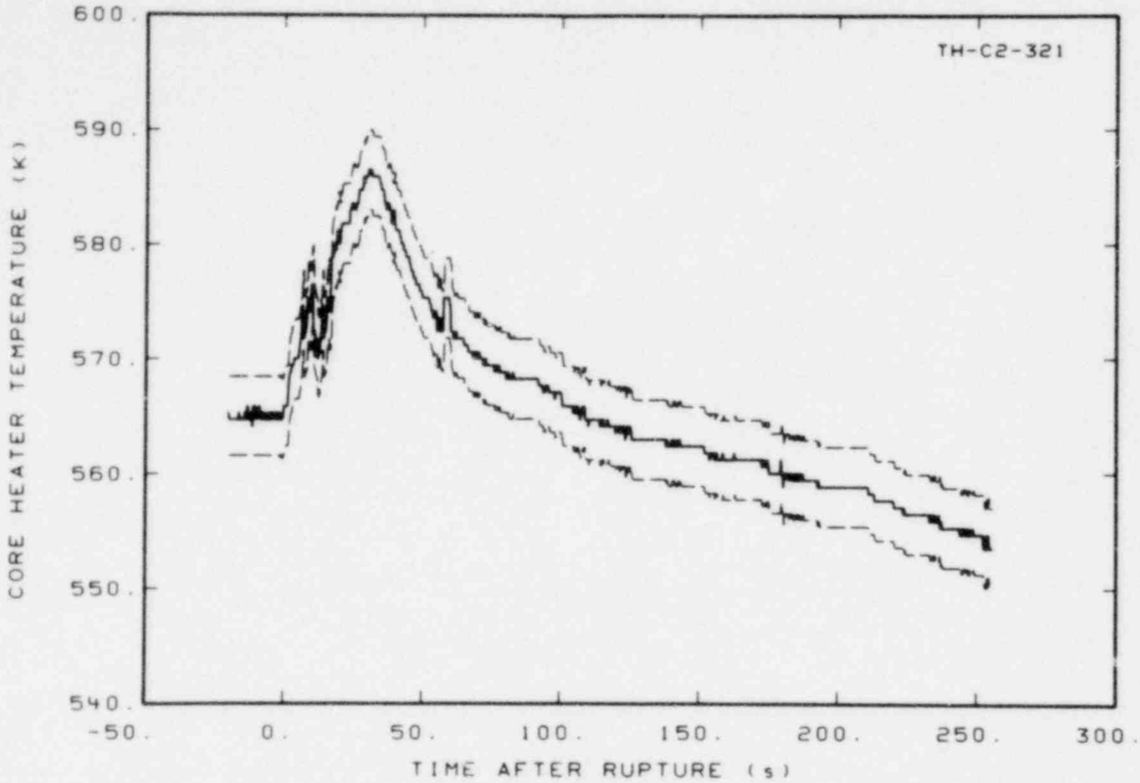


Figure C-24. Core heater temperature, Rod C-2, Test S-SB-4 (TH-C2-321).

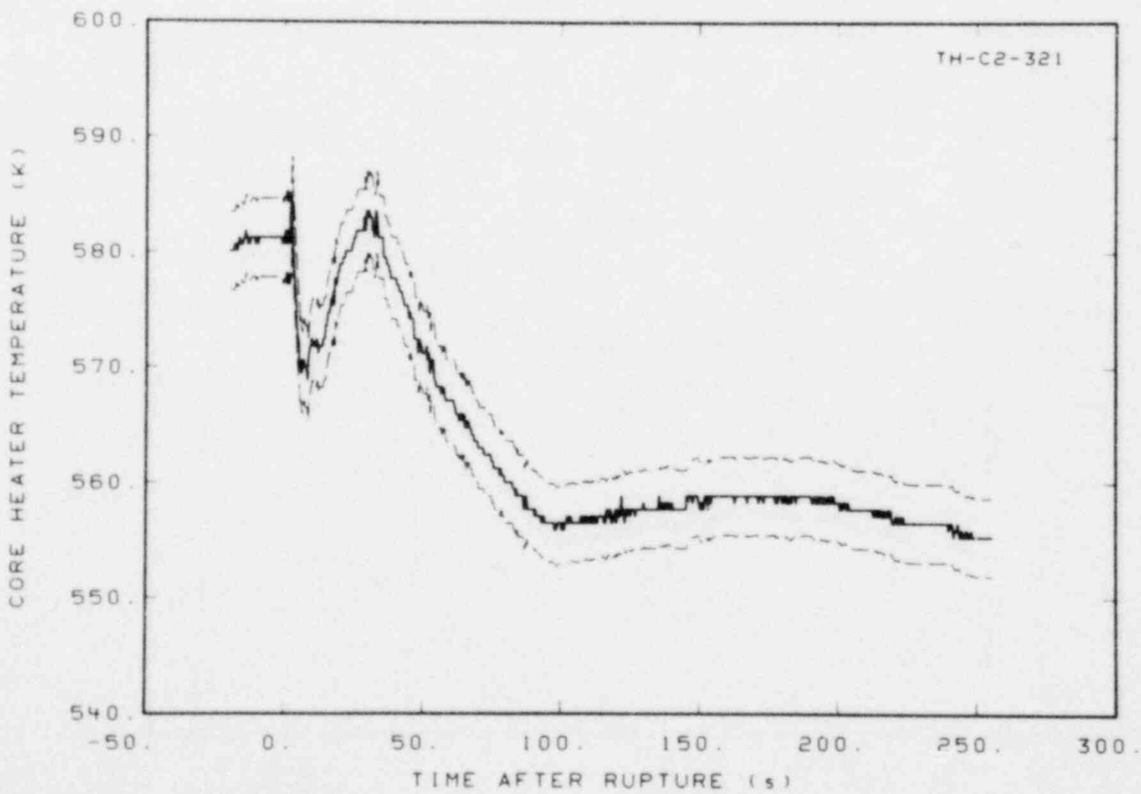


Figure C-25. Core heater temperature, Rod C-2, Test S-SB-4A (TH-C2-321).

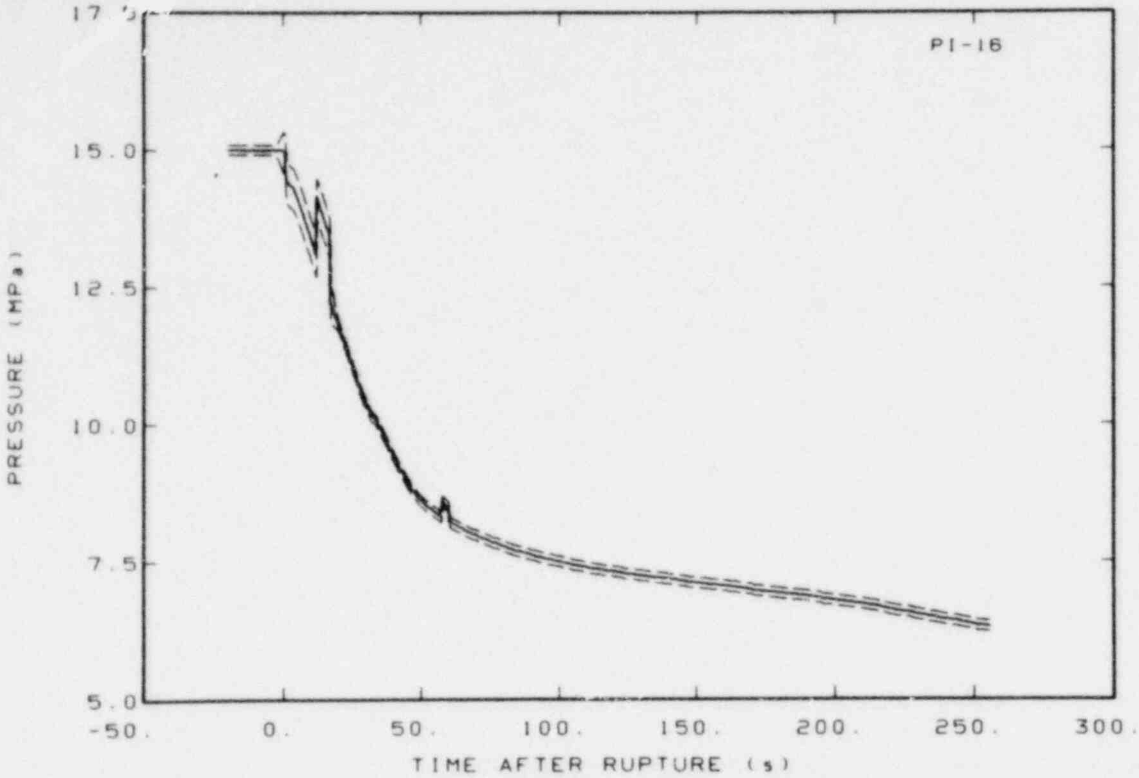


Figure C-26. Pressure in intact loop cold leg, Test S-SB-4 (PI-16).

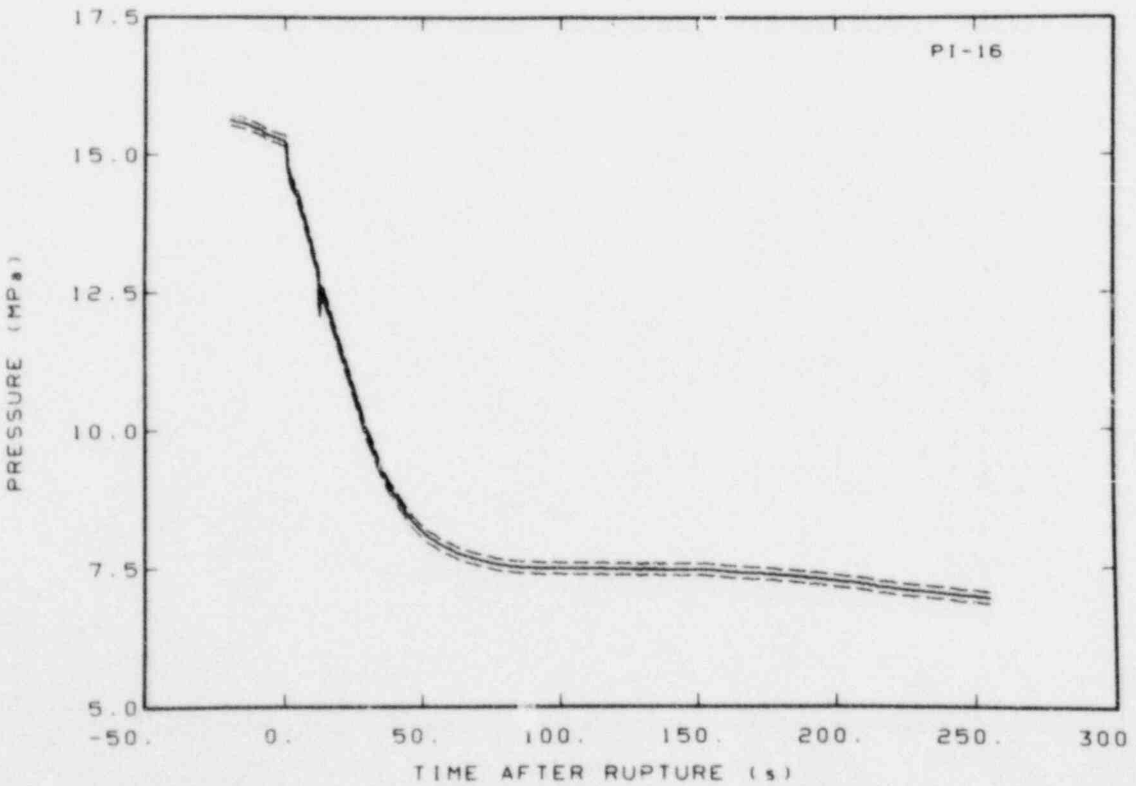


Figure C-27. Pressure in intact loop cold leg, Test S-SB-4A (PI-16).

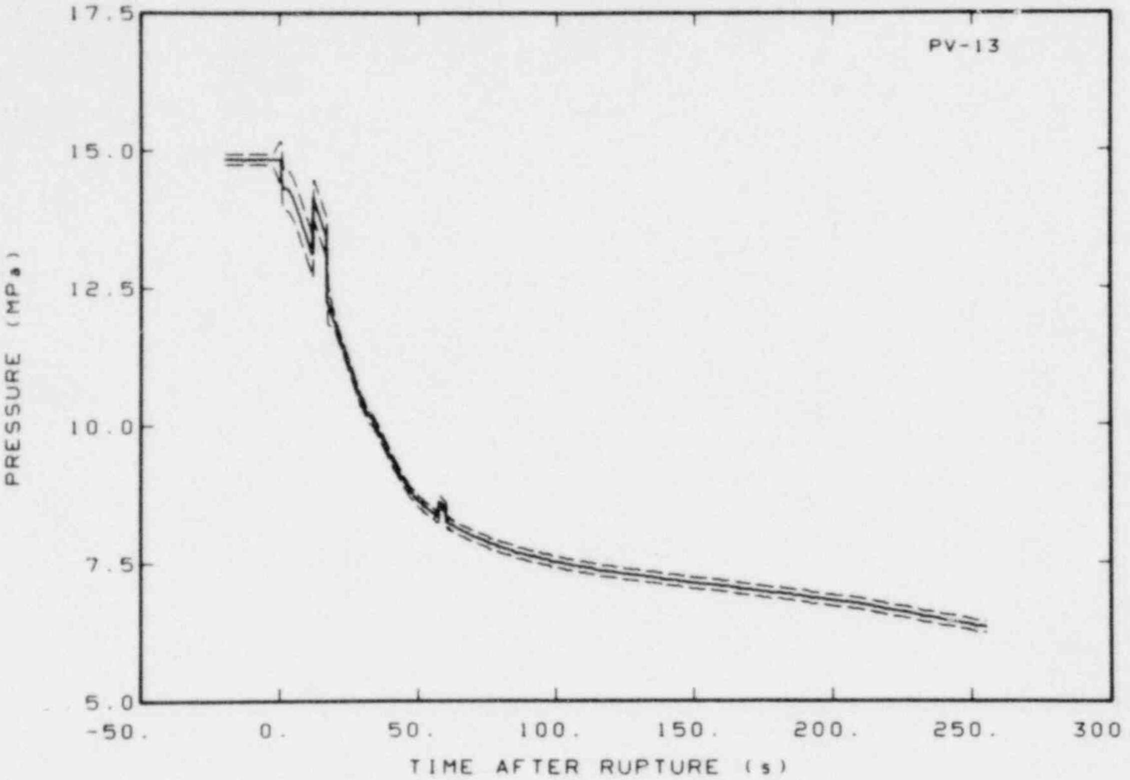


Figure C-28. Pressure in vessel, Test S-SB-4 (PV-13).

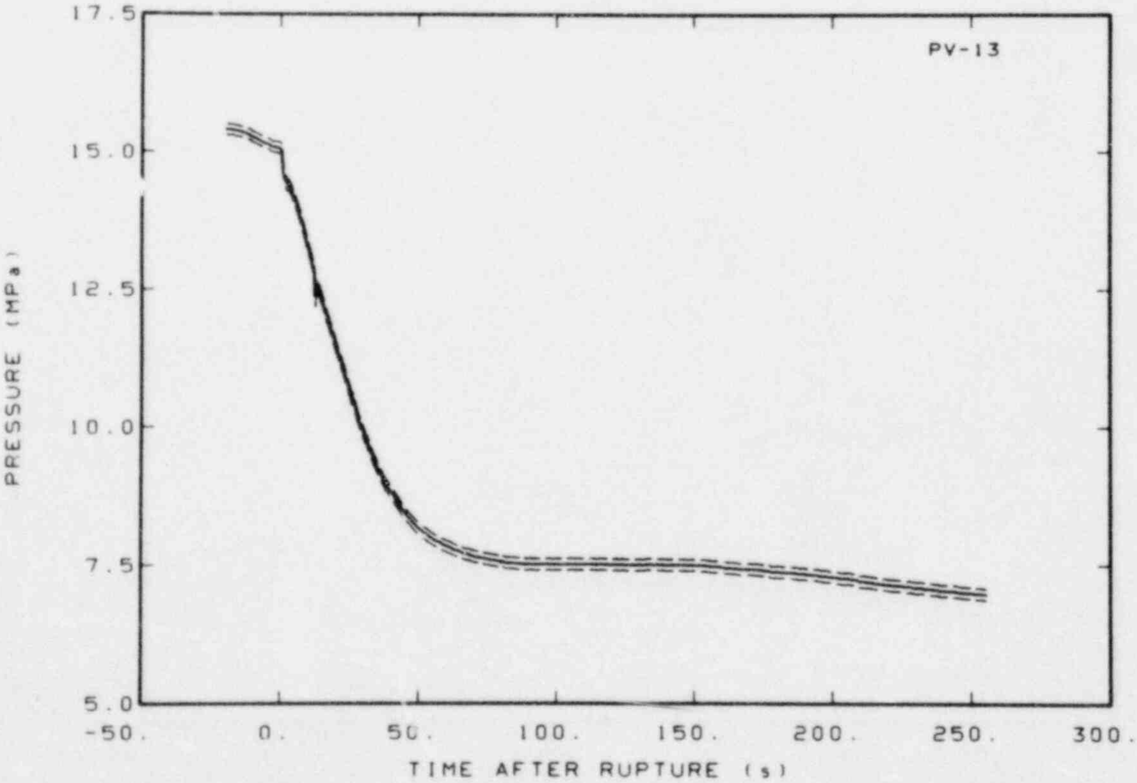


Figure C-29. Pressure in vessel, Test S-SB-4A (PV-13).

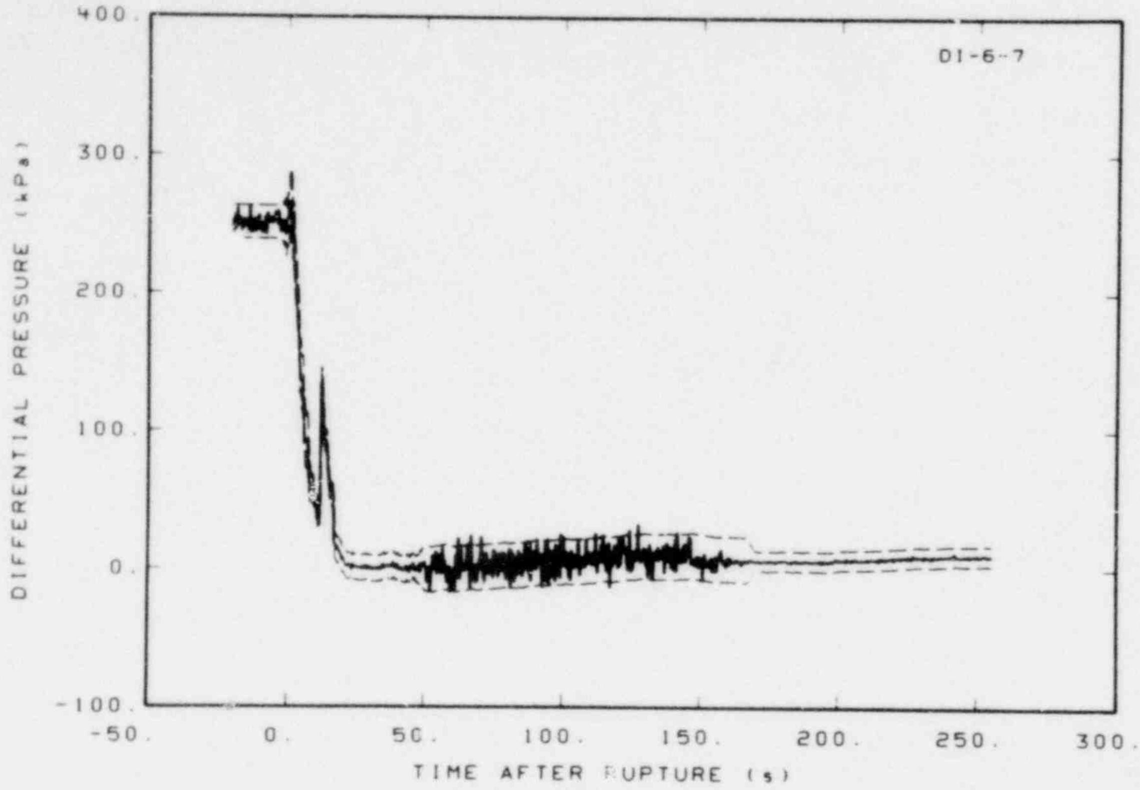


Figure C-30. Differential pressure across intact loop steam generator, Test S-SB-4 (DI-6-7).

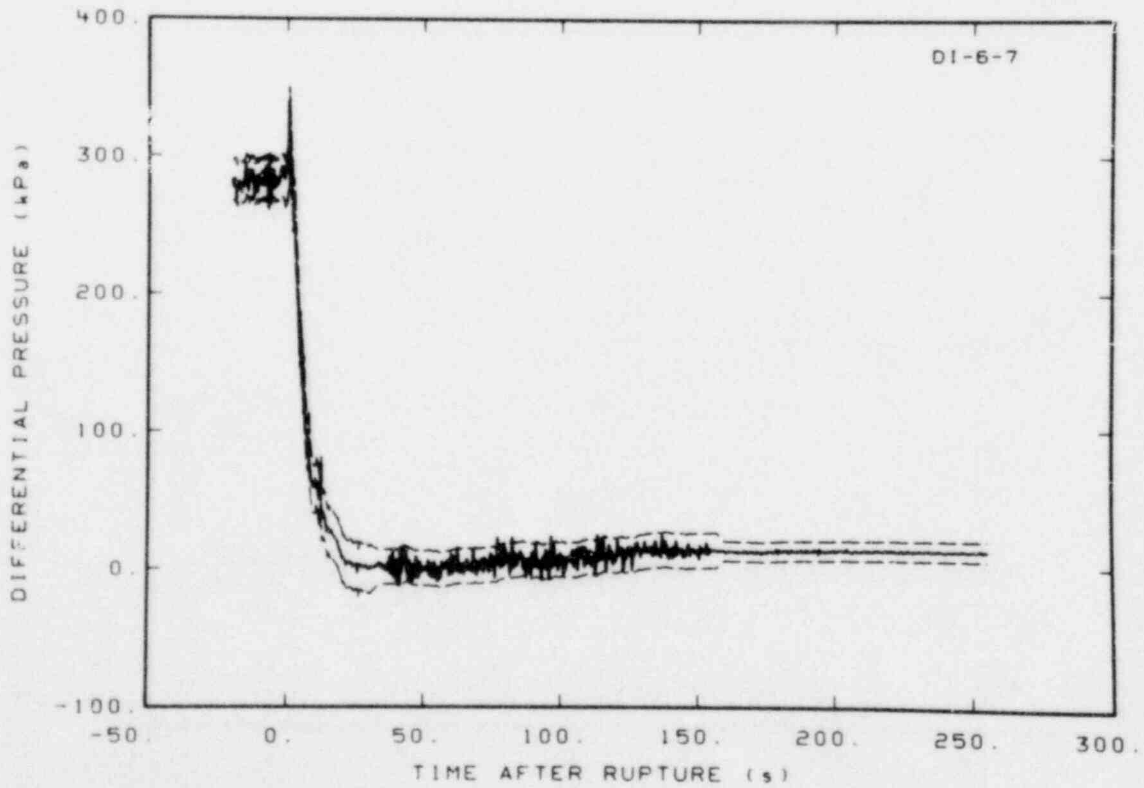


Figure C-31. Differential pressure across intact loop steam generator, Test S-SB-4A (DI-6-7).

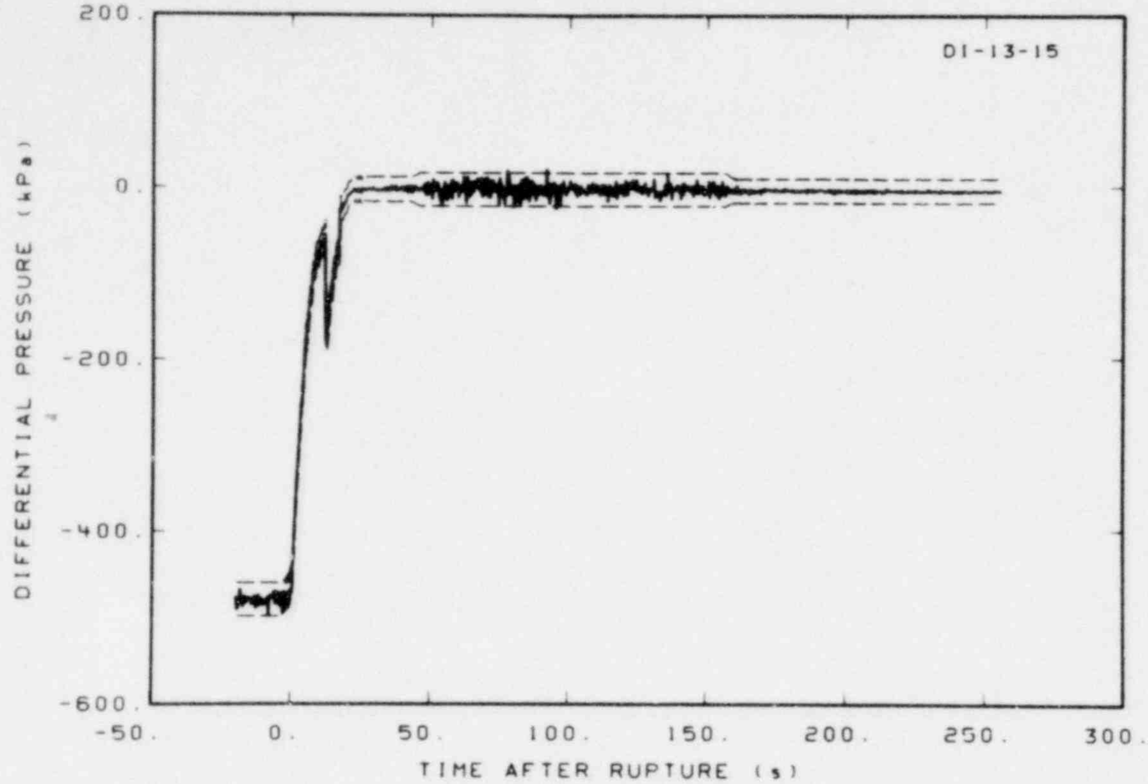


Figure C-32. Differential pressure across intact loop pump, Test S-SB-4 (DI-13-15).

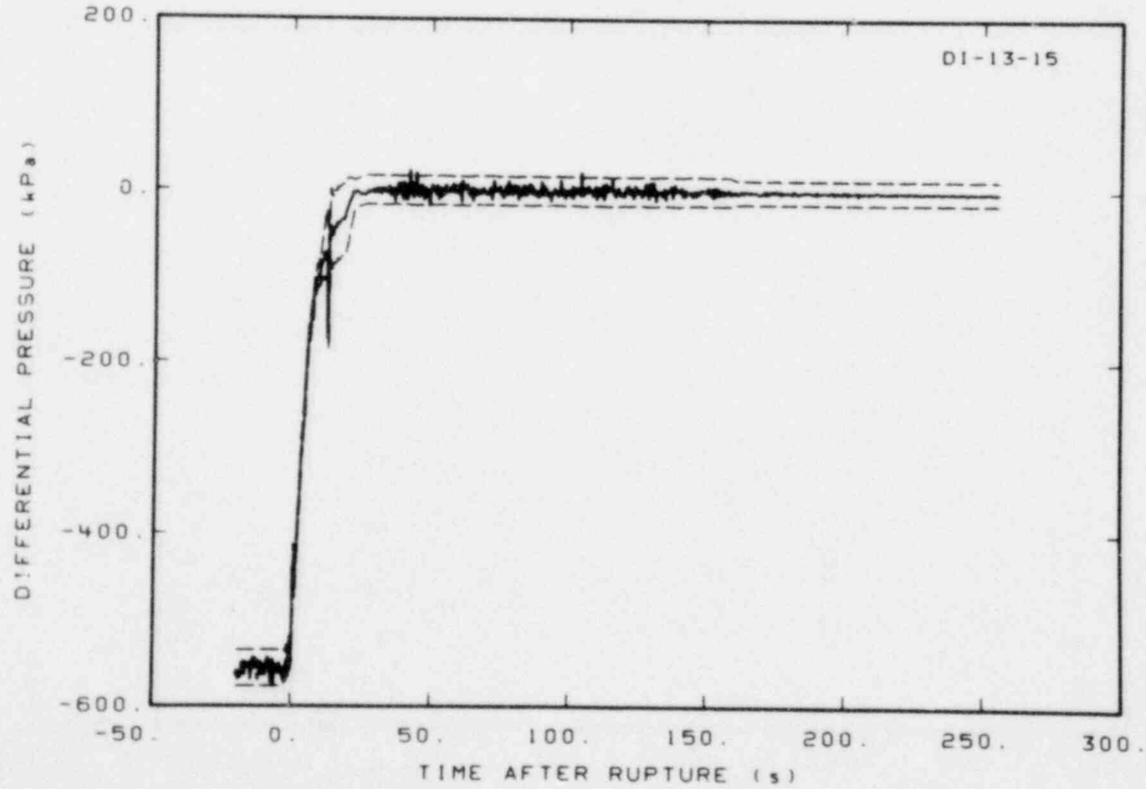


Figure C-33. Differential pressure across intact loop pump, Test S-SB-4A (DI-13-15).

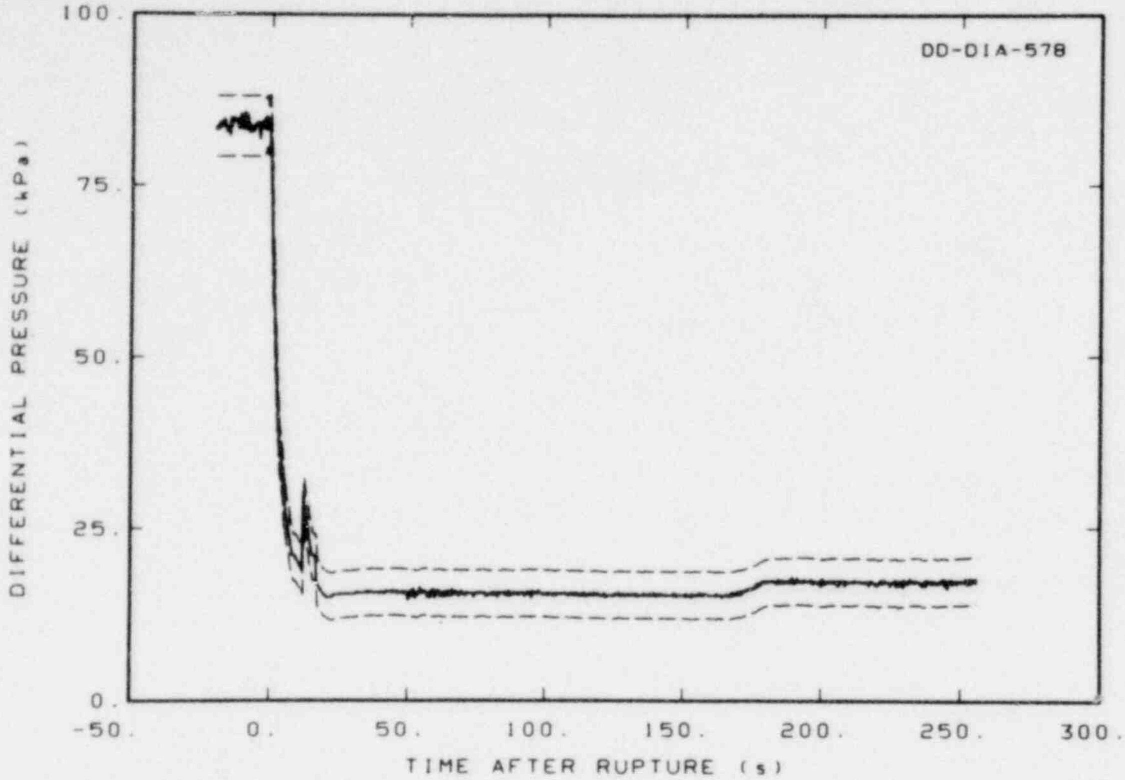


Figure C-34. Differential pressure in downcomer, Test S-SB-4 (DD-DIA-578).

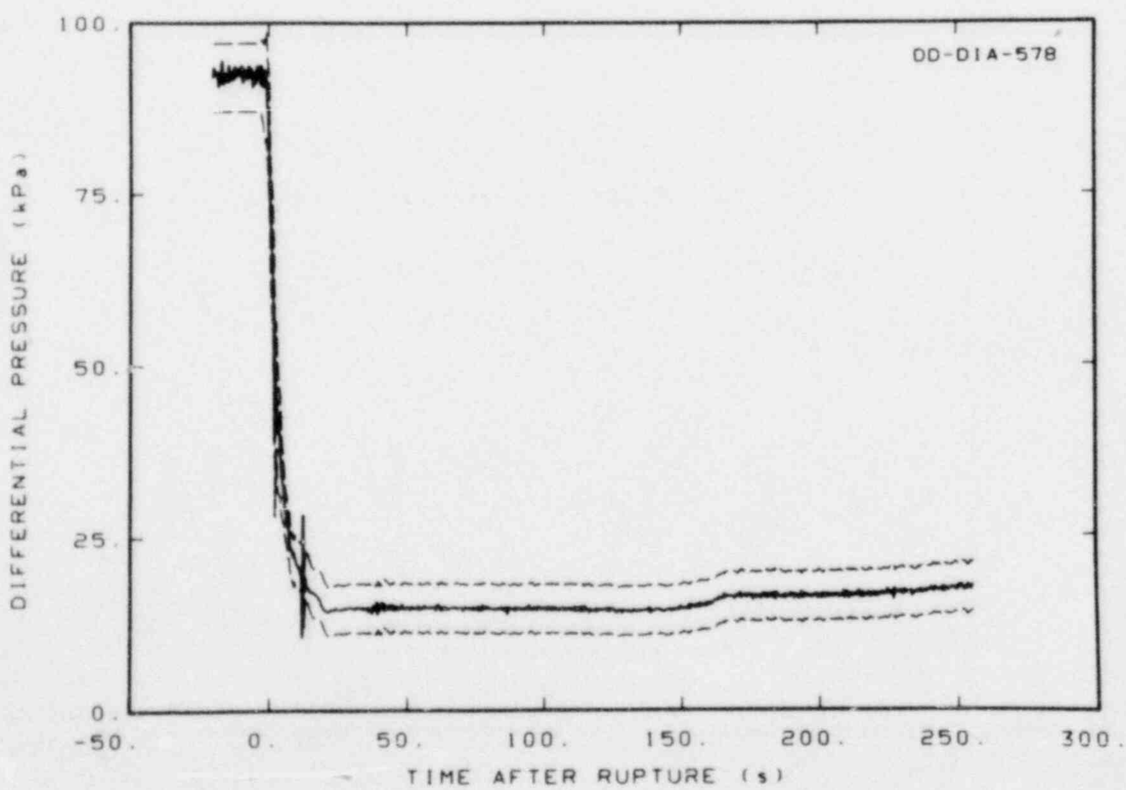


Figure C-35. Differential pressure in downcomer, Test S-SB-4A (DD-DIA-578).

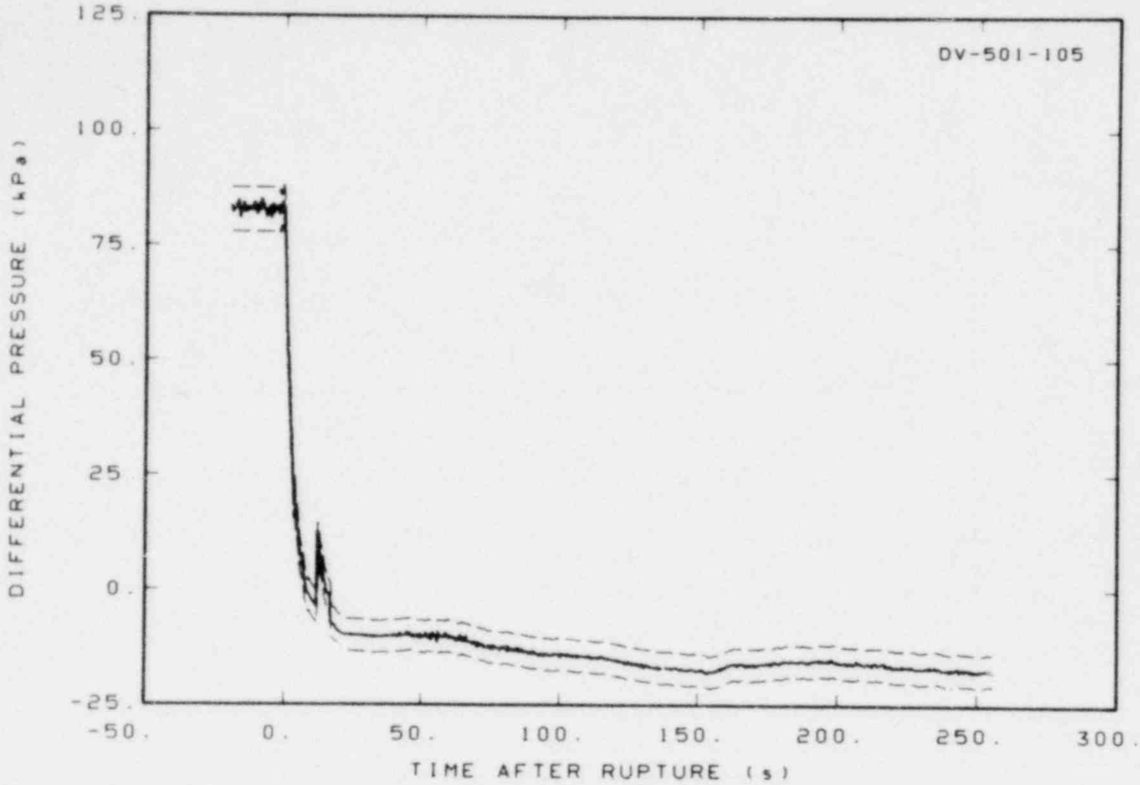


Figure C-36. Differential pressure in vessel, Test S-SB-4 (DV-501-105).

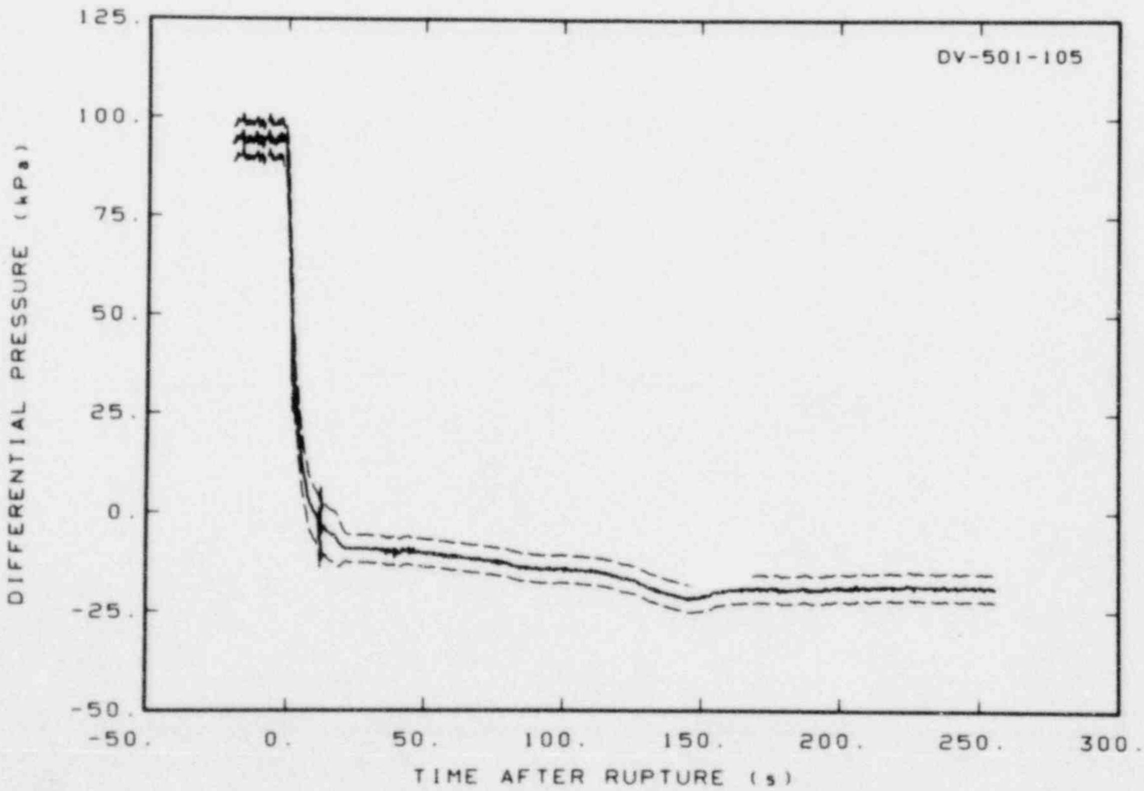


Figure C-37. Differential pressure in vessel, Test S-SB-4A (DV-501-105).

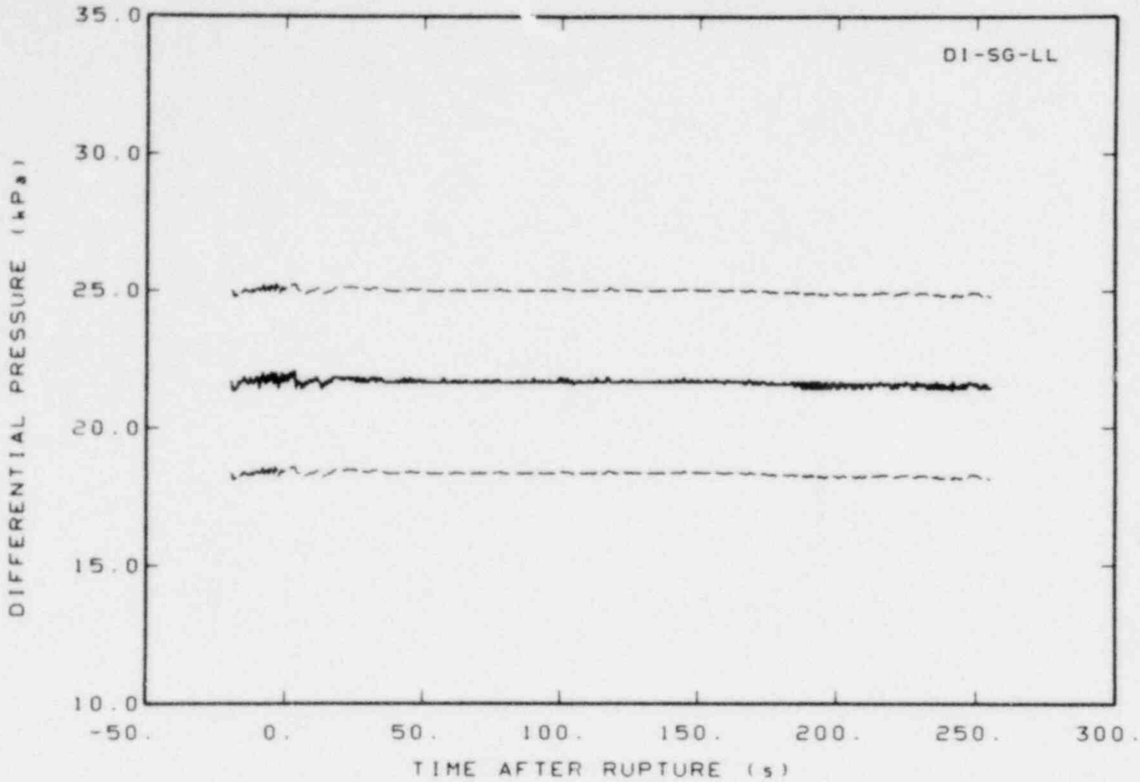


Figure C-38. Differential pressure, intact loop steam generator secondary side liquid level, Test S-SB-4 (DI-SG-LL).

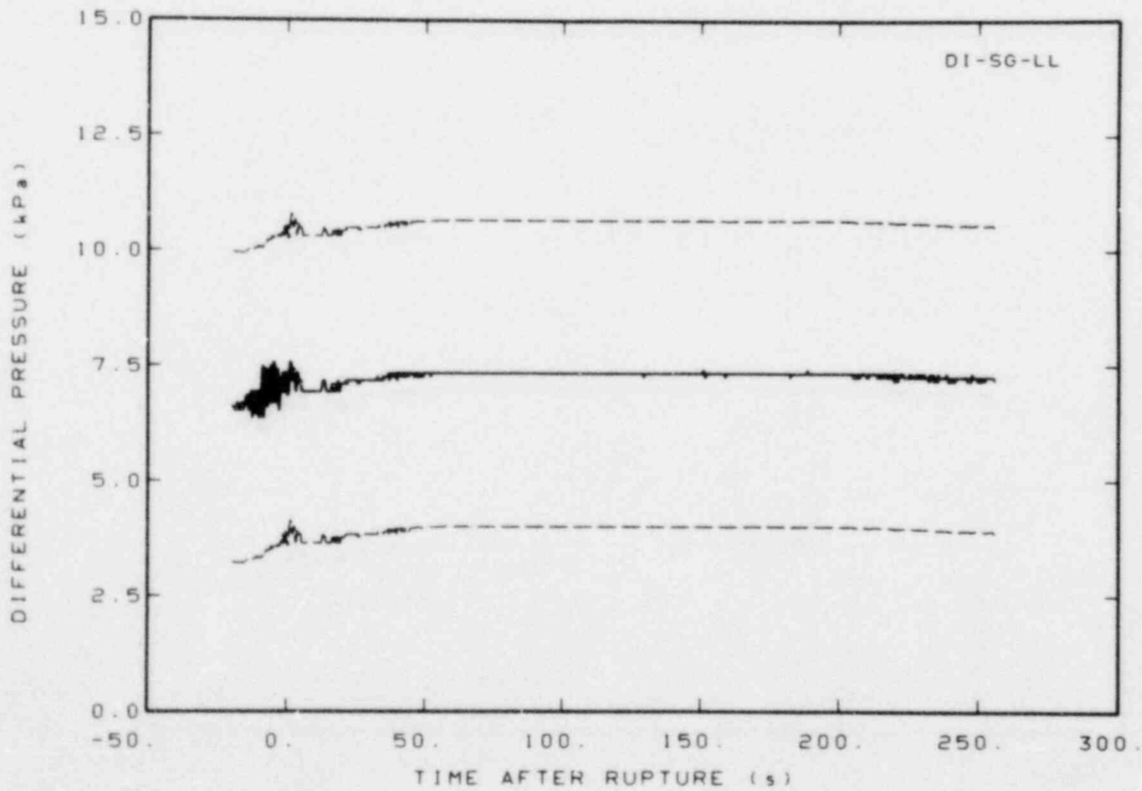


Figure C-39. Differential pressure, intact loop steam generator secondary side liquid level, Test S-SB-4A (DI-SG-LL).

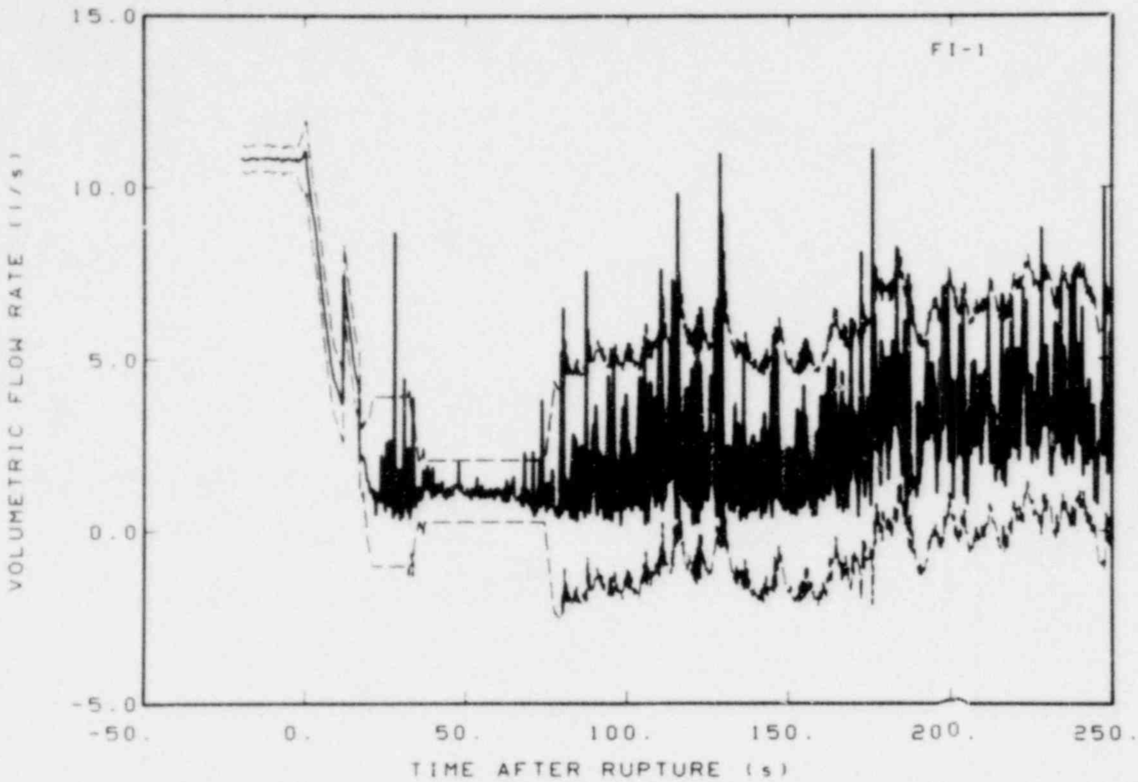


Figure C-40. Volumetric flow rate in intact loop hot leg, Test S-SB-4 (FI-1).

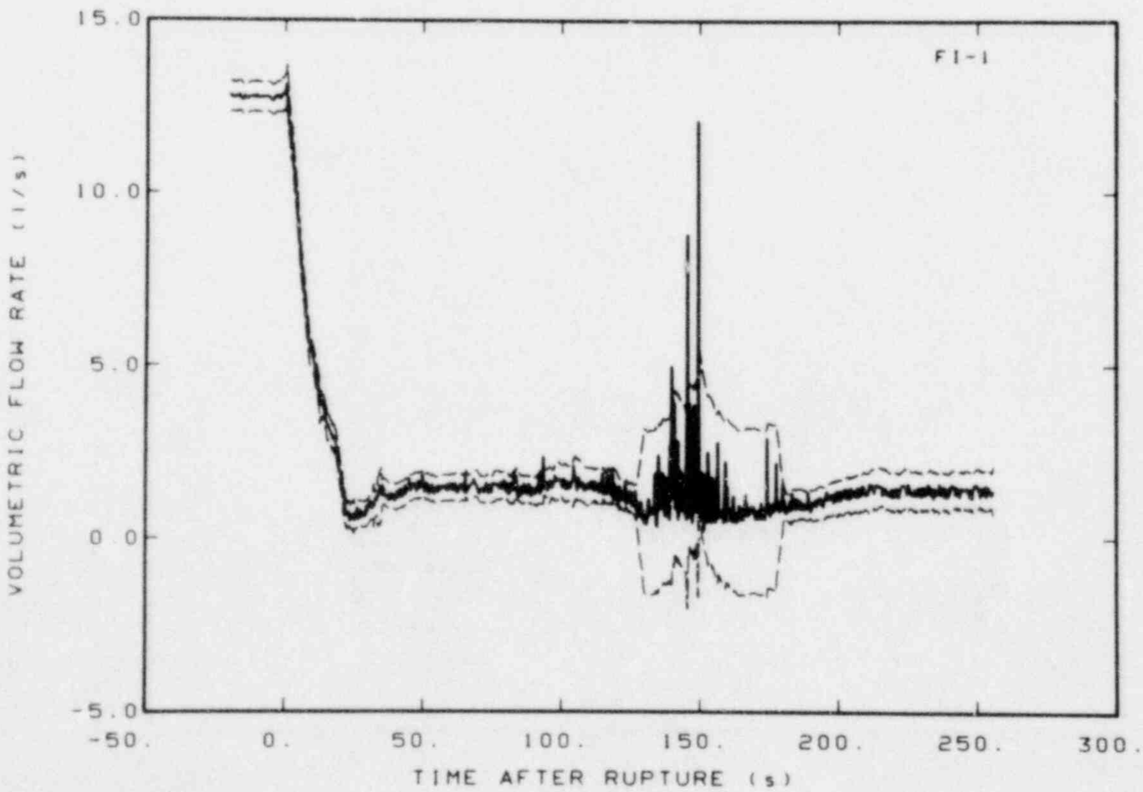


Figure C-41. Volumetric flow rate in intact loop hot leg, Test S-SB-4A (FI-1).

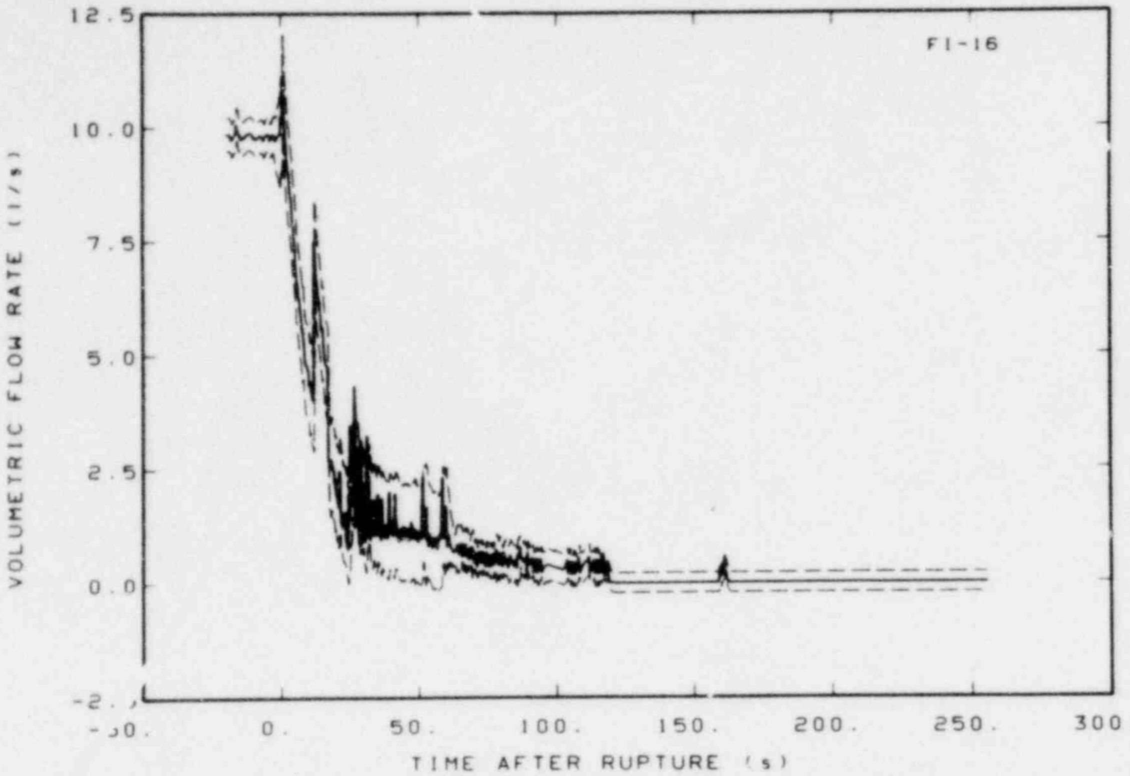


Figure C-42. Volumetric flow rate in intact loop cold leg, Test S-SB-4 (FI-16).

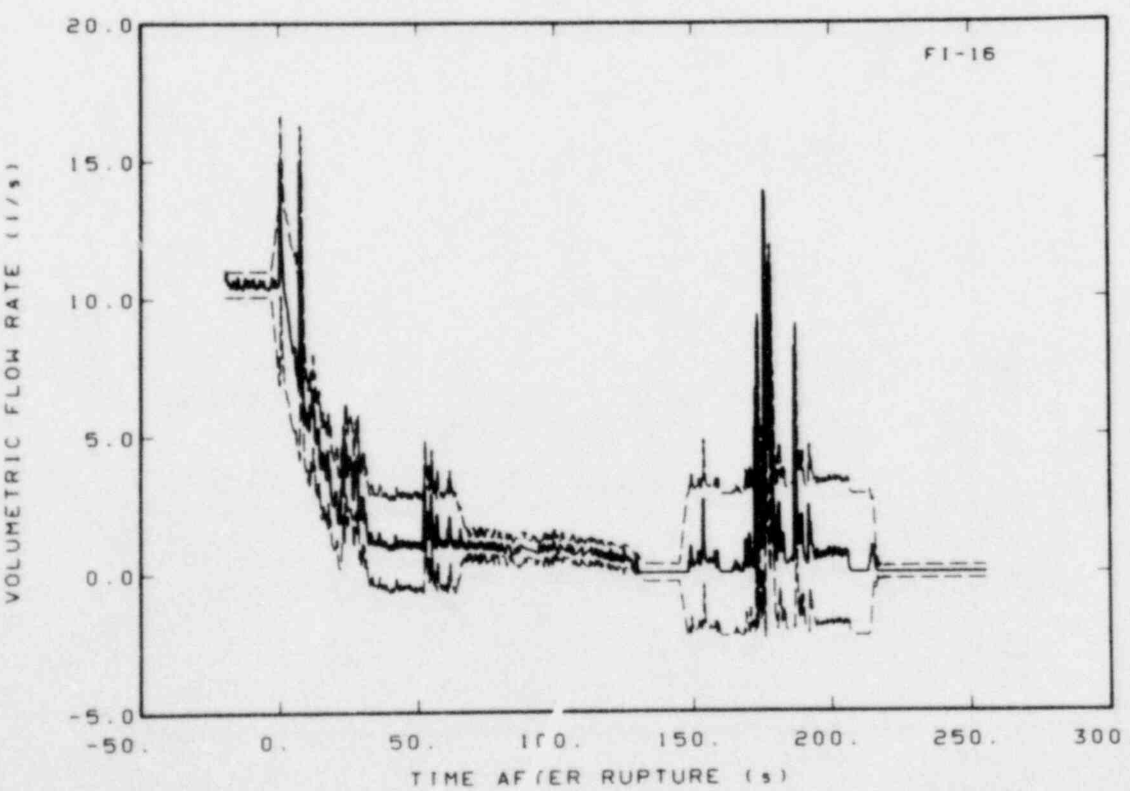


Figure C-43. Volumetric flow rate in intact loop cold leg, Test S-SB-4A (FI-16).

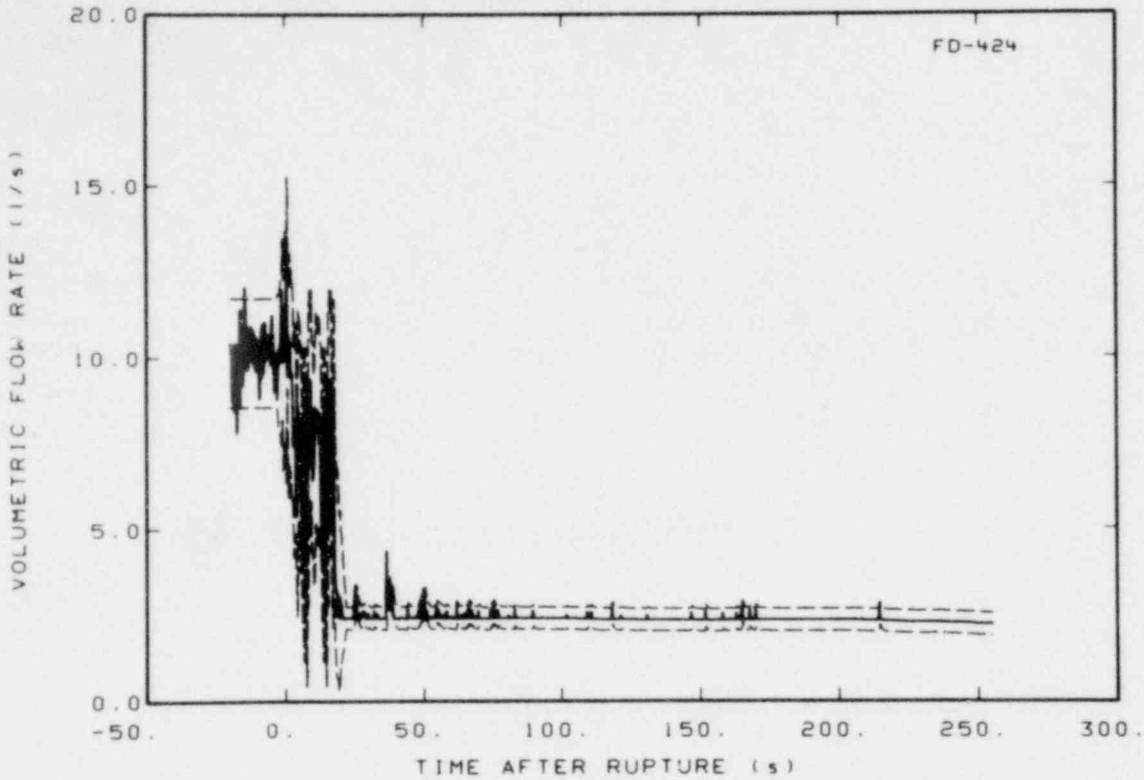


Figure C-44. Volumetric flow rate in downcomer, Test S-SB-4 (FD-424).

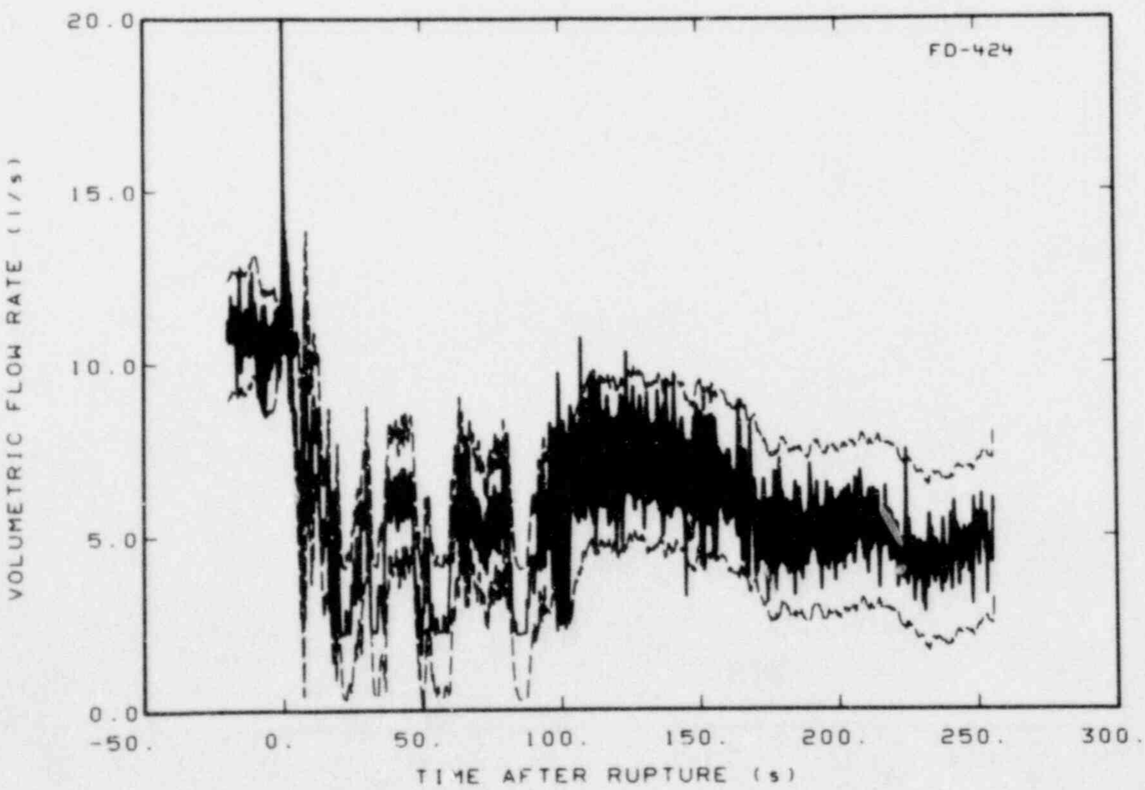


Figure C-45. Volumetric flow rate in downcomer, Test S-SB-4A (FD-424).

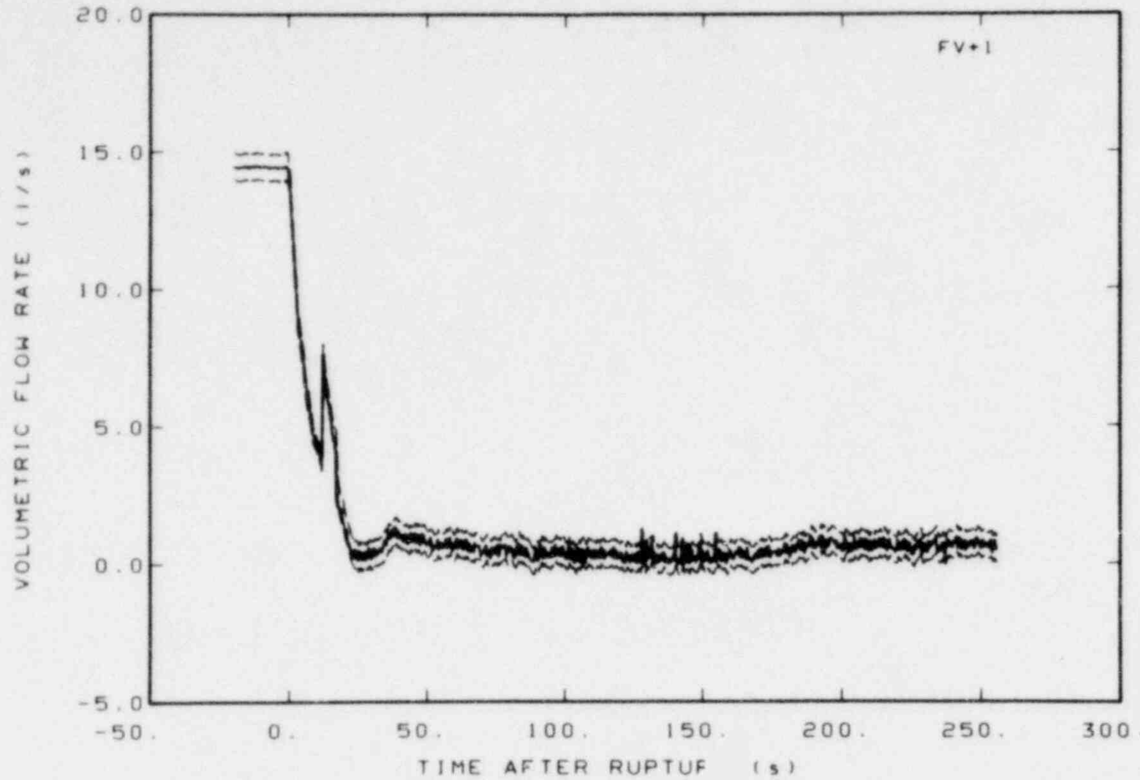


Figure C-46. Volumetric flow rate in vessel, upper plenum, Test S-SB-4 (FV + 1).

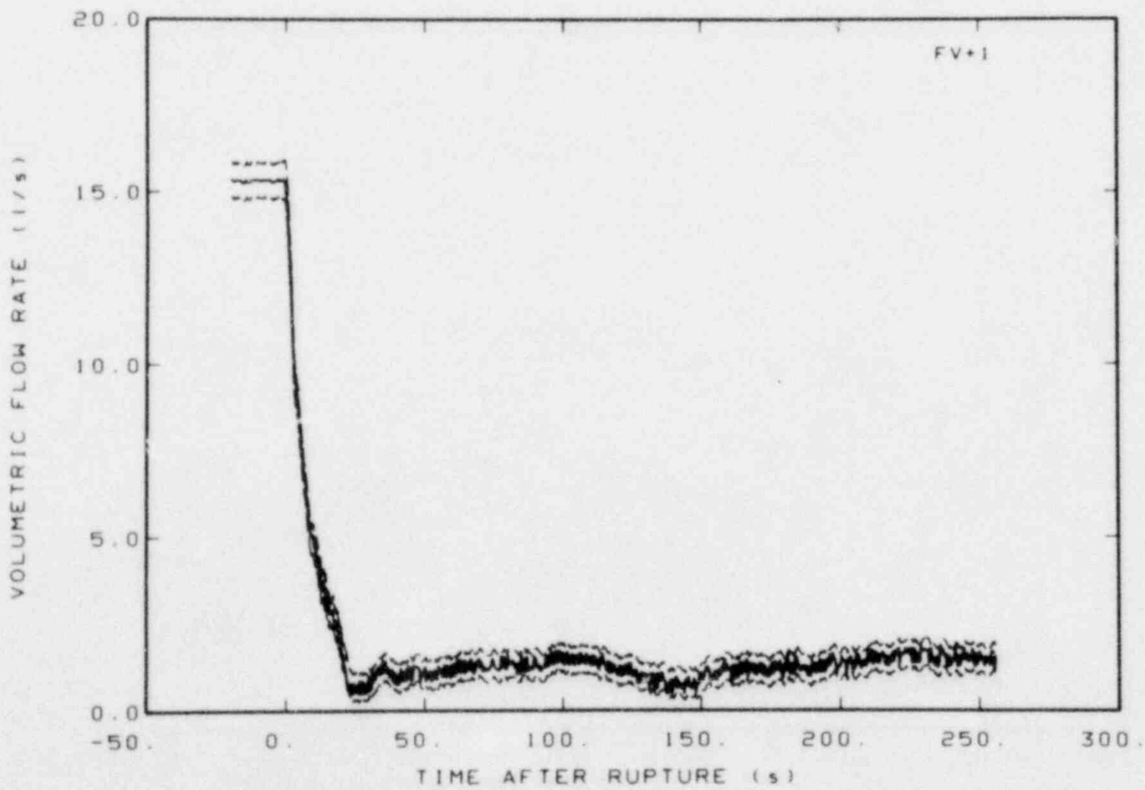


Figure C-47. Volumetric flow rate in vessel, upper plenum, Test S-SB-4A (FV + 1).

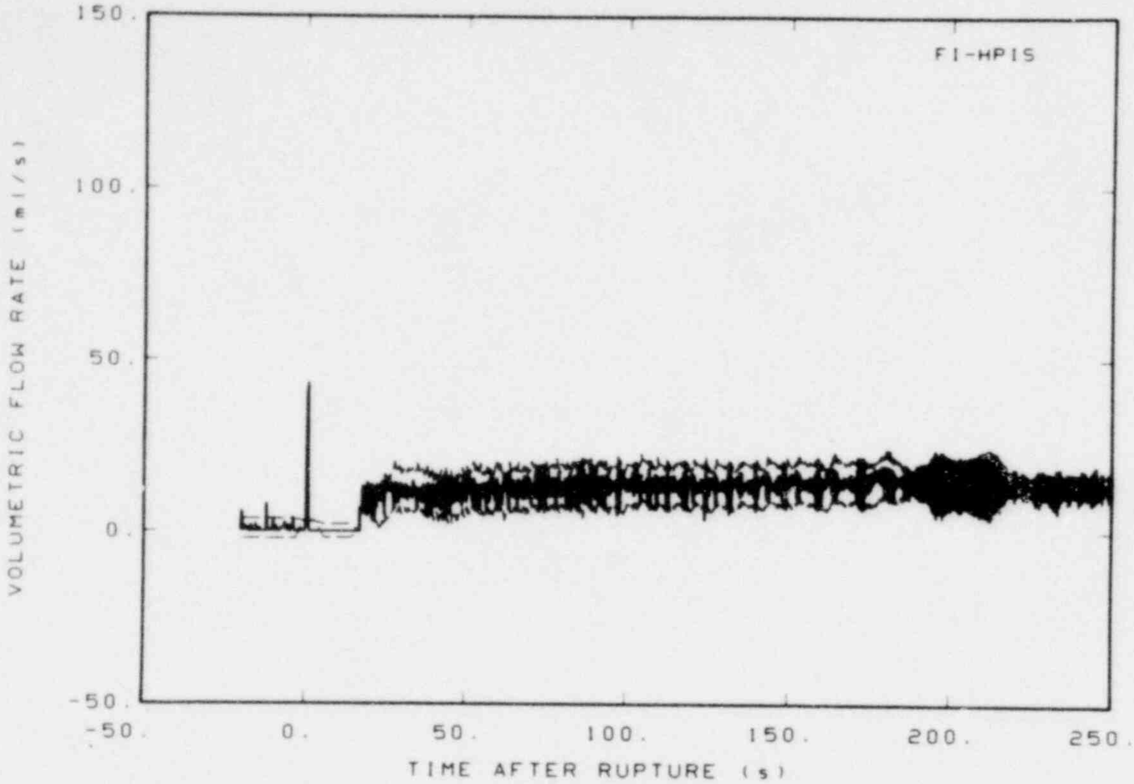


Figure C-48. Volumetric flow rate in intact loop high pressure injection system, Test S-SB-4 (FI-HPIS).

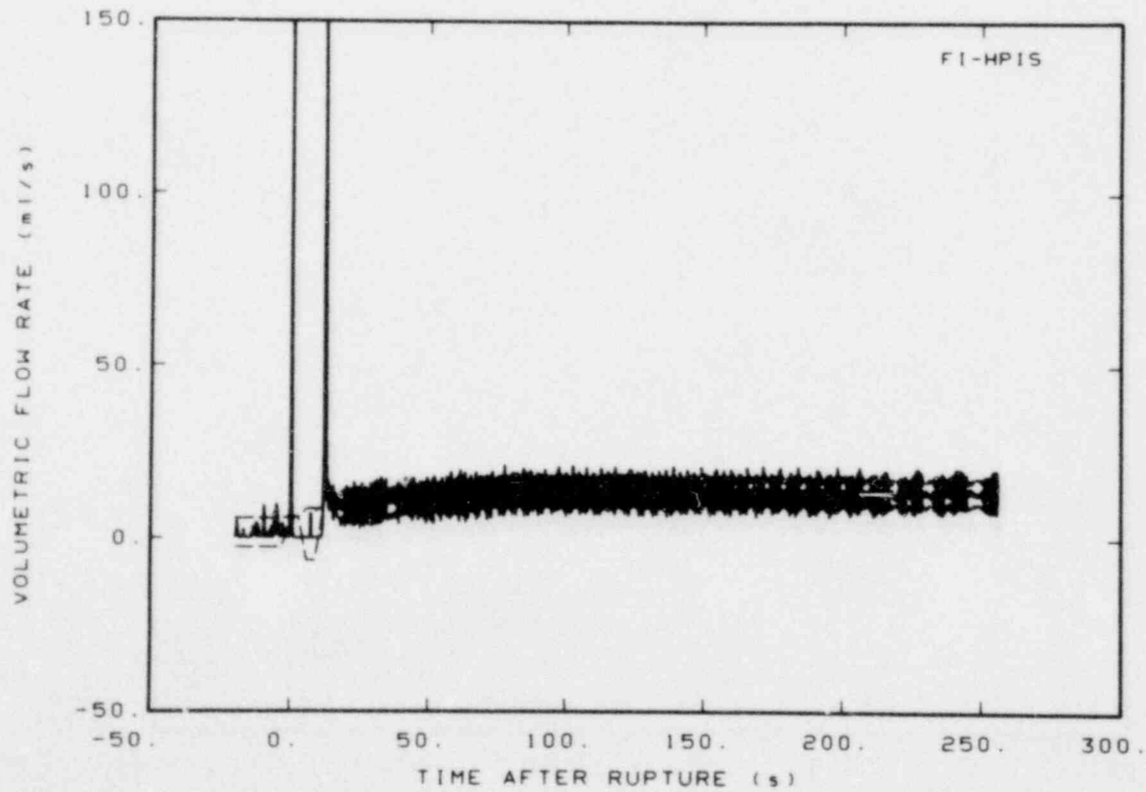


Figure C-49. Volumetric flow rate in intact loop high pressure injection system, Test S-SB-4A (FI-HPIS).

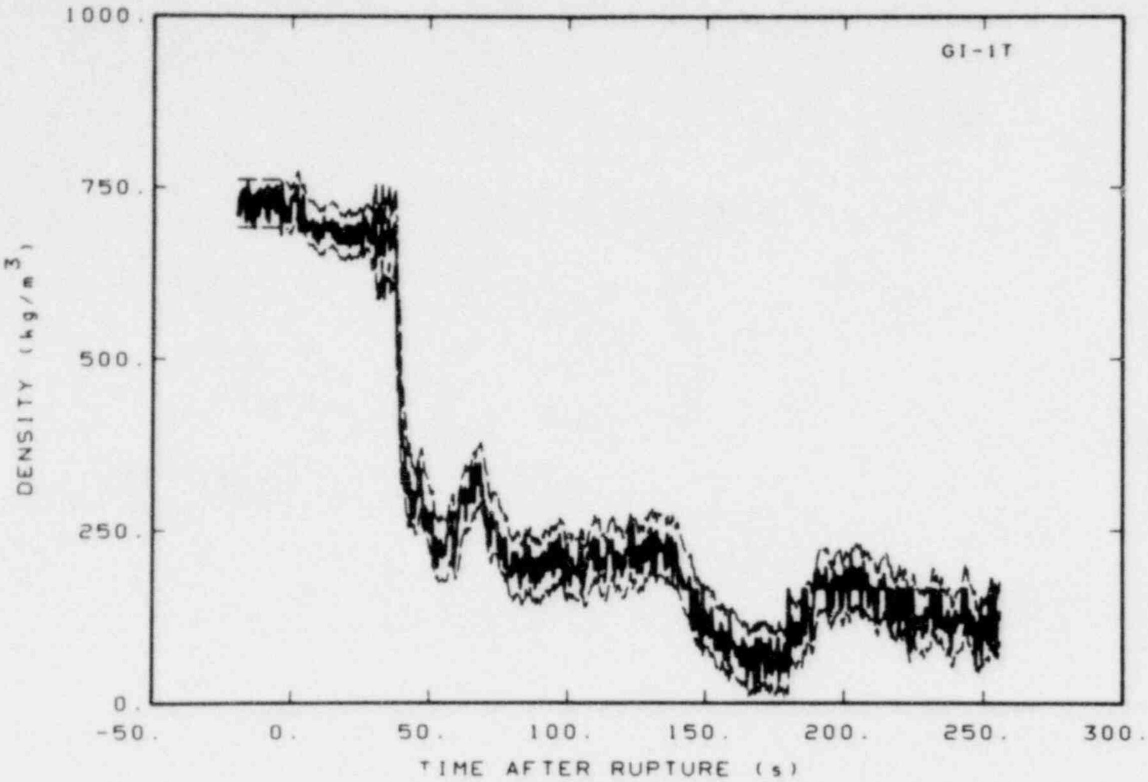


Figure C-50. Density in intact loop hot leg, Test S-SB-4 (GI-1T).

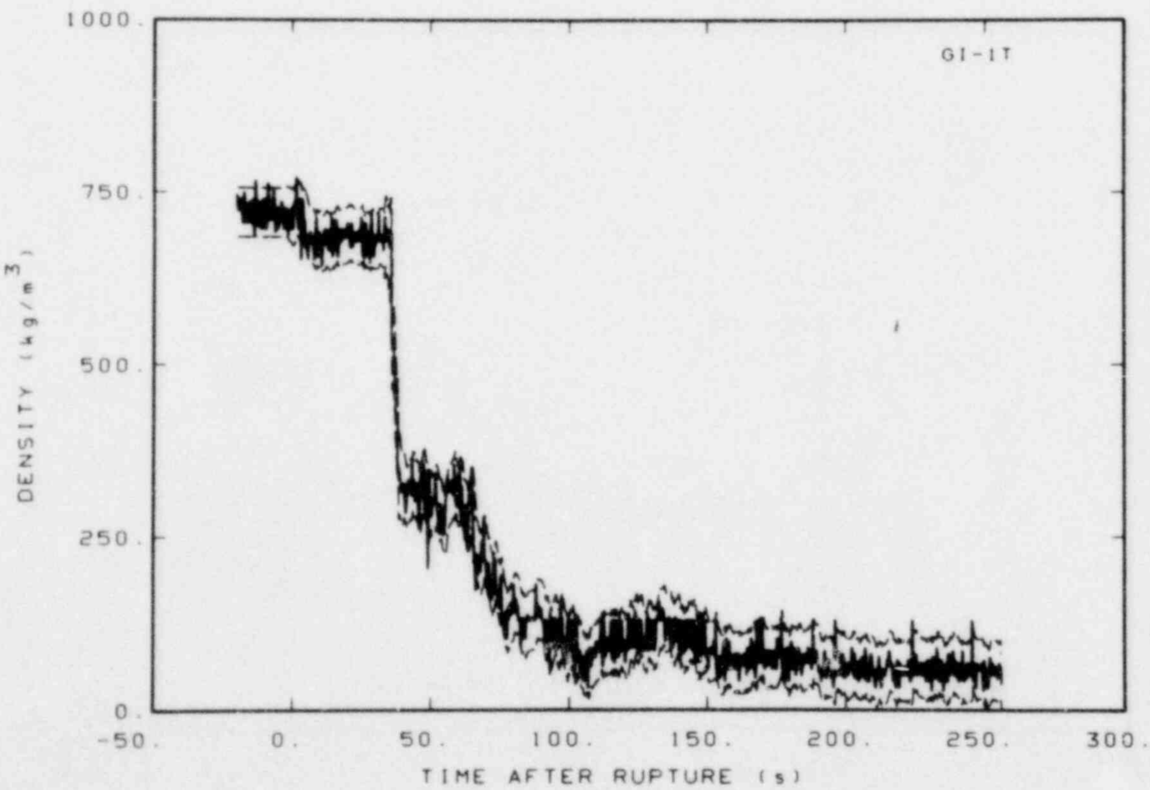


Figure C-51. Density in intact loop hot leg, Test S-SB-4A (GI-1T).

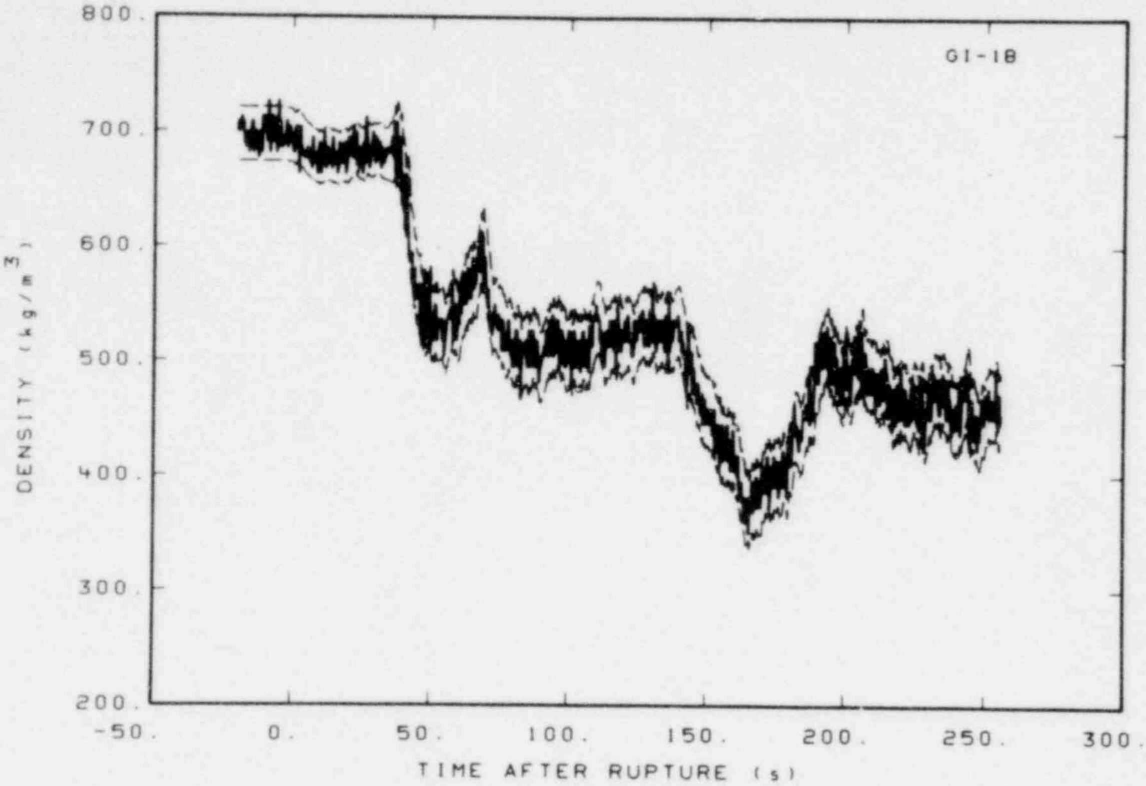


Figure C-52. Density in intact loop hot leg, Test S-SB-4 (GI-1B).

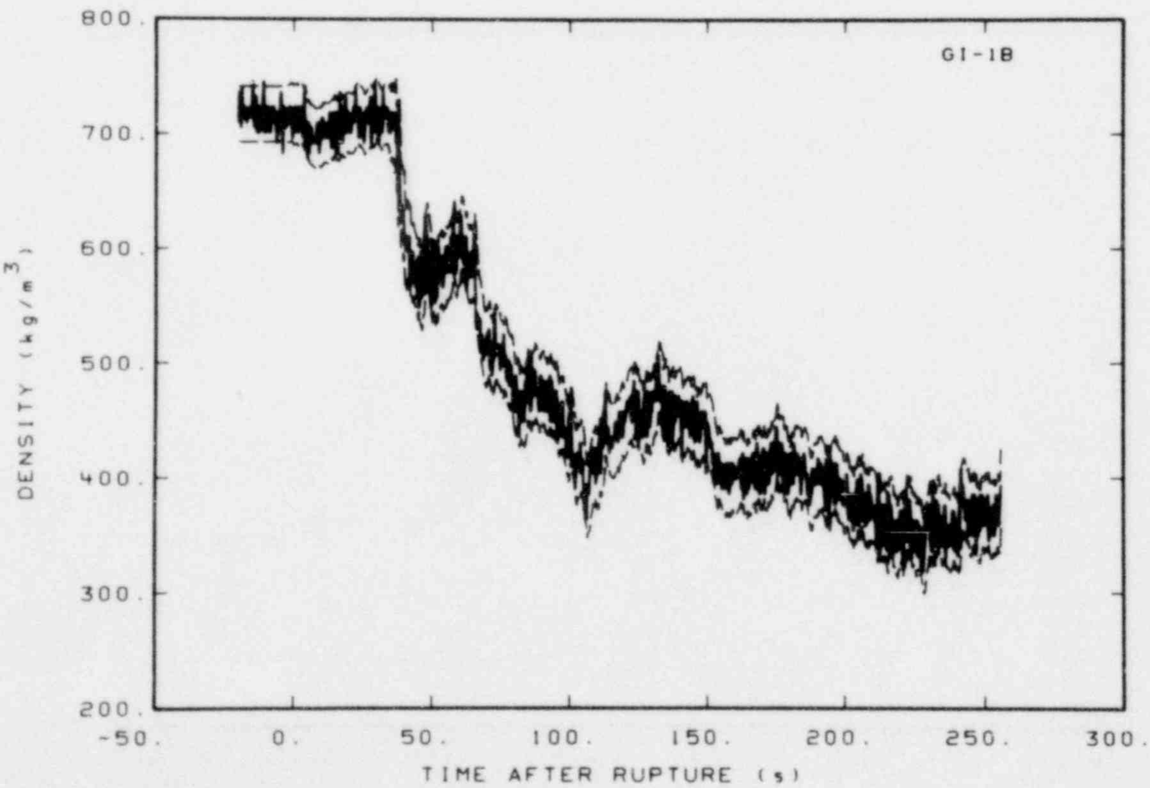


Figure C-53. Density in intact loop hot leg, Test S-SB-4A (GI-1B).

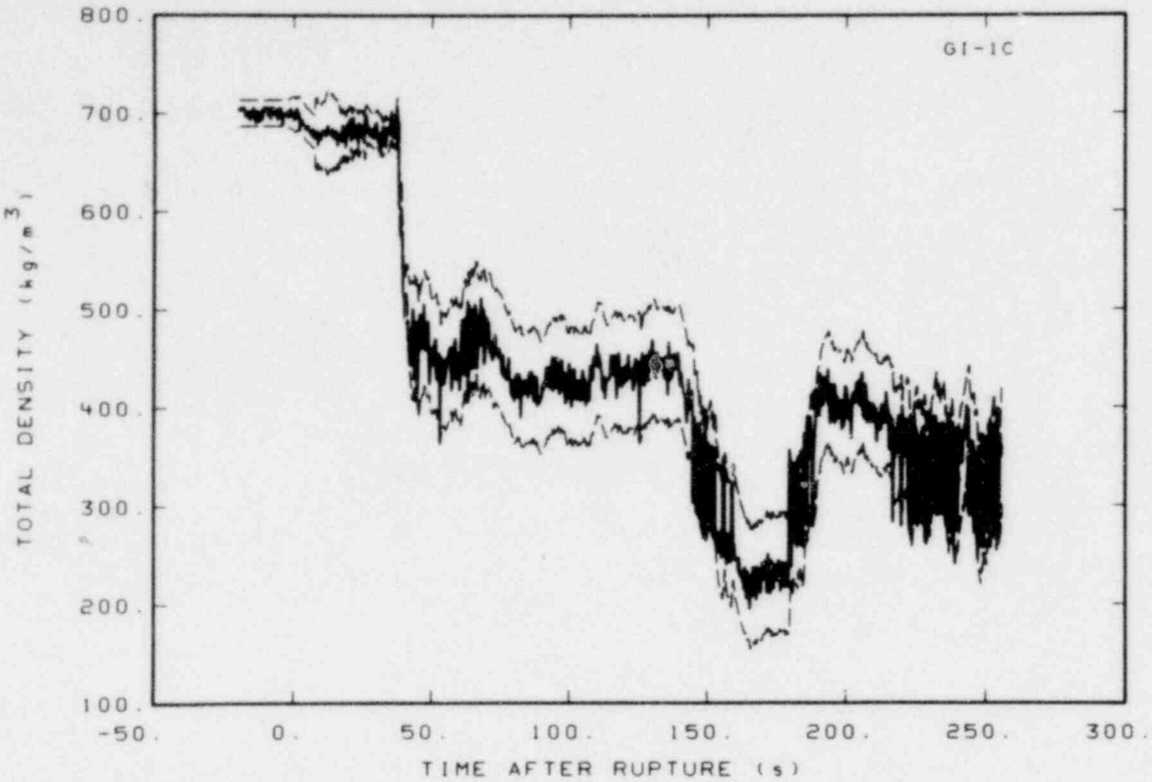


Figure C-54. Density in intact loop hot leg, Test S-SB-4 (GI-1C).

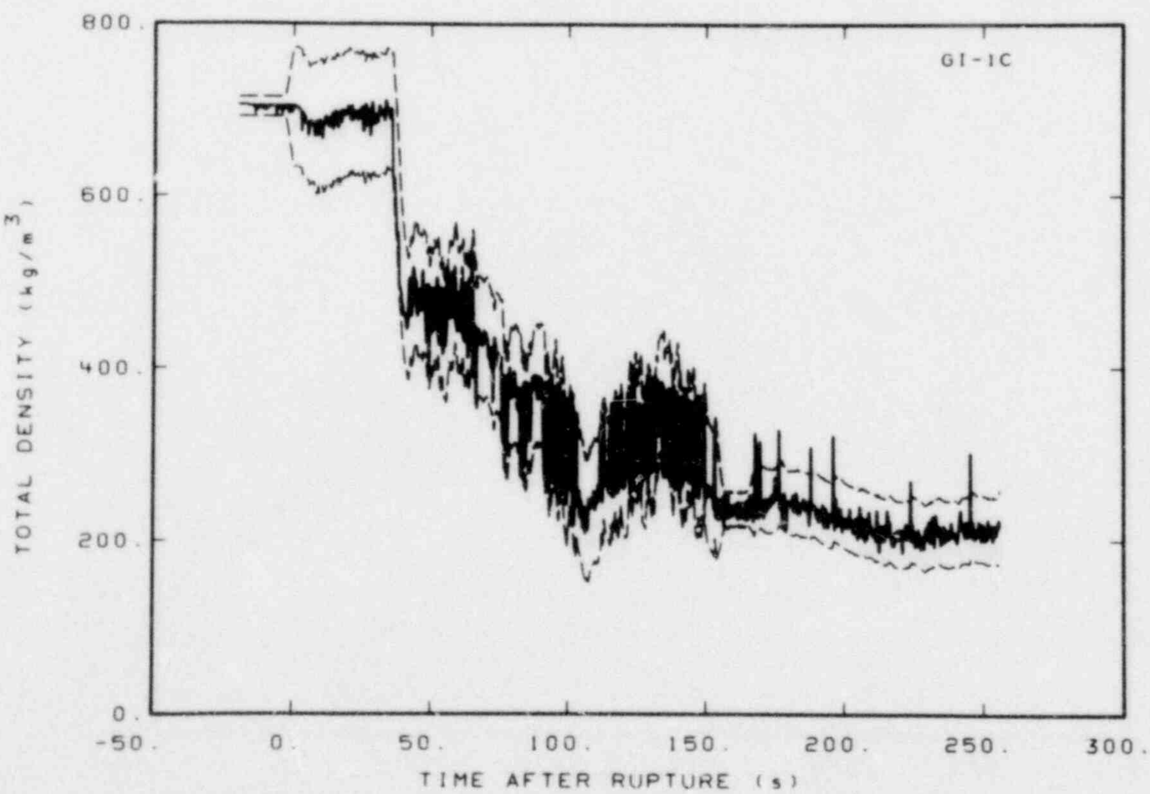


Figure C-55. Density in intact loop hot leg, Test S-SB-4A (GI-1C).

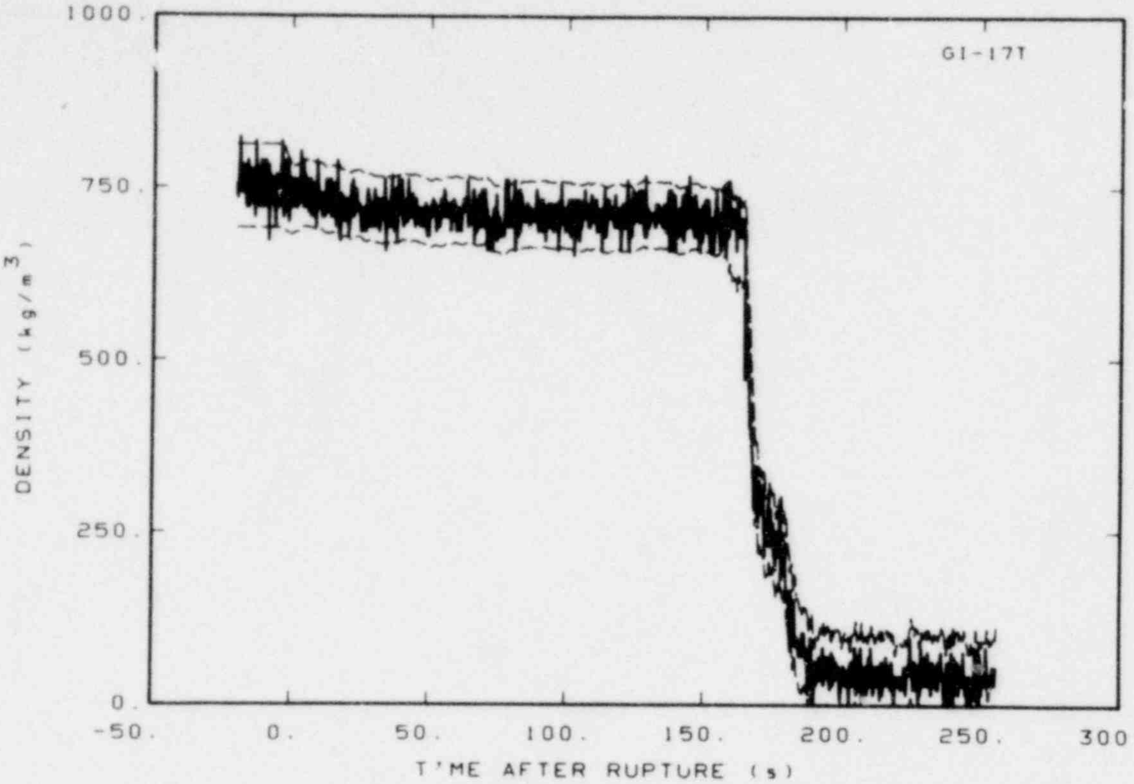


Figure C-56. Density in intact loop cold leg, Test S-SB-4 (GI-17T).

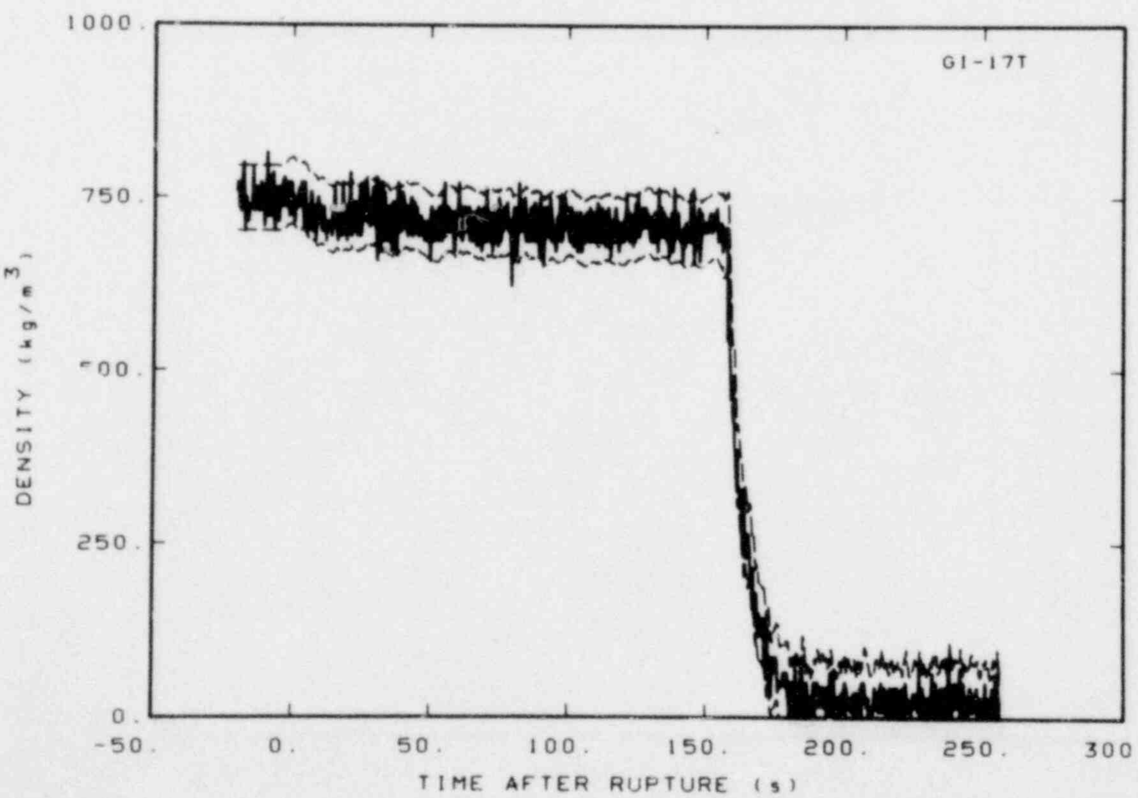


Figure C-57. Density in intact loop cold leg, Test S-SB-4A (GI-17T).

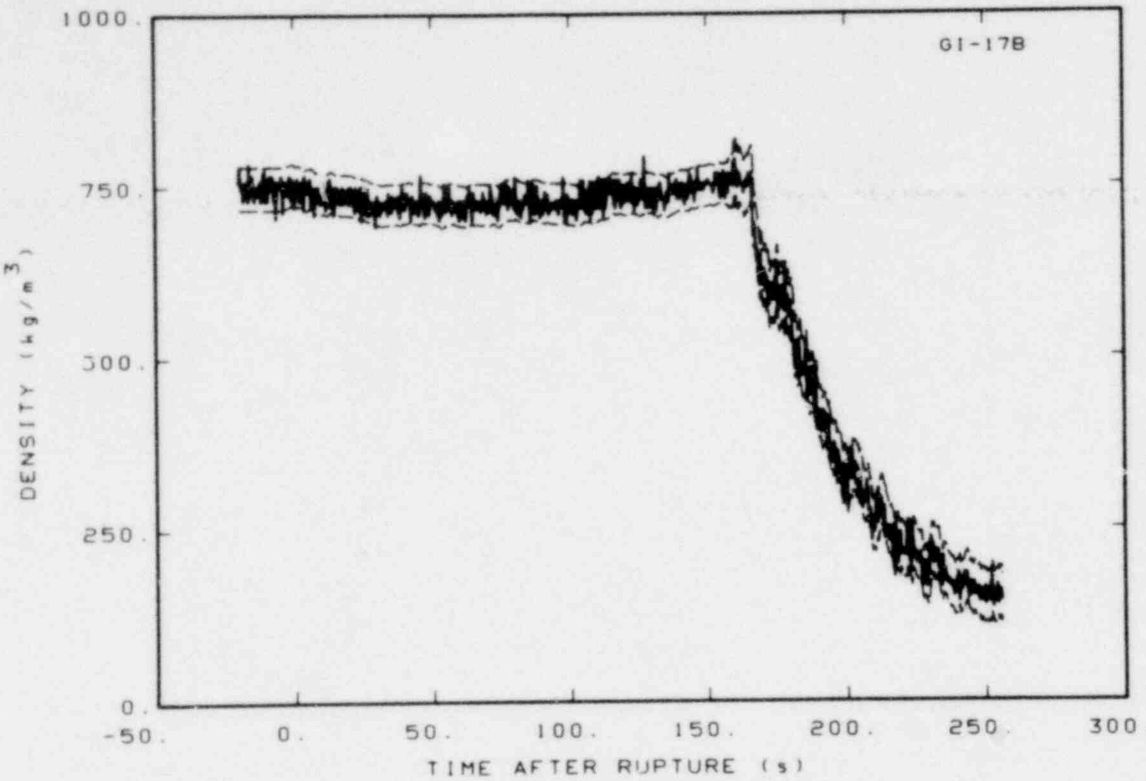


Figure C-58. Density in intact loop cold leg, Test S-SB-4 (GI-17B).

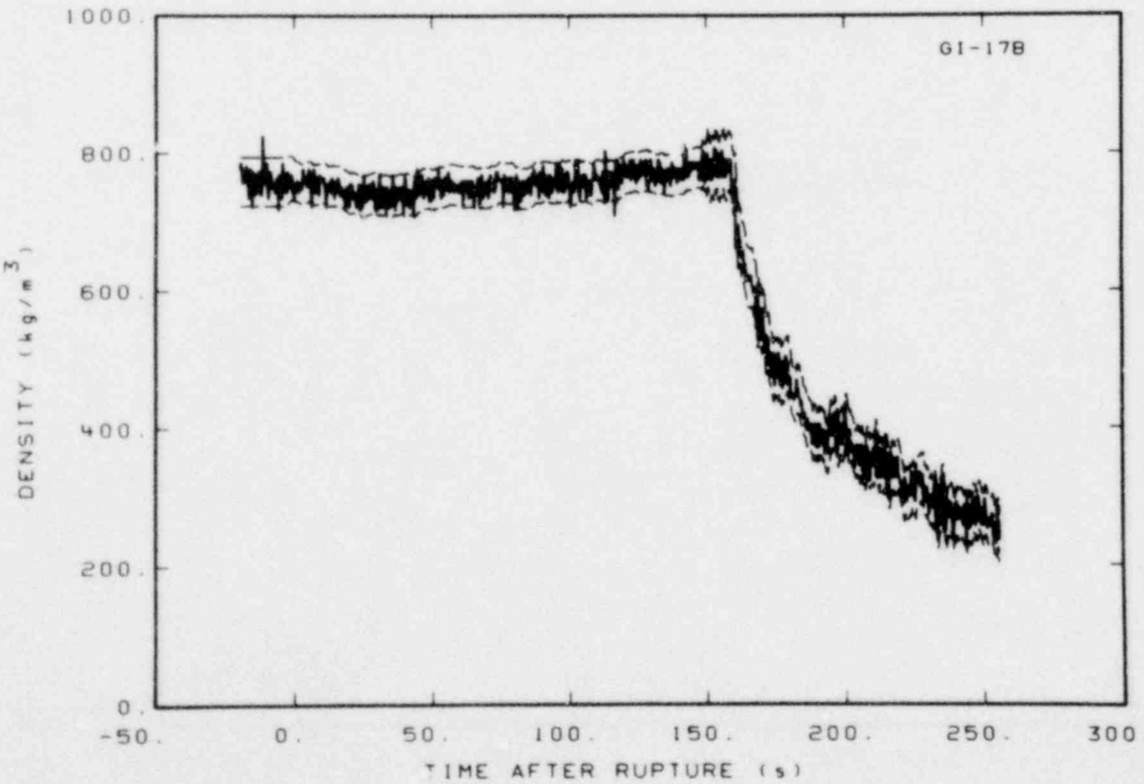


Figure C-59. Density in intact loop cold leg, Test S-SB-4A (GI-17B).

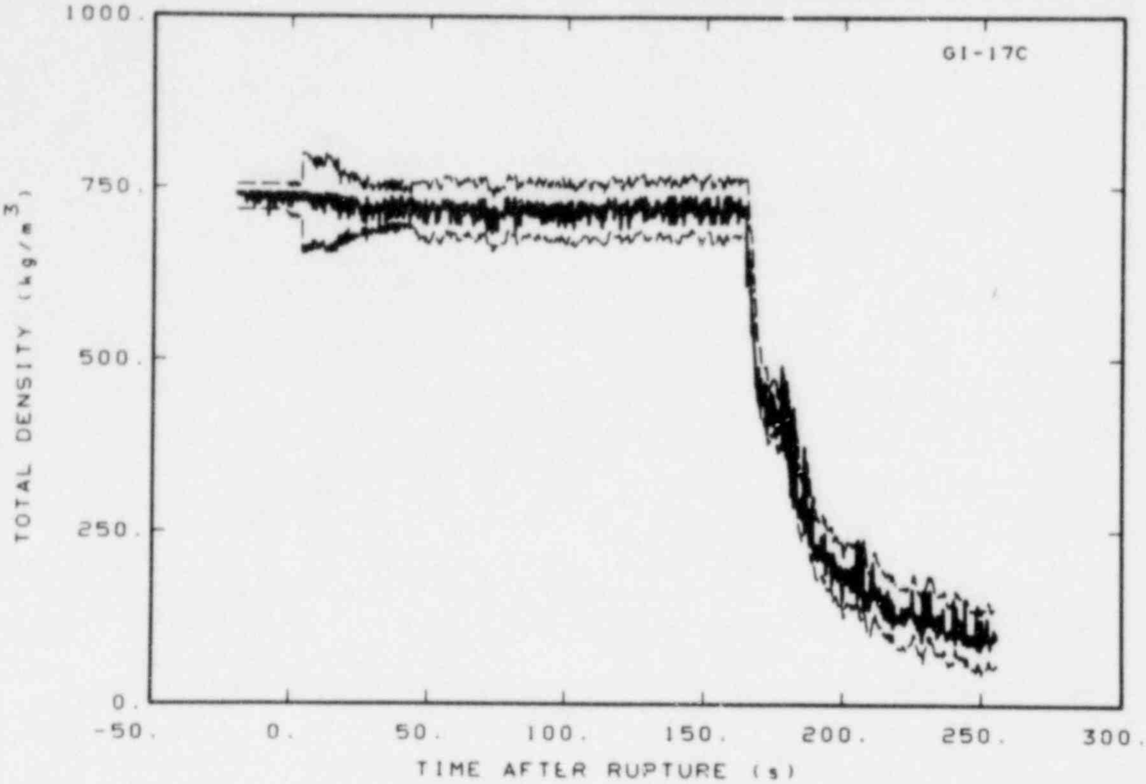


Figure C-60. Density in intact loop cold leg, Test S-SB-4 (GI-17C).

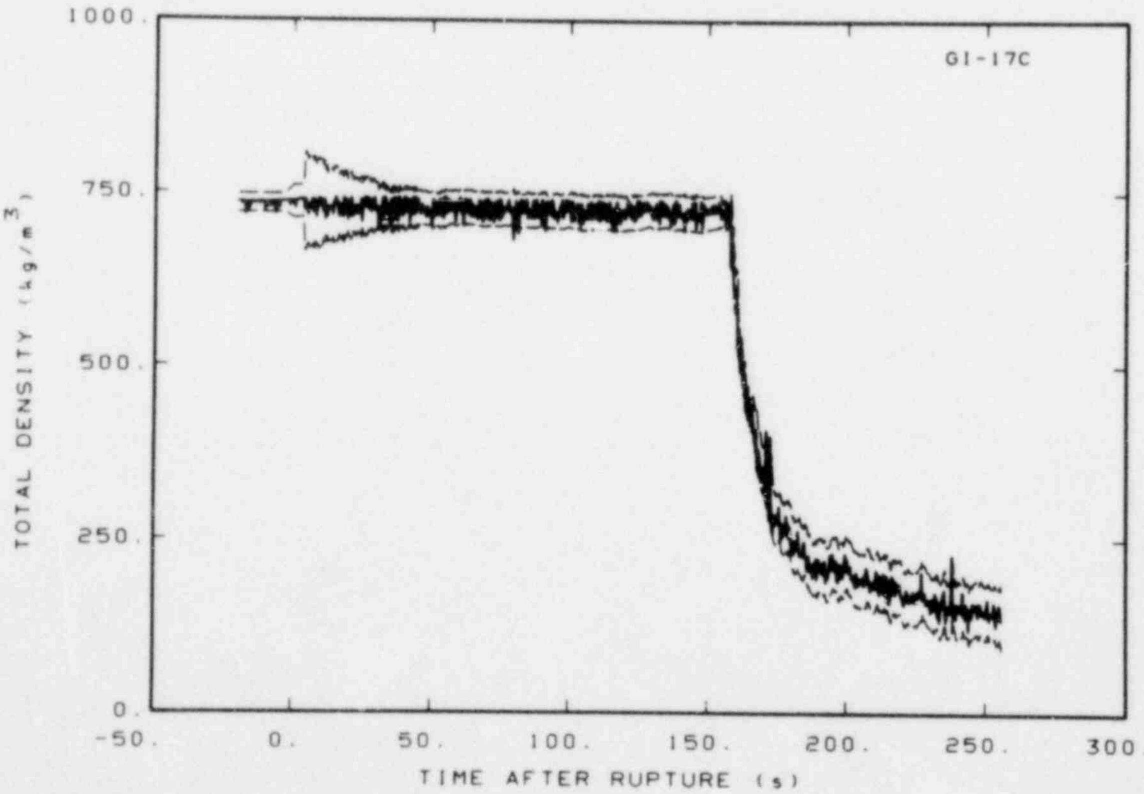


Figure C-61. Density in intact loop cold leg, Test S-SB-4A (GI-17C).

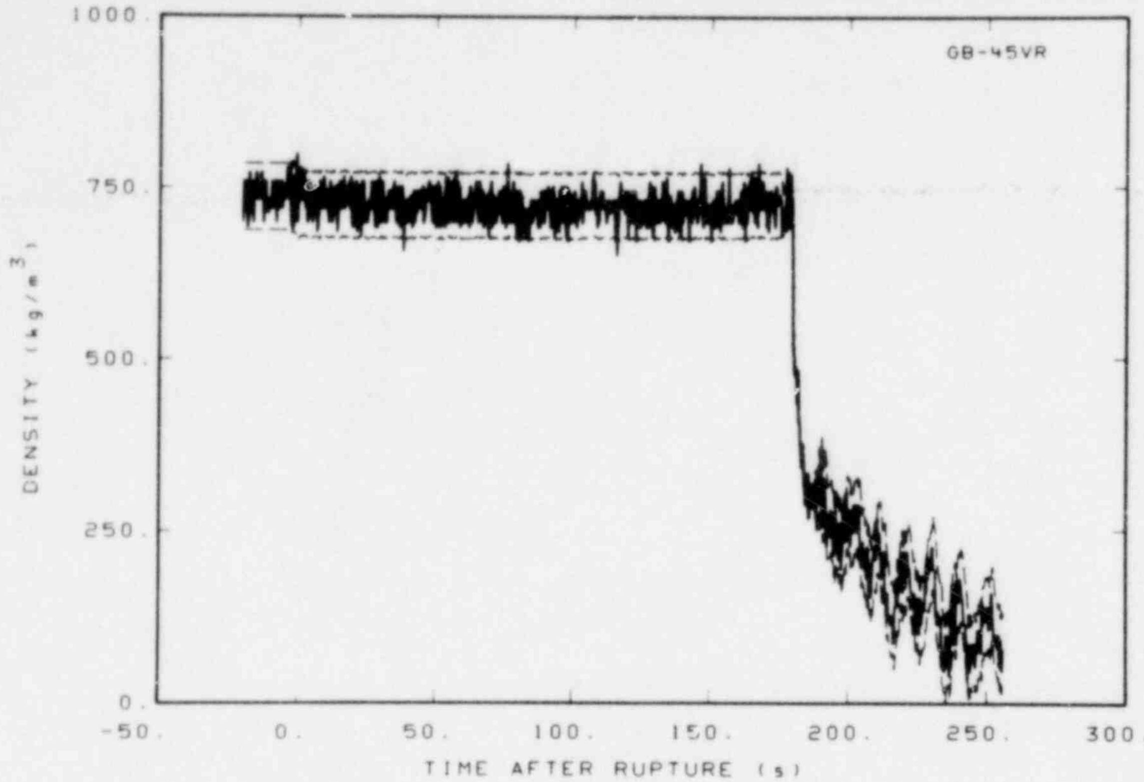


Figure C-62. Density in intact loop cold leg, Test S-SB-4 (GB-45VR).

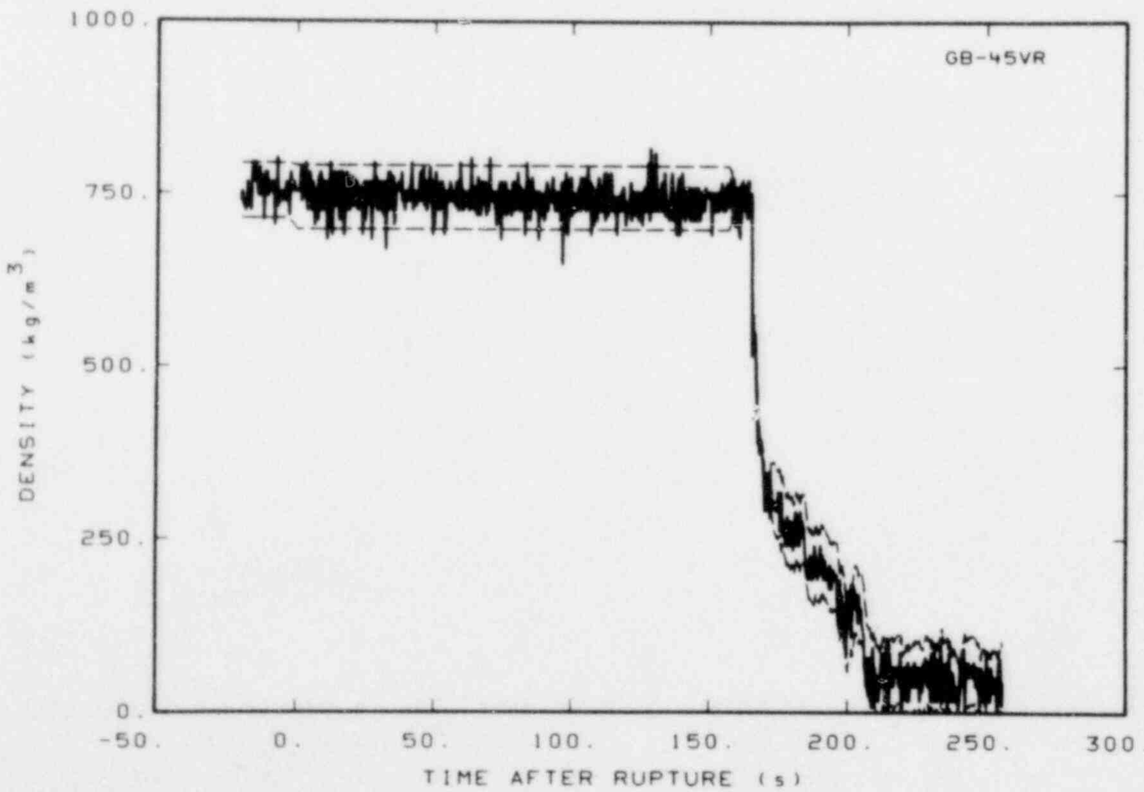


Figure C-63. Density in intact loop cold leg, Test S-SB-4A (GB-45VR).

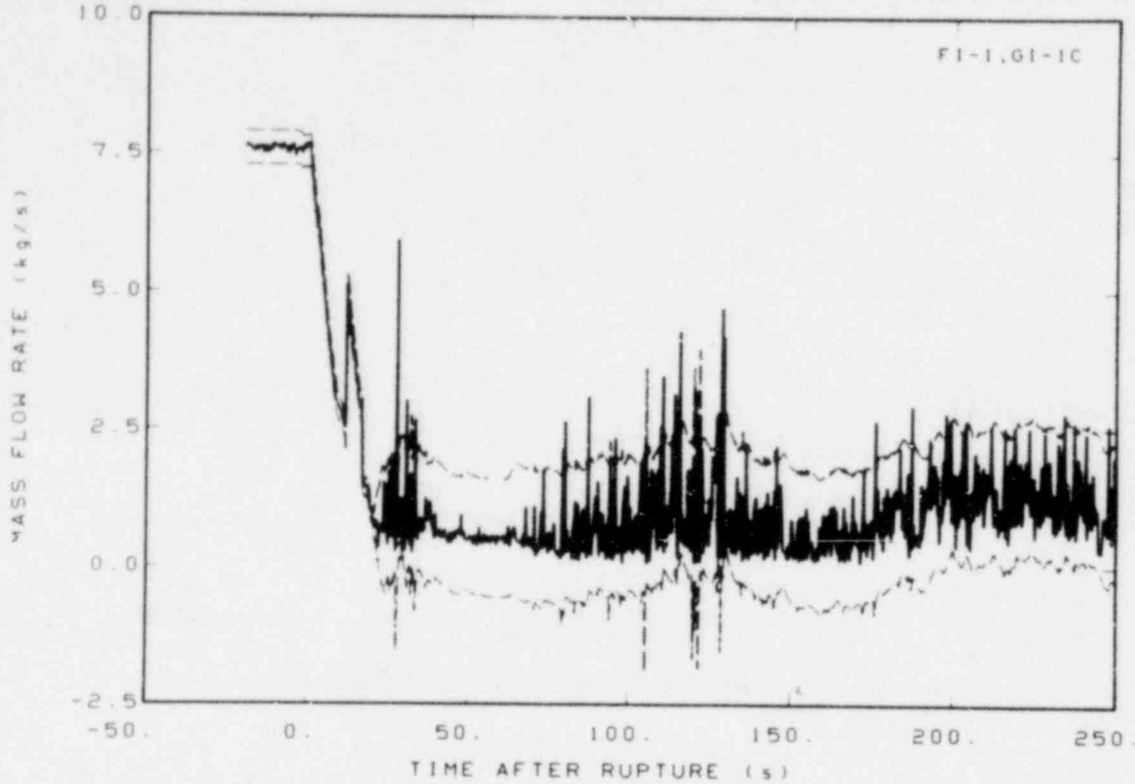


Figure C-64. Mass flow rate in intact loop hot leg, Test S-SB-4 (FI-1 and GI-1C).

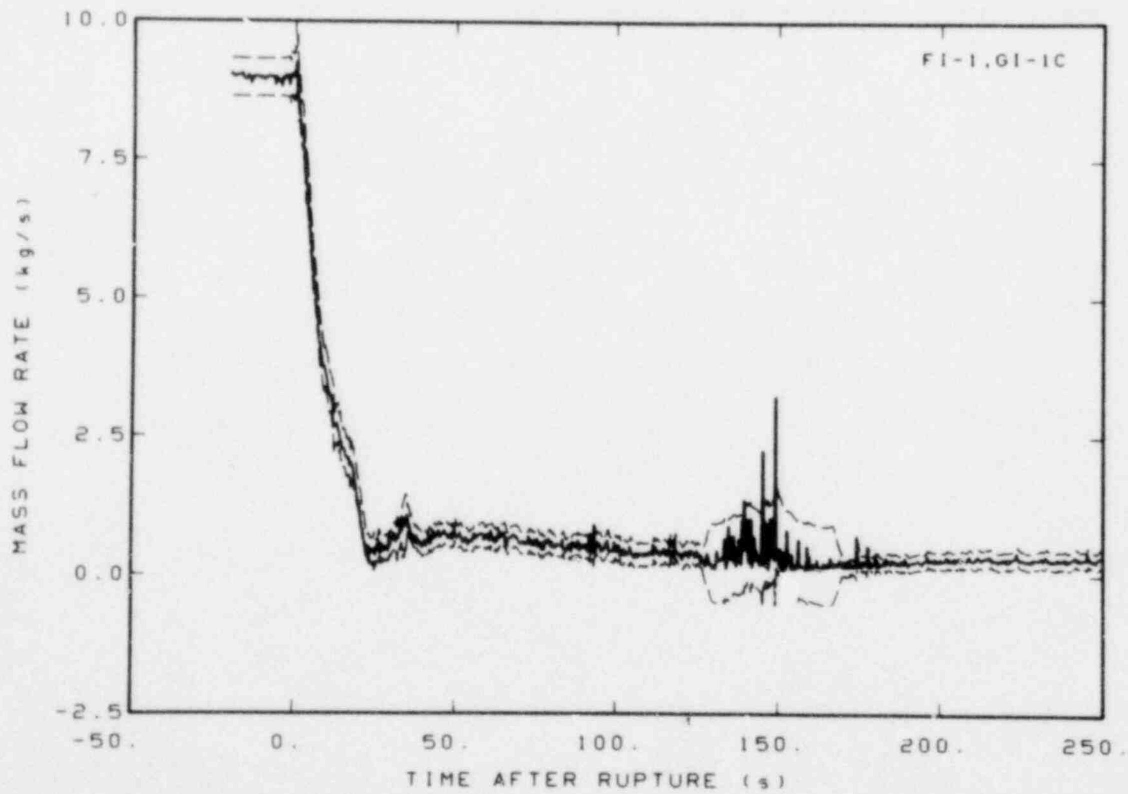


Figure C-65. Mass flow rate in intact loop hot leg, Test S-SB-4A (FI-1 and GI-1C).

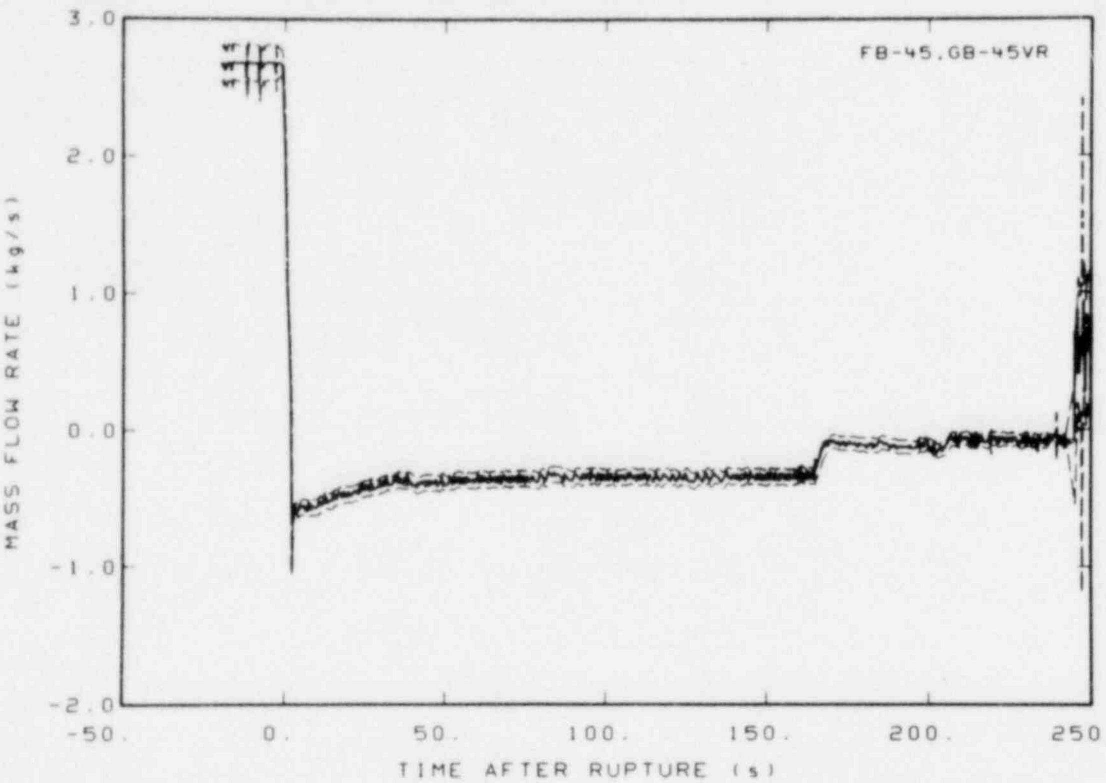


Figure C-66. Mass flow rate in broken loop cold leg, Test S-SB-4A (FB-45 and GB-45VR).

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