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EXPERIMENT DATA REPORT FOR SEMISCALE MOD-1 TEST S-02-3

(BLOWDOWN HEAT TRANSFER TEST)

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ABSTRACT

Recorded test data are presented for Test S-02-3 of the Semiscale Mod-1 blowdown heat transfer test series. Test S-02-3 is one of several Semiscale Mod-1 experiments conducted to investigate the thermal and hydraulic phenomena accompanying a hypothesized loss-of-coolant accident (LOCA) in a water-cooled nuclear reactor system and to provide data for the assessment of the Loss-of-Fluid Test (LOFT) design basis.

Test S-02-3 was conducted from an initial cold leg fluid temperature of 544°F and an initial pressure of 2,263 psig. A simulated double-ended offset shear cold leg break was used to investigate the system response to a depressurization transient with a moderately heated core (75% design power level). An electrically heated core was used in the pressure vessel to simulate the effects of a nuclear core. System flow was also set at the 75% design level to achieve full core temperature differential. The flow resistance of the intact loop was based on core area scaling. During system depressurization, core power was reduced from the initial level of 1.2 MW in such a manner as to simulate the surface heat flux response of the LOFT nuclear fuel rods until such time that departure from nucleate boiling (DNB) occurs. Blowdown to the pressure suppression system was accomplished without simulated emergency core coolant injection or pressure suppression system coolant spray.

The purpose of this report is to make available the uninterpreted data from Test S-02-3 for future data analyses and test results reporting activities. The data, presented in the form of graphs in engineering units, have been analyzed only to the extent necessary to assure that they are reasonable and consistent.

SUMMARY

Test S-02-3 was performed as part of the Semiscale Mod-1 portion of the Semiscale Program conducted by Aerojet Nuclear Company for the United States Government. This test was one of the Semiscale Mod-1 tests (Test Series 2) performed with an electrically heated core in place of the core simulator used in previous isothermal tests (Test Series 1). Hardware configuration and test parameters were selected to yield a system response that simulates the response of a pressurized water reactor (PWR) to a hypothesized loss-of-coolant accident (LOCA). Test S-02-3 utilized a pressure vessel with internals; an intact loop with active pump, steam generator, and pressurizer; a broken loop with simulated pump, simulated steam generator, and rupture assemblies; and a pressure suppression system with header and pressure suppression tank. The electrically heated core consisted of 40 heater rods with a maximum total power capacity of 1.6 MW; however, for this test, core power was initially 1.2 MW and was subsequently reduced to simulate the surface heat flux response of LOFT nuclear fuel rods until such time as DNB occurs.

The test objectives specific to Test S-02-3 were (1) to gain information on the heat transfer characteristics of the Semiscale Mod-1 core while operating at a relatively conservative power level (in terms of the design conditions), and (2) to determine the effects of the differential temperature across the heated core on system response before and during blowdown. Test S-02-3 was conducted from initial conditions of 2,263 psig and 544°F (cold inlet) by a simulated full size (200%) double-ended offset shear of the cold leg broken loop piping at an initial core power level of 1.2 MW with an initial core inlet flow rate of 119 gpm. The instantaneous offset shear of the broken loop cold leg piping was simulated by simultaneous actuation (within 10 milliseconds) of the rupture assemblies. The instrumentation used in Test S-02-3 generally functioned as intended. Of approximately 215 measurements attempted, 205 produced usable data.

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EXPERIMENT DATA REPORT FOR SEMISCALE MOD-1
TEST S-02-3
(Blowdown Heat Transfer Test)

I. INTRODUCTION

The Semiscale Mod-1 experiments represent the current phase of the Semiscale Program conducted by Aerojet Nuclear Company for the United States Government. The program, which is sponsored by the Nuclear Regulatory Commission through the Energy Research and Development Administration, is part of the overall program designed to investigate the response of a water-cooled nuclear reactor 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 an LOCA and to provide an experimental data base for assessing reactor safety evaluation models. The Semiscale Mod-1 program has the further objective of providing support to other experimental programs in the form of instrumentation assessment, optimization of test series, selection of test parameters, and evaluation of test results.

Test S-02-3 was conducted in the Semiscale Mod-1 system as part of a series of tests (Test Series 2) to obtain thermal-hydraulic response data from a blowdown transient in a simulated reactor system with a heated core to provide an experimental basis for analytical model development and verification. The test was also conducted to obtain data to aid in assessing the Loss-of-Fluid Test (LOFT) design basis and in planning LOFT experiments.

A 40-rod electrically heated core was used in the core barrel of the pressure vessel in place of the core simulator used in previous (isothermal) tests. Maximum design power for the core is 1.6 MW. For Test S-02-3, the core power level was set at 75% of design to minimize the risk of damaging the core until more experience is gained in its use. However, the core flow rate was also set at 75% of design flow to allow full core temperature differential to be achieved. During the blowdown, the core heater power was adjusted to simulate the thermal response characteristics of nuclear-heated rods prior to DNB. The pipe break configuration simulated a full size (200%) double-ended break in the cold leg broken loop piping.

The purpose of this report is to present the test data in an uninterpreted, but readily usable, form for use by the nuclear community in advance of detailed analysis and interpretation. Section II briefly describes the system configuration, procedures, initial test conditions, and events that are applicable to Test S-02-3; Section III presents the data graphs and provides comments and supporting information necessary for interpretation of the data. A description of the overall semiscale program and test series, a more detailed description of the Semiscale Mod-1 system, and a description of the measurement and data processing techniques and uncertainties can be found in Reference 1.

II. SYSTEM, PROCEDURES, CONDITIONS, AND EVENTS FOR TEST S-02-3

The following system configuration, procedures, initial test conditions, and events are specific to Test S-02-3.

1. SYSTEM CONFIGURATION AND TEST PROCEDURES

The Semiscale Mod-1 system used for Test S-02-3 consisted of a pressure vessel with internals; an intact loop with steam generator, pump, and pressurizer; a blowdown loop with simulated steam generator. simulated pump, and two rupture assemblies; a 40-rod electrically heated core; and a pressure suppression system with a suppression tank and header. The Semiscale Mod-1 experimental system is described in more detail in Reference 1.

For Test S-02-3, the intact loop steam generator was maintained in the active condition, in which the steam generator secondary pressure and water level are automatically adjusted to control the water temperature in the cold leg of the intact loop.

In preparation for Test S-02-3, the system was filled with treated demineralized water and vented at strategic points to assure a liquid full system. Prior to warmup, the system was pressurized to check for leakage. Warmup to initial test conditions was accomplished with the heaters in the vessel core. Heatup of the broken loop piping was accomplished with bypass lines which served to allow circulation through the broken loop. During warmup, the purification and sampling systems were valved into the primary system to maintain water chemistry requirements and to provide a water sample at system conditions for subsequent analysis. At 100-degree temperature intervals during warmup, detector readings were sampled to allow the integrity of the measurement instrumentation and the operability of the data acquisition system to be checked. After increasing core power to 1.2 MW, initial test conditions were held for about 12 minutes to establish equilibrium in the system. At the end of this period, all auxiliary systems including the bypass lines were isolated to prevent blowdown through those systems.

The system was successfully subjected to a simulated double-ended cold leg pipe break through two rupture assemblies and two blowdown nozzles, each nozzle having a break area of 0.00262 ft^2. Pressure to operate the rupture assemblies and initiate blowdown was taken from an accumulator system filled with water and pressurized to 2,250 psig with gaseous nitrogen. Immediately following initiation of blowdown (0.02 second after initiation of blowdown) the lines to the accumulator were again isolated. The effluent from the primary system was ejected into the pressure suppression system. At blowdown, power to the primary coolant circulation pump was reduced, and the pump was allowed to coast down to a speed of 1,250 rpm which was maintained for the duration of the test. A flywheel mounted on the pump motor shaft provided a simulation of the predicted coastdown of the LOFT pumps. During the blowdown, transient power to the electrically heated core was automatically controlled to simulate the thermal response of the nuclear-heated LOFT fuel rods until such time as DNB occurred (Reference 1).

2. INITIAL TEST CONDITIONS AND SEQUENCE OF EVENTS

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

TABLE I

CONDITIONS AT BLOWDOWN INITIATION

	Measured[a]	Specified
Core Power	1.19 MW	1.19 ± 0.1 MW
Intact Loop Cold Leg Fluid Temperature	544°F	544 ± 2°F
Hot Leg to Cold Leg Temperature Differential	68°F	66 ± 1°F
Pressurizer Pressure	2,263 psig	2,250 ± 5 psig
Pressurizer Liquid Volume	0.41 ft^3	0.50 ± 0.1 ft^3
Steam Generator Feedwater Temperature	440°F	435 ± 10°F
Steam Generator Liquid Level (from bottom of tube sheet)	116 in.	116 ± 2 in.
Fluid Temperature in Broken Loop (Pump Side)	[b]	605 ± 5°F
Intact Loop Cold Leg Flow	119 gpm	124 ± 5 gpm
Pressure Suppression Tank Water Level	21.5 in.	
Pressure Suppression Tank Pressure	17.6 psig	17.5 psig
Pressure Suppression Tank Water Temperature	67°F	<75°F

[a] Measured initial conditions are from a digital data survey taken 2 min sec prior to blowdown. Those measured conditions which did not meet the specified initial conditions were considered acceptable for analysis purposes within the test objectives.

[b] No measurement obtained.

TABLE II

PRIMARY COOLANT TEMPERATURE DISTRIBUTION AT RUPTURE

	Detector	Temperature (°F)
Vessel Lower Plenum (lower portion)	TFV-LP-7-1/2	541
Vessel Lower Plenum (upper portion)	TFV-LP-27-1/2	546
Intact Loop Hot Leg (near vessel)	RBU-2	607
Intact Loop Hot Leg (104 in. from vessel center)	TFU-5	593
Intact Loop Cold Leg (near steam generator	TFU-7	545
Intact Loop Cold Leg	RBU-14	543
Broken Loop Cold Leg (near nozzle)	TFB-23	536
Broken Loop Hot Leg (near vessel)	TFB-30	591
Broken Loop Cold Leg (near nozzle)	TFB-42	565

TABLE III

WATER CHEMISTRY PRIOR TO BLOWDOWN[a]

pH	10.15
Conductivity (μmhos/cm)	97
Lithium (ppm)	3.3
Chlorides (ppm)	0.433
Fluorides (ppm)	<0.5
Oxygen (ppm)	0.17
Total gas (cc/l)	187
Residual hydrazine (ppm)	1.6

[a] Water sample taken at a system pressure of 2,250 psig and a system temperature of 540°F.

TABLE IV

SEQUENCE OF EVENTS DURING TEST[a]

Event	Time Relative To Rupture
Core Power Level Established	-14 min
Bypass Lines Valved Out of System	-30 min
Pump Power Reduced	0
Steam Generator Discharge Valve Closed	+1 sec
Core Power Tripped Off [b]	+24.5 sec

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

[b] Premature core power trip caused by an erroneous high temperature reading from a core heater thermocouple that failed during blowdown.

III. DATA PRESENTATION

The data from Semiscale Mod-1 Test S-02-3 are presented with brief comment. Processing analysis has been performed only to the extent necessary to obtain appropriate engineering units and to assure that the data are reasonable and consistent. In all cases, in converting transducer output to engineering units, a homogeneous fluid was assumed. Further interpretation and analysis should consider that sudden decompression processes such as those occurring during blowdown may have subjected the measurement devices to nonhomogeneous fluid conditions.

The performance of the system during Test S-02-3 was monitored by about 200 detectors. The data obtained were recorded on both digital and analog data acquisition systems. The digital system was used to process the data presented in this report. The analog system was used to provide better resolution capability (needed as input to various data analysis codes) and to provide redundancy.

The data are presented, in many instances, in the form of composite graphs to facilitate comparison of a given variable at several locations. The scales selected for the graphs do not reflect the obtainable resolution of the data. (The data processing techniques are described in greater detail in Reference 1.)

Figures 1 through 6 and Table V provide supporting information for interpretation of the data graphs shown in Figures 7 through 145. Figures 1 through 6 show the relative locations of all detectors used during the Semiscale Mod-1 blowdown heat transfer test series. Table V groups the measurements taken during Test S-02-3 according to measurement type; identifies the specific measurement location, and the range of the detector and actual recording range of the data acquisition system; provides brief comments regarding the data; and references the measurements and comments to the corresponding figure. Figures 7 through 145 present the blowdown data obtained. Time zero on the graphs is the time of rupture initiation.

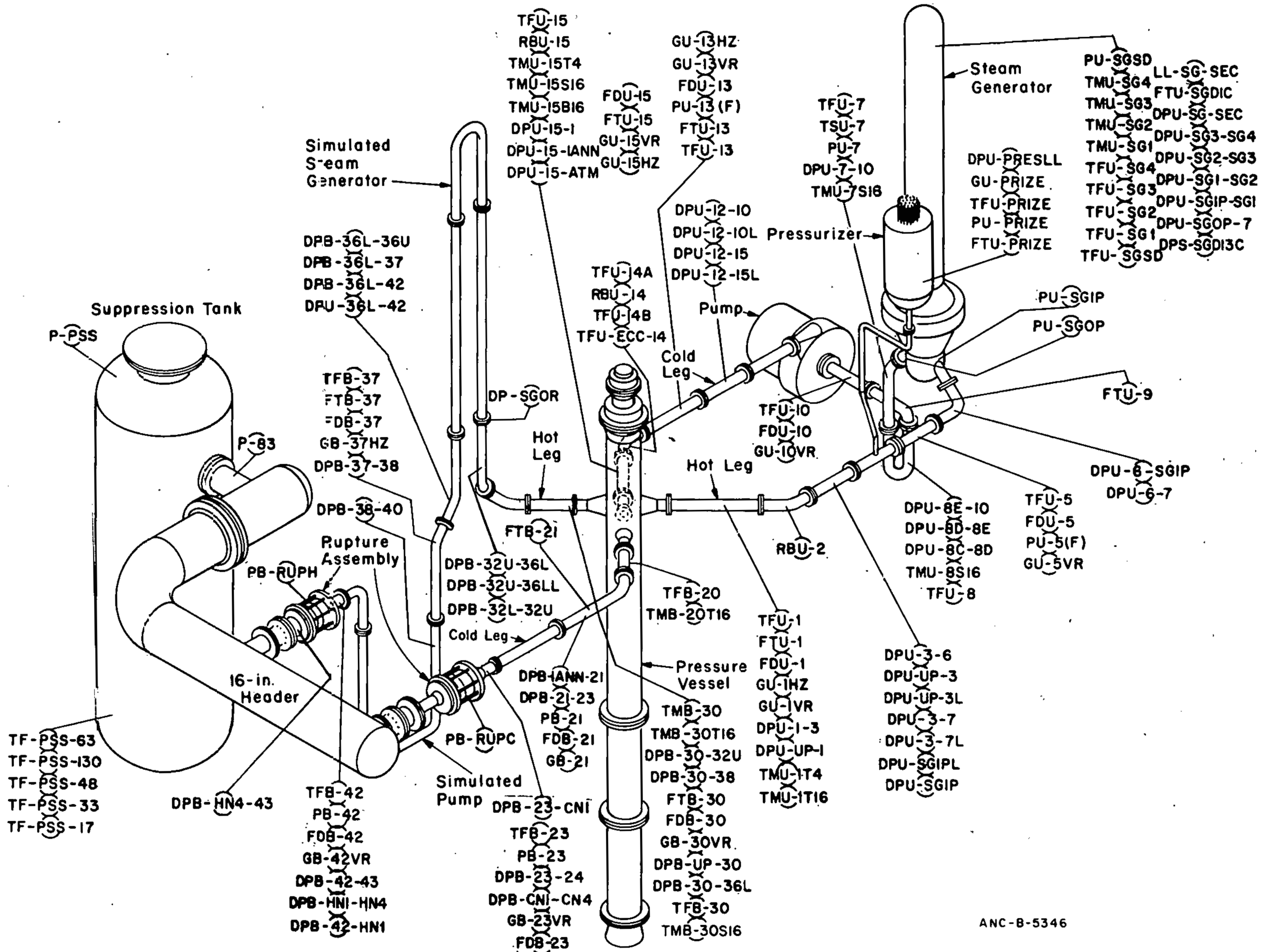

Fig. 1 Semiscale Mod-1 system and instrumentation for cold leg break configuration -- isometric.

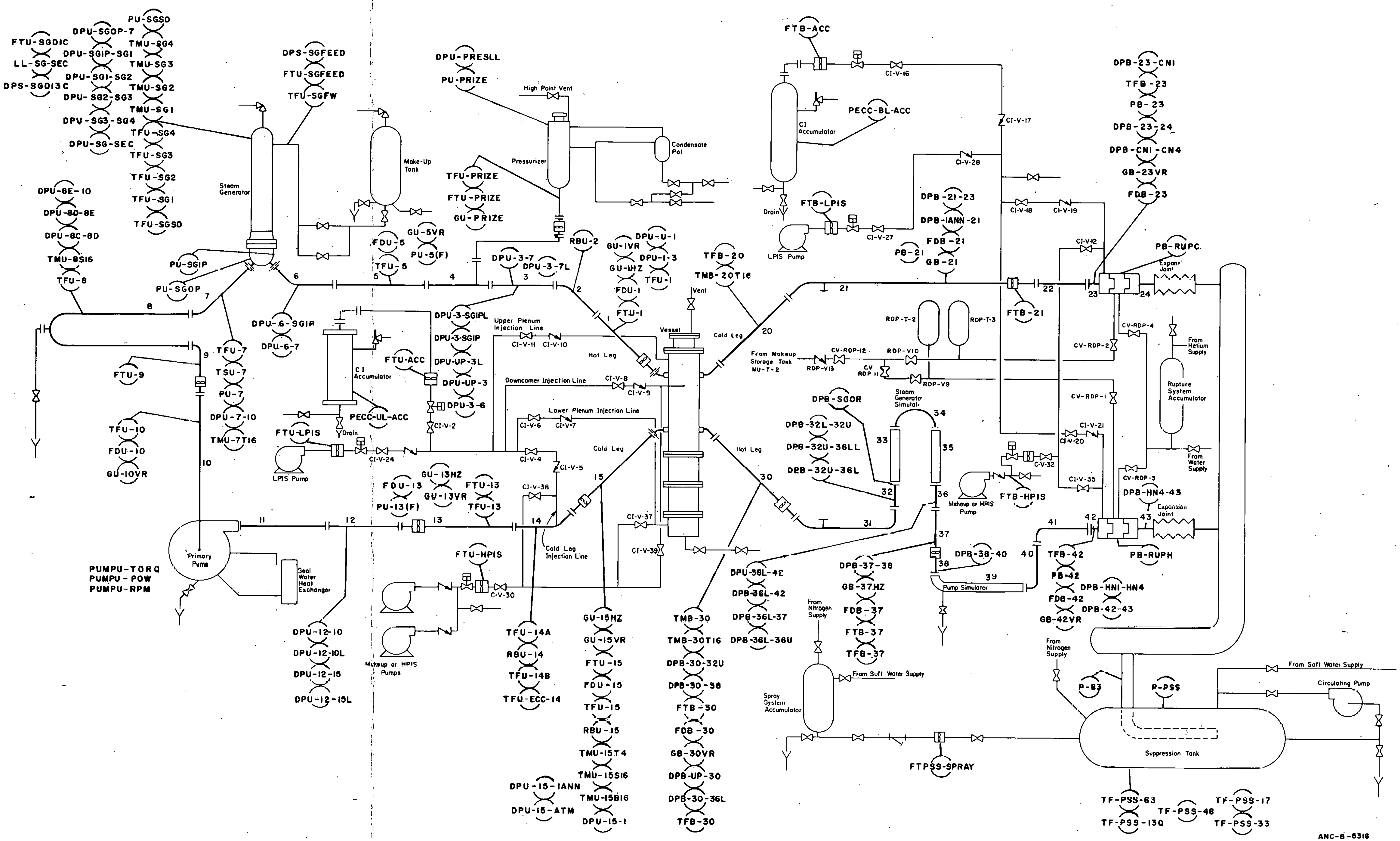

Fig. 2 Semiscale Mod-1 system and instrumentation for cold leg break configuration -- schematic.

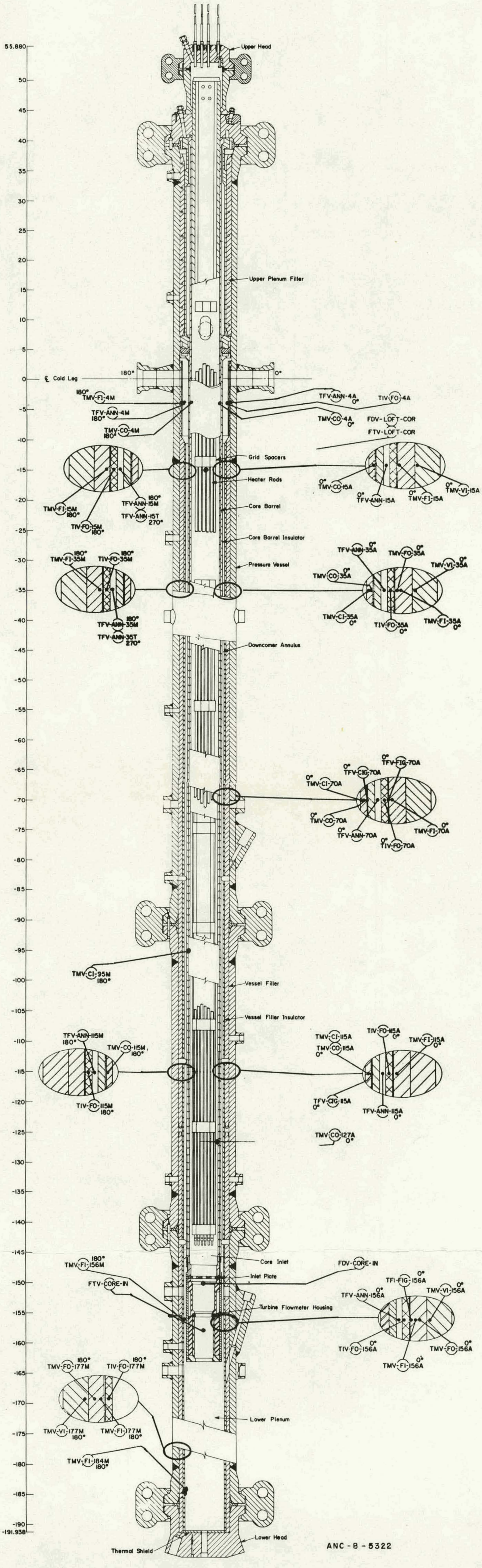

Fig. 3 Semiscale Mod-1 pressure vessel -- cross section showing instrumentation.

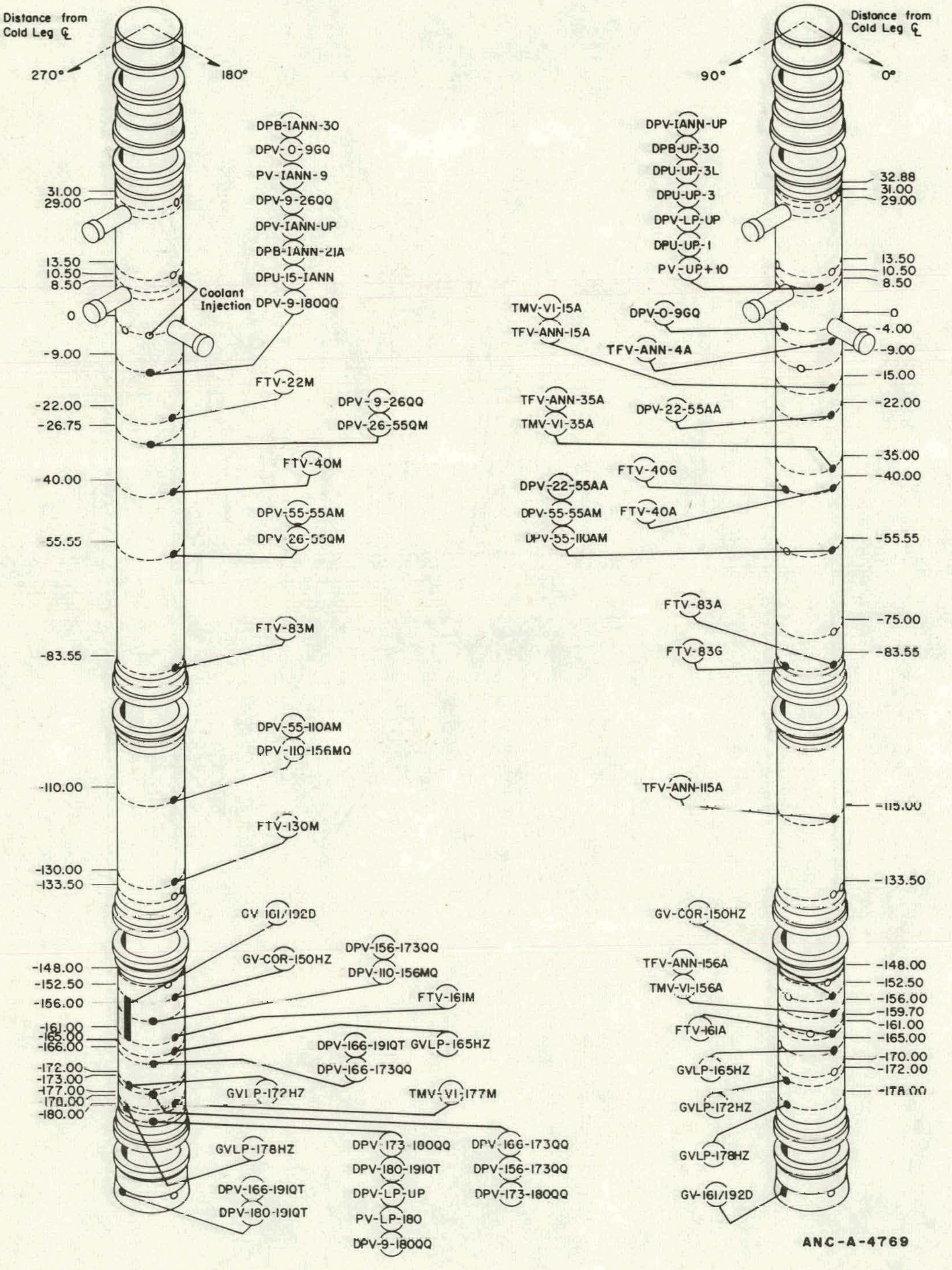

Fig. 4 Semiscale Mod-1 pressure vessel -- isometric showing instrumentation.

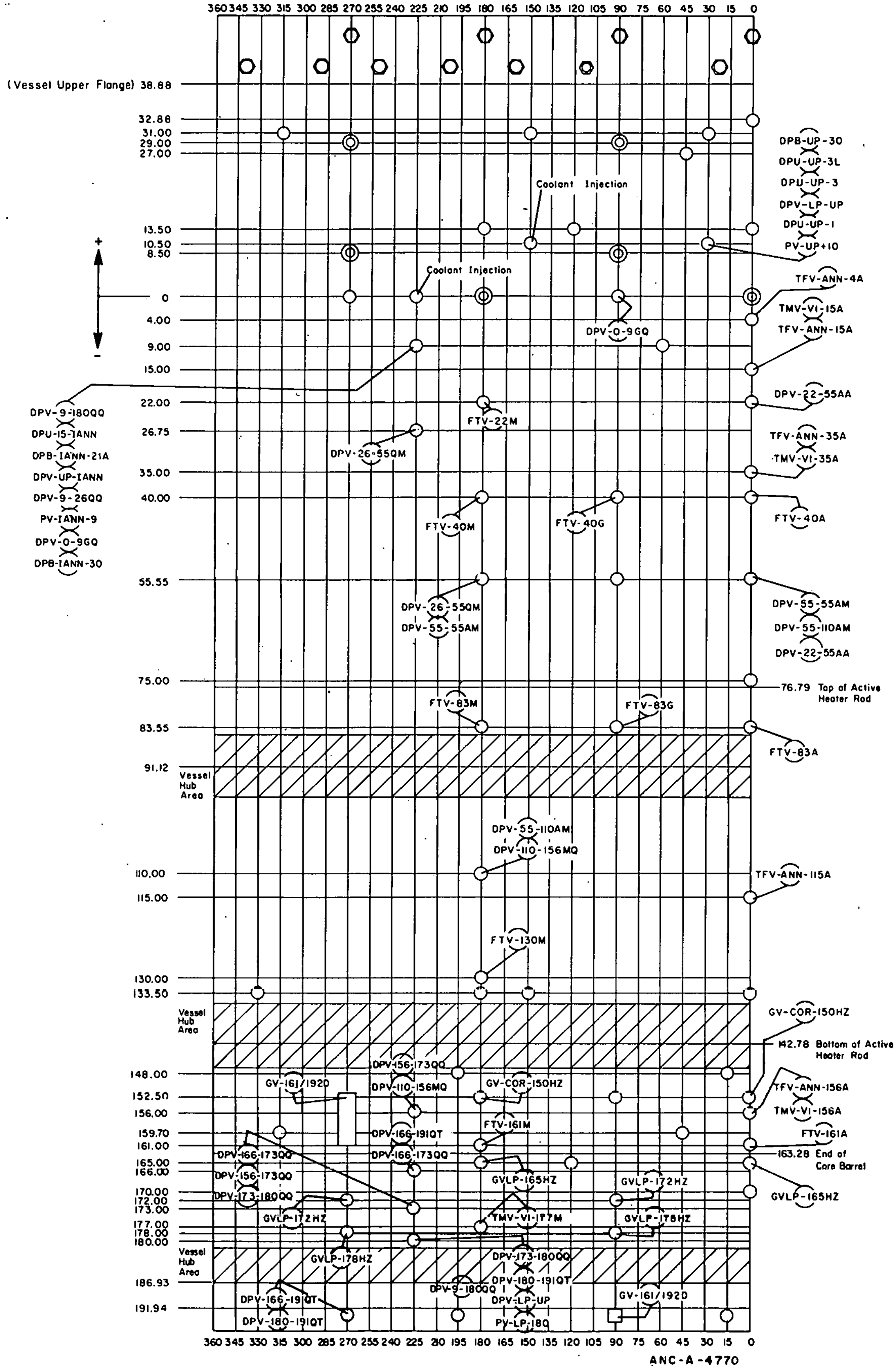

Fig. 5 Semiscale Mod-1 pressure vessel -- penetrations and instrumentation.

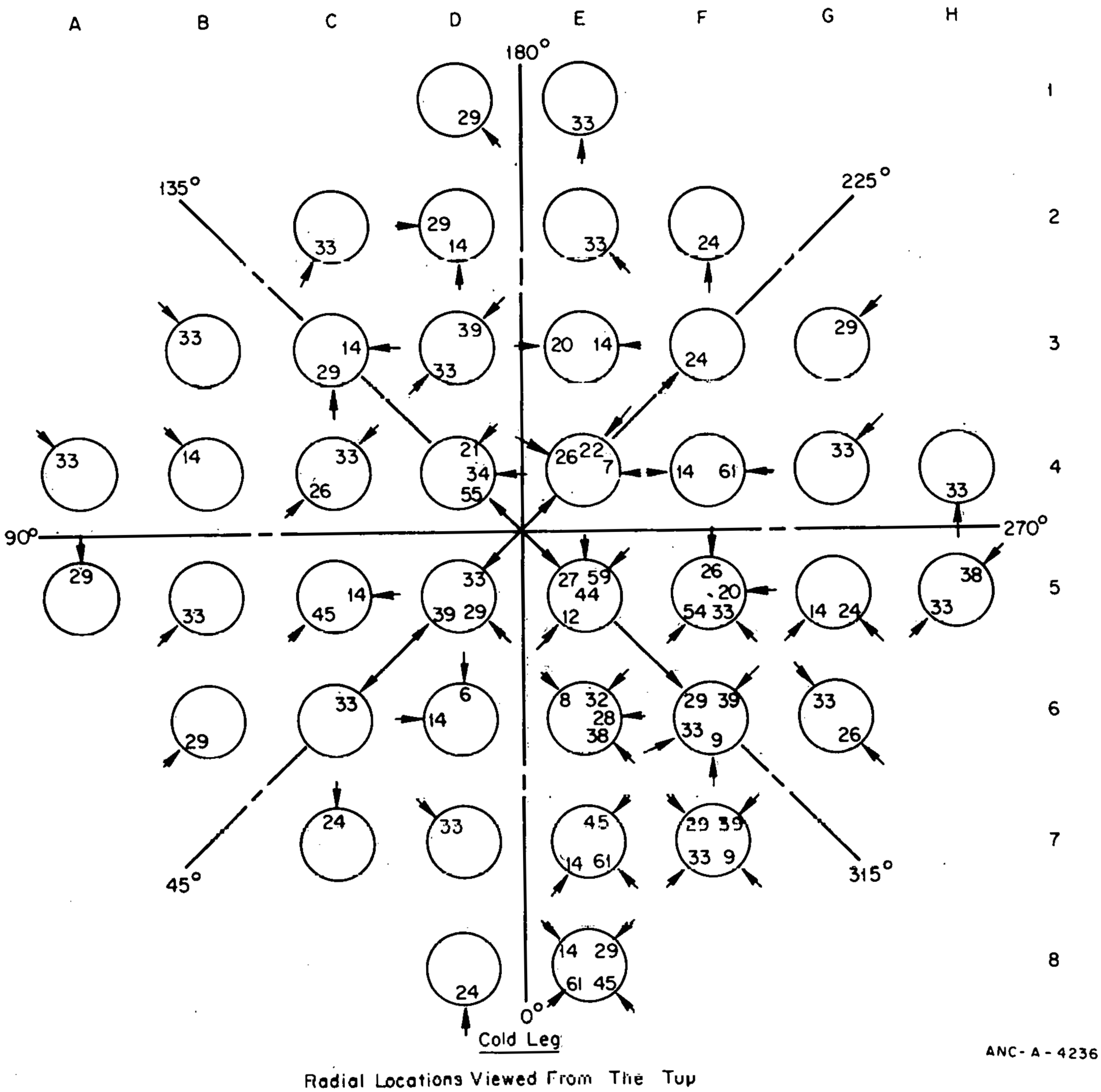

Fig. 6 Semiscale Mod-1 heated core, plan view.

TABLE V

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-02-3

Measurement	Location and Comments[a]	Range[a] Detector	Range[a] Data Acquisition System	Figure[a]	Measurement Comments[b]
FLUID TEMPERATURE	Chromel-Alumel thermocouples unless specified otherwise				
Intact Loop		0-2000°F	0-591°F	7	
RDU-2	Hot leg, Spool 2, 46 in. from vessel center (platinum resistance bulb)				
TFU-5	Hot leg, Spool 5, 104 in. from vessel center				Data acquisition system saturated at 591°F
TFU-7	Cold leg, Spool 7, 246 in. from vessel center				
TFU-10	Cold leg, Spool 10, 144 in. from vessel center				
TFU-13	Cold leg, Spool 13, 51 in. from vessel center				
RBU-14A	Cold leg, Spool 14, 43 in. from vessel center, upstream of cold leg injection port (platinum resistance bulb)	0-1000°F	0-1000°F		
Broken Loop		0-2300°F	0-591°F	8	
TFB-23	Cold leg, Spool 23, 91 in. from vessel center, upstream of vessel-side nozzle				
TFB-30	Hot leg, Spool 30, 16 in. from vessel center				Data acquisition system saturated at 591°F
TFB-42	Hot leg, Spool 42, 414 in. from vessel center along cold leg, upstream of pump-side nozzle				
Downcomer Annulus	Centered in annulus, Type J iron-constantan thermocouples	0-1400°F	0-803°F	9	
TFV-ANN-35M	35 in. below cold leg centerline, 180°				
Upper Plenum		0-2300°F	0-591°F	10	Data acquisition system saturated at 591°F
TVF-UP+13	In upper plenum 13.5 in. above cold leg centerline at 180°				
Lower Plenum	On fluid thermocouple rack, 1 in. from vessel center, 45°	0-2300°F	0-591°F	11	
TFV-LP-7-1/2	7.5 in. from bottom				
TFV-LP-14-1/2	14.5 in. from bottom				
TFV-LP-27-1/2	27.5 in. from bottom				
Steam Generator		0-2300°F	0-591°F	12	
TFU-SGSD	In steam dome, 129.5 in. from bottom of tube sheet				
TFU-SG1	Secondary side, 12 in. above bottom of tube sheet				
TFU-SG2	Secondary side, 24 in. above bottom of tube sheet				
TFU-SG3	Secondary side, 48 in. above bottom of tube sheet				
TFU-SG4	Secondary side, 96 in. above bottom of tube sheet				
Pressurizer		0-2300°F	0-591°F	13	
TFU-PRIZE	In surge line, near pressurizer exit, between turbine flowmeter and pressurizer				
Pressure Suppression System		0-2300°F	0-591°F	14	
TF-PSS-33	33 in. from bottom of tank				
TF-PSS-130	130 in. from bottom of tank				
MATERIAL TEMPERATURE	Chromel-Alumel thermocouples unless specified otherwise	0-2300°F	0-591°F		
Intact Loop				15	
TMU-7S16	Cold leg, Spool 7, side, 1/16 in. from pipe ID, 242 in. from vessel center (vertical pipe)				
TMU-8S16	Cold leg, Spool 8, side, in pump trap, 1/16 in. from pipe ID, 195 in. from vessel center				

TABLE V (Contd.)

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-02-3

Measurement	Location and Comments[a]	Range[a] Detector	Range[a] Data Acquisition System	Figure[a]	Measurement Comments[b]
MATERIAL TEMPERATURE (Contd.)					
Broken Loop				16	
TMB-20T16	Cold leg, Spool 20, top, 1/16 in. from pipe ID, 21 in. from vessel center				
TMB-30T16	Hot leg, Spool 30, top, 1/16 in. from pipe ID, 16 in. from vessel center				Detector failed
Vessel Wall	1/8 in. from vessel ID			17	
TMV-VI-35A	35 in. below cold leg centerline, 0°				
TMV-VI-177M	177 in. below cold leg centerline, 180°				
Vessel Filler	Type J iron-constantan thermocouples	0-1400°F	0-803°F	18	
TMV-FO-35A	35 in. below cold leg centerline, 0.65 in. from filler ID, 0°				
TMV-FI-35M	35 in. below cold leg centerline, 1/16 in. from filler ID, 180				
TMV-FI-177M	177 in. below cold leg centerline, 1/16 in. from filler ID, 180°				
Vessel Filler Insulator	Outer surface of insulator, Type J iron-constantan thermocouples	0-1400°F	0-803°F	19	
TIV-FO-35M	35 in. below cold leg centerline, 180°				
TIV-FO-177M	177 in. below cold leg centerline, 180°				Rapid response indicates possible contact with fluid
Core Barrel	Type J iron-constantan thermocouples	0-1400°F	0-803°F	20	
TMV-CO-35A	35 in. below cold leg centerline, 1/16 in. from core barrel OD, 0°				
TMV-CI-35A	35 in. below cold leg centerline, 1/16 in. from core barrel ID, 0°				
Core Heater Cladding Temperatures					
High Power Heaters	Chromel-Alumel thermocouples unless specified otherwise	0-2300°F	0-2392°F		
TH-D4-21 -34 -55	Heater at Column D Row 4. Thermocouples 21 in. (225°), 34 in. (270°) and 55 in. (315°) above bottom of core			21	
TH-E4-7 -22 -26	Heater at Column E Row 4. Thermocouples 7 in. (315°), 22 in. (220°) and 26 in. (120°) above bottom of core			22	Thermocouple at 7 in. elevation opened at t=20 sec; signal after t=20 sec is from interference
TH-E5-12 -27 -44 -59	Heater at Column E Row 5. Thermocouples 7 in. (315°), 22 in. (130°), 44 in. (180°), 59 in. (225°) above bottom of core			23	
Low Power Heaters		0-2300°F	0-2382°F		
TH-A4-28 -29	Heater at Column A Row 4. Thermocouples 28 in. (210°), 29 in. (135°) above bottom of core			24	
TH-A5-29	Heater at Column A Row 5. Thermocouple 29 in. (180°) above bottom of core			25	
TH-B3-33	Heater at Column B Row 3. Thermocouple 33 in. (135°) above bottom of core			26	
TH-B4-24	Heater at Column B Row 4. Thermocouple 24 in. (180°) above bottom of core				Open thermocouple
TH-B5-33 -38	Heater at Column B Row 5. Thermocouples 33 in. (45°), 38 in. (240°) above bottom of core			27	
TH-B6-29	Heater at Column B Row 6. Thermocouple 29 in. (45°) above bottom of core			28	
TH-C2-29 -33	Heater at Column C Row 2. Thermocouples 29 in. (135°), 33 in. (45°) above bottom of core			29	
TH-C3-14 -29	Heater at Column C Row 3. Thermocouples 14 in. (45°), 29 in. (0°) above bottom of core			30	

TABLE V (Contd.)

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-02-3

Measurement	Location and Comments[a]	Range[a] Detector	Range[a] Data Acquisition System	Figure[a]	Measurement Comments[b]
MATERIAL TEMPERATURE (Contd.)					
Low Power Heaters (Contd.)					
TH-C4-26 -33	Heater at Column C Row 4. Thermocouples 26 in. (45°), 33 in. (225°) above bottom of core			31	
TH-C5-28W	Heater at Column C Row 5. Thermocouple 28 in. (315°) above bottom of core			32	
TH-C6-33	Heater at Column C Row 6. Thermocouple 33 in. (225°) above bottom of core			33	
TH-D1-29	Heater at Column D Row 1. Thermocouple 29 in. (315°) above bottom of core			34	
TH-D2-14 -29	Heater at Column D Row 2. Thermocouples 14 in. (0°), 29 in. (90°) above bottom of core			35	
TH-D3-29 -33 -39	Heater at Column D Row 3. Thermocouples 29 in. (150°), 33 in. (45°), 39 in. (225°) above bottom of core			36	
TH-D6-6 -14	Heater at Column D Row 6. Thermocouples 6 in. (180°), 14 in. (90°) above bottom of core			37	
TH-D8-24	Heater at Column D Row 8. Thermocouple 24 in. (0°) above bottom of core			38	
TH-E1-33	Heater at Column E Row 1. Thermocouple 33 in. (0°) above bottom of core			39	
TH-E2-33	Heater at Column E Row 2. Thermocouple 33 in. (315°) above bottom of core			40	
TH-E3-14 -20	Heater at Column E Row 3. Thermocouples 14 in. (270°), 20 in. (90°) above bottom of core			41	
TH-E6-9 -29 -33 -39	Heater at Column E Row 6. Thermocouples 9 in. (150°), 29 in. (270°), 33 in. (225°), 39 in. (315°) above bottom of core			42	
TH-E7-14 -29 -45 -61	Heater at Column E Row 7. Thermocouples 14 in. (45°), 29 in. (125°), 45 in. (225°), 61 in. (315°) above bottom of core			43	
TH-E8-14 -29 -45 -61	Heater at Column E Row 8. Thermocouples 14 in. (150°), 29 in. (225°), 45 in. (315°), 61 in. (45°) above bottom of core			44	
TH-F2-29	Heater at Column F Row 2. Thermocouple 29 in. (0°) above bottom of core			45	
TH-F3-24	Heater at Column F Row 3. Thermocouple 24 in. (45°) above bottom of core			46	
TH-F4-14 -45 -61	Heater at Column F Row 5. Thermocouples 14 in. (90°), 45 in. (210°), 61 in. (270°) above bottom of core			47	
TH-F5-20 -26 -33 -54	Heater at Column F Row 5. Thermocouples 20 in. (270°), 26 in. (180°), 33 in. (315°), 54 in. (45°) above bottom of core			48	
TH-F6-9 -29 -33 -39	Heater at Column F Row 6. Thermocouples 9 in. (0°), 29 in. (150°), 33 in. (45°), 39 in. (225°) above bottom of core			49	
TH-F7-9 -29 -33 -39	Heater at Column F Row 7. Thermocouples 29 in. (150°), 33 in. (45°), 39 in. (225°) above bottom of core			50	
TH-G3-29	Heater at Column G Row 3. Thermocouple 29 in. (225°) above bottom of core			51	

TABLE V (Contd.)

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-02-3

Measurement	Location and Comments[a]	Range[a] Detector	Range[a] Data Acquisition System	Figure[a]	Measurement Comments[b]
MATERIAL TEMPERATURE (Contd.)					
Low Power Heaters (Contd.)					
TH-G4-33	Heater at Column G Row 4. Thermocouple 33 in. (225°) above bottom of core			52	
TH-G5-14 -24	Heater at Column G Row 5. Thermocouples 14 in. (45°), 24 in. (315°) above bottom of core			53	
TH-G6-26 -33	Heater at Column G Row 6. Thermocouple 33 in. (135°) above bottom of core			54	
TH-H4-29 -38	Heater at Column H Row 4. Thermocouples 29 in. (105°), 38 in. (180°) above bottom of core			55	
TH-H5-33 -38	Heater at Column H Row 4. Thermocouple 33 in. (45°) above bottom of core			56	
Core Grid Spacer (Ref Figure 6)		0-2300°F	0-1017°F	57	
Grid Spacer 6	76 in. below cold leg centerline, 1.2 in. above top of heated length				
TFG-6AB-45	Thermocouple in space defined by Columns A and B, Rows 4 and 5				
TFG-6CD-56	Thermocouples in space defined by Columns C and D, Rows 5 and 6				
TFG-6DE-45	Thermocouples in space defined by Columns D and E, Rows 4 and 5				
TFG-6FG-45	Thermocouple in space defined by Columns F and G, Rows 4 and 5				
Grid Spacer 8	109 in. below cold leg centerline at center of heated length	0-2300°F	0-1017°F	58	
TFG-8AB-45	Thermocouple in space defined by Columns A and B, Rows 4 and 5				
TFG-8CD-45	Thermocouple in space defined by Columns C and D, Rows 4 and 5				
TFG-8DE-34	Thermocouple in space defined by Columns D and E, Rows 3 and 4				
Grid Spacer 10	143 in. below cold leg centerline at bottom of heated length	0-2300°F	0-1017°F	59	
TFG-10AB-45	Thermocouple in space defined by Columns A and B, Rows 4 and 5				
TFG-10BC-45	Thermocouple in space defined by Columns B and C, Rows 4 and 5				
TFG-10CD-45	Thermocouple in space defined by Columns C and D, Rows 4 and 5				
TFG-10DE-45	Thermocouple in space defined by Columns D and E, Rows 4 and 5				
TFG-10FG-45	Thermocouple in space defined by Columns F and G, Rows 4 and 5				
Steam Generator		0-2300°F	0-591°F	60	
TMU-SG1	On steam generator tubes, 12 in. above bottom of tube sheet, on OD of tube				
TMU-SG2	On steam generator tubes, 24 in. above bottom of tube sheet, on OD of tube				
TMU-SG3	On steam generator tubes, 48 in. above bottom of tube sheet, on OD of tube				Thermocouple failed, possibly due to external junction
TMU-SG4	On steam generator tubes, 96 in. above bottom of tube sheet, on OD of tube				

TABLE V (Contd.)

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-02-3

Measurement	Location and Comments[a]	Range[a] Detector	Range[a] Data Acquisition System	Figure[a]	Measurement Comments[b]
PRESSURE					
Intact Loop		0-3000 psig		61	
PU-5(F)	Hot leg, Spool 5, 100 in. from vessel center		0-4086 psig		
PU-7	Cold leg, Spool 7, 240 in. from vessel center		0-4870 psig		
PU-13(F)	Cold leg, Spool 13, 54 in. from vessel center (flush mount)		0-4332 psig		
Broken Loop		0-3000 psig		62	
PB-23	Hot leg, Spool 23, 92 in. from vessel center, upstream of vessel-side nozzle (tee off DP tap)		0-4747 psig		
PB-42	Cold leg, Spool 42, 415 in. from vessel center along hot leg, upstream of pump-side nozzle (tee off DP tap)		0-4374 psig		Trace noisy due to intermittent short in transducer. Trend of data appears correct..
Vessel		0-3000 psig		63	
PV-UP+10	In upper plenum, 10 in. above cold leg centerline, mounted on standoff, 30°		0-4024 psig		
PV-LP-180	In upper part of lower plenum, 180 in. below cold leg centerline, mounted on standoff, 225°		0-4848 psig		
Steam Generator		0-3000 psig			
PU-SGSD	Secondary side, steam dome		0-4249 spig	64	
PU-SGIP	Inlet plenum, 13 in. below bottom of tube sheet (flush mount)		0-4556 psig	65	
PU-SGOP	Outlet plenum, 13 in. below bottom of tube sheet (flush mount)		0-4505 psig	65	
Pressurizer		0-3000 psig	0-4726 psig	66	
PU-PRIZE	Steam dome				
Pressure Suppression System				67	
P-PSS	Suppression tank top	0-750 psig	0-311 psig		
P-83	Suppression tank header just down stream from entrance to suppression tank	0-100 psig	0-200 psig		
DIFFERENTIAL PRESSURE	Elevation difference between transducer taps is zero unless otherwise specified				
Intact Loop					
DPU-UP-1	Upper plenum 10.5 in. above cold leg centerline at 30° to hot leg, Spool 1, 31 in. from vessel center, upper plenum tap approximately 2 in. above Spool 1 tap	±100 in. water	±5.0 psid	68	
DPU-UP-3	Upper plenum 10.5 in. above cold leg centerline at 30° to hot leg, Spool 3, 62 in. from vessel center, upper plenum tap approximately 2 in. above Spool 3 tap	±300 in. water	±15 psid	69	
DPU-1-3	Hot leg Spool 1, 31 in. from vessel center to hot leg Spool 3, 62 in. from vessel center	±20 in. water	±1.0 psid	70	
DPU-3-6	Hot leg Spool 3, 62 in. from vessel center to hot leg Spool 6, 114 in. from vessel center	±20 in. water	±1.0 psid	71	
DPU-6-7	Hot leg Spool 6, 114 in. from vessel center, across steam generator, to cold leg Spool 7, 231 in. from vessel center. Spool 6 tap is 17 in. above Spool 7 tap	±500 in. water	±25 psid	72	
DPU-SG1-SG2	Across primary side tubes, 12 to 24 in. above bottom of tube sheet, SG1 tap is 12 in. below SG2 tap	±20 in. water	±1.0 psid	73	Questionable measurement due to possible blowdown of sense lines.
DPU-SGOP-7	From steam generator outlet plenum, 269 in. from vessel center along cold leg to cold leg Spool 7, 231 in. from vessel center, including orifice, Spool 7 tap is 35 in. below SGOP tap	±500 in. water	±25 psid	74	

TABLE V (Contd.)

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-02-3

Measurement	Location and Comments[a]	Range[a] Detector	Range[a] Data Acquisition System	Figure[a]	Measurement Comments[b]
DIFFERENTIAL PRESSURE (Contd.)					
Intact Loop (Contd.)					
DPU-7-10	Steam generator outlet to pump inlet, cold leg Spool 7, 231 in. from vessel center to cold leg Spool 10, 141 in. from vessel center	±50 in. water	±2.5 psid	75	
DPU-12-10	Pump outlet to pump inlet, cold leg Spool 12, 75 in. from vessel center to cold leg Spool 10, 141 in. from vessel center, Spool 10 tap is 10 in. below Spool 12 tap	±50 psid	±50 psid	76	
DPU-12-10L	Pump outlet to pump inlet, cold leg Spool 12, 75 in. from vessel center to cold leg Spool 10, 141 in. from vessel center, Spool 10 tap is 10 in. below Spool 12 tap (low range)	±100 in. water	±5.0 psid	77	
DPU-12-15	Across cold leg injection point, cold leg Spool 12, 75 in. from vessel center to cold leg Spool 15, 16 in. from vessel center	±100 in. water	±5.0 psid	78	
DPU-15-1	Cold leg to hot leg, cold leg Spool 15, 16 in. from vessel center to hot leg Spool 1, 31 in. from vessel center, Spool 15 tap is 8.5 in. below Spool 1 tap	±500 in. water	±25 psid	79	
DPU-15-IANN	Cold leg Spool 15, 16 in. from vessel center to inlet annulus 9 in. below cold leg centerline at 225°, Spool 15 tap is 9 in. above inlet annulus tap	±100 in. water	±5.0 psid	80	
DPU-15-ATM	Cold leg Spool 15, 16 in. from vessel center to atmosphere	±500 psid	±500 psid	81	
DPU-PRESLL	Pressurizer water level, elevation difference between taps is 34 in., lower tap is approximately 3.5 in. above pressurizer exit	±50 in. water	±2.5 psid	82	
Broken Loop					
DPB-23-CNI	Cold leg Spool 23, 92 in. from vessel center to vessel side nozzle throat, 96 in. from vessel center	±500 psid	±1000 psid	83	
DPB-CN1-CN4	Vessel-side nozzle, nozzle throat, 96 in. from vessel center to nozzle divergent section, 101 in. from vessel center	±1000 psid	±1000 psid	84	
DPB-30-36L	Across entire simulated steam generator assembly, hot leg Spool 30, 18 in. from vessel center to cold leg Spool 36 lower tap, 242 in. from vessel center. Spool 30 tap is 19 in. below Spool 36 lower tap	±500 in. water	±500 psid	85	
DPB-32U-36L	Across simulated steam generator orifice assembly, hot leg Spool 32 upper tap, 73 in. from vessel center to Spool 36 lower tap, 242 in. from vessel center, Spool 32 upper tap is 16 in. above Spool 36 lower tap	±500 psid	±500 psid	86	
DPB-38-40	Across simulated pump, cold leg Spool 38, 305 in. from vessel center along hot leg to cold leg Spool 40, 365 in. from vessel center along hot leg	±1000 psid	±1000 psid	87	
DPB-42-HN1	Spool 42 upstream of pump-side nozzle, 415 in. from vessel center along hot leg to nozzle throat, 419 in. from vessel center along hot leg	±50 psid	±500 psid	88	
Vessel					
DPU-15-IANN	Intact loop cold leg Spool 15, 16 in. from vessel center to inlet annulus 9 in. below cold leg centerline at 225°, Spool 15 tap is 9 in. above inlet annulus tap.	±100 in. water	±5.0 psid	80	
DPV-IANN-UP	Inlet annulus, 9 in. below cold leg centerline at 225° to upper plenum, 10.5 in. above cold leg centerline at 30°, elevation difference between taps is 19 in.	±300 in. water	±15 psid	89	

TABLE V (Contd.)

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-02-3

Measurement	Location and Comments[a]	Range[a] Detector	Range[a] Data Acquisition System	Figure[a]	Measurement Comments[b]
DIFFERENTIAL PRESSURE (Contd.)					
Vessel (Contd.)					
DPV-9-180QQ	Inlet annulus, 9 in. below cold leg centerline at 225° to lower plenum, 180 in. below cold leg centerline at 225°, elevation difference between taps is 171 in.	±300 in. water	±15 psid	90	
DPV-26-55QM	Across part of downcomer, 26 in. (225°) to 55 in. (180°) below centerline of cold leg, elevation difference between taps is 29 in.	±50 in. water	±2.5 psid	91	
DPV-156-173QQ	Across downcomer exit, 7 in. above exit to 10 in. below exit, taps at 156 in. (225°) and 173 in. (225°) below cold leg centerline, elevation difference between taps is 17 in.	±20 in. water	±1.0 psid	92	
DPV-166-191QT	Across lower plenum, 166 in. (225°) to 191 in. (270°) below cold leg centerline, elevation difference between taps is 25 in.	±50 in. water	±2.5 psid	93	
DPV-LP-UP	Lower plenum, 180 in. below cold leg centerline at 225° to upper plenum 10.5 in. above cold leg centerline at 30°, elevation difference between taps is 191 in.	±300 in. water	±15 psid	94	
DPU-UP-1	Upper plenum, 10.5 in. above cold leg centerline at 30° to intact loop hot leg Spool 1, 31 in. from vessel center, upper plenum tap is approximately 2 in. above Spool 1 tap	±100 in. water	±5.0 psid	68	
DPU-UP-3	Vessel upper plenum, 10.5 in. above cold leg centerline at 30° to intact loop hot leg Spool 3, 62 in. from vessel center, upper plenum tap is approximately 2 in. above Spool 3 tap	±300 in. water	±15 psid	69	
Steam Generator					
DPU-SG1-SG2	Across primary side tubes, 12 to 24 in. above bottom of tube sheet, SG1 tap is 12 in. below SG2 tap	±20 in. water	±1.0 psid	73	Questionable measurement due to possible blowdown of sense lines.
DPU-SGOP-7	From steam generator outlet plenum, 269 in. from vessel center along cold leg to cold leg Spool 7, 231 in. from vessel center, including orifice, Spool 7 tap is 35 in. below SGOP tap	±500 in. water	±25 psid	74	
DPU-SG-SEC	Secondary side, differential pressure taps at 45 and 126 in. above bottom of tube sheet, elevation difference between taps is 81 in.	±100 in. water	±5.0 psid		Detector failed
DPS-SGFEED	In steam generator feed line	±100 in. water	±5.0 psid	95	
DPS-SGDISC	In steam generator discharge line	±100 in. water	±5.0 psid	96	
Pressurizer					
DPU-PRESLL	Pressurizer water level, elevation difference between taps is 34 in., lower tap is approximately 3.5 in. above pressurizer exit	±500 in. water	±2.5 psid	82	
VOLUMETRIC FLOW RATE	Turbine flowmeter, bidirectional				
Intact Loop	3-in. Schedule 160 pipe				
FTU-1	Hot leg, Spool 1, 18 in. from vessel center	±20-±400 gpm	±800 gpm	97	
FTU-9	Cold leg, Spool 9, 154 in. from vessel center	±20-±400 gpm	±800 gpm	97	
FTU-13	Cold leg, Spool 13, 64 in. from vessel center	±20-±400 gpm	±800 gpm	98	
FTU-15	Cold leg, Spool 15, 29 in. from vessel center	±10-±200 gpm	±200 gpm	98	
Broken Loop	All measurements bidirectional, Schedule 160 pipe				
FTB-21	Cold leg, Spool 21, 58 in. from vessel center, 3-in. pipe	±20-±400 gpm	±850 gpm		Detector saturated from t=17 sec to t=34 sec
FTB-30	Hot leg, Spool 30, 25 in. from vessel center, 3-in. pipe	±20-±400 gpm	±500 gpm		

TABLE V (Contd.)

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-02-3

Measurement	Location and Comments[a]	Range[a] Detector	Range[a] Data Acquisition System	Figure[a]	Measurement Comments[b]
VOLUMETRIC FLOW RATE (Contd.)					
Core					
FTV-CORE-IN	Entrance to core, approximately 158 in. below cold leg centerline	±20–±400 gpm	±400 gpm	100	
Pressurizer	1-1/2-in. turbine				
FTU-PRIZE	Surge line	5-100 gpm	0-100 gpm		Turbine bearings failed
FLUID VELOCITY	Turbine flowmeter, bidirectional				
Downcomer Gap				101	
FTV-40A	40 in. below cold leg centerline, 0°	±2.5–±50 ft/sec	±70 ft/sec		
FTV-40M	40 in. below cold leg centerline, 180°	±2.5–±50 ft/sec	±50 ft/sec		Detector failed
MOMENTUM FLUX	Drag-disc bidirectional. Computer conversion of voltage output to momentum flux is unidirectional and therefore shows magnitude only				
Intact Loop	3-in. pipe				
FDU-1	Hot leg, Spool 1, 29 in. from vessel center, target size 0.875 in.	±250–±11,500 lbm/ft-sec^2	±15,000 lbm/ft-sec^2	102	
FDU-5	Hot leg, Spool 5, 100 in. from vessel center, target size 1.0 in.	±1–±2,000 lbm/ft-sec^2	±2,000 lbm/ft-sec^2	103	
FDU-10	Cold leg, Spool 10, 137 in. from vessel center, target size 0.875 in.	±200–±10,400 lbm/ft-sec^2	±130,000 lbm/ft-sec^2	104	
FDU-13	Cold leg, Spool 13, 54 in. from vessel center, target size 0.875 in.	±200–±11,000 lbm/ft-sec^2	±14,800 lbm/ft-sec^2	105	
FDU-15	Cold leg, Spool 15, 19 in. from vessel center, target size 0.875 in.	±200–±11,600 lbm/ft-sec^2	±15,500 lbm/ft-sec	106	
Broken Loop					
FDB-21	Cold leg, Spool 21, 53 in. from vessel center, 3-in. pipe, target size 0.656 in.	±200–±70,500 lbm/ft-sec^2	±94,000 lbm/ft-sec^2	107	
FDB-23	Hot leg, Spool 23, 93 in. from vessel center, upstream of vessel-side nozzle, downstream of injection point, 2-in. pipe, target size 0.406 in.	±200–±123,000 lbm/ft-sec^2	±167,000 lbm/ft-sec^2	108	
FDB-30	Cold leg, Spool 30, 20 in. from vessel center, 3-in. pipe, target size 0.656 in.	±200–±60,000 lbm/ft-sec^2	±80,000 lbm/ft-sec^2	109	
FDB-37	Cold leg, Spool 37, 284 in. from vessel center along hot leg, steam generator outlet vertical pipe, 2-in. pipe, target size 0.406 in.	±200–±121,000 lbm/ft-sec^2	±175,000 lbm/ft-sec^2	110	
FDB-42	Hot leg, Spool 42, 416 in. from vessel center along cold leg, upstream of pump-side nozzle, downstream of injection point, 2-in. pipe, target size 0.406 in.	±200–±116,000 lbm/ft-sec^2	±155,000 lbm/ft-sec^2	111	
Vessel					
FDV-CORE-IN	In core flow mixer box, 150 in. below cold leg centerline, target size 1.0 in.	±100–±1,000 lbm/ft-sec^2	±1,000 lbm/ft-sec^2	112	Experimental transducer. Output appears to be affected by blowdown.
DENSITY		0.1-100 lbm/ft^3	0-100 lbm/ft^3		
Intact Loop					
GU-1VR	Hot leg, Spool 1, 24 in. from vessel center, vertical			113	
GU-1HZ	Hot leg, Spool 1, 26 in. from vessel center, horizontal			113	
GU-5VR	Hot leg, Spool 5, 96 in. from vessel center, vertical			114	
GU-10VR	Cold leg, Spool 10, 141 in. from vessel center, vertical			114	
GU-13VR	Cold leg, Spool 13, 59 in. from vessel center, vertical			115	
GU-15HZ	Cold leg, Spool 15, 20 in. from vessel center, horizontal			116	
GU-15VR	Cold leg, Spool 15, 23 in. from vessel center, vertical			116	

TABLE V (Contd.)

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-02-3

Measurement	Location and Comments[a]	Range[a] Detector	Range[a] Data Acquisition System	Figure[a]	Measurement Comments[b]
DENSITY (Contd.)					
Broken Loop					
GB-21VR	Cold leg, Spool 21, 49 in. from vessel center, vertical			117	
GB-23VR	Cold leg, Spool 23, 92 in. from vessel center, vertical			117	
GB-30VR	Cold leg, Spool 30, 18 in. from vessel center, vertical			118	
GB-37HZ	Cold leg, Spool 37, 279 in. from vessel center along hot leg, across vertical pipe, simulated steam generator discharge				Detector failed
GB-42VR	Hot leg, Spool 42, 414 in. from vessel center along hot leg, vertical			118	
Vessel					
GV-COR-150HZ	Core flow mixer box, 152 in. below cold leg centerline, horizontal, 0-180°			119	
GV-161/192D	Lower plenum 161 in. below cold leg centerline (270°) to 192 in. below cold leg centerline (90°), 31 in. vertical 32.2 in. diagonal			119	
GVLP-165HZ	Upper part of lower plenum, 165 in. below cold leg centerline, 1.724 in. below downcomer exit, horizontal, 0-180°			120	
GVLP-172HZ	Lower plenum, 172 in. below cold leg centerline, 8.729 in. below downcomer exit, horizontal, 90-270°			120	
Pressurizer				121	
GU-PRIZE	Surge line				
MASS FLOW RATE	Mass flow rate obtained by combining density (gamma attenuation technique) with volumetric flow rate (turbine flowmeter) or momentum flux (drag disc)	Range for mass flow is determined from range of individual detectors used in calculation			
Intact Loop					
FDU-1 GU-1VR FTU-1 GU-1VR	Hot leg, Spool 1			122 123	
FDU-5 GU-5VR	Hot leg, Spool 5			124	
FTU-9 GU-10VR	Cold leg, Spool 9			125	
FDU-10 GU-10VR	Cold leg, Spool 10			126	
FDU-13 GU-13VR FTU-13 GU-13VR	Cold leg, Spool 13			127 128	
FDU-15 GU-15VR FTU-15 GU-15VR	Cold leg, Spool 15			129 130	
FTU-PRIZE GU-PRIZE	Pressurizer surge line				Detector failed
Broken Loop					
FDB-21 GB-21VR FTB-21 GB-21VR	Cold leg, Spool 21			131 132	Discrepancies in mass flow rate measurements from Transducers FDB-21 and FTB-21 may be due to changes in the calibration factors due to the combined effects of two-phase flow and complex geometries not accounted for in present calibration techniques
FDB-23 GB-23VR	Cold leg, Spool 23			133	
FDB-30 GB-30VR FTB-30 GB-30VR	Hot leg, Spool 30			134 135	
FDB-37 GB-42	Cold leg, Spool 37			136	Combination has questionable validity because of physical difference in detector location
FDB-42 GB-42VR	Cold leg, Spool 42			137	
Vessel					
FTV-CORE-IN GV-COR-150HZ	Entrance to core			138	
FDV-CORE-IN GV-COR-150HZ	Entrance to core			139	Experimental transducer. Output appears to be affected by blowdown.

TABLE V (Contd.)

DATA PRESENTATION FOR SEMISCALE MOD-1 Test S-02-3

Measurement	Location and Comments[a]	Range[a] Detector	Range[a] Data Acquisition System	Figure[a]	Measurement Comments[b]
CORE CHARACTERISTICS					
PWRCOR T-1	Core power		1600 kW	140	
PWRCOR T-2	Core power		1600 kW	140	
VOLTCORE-T	Core voltage		200 V	141	
AMPCORE-T	Core current		10,000 A	142	
PUMP CHARACTERISTICS					
PUMPU-TORQ	Pump torque	0-500 in.-lb	0-500 in.-lb	143	
PUMPU-POW	Pump motor power		25 kW	144	Power calculated from torque and speed exceeds measured power
PUMPU-RPM	Pump speed	0-3600 rpm	0-3600 rpm	145	

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

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

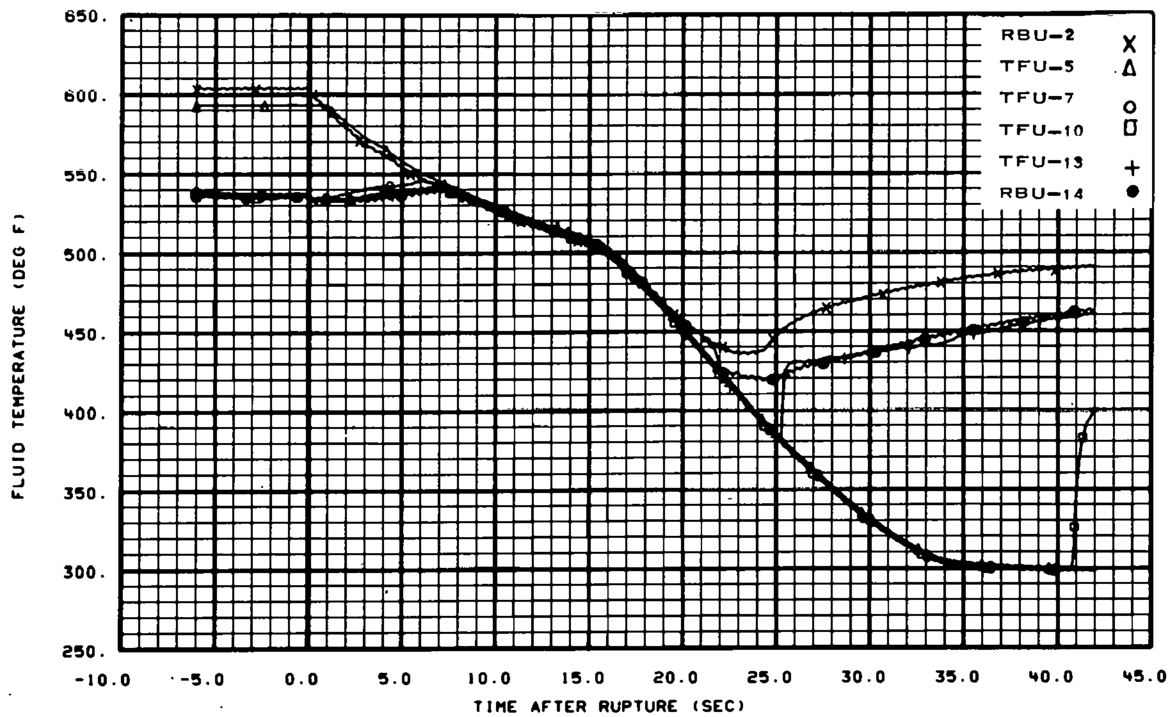

Fig. 7 Fluid temperature in intact loop.

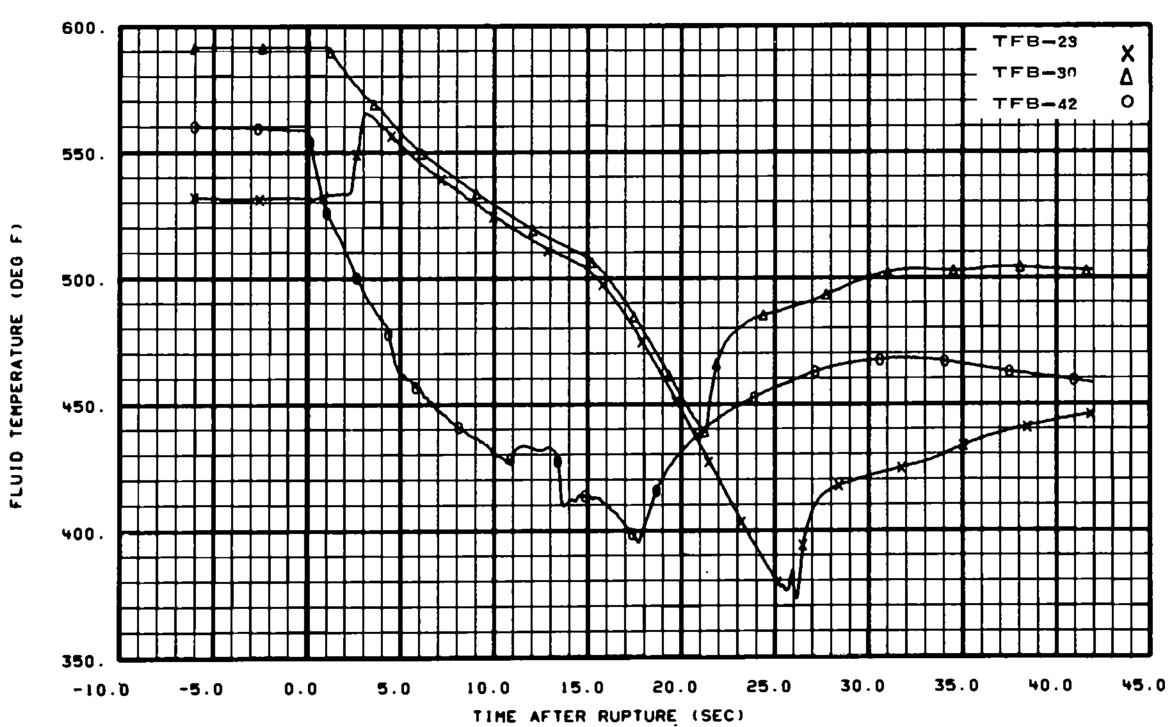

Fig. 8 Fluid temperature in broken loop.

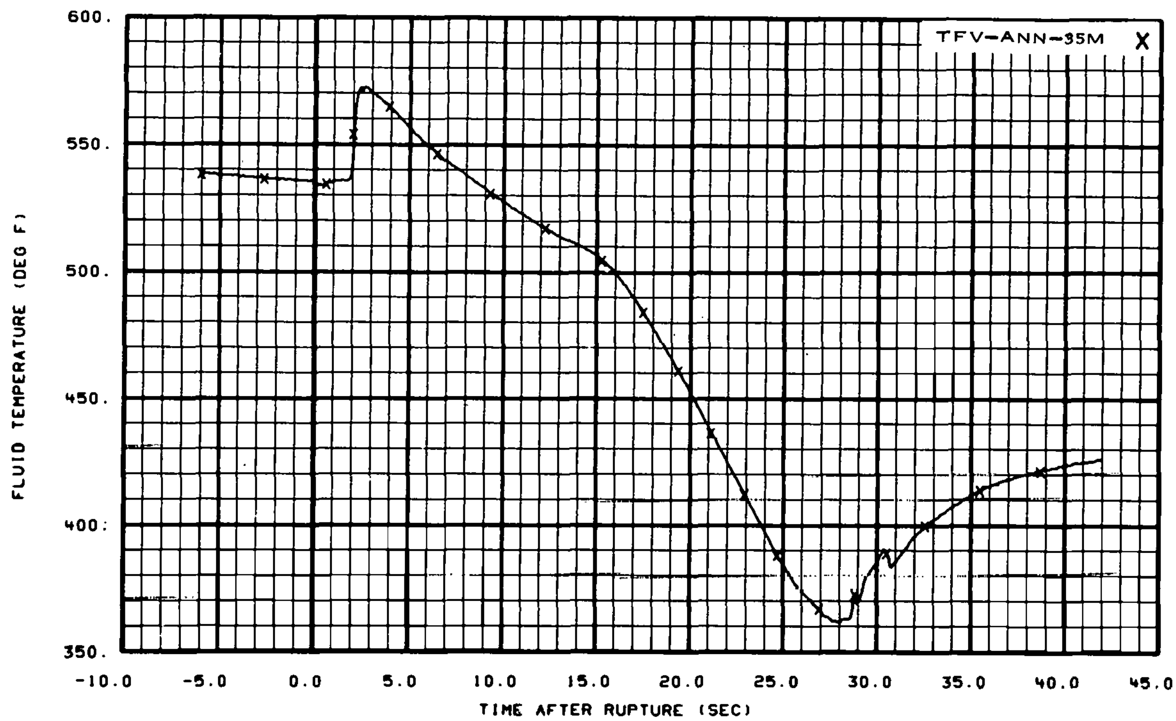

Fig. 9 Fluid temperature in downcomer annulus.

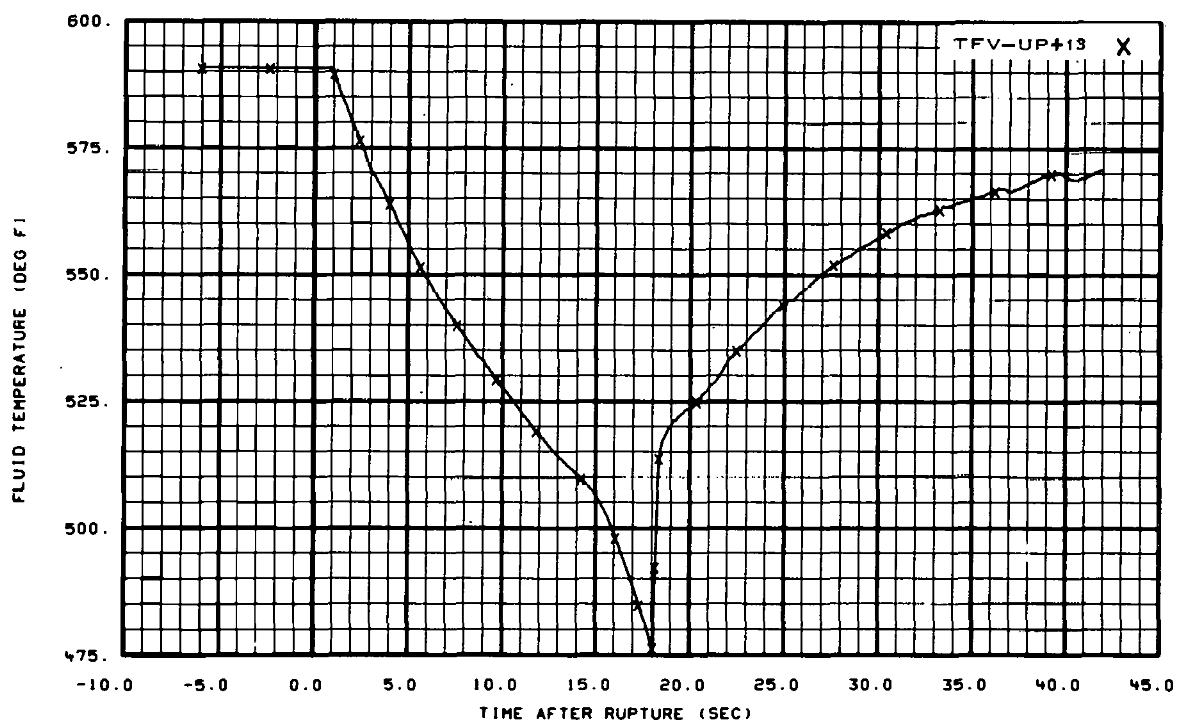

Fig. 10 Fluid temperature in upper plenum.

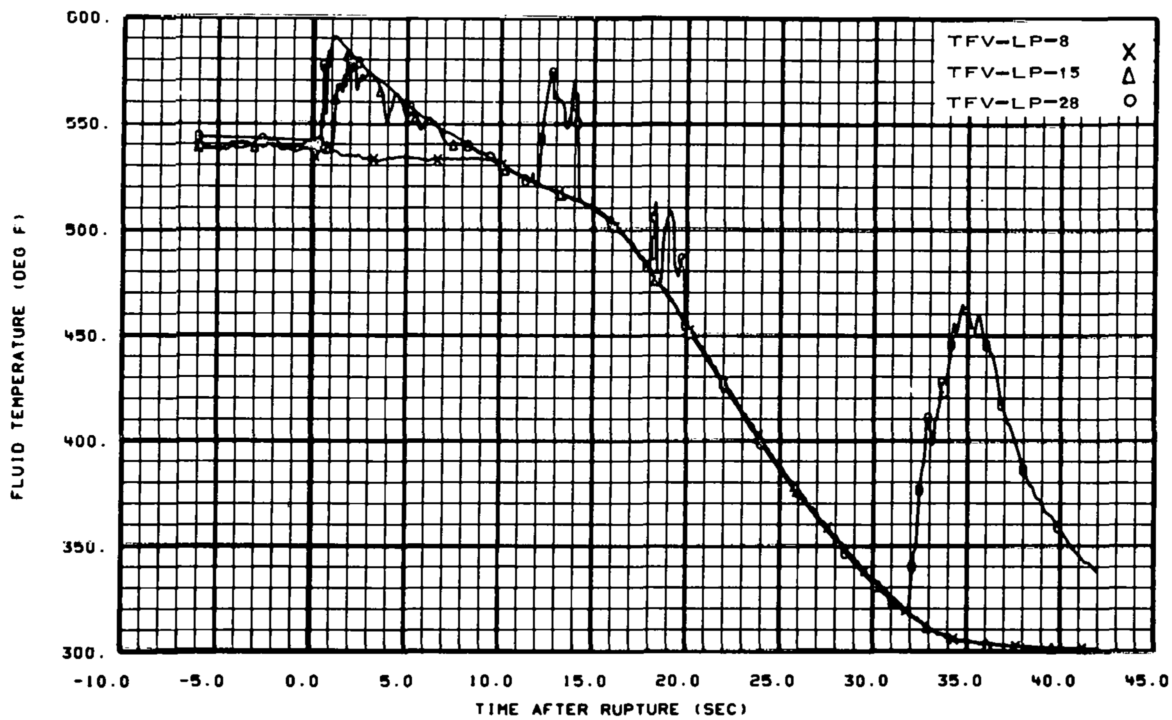

Fig. 11 Fluid temperature in lower plenum.

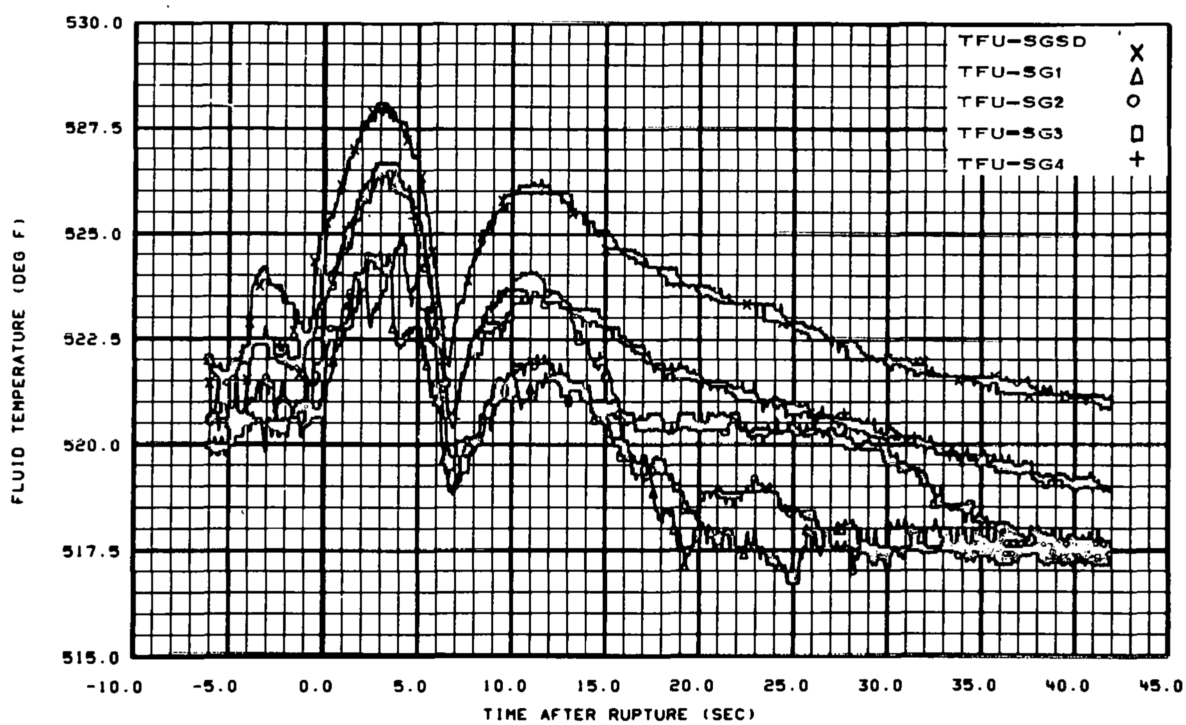

Fig. 12 Fluid temperature in steam generator.

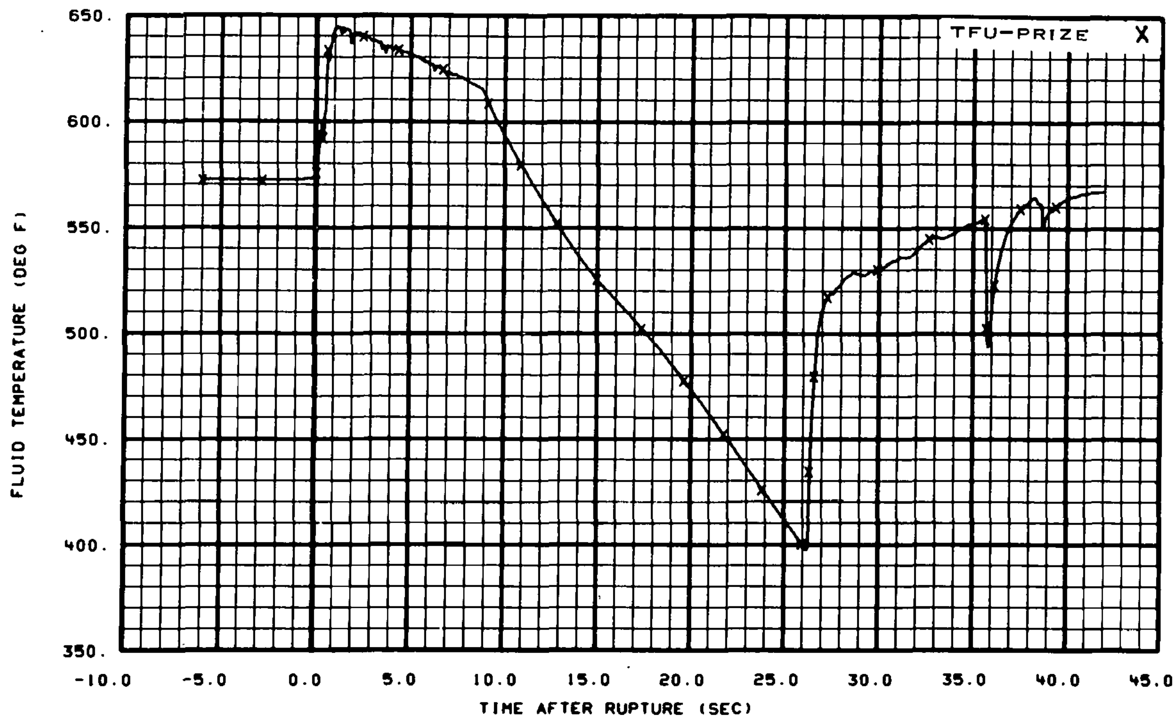

Fig. 13 Fluid temperature in pressurizer surge line.

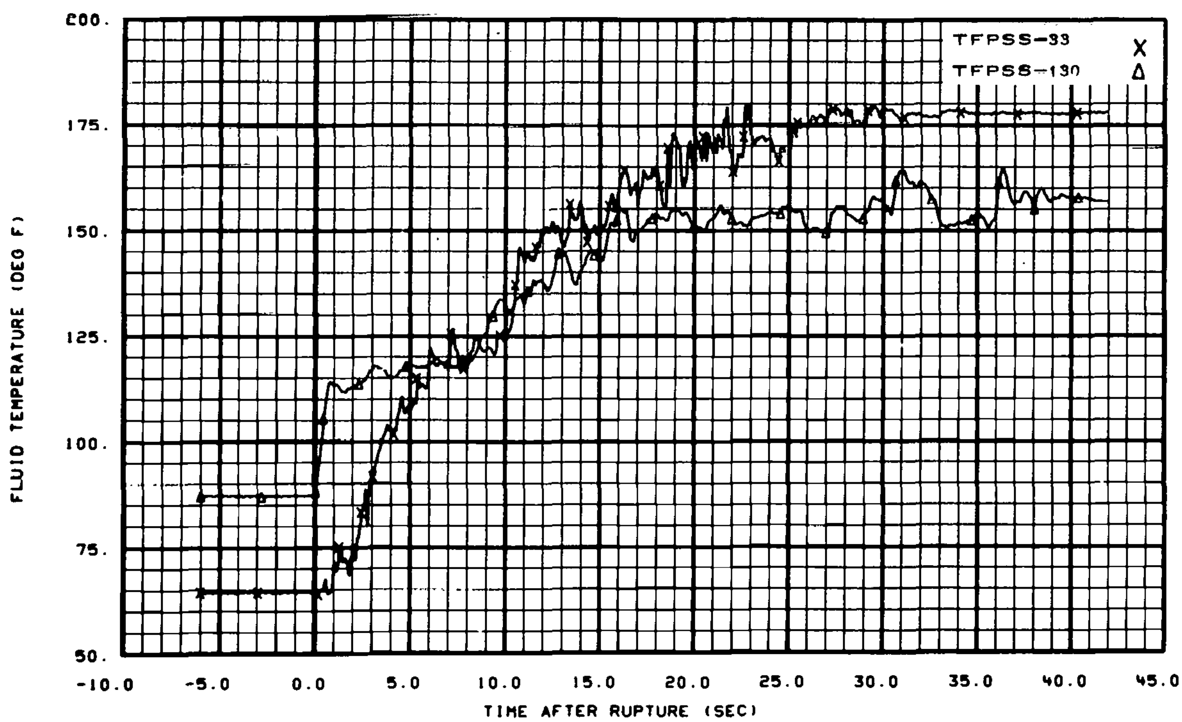

Fig. 14 Fluid temperature in pressure suppression system.

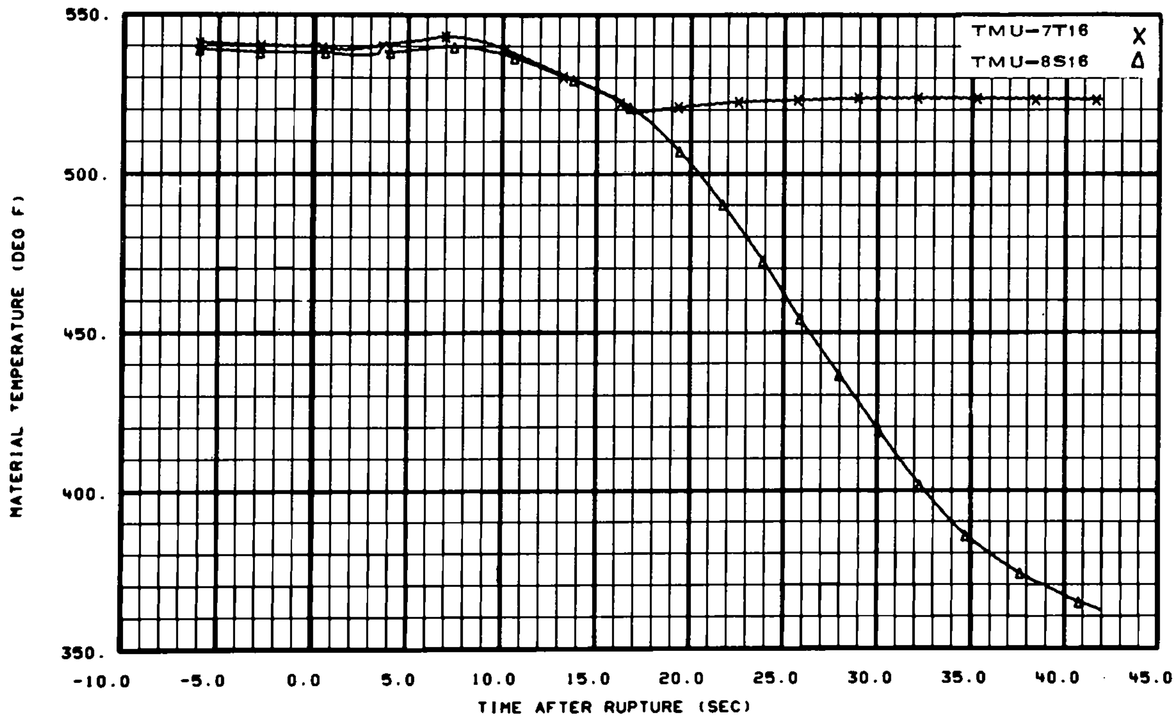

Fig. 15 Material temperature in intact loop.

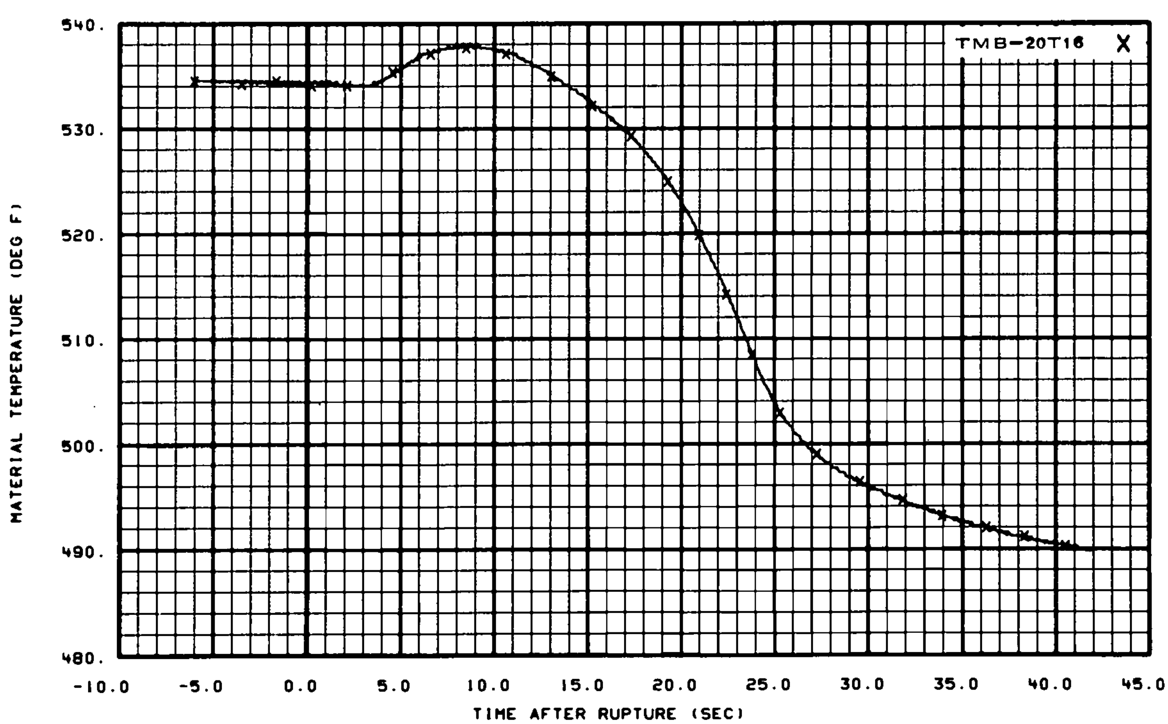

Fig. 16 Material temperature in broken loop.

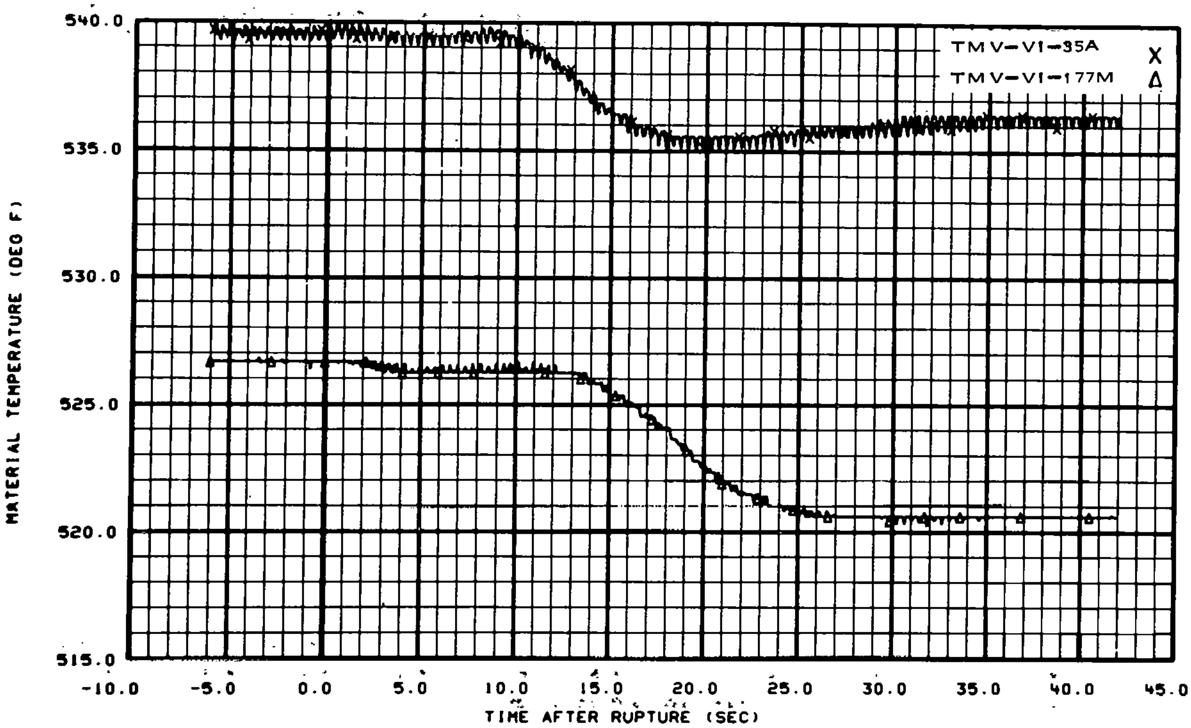

Fig. 17 Material temperature in vessel wall.

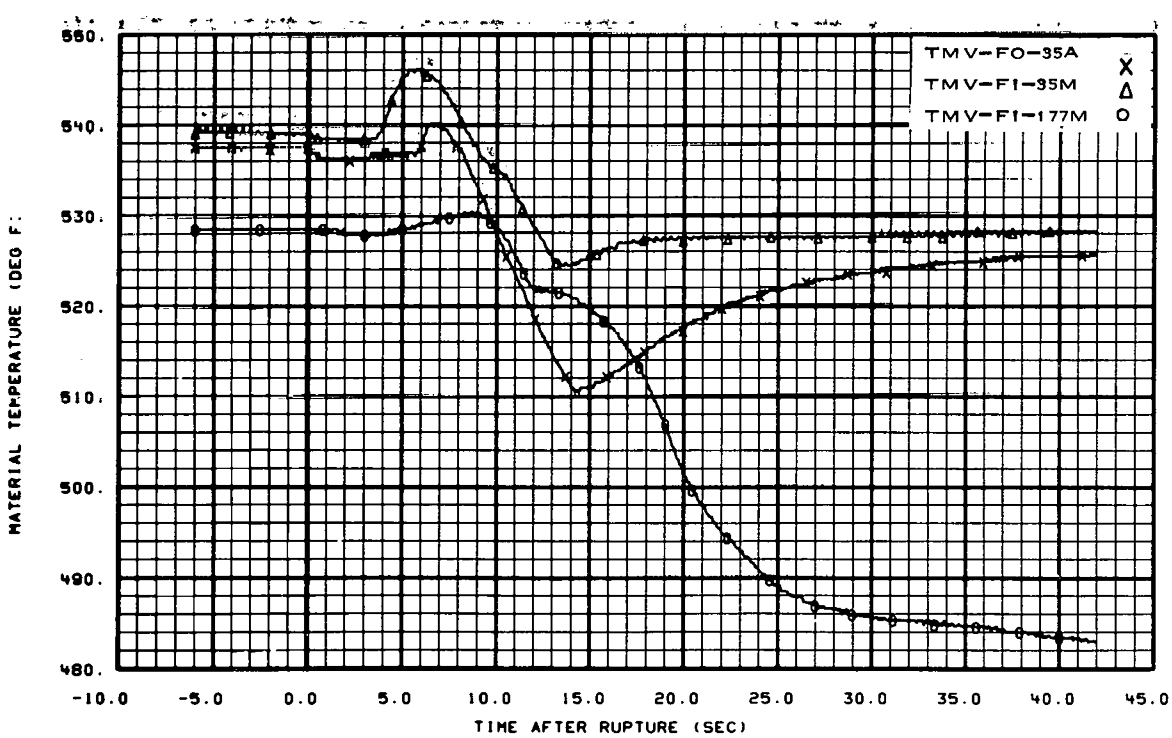

Fig. 18 Material temperature in vessel filler.

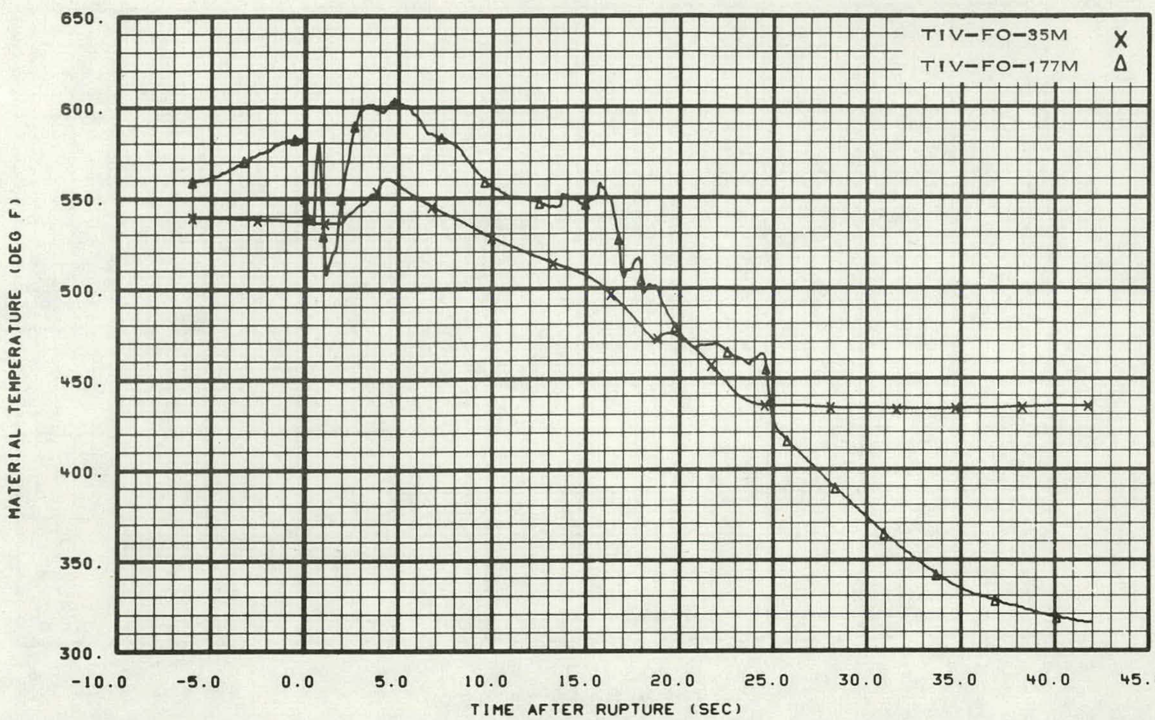

Fig. 19 Material temperature in vessel filler insulator.

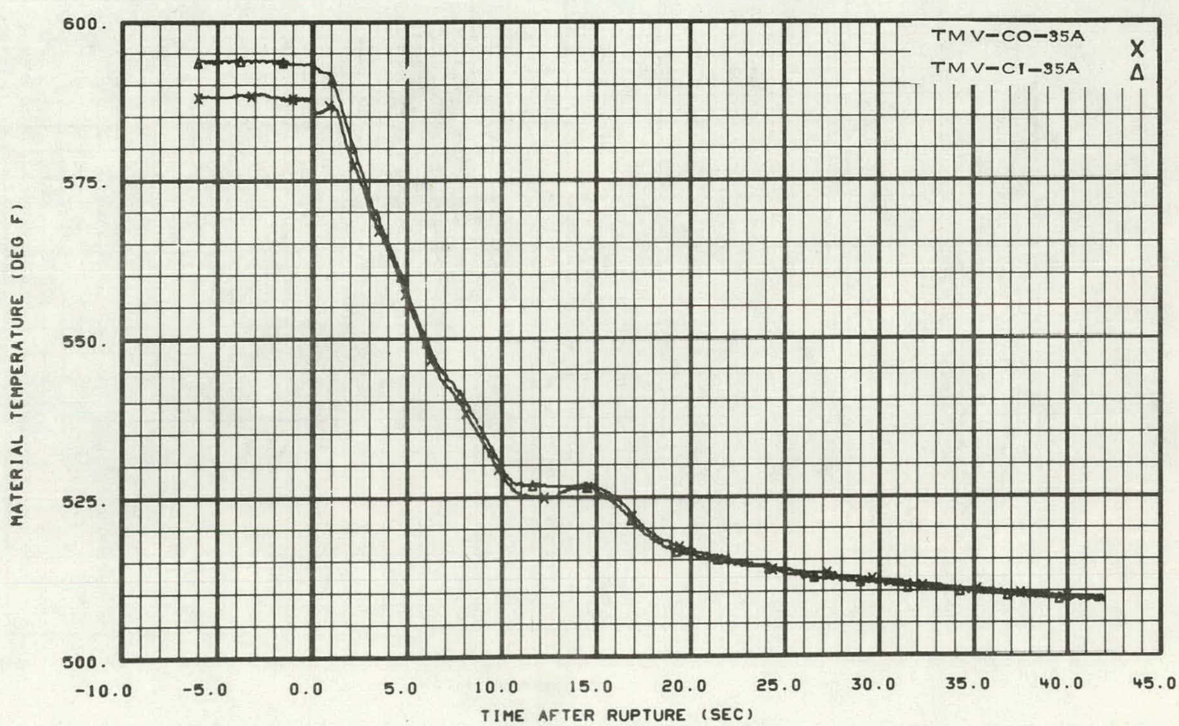

Fig. 20 Material temperature in core barrel.

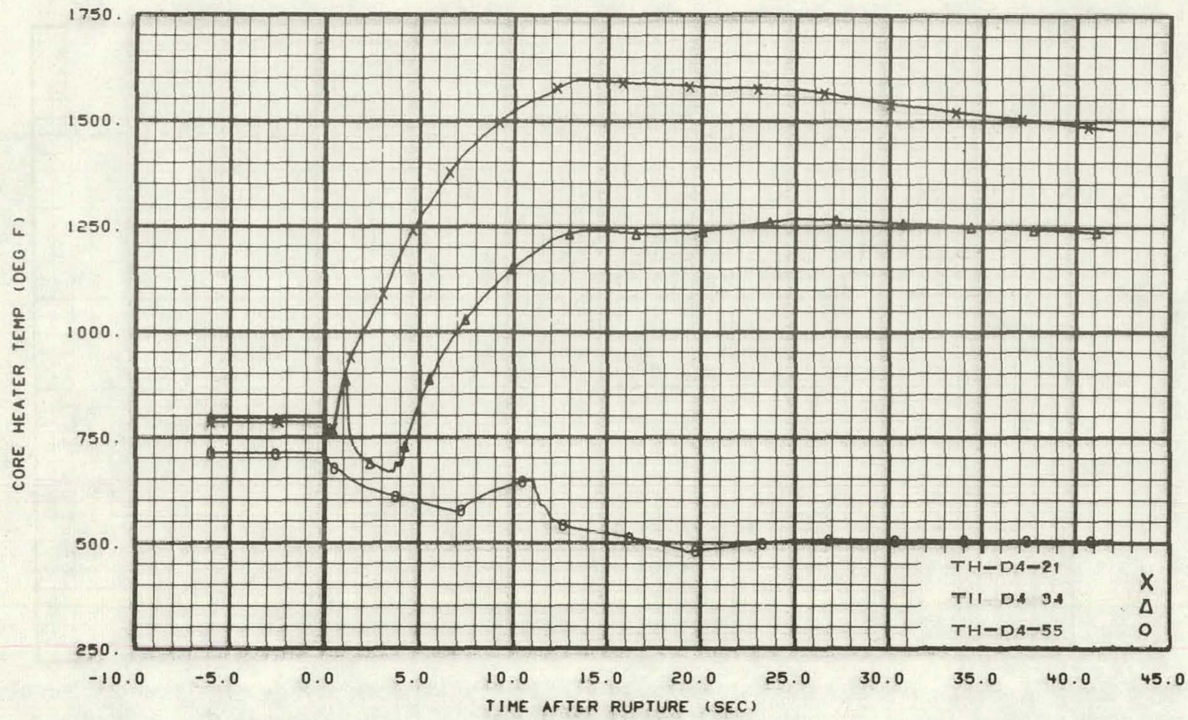

Fig. 21 Core heater temperature, Rod D-4 (high power).

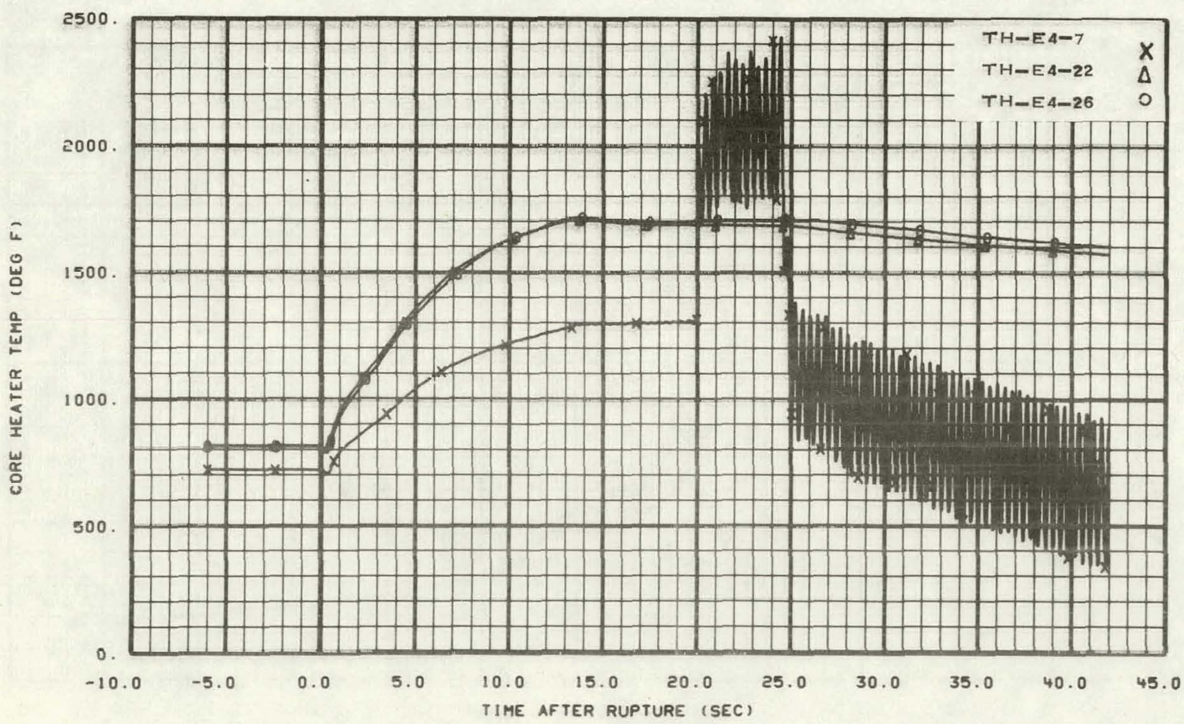

Fig. 22 Core heater temperature, Rod E-4 (high power).

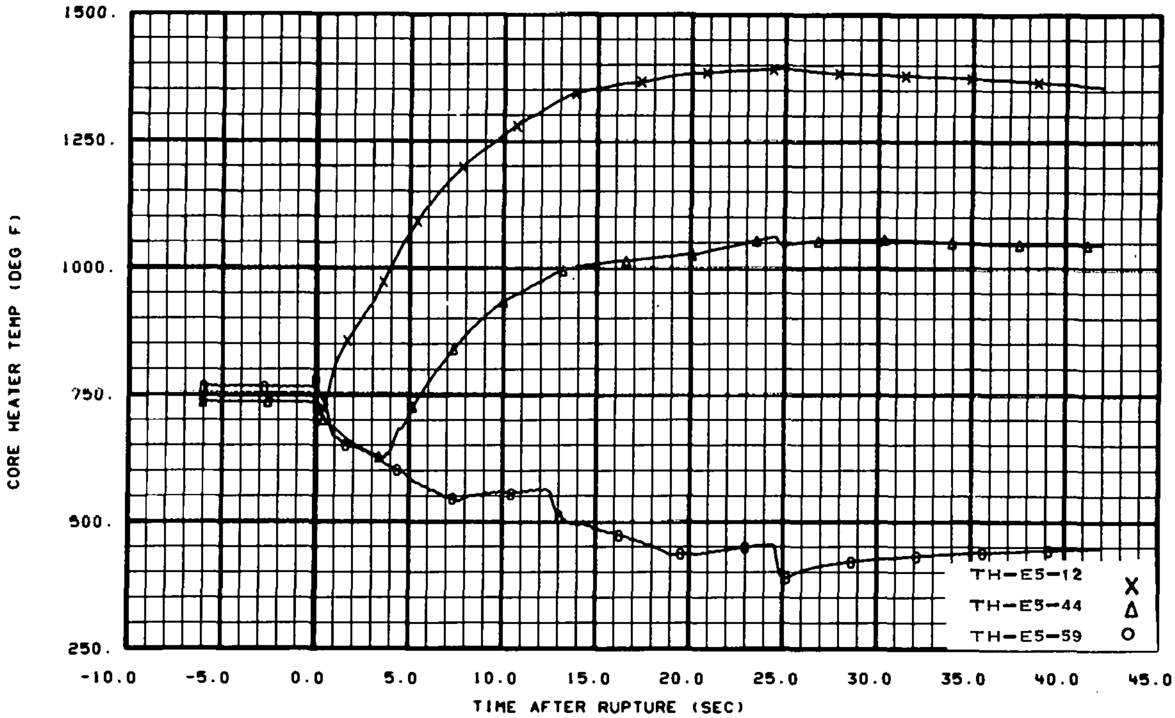

Fig. 23 Core heater temperature, Rod E-5 (high power).

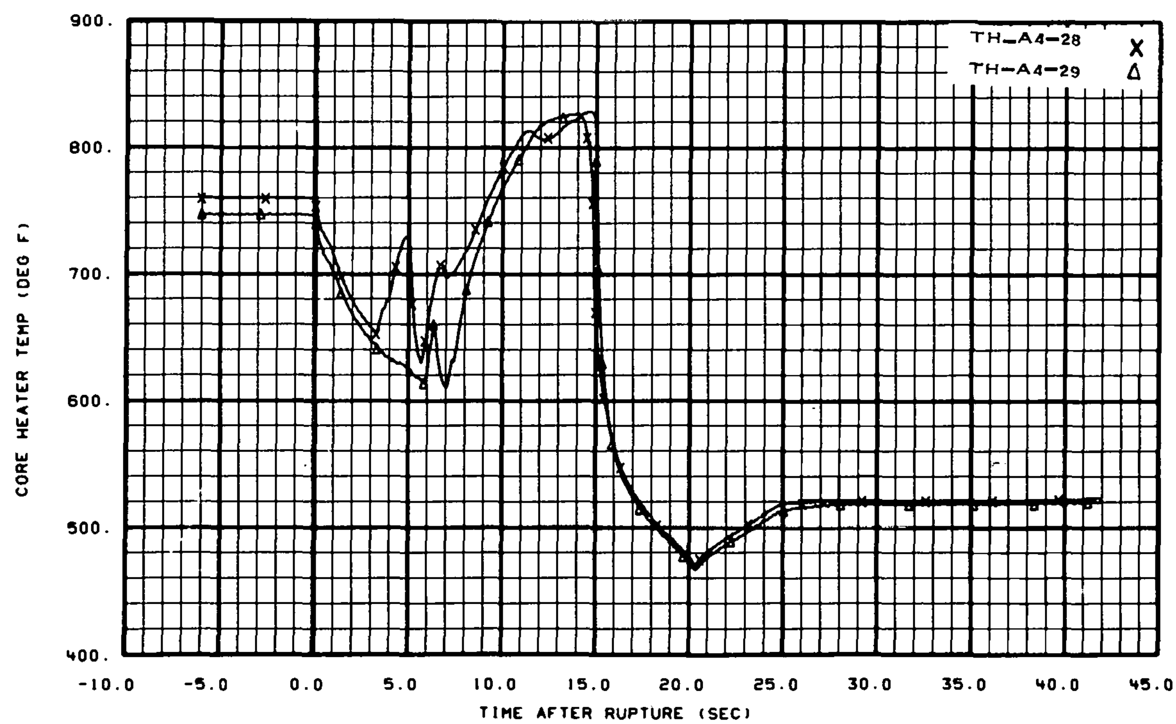

Fig. 24 Core heater temperature, Rod A-4.

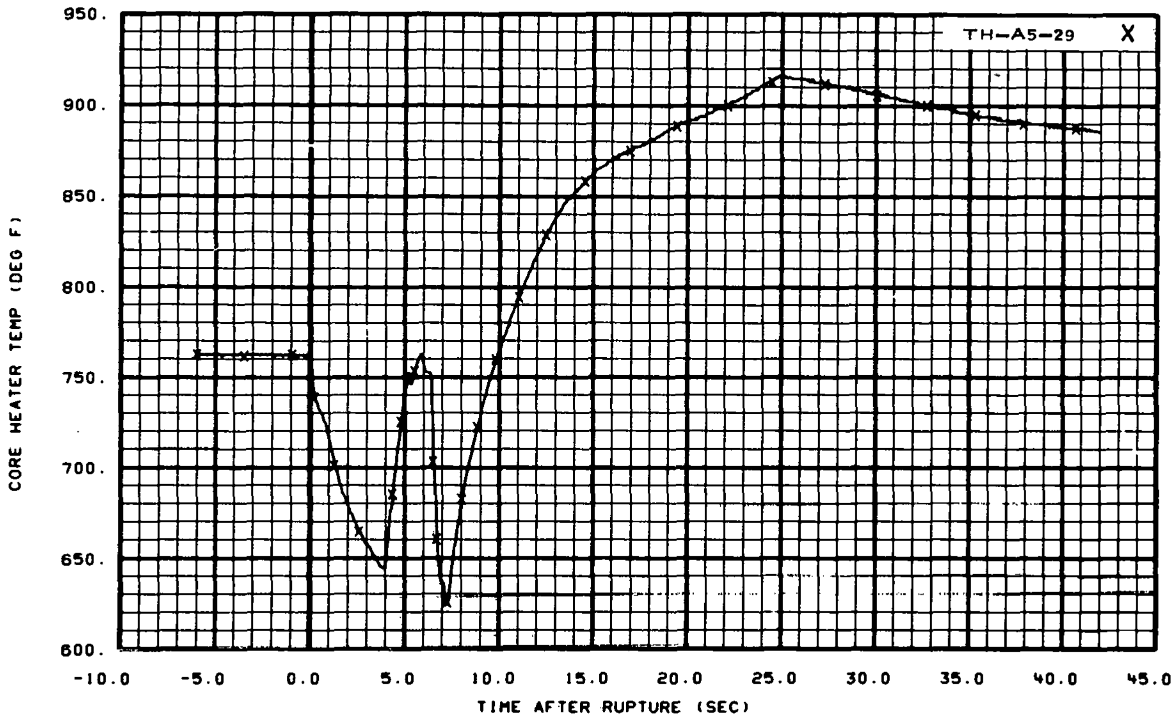

Fig. 25 Core heater temperature, Rod A-5.

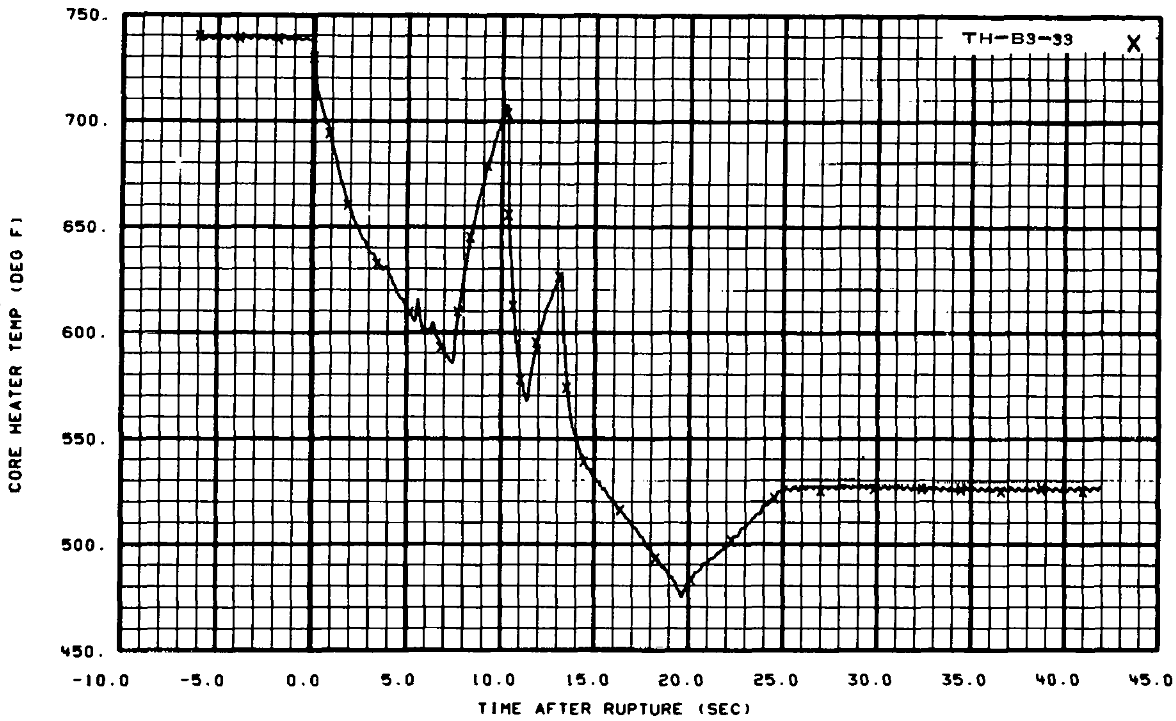

Fig. 26 Core heater temperature, Rod B-3.

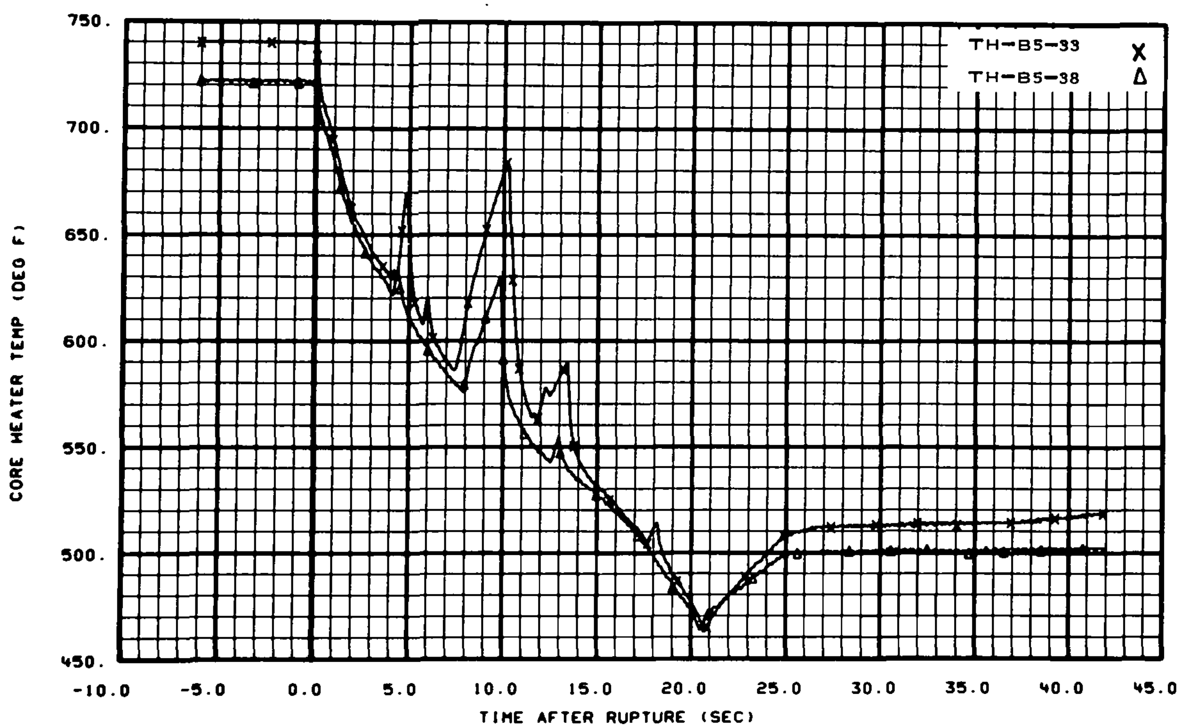

Fig. 27 Core heater temperature, Rod B-5.

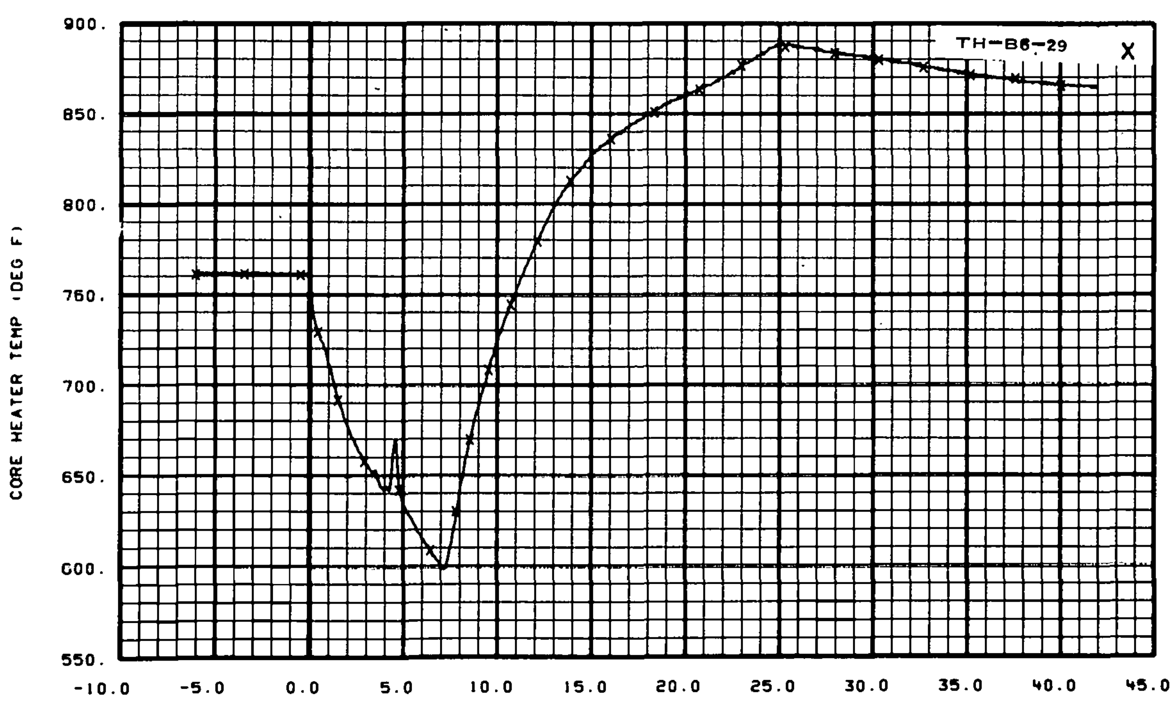

Fig. 28 Core heater temperature, Rod B-6.

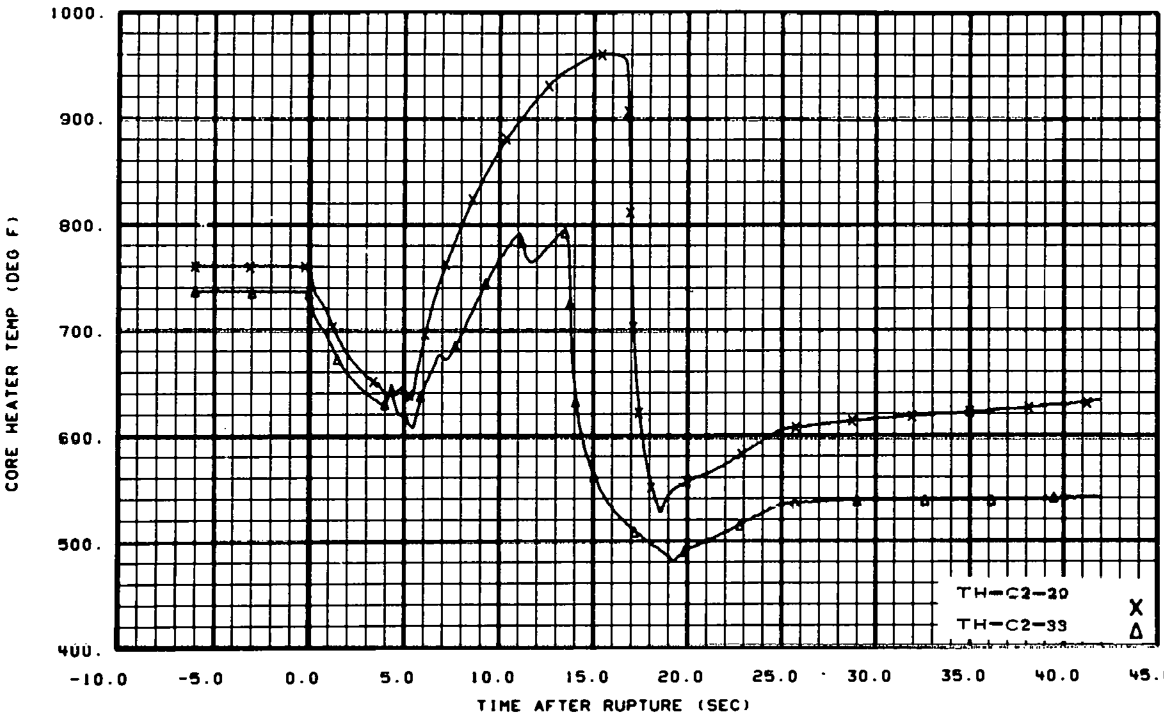

Fig. 29 Core heater temperature, Rod C-2.

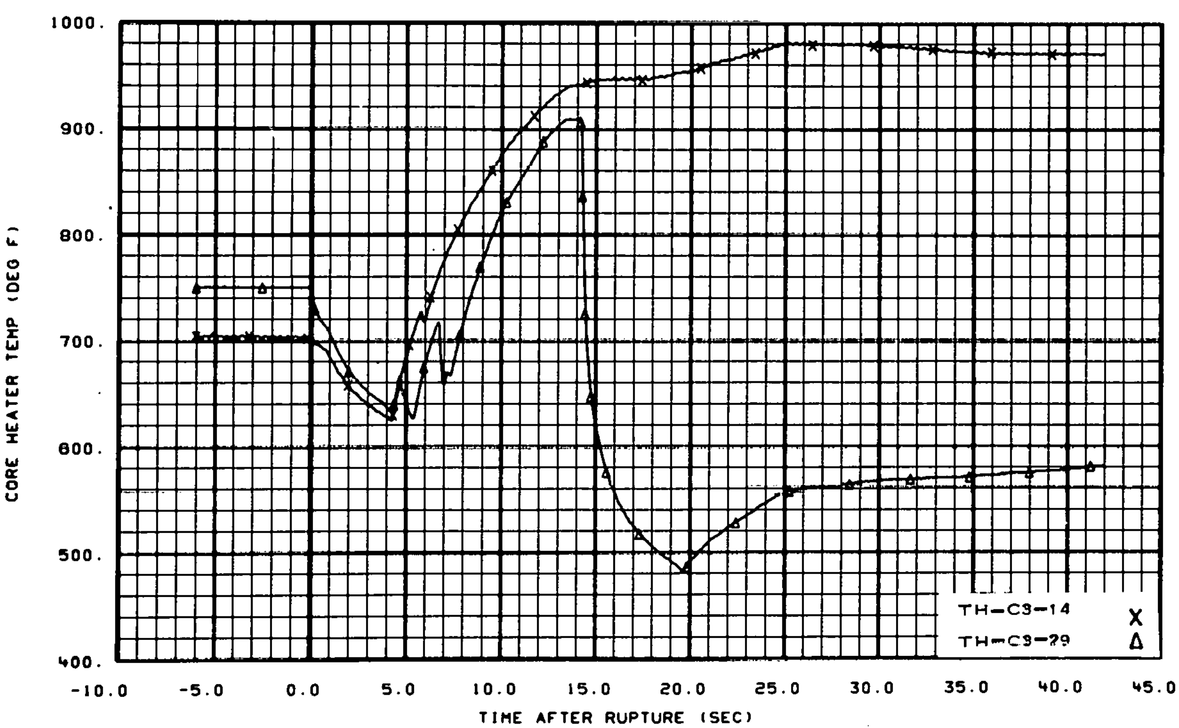

Fig. 30 Core heater temperature, Rod C-3.

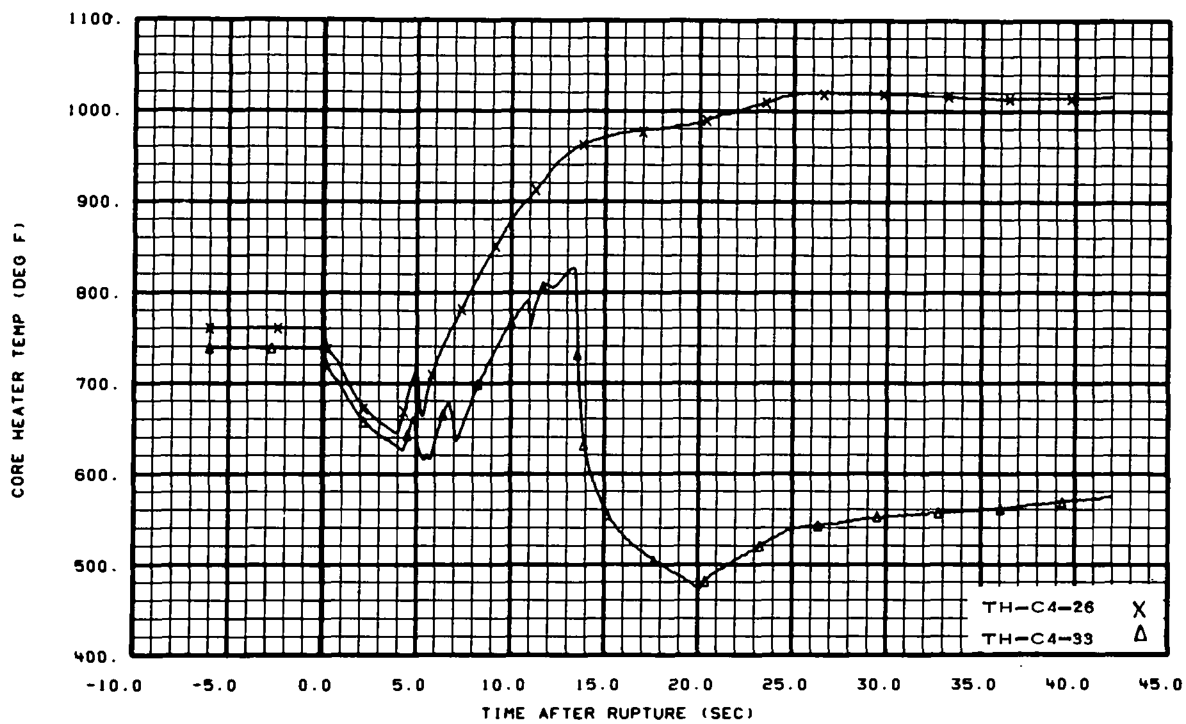

Fig. 31 Core heater temperature, Rod C-4.

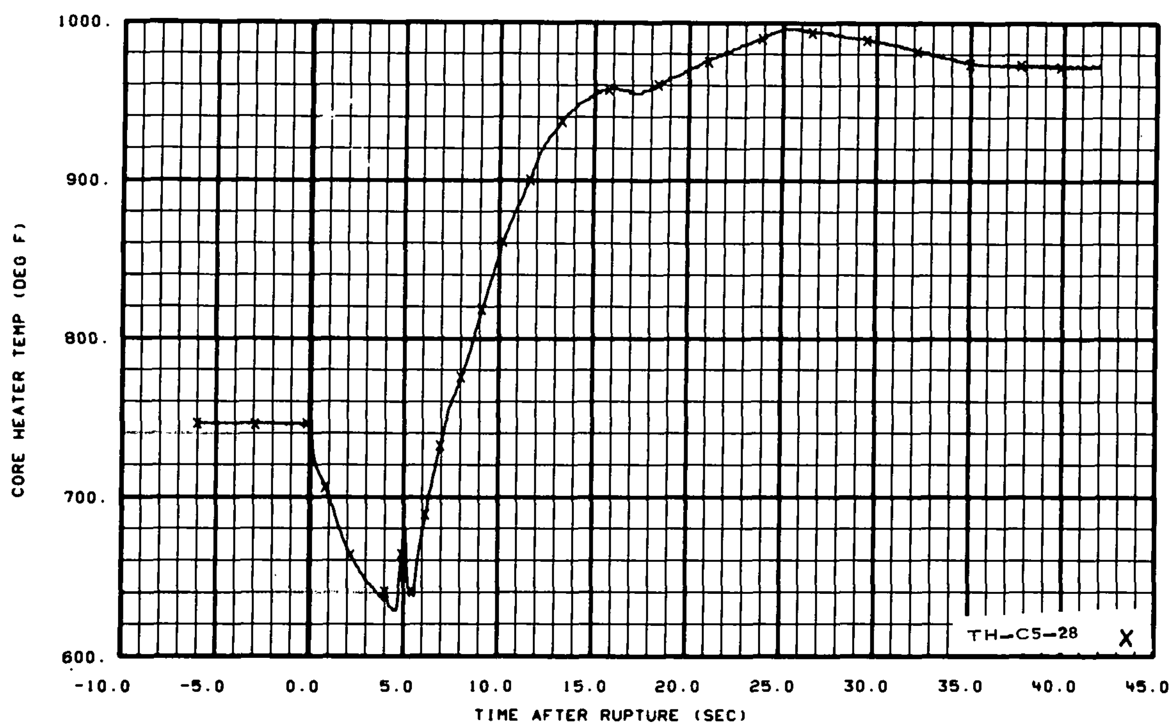

Fig. 32 Core heater temperature, Rod C-5.

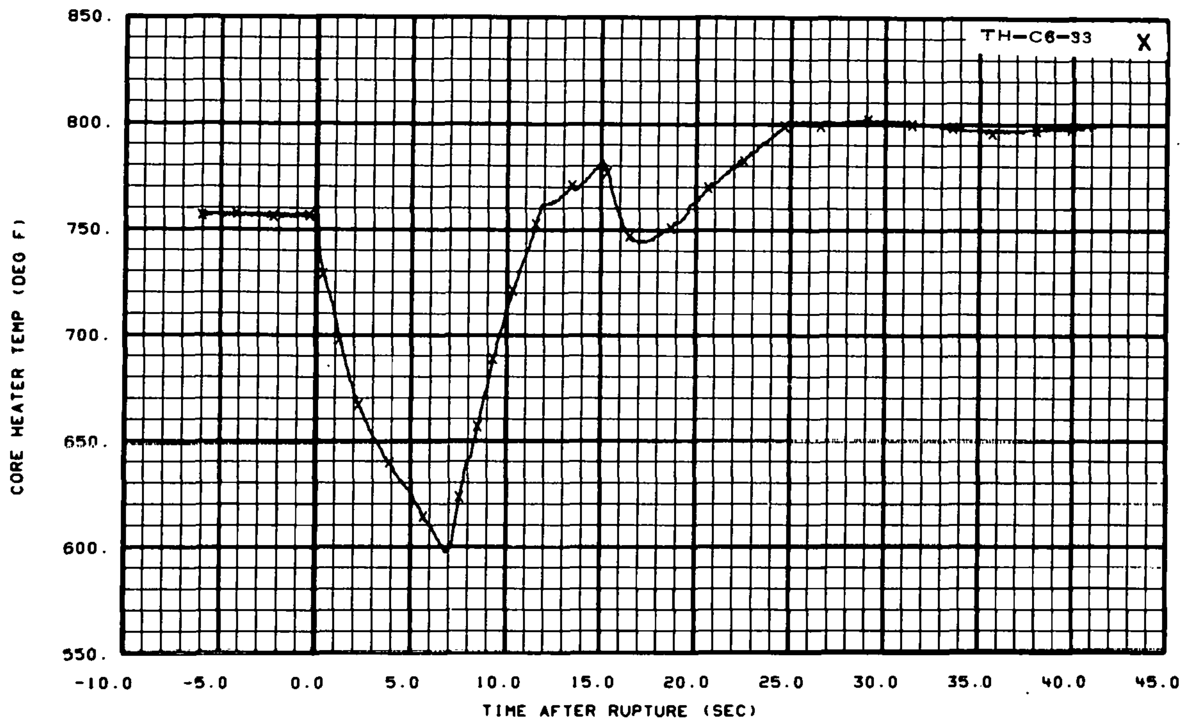

Fig. 33 Core heater temperature, Rod C-6.

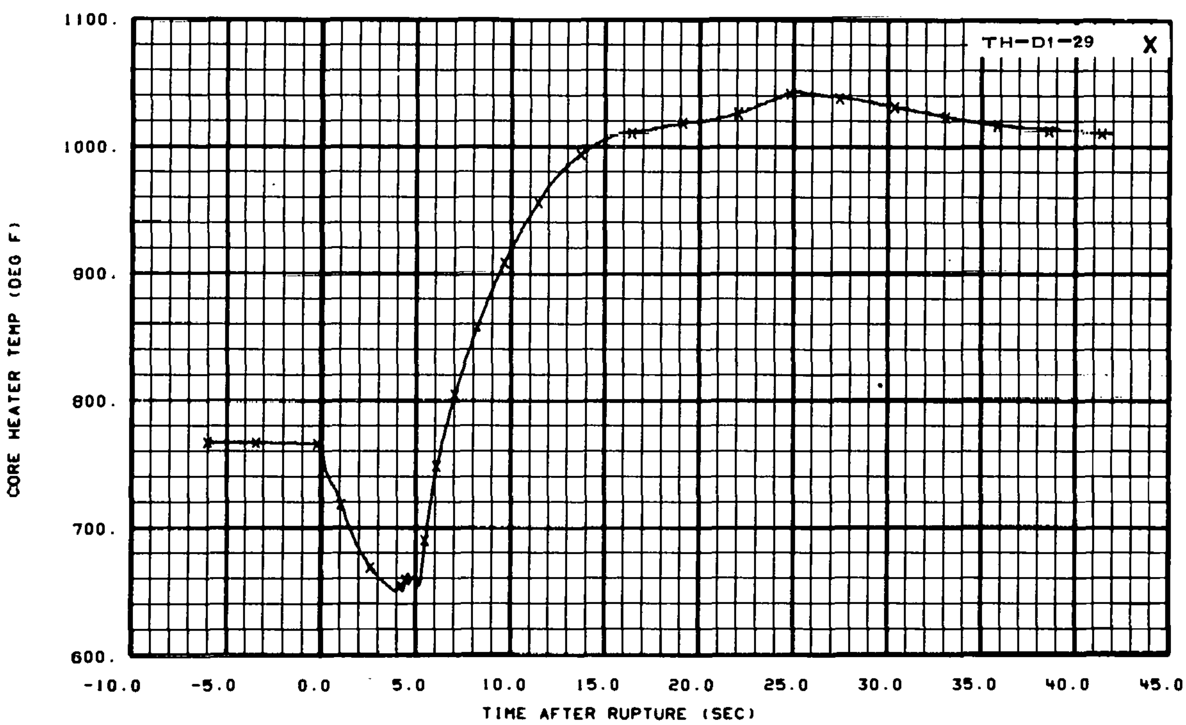

Fig. 34 Core heater temperature, Rod D-1.

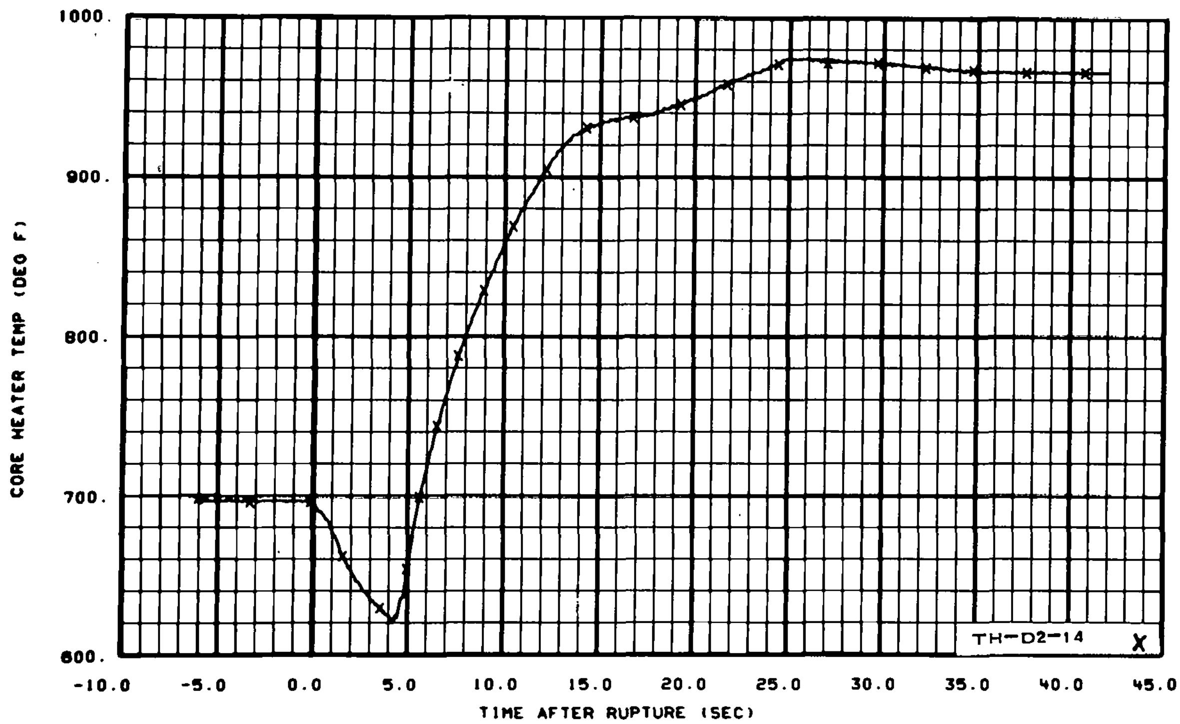

Fig. 35 Core heater temperature, Rod D-2.

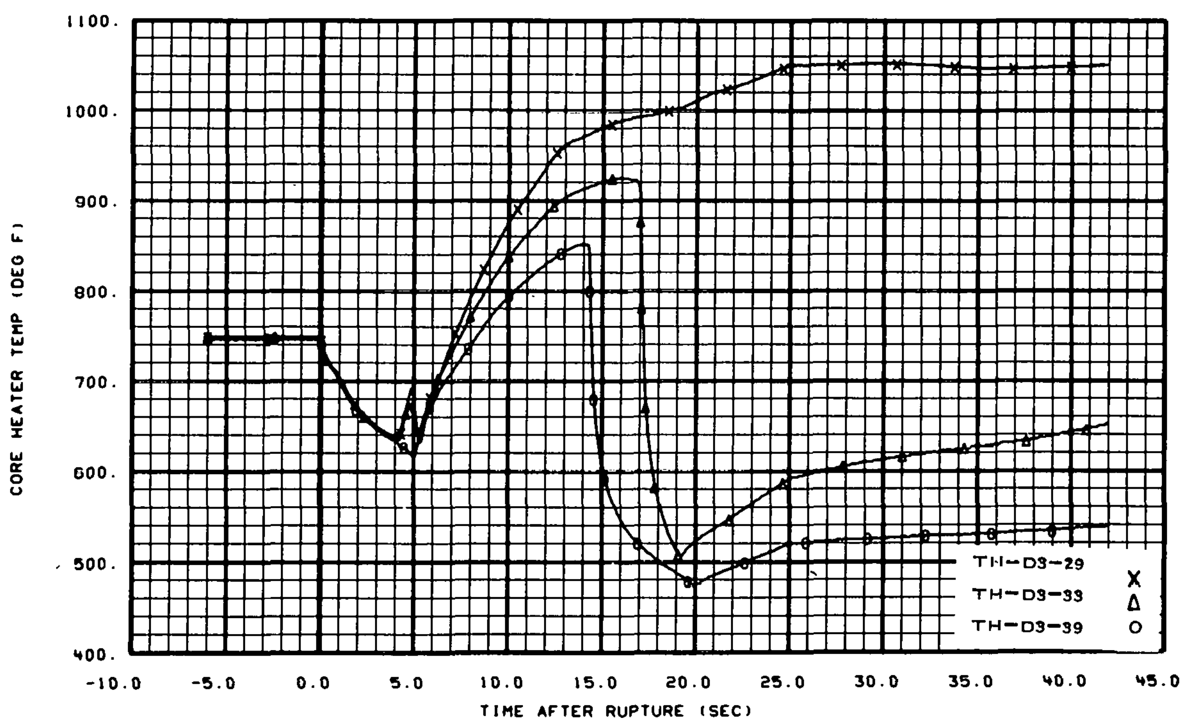

Fig. 36 Core heater temperature, Rod D-3.

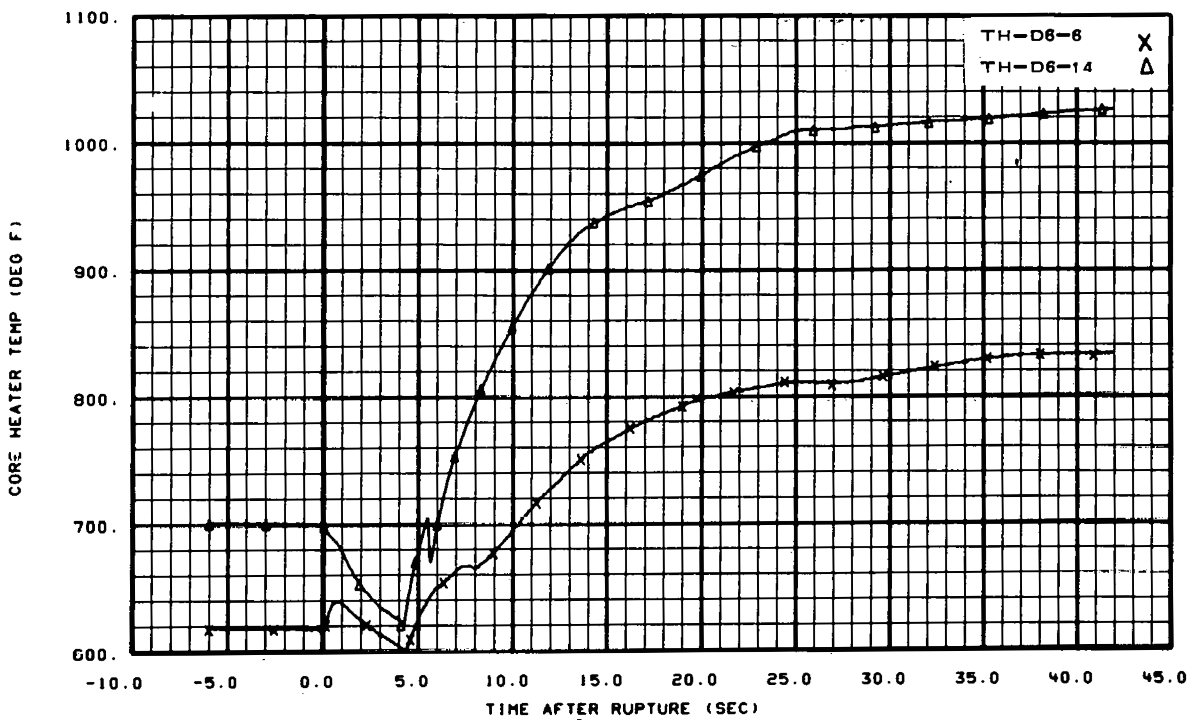

Fig. 37 Core heater temperature, Rod D-6.

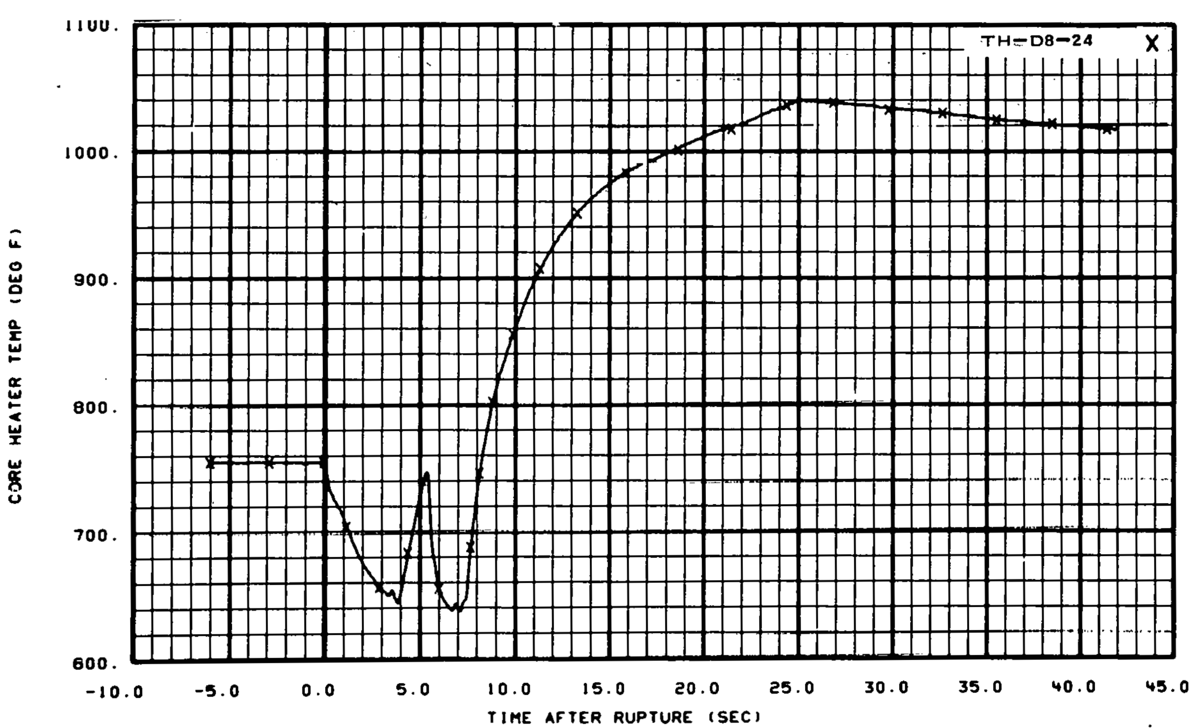

Fig. 38 Core heater temperature, Rod D-8.

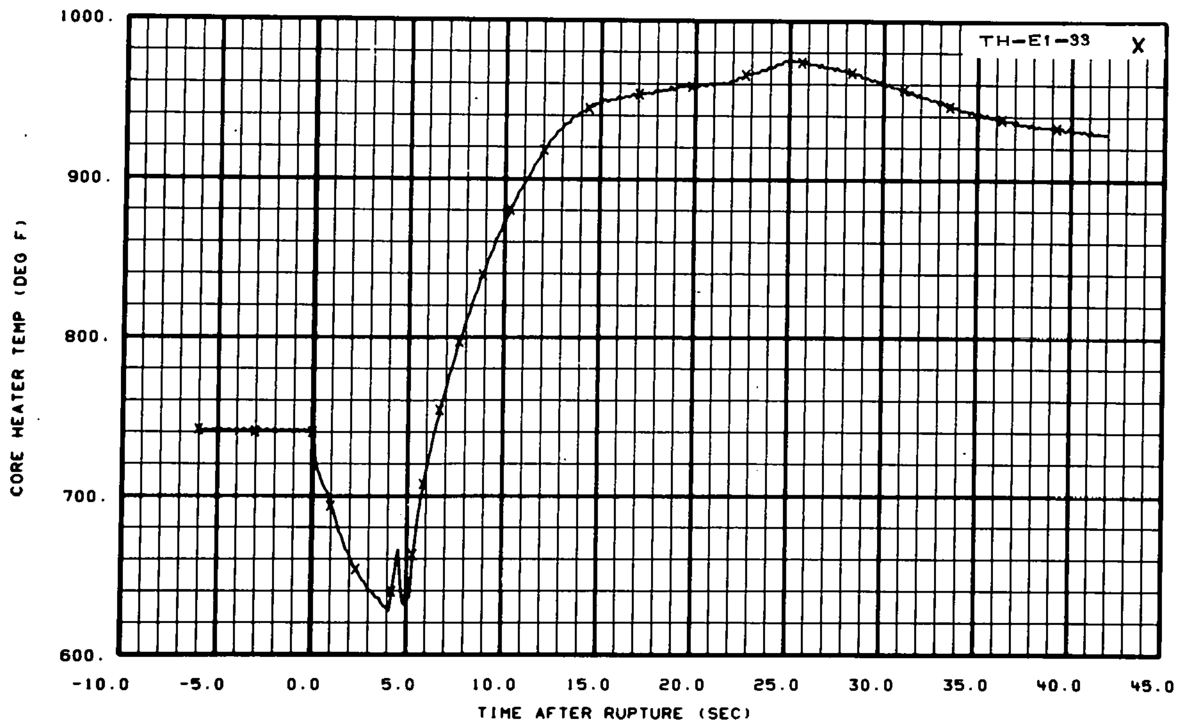

Fig. 39 Core heater temperature, Rod E-1.

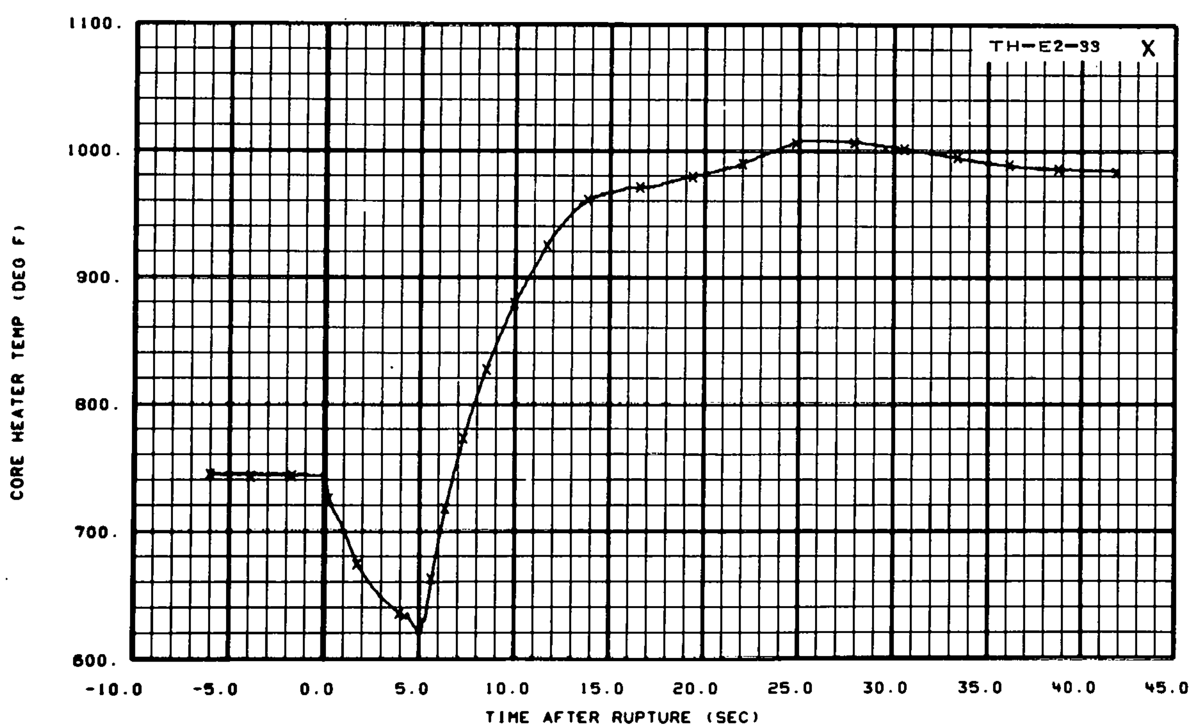

Fig. 40 Core heater temperature, Rod E-2.

Fig. 41 Core heater temperature, Rod E-3.

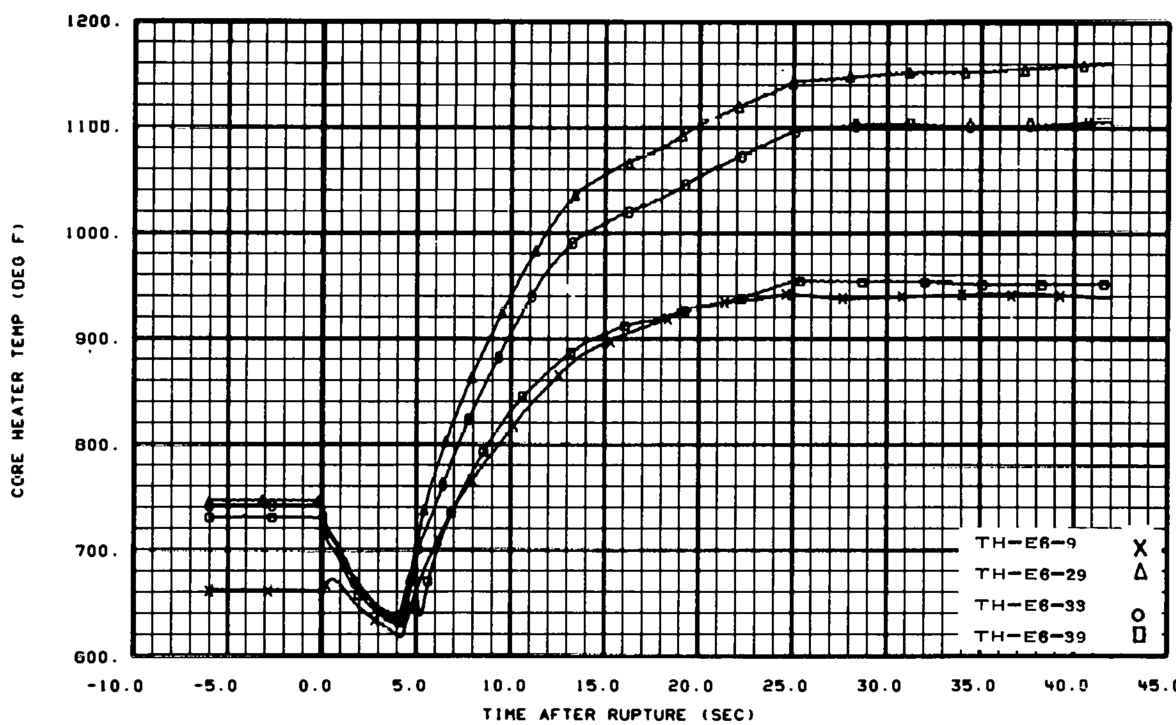

Fig. 42 Core heater temperature, Rod E-6.

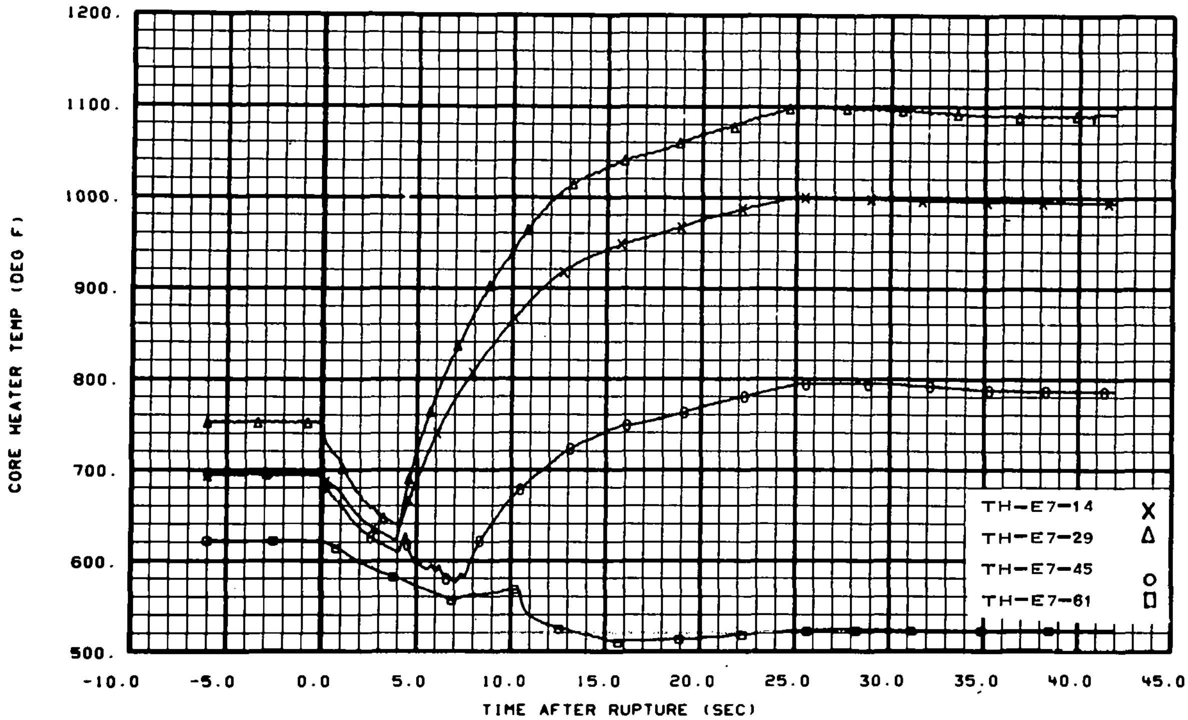

Fig. 43 Core heater temperature, Rod E-7.

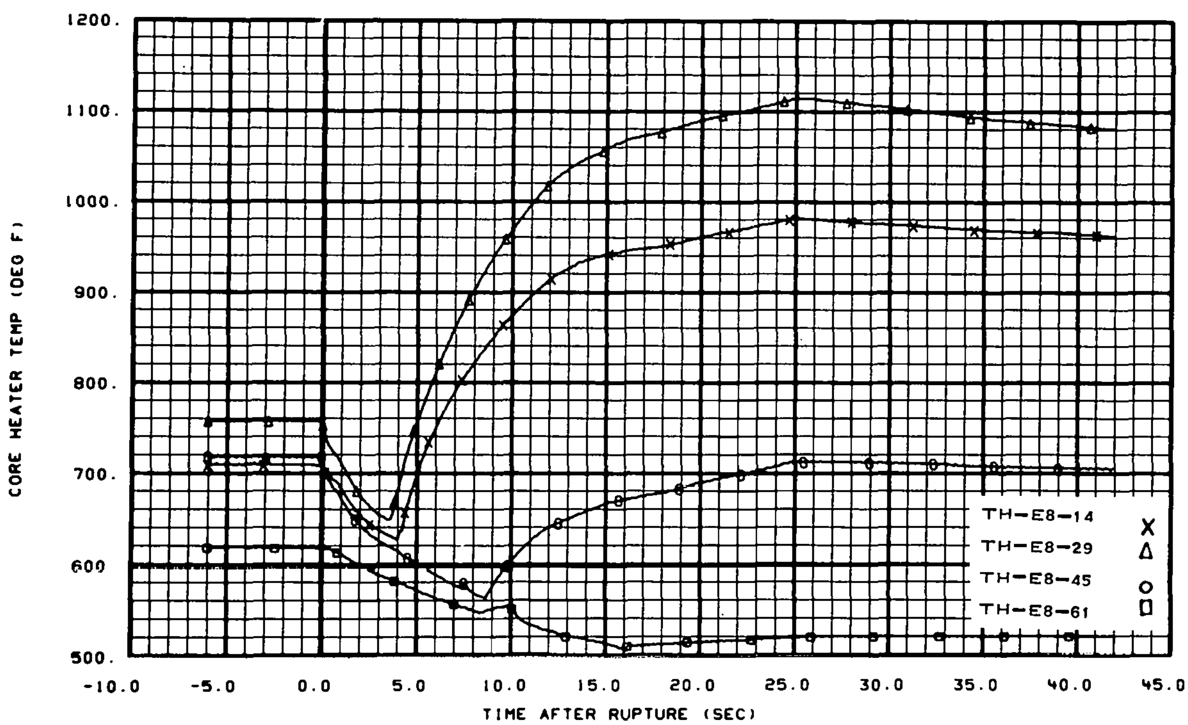

Fig. 44 Core heater temperature, Rod E-8.

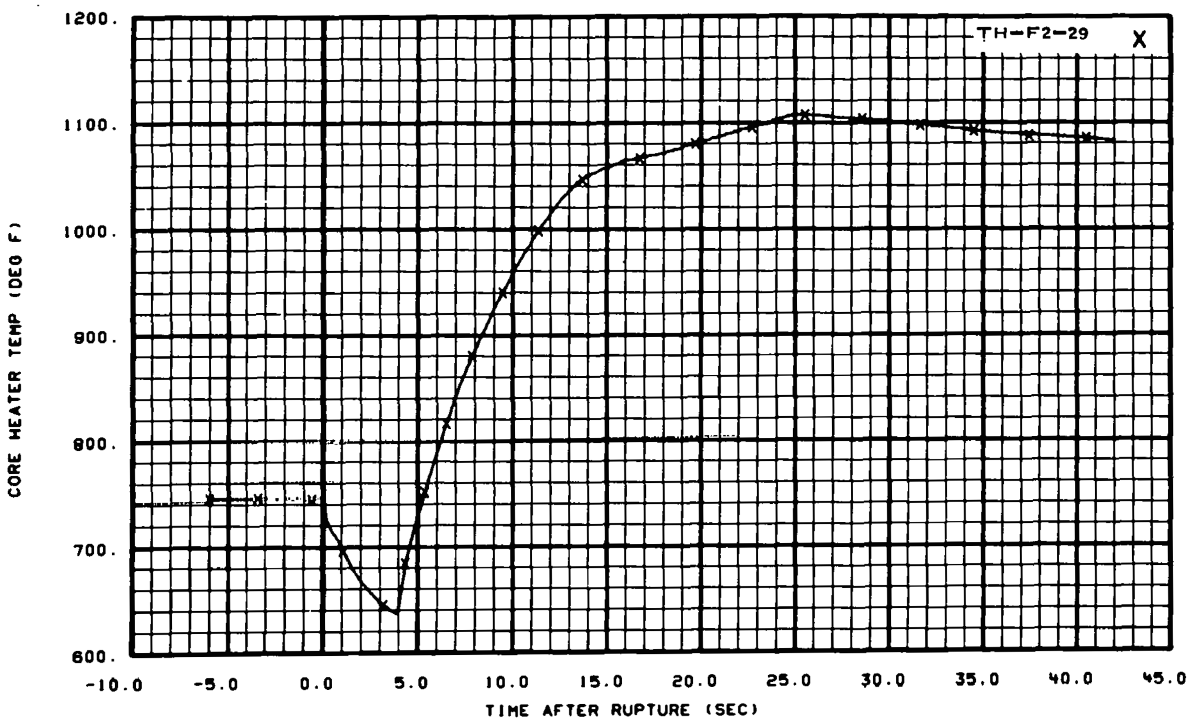

Fig. 45 Core heater temperature, Rod F-2.

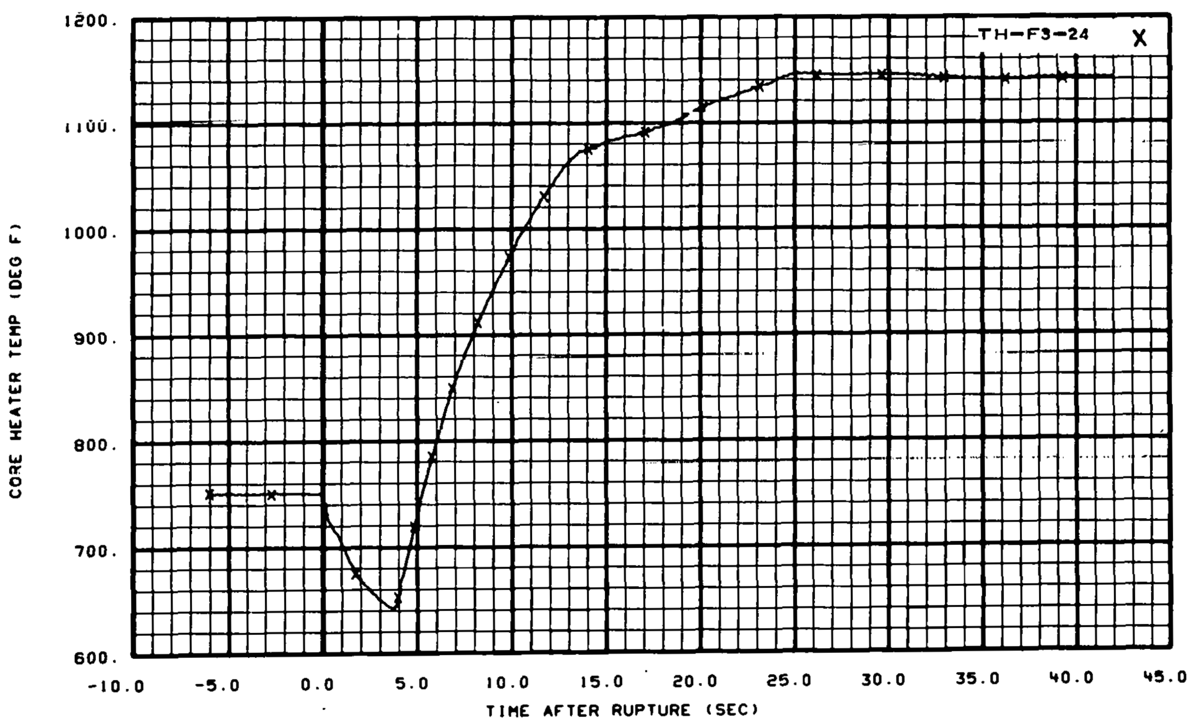

Fig. 46 Core heater temperature, Rod F-3.

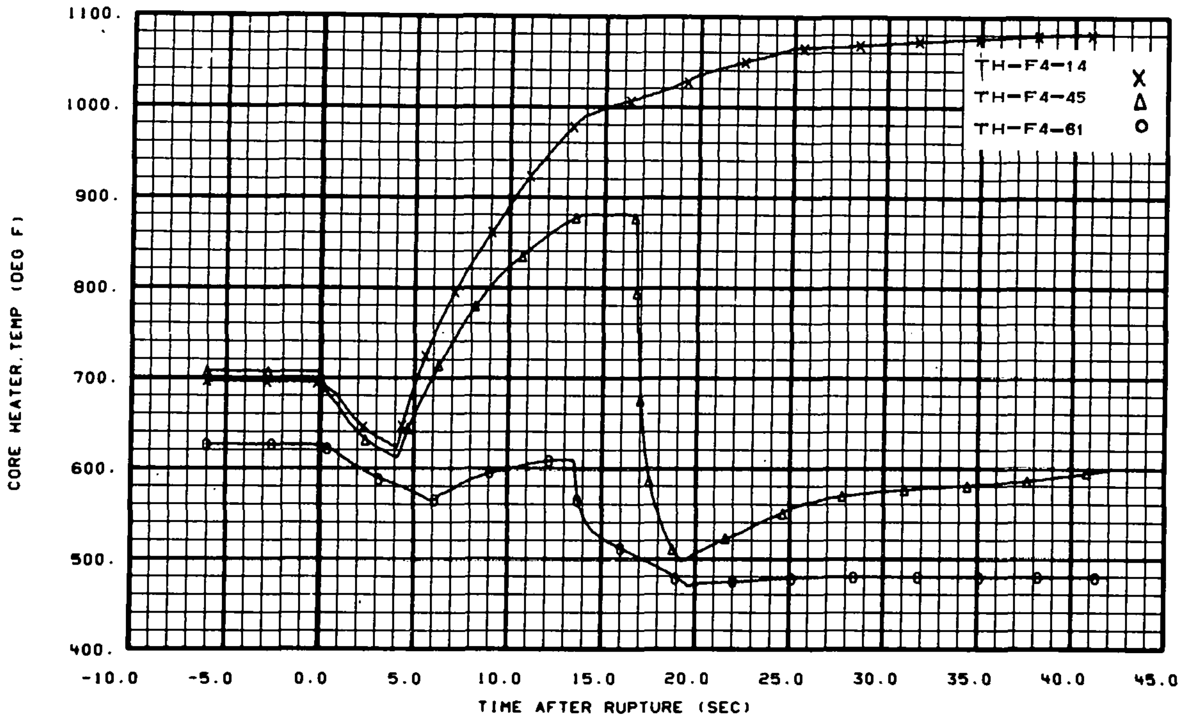

Fig. 47 Core heater temperature, Rod F-4.

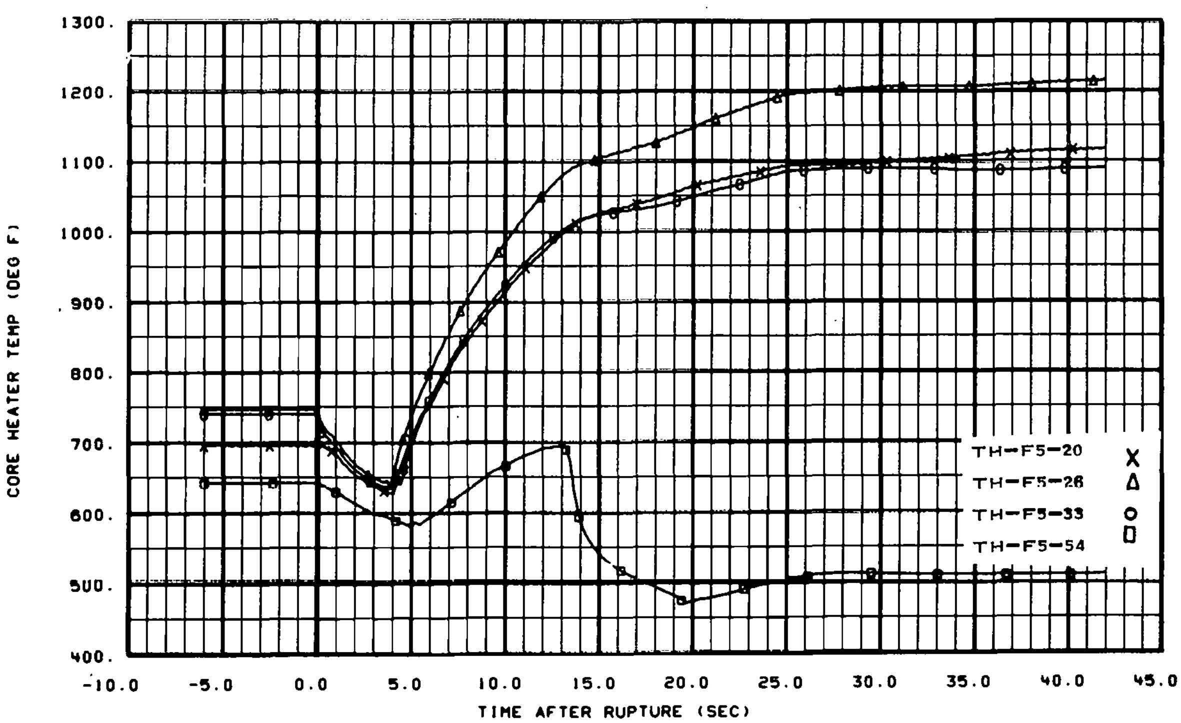

Fig. 48 Core heater temperature, Rod F-5.

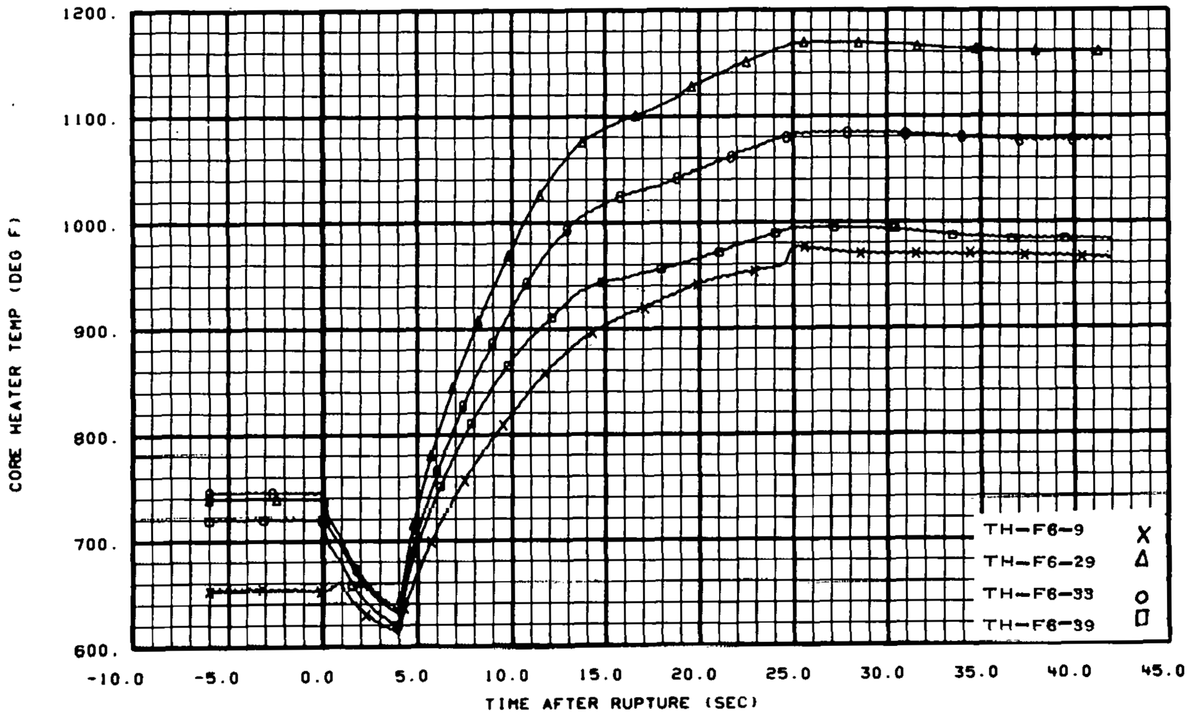

Fig. 49 Core heater temperature, Rod F-6.

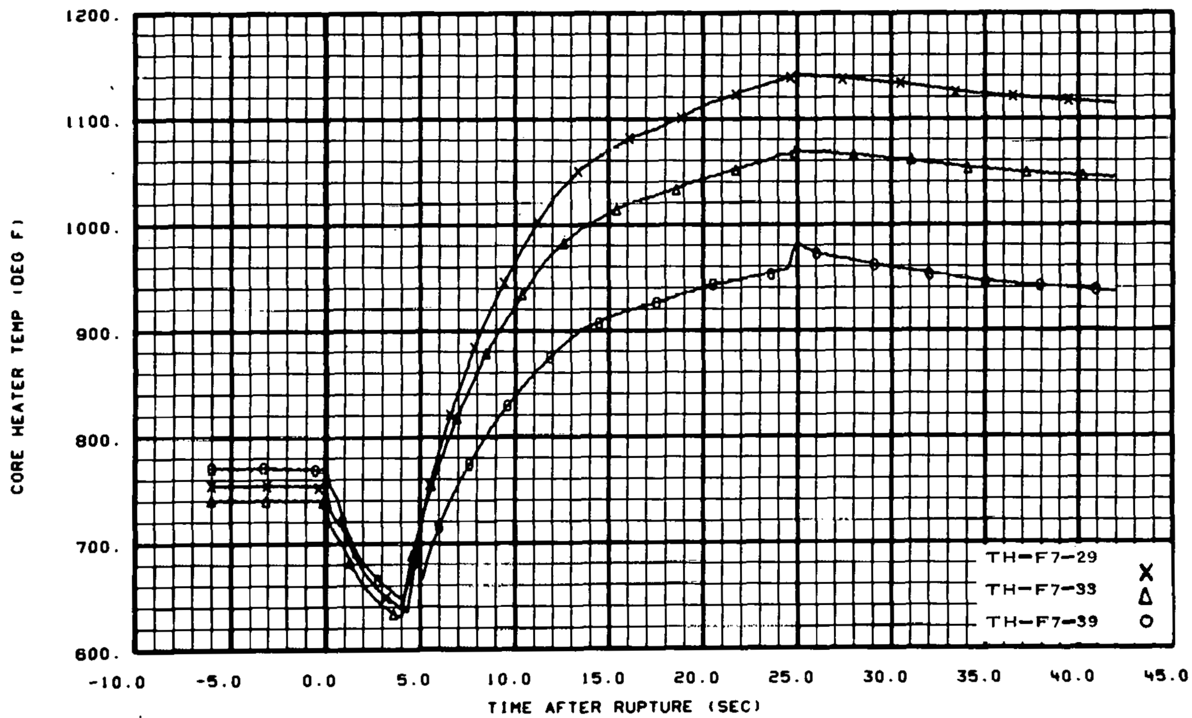

Fig. 50 Core heater temperature, Rod F-7.

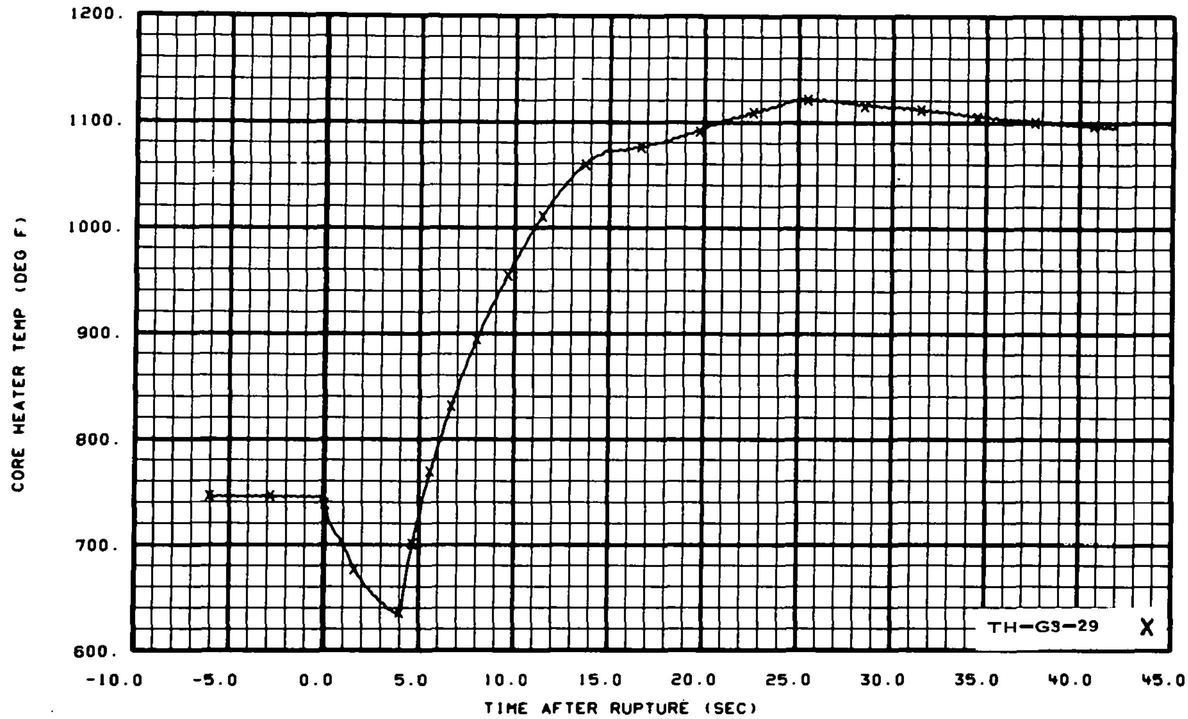

Fig. 51 Core heater temperature, Rod G-3.

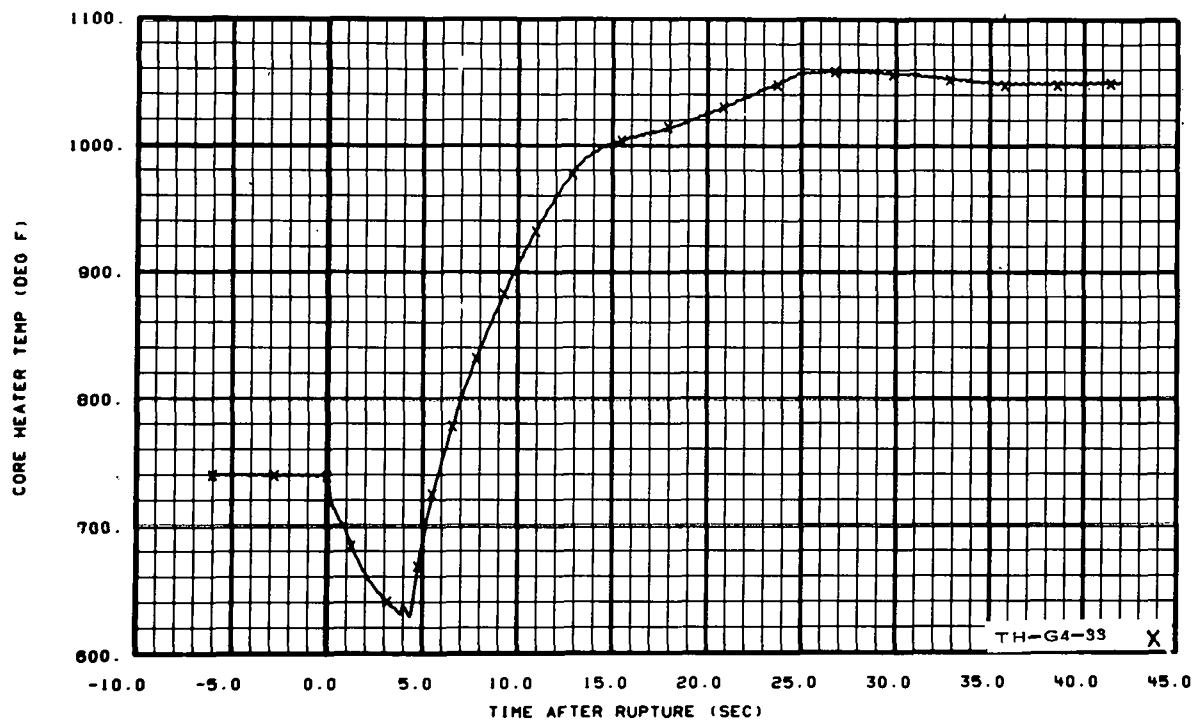

Fig. 52 Core heater temperature, Rod G-4.

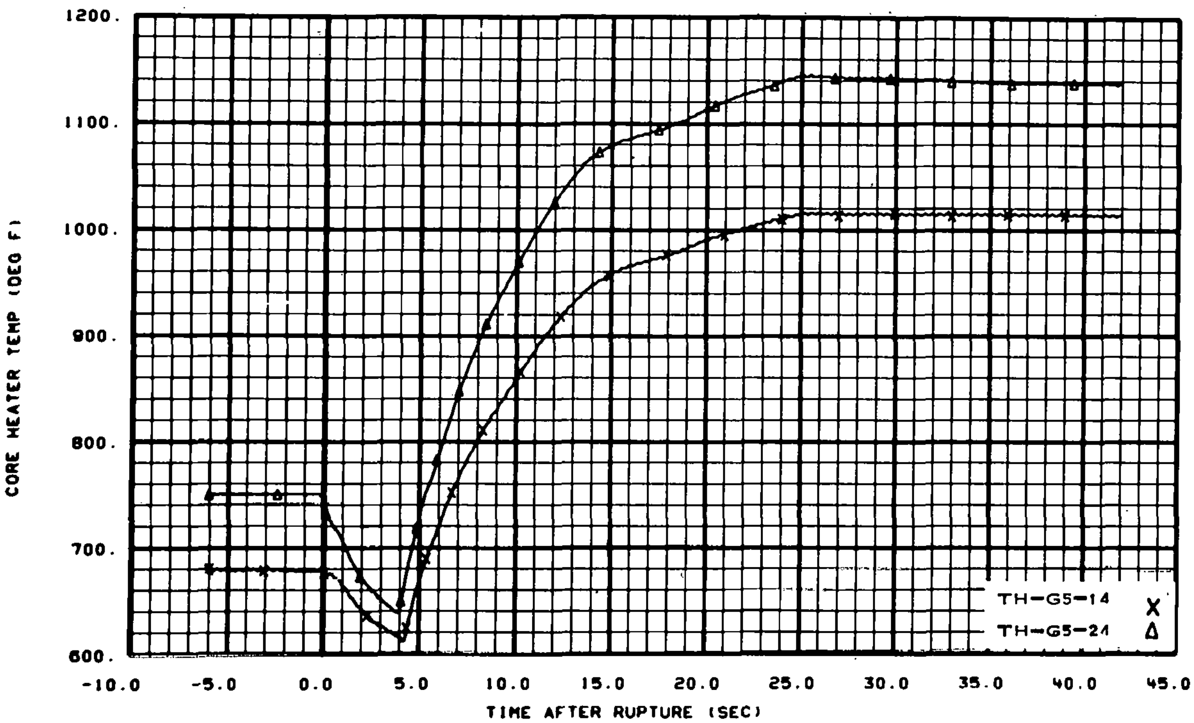

Fig. 53 Core heater temperature, Rod G-5.

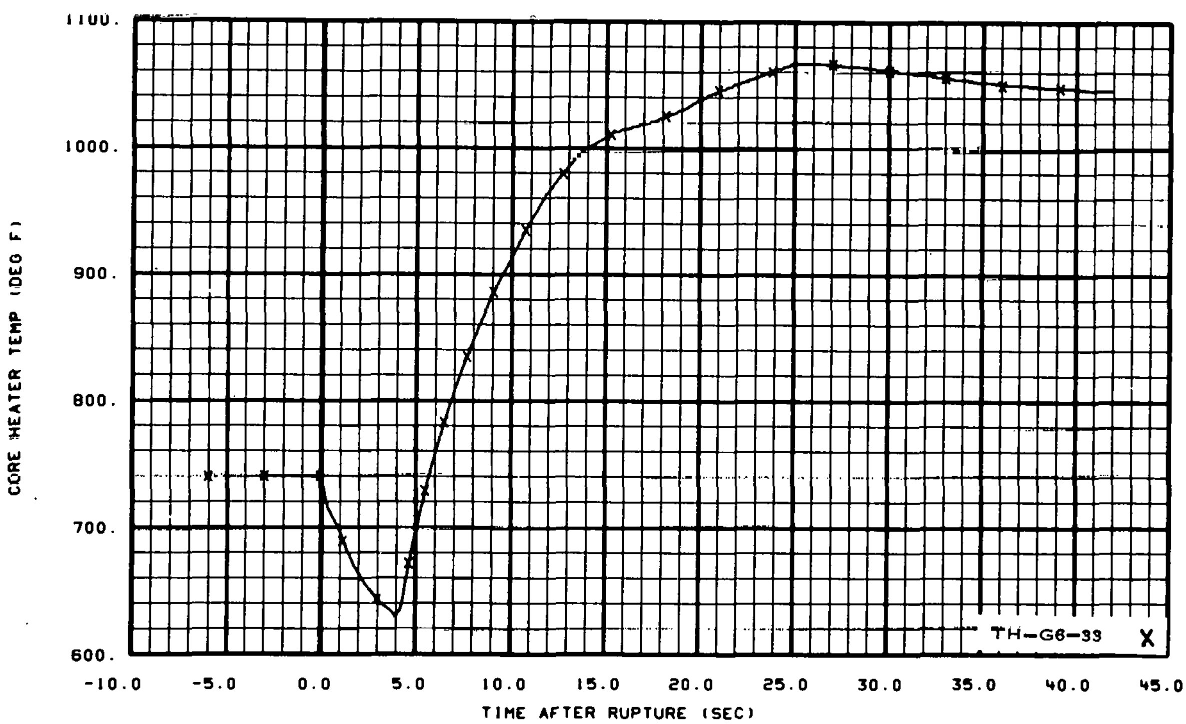

Fig. 54 Core heater temperature, Rod G-6.

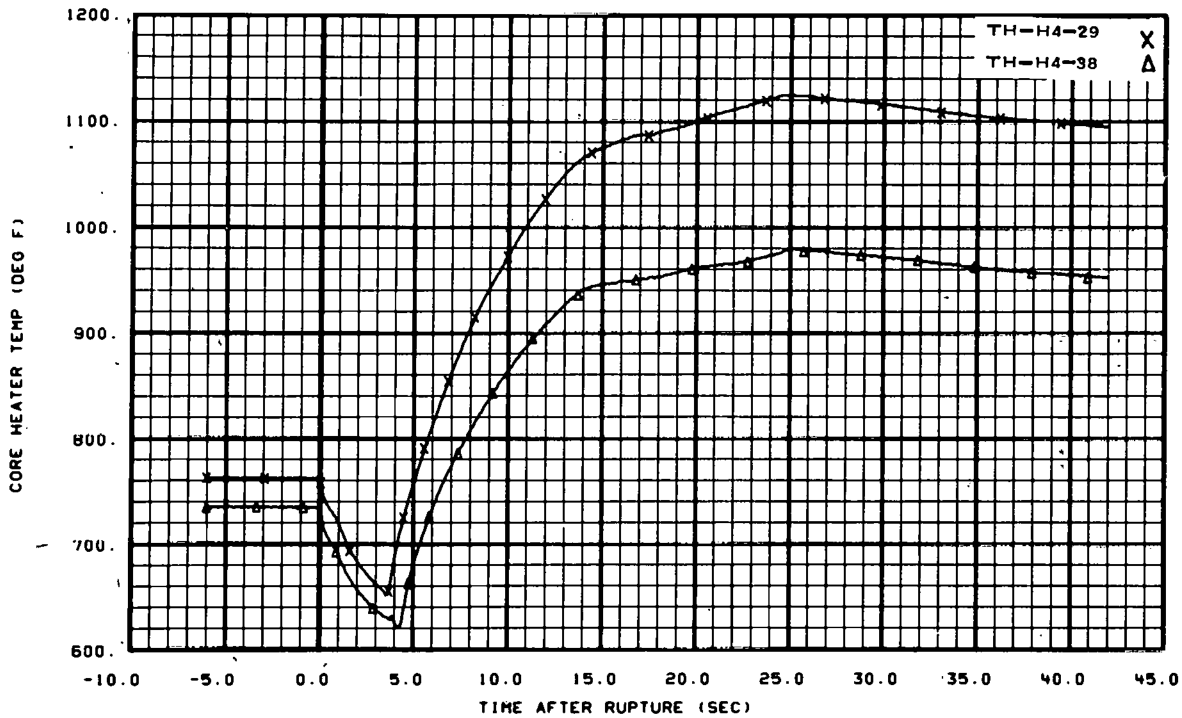

Fig. 55 Core heater temperature, Rod H-4.

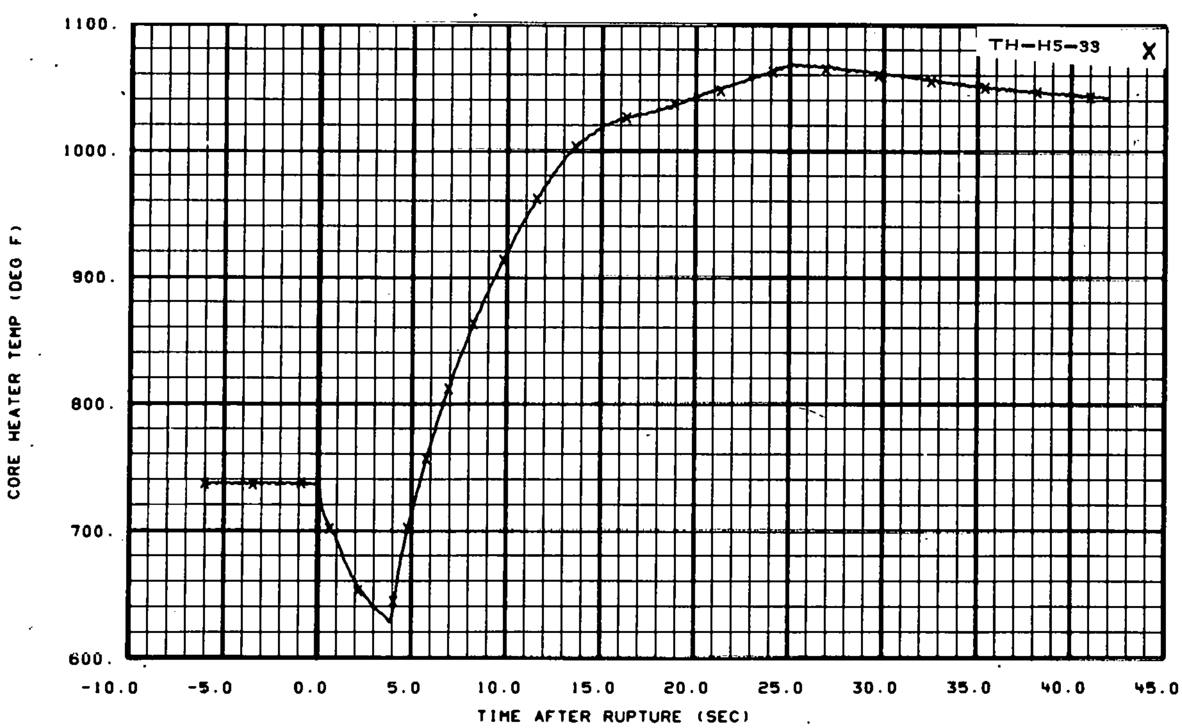

Fig. 56 Core heater temperature, Rod H-5.

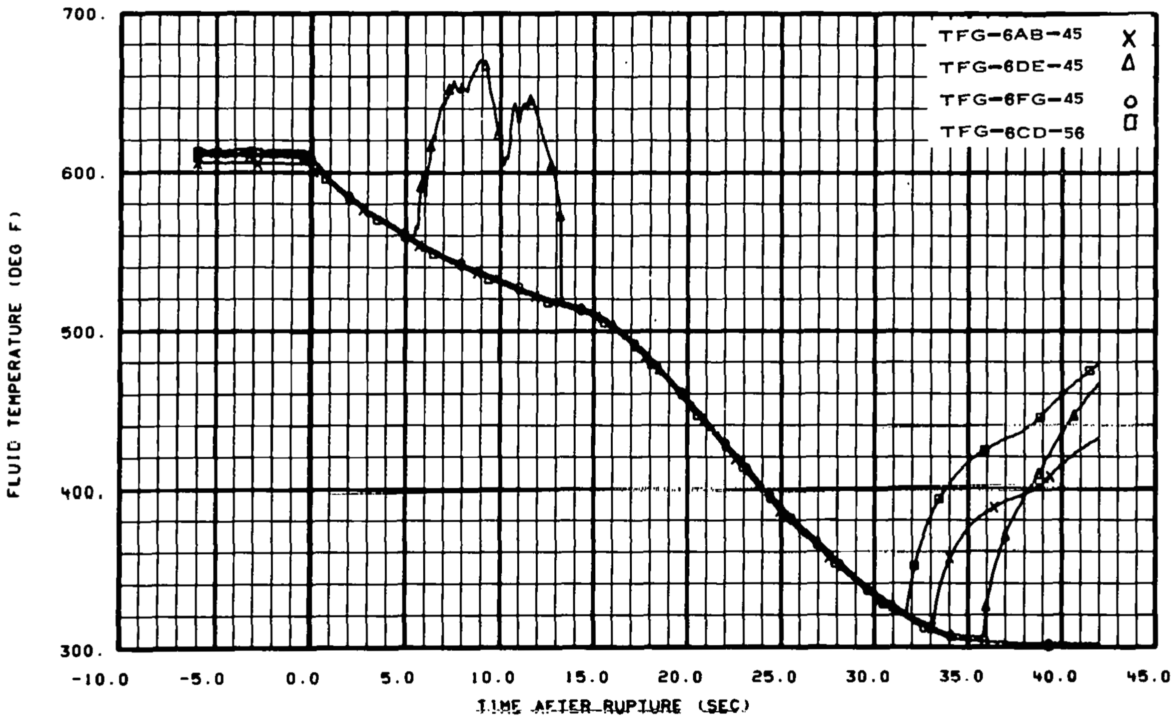

Fig. 57 Fluid temperatures in core (Grid Spacer 6).

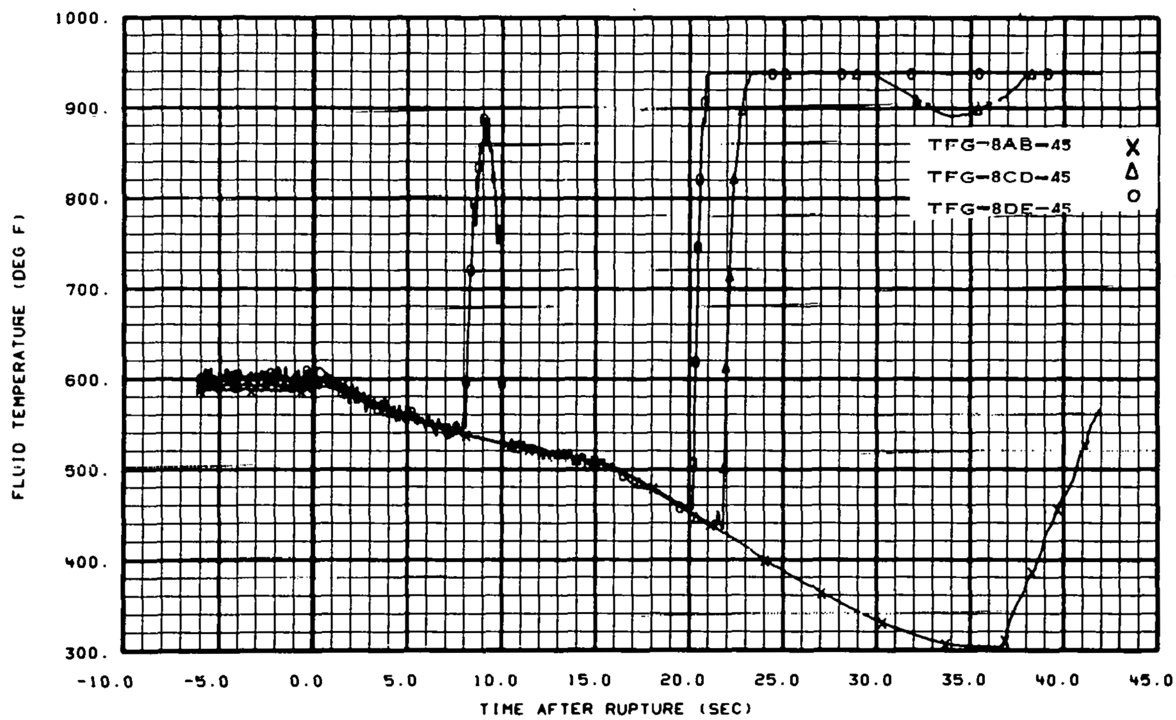

Fig. 58 Fluid temperatures in core (Grid Spacer 8).

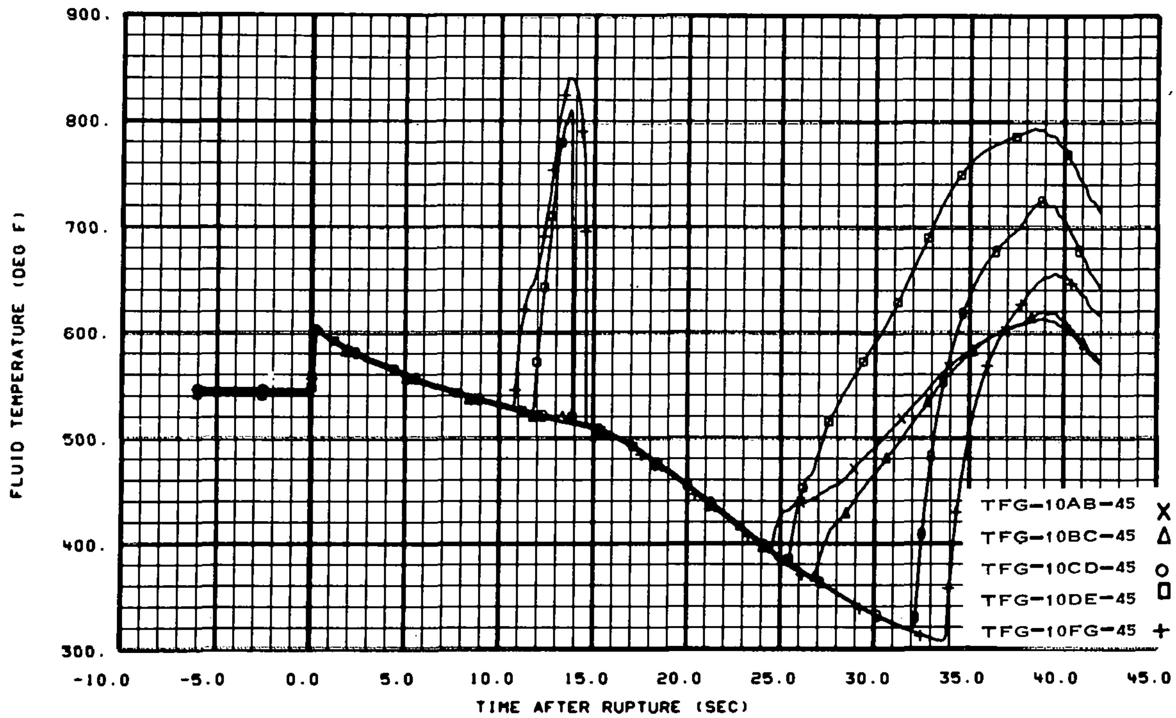

Fig. 59 Fluid temperatures in core (Grid Spacer 10).

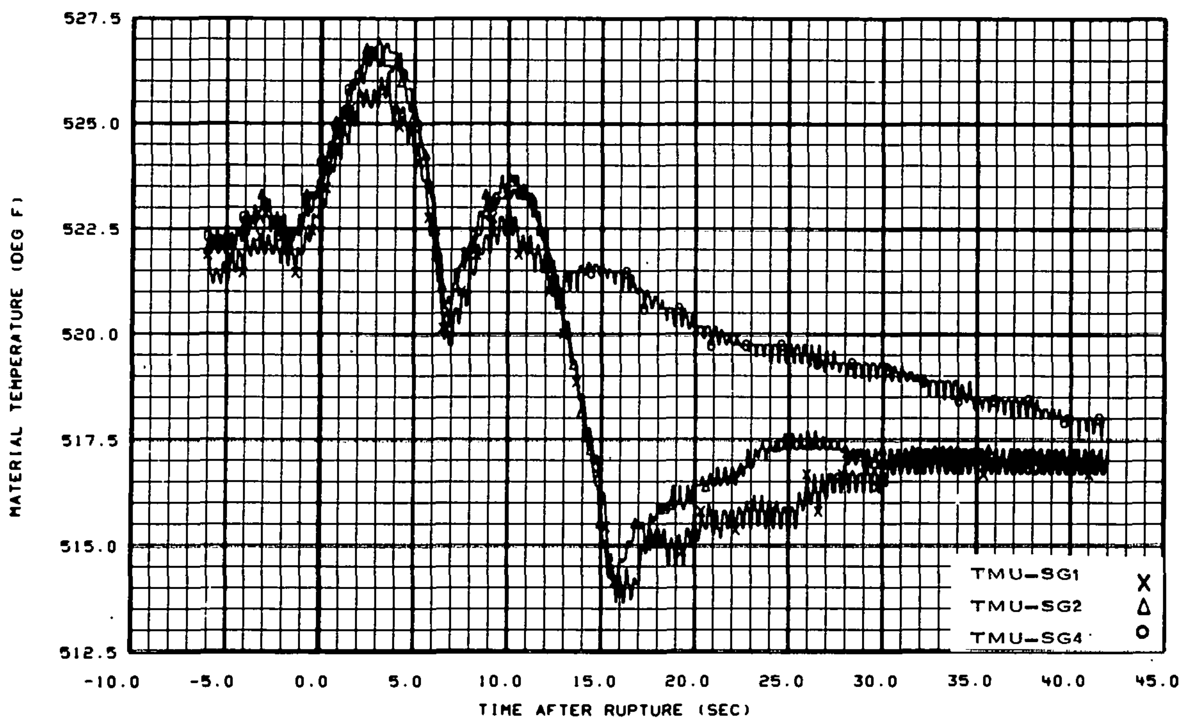

Fig. 60 Material temperatures in steam generator.

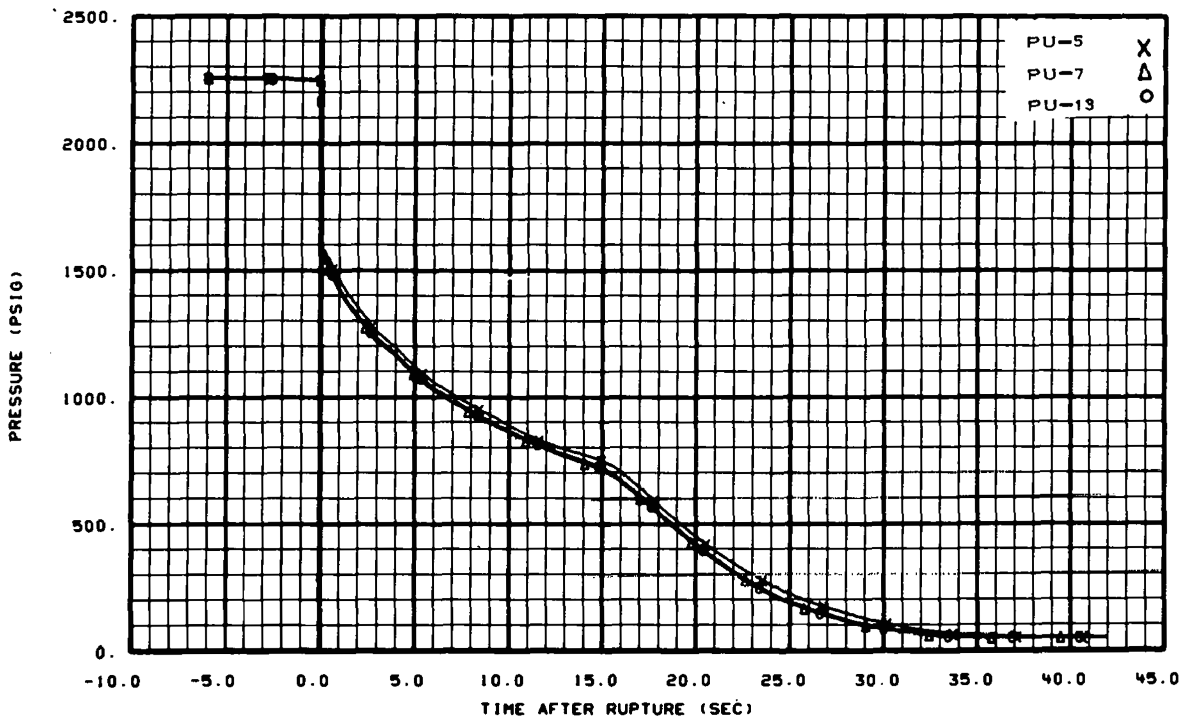

Fig. 61 Pressures in intact loop.

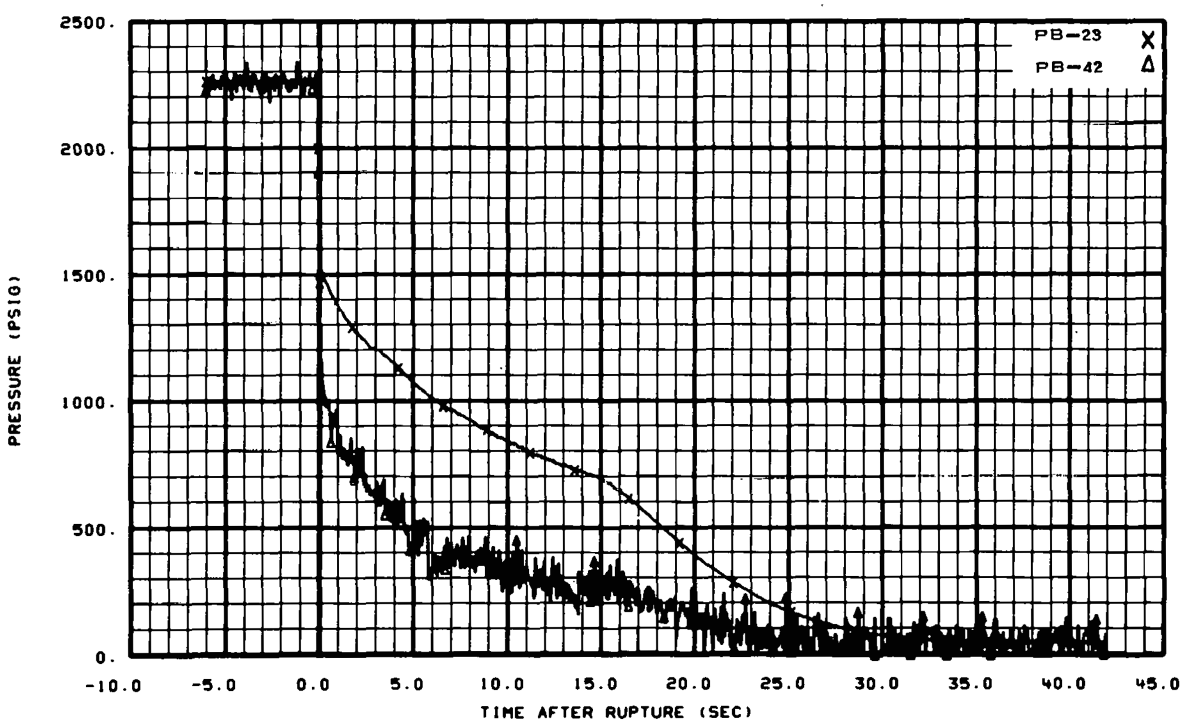

Fig. 62 Pressures in broken loop.

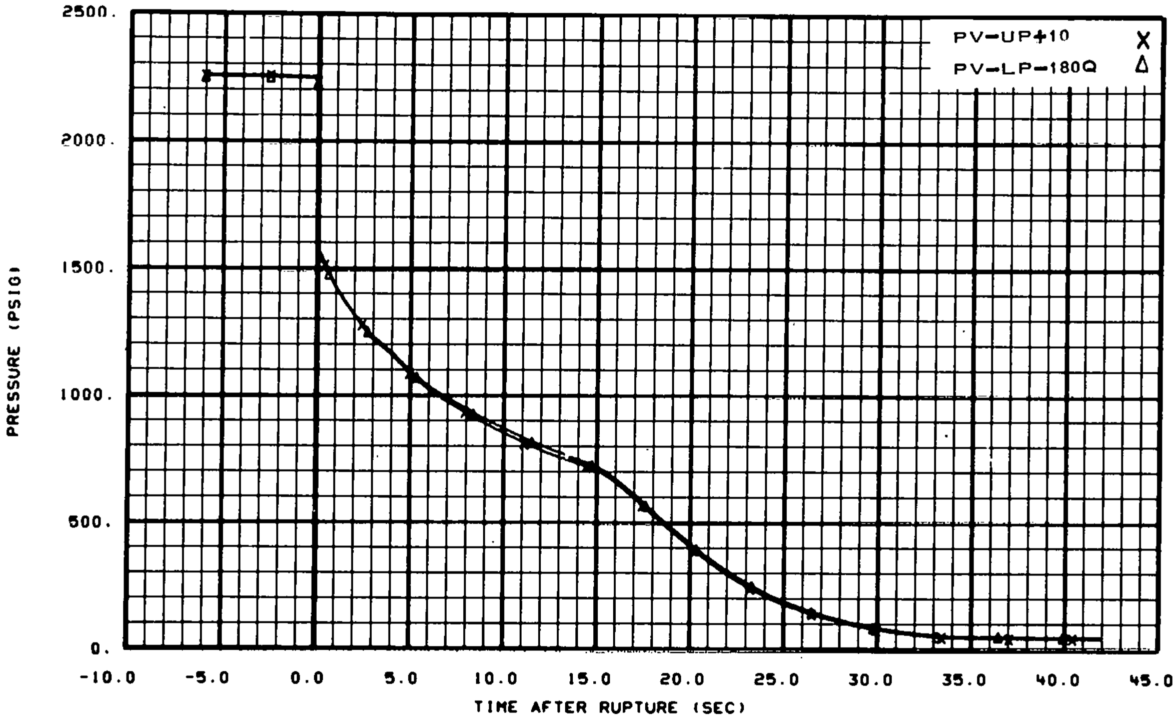

Fig. 63 Pressures in vessel.

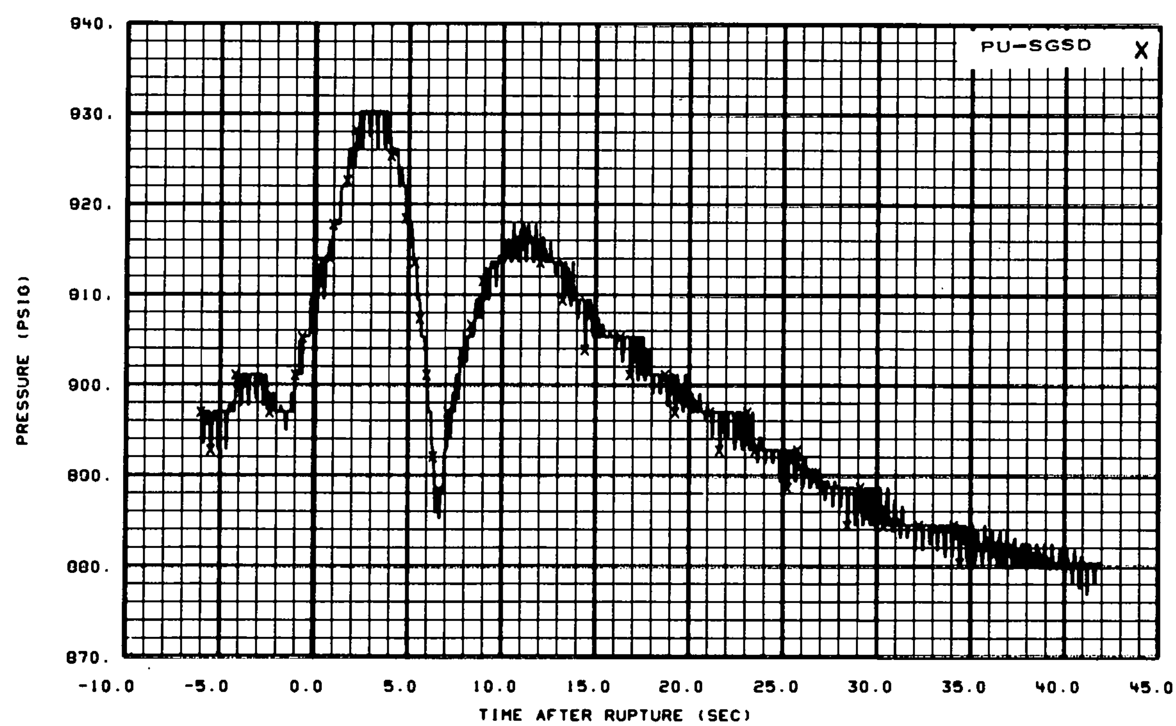

Fig. 64 Pressure in steam generator, secondary side.

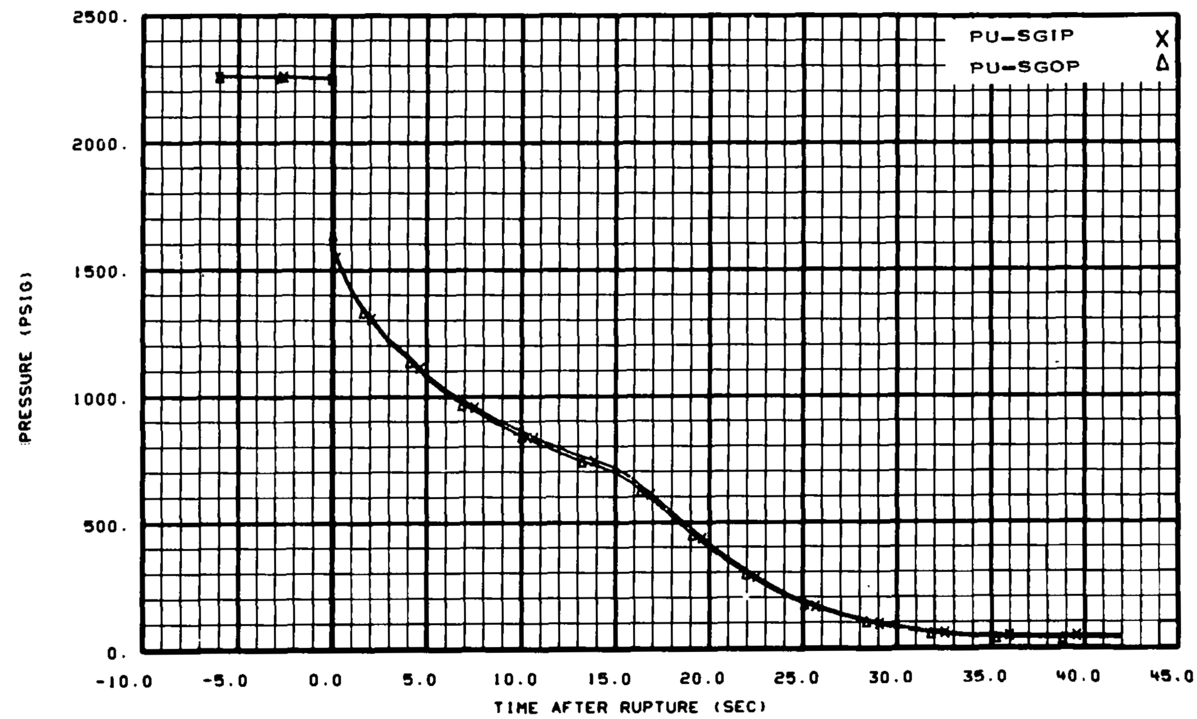

Fig. 65 Pressures in steam generator, primary side.

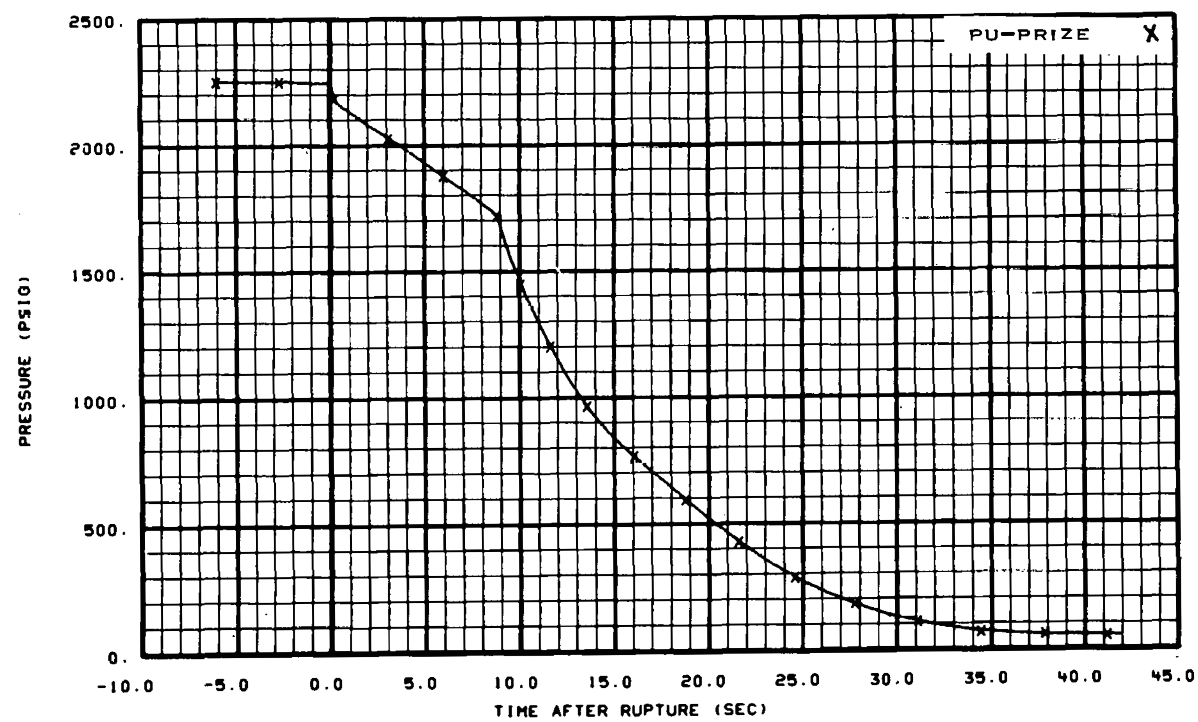

Fig. 66 Pressure in pressurizer.

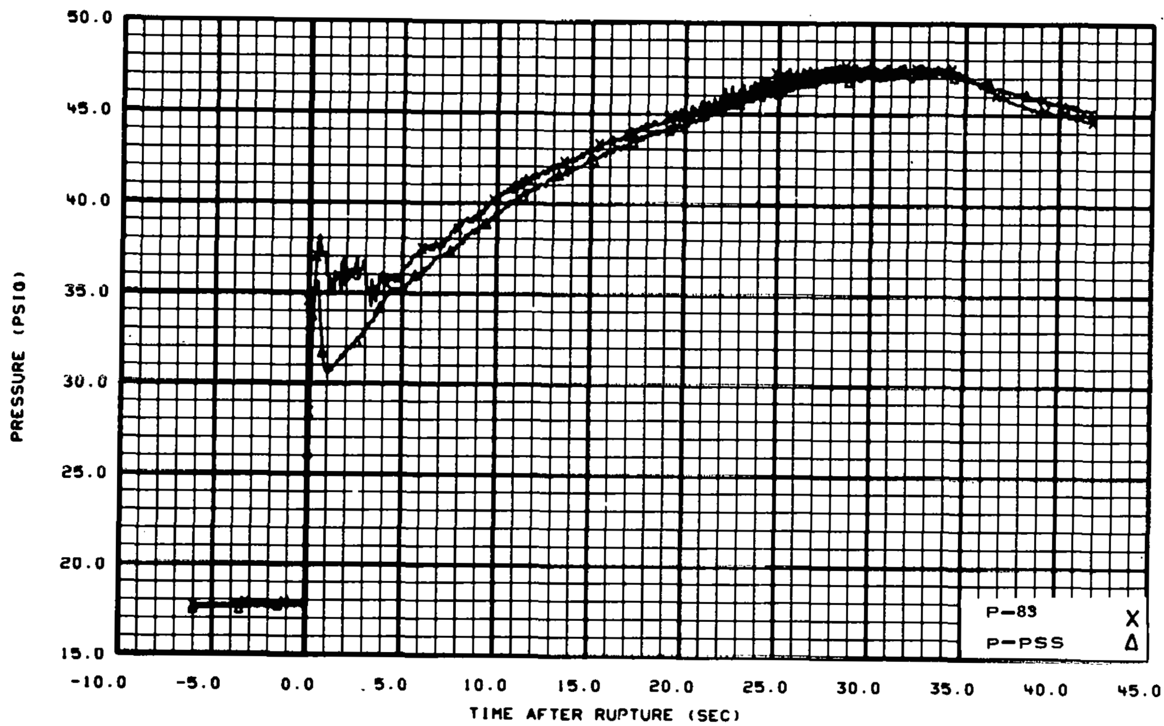

Fig. 67 Pressure in pressure suppression system.

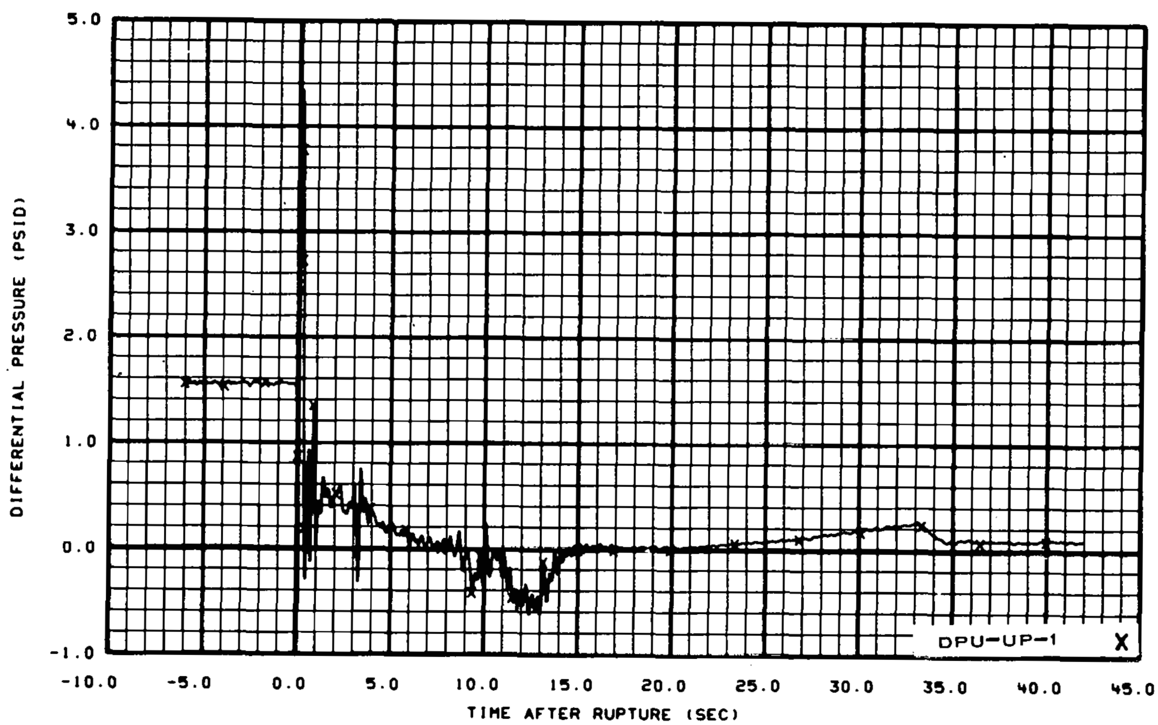

Fig. 68 Differential pressure in intact loop (upper plenum to Spool 1).

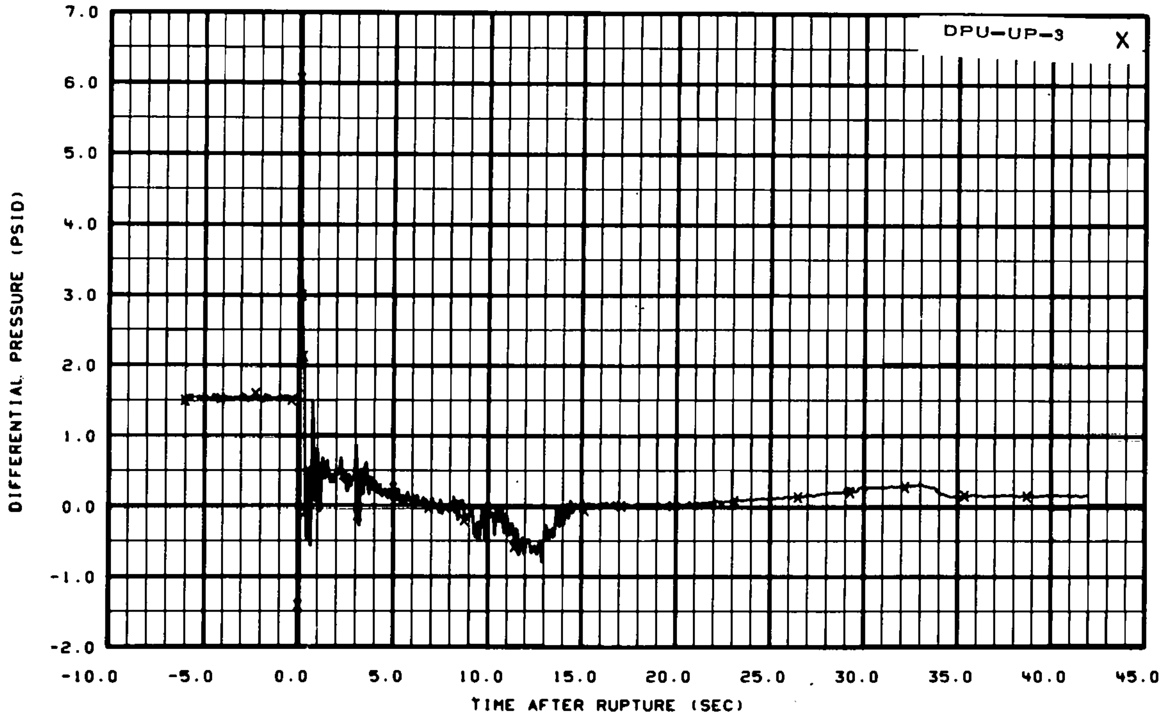

Fig. 69 Differential pressure in intact loop (upper plenum to Spool 3).

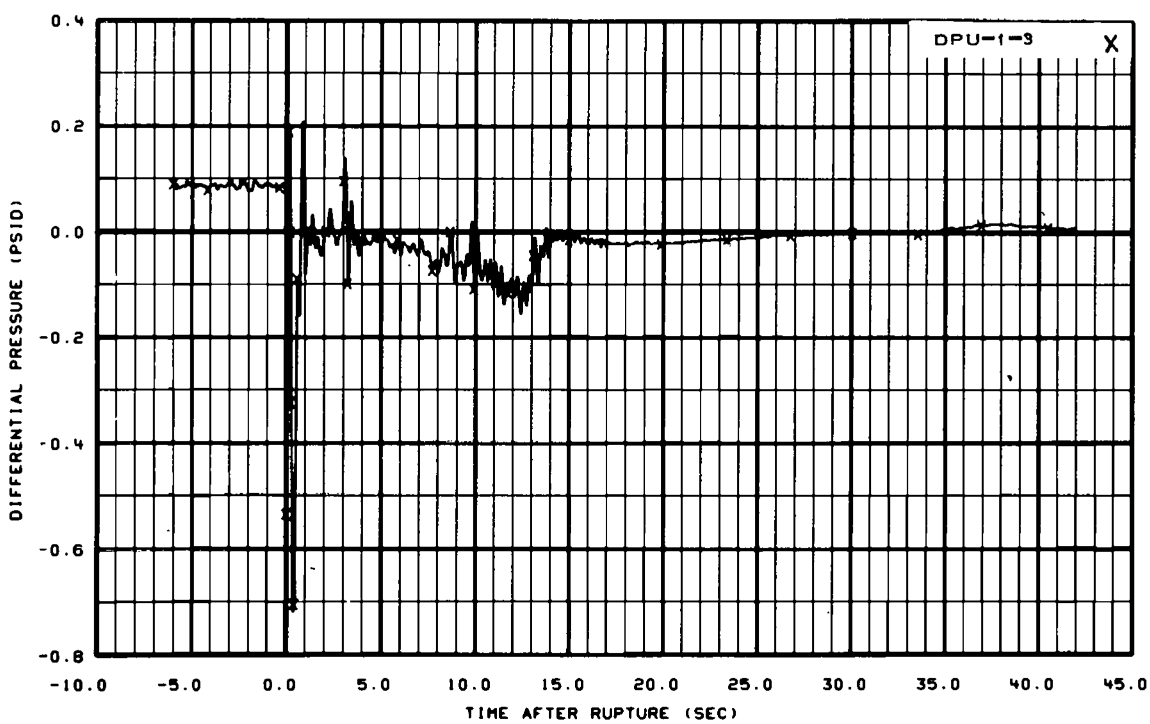

Fig. 70 Differential pressure in intact loop (Spool 1 to Spool 3).

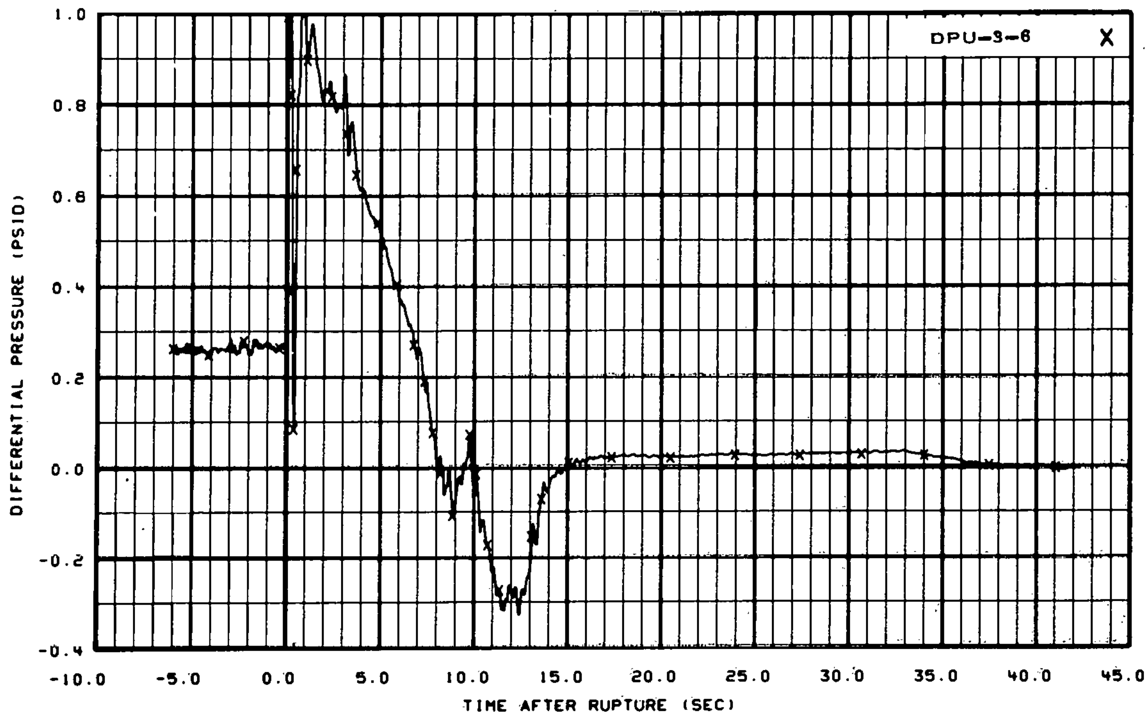

Fig. 71 Differential pressure in intact loop (Spool 3 to Spool 6).

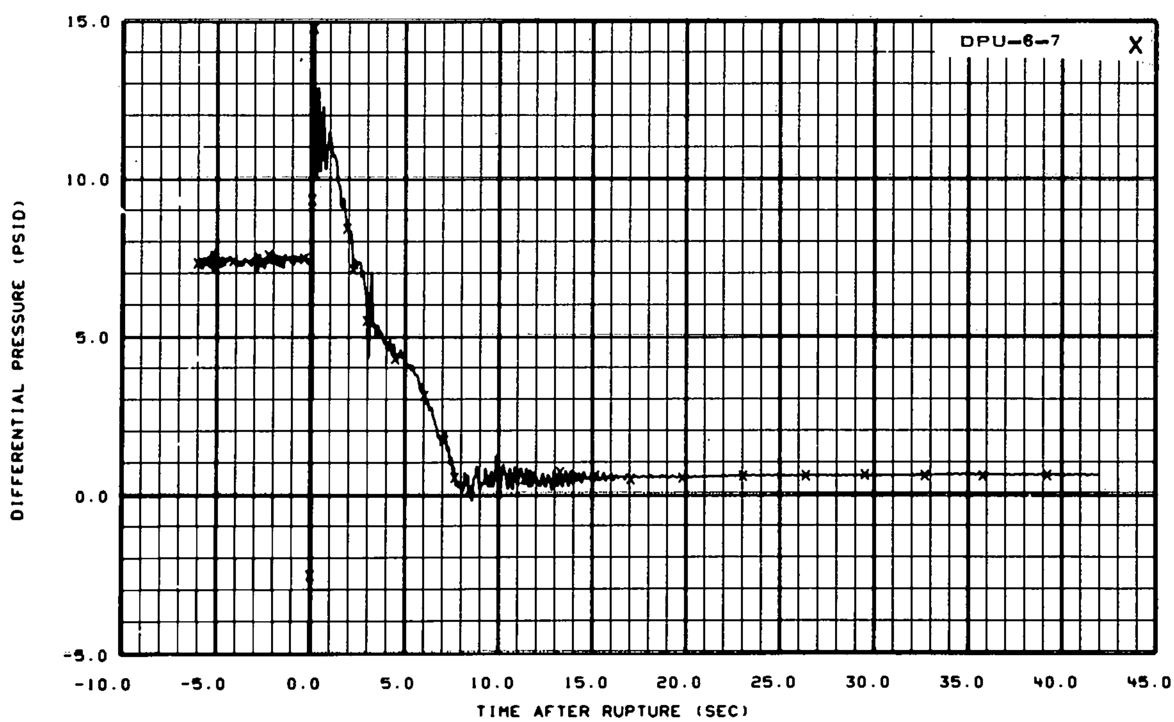

Fig. 72 Differential pressure in intact loop (Spool 6 to Spool 7).

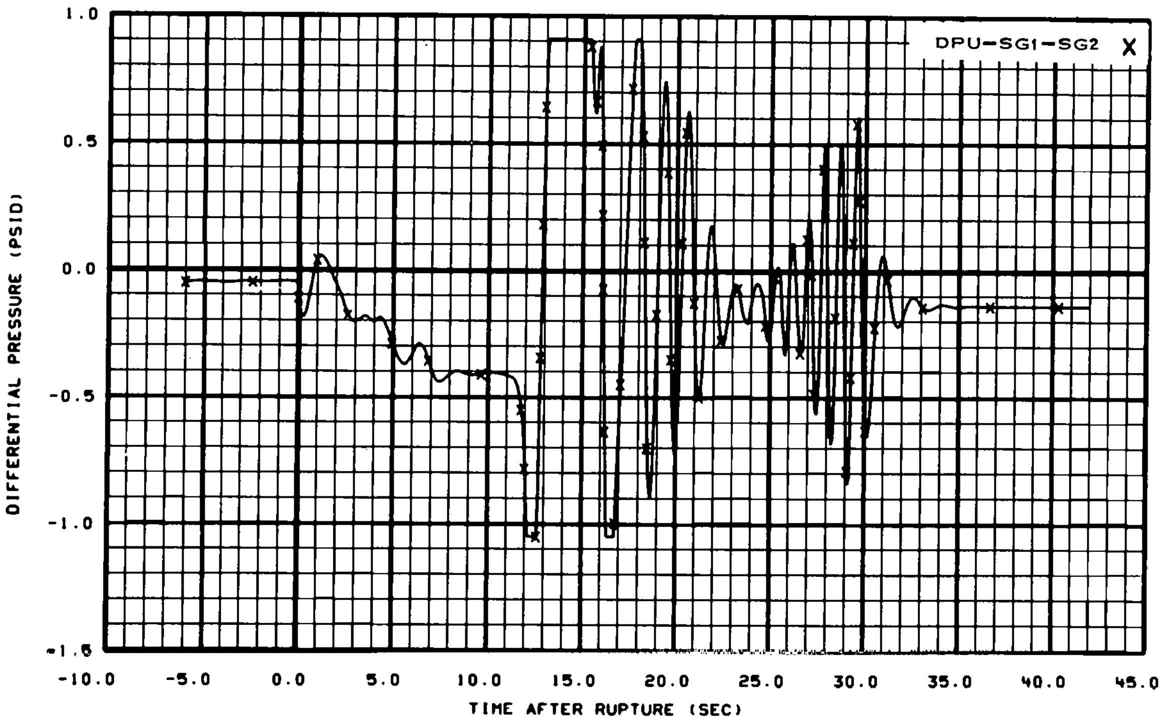

Fig. 73 Differential pressure in intact loop (steam generator primary).

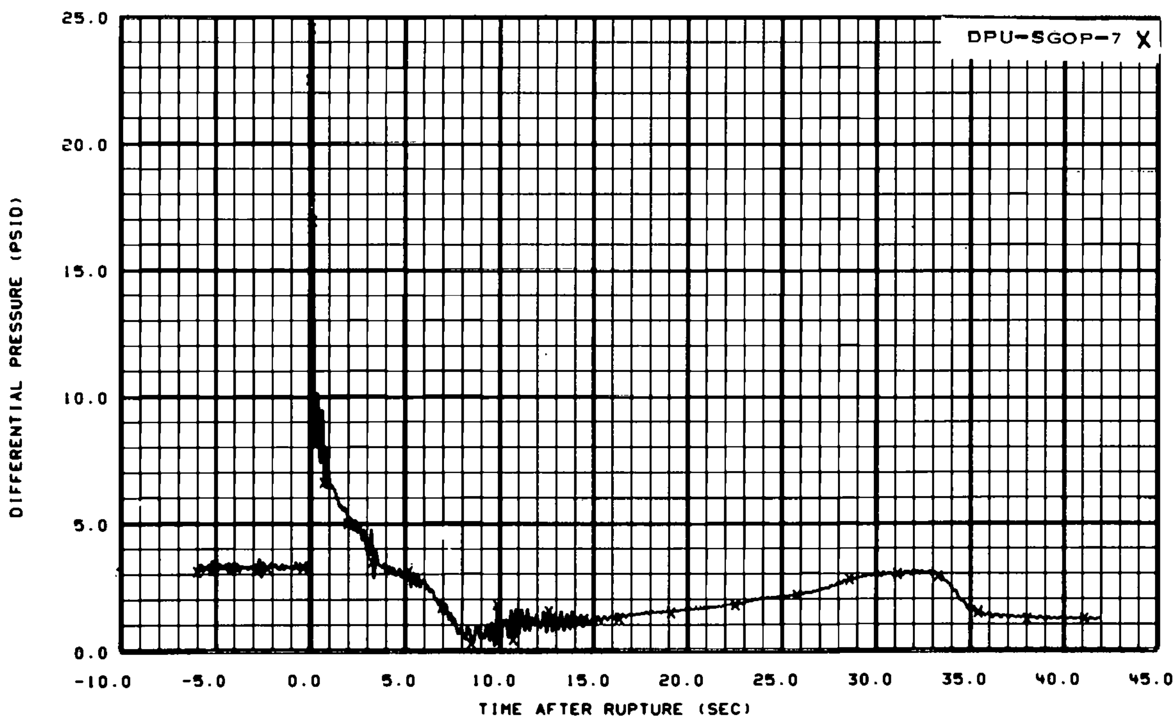

Fig. 74 Differential pressure in intact loop (steam generator outlet plenum to Spool 7).

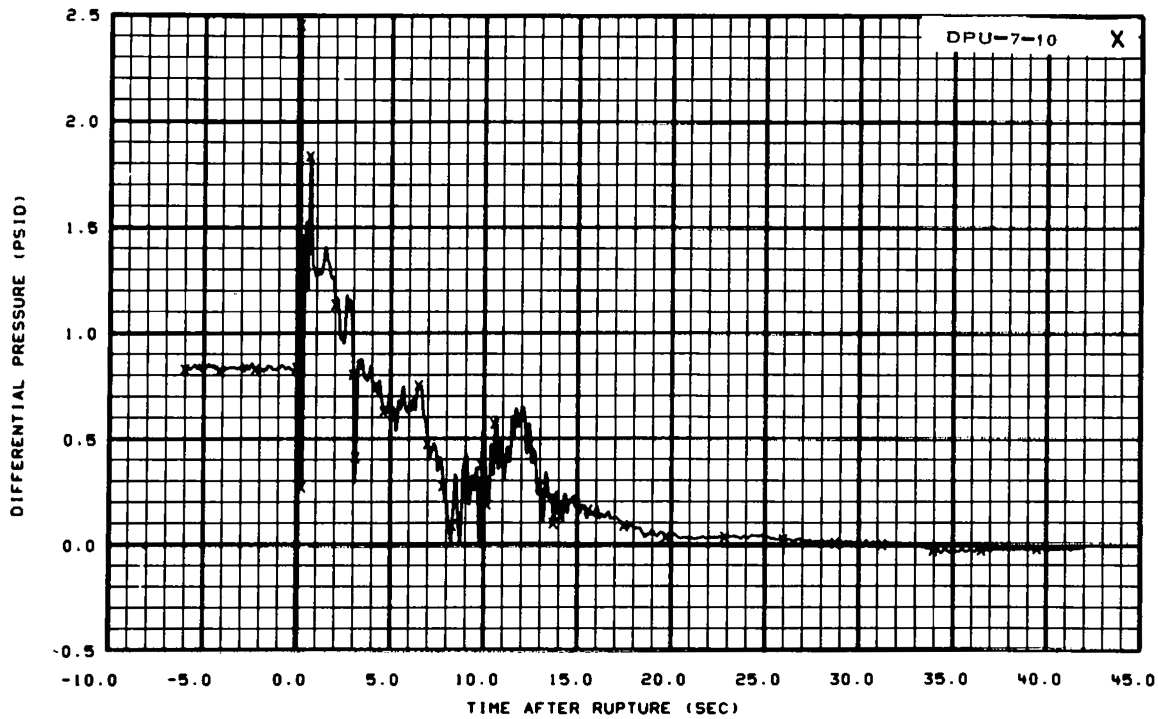

Fig. 75 Differential pressure in intact loop (Spool 7 to Spool 10).

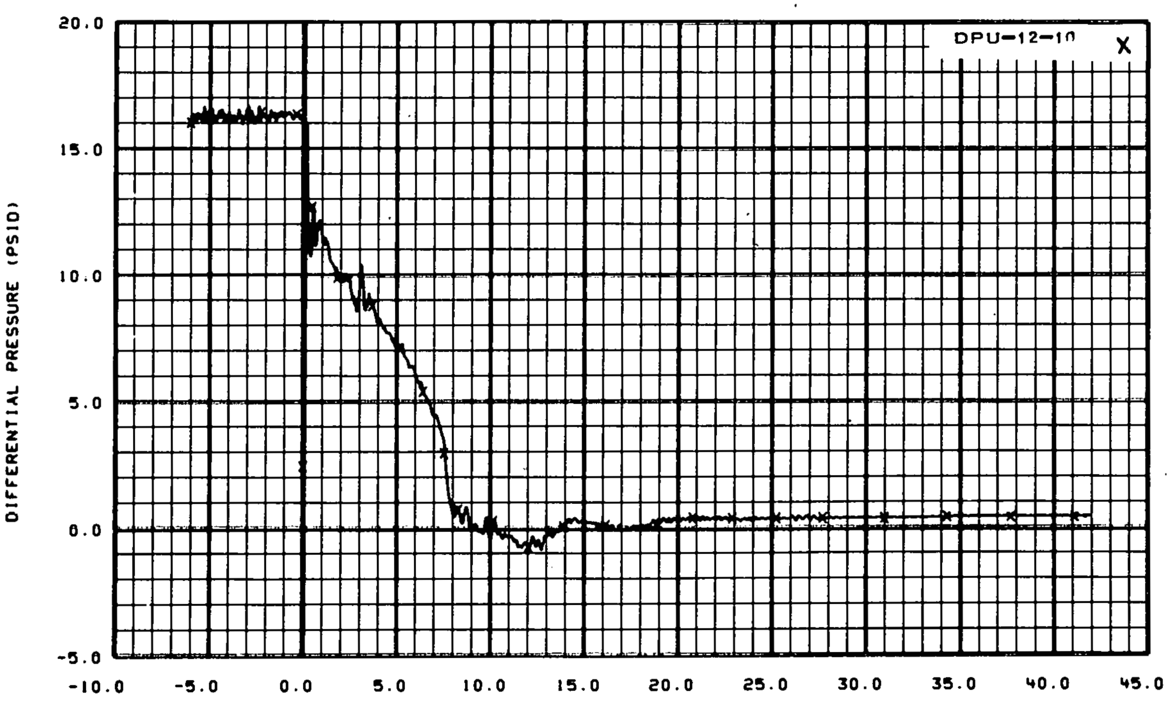

Fig. 76 Differential pressure in intact loop (Spool 12 to Spool 10).

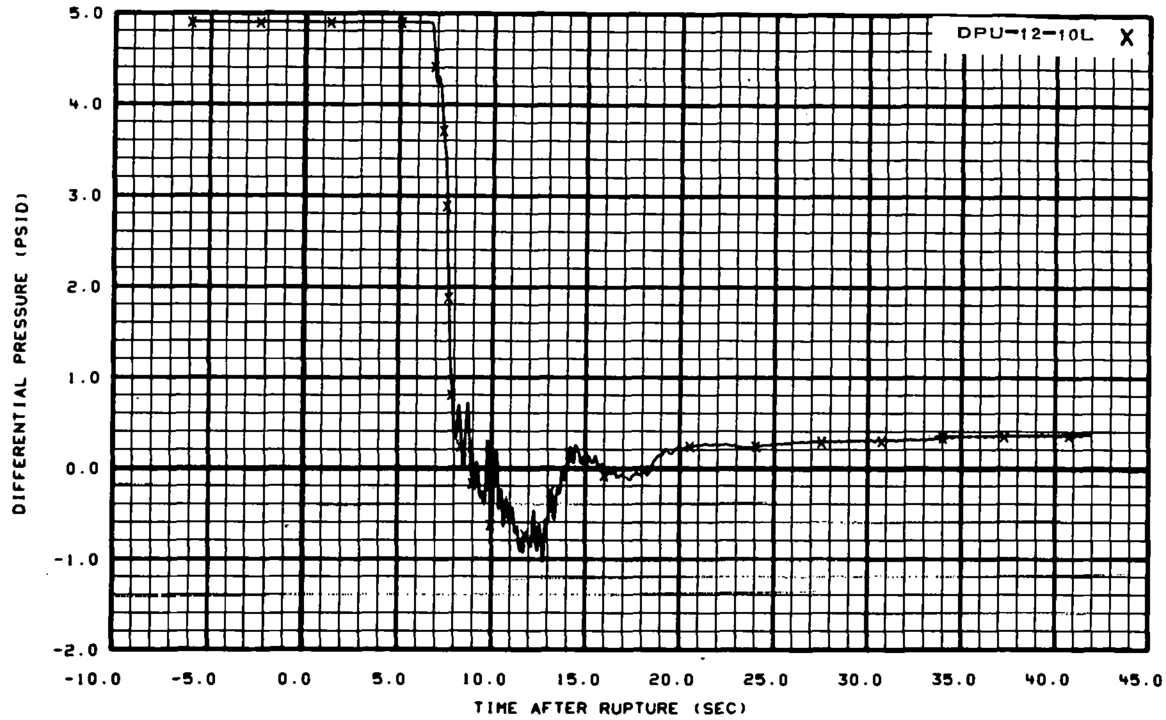

Fig. 77 Differential pressure in intact loop, low range (Spool 12 to Spool 10).

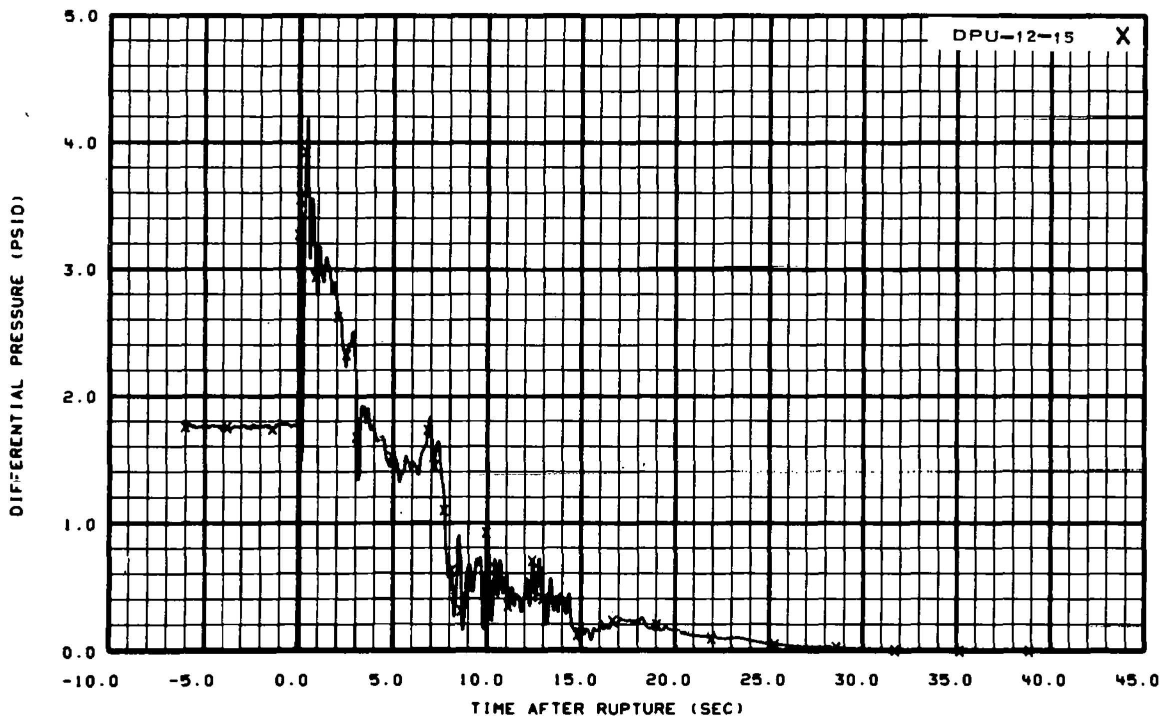

Fig. 78 Differential pressure in intact loop (Spool 12 to Spool 15).

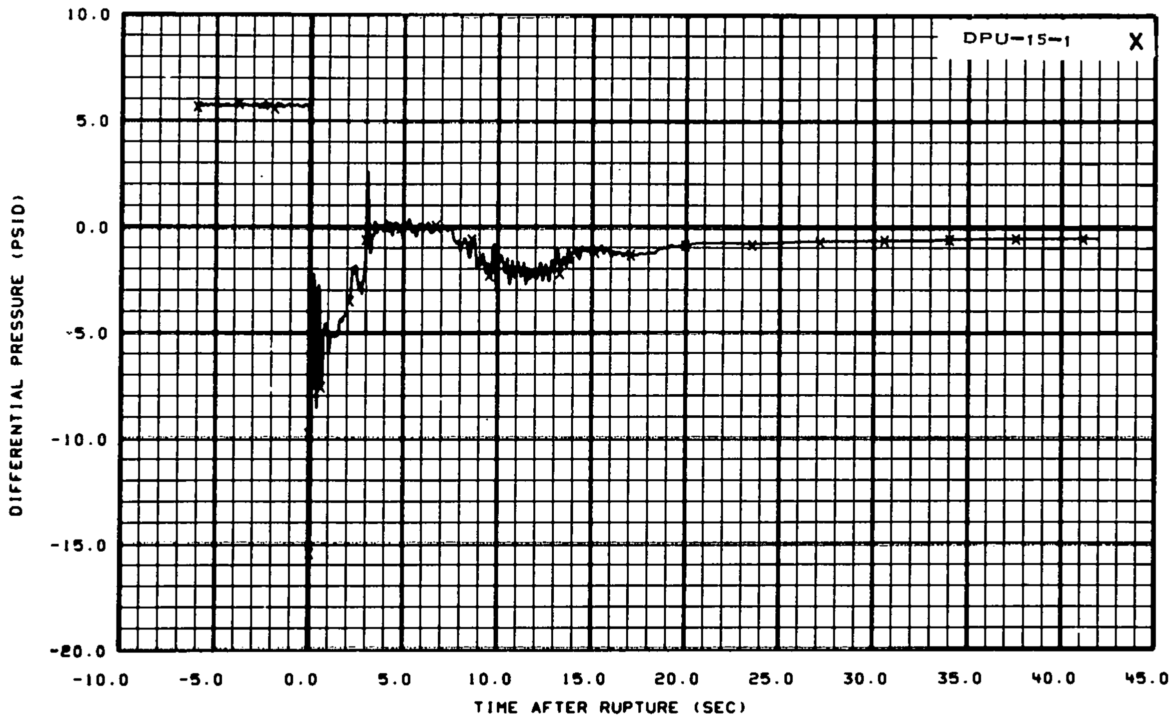

Fig. 79 Differential pressure in intact loop (Spool 15 to Spool 1).

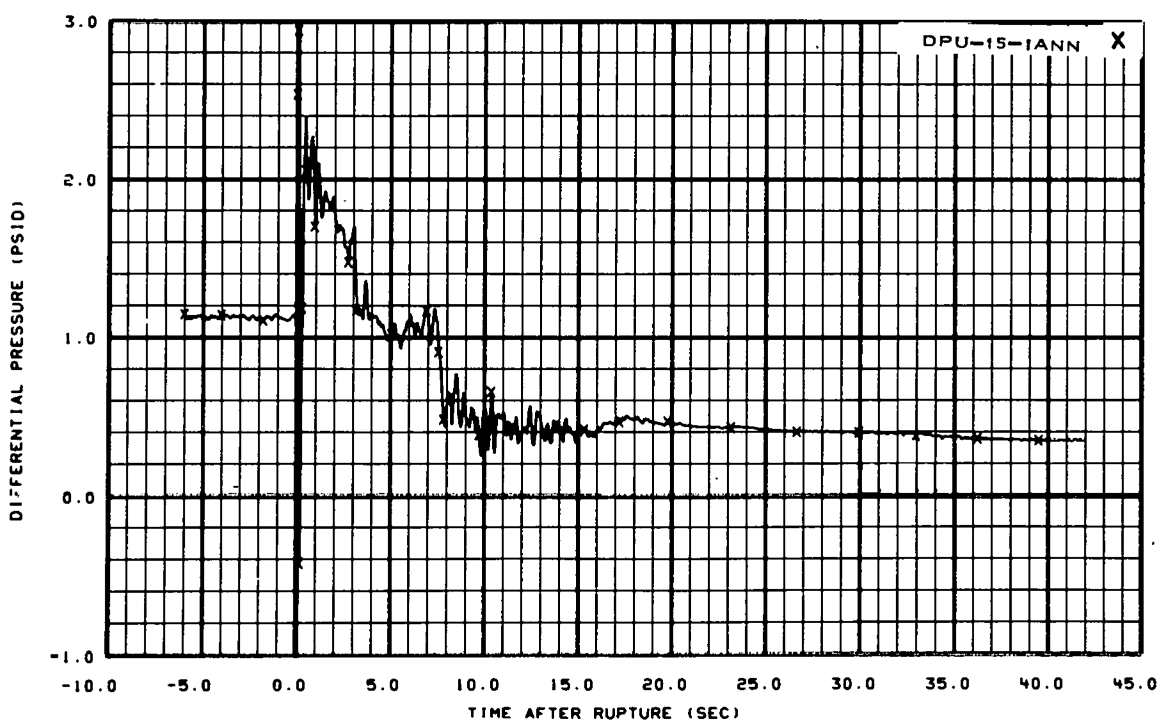

Fig. 80 Differential pressure in intact loop (Spool 15 to vessel inlet annulus).

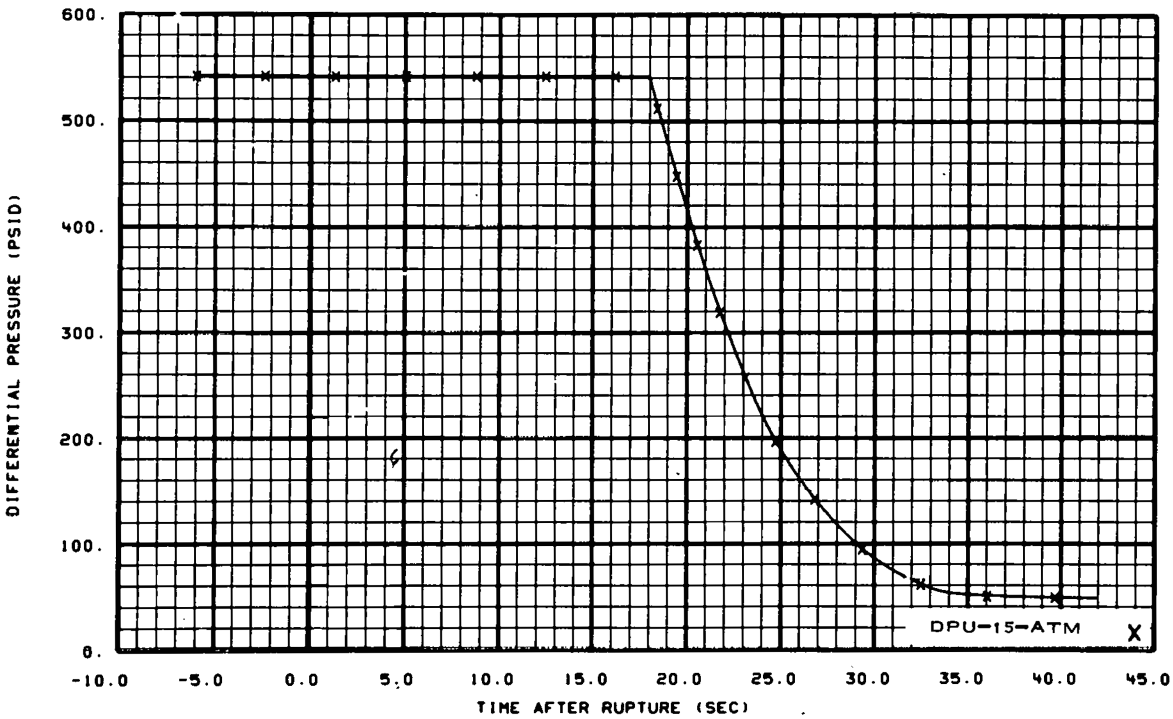

Fig. 81 Differential pressure in intact loop (Spool 15 to atmosphere).

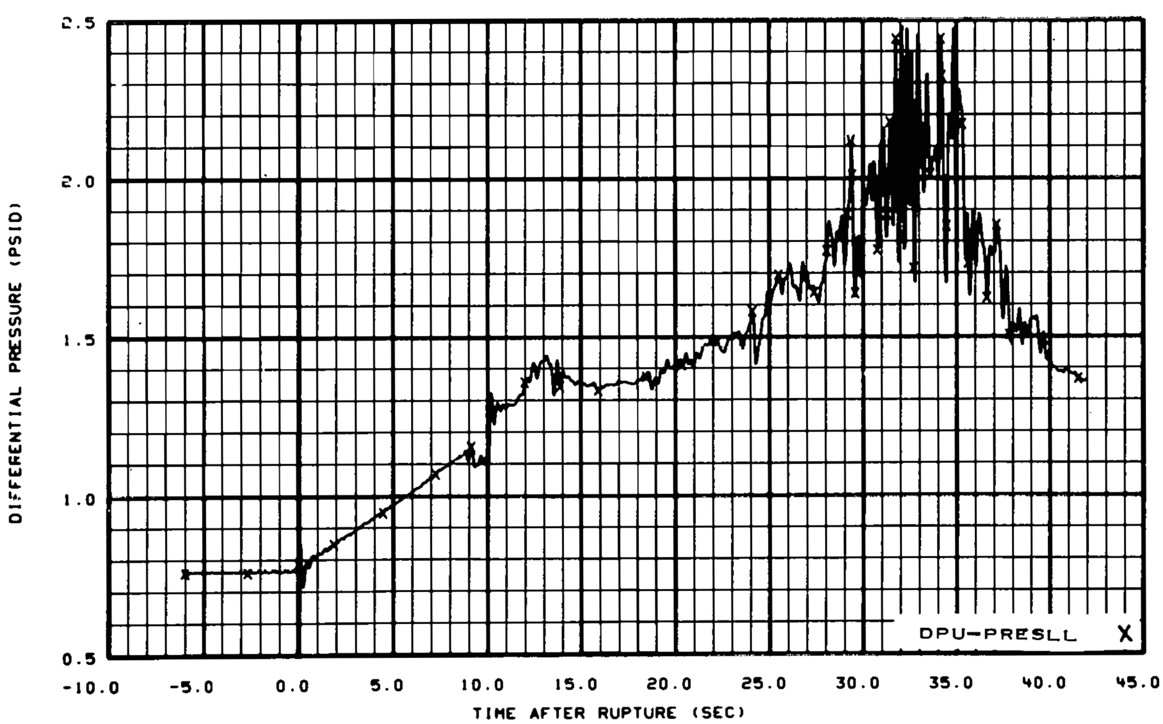

Fig. 82 Differential pressure in intact loop (pressurizer liquid level).

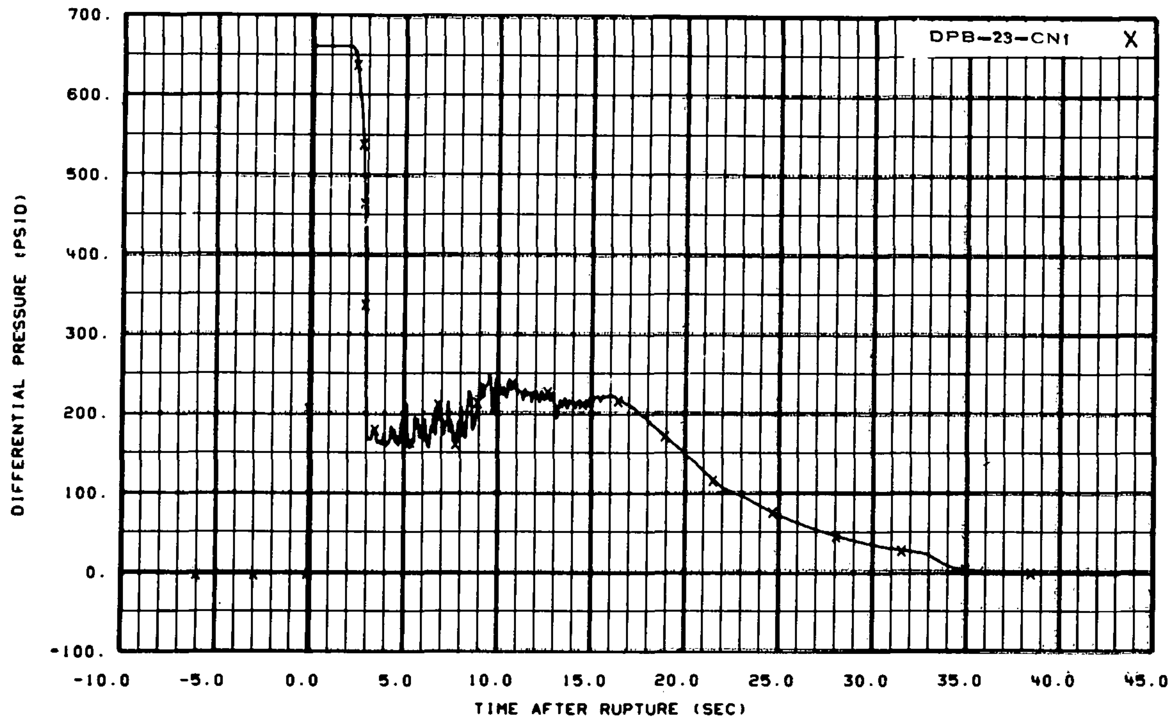

Fig. 83 Differential pressure in broken loop (Spool 23 to vessel-side nozzle throat).

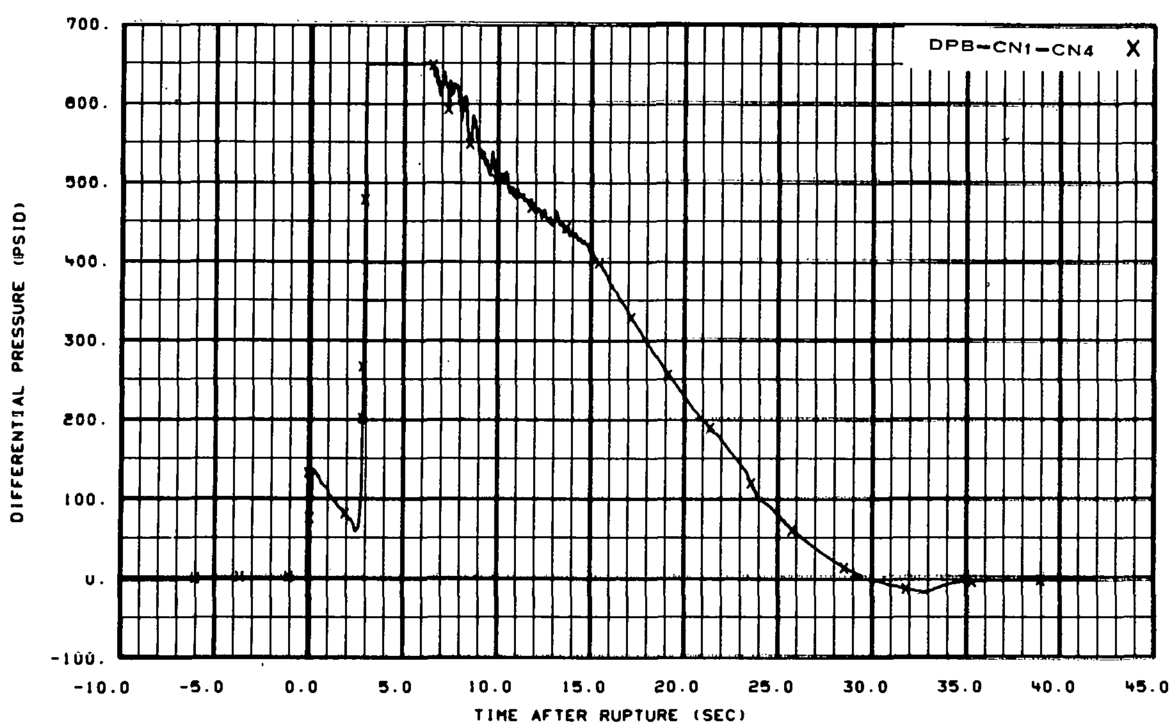

Fig. 84 Differential pressure in broken loop (vessel-side nozzle throat to divergent section).

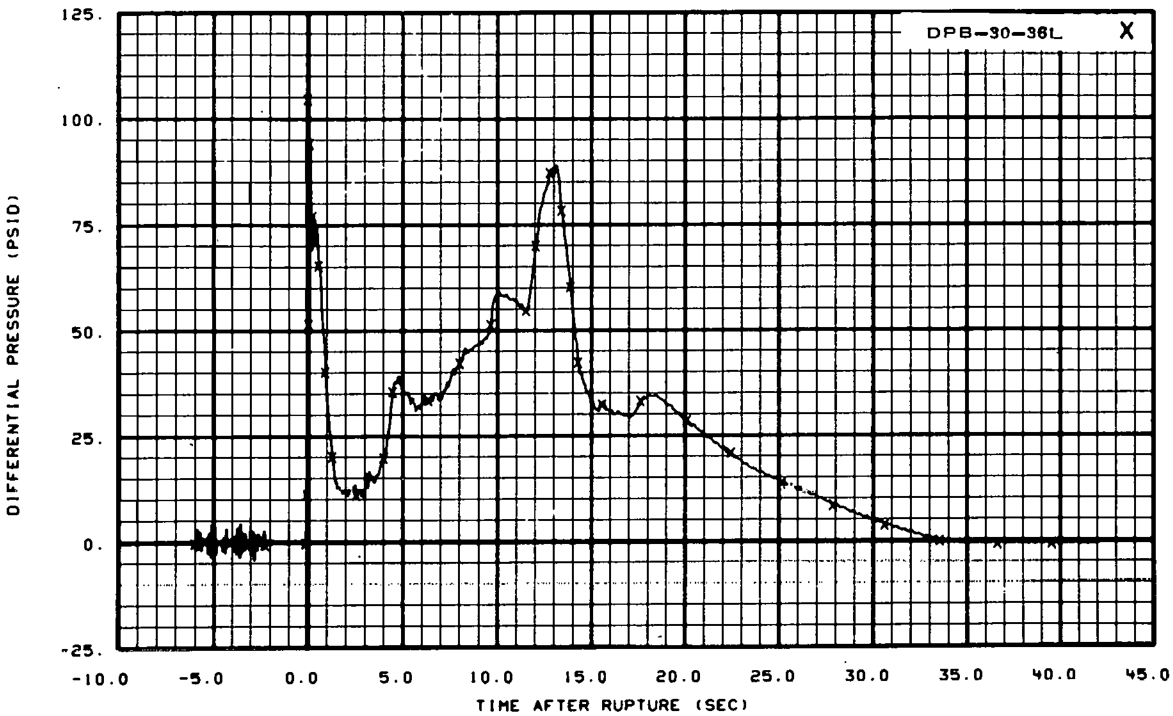

Fig. 85 Differential pressure in broken loop (Spool 30 to Spool 36L).

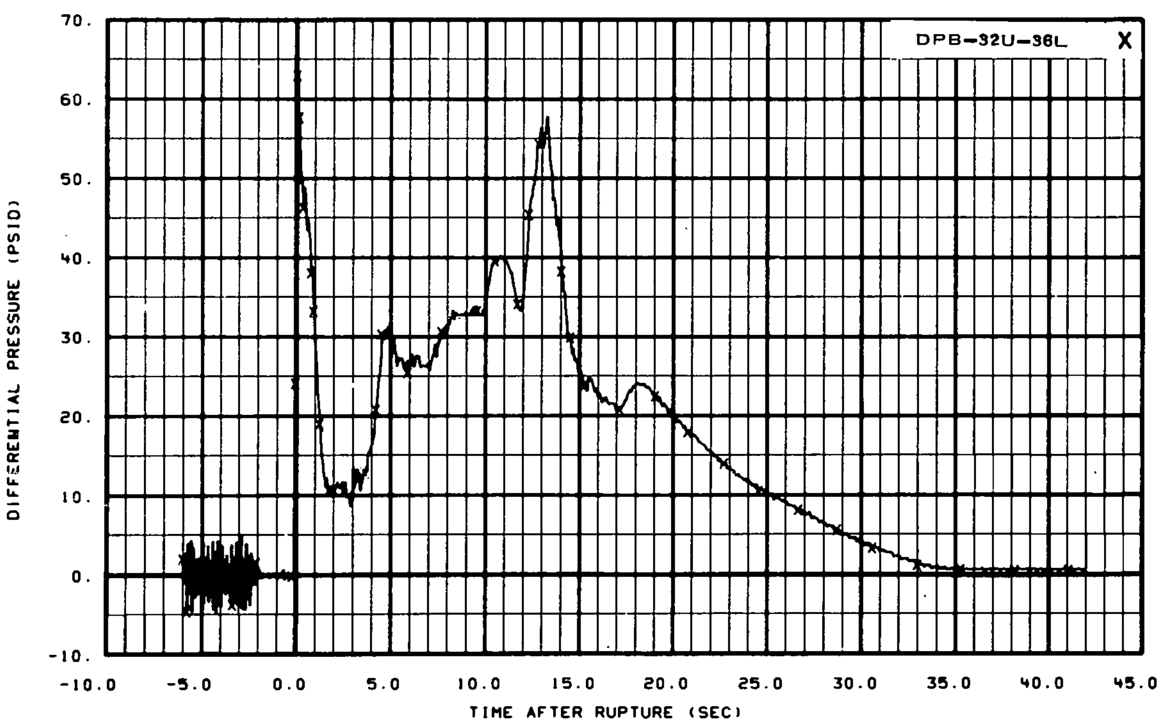

Fig. 86 Differential pressure in broken loop (Spool 32U to Spool 36L).

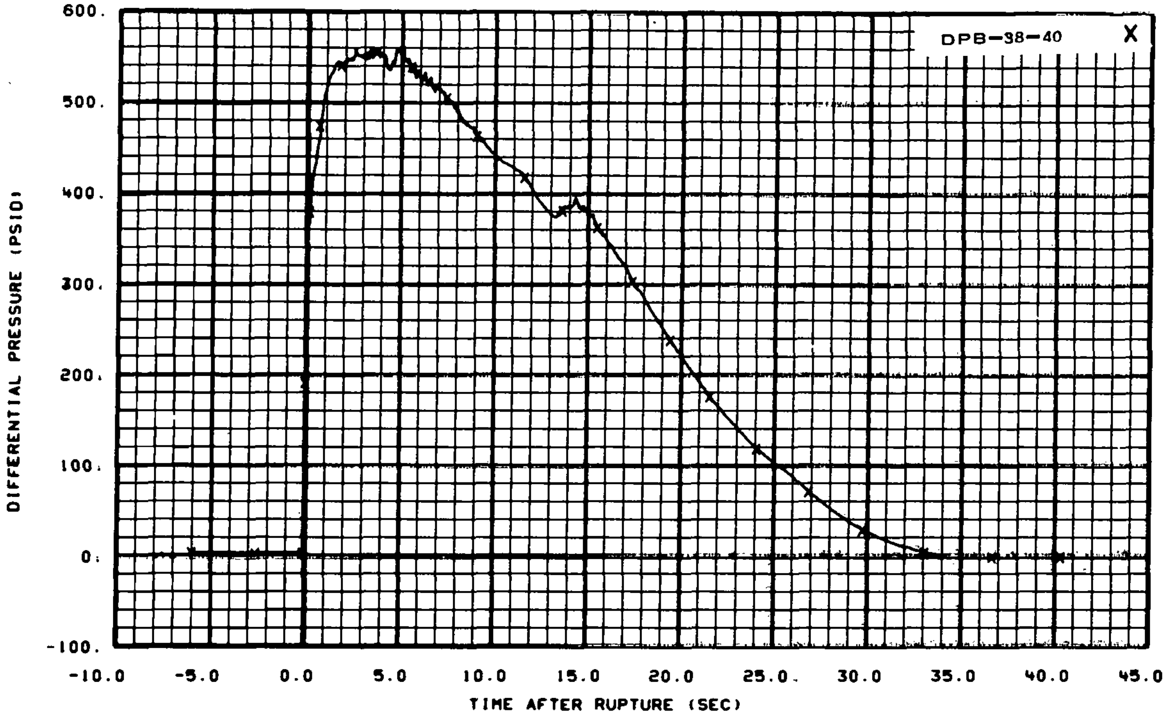

Fig. 87 Differential pressure in broken loop (Spool 38 to Spool 40).

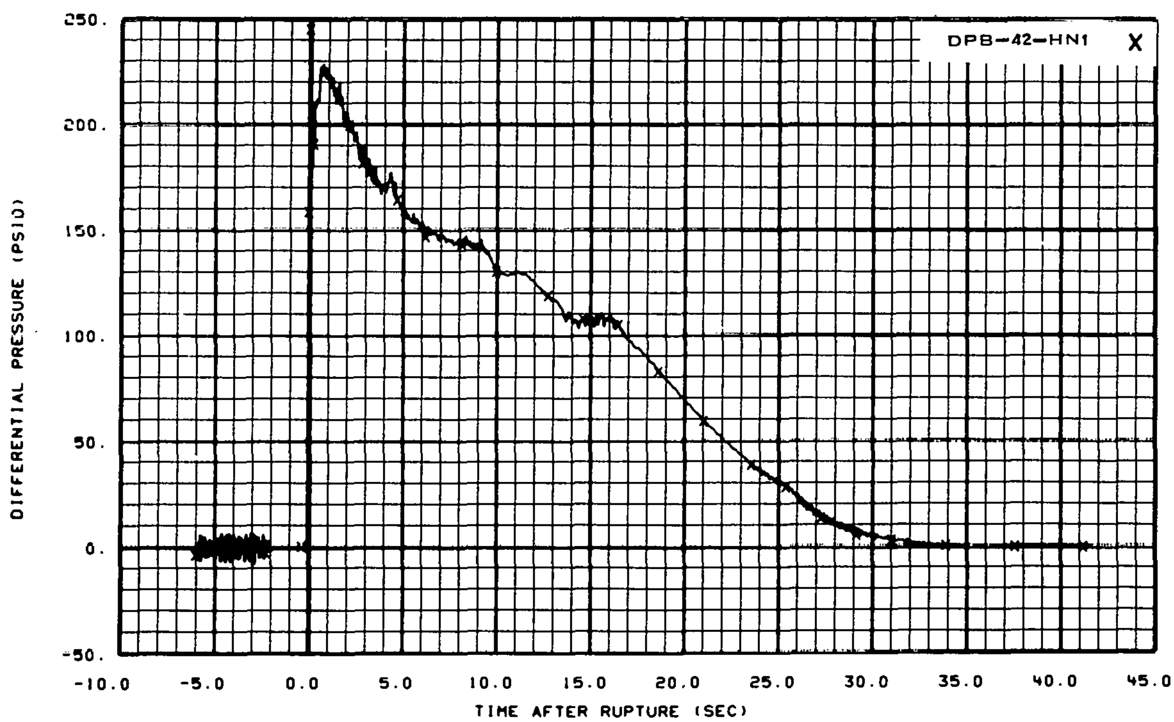

Fig. 88 Differential pressure in broken loop (Spool 42 to pump-side nozzle throat).

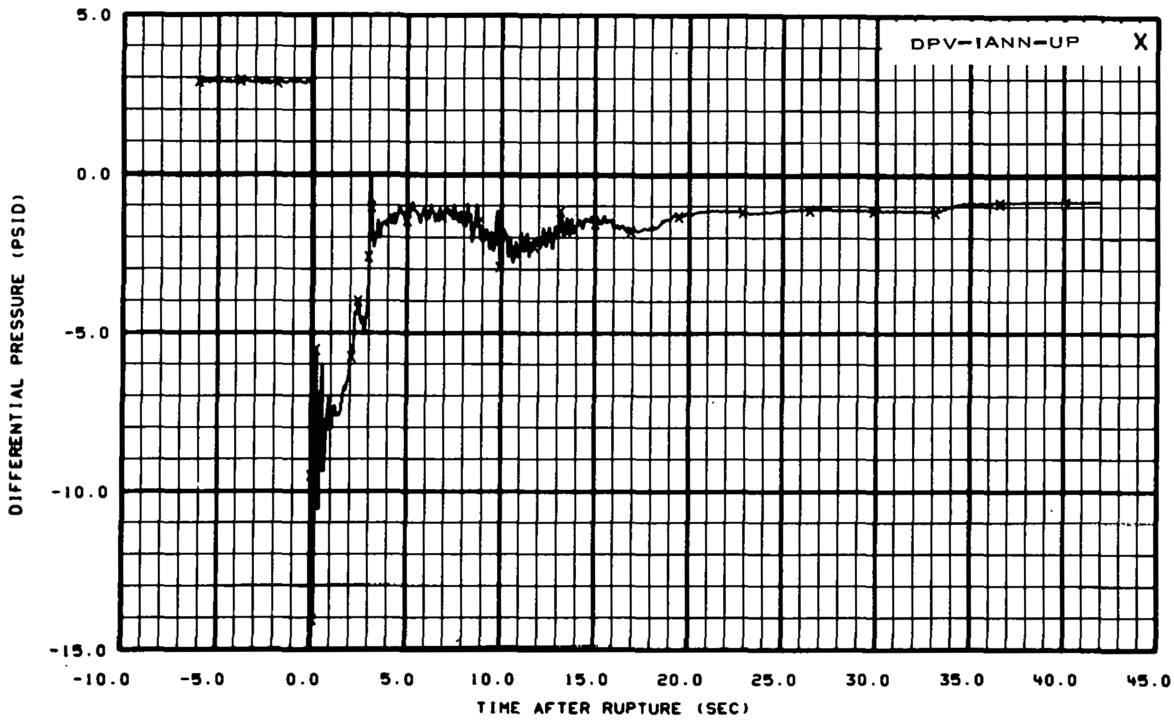

Fig. 89 Differential pressure in vessel (inlet annulus to upper plenum).

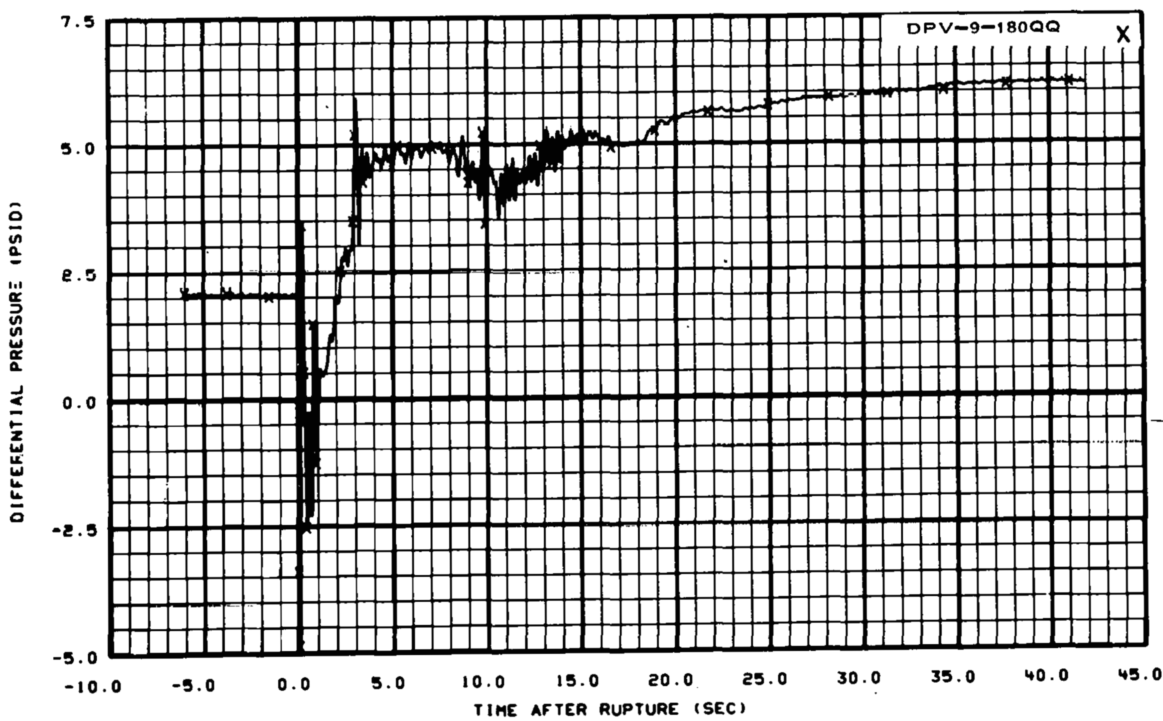

Fig. 90 Differential pressure in vessel (DPV-9-180QQ).

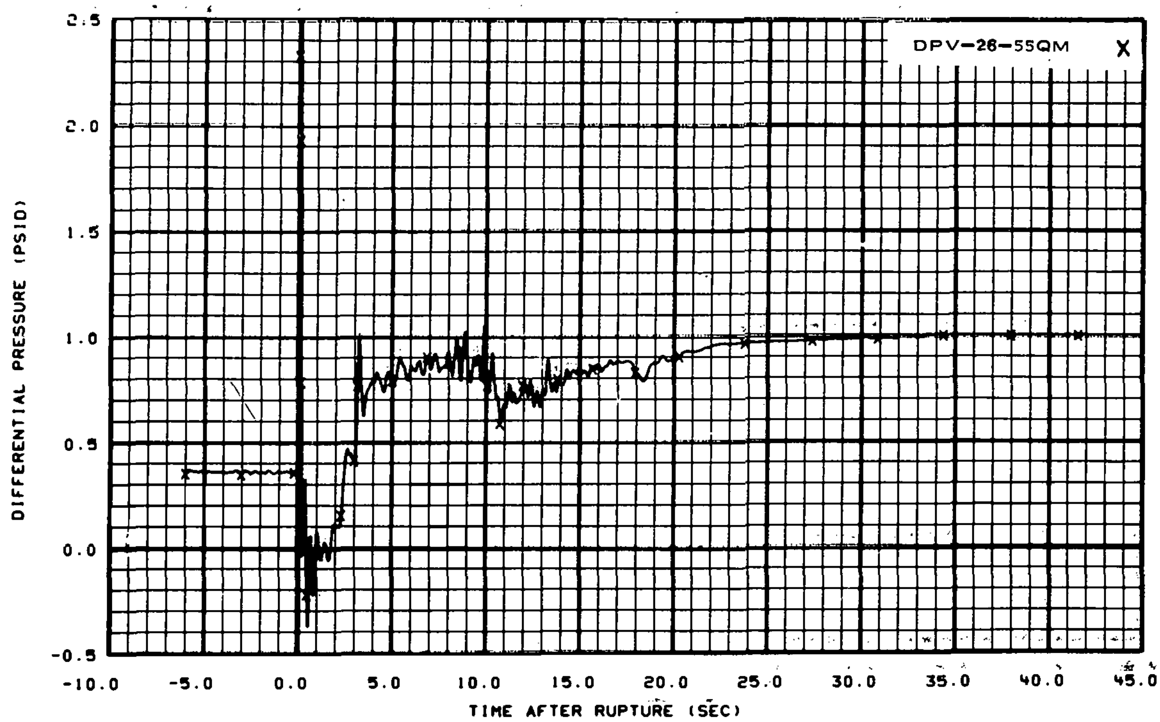

Fig. 91 Differential pressure in vessel (DPV-26-55QM).

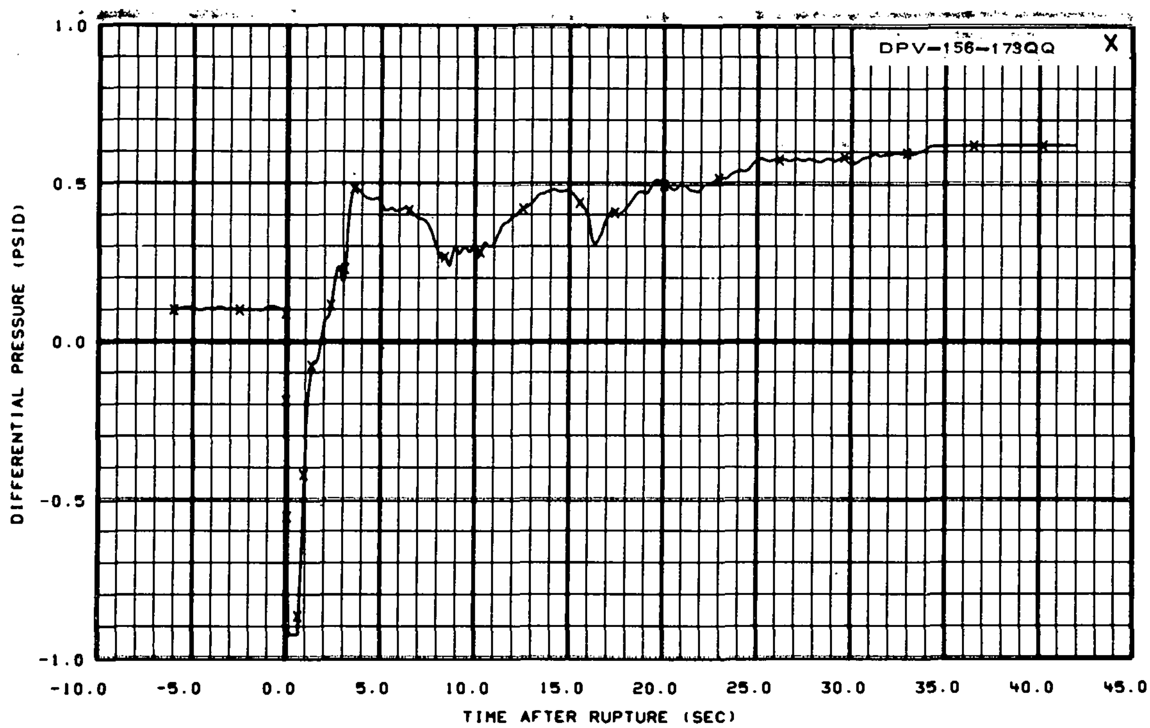

Fig. 92 Differential pressure in vessel (DPV-156-173QQ).

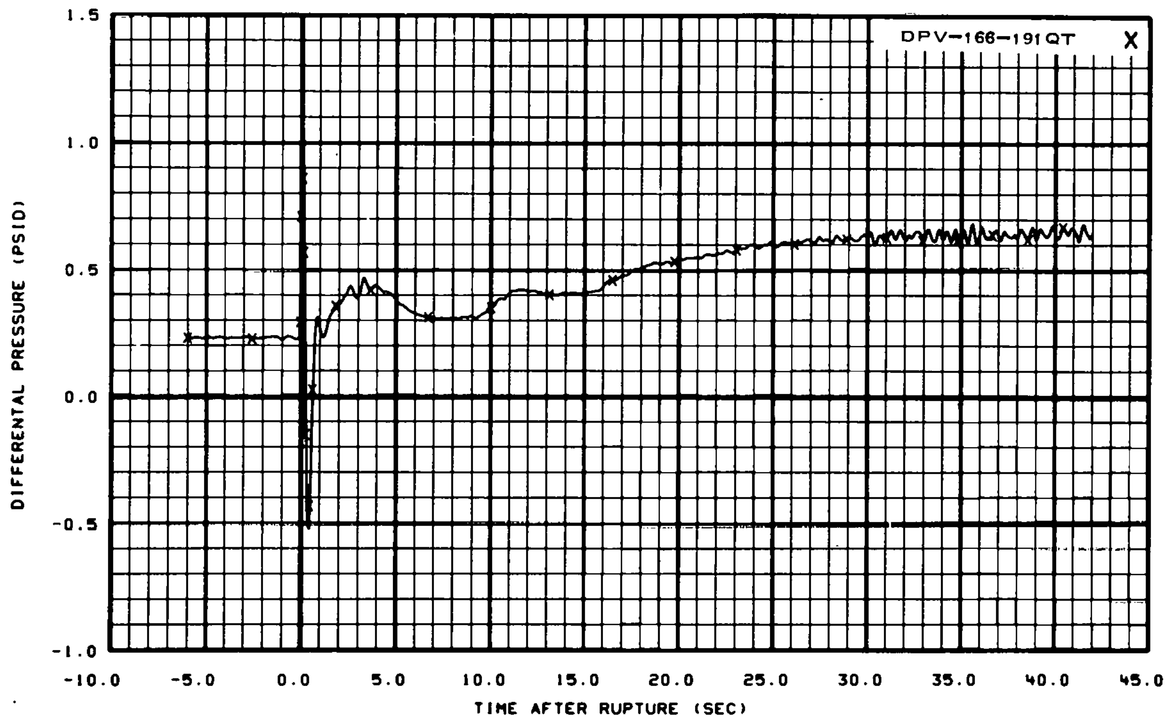

Fig. 93 Differential pressure in vessel (DPV-166-191QT).

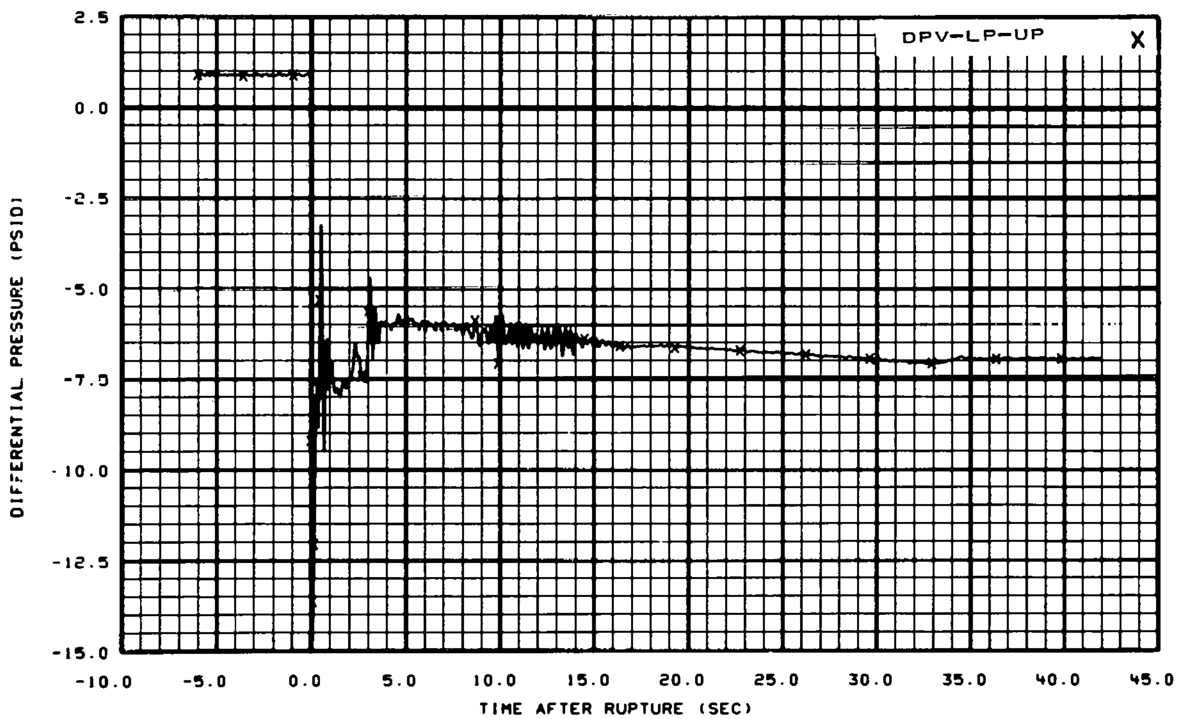

Fig. 94 Differential pressure in vessel (DPV-LP-UP).

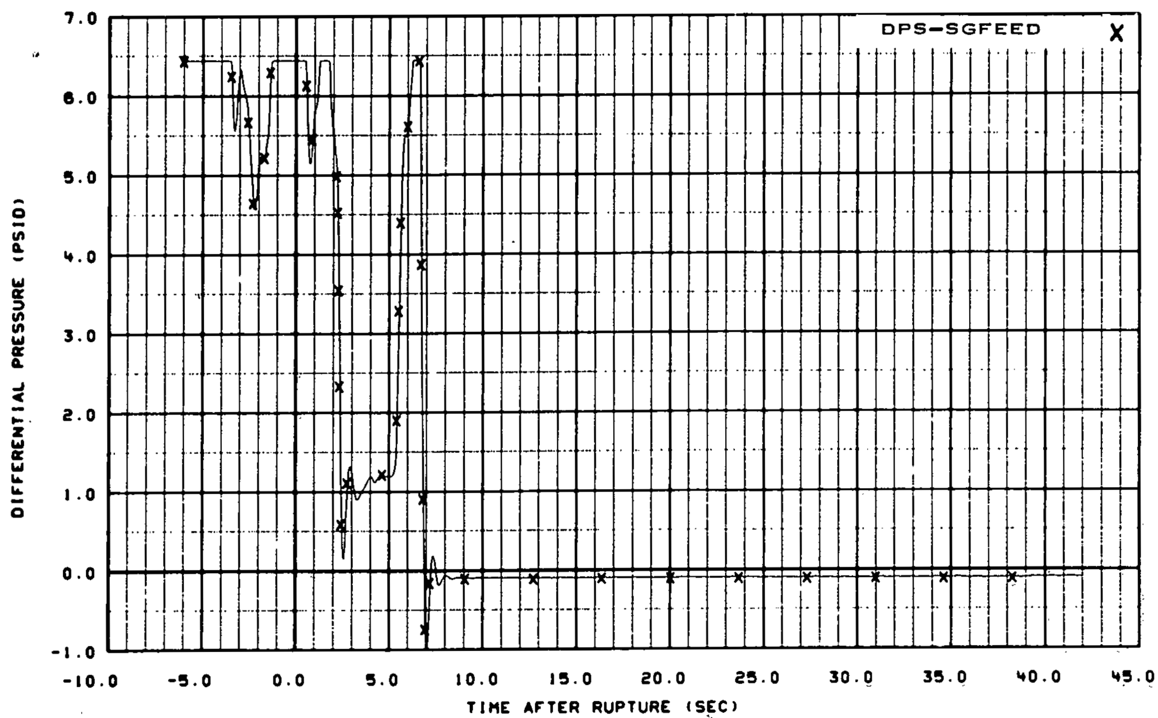

Fig. 95 Differential pressure across steam generator inlet orifice.

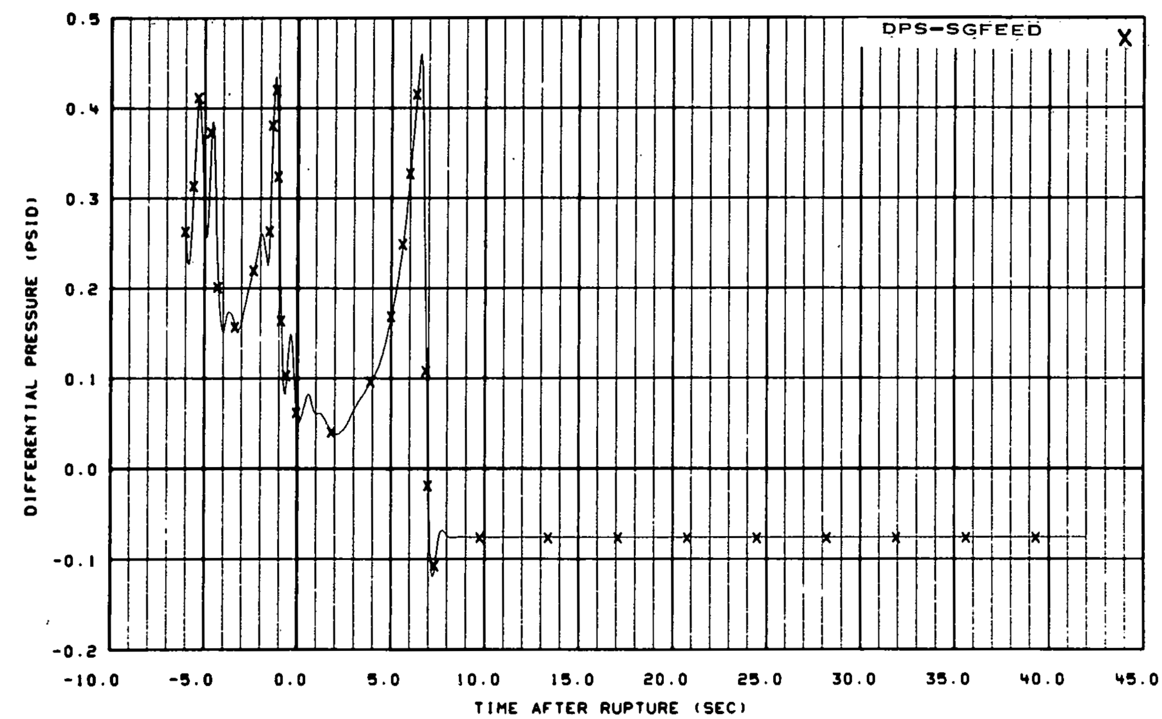

Fig. 96 Differential pressure across steam generator outlet orifice.

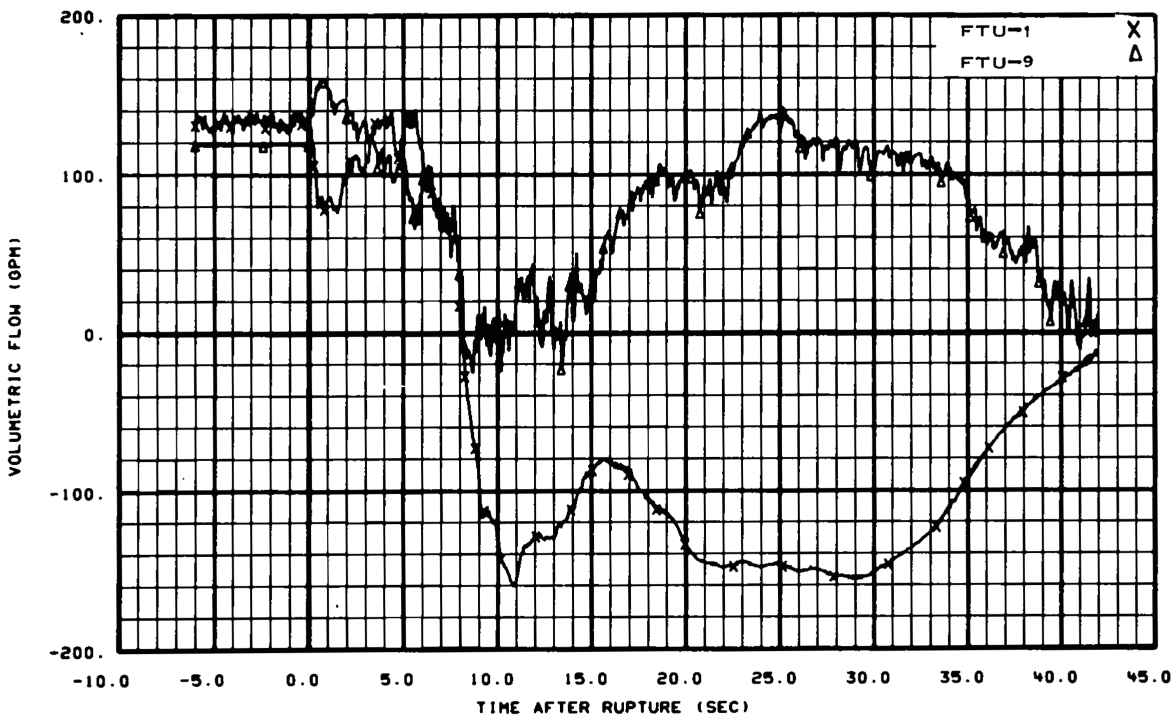

Fig. 97 Volumetric flow in intact loop (FTU-1, FTU-9).

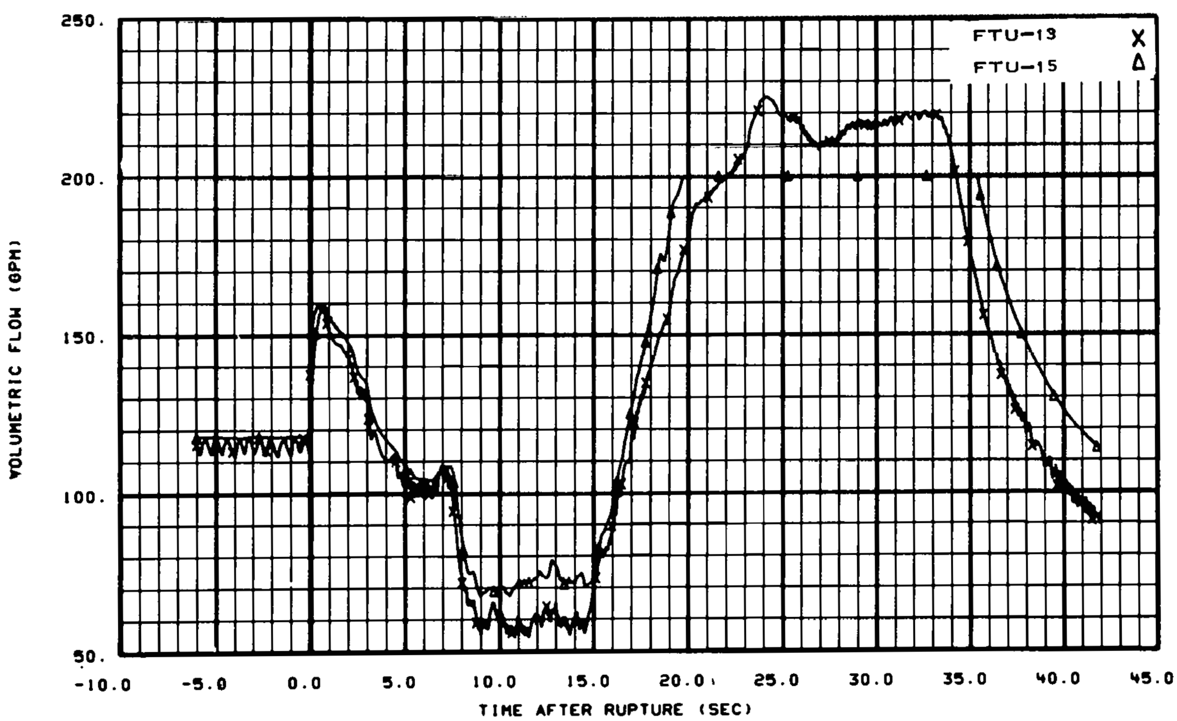

Fig. 98 Volumetric flow in intact loop (FTU-13, FTB-30).

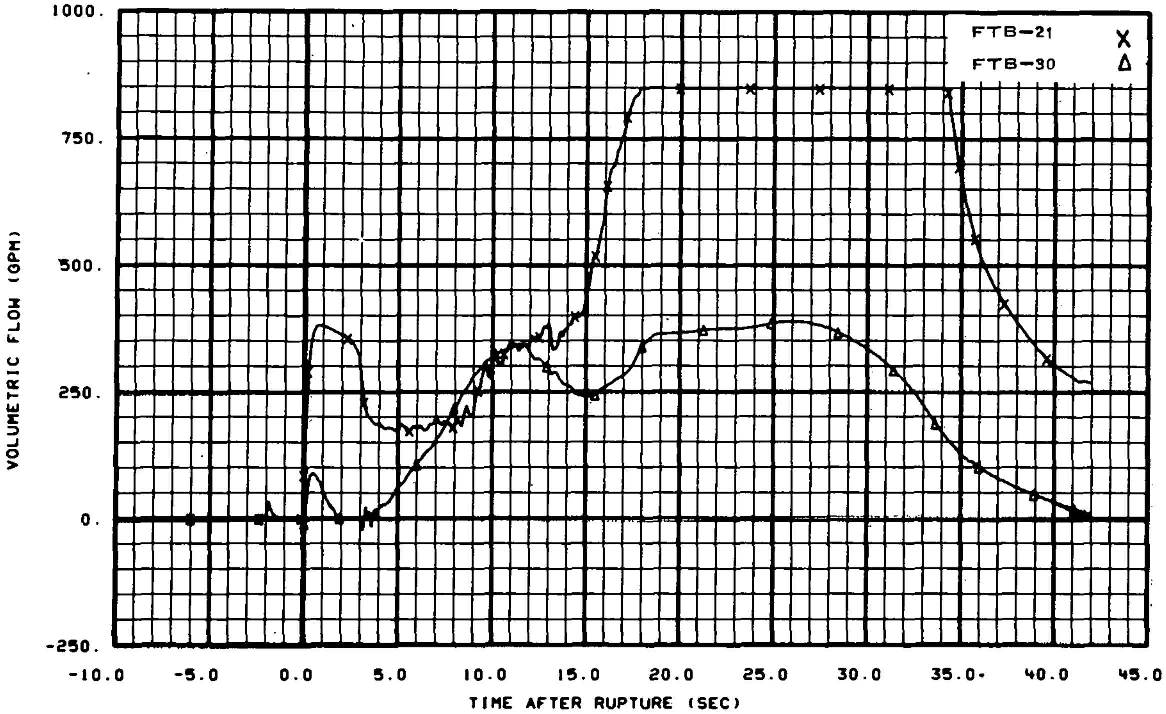

Fig. 99 Volumetric flow in broken loop (FTB-21, FTB-30).

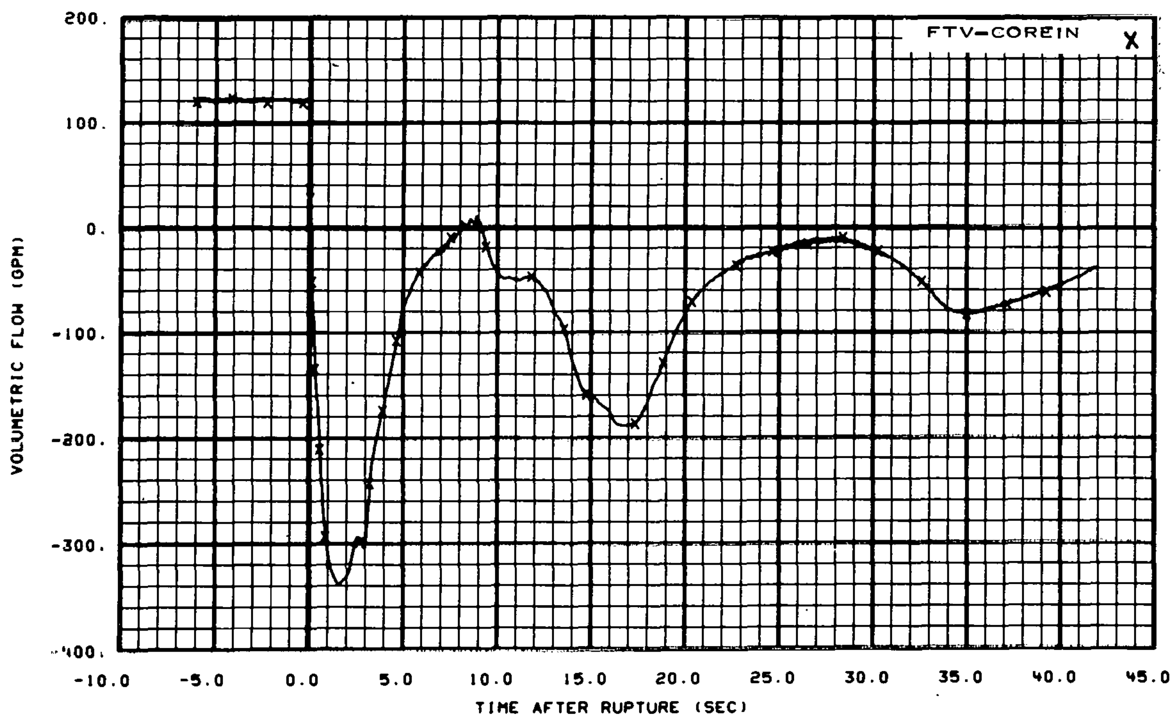

Fig. 100 Volumetric flow in core entrance.

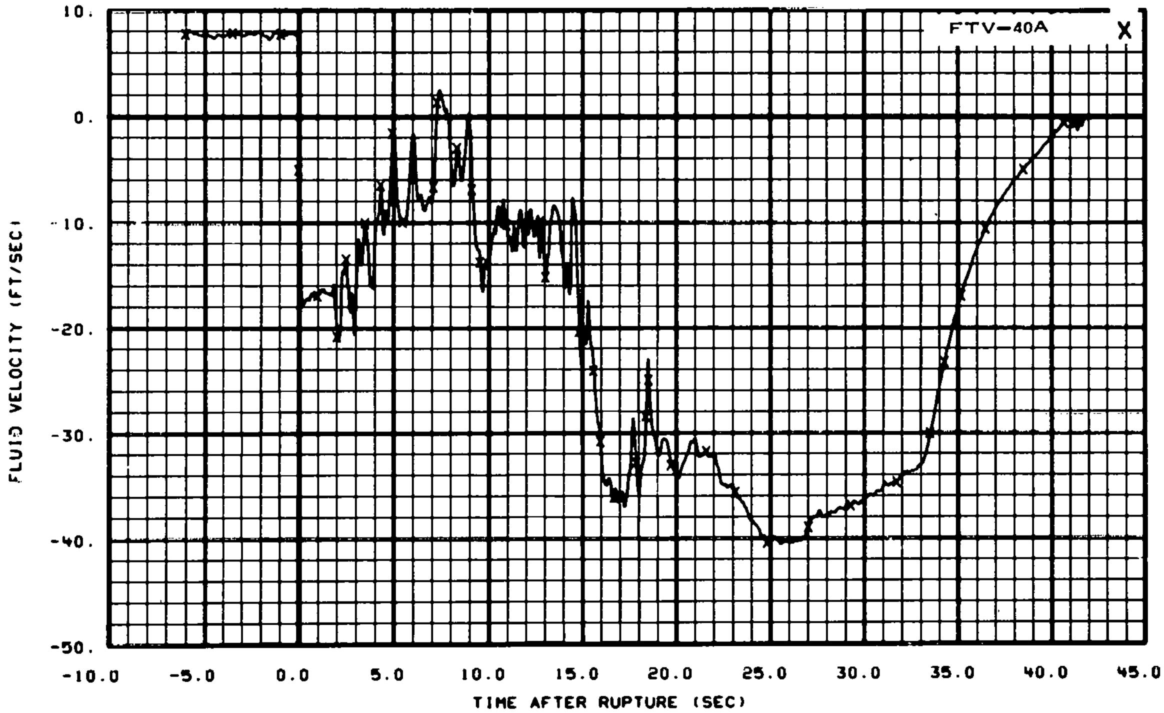

Fig. 101 Fluid velocity in vessel.

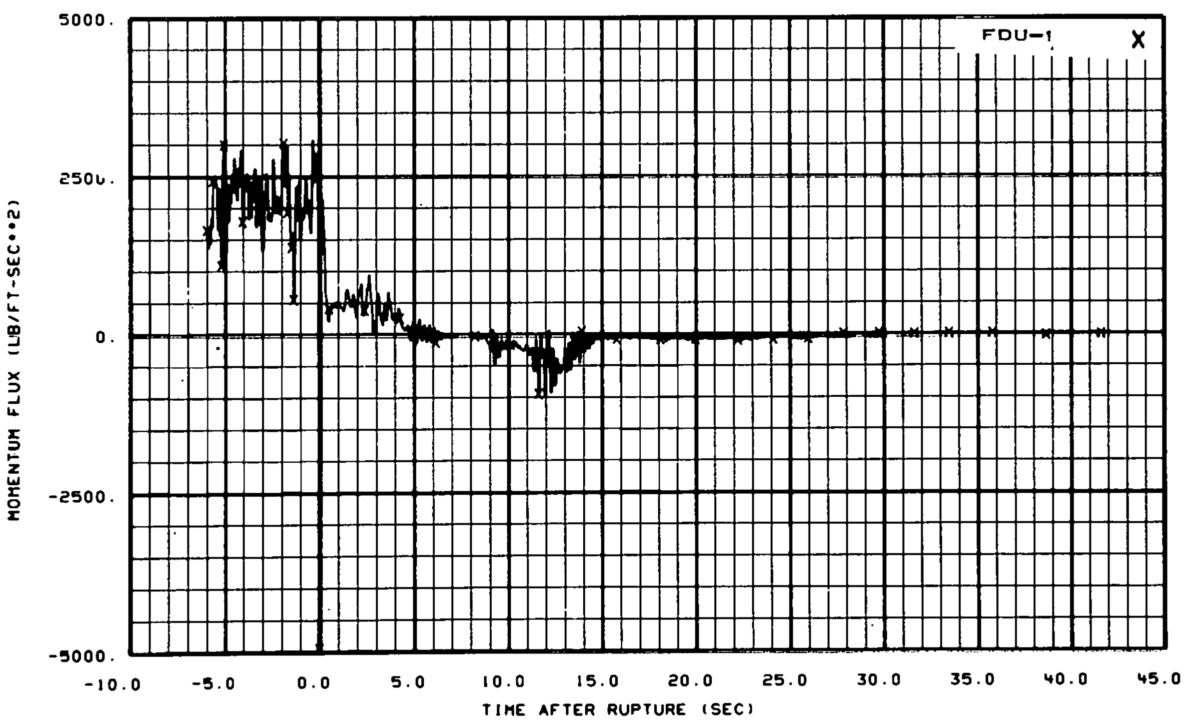

Fig. 102 Momentum flux in intact loop (Spool 1).

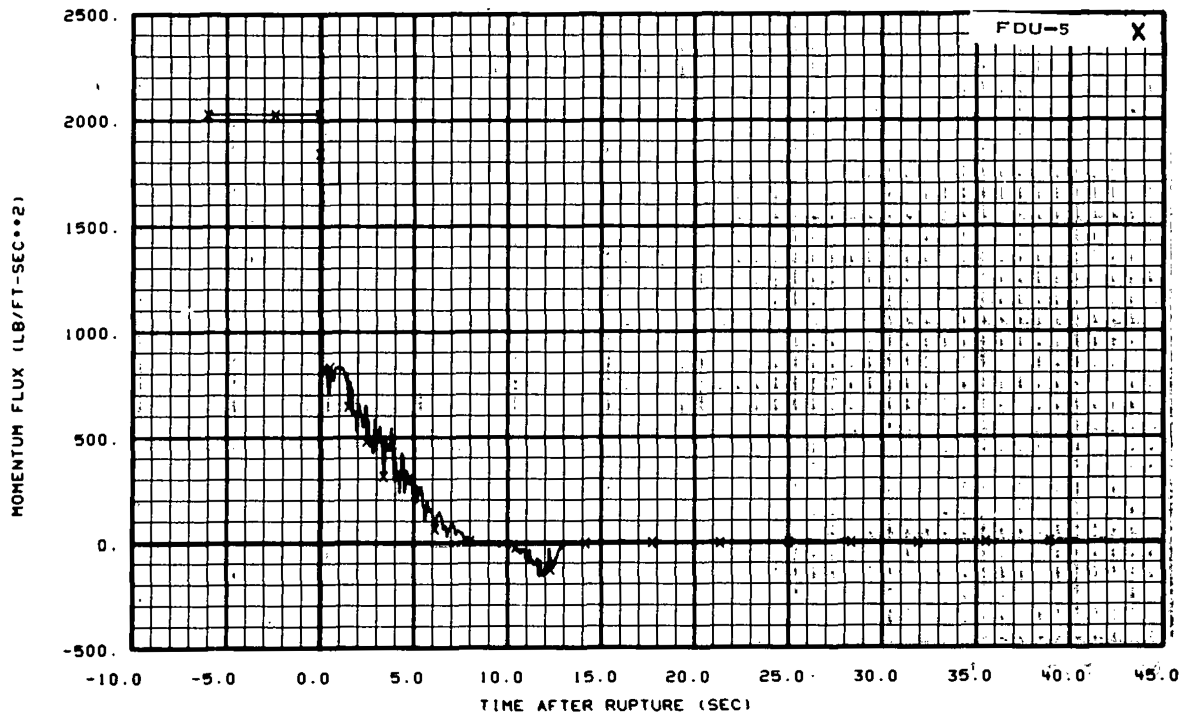

Fig. 103 Momentum flux in intact loop (Spool 5).

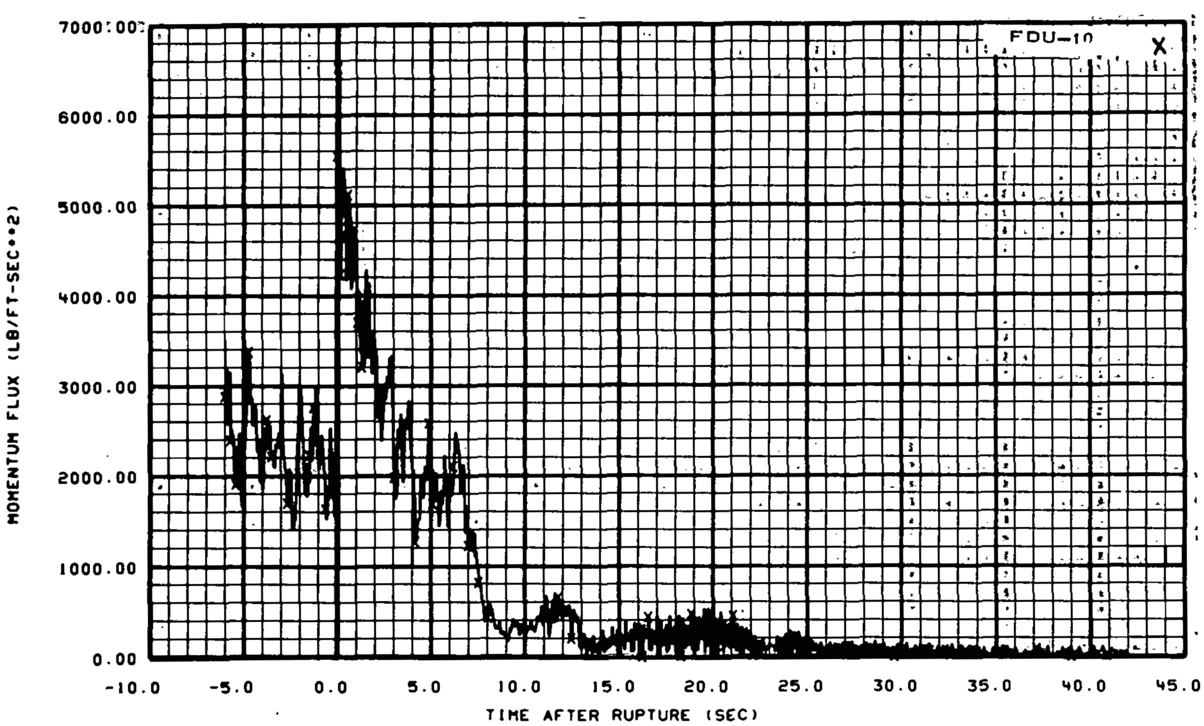

Fig. 104 Momentum flux in intact loop (Spool 10).

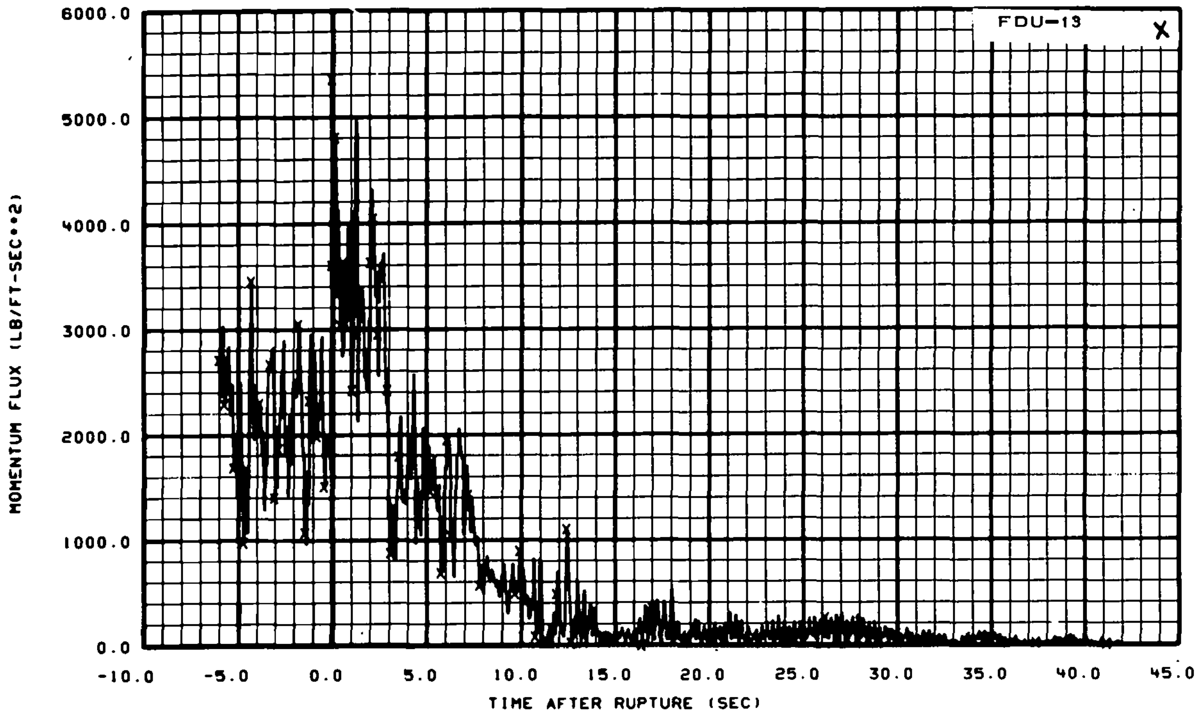

Fig. 105 Momentum flux in intact loop (Spool 13).

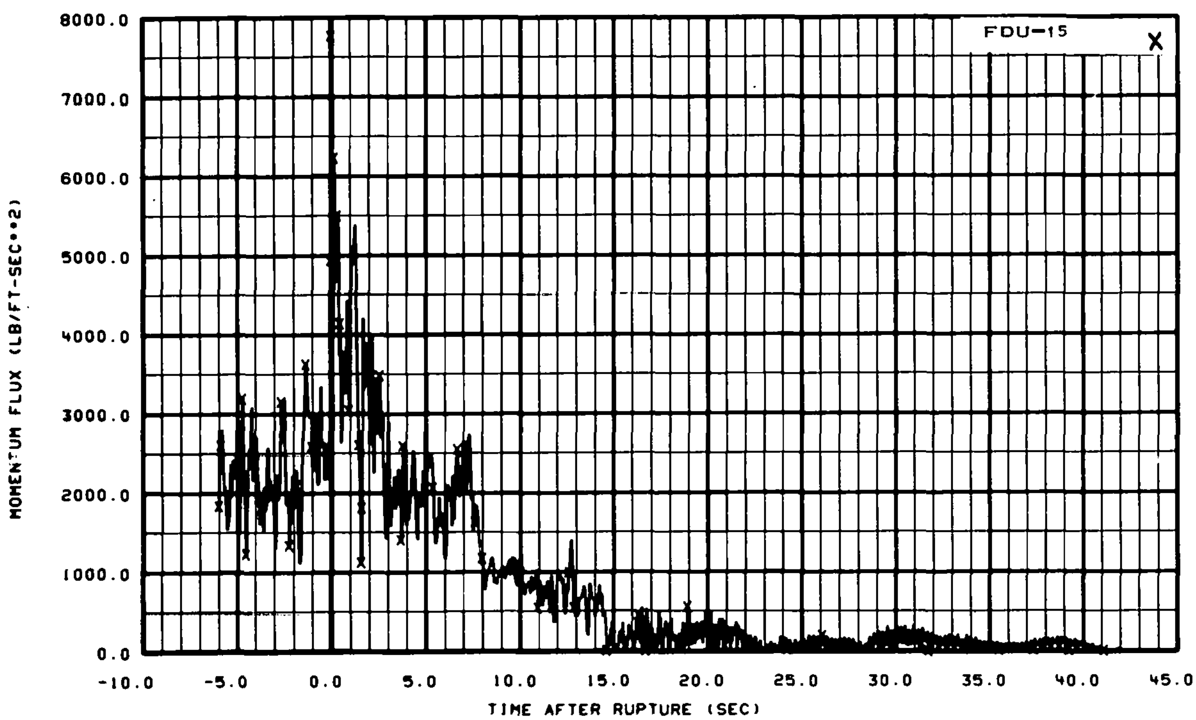

Fig. 106 Momentum flux in intact loop (Spool 15).

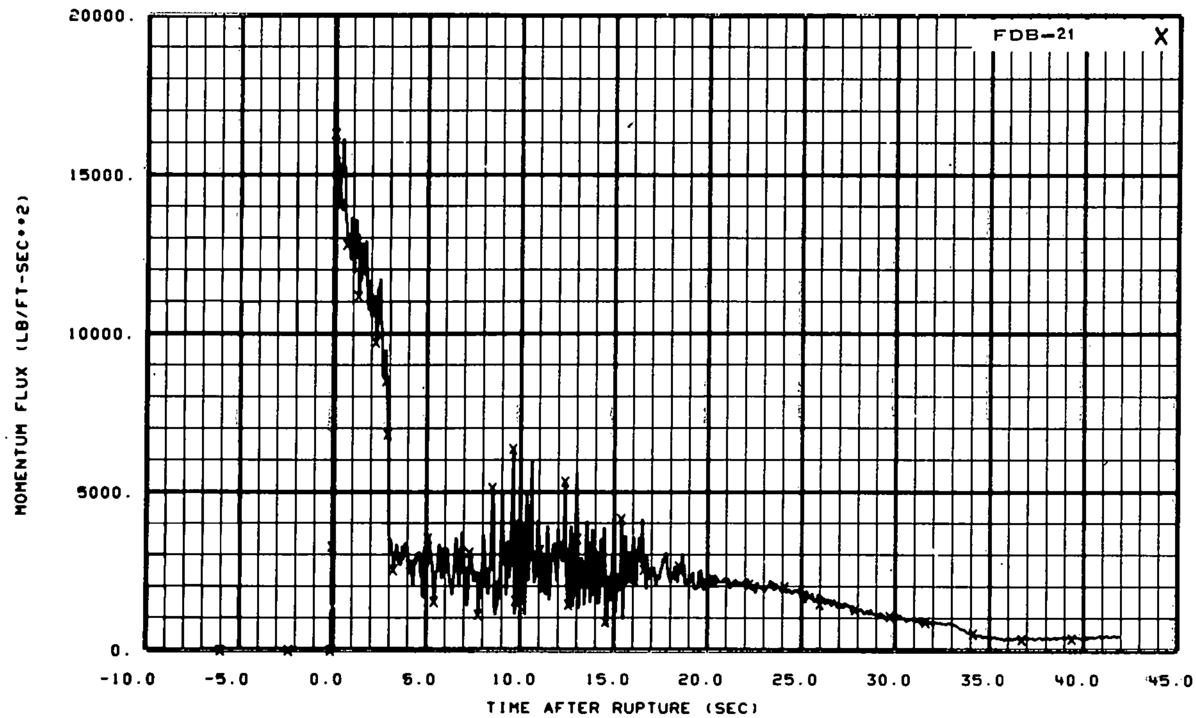

Fig. 107 Momentum flux in intact loop (Spool 21).

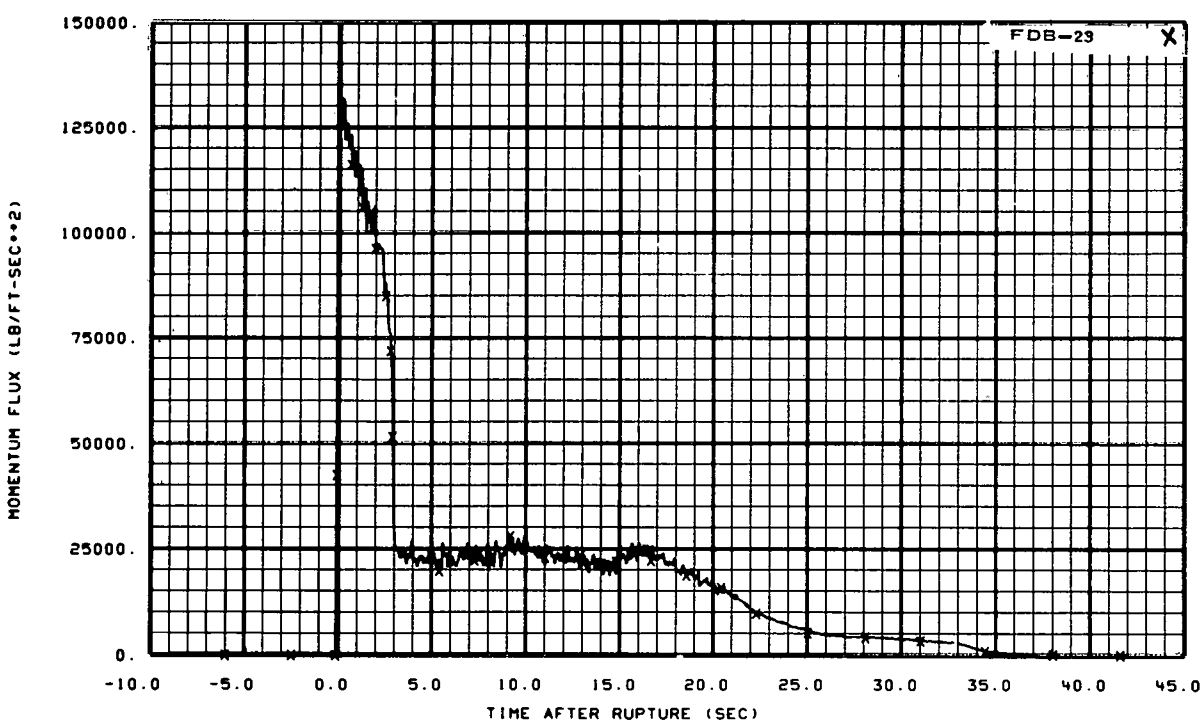

Fig. 108 Momentum flux in broken loop (Spool 23).

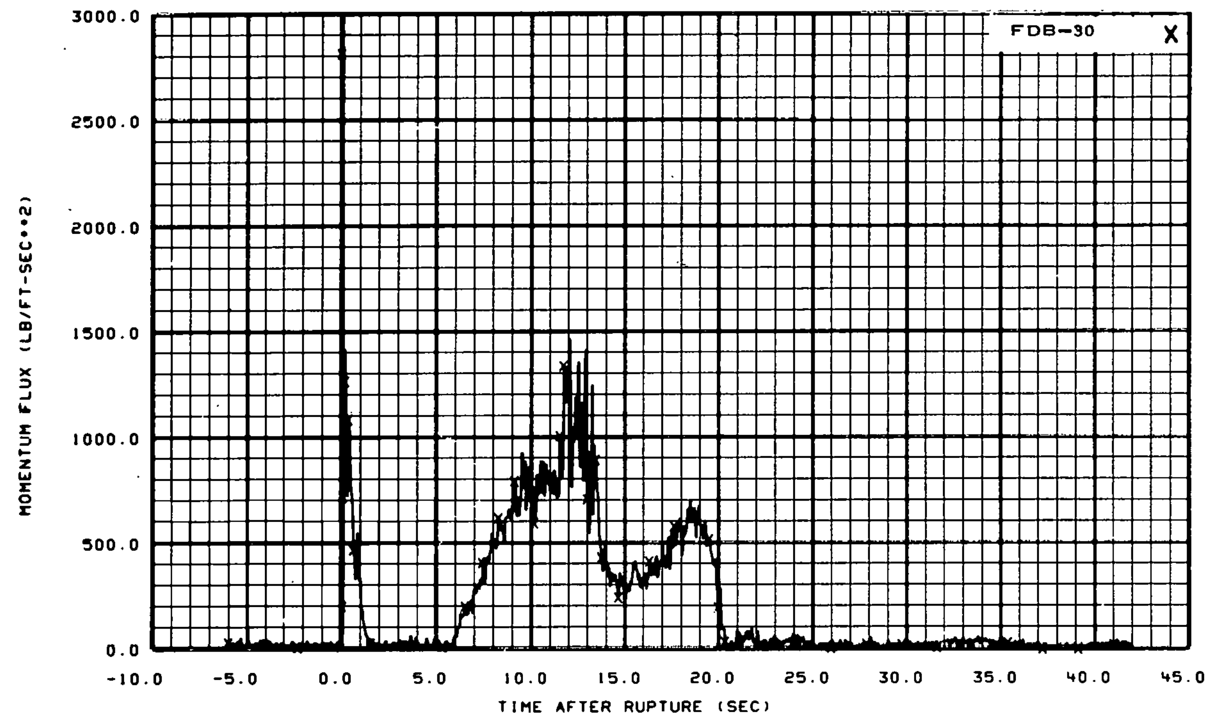

Fig. 109 Momentum flux in broken loop (Spool 30).

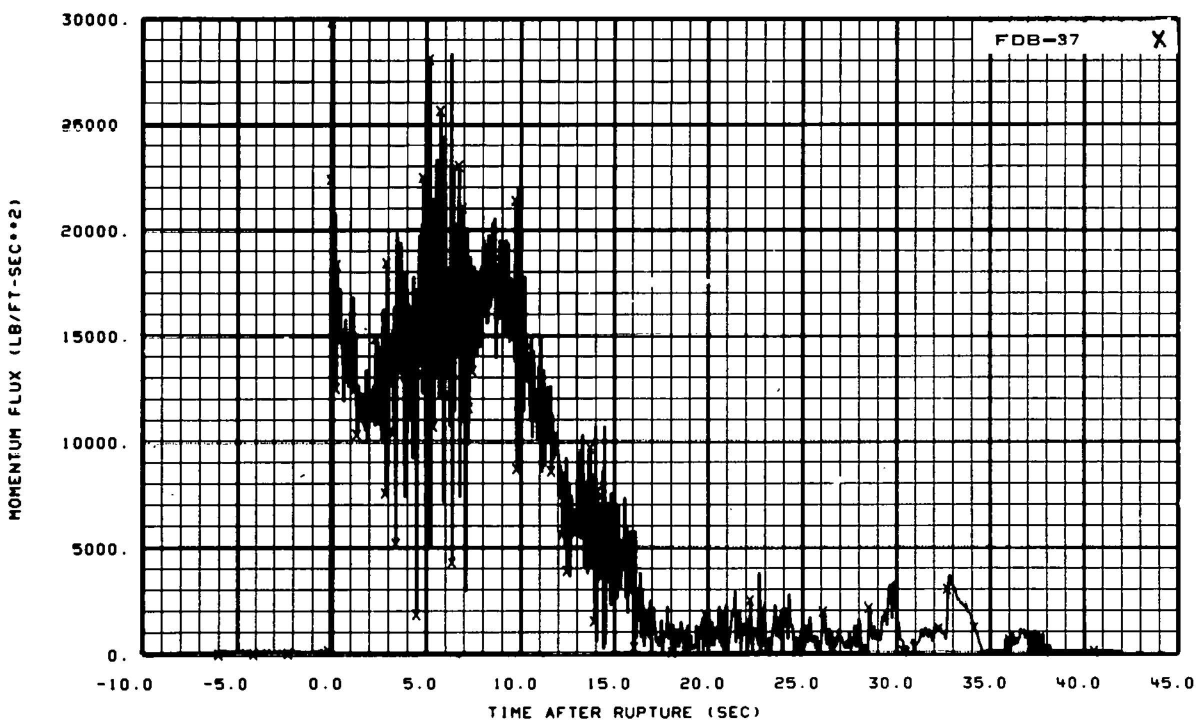

Fig. 110 Momentum flux in broken loop (Spool 37).

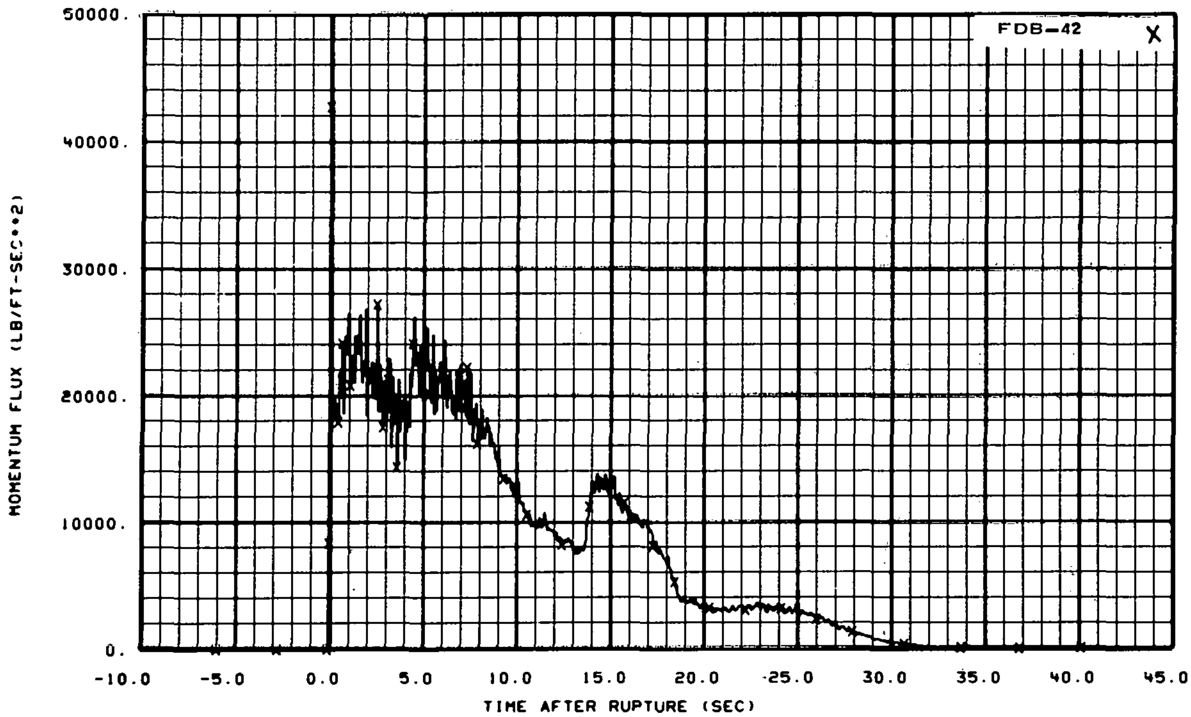

Fig. 111 Momentum flux in broken loop (Spool 42).

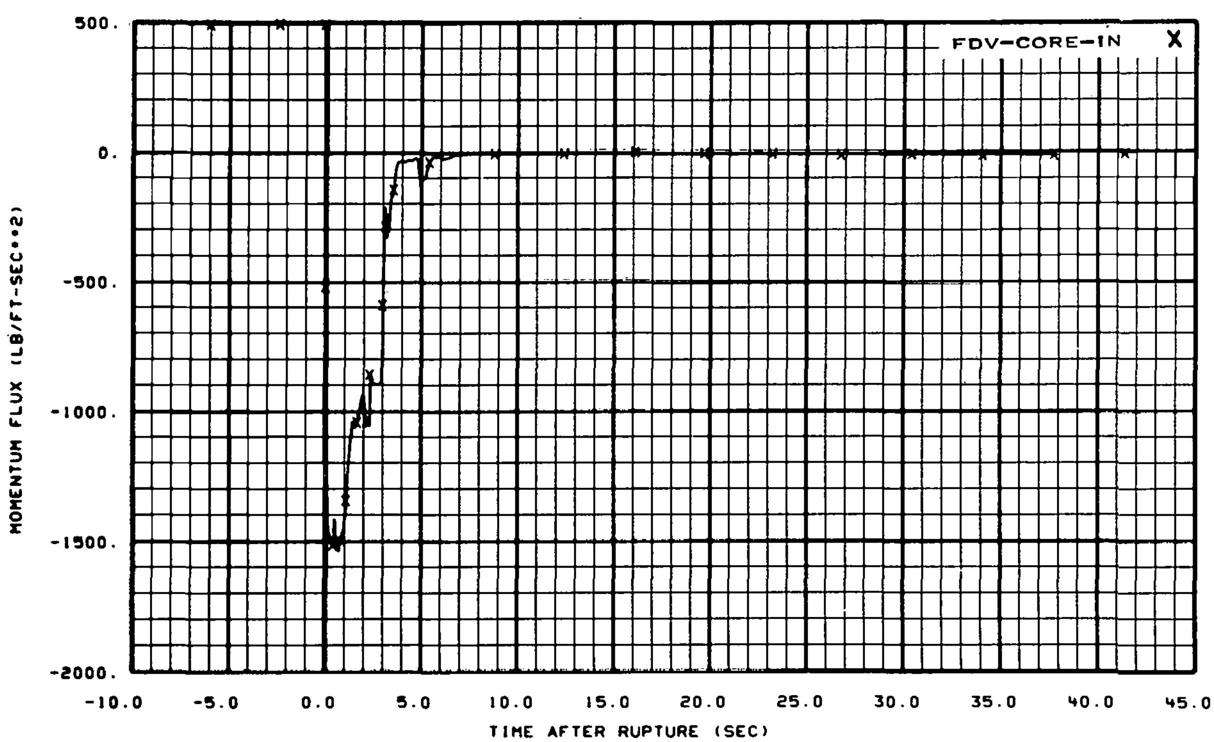

Fig. 112 Momentum flux in core entrance.

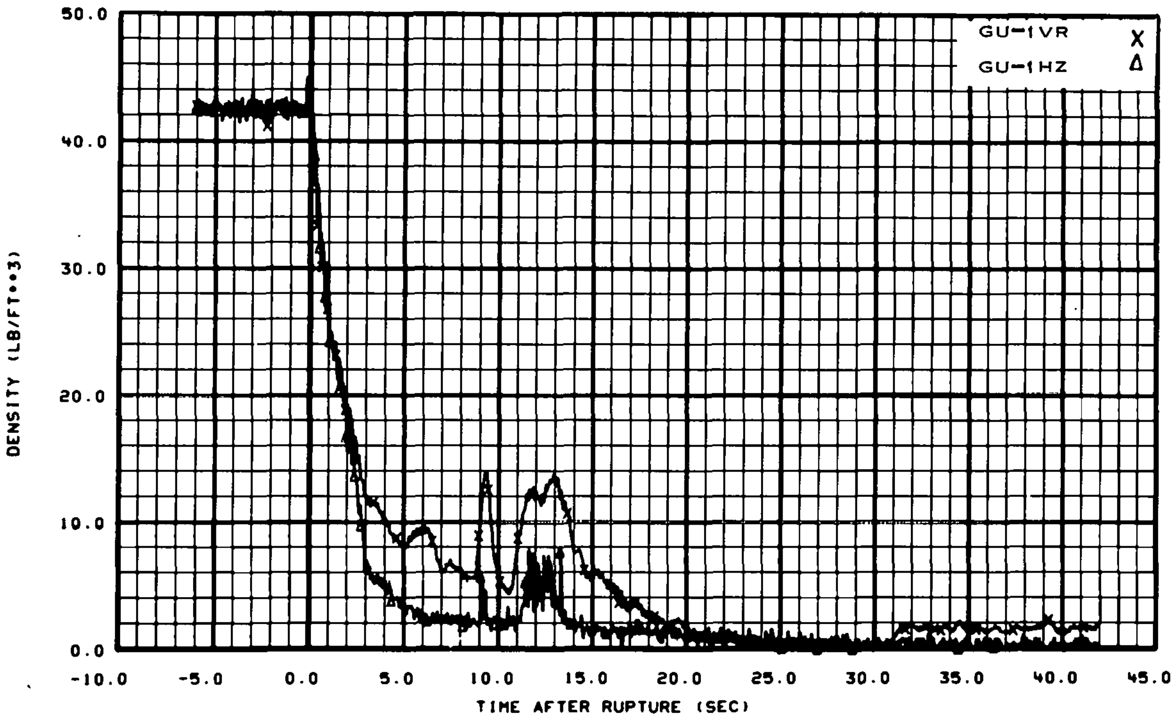

Fig. 113 Density in intact loop (GU-1VR, GU-1HZ).

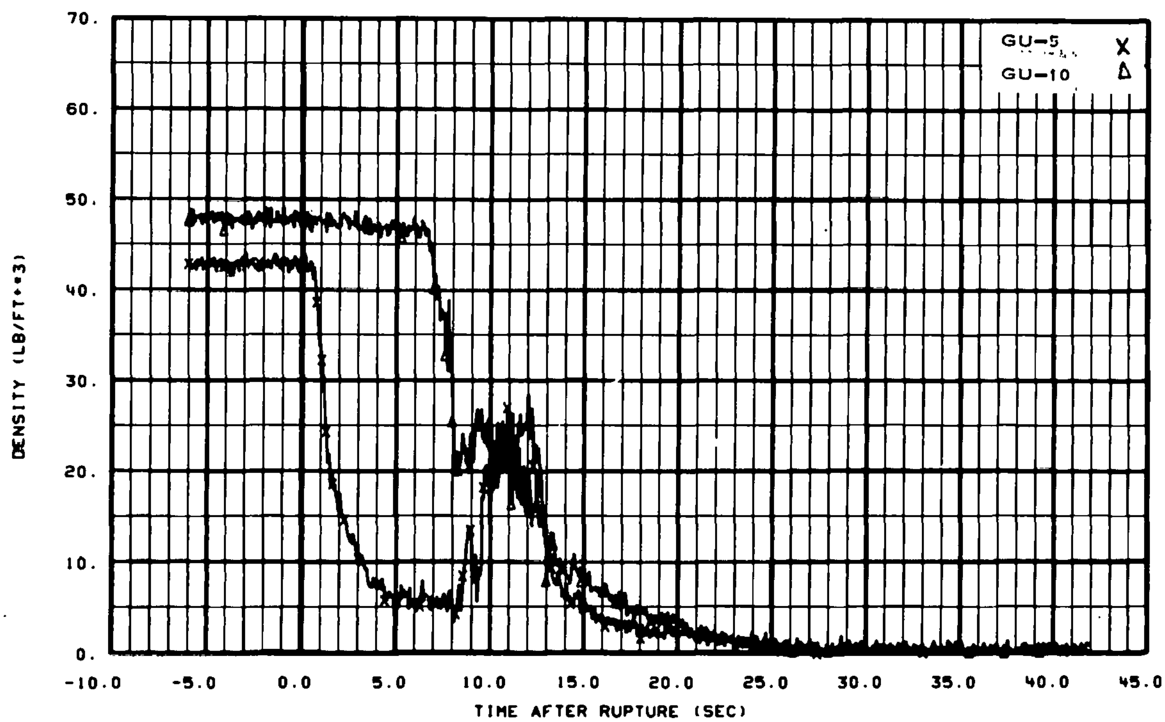

Fig. 114 Density in intact loop (GU-5, GU-10).

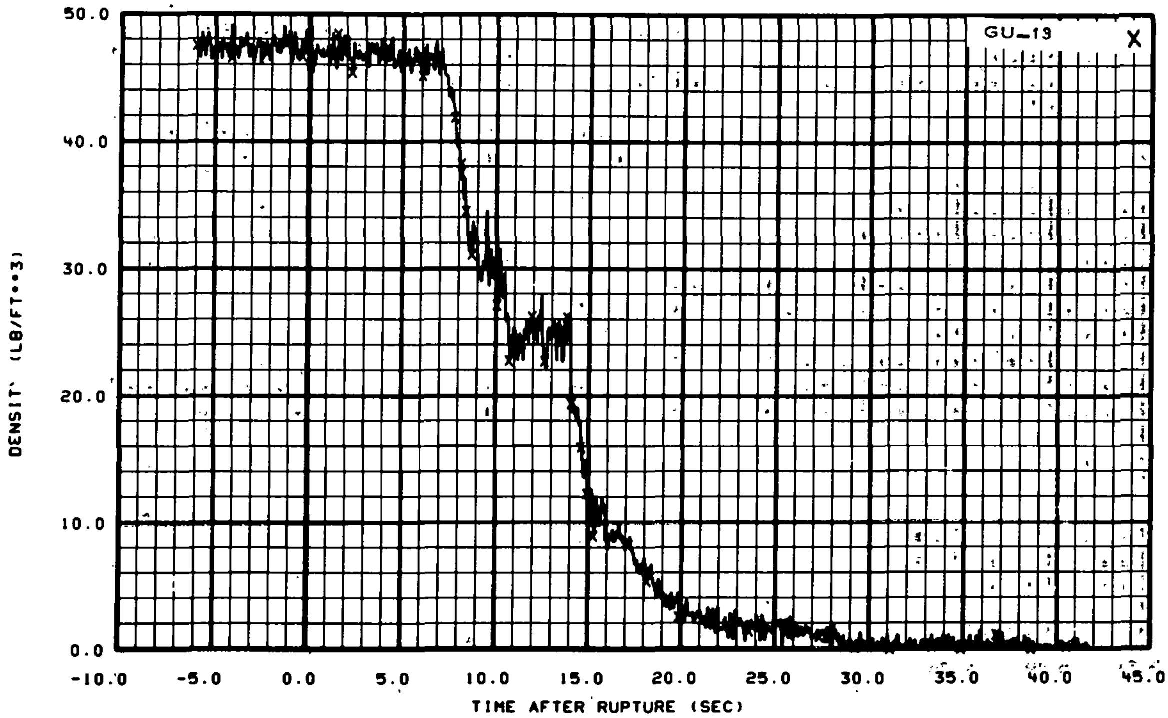

Fig. 115 Density in intact loop (GU-13).

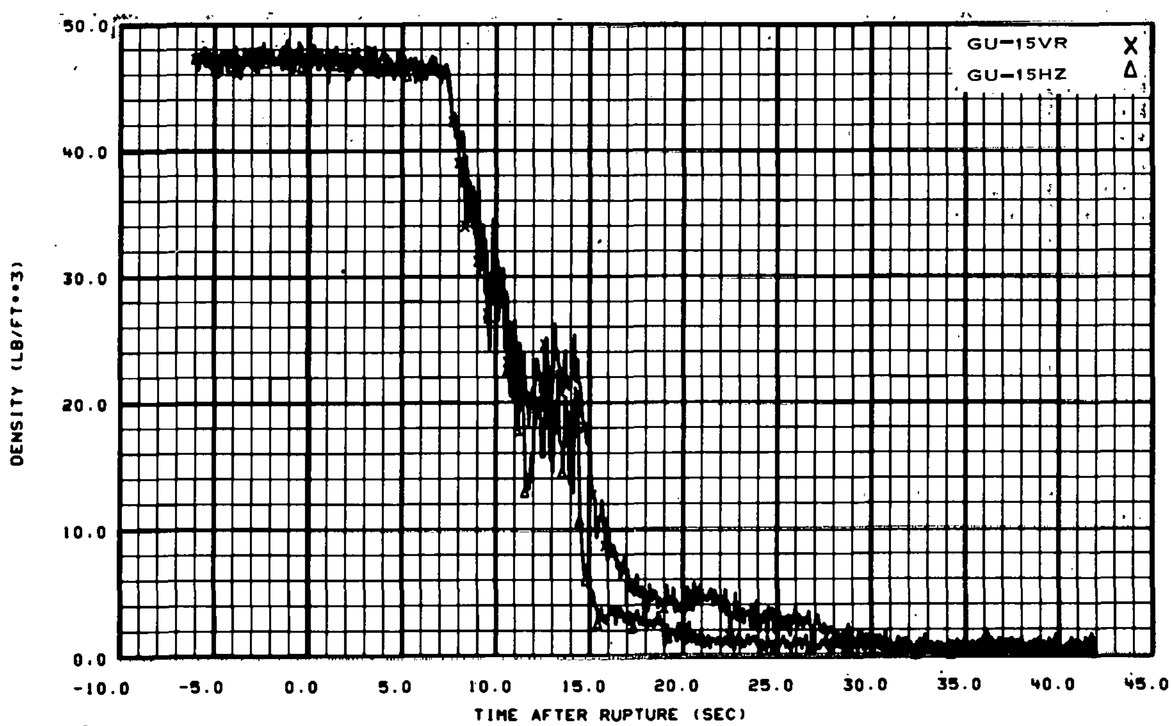

Fig. 116 Density in intact loop (GU-15VR, GU-15HZ).

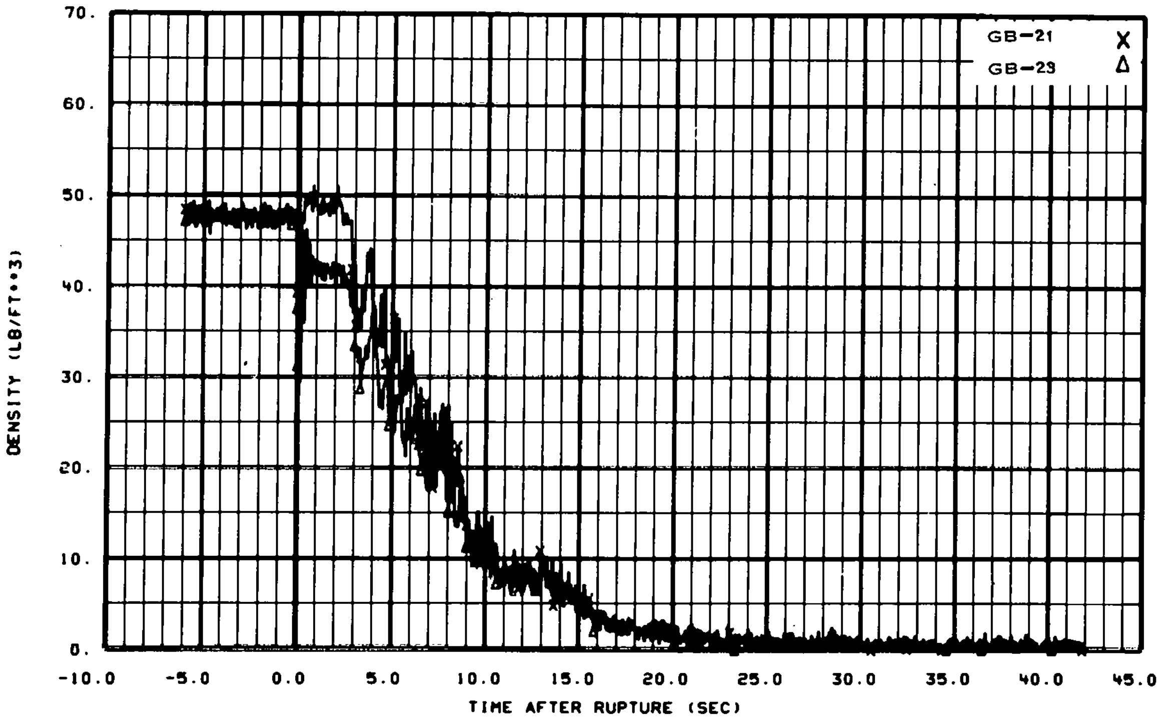

Fig. 117 Density in broken loop (GB-21, GB-23).

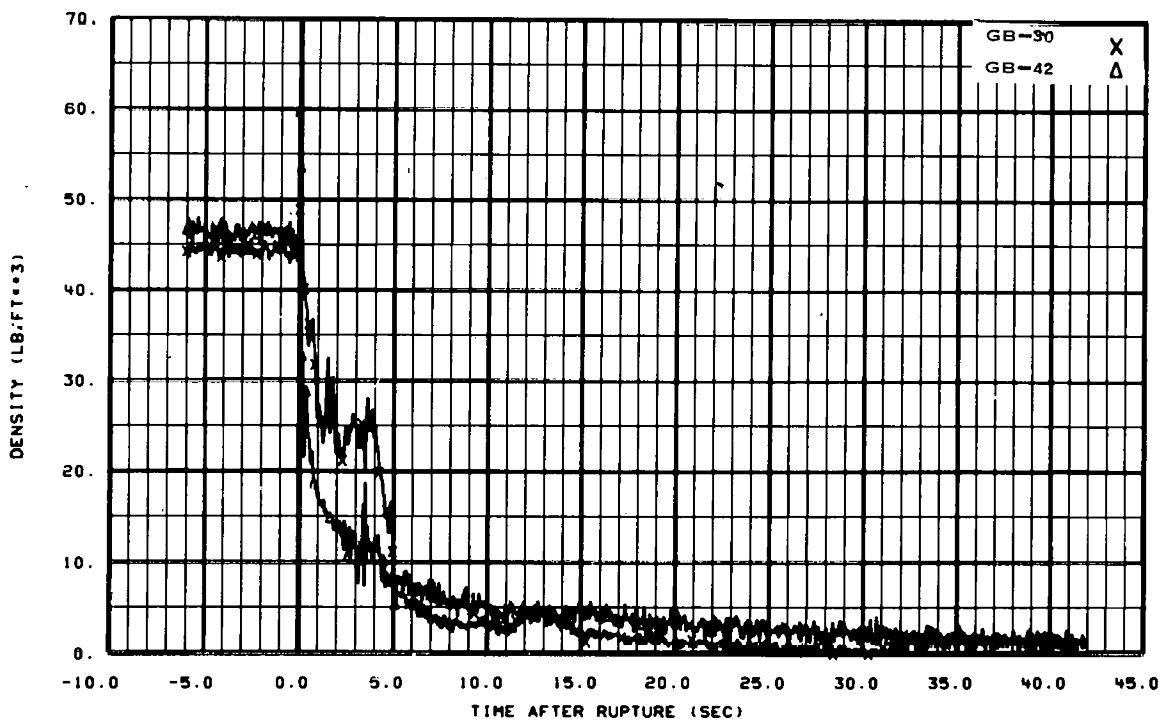

Fig. 118 Density in broken loop (GB-30, GB-42).

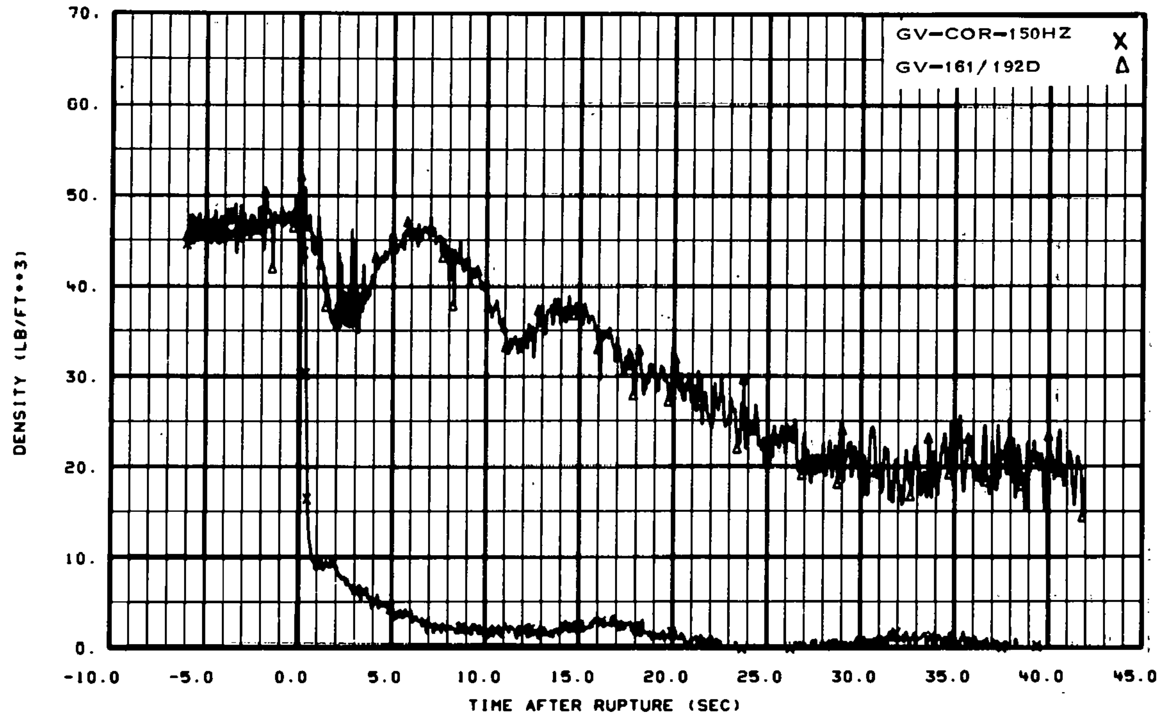

Fig. 119 Density in vessel (GV-COR-150HZ, GV-161/192).

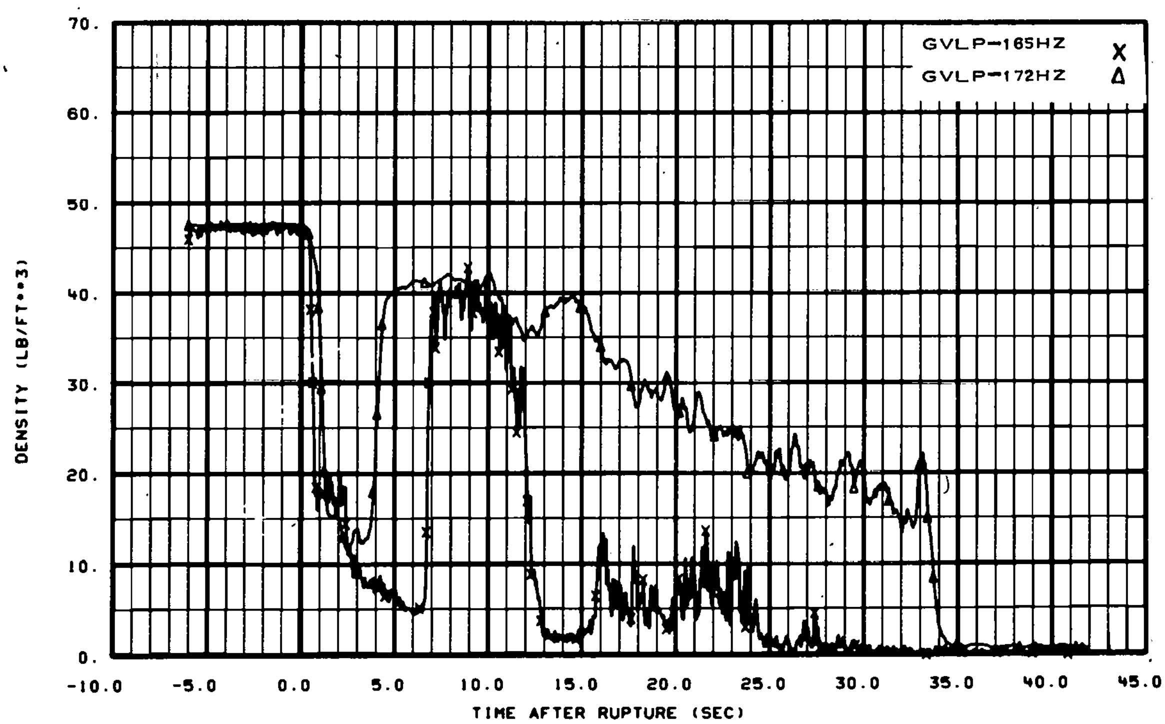

Fig. 120 Density in vessel (GVLP-165HZ, GVLP-172HZ).

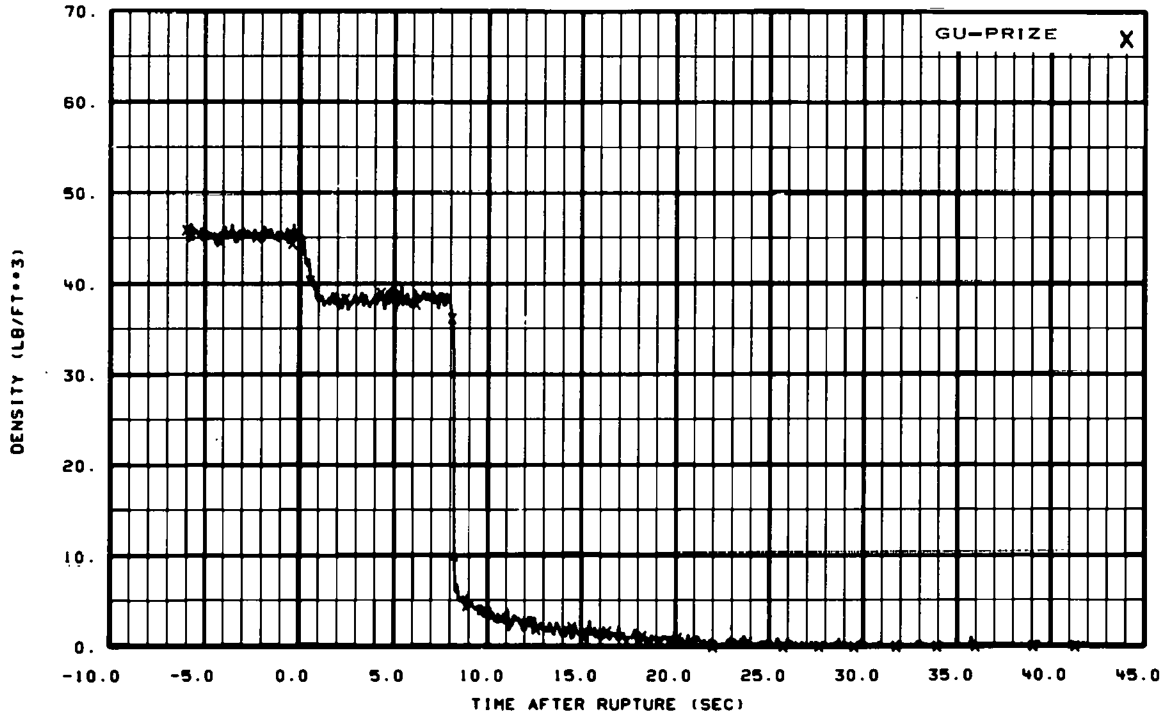

Fig. 121 Density in pressurizer.

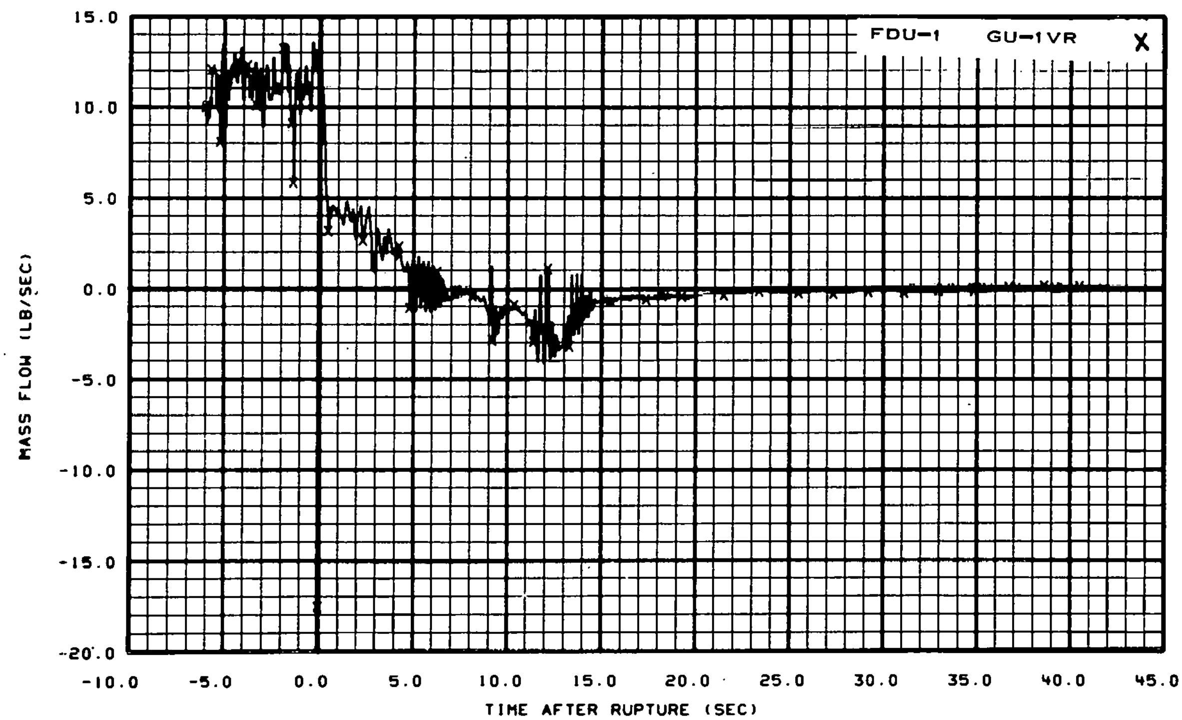

Fig. 122 Mass flow in intact loop (FDU-1 and GU-1VR).

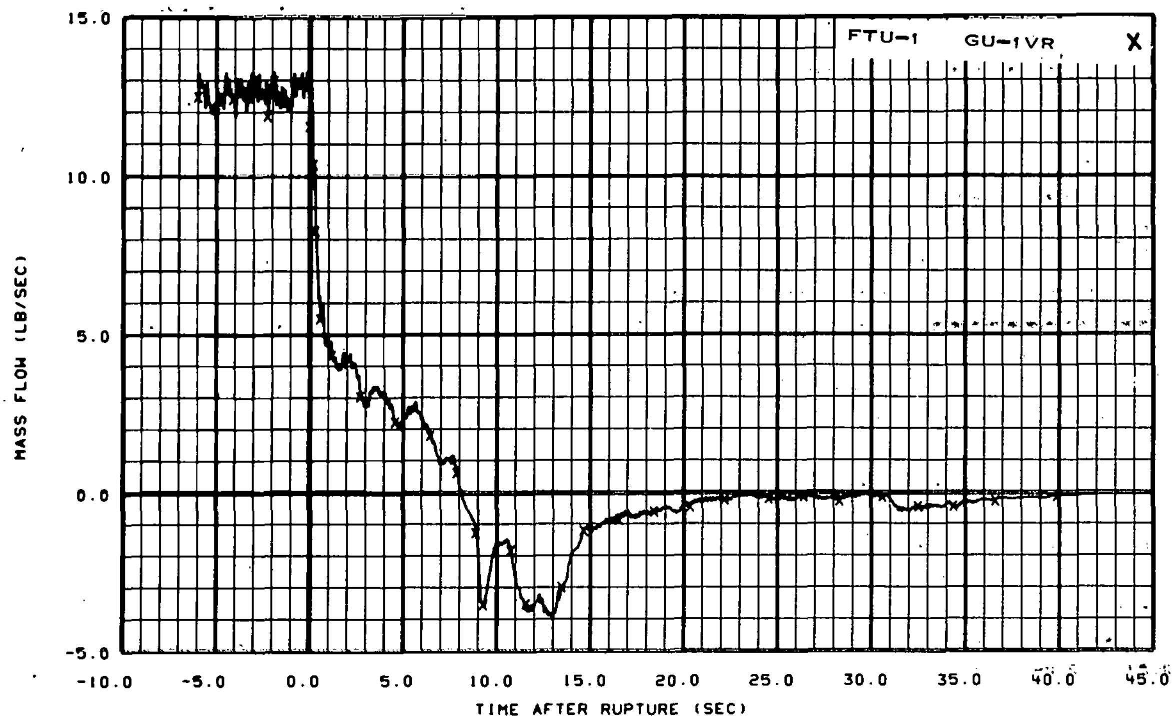

Fig. 123 Mass flow in intact loop (FTU-1 and GU-1VR).

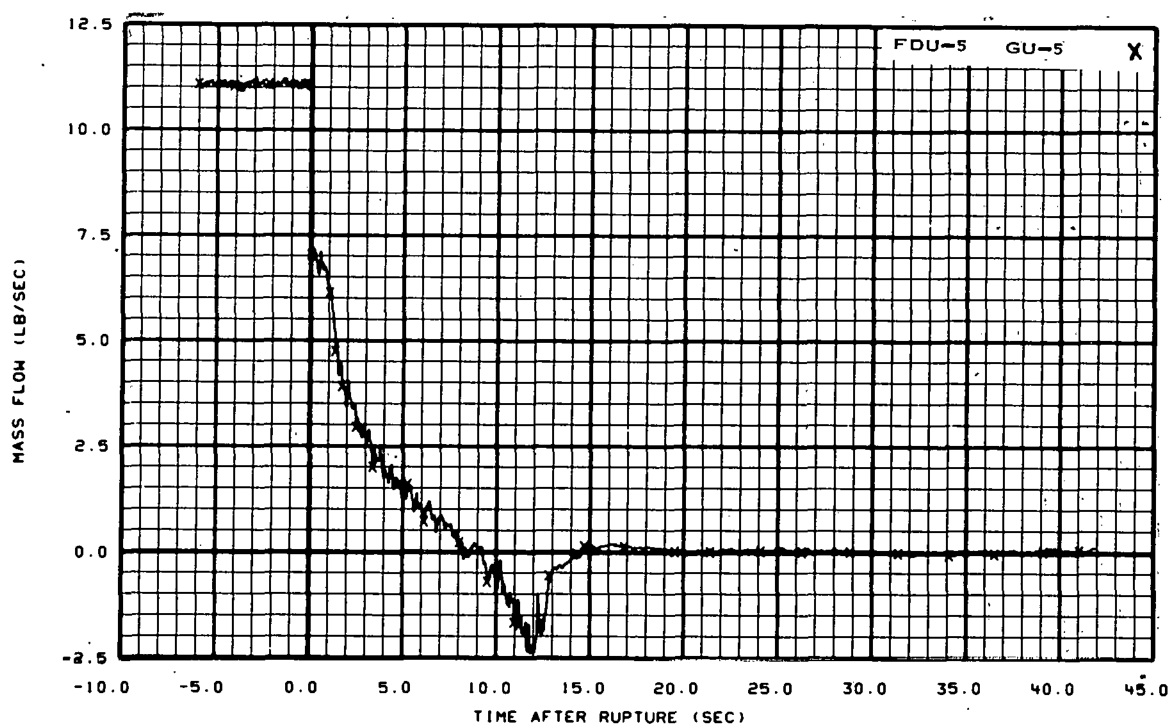

Fig. 124 Mass flow in intact loop (FDU-5 and GU-5).

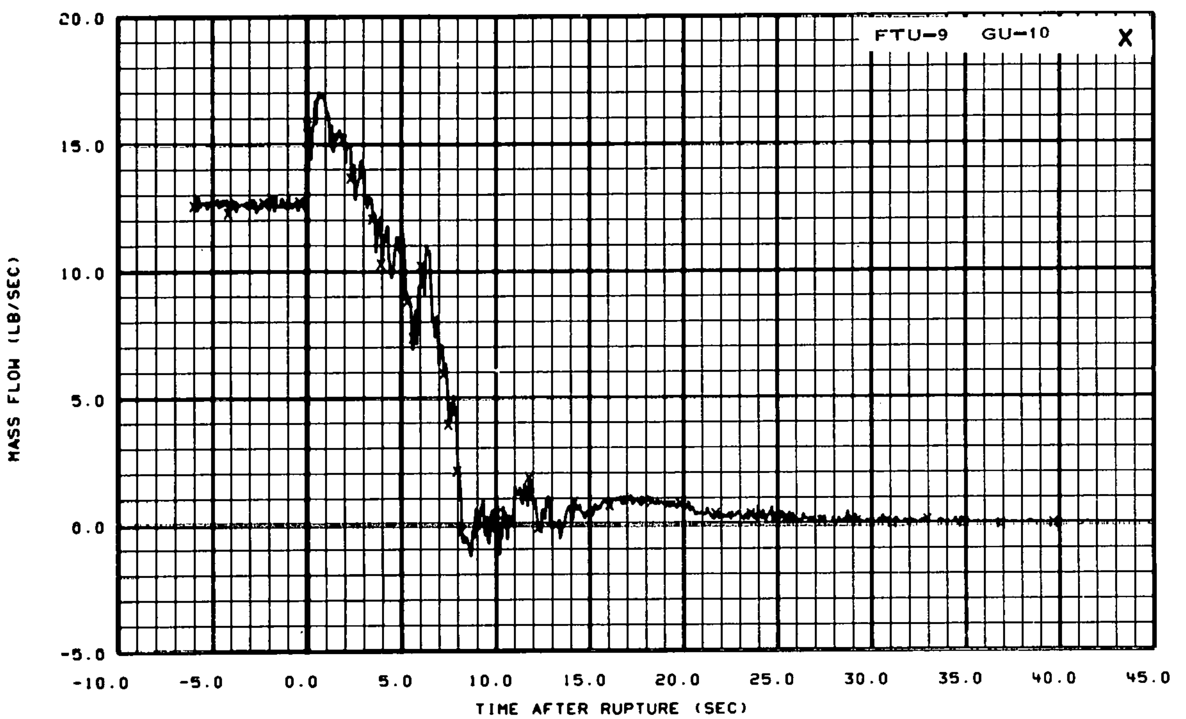

Fig. 125 Mass flow in intact loop (FTU-9 and GU-10).

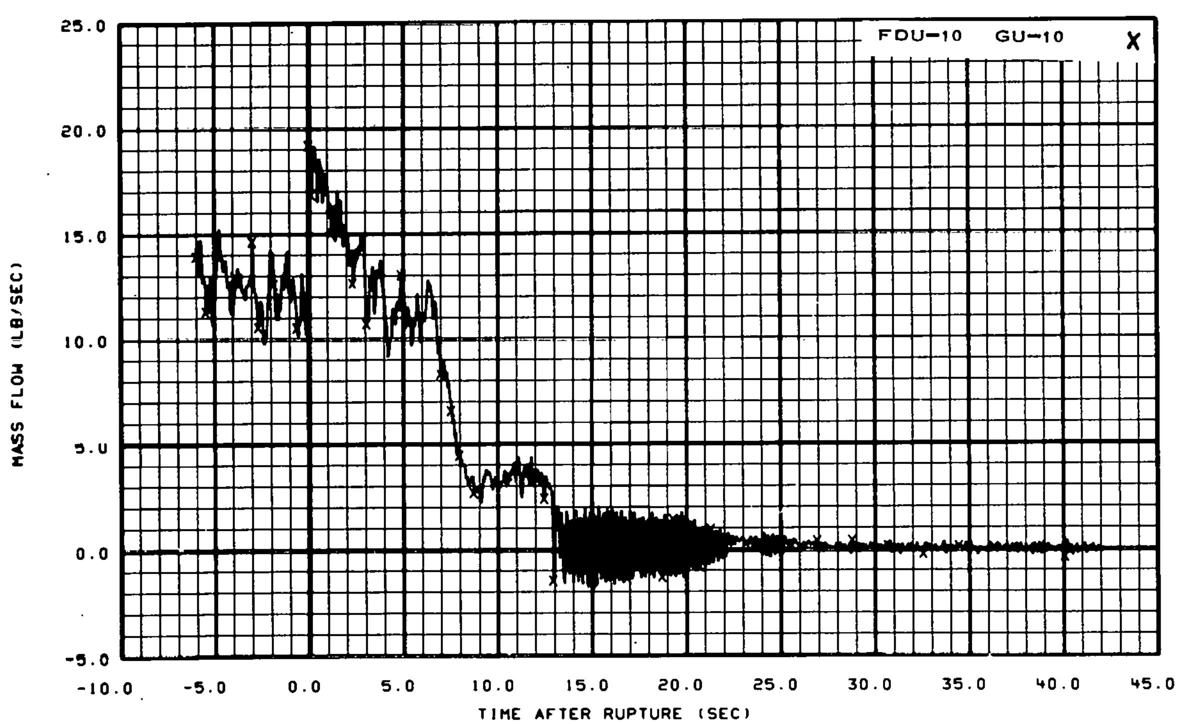

Fig. 126 Mass flow in intact loop (FDU-10 and GU-10).

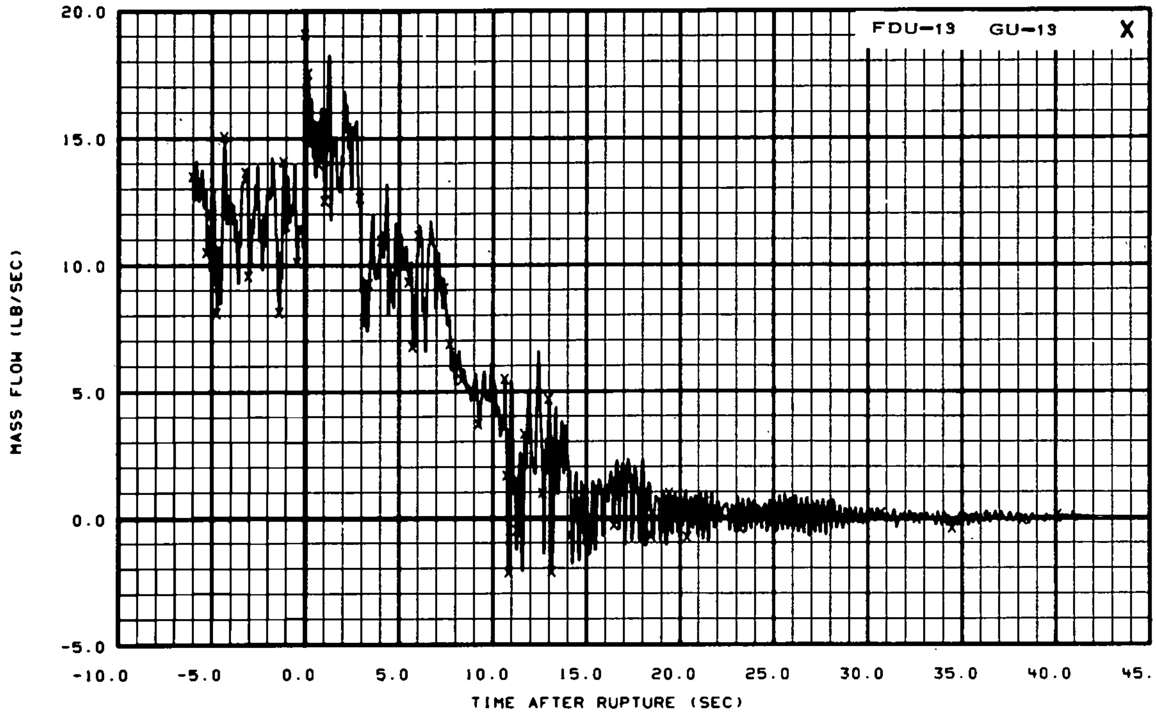

Fig. 127 Mass flow in intact loop (FDU-13 and GU-13).

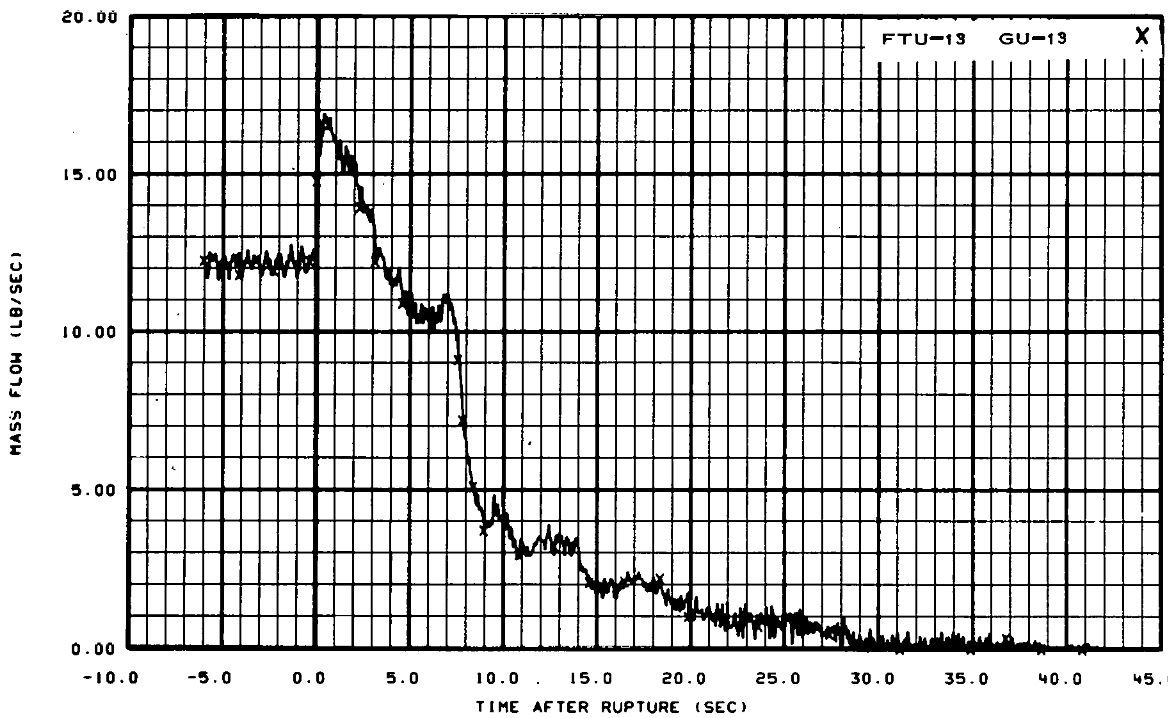

Fig. 128 Mass flow in intact loop (FTU-13 and GU-13).

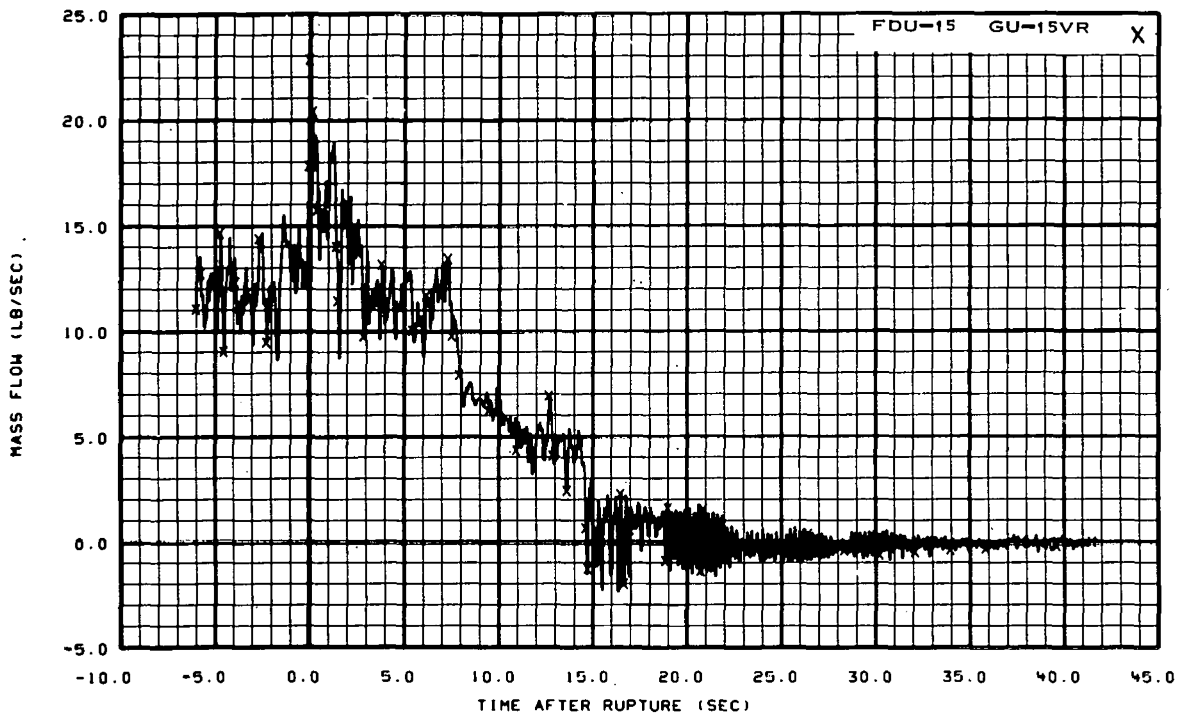

Fig. 129 Mass flow in intact loop (FDU-15 and GU-15VR).

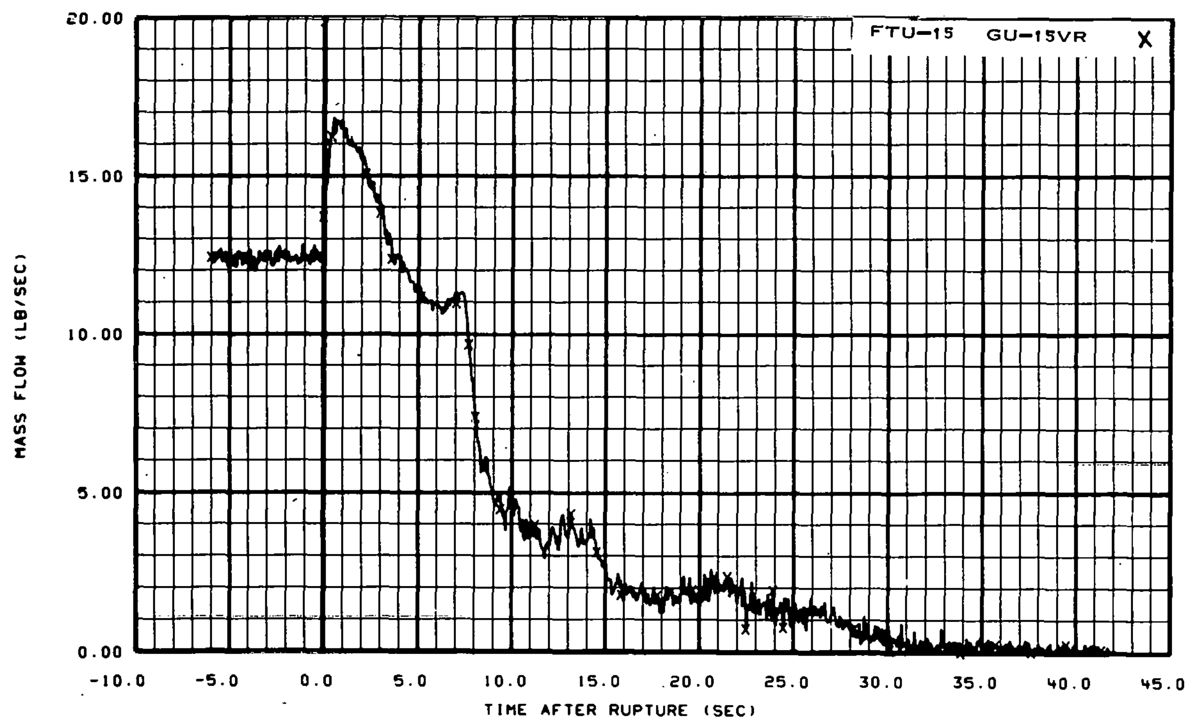

Fig. 130 Mass flow in intact loop (FTU-15 and GU-15VR).

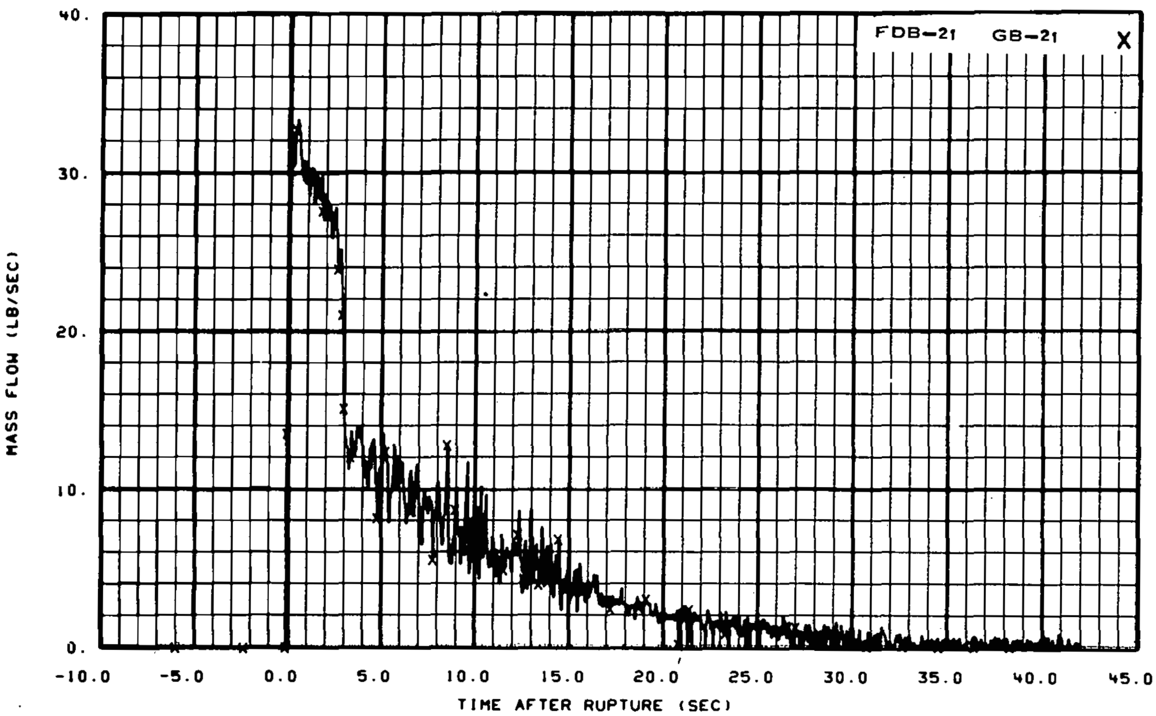

Fig. 131 Mass flow in broken loop (FDB-21 and GB-21).

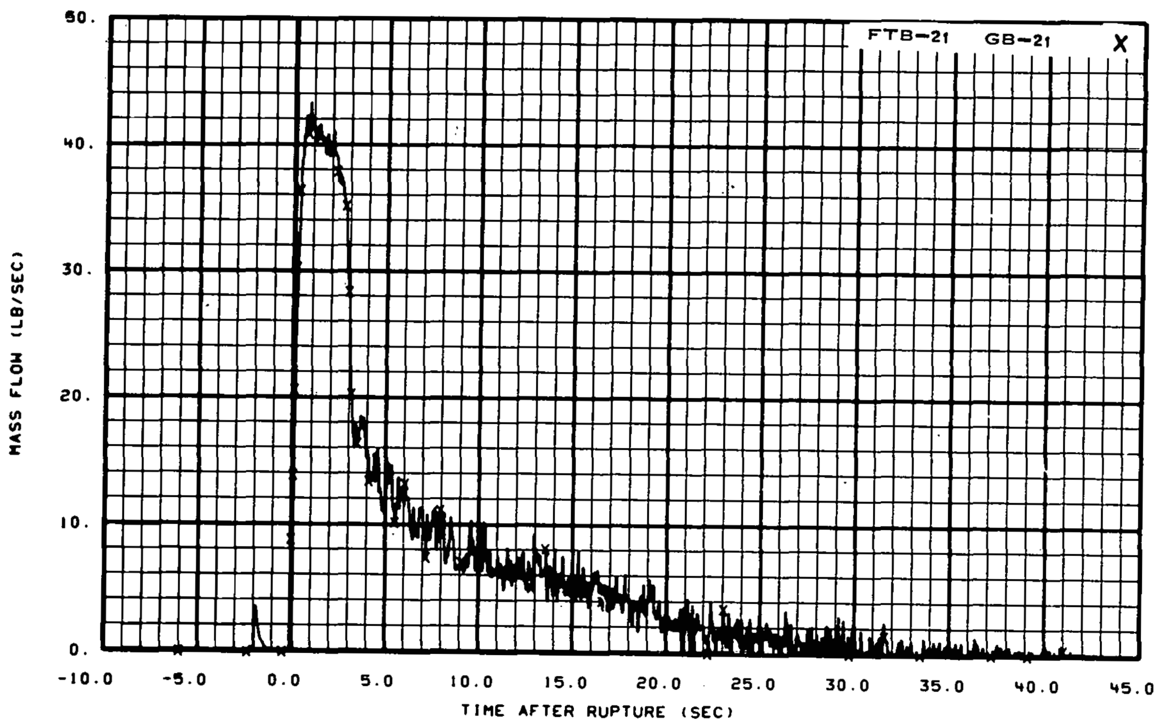

Fig. 132 Mass flow in broken loop (FTB-21 and GB-21).

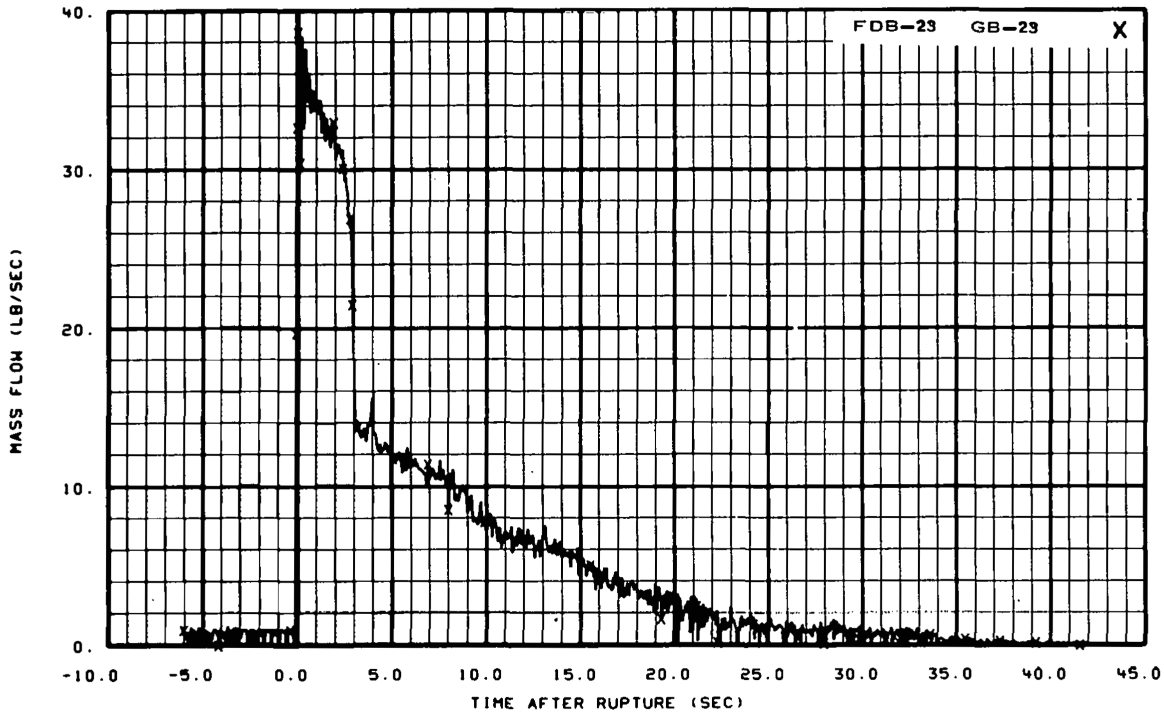

Fig. 133 Mass flow in broken loop (FDB-23 and GB-23).

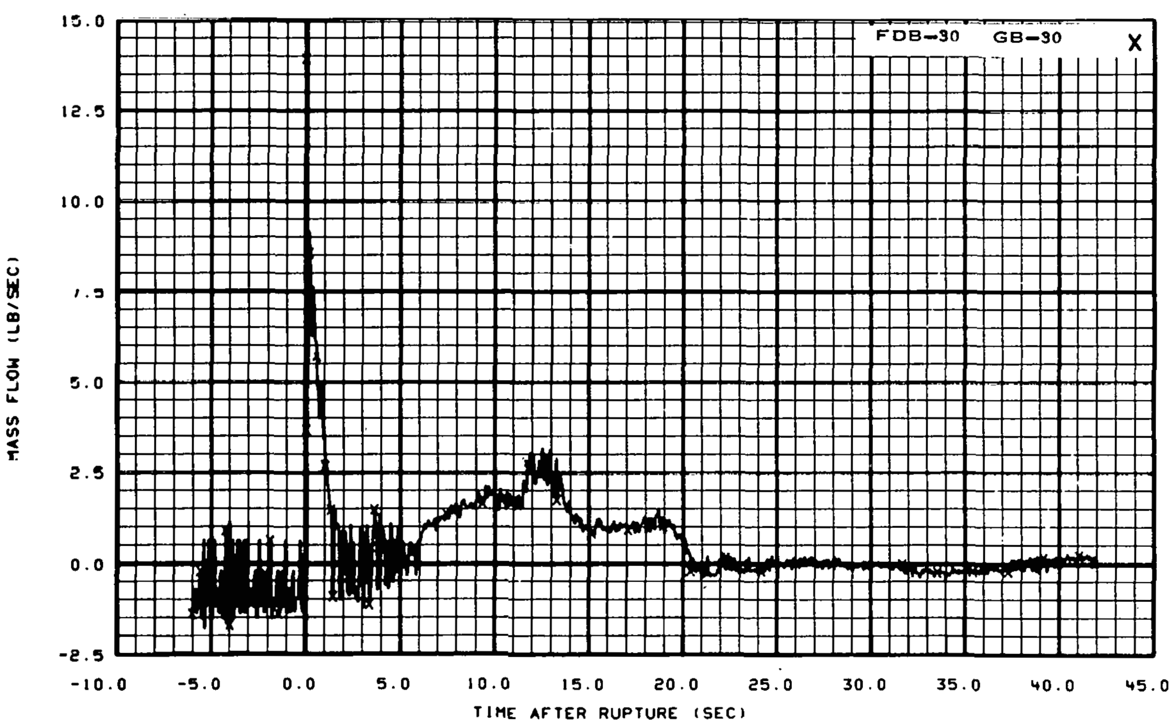

Fig. 134 Mass flow in broken loop (FDB-30 and GB-30).

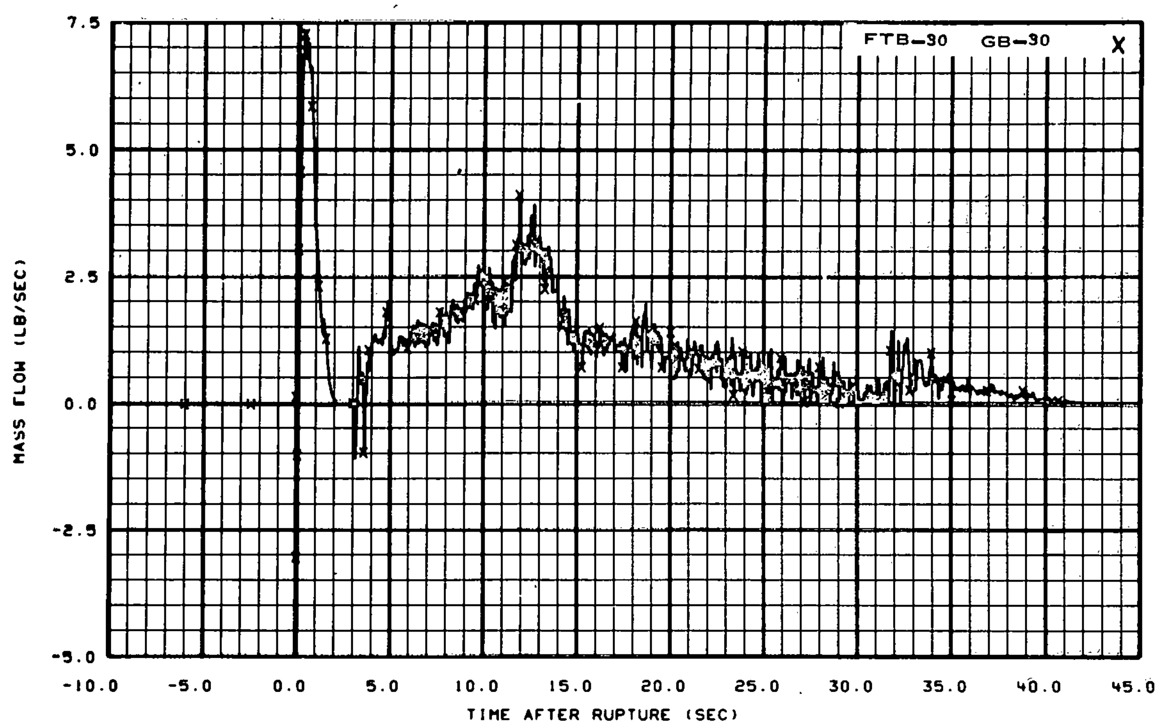

Fig. 135 Mass flow in broken loop (FTB-30 and GB-30).

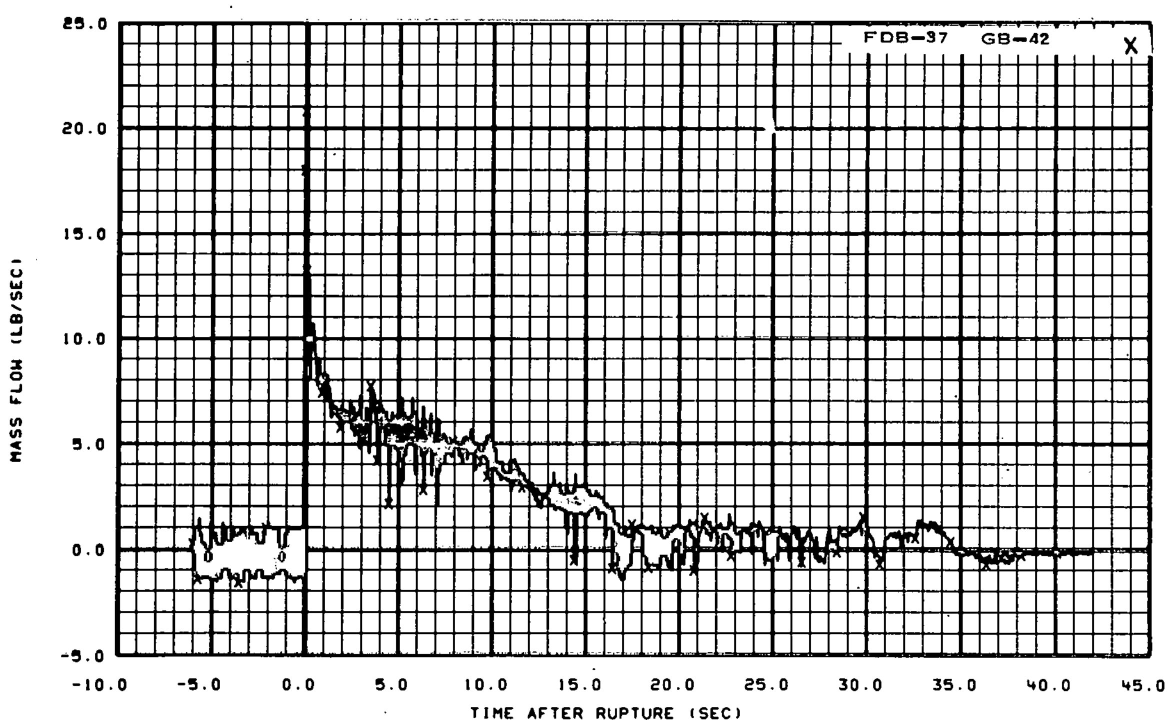

Fig. 136 Mass flow in broken loop (FDB-37 and GB-42).

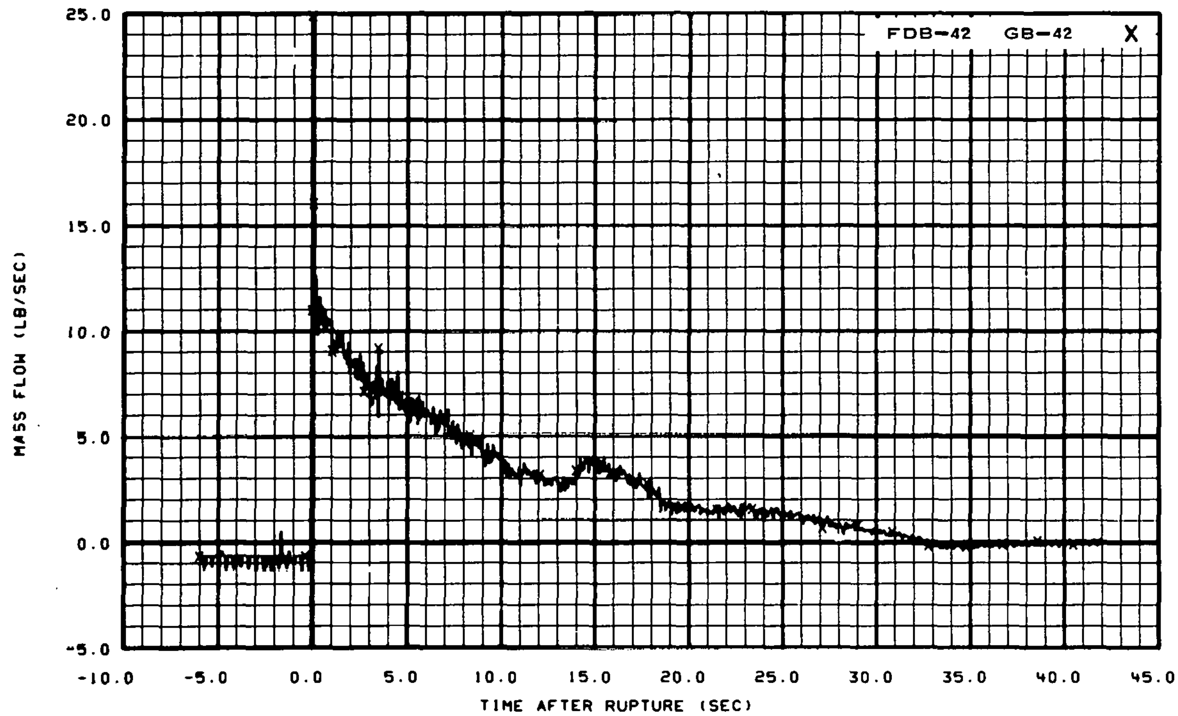

Fig. 137 Mass flow in broken loop (FDB-42 and GB-42).

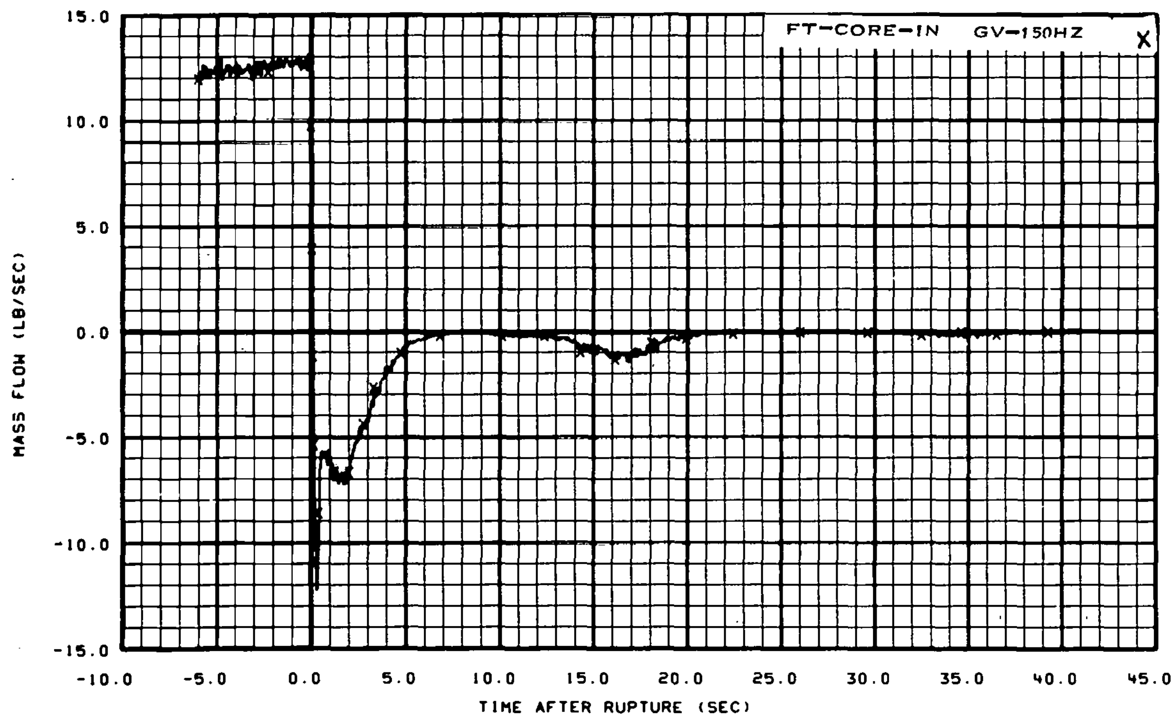

Fig. 138 Mass flow in vessel (FTV-CORE-IN and GV-COR-150HZ).

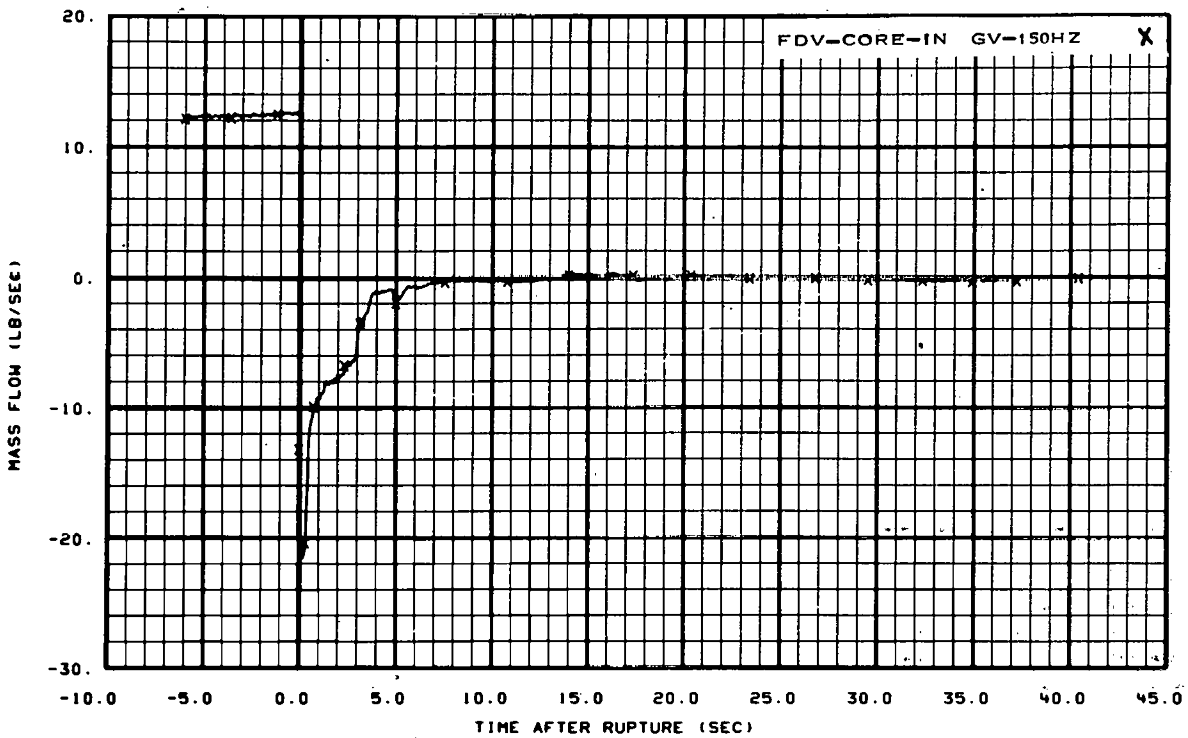

Fig. 139 Mass flow in vessel (FDV-CORE-IN and GV-COR-150HZ).

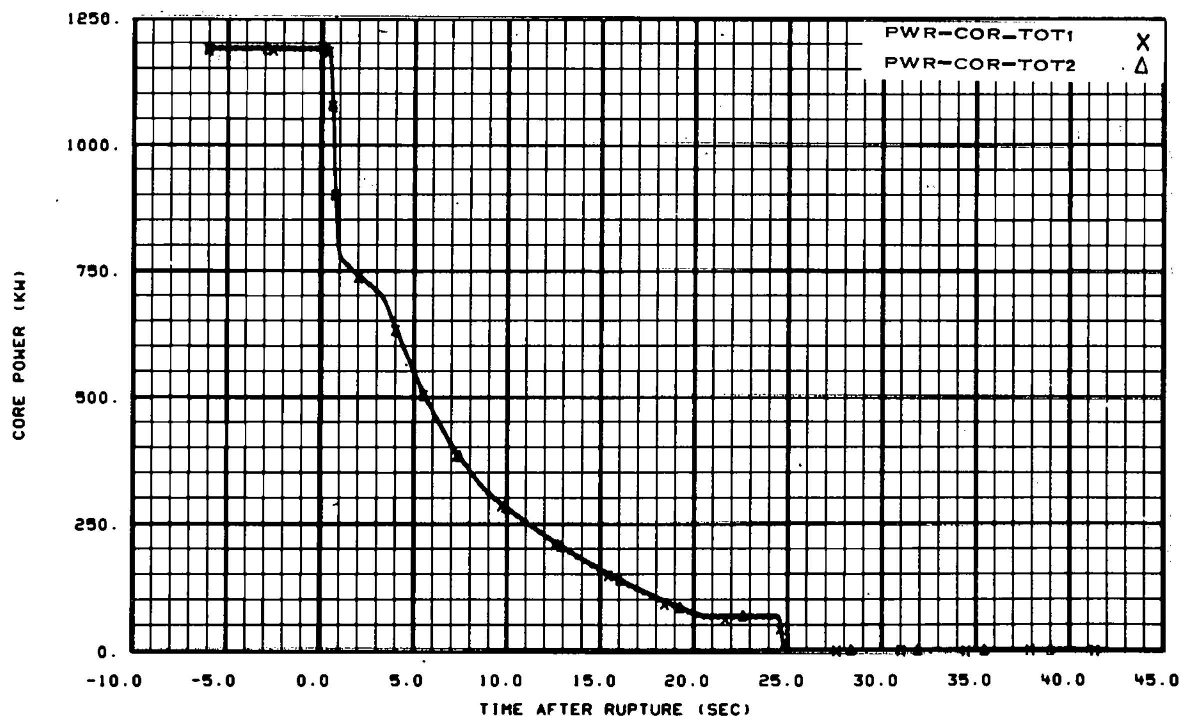

Fig. 140 Core heater pin total power.

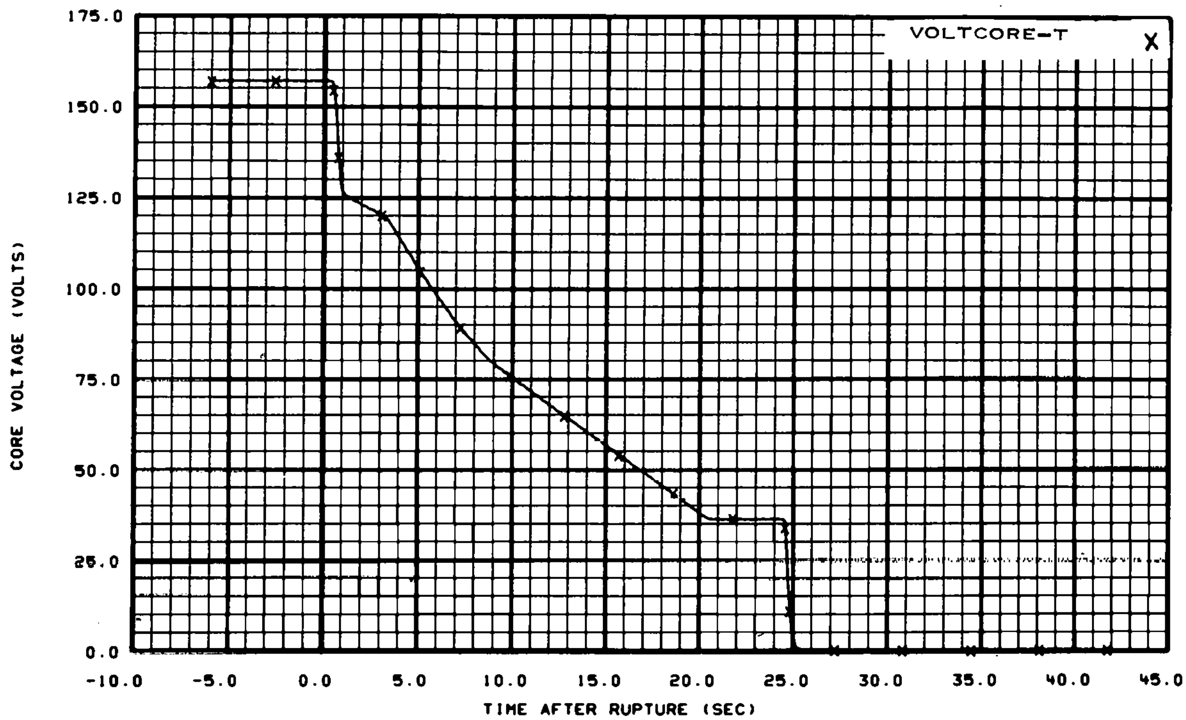

Fig. 141 Core heater voltage.

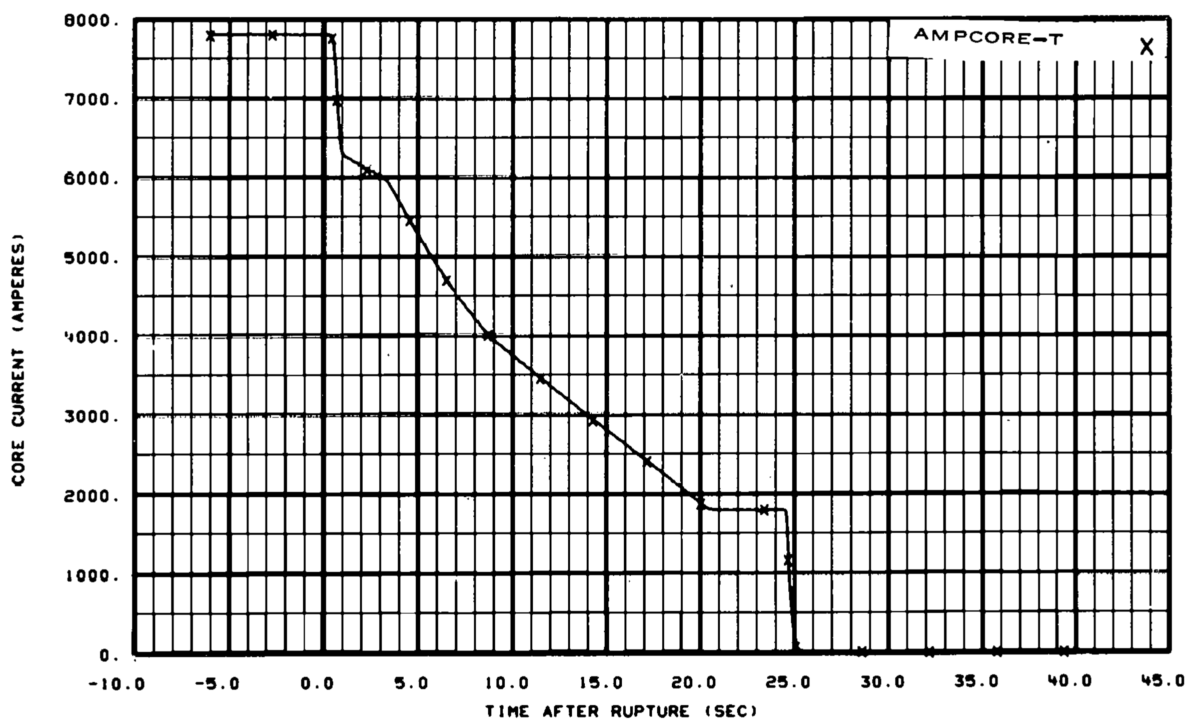

Fig. 142 Core heater total current.

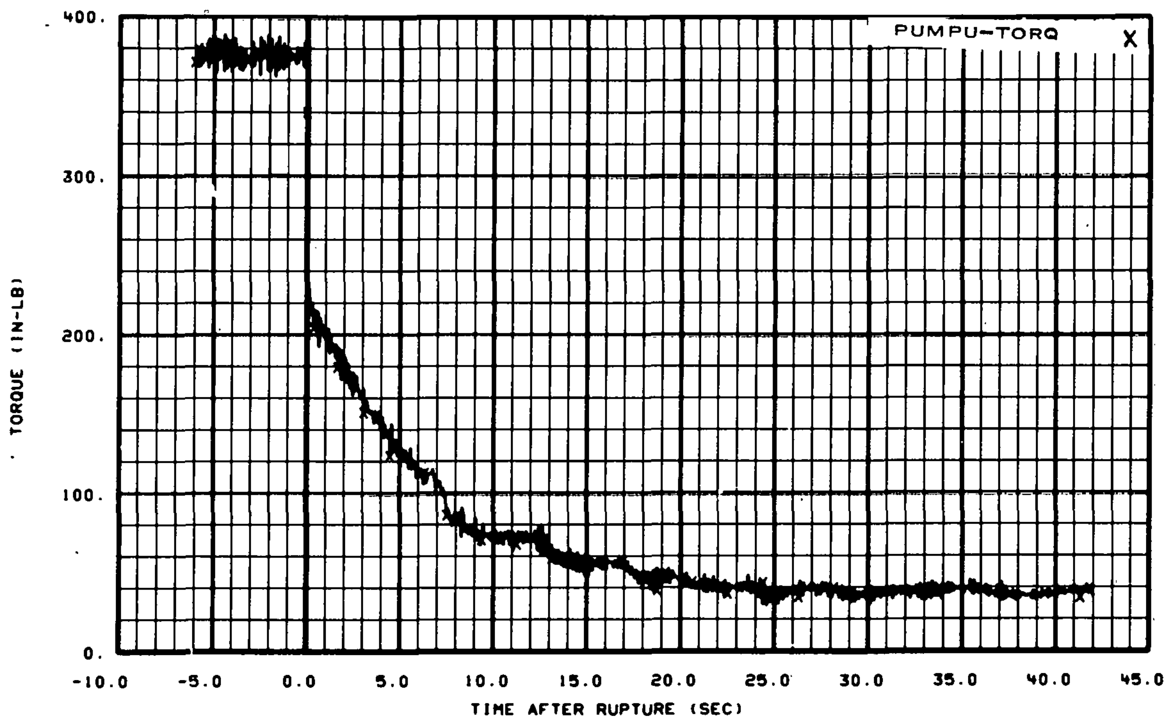

Fig. 143 Primary pump torque.

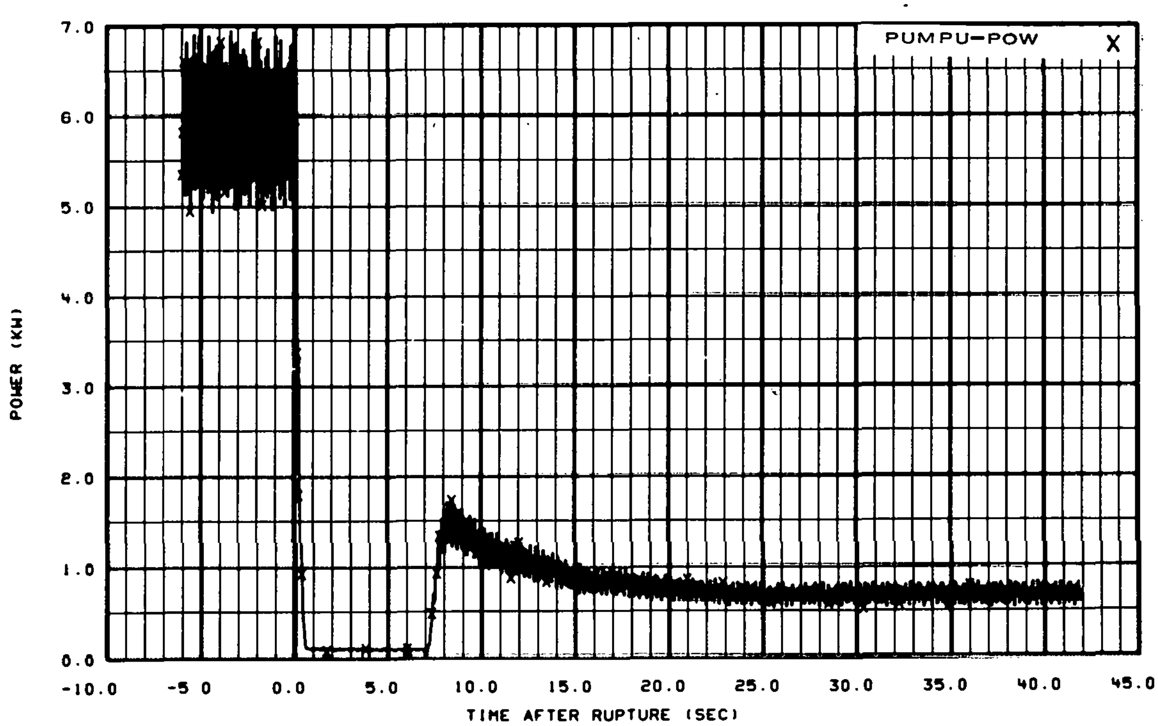

Fig. 144 Primary pump power.

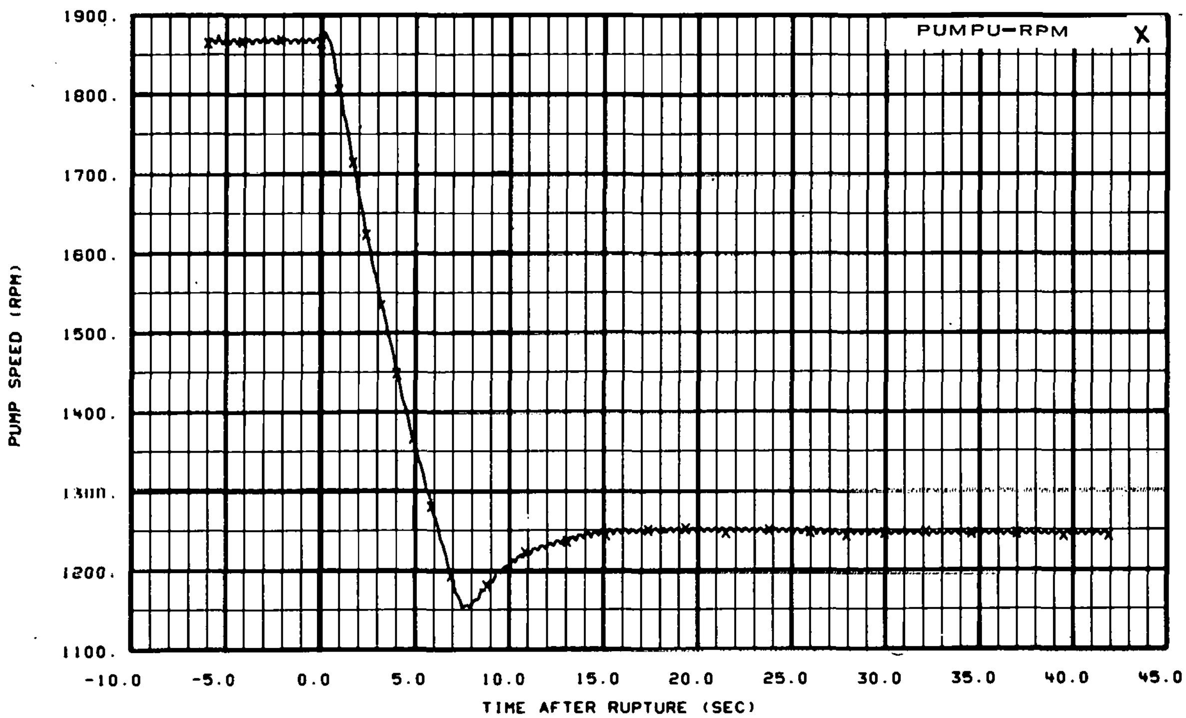

Fig. 145 Primary pump speed.

IV. REFERENCE

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

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