TREE-NUREG-1050
for U.S. Nuclear Regulatory Commission

EXPERIMENT DATA REPORT FOR SEMISCALE MOD-1 TEST S-05-1 (ALTERNATE ECC INJECTION TEST)

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February 1977

EG&G Idaho, Inc.

IDAHO NATIONAL ENGINEERING LABORATORY

ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

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

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Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22161
Price: Printed Copy $7.75; Microfiche $3.00

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(ALTERNATE ECC INJECTION TEST)

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TREE-NUREG-1050

Distributed Under Category:
NRC-2
Water Reactor Safety Research
Systems Engineering

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(ALTERNATE ECC INJECTION TEST)

by

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EG&G IDAHO, INC.

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PREPARED FOR THE
U.S. NUCLEAR REGULATORY COMMISSION
AND
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
IDAHO OPERATIONS OFFICE
UNDER CONTRACT NO. EY-76-C-07-1570

ABSTRACT

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

Test S-05-1 was conducted from initial conditions of 2263 psia and 544°F to investigate the response of the Semiscale Mod-1 system to a depressurization and reflood transient following a simulated double-ended offset shear of the cold leg broken loop piping. During the test, cooling water was injected into the vessel lower plenum to simulate emergency core coolant injection in a PWR, with the flow rate based on system volume scaling.

The purpose of this report is to make available the uninterpreted data from Test S-05-1 for future data analysis and test results reporting activities. The data, presented in the form of graphs in engineering units, have been analyzed only to the extent necessary to assure that they are reasonable and consistent.

SUMMARY

Test S-05-1 was performed as part of the Semiscale Mod-1 portion of the Semiscale Program conducted by EG&G Idaho, Inc., for the United States Government. This test was part of the alternate ECC injection test series (Test Series 5) performed to investigate the response of the Mod-1 system to specific variations in coolant injection location. The test objective specific to Test S-05-1 was to provide data which can be used to assess the influence of lower plenum injection on the core and system response. 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) with subsequent refill and reflood.

Test S-05-1 utilized the Semiscale Mod-1 system equipped with a pressure vessel with a 40-rod electrically heated core; 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, pressure suppression tank, and a heated steam supply system. High and low pressure coolant injection pumps and a coolant injection accumulator were provided for the vessel lower plenum only. The vessel lower plenum volume, coolant flow rate, and total accumulator nitrogen flow were volumetrically scaled to that of a PWR. In addition, for Test S-05-1, four heater rods were intentionally unpowered to simulate the effects of control rod guide tubes and the power in three heater rods was increased to produce a slightly peaked profile.

The test was conducted from initial conditions of 2263 psia and 544°F (at the intact loop cold leg vessel inlet) with a simulated full size (200%) double-ended offset shear of the cold leg broken loop piping at an initial core power level of 1.49 MW, and an initial core inlet flow rate of 143 gpm. The instantaneous offset shear of the broken loop cold leg piping was simulated by simultaneous (within 10 msec) actuation of the rupture assemblies. After initiation of blowdown, power to the heated core was reduced to simulate the predicted heat flux response of nuclear fuel rods during a LOCA. Blowdown was accompanied by simulated emergency core coolant injected directly into the vessel lower plenum.

Test S-05-1 was generally conducted as specified. Conditions which did not conform to the specified test configuration were considered acceptable for analysis purposes within the test objectives. The instrumentation used generally functioned as intended. Of 213 measurements taken, 210 produced usable data.

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EXPERIMENT DATA REPORT FOR SEMISCALE MOD-1

TEST S-05-1

(ALTERNATE ECC INJECTION TEST)

I. INTRODUCTION

The Semiscale Mod-1 experiments represent the current phase of the Semiscale Program conducted by EG&G Idaho, Inc.,[a] for the United States Government. The program, which is sponsored by the Nuclear Regulatory Commission through the Energy Research and Development Administration, is part of the overall program designed to investigate the response of a pressurized water reactor 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-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-05-1 was conducted September 28, 1976 in the Semiscale Mod-1 system as part of the alternate ECC injection test series, which was designed to obtain thermal-hydraulic response data from blowdown, refill, and reflood transients in a simulated nuclear reactor with a heated core, to study system response to change in ECC injection location.

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-05-1; 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.

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[a] Test S-05-1 was conducted by Aerojet Nuclear Company under Contract No. E(10-1)-1375. As of October 1, 1976, the Semiscale Program is being conducted by EG&G Idaho, Inc.

II. SYSTEM, PROCEDURES, CONDITIONS, AND EVENTS FOR TEST S-05-1

The following system configuration, procedures, initial test conditions, and events are specific to Test S-05-1 as indicated.

1. SYSTEM CONFIGURATION AND TEST PROCEDURES

The Semiscale Mod-1 system used for this test consisted of a pressure vessel with internals, including a 40-rod core with 36 electrically heated rods; an intact loop with steam generator, pump, and pressurizer; a broken loop with simulated steam generator, simulated pump, and two rupture assemblies; a coolant injection accumulator for the vessel lower plenum; high and low pressure injection pumps for the vessel lower plenum; and a pressure suppression system with a suppression tank, header, and a heated steam supply system. For Test S-05-1, the volume of the lower plenum was reduced to 0.529 ft^3 by the addition of a metal filled piece. System configuration information is provided in Reference 1. Figures 1 and 2 provide the system configuration for Test S-05-1.

For Test S-05-1, 33 rods of the 40-rod electrically heated core were operated at a peak power density of approximately 11.5 kW/ft, three rods (Rods D-4, E-4, and E-5) were operated at a peak power density of 12.1 kW/ft to yield a slightly peaked power profile, and four rods (Rods C-3, D-5, F-3, and F-6) were unpowered to simulate the effect of control rod guide tubes. The resulting total core power was approximately 1.49 MW.

In preparation for the test, the vessel accumulator was filled with treated demineralized water, drained to the specified initial level, and pressurized with nitrogen to 600 psig. 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, system instrumentation was checked, and transducer readings were initialized. Warmup to initial test conditions was accomplished with the heaters in the vessel core. Heatup of the broken loop piping was accomplished with bypass lines which served to allow circulation through the broken loop. During warmup, the purification and sampling systems were valved into the primary system to maintain water chemistry requirements and to provide a water sample at system conditions for subsequent analysis. At 100°F temperature intervals during warmup, detector readings were sampled to allow the integrity of the measurement instrumentation and the operability of the data acquisition system to be checked.

Prior to establishing the initial core power level, the pressure suppression system was pressurized to 35 psia with saturated steam from the steam supply system. After the core power was increased to 1.49 MW, initial test conditions were held for 6 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.

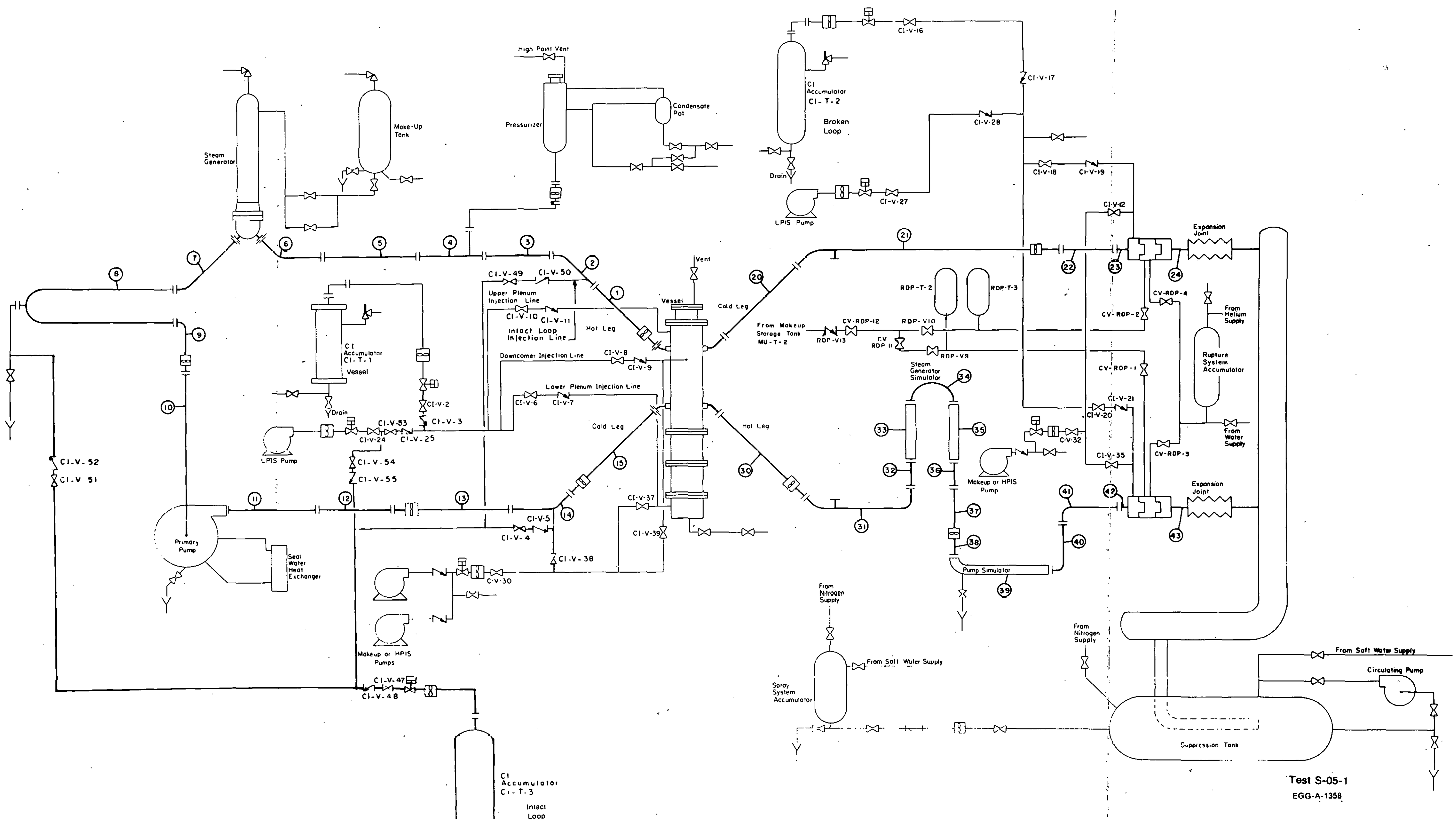

Fig. 1 Semiscale Mod-1 system for cold leg break configuration -- schematic.

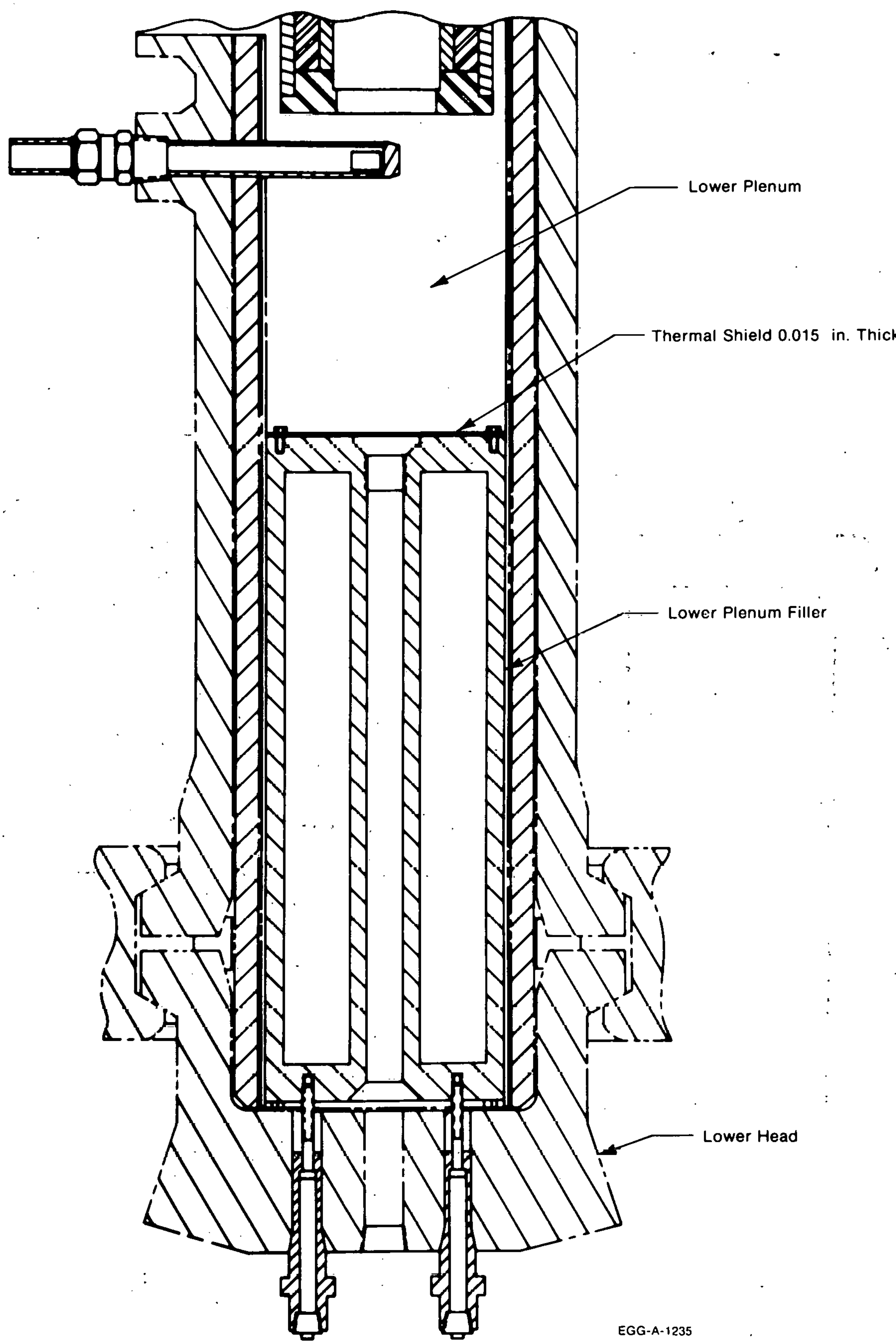

Fig. 2 Cross section of vessel with lower plenum filler.

The system was successfully subjected to a simulated double-ended cold leg break through two rupture assemblies and two blowdown nozzles, each 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 2250 psig with gaseous nitrogen. Immediately (within 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 which was vented to maintain a constant pressure of 35 psia. At blowdown, power to the primary coolant circulation pump was reduced and the pump was allowed to coast down to a speed of 1520 rpm which was maintained for the duration of the test. During the blowdown transient, power to the electrically heated core was automatically controlled to simulate the thermal response of nuclear heated fuel rods.

For Test S-05-1, the coolant injection systems were arranged to discharge only into the lower plenum. Coolant injection started immediately after initiation of blowdown with manual activation of the high pressure injection pump. Coolant injection was then initiated from the vessel accumulator after the system was depressurized to 600 psig. At 150 psig the low pressure injection pump was also started. Coolant injection was continued until the test was terminated at 300 seconds after initiation of blowdown.

2. INITIAL TEST CONDITIONS AND SEQUENCE OF EVENTS

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

TABLE I

CONDITIONS AT BLOWDOWN INITIATION

	Test S-05-1	
	Measured[a]	Specified
Core power (MW)	1.486	1.444 ± 0.03
Intact loop cold leg fluid temperature (°F)	544	544 ± 2
Hot leg to cold leg temperature differential (°F)	65	66 ± 1
Pressurizer pressure (psia)	2263	2263 ± 25
Pressurizer water level (in.)[b]	24.1[c]	27.1
Steam generator feedwater temperature (°F)	440	435 ± 10
Steam generator liquid level (from bottom of tube sheet) (in.)	116	116 ± 2
Fluid temperature in broken loop (pump side) (°F)	572	572
Fluid temperature in broken loop (vessel side) (°F)	540	Not Specified
Intact loop cold leg flow (gpm)	143	[d]
Pressure suppression tank water level (in.)	47.5	47.5 ± 0.5
Pressure suppression tank pressure (psia)	22.5	22.5 ± 1
Pressure suppression tank water temperature (°F)[e]	60	Ambient

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

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

[c] Level shown corresponds to a pressurizer system volume of 0.61 ft^3 (including surge line).

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

[e] Process instrumentation not used. Data taken from last digital scan 138 seconds prior to blowdown initiation.

TABLE II

PRIMARY COOLANT TEMPERATURE DISTRIBUTION PRIOR TO RUPTURE[a]

	Test S-05-1	
	Detector	Temperature (°F)
Vessel lower plenum (upper portion above filler block)	TFV-LP-7	546
Intact loop hot leg (near vessel)	RBU-2	609
Intact loop cold leg (near pump inlet)	TFU-10	541
Intact loop cold leg (near vessel)	RBU-14A	543
Broken loop cold leg (near nozzle)	TFB-23	540
Broken loop hot leg (near vessel)	TFB-30	604
Broken loop cold leg (near nozzle)	TFB-42	596

[a] Data taken from final digital scan 138 seconds before blowdown.

TABLE III

WATER CHEMISTRY PRIOR TO BLOWDOWN[a]

	Test S-05-1
pH	9.35
Conductivity (μmhos/cm)	113
Lithium (ppm)	6.0
Chlorides (ppm)	1.7
Fluorides (ppm)[b]	<0.4
Oxygen (ppm)	0.03
Total Gas (cc/l)	132
Suspended solids (ppm)	1.7

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

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

TABLE IV

SEQUENCE OF EVENTS DURING TEST[a]

Event	Time Relative To Rupture
Core power level established (min)	-6
Bypass lines valved out of system (sec)	-2.5
Blowdown initiated (sec)	0
Pump power reduced (sec)	0
High pressure injection system pumps started (sec)[b]	0
Steam generator feedwater and discharge valves closed (sec)	1
Core power decay transient started (sec)	2.7
ECC accumulators valved in (sec)	5
Low pressure injection system pumps started (sec)[b]	30
Core power tripped off (sec)[c]	300

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

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

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

III. DATA PRESENTATION

The data from Semiscale Mod-1 Test S-05-1 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-05-1 was monitored by 213 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 digital data were recorded at a sample rate of 57.5 points per second. Long term plots (-20 to 300 seconds) were compressed at a 20 to 1 ratio giving an effective sample rate of 2.875 points per second. Short term plots (-6 to 42 seconds) were compressed at a 3 to 1 ratio giving an effective sample rate of 19.17 points per second. 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 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 1.)

Figures 3 through 8 and Table V provide supporting information for interpretation of the data graphs shown in Figures 9 through 300, and provide relative locations of all detectors used during Test S-05-1. Table V groups the measurements according to measurement type; identifies and specific measurement location and 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 9 through 300 present all the blowdown and reflood data obtained. Time zero on the graphs is the time of rupture initiation. Appendix A provides information explaining posttest data processing for data conversion into engineering units and data adjustments.

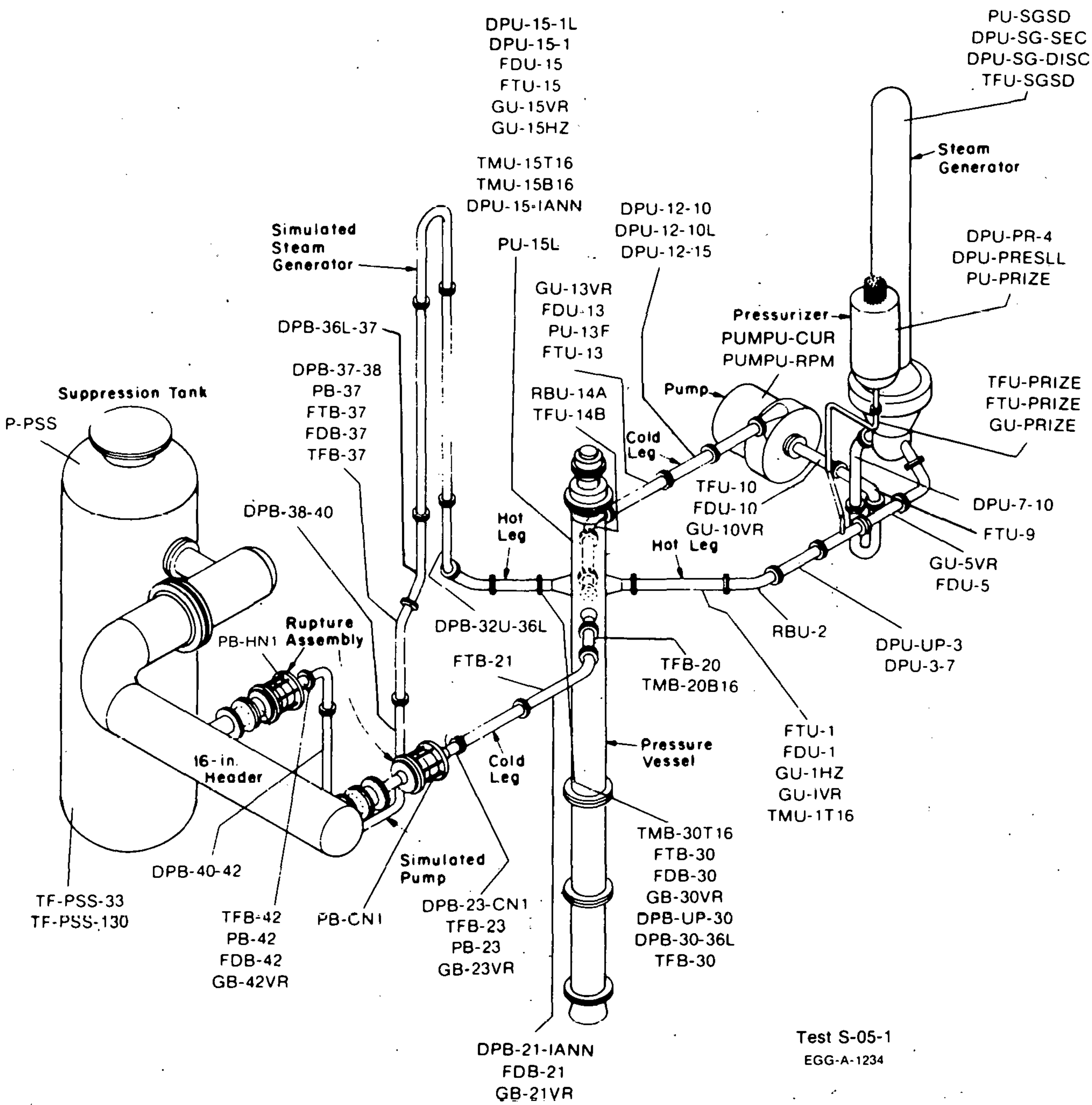

Fig. 3 Semiscale Mod-1 system and instrumentation for cold leg break configuration -- isometric.

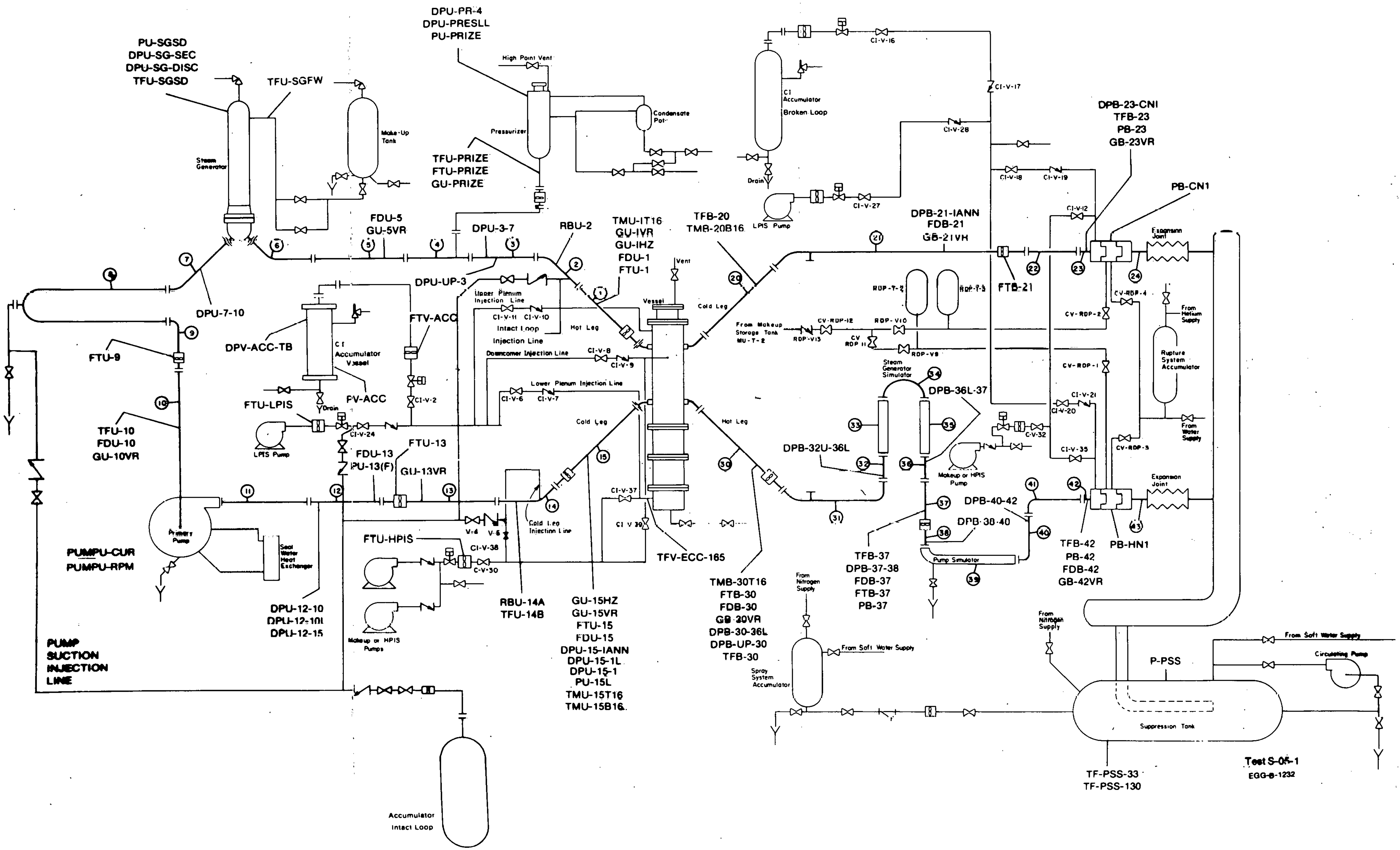

Fig. 4 Semiscale Mod-1 system and instrumentation for cold leg break configuration -- schematic.

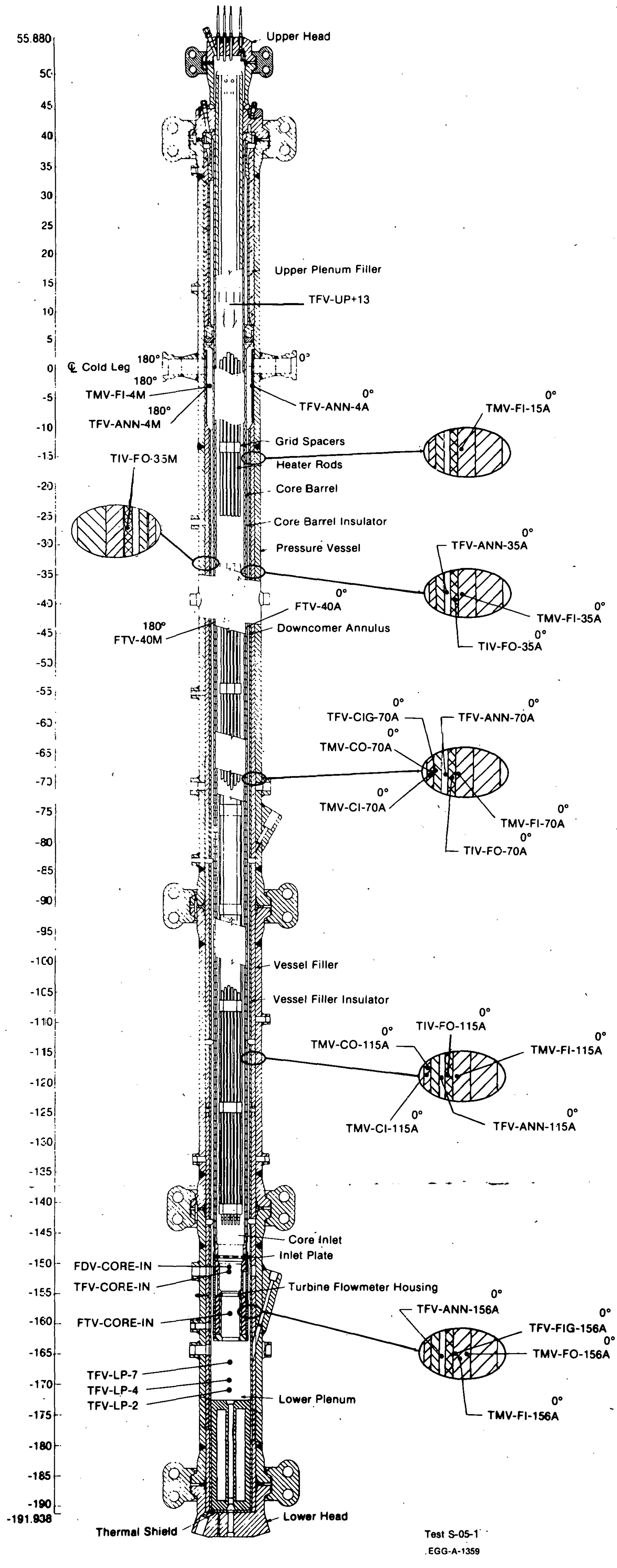

Fig. 5 Semiscale Mod-1 pressure vessel -- cross section showing instrumentation.

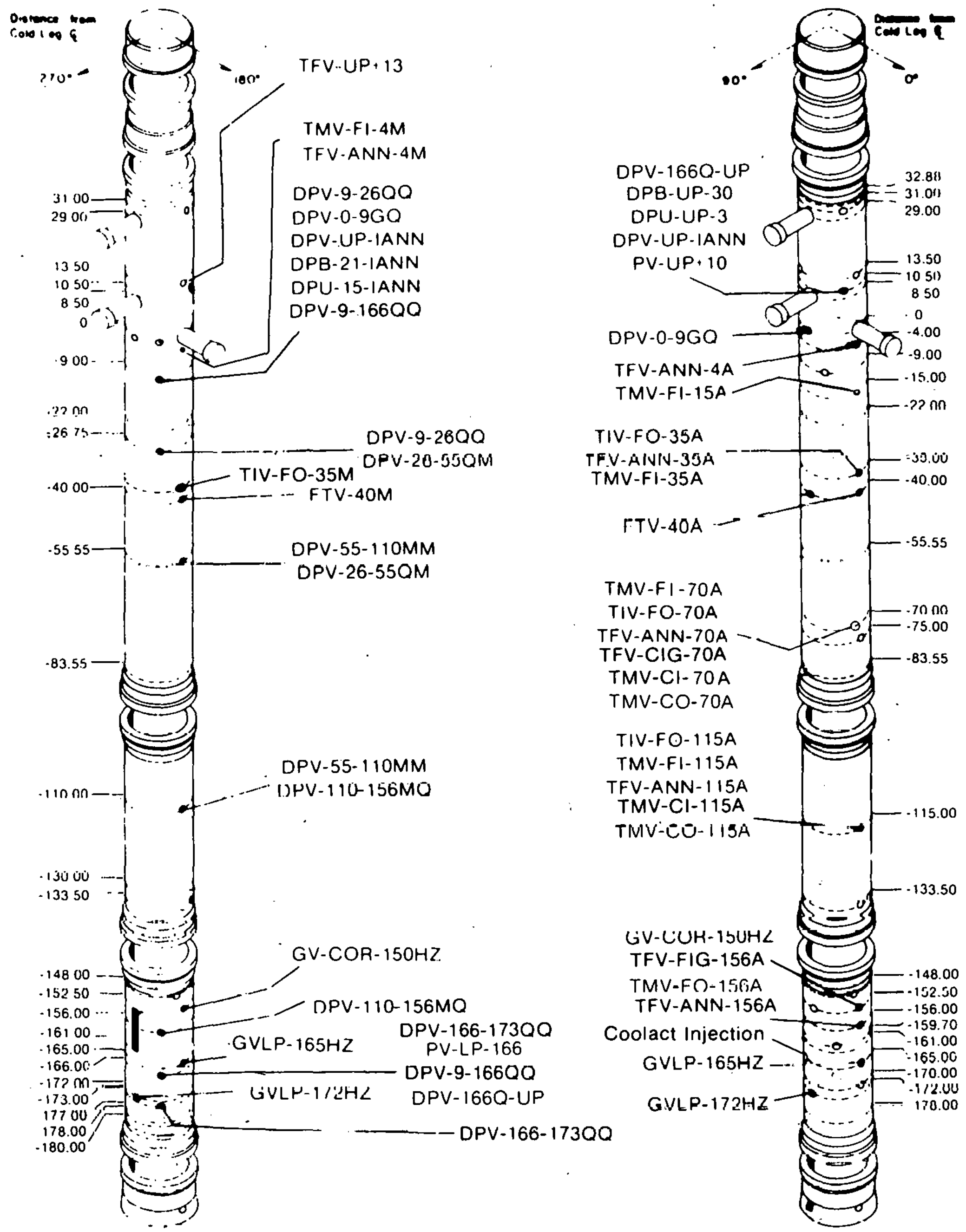

Fig. 6 Semiscale Mod-1 pressure vessel -- isometric showing instrumentation.

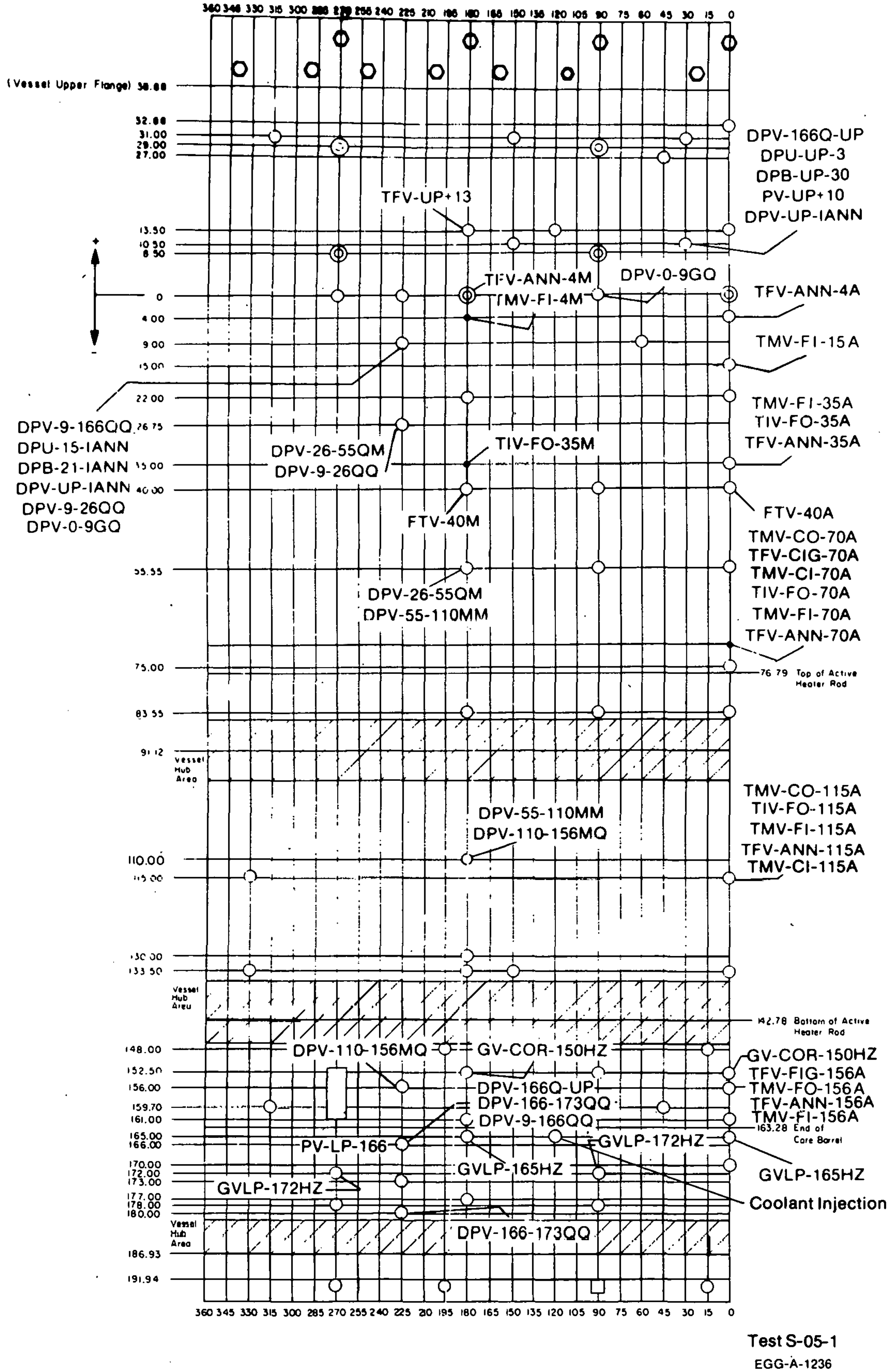

Fig. 7 Semiscale Mod-1 pressure vessel -- penetrations and instrumentation.

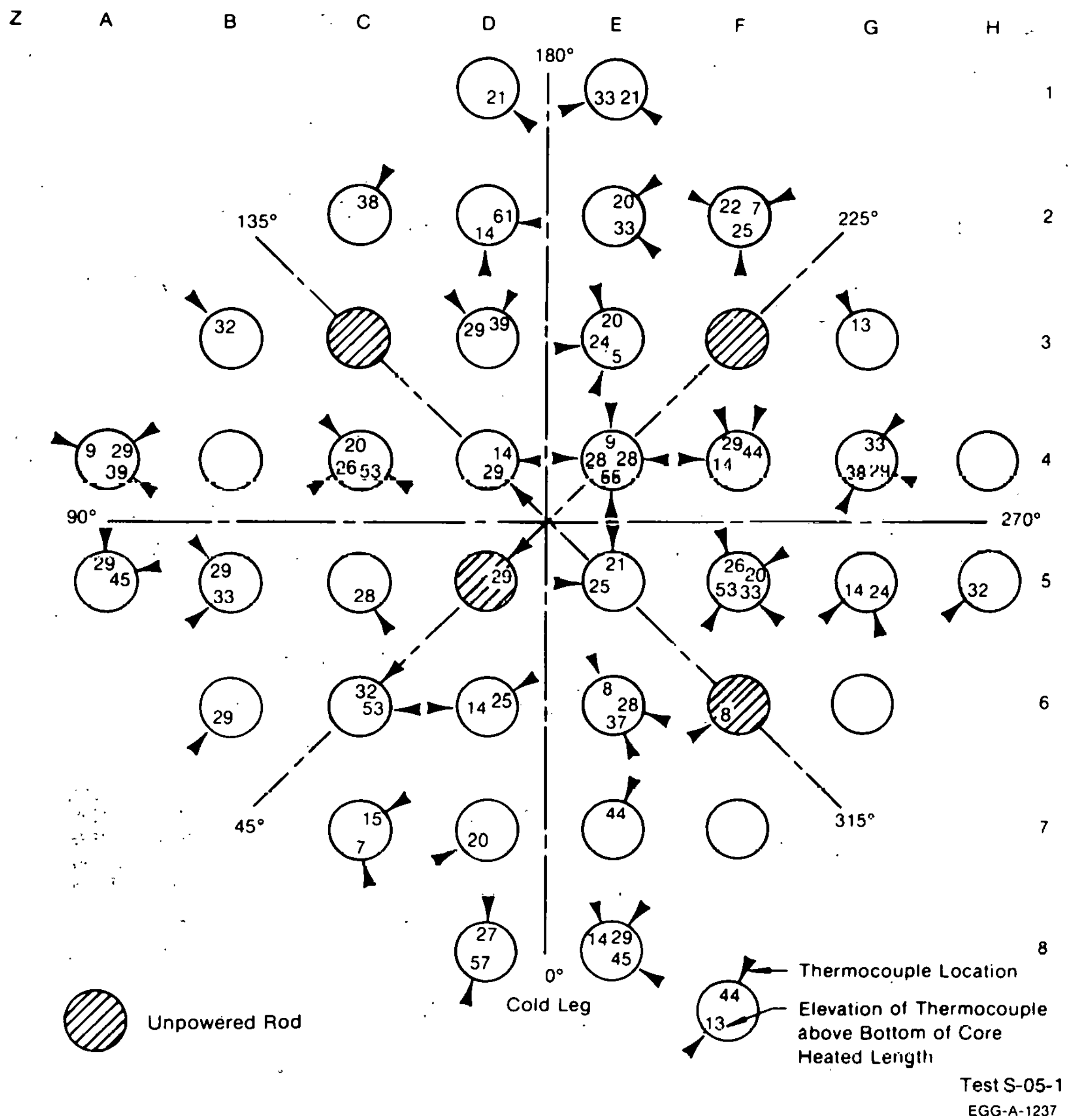

Fig. 8 Semiscale Mod-1 heated core -- plan view.

TABLE V

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-05-1

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 to 2300°F	0 to 591°F		
RBU-2	Hot leg, Spool 2, 46 in. from vessel center (platinum resistance bulb).	0 to 1000°F	0 to 1000°F	9, 10	
TFU-10	Cold leg, Spool 10, 144 in. from vessel center.			11, 12	
RBU-14A	Cold leg, Spool 14, 43 in. from vessel center, upstream of cold leg injection port (platinum resistance bulb).	0 to 1000°F	0 to 1000°F	11, 12	
TFU-14B	Cold leg, Spool 14, 39 in. from vessel center, downstream of cold leg injection port.			11, 12	
Broken Loop		0 to 2300°F	0 to 1017°F		
TFB-20	Cold leg, Spool 20, 21 in. from vessel center.			13, 14	
TFB-23	Cold leg, Spool 23, 91 in. from vessel center, upstream of vessel-side nozzle.			13, 14	
TFB-30	Hot leg, Spool 30, 16 in. from vessel center.			15, 16	
TFB-37	Cold leg, Spool 37, 276 in. from vessel center along hot leg, discharge of simulated steam generator.			15, 16	
TFB-42	Cold leg, Spool 42, 414 in. from vessel center along hot leg, upstream of pump-side nozzle.			15, 16	
Inlet Annulus	4 in. below cold leg centerline, 0.2 in. from vessel wall, Type J iron-constantan thermocouples.	0 to 1400°F	0 to 803°F		
TFV-ANN-4A	0°.			17, 18	
TFV-ANN-4M	180°.				
Downcomer Annulus	Centered in annulus, Type J iron-constantan thermocouples.	0 to 1400°F	0 to 803°F		
TFV-ANN-35A	35 in. below cold leg centerline, 0°.			19, 20	
TFV-ANN-70A	70 in. below cold leg centerline, 0°.			19, 20	
TFV-ANN-115A	115 in. below cold leg centerline, 0°.			19, 20	
TFV-ANN-156A	156 in. below cold leg centerline, 0°.	0 to 2300°F	0 to 591°F	19, 20	
Upper Plenum		0 to 2300°F	0 to 1017°F		
TFV-UP+13	In upper plenum, 13.5 in. above cold leg centerline at 180°.			21, 22	
Lower Plenum	On fluid thermocouple rack, 1 in. from vessel center, 45°.	0 to 2300°F	0 to 1017°F		
TFV-LP-2	2.0 in. above top of lower plenum filler.			23, 24	
TFV-LP-4	4.0 in. above top of lower plenum filler.			23, 24	
TFV-LP-7	7.0 in. above top of lower plenum filler.			23, 24	
Core					
TFV-CORE-IN	In core flow mixer box, 160 in. below cold leg centerline (a part of FDV-CORE-IN).	0 to 2300°F	0 to 1017°F	25, 26	
Core Barrel Insulation Gap					
TFV-CIG-70A	70 in. below cold leg centerline, 0°.	0 to 1400°F	0 to 803°F	27, 28	

TABLE V (continued)

Measurement	Location and Comments[a]	Range[a] Detector	Range[a] Data Acquisition System	Figure[a]	Measurement Comments[b]
Vessel Filler Insulation Gap					
TFV-FIG-156A	156 in. below cold leg centerline, 0°.	0 to 2300°F	0 to 1017°F	29, 30	Noisy reading due to failing thermocouple junction.
ECC System					
TFV-ECC-165	In vessel accumulator ECC line, 165 in. below cold leg centerline 12 in. from vessel.	0 to 2300°F	0 to 591°F	31, 32	
Steam Generator		0 to 2300°F	0 to 591°F		
TFU-SGFW	In feedwater line leading to steam generator.			33, 34	
TFU-SGSD	In steam dome, 129.5 in. from bottom of tube sheet.			33, 34	
Pressurizer					
TFU-PRI7E	In surge line, near pressurizer unit, between turbine flowmeter and pressurizer.	0 to 2300°F	0 to 1017°F	35, 36	
Pressure Suppression System		0 to 2300°F	0 to 591°F		
TF-PSS-33	33 in. from bottom of tank.			37, 38	
TF-PSS-130	130 in. from bottom of tank.			37, 38	
MATERIAL TEMPERATURE	Chromel-Alumel thermocouples unless specified otherwise				
Intact Loop		0 to 2300°F	0 to 591°F		
TMU-1T16	Hot leg, Spool 1, top, 1/16 in. from pipe ID, 29 in. from vessel center.		0 to 1017°F	39, 40	
TMU-15B16	Cold leg, Spool 15, bottom, 1/16 in. from pipe ID, 17 in. from vessel center.			39, 40	
TMU-15T16	Cold leg, Spool 15, top, 1/16 in. from pipe ID, 17 in from vessel center.			39, 40	
Broken Loop		0 to 2300°F	0 to 591°F		
TMB-20B16	Cold leg, Spool 20, bottom, 1/16 in. from pipe ID, 21 in. from vessel center.			41, 42	
TMB-30T16	Hot leg, Spool 30, top, 1/16 in. from pipe ID, 16 in. from vessel center.		0 to 1017°F	41, 42	
Vessel Filler	Type J iron-constantan.	0 to 1400°F	0 to 803°F		
TMV-FI-4M	4 in. below cold leg centerline, 1/16 in. from filler ID, 180°.			43, 44	
TMV-FI-15A	15 in. below cold leg centerline, 1/16 in. from filler ID, 0°.			43, 44	
TMV-FI-35A	35 in. below cold leg centerline, 1/16 in. from filler ID, 0°.			43, 44	
TMV-FI-70A	70 in. below cold leg centerline, 1/16 in. from filler ID, 0°.			45, 46	
TMV-FI-115A	115 in. below cold leg centerline, 1/16 in. from filler ID, 0°.			45, 46	
TMV-FI-156A	156 in. below cold leg centerline, 1/16 in. from filler ID, 0°.	0 to 2300°F	0 to 1017°F	45, 46	
TMV-FO-156A	156 in. below cold leg centerline, 0.65 in. from filler OD, 0°.	0 to 2300°F	0 to 1017°F	47, 48	

TABLE V (continued)

Measurement	Location and Comments[a]	Range[a] Detector	Range[a] Data Acquisition System	Figure[a]	Measurement Comments[b]
Vessel Filler Insulator	Outer surface of insulator, Type J iron-constantan thermocouples.	0 to 1400°F	0 to 803°F		
TIV-FO-35A	35 in. below cold leg centerline, 0°.			49, 50	
TIV-FO-35M	35 in. below cold leg centerline, 180°F.			49, 50	
TIV-FO-70A	70 in. below cold leg centerline, 0°.			49, 50	
TIV-FO-115A	115 in. below cold leg centerline, 0°.			49, 50	
Core Barrel	Type J iron-constantan thermocouples	0 to 1400°F	0 to 803°F		
TMV-CI-70A	70 in. below cold leg centerline, 1/16 in. from core barrel ID, 0°.			51, 52	
TMV-CI-115A	115 in. below cold leg centerline 1/16 in. from core barrel ID, 0°.			51, 52	
TMV-CO-70A	70 in. below cold leg centerline, 1/16 in. from core barrel OD, 0°.			53, 54	
TMV-CO-115A	115 in. below cold leg centerline, 1/16in. from core barrel OD, 0°.			53, 54	
Core Housing Filler		0 to 2300°F	0 to 1017°F		
TMV-HF-115W	On core housing filler, 115 in. below cold leg centerline, 0.20 in. from outer surface, 315°.			55, 56	
TMV-HF-127W	On core housing filler, 127 in. below cold leg centerline, 0.20 in. from outer surface, 315°.			55, 56	
TMV-HF-138W	On core housing filler, 138 in. below cold leg centerline, 0.20 in. from outer surface, 315°.			55, 56	
CORE HEATER CLADDING TEMPERATURES	Chromel-Alumel thermocouples.				
High Power Heaters		0 to 2300°F	0 to 2382°F		
TH-D4-14 TH-D4-29	Heater at Column D, Row 4. Thermocouples 14 in. (270°) and 29 in. (315°) above bottom of core.			57, 58	
TH-D5-29	Heater at Column D, Row 5. Thermocouple 29 in. (225°) above bottom of core.			59, 60	
TH-E4-09 TH-E4-28G TH-E4-28T TH-E4-55	Heater at Column E, Row 4. Thermocouples 9 in. (180°), 28 in. (90°), 28 in. (270°), and 55 in. (0°) above bottom of core.			61, 62	
TH-E5-21 TH-E5-25	Heater at Column E, Row 5. Thermocouples 21 in. (180°) and 25 in. (90°) above bottom of core.			63, 64	
Low Power Heaters		0 to 2300°F	0 to 2382°F		
TH-A4-09 TH-A4-29 TH-A4-39	Heater at Column A, Row 4 Thermocouples 9 in. (105°), 29 in. (240°) and 39 in. (300°) above bottom of core.			65, 66	Noisy reading due to failing thermocouple junction
TH-A5-29 TH-A5-45	Heater at Column A, Row 5. Thermocouples 29 in. (180°) and 45 in. (255°) above bottom of core.			67, 68	
TH-B3-32	Heater at Column B, Row 3. Thermocouple 32 in. (135°) above bottom of core.			69, 70	
TH-B5-29 TH-B5-33	Heater at Column B, Row 5. Thermocouples 29 in. (150°) and 33 in. (45°) above bottom of core.			71, 72	
TH-B6-29	Heater at Column B, Row 6. Thermocouple 29 in. (45°) above bottom of core.			73, 74	
TH-C2-38	Heater at Column C, Row 2. Thermocouple 38 in. (225°) above bottom of core.			75, 76	
TH-C4-20 TH-C4-26 TH-C4-53	Heater at Column C, Row 4. Thermocouples 20 in. (150°), 26 in. (75°) and 53 in. (300°) above bottom of core.			77, 78	
TH-C5-28	Heater at Column C, Row 5. Thermocouple 28 in. (315°) above bottom of core.			79, 80	
TH-C6-32 TH-C6-53	Heater at Column C, Row 6. Thermocouples 32 in. (225°) and 53 in. (270°) above bottom of core.			81, 82	

TABLE V (continued)

Measurement	Location and Comments[a]	Range[a]: Detector	Range[a]: Data Acquisition System	Figure[a]	Measurement Comments[b]
Low Power Heaters (continued)		0 to 2300°F	0 to 2382°F		
TH-C7-07 TH-C7-15	Heater at Column C, Row 7. Thermocouples 7 in. (345°) and 15 in. (255°) above bottom of core.			83, 84	
TH-D1-21	Heater at Column D, Row 1. Thermocouple 21 in. (330°) above bottom of core.			85, 86	
TH-D2-14 TH-D2-61	Heater at Column D, Row 2. Thermocouple 14 in. (0°) and 61 in. (270°) above bottom of core.			87, 88	
TH-D3-29 TH-D3-39	Heater at Column D, Row 3. Thermocouples 29 in. (150°) and 39 in. (210°) above bottom of core.			89, 90	
TH-D6-14 TH-D6-25	Heater at Column D, Row 6. Thermocouples 14 in. (90°) and 25 in. (225°) above bottom of core.			91, 92	TH-D6-14 failed
TH-D7-20	Heater at Column D, Row 7. Thermocouple 20 in. (60°) above bottom of core.			93, 94	
TH-D8-27 TH-D8-57	Heater at Column D, Row 8. Thermocouples 27 in (180°) and 57 in. (15°) above bottom of core.			95, 96	
TH-E1-21 TH-E1-33	Heater at Column E, Row 1. Thermocouples 21 in. (315°) and 33 in. (60°) above bottom of core.			97, 98	
TH-E2-20 TH-E2-33	Heater at Column E, Row 2. Thermocouples 20 in. (210°) and 33 in. (315°) above bottom of core.			99, 100	
TH-E3-05 TH-E3-20 TH-E3-24	Heater at Column E, Row 3. Thermocouples 5 in. (15°), 20 in. (165°), and 24 in. (75°) above bottom of core.			101, 102	
TH-E6-08 TH-E6-28 TH-E6-37	Heater at Column E, Row 6. Thermocouples 8 in. (150°), 28 in. (285°), and 37 in. (330°) above bottom core			103, 104	
TH-E7-44	Heater at Column E, Row 7. Thermocouple 44 in. (195°) above bottom of core.			105, 106	
TH-E8-14 TH-E8-29 TH-E8-45	Heater at Column E, Row 8. Thermocouples 14 in. (190°), 29 in. (225°), and 45 in. (300°) above bottom of core.			107, 108	
TH-F2-07 TH-F2-22 TH-F2-25	Heater at Column F, Row 2. Thermocouples 7 in. (255°), 22 in. (105°), and 25 in. (0°) above bottom of core.			109, 110	
TH-F4-14 TH-F4-29 TH-F4-44	Heater at Column F, Row 4. Thermocouples 14 in. (90°), 29 in. (165°), and 44 in. (210°) above bottom of core.			111, 112	
TH-F5-20 TH-F5-26 TH-F5-33 TH-F5-53	Heater at Column F, Row 5. Thermocouples 20 in. (255°), 26 in. (165°), 33 in. (315°), and 53 in. (30°) above bottom of core.			113, 114	
TH-F6-08	Heater at Column F, Row 6. Thermocouple 8 in. (60°) above bottom of core.			115, 116	
TH-G3-13	Heater at Column G, Row 3. Thermocouple 13 in. (150°) above bottom of core.			117, 118	
TH-G4-29 TH-G4-33 TH-G4-38	Heater at Column G, Row 4. Thermocouples 29 in. (300°), 33 in. (225°), and 38 in. (30°) above bottom of core.			119, 120	

TABLE V (continued)

Measurement	Location and Comments[a]	Range[a] Detector	Range[a] Data Acquisition System	Figure[a]	Measurement Comments[b]
Low Power Heaters (continued)		0 to 2300°F	0 to 2382°F		
TH-G5-14 TH-G5-24	Heater at Column G, Row 5. Thermocouples 14 in. (45°) and 24 in. (330°) above bottom of core.			121, 122	
TH-H5-32	Heater at Column H, Row 5. Thermocouple 32 in. (45°) above bottom of (330°) above bottom of core.			123, 124	
PRESSURE					
Intact Loop		0 to 3000 psi			
PU-13(F)	Cold leg, Spool 13, 54 in. from vessel center (flush mount).		0 to 4497 psia	125, 126	
PU-15L	Cold leg, Spool 15, 16 in. from vessel center, to atmosphere (low range).	0 to 600 psi	0 to 653 psia	127, 128	
Broken Loop		0 to 3,000 psi			
PB-23	Cold leg, Spool 23, 92 in. from vessel center, upstream of nozzle (tee off DP tap).		0 to 4364 psia	129, 130	
PB-37	Cold leg, Spool 37, 282 in. from vessel center along hot leg.		0 to 4402 psia	131, 132	
PB-42	Cold leg, Spool 42, 415 in. from vessel center along hot leg, upstream of pump-side nozzle (tee off DP tap).		0 to 4832 psia	131, 132	
PB-HN1	Pump-side nozzle, nozzle throat, 419 in. from vessel center along hot leg (tee off DP tap).		0 to 4666 psia	133, 134	
PB-CN1	Cold leg, Spool 23, vessel-side nozzle, nozzle throat, 96 in. from vessel center along cold leg, 45°.		0 to 2509 psia	135, 136	
Vessel					
PV-UP+10	In upper plenum, 10 in. above cold leg centerline, mounted on standoff, 30°.	0 to 2500 psi	0 to 3110 psia	137, 138	
PV-LP-166	In upper part of lower plenum, 166 in. below cold leg centerline, mounted on standoff, 225°.	0 to 3000 psi	0 to 2503 psia	137, 138	
ECC System		0 to 750 psi			
PV-ACC	In vessel accumulator.		0 to 743 psia	139, 140	
Steam Generator					
PU-SGSD	Secondary side steam dome.	0 to 3000 psi	0 to 1811 psia	141, 142	
Pressurizer					
PU-PRIZE	Pressurizer steam dome.	0 to 2500 psi	0 to 3210 psia	143, 144	
Pressure Suppression System					
P-PSS	Suppression tank top.	0 to 250 psi	0 to 347 psia	145, 146	

TABLE V (continued)

Measurement	Location and Comments[a]	Range[a]		Figure[a]	Measurement Comments[b]
		Detector	Data Acquisition System		
DIFFERENTIAL PRESSURE	Elevation difference between transducer taps is zero unless otherwise specified.				
Intact Loop					
DPU-UP-3	Upper plenum 10.5 in. above cold leg centerline at 30° to hot leg, Spool 3, 62 in. from vessel center. Upper plenum tap is approximately 2 in. above Spool 3 tap.	±50 in. water	±2.4 psid	147, 148	Data acquisition system or detector saturated near t=0 sec.
DPU-3-7	Across steam generator, hot leg Spool 3, 62 in. from vessel center to cold leg Spool 7, 231 in. from vessel center. Spool 3 tap is approximately 10 in. above Spool 7 tap.	±500 in. water	±25 psid	149, 150	
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	±2.4 psid	151, 152	
DPU-12-10	Pump outlet to pump inlet, cold leg Spool 12, 75 in. from vessel center, to cold leg Spool 10, 141 in. from vessel center. Spool 10 tap is 10 in. below Spool 12 tap.	±50 psi	± 50 psid	153, 154	
DPU-12-10L	Pump outlet to pump inlet, cold leg Spool 12, 75 in. from vessel center, to cold leg Spool 10, 141 in. from vessel center. Spool 10 tap is 10 in. below Spool 12 tap (low range).	±100 in. water	±4.9 psid	155, 156	Detector saturated to t=7 sec.
DPU-12-15	Across cold leg injection point, cold leg Spool 12, 75 in. from vessel center, to cold leg Spool 15, 16 in. from vessel center.	±100 in. water	±4.8 psid	157, 158	
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 0.5 in. below Spool 1 tap.	±500 in. water	±25 psid	161, 162	
DPU-15-1L	Cold leg to hot leg, cold leg Spool 15, 16 in. from vessel center to hot leg Spool 1, 31 in. from vessel center, Spool 15 tap is 8.5 in. below Spool 1 tap (low range).	±100 in. water	±4.8 psid	163, 164	Detector saturated prior to t=0 sec.
DPU-15-IANN	Cold leg Spool 15, 16 in. from vessel center, to inlet annulus, 9 in. below cold leg centerline at 225°. Spool 15 tap is 9 in. above inlet annulus tap.	±100 in. water	±4.8 psid	159, 160	
DPU-PRESLL	Pressurizer water level. Elevation difference between taps is 53 in. Lower tap is 3.5 in. above pressurizer exit.	±50 in. water	±2.5 psid	165, 166	
DPU-PR-4	Pressurizer bottom to Spool 4. Elevation difference between taps is 62 in. Spool 4 tap is 55 in. below pressurizer exit.	±1000 psi	+1357 psid	167, 168	
Broken Loop					
DPB-UP-30	Vessel upper plenum, 10.5 in. above cold leg centerline at 30°, to hot leg Spool 30, 18 in. from vessel center. Upper plenum tap is 2 in. above Spool 30 tap.	±100 in. water	±4.8 psid	169, 170	
DPB-21-IANN	Cold leg Spool 21, 49 in. from vessel center, to vessel inlet annulus, 9 in. below cold leg centerline at 225°. Inlet annulus tap is 9 in. below Spool 21 tap.	±100 in. water	±4.8 psid	171, 172	
DPB-23-CN1	Cold leg Spool 23, 92 in. from vessel center, to vessel-side nozzle throat, 96 in. from vessel center.	±1000 psi	±1336 psid	173, 174	
DPB-30-36L	Across entire simulated steam generator assembly, hot leg Spool 30, 18 in. from vessel center, to cold leg Spool 36 lower tap, 242 in. from vessel center. Spool 30 tap is 19 in. below Spool 36 lower tap.	±500 psi	±500 psid	175, 176	

TABLE V (continued)

Measurement	Location and Comments[a]	Range[a] Detector	Range[a] Data Acquisition System	Figure[a]	Measurement Comments[b]
Broken Loop (continued)					
DPB-32U-36L	Across simulated steam generator orifice assembly, hot leg Spool 32 upper tap, 73 in. from vessel center, to Spool 36 lower tap, 242 in. from vessel center. Spool 32 upper tap is 16 in. above Spool 36 lower tap.	±500 psi	±500 psid	177, 178	
DPB-36L-37	Across nozzle assembly, Spool 36 lower tap, 242 in. from vessel center along hot leg, to Spool 37, 282 in. from vessel center along hot leg. Spool 37 tap is 40 in. below Spool 36 lower tap.	±50 psi	±50 psid	179, 180	
DPB-37-38	Across turbine flowmeter and drag disc, cold leg Spool 37, 282 in. from vessel center along hot leg, to cold leg Spool 38, 305 in. from vessel center along hot leg. Spool 37 tap is 23 in. above Spool 38 tap.	±50 in. water	±2.5 psid	181, 182	
DPB-38-40	Across simulated pump, cold leg Spool 38, 305 in. from vessel center along hot leg, to cold leg Spool 40, 365 in. from vessel center along hot leg.	±1000 psi	±1353 psid	183, 184	
DPB-40-42	Across elbow leading to spool upstream of pump-side nozzle. Cold leg Spool 40, 365 in. from vessel center along hot leg, to Spool 42, 415 in. from vessel center along hot leg. Spool 40 tap is 40 in. below Spool 42 tap.	±50 in. water	±2.5 psid	185,186	Data acquisition system saturated from t=0 to t=1 sec.
Vessel					
DPV-UP-IANN	Upper plenum, 10.5 in. above cold leg centerline at 30° to inlet annulus, 9 in. below cold leg centerline at 225°. Elevation difference between taps is 19 in.	±300 in water	±14.7 psid	187, 188	
DPV-0-9GQ	Inlet annulus cold leg centerline at 90°, to 9 in. below cold leg centerline at 225°. Elevation difference between taps is 9 in.	±50 in. water	±2.5 psid	189, 190	
DPV-9-26QQ	Inlet annulus, 9 in. below cold leg centerline at 225°, to downcomer gap, 26 in. below cold leg centerline at 225°. Elevation difference between taps is 17 in.	±50 in. water	±2.4 psid	191, 192	
DPV-9-166QQ	Inlet annulus, 9 in. below cold leg centerline at 225°, to lower plenum, 166 in. below cold leg centerline at 225°. Elevation difference between taps is 157 in.	±300 in. water	±14.4 psid	193, 194	
DPV-26-55QM	Across part of downcomer, 26 in. (225°), to 55 in. (180°), below cold leg centerline. Elevation difference between taps is 29 in.	±50 in. water	±2.0 psid	195, 196	
DPV-55-110MM	Across part of downcomer, 55 in. (180°), to 110 in. (180°), below cold leg centerline. Elevation difference between taps is 55 in.	±100 in. water	±4.9 psid	197, 198	
DPV-110-156MQ	Across part of downcomer, 110 in. (180°), to 156 in. (225°), below cold leg centerline. Elevation difference between taps is 46 in.	±100 in. water	±4.9 psid	199, 200	
DPV-166-173QQ	Across part of lower plenum, 166 in. (225°), to 173 in. (225°), below cold leg centerline. Elevation difference between taps is 7 in.	±20 in. water	±1.0 psid	201, 202	
DPV-166Q-UP	Lower plenum, 166 in. below cold leg centerline at 225°, to upper plenum, 10.5 in. above cold leg centerline at 30°. Elevation difference between taps is 177 in.	±300 in. water	±14.7 psid	203, 204	

TABLE V (continued)

Measurement	Location and Comments[a]	Range[a] Detector	Range[a] Data Acquisition System	Figure[a]	Measurement Comments[b]
Vessel (continued)					
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 ~2 in. above Spool 3 tap.	±50 in. water	±2.4 psid	147, 148	
DPB-21-IANN	Cold leg Spool 21, 49 in. from vessel center, to vessel inlet annulus, 9 in. below cold leg centerline at 225°. Inlet annulus tap is 9 in. below Spool 21 tap.	±100 in. water	±4.8 psid	171, 172	
Vessel Core					
DPVC-89W-UP	Upper segment of active core region, 89 in. below cold leg centerline (315°), to upper plenum core tube. 10.5 in. above cold leg centerline (30°). Elevation difference between taps is 100 in.	±500 in. water	±25 psid	205, 206	Liquid may have boiled from sense lines; questionable data.
DPVC-89-106WQ	In active core region, upper segment, 89 in. below cold leg centerline (315°), to 106 in. below cold leg centerline (225°). Elevation difference between taps is 17 in.	±50 in. water	±2.5 psid	207, 208	
DPVC-106-122QJ	Across center segment of active core region, 106 in. below cold leg centerline (225°), to 122 in. below cold leg centerline (135°). Elevation difference between taps is 16 in.	±100 in. water	±4.8 psid	209, 210	
DPVC-122-140JD	In active core region, lower segment, 122 in. below cold leg centerline (135°), to 140 in. below cold leg centerline (45°). Elevation difference between taps is 18 in.	±100 in. water	±4.9 psid	211, 212	
ECC SYSTEM					
Vessel					
DPV-ACC-TB	Top to bottom of broken loop accumulator tank. Elevation difference between taps is 117 in.	±100 in. water	±4.9 psid	213, 214	
Steam Generator					
DPU-3G-SEC	Secondary side, differential pressure taps at 45 in. and 126 in. above bottom of tube sheet. Elevation difference between taps is 81 in.	±100 in. water	±4.8 psid	215, 216	
DPU-SG-DISC	Across venturi tube, 66 in. downstream from stream generator discharge.	±500 in.	±24.5 psid	217, 218	
VOLUMETRIC FLOW RATE	Turbine flowmeter, bidirectional.				Data acquisition system range may exceed rated detector range; however, turbine response is linear to flow rates well beyond the rated range.
Intact Loop	3-in. Schedule 160 pipe.				
FTU-1	Hot leg, Spool 1, 18 in. from vessel center.	±20 to ±400 gpm	±1200 gpm	219, 220	
FTU-9	Cold leg, Spool 9, 154 in. from vessel center.	±80 to ±800 gpm	±1200 gpm	219, 220	
FTU-13	Cold leg, Spool 13, [illegible] in. from vessel center.	±20 to ±[illegible] gpm	±1200 gpm	221, 222	
FTU-15	Cold leg, Spool 15, 29 in. from vessel center.	±20 to ±800 gpm	±1000 gpm	221, 222	
Broken Loop	Schedule 160 pipe.				
FTB-21	Cold leg, Spool 21, 58 in. from vessel center; 3-in. pipe.	±20 to ±400 gpm	±1200 gpm	223, 224	
FTB-30	Hot leg, Spool 30, 25 in. from vessel center; 3-in. pipe.	±20 to ±400 gpm	±800 gpm	225, 226	Turbine flowmeter malfunction to t = 4.6 seconds.

TABLE V (continued)

Measurement	Location and Comments[a]	Range[a] Detector	Range[a] Data Acquisition System	Figure[a]	Measurement Comments[b]
Broken Loop (continued)					
FTB-37	Cold leg, Spool 37, 290 in. from vessel center along hot leg; 2-in. pipe.	±20 to ±800 gpm	±800 gpm	225, 226	
Core					
FTV-CORE-IN	Entrance to core, ~158 in. below cold leg centerline.	±2 to ±200 gpm	±900 gpm	227, 228	
ECC System					
FTU-HPIS	In line immediately after HPIS pump for broken loop, 1/2-in. line Pump discharge routed to vessel lower plenum.	±0.75 to ±7.5 gpm	±2 gpm	229, 230	Data acquisition system saturated intermittently.
FTU-LPIS	In line leading from LPIS for intact loop; 1/2-in. line. Pump discharge routed to vessel lower plenum.	±0.75 to ±7.5 gpm	±10 gpm	231, 232	Data acquisition system saturated near t=24 sec.
FTV-ACC	In line leading from vessel accumulator; 1-in. line.	±5 to ±50 gpm	±75 gpm	421, 422	Turbine flowmeter failed.
Pressurizer	1-1/2-in. turbine.				
FTU-PRIZE	Surge line.	±2 to ±20 gpm	±80 gpm	233, 234	
FLUID VELOCITY	Turbine flowmeter, bidirectional.				
Downcomer					
FTV-40A	40 in. below cold leg centerline, 0°.	+2.5 to 50 ft/sec	±50 ft/sec	235, 236	Unidirectional measurement
FTV-40M	40 in. below cold leg centerline, 180°.	+2.5 to 50 ft/sec	±50 ft/sec		
MOMENTUM FLUX	Drag disc, bidirectional.				Momentum flux reported only for -6 to 42 sec, except as noted. Drag disc data may exhibit significant temperature dependence. Drag disc data should be used only for short-term transient response.
Intact Loop	3-in. pipe.				
FDU-1	Hot leg, Spool 1, 29 in. from vessel center; target size 0.875 in.	±200 to ±11,600 lbm/ft-sec^2	±22,400 lbm/ft-sec^2	237	
FDU-5	Hot leg, Spool 5, 100 in. from vessel center; target size 1.0 in.	±1 to ±2000 lbm/ft-sec^2	±4750 lbm/ft-sec^2		Detector failed.
FDU-10	Cold leg, Spool 10, 137 in. from vessel center; target size 0.875 in.	±200 to ±104,000 lbm/ft-sec^2	±23,750 lbm/ft-sec^2	238	
FDU-13	Cold leg, Spool 13, 54 in. from vessel center; target size 0.875 in.	±200 to ±14,800 lbm/ft-sec^2	±20,000 lbm/ft-sec^2	239	
FDU-15	Cold leg, Spool 15, 19 in. from vessel center; target size 0.875 in.	±200 to ±14,500 lbm/ft-sec^2	±20,250 lbm/ft-sec^2	240	
Broken Loop					
FDB-21	Cold leg, Spool 21, 53 in. from vessel center, 3-in. pipe; target size 0.875 in.	±200 to ±70,500 lbm/ft-sec^2	±25,000 lbm/ft-sec^2	241	
FDB-30	Hot leg, Spool 30, 21 in. from vessel center, 3-in. pipe; target size 0.656 in.	±200 to ±60,000 lbm/ft-sec^2	±47,500 lbm/ft-sec^2	242	
FDB-37	Cold leg, Spool 37, 284 in. from vessel center along hot leg, steam generator outlet, vertical pipe, 2-in. pipe; target size 0.406 in.	±200 to ±121,000 lbm/ft-sec^2	±248,000 lbm/ft-sec^2	243	

TABLE V (continued)

Measurement	Location and Comments[a]	Range[a] Detector	Range[a] Data Acquisition System	Figure[a]	Measurement Comments[b]
Broken Loop (continued)					
FDB-42	Cold leg, Spool 42, 416 in. from vessel center along hot leg, upstream of pump-side nozzle, downstream of injection point, 2-in. pipe; target size 0.406 in.	±200 to ±116,000 lbm/ft-sec^2	±121,000 lbm/ft-sec^2	244, 245	Figure 244 is long-term (-20 to 300 sec) plot
Vessel					
FDV-CORE-IN	In core flow mixer box 150 in. below cold leg centerline; target size 1.0 in.	±1 to ±2000 lbm/ft-sec^2	±1235 lbm/ft-sec^2	246, 247	Figure 244 is long-term (-20 to 300 sec) plot; detector overranged near t=0 sec.
DENSITY					
Intact Loop		0.1 to 100 lbm/ft^3	0.1 to 100 lbm/ft^3		
GU-1VR	Hot leg, Spool 1, 24 in. from vessel center, vertical.			248, 249	
GU-1HZ	Hot leg, Spool 1, 26 in. from vessel center, horizontal.			247, 248	
GU-5VR	Hot leg, Spool 5, 96 in from vessel center, vertical.			250, 251	
GU-10VR	Cold leg, Spool 10, 141 in. from vessel center, vertical.			250, 251	
GU-13VR	Cold leg, Spool 13, 59 in. from vessel center, vertical.			252, 253	
GU-15VR	Cold leg, Spool 15, 23 in. from vessel center, vertical.			254, 255	
GU-15HZ	Cold leg, Spool 15, 20 in. from vessel center, horizontal.			254, 255	
Broken Loop		0.1 to 100 lbm/ft^3	0 to 100 lbm/ft^3		
GB-21VR	Cold leg, Spool 21, 49 in. from vessel center, vertical.			256, 257	
GB-23VR	Cold leg, Spool 23, 92 in from vessel center, vertical.			257	Short term (-6 to 42 sec) plot only. Output cable melted near t = 41 sec.
GB-30VR	Hot leg, Spool 30, 10 in. from vessel center, vertical.			258, 259	
GB-42VR	Cold leg, Spool 42, 415 in. from vessel center along hot leg, vertical.			258, 259	
Vessel		0.1 to 100 lbm/ft^3	0 to 100 lbm/ft^3		
GV-COR-150HZ	Core flow mixer box, 152 in. below cold leg centerline, horizontal, 0 to 180°			260, 261	
GVLP-165HZ	Upper part of lower plenum, 165 in. below cold leg centerline, 1.724 in. below downcomer exit, horizontal, 0 to 180°.			262, 263	
GVLP-172HZ	Lower plenum, 172 in. below cold leg centerline, 8.729 in. below downcomer exit, horizontal, 90 to 270°.			262, 263	
Pressurizer					
GU-PRIZE	Surge line.	0.1 to 100 lbm/ft^3	0 to 100 lbm/ft^3	264, 266	

TABLE V (continued)

Measurement	Location and Comments[a]	Range[a] Detector	Range[a] Data Acquisition System	Figure[a]	Measurement Comments[b]
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.			Mass flow rate reported only for -6 to 42 sec for all drag discs except FDV-CORE-IN.
Intact Loop					
FDU-1, GU-1VR FTU-1, GU-1VR	Hot leg, Spool 1.			265 267, 268	
FDU-5, GU-5VR	Hot leg, Spool 5.				Drag disc failed
FTU-9, GU-10VR	Cold leg, Spool 9.			269, 270	
FDU-10, GU-10VR	Cold leg, Spool 10.			270	
FDU-13, GU-13VR FTU-13, GU-13VR	Cold leg, Spool 13.			271 273, 274	
FDU-15, GU-15VR FTU-15, GU-15VR	Cold leg, Spool 15.			275 276, 277	
Broken Loop					
FDB-21, GB-21VR FTB-21, GB-21VR	Cold leg, Spool 21.			278 279, 280	
FDB-30, GB-30VR FTB-30, GB-30VR	Hot leg, Spool 30.			281 282, 283	
FDB-42, GB-42VR	Cold leg, Spool 42.			284	
Vessel					
FDV-CORE-IN, GV-COR-150HZ	Entrance to core.			285, 286	Long-term (-20 to 300 sec) plots are also included for vessel core mass flow measurements.
FTV-CORE-IN, GV-COR-150HZ	Entrance to core.			287, 288	
Pressurizer					
FTU-PRIZE GU-PRIZE	Pressurizer surge line.			289, 290	
CORE CHARACTERISTICS					
PWRCOR T-1	Core power.		1600 kW	291, 292	
PWRCOR T-2	Core power.		1600 kW	291, 292	
VOLTCOR-T	Core voltage.		0 to 200 Vdc	293, 294	
AMPCOR-T	Core current.		0 to 10,000 A	295, 296	
PUMP CHARACTERISTICS					
PUMPU-RPM	Pump speed.		0 to 3600 rpm	297, 298	
PUMPU-CUR	Pump current.		0 to 25 A	299, 300	

[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.

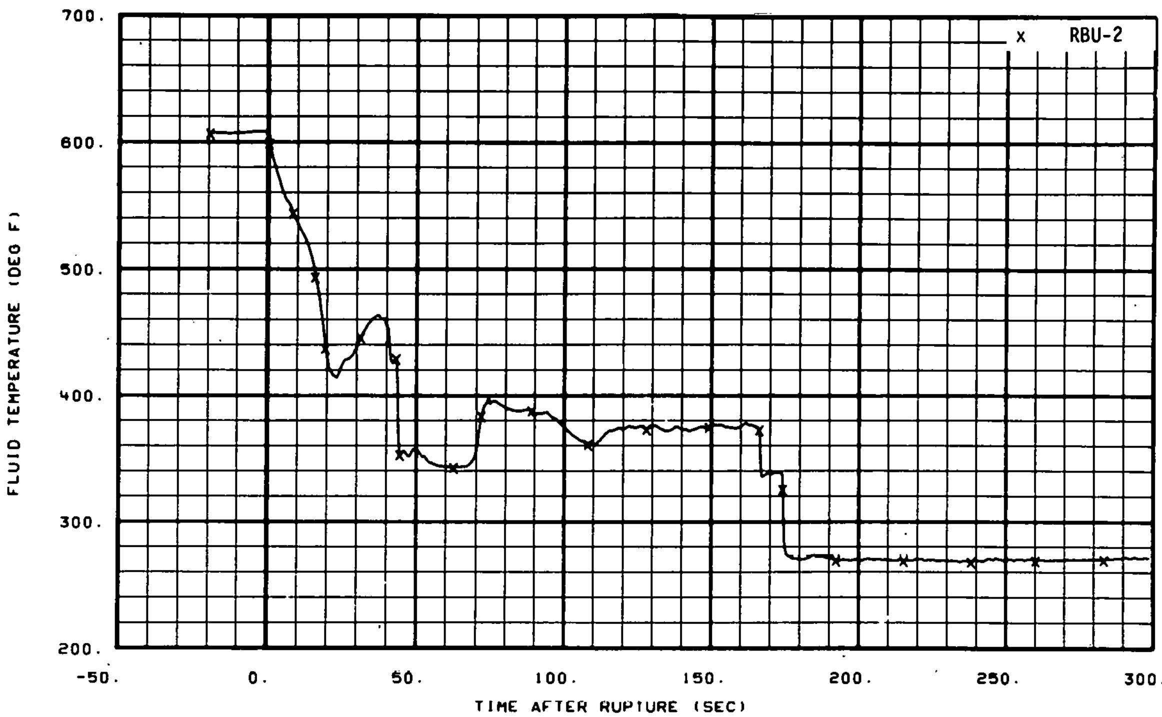

Fig. 9 Fluid temperature in intact loop hot leg (RBU-2), from -20 to 300 seconds.

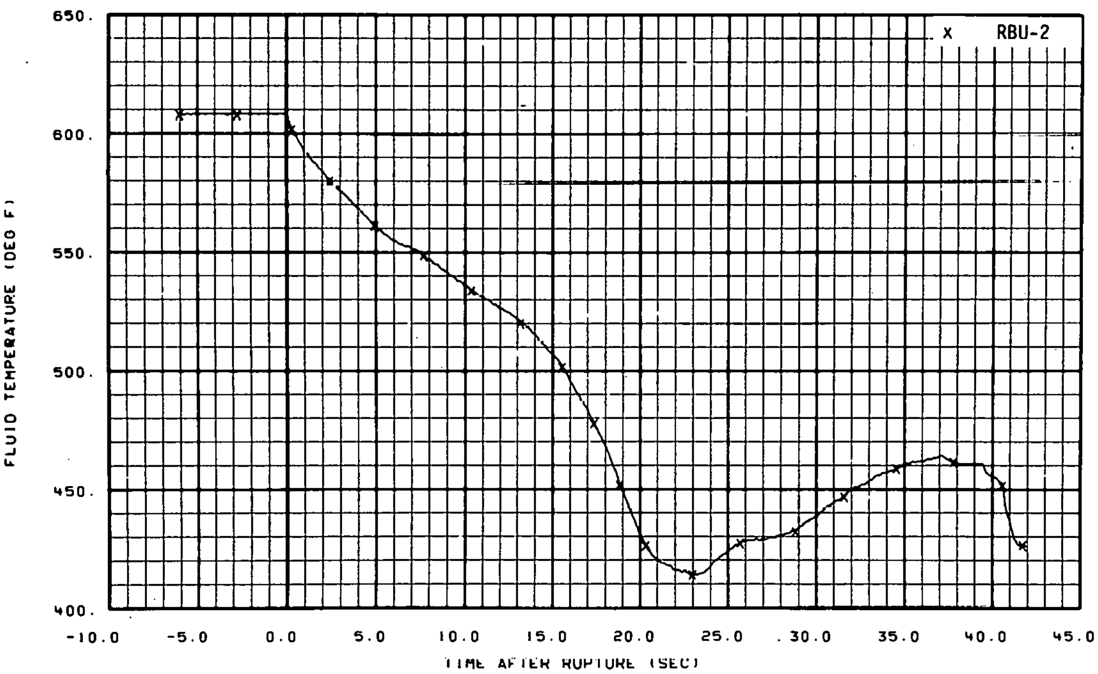

Fig. 10 Fluid temperature in intact loop hot leg (RBU-2), from -6 to 42 seconds.

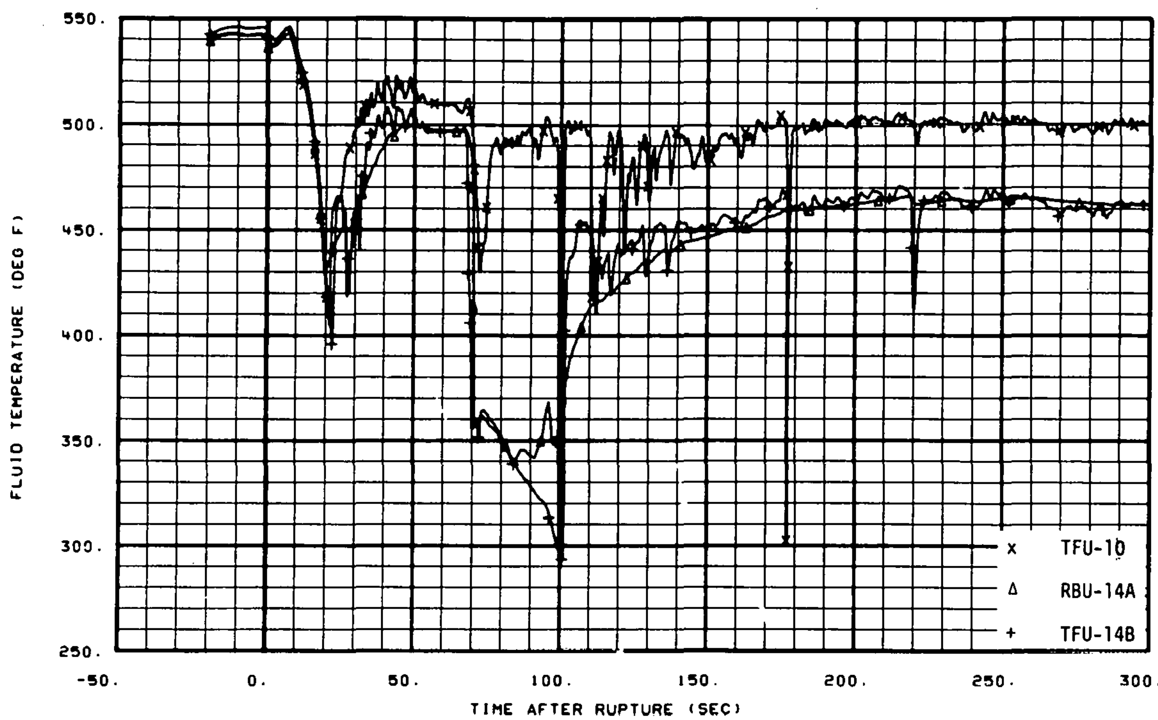

Fig. 11 Fluid temperature in intact loop cold leg (TFU-10, RBU-14A, and TFU-14B), from -20 to 300 seconds.

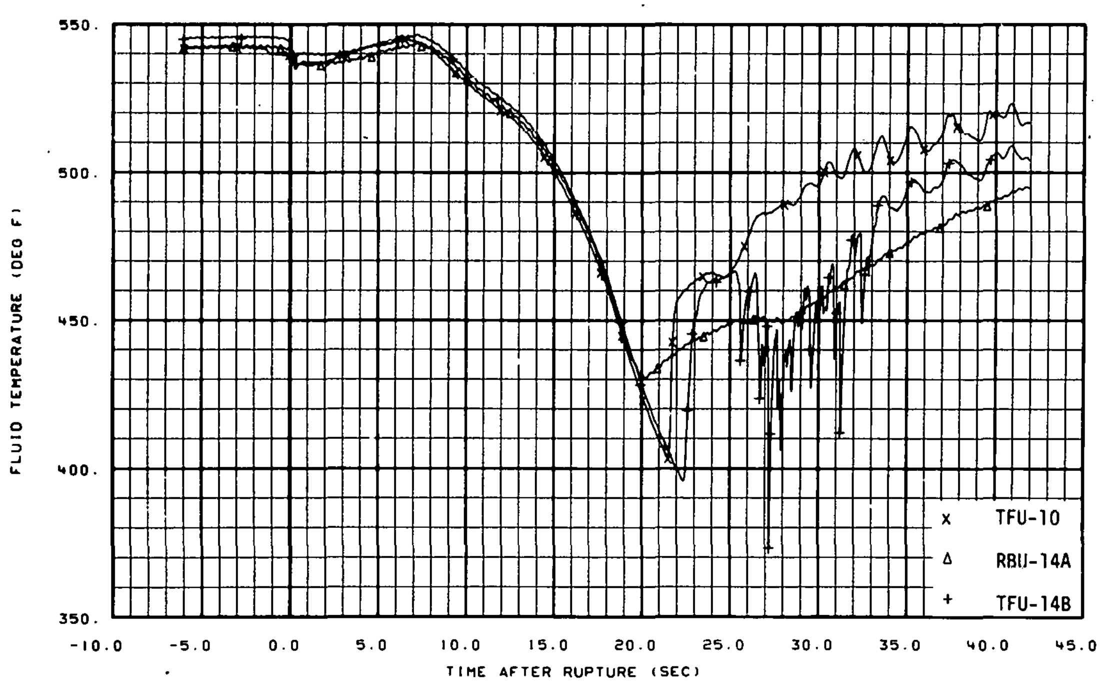

Fig. 12 Fluid temperature in intact loop cold leg (TFU-10, RBU-14A, and TFU-14B), from -6 to 42 seconds.

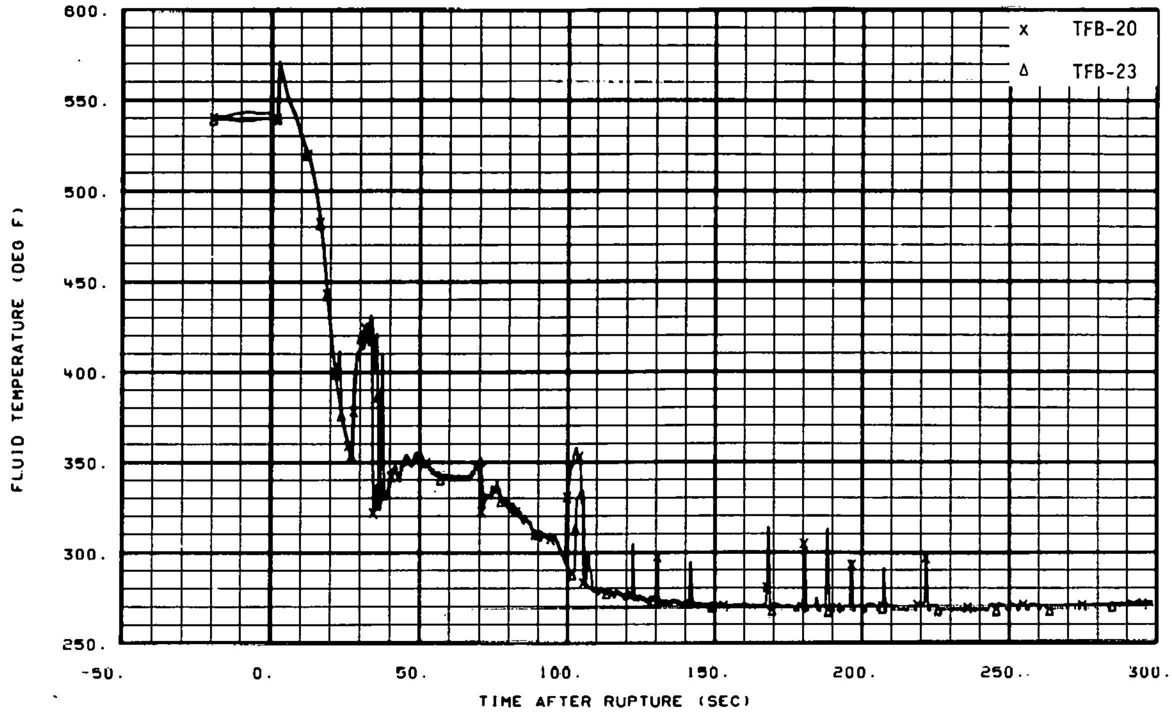

Fig. 13 Fluid temperature in broken loop, vessel side (TFB-20 and TFB-23), from -20 to 300 seconds.

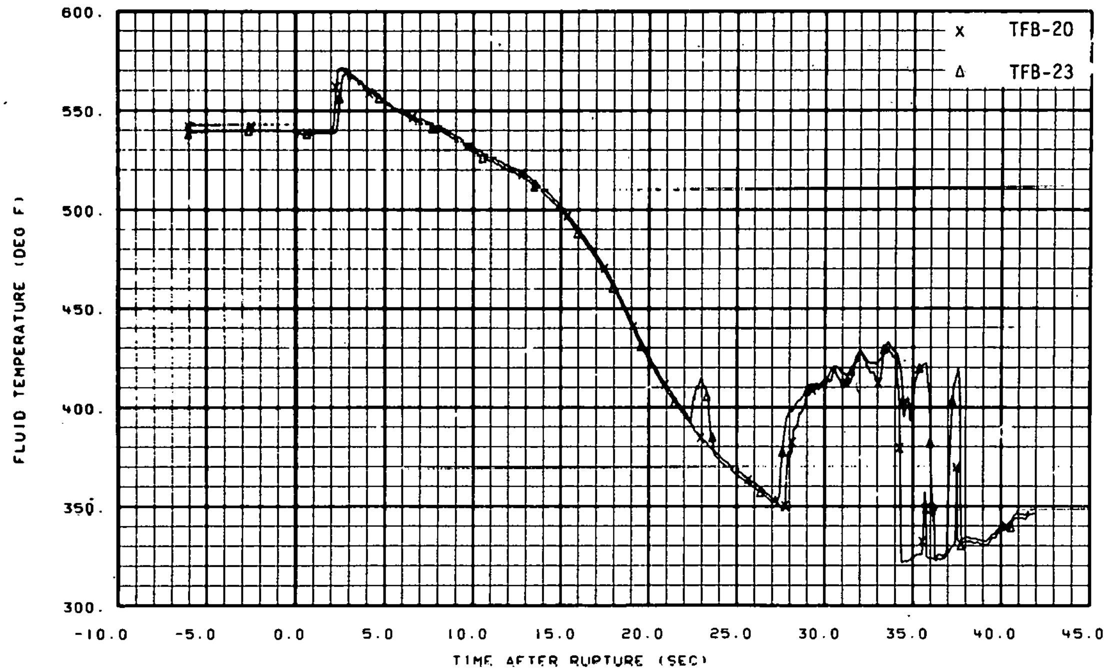

Fig. 14 Fluid temperature in broken loop, vessel side (TFB-20 and TFB-23), from -6 to 42 seconds.

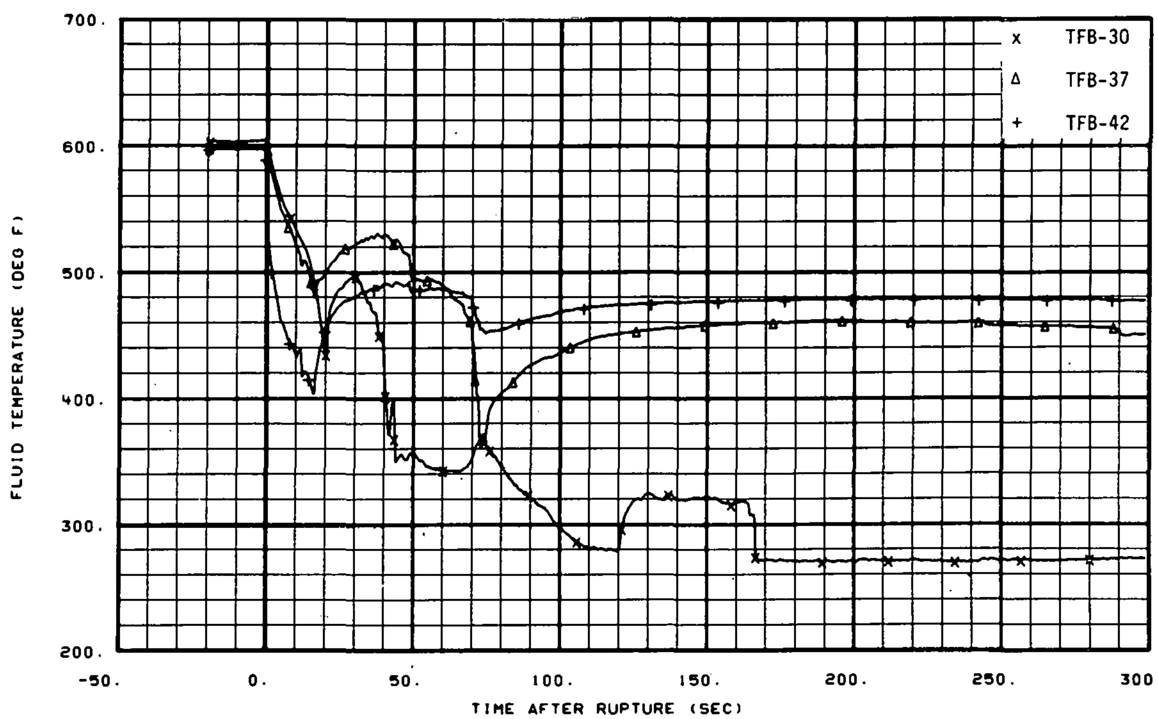

Fig. 15 Fluid temperature in broken loop, pump side (TFB-30, TFB-37, and TFB-42), from -20 to 300 seconds.

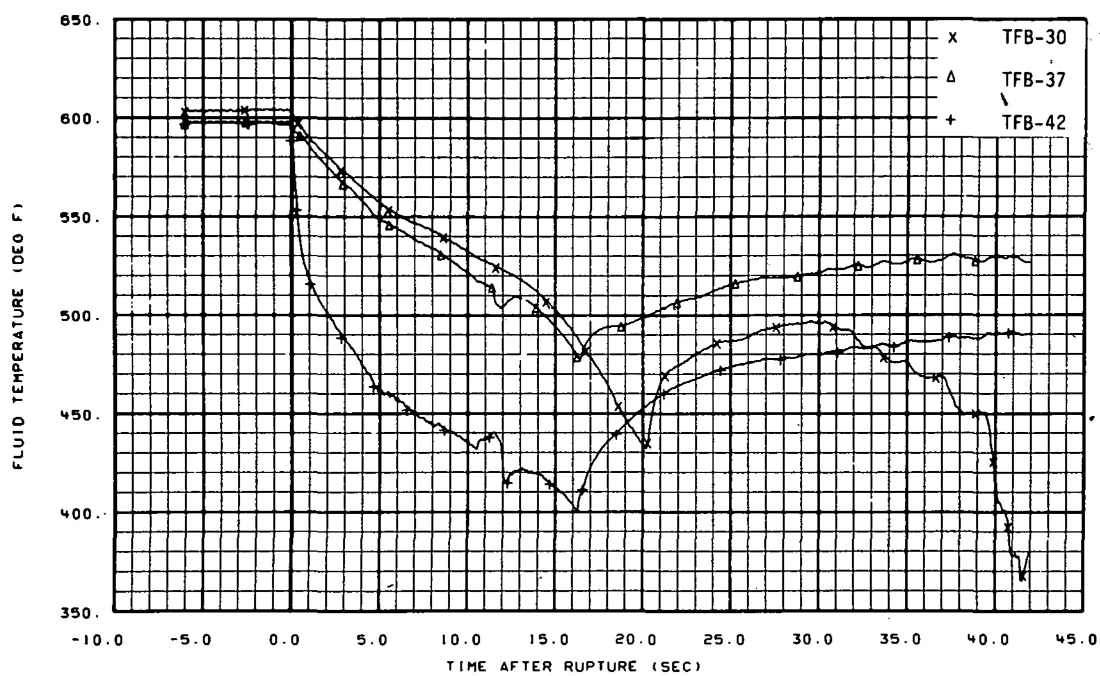

Fig. 16 Fluid temperature in broken loop, pump side (TFB-30, TFB-37, and TFB-42), from -6 to 42 seconds.

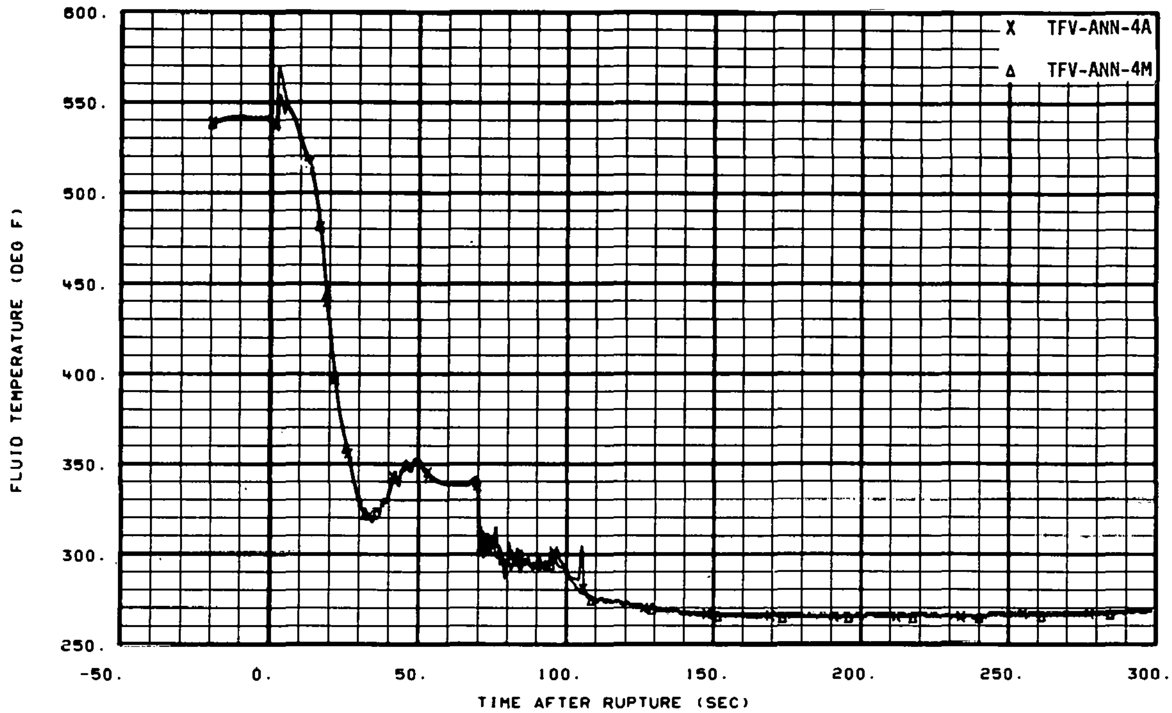

Fig. 17 Fluid temperature in inlet annulus (TFV-ANN-4A and TFV-ANN-4M), from -20 to 300 seconds.

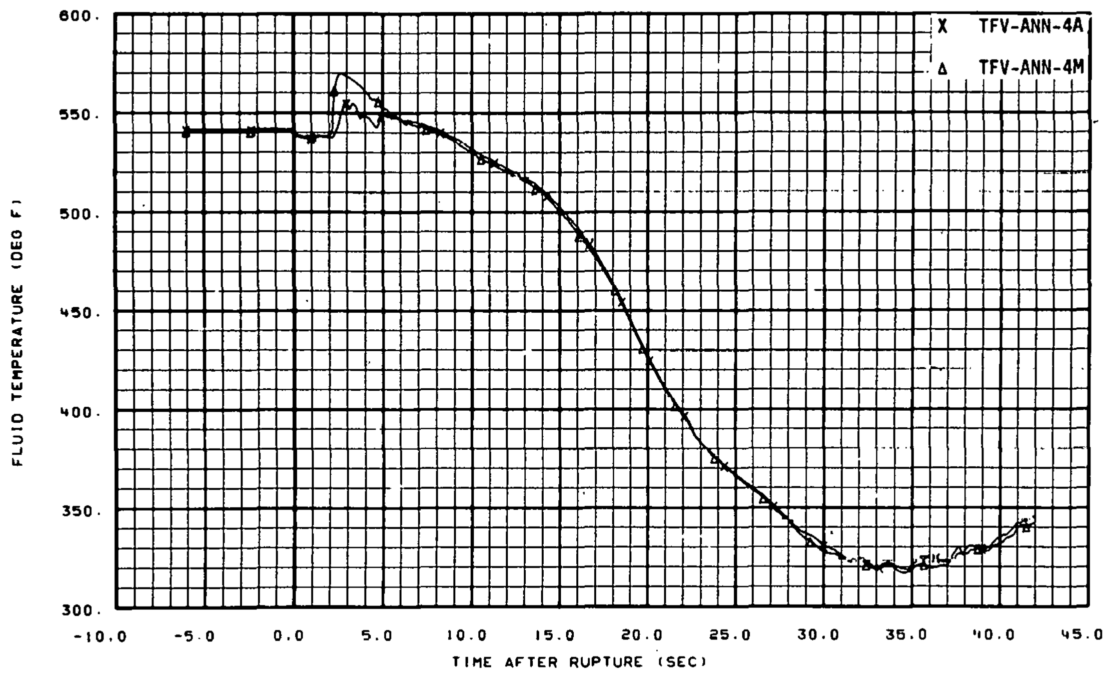

Fig. 18 Fluid temperature in inlet annulus (TFV-ANN-4A and TFV-ANN-4M), from -6 to 42 seconds.

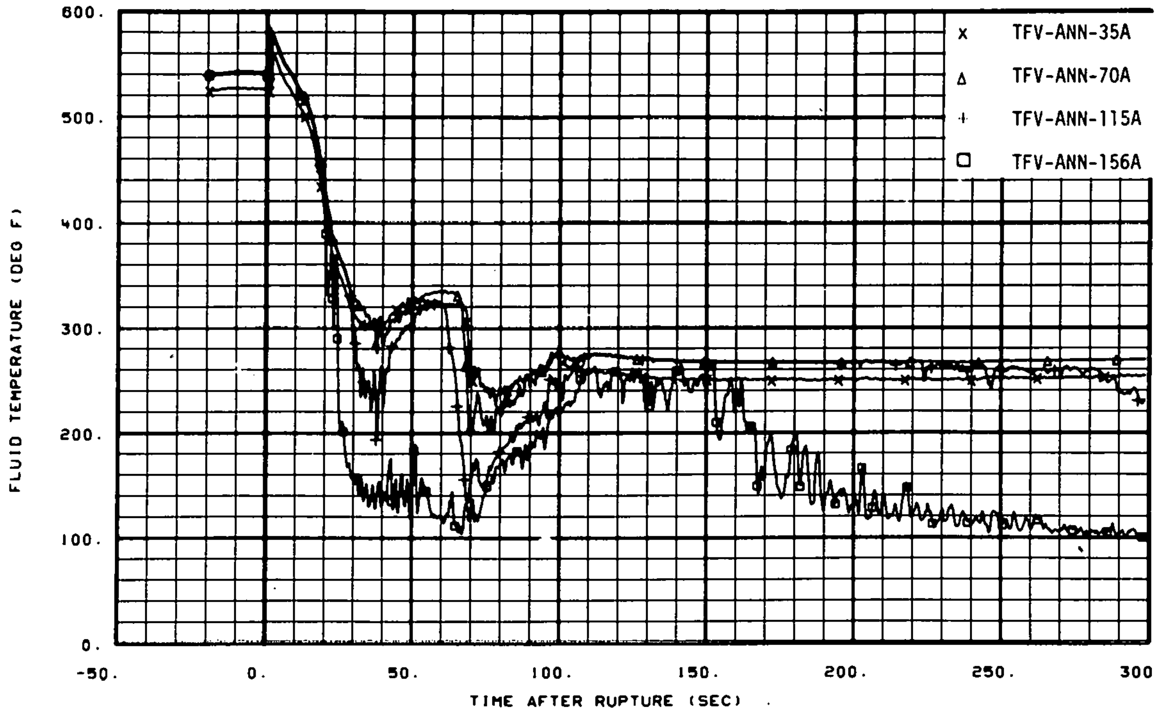

Fig. 19 Fluid temperature in downcomer annulus (TFV-ANN-35A, TFV-ANN-70A, TFV-ANN-115A, and TFV-ANN-156A), from -20 to 300 seconds.

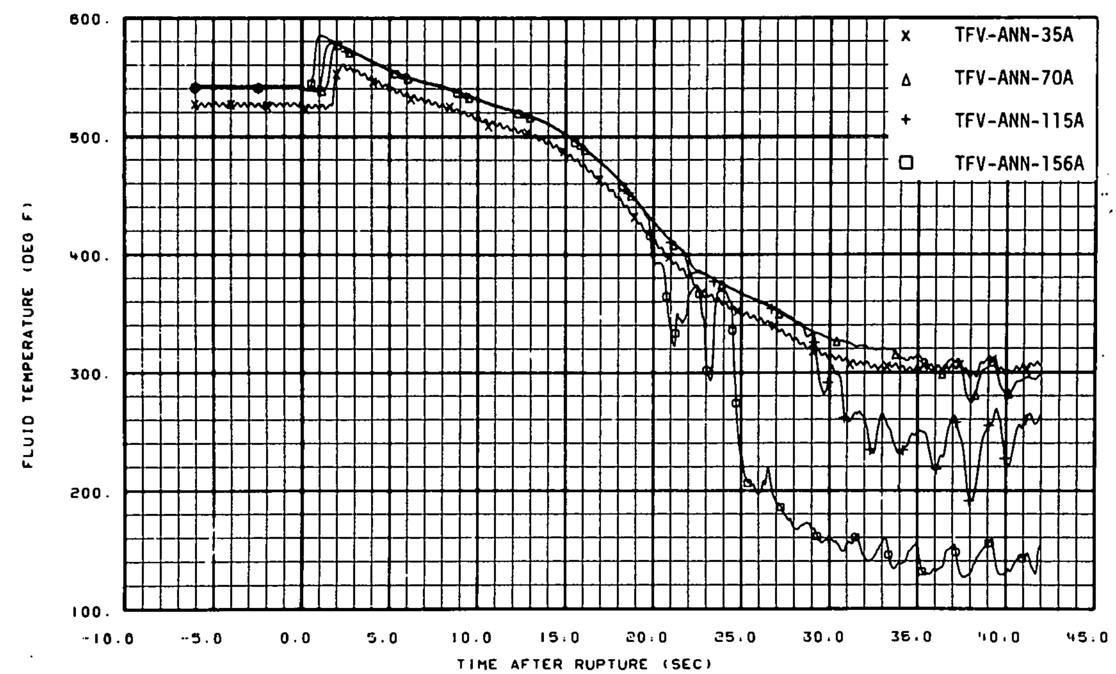

Fig. 20 Fluid temperature in downcomer annulus (TFV-ANN-35A, TFV-ANN-70A, TFV-ANN-115A, and TFV-ANN-156A), from -6 to 42 seconds.

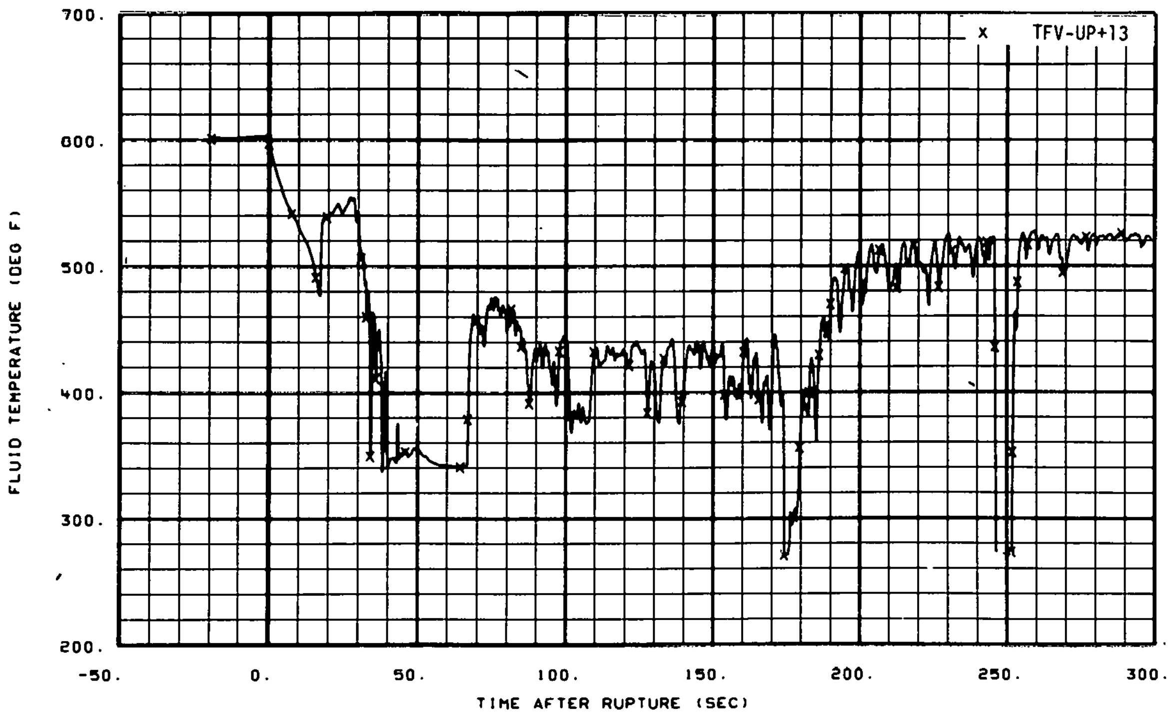

Fig. 21 Fluid temperature in upper plenum (TFV-UP+13), from -20 to 300 seconds.

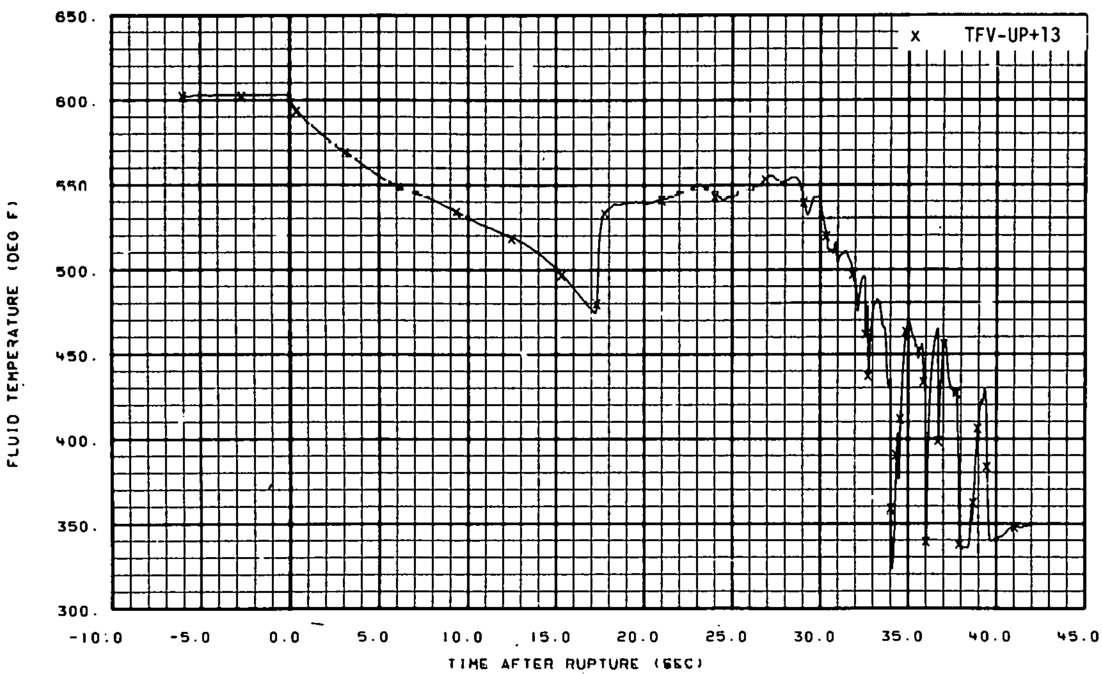

Fig. 22 Fluid temperature in upper plenum (TFV-UP+13), from -6 to 42 seconds.

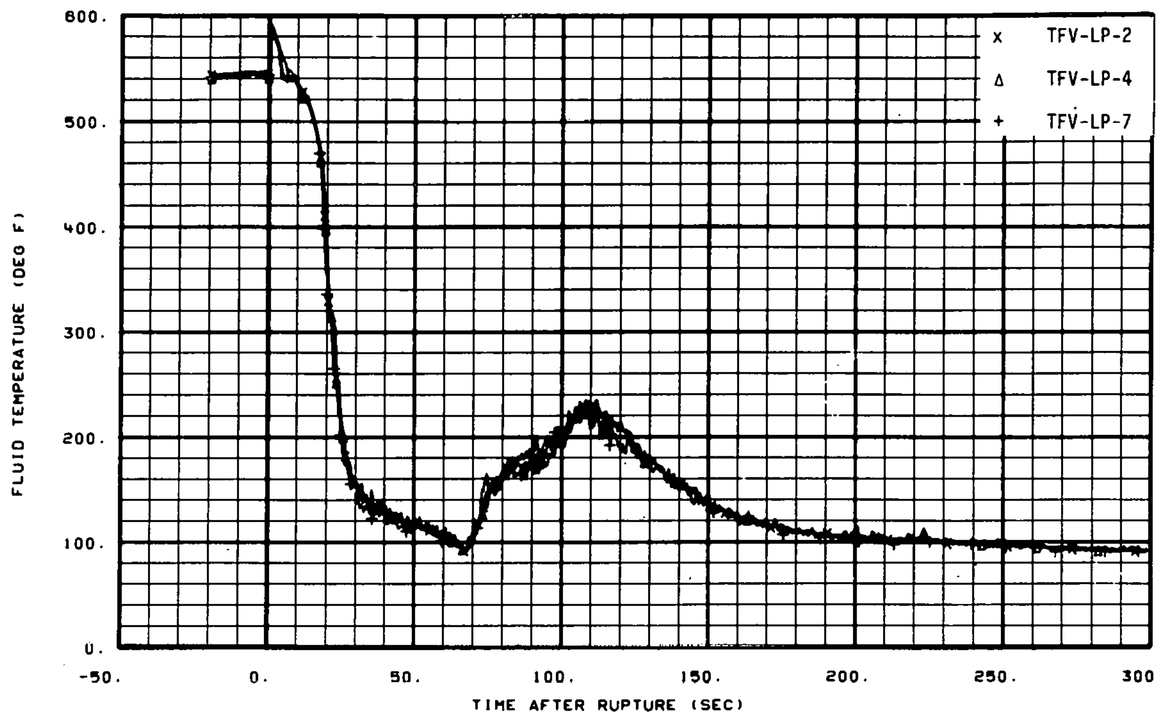

Fig. 23 Fluid temperature in lower plenum (TFV-LP-2, TFV-LP-4, and TFV-LP-7), from -20 to 300 seconds.

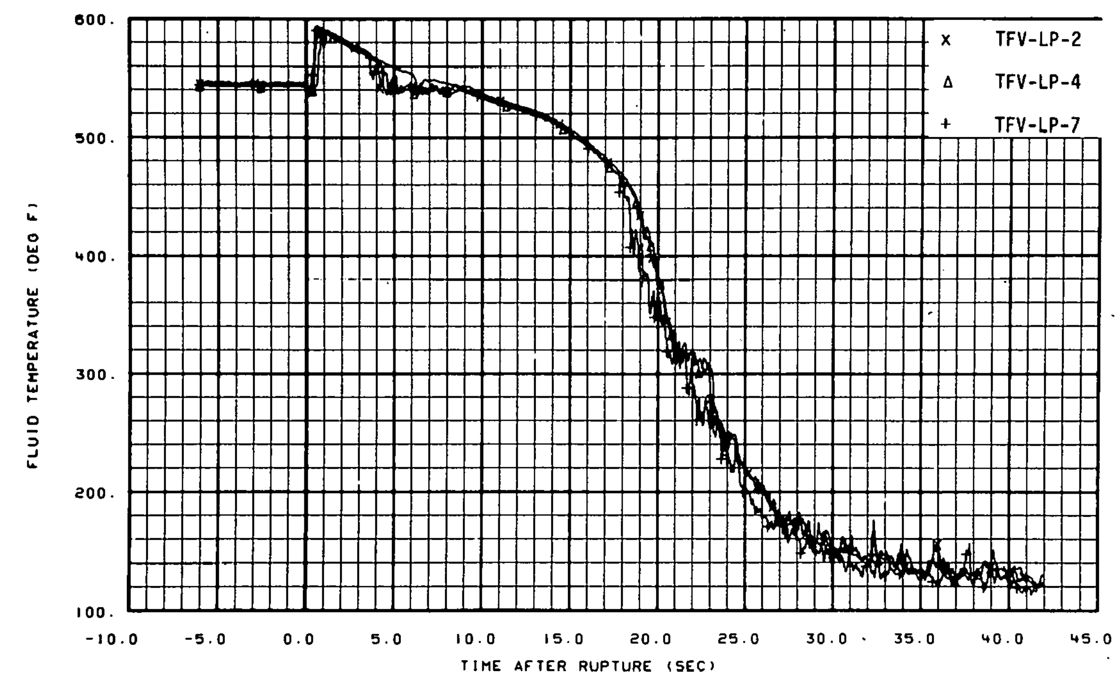

Fig. 24 Fluid temperature in lower plenum (TFV-LP-2, TFV-LP-4, and TFV-LP-7), from -6 to 42 seconds.

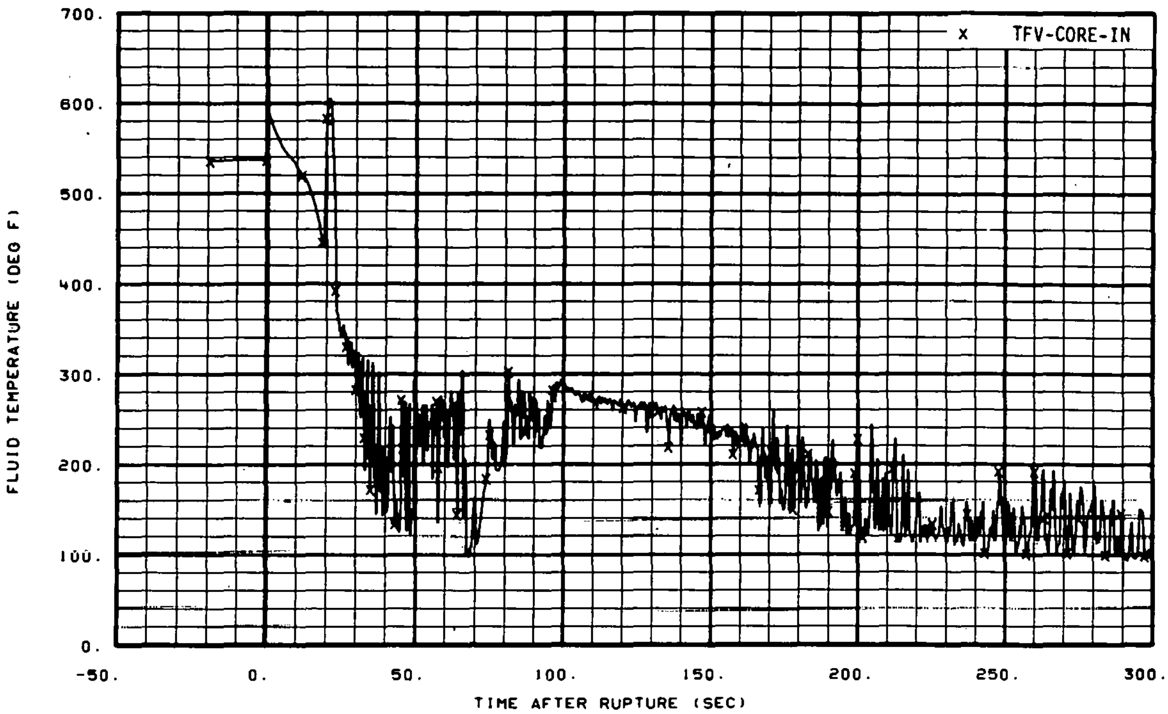

Fig. 25 Fluid temperature in core inlet (TFV-CORE-IN), from -20 to 300 seconds.

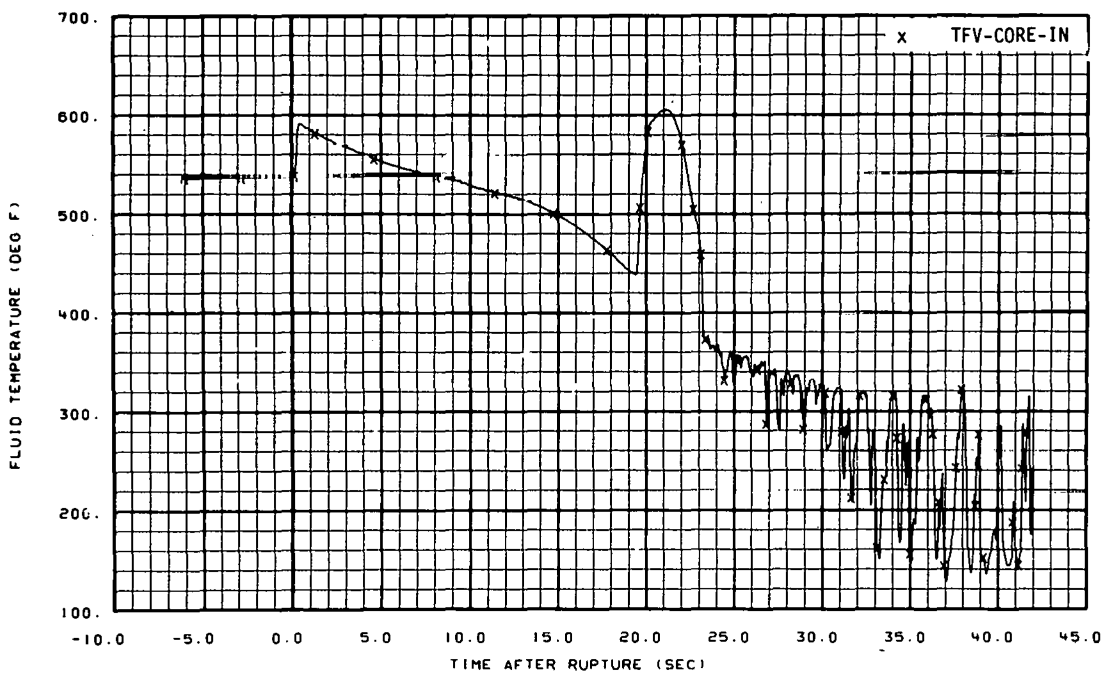

Fig. 26 Fluid temperature in core inlet (TFV-CORE-IN), from -6 to 42 seconds.

Fig. 27 Fluid temperature in core barrel insulation gap (TFV-CIG-70A), from -20 to 300 seconds.

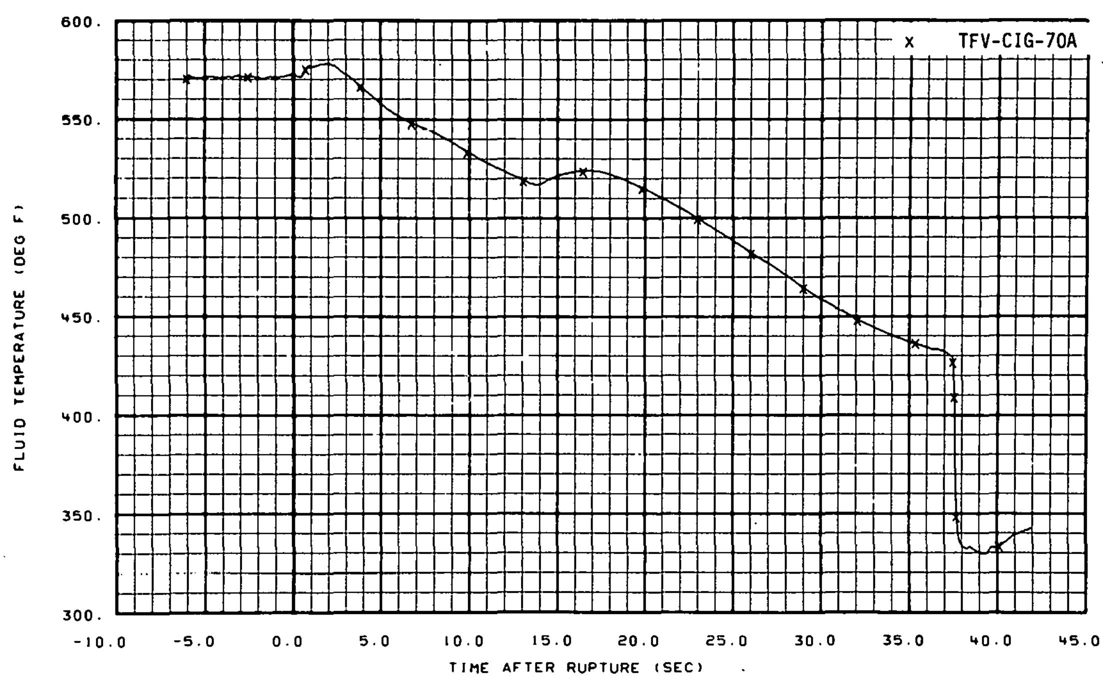

Fig. 28 Fluid temperature in core barrel insulation gap (TFV-CIG-70A), from -6 to 42 seconds.

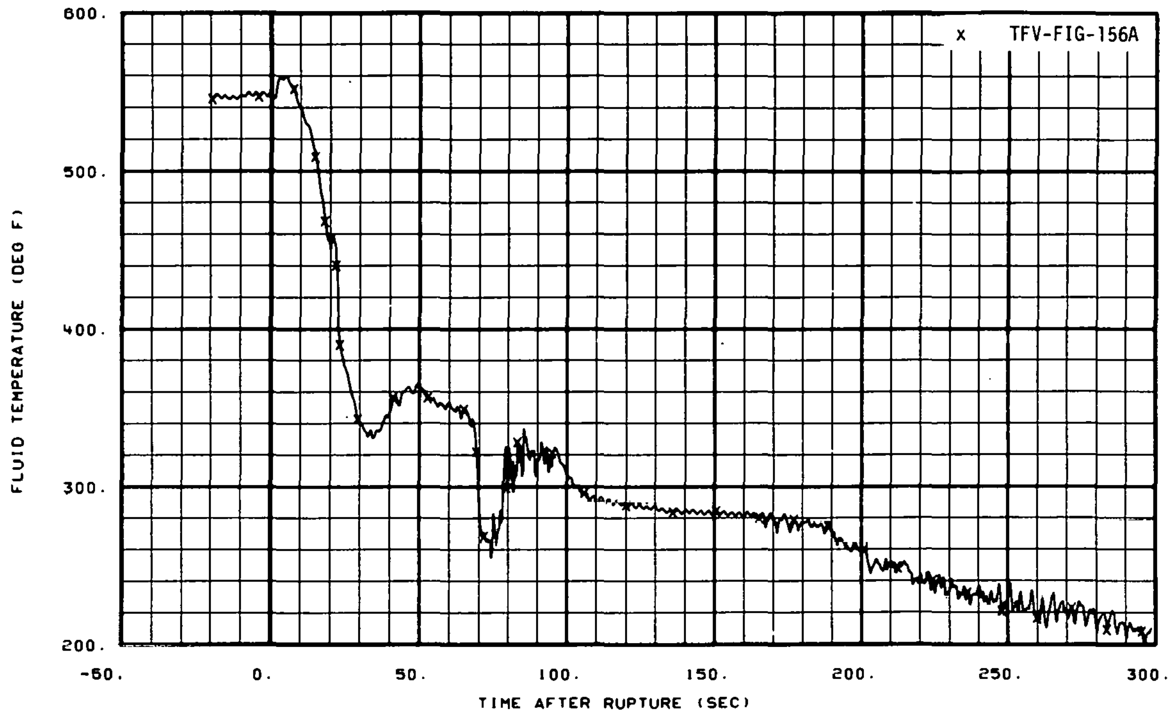

Fig. 29 Fluid temperature in vessel filler insulation gap (TFV-FIG-156A), from -20 to 300 seconds.

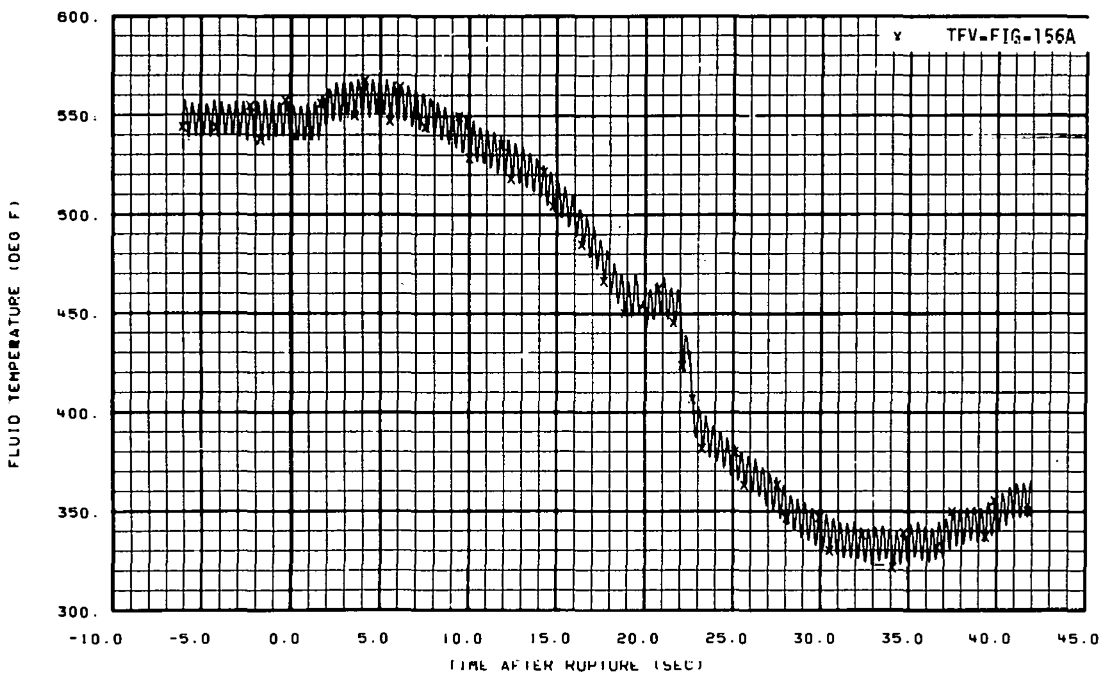

Fig. 30 Fluid temperature in vessel filler insulation gap (TFV-FIG-156A), from -6 to 42 seconds.

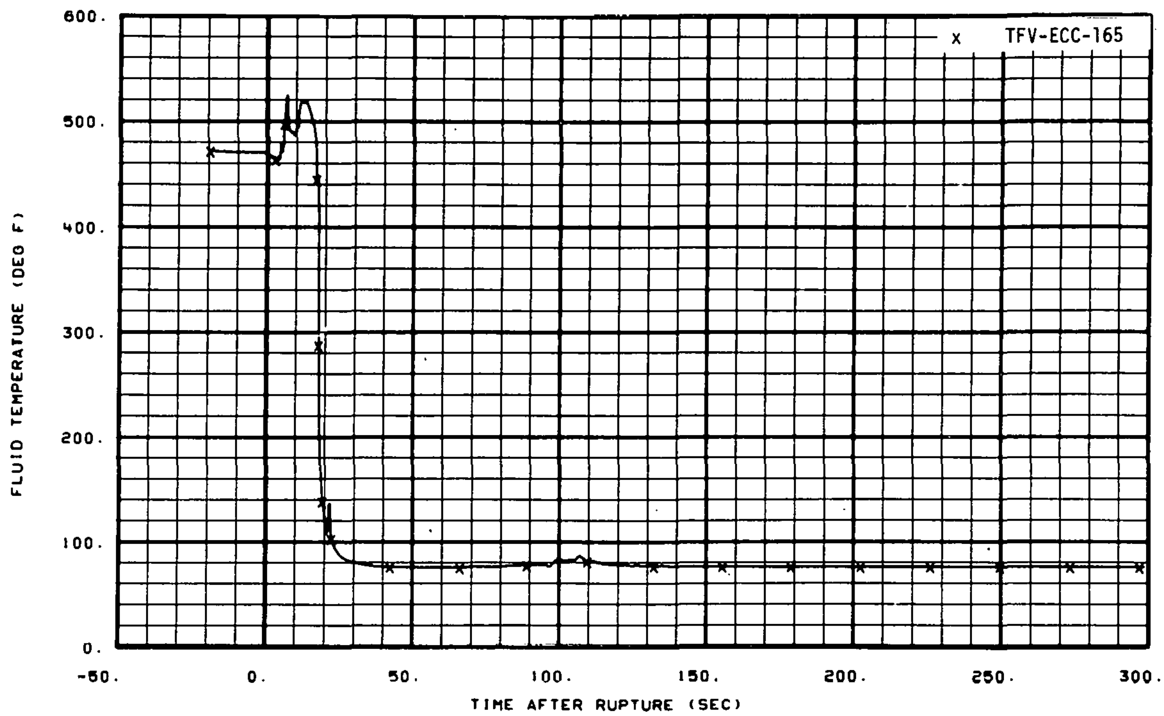

Fig. 31 Fluid temperature in lower plenum (TFV-ECC-165), from -20 to 300 seconds.

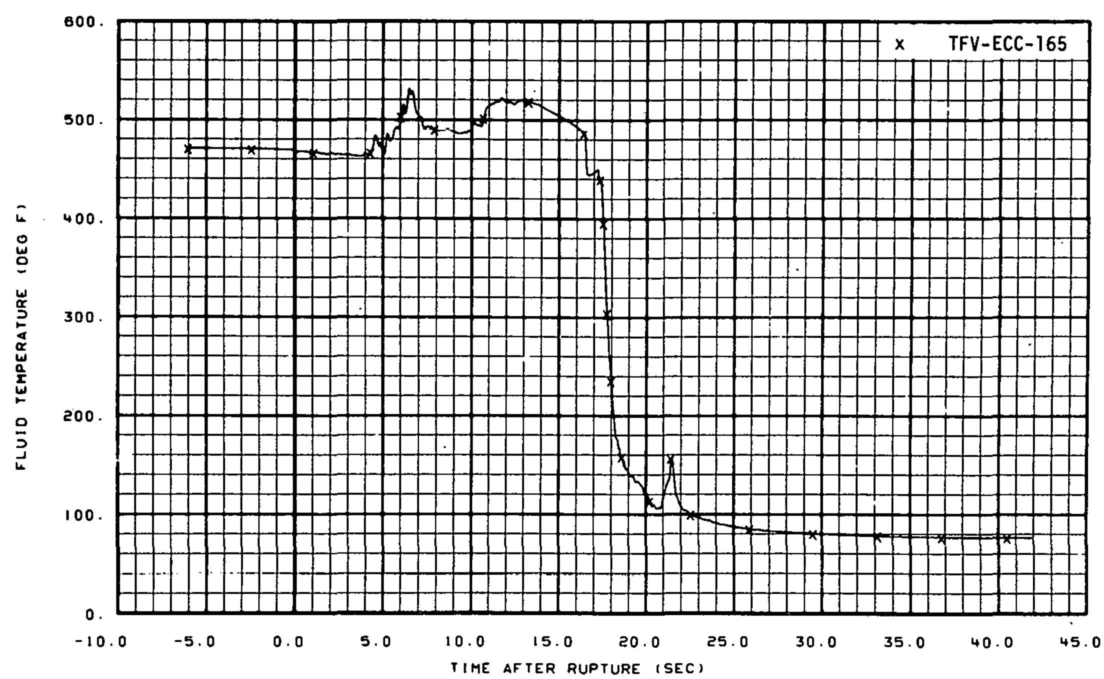

Fig. 32 Fluid temperature in lower plenum (TFV-ECC-165), from -6 to 42 seconds.

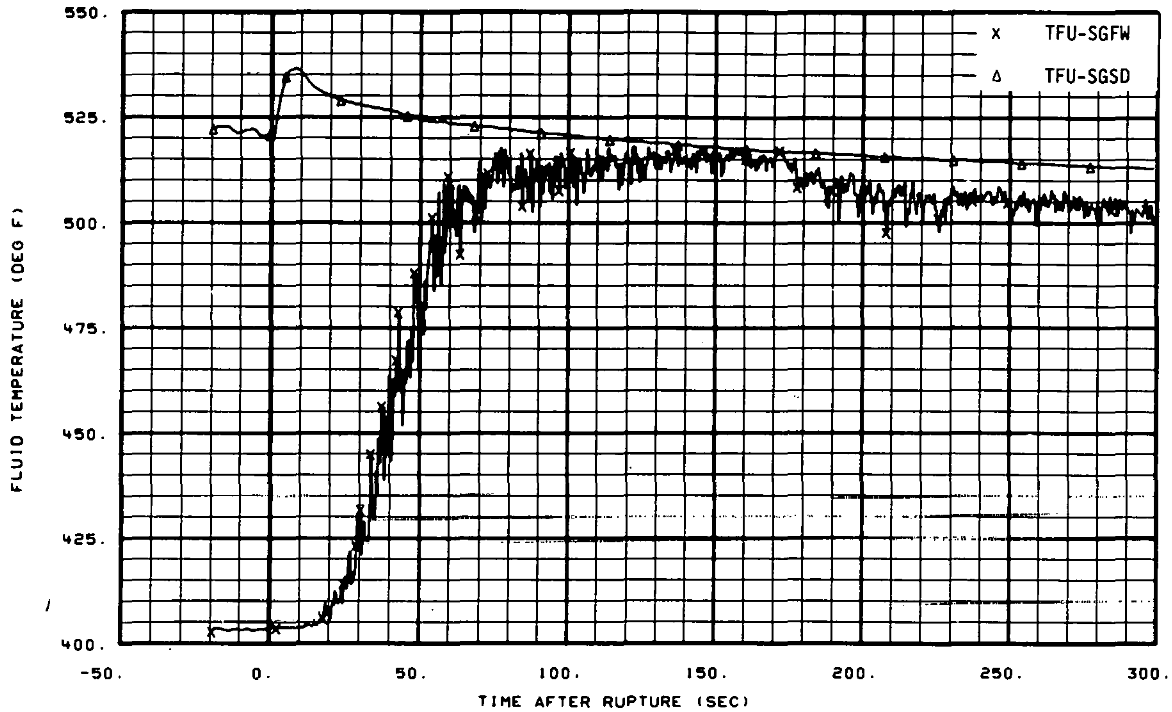

Fig. 33 Fluid temperature in steam generator (TFU-SGFW and TFU-SGSD), from -20 to 300 seconds.

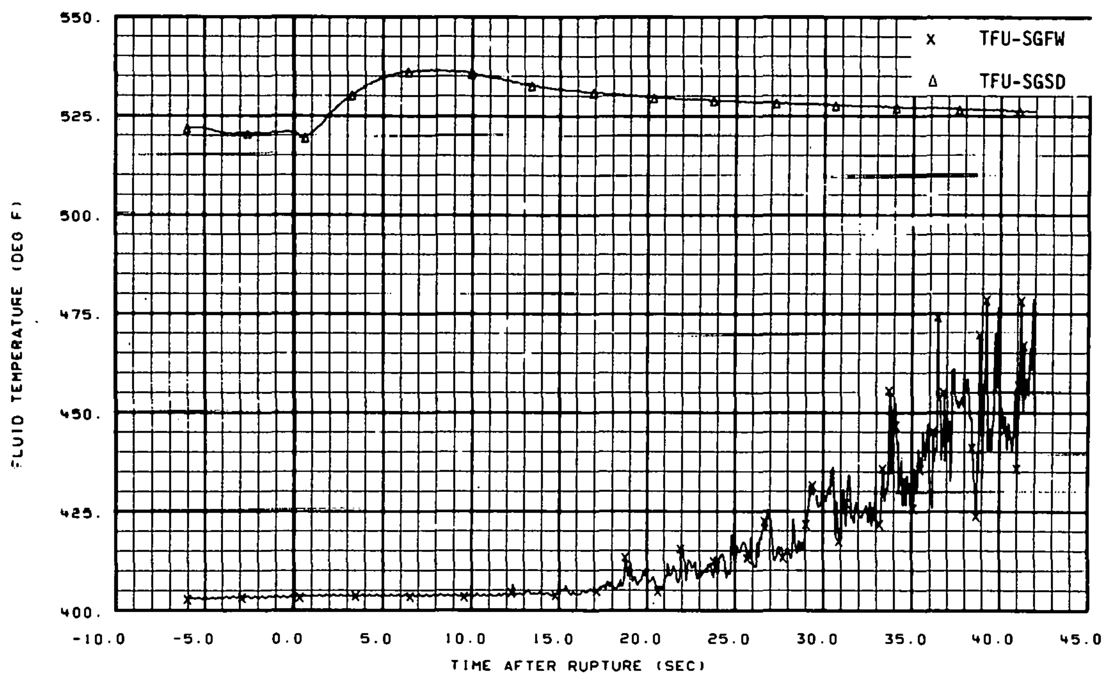

Fig. 34 Fluid temperature in steam generator (TFU-SGFW and TFU-SGSD), from -6 to 42 seconds.

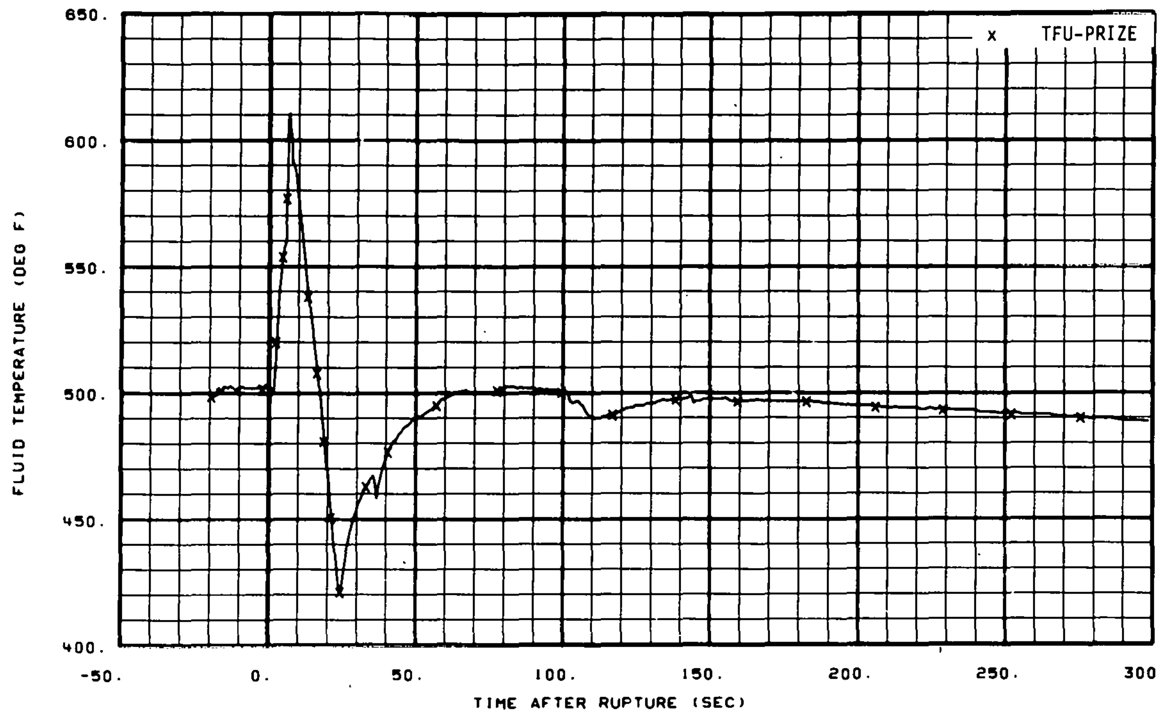

Fig. 35 Fluid temperature in pressurizer surge line (TFU-PRIZE), from -20 to 300 seconds.

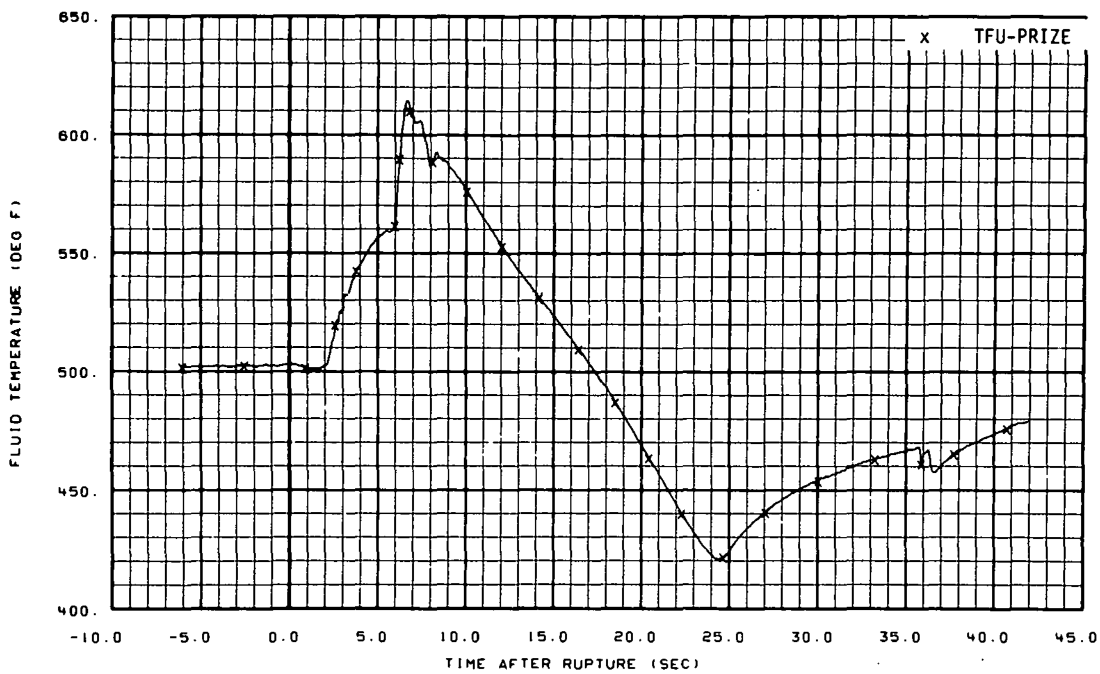

Fig. 36 Fluid temperature in pressurizer surge line (TFU-PRIZE), from -6 to 42 seconds.

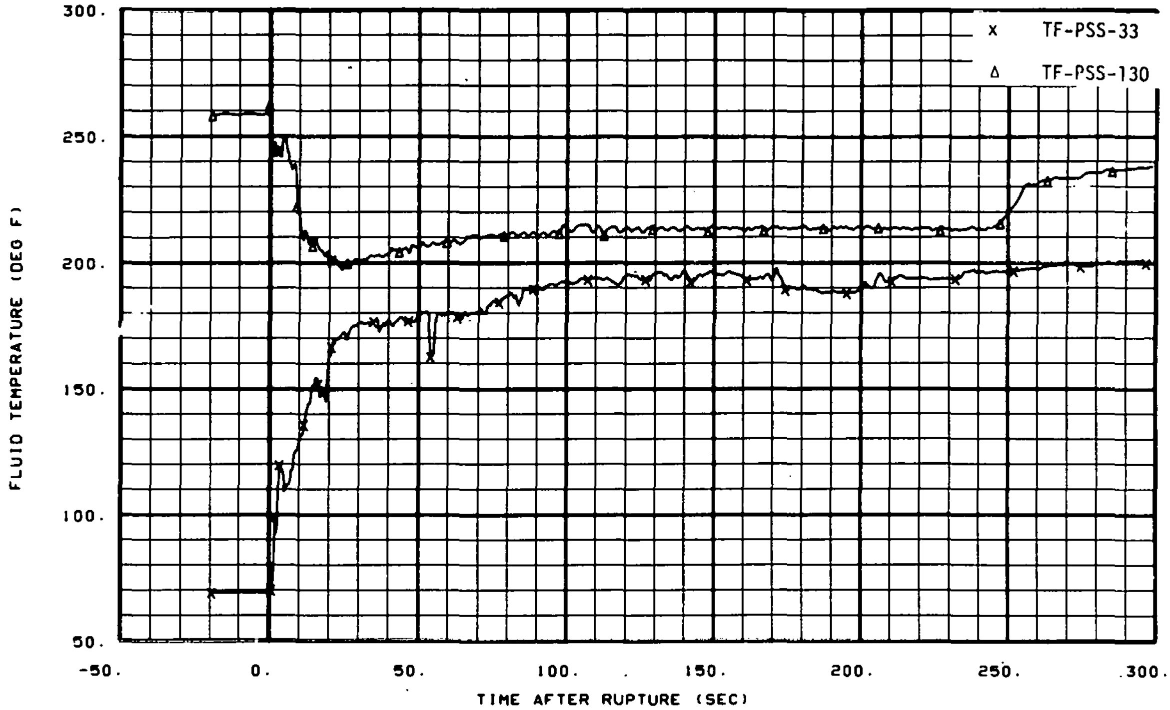

Fig. 37 Fluid temperature in pressure suppression tank (TF-PSS-33 and TF-PSS-130), from -20 to 300 seconds.

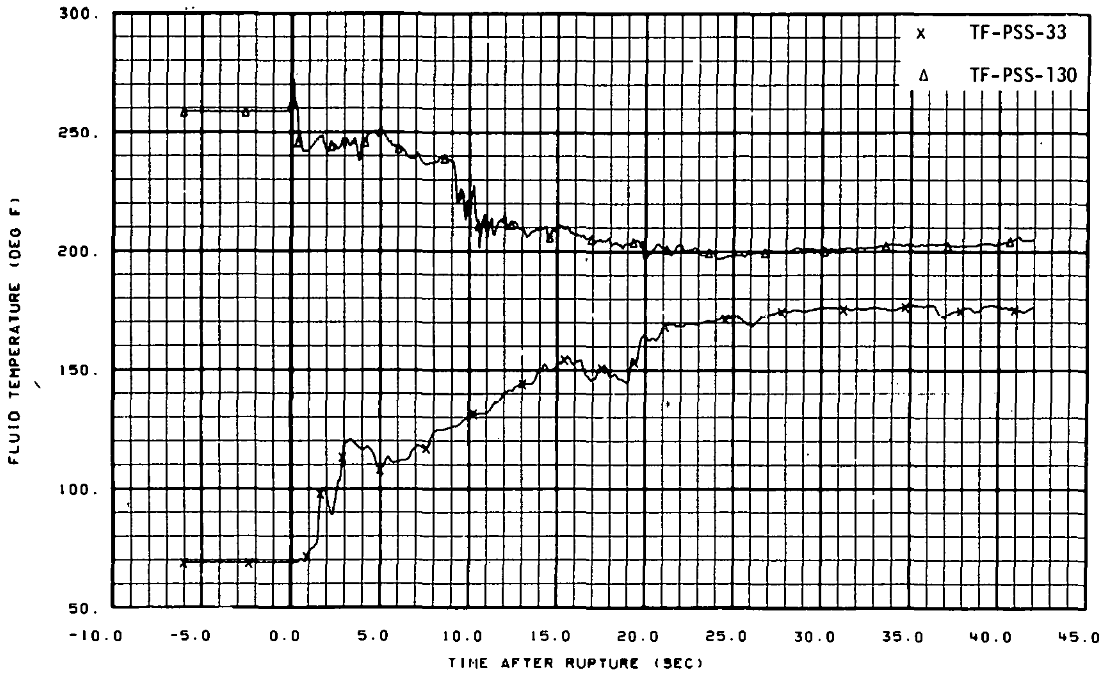

Fig. 38 Fluid temperature in pressure suppression tank (TF-PSS-33 and TF-PSS-130), from -6 to 42 seconds.

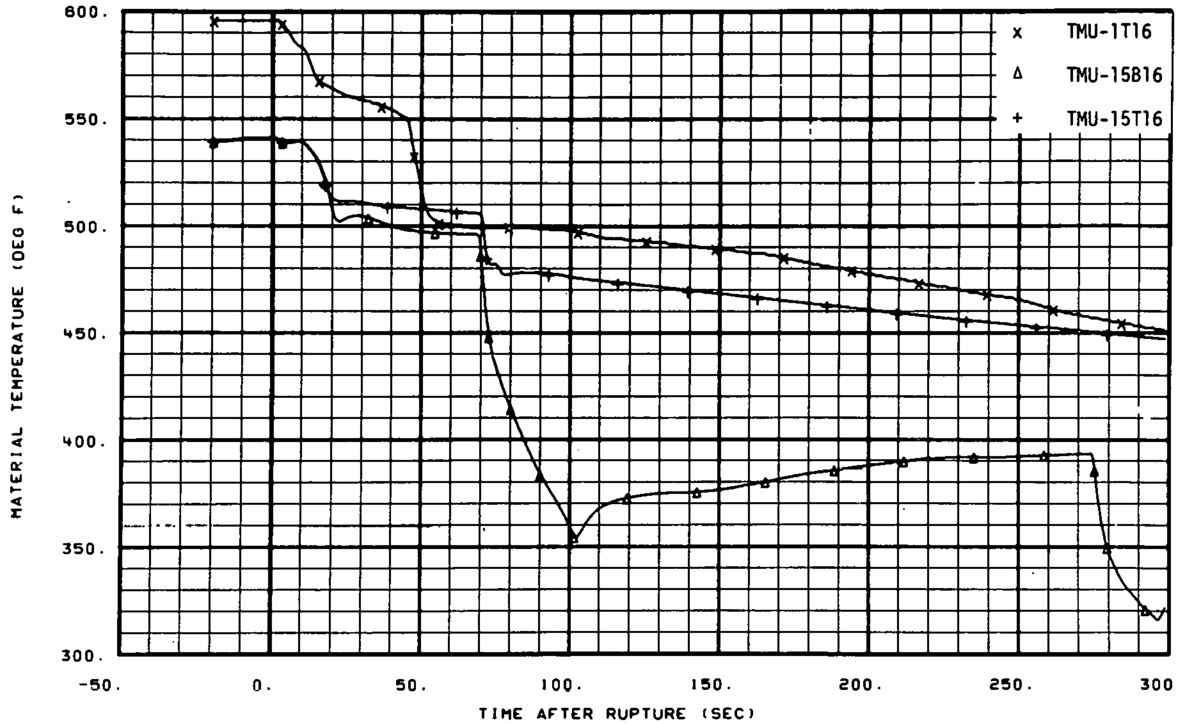

Fig. 39 Material temperature in intact loop (TMU-1T16, TMU-15B16, TMU-15T16), from -20 to 300 seconds.

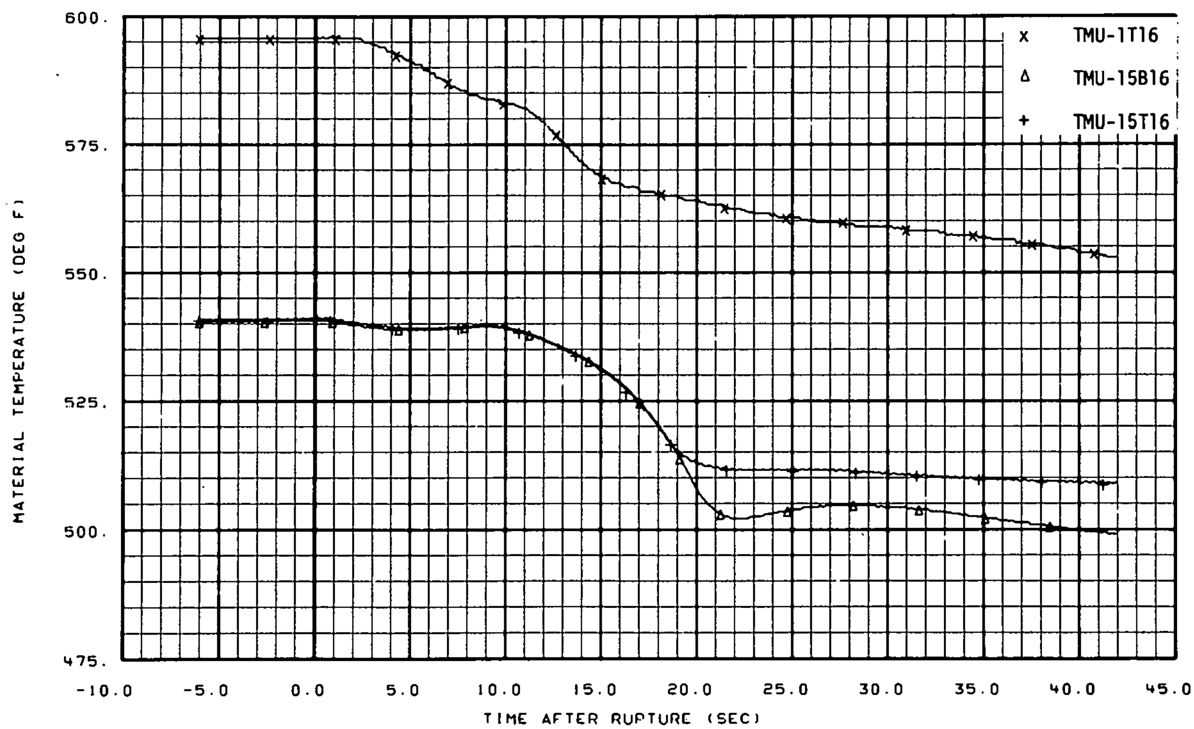

Fig. 40 Material temperature in intact loop (TMU-1T16, TMU-15B16, TMU-15T16), from -6 to 42 seconds.

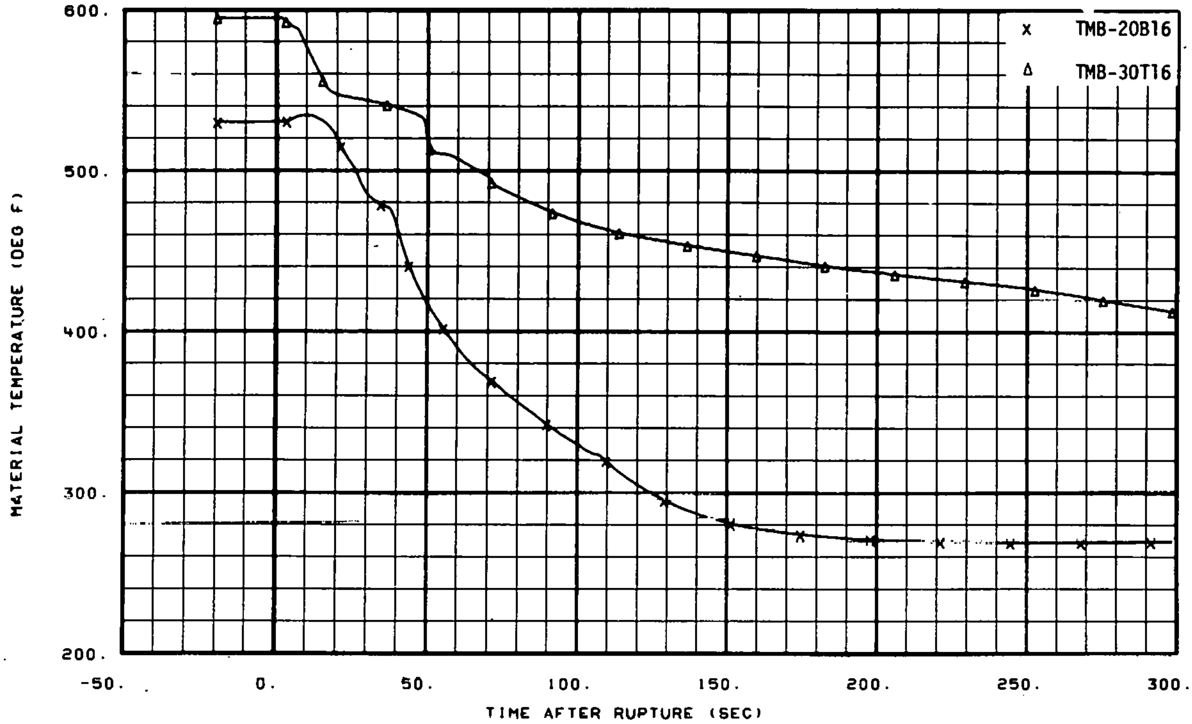

Fig. 41 Material temperature in broken loop (TMB-20B16 and TMB-30T16), from -20 to 300 seconds.

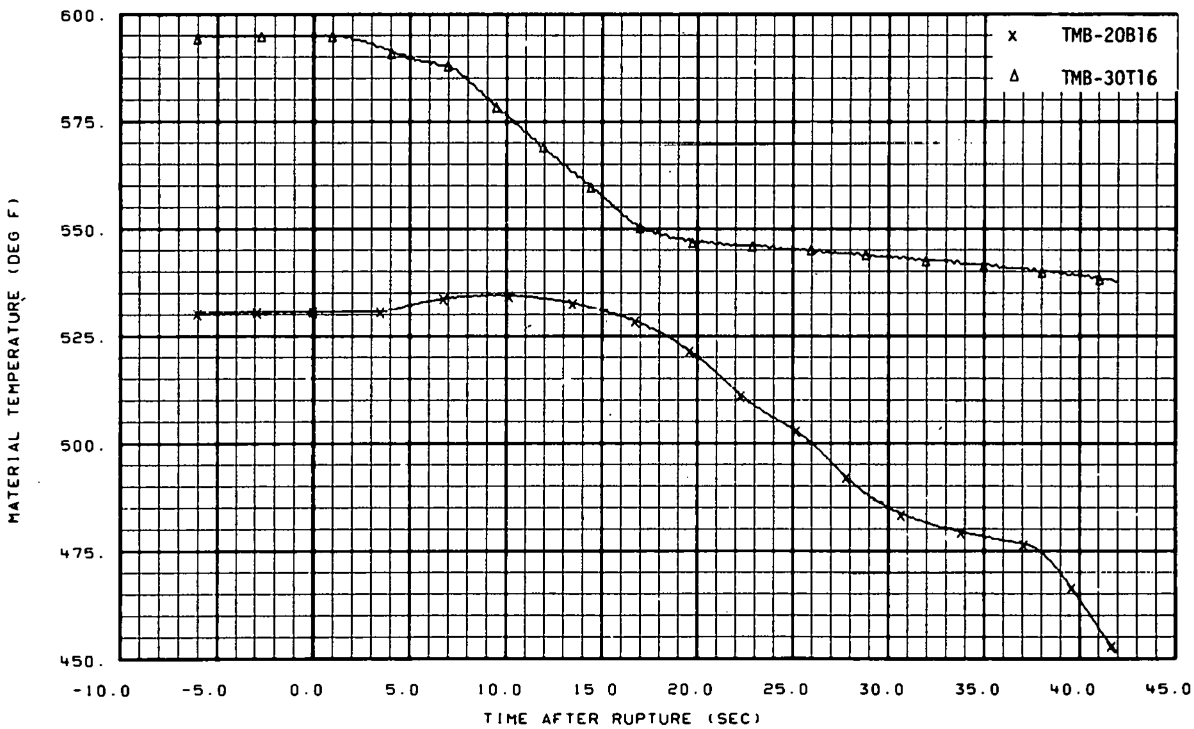

Fig. 42 Material temperature in broken loop (TMB-20B16 and TMB-30T16), from -6 to 42 seconds.

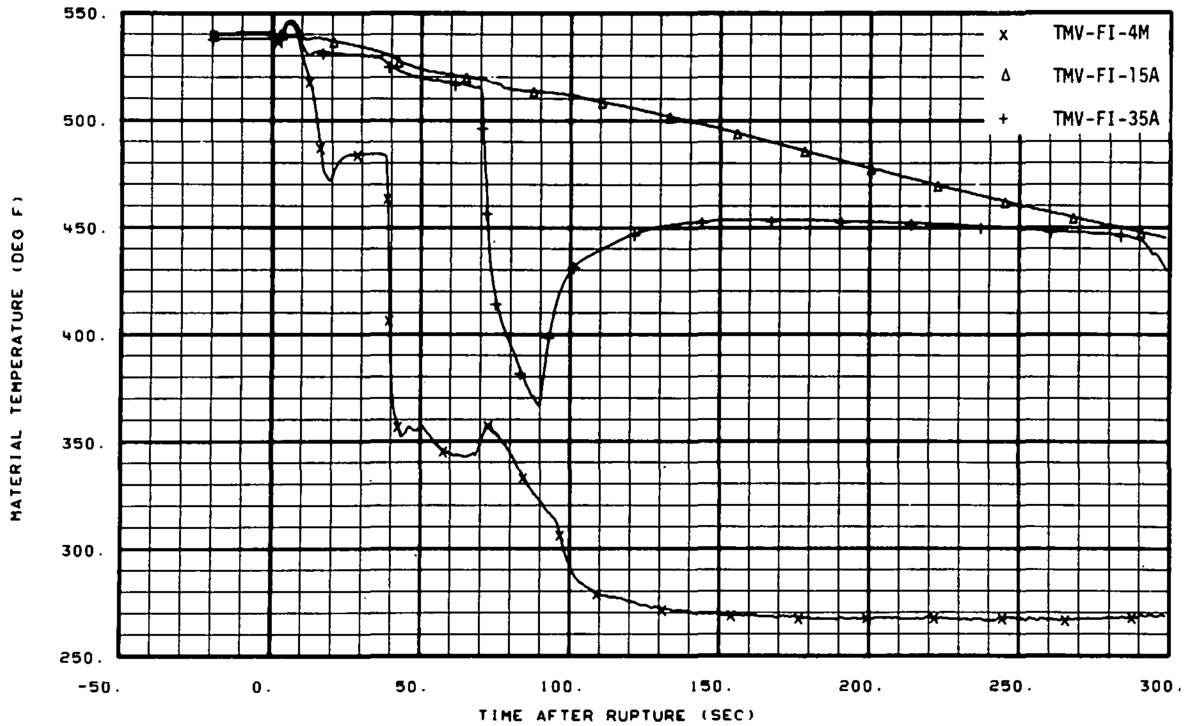

Fig. 43 Material temperature in vessel filler (TMV-FI-4M, TMV-FI-15A, and TMV-FI-35A), from -20 to 300 seconds.

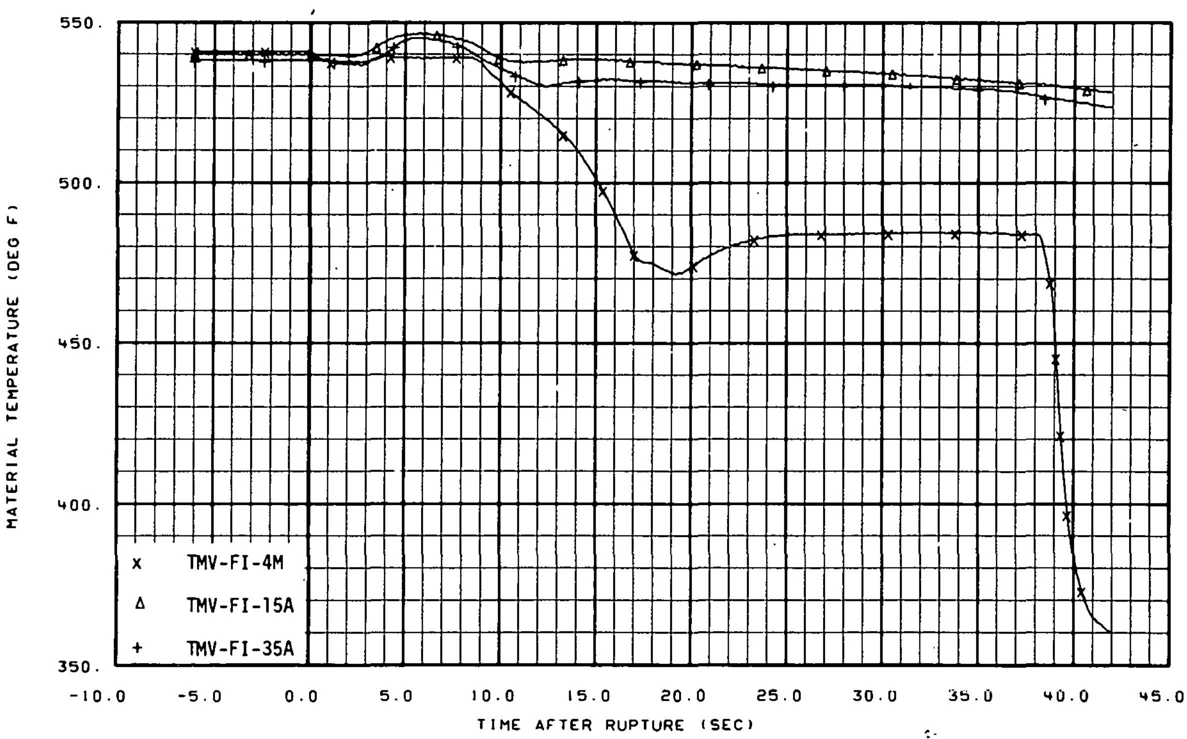

Fig. 44 Material temperature in vessel filler (TMV-FI-4M, TMV-FI-15A, and TMV-FI-35A), from -6 to 42 seconds.

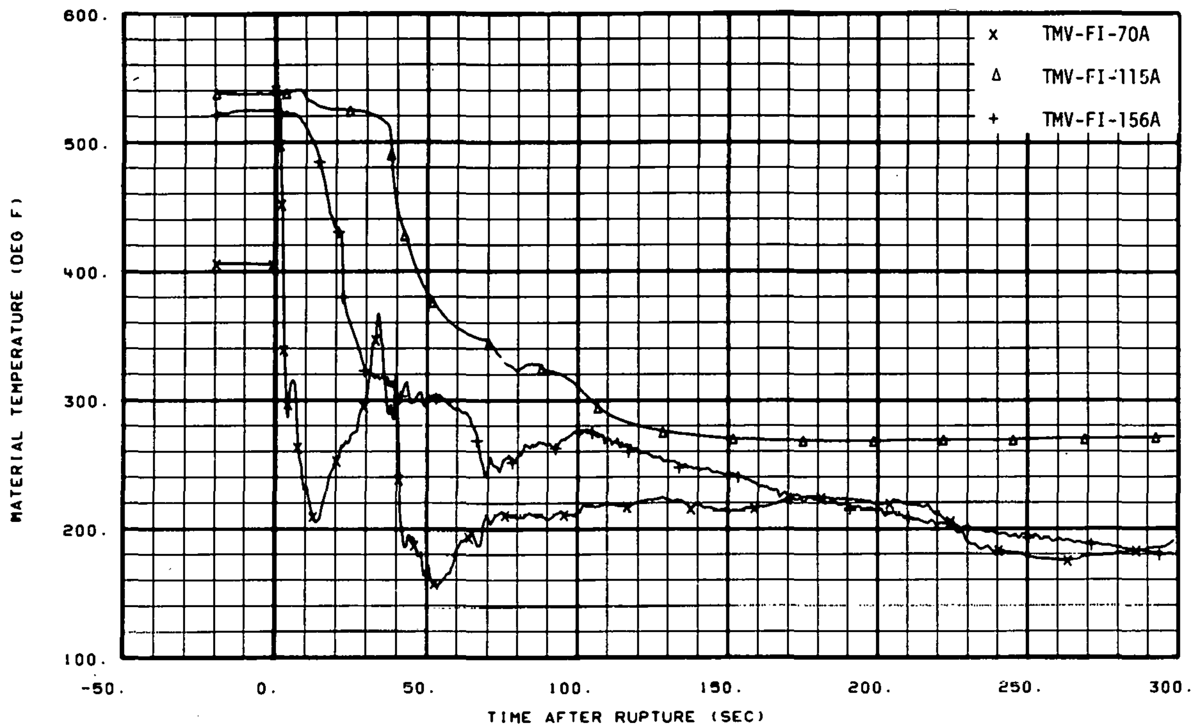

Fig. 45 Material temperature in vessel filler (TMV-FI-70A, TMV-FI-115A, and TMV-FI-156A), from -20 to 300 seconds.

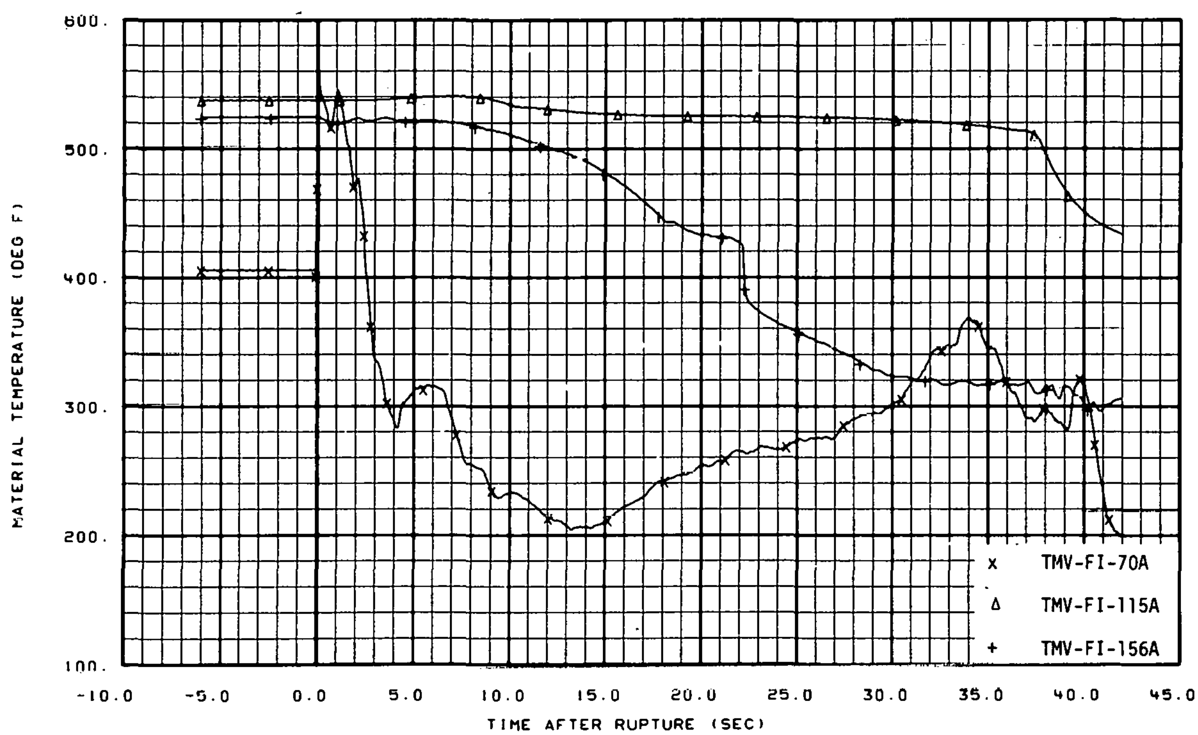

Fig. 46 Material temperature in vessel filler (TMV-FI-70A, TMV-FI-115A, and TMV-FI-156A), from -6 to 42 seconds.

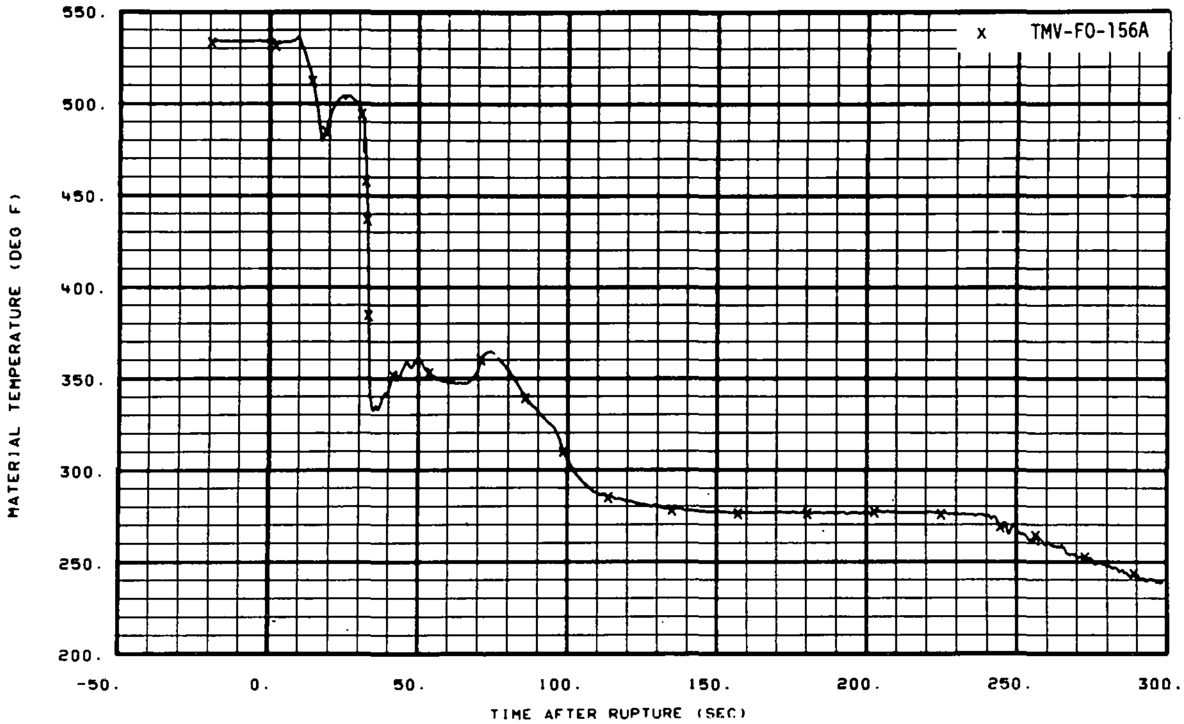

Fig. 47 Material temperature in vessel filler (TMV-FO-156A), from -20 to 300 seconds.

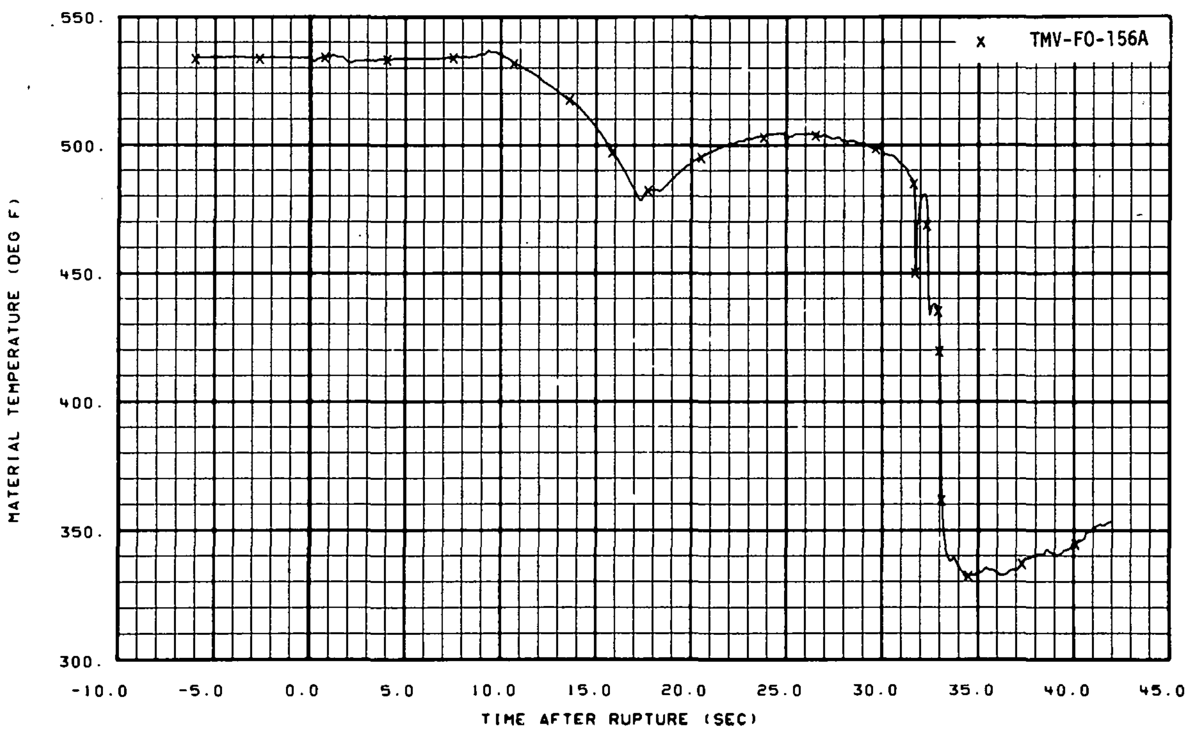

Fig. 48 Material temperature in vessel filler (TMV-FO-156A), from -6 to 42 seconds.

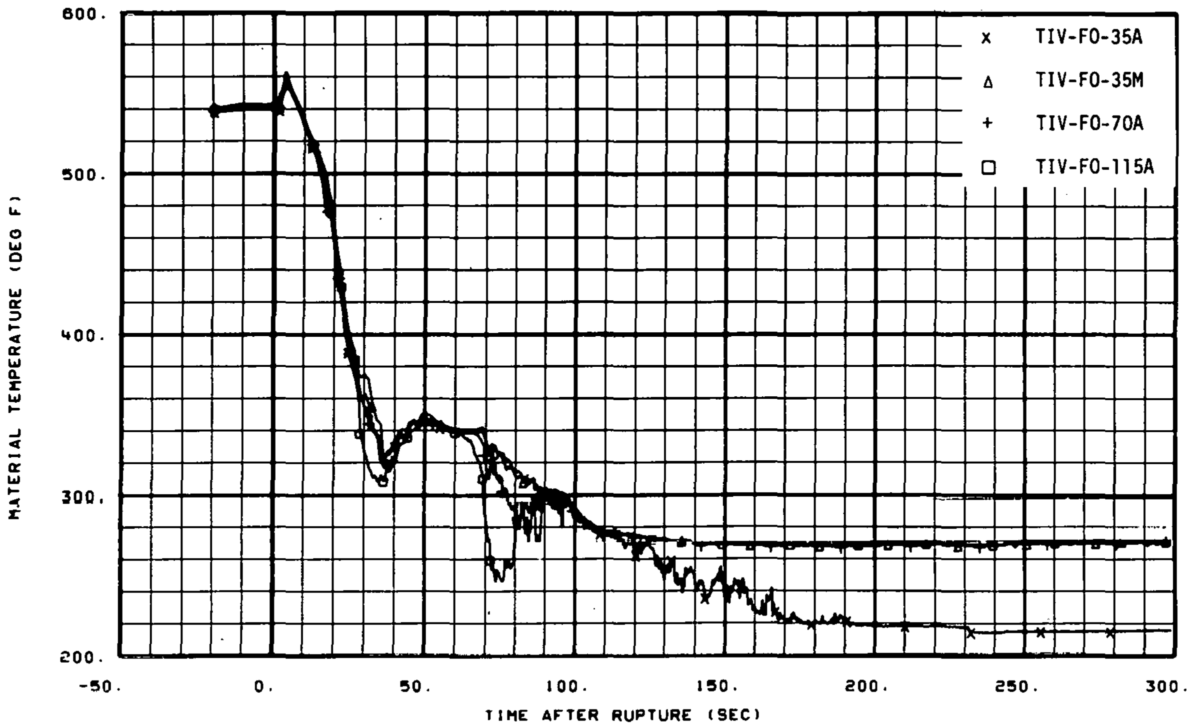

Fig. 49 Material temperature in vessel filler insulator (TIV-FO-35A, TIV-FO-35M, TIV-FO-70A, and TIV-FO-115A), from -20 to 300 seconds.

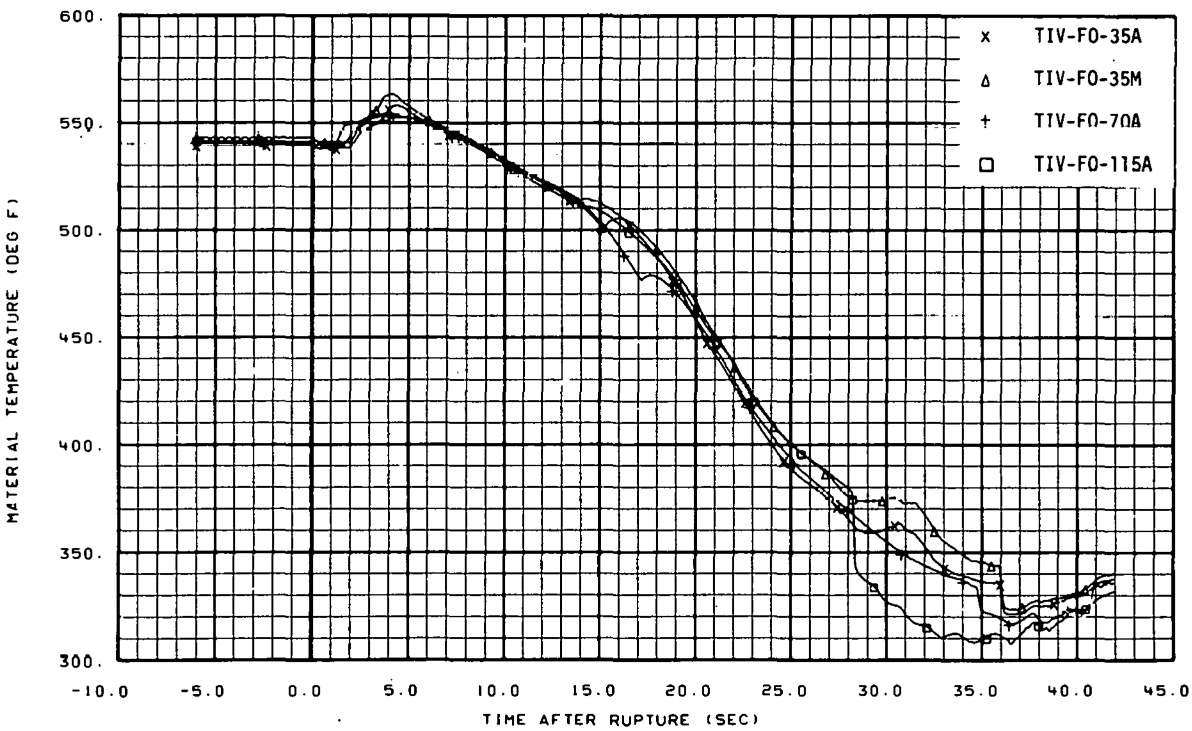

Fig. 50 Material temperature in vessel filler insulator (TIV-FO-35A, TIV-FO-35M, TIV-FO-70A, and TIV-FO-115A), from -6 to 42 seconds.

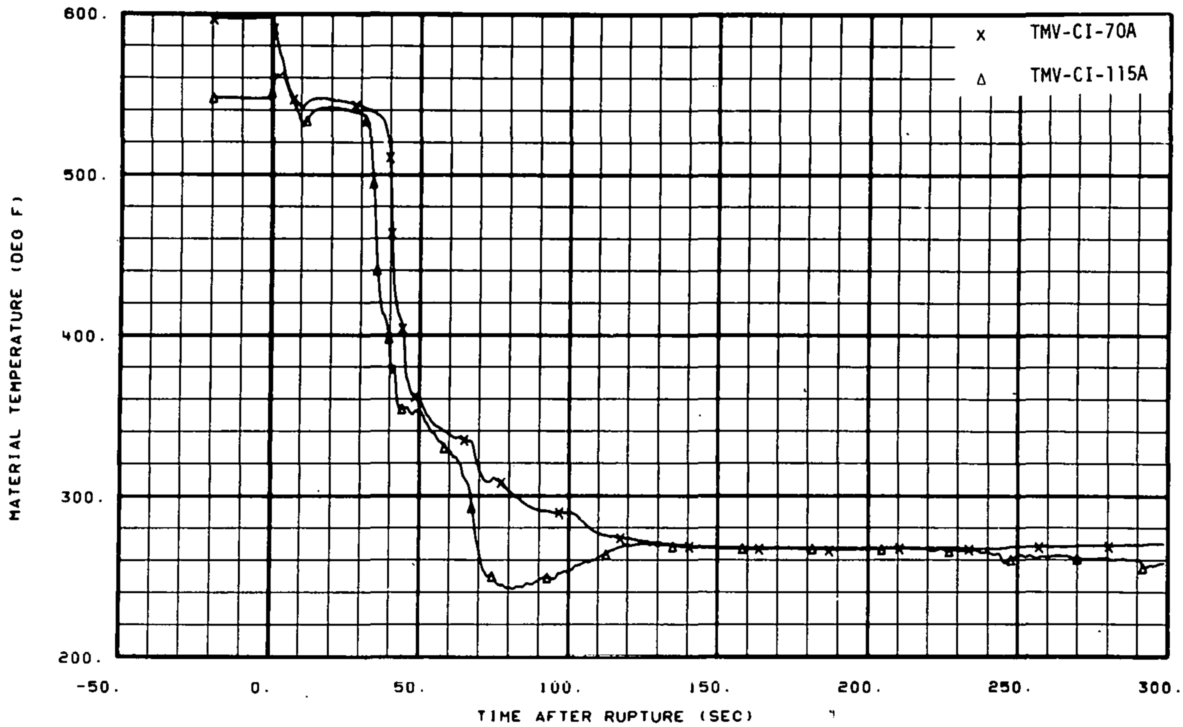

Fig. 51 Material temperature in core barrel inner diameter (TMV-CI-70A and TMV-CI-115A), from -20 to 300 seconds.

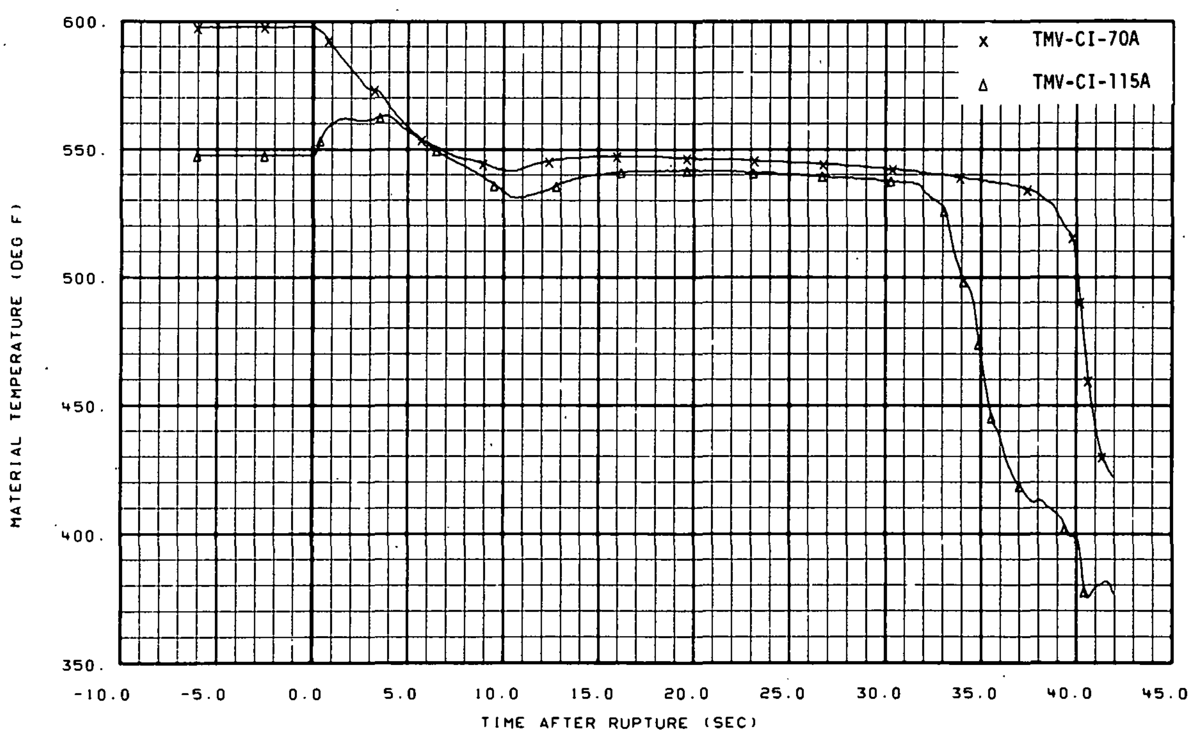

Fig. 52 Material temperature in core barrel inner diameter (TMV-CI-70A and TMV-CI-115A), from -6 to 42 seconds.

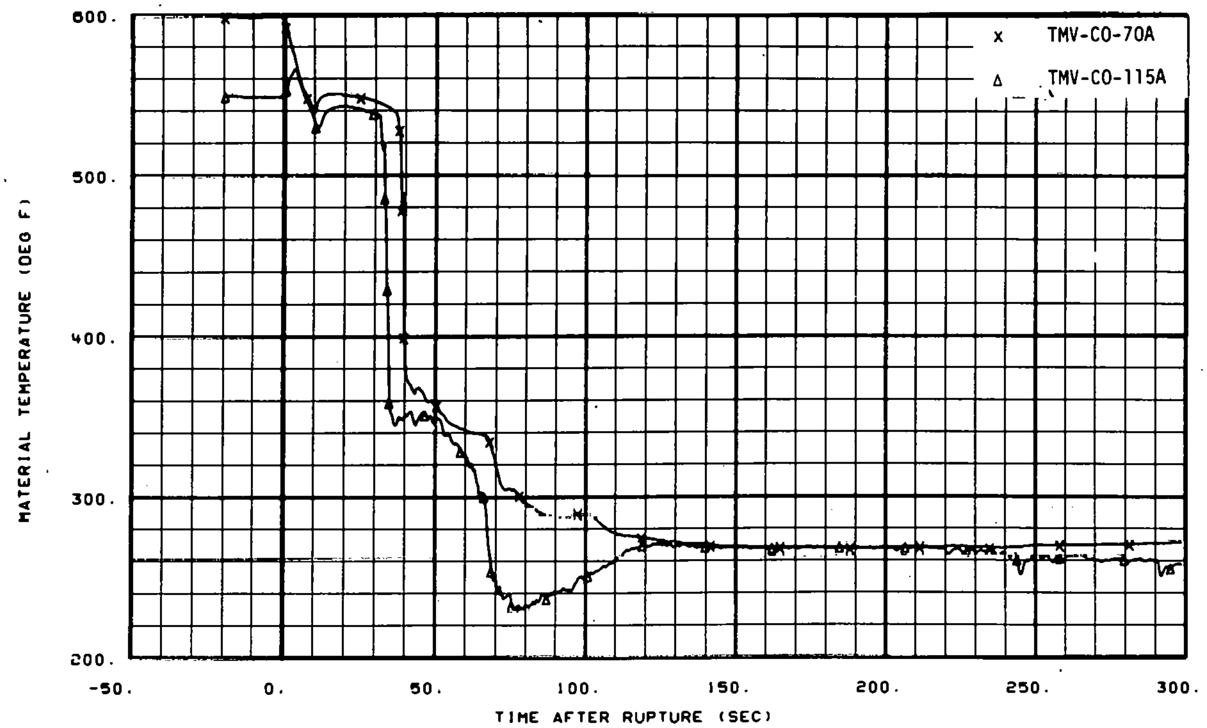

Fig. 53 Material temperature in core barrel outer diameter (TMV-CO-70A and TMV-CO-115A), from -20 to 300 seconds.

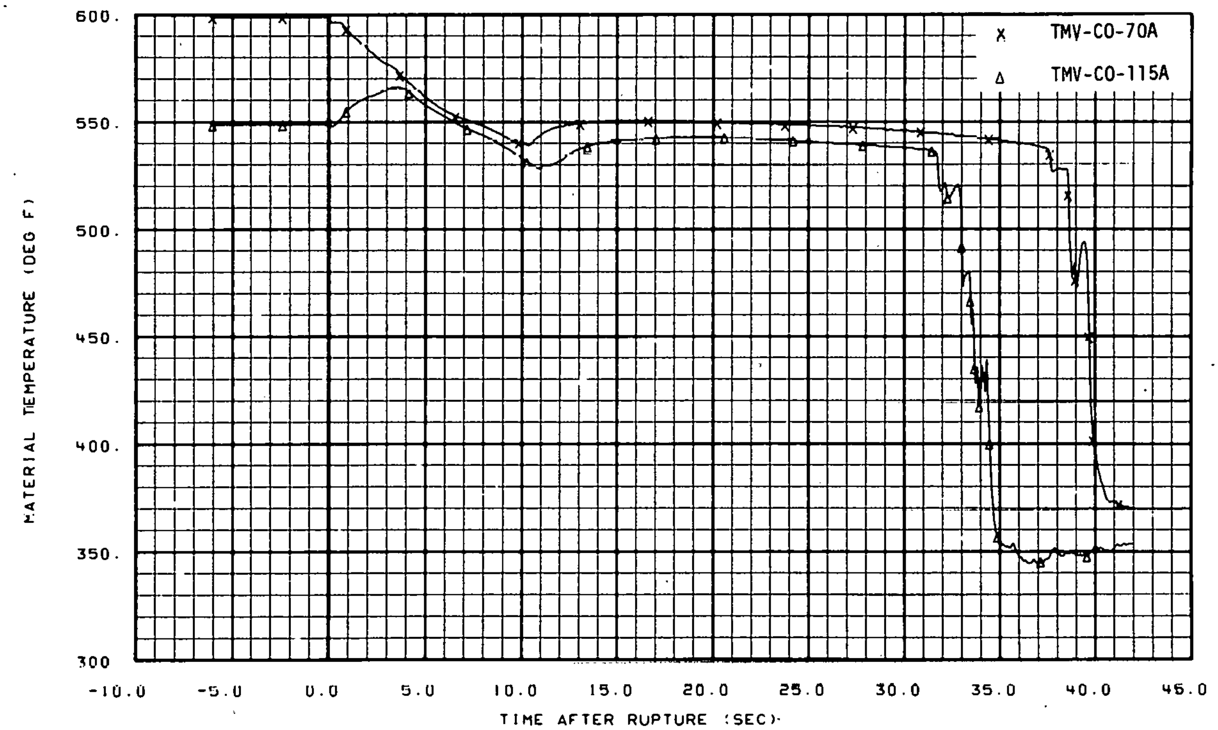

Fig. 54 Material temperature in core barrel outer diameter (TMV-CO-70A and TMV-CO-115A), from -6 to 42 seconds.

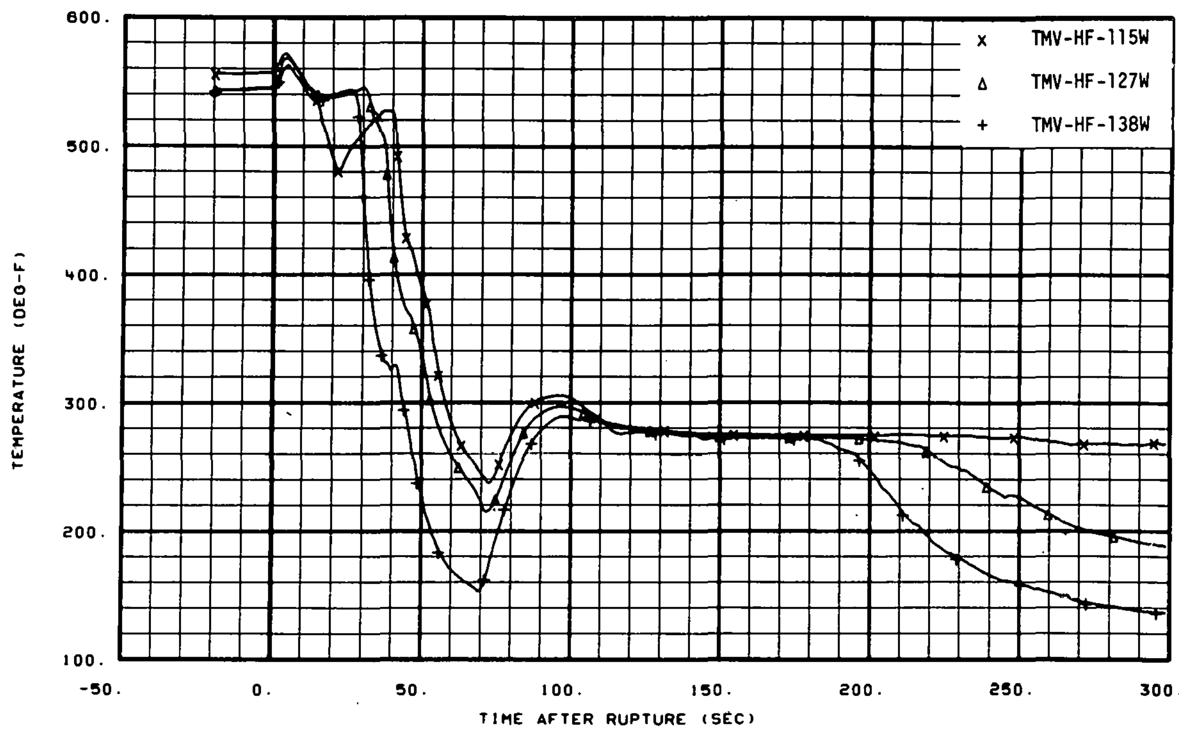

Fig. 55 Material temperature in core housing filler (TMV-HF-115W, TMV-HF-127W, and TMV-HF-138W), from -20 to 300 seconds.

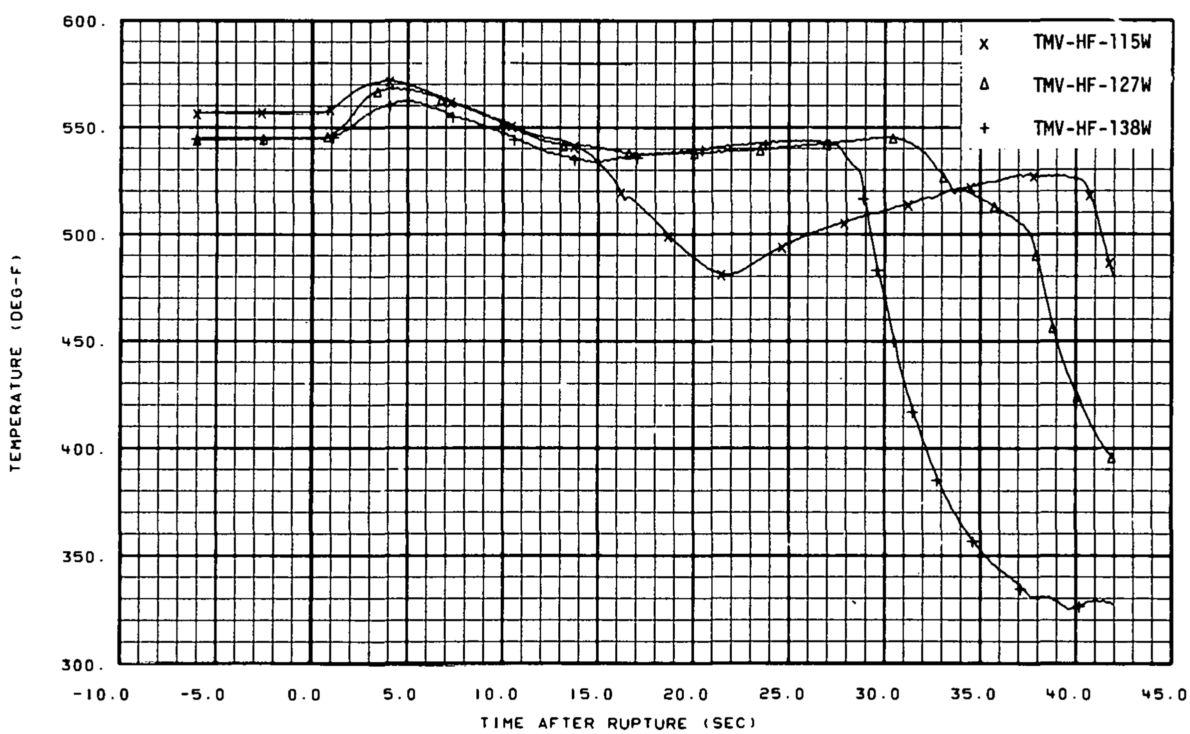

Fig. 56 Material temperature in core housing filler (TMV-HF-115W, TMV-HF-127W, and TMV-HF-138W), from -6 to 42 seconds.

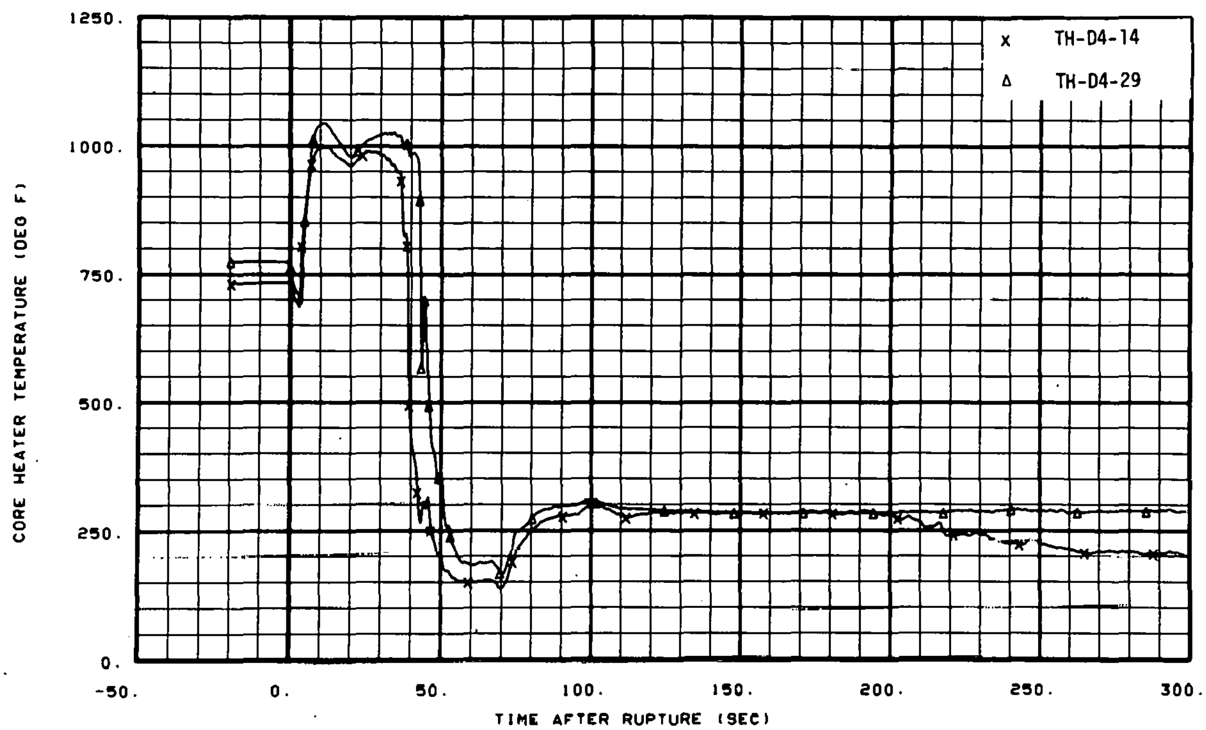

Fig. 57 Core heater temperature, Rod D-4 (TH-D4-14 and TH-D4-29), from -20 to 300 seconds.

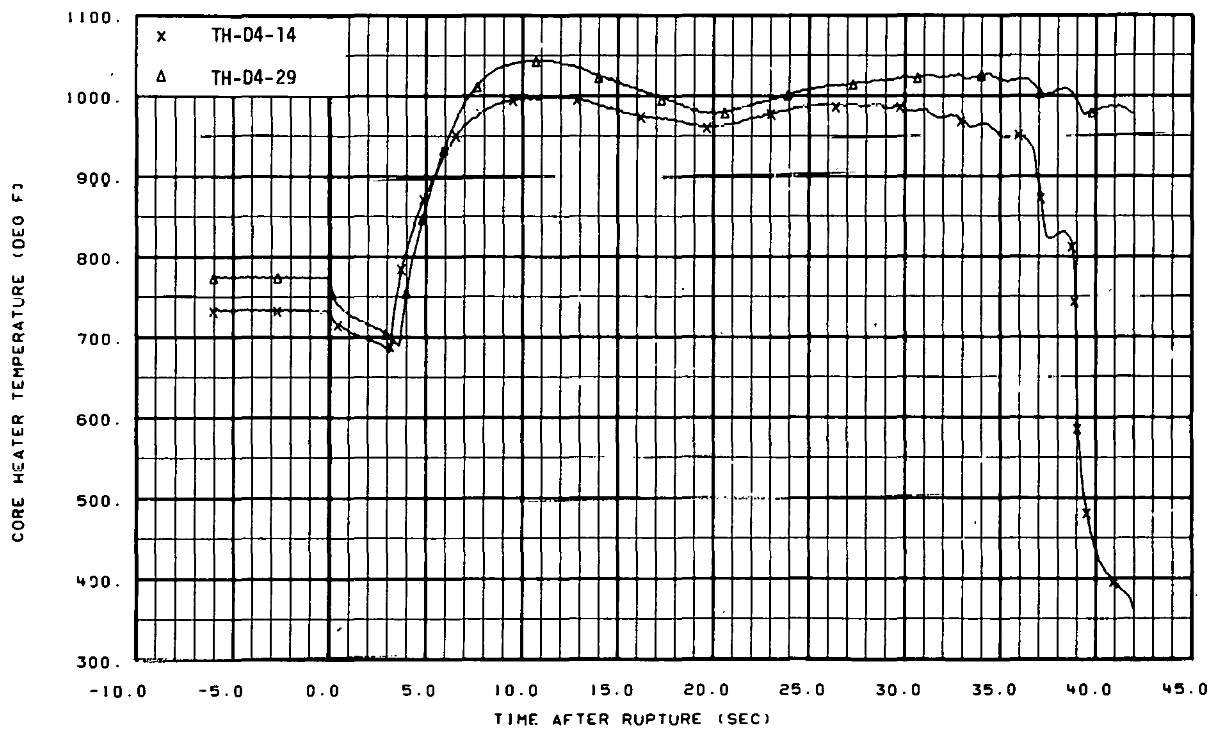

Fig. 58 Core heater temperature, Rod D-4 (TH-D4-14 and TH-D4-29), from -6 to 42 seconds.

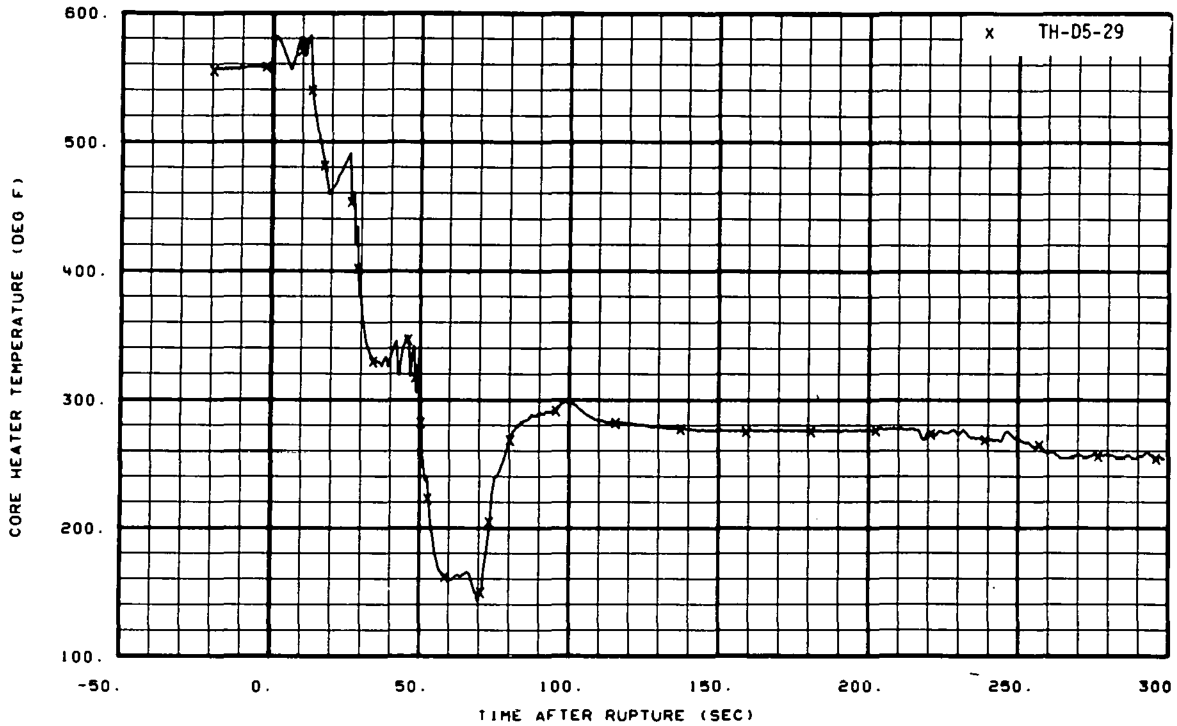

Fig. 59 Core heater temperature, Rod D-5 (TH-D5-29), from -20 to 300 seconds.

Fig. 60 Core heater temperature, Rod D-5 (TH-D5-29), from -6 to 42 seconds.

Fig. 61 Core heater temperature, Rod E-4 (TH-E4-09, TH-E4-28G, TH-E4-28T, and TH-E4-55), from -20 to 300 seconds.

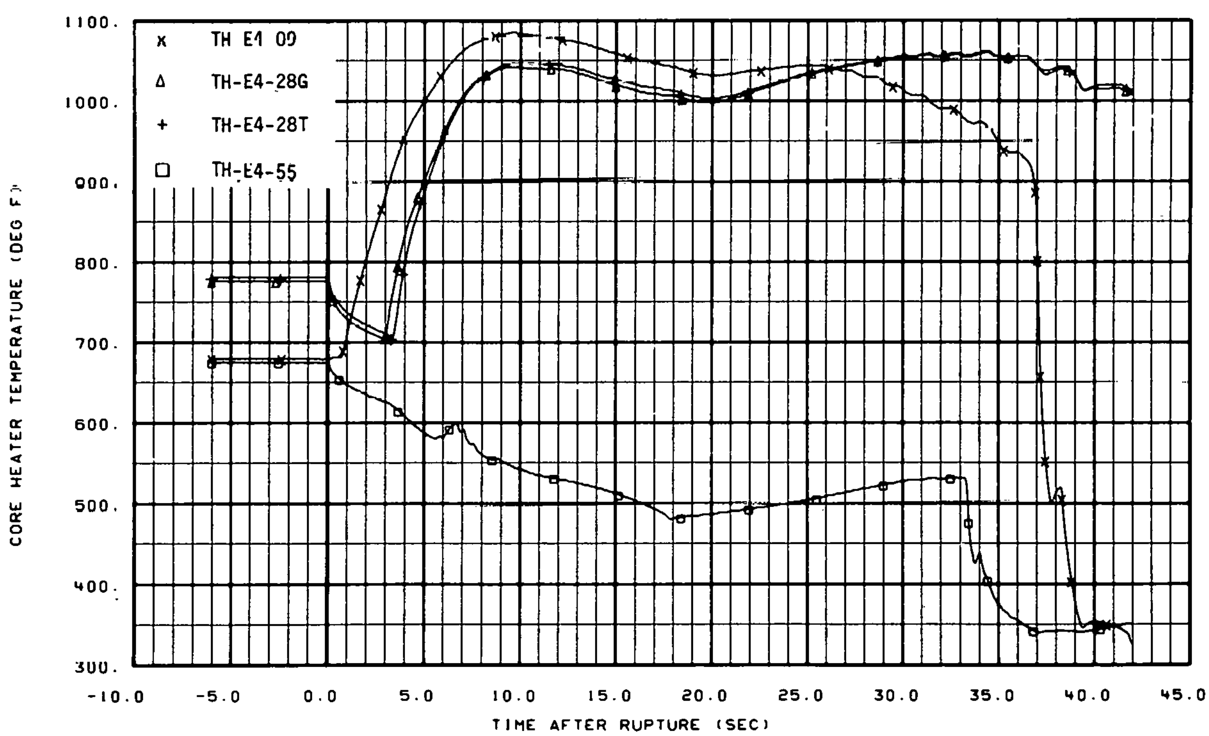

Fig. 62 Core heater temperature, Rod E-4 (TH-E4-09, TH-E4-28G, TH-E4-28T, and TH-E4-55), from -6 to 42 seconds.

Fig. 63 Core heater temperature, Rod E-5 (TH-E5-21 and TH-E5-25), from -20 to 300 seconds.

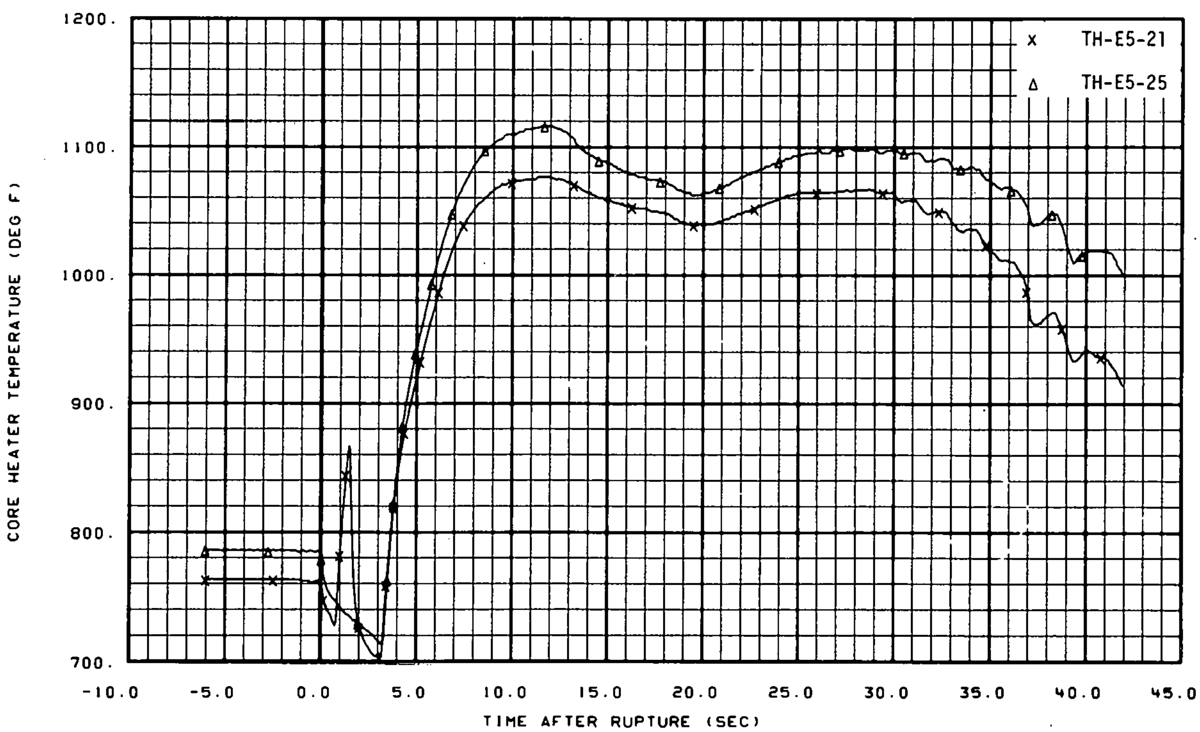

Fig. 64 Core heater temperature, Rod E-5 (TH-E5-21 and TH-E5-25), from -6 to 42 seconds.

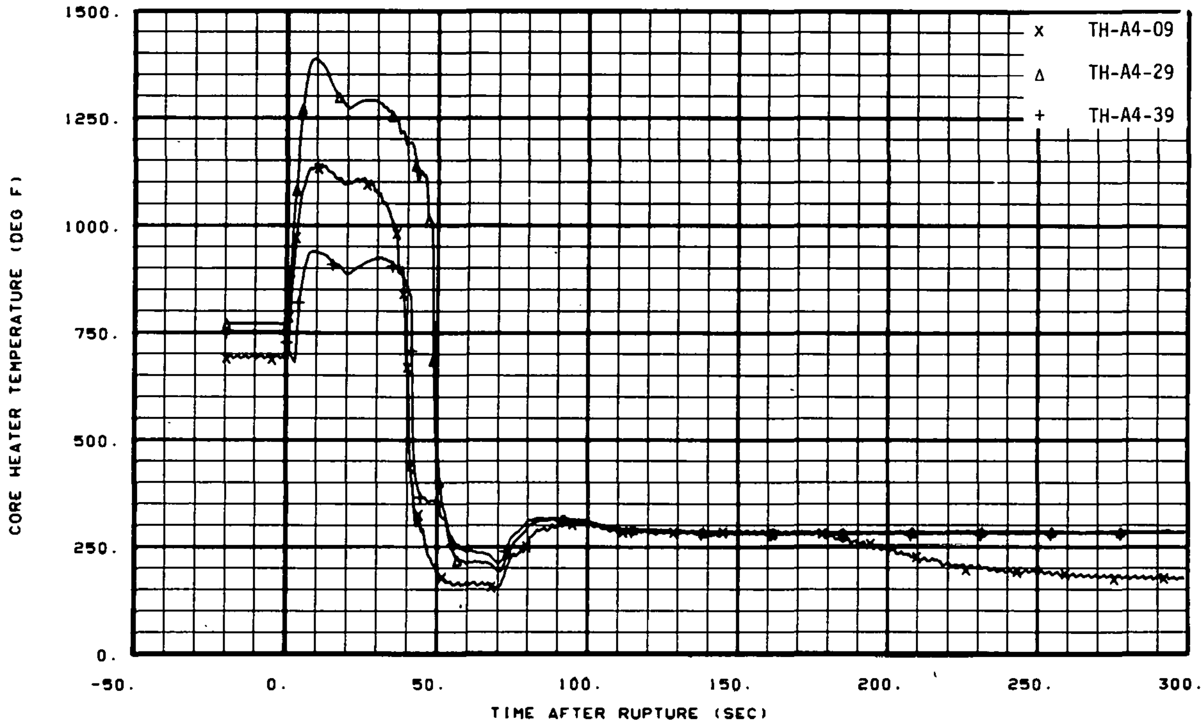

Fig. 65 Core heater temperature, Rod A-4 (TH-A4-09, TH-A4-29, and TH-A4-39), from -20 to 300 seconds.

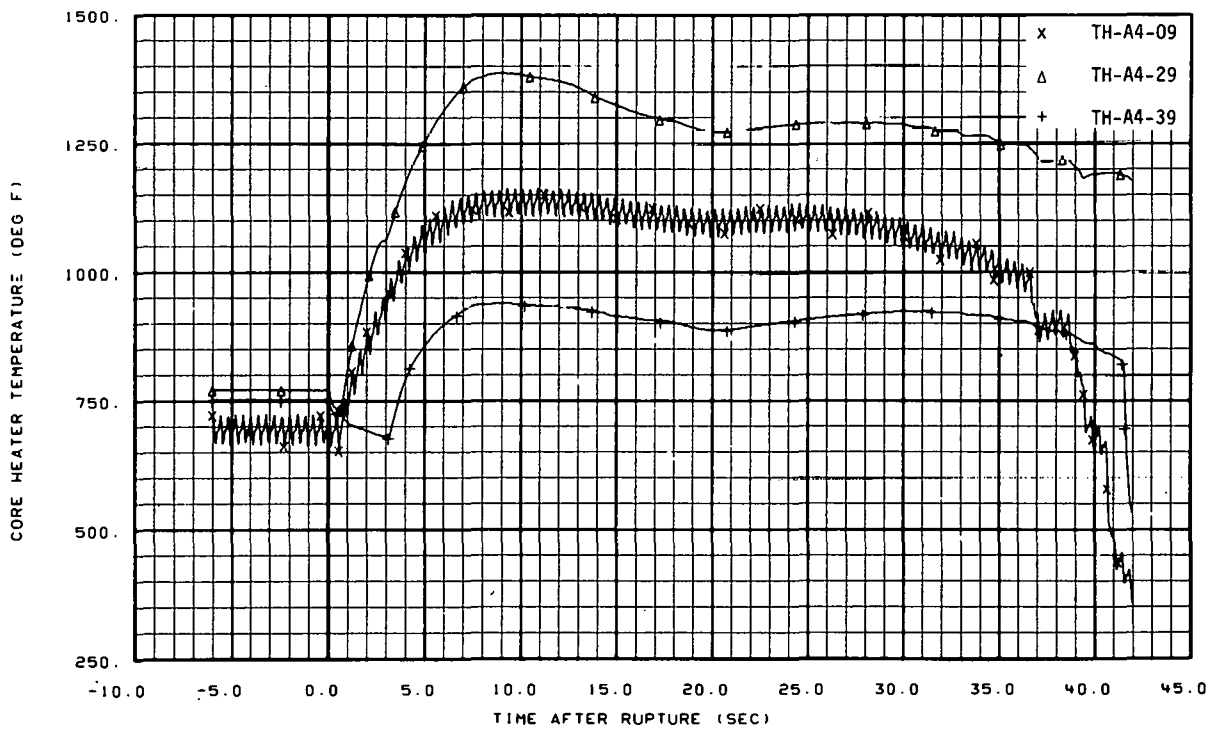

Fig. 66 Core heater temperature, Rod A-4 (TH-A4-09, TH-A4-29, and TH-A4-39), from -6 to 42 seconds.

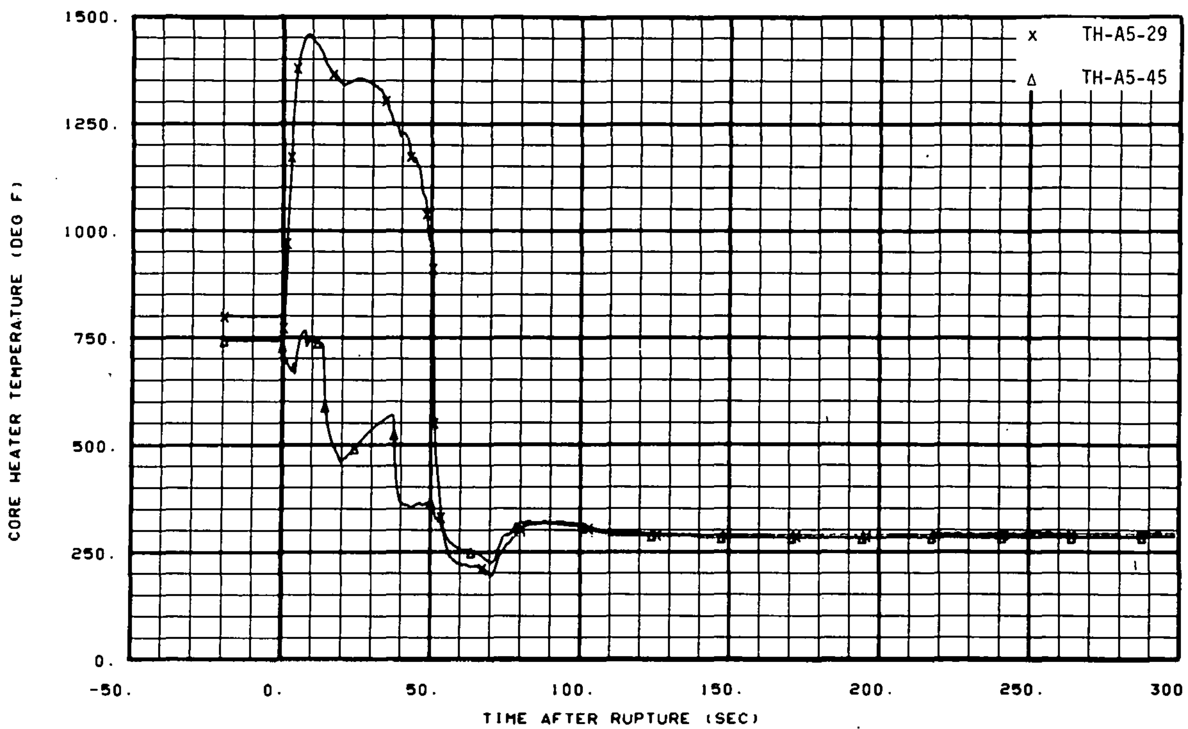

Fig. 67 Core heater temperature, Rod A-5 (TH-A5-29 and TH-A5-45), from -20 to 300 seconds.

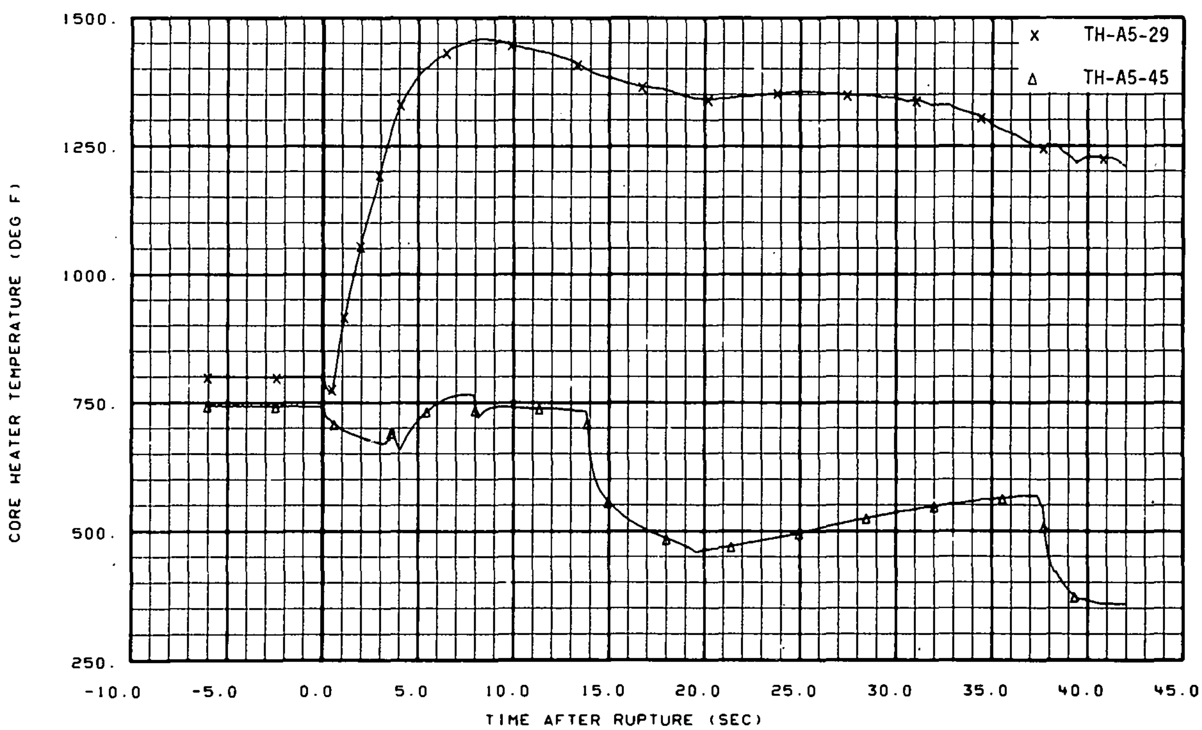

Fig. 68 Core heater temperature, Rod A-5 (TH-A5-29 and TH-A5-45), from -6 to 42 seconds.

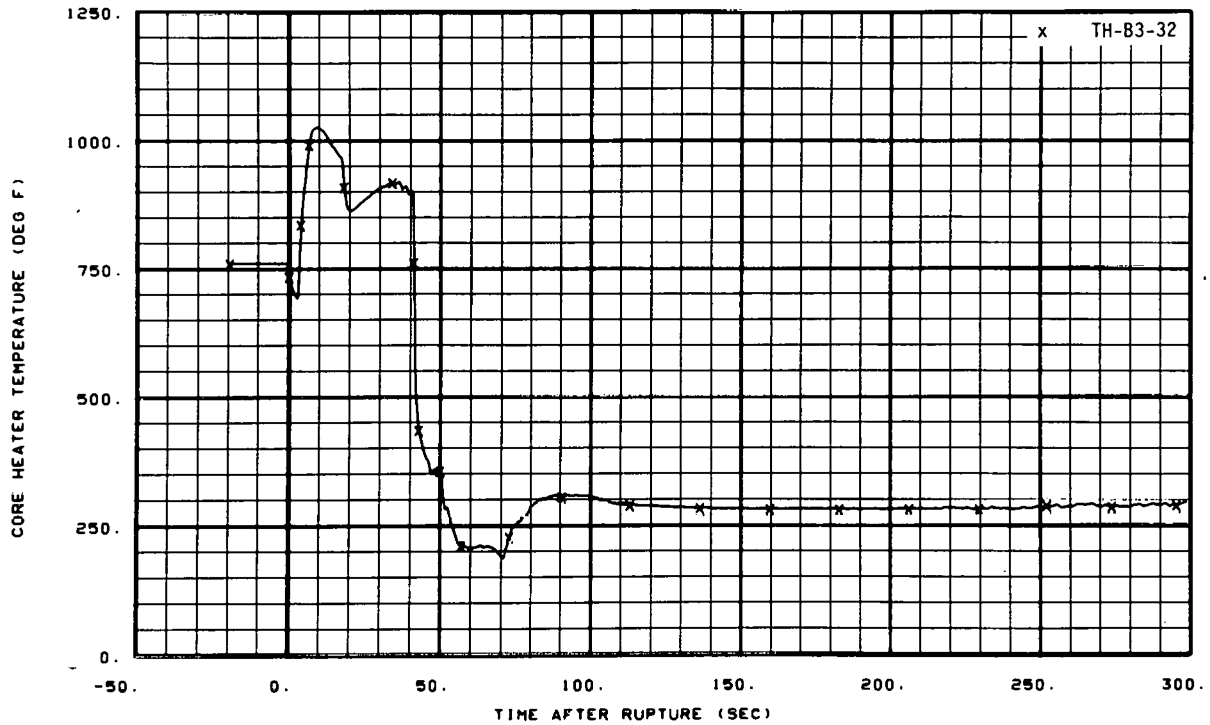

Fig. 69 Core heater temperature, Rod B-3 (TH-B3-32), from -20 to 300 seconds.

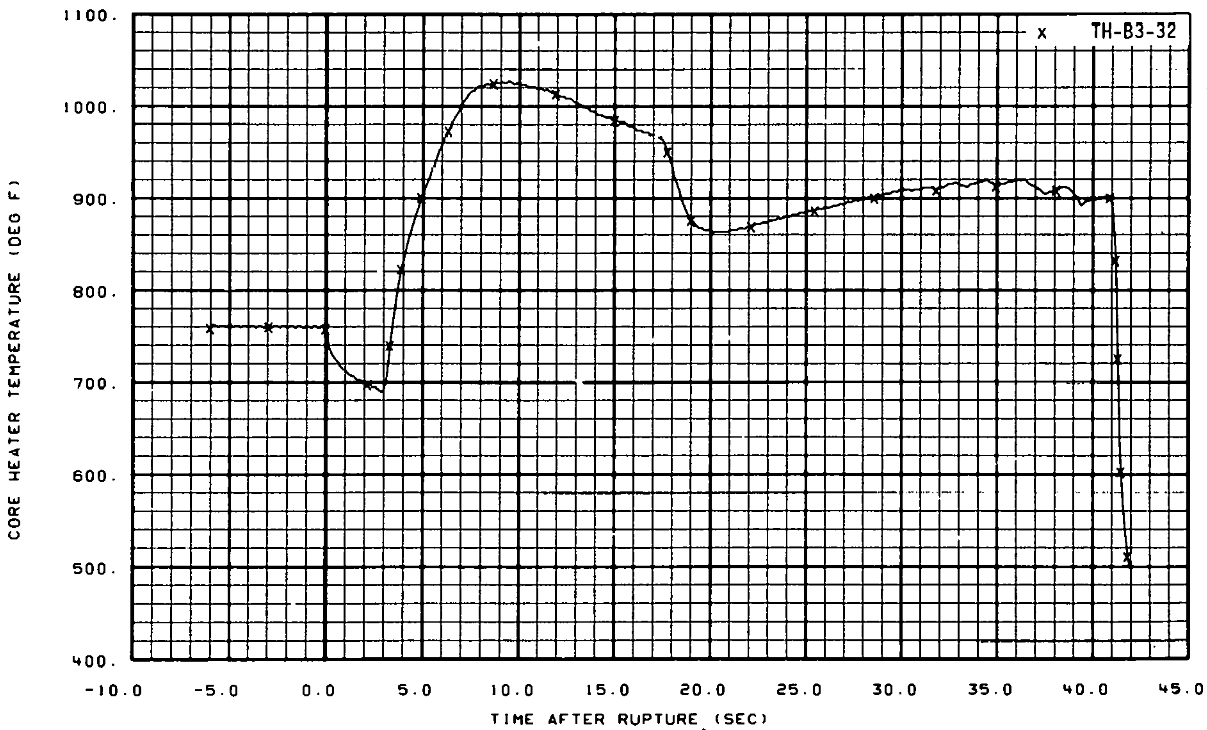

Fig. 70 Core heater temperature, Rod B-3 (TH-B3-32), from -6 to 42 seconds.

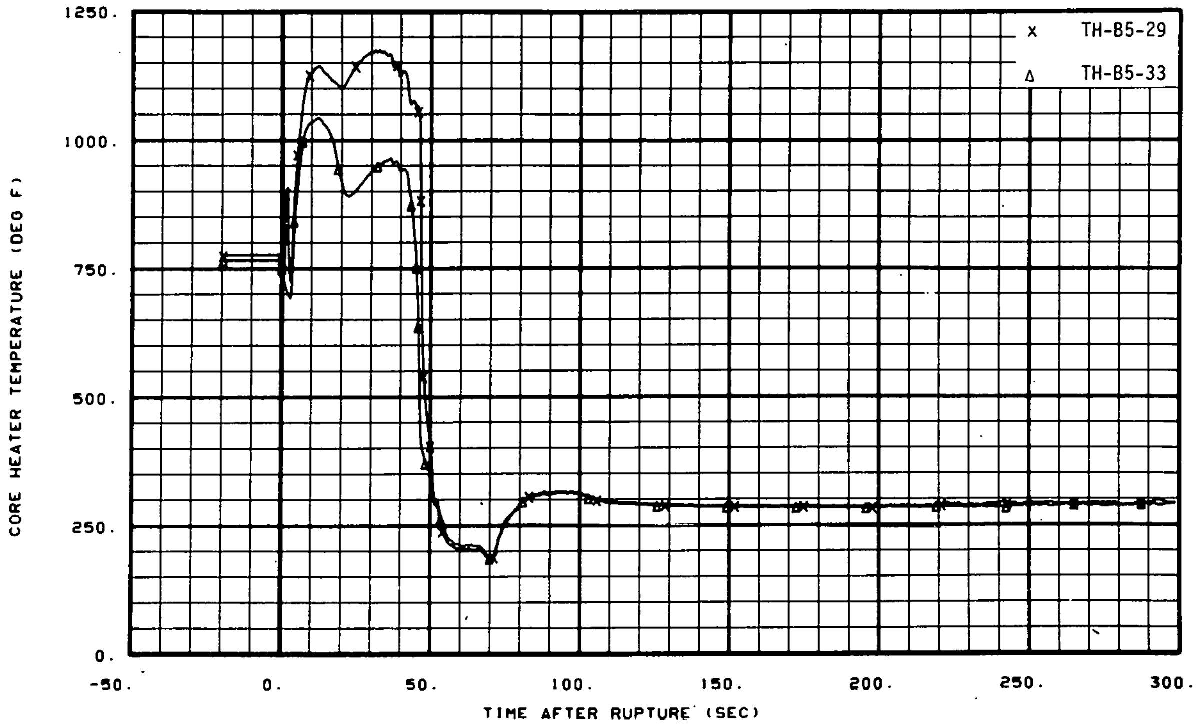

Fig. 71 Core heater temperature, Rod B-5 (TH-B5-29 and TH-B5-33), from -20 to 300 seconds.

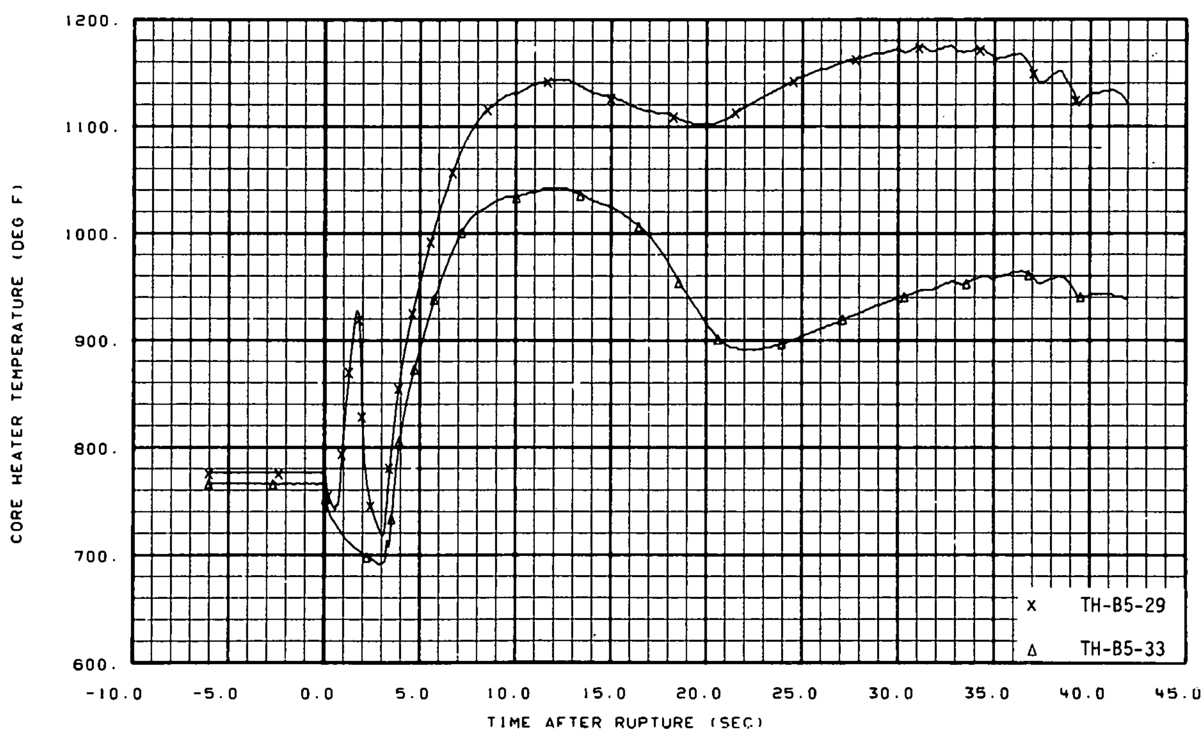

Fig. 72 Core heater temperature, Rod B-5 (TH-B5-29 and TH-B5-33), from -6 to 42 seconds.

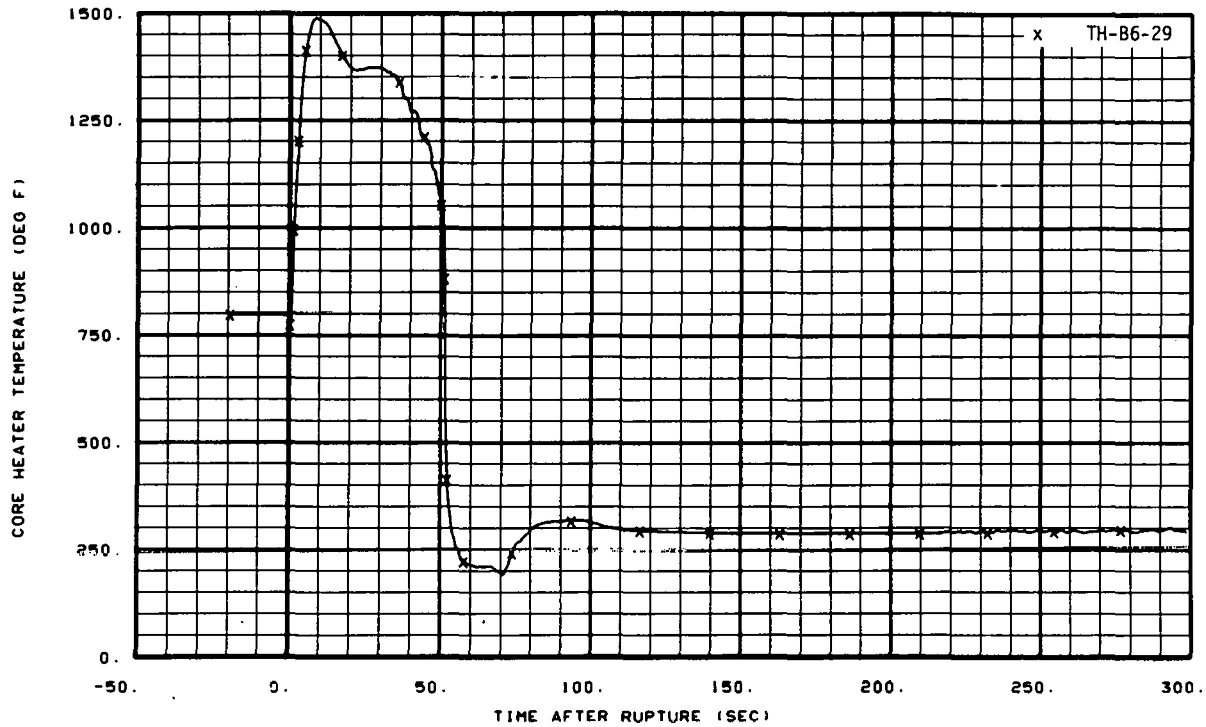

Fig. 73 Core heater temperature, Rod B-6 (TH-B6-29), from -20 to 300 seconds.

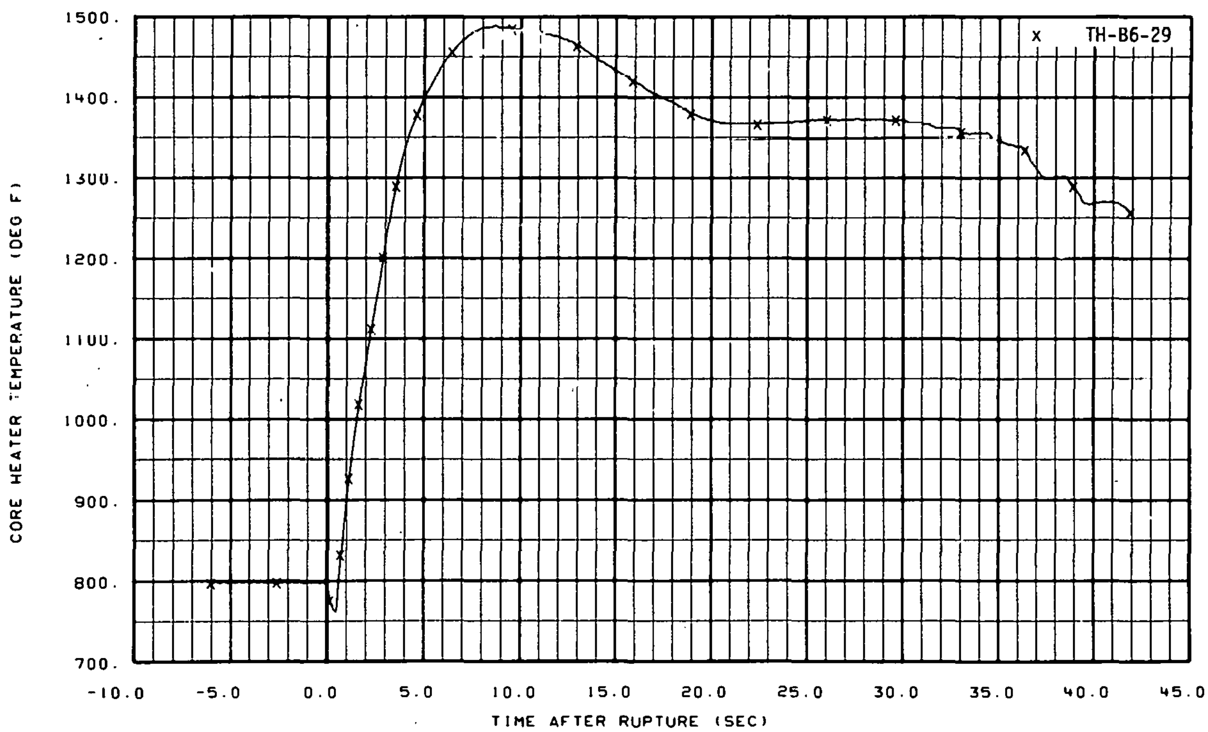

Fig. 74 Core heater temperature, Rod B-6 (TH-B6-29), from -6 to 42 seconds.

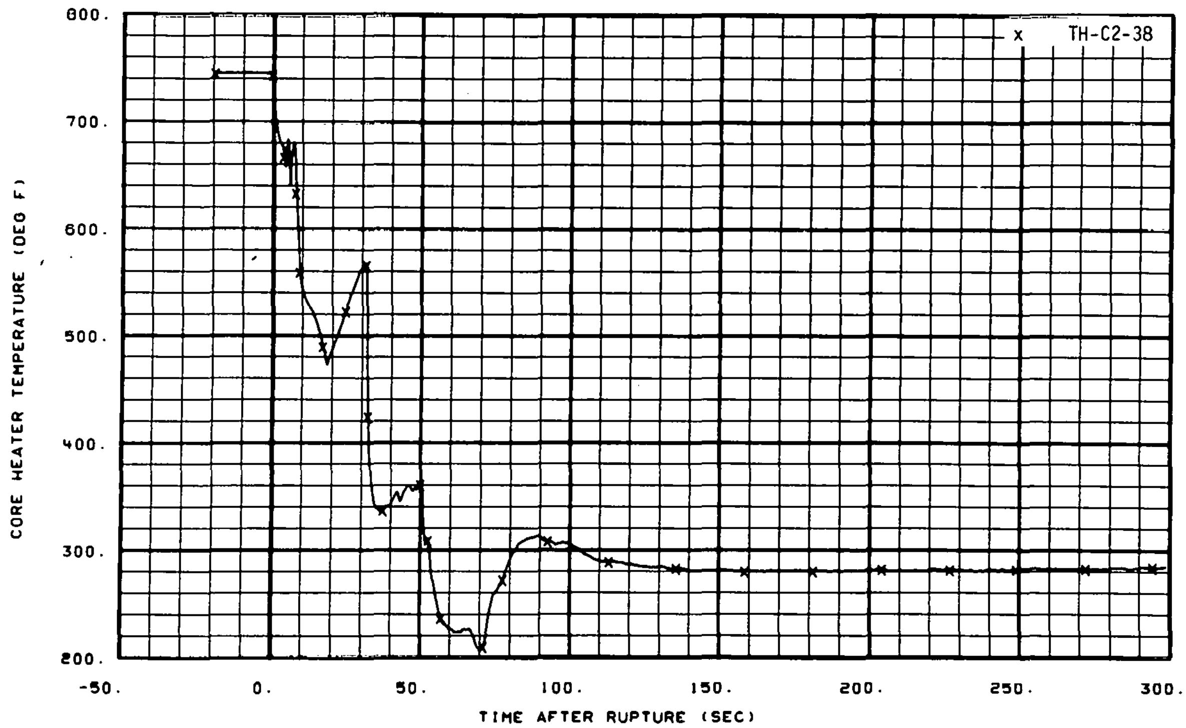

Fig. 75 Core heater temperature, Rod C-2 (TH-C2-38), from -20 to 300 seconds.

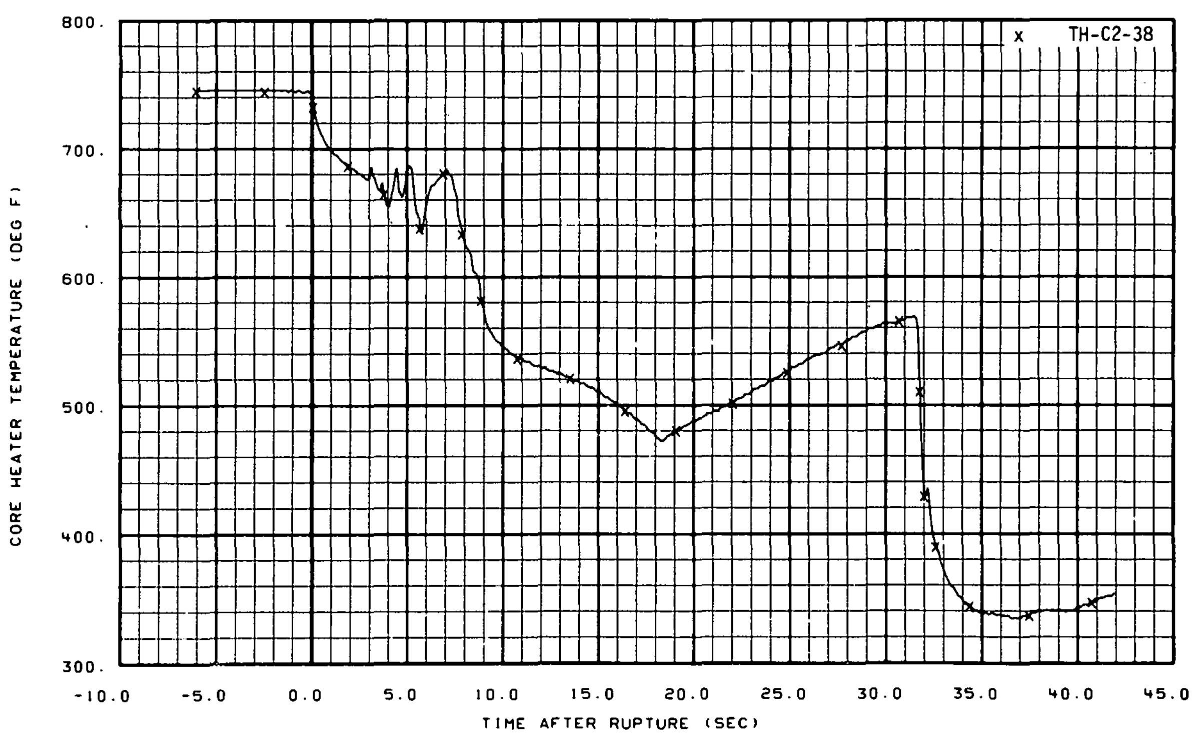

Fig. 76 Core heater temperature, Rod C-2 (TH-C2-38), from -6 to 42 seconds.

Fig. 77 Core heater temperature, Rod C-4 (TH-C4-20, TH-C4-26, and TH-C4-53), from -20 to 300 seconds.

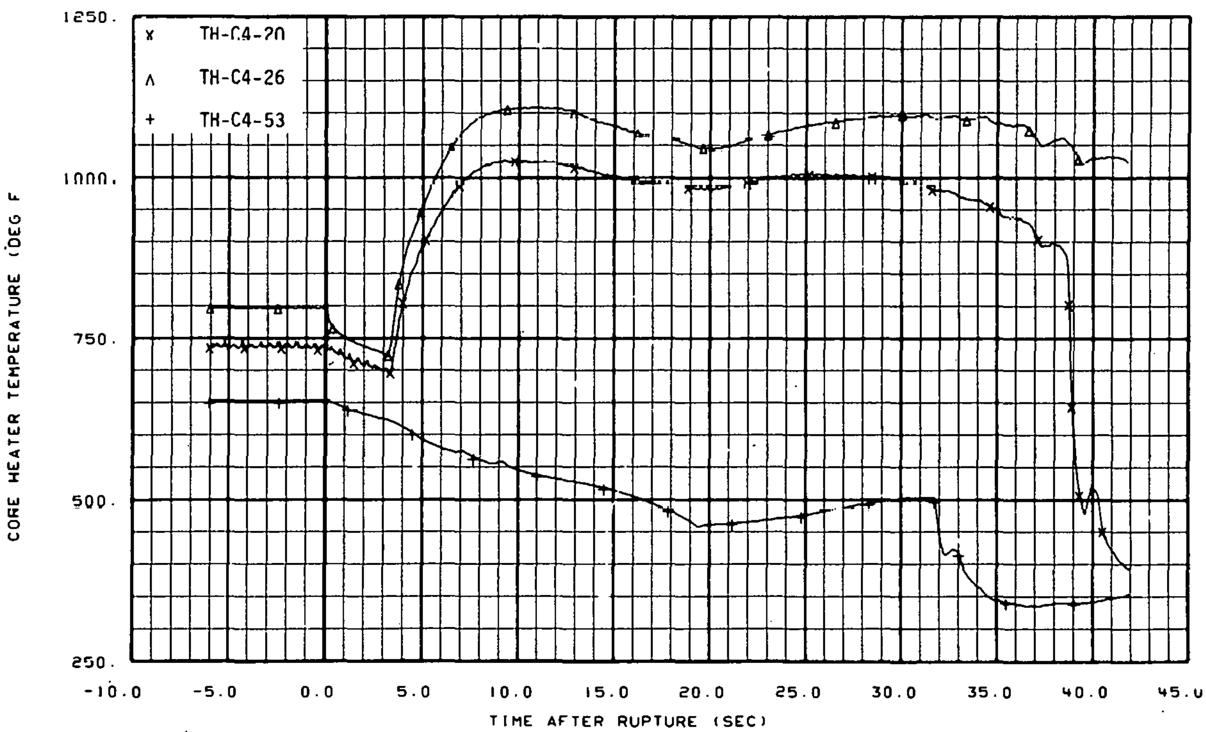

Fig. 78 Core heater temperature, Rod C-4 (TH-C4-20, TH-C4-26, and TH-C4-53), from -6 to 42 seconds.

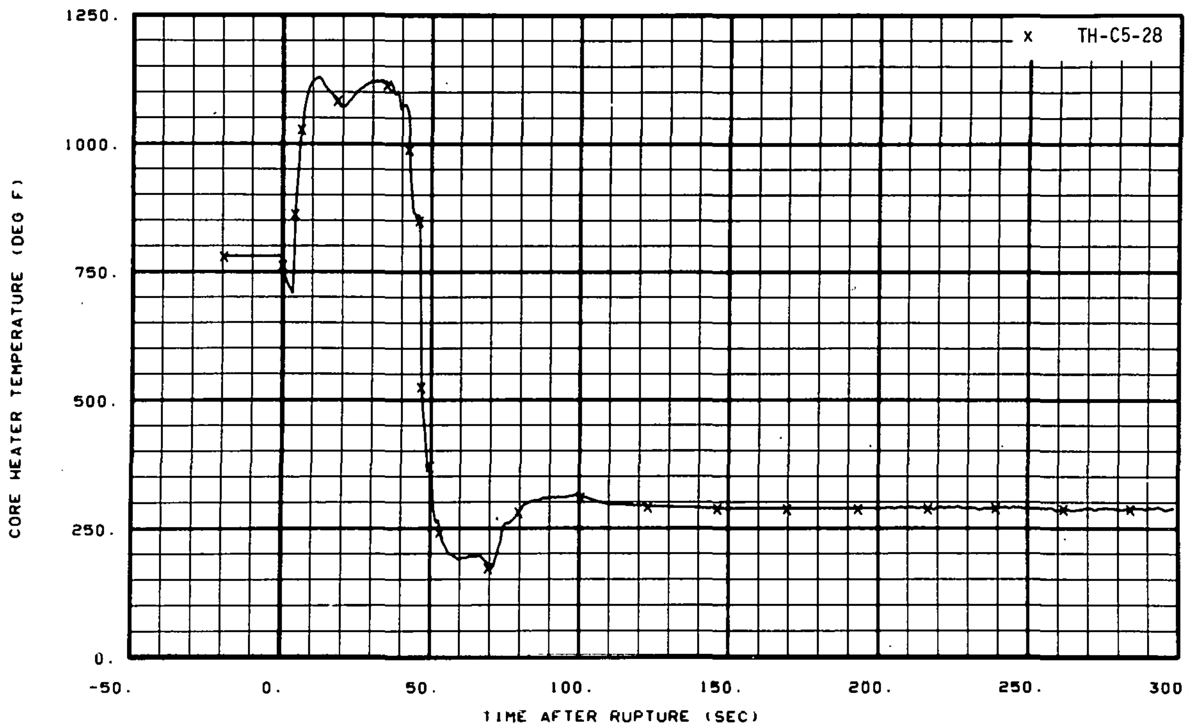

Fig. 79 Core heater temperature, Rod C-5 (TH-C5-28), from -20 to 300 seconds.

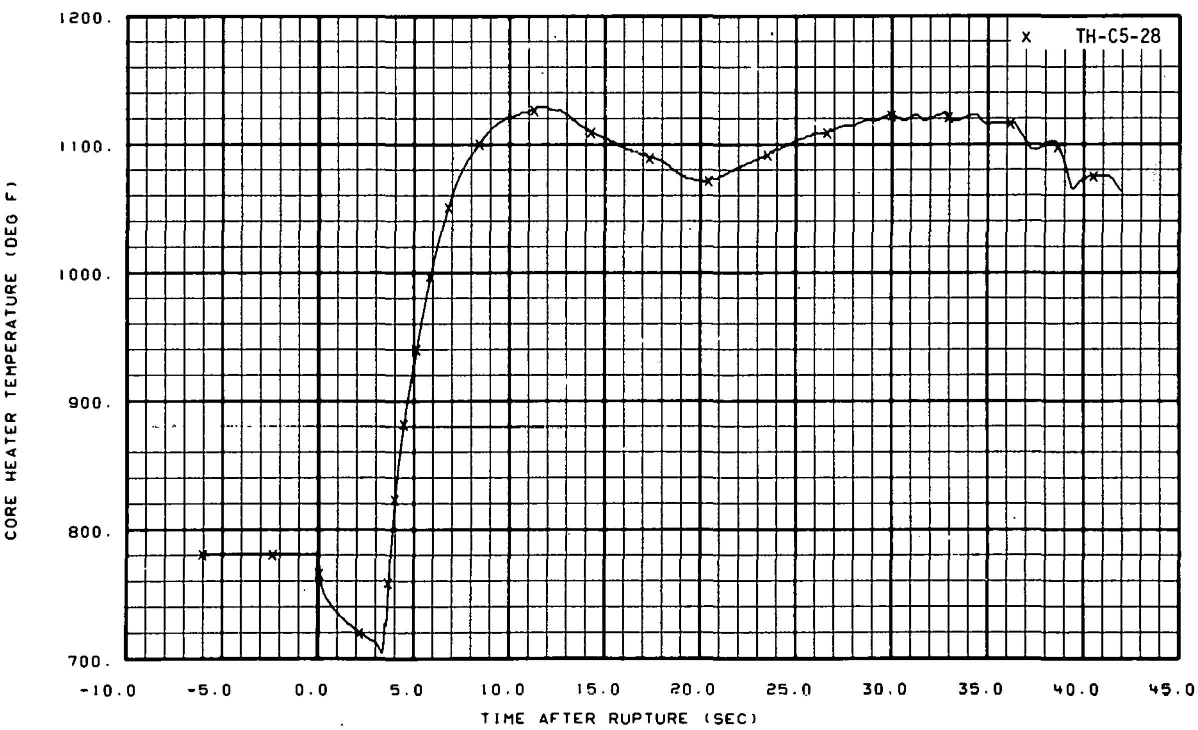

Fig. 80 Core heater temperature, Rod C-5 (TH-C5-28), from -6 to 42 seconds.

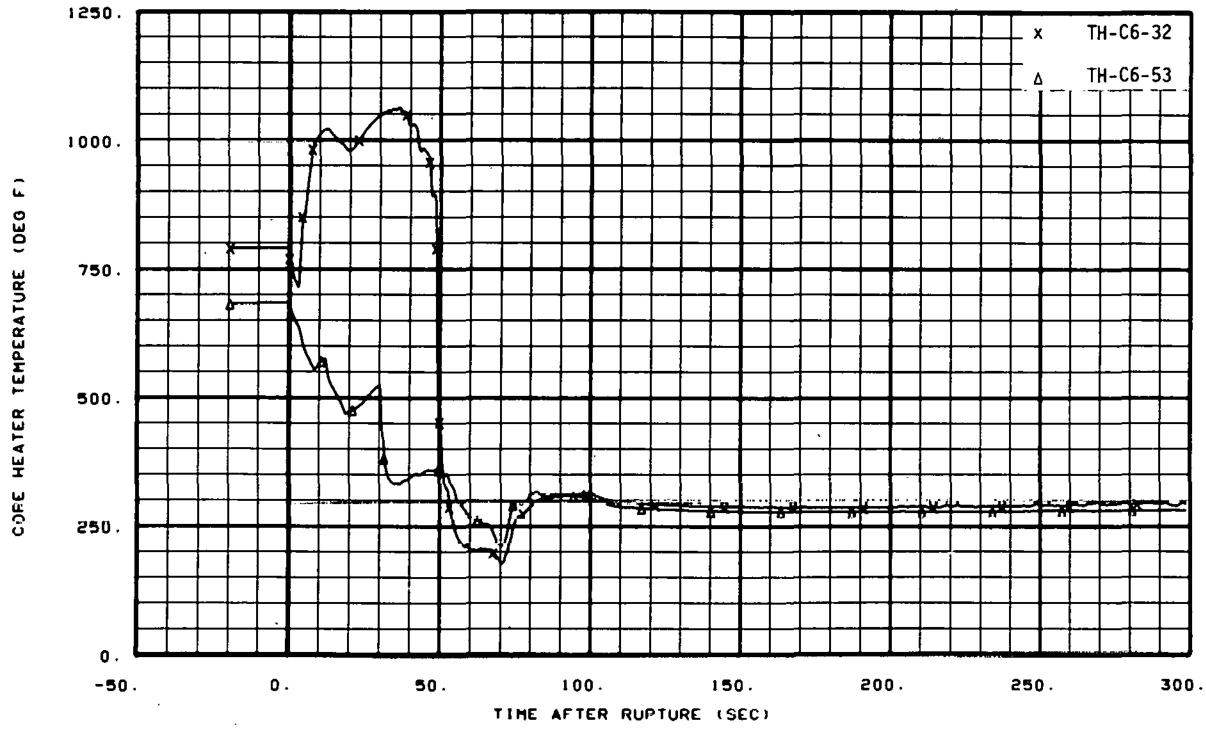

Fig. 81 Core heater temperature, Rod C-6 (TH-C6-32 and TH-C6-53), from -20 to 300 seconds.

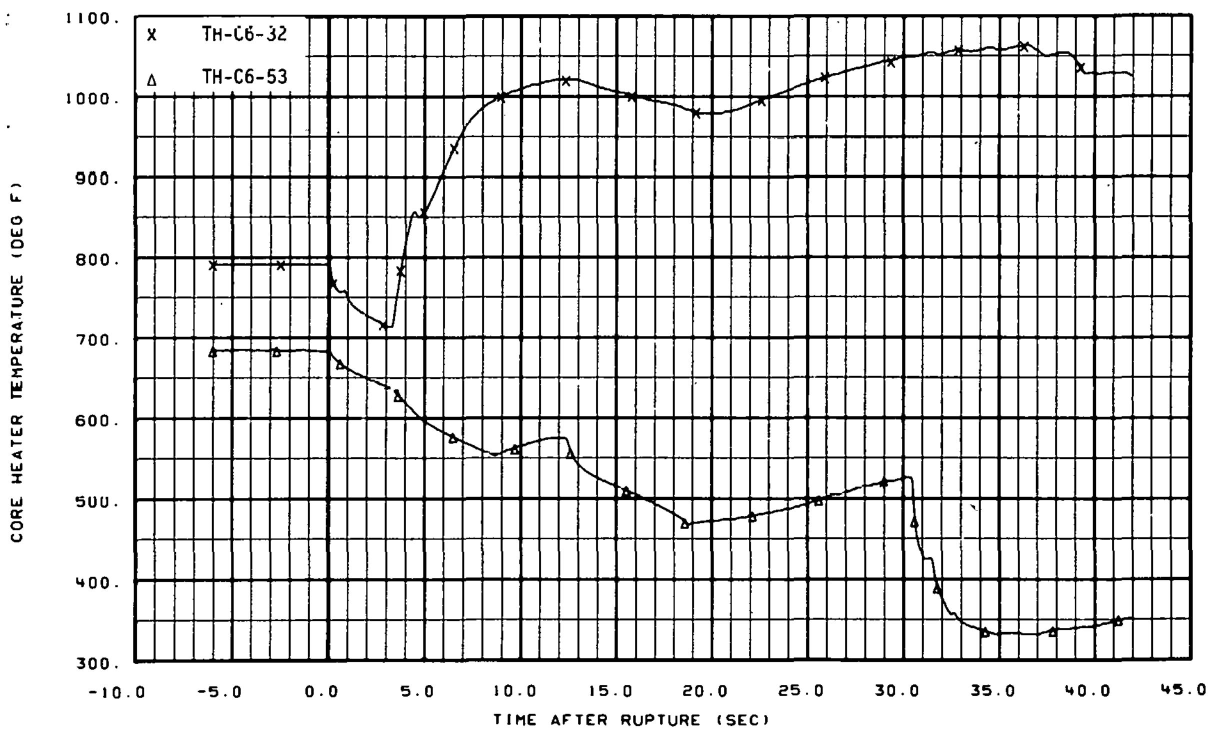

Fig. 82 Core heater temperature, Rod C-6 (TH-C6-32 and TH-C6-53), from -6 to 42 seconds.

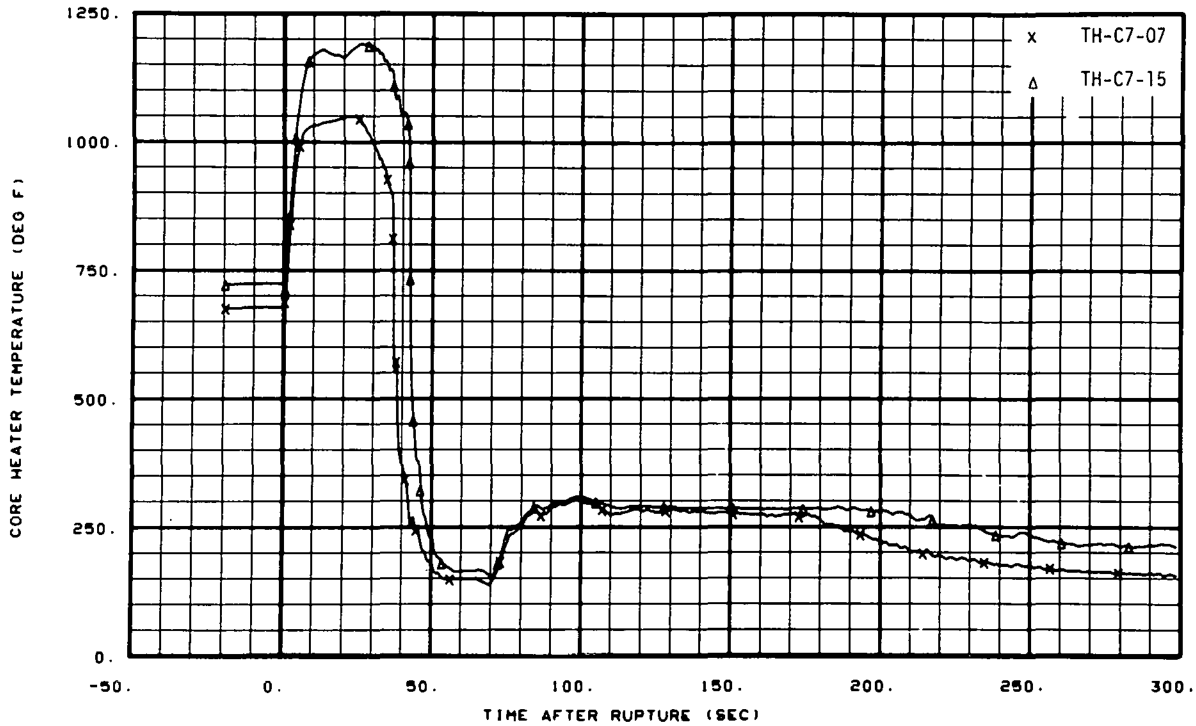

Fig. 83 Core heater temperature, Rod C-7 (TH-C7-07 and TH-C7-15), from -20 to 300 seconds.

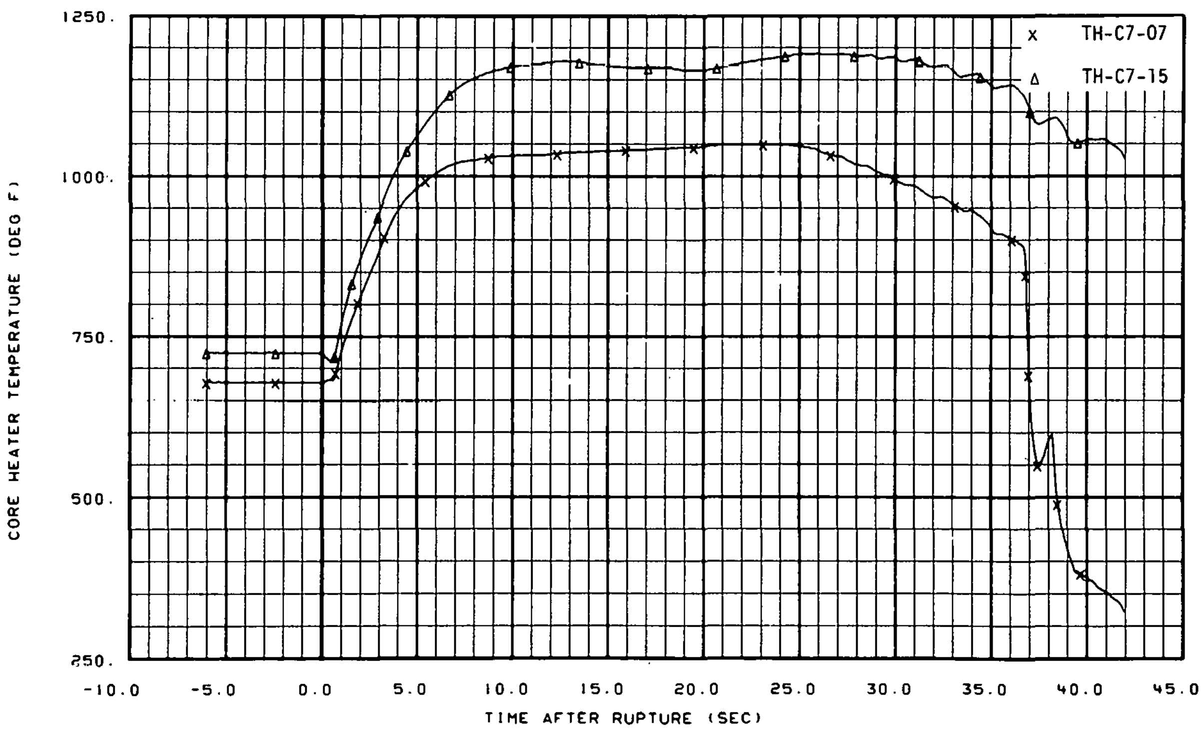

Fig. 84 Core heater temperature, Rod C-7 (TH-C7-07 and TH-C7-15), from -6 to 42 seconds.

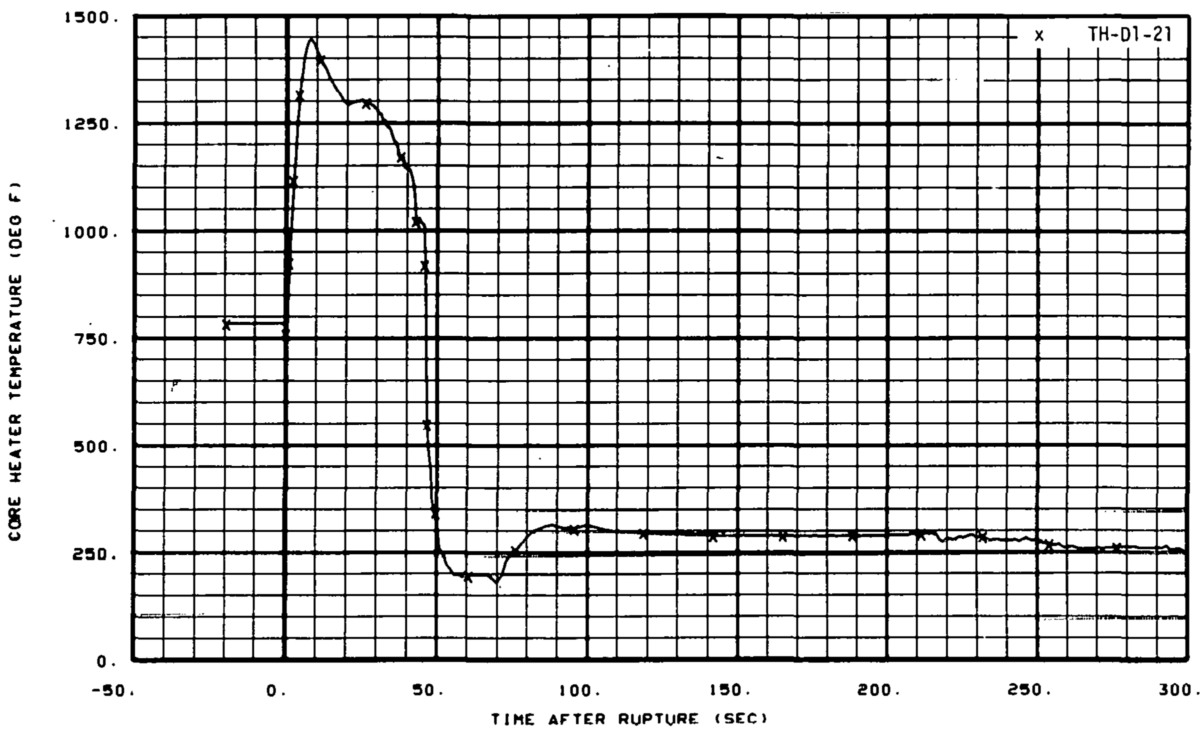

Fig. 85 Core heater temperature, Rod D-1 (TH-D1-21), from -20 to 300 seconds.

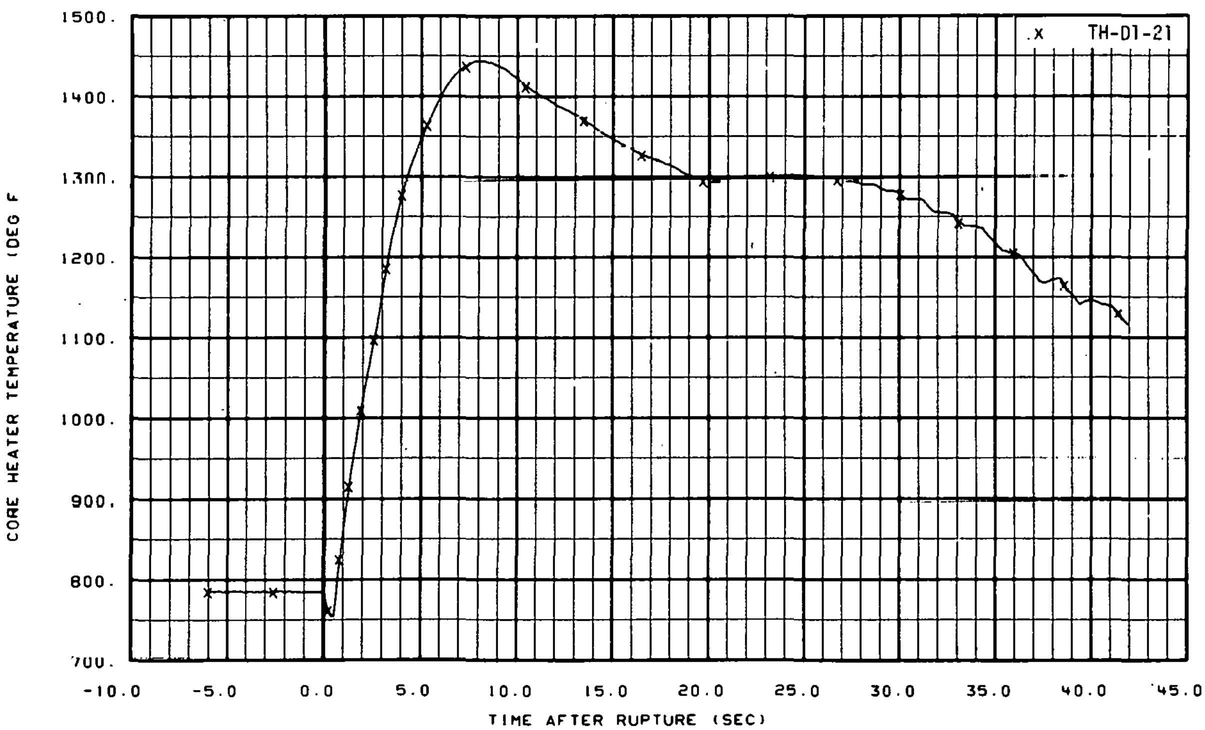

Fig. 86 Core heater temperature, Rod D-1 (TH-D1-21), from -6 to 42 seconds.

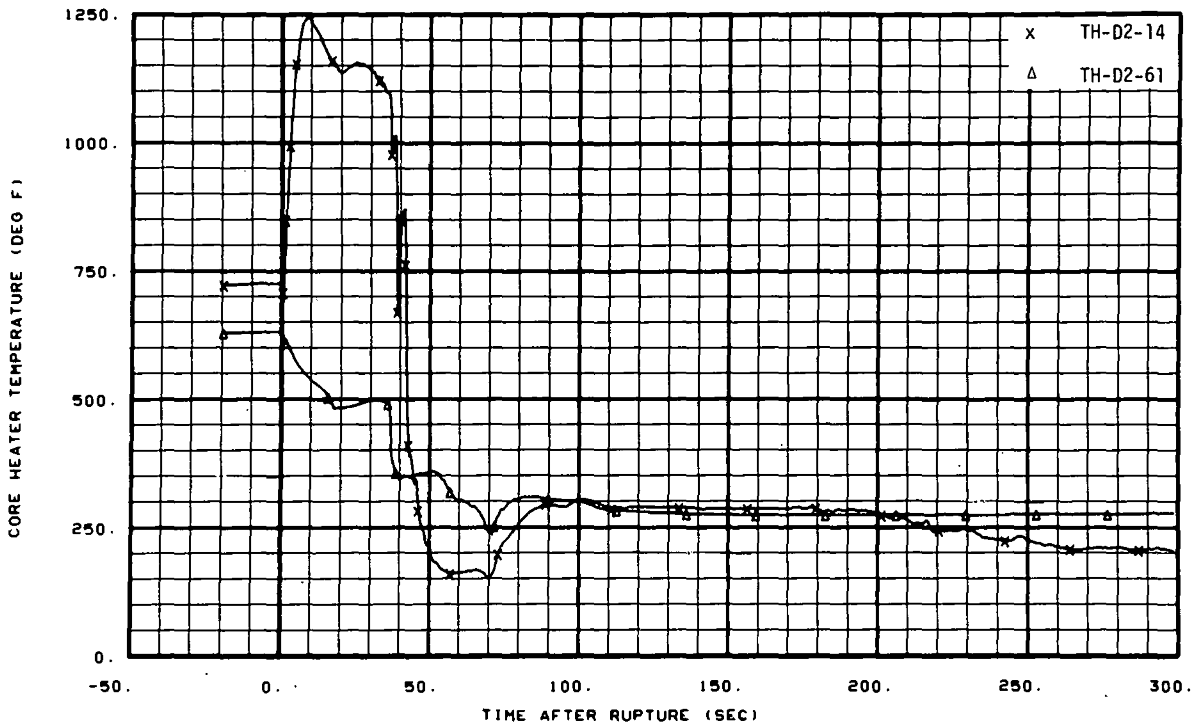

Fig. 87 Core heater temperature, Rod D-2 (TH-D2-14 and TH-D2-61), from -20 to 300 seconds.

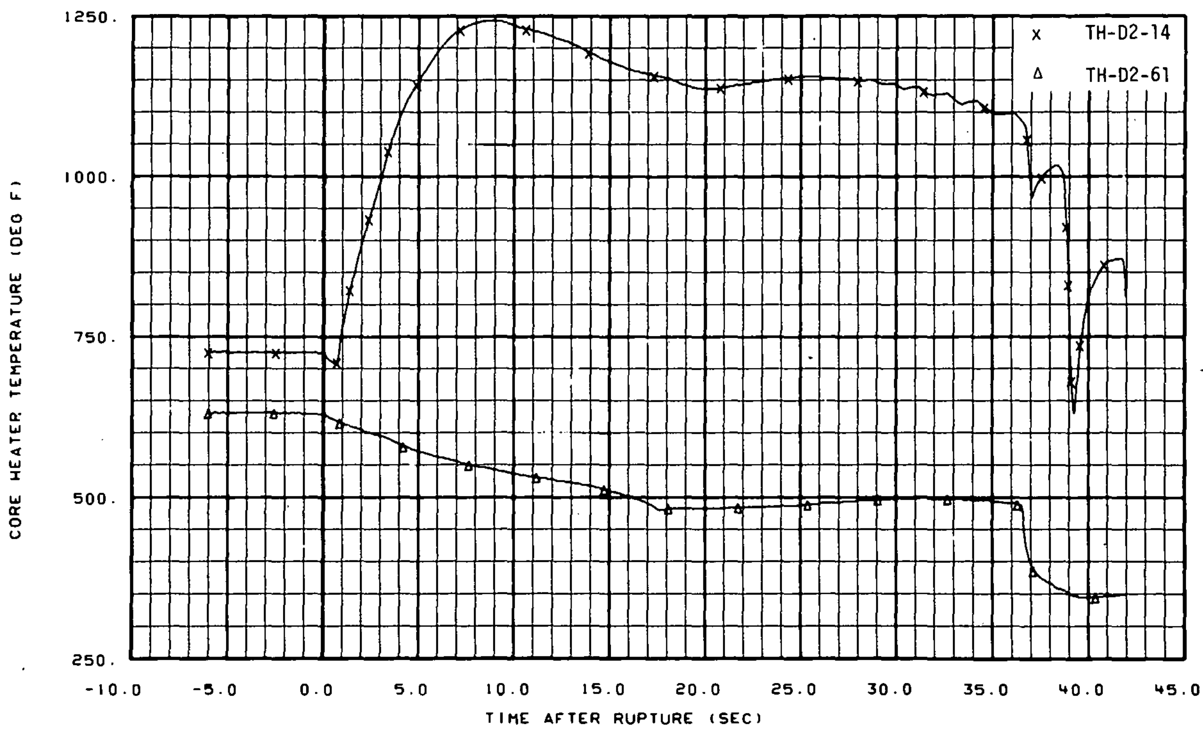

Fig. 88 Core heater temperature, Rod D-2 (TH-D2-14 and TH-D2-61), from -6 to 42 seconds.

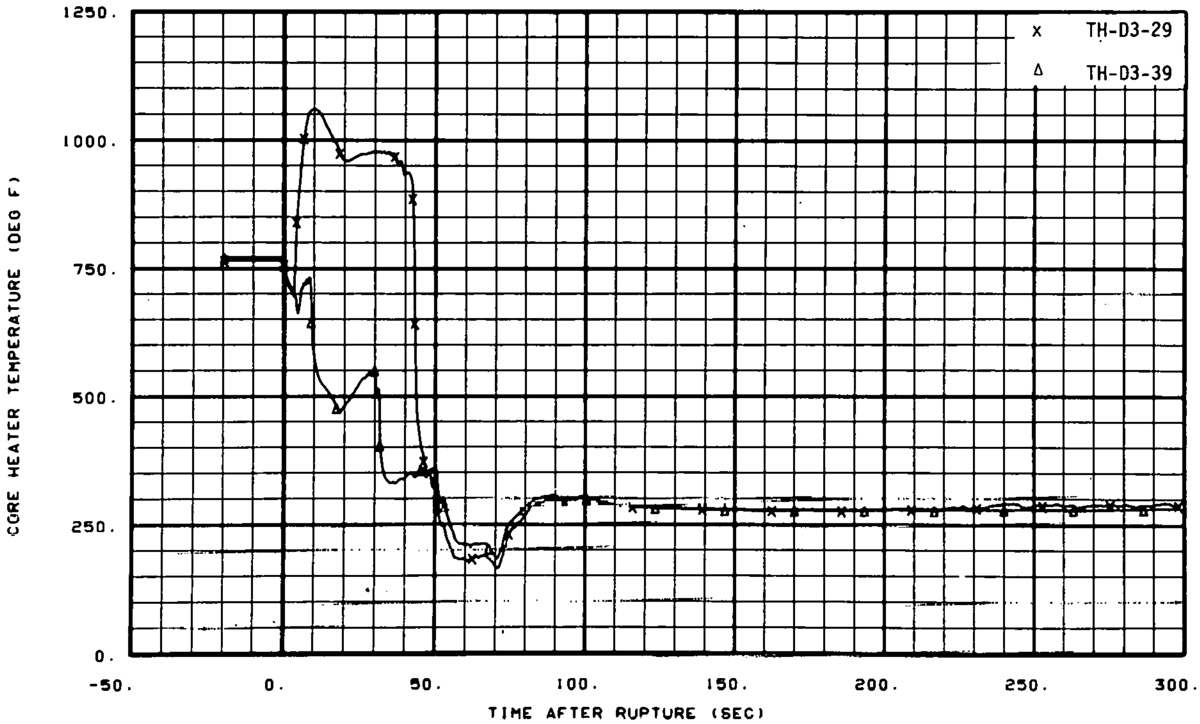

Fig. 89 Core heater temperature, Rod D-3 (TH-D3-29 and TH-D3-39), from -20 to 300 seconds.

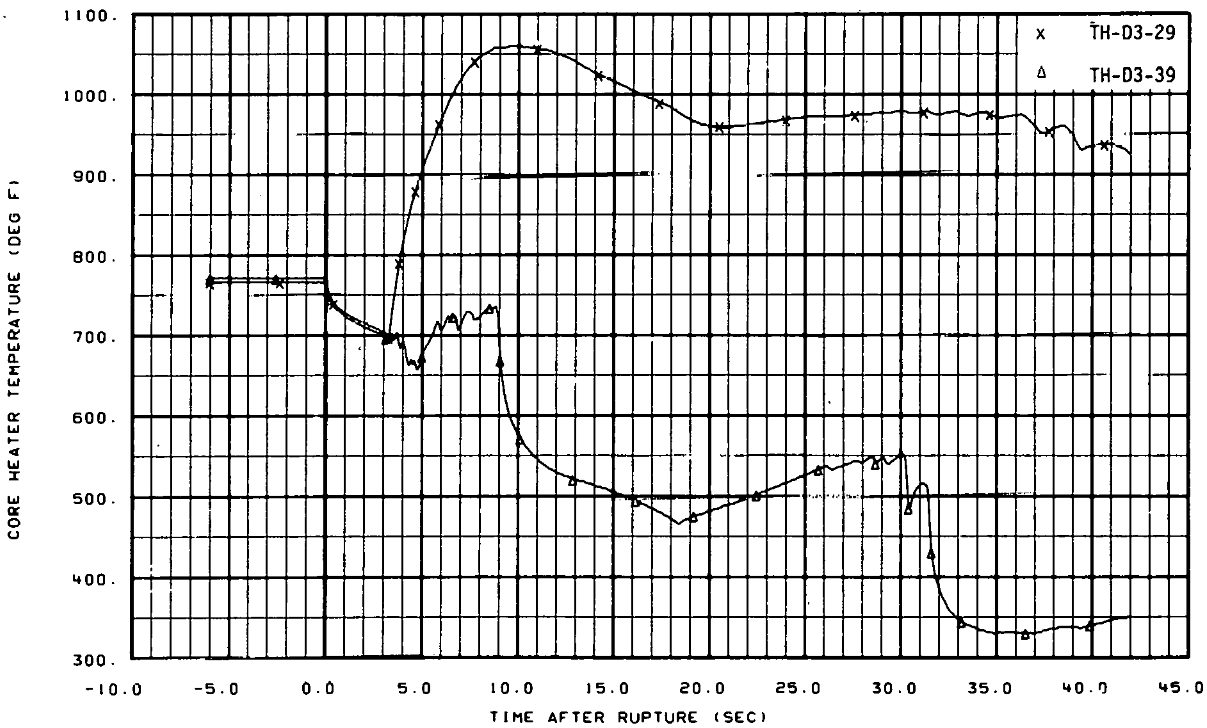

Fig. 90 Core heater temperature, Rod D-3 (TH-D3-29 and TH-D3-39), from -6 to 42 seconds.

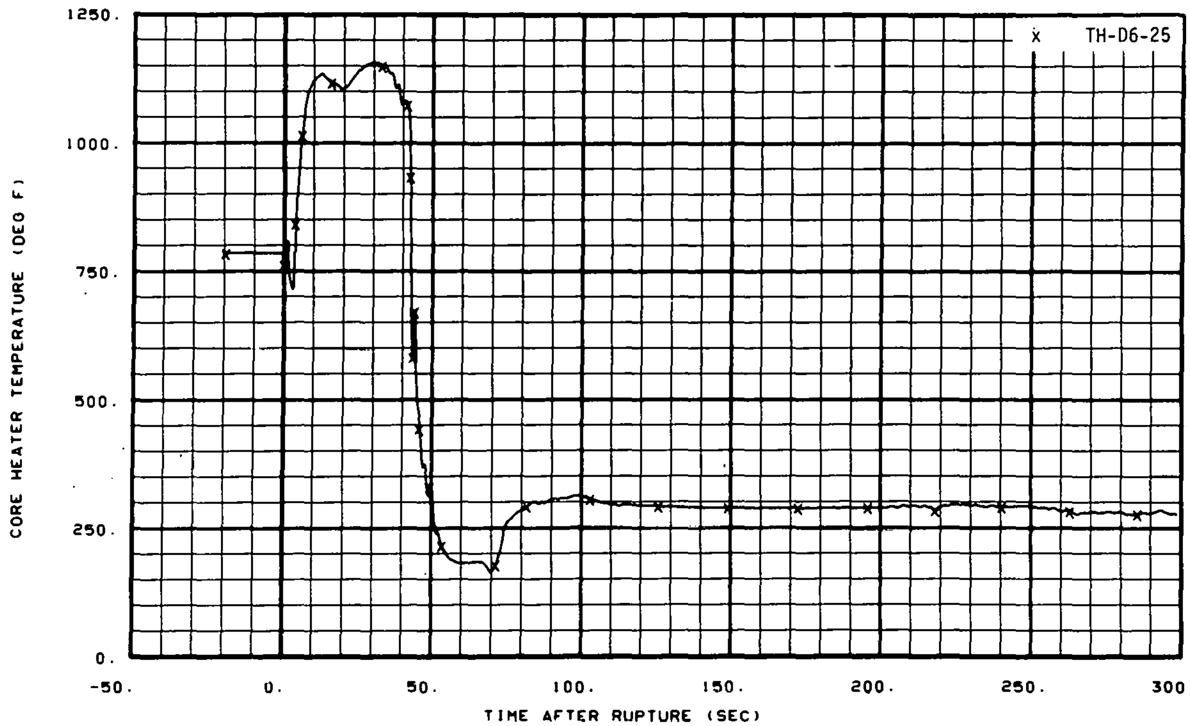

Fig. 91 Core heater temperature, Rod D-6 (TH-D6-25), from -20 to 300 seconds.

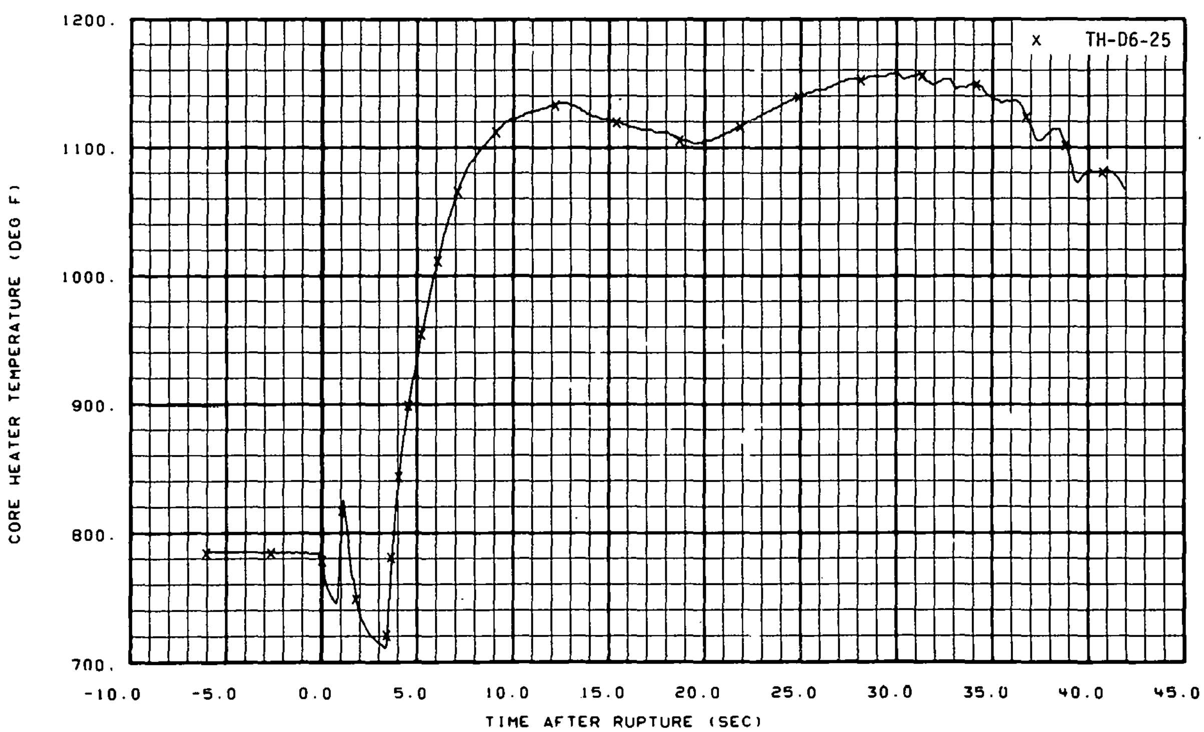

Fig. 92 Core heater temperature, Rod D-6 (TH-D6-25), from -6 to 42 seconds.

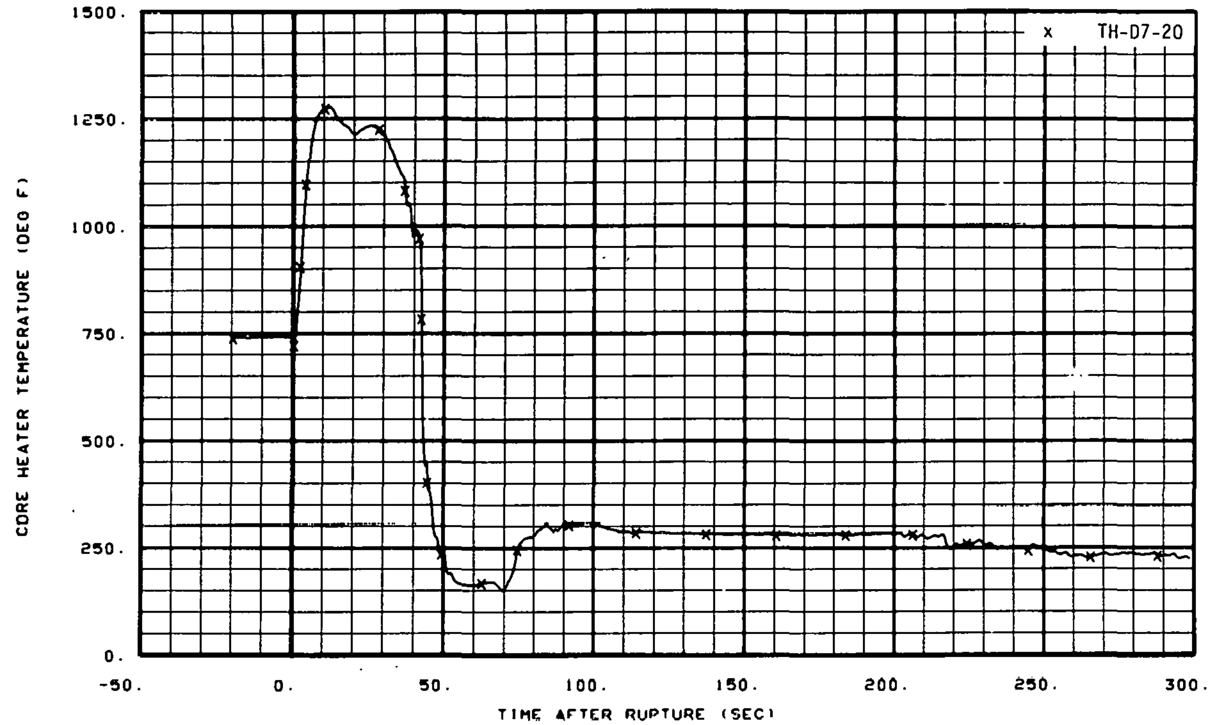

Fig. 93 Core heater temperature, Rod D-7 (TH-D7-20), from -20 to 300 seconds.

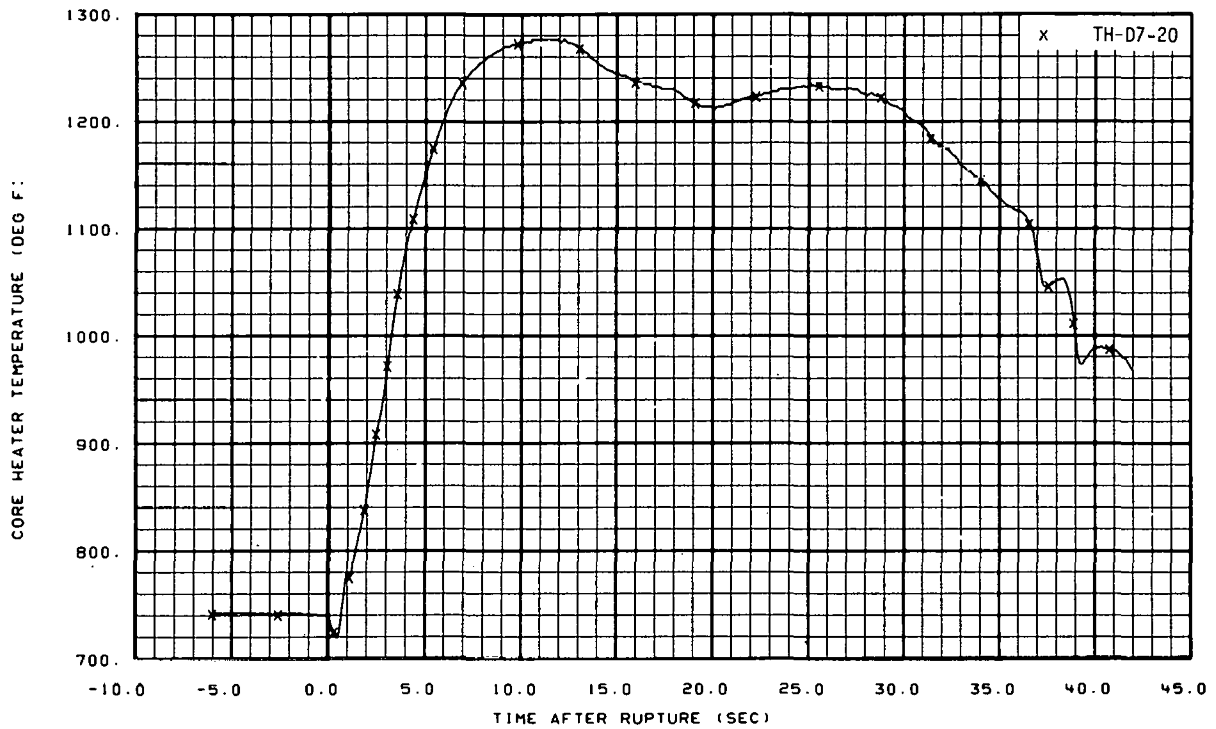

Fig. 94 Core heater temperature, Rod D-7 (TH-D7-20), from -6 to 42 seconds.

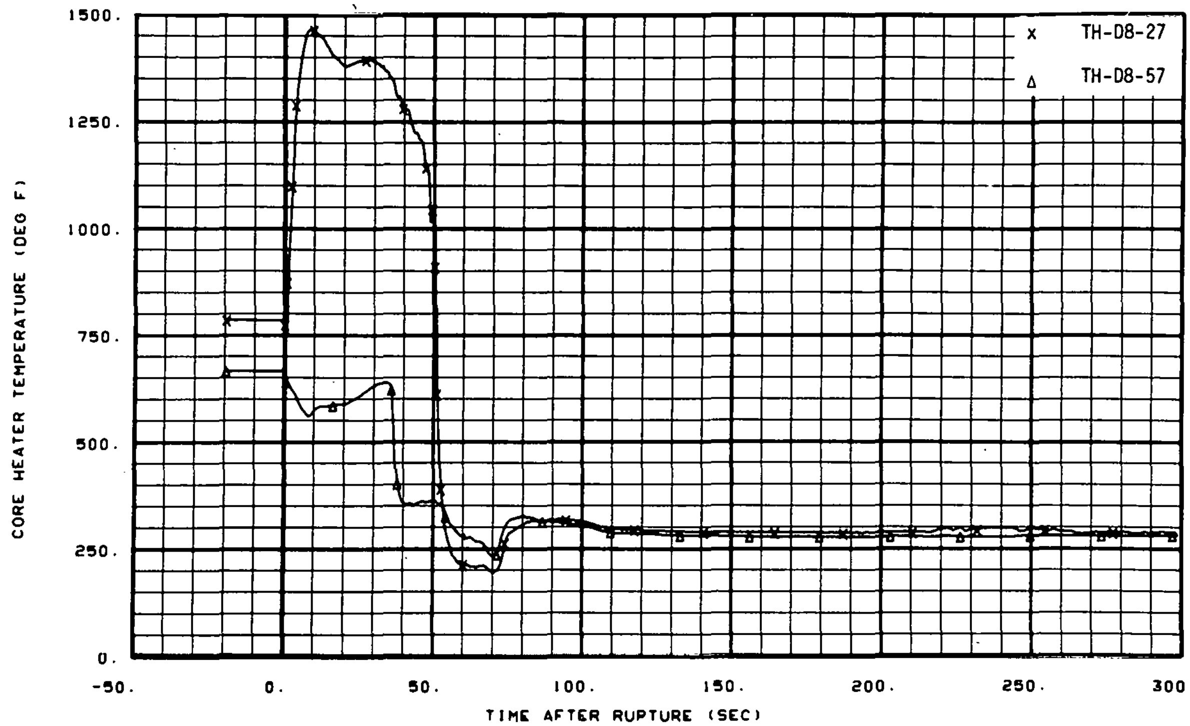

Fig. 95 Core heater temperature, Rod D-8 (TH-D8-27 and TH-D8-57), from -20 to 300 seconds.

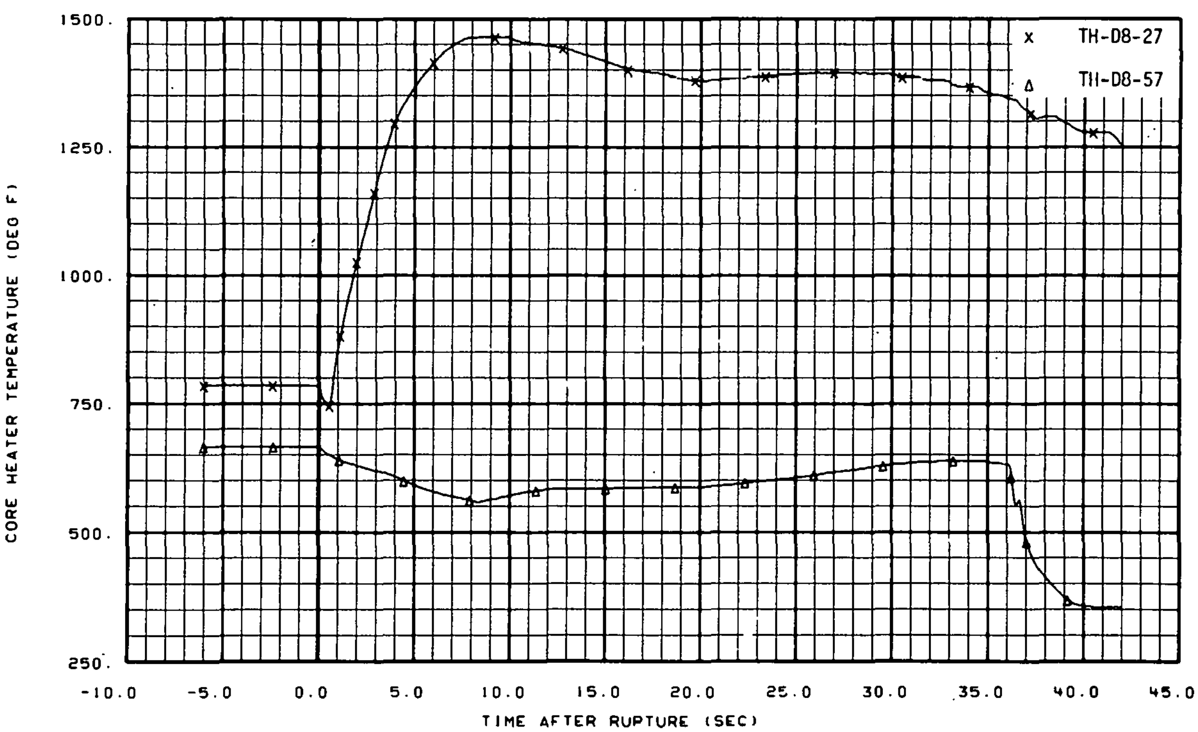

Fig. 96 Core heater temperature, Rod D-8 (TH-D8-27 and TH-D8-57), from -6 to 42 seconds.

Fig. 97 Core heater temperature, Rod E-1 (TH-E1-21 and TH-E1-33), from -20 to 300 seconds.

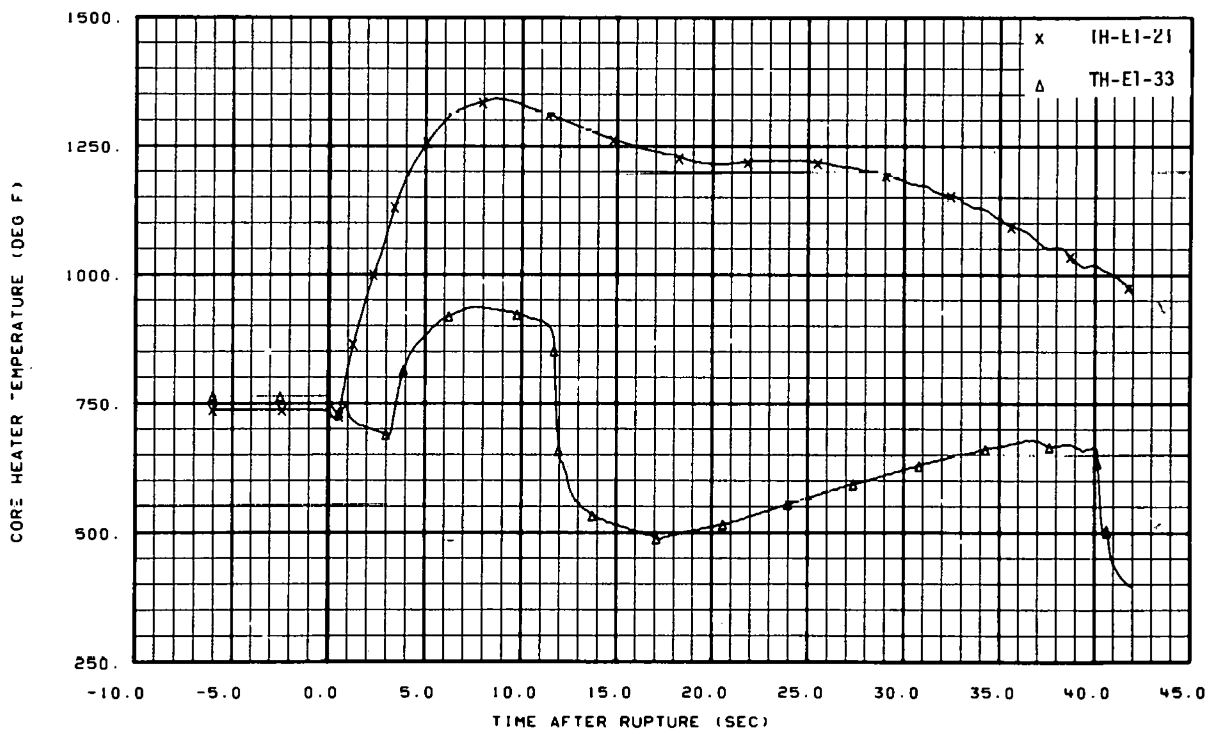

Fig. 98 Core heater temperature, Rod E-1 (TH-E1-21 and TH-E1-33), from -6 to 42 seconds.

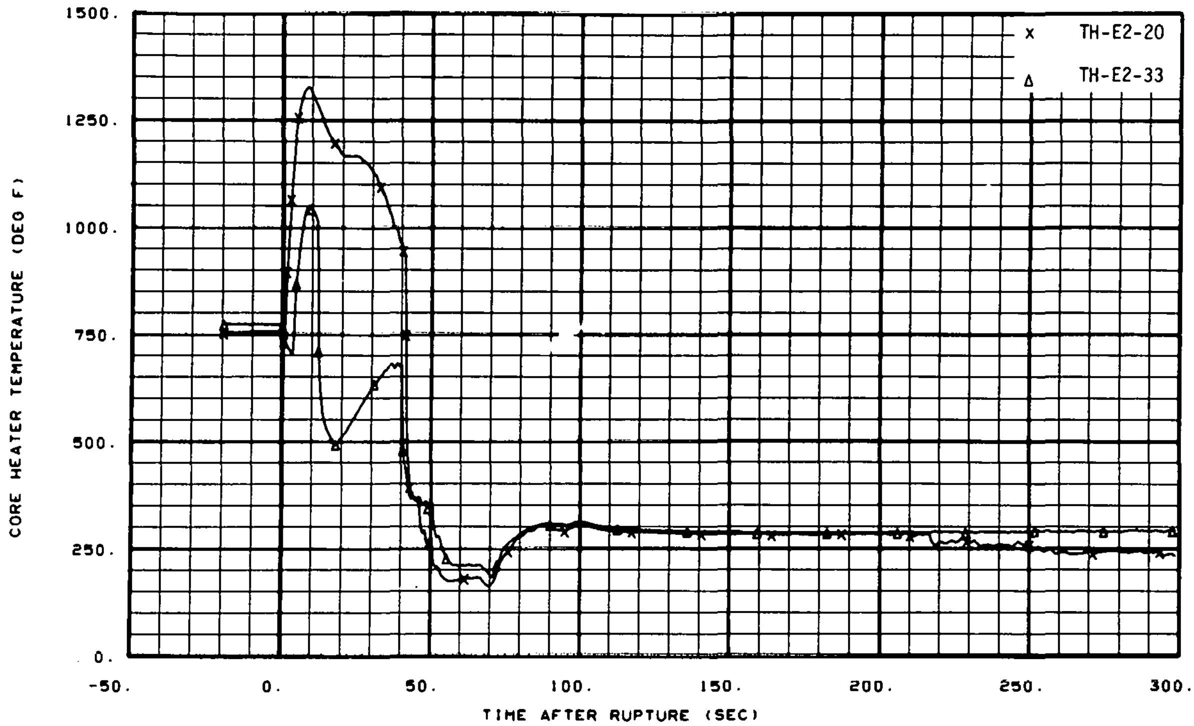

Fig. 99 Core heater temperature, Rod E-2 (TH-E2-20 and TH-E2-33), from -20 to 300 seconds.

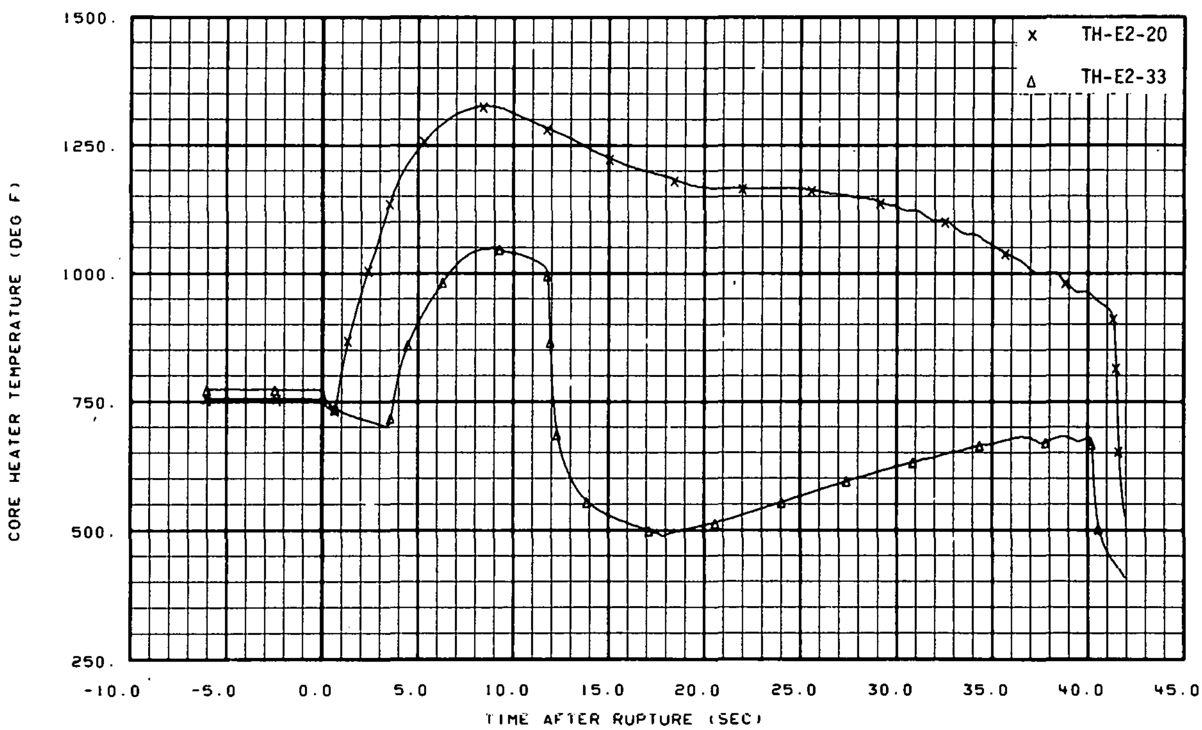

Fig. 100 Core heater temperature, Rod E-2 (TH-E2-20 and TH-E2-33), from -6 to 42 seconds.

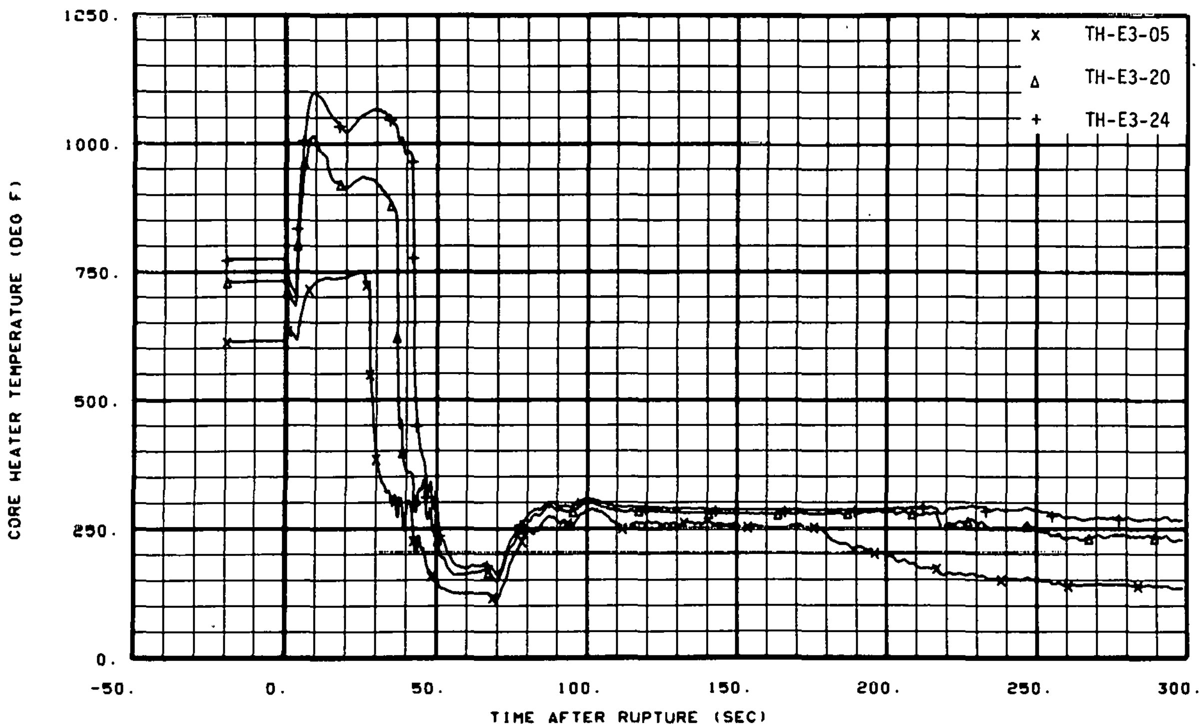

Fig. 101 Core heater temperature, Rod E-3 (TH-E3-05, TH-E3-20, and TH-E3-24), from -20 to 300 seconds.

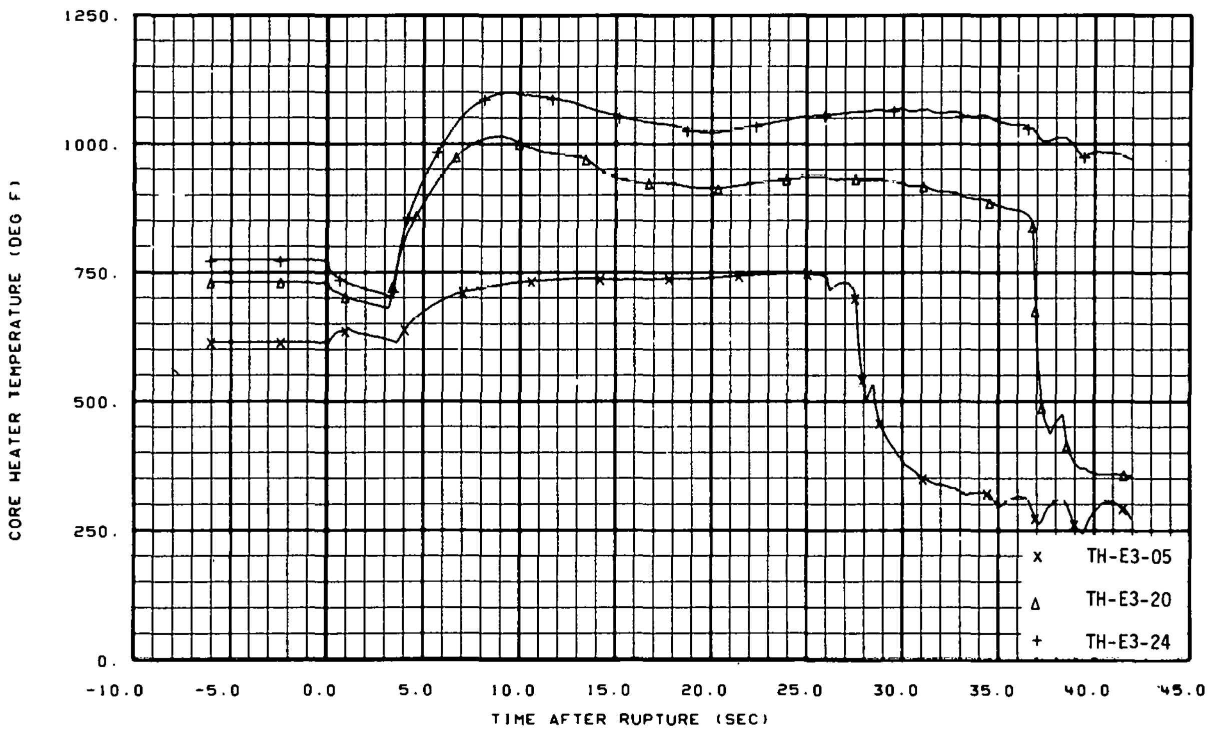

Fig. 102 Core heater temperature, Rod E-3 (TH-E3-05, TH-E3-20, and TH-E3-24), from -6 to 42 seconds.

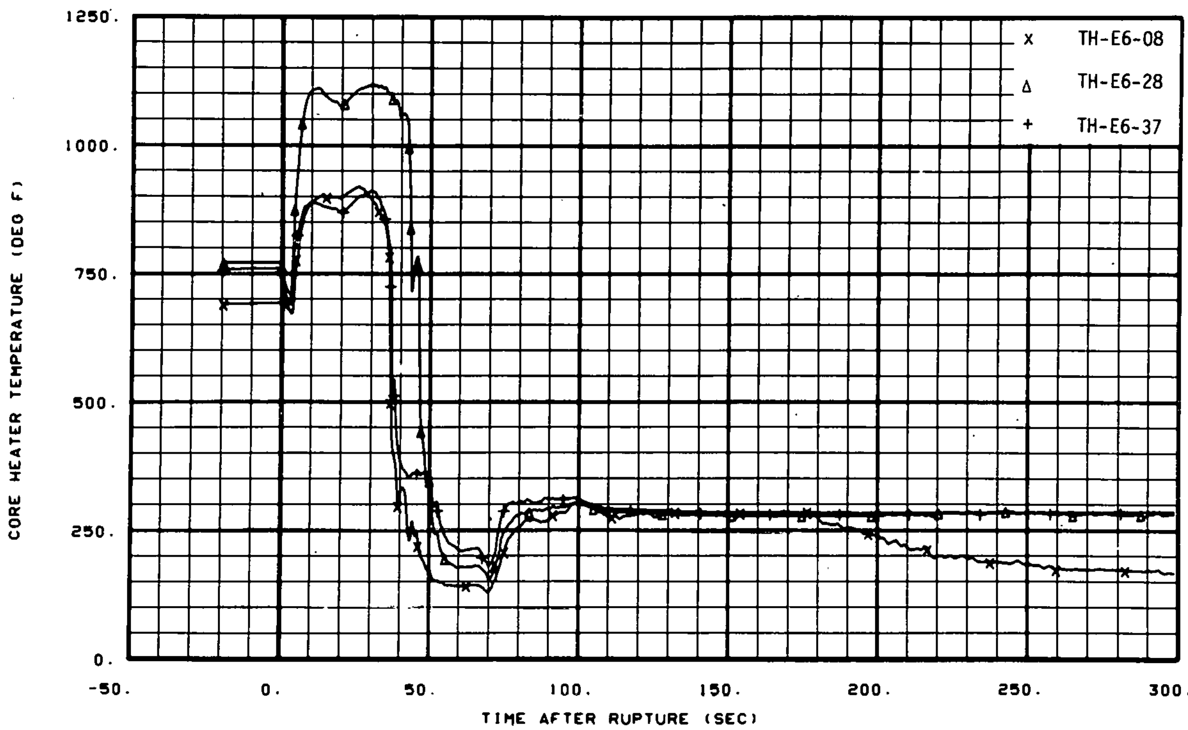

Fig. 103 Core heater temperature, Rod E-6 (TH-E6-08, TH-E6-28, and TH-E6-37), from -20 to 300 seconds.

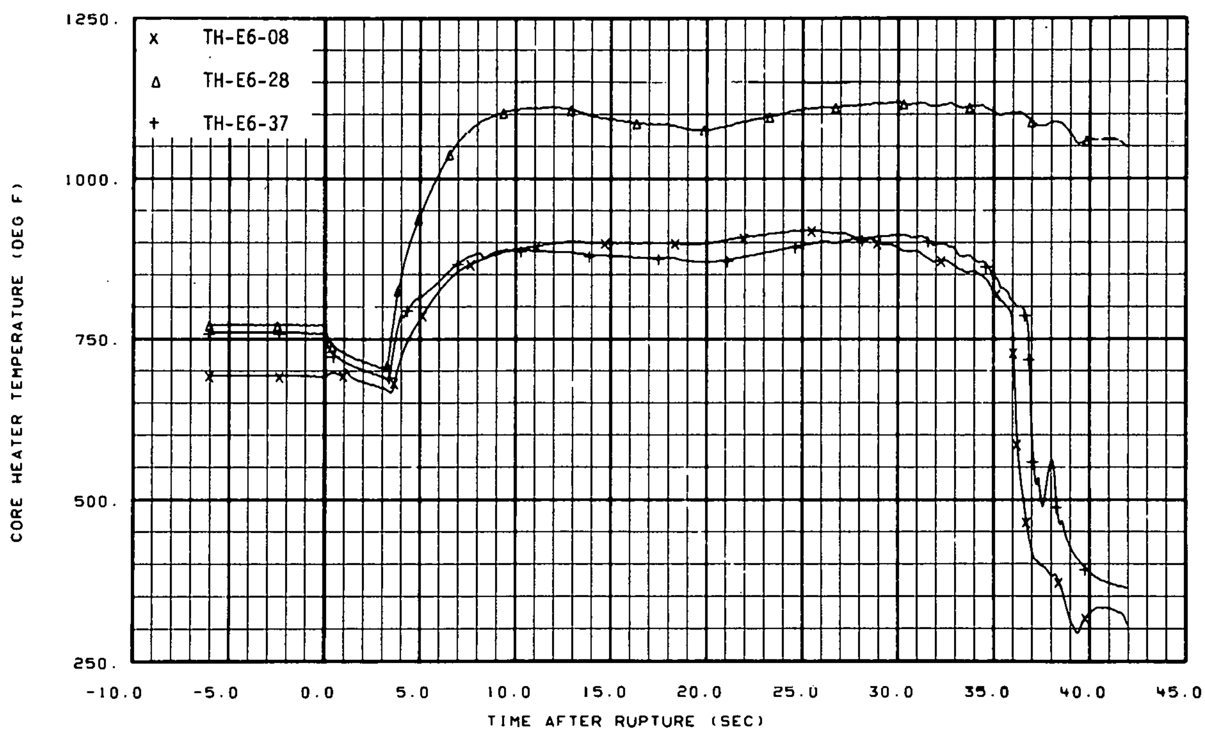

Fig. 104 Core heater temperature, Rod E-6 (TH-E6-08, TH-E6-28, and TH-E6-37), from -6 to 42 seconds.

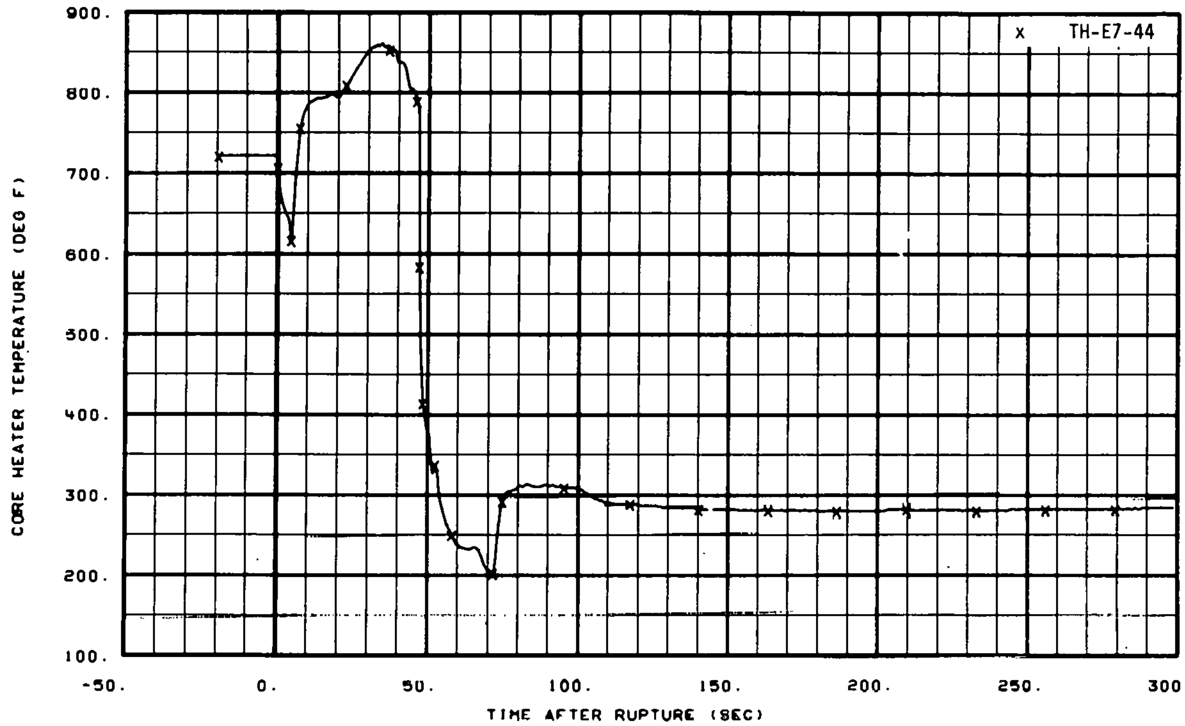

Fig. 105 Core heater temperature, Rod E-7 (TH-E7-44), from -20 to 300 seconds.

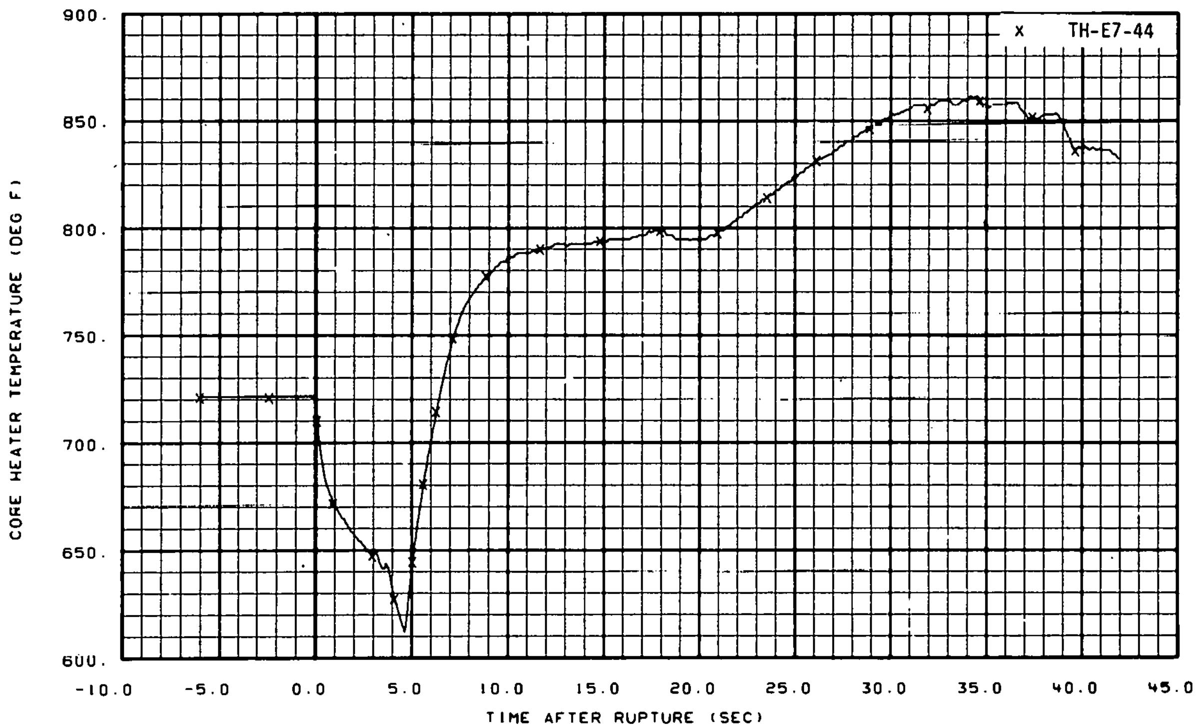

Fig. 106 Core heater temperature, Rod E-7 (TH-E7-44), from -6 to 42 seconds.

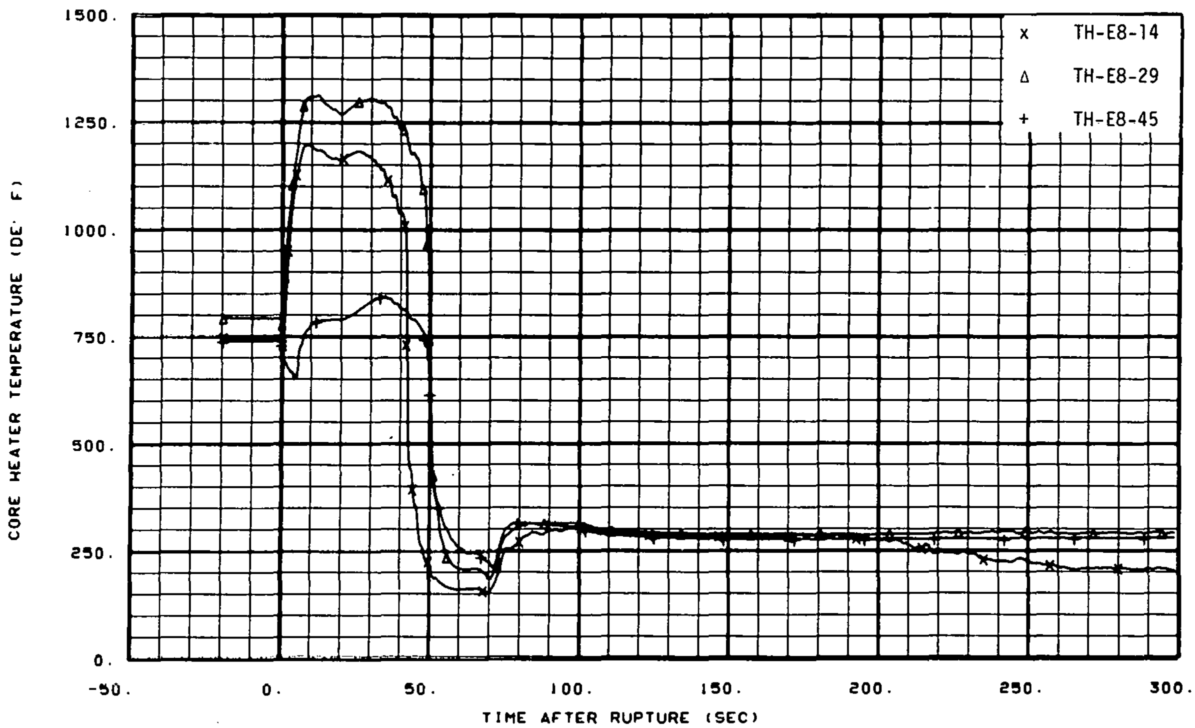

Fig. 107 Core heater temperature, Rod E-8 (TH-E8-14, TH-E8-29, and TH-E8-45), from -20 to 300 seconds.

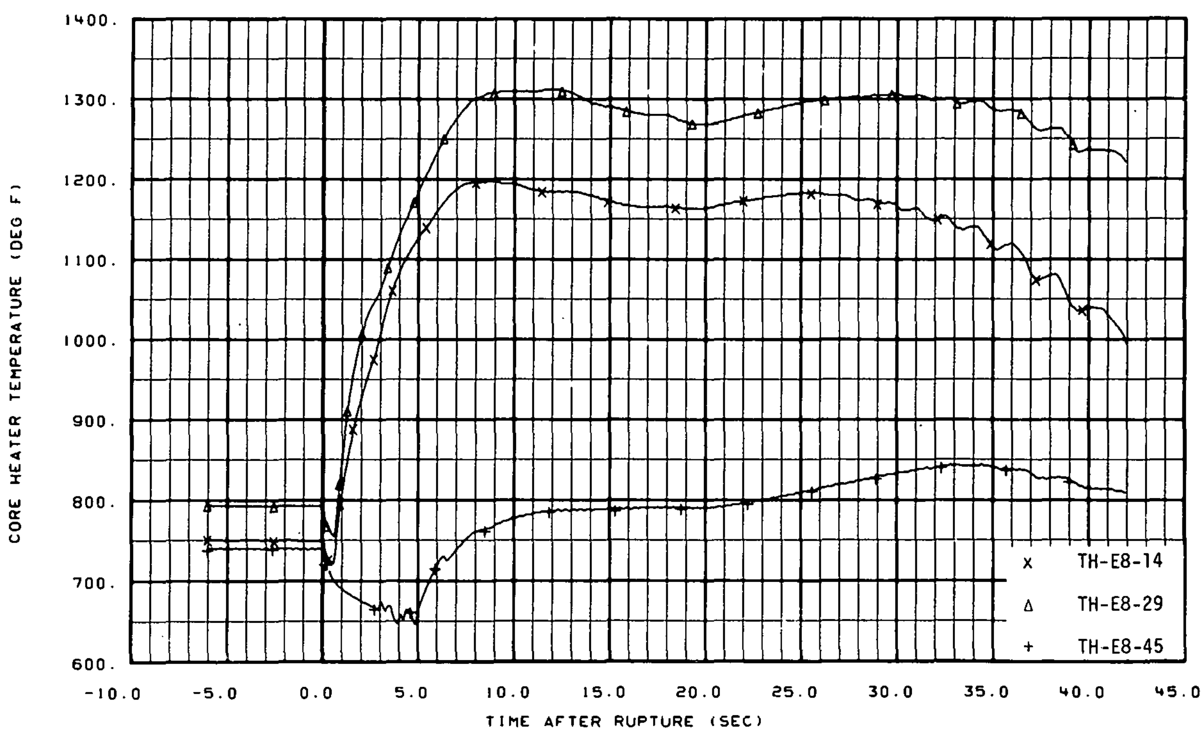

Fig. 108 Core heater temperature, Rod E-8 (TH-E8-14, TH-E8-29, and TH-E8-45), from -6 to 42 seconds.

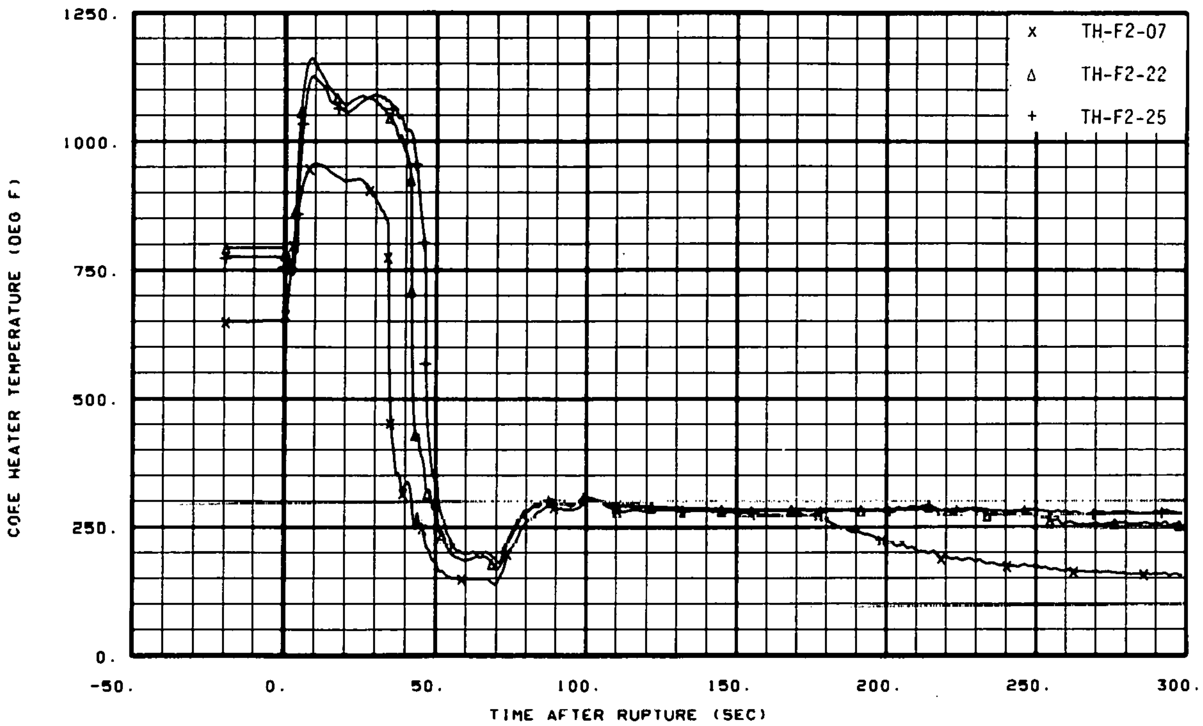

Fig. 109 Core heater temperature, Rod F-2 (TH-F2-07, TH-F2-22, and TH-F2-25), from -20 to 300 seconds.

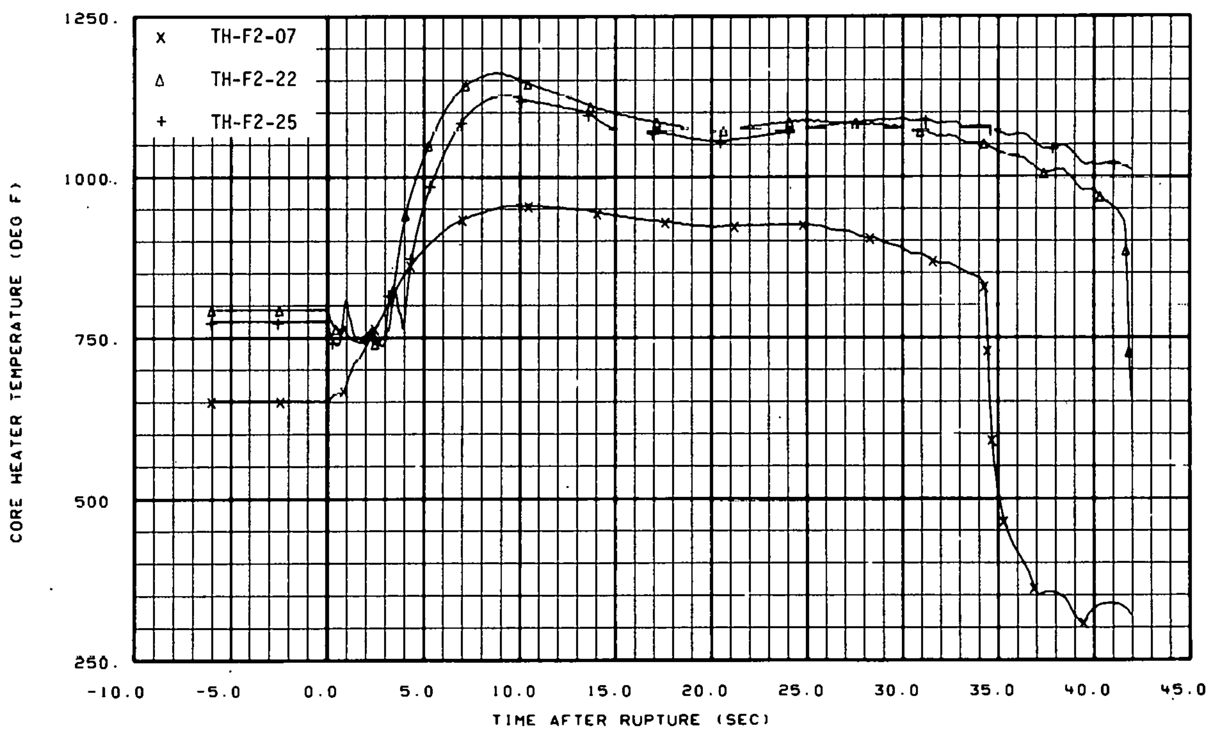

Fig. 110 Core heater temperature, Rod F-2 (TH-F2-07, TH-F2-22, and TH-F2-25), from -6 to 42 seconds.

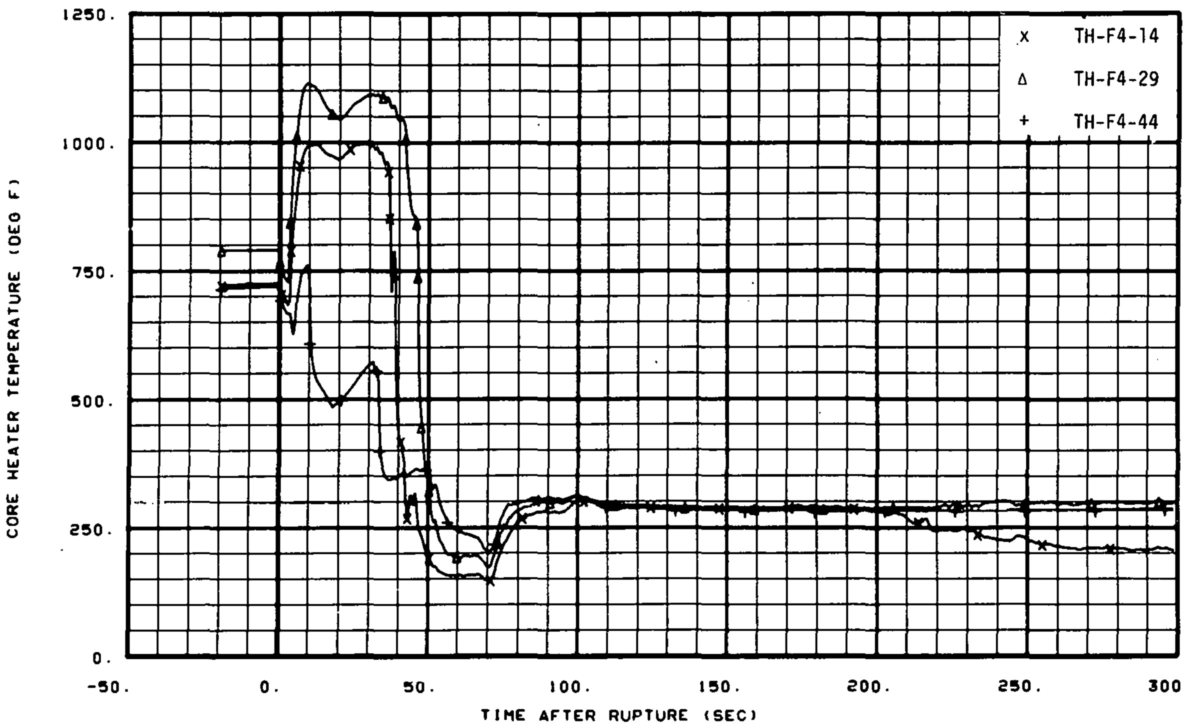

Fig. 111 Core heater temperature, Rod F-4 (TH-F4-14, TH-F4-29, and TH-F4-44), from -20 to 300 seconds.

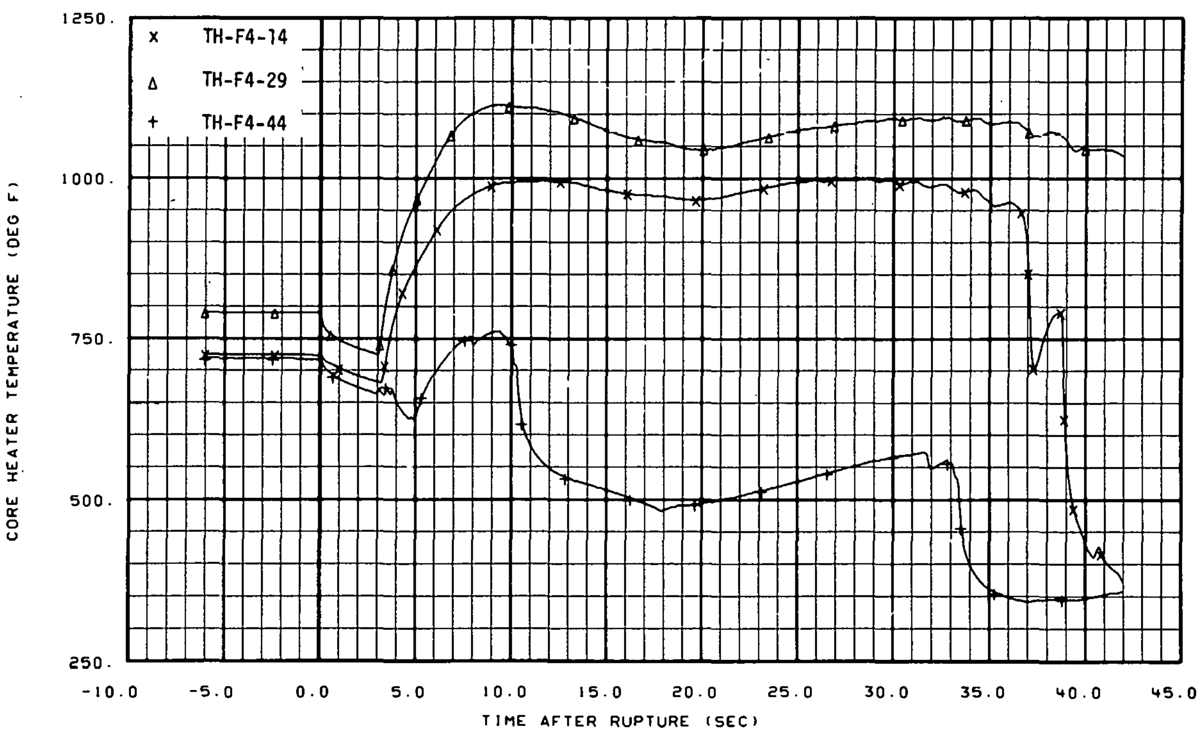

Fig. 112 Core heater temperature, Rod F-4 (TH-F4-14, TH-F4-29, and TH-F4-44), from -6 to 42 seconds.

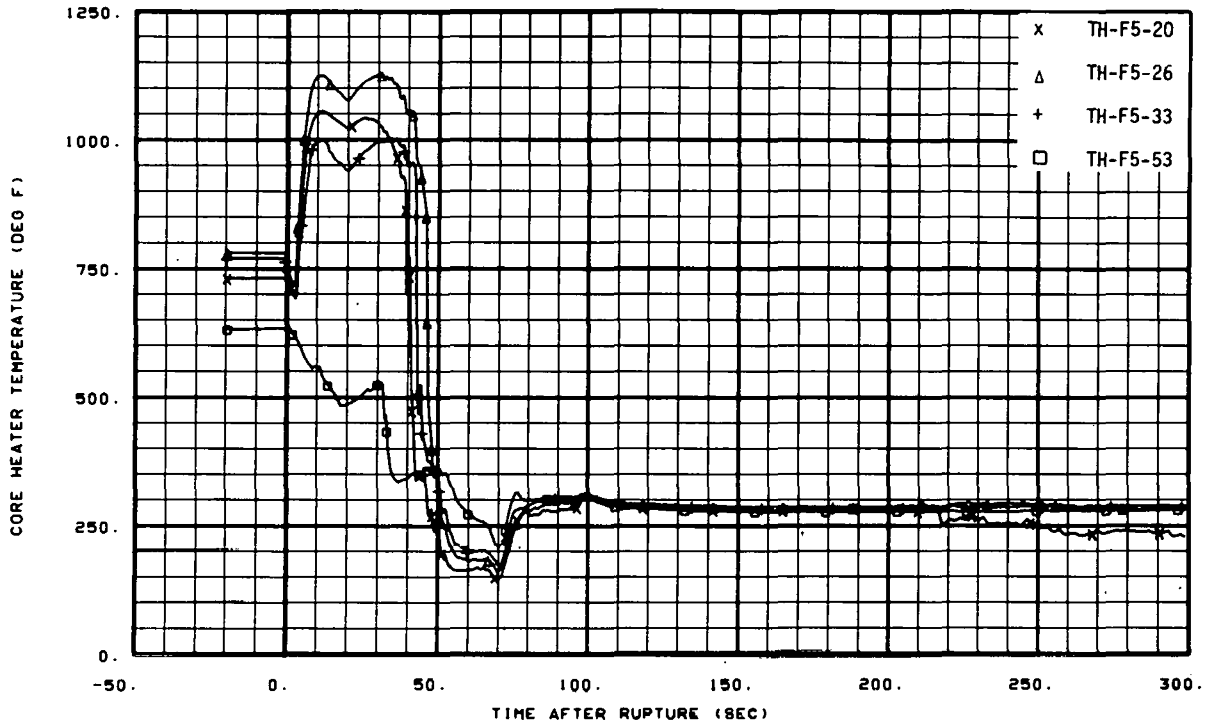

Fig. 113 Core heater temperature, Rod F-5 (TH-F5-20, TH-F5-26, TH-F5-33, and TH-F5-53), from -20 to 300 seconds.

Fig. 114 Core heater temperature, Rod F-5 (TH-F5-20, TH-F5-26, TH-F5-33, and TH-F5-53), from -6 to 42 seconds.

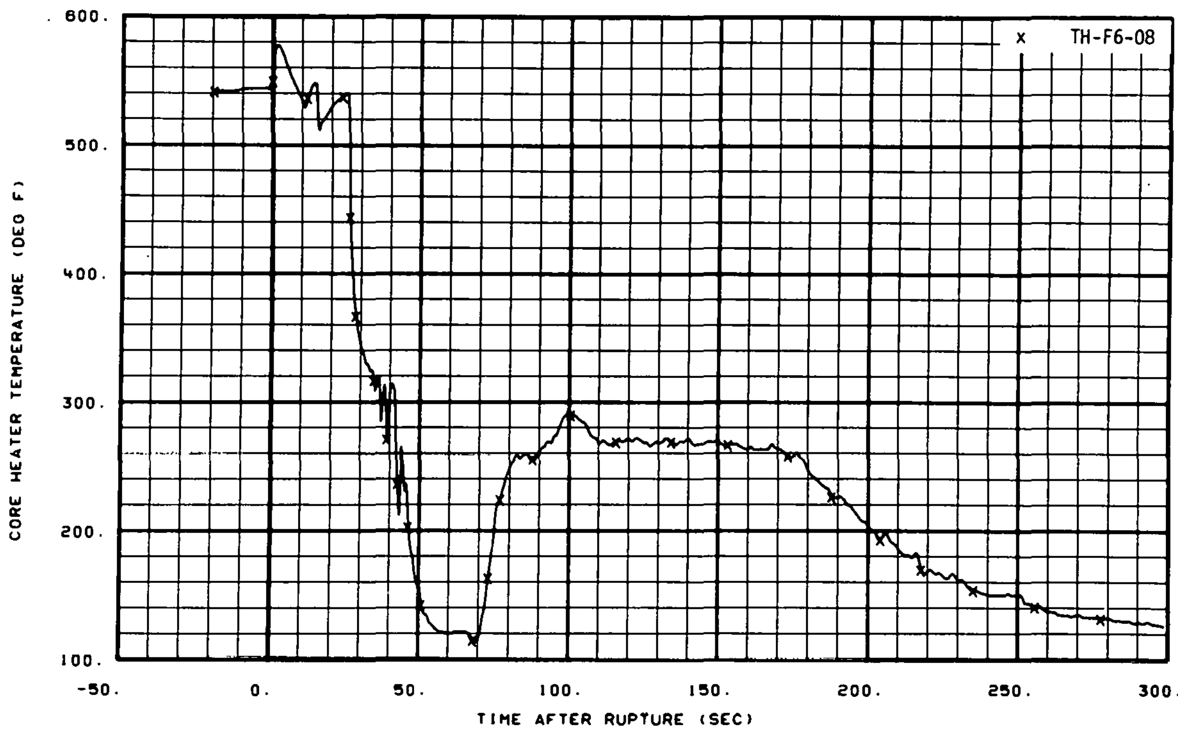

Fig. 115 Core heater temperature, Rod F-6 (TH-F6-08), from -20 to 300 seconds.

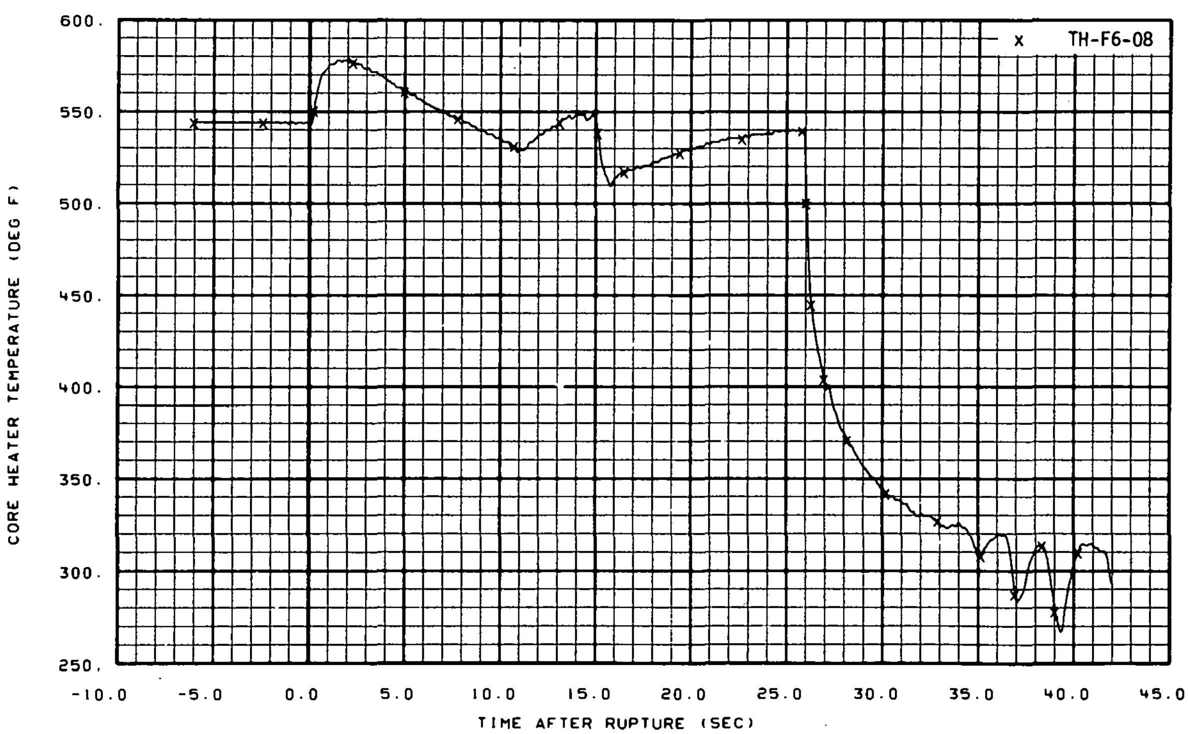

Fig. 116 Core heater temperature, Rod F-6 (TH-F6-08), from -6 to 42 seconds.

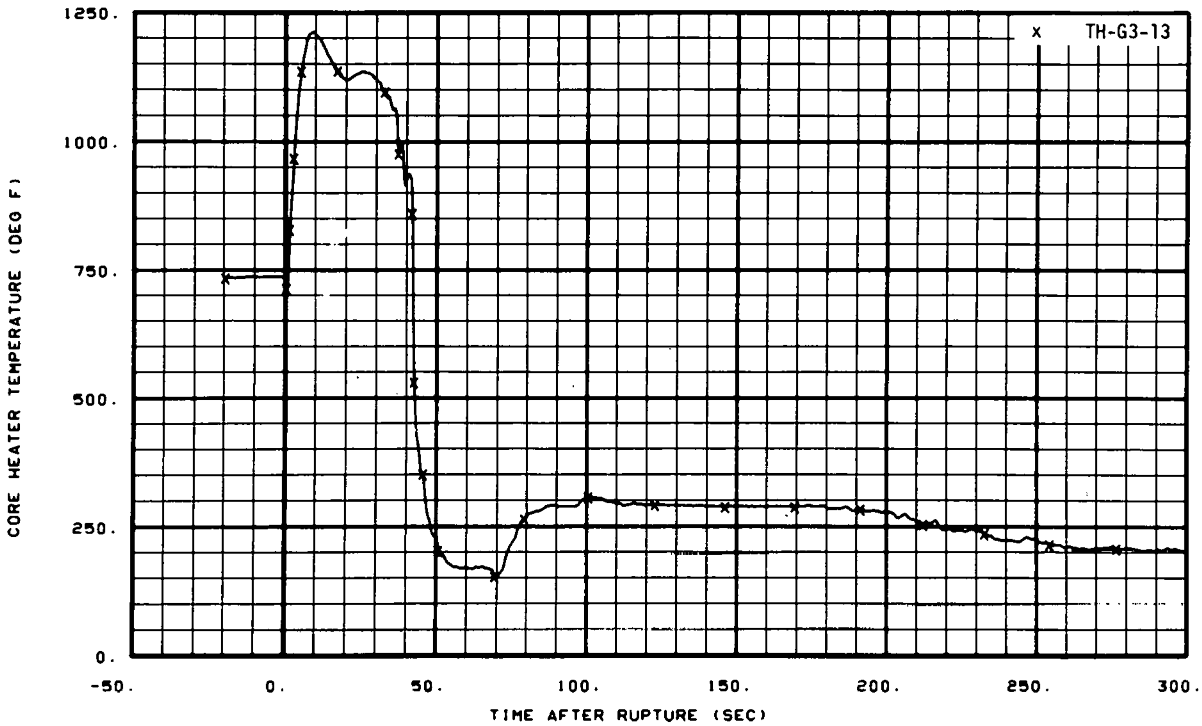

Fig. 117 Core heater temperature, Rod G-3 (TH-G3-13), from -20 to 300 seconds.

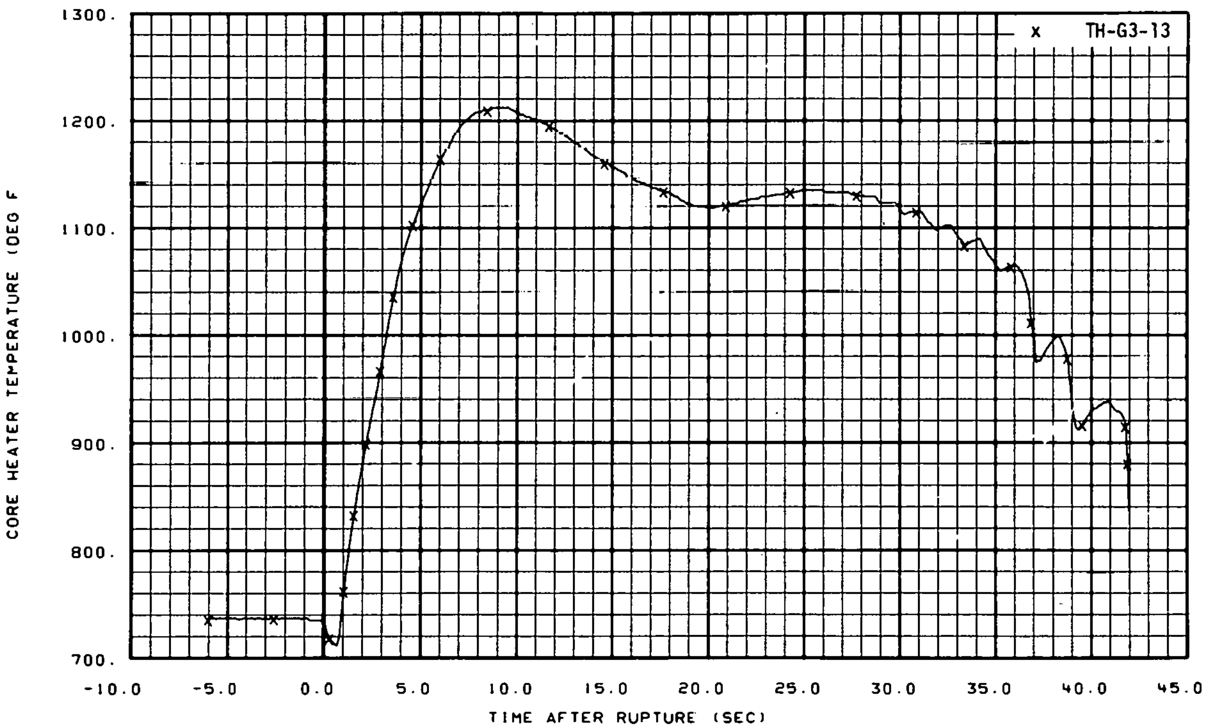

Fig. 118 Core heater temperature, Rod G-3 (TH-G3-13), from -6 to 42 seconds.

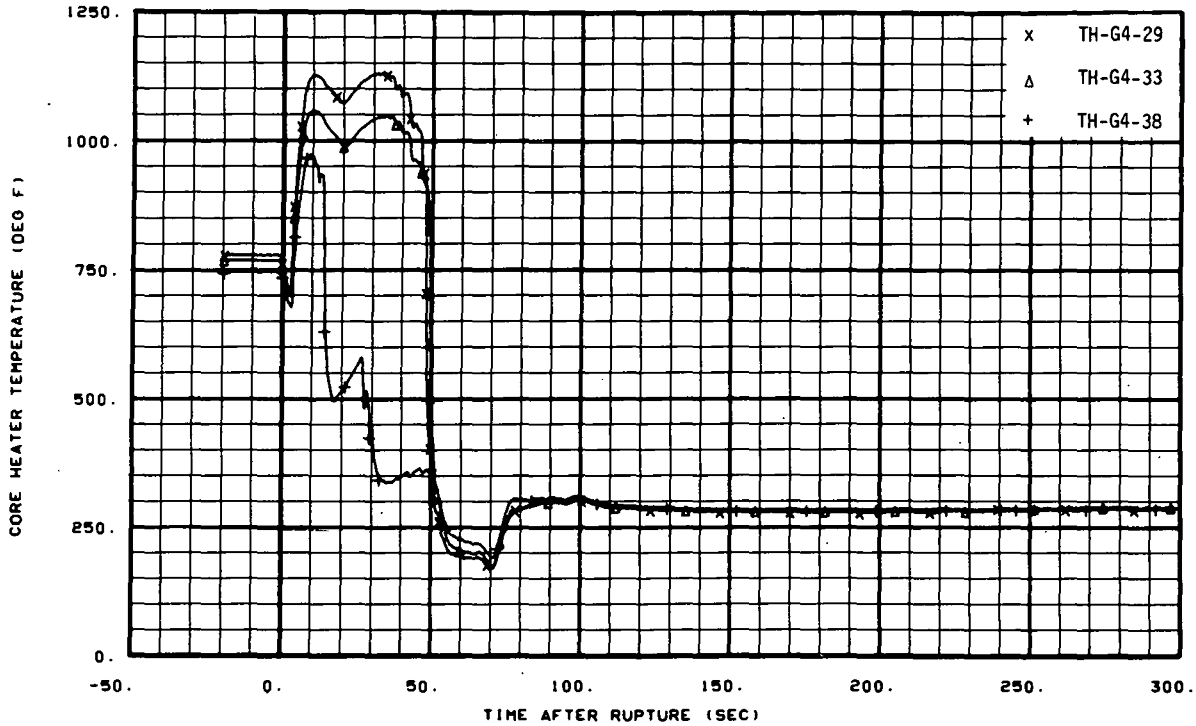

Fig. 119 Core heater temperature, Rod G-4 (TH-G4-29, TH-G4-33, and TH-G4-38), from -20 to 300 seconds.

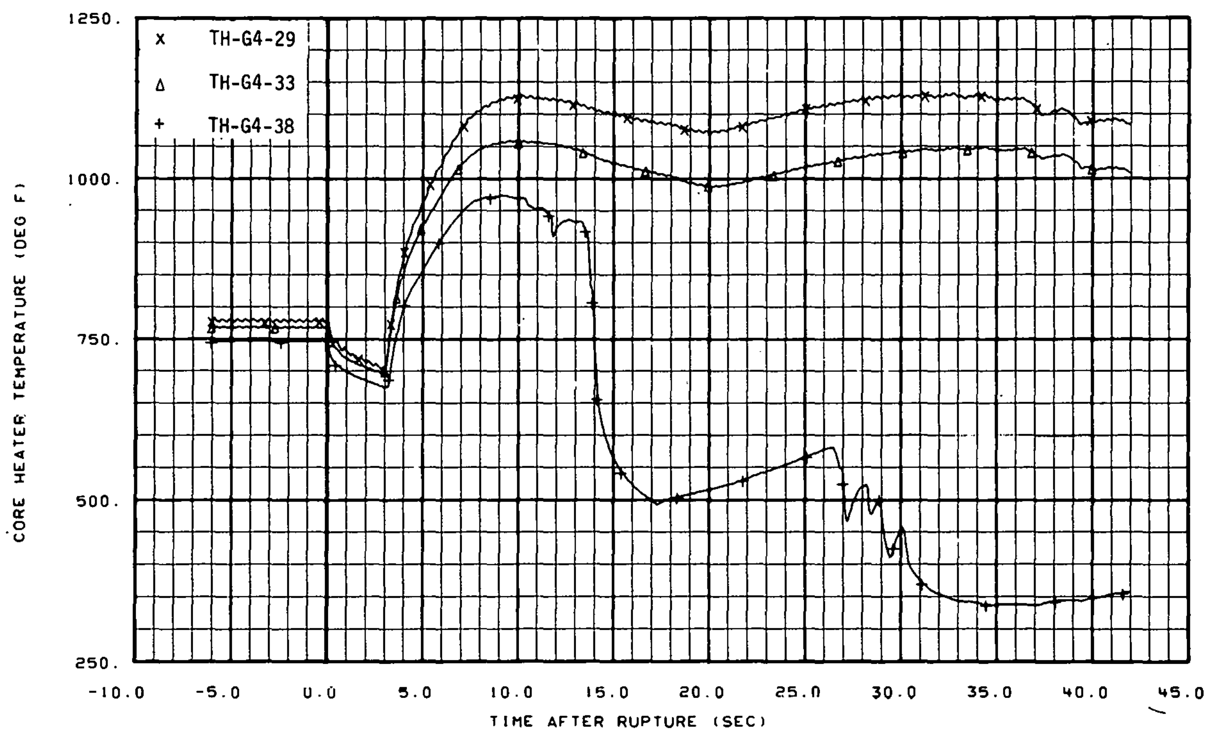

Fig. 120 Core heater temperature, Rod G-4 (TH-G4-29, TH-G4-33, and TH-G4-38), from -6 to 42 seconds.

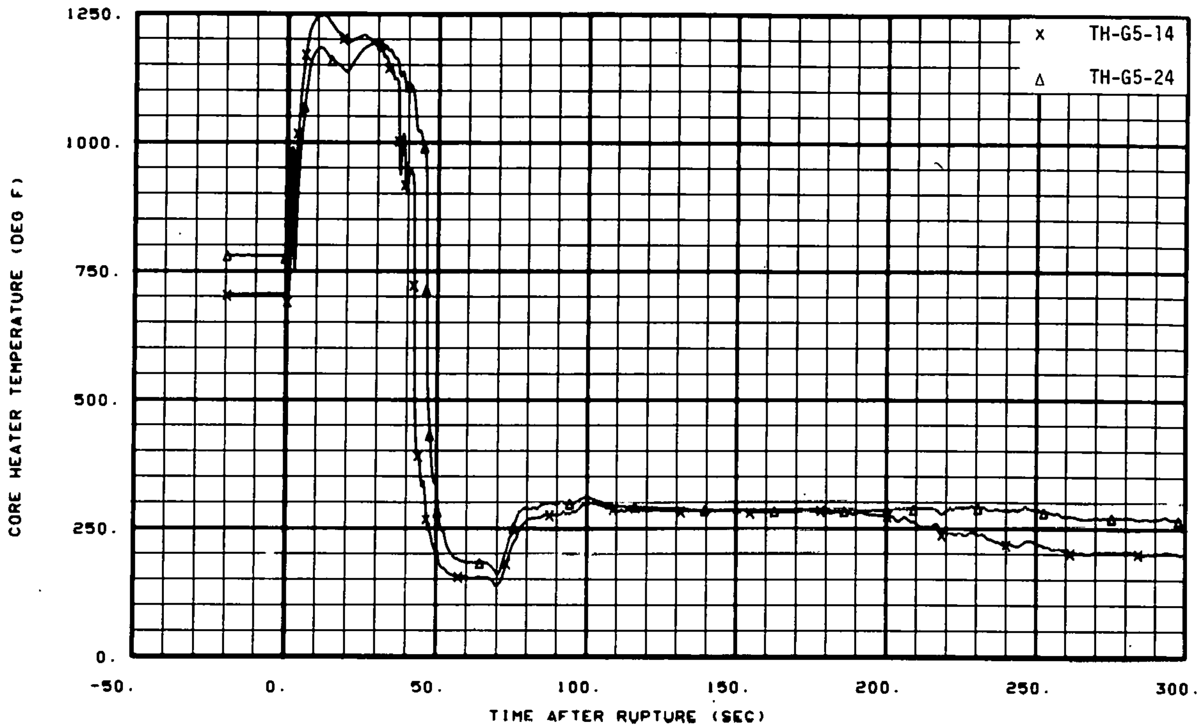

Fig. 121 Core heater temperature, Rod G-5 (TH-G5-14 and TH-G5-24), from -20 to 300 seconds.

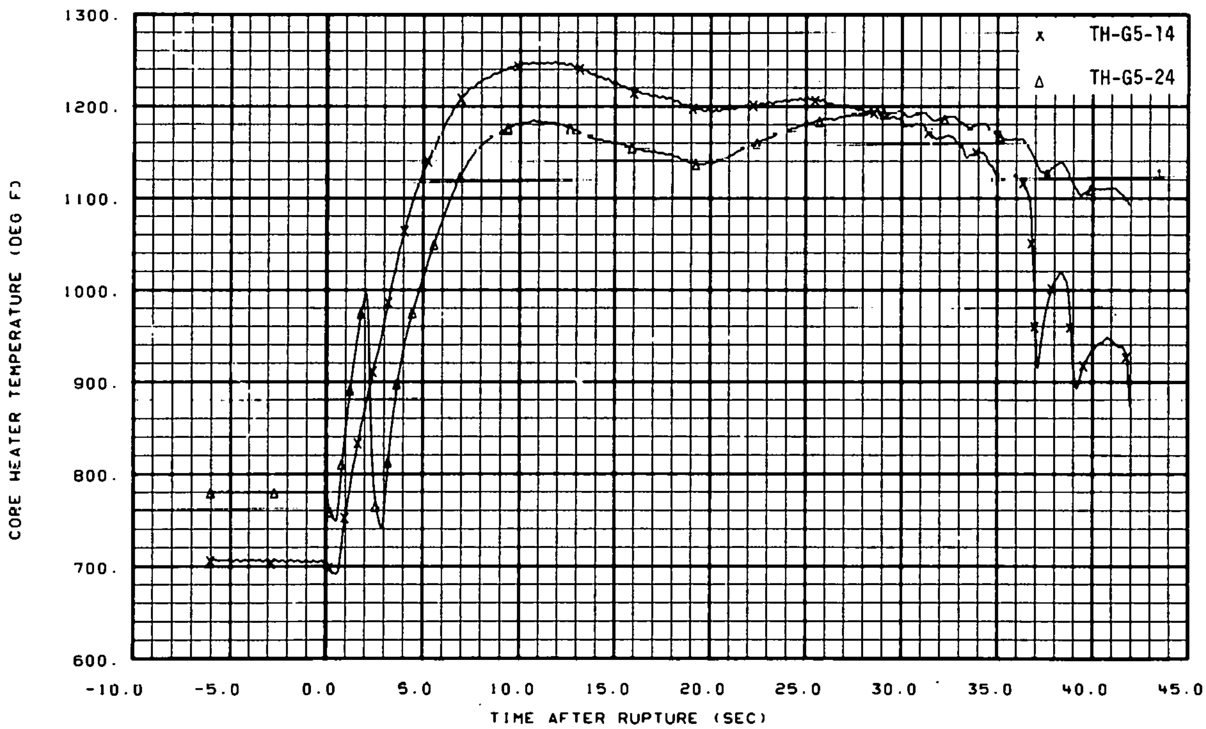

Fig. 122 Core heater temperature, Rod G-5 (TH-G5-14 and TH-G5-24), from -6 to 42 seconds.

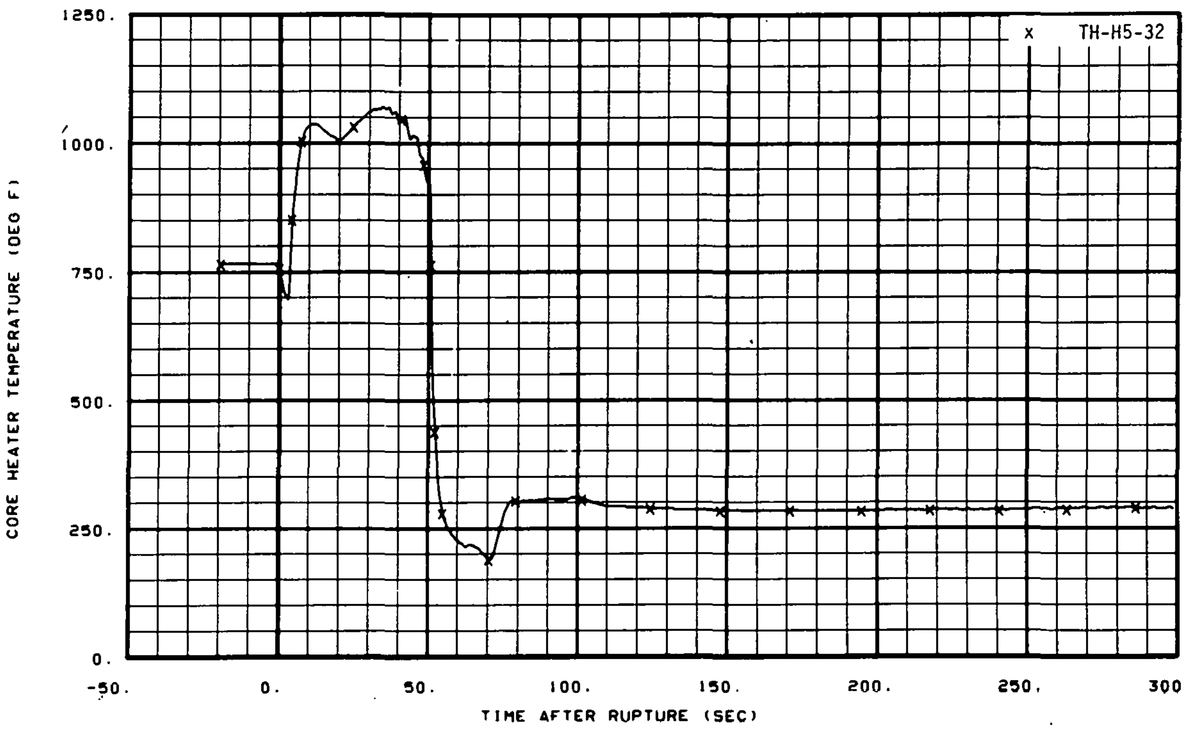

Fig. 123 Core heater temperature, Rod H-5 (TH-H5-32), from -20 to 300 seconds.

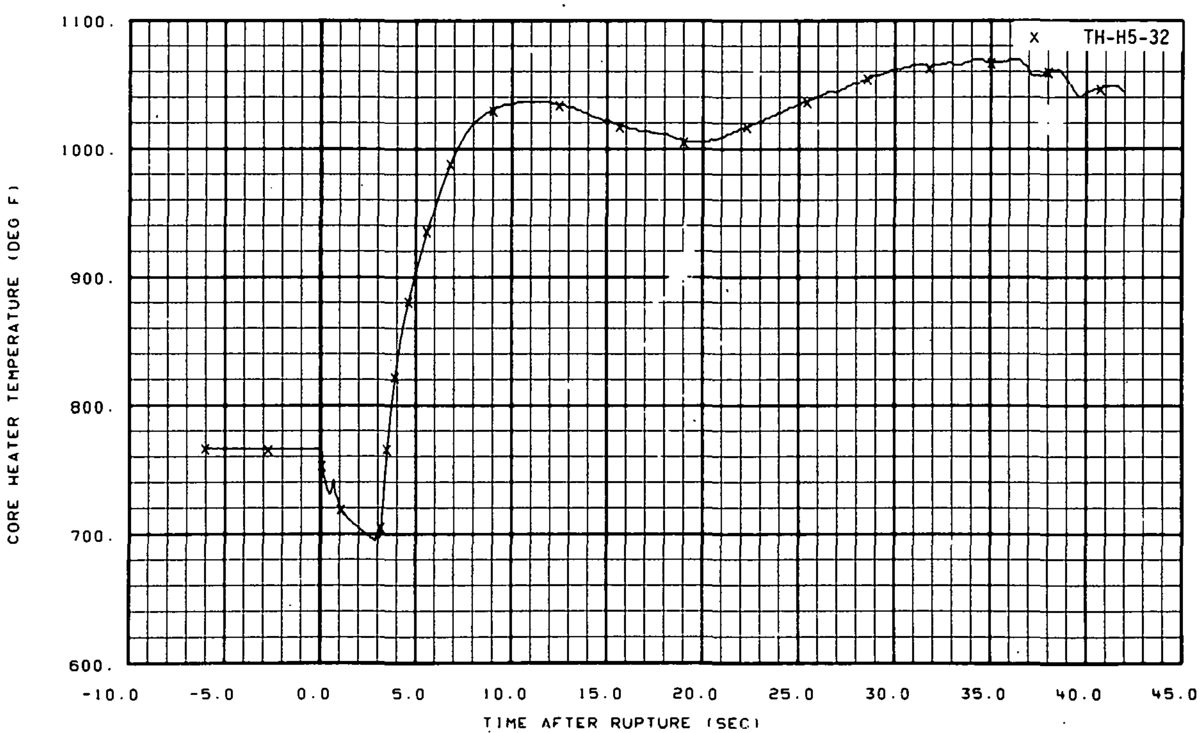

Fig. 124 Core heater temperature, Rod H-5 (TH-H5-32), from -6 to 42 seconds.

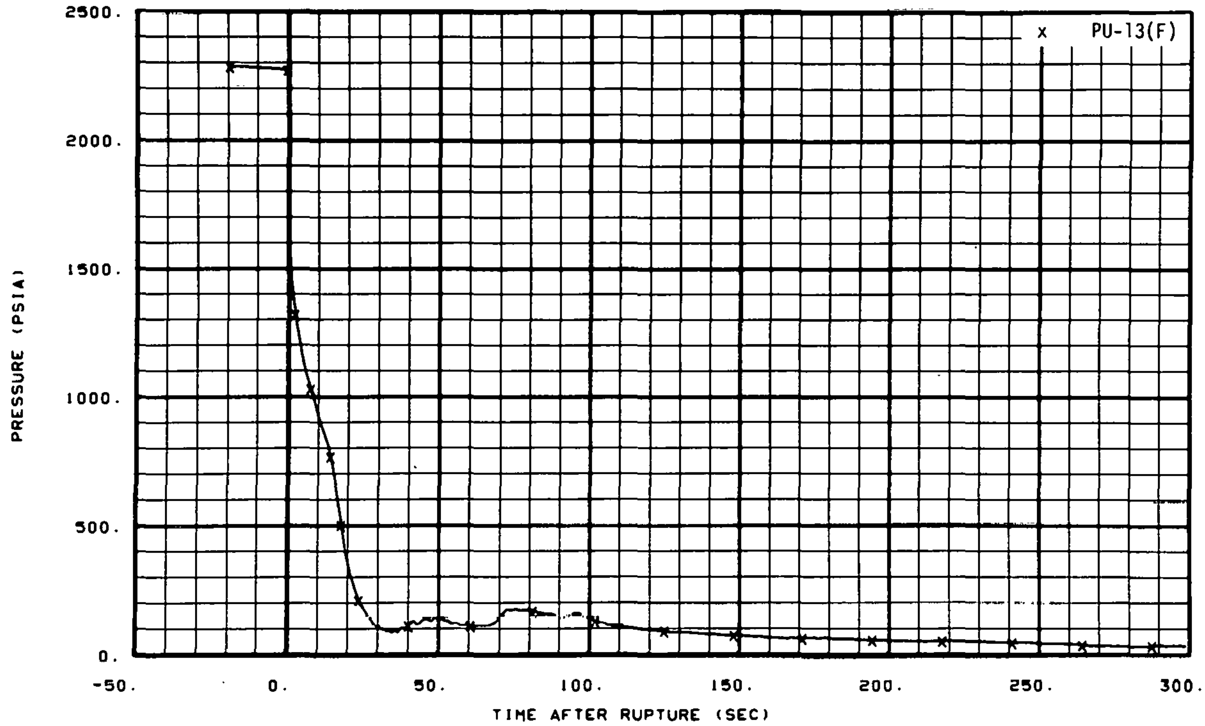

Fig. 125 Pressure in intact loop, Spool 13 PU-13(F), from -20 to 300 seconds.

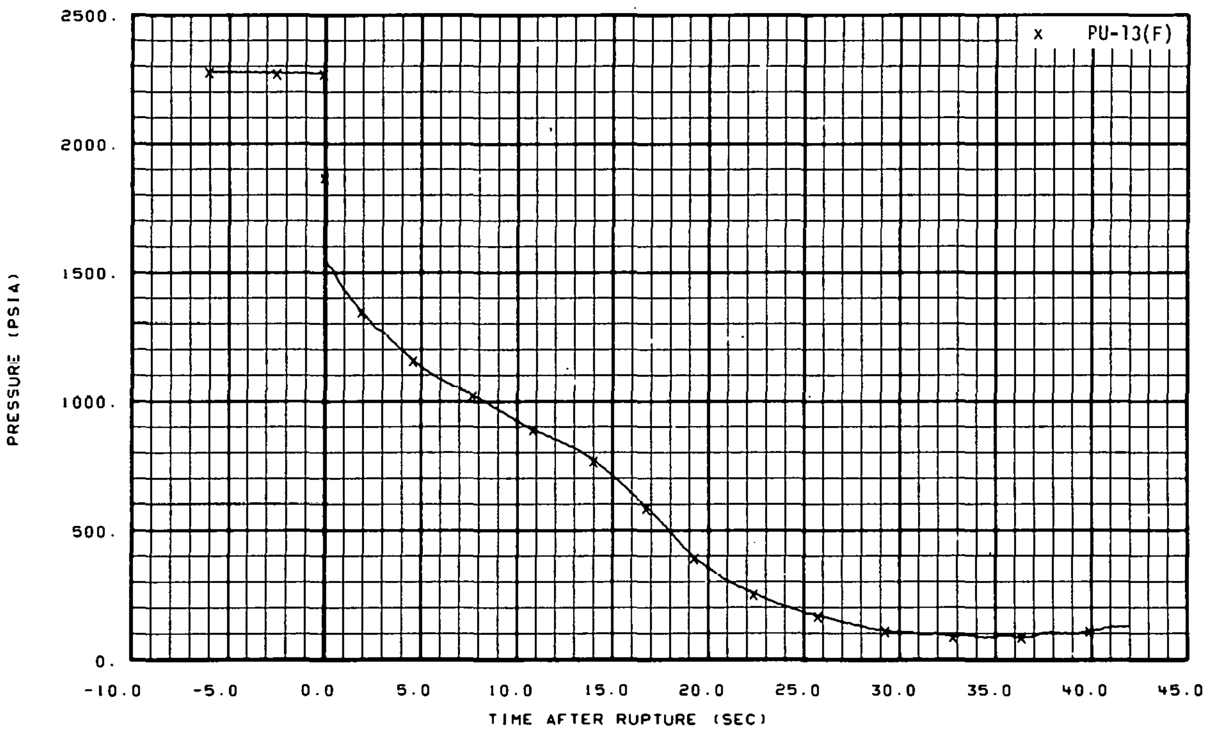

Fig. 126 Pressure in intact loop, Spool 13 PU-13(F), from -6 to 42 seconds.

Fig. 127 Pressure in intact loop, Spool 15, low range, (PU-15L), from -20 to 300 seconds.

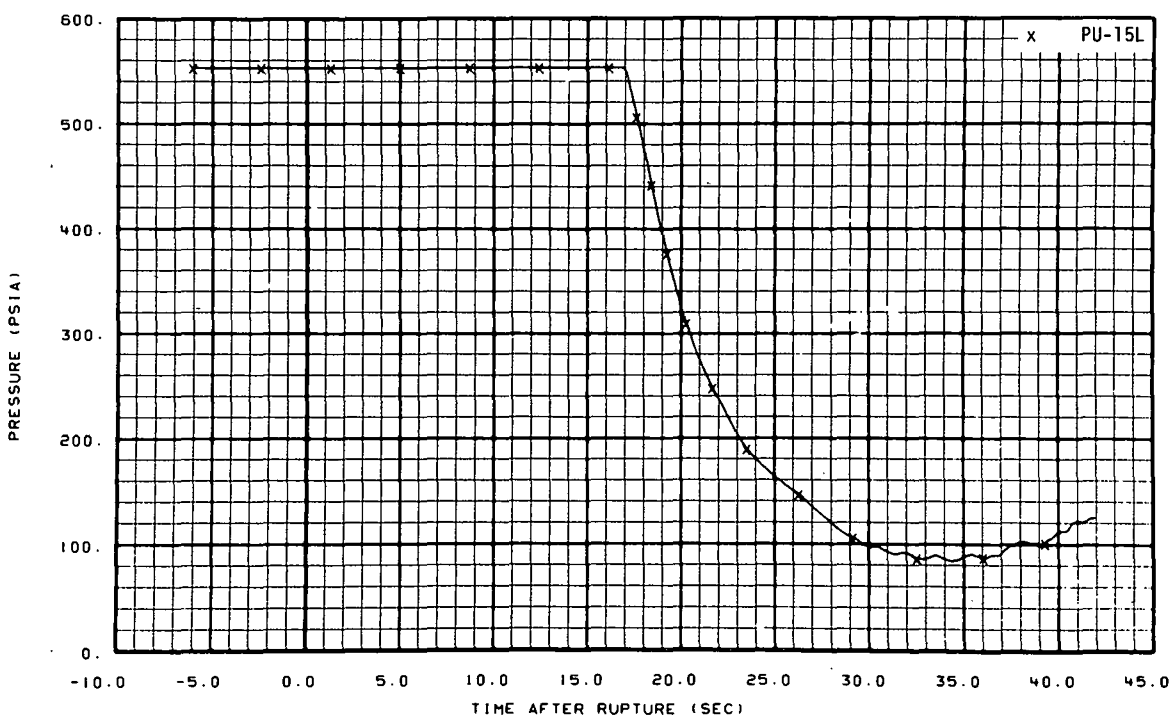

Fig. 128 Pressure in intact loop, Spool 15, low range, (PU-15L), from -6 to 42 seconds.

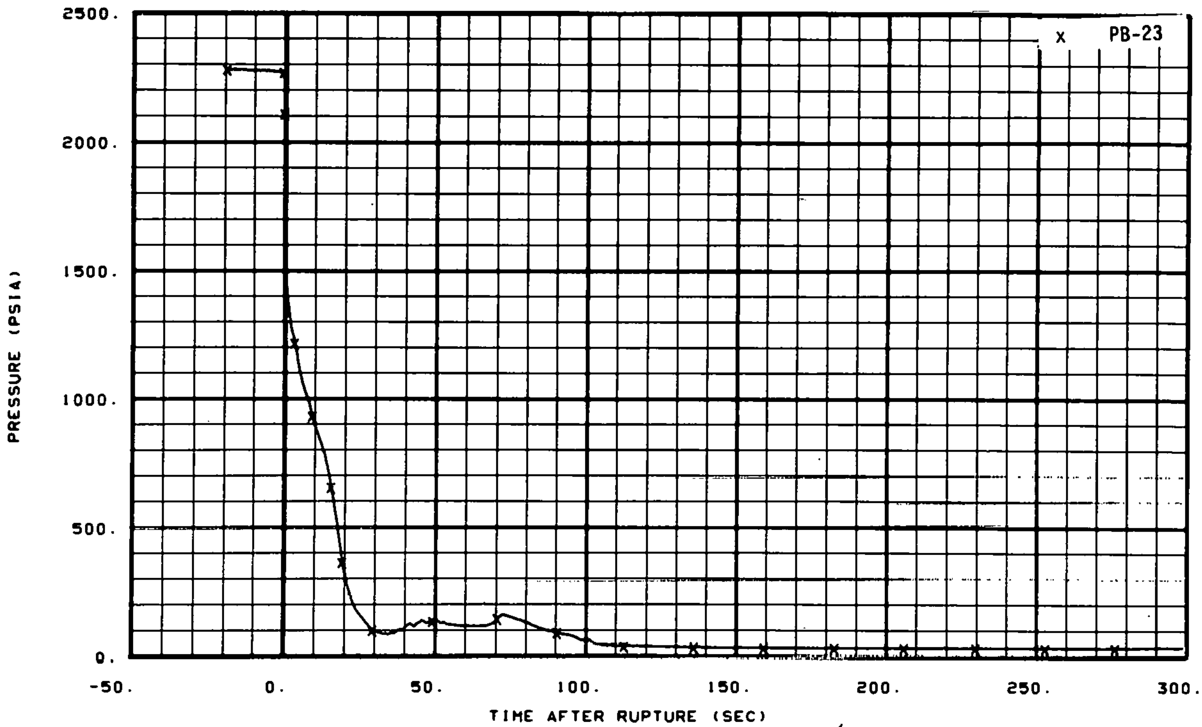

Fig. 129 Pressure in broken loop, vessel side, Spool 23 (PB-23), from -20 to 300 seconds.

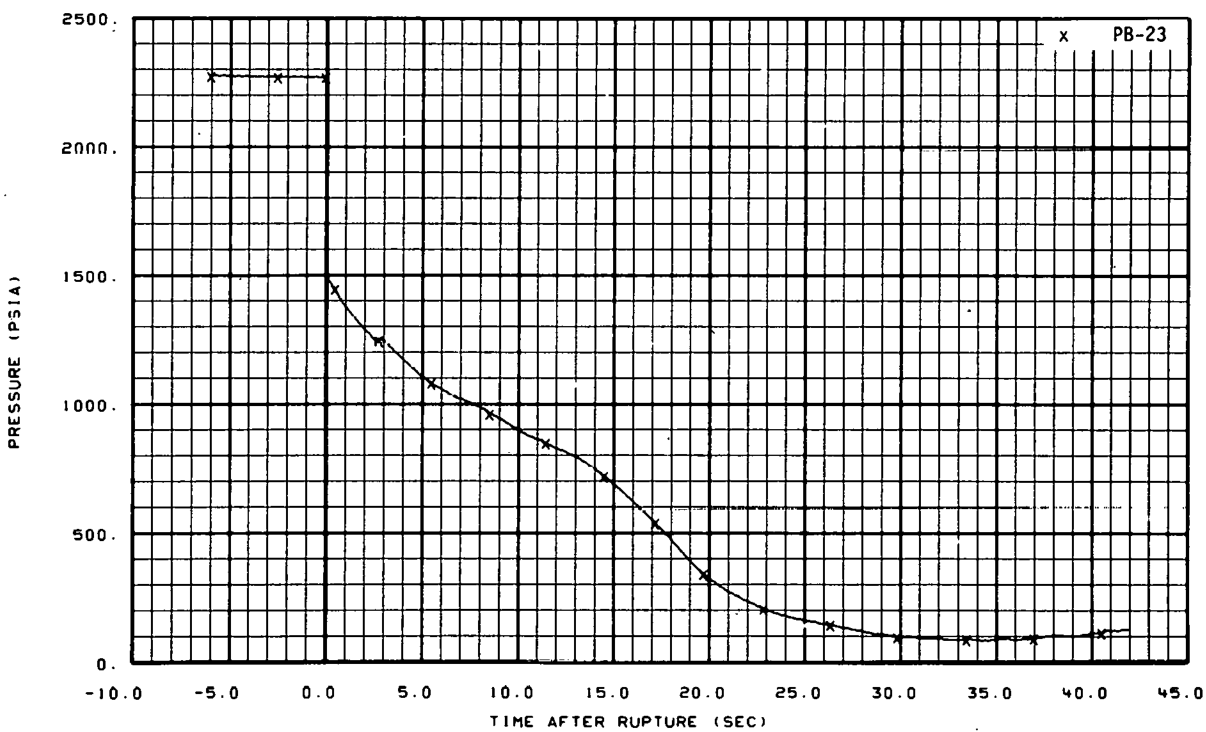

Fig. 130 Pressure in broken loop, vessel side, Spool 23 (PB-23), from -6 to 42 seconds.

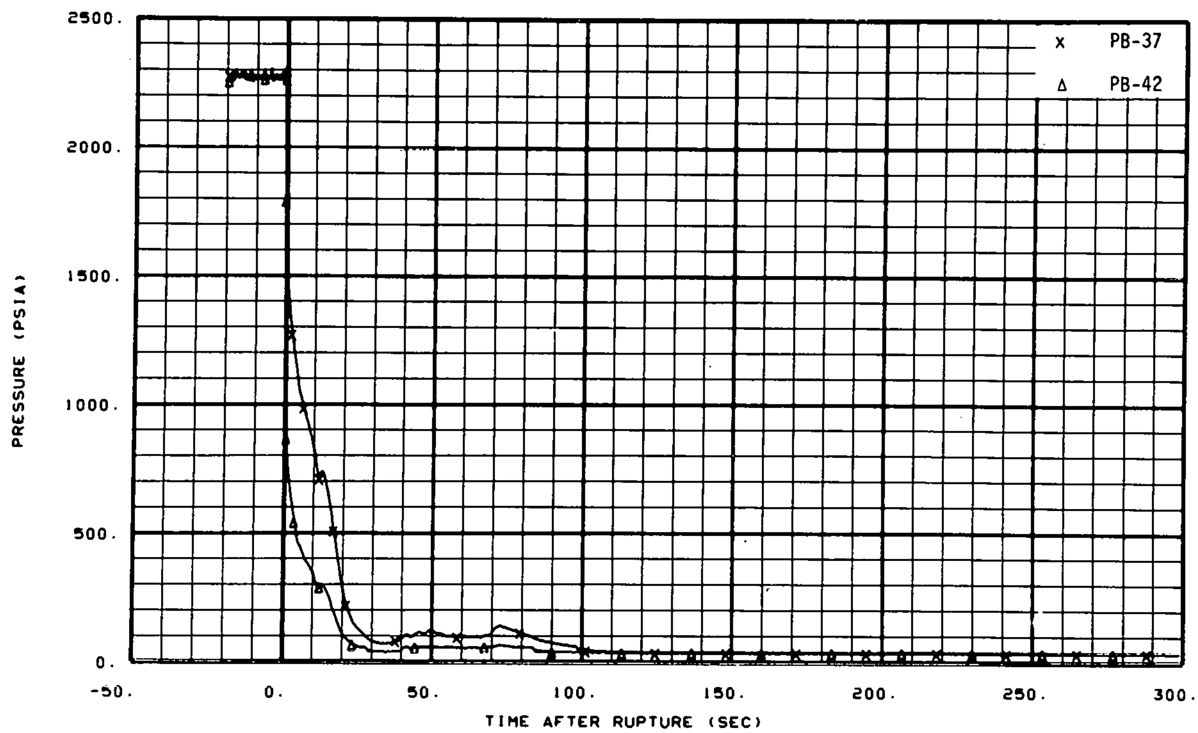

Fig. 131 Pressure in broken loop, pump side (PB-37 and PB-42), from -20 to 300 seconds.

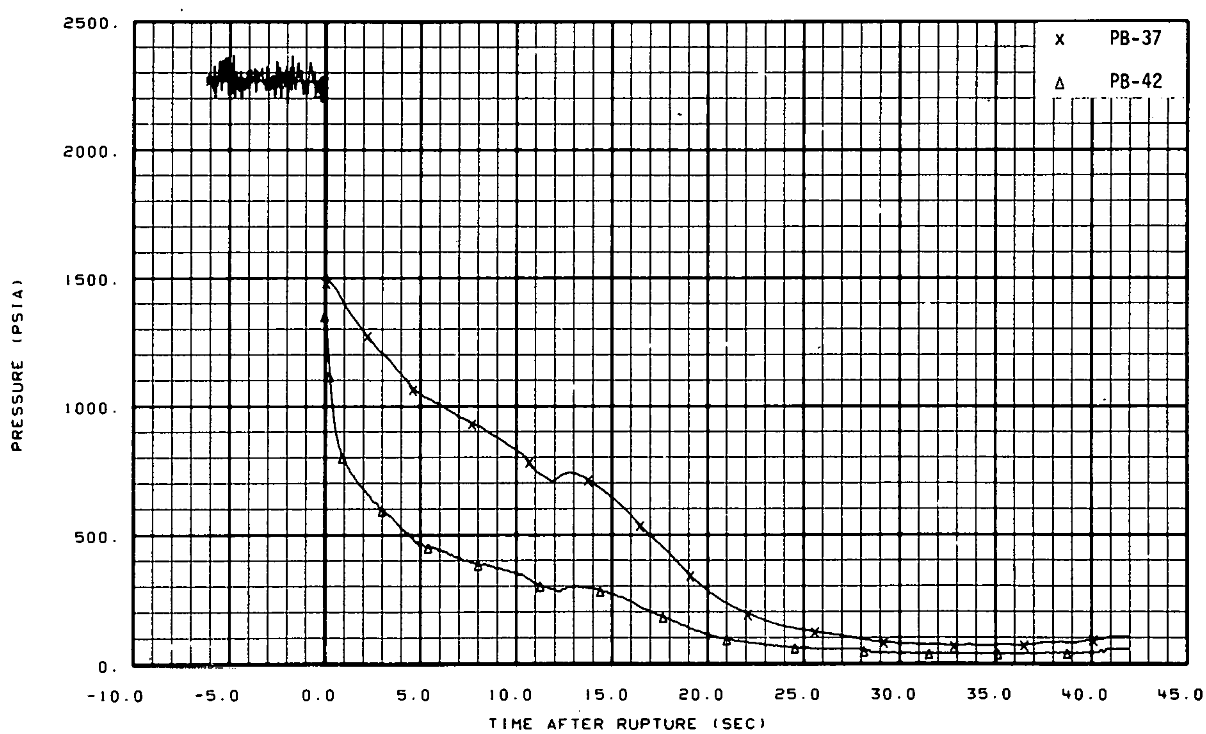

Fig. 132 Pressure in broken loop, pump side (PB-37 and PB-42), from -6 to 42 seconds.

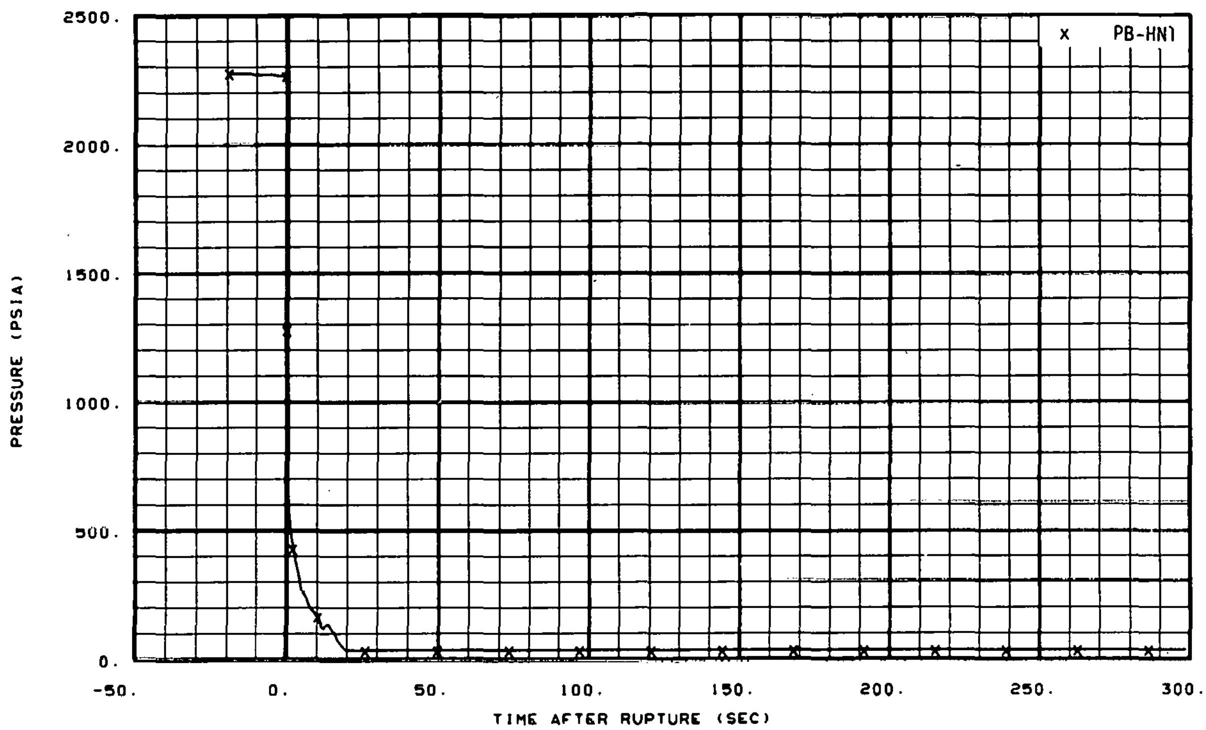

Fig. 133 Pressure in broken loop, pump-side nozzle (PB-HN1), from -20 to 300 seconds.

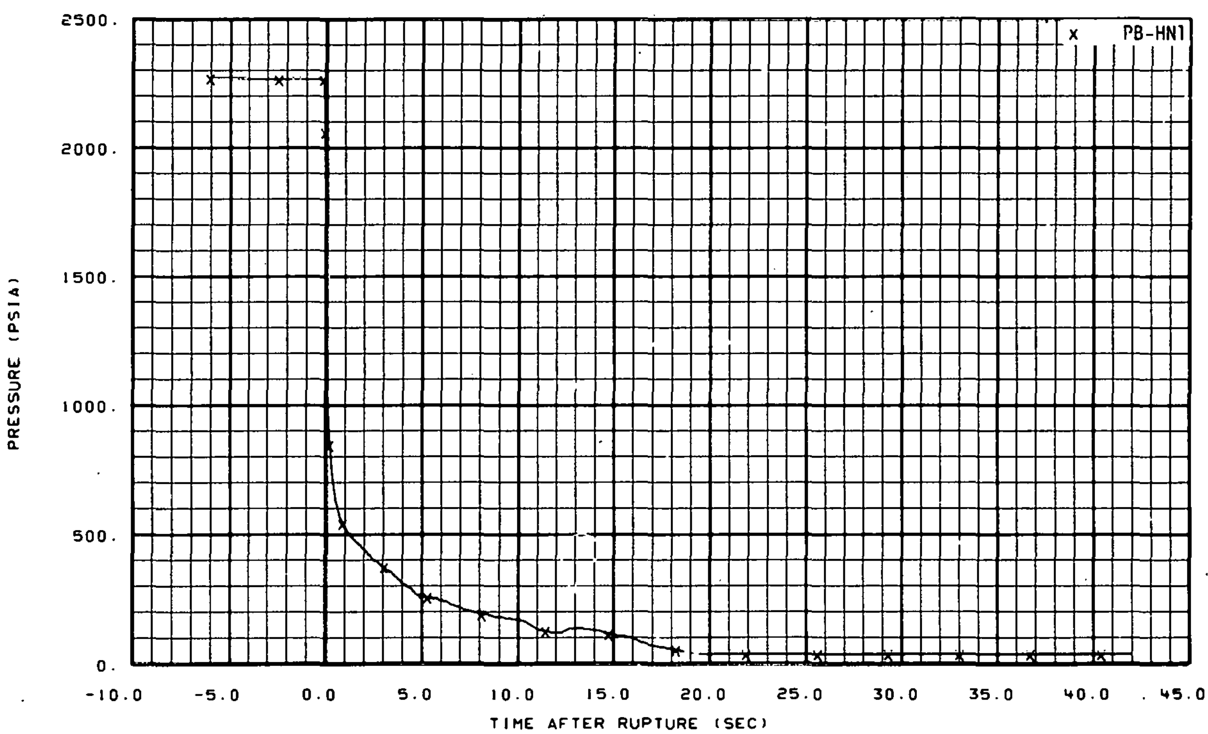

Fig. 134 Pressure in broken loop, pump-side nozzle (PB-HN1), from -6 to 42 seconds.

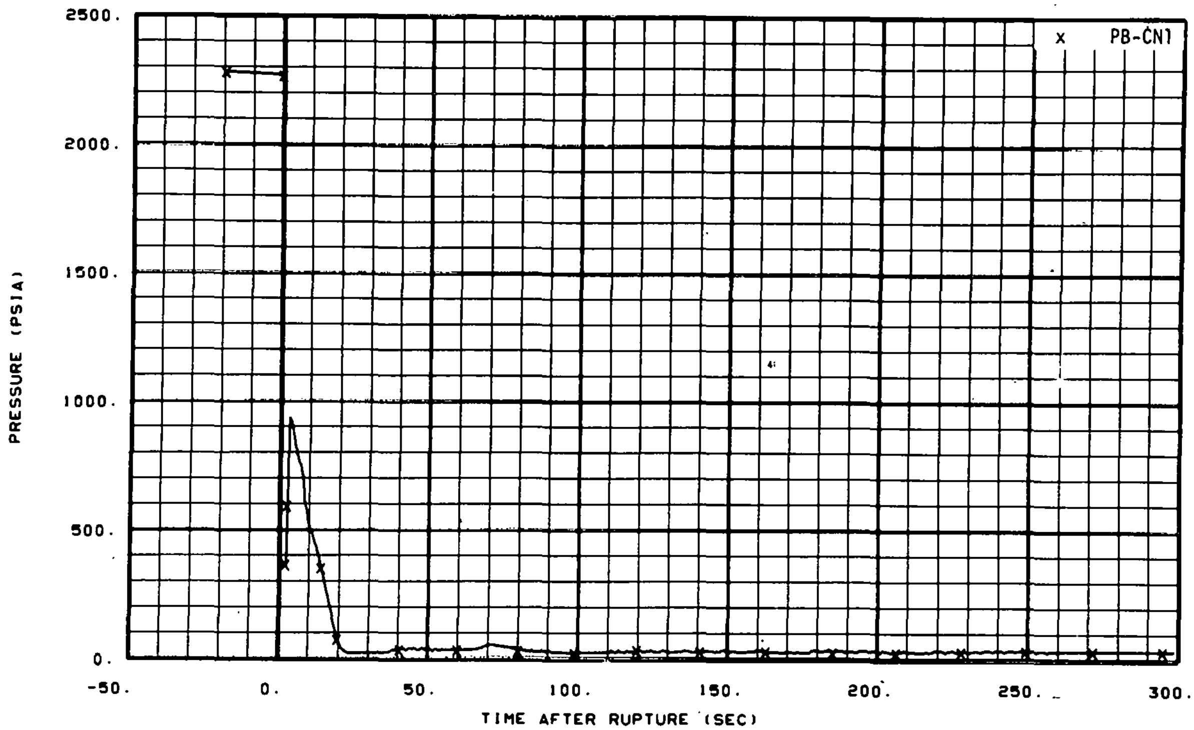

Fig. 135 Pressure in broken loop, vessel-side nozzle (PB-CN1), from -20 to 300 seconds.

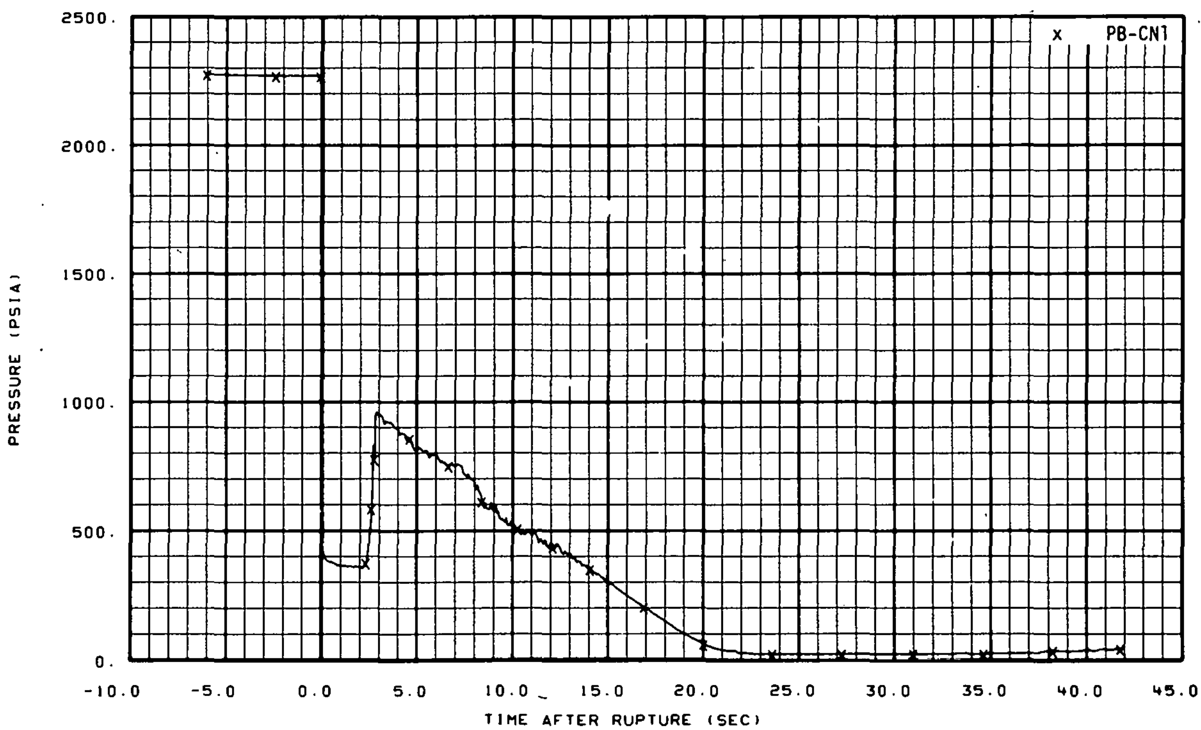

Fig. 136 Pressure in broken loop, vessel-side nozzle (PB-CN1), from -6 to 42 seconds.

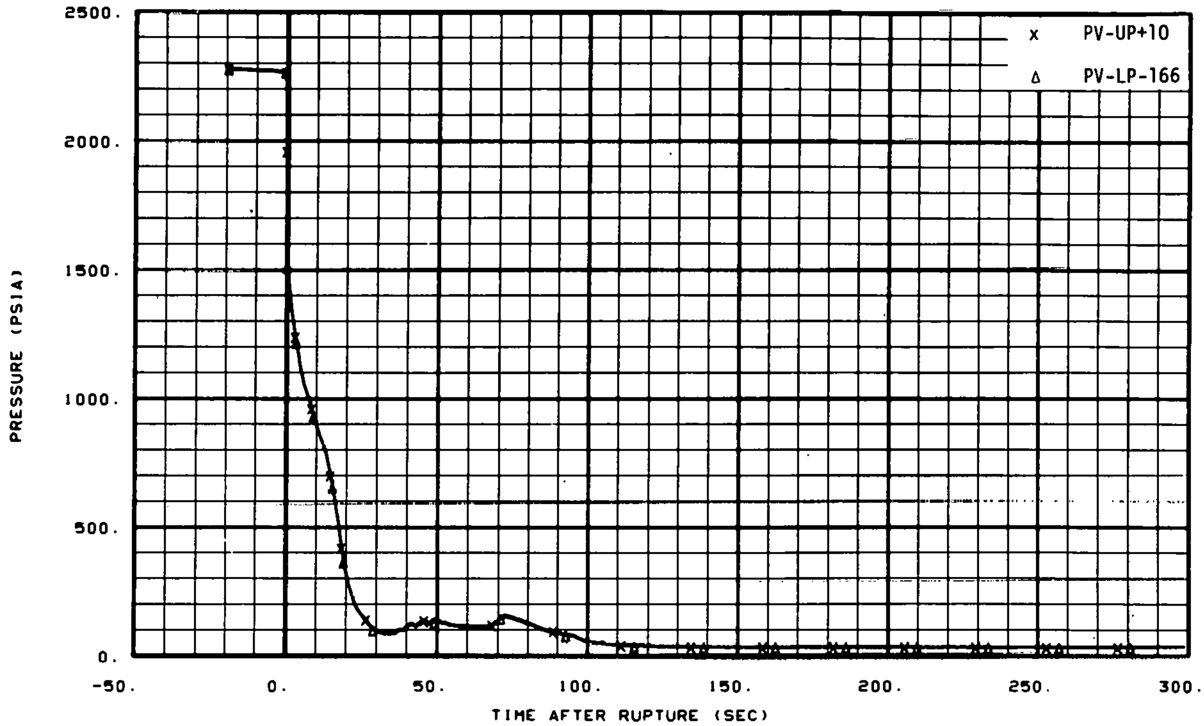

Fig. 137 Pressure in vessel (PV-UP+10 and PV-LP-166), from -20 to 300 seconds.

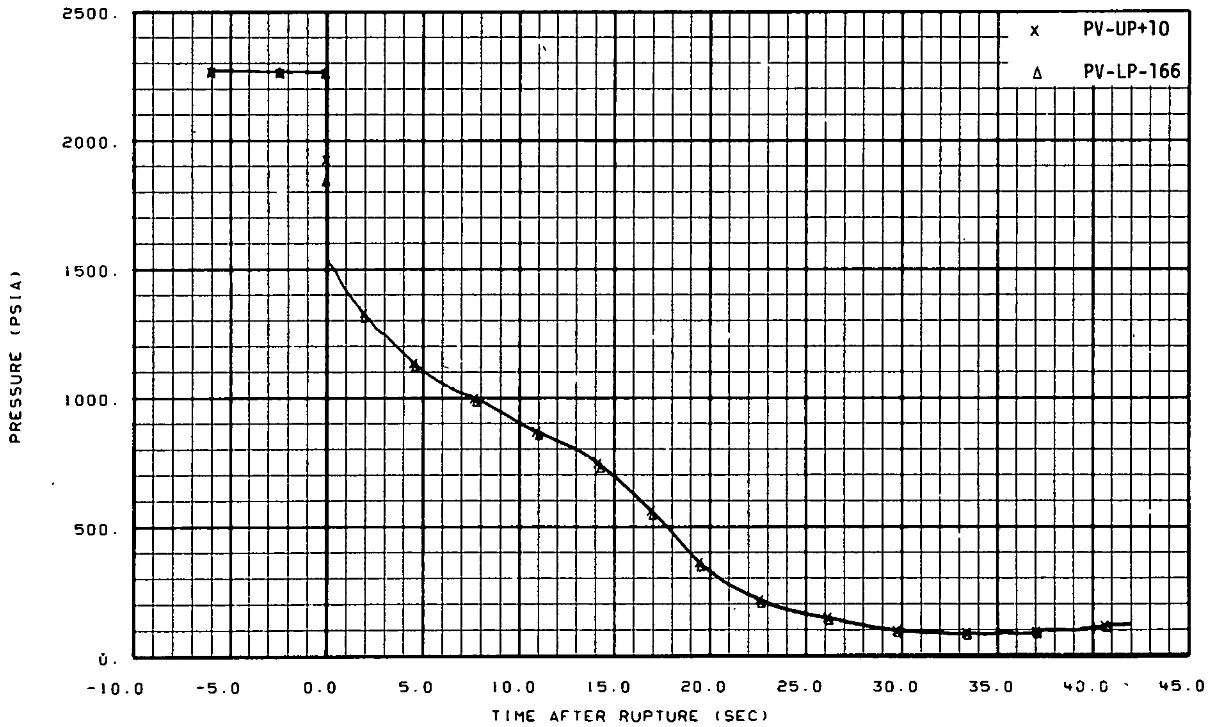

Fig. 138 Pressure in vessel (PV-UP+10 and PV-LP-166), from -6 to 42 seconds.

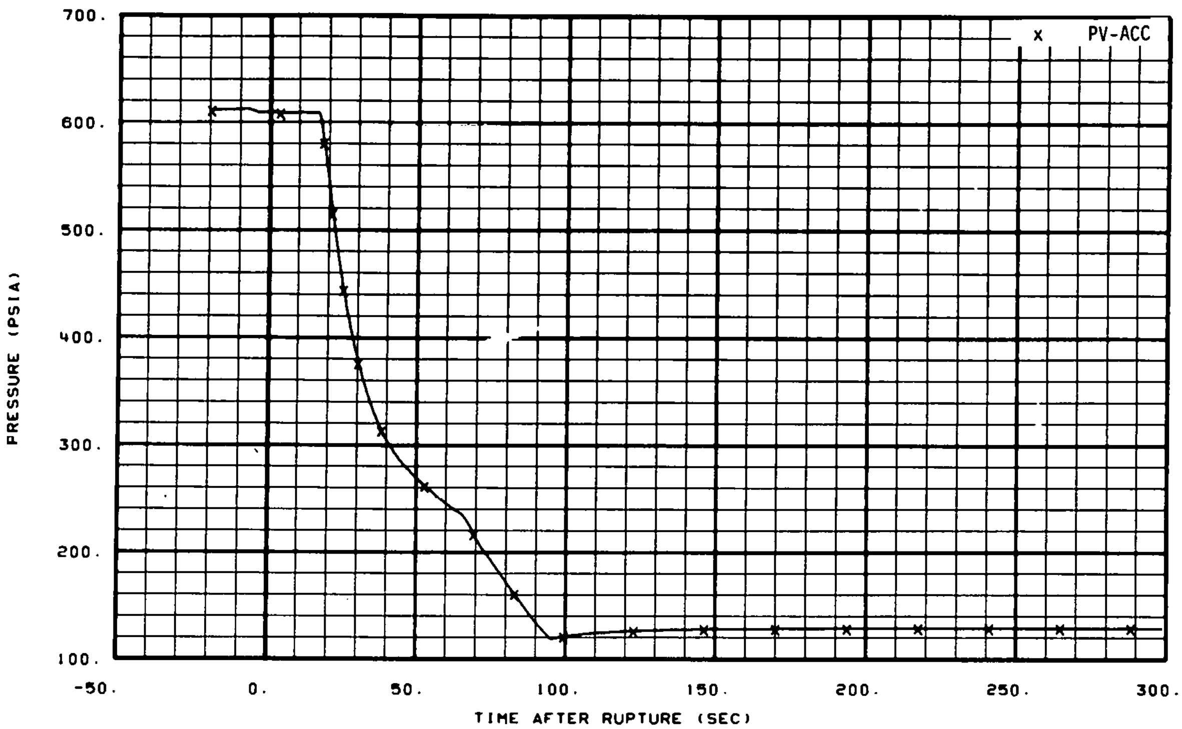

Fig. 139 Pressure in vessel accumulator (PV-ACC), from -20 to 300 seconds.

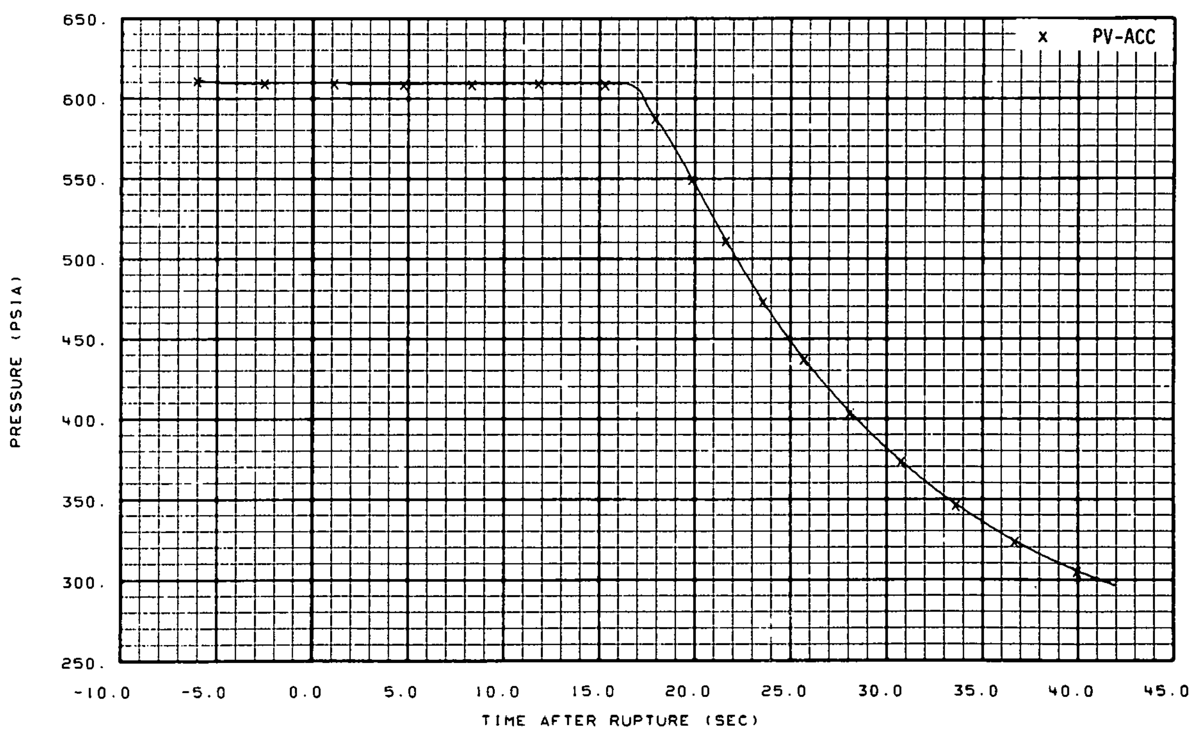

Fig. 140 Pressure in vessel accumulator (PV-ACC), from -6 to 42 seconds.

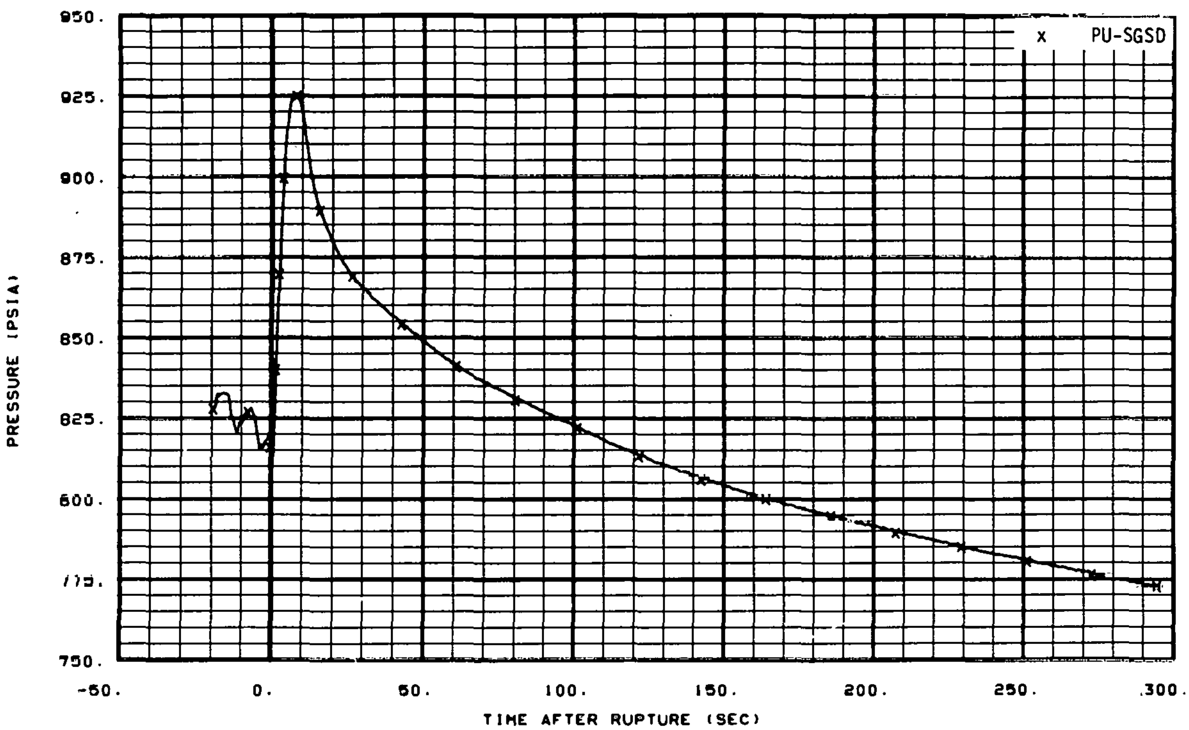

Fig. 141 Pressure in steam generator, secondary side (PU-SGSD), from -20 to 300 seconds.

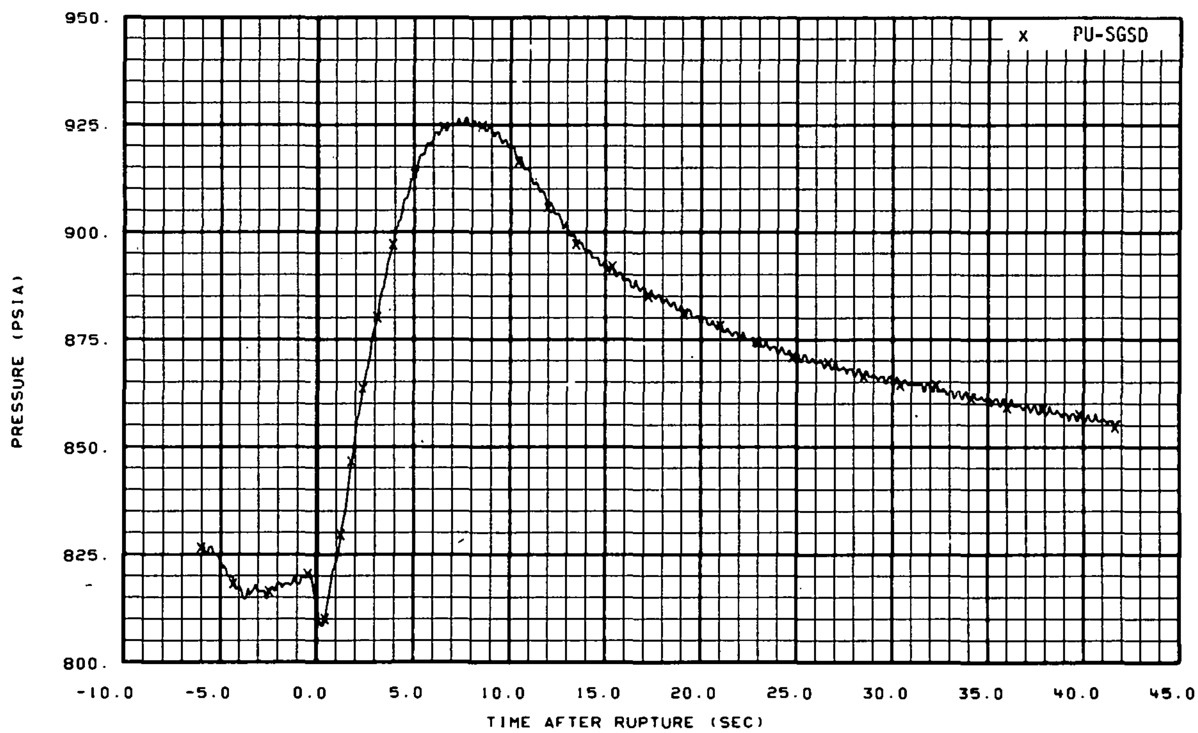

Fig. 142 Pressure in steam generator, secondary side (PU-SGSD), from -6 to 42 seconds.

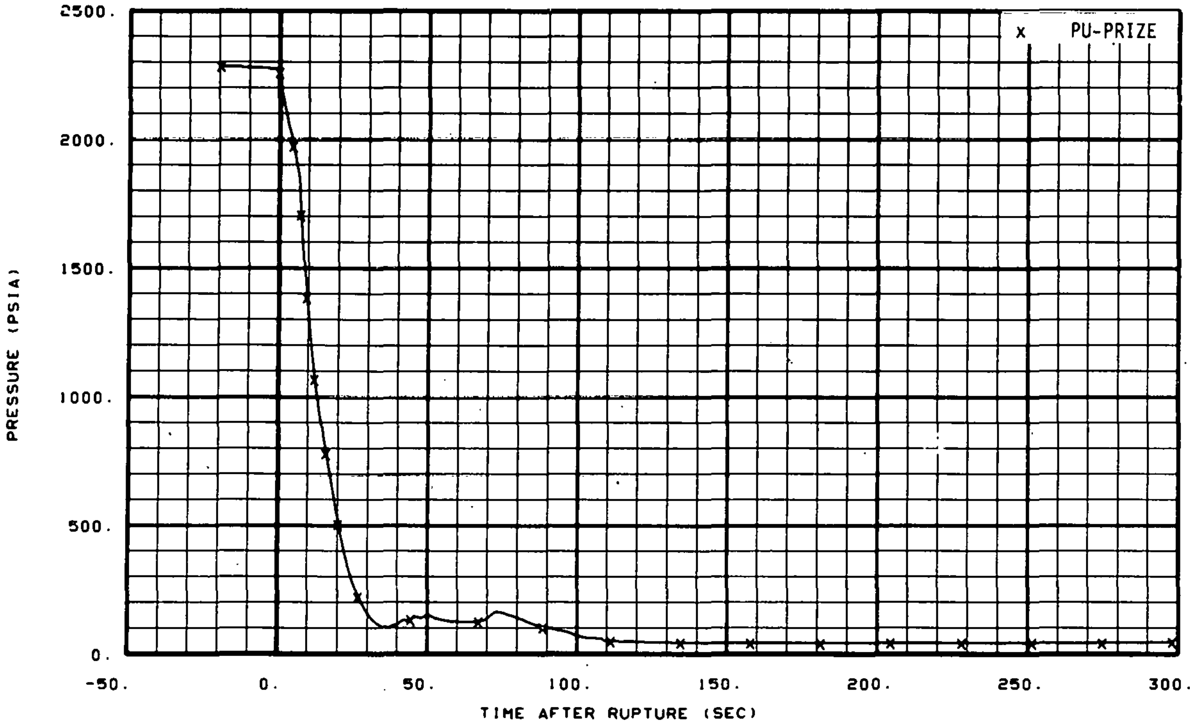

Fig. 143 Pressure in pressurizer (PU-PRIZE), from -20 to 300 seconds.

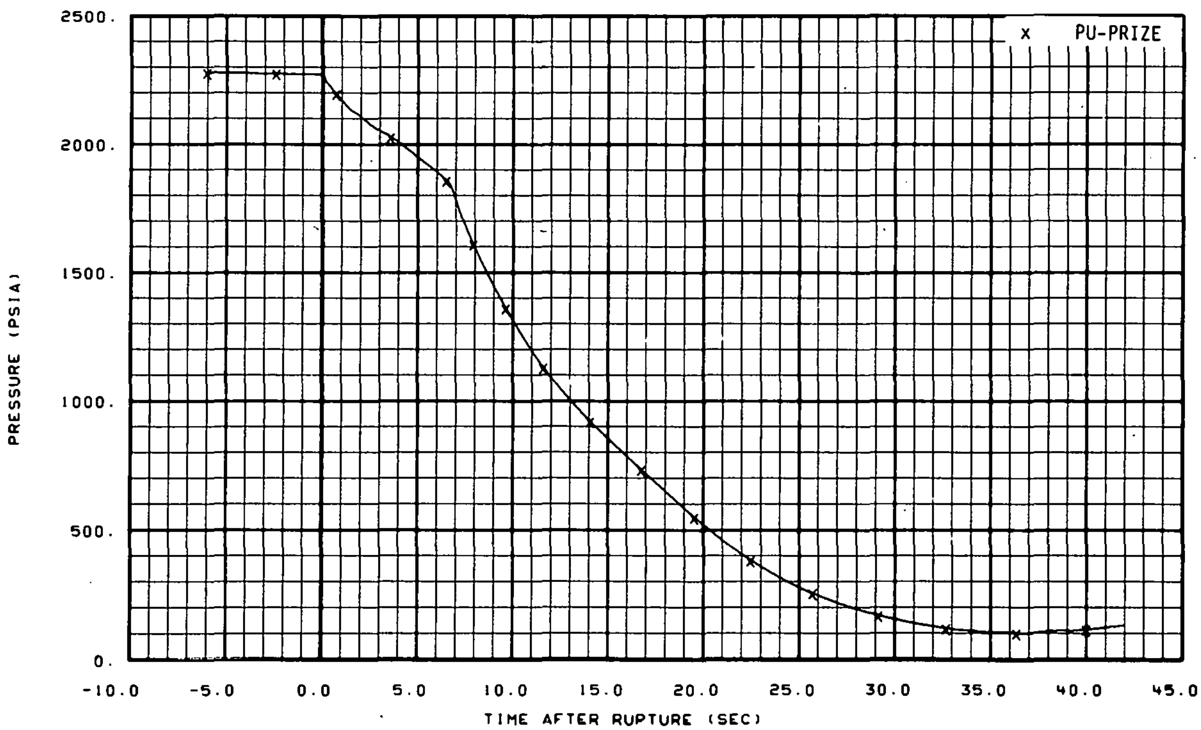

Fig. 144 Pressure in pressurizer (PU-PRIZE), from -6 to 42 seconds.

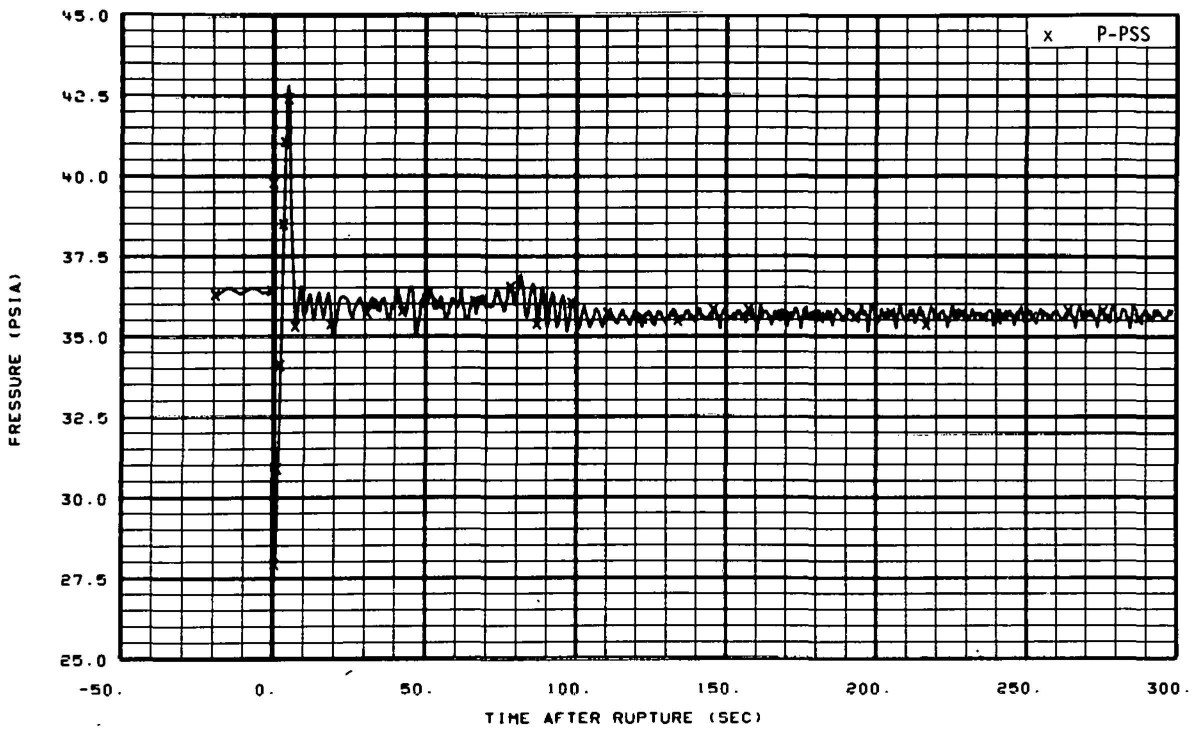

Fig. 145 Pressure in pressure suppression tank (P-PSS), from -20 to 300 seconds.

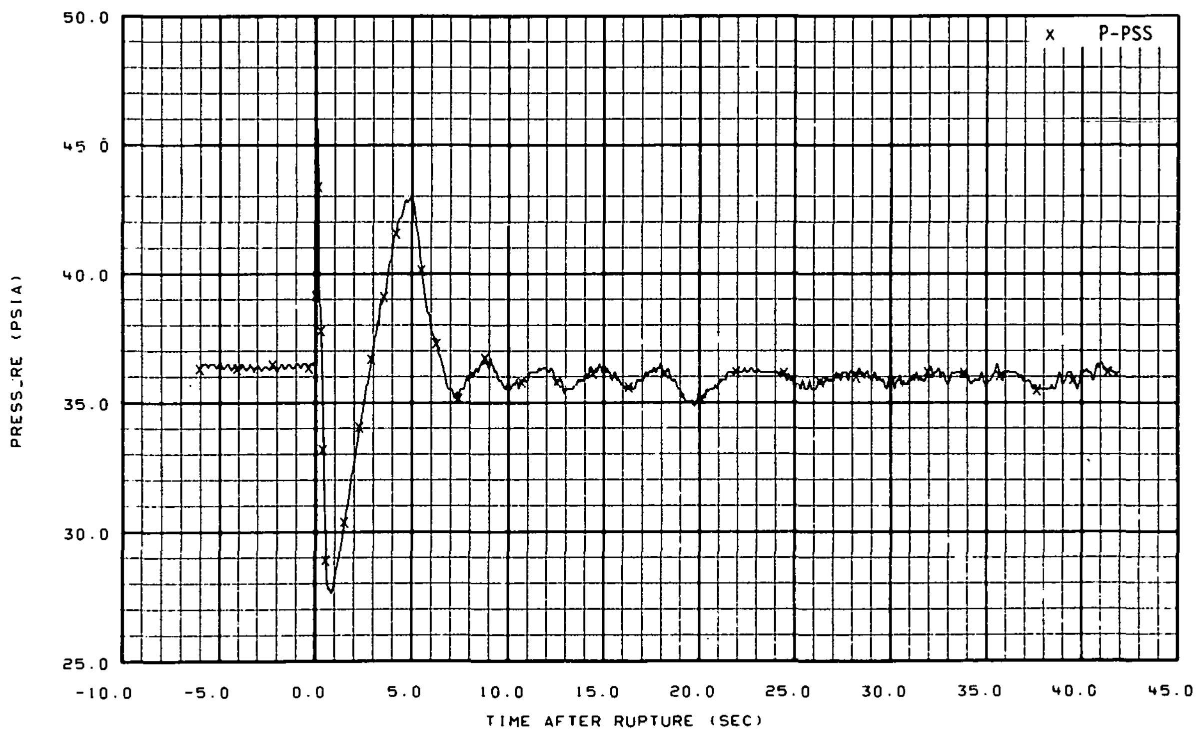

Fig. 146 Pressure in pressure suppression tank (P-PSS), from -6 to 42 seconds.

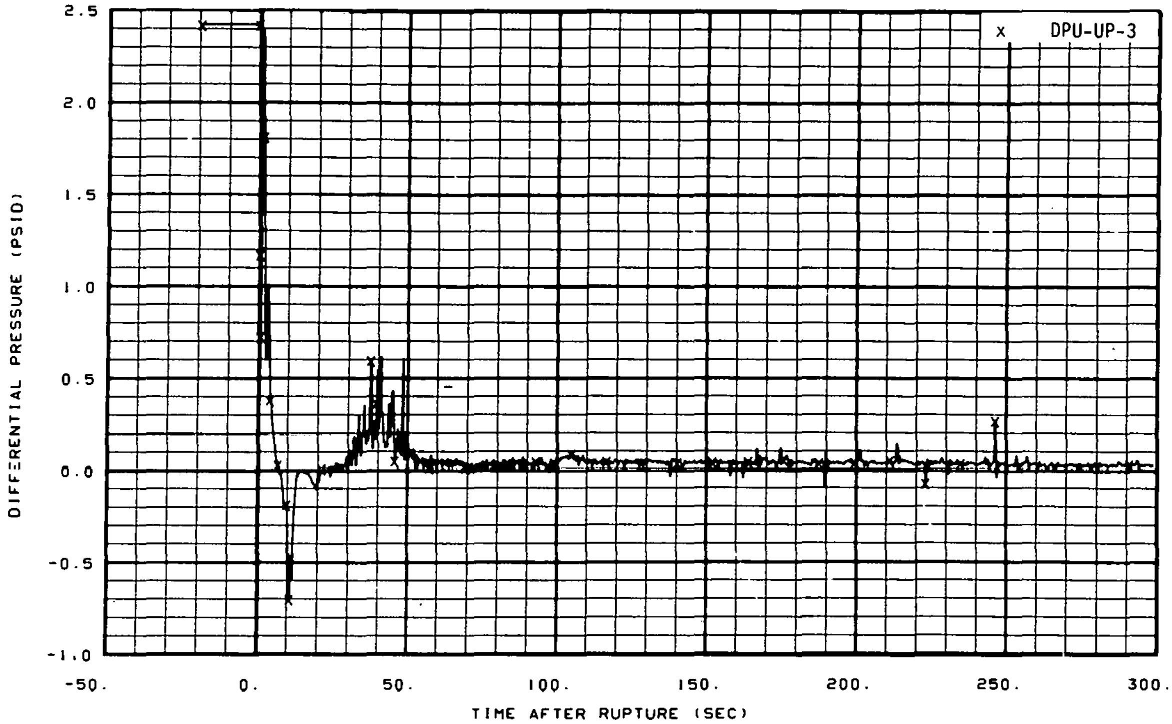

Fig. 147 Differential pressure in intact loop (DPU-UP-3), from -20 to 300 seconds.

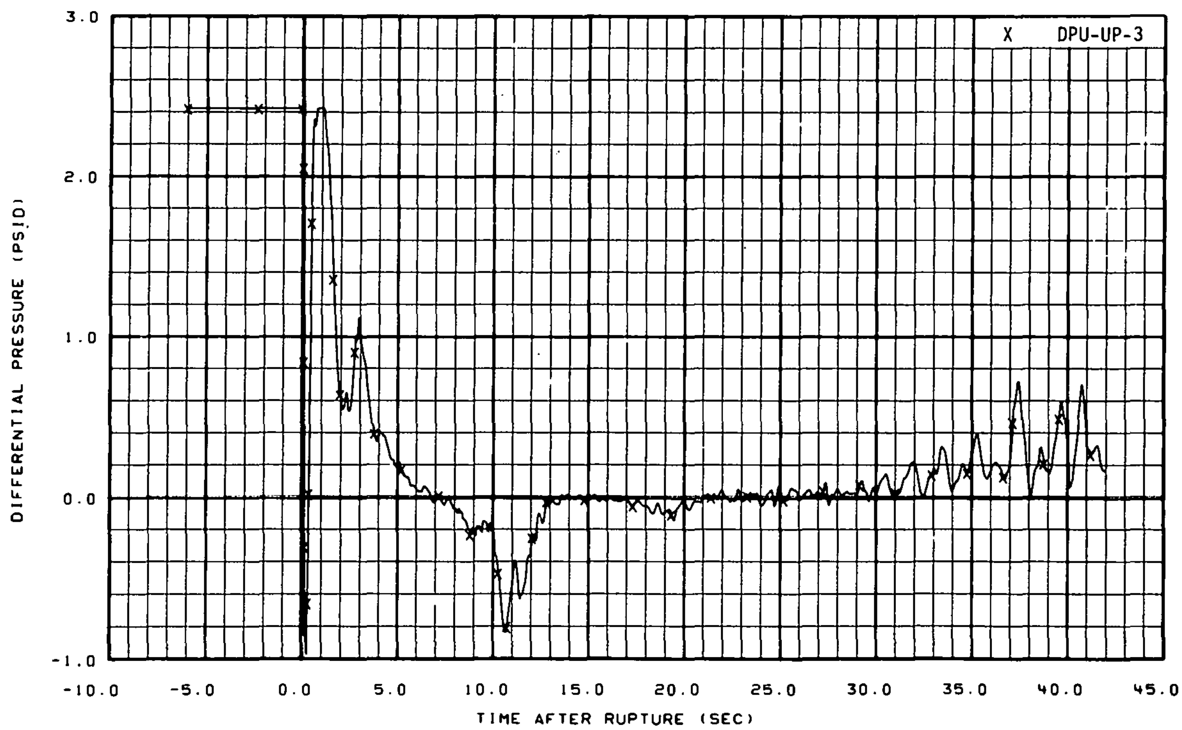

Fig. 148 Differential pressure in intact loop (DPU-UP-3), from -6 to 42 seconds.

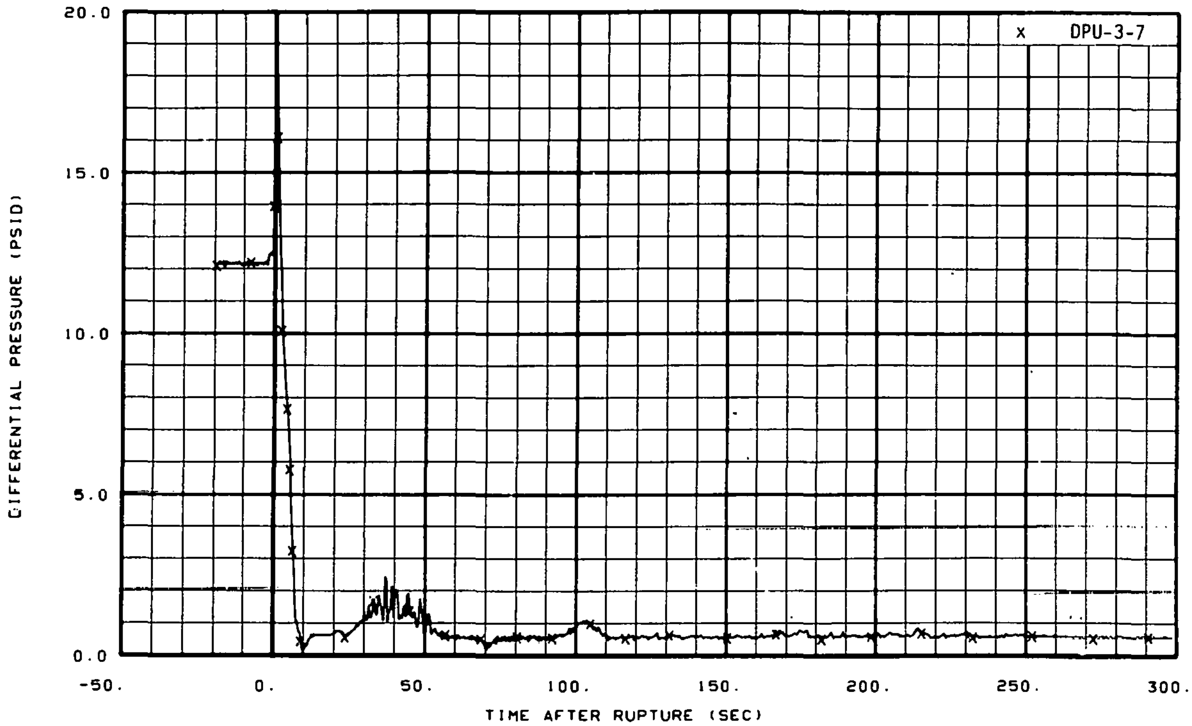

Fig. 149 Differential pressure in intact loop (DPU-3-7), from -20 to 300 seconds.

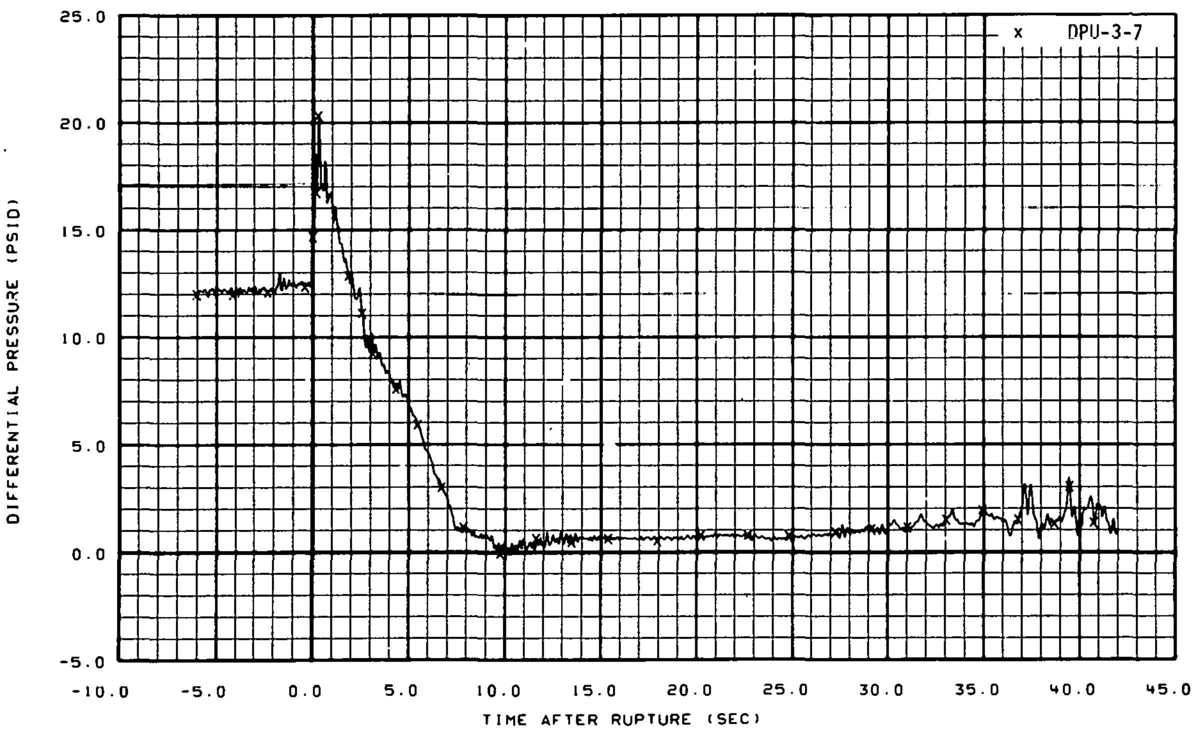

Fig. 150 Differential pressure in intact loop (DPU-3-7), from -6 to 42 seconds.

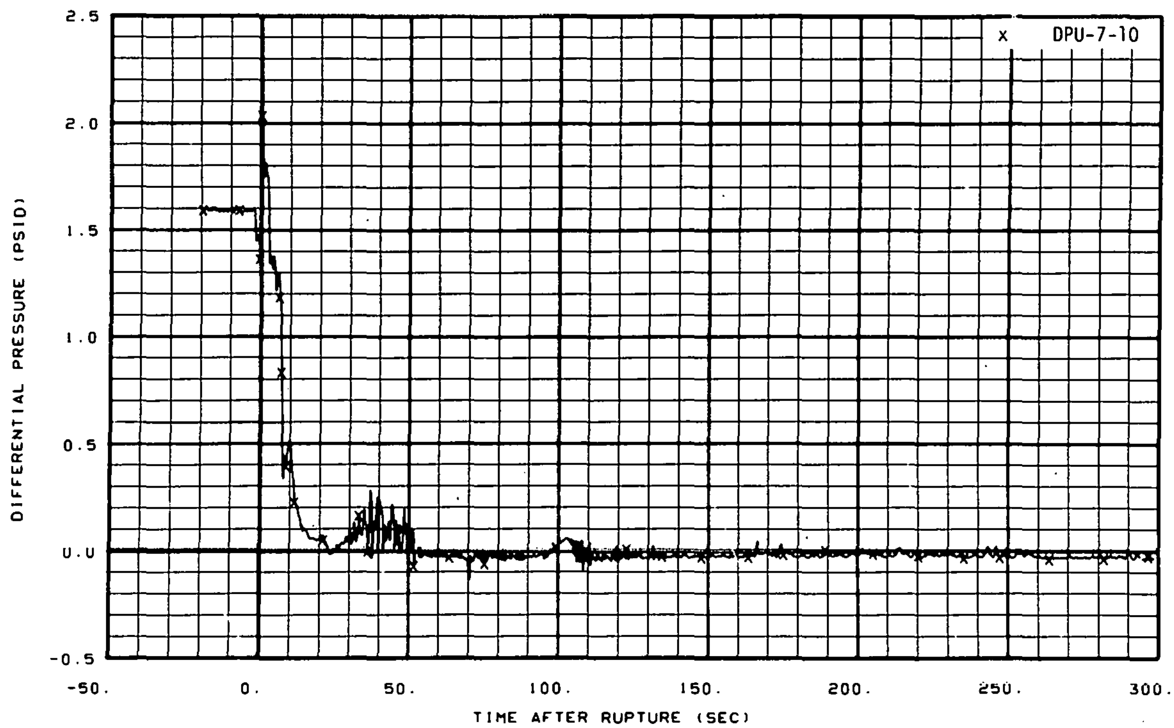

Fig. 151 Differential pressure in intact loop (DPU-7-10), from -20 to 300 seconds.

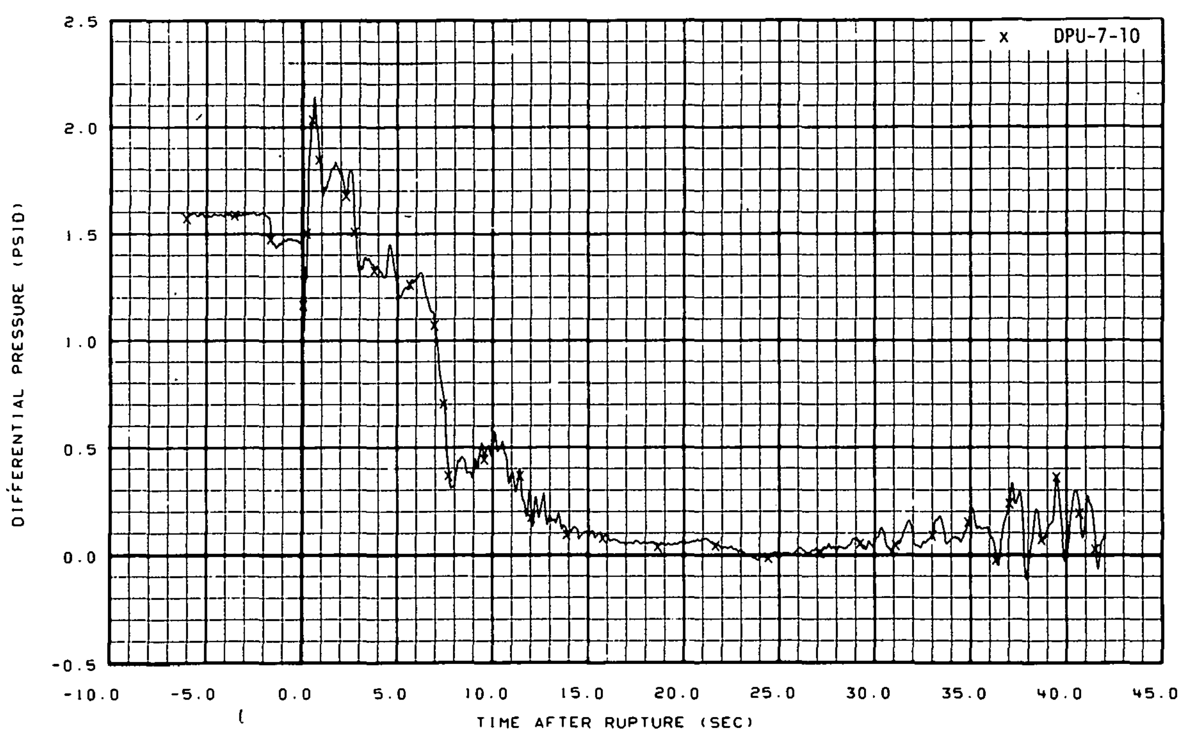

Fig. 152 Differential pressure in intact loop (DPU-7-10), from -6 to 42 seconds.

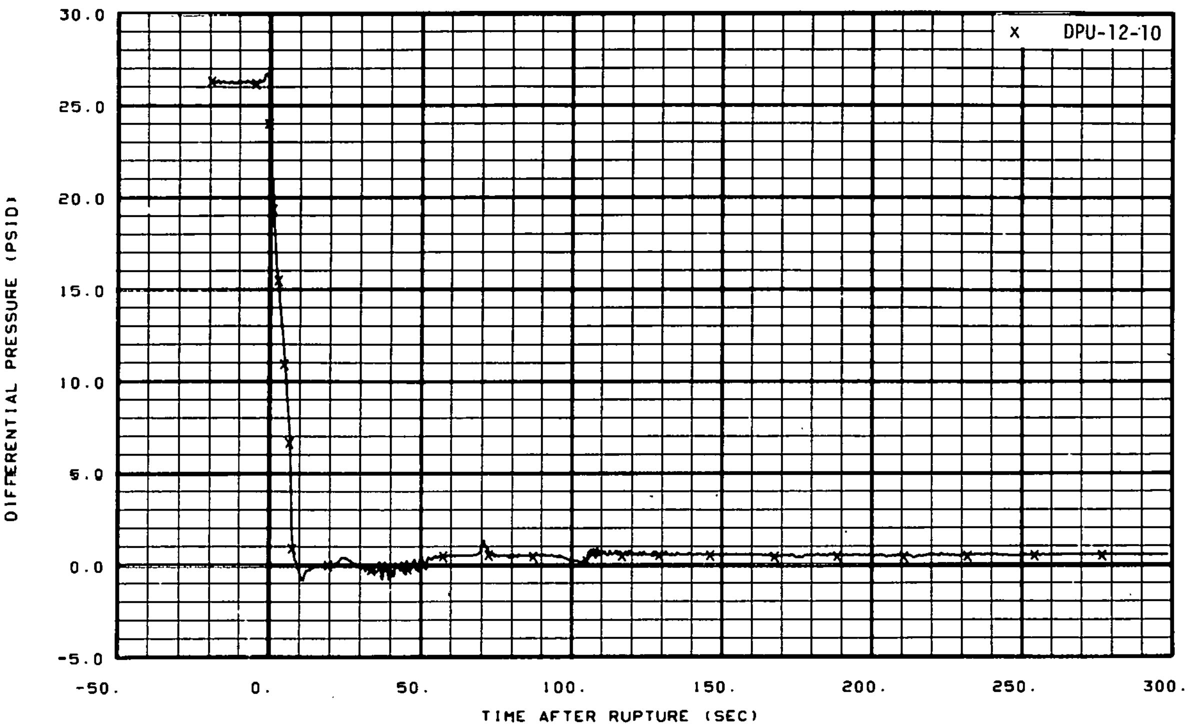

Fig. 153 Differential pressure in intact loop (DPU-12-10), from -20 to 300 seconds.

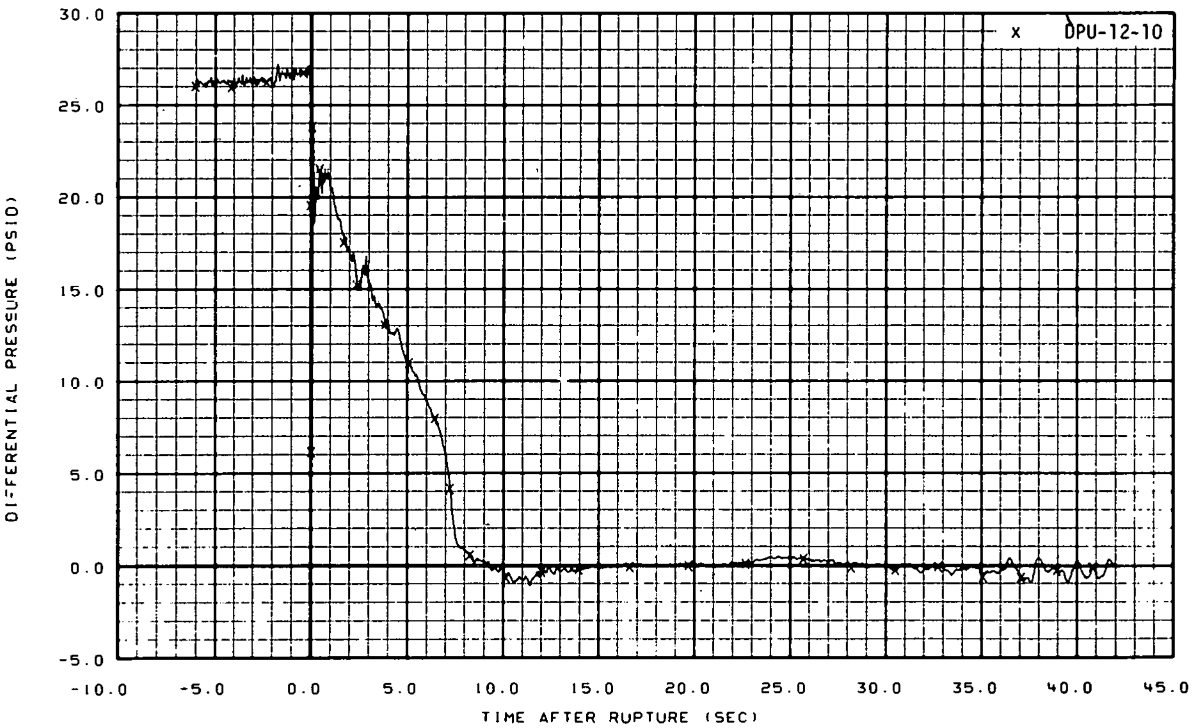

Fig. 154 Differential pressure in intact loop (DPU-12-10), from -6 to 42 seconds.

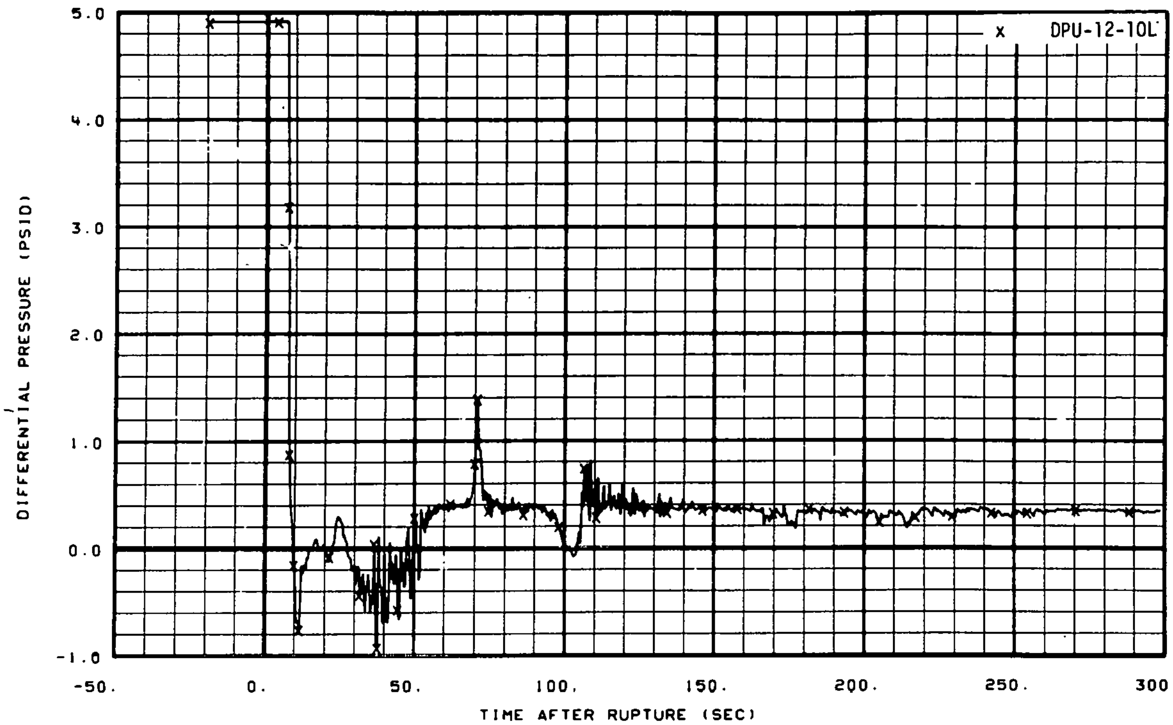

Fig. 155 Differential pressure in intact loop, low range (DPU-12-10L), from -20 to 300 seconds.

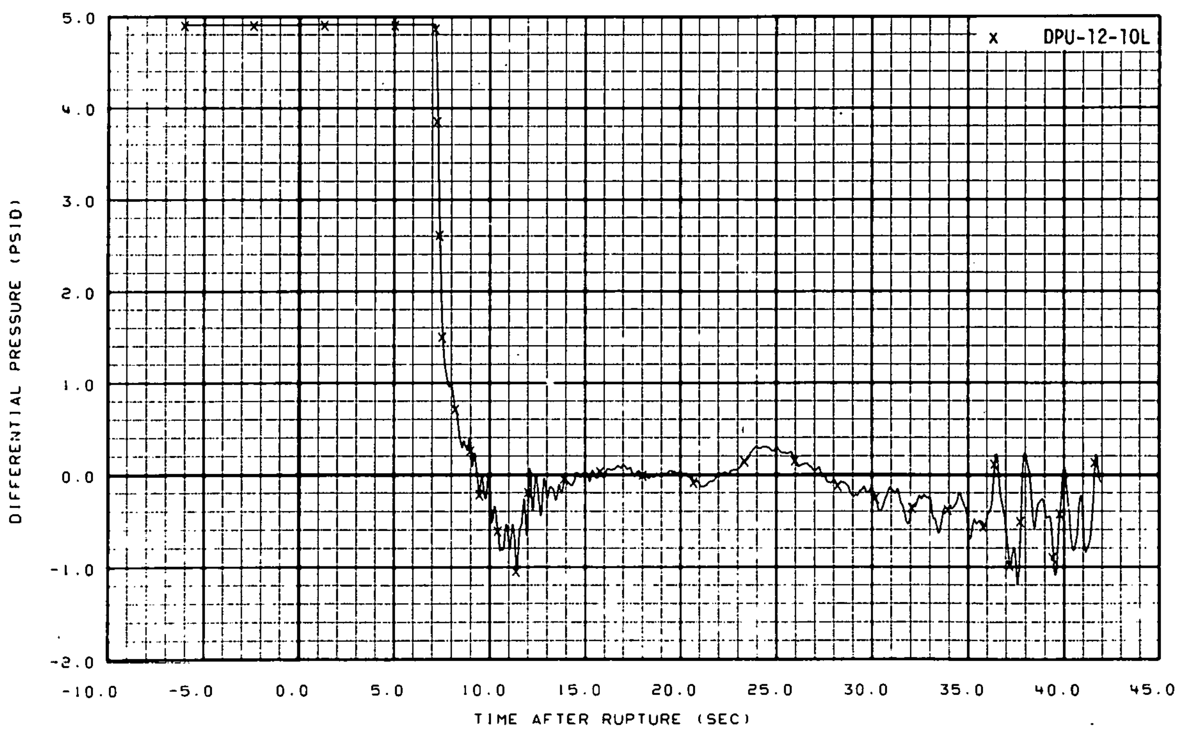

Fig. 156 Differential pressure in intact loop, low range (DPU-12-10L), from -6 to 42 seconds.

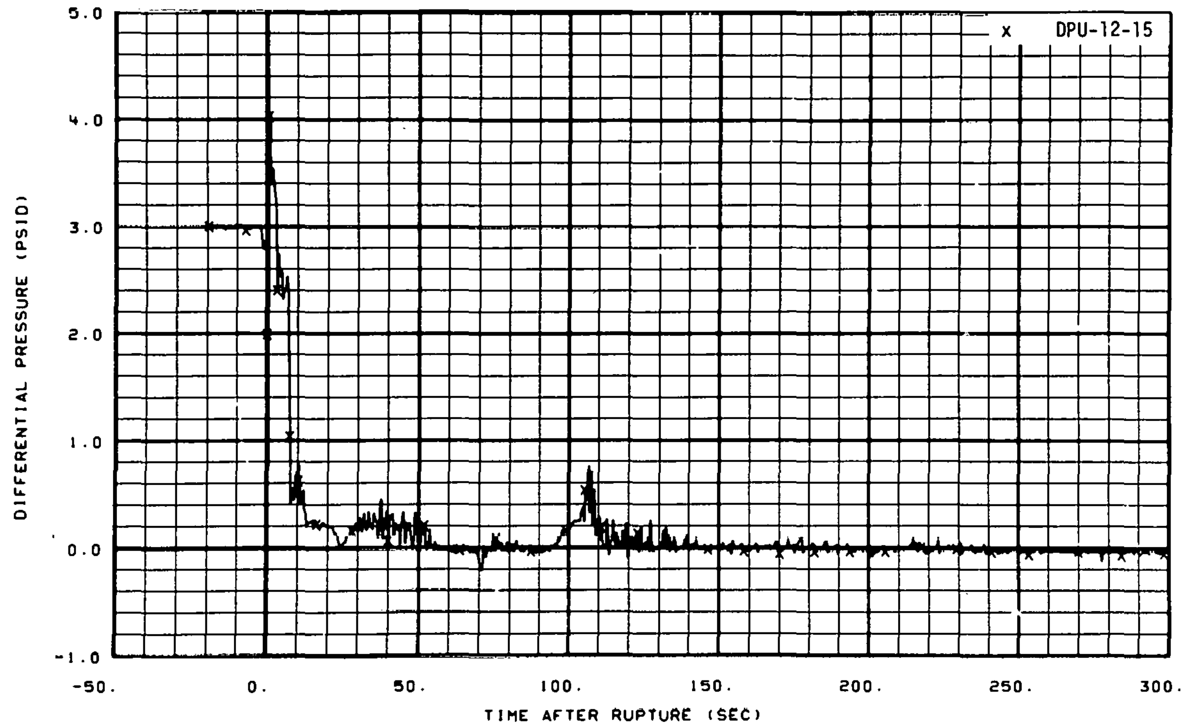

Fig. 157 Differential pressure in intact loop, (DPU-12-15), from -20 to 300 seconds.

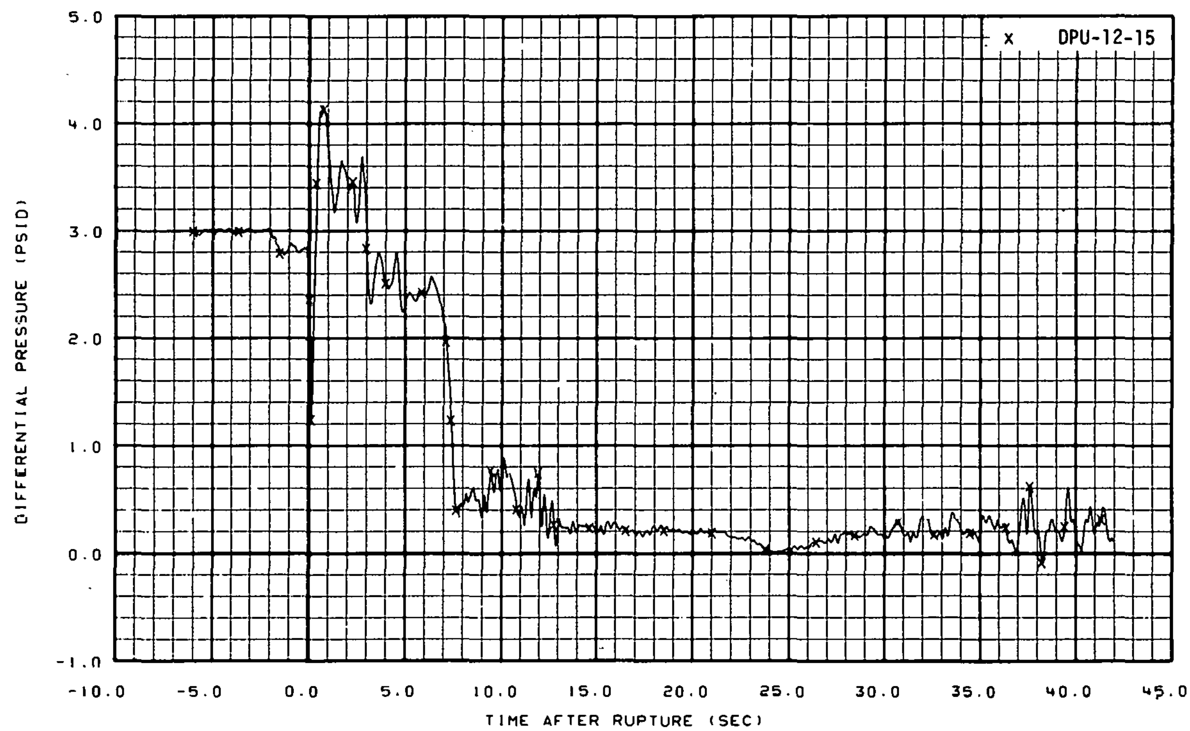

Fig. 158 Differential pressure in intact loop, (DPU-12-15), from -6 to 42 seconds.

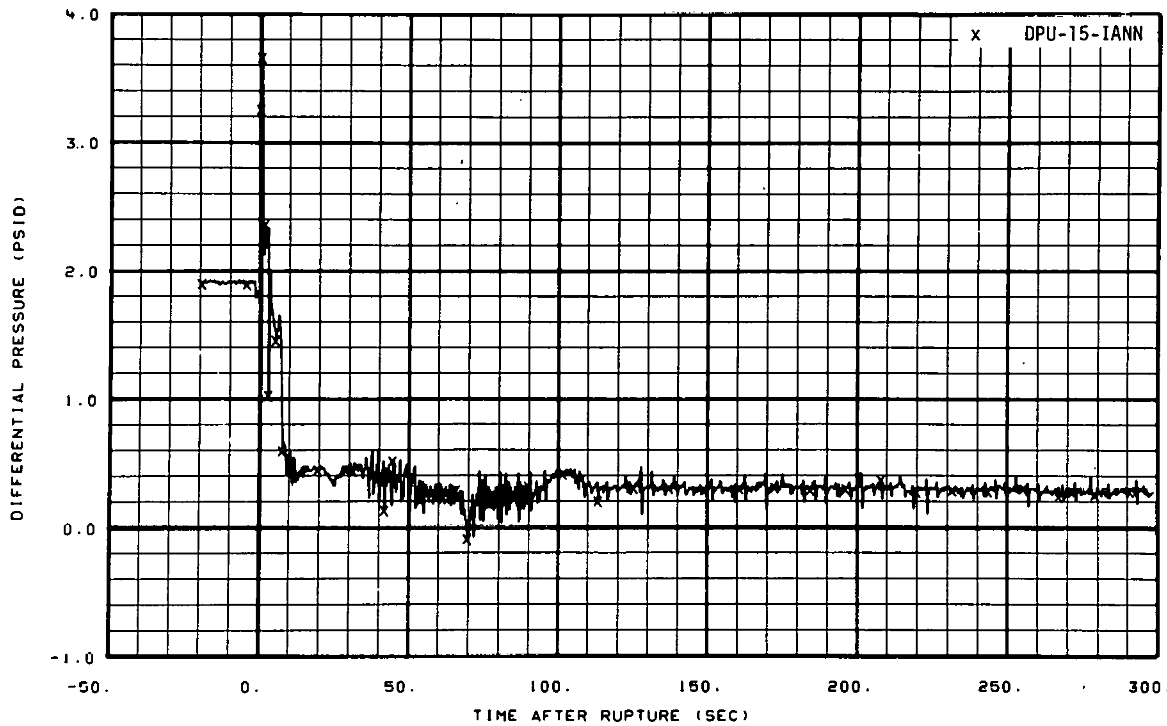

Fig. 159 Differential pressure in intact loop (DPU-15-IANN), from -20 to 300 seconds.

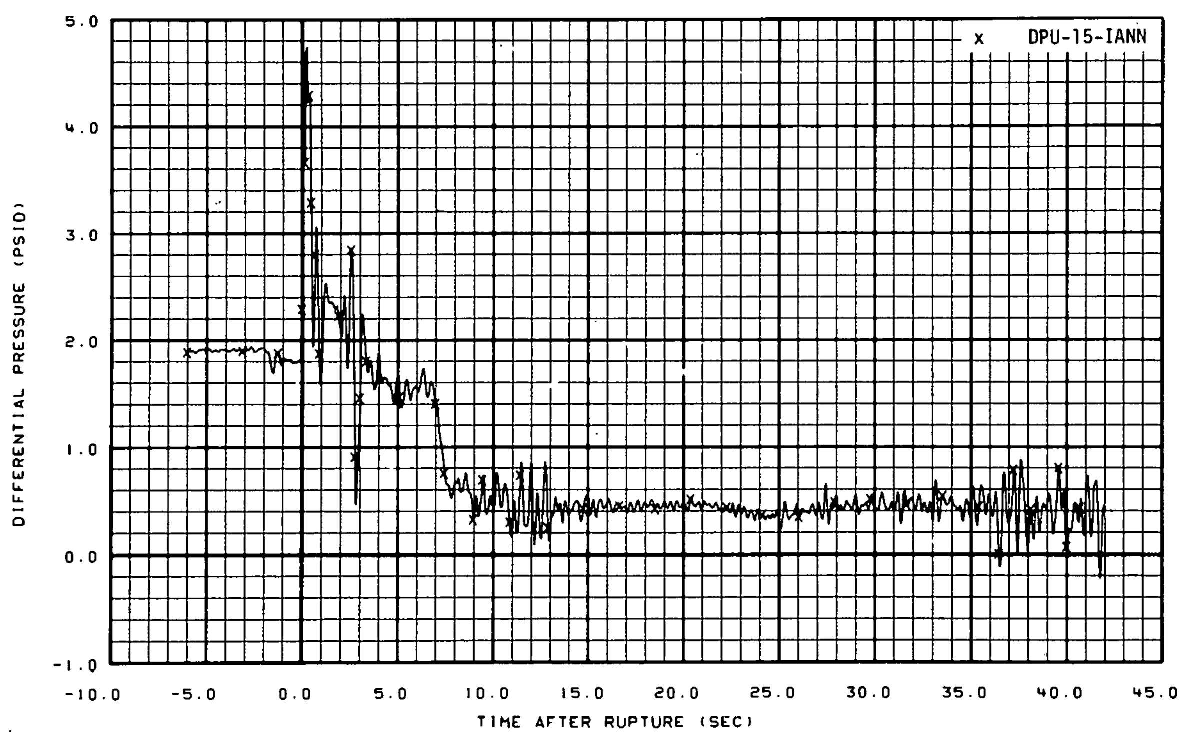

Fig. 160 Differential pressure in intact loop (DPU-15-IANN), from -6 to 42 seconds.

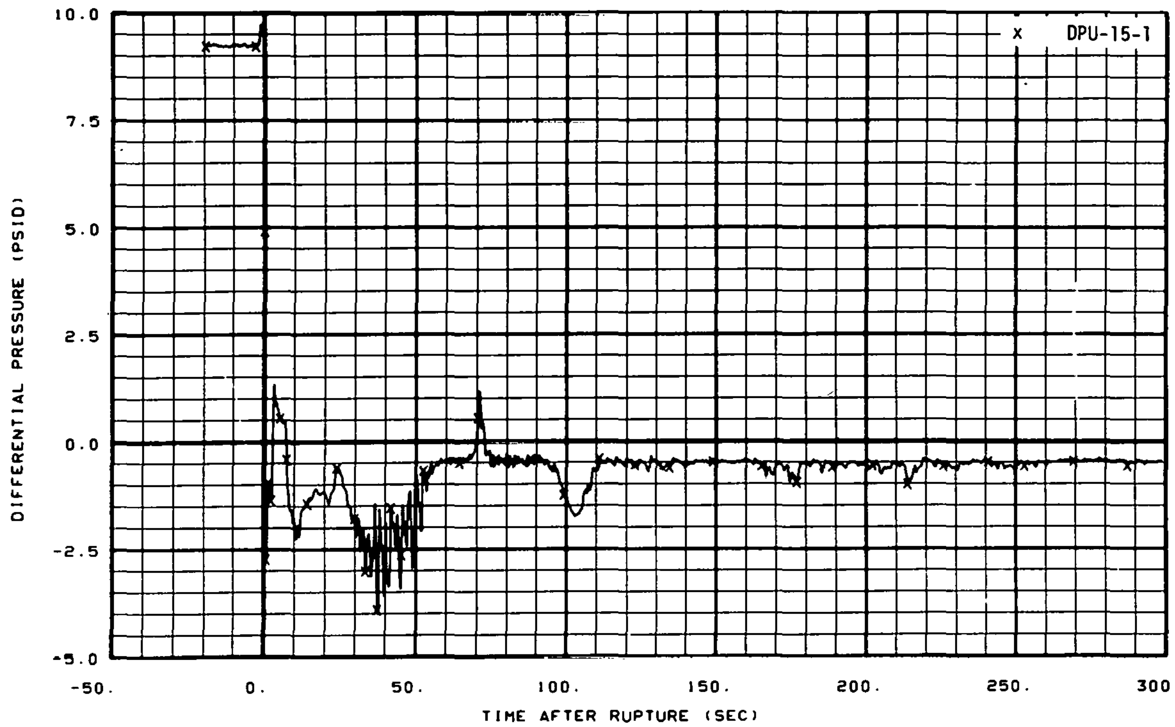

Fig. 161 Differential pressure in intact loop (DPU-15-1), from -20 to 300 seconds.

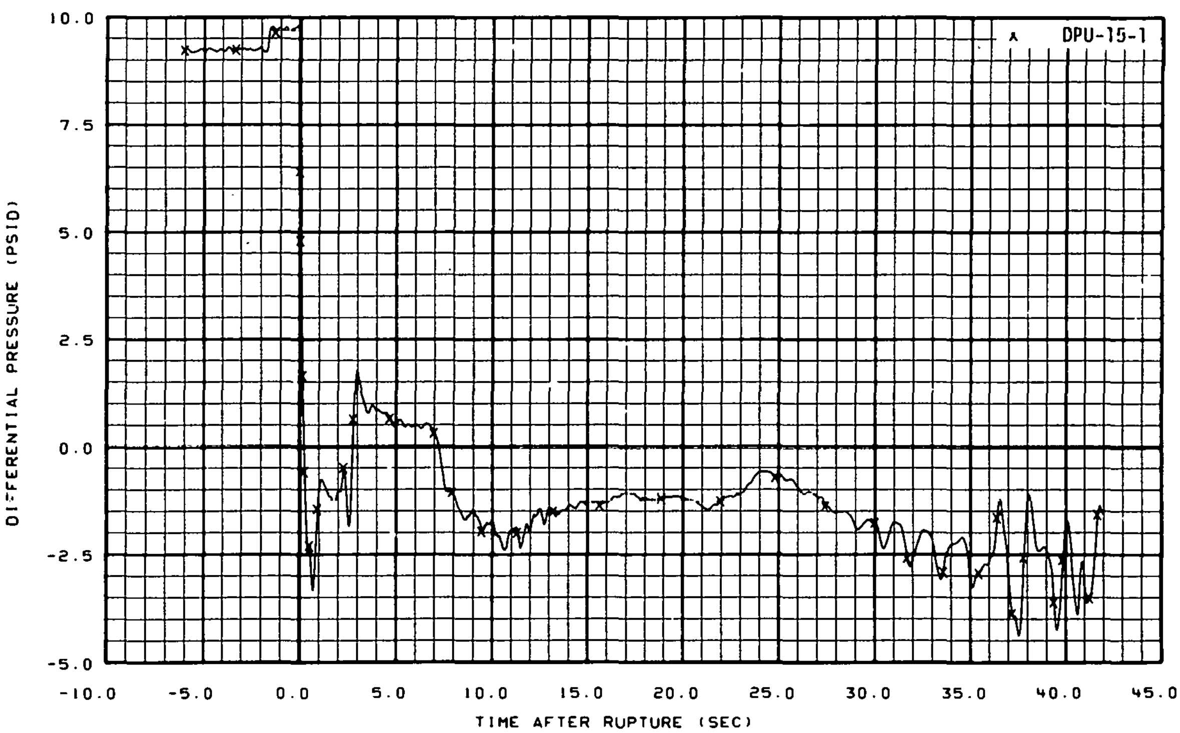

Fig. 162 Differential pressure in intact loop (DPU-15-1), from -6 to 42 seconds.

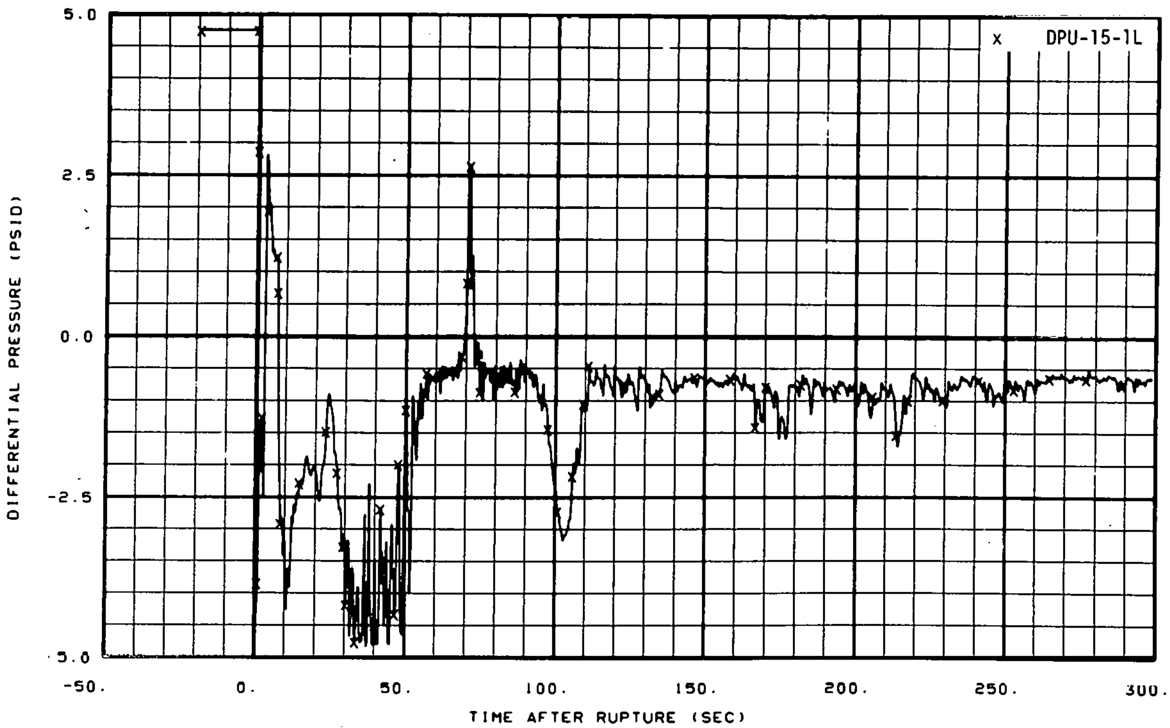

Fig. 163 Differential pressure in intact loop, low range (DPU-15-1L), from -20 to 300 seconds.

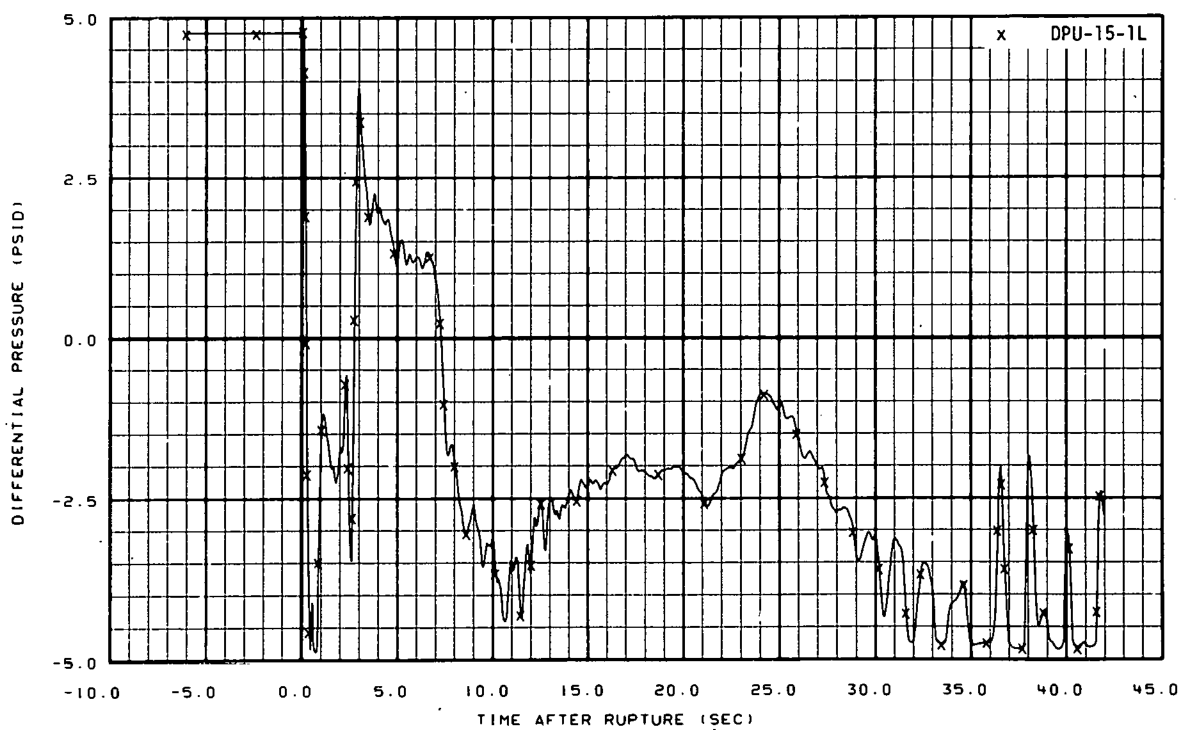

Fig. 164 Differential pressure in intact loop, low range (DPU-15-1L), from -6 to 42 seconds.

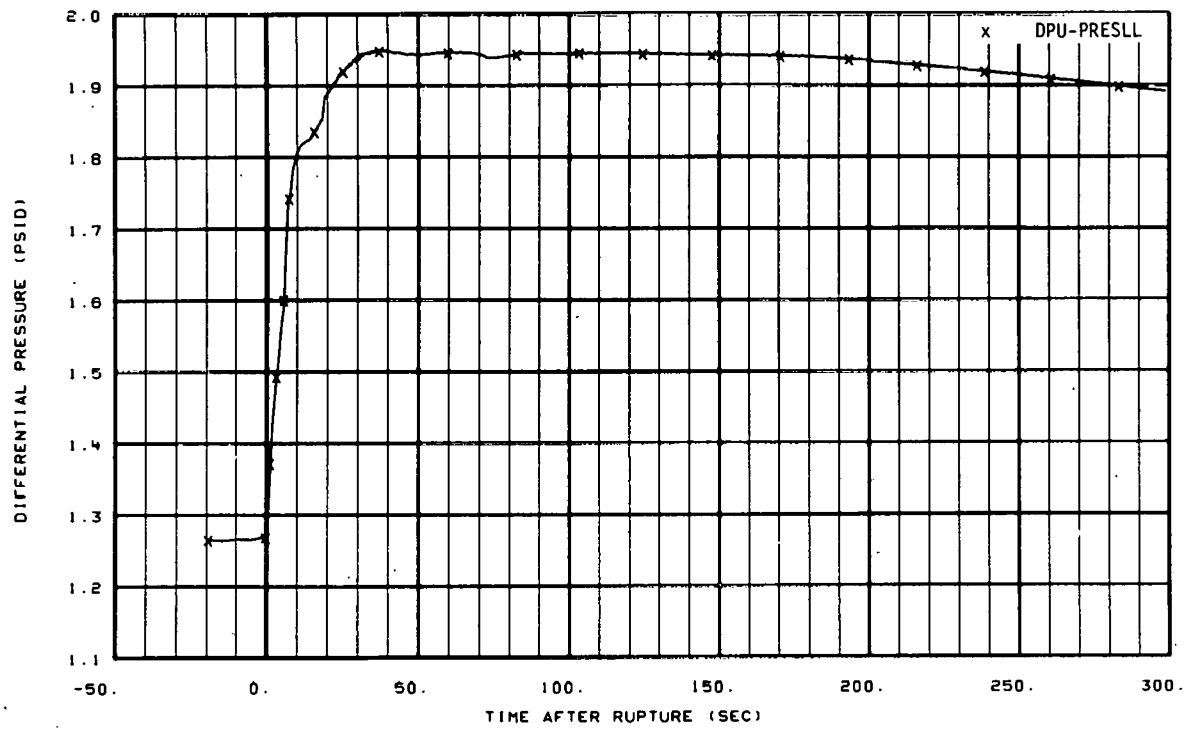

Fig. 165 Differential pressure in intact loop (DPU-PRESLL), from -20 to 300 seconds.

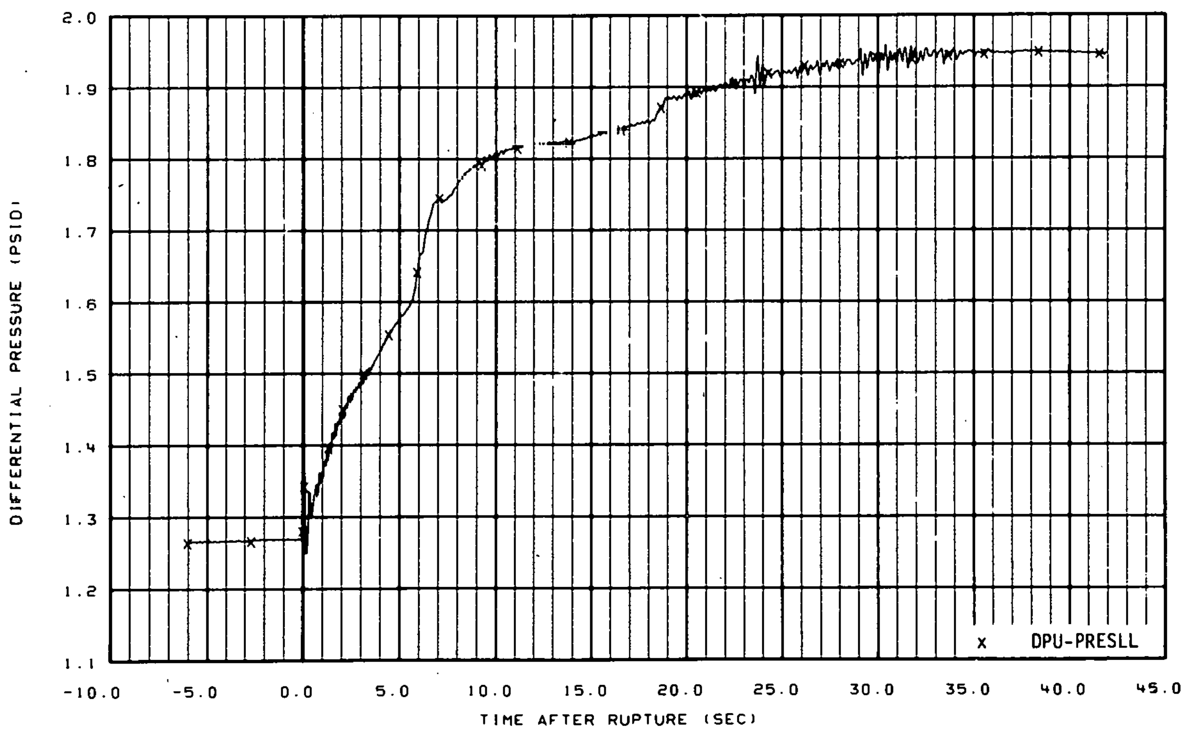

Fig. 166 Differential pressure in intact loop (DPU-PRESLL), from -6 to 42 seconds.

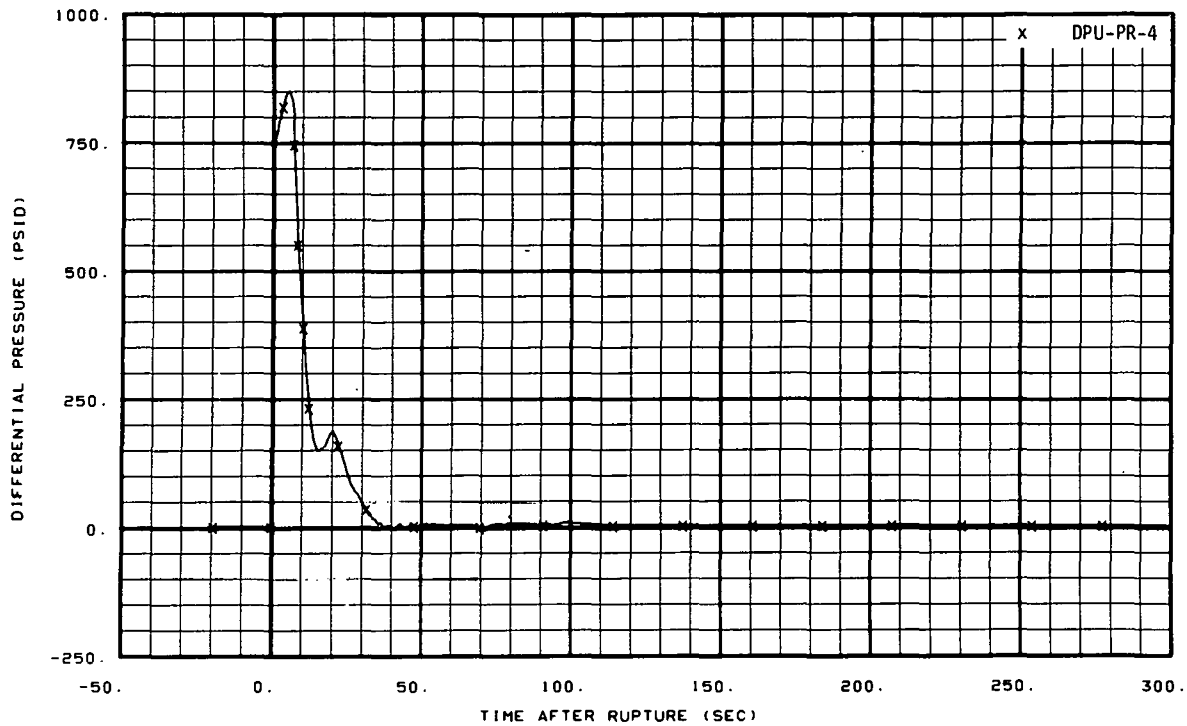

Fig. 167 Differential pressure in intact loop (DPU-PR-4), from -20 to 300 seconds.

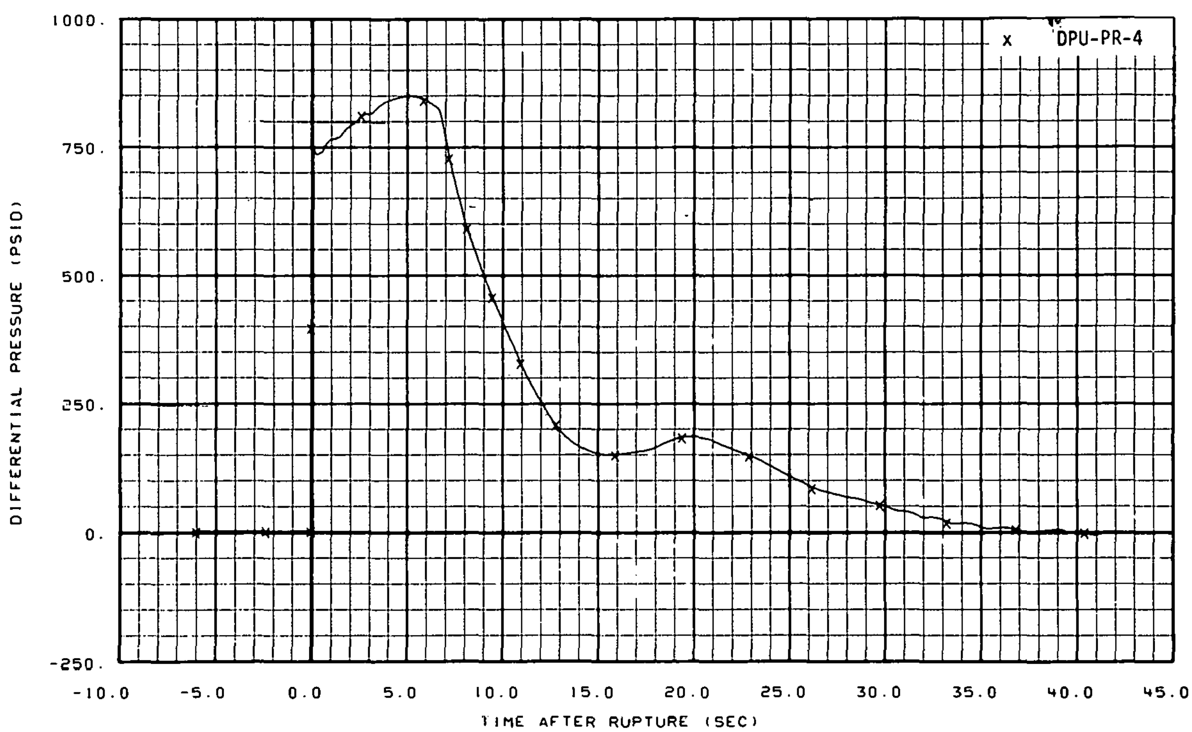

Fig. 168 Differential pressure in intact loop (DPU-PR-4), from -6 to 42 seconds.

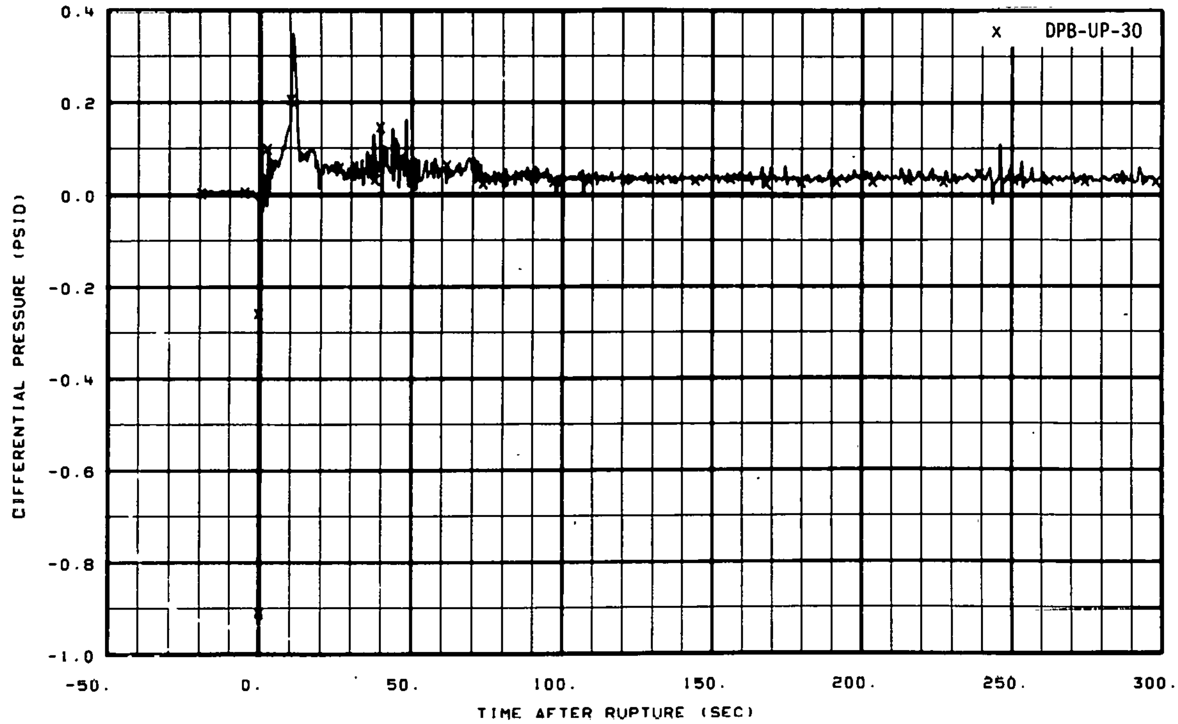

Fig. 169 Differential pressure in broken loop (DPB-UP-30), from -20 to 300 seconds.

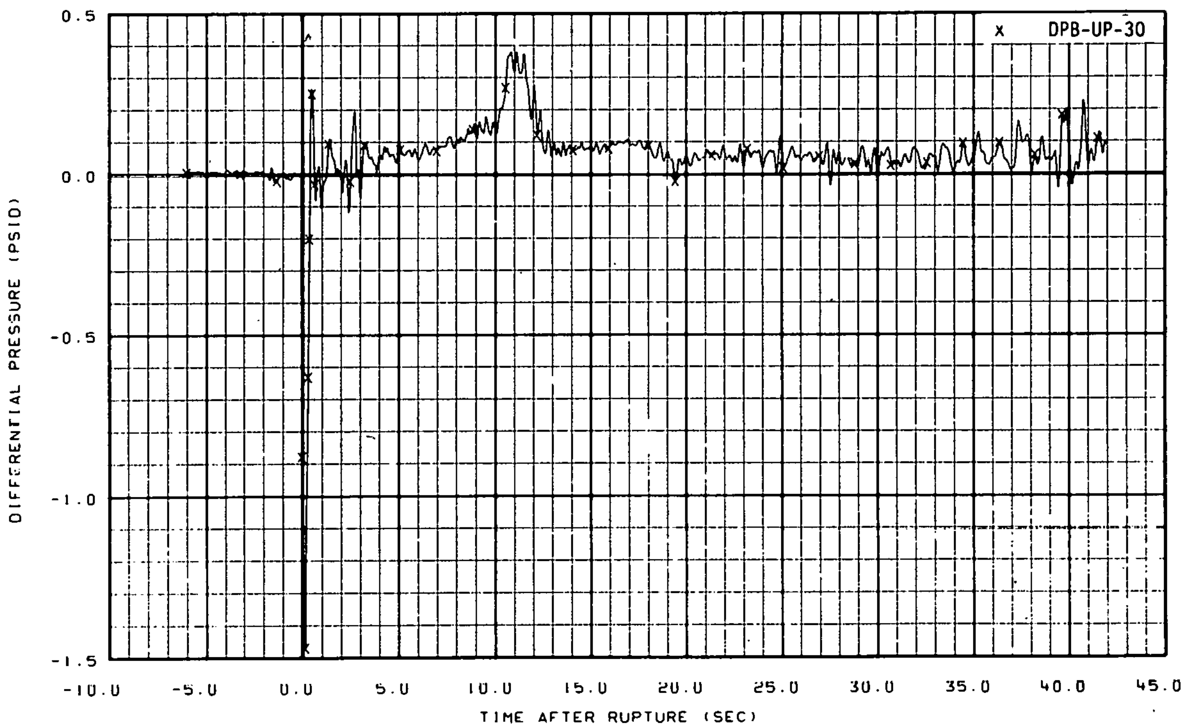

Fig. 170 Differential pressure in broken loop (DPB-UP-30), from -6 to 42 seconds.

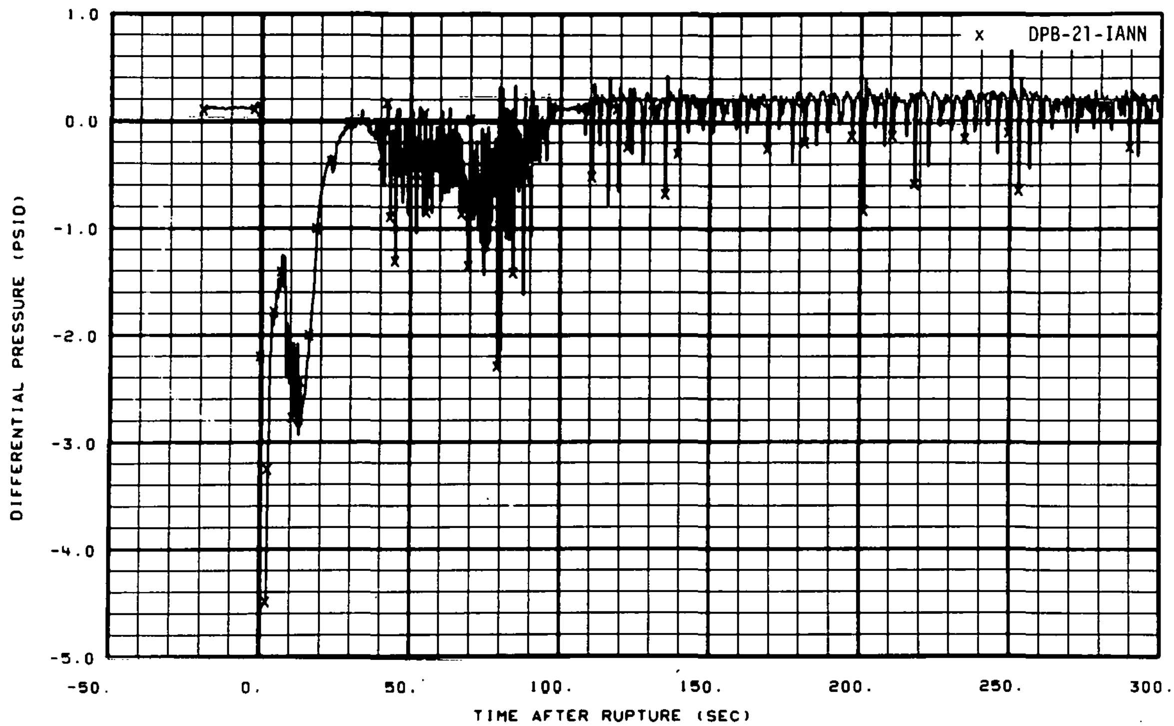

Fig. 171 Differential pressure in broken loop (DPB-21-IANN), from -20 to 300 seconds.

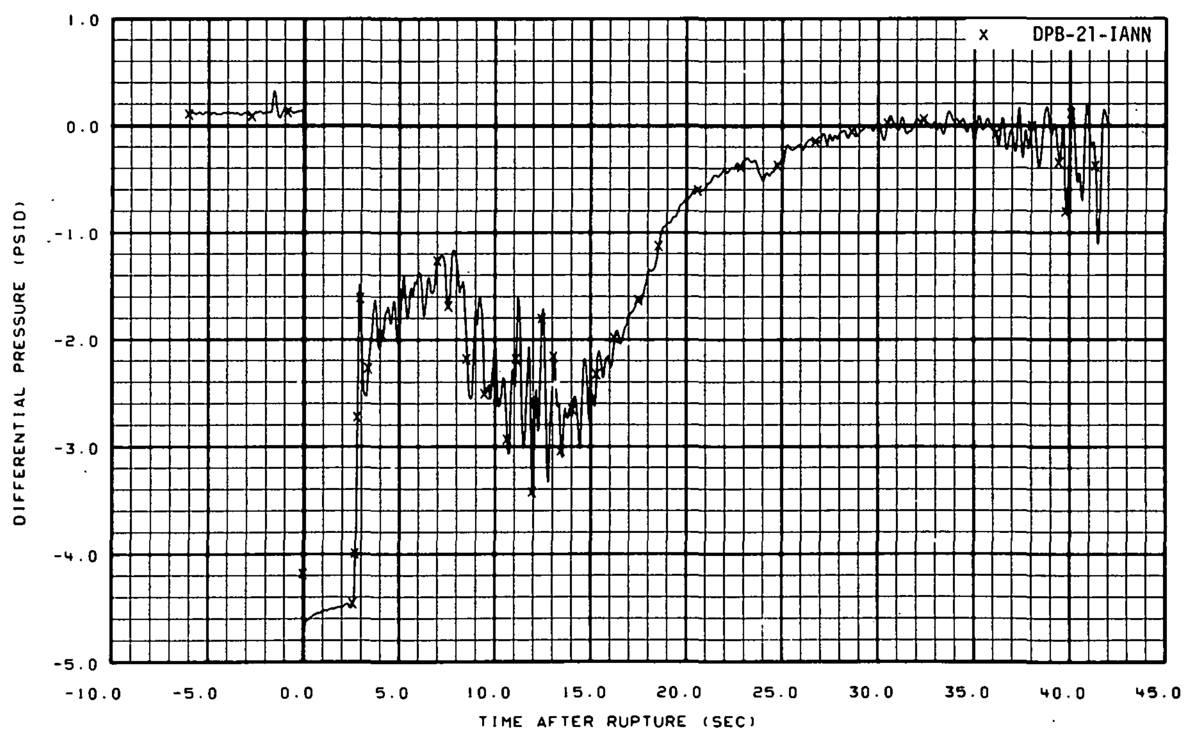

Fig. 172 Differential pressure in broken loop (DPB-21-IANN), from -6 to 42 seconds.

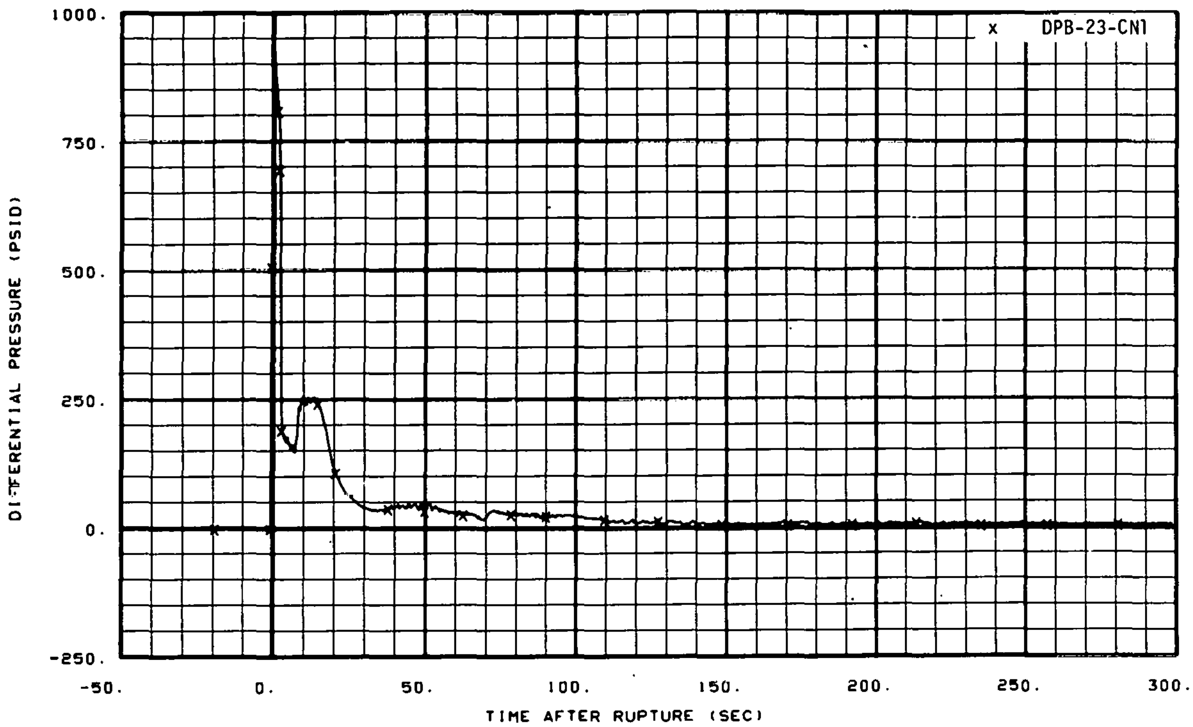

Fig. 173 Differential pressure in broken loop (DPB-23-CN1), from -20 to 300 seconds.

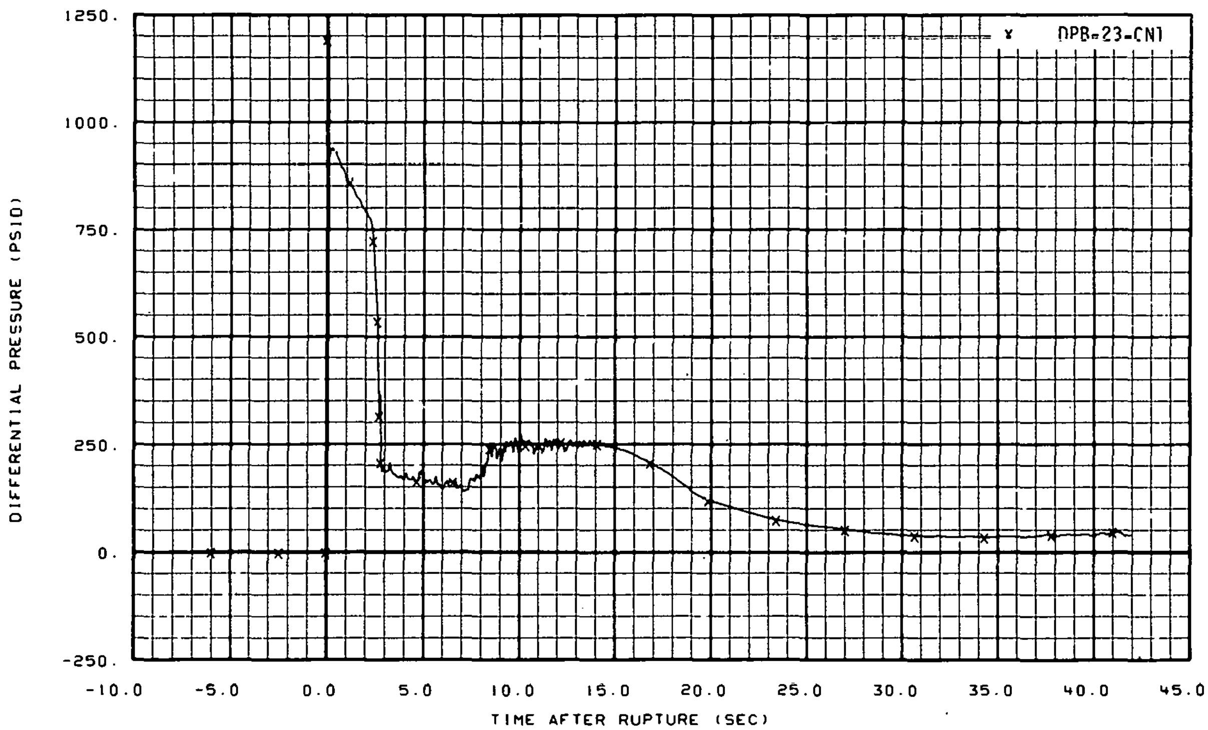

Fig. 174 Differential pressure in broken loop (DPB-23-CN1), from -6 to 42 seconds.

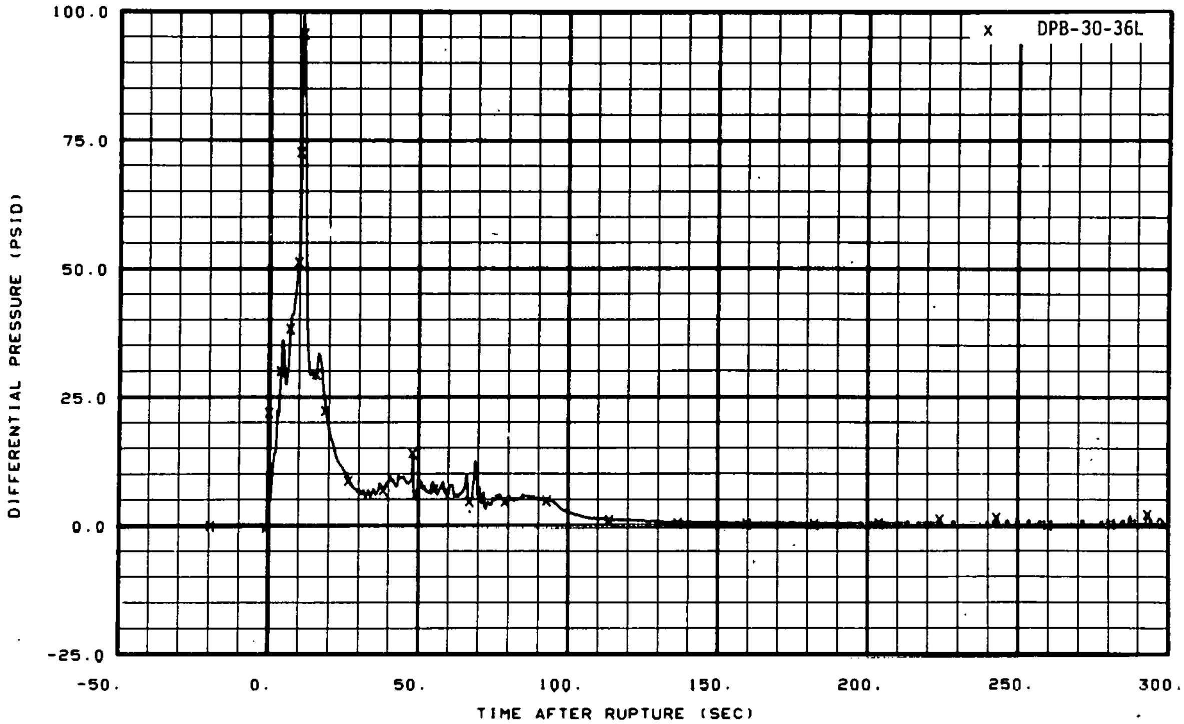

Fig. 175 Differential pressure in broken loop (DPB-30-36L), from -20 to 300 seconds.

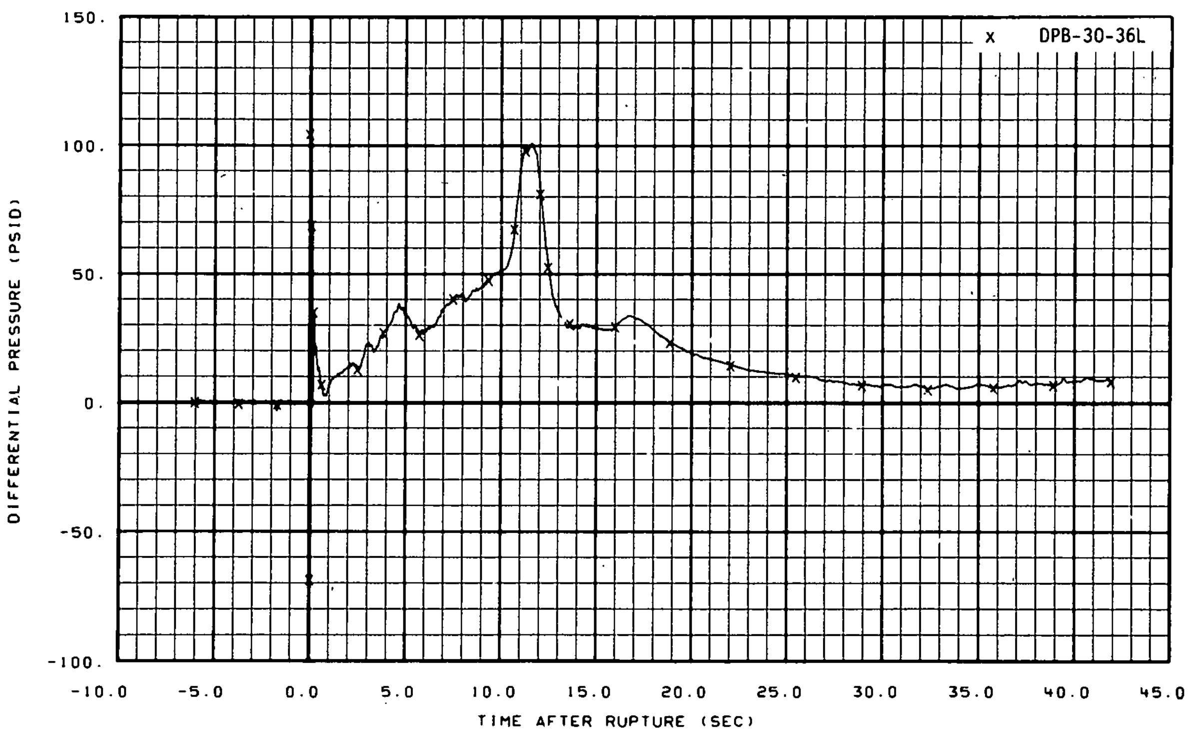

Fig. 176 Differential pressure in broken loop (DPB-30-36L), from -6 to 42 seconds.

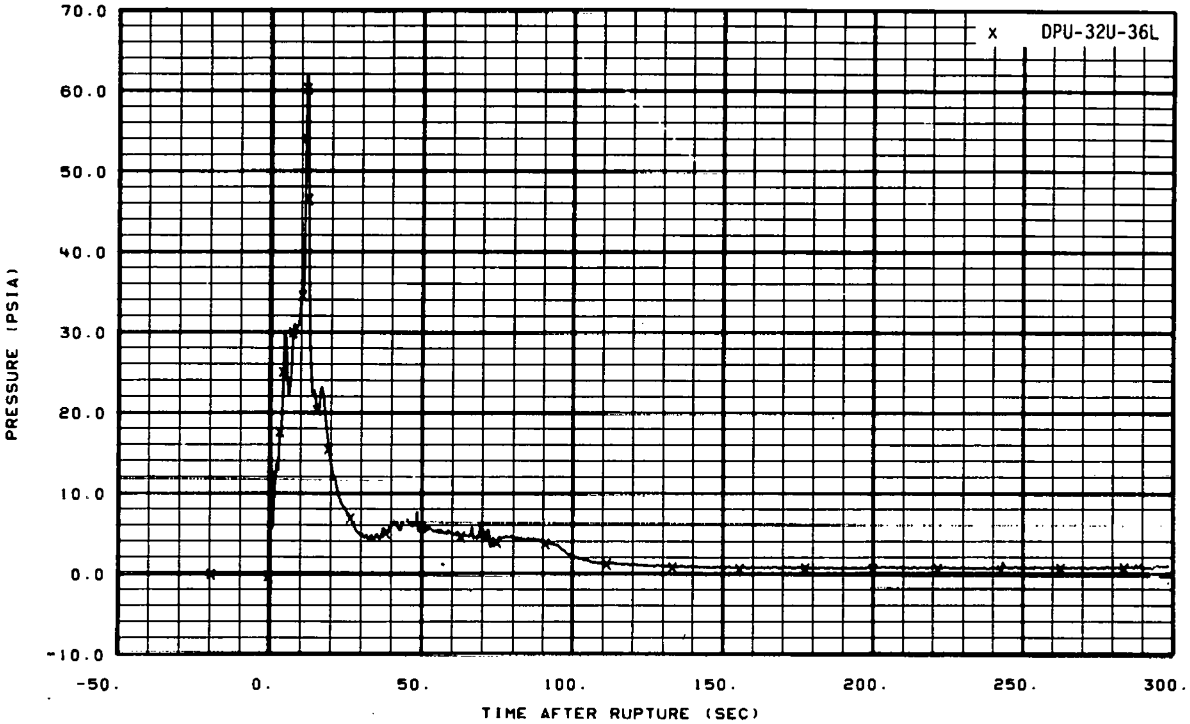

Fig. 177 Differential pressure in broken loop (DPB-32U-36L), from -20 to 300 seconds.

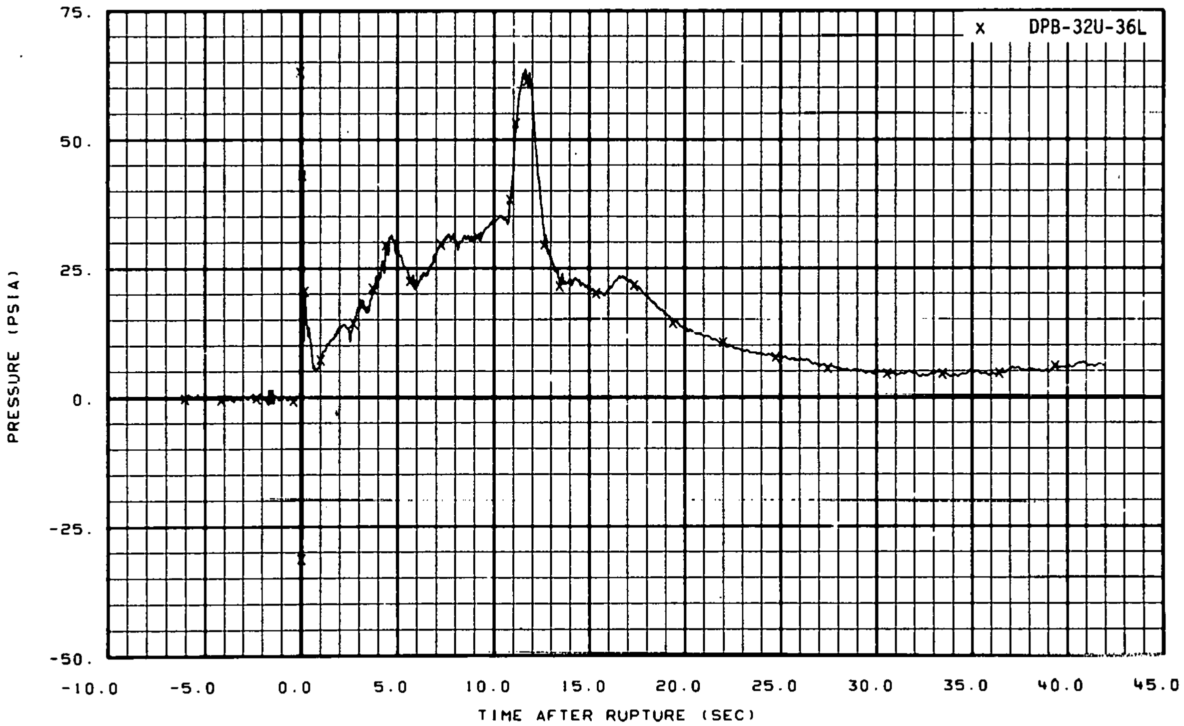

Fig. 178 Differential pressure in broken loop (DPB-32U-36L), from -6 to 42 seconds.

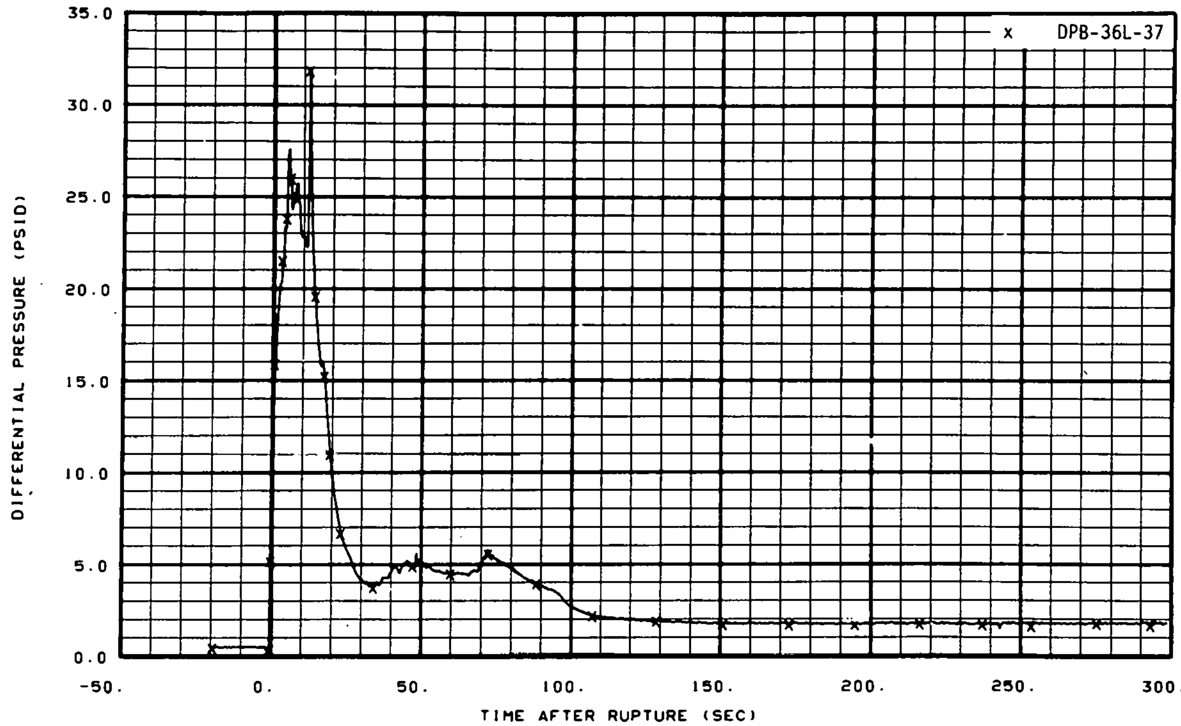

Fig. 179 Differential pressure in broken loop (DPB-36L-37), from -20 to 300 seconds.

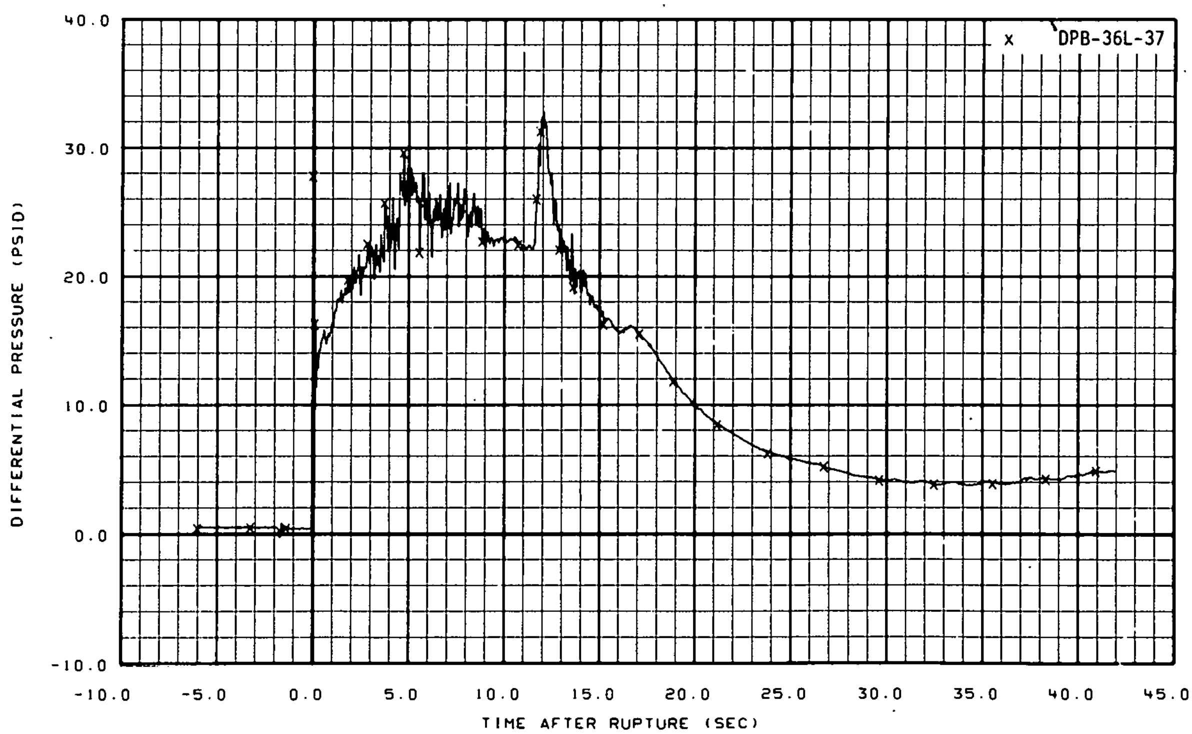

Fig. 180 Differential pressure in broken loop (DPB-36L-37), from -6 to 42 seconds.

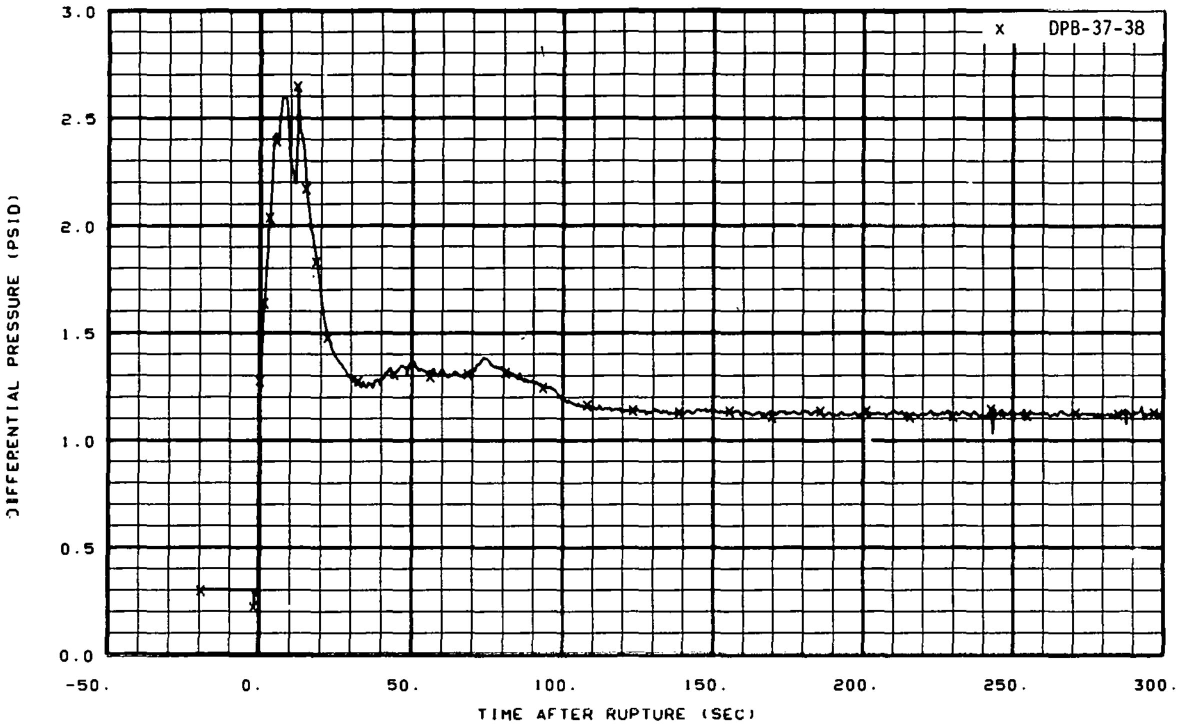

Fig. 181 Differential pressure in broken loop (DPB-37-38), from -20 to 300 seconds.

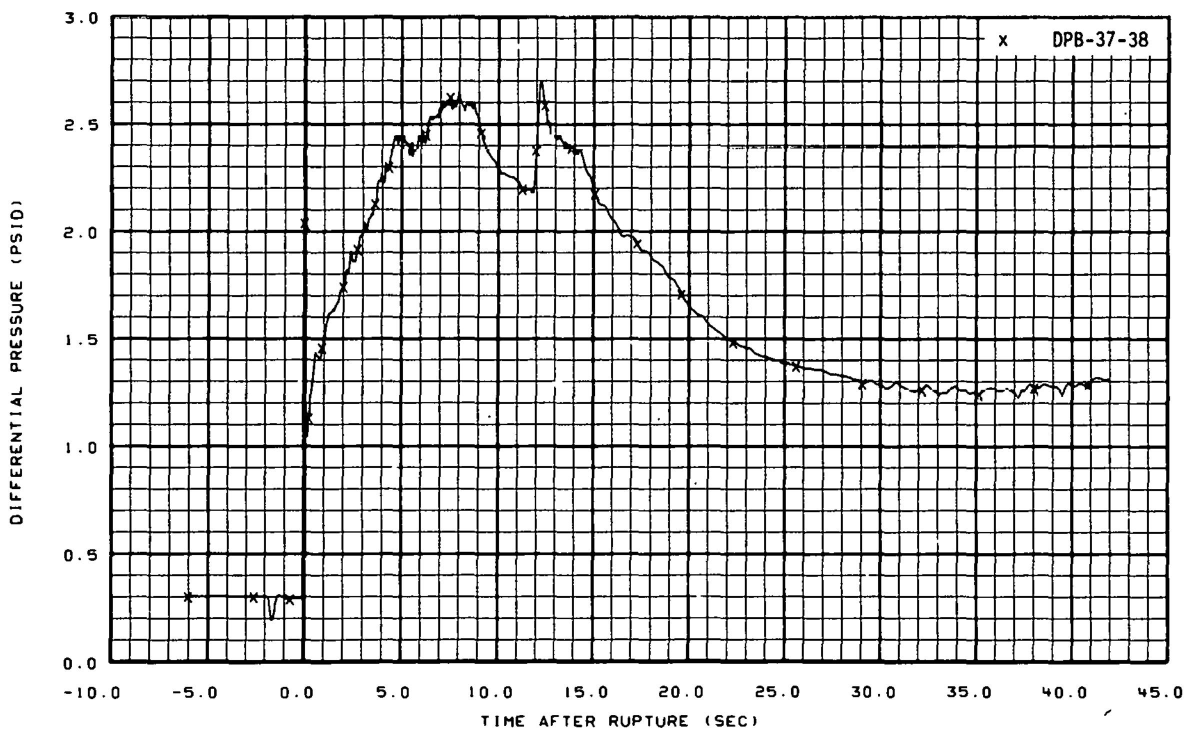

Fig. 182 Differential pressure in broken loop (DPB-37-38), from -6 to 42 seconds.

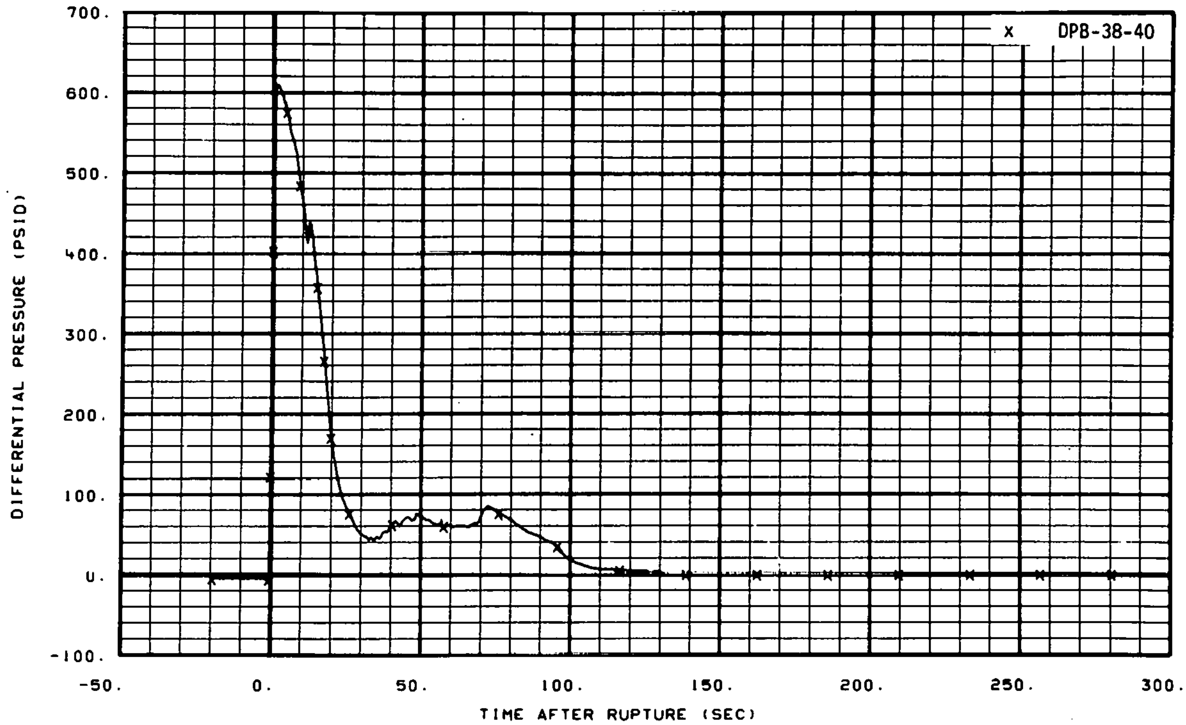

Fig. 183 Differential pressure in broken loop (DPB-38-40), from -20 to 300 seconds.

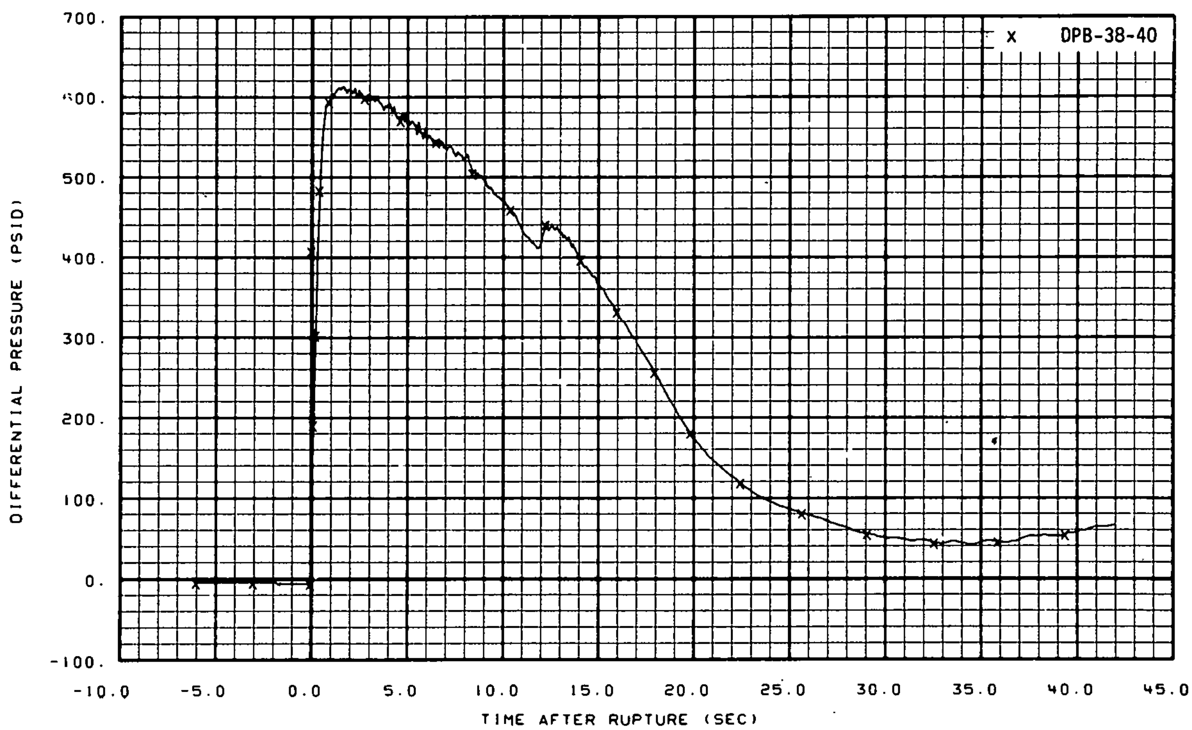

Fig. 184 Differential pressure in broken loop (DPB-38-40), from -6 to 42 seconds.

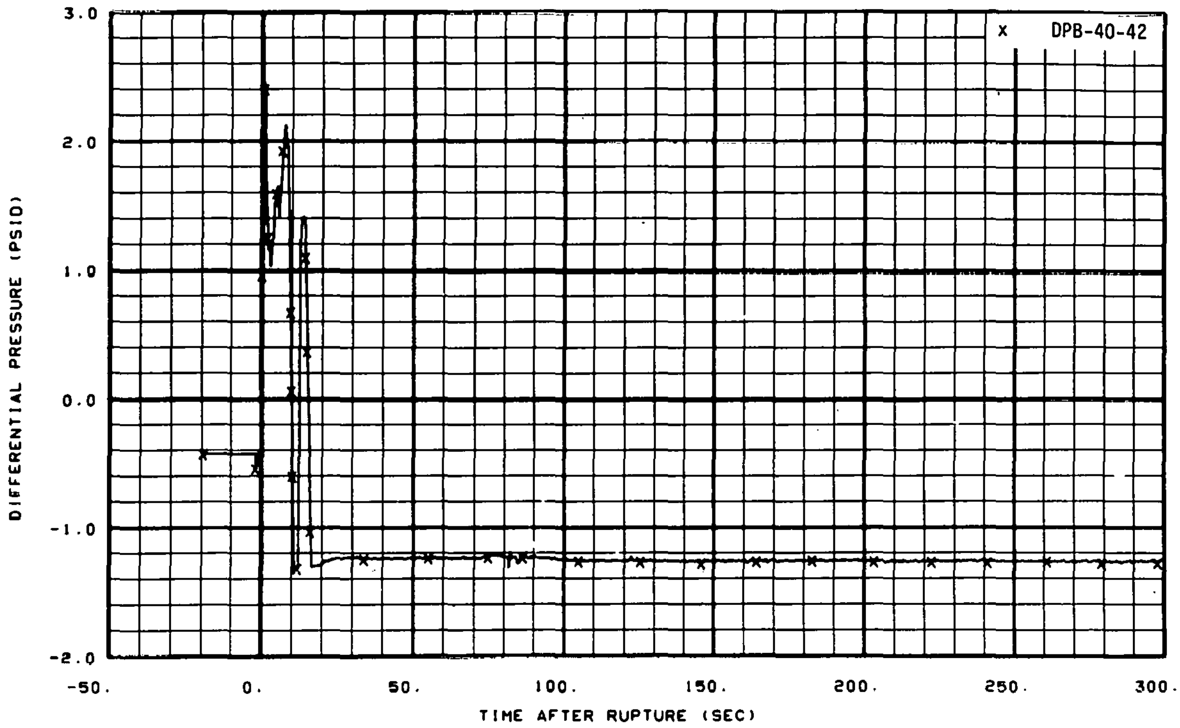

Fig. 185 Differential pressure in broken loop (DPB-40-42), from -20 to 300 seconds.

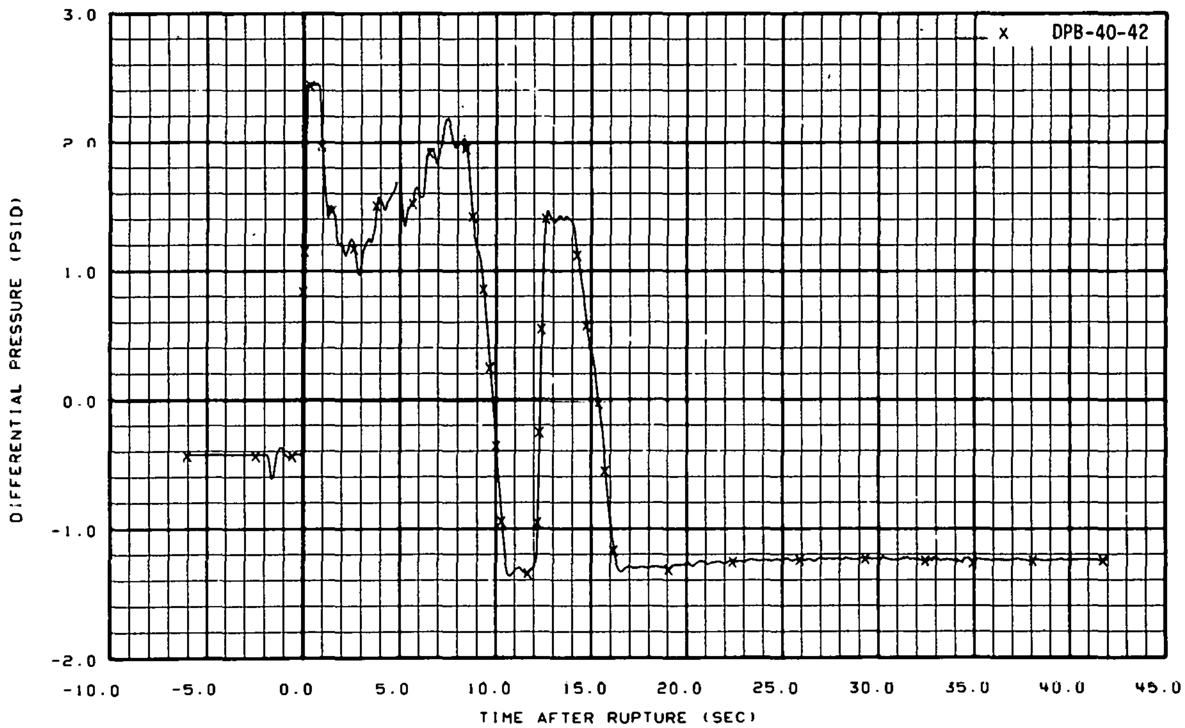

Fig. 186 Differential pressure in broken loop (DPB-40-42), from -6 to 42 seconds.

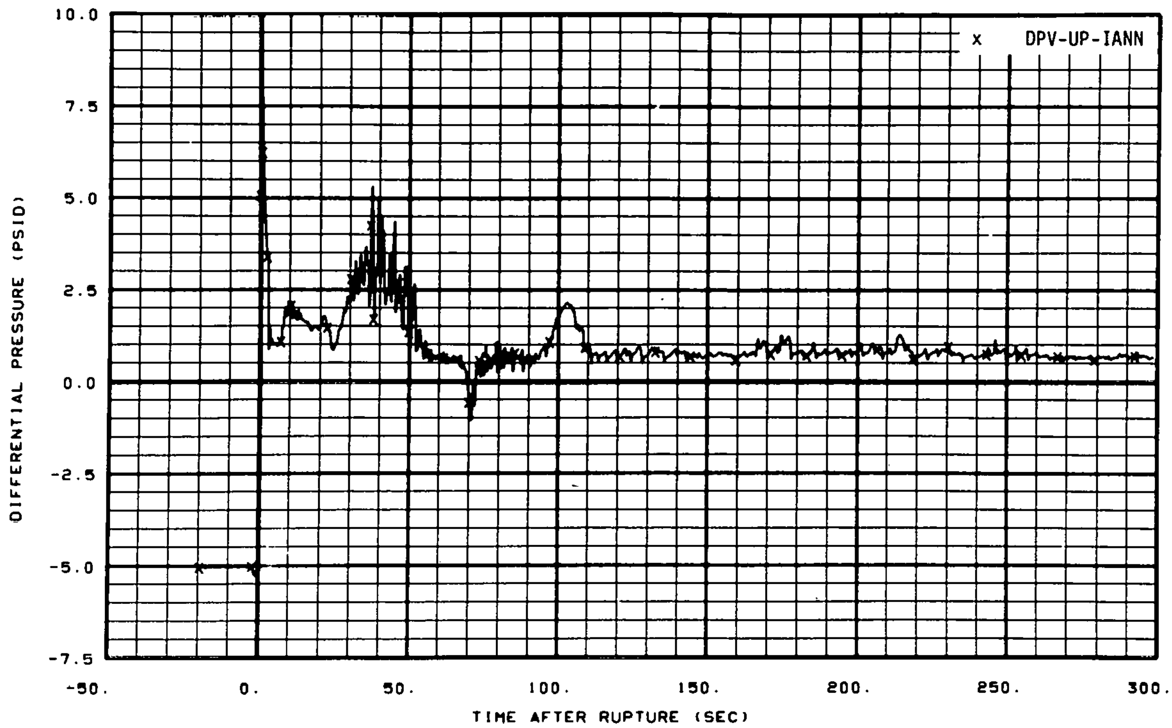

Fig. 187 Differential pressure in vessel (DPV-UP-IANN), from -20 to 300 seconds.

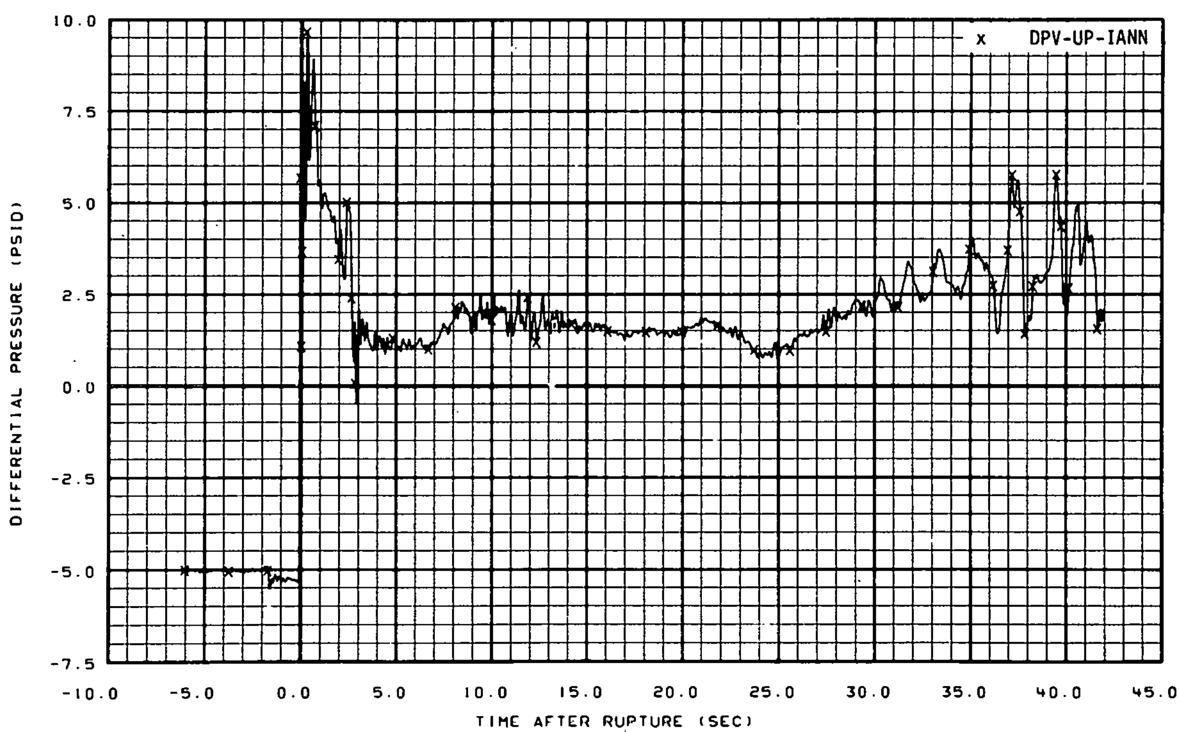

Fig. 188 Differential pressure in vessel (DPV-UP-IANN), from -6 to 42 seconds.

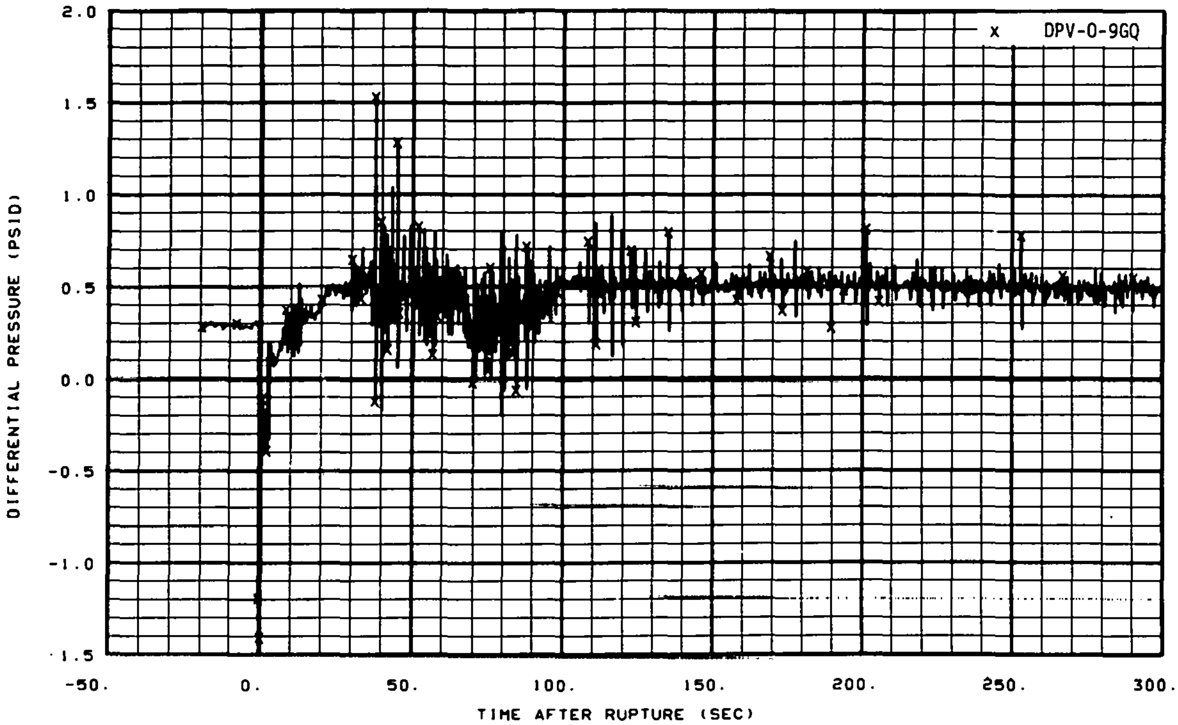

Fig. 189 Differential pressure in vessel (DPV-0-9GQ), from -20 to 300 seconds.

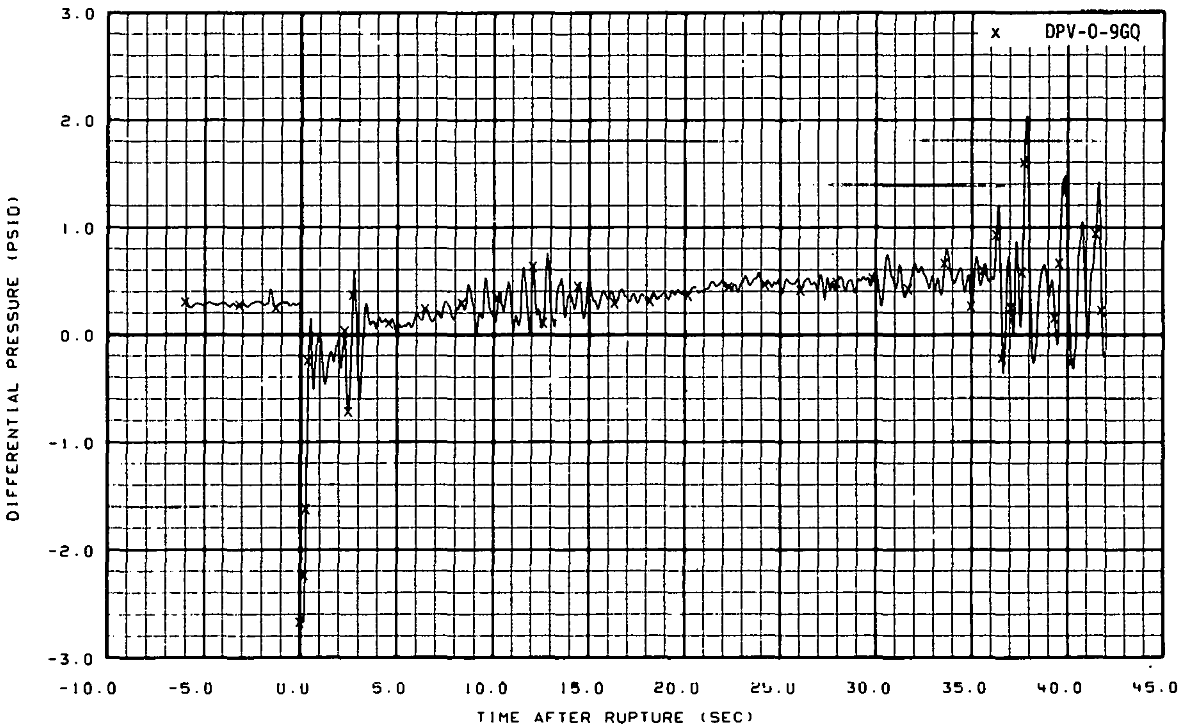

Fig. 190 Differential pressure in vessel (DPV-0-9GQ), from -6 to 42 seconds.

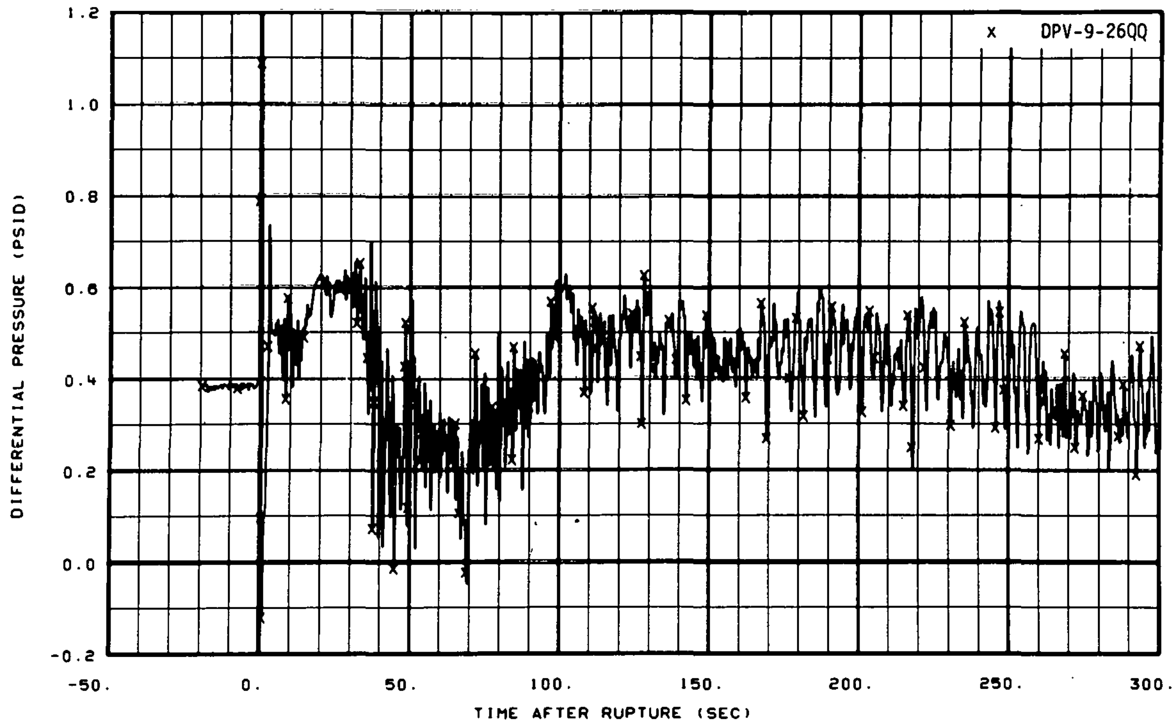

Fig. 191 Differential pressure in vessel (DPV-9-26QQ), from -20 to 300 seconds.

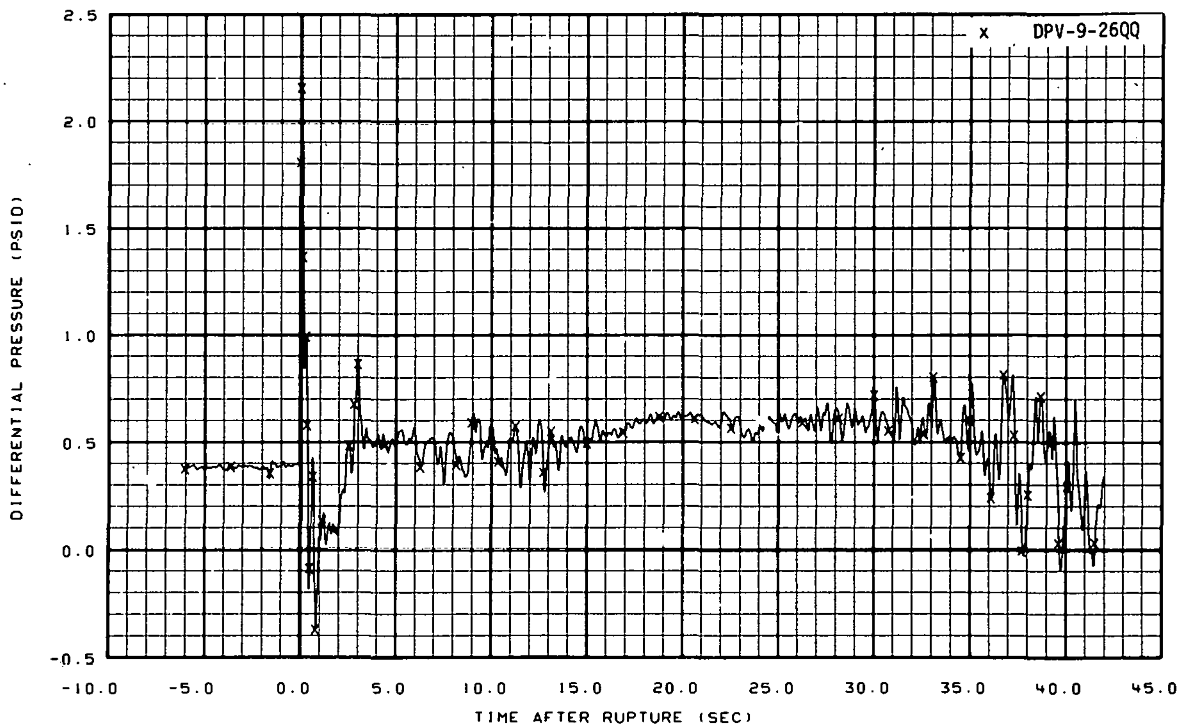

Fig. 192 Differential pressure in vessel (DPV-9-26QQ), from -6 to 42 seconds.

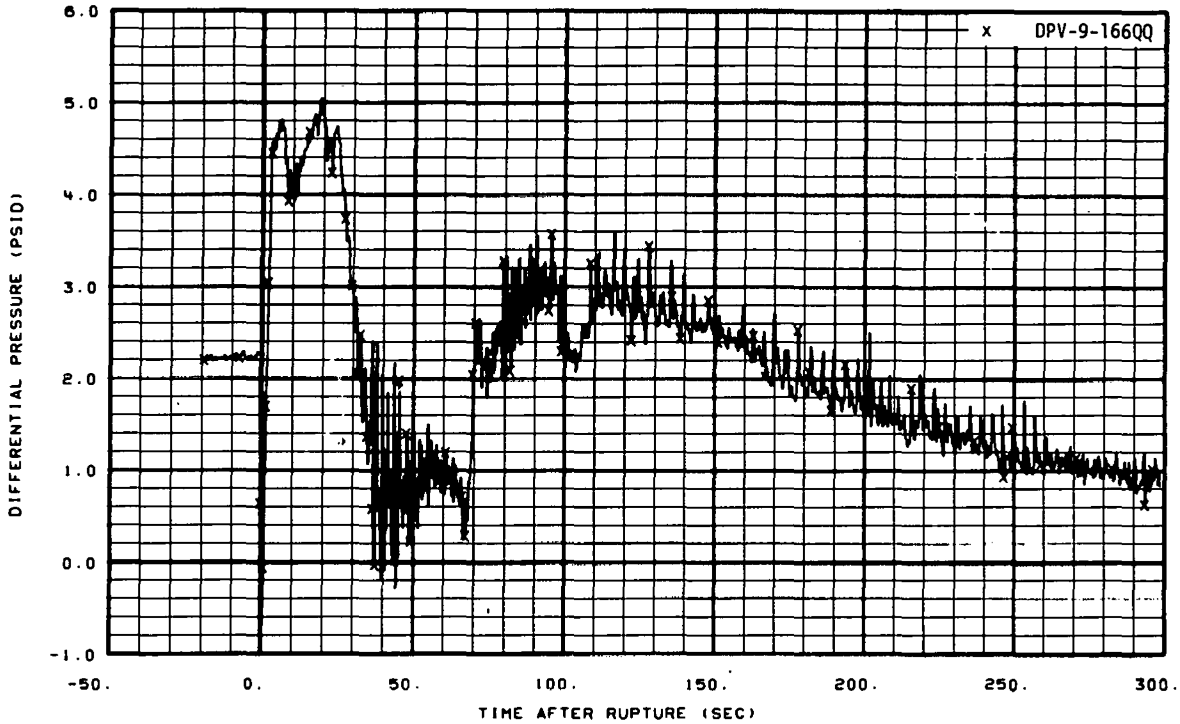

Fig. 193 Differential pressure in vessel (DPV-9-166QQ), from -20 to 300 seconds.

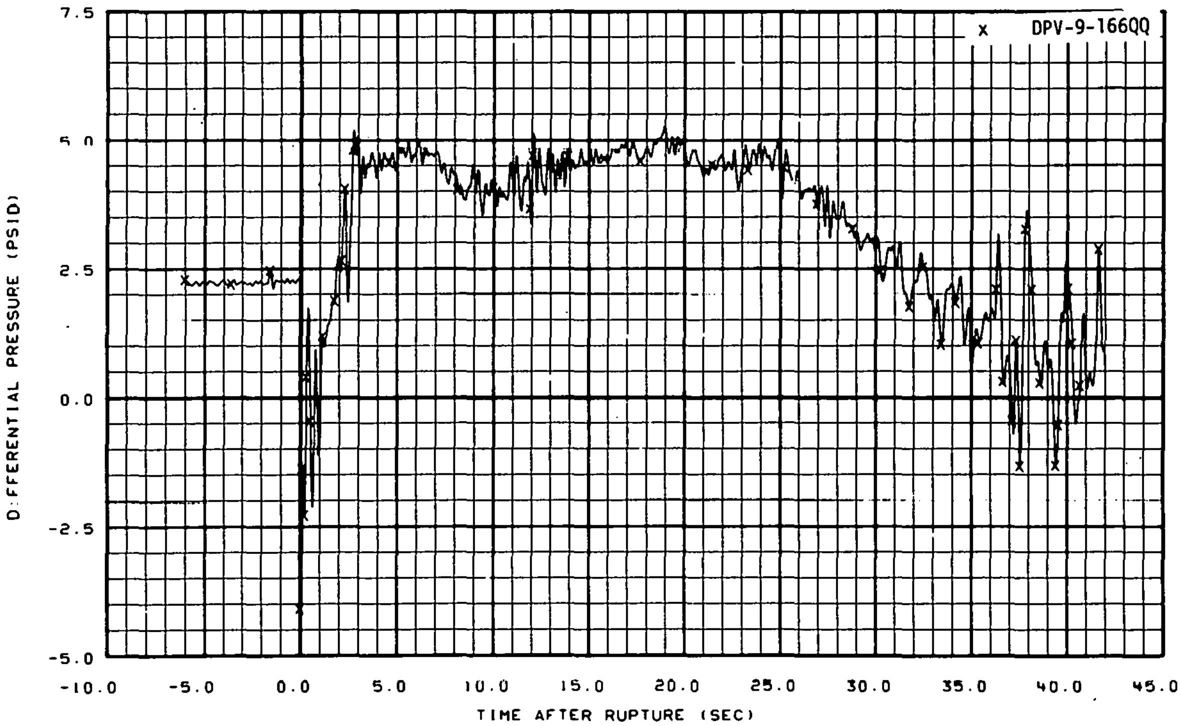

Fig. 194 Differential pressure in vessel (DPV-9-166QQ), from -6 to 42 seconds.

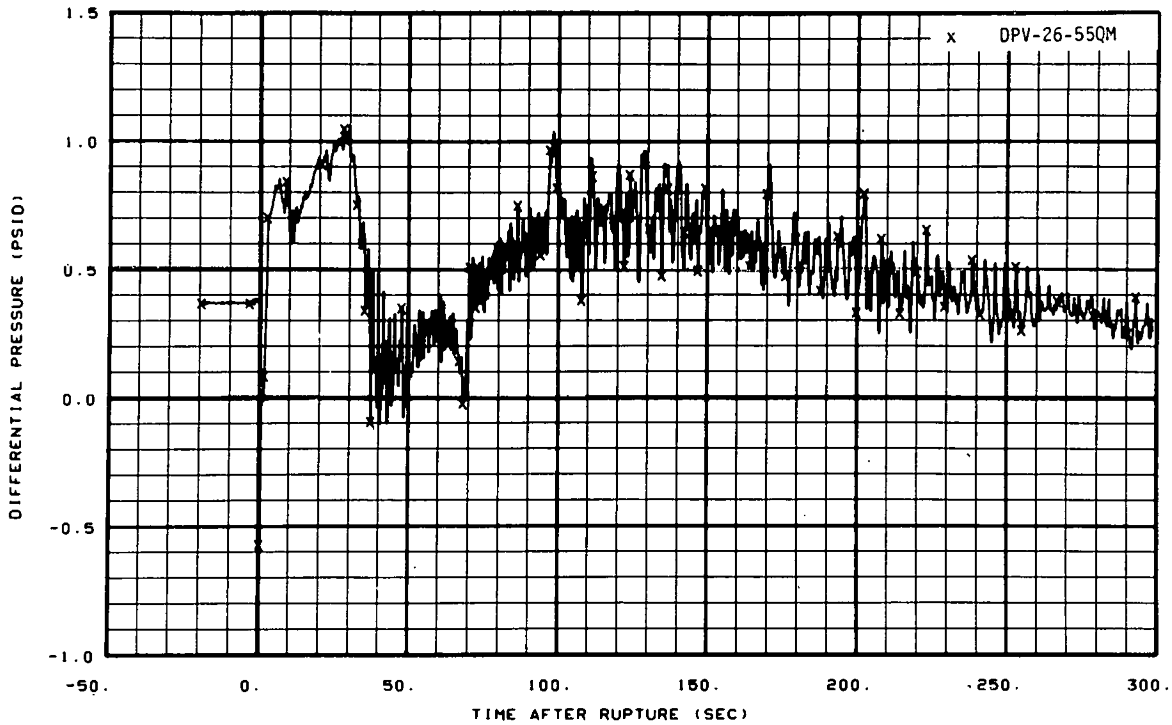

Fig. 195 Differential pressure in vessel (DPV-26-55QM), from -20 to 300 seconds.

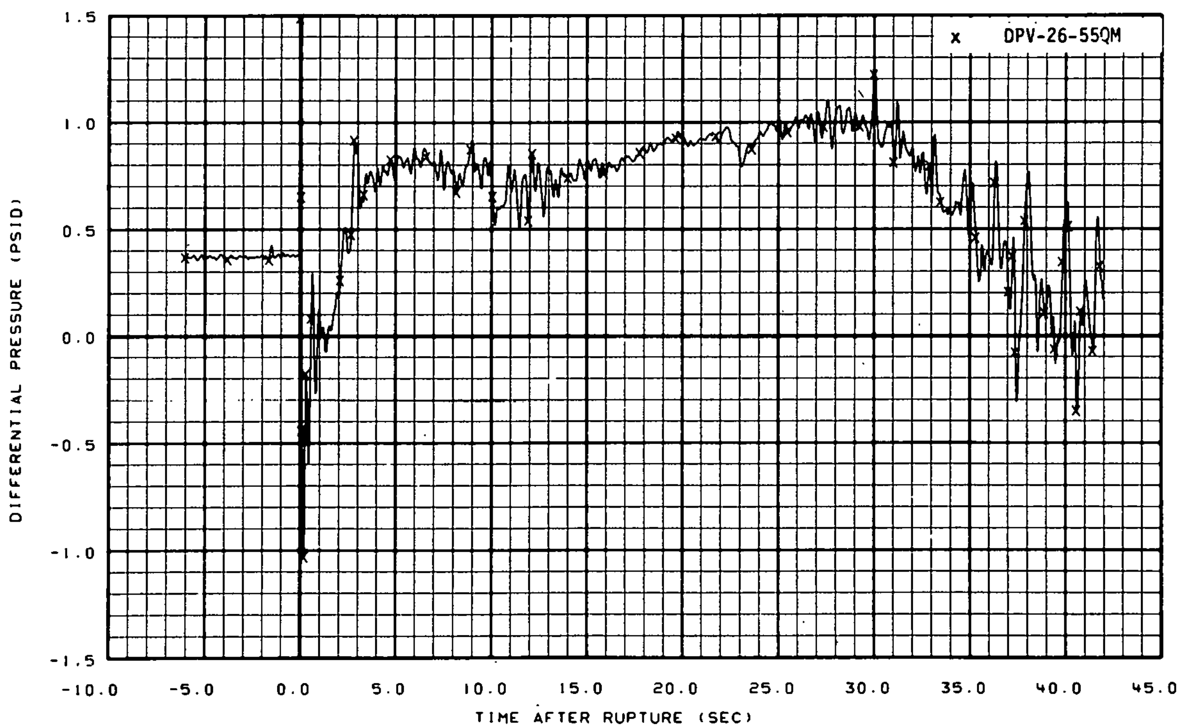

Fig. 196 Differential pressure in vessel (DPV-26-55QM), from -6 to 42 seconds.

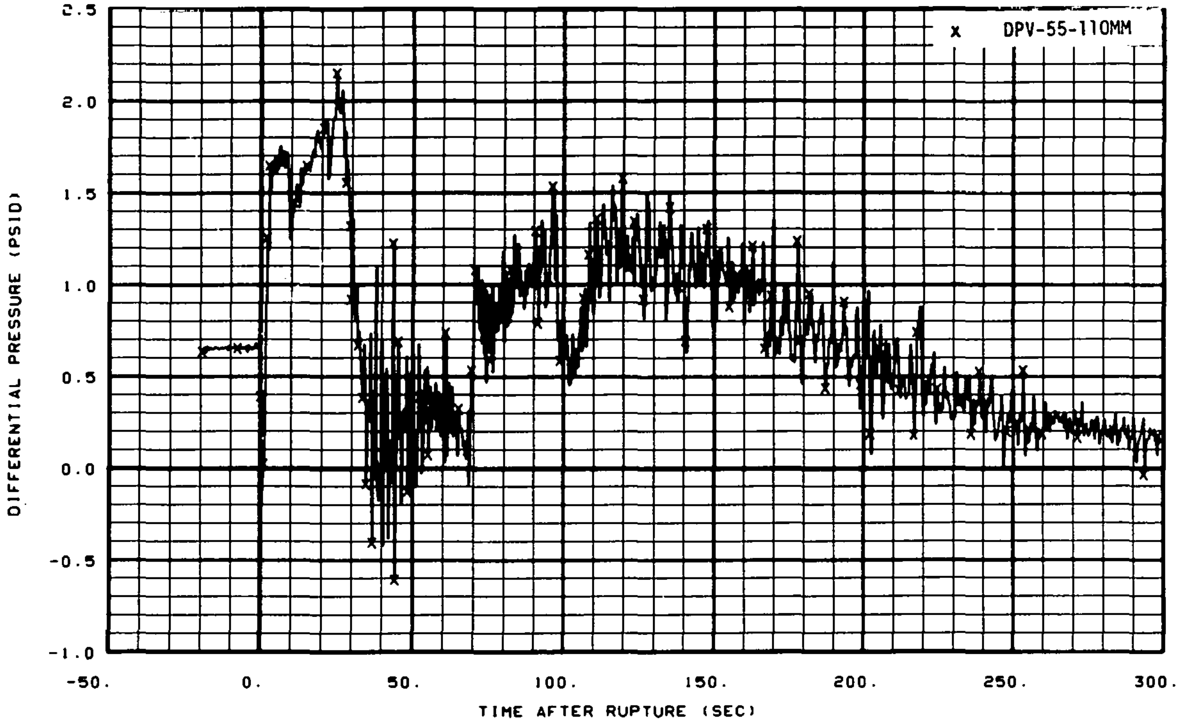

Fig. 197 Differential pressure in vessel (DPV-55-110MM), from -20 to 300 seconds.

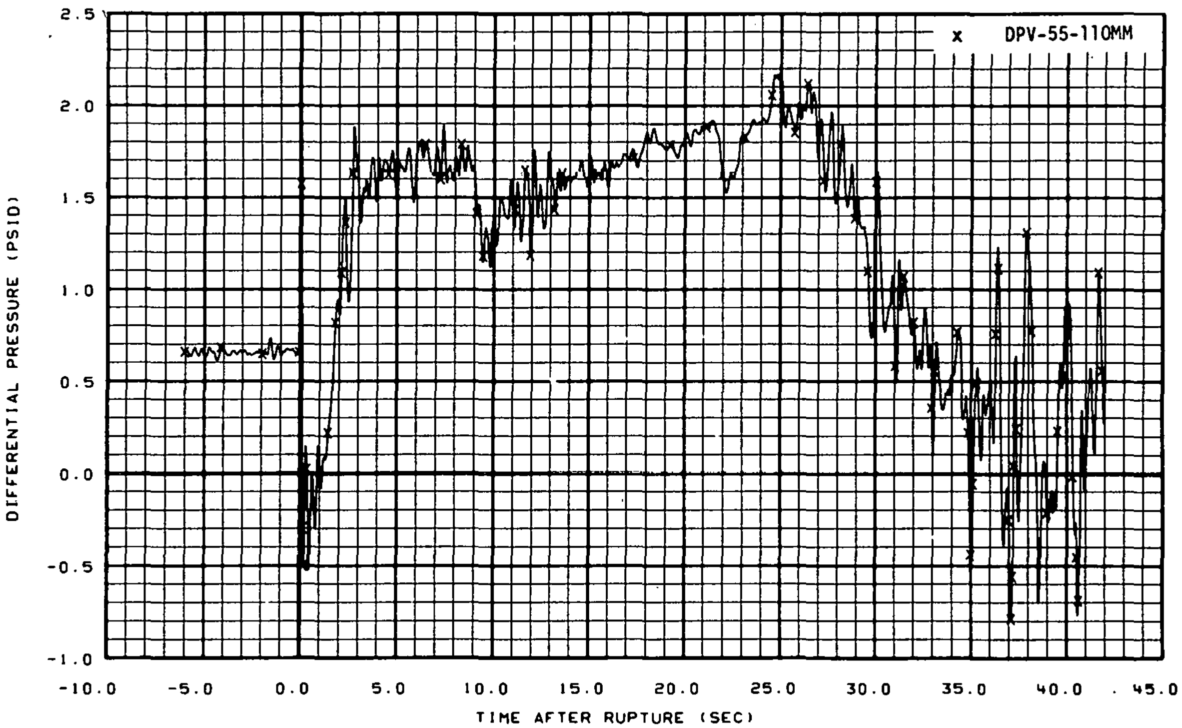

Fig. 198 Differential pressure in vessel (DPV-55-110MM), from -6 to 42 seconds.

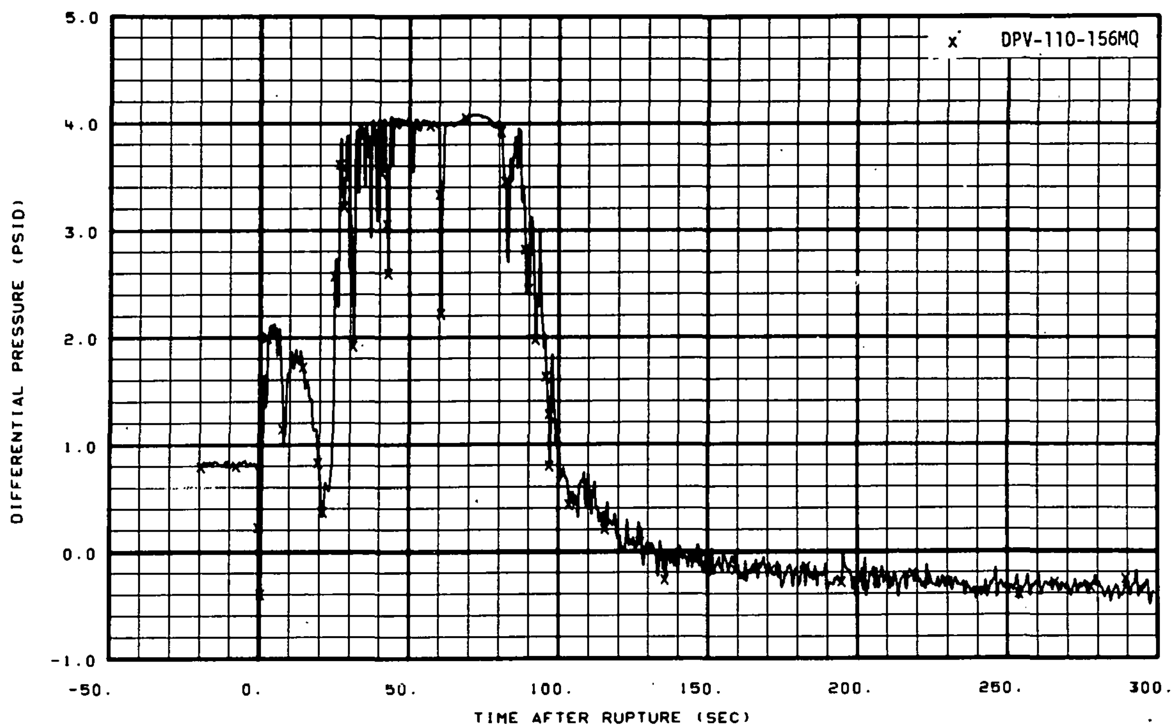

Fig. 199 Differential pressure in vessel (DPV-110-156MQ), from -20 to 300 seconds.

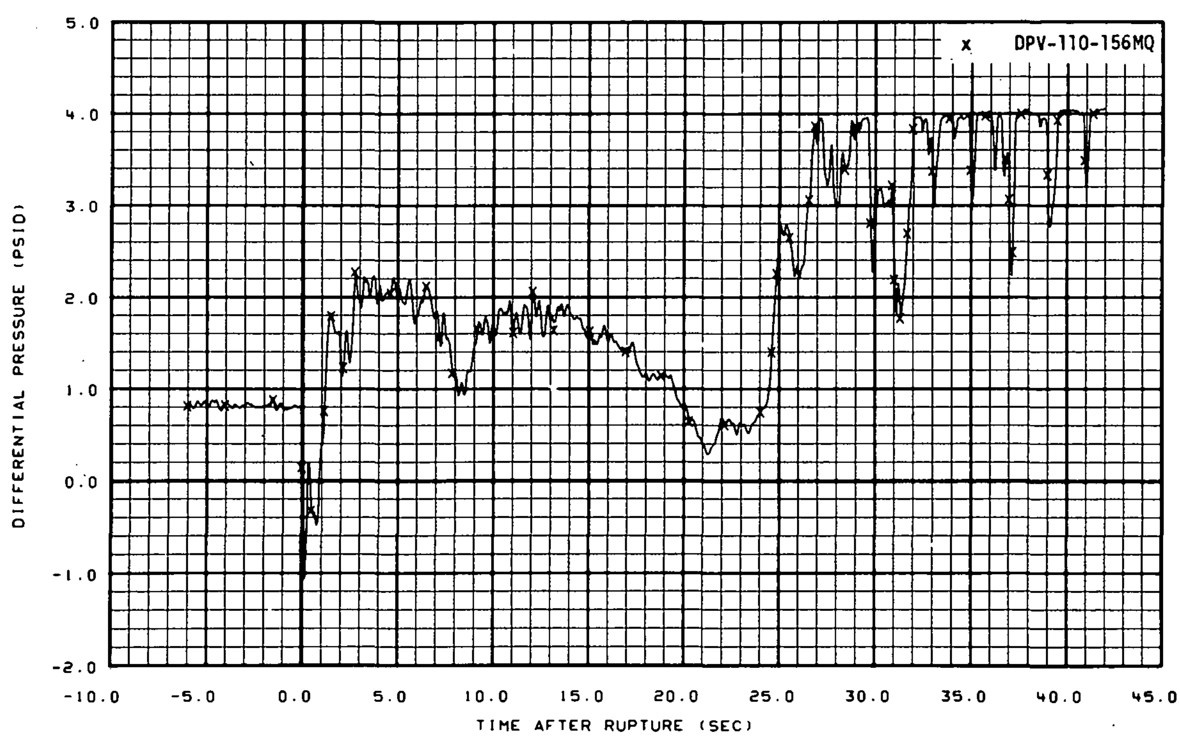

Fig. 200 Differential pressure in vessel (DPV-110-156MQ), from -6 to 42 seconds.

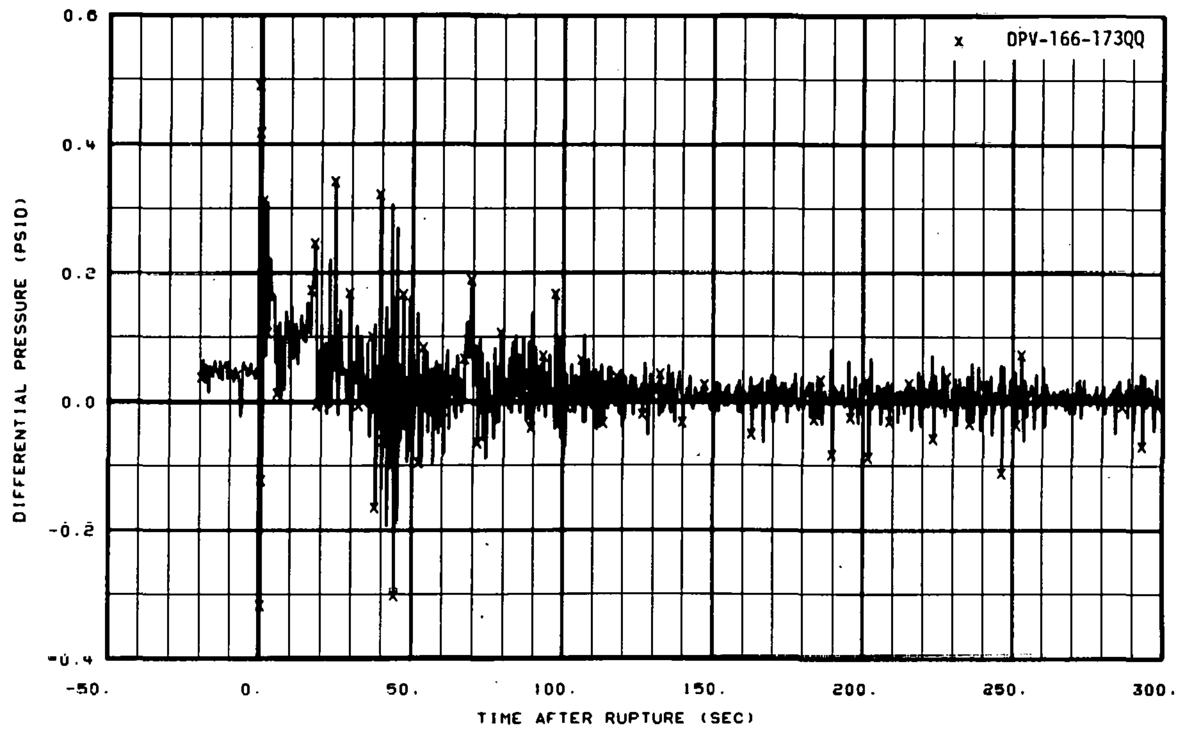

Fig. 201 Differential pressure in vessel (DPV-166-173QQ), from -20 to 300 seconds.

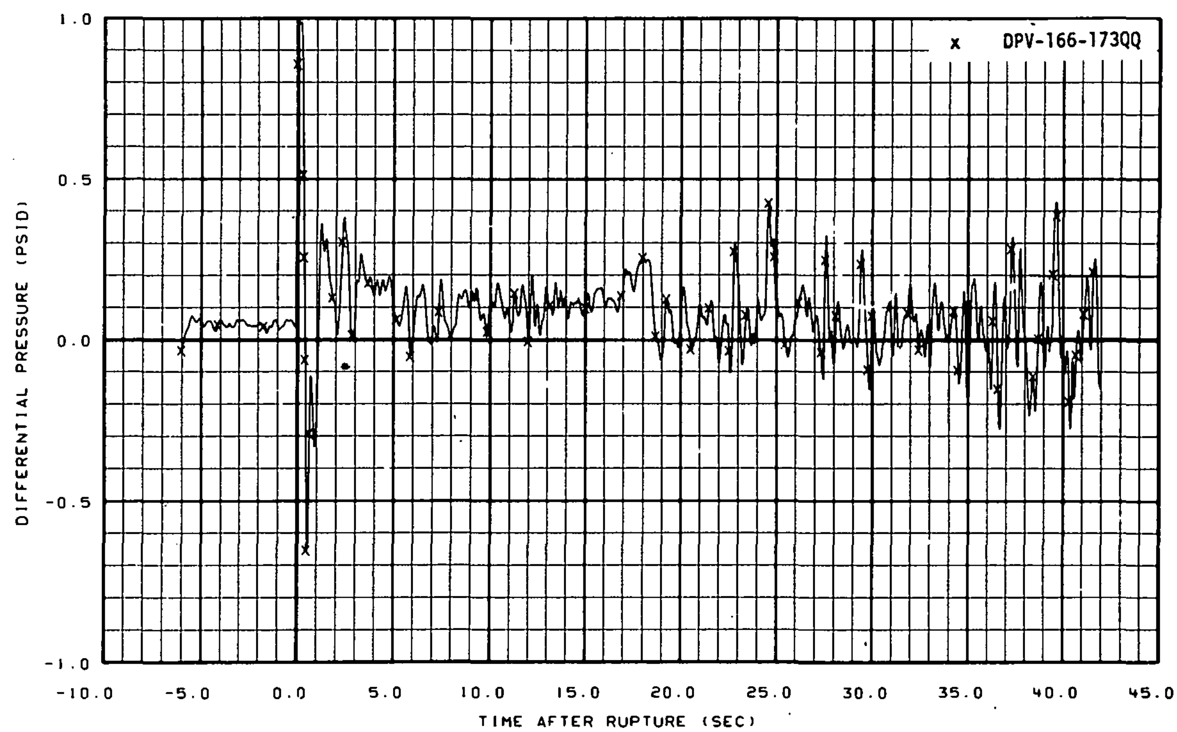

Fig. 202 Differential pressure in vessel (DPV-166-173QQ), from -6 to 42 seconds.

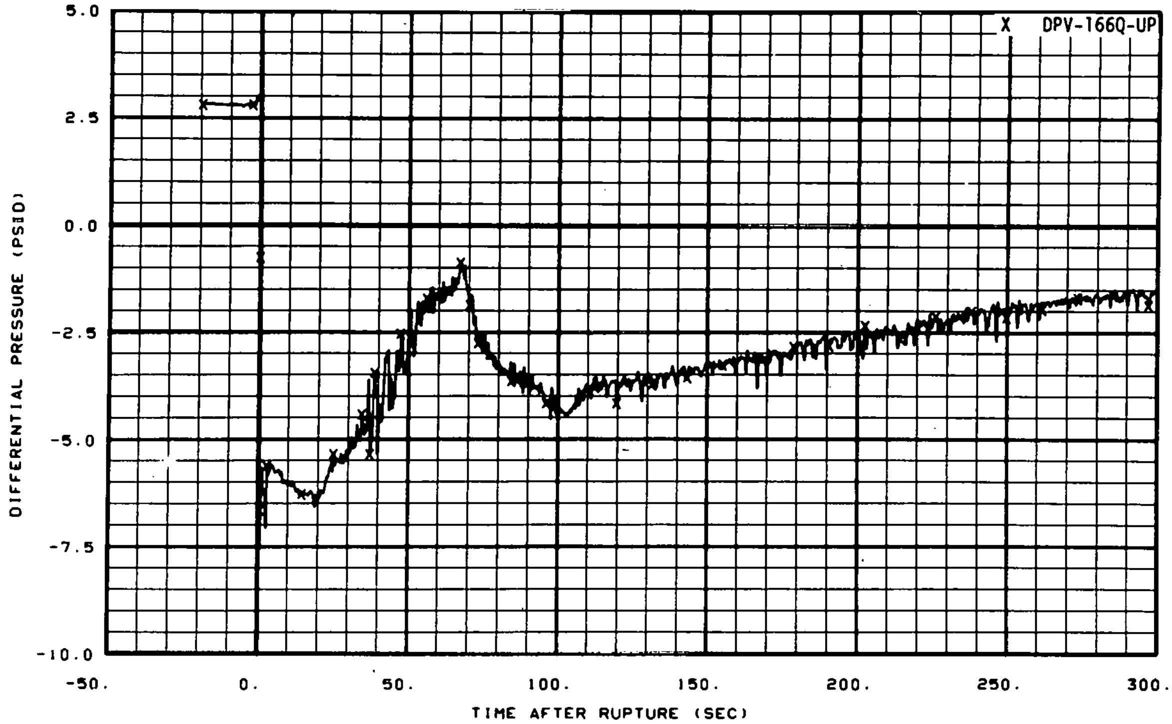

Fig. 203 Differential pressure in vessel (DPV-166Q-UP), from -20 to 300 seconds.

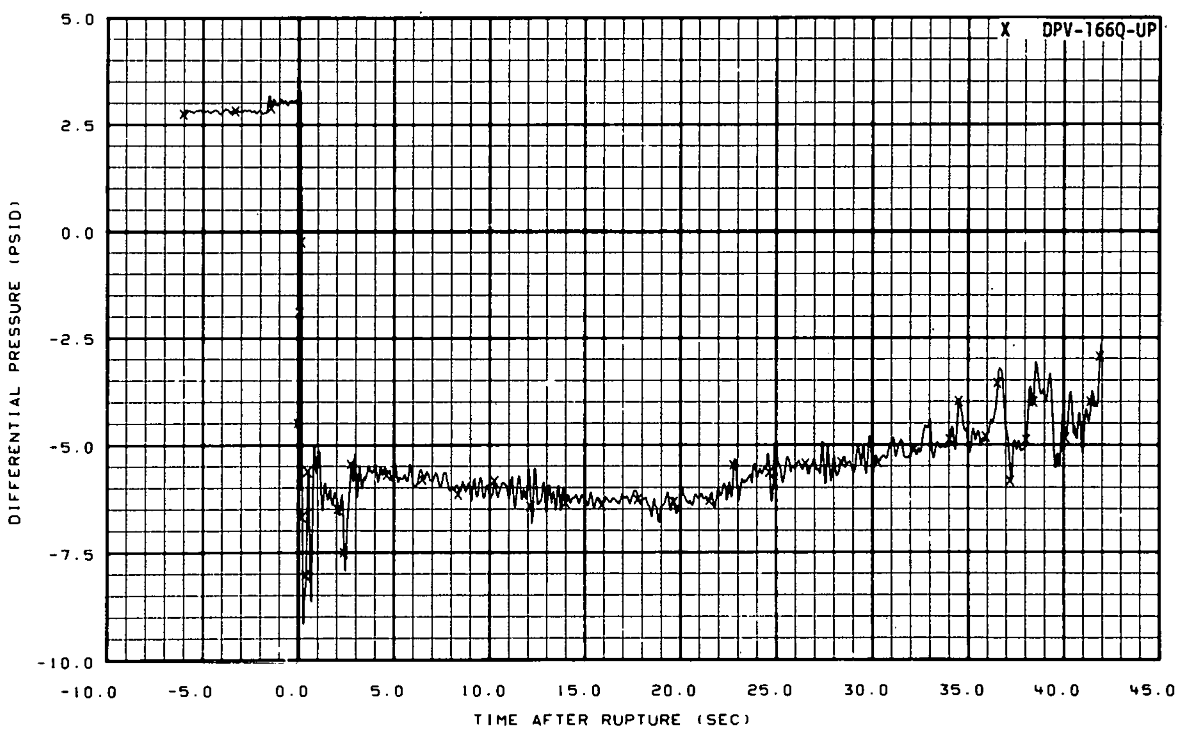

Fig. 204 Differential pressure in vessel (DPV-166Q-UP), from -6 to 42 seconds.

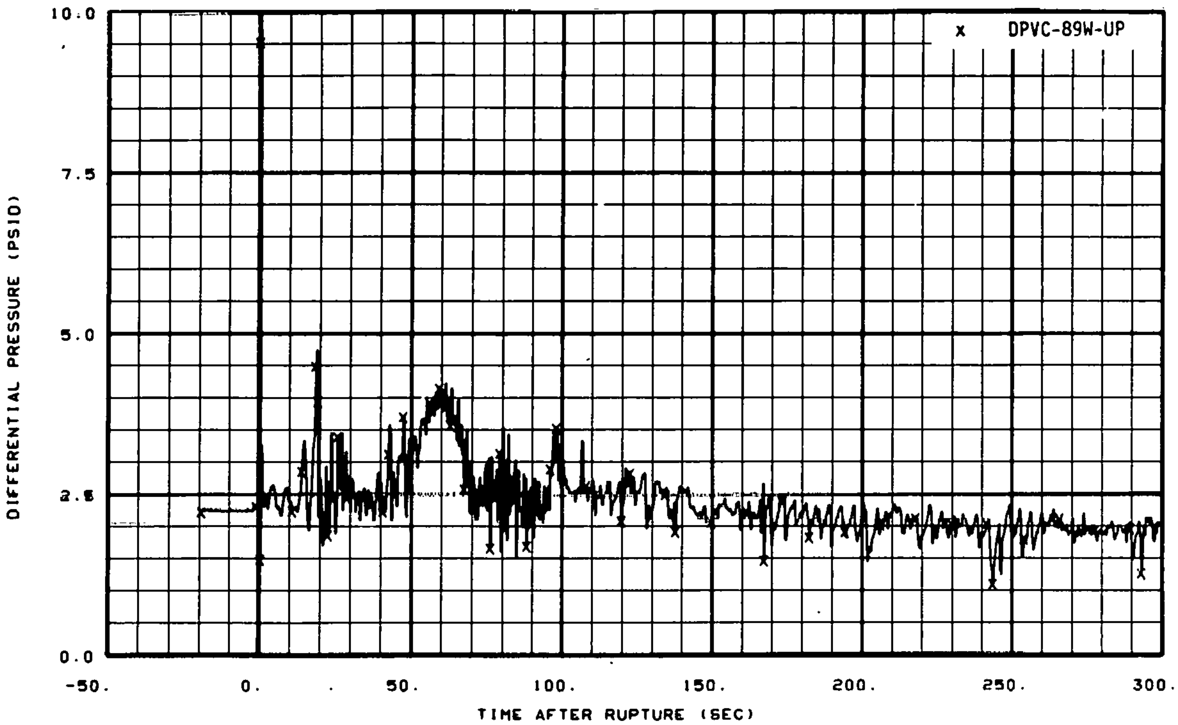

Fig. 205 Differential pressure in vessel core (DPVC-89W-UP), from -20 to 300 seconds.

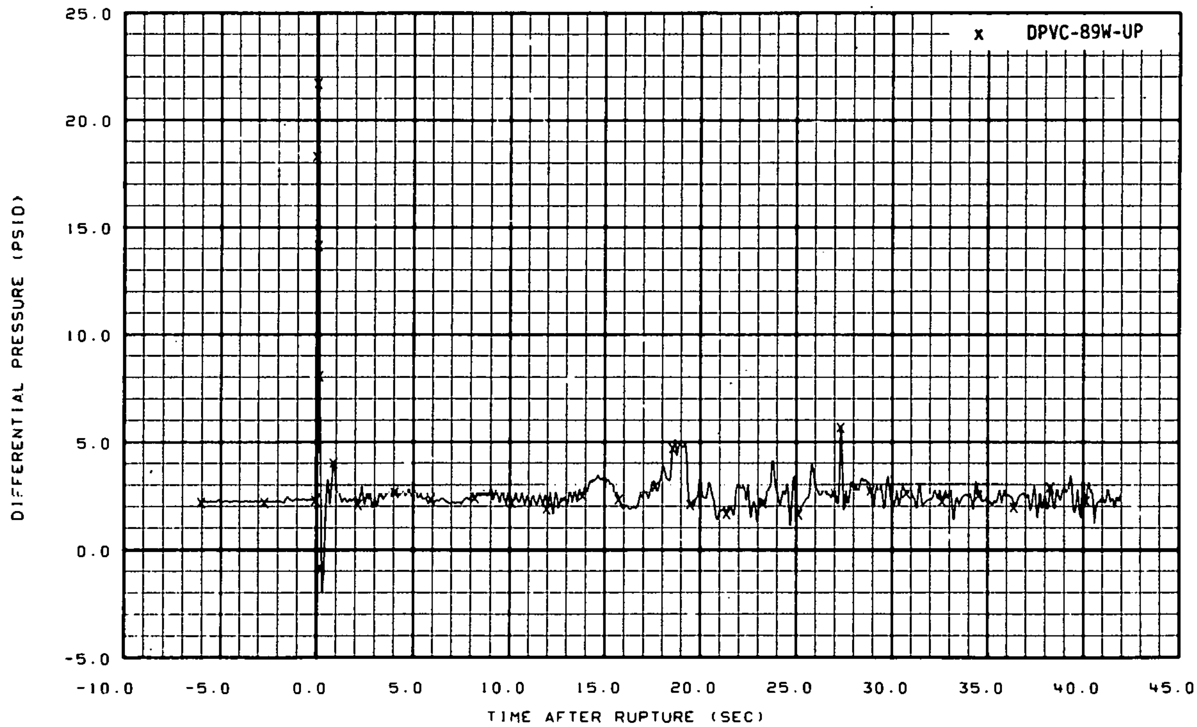

Fig. 206 Differential pressure in vessel core (DPVC-89W-UP), from -6 to 42 seconds.

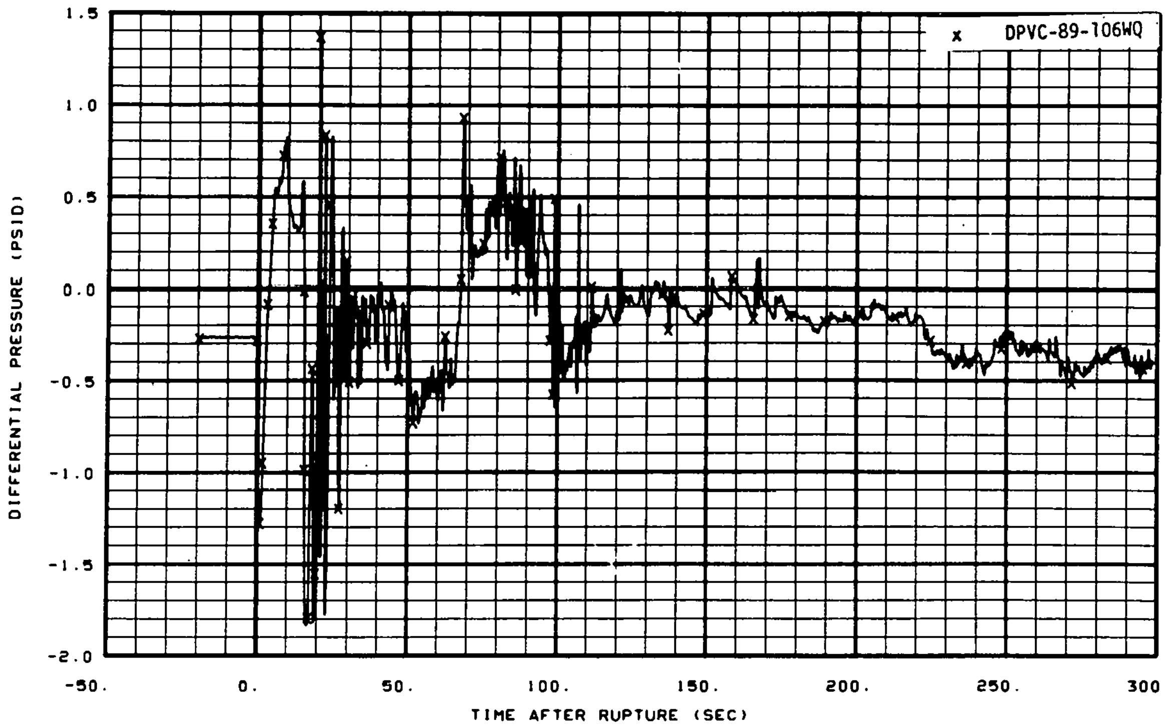

Fig. 207 Differential pressure in vessel core (DPVC-89-106WQ), from -20 to 300 seconds.

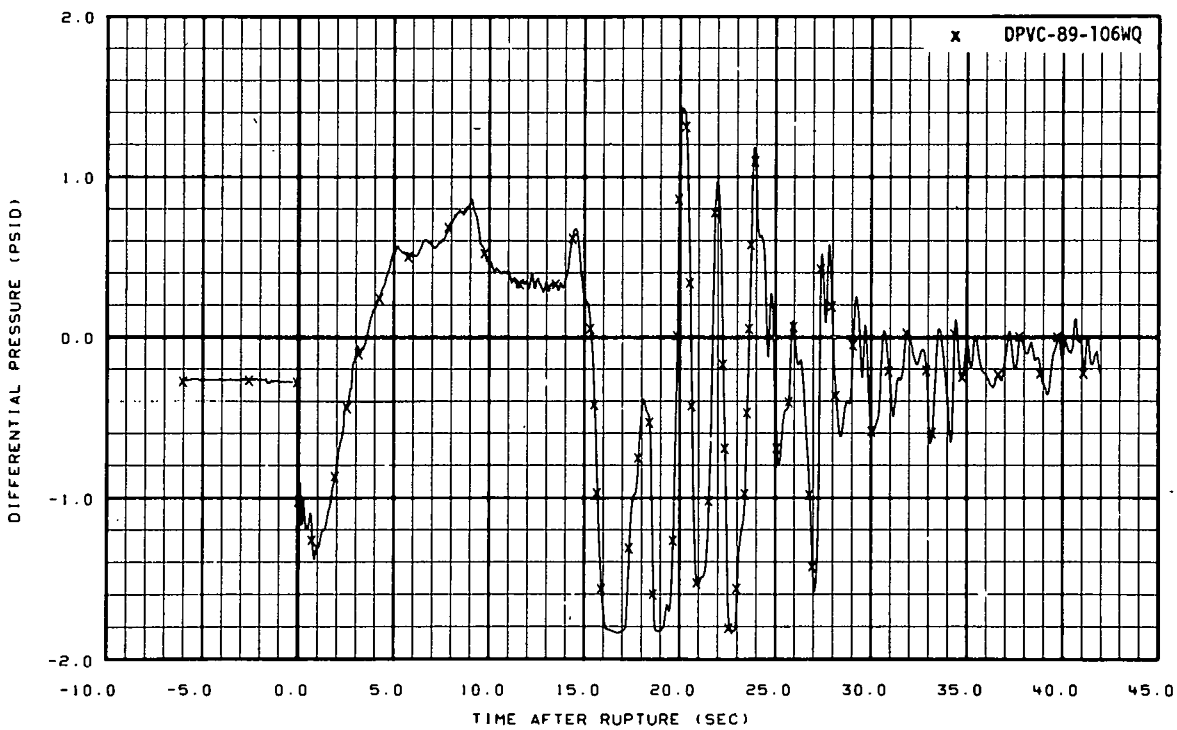

Fig. 208 Differential pressure in vessel core (DPVC-89-106WQ), from -6 to 42 seconds.

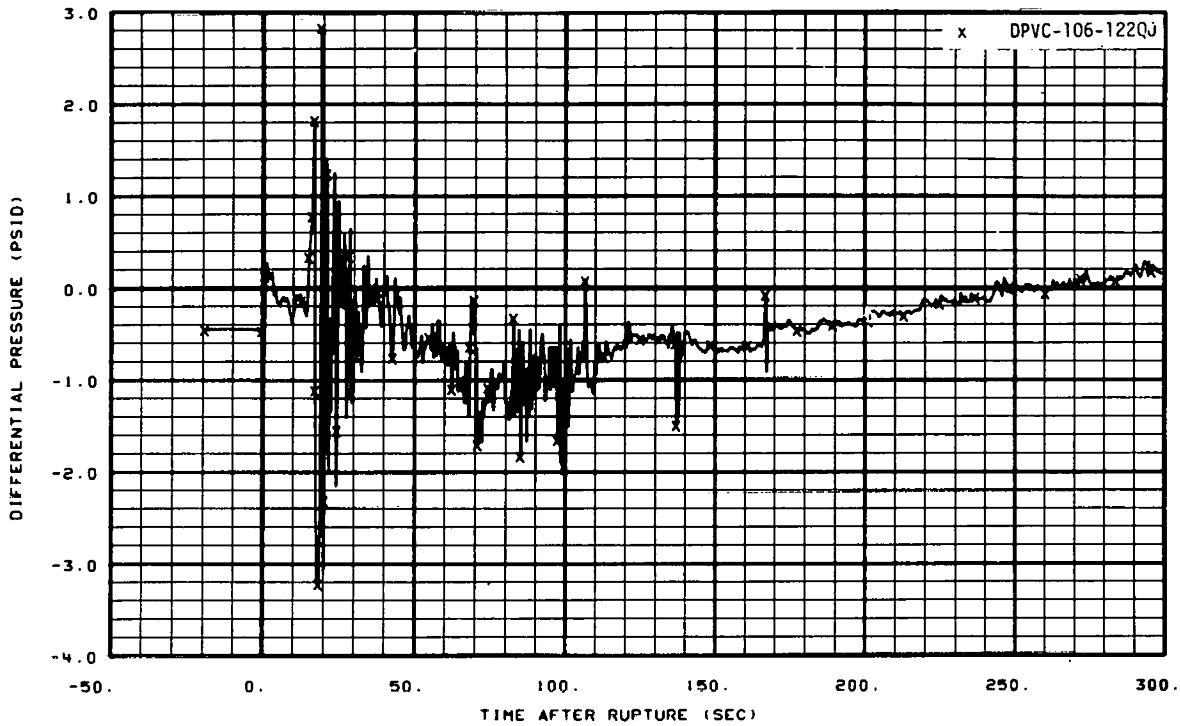

Fig. 209 Differential pressure in vessel core (DPVC-106-122QJ), from -20 to 300 seconds.

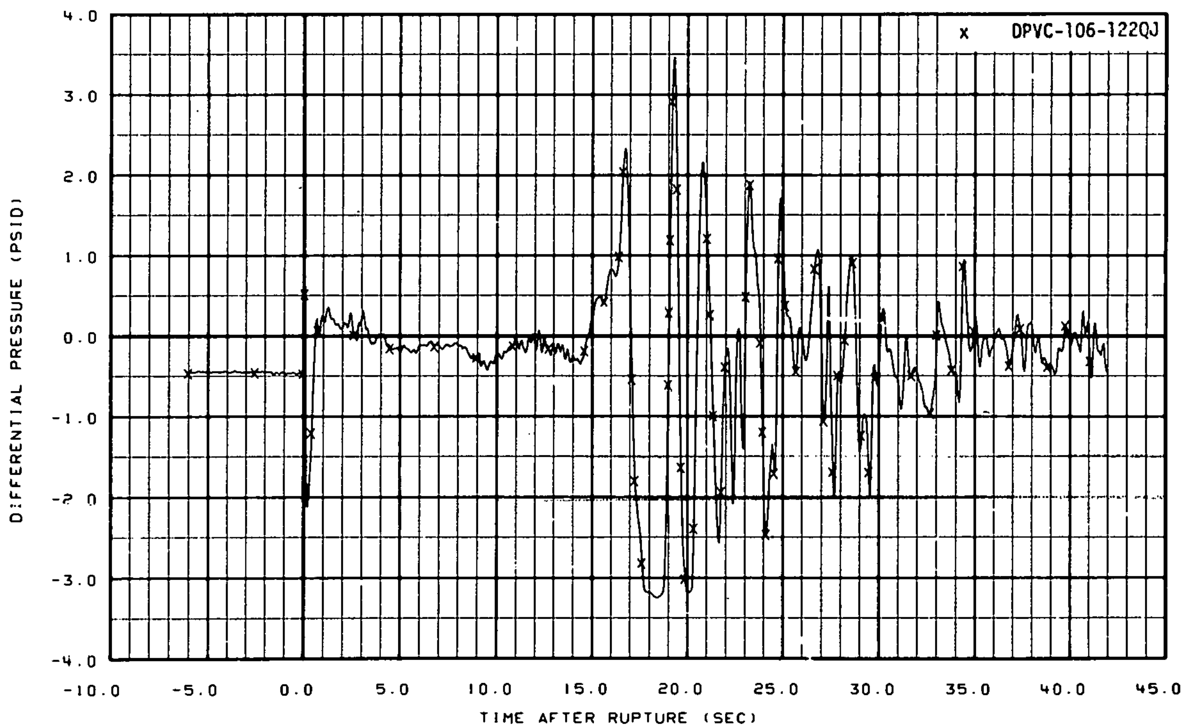

Fig. 210 Differential pressure in vessel core (DPVC-106-122QJ), from -6 to 42 seconds.

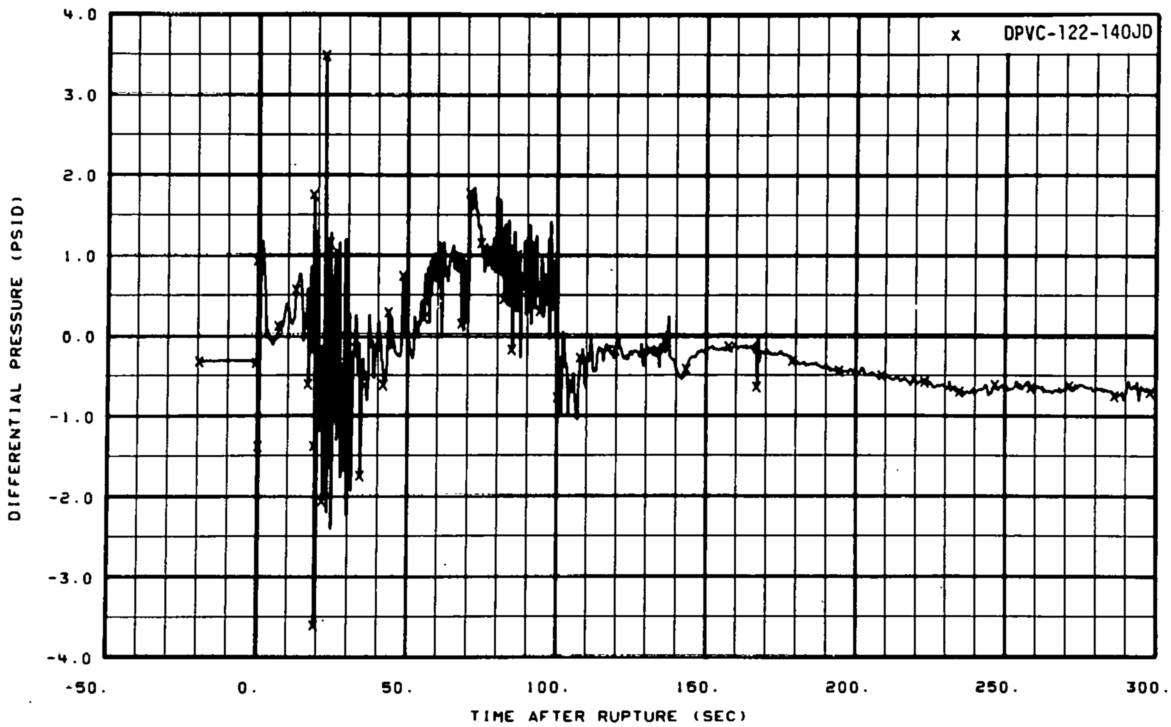

Fig. 211 Differential pressure in vessel core (DPVC-122-140JD), from -20 to 300 seconds.

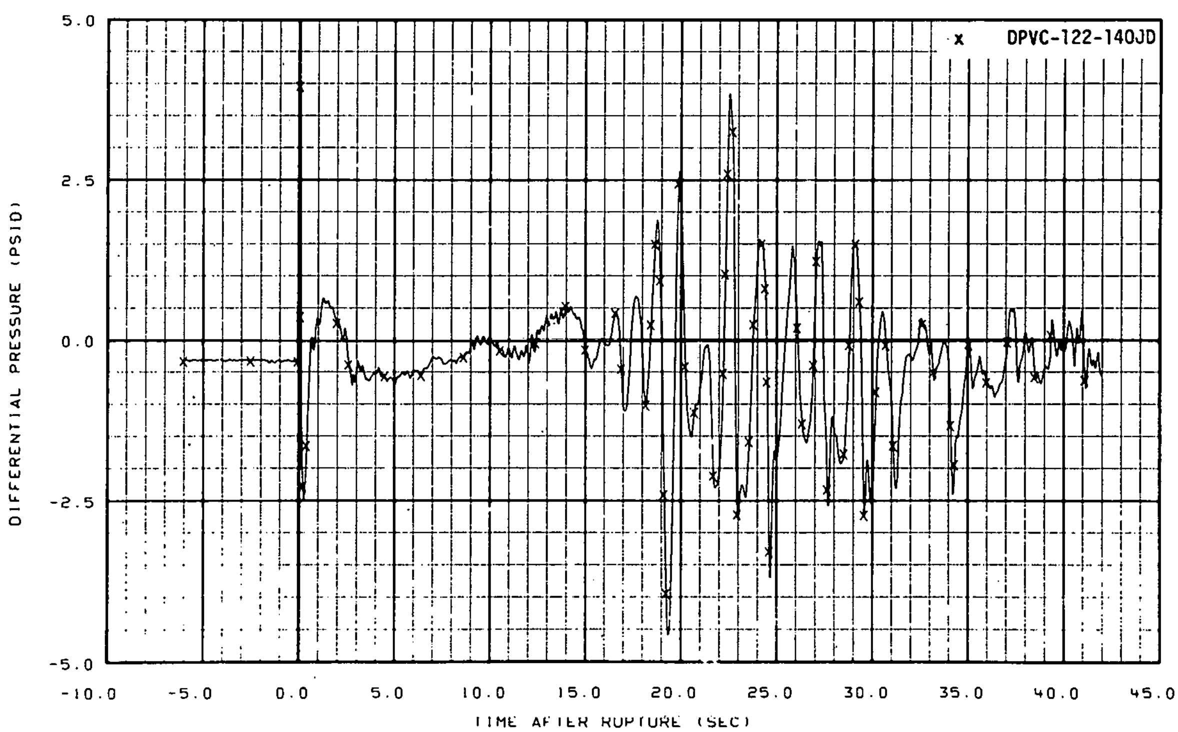

Fig. 212 Differential pressure in vessel core (DPVC-122-140JD), from -6 to 42 seconds.

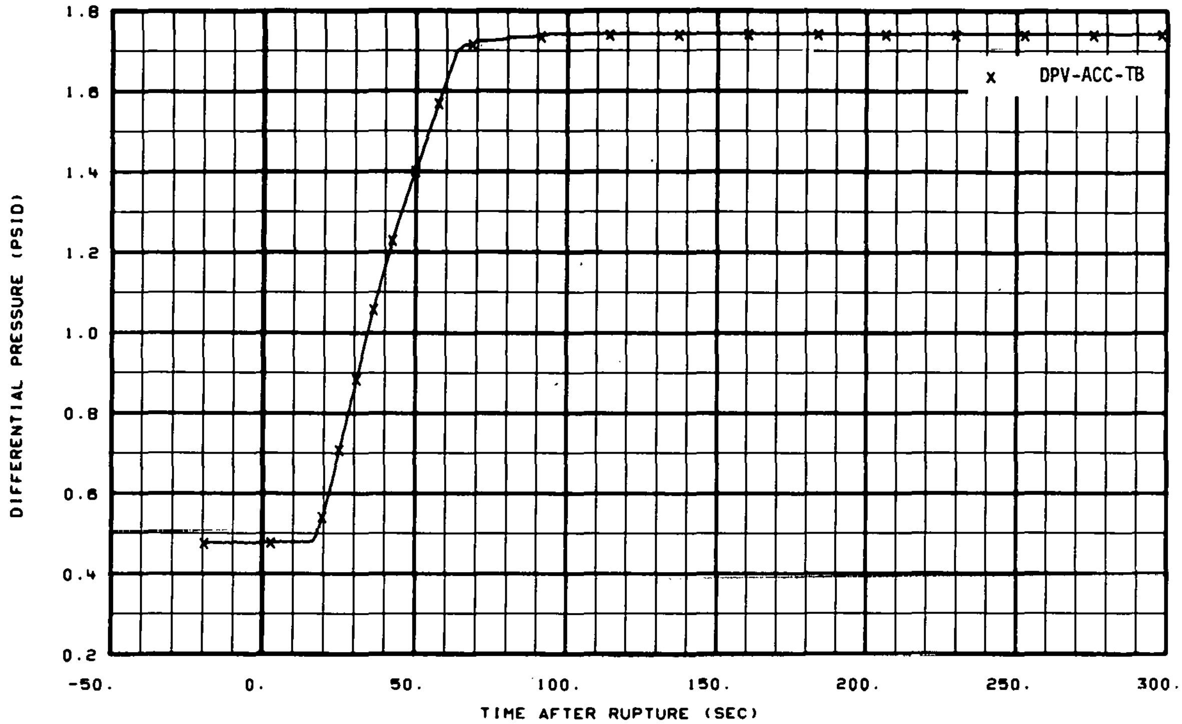

Fig. 213 Differential pressure in vessel accumulator (DPV-ACC-TB), from -20 to 300 seconds.

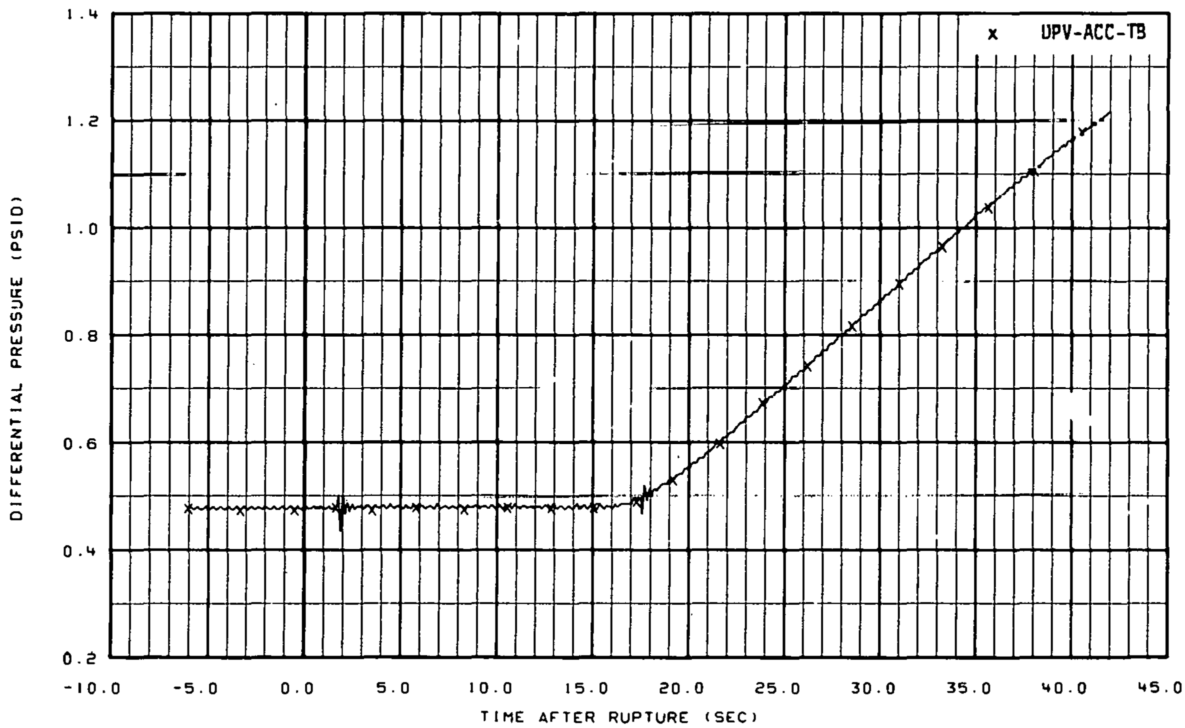

Fig. 214 Differential pressure in vessel accumulator (DPV-ACC-TB), from -6 to 42 seconds.

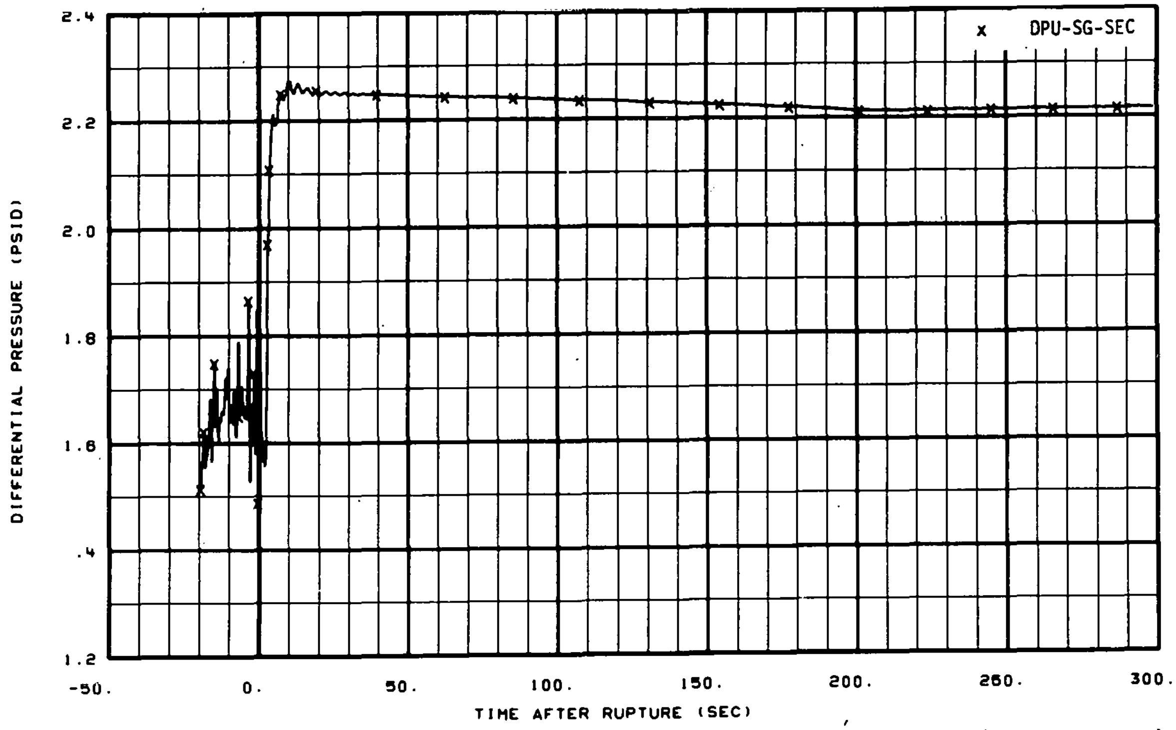

Fig. 215 Differential pressure in steam generator secondary (DPU-SG-SEC), from -20 to 300 seconds.

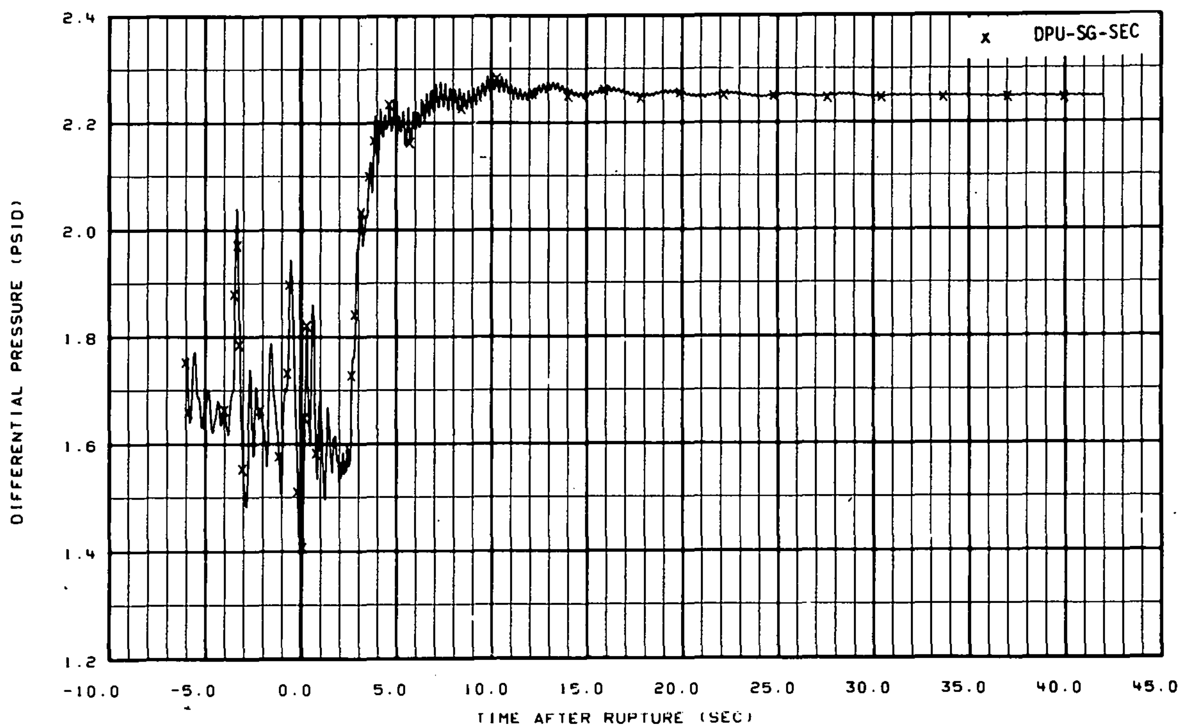

Fig. 216 Differential pressure in steam generator secondary (DPU-SG-SEC), from -6 to 42 seconds.

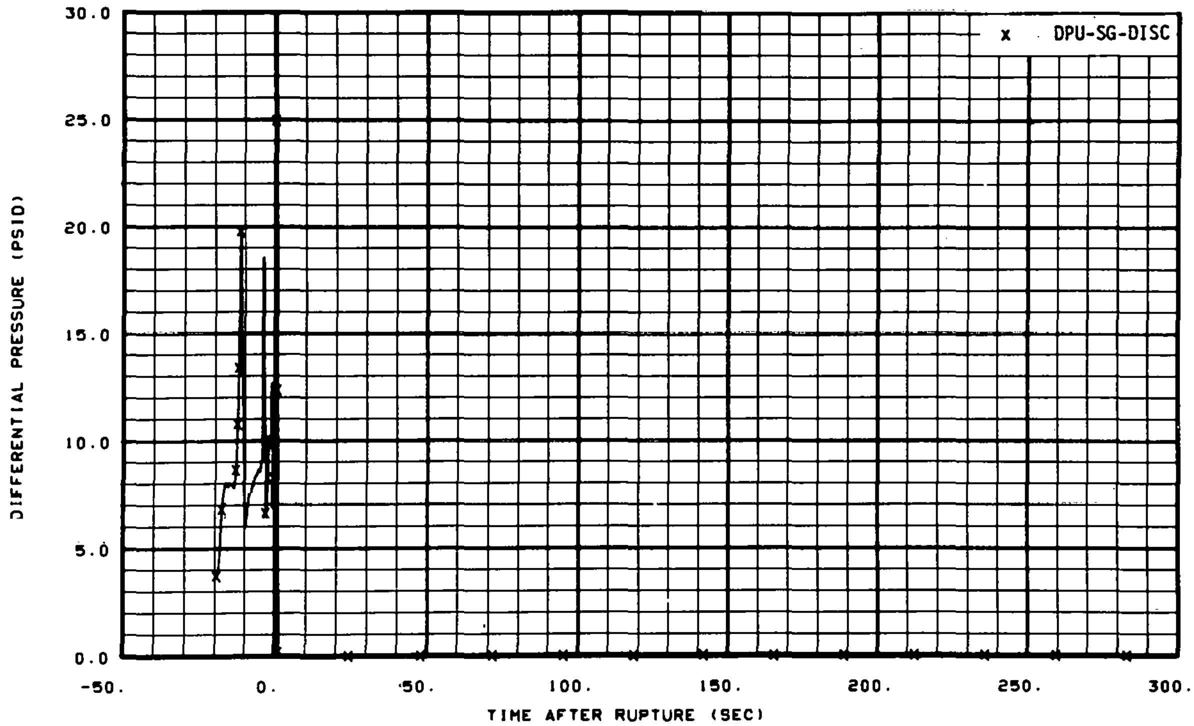

Fig. 217 Differential pressure across steam generator outlet orifice (DPU-SG-DISC), from -20 to 300 seconds.

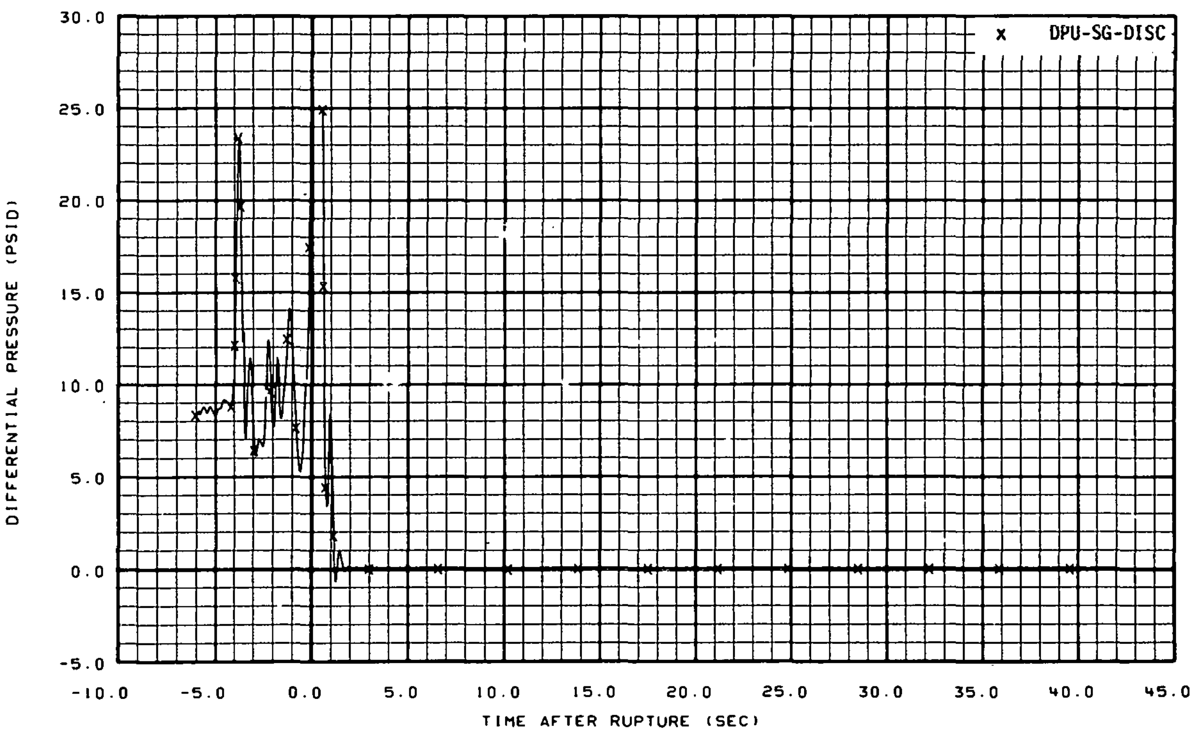

Fig. 218 Differential pressure across steam generator outlet orifice (DPU-SG-DISC), from -6 to 42 seconds.

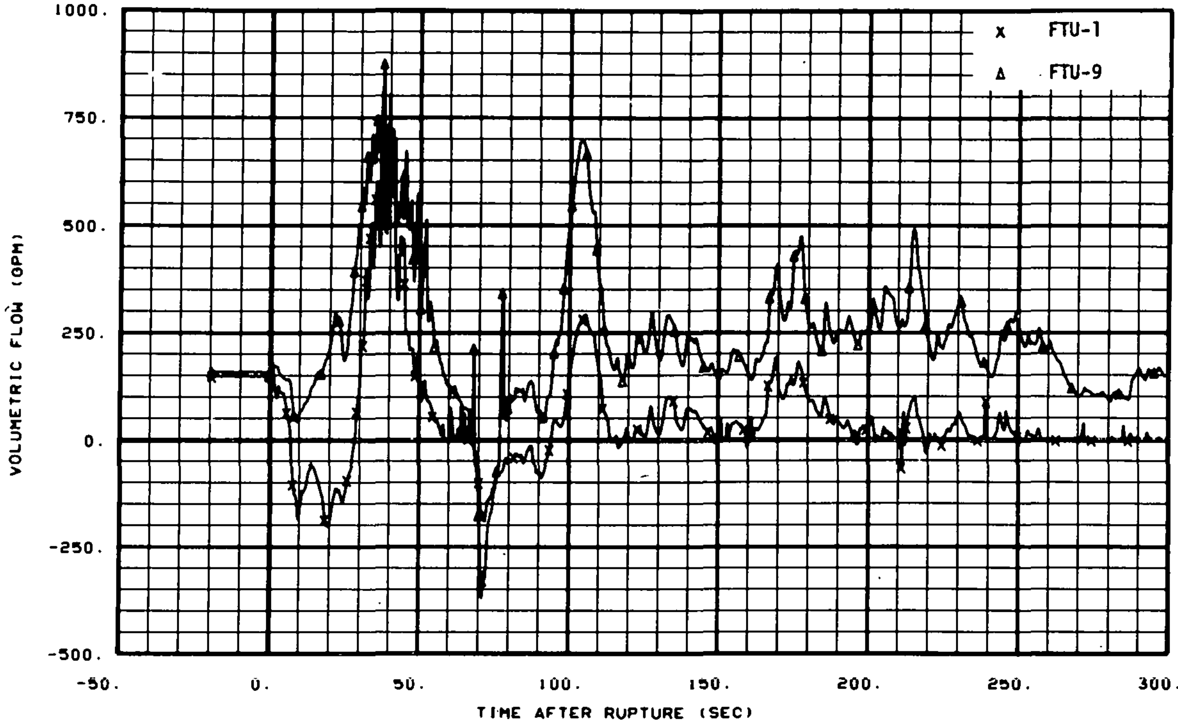

Fig. 219 Volumetric flow in intact loop (FTU-1 and FTU-9), from -20 to 300 seconds.

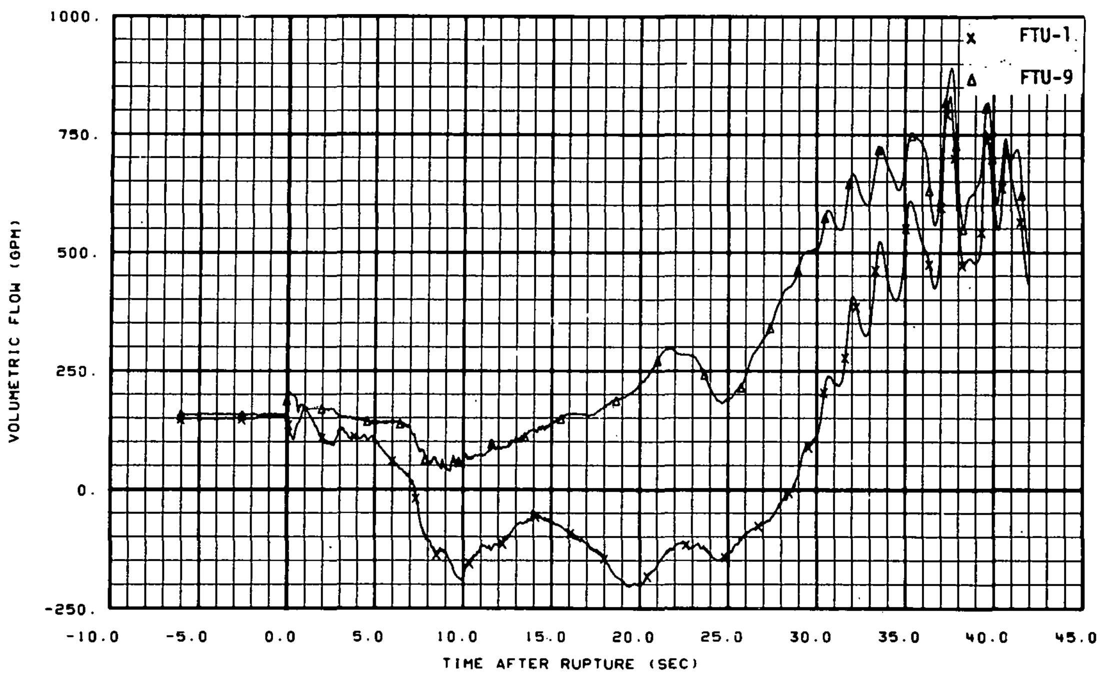

Fig. 220 Volumetric flow in intact loop (FTU-1 and FTU-9), from -6 to 42 seconds.

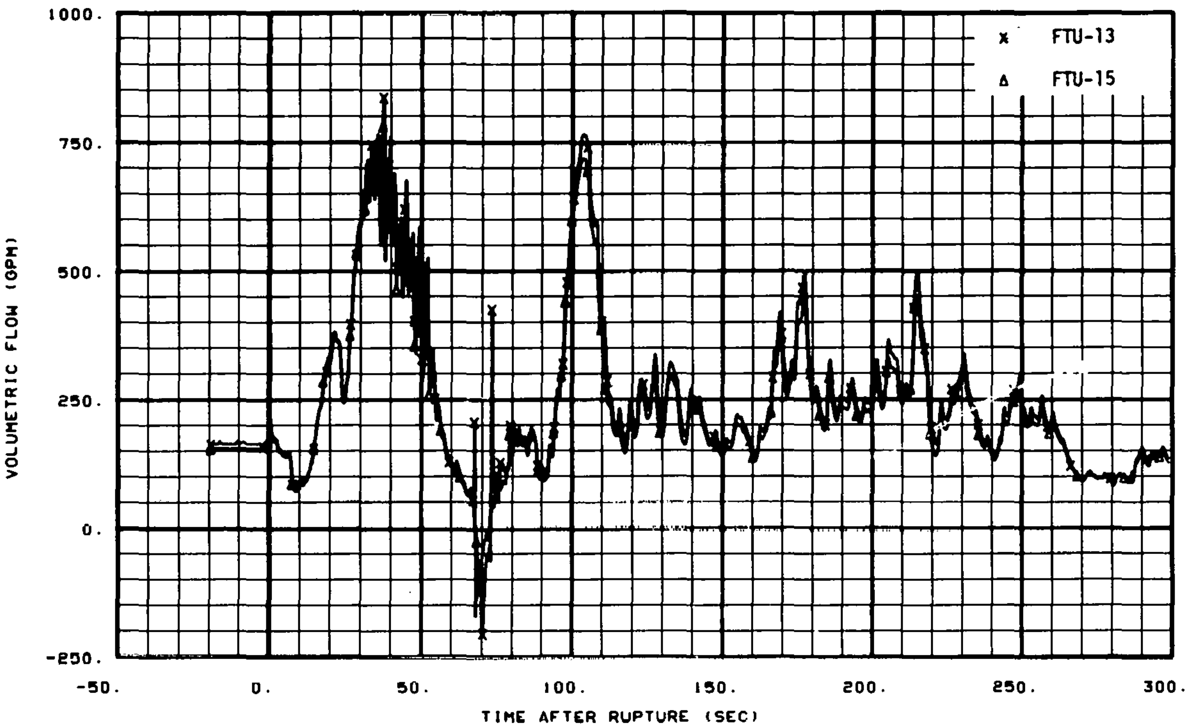

Fig. 221 Volumetric flow in intact loop (FTU-13 and FTU-15), from -20 to 300 seconds.

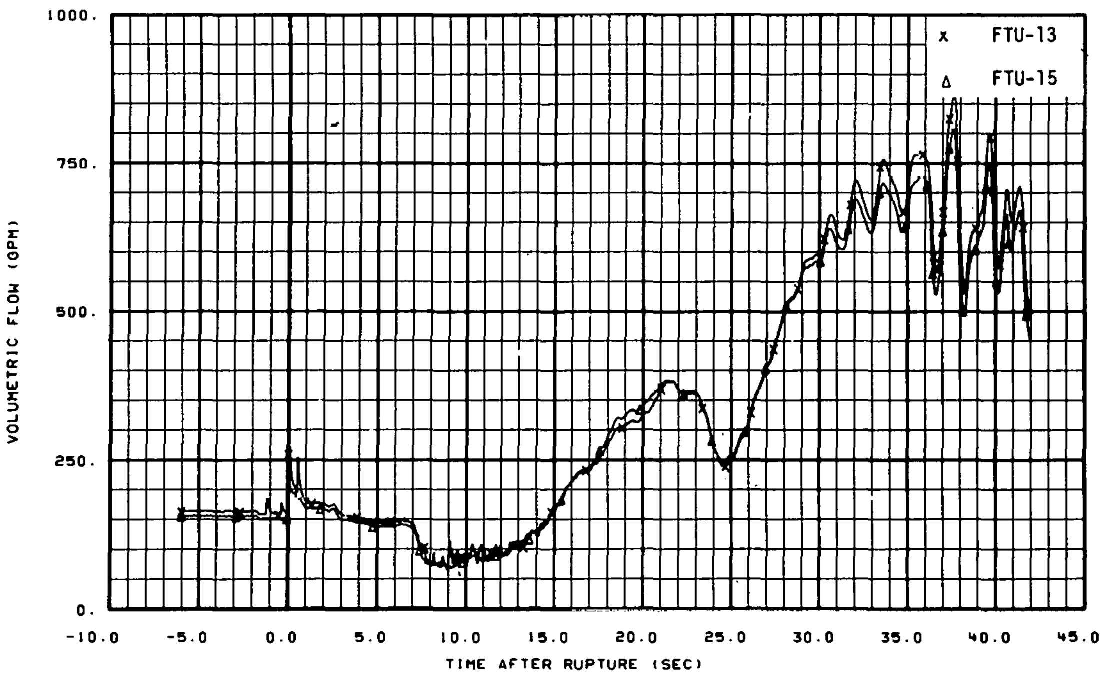

Fig. 222 Volumetric flow in intact loop (FTU-13 and FTU-15), from -6 to 42 seconds.

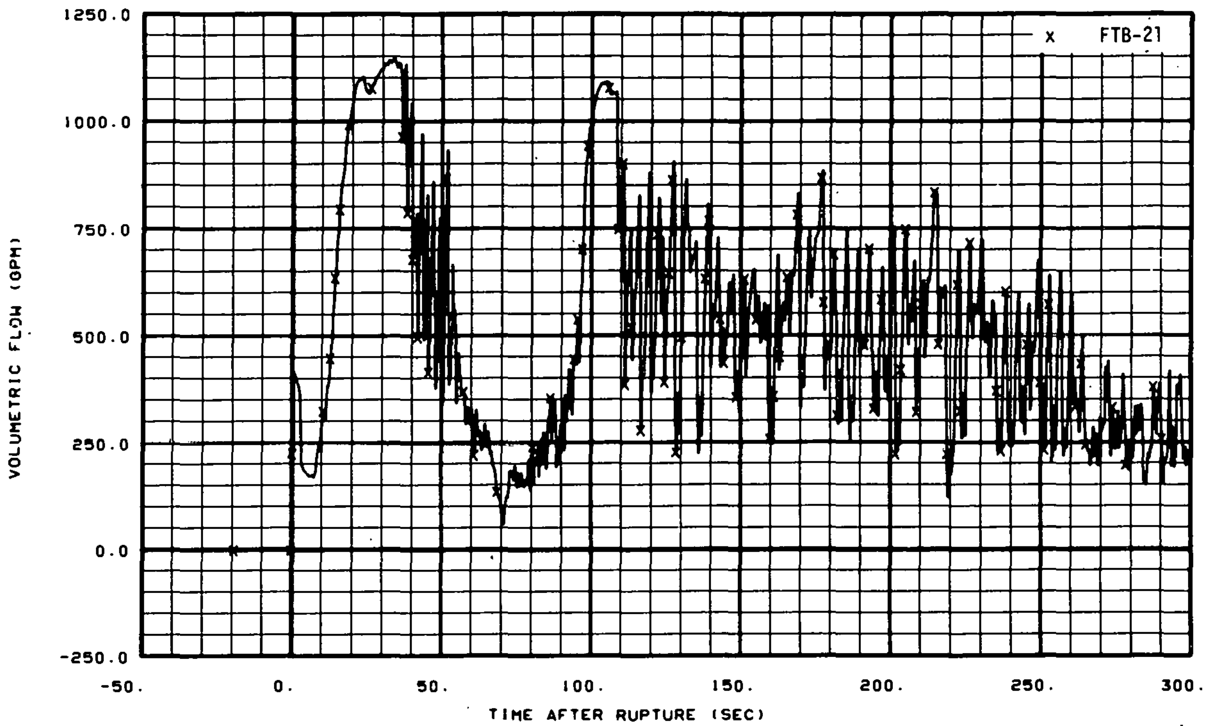

Fig. 223 Volumetric flow in broken loop (FTB-21), from -20 to 300 seconds.

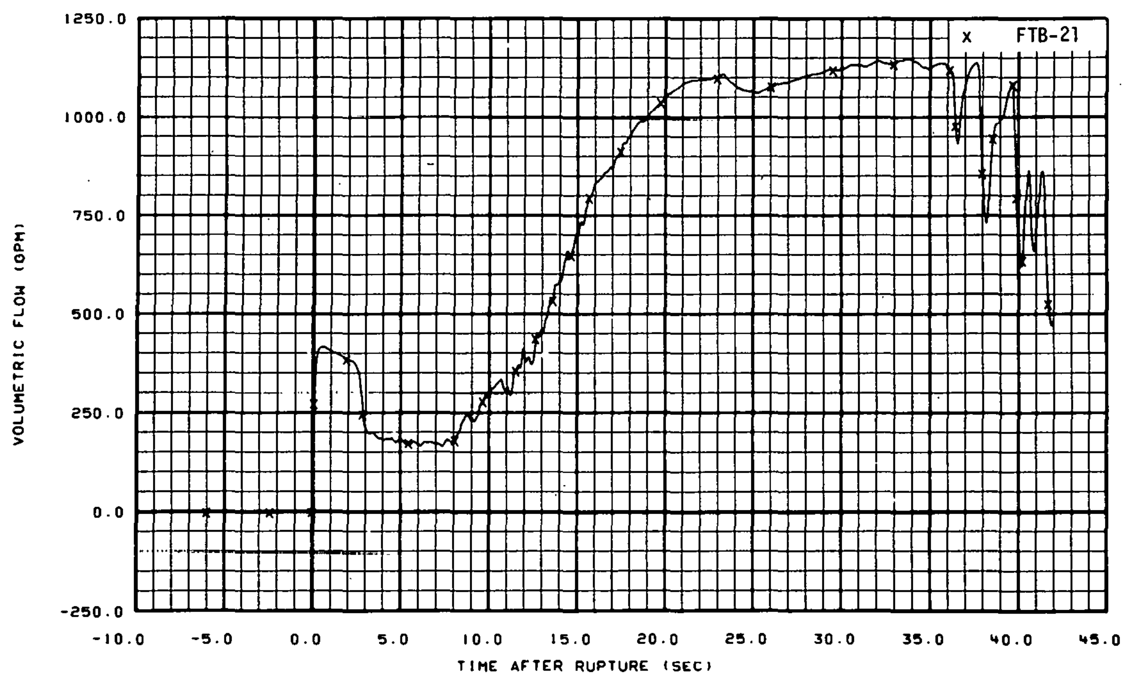

Fig. 224 Volumetric flow in broken loop (FTB-21), from -6 to 42 seconds.

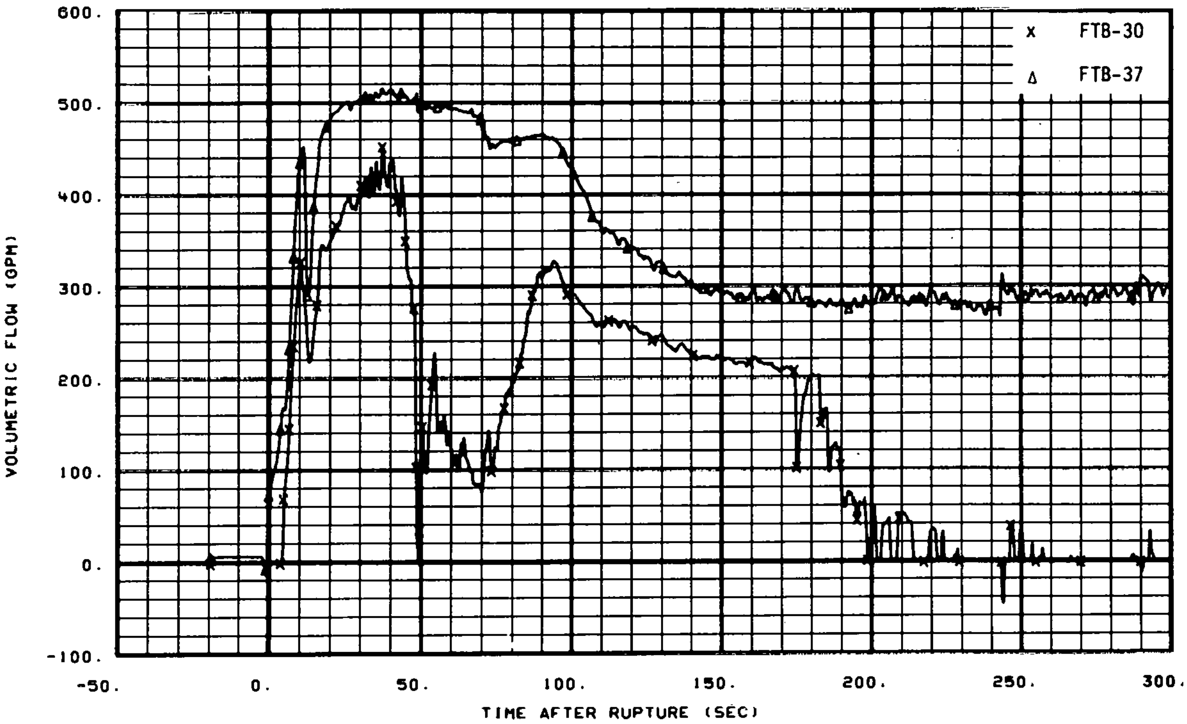

Fig. 225 Volumetric flow in broken loop (FTB-30 and FTB-37), from -20 to 300 seconds.

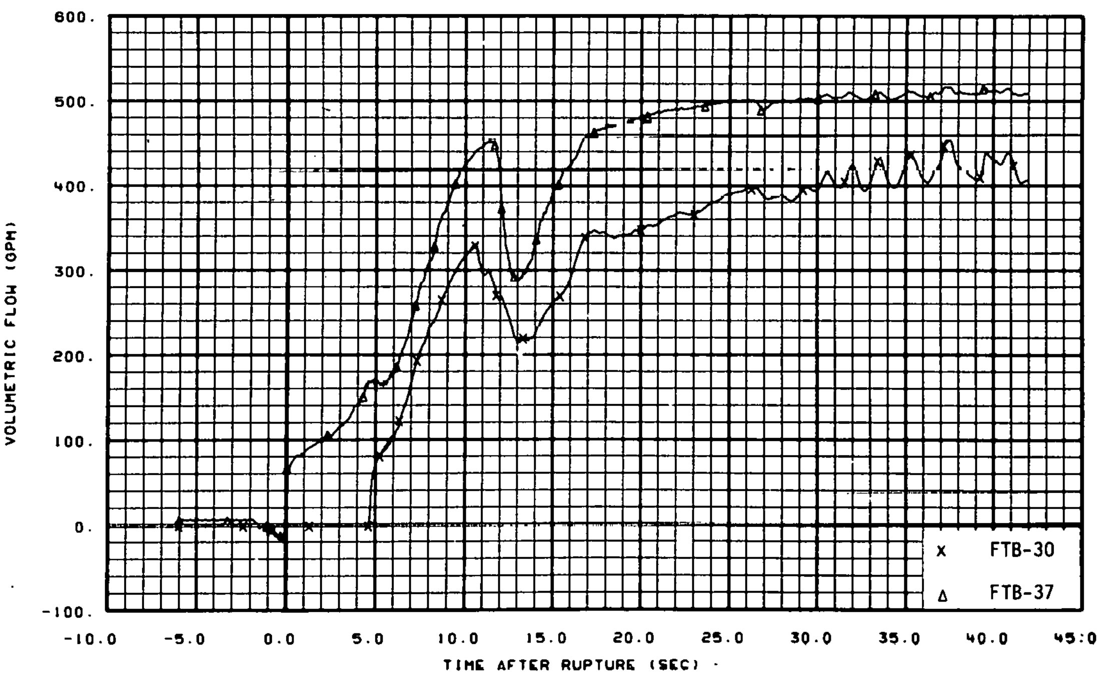

Fig. 226 Volumetric flow in broken loop (FTB-30 and FTB-37), from -6 to 42 seconds.

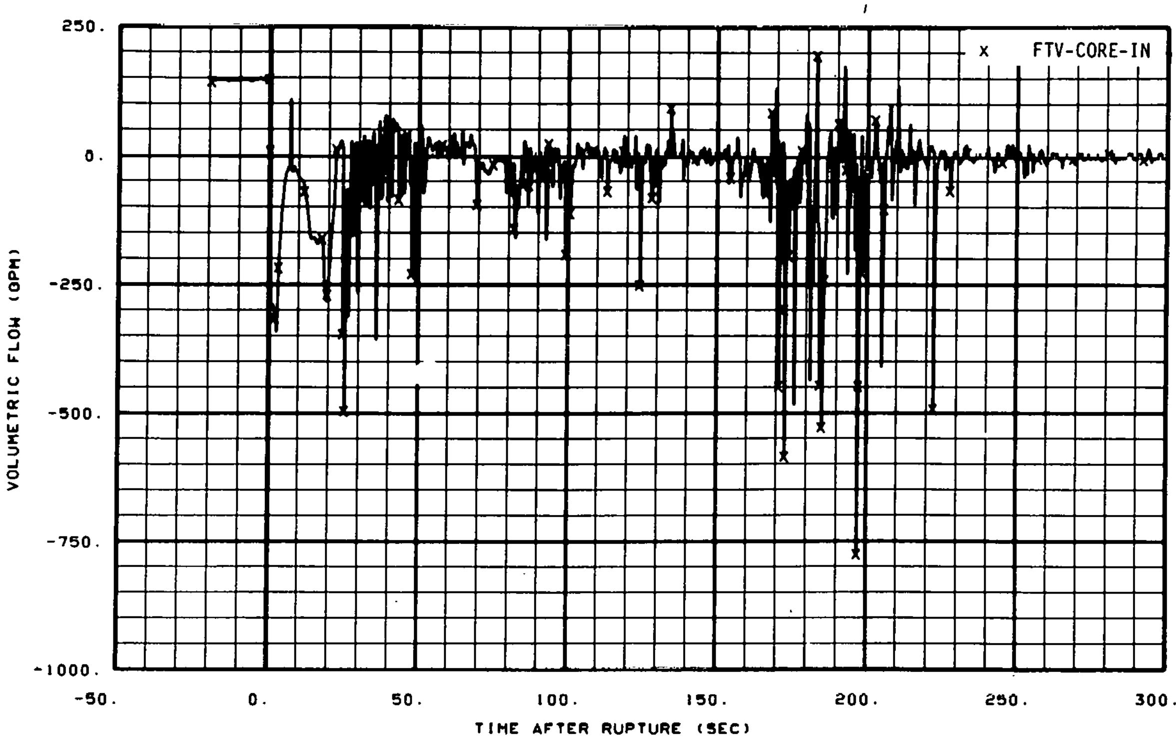

Fig. 227 Volumetric flow in core entrance (FTV-CORE-IN), from -20 to 300 seconds.

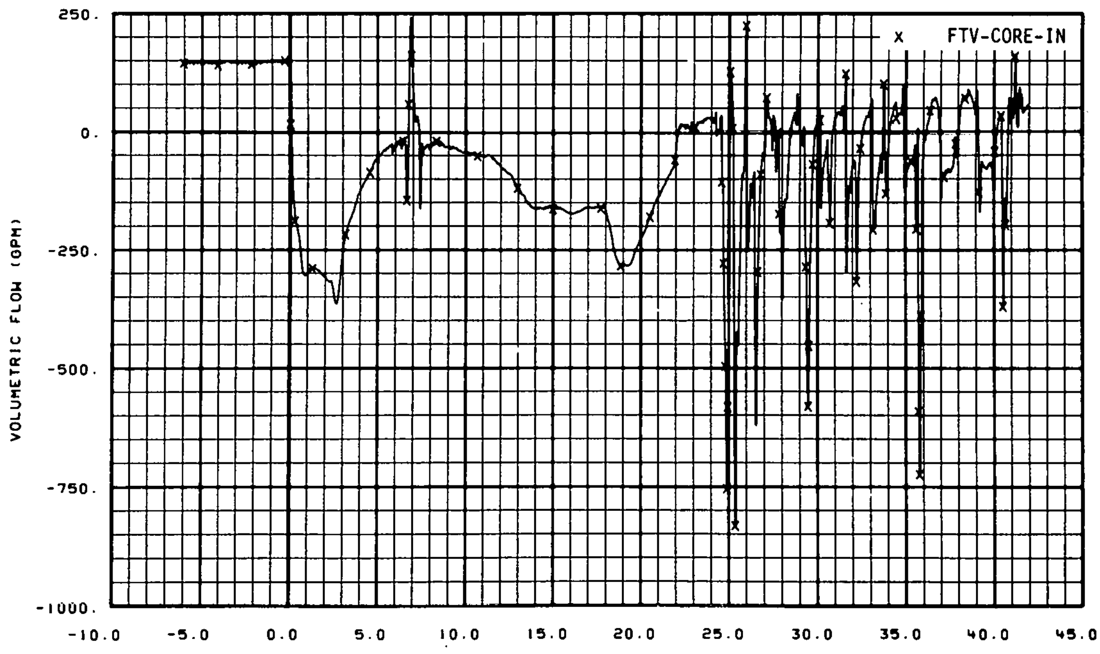

Fig. 228 Volumetric flow in core entrance (FTV-CORE-IN), from -6 to 42 seconds.

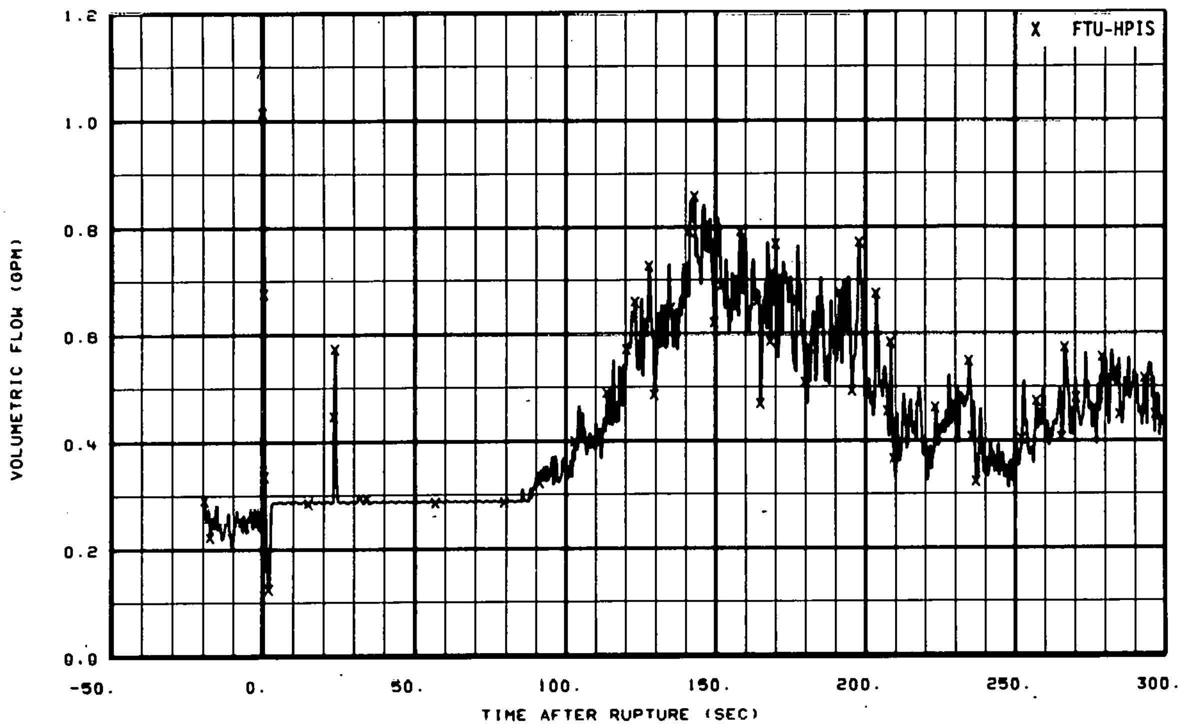

Fig. 229 Volumetric flow in intact loop high pressure injection line, to vessel (FTU-HPIS), from -20 to 300 seconds.

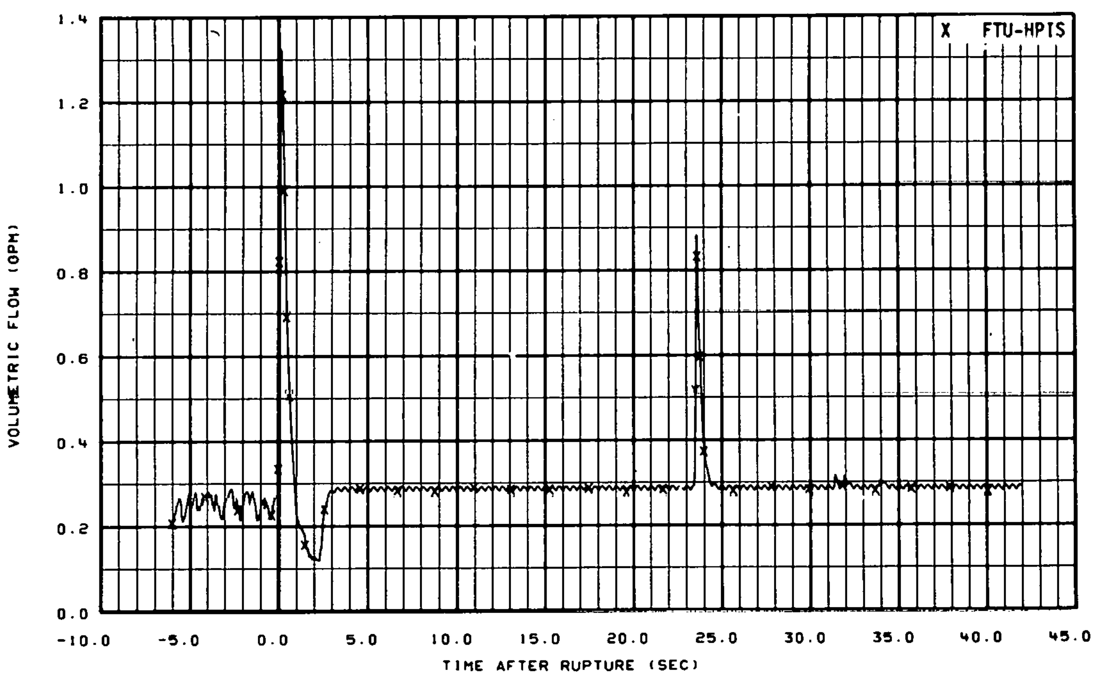

Fig. 230 Volumetric flow in intact loop high pressure injection line, to vessel (FTU-HPIS), from -6 to 42 seocnds.

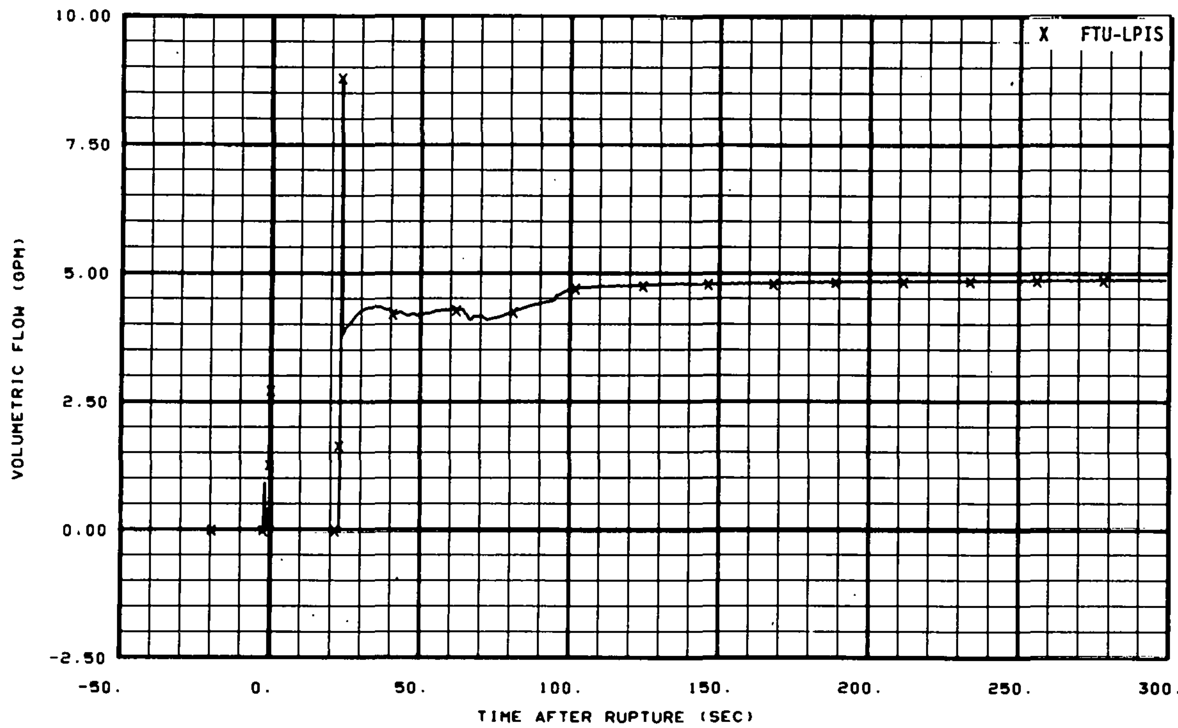

Fig. 231 Volumetric flow in intact loop low pressure injection line, to vessel (FTU-LPIS), from -20 to 300 seconds

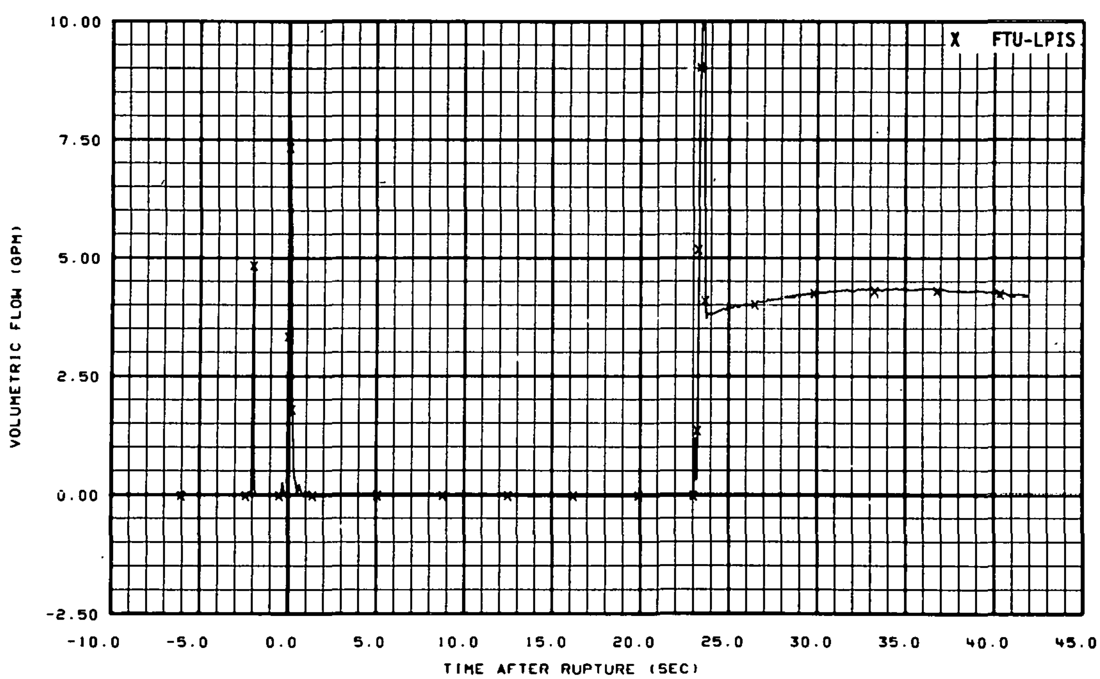

Fig. 232 Volumetric flow in intact loop low pressure injection line, to vessel (FTU-LPIS), from -6 to 42 seconds.

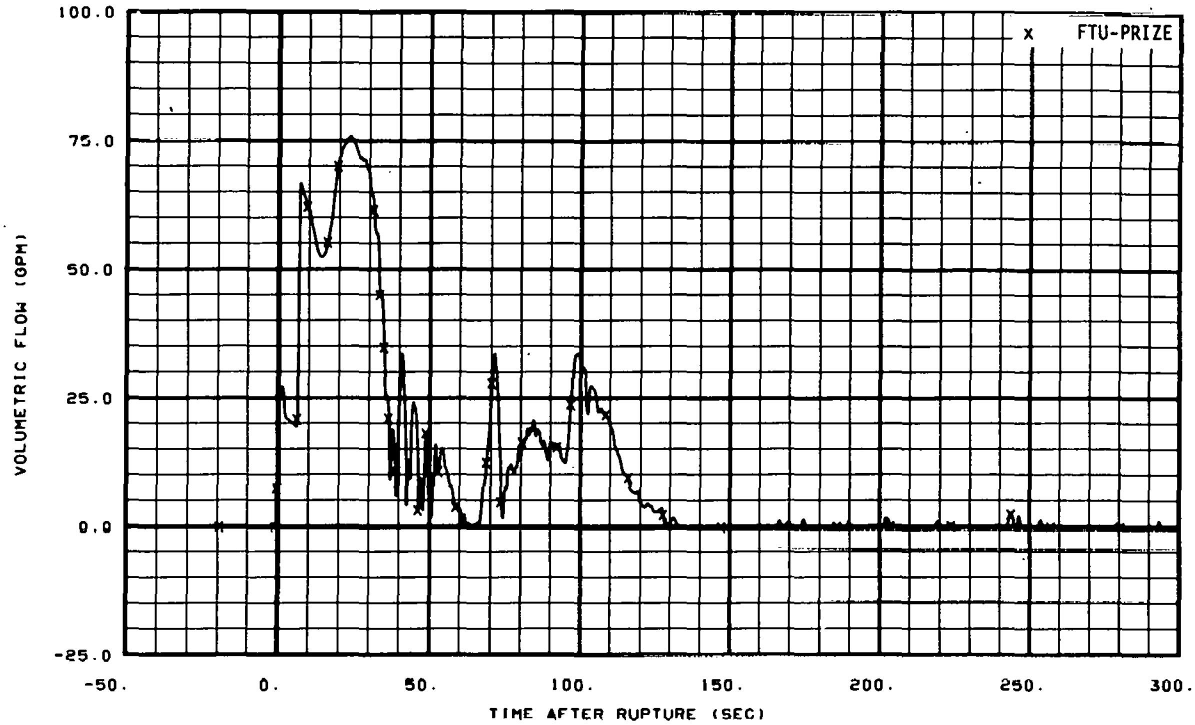

Fig. 233 Volumetric flow from pressurizer (FTU-PRIZE), from -20 to 300 seconds.

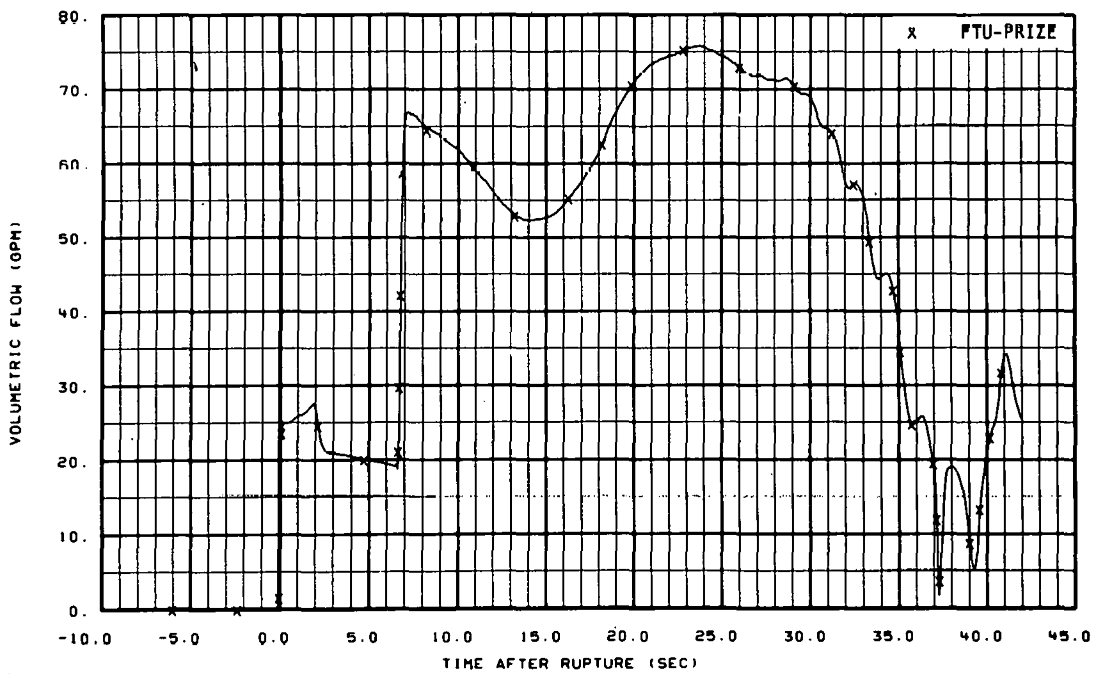

Fig. 234 Volumetric flow from pressurizer (FTU-PRIZE), from -6 to 42 seconds.

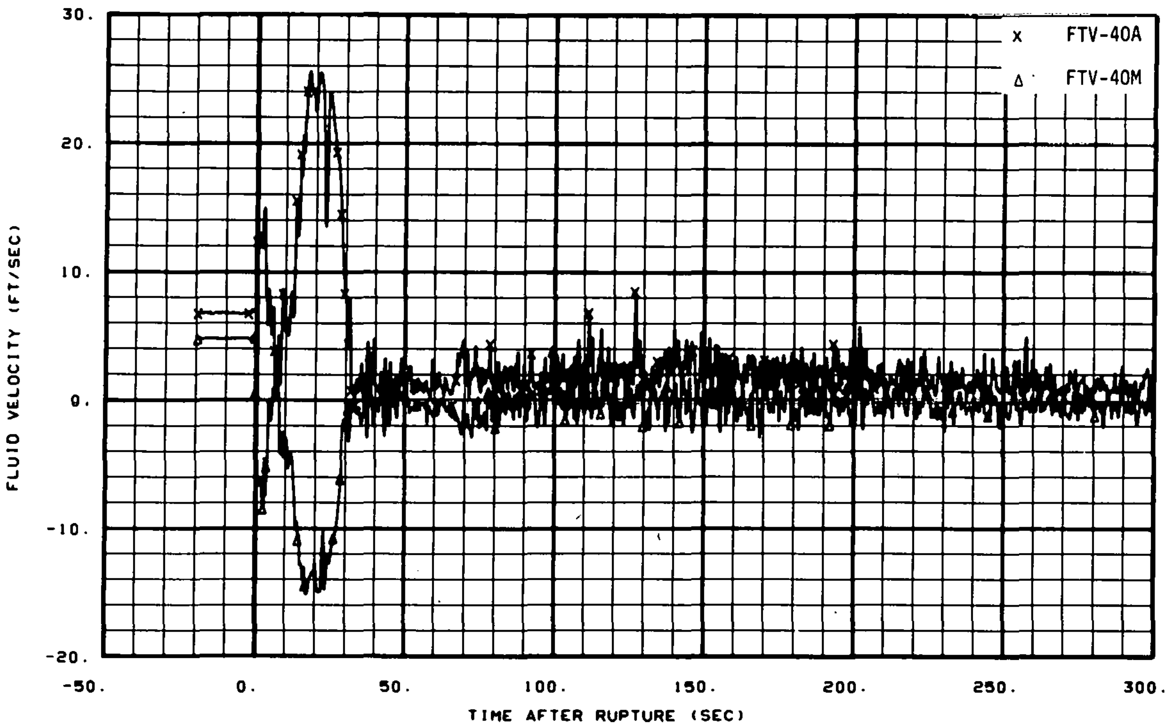

Fig. 235 Fluid velocity in vessel (FTV-40A and FTV-40M), from -20 to 300 seconds.

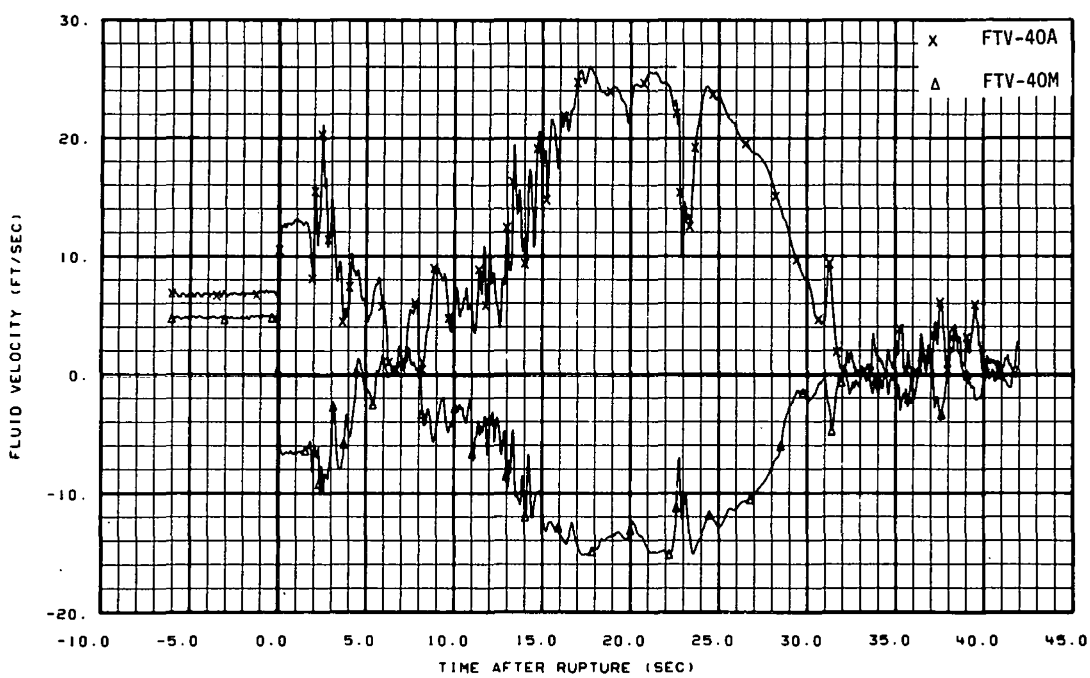

Fig. 236 Fluid velocity in vessel (FTV-40A and FTV-40M), from -6 to 42 seconds.

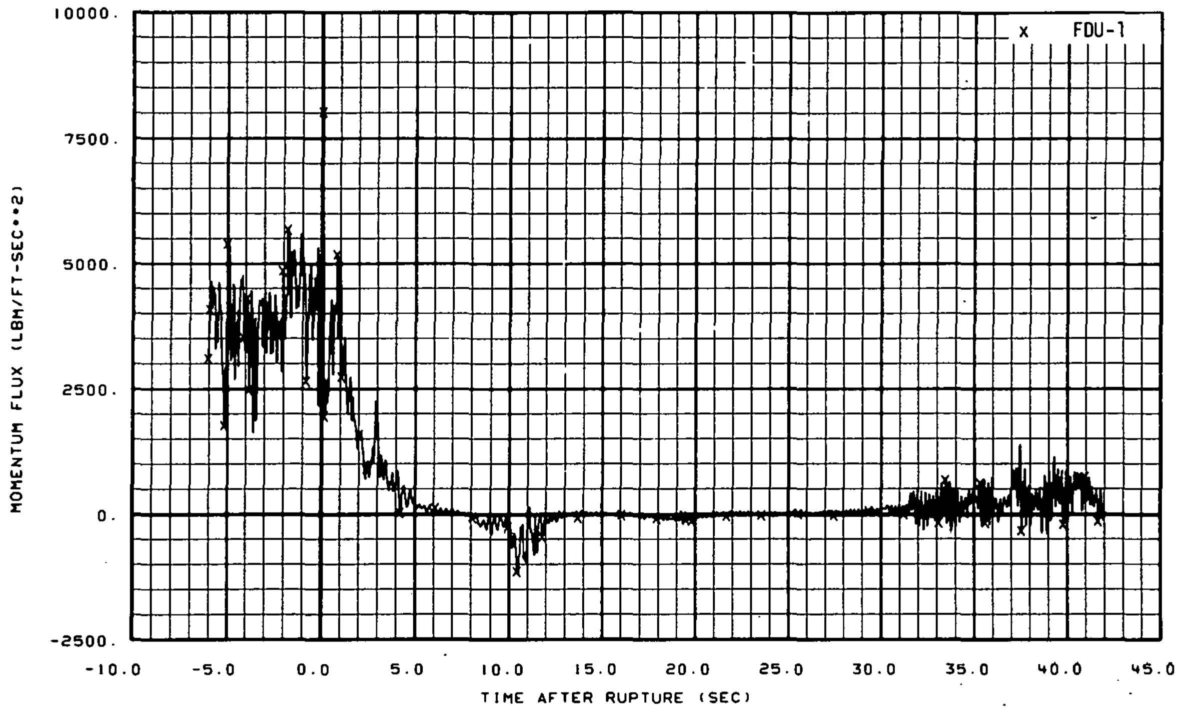

Fig. 237 Momentum flux in intact loop (FDU-1), from -6 to 42 seconds.

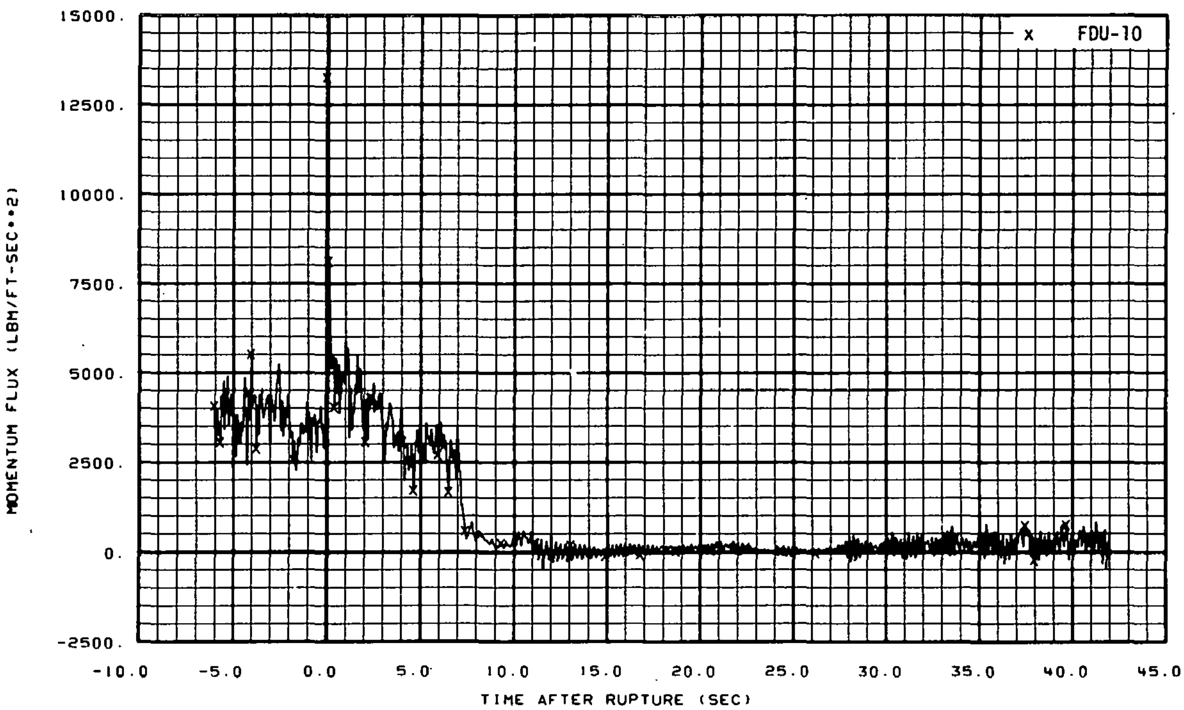

Fig. 238 Momentum flux in intact loop (FDU-10), from -6 to 42 seconds.

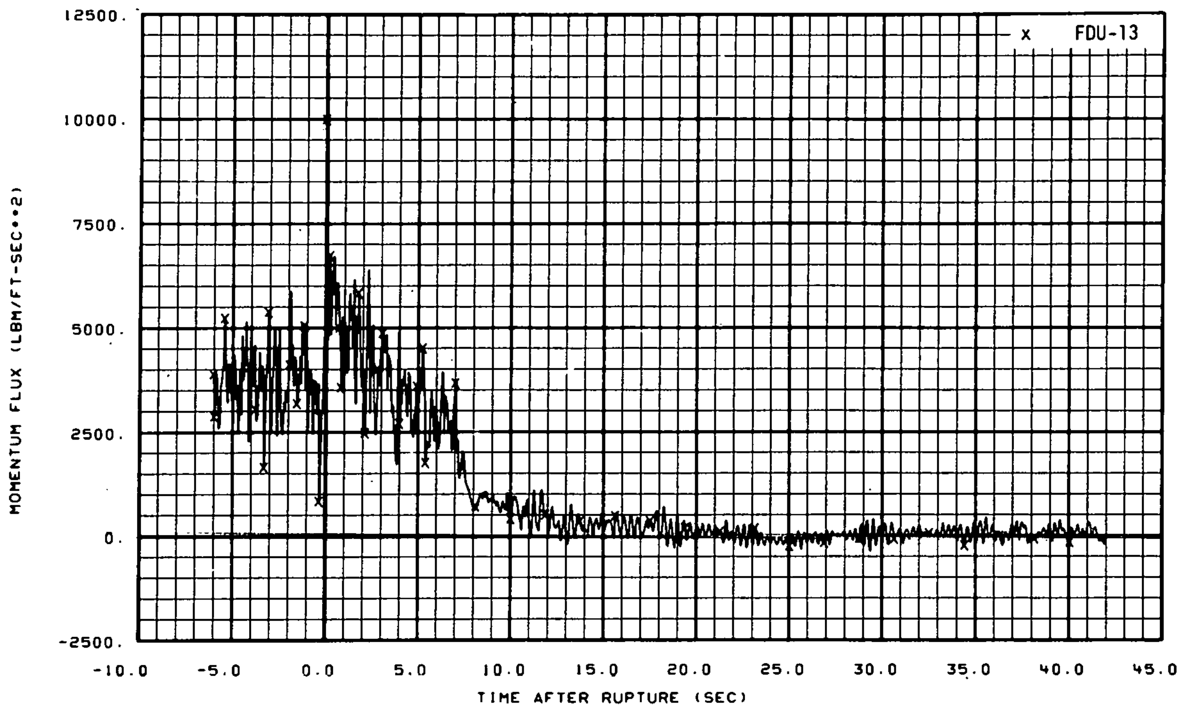

Fig. 239 Momentum flux in intact loop (FDU-13), from -6 to 42 seconds.

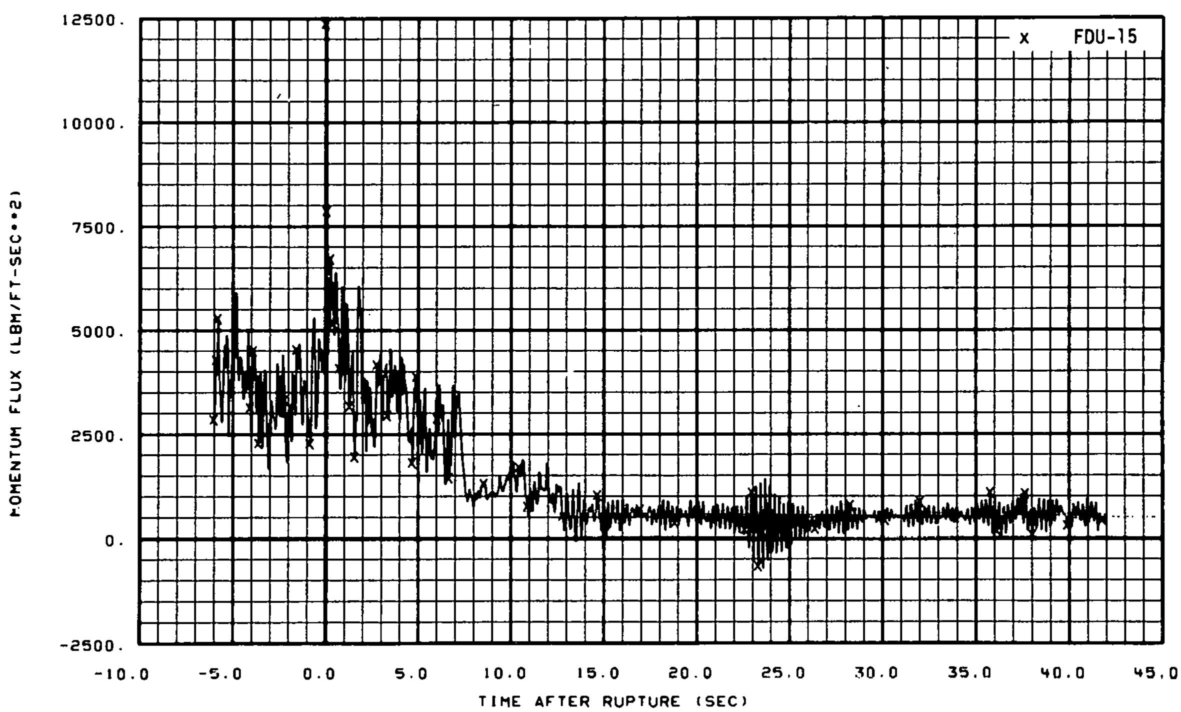

Fig. 240 Momentum flux in intact loop (FDU-15), from -6 to 42 seconds.

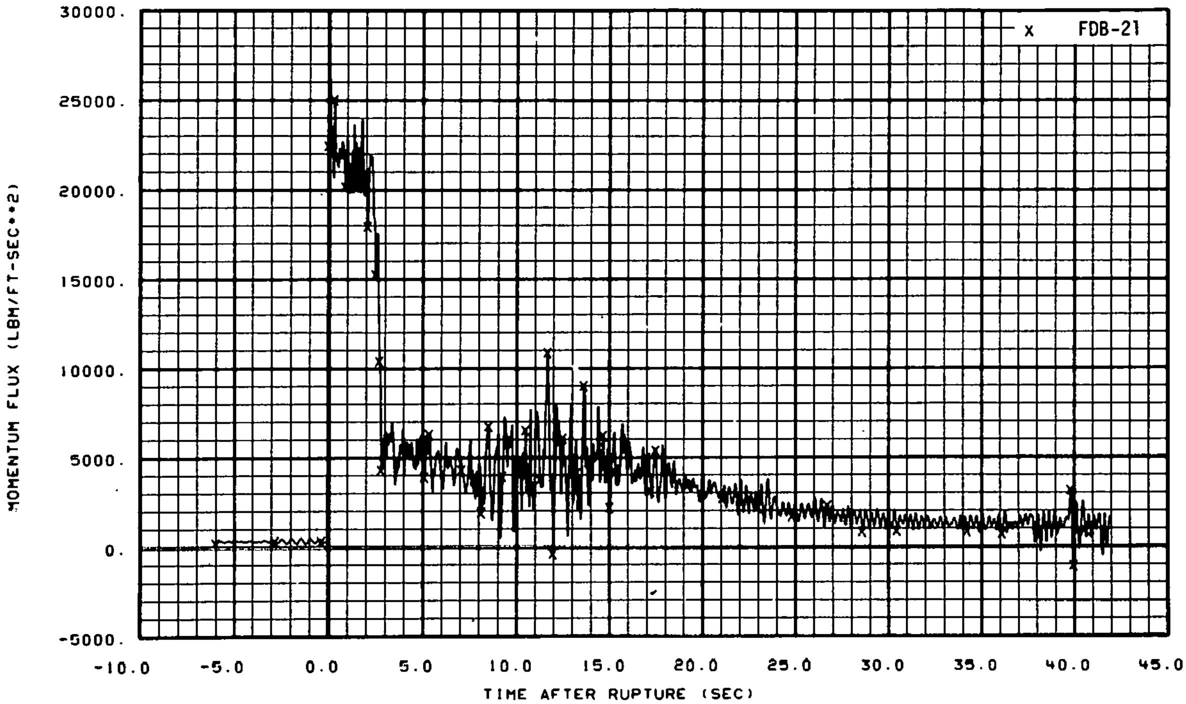

Fig. 241 Momentum flux in broken loop (FDB-21), from -6 to 42 seconds.

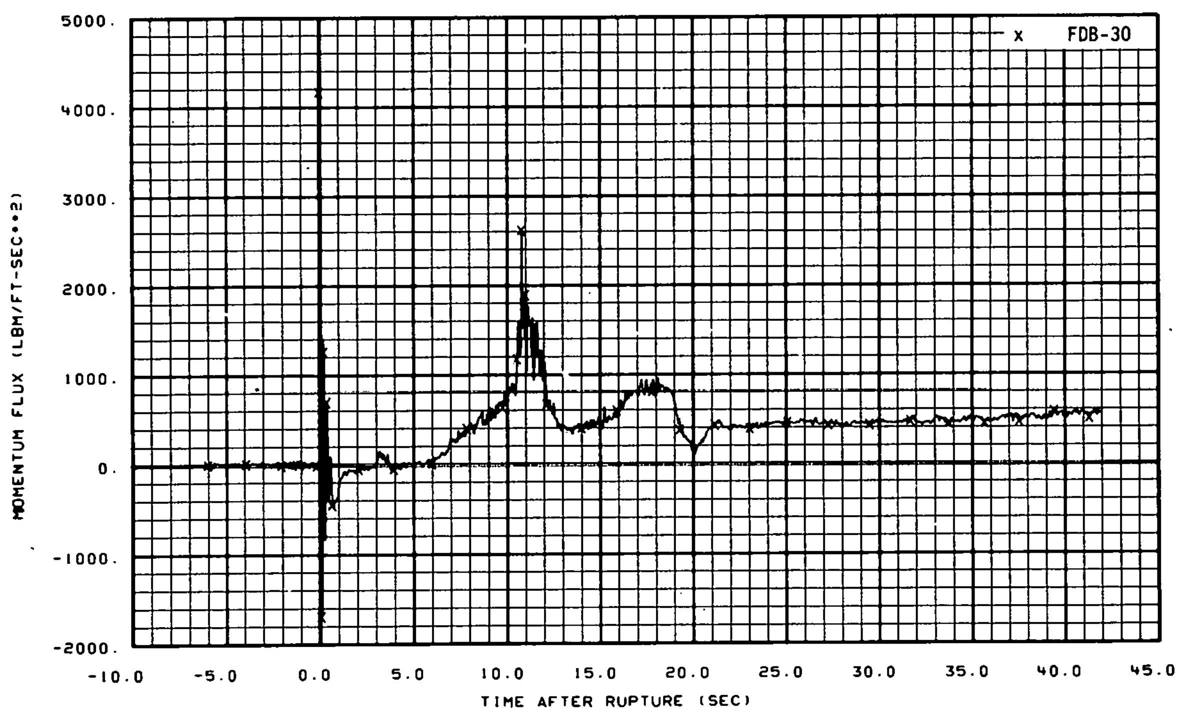

Fig. 242 Momentum flux in broken loop (FDB-30), from -6 to 42 seconds.

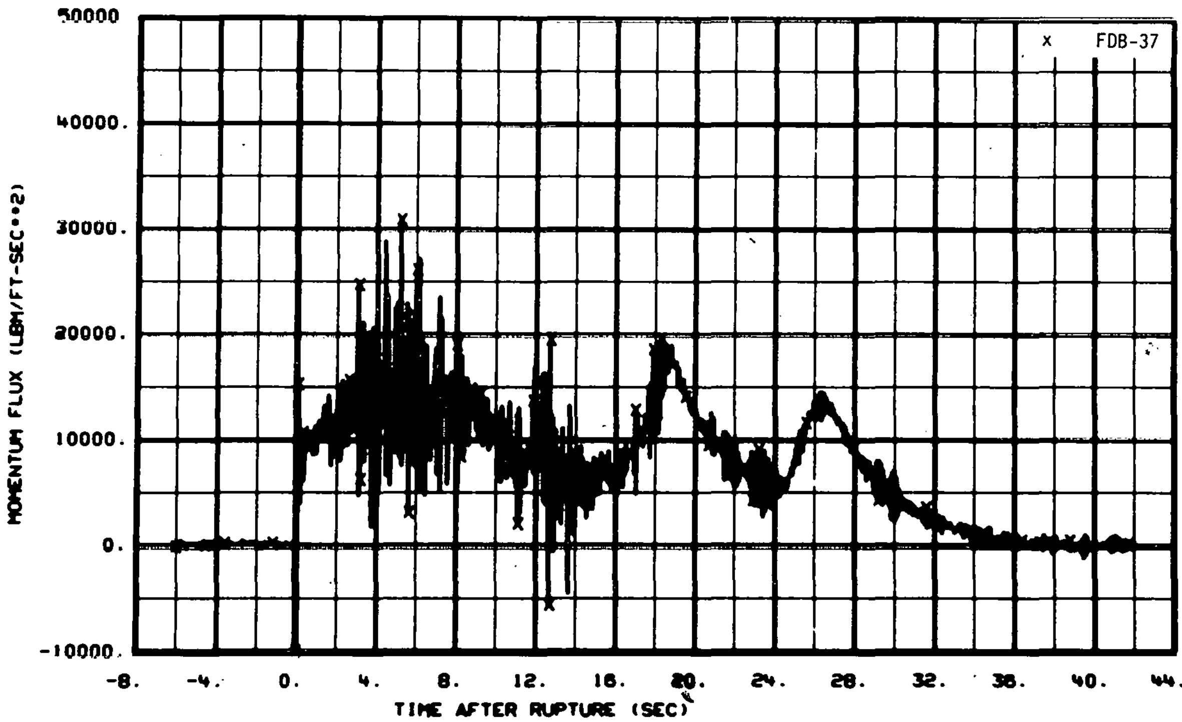

Fig. 243 Momentum flux in broken loop (FDB-37), from -6 to 42 seconds.

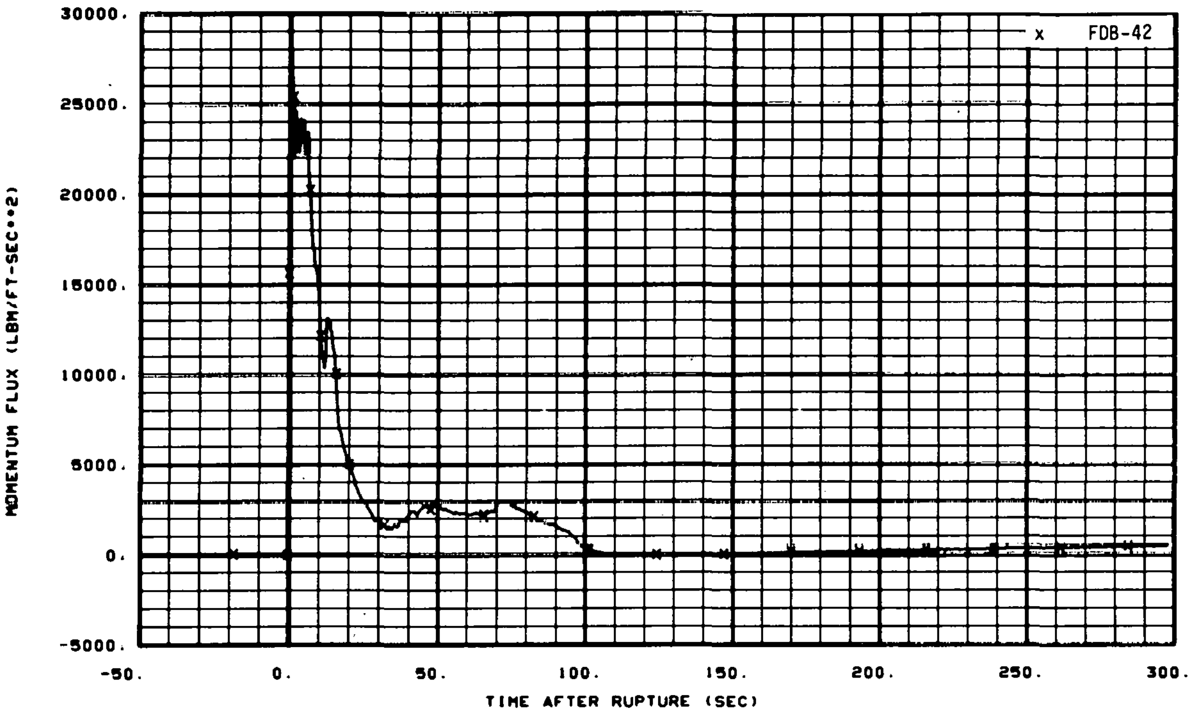

Fig. 244 Momentum flux in broken loop (FDB-42), from -20 to 300 seconds.

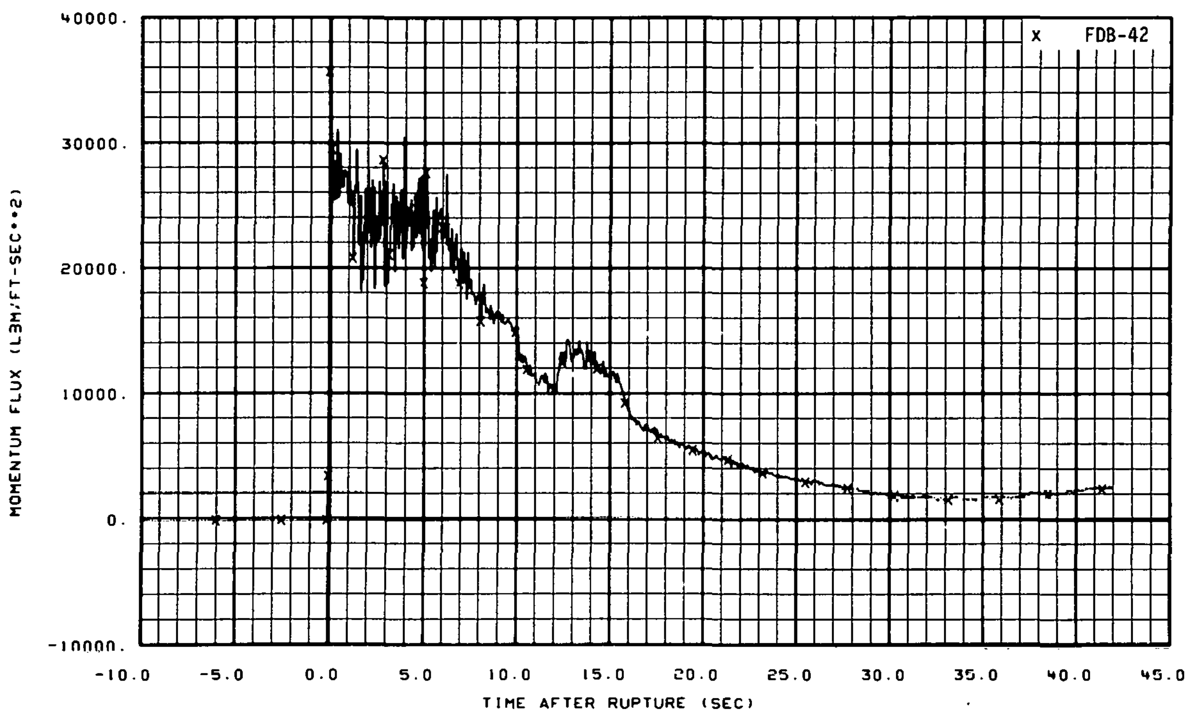

Fig. 245 Momentum flux in broken loop (FDB-42), from -6 to 42 seconds.

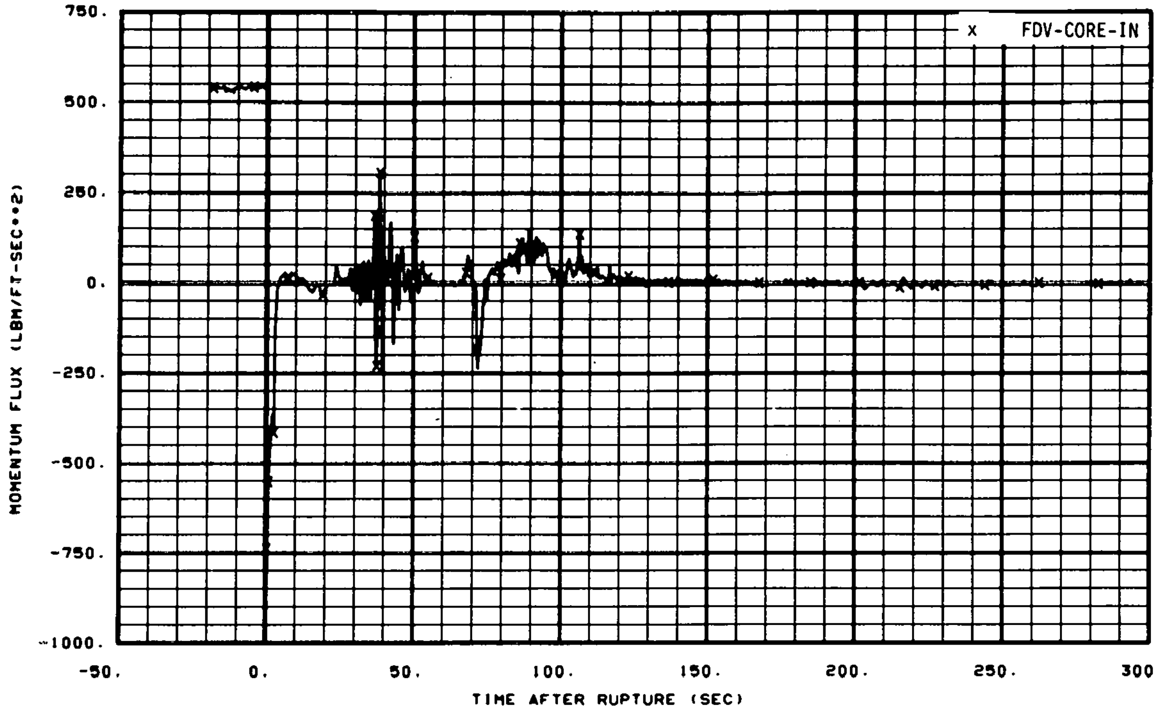

Fig. 246 Momentum flux in core entrance (FDV-CORE-IN), from -20 to 300 seconds.

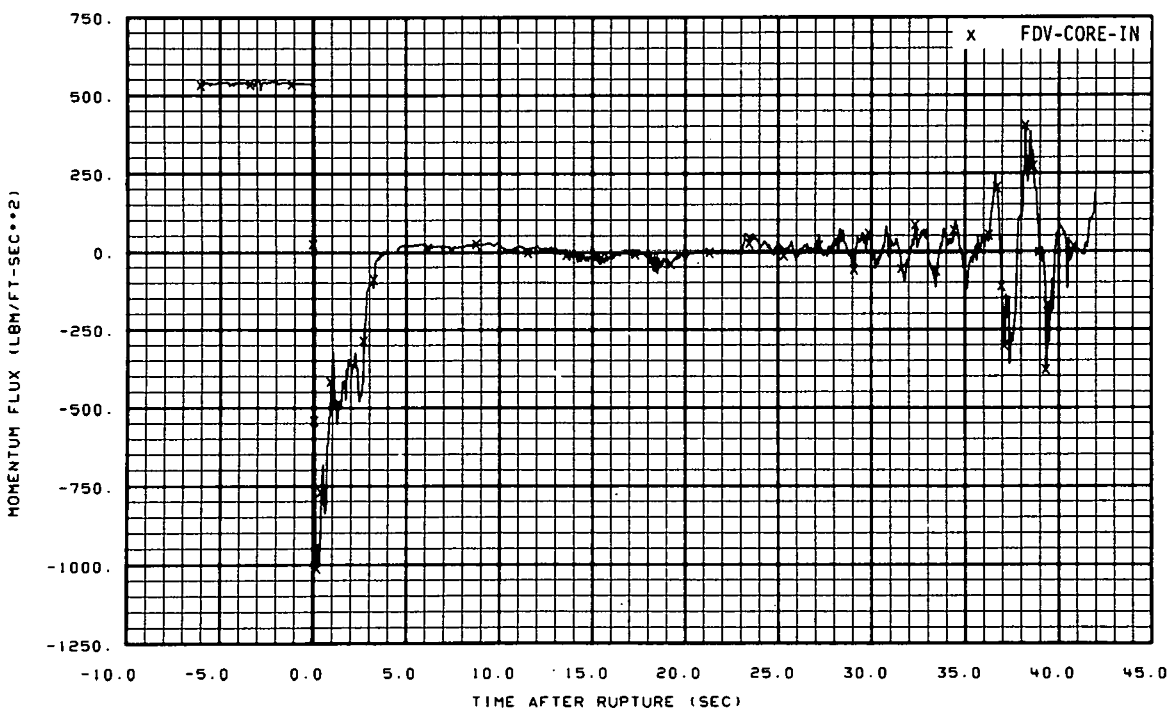

Fig. 247 Momentum flux in core entrance (FDV-CORE-IN), from -6 to 42 seconds.

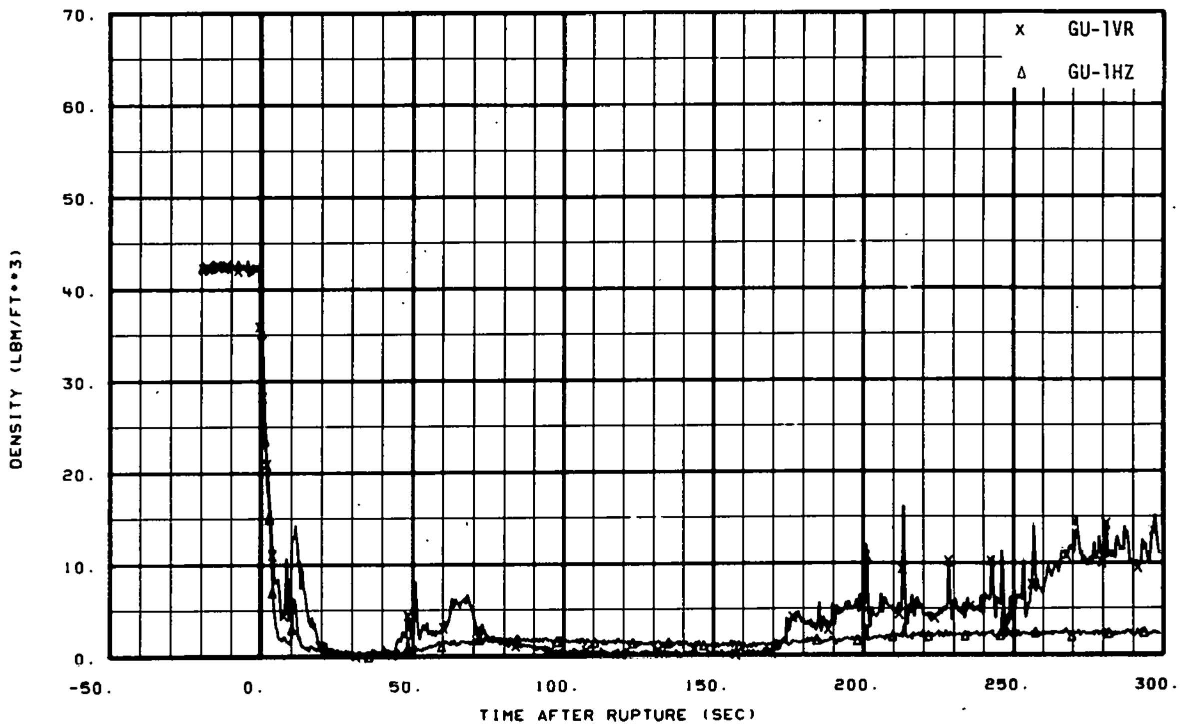

Fig. 248 Density in intact loop (GU-1VR and GU-1HZ), from -20 to 300 seconds.

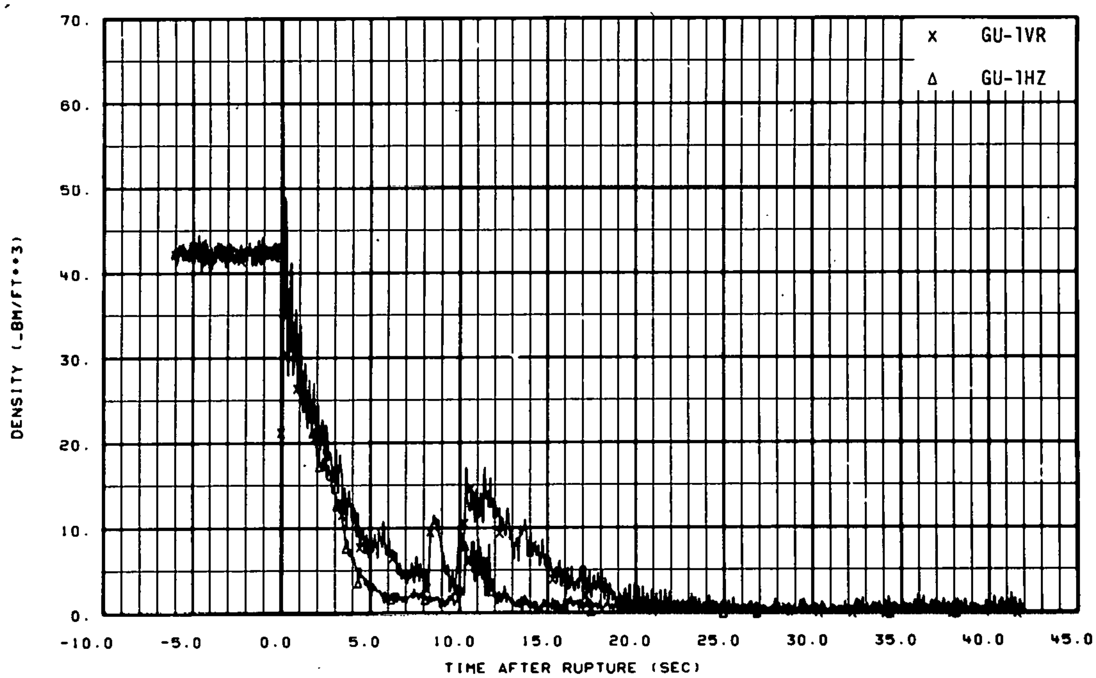

Fig. 249 Density in intact loop (GU-1VR and GU-1HZ), from -6 to 42 seconds.

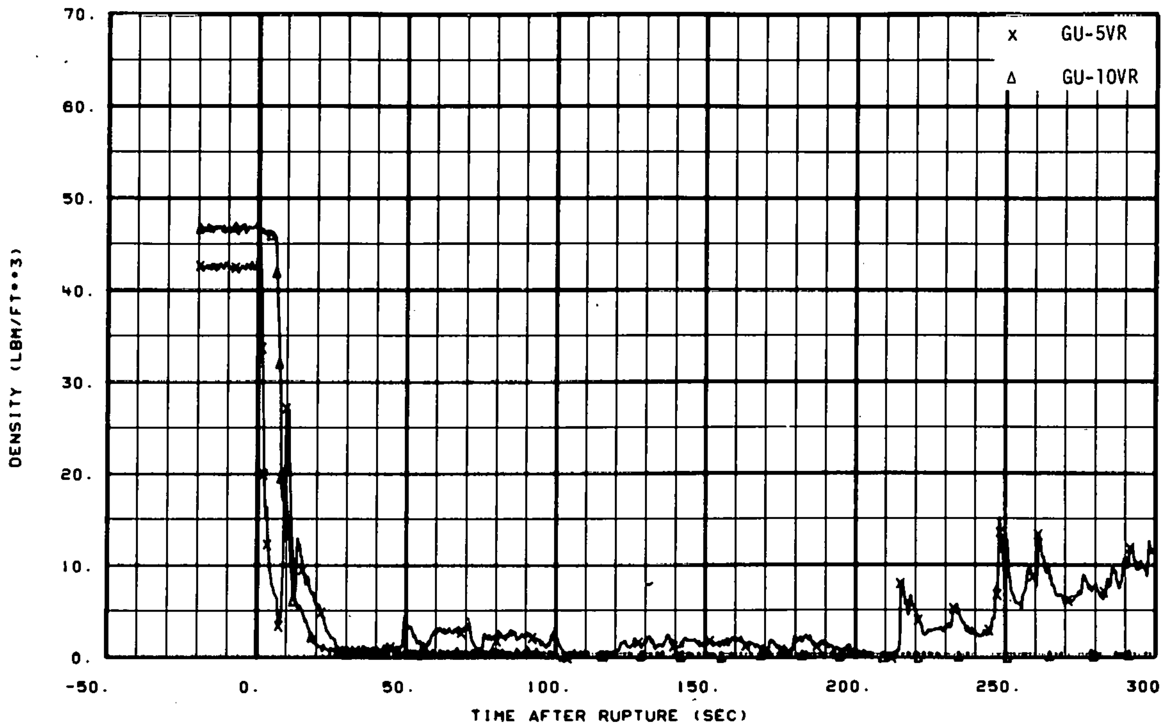

Fig. 250 Density in intact loop (GU-5VR and GU-10VR), from -20 to 300 seconds.

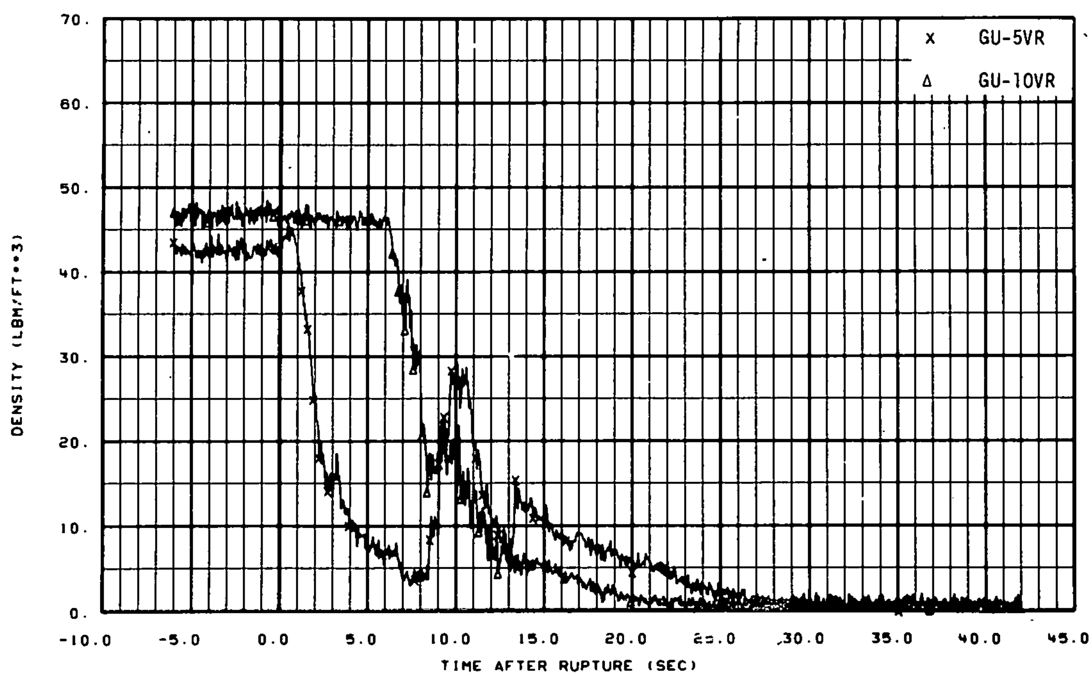

Fig. 251 Density in intact loop (GU-5VR and GU-10VR), from -6 to 42 seconds.

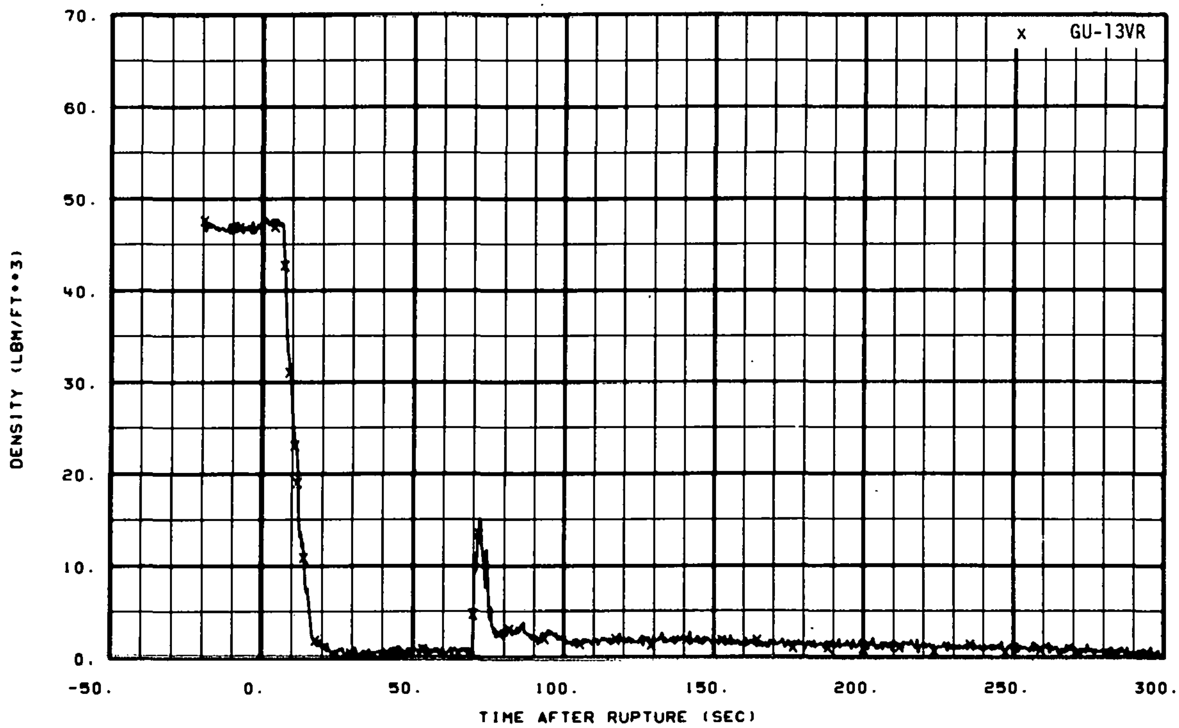

Fig. 252 Density in intact loop (GU-13VR), from -20 to 300 seconds.

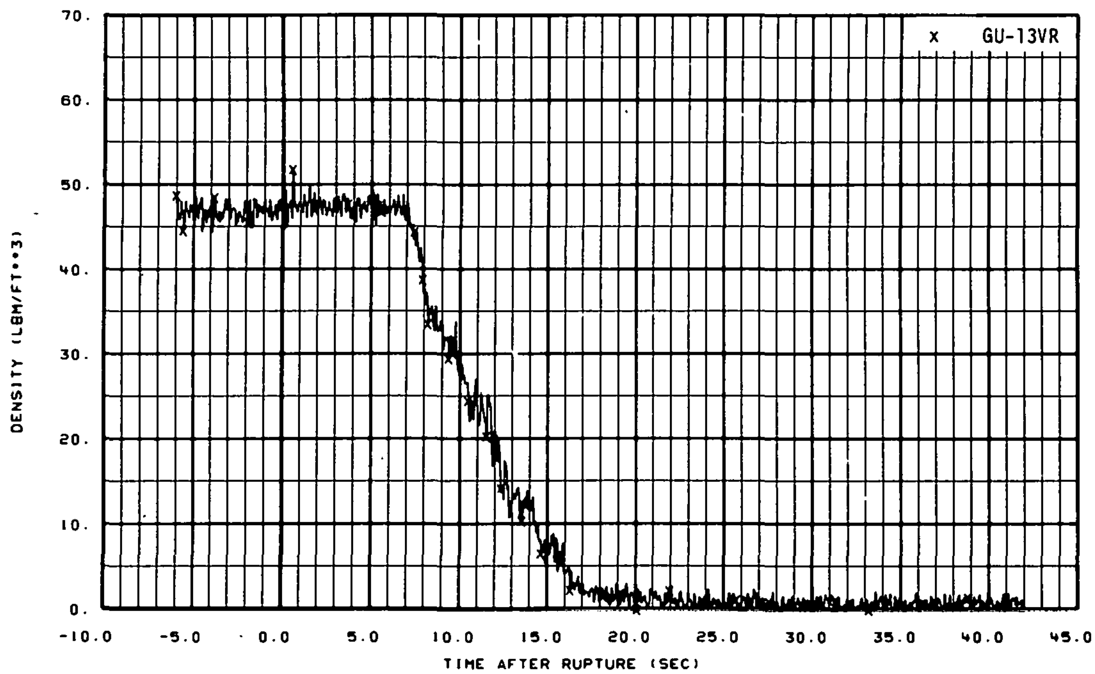

Fig. 253 Density in intact loop (GU-13VR), from -6 to 42 seconds.

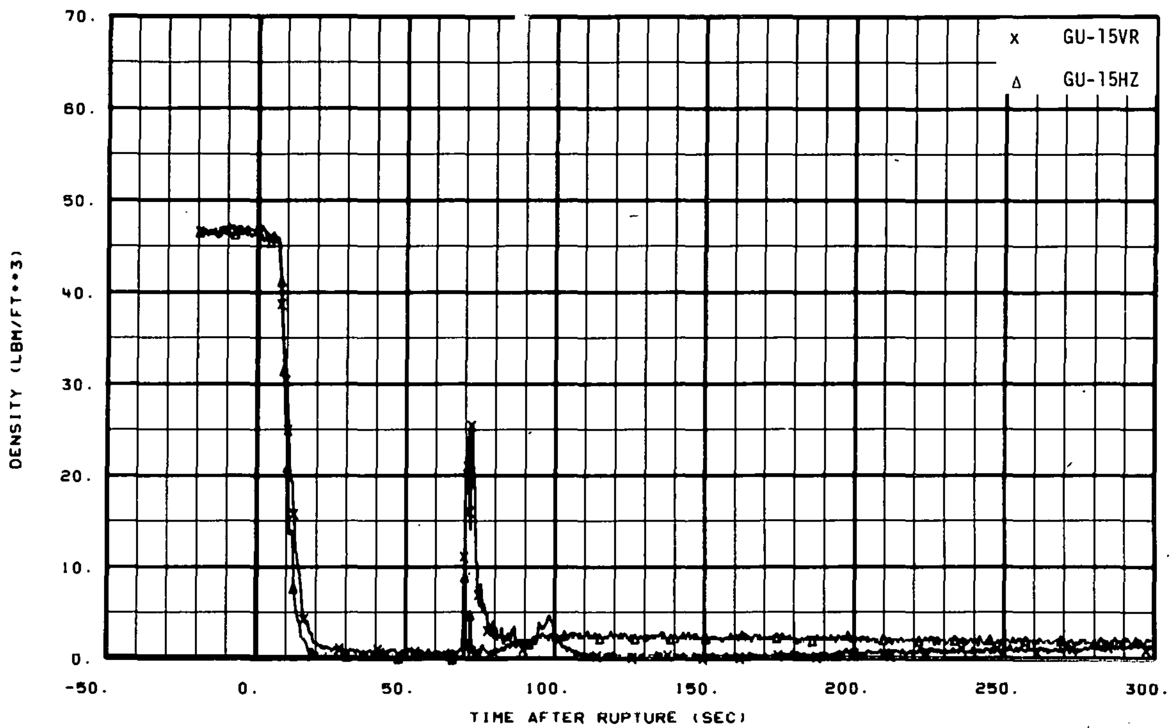

Fig. 254 Density in intact loop (GU-15VR and GU-15HZ), from -20 to 300 seconds.

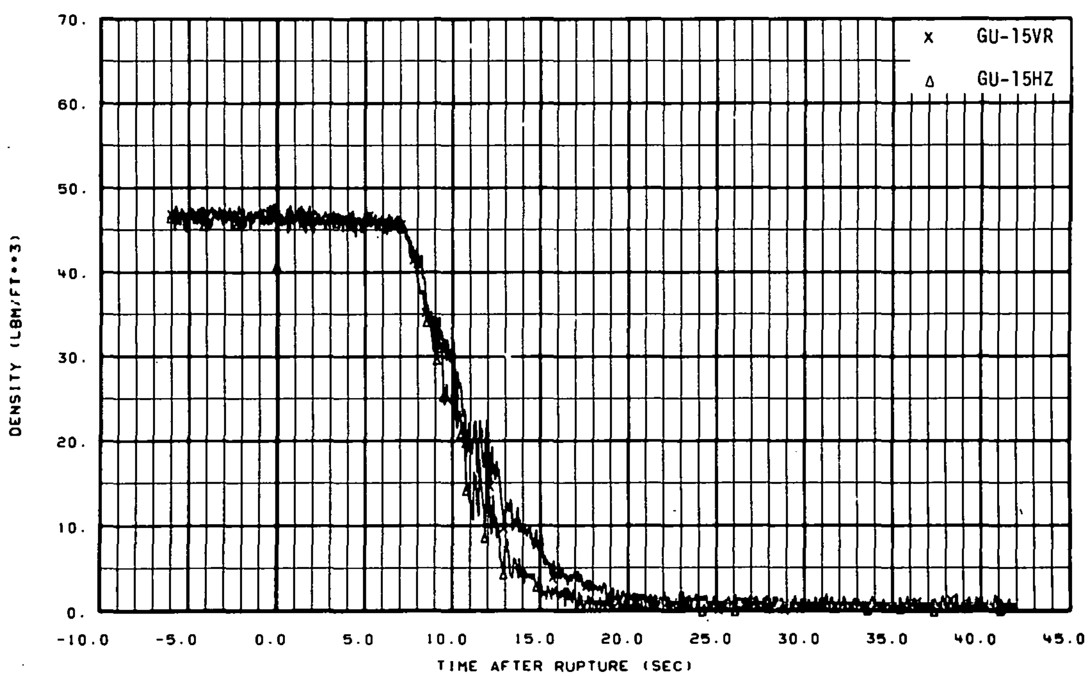

Fig. 255 Density in intact loop (GU-15VR and GU-15HZ), from -6 to 42 seconds.

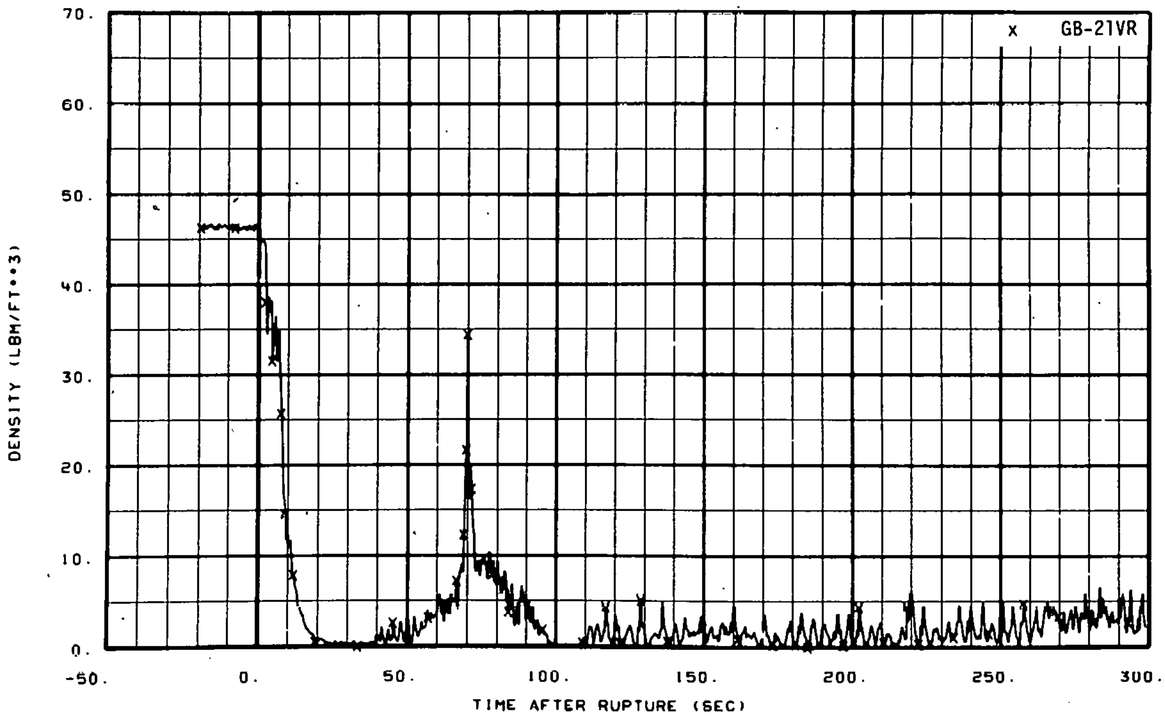

Fig. 256 Density in broken loop (GB-21VR), from -20 to 300 seconds.

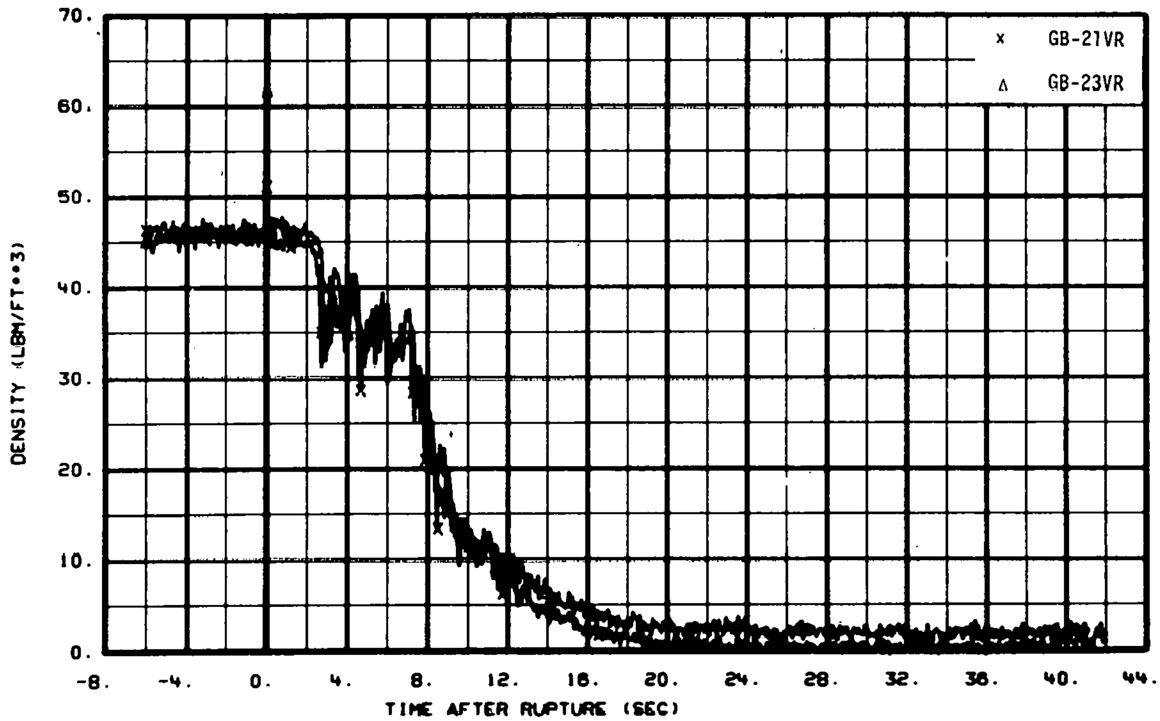

Fig. 257 Density in broken loop (GB-21VR and GB-23VR), from -6 to 42 seconds.

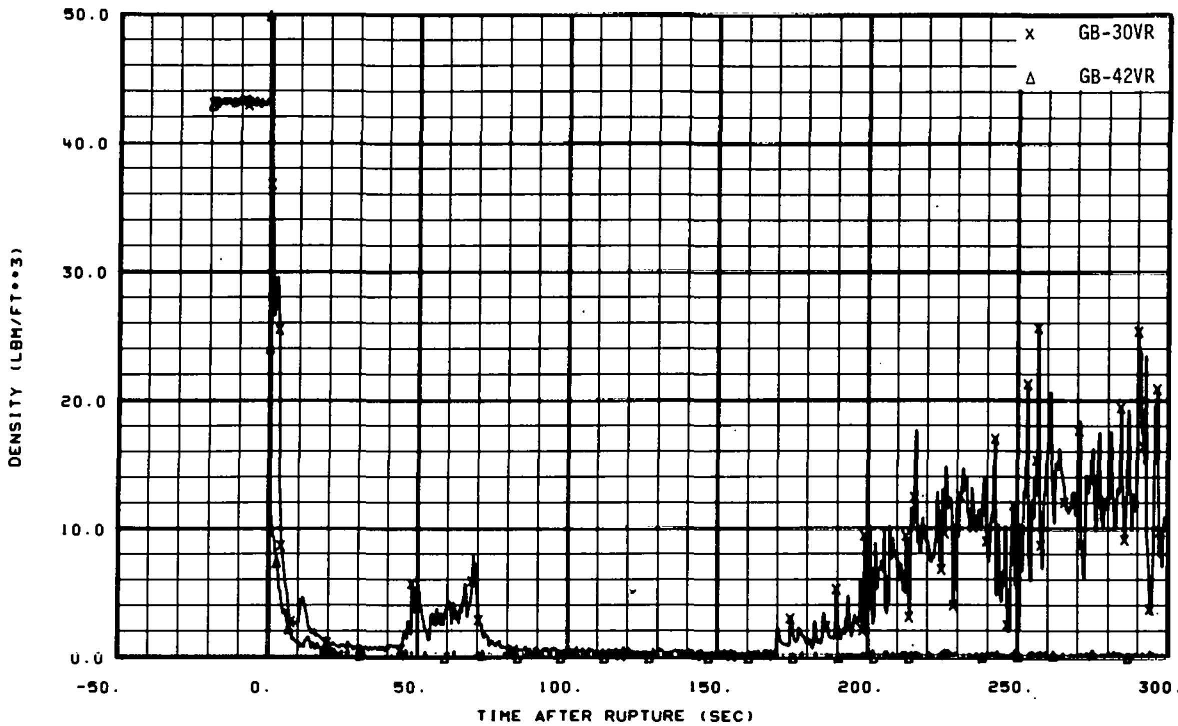

Fig. 258 Density in broken loop (GB-30VR and GB-42VR), from -20 to 300 seconds.

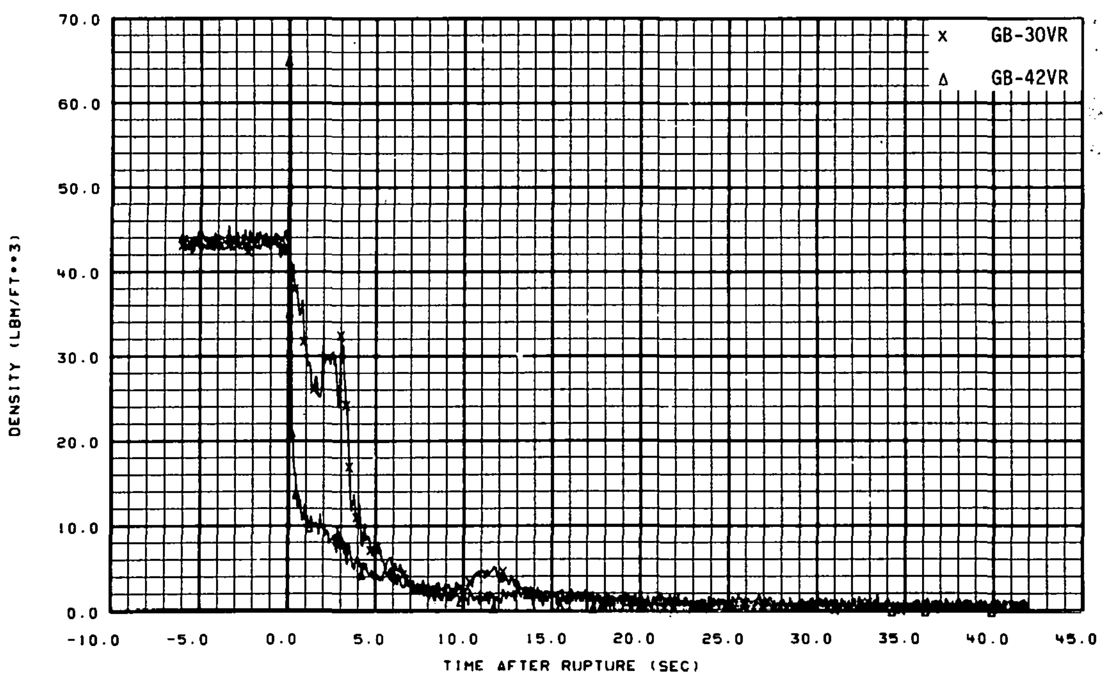

Fig. 259 Density in broken loop (GB-30VR and GB-42VR), from -6 to 42 seconds.

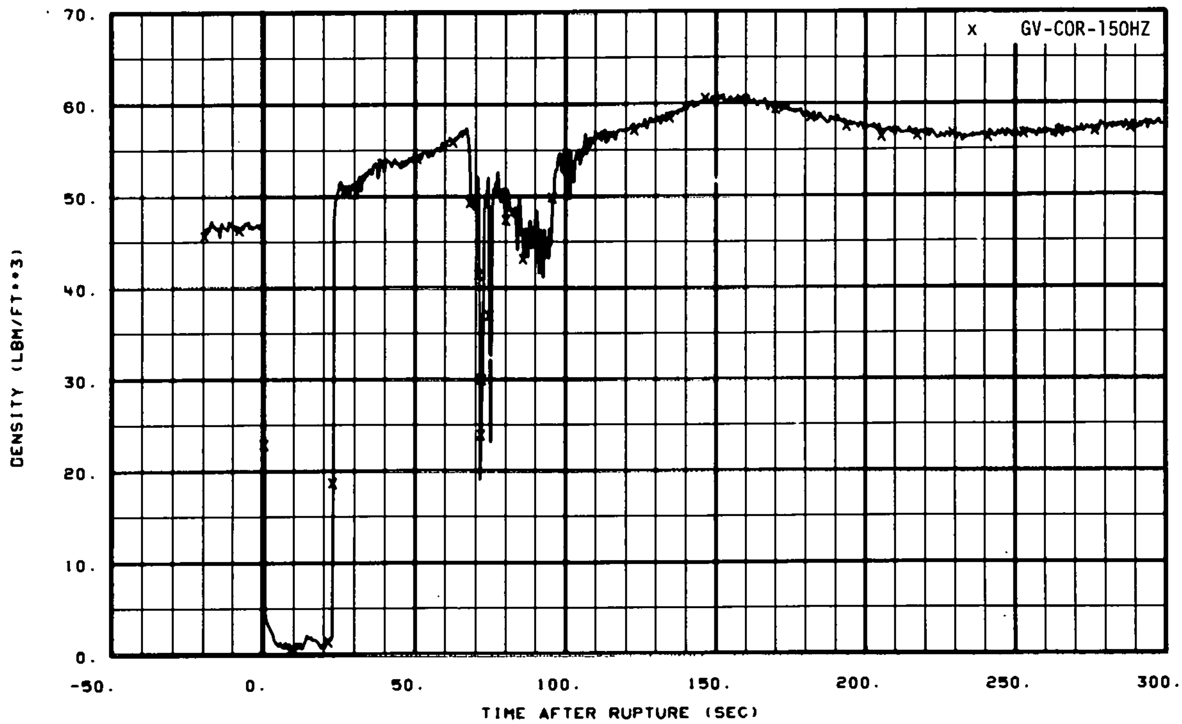

Fig. 260 Density in vessel (GV-COR-150HZ), from -20 to 300 seconds.

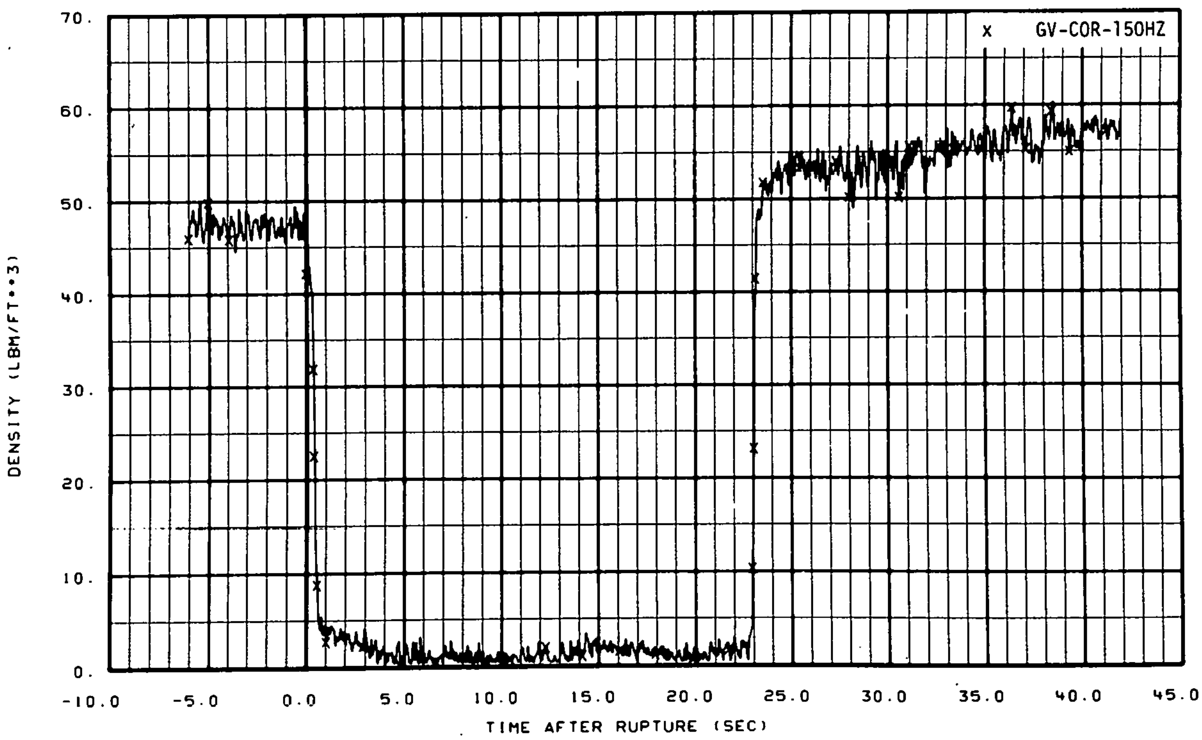

Fig. 261 Density in vessel (GV-COR-150HZ), from -6 to 42 seconds.

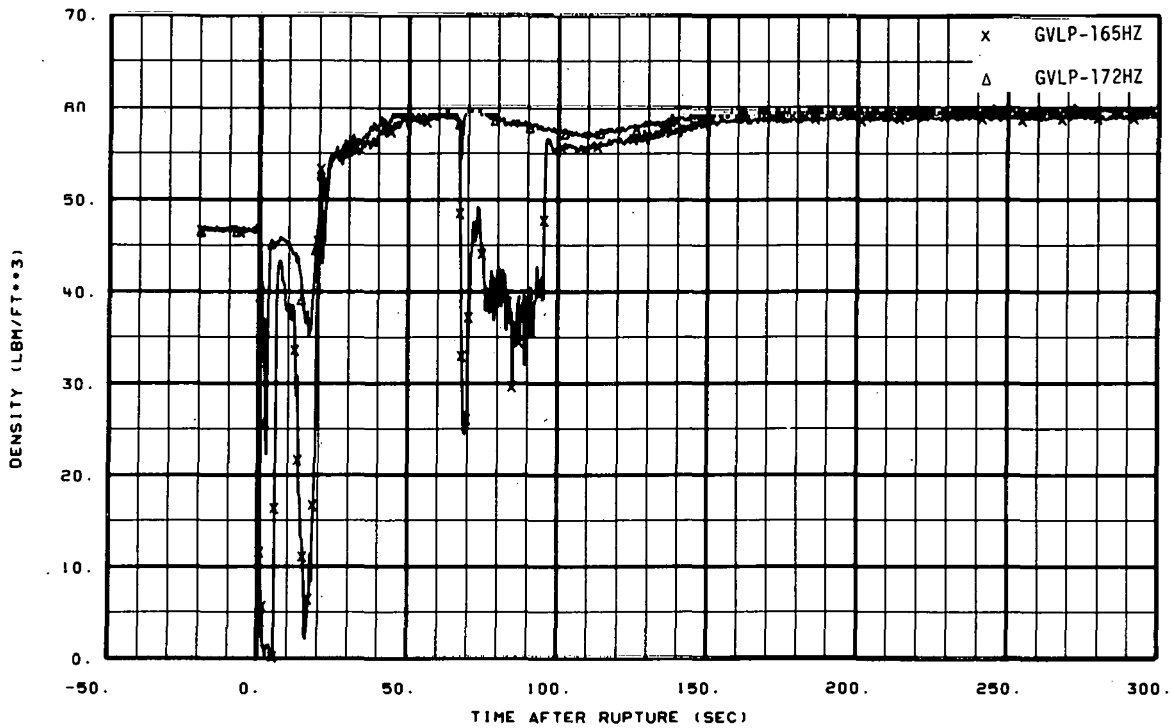

Fig. 262 Density in vessel (GVLP-165HZ and GVLP-172HZ), from -20 to 300 seconds.

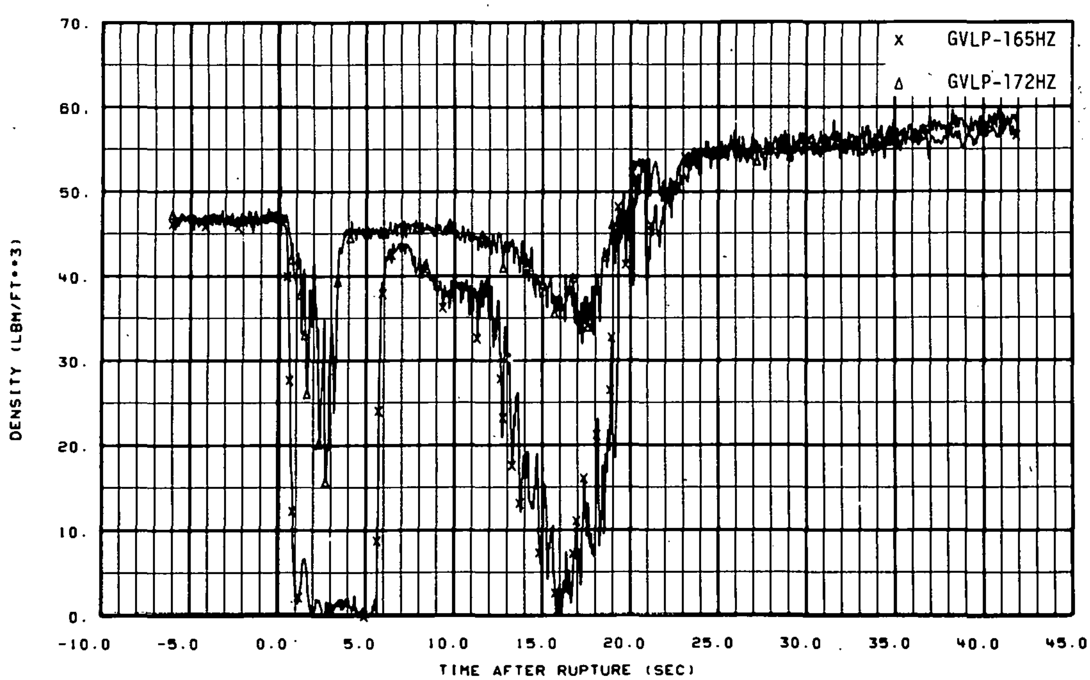

Fig. 263 Density in vessel (GVLP-165HZ and GVLP-172HZ), from -6 to 42 seconds.

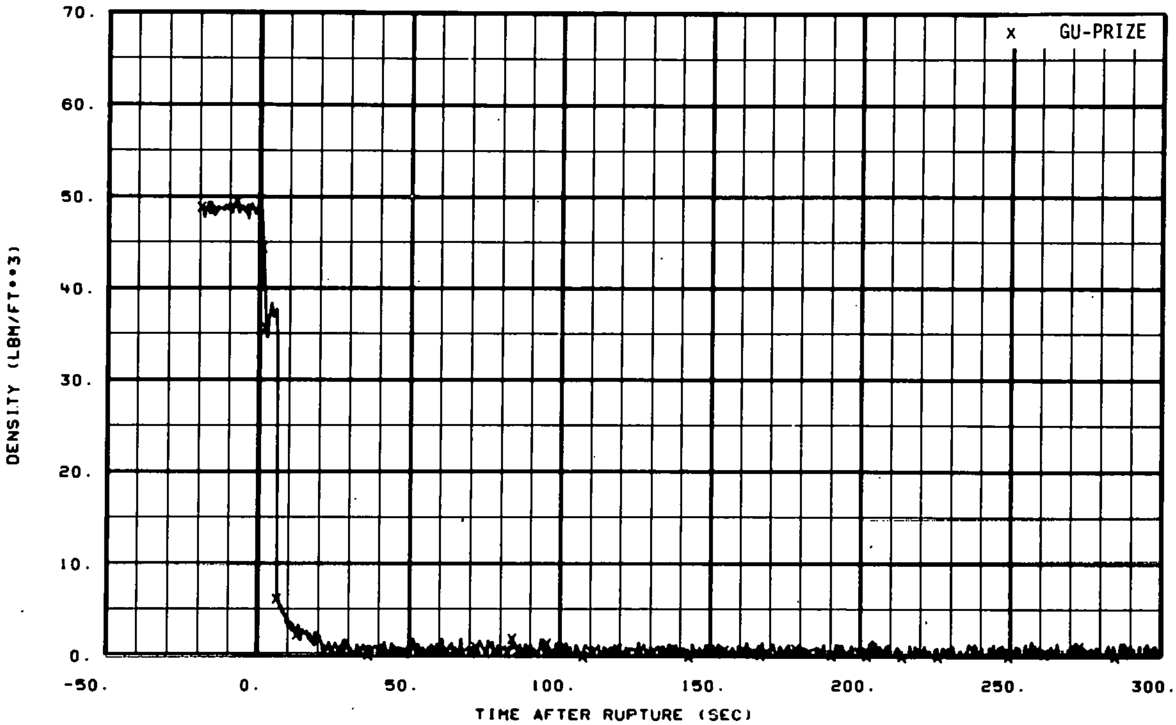

Fig. 264 Density in pressurizer (GU-PRIZE), from -20 to 300 seconds.

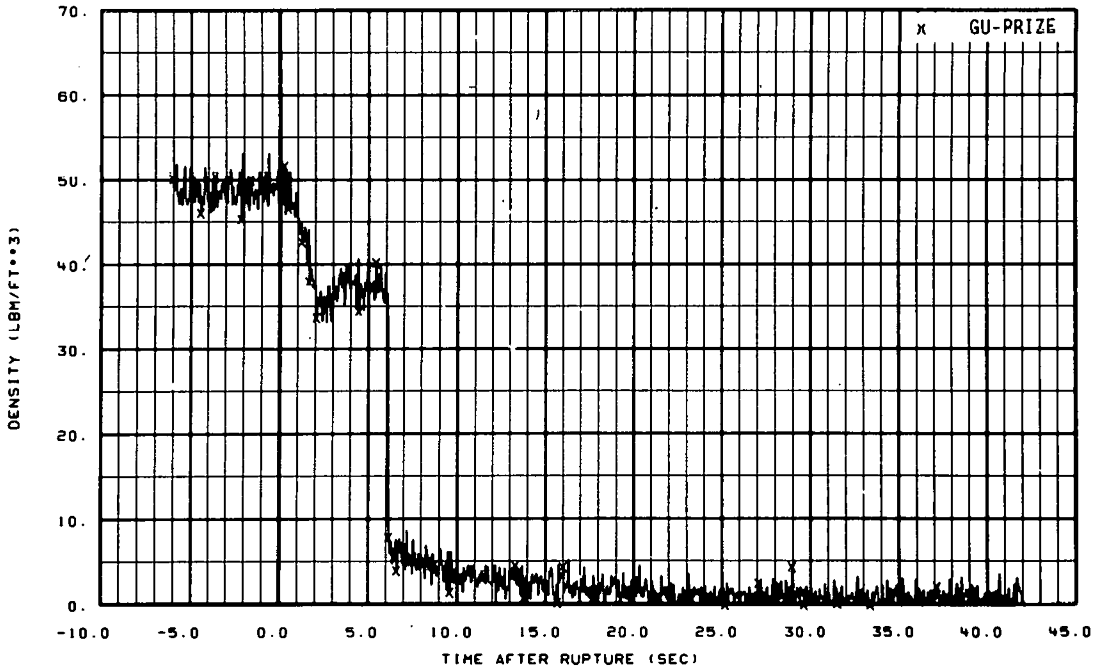

Fig. 265 Density in pressurizer (GU-PRIZE), from -6 to 42 seconds.

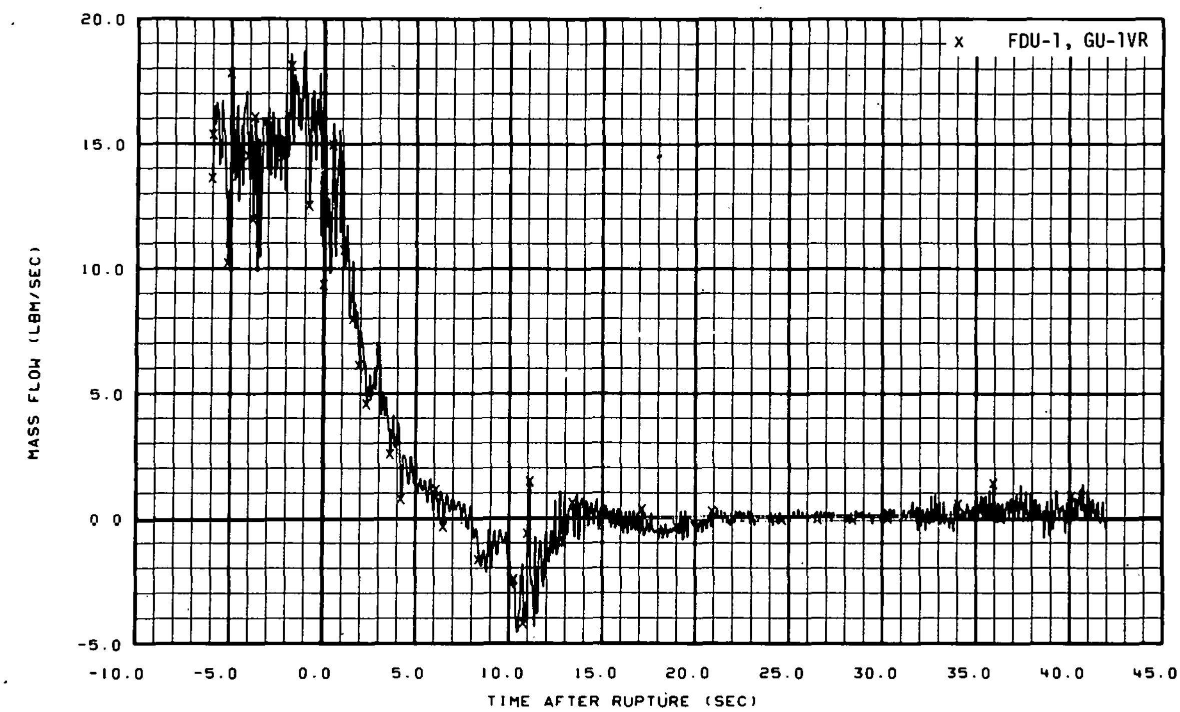

Fig. 266 Mass flow in intact loop (FDU-1 and GU-1VR), from -6 to 42 seconds.

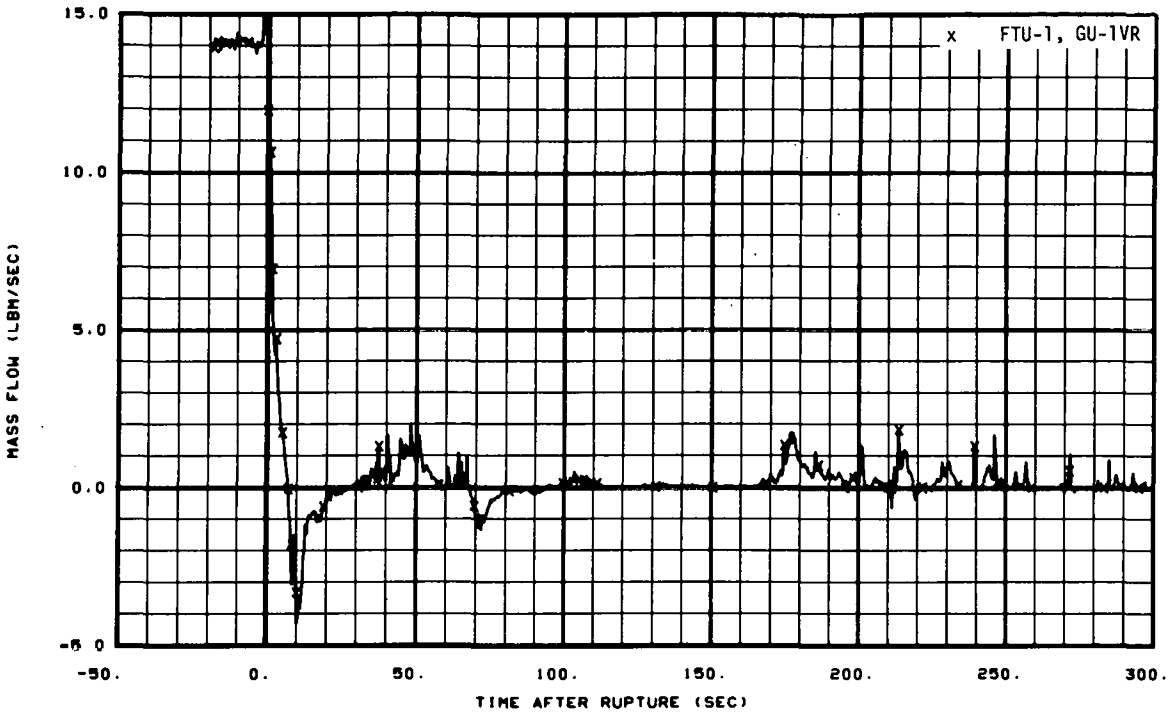

Fig. 267 Mass flow in intact loop (FTU-1 and GU-1VR), from -20 to 300 seconds.

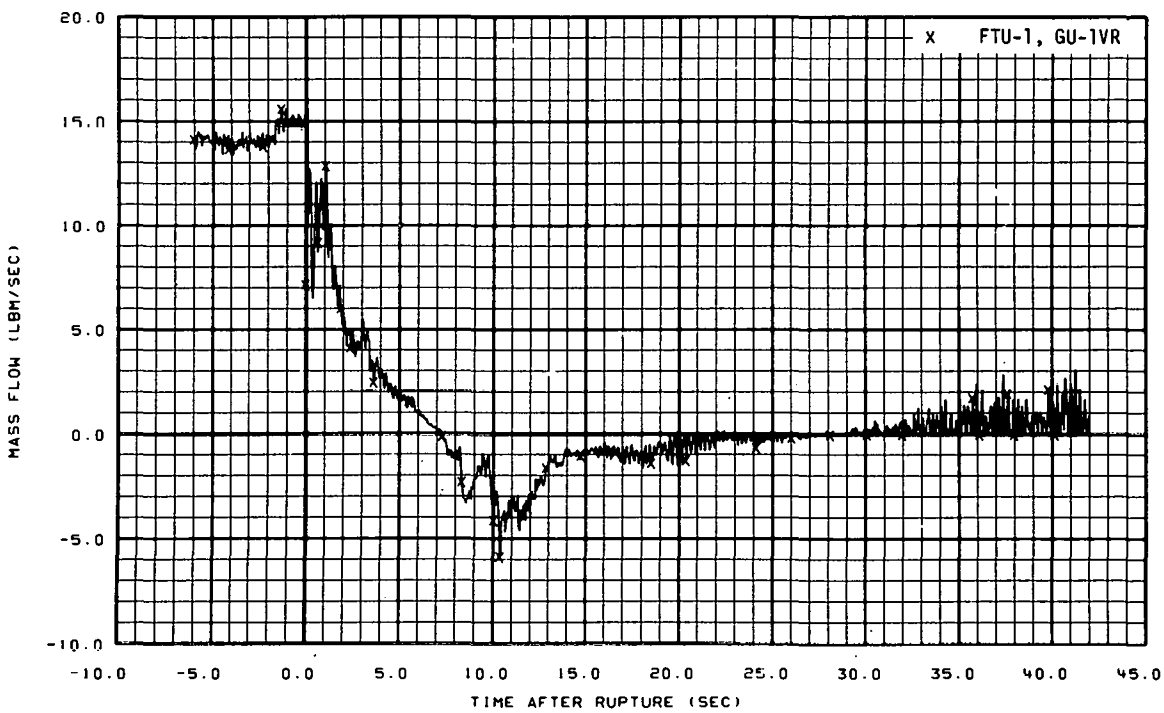

Fig. 268 Mass flow in intact loop (FTU-1 and GU-1VR), from -6 to 42 seconds.

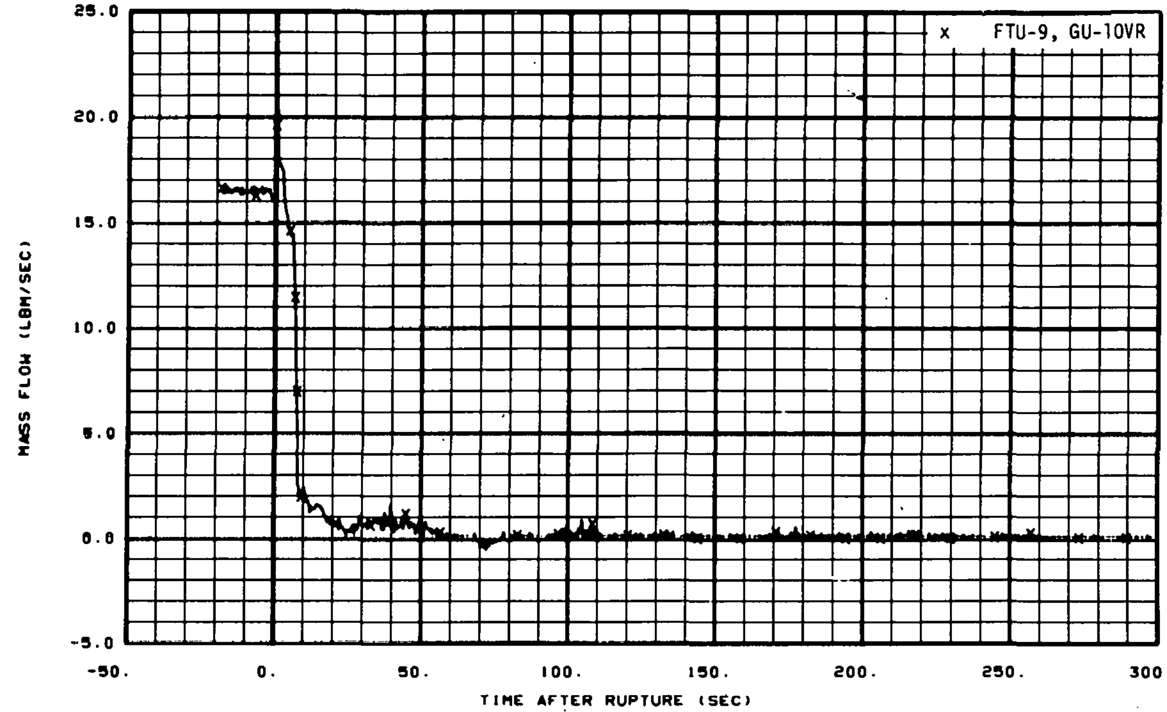

Fig. 269 Mass flow in intact loop (FTU-9 and GU-10VR), from -20 to 300 seconds.

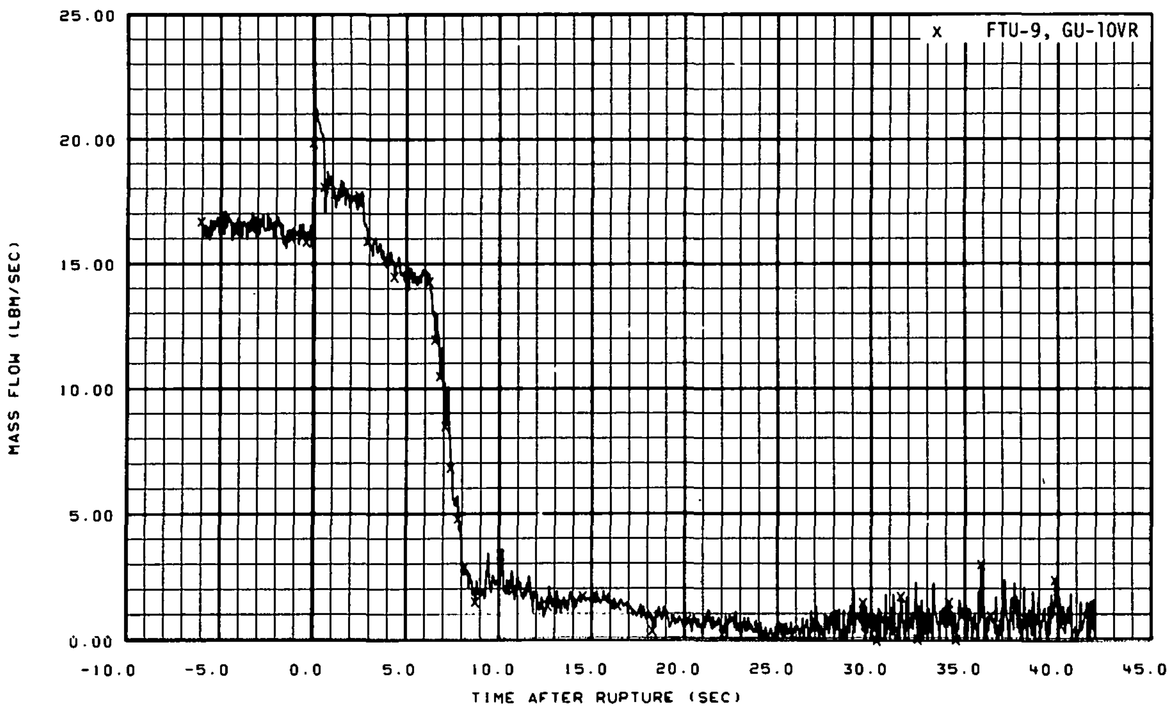

Fig. 270 Mass flow in intact loop (FTU-9 and GU-10VR), from -6 to 42 seconds.

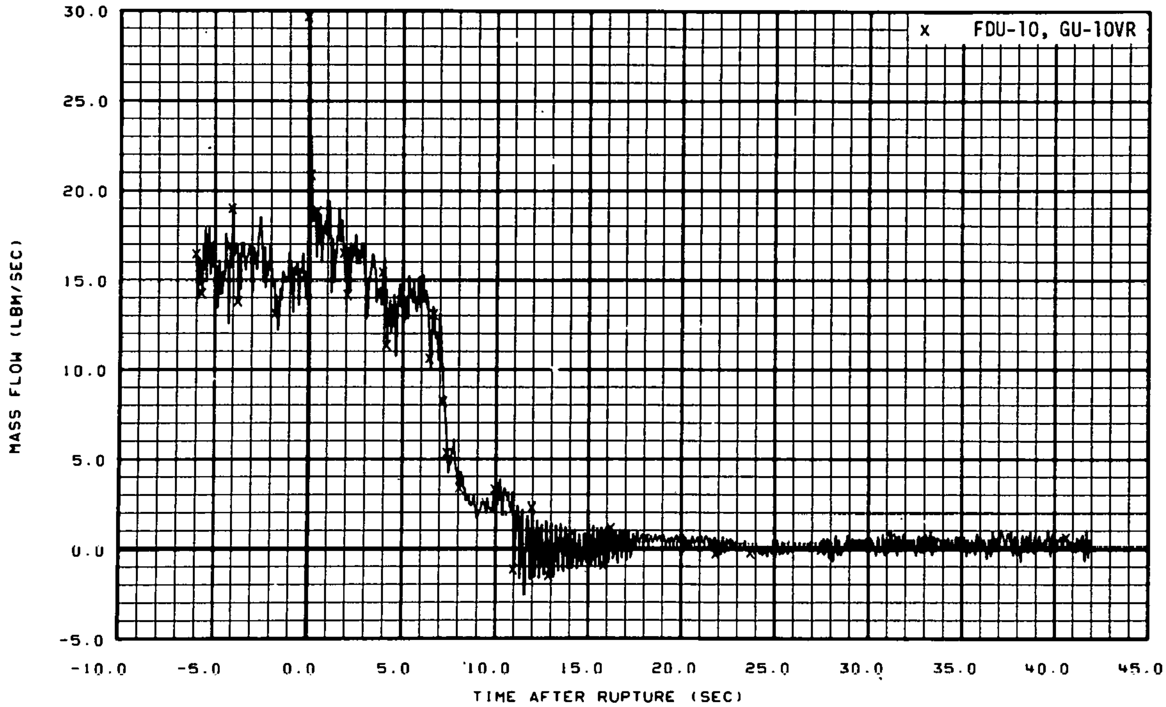

Fig. 271 Mass flow in intact loop (FDU-10 and GU-10VR), from -6 to 42 seconds.

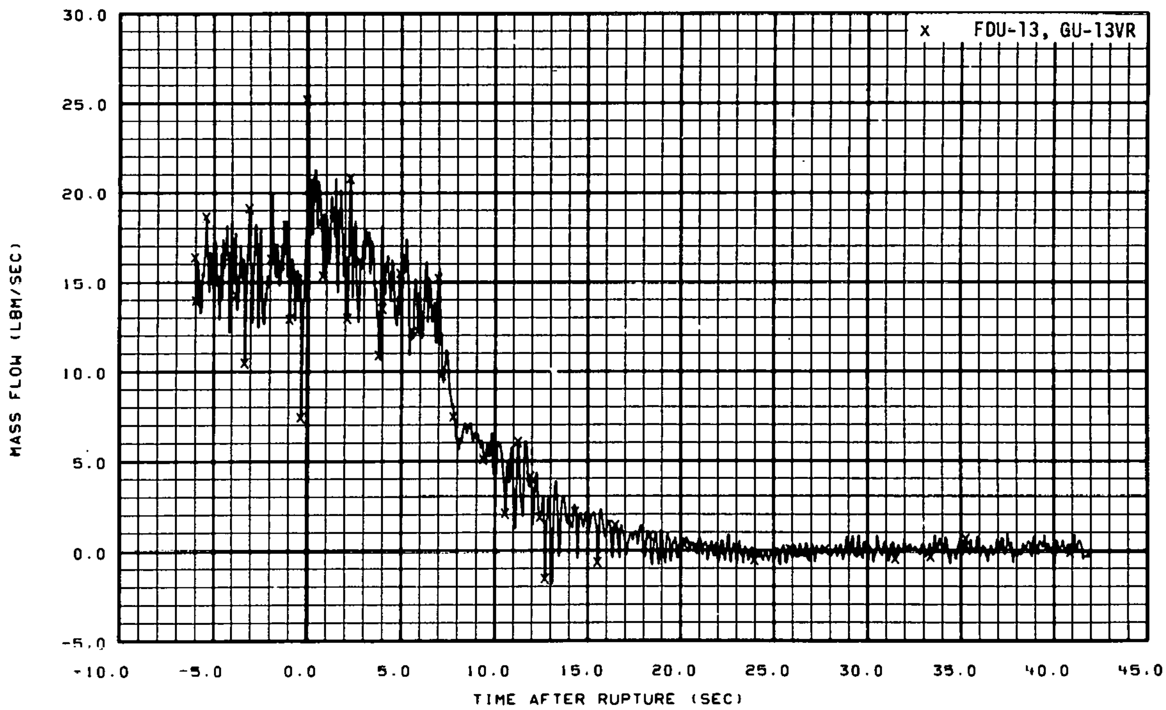

Fig. 272 Mass flow in intact loop (FDU-13 and GU-13VR), from -6 to 42 seconds.

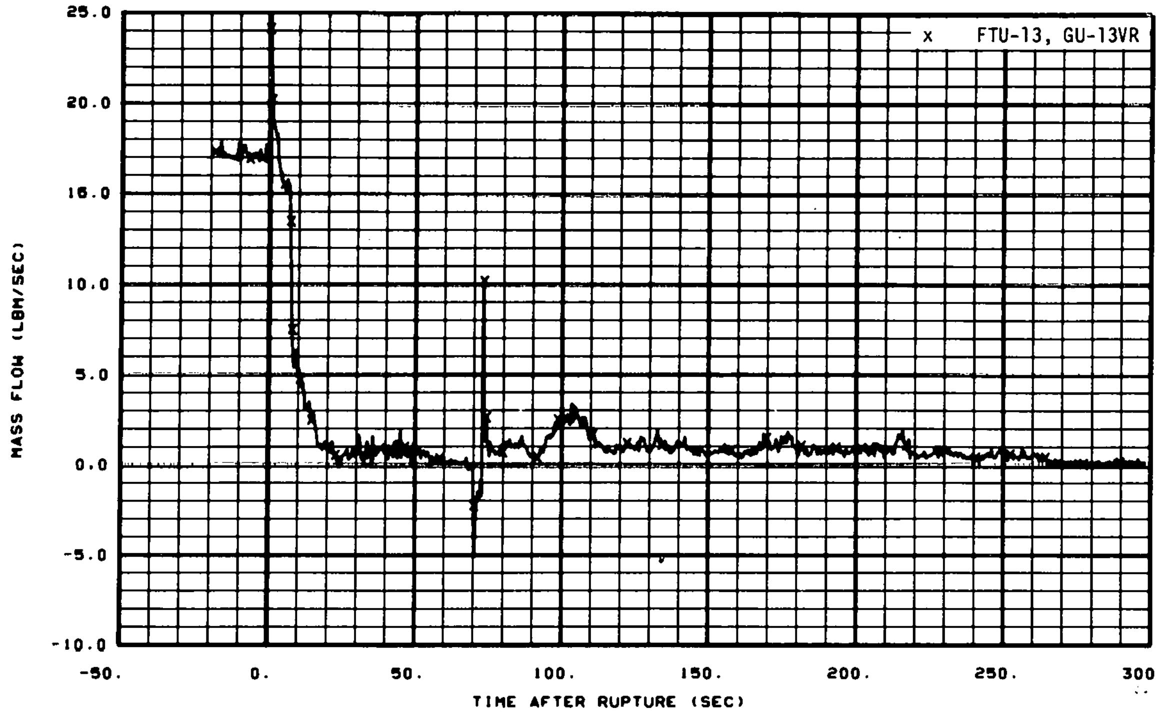

Fig. 273 Mass flow in intact loop (FTU-13 and GU-13VR), from -20 to 300 seconds.

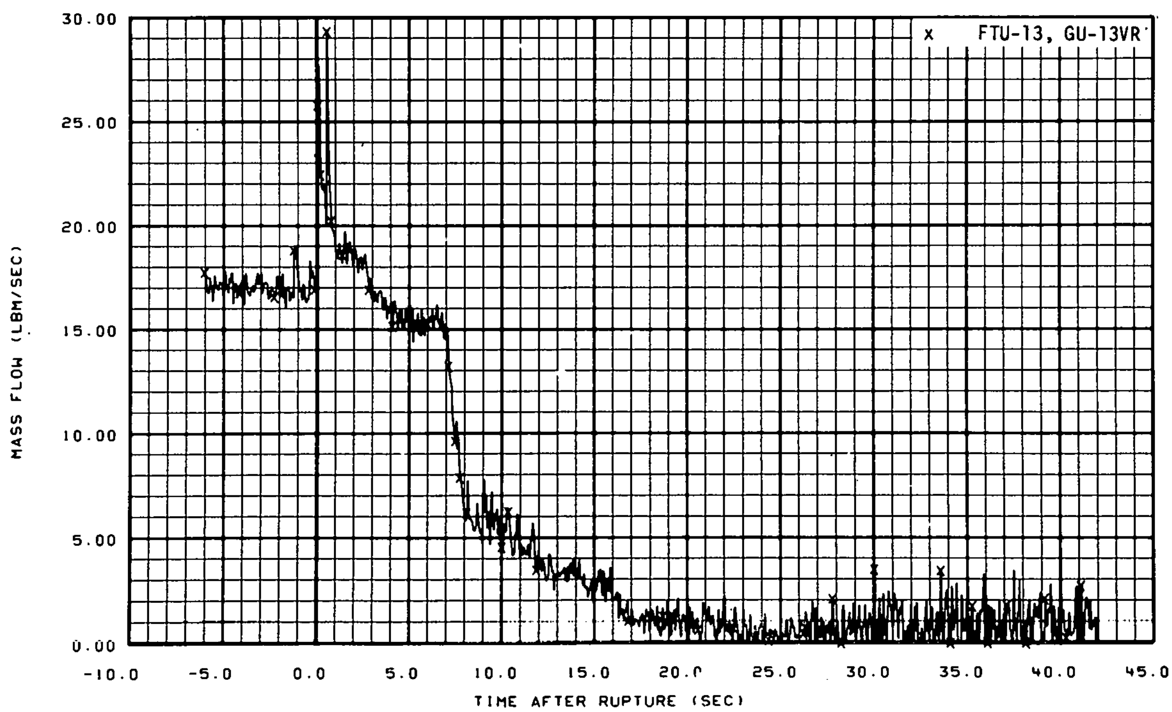

Fig. 274 Mass flow in intact loop (FTU-13 and GU-13VR), from -6 to 42 seconds.

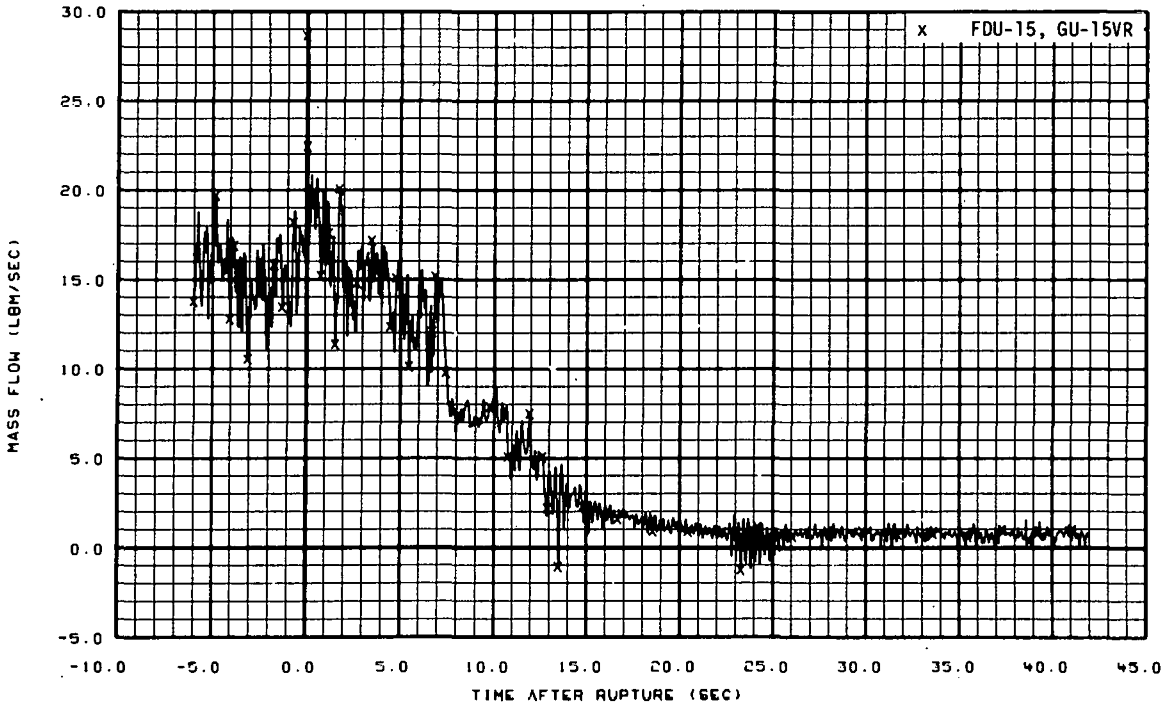

Fig. 275 Mass flow in intact loop (FDU-15 and GU-15VR), from -6 to 42 seconds.

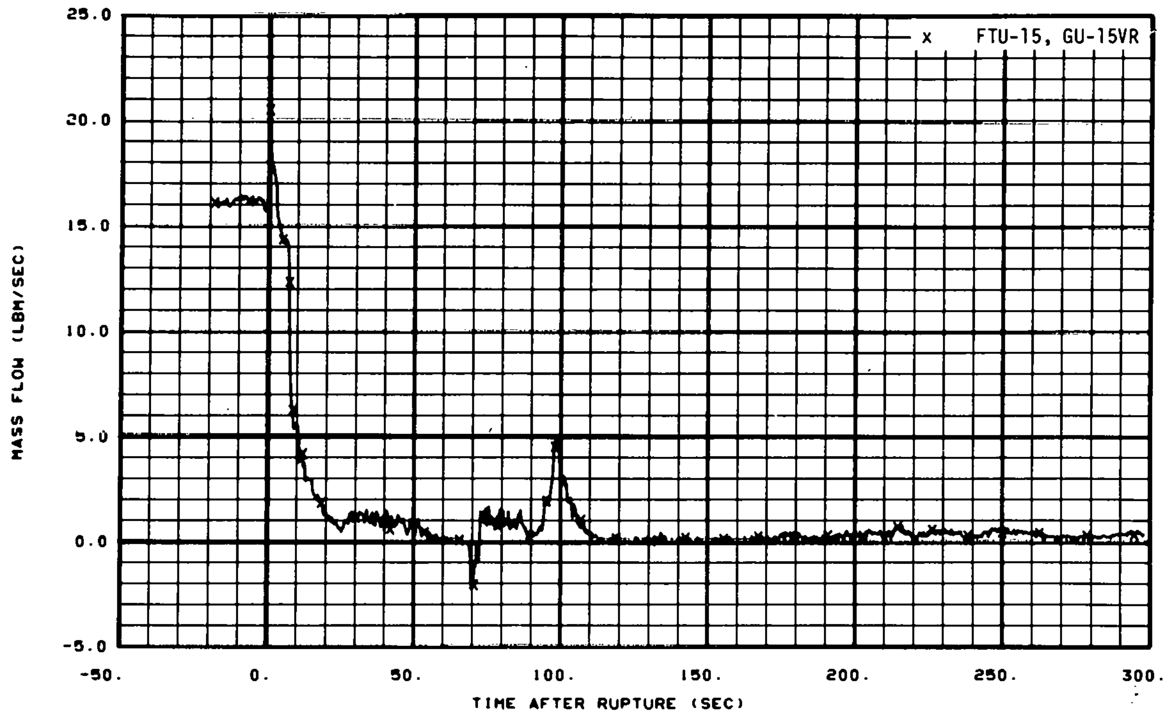

Fig. 276 Mass flow in intact loop (FTU-15 and GU-15VR), from -20 to 300 seconds.

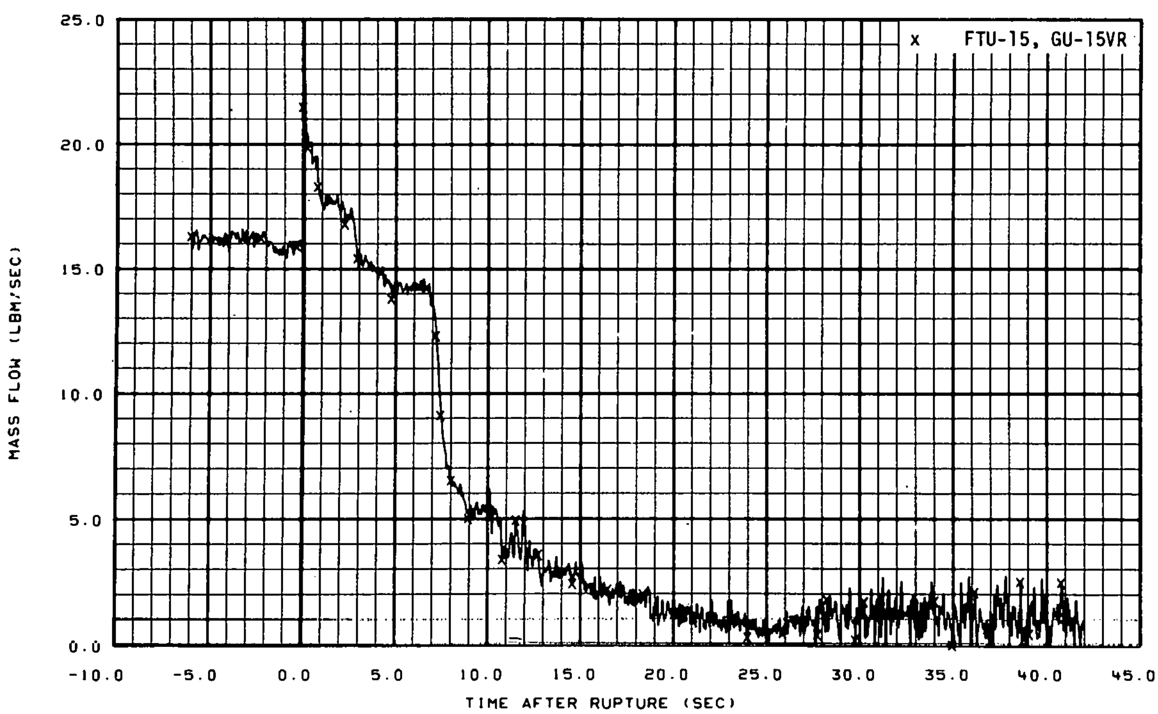

Fig. 277 Mass flow in intact loop (FTU-15 and GU-15VR), from -6 to 42 seconds.

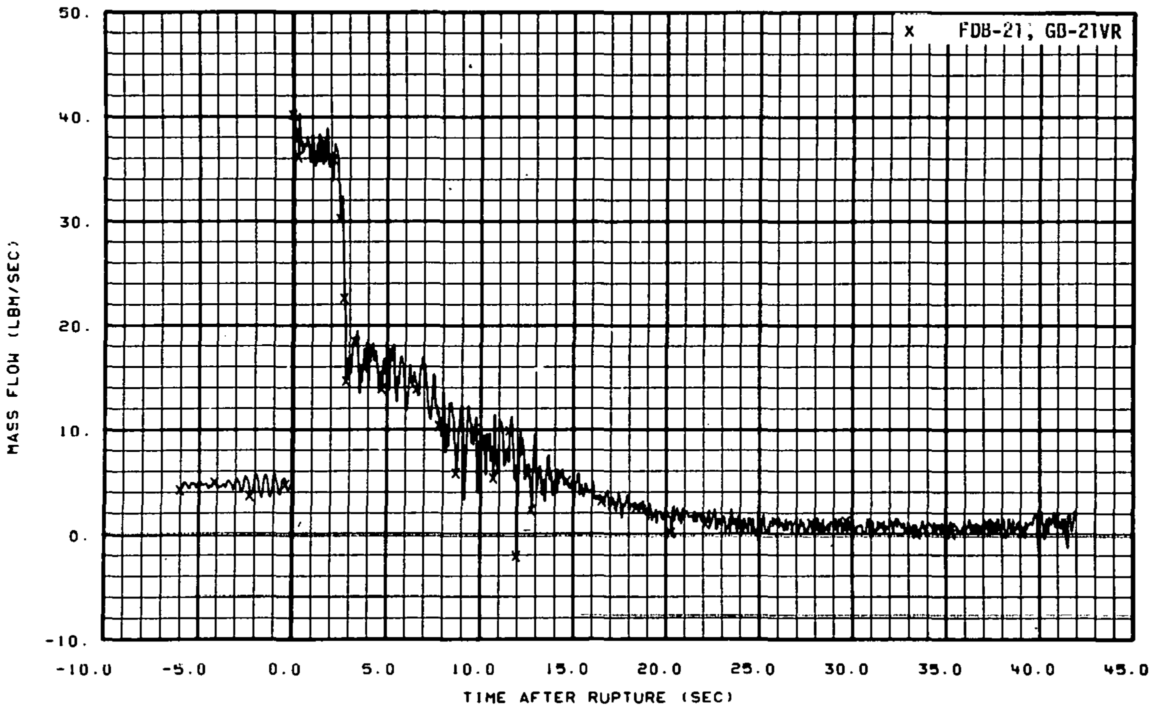

Fig. 278 Mass flow in broken loop (FDB-21 and GB-21VR), from -6 to 42 seconds.

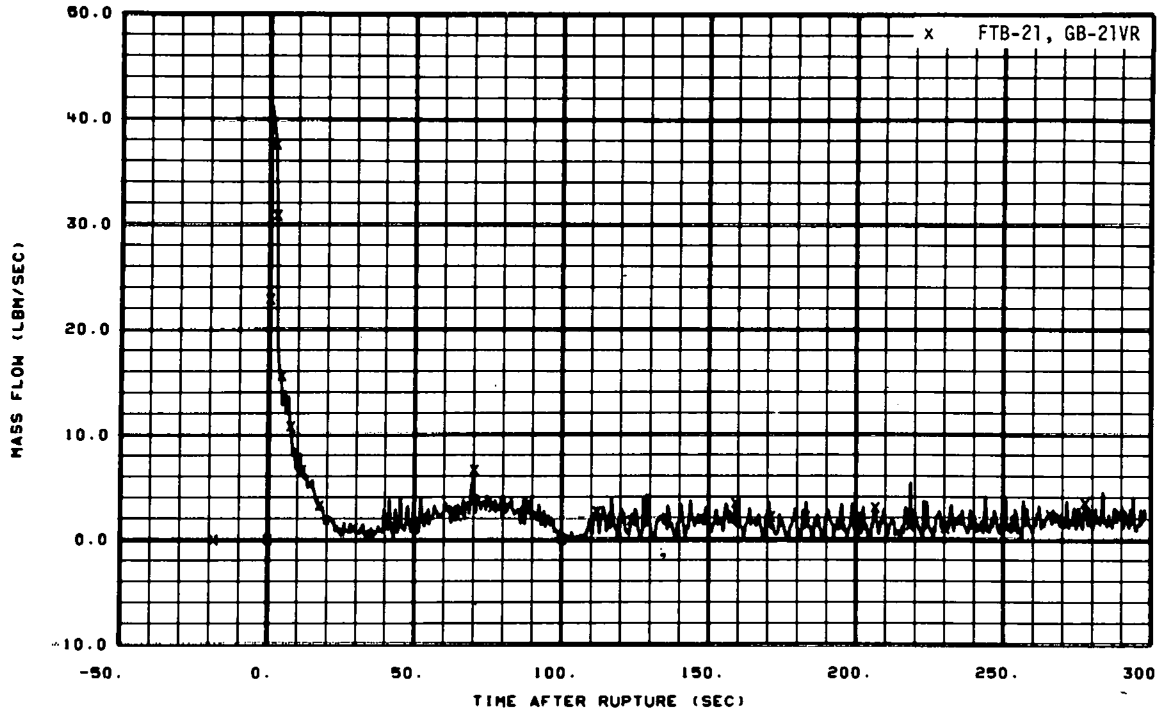

Fig. 279 Mass flow in broken loop (FTB-21 and GB-21VR), from -20 to 300 seconds.

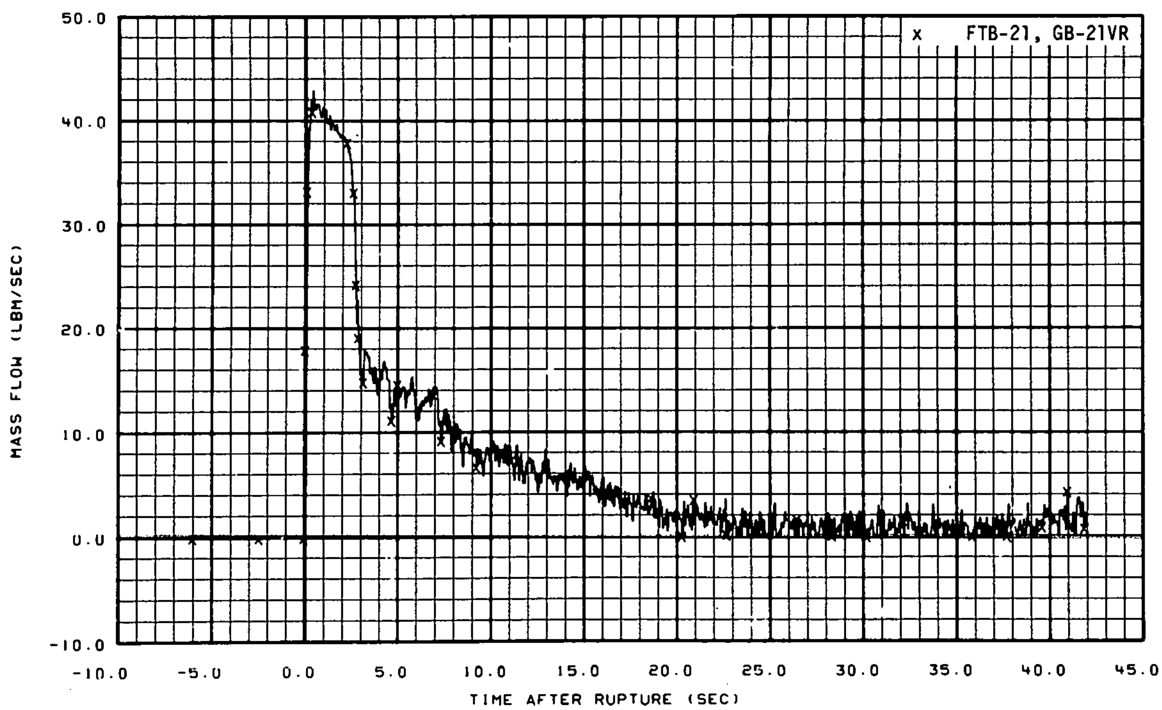

Fig. 280 Mass flow in broken loop (FTB-21 and GB-21VR), from -6 to 42 seconds.

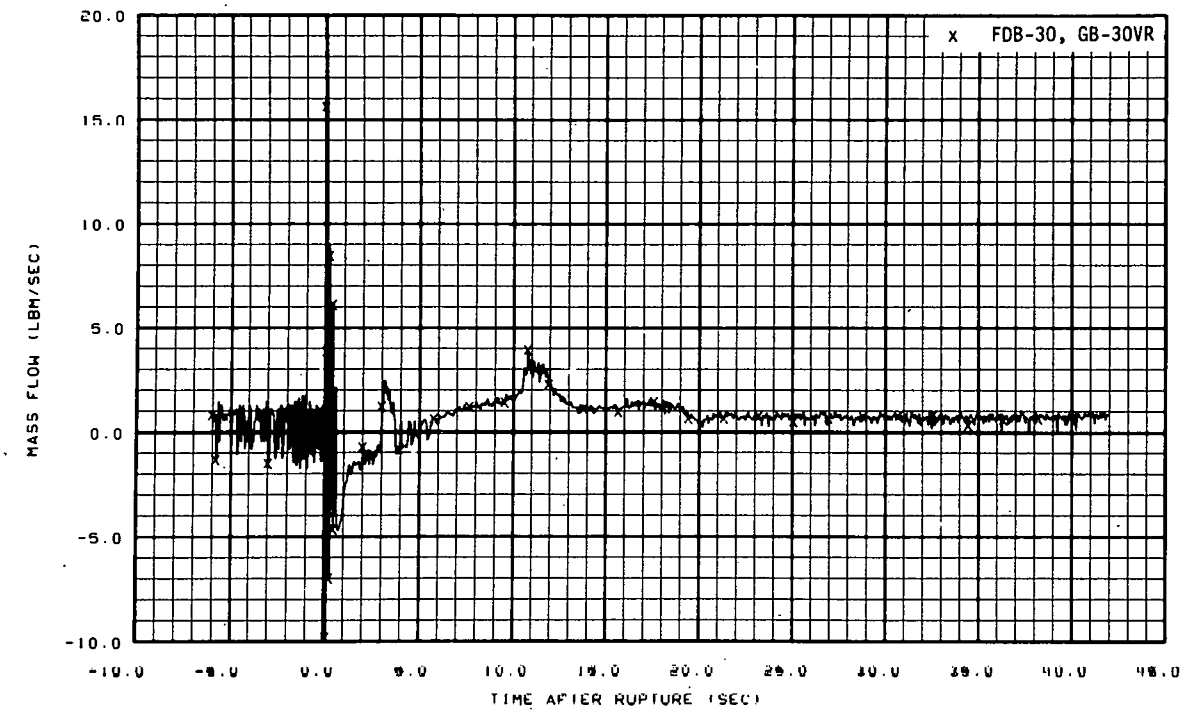

Fig. 281 Mass flow in broken loop (FDB-30 and GB-30VR), from -6 to 42 seconds.

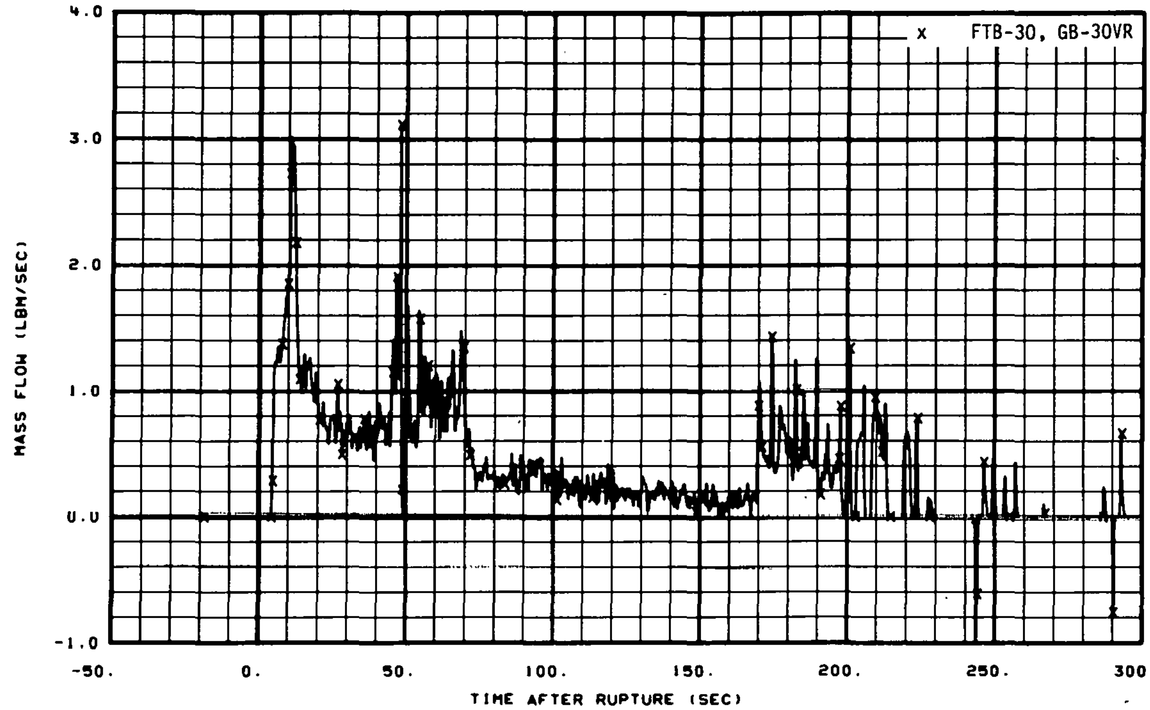

Fig. 282 Mass flow in broken loop (FTB-30 and GB-30VR), from -20 to 300 seconds.

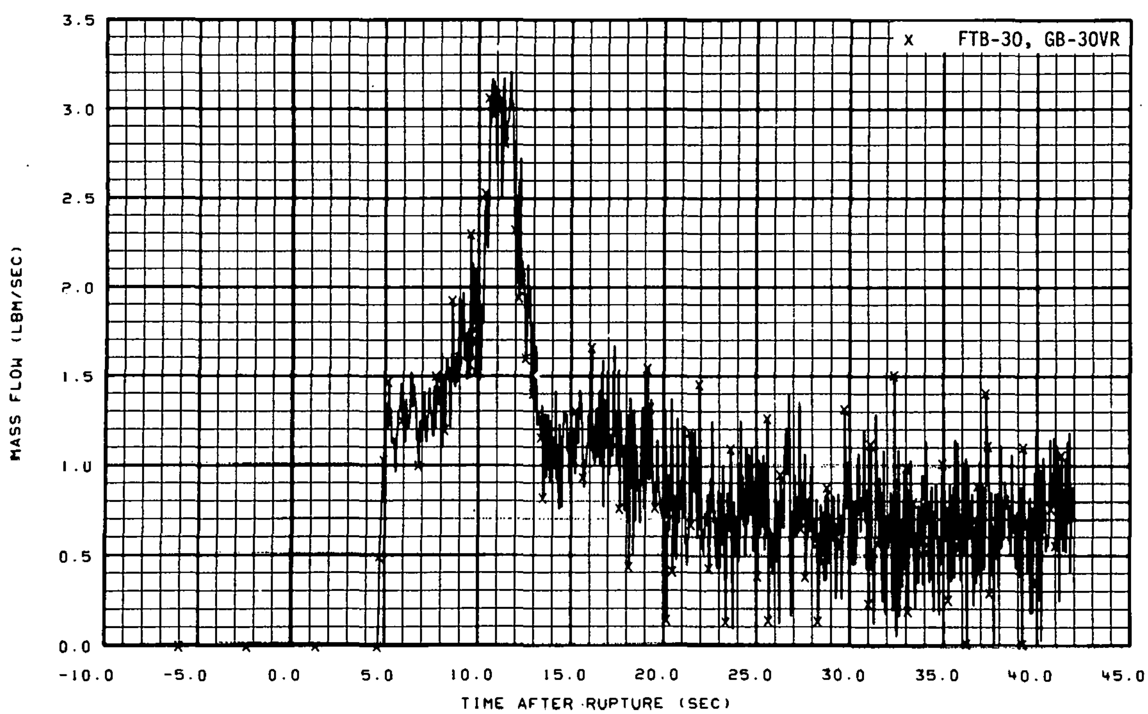

Fig. 283 Mass flow in broken loop (FTB-30 and GB-30VR), from -6 to 42 seconds.

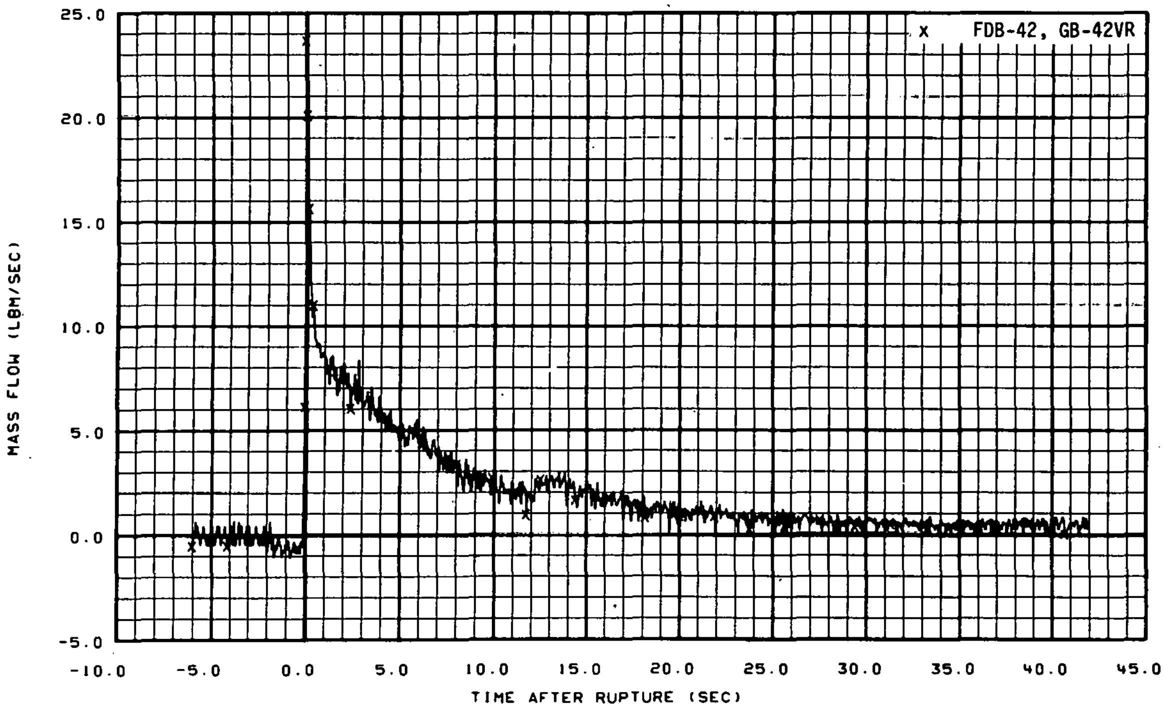

Fig. 284 Mass flow in broken loop (FDB-42 and GB-42VR), from -6 to 42 seconds.

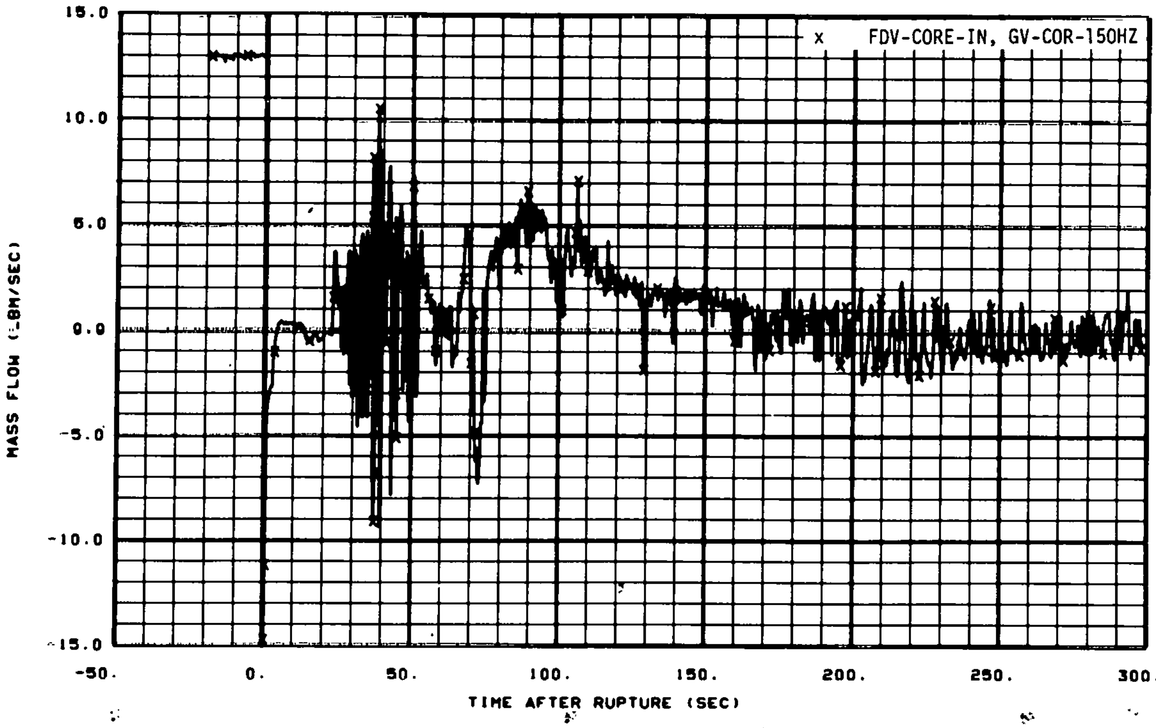

Fig. 285 Mass flow in vessel (FDV-CORE-IN and GV-COR-150HZ), from -20 to 300 seconds.

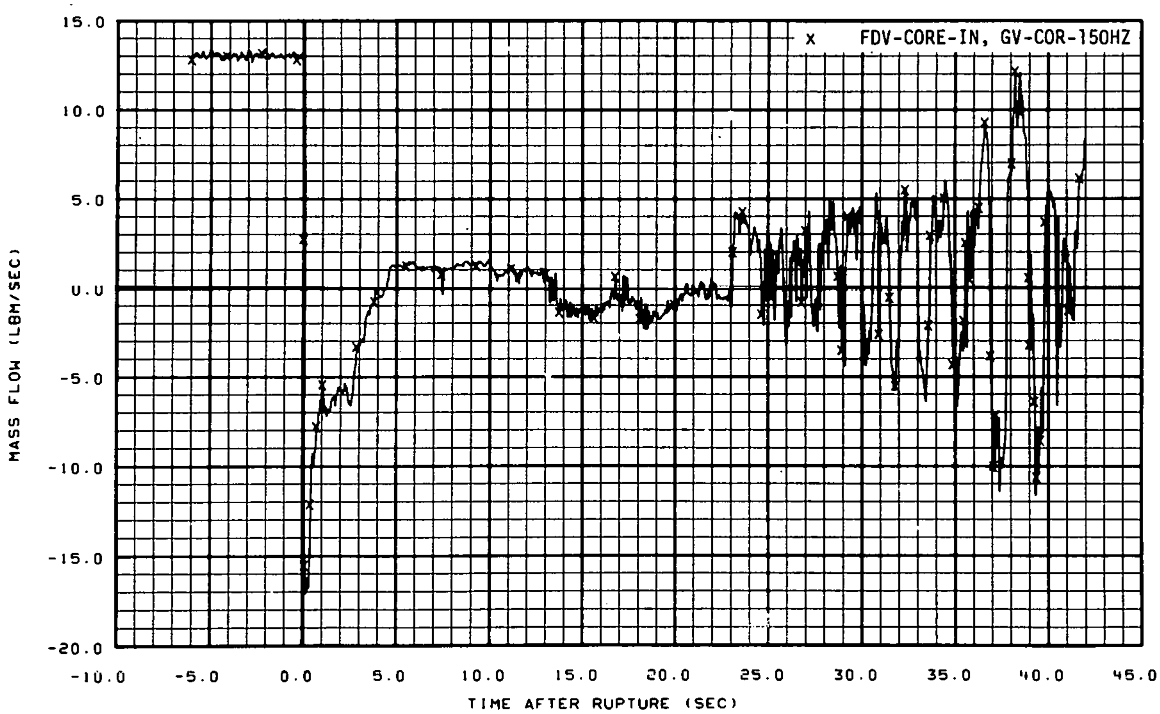

Fig. 286 Mass flow in vessel (FDV-CORE-IN and GV-COR-150HZ), from -6 to 42 seconds.

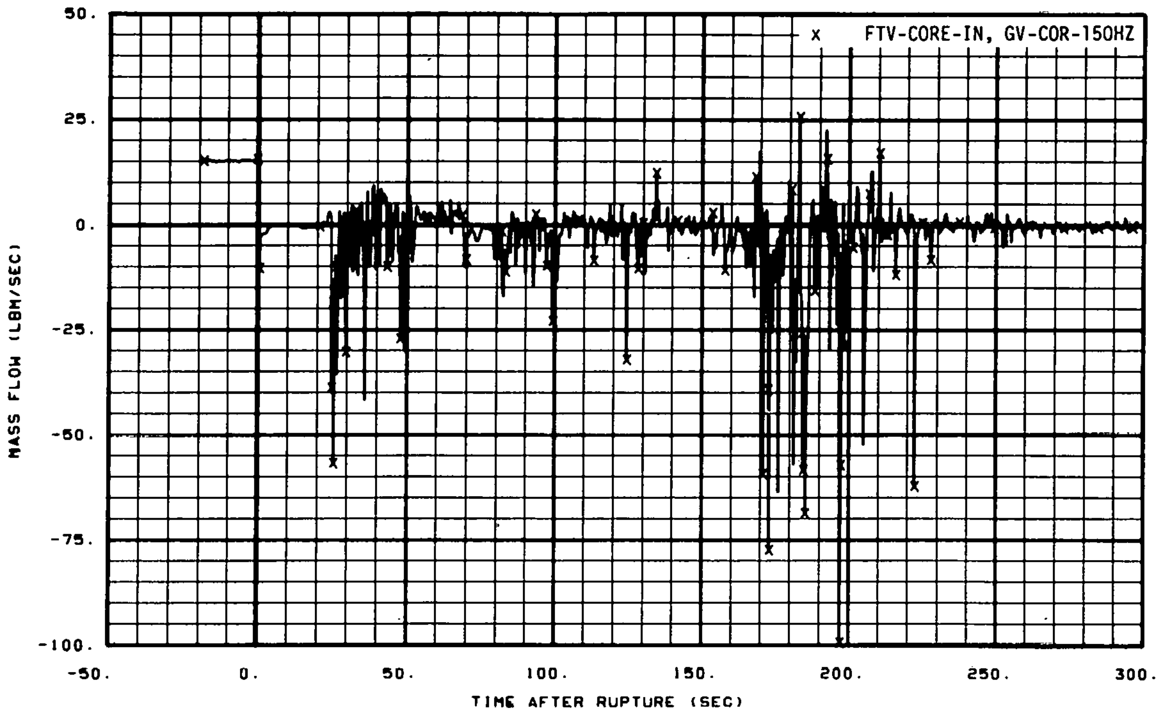

Fig. 287 Mass flow in vessel (FTV-CORE-IN and GV-COR-150HZ), from -20 to 300 seconds.

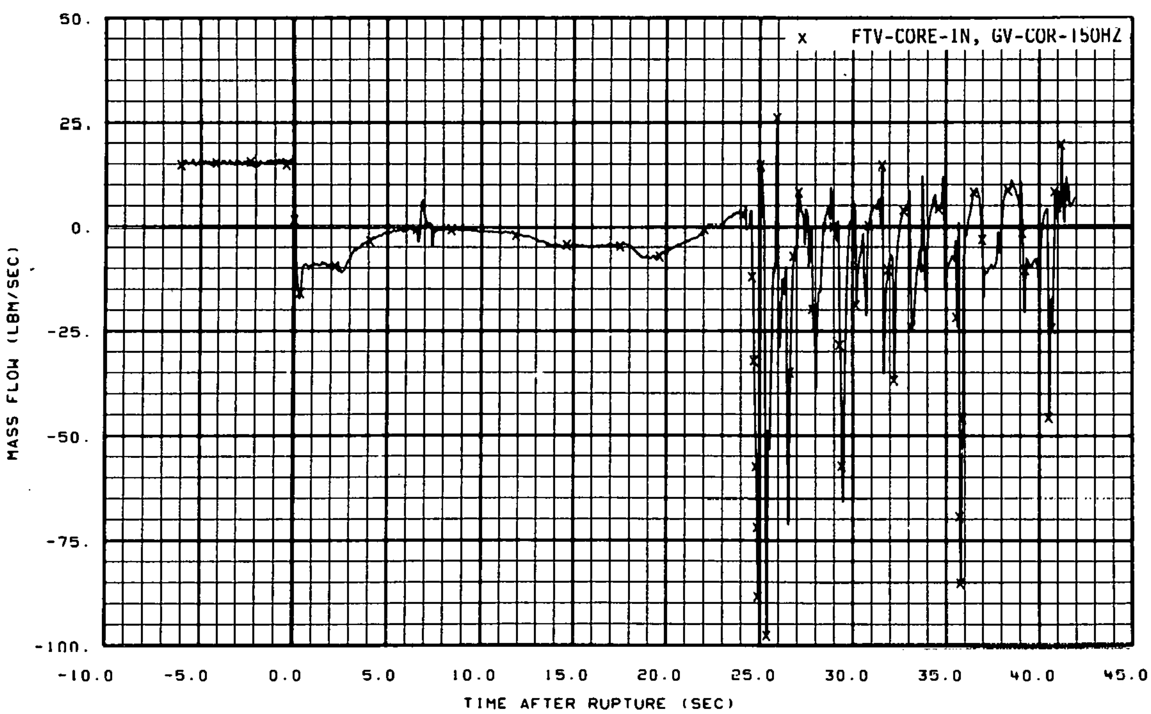

Fig. 288 Mass flow in vessel (FTV-CORE-IN and GV-COR-150HZ), from -6 to 42 seconds.

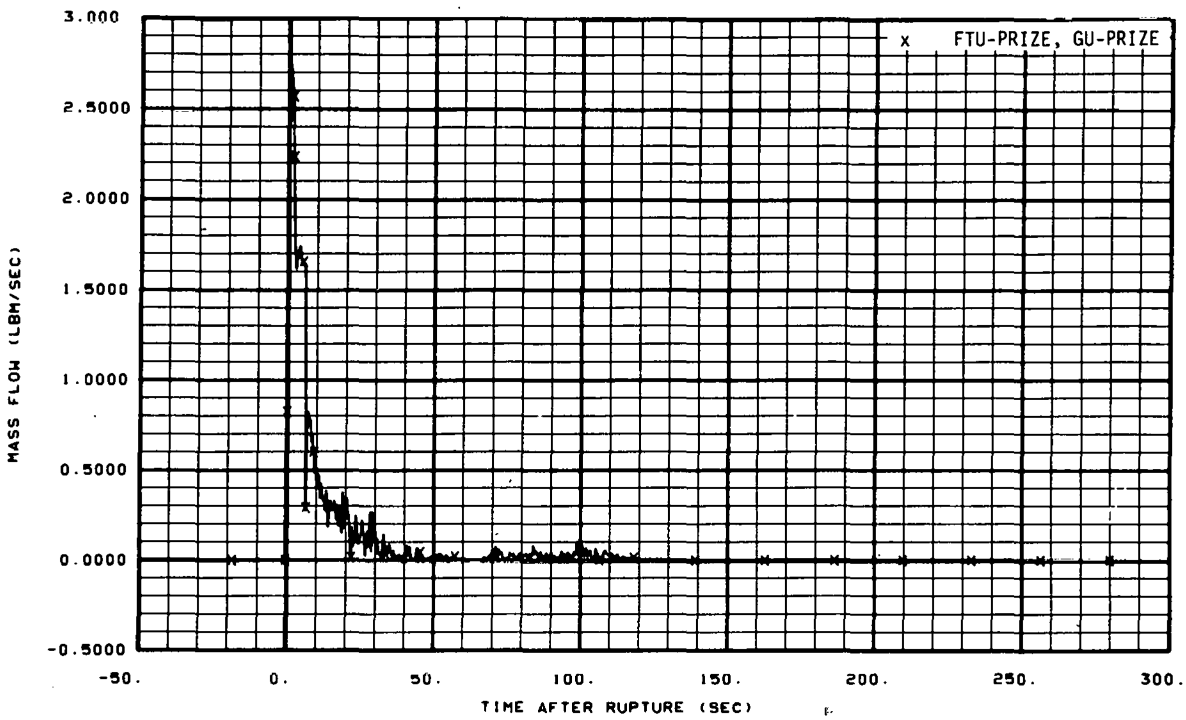

Fig. 289 Mass flow in pressurizer surge line (FTU-PRIZE and GU-PRIZE), from -20 to 300 seconds.

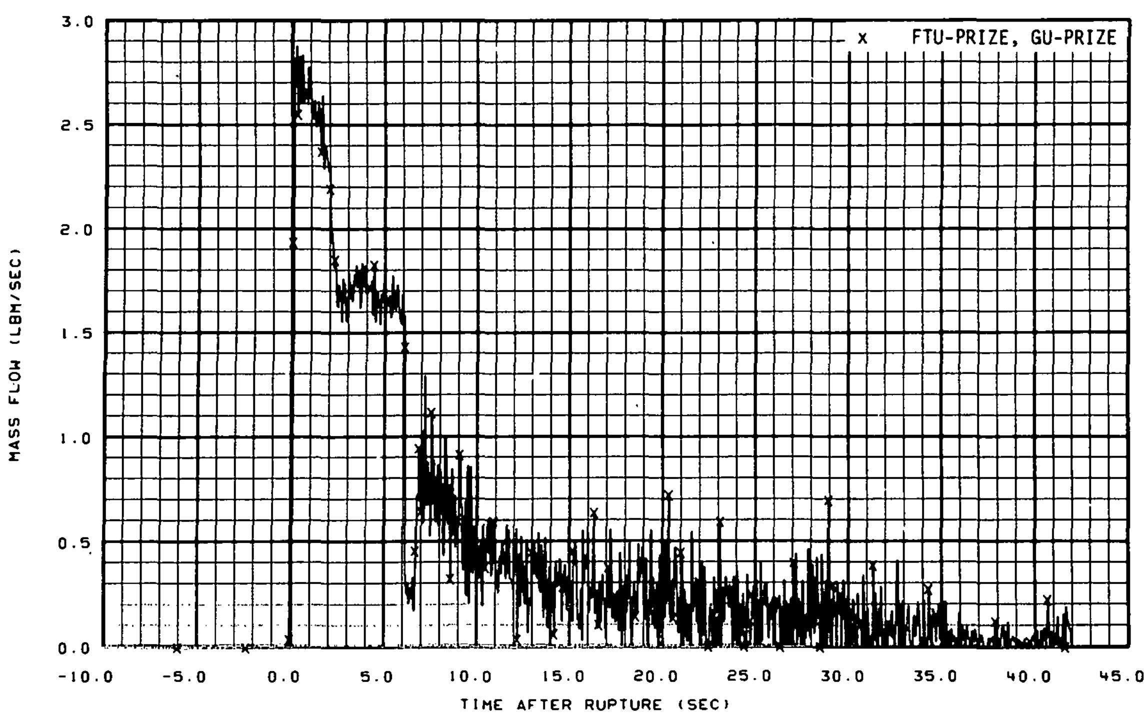

Fig. 290 Mass flow in pressurizer surge line (FTU-PRIZE and GU-PRIZE), from -6 to 42 seconds.

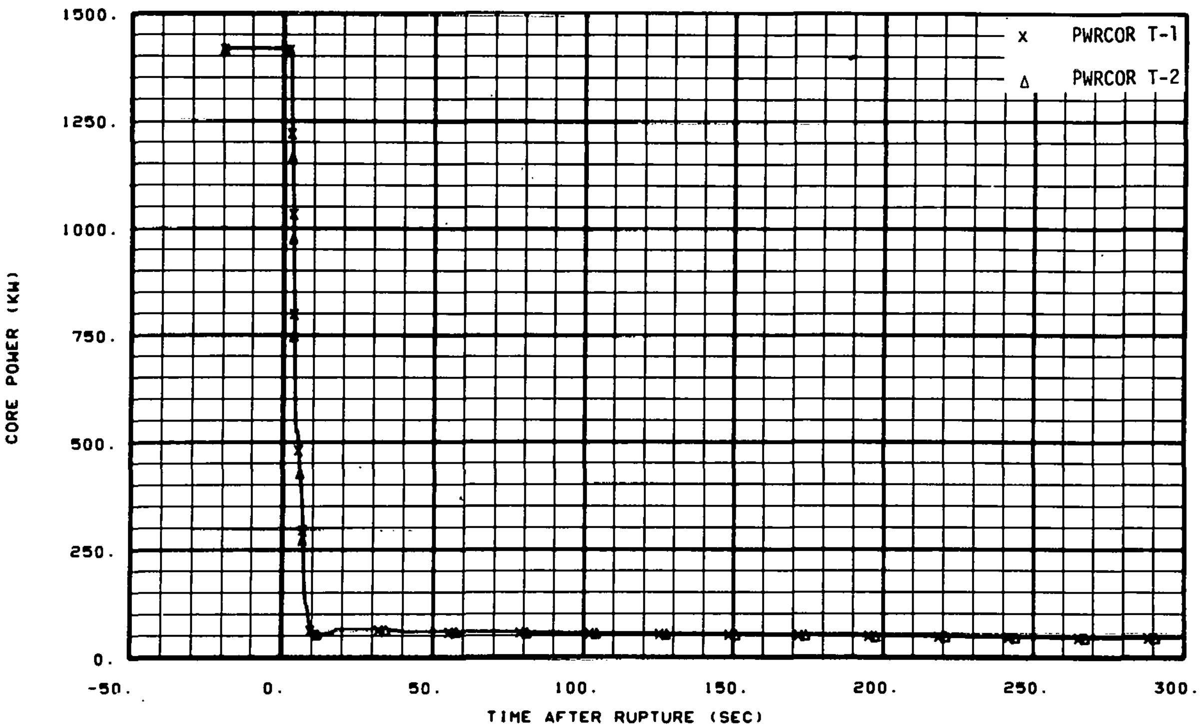

Fig. 291 Core heater pin total power (PWRCOR T-1 and PWRCOR T-2), from -20 to 300 seconds.

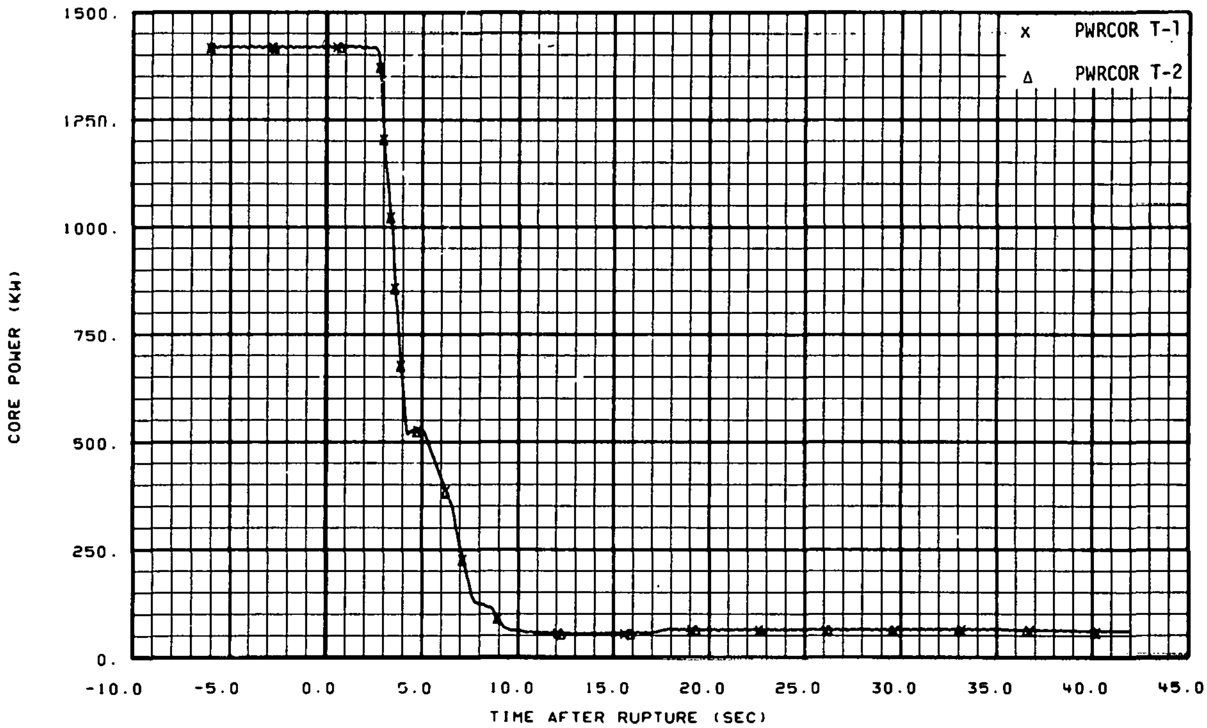

Fig. 292 Core heater pin total power (PWRCOR T-1 and PWRCOR T-2), from -6 to 42 seconds.

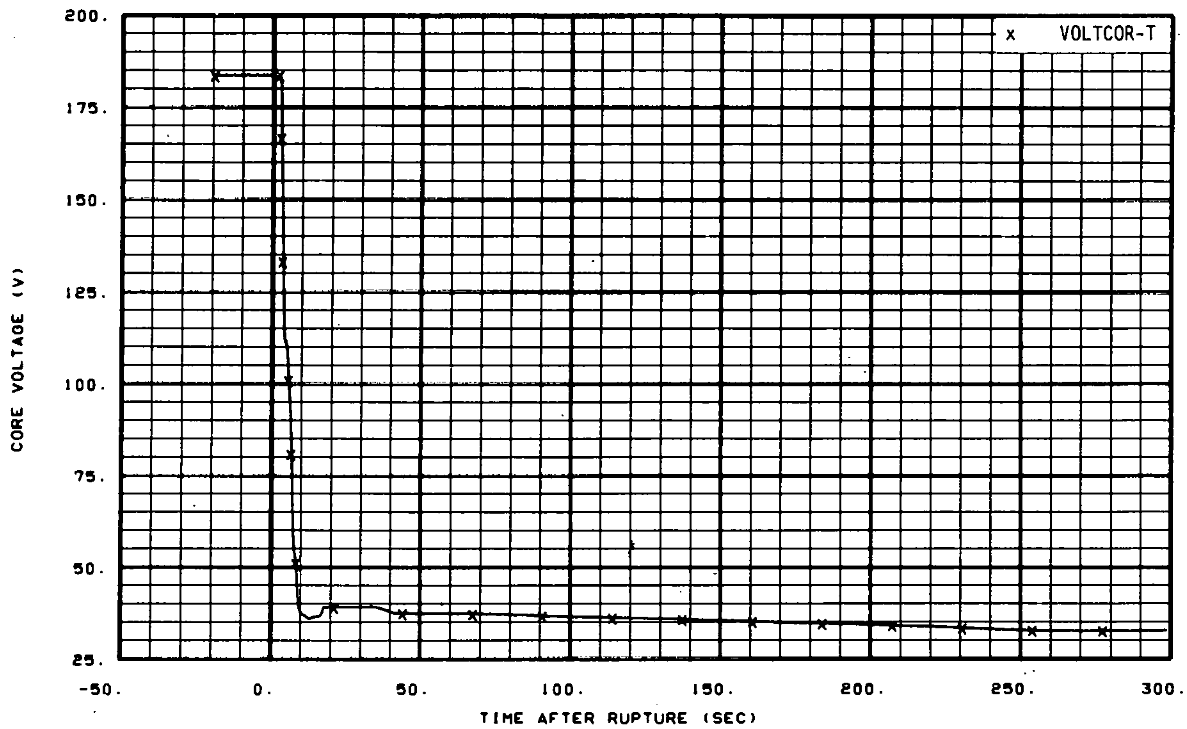

Fig. 293 Core heater voltage (VOLTCOR-T), from -20 to 300 seconds.

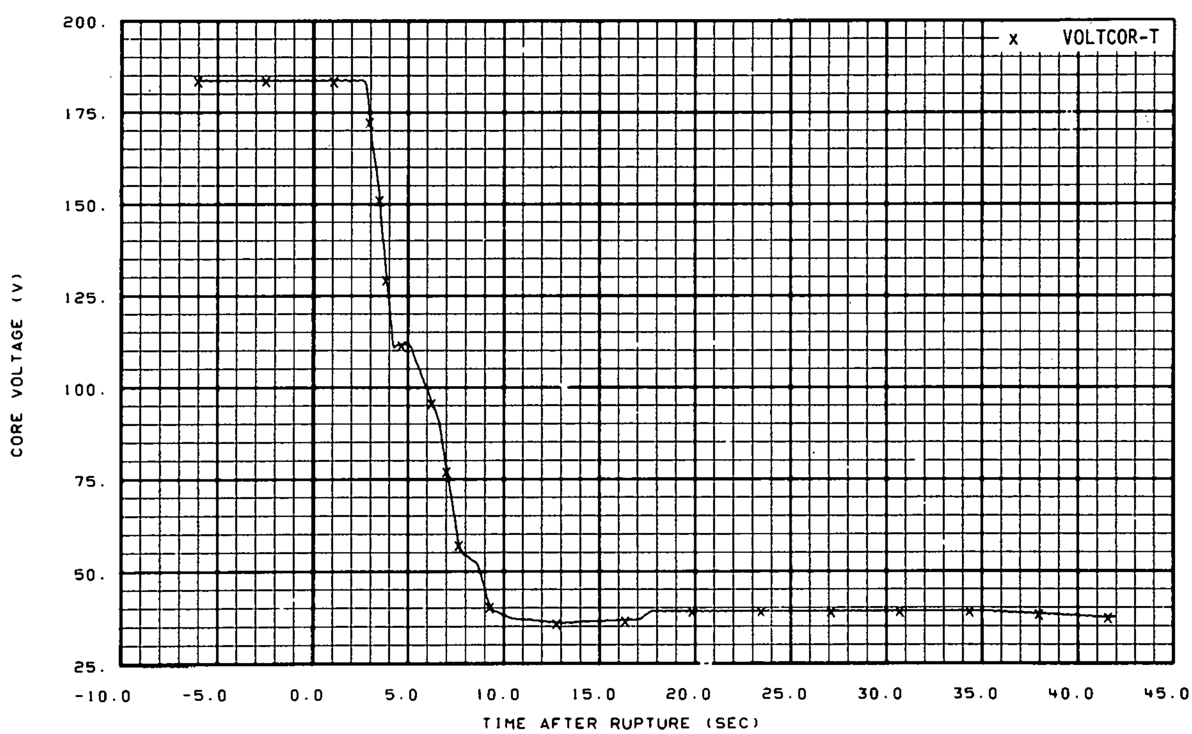

Fig. 294 Core heater voltage (VOLTCOR-T), from -6 to 42 seconds.

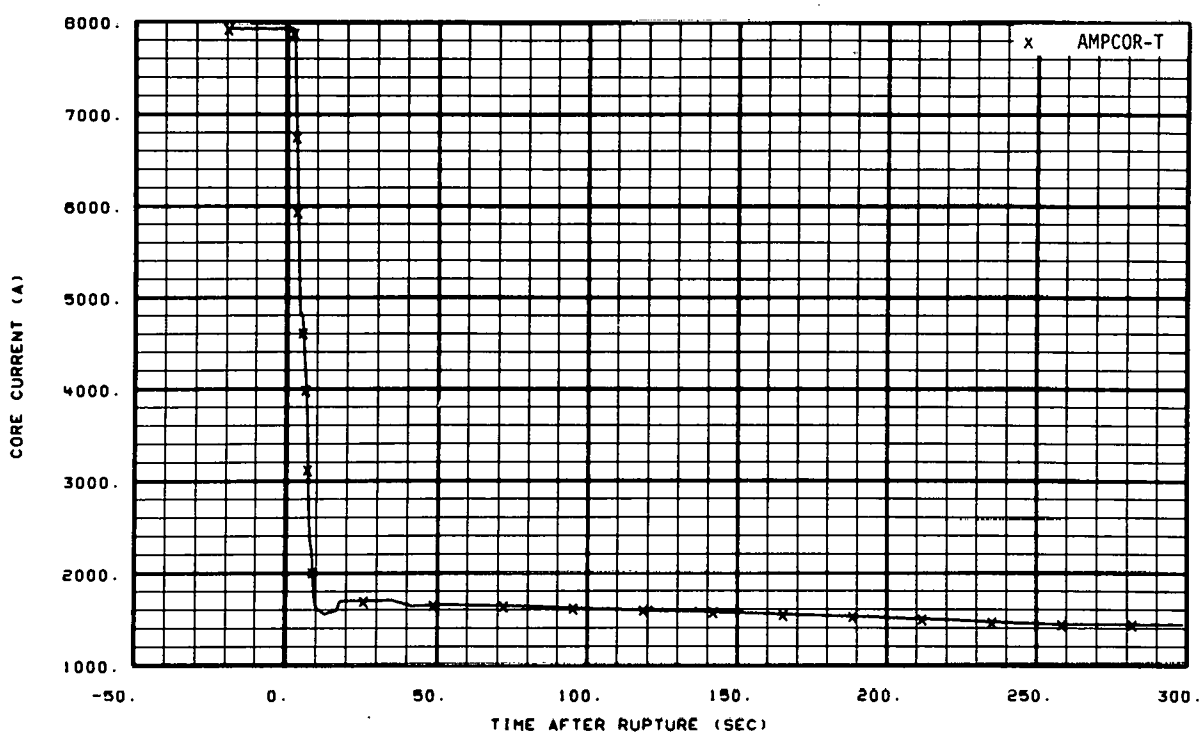

Fig. 295 Core heater total current (AMPCOR-T), from -20 to 300 seconds.

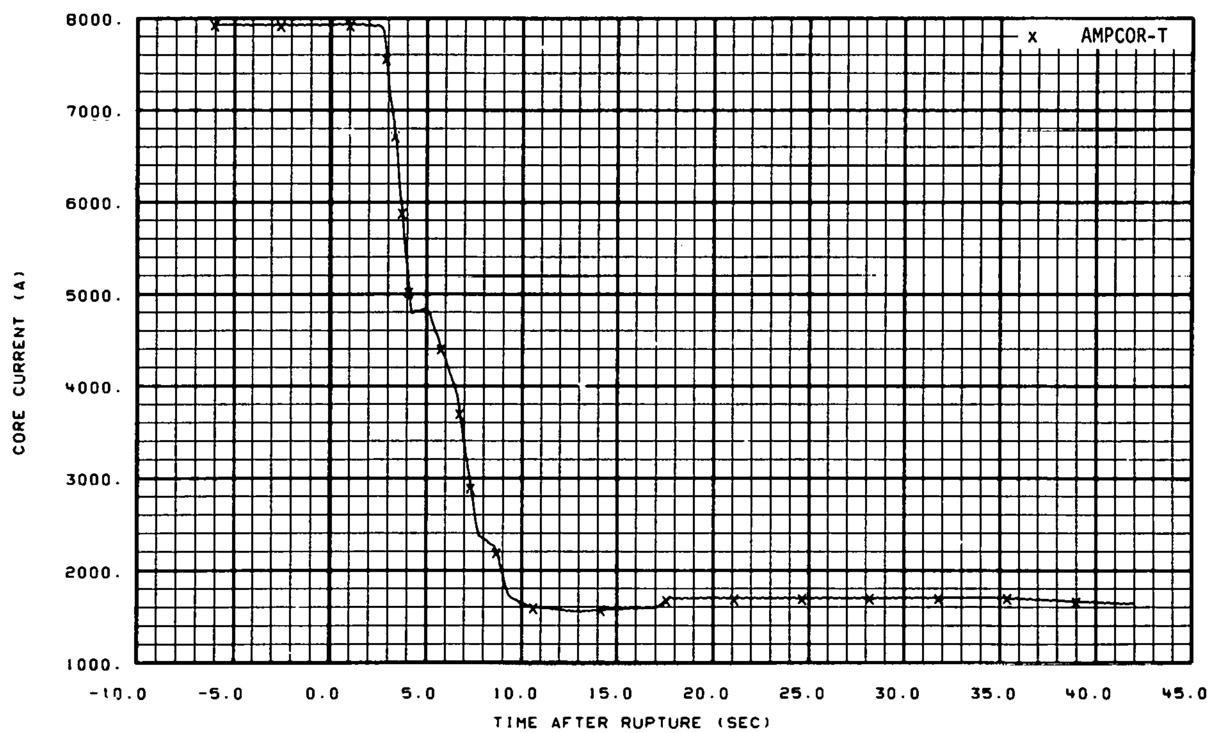

Fig. 296 Core heater total current (AMPCOR-T), from -6 to 42 seconds.

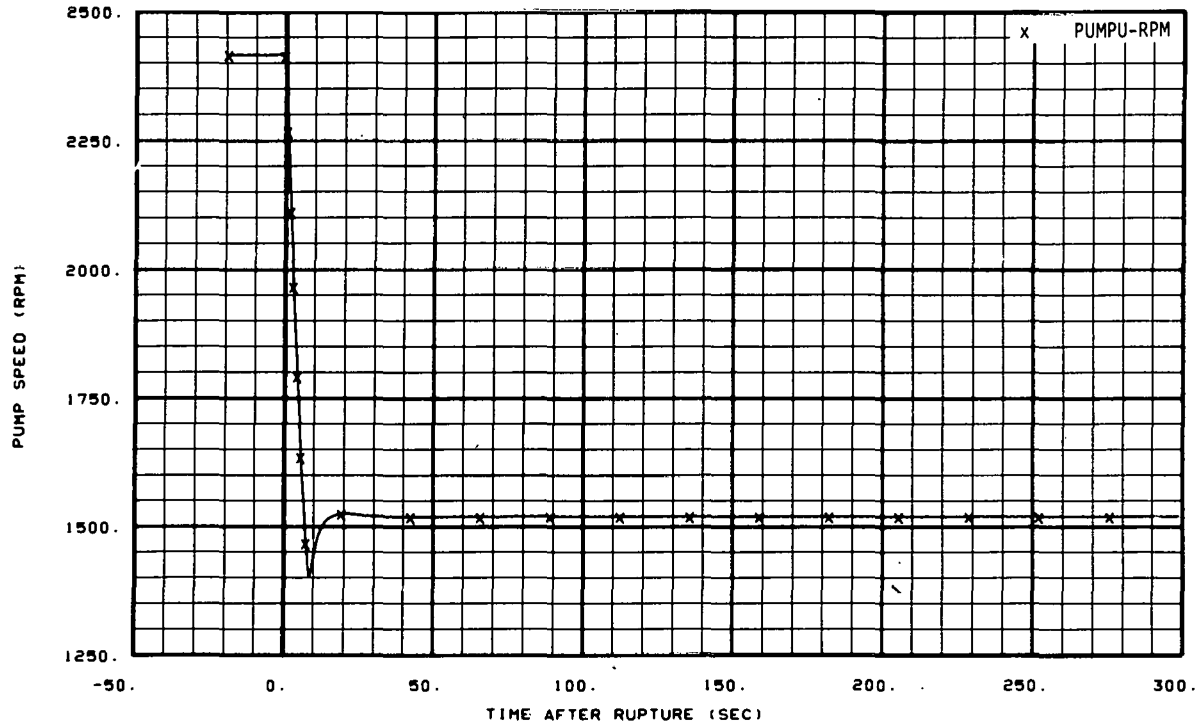

Fig. 297 Primary pump speed (PUMPU-RPM), from -20 to 300 seconds.

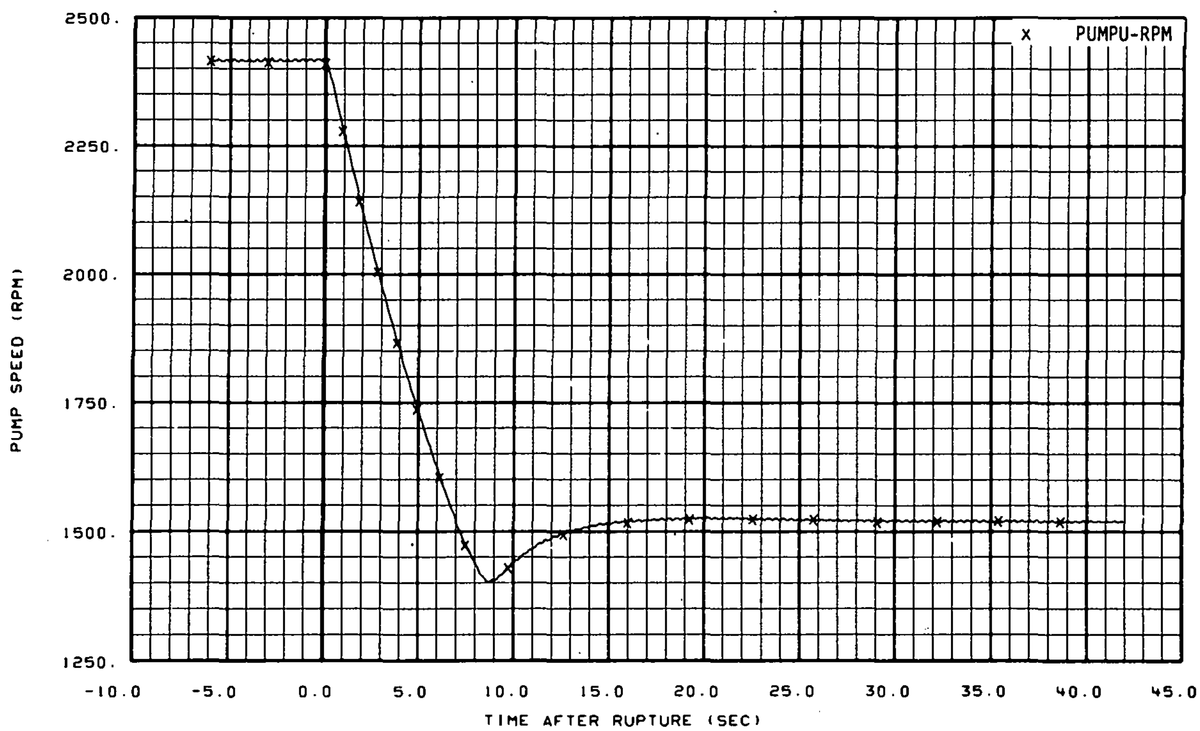

Fig. 298 Primary pump speed (PUMPU-RPM), from -6 to 42 seconds.

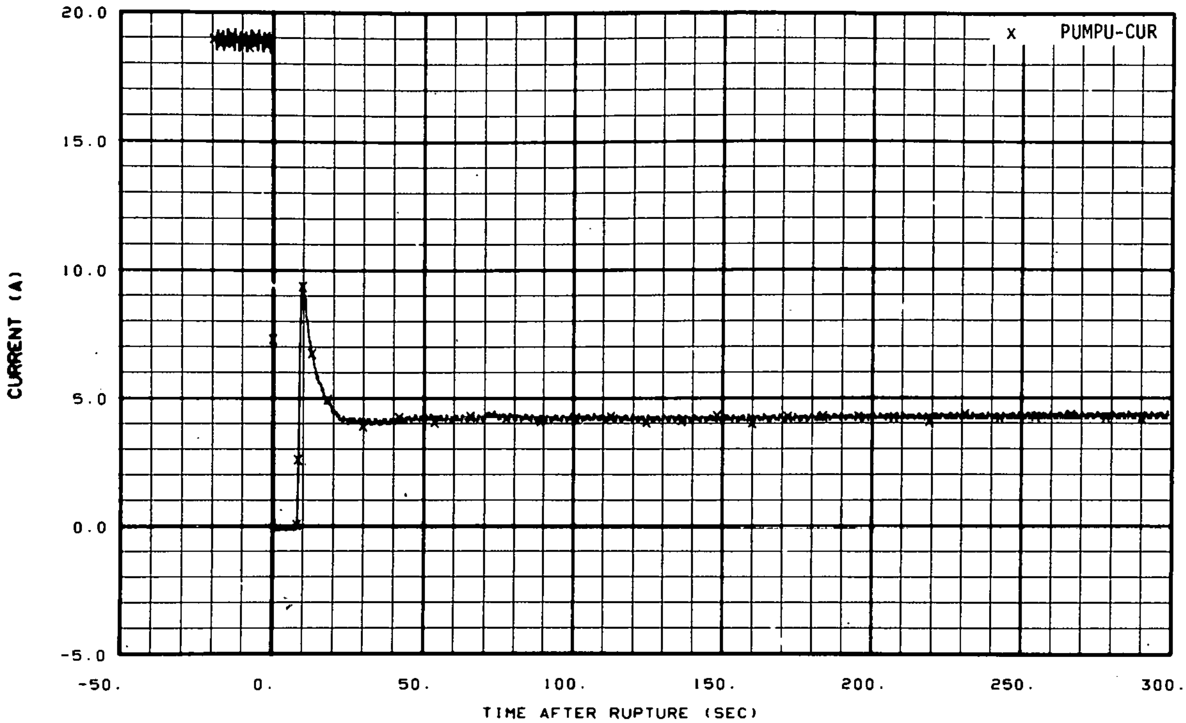

Fig. 299 Primary pump current (PUMPU-CUR), from -20 to 300 seconds.

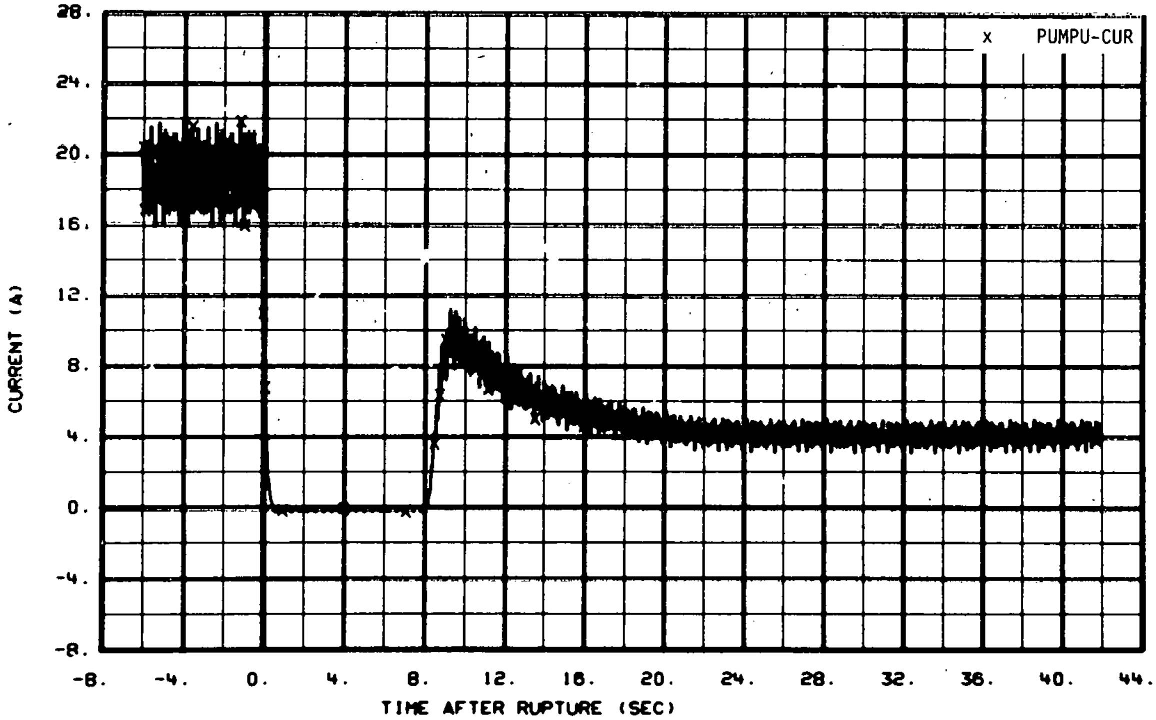

Fig. 300 Primary pump current (PUMPU-CUR), from -6 to 42 seconds.

IV. REFERENCE

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

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APPENDIX A

POSTTEST ADJUSTMENTS TO DATA FROM SEMISCALE MOD-1 TEST S-05-1

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APPENDIX A

POSTTEST ADJUSTMENTS TO DATA FROM SEMISCALE MOD-1 TEST S-05-1

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

Although the errors introduced into the data by spurious secondary inputs generally do not exceed the specified error ranges of the transducers, significant improvement in measurement accuracy can be achieved if the secondary sensitivity can be identified and removed. In the case of the drag discs, corrections are absolutely necessary because the signal due to temperature fluctuations can exceed that due to flow by several hundred percent. Since the exact values of the spurious inputs to which different transducers might be sensitive cannot often be easily predicted and are sometimes inconvenient to measure, secondary effects have been accounted for by correcting the data after the test rather than by using elaborate real time programs in the data acquisition system computer. The methods and results of the posttest data correction analysis for Test S-05-1 are presented in the following paragraphs and tables.

1. PRESSURE MEASUREMENTS

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

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

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

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

where

$F'(t)$	=	corrected data
$F(t)$	=	raw data
C_0	=	offset
C_1	=	scaling factor.

The exact values of C_0 and C_1 are given in Table A-I.

TABLE A-I

CONSTANTS FOR PRESSURE MEASUREMENT CORRECTIONS (TEST S-05-1)

Detector Identification	C_0	C_1
PU-13(F)	-56.5	1.0167
PU-SGSD	57.7	0.9820
PV-UP+10	1.4	0.9993
PU-PRIZE	10.4	0.9877
PB-CN1	-15.5	0.9953
PB-23	8.0	0.9950
PB-42	6.3	0.9954
PB-HN1	-15.0	0.9956
PB-37	10.6	0.9943
PV-LP-166	-4.2	0.9975

2. DIFFERENTIAL PRESSURE MEASUREMENTS

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

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

The difference between the measured pressure corrected value and the calculated value is the thermal drift. After the data scan at 500°F is made, no more opportunities exist to obtain data with the pump stopped and the system full of liquid; therefore, for lack of later data, the thermal drift calculated from the 500°F data is assumed to be constant throughout the test.

For some differential pressure measurements, the data scan at 500°F cannot be used as a reference for thermal drift, so other references are used. The liquid level measurements in the vessel accumulator (DPV-ACC-TB) and pressurizer (DPU-PRESLL) are referenced to calculated values based on geometrical considerations at the time when gas flow from the respective vessel is first noted. The reading from the steam generator discharge venturi (DPU-SGDISC) is shifted to read zero after flow is stopped. The steam generator secondary liquid level measurement (DPU-SG-SEC) is shifted to match the output of the process instrumentation prior to blowdown.

In correcting differential pressure data for pressure sensitivity, the corrections are calculated for various times during the test by referring to nearby system pressure transducers. The thermal drift correction is then added to each pressure sensitivity correction and the combined value is added to the raw data using a computer program that linearly interpolates the corrections between the specified time points. The corrections are performed according to the following equations:

$$F'(t) = KF(t) + C_1 \text{ for } t < t_1 \text{ or when no } t_i \text{ are listed}$$

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

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

i takes on values 1 to n-1

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

where

t	=	time
F'(t)	=	corrected data
F(t)	=	raw data
K	=	scaling factor
C_i and t_i	=	corrections and time points.

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

TABLE A-II

CONSTANTS FOR DIFFERENTIAL PRESSURE MEASUREMENT CORRECTIONS (TEST S-05-1)

Detector Identification	K	C_1	t_1	C_2	t_2	C_3	t_3
DPV-ACC-TB	2[a]	-1.64					
DPU-SGDISC	1	0.5					
DPV-0-9GQ	1	-0.077	0	-0.073	0.01	-0.057	30
DPU-3-7	1	0.175	0	0.10	0.01	-0.03	30
DPB-30-36L	1	3.6	0	2.5	0.01	0.2	30
DPU-PRESLL	1	-0.4					
DPU-SG-SEC	-1[b]	3.06					
DPB-23-CNI	-1[c]						
DPB-32U-36L	1	4.0	0	2.6	0.01	0	30
DPV-UP-IANN	1	4.0	0	0.075	0.01	0.02	30
DPB-37-38	1	0.11	0	0.1	0.01	0.08	30
DPB-36L-37	1	-0.3	0	-0.2	0.01	-0.03	30
DPU-15-1	1	0.24	0	0.16	0.01	0.02	30
DPU-15-1L	1	-0.065	0	-0.04	0.01	-0.0003	30
DPB-38-40	-1[c]	3.7	0	2.5	0.01	0.3	30
DPB-40-42	1	-0.035	0	-0.033	0.01	-0.023	30
DPB-21-IANN	1	-0.051	0	-0.036	0.01	-0.006	30
DPU-12-10	1	0.61	0	0.50	0.01	0.28	30
DPU-12-10L	1	0.044	0	0.048	0.01	0.054	30
DPB-UP-30	1	0.03	0	0.022	0.01	0	30
DPU-PR-4	1	-9.3	0	-7.4	0.01	-4.6	30
DPV-9-26QQ	1	0.027	0	0.015	0.01	0	30
DPV-26-55QM	1	-0.11	0	-0.05	0.01	0.045	30
DPU-15-IANN	1	0.038	0	0.024	0.01	-0.006	30
DPU-7-10	1	-0.045	0	-0.033	0.01	0.01	30
DPVC-89-W-UP	1	0.39	0	0.25	0.01	0.02	30
DPVC-9-166QQ	1	0.55	0	0.42	0.01	0.14	30
DPVC-122-140JD	1	0.04	0	0.065	0.01	0.10	30
DPVC-106-122QJ	1	-0.033	0	-0.022	0.01	0	30
DPV-55-110MM	1	-0.08	0	-0.065	0.01	-0.04	30

TABLE A-II (continued)

Detector Identification	K	C_1	t_1	C_2	t_2	C_3	t_3
DPV-166-173QQ	1	-0.02	0	-0.013	0.01	-0.001	30
DPV-110-136MQ	1	-0.75					

[a] Data acquisition computer used wrong multiplier.

[b] Transducer output was inverted and offset to show liquid level.

[c] Patch panel connections were reversed.

3. MOMENTUM FLUX MEASUREMENTS (DRAG DISCS)

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

$$F'(t) = F(t) + D_o - D_1T(t)$$

where

$F'(t)$ = corrected data

$F(t)$ = raw data

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

D_o = ambient offset

D_1 = temperature sensitivity.

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

The drag discs, FDB-30 and FDB-37, were partially filled with subcooled water during blowdown, giving them an unpredictable temperature response. Due to this problem, corrections to FDB-30 and FDB-37 are done only to set the transducer output to zero at

TABLE A-III

CONSTANTS FOR MOMENTUM FLUX
MEASUREMENT CORRECTIONS (TEST S-05-1)

Detector Identification	D_o	D_1	T(t)[a]	K	C_1	t_1	C_2	t_2
FDV-CORE-IN	-0.04	-0.000626	TFV-LP-7					
FDU-10		0.000216	TMU-1T16					
FDU-13	0.01	0.000729	TMU-15B16					
FDB-21		-0.000748	TMB-20B16					
FDB-42		0.000787	TFB-42					
FDU-1	0.01	-0.000663	TMU-1T16					
FDU-15		-0.001533	TMU-15B16					
FDB-30				1	0.433			
FDB-37				1	-0.265	0	0.05	40

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

times when no flow occurs in the broken loop. Adjustments were made using the same time-based equations used for the differential pressure corrections described in Section A-2. Values of the constants are given in Table A-III.

4. DENSITY MEASUREMENTS

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

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

where

ρ	=	density in lbm/ft^3
C	=	constant based on the length of the gamma beam path
D	=	theoretical voltage for zero attenuation inside the vessel
A	=	amplification factor
B	=	biasing factor
F(t)	=	transducer voltage output.

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

The density measurement GVLP-172HZ uses an amplifier which precalculates the logarithm function, and hence has a simpler conversion formula

$$\rho = 10 - 1.845\ F(t).$$

TABLE A-IV

CONSTANTS FOR DENSITY MEASUREMENT
CONVERSIONS TO ENGINEERING UNITS (TEST S-05-1)

Detector Identification	A	B	C	D
GV-COR-150Hz	0.7376	0.528	0.014	4.1
GB-30 VR	1.027	-0.137	0.0095	6.75
GB-42	0.907	0.593	0.006	6.1
GU-1VR	1.087	-0.194	0.0095	3.2
GU-1Hz	1.261	-1.27	0.0095	5.3
GU-5VR	1.153	-0.861	0.0095	6.2
GU-10VR	1.083	-0.543	0.0095	7.2
GU-13VR	1.281	-0.765	0.0095	2.9
GU-15VR	1.047	-0.329	0.0095	7.2
GU-15Hz	1.035	-0.041	0.0095	1.75
GB-21VR	1.015	-0.079	0.0095	6.55
GB-23VR	1.034	-0.274	0.006	7.9
GU-PRIZE	1.043	-0.068	0.0095	2.3
GVLP-165Hz	0.771	1.469	0.014	6.4

5. CORE POWER MEASUREMENTS

Corrections to core power readings are determined from the core voltage and core current readings, with a slight adjustment for the power lost in setting the core radial peaking factor. The adjustments are as follows:

PWRCOR T-1: $F'(t) = 0.9950\ F(t) - 1.06 = [(\text{Voltage})\ (\text{Current})\ (0.974)]$

PWRCOR T-2: $F'(t) = 0.9891\ F(t) + 4.85 = [(\text{Voltage})\ (\text{Current})\ (0.974)]$

where

$F'(t)$ = core power in kilowatts

$F(t)$ = raw core power reading.

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