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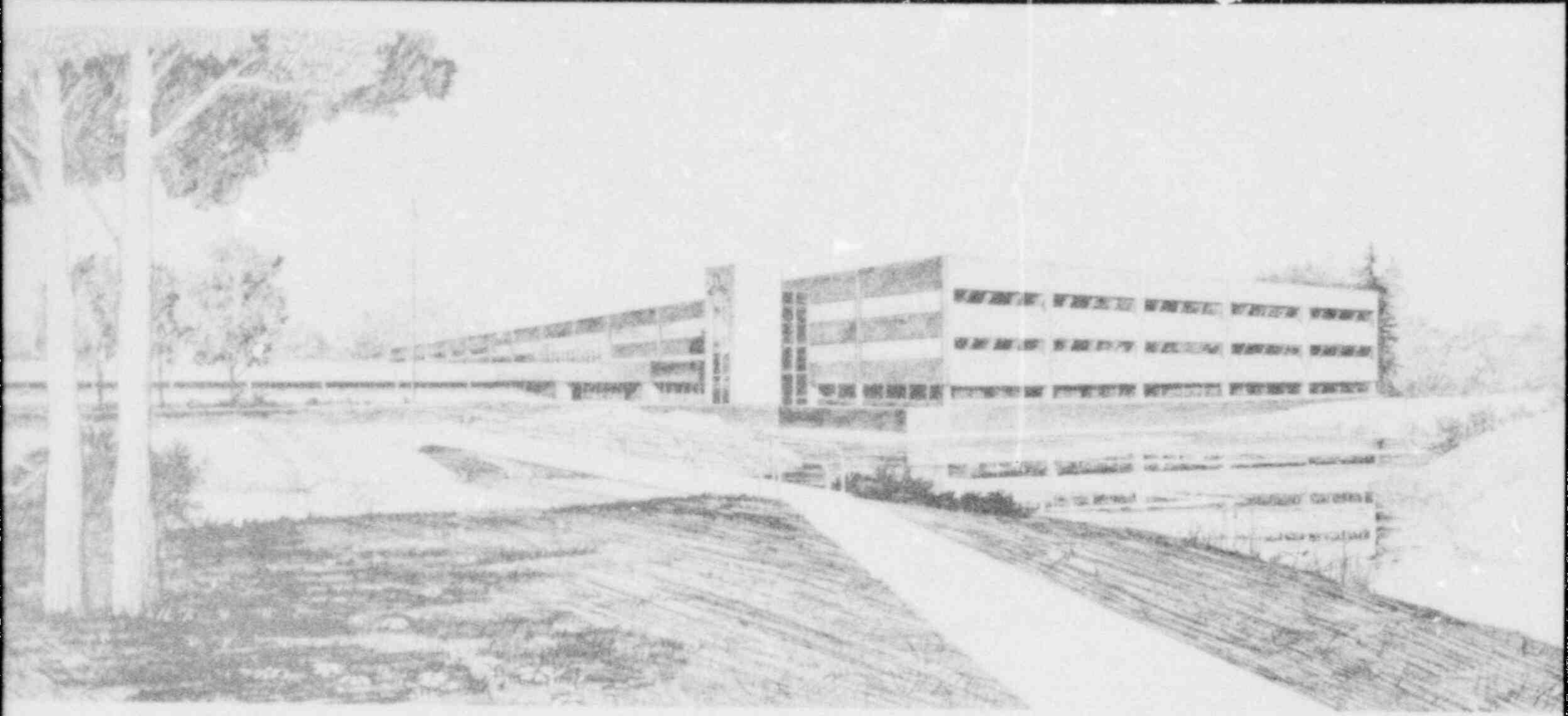

U.S. Department of Energy
Idaho Operations Office • Idaho National Engineering Laboratory

Experiment Data Report For LOFT Nuclear Small Break Experiment L3-2

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EXPERIMENT DATA REPORT FOR LOFT NUCLEAR SMALL BREAK EXPERIMENT L3-2

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ABSTRACT

Experiment L3-2 was the second nuclear small break loss-of-coolant experiment conducted at the Loss-of-Fluid Test (LOFT) facility. The primary objectives of the experiment were to obtain data for analytical code assessment and to further the understanding of the thermal-hydraulic behavior which occurs during a postulated loss-of-coolant accident in a pressurized water reactor. Additional objectives of the experiment were to determine emergency core cooling system performance, determine any unexpected thresholds or events, determine how effectively typical process instrumentation indicated the true system condition, and define variations in system design or plant operation that could mitigate small break transient phenomena. The experiment successfully accomplished the objectives. The LOFT facility was configured to simulate a postulated loss-of-coolant accident caused by a small break in the primary coolant system cold leg in a commercial pressurized water reactor (~1000 MWe). The cold leg break size was equivalent to a 1-inch diameter rupture in a commercial plant, scaled on a break area to system volume basis. The break size caused the break flow to be approximately equal to the high-pressure injection system (HPIS) flow at a pressure lower than the HPIS initiation pressure but greater than the accumulator initiation pressure. The system mass flow rate was greater than predicted, and it is currently being investigated. Steam generator feed and bleed was used to reduce primary system pressure to the residual heat removal initiation pressure for typical large pressurized water reactors (≈2.5 MPa). Purification system recirculation flow simulated a residual heat removal system during Experiment L3-2. During system depressurization, emergency core cooling water was injected into the intact loop cold leg. Pertinent initial conditions were near nominal for a typical large pressurized water reactor. Recorded data for Experiment L3-2 are presented.

SUMMARY

Experiment L3-2 was performed on February 6, 1980, as part of the Loss-of-Fluid Test (LOFT) Program conducted by EG&G Idaho, Inc., for the U.S. Nuclear Regulatory Commission. This experiment is part of the LOFT Small Break Experiment Series L3 which was designed to investigate the thermal-hydraulic response of LOFT reactor systems to small primary system ruptures. Experiment L3-2 was conducted at 49 ± 1 MW (yielding a maximum linear heat generation rate of 52.2 ± 3.7 kW/m). The following L3 series objectives pertain to Experiment L3-2:

1. How does the primary coolant system respond during a small break when break flow is the same order of magnitude as the high-pressure injection system (HPIS) as system pressure stabilizes later in the transient?
2. How many of the major systems, such as low-pressure injection system (LPIS), accumulator, HPIS, steam generator, etc., are needed to prevent core damage during a small break, and are these same systems required for other break sizes or locations?
3. How effectively do the emergency core coolant (ECC) systems perform during the consequent pressure transients for these types of depressurizations?
4. What kind of recovery procedures should be used in the event of a small break loss-of-coolant accident (LOCA)?
5. Are there key times in the transient when operator action is required to protect the core?
6. Are there operator/equipment actions that must not occur?
7. Given a small break occurrence of unknown size or location, are there any operator actions that are dependent on the break unknowns that would aid plant recovery in one case and impede plant recovery for another case?
8. Are typical commercial reactor process instruments capable of providing accurate information on plant conditions during a transient? Specifically,
    a. Which instruments furnish relevant data and which do not?
    b. Can the operator use information from typical process instruments to estimate the break size and location?
9. Are there improvements that can be made to typical commercial reactor instrumentation to monitor a small LOCA? Are there any additional measurements that should be provided?
10. Are there improvements that can be made in commercial plant design to improve the safety of the plant?

The LOFT integral test facility has been designed to simulate the major components and system responses of a commercial four-loop pressurized water reactor (~1000 MWe) during a loss-of-coolant accident. The LOFT facility consists of

1. A reactor vessel with a nuclear core (Core 1)
2. An intact loop with active steam generator, pressurizer, and two primary coolant pumps connected in parallel
3. A broken loop with simulated free-wheeling pump, simulated steam generator, and two quick-opening blowdown valve assemblies (for Experiment L3-2, only the cold leg quick-opening blowdown valve was opened)
4. A blowdown suppression system consisting of a blowdown header, blowdown suppression tank, and a blowdown suppression tank spray system
5. An ECC injection system consisting of two LPIS pumps, two HPIS pumps, and two accumulators.

For the performance of Experiment L3-2, the LOFT test system was assembled to represent a postulated small break, equivalent to a 1-inch diameter rupture, in the cold leg of a commercial pressurized water reactor. The system mass flow rate was greater than predicted, and it is currently being investigated.

Experiment L3-2 was initiated from primary coolant system initial conditions of: hot leg temperature, 575.8 ± 0.5 K; cold leg temperature, 557.8 ± 3 K; hot leg pressure, 14.85 ± 0.04 MPa; and intact loop flow rate, 481.5 ± 6.3 kg/s. The preblowdown power level was 49 ± 1 MW, with a maximum linear heat generation rate of 52.2 ± 3.7 kW/m. To determine system thermal-hydraulic response, scaled ECC was directed into the intact loop cold leg injection line through use of an accumulator, a HPIS pump, and a LPIS pump.

Steam generator feed and bleed was used to reduce primary system pressure to the residual heat removal initiation pressure for typical large pressurized water reactors (≈ 2.5 MPa). Purification system recirculation flow simulated a residual heat removal system during Experiment L3-2.

Experiment L3-2 satisfied the specified objectives. This report presents data in the form of graphs in engineering (standard international) units. In conjunction with data obtained from direct measurement, chosen computed variables are included to facilitate the analysis of the system thermal-hydraulic behavior.

ACKNOWLEDGMENTS

Appreciation is expressed to the experimental data report group members, the personnel of the Data System Branch, and the personnel of the LOFT Experimental Measurements Branch. Special appreciation is expressed to C. E. Coppin for the technical editing.

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ACRONYMS

BL	Broken loop
BST	Blowdown suppression tank
BSTSS	Blowdown suppression tank spray system
BWST	Borated water storage tank
CL	Cold leg
DAVDS	Data acquisition and visual display system
DC	Downcomer
DTT	Drag disc turbine transducer
ECC	Emergency core cooling or coolant
ECCS	Emergency core coolant system
HL	Hot leg
HPIS	High-pressure injection system
LOCA	Loss-of-coolant accident
LOCE	Loss-of-coolant experiment
LOFT	Loss-of-Fluid Test
LP	Lower plenum
LPIS	Low-pressure injection system
PCP	Primary coolant pump
PNA	Pulsed neutron activation system
PORV	Power operated relief valve
PWR	Pressurized water reactor
QOBV	Quick-opening blowdown valve
RABV	Reflood assist bypass valve
RV	Reactor vessel
SCS	Secondary coolant system
SG	Steam generator
TTF	Transit time flowmeter
XRO	Orifice

EXPERIMENT DATA REPORT FOR LOFT NUCLEAR SMALL BREAK EXPERIMENT L3-2

1. INTRODUCTION

The Loss-of-Fluid Test (LOFT) Program is one of several water reactor research experimental programs conducted by EG&G Idaho, Inc., for the U.S. Nuclear Regulatory Commission (NRC) and administered by the Department of Energy. The LOFT Program objectives are to

1. Provide data required to evaluate the adequacy of and to improve the analytical methods currently used to predict the response of large pressurized water reactors (LPWRs) to postulated accident conditions; the performance of engineered safety features (ESF) with particular emphasis on the emergency core coolant system (ECCS); and the quantitative margins of safety inherent in the performance of the ESF.

2. Identify and investigate any unexpected event(s) or threshold(s) in the response of either the plant or the ESF and develop analytical techniques that adequately describe and account for the unexpected behavior(s).

3. Evaluate and develop methods to prepare, operate, and recover systems and plant for and from reactor accident conditions.

4. Identify and investigate methods by which reactor safety can be enhanced, with emphasis on the interaction of the operator with the plant.

To meet these objectives, the LOFT integral[a] test facility was designed to simulate the major components of a four-loop, commercial pressurized water reactor (PWR), thereby producing data on the thermal, hydraulic, nuclear, and structural processes expected to occur during a loss-of-coolant accident (LOCA) in a PWR. Reference 1 describes the LOFT facility in detail.

The LOFT Small Break Experiment Series (Experiment Series L3) was designed to provide large-scale blowdown system data for a PWR small break transient. Parameters varied for Experiment Series L3 include initial power level, break size and location, primary coolant pump operation, and recovery procedures.

Experiment L3-2 was conducted in the LOFT facility on February 6, 1980, at a maximum linear heat generation rate of 52.2 ± 3.7 kW/m and a power of 49 ± 1 MW. This power level is about 98% of the LOFT rated thermal power of 50 MW. The following L3 series objectives pertain to Experiment L3-2:

1. How does the primary coolant system respond during a small break when break flow is the same order of magnitude as the high-pressure injection system (HPIS) as system pressure stabilizes later in the transient?

2. How many of the major systems, such as, low-pressure injection system (LPIS), accumulator, HPIS, steam generator, etc., are needed to prevent core damage during a small break, and are these same systems required for other break sizes or locations?

3. How effectively do the ECC systems perform during the consequent pressure transients for these types of depressurizations?

4. What kind of recovery procedures should be used in the event of a small break LOCA?

5. Are there key times in the transient when operator action is required to protect the core?

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[a] The term "integral" is used to describe an experiment combining the nuclear, thermal, hydraulic, and structural processes occurring during a LOCA as distinguished from separate effects, nonnuclear, small-scale, and thermal-hydraulic experiments conducted for loss-of-coolant analysis.

6. Are there operator/equipment actions that must not occur?

7. Given a small break occurrence of unknown size or location, are there any operator actions that are dependent on the break unknowns that would aid plant recovery in one case and impede plant recovery for another case?

8. Are typical commercial reactor process instruments capable of providing accurate information on plant conditions during a transient? Specifically,

    a. Which instruments furnish relevant data and which do not?

    b. Can the operator use information from typical process instruments to estimate the break size and location?

9. Are there improvements that can be made to typical commercial reactor instrumentation to monitor a small LOCA? Are there any additional measurements that should be provided?

10. Are there improvements that can be made in commercial plant design to improve the safety of the plant?

Experiment L3-2 was conducted from initial temperatures in the primary coolant system intact loop of 575.8 ± 0.5 and 557.8 ± 3 K in the hot and cold legs, respectively, and hot leg pressure of 14.85 ± 0.04 MPa. The experiment simulated a small break in the cold leg of a four-loop, commercial PWR with the break flow approximately equal to the HPIS flow at a pressure lower than the HPIS initiation pressure (13.16 MPa) but greater than the accumulator initiation pressure (4.22 MPa). The system mass flow rate was greater than predicted, and it is currently being investigated. The reactor was operated sufficiently long to establish a decay heat level at one hour into the transient corresponding to 40 hours of full power operation.

The purpose of this report is to present the data from Experiment L3-2 in an uninterpreted but readily usable form for use by the nuclear community in advance of detailed analysis and interpretation. The data, in the form of graphs in engineering units, have been analyzed only to the extent necessary to ensure that they are reasonable and consistent. There were 595 instruments operable prior to and recorded for Experiment L3-2. The 160 instruments presented in this report contain the majority of information collected that is pertinent to the understanding of this small break experiment.

Section 2 briefly describes the LOFT configuration. Section 3 discusses the LOFT instrumentation system and the methods of obtaining certain measurements. Section 4 summarizes Experiment L3-2 initial conditions and experiment procedures. Section 5 presents the data with supporting information for data interpretation. Appendix A discusses the methods used to verify the consistency and accuracy of the data.

2. SYSTEM CONFIGURATION

The LOFT facility has been designed to simulate the major components and system responses of a commercial PWR during a LOCA. The experiment assembly comprises five major subsystems which have been instrumented such that system variables can be measured and recorded during a loss-of-coolant experiment (LOCE). The subsystems include: (a) the reactor vessel, (b) the intact loop, (c) the broken loop, (d) the blowdown suppression system, and (e) the ECCS. The LOFT major components are shown in Figure 1, and the LOFT piping configuration is shown in Figure 2.

The LOFT reactor vessel, which simulates the reactor vessel of a commercial PWR, has an annular downcomer, a lower plenum, lower core support plates, a nuclear core, and an upper plenum. The downcomer is connected to the cold legs of the intact and broken loops and contains two instrument stalks. The upper plenum is connected to the hot legs of the intact and broken loops. The core contains 1300 unpressurized nuclear fuel rods arranged in five square (15x15 assemblies) and four triangular (corner) fuel modules, shown in Figure 3 and described in Reference 2. The center assembly is highly instrumented. Two of the corner and one of the square assemblies are not instrumented. The fuel rods have an active length of 1.67 m and an outside diameter of 10.72 mm.

The fuel consists of UO_2 sintered pellets with an average enrichment of 4.0 wt% fissile uranium (U^{235}) and with a density that is 93% of theoretical density. Fuel pellet diameter and length are 9.29 and 15.24 mm, respectively. Both ends of the pellets are dished with the total dish volume equal to 2% of the pellet volume. Cladding material is zircaloy-4. Cladding inside and outside diameters are 9.48 and 10.72 mm, respectively.

The intact loop simulates the three unbroken loops of a commercial four-loop PWR and contains a steam generator, two circulating coolant pumps in parallel, a pressurizer, a venturi flowmeter, and connecting piping.

The broken loop consists of a hot leg and a cold leg that are connected to the reactor vessel and the blowdown suppression tank header. Each leg consists of a break plane orifice, a quick-opening blowdown valve (QOBV), a recirculation line, an isolation valve, and connecting piping. The recirculation lines establish a small flow from the broken loop to the intact loop to maintain approximately equal loop temperatures. An attempt was made to isolate these lines from the system prior to blowdown initiation. However, the recirculation line from the intact loop hot leg to the broken loop cold leg may have remained open. The hot leg valves remained closed during the experiment.

The broken loop hot leg also contains a simulated steam generator and a simulated pump. These simulators have hydraulic orifice plate assemblies which have similar (passive) resistances to flow as an active steam generator and a free-wheeling pump.

The blowdown suppression system comprises the blowdown suppression tank header, the blowdown suppression tank (BST), the nitrogen pressurization system, and the blowdown suppression tank spray system. The blowdown header is connected to the suppression tank downcomers that extend inside the tank and discharge below the water level. The nitrogen pressurization system is supplied by the LOFT inert gas system and uses a remote controlled pressure regulator to establish and maintain the specified blowdown suppression tank initial pressure. The spray system consists of a centrifugal pump which discharges through a heatup heat exchanger and any of three spray headers or a pump recirculation line that contains a cooldown heat exchanger. The spray pump suction can be aligned to either the blowdown suppression tank or the borated water storage tank. The three spray headers have flow rate capacities of 1.3, 3.8, and 13.9 l/s, respectively, and are located in the blowdown suppression tank along the upper centerline. For Experiment L3-2 the BST spray pump suction was connected to the BST so that no heat was added or removed from the fluid.

The LOFT ECCS simulates the ECCS of a commercial PWR. The accumulator, the HPIS, and the LPIS were used during this experiment. Each system was arranged to inject scaled flow rates of ECC directly into the primary coolant system cold leg. To provide these scaled flow rates, Accumulator A, HPIS Pump A, and LPIS Pump A were utilized. Accumulator A was preset to

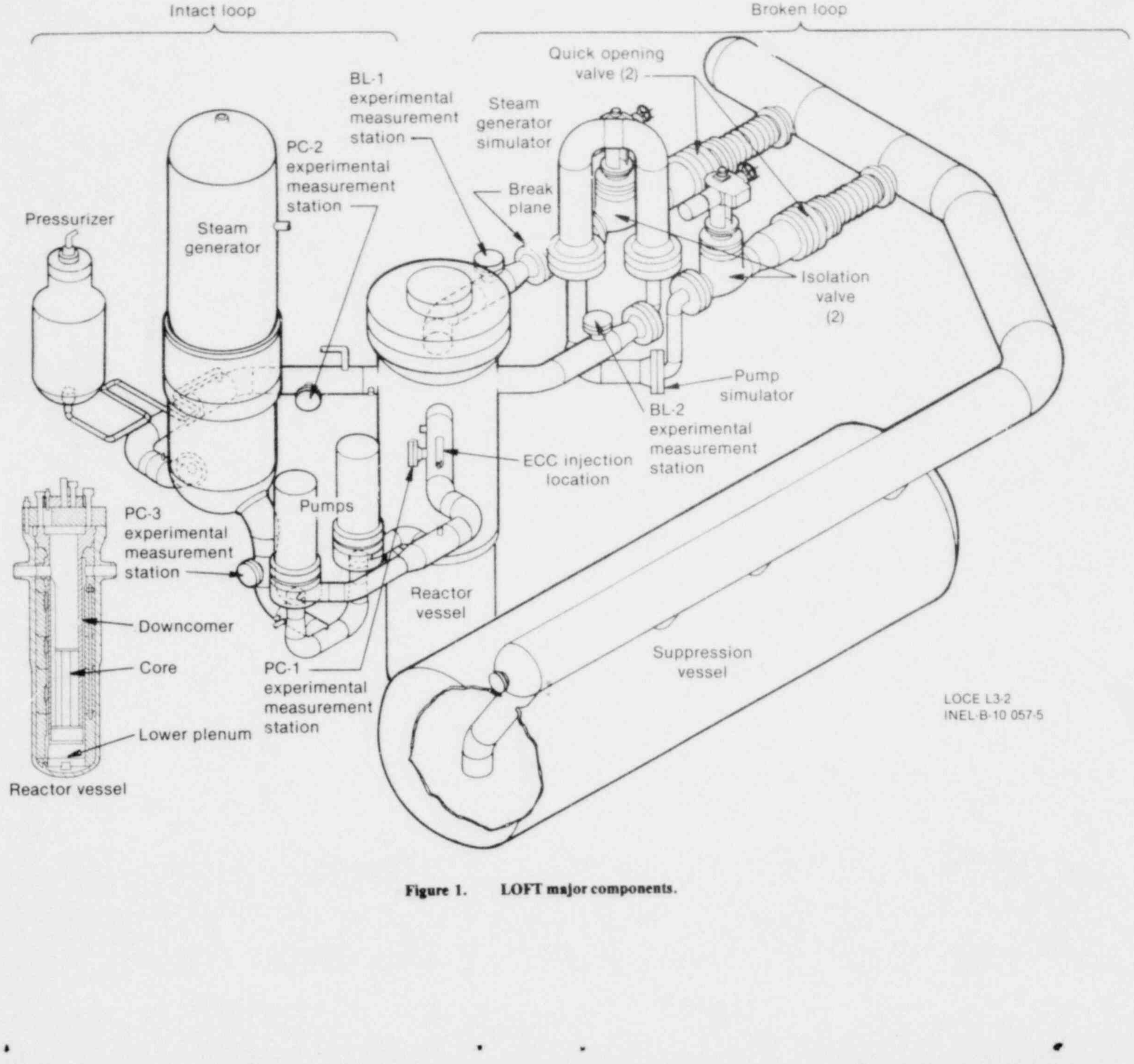


Figure 1. LOFT major components.

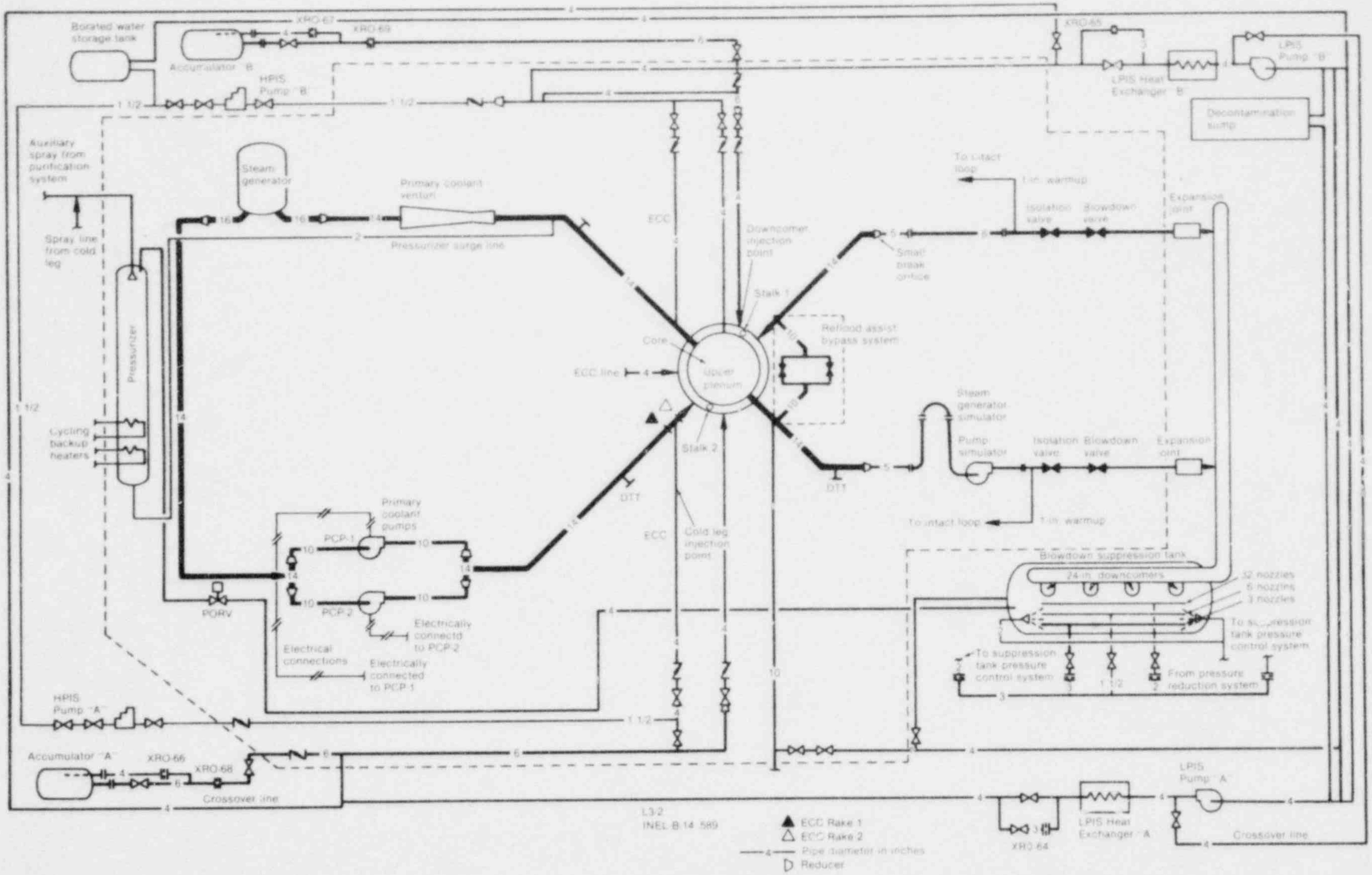


Figure 2. LOFT piping schematic.

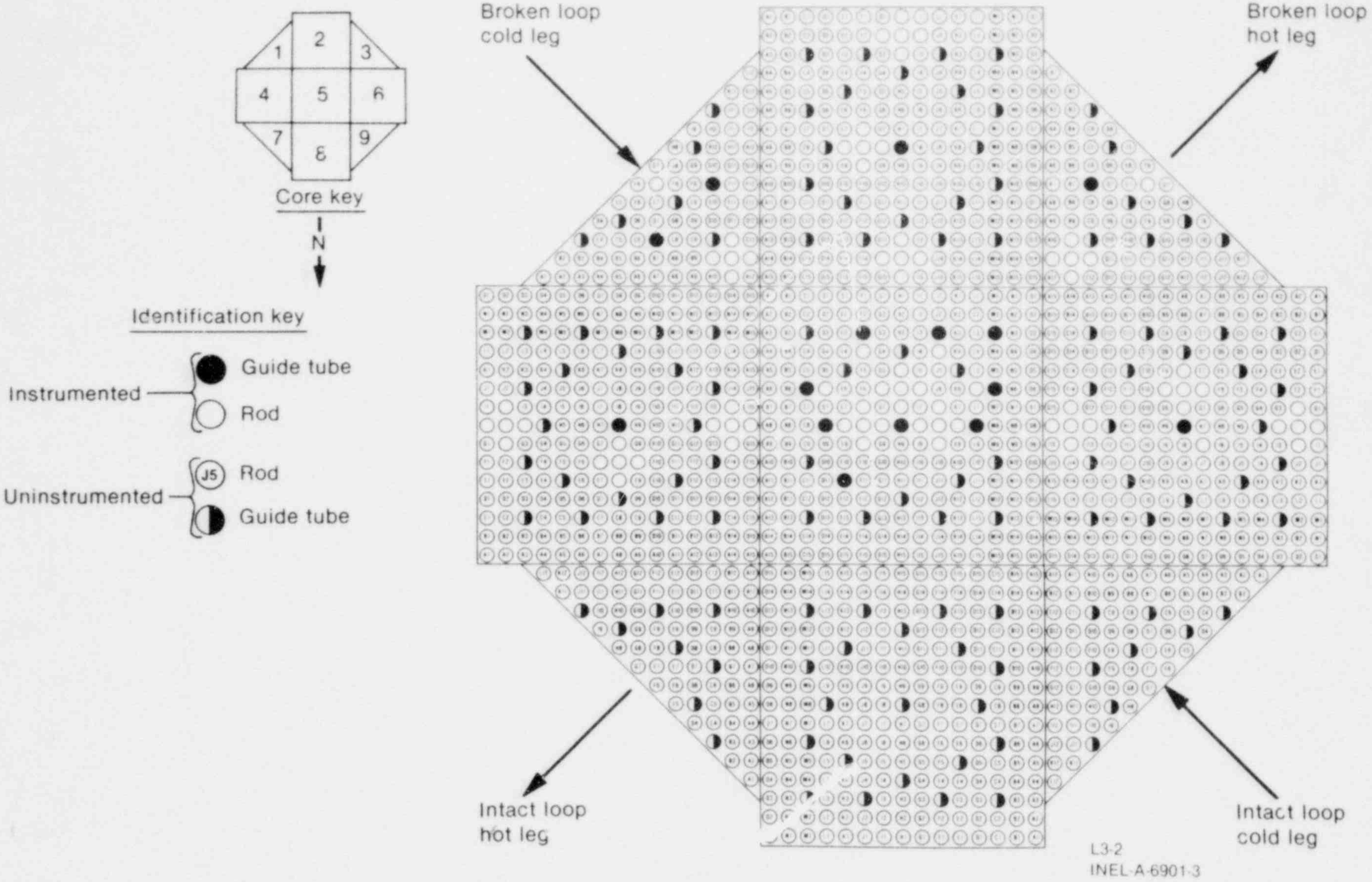


Figure 3. LOFT Core 1 configuration showing rod designations.

inject ECC at a system pressure of 4.22 MPa. HPIS Pump A was set to initiate injection at a system pressure of 13.16 MPa. The pressure setpoint for automatic LPIS initiation was 1.60 MPa. During plant recovery, the purification system was used to simulate the residual heat removal system of a large commercial power reactor.

3. MEASUREMENTS AND INSTRUMENTATION

The LOFT instrumentation system was designed to measure and record the important parameters and events that occur during a LOCE.

Temperatures at all major locations in the system were obtained from thermocouples and resistance temperature detectors.

Pressure measurements were obtained with strain-gage transducers with pressure transmission lines connecting the transducers to the measurement points.

Differential pressures were measured by strain-gage transducers with double chambers. The transducers were externally located and connected to the measurement points with pressure transmission lines.

Flow velocity measurements were attempted by three types of instruments. A pulsed neutron activation system (PNA), shown in Figure 4 and located in the intact loop hot leg, measures velocity from the time required for an activated slug of coolant to traverse the distance between the neutron sources and the detectors. A broken loop cold leg transit time flowmeter determines velocity from the perturbation time difference between two fast response, matched thermocouples. These thermocouples are located a given distance apart in the fluid flow and sense the same local thermal disturbance. Turbine flowmeters measure the velocity directly.

Momentum flux was measured by drag discs. The data presented for fluid velocity (from the turbine flowmeters) and momentum flux are based on the following flow areas at the instrument locations.

Instrument	Flow Area
ME-2ST-1	0.141 m^2
FE-5UP-1	0.125 m^2
ME-1UP-1, ME-3UP-1, and ME-5UP-1	0.125 m^2

Fluid density was measured by gamma densitometers, each of which consisted of a source and several detectors. Three detectors (A, B, and C shown in Figure 5) were aligned with collimated gamma ray beams passing through the pipe; the attenuation of the gamma rays varied inversely with the density of the fluid in the pipe. Each densitometer also had a detector (D) located so that it measured background radiation continuously, except for DE-PC-3, which checked the background by alternately exposing and storing the source. DE-PC-3 was a nonnuclear-hardened densitometer, had a Cs^{137} source, and was located in a vertical piping section. The rest of the densitometers were nuclear, had Co^{60} sources, and were located in horizontal piping. Figure 5 shows the gamma densitometer configuration relative to the piping.

Liquid levels were obtained by means of (a) differential pressure transducers in the pressurizer, accumulator, steam generator secondary side, pump suction piping, and blowdown suppression tank and (b) liquid detectors which sense the conductivity of the fluid near each of a series of electrical contacts in the reactor vessel.

Control rod position was experimentally indicated by means of proximity switches. The circuitry associated with the proximity switches controls a set of lamps. Each set of lamps consists of a "rod bottom" lamp and four "rod location" lamps. The rod bottom lamp lights only when the control rod is bottomed. Each rod location lamp lights as the leadscrew on the control rod passes its switch position during withdrawal, and it remains lit whenever the leadscrew is above this position.

Valve positions (analog indication from 0 to 100% of opening) were measured by either resistance potentiometers or differential transformers.

Mechanical pump speed was measured by an eddy current displacement transducer which used a slotted metallic target attached to the top of the pump motor shaft. The target contains six asymmetrical slots so that pump speed can be determined. Electrical pump power was measured by a wattmeter.

The transient local linear heat generation rate was measured by self-powered neutron detectors. Each detector consists of a cylindrical Co^{59} emitter, a layer of aluminum oxide for electrical insulation, and an outer sheath of Inconel. The

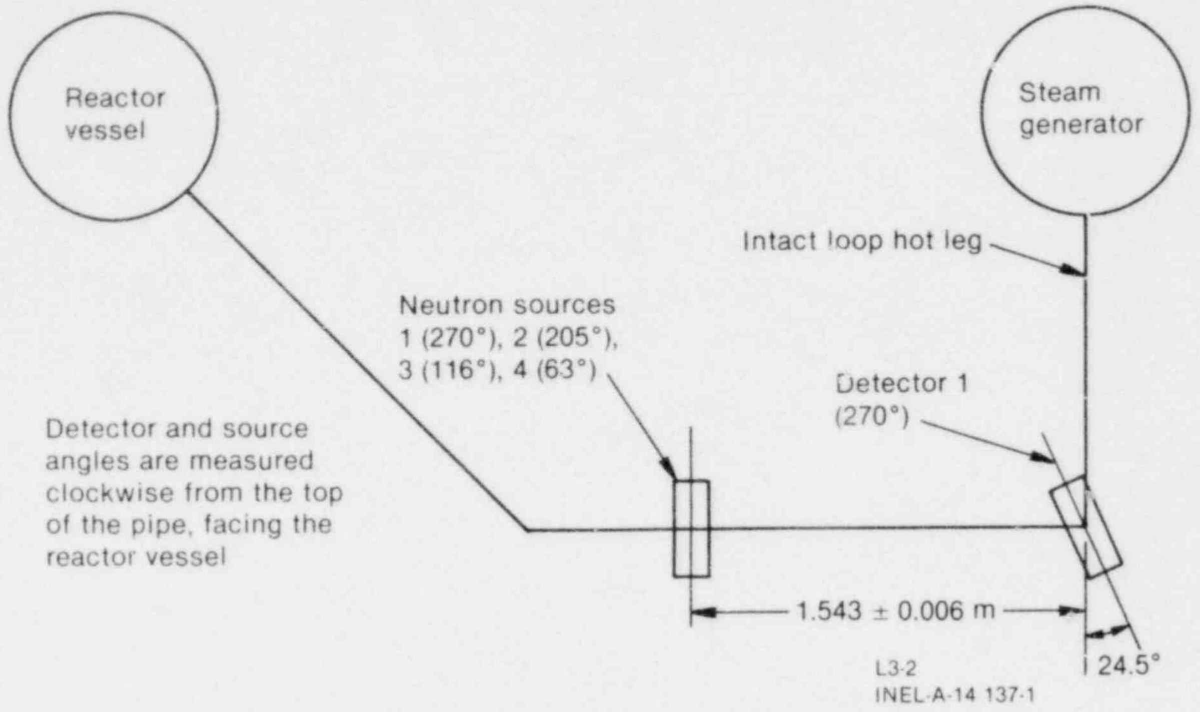


Figure [illegible]. View of PNA sources and detectors.

cable connected to the detector consists of two Inconel wires in an Inconel sheath with magnesium oxide insulation. One of the wires is connected to the cobalt emitter and the other is open ended. The open-ended wire gives a background subtraction signal to compensate for the radiation sensitivity of the cable.

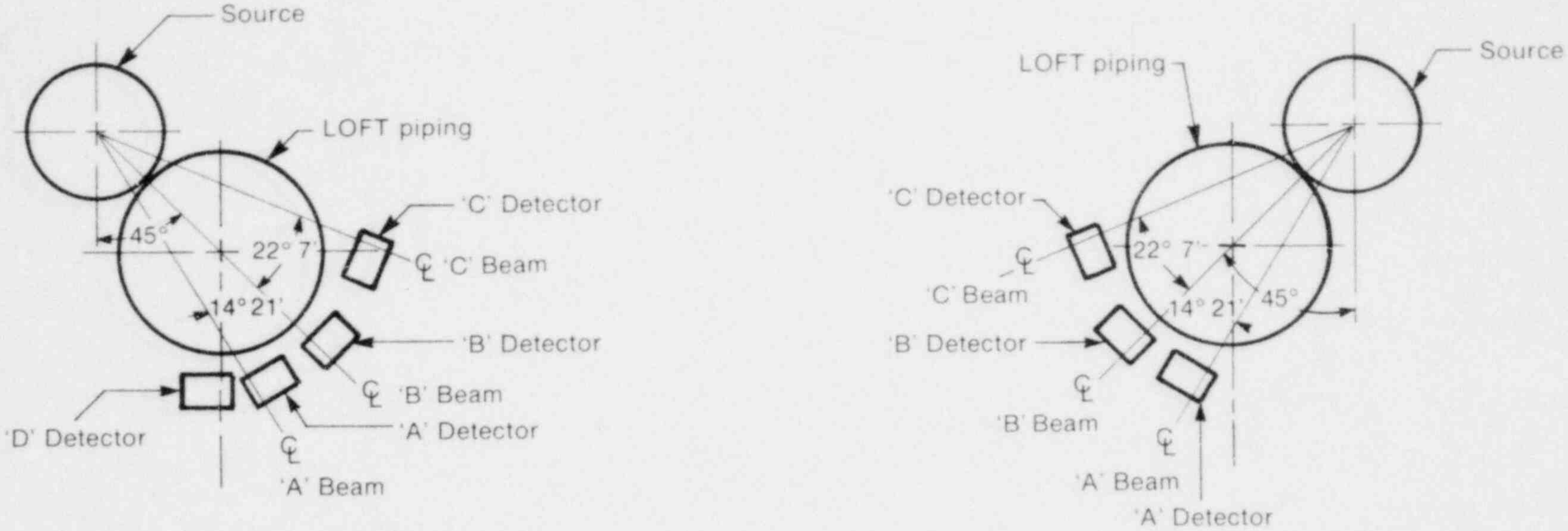
The steady state linear heat generation rate was determined from neutron flux measurements taken with a traversing in-core probe (TIP) at four guide tube locations in the core. This instrument consists of a U-235 fission chamber attached to a flexible cable and its own data recording system. The probe is withdrawn and stored outside the core prior to blowdown initiation.

The data acquisition and visual display system (DAVDS) was used to record measured data from the various instrumentation systems on a combination of digital recorders and wideband frequency modulation (FM) tape recorders, and oscillographic recorders[3]. Redundant records were made where use dictated more than one recording mode or where an extra measure of assurance was desired for critical measurements. Additional measured data were recorded on the plant monitor system. Selected data recorded on this system were digitized and are presented as long-term plots.

A digital computer was used to collect the LOCE data in a multiplex format at the LOFT facility and to perform equipment calibrations, posttest data reduction, and plotting[4]. The recorded FM data were converted into digital form which were then demultiplexed to be compatible with the CDC CYBER 176/173 computer system.

The CDC CYBER 176/173 computer system was used to further reduce the data. Calibration factors were first applied to produce data plots in engineering units so that engineering specialists could examine each channel for discrepancies or unexpected events. Where possible, instrument channel outputs and computed variables were compared with test predictions, previous tests, corresponding parameter channels, and calculated quantities. Those measurement comparisons that were determined to be within the accuracy of the particular instrument were labeled as Qualified.

Most transducers were calibrated under laboratory conditions prior to installation in LOFT. Verification of calibration constants was



(a) for densitometers except DE-PC-3

(b) for DE-PC-3

Figure 5. Relation of source and detectors to pipe for (a) densitometers except DE-PC-3 and (b) for DE-PC-3.

accomplished by special tests performed during heatup and by analysis of initial conditions data. In addition, post-LOCE checks were performed to pinpoint questionable data and to verify data consistency. Appendix A discusses the techniques used to perform data consistency checks.

Figure 6 shows a piping schematic with instrument locations indicated. Table 1 gives the nomenclature for LOFT experimental and process instrumentation. Both types of instrumentation are included in this report. Thermocouples and neutron flux detectors located in the nuclear core have special identification. Each of these transducers has been given an identification number which identifies the type of transducer and its location within the core as follows:

Transducer location (inches from bottom of fuel rod)
Fuel assembly row
Fuel assembly column
Fuel assembly number
Transducer type
TE-3B11-28

Figures 7 and 8 show isometric views of the major system components with instrument locations indicated, and Figures 9 through 19 give more specific locations for instruments located on individual components. Some of the temperature instruments shown in the figures were not recorded during the experiment. Reference 1 may be consulted if additional details of instrument design and locations are desired.

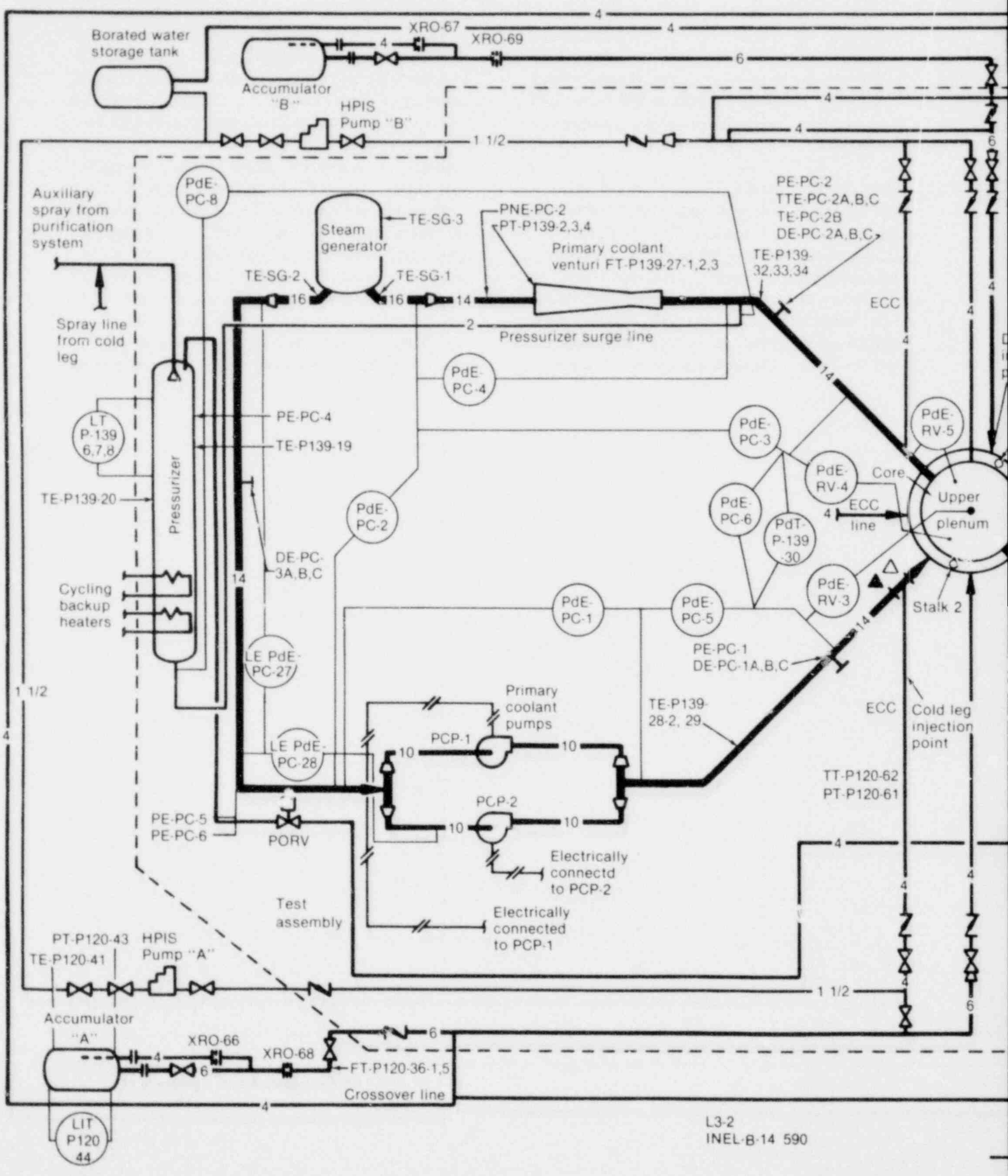
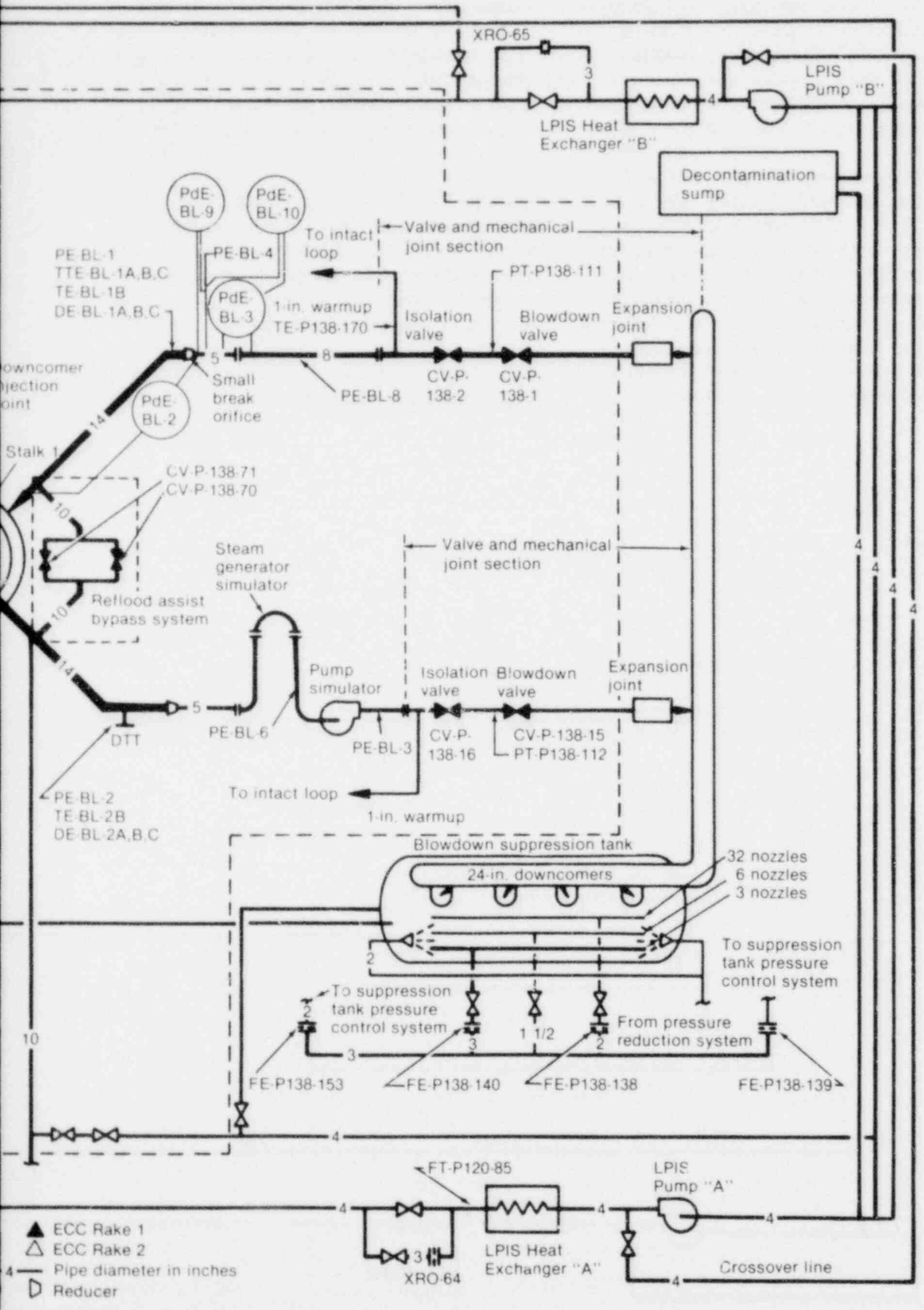


Figure 6. LOFT piping schematic with i



strumentation.

TABLE 1. NOMENCLATURE FOR LOFT INSTRUMENTATION

Designations for the different types of experimental instruments.

AE	Accelerometer
DE	Densitometer
DIE	Displacement element
FE	Coolant flow element
LE	Coolant level element
LEPdE	Coolant level element
ME	Momentum flux detector
NE	Neutron detector
PCP	Primary coolant pump
PdE	Differential pressure element
PE	Pressure element
PNE	Pulsed neutron activation system element
RPE	Pump speed element
TE	Temperature element
TTE	Transit time flowmeter element

Designations for the different experimental systems except the core.

BL	Broken loop
LP	Lower plenum
PC	Primary coolant intact loop
RV	Reactor vessel
SG	Steam generator
1ST	Downcomer Stalk 1
2ST	Downcomer Stalk 2
SV	Suppression tank
UP	Upper plenum

TABLE 1. (continued)

Designations for the different types of process instruments.

CV	Control valve
FE	Flow element
FT	Flow transmitter
LIT	Level indicating transmitter
LT	Liquid level transmitter
PdT	Differential pressure transmitter
PT	Absolute pressure transmitter
RE	Radiation element
TE	Temperature element
TT	Temperature transmitter

Designations for the different systems associated with process instruments.

P4	Secondary coolant system
P120	Emergency core coolant system
P128	Primary coolant addition and control system and HPIS
P138	Broken loop and pressure suppression system
P139	Intact loop
P141	Primary component cooling system
T-77,T-87	Power range

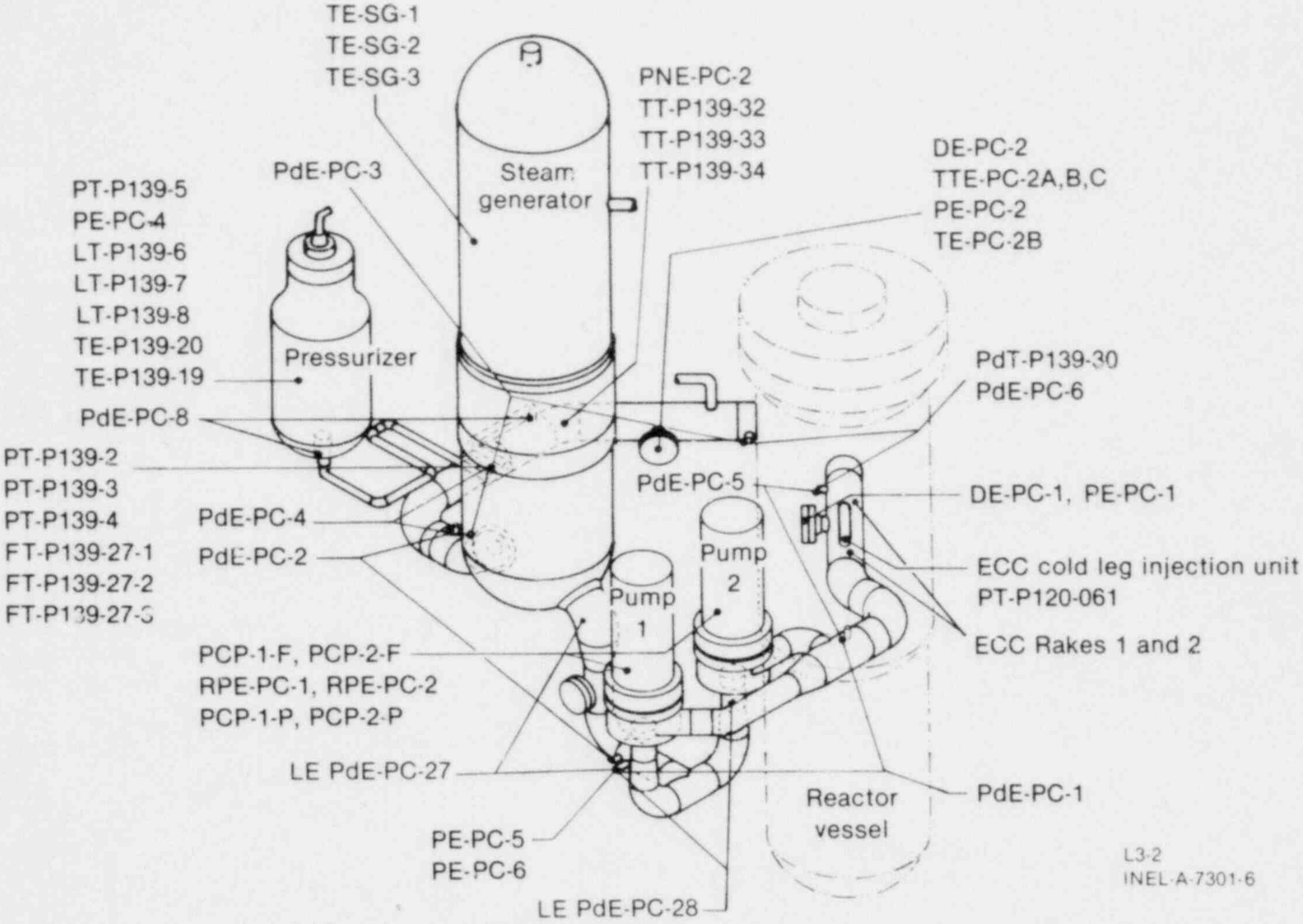


Figure 7. LOFT thermal-hydraulic instrumentation for intact loop.

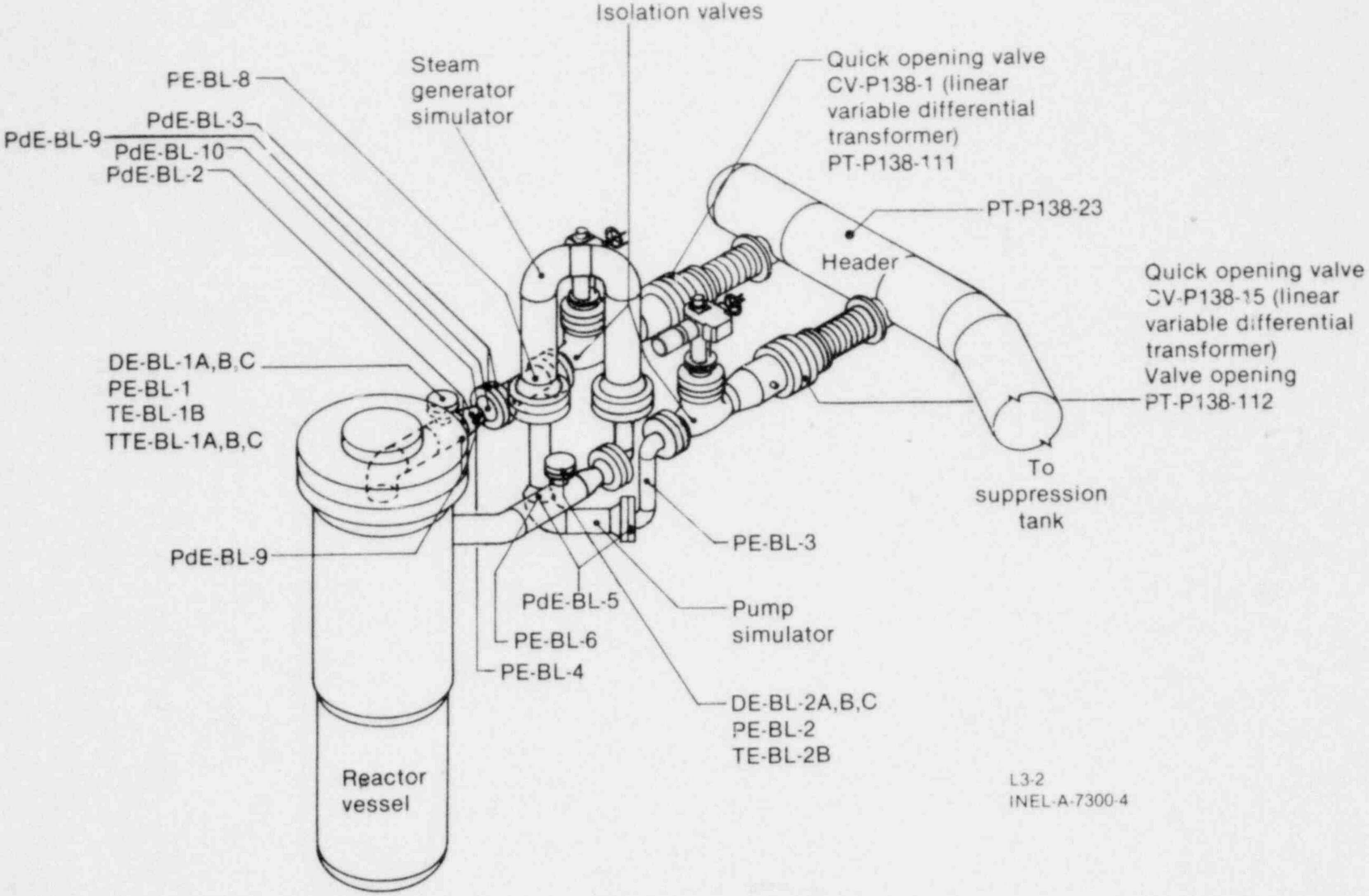
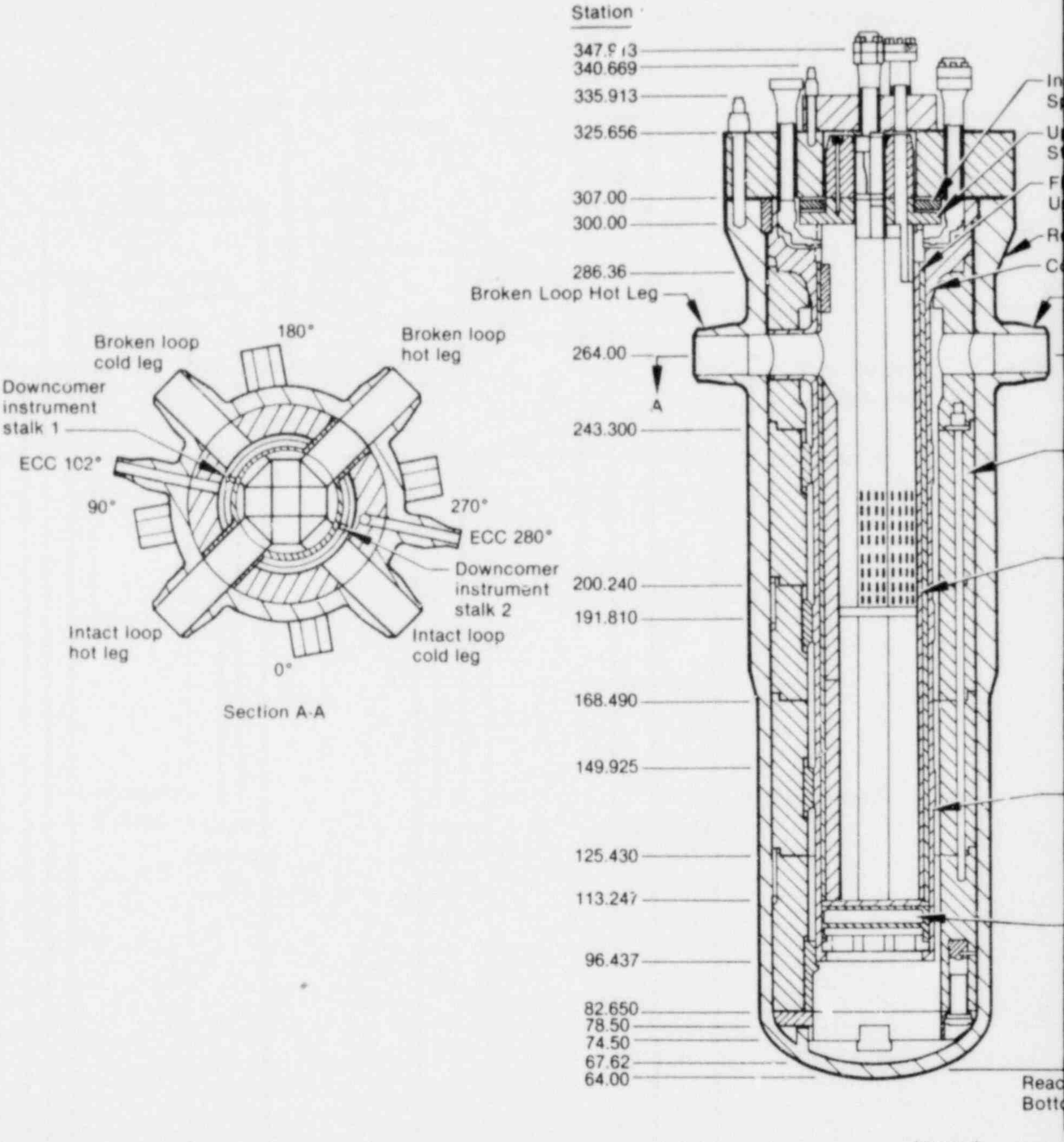


Figure 8. LOFT thermal-hydraulic instrumentation for broken loop.

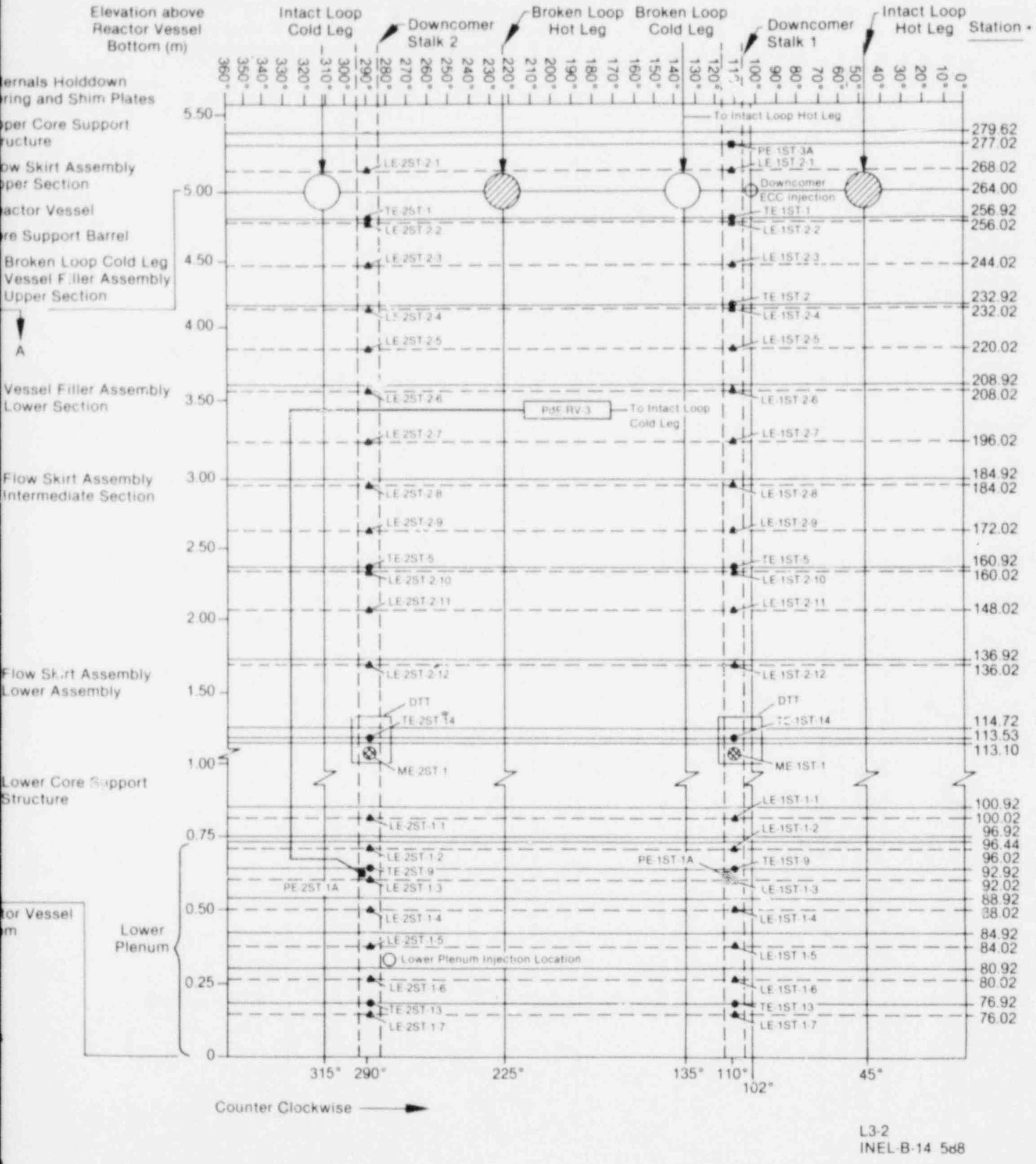


Legend:

- ● Thermocouples
- ▲ Liquid Level Sting
- ■ Pressure
- ⊗ Drag Discs
- ▨ Turbinemeter
- Drag Disc Turbinemeter (DT

* Station numbers are a dimensionless measure of relative elevation within the reactor vessel. They are assigned in increments of 2.54 centimeters with station 300.00 defined at the core barrel support ledger inside the reactor vessel flange.

Figure 9.



LOFT reactor vessel instrumentation.

* Station numbers are a dimensionless measure of relative elevation within the reactor vessel. They are assigned in increments of 25.4 mm with Station 300.00 defined at the core barrel support ledge inside the reactor vessel flange.

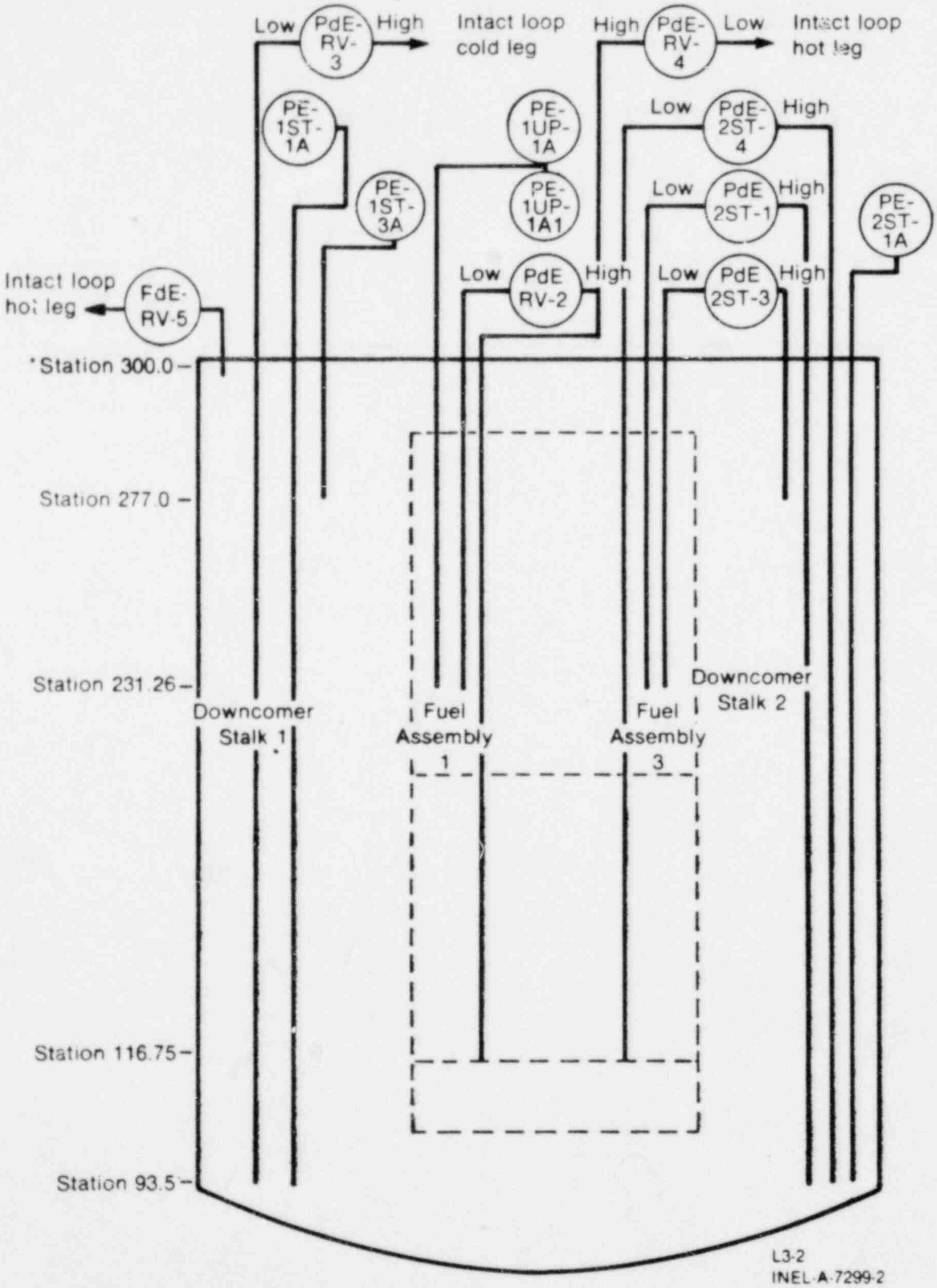
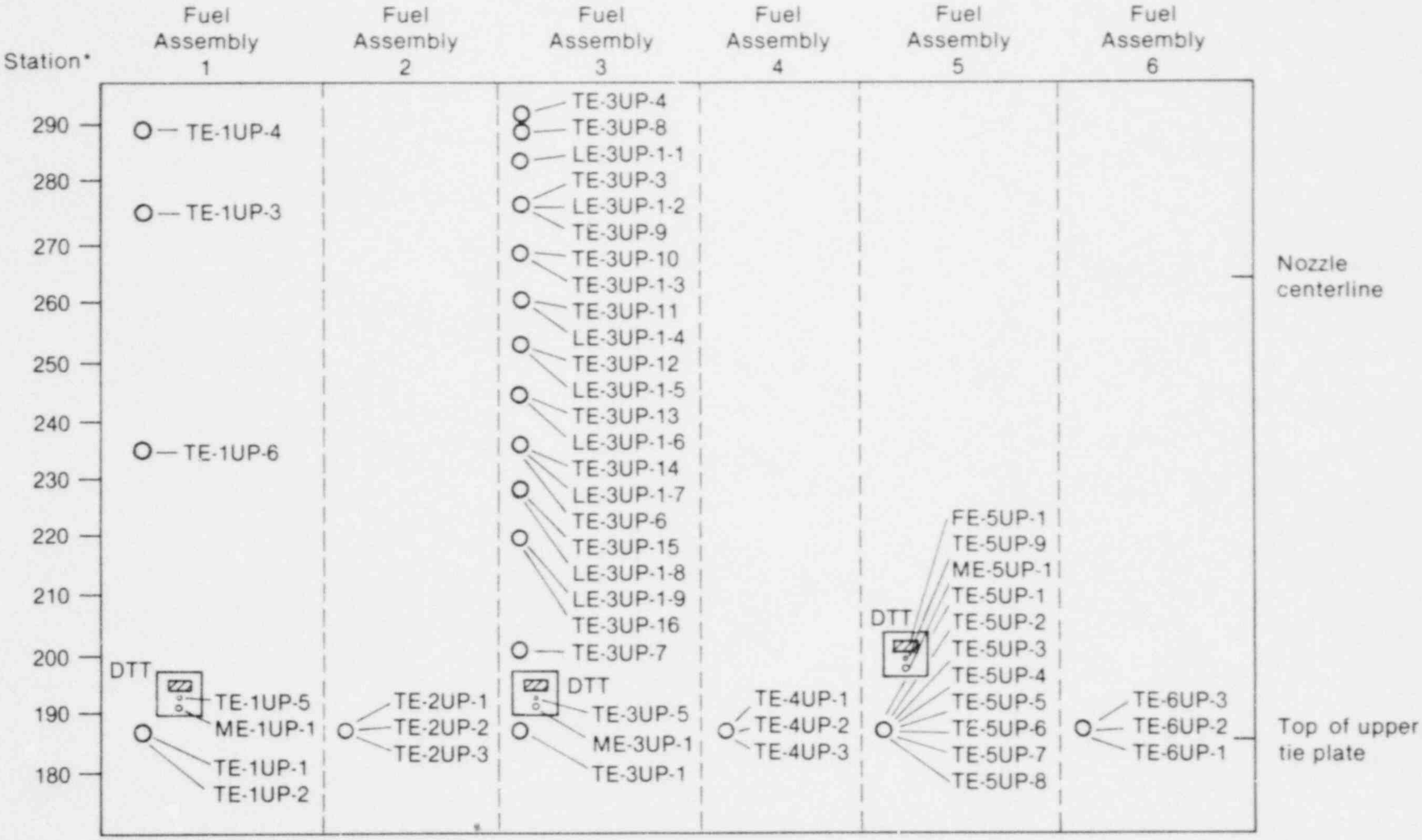


Figure 10. LOFT reactor vessel pressure and differential pressure instrumentation.



*Station numbers are a dimensionless measure of relative elevation within the reactor vessel. They are assigned in increments of 25.4 mm with station 300.00 defined at the core barrel support ledge inside the reactor vessel flange.

L3-2
INEL-A-7373-1

Figure 11. LOFT reactor vessel upper plenum DTT, LE, and TE elevations.

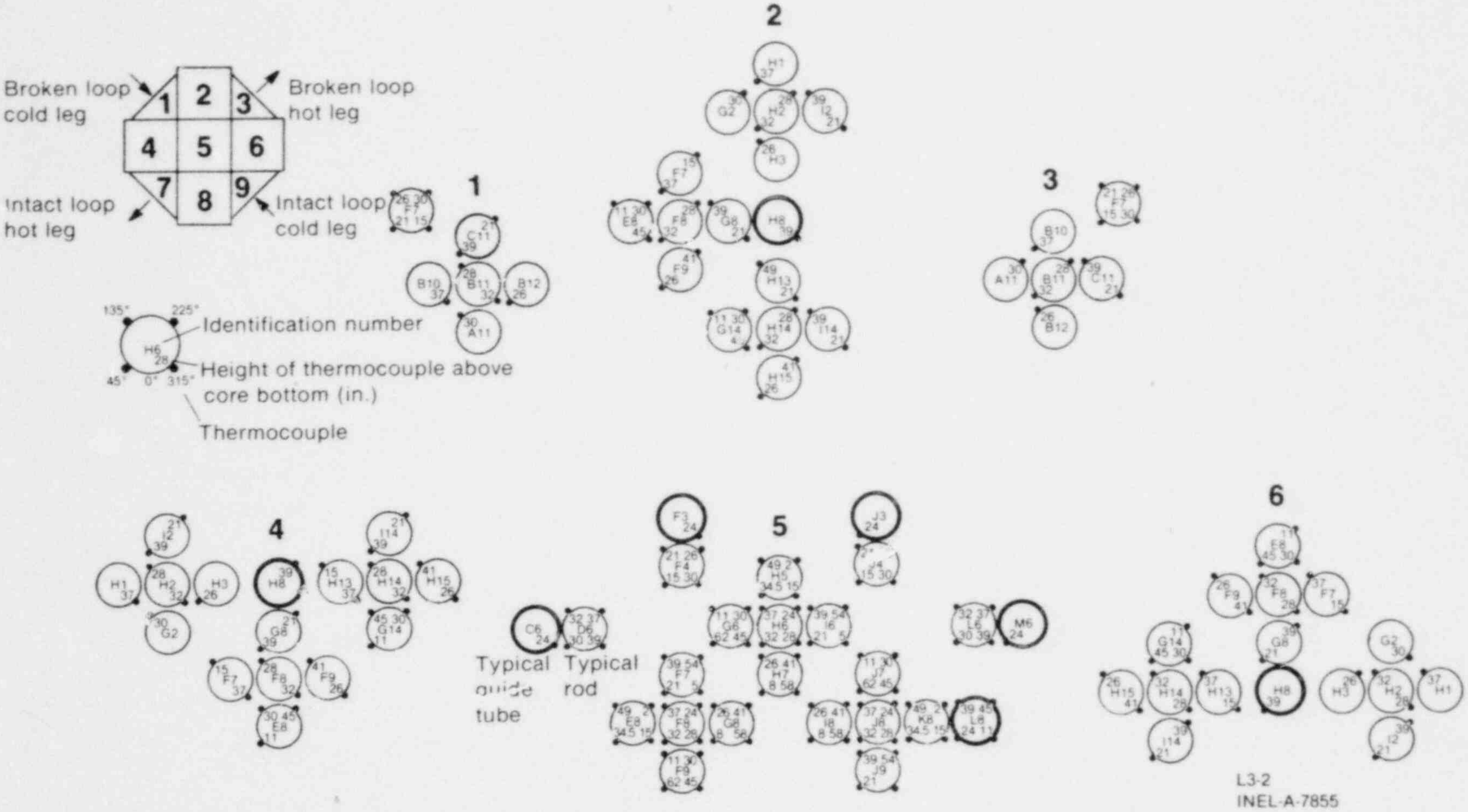


Figure 12. In-core thermocouple locations for LOFT Core 1.

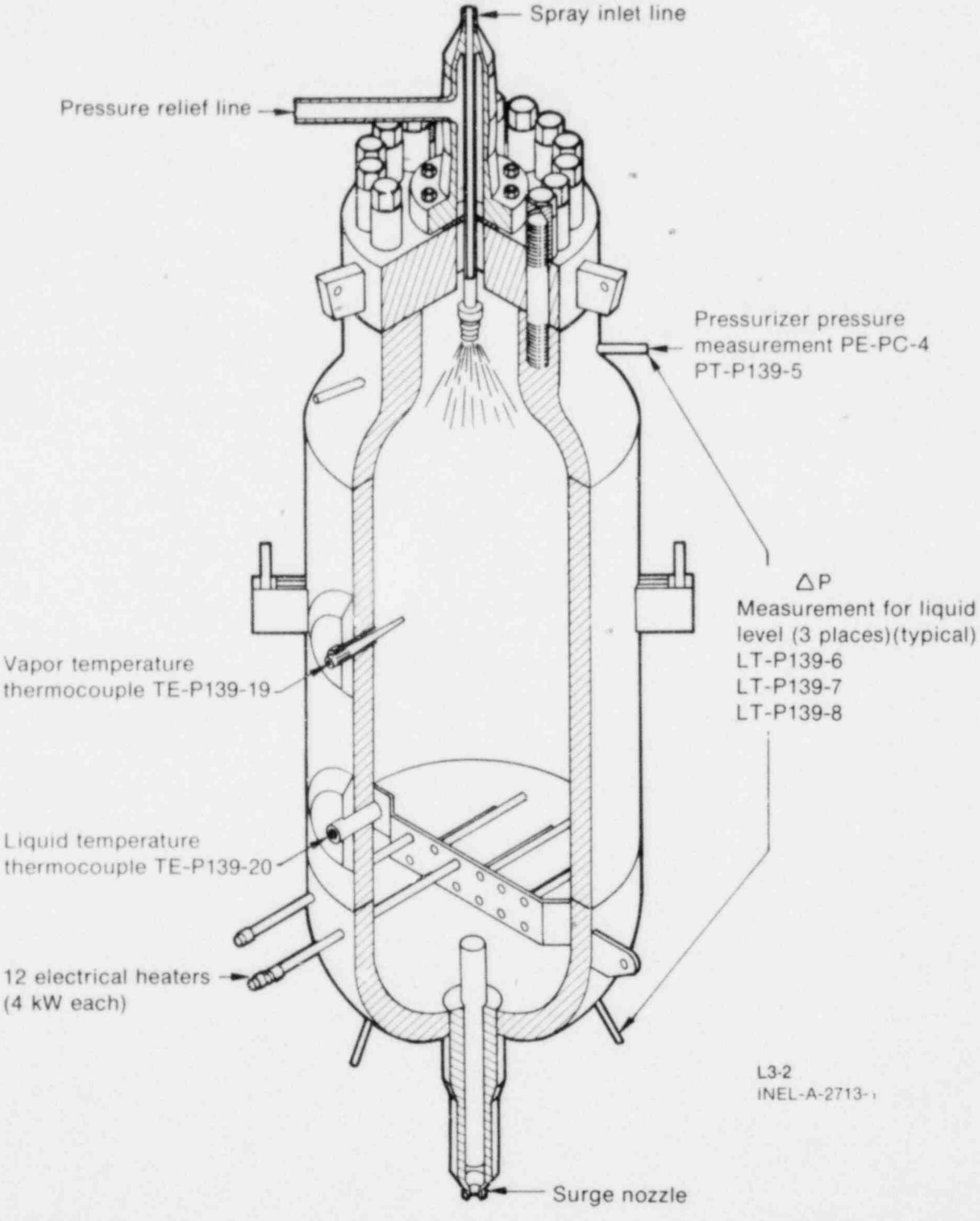


Figure 13. LOFT pressurizer instrumentation.

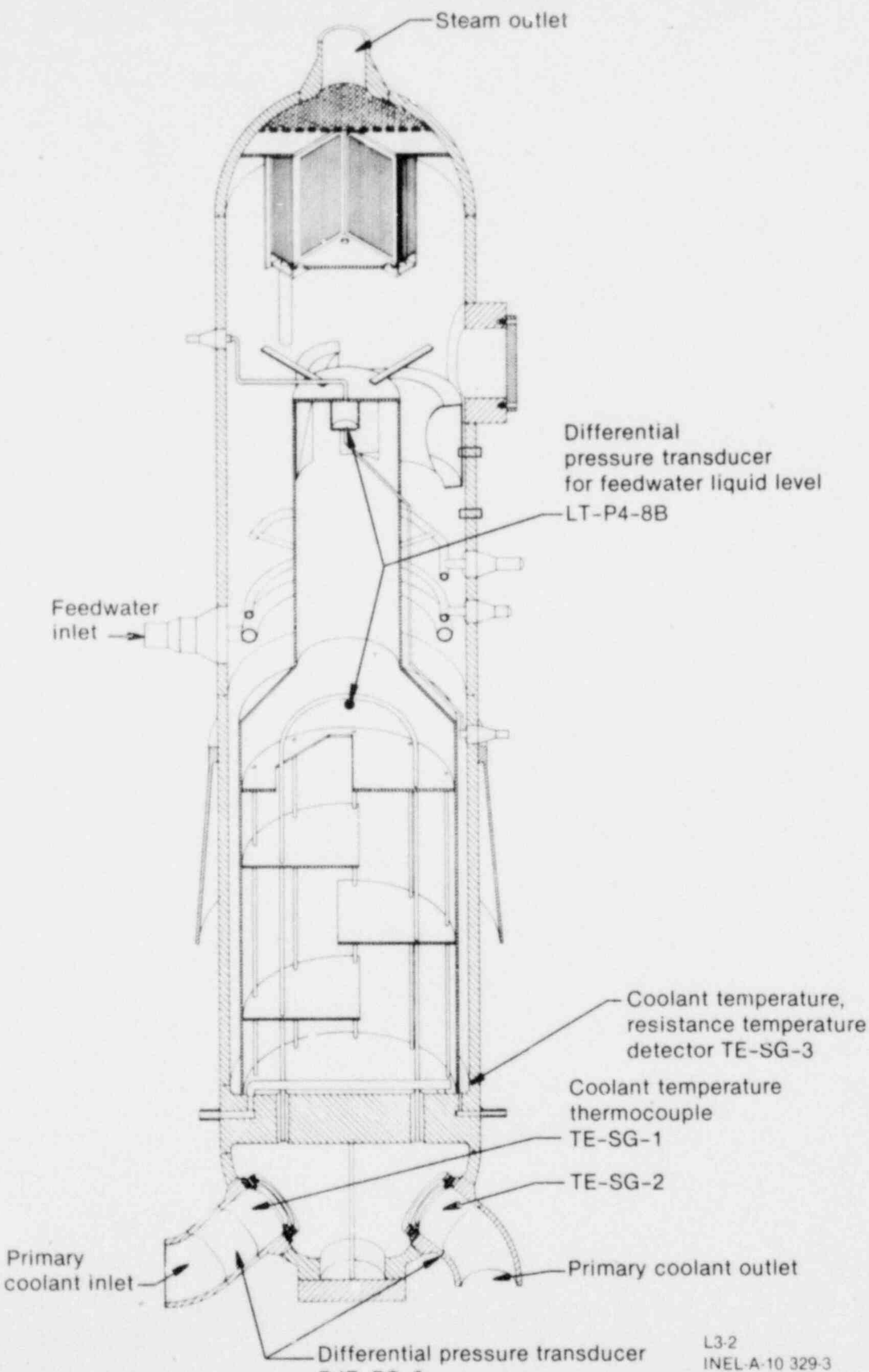


Figure 14. LOFT steam generator instrumentation.

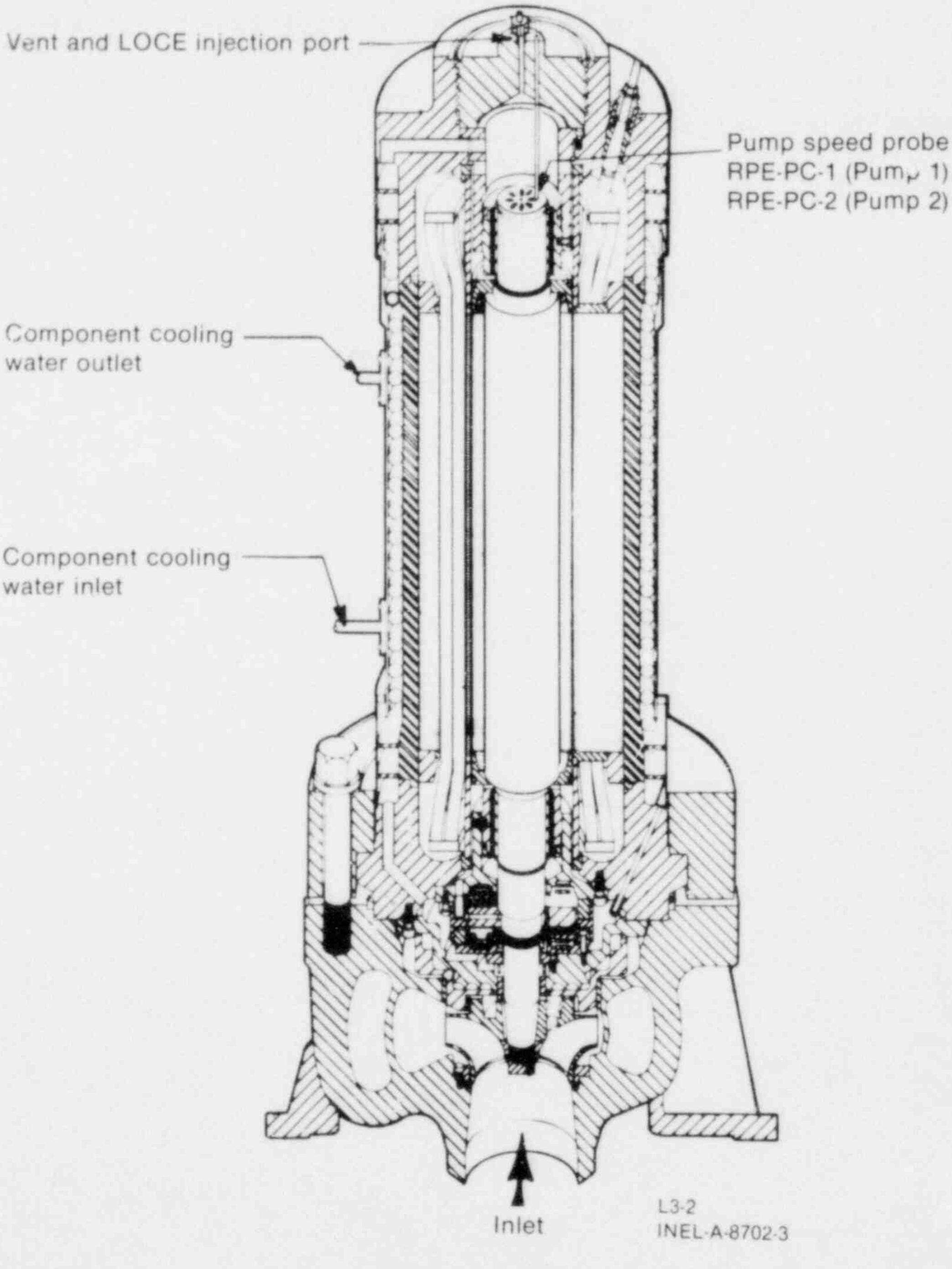


Figure 15. LOFT intact loop pump instrumentation.

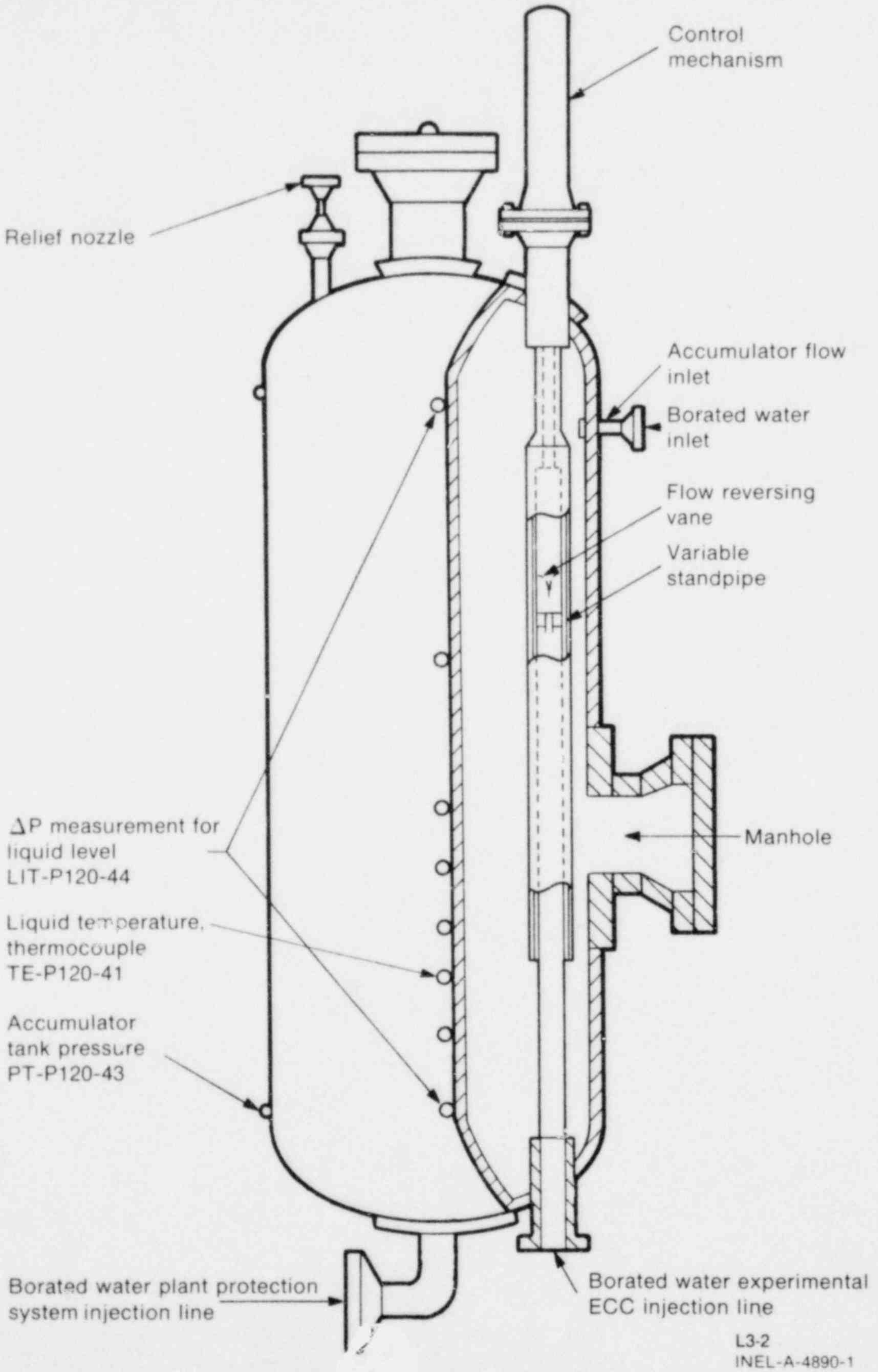


Figure 15. LOFT accumulator instrumentation.

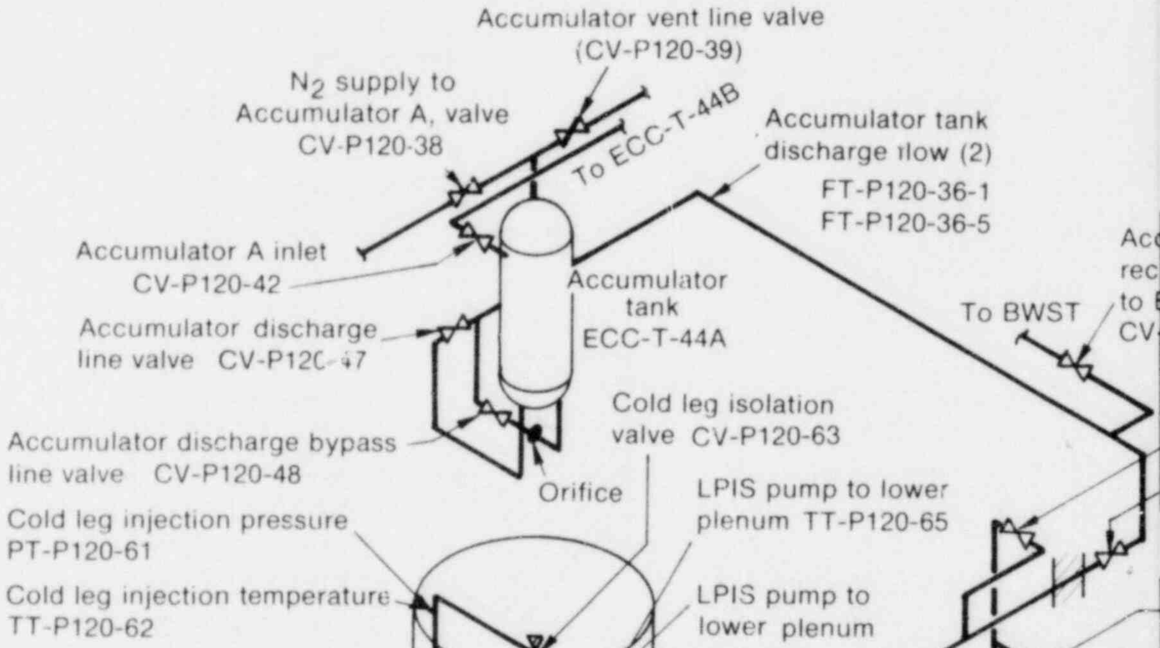
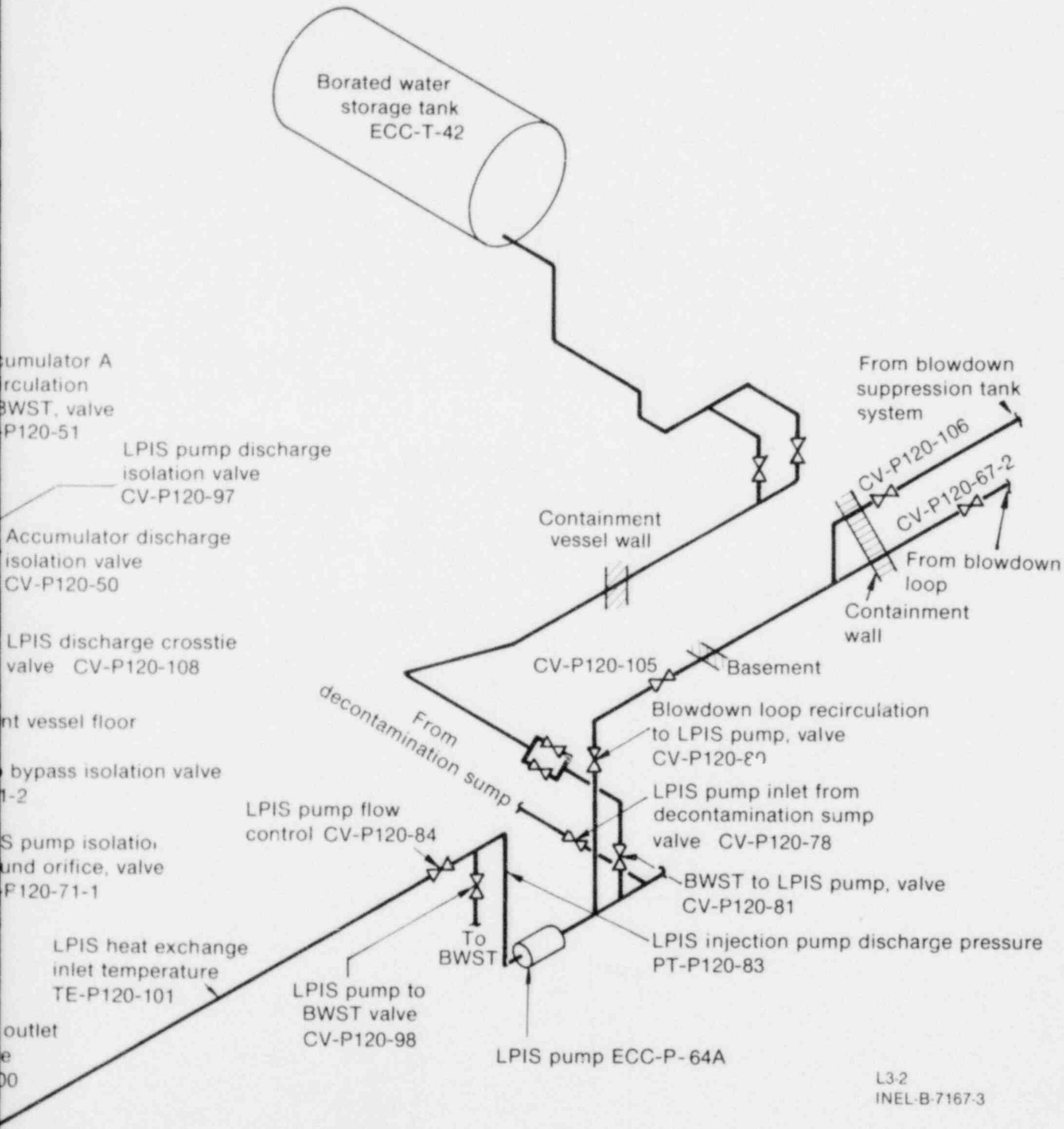

Accumulator vent line valve
(CV-P120-39)
N$_2$ supply to
Accumulator A, valve
CV-P120-38
To ECC-T-44B
Accumulator tank
discharge flow (2)
FT-P120-36-1
FT-P120-36-5
Acc
rec
to E
CV-
Accumulator A inlet
CV-P120-42
Accumulator
tank
ECC-T-44A
To BWST
Accumulator discharge
line valve CV-P120-47
Cold leg isolation
valve CV-P120-63
Accumulator discharge bypass
line valve CV-P120-48
Orifice
LPIS pump to lower
plenum TT-P120-65
Cold leg injection pressure
PT-P120-61
Cold leg injection temperature
TT-P120-62
LPIS pump to
lower plenum
pressure
PT-P120-64
Cold injection isolation valve
CV-P120-90
Containme
Operating
loop cold leg
LPIS pump
CV-P120-7
Orifice
Lower plenum
isolation valve
CV-P120-66
LP
aro
CV
Reactor vessel
LPIS flow
FT-P120-85
LPIS heat
exchanger
temperatu
TE-P120-1
LPIS heat
exchanger
ECC-H-24A

Figure 17



. **LOFT ECCS instrumentation.**

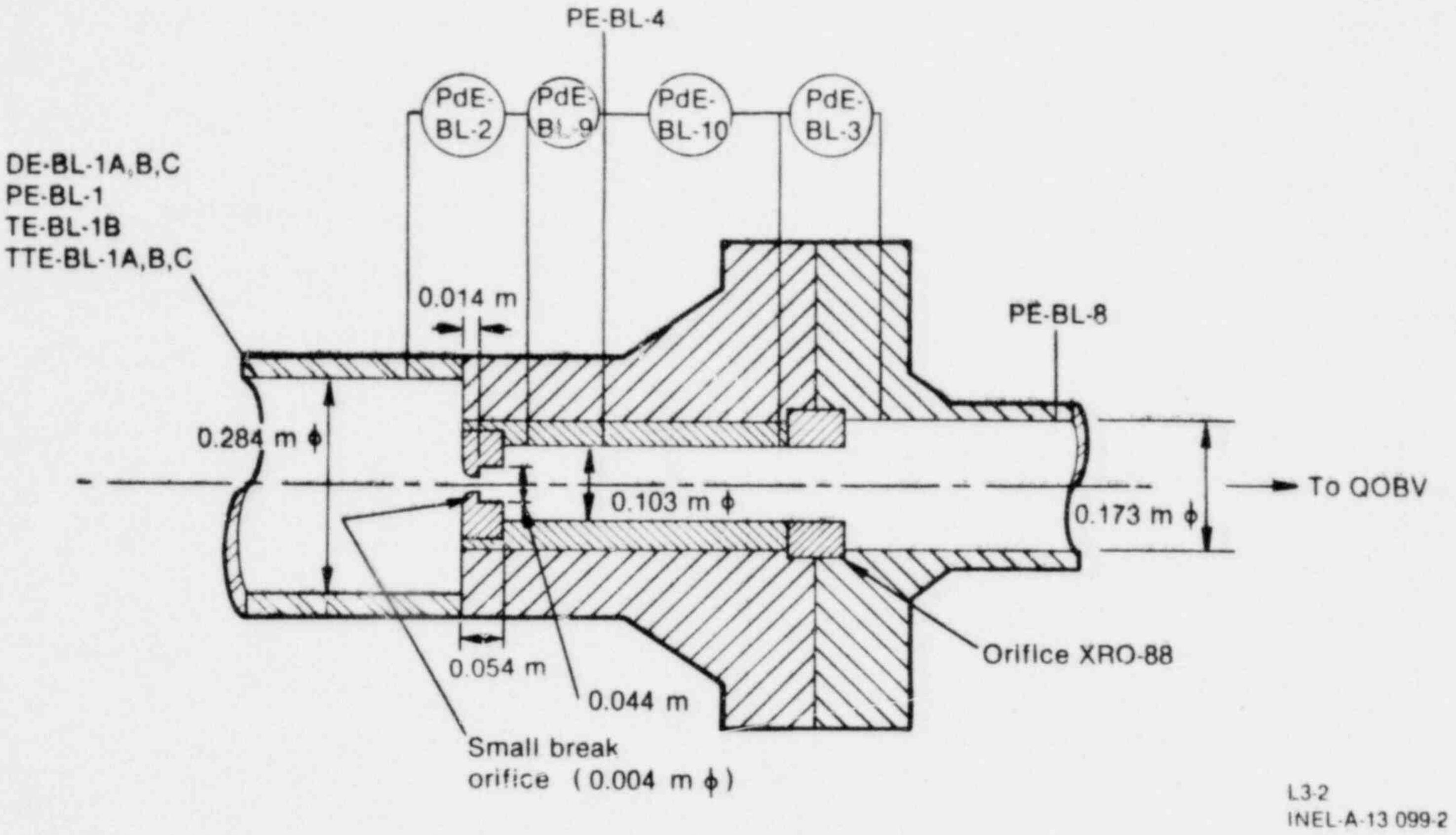
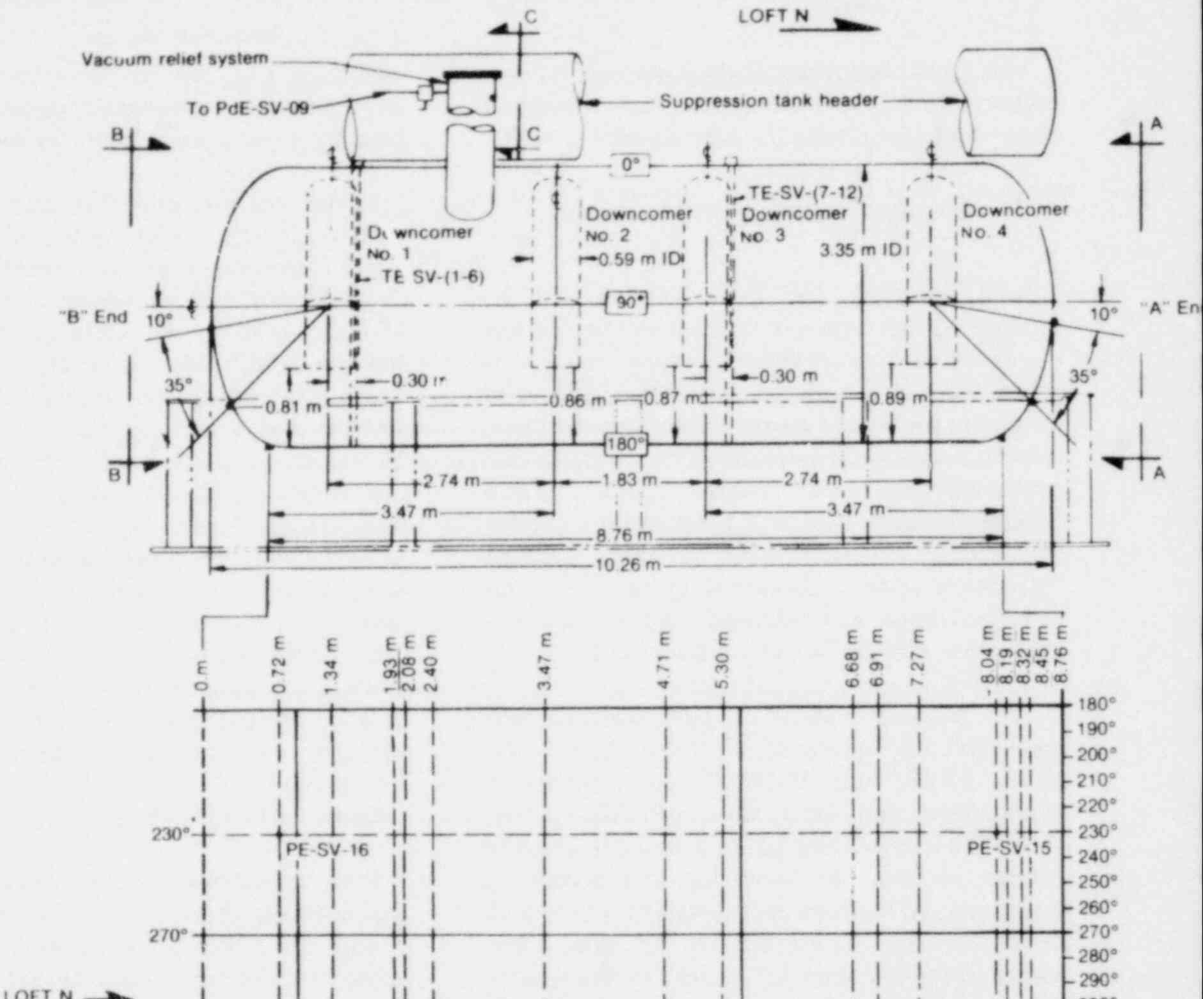
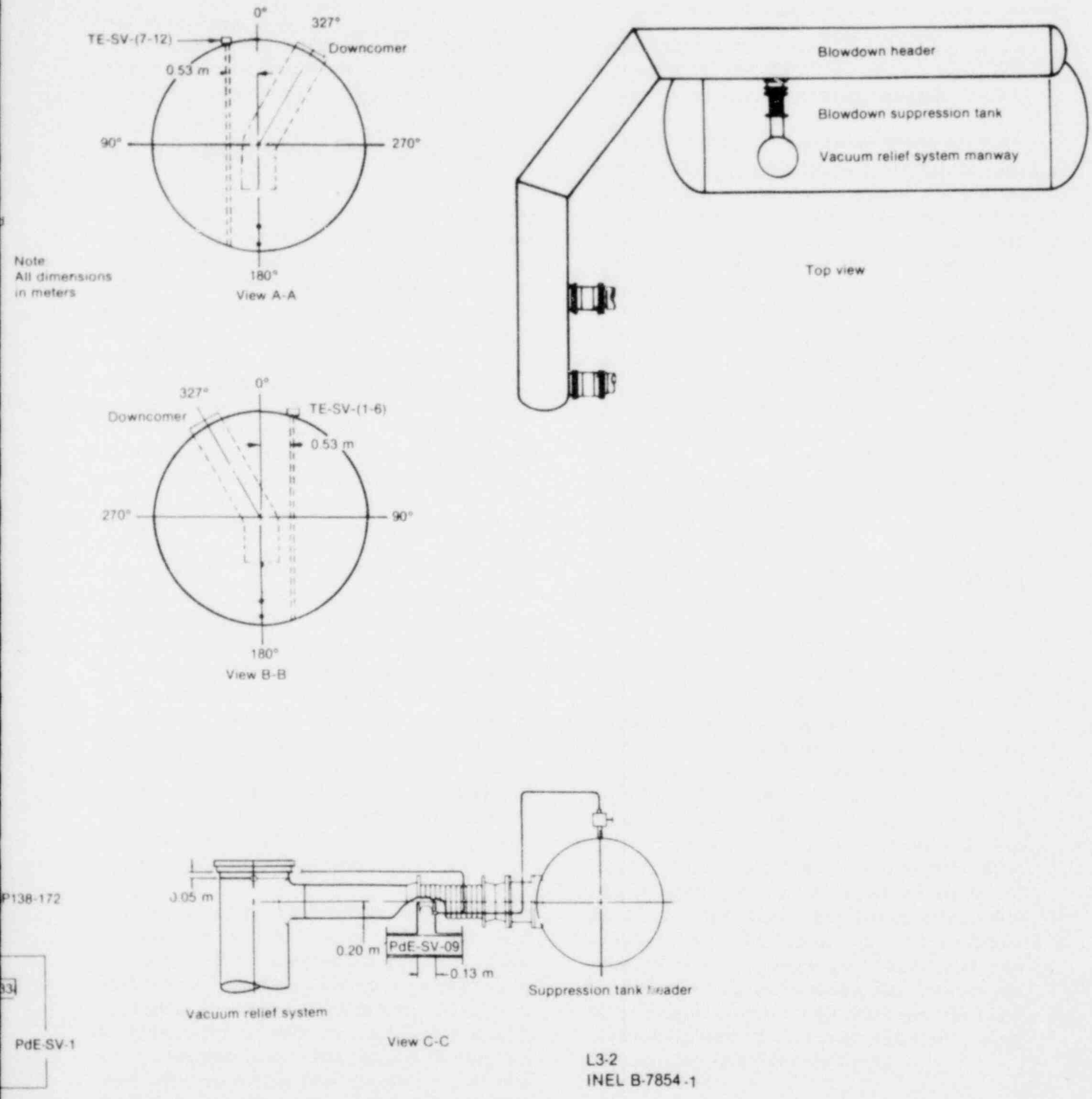


Figure 18. LOFT small break orifice area instrumentation.



LOFT N
Vacuum relief system
To PdE-SV-09
Suppression tank header
C
C
B
B
A
A
0°
90°
180°
Downcomer No. 1
TE SV-(1-6)
Downcomer No. 2
0.59 m ID
TE-SV-(7-12)
Downcomer No. 3
3.35 m ID
Downcomer No. 4
"B" End
"A" En
10°
10°
35°
35°
0.30 m
0.30 m
0.81 m
0.86 m
0.87 m
0.89 m
2.74 m
1.83 m
2.74 m
3.47 m
3.47 m
8.76 m
10.26 m
0 m
0.72 m
1.34 m
1.93 m
2.08 m
2.40 m
3.47 m
4.71 m
5.30 m
6.68 m
6.91 m
7.27 m
8.04 m
8.19 m
8.32 m
8.45 m
8.76 m
180°
190°
200°
210°
220°
230°
240°
250°
260°
270°
280°
290°
300°
310°
320°
330°
340°
350°
0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
100°
110°
120°
130°
140°
150°
160°
170°
180°
230°
270°
327°
0°
22.5°
45°
67.5°
90°
112.5°
157.5°
PE-SV-16
PE-SV-15
LOFT N
Downcomer No. 1
Downcomer No. 2
Downcomer No. 3
Downcomer No. 4
PE-SV-17
PE-SV-60
PE-SV-55
PT-
Vacuum relief system manway
LT-P138-58
LT-P138-
0 m
0.51 m
1.02 m
1.52 m
2.03 m
2.54 m
3.05 m
3.56 m
4.06 m
4.57 m
5.08 m
5.59 m
6.10 m
6.60 m
7.11 m
7.62 m
8.13 m
8.64 m

Figure 19. LO



T blowdown suppression tank instrumentation.

4. EXPERIMENT PROCEDURES AND INITIAL CONDITIONS

This section summarizes the experimental procedures, initial conditions, and the significant events recorded during the experiment.

4.1 Experiment Procedures

In preparation for Experiment L3-2, the primary coolant system was filled and vented and the specified system water chemistry was established. Prior to the primary system heatup, several tests were performed on the LOFT system. These tests included plant requalification tests, QOBV operation and seat leakage checks, pump coastdown runs, LOCE control system checks, and operational verification of newly installed instrumentation. Selected system process instrumentation was calibrated and an electrical calibration was performed on the DAVDS.

The primary coolant system pressure was hydrostatically increased to 1.46, 3.53, 6.98, 10.43, 13.87, and 15.60 MPa at cold plant temperature and zero flow conditions. The DAVDS recorded 20 s of data at each pressure plateau in both the increasing and decreasing directions to determine the degree of sensitivity of the pressure sensing instruments. The system was concurrently inspected for leakage at the various test pressures. The pumps were operated at 15, 20, 30, 40, 50, and 60 Hz with 20 s of data taken at each frequency. During heatup of the plant, the appropriate initial conditions were established for the blowdown suppression tank, accumulator, and borated water storage tank.

The plant was stabilized at three different temperatures during heatup: 422, 489, and 555 K. At each of these temperatures, 20 to 30 s of data were recorded for calibration checks and to determine the degree of instrument temperature sensitivity. At the 489- and 555-K stabilization points, the pumps were stopped and 20 s of data were recorded during flow coastdown and zero flow conditions. With the pumps off at the 555-K stabilization point, 20 s of data were obtained at 14.95, 13.87, 12.50, 11.12, and 9.74 MPa in both the increasing and decreasing directions. Frequency tests were performed by varying the primary coolant pump frequency from 20 to 60 Hz in 10-Hz increments at 555 K. Before the reactor was brought critical, the DAVDS was calibrated and the boron concentration in the accumulators, blowdown suppression tank, and borated water storage tank was verified.

Initial reactor criticality occurred approximately 122 hours prior to test initiation. Following this time, there were two periods of time when the reactor was at zero power. At approximately 36 hours prior to test initiation the reactor was brought to criticality for the last time. Twenty-two hours prior to the test, the power level reached 49 MW and was maintained at that level until blowdown occurred. A plot of the power level versus time for the 125-hour period prior to blowdown is given in Figure 20. During this time, measurements of power level were performed using a secondary calorimetric calculation. The flow rate was set at 478.8 ± 8.8 kg/s and adjustment of the secondary coolant system (SCS) was made to maintain the experiment power level. The primary coolant system boron concentration was adjusted to establish a reactor vessel inlet temperature of 556.7 ± 2.2 K at a hot leg pressure of 14.95 ± 0.34 MPa.

Prior to blowdown, a DAVDS calibration and a data integrity check were performed. During this period, the initial condition water samples were taken from the primary coolant system, the secondary coolant system, and the blowdown suppression tank. The intact loop conditions were checked, and adjusted as necessary, to ensure the specified conditions (478.8 ± 8.8 kg/s flow with temperature in the cold leg and pressure in the hot leg at 556.7 ± 2.2 K and 14.95 ± 0.34 MPa, respectively) were met at blowdown initiation. Purification lines were closed, and pressurizer and broken loop hot leg heaters were turned off just prior to blowdown initiation. An attempt was made to close the recirculation lines between the intact loop and broken loop. However, the valve between the intact loop hot leg and broken loop cold leg may have remained open.

The DAVDS was activated and data recording was started 7 minutes prior to the blowdown. The reactor was scrammed by the reactor shutdown system at 12.9 ± 0.1 s after blowdown initiation. When the four rod bottom lights came on indicating that the control rods were fully inserted, the primary coolant pumps were manually tripped. The pumps then coasted down

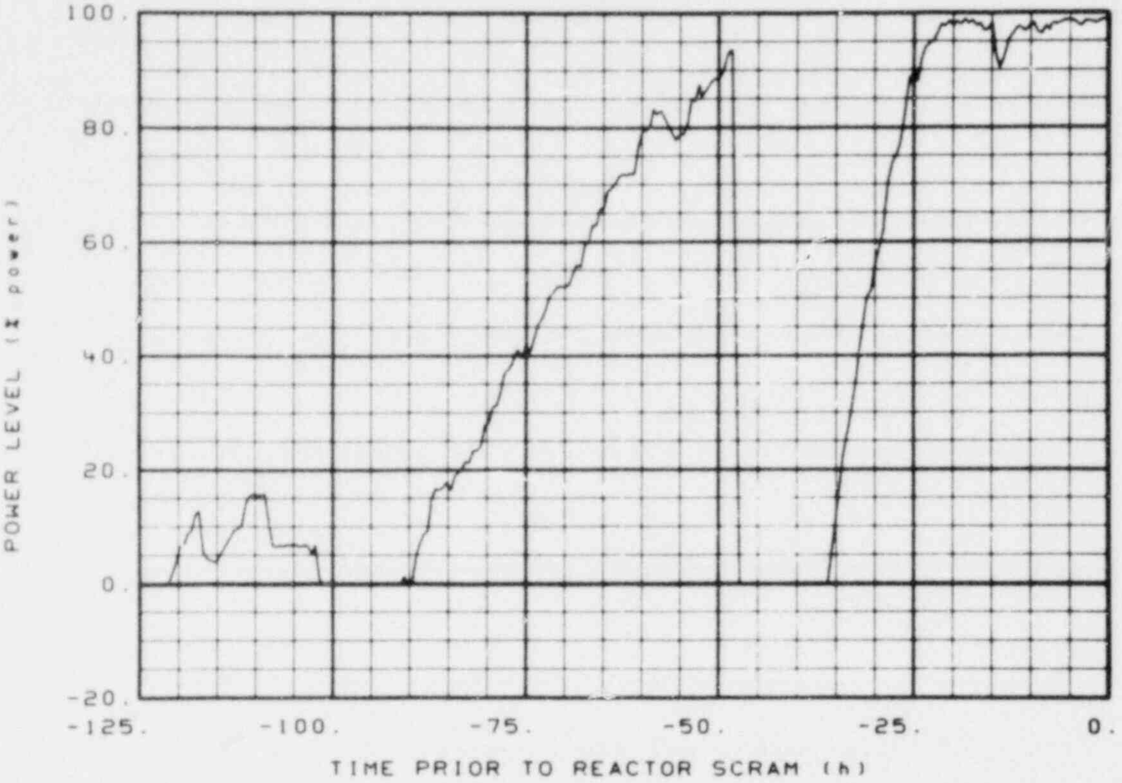


Figure 20. LOFT power history prior to Experiment L3-2 reactor scram (full power = 50 MWt).

under the influence of the installed flywheel system until the field breakers to the primary system motor generator sets tripped at 35 ± 1 s as the pump coasted down below 12.5 Hz (750 rpm). The break orifice area (13.2 mm^2) corresponded to the flow area of a 1-inch diameter break in a commercial PWR. The sequence of events for the experiment is provided in Table 2. Figure 21 shows the decay heat during the experiment, which was calculated using the American Nuclear Society Standard 5.1[5].

Emergency core coolant injection was directed to the intact loop cold leg during blowdown. The HPIS flow was initiated automatically 33.8 ± 0.1 s after blowdown initiation. Accumulator A injection at a system pressure of 4.33 ± 0.20 MPa began 5029 ± 4 s after initiation of the blowdown and continued to inject water throughout the remainder of the experiment. Initiation of the LPIS flow occurred 21 418 ± 5 s after blowdown initiation.

Operator actions involving the SCS and the purification system were used to reduce primary system pressure and temperature. The SCS auxiliary feed pump was operated for 30 minutes starting at 1 minute after scram to simulate the automatic initiation of auxiliary feed for a LPWR and, later during the transient to fill the steam generator during bleeding operations. The SCS steam bleed began at 4118 ± 1 s. Beginning at 12 300 ± 60 s circulation through the purification system heat exchanger was used to simulate the residual heat removal system of a LPWR.

The blowdown suppression tank pressure was not controlled because the back pressure was not expected to affect the blowdown. BST recirculation through the spray headers was operated at full spray pump capacity throughout the transient to ensure homogeneous temperatures throughout the water volume in the BST.

The DAVDS and plant monitor recorded approximately 221 and 487 minutes of data respectively, after the simulated rupture. An electrical calibration of the DAVDS was performed following the experiment.

TABLE 2. SEQUENCE OF EVENTS FOR SMALL BREAK EXPERIMENT L3-2

Event	Time after LOCE Initiation (s)
LOCE initiated	0
Reactor scrammed	12.9 ± 0.1
Control rods on bottom	15.0 ± 0.1
Primary coolant pumps tripped	16.9 ± 0.1
HPIS injection initiated	33.8 ± 0.1
PCP coastdown completed	35 ± 1
First indication of core natural circulation	36 ± 2
SCS auxiliary feed initiated	114 ± 1
Pressurizer emptied	136 ± 7
Upper plenum reached saturation pressure	180 ± 1
SCS auxiliary initial feed termination	1878 ± 1
Initiate SCS steam bleed	4118 ± 1
Accumulator injection initiated	5029 ± 4
Purification system recirculation initiated	12 300 ± 60
Pressurizer refill initiated	21 394 ± 3
LPIS injection initiated	21 418 ± 5
Pressurizer refill terminated[a]	21 422 ± 5
Experiment completed[b]	23 350 ± 100

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[a] The level at which pressurizer refill terminated was 1.4 m.

[b] The experiment was finished when the primary coolant system temperature dropped to 366.5 K.

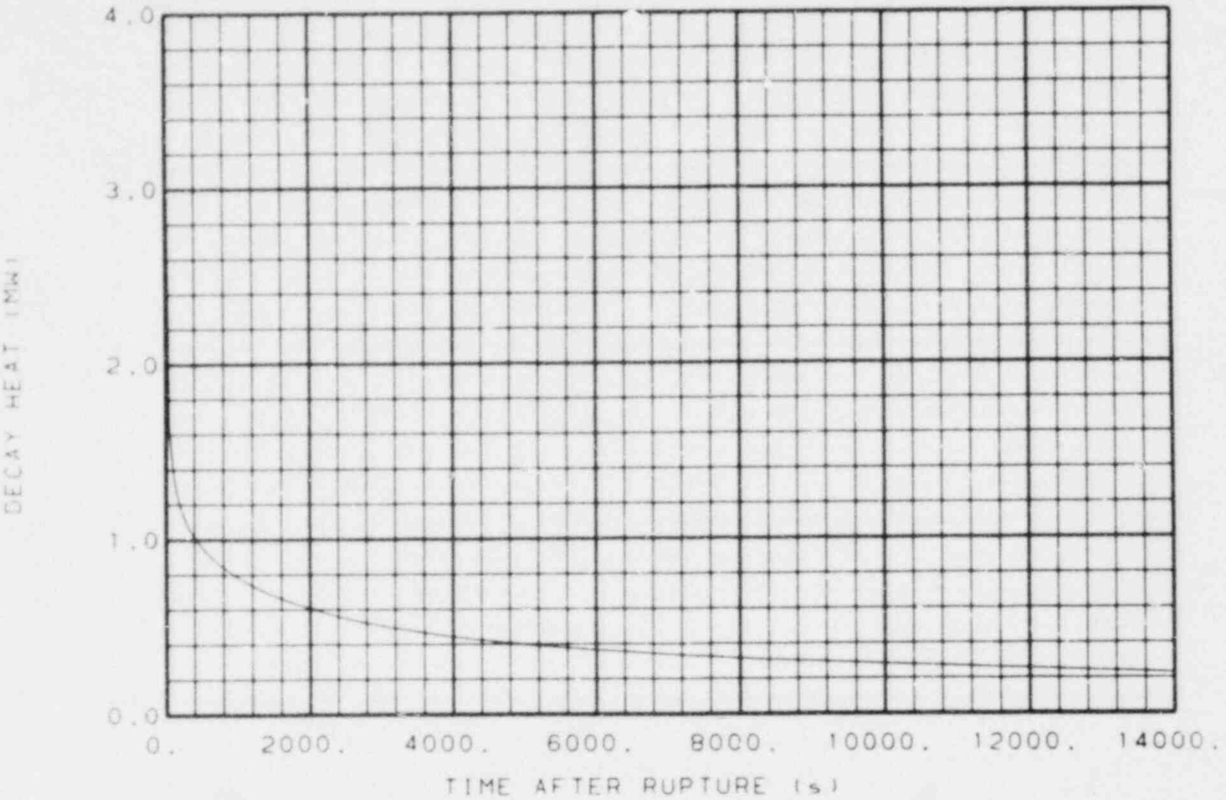

Figure 21. **LOFT decay heat following Experiment L3-2 reactor scram.**

4.2 Initial Conditions

The initial conditions (except for the linear heat generation rate conditions) and tolerance bands for Experiment L3-2 are presented in Table 3 along with the values measured immediately prior to the blowdown initiation. All initial conditions were within specified tolerances. Table 4 gives the linear heat generation rate versus core height for three locations within the LOFT core prior to blowdown initiation. The data for Table 4 were obtained from the traversing in-core probe system.

Table 5 gives the measured fluid temperatures of the primary coolant system immediately prior to blowdown initiation.

Table 6 specifies the required water chemistry for the primary coolant system, the blowdown suppression tank, and the secondary coolant system. In addition, the results of the water chemistry analyses for these systems are presented for pre-LOCE conditions and for the blowdown suppression tank post-LOCE conditions. The pre-LOCE Accumulator A boron concentration was 3396 ± 15 ppm.

TABLE 3. INITIAL CONDITIONS FOR SMALL BREAK EXPERIMENT L3-2

Parameter	Specified Value	Measured Value
Primary Coolant System		
Mass flow rate (kg/s)	478.8 ± 8.8	481.5 ± 6.3
Hot leg pressure (MPa)	14.95 ± 0.34	14.85 ± 0.04
Cold leg temperature (K)	556.8 ± 2.2	557.8 ± 3
Hot leg temperature (K)	--	575.8 ± 0.5
Boron concentration (ppm)	As required to maintain temperature	747 ± 15
Reactor Vessel		
Power level (MW)	50 ± 2	49 ± 1
Maximum linear heat generation rate (kW/m)	--	52.2 ± 3.7
Control rod position (above full-in position) (m)	1.372 ± 0.013	1.372 ± 0.010
Pressurizer		
Steam volume (m^3)	--	0.29 ± 0.05
Liquid volume (m^3)	--	0.67 ± 0.05
Water temperature (K)	--	614.8 ± 0.3
Pressure (MPa)	14.95 ± 0.34	14.85 ± 0.04
Level (m)	1.13 ± 0.18	1.20 ± 0.02
Broken Loop		
Cold leg temperature near reactor vessel (K)	--	556.9 ± 5.0
Hot leg temperature near reactor vessel (K)	--	561.9 ± 5.0
Steam Generator Secondary Side		
Water level (m)[a,b]	0.25 ± 0.05	--
Water temperature (K)	--	543.1 ± 1.4
Pressure (MPa)	--	5.51 ± 0.11
Mass flow rate (kg/s)	--	27.3 ± 0.4
ECC Accumulator A		
Liquid level (m)	1.85 ± 0.05	1.84 ± 0.01
Liquid volume (m^3)	--	1.69 ± 0.03
Gas volume (m^3)	--	1.22 ± 0.03
Pressure (MPa)	4.22 ± 0.17	4.38 ± 0.06
Temperature (K)	305.4 ± 5.6	307.5 ± 0.7
Boron concentration (ppm)	3000	3396 ± 15

TABLE 3. (continued)

Parameter	Specified Value	Measured Value
HPIS		
Initial flow rate (l/s)	0.32 ± 0.13	0.38 ± 0.02
Initiation pressure (MPa)	13.16 ± 0.19	13.07 ± 0.24
LPIS		
Initiation pressure (MPa)	1.60 ± 0.19	1.59 ± 0.04
Suppression Tank		
Liquid level (m)	1.27 ± 0.05	1.30 ± 0.03
Liquid volume (m^3)	--	30.1 ± 1.5
Gas volume (m^3)	--	54.8 ± 1.5
Liquid temperature (K)	--	363.2 ± 2.7
Pressure (MPa)	--	0.136 ± 0.008
Average downcomer submergence (m)	--	0.42 ± 0.06

---

a. The water level is defined as 0 at 2.95 m above the top of the tube sheet.

b. Ambiguous initial readings. Absolute value cannot be determined.

TABLE 4. LINEAR HEAT GENERATION RATE PRIOR TO EXPERIMENT L3-2 (Reading Uncertainty ± 7.6%)

Height above Core Bottom (m)	Linear Heat Generation Rate for Core Position (kW/m)		
	1C7	5H8	5M3
0.152	10.45	18.71	18.35
0.305	22.06	37.52	37.50
0.406	26.14	42.57	42.61
0.460	25.16	40.98	41.02
0.508	25.31	43.05	43.03
0.559	29.01	47.26	47.30
0.660	30.10	49.04	49.08
0.762	29.73	48.44	48.47
0.838	28.09	45.75	45.79
0.891	26.16	40.39	40.43
0.940	25.04	41.69	41.72
1.067	25.59	38.12	38.61
1.219	23.34	29.50	29.88
1.270	15.84	25.09	25.41
1.303	13.18	20.89	21.16
1.372	11.59	18.36	18.60
1.524	5.17	9.35	8.78
1.626	2.57	4.65	4.37
1.676	1.59	2.87	2.69

TABLE 5. PRIMARY COOLANT TEMPERATURES AT BLOWDOWN INITIATION

Location	Detector	Temperature (K)
Intact loop hot leg (near vessel)	TE-P139-32-1	577.2 ± 1.4
Intact loop steam generator inlet	TE-SG-001	576.4 ± 3.9
Intact loop steam generator outlet	TE-SG-002	560.04 ± 3.9
Intact loop cold leg (near vessel)	TE-PC-004	559.3 ± 3
Reactor vessel downcomer:		
Instrument Stalk 1	TE-1ST-001	559.8 ± 5.1
Instrument Stalk 2	TE-2ST-001	561.7 ± 5.1
Reactor vessel lower plenum	TE-1LP-001	559.9 ± 5.1
Reactor vessel upper plenum	TE-1UP-001	585.8 ± 5.1
	TE-4UP-001	574.5 ± 5.1
	TE-5UP-001	589.1 ± 5.1
Broken loop hot leg (near vessel)	TE-BL-002B	561.9 ± 5
Broken loop cold leg (near vessel)	TE-BL-001B	556.8 ± 5
Intact loop pressurizer: Saturation	PE-PC-004	614.8 ± 1.3

TABLE 6. WATER CHEMISTRY RESULTS FOR EXPERIMENT L3-2

	Primary Coolant Intact Loop		Blowdown Suppression Tank			Secondary Coolant System	
Parameter	Specified	Pre-LOCE[a]	Specified	Pre-LOCE	Post-LOCE	Specified	Pre-LOCE
pH (each at 298 K)	4.2 to 10.5	5.81	4.2 to 10.5	4.40	4.61	9.0 to 10.2	9.83
Conductivity (μmho/cm^3) (each at 298 K)	60 maximum	3.25	60 maximum	18.5	14.8	2 maximum[b]	1.3[b]
Total gas (cm^3/kg)	100 maximum	44.3	--	30.4	25	--	--
Dissolved oxygen (ppm)	--	--	--	--	--	0.005 maximum	<0.010
Lithium (ppm)	0.2 to 2.2	0.2	--	--	--	--	--
Chloride (ppm)	0.15 maximum	<0.1	0.15 maximum	<0.1	<0.1	0.15 maximum	<0.1
Undissolved solids (ppm)	1.0 maximum	<0.5	1.0 maximum	<0.5	<0.5	1.0 maximum	4.8
Boron (ppm)	--	747	3050	4353	3674	--	--
Fluoride (ppm)	0.1 maximum	<0.02	0.1 maximum	<0.02	<0.02	--	--
Hydrogen (cm^3/kg)[c]	10 to 60	18	--	0	0	--	--
Total gross activity (μc/ml)	375 maximum	2.9×10^{-2}	--	--	1.8×10^{-3}	--	--
Gross beta and gamma (μc/ml)	--	2.9×10^{-2}	--	--	1.8×10^{-3}	--	--
I^{131} (μc/ml)	0.37 maximum	0	--	--	0	9×10^{-4} maximum	0
I^{135} (μc/ml)	0.76 maximum	0	--	--	0	--	0

---

a. Sample taken upstream of the primary coolant system ion exchanger.

b. Cation conductivity.

c. Prior to depressurization.

5. DATA PRESENTATION

The data presented in this report include selected pertinent thermal-hydraulic and nuclear data from LOFT Experiment L3-2.

The selected data have been divided into two categories, qualified and channel failed. The qualified designation was applied to measurements that have been found to be within the uncertainty of the instrument. The absence of a comment following the "Qualified" designation indicates that the data are valid (that is, within specified uncertainty bands) over the entire time span recorded. Restrictive statements accompany data that are invalid over a portion of the recorded time span. Instrument channels were not presented if the data were in the instrument dead band or showed a similar response to nearby like instruments (such as the core thermocouples). These data are available upon special request. The checks on data consistency and instrument performance are discussed in detail in Appendix A.

The data were processed and are presented in graphical form in SI units. Measurements were combined to produce computed variables, and graphs of similar variables at several locations were overlaid to facilitate comparison. The number of data points shown for each instrument have been reduced to 2000 for ease of plotting. To accomplish this reduction, the data were passed through a low-pass filter and then decimated (refer to footnotes (a) and (b) at the end of this section). The long-term plots were digitized from plant monitor system data. This digitization led to uncertainties in excess of the recording uncertainties, both in magnitude and time. Therefore, the uncertainties for the long-term plots are specified in the figure captions rather than Table 7.

The long-term plots were digitized and cannot be accessed from the L3-2 computerized data base. However, they may be obtained by special request. Computed parameter data from the drag discs, the turbine flowmeters, and the gamma densitometers were filtered with a 4-Hz, low-pass filter prior to presentation.

The 2-σ confidence intervals have been determined from knowledge of the systematic and random errors of the sensors, data system, calibration procedures, and the channel random noise during pretest calibrations. These are presented as functions of output level so that the user may determine the approximate uncertainty over each range of interest for a given variable.

Table 7 lists Experiment L3-2 instrumentation and gives the detector location, range, initial condition uncertainty, uncertainty at specific readings, and recording frequency along with the figure numbers. This table also contains a "Comments" column which gives information relative to the usability of the data.

Table 8 lists the variables that were computed from the transducer outputs and other factors, such as geometrical constants. This table also gives the equations used to compute these variables, the figure number, and comments which may reflect on the usefulness of the data.

The data are divided into three major sections with the individual plots in each section being presented in alphanumeric order to facilitate comparison and location of desired variables. These data sections include

1. Experiment L3-2 Measured Variables, Short-Term Plots[a] (-200 to 1000 s) Figures 22 through 103
2. Experiment L3-2 Measured Variables, Medium-Term Plots[b,c] (-400 to 14 000 s) Figures 104 through 204
3. Experiment L3-2 Measured Variables, Long-Term Plots (0 to 30 000 s) Figures 205 through 216
4. Experiment L3-2 Computed Variables, Figures 217 through 223.

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[a] The short-term plots were decimated by plotting every third point.

[b] The medium-term plots were decimated by plotting every 36th point.

[c] The medium-term plots experienced a gap in the data at approximately 6750 s due to a temporary data acquisition system malfunction.

TABLE 7. MEASURED VARIABLES FOR EXPERIMENT L3-2

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
VALVE OPENING								
Intact Loop CV-P004-008	Main feedwater control valve.	0 to 100%	1 Hz	3.2%	0%	3.0%	--	Channel failed.
					25%	3.13%		
					50%	3.47%		
					100%	4.61%		
Intact Loop CV-P004-010	Main steam control valve.	0 to 100%	1 Hz	3.9%	0%	3.0%	104	Qualified.
					25%	3.13%		
					50%	3.47%		
					100%	4.61%		
Broken Loop CV-P138-001	Broken loop cold leg between break plane and suppression tank.	0 to 100%	1 Hz	3.0%	0%	3.0%	--	Not presented.[b]
					25%	3.13%		
					50%	3.47%		
					100%	4.61%		
Broken Loop CV-P138-123	1.3 l/s spray header control valve.	0 to 100%	1 Hz	4.61%	0%	3.0%	--	Not presented.
					25%	3.13%		
					50%	3.47%		
					100%	4.61%		
Broken Loop CV-P138-124	3.8 l/s spray header control valve.	0 to 100%	1 Hz	4.61%	0%	3.0%	--	Not presented.
					25%	3.13%		
					50%	3.47%		
					100%	4.61%		
Broken Loop CV-P138-125	13.9 l/s spray header control valve.	0 to 100%	1 Hz	4.61%	0%	3.0%	--	Not presented.
					25%	3.13%		
					50%	3.47%		
					100%	4.61%		

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
CHORDAL DENSITY								
Broken Loop DE-BL-001A	Broken loop cold leg at DTT flange. Beam line 14° 21 min from -1B line (CW looking toward reactor vessel RV).	0 to 1.0 Mg/m^3	10 Hz	0.072 Mg/m^3	--	0.072 Mg/m^3[c]	22, 105	Qualified, spikes caused by data processing.
Broken Loop DE-BL-001B	Broken loop cold leg at DTT flange. Beam line through C_L of pipe 45° from vertical (CCW looking toward RV).	0 to 1.0 Mg/m^3	10 Hz	0.072 Mg/m^3	--	0.072 Mg/m^3	23, 106	Qualified, spikes caused by data processing.
Broken Loop DE-BL-001C	Broken loop cold leg at DTT flange. Beam line 22° 7 min from -1B line (CCW looking toward RV).	0 to 1.0 Mg/m^3	10 Hz	0.116 Mg/m^3	--	0.116 Mg/m^3	24, 107	Qualified, spikes caused by data processing.
Broken Loop DE-BL-002A	Broken loop hot leg at DTT flange. Beam line 14° 21 min from -2B line (CCW looking toward RV).	0 to 1.0 Mg/m^3	10 Hz	0.068 Mg/m^3	--	0.068 Mg/m^3	25, 108	Failed, originally qualified but further investigation determined instrument failed.
Broken Loop DE-BL-002B	Broken loop hot leg at DTT flange. Beam line through C_L of pipe 45° from vertical (CW looking toward RV).	0 to 1.0 Mg/m^3	10 Hz	--	--	Not available	--	Not installed.
Intact Loop DE-BL-002C	Broken loop hot leg at DTT flange. Beam line 22° 7 min from -2B line (CW looking toward RV).	0 to 1.0 Mg/m^3	10 Hz	--	--	Not available	--	Not installed.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
CHORDAL DENSITY (continued)								
Intact Loop DE-PC-001A	Intact loop cold leg at DTT flange. Beam line 14° 21 min from -1B line (CW looking away from RV).	0 to 1.0 Mg/m^3	10 Hz	--	--	Not available	--	Channel failed.
Intact Loop DE-PC-001B	Intact loop cold leg at DTT flange. Beam line through ℄ of pipe 45° from vertical (CCW looking away from RV).	0 to 1.0 Mg/m^3	10 Hz	0.072 Mg/m^3	--	0.072 Mg/m^3	26, 109	Qualified, spikes caused by data processing.
Intact Loop DE-PC-001C	Intact loop cold leg at DTT flange. Beam line 22° 7 min from -1B line (CCW looking away from RV).	0 to 1.0 Mg/m^3	10 Hz	--	--	Not available	--	Channel failed.
Intact Loop DE-PC-002A	Intact loop hot leg at DTT flange. Beam line 14° 21 min from -2B line (CW looking away from RV).	0 to 1.0 Mg/m^3	10 Hz	--	--	Not available	--	Channel failed.
Intact Loop DE-PC-002B	Intact loop hot leg at DTT flange. Beam line through ℄ of pipe 45° from vertical (CCW looking away from RV).	0 to 1.0 Mg/m^3	10 Hz	--	--	Not available	--	Channel failed.
Intact Loop DE-PC-002C	Intact loop hot leg at DTT flange. Beam line 22° 7 min from -2B line (CCW looking away from RV).	0 to 1.0 Mg/m^3	10 Hz	--	--	Not available	--	Channel failed.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
CHORDAL DENSITY (continued)								
Intact Loop DE-PC-003A	Intact loop below steam generator at DTT flange. Beam line 14° 21 min from PC-3B line (CCW looking away from RV).	0 to 1.0 Mg/m^3	1 Hz	--	--	Not available	--	Channel failed.
Intact Loop DE-PC-003B	Intact loop below steam generator at DTT flange. Beam line through ℄ of pipe 45° from vertical (CW looking away from RV).	0 to 1.0 Mg/m^3	1 Hz	--	--	Not available	--	Channel failed.
Intact Loop DE-PC-003C	Intact loop below steam generator at DTT flange. Beam line 22° 7 min from PC-3B line (CW looking away from RV).	0 to 1.0 Mg/m^3	1 Hz	--	--	Not available	--	Channel failed.
FUEL ASSEMBLY DISPLACEMENT								
Assembly 5 DIE-5UP-001	At top center of Fuel Assembly 5.	±12.7 mm	100 Hz	0.3 mm	0 mm 6.35 mm 12.7 mm	0.3 mm[d] 0.33 mm 0.39 mm	--	Not presented.
Assembly 5 DIE-5UP-002	At top center of Fuel Assembly 5.	±12.7 mm	100 Hz	0.3 mm	0 mm 6.35 mm 12.7 mm	0.3 mm 0.33 mm 0.39 mm	--	Not presented.
FLUID VELOCITY								
Reactor Vessel FE-5UP-001	Above upper end box of Fuel Assembly 5.	0.5 to 10.0 m/s	1 Hz	2.3 m/s	--	2.3 m/s[e]	27	Qualified.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
FLOW RATE								
Blowdown Suppression Tank Spray System FE-P138-138	Suppression tank spray flow rate in the 3.79-l/s header.	0 to 6.3 l/s	1 Hz	0.1 l/s	--	0.1 l/s	--	Not presented.
Blowdown Suppression Tank Spray System FE-P138-139	Suppression tank spray flow rate from pump discharge.	0 to 25.2 l/s	1 Hz	--	--	0.35 l/s	--	Channel failed.
Blowdown Suppression Tank Spray System FE-P138-140	Suppression tank spray flow rate in 13.9-l/s header.	0 to 18.9 l/s	1 Hz	0.27 l/s	--	0.27 l/s	--	Not presented.
Blowdown Suppression Tank Spray System FE-P138-153	Suppression tank spray flow rate in the spray pump recirculation line.	0 to 9.5 l/s	1 Hz	--	--	0.13 l/s	--	Channel failed.
Intact Loop FT-P004-012	Inlet to air cooled condenser inlet header.	0 to 40 kg/s	Hz	0.8 kg/s	--	0.8 kg/s	110	Qualified.
Intact Loop FT-P004-072A	Main feedwater pump discharge flow.	0 to 25 kPa	10 Hz	0.17 kPa	--	0.17 kPa	--	Not presented.
Intact Loop FT-P004-72-2	Flow out of main feedwater pump.	0 to 40 kg/s	1 Hz	0.8 kg/s	--	0.8 kg/s	--	Not presented.
Emergency Core Cooling System FT-P120-36-1	Accumulator A in 6-in. line downstream of orifice.	0 to 126.2 l/s	1 Hz	3.5 l/s	--	3.5 l/s	--	Not presented.
Emergency Core Cooling System FT-P120-36-5	Accumulator A in 6-in. line downstream of orifice.	0 to 37.9 l/s	1 Hz	3.5 l/s	--	3.5 l/s	--	Not presented.
Emergency Core Cooling System FT-P120-085	LPIS Pump A in 4-in. line between heat exchanger and orifice.	0 to 25.2 l/s	1 Hz	0.25 l/s	--	2.5 l/s	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
FLOW RATE (continued)								
Emergency Core Cooling System FT-P128-104	HPIS Pump A discharge.	0 to 1.9 l/s	1 Hz	0.02 l/s	--	0.02 l/s	111	Qualified.
Intact Loop FT-P139-27-1	Intact loop hot leg venturi flowmeter (right side facing steam generator).	0 to 630.0 kg/s	1 Hz	17 kg/s	--	17 kg/s	28	Qualified, good for initial conditions only.
Intact Loop FT-P139-27-2	Intact loop hot leg venturi flowmeter (bottom of pipe).	0 to 630.0 kg/s	1 Hz	17 kg/s	--	17 kg/s	29	Qualified, good for initial conditions only.
Intact Loop FT-P139-27-3	Intact loop hot leg venturi flowmeter (left side facing steam generator).	0 to 630.0 kg/s	1 Hz	17 kg/s	--	17 kg/s	30	Qualified, good for initial conditions only.
Primary Component Cooling System FT-P141-022	Primary component coolant system.	0 to 22 l/s	10 Hz	0.11 l/s[f]	--	0.11 l/s[f]	205	Qualified.
LIQUID LEVEL								
Intact Loop LEPdE-PC-027	Steam generator outlet to pump suction, lowest point.	0 to 1.55 m	1 Hz	Not applicable, data meaningful only after 500 s.	--	0.12 m	31, 112	Qualified, good from 500 to 6000 s. (Pipe full reading = 1.55 m.)
Intact Loop LEPdE-PC-028	Pump suction lowest point to Pump 2 inlet.	0 to 0.66 m	1 Hz	Not applicable, data meaningful only after 500 s.	--	0.1 m	32, 113	Qualified, good from 500 to 6000 s. (Pipe full reading = 0.66 m.)
Emergency Core Cooling System LIT-P120-044	Accumulator A.	0 to 3.0 m	1 Hz	0.02 m[f]	--	0.02 m[f]	114, 206	Qualified.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
LIQUID LEVEL (continued)								
Secondary Coolant System LT P004-008A	Steam generator feedwater level (narrow range).	-1.1 to 1.5 m	1 Hz	0.03 m	--	0.03 m	115	Qualified, absolute magnitude uncertain--narrow range instrument.
Secondary Coolant System LT-P004-008B	Steam generator feedwater level (wide range).	-3.6 to 1.4 m[g]	1 Hz	0.05 m	--	0.05 m	--	Channel failed.
Intact Loop LT-P004-042	Condensate receiver level, 183 m south of condensate reciever C_L.	0 to 1.2 m	1 Hz	0.02 m	--	0.02 m	--	Not presented.
Blowdown Suppression Tank LT-P138-033	Blowdown suppression tank level on north end of tank.	0 to 3.8 m	1 Hz	0.03 m	--	0.03 m	116	Qualified, level decrease at approximately 4600 s was caused by pressure equalization between the tank and header, which forced liquid back up into the downcomers.
Blowdown Suppression Tank LT-P138-058	Blowdown suppression tank level on south end of tank.	0 to 3.4 m	1 Hz	0.07 m	--	0.07 m	--	Not presented.
Intact Loop LT-P139-006	Pressurizer level on southeast side.	0 to 1.9 m	1 Hz	0.04 m	--	0.04 m	--	Not presented.
Intact Loop LT-P139 007	Pressurizer level on southwest side.	0 to 1.9 m	1 Hz	0.04 m[f]	--	0.04 m[f]	33, 117	Qualified.
Intact Loop LT-P139-008	Pressurizer level on north side.	0 to 1.9 m	1 Hz	0.04 m	--	0.04 m	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
MOMENTUM FLUX								
Reactor Vessel ME-1ST-001	Downcomer Stalk 1, 1.16 m above RV bottom.	0.3 to 5.2 Mg/m·s^2	1 Hz	0.78 Mg/m·s^2	--	0.78 Mg/m·s^2	--	Not presented.
Reactor Vessel ME-2ST-001	Downcomer Stalk 2, 1.16 m above RV bottom.	0.3 to 5.2 Mg/m·s^2	1 Hz	0.78 Mg/m·s^2	--	0.78 Mg/m·s^2	--	Not presented.
Reactor Vessel ME-1UP-001	Fuel Assembly 1 above upper end box.	0.3 to 5.2 Mg/m·s^2	1 Hz	0.78 Mg/m·s^2	--	0.78 Mg/m·s^2	34	Qualified, initial conditions out of measurement range.
Reactor Vessel ME-3UP-001	Fuel Assembly 3 above upper end box.	0.3 to 5.2 Mg/m·s^2	1 Hz	0.78 Mg/m·s^2	--	0.78 Mg/m·s^2	35	Qualified.
Reactor Vessel ME-5UP-001	Fuel Assembly 5 above upper end box.	0.3 to 5.2 Mg/m·s^2	1 Hz	0.78 Mg/m·s^2	--	0.78 Mg/m·s^2	36	Qualified.
NEUTRON DETECTION								
Reactor Vessel NE-2H8-26	Neutron detector in Fuel Assembly 2.	0 to 52.5 Local kW/m	1 Hz	2.03 kW/m	--	2.03 kW/m[h]	--	Not presented.
Reactor Vessel NE-4H8-26	Neutron detector in Fuel Assembly 4.	0 to 52.5 Local kW/m	1 Hz	2.03 kW/m	--	2.03 kW/m	--	Not presented.
Reactor Vessel NE-5D8-26	Neutron detector in Fuel Assembly 5.	0 to 52.5 Local kW/m	1 Hz	2.03 kW/m	--	2.03 kW/m	--	Not presented.
Reactor Vessel NE-6H8 26	Neutron detector in Fuel Assembly 6.	0 to 52.5 Local kW/m	1 Hz	2.03 kW/m	--	2.03 kW/m	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
ELECTRICAL FREQUENCY								
Intact Loop PCP-1-F	Intact loop Pump 1.	0 to 75 Hz	10 Hz	0.75 Hz	--	0.75 Hz[i]	--	Not presented.
Intact Loop PCP-2-F	Intact loop Pump 2.	0 to 75 Hz	10 Hz	0.75 Hz	--	0.75 Hz	--	Not presented.
ELECTRICAL POWER								
Intact Loop PCP-1-P	Intact loop Pump 1.	0 to 1 MW	10 Hz	0.05 MW	--	0.05 MW	37	Qualified.
Intact Loop PCP-2-P	Intact loop Pump 2.	0 to 1 MW	10 Hz	0.05 MW	--	0.05 MW	38	Qualified.
DIFFERENTIAL PRESSURE								
Broken Loop PDE-BL-002	Broken loop cold leg across small break orifice.	±17.5 MPa (differential)	1 Hz	0.025 MPa	0 MPa 5 MPa 10 MPa 15 MPa	0.0247 MPa 0.0255 MPa 0.0279 MPa 0.0315 MPa	39, 118	Qualified.
Broken Loop PDE-BL-003	Broken loop cold leg across 5- to 8-inch expansion.	±3.5 MPa (differential)	1 Hz	0.000 88 MPa	0 MPa 2 MPa 3.5 MPa	0.000 88 MPa 0.01 MPa 0.01 MPa	--	Not presented.
Broken Loop PDE-BL-009	Broken loop from end to middle of 5-inch pipe.	±0.7 MPa (differential)	1 Hz	0.0017 MPa	0 MPa 0.35 MPa 0.70 MPa	0.0017 MPa 0.0017 MPa 0.0019 MPa	--	Not presented.
Broken Loop PDE-BL-010	Broken loop from middle to end of 5-inch pipe.	±0.7 MPa (differential)	1 Hz	0.0005 MPa	0 MPa 0.35 MPa 0.70 MPa	0.0017 MPa 0.0017 MPa 0.0019 MPa	--	Not presented.
Intact Loop PDE-PC-001	Intact loop cold leg across primary coolant pumps.	±0.7 MPa (differential)	1 Hz	0.0018 MPa	0 MPa 0.35 MPa 0.70 MPa	0.0017 MPa 0.0017 MPa 0.0019 MPa	40	Qualified.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
DIFFERENTIAL PRESSURE (continued)								
Intact Loop PDE-PC-002	Intact loop across SG.	±0.35 MPa (differential)	1 Hz	0.0009 MPa	0 MPa 0.15 MPa 0.30 MPa	0.000 88 MPa 0.0009 MPa 0.0009 MPa	41	Qualified.
Intact Loop PDE-PC-003	Intact loop hot leg piping, RV to SG inlet.	±0.1 MPa (differential)	1 Hz	0.0005 MPa	0 MPa 0.05 MPa 0.10 MPa	0.000 49 MPa 0.000 50 MPa 0.000 52 MPa	42	Qualified, good for initial conditions only.
Intact Loop PDE-PC-004	Intact loop hot leg piping, surge line junction to SG inlet.	±0.1 MPa (differential)	1 Hz	0.0005 MPa	0 MPa 0.05 MPa 0.10 MPa	0.000 49 MPa 0.000 50 MPa 0.000 52 MPa	--	Not presented.
Intact Loop PDE-PC-005	Intact loop cold leg primary coolant pumps to RV nozzle.	±0.1 MPa (differential)	1 Hz	0.0005 MPa	0 MPa 0.05 MPa 0.10 MPa	0.000 49 MPa 0.000 50 MPa 0.000 52 MPa	43	Qualified.
Intact Loop PDE-PC-006	Intact loop reactor vessel outlet to inlet.	±0.1 MPa (differential)	1 Hz	0.0005 MPa	0 MPa 0.05 MPa 0.10 MPa	0.000 49 MPa 0.000 50 MPa 0.000 52 MPa	44	Qualified, low range instrument.
Intact Loop PDE-PC-008	Intact loop across pressurizer surge line.	±10.34 MPa (differential)	1 Hz	0.025 MPa	0 MPa 5 MPa 10 MPa	0.025 MPa 0.0258 MPa 0.028 MPa	45	Qualified.
Intact Loop PDE-PC-009	Intact loop across Pump 1.	±0.7 MPa (differential)	1 Hz	0.0018 MPa	0 MPa 0.3 MPa 0.6 MPa	0.0017 MPa 0.0017 MPa 0.0018 MPa	--	Not presented.
Intact Loop PDE-PC-010	Intact loop across Pump .	±0.7 MPa (differential)	1 Hz	0.0018 MPa	0 MPa 0.3 MPa 0.6 MPa	0.0017 MPa 0.0017 MPa 0.0018 MPa	--	Not presented.
Intact Loop PDE-PC-011	Pitot tube at top of ECC Rake 1 (facing reactor vessel).	± 40 kPa (differential)	1 Hz	0.29 kPa	0 kPa 20 kPa 40 kPa	0.28 kPa 0.285 kPa 0.291 kPa	--	Not presented.
Intact Loop PDE-PC-012	Pitot tube next to top of ECC Rake 1 (facing reactor vessel).	± 40 kPa (differential)	1 Hz	0.29 kPa	0 kPa 20 kPa 40 kPa	0.28 kPa 0.285 kPa 0.291 kPa	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
DIFFERENTIAL PRESSURE (continued)								
Intact Loop PDE-PC-015	Pitot tube at top of ECC Rake 1 (facing pump).	± 40 kPa (differential)	1 Hz	0.29 kPa	0 kPa 20 kPa 40 kPa	0.28 kPa 0.285 kPa 0.291 kPa	--	Not presented.
Intact Loop PDE-PC-016	Pitot tube next to top of ECC Rake 1 (facing pump).	± 40 kPa (differential)	1 Hz	0.29 kPa	0 kPa 20 kPa 40 kPa	0.28 kPa 0.285 kPa 0.291 kPa	--	Not presented.
Intact Loop PDE-PC-017	Pitot tube next to bottom of ECC Rake 1 (facing pump).	± 40 kPa (differential)	1 Hz	0.29 kPa	0 kPa 20 kPa 40 kPa	0.28 kPa 0.285 kPa 0.291 kPa	--	Not presented.
Intact Loop PDE-PC-17B	Pitot tube next to bottom of ECC Rake 1 (facing pump).	± 5 kPa (differential)	1 Hz	0.037 kPa	--	0.037 kPa	--	Not presented.
Intact Loop PDE-PC-018	Pitot tube at bottom of ECC Rake 1 (facing pump).	± 40 kPa (differential)	1 Hz	0.29 kPa	0 kPa 20 kPa 40 kPa	0.28 kPa 0.285 kPa 0.291 kPa	--	Not presented.
Intact Loop PDE-PC-18B	Pitot tube at bottom of ECC Rake 1 (facing pump).	± 5 kPa (differential)	1 Hz	0.037 kPa	--	0.037 kPa	--	Not presented.
Intact Loop PDE-PC-019	Pitot tube at top of ECC Rake 2 (facing reactor vessel).	± 40 kPa (differential)	1 Hz	0.29 kPa	0 kPa 20 kPa 40 kPa	0.28 kPa 0.285 kPa 0.291 kPa	--	Not presented.
Intact Loop PDE-PC-020	Pitot tube next to top of ECC Rake 2 (facing reactor vessel).	± 40 kPa (differential)	1 Hz	0.29 kPa	0 kPa 20 kPa 40 kPa	0.28 kPa 0.285 kPa 0.291 kPa	--	Not presented.
Intact Loop PDE-PC-023	Pitot tube at top of ECC Rake 2 (facing pump).	± 40 kPa (differential)	1 Hz	0.29 kPa	0 kPa 20 kPa 40 kPa	0.28 kPa 0.285 kPa 0.291 kPa	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
DIFFERENTIAL PRESSURE (continued)								
Intact Loop PDE-PC-024	Pitot tube next to top of ECC Rake 2 (facing pump).	± 40 kPa (differential)	1 Hz	0.29 kPa	0 kPa 20 kPa 40 kPa	0.28 kPa 0.285 kPa 0.291 kPa	--	Not presented.
Intact Loop PDE-PC-025	Pitot tube next to bottom of ECC Rake 2 (facing pump).	± 40 kPa (differential)	1 Hz	0.29 kPa	0 kPa 20 kPa 40 kPa	0.28 kPa 0.285 kPa 0.291 kPa	--	Not presented.
Intact Loop PDE-PC-25B	Pitot tube next to bottom of ECC Rake 2 (facing pump).	± 5 kPa (differential)	1 Hz	0.037 kPa	--	0.037 kPa	--	Not presented.
Intact Loop PDE-PC-026	Pitot tube at bottom of ECC Rake 2 (facing pump).	± 40 kPa (differential)	1 Hz	0.29 kPa	0 kPa 20 kPa 40 kPa	0.28 kPa 0.285 kPa 0.291 kPa	--	Not presented.
Intact Loop PDE-PC-26B	Pitot tube at bottom of ECC Rake 2 (facing pump).	± 5 kPa (differential)	1 Hz	0.037 kPa	--	0.037 kPa	--	Not presented.
Intact Loop PDE-PC-029	Pitot tube next to bottom of ECC Rake 1 (facing reactor vessel).	± 40 kPa (differential)	1 Hz	0.29 kPa	0 kPa 20 kPa 40 kPa	0.28 kPa 0.285 kPa 0.291 kPa	46, 119	Qualified.
Intact Loop PDE-PC-030	Pitot tube at bottom of ECC Rake 1 (facing reactor vessel).	± 40 kPa (differential)	1 Hz	0.29 kPa	0 kPa 20 kPa 40 kPa	0.28 kPa 0.285 kPa 0.291 kPa	47, 120	Qualified.
Intact Loop PDE-PC-031	Pitot tube next to bottom of ECC Rake 2 (facing reactor vessel).	± 40 kPa (differential)	1 Hz	0.29 kPa	0 kPa 20 kPa 40 kPa	0.28 kPa 0.285 kPa 0.291 kPa	--	Not presented.
Intact Loop PDE-PC-032	Pitot tube at bottom of ECC Rake 2 (facing reactor vessel).	± 40 kPa (differential)	1 Hz	0.29 kPa	0 kPa 20 kPa 40 kPa	0.28 kPa 0.285 kPa 0.291 kPa	48, 121	Qualified.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
DIFFERENTIAL PRESSURE (continued)								
Reactor Vessel PDE-RV-002	Fuel Assembly 1 from lower end box to upper end box.	±172 kPa (differential)	1 Hz	1.22 kPa	0 kPa 100 kPa 170 kPa	1.2 kPa 0.23 kPa 0.391 kPa	49, 122	Qualified.
Reactor Vessel PDE-RV-003	Intact loop cold leg inlet to bottom of downcomer.	±0.1 MPa (differential)	1 Hz	0.000 49 MPa	0 MPa 0.05 MPa 0.10 MPa	0.000 49 MPa 0.000 50 MPa 0.000 52 MPa	--	Not presented.
Reactor Vessel PDE-RV-004	Fuel Assembly 1 lower end box to the RV outlet nozzle in the intact loop hot leg.	±0.2 MPa (differential)	1 Hz	0.0012 MPa	0 MPa 0.1 MPa 0.2 MPa	0.0012 MPa 0.001 22 MPa 0.001 26 MPa	--	Not presented.
Reactor Vessel PDE-RV-005	Top of reactor vessel to intact loop hot leg.	± 40 kPa (differential)	1 Hz	0.29 kPa	0 kPa 20 kPa 40 kPa	0.28 kPa 0.285 kPa 0.291 kPa	50, 123	Qualified.
Blowdown Suppression Tank PDE-SV-001	Blowdown suppression tank.	0 to 1.27 m	1 Hz	--	0 m 0.7 m 1.4 m	0.005 m 0.006 m 0.008 m	--	Channel failed.
Blowdown Suppression Tank PDE-SV-009	Suppression tank across the vacuum breaker line.	±69.0 kPa (differential)	10 Hz	0.49 kPa	0 kPa 30 kPa 69 kPa	0.49 kPa 0.492 kPa 0.502 kPa	--	Not presented.
Reactor Vessel PDE-2ST-001	Bottom of downcomer Stalk 2 to Fuel Assembly 3 upper end box.	±69 kPa (differential)	1 Hz	0.49 kPa	0 kPa 30 kPa 69 kPa	0.49 kPa 0.492 kPa 0.502 kPa	--	Not presented.
Reactor Vessel PDE-2ST-003	Top of downcomer Stalk 2 to Fuel Assembly 3 upper plenum.	±173 kPa (differential)	2.3 Hz	1.2 kPa	0 kPa 100 kPa 173 kPa	1.2 kPa 1.22 kPa 1.26 kPa	--	Not presented.
Reactor Vessel PDE-2ST-004	Bottom of downcomer Stalk 2 to Fuel Assembly 3 lower end box.	±69 kPa (differential)	1 Hz	0.49 kPa	0 kPa 30 kPa 69 kPa	0.49 kPa 0.492 kPa 0.502 kPa	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
DIFFERENTIAL PRESSURE (continued)								
Intact Loop PDT-P139-27-1	Intact loop venturi, Channel A.	0 to 0.199 MPa (differential)	1 Hz	0.002 MPa	--	0.002 MPa	--	Not presented.
Intact Loop PDT-P139-27-2	Intact loop venturi, Channel B.	0 to 0.199 MPa (differential)	1 Hz	0.002 MPa	--	0.002 MPa	--	Not presented.
Intact Loop PDT-P139-27-3	Intact loop venturi, Channel C.	0 to 0.199 MPa (differential)	1 Hz	0.002 MPa	--	0.002 MPa	--	Not presented.
Intact Loop PDT-P139-030	Across RV just beyond intact loop inlet and and outlet nozzles.	0 to 0.3 MPa (differential)	1 Hz	0.003 MPa	--	0.003 MPa	51	Qualified, valid above zero only.
PRESSURE[j]								
Broken Loop PE-BL-001	Broken loop cold leg at DTT flange.	0.1 to 20.8 MPa[j]	1 Hz	0.25 MPa	0 MPa 10 MPa 20 MPa	0.199 MPa 0.223 MPa 0.282 MPa	52, 124	Qualified.
Broken Loop PE-BL-002	Broken loop hot leg at DTT flange.	0.1 to 20.8 MPa	1 Hz	0.25 MPa	0 MPa 10 MPa 20 MPa	0.199 MPa 0.223 MPa 0.282 MPa	125	Qualified.
Broken Loop PE-BL-003	Broken loop hot leg downstream of pump simulator.	0.1 to 20.8 MPa	1 Hz	0.25 MPa	0 MPa 10 MPa 20 MPa	0.199 MPa 0.223 MPa 0.282 MPa	--	Not presented.
Broken Loop PE-BL-004	Broken loop cold leg at inlet of spool piece.	0.1 to 20.8 MPa	1 Hz	0.25 MPa	0 MPa 10 MPa 20 MPa	0.199 MPa 0.223 MPa 0.282 MPa	--	Not presented.
Broken Loop PE-BL-006	Broken loop hot leg at outlet of SG simulator.	0.1 to 20.8 MPa	1 Hz	0.25 MPa	0 MPa 10 MPa 20 MPa	0.199 MPa 0.223 MPa 0.282 MPa	--	Not presented.
Broken Loop PE-BL-008	Broken loop cold leg in 8-in. pipe downsteam of break.	0.1 to 20.8 MPa	1 Hz	0.25 MPa	0 MPa 10 MPa 20 MPa	0.199 MPa 0.223 MPa 0.282 MPa	53	Qualified.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
PRESSURE (continued)								
Intact Loop PE-PC-001	Intact loop cold leg at DTT flange.	0.1 to 20.8 MPa	1 Hz	0.25 MPa	0 MPa 10 MPa 20 MPa	0.199 MPa 0.223 MPa 0.282 MPa	54, 126	Qualified.
Intact Loop PE-PC-002	Intact loop hot leg at DTT flange.	0.1 to 20.8 MPa	1 Hz	--	0 MPa 10 MPa 20 MPa	0.199 MPa 0.223 MPa 0.282 MPa	--	Not installed.
Intact Loop PE-PC-004	Intact loop pressurizer vapor space.	0.1 to 20.8 MPa	1 Hz	0.25 MPa	0.1 MPa 10 MPa 20 MPa	0.199 MPa 0.223 MPa 0.282 MPa	55, 127	Qualified.
Intact Loop PE-PC-005	Intact loop reference pressure between steam generator outlet and pump inlet.	0.1 to 17.0 MPa	1 Hz	0.002 MPa	--	0.028 MPa	56, 128	Qualified.
Intact Loop PE-PC-006	Intact loop reference pressure between steam generator outlet and pump inlet.	0.1 to 17.0 MPa	1 Hz	0.002 MPa	--	0.028 MPa	129	Qualified.
Blowdown Suppression System PE-SV-003	Blowdown suppression tank across from Downcomer 1 (south end), 157.5° from top vertical (CW looking north).	0.1 to 0.7 MPa	1 Hz	0.008 MPa	--	0.008 MPa	130	Qualified.
Blowdown Suppression System PE-SV-014	Blowdown suppression tank header above Downcomer 4, 327° from top vertical (CW looking north).	0.1 to 0.7 MPa	1 Hz	0.008 MPa	--	0.008 MPa	131	Qualified.
Blowdown Suppression System PE-SV-015	Blowdown suppression tank across from Downcomer 4, 230° from top vertical (CW looking north).	0.1 to 0.7 MPa	1 Hz	0.008 MPa	--	0.008 MPa	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o			
					Reading	Uncertainty (±)	Figure	Comments
PRESSURE (continued)								
Blowdown Suppression System PE-SV-016	Blowdown suppression tank across from Downcomer 1, 230° from top vertical (CW looking north).	0.1 to 0.7 MPa	1 Hz	0.008 MPa	--	0.008 MPa	--	Not presented.
Blowdown Suppression System PE-SV-017	Blowdown suppression tank, 1.38 m north of Downcomer 3 ℄, 0° from top vertical (CW looking north).	0.1 to 0.7 MPa	1 Hz	0.008 MPa	--	0.008 MPa	132	Qualified.
Blowdown Suppression System PE-SV-018	Blowdown suppresson tank header above Downcomer 1.	0.1 to 0.7 MPa	1 Hz	0.008 MPa	--	0.008 MPa	--	Not presented.
Blowdown Suppression System PE-SV-043	Blowdown suppression tank bottom under Downcomer 2.	0.1 to 0.7 MPa	1 Hz	0.008 MPa	--	0.008 MPa	--	Not presented.
Blowdown Suppression System PE-SV-044	Blowdown suppression tank bottom under Downcomer 3.	0.1 to 0.7 MPa	1 Hz	0.008 MPa	--	0.008 MPa	--	Not presented.
Blowdown Suppression System PE-SV-055	Blowdown suppression tank top, 0.15 m north of Downcomer 4 ℄.	0.1 to 0.7 MPa	1 Hz	0.008 MPa	--	0.008 MPa	133	Qualified.
Blowdown Suppression System PE-SV-060	Blowdown suppression tank top above Downcomer 1.	0.1 to 0.7 MPa	1 Hz	0.008 MPa	--	0.008 MPa	--	Not presented.
Reactor Vessel PE-1ST-001A	Downcomer Stalk 1, 0.62 m above RV bottom, wide range (0 to 20.8 MPa).	0.1 to 20.8 MPa	1 Hz	--	0.1 MPa 10.0 MPa 20.5 MPa	0.199 MPa 0.199 MPa 0.200 MPa	--	Channel failed.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
PRESSURE (continued)								
Reactor Vessel PE-1ST-003A	Downcomer Stalk 1, 5.32 m above RV bottom, wide range (0 to 20.8 MPa).	0.1 to 20.8 MPa	1 Hz	0.25 MPa	0.1 MPa 10 MPa 20 MPa	0.2 MPa 0.22 MPa 0.28 MPa	134	Qualified.
Reactor Vessel PE-1UP-001A	Above Fuel Assembly 1 upper end box, high range.	0.1 to 20.8 MPa	1 Hz	0.25 MPa[f]	0.1 MPa 10 MPa 20 MPa	0.2 MPa[f] 0.22 MPa 0.28 MPa	135, 207	Qualified.
Reactor Vessel PE-1UP-001A1	Above Fuel Assembly 1 upper end box, high range.	0 to 21.0 MPa	1 Hz	0.25 MPa	0.1 MPa 10 MPa 20 MPa	0.2 MPa 0.22 MPa 0.28 MPa	57	Qualified.
Reactor Vessel PE-2ST-001A	Downcomer Stalk 2, 0.62 m above RV bottom, wide range (0 to 20.8 MPa).	0.1 to 20.8 MPa	1 Hz	0.25 MPa	0.1 MPa 10 MPa 20 MPa	0.2 MPa 0.22 MPa 0.28 MPa	136	Qualified.
Secondary Coolant System PT-P004-010A	In 10-in. line from steam generator.	0.1 to 8.4 MPa	1 Hz	0.110 MPa	--	0.110 MPa	137	Qualified.
Secondary Coolant System PT-P004-034	Downstream of main feedwater pump.	0 to 10.3 MPa	10 Hz	0.07 MPa	--	0.07 MPa	--	Not presented.
Secondary Coolant System PT-P004-085	Upstream of inlet to air-cooled condenser header.	0 to 2.8 MPa	1 Hz	0.075 MPa	--	0.075 MPa	138	Qualified.
Emergency Core Cooling System PT-P120-043	Accumulator A, 0.69 m above water outlet.	0.1 to 7.0 MPa	1 Hz	0.055 MPa[f]	--	0.055 MPa[f]	139, 208	Qualified.
Emergency Core Cooling System PT-P120-061	Emergency core cooling injection.	0.1 to 20.8 MPa	1 Hz	0.158 MPa	--	0.158 MPa	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
PRESSURE (continued)								
Emergency Core Cooling System PT-P120-083	LPIS Pump A discharge.	0.1 to 7.0 MPa	1 Hz	0.04 MPa[f]	--	0.04 MPa[f]	140, 209	Qualified.
Broken Loop PT-P138-023	Blowdown header.	0.1 to 1.4 MPa	10 Hz	0.007 MPa	--	0.007 MPa	--	Not presented.
Broken Loop PT-P138-111	Broken loop cold leg QOBV inlet between isolation valve and QOBV.	0.1 to 13.9 MPa	100 Hz	0.20 MPa	--	0.20 MPa	--	Not presented.
Broken Loop PT-P138-112	Broken loop hot leg QOBV inlet between isolation valve and QOBV.	0.1 to 13.9 MPa	100 Hz	0.20 MPa	--	0.20 MPa	--	Not presented.
Intact Loop PT-P139-002	Intact loop hot leg at venturi on bottom.	0.1 to 20.8 MPa	1 Hz	0.25 MPa[f]	--	0.25 MPa[f]	141, 210	Qualified, good to 26 000 s.
Intact Loop PT-P139-003	Intact loop hot leg at venturi on left side when looking toward SG.	0.1 to 20.8 MPa	1 Hz	0.25 MPa	--	0.25 MPa	142	Qualified.
Intact Loop PT-P139-004	Intact loop hot leg at venturi on right side when looking toward SG.	0.1 to 20.8 MPa	1 Hz	0.25 MPa	--	0.25 MPa	143	Qualified at low end of uncertainty band.
Intact Loop PT-P139-005	1.88 m above pressurizer bottom (vapor space).	10.3 to 17.2 MPa	1 Hz	0.12 MPa[f]	--	0.12 MPa[f]	211	Qualified, narrow range instrument.
PUMP SPEED								
Intact Loop RPE-PC-001	Intact loop Pump 1.	0 to 10 000 rpm	1 Hz	8.825 rpm	1000 rpm 2000 rpm 3000 rpm 4000 rpm	7.65 rpm 8.825 rpm 10.10 rpm 11.66 rpm	58	Qualified.
Intact Loop RPE-PC-002	Intact loop Pump 2.	0 to 10 000 rpm	1 Hz	8.825 rpm	1000 rpm 2000 rpm 3000 rpm 4000 rpm	7.65 rpm 8.825 rpm 10.10 rpm 11.66 rpm	59	Qualified.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
REACTIVITY								
Reactor Vessel RE-TRM-86-5	Transient reactivity meter in shield tank.	±0.145 Rho	10 Hz	0.01 Rho	--	0.01 Rho	--	Not presented.
Reactor Vessel RE-TRM-86-6	Transient reactivity meter in shield tank.	±0.145 Rho	10 Hz	0.01 Rho	--	0.01 Rho	--	Not presented.
Reactor Vessel RE-T-77-1A2	Power range Channel A-level.	0 to 100% power	1 Hz	3%	--	3%	--	Not presented.
Reactor Vessel RE-T-77-2A2	Power range Channel B-level.	0 to 100% power	1 Hz	3%	--	3%	--	Not presented.
Reactor Vessel RE-T-77-3A2	Power range Channel C-level.	0 to 100% power	1 Hz	3%	--	3%	--	Not presented.
Reactor Vessel RE-T-87-4A2	Power range Channel D-level.	0 to 100% power	10 Hz	3%	--	3%	--	Not presented.
TEMPERATURE								
Broken Loop TE-BL-001B	Broken loop cold leg at DTT rake center.	255.2 to 588.6 K	1 Hz	2.5 K	400 K 450 K 500 K 550 K	2.4 K 2.5 K 2.5 K 2.5 K	60, 144	Qualified.
Broken Loop TE-BL-002B	Broken loop hot leg at middle of DTT flange.	255.2 to 588.6 K	1 Hz	2.5 K	400 K 450 K 500 K 550 K	2.4 K 2.5 K 2.5 K 2.5 K	145	Qualified.
Intact Loop TE-PC-002B	Intact loop hot leg at DTT flange at middle of pipe.	255 to 980 K	1 Hz	--	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.7 K 2.7 K	--	Not installed.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
TEMPERATURE (continued)								
Intact Loop TE-PC-004	Bottom of ECC Rake 1 (between PDE-PC-014 and PDE-PC-018).	270 to 1530 K	1 Hz	3 K	400 K 450 K 500 K 550 K	2.8 K 2.9 K 3.0 K 3.0 K	61, 146	Qualified.
Intact Loop TE-PC-005	Next to bottom of ECC Rake 1 (between PDE-PC-013 and PDE-PC-017).	270 to 1530 K	1 Hz	3 K	400 K 450 K 500 K 550 K	2.8 K 2.9 K 3.0 K 3.0 K	62, 147	Qualified.
Intact Loop TE-PC-006	Next to top of ECC Rake 1 (between PDE-PC-012 and PDE-PC-016).	270 to 1530 K	1 Hz	3 K	400 K 450 K 500 K 550 K	2.8 K 2.9 K 3.0 K 3.0 K	63, 148	Qualified.
Intact Loop TE-PC-007	Top of ECC Rake 1 (between PDE-PC-011 and PDE-PC-015).	270 to 1530 K	1 Hz	3 K	400 K 450 K 500 K 550 K	2.8 K 2.9 K 3.0 K 3.0 K	64, 149	Qualified.
Intact Loop TE-PC-008	Bottom of ECC Rake 2 (between PDE-PC-022 and PDE-PC-026).	270 to 1530 K	1 Hz	3 K	400 K 450 K 500 K 550 K	2.8 K 2.9 K 3.0 K 3.0 K	65, 150	Qualified.
Intact Loop TE-PC-009	Next to bottom of ECC Rake 2 (between PDE-PC-021 and PDE-PC-025).	270 to 1530 K	1 Hz	3 K	400 K 450 K 500 K 550 K	2.8 K 2.9 K 3.0 K 3.0 K	66, 151	Qualified.
Intact Loop TE-PC-010	Next to top of ECC Rake 2 (between PDE-PC-020 and PDE-PC-024).	270 to 1530 K	1 Hz	3 K	400 K 450 K 500 K 550 K	2.8 K 2.9 K 3.0 K 3.0 K	67, 152	Qualified.
Intact Loop TE-PC-011	Top of ECC Rake 2 (between PDE-PC-019 and PDE-PC-023).	270 to 1530 K	1 Hz	3 K	400 K 450 K 500 K 550 K	2.8 K 2.9 K 3.0 K 3.0 K	68, 153	Qualified.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
TEMPERATURE (continued)								
Emergency Core Cooling System TE-P120-041	Accumulator A temperature.	255.2 to 366.3 K	1 Hz	0.7 K	--	0.7 K	154	Qualified.
Blowdown Suppression Tank TE-P138-137	Outlet of suppression tank spray system heat exchanger.	250 to 420 K	1 Hz	0.7 K	--	0.7 K	--	Not presented.
Blowdown Suppression Tank Spray System TE-P138-141	Temperature of spray in the 3.79-l/s header.	255.2 to 420 K	1 Hz	1.3 K	--	1.3 K	155	Qualified.
Blowdown Suppression Tank Spray System TE-P138-142	Temperature of spray pump discharge.	255.2 to 420 K	1 Hz	1.3 K	--	1.3 K	--	Channel failed.
Blowdown Suppression Tank Spray System TE-P138-143	Temperature of spray in 13.88-l/s header.	255.2 to 420 K	1 Hz	1.3 K	--	1.3 K	155	Qualified.
Intact Loop TE-P139-019	Pressurizer vapor space, 0.86 m above the heater rods.	588.6 to 644.1 K	1 Hz	0.5 K	--	0.5 K	156	Qualified, appears approximately 6 K high based on isothermal test and may experience hot wall effects.
Intact Loop TE-P139-020	Pressurizer liquid volume, 0.36 m above heater rods.	283 to 644.1 K	1 Hz	3.0 K[f]	--	3.0 K[f]	157, 212	Qualified, appears approximately 6 K high based on isothermal test and may experience hot wall effects.
Intact Loop TE-P139-028-2	Intact loop cold leg.	530 to 620 K	1 Hz	0.6 K	--	0.6 K	158	Qualified, narrow range instrument.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
TEMPERATURE (continued)								
Intact Loop TE-P139-029	Intact loop cold leg.	280 to 620 K	1 Hz	2.1 K[f]	--	2.1 K[f]	159, 213	Qualified.
Intact Loop TE-P139-32-1	Intact loop hot leg.	280 to 620 K	1 Hz	1.43 K	--	1.43 K	160	Qualified.
Primary Component Cooling System TE-P141-94	Downstream from primary component cooling system heat exchanger.	275 to 350 K	10 Hz	0.32 K[f]	--	0.32 K[f]	214	Qualified.
Primary Component Cooling System TE-P141-95	Upstream from primary component cooling system heat exchanger.	275 to 350 K	10 Hz	0.32 K[f]	--	0.32 K[f]	215	Qualified.
Intact Loop TE-SG-001	Intact loop cold leg SG outlet.	255.4 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.7 K	69, 161	Qualified, may experience hot wall effects.
Intact Loop TE-SG-002	Intact loop hot leg SG inlet.	255.4 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.7 K	69, 161	Qualified, may experience hot wall effects.
Secondary Coolant System TE-SG-003	SG secondary side.	255.4 to 588.6 K	1 Hz	2.5 K	500 K 550 K	2.5 K 2.5 K	162	Qualified.
Blowdown Suppression System TE-SV-002	Blowdown suppression tank, 0.3 m north of Downcomer 1, 0.53 m east of tank ℄, 2.36 m from tank bottom.	253.2 to 477.4 K	1 Hz	1.1 K	300 K 350 K 400 K	0.9 K 1.0 K 1.3 K	163	Qualified.
Blowdown Suppression System TE-SV-004	Blowdown suppression tank, 0.3 m north of Downcomer 1, 0.53 m east of tank ℄, 1.45 m from tank bottom.	253.2 to 477.4 K	1 Hz	1.1 K	300 K 350 K 400 K	0.9 K 1.0 K 1.3 K	164	Qualified.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
TEMPERATURE (continued)								
Blowdown Suppression System TE-SV-005	Blowdown suppression tank, 0.3 m north of Downcomer 1, 0.53 m east of tank C_L, 0.99 m from tank bottom.	253.2 to 477.4 K	1 Hz	--	300 K 350 K 400 K	0.9 K 1.0 K 1.3 K	--	Not installed.
Blowdown Suppression System TE-SV-006	Blowdown suppression tank, 0.3 m north of Downcomer 1, 0.53 m east of tank C_L, 0.37 m from tank bottom.	253.2 to 477.4 K	1 Hz	1.1 K	300 K 350 K 400 K	0.9 K 1.0 K 1.3 K	166	Qualified.
Blowdown Suppression System TE-SV-007	Blowdown suppression tank, 0.3 m north of Downcomer 3, 0.53 m east of tank C_L, 2.72 m from tank bottom.	253.2 to 477.4 K	1 Hz	1.1 K	300 K 350 K 400 K	0.9 K 1.0 K 1.3 K	--	Not presented.
Blowdown Suppression System TE-SV-008	Blowdown suppression tank, 0.3 m north of Downcomer 3, 0.53 m east of tank C_L, 2.36 m from tank bottom.	253.2 to 477.4 K	1 Hz	1.1 K	300 K 350 K 400 K	0.9 K 1.0 K 1.3 K	163	Qualified.
Blowdown Suppression System TE-SV-010	Blowdown suppression tank, 0.3 m north of Downcomer 3, 0.53 m east of tank C_L, 1.45 m from tank bottom.	253.2 to 477.4 K	1 Hz	1.1 K	300 K 350 K 400 K	0.9 K 1.0 K 1.3 K	164	Qualified.
Blowdown Suppression System TE-SV-011	Blowdown suppression tank, 0.3 m north of Downcomer 3, 0.53 m east of tank C_L, 0.99 m from tank bottom.	253.2 to 477.4 K	1 Hz	1.1 K	300 K 350 K 400 K	0.9 K 1.0 K 1.3 K	165	Qualified.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	[illegible]		Figure	Comments
					Reading	Uncertainty (±)		
TEMPERATURE (continued)								
Blowdown Suppression System TE-SV-012	Blowdown suppression tank, 0.3 m north of Downcomer 3, 0.53 m east of tank C_L, 0.37 m from tank bottom.	253.2 to 477.4 K	1 Hz	1.1 K	300 K 350 K 400 K	0.9 K 1.0 K 1.3 K	166	Qualified.
Reactor Vessel TE-1B12-026	Fuel Assembly 1, Row B, Column 12, 0.660 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-1C11-021	Fuel Assembly 1, Row C, Column 11, 0.533 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-1C11-039	Fuel Assembly 1, Row C, Column 11, 0.991 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-1F7-015	Fuel Assembly 1, Row F, Column 7, 0.381 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	70, 167	Qualified.
Reactor Vessel TE-1F7-021	Fuel Assembly 1, Row F, Column 7, 0.533 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	71, 167	Qualified.
Reactor Vessel TE-1F7-026	Fuel Assembly 1, Row F, Column 7, 0.660 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	72, 167	Qualified.
Reactor Vessel TE-1F7-030	Fuel Assembly 1, Row F, Column 7, 0.762 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	73, 167	Qualified.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
TEMPERATURE (continued)								
Reactor Vessel TE-1LP-001	Fuel Assembly 1 lower end box.	310 to 977.4 K	1 Hz	2.7 K	400 K	2.5 K	74, 168	Qualified.
					450 K	2.6 K		
					500 K	2.6 K		
					550 K	2.6 K		
Reactor Vessel TE-1ST-001	Downcomer Stalk 1, 4.8 m from RV bottom.	253.2 to 977.4 K	1 Hz	2.7 K	400 K	2.5 K	75, 169	Qualified.
					450 K	2.6 K		
					500 K	2.6 K		
					550 K	2.7 K		
Reactor Vessel TE-1ST-002	Downcomer Stalk 1, 4.2 m from RV bottom.	253.2 to 977.4 K	1 Hz	2.7 K	400 K	2.5 K	169	Qualified.
					450 K	2.6 K		
					500 K	2.6 K		
					550 K	2.7 K		
Reactor Vessel TE-1ST-005	Downcomer Stalk 1, 2.37 m from RV bottom.	253.2 to 977.4 K	1 Hz	2.7 K	400 K	2.5 K	169	Qualified.
					450 K	2.6 K		
					500 K	2.6 K		
					550 K	2.7 K		
Reactor Vessel TE-1ST-009	Downcomer Stalk 1, 0.64 m from RV bottom.	253.2 to 977.4 K	1 Hz	2.7 K	400 K	2.5 K	170	Qualified.
					450 K	2.6 K		
					500 K	2.6 K		
					550 K	2.7 K		
Reactor Vessel TE-1ST-013	Downcomer Stalk 1, 0.24 m from RV bottom.	253.2 to 977.4 K	1 Hz	2.7 K	400 K	2.5 K	170	Qualified.
					450 K	2.6 K		
					500 K	2.6 K		
					550 K	2.7 K		
Reactor Vessel TE-1ST-014	Downcomer Stalk 1, 1.17 m from RV bottom (inside of DTT).	253.2 to 977.4 K	1 Hz	2.7 K	400 K	2.5 K	--	Channel failed.
					450 K	2.6 K		
					500 K	2.6 K		
					550 K	2.7 K		
Reactor Vessel TE-1UP-001	Fuel Assembly 1 upper end box.	310 to 977.4 K	1 Hz	2.7 K	400 K	2.5 K	76, 171	Qualified.
					450 K	2.6 K		
					500 K	2.6 K		
					550 K	2.6 K		

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency^{a}	Initial Condition Uncertainty (±)	After T_0 Reading	After T_0 Uncertainty (±)	Figure	Comments
TEMPERATURE (continued)								
Reactor Vessel TE-1UP-002	Fuel Assembly 1 upper end box.	310 to 977.4 K	10 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	77, 172	Qualified.
Reactor Vessel TE-1UP-003	Fuel Assembly 1 support column above reactor vessel.	310 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.
Reactor Vessel TE-1UP-004	Fuel Assembly 1 support column above reactor vessel.	310 to 977.4 K	10 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.
Reactor Vessel TE-1UP-005	DTT FE-1UP-1 above Fuel Assembly 1.	310 to 977.4 K	10 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.
Reactor Vessel TE-1UP-006	Fuel Assembly 1 support column.	310 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.
Reactor Vessel TE-2E8-045	Cladding on Fuel Assembly 2, Row E, Column 8 at 1.14 m above bottom of fuel rod.	422 to 1533 K	10 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-2F7-337	Cladding on Fuel Assembly 2, Row F, Column 7 at 0.94 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-2G14-011	Cladding on Fuel Assembly 2, Row G, Column 14 at 0.28 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
TEMPERATURE (continued)								
Reactor Vessel TE-2G14-030	Cladding on Fuel Assembly 2, Row G, Column 14 at 0.76 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-2G14-045	Cladding on Fuel Assembly 2, Row G, Column 14 at 1.14 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	78, 173	Qualified.
Reactor Vessel TE-2H01-037	Cladding on Fuel Assembly 2, Row H, Column 1 at 0.94 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	79, 174	Qualified.
Reactor Vessel TE-2H02-028	Cladding on Fuel Assembly 2, Row H, Column 2 at 0.71 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	80, 174	Qualified.
Reactor Vessel TE-2H02-032	Cladding on Fuel Assembly 2, Row H, Column 2 at 0.81 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	81, 174	Qualified.
Reactor Vessel TE-2H08-039	Guide tube for Fuel Assembly 2, Row H, Column 8 at 0.99 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-2LP-001	Fuel Assembly 2 lower end box.	311 to 977.4 K	1 Hz	2.6 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	82, 175	Qualified.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
TEMPERATURE (continued)								
Reactor Vessel TE-2LP-003	Fuel Assembly 2 lower end box.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.7 K	--	Not presented.
Reactor Vessel TE-2ST-001	Downcomer Stalk 2, 4.8 m from RV bottom.	253.2 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.7 K	176	Qualified.
Reactor Vessel TE-2ST-005	Downcomer Stalk 2, 2.37 m from RV bottom.	253.2 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.7 K	177	Qualified.
Reactor Vessel TE-2ST-009	Downcomer Stalk 2, 0.64 m from RV bottom.	253.2 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.7 K	178	Qualified.
Reactor Vessel TE-2ST-013	Downcomer Stalk 2, 0.24 m from RV bottom.	253.2 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.7 K	179	Qualified.
Reactor Vessel TE-2ST-014	Downcomer Stalk 2, 1.17 m from RV bottom.	253.2 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.7 K	180	Qualified.
Reactor Vessel TE-2UP-001	Fuel Assembly 2 upper end box.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.
Reactor Vessel TE-2UP-002	Fuel Assembly 2 upper end box.	311 to 977.4 K	10 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
TEMPERATURE (continued)								
Reactor Vessel TE-2UP-003	Fuel Assembly 2 upper end box.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.
Reactor Vessel TE-3B12-026	Cladding on Fuel Assembly 3, Row B, Column 12 at 0.66 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-3C11-021	Cladding on Fuel Assembly 3, Row C, Column 11 at 0.53 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-3C11-039	Cladding on Fuel Assembly 3, Row C, Column 11 at 0.99 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	83, 181	Qualified.
Reactor Vessel TE-3F7-015	Cladding on Fuel Assembly 3, Row F, Column 7 at 0.38 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-3F7-021	Cladding on Fuel Assembly 3, Row F, Column 7 at 0.53 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-3F7-026	Cladding on Fuel Assembly 3, Row F, Column 7 at 0.66 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
TEMPERATURE (continued)								
Reactor Vessel TE-3F7-030	Cladding on Fuel Assembly 3, Row F, Column 7 at 0.76 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K	2.7 K	--	Not presented.
					600 K	3.2 K		
					800 K	4.7 K		
					1000 K	6.2 K		
Reactor Vessel TE-3LP-001	Fuel Assembly 3 lower end box.	311 to 977.4 K	1 Hz	2.6 K	400 K	2.5 K	84, 182	Qualified.
					450 K	2.6 K		
					500 K	2.6 K		
					550 K	2.6 K		
Reactor Vessel TE-3UP-001	Fuel Assembly 3 upper end box.	311 to 977.4 K	1 Hz	2.7 K	400 K	2.5 K	85, 183	Qualified.
					450 K	2.6 K		
					500 K	2.6 K		
					550 K	2.6 K		
Reactor Vessel TE-3UP-002	Fuel Assembly 3 upper end box.	311 to 977.4 K	1 Hz	2.7 K	400 K	2.5 K	--	Not presented.
					450 K	2.6 K		
					500 K	2.6 K		
					550 K	2.6 K		
Reactor Vessel TE-3UP-003	Fuel Assembly 3 support column above RV nozzle.	311 to 977.4 K	1 Hz	2.7 K	400 K	2.5 K	183	Qualified.
					450 K	2.6 K		
					500 K	2.6 K		
					550 K	2.6 K		
Reactor Vessel TE-3UP-004	Fuel Assembly 3 support column above RV nozzle.	311 to 977.4 K	1 Hz	2.7 K	400 K	2.5 K	--	Not presented.
					450 K	2.6 K		
					500 K	2.6 K		
					550 K	2.6 K		
Reactor Vessel TE-3UP-005	DTT FE-3UP-1 above Fuel Assembly 3.	311 to 977.4 K	1 Hz	2.7 K	400 K	2.5 K	--	Not presented.
					450 K	2.6 K		
					500 K	2.6 K		
					550 K	2.6 K		
Reactor Vessel TE-3UP-006	Support column.	311 to 977.4 K	1 Hz	2.7 K	400 K	2.5 K	--	Not presented.
					450 K	2.6 K		
					500 K	2.6 K		
					550 K	2.6 K		

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
TEMPERATURE (continued)								
Reactor Vessel TE-3UP-007	Support column.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.
Reactor Vessel TE-3UP-008	Liquid level transducer above Fuel Assembly 3.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.
Reactor Vessel TE-3UP-009	Liquid level transducer above Fuel Assembly 3.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.
Reactor Vessel TE-3UP-010	Liquid level transducer above Fuel Assembly 3.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.
Reactor Vessel TE-3UP-011	Liquid level transducer above Fuel Assembly 3.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	184	Qualified.
Reactor Vessel TE-3UP-012	Liquid level transducer above Fuel Assembly 3.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.
Reactor Vessel TE-3UP-013	Liquid level transducer above Fuel Assembly 3.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	184	Qualified.
Reactor Vessel TE-3UP-014	Liquid level transducer above Fuel Assembly 3.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
TEMPERATURE (continued)								
Reactor Vessel TE-3UP-015	Liquid level transducer above Fuel Assembly 3.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	184	Qualified.
Reactor Vessel TE-3UP-016	Liquid level transducer above Fuel Assembly 3.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.
Reactor Vessel TE-4G14-011	Cladding on Fuel Assembly 4, Rod G, Column 14 at 0.28 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-4G14-030	Cladding on Fuel Assembly 4, Row G, Column 14 at 0.76 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-4G14-045	Cladding on Fuel Assembly 4, Row G, Column 14 at 1.14 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	86, 185	Qualified.
Reactor Vessel TE-4H01-037	Cladding on Fuel Assembly 4, Row H, Column 1 at 0.94 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-4H02-028	Cladding on Fuel Assembly 4, Row H, Column 2 at 0.71 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
TEMPERATURE (continued)								
Reactor Vessel TE-4H02-032	Cladding on Fuel Assembly 4, Row H, Column 2 at 0.81 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-4H08-039	Cladding on Fuel Assembly 4, Row H, Column 8 at 0.99 m above bottom of fuel rod.	422 to 1533 K	10 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-4LP-001	Fuel Assembly 4 lower end box.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.
Reactor Vessel TE-4LP-003	Fuel Assembly 4 lower end box.	311 to 977.4 K	1 Hz	2.6 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	87, 186	Qualified.
Reactor Vessel TE-4UP 001	Fuel Assembly 4 upper end box.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	187	Qualified.
Reactor Vessel TE-4UP-002	Fuel Assembly 4 upper end box.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.
Reactor Vessel TE-4UP-003	Fuel Assembly 4 upper end box.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.
Reactor Vessel TE-5C06-024	Guide tube for Fuel Assembly 5, Row C, Column 6 at 0.61 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	188	Qualified.

TABLE 7. (continued)

					After T_o			
VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	Reading	Uncertainty (±)	Figure	Comments
TEMPERATURE (continued)								
Reactor Vessel TE-5D6-030	Cladding on Fuel Assembly 5, Row D, Column 6 at 0.76 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	189	Qualified.
Reactor Vessel TE-5D6-032	Cladding on Fuel Assembly 5, Row D, Column 6 at 0.81 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	189	Qualified.
Reactor Vessel TE-5D6-037	Cladding on Fuel Assembly 5, Row D, Column 6 at 0.94 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	189	Qualified.
Reactor Vessel TE-5D6-039	Cladding on Fuel Assembly 5, Row D, Column 6 at 0.99 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	189	Qualified.
Reactor Vessel TE-5E8-002	Cladding on Fuel Assembly 5, Row E, Column 8 at 0.05 m above bottom of fuel rod.	422 to 1533 K	1 Hz	--	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not installed.
Reactor Vessel TE-5E8-015	Cladding on Fuel Assembly 5, Row E, Column 8 at 0.38 m above bottom of fuel rod.	420 to 1810 K	1 Hz	4.3 K	400 K 600 K 800 K 1000 K	4.8 K 4.2 K 5.2 K 6.7 K	--	Not presented.
Reactor Vessel TE-5E8-034.5	Cladding on Fuel Assembly 5, Row E, Column 8 at 0.88 m above bottom of fuel rod.	420 to 1810 K	1 Hz	4.3 K	400 K 600 K 800 K 1000 K	4.8 K 4.2 K 5.2 K 6.7 K	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
TEMPERATURE (continued)								
Reactor Vessel TE-5E8-049	Cladding on Fuel Assembly 5, Row E, Column 8 at 1.24 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K	2.7 K	--	Not presented.
					600 K	3.2 K		
					800 K	4.7 K		
					1000 K	6.2 K		
Reactor Vessel TE-5F3-024	Cladding on Fuel Assembly 5, Row F, Column 3 at 0.61 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K	2.7 K	--	Not presented.
					600 K	3.2 K		
					800 K	4.7 K		
					1000 K	6.2 K		
Reactor Vessel TE-5F4-015	Cladding on Fuel Assembly 5, Row F, Column 4 at 0.38 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K	2.7 K	--	Not presented.
					600 K	3.2 K		
					800 K	4.7 K		
					1000 K	6.2 K		
Reactor Vessel TE-5F4-021	Cladding on Fuel Assembly 5, Row F, Column 4 at 0.53 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K	2.7 K	--	Not presented.
					600 K	3.2 K		
					800 K	4.7 K		
					1000 K	6.2 K		
Reactor Vessel TE-5F4-026	Cladding on Fuel Assembly 5, Row F, Column 4 at 0.66 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K	2.7 K	--	Not presented.
					600 K	3.2 K		
					800 K	4.7 K		
					1000 K	6.2 K		
Reactor Vessel TE-5F4-030	Cladding on Fuel Assembly 5, Row F, Column 4 at 0.76 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K	2.7 K	--	Not presented.
					600 K	3.2 K		
					800 K	4.7 K		
					1000 K	6.2 K		
Reactor Vessel TE-5F7-005	Cladding on Fuel Assembly 5, Row F, Column 7 at 0.13 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K	2.7 K	--	Not presented.
					600 K	3.2 K		
					800 K	4.7 K		
					1000 K	6.2 K		

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_0 Reading	After T_0 Uncertainty (±)	Figure	Comments
TEMPERATURE (continued)								
Reactor Vessel TE-5F7-021	Cladding on Fuel Assembly 5, Row F, Column 7 at 0.53 m above bottom of fuel rod.	420 to 1810 K	1 Hz	4.3 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5F7-039	Cladding on Fuel Assembly 5, Row F, Column 7 at 0.99 m above bottom of fuel rod.	420 to 1810 K	1 Hz	4.3 K	400 K 600 K 800 K 1000 K	4.8 K 4.2 K 5.2 K 6.7 K	190	Qualified.
Reactor Vessel TE-5F7-054	Cladding on Fuel Assembly 5, Row F, Column 7 at 1.37 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5F8-024	Cladding on Fuel Assembly 5, Row F, Column 8 at 0.61 m above bottom of fuel rod.	420 to 1810 K	1 Hz	4.3 K	400 K 600 K 800 K 1000 K	4.8 K 4.2 K 5.2 K 6.7 K	--	Not presented.
Reactor Vessel TE-5F8-028	Cladding on Fuel Assembly 5, Row F, Column 8 at 0.71 m above bottom of fuel rod.	420 to 1810 K	1 Hz	4.3 K	400 K 600 K 800 K 1000 K	4.8 K 4.2 K 5.2 K 6.7 K	--	Not presented.
Reactor Vessel TE-5F8-032	Cladding on Fuel Assembly 5, Row F, Column 8 at 0.81 m above bottom of fuel rod.	420 to 1810 K	1 Hz	4.3 K	400 K 600 K 800 K 1000 K	4.8 K 4.2 K 5.2 K 6.7 K	--	Not presented.
Reactor Vessel TE-5F8-037	Cladding on Fuel Assembly 5, Row F, Column 8 at 0.94 m above bottom of fuel rod.	420 to 1810 K	1 Hz	4.3 K	400 K 600 K 800 K 1000 K	4.8 K 4.2 K 5.2 K 6.7 K	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
TEMPERATURE (continued)								
Reactor Vessel TE-5F9-011	Cladding on Fuel Assembly 5, Row F, Column 9 at 0.28 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	88, 191	Qualified.
Reactor Vessel TE-5F9-030	Cladding on Fuel Assembly 5, Row F, Column 9 at 0.76 m above bottom of fuel rod.	420 to 1810 K	1 Hz	4.3 K	400 K 600 K 800 K 1000 K	4.8 K 4.2 K 5.2 K 6.7 K	89, 191	Qualified.
Reactor Vessel TE-5F9-045	Cladding on Fuel Assembly 5, Row F, Column 9 at 1.14 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	90, 191	Qualified.
Reactor Vessel TE-5F9-062	Cladding on Fuel Assembly 5, Row F, Column 9 at 1.57 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	91, 191	Qualified.
Reactor Vessel TE-5G6-011	Cladding on Fuel Assembly 5, Row G, Column 6 at 0.28 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5G6-030	Cladding on Fuel Assembly 5, Rod G, Column 6 at 0.76 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5G6-045	Cladding on Fuel Assembly 5, Row G, Column 6 at 1.14 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	192	Qualified.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
TEMPERATURE (continued)								
Reactor Vessel TE-5G6-062	Cladding on Fuel Assembly 5, Row G, Column 6 at 1.57 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5G8-008	Cladding on Fuel Assembly 5, Row G, Column 8 at 0.20 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5G8-026	Cladding on Fuel Assembly 5, Row G, Column 8 at 0.66 m above bottom of fuel rod.	410 to 1820 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	4.8 K 4.2 K 5.2 K 6.7 K	--	Not presented.
Reactor Vessel TE-5G8-041	Cladding on Fuel Assembly 5, Row G, Column 8 at 1.04 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5G8-058	Cladding on Fuel Assembly 5, Row G, Column 8 at 1.47 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	193	Qualified.
Reactor Vessel TE-5H5-002	Cladding on Fuel Assembly 5, Row H, Column 5 at 0.05 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	92, 194	Qualified.
Reactor Vessel TE-5H5-015	Cladding on Fuel Assembly 5, Row H, Column 5 at 0.38 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	92, 194	Qualified.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
TEMPERATURE (continued)								
Reactor Vessel TE-5H5-034.5	Cladding on Fuel Assembly 5, Row H, Column 5 at 0.88 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	92, 194	Qualified.
Reactor Vessel TE-5H5-049	Cladding on Fuel Assembly 5, Row H, Column 5 at 1.24 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	92, 194	Qualified.
Reactor Vessel TE-5H6-024	Cladding on Fuel Assembly 5, Row H, Column 6 at 0.61 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5H6-028	Cladding on Fuel Assembly 5, Row H, Column 6 at 0.71 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5H6-032	Cladding on Fuel Assembly 5, Row H, Column 6 at 0.81 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5H6-037	Cladding on Fuel Assembly 5, Row H, Column 6 at 0.94 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5H7-008	Cladding on Fuel Assembly 5, Row H, Column 7 at 0.20 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
TEMPERATURE (continued)								
Reactor Vessel TE-5H7-026	Cladding on Fuel Assembly 5, Row H, Column 7 at 0.66 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5H7-041	Cladding on Fuel Assembly 5, Row H, Column 7 at 1.04 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5H7-058	Cladding on Fuel Assembly 5, Row H, Column 7 at 1.47 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5I6-005	Cladding on Fuel Assembly 5, Row I, Column 6 at 0.13 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5I6-021	Cladding on Fuel Assembly 5, Row I, Column 6 at 0.53 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5I6-039	Cladding on Fuel Assembly 5, Row I, Column 6 at 0.99 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5I6-054	Cladding on Fuel Assembly 5, Row I, Column 6 at 1.37 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
TEMPERATURE (continued)								
Reactor Vessel TE-5I8-008	Cladding on Fuel Assembly 5, Row I, Column 8 at 0.20 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	195	Qualified.
Reactor Vessel TE-5I8-026	Cladding on Fuel Assembly 5, Row I, Column 8 at 0.66 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	195	Qualified.
Reactor Vessel TE-5I8-041	Cladding on Fuel Assembly 5, Row I, Column 8 at 1.04 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	195	Qualified.
Reactor Vessel TE-5I8-058	Cladding on Fuel Assembly 5, Row I, Column 8 at 1.47 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	195	Qualified.
Reactor Vessel TE-5J3-024	Cladding on Fuel Assembly 5, Row J, Column 3 at 0.61 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5J4-015	Cladding on Fuel Assembly 5, Row J, Column 4 at 0.38 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5J4-021	Cladding on Fuel Assembly 5, Row J, Column 4 at 0.53 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
TEMPERATURE (continued)								
Reactor Vessel TE-5J4-026	Cladding on Fuel Assembly 5, Row J, Column 4 at 0.66 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5J4-030	Cladding on Fuel Assembly 5, Row J, Column 4 at 0.76 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5J7-011	Cladding on Fuel Assembly 5, Row J, Column 7 at 0.28 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5J7-030	Cladding on Fuel Assembly 5, Row J, Column 7 at 0.76 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5J7-045	Cladding on Fuel Assembly 5, Row J, Column 7 at 1.14 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5J7-062	Cladding on Fuel Assembly 5, Row J, Column 7 at 1.57 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5J8-024	Cladding on Fuel Assembly 5, Row J, Column 8 at 0.61 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
TEMPERATURE (continued)								
Reactor Vessel TE-5J8-028	Cladding on Fuel Assembly 5, Row J, Column 8 at 0.71 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5J8-032	Cladding on Fuel Assembly 5, Row J, Column 8 at 0.81 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5J8-037	Cladding on Fuel Assembly 5, Row J, Column 8 at 0.94 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5J9-005	Cladding on Fuel Assembly 5, Row J, Column 9 at 0.13 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5J9-021	Cladding on Fuel Assembly 5, Row J, Column 9 at 0.53 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5J9-039	Cladding on Fuel Assembly 5, Row J, Column 9 at 0.99 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5J9-054	Cladding on Fuel Assembly 5, Row J, Column 9 at 1.37 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
TEMPERATURE (continued)								
Reactor Vessel TE-5K8-002	Cladding on Fuel Assembly 5, Row K, Column 8 at 0.05 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5K8-015	Cladding on Fuel Assembly 5, Row K, Column 8 at 0.38 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5K8-034.5	Cladding on Fuel Assembly 5, Row K, Column 8 at 0.88 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5K8-049	Cladding on Fuel Assembly 5, Row K, Column 8 at 1.24 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5LP-001	Fuel Assembly 5 lower end box.	311 to 977.4 K	1 Hz	2.6 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	93, 196	Qualified.
Reactor Vessel TE-5LP-002	Fuel Assembly 5 lower end box.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.
Reactor Vessel TE-5LP-003	Fuel Assembly 5 lower end box.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
TEMPERATURE (continued)								
Reactor Vessel TE-5LP-004	Fuel Assembly 5 lower end box.	311 to 977.4 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.
Reactor Vessel TE-5L6-030	Cladding on Fuel Assembly 5, Row L, Column 6 at 0.76 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5L6-032	Cladding on Fuel Assembly 5, Row L, Column 6 at 0.81 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5L6-037	Cladding on Fuel Assembly 5, Row L, Column 6 at 0.94 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5L6-039	Cladding on Fuel Assembly 5, Row L, Column 6 at 0.99 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-5L8-011	Guide tube for Fuel Assembly 5, Row L, Column 8 at 0.28 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	94	Qualified.
Reactor Vessel TE-5L8-024	Guide tube for Fuel Assembly 5, Row L, Column 8 at 0.61 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	95, 197	Qualified.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
TEMPERATURE (continued)								
Reactor Vessel TE-5L8-039	Guide tube for Fuel Assembly 5, Row L, Column 8 at 0.99 m above bottom of fuel rod.	422 to 1533	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	96	Qualified.
Reactor Vessel TE-5L8-045	Guide tube for Fuel Assembly 5, Row L, Column 8 at 1.14 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	97, 198	Qualified.
Reactor Vessel TE-5M6-024	Guide tube for Fuel Assembly 5, Row M, Column 6 at 0.61 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	98	Qualified.
Reactor Vessel TE-5UP-001	Fuel Assembly 5, upper end box.	311 to 978 K	1 Hz	2.7 K[f]	400 K 450 K 500 K 550 K	2.7 K[f] 3.2 K 4.7 K 6.2 K	99, 199, 216	Qualified.
Reactor Vessel TE-5UP-002	Fuel Assembly 5, upper end box.	311 to 978 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.7 K 3.2 K 4.7 K 6.2 K	199	Qualified.
Reactor Vessel TE-5UP-003	Fuel Assembly 5, upper end box.	311 to 978 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.7 K 3.2 K 4.7 K 6.2 K	199	Qualified.
Reactor Vessel TE-5UP-004	Fuel Assembly 5, upper end box.	311 to 978 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	199	Qualified.

TABLE 7. (continued)

					After T_o			
VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	Reading	Uncertainty (±)	Figure	Comments
TEMPERATURE (continued)								
Reactor Vessel TE-5UP-00[illegible]	Fuel Assembly 5, upper end box.	311 to 978 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	200	Qualified.
Reactor Vessel TE-5UP-006	Fuel Assembly 5, upper end box.	311 to 978 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	200	Qualified.
Reactor Vessel TE-5UP-007	Fuel Assembly 5, upper end box.	311 to 978 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	200	Qualified.
Reactor Vessel TE-5UP-008	Fuel Assembly 5, upper end box.	311 to 978 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	200	Qualified.
Reactor Vessel TE-5UP-009	Fuel Assembly 5, upper end box.	311 to 978 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.
Reactor Vessel TE-6E8-045	Cladding on Fuel Assembly 6, Row E, Column 8 at 1.14 m above bottom of fuel rod.	422 to 1533 K	10 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-6G14-011	Cladding on Fuel Assembly 6, Row G, Column 14 at 0.28 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments
TEMPERATURE (continued)								
Reactor Vessel TE-6G14-030	Cladding on Fuel Assembly 6, Row G, Column 14 at 0.76 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	100, 201	Qualified.
Reactor Vessel TE-6G14-045	Cladding on Fuel Assembly 6, Row G, Column 14 at 1.14 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.2 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-6H01-037	Cladding on Fuel Assembly 6, Row H, Column 1 at 0.94 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-6H02-028	Cladding on Fuel Assembly 6, Row H, Column 2 at 0.71 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-6H02-032	Cladding on Fuel Assembly 6, Row H, Column 2 at 0.81 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-6H08-039	Cladding on Fuel Assembly 6, Row H, Column 8 at 0.99 m above bottom of fuel rod.	422 to 1533 K	1 Hz	3.1 K	400 K 600 K 800 K 1000 K	2.7 K 3.2 K 4.7 K 6.2 K	--	Not presented.
Reactor Vessel TE-6LP-001	Fuel Assembly 6 lower end box.	311 to 978 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	101, 202	Qualified.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o		Figure	Comments
					Reading	Uncertainty (±)		
TEMPERATURE (continued)								
Reactor Vessel TE-6LP-003	Fuel Assembly 6 lower end box.	311 to 978 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	--	Not presented.
Reactor Vessel TE-6UP-001	Fuel Assembly 6 upper end box.	311 to 978 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	102, 203	Qualified.
Reactor Vessel TE-6UP-003	Fuel Assembly 6 upper end box.	311 to 978 K	1 Hz	2.7 K	400 K 450 K 500 K 550 K	2.5 K 2.6 K 2.6 K 2.6 K	203	Qualified.
Secondary Coolant System TT-P004-004	Secondary coolant system feedwater.	366 to 505 K	1 Hz	0.9 K	--	0.9 K	--	Not presented.
Emergency Core Cooling System TT-P120-062	Cold leg injection in 4-in. line upstream of cold leg injection point.	280 to 620 K	1 Hz	2.1 K	--	2.1 K	--	Not presented.
Intact Loop TT-P139-032	Intact loop hot leg primary coolant, Channel A.	533 to 616 K	1 Hz	0.5 K	--	0.5 K	103, 204	Qualified, narrow range instrument.
Intact Loop TT-P139-033	Intact loop hot leg primary coolant, Channel B.	533 to 616 K	1 Hz	0.5 K	--	0.5 K	204	Qualified, narrow range instrument.
Intact Loop TT-P139-034	Intact loop hot leg primary coolant, Channel C.	533 to 616 K	1 Hz	0.5 K	--	0.5 K	204	Qualified, narrow range instrument.

TABLE 7. (continued)

VARIABLE System Detector	Location	Measurement Range	Recording Frequency[a]	Initial Condition Uncertainty (±)	After T_o Reading	After T_o Uncertainty (±)	Figure	Comments

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a. Recording frequency is the measurement channel bandwidth at the ± 3 dB level.

b. Instrument channels were "not presented" if the data were in the instrument dead band or showed a similar response to nearby like instruments (such as the core thermocouples). These data are available upon special request.

c. Reference 6.

d. Reference 7.

e. Reference 8.

f. Refer to figure caption for error band for long-term plots.

g. The steam generator level is defined as 0 at 2.95 m above the top of the tube sheet.

h. Reference 9.

i. Reference 10.

j. Pressure measurements are presented as absolute values.

TABLE 8. COMPUTED VARIABLES FOR EXPERIMENT L3-2

Variable Location Detectors	Units	Uncertainty	Calculation Method	Figure	Comments
DENSITY, AVERAGE	Mg/m^3	a	Density, average:		The individual beam densities were filtered with a 4-Hz filter prior to being used in the average calculation.
Broken Loop Cold Leg DE-BL-1A (ρ_A) DE-BL-1B (ρ_B) DE-BL-105 DE-BL-1C (ρ_C)	Mg/m^3	±0.03 Mg/m^3	Except where the density distribution reduces to an average directly, the following method is used to determine the average density: (1) A calculated density profile is determined from an assumed distribution which has been "fit" to each beam measurement. These are optimized as shown below. (2) The least squares curve fits are compared to determine the optimum assumed density profile to fit the data. (3) The best profile is area averaged to give average density by $\bar{\rho} = 1/A \int \rho (\bar{r}) dA$ where A = cross-sectional area of the pipe $\rho(\bar{r})$ = chordal profile.	218	Qualified, spikes caused by data processing.

TABLE 8. (continued)

Variable Location Detectors	Units	Uncertainty	Calculation Method	Figure		Comments
DENSITY, AVERAGE (continued)			The assumed profiles are as follows: (1) For homogeneous flow the average results directly in $\bar{\rho} = \frac{(\rho_A + \rho_B + \rho_C)}{3}$ where ρ_A, ρ_B, and ρ_C, = density along gamma densitometer beam lines A, B, and C. (2) For tilted stratified flow, $\rho(\bar{r}) = \rho_\ell - \frac{\rho_\ell - \rho_g}{1 + \exp\left[-4a(x-b)\right]}$ where a and b = two adjustable parameters ρ_g and ρ_ℓ = gas and liquid densities x = position in maximum density gradient direction. (3) For annular distribution, $\rho(\bar{r}) = \begin{matrix} \rho_c \text{ for } r < R-D \\ \rho_\ell \text{ for } r > R-D \end{matrix}$ where ρ_c and D are two adjustable parameters.			

TABLE 8. (continued)

Variable Location Detectors	Units	Uncertainty	Calculation Method	Figure	Comments
DENSITY, AVERAGE (continued)			(4) Eccentric annular is the same as annular, except that the core region may be vertically displaced from the pipe center. (5) For default calculation if the above distributions do not represent the data, the density is calculated by a beam length weighted average of the chordal average density readings ρ_i. $\bar{\rho} = 0.34485\ \rho_A + 0.40034\ \rho_B + 0.25481\ \rho_C$.		
FLUID VELOCITY	m/s				
Intact Loop Hot Leg PNE-PC-2	m/s	Not available	The output from the detector gives a plot of counts versus time for each pulsing of the neutron sources. A peak appears in the output, and its location (which corresponds to the time after the source pulsing) is determined. The distance between the sources and detector (see Figure 4) is divided by this time, giving the fluid velocity.	219	Qualified. This is a developmental instrument and should not be used for quantitative analysis. Applies to data at 120, 240, 360, 720, 1080, and 1800 s.

TABLE 8. (continued)

Variable Location Detectors		Units	Uncertainty	Calculation Method	Figure	Comments
FLUID VELOCITY (continued)						
Broken Loop Cold Leg						
TTE-BL-1A-1 TTE-BL-1A-2 TTE-BL-1A-3	TTE-BL-1A	m/s	Not Available	The A, B, and C measurement positions are located vertically in the pipe. At the A and C locations there are three axially positioned thermocouples. To analyze the data, two pairs of thermocouples (each consisting of the middle and one end thermocouple) are examined. The two end thermocouples are separated from the middle one by 25.4 and 50.8 mm. At each location, a cross-correlation technique is used on each thermocouple pair to determine the fluid transit time. The two pairs at each location are compared, and the one with the greater signal-to-noise ratio is used, together with the separation distance, to determine the fluid velocity. At the B location there are two thermocouples (and hence only one thermocouple pair) separated by 76.2 mm. Again, the cross-correlation technique is used to determine the transit time, which is used to calculate the fluid velocity.	--	Channel failed.
TTE-BL-1B-1 TTE-BL-1B-3	TTE-BL-1B	m/s	Not Available		--	Channel failed.
TTE-BL-1C-1 TTE-BL-1C-2 TTE-BL-1C-3	TTE-BL-1C	m/s	Not Available		--	Channel failed.

TABLE 8. (continued)

Variable Location Detectors	Units	Uncertainty	Calculation Method	Figure	Comments
LIQUID LEVEL			The liquid distribution was interpreted from the voltage output of the conductivity probes using the following criteria.		
Downcomer and Lower Plenum					
LE-1ST-1 and -2	m	b	(1) A response time of 550 ms during dryout was assumed.	220	Qualified.
LE-2ST-1 and -2	m			--	Not presented.
Upper Plenum					
LE-3UP-1	m	b	(2) The void fraction is assumed to vary linearly with the voltage. The maximum voltage measured during the test from each probe is an indication of 100% void.	221	Qualified.
Core			(3) When there is a change in phase from water to steam, an X is indicated for void fractions less than 15% with the space left blank for void fractions greater than 15%. When there is a change in phase from steam to water, an X is indicated for void fractions less than 85% with the space left blank for void fractions greater than 85%.	--	Core liquid levels not presented.
LE-1F10	m	b			
LE-[illegible]F10	m				
LE-5E11	m				
			Engineering judgment was required at times on each conductivity probe in order to best satisfy the preceding criteria.		

TABLE 8. (continued)

Variable Location Detectors	Units	Uncertainty	Calculation Method	Figure	Comments
LIQUID LEVEL (continued)			Caution should be exercised in applying the in-core liquid level data to the core as a whole because the in-core liquid level stings are located at "cold spots" (that is, along guide tubes rather than fuel rods) in the core.		
MASS FLOW RATE Broken Loop Cold Leg	kg/s	± 10%	Mass flow rate is based on the BST level. The integrated level change was multiplied by the fluid density to yield an integrated mass increase in the tank. These data were then differentiated to give a mass flow rate. (Note: The mass flow into the BST was greater than the flow predicted to occur through the break orifice. This flow is currently being investigated.)	222	Qualified, calculation was based on LT-P138-033. The first spike at about 0 is a combination of initial flow surge and calculation method. The second spike at approximately 4600 s was caused by pressure equalization between the tank and header, which forced liquid back into the downcomers.

TABLE 8. (continued)

Variable Location Detectors	Units	Uncertainty	Calculation Method	Figure	Comments
FLUID SUBCOOLING					
Upper Plenum	K	± 6 K	The subcooling is defined as $T_{sat}-T$. The saturation temperature is calculated from the pressure reading of PE-1UP-001A1 using the following curve fits of steam table data: for $P < 1.4$ MPa, $T_{sat} = 348.225 - 290.13P + 399.543P^2 + 298.730P^3 - 84.196P^4$ for $1.4 \text{ MPa} \leq P \leq 12 \text{ MPa}$, $T_{sat} = 419.024 + 42.6705P - 5.63957P^2 + 0.433108P^3 - 0.0130329P^4$ for $P > 12$ MPa, $T_{sat} = 508.252 + 8.84806P - 0.114572P^2$. The measured temperature is an average of TE-5UP-1 through TE-5UP-8.	217, 223	Qualified.

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a. Reference 11.

b. The uncertainty in each conductivity probe for (a) LE-1ST-1 and LE-2ST-1 is ± 4.5% of range, (b) LE-1ST-2 and LE-2ST-2 is ± 7.1% of range, and (c) LE-1F10, LE-3F10, LE-5E11, and LE-3UP-1 is ± 2.9% of range. All conductivity probes have a response time of 340 ms.

SHORT-TERM PLOTS
(-200 to 1000 s)

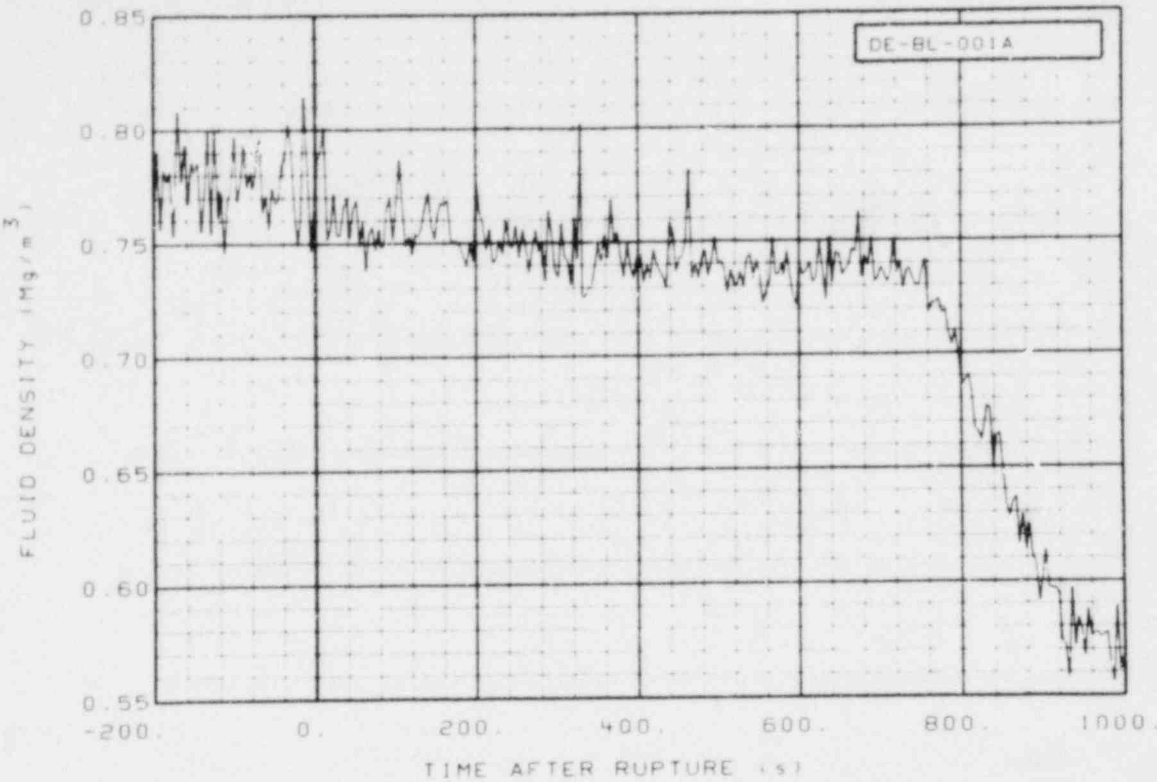


Figure 22. Fluid density in broken loop cold leg, chordal density (DE-BL-001A) (Qualified, spikes caused by data processing).

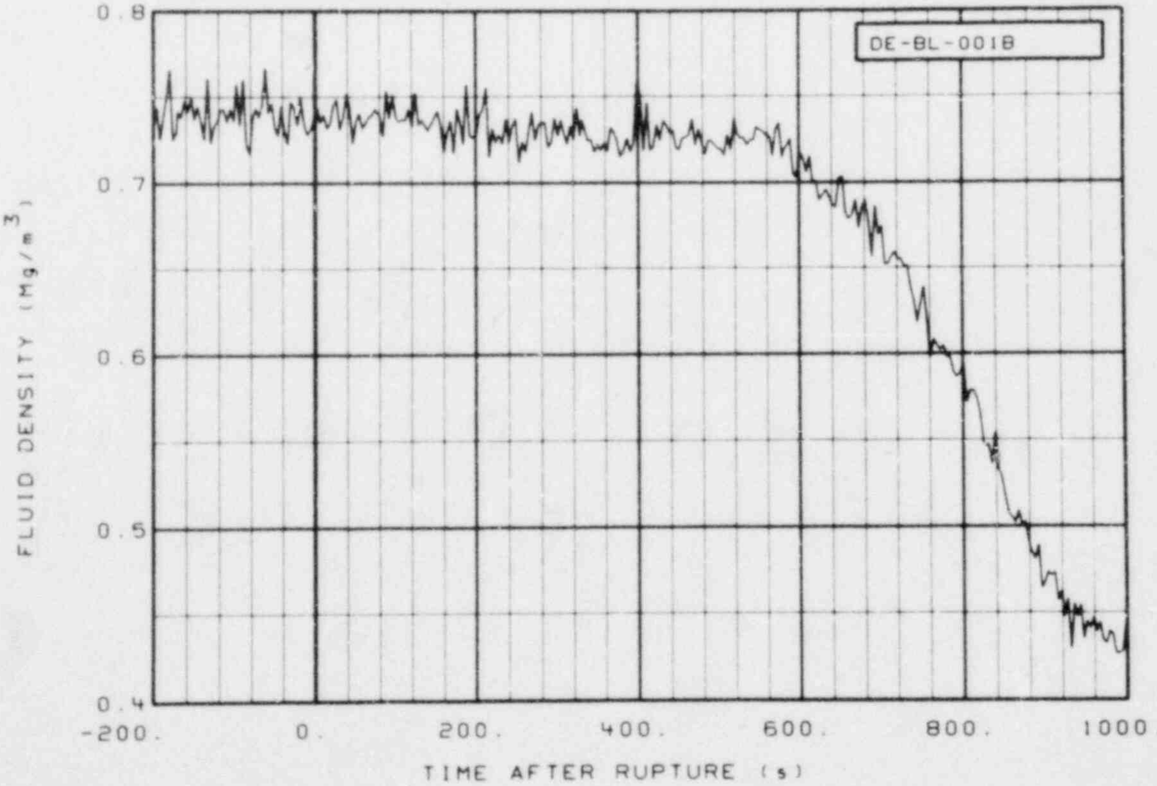


Figure 23. Fluid density in broken loop cold leg, chordal density (DE-BL-001B) (Qualified, spikes caused by data processing).

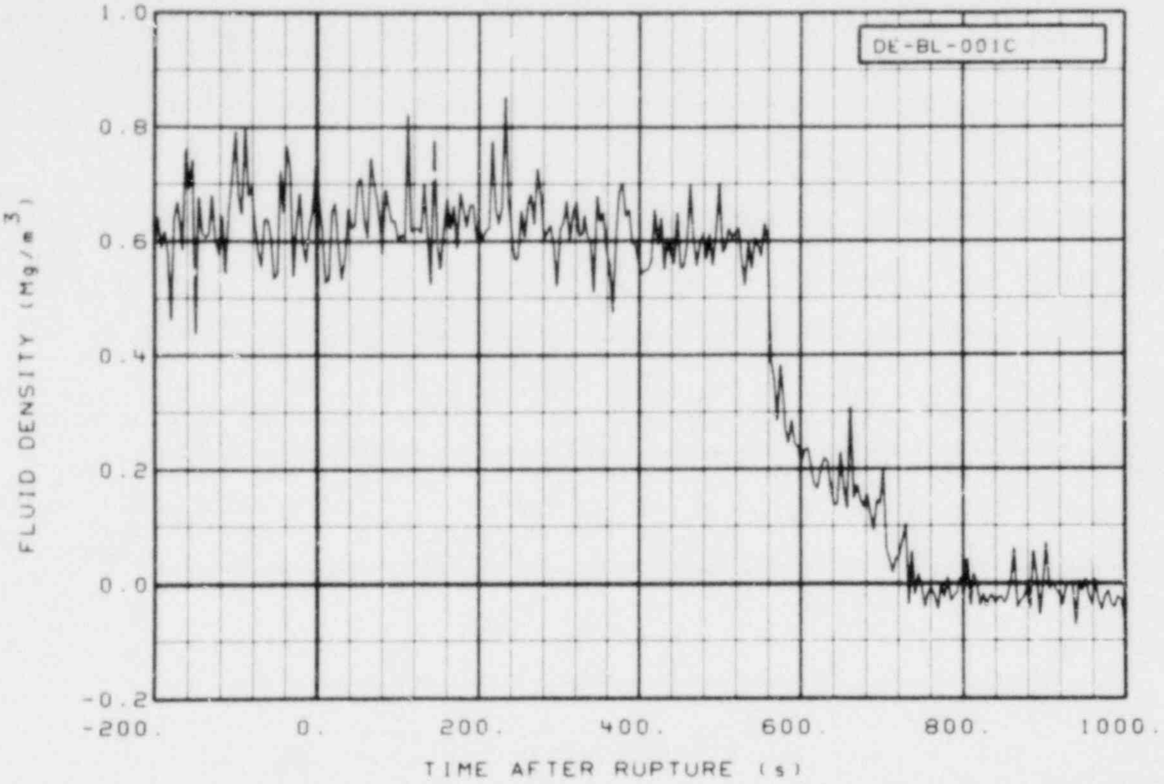


Figure 24. Fluid density in broken loop cold leg, chordal density (DE-BL-001C) (Qualified, spikes caused by data processing).

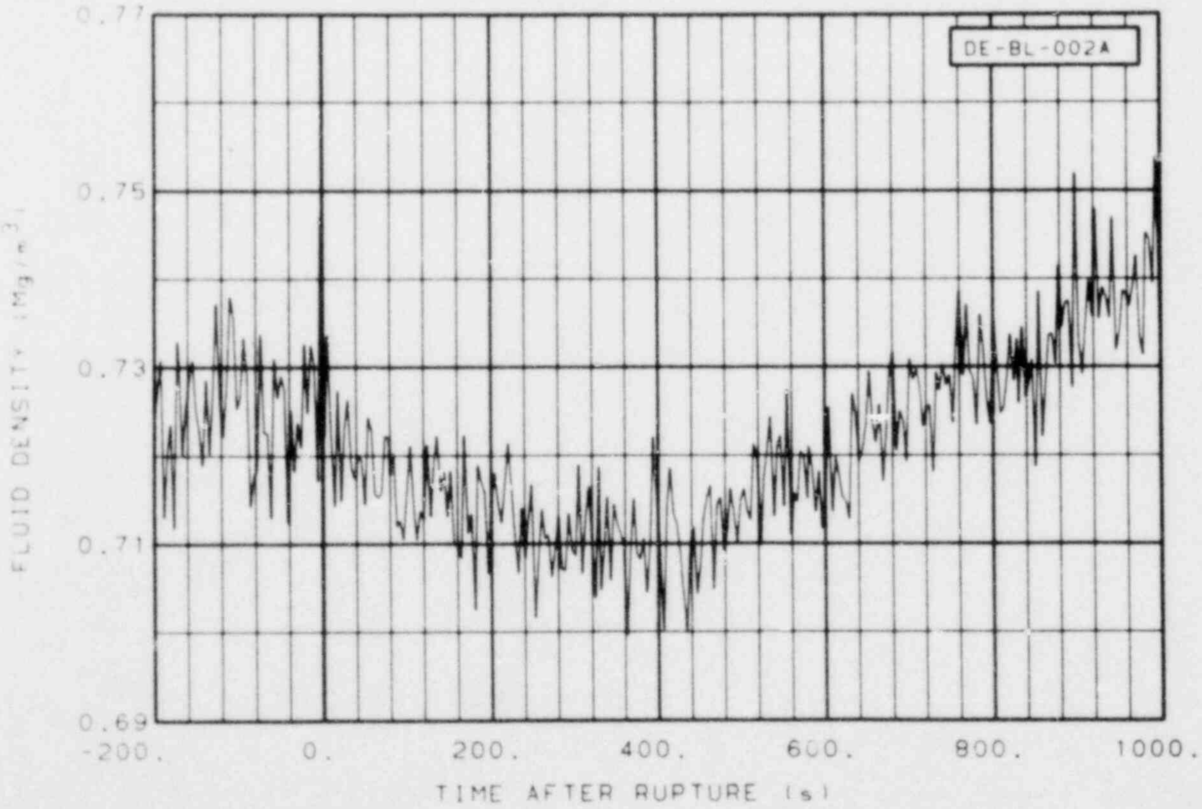


Figure 25. Fluid density in broken loop hot leg, chordal density (DE-BL-002A) (Failed; originally qualified but further investigation determined instrument failed).

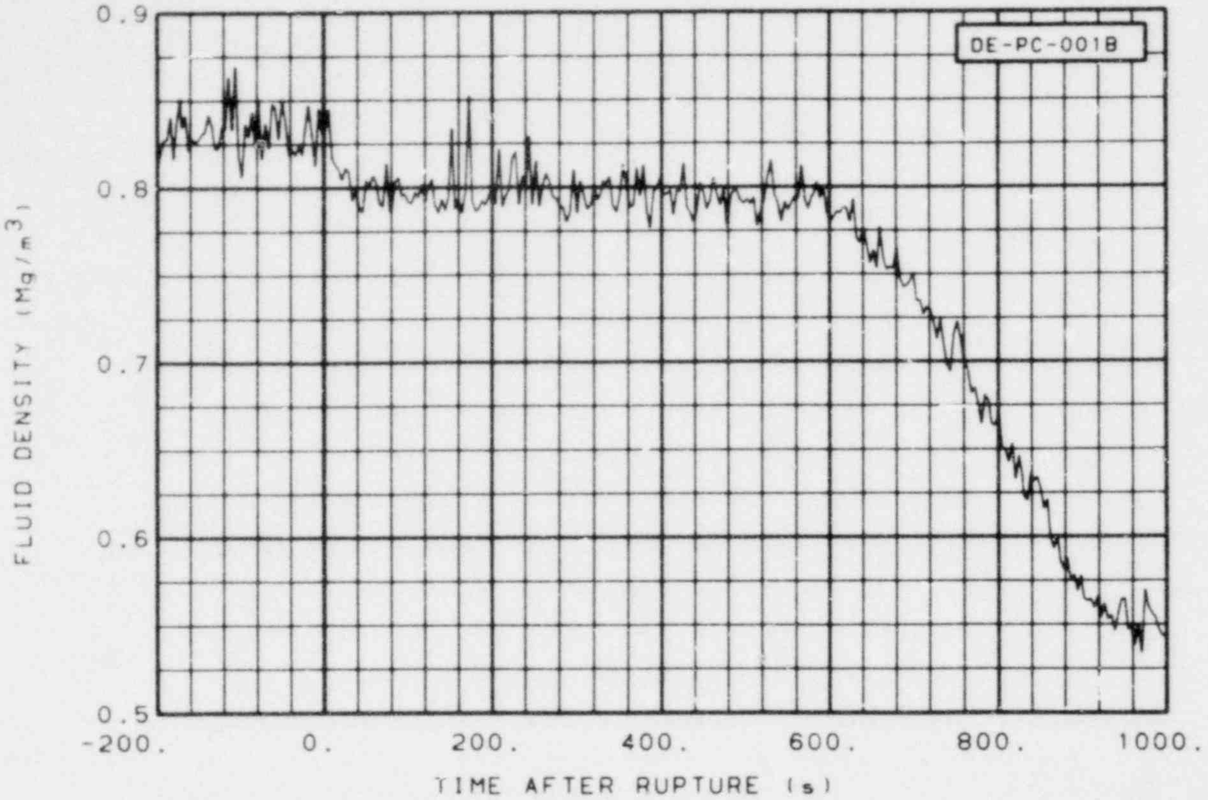


Figure 26. Fluid density in intact loop cold leg, chordal density (DE-PC-001B) (Qualified, spikes caused by data processing).

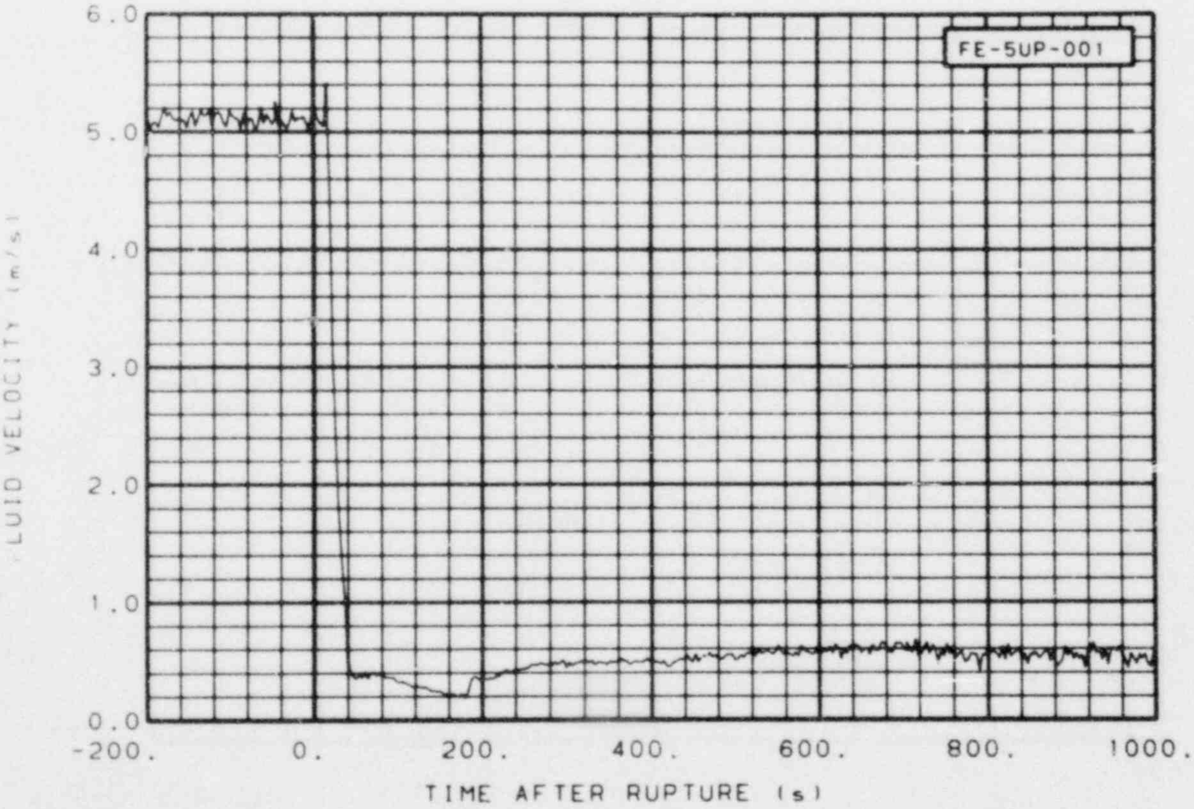


Figure 27. Fluid velocity above upper end box of Fuel Assembly 5 (FE-5UP-001) (Qualified).

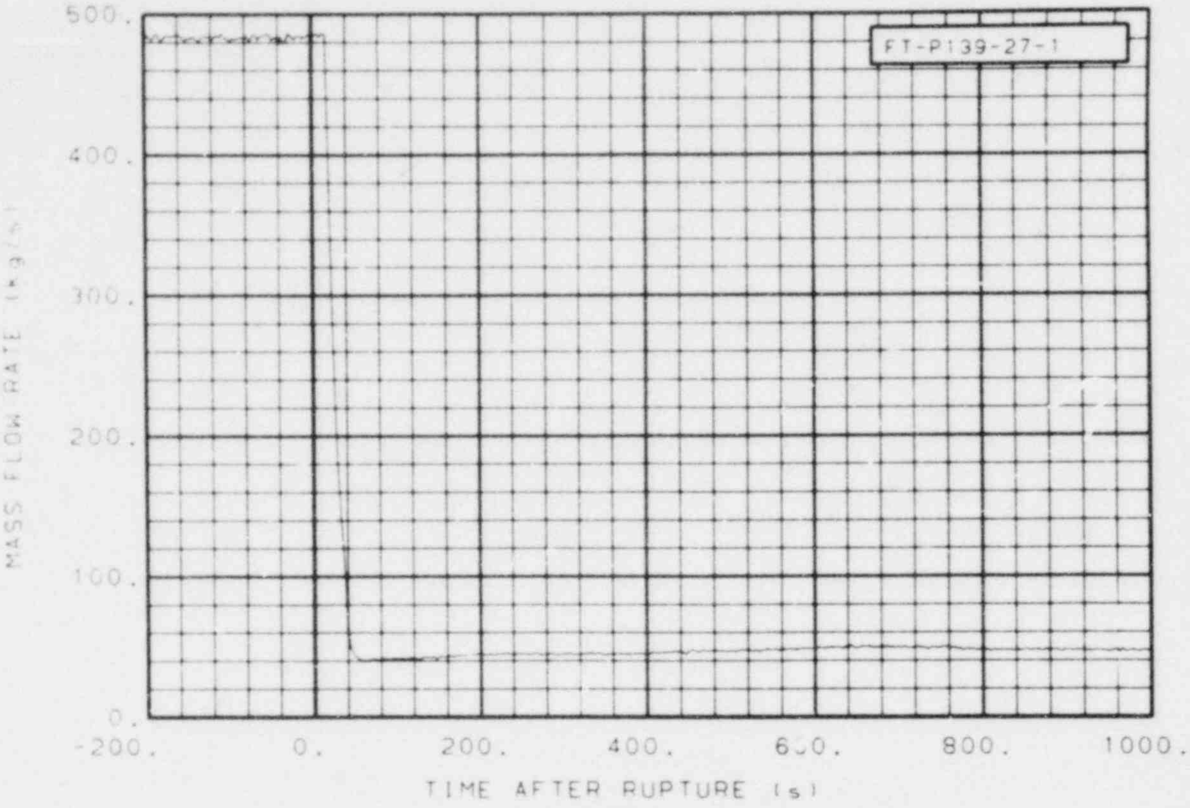


Figure 28. Flow rate in intact loop hot leg venturi (FT-P139-27-1) (Qualified, good for initial conditions only).

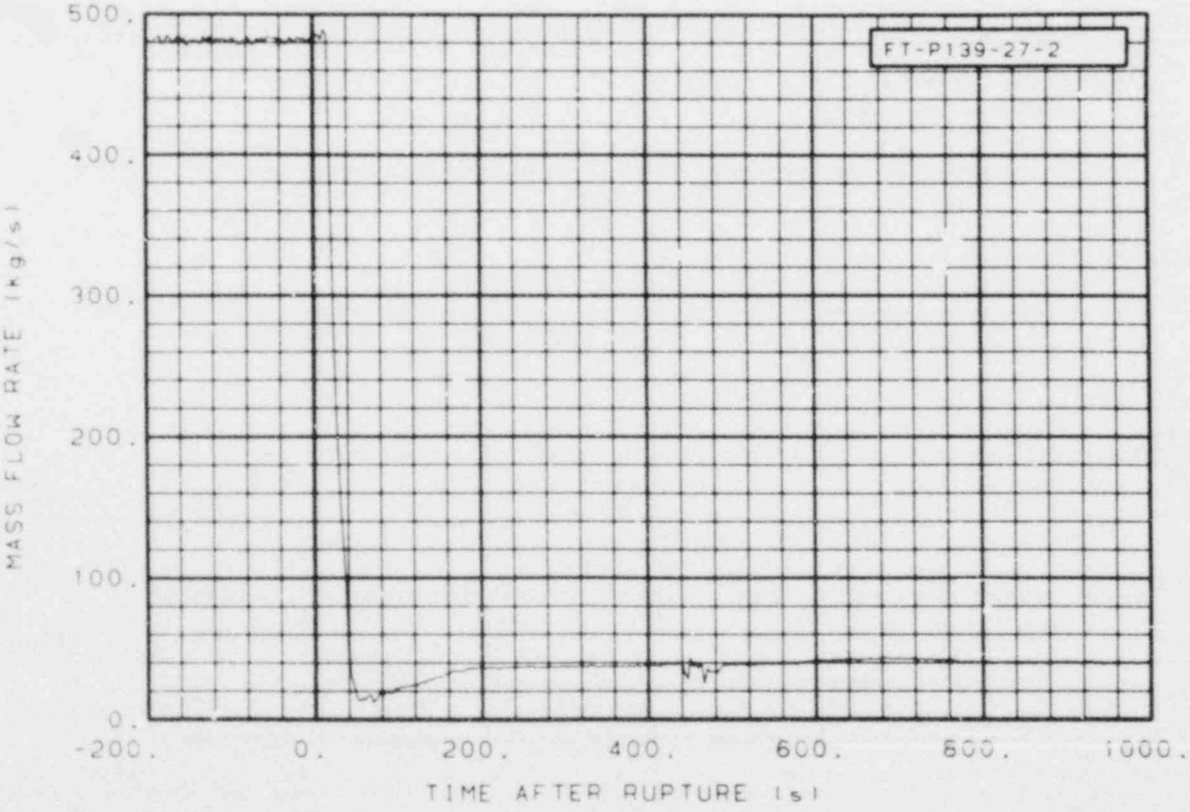


Figure 29. Flow rate in intact loop hot leg venturi (FT-P139-27-2) (Qualified, good for initial conditions only).

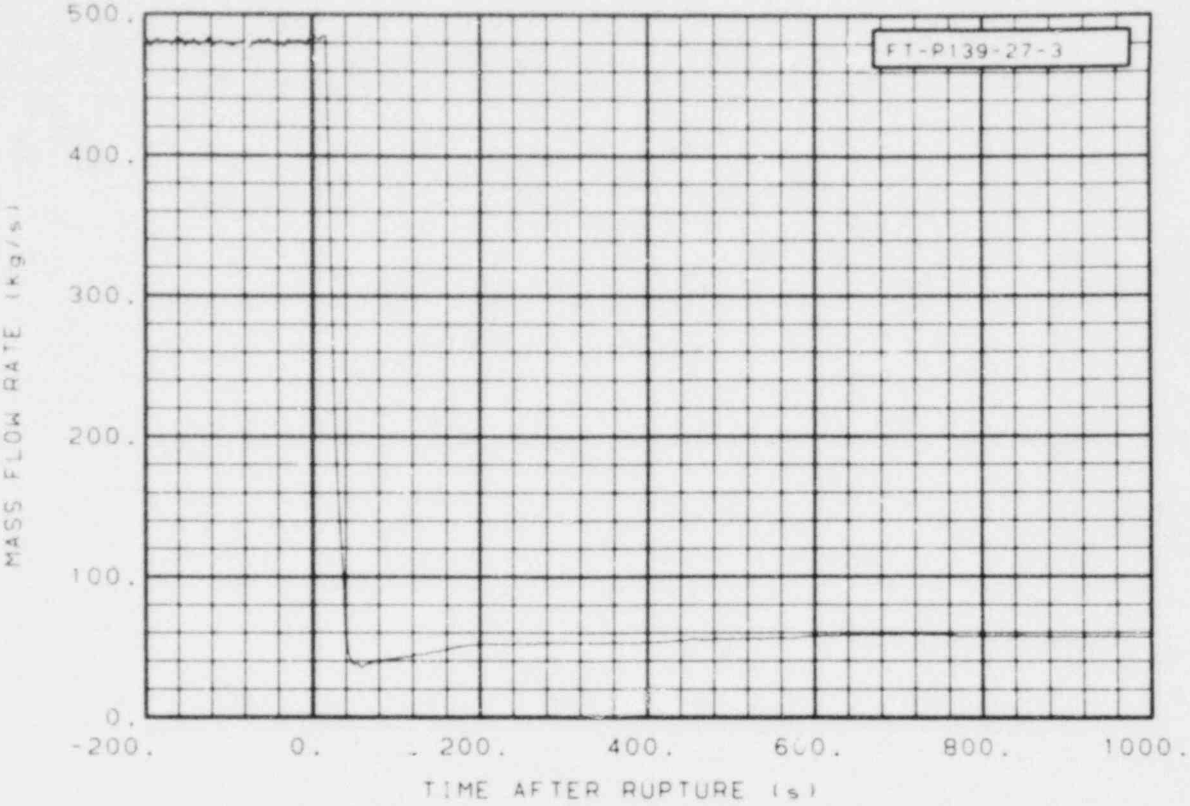


Figure 30. Flow rate in intact loop hot leg venturi (FT-P139-27-3) (Qualified, good for initial conditions only).

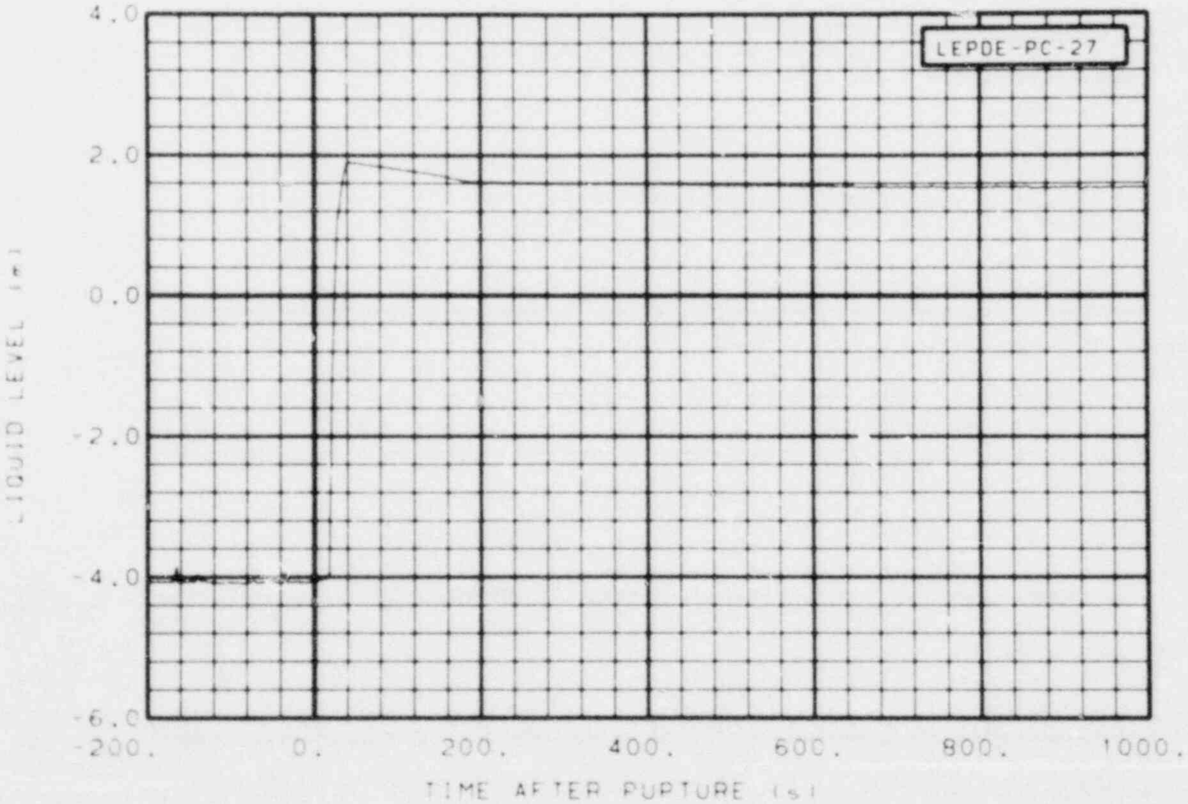


Figure 31. Liquid level in intact loop from steam generator outlet to bottom of loop seal (LEPDE-PC-027) (Qualified, good from 500 to 6000 s).

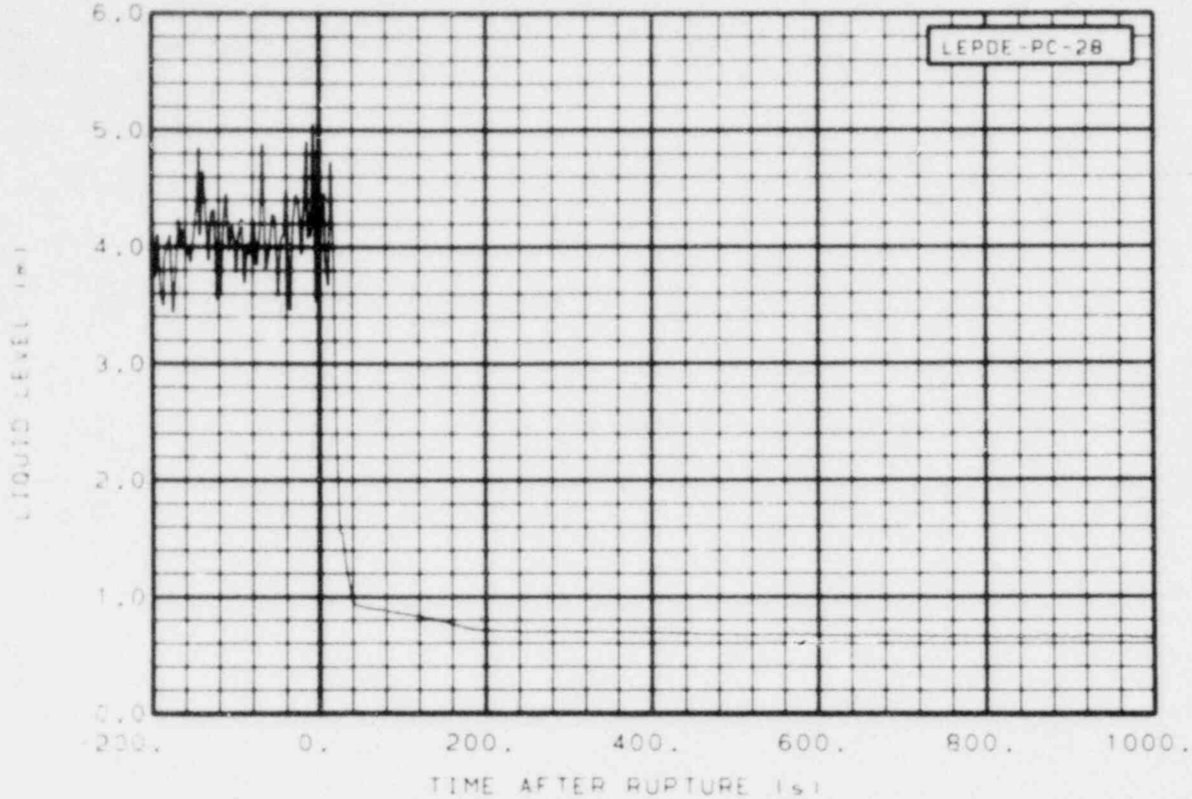


Figure 32. Liquid level in intact loop from bottom of loop seal to primary coolant Pump 2 inlet (LEPDE-PC-028) (Qualified, good from 500 to 6000 s).

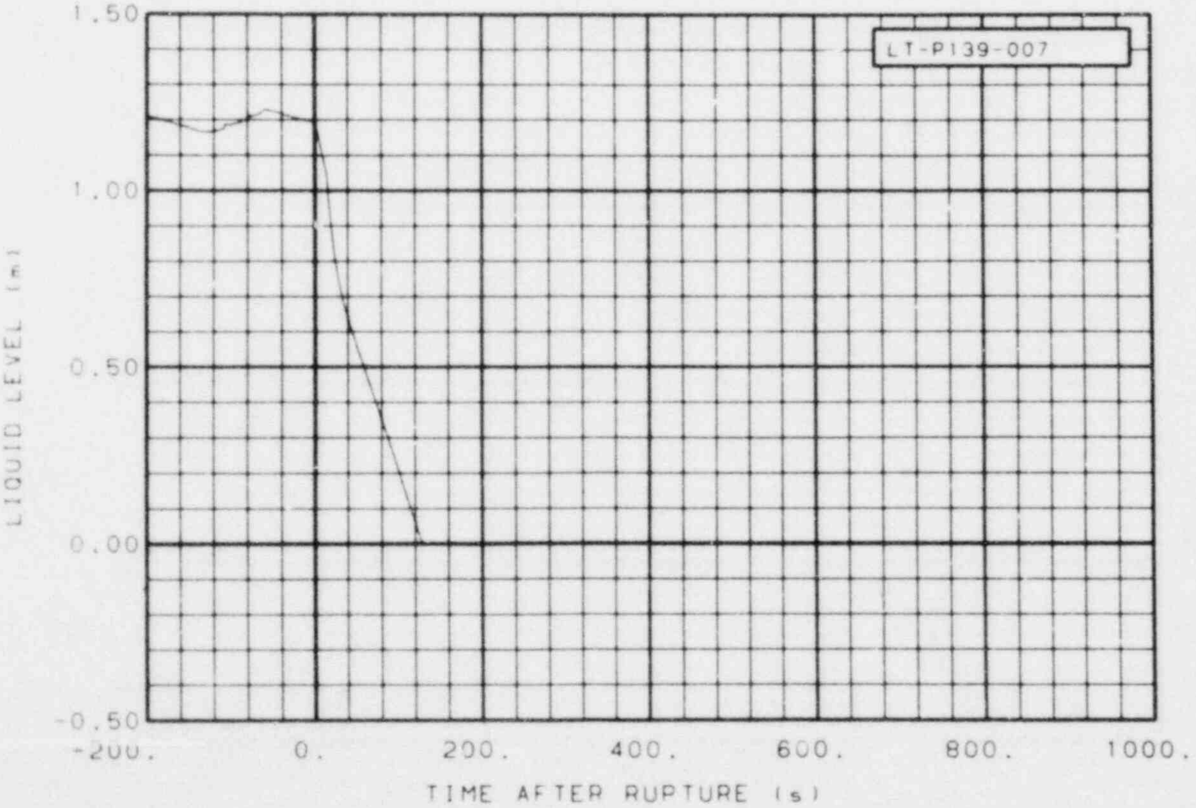


Figure 33. Liquid level in urizer (LT-P139-007) (Qualified).

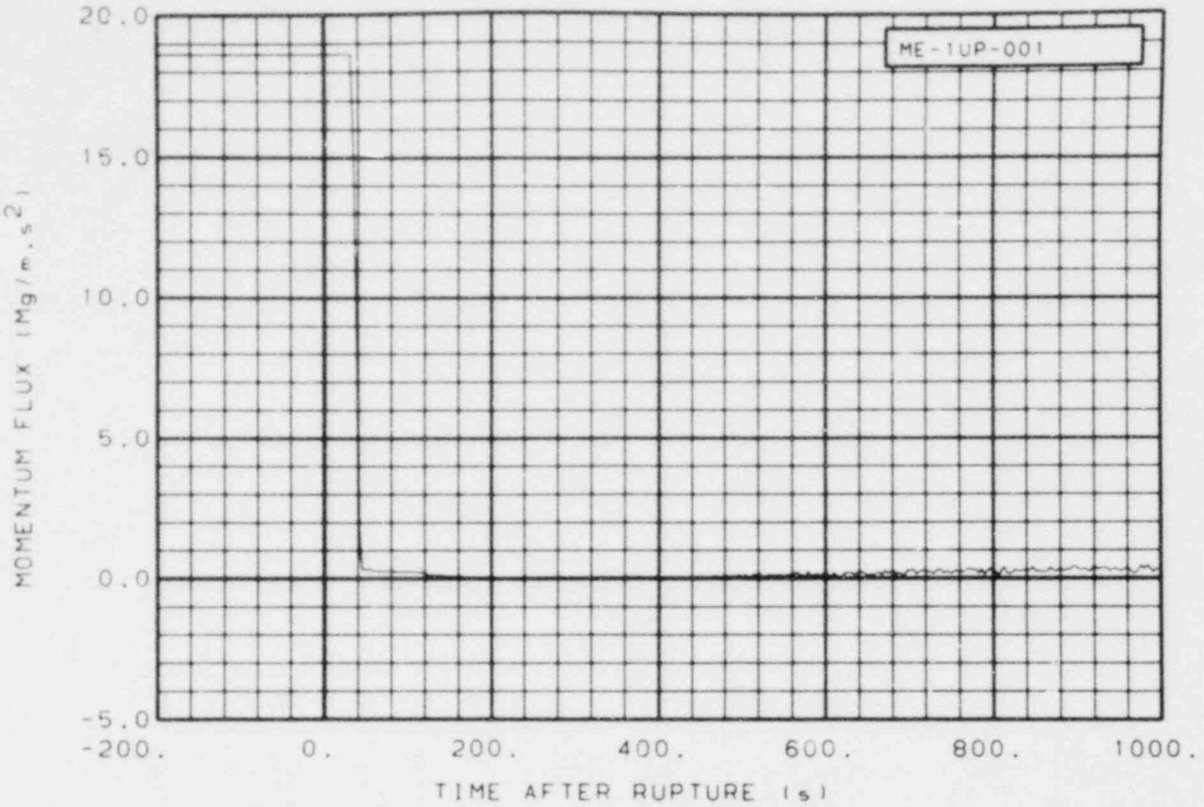


Figure 34. Momentum flux in reactor vessel above Fuel Assembly 1 upper end box (ME-1UP-001) (Qualified, initial conditions out of measurement range).

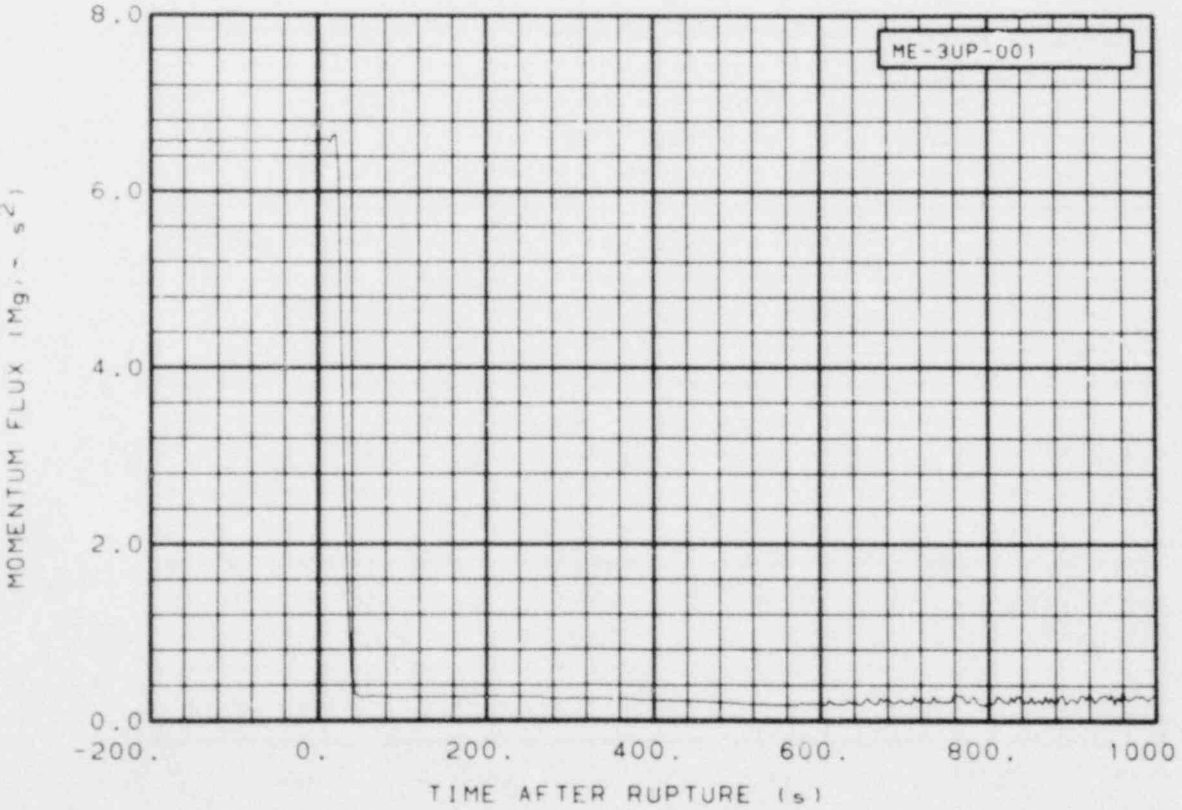


Figure 35. Momentum flux in reactor vessel above Fuel Assembly 3 upper end box (ME-3UP-001) (Qualified).

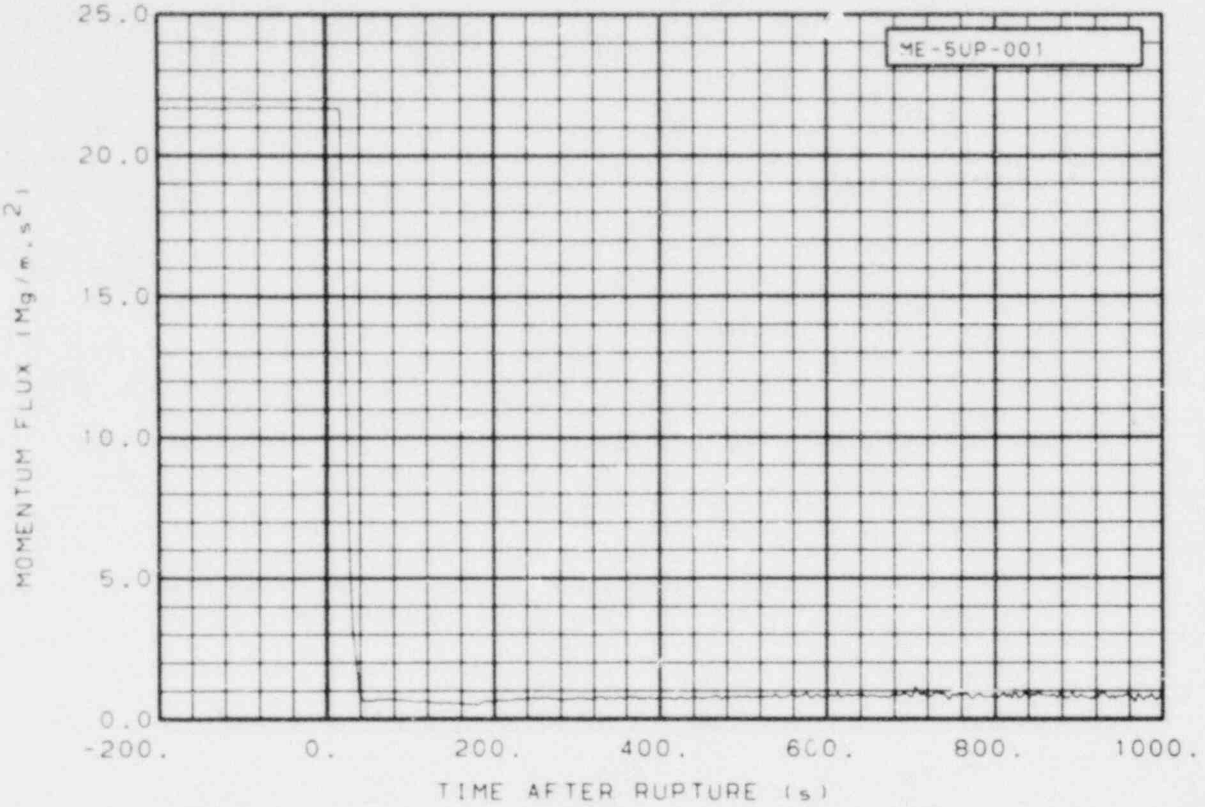


Figure 36. Momentum flux in reactor vessel above Fuel Assembly 5 upper end box (ME-5UP-001) (Qualified).

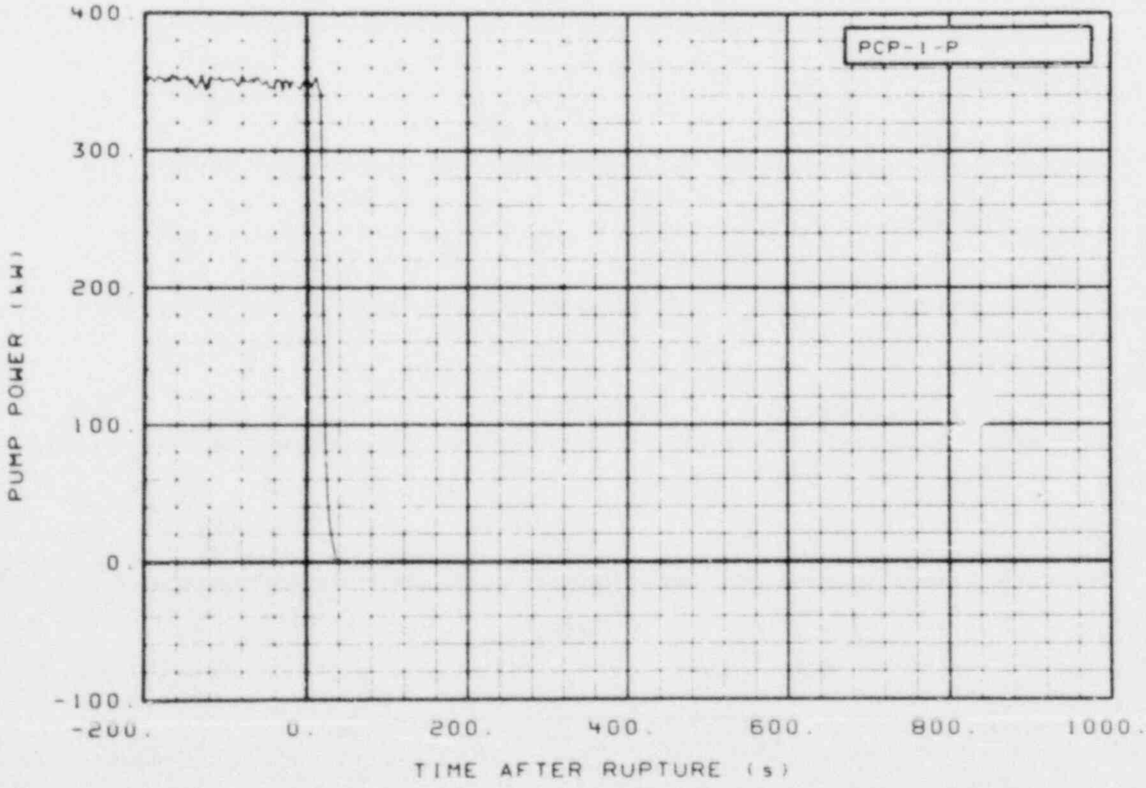


Figure 37. Pump power for primary coolant Pump 1 (PCP-1-P) (Qualified).

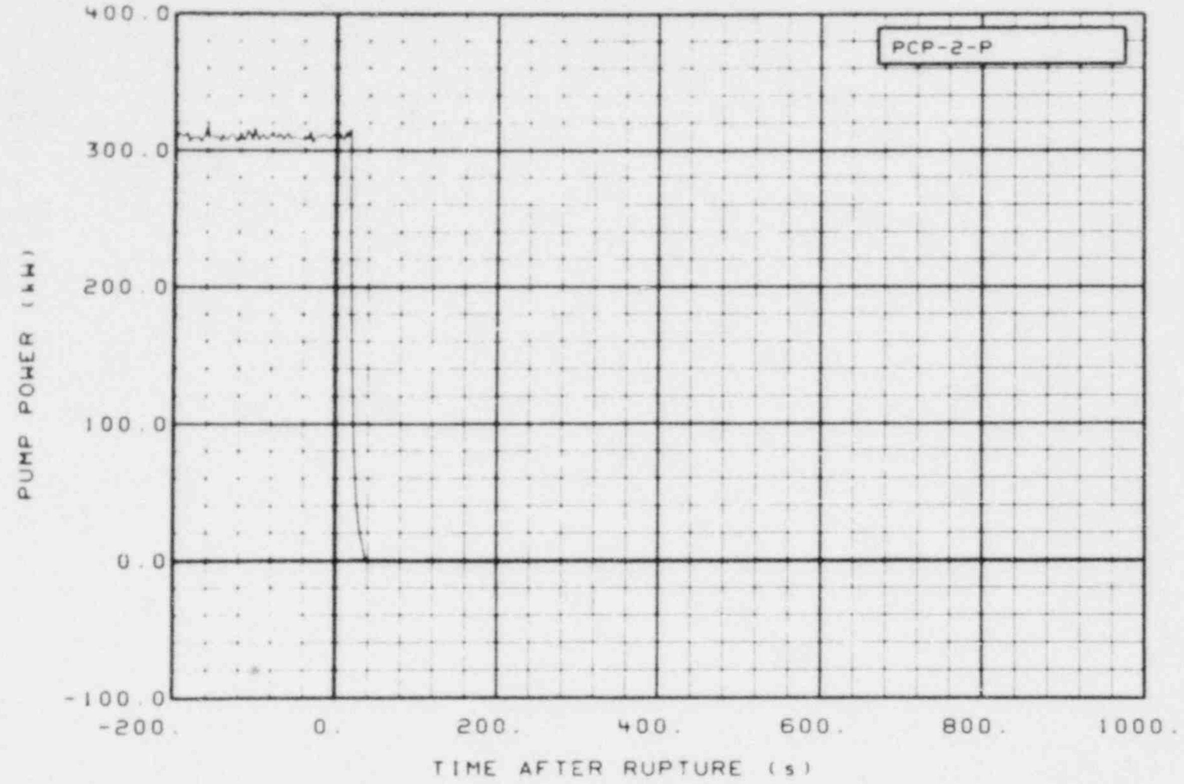


Figure 38. Pump power for primary coolant Pump 2 (PCP-2-P) (Qualified).

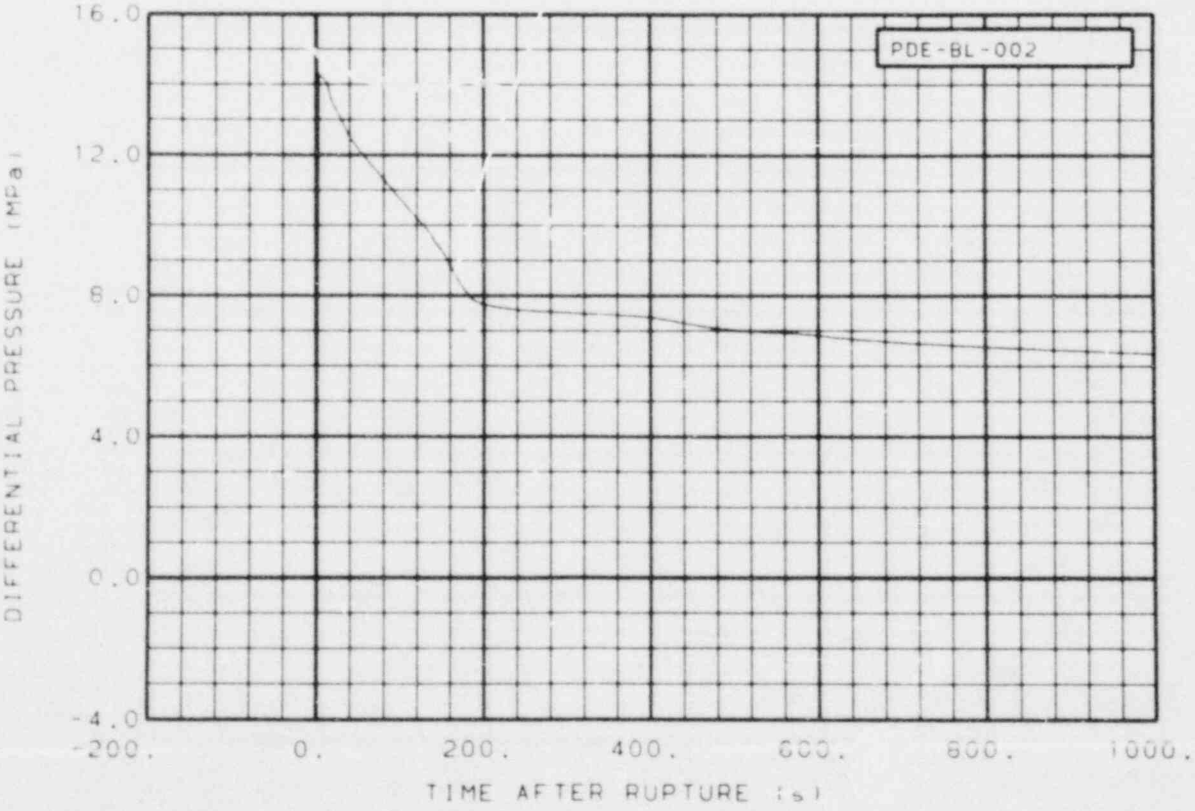


Figure 39. Differential pressure in broken loop cold leg across small break orifice (PDE-BL-002) (Qualified).

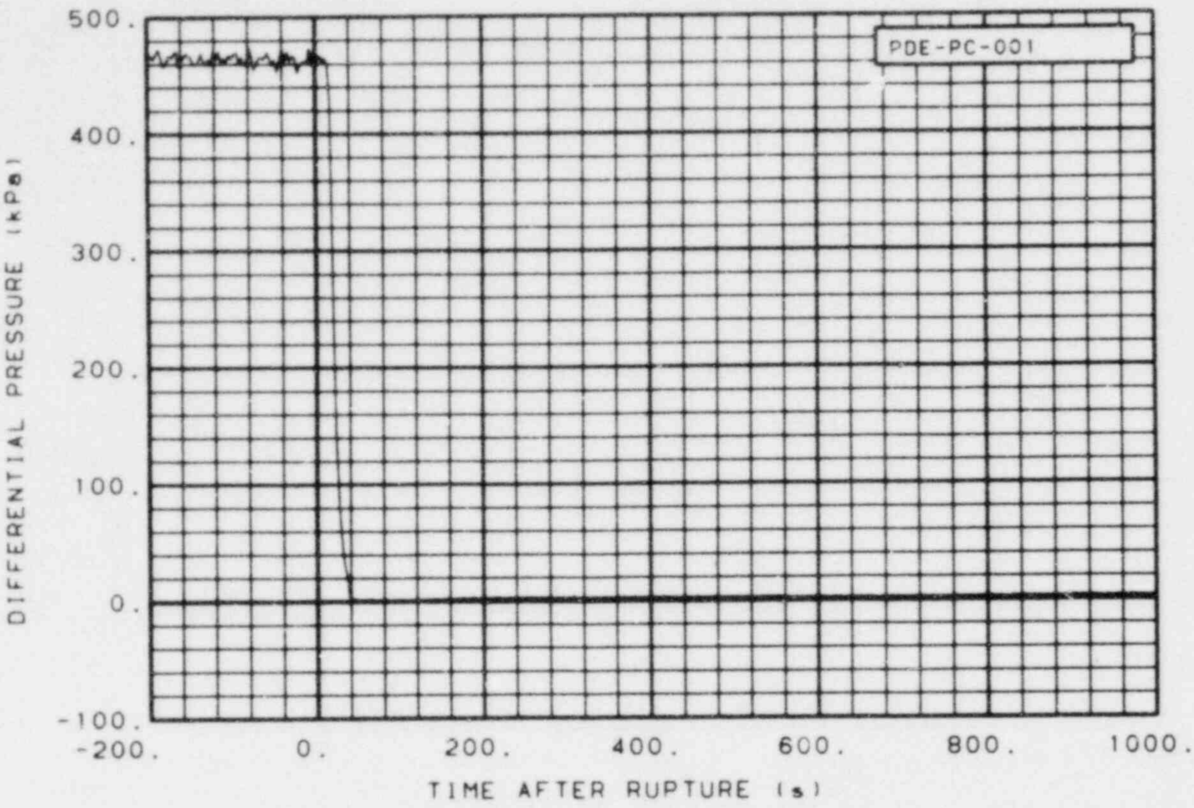


Figure 40. Differential pressure in intact loop across primary coolant Pumps 1 and 2 (PDE-PC-001) (Qualified).

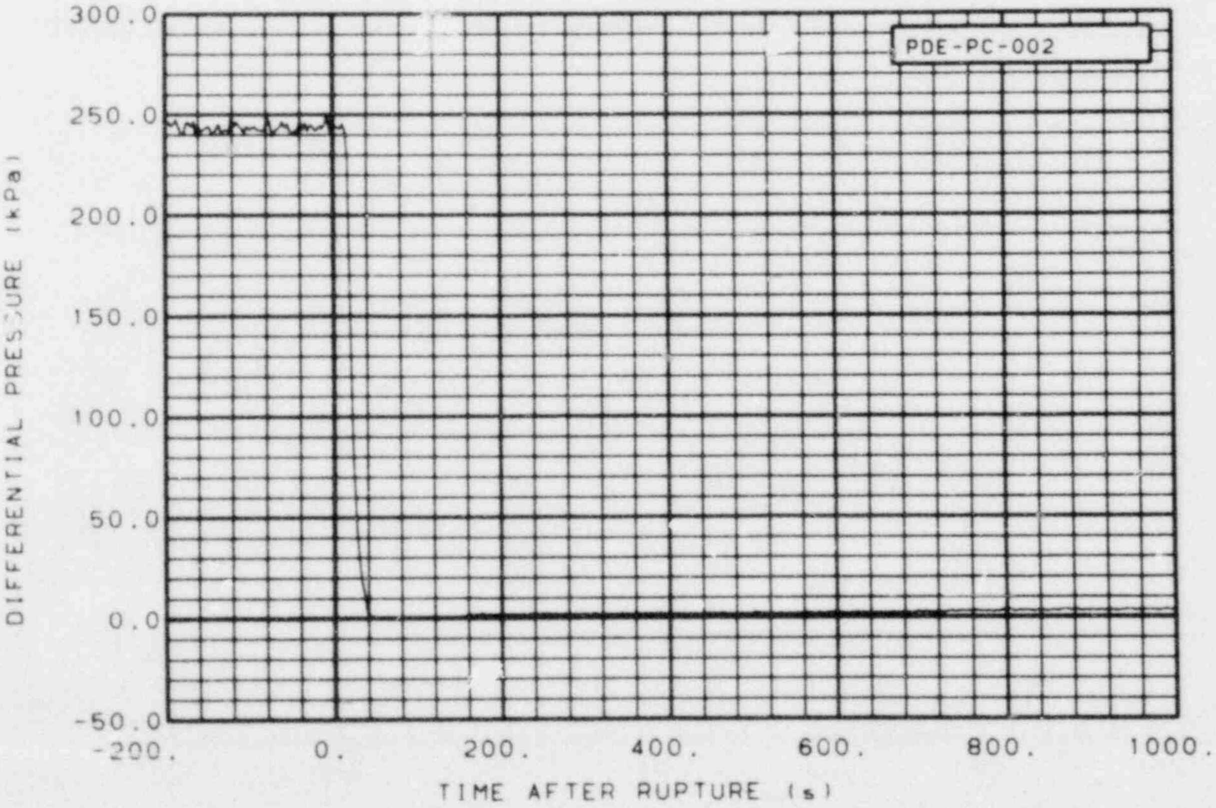


Figure 41. Differential pressure in intact loop across the steam generator (PDE-PC-002) (Qualified).

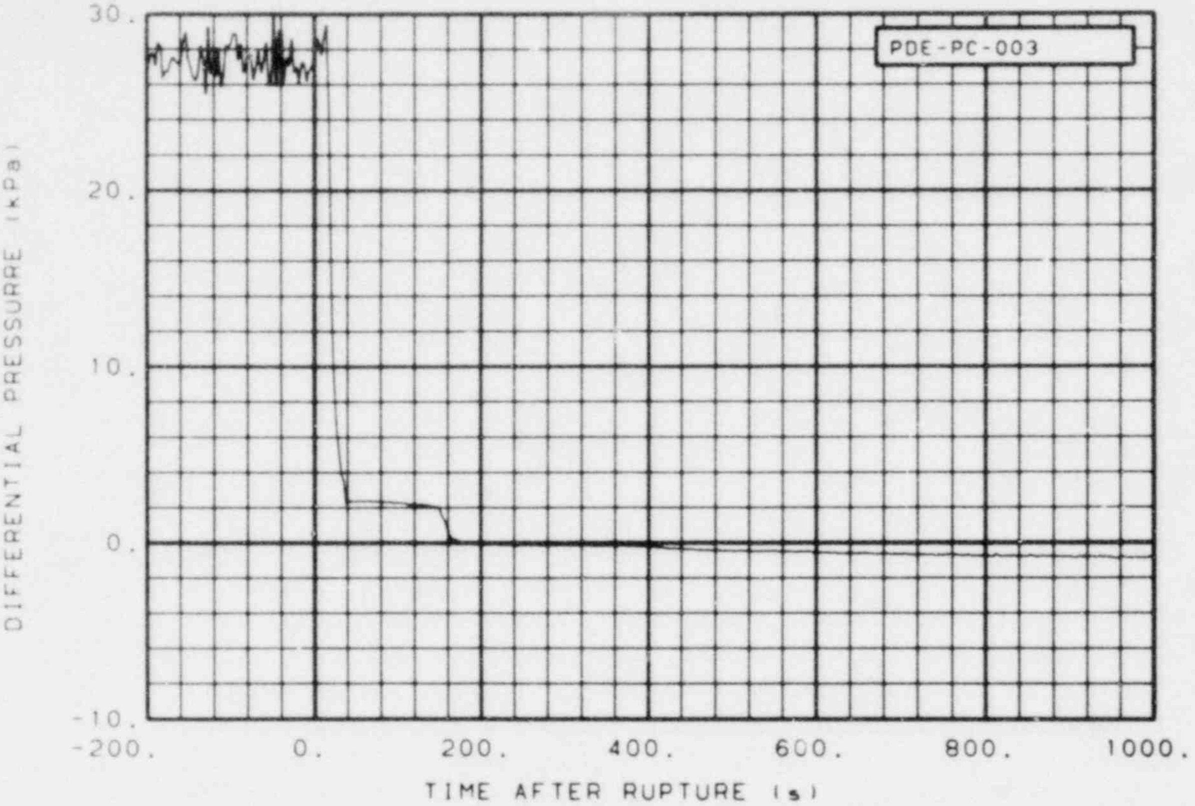


Figure 42. Differential pressure in intact loop hot leg from reactor vessel outlet to pressurizer surge line junction (PDE-PC-003) (Qualified, good for initial conditions only).

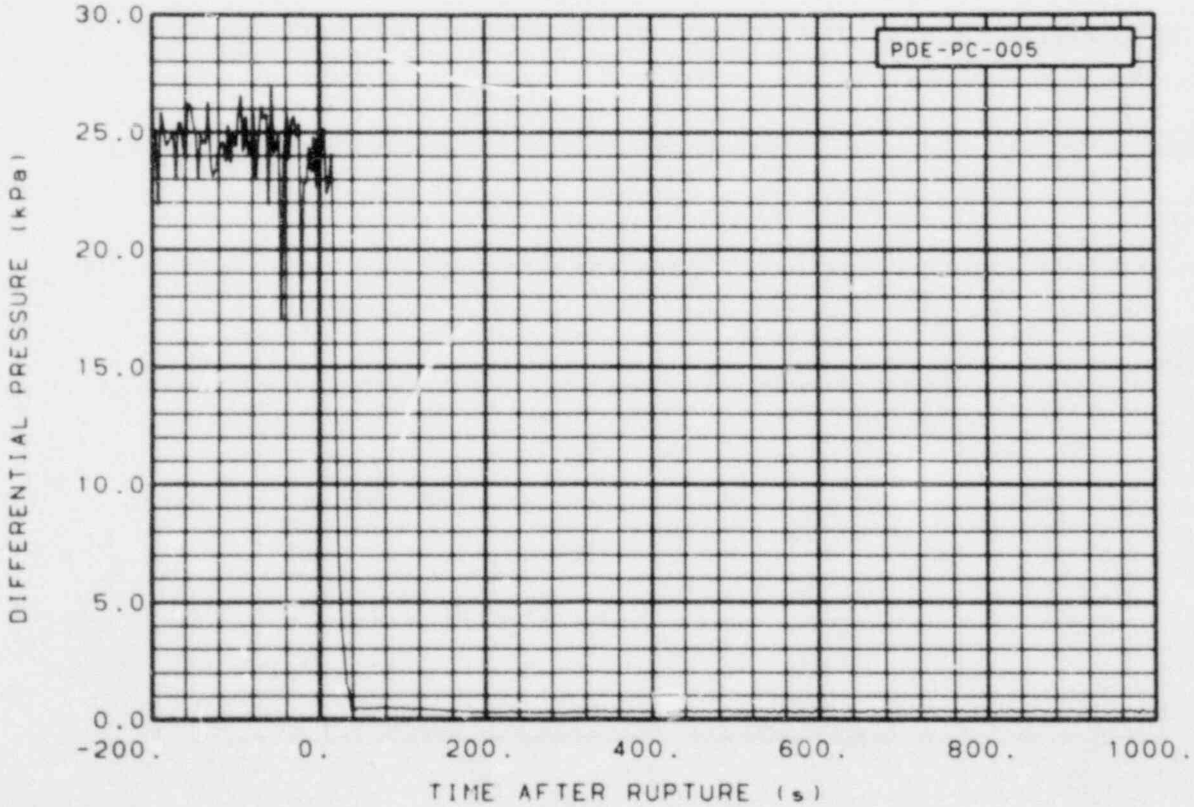


Figure 43. Differential pressure in intact loop cold leg from primary coolant pump discharge to reactor vessel inlet (PDE-PC-005) (Qualified).

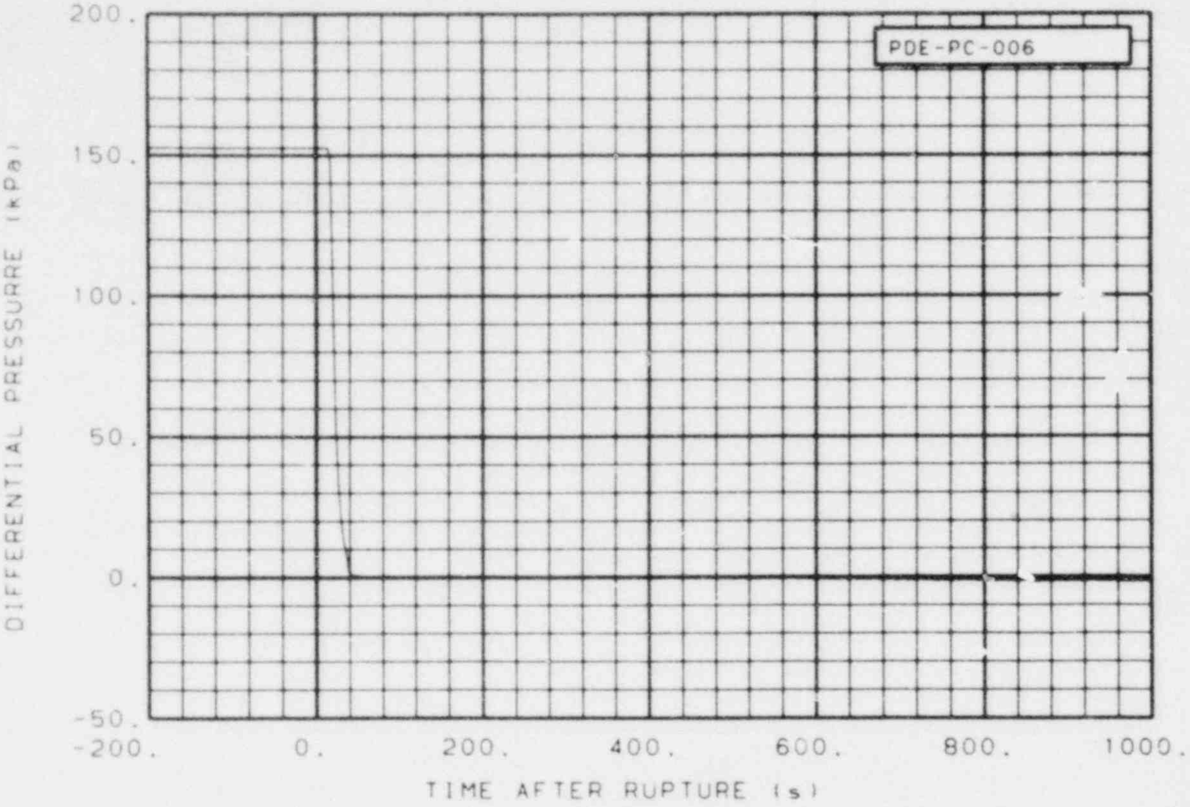


Figure 44. Differential pressure in intact loop across reactor vessel (PDE-PC-006) (Qualified, low range instrument).

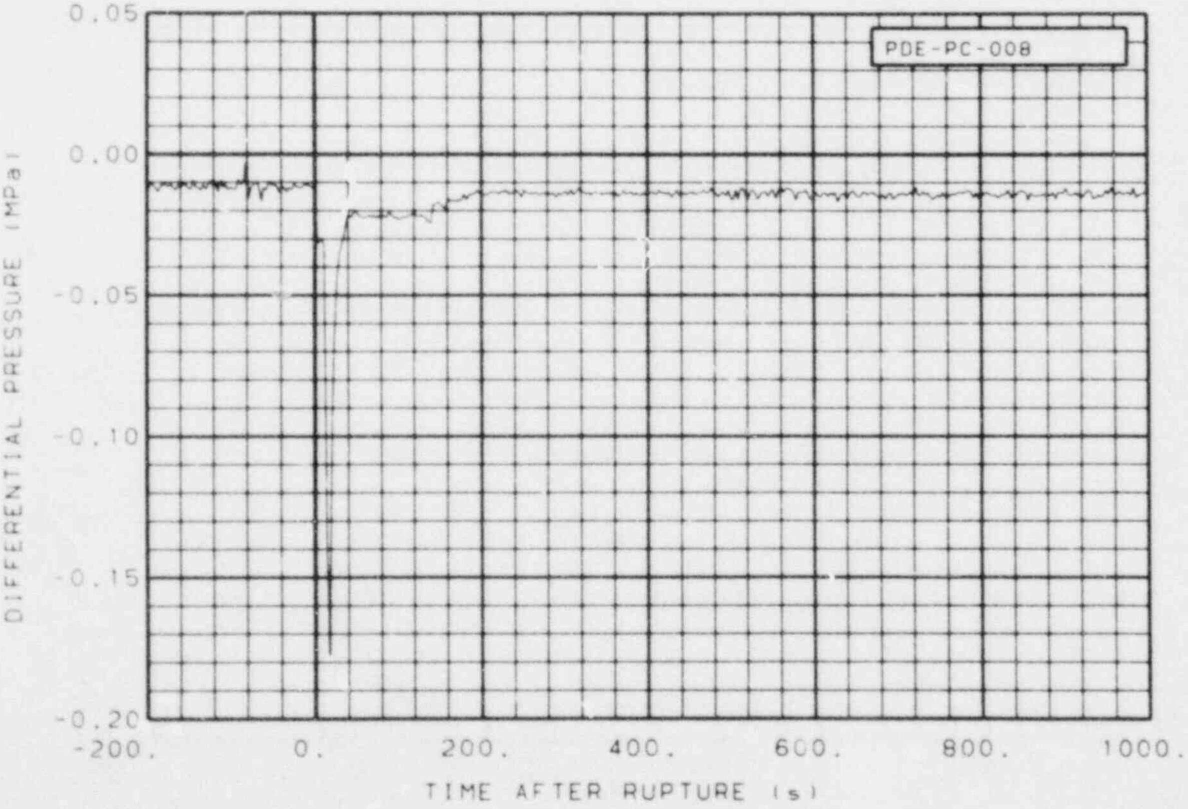


Figure 45. Differential pressure in intact loop across pressurizer surge line (PDE-PC-008) (Qualified).

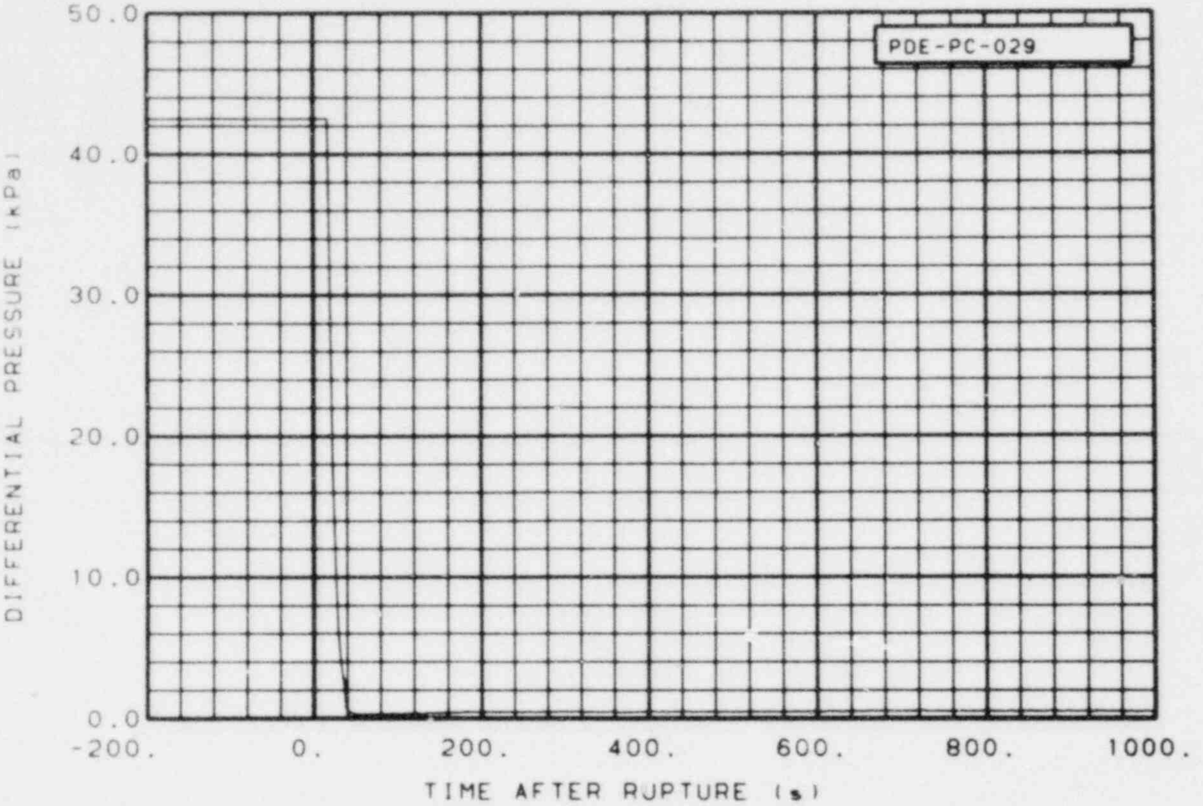


Figure 46. Differential pressure in intact loop next to bottom of ECC Rake 1, pitot tube facing reactor vessel (PDE-PC-029) (Qualified).

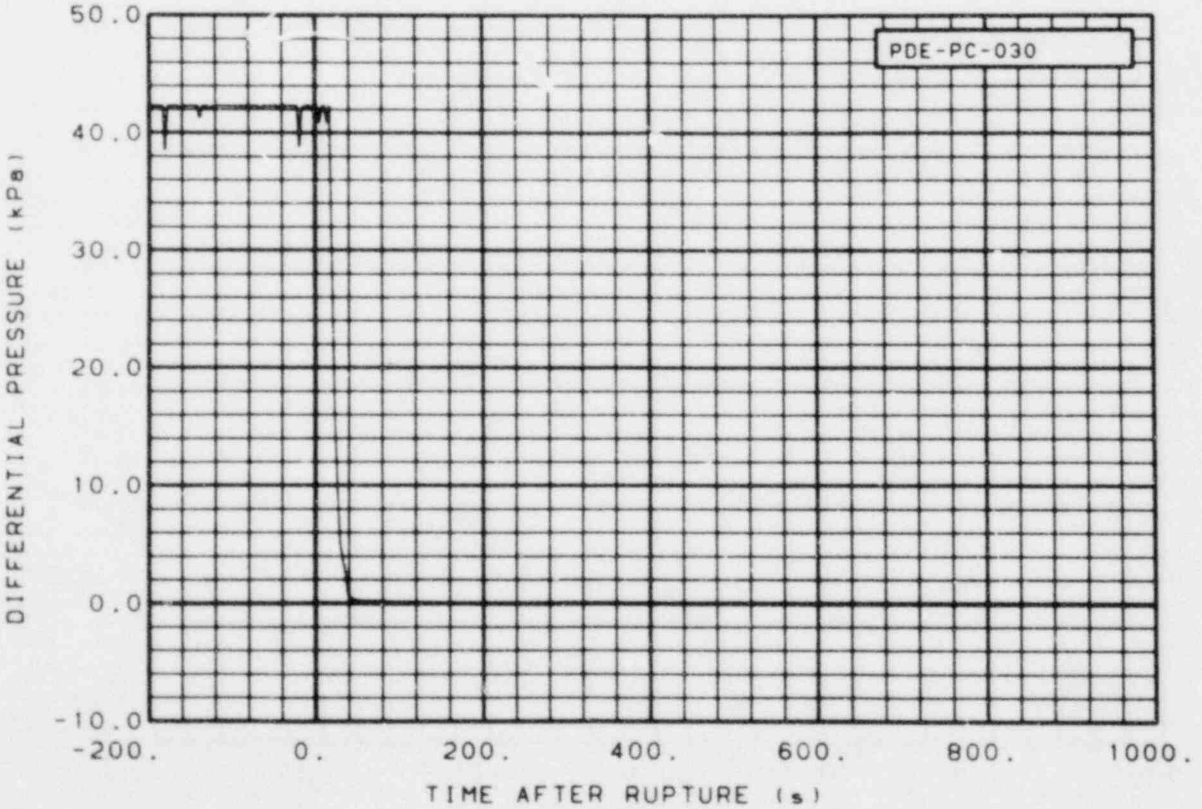


Figure 47. Differential pressure in intact loop at bottom of ECC Rake 1, pitot tube facing reactor vessel (PDE-PC-030) (Qualified).

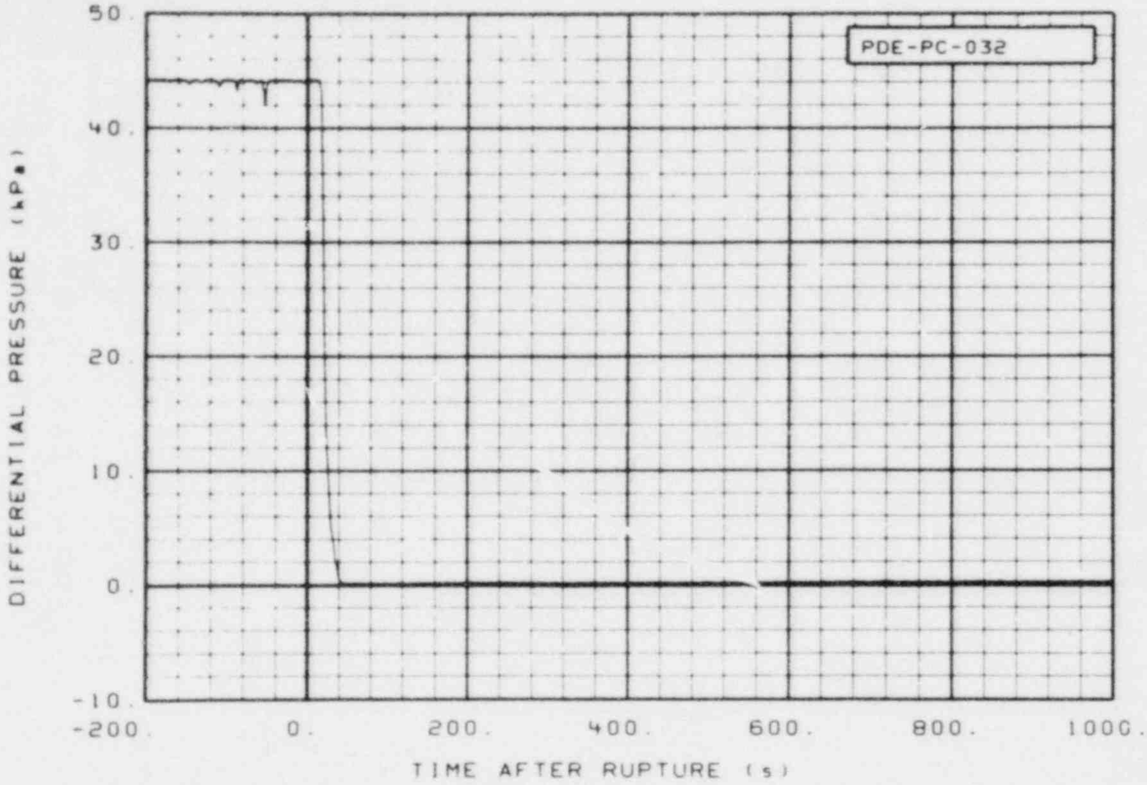


Figure 48. Differential pressure in intact loop at bottom of ECC Rake 2, pitot tube facing reactor vessel (PDE-PC-032) (Qualified).

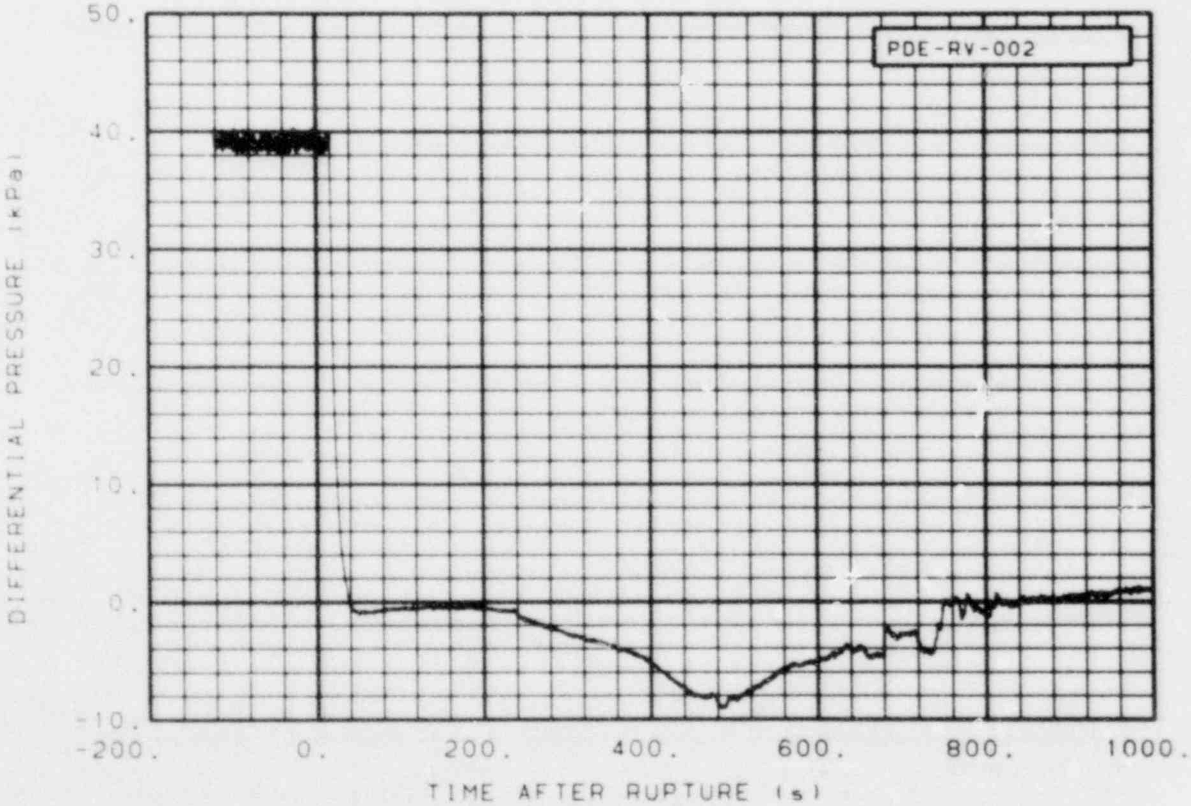


Figure 49. Differential pressure in reactor vessel core from upper end box to lower end box of Fuel Assembly 1 (PDE-RV-002) (Qualified).

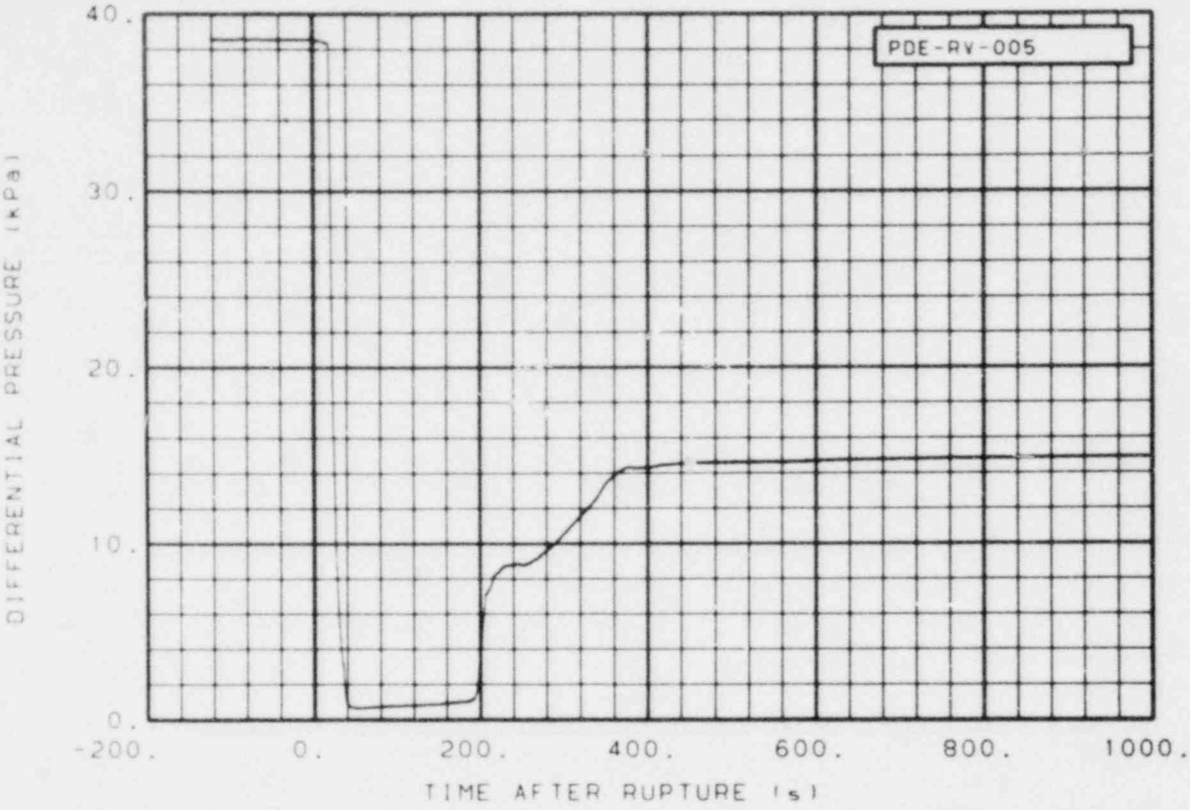


Figure 50. Differential pressure in reactor vessel from vessel top to intact loop hot leg outlet (PDE-RV-005) (Qualified).

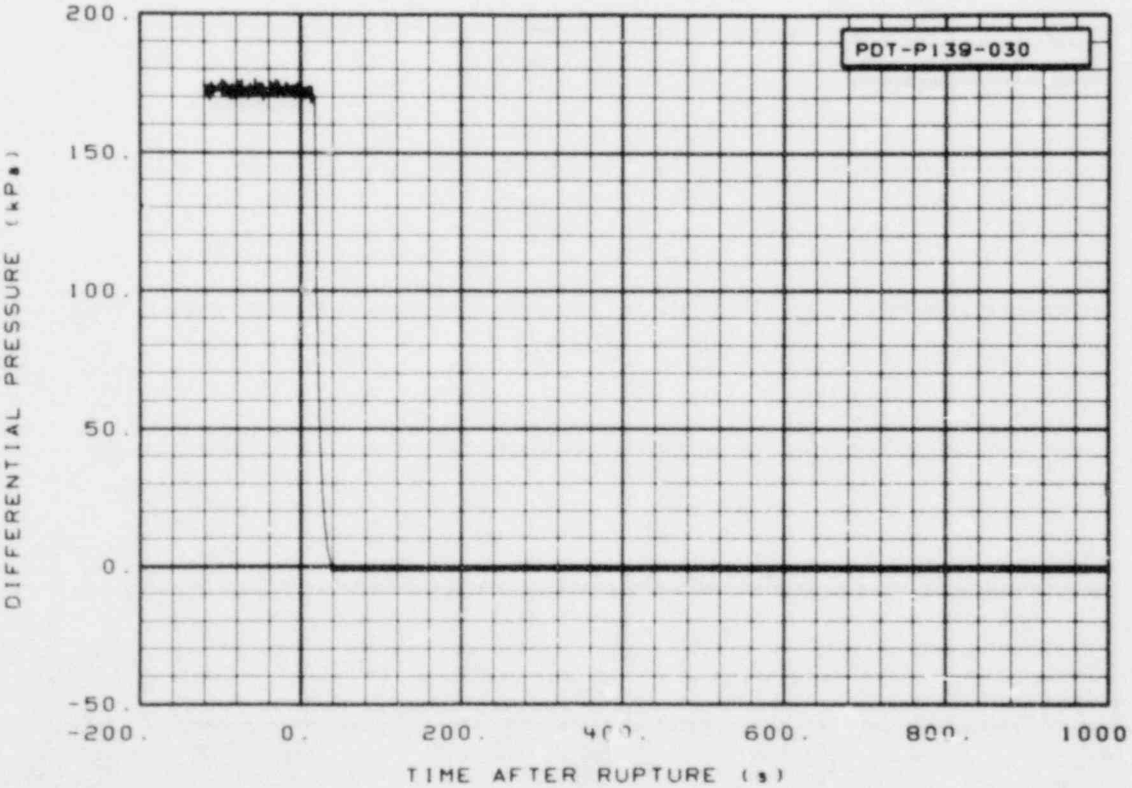


Figure 51. Differential pressure in intact loop across reactor vessel (PDT-P139-030) (Qualified, valid above zero only).

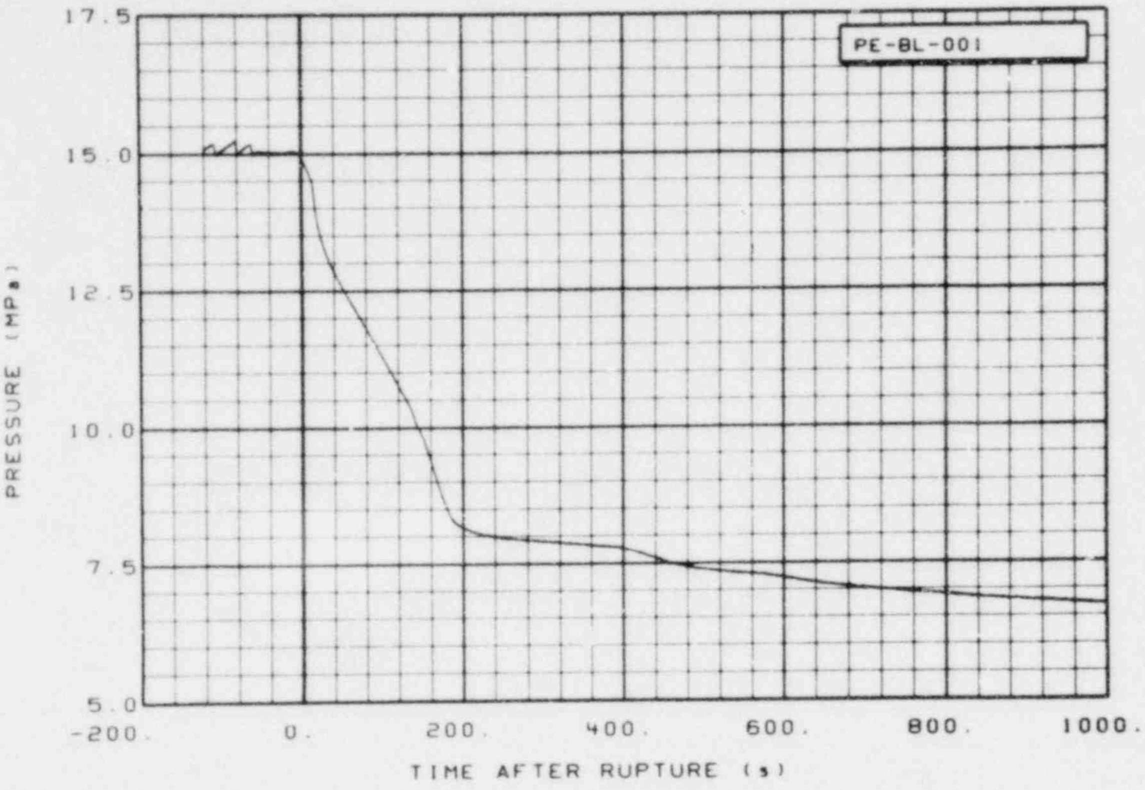


Figure 52. Pressure in broken loop cold leg (PE-BL-001) (Qualified).

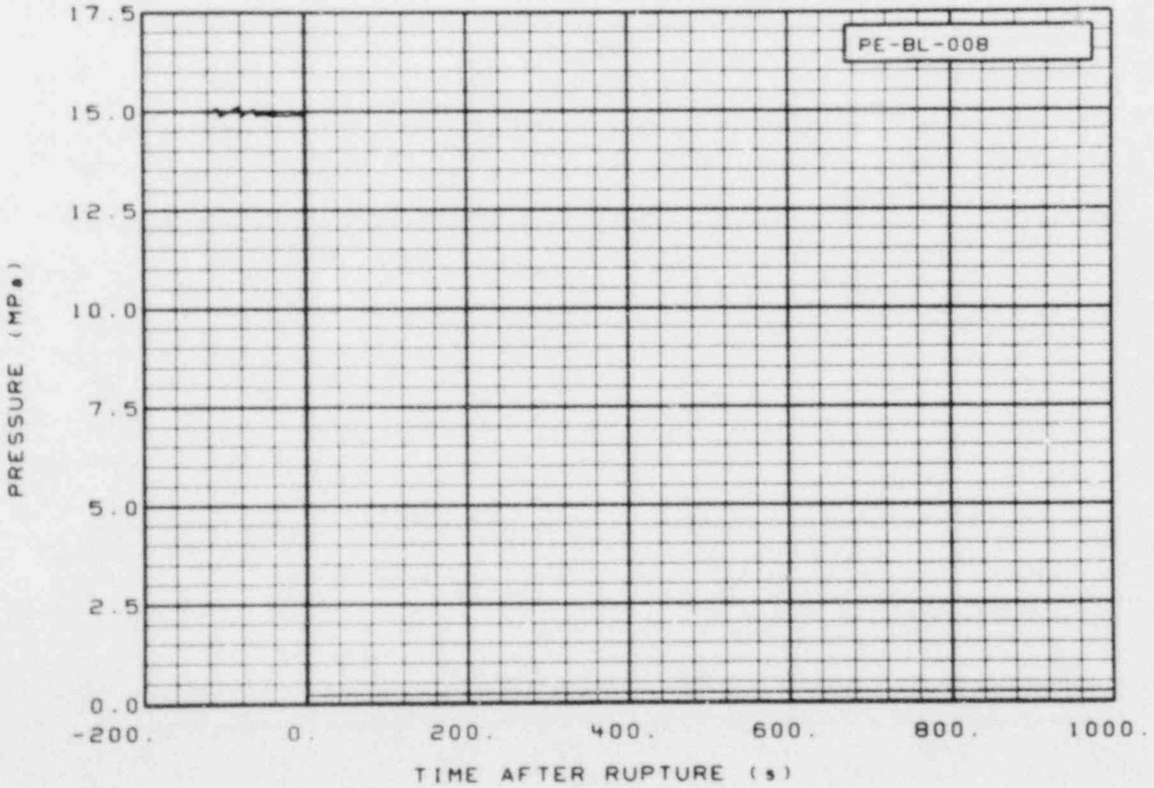


Figure 53. Pressure in broken loop cold leg 8-inch pipe (PE-BL-008) (Qualified).

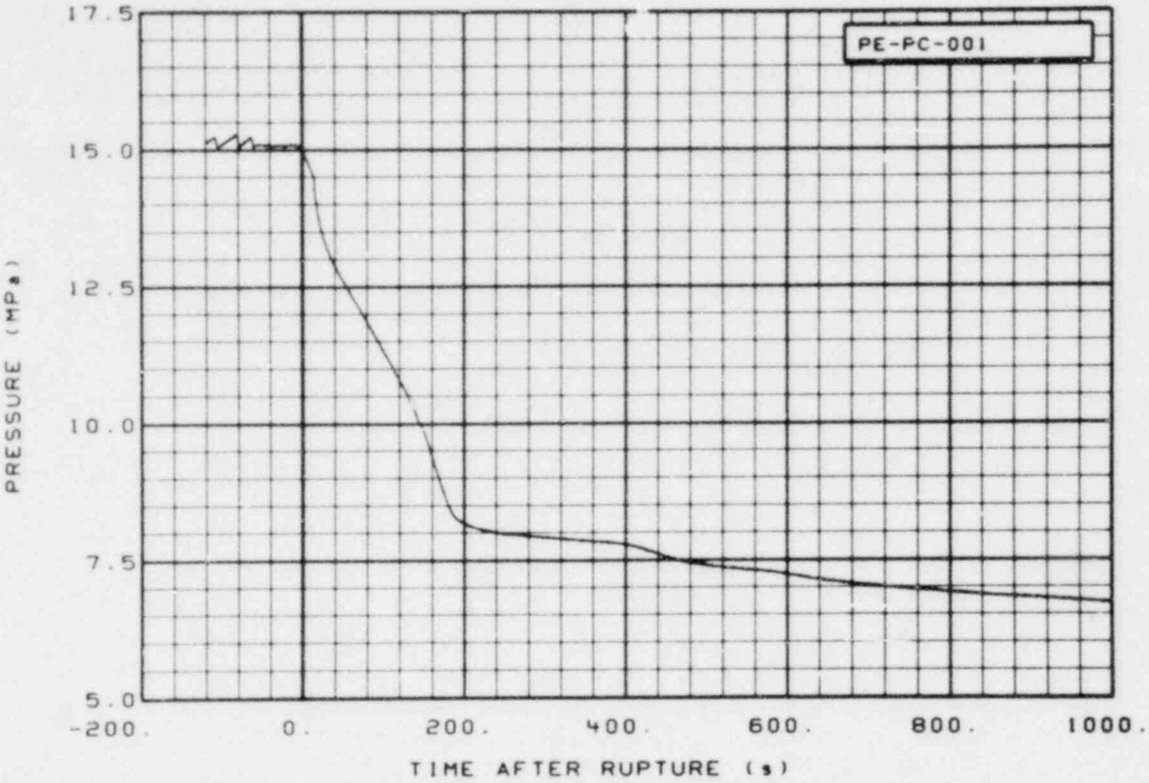


Figure 54. Pressure in intact loop cold leg (PE-PC-001) (Qualified).

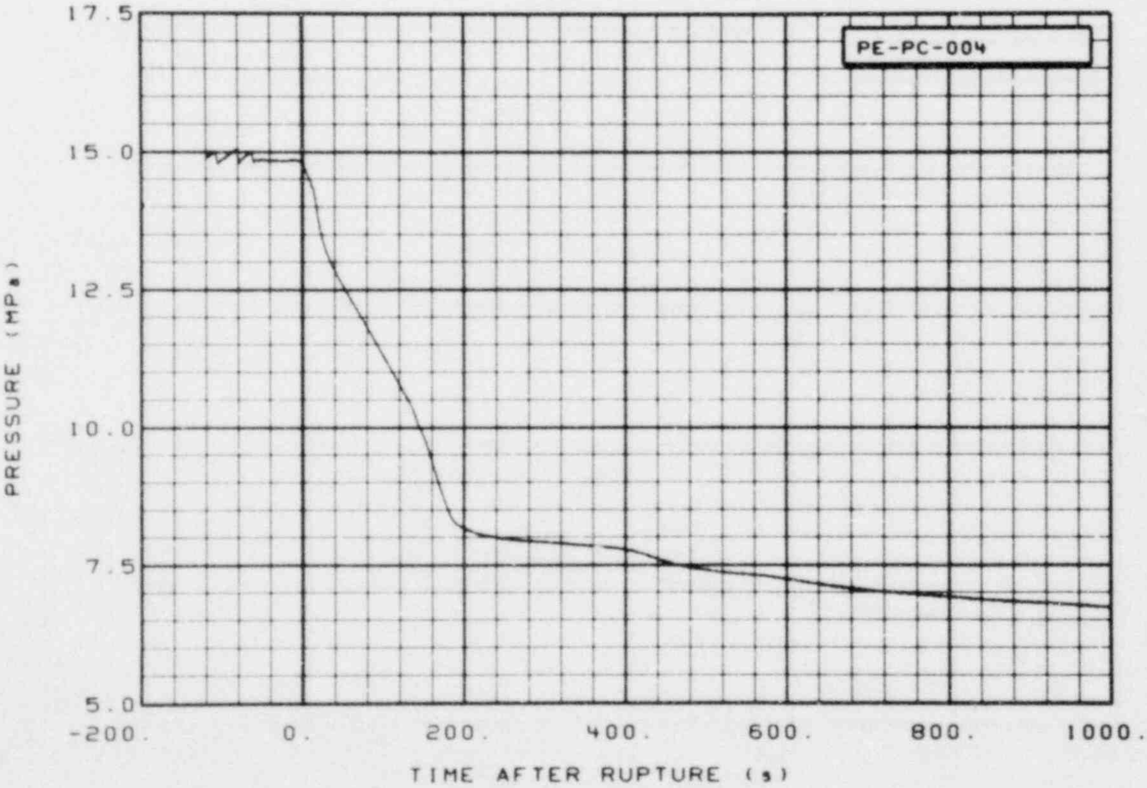


Figure 55. Pressure in pressurizer (PE-PC-004) (Qualified).

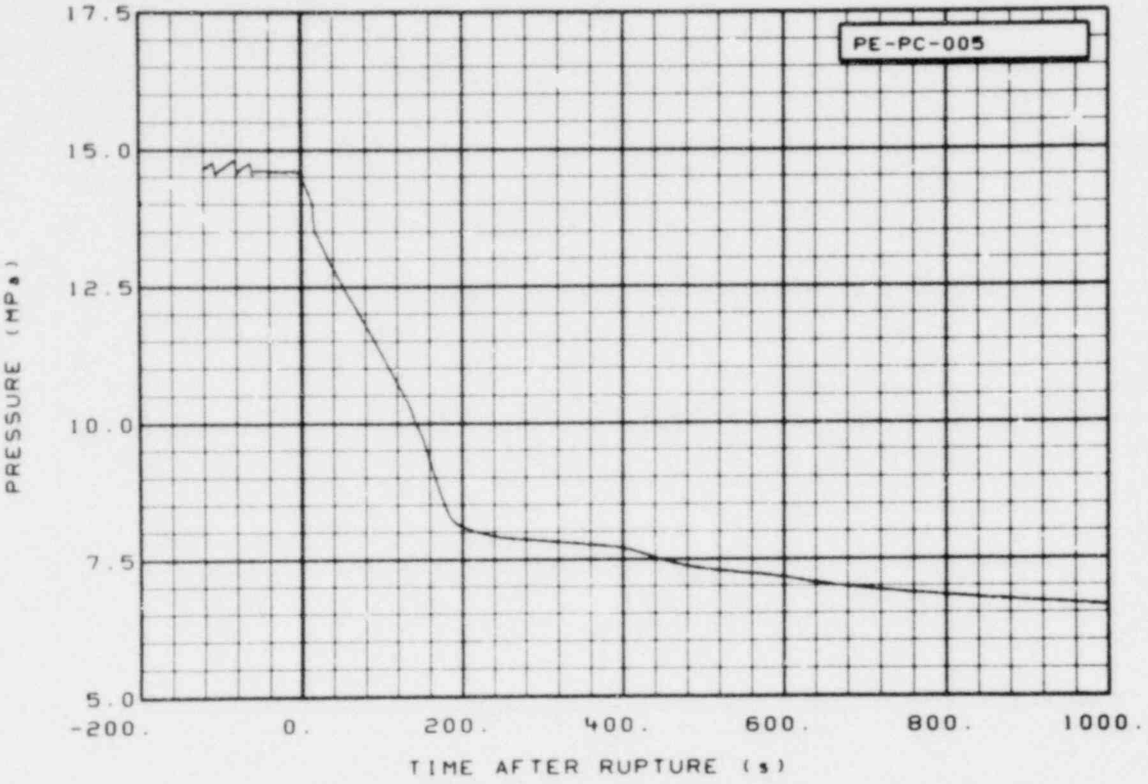


Figure 56. Reference pressure in intact loop between steam generator outlet and pump inlet (PE-PC-005) (Qualified).

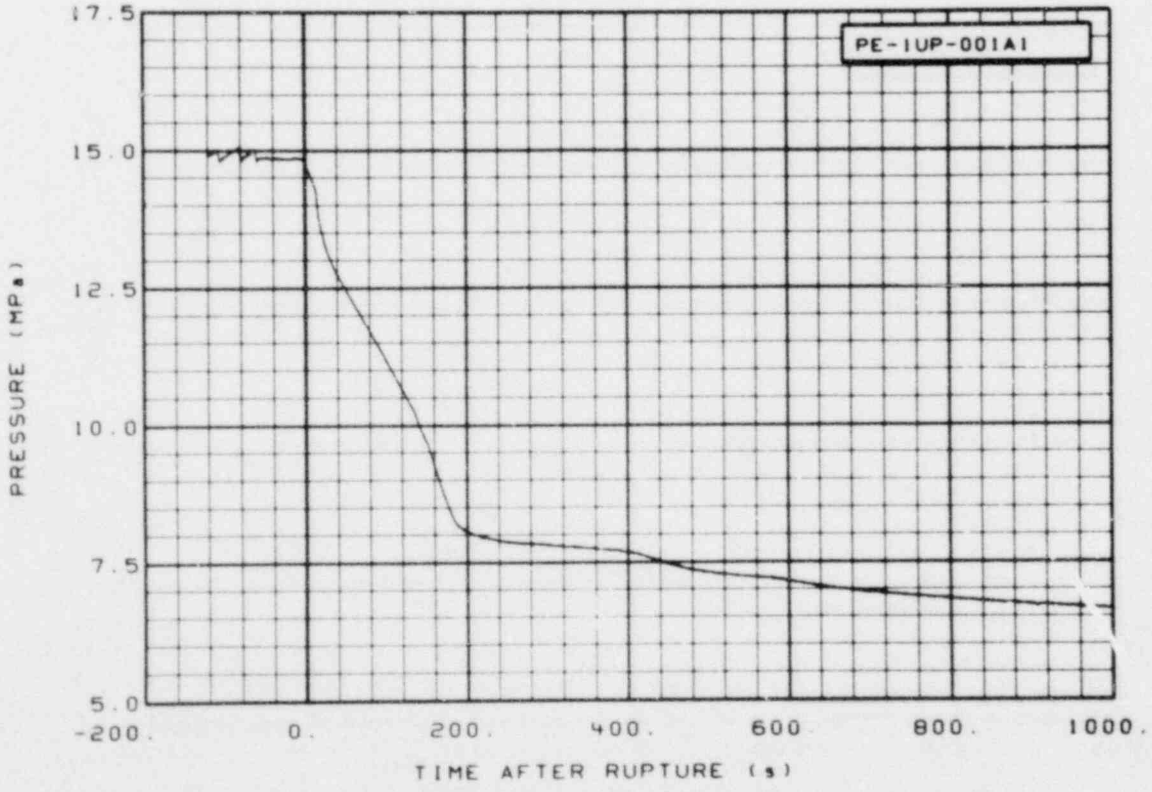


Figure 57. Pressure in reactor vessel above upper end box of Fuel Assembly 1 (PE-1UP-001A1) (Qualified).

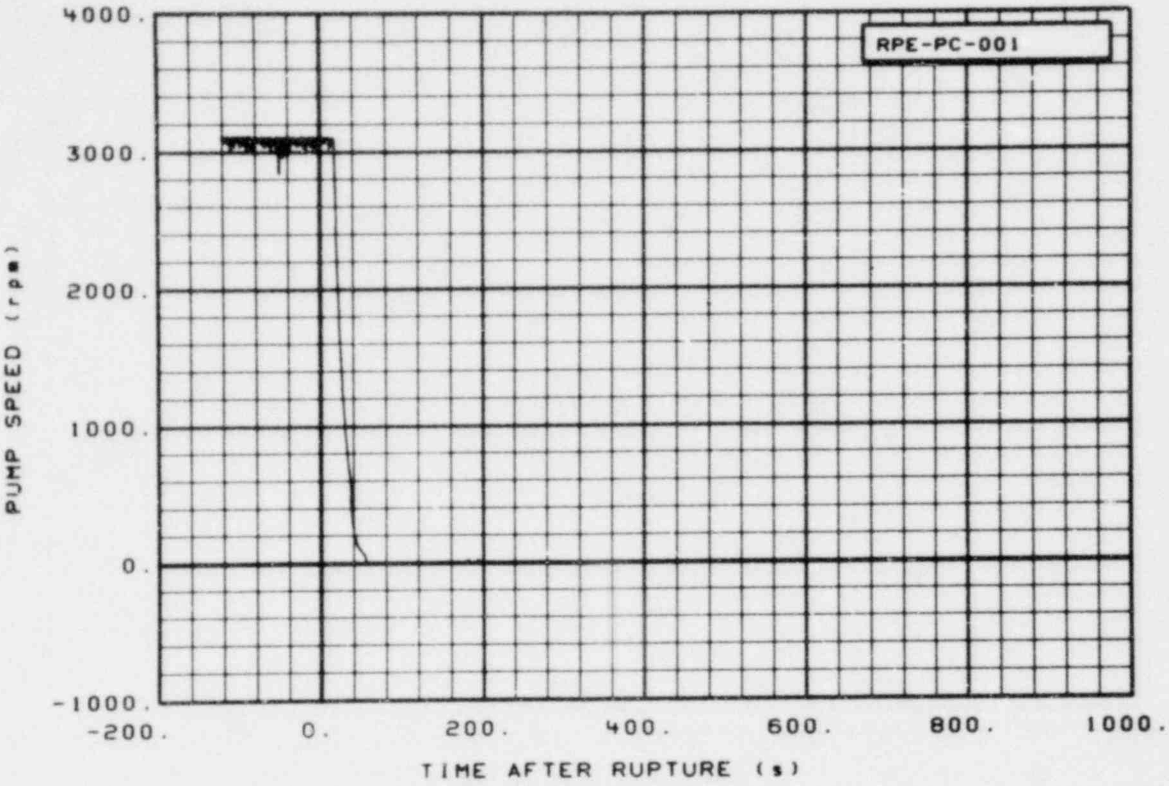


Figure 58. Pump speed for primary coolant Pump 1 (RPE-PC-001) (Qualified).

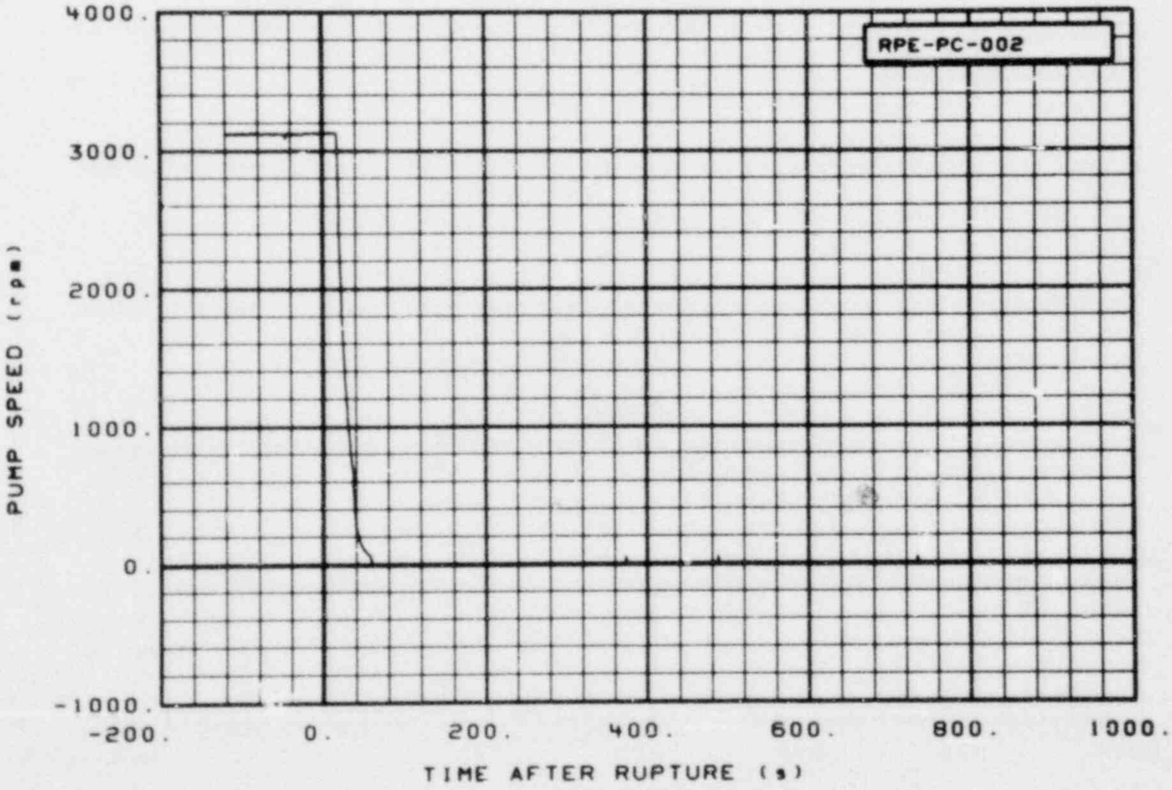


Figure 59. Pump speed for primary coolant Pump 2 (RPE-PC-002) (Qualified).

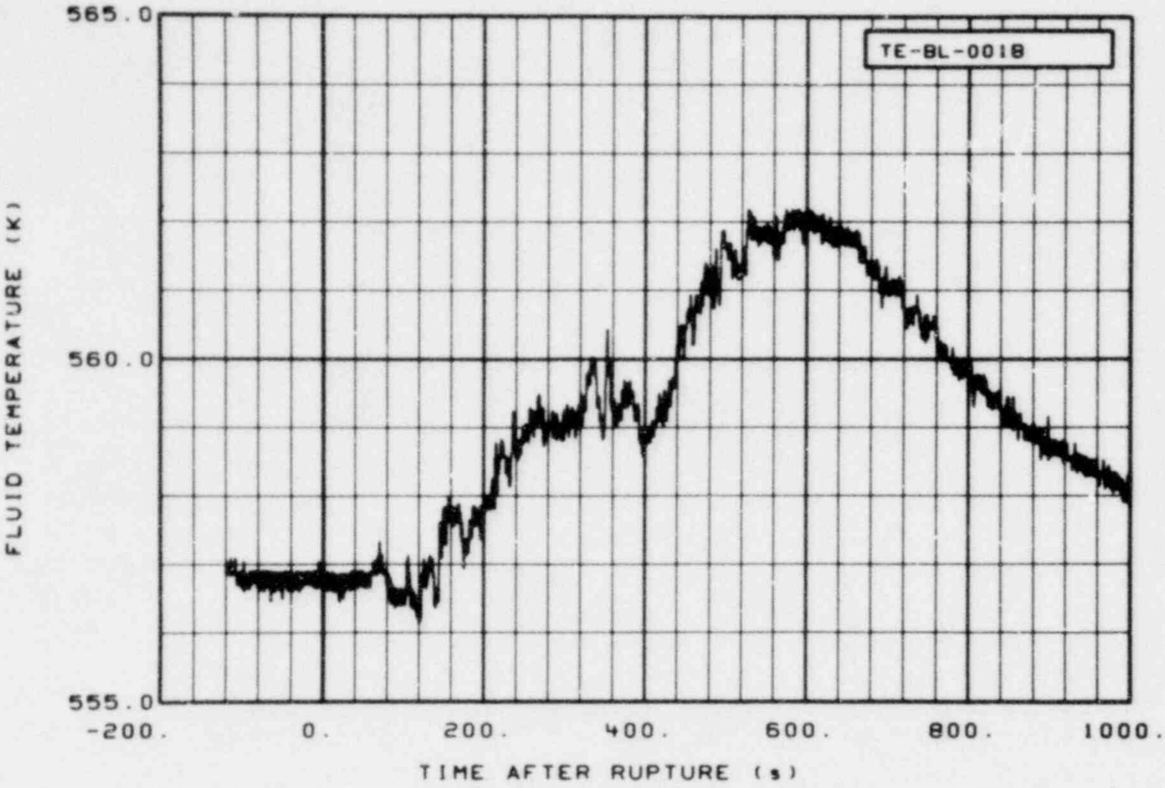


Figure 60. Coolant temperature in broken loop cold leg (TE-BL-001B) (Qualified).

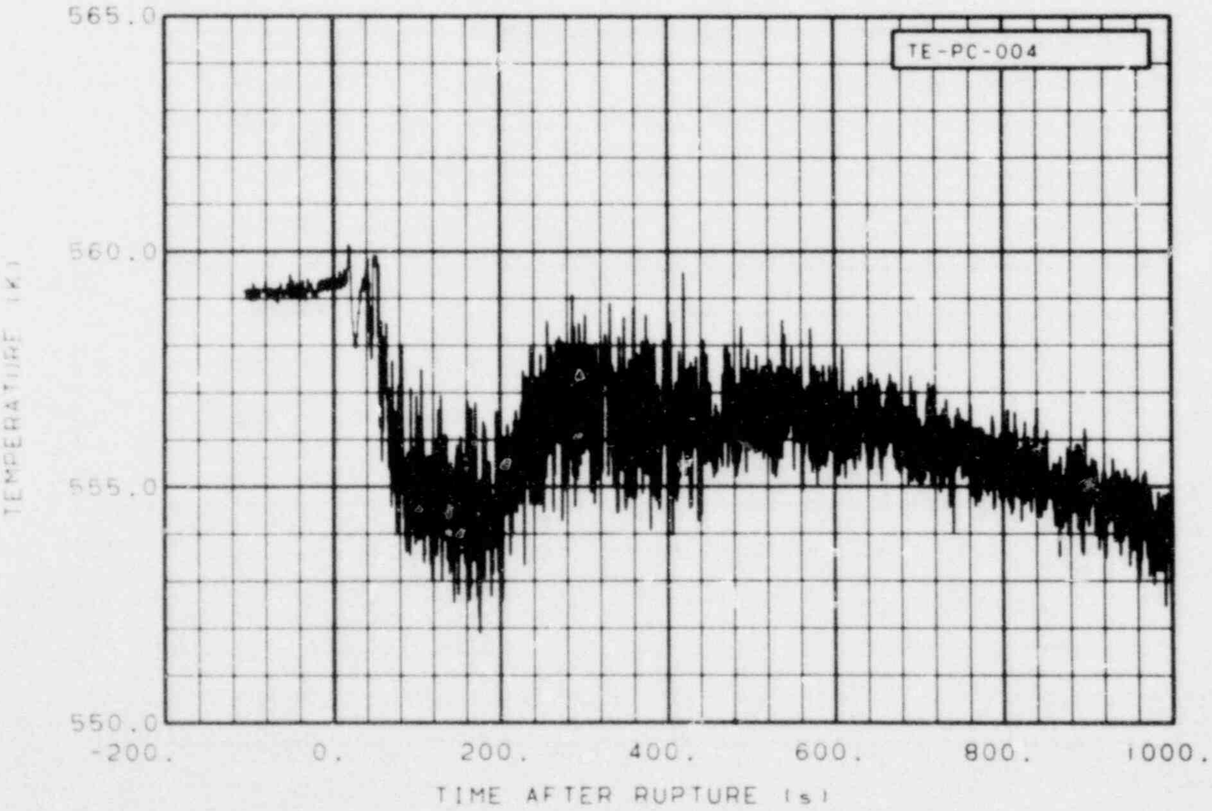


Figure 61. Coolant temperature in intact loop cold leg at bottom of ECC Rake 1 (TE-PC-004) (Qualified).

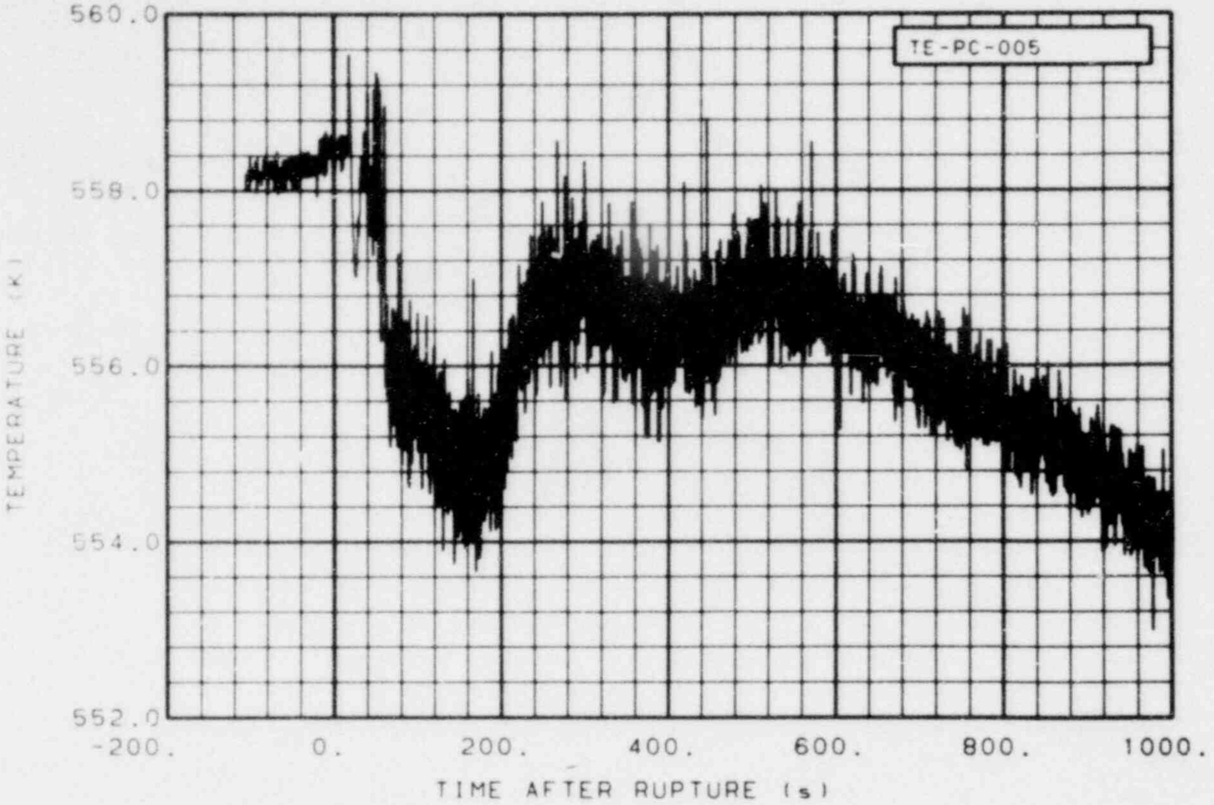


Figure 62. Coolant temperature in intact loop cold leg next to bottom of ECC Rake 1 (TE-PC-005) (Qualified).

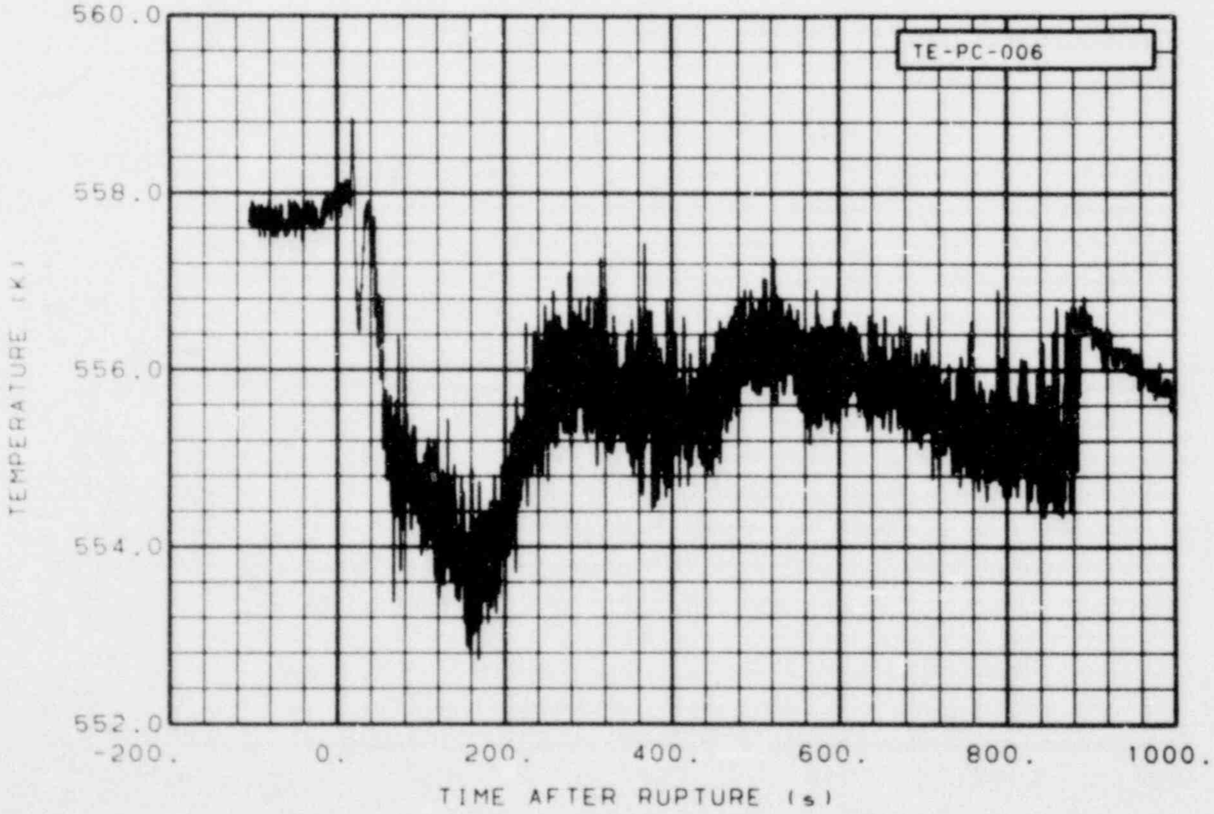


Figure 63. Coolant temperature in intact loop cold leg next to top of ECC Rake 1 (TE-PC-006) (Qualified).

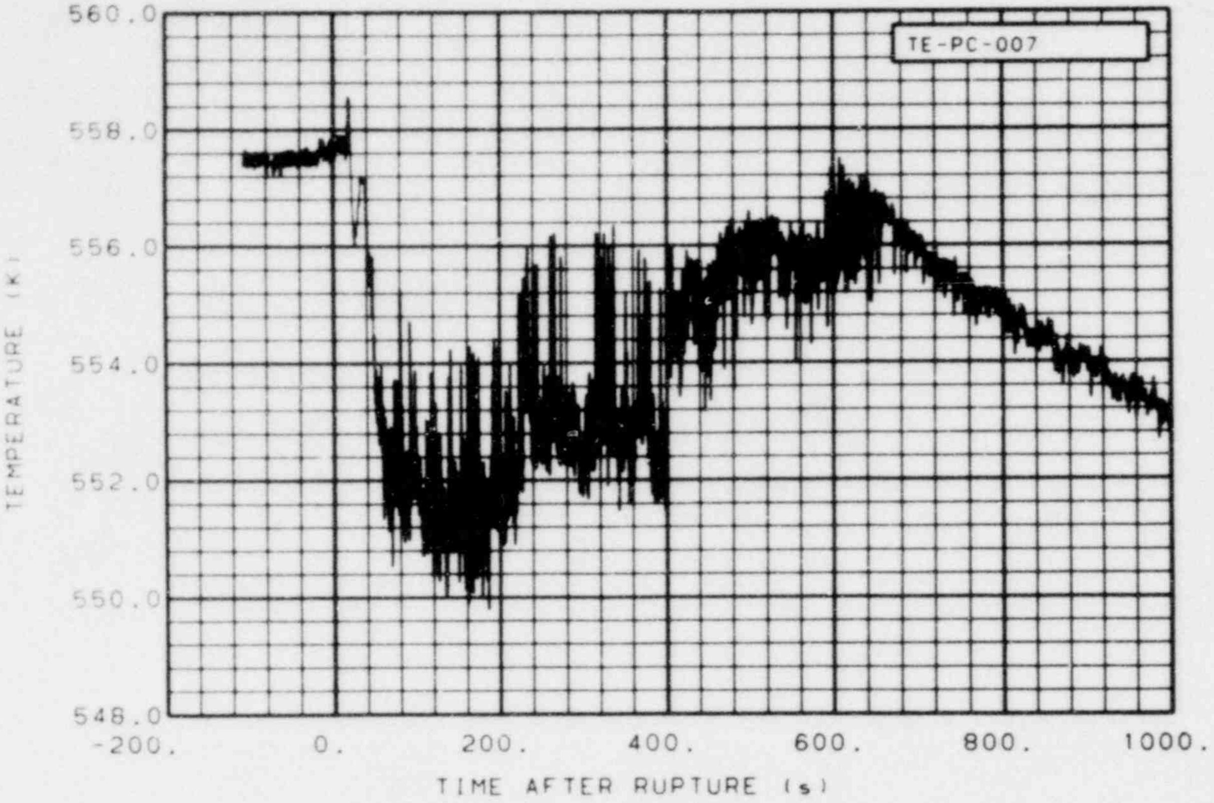


Figure 64. Coolant temperature in intact loop cold leg at top of ECC Rake 1 (TE-PC-007) (Qualified).

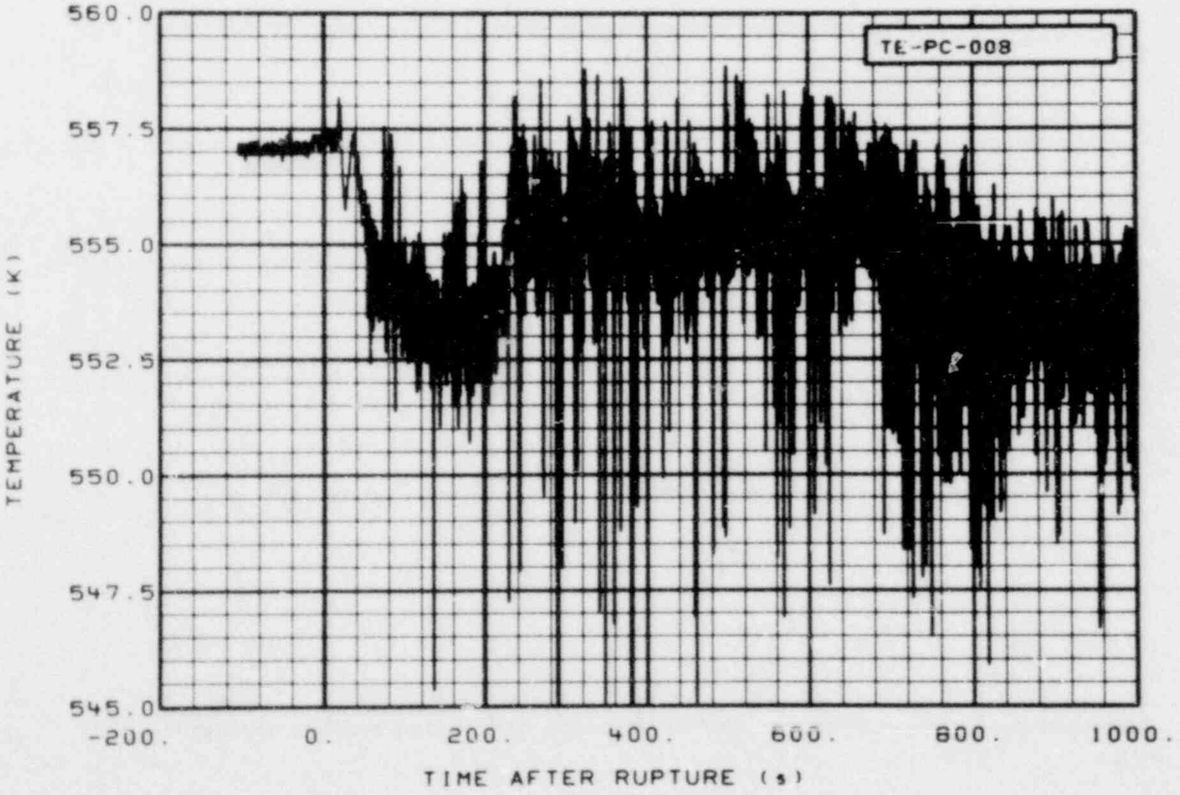


Figure 65. Coolant temperature in intact loop cold leg at bottom of ECC Rake 2 (TE-PC-008) (Qualified).

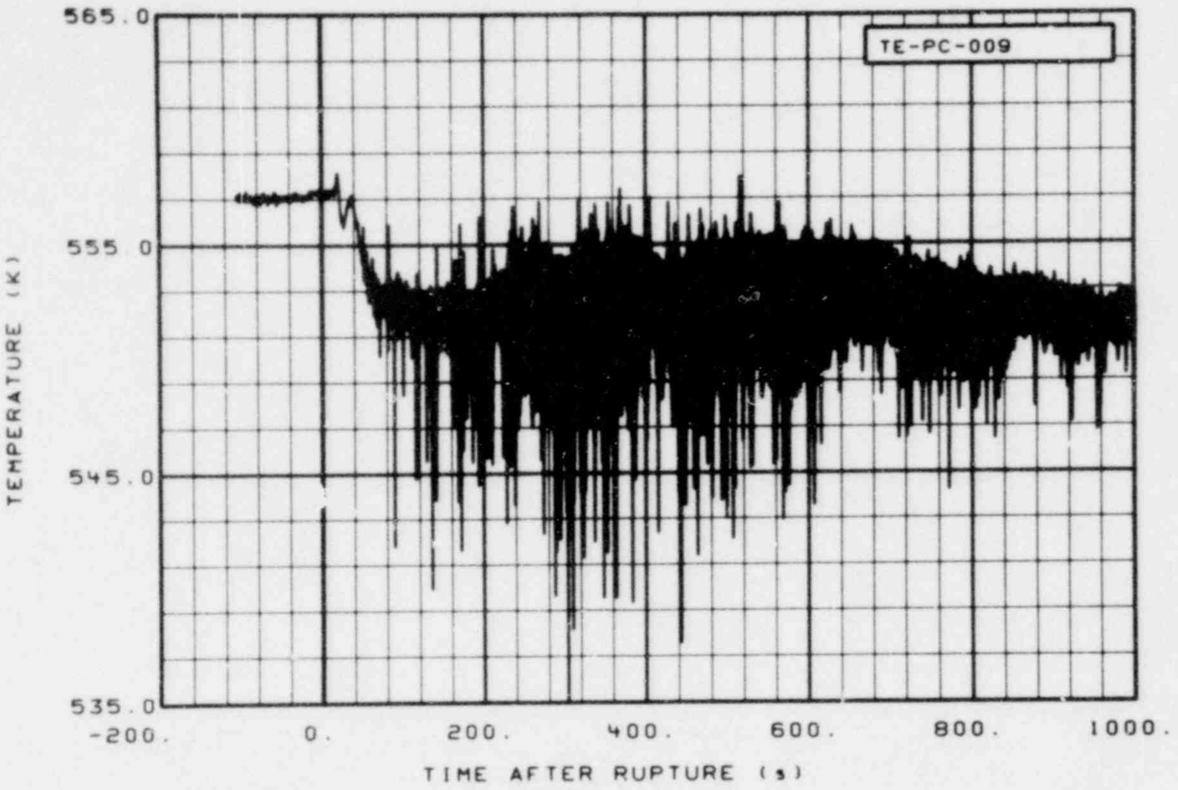


Figure 66. Coolant temperature in intact loop cold leg next to bottom of ECC Rake 2 (TE-PC-009) (Qualified).

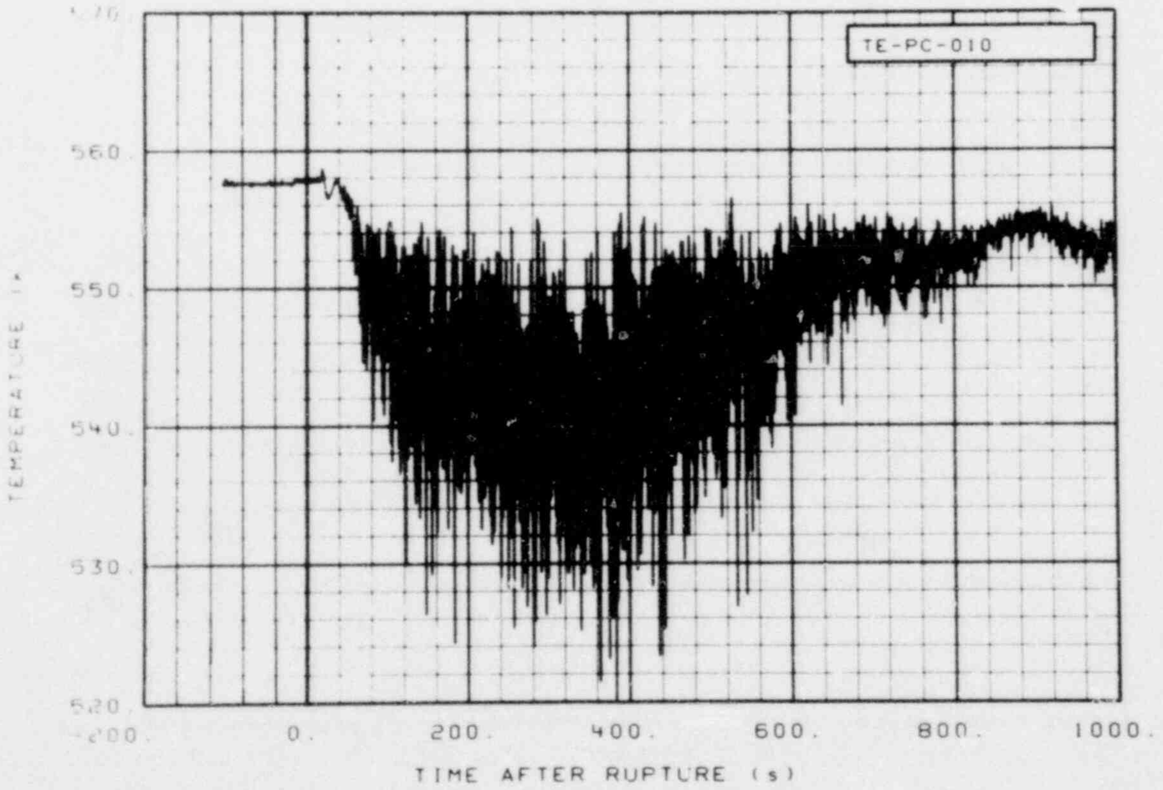


Figure 67. Coolant temperature in intact loop cold leg next to top of ECC Rake 2 (TE-PC-010) (Qualified).

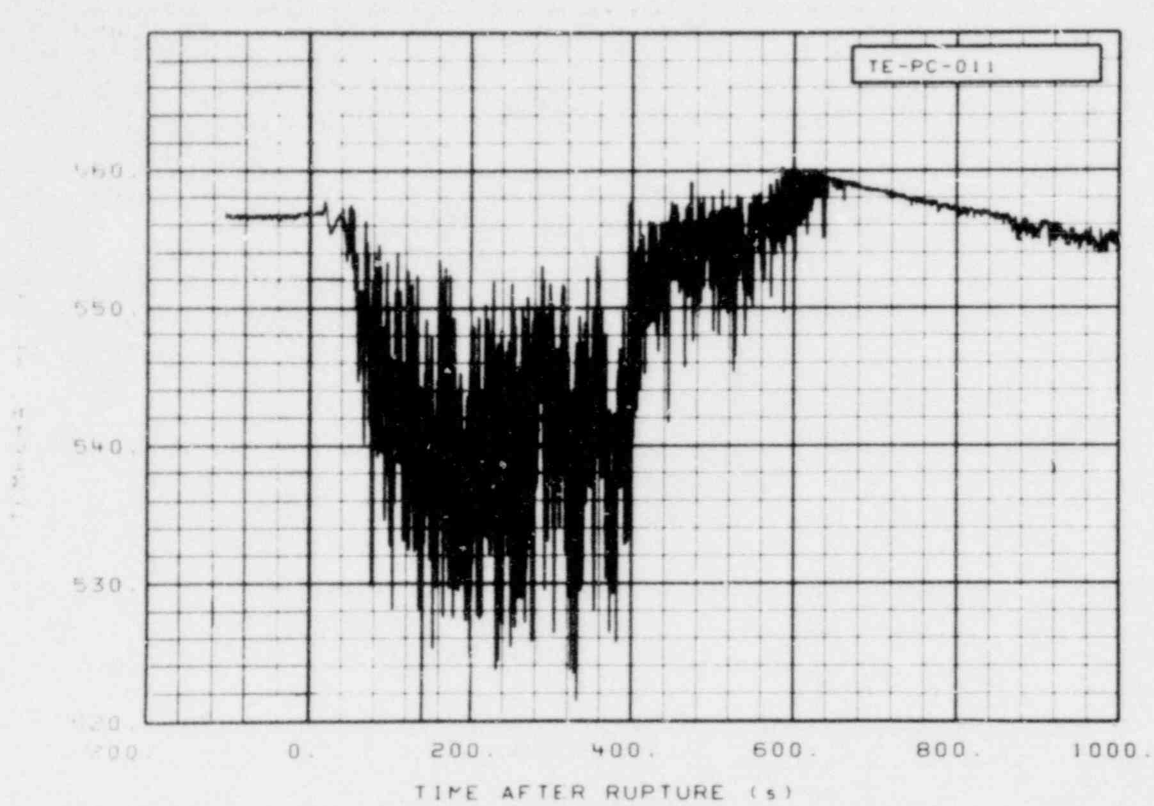


Figure 68. Coolant temperature in intact loop cold leg at top of ECC Rake 2 (TE-PC-011) (Qualified).

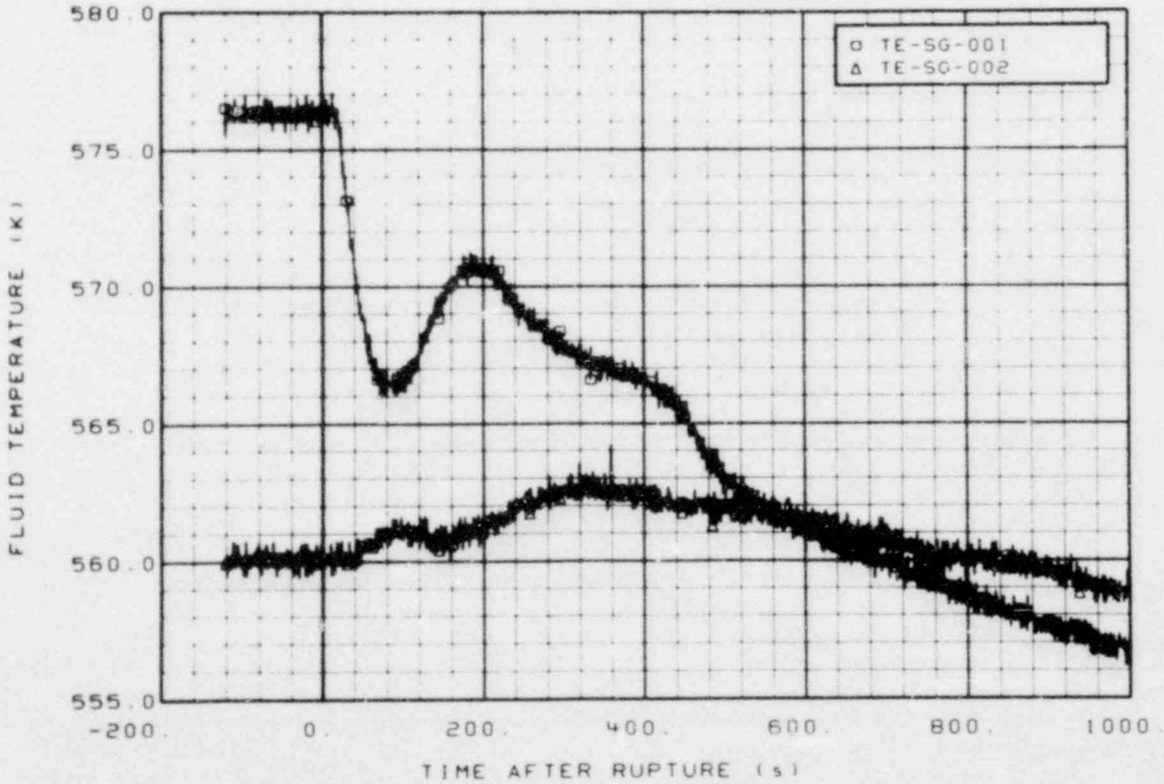


Figure 69. Fluid temperature in intact loop steam generator inlet and outlet plenums (TE-SG-001 and -002) (Qualified, may experience hot wall effects).

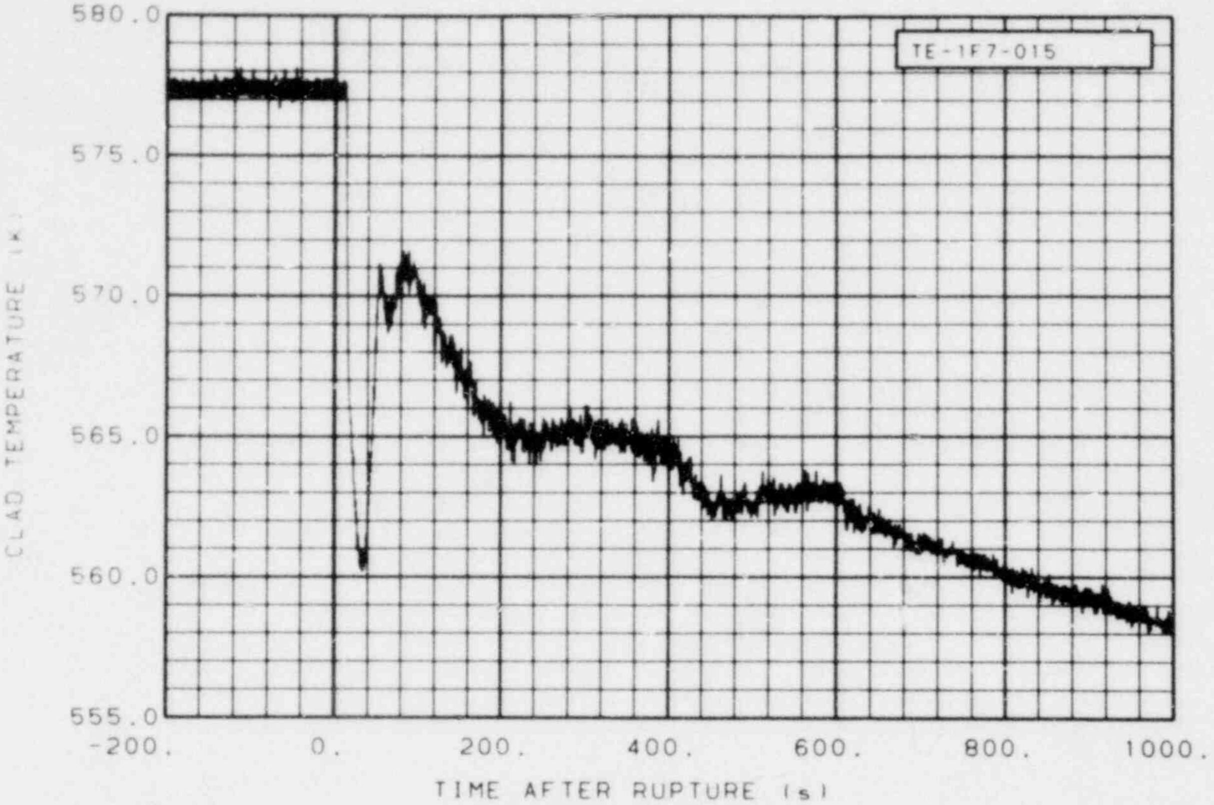


Figure 70. Cladding temperature in reactor vessel at Fuel Assembly 1, Row F, Column 7 at 0.38 m above bottom of fuel rod (TE-1F7-015) (Qualified).

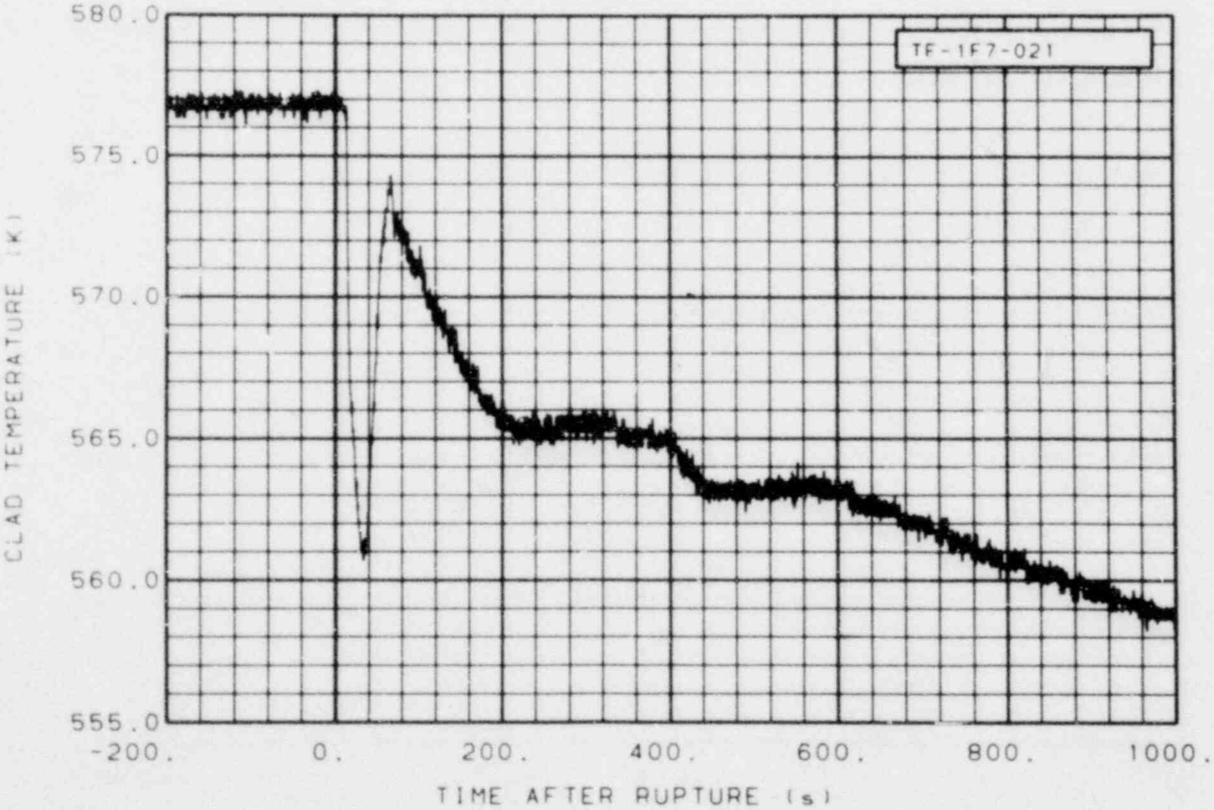


Figure 71. Cladding temperature in reactor vessel at Fuel Assembly 1, Row F, Column 7 at 0.53 m above bottom of fuel rod (TE-1F7-021) (Qualified).

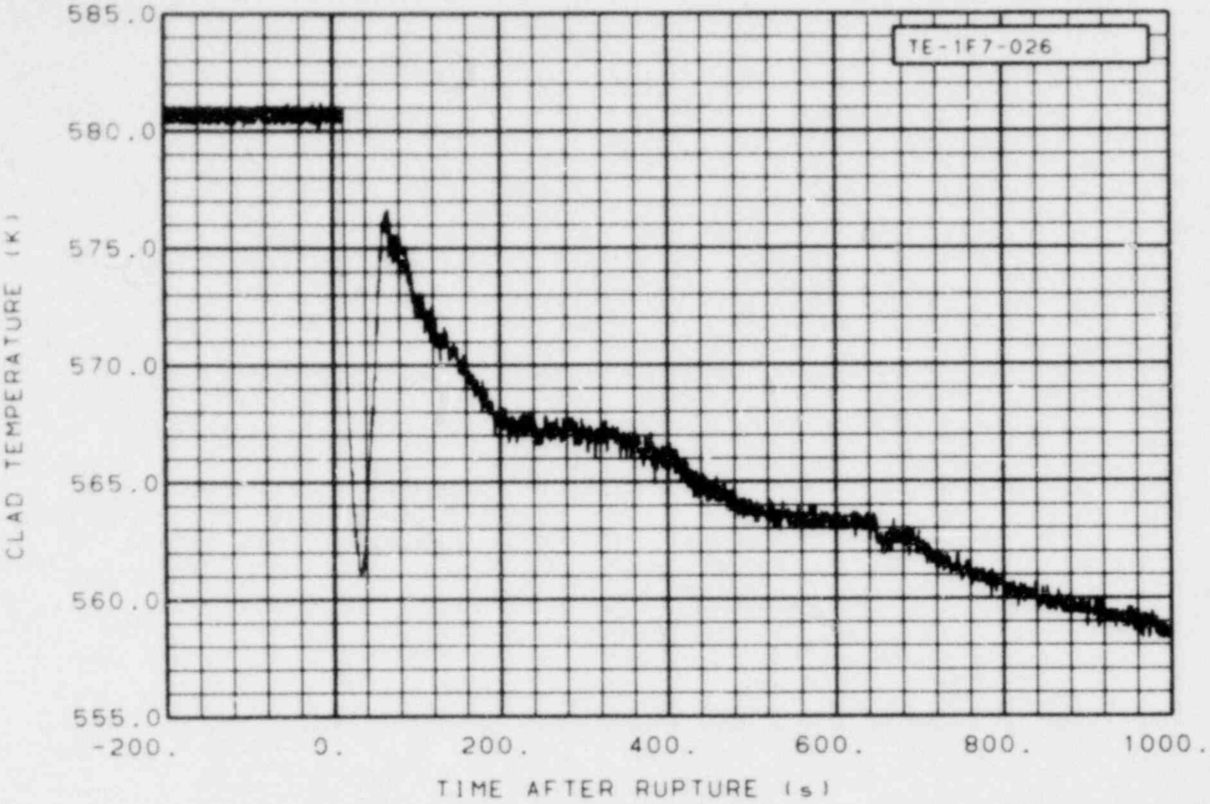


Figure 72. Cladding temperature in reactor vessel at Fuel Assembly 1, Row F, Column 7 at 0.66 m above bottom of fuel rod (TE-1F7-026) (Qualified).

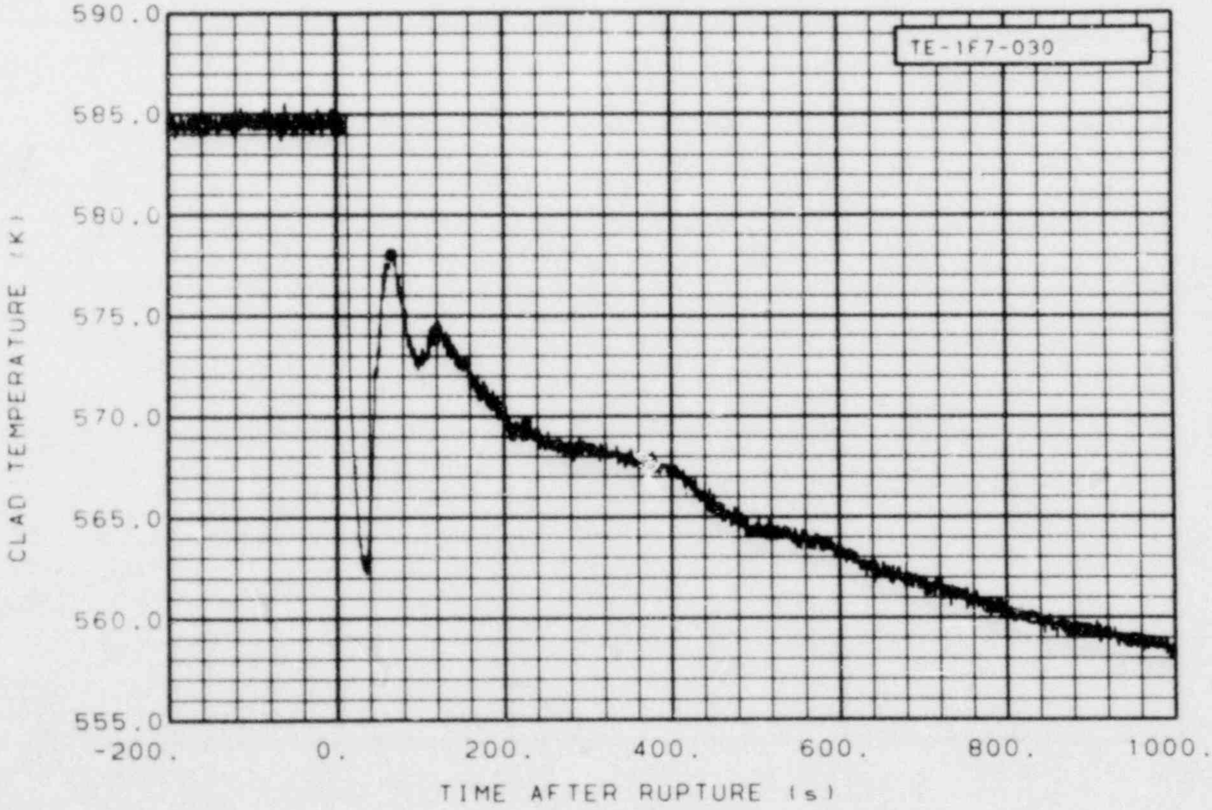


Figure 73. Cladding temperature in reactor vessel at Fuel Assembly 1, Row F, Column 7 at 0.76 m above bottom of fuel rod (TE-1F7-030) (Qualified).

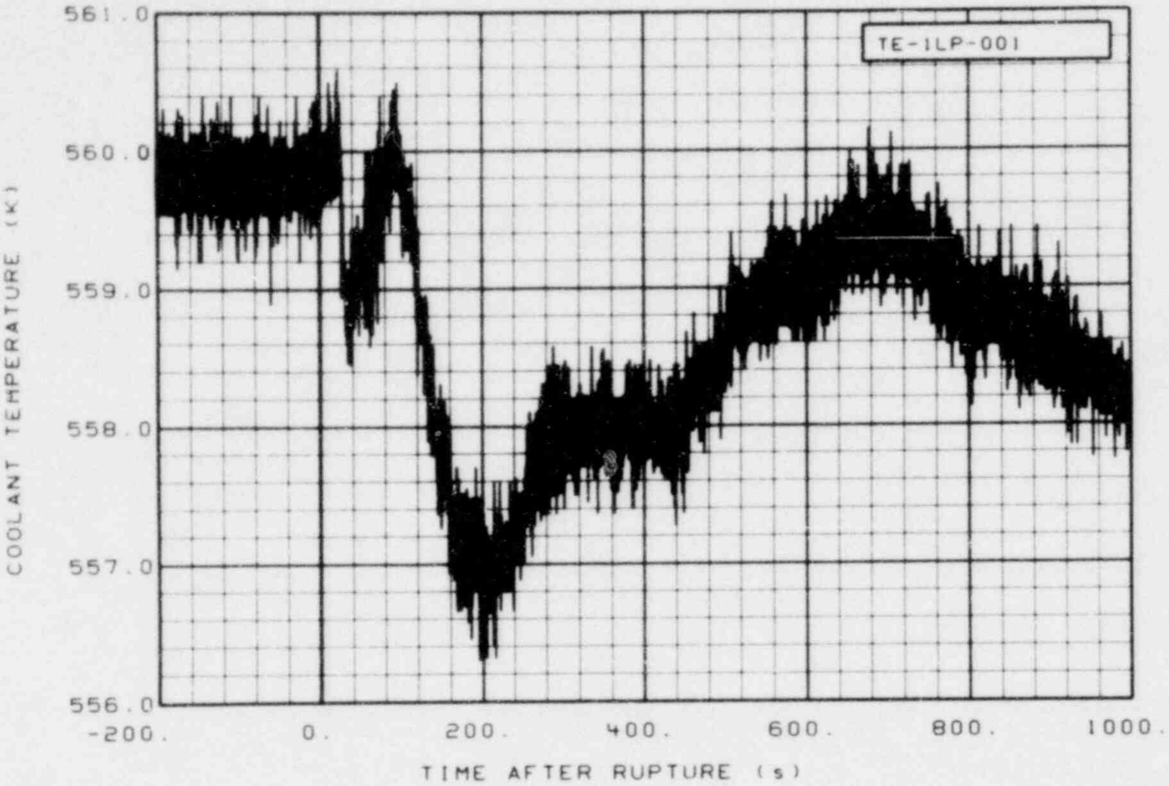


Figure 74. Coolant temperature in reactor vessel at lower end box of Fuel Assembly 1 (TE-1LP-001) (Qualified).

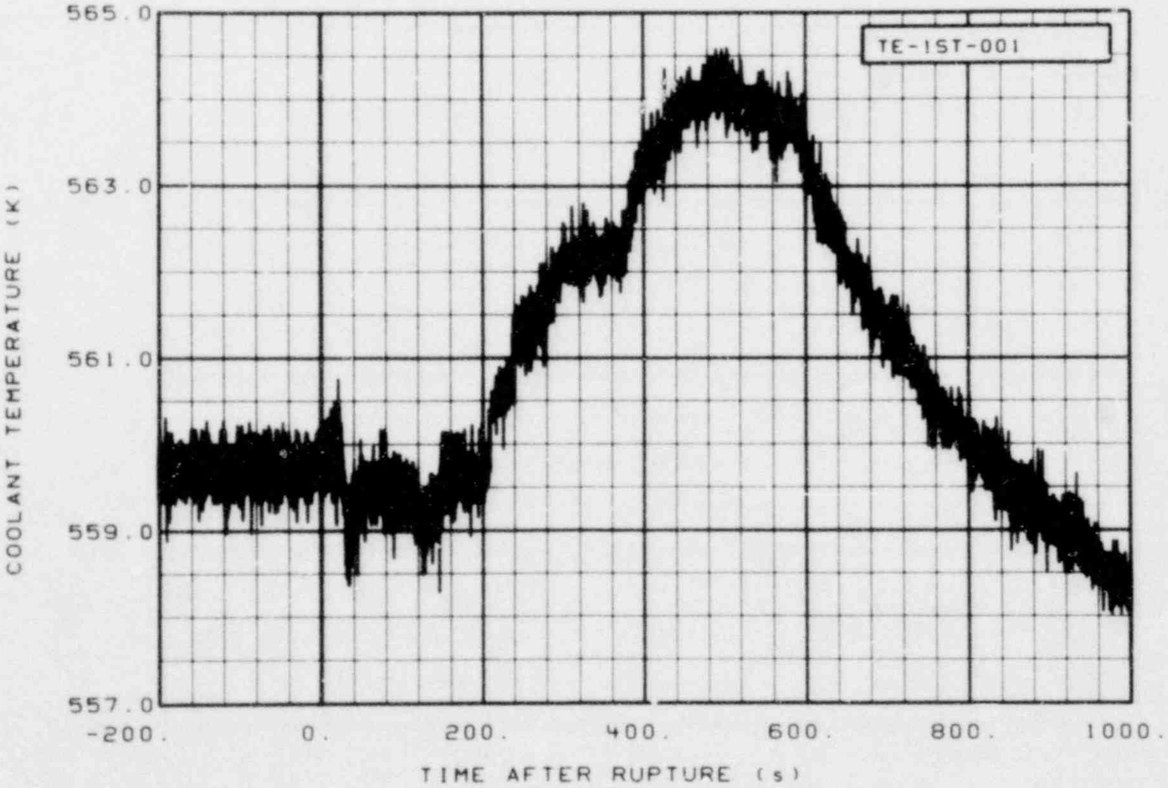


Figure 75. Coolant temperature in reactor vessel at Downcomer Stalk 1, 4.8 m from RV bottom (TE-1ST-001) (Qualified).

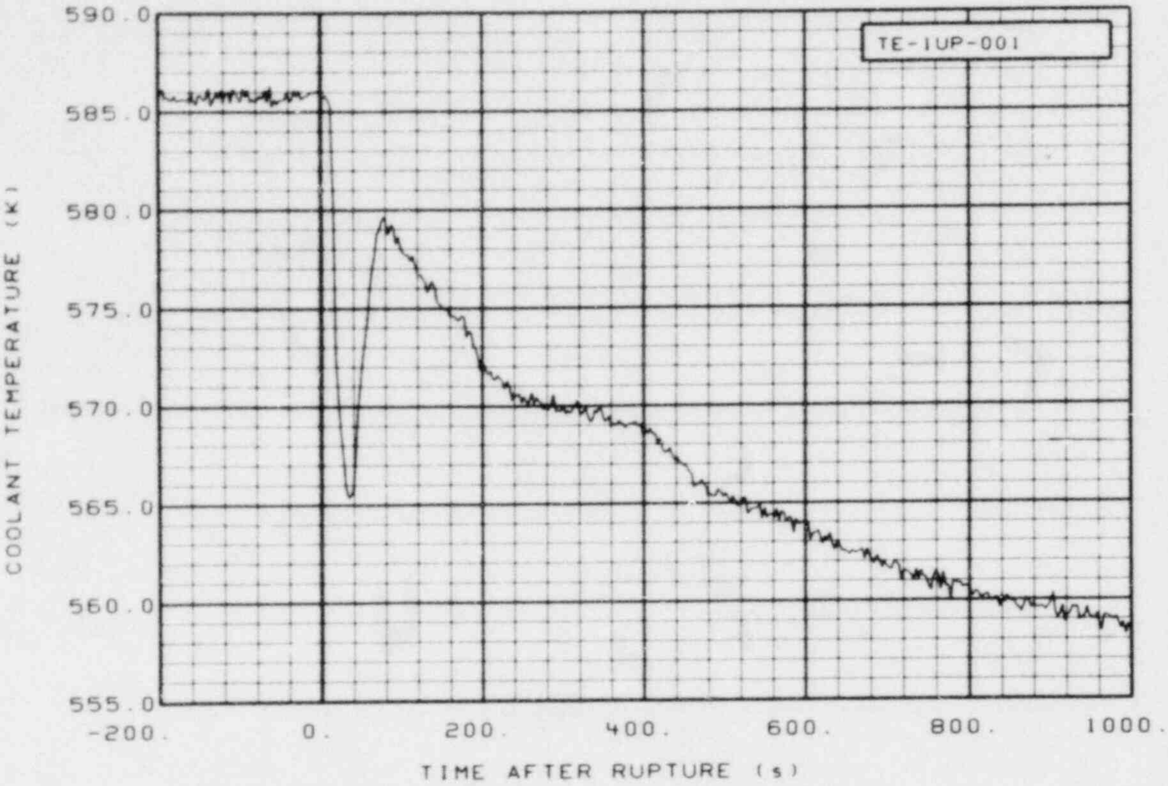


Figure 76. Coolant temperature in reactor vessel at upper end box of Fuel Assembly 1 (TE-1UP-001) (Qualified).

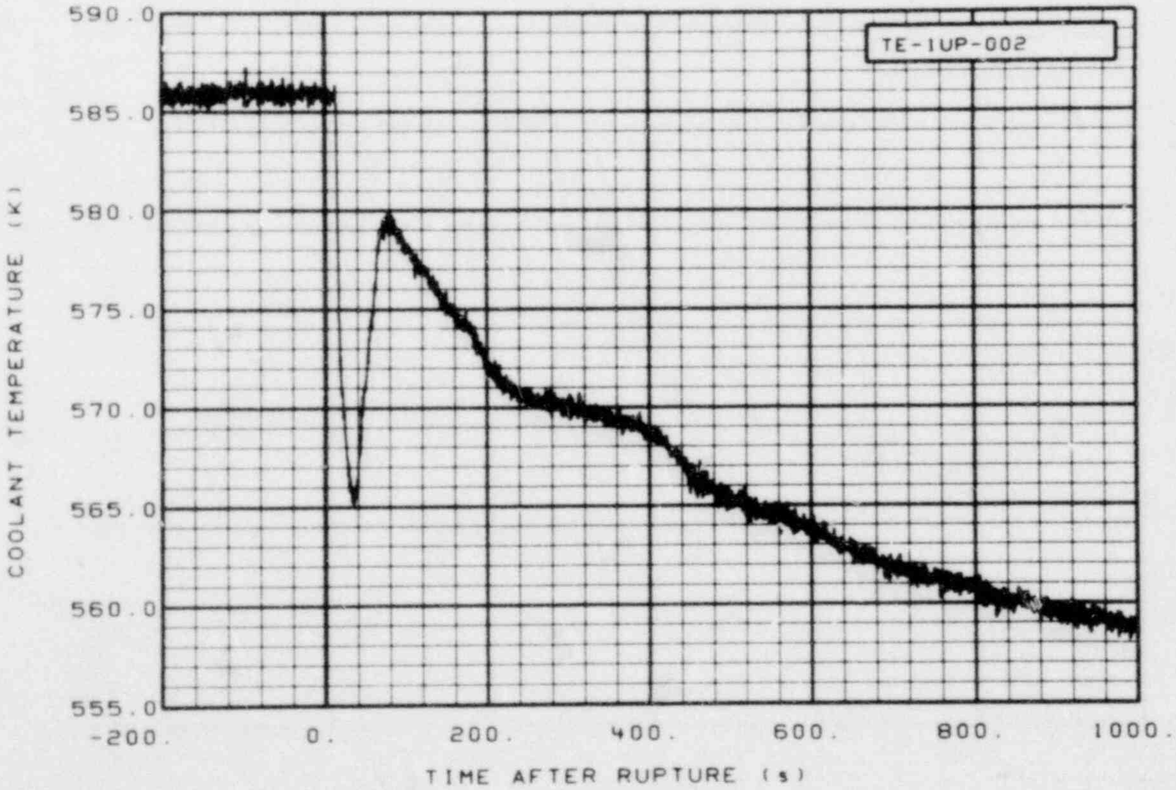


Figure 77. Coolant temperature in reactor vessel at upper end box of Fuel Assembly 1 (TE-1UP-002) (Qualified).

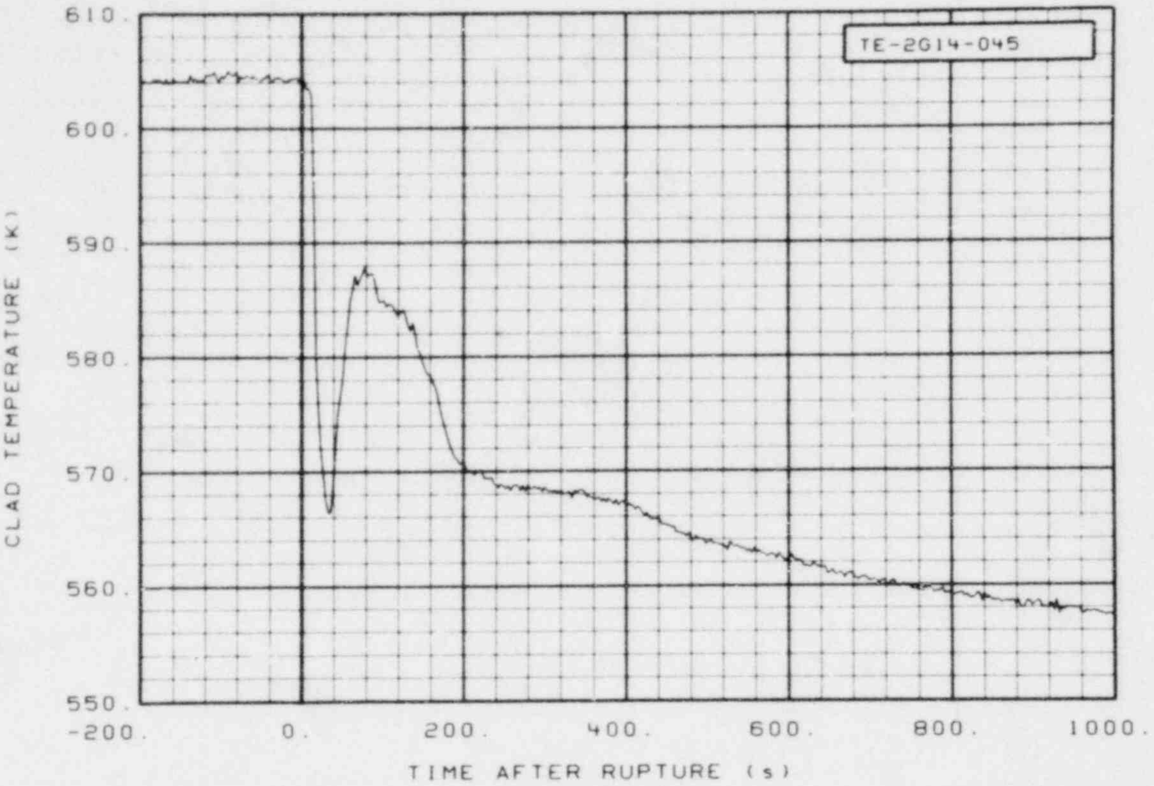


Figure 78. Cladding temperature in reactor vessel at Fuel Assembly 2, Row G, Column 14 at 1.14 m above bottom of fuel rod (TE-2G14-045) (Qualified).

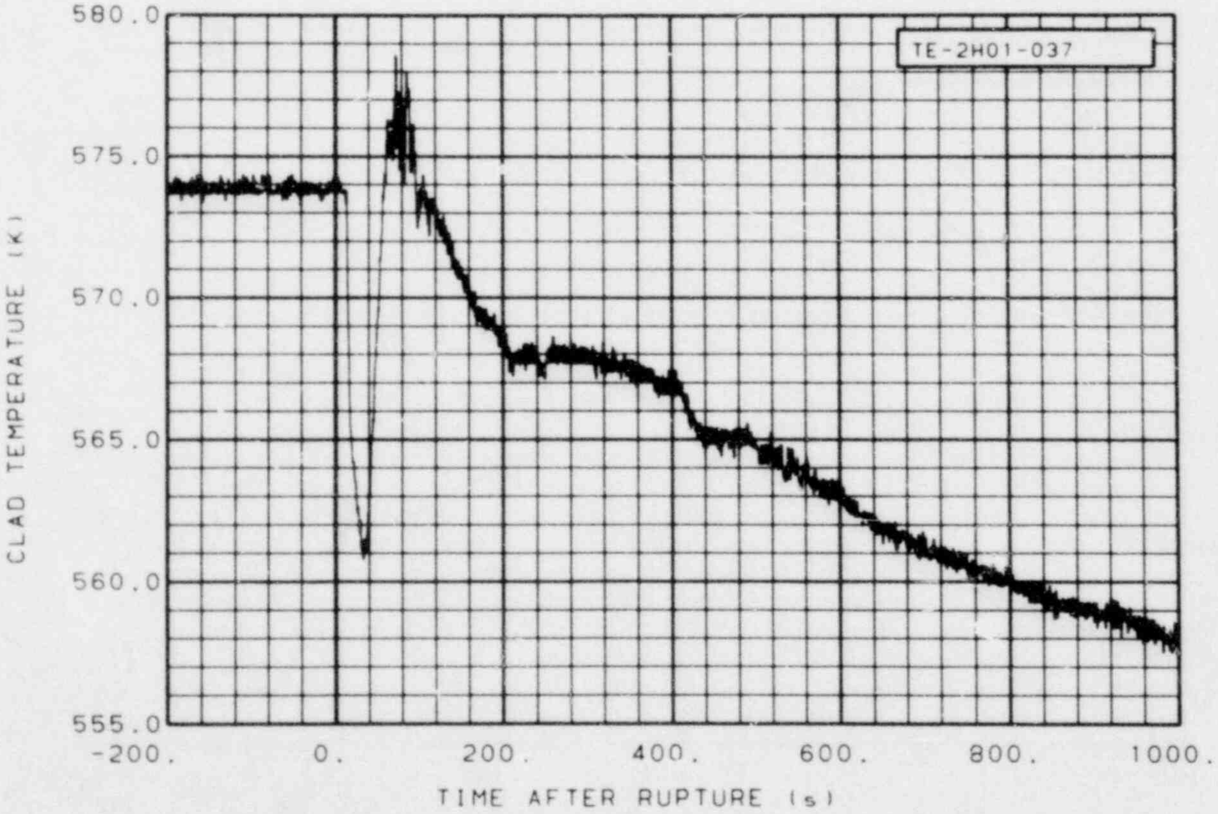


Figure 79. Cladding temperature in reactor vessel at Fuel Assembly 2, Row H, Column 1 at 0.94 m above bottom of fuel rod (TE-2H01-037) (Qualified).

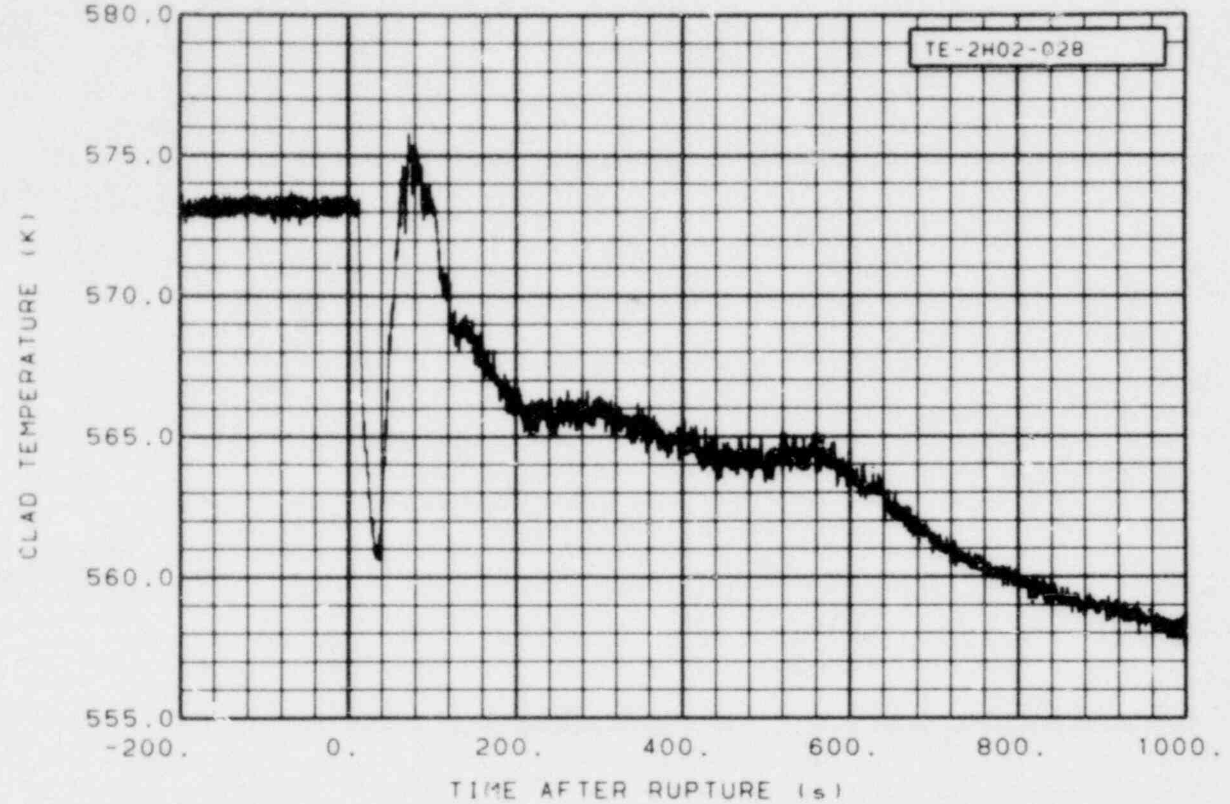


Figure 80. Cladding temperature in reactor vessel at Fuel Assembly 2, Row H, Column 2 at 0.71 m above bottom of fuel rod (TE-2H02-028) (Qualified).

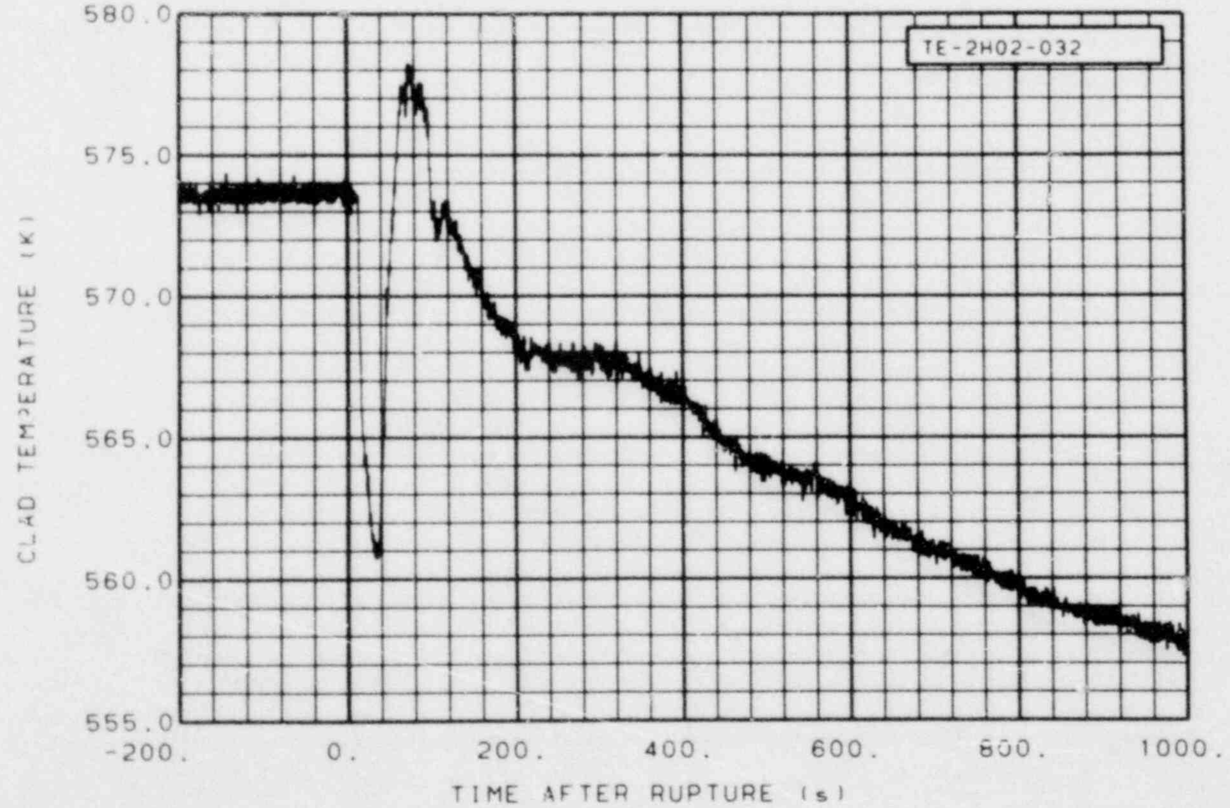


Figure 81. Cladding temperature in reactor vessel at Fuel Assembly 2, Row H, Column 2 at 0.81 m above bottom of fuel rod (TE-2H02-032) (Qualified).

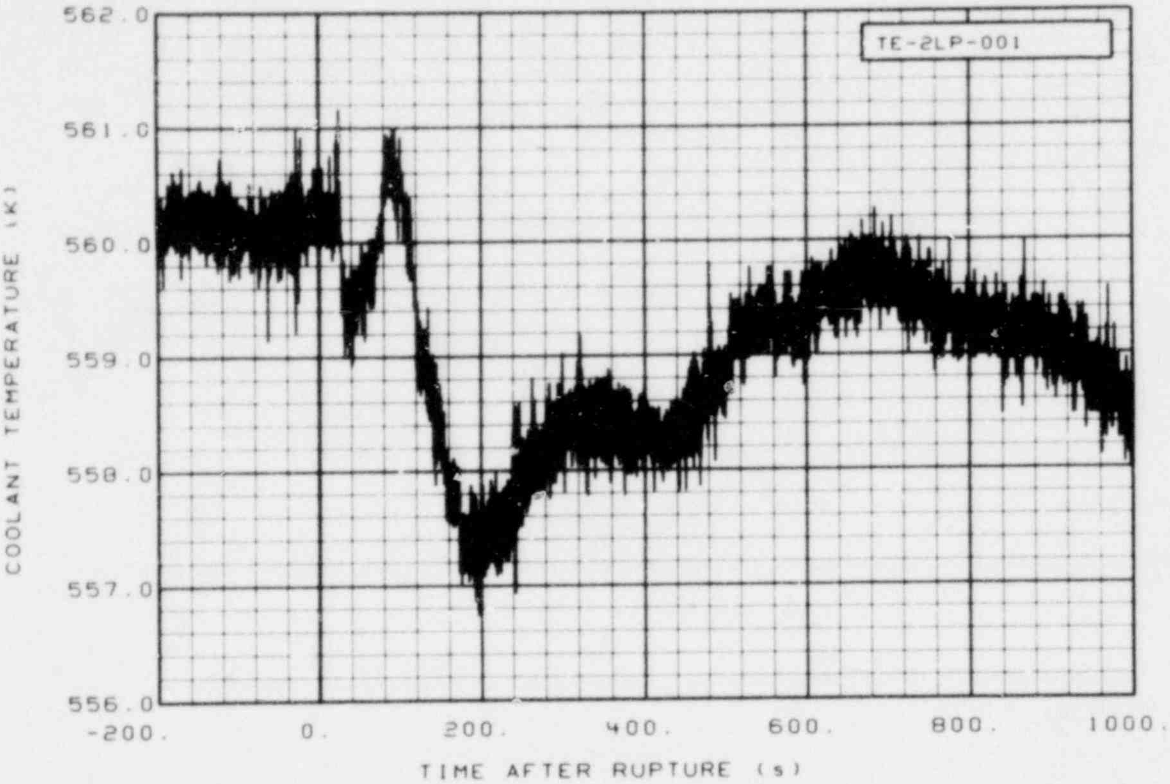


Figure 82. Coolant temperature in reactor vessel at Fuel Assembly 2 lower end box (TE-2LP-001) (Qualified).

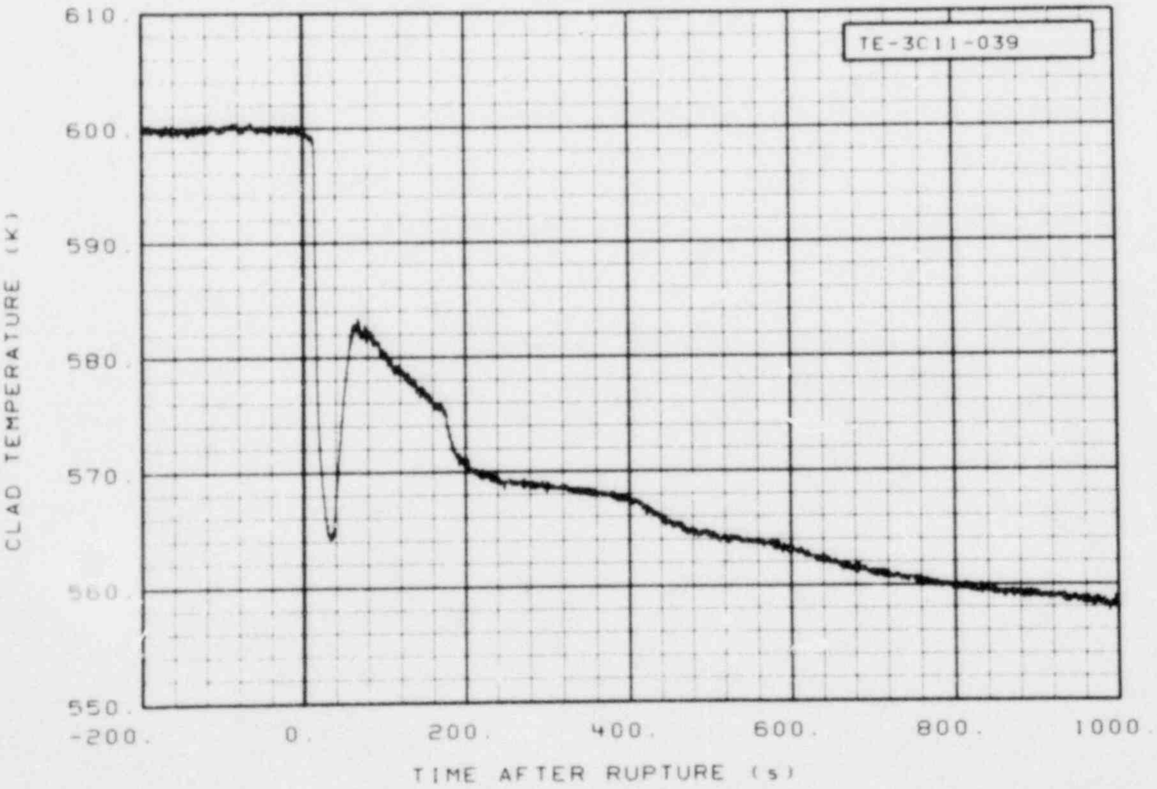


Figure 83. Cladding temperature in reactor vessel at Fuel Assembly 3, Row C, Column 11 at 0.99 m above bottom of fuel rod (TE-3C11-039) (Qualified).

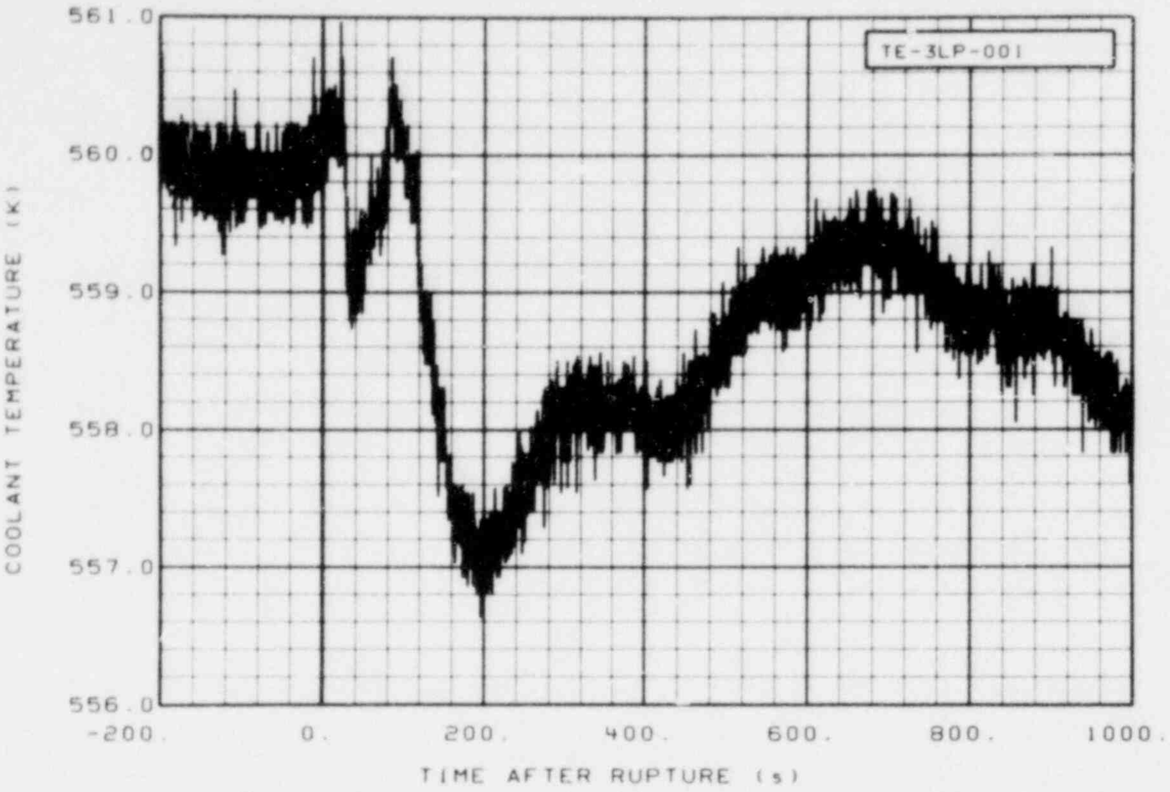


Figure 84. Coolant temperature in reactor vessel at Fuel Assembly 3 lower end box (TE-3LP-001) (Qualified).

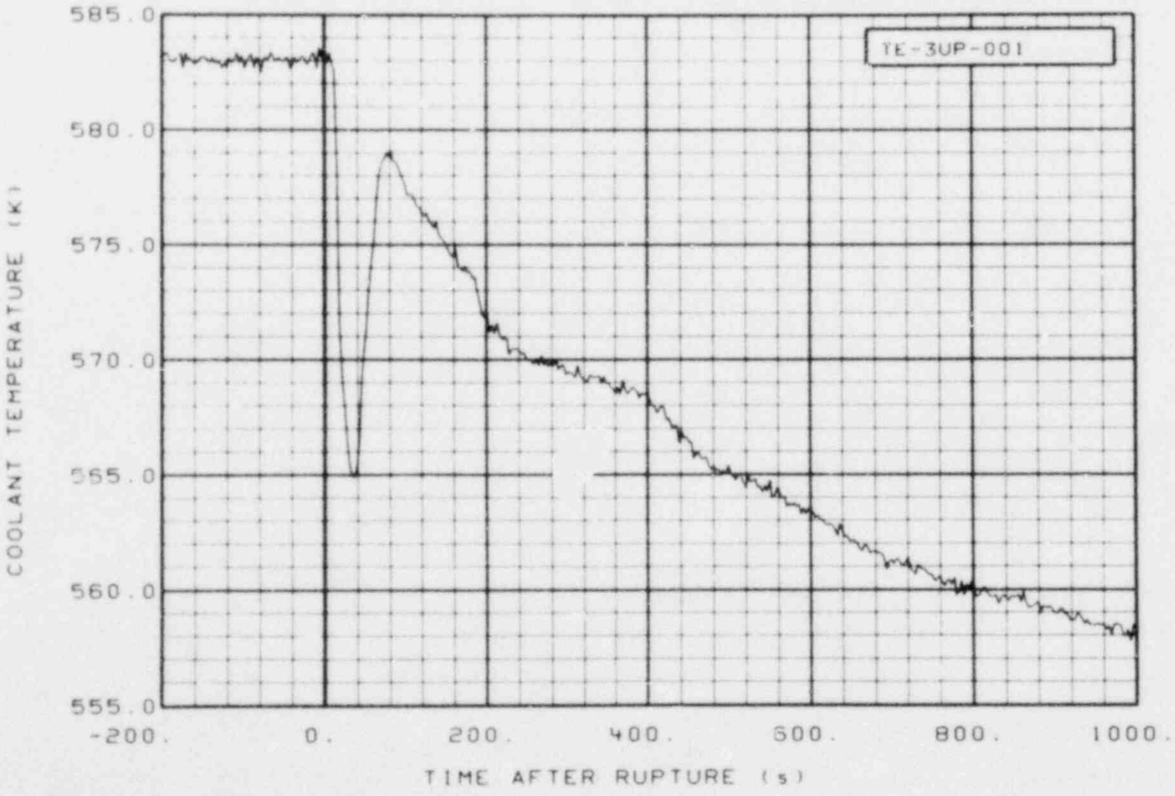


Figure 85. Coolant temperature in reactor vessel at Fuel Assembly 3 upper end box (TE-3UP-001) (Qualified).

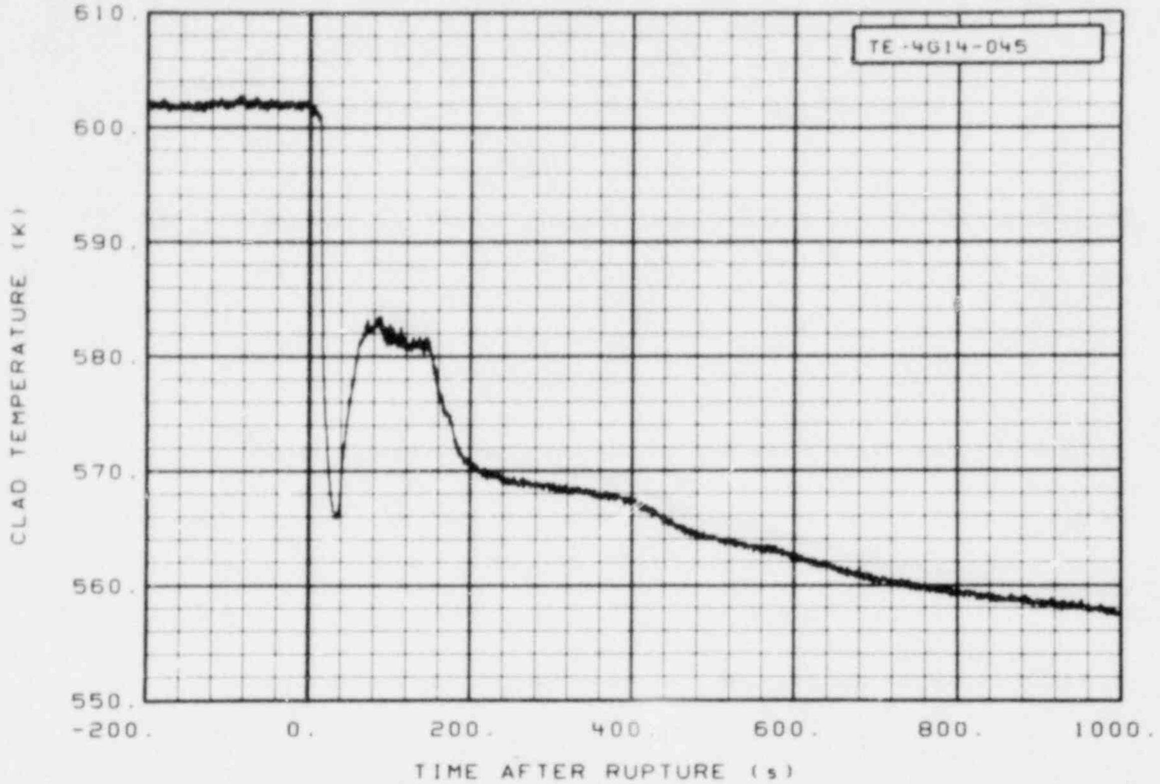


Figure 86. Cladding temperature in reactor vessel at Fuel Assembly 4, Row G, Column 14 at 1.14 m above bottom of fuel rod (TE-4G14-045) (Qualified).

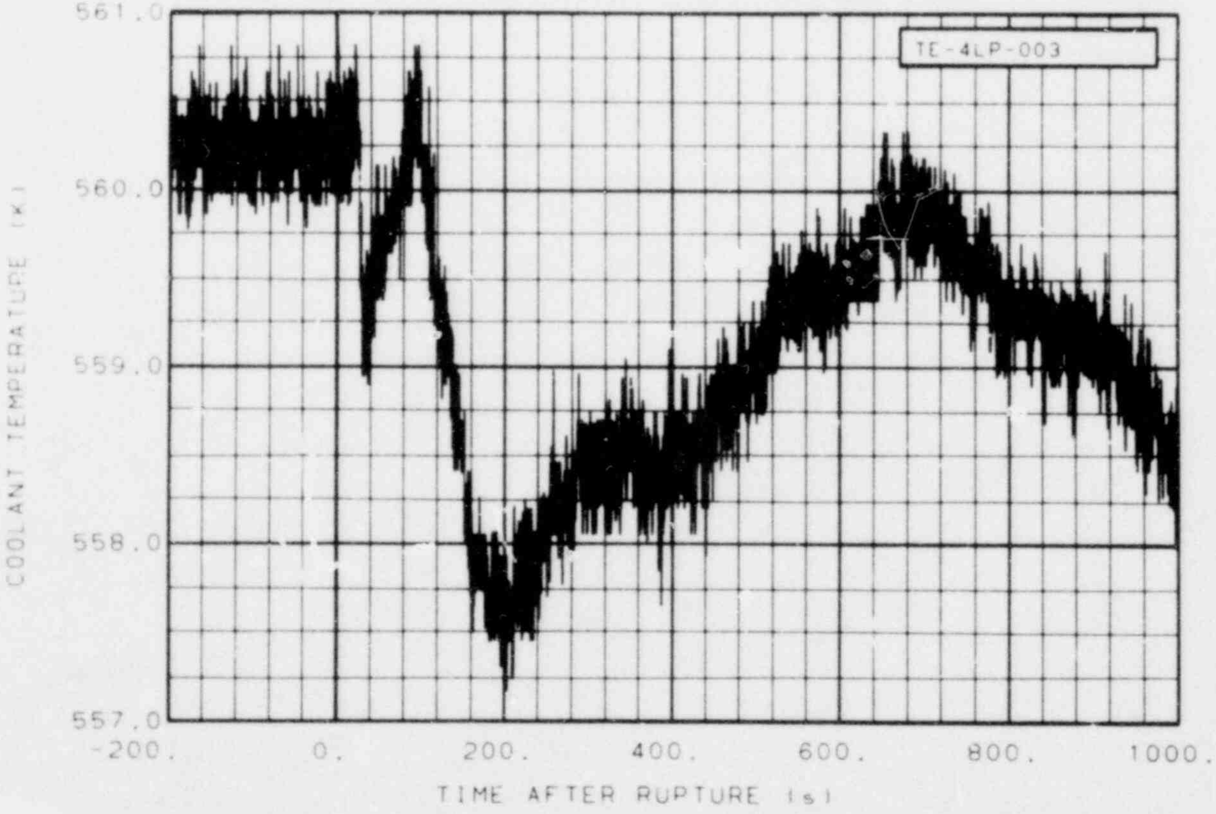


Figure 87. Coolant temperature in reactor vessel at Fuel Assembly 4 lower end box (TE-4LP-003) (Qualified).

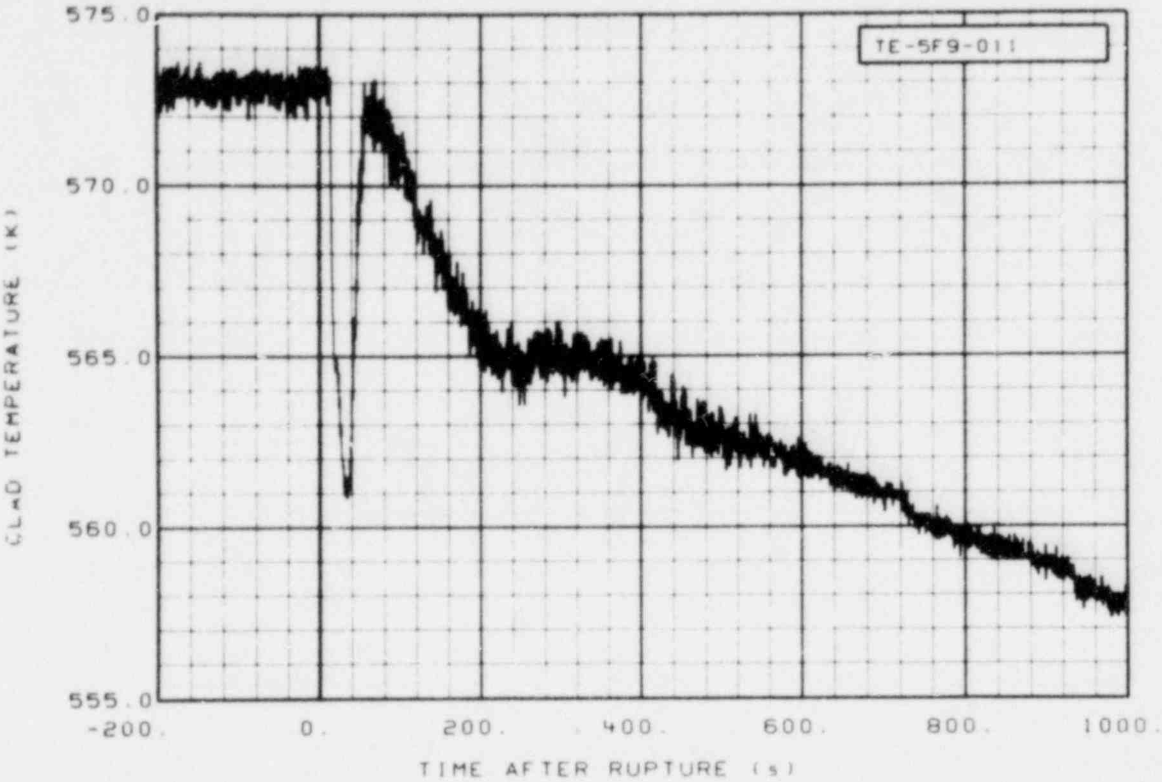


Figure 88. Cladding temperature in reactor vessel at Fuel Assembly 5, Row F, Column 9 at 0.28 m above bottom of fuel rod (TE-5F9-011) (Qualified).

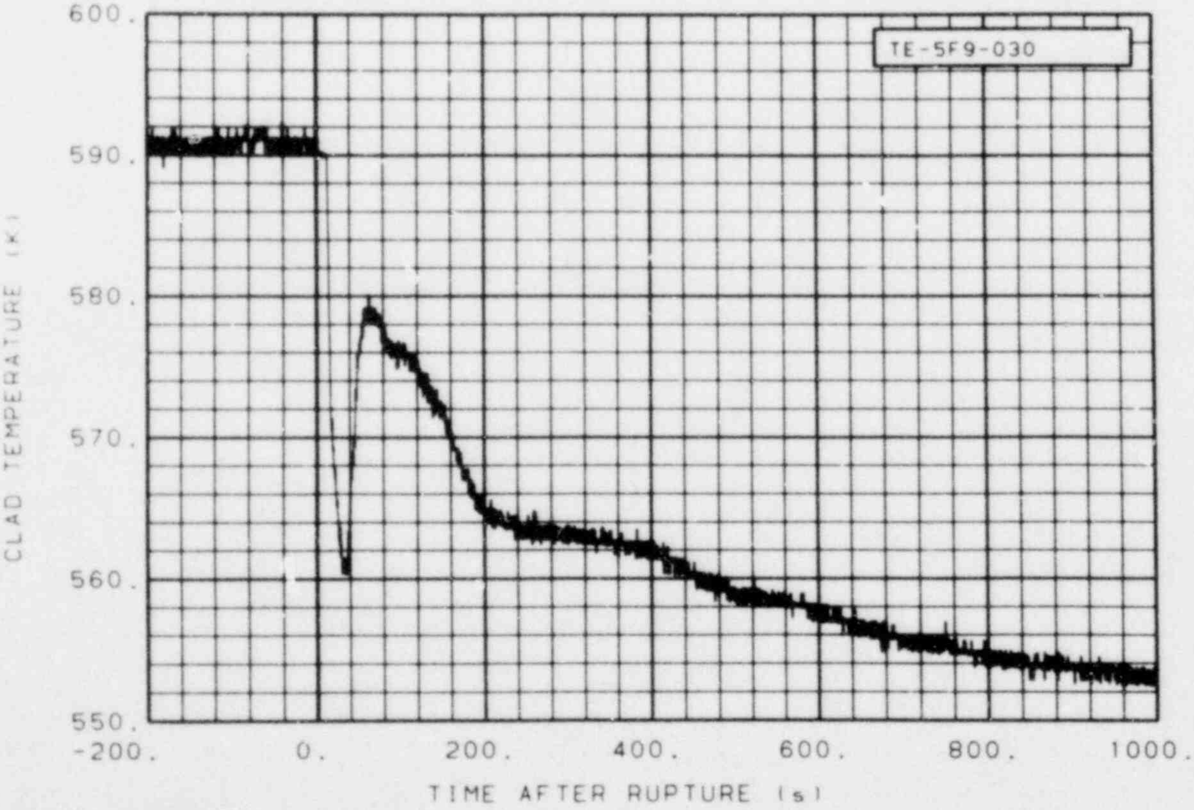


Figure 89. Cladding temperature in reactor vessel at Fuel Assembly 5, Row F, Column 9 at 0.76 m above bottom of fuel rod (TE-5F9-030) (Qualified).

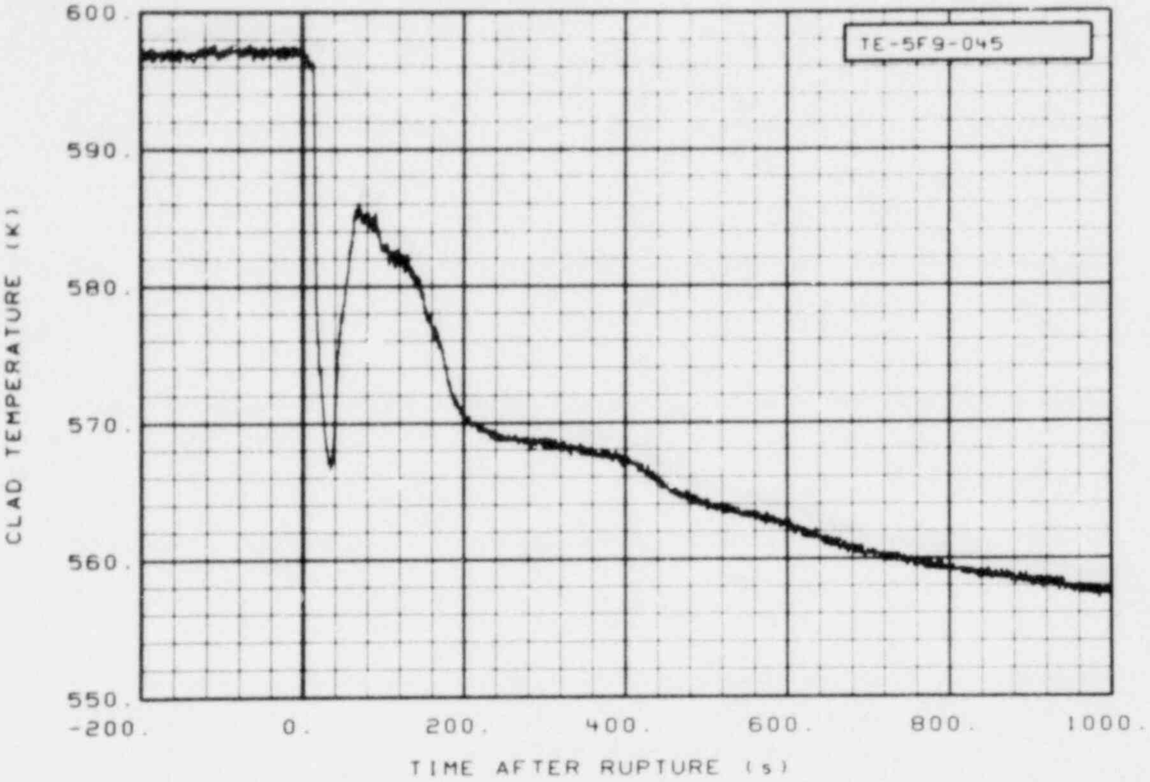


Figure 90. Cladding temperature in reactor vessel at Fuel Assembly 5, Row F, Column 9 at 1.14 m above bottom of fuel rod (TE-5F9-045) (Qualified).

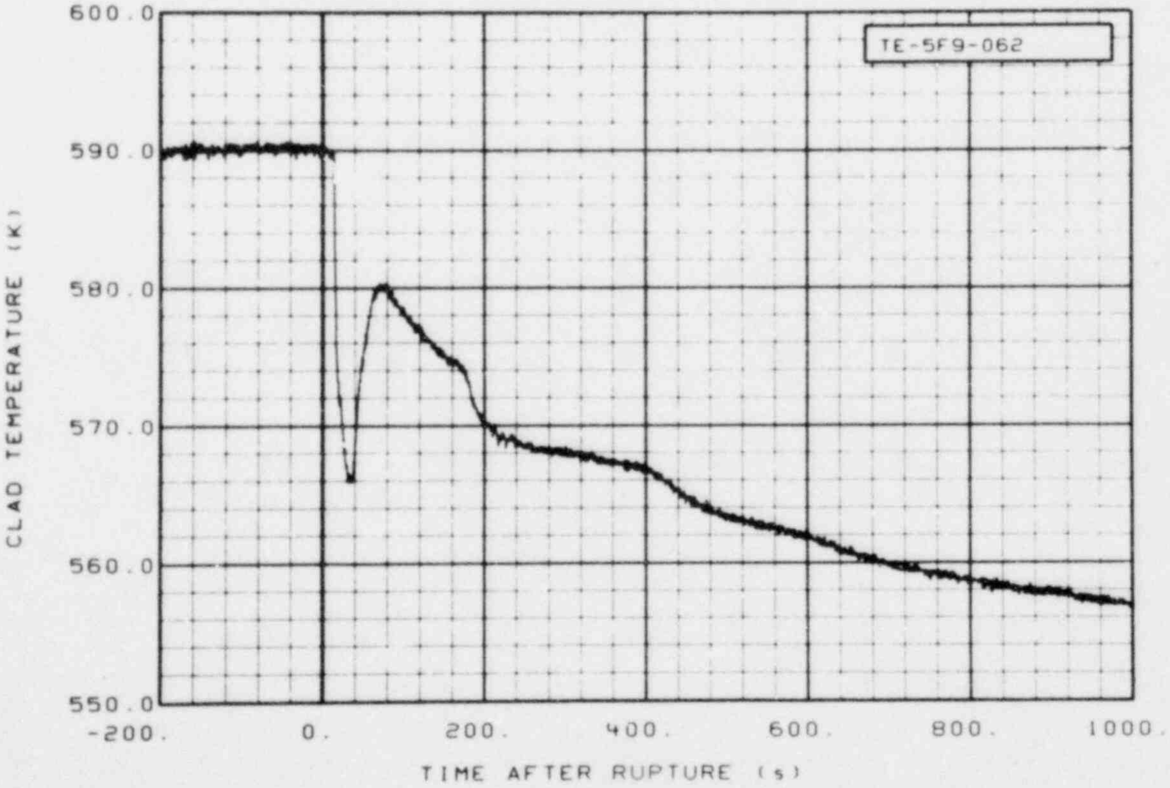


Figure 91. Cladding temperature in reactor vessel at Fuel Assembly 5, Row F, Column 9 at 1.57 m above bottom of fuel rod (TE-5F9-062) (Qualified).

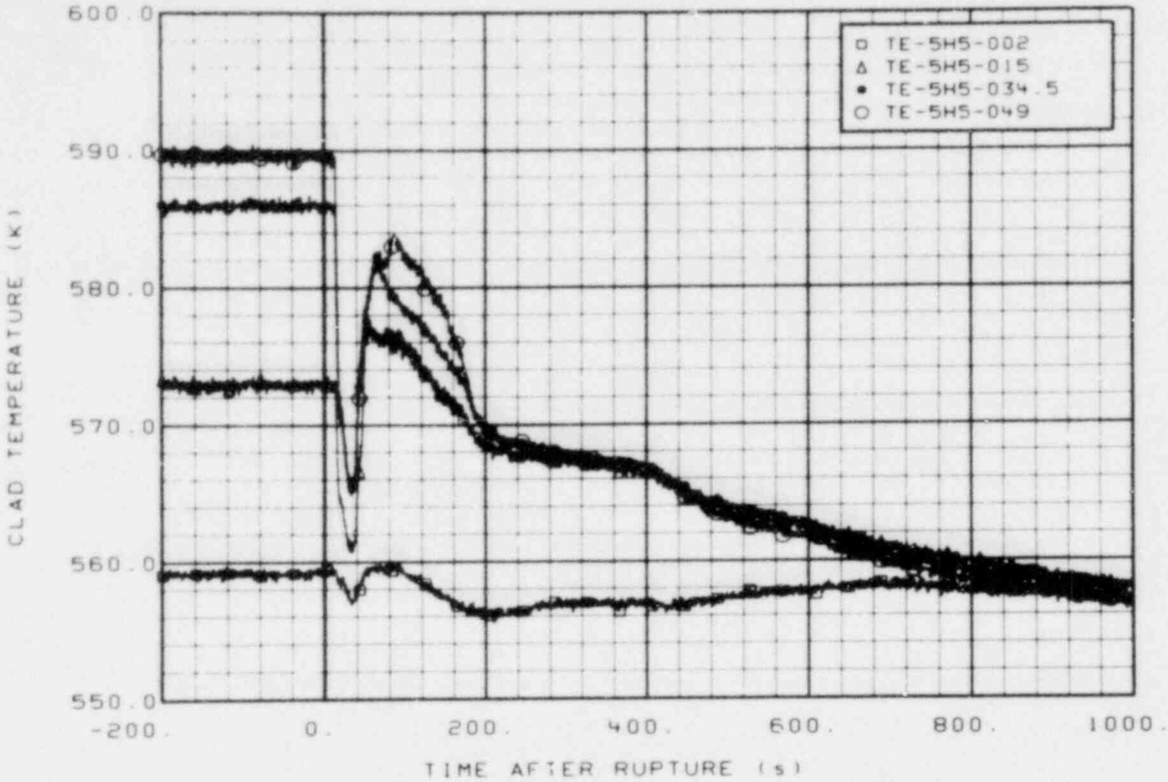


Figure 92. Cladding temperature in reactor vessel at Fuel Assembly 5, Row H, Column 5 at 0.05, 0.38, 0.88, and 1.24 m above bottom of fuel rod (TE-5H5-002, -015, -034.5, and -049) (Qualified).

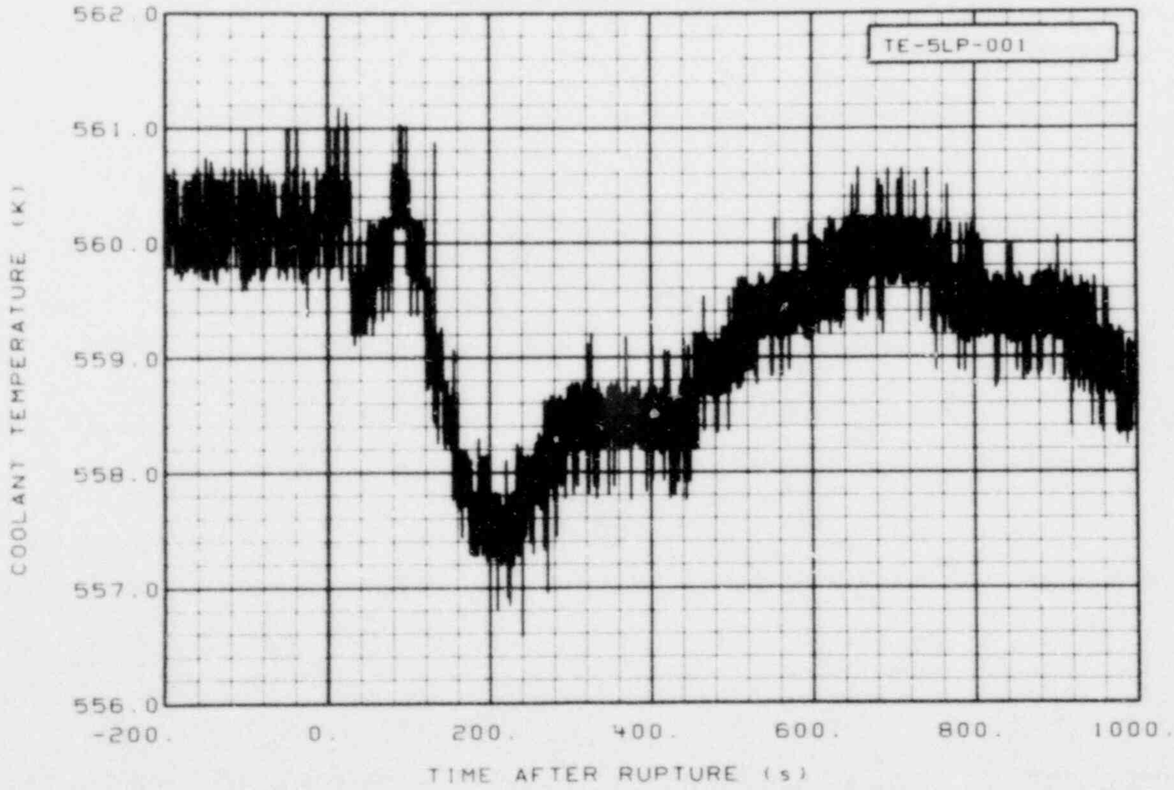


Figure 93. Coolant temperature in reactor vessel at Fuel Assembly 5 lower end box (TE-5LP-001) (Qualified).

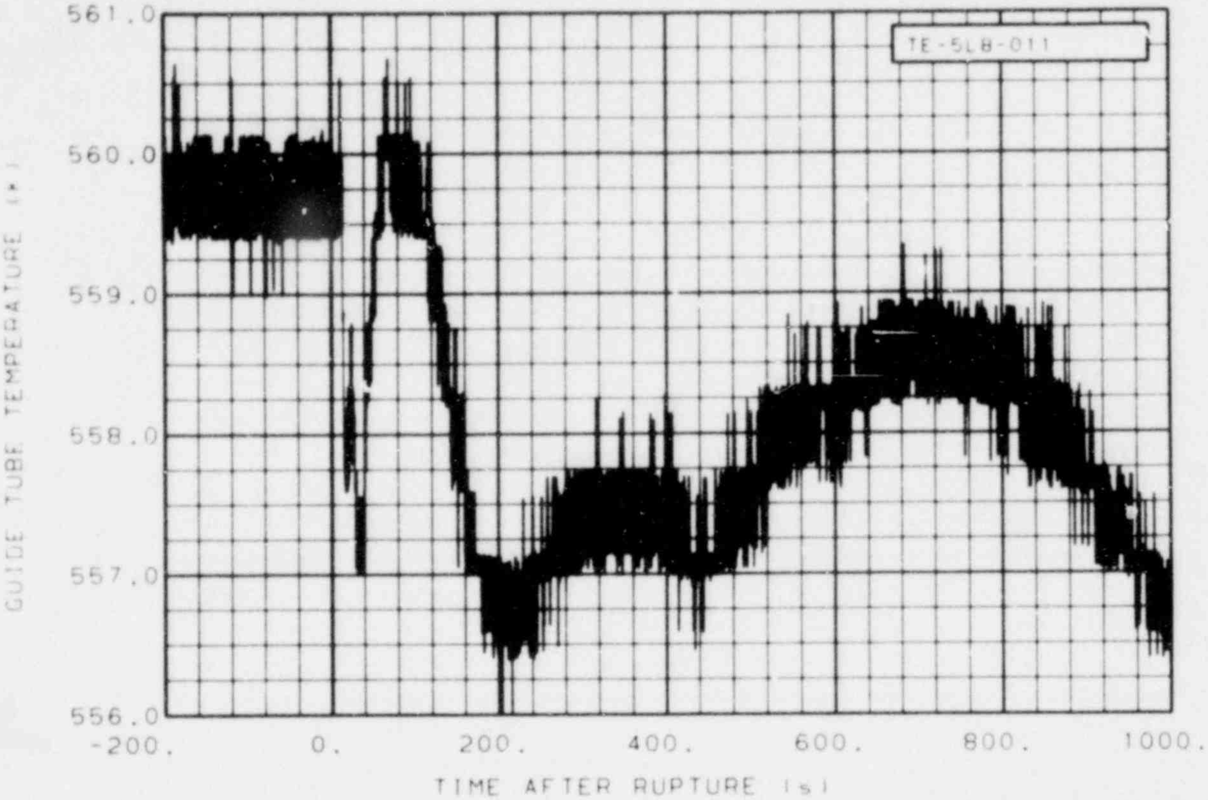


Figure 94. Guide tube temperature in reactor vessel at Fuel Assembly 5, Row L, Column 8 at 0.28 m above bottom of guide tube (TE-5L8-011) (Qualified).

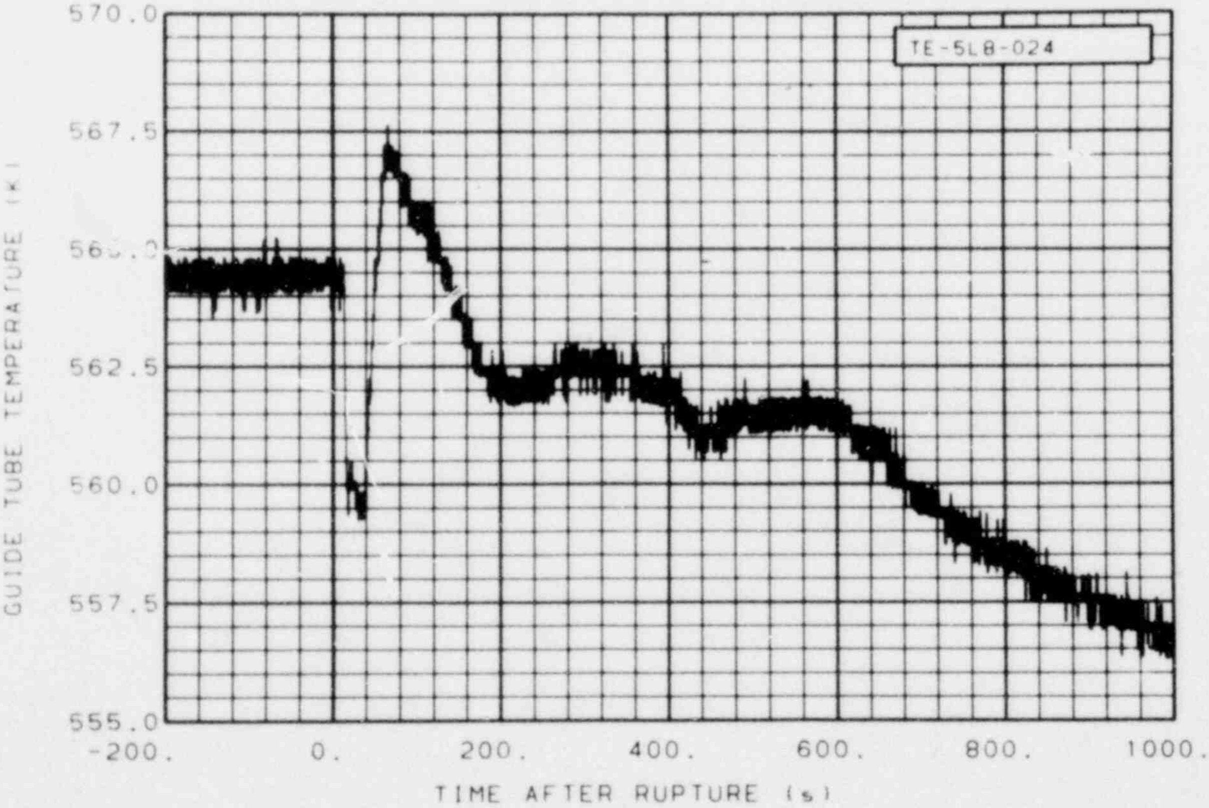


Figure 95. Guide tube temperature in reactor vessel at Fuel Assembly 5, Row L, Column 8 at 0.61 m above bottom of guide tube (TE-5L8-024) (Qualified).

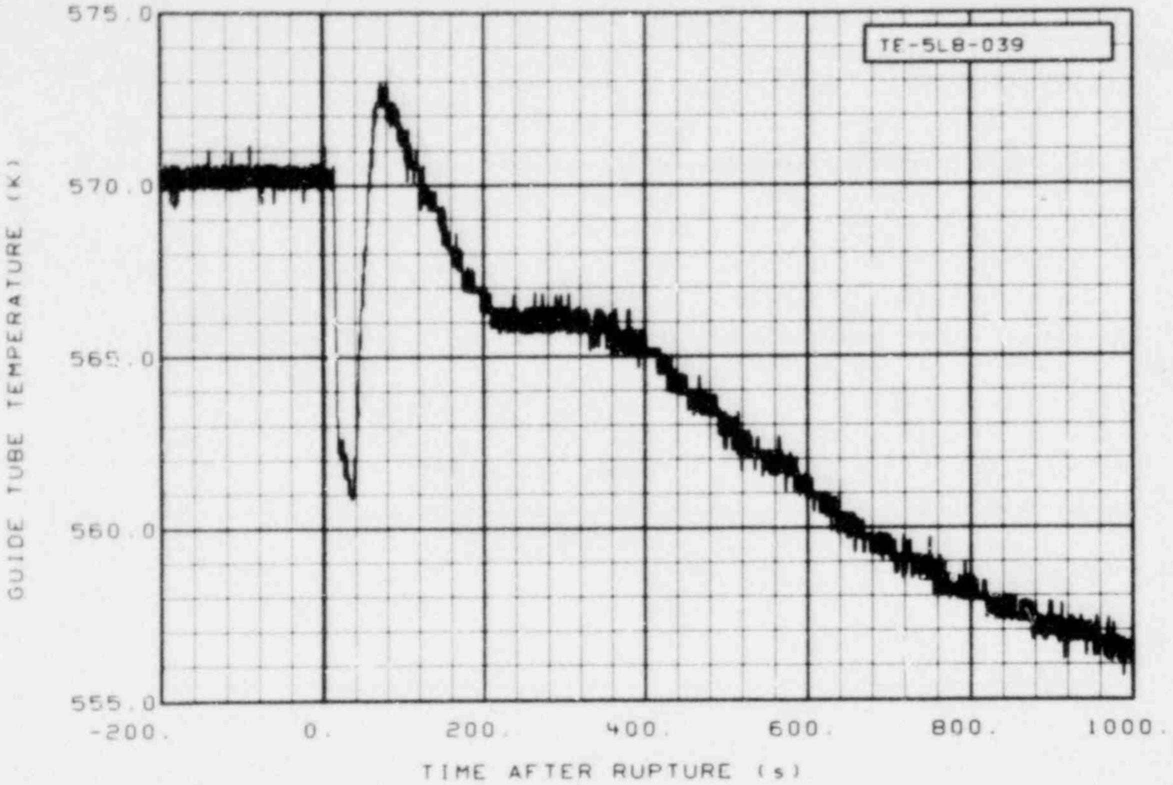


Figure 96. Guide tube temperature in reactor vessel at Fuel Assembly 5, Row L, Column 8 at 0.99 m above bottom of guide tube (TE-5L8-039) (Qualified).

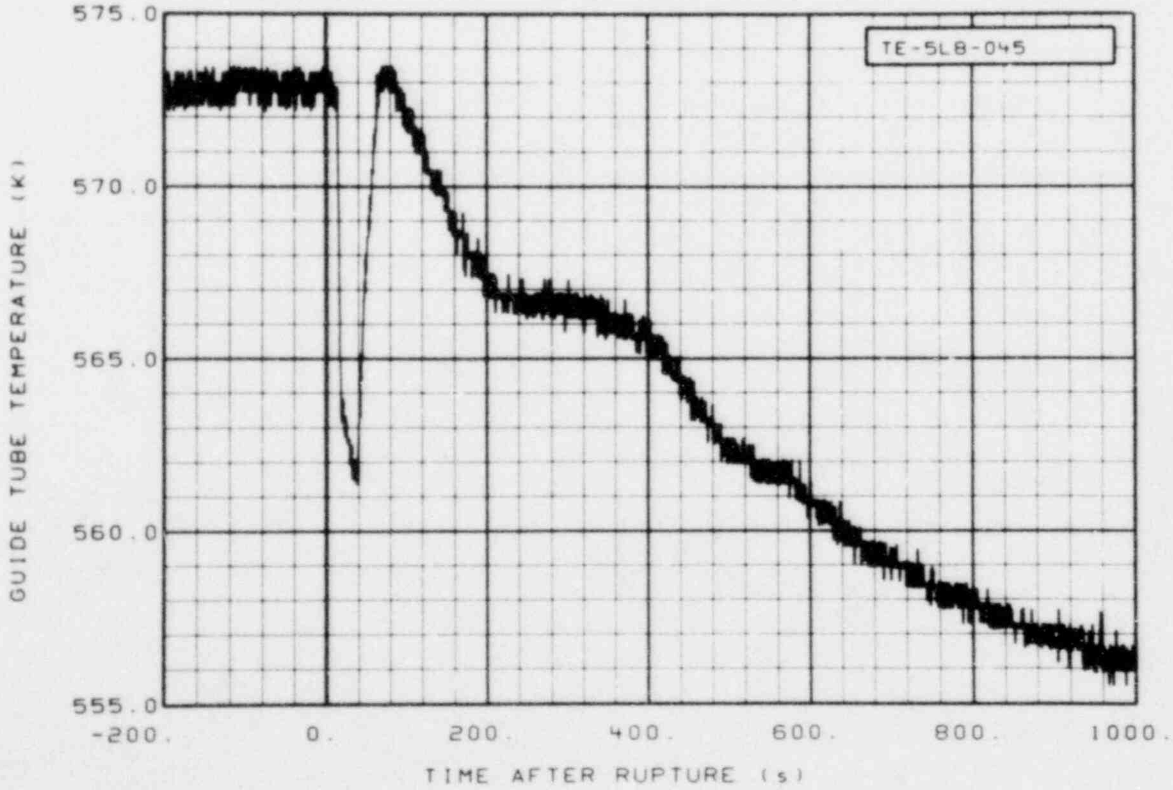


Figure 97. Guide tube temperature in reactor vessel at Fuel Assembly 5, Row L, Column 8 at 1.14 m above bottom of guide tube (TE-5L8-045) (Qualified).

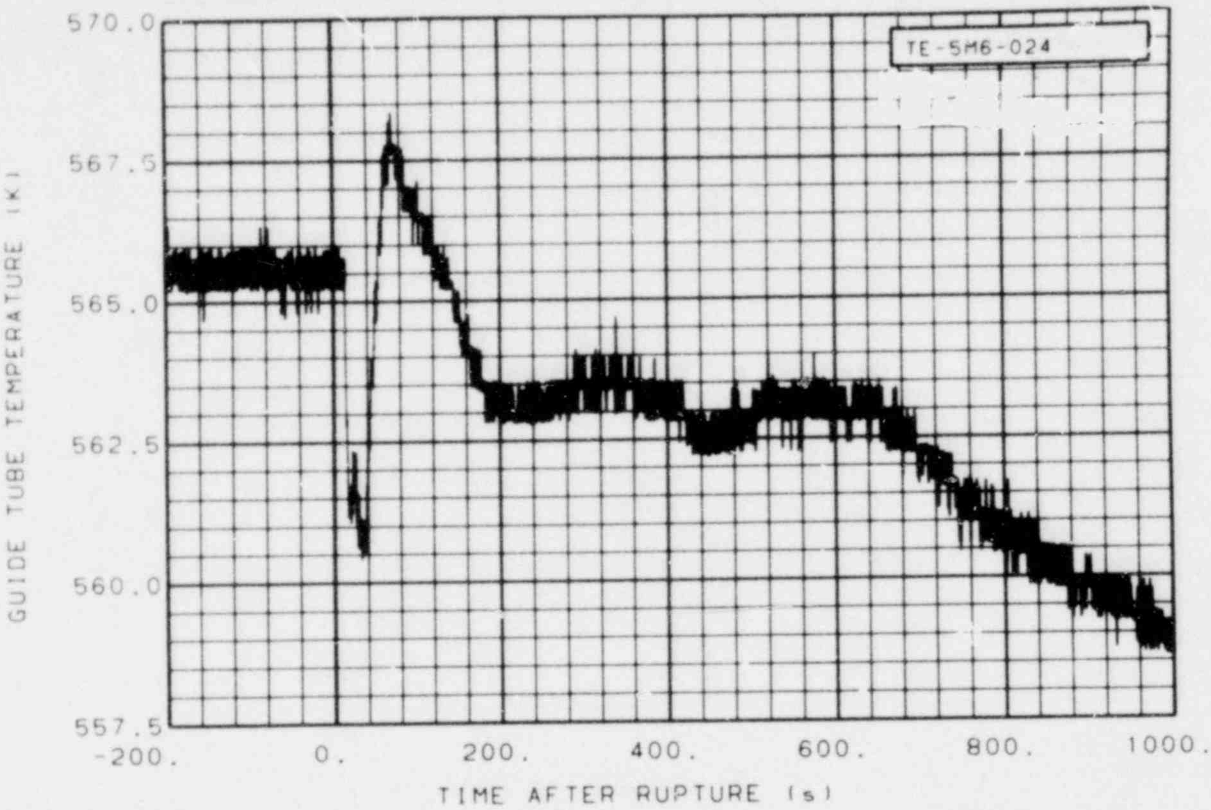


Figure 98. Guide tebe temperature in reactor vessel at Fuel Assembly 5, Row M, Column 6 at 0.61 m above bottom of guide tube (TE-5M6-024) (Qualified).

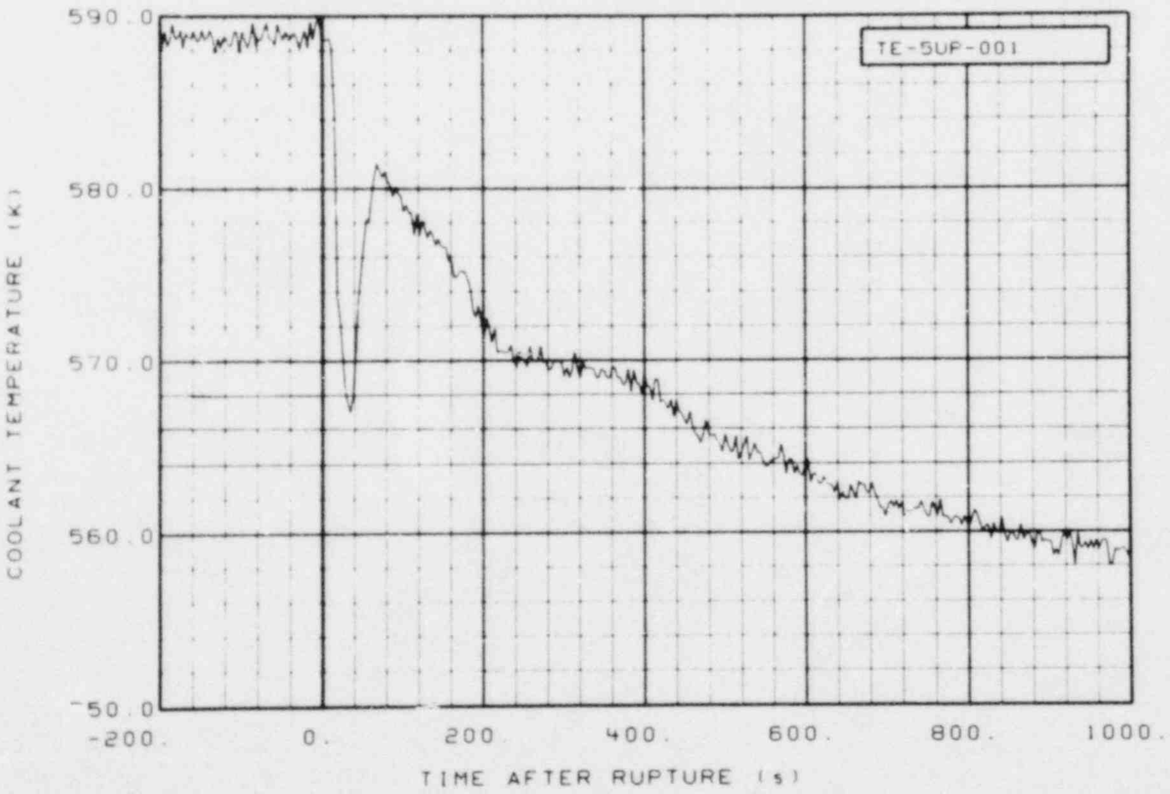


Figure 99. Coolant temperature in reactor vessel at Fuel Assembly 5 upper end box (TE-5UP-001) (Qualified).

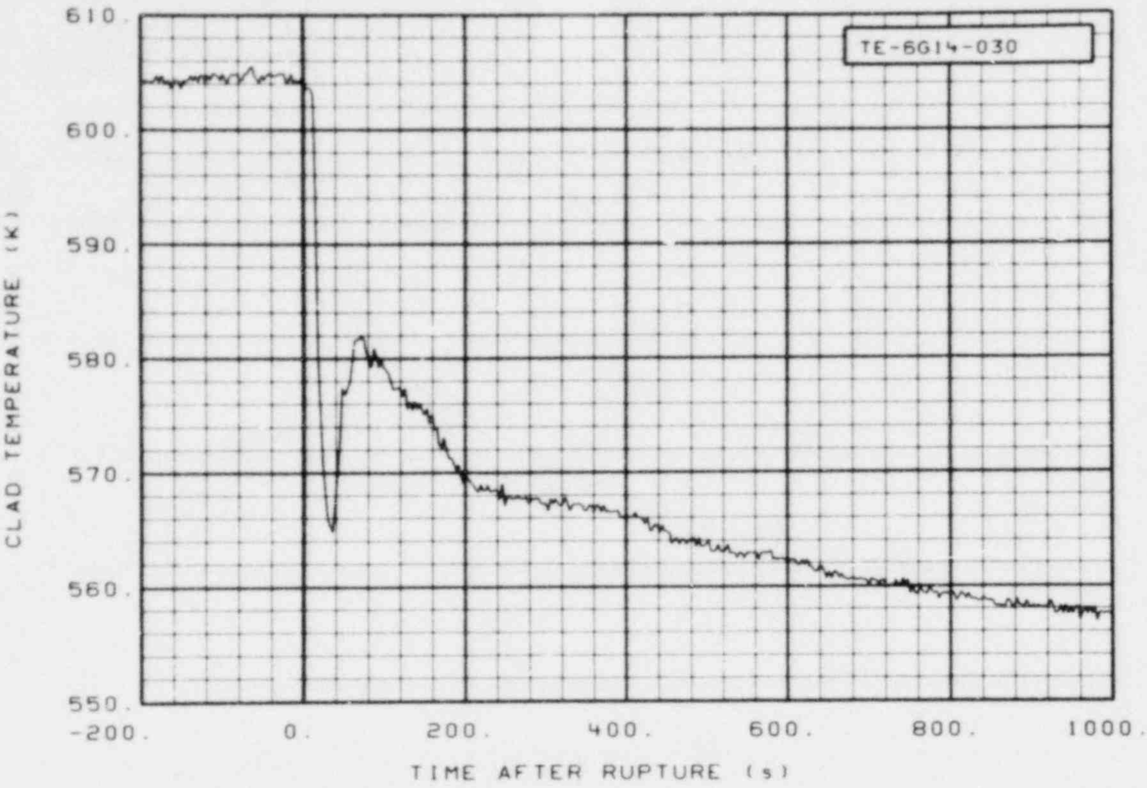


Figure 100. Cladding temperature in reactor vessel on Fuel Assembly 6, Row G, Column 14 at 0.76 m above bottom of fuel rod (TE-6G14-030) (Qualified).

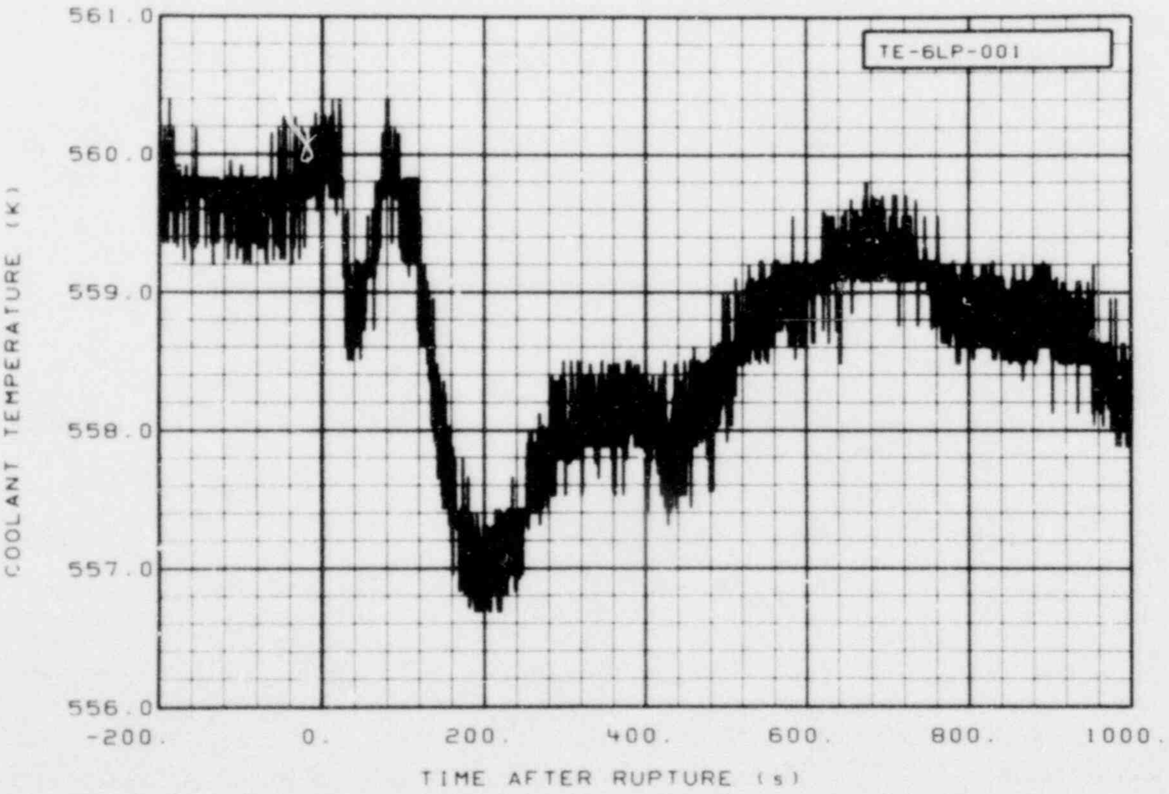


Figure 101. Coolant temperature in reactor vessel at Fuel Assembly 6 lower end box (TE-6LP-001) (Qualified).

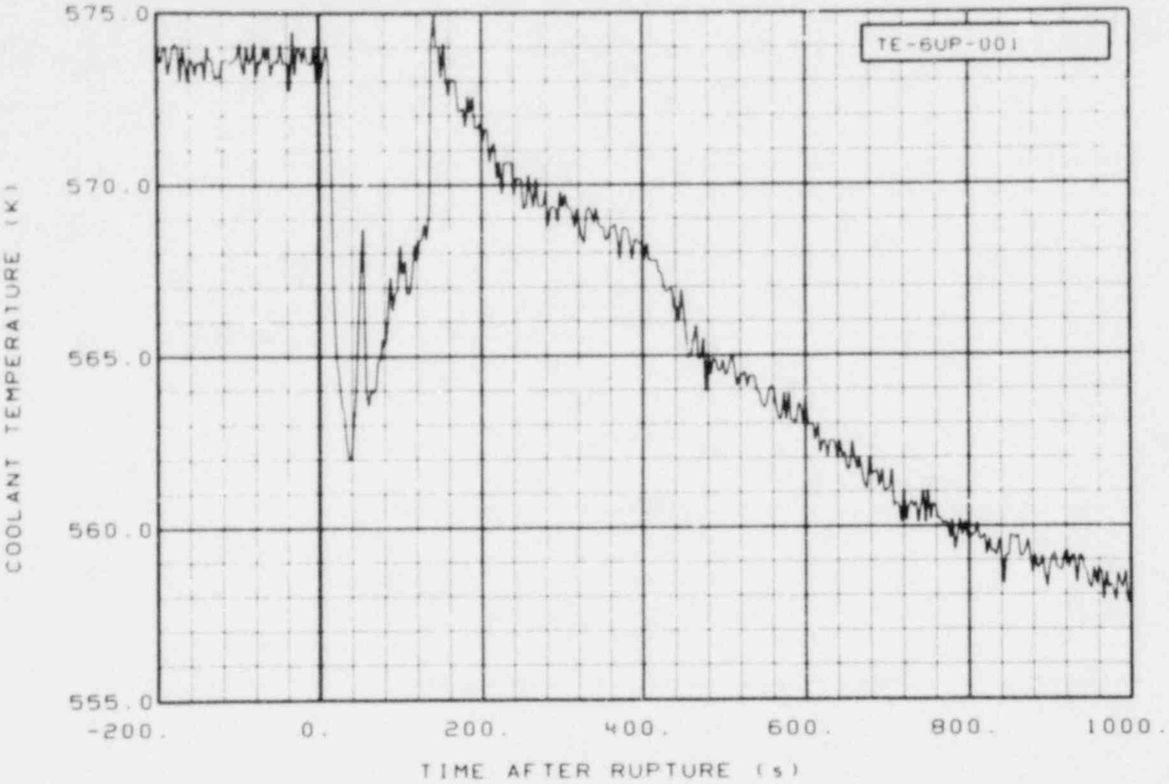


Figure 102. Coolant temperature in reactor vessel at Fuel Assembly 6 upper end box (TE-6UP-001) (Qualified).

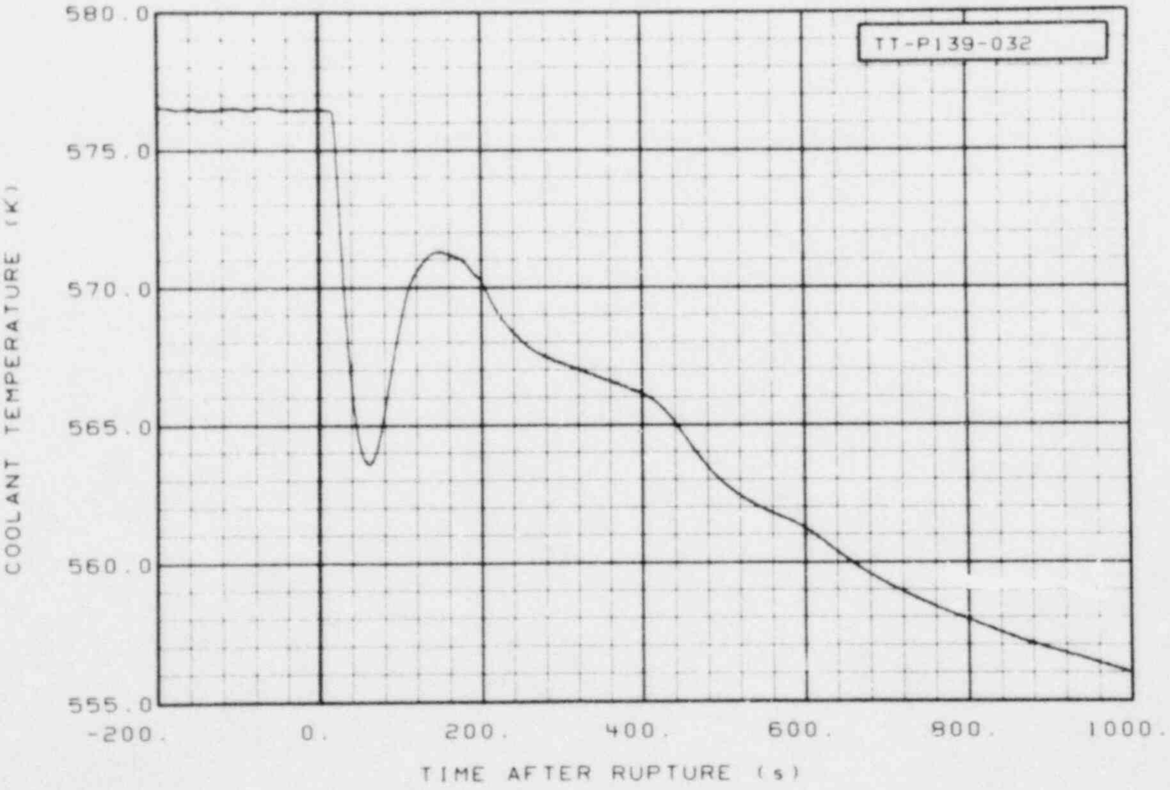


Figure 103. Coolant temperature in intact loop hot leg, Channel A (TT-P139-032) (Qualified, narrow range instrument).

MEDIUM-TERM PLOTS
(-400 to 14 000 s)

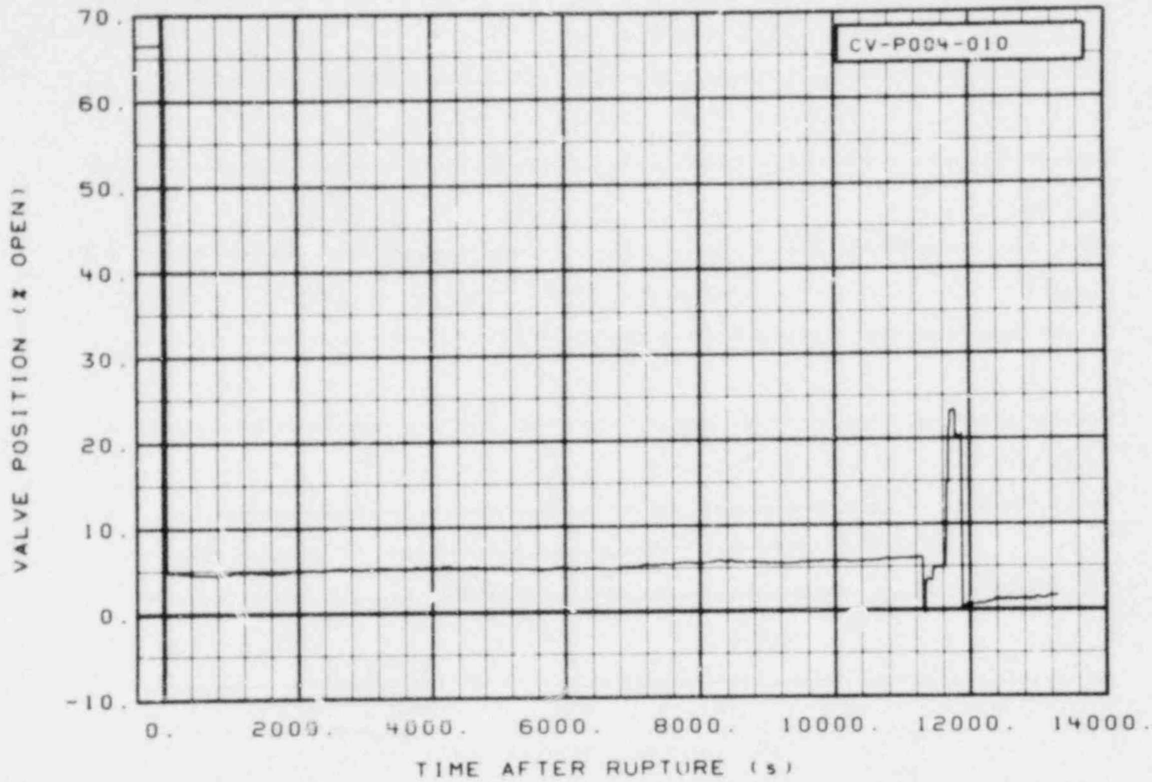


Figure 104. Valve position for secondary coolant system steam flow control valve (CV-P004-010) (Qualified).

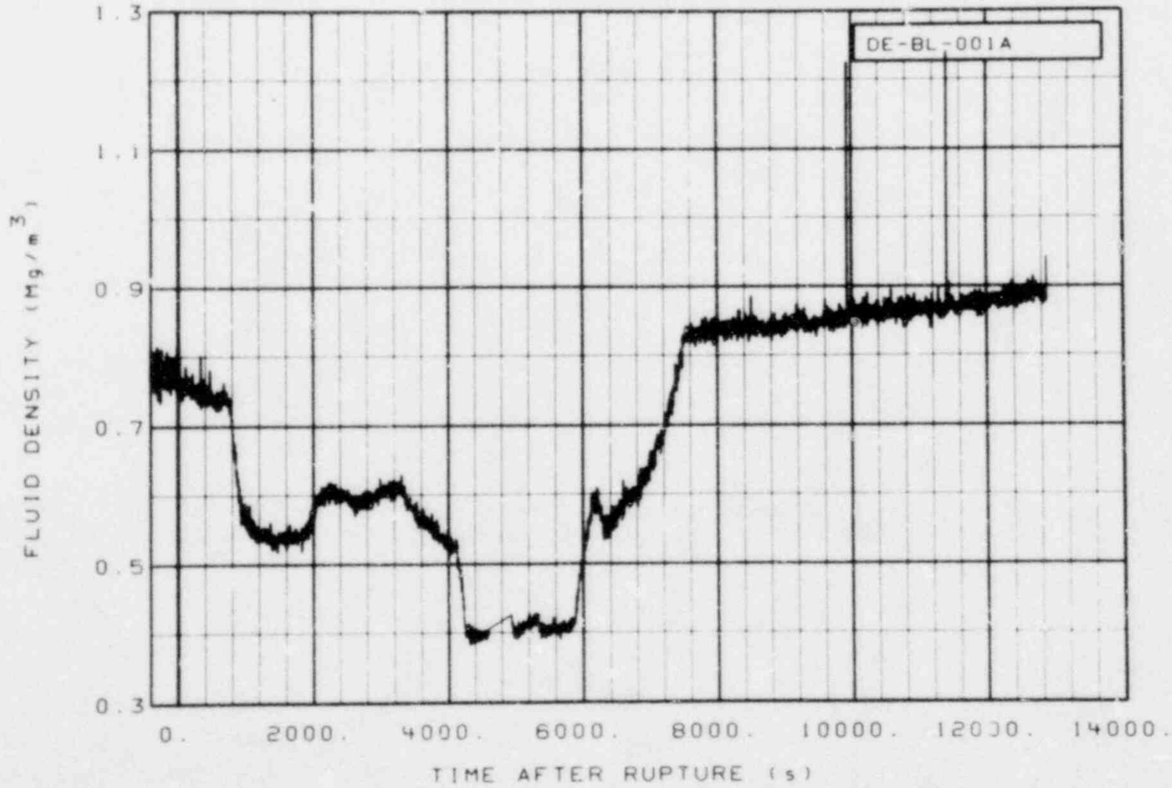


Figure 105. Fluid density in broken loop cold leg, chordal density (DE-BL-001A) (Qualified, spikes caused by data processing).

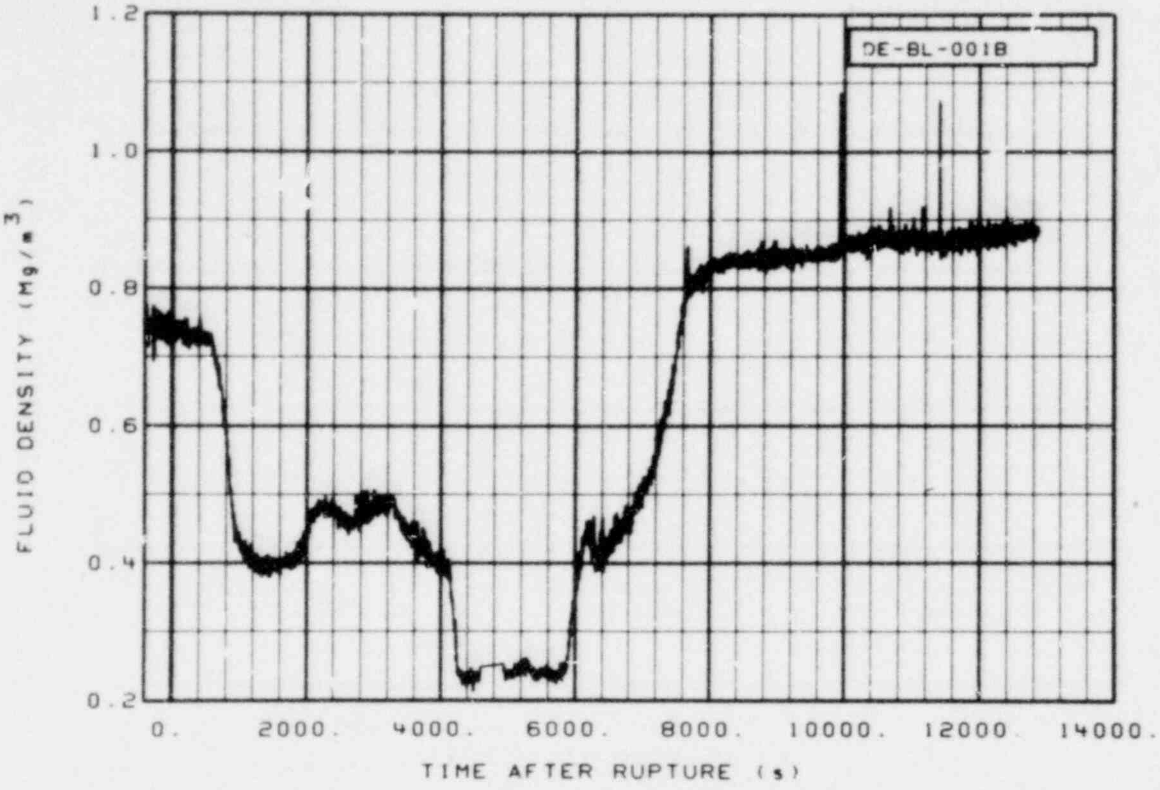


Figure 106. Fluid density in broken loop cold leg, chordal density (DE-BL-001B) (Qualified, spikes caused by data processing).

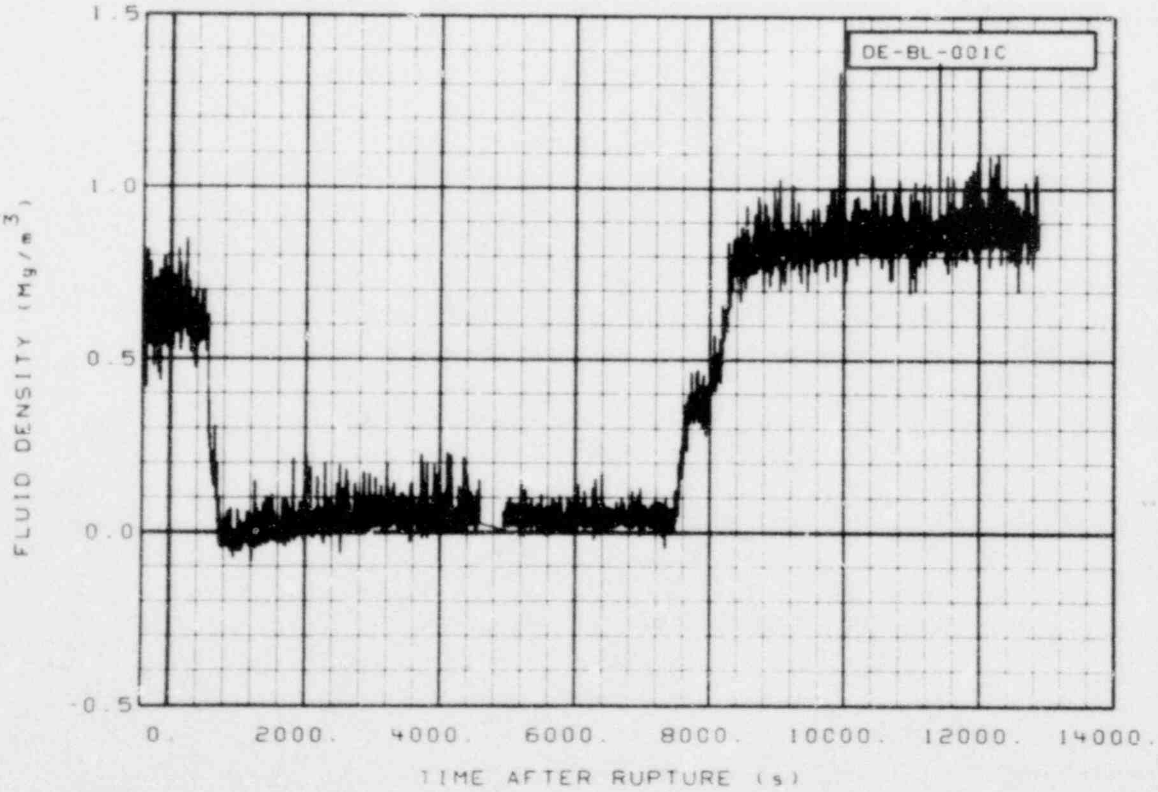


Figure 107. Fluid density in broken loop cold leg, chordal density (DE-BL-001C) (Qualified, spikes caused by data processing).

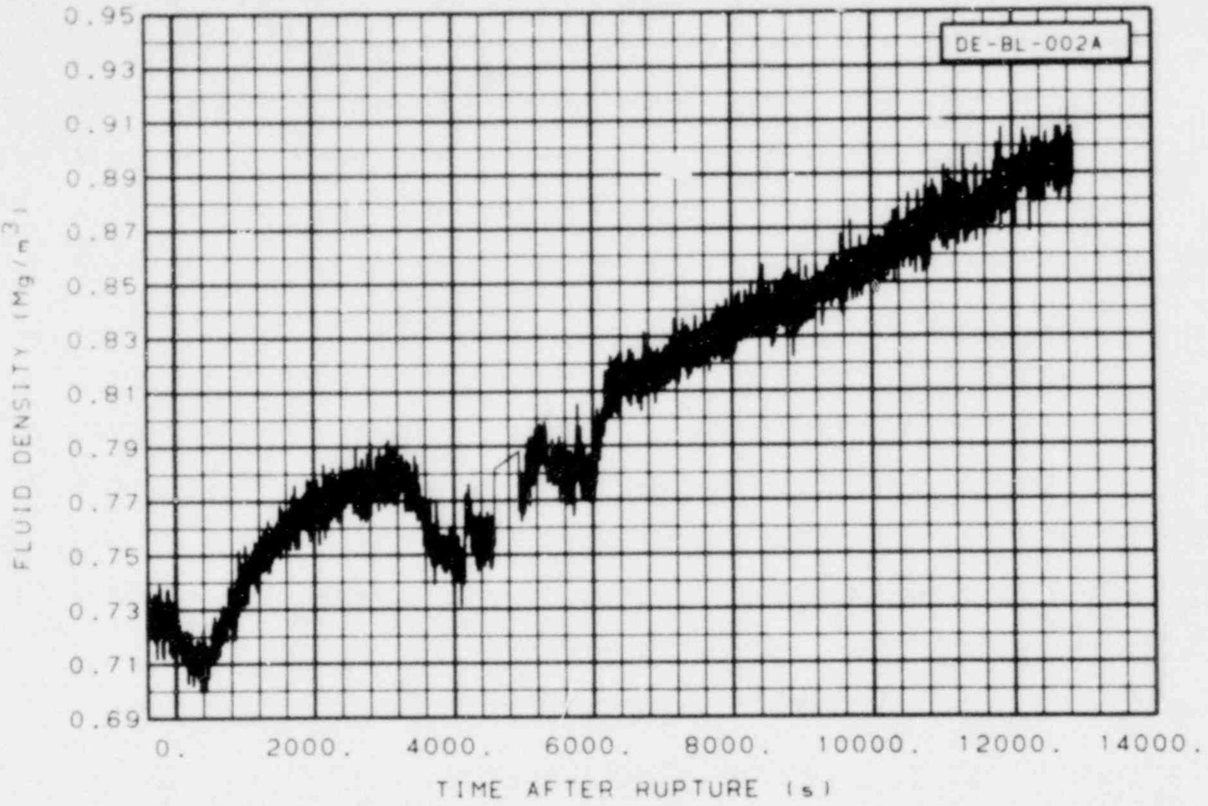


Figure 108. Fluid density in broken loop hot leg, chordal density (DE-BL-002A) (Failed, originally qualified but further investigation determined instrument failed).

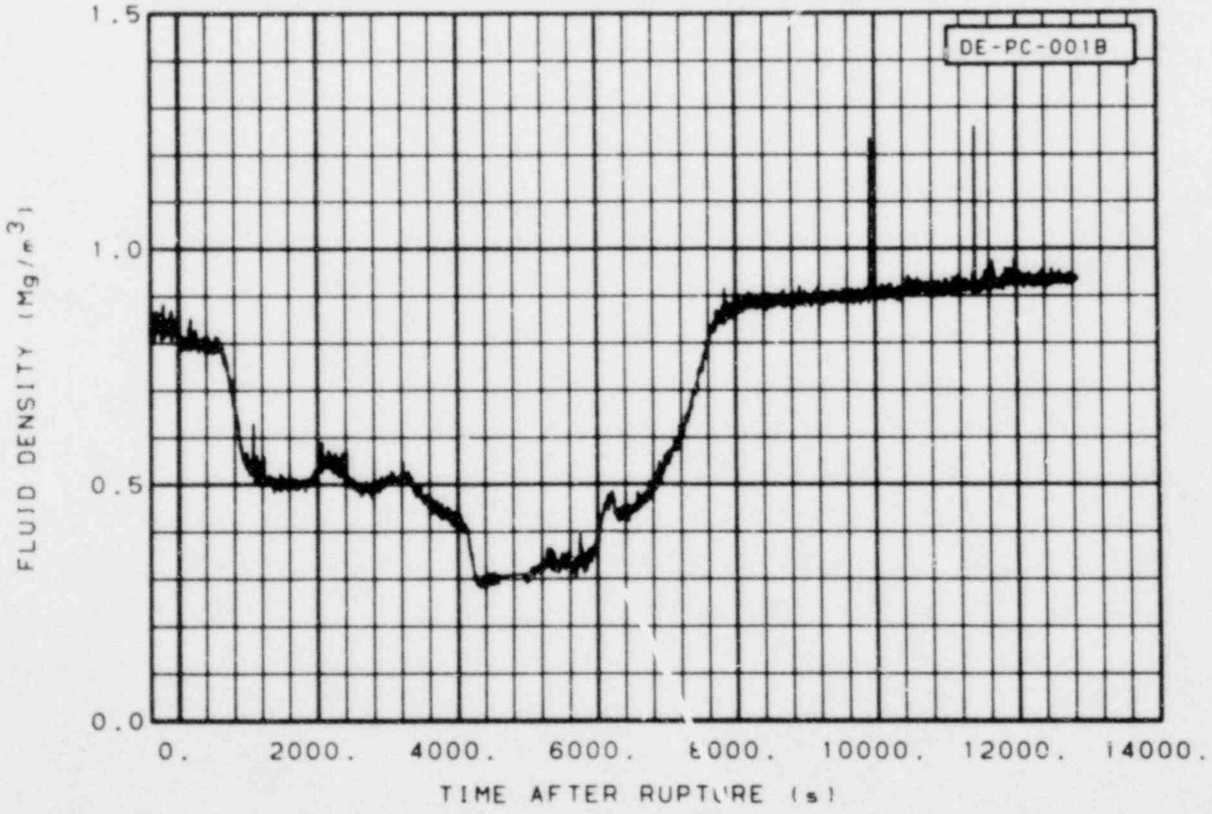


Figure 109. Fluid density in intact loop cold leg, chordal density (DE-PC-001B) (Qualified, spikes caused by data processing).

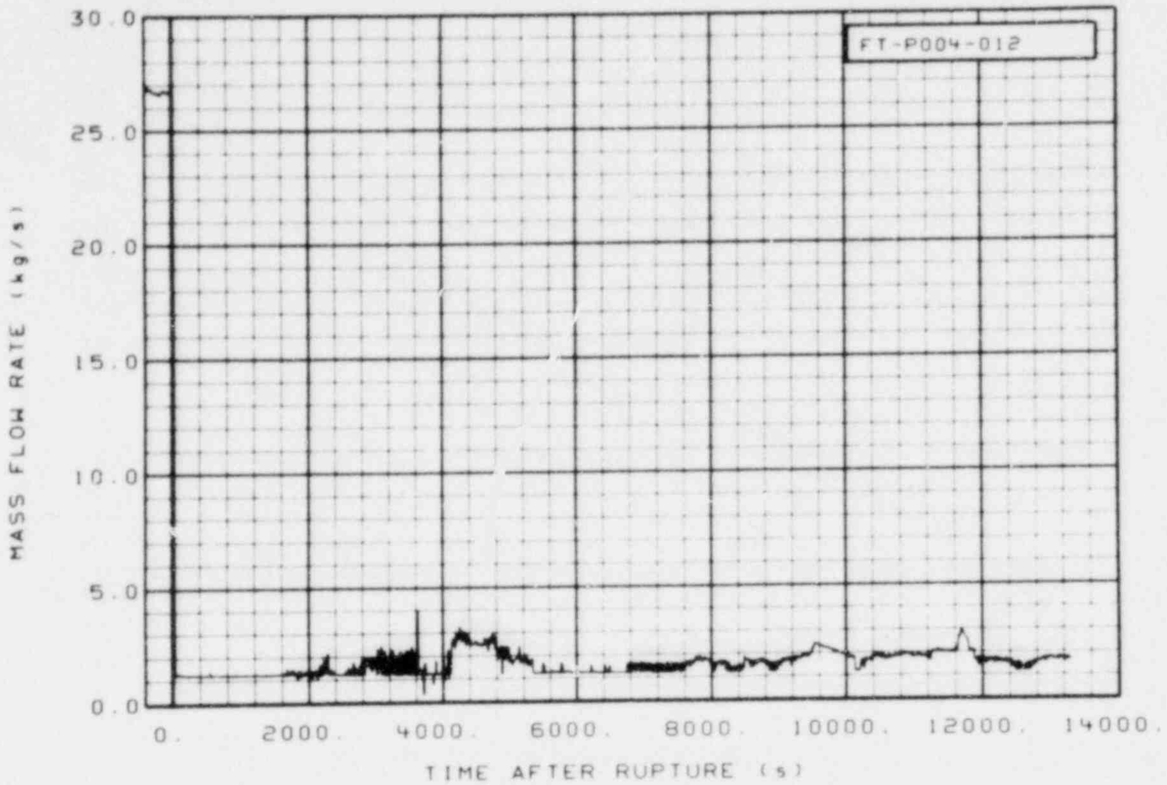


Figure 110. Steam flow rate at condenser inlet (FT-P004-012) (Qualified).

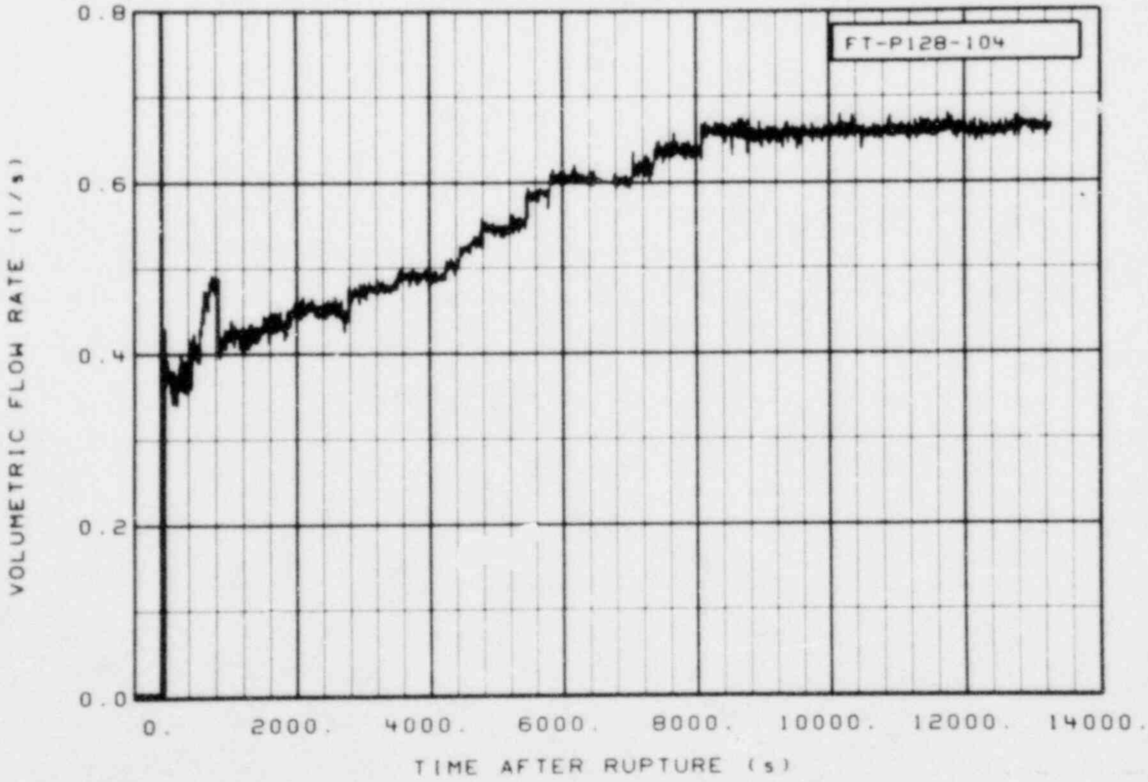


Figure 111. Flow rate in HPIS Pump A discharge (FT-P128-104) (Qualified).

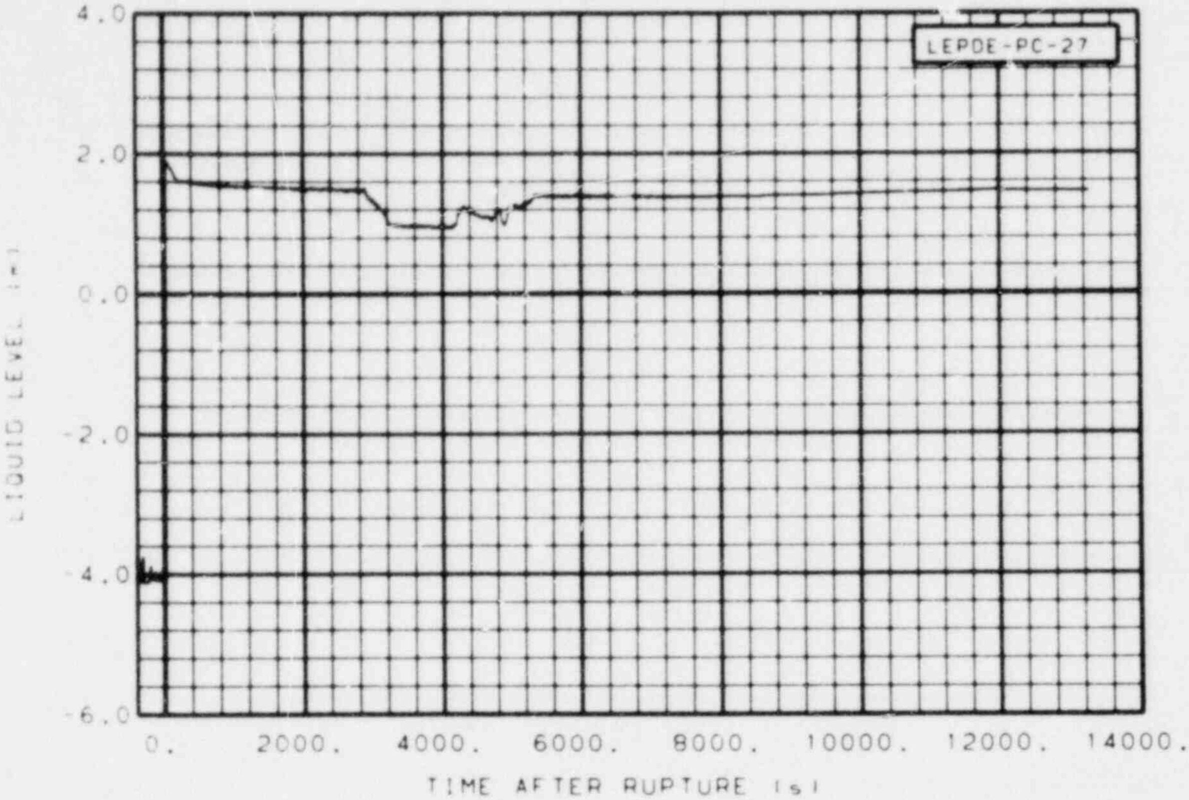


Figure 112. Liquid level in intact loop from steam generator outlet to bottom of loop seal (LEPDE-PC-027) (Qualified, good from 500 to 6000 s).

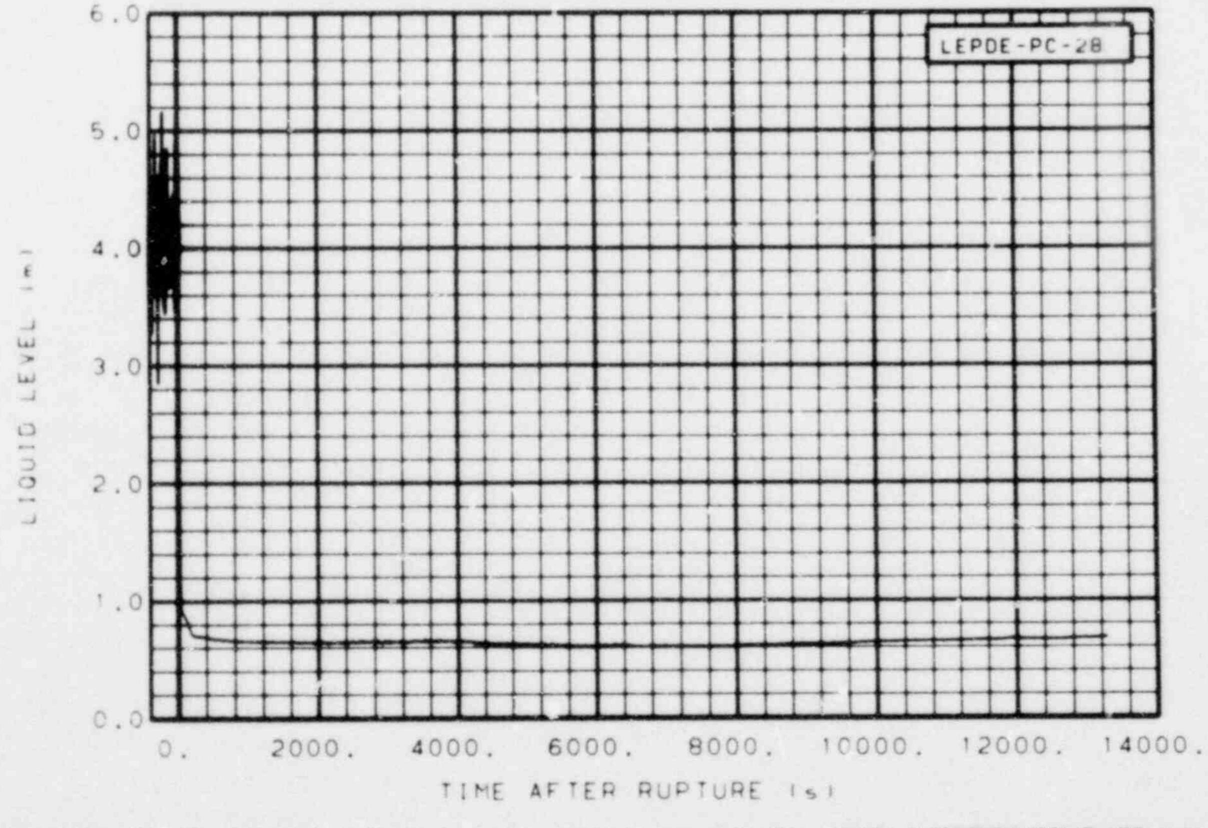


Figure 113. Liquid level in intact loop from bottom of loop seal to primary coolant Pump 2 inlet (LEPDE-PC-028) (Qualified, good from 500 to 6000 s).

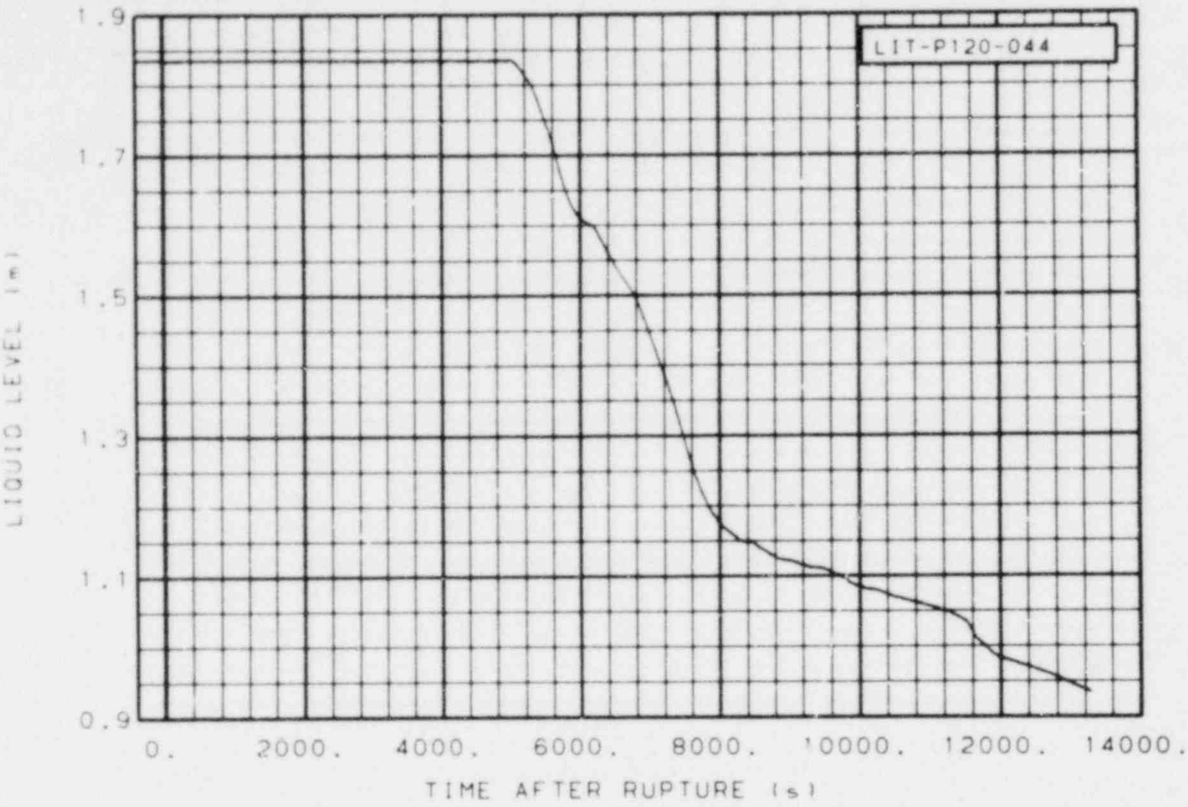


Figure 114. Liquid level in ECCS Accumulator A (LIT-P120-044) (Qualified).

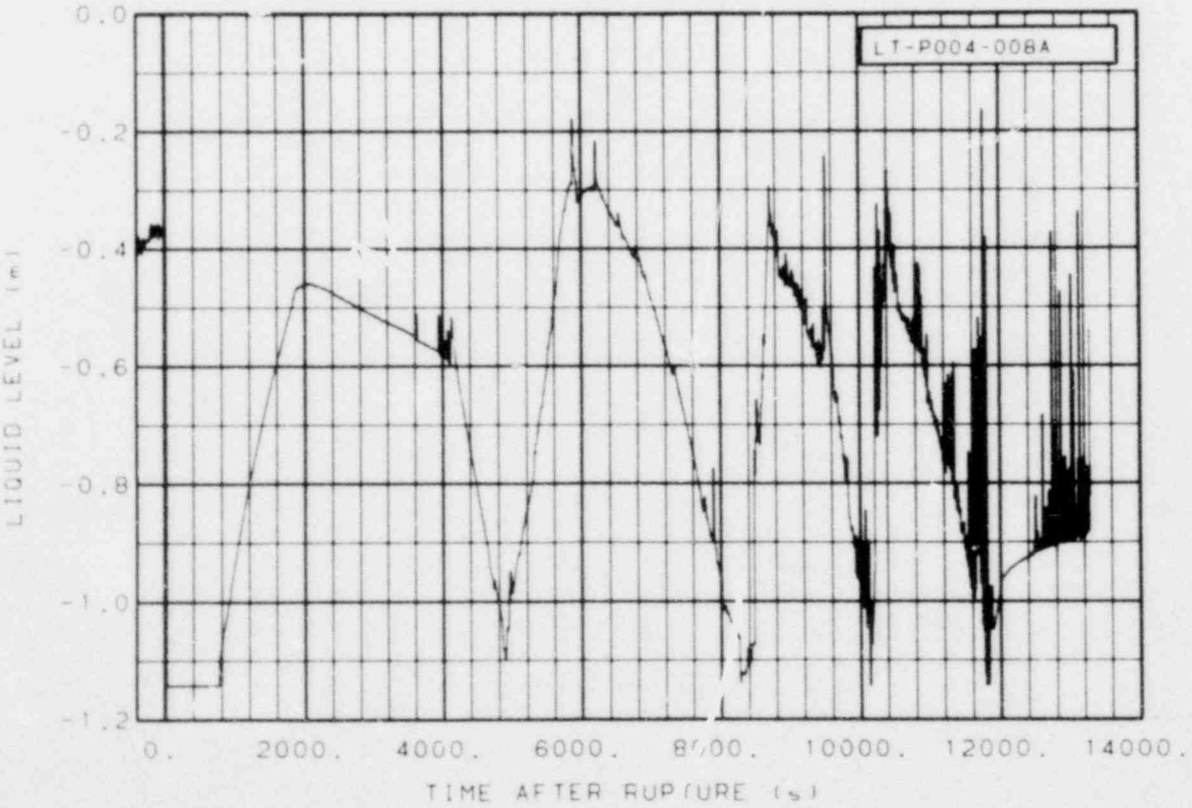


Figure 115. Liquid level in steam generator secondary side, narrow range (LT-P004-008A) (Qualified, absolute magnitude uncertain-narrow range instrument).

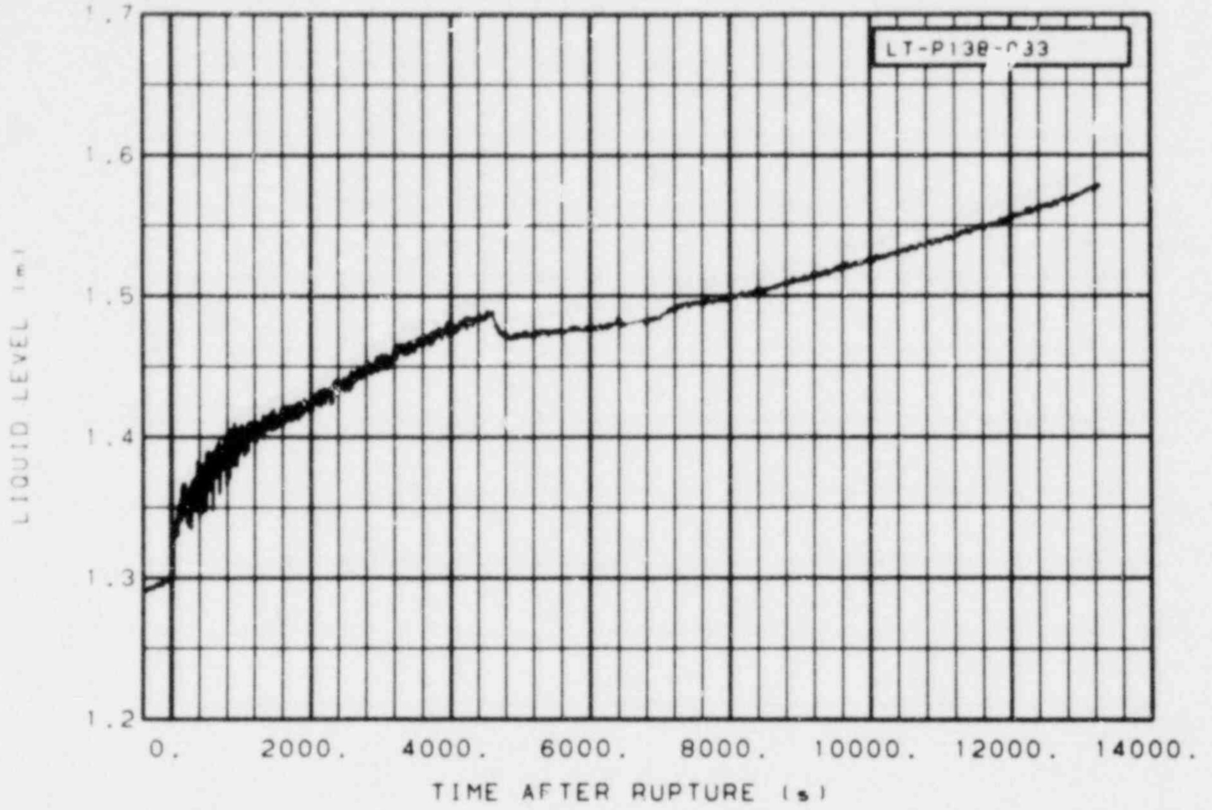


Figure 116. Liquid level in blowdown suppression tank, north end (LT-P138-033) (Qualified, level decrease at approximately 4600 s was caused by pressure equalization between the tank and header, which forced liquid back up into the downcomers).

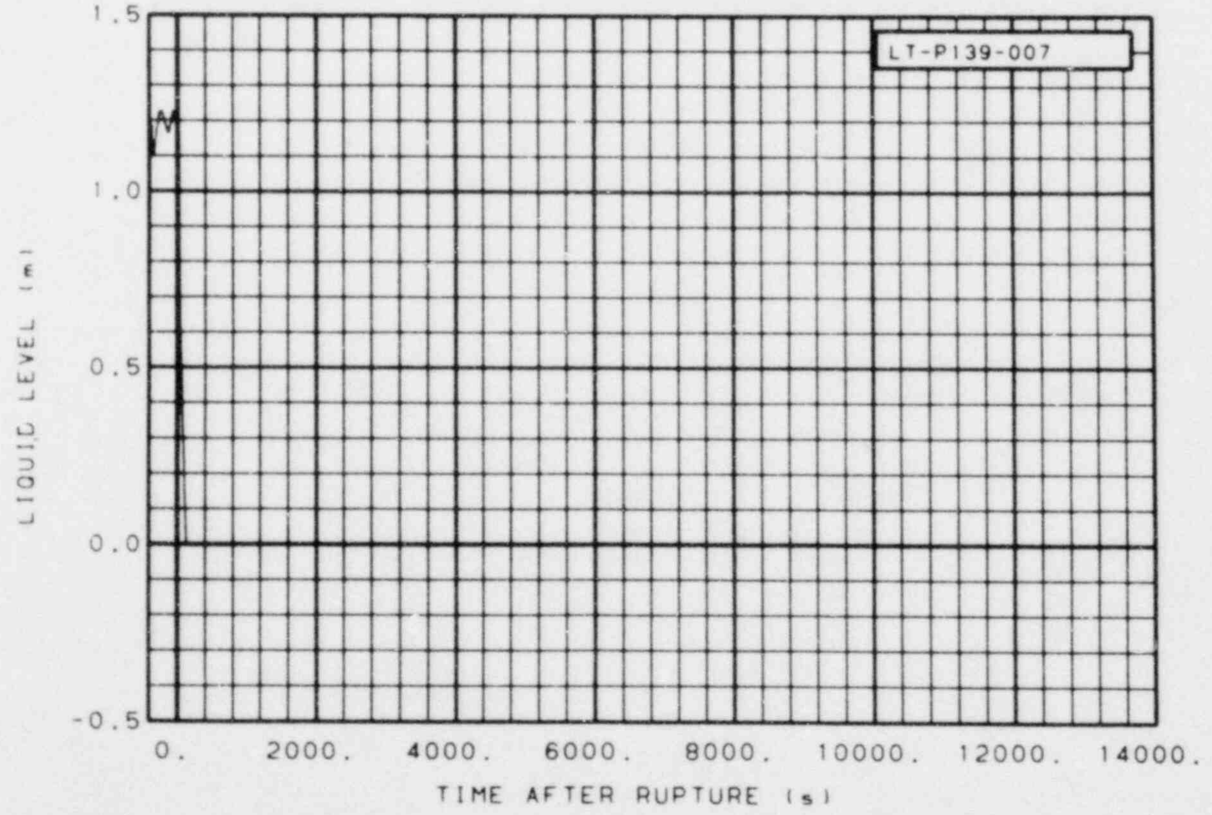


Figure 117. Liquid level in pressurizer (LT-P139-007) (Qualified).

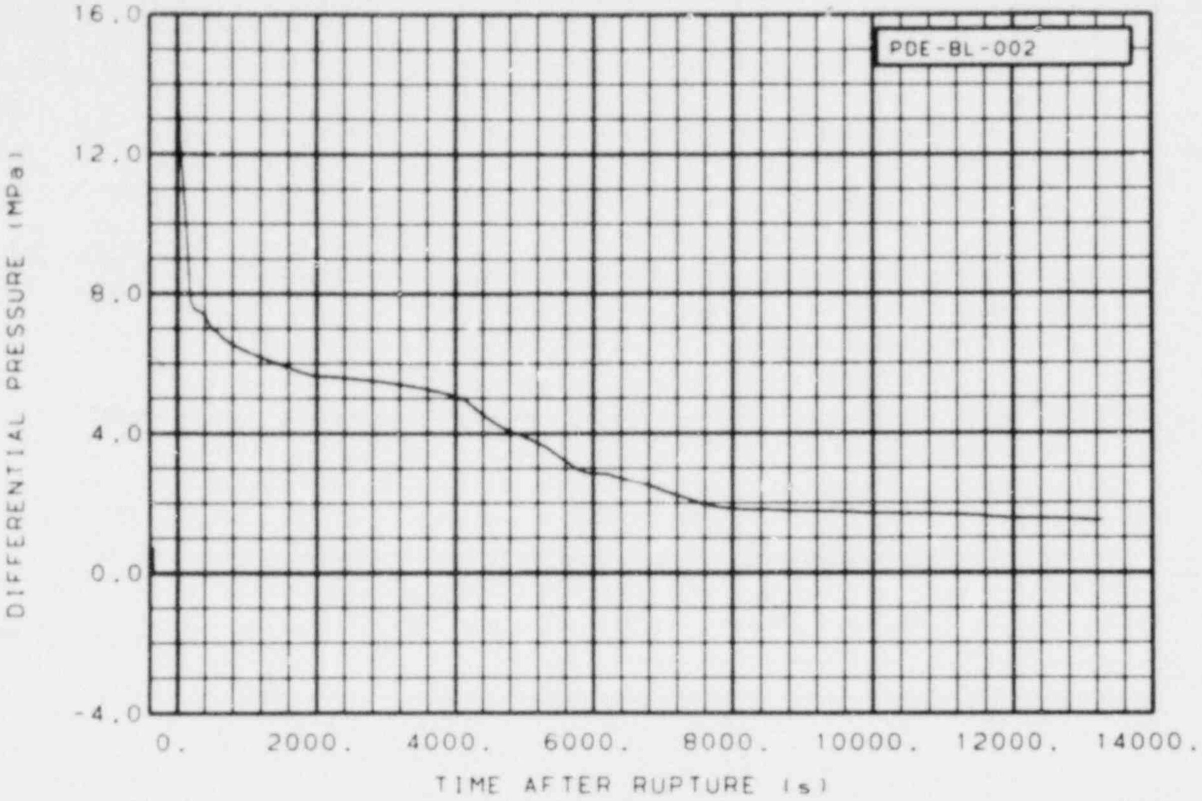


Figure 118. Differential pressure in broken loop cold leg across small break orifice (PDE-BL-002) (Qualified).

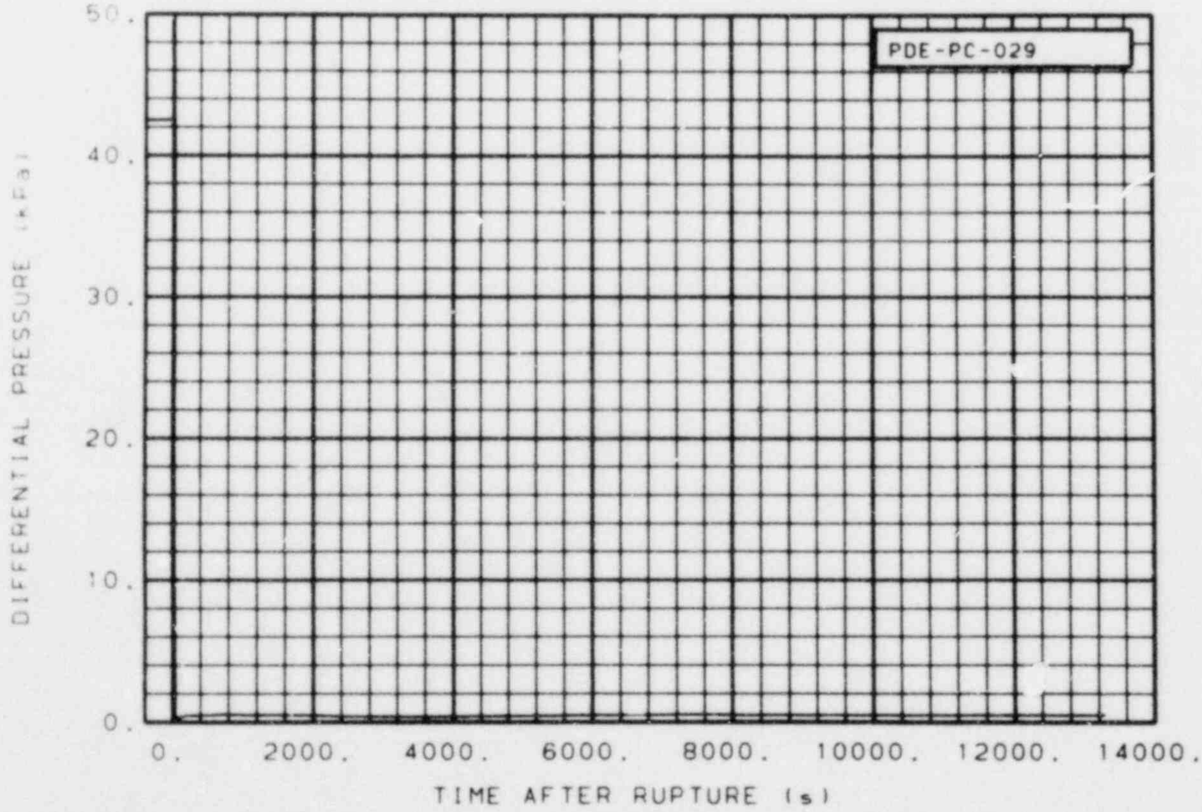


Figure 119. Differential pressure in intact loop next to bottom of ECC Rake 1, pitot tube facing reactor vessel (PDE-PC-029) (Qualified).

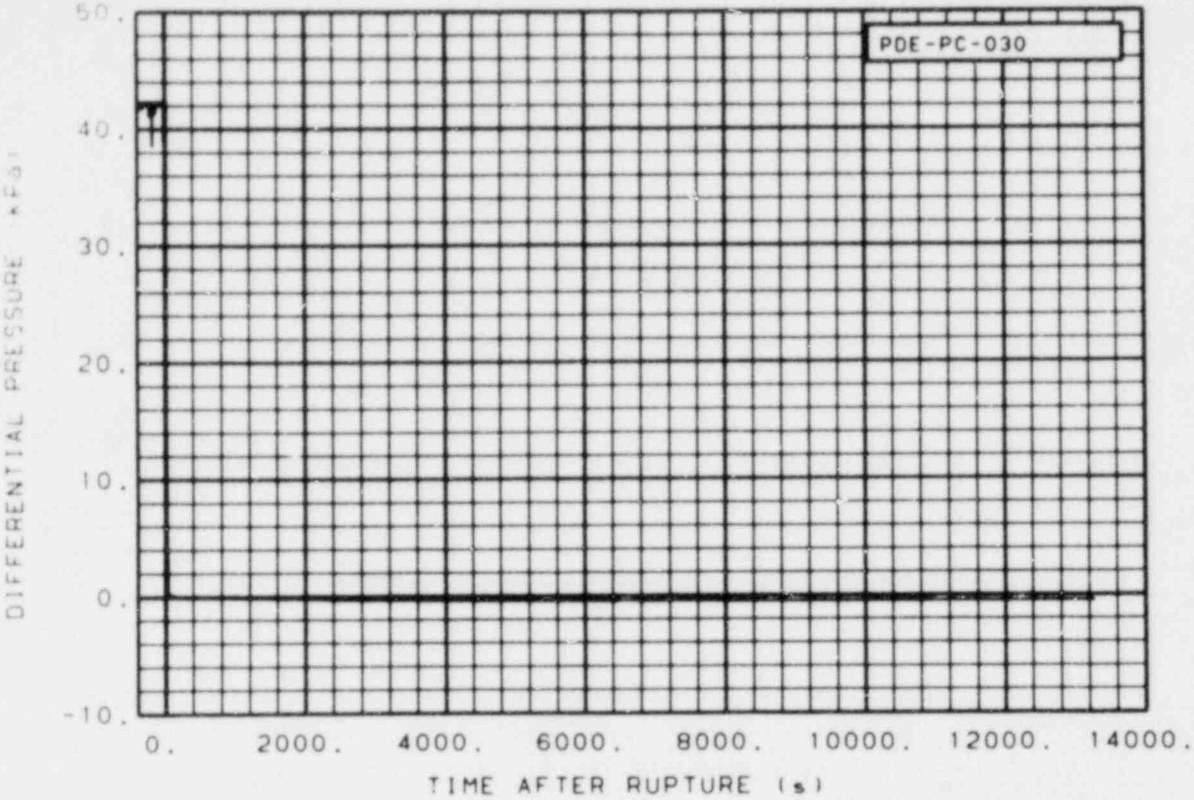


Figure 120. Differential pressure in intact loop at bottom of ECC Rake 1, pitot tube facing reactor vessel (PDE-PC-030) (Qualified).

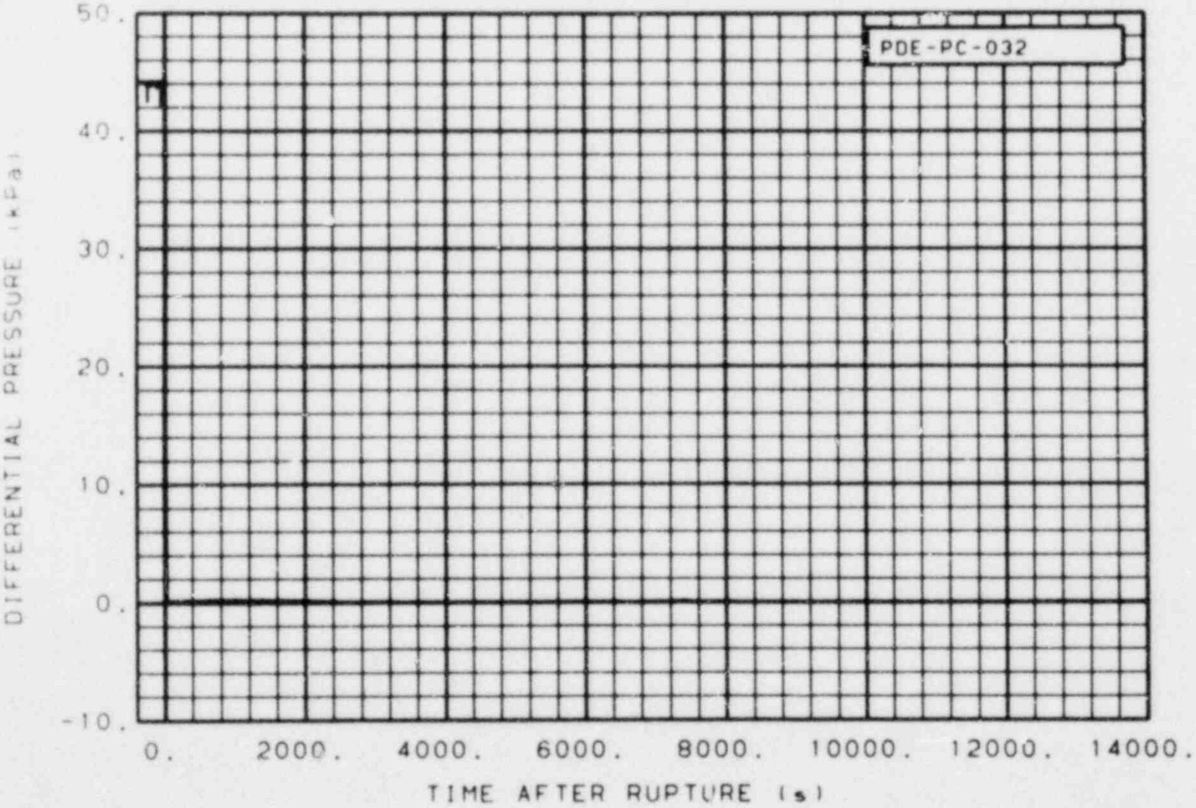


Figure 121. Differential pressure in intact loop at bottom of ECC Rake 2, pitot tube facing reactor vessel (PDE-PC-032) (Qualified).

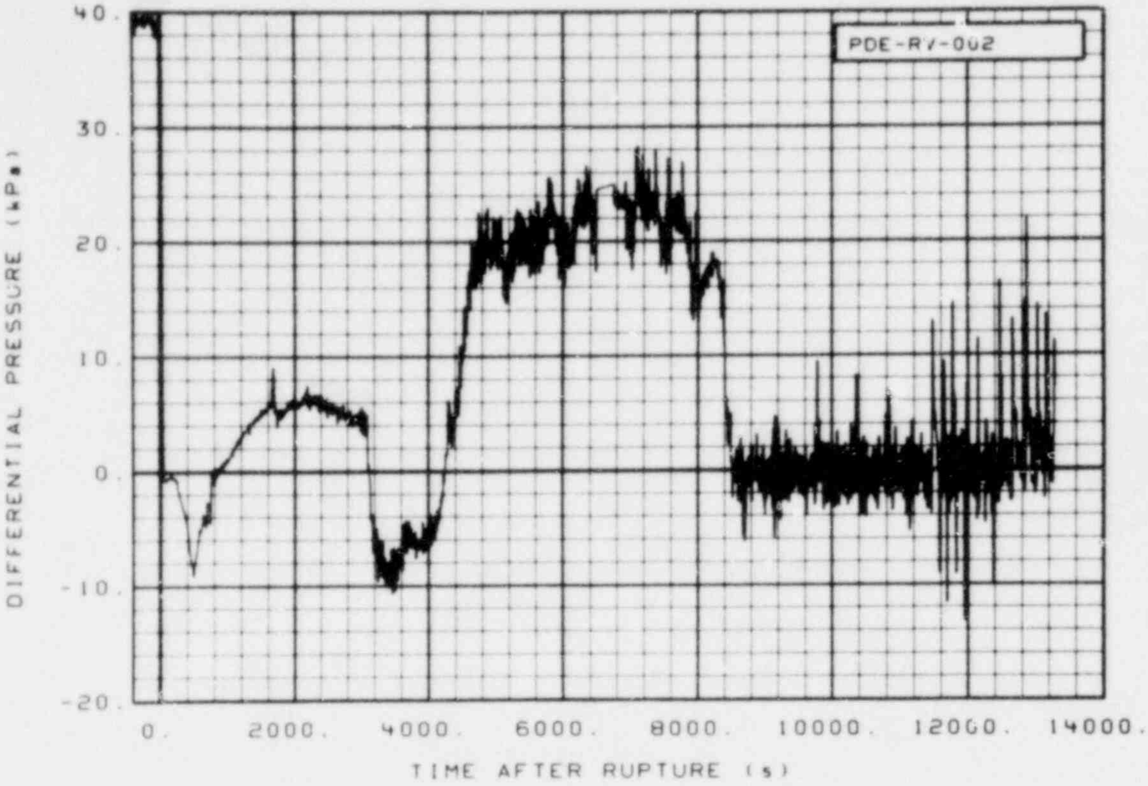


Figure 122. Differential pressure in reactor vessel core from upper end box to lower end box of Fuel Assembly 1 (PDE-RV-002) (Qualified).

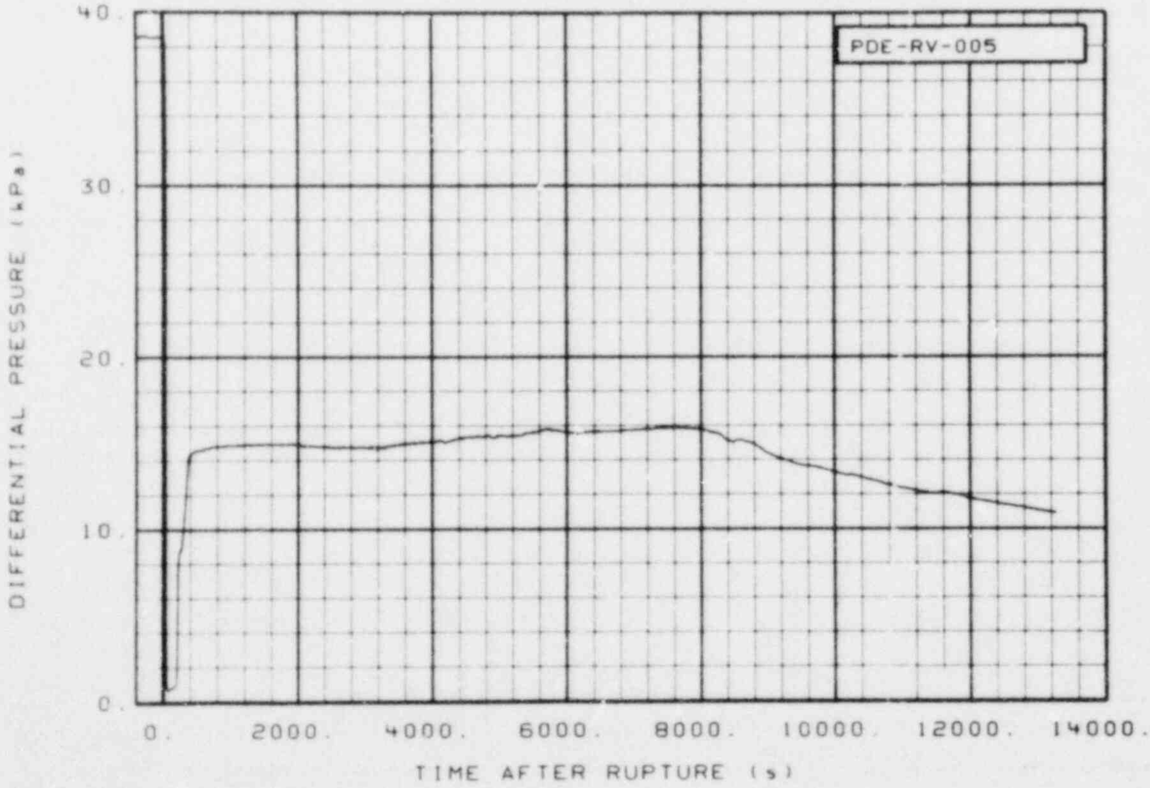


Figure 123. Differential pressure in reactor vessel from vessel top to intact loop hot leg outlet (PDE-RV-005) (Qualified).

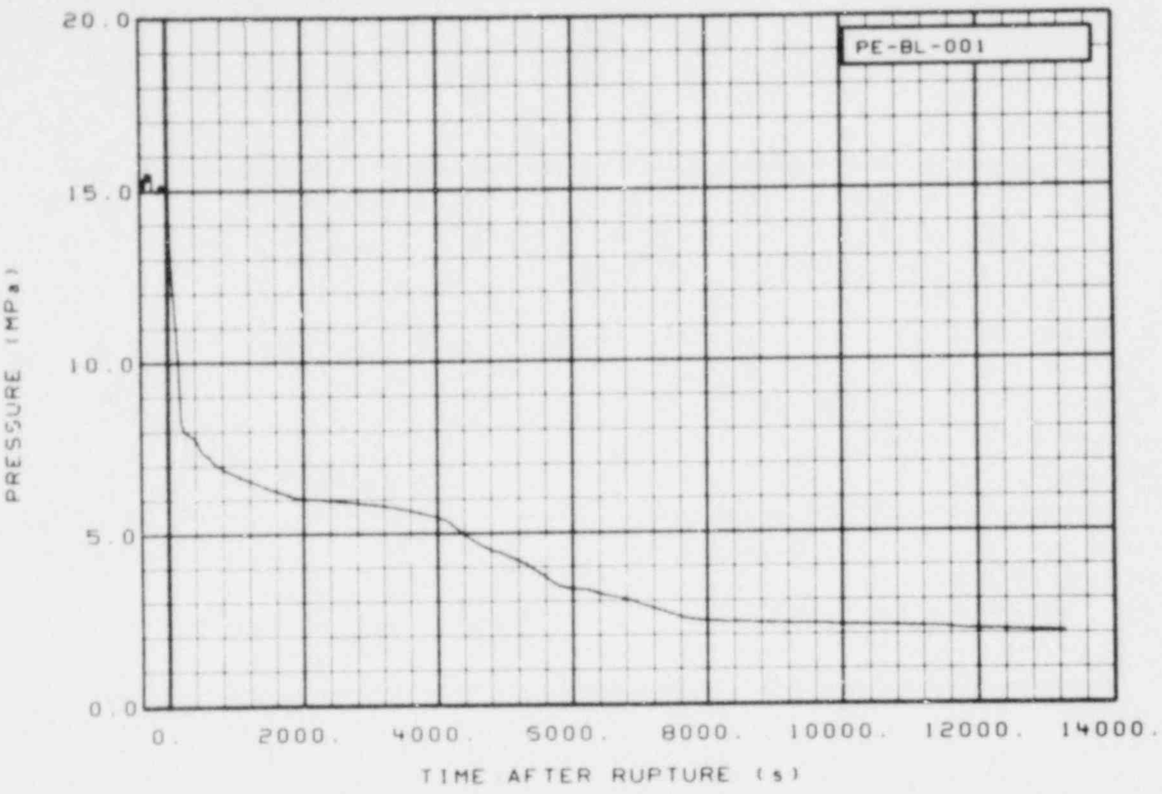


Figure 124. Pressure in broken loop cold leg (PE-BL-001) (Qualified).

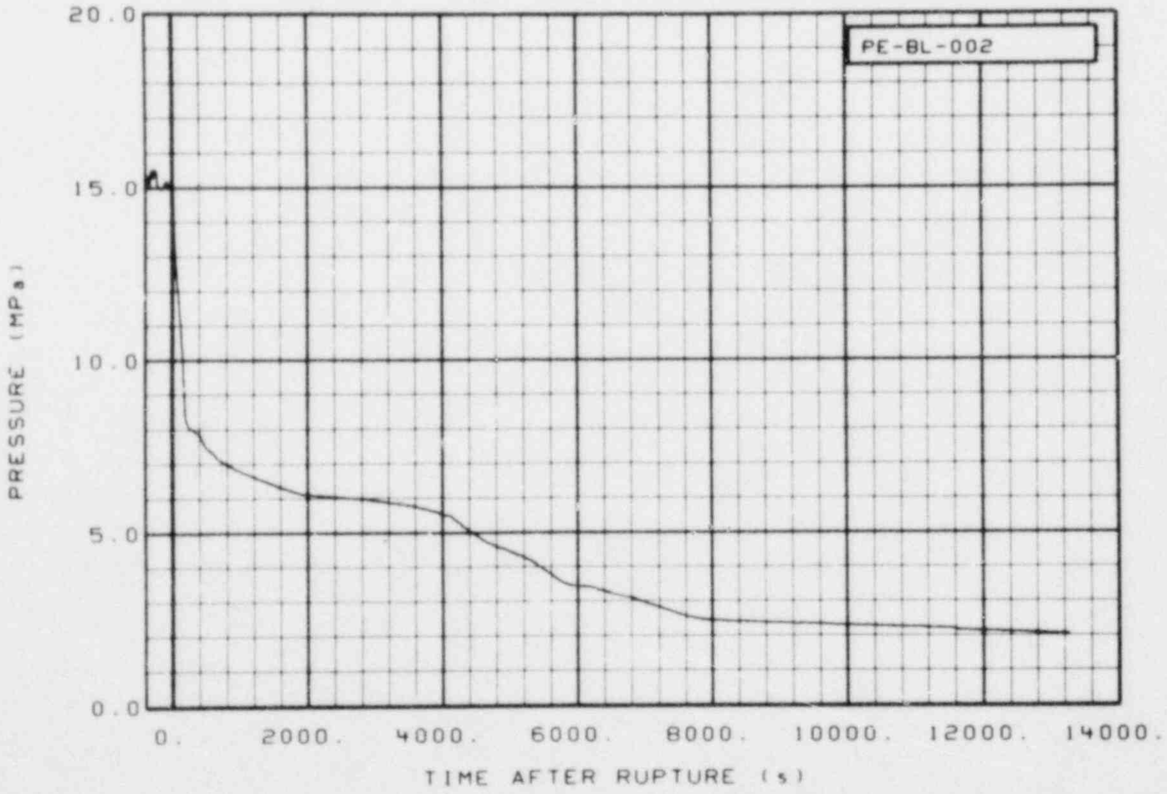


Figure 125. Pressure in broken loop hot leg (PE-BL-002) (Qualified).

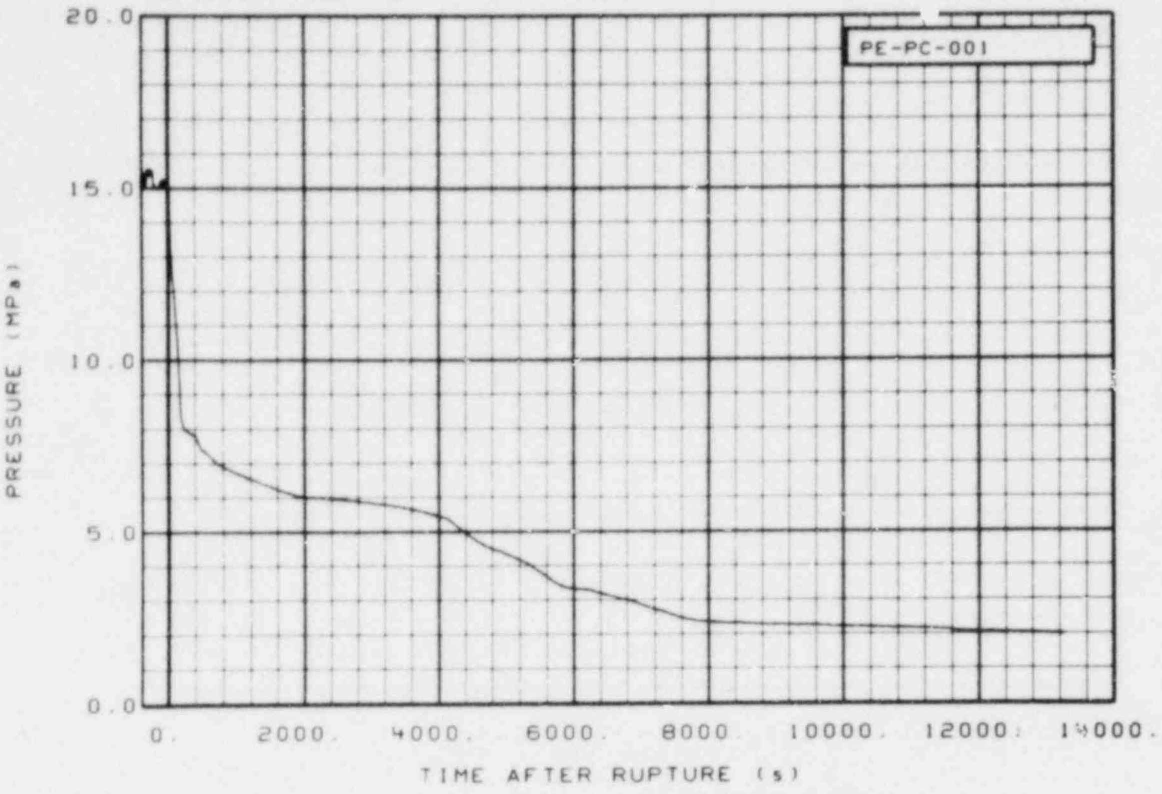


Figure 126. Pressure in intact loop cold leg (PE-PC-001) (Qualified).

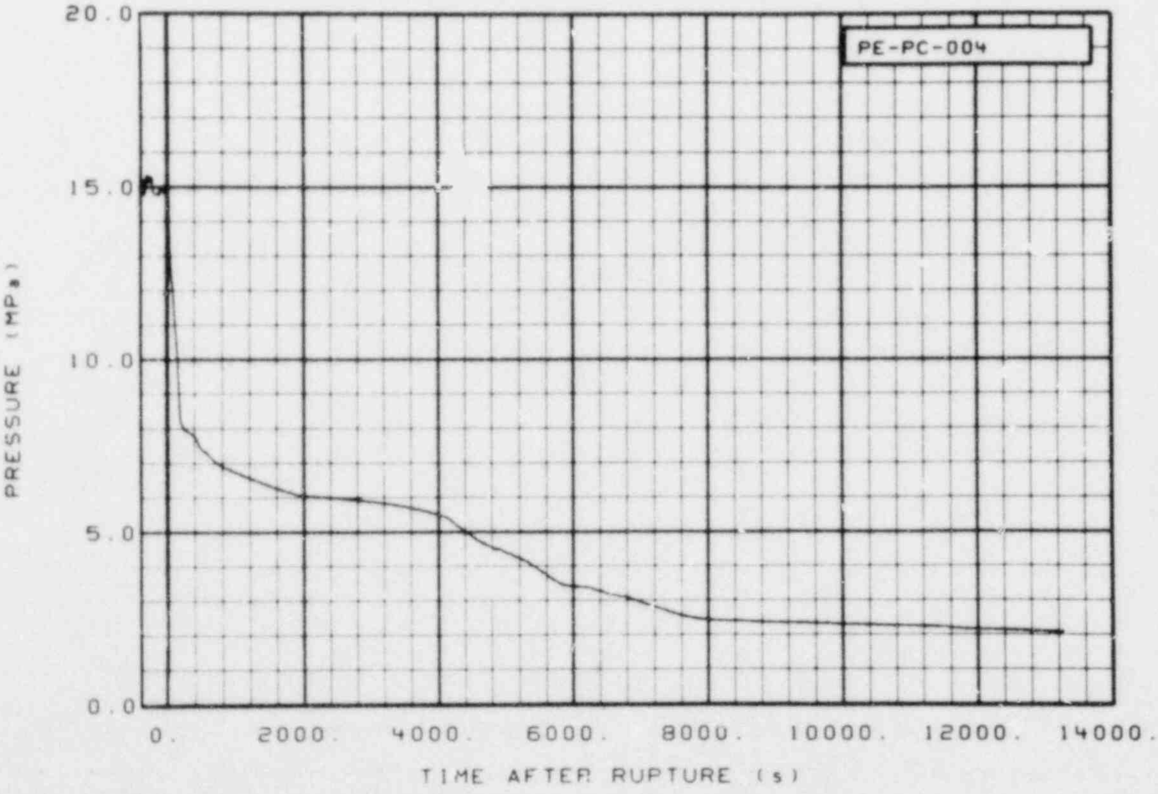


Figure 127. Pressure in pressurizer (PE-PC-004) (Qualified).

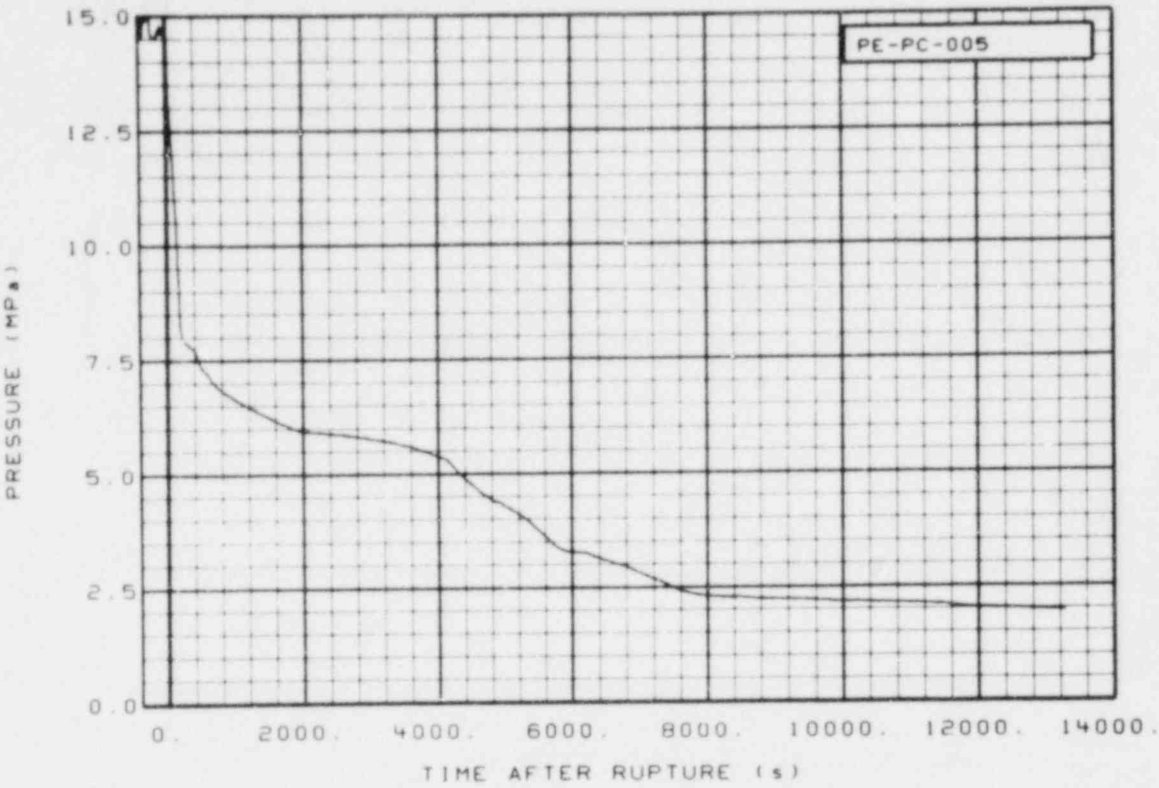


Figure 128. Reference pressure in intact loop between steam generator outlet and pump inlet (PE-PC-005) (Qualified).

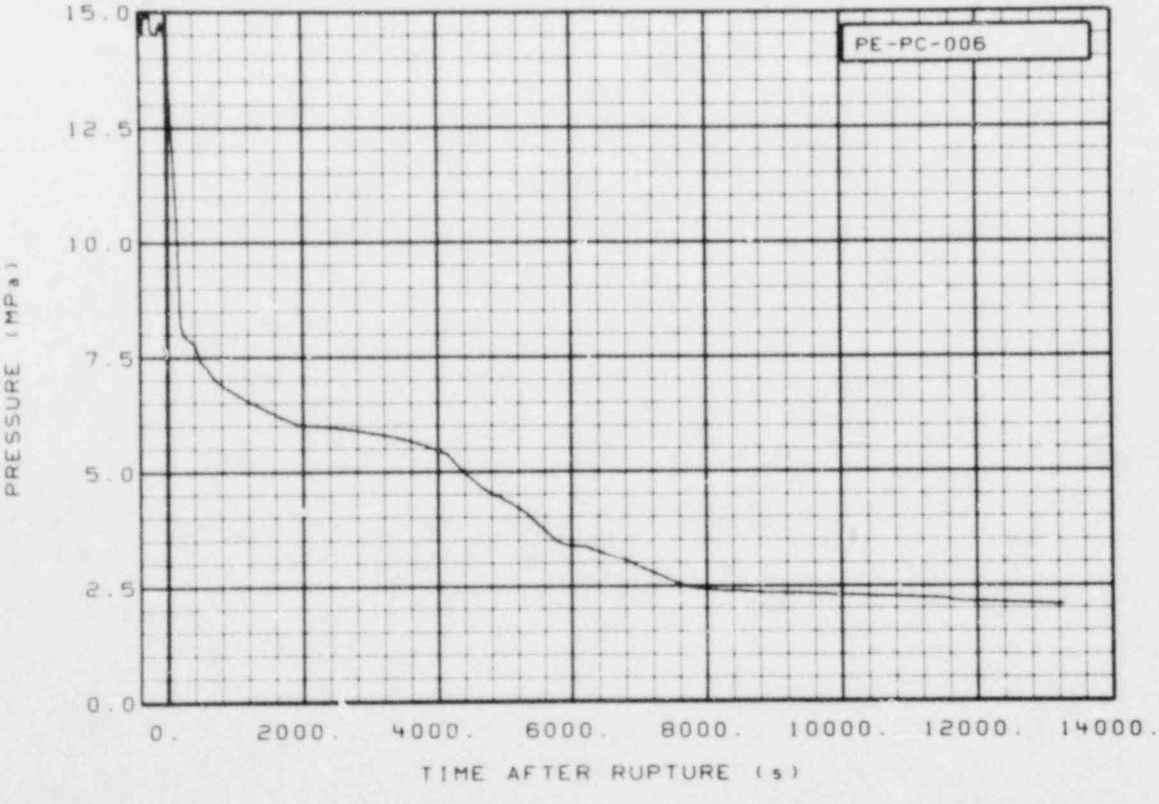


Figure 129. Reference pressure in intact loop between steam generator outlet and pump inlet (PE-PC-006) (Qualified).

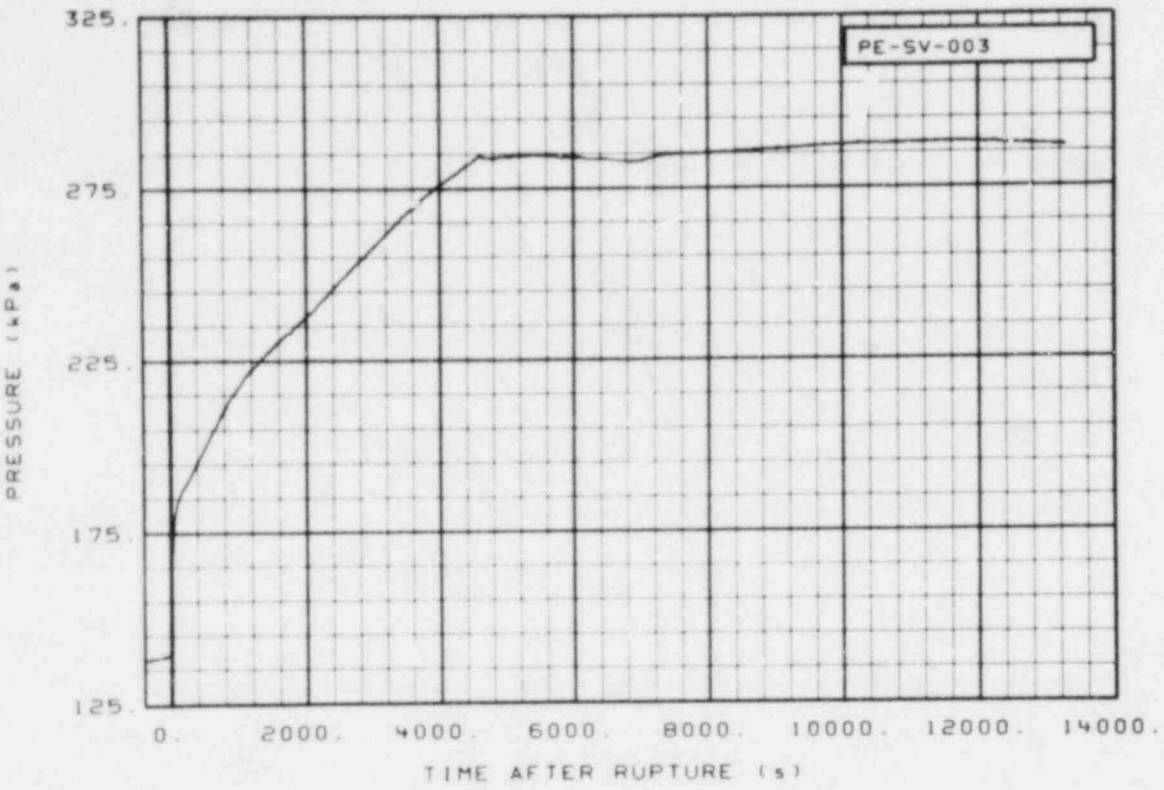


Figure 130. Pressure in blowdown suppression tank submerged near Downcomer 1 (PE-SV-003) (Qualified).

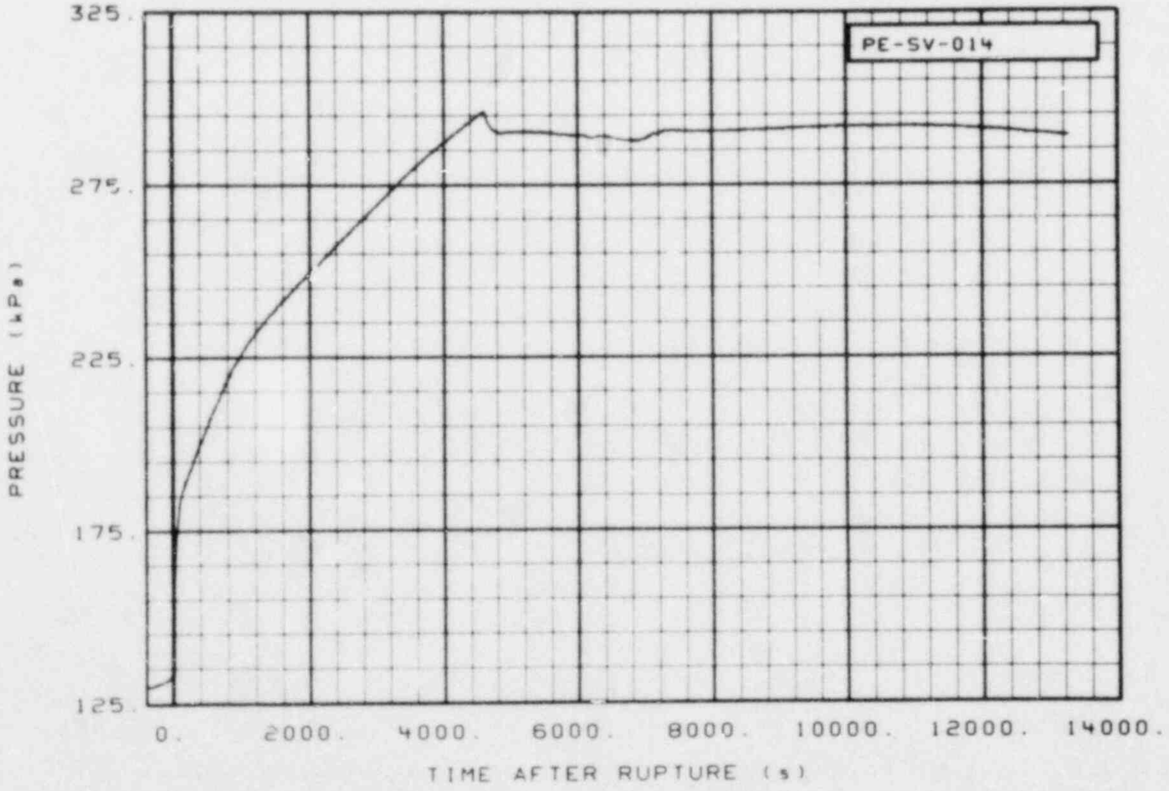


Figure 131. Pressure in blowdown suppression tank header submerged above Downcomer 4 (PE-SV-014) (Qualified).

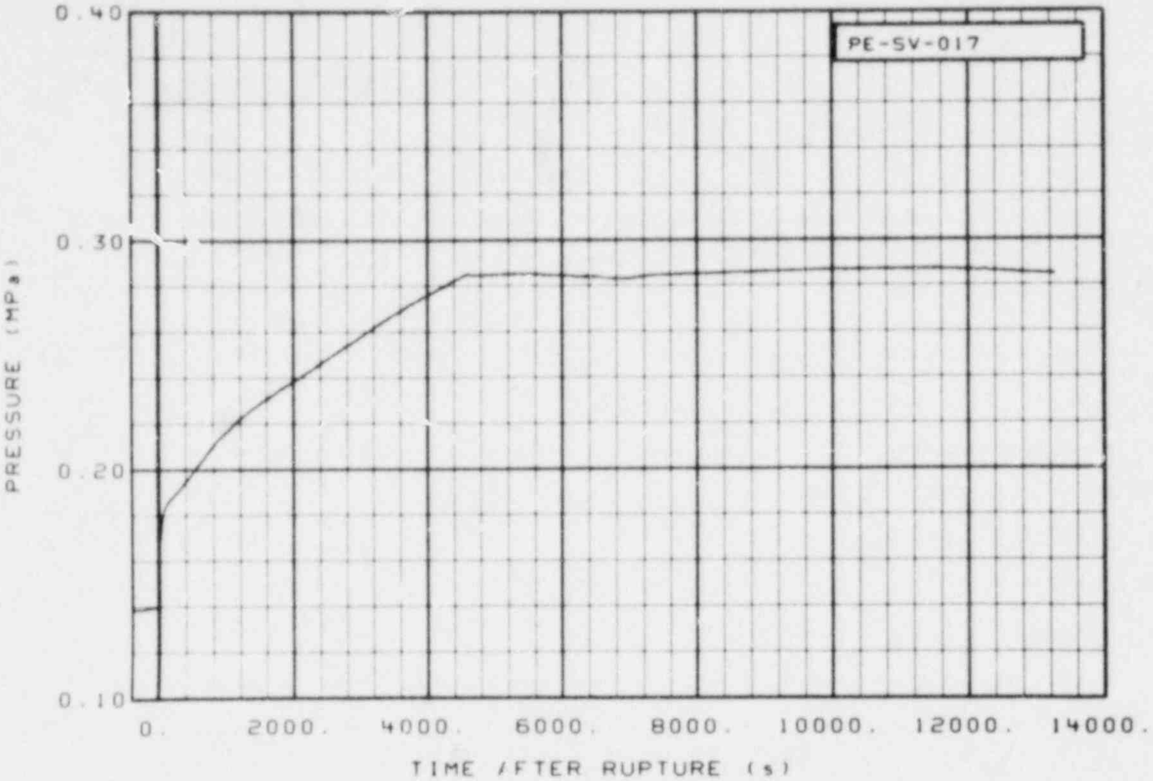


Figure 132. Pressure in blowdown suppression tank top 1.38 m north of Downcomer 3 (PE-SV-017) (Qualified).

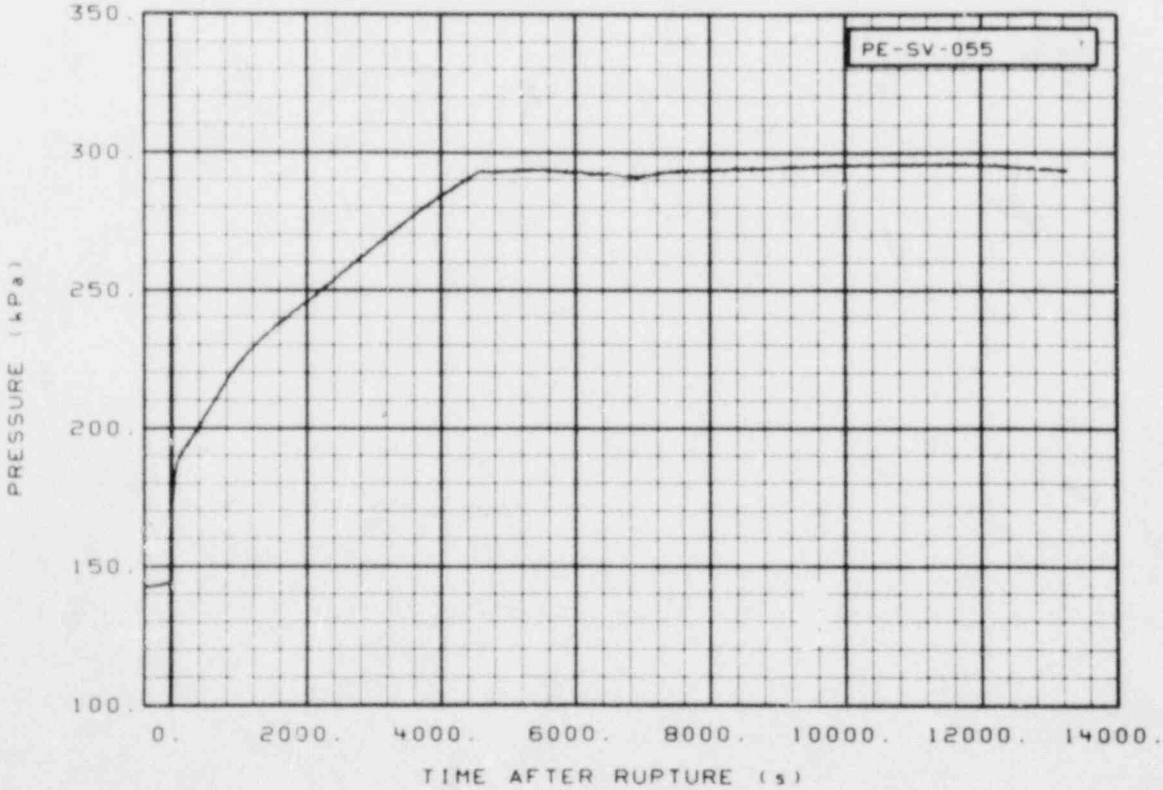


Figure 133. Pressure in blowdown suppression tank top north of Downcomer 4 (PE-SV-055) (Qualified).

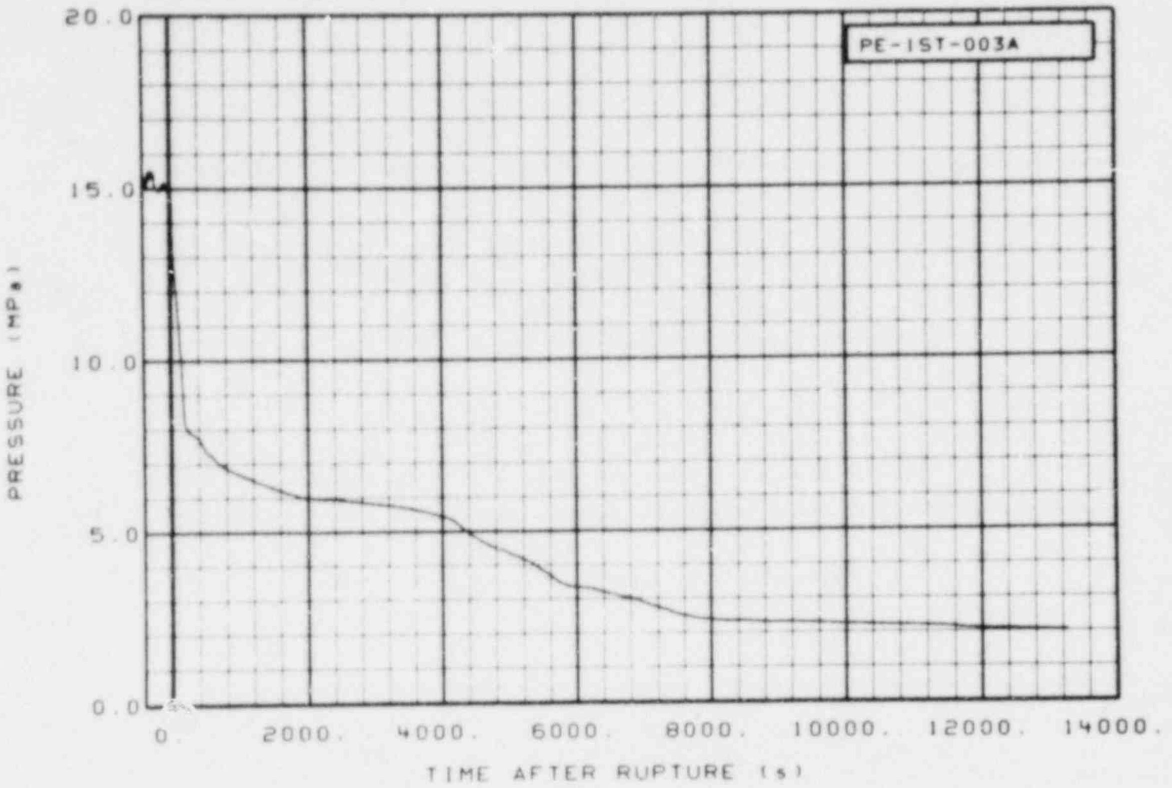


Figure 134. Pressure in reactor vessel Downcomer Stalk 1 (PE-1ST-003A) (Qualified).

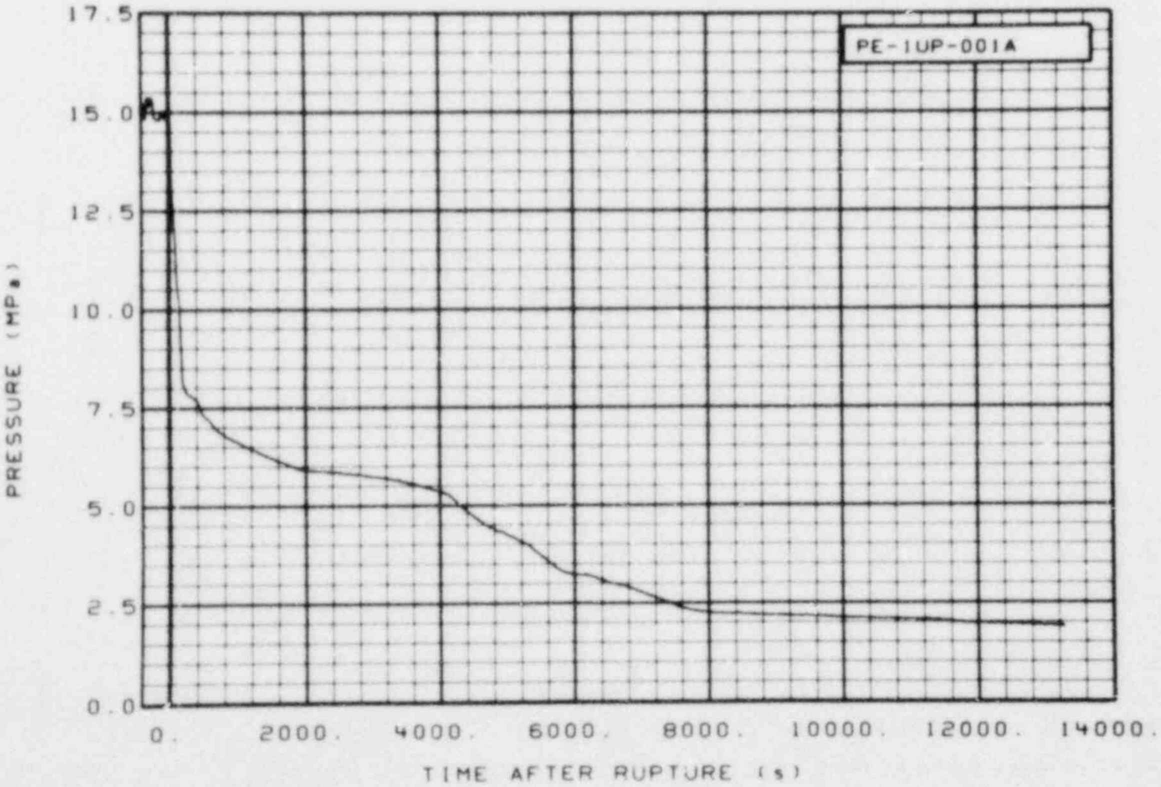


Figure 135. Pressure in reactor vessel above upper end box of Fuel Assembly 1 (PE-1UP-001A) (Qualified).

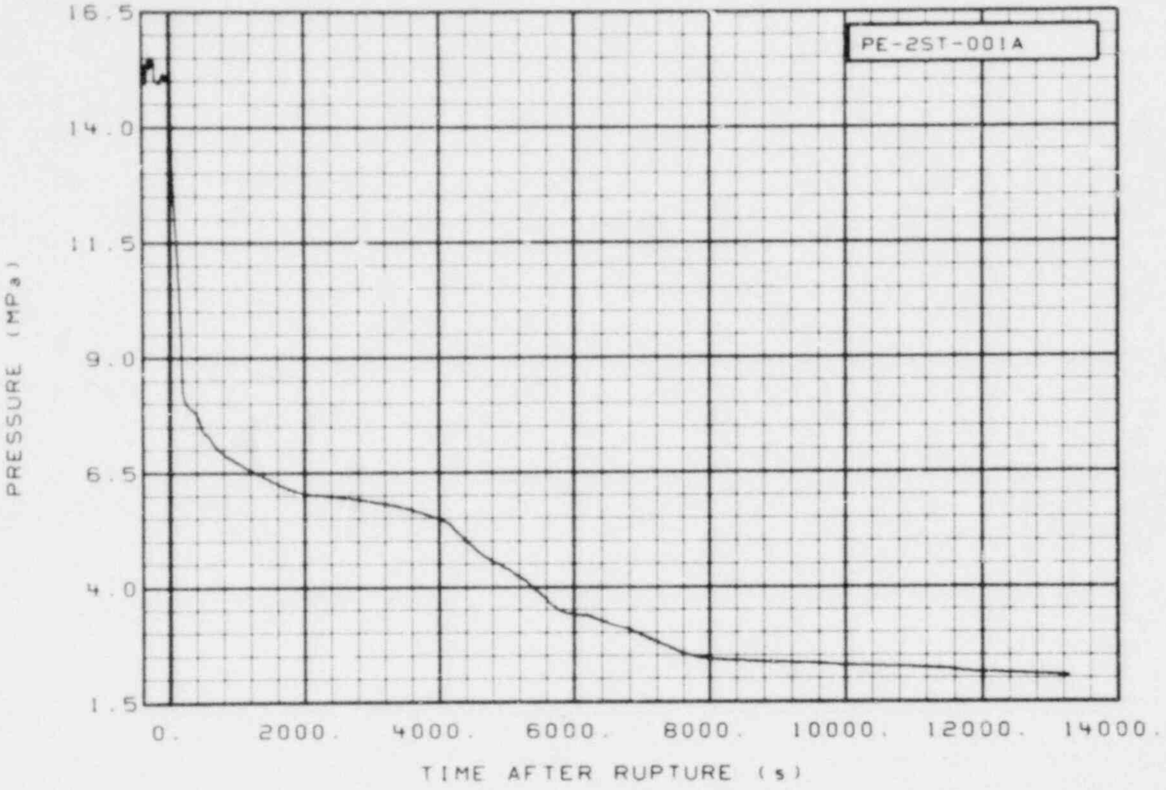


Figure 136. Pressure in reactor vessel Downcomer Stalk 2 (PE-2ST-001A) (Qualified).

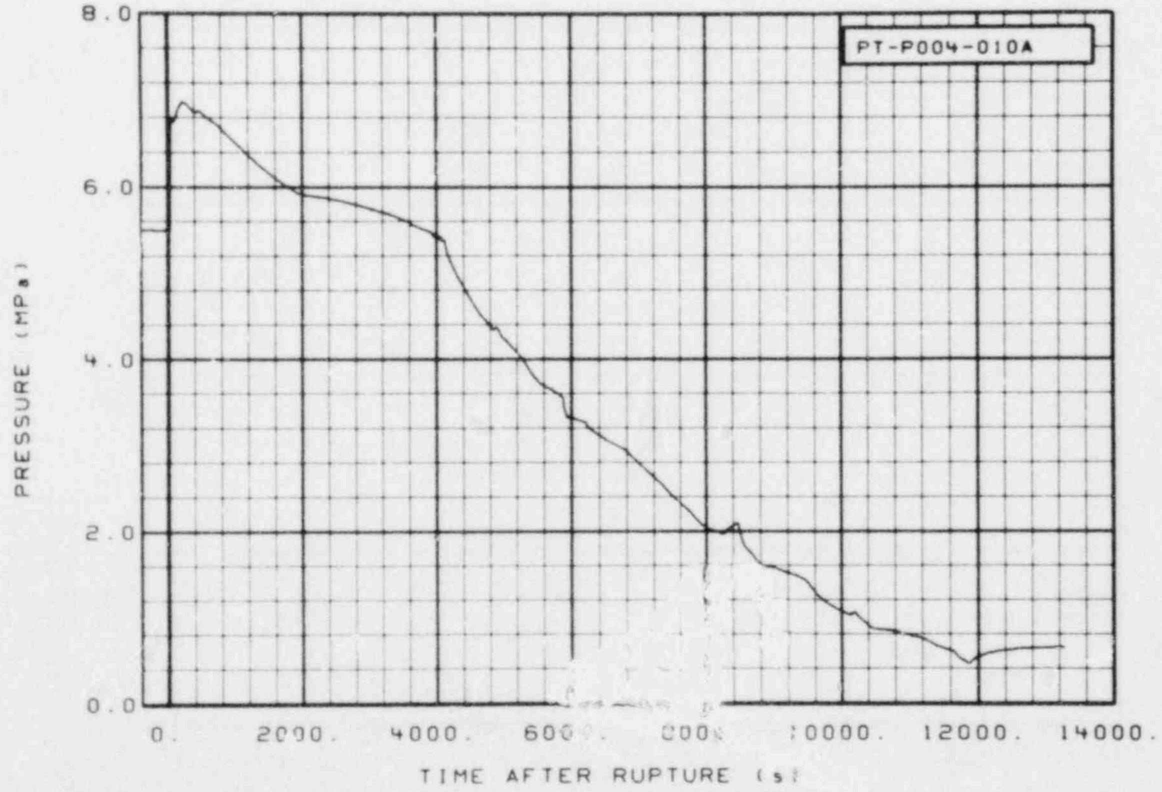


Figure 137. Pressure in steam generator secondary side 10-inch outlet (PT-P004-010A) (Qualified).

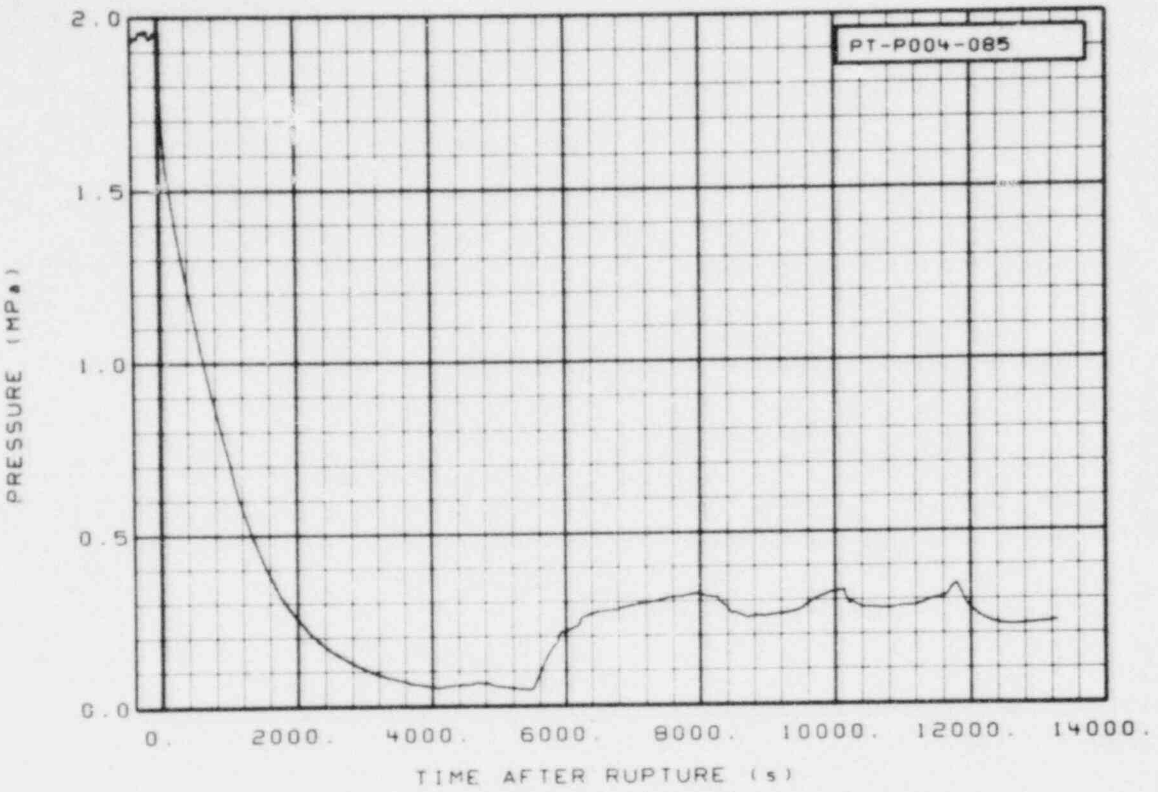


Figure 138. Pressure in secondary coolant system condenser 12-inch inlet (PT-P004-085) (Qualified).

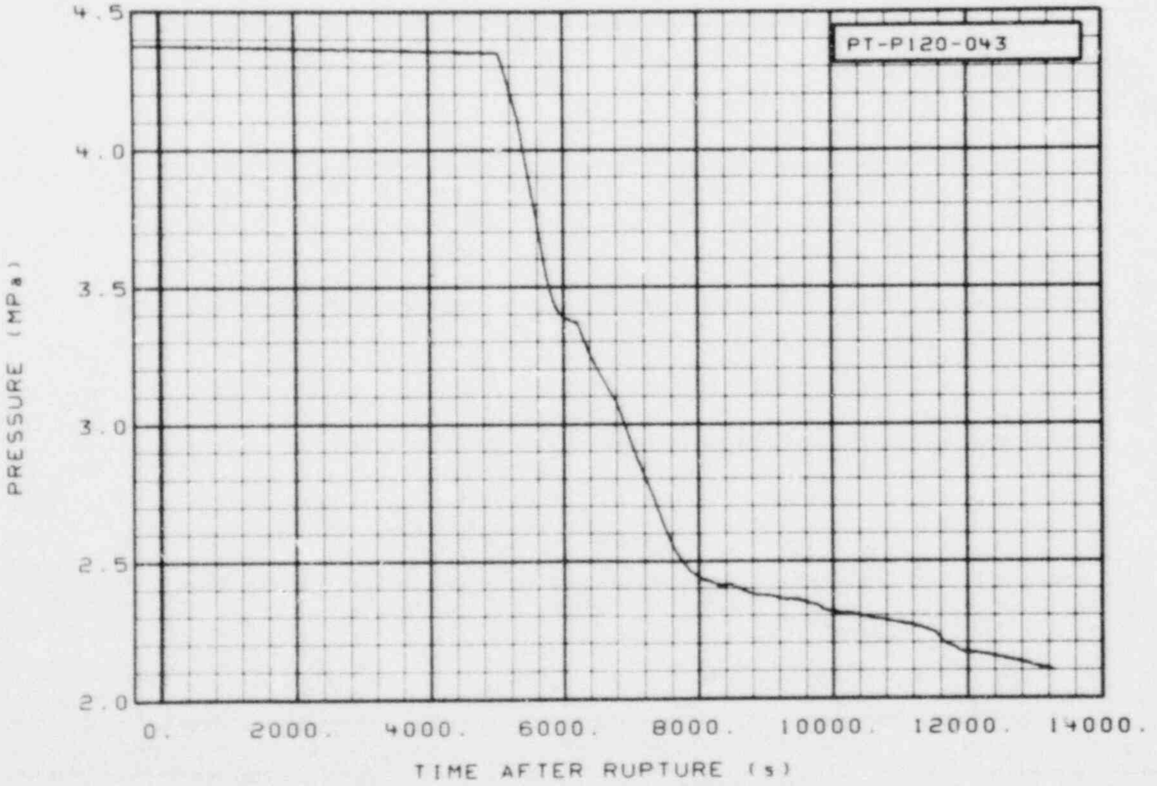


Figure 139. Pressure in ECCS Accumulator A (PT-P120-043) (Qualified).

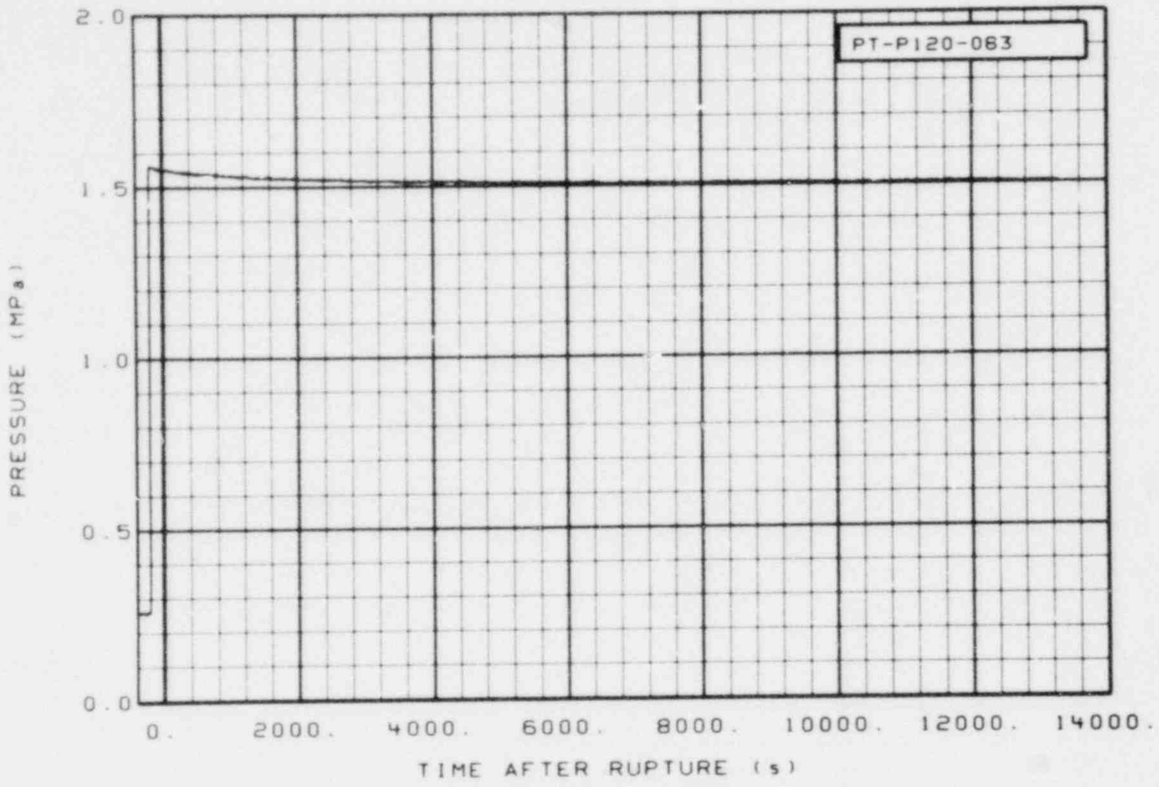


Figure 140. Pressure in ECCS LPIS Pump A discharge (PT-P120-083) (Qualified).

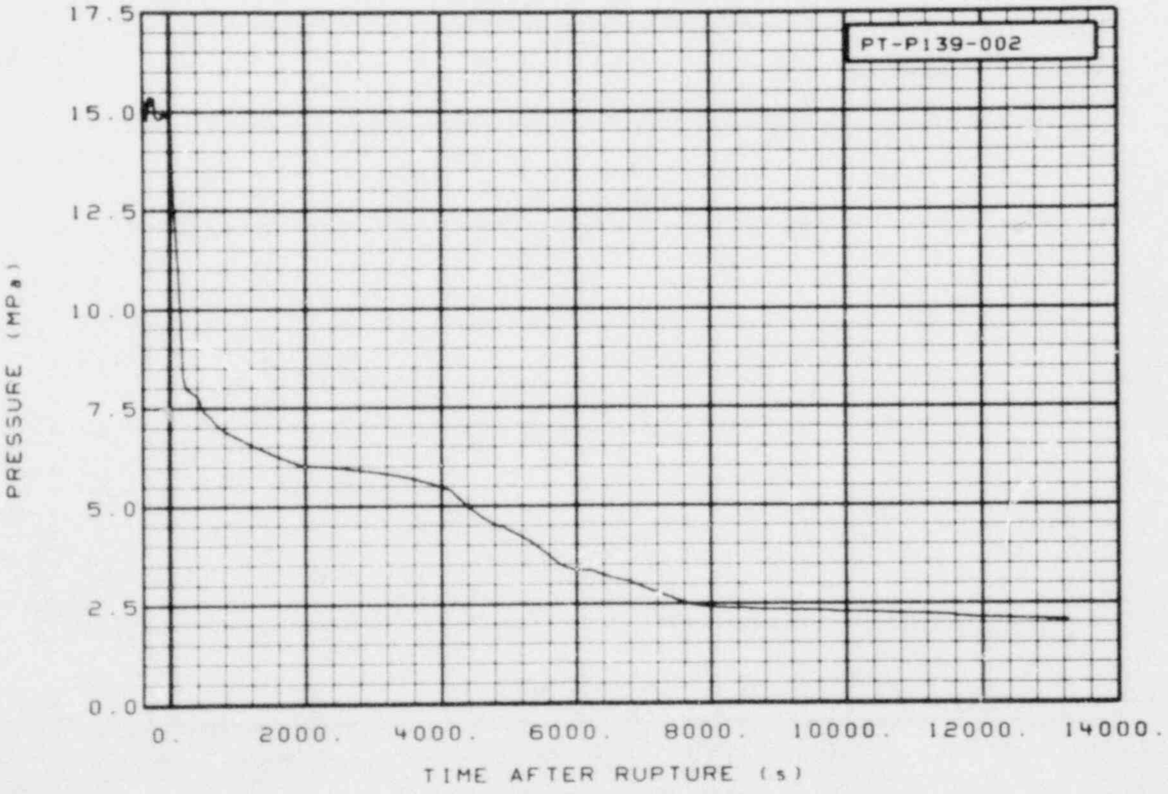


Figure 14!. Pressure in intact loop hot leg at venturi on bottom (PT-P139-002) (Qualified, good to 26 000 s).

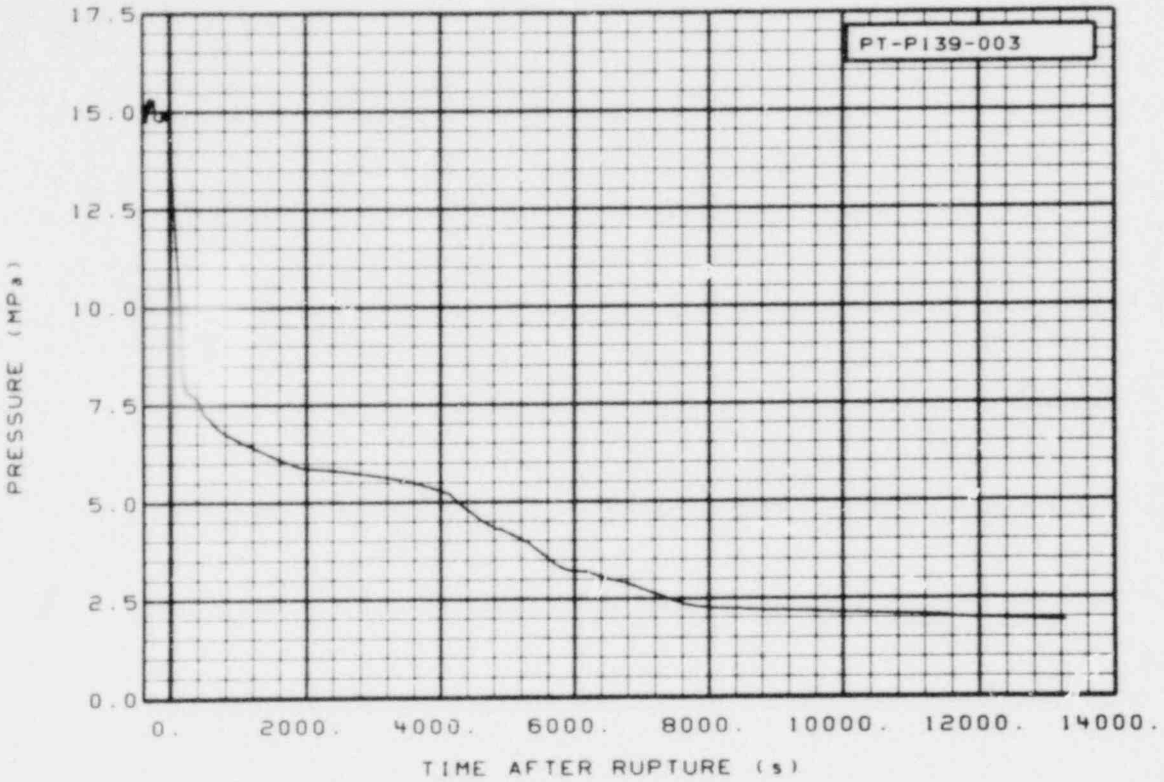


Figure 142. Pressure in intact loop hot leg at venturi on left side looking toward SG (PT-P139-003) (Qualified).

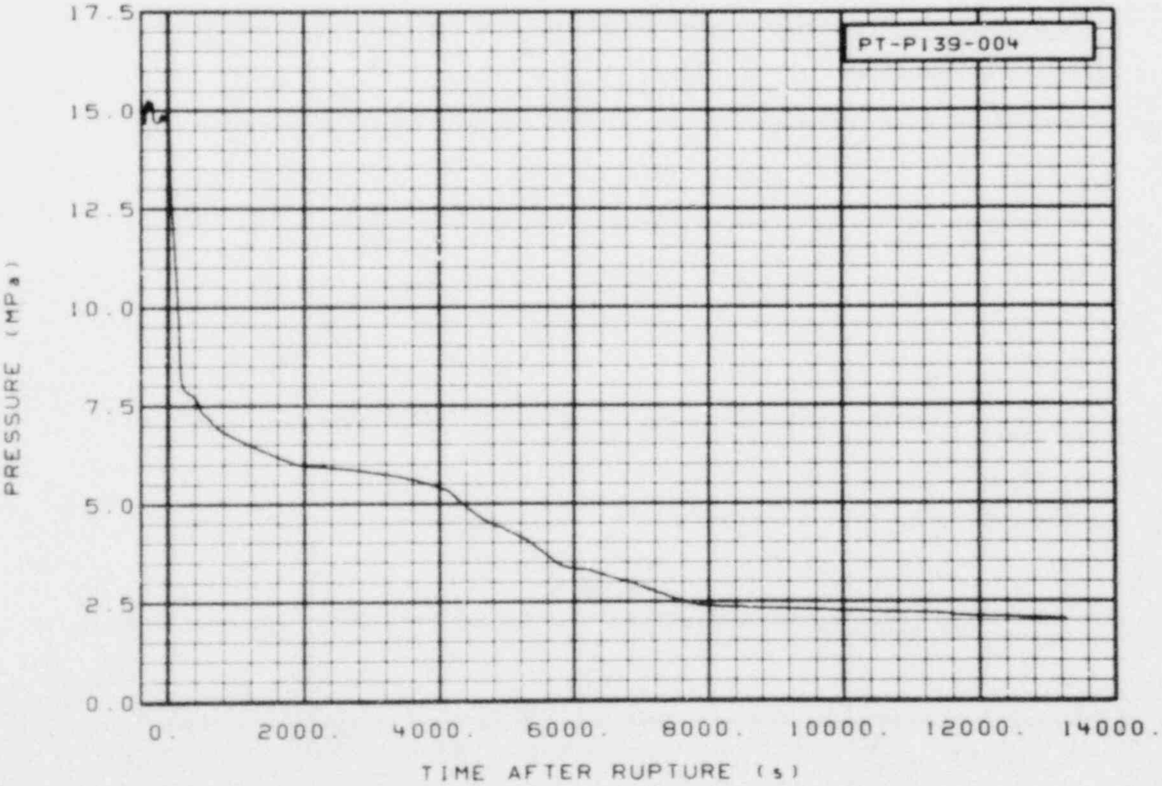


Figure 143. Pressure in intact loop hot leg at venturi on right side looking toward SG (PT-P139-004) (Qualified at low end of uncertainty band).

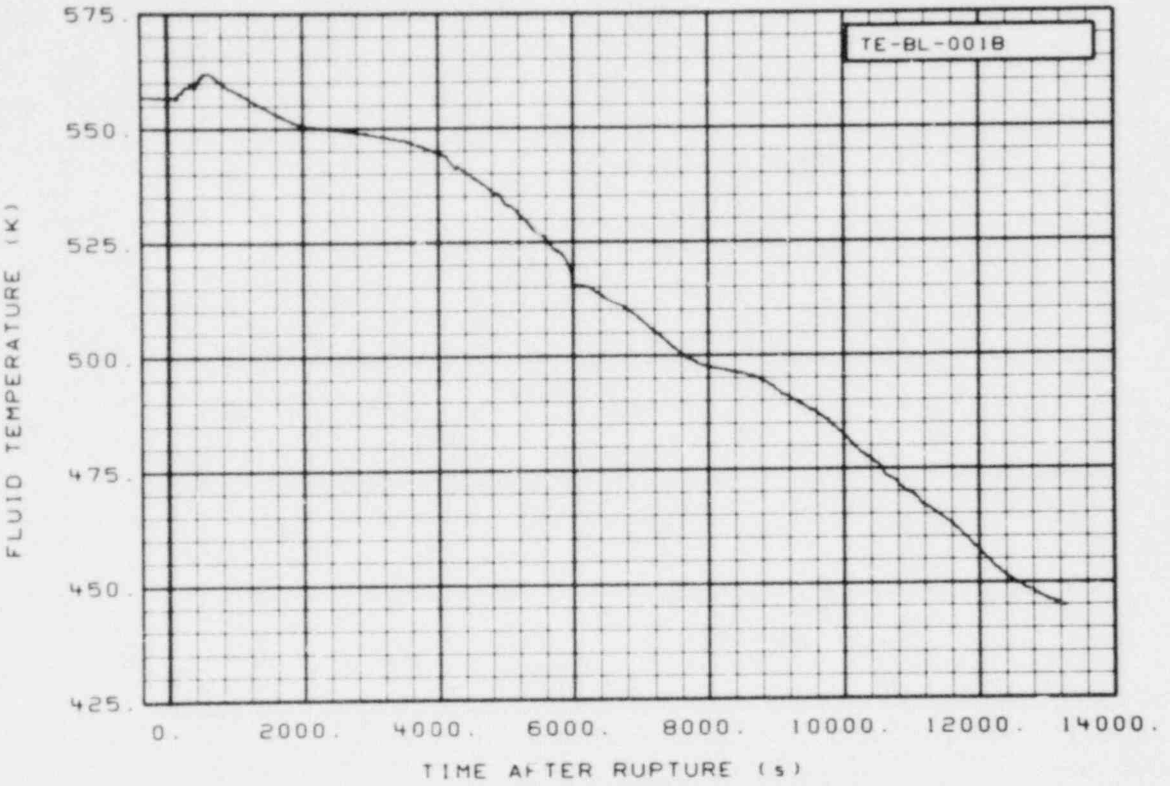


Figure 144. Coolant temperature in broken loop cold leg (TE-BL-001B) (Qualified).

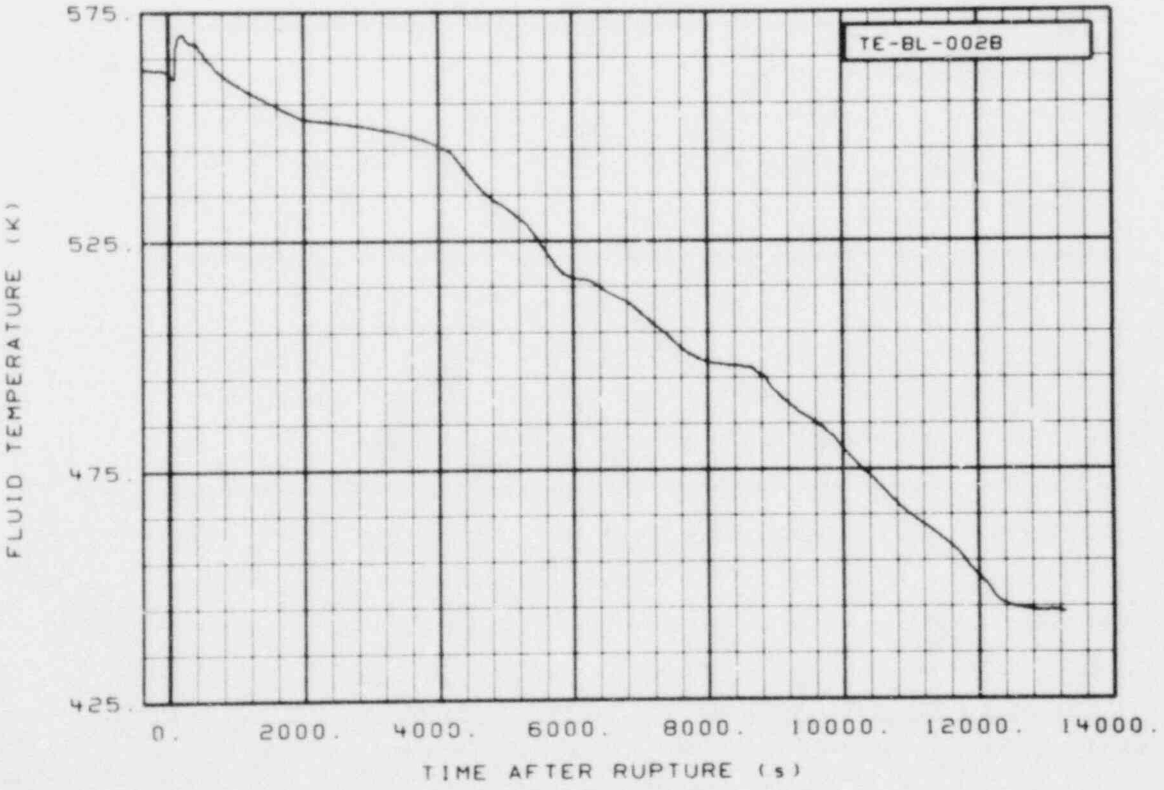


Figure 145. Coolant temperature in broken loop hot leg (TE-BL-002B) (Qualified).

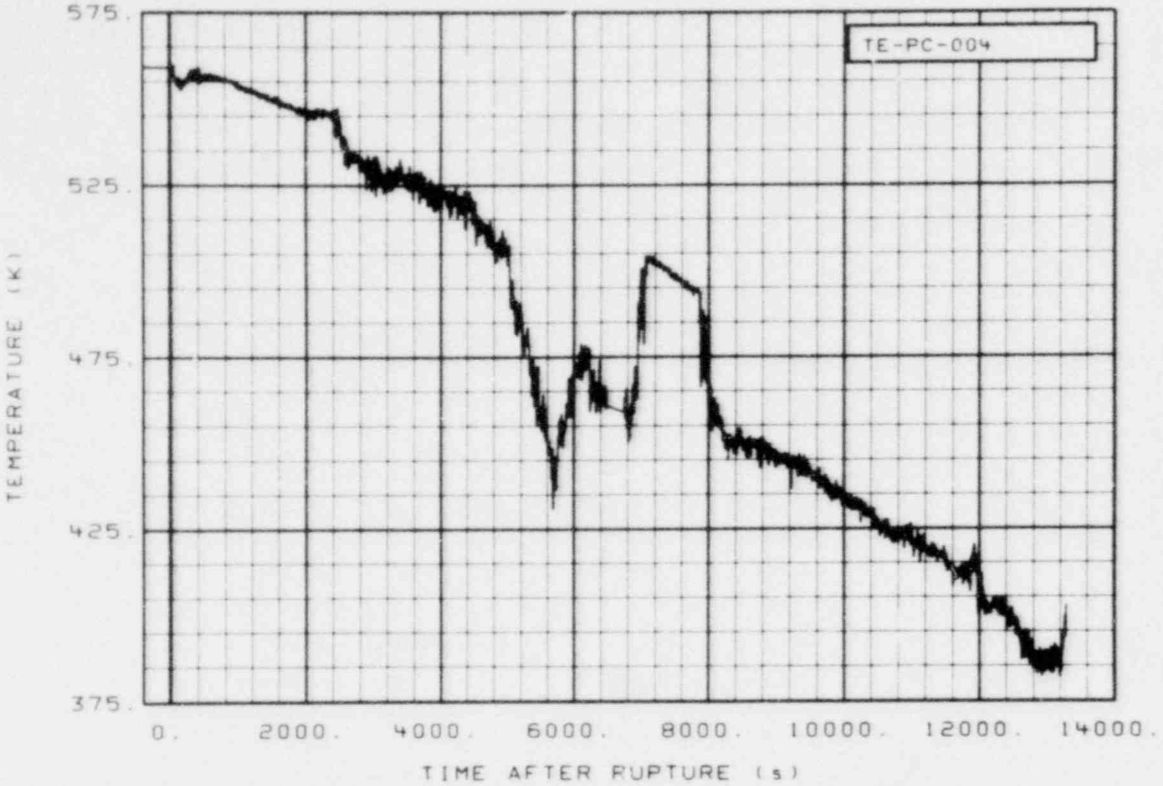


Figure 146. Coolant temperature in intact loop cold leg at bottom of ECC Rake 1 (TE-PC-004) (Qualified).

Figure 147. Coolant temperature in intact loop cold leg next to bottom of ECC Rake 1 (TE-PC-005) (Qualified).

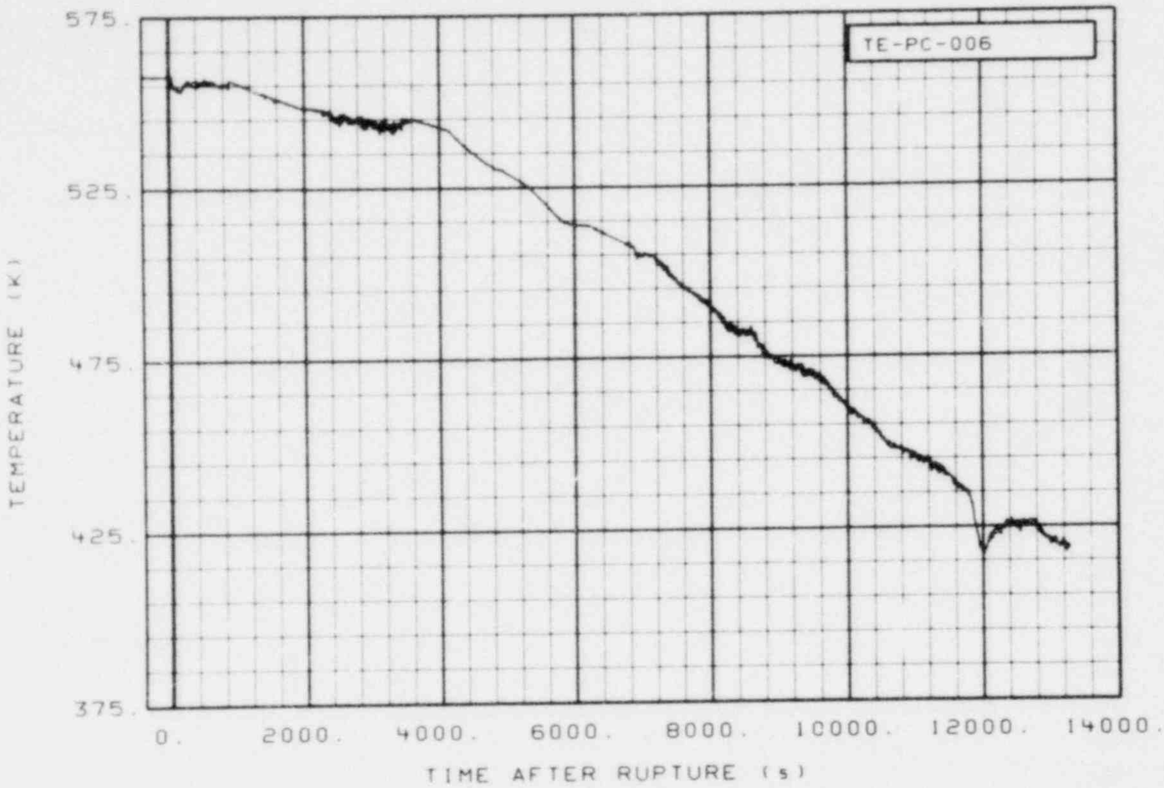


Figure 148. Coolant temperature in intact loop cold leg next to top of ECC Rake 1 (TE-PC-006) (Qualified).

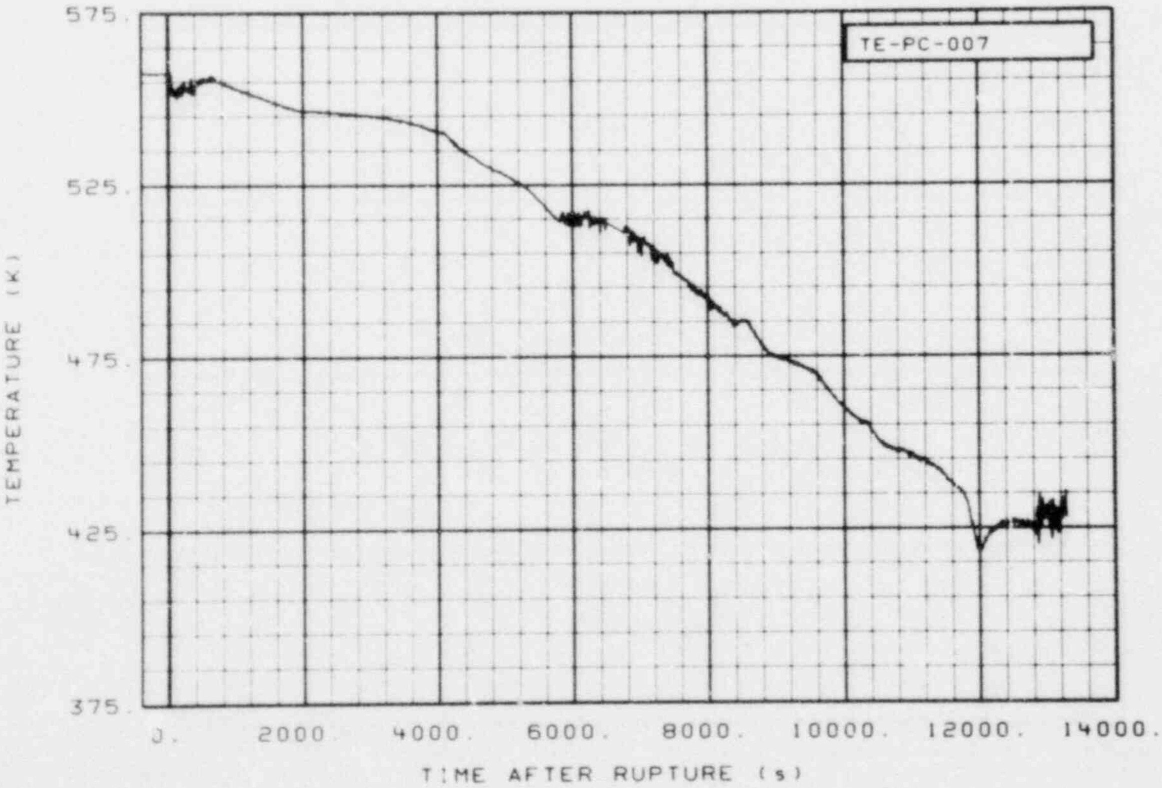


Figure 149. Coolant temperature in intact loop cold leg at top of ECC Rake 1 (TE-PC-007) (Qualified).

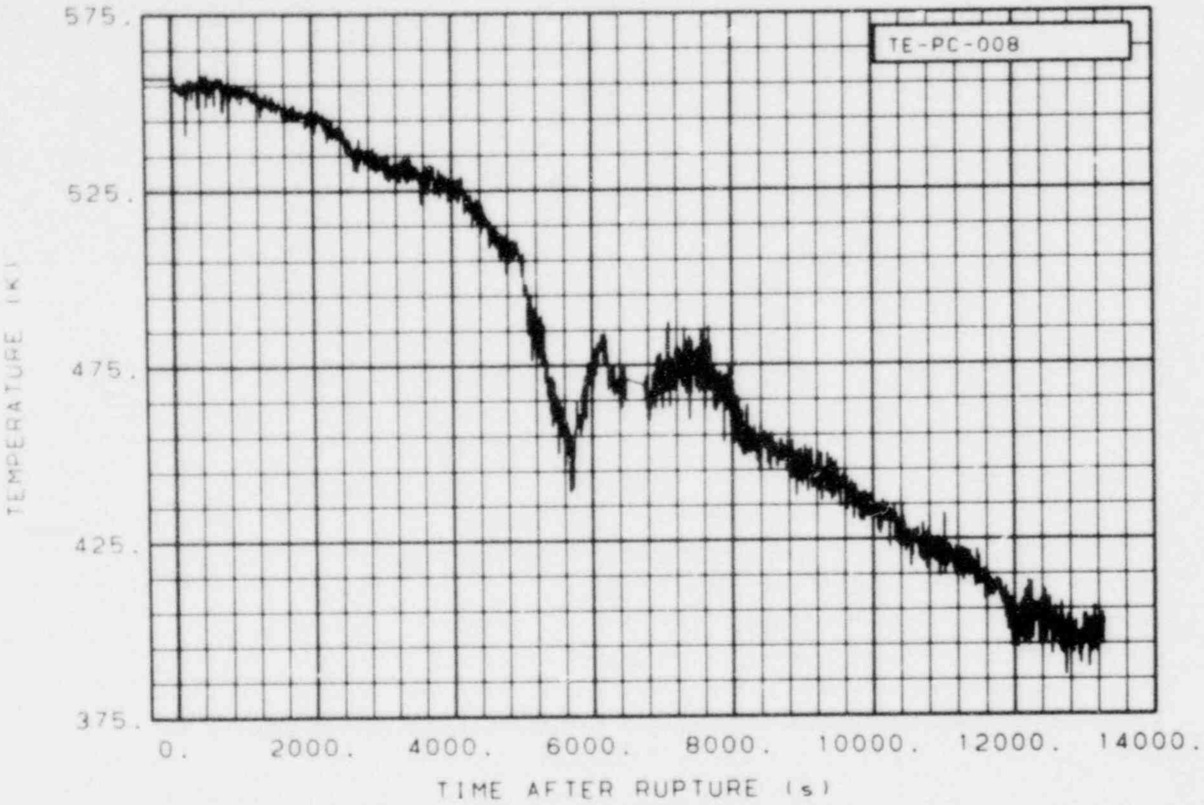


Figure 150. Coolant temperature in intact loop cold leg at bottom of ECC Rake 2 (TE-PC-008) (Qualified).

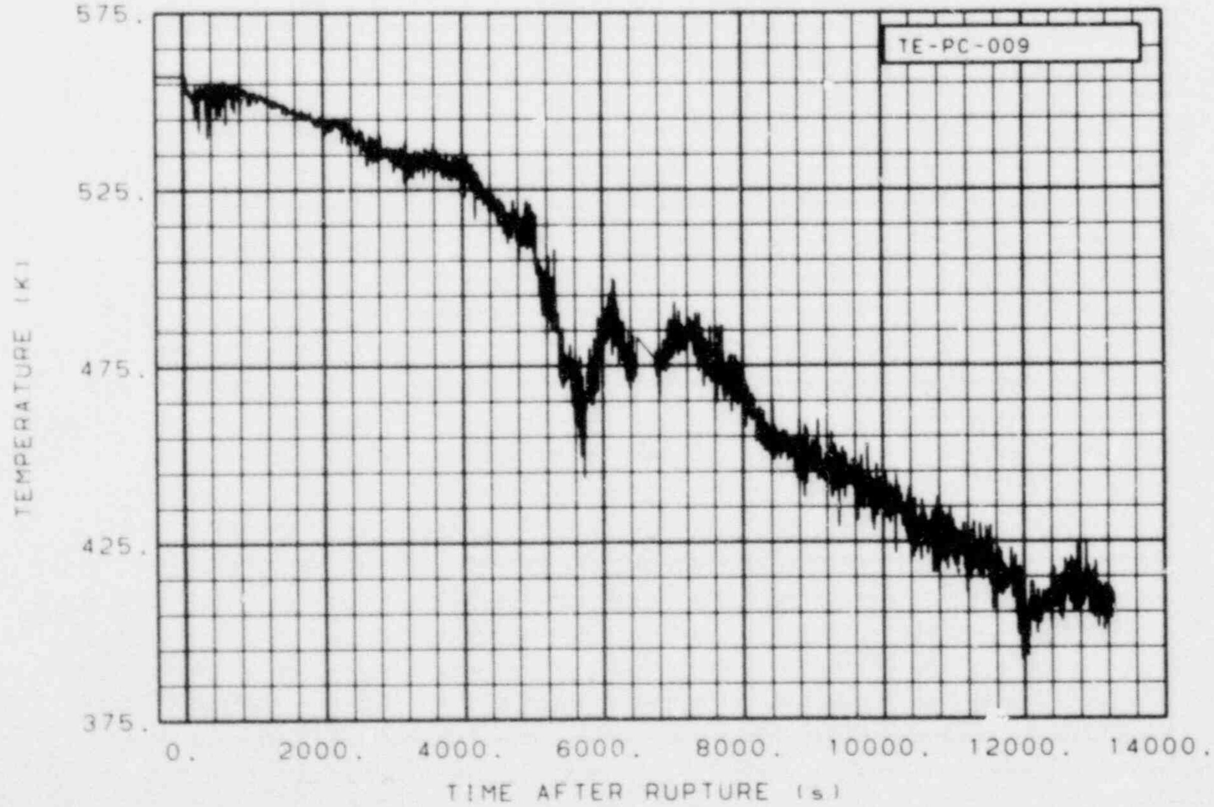


Figure 151. Coolant temperature in intact loop cold leg next to bottom of ECC Rake 2 (TE-PC-009) (Qualified).

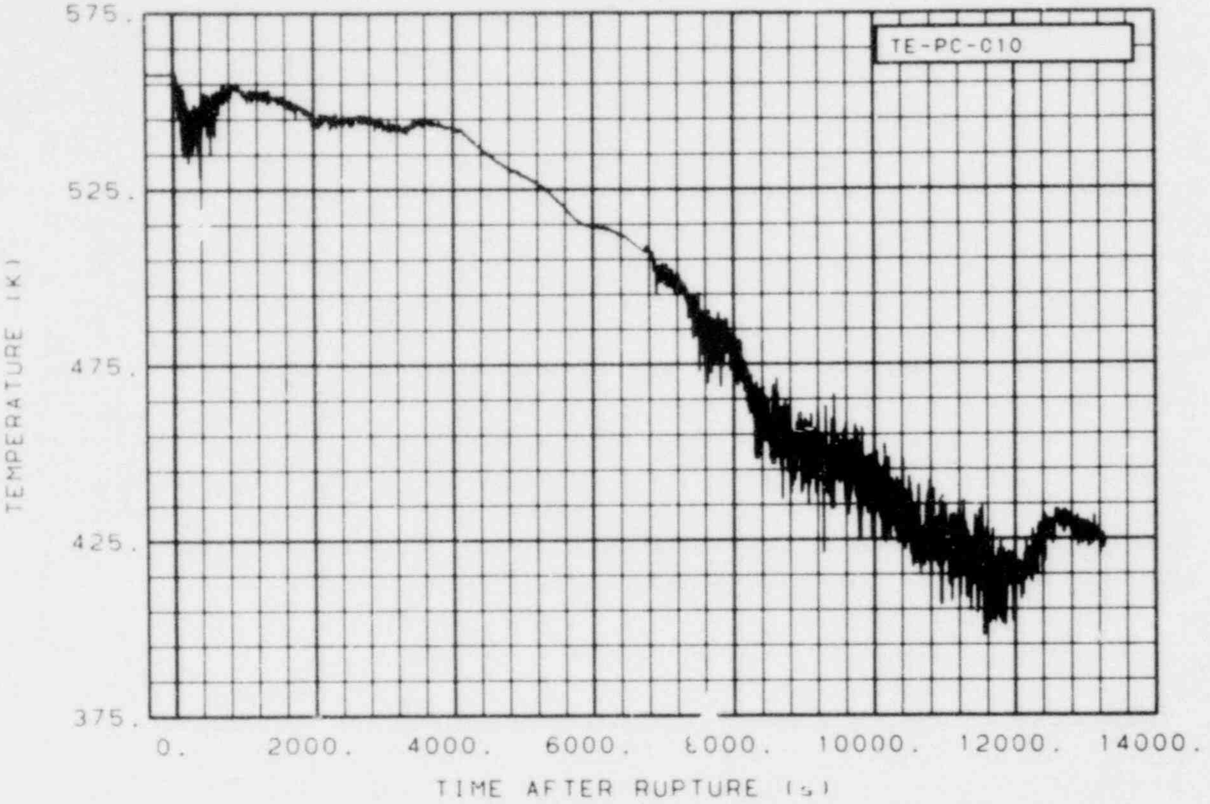


Figure 152. Coolant temperature in intact loop cold leg next to top of ECC Rake 2 (TE-PC-010) (Qualified).

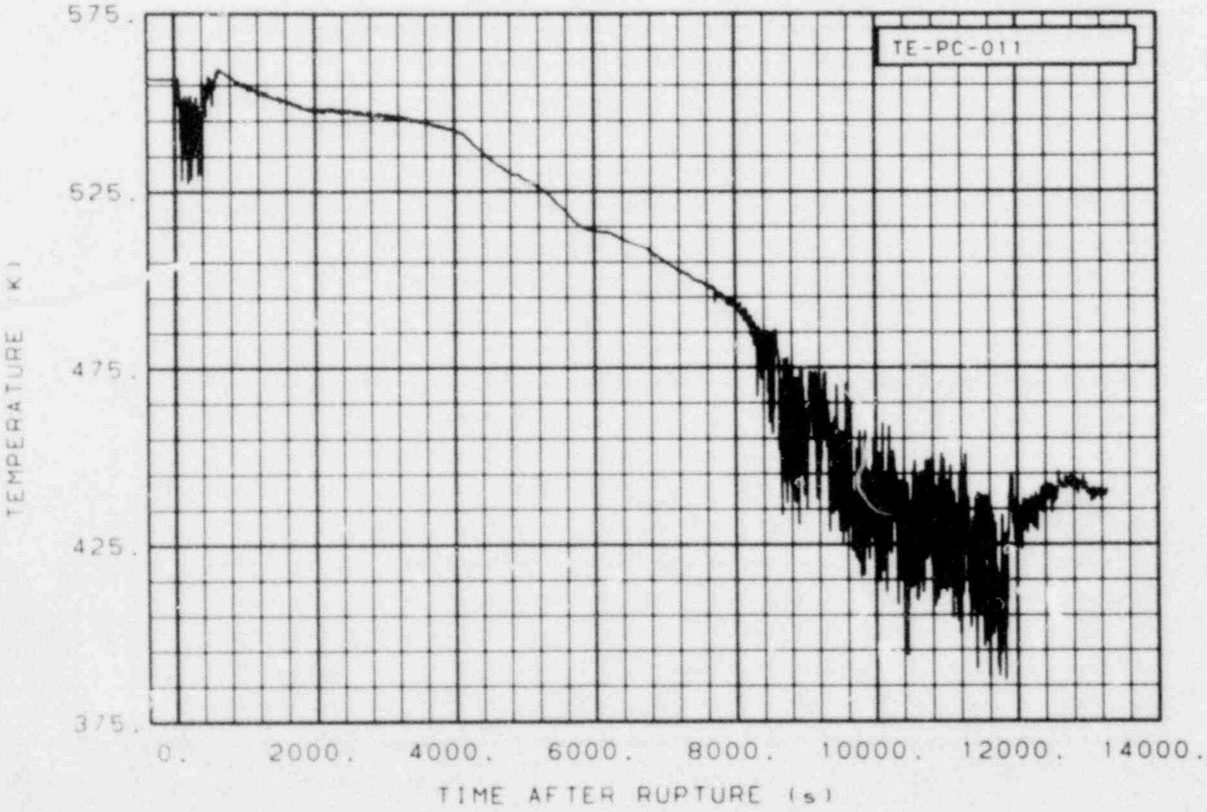


Figure 153. Coolant temper iture in intact loop cold leg at top of ECC Rake 2 (TE-PC-011) (Qualified).

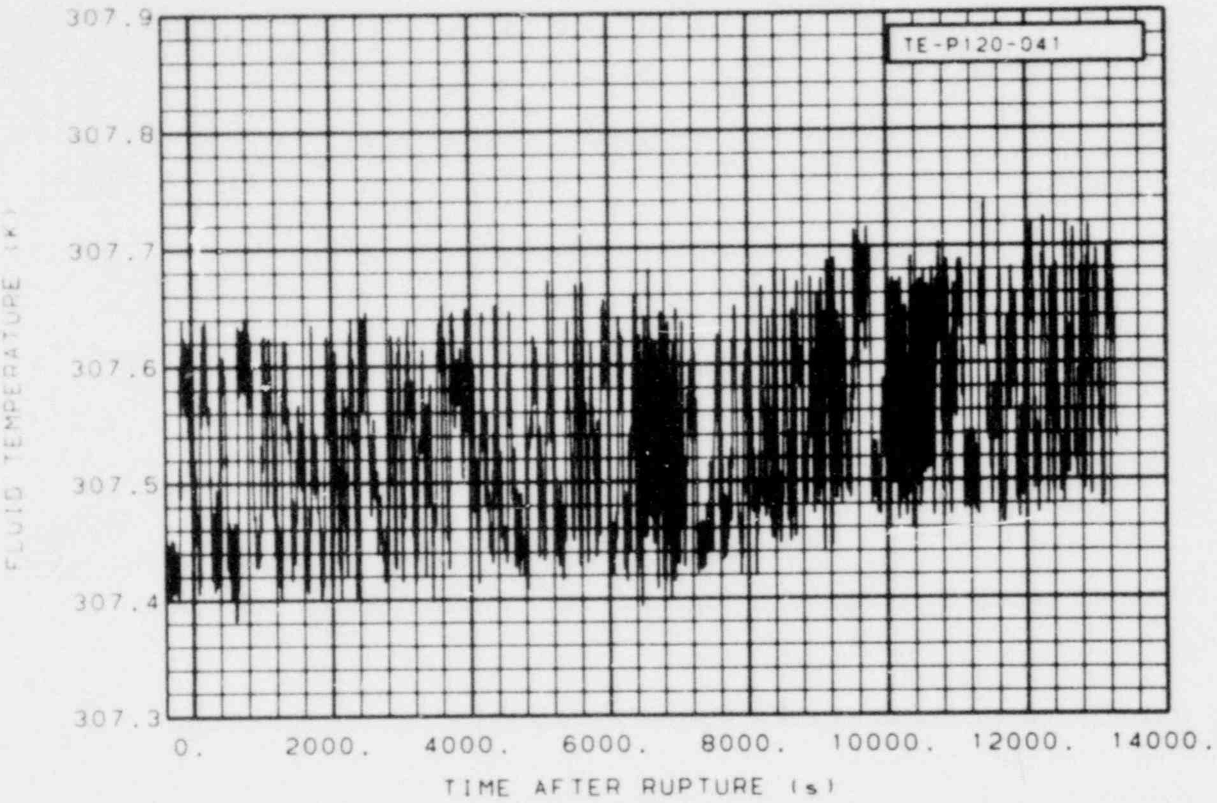


Figure 154. Liquid temperature in ECCS Accumulator A (TE-P120-041) (Qualified).

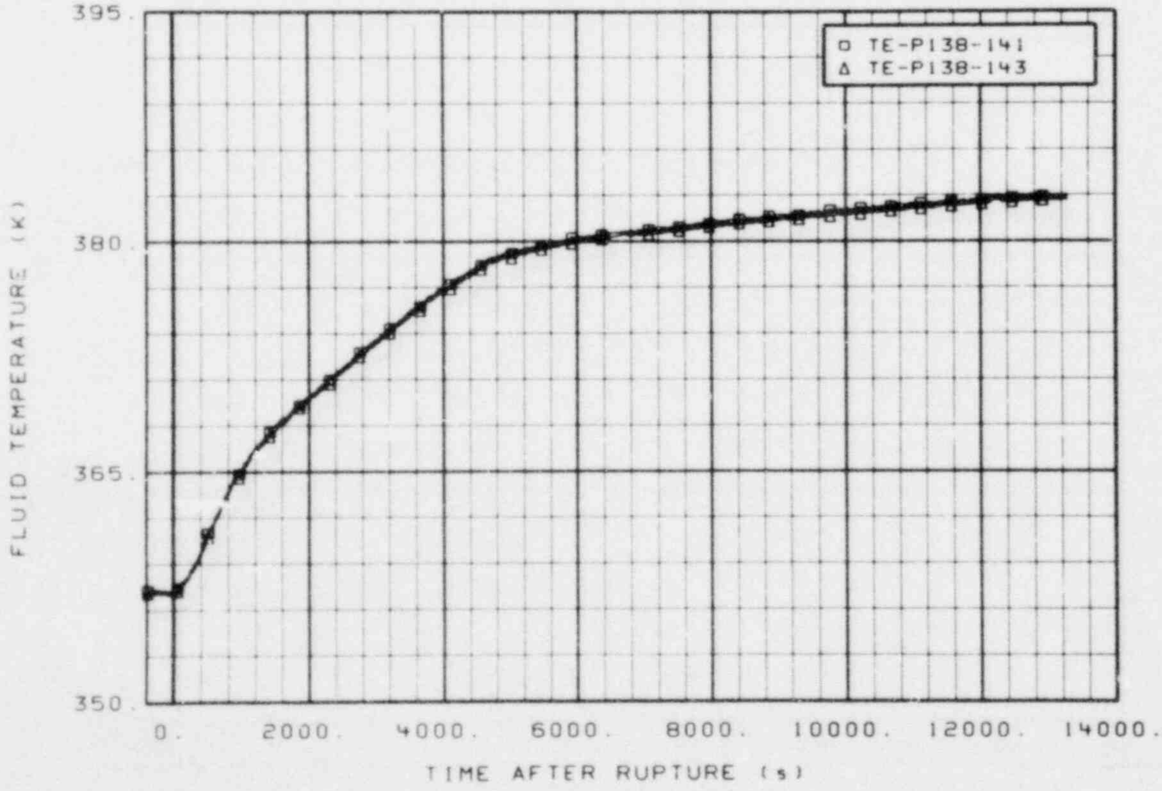


Figure 155. Fluid temperature in blowdown suppression tank spray system 3.8 and 13.9 l/s spray headers (TE-P138-141 and -143) (Qualified).

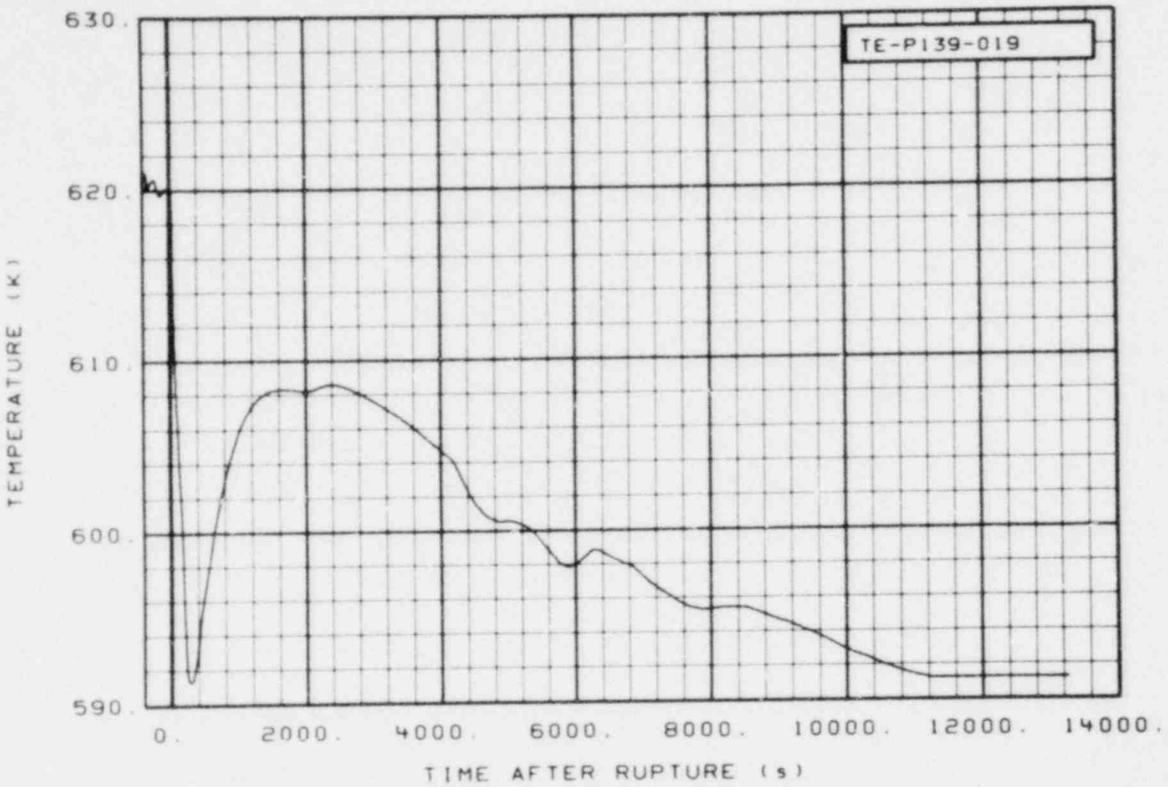


Figure 156. Fluid temperature in pressurizer vapor space (TE-P139-019) (Qualified, appears approximately 6 K high based on isothermal test and may experience hot wall effects, narrow range instrument).

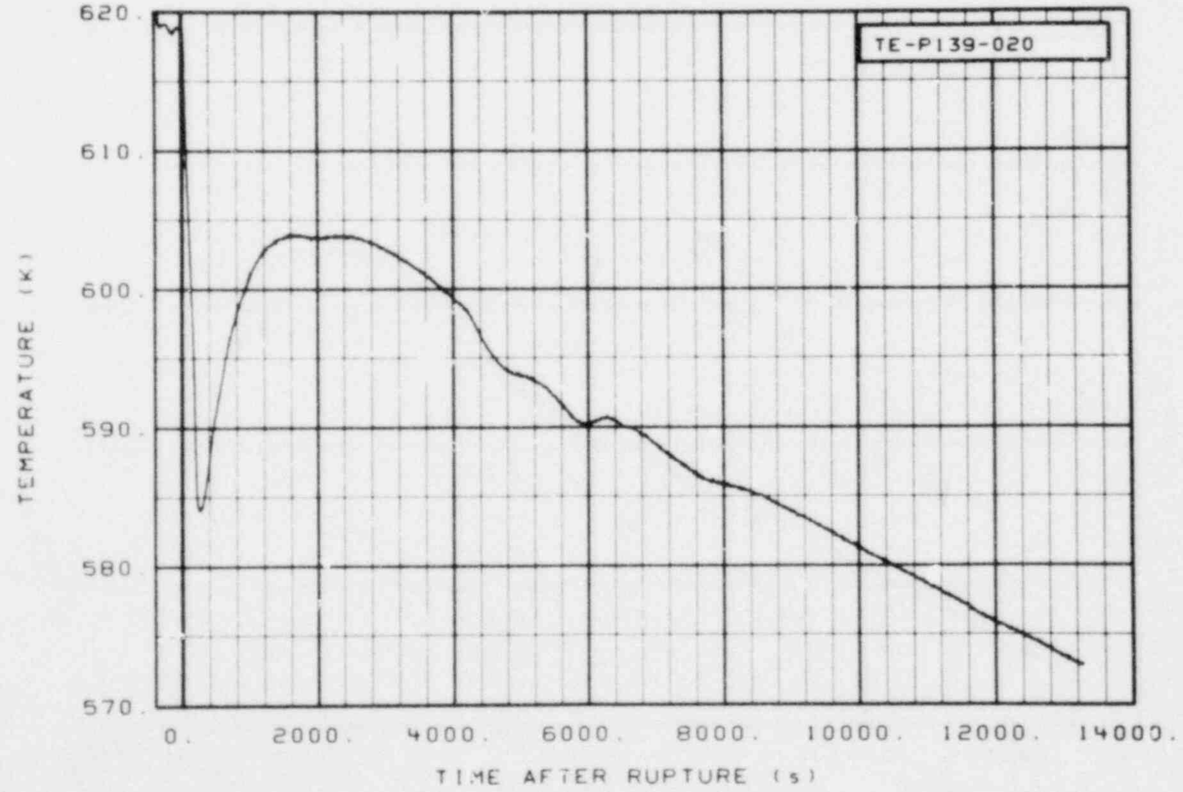


Figure 157. Fluid temperature in the pressurizer liquid space (TE-P139-020) (Qualified, appears approximately 6 K high based on isothermal test and may experience hot wall effects).

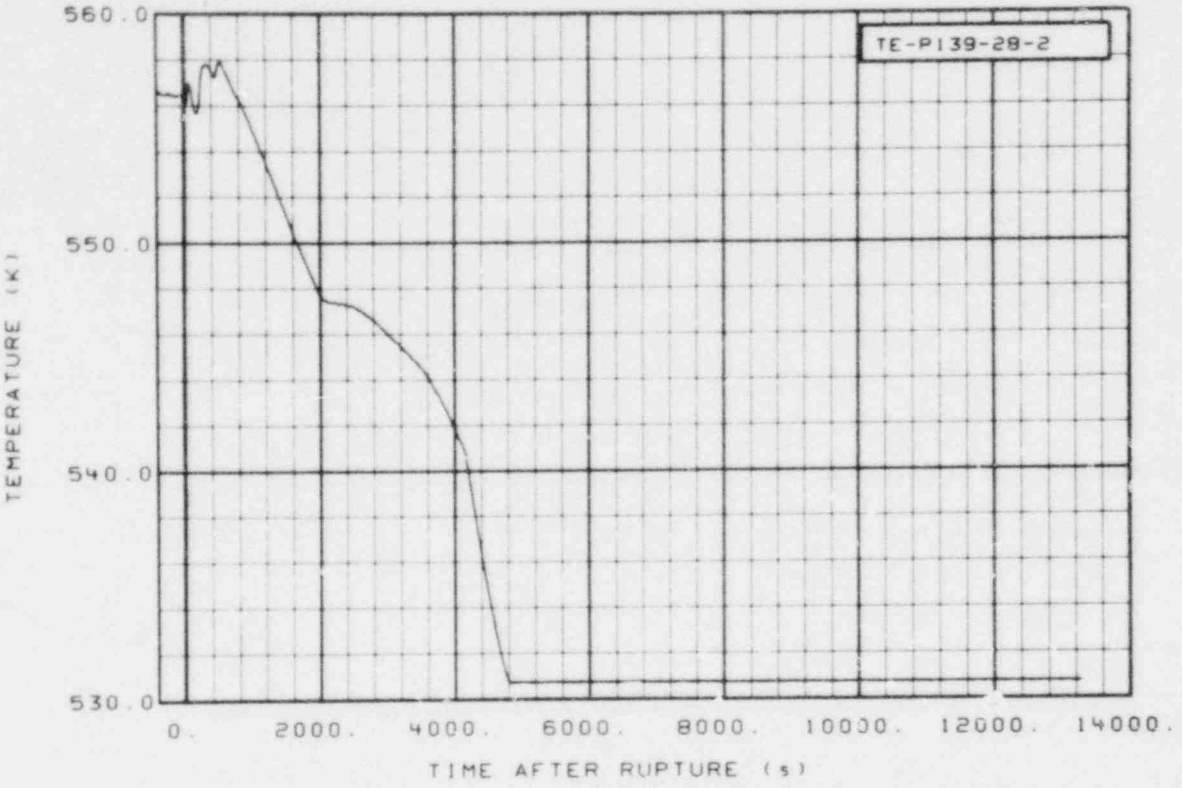


Figure 158. Fluid temperature in intact loop cold leg (TE-P139-028-2) (Qualified, narrow range instrument).

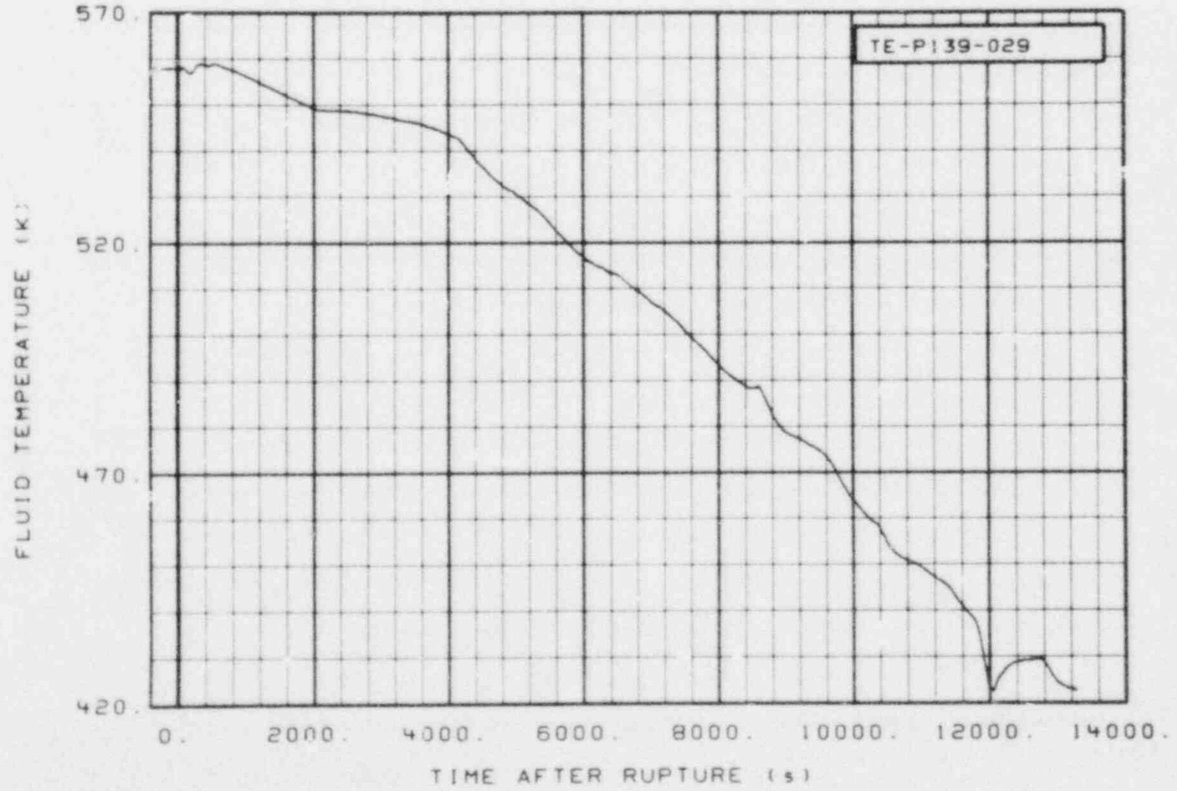


Figure 159. Fluid temperature in intact loop cold leg upstream of DTT flange (TE-P139-029) (Qualified).

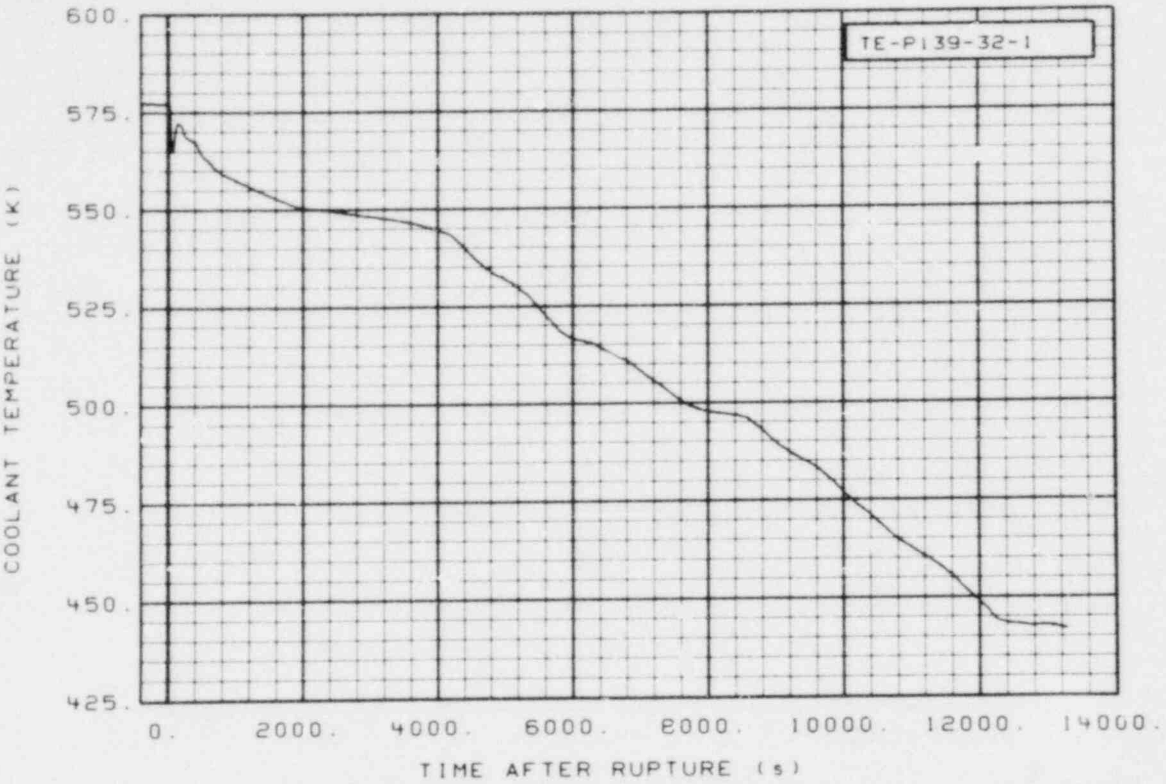


Figure 160. Fluid temperature in intact loop hot leg (TE-P139-32-1) (Qualified).

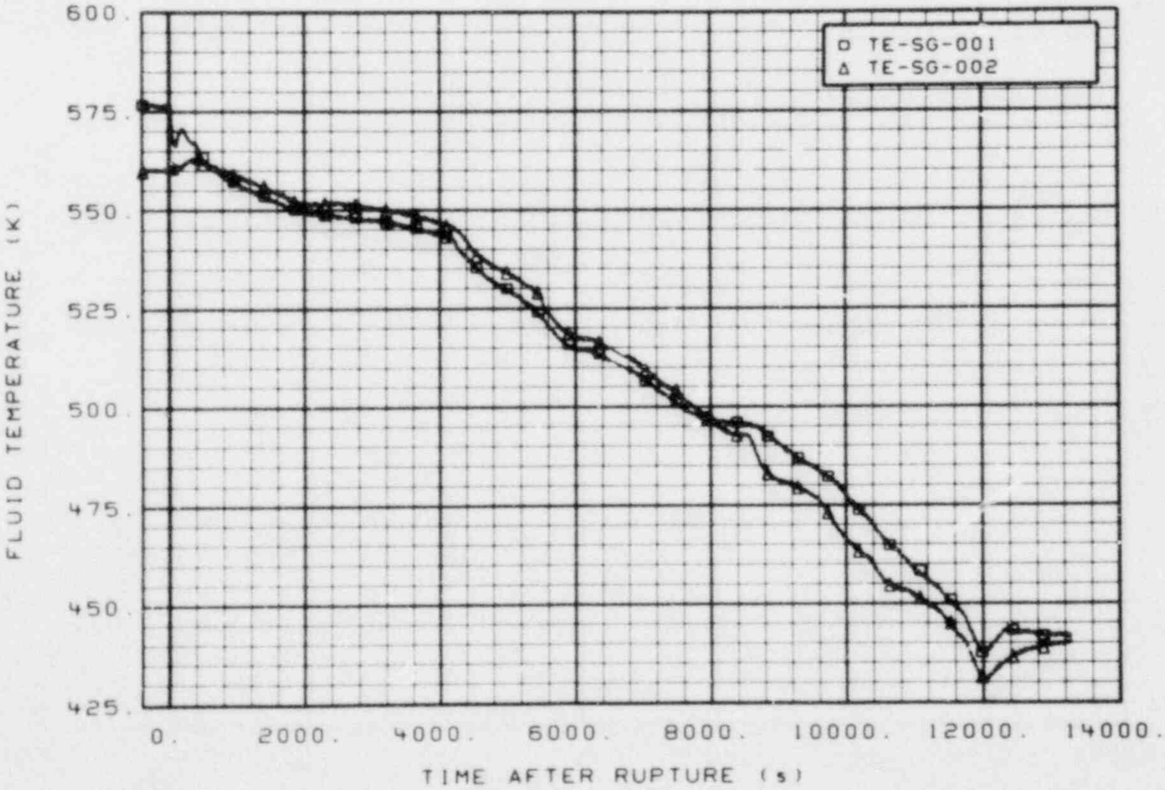


Figure 161. Fluid temperature in intact loop steam generator inlet and outlet plenums (TE-SG-001 and -002) (Qualified, may experience hot wall effects).

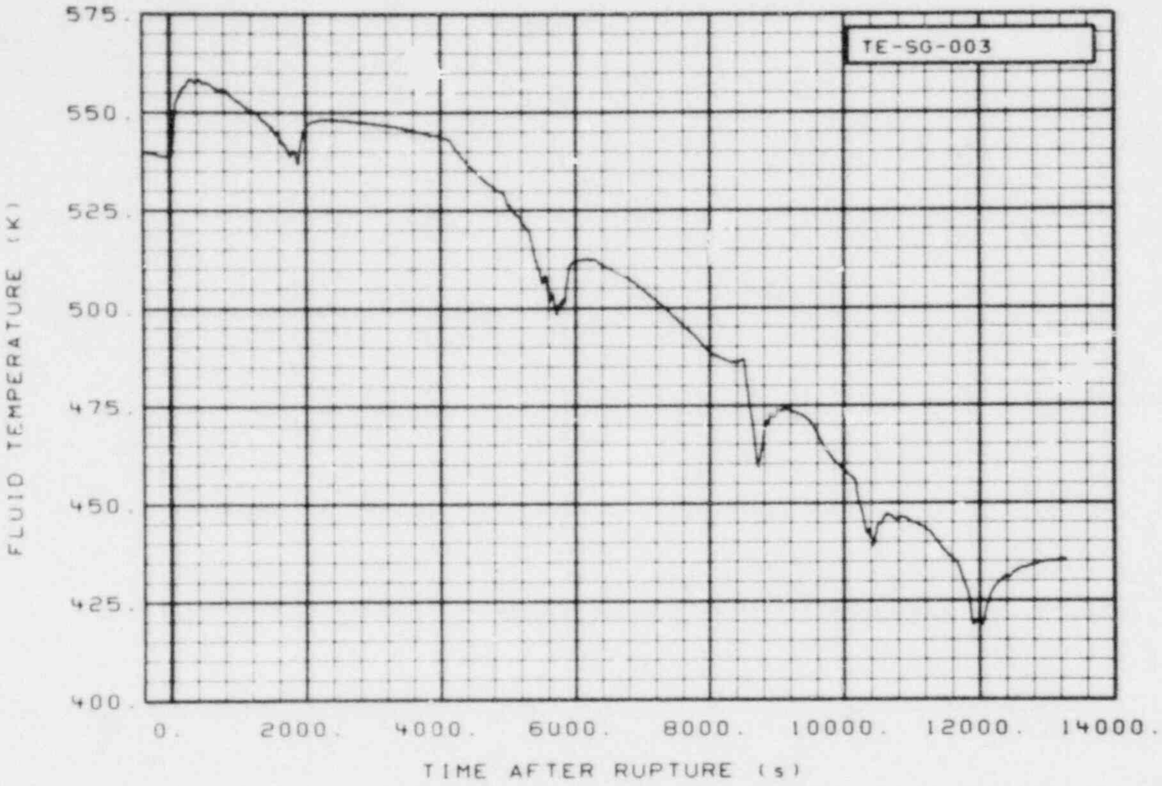


Figure 162. Fluid temperature in steam generator secondary side downcomer (TE-SG-003) (Qualified).

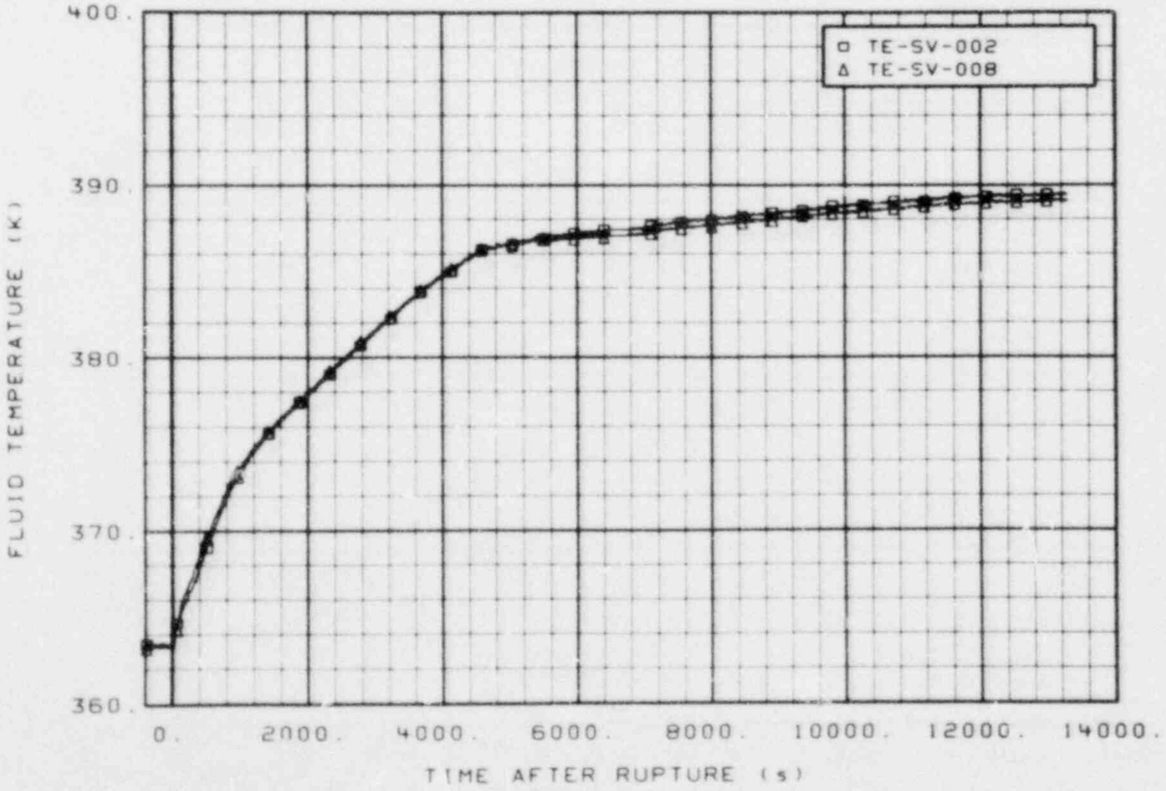


Figure 163. Fluid temperature in blowdown suppression tank 2.362 m above tank bottom (TE-SV-002 and -008) (Qualified).

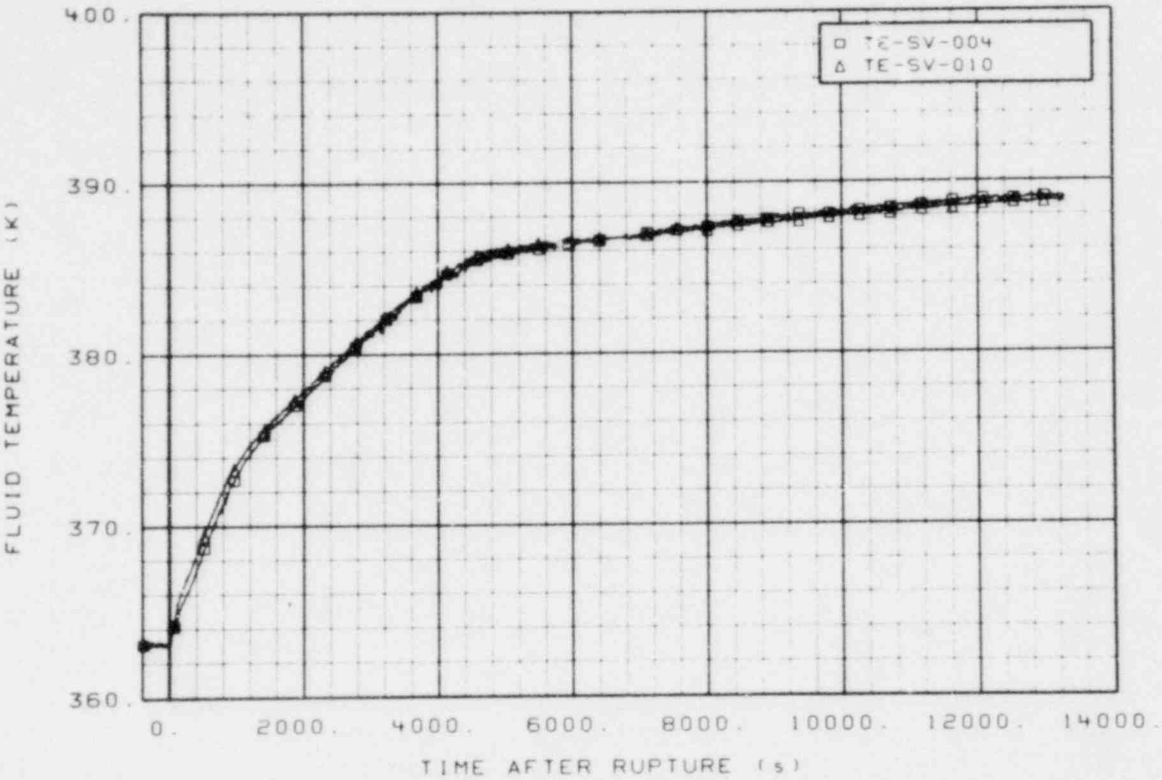


Figure 164. Fluid temperature in blowdown suppression tank 1.453 m above tank bottom (TE-SV-004 and -010) (Qualified).

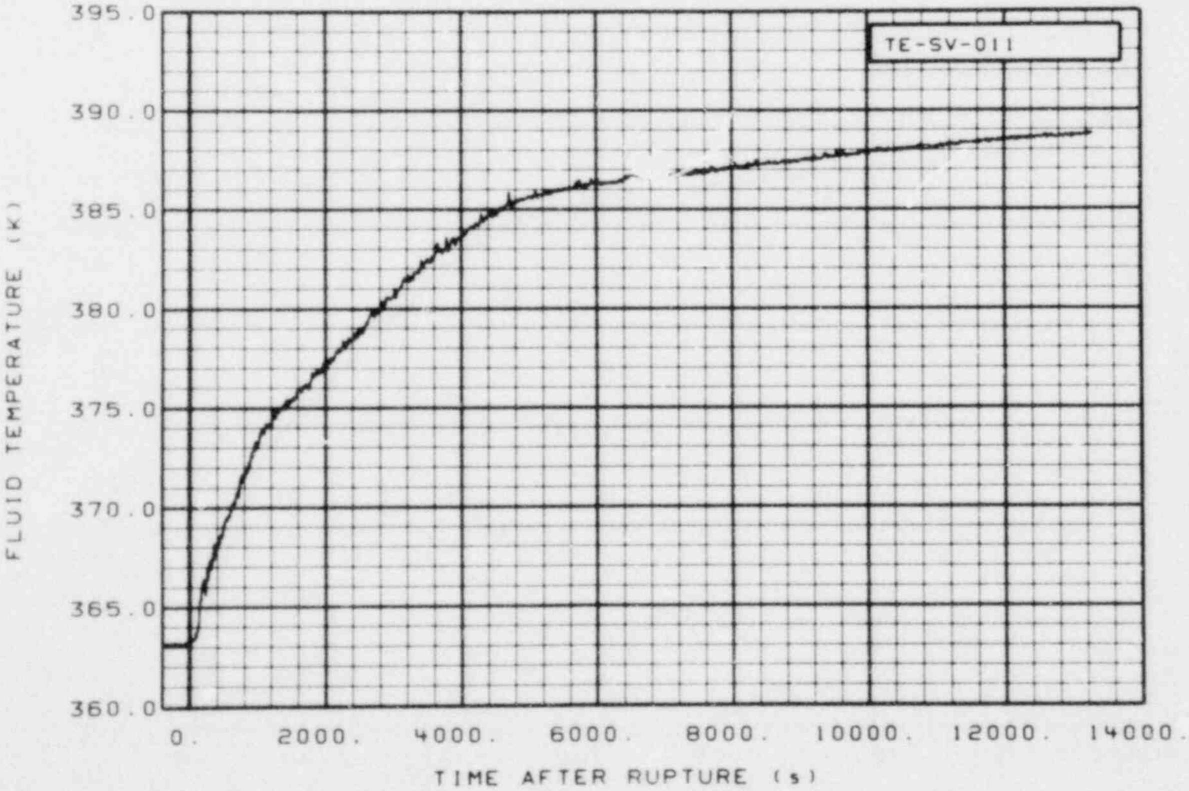


Figure 165. Fluid temperature in blowdown suppression tank 0.991 m above tank bottom (TE-SV-011) (Qualified).

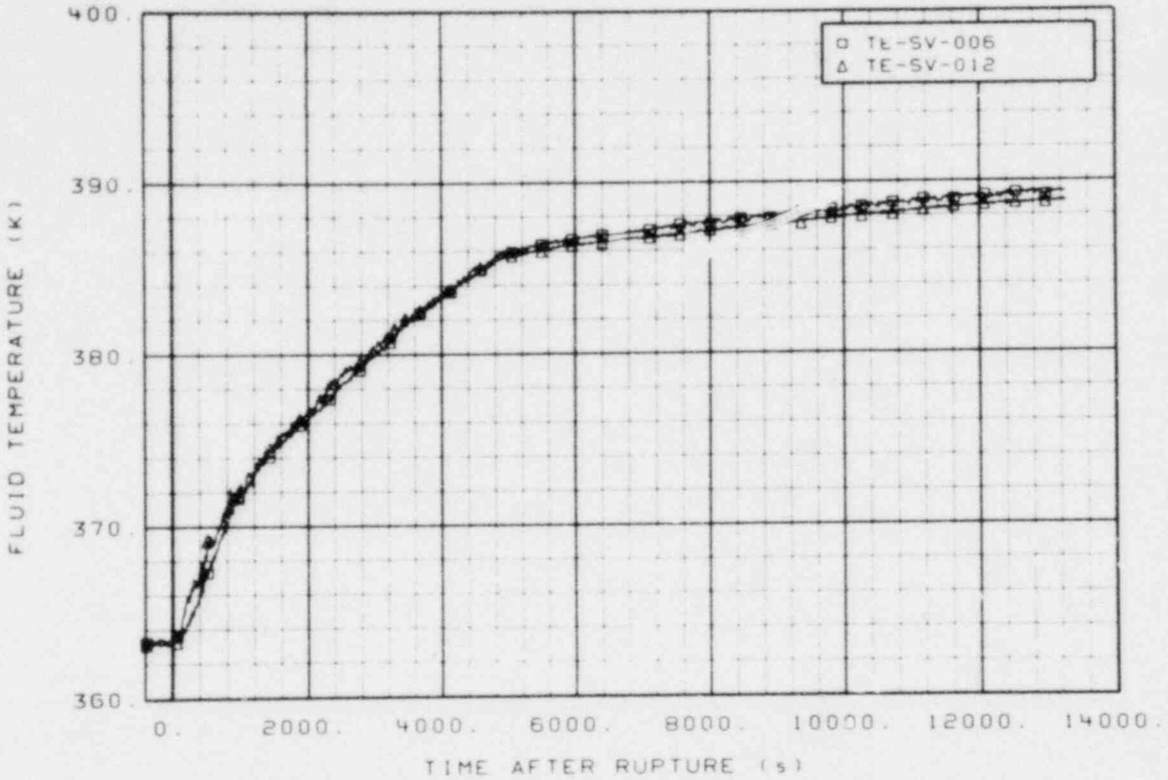


Figure 166. Fluid temperature in blowdown suppression tank 0.37 m above tank bottom (TE-SV-006 and -012) (Qualified).

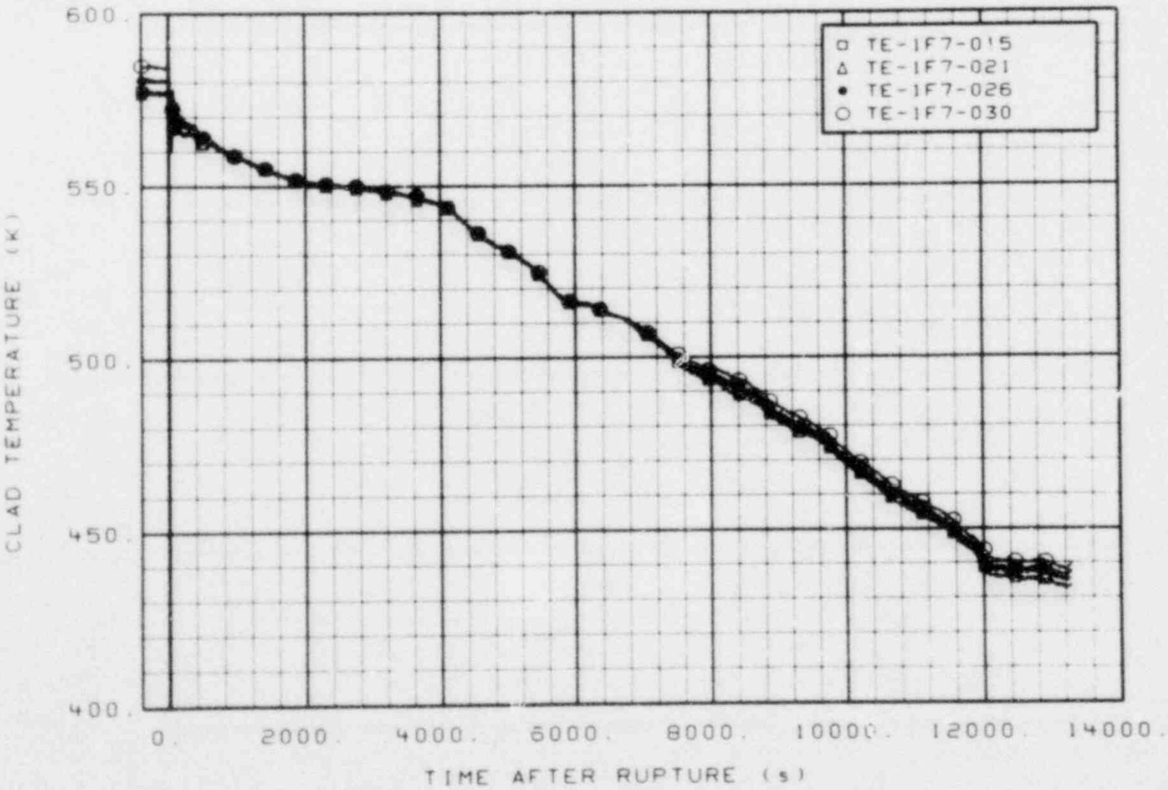


Figure 167. Cladding temperature in reactor vessel at Fuel Assembly 1, Row F, Column 7 at 0.38, 0.53, 0.66, and 0.76 m above bottom of fuel rod (TE-1F7-015, -021, -026, and -030) (Qualified).

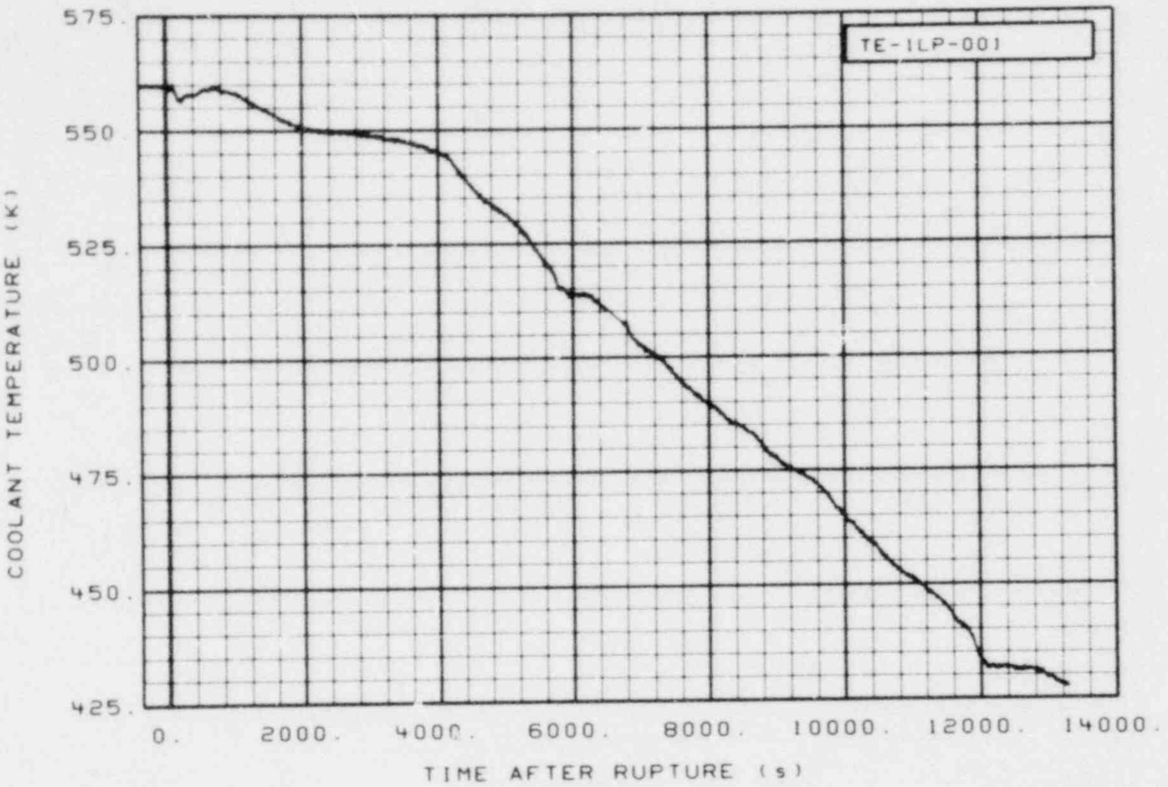


Figure 168. Coolant temperature in reactor vessel at lower end box of Fuel Assembly 1 (TE-1LP-001) (Qualified).

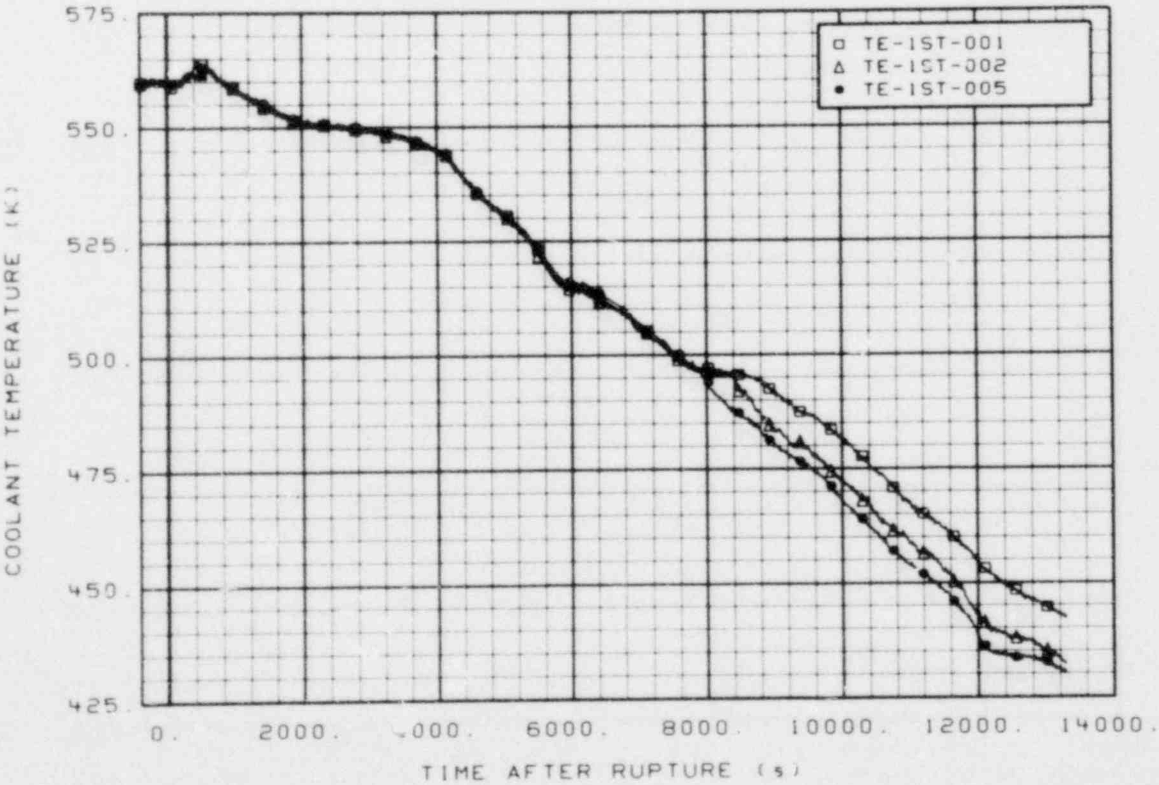


Figure 169. Coolant temperature in reactor vessel Downcomer Instrument Stalk 1 (TE-1ST-001, -002, and -005) (Qualified).

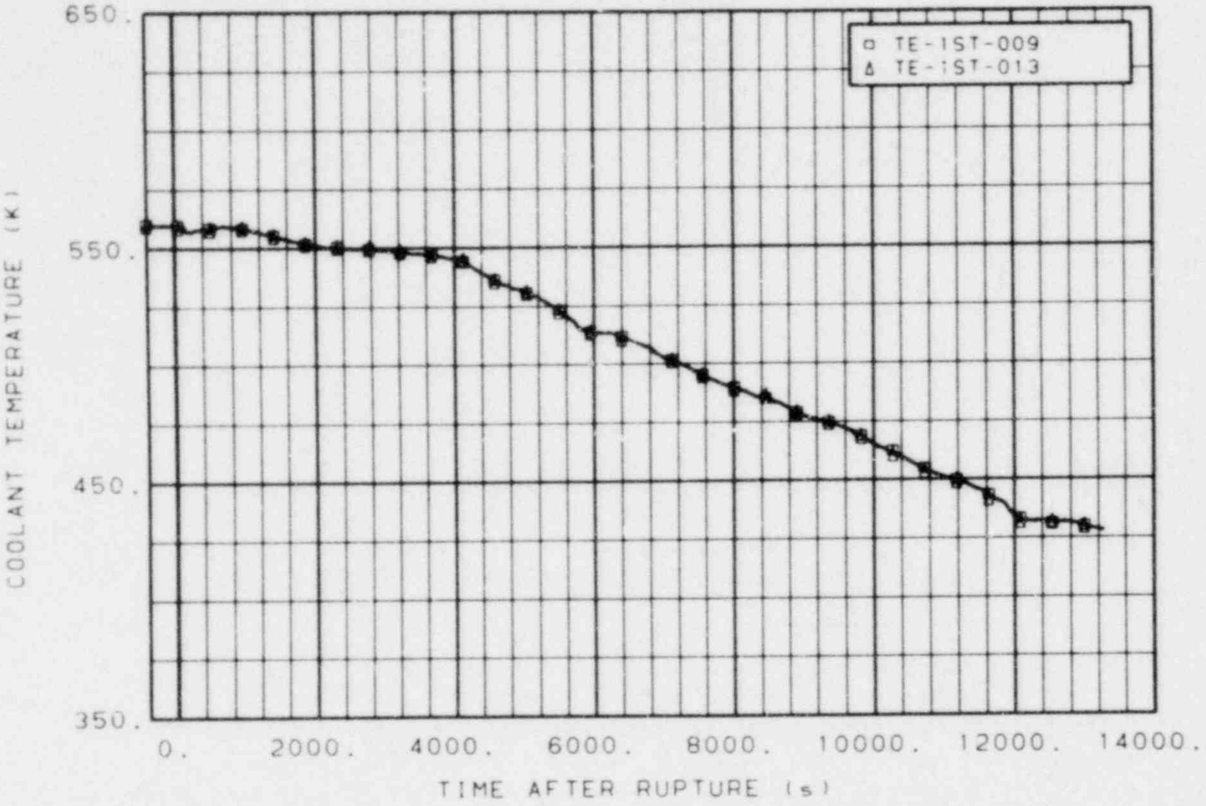


Figure 170. Coolant temperature in reactor vessel Downcomer Instrument Stalk 1 (TE-1ST-009 and -013) (Qualified).

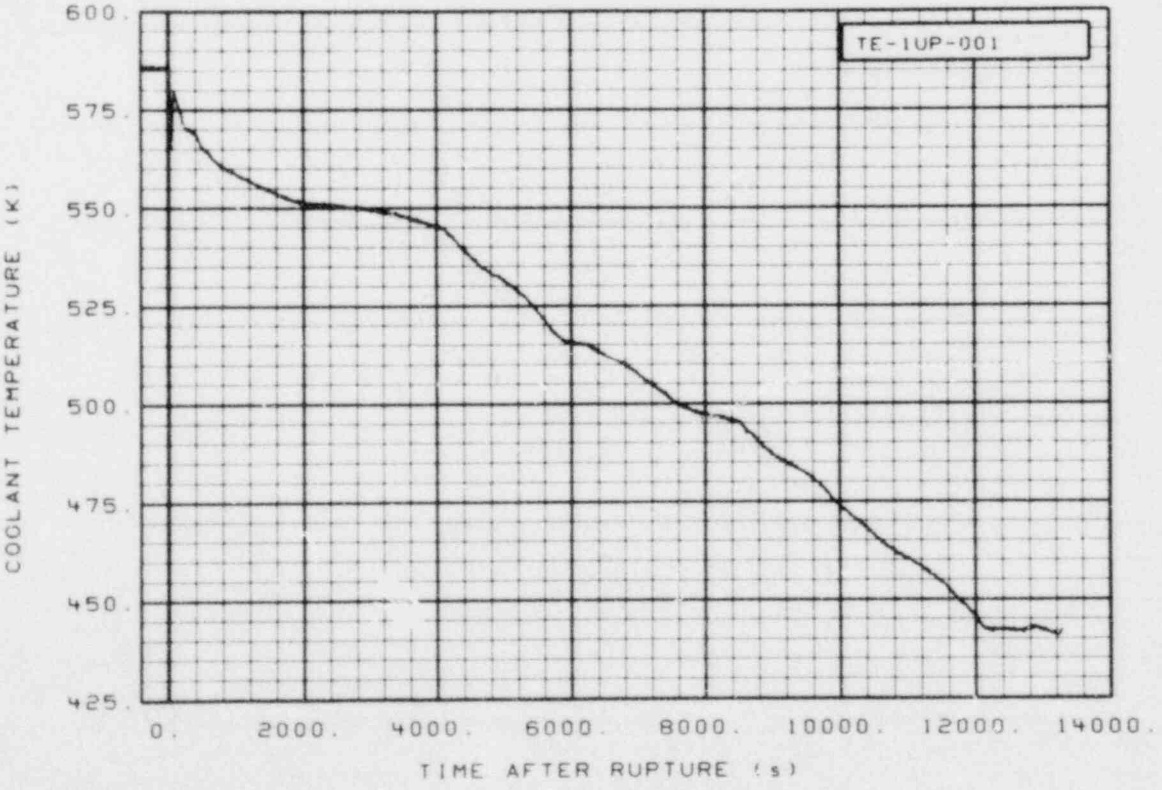


Figure 171. Coolant temperature in reactor vessel at upper end box of Fuel Assembly 1 (TE-1UP-001) (Qualified).

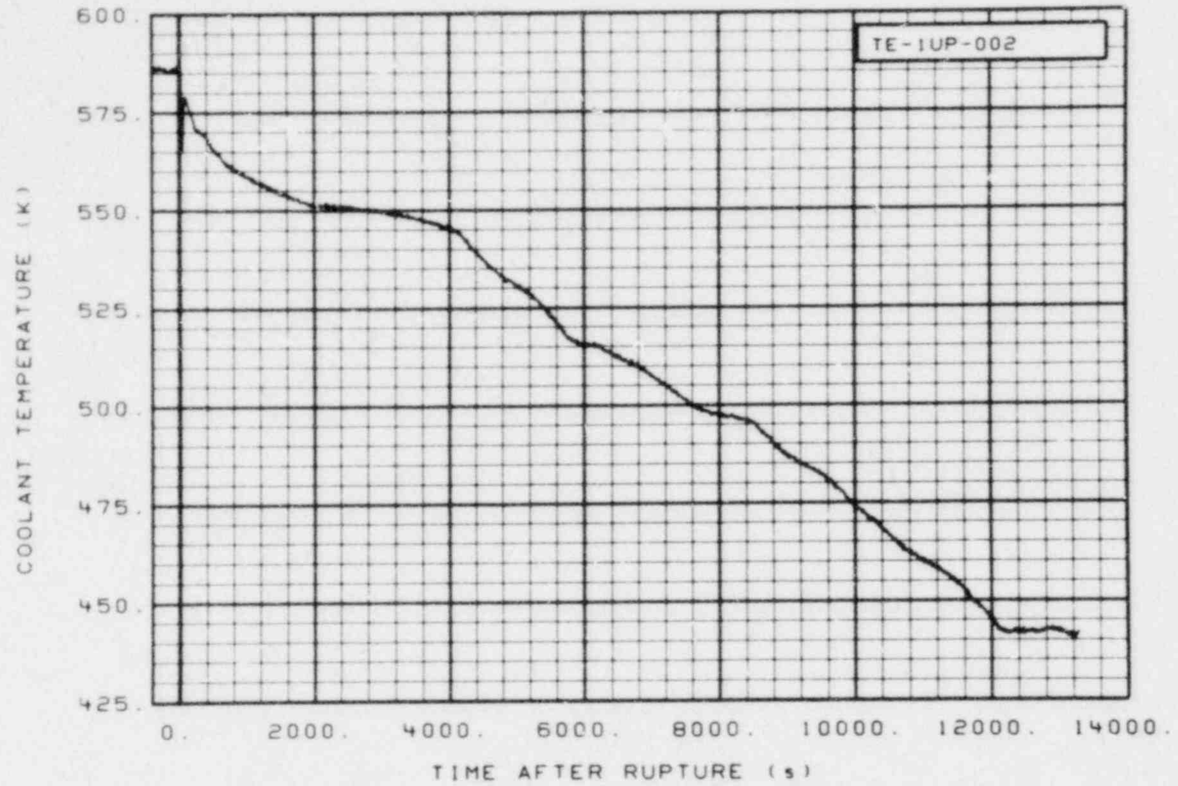


Figure 172. Coolant temperature in reactor vessel at upper end box of Fuel Assembly 1 (TE-1UP-002) (Qualified).

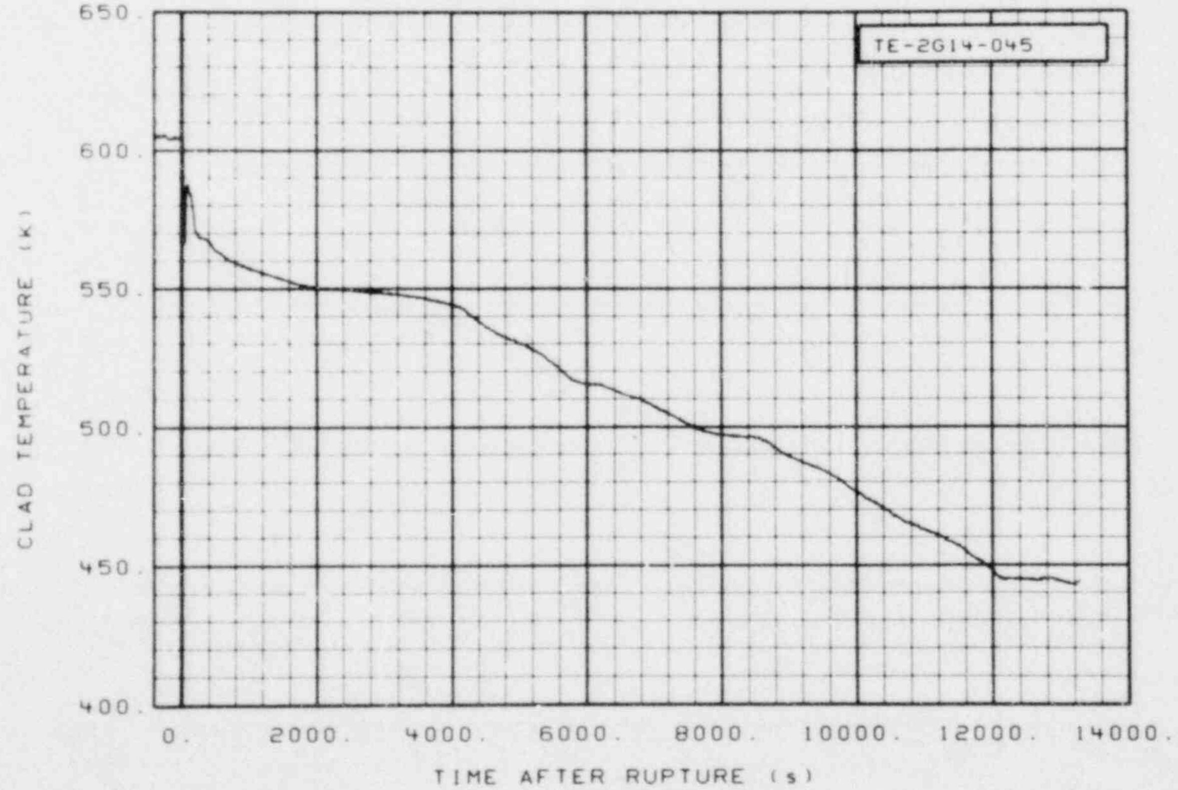


Figure 173. Cladding temperature in reactor vessel at Fuel Assembly 2, Row G, Column 14 at 1.14 m above bottom of fuel rod (TE-2G14-045) (Qualified).

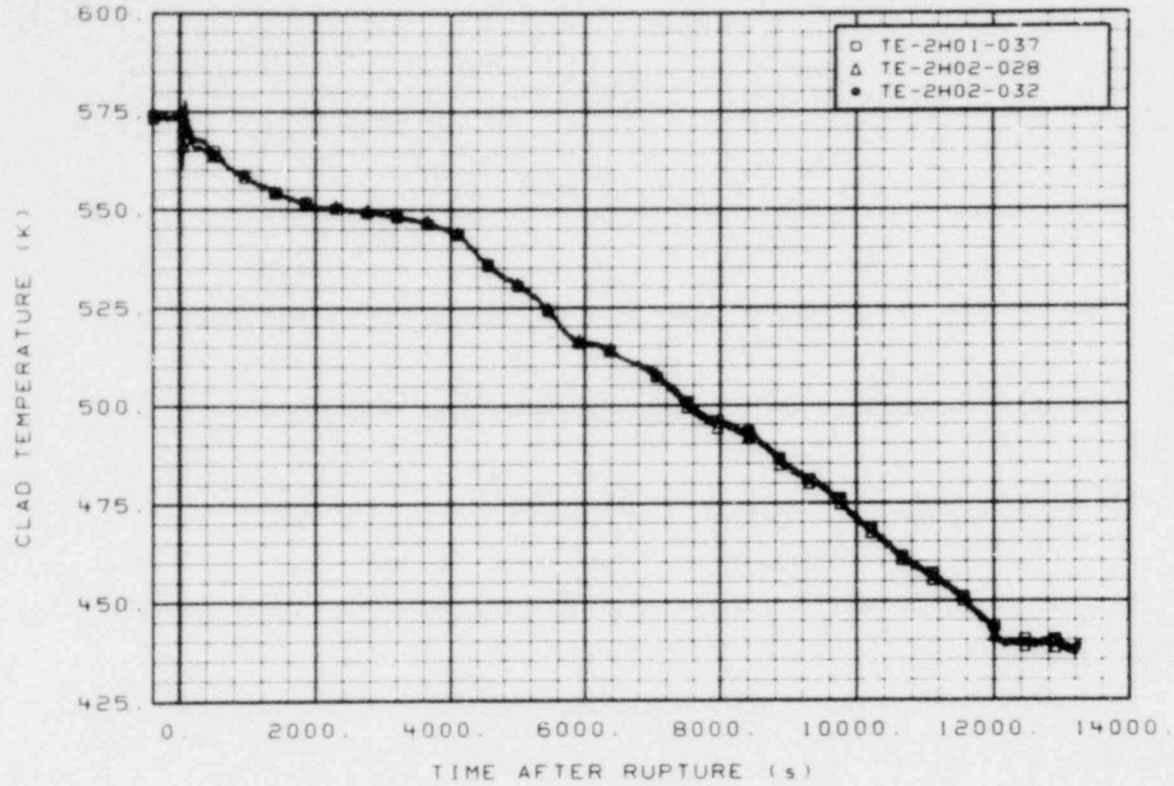


Figure 174. Cladding temperature in reactor vessel at Fuel Assembly 2, Row H, Column 1 at 0.94 m, Column 2 at 0.71 m and 0.81 m above bottom of fuel rod (TE-2H01-037, -2H02-028, and -032) (Qualified).

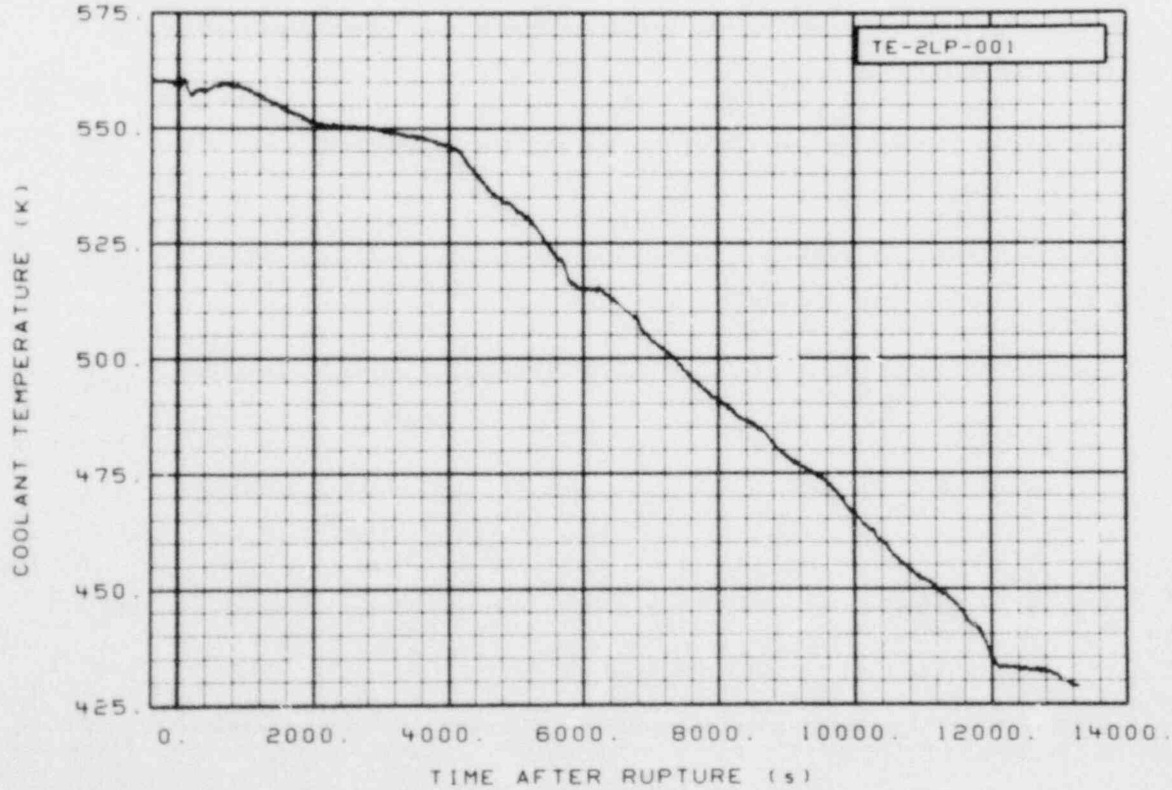


Figure 175. Coolant temperature in reactor vessel at Fuel Assembly 2 lower end box (TE-2LP-001) (Qualified).

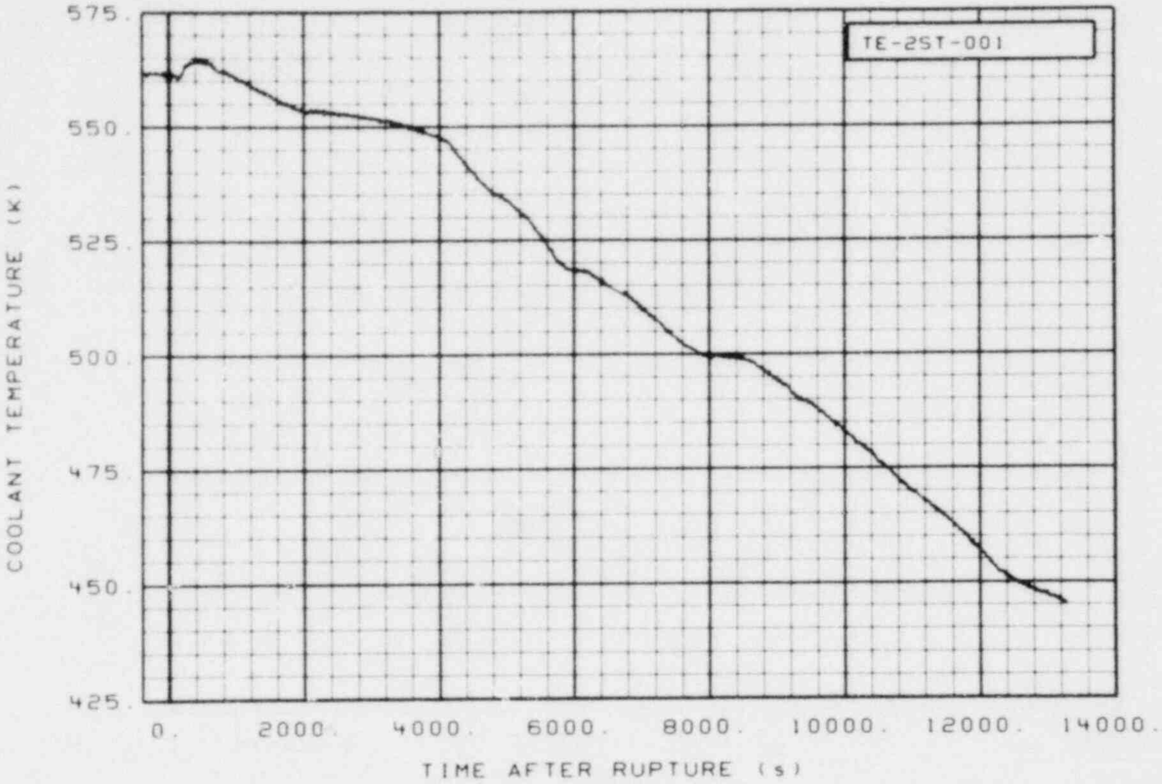


Figure 176. Coolant temperature in reactor vessel Downcomer Instrument Stalk 2 (TE-2ST-001) (Qualified).

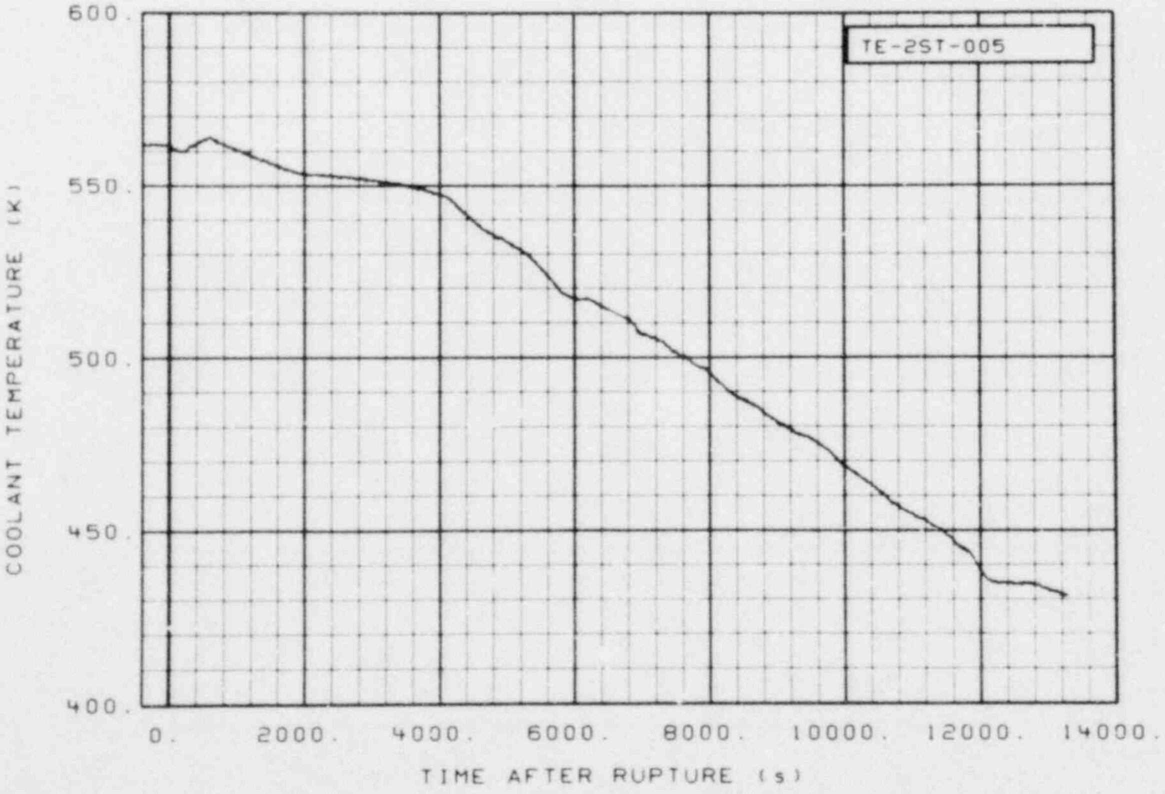


Figure 177. Coolant temperature in reactor vessel Downcomer Instrument Stalk 2 (TE-2ST-005) (Qualified).

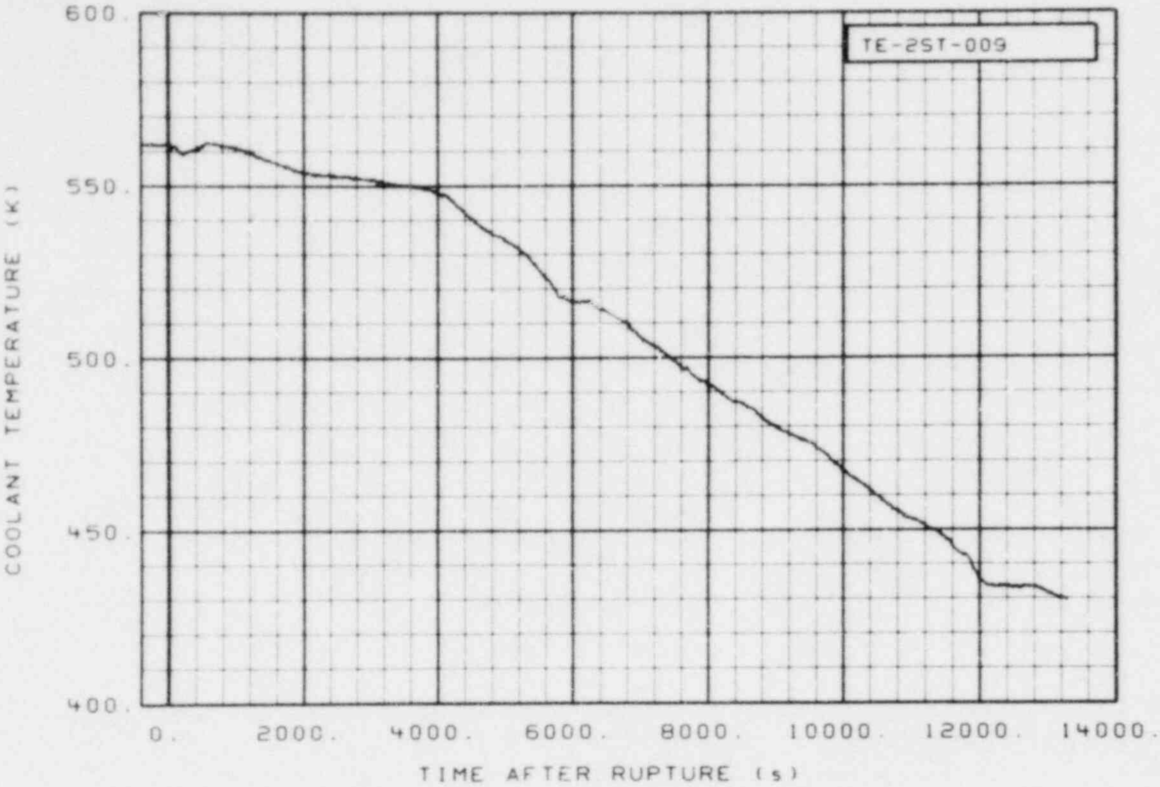


Figure 178. Coolant temperature in reactor vessel Downcomer Instrument Stalk 2 (TE-2ST-009) (Qualified).

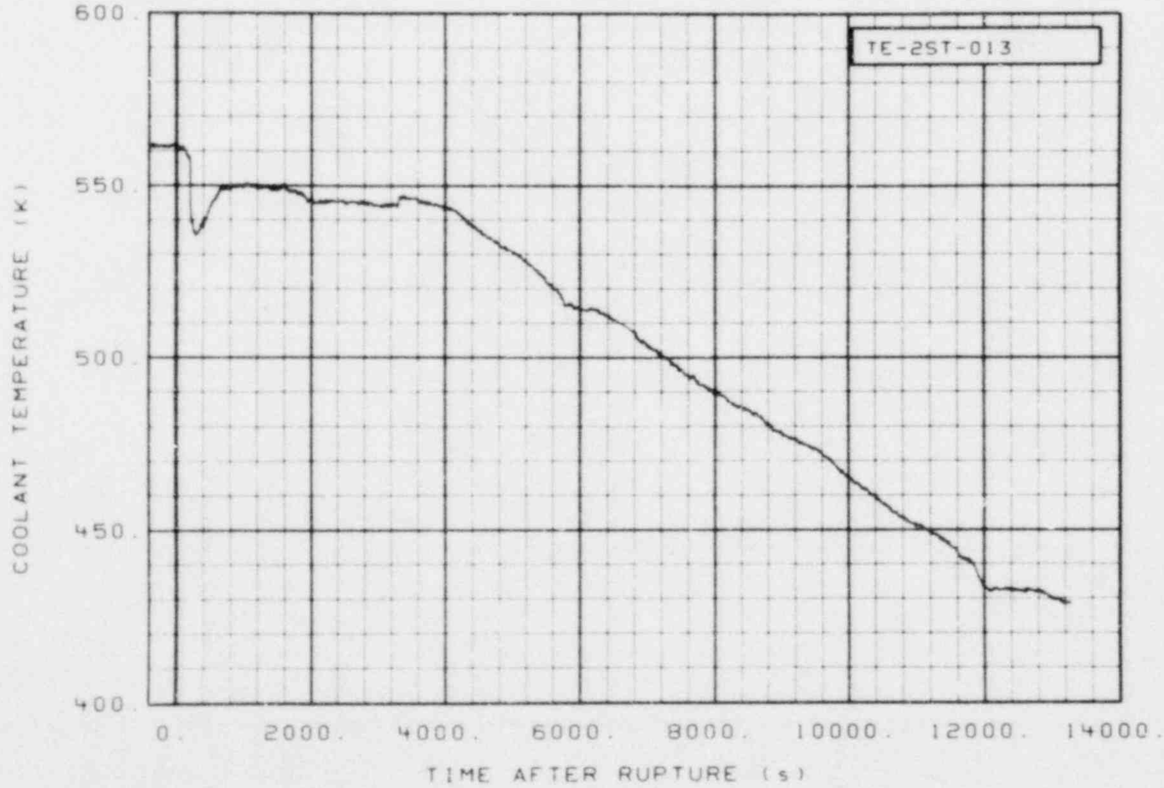


Figure 179. Coolant temperature in reactor vessel Downcomer Instrument Stalk 2 (TE-2ST-013) (Qualified).

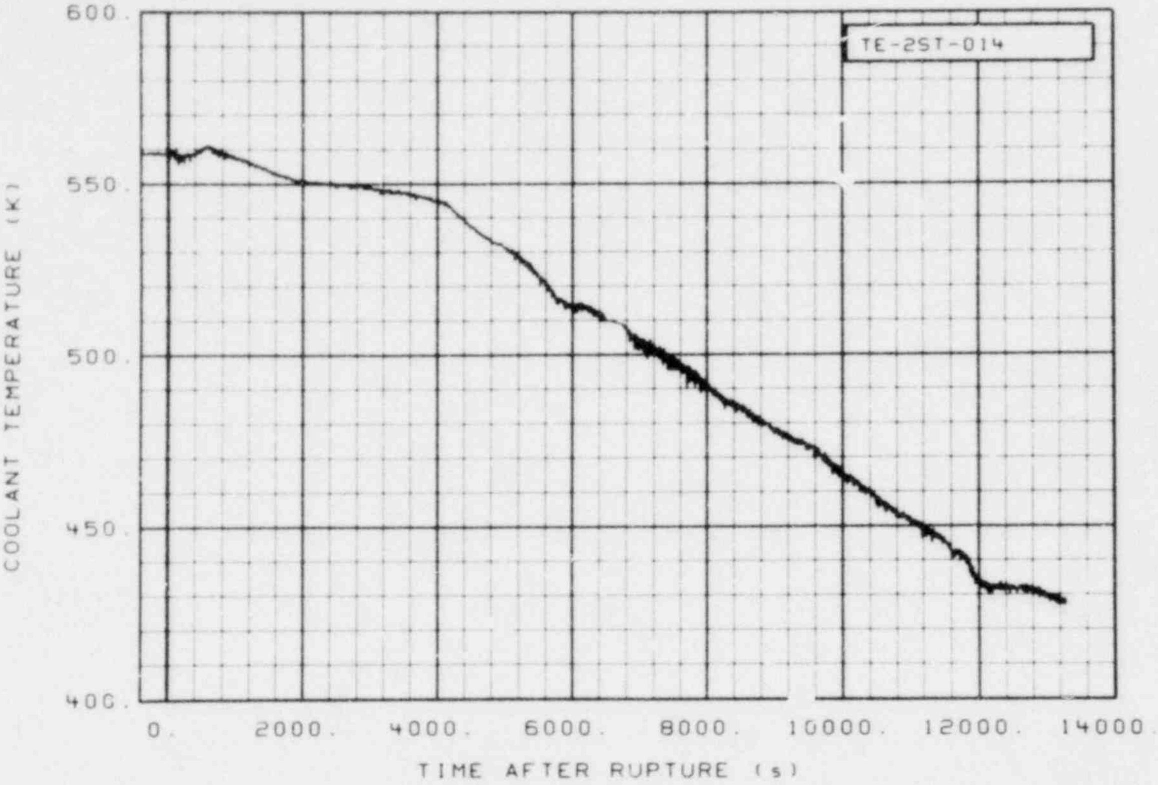


Figure 180. Coolant temperature in reactor vessel Downcomer Instrument Stalk 2 (TE-2ST-014) (Qualified).

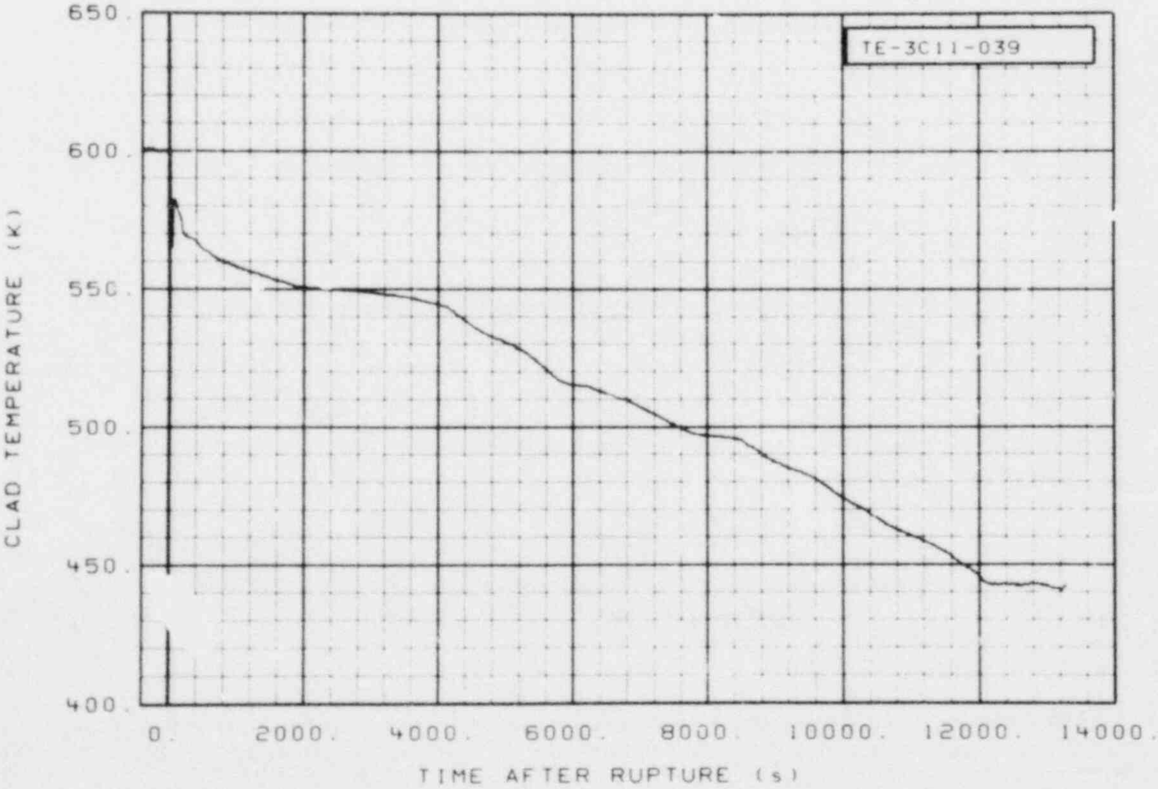


Figure 181. Cladding temperature in reactor vessel at Fuel Assembly 3, Row C, Column 11 at 0.99 m above bottom of fuel rod (TE-3C11-039) (Qualified).

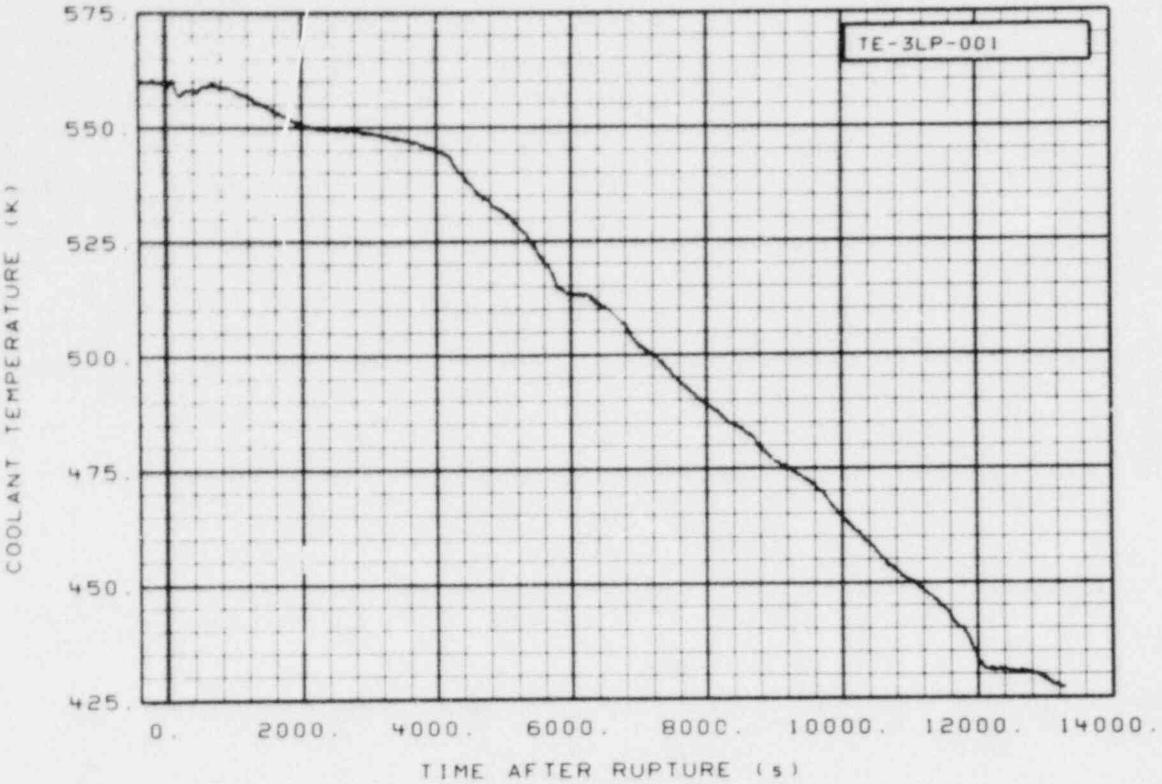


Figure 182. Coolant temperature in reactor vessel at Fuel Assembly 3 lower end box (TE-3LP-001) (Qualified).

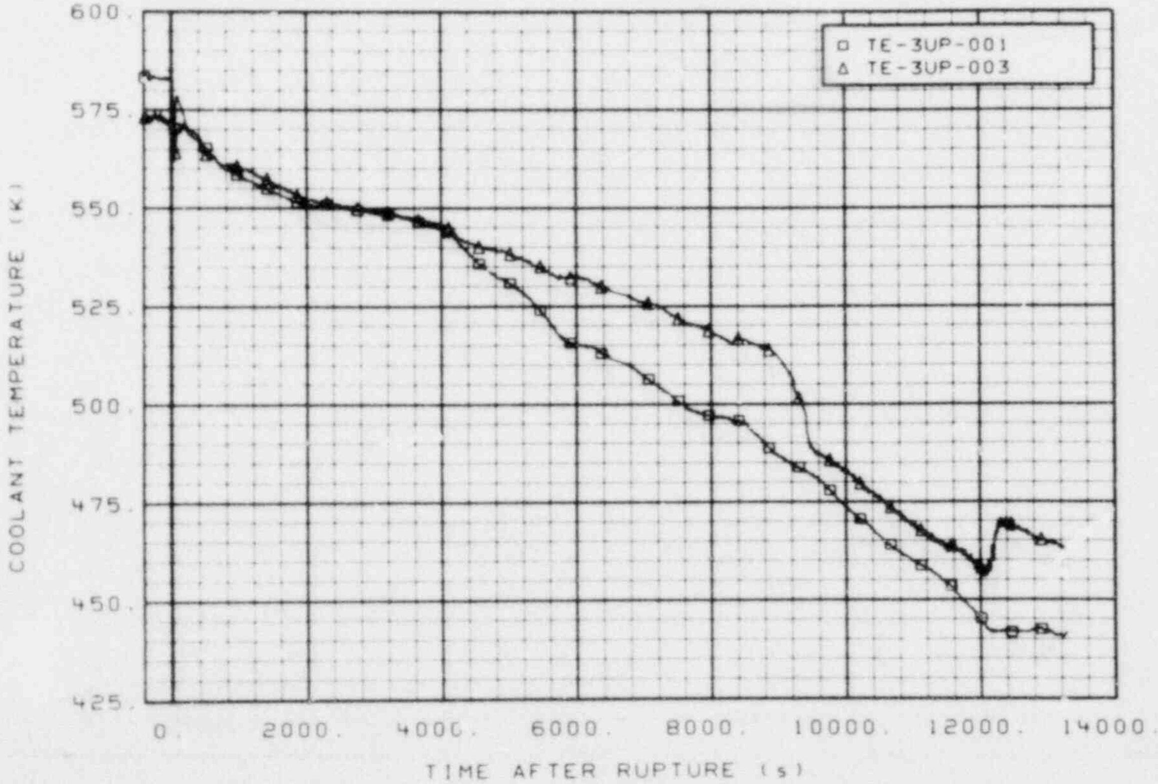


Figure 183. Coolant temperature in reactor vessel above Fuel Assembly 3 at upper end box and above outlet nozzle (TE-3UP-001 and -003) (Qualified).

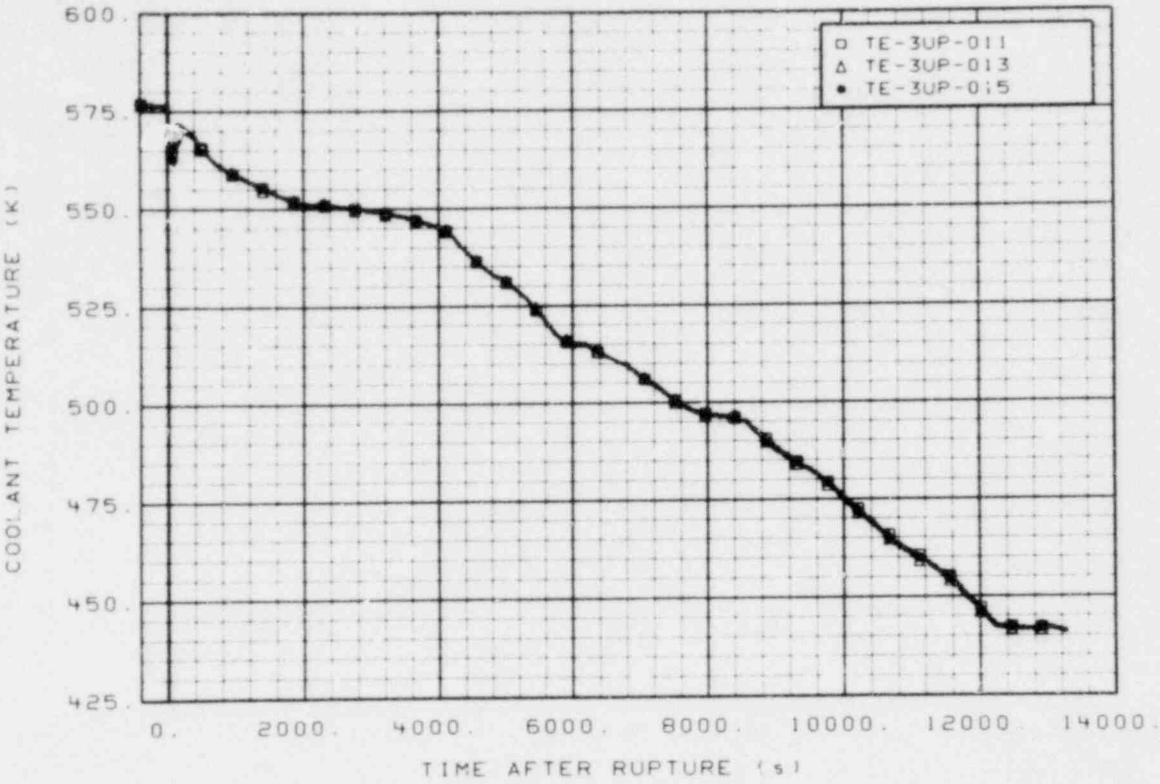


Figure 184. Coolant temperature in reactor vessel at liquid level sting above Fuel Assembly 3 (TE-3UP-011, -013, and -015) (Qualified).

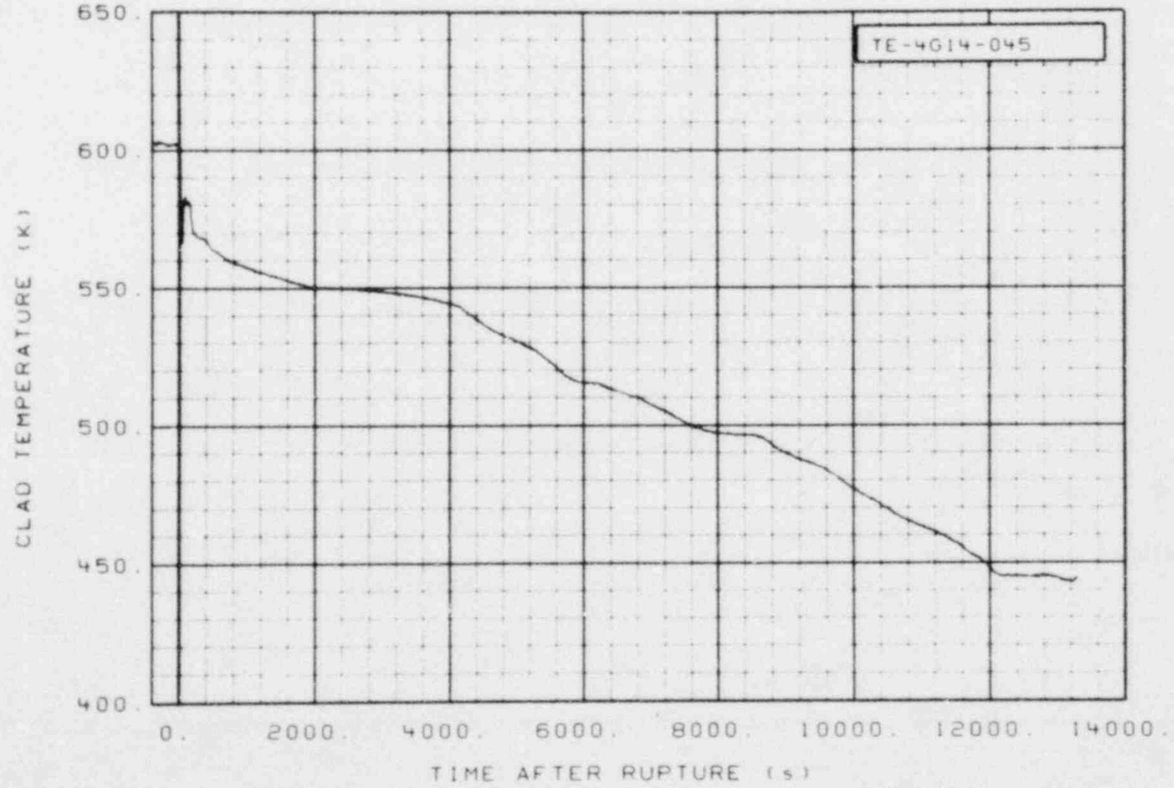


Figure 185. Cladding temperature in reactor vessel at Fuel Assembly 4, Row G, Column 14 at 1.14 m above bottom of fuel rod (TE-4G14-045) (Qualified).

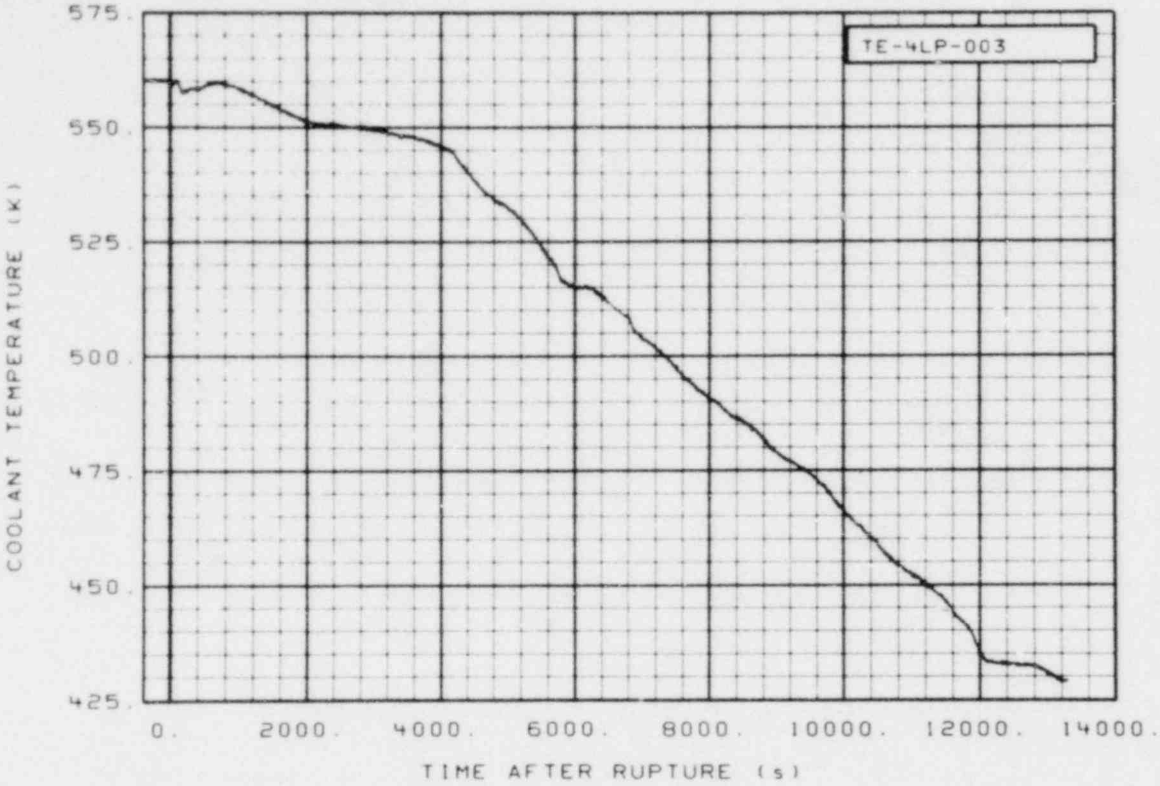


Figure 186. Coolant temperature in reactor vessel at lower end box of Fuel Assembly 4 (TE-4LP-003) (Qualified).

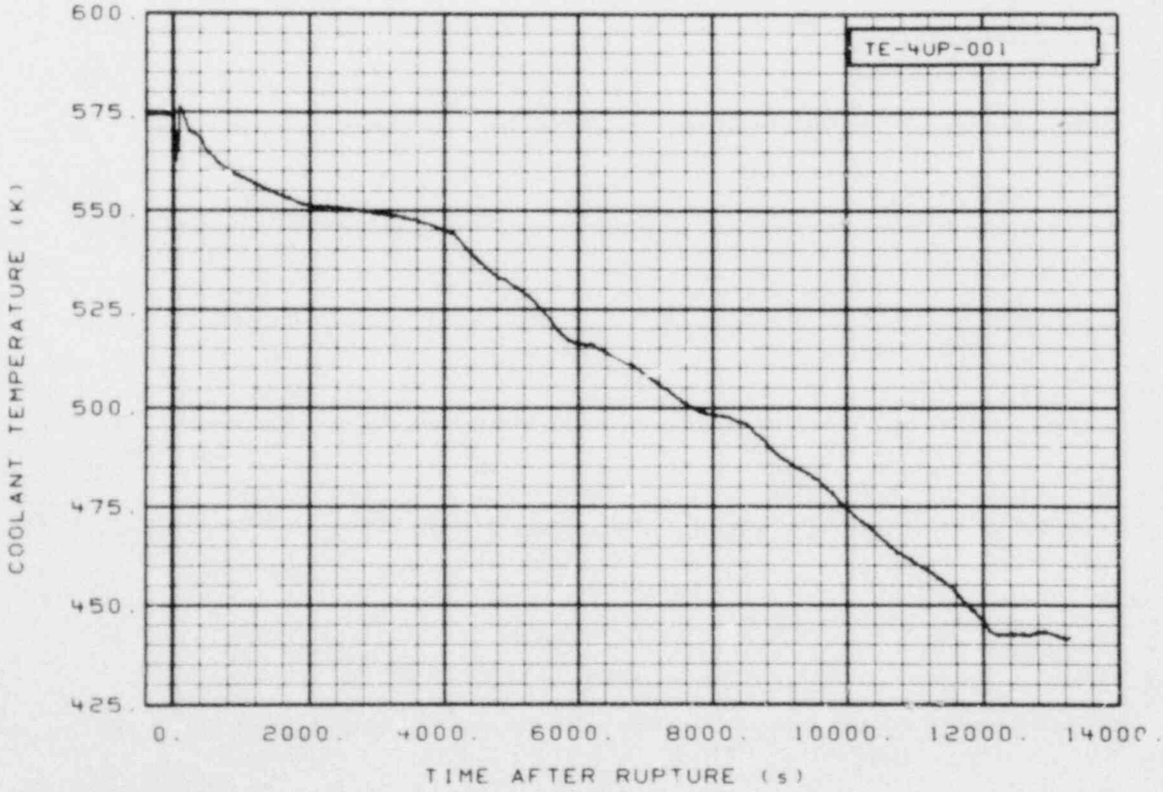


Figure 187. Coolant temperature in reactor vessel at upper end box of Fuel Assembly 4 (TE-4UP-001) (Qualified).

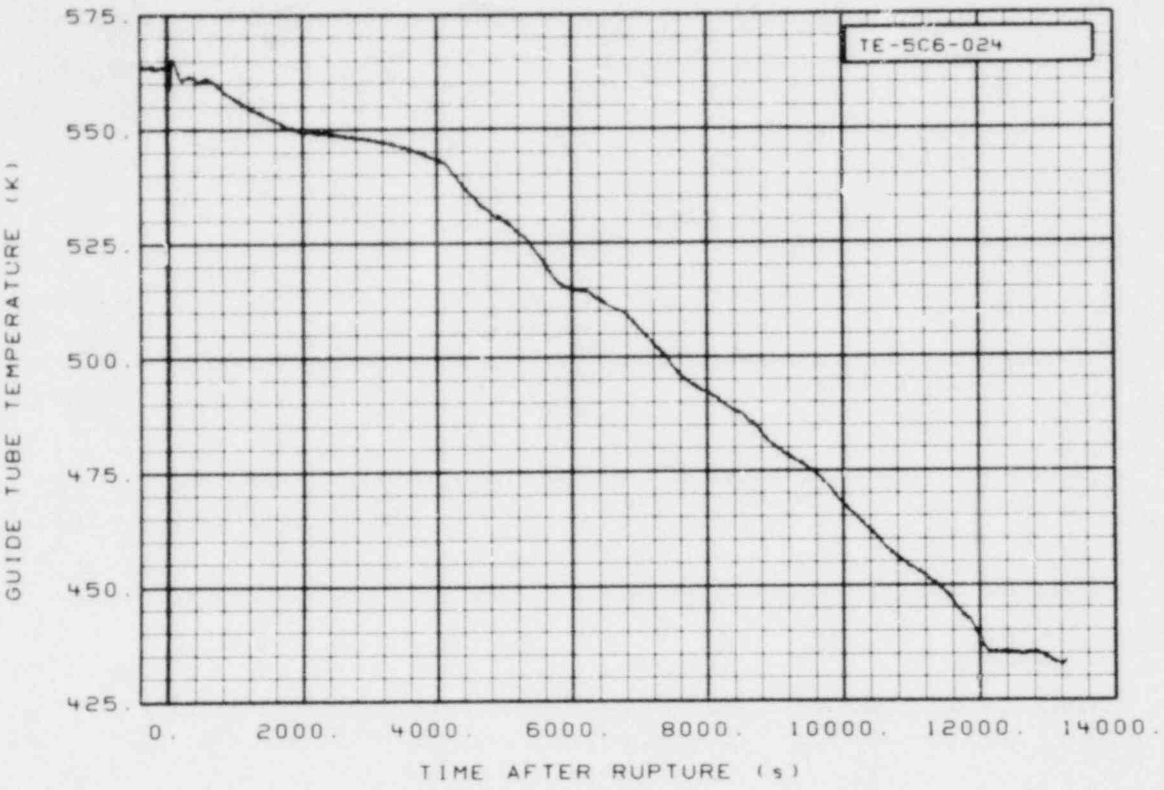


Figure 188. Guide tube temperature in reactor vessel at Fuel Assembly 5, Row C, Column 6 at 0.61 m above bottom of guide tube (TE-5C6-024) (Qualified).

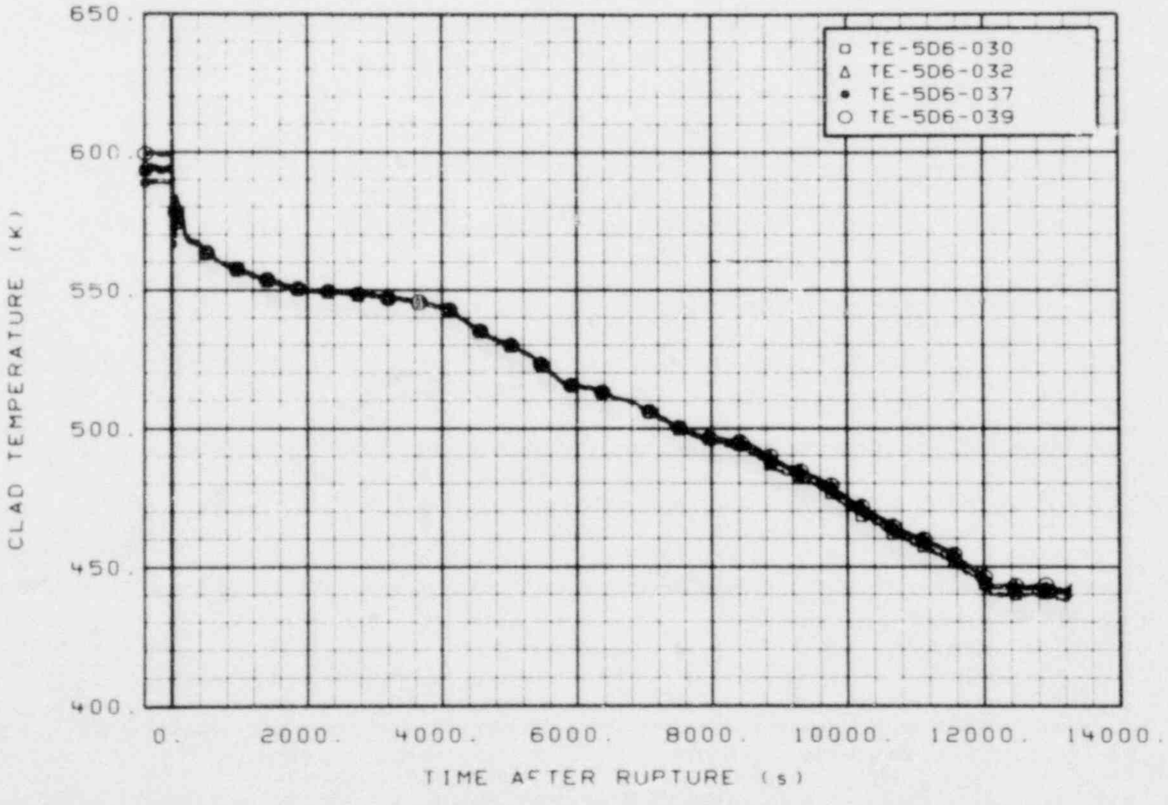


Figure 189. Cladding temperature in reactor vessel at Fuel Assembly 5, Row D, Column 6 at 0.76, 0.81, 0.94, and 0.99 m above bottom of fuel rod (TE-5D6-030, -032, -037, and -039) (Qualified).

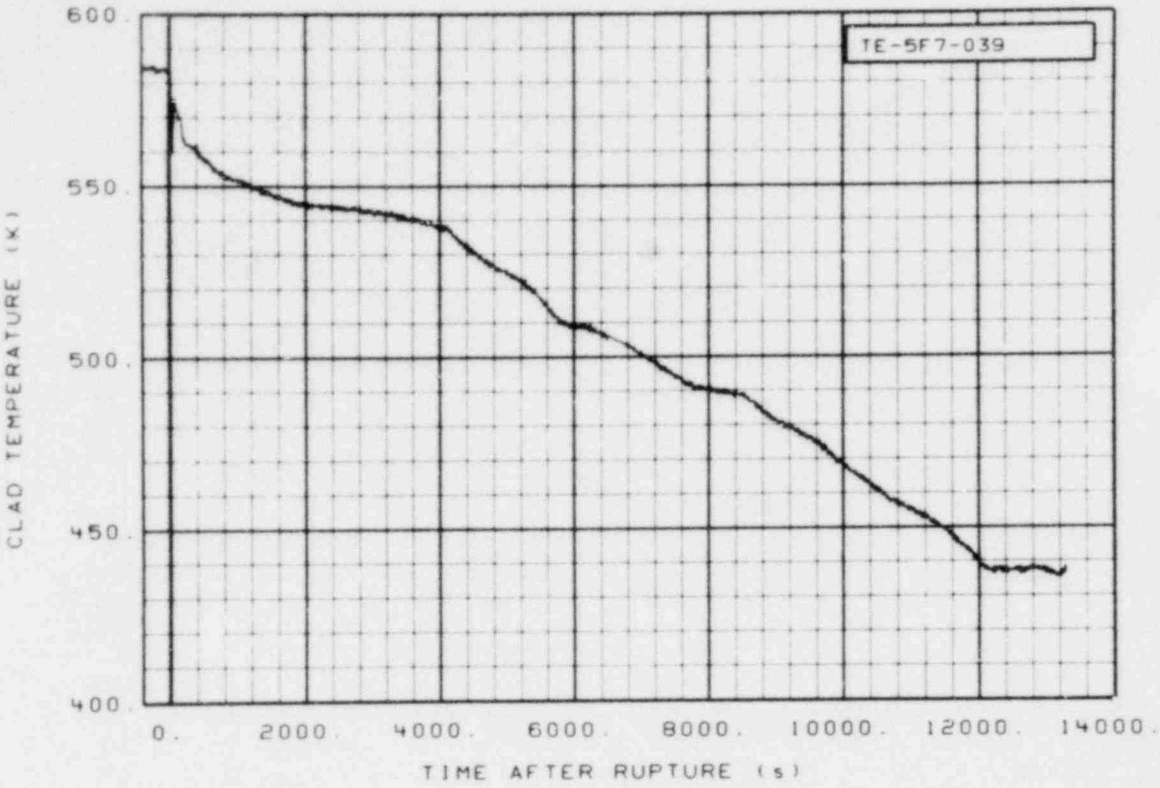


Figure 190. Cladding temperature in reactor vessel at Fuel Assembly 5, Row F, Column 7 at 0.99 m above bottom of fuel rod (TE-5F7-039) (Qualified).

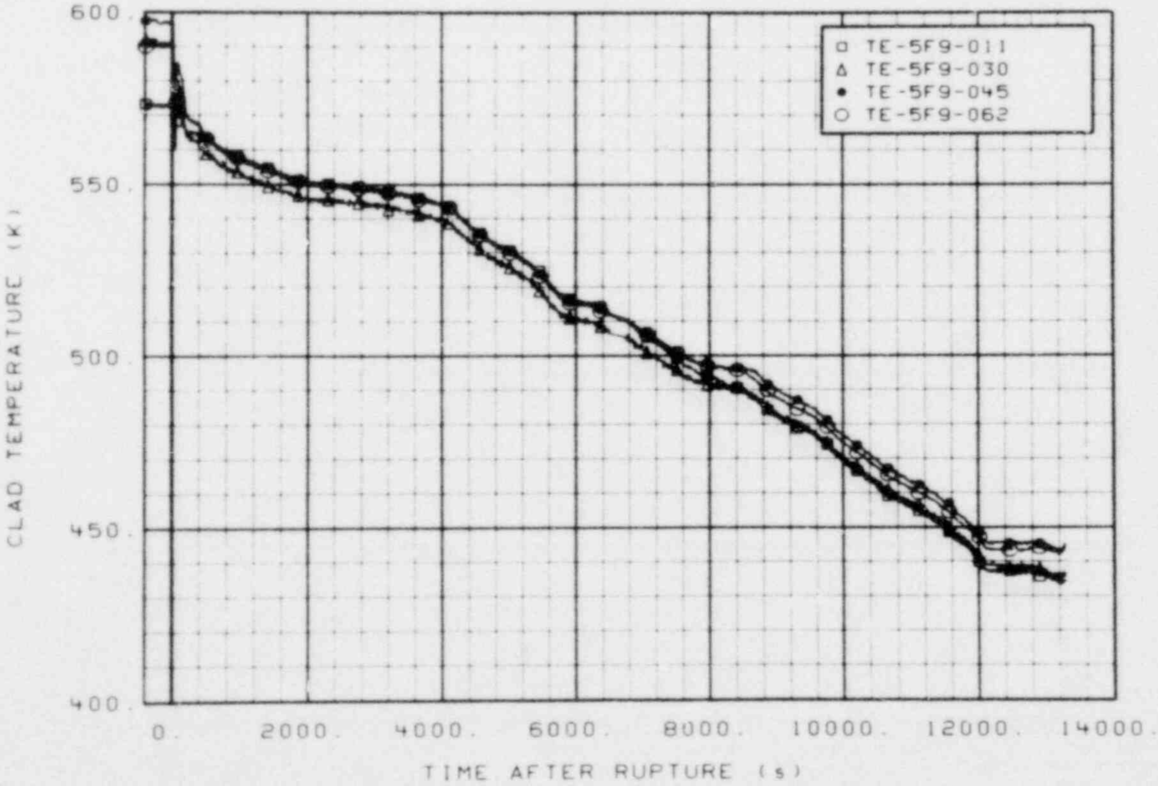


Figure 191. Cladding temperature in reactor vessel at Fuel Assembly 5, Row F, Column 9 at 0.28, 0.76, 1.14, and 1.57 m above bottom of fuel rod (TE-5F9-011, -030, -045, and -062) (Qualified).

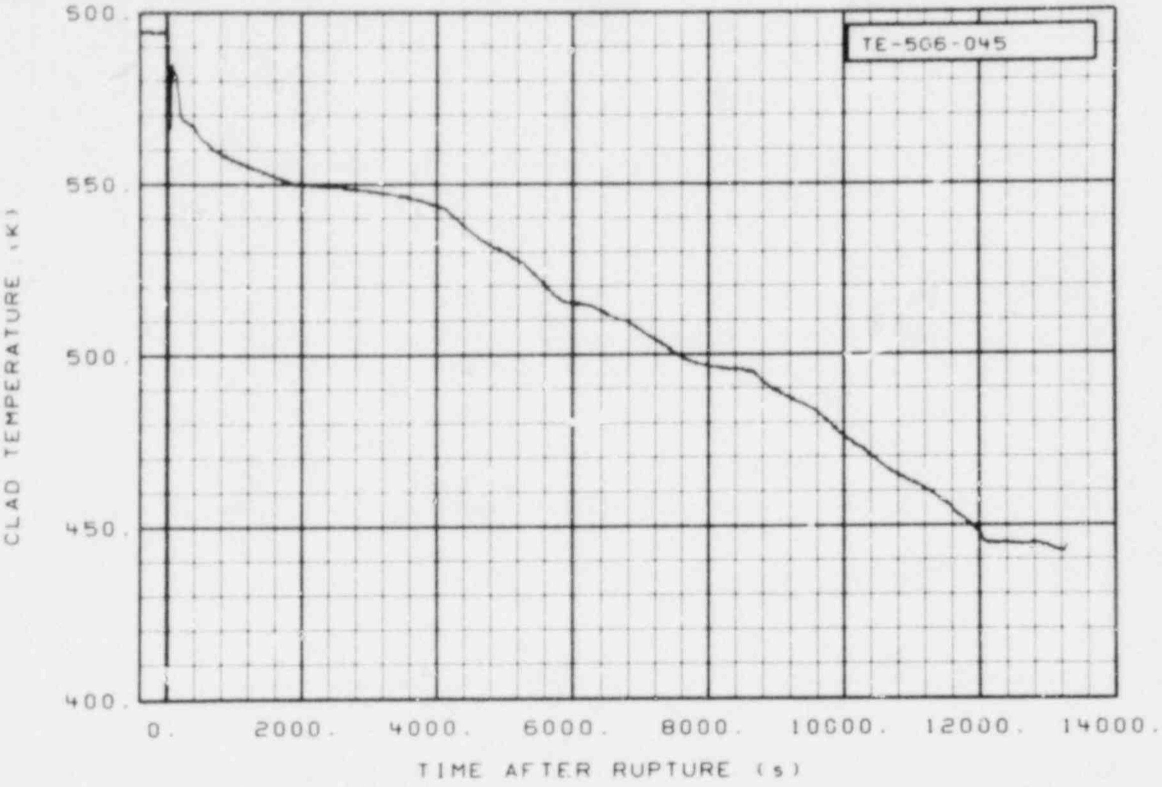


Figure 192. Cladding temperature in reactor vessel at Fuel Assembly 5, Row G, Column 6 at 1.14 m above bottom of fuel rod (TE-5G6-045) (Qualified).

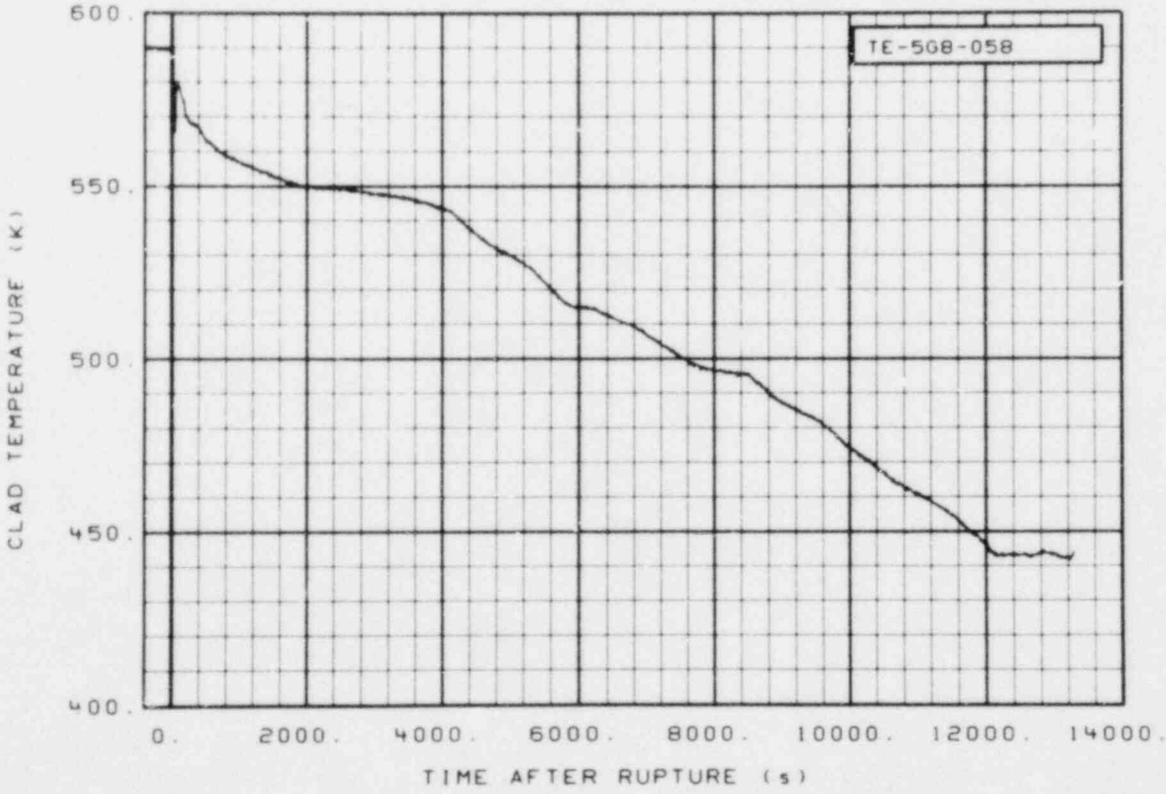


Figure 193. Cladding temperature in reactor vessel on Fuel Assembly 5, Row G, Column 8 at 1.47 m above bottom of fuel rod (TE-5G8-058) (Qualified).

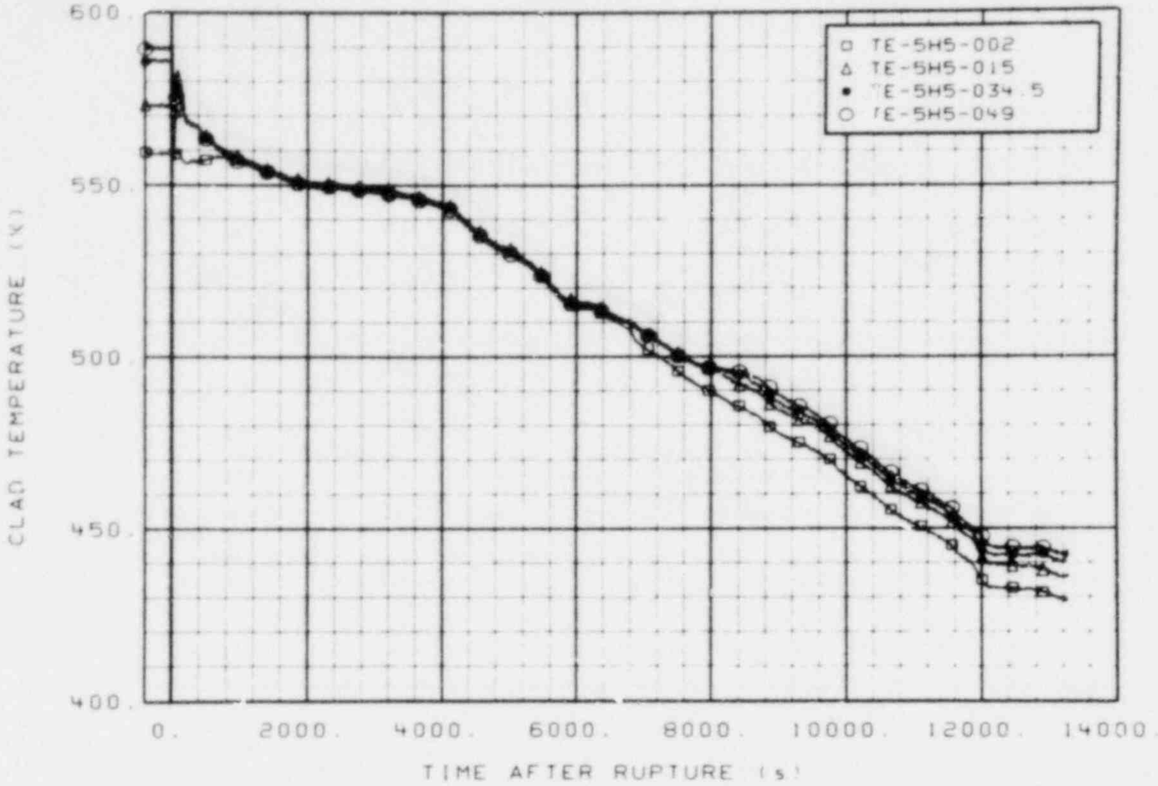


Figure 194. Cladding temperature in reactor vessel at Fuel Assembly 5, Row H, Column 5 at 0.05, 0.38, 0.88, and 1.24 m above bottom of fuel rod (TE-5H5-002, -015, -034.5, and -049) (Qualified).

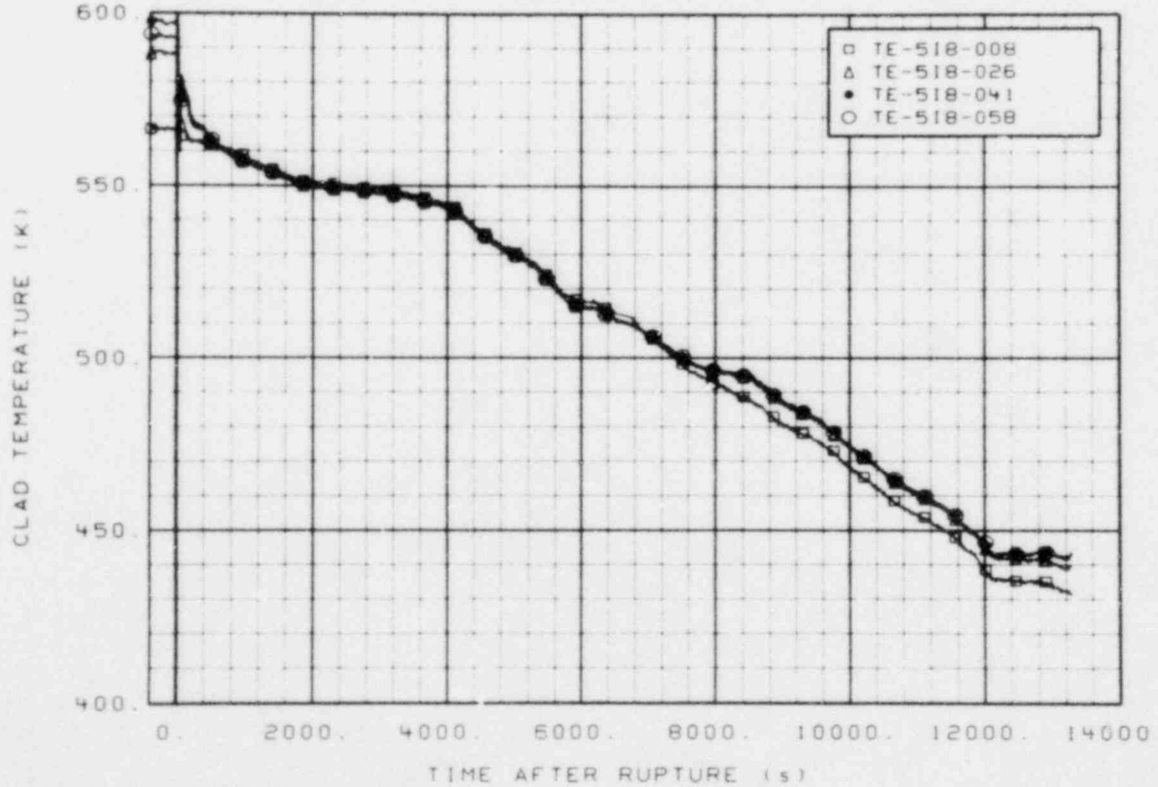


Figure 195. Cladding temperature in reactor vessel at Fuel Assembly 5, Row I, Column 8 at 0.20, 0.66, 1.04, and 1.47 m above bottom of fuel rod (TE-5I8-008, -026, -041, and -058) (Qualified).

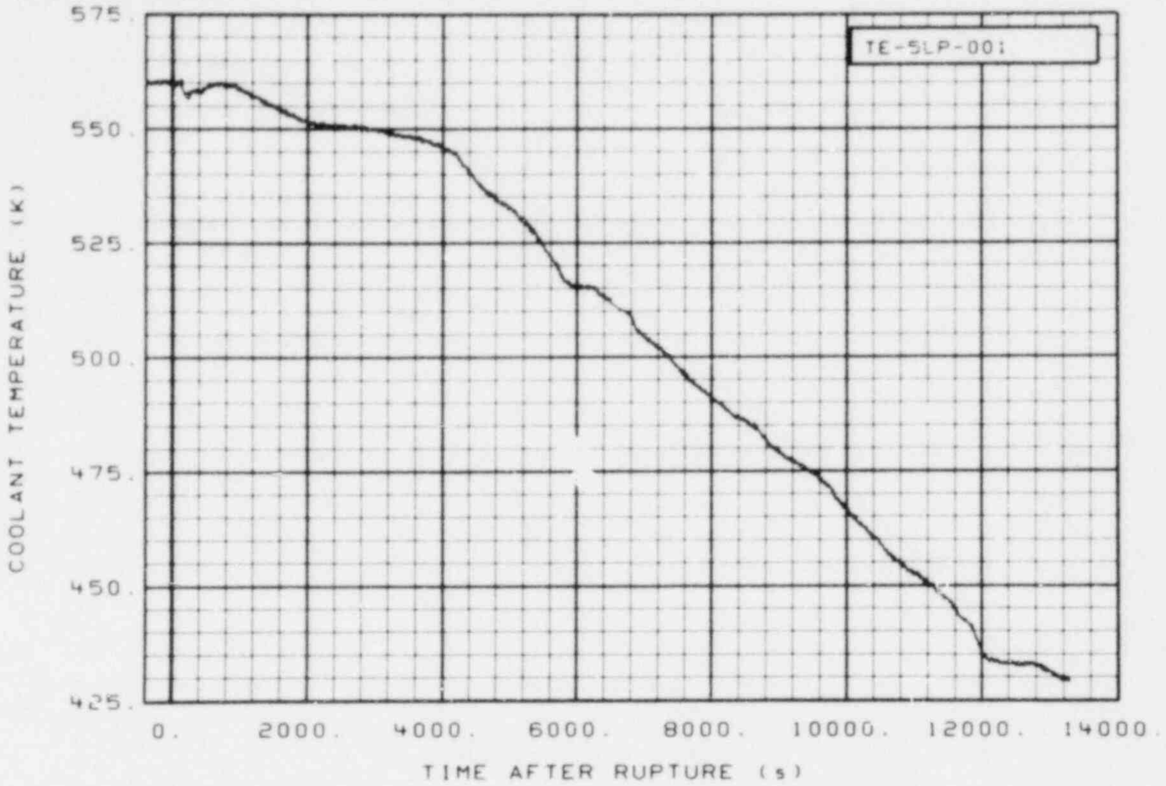


Figure 196. Coolant temperature in reactor vessel at lower end box of Fuel Assembly 5 (TE-5LP-001) (Qualified).

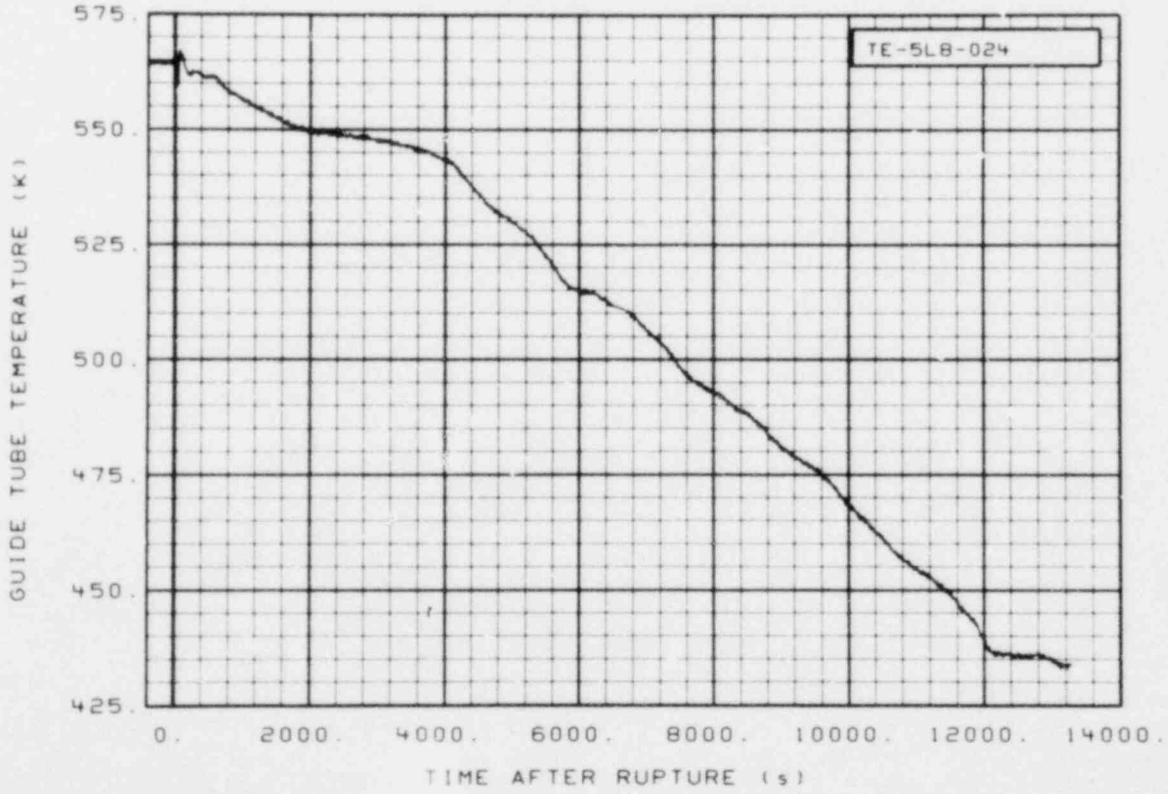


Figure 197. Guide tube temperature in reactor vessel at Fuel Assembly 5, Row L, Column 8 at 0.61 m above bottom of guide tube (TE-5L8-024) (Qualified).

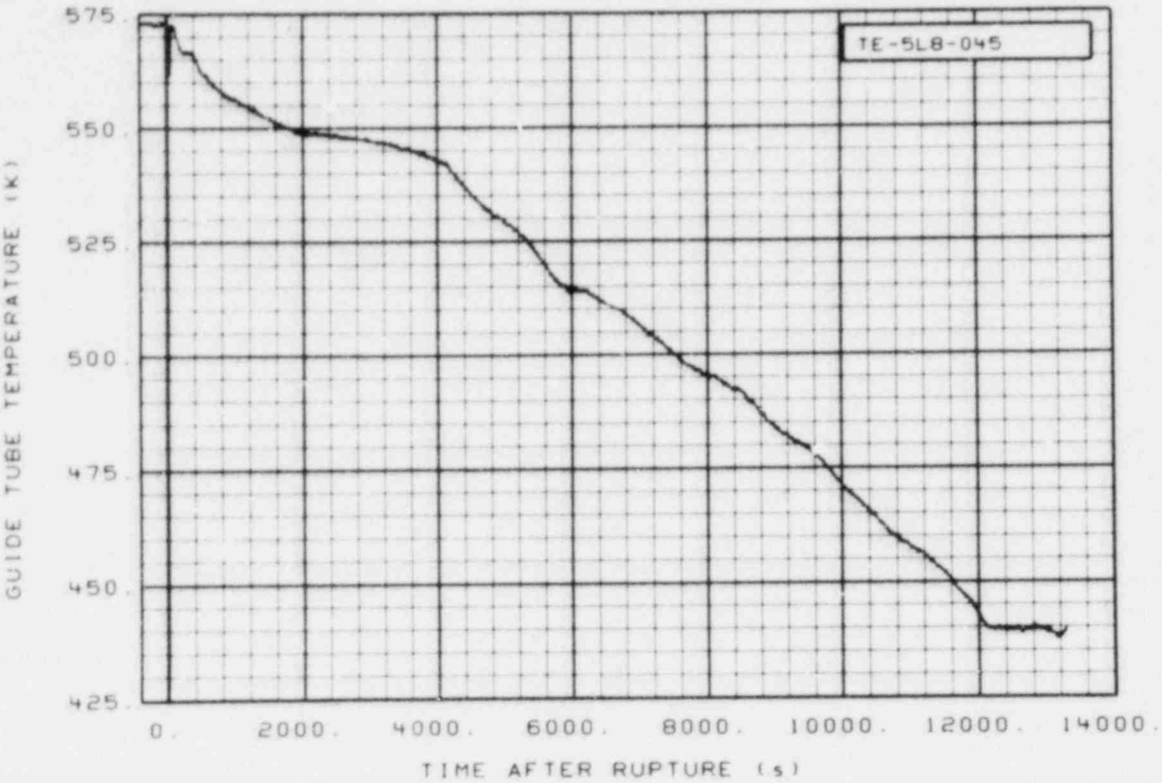


Figure 198. Guide tube temperature in reactor vessel at Fuel Assembly 5, Row L, Column 8 at 1.14 m above bottom of guide tube (TE-5L8-045) (Qualified).

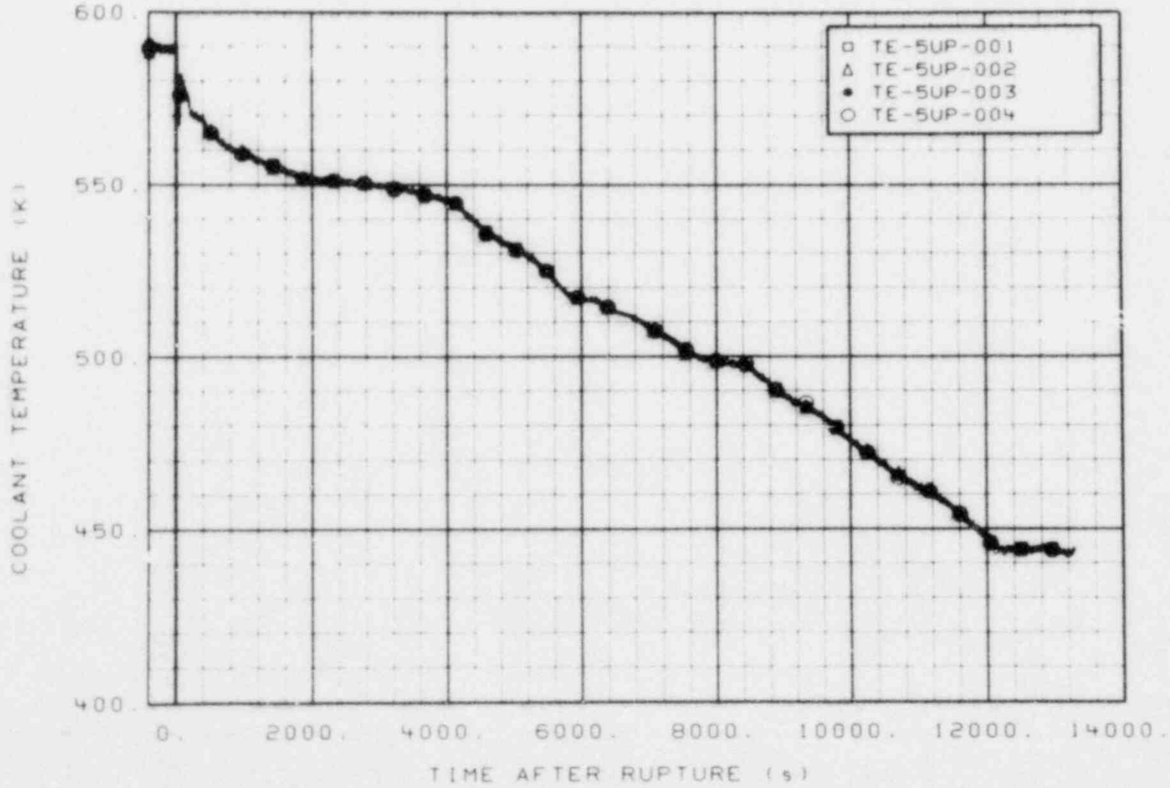


Figure 199. Coolant temperature in reactor vessel at upper end box of Fuel Assembly 5 (TE-5UP-001, -002, -003, and -004) (Qualified).

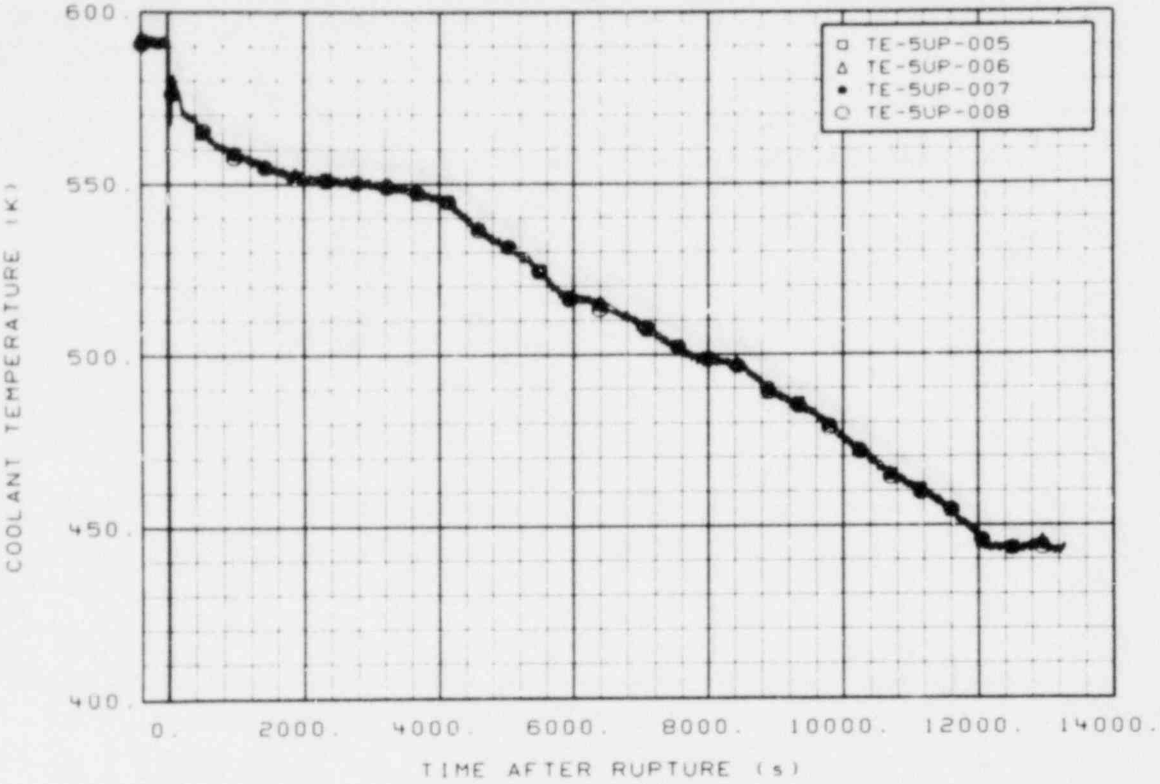


Figure 200. Coolant temperature in reactor vessel at upper end box of Fuel Assembly 5 (TE-5UP-005, -006, -007, and -008) (Qualified).

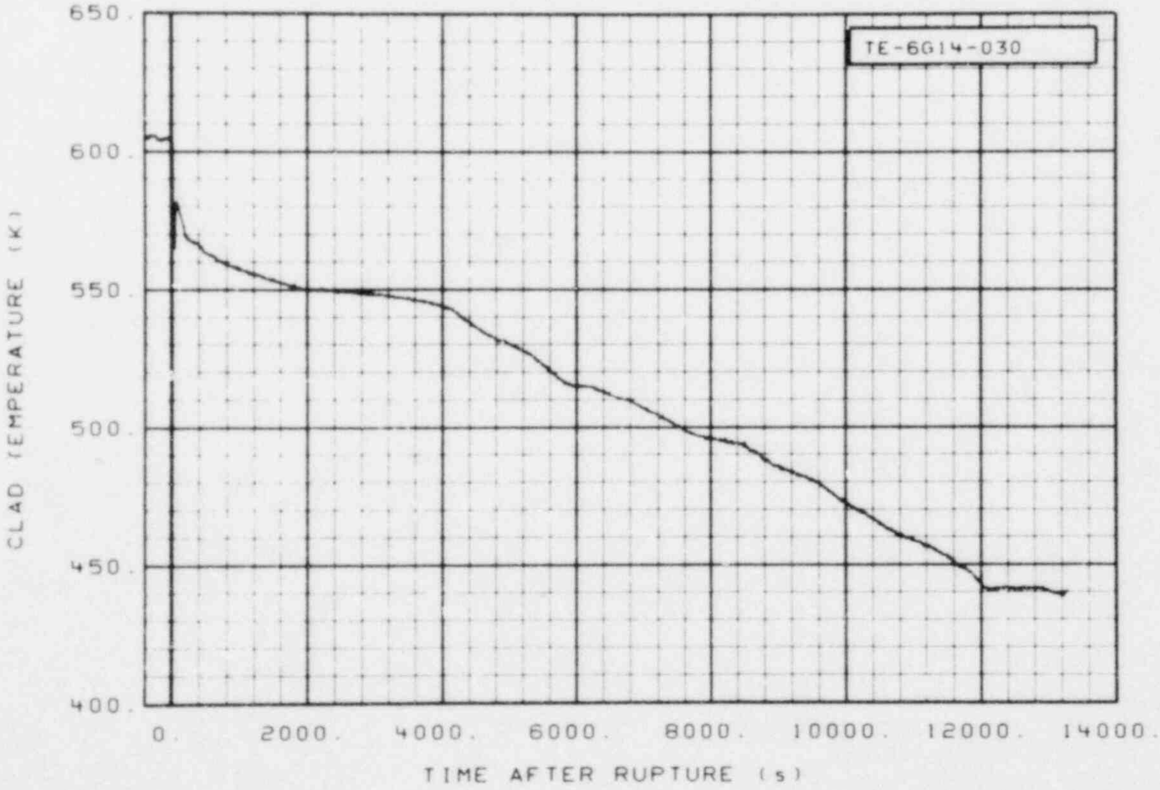


Figure 201. Cladding temperature in reactor vessel at Fuel Assembly 6, Row G, Column 14 at 0.76 m above bottom of fuel rod (TE-6G14-030) (Qualified).

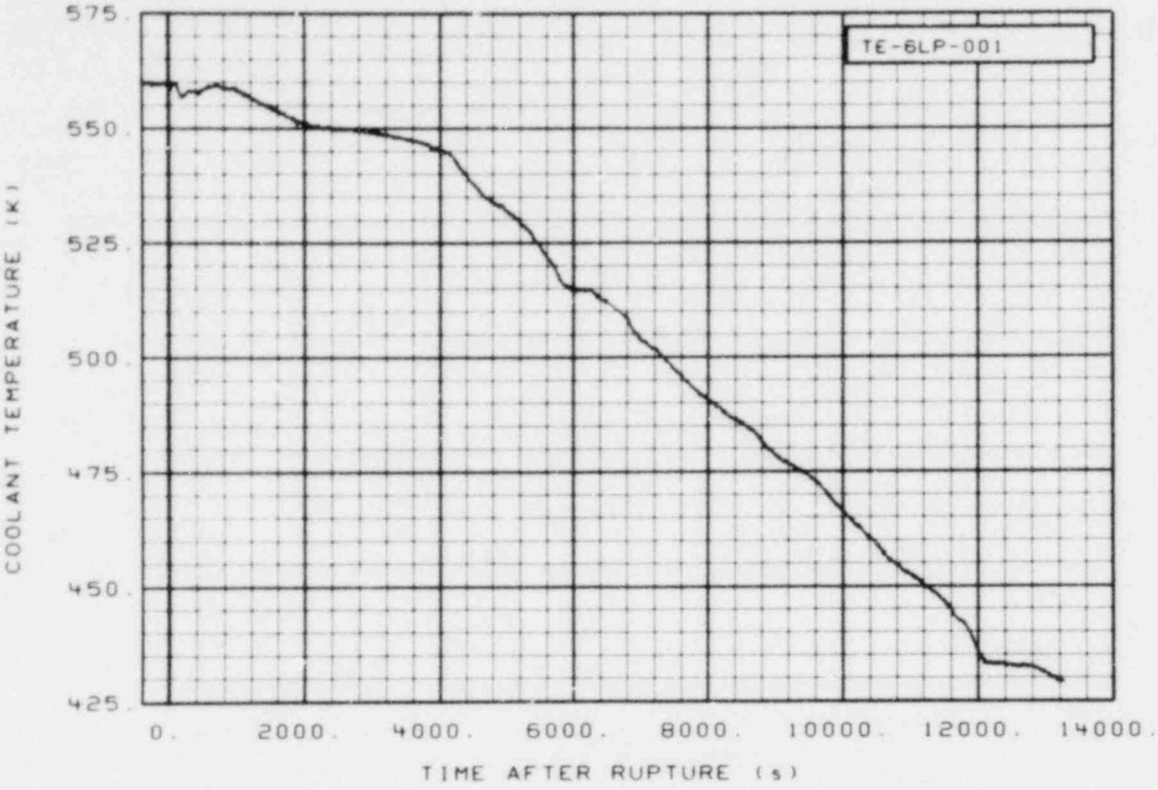


Figure 202. Coolant temperature in reactor vessel at lower end box of Fuel Assembly 6 (TE-6LP-001) (Qualified).

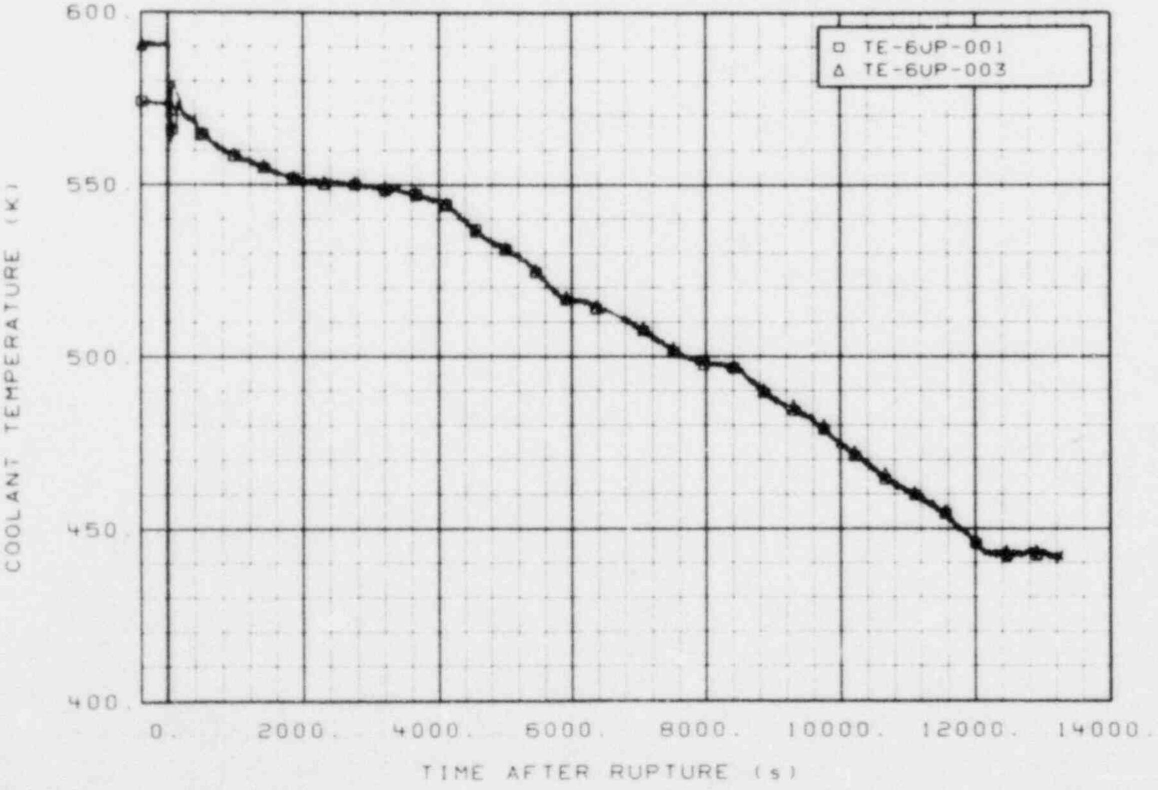


Figure 203. Coolant temperature in reactor vessel at upper end box of Fuel Assembly 6 (TE-6UP-001 and -003) (Qualified).

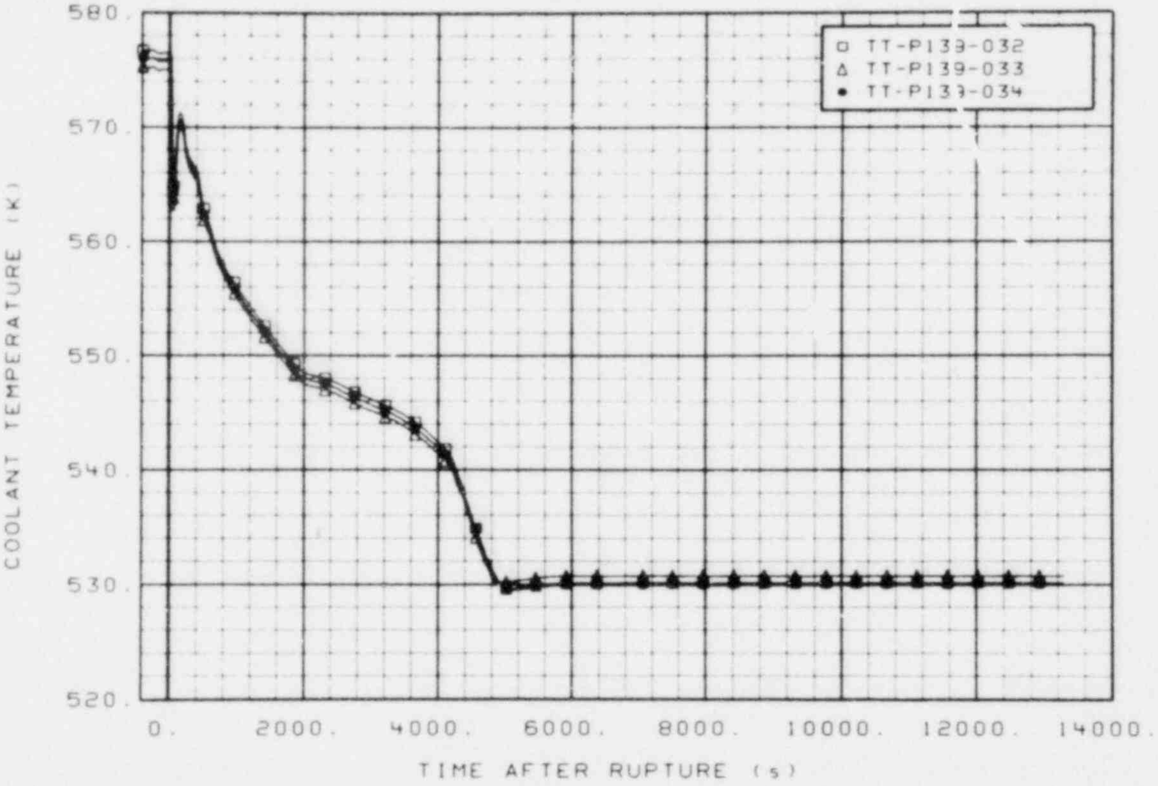


Figure 204. Coolant temperature in intact loop hot leg Channels A, B, and C (TT-P139-032, -033, -034) (Qualified, narrow range instruments).

LONG-TERM PLOTS
(o to 30 000 s)

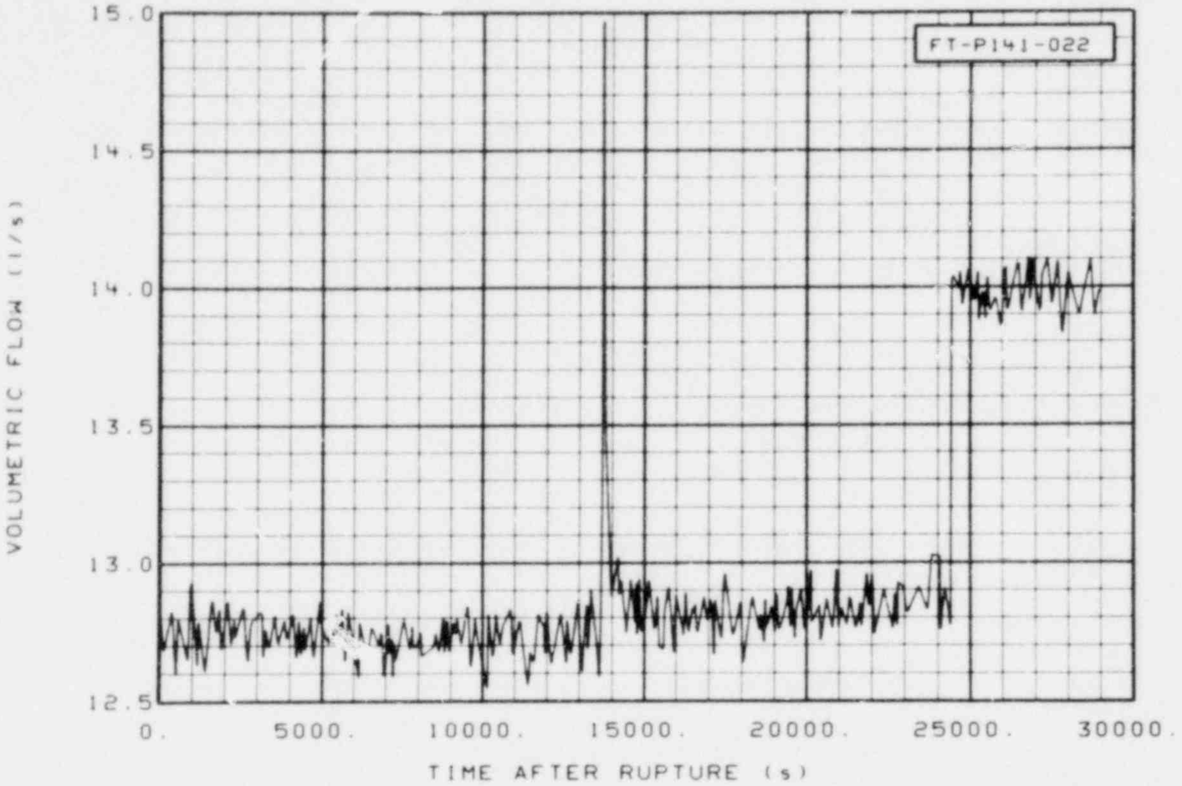


Figure 205. Flow rate in primary component coolant pump discharge (FT-P141-022) (Qualified, uncertainty: ± 0.3 l/s and ± 200 s).

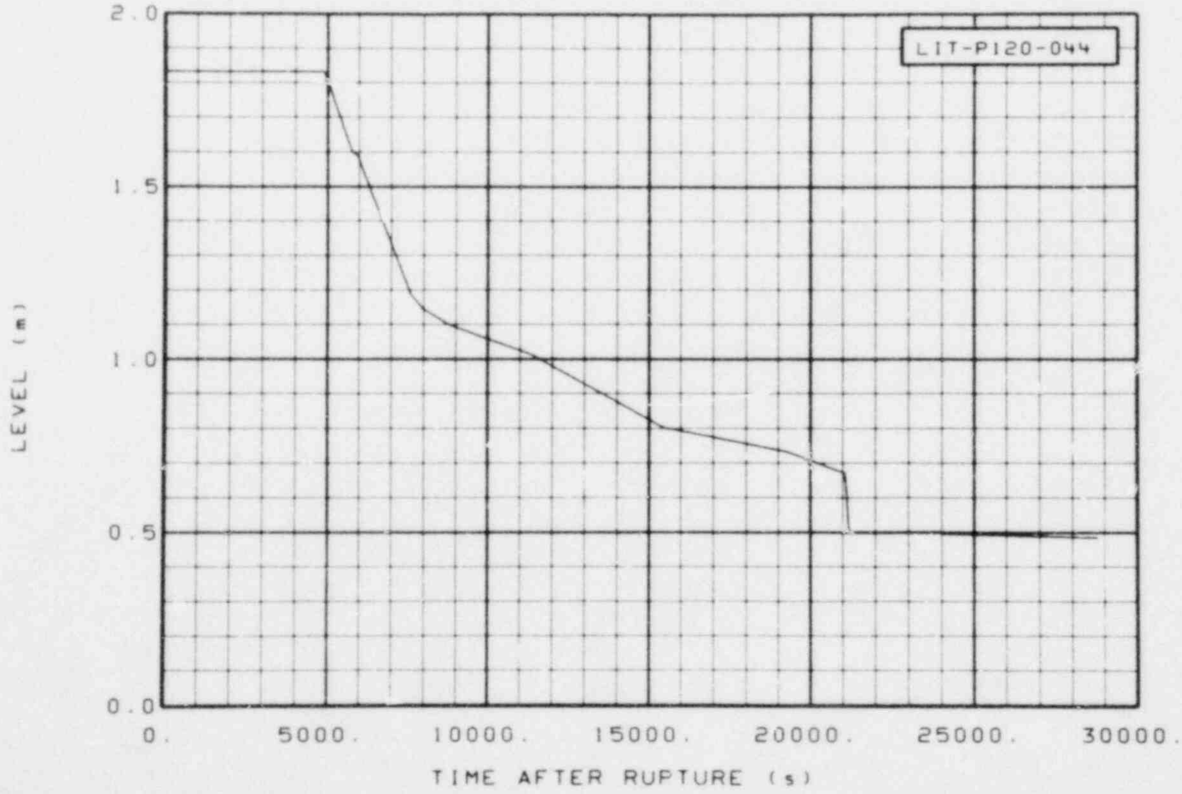


Figure 206. Liquid level in ECCS Accumulator A (LIT-P120-044) (Qualified, uncertainty: ± 0.1 m and ± 300 s).

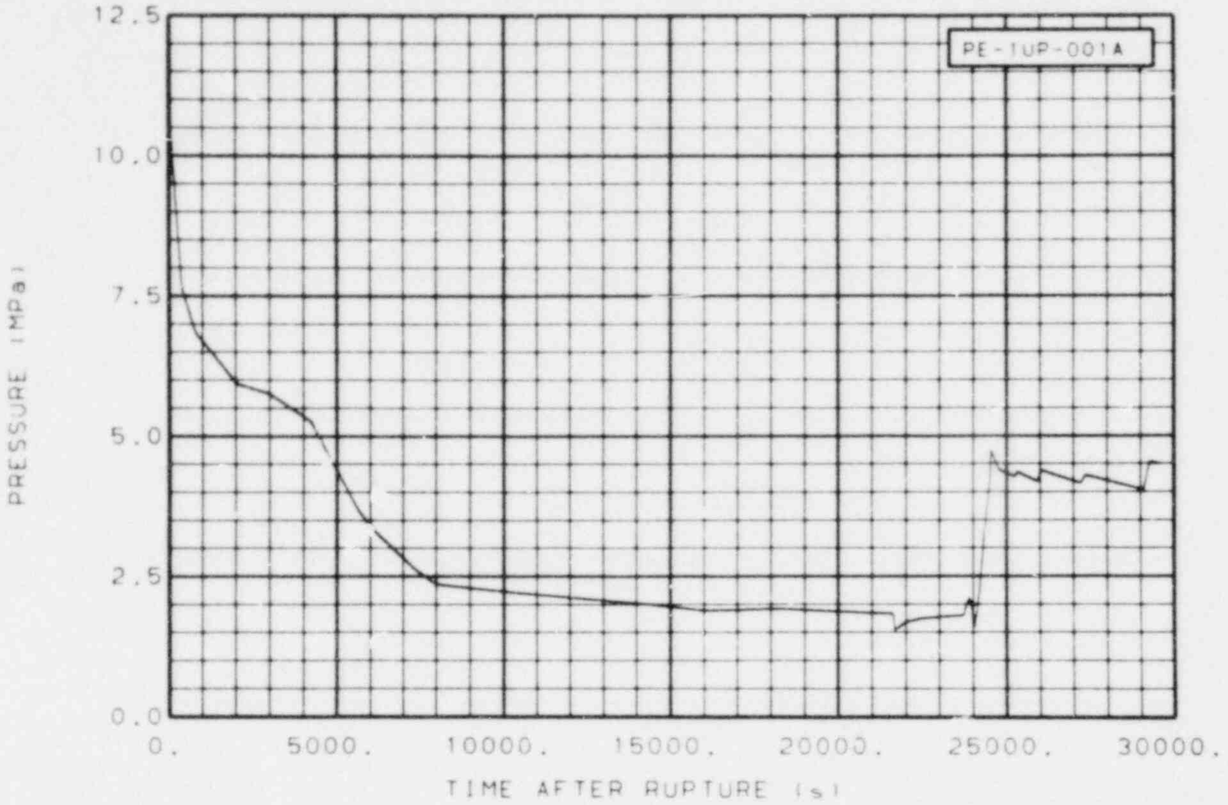


Figure 207. Pressure in reactor vessel above upper end box of Fuel Assembly 1 (PE-1UP-001A) (Qualified, uncertainty: ± 0.8 MPa and ± 200 s).

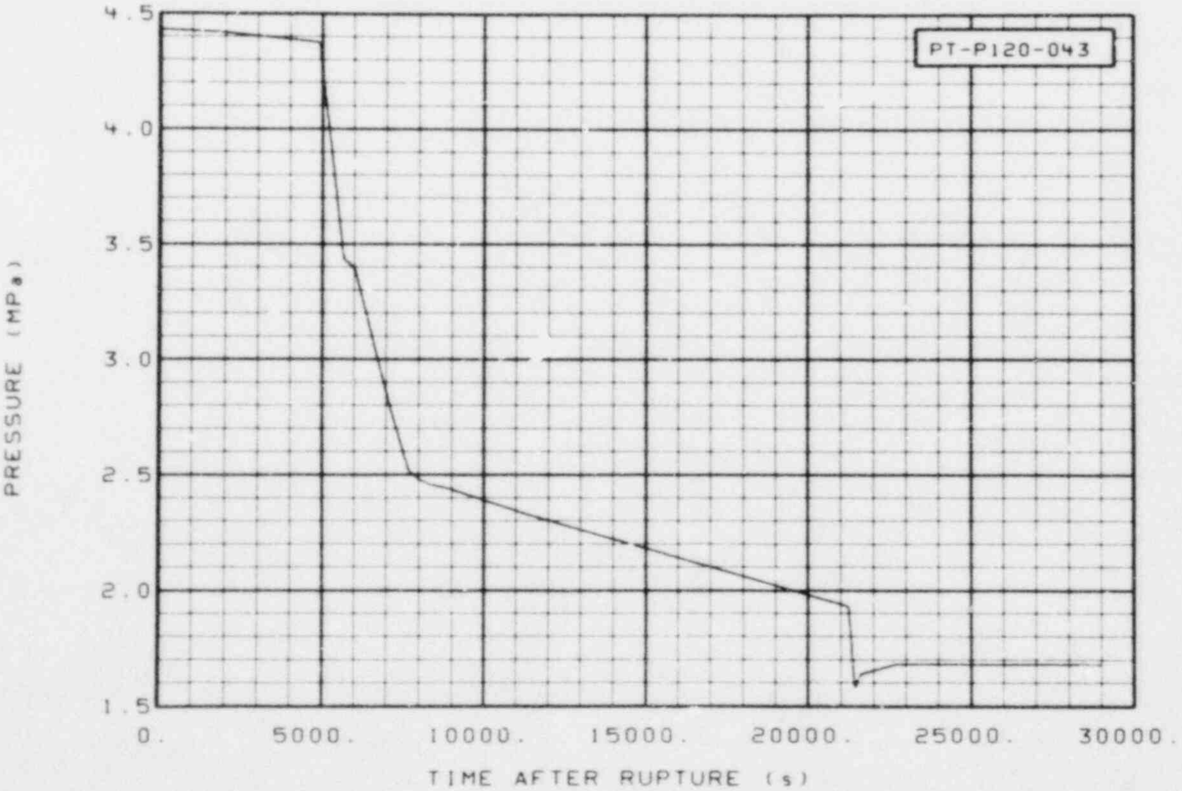


Figure 208. Pressure in ECCS Accumulator A (PT-P120-043) (Qualified, uncertainty: ± 0.3 MPa and ± 200 s).

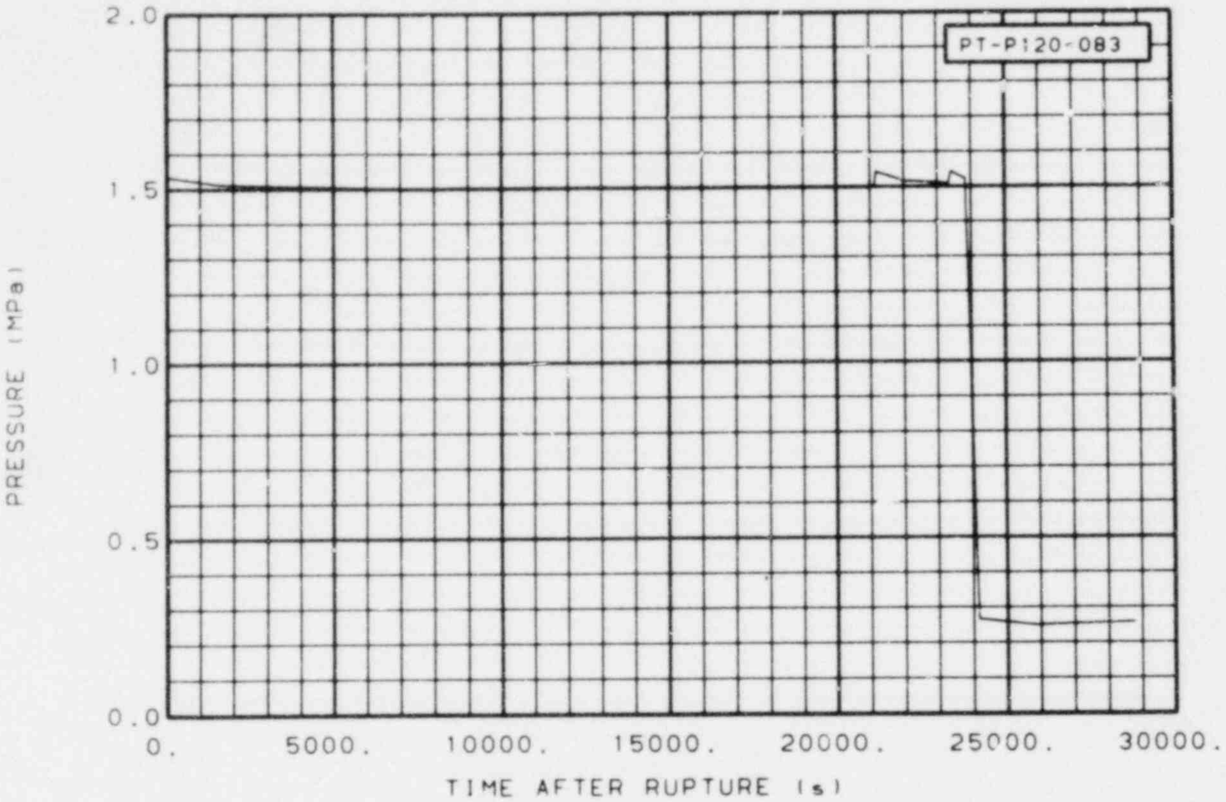


Figure 209. Pressure in ECCS LPIS Pump A discharge (PT-P120-083) (Qualified, uncertainty: ± 0.1 MPa and ± 100 s).

Figure 210. Pressure in intact loop on bottom of pipe at venturi (PT-P139-002) (Qualified, good to 26 000 s, uncertainty: ± 0.5 MPa and ± 200 s).

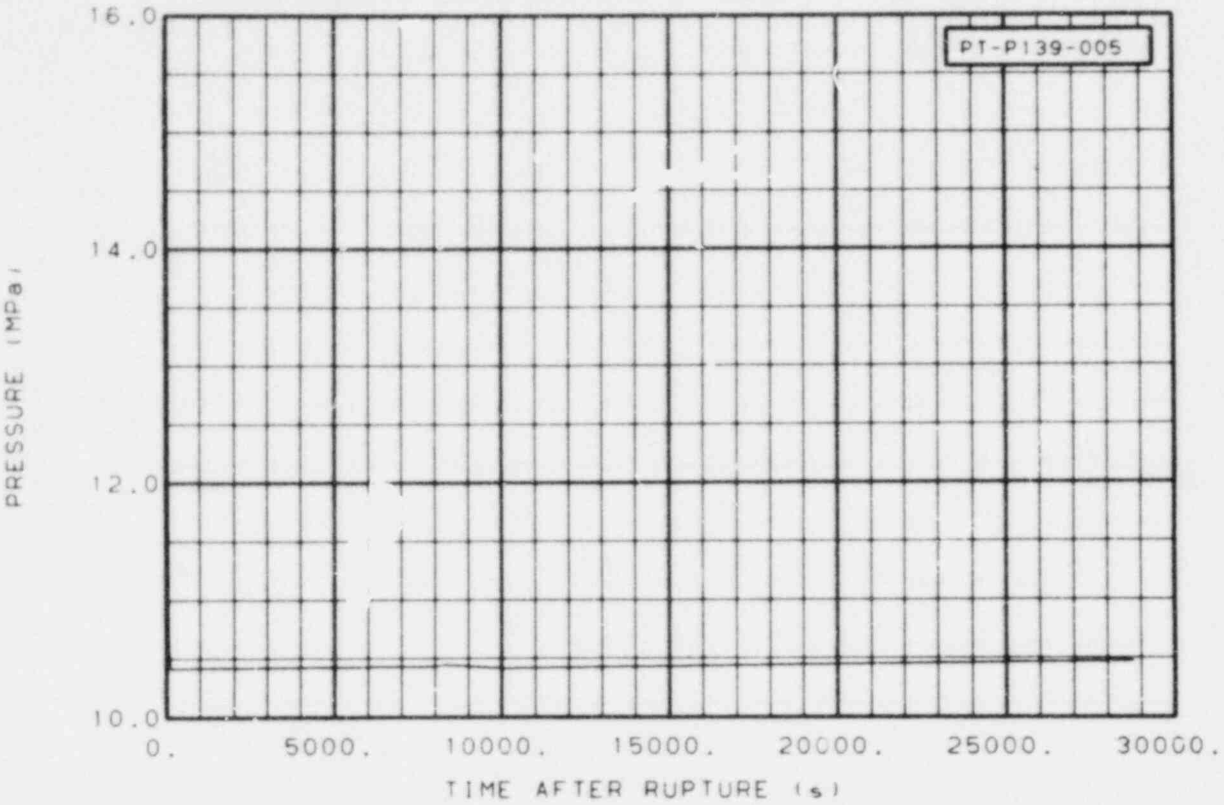


Figure 211. Pressure in pressurizer 1.88 m above pressurizer bottom (vapor space) (PT-P139-005) (Qualified, narrow range instrument, uncertainty: ± 0.3 MPa and ± 200 s).

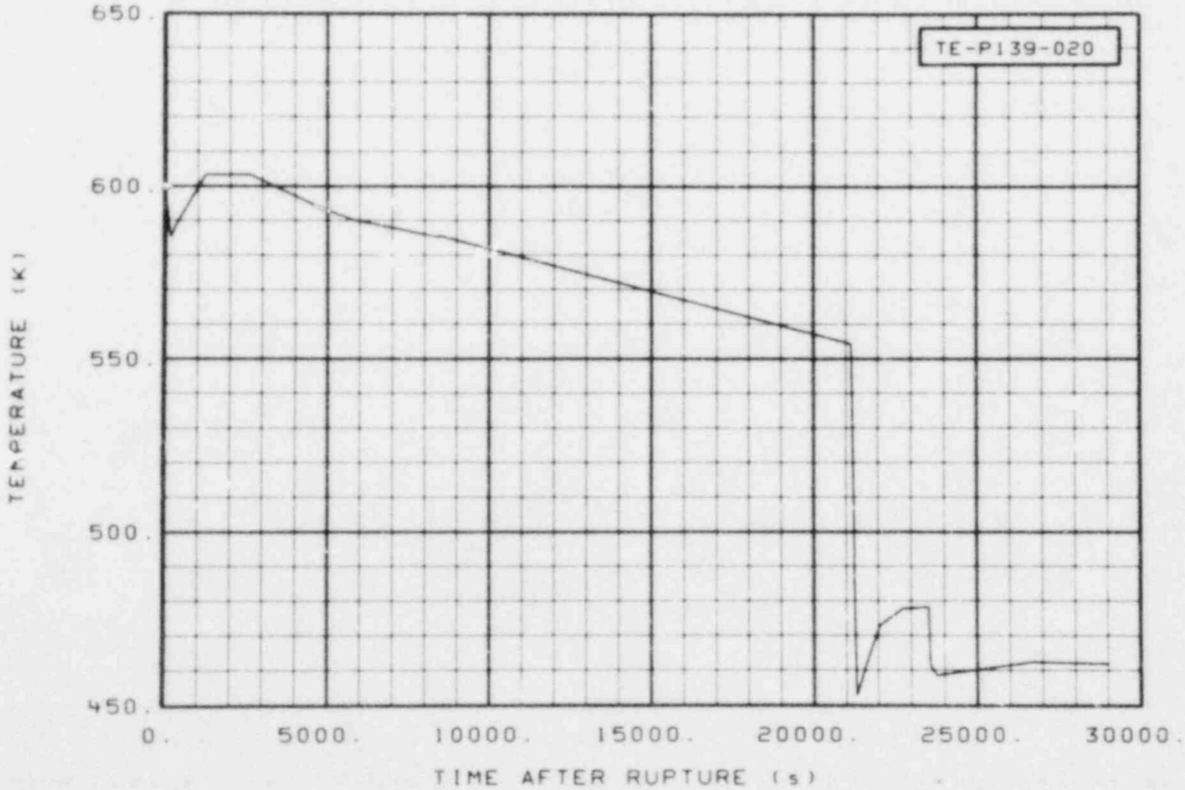


Figure 212. Fluid temperature in the pressurizer liquid space (TE-P139-020) (Qualified, appears approximately 6 K high based on isothermal test and may experience hot wall effects, uncertainty: ± 10 K and ± 200 s).

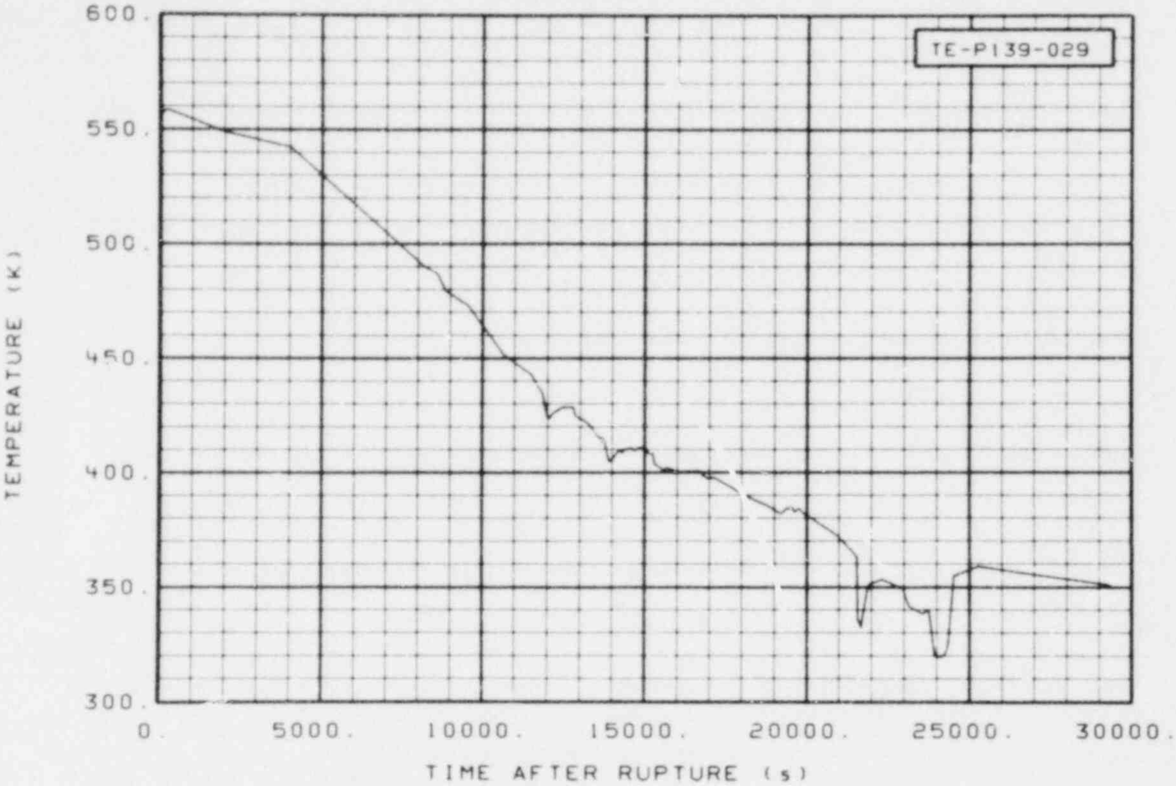


Figure 213. Coolant temperature in intact loop cold leg (TE-P139-029) (Qualified, uncertainty: ± 10 K and ± 150 s).

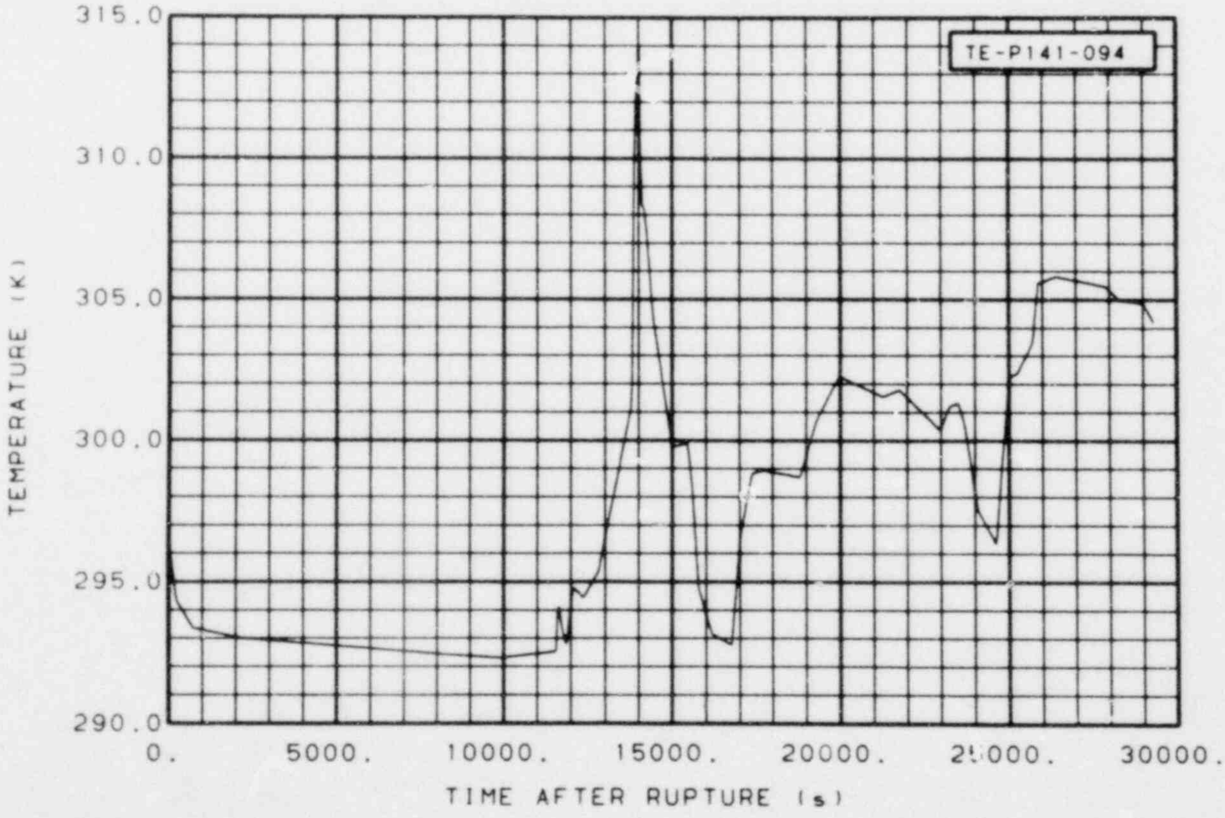


Figure 214. Fluid temperature in primary component cooling system heat exchanger hot leg (TE-P141-094) (Qualified, uncertainty: ± 2.5 K and ± 200 s).

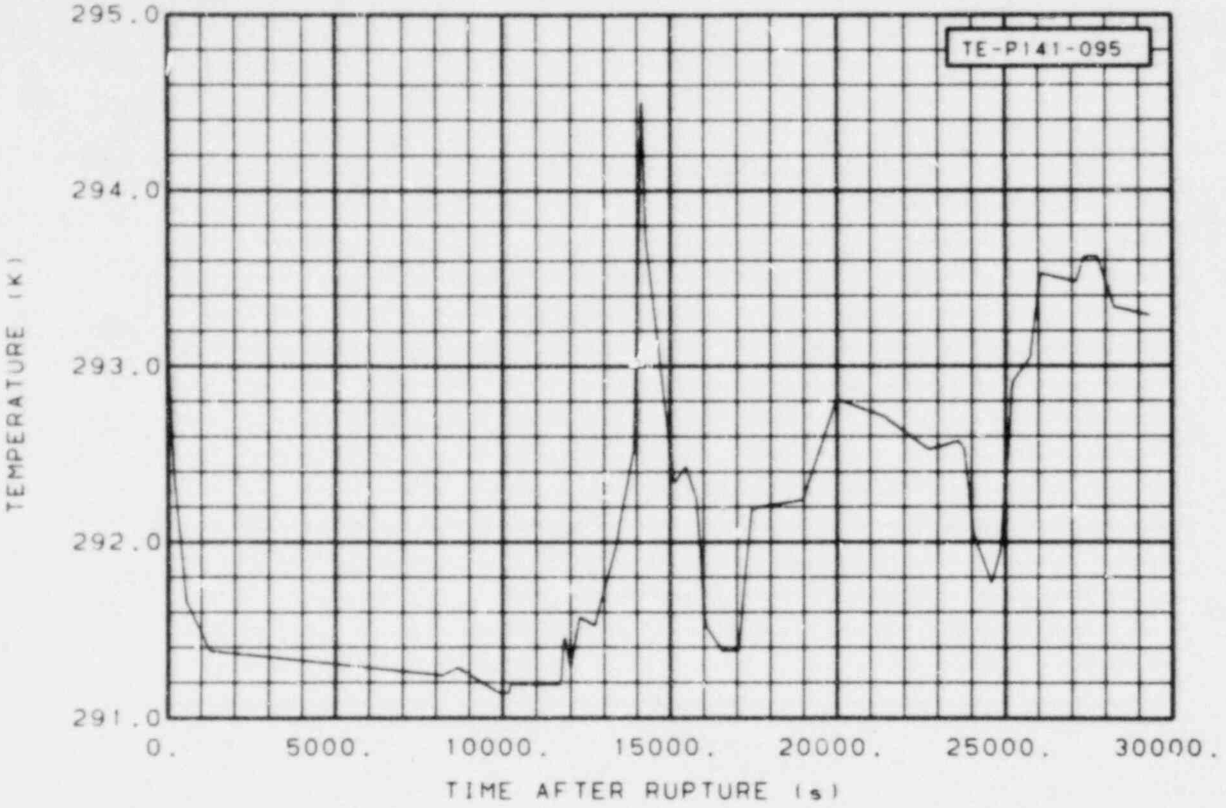


Figure 215. Fluid temperature in primary component cooling system heat exchanger cold leg (TE-P141-095) (Qualified, uncertainty: ± 25 K and ± 200 s).

Figure 216. Coolant temperature in reactor vessel at upper end box of Fuel Assembly 5 (TE-5UP-001) (Qualified, uncertainty: ± 25 K and ± 300 s).

COMPUTED VARIABLES

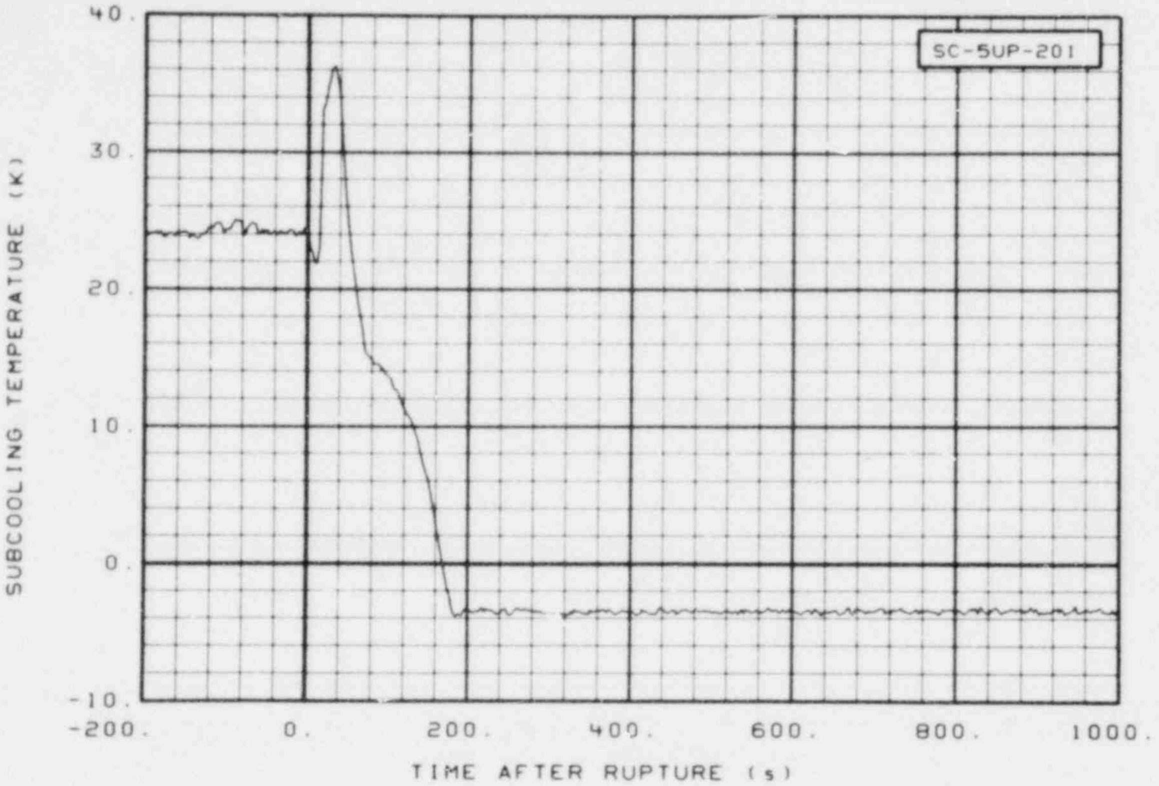


Figure 217. Fluid subcooling in reactor vessel upper plenum (SC-5UP-201) (Qualified).

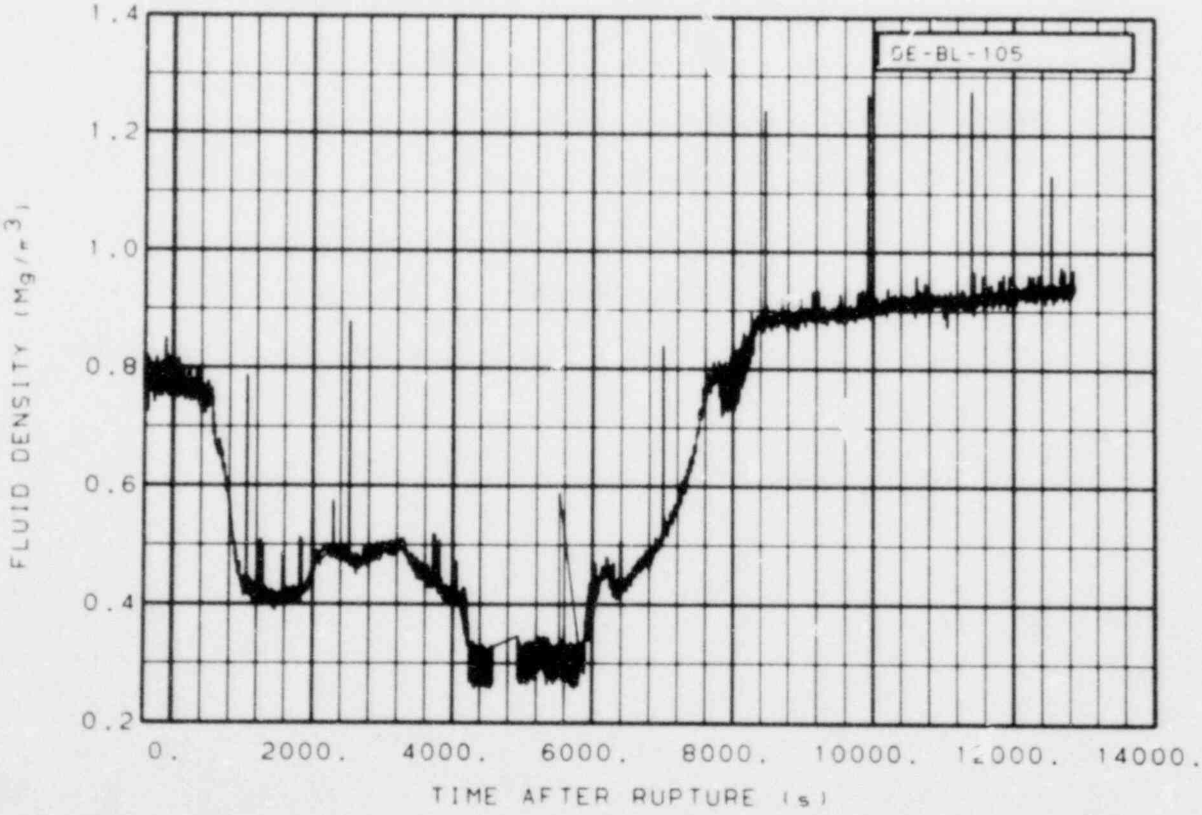


Figure 218. Average fluid density in broken loop cold leg (DE-BL-105) (Qualified, spikes caused by data processing).

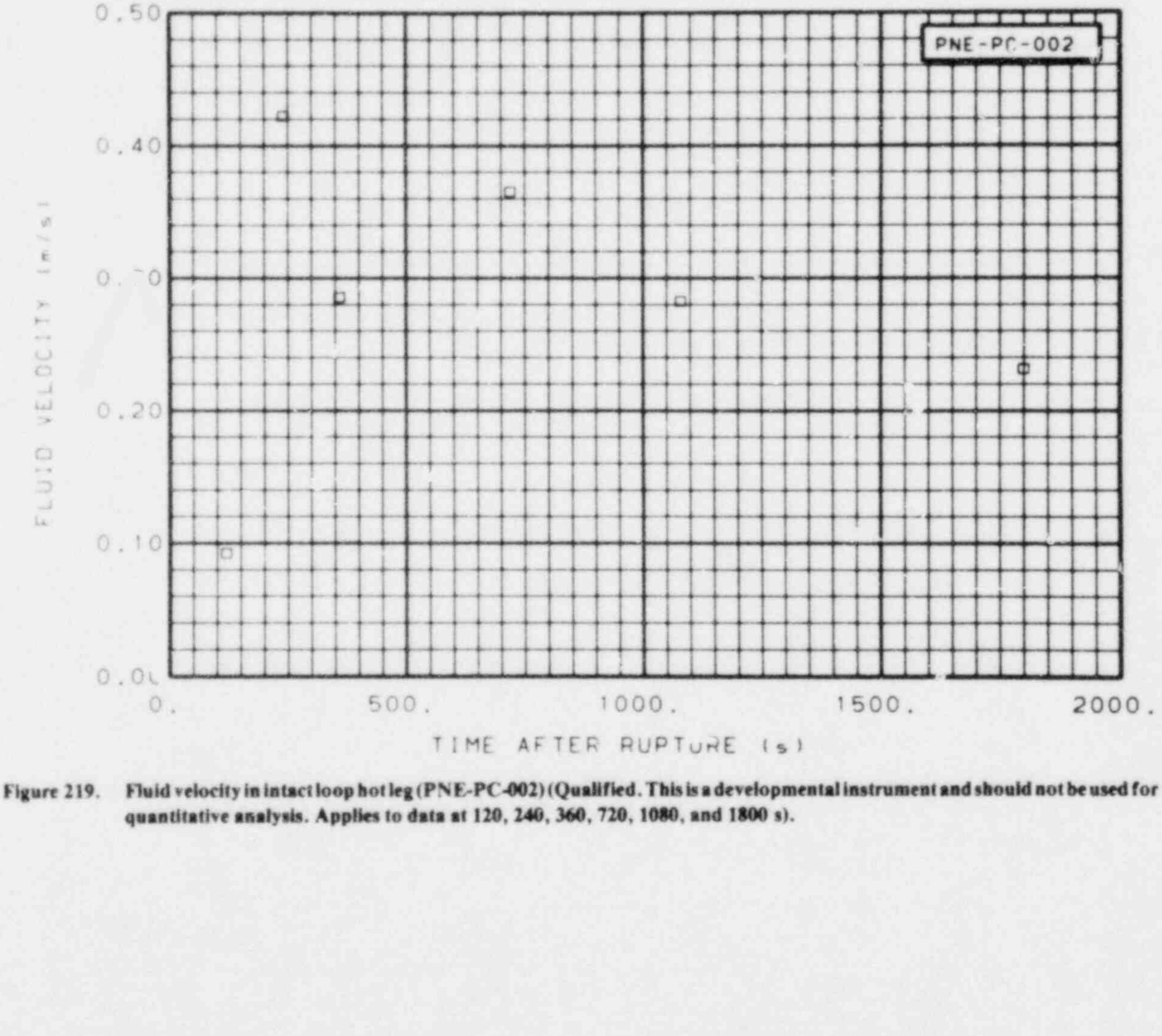


Figure 219. Fluid velocity in intact loop hot leg (PNE-PC-002) (Qualified. This is a developmental instrument and should not be used for quantitative analysis. Applies to data at 120, 240, 360, 720, 1080, and 1800 s).

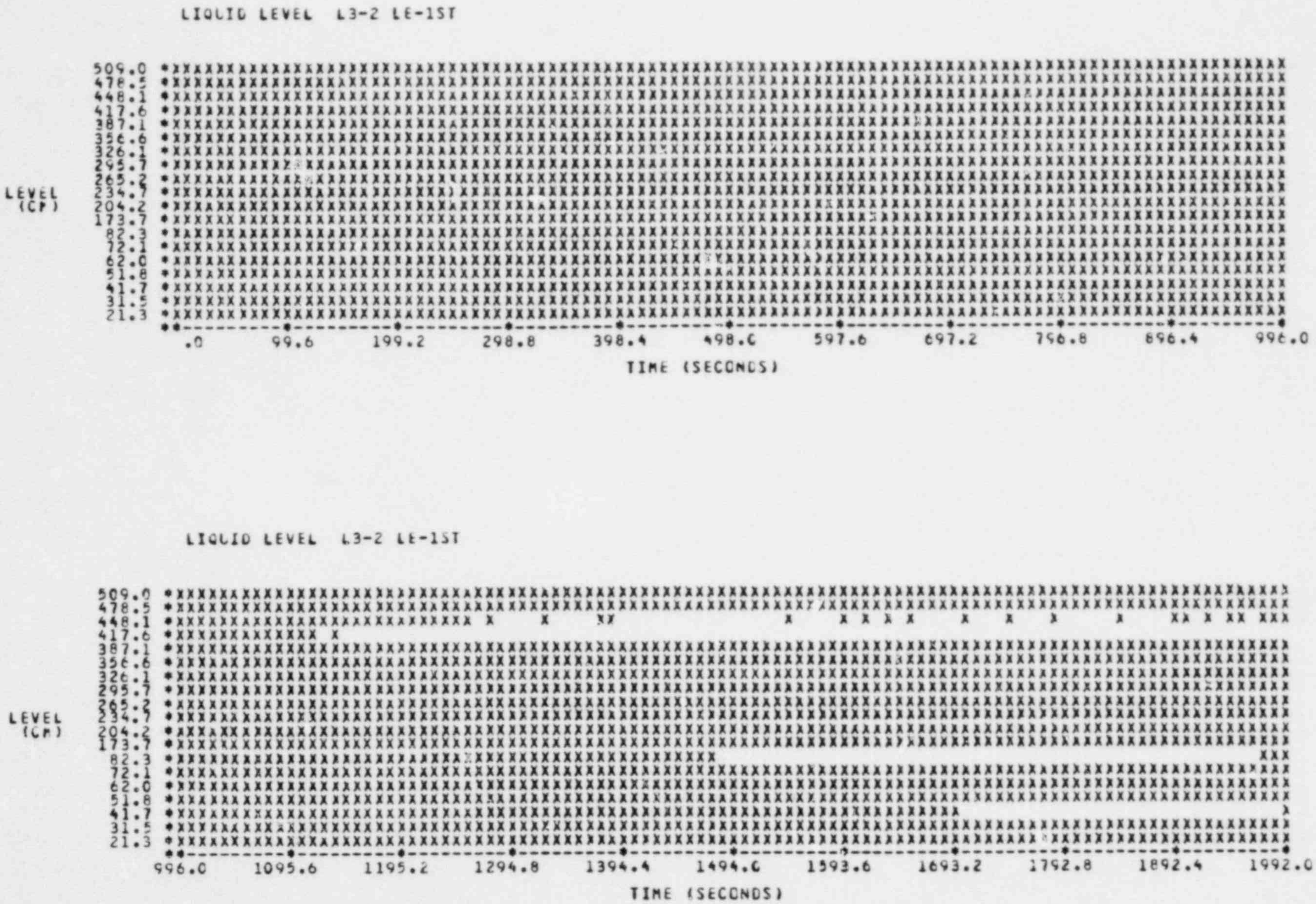
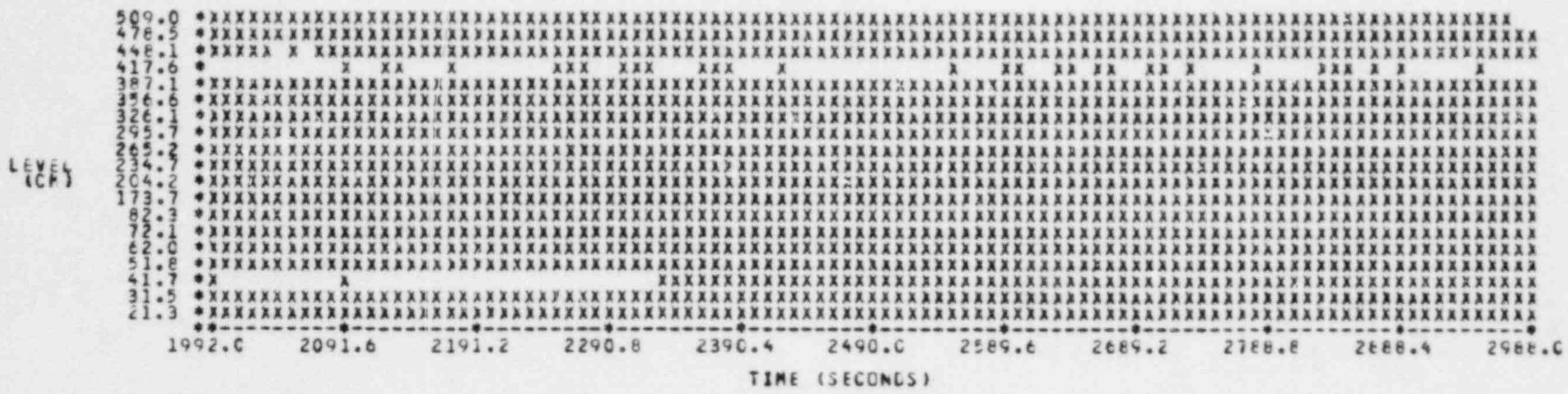
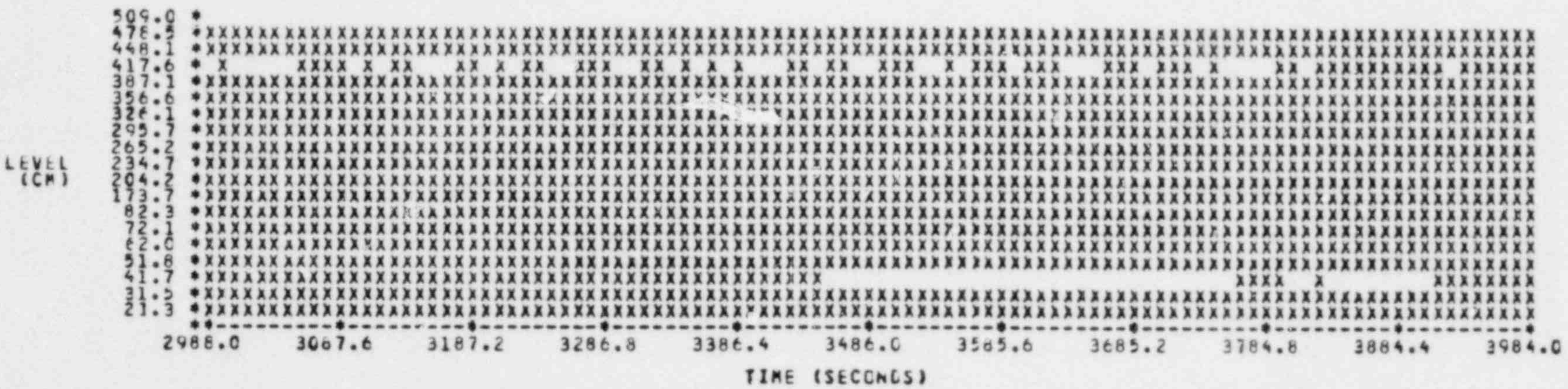


Figure 220. Liquid level in reactor vessel Downcomer Instrument Stalk 1, bubble plot (LE-1ST) (Qualified).



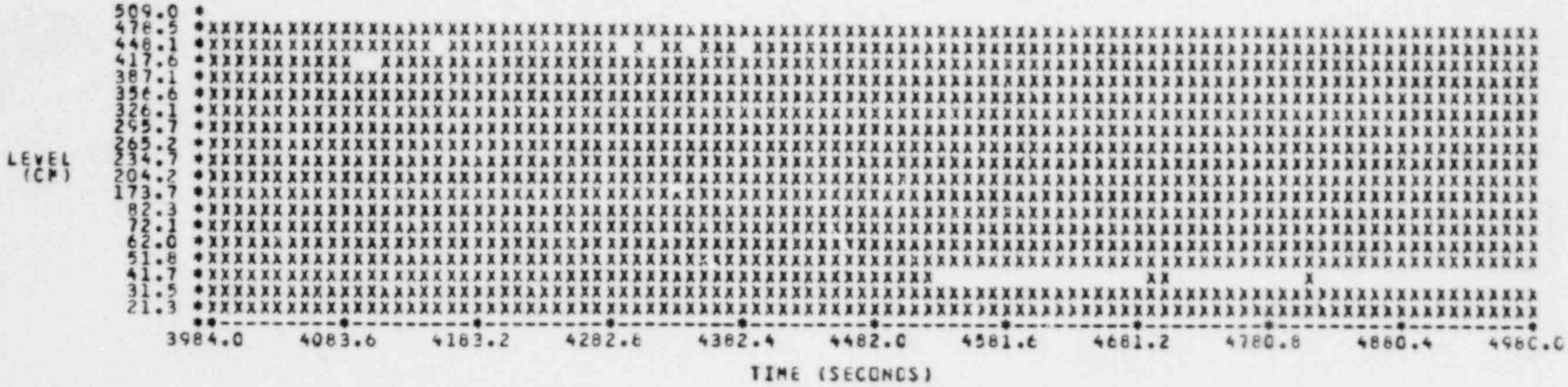
LIQUID LEVEL L3-2 LE-1ST



LIQUID LEVEL L3-2 LE-1ST

Figure 220. (continued).

LIQUID LEVEL L3-2 LE-1ST



LIQUID LEVEL L3-2 LE-1ST

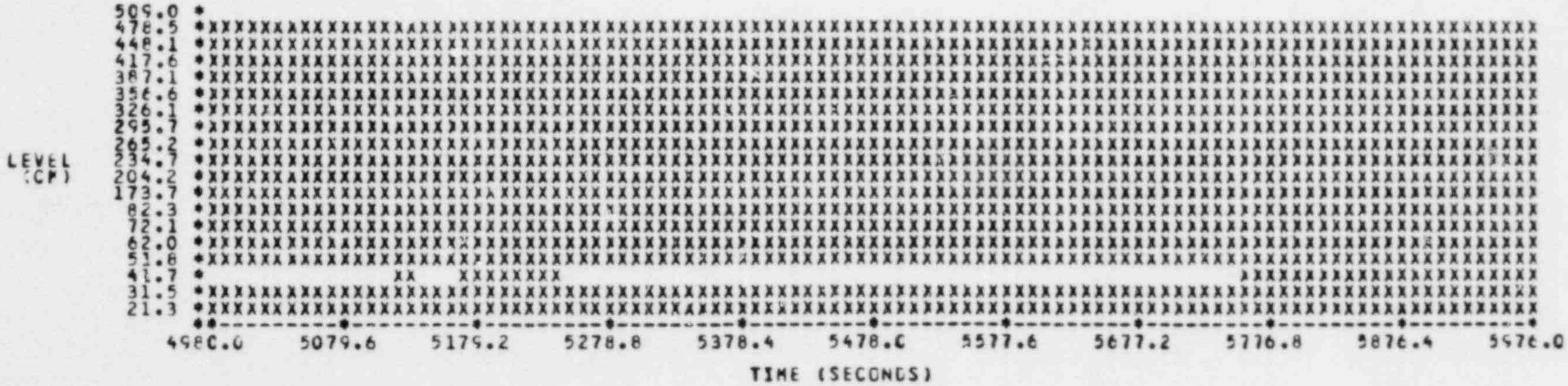
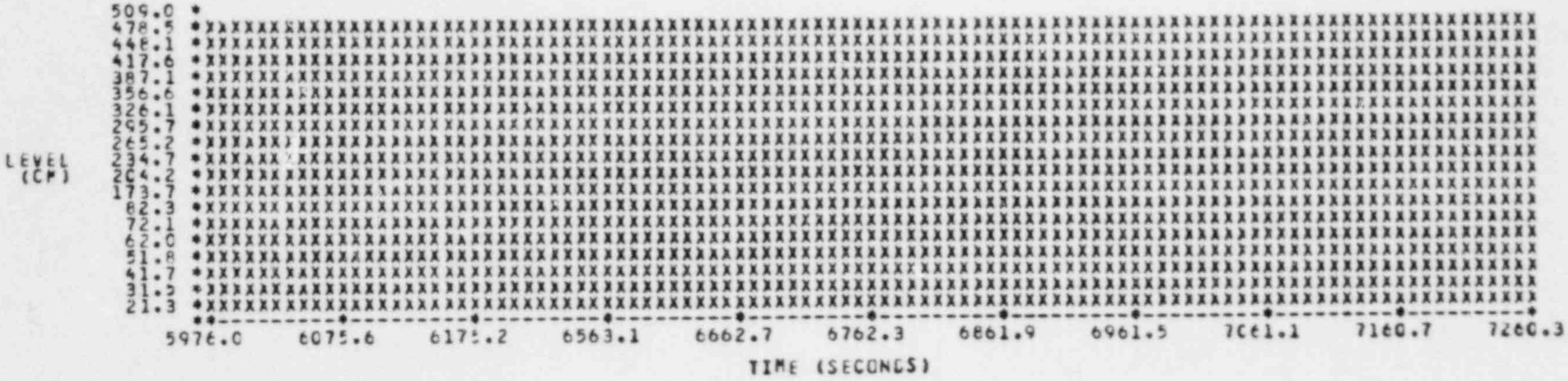


Figure 220. (continued).

LIQUID LEVEL L3-2 LE-1ST



LIQUID LEVEL L3-2 LE-1ST

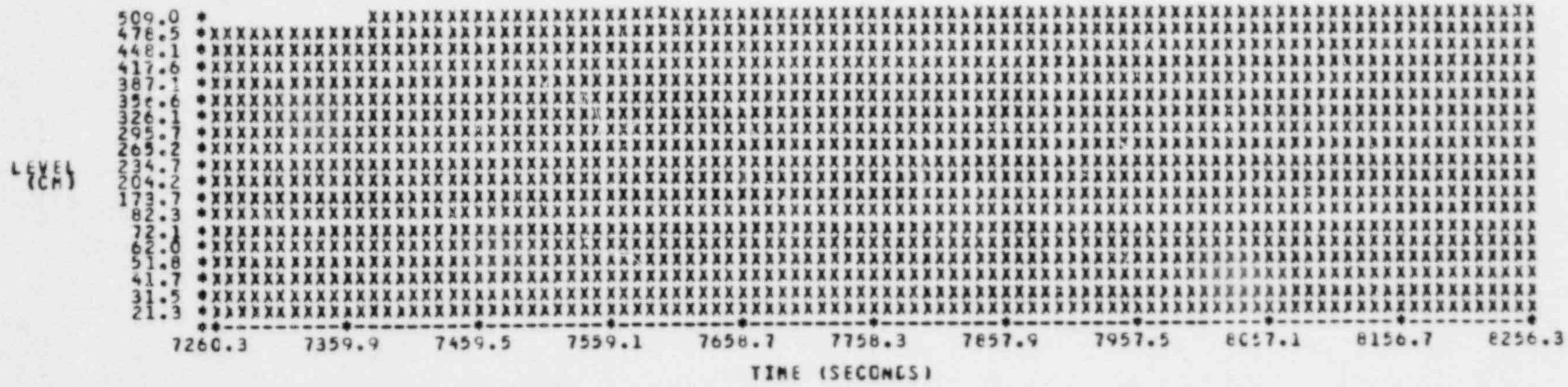


Figure 220. (continued).

Figure 220. (continued).

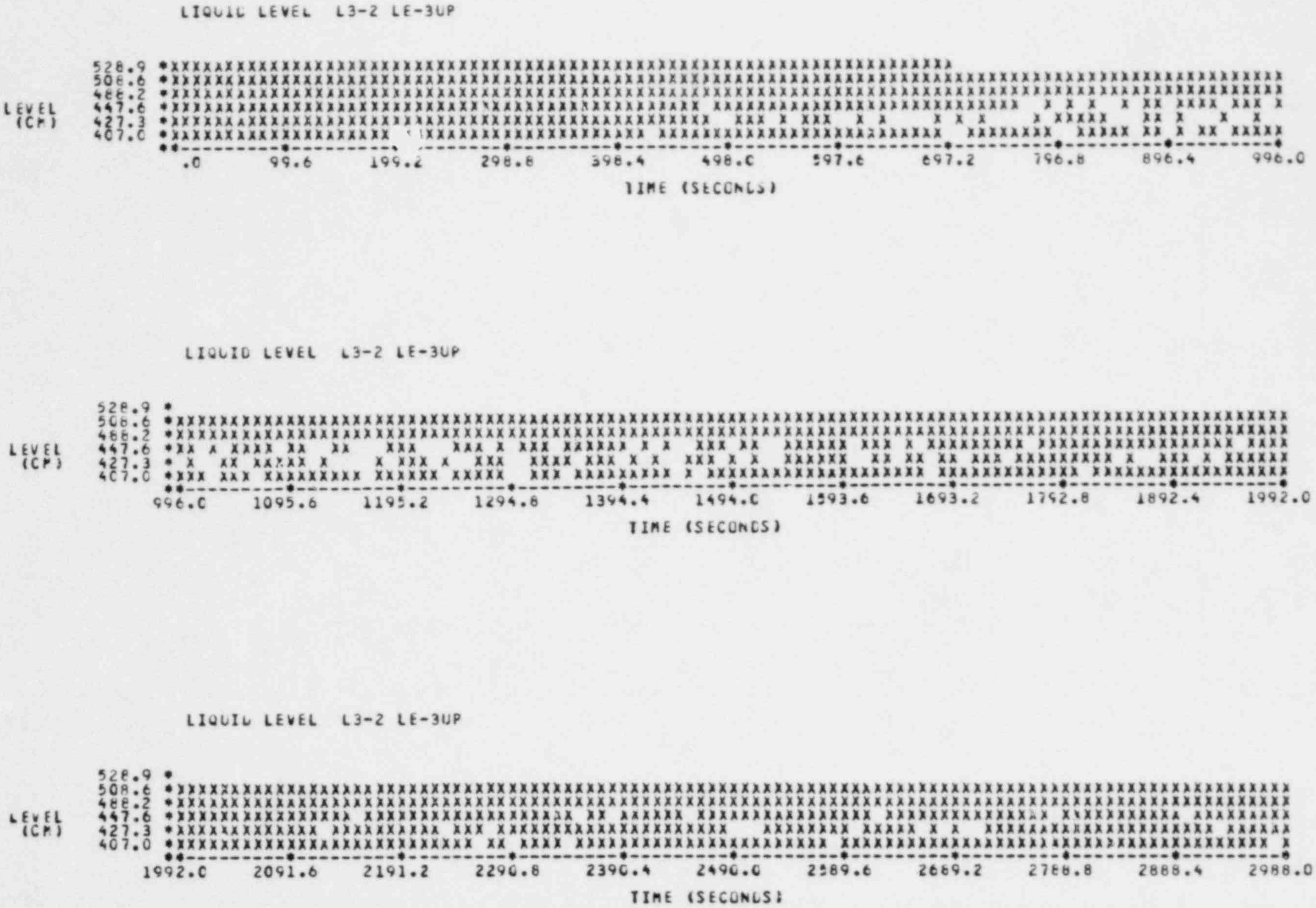


Figure 221. Liquid level in reactor vessel upper plenum above Fuel Assembly 3, bubble plot (LE-3UP-1) (Qualified).

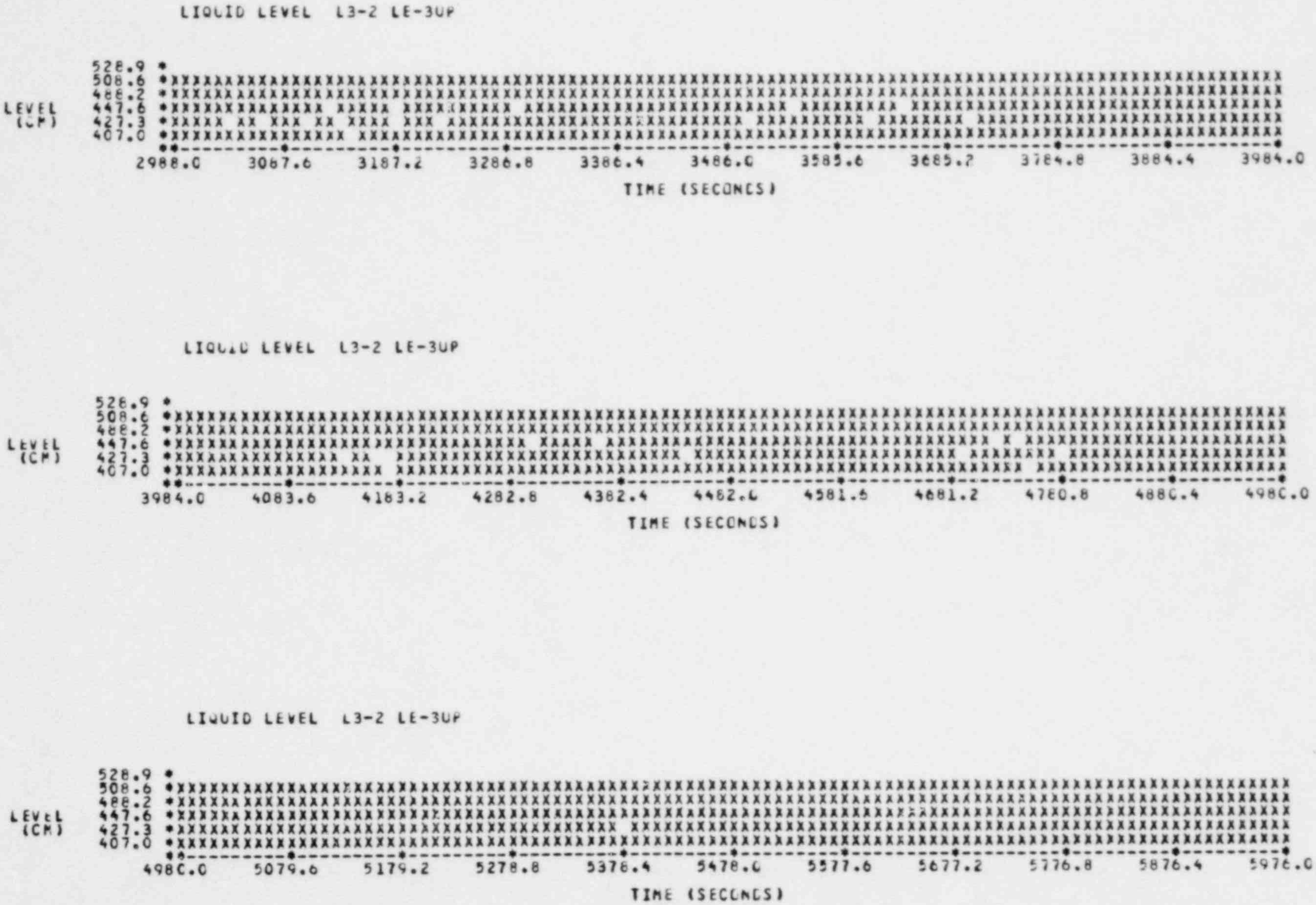
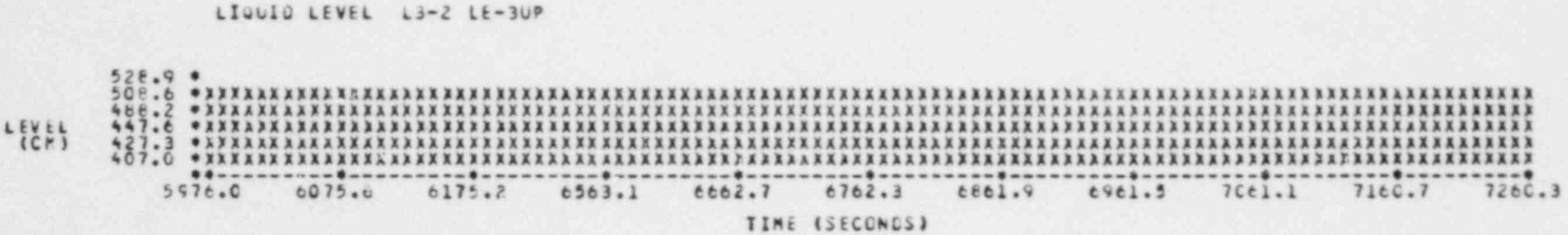
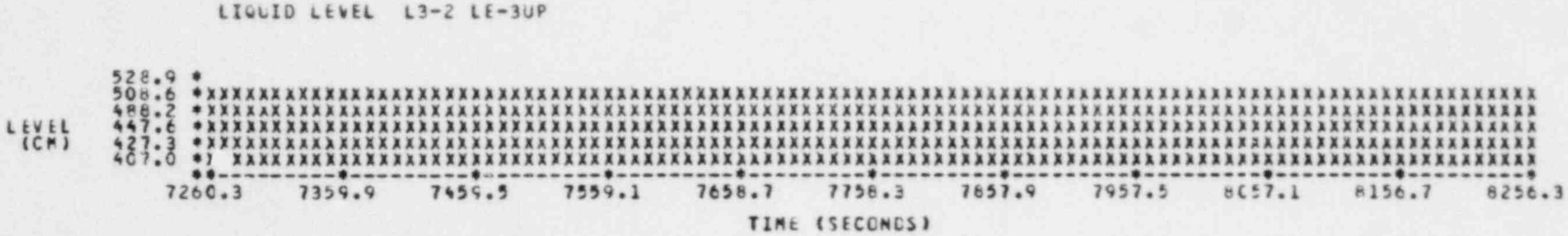


Figure 221. (continued).





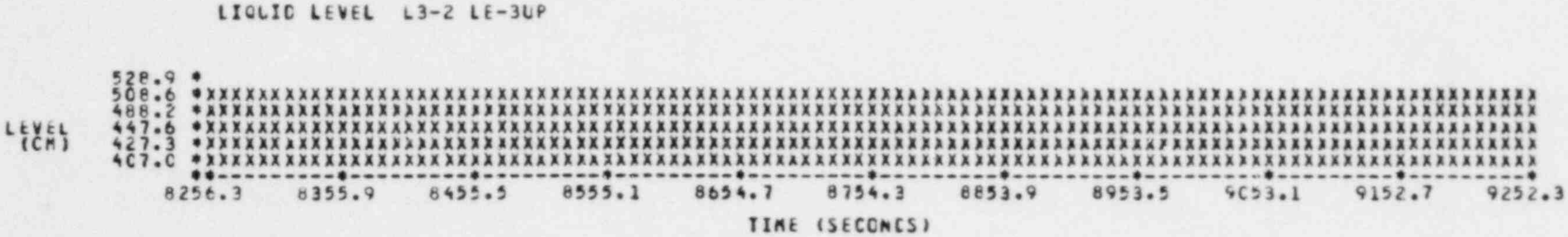


Figure 221. (continued).

LIQUID LEVEL L3-2 LE-3UP

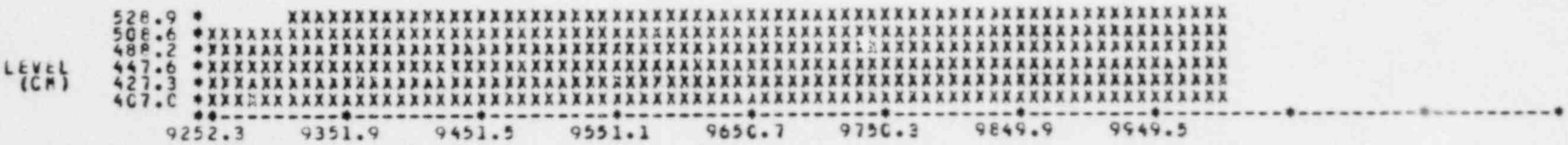


Figure 221. (continued).

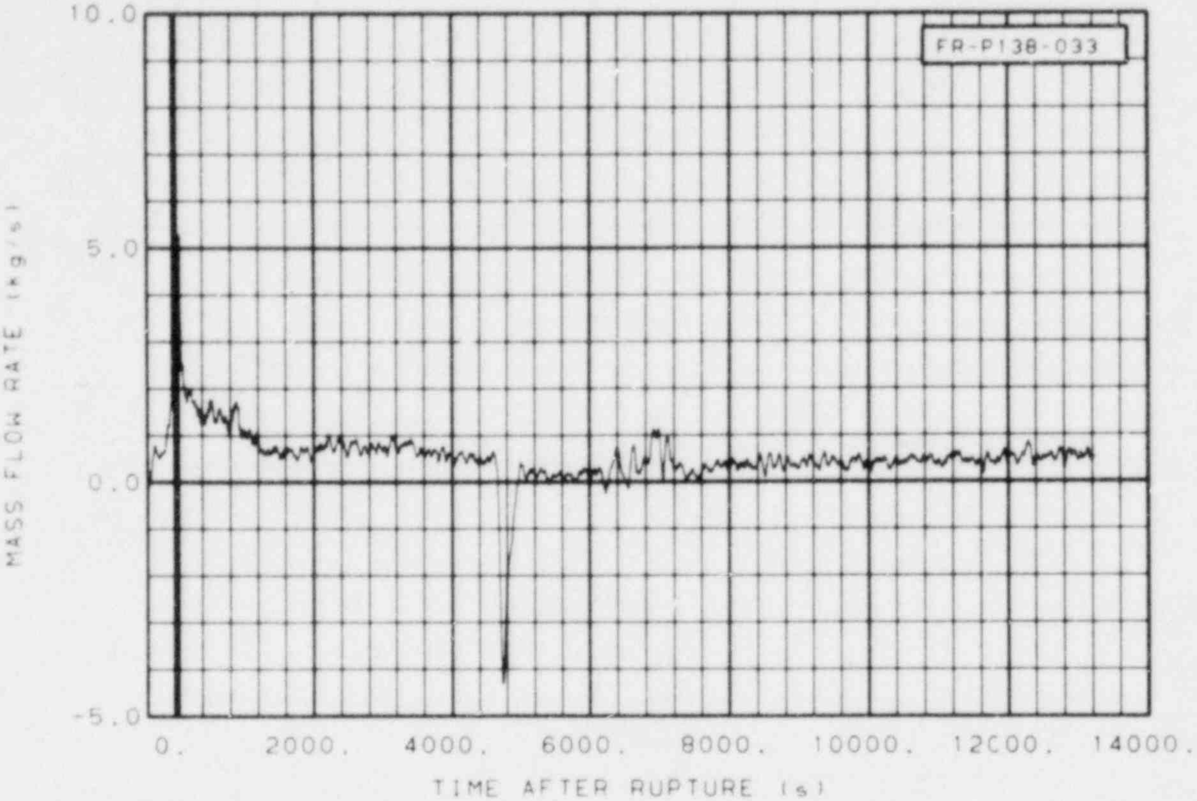


Figure 222. Mass flow rate in broken loop cold leg (Qualified, calculation based on LT-P138-033. The first spike at about 0 s is a combination of initial flow surge and calculation method. The second spike at approximately 4600 s was caused by pressure equalization between the tank and header, which forced liquid back up into the downcomers.).

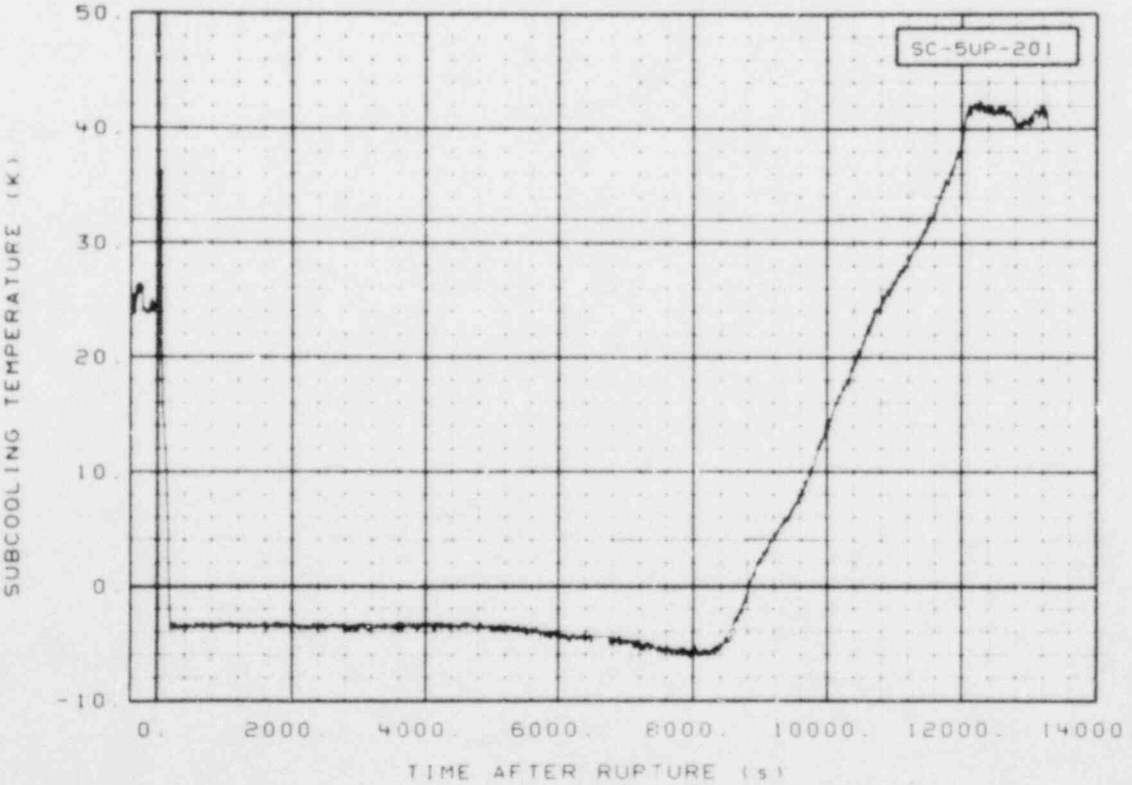


Figure 223. Fluid subcooling in reactor vessel upper plenum (SC-5UP-201) (Qualified).

6. REFERENCES

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3. F. S. Miyasaki, *Digital Data Acquisition Program*, ANCR-1250, August 1975.

4. N. L. Norman, *LOFT Data Reduction*, ANCR-1251, August 1975.

5. *Proposed ANS Standard 5.1 Decay Heat Power in Light Water Reactors*, September 1978.

6. G. D. Lassahn, *LOFT Experimental Measurements Uncertainties Analyses, Vol. XVI, LOFT Three-Beam Gamma Densitometer System*, TREE-NUREG-1089, February 1979.

7. G. L. Biladeau, *LOFT Experimental Measurements Uncertainties Analyses, Vol. VI, LOFT Linear Variable Differential Transformer Displacement Transducer Uncertainty Analysis*, TREE-NUREG-1089, February 1978.

8. S. Silverman, *LOFT Experimental Measurements Uncertainties Analyses, Vol. XIV, LOFT Drag Disc-Turbine Transducer Uncertainty Analysis*, TREE-NUREG-1089, November 1978.

9. G. D. Lassahn, *LOFT Experimental Measurements Uncertainties Analyses, Vol. VII, LOFT Self-Powered Neutron Detector Uncertainty Analysis*, TREE-NUREG-1089, August 1978.

10. L. D. Goodrich, Jr., *LOFT Experimental Measurements Uncertainties Analyses, Vol. XV, LOFT Primary Coolant Pump Speed Measurement Uncertainty Analysis*, TREE-NUREG-1089, April 1978.

11. G. D. Lassahn, *LOFT Three-Beam Densitometer Data Interpretation*, TREE-NUREG-1111, October 1977.

APPENDIX A

DATA CONSISTENCY CHECKS

APPENDIX A

DATA CONSISTENCY CHECKS

The following discussion describes several techniques used to perform consistency checks on the data presented in this report. The purpose of these checks is to establish data integrity and to evaluate the performance of a given transducer.

1. CHECKS OF PRE-LOCE DATA

A series of tests was conducted at various temperatures, pressures, and flow rates prior to the loss-of-coolant experiment (LOCE). These tests included static pressure, steady state flow, zero flow, pump coast down, isothermal, and accumulator blowdown tests. Using the data from these tests, the following checks were performed.

1.1 Absolute Pressure Data

During the approach to initial conditions, a series of static pressure tests was performed. After each test, the absolute pressure measurements were compared with two reference pressures (PE-PC-005 and PE-PC-006). The pressure tests were used to evaluate the slope coefficient of the calibration equations, and to evaluate the pressure sensitivity of the transducers.

The blowdown suppression tank pressure measurements were checked against atmospheric pressure prior to the LOCE.

The steam generator pressure was checked against the temperature in the steam generator by comparing the pressure obtained from the steam tables, using the steam generator temperature, with the pressure transducer reading.

When the accumulator was pressurized, both accumulator pressure transducer readings were checked by comparing one with the other.

1.2 Flow Data

Measurements of fluid flow included pump speed, differential pressure, venturi, turbines, drag discs, the pulsed neutron activation system and transit time flowmeter. The measurements were analyzed primarily to check the zero offset. Turbine and drag-disc measurements were also analyzed to check slope coefficient (gain) changes.

1.2.1 Pump Speed Data. The reference measurement for all intact loop flow measurements was primary coolant pump speed, because it is the most accurate and stable of the flow measurements. The pump speed measurement was adjusted using a square wave generator to calibrate the digital to analog conversion.

During heatup the zero reading was checked at every zero flow point, and during flow tests the pump speed was checked against pump frequency. Pump speed measurements were checked for consistency by comparison with pump speed as calculated from the primary system motor generator frequencies. This check was valid prior to and during the LOCE until the primary system motor generator field breakers were opened at 35 ± 1 s. Prior to the LOCE, the pump speed was further checked by reviewing the agreement with previous loss-of-fluid tests (LOFT). Pump run voltages and currents were evaluated prior to the LOCE by calculating the pump electrical horsepower input, the pump water power, and finally the combined pump efficiency. These calculated efficiencies were then compared with previously recorded efficiencies determined during pump requalification tests.

1.2.2 Differential Pressure Data. Zero offsets were determined from flow data, static pressure tests, and temperature sensitivity data derived during the heatup. Steady state flow conditions for the primary coolant system were then established, and selected primary coolant system pressure drops were compared with predicted values. At various flow conditions, intact loop flow resistance coefficients were calculated and verified to remain essentially constant and to agree with previously tabulated data. Further consistency checks were performed on the intact loop differential pressure measurements by plotting the square root of the differential pressure against pump speed using data from the pump frequency tests. The results of the curve fits performed on those plots were then used to confirm zero offsets. Both prior to and during the LOCE, differential pressure measurements were compared with the differential pressure computed by subtracting appropriate absolute pressure measurements. Finally, pressure closure was calculated for the two flow loops: (a) the primary coolant system intact loop, and (b) the broken loop cold leg to the blowdown suppression tank.

1.2.3 Venturi Data. Consistency checks were performed by comparing the venturi mass flow rate with venturi mass flow rates from previous LOFT tests (with the same loop resistance) and to each other. A comparison of the venturi with the pump speed consisted of performing a least squares fit of the venturi data versus the pump data (derived from the pump speed frequency test). The results were used to correct any zero offset in the venturi. The corrected venturi data were then used to calculate the average fluid velocity and momentum flux of the intact loop. The computed velocity was compared to the differential pressure measured across the pumps, the steam generator, and the reactor vessel.

In addition, the computed fluid velocity and the momentum flux were compared to the output of the turbines and drag discs in the reactor vessel.

1.2.4 Drag-Disc Turbine (DTT) Data. Reactor vessel drag discs were compared with values calculated from venturi mass flow, assuming the full flow area. Slope coefficients were calculated and the effect of temperature on the calibration coefficients was determined.

After the slope coefficients had been verified, the data for a given transducer were plotted against pump speed and a least squares fit performed. The zero offset from this curve fit was used to modify the zero offset of the transducers.

As an independent check, the turbine flowmeter and drag-disc data were used to calculate fluid density. These values were then compared to the known single-phase density prior to the LOCE. This analysis was performed on all the turbine flowmeter and drag disc measurements in the reactor vessel with the exception of those that failed.

1.2.5 Pulsed Neutron Activation System (PNA) Data. Fluid velocities during steady state operation were measured by the PNA. These velocities were compared with fluid velocities as computed by the venturi.

1.2.6 Transit Time Flowmeter (TTF) Data. Checks of the TTF were performed during the pre-LOCE accumulator blowdown by comparing the computed velocity using different combinations of the TTF thermocouples.

In addition, a check of the TTF was performed by comparing the TTF data to the suppression tank liquid levels. The TTF data and the fluid density were used to calculate the total fluid mass that flowed out the break, which was then compared to the suppression tank fluid mass increase calculated using the liquid levels.

1.3 Gamma Densitometer Data

To evaluate the primary coolant system average fluid densities, calculations were performed using the gamma densitometers. The densitometers were checked for normal operation by recording and examining data tapes approximately one day before the LOCE, and by observing spectra, count rate data, and live-time data on the densitometer system display console during and immediately before the LOCE.

1.4 Level Measurement Data

Four system level measurements were evaluated: (a) Accumulator A liquid level, (b) blowdown suppression tank liquid level, (c) pressurizer coolant level, (d) pump suction liquid level, and (e) reactor vessel coolant level. The accumulator level was qualified by comparing the pre-LOCE liquid levels as measured with the level detector to the level measured by an external sightglass. Blowdown suppression tank liquid level measurements were qualified by comparing the two available measurements. In addition, a sightglass measurement was made both prior to and following the test. Similarly, pressurizer level was reviewed by redundant level measurements. The pump suction liquid levels were checked at zero flow conditions with the plant full of water. The reactor vessel liquid level probes were verified by performing a pretest conductivity calibration with the vessel full under cold and hot plant conditions.

1.5 Thermocouple Data

Temperature measurements were analyzed by comparing them with other temperature data obtained during the isothermal tests. Resistance temperature measurements were used for reference where they existed. If saturation conditions existed, the temperature was compared with the temperature from the steam tables using pressure measurements as the reference. Temperature measurements outside the primary coolant were compared with any known temperature in the same area.

2. CHECKS DURING AND AFTER THE LOCE

The purpose of these checks was to further establish the data integrity. For each type of measurement, comparable data channels were evaluated and the determination of data consistency was identified. The following is a brief summary of those checks.

2.1 Absolute Pressure Data

During the LOCE the saturated steam temperature was determined from the saturated steam table using pressure transducer data. The computed temperature was compared with the temperature measured by the thermocouple. However, this was valid only during saturation. When complete voiding occurred, the measured temperature increased above the corresponding saturation temperature because of conduction and radiant heating of the detector element by the surrounding warmer environment (pipe walls, etc.).

2.2 Flow Data

Immediately prior to the LOCE, flow data were again compared for consistency. In addition, LOCE data were compared with previous similar tests. A summary of the consistency checks for the pump and flow transducer measurements follows.

2.2.1 Pump Speed Data. The primary coolant pump motor generator field breakers were opened at 35 ± 1 s after initiation of the LOCE. Pump speed measurements were compared during pump coastdown.

2.2.2 Differential Pressure Data. Immediately prior to the LOCE, when steady state operating conditions had been established, the differential pressure measurements around the intact loop were summed and compared with the differential pressure across the primary coolant pumps.

2.2.3 Venturi Data. The initial conditions data from the venturi were checked for data consistency by comparing them with pre-LOCE flow test data. The flow venturi was used only for steady state initial conditions information.

2.2.4 Drag-Disc Turbine (DTT) Data. Initial conditions data were checked by calculating momentum flux from the venturi mass flow rate and from the known density for those DTTs that were not overranged. These values were then compared with the measured values from the DTT.

LOCE data were checked by comparing data from previous tests. An additional check was made by comparing the basic shape of the velocity or momentum flux curves with a differential pressure close to the DTT.

2.3 Gamma Densitometer Data

Checks of the calibration constants were obtained from the all-liquid readings a few seconds prior to the LOCE and half-liquid, half-steam conditions when the break orifice uncovered. The fluid densities for the all-liquid and all-steam conditions were determined from the steam tables using temperature and pressure measurements.

2.4 Liquid Level Data

The accumulator level was verified by comparing the pre-LOCE and post-LOCE liquid levels, as measured with the level detector, with the level measured by an external sightglass. The blowdown suppression tank liquid level was evaluated by comparing two independent level measurements (LT-P138-33 and -58). Similarly, pressurizer level was reviewed by redundant level measurements. During the LOCE, the reactor vessel level measurements were compared to core thermocouple data; when the fluid level dropped below a given thermocouple, the measured temperature increased.

2.5 Temperature Data

The temperatures during the LOCE were compared with saturation temperatures from the steam tables using pressure data and with previous data. Initial conditions were also checked by comparing all primary coolant thermocouple and resistance thermometer detector measurements. Suppression tank thermocouple measurements were compared in a like manner.