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for U.S. Nuclear Regulatory Commission

EXPERIMENT DATA REPORT FOR LOFT NONNUCLEAR TEST L1-4

DOYLE L. BATT

July 1977

MASTER

EG&G Idaho, Inc.

IDAHO NATIONAL ENGINEERING LABORATORY

ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

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EXPERIMENT DATA REPORT FOR LOFT

NONNUCLEAR TEST L1-4

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by

Doyle L. Batt

EG&G Idaho, Inc.

July 1977

PREPARED FOR THE
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ABSTRACT

Test L1-4 was the fourth in a series of five nonnuclear isothermal blowdown tests conducted by the Loss of Fluid Test (LOFT) Program. Test L1-4 was the first Nuclear Regulatory Commission standard problem (International Problem No. 5 and U. S. Problem No. 7) experiment conducted at LOFT. Data from this test will be compared with predictions generated by the standard problem participants. For this test the LOFT Facility was configured to simulate a loss-of-coolant accident in a large pressurized water reactor resulting from a 200% double-ended offset shear break in a cold leg of the primary coolant system. A hydraulic core simulator assembly was installed in place of the nuclear core. The initial conditions in the primary coolant system intact loop were: temperature at 279°C, gauge pressure at 15.65 MPa, and intact loop flow at 268.4 kg/s. During system depressurization into a simulated containment, emergency core cooling water was injected into the primary coolant system cold leg to provide data on the effects of emergency core cooling on system thermal-hydraulic response. The experiment was successful in accomplishing all of the objectives outlined in the experiment operating specification for this test.

SUMMARY

The intent of this report is to present selected data from LOFT Test L1-4, which was performed as a part of the L1 (nonnuclear) series of LOFT Program tests. The data are presented in the form of graphs in SI units. In conjunction with the data obtained from direct measurement, chosen computed parameters are included to facilitate in the analysis of the system thermal-hydraulic behavior. Plots of representative instrument types and ranges and their associated error bands are also presented.

The L1 test series consists of five nonnuclear blowdown experiments which are initiated with isothermal conditions established in the reactor intact coolant loop and vessel. Test L1-4, the fourth test in the L1 series, was successfully conducted on May 3, 1977. This test was designated as a standard problem (International Problem No. 5 and U. S. Problem No. 7) by the Nuclear Regulatory Commission. The data were released for review by all participants on June 21, 1977.

The LOFT Integral Test Facility is a highly instrumented, pressurized water reactor test system designed to be representative of large pressurized water reactors (LPWR) for the simulation of loss-of-coolant accidents (LOCA). The test assembly consists of:

- (1) A reactor vessel with a hydraulic core simulator installed in place of a nuclear core.
- (2) An intact loop with active steam generator, pressurizer, and two primary coolant pumps connected in parallel.
- (3) A broken loop with a simulated pump, a simulated steam generator, and the two quick-opening blowdown valve assemblies.

- (4) A blowdown suppression system consisting of a blowdown header, blowdown suppression tank, and a blowdown suppression tank spray system.
- (5) An emergency core coolant (ECC) injection system consisting of a low-pressure injection system (LPIS) pump, a high-pressure injection system (HPIS) pump, and an accumulator. For the performance of the L1-4 loss-of-coolant experiment (LOCE), the test assembly was configured to represent a 200% double-ended offset shear in a cold leg of a LPWR.

The areas of interest specific to Test L1-4 were to (a) provide comparison of delayed HPIS and LPIS injection to the cold leg and the lower plenum and (b) obtain data for evaluating downcomer bypass and mixing of the ECC with the primary coolant. To determine system thermal-hydraulic response, ECC was directed to the primary coolant system cold leg injection line using accumulator ACC-A, HPIS pump A, and LPIS pump A. The accumulator initiated injection at 22 seconds, and HPIS flow and LPIS flow were initiated at 23 and 39 seconds after rupture, respectively.

Test L1-4 was initiated from primary coolant system initial conditions of 15.65 MPa gauge pressure and 279°C with an intact loop flow rate of 268.4 kg/s. The complete set of initial test conditions is specified in Reference 1 and is summarized in Table IV of this report.

Data were successfully collected and processed from 526 of the 551 data channels utilized during Test L1-4. Instrument malfunctions pertinent to a particular data channel are specified in Table VII. Of the instruments which malfunctioned, none impacted the success of the experiment.

Test L1-4 was successful in accomplishing the objectives as presented in Reference 1 and summarized in Section I of this report.

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EXPERIMENT DATA REPORT FOR LOFT NONNUCLEAR TEST L1-4

I. INTRODUCTION

The intent of this report is to present the L1-4 test data in an uninterpreted but readily usable form for use by the nuclear community in advance of detailed analysis and interpretation. The data, presented herein in the form of graphs in International System of Units (SI units), have been analyzed and qualified to the extent necessary to ensure that they are reasonable and consistent. Initial assessment of the data from this test and comparison with the experiment prediction^[2] were performed in the quick look report for nonnuclear experiment L1-4^[3]. Test L1-4 was designated as a Nuclear Regulatory Commission (NRC) standard problem (International Problem No. 5 and U. S. Problem No. 7). Data from the test will be compared with Test L1-4 predictions performed by the standard problem participants and with the LOFT experiment prediction. Test L1-4 was performed on May 3, 1977, and the data were released for analysis on June 21, 1977.

The Loss of Fluid Test (LOFT) Program is part of the Water Reactor Safety Research Program sponsored by the Nuclear Regulatory Commission and is administered by the Energy Research and Development Administration. The tests are conducted at the Idaho National Engineering Laboratory (INEL), Test Area North (TAN). The objectives of the program are:

- (1) To provide data required to evaluate the adequacy and improve the analytical methods currently used to predict the loss-of-coolant accident (LOCA) response of large pressurized water reactors (LPWRs). The performance of engineered safety features (ESF) with particular emphasis on emergency core cooling system (ECCS) and the quantitative margins of safety inherent in the performance of ESF is of primary interest.

- (2) To 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 such unexpected behavior.

In order to meet these objectives, the LOFT Integral Test Facility^[a] has been designed to simulate the major components of a LPWR, and several series of the experiments have been planned to produce data on the combined thermal, hydraulic, nuclear, and structural processes expected to occur during a LOCA.

The first LOFT test series (designated L1) is the nonnuclear test series which consists of five isothermal blowdown tests. This test series has been designed to make available large scale isothermal blowdown system data as a first phase of the LOFT Experimental Program. Varied parameters include break size, break location, break opening time, primary coolant system (PCS) flow resistance, emergency core coolant (ECC) injection location, and PCS pressure. Specifically, the purposes of this test series are:

- (1) To determine that the equipment/systems function properly
- (2) To demonstrate that the entire test facility can withstand the structural loads of blowdown
- (3) To determine that the blowdown test procedures are adequate

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

- (4) To provide experience to operators prior to nuclear tests
- (5) To obtain isothermal loss-of-coolant experiment (LOCE) data for comparison with similar data from other experimental programs, and to experimentally determine thermal-hydraulic system behavior prior to nuclear blowdown.

A detailed description of the LOFT Facility and the L1 test series can be found in Reference 4.

Tests in the L1 test series conducted prior to Test L1-4 consist of:

- (1) Test L1-1^[5], which was conducted from initial conditions of 282.2°C and 9.11 MPa (gauge pressure) and was a 100% hot leg break simulation. ECC injection was directed to the cold leg.
- (2) Test L1-2^[6], which was conducted from initial conditions of 282°C and 15.55 MPa (gauge pressure) and was a 200% cold leg break simulation without ECC injection. ECC was injected into the intact loop cold leg 13.3 minutes after Test L1-2 initiation for a "hot wall delay" experiment.
- (3) Test L1-3^[7], which was conducted from initial conditions of 282°C and 15.55 MPa (gauge pressure) and was a 200% cold leg break simulation. ECC injection was directed to the lower plenum of the reactor vessel using low-pressure injection system (LPIS) pump A and high-pressure injection system (HPIS) pump A. Accumulators ACC-A and ACC-B, however, failed to inject ECC into the lower plenum during this test. The original Test L1-3 was conducted again as Test L1-3A to obtain accumulator ACC-A injection.
- (4) Test L1-3A^[8], which was conducted from initial conditions of 283.3°C and 15.46 MPa (gauge pressure) and was a 200% cold leg

break simulation. ECC injection was directed to the lower plenum of the reactor vessel.

Test L1-4 was conducted from initial conditions of 279°C and 15.65 MPa (gauge pressure) and was a 200% (100% of the break area in each leg) double-ended offset shear in the cold leg of a four-loop LPWR. The specific purposes of Test L1-4 were to:

- (1) Provide comparison of delayed HPIS and LPIS injection to the cold leg and the lower plenum
- (2) Provide data reproducibility information by comparing with other related tests
- (3) Obtain data for evaluating downcomer bypass and mixing of the ECC with the primary coolant
- (4) Determine the effects of PCS operation and rapid depressurization with boric acid coolant
- (5) Test system performance with plant protection system (PPS) backup under operating procedures as similar as possible to those planned for nuclear operation
- (6) Provide system thermal-hydraulic data to compare with predictions and other experimental data for code verification purposes.

Section II of this report briefly describes the LOFT system and the facility configuration specific to this test. Section III discusses the LOFT instrumentation system including the basic types of detectors utilized, the methods of obtaining certain measurements, and the LOFT data reduction process. Section IV summarizes the test procedures used to conduct Test L1-4 and presents a chronology of events that occurred during the test. Section V presents the initial conditions of the test, both specified and as measured. Section VI discusses numerous methods

employed to verify the consistency and accuracy of the data presented. Finally, Section VII presents the data graphs and provides tables of comments and supporting information necessary for the interpretation of the data.

II. SYSTEM CONFIGURATION

The LOFT Facility has been designed to simulate the major components and system responses of a LPWR during a LOCA. The test assembly is comprised of five major subsystems which have been instrumented such that desirable system parameters can be measured and recorded during a 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. System instrumentation is discussed in Section III.

The LOFT reactor vessel simulates the reactor vessel of a LPWR. It has an annular downcomer, a lower plenum, lower core support plates, a core simulator, and an upper plenum. The downcomer connects with the cold leg of both the intact loop and the broken loop and contains two instrument stalks; the upper plenum connects the hot leg of both the intact loop and the broken loop. The core simulator contains an instrument stalk and a hydraulic orifice plate assembly to simulate the flow resistance of a nuclear core which will be installed for nonnuclear LOCE L1-5.

The intact loop simulates the unbroken loops of a LPWR. This loop contains a steam generator, two circulating coolant pumps connected in parallel, a pressurizer, a venturi flowmeter, and connecting piping. For this experiment, the primary side steam generator inlet and outlet plenums contained square edged orifice plates sized for a low resistance or core flow area scaling. Thus, these orifices provided a similar pressure drop at scaled flow rates around the LOFT intact loop (excluding the reactor vessel) as exists in a LPWR operating loop. The secondary side of the steam generator was filled to a predetermined level and isolated from the remainder of the secondary coolant system (SCS). The intact loop circulating coolant pumps were used to bring the system to the initial test temperature of 279°C. For Test L1-4, the electrical power to the primary system motor generator (PSMG) sets was terminated within 1 second after blowdown initiation. This action left

the PSMG sets electrically connected to their respective intact loop pumps such that pump coastdown characteristics were under the influence of the 316 kg/m^2 (effective) inertia flywheels on the generators. This electrically coupled system represented the inertia and the subsequent coastdown of the circulating coolant pumps in a LPWR. When the intact loop pumps reached a speed of approximately 750 rpm, the electrical power to the pump motors was terminated by opening the generator field breakers.

The broken loop simulates the broken loop of a LPWR. It consists basically of a hot leg and cold leg that are connected to the reactor vessel and the blowdown suppression tank header. Each leg consists of a break plane orifice which determines the break size to be simulated, a quick-opening blowdown valve (QOBV) which simulates a pipe break, a recirculation line, an isolation valve, and connecting piping. The recirculation lines established a small flow from the broken loop to the intact loop to maintain these loop temperatures approximately equal prior to the blowdown. These recirculation paths are secured just prior to blowdown initiation.

Test L1-4 simulated a 200% double-ended shear break in a cold leg of a LPWR operating loop. In this configuration, the broken loop hot leg contained, in addition to the above mentioned components, a steam generator simulator and a pump simulator. These simulators have hydraulic orifice plate assemblies installed which have similar (passive) resistances to flow as a real steam generator and a locked rotor pump. The break flow area (break plane orifice area) in this configuration is 0.0084 m^2 in each line; this is 100% of the possible break flow area.

The blowdown suppression system simulates the containment back pressure of a LPWR. This system is comprised of the blowdown suppression tank header, the blowdown suppression tank (BDST), the nitrogen pressurization system, and the blowdown suppression tank spray system (BDSTSS). The blowdown header is connected to the suppression tank by four suppression tank downcomers that extend inside the tank and

discharge below the water level established as a Test L1-4 initial condition. The nitrogen pressurization system is supplied by the LOFT inert gas system and utilizes a remote controlled pressure regulator to establish and maintain the specified BDST initial pressure. The spray system consists of a centrifugal pump which discharges through a heatup heat exchanger and either three spray headers or a pump recirculation line that contains a cooldown heat exchanger. The spray pump suction can be aligned to either the BDST or the borated water storage tank (BWST). The three spray headers have a 1.3 l/s, a 3.8 l/s, and a 13.9 l/s flow rate capacity and are located in the BDST along the upper centerline. To model the containment back pressure of a LPWR, predetermined initial conditions are established in the BDST. For Test L1-4, suppression tank spray was automatically initiated and adjusted to follow a predetermined pressure trace after accumulator nitrogen entered the tank. Therefore, the blowdown effluent was contained within the BDST while obtaining the same peak pressure and predetermined pressure trace as if the break was in a LPWR which was discharging into its containment vessel.

The LOFT ECCS simulates the ECCS of a LPWR. The accumulator, the HPIS, and the LPIS were used during this experiment. Each system was configured to inject scaled^[2] flow rates of ECC directly into the PCS cold leg. To provide these scaled flow rates, accumulator ACC-A, HPIS pump A, and LPIS pump A were utilized. Accumulator ACC-A was preset to inject ECC at a system pressure of 4.14 MPa (gauge pressure). HPIS pump A was preset to inject at 1.085 l/s and to initiate by LOCE control at 22 seconds after the initiation of blowdown; LPIS pump A was adjusted to initiate by LOCE control no sooner than 35.5 seconds after the initiation of blowdown. While the above ECCS injection times and pressure represent those preset test conditions specified in the EOS, the actual recorded parameters are presented in the test summary and in Section IV.

The LOFT major components are shown pictorially in Figure 1, and a LOFT piping schematic, with instrumentation, is shown in Figure 2.

ANC-C-8672

Fig. 1 LOFT major components.

Fig. 2 LOFT piping schematic (with instrumentation).

Reference 1 gives details of the experiment configuration and operation;
Reference 4 gives a detailed description of the LOFT system.

III. MEASUREMENTS AND INSTRUMENTATION

The LOFT instrumentation system was designed to measure and record the important events that occur during a LOCE. For Test L1-4, 551 channels of data were recorded. Data from the thermal-hydraulic measurements (i.e., temperatures, pressures, flow rates, liquid levels, densities, pump speeds, and QOBV positions as functions of time) are of primary importance and are included in this report. Mechanical measurement data such as acceleration and strain are essential for monitoring structural loads on the LOFT system but are not of primary interest as the results are specific to the LOFT mechanical arrangement and therefore are not included.

Thermocouples and resistance temperature devices were used to sense the fluid temperatures at all major locations in the system.

Pressure measurements were generally obtained with strain-gage-type transducers with pressure transmission lines connecting the transducers to the measurement points. A few piezoelectric-type transducers were used where high-frequency response was desired rather than absolute accuracy. Free-field pressure transducers, in which the sensing elements were inside a bellows arrangement, were also used to eliminate connecting transmission lines and thereby produce higher frequency response without the distortion caused by the lines.

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

Flow velocities were generally obtained directly by use of turbine flowmeters.

Density was measured by means of gamma densitometers (shown in Figure 3), which use the attenuation of gamma rays from a cesium-137 source to sense the mass of fluid within a pipe. The densitometers used

Relation of source and detector to pipe in DE-BL-1 and DE-PC-1 (view looking toward reactor vessel).

Relation of source and detector to pipe in DE-BL-2 and DE-PC-2 (view looking toward reactor vessel).

Relation of source and detector to pipe in DE-PC-3 (view looking down).

INEL-A-2711

Fig. 3 Gamma densitometer beam configuration.

in LOFT each have three beams (designated A, B, and C) which traverse the lower, middle, and upper parts of the pipe, respectively, for the horizontal pipe densitometers. For the steam generator discharge densitometer, where the pipe is vertical, the densitometer 'B' beam is in the plane of the adjacent pipe bends. By using the logic table given in Figure 4 and special calibrations, the average density and the flow regime can be obtained. The special calibrations mentioned were obtained from testing with lucite and wood representations of various fluid density distributions in an actual piece of LOFT piping. These calibrations were then used to produce weighting factors to be used on each beam in combining the individual beam outputs to obtain the average density. Experimentation showed the use of simple weighting factors to be as accurate for average density and several more complex methods of determining the fluid distribution in the pipe. The resultant weighting factors were changed as a function of the flow regime. The weighting factors used in this report were as shown in the following equations:

$$\bar{\rho} = 0.437\rho_A + 0.417\rho_B + 0.146\rho_C$$

for stratified flow, and

$$\bar{\rho} = 0.345\rho_A + 0.401\rho_B + 0.254\rho_C$$

for other flow regimes.

Liquid levels were obtained by means of (a) differential pressure transducers in the pressurizer, accumulators, and 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.

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

Fig. 4 Gamma densitometer flow regime logic.

the pump motor shaft. The target contains six asymmetrical slots such that pump speed and direction of rotation can be determined. Pump speed was also calculated from the PSMG set frequency. No allowance for slip between the electrical field and the rotor was used in this latter calculation. Electrical pump power was measured by a wattmeter.

Acceleration, displacement, mechanical strain, and valve off-on indicators were sensed by accelerometers, linear variable differential transformers, bonded strain gages, and microswitches, respectively. Since these are not considered of prime importance in understanding this experiment, they are not included here. This information will be reported in an addendum to this report if sufficient requests for the information are received.

Many quantities such as mass flow rates can be computed by combining measured parameters. The calculated quantities, termed "computed parameters", that appear in this report are identified in Table VIII in Section VII.

The data acquisition and visual display system (DAVDS) was used to record the measurement data from the various instrumentation systems on a combination of digital recorders, medium- and wide-band frequency modulation (FM) tape recorders, and oscillographic recorders. Redundant records were made where different uses dictated more than one recording mode or extra safety measures were desired for critical measurements.

A digital computer was used to collect the LOCE data in a multiplex format at the LOFT Facility and to perform equipment calibrations and post-test data reduction and plotting. Immediately following the test, the computer was used to reduce critical channels of the data so that a decision could be made quickly as to the success of the experiment. The recorded analog data were converted into digital form, and the digital data were demultiplexed to be compatible with the CDC CYBER 76/173 computer.

The CDC CYBER 76/173 computer was used to further reduce the data. Calibration factors were first applied to produce engineering units data plots so that engineering specialists could examine each channel for discrepancies or unexpected events. After the data graphs were examined and qualified, they were then used to generate graphs and compute variables. Specifics of these topics are given in Section VII and a complete description of the data acquisition system and data reduction is given in References 9 and 10.

Figure 2 shows a piping schematic with instrument locations indicated. Table I gives the nomenclature for LOFT instrumentation designations, Figure 5 shows an isometric view of the major system components with instrument locations indicated, and Figures 6 through 12 give more specific locations for instruments located on individual components. Reference 4 should be consulted for details of instrument design and locations. (Locations, ranges, and frequency responses for instruments used in obtaining data presented in this report may also be obtained from Table VII which is presented in Section VII.) Various new instruments were added for Test L1-4. The new instruments are given, with their locations, in Table II. Figures 13, 14, and 15 show the locations of the new instrumentation.

TABLE I
NOMENCLATURE FOR LOFT INSTRUMENTATION

Designations for the different types of transducers.

1. CV	- Control Valve
2. DE	- Densitometer
3. FE	- Flow
4. FT	- Flow
5. LE	- Level
6. LIT	- Level
7. LT	- Level
8. ME	- Momentum Flux
9. PdE	- Differential Pressure
10. PdT	- Differential Pressure
11. PE	- Pressure
12. PT	- Pressure
13. RPE	- Pump Speed
14. TE	- Temperature
15. TT	- Temperature
16. VPE	- QOBV 17% Position Switch

Designations for the different systems, except for the nuclear core which has not been installed.

1. BL	- Broken Loop
2. CS	- Core Simulator
3. PC	- Intact Loop
4. RV	- Reactor Vessel
5. SG	- Steam Generator
6. ST	- Downcomer Instrument Stalk
7. SV	- Blowdown Suppression Tank

Fig. 5 LOFT thermo-fluid measurements instrumentation.

Fig. 6 LOFT reactor vessel instrumentation.

Fig. 7 LOFT pressurizer instrumentation.

LOFT OPERATING LOOP PROCESS INSTRUMENTATION

Fig. 8 LOFT steam generator instrumentation.

Fig. 9 LOFT intact loop pump instrumentation.

Fig. 10 LOFT accumulator instrumentation.

INEL-A-1713

Fig. 11 LOFT ECCS instrumentation -- left side.

Note:
All Dimensions
in Meters

Fig. 12 LOFT blowdown suppression tank instrumentation.

TABLE II

NEW INSTRUMENTATION FOR NONNUCLEAR TEST L1-4

Measurement Identification	Description
PdE-PC-8	Differential pressure across the pressurizer surge line
PdE-PC-9	Differential pressure across intact loop pump 1
PdE-PC-10	Differential pressure across intact loop pump 2
PdE-BL-9	Broken loop cold leg differential pressure from end of 14-to-5-in. contraction to middle of 5-in.-diameter pipe
PdE-BL-10	Broken loop cold leg differential pressure from middle of 5-in.-diameter pipe to break plane
FE-BL-1A ME-BL-1A TE-BL-1A	Broken loop cold leg fluid velocity, momentum flux, and fluid temperature at DTT flange on bottom DTT
FE-BL-1B ME-BL-1B TE-BL-1B	Broken loop cold leg fluid velocity, momentum flux, and fluid temperature at DTT flange on middle DTT
FE-BL-1C ME-BL-1C TE-BL-1C	Broken loop cold leg fluid velocity, momentum flux, and fluid temperature at DTT flange on top DTT
PE-SV-75	Pressure at broken loop cold leg expansion joint
PCP-1-P	Pump power, intact loop pump 1
PCP-2-P	Pump power, intact loop pump 2

Instruments were calibrated before installation either by the instrument vendor or at the INEL. Calibration data were then correlated with other parameters to determine the functional relationships between errors and variables other than those the instrument was designed to measure. These error functions were then represented by mathematical equations (usually in the form of polynomials of degree five or less) and incorporated in the data reduction program.

Fig. 13 New instrumentation in the intact loop.

Fig. 14 New instrumentation in the broken loop.

Fig. 15 New DTT locations in the broken loop cold leg (BL-1).

The turbine meters and the drag discs in the intact loop were calibrated to convert the point measurement values to the mean values across the entire flow area. These calibrations were performed using the data from the single-phase variable frequency pump tests conducted prior to blowdown initiation. Least squares curve fits were calculated for the square root of the intact loop differential pressures plotted against the pump speed to confirm the adequacy of the differential pressure offset corrections. Similarly, the intact loop venturi meter data were plotted against the square root of the corrected differential pressure measurements to confirm or adjust the venturi meter offset corrections. The corrected venturi meter data were then used to calculate average velocities and momentum fluxes in the intact loop and the reactor vessel. These calculated quantities were subsequently compared to the measured turbine meter velocities and drag disc momentum fluxes to verify or to provide changes to the respective instrument calibration equations.

Additional calibrations were performed on specified turbine meters and drag discs to convert the point measurements to average measurements. These instruments included broken loop turbine meters and drag discs in the intact loop and reactor vessel which were overranged during the pump frequency tests. In the intact loop and reactor vessel, the flow rates calculated using the turbine meters and their associated areas were normalized with the intact loop venturi during steady-state (initial) conditions to determine the calibration factors for the turbine flowmeters. These calibration factors were squared and applied to the drag discs. To determine the calibration factors for the drag disc in the core simulator, the flow rate was calculated using the flow area of the LOFT nuclear core and normalized with the venturi flow rate. Similar calibration factors were developed for the broken loop drag discs using the results of accumulator blowdown tests (where the accumulator flow was directed through the broken loop).

The differential pressures were calibrated to read zero at zero flow regardless of the elevation differences between taps.

The presented data for average velocity and average momentum flux are based on the following flow areas at the instrument locations:

<u>Instrument</u>	<u>Flow Area</u>
FE-BL-1A, -1B, -1C, and -2 ME-BL-1A, -1B, -1C, and -2	0.0634 m ²
FE-PC-1, -2, and -3 ME-PC-1, -2, and -3	0.0634 m ²
FE-CS-1 ME-CS-1	0.165 m ²
FE-1ST-1 and FE-2ST-1 ME-1ST-1 and ME-2ST-1	0.141 m ²

Error bands (upper and lower) were added as overlays to the plots of certain representative instruments from Test L1-3. These plots can be found in Section 5 of the presented data.

Information on the calibration factors, accuracy, and response of specific instruments is given in the LOFT Experimental Measurements Uncertainty Analysis^[11]. Instrument calibrations and system testing conducted subsequent to completing the uncertainty analysis have been used to update the information presented and to process the data contained herein. Reference 11 is currently being revised to reflect the improved information and the observed instrument performances obtained to date.

IV. TEST PROCEDURES

In preparation for Test L1-4, the PCS was filled and vented and the system water chemistry was established to the specifications listed in Table VI. The SCS, ECCS, the blowdown suppression system, and supporting plant systems were configured as specified in the experiment operating specification (EOS)^[1].

Prior to the heatup of the plant, 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 PCS pressure was hydrostatically increased to 1.38, 3.45, 6.90, 10.35, 13.8, and 15.5 MPa (gauge pressure) at cold plant temperature and zero flow conditions. The DAVDS recorded 20 seconds of data at each pressure plateau to provide information to determine the degree of sensitivity of the pressure sensing instruments. The system was concurrently inspected for leakage at the various test pressures.

The plant was brought to the initial temperature of 279°C in a stepwise manner using the work energy addition of the primary coolant pumps. During the warmup, the purification and sampling systems were valved into the PCS to maintain water chemistry requirements and to provide a water sample at system conditions for subsequent analysis. Isothermal conditions were obtained in the nonflowing broken loop by means of the recirculation lines back to the intact loop. Before plant temperature exceeded 93.3°C, the secondary side of the steam generator was drained to the 0% power program reference level (2.59 m from the top of the tube sheet), water chemistry was established, and the steam generator secondary side was valved out. Prior to LOCE initiation, the BDST was heated up and pressurized with nitrogen to its specified initial conditions.

The plant was stabilized at three points during heatup: 121°C - 3.45 MPa (gauge pressure), 238°C - 15.5 MPa (gauge pressure), and 279°C - 15.45 MPa (gauge pressure). At each stabilization point a burst (20 to 30 seconds) of data was recorded for calibration checks and to determine the degree of instrument temperature sensitivity. At the 121, 238, and 279°C stabilization points, frequency tests were performed by varying primary coolant pump frequency from 20 to 60 Hz in 10 Hz increments. Following the frequency tests, single-phase pump coastdown tests were conducted at the 9.2 MPa and 211.5°C points with an initial flow of 475 kg/s. At the 282°C stabilization point, single-phase pump coastdown tests were performed with initial flows of 269 kg/s. Data were recorded for about 60 seconds for each of the four pump coastdowns and the data were used for calibration checks. Following each pump coastdown, data were recorded for zero flow conditions. When plant conditions were stabilized at 283°C and 15.6 MPa, the plant was allowed to soak for more than 40 hours to assure isothermal conditions for the blowdown. During this 40-hour soak, an electrical calibration of the DAVDS was performed. Additionally, ECCS accumulator ACC-A was filled and pressurized to its specified values.

Prior to blowdown initiation, the system parameters were checked to insure that they were within specified bands and last-minute instrument checks and valve lineup checks were performed. During this period, the initial-condition water samples were taken from the primary coolant system, the secondary coolant system, and the BDST. The pressurizer, steam generator, and BDST water levels were established. The purification system, which was the primary mode of plant temperature control, was valved out. The conditions in the intact loop were established to provide 268.4 kg/s flow with temperature and pressure at 279°C and 15.65 MPa (gauge), respectively, at the time of blowdown initiation. Primary coolant pump injection flow was initiated and the broken loop recirculation lines to the intact loop were closed.

Immediately prior to blowdown (within 60 seconds), the DAVDS was activated and data recording was started, the QOBV isolation valves were opened, and the pressurizer heaters were secured. Test LI-4 blowdown

was initiated. QOBV-2 (CV-P138-15) commenced opening 1.3 ms before QOBV-1 (CV-P138-1) and opened to a 12-inch Schedule 160 (0.30-m OD) pipe area in 22 ms; QOBV-1 opened to the same flow area in 17.9 ms. Thus Test L1-4 successfully simulated a simultaneous 200% offset cold leg shear.

Electrical power to the PSMG sets was terminated within 1 second after blowdown initiation which allowed the pumps to coastdown under the influence of the flywheels and the fluid dynamic forces on the pump impellers. The PSMG set field breakers were tripped at 24.5 seconds before the primary coolant pumps coasted down below 12.5 Hz.

ECC injection was directed to the intact loop cold leg during blowdown. Injection from accumulator ACC-A at a system pressure of 4.14 MPa began approximately 23 seconds after initiation of blowdown and continued for 42 seconds. HPIS pump A was initiated by LOCE control 23 seconds after the initiation of blowdown and injected at a flow rate of 1.1 l/s. LPIS pump A was initiated by LOCE control 39 seconds after the initiation of blowdown. Nitrogen gas from accumulator ACC-A entered the system at 65 seconds and continued to flow for about 35 seconds.

After accumulator nitrogen entered the BDST, the BDST spray was automatically initiated. This spray was continued for approximately 5 minutes and then secured.

The DAVDS digital recording system obtained approximately 6 minutes of data after simulated rupture and was secured. The DAVDS analog system continued recording blowdown suppression tank parameters for 10 minutes after blowdown initiation and was then secured. An electrical calibration of the DAVDS was performed following the test completion.

A sequence of events for Test L1-4 is provided in Table III.

TABLE III

CHRONOLOGY OF EVENTS FOR NONNUCLEAR TEST L1-4

Event	Time (Seconds After Blowdown Initiation)
L1-4 initiation	0
End of subcooled blowdown	~ 0.08
PCS pump trip	~ 1.0
Pressurizer empty	14
Accumulator A injection initiated	23
HPIS injection initiated	23 (22 ± 2 specified ^[1])
LPIS injection initiated	39 (35 ± 2 specified ^[1])
End of saturated blowdown	~ 50
Accumulator A empty of liquid	58
Accumulator liquid line flow ends ^[a]	65
BDST spray flow initiated	84

[a] Flow measuring point is downstream from accumulator level indicators.

V. INITIAL CONDITIONS

The initial conditions and tolerance bands for Test L1-4 are presented in Table IV along with the values measured immediately prior to the blowdown initiation. These pretest requirements and the justification for their selection are specified in EOS Volume 2^[1].

Six initial conditions were slightly out of tolerance for this test: The measured PCS pressure was 15.65 MPa (gauge) instead of the 15.60 MPa (gauge) maximum pressure as specified in EOS Volume 2. The PCS temperature was 279°C instead of the specified 282°C. The ECC accumulator injected water volume was 2.05 m³ instead of the maximum specified of 2.04 m³. The pressurizer pressure like the PCS pressure was 15.65 MPa (gauge) instead of the 15.60 MPa (gauge) maximum pressure specified. The steam generator secondary side water level was 3.02 m instead of the maximum specified value of 2.97 m. The suppression tank level was 1.41 m instead of the maximum specified level of 1.40 m.

These discrepancies did not have any adverse effect on the experiment.

TABLE IV
INITIAL CONDITIONS FOR NONNUCLEAR TEST L1-4

<u>Parameter</u>	<u>EOS Specified Value</u> ^[1]	<u>Measured Value</u>
<u>Primary Coolant System</u>		
Mass flow rate (kg/s)	270.9 ± 6.3	268.4
Pressure (gauge) (MPa)	15.5 ± 0.10	15.65
Temperature (°C)	282	279
Boron concentration (PC and ECC) (ppm)	0-3600	1494

TABLE IV (contd.)

<u>Parameter</u>	<u>EOS Specified Value^[1]</u>	<u>Measured Value</u>
<u>ECC Accumulator</u>		
Gas volume (m ³)	1.1 ± 0.07	1.16
Water volume injected (m ³)	1.97 ± 0.07	2.05
Pressure (gauge) (MPa)	4.14 ± 0.172	4.14
Temperature (°C)	32 ± 3	33
Standpipe gate height (m)	0.86 ± 0.05	0.86
<u>Pressurizer</u>		
Steam volume (m ³)	0.33 ± 0.1	0.30
Water volume (m ³)	0.63 ± 0.1	0.66
Water temperature (°C)	Not specified	346
Pressure (MPa)	15.5 ± 0.10	15.65
<u>Steam Generator</u>		
<u>Secondary Side</u>		
Water volume (m ³)	Not specified	3.46
Water level (m)	2.946 ± 0.025	3.02
Water temperature (°C)	Not specified	279
Pressure (gauge) (MPa)	Not specified	6.55
<u>Suppression Tank</u>		
Liquid level (m)	1.37 ± 0.03	1.41
Gas volume (m ³)	Not specified	33.79
Liquid volume (m ³)	Not specified	41.26
Downcomer ^[a] submergence (m)	Not specified	0.55
Water temperature (°C)	84 ± 3.6	85
Pressure (gas space) (gauge) (KPa)	9.65 ± 6.89	7.85

TABLE IV (contd.)

<u>Parameter</u>	<u>EOS Specified Value</u> ^[1]	<u>Measured Value</u>
Differential water level between downcomer and suppression tank ^[a] (m)	Not specified	0.31
<u>Broken Loop</u>		
Hot leg temperature (°C)	282 - -14	
Near vessel		279
Near break		272
Cold leg temperature (°C)	282 - -14	281
Near vessel		279
Near break		272

[a] Based on average submergence of four downcomers.

Table V gives the fluid temperature distribution of the PCS immediately prior to blowdown initiation. As can be seen, the system temperature distribution was nearly constant, except for the pressurizer liquid and vapor space. This essentially isothermal condition was due to the greater than 40-hour soak at the initial condition temperature and pressure before the commencement of blowdown.

Table VI specifies the required water chemistry for the PCS, the blowdown suppression tank, and the SCS. In addition, the results of the water chemistry analysis for these systems are presented for pre-LOCE and post-LOCE conditions. The pre-LOCE accumulator A boron concentration was 3307 ppm and the BWST boron concentration was 3258 ppm. After blowdown, the boron concentration in the PCS was 4941 ppm. These analyses were required to utilize the data from the reactor vessel downcomer liquid level probes.

TABLE V

PRIMARY COOLANT TEMPERATURE DISTRIBUTION AT BLOWDOWN INITIATION

Location	Detector	Temperature (°C)
Intact loop hot leg (near vessel)	TE-PC-2	279
Intact loop steam generator inlet	TE-SG-1	281
Intact loop steam generator outlet	TE-SG-2	279
Intact loop cold leg (near steam generator outlet)	TE-PC-3	281
Intact loop cold leg (near vessel)	TE-PC-1	279
Reactor vessel downcomer:		
Instrument stalk 1	TE-1ST-2	282
Instrument stalk 2	TE-2ST-2	279
Reactor vessel lower plenum:		
Instrument stalk 1	TE-1ST-9	282
Instrument stalk 2	TE-1ST-14	279
Reactor vessel core simulator	TE-CS-1	279
Broken loop hot leg (near vessel)	TE-BL-2	281
Broken loop hot leg (near break)	TE-P138-171	272
Broken loop cold leg (near vessel)	TE-BL-1	279
Broken loop cold leg (near break)	TE-P138-170	272
Intact loop pressurizer:		
Liquid space	TE-P139-20	349
Vapor space	TE-P139-19	346

TABLE VI

WATER CHEMISTRY RESULTS FOR NONNUCLEAR TEST L1-4

Parameter	Primary Coolant Intact Loop			Blowdown Suppression Tank			Secondary Coolant System	
	Specified ^[a]	Pre-LOCE ^[b]	Post-LOCE ^[c]	Specified	Pre-LOCE	Post-LOCE	Specified	Pre-LOCE
PH (@ 25°C)	4.2 - 10.5	6.3	4.88	4.2 - 10.5	5.88	5.76	9.0 - 10.2	9.72
Conductivity ($\frac{\mu\text{mho}}{\text{cm}}$) (@25°C)	60 max	27	54	60 max	45	37	700 max	71
Total solids (ppm)	---	5414.9	19,509.8	---	10,955.7	10,352	---	---
Total gas (cc/kg)	100 max	28.4	---	---	none	8.2	---	none
Dissolved oxygen (ppm)	0.10 max	0.01	0.05	---	---	---	0.10 max	0.005
Lithium (ppm)	0.2 - 2.2	2.3	2.4	---	---	---	---	---
Hydrazine (ppm) (@ < 250°F)	1.0 min -10	< 0.2	< 0.2	---	---	---	1.0 min	< 0.2
Chloride (ppm)	0.15 max	< 0.1	< 0.1	0.15 max	< 0.1	< 0.1	0.5 max	< 0.1
Dissolved solids (ppm)	---	5413	19,508	---	10,955	10,350	500 max	45.5
Undissolved solids (ppm)	1.0 max	1.925	1.8	1.0 max	0.7	1.575	50 max	< 0.1
Hardness (ppm)	---	---	---	---	---	---	---	< 0.1
Phosphate (ppm)	---	---	---	---	---	---	15 - 75	26
Gas O ₂ content (%)	---	---	---	---	---	---	---	---
Boron (ppm)	0 - 3600	1494	4941	3000 - 3600	2514	2557	1000 max	---

[a] Specified values revised February 7, 1977, in LOFT Plant Operating Manual^[12].

[b] Sample taken upstream of the PCS ion exchanger.

[c] Sample taken from the pressurizer.

VI. DATA CONSISTENCY CHECKS

As a subsequent step in the data reduction process described in Section III, all data presented in this report were subjected to a thorough review to verify that they were consistent and reasonable. Where possible, instrument channel outputs and computed parameters were compared to test predictions, previous tests, corresponding parameter channels, and calculated quantities. In many instances, these consistency checks were performed as data plot overlays and, therefore, the respective figure numbers are specified below as the individual topics are discussed. For other measurements, the comparisons and resulting calculations were performed within the company and are not included in this report. Those measurement comparisons that were determined to be within the accuracy of the particular instrument, as specified in Reference 11 were labeled as qualified engineering units data (QEUD). Specifically, several techniques have been developed and employed to perform data consistency checks on the presented data; these techniques are discussed below and results of these checks are reflected in Table VII.

Measured system temperatures were qualified where possible by reviewing the isothermal temperature distributions just prior to blowdown initiation and during the blowdown transient. When temperatures measuring a similar condition were within the specified accuracy of the detectors, the detector output was considered reasonable and was qualified. All PCS channels were reviewed in this manner, and selected initial temperature measurements are summarized in Table V. The pressurizer liquid and vapor space temperatures were checked for consistency by comparing these values with the saturation temperature for the corresponding pressurizer pressure at various points in time. This check was valid prior to and during the system blowdown until the pressurizer emptied at 14 seconds. Similarly, steam generator secondary side temperature was examined throughout the test by comparing the measured temperature with the saturation temperature for the respective SCS pressure. BDST temperature elements TE-SV-1-6 and TE-SV-7-12 were

evaluated by comparing the pretest measurements of the thermocouples in the same horizontal stratum. Overlays of these parameters are presented in Figures 118 through 121. BDST temperature comparison after the initiation of blowdown was not meaningful for data consistency checks due to uneven mixing and condensation producing temperature stratification in the tank.

Pressure data were reviewed in a similar manner. During the approach to Test L1-4 initial conditions at zero-flow conditions, the PCS was raised to various specified temperatures and pressures as described in Section V. At each data point, PCS pressure measurement detectors were compared to a 0.1% accuracy, 0 to 34.5 MPa (gauge pressure) pressure test gauge to verify that the slope had not statistically changed and to establish the offset of the instrument. Immediately prior to blowdown, PCS pressures were again compared to the test gauge standards (Heise, PE-PC-5, and PE-PC-6) to ensure that all detectors were measuring within their specified accuracy bands. During the blowdown transient, pressure data from corresponding measurement locations were compared by overlaying the data plots. These plots are presented in Figures 79 through 90. Pressurizer pressure was qualified by comparison with PCS pressure channels and by saturation temperature as discussed above; SCS pressure was qualified by comparison of saturation temperature to the measured temperature as presented in the paragraph on temperature techniques. The BDST pressure instruments were evaluated by comparing process and experimental pressure measurements prior to and during the blowdown transient. Representative instrument plots are presented for this comparison in Figures 91 through 97.

Comparison of measured temperature with the saturation temperature of the pressure measurement at the same location provided another method to verify PCS data consistency. This technique, however, was valid only during the saturated blowdown transient up till the time the measurement location voided of fluid. After voiding occurred, the measured temperature increased above the corresponding saturation temperature due to radiant heating of the detector element by the structural system components and detector element stem conduction. Temperature detectors

in the reactor vessel which became wetted by the ECCS lower plenum injection displayed a measured temperature which decreased below the corresponding saturation temperature as the detector became immersed in the cooler fluid. Comparisons of saturated temperature and measured temperature are presented in Figures 221 through 228.

Data consistency checks for the differential pressure measurements were provided by several basic methods. Prior to blowdown initiation, no flow data were recorded to determine instrument offsets. PCS operating conditions were then established as specified in EOS Volume 2, and selected PCS pressure drops were compared with predicted values. At various PCS operating 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 instruments by plotting the square root of the differential pressure against pump speed using data from the pump frequency tests conducted prior to blowdown. The results of least squares curve fits performed on these plots were then used to confirm instrument zero offsets. Both prior to and during the blowdown transient, differential pressure measurements were compared with the differential pressure computed by subtracting appropriate absolute pressure measurements. Finally, pressure closure was calculated for three flow loops: (a) the PCS intact loop, (b) the broken loop hot leg to the BDST, and (c) the broken loop cold leg to the BDST. The pressure closure for these three loops is defined in Table VIII and presented for loop (a) in Figure 208.

Four system level measurements were important for Test L1-4: (a) accumulator ACC-A liquid level, (b) BDST liquid level, (c) pressurizer coolant level, and (d) reactor vessel coolant level. The accumulator level was qualified by comparing the pre-LOCE and post-LOCE liquid levels as measured with the level detector to the level measured by an external sightglass. Further post-test data consistency checks were performed by comparing the injected accumulator volume as determined by the external sightglass with the accumulator volumetric flow rate integrated with respect to time. BDST liquid level was

evaluated by comparing two independent level measurements which are plotted as an overlay in Figure 162. Similarly, pressurizer level was reviewed by redundant level measurements. The three independent level measurements are plotted as an overlay in Figure 48. The reactor vessel liquid level probes were verified to be indicating satisfactorily by performing a pretest conductivity calibration with the vessel liquid full and under cold and hot plant conditions.

Primary coolant pump speed measurements were checked for consistency by comparison with pump speed as calculated from the PSMG frequencies. This check was valid prior to and during the blowdown transient until the PSMG field breakers were opened at 24.5 seconds. Prior to test initiation, the pump speed was further checked, along with the intact loop flow rate and pump differential pressure, by reviewing the agreement with the manufacturer's pump performance curves. Pump run voltages and currents were evaluated prior to the initiation of blowdown by calculating the pump electrical horsepower input, the pump water horsepower, and finally the combined pump efficiency. These calculated efficiencies were then compared to previously recorded efficiencies determined during pump requalification tests.

To evaluate the PCS average fluid densities, calculations were performed by using the gamma densitometer. To ensure that the gamma densitometer measurements were accurate for these calculations, the individual beam densities were compared to the known density of the PCS just prior to blowdown initiation. Additionally each densitometer gamma source was stowed in its lead cask to obtain an essentially infinite density data point for each densitometer calibration curve. These known density values were then used to adjust the instrument electronics to give the correct readings from the gamma densitometers. As a final pretest check on the densitometer calibrations, a high and low calibration tungsten shim of known density was inserted in each individual densitometer beam. DAVDS data were then taken and reviewed for these measurement channels in each shim position.

Several techniques were employed to verify the validity of the measured data from the turbine meters, the drag discs, and the intact loop mass flow rate venturi meters. In particular, the broken loop turbine meters and drag discs were calibrated as discussed in Section III. The intact loop venturi meter data were examined by performing least squares curve fits for the computed venturi meter velocities plotted against the corrected average pump speed. The results of these data consistency checks for this test indicated discrepancies in the intact loop mass flow rates measured by the venturi meters. New venturi meter calibration equation offsets were therefore derived by using the above curve fitting technique with the variable-frequency single-phase test data obtained prior to blowdown initiation. These corrected venturi meter mass flow rates were then used to calculate average velocities and momentum fluxes in the intact loop and the reactor vessel. These values were subsequently used to correlate the output of the turbine meters and drag discs. Finally, the measured average turbine meter velocities and drag disc momentum fluxes were confirmed or adjusted to produce consistent data in the pump frequency tests. As an independent check, the turbine meter and drag disc data were used to calculate fluid density as specified in Section III. These values were then compared to the known single-phase density prior to blowdown. This analysis was performed on all the turbine meters and drag discs in the intact loop and the reactor vessel with the exceptions of those instruments that failed as listed in Table VII.

The computed parameter, mass flow rate per system volume, was calculated by five different methods at various locations in the intact loop, broken loop, and the reactor vessel. A list of the measurement parameters, measurement locations, and the calculation methods used are summarized in Table VIII. Comparison of the calculated results obtained by each method at a particular measurement location was utilized to provide the data consistency checks for this computed parameter. It should also be noted that these comparisons provided a redundant check of the individual instruments used for each computation. The mass flow rates per system volume were also calculated for the pressurizer and the BDST as defined in Table VIII. Consistency for the pressurizer was

verified by integrating the mass flow rate with time and comparing the total mass ejected with the known mass in the pressurizer prior to blowdown initiation. The results are presented in Figure 204. The mass flow rate into the BDST by the method of instantaneous level change with time produced unreliable transient results due to the erratic BDST level measurement during the blowdown. This method, therefore, did not produce a reliable data consistency check.

System fluid velocities were evaluated during the blowdown transient by utilizing two independent methods. Velocities were measured directly by the turbine meters. Data consistency checks were performed by comparing the turbine flowmeter velocities for representative system locations with the respective calculated fluid velocities. To provide reliable data for these velocity checks, the gamma densitometers, the drag discs, and the turbine flowmeters were calibrated prior to test initiation as discussed in Section III and in this section.

As a redundant approach to verify the validity of Test L1-4 data, selected instrument parameters were overlaid with plots from (a) the experiment prediction for Test L1-4^[2], (b) the Semiscale counterpart test (S-01-4A)^[13], and (c) the LOFT nonnuclear Test L1-3A^[8]. Parameters of interest in these comparisons included broken and intact loop average densities, pressures, temperatures, fluid velocities, and computed mass flow rates per system volume. The differential pressure measurements across selected PCS components were also examined. The results of these comparisons are not included in this report.

A number of additional techniques are being developed to reconcile inconsistencies in the mass flow rates through the break planes. As of yet, the analysis has not been completed for Test L1-4 and thus will not be presented here.

VII. DATA PRESENTATION

The data presented in this report include selected pertinent thermal-hydraulic data from LOFT Test L1-4. The data have been divided into four categories: qualified engineering units data (QEUD), restrained, trend, and channel failed. The "QEUD" designation was applied to measurements that have been compared to other measurements and have been found to be within the accuracy of the instrument. These data checks are discussed in detail in Section VI. The "restrained" designation was applied to measurements in which the instruments did not fail but the data have some restrictions. The "trend" designation was applied to measurements that appeared to be reasonable but no comparable measurement for cross-checking was recorded.

The data were processed to the extent of converting the data to SI units, combining measurements to produce computed parameters, and overlaying graphs of corresponding parameters at several locations to facilitate comparison. Point values of momentum flux from the drag discs and velocity from the turbine flowmeters have been converted to average values by using the intact loop venturi meter as discussed in Section III. Data from the drag discs, the turbine flowmeters, specified differential pressure instruments, and the gamma densitometers were filtered with a 4-Hz low pass filter prior to presentation.

Measurement uncertainties for each instrument were reported in Reference 11 and are subsequently being revised as dictated by in situ testing and calibrations. These uncertainties have been used to produce error band plots of Test L1-3 data [plots of data with upper and lower bounds of the 95% (2σ) confidence levels overlaid]. For the drag discs and gamma densitometers, uncertainty analyses have been performed for the point measurements only. Further analyses will be required before average value uncertainties can be reported.

For LOFT Test L1-4, the instrumentation system performed well. Of 551 instrument channels recorded during this experiment, only 25 instrument channels failed.

Table VII lists the sensors that were intended to be reported for Test L1-4. It gives the detector location, range, and frequency response along with the figure number where the data can be found. This table also contains a "Comments" column which gives information relative to the usability of the data.

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

The data are presented in graphical form, and are arranged two plots per page. The data plots are further divided into five major sections with the individual plots in each section being presented in alphanumeric order to facilitate comparison and location of desired parameters. These data sections include:

1. TEST L1-4 MEASURED PARAMETERS -- SHORT-TERM PLOTS (2 SECONDS OR LESS) - Figures 16 through 26. This section contains the detector outputs, including overlays, which were specifically designed for the short-term transient and, therefore, do not exceed 2-second duration.
2. TEST L1-4 MEASURED PARAMETERS -- MEDIUM-TERM PLOTS (-10 TO 70 SECONDS) - Figures 27 through 136.
3. TEST L1-4 MEASURED PARAMETERS -- LONG-TERM PLOTS (190 AND 600 SECONDS) - Figures 137 through 174. This section contains selected detector outputs, including overlays of 190- and 600-second duration.
4. TEST L1-4 COMPUTED PARAMETERS - Figures 175 through 231.

5. ERROR BAND PLOTS - Figures 232 through 256. This section contains error band plots for several representative instrument types, ranges, and frequency responses.

Time zero for each plot is the average of the times at which each of the two QOBV sleeves opened to 17% of full travel. This definition for time of blowdown initiation (T_0) was used since (a) a flow area does not exist through each QOBV until the valve sleeve clears the huddle chamber at 17% of its full travel and (b) QOBV-2 (CV-P138-15) commenced opening 1.3 ms sooner than QOBV-1 (CV-P138-1). It should be noted that, while this definition of time zero is adequate for measurement comparisons using time scales on the order of several seconds, the user may wish to utilize a different time zero definition for evaluation of shorter time phenomena. The data are presented prior to the defined time zero to allow for such a comparison.

The scales selected for the graphs were chosen to provide an overview of the test and do not reflect the obtainable resolution of the data.

It should be noted that the instrument uncertainties presented in Section 5, "Error Band Plots", apply to data that are tabulated. The printing error and error from individuals reading these plots cannot be quantified, thereby necessitating the application of uncertainties to only tabulated data.

The volume of data contained in this report is large, and although every effort was made to prevent it, an error may have found its way into the report. In the event a user detects an error, prompt notification would be appreciated so that other users may be notified.

TABLE VII

MEASURED PARAMETERS FOR LOFT NONNUCLEAR TEST L1-4

PARAMETER System Detector	Location	Range		Frequency Response			Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System	Data Fig. No.	
VALVE OPENING							
Broken Loop CV-P138-1	Broken loop cold leg between break plane and suppression tank.	0-100%	0-100%	35 Hz	500 pps	16 17	Trend data ^[b] .
Broken Loop CV-P138-15	Broken loop hot leg between break plane and suppression tank.	0-100%	0-100%	35 Hz	500 pps	16	Trend data.
CHORDAL DENSITY							
Broken Loop DE-BL-1A	Broken loop cold leg at DTT flange. Beam line 14° 21 min from -1B line [CW looking toward reactor vessel (RV)].	8.0×10^{-3} -1.0 mg/m ³	8.0×10^{-3} -1.0 mg/m ³	1,000 Hz 10 Hz	1,000 Hz 50 pps	27 137	QEUD ^[c] . Filtered to 4 Hz for 0 to 70 s plots only.
Broken Loop DE-BL-1B	Broken loop cold leg at DTT flange. Beam line through C of pipe 45° from vertical (CCW looking toward RV).	8.0×10^{-3} -1.0 mg/m ³	8.0×10^{-3} -1.0 mg/m ³	1,000 Hz 10 Hz	1,000 Hz 50 pps	27 137	QEUD. Filtered to 4 Hz for 0 to 70 s plots only.
Broken Loop DE-BL-1C	Broken loop cold leg at DTT flange. Beam line 22° 7 min from -1B line (CCW looking toward RV).	8.0×10^{-3} -1.0 mg/m ³	8.0×10^{-3} -1.0 mg/m ³	1,000 Hz 10 Hz	1,000 Hz 50 pps	27 137	QEUD. Filtered to 4 Hz for 0 to 70 s plots only.
Broken Loop DE-BL-2A	Broken loop hot leg at DTT flange. Beam line 14° 21 min from -2B line (CCW looking toward RV).	8.0×10^{-3} -1.0 mg/m ³	8.0×10^{-3} -1.0 mg/m ³	1,000 Hz 10 Hz	1,000 Hz 50 pps	28 138	QEUD. Filtered to 4 Hz for 0 to 70 s plots only.
Broken Loop DE-BL-2B	Broken loop hot leg at DTT flange. Beam line through C of pipe 45° from vertical (CW looking toward RV).	8.0×10^{-3} -1.0 mg/m ³	8.0×10^{-3} -1.0 mg/m ³	1,000 Hz 10 Hz	1,000 Hz 50 pps	28 138	QEUD. Filtered to 4 Hz for 0 to 70 s plots only.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response			Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System			
Broken Loop DE-BL-2C	Broken loop hot leg at DTT flange. Beam line 22° 7 min from -2B line (CW looking toward RV).	8.0×10^{-3} -1.0 mg/m ³	8.0×10^{-3} -1.0 mg/m ³	1,000 Hz 10 Hz	1,000 Hz 50 pps	28 138	QEUD. Filtered to 4 Hz for 0 to 70 s plots only.	
Intact Loop DE-PC-1A	Intact loop cold leg at DTT flange. Beam line 14° 21 min from -1B line (CW looking away from RV).	8.0×10^{-3} -1.0 mg/m ³	8.0×10^{-3} -1.0 mg/m ³	1,000 Hz 10 Hz	1,000 Hz 50 pps	30	QEUD. Filtered to 4 Hz for 0 to 70 s plots only.	
Intact Loop DE-PC-1B	Intact loop cold leg at DTT flange. Beam line through C of pipe 45° from vertical (CCW looking away from RV)	8.0×10^{-3} -1.0 mg/m ³	8.0×10^{-3} -1.0 mg/m ³	1,000 Hz 10 Hz	1,000 Hz 50 pps	30	QEUD. Filtered to 4 Hz for 0 to 70 s plots only.	
Intact Loop DE-PC-1C	Intact loop cold leg at DTT flange. Beam line 22° 7 min from -1B line (CCW looking away from RV).	8.0×10^{-3} -1.0 mg/m ³	8.0×10^{-3} -1.0 mg/m ³	1,000 Hz 10 Hz	1,000 Hz 50 pps	30	QEUD. Filtered to 4 Hz for 0 to 70 s plots only.	
Intact Loop DE-PC-2A	Intact loop hot leg at DTT flange. Beam line 14° 21 min from -2B line (CW looking away from RV).	8.0×10^{-3} -1.0 mg/m ³	8.0×10^{-3} -1.0 mg/m ³	1,000 Hz 10 Hz	1,000 Hz 50 pps	31	QEUD. Filtered to 4 Hz for 0 to 70 s plots only.	
Intact Loop DE-PC-2B	Intact loop hot leg at DTT flange. Beam line through C of pipe 45° from vessel (CCW looking away from RV).	8.0×10^{-3} -1.0 mg/m ³	8.0×10^{-3} -1.0 mg/m ³	1,000 Hz 10 Hz	1,000 Hz 50 pps	31	QEUD. Filtered to 4 Hz for 0 to 70 s plots only.	

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response		Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System		
Intact Loop DE-PC-2C	Intact loop hot leg at DTT flange. Beam line 22° 7 min from -2B line (CCW looking away from RV).	8.0×10^{-3} -1.0 mg/m ³	8.0×10^{-3} -1.0 mg/m ³	1,000 Hz 10 Hz	1,000 Hz 50 pps	31	QEUD. Filtered to 4 Hz for 0 to 70 s plots only.
Intact Loop DE-PC-3A	Steam generator (SG) outlet at DTT flange. Beam line 14° 21 min from -3B line (CCW looking down).	8.0×10^{-3} -1.0 mg/m ³	8.0×10^{-3} -1.0 mg/m ³	1,000 Hz 10 Hz	1,000 Hz 50 pps	32	QEUD. Filtered to 4 Hz for 0 to 70 s plots only.
Intact Loop DE-PC-3B	SG outlet at DTT flange. Beam line 65° from flange [C (CW looking down).	8.0×10^{-3} -1.0 mg/m ³	8.0×10^{-3} -1.0 mg/m ³	1,000 Hz 10 Hz	1,000 Hz 50 pps	32	QEUD. Filtered to 4 Hz for 0 to 70 s plots only.
Intact Loop DE-PC-3C	SG outlet at DTT flange. Beam line 22° 7 min from -2B [C (CW looking down).	8.0×10^{-3} -1.0 mg/m ³	8.0×10^{-3} -1.0 mg/m ³	1,000 Hz 10 Hz	1,000 Hz 50 pps	32	QEUD. Filtered to 4 Hz for 0 to 70 s plots only.
FLUID VELOCITY, AVERAGED							All turbine meter measure- ments are unidirectional.
Broken Loop FE-BL-1A	Broken loop cold leg at DTT rake bottom.	2.3-45.7 m/s	0-57.9 m/s	9 Hz	1,000 Hz 50 pps	34 139	Restrained data [d]. Filtered to 4 Hz for 0 to 70 s plot only. QEUD only above 1.0 m/s.
Broken Loop FE-BL-1B	Broken loop cold leg at DTT rake center.	2.3-45.7 m/s	0-57.9 m/s	9 Hz	1,000 Hz 50 pps	34 139	Restrained data. Filtered to 4 Hz for 0 to 70 s plot only. QEUD only above 1.0 m/s.
Broken Loop FE-BL-1C	Broken loop cold leg at DTT rake top.	2.3-45.7 m/s	0-57.9 m/s	9 Hz	1,000 Hz 50 pps	34 139	Restrained data. Filtered to 4 Hz for 0 to 70 s plot only. QEUD only above 1.0 m/s.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response			Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System	Data Fig. No.	
Broken Loop FE-BL-2	Broken loop hot leg at DTT flange.	2.3-45.7 m/s	0-57.9 m/s	9 Hz	1,000 Hz 50 pps	35	Trend data. Filtered to 4 Hz.
Reactor Vessel FE-CS-1	Core simulator in instrument stalk above orifice.	0.5-9.1 m/s	0-18.3 m/s	9 Hz	1,000 Hz 50 pps	36	Restrained data. Filtered to 4 Hz. QEUD only above 1.0 m/s. Flow is negative from $T_0 + 6$ s to $T_0 + 18$ s.
Intact Loop FE-PC-1	Intact loop cold leg at DTT flange.	2.3-45.7 m/s	0-54.9 m/s	9 Hz	1,000 Hz 50 pps	37	Restrained data. Filtered to 4 Hz. QEUD only above 1.0 m/s.
Intact Loop FE-PC-2	Intact loop hot leg at DTT flange.	2.3-45.7 m/s	0-61.0 m/s	9 Hz	1,000 Hz 50 pps	37	Restrained data. Filtered to 4 Hz. QEUD only above 1.0 m/s.
Intact Loop FE-PC-3	SG outlet at DTT flange.	2.3-45.7 m/s	0-64.0 m/s	9 Hz	1,000 Hz 50 pps	37	Restrained data. Filtered to 4 Hz. QEUD only above 1.0 m/s.
Reactor Vessel FE-1ST-1	Downcomer stalk 1, 1.2 m from RV bottom.	0.5-9.1 m/s	0-18.3 m/s	9 Hz	1,000 Hz 50 pps	--	Channel failed.
Reactor Vessel FE-2ST-1	Downcomer stalk 2, 1.2 m from RV bottom.	0.5-9.1 m/s	0-19.5 m/s	9 Hz	1,000 Hz 50 pps	--	Channel failed.
FLOW RATE							
Blowdown Suppression Tank Spray System FE-P138-138	Suppression tank spray flow rate in 3.79 l/s header.	0-6.3 l/s	0-6.3 l/s	7 Hz	50 pps	--	Restrained data. Not presented.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response			Measurement Comments
		Detector	Data Acquisition System	Detector	Data ^[a] System	Data Fig. No.	
Blowdown Suppression Tank Spray System FE-P138-139	Suppression tank spray flow rate from pump discharge.	0-25.2 l/s	0-25.2 l/s	7 Hz	50 pps	161	QEUD.
Blowdown Suppression Tank Spray System FE-P138-140	Suppression tank spray flow rate in the 13.9 l/s header.	0-18.9 l/s	0-18.9 l/s	7 Hz	50 pps	--	Restrained data. Not presented.
Blowdown Suppression Tank Spray System FE-P138-153	Suppression tank spray flow rate in the spray pump recirculation line.	0-9.5 l/s	0-9.5 l/s	7 Hz	50 pps	--	Restrained data. Valid to 85 s. Not presented.
Emergency core Cooling System FT-P120-36-1	Accumulator A in 6-in. line downstream of orifice.	0-1.5 m	0-126.2 l/s	5 Hz	50 pps	38 140	QEUD.
Emergency Core Cooling System FT-P120-36-5	Accumulator A in 6-in. line downstream of orifice.	0-15.2 m	0-37.9 l/s	5 Hz	50 pps	39 141 144	Restrained data. Overranged from $T_0 + \sim 28$ s to $T_0 + \sim 62$ s.
Emergency Core Cooling System FT-P120-85	LPIS pump A in 4-in. line between heat exchanger and orifice.	2.5-50.5 l/s	0-25.2 l/s	5 Hz	50 pps	40 142 144	QEUD.
Emergency Core Cooling System FT-P128-104	HPIS pump A discharge.	0.1-1.9 l/s	0-1.9 l/s	5 Hz	50 pps	41 144 143	QEUD.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response		Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data ^{a)} System		
Intact Loop FT-P139-27-1	Intact loop hot leg venturi flowmeter (right side facing SG).	63.0-630.0 kg/s	0-630.0 kg/s	5 Hz	1,000 Hz 50 pps	42	Restrained data. Good for initial conditions only; data not corrected for density changes after T_0 .
Intact Loop FT-P139-27-2	Intact loop hot leg venturi flowmeter (left side facing SG).	0-19.3 m H ₂ O	0-19.3 m H ₂ O	5 Hz	1,000 Hz 50 pps	--	Channel failed.
Intact Loop FT-P139-27-3	Intact loop hot leg venturi flowmeter (bottom).	63.0-630.0 kg/s	0-630.0 kg/s	5 Hz	50 pps	43	Restrained data. Good for initial conditions only; data not corrected for density changes after T_0 .
LIQUID LEVEL							
Reactor Vessel LE-1ST-1 and -2	Downcomer 1 with stings between 5.1 m and 0.21 m above RV bottom.	0-4.1 m	-1-+1 V	0.7 Hz	1,000 Hz	44	QEUD.
Reactor Vessel LE-2ST-1 and -2	Downcomer 2 with stings between 5.1 m and 0.21 m above RV bottom.	0-4.1 m	-1-+1 V	0.7 Hz	1,000 Hz	45	QEUD. LE-2ST-2-2 channel failed.
Emergency Core Cooling System LIT-P120-44	Accumulator A.	0-3 m	0-3 m	5 Hz	50 pps	46	QEUD.
Secondary Coolant System LT-P4-88	SG secondary level.	-3.6-+1.4 m H ₂ O	-3.6-+1.4 m H ₂ O	5 Hz	50 pps 1,000 Hz	49	QEUD. Data display instru- ment ringing from T_0 to ~ 5 s.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response			Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System	Data Fig. No.	
Blowdown Suppression Tank LT-P138-33	Blowdown suppression tank level on north end of tank.	0-3.3 m	0-3.4 m	5 Hz	1,000 Hz 50 fps	47 145 162	QEUD. Data display instrument saturation from T_0 to $\sim T_0 + 1.5$ s.
Blowdown Suppression Tank LT-P138-58	Blowdown suppression tank level on south end of tank.	0-3.4 m	0-3.4 m	5 Hz	1,000 Hz 50 fps	47 145 162	QEUD. Data display instrument saturation from T_0 to $\sim T_0 + 1.5$ s.
Intact Loop LT-P139-6	Pressurizer level on southeast side.	0-1.9 m	0-1.9 m	5 Hz	1,000 Hz 50 fps	48	QEUD from T_0 to $T_0 + 13$ s.
Intact Loop LT-P139-7	Pressurizer level on southwest side.	0-1.9 m	0-1.9 m	5 Hz	1,000 Hz 50 fps	48	QEUD from T_0 to $T_0 + 13$ s.
Intact Loop LT-P139-8	Pressurizer level on north side.	0-1.9 m	0-1.9 m	5 Hz	50 fps	48	QEUD from T_0 to $T_0 + 13$ s.
MOMENTUM FLUX, AVERAGED							
Broken Loop ME-BL-1A	Broken loop cold leg at DTT rake bottom.	2.98-74.4 mg/m-s ²	-684.5 ₂ +684.5 mg/m-s ²	35 Hz	1,000 Hz 50 fps	50	Trend data. Filtered to 4 Hz for 0 to 70 s plot. Unfiltered for 0 to 175 s plot. Data temperature sensitive after $\sim T_0 + 50$ s.
Broken Loop ME-BL-1B	Broken loop cold leg at DTT rake center.	2.98-74.4 mg/m-s ²	-684.5 ₂ +684.5 mg/m-s ²	35 Hz	1,000 Hz 50 fps	--	Channel failed.
Broken loop ME-BL-1C	Broken loop cold leg at DTT rake top.	2.98-74.4 mg/m-s ²	-684.5 ₂ +684.5 mg/m-s ²	35 Hz	1,000 Hz 50 fps	50	Trend data. Filtered to 4 Hz for 0 to 70 s plot. Unfiltered for 0 to 175 s plot. Data temperature sensitive after $\sim T_0 + 50$ s.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response		Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System		
Broken loop ME-BL-2	Broken loop hot leg at DTT flange.	3.0-7.4 mg/m-s ²	-625.0 ₂ +684.5 mg/m-s ²	35 Hz	1,000 Hz 50 pps	51	Trend data. Filtered to 4 Hz for 0 to 70 s plot; unfiltered for 0 to 190 s plot.
Reactor Vessel ME-CS-1	Core simulator stalk above orifice plates.	0.3-5.2 mg/m-s ²	-29.8 ₂ +29.8 mg/m-s ²	35 Hz	1,000 Hz 50 pps	52	Trend data. Filtered to 4 Hz.
Intact Loop ME-PC-1	Intact loop cold leg at DTT flange.	3.0-74.4 mg/m-s ²	-759.0 ₂ +759.0 mg/m-s ²	35 Hz	1,000 Hz 50 pps	53	QEJD. Data temperature sensitive after T ₀ + 22 s. Filtered to 4 Hz.
Intact Loop ME-PC-2	Intact loop hot leg at DTT flange.	0.3-5.2 mg/m-s ²	-41.7 ₂ +41.7 mg/m-s ²	35 Hz	1,000 Hz 50 pps	53	QEJD.
Intact Loop ME-PC-3	SG outlet at DTT flange.	3.0-7.4 mg/m-s ²	-654.8 ₂ +654.8 mg/m-s ²	35 Hz	1,000 Hz 50 pps	--	Channel failed.
Reactor Vessel ME-1ST-1	Downcomer 1, 1.16 m above RV bottom.	0.3-5.2 mg/m-s ²	-28.3 ₂ +28.3 mg/m-s ²	35 Hz	1,000 Hz 50 pps	54 146	QEUD. Filtered to 4 Hz; unfiltered for 0 to 190 s.
Reactor Vessel ME-2ST-1	Downcomer 2, 1.16 m above RV bottom.	0.3-5.2 mg/m-s ²	-28.3 ₂ +28.3 mg/m-s ²	35 Hz	1,000 Hz 50 pps	55 147	QEUD. Filtered to 4 Hz for 0 to 70 s; unfiltered for 0 to 190 s.
ELECTRICAL FREQUENCY							
Intact Loop PCP-1-F	Intact loop pump 1.	0-75 Hz	0-75 Hz	1,000 Hz	50 pps	--	QEUD. Not presented.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response			Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System			
ELECTRICAL CURRENT								
Intact Loop PCP-1-I	Intact loop pump 1.	0-1,000 amps	0-1,000 amps	---	500 pps	--	QEUD. Not presented.	
ELECTRICAL VOLTAGE								
Intact Loop PCP-1-V	Intact loop pump 1.	0-600 V	0-600 V	---	500 pps	--	QEUD. Not presented.	
ELECTRICAL FREQUENCY								
Intact Loop PCP-2-F	Intact loop pump 2.	0-75 Hz	0-75 Hz	1,000 Hz	50 pps	--	QEUD. Not presented.	
ELECTRICAL CURRENT								
Intact Loop PCP-2-I	Intact loop pump 2.	0-1,000 amps	0-1,000 amps	---	500 pps	--	QEUD. Not presented.	
ELECTRICAL POWER								
Intact Loop PCP-1-P	Intact loop pump 1.	0-1 MW	---	---	---	106	Trend data.	
Intact Loop PCP-2-P	Intact loop pump 2.	0-1 MW	---	---	---	106	Trend data.	

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response			Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System			
ELECTRICAL VOLTAGE								
Intact Loop PCP-2-V	Intact loop pump 2.	0-600 V	0-600 V	---	500 pps	--	QELD.	Not presented.
DIFFERENTIAL PRESSURE								
Broken Loop PdE-BL-1	Broken loop hot leg from flange in front of SG simulator to pipe in front of reflux assist bypass system tee.	0-0.3 MPa (differential)	-0.3-+0.3 MPa (differential)	60 Hz	500 pps	56	QELD.	Filtered to 4 Hz.
Broken Loop PdE-BL-2	Broken loop cold leg from flange in front of spool piece to pipe in front of reflux assist bypass system tee.	0-10.3 MPa (differential)	-10.3-+10.3 MPa (differential)	60 Hz	500 pps	57	QELD.	Filtered to 4 Hz.
Broken Loop PdE-BL-3	Broken loop cold leg across break plane.	0-10.3 MPa (differential)	-10.3-+10.3 MPa (differential)	1.2 Hz	50 pps	58	QELD.	
Broken Loop PdE-BL-4	Broken loop hot leg across break plane.	0-10.3 MPa (differential)	-10.3-+10.3 MPa (differential)	1.2 Hz	50 pps	58	QELD.	
Broken Loop PdE-BL-5	Broken loop hot leg across pump simulator.	0-10.3 MPa (differential)	-10.3-+10.3 MPa (differential)	1.2 Hz	1,000 Hz 50 pps	59	QELD.	
Broken Loop PdE-BL-6	Broken loop hot leg across SG simulator outlet flange.	0-0.3 MPa (differential)	-0.3-+0.3 MPa (differential)	3.5 Hz	50 pps	60	QELD.	

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response		Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System		
Broken Loop PdE-BL-7	Broken loop hot leg across SG simulator.	0-0.7 MPa (differential)	-0.3-+0.3 MPa (differential)	3.5 Hz	1,000 Hz 50 pps	61	QEUD.
Broken Loop PdE-BL-8	Broken loop hot leg across SG simulator inlet flange.	0-0.3 MPa (differential)	-0.3-+0.3 MPa (differential)	3.5 Hz	50 pps	62	QEUD. Filtered to 4 Hz.
Broken Loop PdE-BL-9	Broken loop across 14-to-5-in. contraction to middle of 5-in. pipe.	0-1.37 MPa (differential)	0-1.38 MPa (differential)	194 Hz	---	63	Trend data.
Broken Loop PdE-BL-10	Broken loop from middle of 5-in. pipe to break plane.	0-1.37 MPa (differential)	0-1.38 MPa (differential)	194 Hz	---	64	Trend data.
Reactor Vessel PdE-CS-1	RV between core simulator instrument stalk and down- comer 2, 0.62 m from RV bottom.	+ 0.3 MPa (differential)	+ 0.2 MPa (differential)	2.3 Hz	50 pps	65	Restrained data. Valid prior to T ₀ . Filtered to 4 Hz.
Intact Loop PdE-PC-1	Intact loop cold leg across primary coolant pumps.	0-0.7 MPa (differential)	-0.7-+0.7 MPa (differential)	0.7 Hz	1,000 Hz 50 pps	66	QEUD.
Intact Loop PdE-PC-2	Intact loop across SG.	0-0.7 MPa (differential)	-0.7-+0.7 MPa (differential)	3.5 Hz	50 pps	67	QEUD.
Intact Loop PdE-PC-3	Intact loop hot leg piping, RV to venturi.	+ 0.1 MPa (differential)	+ 0.1 MPa (differential)	2.3 Hz	50 pps	68	Trend data. Tap relocated prior to L1-4 at 90° from pressurizer surge line inlet and in plane of inlet. Differential pressures in- fluenced by velocity effects from pressurizer flow. Filtered to 4 Hz.
Intact Loop PdE-PC-4	Intact loop hot leg piping, venturi to SG.	+ 0.1 MPa (differential)	+ 0.1 MPa (differential)	2.3 Hz	50 pps	69	

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response		Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System		
Intact Loop PdE-PC-5	Intact loop cold leg primary coolant pumps to RV nozzle.	+ 0.1 MPa (differential)	+ 0.1 MPa (differential)	2.3 Hz	50 pps	70	QEUD. Filtered to 4 Hz.
Intact Loop PdE-PC-7	Intact loop cold leg RV inlet to broken loop cold leg RV inlet.	+ 0.1 MPa (differential)	+ 0.1 MPa (differential)	2.3 Hz	50 pps	71	QEUD. Filtered to 4 Hz.
Intact Loop PdE-PC-8	Intact loop across pressurizer surge line.	0-10.34 MPa (differential)	0-10.34 MPa (differential)	---	---	72	QEUD.
Intact Loop PdE-PC-9	Intact loop across pump 1.	0-0.689 MPa (differential)	0-0.689 MPa (differential)	---	---	73	QEUD.
Intact Loop PdE-PC-10	Intact loop across pump 2.	0-0.689 MPa (differential)	0-0.689 MPa (differential)	---	---	73	QEUD.
Reactor Vessel PdE-RV-1	Between downcomer stalk 1 and blowdown suppression tank.	0-10.3 MPa (differential)	-10.3-+10.3 MPa (differential)	1.2 Hz	50 pps	---	Channel failed.
Reactor Vessel PdE-RV-3	Intact loop cold leg inlet to bottom of downcomer.	+ 0.1 MPa (differential)	+ 0.1 MPa (differential)	2.3 Hz	50 pps	74	QEUD. Filtered to 4 Hz.
Reactor Vessel PdE-RV-4	Upper plenum to the RV outlet nozzle in the intact loop hot leg.	+ 0.1 MPa (differential)	+ 0.1 MPa (differential)	2.3 Hz	50 pps	75	Trend data. Uninterpreted data after T ₀ .
Blowdown Suppres- sion Tank PdE-SV-9	Suppression tank across the vacuum breaker line.	0-5.1 m H ₂ O	-2.5-+2.5 m H ₂ O	5 Hz	50 pps	76	Trend data. Good data - not qualified.
Reactor Vessel PdE-2ST-2	Downcomer 2 between 5.32 and 0.62 m above RV bottom.	0-0.2 MPa (differential)	-0.2-+0.2 MPa (differential)	60 Hz	50 pps	77	Trend data. Uninterpreted data after T ₀ . (Filtered to 4 Hz.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response		Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System		
Intact Loop PdT-P139-27-1	Primary coolant flow, Channel A.	0-0.199 MPa (differential)	0-0.199 MPa (differential)	---	---	--	Restrained data. Good for initial conditions only. Plot not presented.
Intact Loop PdT-P139-27-2	Primary coolant flow, Channel B.	0-0.189 MPa (differential)	0-0.189 MPa (differential)	---	---	--	Restrained data. Good for initial conditions only. Plot not presented.
Intact Loop PdT-P139-27-3	Primary coolant flow, Channel C.	0-0.195 MPa (differential)	---	---	---	--	Restrained data. Good for initial conditions only. Plot not presented.
Intact Loop PdT-P139-30	Across RV just beyond intact loop inlet and outlet nozzles.	0-0.3 MPa (differential)	0-0.3 MPa (differential)	5 Hz	50 pps	78	Restrained data. Valid for initial conditions only.
PRESSURE							
Broken Loop PE-BL-1	Broken loop cold leg at DTT flange.	0-20.7 MPa (gauge)	0-20.7 MPa (gauge)	>500 Hz	1,000 Hz 50 pps	18 79 81	QEUD.
Broken Loop PE-BL-2	Broken loop hot leg at DTT flange.	0-20.7 MPa (gauge)	0-20.7 MPa (gauge)	>500 Hz	1,000 Hz 50 pps	19 79 82	QEUD.
Broken Loop PE-BL-3	Broken loop hot leg downstream of pump simulator.	0-20.7 MPa (gauge)	0-20.7 MPa (gauge)	>500 Hz	1,000 Hz 50 pps	19 80 82	QEUD.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response		Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System		
Broken Loop PE-BL-4	Broken loop cold leg at inlet of spool piece.	0-20.7 MPa (gauge)	0-20.7 MPa (gauge)	>500 Hz	1,000 Hz 50 pps	80 81	Restrained data. Filtered at 500 Hz. QEUD below 500 Hz.
Broken Loop PE-BL-6	Broken loop hot leg at outlet of SG simulator.	0-20.7 MPa (gauge)	0-20.7 MPa (gauge)	>500 Hz	1,000 Hz 50 pps	19 82	QEUD.
Broken Loop PE-BL-8	Broken loop cold leg at center of spool piece.	0-20.7 MPa (gauge)	0-20.7 MPa (gauge)	>500 Hz	1,000 Hz 50 pps	18 81	QEUD.
Reactor Vessel PE-CS-1A	Core simulator stalk above orifice plate, wide range (20.7 MPa).	0-20.7 MPa (gauge)	0-20.7 MPa (gauge)	45 Hz	1,000 Hz 50 pps	83 88 90	QEUD.
Reactor Vessel PE-CS-1B	Core simulator stalk above orifice plate, narrow range (1.4 MPa).	0-1.4 MPa (gauge)	0-1.4 MPa (gauge)	45 Hz	1,000 Hz 50 pps	84 148	Restrained data. Pressure beyond instrument range until $T_0 + 31$ s.
Reactor Vessel PE-CS-1FF	Core simulator stalk above orifice plate.	0-20.7 MPa (gauge)	0-17.2 MPa (gauge)	4,100 Hz	1,000 Hz 50 pps	21	Restrained data. Instrument temperature sensitive after $\sim T_0 + 10$ s.
Reactor Vessel PE-CS-2FF	Core simulator stalk above orifice plate.	0-20.7 MPa (gauge)	0-17.2 MPa (gauge)	4,100 Hz	1,000 Hz 50 pps	21	Restrained data. Instrument temperature sensitive after $\sim T_0 + 10$ s.
Intact Loop PE-PC-1	Intact loop cold leg at DTT flange.	0-20.7 MPa (gauge)	0-20.7 MPa (gauge)	>500 Hz	1,000 Hz 50 pps	85 87	QEUD. Analog channel failed.
Intact Loop PE-PC-2	Intact loop hot leg at DTT flange.	0-20.7 MPa (gauge)	0-20.7 MPa (gauge)	>500 Hz	1,000 Hz 50 pps	20 85 87	QEUD.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response			Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System			
Intact Loop PE-PC-3A	SG outlet at DTT flange, wide range (0-20.7 MPa).	0-20.7 MPa (gauge)	0-20.7 MPa (gauge)	>500 Hz	1,000 Hz 50 pps	20 85	QEUD.	
Intact Loop PE-PC-3B	SG outlet at DTT flange, narrow range (0-1.4 MPa).	0-1.4 MPa (gauge)	0-1.4 MPa (gauge)	>500 Hz	50 pps	86 148	Restrained data. Pressure beyond instrument range until $T_0 + 31$ s.	
Intact Loop PE-PC-4	Intact loop pressurizer vapor space.	0-20.7 MPa (gauge)	0-20.7 MPa (gauge)	>500 Hz	1,000 Hz 50 pps	20 87	QEUD.	
Intact Loop PE-PC-5	Intact loop reference pressure.	0-20.68 MPa (gauge)	0-20.68 MPa (gauge)	---	---	--	QEUD.	Not presented.
Intact Loop PE-PC-6	Intact loop reference pressure.	0-20.68 MPa (gauge)	0-20.68 MPa (gauge)	---	---	--	QEUD.	Not presented.
Blowdown Suppres- sion System PE-SV-1	Blowdown suppression tank bottom under downcomer 4 (north end), 180° from top vertical (CW looking north).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	1,000 Hz 500 pps	23 91 163	QEUD. Filtered to 60 Hz. All BDST pressure instrument initial values are adjusted to 0.01 MPa. Use PT-P138-56 and -57 to obtain the initial pressure for all [PE-SV-].	
Blowdown Suppres- sion System PE-SV-2	Blowdown suppression tank across from downcomer 4 (north end), 112.5° from top vertical (CW looking north).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	92	QEUD.	
Blowdown Suppres- sion System PE-SV-3	Blowdown suppression tank across from downcomer 1 (south end), 157.5° from top vertical (CW looking north).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	1,000 Hz 500 pps	23	QEUD.	

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response		Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System		
Blowdown Suppres- sion System PE-SV-4	Blowdown suppression tank across from downcomer 1 (south end). 112.5° from top vertical (CW looking north).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	92	QEUD. All BDST pressure instru- ment initial values are adjusted to 0.01 MPa. Use PT-P138-56 and -57 to obtain the initial pres- sure for all [PE-SV-].
Blowdown Suppres- sion System PE-SV-10	Blowdown suppression tank A-end (north end), 10° from tank horizontal ζ (CW looking west) (vertex of angle at intersection of downcomer 4 ζ and tank hori- zontal ζ).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	93	QEUD.
Blowdown Suppres- sion System PE-SV-11	Blowdown suppression tank B-end (south end), 10° from tank horizontal ζ (CCW looking west) (vertex of angle at intersection of downcomer 1 ζ and tank ζ).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	--	Channel failed.
Blowdown Suppres- sion System PE-SV-12	Blowdown suppression tank A-end (north end), 45° from tank horizontal ζ (CW looking west) (vertex of angle at intersection of downcomer 4 ζ and tank hori- zontal ζ).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	93	QEJD.
Blowdown Suppres- sion System PE-SV-13	Blowdown suppression tank B-end (south end), 45° from tank horizontal ζ (CCW looking west) (vertex of angle at intersection of downcomer 1 ζ and tank hori- zontal ζ).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	94	QEJD.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response		Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System		
Blowdown Suppression System PE-SV-14	Blowdown suppression tank header above downcomer 4, 327° from top vertical (CW looking north).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	95	QEUD. All BDST pressure instrument initial values are adjusted to 0.01 MPa. Use PT-P138-56 and -57 to obtain the initial pressure for all [PE-SV-].
Blowdown Suppression System PE-SV-15	Blowdown suppression tank across from downcomer 4, 230° from top vertical (CW looking north).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	96	QEUD.
Blowdown Suppression System PE-SV-16	Blowdown suppression tank across from downcomer 1, 230° from top vertical (CW looking north).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	96	QEUD.
Blowdown Suppression System PE-SV-17	Blowdown suppression tank, 1.38 m north of downcomer 3 C, 327° from top vertical (CW looking north).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	--	QEUD. Not presented.
Blowdown Suppression System PE-SV-18	Blowdown suppression tank header above downcomer 1.	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	24 95 164	QEUD.
Blowdown Suppression System PE-SV-22	Blowdown suppression tank bottom, 1.38 m north of downcomer 3 C.	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	1,000 Hz 500 pps	24 91 163	QEUD.
Blowdown Suppression System PE-SV-23	Blowdown suppression tank, 1.38 m north of downcomer 3 C, 112.5° from top vertical (CW looking north).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	92	QEUD.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response		Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System		
Blowdown Suppres- sion System PE-SV-24	Blowdown suppression tank bottom, 3.47 m north of downcomer 3 C.	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	93	QEUD. All BDST pressure instru- ment initial values are adjusted to 0.01 MPa. Use PT-P138-56 and -57 to obtain the initial pres- sure for all [PE-SV-].
Blowdown Suppres- sion System PE-SV-25	Blowdown suppression tank, 3.47 m north of downcomer 3 C, 112.5° from top vertical (Cw looking north).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	--	QEUD. Not presented.
Blowdown Suppres- sion System PE-SV-26	Blowdown suppression tank bottom, 1.38 m south of downcomer 2 C.	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	1,000 Hz 500 pps	25 91 163	QEUD.
Blowdown Suppres- sion System PE-SV-27	Blowdown suppression tank bottom, 3.47 m south of downcomer 2 C.	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	1,000 Hz 500 pps	--	Channel failed.
Blowdown Suppres- sion System PE-SV-28	Blowdown suppression tank, 1.38 m south of downcomer 2 C, 112.5° from top vertical (Cw looking north).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	--	QEUD. Not presented.
Blowdown Suppres- sion System PE-SV-29	Blowdown suppression tank, 3.47 m south of downcomer 2 C, 112.5° from top vertical (Cw looking north).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	--	QEUD. Not presented.
Blowdown Suppres- sion System PE-SV-43	Blowdown suppression tank bottom under downcomer 2.	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	1,000 Hz 500 pps	25 91	QEUD.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response		Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data ^[a] System		
Blowdown Suppres- sion System PE-SV-44	Blowdown suppression tank bottom under downcomer 3.	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	1,000 Hz 500 pps	25 91	QEUD. All BDST pressure instru- ment initial values are adjusted to 0.01 MPa. Use PT-P138-56 and -57 to obtain the initial pres- sure for all [PE-SV-].
Blowdown Suppres- sion System PE-SV-54	Blowdown vacuum relief system rupture disc standpipe.	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	--	QEUD. Nct presented.
Blowdown Suppres- sion System PE-SV-55	Blowdown suppression tank top, 0.15 m north of downcomer 4 C.	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	--	Channel failed.
Blowdown Suppres- sion System PE-SV-57	Blowdown suppression tank across from downcomer 4, 45° from top vertical (CW looking north).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	--	QEUD. Not presented.
Blowdown Suppres- sion System PE-SV-58	Blowdown suppression tank across from downcomer 4, 67.5° from top vertical (CW looking north).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	97	QEUD.
Blowdown Suppres- sion System PE-SV-59	Blowdown suppression tank, 1.61 m north of downcomer 3, 45° from top vertical (CW looking north).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	--	Not presented. <i>Channel failed</i>
Blowdown Suppres- sion System PE-SV-60	Blowdown suppression tank top above downcomer 1.	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	--	Channel failed.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response			Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System			
Blowdown Suppression System PE-SV-61	Blowdown suppression tank across from downcomer 1 67.5° from top vertical (CW looking north).	0-0.7 MPa (gauge)	0-0.7 MPa (gauge)	500 Hz	500 pps	97		QEUD. All BDST pressure instrument initial values are adjusted to 0.01 MPa. Use PT-P138-56 and -57 to obtain the initial pressure for all [PE-SV-].
Blowdown Suppression System PE-SV-70	Bellows between broken loop and blowdown suppression tank header.	0-3.4 MPa (gauge)	0-3.4 MPa (gauge)	30 Hz	500 pps	26 165		QEUD.
Blowdown Suppression System PE-SV-75	Blowdown suppression tank header.	0-3.4 MPa (gauge)	0-3.4 MPa (gauge)	---	---	26 166		QEUC.
Reactor Vessel PE-1ST-1A	Downcomer stalk 1, 0.62 m above RV bottom, wide range (0-20.7 MPa).	0-20.7 MPa (gauge)	0-20.7 MPa (gauge)	30 Hz	1,000 Hz 50 pps	88 100		QEUC.
Reactor Vessel PE-1ST-1B	Downcomer stalk 1, 0.62 m above RV bottom, narrow range (0-1.4 MPa).	0-1.4 MPa (gauge)	0-1.4 MPa (gauge)	30 Hz	50 pps	89		Restrained data. Pressure beyond instrument range until $\sim T_0 + 31$ s.
Reactor Vessel PE-1ST-1FF	Downcomer stalk 1, 0.55 m above RV bottom.	0-20.7 MPa (gauge)	0-17.2 MPa (gauge)	4,100 Hz	1,000 Hz 50 pps	22		Restrained data. Instrument temperature sensitive after $\sim T_0 + 10$ s. Channel failed (and og).
Reactor Vessel PE-1ST-3A	Downcomer stalk 1, 5.32 m above RV bottom, wide range (0-20.7 MPa).	0-20.7 MPa (gauge)	0-20.7 MPa (gauge)	47 Hz	1,000 Hz 50 pps	88		QEUD.
Reactor Vessel PE-1ST-3B	Downcomer stalk 1, 5.32 m above RV bottom, narrow range (0-1.4 MPa).	0-1.4 MPa (gauge)	0-1.4 MPa (gauge)	47 Hz	50 pps	89		Restrained data. Pressure beyond instrument range until $\sim T_0 + 30$ s.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response		Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data ^[a] System		
Reactor Vessel PE-1ST-3FF	Downcomer stalk 1, 5.39 m above RV bottom.	0-20.7 MPa (gauge)	0-17.2 MPa (gauge)	4,100 Hz	1,000 Hz 50 pps	22	Restrained data. Instrument temperature sensitive after $\sim T_0 + 10$ s.
Reactor Vessel PE-2ST-1A	Downcomer stalk 2, 0.62 m above RV bottom, wide range (0-20.7 MPa).	0-20.7 MPa (gauge)	0-20.7 MPa (gauge)	30 Hz	1,000 Hz 50 pps	90	QEUD.
Reactor Vessel PE-2ST-1B	Downcomer stalk 2, 0.62 m above RV bottom, narrow range (0-1.4 MPa).	0-1.4 MPa (gauge)	0-1.4 MPa (gauge)	30 Hz	50 pps	--	Restrained data. Pressure beyond instrument range until $\sim T_0 + 30$ s.
Reactor Vessel PE-2ST-1FF	Downcomer stalk 2, 0.55 m above RV bottom.	0-20.7 MPa (gauge)	0-17.2 MPa (gauge)	4,100 Hz	1,000 Hz 50 pps	22	Restrained data. Instrument temperature sensitive after $\sim T_0 + 10$ s.
Reactor Vessel PE-2ST-3FF	Downcomer stalk 2, 5.39 m above RV bottom.	0-20.7 MPa (gauge)	0-17.2 MPa (gauge)	4,100 Hz	1,000 Hz 50 pps	22	Restrained data. Instrument temperature sensitive after $\sim T_0 + 10$ s.
Emergency Core Cooling System PT-P120-43	Accumulator A, 0.69 m above water outlet.	0-6.9 MPa (gauge)	0-6.9 MPa (gauge)	5 Hz	50 pps	98 100	QEUD.
Emergency Core Cooling System PT-P120-61	Emergency core cooling injection into cold leg.	0-20.7 MPa (gauge)	0-20.7 MPa (gauge)	5 Hz	50 pps	99 100 149	QEUD.
Emergency Core Cooling System PT-P120-83	LPIS pump A discharge line.	0-6.9 MPa (gauge)	0-6.9 MPa (gauge)	5 Hz	50 pps	101 150	QEUD.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response			Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System	Data Fig. No.	
Blowdown Suppression System PT-P138-23	Blowdown header, 0.89 m south of downcomer 1, 5° from bottom vertical (CCW looking south).	0-1.4 MPa (gauge)	0-1.4 MPa (gauge)	5 Hz	50 pps	--	QEUD. Not presented.
Blowdown Suppression System PT-138-55	Blowdown suppression tank top, 1.22 m north of downcomer 1.	0-0.69 MPa (gauge)	0-0.69 MPa (gauge)	5 Hz	1,000 Hz 50 pps	182 167	QEUC. Short-term analog not reviewed.
Blowdown Suppression System PT-P138-56	Blowdown suppression tank top, 1.24 m north of downcomer 2.	0-0.69 MPa (gauge)	0-0.69 MPa (gauge)	5 Hz	1,000 Hz 50 pps	182 167	QEUC. Short-term analog not reviewed.
Blowdown Suppression System PT-P138-57	Blowdown suppression tank vapor space, Channel C.	0-0.69 MPa (gauge)	---	---	---	167	QEUD.
Broken Loop PT-P138-111	Broken loop cold leg QOBV inlet between isolation valve and QOBV.	0-13.8 MPa (gauge)	-13.8-+13.8 MPa (gauge)	5 Hz	1,000 Hz 500 pps	17	QEUD analog data only.
Broken Loop PT-P138-112	Broken loop hot leg QOBV inlet between isolation valve and QOBV.	0-13.8 MPa (gauge)	-13.8-+13.8 MPa (gauge)	5 Hz	1,000 Hz 500 pps	--	Channel failed.
Blowdown Suppression Tank Spray System PT-P138-136	Spray pump BS-P-83 discharge pressure.	0-3.4 MPa (gauge)	0-3.4 MPa (gauge)	5 Hz	50 pps	151 168	QEUD.
Blowdown Suppression Tank Spray System PT-P138-151	Spray system cool down heat exchanger outlet pressure.	0-3.4 MPa (gauge)	0-3.4 MPa (gauge)	5 Hz	50 pps	151 168	QEUD.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response			Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System	Data Fig. No.	
Intact Loop PT-P139-2	Intact loop hot leg at venturi on bottom.	0-20.7 MPa (gauge)	0-20.7 MPa (gauge)	5 Hz	1,000 Hz 50 pps	103	QEUD.
Intact Loop PT-P139-3	Intact loop hot leg at venturi on left side when looking toward SG.	0-20.7 MPa (gauge)	0-20.7 MPa (gauge)	5 Hz	1,000 Hz 50 pps	103	QEUD.
Intact Loop PT-P139-4	Intact loop hot leg at venturi on right side when looking toward SG.	0-20.7 MPa (gauge)	0-20.7 MPa (gauge)	5 Hz	1,000 Hz 50 pps	103	QEUD.
PUMP SPEED							
Intact Loop RPE-PC-1	Intact loop pump 1 speed.	0-4,500 rpm	0-10,000 rpm	3.5 Hz	50 pps	104 105	QEUD.
Intact Loop RPE-PC-2	Intact loop pump 2 speed.	0-4,500 rpm	0-10,000 rpm	3.5 Hz	50 pps	104 105	Restrained data. Unexplainable spikes.
TEMPERATURE							
Broken Loop TE-BL-1A	Broken loop cold leg at DTT rake bottom.	0-1,260°C	0-315.6°C	1.8 Hz	50 pps	107 108 152	QEUD.
Broken Loop TE-BL-1B	Broken loop cold leg at DTT rake center.	0-1,260°C	0-315.6°C	1.8 Hz	50 pps	107 108 152	QEUD.
Broken Loop TE-BL-1C	Broken loop cold leg at DTT rake top.	0-1,260°C	0-315.6°C	1.8 Hz	50 pps	107 108 152	QEUD.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response		Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System		
Broken Loop TE-BL-2	Broken loop hot leg at DTT flange.	0-1,260°C	0-315.6°C	1.8 Hz	50 pps	107 152	Restrained data. Data display hot wall effects after $\sim T_0$ + 40 s.
Broken Loop TE-BL-3	Reflood assist bypass system near CV-P138-71.	0-1,260°C	0-315.6°C	1.8 Hz	50 pps	107	Restrained data.
Broken Loop TE-CL-1	Broken loop cold leg warm-up line.	0-1,260°C	0-315.6°C	1.8 Hz	50 pps	---	Instrument not connected for test.
Reactor Vessel TE-CS-1	Core simulator in instrument stalk above orifice plate.	0-1,260°C	0-315.6°C	1.8 Hz	50 pps	109 153	QEUD.
Broken Loop TE-HL-2	Broken loop hot leg warm-up line.	0-1,260°C	0-315.6°C	1.8 Hz	50 pps	---	Instrument not connected for test.
Intact Loop TE-PC-1	Intact loop cold leg at DTT flange.	0-1,260°C	0-704.4°C	1.8 Hz	1,000 Hz 50 pps	110 154	Restrained data. Displays hot wall effects after $\sim T_0$ + 70 s.
Intact Loop TE-PC-2	Intact loop hot leg at DTT flange.	0-1,260°C	0-704.4°C	1.8 Hz	50 pps	110 154	Restrained data. Data display hot wall effects after $\sim T_0$ + 60 s.
Intact Loop TE-PC-3	Intact loop at SG outlet DTT flange.	0-1,260°C	0-704.4°C	1.8 Hz	50 pps	110 154	Restrained data. Display hot wall effects after $\sim T_0$ + 45 s.
Emergency Core Cooling System TE-P120-41	Accumulator A temperature.	-17.8-+93.3°C	-17.8-+93.3°C	7 Hz	50 pps	111	Trend data.
Blowdown Suppres- sion System TE-P138-22	Blowdown suppression tank bottom, 0.61 m north of downcomer 1.	10.0-148.9°C	10.0-148.9°C	7 Hz	50 pps	112	Trend data. Thermocouple located in a stagnant fluid zone.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response		Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System		
Blowdown Suppres- sion System TE-P138-34	Blowdown suppression tank top, 1.30 m south of downcomer 4.	10.0-204.4°C	10.0-204.4°C	1.8 Hz	50 pps	112	QEUD.
Broken Loop TE-P138-62	Broken loop cold leg QOBV inlet.	0-760.0°C	10.0-343.3°C	1.8 Hz	50 pps	113	Trend data.
Broken Loop TE-P138-63	Broken loop cold leg isolation valve inlet.	10.0-343.3°C	10.0-343.3°C	0.06 Hz	50 pps	113	Trend data.
Broken Loop TE-P138-65	Broken loop hot leg isolation valve inlet.	10.0-343.3°C	10.0-343.3°C	0.06 Hz	50 pps	114	Trend data.
Broken Loop TE-P138-66	Broken loop hot leg QOBV inlet.	0-760.0°C	10.0-343.3°C	1.8 Hz	50 pps	114	Trend data.
Blowdown Suppres- sion Tank Spray System TE-P138-141	Temperature of spray in the 3.79 l/s header.	-17.8-204.4°C	-17.8-204.4°C	7 Hz	50 pps	156 170	Trend data.
Blowdown Suppres- sion Tank Spray System TE-P138-142	Temperature of spray at spray pump BS-P-83 discharge.	-17.8-204.4°C	-17.8-204.4°C	7 Hz	50 pps	155 169	Trend data.
Blowdown Suppres- sion Tank Spray System TE-P138-143	Temperature of spray in the 13.88 l/s header.	-17.8-204.4°C	-17.8-204.4°C	7 Hz	50 pps	156 170	Trend data.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response		Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System		
Intact Loop TE-P139-19	Pressurizer vapor temperature, 0.86 m above the heater rods.	315.6 - 371.1°C	315.6 - 371.1°C	7 Hz	50 pps.	115	Restrained data. Temperature below instrument range after 23 s.
Intact Loop TE-P139-20	Pressurizer liquid temperature, 0.36 m above heater rods.	10.0-371.1°C	10.0-371.1°C	7 Hz	50 pps.	115	Restrained data. Valid to 70 s.
Intact Loop TE-P139-29	Intact loop cold leg just upstream of DTT flange.	10.0-343.3°C	10.0-343.3°C	0.06 Hz	50 pps.	116	Restrained data. Good for initial conditions only.
Intact Loop TE-P139-32	Intact loop hot leg in elbow near venturi.	10.0-343.3°C	10.0-343.3°C	0.06 Hz	1,000 Hz 50 pps.	136	QEUB for initial conditions only.
Intact Loop TE-P139-33	Intact loop hot leg in elbow near venturi.	10.0-343.3°C	10.0-343.3°C	0.06 Hz	1,000 Hz 50 pps.	136	QEUB for initial conditions only.
Intact Loop TE-SG-1	Intact loop cold leg SG outlet.	0-1,260°C	-17.8-+704.4°C	0.35 Hz	50 pps.	117	Restrained data. Good for initial conditions only.
Intact Loop TE-SG-2	Intact loop hot leg SG inlet.	0-1,260°C	-17.8-+704.4°C	0.35 Hz	50 pps.	117	Restrained data. Good for initial conditions only.
Secondary Coolant System TE-SG-3	SG secondary side.	-201.1 - +610.0°C	-17.8 - +315.6°C	0.07 Hz	50 pps.	117	Restrained data. Good for initial conditions only.
Blowdown Suppres- sion System TE-SV-1	Blowdown suppression tank, 0.3 m north of downcomer 1, 0.53 m east of tank C, 2.72 m from tank bottom.	-101.1 - +371.1°C	-17.8 - +204.4°C	1.8 Hz	1,000 Hz 50 pps.	118 122 157 171	QEUB while instrument immersed. Designed to measure liquid temperature.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response		Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System		
Blowdown Suppres- sion System TE-SV-2	Blowdown suppression tank, 0.3 m north of downcomer 1, 0.53 m east of tank ζ , 2.36 m from tank bottom.	-101.1 - +371.1°C	-17.8 - +204.4°C	1.8 Hz	1,000 Hz 50 pps	118 123 157 171	QEUD while instrument immersed. Designed to measure liquid temperature.
Blowdown Suppres- sion System TE-SV-3	Blowdown suppression tank, 0.3 m north of downcomer 1, 0.53 m east of tank ζ , 1.9 m from tank bottom.	-101.1 - +371.1°C	-17.8 - +204.4°C	1.8 Hz	1,000 Hz 50 pps	118 124 157 171	QEUD while instrument immersed. Designed to measure liquid temperature.
Blowdown Suppres- sion System TE-SV-4	Blowdown suppression tank, 0.3 m north of downcomer 1, 0.53 m east of tank ζ , 1.45 m from tank bottom.	-101.1 - +371.1°C	-17.8 - +204.4°C	1.8 Hz	1,000 Hz 50 pps	--	Channel failed.
Blowdown Suppres- sion System TE-SV-5	Blowdown suppression tank, 0.3 m north of downcomer 1, 0.53 m east of tank ζ , 0.99 m from tank bottom.	-101.1 - +371.1°C	-17.8 - +204.4°C	1.8 Hz	1,000 Hz 50 pps	119 125 158 172	QEUD.
Blowdown Suppres- sion System TE-SV-6	Blowdown suppression tank, 0.3 m north of downcomer 1, 0.53 m east of tank ζ , 0.37 m from tank bottom.	-101.1 - +371.1°C	-17.8 - +204.4°C	1.8 Hz	1,000 Hz 50 pps	119 126 158 172	QEUD.
Blowdown Suppres- sion System TE-SV-7	Blowdown suppression tank, 0.3 m north of downcomer 3, 0.53 m east of tank ζ , 2.72 m from tank bottom.	-101.1 - +371.1°C	-17.8 - +204.4°C	1.8 Hz	50 pps	120 122 159 173	QEUD while instrument immersed. Designed to measure liquid temperature.
Blowdown Suppres- sion System TE-SV-8	Blowdown suppression tank, 0.3 m north of downcomer 3, 0.53 m east of tank ζ , 2.36 m from tank bottom.	-101.1 - +371.1°C	-17.8 - +204.4°C	1.8 Hz	50 pps	120 123 159	QEUD while instrument immersed. Designed to measure liquid temperature.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response		Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System		
Blowdown Suppres- sion System TE-SV-9	Blowdown suppression tank, 0.3 m north of downcomer 3, 0.53 m east of tank C, 1.9 m from tank bottom.	-101.1 - +371.1°C	-17.8 - +204.4°C	1.8 Hz	1,000 Hz 50 pps	120 124 159 173	QEUD while instrument immersed. Designed to measure liquid temperature.
Blowdown Suppres- sion System TE-SV-10	Blowdown suppression tank, 0.3 m north of downcomer 3, 0.53 m east of tank C, 1.45 m from tank bottom.	-101.1 - +371.1°C	-17.8 - +204.4°C	1.8 Hz	1,000 Hz 50 pps	121 127 160 174	QEUD while instrument immersed. Designed to measure liquid temperature.
Blowdown Suppres- sion System TE-SV-11	Blowdown suppression tank, 0.3 m north of downcomer 3, 0.53 m east of tank C, 0.99 m from tank bottom.	-101.1 - +371.1°C	-17.8 - +204.4°C	1.8 Hz	50 pps	121 125 160 174	QEUD.
Blowdown Suppres- sion System TE-SV-12	Blowdown suppression tank, 0.3 m north of downcomer 3, 0.53 m east of tank C, 0.37 m from tank bottom.	-101.1 - +371.1°C	-17.8 - +204.4°C	1.8 Hz	50 pps	121 126 160 174	QEUD.
Reactor Vessel TE-1ST-1	Downcomer 1, 4.8 m from RV bottom	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	128	Restrained data. Reading tem- perature radiated from metal after 75 s.
Reactor Vessel TE-1ST-2	Downcomer 1, 4.2 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	128 133	Restrained data. Reading tem- perature radiated from metal after 75 s.
Reactor Vessel TE-1ST-3	Downcomer 1, 3.59 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	128	Restrained data. Reading tem- perature radiated from metal after 75 s.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response		Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data ^[a] System		
Reactor Vessel TE-1ST-4	Downcomer 1, 2.98 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	128	Restrained data. Reading temperature radiated from metal after 75 s.
Reactor Vessel TE-1ST-5	Downcomer 1, 2.37 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	--	Channel failed (digital).
Reactor Vessel TE-1ST-6	Downcomer 1, 1.76 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	129	Restrained data. Good to $T_0 + \sim 75$ s.
Reactor Vessel TE-1ST-7	Downcomer 1, 0.85 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	--	Channel failed (digital).
Reactor Vessel TE-1ST-8	Downcomer 1, 0.74 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	129	Restrained data. Good to $T_0 + \sim 75$ s.
Reactor Vessel TE-1ST-9	Downcomer 1, 0.64 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	129	Restrained data. Good to $T_0 + \sim 75$ s.
Reactor Vessel TE-1ST-10	Downcomer 1, 0.54 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	129	Restrained data. Good to $T_0 + \sim 75$ s.
Reactor Vessel TE-1ST-11	Downcomer 1, 0.44 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	130	Restrained data. Good to $T_0 + \sim 75$ s.
Reactor Vessel TE-1ST-12	Downcomer 1, 0.34 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	130	Restrained data. Good to $T_0 + \sim 75$ s.
Reactor Vessel TE-1ST-13	Downcomer 1, 0.24 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	130	Restrained data. Good to $T_0 + \sim 75$ s.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response			Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System	Data Fig. No.	
Reactor Vessel TE-1ST-14	Downcomer 1, 1.17 m from RV bottom (inside of DTT).	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	130 134	Restrained data. Good to $T_D + \sim 75$ s.
Reactor Vessel TE-2ST-1	Downcomer 2, 4.8 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	1,000 Hz 50 pps	--	Channel failed (digital).
Reactor Vessel TE-2ST-2	Downcomer 2, 4.20 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	131 133	Restrained data. Good to $T_D + \sim 75$ s.
Reactor Vessel TE-2ST-3	Downcomer 2, 3.59 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	1,000 Hz 50 pps	--	Channel failed (digital).
Reactor Vessel TE-2ST-4	Downcomer 2, 2.98 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	--	Channel failed (digital).
Reactor Vessel TE-2ST-5	Downcomer 2, 2.37 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	1,000 Hz 50 pps	--	Channel failed (digital).
Reactor Vessel TE-2ST-6	Downcomer 2, 1.76 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	--	Channel failed (digital).
Reactor Vessel TE-2ST-7	Downcomer 2, 0.85 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	1,000 Hz 50 pps	--	Channel failed (digital).
Reactor Vessel TE-2ST-8	Downcomer 2, 0.74 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	--	Channel failed (digital).
Reactor Vessel TE-2ST-9	Downcomer 2, 0.64 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	1,000 Hz 50 pps	--	Channel failed (digital).

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response			Data Fig. No.	Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System			
Reactor Vessel TE-2ST-10	Downcomer 2, 0.54 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	--		Channel failed (digital).
Reactor Vessel TE-2ST-11	Downcomer 2, 0.44 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	1,000 Hz 50 pps	--		Channel failed (digital).
Reactor Vessel TE-2ST-12	Downcomer 2, 0.34 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	--		Channel failed (digital).
Reactor Vessel TE-2ST-13	Downcomer 2, 0.24 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	--		Channel failed (digital).
Reactor Vessel TE-2ST-14	Downcomer 2, 1.17 m from RV bottom.	0-1,260°C	-17.8-+704.4°C	1.8 Hz	50 pps	132 134		QEUD.
Emergency Core Cooling System TT-P120-62	Cold leg injection in 4-in. line upstream of cold leg injection point.	10.0-343.3°C	10.0-343.3°C	0.07 Hz	50 pps	135		Restrained data. Good for initial conditions only.
Intact Loop TT-P139-32	Intact loop hot leg primary coolant, Channel A.	260-343°C	---	---	---	136		Restrained data.

TABLE VII (contd.)

PARAMETER System Detector	Location	Range		Frequency Response			Measurement Comments
		Detector	Data Acquisition System	Detector	Data [a] System	Data Fig. No.	
Intact Loop TT-P139-33	Intact loop hot leg primary coolant, Channel B.	260-343°C	---	---	---	135	Restrained data.

[a] pps = points per second sample rate of the digital system.

[b] Trend data - measurements appear to be reasonable but no comparable measurement for cross-checking was recorded.

[c] QEUD - qualified engineering units data where measurements have been compared to other measurements and found to be within the accuracy of the instrument.

[d] Restrained data - measurements from instruments that did not fail, but the data have some restrictions.

TABLE VIII

COMPUTED PARAMETERS FOR LOFT NONNUCLEAR TEST L1-4

PARAMETER Location Detectors	Units	Calculation Method	Fig. No.	Remarks
DENSITY, AVERAGE	Mg/m ³	Density, Average $\bar{\rho} = K_1\rho_A + K_2\rho_B + K_3\rho_C$		
Broken Loop Cold Leg				
DE-BL-1A (ρ_A)	Mg/m ³		29	The individual beam densities were filtered with a 4 Hz filter prior to being used in the averaging calculation.
DE-BL-1B (ρ_B)				
DE-BL-1C (ρ_C)				
Broken Loop Hot Leg		where:		
DE-BL-2A (ρ_A)	Mg/m ³	ρ_A, ρ_B, ρ_C = average density along gamma densitometer beam lines A, B, and C.	29	
DE-BL-2B (ρ_B)				
DE-BL-2C (ρ_C)				
Intact Loop Cold Leg		For stratified flow,		
DE-PC-1A (ρ_A)	Mg/m ³	$\bar{\rho} = 0.437\rho_A + 0.417\rho_B + 0.146\rho_C$	33	
DE-PC-1B (ρ_B)				
DE-PC-1C (ρ_C)				
Intact Loop Hot Leg		For other flow regimes,		
DE-PC-2A (ρ_A)	Mg/m ³	$\bar{\rho} = 0.345\rho_A + 0.401\rho_B + 0.254\rho_C$	33	
DE-PC-2B (ρ_B)				
DE-PC-2C (ρ_C)				
Intact Loop Steam Generator Outlet			33	
DE-PC-3A (ρ_A)	Mg/m ³			
DE-PC-3B (ρ_B)				
DE-PC-3C (ρ_C)				

TABLE VIII (contd.)

PARAMETER Location Detectors	Units	Calculation Method	Fig. No.	Remarks
FLOW REGIME AND DENSITY	Mg/m ³	Homogeneous flow regimes are indicated by (H) when		Rapid fluctuation back and forth between flow regimes usually indicated slug flow. The logic table and mathematical model for this regime have not yet been developed.
Broken Loop Cold Leg			175	
DE-BL-1A (ρ_A)	Mg/m ³	$\rho_A = \rho_B = \rho_C$		
DE-BL-1B (ρ_B)		Annular flow regimes are indicated by (A) when		
DE-BL-1C (ρ_C)		$\rho_C > \rho_B$		
Broken Loop Hot Leg			176	
DE-BL-2A (ρ_A)	Mg/m ³	Stratified flow regimes are indicated by (S) when		
DE-BL-2B (ρ_B)		$\rho_A > \rho_C$		
DE-BL-2C (ρ_C)				
Intact Loop Cold Leg			177	
DE-PC-1A (ρ_A)	Mg/m ³	Inverted annular flow regimes are indicated by (I) when		
DE-PC-1B (ρ_B)		$\rho_A < \rho_B$		
DE-PC-1C (ρ_C)				
Intact Loop Hot Leg			178	Intact loop hot leg should be stratified after ~18 s.
DE-PC-2A (ρ_A)	Mg/m ³	Unmodeled flow regimes are indicated by default (D) when none of the above conditions are satisfied.		
DE-PC-2B (ρ_B)				
DE-PC-2C (ρ_C)				
ENTHALPY				
	kJ/kg	Enthalpy = $H = h_f + x_{\text{flow}} h_g$		Data before T_D is invalid due to the saturated fluid assumption.
Broken Loop Cold Leg			179	
PE-BL-1 (P: h_f , h_{fg})	MPa: kJ/kg		184	

TABLE VIII (contd.)

PARAMETER Location Detectors	Units	Calculation Method	Fig. No.	Remarks
ENTHALPY (contd.)	kJ/kg	where:		Data before T_0 is invalid due to saturated fluid assumption.
Broken Loop Hot Leg PE-BL-2 (P: h_f , h_{fg})	MPa:kJ/kg	h_f = saturated fluid enthalpy from ASME steam tables using the pressure at the measurement location	180 184	
Intact Loop Cold Leg PE-PC-1 (P: h_f , h_{fg})	MPa:kJ/kg		181	
Intact Loop Hot Leg PE-PC-2 (P: h_f , h_{fg})	MPa:kJ/kg	h_{fg} = latent heat of vapor- ization from the ASME steam tables using the pressure at the measurement location	182	
Intact Loop, Steam Generator Outlet PE-PC-3A (P: h_f , h_{fg})	MPa:kJ/kg		183	
		x_{flow} = flow quality (see "QUALITY, FLOW" entry in this table).		
MASS FLOW RATE/SYSTEM VOLUME	kg/(m ³ -s)	Mass flow rate/vol _{sys} Type A =		The output from the drag discs, the turbine flow- meters, and the gamma den- sitometers were filtered to 4 Hz prior to performing calculations. The measured point values for the fluid velocity and momentum flux from the turbine flowmeters and the drag discs, respec- tively, were converted to average values prior to per- forming the calculations.
Broken Loop Cold Leg Type A: FE-BL-1 (v) ME-BL-1 (ρv^2)	m/s kg/(m ³ -s)	$m_A = \frac{\rho v^2 A}{v \times vol_{sys}}$	---	
Type B: FE-BL-1 (v) PE-BL-1 (P: ρ_L)	m/s kg/(m ³ -s)	Mass flow rate/vol _{sys} Type B = $m_B = \frac{[(1 - \langle \alpha \rangle)/(1 - x)] \rho_L VA}{vol_{sys}}$	---	

TABLE VIII (contd.)

PARAMETER Location Detectors	Units	Calculation Method	Fig. No.	Remarks
MASS FLOW RATE/SYSTEM VOLUME (contd.)	kg/(m ³ -s)	Mass flow rate/vol _{sys} Type C =		Broken loop cold leg Type B mass flow rate/system volume not presented.
Type C: ME-BL-1 (ρv^2) DE-BL-1 (ρ)	Mg/(m-s ²) Mg/m ³	$m_C = \frac{[\bar{\rho}(\rho v^2)]^{1/2} A}{vol_{sys}}$	188 190	Broken cold leg Type C and Type D used a weighted beam equation because of the new DTT rake.
Type D: FE-BL-1 (v) DE-BL-1 ($\bar{\rho}$)	m/s Mg/m ³	Mass flow rate/vol _{sys} Type C for ME-BL-1 =	194 196	
Type E: PdE-BL-2 (ΔP) DE-BL-1 ($\bar{\rho}$)	MPa(differential) Mg/m ³	$m_C = a' \{ [(b' \rho_A + c' \rho_B + d' \rho_C)(\rho v^2)_A]^{1/2} +$ $[(e' \rho_A + f' \rho_B + g' \rho_C)(\rho v^2)_B]^{1/2} +$ $[(h' \rho_A + i' \rho_B + j' \rho_C)(\rho v^2)_C]^{1/2} \} / K'$	201 203	
Broken Loop Hot Leg Type A: FE-BL-2 (v) ME-BL-2 (ρv^2)	m/s Mg/(m-s ²)	where: a' = 0.31 b' = 0.65 c' = 0.35 d' = 0 e' = 0 f' = 0 g' = 0 h' = 0.068 i' = 0.189 j' = 0.743 k' = 273	---	Not presented.
Type B: FE-BL-2 (v) PE-BL-2 (P: ρ_L)	m/s MPa:Mg/m ³		---	Not presented.
Type C: ME-BL-2 (ρv^2) DE-BL-2 (ρ)	Mg/(m-s ²) Mg/m ³	ME-BL-1B failed	189 190	

TABLE VIII (contd.)

PARAMETER Location Detectors	Units	Calculation Method	Fig. No.	Remarks
MASS FLOW RATE/SYSTEM VOLUME (contd.)	kg/(m ³ -s)	Mass flow rate/vol _{sys} Type D =		
Type D:		$m_D = \frac{\bar{\rho} v A}{\text{vol}_{\text{sys}}}$		
FE-BL-2 (v)	m/s		195	
DE-BL-2 ($\bar{\rho}$)	Mg/m ³	Mass flow rate/vol _{sys} Type D for FE-BL-1=	196	
Type E:		$m_D = a[(b\rho_A + c\rho_B + d\rho_C)V_A +$	202	
PdE-BL-1 (ΔP)	MPa(differential)	$(e\rho_A + f\rho_B + g\rho_C)V_B$	203	
DE-BL-2 ($\bar{\rho}$)	Mg/m ³	$+(h\rho_A + i\rho_B + j\rho_C)V_C]/K$		
Intact Loop Cold Leg				
Type A:			185	
FE-PC-1 (v)	m/s	where:	187	
ME-PC-1 (ρv^2)	Mg/(m-s ²)	a = 0.2073		
		b = 0.65		
		c = 0.35		
Type B:		d = 0	---	
FE-PC-1 (v)	m/s	e = 0.49		
PE-PC-1 (P: ρ_ℓ)	MPa:Mg/m ³	f = 0.51		
Type C:		g = 0		
ME-PC-1 (ρv^2)	Mg/(m-s ²)	h = 0.068	191	
DE-PC-1 ($\bar{\rho}$)	Mg/m ³	i = 0.189	193	
		j = 0.743		
		k = 273		
Type D:			197	
FE-PC-1 (v)	m/s	Mass flow rate/vol _{sys} Type E=	200	
DE-PC-1 ($\bar{\rho}$)	Mg/m ³			
Intact Loop Hot Leg				
Type A:		$m_E = \frac{\bar{\rho} [(K\Delta P)/\bar{\rho}]^{1/2} A}{\text{vol}_{\text{sys}}}$		
FE-PC-2 (v)	m/s		186	
ME-PC-2 (ρv^2)	Mg/(m-s ²)		187	Small FE or ME values can cause large errors in M calculations.

TABLE VIII (contd.)

PARAMETER Location Detectors	Units	Calculation Method	Fig. No.	Remarks
MASS FLOW RATE/SYSTEM VOLUME (contd.)	kg/(m ³ -s)	where:		
		$\bar{\rho}$ = average fluid density at measurement location		
Type B:			---	
FE-PC-2 (v)	m/s	ρ_{ℓ} = saturated liquid density from ASME steam tables		
PE-PC-2 (P: ρ_{ℓ})	MPa:Mg/m ³			
Type C:		ρv^2 = momentum flux [ME...]	192	
ME-PC-2 (ρv^2)	Mg/(m-s ²)	$\langle \alpha \rangle$ = void fraction (see "VOID FRACTION" entry in this table)	193	
DE-PC-2 ($\bar{\rho}$)	Mg/m ³			
Type D:			198	
FE-PC-2 (v)	m/s	A = flow area for the measurement location	200	
DE-PC-2 ($\bar{\rho}$)	Mg/m ³			
Intact Loop, Steam Generator Outlet		$A_{\text{pipes}} = 0.0634 \text{ m}^2$ in the plane of the DTTs	---	Not presented; ME-PC-3 failed.
Type A:		K = conversion constant		
FE-PC-3 (v)	m/s			
ME-PC-3 (ρv^2)	Mg/(m-s ²)			
Type B:		v = velocity of fluid at measurement location [FE.....]		
FE-PC-3 (v)	m/s			
PE-PC-3A (P: ρ_{ℓ})	MPa:Mg/m ³			
Type C:		s = flow quality (see "QUALITY, FLOW" this table)	---	Not presented; ME-PC-3 failed.
ME-PC-3 (ρv^2)	Mg/(m-s ²)			
DE-PC-3 ($\bar{\rho}$)	Mg/m ³			
Type D:		$Vol_{\text{sys}} = 7.73 \text{ m}^3$	199	
FE-PC-3 (v)	m/s		200	
DE-PC-3 ($\bar{\rho}$)	Mg/m ³			

TABLE VIII (contd.)

PARAMETER Location Detectors	Units	Calculation Method	Fig. No.	Remarks
MASS FLOW RATE/SYSTEM VOLUME (contd.)	kg/(m ³ -s)			
Pressurizer PE-PC-4 (P: ρ_g) LT-P139-6 (m) ^g	MPa:Mg/m ³ m	Mass flow rate/vol _{sys} pres- surizer = $\dot{m} = -0.08978 \frac{dL}{dt}$ $- 11.677 \frac{d\rho_g}{dt}$	204	
PE-PC-4 (P: ρ_g) LT-P139-7 (m) ^g	MPa:Mg/m ³ m	$- 11.026 \frac{d\rho_L}{dt}$	204	
PE-PC-4 (P: ρ_g) LT-P139-8 (m)	MPa:Mg/m ³ m	where: ρ_g = density of saturated steam corresponding to the pressure from PE-PC-4 ρ_L = density of saturated liquid remaining in pressurizer corre- sponding to the pres- sure from PE-PC-4 L = level in pressurizer in metres.	204	
PUMP SPEED, ELECTRICAL	rpm			
Intact Loop, Primary Coolant Pump 1 PCP-1-F	Hz	Pump speed, electrical = $N_G = 60$ (PSMG frequency).	205	

TABLE VIII (contd.)

PARAMETER Location Detectors	Units	Calculation Method	Fig. No.	Remarks
PUMP SPEED, ELECTRICAL (contd.)	rpm			
Primary Coolant Pump 2 PCP-2-F	Hz		205	
PUMP MOTOR SLIP	None			
Intact Loop, Primary Coolant Pump 1 RPE-PC-1	None	Pump motor slip =	206	
Primary Coolant Pump 2 RPE-PC-2	None	$S_{\text{pump}} = \frac{N_G - (\text{RPE-PC-1, -2})}{N_G}$	206	
		where: N_G = pump speed, electrical (see "PUMP SPEED, ELECTRICAL" above).		
PUMP WATER HORSEPOWER	W	Pump water horsepower =		
Intact Loop, Primary Coolant Pumps 1 and 2 PdE-PC-1 (ΔP) FE-PC-3(V)	MPa m/s	$P_{\text{whp}} = 6.3425 \times 10^4 V \Delta P$	207	

TABLE VIII (contd.)

PARAMETER Location Detectors	Units	Calculation Method	Fig. No.	Remarks
PUMP EFFICIENCY	None	Primary coolant pump efficiency = $\eta = P_{whp} / P_{ehp_{tot}}$ where: $P_{whp} = \text{pump water horsepower}$ (see "PUMP WATER HORSEPOWER" in this table). $P_{ehp_{tot}} = PCP-1-P + PCP-2-P$		
Intact Loop, Primary Coolant Pumps 1 and 2			---	Not presented.
PRESSURE, CLOSURE	MPa(differential)	Pressure, closure = $P_1 - \sum_{i=2}^n P_i$ where: $P_1 \text{ and } P_i \text{ are the differential pressure readings for each calculation as assigned in Column 1.}$		
Broken Loop Cold Leg			---	Not presented; PdE-RV-1 failed.
PdE-RV-1 (P_1)	MPa			
PdE-BL-2 (P_2)	MPa			
PdE-BL-3 (P_3)	MPa			
Broken Loop Hot Leg			---	Not presented.
PdE-RV-1 (P_1)	MPa			
PdE-BL-1 (P_1)	MPa			
PdE-BL-4 (P_2)	MPa			
PdE-BL-5 (P_3)	MPa			
PdE-BL-6 (P_4)	MPa			
PdE-BL-7 (P_5)	MPa			
PdE-BL-8 (P_6)	MPa			

TABLE VIII (contd.)

PARAMETER Location Detectors	Units	Calculation Method	Fig. No.	Remarks
PRESSURE, CLOSURE (contd.)	MPa:(differential)			
Intact Loop			208	
PdE-PC-1 (P_1)	MPa			
PdE-PC-2 (P_2)	MPa			
PdE-PC-3 (P_3)	MPa			Trend data. Refer to Table VII.
PdE-PC-4 (P_4)	MPa			Trend data. Refer to Table VII.
PdE-PC-5 (P_5)	MPa			
PdT-P139-30 (P_6)	MPa			
QUALITY, STATIC	None	Quality static = $x_{static} = 1 - [(1-\langle\alpha\rangle)(\rho_l/\bar{\rho})]$		
Broken Loop Cold Leg PE-BL-1 ($P: \rho_l, \rho_g$)	MPa:Mg/m ³	where: $\langle\alpha\rangle$ = void fraction (see "VOID FRACTION" entry).	209	
Broken Loop Hot Leg PE-BL-2 ($P: \rho_l, \rho_g$)	MPa:Mg/m ³		210	
Intact Loop Cold Leg PE-PC-1 ($P: \rho_l, \rho_g$)	MPa:Mg/m ³	ρ_l = saturated liquid density from the ASME steam tables using the pressure at the measurement location	211	Static quality data are re- stricted between values of 0.0 and 1.0 in the computer program.
Intact Loop Hot Leg PE-PC-2 ($P: \rho_l, \rho_g$)	MPa:Mg/m ³	$\bar{\rho}$ = average density from gamma densitometer.	212	Static quality in the intact loop cold leg was calculated using DE-PC-1B since DE-PC-1A failed and average density could not be calculated.
Intact Loop, Steam Generator Outlet PE-PC-3A ($P: \rho_l, \rho_g$)	MPa:Mg/m ³		213	

TABLE VIII (contd.)

PARAMETER Location Detectors	Units	Calculation Method	Fig. No.	Remarks
QUALITY, FLOW (Lockhart and Martinelli Correlation)	None	Quality, flow = $x_{\text{flow}} = \left(\frac{1}{1 + N} \right)$		Flow quality data are restricted between values of 0.0 and 1.0 in the computer program.
Broken Loop Cold Leg PE-BL-1 (P: ρ_l, ρ_g) TE-BL-1 (T: μ_l, μ_g)	MPa:Mg/m ³ °C:kg/s-m	$N = (1/A)^{-1/P} [(1-\langle\alpha\rangle)/\langle\alpha\rangle]^{1/P}$	214 216	
Broken Loop Hot Leg PE-BL-2 (P: ρ_l, ρ_g) TE-BL-2 (T: μ_l, μ_g)	MPa:Mg/m ³ °C:kg/s-m	$(\rho_g/\rho_l)^{-Q/P} (\mu_l/\mu_g)^{-R/P}$	215 216	
Intact Loop Cold Leg PE-PC-1 (P: ρ_l, ρ_g) TE-PC-1 (T: μ_l, μ_g)	MPa:Mg/m ³ °C:kg/s-m	where: $\langle\alpha\rangle$ = void fraction (see "VOID FRACTION" entry)	217 220	
Intact Loop Hot Leg PE-PC-2 (P: ρ_l, ρ_g) TE-PC-2 (T: μ_l, μ_g)	MPa:Mg/m ³ °C:kg/s-m	ρ_l = saturated liquid density from the ASME steam tables using the pressure at the measurement location	218 220	
Intact Loop, Steam Generator Outlet PE-PC-3A (P: ρ_l, ρ_g) TE-PC-3 (T: μ_l, μ_g)	MPa:Mg/m ³ °C:kg/s-m	ρ_g = saturated vapor den- sity from the ASME steam tables using the temperature at the measurement location μ_l = saturated liquid vis- cosity from tempera- ture	219 220	

TABLE VIII (contd.)

PARAMETER Location Detectors	Units	Calculation Method	Fig. No.	Remarks
QUALITY, FLOW (Lockhart and Martinelli Correlation) (contd.)	None	μ_g = saturated vapor viscosity from temperature. Lockhart and Martinelli Coefficients [14]: A = 0.28 P = 0.64 Q = 0.36 R = 0.07		
94 TEMPERATURE, SATURATION	°C	Saturation temperatures are taken from ASME steam tables for measured pressures. Temperatures are measured by the detectors in parentheses.		Saturation temperature data are not valid prior to T.
Broken Loop Cold Leg PE-BL-1 (TE-BL-1)	MPa °C		221	TE-BL-1 displays hot wall effects after ~53 s.
Broken Loop Hot Leg PE-BL-2 (TE-BL-2)	MPa °C		222	TE-BL-2 displays hot wall effects after ~40 s.
Intact Loop Cold Leg PE-PC-1 (TE-PC-1)	MPa °C		223	TE-PC-1 displays hot wall effects after ~30 s.
Intact Loop Hot Leg PE-PC-2 (TE-PC-2)	MPa °C		224	
Intact Loop, Steam Generator Outlet PE-PC-3A (TE-PC-3)	MPa °C		225	TE-PC-3 displays hot wall effects after ~30 s.

TABLE VIII (contd.)

PARAMETER Location Detectors	Units	Calculation Method	Fig. No.	Remarks
TEMPERATURE, SATURATION (contd.)	°C			
Reactor Vessel, Core Simulator PE-CS-1A (TE-CS-1)	MPa °C		226	
Downcomer Instrument Stalk 1 PE-1ST-1A (TE-1ST-1A)	MPa °C		227	
Downcomer Instrument Stalk 2 PE-2ST-1A (TE-2ST-1A)	MPa °C		228	
VOID FRACTION	None	Void fraction = $\frac{\rho_L - \bar{\rho}}{\rho_L - \rho_g}$		
Broken Loop Cold Leg PE-BL-1 (P: ρ_L, ρ_g) DE-BL-1 ($\bar{\rho}$)	MPa Mg/m ³		229	Void fraction data are restricted between the values of 0.0 and 1.0 in the computer program.

TABLE VIII (contd.)

PARAMETER Location Detectors	Units	Calculation Method	Fig. No.	Remarks
VOID FRACTION (contd.)	None	where:		
Broken Loop Hot Leg PE-BL-2 (P: ρ_l, ρ_g) DE-BL-2 ($\bar{\rho}$)	MPa Mg/m ³	ρ_l = saturated liquid density from the ASME steam tables using the pressure at the measurement location	229	
Intact Loop Cold Leg PE-PC-1 (P: ρ_l, ρ_g) DE-PC-1 ($\bar{\rho}$)	MPa Mg/m ³	ρ_g = saturated vapor density from the ASME steam tables using the pressure at the measurement location	230	
Intact Loop Hot Leg PE-PC-2 (P: ρ_l, ρ_g) DE-PC-2 ($\bar{\rho}$)	MPa Mg/m ³	$\bar{\rho}$ = average density from gamma densitometer.	230	
Intact Loop, Steam Generator Outlet PE-PC-3A (P: ρ_l, ρ_g) DE-PC-3 ($\bar{\rho}$)	MPa Mg/m ³		230	
VOLUMETRIC FLOW RATE	l/s			
Emergency Core Cooling System				
FT-P120-36-1(f_1)	l/s	$f_T = \sum f_i$	231	
FT-P120-85(f_2)	l/s			
FT-P128-104(f_3)	l/s			

1. TEST L1-4 MEASURED PARAMETERS --
SHORT-TERM PLOTS (2 SECONDS OR LESS)

This section of presented data consists of Figures 16 through 26.

Fig. 16 Valve opening (%) for broken loop QOBV cold leg valve (CV-P138-1) and hot leg valve (CV-P138-15).

Fig. 17 Valve opening (%) for broken loop cold leg QOBV (CV-P138-1) and cold leg QOBV inlet pressure (PT-P138-111).

Fig. 18 Pressure in broken loop cold leg (PE-BL-1 and -8) (filtered to 250 Hz).

Fig. 19 Pressure in broken loop hot leg (PE-BL-2, -3, and -6) (filtered to 250 Hz).

Fig. 20 Pressure in intact loop hot leg, steam generator outlet, and pressurizer (PE-PC-2, -3A, and -4) (filtered to 250 Hz).

Fig. 21 Pressure in reactor vessel core simulator instrument stalk (PE-CS-1FF and -2FF) (filtered to 250 Hz).

Fig. 22 Pressure in reactor vessel downcomer instrument stalks 1 and 2 (PE-1ST-1FF and -3FF and PE-2ST-1FF and -3FF) (filtered to 250 Hz).

Fig. 23 Pressure in blowdown suppression tank bottom under downcomer 4, 180° (PE-SV-01) and under downcomer 1, 157.5° (PE-SV-03).

Fig. 24 Pressure in blowdown suppression tank header above downcomer 1 (PE-SV-18) and tank bottom, 1.38 m north of downcomer 3, 180° (PE-SV-22).

Fig. 25 Pressure in blowdown suppression tank bottom, 1.379 m south of downcomer 2, 180° (PE-SV-26); under downcomer 2, 180° (PE-SV-43); and under downcomer 3, 180° (PE-SV-44).

Fig. 26 Pressure in bellows between broken loop and blowdown suppression tank header (hot leg PE-SV-70 and cold leg PE-SV-75).

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2. TEST L1-4 MEASURED PARAMETERS --
MEDIUM-TERM PLOTS (-10 TO 70 SECONDS)

This section of presented data consists of Figures 27 through 136.

Fig. 27 Density in broken loop cold leg, chordal density (DE-BL-1A, -1B, and -1C).

Fig. 28 Density in broken loop hot leg, chordal density (DE-BL-2A, -2B, and -2C).

Fig. 29 Density in broken loop, average fluid densities (DE-BL-1 and -2).

Fig. 30 Density in intact loop cold leg, chordal density (DE-PC-1A, -1B, and -1C).

Fig. 31 Density in intact loop hot leg, chordal density (DE-PC-2A, -2B, and -2C).

Fig. 32 Density in intact loop at steam generator outlet, chordal density (DE-PC-3A, -3B, and -3C).

Fig. 33 Density in intact loop, average fluid densities (DE-PC-1, -2, and -3).

Fig. 34 Fluid velocity in broken loop cold leg at DTT flange (FE-BL-1A, -1B, and -1C) (filtered to 4 Hz).

Fig. 35 Fluid velocity in broken loop hot and cold legs at DTT flanges (FE-BL-1 and -2).

Fig. 36 Fluid velocity in reactor vessel core simulator instrument stalk (FE-CS-1).

Fig. 37 Fluid velocity in intact loop cold leg, hot leg, and steam generator outlet at DTT flanges (FE-PC-1, -2, and -3).

Fig. 38 Flow rate in ECCS accumulator A discharge, high range (FT-P120-36-1).

Fig. 39 Flow rate in ECCS accumulator A discharge, low range (FT-P120-36-5).

Fig. 40 Flow rate in ECCS LPIS pump A discharge (FT-P120-85).

Fig. 41 Flow rate in ECCS HPIS pump A discharge (FT-P128-104).

Fig. 42 Flow rate in intact loop hot leg venturi (FT-P139-27-1).

Fig. 43 Flow rate in intact loop hot leg venturi (FT-P139-27-3).

Fig. 44 Liquid level in reactor vessel downcomer instrument stalk 1, bubble plot (LE-1ST-1 and -2).

Fig. 45 Liquid level in reactor vessel downcomer instrument stalk 2, bubble plot (LE-2ST-1 and -2).

Fig. 46 Liquid level in ECCS accumulator A (LIT-P120-44).

Fig. 47 Liquid level in blowdown suppression tank (LT-P138-33 and -58).

Fig. 48 Liquid level in pressurizer (LT-P139-6, -7, and -8).

Fig. 49 Liquid level in steam generator secondary side (LT-P4-8B).

Fig. 50 Momentum flux in broken loop cold leg at DTT flange (ME-BL-1A and -1C) (filtered to 4 Hz).

Fig. 51 Momentum flux in broken loop cold and hot legs (ME-BL-1 and -2) (filtered to 4 Hz).

Fig. 52 Momentum flux in reactor vessel core simulator stalk (ME-CS-1) (filtered to 4 Hz).

Fig. 53 Momentum flux in intact loop cold leg and hot leg (ME-PC-1 and -2) (filtered to 4 Hz).

Fig. 54 Momentum flux in reactor vessel downcomer stalk 1, 1.13 m above reactor vessel bottom ME-1ST-1 (filtered to 4 Hz).

Fig. 55 Momentum flux in reactor vessel downcomer stalk 2, 1.13 m above reactor vessel bottom (ME-2ST-1) (filtered to 4 Hz).

Fig. 56 Differential pressure in broken loop hot leg across 14-to-5-in. contraction (PdE-BL-1).

Fig. 57 Differential pressure in broken loop cold leg across 14-to-5-in. contraction (PdE-BL-2).

Fig. 58 Differential pressure in broken loop across break planes (PdE-BL-3 and -4).

Fig. 59 Differential pressure in broken loop hot leg across pump simulator (PdE-BL-5).

Fig. 60 Differential pressure in broken loop hot leg across steam generator simulator outlet flange (PdE-BL-6).

Fig. 61 Differential pressure in broken loop hot leg across the steam generator simulator (PdE-BL-7).

Fig. 62 Differential pressure in broken loop hot leg across steam generator simulator inlet flange (PdE-BL-8) (filtered to 4 Hz).

Fig. 63 Differential pressure in broken loop from 14-to-5-in. contraction to first tap (0.127 m downstream) (PdE-BL-9).

Fig. 64 Differential pressure in broken loop from 14-to-5-in. contraction inlet to break plane (PdE-BL-10).

Fig. 65 Differential pressure in reactor vessel core simulator to downcomer instrument stalk 2, 0.62 m from reactor vessel bottom (PdE-CS-1).

Fig. 66 Differential pressure in intact loop cold leg across primary coolant pumps 1 and 2 (PdE-PC-1).

Fig. 67 Differential pressure in intact loop across the steam generator (PdE-PC-2).

Fig. 68 Differential pressure in intact loop hot leg piping from reactor vessel outlet to the flow venturi (PdE-PC-3) (filtered to 4 Hz).

Fig. 69 Differential pressure in intact loop hot leg piping from flow venturi to steam generator inlet (PdE-PC-4).

Fig. 70 Differential pressure in intact loop cold leg primary coolant pump discharge to reactor vessel inlet nozzle (PdE-PC-5) (filtered to 4 Hz).

Fig. 71 Differential pressure in intact loop cold leg reactor vessel inlet to broken loop cold leg reactor vessel inlet (PdE-PC-7) (filtered to 4 Hz).

Fig. 72 Differential pressure in intact loop across surge line (PdE-PC-8).

Fig. 73 Differential pressure in intact loop across primary coolant pumps 1 and 2 (PdE-PC-9 and -10).

Fig. 74 Differential pressure in reactor vessel intact loop cold leg inlet to downcomer stalk 2 (PdE-RV-3) (filtered to 4 Hz).

Fig. 75 Differential pressure in reactor vessel upper plenum to intact loop hot leg reactor vessel outlet nozzle (PdE-RV-4).

Fig. 76: Differential-pressure in blowdown suppression tank across vacuum breaker line (PdE-SV-9):

Fig. 77 Differential pressure in reactor vessel downcomer stalk 2, between 5.32 and 0.62 m above reactor vessel bottom (PdE-2ST-2) (filtered to 4 Hz).

Fig. 78 Differential pressure in intact loop across reactor vessel inlet and outlet nozzles (PdT-P139-30).

Fig. 79 Pressure in broken loop hot and cold legs (PE-BL-1 and -2).

Fig. 80 Pressure in broken loop hot leg downstream of pump simulator and cold leg upstream of break plane (PE-BL-3 and -4).

Fig. 81 Pressure in broken loop cold leg (PE-BL-1, -4, and -8).

Fig. 82 Pressure in broken loop hot leg (PE-BL-2, -3, and -6).

Fig. 83 Pressure in reactor vessel core simulator instrument stalk, wide range (PE-CS-1A).

Fig. 84 Pressure in reactor vessel core simulator instrument stalk, narrow range (PE-CS-1B).

Fig. 85 Pressure in intact loop cold leg, hot leg, and steam generator outlet (PE-PC-1, -2, and -3A).

Fig. 86 Pressure in intact loop steam generator outlet, narrow range (PE-PC-3B).

Fig. 87 Pressure in intact loop cold leg, hot leg, and pressurizer (PE-PC-1, -2, and -4).

Fig. 88 Pressure in reactor vessel downcomer instrument stalk 1 and core simulator (PE-CS-1A and PE-1ST-1A and -3A).

Fig. 89 Pressure in reactor vessel downcomer instrument stalk 1, 0.62 and 5.32 m above reactor vessel bottom, narrow range (PE-1ST-1B and -3B).

Fig. 90 Pressure in reactor vessel downcomer instrument stalk 2 and core simulator (PE-CS-1A and PE-2ST-1A).

Fig. 91 Pressure in blowdown suppression tank bottom under downcomer 4, 180°; 1.384 m north of downcomer 3, 180°; under downcomer 3; under downcomer 2, 180°; and 1.379 m south of downcomer 2, 180° (PE-SV-1, -22, -26, -43, and -44).

Fig. 92 Pressure in blowdown suppression tank bottom under downcomer 4, 67.5°; between downcomers 3 and 4, 67.5°; and under downcomer 1, 67.5° (PE-SV-2, -4, and -23).

Fig. 93 Pressure in blowdown suppression tank submerged at A-end and tank bottom north of downcomer 4 (PE-SV-10, -12, and -24).

Fig. 94 Pressure in blowdown suppression tank bottom south of downcomer 1 (PE-SV-13).

Fig. 95 Pressure in blowdown suppression tank header above downcomer 4, 321°, and above downcomer 1 (PE-SV-14 and -18).

Fig. 96 Pressure in blowdown suppression tank submerged near downcomers 4 and 1 (PE-SV-15 and -16).

Fig. 97 Pressure in blowdown suppression tank gas space near downcomers 4 and 1 (PE-SV-58 and -61).

Fig. 98 Pressure in ECCS accumulator A (PT-P120-43).

Fig. 99 Pressure in ECCS cold leg injection line (PT-P120-61).

Fig. 100 Pressure in ECCS injection from accumulator A to the cold leg (PE-1ST-1A and PT-P120-43 and -61).

Fig. 101 Pressure in ECCS LPIS pump A discharge (PT-P120-83).

Fig. 102 Pressure in blowdown suppression tank top (PT-P138-55, -56, and -57).

Fig. 103 Pressure in intact loop hot leg venturi (PT-P139-2, -3, and -4).

Fig. 104 Pump speed for intact loop pumps 1 and 2 (RPE-PC-1 and -2).

Fig. 105 Pump speed (normalized) for intact loop pumps 1 and 2 (RPE-PC-1 and -2).

Fig. 106 Pump power for intact loop pumps 1 and 2 (PCP-1-P and PCP-2-P).

Fig. 107 Temperature in broken loop cold leg, hot leg, and reflood assist bypass system (TE-BL-1, -2, and -3).

Fig. 108 Temperature in broken loop cold leg bottom, middle, and top at DTT flange (TE-BL-1A, -1B, and -1C).

Fig. 109 Temperature in reactor vessel core simulator instrument stalk (TE-CS-1).

Fig. 110 Temperature in intact loop cold leg, hot leg, and steam generator outlet (TE-PC-1, -2, and -3).

Fig. 111 Temperature in ECCS accumulator A (TE-P120-41).

Fig. 112 Temperature in blowdown suppression tank liquid at tank bottom and vapor at tank top (TE-P138-22 and -34).

Fig. 113 Temperature in broken loop cold leg QOBV inlet and isolation valve inlet (TE-P138-62 and -63).

Fig. 114 Temperature in broken loop hot leg QOBV inlet and isolation valve inlet (TE-P138-66 and -65).

Fig. 115 Temperature in intact loop pressurizer vapor and liquid (TE-P139-19 and -20).

Fig. 116 Temperature in intact loop cold leg upstream of DTT flange (TE-P139-29).

Fig. 117 Temperature in steam generator intact loop cold leg, hot leg, and secondary side (TE-SG-1, -2, and -3).

Fig. 118 Temperature in blowdown suppression tank B-end thermocouple stalk (TE-SV-1, -2, and -3).

Fig. 119 Temperature in blowdown suppression tank B-end thermocouple stalk (TE-SV-5 and -6).

Fig. 120 Temperature in blowdown suppression tank A-end thermocouple stalk (TE-SV-7, -8, and -9).

Fig. 121 Temperature in blowdown suppression tank A-end thermocouple stalk (TE-SV-10, -11, and -12).

Fig. 122 Temperature in blowdown suppression tank 2.72 m from tank bottom (TE-SV-1 and -7).

Fig. 123 Temperature in blowdown suppression tank 2.36 m from tank bottom (TE-SV-2 and -8).

Fig. 124 Temperature in blowdown suppression tank 1.90 m from tank bottom (TE-SV-3 and -9).

Fig. 125 Temperature in blowdown suppression tank 0.99 m from tank bottom (TE-SV-5 and -11).

Fig. 126 Temperature in blowdown suppression tank 0.374 m from tank bottom (TE-SV-6 and -12).

Fig. 127 Temperature in blowdown suppression tank 1.45 m from tank bottom (TE-SV-10).

Fig. 128 Temperature in reactor vessel downcomer instrument stalk 1 (TE-1ST-1, -2, -3, and -4).

Fig. 129 Temperature in reactor vessel downcomer instrument stalk 1 (TE-1ST-6, -8, -9, and -10).

Fig. 130 Temperature in reactor vessel downcomer instrument stalk 1 (TE-1ST-11, -12, -13, and -14).

Fig. 131 Temperature in reactor vessel downcomer instrument stalk 2 (TE-2ST-2).

Fig. 132 Temperature in reactor vessel downcomer instrument stalk 2 (TE-2ST-14).

Fig. 133 Temperature in reactor vessel downcomer instrument stalks 1 and 2, 4.2 m above reactor vessel bottom (TE-1ST-2 and TE-2ST-2).

Fig. 134 Temperature in reactor vessel downcomer instrument stalks 1 and 2, 1.17 m above reactor vessel bottom in DTTs (TE-1ST-14 and TE-2ST-14).

Fig. 135 Temperature in ECCS cold leg injection line (TT-P120-62).

Fig. 136 Temperature in intact loop hot leg in elbow near venturi (TT-P139-32 and -33).

3. TEST L1-4 MEASURED PARAMETERS --
LONG-TERM PLOTS (190 AND 600 SECONDS)

This section of presented data consists of Figures 137 through 174.

Fig. 137 Density in broken loop cold leg, chordal density (DE-BL-1A, -1B, and -1C).

Fig. 138 Density in broken loop hot leg, chordal density (DE-BL-2A, -2B, and -2C).

Fig. 139 Fluid velocity in broken loop cold leg at DTT flanges (FE-BL-1).

Fig. 140 Flow rate in ECCS accumulator A discharge, high range (FT-P120-36-1).

Fig. 141 Flow rate in ECCS accumulator A discharge, low range (FT-P120-36-5).

Fig. 142 Flow rate in ECCS LPIS pump A discharge (FT-P120-85).

Fig. 143 Flow rate in ECCS HPIS pump A discharge (FT-P128-104).

Fig. 144 Flow rate in ECCS lines to intact loop cold leg (FT-P128-104, FT-P120-36-5, and FT-P120-85).

Fig. 145 Liquid level in blowdown suppression tank (LT-P138-33 and -58).

Fig. 146 Momentum flux in reactor vessel downcomer instrument stalk 1, 1.13 m above reactor vessel bottom (ME-1ST-1).

Fig. 147 Momentum flux in reactor vessel downcomer instrument stalk 2, 1.13 m above reactor vessel bottom (ME-2ST-1).

Fig. 148 Pressure in reactor vessel core simulator instrument stalk, narrow range, and intact loop steam generator outlet (PE-CS-1B and PE-PC-3B).

Fig. 149 Pressure in ECCS cold leg injection line (PT-P120-61).

Fig. 150 Pressure in ECCS LPIS pump A discharge (PT-P120-83).

Fig. 151 Pressure in blowdown suppression tank spray system pump discharge and cooldown heat exchanger outlet (PT-P138-136 and -151).

Fig. 152 Temperature in broken loop cold leg and hot leg (TE-BL-1 and -2).

Fig. 153 Temperature in reactor vessel core simulator instrument stalk (TE-CS-1).

Fig. 154 Temperature in intact loop cold leg, hot leg, and steam generator outlet (TE-PC-1, -2, and -3).

Fig. 155 Temperature in blowdown suppression tank spray system pump discharge (TE-P138-142).

Fig. 156 Temperature in blowdown suppression tank spray system 3.79-l/s header and 13.88-l/s spray header (TE-P138-141 and -143).

Fig. 157 Temperature in blowdown suppression tank B-end thermocouple stalk (TE-SV-1, -2, and -3).

Fig. 158 Temperature in blowdown suppression tank B-end thermocouple stalk (TE-SV-5 and -6).

Fig. 159 Temperature in blowdown suppression tank A-end thermocouple stalk (TE-SV-7, -8, and -9).

Fig. 160 Temperature in blowdown suppression tank A-end thermocouple stalk (TE-SV-10, -11, and -12).

Fig. 161 Flow rate in blowdown suppression tank system pump discharge (FE-P138-139 and -140).

Fig. 162 Liquid level in blowdown suppression tank north and south ends (LT-P138-33 and -58).

Fig. 163 Pressure in blowdown suppression tank bottom under downcomers 4, 3, and 2 (PE-SV-1, -22, and -26).

Fig. 164 Pressure in blowdown suppression tank header above downcomer 1 (PE-SV-18).

Fig. 165 Pressure in blowdown suppression tank bellows at header to test assembly (PE-SV-70).

Fig. 166 Pressure in blowdown suppression tank header (PE-SV-75).

Fig. 167 Pressure in blowdown suppression tank top (PT-P138-55, -56, and -57).

Fig. 168 Pressure in blowdown suppression tank spray pump BS-P-83 discharge and at heat exchanger BS-H-32 tube side (PT-P138-136 and -151).

Fig. 169 Temperature in blowdown suppression tank spray pump discharge (TE-P138-142).

Fig. 170 Temperature of liquid at 3.79 l/s and 13.88 l/s spray headers (TE-P138-141 and -143).

Fig. 171 Temperature in blowdown suppression tank B-end thermocouple stalk 1 (TE-SV-1, -2, and -3).

Fig. 172 Temperature in blowdown suppression tank B-end thermocouple stalk 1 (TE-SV-5 and -6).

Fig. 173 Temperature in blowdown suppression tank A-end thermocouple stalk 2 (TE-SV-7 and -9).

Fig. 174 Temperature in blowdown suppression tank A-end thermocouple stalk 2 (TE-SV-10, -11, and -12).

4. TEST L1-4 COMPUTED PARAMETERS

This section of presented data consists of Figures 175 through 231.

Fig. 175 Flow regime and average density in broken loop cold leg.

Fig. 176 Flow regime and average density in broken loop hot leg.

Fig. 177 Flow regime and average density in intact loop cold leg.

Fig. 178 Flow regime and average density in intact loop hot leg.

Fig. 179 Enthalpy in broken loop cold leg.

Fig. 180 Enthalpy in broken loop hot leg.

Fig. 181 Enthalpy in intact loop cold leg.

Fig. 182 Enthalpy in intact loop hot leg.

Fig. 183 Enthalpy in intact loop at steam generator outlet.

Fig. 184 Enthalpy in broken loop cold and hot legs.

Fig. 185 Mass flow rate per system volume in intact loop cold leg calculated from FE-PC-1 and ME-PC-1.

Fig. 186 Mass flow rate per system volume in intact loop hot leg calculated from FE-PC-2 and ME-PC-2.

Fig. 187 Mass flow rate per system volume in intact loop cold and hot legs calculated from FE and ME.

Fig. 188 Mass flow rate per system volume in broken loop cold leg calculated from DE-BL-1 and ME-BL-1.

Fig. 189 Mass flow rate per system volume in broken loop hot leg calculated from DE-BL-2 and ME-BL-2.

Fig. 190 Mass flow rate per system volume in broken loop hot and cold legs calculated from DE and ME.

Fig. 191 Mass flow rate per system volume in intact loop cold leg calculated from DE-PC-1 and ME-PC-1.

Fig. 192 Mass flow rate per system volume in intact loop hot leg calculated from DE-PC-2 and ME-PC-2.

Fig. 193 Mass flow rate per system volume in intact loop cold and hot legs calculated from DE and ME.

Fig. 194 Mass flow rate per system volume in broken loop cold leg calculated from FE-BL-1 and DE-BL-1.

Fig. 195 Mass flow rate per system volume in broken loop hot leg calculated from FE-BL-2 and DE-BL-2.

Fig. 196 Mass flow rate per system volume in broken loop hot and cold legs calculated from FE and DE.

Fig. 197 Mass flow rate per system volume in intact loop cold leg calculated from FE-PC-1 and DE-PC-1.

Fig. 198 Mass flow rate per system volume in intact loop hot leg calculated from FE-PC-2 and DE-PC-2.

Fig. 199 Mass flow rate per system volume in intact loop steam generator outlet calculated from FE-PC-3 and DE-PC-3.

Fig. 200 Mass flow rate per system volume in intact loop cold leg, hot leg, and steam generator outlet calculated from FE and DE.

Fig. 201 Mass flow rate per system volume in broken loop cold leg calculated from PdE-BL-2 and DE-BL-1.

Fig. 202 Mass flow rate per system volume in broken loop hot leg calculated from PdE-BL-1 and DE-BL-2.

SAME AS FIG. 204

MASS FLOW RATE (kg/s)

Fig. 203 Mass flow rate per system volume in broken loop hot and cold legs calculated from PdE and DE.

Fig. 204 Mass flow rate per system volume in pressurizer calculated from LT-P139-6, -7, and -8 and PE-PC-4.

Fig. 205 Pump speed, electrical, in intact loop primary coolant pumps 1 and 2.

Fig. 206 Pump motor slip in intact loop primary coolant pumps 1 and 2.

Fig. 207 Pump water horsepower (normalized for PCP-1 and PCP-2).

Fig. 208 Pressure, closure, in intact loop.

Fig. 209 Static quality in broken loop cold leg.

Fig. 210 Static quality in broken loop hot leg.

Fig. 211 Static quality in intact loop cold leg.

Fig. 212 Static quality in intact loop hot leg.

Fig. 213 Static quality in intact loop at steam generator outlet.

Fig. 214 Flow quality in broken loop cold leg.

Fig. 215 Flow quality in broken loop hot leg.

Fig. 216 Flow quality in broken loop cold and hot legs.

Fig. 217 Flow quality in intact loop cold leg.

Fig. 218 Flow quality in intact loop hot leg.

Fig. 219 Flow quality in intact loop at steam generator outlet.

Fig. 220 Flow quality in intact loop cold leg, hot leg, and steam generator outlet.

Fig. 221 Saturation temperature in broken loop cold leg overlaid with TE-BL-1.

Fig. 222 Saturation temperature in broken loop hot leg overlaid with TE-BL-2.

Fig. 223 Saturation temperature in intact loop cold leg overlaid with TE-PC-1.

Fig. 224 Saturation temperature in intact loop hot leg overlaid with TE-PC-2.

Fig. 225 Saturation temperature in intact loop steam generator outlet overlaid with TE-PC-3.

Fig. 226 Saturation temperature in reactor vessel core simulator instrument stalk overlaid with TE-CS-1.

Fig. 227 Saturation temperature in reactor vessel downcomer instrument stalk 1 overlaid with TE-1ST-1A.

Fig. 228 Saturation temperature in reactor vessel downcomer instrument stalk 2 overlaid with TE-2ST-1A.

Fig. 229 Void fraction in broken loop cold and hot legs.

Fig. 230 Void fraction in intact loop cold leg, hot leg, and steam generator outlet.

Fig. 231 Volumetric flow rate of ECC into cold leg injection line calculated from FT-P120-36-1, FT-P120-85, and FT-P128-104.

5. ERROR BAND PLOTS

This section of presented data consists of Figures 232 through 256.

The uncertainty for various instruments used only to establish steady state conditions are presented in Table IX. A complete list of the instrument uncertainties is contained in Reference 11.

TABLE IX
TYPICAL ERROR BANDS

Typical Instrument	Uncertainty
FE-P138-139	+ 0.33 1/s
FT-P120-85	+ 0.18 1/s
FT-P139-27-3	+ 0.007 m
PdE-PC-2	+ 0.007 MPa
PdE-RV-1	+ 0.24 MPa
PE-CS-2FF	+ 0.14 MPa
PT-P120-64	+ 0.15 MPa
PT-P120-83	+ 0.05 MPa
PT-P138-55	+ 0.005 MPa
PT-P138-111	+ 0.09 + 0.0022 RD (MPa) [a]
PT-P138-136	+ 0.69 + 0.02 RD (MPa) [a]
TE-P138-22	+ 1.28°C
TE-P138-34	+ 1.69°C
TE-P138-62	+ 3.4°C
TE-P138-63	+ 3.0°C
TE-P138-141	+ 2.67°C
TE-P139-020	+ 4.0°C
TE-SG-001	+ 4.3% reading

[a] To apply uncertainty values, use the root mean square method (i.e.

$$\sqrt{[0.09 (\text{range})]^2 + [0.0022 (\text{reading})]^2}).$$

Fig. 232 Valve opening (%) in broken loop hot leg QOBV with error bands (CV-P138-15).

Fig. 233 Chordal density in broken loop cold leg with error bands (DE-BL-1A) (filtered to 4 Hz).

Fig. 234 Average velocity in broken loop cold leg at DTT flange with error bands (FE-BL-1) (filtered to 4 Hz).

Fig. 235 Average velocity in reactor vessel downcomer instrument stalk 1 with error bands (FE-1ST-1) (filtered to 4 Hz).

Fig. 236 Flow rate in ECCS HPIS pump A discharge with error bands (FT-P128-104).

Fig. 237 Liquid level in blowdown suppression tank south end with error bands (LT-P138-58).

Fig. 238 Liquid level in pressurizer north side with error bands (LT-P139-8).

Fig. 239 Momentum flux in broken loop cold leg at DTT flange with error bands (ME-BL-1) (filtered to 4 Hz).

Fig. 240 Momentum flux in reactor vessel downcomer instrument stalk 1 with error bands (ME-1ST-1) (filtered to 4 Hz).

Fig. 241 Differential pressure in broken loop hot leg at 14-to-5-in. reduction with error bands (PdE-BL-1) (filtered to 4 Hz).

Fig. 242 Differential pressure in broken loop cold leg at 14-to-5-in. reduction with error bands (PdE-BL-2) (filtered to 4 Hz).

Fig. 243 Differential pressure in broken loop cold leg across break plane with error bands (PdE-BL-3).

Fig. 244 Differential pressure in broken loop hot leg across steam generator simulator outlet flange with error bands (PdE-BL-6) (filtered to 4 Hz).

Fig. 245 Differential pressure in intact loop cold leg across primary coolant pumps 1 and 2 with error bands (PdE-PC-1).

Fig. 246 Differential pressure in intact loop hot leg reactor vessel outlet to flow venturi with error bands (PdE-PC-3).

Fig. 247 Differential pressure in intact loop across the reactor vessel inlet and outlet nozzles with error bands (PdT-P139-30).

Fig. 248 Pressure in broken loop hot leg with error bands (PE-BL-2).

Fig. 249 Pressure in reactor vessel core simulator instrument stalk, wide range, with error bands (PE-CS-1A).

Fig. 250 Pressure in reactor vessel core simulator instrument stalk, narrow range, with error bands (PE-CS-1B).

Fig. 251 Pressure in reactor vessel core simulator instrument stalk, short-term plot, with error bands (PE-CS-2FF).

Fig. 252 Pressure in blowdown suppression tank header above downcomer 4, short-term plot, with error bands (PE-SV-14).

Fig. 253 Pressure in blowdown suppression tank header above downcomer 4, 70-second plot, with error bands (PE-SV-14).

Fig. 254 Pump speed in intact loop operating pump 2 with error bands (RPE-PC-2).

Fig. 255 Temperature in broken loop hot leg with error bands (TE-BL-2).

Fig. 256 Temperature in blowdown suppression tank B-end thermocouple stalk with error bands (TE-SV-6).

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IX. LIST OF ABBREVIATIONS AND ACRONYMS

ac	Alternating current	max	Maximum
ACC	Accumulator	mg	Milligram
BL	Broken Loop	min	Minimum
BDST	Blowdown Suppression Tank	MPa	Megapascal
BDSTSS	Blowdown Suppression Tank Spray System	ms	Milliseconds
BWST	Borated Water Storage Tank	MW	Megawatt
CCW	Counterclockwise	N ₂	Nitrogen
C	Centerline	NRC	Nuclear Regulatory Commission
CL	Cold Leg	OD	Outside Diameter
CS	Core Simulator	P	Pressure
CW	Clockwise	PC	Primary Coolant
DAVDS	Data Acquisition and Visual Display System	PCP	Primary Coolant Pump
°C	Degrees Celsius	PCS	Primary Coolant System
DC	Downcomer	PCT	Percent
DP	Differential Pressure	ppm	Parts per million
DTT	Drag Disc-Turbine Transducer	pps	Points per second
ECC	Emergency Core Cooling or Coolant	PPS	Plant Protection System
ECCS	Emergency Core Coolant System	PSMG	Primary System Motor Generator (Sets)
EOS	Experiment Operating Specification	QEUD	Qualified Engineering Units Data
ESF	Engineered Safety Features	QOBV	Quick-Opening Blowdown Valve
FF	Free Field	RABV	Reflood Assist Bypass Valve
Fig.	Figure	RMS	Root Mean Square
FM	Frequency Modulation	rpm	Revolutions per minute
g	Acceleration Due to Gravity	RTD	Resistance Temperature Detector
HL	Hot Leg	RV	Reactor Vessel
HPIS	High-Pressure Injection System	SCS	Secondary Coolant System
hr	Hour	s	Second(s)
HX	Heat Exchanger	SG	Steam Generator
Hz	Hertz	SI	International System of Units
in.	Inch(s)	TAN	Test Area North
INEL	Idaho National Engineering Laboratory	UP	Upper Plenum
kg	Kilogram	μs	Microseconds
LOCA	Loss-of-Coolant Accident	v	Velocity
LOCE	Loss-of-Coolant Experiment	V	Volt(s)
LOFT	Loss of Fluid Test	vol _{sys}	Volume of system
LP	Lower Plenum	ρ	Density
LPIS	Low-Pressure Injection System	$\bar{\rho}$	Average density
LPWR	Large Pressurized Water Reactor (~1000 MW)	ρ _g	Density of saturated vapor
l/s	Litre per second	ρ _l	Density of saturated liquid
LVDT	Linear Variable Differential Transformer	<>	Averaged over a specified cross-sectional area
m	Metre		

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E R R A T A

Errata to TREE-NUREG-1084, "Experiment Data Report For LOFT Nonnuclear Test L1-4", July 1977, D. L. Batt.

1. On page 69, TABLE VII, under "Measurement Comments" for PE-SV-59, change "Not presented." to "Channel failed."
2. On page 109, replace Figure 34 with the attached Figure 34.
3. On page 110, replace Figure 35 with the attached Figure 35.
4. On page 115, Figure 44, change ordinate labeled "LIQUID LEVEL (m), in. = 39.37 (m)" to "LIQUID LEVEL (cm), in. = 0.3937 (cm)".
5. On page 116, Figure 45, change ordinate labeled "LIQUID LEVEL (m), in. = 39.37 (m)" to "LIQUID LEVEL (cm), in. = 0.3937 (cm)".
6. On page 119, replace Figures 50 and 51 with the attached Figures 50 and 51.
7. On page 127, replace Figure 67 with the attached Figure 67.
8. On page 132, replace Figure 76 with the attached Figure 76.
9. On page 165, replace Figure 139 with the attached Figure 139.
10. On pages 199 and 200, Figures 201, 202, and 203, change ordinates labeled "MASS FLOW RATE (kg/s), mlbm/hr. = 0.00794 (kg/s)" to "MASS FLOW PER SYSTEM VOLUME (kg/m³-s), lbm/(s-ft³) = 0.06243 (kg/s-m³)."

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Errata to TREE-NUREG-1084, "Experiment Data Report for LOFT Nonnuclear Test L1-4", July 1977, D. L. Batt.

On page 109, replace Figure 34 with the one below.

Fig. 34 Fluid velocity in broken loop cold leg at DTT flange (FE-BL-1A, -1B, and -1C) (filtered to 4 Hz).

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Errata to TREE-NUREG-1084, "Experiment Data Report for LOFT Nonnuclear Test L1-4", July 1977, D. L. Batt.

On page 110, replace Figure 35 with the one below.

Fig. 35 Fluid velocity in broken loop hot and cold legs at DTT flanges (FE-BL-1 and -2).

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Errata to TREE-NUREG-1084, "Experiment Data Report for LOFT Nonnuclear Test L1-4", July 1977, D. L. Batt.

On page 119, replace Figure 50 with the one below.

Fig. 50 Momentum flux in broken loop cold leg at DTT flange (ME-BL-1A and -1C) (filtered to 4 Hz).

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On page 119, replace Figure 51 with the one below.

Fig. 51 Momentum flux in broken loop cold and hot legs (ME-BL-1 and -2) (filtered to 4 Hz).

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On page 127, replace Figure 67 with the one below.

Fig. 67 Differential pressure in intact loop across the steam generator (PdE-PC-2).

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On page 132, replace Figure 76 with the one below.

Fig. 76 Differential pressure in blowdown suppression tank across vacuum breaker line (PdE-SV-9).

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Errata to TREE-NUREG-1084, "Experiment Data Report for LOFT Nonnuclear Test L1-4", July 1977, D. L. Batt.

On page 165, replace Figure 139 with the one below.

Fig. 139 Fluid velocity in broken loop cold leg at DTT flanges (FE-BL-1).