NUREG/IA-0037
STUDSVIK/NP-87/63

International Agreement Report

Assessment of RELAP5/MOD2, Cycle 36.04 Against LOFT Small Break Experiment L3-5

Prepared by
J. Eriksson

Swedish Nuclear Power Inspectorate
S-61182 Nykoping
Sweden

Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, DC 20555

March 1992

Prepared as part of
The Agreement on Research Participation and Technical Exchange
under the International Thermal-Hydraulic Code Assessment
and Application Program (ICAP)

Published by
U.S. Nuclear Regulatory Commission

Available from

Superintendent of Documents
U.S. Government Printing Office
P.O. Box 37082
Washington, D.C. 20013-7082

and

National Technical Information Service
Springfield, VA 22161

NUREG/IA-0037
STUDSVIK/NP-87/63

International
Agreement Report

Assessment of RELAP5/MOD2, Cycle 36.04 Against LOFT Small Break Experiment L3–5

Prepared by
J. Eriksson

Swedish Nuclear Power Inspectorate
S-61182 Nykoping
Sweden

Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, DC 20555

March 1992

Prepared as part of
The Agreement on Research Participation and Technical Exchange
under the International Thermal-Hydraulic Code Assessment
and Application Program (ICAP)

Published by
U.S. Nuclear Regulatory Commission

NOTICE

This report documents work performed under the sponsorship of the SKI/STUDSVIK of Sweden. The information in this report has been provided to the USNRC under the terms of an information exchange agreement between the United States and Sweden (Technical Exchange and Cooperation Arrangement Between the United States Nuclear Regulatory Commission and the Swedish Nuclear Power Inspectorate and Studsvik Enerigiteknik AB of Sweden in the field of reactor safety research and development, February 1985). Sweden has consented to the publication of this report as a USNRC document in order that it may receive the widest possible circulation among the reactor safety community. Neither the United States Government nor Sweden or any agency thereof, or any of their employees, makes any warranty, expressed or implied, or assumes any legal liability of responsibility for any third party's use, or the results of such use, or any information, apparatus, product or process disclosed in this report, or represents that its use by such third party would not infringe privately owned rights.

STUDSVIK ENERGITEKNIK AB
STUDSVIK/NP-87/63

1987-06-09

John Eriksson
SKI Project 85026, 13.3-917/84

Swedish Nuclear Power Inspectorate

ICAP
ASSESSMENT OF RELAP5/MOD2, Cycle 36.04 AGAINST LOFT SMALL BREAK EXPERIMENT L3-5

ABSTRACT

The LOFT small break experiment L3-5 has been analyzed using the RELAP5/MOD2 code. The code version used, Cycle 36.04, is a frozen version of the code.

Three calculations were carried out in order to study the sensitivity to changes of steam generator modelling and of core bypass flow. The differences between the calculations and the experiment have been quantified over intervals in real time for a number of variables available from the experiment.

Approved by

LIST OF CONTENTS

1 INTRODUCTION

An International Thermal-Hydraulic Code Assessment and Applications Program (ICAP) is at present being conducted by several countries under the auspices of the USNRC (1). The goal of the program is to make quantitative statements regarding the prediction capabilities of current best-estimate thermal-hydraulic computer codes. Such codes have been used for many years as state-of-the-art instruments to study and verify numerical and correlative computational models with experimental results. Some of these codes have reached a high degree of sophistication. They include models for all processes which are essential to thermal-hydraulic scenarios in the nuclear power reactor application. So far, however, these codes have not achieved status as reactor licensing tools, i.e. they do not fulfill the Appendix K rules (2), although they are often applied to other calculations. The present ICAP aims to quantify uncertainties in the codes so that the codes may be used for licensing purposes.

Sweden's contributions to ICAP encompass assessment calculations using the two thermal-hydraulic codes TRAC-PF1/MOD1 (3) and RELAP5/MOD2 (4). The work is conducted by Studsvik Energiteknik AB and is sponsored by the Swedish Nuclear Power Inspectorate.

A data package on tape containing input files and predicted data has been produced. The content is described in Appendix D. A copy of this tape is submitted to USNRC as a part of the ICAP agreement.

2 FACILITY AND TEST DESCRIPTION

The LOFT-experiment series L3 was designed to provide large-scale blowdown system data for PWR small break transients. As part of the Swedish ICAP contribution two experiments out of the L3 series were assigned. In the experiment treated in this report, the LOFT L3-5, the main circulation pumps were stopped shortly after the break was opened. In the other experiment, the LOFT L3-6, see (7), the pumps were allowed to operate at normal speed throughout the test in order to provide data for analyzing the differences in the two-phase scenarios between the two tests. Apart from the difference in pump operational mode the two experiments were nominally identical.

This chapter shall briefly describe the test facility, the L3-5 experiment, the assessment parameters used and some aspects of the measurement uncertainties as well as experimental data preparation.

2.1 Test Facility

The objective of the LOFT experiments was to demonstrate thermal-hydraulic phenomena which might occur in commercial PWR systems during abnormal situations. The facility is capable of performing a variety of operational transients and LOCAs. Brief descriptions of the LOFT are given in a number of experiment reports such as (5). The most thorough description is provided by Reeder (6). Only particular design features and characteristics relevant to the L3-5 experiment will be discussed in the following sections.

A general view of LOFT is shown in Figure 1. In the L3-5 small break experiment the two isolation valves on the broken loop legs were closed so as to prevent the passage of fluid via the header to the suppression vessel.

The break was simulated by a 205.6 mm^2 orifice in a T-branch line from the intact loop cold leg near the reactor vessel. The aim of the break configuration was to simulate an equally placed 4-in diameter small break on a four-loop 1000 MW(e) PWR.

During the L3-5 experiment the only primary coolant injection was carried out by the HPIS into the reactor vessel downcomer. The experiment was terminated before the LPIS pressure set point was reached.

2.2 The Experiment

After approximately 45 h of nuclear heating the initial conditions listed in Table 1 were obtained. The sequence of events which occured during this experiment is listed in Table 2. Main imposed actions during the experiment were:

a. At the time of reactor scram (which for safety reasons had to be verified before the break) the steam generator feed water and steam line valves started to close.

b. The two main circulation pumps were manually tripped just after the break. Pump coastdown was assumed to end at 750 r/min when the speed control carried out by the motor-generator driving unit was disconnected.

c. The HPIS injection started at 13.2 MPa.

d. The steam generator auxiliary feed was initiated and terminated manually.

2.3 Assessment Parameters

The selection of the appropriate assessment parameters for the LOFT L3-5 experiment, Table 3, followed the recommendations of the ICAP Guidelines (1). The selection was made during the input preparation, since a number of expanded Edit/Plot variables from RELAP5/MOD2 calculations are not available from the restart file but must be saved as control variables.

In some cases liquid level data are compared as pressure differences. For the upper plenum and downcomer levels only bubble plot data shown in (5) were available. These plots were converted into slightly smoothed elevation histories. Due to ambiguous bubble plot data the indicated level behaviour is rather uncertain.

The early break flow was not qualified until 40 s after the break, and showed rather large errors during the remainder of the transient. Comparisons of mass inventory obtained through flow integration were therefore not carried out. For the energy balance, the steam generator heat transfer was not known, and could not even be estimated by the steam produced.

2.4 Measurement Uncertainty

The instrumentation involves a variety of transducers which may have different accuracies for the same kinds of quantities (5,6). Table 4 is a summary of the accuracies of the measured quantities.

2.5 Experimental Data Preparation

The preparation of the experimental data for plotting and uncertainty analysis required several steps of manipulation of the information. First of all, the data were copied from the original blocked tape files to the CDC standard display code.

A program, LOFTDEC, was developed to sort out the keyword and channel information to be used in the assessment work. The program also decimated the channel data by averaging over time intervals so that information was copied to an intermediate channel information file only every 2nd second up to 200 s after the break, and then every 5th second.

A program, R5SILFT, was developed to select data for desired channels from the intermediate data file. These data were transformed into a new file with the same format as a RELAP5 restart file. Experimental and predicted data could later on be similarly used in plotting and assessment.

3 CODE AND MODEL DESCRIPTION

The assessment calculations with RELAP5/MOD2 for the LOFT L3-5 experiment were carried out using the cycle 36.04 code version. The code was implemented in June 1986 on a CDC 170-810 computer. The calculational model was based on available LOFT input files and listings. Some changes in the input model were introduced as a result of findings in the L3-5 experiment.

3.1 Code Features

The descriptive document available for the RELAP5/MOD2 code is a rather detailed code manual (4). The main characteristics of the code are summarised in Table 5. A new feature of RELAP5/MOD2 is the cross junction which, according to code manual recommendations, was applied at the steam separator upstream volume and at the hot leg and cold leg vessel junctions.

3.2 Input Model

The basis of the input preparation for L3-5 was an existing file which had previously been used for RELAP5/MOD2 fast transient calculations on LOFT. It was necessary to update and expand the input file, and several of the available input listings (7, 8, 9) were used. The reasons for particular approaches used in modelling are presented below. Figure 2 shows the nodalization used. The input listing is given in Appendix A.

3.2.1 The Initial System Pressure

To avoid an explicit steady-state pressurizer pressure and level control, the surge line junction was modelled as a trip valve which was closed until scram. The pressurizer initial fluid conditions were saturated with correct fluid content and pressure. In the case A calculation no boundary heat structures were involved in keeping the pressurizer state steady. However, for cases B and C pressurizer heat structures were applied with the outer surface at saturation temperature until scram and thereafter at room temperature.

A time dependent volume was connected to the pressurizer surge line by a trip valve adjacent to the pressurizer bottom in order to maintain the initial primary pressure constant during the steady state calculation. During steady state the pressurizer was isolated from the surge line. The pressure of the time dependent volume was equal to the pressure in the bottom volume of the pressurizer. At scram time the trip valve closed and the pressurizer isolation ceased.

3.2.2 Primary Fluid Temperatures

The bulk heat loss occurred in the steam generator. Effects from structural heat losses, pump power and pump cooling water were relatively small. The base case fluid temperatures in the hot leg were 576±2 K and in the cold leg 558±1 K (5). These temperatures satisfy the loop flow heat balance.

It was observed that some of the primary fluid temperature measurements were not consistent with the heat balance. For example, the core inlet temperature (TE-ILP-001 in the experiment) was 3 K higher than the cold leg fluid temperature. Several upper plenum thermocouple measurements showed temperatures which were as much as 10 K higher than the measured hot leg fluid temperature. The reason for these inconsistencies can not be fully understood although three-dimensional flow might be the main cause. Furthermore, the steam generator inlet to outlet temperature difference was about 4 K lower than it ought to be. The measured temperatures had mostly uncertainties of about 3 K or more (5).

3.2.3 Core Flow Bypass

Several core bypass flow paths existed. The following two (7) were modelled by servo valves in order to adjust the flows before scram:

- The inlet annulus to upper plenum with 6.6 % of the primary loop flow
- The lower plenum to upper plenum with 3.6 % of the primary loop flow.

The reflood assist bypass valve leakage and the broken loop heat up lines were not explicitly modelled since the mass flow rates were quite small. The reflood assist bypass valve leakage is further discussed for the case C calculation (see 5.2 below).

3.2.4 Environmental Heat Losses

The exchange of heat with structural material is important in small break analysis. Since the available input had only restricted material included, structures had to be added to the input. The bulk structures of the facilities were modelled to represent the correct structural masses.

For RELAP5/MOD2 an overall environmental heat transfer coefficient was determined by test calculations in order to obtain approximately the total heat loss of 250 kW as found in the experiment (7).

3.2.5 Break Discharge Coefficient

Test calculations showed a too rapid decrease in pressurizer fluid inventory when the default subcooled discharge coefficient of unity was used. Using a coefficient of .85 the rates of emptying the pressurizer and of the early system depressurization were close to the experiment. The assumption that the pressurizer emptying rate is an indicator of the break discharge flow is only applicable for low pressure drop in the surge line as it occurs in small break experiments.

3.2.6 Pump Model

The primary coolant pumps were tripped .8 s after the break. Coast down followed under the influence of the coolant flow inertia and the pump moment of inertia. Since the primary pumps in the experiment have a too small moment of inertia, compared to that of commercial PWRs, their coastdown was simulated by a fluid clutch coupling to a motor-generator driving unit. When the speed reached 12.5 Hz (10) the coupling was disconnected.

The combined inertia of the pump and the motor-generator flywheel was modelled by pump inertia data closely similar to those reported by T R White (11). The inertia polynomial was modified to avoid negative moment of inertia at higher pump speeds.

3.2.7 Steam Generator

The steam generator steady state was achieved using auxiliary components. The pressure was maintained by a steam filled control volume connected to the steam generator top. The downcomer level was attained through a flow controlled junction connecting a time dependent volume to the upper part of the downcomer.

The main steam valve was modelled as a time dependent junction rather than a motor or servo valve. The main reason for this was to use the steam flow (6) directly as boundary value and also to facilitate modelling of the pressure dependent leakage of the closed valve (7).

Closure of the steam valve started from the experimental initial flow at 5.58 MPa steam generator pressure and a 2.0 MPa downstream pressure. After the valve closure had been initiated a secondary pressure of 6.9 MPa was assumed in order to obtain the mass flow from the curve giving the valve characteristic as a function of stem lift (6). The leakage from the closed valve which was .053 kg/s at 4.19 MPa (7), was assumed to be proportional to the secondary pressure measured in the experiment.

The feedwater valve was modelled as a time dependent junction which gave the experimental mass flow until closure of the valve. The feedwater valve closure was assumed to be as fast as in the LOFT base input. Test calculations showed that the predicted secondary pressure continued to increase more than in the experiment when the steam valve began to close. Discrepancies in the downcomer level and the pressure behaviour could be suspected to be caused by the fast feedwater valve closure. An example of a different valve closure rate is given in a calculation for the L3-6 experiment carried out by L N Kmetyk (9) who used a rate of 5 %/s similar to the rate of the main steam valve.

No feedwater temperature data were found in available reports. Therefore the steam generator operation was achieved by controlling the feedwater internal energy so that the sum of steam generated in each secondary volume was equal to the main steam valve mass flow. This procedure achieves a steam generator steady state irrespective of the tube package heat transfer, or the heat exchange with structures.

4 THE BASE CASE CALCULATION (CASE A)

The input listing of case A is given in Appendix A.

After the depressurization had reached saturation conditions obstinate fluctuations in the calculation time step were observed. This effect was arrested by reducing the maximum time step from 1. s to .4 s. From previous experience, the RELAP5/MOD2 time step control may reduce the time step so much, after preceeding long time steps, that even execution error might occur.

Mid-transient water packing occurred several times due to water plugs in the cold leg passing forth and back at the break line T-junction. The code water packing mitigation scheme dealt correctly with the calculated pressure spikes, and as a result the calculation could be continued.

The results of the comparisions are shown in Appendix B. Primary system pressures are shown in Plots B.21, B22, B.22, B27, B34, B.35 and B.43. After the subcooled depressurization, the primary system pressure is underpredicted until about 900 s. It is noted that the experiment depressurizes at an increased rate in the time interval from about 600 s to 1200 s which is not reflected in the calculations. The primary fluid temperatures, Plots B.9, B.17, B.18, B.20, B.26, B.33, B.41 and B.44, show the corresponding discrepancies. The pressure and temperature comparisons at the secondary side, Plots B.51 and B.50 respectively, are also similar. The decreased depressurization rate after about 1000 s is caused by the increased temperature difference between primary and secondary sides shown in the experiment, but not in the calculations, Plot B.52.

A contributory cause for the mid-transient increase of the experimental depressurization rate is the hot leg steam production, Plots B.23 and B.24, which occurs in the time interval from 450 s to 800 s. The case A shows a corresponding density decrease but it is delayed by about 500 s, and the calculated water content is not reduced to the low experimental level.

The cold leg densities, Plots B.28 and B.30, show opposite differences - the calculated densities are lower than the experimental densities.

The predicted main recirculation flows, Plots B.11, B.25 and B.39, cannot be assessed due to unqualified experimental data (5). The experimental hot leg mass flow, Plot B.25, is qualified for the initial condition only. Condie et al (7), assume that natural circulation continued in the experiment from pump coast down until 750 s.

5 SENSITIVITY CALCULATIONS

The case A comparisons, dicussed in Chapter 4, revealed some discrepancies which were studied by two sensitivity calculations, case B and case C. The salient problems concern the fast early phase of the depressurization and the primary fluid temperatures.

5.1 Case B

The input changes introduced to the case B calculation were aimed at improving the predictions early in the transient until 250 s. Two updates were introduced in the steam generator modelling in this sensitivity study.

The first update was to change the main steam valve leakage after 68 s. Due to instrument noise the main steam valve started to open at about this time and operated intermittently during a period of 10 s. The unintended valve cycle is evident from the secondary pressure, Plot B.51. The base case calculation had used the valve threshold mass flow, see valve characteristic (6), which at the prevailing pressure, ought to have been about 5.7 kg/s. However, the pressure comparison, Plot B.51, shows a predicted pressure drop rate starting at 68 s which is about twice that of the experiment. Consequently, the steam mass flow in the case B was halved during the main steam valve open cycle, and a pressure drop rate close to the measured one was calculated.

The second update concerned the downcomer liquid level which had shown discrepancies, Plot B.49. Even though a questionably slow closure of the feed water valve was applied in case A the liquid level was predicted not to start to recover by the auxiliary feed, until about 400 s as compared to about 100 s in the experiment. A contribution to that discrepancy would follow from a predicted excess steam production in the lower part of the riser section. A check-up of the steam generator tube section primary and secondary volumes distribution revealed an inconsistency in the initial, case A, base input used. Due to this error much steam was generated in the lower riser volumes. A more correct tube structure distribution was introduced. However, only a slightly better agreement with the experimental level rise turned out.

Some water still remained distributed in the pressurizer after the emptying period, Plot B.54. The reason had been an unjustified application of the junction equal phase velocity between the uppermost pressurizer volumes. A correction was applied even though no apparent effect on the prediction plots ld be expected.

5.2 Case C

The next calculation, case C, focused on the primary side hydraulic scenario. The loop mass flow rate was not measured during the transient. Moreover, the vessel downcomer and upper plenum water contents measured by conductivity probes, and presented as bubble plots (5), suffered from error margins when converted into level heights, Plots B.15 and B.16.

After disconnection of the flywheels the low internal moment of inertia of the two recirculation pumps will make the speed of the two recirculation pumps sensitive to the loop mass flow. Plot B.37 evidently shows that the intact loop flow of the experiment ceases at about 130 s. The cases A and B show a prolonged and gradual flow decrease. These two calculations had about 20 kg/s primary mass flow at 250 s through the steam generator. A reverse flow of about 6 kg/s prevailed in the vessel inlet annulus to the outlet plenum junction. There was also a 1.5 kg/s reverse core bypass flow. Thus three paths of natural circulation due to the core decay heat have been identified.

The modeled flow bypass from the vessel inlet annulus to the upper plenum was insufficient to reduce the intact loop driving pressure difference to stop the main fluid flow in the previous predictions as early as in the experiment. This may have partly been caused by the omission of the reflood assist bypass valve (RABV) in the model. The reason for the omission was that the initial RABV vessel bypass flow was quite low and uncertain. Likewise the broken loop hot leg and cold leg fluid temperatures did not indicate any substantial initial RABV leakage.

The previous discussion focused on the natural circulation in the intact loop due to the core decay heat. A flow reduction could result from an increased bypass flow area between the inlet annulas and the upper plenum. It was intended, for the case C calculation, to determine an area which terminates the loop circulation at about the same time as in the experiment. To obtain the initial intact loop mass flow a servo valve was used as the junction between the inlet annulus (vol.290) and the downcomer (vol.205). Valve control was applied only through the steady state. Ideally, the flow control ought to have been applied at the inlet nozzle (junction between vols. 185 and 290). A cross junction modelling, however, cannot be applied for a valve component.

The leakage from the cold leg inlet annulus to the upper plenum is caused by a flow path in the narrow gap between the vessel filler blocks and the vessel wall. This leakage path has a vertical extension equal to the nozzle diameter. To enhance a reduction of the transient pressure difference over the core, the leakage junction was divided into two junctions at slightly different elevations. One leakage path connected the upper ends of the adjacent volumes below the inlet and the outlet annuli. The other path similarly connects the bottom ends of the volumes above the inlet and the outlet annuli. This higher level leakage will, compared to the previous modelling, promote steam bypass, and thus contribute to a lower pressure difference between vessel outlet and inlet .

The split up of the core bypass into two different leakage paths did not reproduce the fast pump coast down at 130 s as seen in Plot B. 37. However, some improvement was obtained as can be seen from the data uncertainty analysis in Appendix C (experiment code CLAX). In addition the core clad temperatures, Plots B.3 through B.6, obtained in the case C are more similar to the experiment than the two previous cases. This is more evident from Figure 3 which compares the time derivatives, obtained from Plot B.5, of the predicted and experimental clad temperatures. Evidently, the model change in the flow bypass had a positive impact on the core fluid distribution. Moreover, the case C break fluid density dropped at the same time as in the experiment (at about 130 s), see Plot B.38.

6 RUN STATISTICS

The input model for the base case RELAP5/MOD2 calculation for LOFT L3-5 encompassed:

113	volumes
120	junctions
99	heat structures

The volumes include two pump components, one separator component and nine time dependent volumes of which three were used for the steady state. Among the junctions there are totally five valve components and four time dependent junctions which are connected during steady state.

During the transient calculation the following resources were used:

Computer time	CPU=25778 s
Number of time steps	DT =12374
Number of volumes	C =113
Transient real time	RT =2032 s

resulting in the following code efficiency factor (1)

$$\frac{CPU * 10^3}{C * DT} = 18.44$$

The computer used was a Cyber 170-810.

7 CONCLUSIONS

The LOFT small break experiment L3-5 has been assessed using the RELAP5/MOD2 code. Three calculations were carried out; one base case calculation and two sensitivity calculations with model changes concerning the steam generator operation and the core bypass mass flow. The transient predictions compare reasonably well with the experiment as regards first-hand parameters such as system pressures and fluid temperatures. Uncertainties, over time intervals, of the predicted data compared with the experiment are given in Appendix C.

In the calculated steady state, the experimental initial data could be fairly well reproduced. Some experimental fluid temperatures, particularly in the upper part of the vessel, revealed relatively large discrepancies which could not readily be explained.

The predicted start of voiding in the intact loop hot leg as well as the cold leg occurred late as compared to the experiment although the predicted system pressure was underestimated.

The steam generator liquid level rise, recovered by the auxiliary water feed, was underpredicted in case A. Although the limited steam generator experimental data available do not help to single out any particular detail in the model as the cause, the most probable reason is the underestimation of the water content early in the test.

In the case B calculation, the steam generator boiling region was remodelled to promote void formation at higher elevations. The improvement gained in the transient downcomer level was rather limited. A contributory cause for the discrepancy in the level could be a significant droplet field initially residing in the space between the primary separator, modelled by the RELAP5 separator component, and the mist extractor adjacent to the steam line nozzle. Imposing a predetermined steady state water content on this space is, however, not possible unless the geometric model is considerably modified.

The case C calculation concentrated on the primary mass flow rate. The downcomer to upper plenum leakage was split into one junction promoting the steam bypass and an other one the water bypass in the case of voided fluid in the cold leg. The clad temperatures as well as the break fluid density were improved.

REFERENCES

1 ODAR, F and BESSETTE D E
Guidelines and Procedures for the
International Thermal-Hydraulic Code
Assessment and Applications Program
(Draft)
U.S. Nuclear Regulatory Commission,
1985

2 Acceptance Criteria for Emergency Core
Cooling Systems for Light-Water Cooled
Nuclear Power Reactors, 10 CFR, Part 50
(Appendix K), Fed Regist, 39(3).
(January 1974)

3 TRAC-PF1/MOD1:
An Advanced Best-Estimate Computer
Program for Pressurized Water Reactor
Thermal-Hydraulic Analysis.
NUREG/CR-3858

4 RANSOM, V H et al
RELAP5/MOD2 Code Manual
Volume 1: Code Structure, Systems
Models, and Solution Methods
Volume 2: Users Guide and Input
Requirements (Draft)
EG&G Idaho, Inc.
NUREG(CR-4312, EGG-2396)
(August 1985)

5 DAO, L T L and CARPENTER, J M
Experimental Data Report for LOFT
Nuclear Small Break Experiment
L3-5/L3-5A.
NUREG/CR-1695, EGG-2060 (Nov 1980)

6 REEDER D L
LOFT System and Test Description
(5.5-ft Nuclear Core 1 Loces)
NUREG/CR-DR47
TREE-1208

7 CONDIE, K G et al
Four-Inch Equivalent Break
Loss-of-Coolant Experiments:
Posttest Analysis of LOFT
Experiments L3-1, L3-5 (Pumps off),
and L3-6 (Pump on)
EGG-LOFT-8480.

8 GRUSH WM, TANAKA M and MARSILI P
Best estimate predictions for the OECD
LOFT Project Small Cold Leg Break
Experiment LP-SB-3
OECD LOFT-T-3603 (Febr 1984)

9 KMETYK L N
RELAP5 Assessment: LOFT Small Break
L3-6/L8-1.
NUREG/CR-3163, SAND83-0245 (March 1983)

10 MODRO, S M and CONDIE, K G
Best Estimate Prediction for LOFT
Nuclear Experiment L3-5/L3-5A
EGG-LOFT-5240 (Sept 1980)

11 WHITE J R et al
Experiment Prediction for LOFT Non-Nuclear Experiment L1-4.
TREE-NUREG-1086 (April 1977)

Table 1

Initial conditions

Quantity		Measured	Predicted Case A	Case B	Case C
Primary coolant system					
Mass flow rate	(kg/s)	476.4	478.8	476.4	476.6
Hot leg pressure	(MPa)	14.86	14.86	14.87	14.86
Cold leg temperature	(K)	558.	557.4	559.4	559.9
Hot leg temperature	(K)	576.	576.4	578.4	579.5
Reactor vessel					
Power level	(MW)	49.	49.0	49.	49.
Pressurizer					
Water temperature	(K)	614.6	614.7	614.7	614.7
Pressure	(MPa)	14.88	14.88	14.88	14.88
Liquid level	(m)	1.25	1.25	1.25	1.25
Broken loop					
Cold leg temperature	(K)	556.	555.	555.	554.
Hot leg temperature	(K)	562.	561.	561.	559.
SG secondary side					
Water level	(m)	0.19	0.19	0.19	0.19
Water temperature	(K)	543.	544.	534.	532.
Pressure	(MPa)	5.58	5.58	5.58	5.58
Mass flow rate	(kg/s)	26.4	26.2	26.0	26.0

Table 2

Sequence of events

Event	Time (s) Imposed action	System reaction	Predicted Case A	Case B	Case C
Reactor scrammed	-4.8		-4.8	-4.8	-4.8
LOCA initiated	0.		0.	0.	0.
Primary coolant pumps tripped		0.8	0.9	0.9	0.9
HPIS injection initiated (13.2 MPa)		4.0	2.5	2.6	3.3
Primary pump coastdown complete (12.5 Hz)		17.7	20.8	17.9	20.3
Prssurizer emptied		22.2	24.4	23.6	24.4
Upper plenum reached saturation		28.4	38.3	37.3	35.7
Intact loop hot leg voiding begin		30.	42.	45.	45.
SCS auxiliary feed initiated	63.		63.	63.	63.
Intact loop cold leg voiding begin		80.	138.	133.	147.
End of subcooled break flow		92.9	140.	109.	163.
SCS pressure exceeds primary pressure		745.	1810.	1490.	not obtnd.
Primary fluid mass at minimum		1480.	not obtnd.	1750.	not obtnd.
SCS auxiliary feed terminated	1800.		1800.	1800.	1800.

Table 3

Parameters plotted and used in the assessment comparisons.

COMPONENT	CONTINOUS PARAMETER *	EXPERIMENT (IDENTIFIER)	PREDICTION (MINOR EDIT)	PLOT IDENTIF. EXP.	CALC.	PLOT NO.
CORE	FLUID DENSITY (INLET)	**	CNTRLVAR 901		C 1?	B. 1
	HEATING POWER	**	RKTPOW 0		C 2?	B. 2
	CLAD TEMPERATURE, VOLUME 1 (BOTTOM)	TE-2G14-011 TE-5G6-011 TE-5I6-005	CNTRLVAR 903	C 3X	C 3?	B. 3
	- " - , VOLUME 2	TE-1F7-015 TE-1F7-021 TE-2G08-021 TE-4I14-021 TE-5F4-015 TE-5I6-021	CNTRLVAR 903	C 4X	C 4?	B. 4
	- " - , VOLUME 3	TE-1F7-026 TE-1F7-030 TE-2G14-030 TE-2H02-032 TE-4H14-028 TE-4H14-032 TE-5H7-026	CNTRLVAR 905	C 5X	C 5?	B. 5
	- " - , VOLUME 4	TE-2G08-039 TE-2H01-037 TE-3C11-039 TE-4I14-039 TE-5H6-037	CNTLRVAR 906	C 6X	C 6?	B. 6
	- " - , VOLUME 5	TE-2G14-045 TE-4G14-045 TE-5F9-045 TE-5G6-045 TE-5H5-049	CNTRLVAR 907	C 7X	C 7?	B. 7
	- " - , VOLUME 6 (TOP)	TE-5H7-058 TE-5G6-062	CNTRLVAR 908	C 8X	C 8?	B. 8
	TEMPERTURE (OUTLET)	TE-1UP-001 TE-5UP-001 TE-5UP-003	CNTRLVAR 909	C 9X	C 9?	B. 9
	TEMP. DIFF. (OUTLET-INLET)	TE-1UP-001 - TE-1LP-001	CNTRLVAR 910	C AX	C A?	B.10
	CORE FLOW (INLET)	**	MFLOWJ 125.01		C B?	B.11
	CORE INVENTORY	PDE-RV-002 **	CNTRLVAR 912		C C?	B.12
VESSEL	DOWNCOMER MASS INVENTORY	PDE-RV-003 **	CNTRLVAR 913		V 1?	B.13
	MASS INVENTORY (TOTAL VESSEL)	**	CNTRLVAR 914		V 2?	B.14
	DOWNCOMER LIQUID LEVEL	LE-1ST-001 ***	CNTRLVAR 915	V 3X	V 3?	B.15
	UPPER PLENUM LIQUID LEVEL	LE-3UP-001 ***	CNTRLVAR 916	V 4X	V 4?	B.16
	DOWNCOMER TEMPERATURE (INLET)	TE-1ST-001 TE-2ST-001	TEMPF 205	V 5X	V 5?	B.17
	UPPER PLENUM TEMPERATURE	TE-1UP-001 TE-4UP-001 TE-5UP-001	TEMPF 240	V 6X	V 6?	B.18
	UPPER PLENUM FLUID SUBCOOLING	SC-5UP-102 ST-1UP-111 - TE-1UP-001	CNTRLVAR 919	V 7X	V 7?	B.19
	LOWER PLENUM TEMPERATURE	TE-1LP-001	TEMPF 225	V 8X	V 8?	B.20
	UPPER PLENUM PRESSURE	PE-1UP-001A1	P 245	V 9X	V 9?	B.21
	LOWER PLENUM PRESSURE	PE-1ST-001A PE-2ST-001A	P 225	V AX	V A?	B.22
HOT LEG	FLUID DENSITY (I.L.)	DE-PC-205 ** DE-PC-002A DE-PC-002B ** DE-PC-002C **	RHO 105	HL1X	HL1?	B.23
	FLUID DENSITY (B.L.)	DE-BL-002B	RHO 305	HL2X	HL2?	B.24
	MASS FLOW RATE	FT-P139-27-1 ** FT-P139-27-2 ** FT-P139-27-3 **	MFLOWJ 110		HL3?	B.25
	TEMPERATURE (I.L.)	TE-PC-002B	TEMPF 105	HL4X	HL4?	B.26
	PRESSURE (I.L.)	PE-PC-002	P 105	HL5X	HL5?	B.27

COLD LEG	FLUID DENSITY (I.L)	DE-PC-115 DE-PC-001A DE-PC-001B DE-PC-001C	** **	RHO 185	CL1X	CL1?	B.28
	FLUID DENSITY (I.L. PUMP SUCTION)	DE-PC-305 /DE-PC-003A/ /DE-PC-003B/ /DE-PC-003C/		RHO 115.13	CL2X	CL2?	B.29
	FLUID DENSITY (B.L.)	DE-BL-105 DE-BL-001A DE-BL-001B DE-BL-001C	** **	RHO 345	CL3X	CL3?	B.30
	LIQUID LEVEL (I.L. LOOP SEAL)	LEPDE-PC-028		CNTRLVAR 931	CL4X	CL4?	B.31
	- " - (B.L.)	LEPDE-BL-014	**	CNTRLVAR 932		CL5?	B.32
	TEMPERATURE (I.L. NEAR VESSEL)	TE-PC-004		TEMPF 185	CL6X	CL6?	B.33
	PRESSURE (I.L.)	PE-PC-005		P 120	CL7X	CL7?	B.34
	- " - (B.L.)	PE-BL-001		P 345	CL8X	CL8?	B.35
	PRESS. DIFF. (ACROSS THE PUMPS)	PDE-PC-001		CNTRLVAR 936	CL9X	CL9?	B.36
	PUMP SPEED (PUMP 1)	RPE-PC-001		PMPVEL 135	CLAX	CLA?	B.37
BREAK	FLUID DENSITY	DE-PC-502A		RHO 800	BR1X	BR1?	B.38
	MASS FLOW RATE	FR-PC-SBRK		MFLOWJ 805	BR2X	BR2?	B.39
	ENERGY RELEASE	**		CNTRLVAR 940		BR3?	B.40
	INLET TEMPERATURE	TE-PC-501C		TEMPF 800	BR4X	BR4?	B.41
	INLET SUBCOOLING	ST-PC-5101 - TE-PC-501C		CNTRLVAR 942	BR5X	BR5?	B.42
	INLET PRESSURE	PE-PC-501		P 800	BR6X	BR6?	B.43
SG PRI. SIDE	TEMPERATURE (INLET)	TE-SG-001		TEMPF 115.03	SP1X	SP1?	B.44
	TEMP. DIFF. (INLET-OUTLET)	TE-SG-001 - TE-SG-002		CNTRLVAR 945	SP2X	SP2?	B.45
	PRESSURE DIFF.	PDE-PC-002		CNTRLVAR 946	SP3X	SP3?	B.46
SG SEC. SIDE	FLUID DENSITY	**		RHO 515.03		SS1?	B.47
	MASS FLOW RATE	**		MFLOWJ 516		SS2?	B.48
	LIQUID LEVEL	LD-P004-008B		CNTRLVAR 949	SS3X	SS3?	B.49
	LIQUID TEMPERATURE	TE-SG-003		TEMPF 515.03	SS4X	SS4?	B.50
	PRESSURE	PE-SGS-001		P 530.01	SS5X	SS5?	B.51
SG	PRIMARY-SECONDARY TEMP.-DIFF. (AT INLET)	TE-SG-001 - TE-SG-003		CNTRLVAR 952	S 1X	S 1?	B.52
	HEAT TRANSFER RATE	**		CNTRLVAR 953		S 2?	B.53
PRESSURIZER	LIQUID LEVEL	LT-P139-006		CNTRLVAR 954	P 1X	P 1?	B.54
	LIQUID TEMPERATURE	TE-P139-020		TEMPF 415.02	P 2X	P 2?	B.55
	STEAM TEMPERATURE	TE-P139-019		TEMPG 415.07	P 3X	P 3?	B.56
	PRESSURE	PE-PC-004		P 415.08	P 4X	P 4?	B.57
ECCS	HPIS VOLYMETRIC FLOW RATE	FT-P128-104		CNTRLVAR 958	EC1X	EC1?	B.58
SYSTEM	MASS BALANCE (INTEG. FROM BREAK NO PUMP SEAL W.)	**		CNTRLVAR 959		SY1?	B.59
	COOLANT EGY. BALANCE (INTEGR.)	**		CNTRLVAR 960		SY2?	B.60
	PRIM. EXTERNALS HEATFLOW	**		CNTRLVAR 982		SY3?	[illegible]
RELAP5	COMPUTATION CPU TIME	**		CPUTIME 0		R 1?	B.61
	COMPUTATION MASS ERROR	**		EMASS 0		R 2?	B.62

* THE COMPARISON PARAMETERS ARE THOSE REPORTED AS DIRECTLY MEASURED OR AS COMPUTED RESULTS FROM THE EXPERIMENT

** NO DATA AVAILABEL FROM THE EXPERIMENT

*** DATA OBTAINED FROM BUBBLE PLOT IN EXPERIMENT REPORT

/ / EXPERIMENT DATA AVAILABLE BUT NOT USED IN COMPARISONS

? CALCULATION CASE (A, B OR C)

Table 4

Measurement errors

Quality	Uncertainty	Comment
Pressure	251-282 kPa	Primary side
	120 kPa	Secondary side
Fluid temp	2.7-3.1 K	Mostly
	.5 K	TE-P139-019, steam
	5.9 K	TE-SG-001, TE-SG-002
	10.4 K	TE-PC-004
Fluid density	78-82 kg/m^3	Mostly
	129-131 kg/m^3	DE-BL-001A, DE-BL-001C DE-PC-002B, DE-PC-002C
Clad temp	3.1-3.2 K	All
Diff pressure	.49 k Pa	PDE-RV-003
	1. kPa	PDE-PC-002
	1.3 kPa	PDE-RV-002
	1.8 kPa	PDE-PC-001
Mass flow	.02 L/s	HPIS
	6.3 kg/s	I.L. init condition
	17 kg/s	I.L. hot leg
	25 percent	Break, 40-750 s
	1 kg/s	Break, 750-2100 s
Liq level	.04 m	Pressurizer
	.05 m	SG secondary
	.099-.137 m	Cold legs
	Bubble plot	Upper plen, downcomer
Speed	1.22 rad/s	Main recirc pumps

Table 5

RELAP5/MOD2 code features.

COMPUTATION PROCESSING FEATURES

- Several problem type and execution control options as
    - a. steady state initialisation using fictitious structure heat capacities for faster convergence
    - b. transient calculation
    - c. strip type execution, to select requested parameters from a restart file
    - d. trip system, to decide on actions during calculation due to reaching specified conditions in calculation parameters.
    - e. ability to delete or add hydrodynamic components, structure components and control variables at a restart of calculation.

CLASSIFICATION OF HYDRODYNAMIC MODEL

- One-dimensional, with provisions for
    - a. choked flow model
    - b. abrupt area change model
    - c. cross flow junctions.
- Two-fluid, six equation, space-time numerical solution scheme.
- flow ragime oriented field characteristics depending on mass flux and void fraction for
    - a. horizontal flow with bubbly, slug, mist and stratified fields
    - b. vertical flow with bubbly, slug, annular-mist (and stratified) fields
    - c. high mixing flow with bubbly and mist fields (for pumps).

Table 5 cont'd

HYDRODYNAMIC COMPONENENTS (Input systematics)

- Volume type components
  - a. single volume
  - b. pipe and annulus, for condensed input of several similar single volumes
  - c. time dependent volume, for defining a boundary source with a time dependent fluid state
  - d. branch, a volume capable of two or more connecting junctions at either end
  - e. pump, characterized by rated values for flow, head, torque, density and moment of inertia. The single phase homologous curve, two-phase multipliers and phase difference tables to model the dynamic pump behaviour
  - f. special system components for steam separator, jetmixer, turbine and accumulator.
- Junction type components
  - a. single junction
  - b. time dependent junction, for a time dependent junction flow whith a time dependent or controlled flow state
  - c. cross-flow junction, to model a small cross flow, a tee branch or a small leak flow
  - d. valve, various operation characteristics available for check valve, trip valve, inertial valve and relief valve.

INTERPHASE CONSTITUTIVE EQUATIONS

- Interphase drag
  - a. steady drag due to viscous shear depending on flow regime. Semi-empirical mechanisms to describe flow regime transitions
  - b. dynamic drag due to virtual mass effect.
- Interphase mass and heat transfer depending on flow regime and the fluid fields to saturation temperature differences

Table 5 cont'd

FLUID TO WALL CONSTITUTIVE EQUATIONS

- Wall friction due to wall shear effects formulated for flow regimes and based on a two-phase multiplier approach.

- Wall heat transfer depending on flow characteristics defined for

  a. single-phase forced convection (Dittus-Boelter)

  b. saturated nucleate boiling (Chen)

  c. subcooled nucleate boiling (modified Chen)

  d. critical heat flux (Biasi or modified Zuber)

  e. transition film boiling (Chen)

  f. film boiling (Bromley-Pomeranz and Dougall-Rohsenow)

  g. condensation (partly Dittus-Boelter).

- Interfacial mass transfer at the wall depending on wall, fluid and saturation temperatures for

  a. subcooled and saturated boiling

  b. transition film and film boiling

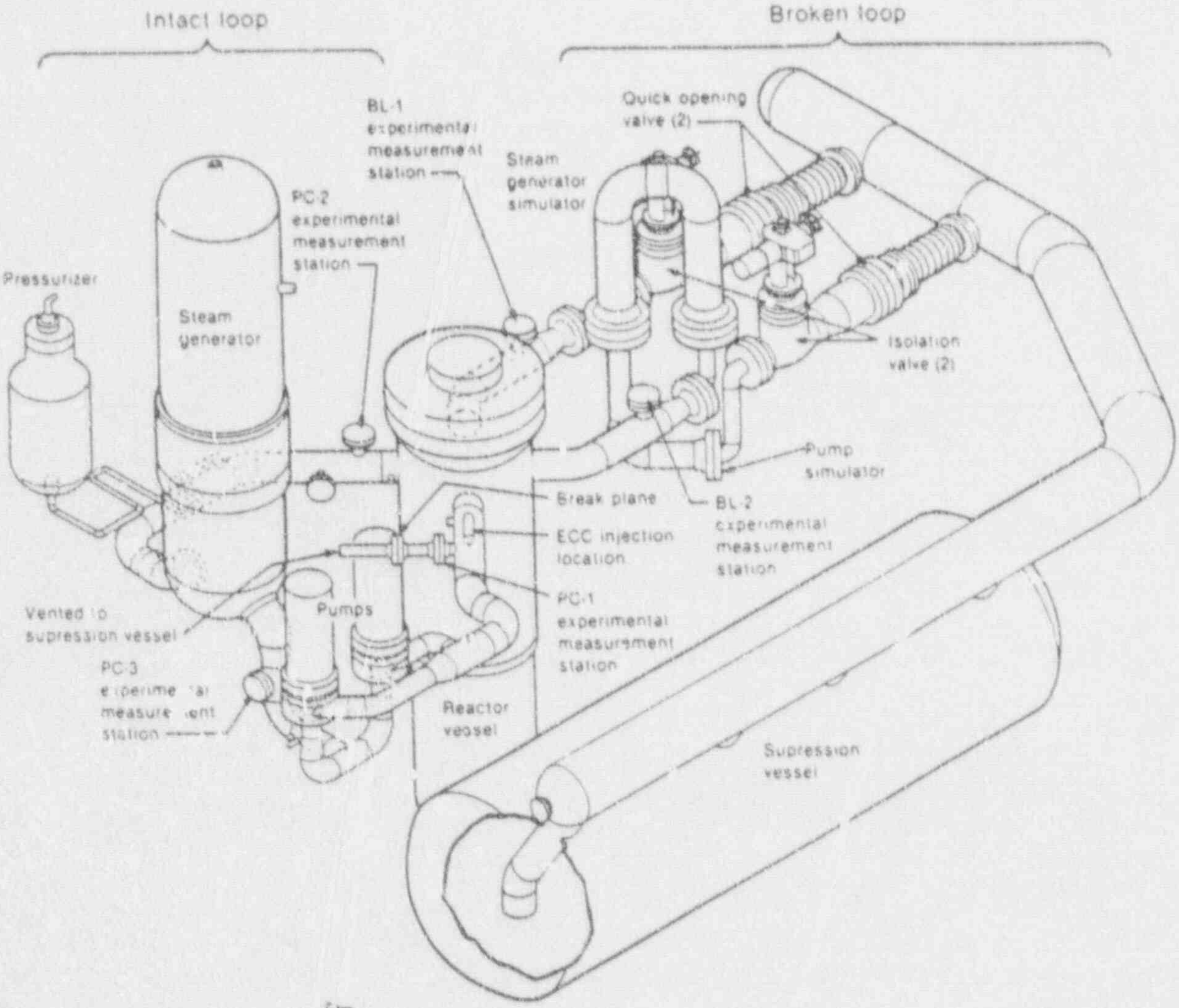
  c. condensation.

HEAT STRUCTURES

These may be rectangular, cylindrical or spherical in shape. The structure position is defined through component numbers of left and right hand side hydraulic components. A structure is physically defined by the geometry and the temperature dependent conductivity and volumetric heat capacity data. The structure model is further specified by the number of internal mesh points in the direction of heat flow.

CONTROL COMPONENTS

By these new (control) variables are defined from calculated parameters using algebra, standard functions, trip type operands or integrals.



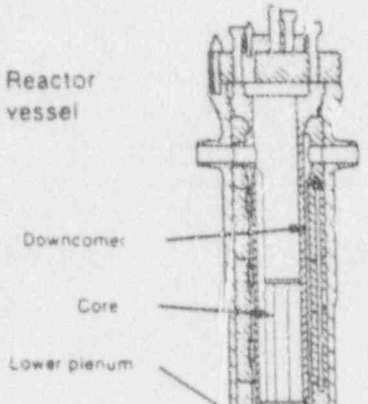


Figure 1

LOFT system configuration

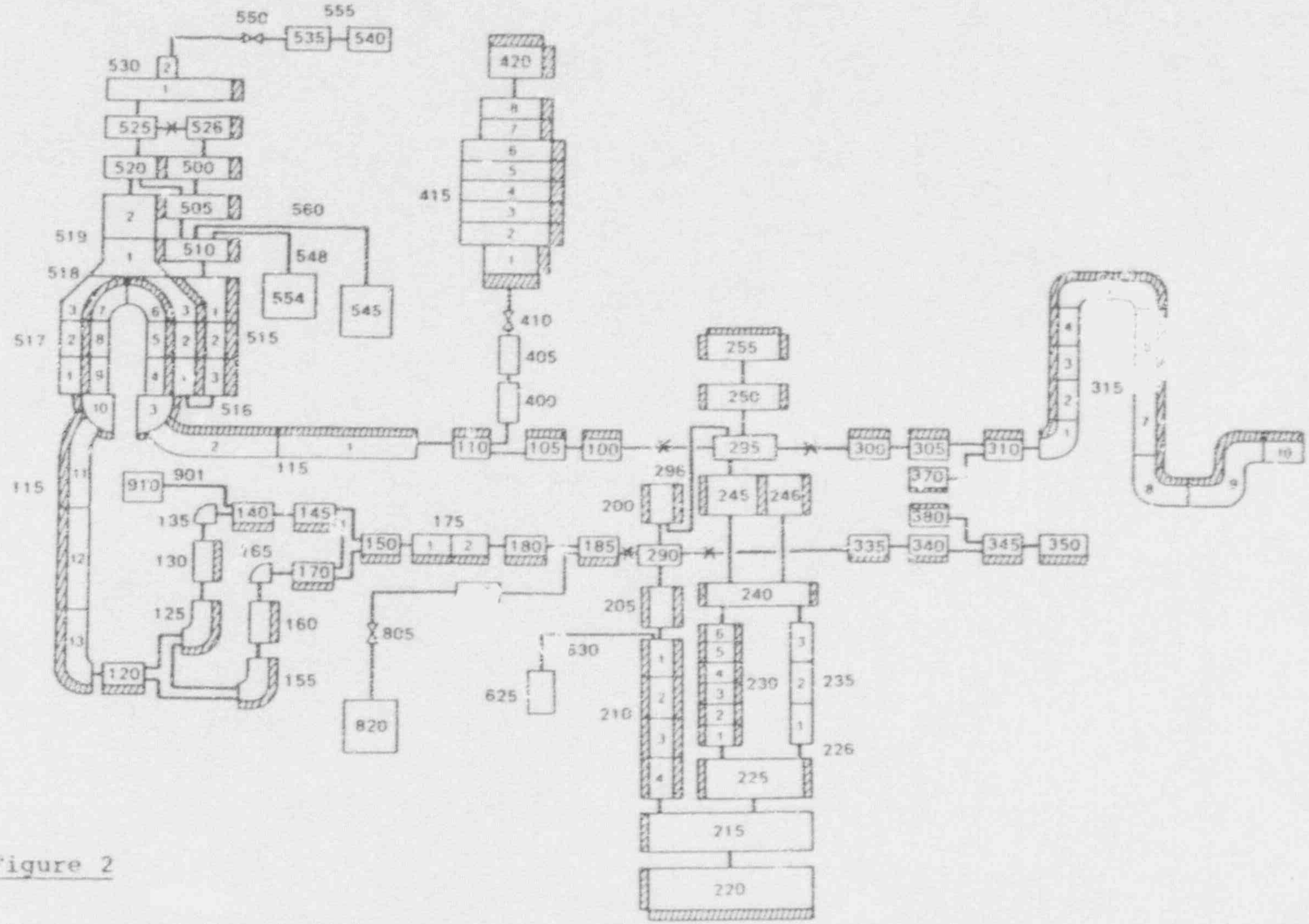


Figure 2

The nodalization diagram for LOFT L3-5

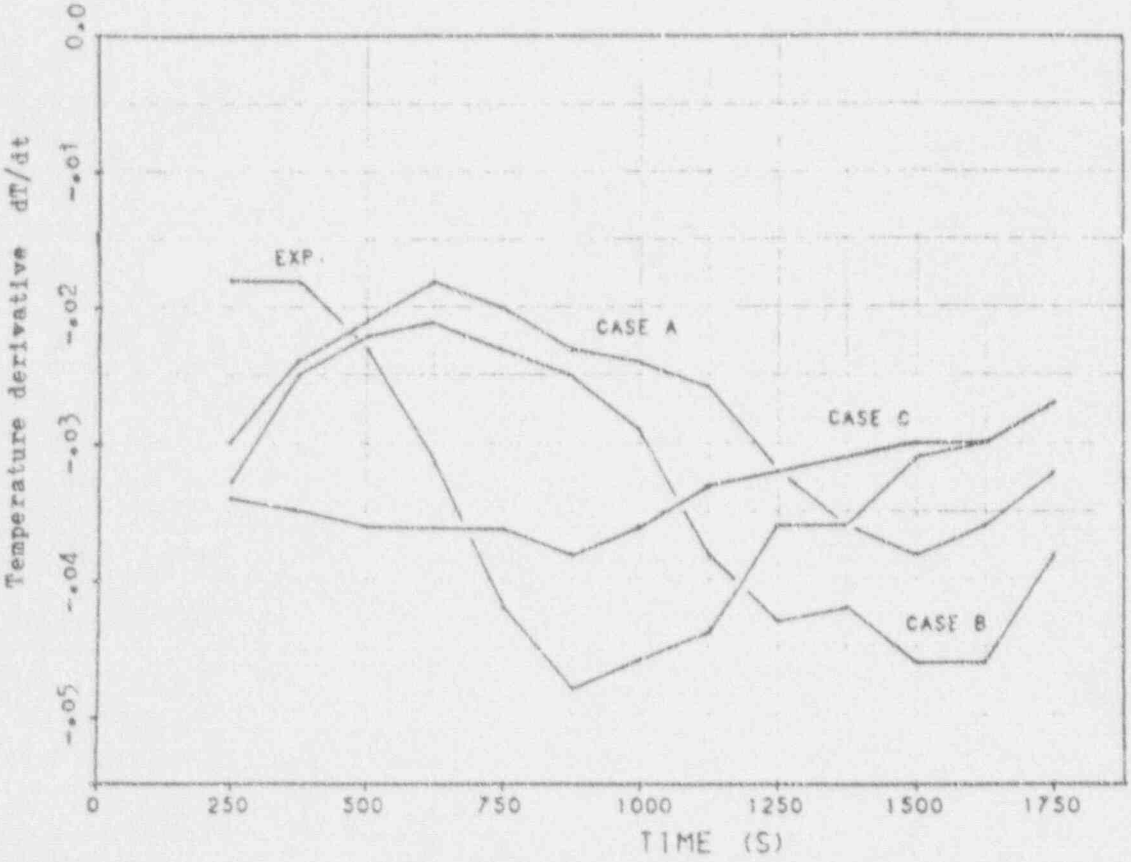


Figure 3 Time derivative of the core volume 3 clad temperature

Input listing (Case A)

```
* ** LOFT L3-5 ANALYSIS (PRIMRY+SECNDRY+KINTCS) **
***************************************************************
*
0000100    NEW        STDY-ST
*
0000101    RUN
*
0000102    SI         SI
*
*0000104    NOACTION
*
0000105    40.        60.0
*
0000120    100010000 0.0        WATER     PRIMARY
0000121    517010000 0.0        WATER     SECONDARY
*
*        TIME END    MIN STP    MAX STP    EDY OPT  KNOR   MAJR   RST *
000020-    45.2      1.0E-5      .4         00001     5     200    200
*
***************************************************************
***************************************************************
*
* MINOR EDIT VARIABLES FOR THE ICAP ASSESSMENT
*
***************************************************************
*
* CORE
*
0000301    CNTRLVAR  901
0000302    RKTPOW    0
0000303    CNTRLVAR  903
0000304    CNTRLVAR  904
0000305    CNTRLVAR  905
0000306    CNTRLVAR  906
0000307    CNTRLVAR  907
0000308    CNTRLVAR  908
0000309    CNTRLVAR  909
0000310    CNTRLVAR  913
0000311    MFLOWJ    225010000
0000312    CNTRLVAR  912
***************************************************************
* VESSEL
*
0000313    CNTRLVAR  913
0000314    CNTRLVAR  914
0000315    CNTRLVAR  915
0000316    CNTRLVAR  916
0000317    TEMPF     205010000
0000318    TEMPF     240010000
0000319    CNTRLVAR  919
0000320    TEMPF     225010000
0000321    P         245010000
0000322    P         225010000
***************************************************************
* HOT LEG
*
0000323    RHO       105010000
0000324    RHO       205010000
0000325    MFLOWJ    1 3010000
0000326    TEMPF     105010000
0000327    P         105010000
***************************************************************
* COLD LEG
*
0000328    RHO       185010000
```

```
0000329    RHO       115070000
0000330    RHO       345010000
0000331    CNTRLVAR  931
0000332    CNTRLVAR  932
0000333    TEMPF     185010000
0000334    P         120010000
0000335    P         345010000
0000336    CNTRLVAR  936
0000337    PMPVEL    135
***************************************************************
* BREAK
*
0000338    RHO       185010000
0000339    MFLOWJ    805000000
0000340    CNTRLVAR  940
0000341    TEMPF     800010000
0000342    CNTRLVAR  942
0000343    P         185010000
0000344    TEMPF     115030000
***************************************************************
* STEAM GENERATOR
*
0000345    CNTRLVAR  945
0000346    CNTRLVAR  946
0000347    RHO       515030000
0000348    MFLOWJ    515000000
0000349    CNTRLVAR  949
0000350    TEMPF     515030000
0000351    P         530010000
0000352    CNTRLVAR  952
0000353    CNTRLVAR  953
***************************************************************
* PRESSURIZER
*
0000354    CNTRLVAR  954
0000355    TEMPF     415020000
0000356    TEMPG     415070000
0000357    P         415080000
***************************************************************
* ECCS
*
0000358    CNTRLVAR  958
***************************************************************
* SYSTEM
*
0000359    CNTRLVAR  959
0000360    CNTRLVAR  960
0000382    CNTRLVAR  962
***************************************************************
* RELAP5
*
0000361    CPUTIME   0
0000362    EMASS     0
*
***************************************************************
***************************************************************
* TRIP INPUT DATA                                                  *
* 501        SCRAM      REACTIVITY, GEN. TABLE           609
*                       SS AUX PRESSURIZ. VALVE CLOS     410
*                       MAIN STEAM VALVE, CLOSE          550
*                       FEED WATER VALVE, CLOSE          560
*
* 510        S.TAK      TIME
*                       AUX FEED WATER                   548
*
```

```
* 511        TRIP       PUMP 1                           125
*                       PUMP 2                           165
*
* 516        BREAK      CLOSE                            805
*
* 515                   AFTER EXPERIMENT END
*
* 518        MFLOW      DIRECTION OF FLOW FROM CORE      240
*
* 535        50 S       EXP. BREAK FLOW QUALIFIED        805
*
* 500                   STOP ADV. OF CALCULATION
*
* 645                   BREAK OPEN                       805
*
* 646                   PRESS. VALVE OPEN, AFTER 55      435
*
* 661        HPIS       INITIATED                        640
*
* 699                   PUMP COOLANT INJECTION           901
*
*
***************************************************************
*
501        TIME      0            GE        NULL 0     45.2      L
508        TIME      0            GE        NULL 0     0.0       L
510        TIME      0            GE     TIMEOF 501    4.8       N
511        TIME      0            GE     TIMEOF 510    .8        L
512        TIME      0            GE        NULL 0     10000.    L
513        P         100010000    LE        NULL 0     13.2E6    N
514        P         100010000    LE        NULL 0     2.15E6    L
515        TIME      0            GE     TIMEOF 514    20.       L
518        VELFJ     240010000    GE     NULL    0     0.0       N
520        P         530020000    GT        NULL 0     5.63E6    N
521        P         530020000    LT        NULL 0     5.61E6    N
522        P         530020000    GT        NULL 0     5.55E6    N
523        P         530020000    LT        NULL 0     5.53E6    N
*530        CNTRLVAR  10           LT         NULL 0     3.10       N
*531        CNTRLVAR  10           GT         NULL 0     3.18       N
535        TIME      0            GE      TIMEOF 510     50.     L
533        TIME      0            GT     TIMEOF 510    63.       N
561        P       100010000 GT          P   530020000 0.        N
562        TIME      0            GE     TIMEOF 660    1800.     L
500        515
660        514          AND        561        N
661        513          AND        -514       N
699        -514         AND        -514       N
*601         530         OR         602        N
*602         -531        AND        601        N
*603         562         AND        602        N
*
610        612          OR         620        N
611        -521         AND        -616       N
612        611          AND        610        N
*
613        616          OR         523        N
614        -522         AND        613        N
615        -612         AND        501        N
616        615          AND        614        N
*
633        533          AND        -660       N
*534        533          OR         603        N
634        510          AND        510        L
*
645        510          AND        -514       N
```

```
*
5 6        -501        AND        -501       N
*
**********************************************************************
**********************************************************************
*
*                     INTACT LOOP
*
**********************************************************************
*
* REACTOR VESSEL NOZZLE INTACT LOOP HOT LEG                          *
*
1000000    RVHILHL    BRANCH
1000001    2          1
1000101    0.0634     1.5373    0.0       0.0       0.0       0.0
1000102    4.0E-5     0.0       00
1001101    295010000 100000000 0.0534    0.1       0.1       0102
1002101    100010000 105000000 0.0       0.085     0.085     0100
*
**********************************************************************
* PRESSURIZER CONNECTION TEE REACTOR VESSEL SIDE                     *
*
1050000    PRCTRVS    BRANCH
1050001    1          1
1050101    0.0634     1.634     0.0       0.0       0.0       0.0
1050102    4.0E-5     0.0       00
1051101    105010000 110000000 0.0       0.085     0.085     0100
*
**********************************************************************
* STEAM GENERATOR INLET PIPING                                       *
*
1100000    SGINLP     BRANCH
1100001    1          1
1100101    0.0        1.[illegible]   0.06204   0.0       0.0       0.0
1100102    4.0E-5     0.0       00
1101101    110010000 115000000 0.2       0.17      0.17      0100
*
**********************************************************************
* STEAM GENERATOR PLUS PIPING                                        *
*
1150000    SGAPS      PIPE
1150001    13
1150101    0.0        3
1150102    0.151      9
1150103    0.0        12
1150104    0.0634     13
1150201    0.0        1
1150202    0.0512     2
1150203    0.0        9
1150204    0.0512     10
1150205    0.0        12
1150301    0.93124    1
1150302    0.708      2
1150303    0.63       3
1150304    1.067      5
1150305    0.45       7
1150306    1.067      9
1150307    0.63       10
1150308    0.547      11
1150309    0.689      12
1150310    0.359      13
1150401    0.05826    1
1150402    0.057      2
1150403    0.223      3
1150404    0.0        9
1150405    0.223      10
1150406    0.0437     11
1150407    0.0462     12
1150408    0.0        13
1150501    0.0        13
1150601    0.0        1
1150602    90.0       6
1150603    -90.0      13
1150701    0.0        1
1150702    0.246      2
1150703    0.513      3
1150704    1.067      5
1150705    0.2865     6
1150706    -0.2865    7
1150707    -1.067     9
1150708    -0.513     10
1150709    -0.498     11
1150710    -0.689     12
1150711    -0.356     13
1150801    4.0E-5     0.0       2
1150802    4.0E-5     0.0102    3
1150803    1.0E-5     0.0103    9
1150804    4.0E-5     0.0102    10
1150805    4.0E-5     0.0       13
1150901    0.255      0.255     1
1150902    0.048      0.048     2
1150903    0.0        0.0       4
1150904    0.096      0.096     5
1150905    0.192      0.192     6
1150906    0.096      0.096     7
1150907    0.0        0.0       9
1150908    0.048      0.048     11
1150909    0.096      5.096     12
1151001    00         13
1151101    0100       3
1151103    0000       6
1151103    0100       12
1151300    1
*
**********************************************************************
* PUMP SUCTION TEE                                                   *
*
1200000    PSTEE      BRANCH
1200001    3          1
1200101    0.0634     0.78      0.0       0.0       0.0       0.0
1200102    4.0E-5     0.0       00
1201101    115010000 120000000 0.5       0.096     0.096     0000
1202101    120010000 125000000 0.0317    0.2       0.2       0100
1203101    120010000 155000000 0.0317    0.2       0.2       0100
*
**********************************************************************
* PUMP1 SUCTION TEE OUTLET                                           *
*
1250000    P1STOL     BRANCH
1250001    2          1
1250101    0.0        1.003     0.0613    0.0       90.0      0.521
1250102    4.0E-5     0.0       00
1251101    125010000 130000000 0.0       0.1       0.1       0100
1252101    125000000 155000000  .029477  0.0       0.0       0100
*
**********************************************************************
* PUMP 1 INLET                                                       *
*
1300000    P1INL      SNGLVOL
1300101    0.0        0.457     0.0189    0.0       90.0      0.457
1300102    4.0E-5     0.0       00
*
**********************************************************************
* PRIMARY COOLANT PUMP 1     TRIP=511                                *
*
1350000    PCP1       PUMP
1350101    0.0366     0.0       0.099     0.0       90.0      0.319
1350102    0
1350108    130010000 0.0        0.0       0.0       0100
1350109    140000000 0.0        0.05      0.05      0100
1350301    0    0     0    -1   -1   511   0
1350302    369.0      0.869     0.3155    96.0      500.6     1.43
1350303    613.6      0.0       207.4     0.004     19.598    0.0
1350308    .212465    0.0       -25.      79.5      6.28
1350310    0.0        0.0       0.0
*
**********************************************************************
* PUMP 1 OUTLET PUMP SIDE                                            *
*
1400000    P1OTLPS    SNGLVOL
1400101    0.0366     0.502     0.0       0.0       0.0       0.0
1400102    4.0E-5     0.0       00
*
**********************************************************************
* COOLANT PUMP INJ. (JOINED ONE PUMP)
*
9010000    PCPINJ1    TMDPJUN
9010101    910000000 140000000 0.0
9010200    1          699
9010201    -1.        0.0       0.0       0.0
9010202    0.0        .094      0.0       0.0
9010203    10000.     .094      0.0       0.0
*
9100000    PCPWATER   TMDPVOL
9100101    7.E-3      1.0       0.0  0.0  0.0  0.0
9100102    0.0        0.0       00
9100200    1
9100201    0.0        305.      0.0
9100202    10000.     305.      0.0
*
**********************************************************************
* PUMP1 OUTLET PIPE TEE SIDE                                         *
*
1450000    POPTS      BRANCH
1450001    2          1
1450101    0.0        1.4084    0.0633    0.0       0.0       0.0
1450102    4.0E-5     0.0       00
1451101    140010000 145000000 0.0       0.0       0.0       0100
1452101    145010000 150000000  .035873  0.0       0.0       0100
*
**********************************************************************
* PUMP OUTLET TEE                                                    *
*
1500000    POTLTEE    BRANCH
1500001    2          1
1500101    0.0634     0.4906    0.0       0.0       0.0       0.0
1500102    4.0E-5     0.0       00
1501101    170010000 150000000  .027528  0.2       0.2       0100
1502101    150010000 175000000 0.0       0.134     0.134     0100
*
**********************************************************************
* PUMP 2 SUCTION TEE OUTLET                                          *
*
1550000    P2STOL     BRANCH
1550001    1          1
```

```
1550101   0.0       1.003     0.0615    0.0       90.0      0.521
1550102   4.0E-5    0.0       00
1551101   155010000 160000000 0.0       0.05      0.05      0100
*
******************************************************************
* PUMP 2 INLET PIPE                                              *
*
1600000   P2INL     SNGLVOL
1600101   0.0       0.457     0.0189    0.0       90.0      0.457
1600102   4.0E-5    0.0       00
*
******************************************************************
* PRIMARY COOLANT PUMP 2                                         *
*
1650000   PCP2      PUMP
1650101   0.0368    0.0       0.999     0.0       90.0      0.319
1650102   0
1650108   160010000 0.0       0.0       0.0       0100
1650109   170000000 0.0       0.05      0.05      0100
1650301   135  135  135  -1   -1   511  0
1650302   365.0     0.889     0.3155    96.0      200.6     1.431
1650303   513.6     0.0       207.4     0.004     15.598    0.0
1650308   .212465   0.0       -25.      29.5      6.28
1650310   0.0       0.0       0.0
*
******************************************************************
* PUMP 2 OUTLET                                                  *
*
1700000   P2OUTL    BRANCH
1700001   1         1
1700101   0.0368    0.514     0.0       0.0       0.0       0.0
1700102   4.0E-5    0.0       00
1701101   145010000 170010000 0.009073  0.2       0.2       0100
*
******************************************************************
* COLD LEG PIPE TO ECC  CONNECTION TEE                           *
*
1750000   PTECT     PIPE
1750001   2
1750101   0.0634    2
1750201   0.0       1
1750301   0.559     1
1750302   0.613     2
1750401   0.0       2
1750501   0.0       2
1750601   0.0       2
1750701   0.0       2
1750801   4.0E-5    0.0       2
1750901   0.15      0.15      1
1751001   00        2
1751101   0100      1
1751300   1
*
******************************************************************
* ECC CONNECTION TEE PUMP SIDE                                   *
*
1800000   ECTPS     BRANCH
1800001   1         1
1800101   0.0634    .701      0.0       0.0       0.0       0.0
1800102   4.0E-5    0.0       00
1801101   175010000 180000000 0.0       0.0664    0.0664    0100
*
******************************************************************
* COLD LEG PIPE FROM ECC CONNECTION TO REACTOR VESSEL            *
*
1850000   CLPRVS    BRANCH
1850001   2         1
1850101   0.0634    1.461     0.0       0.0       0.0       0.0
1850102   4.0E-5    0.0       00
1851101   185010000 290000000 0.0634    1.        1.        0101
1852101   180010000 185000000 0.0       0.0       0.0       0100
*
******************************************************************
******************************************************************
*
*         BREAK
*
******************************************************************
*
* DISCHARGE VOLUME
*
8200000   BREAKVOL  TMDPVOL
8200101   3.5E-3    1.        0.0       0.0       0.0       0.0
8200102   0.0       0.0       0.0
8200200   2
8200201   0.0       1.E5      1.
8200202   10000.    1.E5      1.
*
******************************************************************
* BREAK OUTLET LINE
*
8000000   BRKOUTL   BRANCH
8000001   1         1
8000101   000908    1         0.0       0.0       0.0       0.0
8000102   1.E-5     0.0       00
8001101   185010000 800000000 0.0       .5        .5        0102
*
******************************************************************
* BRAKE VALVE (ORIFICE)
8050000   BRKVLV    VALVE
8050101   800010000 820000000 205.8E-6   .4  .4   0100   .85  .55
8050300   MTRVLV
8050301   645       514       5.        0.0
*
******************************************************************
******************************************************************
*
*                   REACTOR VESSEL
*
******************************************************************
*
* COLD LEG INLET ANNULUS
*
2900000   INANLCVOL BRANCH
2900001   2    1
2900101   0.0       .30       .078      0.0   -90.    -.30
2900102   4.E-5     .172      00
2901101   290010000 205000000 0.0  0.0  0.0       0100
2902101   200010000 290000000 0.0  0.0  0.0       0100
*
******************************************************************
* INLET ANNULUS TOP VOLUME                                       *
*
2000000   IANLTVOL  BRANCH
2000001   0         1
2000101   0.0       0.15      0.0465    0.0       90.0      0.15
2000102   4.0E-5    0.178     00
*
******************************************************************
* INLET ANNULUS LOWER VOLUME                                     *
*
2050000   IANLVOL   BRANCH
2050001   1         1
2050101   0.0       0.274     0.071     0.0       -90.0     -0.274
2050102   4.0E-5    0.172     00
2051101   205010000 210000000 0.0       0.0       0.0       0100
*
******************************************************************
* DOWNCOMER                                                      *
*
2100000   DWNCOMR   PIPE
2100001   4
2100101   0.142     4
2100201   0.0       3
2100301   0.958     4
2100401   0.0       4
2100501   0.0       4
2100601   -90.0     4
2100801   4.0E-5    0.102     4
2100901   0.0       0.0       3
2101001   00        4
2101101   0000      3
2101300   1
*
******************************************************************
* LOWER PLENUM UPPER VOLUME                                      *
*
2150000   LPUPVOL   BRANCH
2150001   3         1
2150101   0.740     0.360     0.0       0.0       -90.0     -0.360
2150102   4.0E-5    0.0       00
2151101   210010000 215000000 0.0       0.0       0.0       0100
2152101   215010000 220000000 0.0       0.0       0.0       0100
2153101   215000000 225000000 0.15      0.0       0.0       0100
*
******************************************************************
* LOWER PLENUM LOWER VOLUME                                      *
*
2200000   LPLOVOL   SNGLVOL
2200101   0.790     0.370     0.0       0.0       -90.0     -0.370
2200102   4.0E-5    0.0       00
*
******************************************************************
* LOWER CORE SUPPORT STRUCTURE                                   *
*
2250000   LCOSUST   BRANCH
2250001   1         1
2250101   0.25      0.52      0.0       0.0       90.0      0.52
2250102   4.0E-5    0.095     00
2251101   225010000 230000000 0.3875    2.4       2.4       0100
*
******************************************************************
* VALVE JUNCTION FOR CORE BYPASS FLOW
*
2260000   CBPVLV    VALVE
2260101   225010000 235000000 .015      1.        1.        0100
2260201   1         20.       0.0       0.0
2260300   SRVVLV
2260301   226
*
******************************************************************
* ACTIVE CORE                                                    *
*
2300000   CORE      PIPE
2300001   6
```

```
2300101   0.1705    6
2300201   0.1705    1
2300202   0.1470    2
2300203   0.1705    3
2300204   0.1440    4
2300205   0.1705    5
2300301   0.2795    5
2300302   0.3775    6
2300401   0.0       6
2300501   0.0       6
2300601   90.0      6
2300801   4.0E-5    0.012     6
2300901   0.0       0.0       1
2300902   .5        .5        2
2300903   0.0       0.0       3
2300904   .5        .5        4
2300905   0.0       0.0       5
2301001   00        6
2301101   0100      5
2301300   1
*
*****************************************************************
* BYPASS VOLUME                                                 *
*
2350000   BYPVOL    PIPE
2350001   3
2350101   0.015     3
2350201   0.0       2
2350301   0.659     2
2350302   0.657     3
2350401   0.0       3
2350501   0.0       3
2350601   90.0      3
2350801   4.0E-5    0.003     3
2350901   0.0       0.0       2
2351001   00        3
2351101   0000      2
2351300   1
*
*****************************************************************
* UPPER CORE SUPPORT  STRUCTURE                                 *
*
2400000   UCOCST    BRANCH
2400001   2         1
2400101   0.297     1.118     0.0       0.0       90.0      1.118
2400102   4.0E-5    0.145     00
2401101   230010000 240000000 0.12      7.40      7.40      0100
2402101   235010000 249000000 0.0       1.50      1.50      0100
*
*****************************************************************
* UPPER  FLOW SKIRT REGION                                      *
*
2450000   UFOSRE    BRANCH
2450001   1         1
2450101   0.114     0.693     0.0       0.0       90.0      0.693
2450102   4.0E-5    0.131     00
2451101   240010000 245000000 0.0       0.0       0.0       0100
*
*****************************************************************
* DEAD END OF FUEL MODULES                                      *
*
2460000   FUMODL    BRANCH
2460001   1         1
2460101   0.183     0.700     0.0       0.0       90.0      0.700
2460102   4.0E-5    0.214     00
```

```
2461101   240010000 246000000 0.0       0.0       0.0       0100
*
*****************************************************************
* REACTOR VESSEL HOT LEG OUTLET
*
2950000   RVHLOUT   BRANCH
2950001   2    1
2950101   .201      .30       0.0  0.0  90.       .30
2950102   4.E-5     0.0       00
2951101   295010000 250000000 0.0  0.0  0.0       0100
2952101   245010000 295000000 0.0  0.0  0.0       0100
*
*****************************************************************
* VALVE JUNCTION INLET ANN. TO UPPER PLENUM
*
2960000   ISUPVLV   VALVE
2960101   200010000 295010000  .01       1.        1.        0100
2960201   1         30.       0.0       0.0
2960300   SRVVLV
2960301   296
*
*****************************************************************
* UPPER PLENUM LOWER VOLUME                                     *
*
2500000   UPLLVOL   BRANCH
2500001   2         1
2500101   0.298     0.704     0.0       0.0       90.0      0.704
2500102   4.0E-5    0.0       00
2501101   295010000 250000000 0.0       0.0       0.0       0100
2502101   250010000 255000000 0.0       0.0       0.0       0100
*
*****************************************************************
* UPPER PLENUM UPPER VOLUME                                     *
*
2550000   UPLUVOL   SNGLVOL
2550101   0.244     0.712     0.0       0.0       90.0      0.712
2550102   4.0E-5    0.0       00
*
*****************************************************************
*****************************************************************
*
*                   PRESSURIZER
*
*****************************************************************
*
* SURGE LINE PCS SIDE                                           *
*
4000000   SLPCS     BRANCH
4000001   2         1
4000101   0.00145   3.45      0.0       0.0       90.0      0.54
4000102   4.0E-5    0.0       00
4001101   110000000 400000000 0.0       0.93      0.93      0100
4002101   400010000 405000000 0.0       0.93      0.93      0000
*
*****************************************************************
* SURGE LINE PRESSURIZER VESSEL                                 *
*
4050000   SLPRV     SNGLVOL
4050101   0.00145   3.45      0.0       0.0       90.0      0.60
4050102   4.0E-5    0.0       00
*
*****************************************************************
* PRESSURIZER SURGE LINE VALVE                                  *
*
4100000   SLVALV    VALVE
```

```
4100101   405010000 415000000 0.0       0.93      0.93      0100
4100300   TRPVLV
4100301   501
*
*****************************************************************
* PRESSURIZER VESSEL                                            *
*
4150000   PRESSV    PIPE
4150001   8
4150101   0.382     1
4150102   0.565     5
4150103   0.466     7
4150104   0.13      8
4150201   0.0       7
4150301   0.224     1
4150302   0.403     3
4150303   0.207     5
4150304   0.1705    7
4150305   0.118     8
4150401   0.0       8
4150501   0.0       8
4150601   90.0      8
4150801   4.0E-5    0.0       8
4151001   00        4
4151002   01        8
4151101   0100      1
4151102   0000      4
4151103   0020      5
4151104   0120      7
4151300   1
*
*****************************************************************
* TOP VOLUME PRESSURIZER                                        *
*
4200000   TOPPRE    BRANCH
4200001   1         0
4200101   0.13      0.236     0.0       0.0       90.0      0.236
4200102   4.5E-5    0.0    01
4201101   415010000  420000000  0.0    0.0    0.0    0120
*
*****************************************************************
*****************************************************************
*
*                 HEAT STRUCTURE INPUT DATA
*
*****************************************************************
* REACTOR VESSEL HEAT STRUCTURES                                *
*
*****************************************************************
* FILLER BLOCKS  INLET ANNULUS TOP VOLUME                       *
*
12000000  1         5         2         1         0.508
12000100  0         1
12000101  4         0.773
12000201  4         4
12000301  0.0       4
12000401  565.2     5
12000501  200010000 0         1         1         0.33      1
12000601  0         0         0         1         0.33      1
12000701  0         0.5       0.0       0.0       1
12000801  0         .178      0.0       0.33      1
*
*****************************************************************
* FILLER BLOCKS INLET ANNULUS LOWER VOLUME                      *
*
```

```
12050000  1         5         2         1         0.561
12050100  0         1
12050101  4         0.786
12050201  4         4
12050301  0.0       4
12050401  565.2     5
12050501  205010000 0         1         1         0.424     1
12050601  0         0         0         1         0.424     1
12050701  0         0.0       0.0       0.0       1
12050801  0         .172      0.0       0.424     1
*
*******************************************************************
* FILLER BLOCKS DOWNCOMER AND LOWER PLENUM                        *
*
12100000  6         5         2         1         0.47
12100100  0         1
12100101  4         0.736
12100201  4         4
12100301  0.0       4
12100401  565.2     5
12100501  210010000 0         1         1         0.958     1
12100503  2100 0000 0         1         1         0.958     3
12100504  2,0040000 0         1         1         0.958     4
12100505  215010000 0         1         1         0.36      5
12100506  220010000 0         1         1         0.37      6
12100601  0         0         0         1         0.958     4
12100602  0         0         0         1         0.36      5
12100603  0         0         0         1         0.37      6
12100701  0         0.0       0.0       0.0       6
12100801  0         0.102     0.0       0.958     4
12100802  0         0.9 1     0.0       0.36      5
12100803  0         1.003     0.0       0.37      6
*
*******************************************************************
* CORE SUPPORT BARREL                                             *
*
12010000  6         5         2         1         0.3810
12010100  0         1
12010101  6         0.4191
12010201  4         4
12010301  0.0       4
12010401  565.2     5
12010501  200010000 0         1         1         0.33      1
12010502  205010000 0         1         1         0.424     2
12010503  210010000 0         1         1         0.958     3
12010504  210020000 0         1         1         0.958     4
12010505  210030000 0         1         1         0.958     5
12010506  210040000 0         1         1         0.958     6
12010601  0         0         0         1         0.33      1
12010602  0         0         0         1         0.424     2
12010603  0         0         0         1         0.958     3
12010604  0         0         0         1         0.958     4
12010605  0         0         0         1         0.958     5
12010606  0         0         0         1         0.958     6
12010701  0         0.0       0.0       0.0       6
12010801  0         0.178     0.0       0.33      1
12010802  0         0.172     0.0       0.424     2
12010803  0         0.102     0.0       0.958     6
*
*******************************************************************
* FLOW SKIRT - CORE FILLER ASSEMBLY                               *
*
12250000  10        5         2         1         0.5
12250100  0         1
12250101  4         0.
```

```
12250201  4         4
12250301  0.0       4
12250401  565.2     5
12250501  225010000 0         1         1         0.52      1
12250502  230010000 10000     1         1         0.2795    6
12250503  230060000 0         1         1         0.3775    7
12250504  240010000 0         1         1         1.118     8
12250505  245010000 0         1         1         0.42      9
12250506  246010000 0         1         1         0.35      10
12250601  0         0         0         1         0.52      1
12250602  0         0         0         1         0.2795    6
12250603  0         0         0         1         0.3775    7
12250604  0         0         0         1         1.118     8
12250605  0         0         0         1         0.42      9
12250606  0         0         0         1         0.35      10
12250701  0         0.0       0.0       0.0       10
12250801  0         0.        0.0       0.52      1
12250802  0         0.012     0.0       0.2795    6
12250803  0         0.012     0.0       0.3775    7
12250804  0         0.145     0.0       1.118     8
12250805  0         0.131     0.0       0.42      9
12250806  0         0.214     0.0       0.35      10
*
*******************************************************************
* ACTIVE CORE                                                     *
*
12300000  6         9         2         1         0.0
12300100  0         1
12300101  5         4.647E-3
12300102  1         4.742E-3
12300103  2         5.355E-3
12300201  1         5
12300202  -2        6
12300203  -3        8
12300301  1.0       5
12300302  0.0       8
12300401  1150.     6
12300402   560.     9
12300501  0         0         0         1         363.35    5
12300502  0         0         0         1         490.75    6
12300601  230010000 10000     1         1         363.35    5
12300602  230060000 0         1         1         490.75    6
12300701  1000      0.061     0.0       0.0       1
12300702  1000      0.282     0.0       0.0       2
12300703  1000      0.245     0.0       0.0       3
12300704  1000      0.228     0.0       0.0       4
12300705  1000      0.146     0.0       0.0       5
12300706  1000      0.038     0.0       0.0       6
12300901  0         0.01250   0.0       0.2795    5
12300902  0         0.01250   0.0       0.3775    6
*
*******************************************************************
* FUEL MODULES                                                    *
*
12460000  1         5         1         1         0.0
12460100  0         1
12460101  4         0.01
12460201  4         4
12460301  0.0       4
12460401  565.2     5
12460501  245010000 0         1         1         1.8       1
12460601  246010000 0         1         1         1.8       1
12460701  0         0.0       0.0       1.8       1
12460801  0         0.131     0.0       1.8       1
12460901  0         0.214     0.0       1.8       1
```

```
*
*******************************************************************
* REACTOR VESSEL BOTTOM                                           *
*
12200000  1         5         1         1         0.0
12200100  0         1
12200101  4         0.092
12200201  4         4
12200301  0.0       4
12200401  565.2     5
12200501  -999      0         3949      0         1.68      1
12200601  220010000 0         1         0         1.68      1
12200701  0         0.0       0.0       0.0
12200901  0         0.0       0.0       0.52
*
*******************************************************************
* LOWER CORE SUPPORT STRUCTURE                                    *
*
12260000  1         5         2         1         0.282
12260100  0         1
12260101  4         0.3
12260201  4         4
12260301  0.0       4
12260401  565.2     5
12260501  225010000 0         1         1         0.52      1
12260601  0         0         0         1         0.52      1
12260701  0         0.0       0.0       0.0       1
12260801  0         0.0       0.0       0.52      1
*
*******************************************************************
* UPPER CORE SUPPORT STRUCTURE                                    *
*
12400000  1         5         2         1         0.282
12400100  0         1
12400101  4         0.31
12400201  4         4
12400301  0.0       4
12400401  565.2     5
12400501  240010000 0         1         1         .559      1
12400601  0         0         0         1         .559      1
12400701  0         0.0       0.0       0.0       1
12400801  0         0.145     0.0       .559      1
*
*******************************************************************
* UPPER HEAD TOP PLATE                                            *
*
12550000  1         5         1         1         0.0
12550100  0         1
12550101  4         0.474
12550201  4         4
12550301  0.0       4
12550401  565.2     5
12550501  255010000 0         1         1         0.712     1
12550601  -999      0         2949      1         0.712     1
12550701  0         0.0       0.0       0.0       1
12550801  0         0.0       0.0       0.712     1
*
*******************************************************************
* CORE SUPPORT BARREL UPPER PLENUM LOWER VOLUME                   *
*
12500000  1         5         2         1         0.381
12500100  0         1
12500101  4         0.419
12500201  4         4
12500301  0.0       4
```

```
12500401   565.2     5
12500501   250010000 0         1         1         0.854     1
12500601   0         0         0         1         0.854     1
12500701   0         0.0       0.0       0.5       1
12500801   0         0.0       0.0       0.854     1
*
*******************************************************************
* CORE SUPPORT BARREL UPPER PLENUM TOP VOLUME                     *
*
12520000   1         5         2         1         0.381
12520100   0         1
12520101   4         0.728
12520201   4         4
12520301   0.0       4
12520401   565.2     5
12520501   255010000 0         1         1         0.712     1
12520601   -999      0         3949      1         0.712     1
12520701   0         0.0       0.0       0.0       1
12520801   0         0.0       0.0       0.712     1
*
*******************************************************************
* INTERNALS UPPER PLENUM                                          *
*
12510000   2         5         1         1         0.0
12510100   0         1
12510101   4         0.005
12510201   4         4
12510301   0.0       4
12510401   565.2     5
12510501   250010000 0         1         1         1.0       1
12510502   255010000 0         1         1         1.0       2
12510601   0         0         0         1         1.0       1
12510602   0         0         0         1         1.0       2
12510701   0         0.0       0.0       0.0       2
12510801   0         0.0       0.0       1.0       1
12510802   0         0.0       0.0       1.0       2
*
*******************************************************************
*******************************************************************
*
* PRIMARY SYSTEM PIPING
*
*******************************************************************
*
* BROKEN HOT LEG
*
13150000   2         6         2         1         .0518
13150100   0         1
13150101   5         .0705
13150201   4         5
13150301   0.0       5
13150401   540.      6
13150501   315010000 0         1         1         .4054     1
13150502   315020000 0         1         1         .5265     2
13150601   -999      0         3949      1         .4054     1
13150602   -999      0         3949      1         .5265     2
13150701   0         0         0         0         2
13150801   0         0         0         .4054     1
13150802   0         0         0         .5265     2
*
13151000   1         6         2         1         .1074
13151100   0         1
13151101   5         .1050
13151201   4         5
13151301   0.0       5
```

```
13151401   540.      6
13151501   315080000 0         1         1         2.671     1
13151601   -999      0         3949      1         2.671     1
13151701   0         0         0         0         1
13151801   0         0         0         2.671     1
*
13152000   1         6         2         1         .0660
13152100   0         1
13152101   5         .0840
13152201   4         5
13152301   0.0       5
13152401   540.      6
13152501   315090000 0         1         1         1.842     1
13152601   -995      0         3949      1         1.842     1
13152701   0         0         0         0         1
13152801   0         0         0         1.842     1
*
13153000   5         6         2         1         .1835
13153100   0         1
13153101   5         .2285
13153201   4         5
13153301   0.0       5
13153401   540.      6
13153501   315030000 10000     1         1         1.699     4
13153502   315070000 0         1         1         .362      5
13153601   -999      0         3949      1         1.699     4
13153602   -999      0         3949      1         .362      5
13153701   0         0         0         0         5
13153801   0         0         0         1.699     4
13153802   0         0         0         .362      5
*
13154000   1         6         2         1         .1285
13154100   0         1
13154101   5         .1620
13154201   4         5
13154301   0.0       5
13154401   540.      6
13154501   315100000 0         1         1         .667      1
13154601   -999      0         3949      1         .667      1
13154701   0         0         0         0         1
13154801   0         0         0         .667      1
*
13000000   3         6         2         1         .1420
13000100   0         1
13000101   5         .1780
13000201   4         5
13000301   0.0       5
13000401   540.      6
13000501   300010000 0         1         1         .8760     1
13000502   305010000 0         1         1         .6980     2
13000503   310010000 0         1         1         1.424     3
13000601   -999      0         3949      1         .8760     1
13000602   -999      0         3949      1         .6980     2
13000603   -999      0         3949      1         1.424     3
13000701   0         0         0         0         3
13000801   0         0         0         .8760     1
13000802   0         0         0         .6980     2
13000803   0         0         0         1.424     3
*
*******************************************************************
* REFLOOD ASSIST BYPASS
*
13750000   2         6         2         1         .111
13750100   0         1
13750101   5         .1365
```

```
13750201   4         5
13750301   0.0       5
13750401   540.      6
13750501   370010000 0         1         1         4.415     1
13750502   380010000 0         1         1         5.240     2
13750601   -999      0         3949      1         4.415     1
13750602   -999      0         3949      1         5.240     2
13750701   0         0         0         0         2
13750801   0         0         0         4.415     1
13750802   0         0         0         5.240     2
*
*******************************************************************
* B.L. COLD LEG
*
13350000   3         6         2         1         .1420
13350100   0         1
13350101   5         .1780
13350201   4         5
13350301   0.0       5
13350401   540.      6
13350501   335010000 0         1         1         .7495     1
13350502   340010000 0         1         1         .6980     2
13350503   345010000 0         1         1         .9740     3
13350601   -999      0         3949      1         .7495     1
13350602   -999      0         3949      1         .6980     2
13350603   -999      0         3949      1         .9740     3
13350701   0         0         0         0         3
13350801   0         0         0         .7495     1
13350802   0         0         0         .6980     2
13350803   0         0         0         .9740     3
*
13501000   1         6         2         1         .0803
13501100   0         1
13501101   5         .1287
13501201   4         5
13501301   0.0       5
13501401   540.      6
13501501   350010000 0         1         1         2.0965    1
13501601   -999      0         3949      1         2.0965    1
13501701   0         0         0         0         1
13501801   0         0         0         2.0965    1
*
*******************************************************************
* INTACT LOOP PIPING
*
11001000   12        6         2         1         .142
11001100   0         1
11001101   5         .178
11001201   4         5
11001301   0.0       5
11001401   540.      6
11001501   100010000 0         1         1         1.5373    1
11001502   105010000 0         1         1         1.6340    2
11001503   110010000 0         1         1         1.1303    3
11001504   115010000 0         1         1         .93174    4
11001505   115120000 0         1         1         .6890     5
11001506   115130000 0         1         1         .5590     6
11001507   120010000 0         1         1         .7600     7
11001508   150010000 0         1         1         .4966     8
11001509   175010000 0         1         1         .5590     9
11001510   175020000 0         1         1         .6130     10
11001511   180010000 0         1         1         .7010     11
11001512   185010000 0         1         1         1.4610    12
11001601   -999      0         3949      1         1.5373    1
11001602   -999      0         3949      1         1.6340    2
```

```
11001603   -999       0       3949    1       1.1303   3
11001604   -999       0       3949    1       .93124   4
11001605   -999       0       3949    1       .6890    5
11001606   -999       0       3949    1       .5590    6
11001607   -999       0       3949    1       .7600    7
11001608   -999       0       3949    1       .4966    8
11001609   -999       0       3949    1       .5590    9
11001610   -999       0       3949    1       .6130    10
11001611   -999       0       3949    1       .7010    11
11001612   -999       0       3949    1       1.461    12
11001701   0          0       0       0       12
11001801   0          0       0       1.5073  1
11001802   0          0       0       1.6340  2
11001803   0          0       0       1.12303 3
11001804   0          0       0       .93124  4
11001805   0          0       0       .6890   5
11001806   0          0       0       .5590   6
11001807   0          0       0       .7600   7
11001808   0          0       0       .4968   8
11001809   0          0       0       .5590   9
11001810   0          0       0       .5130   10
11001811   0          0       0       .7010   11
11001812   0          0       0       1.461   12
*
11002000   2          5       2       1       .1625
11002100   0          1
11002101   5          .2030
11002201   4          5
11002301   0.0        5
11002401   540.       6
11002501   115020000  0       1       1       .708     1
11002502   115110000  0       1       1       .547     2
11002601   -999       0       3949    1       .708     1
11002602   -999       0       3949    1       .547     2
11002701   0          0       0       0       2
11002801   0          0       0       .708    1
11002802   0          0       0       .547    2
*
11003000   7          6       2       1       .108
11003100   0          1
11003101   5          .1365
11003201   4          5
11003301   0.0        5
11003401   540.       6
11003501   125010000  0       1       1       1.003    1
11003502   130010000  0       1       1       .457     2
11003503   140010000  0       1       1       .502     3
11003504   145010000  0       1       1       1.4084   4
11003505   155010000  0       1       1       1.003    5
11003506   160010000  0       1       1       .457     6
11003507   170010000  0       1       1       .514     7
11003601   -999       0       3949    1       1.003    1
11003602   -999       0       3949    1       .457     2
11003603   -999       0       3949    1       .502     3
11003604   -999       0       3949    1       1.4084   4
11003605   -999       0       3949    1       1.003    5
11003606   -999       0       3949    1       .457     6
11003607   -999       0       3949    1       .514     7
11003701   0          0       0       0       7
11003801   0          0       0       1.003   1
11003802   0          0       0       .457    2
11003803              0       0       .502    3
11003804   0          0       0       1.4084  4
11003805   0          0       0       1.003   5
11003806   0          0       0       .457    6
11003807   0          0       0       .514    7
*
11004000   2          6       3       1       .6858
11004100   0          1
11004101   5          .7747
11004201   4          5
11004301   0.0        5
11004401   540.       6
11004501   115010000  0       1       1       .25      1
11004502   115100000  0       1       1       .25      2
11004601   -999       0       3949    1       .25      1
11004602   -999       0       3949    1       .25      2
11004701   0          0       0       0       2
11004801   0          0       0       .630    1
11004802   0          0       0       .630    2
11004901   0          0       0       .630    2
*
****************************************************************
****************************************************************
*
* STEAM GENERATOR PRI-SEC HEAT STRUCTURES
*
****************************************************************
*
* STEAM GENERATOR TUBING                                        *
*
10060000   6          8       2       1       0.0051054
10060100   0          1
10060101   7          0.006346984
10060201   6          7
10060301   0.0        7
10060401   540.0      8
10060601   517010000  0       1  1  1624.338  1
10060602   517020000  0       1  1  2236.34   2
10060603   517030000  0       1  1   943.16   3
10060604   517030000  0       1  1   943.16   4
10060605   517020000  0       1  1  2236.34   5
10060606   517010000  0       1  1  1624.338  6
10060501   115040000  0       1  1  1624.338  1
10060502   115050000  0       1  1  2236.34   2
10060503   115060000  0       1  1   943.16   3
10060504   115070000  0       1  1   943.16   4
10060505   115080000  0       1  1  2236.34   5
10060506   115090000  0       1  1  1624.338  6
10060701   0          0       0         0        6
10060801   0          0       0         0        6
10060901   0          0       0         0        6
*
****************************************************************
****************************************************************
*
* HEAT STRUCTURE THERMAL PROPERTY DATA                          *
*
20100100   TBL/FCTN   1            1     * UO2
20100200   TBL/FCTN   1            1     * GAP
20100300   TBL/FCTN   1            1     * ZR
~~20100100   TBL/FCTN   1            1     * UO2~~
~~20100300   ZR~~
20100400   S-STEEL
20100500   C-STEEL
20100600   TBL/FCTN   1            1     * INCONEL 600
****************************************************************
* THERMAL CONDUCTIVITY UO2
*
20100101    366.48  7.7796    449.81  5.5287    533.15  5.7824
20100102    616.48  4.6228    699.82  4.6332    783.15  4.2213
20100103    866.48  3.8803    949.82  3.5965    1033.15 3.3576
20100104    1088.71 3.1651    1199.82 2.9838    1283.15 2.8367
20100105    1366.48 2.7138    1449.82 2.6082    1533.32 2.5217
20100106    1616.48 2.4390    1699.82 2.3919    1977.59 2.2898
20100107    2255.37 2.3071    2533.15 2.4334    2810.93 2.5519
20100108    3088.71 2.9942
*
****************************************************************
* VOLYMETRIC HEAT CAPACITY UO2
*
20100151    273.15  2.3104E6  323.15  2.5720E6  373.15  2.7484E6
20100152    473.15  2.9207E6  673.15  3.1387E6  1373.15 3.4438E6
20100153    1773.15 3.5310E6  1973.15 3.7926E6  2173.15 4.2285E6
20100154    2273.15 4.8824E6  2673.15 6.0158E6  2773.15 6.3210E6
20100155    2873.15 6.5625E6  2973.15 6.7133E6  3113.15 6.8005E6
20100156    4699.82 6.8005E6
*
****************************************************************
* THERMAL CONDUCTIVITY ZR
*
20100301    273.15  9.5744    473.15  12.0044   673.15  14.0051
20100302    873.15  17.0079   1072.15 19.0087   1273.15 22.0098
20100303    1473.15 25.0109   1673.16 30.0127   1873.15 35.0149
20100304    2073.15 44.0178   2273.15 55.0235   2473.15 68.0283
*
****************************************************************
* VOLYMETRIC HEAT CAPACITY ZR
*
20100351    255.37  1.9041E6  1077.59 2.3122E6  1185.93 5.7124E6
20100352    1248.43 2.3118E6  2199.82 2.3122E6
*
*
****************************************************************
* THERMAL CONDUCTIVITY GAP                                      *
*
20100201   273.15     0.14
20100202   590.0      0.24
20100203   810.0      0.29
20100204   1090.0     0.36
20100205   1370.0     0.42
20100206   3260.0     0.75
*
****************************************************************
* THERMAL CONDUCTIVITY INCONEL 600
*
20100601   366.5      13.85
20100602   477.6      15.92
20100603   588.7      18.17
20100604   700.0      20.42
20100605   810.9      22.50
20100606   922.0      24.92
20100607   1033.2     26.33
20100608   1144.3     29.42
20100609   1477.6     36.06
*
****************************************************************
* VOLUMETRIC HEAT CAPACITY GAP                                  *
*
20100251   273.15     5.4
20100252   3260.0     5.4
*
****************************************************************
* VOLUMETRIC HEAT CAPACITY INCONEL 600                          *
*
```

```
20100651  366.5      3.908E5
20100652  477.6      4.084E5
20100653  588.7      4.260E5
20100654  700.0      4.436E5
20100656  810.9      4.665E5
20100657  922.0      4.929E5
20100658  1033.2     5.105E5
20100659  1477.6     5.727E5
*
******************************************************************
* HEAT STRUCTURE GENERAL TABLES
*
20299900   TEMP
20299901   0.0        305.
*
20294900   HTC-T
20294901   0.0        20.   * 250 KW SS SURROUNDINGS HEAT LOSS
*
******************************************************************
* POWER                                                          *
*
20290000  POWER
20290001  0.0        0.0
20290002  1000.0     0.0
*
******************************************************************
******************************************************************
*
*                     PUMP DATA
*
******************************************************************
*
* SINGLE PHASE HEAD CURVES                                       *
******************************************************************
*
* HEAD CURVE NO. 1                                               *
*
1351100    1                        1
1351101    0.000000E+00             1.403600E+00
1351102    1.906100E-01             1.363600E+00
1351103    3.896300E-01             1.318600E+00
1351104    5.939600E-01             1.232800E+00
1351105    7.902000E-01             1.132600E+00
1351106    1.000000E+00             1.000000E+00
******************************************************************
* HEAD CURVE NO. 2                                               *
*
1351200    1                        2
1351201    0.000000E+00             -6.700000E-01
1351202    2.000000E-01             -5.000000E-01
1351203    4.000000E-01             -2.500000E-01
1351204    5.755400E-01             0.000000E+00
1351205    7.443200E-01             2.583000E-01
1351206    7.734800E-01             3.775000E-01
1351207    8.631300E-01             6.326000E-01
1351208    1.000000E+00             1.000000E+00
******************************************************************
* HEAD CURVE NO. 3                                               *
*
1351300    1                        3
1351301    -1.000000E+00            2.472200E+00
1351302    -8.057400E-01            2.047400E+00
1351303    -6.069000E-01            1.831000E+00
1351304    -4.068300E-01            1.674000E+00
1351305    -2.001710E-01            1.470500E+00
1351306    0.000000E+00             1.403600E+00
******************************************************************
* HEAD CURVE NO. 4                                               *
*
1351400    1                        4
1351401    -1.000000E+00            2.472200E+00
1351402    -8.229700E-01            1.996800E+00
1351403    -6.333200E-01            1.589700E+00
1351404    -4.553400E-01            1.327900E+00
1351405    -2.710900E-01            1.194900E+00
1351406    -1.771600E-01            1.060500E+00
1351407    -9.073000E-02            1.015600E+00
1351408    0.000000E+00             9.342790E-01
******************************************************************
* HEAD CURVE NO. 5                                               *
*
1351500    1                        5
1351501    0.000000E+00             2.500000E-01
1351502    2.000000E-01             2.800000E-01
1351503    4.000000E-01             3.400000E-01
1351504    4.118000E-01             2.768000E-01
1351505    5.975300E-01             4.584000E-01
1351506    7.934670E-01             6.992000E-01
1351507    1.000000E+00             1.000000E+00
******************************************************************
* HEAD CURVE NO. 6                                               *
*
1351600    1                        6
1351601    0.000000E+00             9.342790E-01
1351602    9.109900E-02             9.229000E-01
1351603    1.865090E-01             8.968000E-01
1351604    2.717620E-01             8.750000E-01
1351605    4.558720E-01             8.433000E-01
1351606    5.744060E-01             8.355000E-01
1351607    7.405760E-01             8.466000E-01
1351608    7.656190E-01             8.469000E-01
1351609    8.714710E-01             8.638000E-01
1351610    1.000000E+00             1.000000E+00
******************************************************************
* HEAD CURVE NO. 7                                               *
*
1351700    1                        7
1351701    -1.000000E+00            -1.000000E+00
1351702    -8.000000E-01            -6.300000E-01
1351703    -6.000000E-01            -3.000000E-01
1351704    -4.000000E-01            -5.000000E-02
1351705    -2.000000E-01            1.500000E-01
1351706    0.000000E+00             2.500000E-01
******************************************************************
* HEAD CURVE NO. 8                                               *
*
1351800    1                        8
1351801    -1.000000E+00            -1.000000E+00
1351802    -8.000000E-01            -9.700000E-01
1351803    -8.000000E-01            -9.500000E-01
1351804    -4.000000E-01            -8.800000E-01
1351805    -2.000000E-01            -8.000000E-01
1351806    0.000000E+00             -6.700000E-01
*
******************************************************************
* SINGLE PHASE TORQUE DATA                                       *
*
******************************************************************
* TORQUE CURVE NO. 1                                             *
*
1351900    2                        1
1351901    0.000000E+00             6.032000E-01
1351902    1.930000E-01             6.325000E-01
1351903    3.930000E-01             7.369000E-01
1351904    5.955200E-01             8.331000E-01
1351905    7.978200E-01             9.229000E-01
1351906    1.000000E+00             1.000000E+00
******************************************************************
* TORQUE CURVE NO. 2                                             *
*
1352000    2                        2
1352001    0.000000E+00             -6.700000E-01
1352002    4.000000E-01             -2.500000E-01
1352003    5.000000E-01             1.500000E-01
1352004    7.372550E-01             5.258660E-01
1352005    7.880490E-01             6.065940E-01
1352006    8.672300E-01             7.436600E-01
1352007    1.000000E+00             1.000000E+00
******************************************************************
* TORQUE CURVE NO. 3                                             *
*
1352100    2                        3
1352101    -1.000000E+00            1.984300E+00
1352102    -8.009600E-01            1.394000E+00
1352103    -6.063800E-01            1.097500E+00
1352104    -4.068600E-01            8.220000E-01
1352105    -1.992800E-01            6.648000E-01
1352106    0.000000E+00             6.032000E-01
******************************************************************
* TORQUE CURVE NO. 4                                             *
*
1352200    2                        4
1352201    -1.000000E+00            1.984300E+00
1352202    -8.223400E-01            1.830800E+00
1352203    -5.337100E-01            1.682400E+00
1352204    -4.585300E-01            1.557000E+00
1352205    -2.670230E-01            1.436200E+00
1352206    -1.761070E-01            1.397900E+00
1352207    -8.931000E-02            1.348100E+00
1352208    0.000000E+00             1.233610E+00
******************************************************************
* TORQUE CURVE NO. 5                                             *
*
1352300    2                        5
1352301    0.000000E+00             -4.500000E-01
1352302    4.000000E-01             -2.500000E-01
1352303    5.000000E-01             0.000000E+00
1352304    1.000000E+00             3.569000E-01
******************************************************************
* TORQUE CURVE NO. 6                                             *
*
1352400    2                        6
1352401    0.000000E+00             1.233610E+00
1352402    9.064300E-02             1.196500E+00
1352403    1.885690E-01             1.109600E+00
1352404    2.734700E-01             1.041600E+00
1352405    4.586690E-01             8.958000E-01
1352406    5.744800E-01             7.807000E-01
1352407    7.381600E-01             6.134000E-01
1352408    7.685200E-01             5.849000E-01
1352409    8.700570E-01             4.877000E-01
1352410    1.000000E+00             3.569000E-01
******************************************************************
* TORQUE CURVE NO. 7                                             *
*
```

```
1352500   7                   7
1352501   -1.000000E+00       -1.000000E+00
1352502   -3.000000E-01       -9.000000E-01
1352503   -1.000000E-01       -5.000000E-01
1352504   0.000000E+00        -4.500000E-01
**********************************************************************
* FOR TORQUE CURVE NO. 8                                             *
*
1352600   7                   8
1352601   -1.000000E+00       -1.000000E+00
1352602   -2.500000E-01       -9.000000E-01
1352603   -8.000000E-02       -8.000000E-01
1352604   0.000000E+00        -6.700000E-01
*
**********************************************************************
* TWO - PHASE MULTIPLIER DATA                                        *
*
**********************************************************************
* HEAD CURVE                                                         *
*
1353000   0
1353001   0.000000E+00        0.000000E+00
1353002   2.000000E-02        2.000000E-02
1353003   6.000000E-02        5.000000E-02
1353004   1.000000E-01        1.000000E-01
1353005   2.000000E-01        4.600000E-01
1353006   2.400000E-01        8.000000E-01
1353007   3.000000E-01        9.600000E-01
1353008   4.000000E-01        9.800000E-01
1353009   6.000000E-01        9.700000E-01
1353010   8.000000E-01        9.000000E-01
1353011   9.000000E-01        8.000000E-01
1353012   9.600000E-01        5.000000E-01
1353013   1.000000E+00        0.000000E+00
**********************************************************************
* TORQUE CURVE                                                       *
*
1353100   0
1353101   0.000000E+00        0.000000E+00
1353102   1.250000E-01        7.000000E-02
1353103   1.650000E-01        1.250000E-01
1353104   2.400000E-01        5.600000E-01
1353105   8.000000E-01        5.600000E-01
1353106   9.600000E-01        4.500000E-01
1353107   1.000000E+00        0.000000E+00
*
**********************************************************************
* PUMP 2-PHASE DIFFERENCE DATA                                       *
*
**********************************************************************
* HEAD CURVE NO. 1                                                   *
*
1354100   1                   1
1354101   0.000000E+00        0.000000E+00
1354102   1.000000E-01        8.300000E-01
1354103   2.000000E-01        1.090000E+00
1354104   5.000000E-01        1.020000E+00
1354105   7.000000E-01        1.010000E+00
1354106   9.000000E-01        9.400000E-01
1354107   1.000000E+00        1.000000E+00
**********************************************************************
* HEAD CURVE NO. 2                                                   *
*
1354200   1                   2
1354201   0.000000E+00        0.000000E+00
1354202   1.000000E-01        -4.000000E-02
1354203   2.000000E-01        0.000000E+00
1354204   3.000000E-01        1.000000E-01
1354205   4.000000E-01        2.100000E-01
1354206   8.000000E-01        6.700000E-01
1354207   9.000000E-01        8.000000E-01
1354208   1.000000E+00        1.000000E+00
**********************************************************************
* HEAD CURVE NO. 3                                                   *
*
1354300   1                   3
1354301   -1.000000E+00       -1.160000E+00
1354302   -9.000000E-01       -1.240000E+00
1354303   -8.000000E-01       -1.770000E+00
1354304   -7.000000E-01       -2.360000E+00
1354305   -6.000000E-01       -2.790000E+00
1354306   -5.000000E-01       -2.910000E+00
1354307   -4.000000E-01       -2.670000E+00
1354308   -2.500000E-01       -1.690000E+00
1354309   -1.000000E-01       -5.000000E-[illegible]
1354310   0.000000E+00        0.000000E+00
**********************************************************************
* HEAD CURVE NO. 4                                                   *
*
1354400   1                   4
1354401   -1.000000E+00       -1.160000E+00
1354402   -9.000000E-01       -7.800000E-01
1354403   -8.000000E-01       -5.000000E-01
1354404   -7.000000E-01       -3.100000E-01
1354405   -6.000000E-01       -1.700000E-01
1354406   -5.000000E-01       -8.000000E-02
1354407   -3.500000E-01       0.000000E+00
1354408   -2.000000E-01       5.000000E-02
1354409   -1.000000E-01       8.000000E-02
1354410   0.000000E+00        1.100000E-01
**********************************************************************
* HEAD CURVE NO. 5                                                   *
*
1354500   1                   5
1354501   0.000000E+00        0.000000E+00
1354502   2.000000E-01        -3.400000E-01
1354503   4.000000E-01        -6.500000E-01
1354504   6.000000E-01        -9.300000E-01
1354505   8.000000E-01        -1.190000E+00
1354506   1.000000E+00        -1.470000E+00
**********************************************************************
* HEAD CURVE NO. 6                                                   *
*
1354600   1                   6
1354601   0.000000E+00        1.100000E-01
1354602   1.000000E-01        1.370000E-01
1354603   2.500000E-01        1.500000E-01
1354604   4.000000E-01        1.300000E-01
1354605   5.000000E-01        7.000000E-02
1354606   6.000000E-01        -4.000000E-02
1354607   7.000000E-01        -2.300000E-01
1354608   8.000000E-01        -5.100000E-01
1354609   9.000000E-01        -9.100000E-01
1354610   1.000000E+00        -1.470000E+00
**********************************************************************
* HEAD CURVE NO. 7                                                   *
*
1354700   1                   7
1354701   -1.000000E+00       0.000000E+00
1354702   0.000000E+00        0.000000E+00
**********************************************************************
* HEAD CURVE NO. 8                                                   *
*
1354800   1                   8
1354801   -1.000000E+00       0.000000E+00
1354802   0.000000E+00        0.000000E+00
**********************************************************************
* TORQUE CURVE NO. 1                                                 *
*
1354900   2                   1
1354901   0.000000E+00        6.332000E-01
1354902   1.930000E-01        6.325000E-01
1354903   3.930000E-01        7.369000E-01
1354904   5.955200E-01        8.331000E-01
1354905   7.978200E-01        9.229000E-01
1354906   1.000000E+00        1.000000E+00
**********************************************************************
* TORQUE CURVE NO. 2                                                 *
*
1355000   2                   2
1355001   0.000000E+00        -6.700000E-01
1355002   4.000000E-01        -2.5[illegible]00E-01
1355003   5.000000E-01        1.50[illegible]00E-01
1355004   7.372550E-01        5.265860E-01
1355005   7.680490E-01        6.065940E-01
1355006   8.672300E-01        7.436600E-01
1355007   1.000000E+00        1.000000E+00
**********************************************************************
* TORQUE CURVE NO. 3                                                 *
*
1355100   2                   3
1355101   -1.000000E+00       1.984300E+00
1355102   -8.009600E-01       1.394000E+00
1355103   -6.063800E-01       1.097500E+00
1355104   -4.068600E-01       8.220000E-01
1355105   -1.992800E-01       6.648000E-01
1355106   0.000000E+00        6.032000E-01
**********************************************************************
* TORQUE CURVE NO. 4                                                 *
*
1355200   2                   4
1355201   -1.000000E+00       1.584300E+00
1355202   -8.[illegible]3400E-01     1.530800E+00
1355203   -6.337100E-01       1.682400E+00
1355204   -4.585300E-01       1.557000E+00
1355205   -2.670230E-01       1.436200E+00
1355206   -1.761070E-01       1.387900E+00
1355207   -8.931000E-02       1.348100E+00
1355208   0.000000E+00        1.233610E+00
**********************************************************************
* TORQUE CURVE NO. 5                                                 *
*
1355300   2                   5
1355301   0.000000E+00        -4.500000E-01
1355302   4.000000E-01        -2.500000E-01
1355303   5.000000E-01        0.000000E+00
1355304   1.000000E+00        3.569000E-01
**********************************************************************
* TORQUE CURVE NO. 6                                                 *
*
1355400   2                   6
1355401   0.000000E+00        1.233610E+00
1355402   9.064300E-02        1.196[illegible]00E+00
1355403   1.885690E-01        1.109600E+00
1355404   2.734700E-01        1.041600E+00
```

```
1355405    4.686690E-01          8.920000E-01
1355406     .744800E-01          7.807000E-01
1355407    7.381600E-01          6.134000E-01
1355408    7.685200E-01          5.849000E-01
1355409    8.700570E-01          4.817000E-01
1355410    1.000000E+00          3.585300E-01
******************************************************************
* TORQUE CURVE NO. 7                                             *
*
1355500    2                     7
1355501    -1.000000E+00         -1.000000E+00
1355502    -3.000000E-01         -8.000000E-01
1355503    -1.000000E-01         -5.000000E-01
1355504    0.000000E+00          -4.500000E-01
******************************************************************
* TORQUE CURVE NO. 8                                             *
*
1355600    2                     8
1355601    -1.000000E+00         -1.000000E+00
1355602    -2.500000E-01         -9.000000E-01
1355603    -8.000000E-02         -8.000000E-01
1355604    0.000000E+00          -6.700000E-01
*
******************************************************************
******************************************************************
*
*  REACTOR KINETICS                                              *
*
******************************************************************
*
* POINT KINETICS                                                 *
*
30000000  POINT
30000001  GAMMA-AC  49.0E6    0.         371.875
*
******************************************************************
* DELAYED NEUTRON CONSTANTS                                      *
*
30000101  0.042      3.01
30000102  0.1150     1.14
30000103  0.3950     3.301
30000104  0.1960     0.301
30000105  0.2190     0.305
30000106  0.0330     0.0124
*
******************************************************************
* POWER HISTORY                                                  *
*
30000401  25.E+6     9.        HR
30000402  49.0E+6   36.        HR
*
******************************************************************
* REACTIVITY CURVE                                               *
*
30000011  609
*
******************************************************************
* MODERATOR DENSITY REACTIVITY TABLE                             *
*
30000501  0.8125  -3.4
30000502  0.875   -1.8
30000503  0.9375  -0.3
30000504    1.0    1.0
30000505  1.0625   2.2
30000506  1.125    3.1
```

```
30000507  1.1875    4.0
30000508  1.25      4.9
*
******************************************************************
* DOPPLER  REACTIVITY TABLE                                      *
*
30000601     255.    1.5
30000602     500.    0.3
30000603     750.   -0.7
30000604    1000.    -1.6
30000605    1250.    -2.3
30000606    1500.    -3.0
30000607    1750.    -3.7
30000608    2000.    -4.3
30000609    2250.    -4.9
30000610    2500.    -5.4
30000611    2750.    -5.9
30000612    3000.    -6.3
*
******************************************************************
* SCRAM ROD WORTH CURVE      609                                 *
*
20260900  REAC-T     501
20260901  0.0        0.0
20260902  0.1       -2.1
20260903  0.2       -4.3
20260904  0.3       -6.8
20260905  0.4       -9.2
20260906  0.5       -11.1
20260907  0.6       -12.2
20260908  0.7       -12.9
20260909  0.8       -13.3
20260910  0.9       -13.6
20260911  1.0       -13.7
20260912  1.1       -13.8
20260913  1.2       -13.9
20260914  1.8       -14.0
20260915  1000.     -14.0
*
******************************************************************
* MODERATOR DENS. FEEDBACK                                       *
*
30000701   230010000       0     0.16746    0.0
30000702   230020000       0     0.15746    0.0
30000703   230030000       0     0.15746    0.0
30000704   230040000       0     0.15746    0.0
30000705   230050000       0     0.15746    0.0
30000706   230060000       0     0.21270    0.0
*
******************************************************************
* DOPPLER  FEEDBACK                                              *
*
30000801   2300001         0     0.0170     0.0
30000802   2300002         0     0.3639     0.0
30000803   2300003         0     0.2747     0.0
30000804   2300004         0     0.2279     0.0
30000805   2300005         0     0.0976     0.0
30000806   2300006         0     0.0085     0.0
*
**********  ******************************************************
**********  ******************************************************
*
*            STEAM GENERATOR SECONDARY SIDE
*
******************************************************************
```

```
*
* TOP OF DOWNCOMER (OUTLET OF PRIMARY SEPARATOR)                 *
*
5000000    DOWNTOP     BRANCH
5000001    1           1
5000101    1.273       0.718      0.0         0.0         -90.0    -0.718
5000102    4.E-5       0.7874     00
5001101    500010000 505000000 0.0      0.0          0.0        0100
*
******************************************************************
* LOWER SEPARATOR SECTION                                        *
*
5050000    LWR-SEP     SNGLVOL
5050101    1.273       0.718      0.0         0.0         -90.0    -0.718
5050102    4.E-5       0.7874     00
*
******************************************************************
* FEED INLET VOLUME                                              *
*
5100000    FEED-INLET             BRANCH
5100001    2     1
5100101    0.7525      0.518      0.0         0.0         -90.0    -0.518
5100102    4.E-5       0.10796    00
5101101    505010000 510000000 0.0          0.0         0.0        0100
5102101    510010000 515000000 0.0          0.0         0.0        0100
*
******************************************************************
* SEPARATOR (INSIDE SHROUD, ABOVE TUBES)
*
5200000    SEPAR       SEPARATR
5200001    3           1
5200101    0.27871     0.718      0.0         0.0         90.0     0.718
5200102    4.E-5       0.0        00
5201101    520010000 525000000 0.0     2.           2.         1000   .5
5202101    520000000 505000000 0.0     5.           5.         1000   .10
5203101    519010000 520000000 0.196   0.4          0.4        1000
*
******************************************************************
* BELOW MIST EXTRACTOR, ABOVE TOP OF SHROUD IN STEAM DOME        *
*
5250000    BOTSTMDM               BRANCH
5250001    1           1
5250101    .90         0.762      0.0         0.0         90.0     0.762
5250102    4.E-5       0.0        00
5251101    525010000 530000000 0.0          0.8         0.8        0100
*
******************************************************************
* BELOW MIST EXTRACTOR, PRALLEL VOLUME
*
5260000    BOTSTMDMP              BRANCH
5260001    2           1
5260101    .2148       0.762      0.0         0.0         -90.0    -0.762
5260102    4.E-5       0.0        00
5261101    526010000 525000000 0.0          0.8         0.8        0103
5262101    526010000 500000000 0.0          0.0         0.0        0100
*
****************************************************** ***********
* MIST EXTRACTOR AND S 'M GEN OUTLET PIPE TO SCV                 *
*
5300000    STMDM-PIPE             PIPE
5300001    2
5300101    0.79900R     1
5300102    0.04635      2
5300201    0.01365      1
5300301    0.762        1
```

```
5300302   25.074    2
5300401   0.0       2
5300601   90.0      1
5300602   0.0       2
5300801   4.E-5     0.0       2
5300901   0.4       0.4       1
5301001   00        2
5301101   0100      1
5301300   0
5301300   1
*
**********************************************************************
* PIPE DOWNSTREAM OF SCV                                             *
*
5350000   CONDINL             SNGLVOL
5350101   0.06557   54.44     0.0       0.0       0.0       0
5350102   4.E-5     0.0       00
*
**********************************************************************
* AIR COOLED CONDENSER                                               *
*
5400000   CONDSER             TMDPVOL
5400101   0.21577   17.67     0.0       0.0       0.5       0.0
5400102   4.E-5     0.02      00
5400200   3
5400207   0.0       2.0200E6 1.0
5400208 1000.       2.0200E6 1.0
*
**********************************************************************
* MAKE UP FEED STORAGE TANK                                          *
*
5450000   FEEDTANK            TMDPVOL
5450101   29.81     3.048     0.0       0.0       0.0       0.0
5450102   4.E-5     0.0       00
5450200   0         0         CNTRLVAR  606
5450201   .854OE6   6.0E6     .854OE6   2.785E6   .5
5450202   1.0378E6  6.0E6     1.0378E6  2.785E6   .5
*
**********************************************************************
* FLOW PATH TO THE AIR COOLED CONDENSER
*
5550000   COACCO    SNGLJUN
5550101   535010000 540000000 0.0       0.0       0.0       0100
*
**********************************************************************
**********************************************************************
*
*               HEAT STRUCTURE INPUT DATA
*
**********************************************************************
*
* STEAM GENERATOR HEAT STRUCTURES                                    *
*
**********************************************************************
* SHROUD SECONDARY SIDE STEAM GENERATOR                              *
*
15000000  3         4         2         1         0.3048
15000100  0         1
15000101  3         0.314225
15000201  5         3
15000301  0.0       3
15000401  E:0.0     4
15000501  500010000 0         1         1         0.7725    1
15000502  505010000 0         1         1         0.7725    2
15000503  510010000 0         1         1         0.152     3
```

```
15000601  520010000 0         1         1         0.7725    1
15000602  519020000 0         1         1         0.7725    2
15000603  519010000 0         1         1         0.152     3
15000701  0         0         0         0         3
15000801  0         0.0       0.0       0.0       3
15000901  0         0.0       0.0       0.0       3
15150000  4         4         2         0         0.6445
15150100  0         1
15150101  3         0.6572
15150201  5         3
15150301  0.0       3
15150401  540.0     4
15150501  510010000 0         1         1         0.152     1
15150502  515010000 10000     1         1         0.7113    4
15150601  519010000 0         1         1         0.152     1
15150602  517030000 -10000    1         1         0.7113    4
15150701  0         0         0         0         4
15150801  0         0.0       0.0       0.0       4
15150901  0         0.0       0.0       0.0       4
**********************************************************************
* SG VESSEL WALL - SURROUNDINGS
*
15050000  5         4         2         1         .7112
15050100  0         1
15050101  3         .73816
15050201  5         3
15050301  0.0       3
15050401  540.      4
15050501  505010000 0         1         1         .718      1
15050502  510010000 0         1         1         .518      2
15050503  515010000 10000     1         1         .7102     5
15050601  -999      0         3949      1         .718      1
15050602  -999      0         3949      1         .518      2
15050603  -999      0         3949      1         .7102     5
15050701  0         0.0       0.0       0.0       5
15050801  0         0.0       0.0       0.0       5
15050901  0         0.0       0.0       0.0       5
*
**********************************************************************
**********************************************************************
*
*               S.G. SECONDARY DWNC-BOIL-RISR
*
**********************************************************************
*
* STEAM GENRATOR DOWNCOMER
*
5150000   DWNCMR              PIPE
5150001   3
5150101   0.23229   3
5150201   0.0       2
5150301   0.7102    3
5150401   0.0       3
5150601   -90.      3
5150701   -0.7102   3
5150801   4.E-5     0.10796   3
5150901   0.0       0.0       2
5151001   00        3
5151101   0000      2
5151300   1
*
**********************************************************************
* STEAM GENERATOR BOILING SECTION
*
5170000   BILSCT              PIPE
```

```
5170001   3
5170101   0.27871   3
5170201   0.0       2
5170301   1.85075   3
5170401   0.0       3
5170601   21.0      3
5170701   0.7102    3
5170801   4.E-5     0.0082    3
5170901   0.0       0.0       1
5170902   0.0       0.0       2
5171001   00        3
5171101   0000      2
5171300   0
*
**********************************************************************
* STEAM GENERATOR RISER                                              *
*
5190000   RISER               PIPE
5190001   2
5190101   0.27871   2
5190201  0.0       1
5190301   1.85075   1
5190302   0.718     2
5190401   0.0       2
5190601   15.0      1
5190602   90.0      2
5190701   0.518     1
5190702   0.718     2
5190801   4.E-5     0.5957    1
5190802   4.E-5     0         2
5190901   0.0       0.0       1
5191001   00        2
5191101   0000      1
5191300   0
*
**********************************************************************
* SG DOWNCOMER TO BOILING SECTION
*
5160000   DWNBOIL             SNGLJUN
5160101   515010000 5.7000000 0.0       0.0       0.0       0100
*
**********************************************************************
* SG BOILING SECTION TO RISER
*
5180000   BOILRSR             SNGLJUN
5180101   517010000 519000000 0.0       0.0       0.0       0000
*
**********************************************************************
**********************************************************************
*
*                    BROKEN LOOP
*
**********************************************************************
* REACTOR VESSEL BROKEN LOOP HOT LEG                                 *
*
3000000   RVBLHL    BRANCH
3000001   2         1
3000101   0.0634    0.876     0.0       0.0       0.0       0.0
3000102   4.0E-5    0.0       00
3001101   295010000 300000000 0.0634    0.1       0.1       0102
3002101   300010000 305000000 0.0       0.1       0.1       0000
*
**********************************************************************
* HOT LEG PIPE TO REFLOOD ASSIST BYPASS TEE                          *
*
```

```
3050000    HLPRAS    BRANCH
3050001     1         1
3050101    0.0634    0.698      0.0        0.0        0.0        0.0
3050102    4.0E-5    0.0        00
3051101    305010000 210000000 0.0         0.05       0.05       0100
*
****************************************************************
* STEAM GENERATOR SIMULATOR INLET                               *
*
3100000    SGSII    BRANCH
3100001    2        1
3100101    0.0  1.424  0.0668  0.0  0.0  0.0
3100102    4.0E-5  0.0   00
3101101    370010000 310000000 0.0  0.0  0.0  0100
3102101    310010000 315000000  0.0  0.05  0.05  0100
*
****************************************************************
* S.G. PIPE AND PUMP SIMULATOR                                  *
*
3150000    SGPSI      PIPE
3150001   10
3150101    0.00836  2
3150102    0.108    7
3150103    0.0      8
3150104    0.00836 9
3150105    0.0526    10
3150201    0.0       2
3150202    0.0376    6
3150203    0.0       7
3150204    0.0081    8
3150205    0.0       9
3150301    0.4054     1
3150302     0.5285    2
3150303    0.362   3
3150304    1.692   4
3150305    1.699   5
3150306    1.692   6
3150307    0.362   7
3150308    2.671   8
3150309    1.842   9
3150310    0.657   10
3150401    0.0         7
3150402    0.081       8
3150403    0.0         10
3150601    90.         4
3150602    0.          5
3150603    -90.        8
3150604    90.         9
3150605    0.          10
3150701    0.127     1
3150702    0.488     2
3150703    0.362     3
3150704    1.692     4
3150705    0.0       5
3150706    -1.692    6
3150707    -0.362    7
3150708    -1.823    8
3150709    1.214     9
3150710    0.6    10
3150801    4.0E-5     0.0   3
3150802    4.0E-5    0.124   4
3150803    4.0E-5    0.0     5
3150804    4.0E-5    0.124   6
3150805    4.0E-5    0.0   10
3150901   0.1   0.1   1
3150902  0.1  0.1  2
3150903  93.9  93.9  4
3150904  93.9  93.9  6
3150905  0.0  0.0  7
3150906  4.1  4.1  8
3150907  0.4  0.4  9
3151001  00  10
3151101  0100  9
3151300   1
*
****************************************************************
* BROKEN LOOP COLD LEG REACTOR VESSEL NOZZLE                    *
*
3350000    RVNBL      BRANCH
3350001    2          1
3350101    0.0634     0.7495     0.0        0.0        0.0        0.0
3350102    4.0E-5     0.0        00
3351101    290000000 335000000 0.0634      1.0        1.0        0102
3352101    335010000 340000000 0.0         0.1        0.1        0000
*
****************************************************************
* CONNECTION TEE OF THE BYPASS ASSIST SYSTEM REACTOR VESSEL SIDE*
*
3400000    CTBAR      BRANCH
3400001    1
3400101    0.0634     0.698      0.0        0.0        0.0        0.0
3400102    4.0E-5     0.0        00
3401101    340010000 345000000 0.0         0.1        0.1        0000
*
****************************************************************
* BYPASS ASSIST OUTLET ECC TEE COLD LEG                         *
*
3450000    BAOET    BRANCH
3450001    2   1
3450101    0.0634    0.974   0.0  0.0  0.0  0.0
3450102    4.0E-5    0.0    00
3451101    380010000 345000000  0.0    0.0    0.0   0100
3452101    345010000 350000000  0.0    0.0    0.0   0100
*
****************************************************************
* ECC TEE OF BROKEN LOOP                                        *
*
3500000    ETIVCL    SNGLVOL
3500101    0.0    2.0965    0.09311    0.0    0.0    0.0
3500102    4.0E-5    0.0    00
*
****************************************************************
* REFLOOD ASSIST HOT LEG                                        *
*
3700000    RFASHL    SNGLVOL
3700101    0.9368    0.0    0.1713   0.0   90.   0.653
3700102    4.0E-5    0.0    00
*
****************************************************************
* REFLOOD ASSIST BYPASS SINGLE PIPE COLD LEG SIDE               *
*
3800000    RFASCL    SNGLVOL
3800101    0.0368    0.0    0.20353   0.0   90.   0.657
3800102    4.0E-5    0.0    00
*
****************************************************************
****************************************************************
*
*                     ECC SYSTEM
*
****************************************************************
*
* BWST HPIS                                                     *
*
6250000      3BTHPI    TMDPVOL
6250101      20.44     5.0   0.0    0.0  90.0  5.0
6250102      4.0E-5    0.0   00
6250200      3
6250201      0.0  1.0E5  305.0
6250202   1000.0 1.0E5  305.0
*
****************************************************************
* HIGH PRESSURE INJECTION SYSTEM - A+B
*
6300000    HPIS        TMDPJUN
6300101    625000000 210000000        0.009099
6300200    1           661          P            210010000
6300201   -1.0         0.0          0.0          0.0
6300202    0.0         0.0          0.0          0.0
6300203    0.0         .75687       0.0          0.0
6300204    .7725E6     .75687       0.0          0.0
6300205    8.3597E6    .31536       0.0          0.0
6300206    17.2436E6   .31536       0.0          0.0
*
****************************************************************
****************************************************************
*
* ICAP ASSESSMENT PARAMETERS
*
****************************************************************
*
* CORE INLET FLUID DENSITY
20550100    DCOREINF  MULT        1.         0.0        1
20550101    VOIDFJ     225010000
20550102    RHOFJ      225010000
*
20550200    DCOREING  MULT        1.         0.0        1
20550201    VOIDGJ     225010000
20550202    RHOGJ      225010000
*
20590100    DENSCORIN SUM         1.         0.0        1
20590101    0.0        1.         CNTRLVAR  501
20590102               1.         CNTRLVAR  502
*
* ROD CLADDING TEMPERATURE SAVE UP
20590300    CLDTEMP1  MULT        1.         0.0        1
20590301    HTTEMP     230000109
20590400    CLDTEMP2  MULT        1.         0.0        1
20590401    HTTEMP     230000209
20590500    CLDTEMP3  MULT        1.         0.0        1
20590501    HTTEMP     230000309
20590600    CLDTEMP4  MULT        1.         0.0        1
20590601    HTTEMP     230000409
20590700    CLDTEMP5  MULT        1.         0.0        1
20590701    HTTEMP     230000509
20590800    CLDTEMP6  MULT        1.         0.0        1
20590801    HTTEMP     230000609
*
* FLUID TEMPERATURE AT THE CORE OUTLET
20550400    FLOWDIR    TRIPUNIT  1.         0.0        1
20550401    518
*
20550500    TOIRP      MULT       1.         0.0        1
20550501    CNTRLVAR   503
20550502    TEMPF      225060000
```

```
*
20550800   FLOWDIRW  TRIPUNIT  1.       0.0       1
20550C01   -518
*
20550700   TDIRW     MULT      1.       0.0       1
20550701   CNTRLVAR  506
20550702   TEMPF     240010000
*
20590900   TCOROUT   SUM       1.       0.0       1
20590901   0.    1.  CNTRLVAR  505
20590902         1.  CNTRLVAR  507
*
* CORE TEMPERATURE DIFFERENCF
20591000   CTDIFF    SUM       1.       0.0       1
20591001   0.        1.        TEMPF    240010000
20591002             -1.       TEMPF    225010000
e
* PRESS. DIFF. OVER THE CORE
2C5.1200   COREINV   SUM       1.       0.0       1
20591201   0.0       1.        P        235010000
20591202             -2.26     RHO      225010C00
20591203             -1.       P        245010000
20591204             3.31      RHO      245010000
*
* "RESS.DIFF. OVER THE DOWNCOMER
20591300   DOWNINV   SUM       1.       0.0       0
20591301   0.0       1.        P        185010000
20591302             -1.       P        215010000
20591303             .78       RHO      215010000
*
* VESSEL MASS INVENTORY
20551400   VESSMS1   SUM       1.       0.0       1
20551401   0.0       .0465     RHO      200010000
20551402             .078      RHO      190010000
20551403             .071      RHO      205010000
20551404             .136036   RHO      210010000
20551405             .136036   RHO      210020000
20551406             .136036   RHO      210030000
20551407             .136036   RHO      210040000
20551408             .2664     RHO      215010000
20551409             .2923     RHO      220010000
20551410             .130      RHO      225010000
20551411             .047655   RHO      230010000
20551412             .047655   RHO      230020000
20551413             .047655   RHO      230030000
20551414             .047655   RHO      230040000
20551415             .047655   RHO      230050000
20551416             .064364   RHO      230060000
*
20551500   VESSMS2   SUM       1.       0.0       1
20551501   0.0       .008385   RHO      235010000
20551502             .008385   RHO      235020000
20551503             .008385   RHO      235030000
20551504             .332046   RHO      240010000
20551505             .079002   RHO      245010000
20551506             .1201     RHO      246010000
20551507             .0603     RHO      295010000
20551508             .202752   RHO      250010000
20551509             .173728   RHO      255010000
*
20591400   VESSMASS  SUM       1.       0.0       1
20591401   0.0       1.        CNTRLVAR 514
20591402             1.        CNTRLVAR 515
*
* DOWNCOMER LIQUID LEVEL
```

```
20591500   DOWNLEV   SUM       1.       0.0         1
20591501   0.0       .1065     VOIDF    2000[illegible]000  **
20591502             .300      VOIDF    29[illegible]000
20591503             .274      VOIDF    [illegible]0000
20591504             .958      VOIDF    [illegible]10000
20591505             .958      VOIDF    [illegible]020000
20591506             .958      VOIDF    210030000
20591507             .958      VOIDF    210040000
20591508             .380      VOIDF    215010000
20591509             .208      VOIDF    220010000   **
*
* UPPER PLENUM LIQUID LEVEL
20591600   UPLEV     SUM       1.       0.0         1
20591601   0.0       .3084     VOIDF    240010000   **
20591602             .693      VOIDF    245010000
20591603             .300      VOIDF    235010000
20591604             .3251     VOIDF    250010000   **
*
* UPPER PLENUM SUBCOOLING
20591900   UPSCOOL   SUM       1.       0.0         1
20591901   0.0       1.        SATTEMP  240010000
20591902             -1.       CNTRLVAR 909
*
* I.L. LIQUID LEVEL. FOR .86 M / LEPDE-PC-28
20553100   P31A      SUM       1.       0.0         1
20553101   0.0       1.        P        120010000
20553102             -.183     P        155010000
20553103             -.817     P        160010000
20553104             -6.475    RHOG     155010000
*
20553200   P31B      SUM       9.81     0.0         1
20553201   0.0       1.        RHOF     155010000
20553202             -1.       RHOG     155010000
*
20593100   LIQLIL    DIV       1.       0.0         1
20593101   CNTRLVAR  532
20593102   CNTRLVAR  531
*
* B.L. LIQUID LEVEL. FOR 4.88 M / LEPDE-BL-14
20553300   P32A      SUM       1.       0.0         1
20553301   0.0       1.        P        315030000
20553302             6.97      RHO      315080000
20553303             -1.       P        31'950C00
20553304             -47.87    RHOG     315060000
*
20553400   P32B      SUM       9.81     0.0         1
20553401   0.0       1.        RHOF     315060000
20553402             -1.       RHOG     315060000
*
20593200   LIQLBL    DIV       1.       0.0         1
20593201   CNTRLVAR  534
20593202   CNTRLVAR  533
*
* PUMP PRESSURE DIFF.
20593600   DPPUMP    SUM       1.       0.0         1
20593601   0.0       .5        P        150010000
20593602             .5        P        145010000
20593603             -1.       P        120010000
*
* BREA' ENERGY RELEASE
20553700   PRESSE    MULT      1.       0.0         1
20553701   MFLOWJ    805000000
20553702   P         800010000
*
20553800   PRESSENT  DIV       1.       0.0         1
```

```
20553801   RHO       800010000
20553802   CNTRLVAR  537
*
20553900   BRUFFL    MULT      208.9E-6  0.0       1
20553901   UFJ       805000000
20553902   VELFJ     805000000
20553903   VOIDFJ    805000000
20553904   RHOFJ     805000000
*
20554000   BRUGFL    MULT      208.9E-6  0.0       1
20554001   UGJ       805000000
20554002   VELGJ     805000000
20554003   VOIDGJ    805000000
20554004   RHOGJ     805000000
*
20594000   BRENAELEA SUM       1.        0.0       1
20594001   0.0       1.        CNTRLVAR  539    * FLUID INNER ENERGY
20594002             1.        CNTRLVAR  540    * STEAM INNER ENERGY
20594003             1.        CNTRLVAR  538    * P*V ENTHALPY PART
*
* BREAK INLET FLUID SUBCOOLING
20594200   BRSUBCOOL SUM       1.        0.0       1
20594201   0.0       1.        SATTEMP   800010000
20594202             -1.       TEMPF     800010000
*
* SG PRIM. TEMPERATURE DIFF.
20594500   SGTEDIFF  SUM       1.        0.0       1
20594501   0.0       1.        TEMPF     115030000
20594502             -1.       TEMPF     115100000
*
* SG PRIM. PRESSURE DIFF.
20594600   SGPRPRS   SUM       1.        0.0       1
20594601   0.0       1.        P         115010000
20594602             -1.       P         120010000
*
* SG LIQUID LEVEL
20594900   SGLIQLEV  SUM       1.        0.0       1
20594901   -2.946    .7102     VOIDF     515010000
20594902             .7102     VOIDF     515020000
20594903             .7102     VOIDF     515030000
20594904             .518      VOIDF     510010000
20594905             .718      VOIDF     505010000
20594906             .718      VOIDF     530010000
20594907             .762      VOIDF     526010000
*
* SG PRIM. TO SEC. TEMP DIFFERENCE, INLET
20595200   SGPRSETD  SUM       1.        0.0       1
20595201   0.0       1.        TEMPF     115030000
20595202             -1.       TEMPF     515030000
*
* SG HEAT TRANSFER RATE
20595300   SGHTTRANS SUM       -1.       0.0       1
20595301   0.0       52.1058   HTRNR     006000100
20595302             71.7373   HTRNR     006000200
20595303             30.2548   HTRNR     006000300
20595304             30.2548   HTRNR     006000400
20595305             71.7373   HTRNR     006000500
20595306             52.1058   HTRNR     006000600
*
* PRESSURIZER LIQUID LEVEL
20595400   PRLIQLEV  SUM       1.        0.7       1
20595401   0.0       .224      VOIDF     415010000
20595402             .403      VOIDF     415020000
20595403             .403      VOIDF     415030000
20595404             .207      VOIDF     415040000
```

```
20595405              .2             VOIDF     415050000
20595406              .1705          VOIDF     415060000
20595407              .1705          VOIDF     415070000
20595408              .118           VOIDF     415080000
*
* HPIS VOLYMETRIC FLOW RATE
20595800   HPISVOLF   DIV        1000.      0.0        0
20595801   RHO        625010000 MFLOWJ      530000000
*
* MASS BALANCE, INTEGRATED FORM BREAK TIME
20555900   TRIPSO     TRIPUNIT  1.          0.0        1
20555901   510
*
20556000   MSBAL1     SUM       1.          0.0        1
20556001   0.0        1.         MFLOWJ     630000000
20556002              -1.        MFLOWJ     805000000
20556003              1.         MFLOWJ     501000000
*
20556100   MSBAL2     MULT      1.          0.0        1
20556101   CNTRLVAR   559
20556102   CNTRLVAR   560
*
20595900   MASSBAL    INTEGRAL  1.          0.0        0
20595901   CNTRLVAR   561
*
* PRIMARY COOLANT ENERGY BALANCE (P*V IS CONSERVED)
20556200   HPISEGY    MULT      1.          0.0        1
20556201   MFLOWJ     630000000
20556202   UF         625010000
*
20556300   PUMPENGY   DIV       2.          0.0        1
20556301   RHO        135010000
20556302   PMPHEAD    135
*
* CORE HEATING OF FLUID
20556400   CORENTFL   SUM       1.          0.0        1
20556401   0.         12.23457  HTRNR      230000101
20556402              12.23457  HTRNR      230000201
20556403              12.23457  HTRNR      230000301
20556404              12.23457  HTRNR      230000401
20556405              12.23457  HTRNR      230000501
20556406              16.52433  HTRNR      230000601
*
* PUMP SEAL WATER HEAT FLOW
20556500   PMPSWHF    MULT      1.          0.0        1
20556501   MFLOWJ     901000000
20556502   UF         910010000
*
* SS PRESSURE HEAT FLOW
20556600   SSPRHF     MULT      1.          0.0        1
20556601   MFLOWJ     4.5000000
20556602   UF         405010000
*
20596000   PRIENBAL   SUM       1.          0.0        1
20596001   0.0        -1.        CNTRLVAR   953      * SG
20596002              -1.        CNTRLVAR   982      * EXTERNALS
20596003              1.         CNTRLVAR   562      * HPIS
20596004              -1.        CNTRLVAR   940      * BREAK
20596005              1.         CNTRLVAR   564      * CORE
20596006              1.         CNTRLVAR   565      * PUMP SEAL WATER
20596007              -1.        CNTRLVAR   566      * SS PRESSURIZER
*
* PRIMARY HEAT LOSSES TO SURROUNDINGS
*
20555100   STR-HTL1   SUM       -1.         0.0        1
```

```
20555101   0.0       1.3716    HTRNR     100100100 * 100
20555102             1.4579    HTRNR     100100200 * 105
20555103             1.0085    HTRNR     100100300 * 110
20555104              .8305    HTRNR     100100400 * 115.1
20555105              .7229    HTRNR     100200100 * 115.2
20555106             1.4776    HTRNR     100400100 * 115.3
20555107             1.4776    HTRNR     100400200 * 115.10
20555108              .5585    HTRNR     100200200 * 115.11
20555109              .6147    HTRNR     100100500 * 115.12
20555110              .4988    HTRNR     100100600 * 115.13
20555111              .6781    HTRNR     100100700 * 120
20555112              .6806    HTRNR     100300100 * 125
20555113              .3101    HTRNR     100300190 * 130
20555114              .3406    HTRNR     100300300 * 140
20555115              .9557    HTRNR     100300400 * 145
20555116              .6806    HTRNR     100300500 * 155
20555117              .3101    HTRNR     100300600 * 160
20555118              .3488    HTRNR     100300700 * 170 / = 14.323M
*
20555200   STR-HTL2  SUM       -1.        0.0       1
20555201   0.0        .4431    HTRNR     100100800 * 150
20555202              .4988    HTRNR     100100900 * 175.1
20555203              .5469    HTRNR     100101000 * 175.2
20555204              .6254    HTRNR     100101100 * 180
20555205             1.3035    HTRNR     100101200 * 185
20555206              .6687    HTRNR     335000100 * 335
20555207              .6228    HTRNR     335000200 * 340
20555208              .8690    HTRNR     335000300 * 345
20555209             1.0578    HTRNR     350100100 * 350
20555210             3.6545    HTRNR     370009200 * 380
20555211              .1312    HTRNR     315000100 * 315.1
20555212              .1704    HTRNR     315000200 * 315.2
20555213             1.9589    HTRNR     315300100 * 315.3
20555214             1.9589    HTRNR     315300200 * 315.4
20555215             1.9589    HTRNR     315300300 * 315.5
20555216             1.9589    HTRNR     315300400 * 315.6
20555217              .4174    HTRNR     315300500 * 315.7
20555218             1.8025    HTRNR     315100100 * 315.8
20555219              .7639    HTRNR     315200100 * 315.9
20555220              .5365    HTRNR     315400100 * 315.10/ = 21.9!
*
20555300   S.R-HTL3  SUM       -1.        0.0       1
20555301   0.0        .7616    HTRNR     300000100 * 300
20555302              .6228    HTRNR     300000200 * 305
20555303             1.2705    HTRNR     300000300 * 310
20555304             3.0792    HTRNR     375000100 * 370
20555305            -1.6800    HTRNR     720000101 * 220
20555306             1.2045    HTRNR     252000100 * 252
20555307              .7120    HTRNR     255000100 * 255 / =9.8506 #
*
20598200   STR-HTL   SUM       1.         0.0       1
20598201   0.0       1.        CNTRLVAR  551
20598202             1.        CNTRLVAR  552
20598203             1.        CNTRLVAR  553  * T.AREA =46.1242 M2
*
******************************************************************
******************************************************************
*
*                  BOUNDARY CONDITION CONTROL
*
******************************************************************
*
*     MAIN STEAM CONTROL VALVE                                 **
*
5500000     MSFCV    TMDPJUN
```

```
5500101     53000000  535000000  0.002573
5500200     1    501
5500201     -1.   0.0  26.00  0.0
5500202     0.0   0.0  26.00  0.0   * FLOW RATE FROM NUREG/CR-0247
5500203     3.    0.0  21.8   0.0   * PRESSURE RISE 5.58 - 6.80 MPA
5500204     6.0   0.0  14.1   0.0   * 5% CHANGE RATE ASSUMED
5500205     9.    0.0   8.7   0.0
5500206    13.8   0.0   5.7   0.0
5500207    13.6   0.0  .0865  0.0   * LEAKAGE
5500208    82.8   0.0  .0865  0.0
5500209    82.8   0.0   5.7   0.0   * VALVE OPEN AT 78 S
5500210    92.8   0.0   5.7   0.0   * VALVE CLOSE AT 88 S
5500211    92.8   0.0  .0864  0.0   * LEAKAGE
5500212   500.    0.0  .0794  0.0   * FROM EXP. BOUNDARY PRESSURE
5500213  1000.    0.0  .0654  0.0   * LINEAR P-DEPENDENCE ASSUMED
5500214  1500.    0.0  .0583  0.0   *  .053 KG/S AT 4.16 MPA
5500215  2370.    0.0  .046   0.0
*
******************************************************************
*  FEED WATER VALVE
*
5600000      FWVLV     TMDPJUN
5600101     525000000 510000000 0.05
5600200     1         501
5600201     -1.       26.00     0.0      0.0
5600202     0.0       26.00     0.0      0.0
5600203     14.       0.0       0.0      0.0
5600208     3000.     0.0       0.0      0.0
*
******************************************************************
* AUX. FEEDWATER
*
5540000     AUXFTANK  TMDPVOL
5540101     3.0       10.0      0.0  1.0  0.0  0.0  3.33E-5   1.0    11
5540200     1
5540201     0.0       315.0     0.0
*
5480000     AUXFJUN   TMDPJUN
5480101     554000000 510000000  1
5480200     1         510
5480201     -1.       0.0       0.0      0.0
5480202     62.9      0.0       0.0      0.0
5480203     63.0      .50364    0.0      0.0
5480204     1800.     .50364    0.0      0.0
5480205     1801.0    0.0       0.0      0.0
*
******************************************************************
* SS VOLUME STATES
*
1000200   3    14.8706E6    575.88
1050200   3    14.8644E6    576.87
1100200   3    14.8425E6    576.86
1151201   3    14.8425E6    576.85    0.0  0.0  0.0    1
1151202   3    14.8442E6    576.86    0.0  0.0  0.0    2
1151203   3    14.7673E6    576.82    0.0  0.0  0.0    3
1151204   3    14.7446E6    572.15    0.0  0.0  0.0    4
1151205   3    14.7211E6    567.05    0.0  0.0  0.0    5
1151206   3    14.7045E6    565.07    0.0  0.0  0.0    6
1151207   3    14.6967E6    563.28    0.0  0.0  0.0    7
1151208   3    14.6960E6    559.89    0.0  0.0  0.0    8
1151209   3    14.6825E6    557.68    0.0  0.0  0.0    9
1151210   3    14.6828E6    557.67    0.0  0.0  0.0   10
1151211   3    14.6073E6    557.65    0.0  0.0  0.0   11
1151212   3    14.5982E6    557.64    0.0  0.0  0.0   12
1151213   3    14.5933E6    557.64    0.0  0.0  0.0   13
```

```
1200200   3   14.5899E6   557.64
1250200   3   14.5776E6   557.63
1300200   3   14.5563E6   557.62
1350200   3   14.7940E6   557.75
1400200   3   15.0407E6   557.75
1450200   3   15.0459E6   557.76
1500200   3   15.0193E6   557.79
1550200   3   14.5777E6   557.63
1600200   3   14.5578E6   557.62
1650200   3   14.7982E6   557.76
1700200   3   15.0453E6   557.84
1751201   3   15.0133E6   557.78   0.0  0.0  0.0  1
1751202   3   15.0067E6   557.78   0.0  0.0  0.0  2
1800200   3   15.0030E6   557.78
1850200   3   15.0012E6   557.77
2000200   3   14.9994E6   557.78
2050200   3   15.0000E6   557.77
2101201   3   14.9984E6   557.77   0.0  0.0  0.0   1
2101202   3   15.0040E6   557.78   0.0  0.0  0.0   2
2101203   3   15.0101E6   557.79   0.0  0.0  0.0   3
2101204   3   15.0162E6   557.78   0.0  0.0  0.0   4
2150200   3   15.0247E6   557.79
2200200   3   15.0274E6   559.89
2250200   3   15.0138E6   557.78
2301201   3   14.9845E6   559.12   0.0  0.0  0.0  1
2301202   3   14.9797E6   565.19   0.0  0.0  0.0  2
2301203   3   14.9720E6   570.42   0.0  0.0  0.0  3
2301204   3   14.9671E6   575.08   0.0  0.0  0.0  4
2301205   3   14.9593E6   578.07   0.0  0.0  0.0  5
2301206   3   14.9536E6   578.84   0.0  0.0  0.0  6
2351201   3   14.9671E6   557.77   0.0  0.0  0.0  1
2351202   3   14.9558E6   557.77   0.0  0.0  0.0  2
2351203   3   14.9436E6   557.77   0.0  0.0  0.0  3
2400200   3   14.9308E6   578.05
2450200   3   14.9112E6   578.04
2460200   3   14.9260E6   577.08
2500200   3   14.9128E6   576.84
2550200   3   14.9076E6   575.70
2900200   3   14.9939E6   557.77
2950200   3   14.9156E6   576.90
3000200   3   14.9156E6   562.00
3050200   3   14.9156E6   562.00
3100200   3   14.9156E6   562.00
3151201   3   14.9151E6   562.00  0.0  0.0  0.0  1
3151202   3   14.9122E6   562.00  0.0  0.0  0.0  2
3151203   3   14.9097E6   562.00  0.0  0.0  0.0  3
3151204   3   14.9021E6   562.00  0.0  0.0  0.0  4
3151205   3   14.8959E6   562.00  0.0  0.0  0.0  5
3151206   3   14.9021E6   562.00  0.0  0.0  0.0  6
3151207   3   14.9087E6   562.00  0.0  0.0  0.0  7
3151208   3   14.9177E6   562.00  0.0  0.0  0.0  8
3151209   3   14.9200E6   562.00  0.0  0.0  0.0  9
3151210   3   14.9155E6   562.00  0.0  0.0  0.0  10
3350200   3   14.9999E6   556.00
3400200   3   14.9999E6   556.00
3450200   3   14.9999E6   556.00
3500200   3   14.9999E6   556.00
3700200   3   14.9180E6   562.00
3800200   3   15.0024E6   556.00
4000200   3   14.8934E6   577.35
4050200   3   14.8894E6   576.87
4151201   2   14.8873E6    0.0   0.0 0.0 0.0  1
4151202   2   14.8855E6    0.0   0.0 0.0 0.0  2
4151203   2   14.8831E6    0.0   0.0 0.0 0.0  3
4151204   2   14.8813E6    0.0   0.0 0.0 0.0  4
```

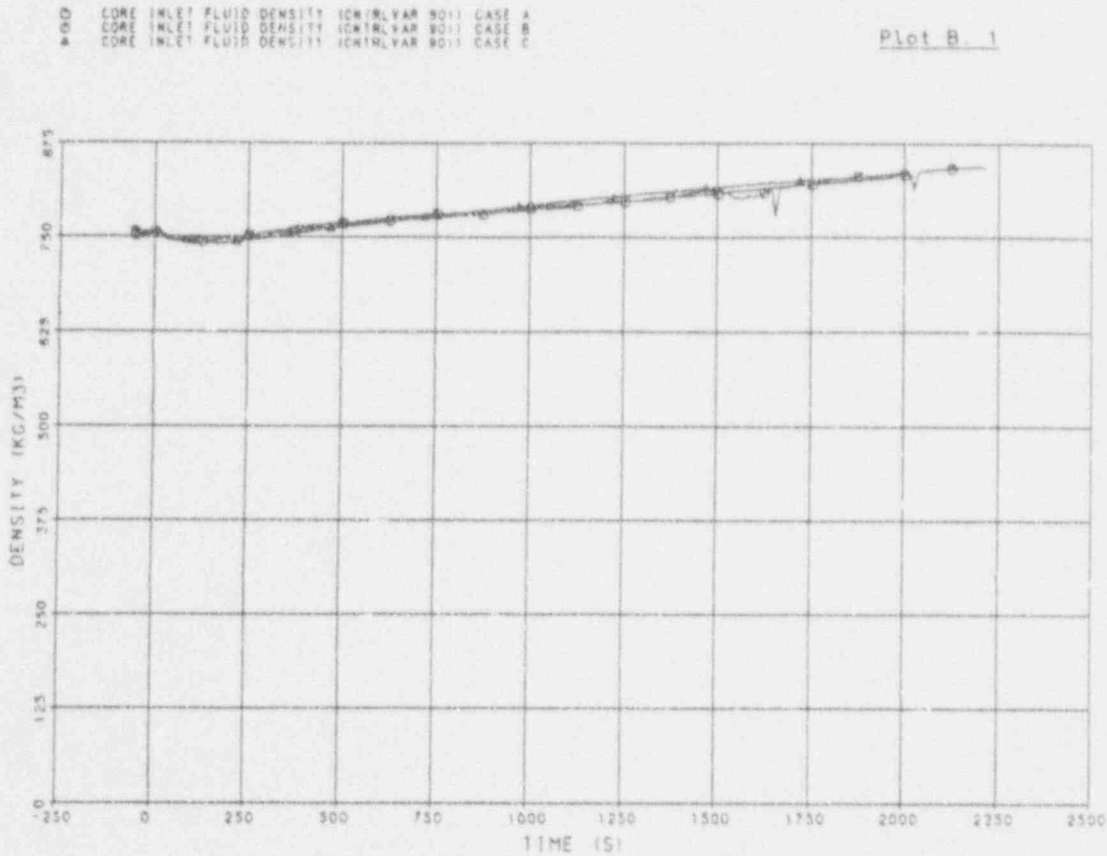
```
4151205   2   14.8803E6    .7019 0.0 0.0 0.0  5
4151206   2   14.8803E6    1.    0.0 0.0 0.0  6
4151207   2   14.8801E6    1.    0.0 0.0 0.0  7
4151208   2   14.8800E6    1.    0.0 0.0 0.0  8
4200200   2   14.8798E6      1.
5000200   2   5.58031E6     1.
5050200   2   5.58223E6   .0164
5100200   3   5.58616E6   533.51
5151201   3   5.59065E6   533.55    0.0        0.0  0.0       1
5151202   3   5.59609E6   533.60    0.0        0.0  0.0       2
5151203   3   5.60153E6   533.67    0.0        0.0  0.0       3
5171201   2   5.60214E6   .043       0.0       0.0    0.0      1
5171202   2   5.59642E6   .118       0.0       0.0    0.0      2
5171203   2   5.58794E6   .158       0.0       0.0    0.0      3
5191201   2   5.58236E6   .183       0.0       0.0   0.0       1
5191202   2   5.58139E6   .183       0.0       0.0   0.0       2
5200200   2   5.58045E6   .344
5250200   2   5.58011E6   1.0
5280200   2   5.58011E6   1.0
5301201   2   5.57987E6   1.0       0.0  0.0  0.0  1
5301202   2   5.42299E6   1.0       0.0  0.0  0.0  2
5350200   2   2.03101E6    1.0
9000200   3   15.0012E6   477.00
*
**************************************************************************
* SS JUNCTION STATES
*
1001201   476.4     0.0       0.0
1002201   476.4     0.0       0.0
1051201   476.4     0.0       0.0
1101201   476.4     0.0       0.0
1151301   476.4     0.0       0.0       2
1151302   476.4     0.0       0.0       4
1151303   476.4     0.0       0.0       7
1151304   476.4     0.0       0.0       9
1151305   476.4     0.0       0.0      12
1201201   476.4     0.0       0.0
1202201   238.2      0.0       0.0
1203201   238.2      0.0       0.0
1251201   238.2      0.0       0.0
1252201   0.0       0.0       0.0
1350201   1          238.2     0.0        0.0
1350202   1          238.2     0.0        0.0
1451201   238.2      0.0       0.0
1452201   238.2      0.0       0.0
1501201   238.2      0.0       0.0
1502201   476.4     0.0       0.0
1551201   238.2      0.0       0.0
1650201   1          238.2     0.0        0.0
1650202   1          238.2     0.0        0.0
1701201   0.0       0.0       0.0
1751301   476.4     0.0       0.0       1
1801201   476.4     0.0       0.0
1851201   476.4     0.0        0.0
1852201   476.4     0.0        0.0
2051201   444.9     0.0       0.0
2101301   444.9     0.0       0.0       2
2101302   444.9     0.0       0.0       3
2151201   444.9     0.0       0.0
2152201   1.E-5     0.0       0.0
2153201   444.9     0.0       0.0
2251201   427.7     0.0       0.0
*                                     226 CORE BYPASS / 3.6 %
2301301   427.7     0.0       0.0       5
2351301   17.2      0.0       0.0       ,
```

```
2401201   427.7      0.0        0.0
2402201   17.2        0.0        0.0
2451201   444.9      0.0        0.0
2461201    1.E-5     0.0        0.0
2501201   0.0         0.0        0.0
2502201   0.0        0.0        0.0
2901201    444.9      0.0        0.0
2902201    31.5       0.0        0.0
2951201    0.0        0.0        0.0
*                                           296 INLET ANN. TO UP / 6.8 %
2952201    444.9      0.0        0.0
3001201    0.0        0.0        0.0
3002201    0.0        0.0        0.0
3051201    0.0        0.0        0.0
3101201   0.0  0.0  0.0
3102201   0.0  0.0  0.0
3151301    0.0   0.0   0.0  9
3351201    0.0        0.0        0.0
3352201    0.0        0.0        0.0
3401201    0.0        0.0        0.0
3451201    0.0   0.0   0.0
3452201    0.0   0.0   0.0
4001201   0.0  0.0  0.0
4002201   0.0  0.0  0.0
4100201   1  0.0  0.0  0.0
4151301   0.0  0.0  0.0  7
4201201   0.0  0.0  0.0
*                                           436  SS SYSTEM PRESSURE
5001201    0.0       0.0       0.0
5101201    96.60     0.0          0.0
5102201     123.0    0.0       0.0
5151301     123.0   0.0       0.0  1
5151302     123.0   0.0       0.0  2
5160201   1  123.0   0.0       0.0
5171301    1.201     1.552   0.0  1
5171302    2.210     3.154   0.0  2
5180201   0   2.759   3.826    0.0
5191301    3.201     3.728   0.0  1
5201201    0.0       26.00   0.0
5202201    96.60     0.0          0.0
5203201    96.60     26.00   0.0
5251201     0.0      26.00   0.0
5261201     0.0       0.0     0.0
5262201     0.0       0.0     0.0
5301301     0.0      25.0    0.0  1
*                                           548  AUX FEED
*                                           550  MAIN STEAM VALVE
5530201    1          0.0          26.0        0.0
*                                           5[illegible]  FEED WATER VALVE
*                                           571  SG SS LEVEL
*                                           591  SG SS PRESSURE
*                                           630  HPIS INJECTION
8001201    0.0        0.0        0.0
8050201    1          0.0        0.0          0.0
*                                           901 PUMP COOLANT INJECTION
*
*
**************************************************************************
* SS CONTROL FOR [illegible] FLOW BY[illegible] / 3.6 %
*
20522400   CBPERF                         0.0       1
20522401   0.                [illegible]  226000000
20522402                     [illegible]  185010000
*
20522500   CBPPF             [illegible]  [illegible]  1
```

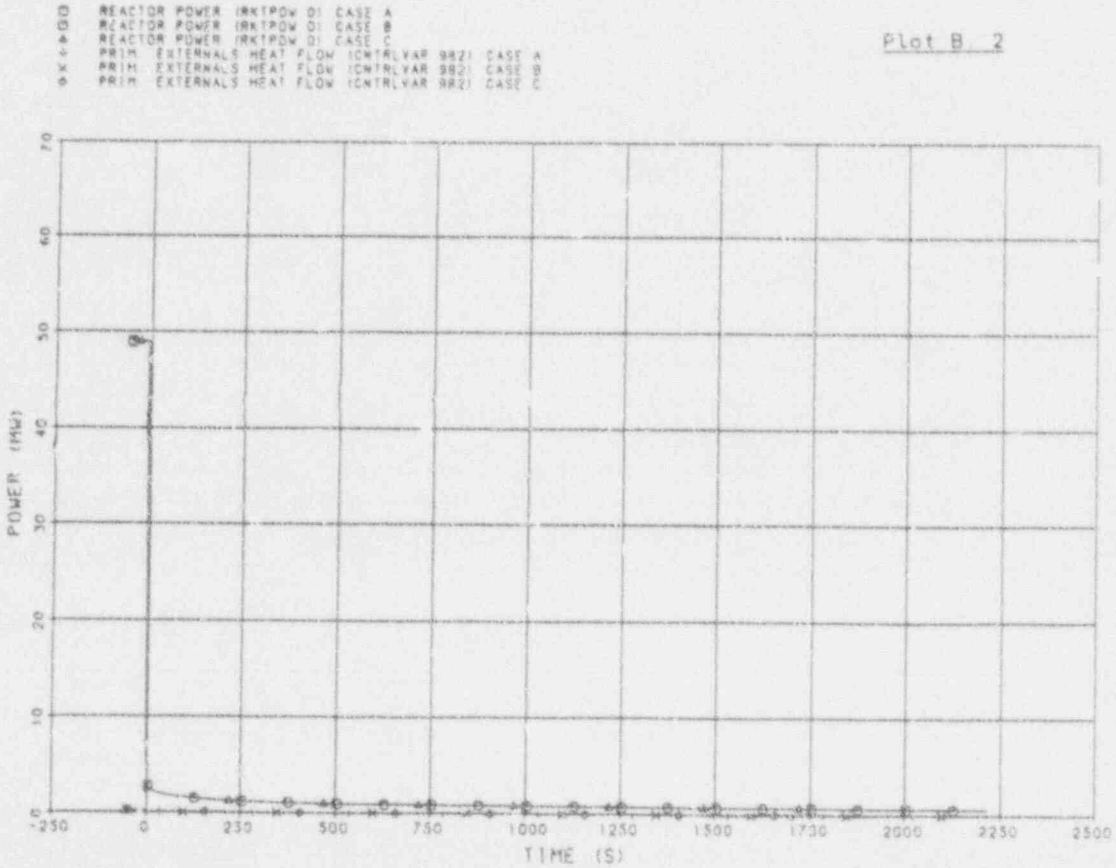
```
20522501    CNTRLVAR  224
20522502    CNTRLVAR  512
*
20522600    CBPV      INTEGRAL  -.10       .5   0    3   .01    .99
20522601    CNTRLVAR  225
*
*****************************************************************
* SS CONTROL FO INLET ANN. TO UPPER PLENUM FLOW / 5.5 %
*
20529400    IAUPERR   SUM       1.         0.5        0
20529401    0.        1.        MFLOWJ     298000000
20529402              -.066     MFLOWJ     185010000
*
20529500    IAUPREG   MULT      1.         0.0        0
20529501    CNTRLVAR  294
20529503    CNTRLVAR  512
*
20529600    IAUPV     INTEGRAL  -.06       .5   0    3   .01    .98
20529601    CNTRLVAR  255
*
*****************************************************************
* SS CONTROL FOR    WATER ENTHALPHY
*
20560100    SPRDERR   SUM       1.0        0.0        0
20560101    0.        -1.       MFLOWJ     560000000
20560102              .914014   VAPGEN     500010000
20560103              .914014   VAPGEN     505010000
20560104              .309795   VAPGEN     510010000
20560105              .164951   VAPGEN     515010000
20560106              .16 951   VAPGEN     5 5020000
20560107              .164951   VAPGEN     515030000
20560108              .515823   VAPGEN     517010000
20560109              .515823   VAPGEN     517020000
20560110              .515823   VAPGEN     517030000
20560111              .515823   VAPGEN     519010000
20560112              .200114   VAPGEN     519020000
20560113              .200114   VAPGEN     520010000
20560114              .685800   VAPGEN     625010  0
20560115              .163678   VAPGEN     526010   
20560116              .605644   VAPGEN     530010000
20560117              1.16218   VAPGEN     530020000
*
20560200    SENTHD    SUM       1.0        0.0        1
20560201    0.0       1.0       UG         530010000
20560202              -1.       UF         545010000
20560203              5.        UF         510010000
20560204              -5.       UF         515030000
*
20560300    SSX1      MULT      -1.        0.0        0
20560301    CNTRLVAR  601
20560302    CNTRLVAR  602
20560303    CNTRLVAR  512
*
20560400    SSX2      MULT      1.         1.         1    1    1.
20560401    MFLOWJ    560000000
*
20560500    SSX3      DIV       1.         0.0        0
20560501    CNTRLVAR  504       CNTRLVAR   603
*
20560600    FDWENTH   INTEGRAL  10     900E6  0   3   700E6    1.10E6
20560601    CNTRLVAR  605
*
*****************************************************************
* STEAM GENERATOR SS PRESSURE
*
5900000     SGSSPR    TMDPVOL
5900101     .1        1.0  0.0  0.0  0.0  0.0
5900102     4.E-5     0.0        00
5900200     2
5900201     0.0       5.58E6     1.
5900202     10000.    5.58E6     1.
*
5910000     SGSSPRJ   VALVE
5910101     530000000 590000000 0.0  0.0  3.0       0100
5910201     1         0.0        0.0       0.0
5910300     TRPVLV
5910301     646
*
*****************************************************************
* SG STEADY STATE LEVEL HOLDING
*
5700000     SGLHOLDV  TMDPVOL
5700101     .1        1.         0.0  0.0  0.0  0.0
5700102     4.E-5     0.0        00
5700200     2         0          P         505010000
5700201     4.E6      4.E6       .5
5700202     7.E6      7.E6       .5
*
5710000     SGLHOLDJ  TMDPJUN
5710101     505310000 570000000            .1
5710200     1         0          CNTRLVAR  513
5710201     -10.      -10.       0.0       0.0
5710202     10.       10.        0.0       0.0
*
20551100    SGLEVER1  SUM        50.       0.0       0
20551101    -.19      1.         CNTRLVAR  949
*
20551200    TRP-501   TRIPUNIT   1.        0.0       1
20551201    -501
*
20551300    SGLEVER2  MULT       1.        0.0       0
20551301    CNTRLVAR  511
20551302    CNTRLVAR  512
*
*****************************************************************
* SS SYSTEM PRESSURE
*
4300000     PRVOL     TMDPVOL
4300101     .362      .224       0.0  0.0  0.0     .724
4300102     4.E-5     0.0        11
4300200     3         0          P         415010000
4300201     .1E6      .1E6       576.
4300202     16.E6     16.E6      576.
*
4350000     PRVALVE   VALVE
4350101     405310000 430000000 0.0        .093      .093      0100
4350201     1         0.0        0.0       0.0
4350300     TRPVLV
4350301     646
*
*****************************************************************
** END OF FILE                                                  **
```

Data Comparison Plots

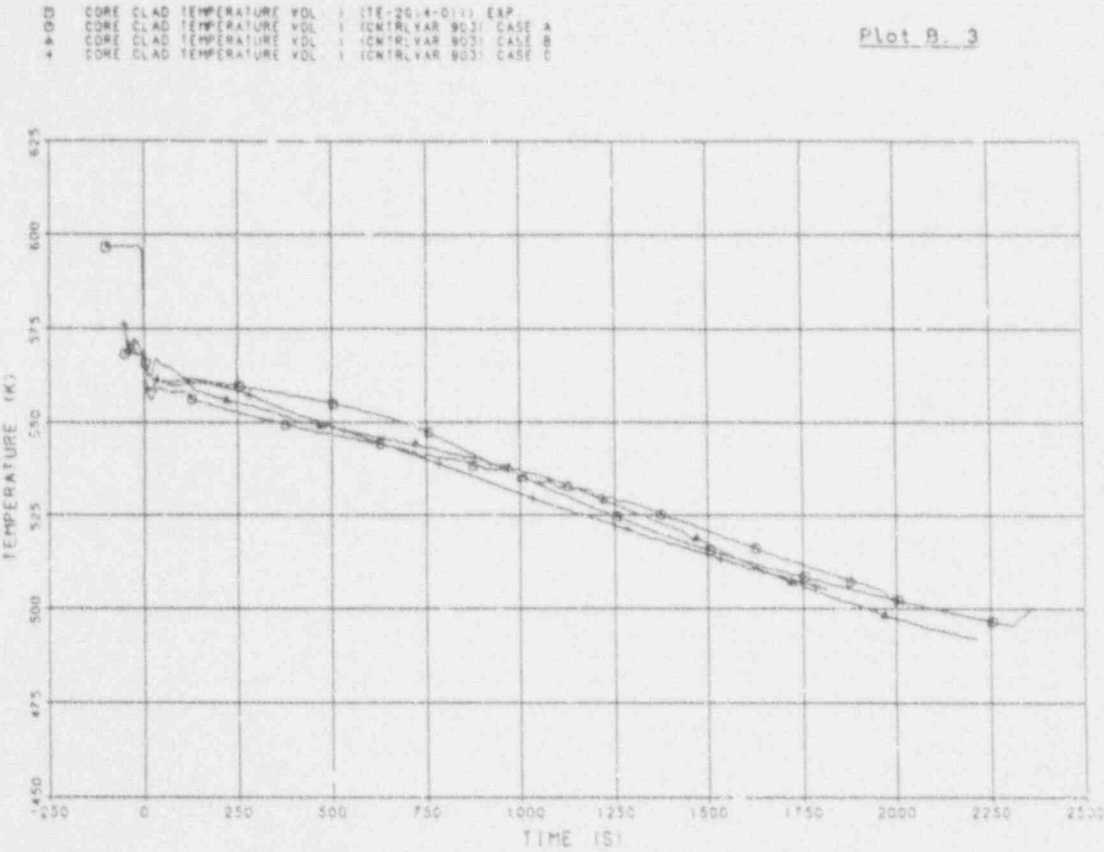
Plot B. 1



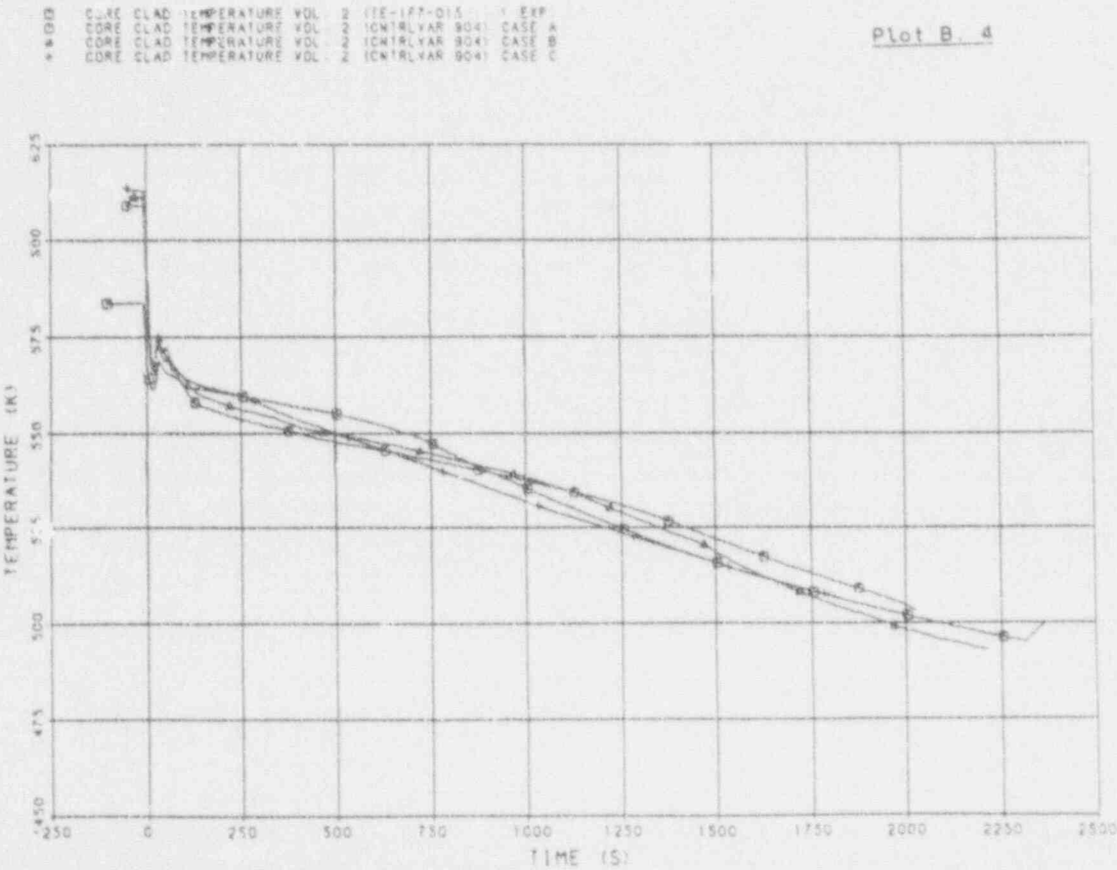
Plot B. 2



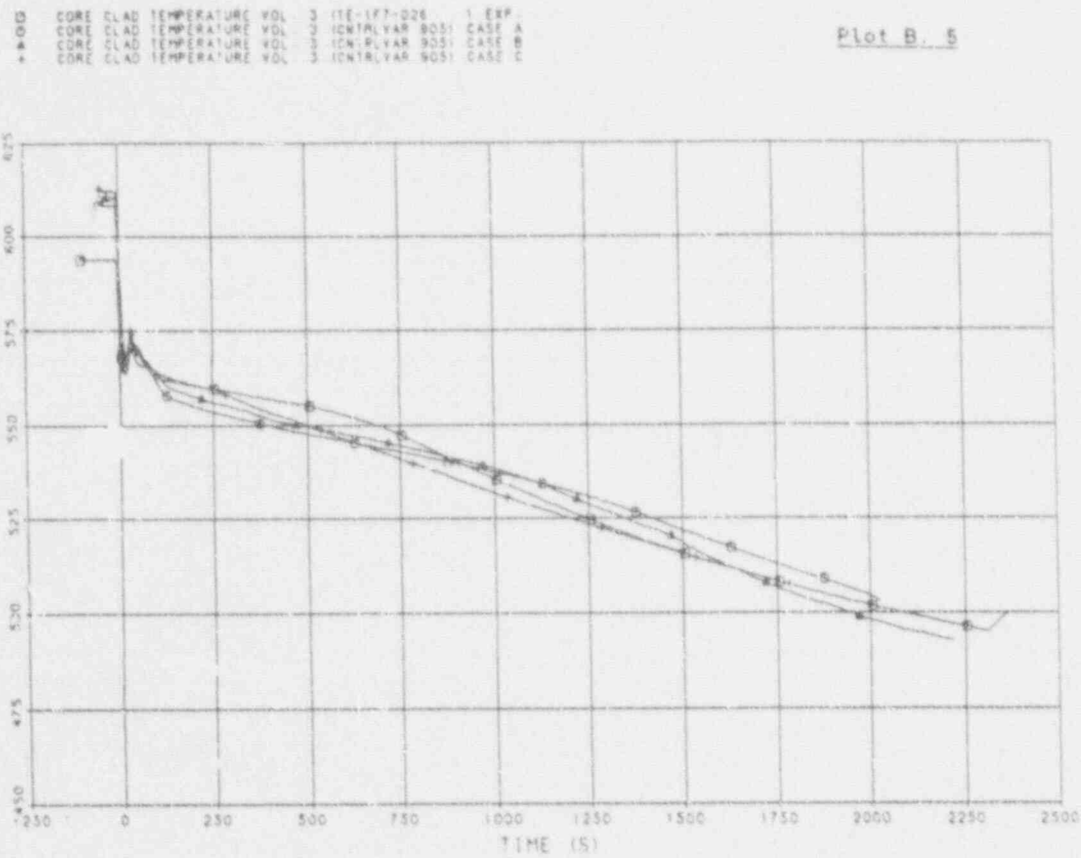
Plot B. 3



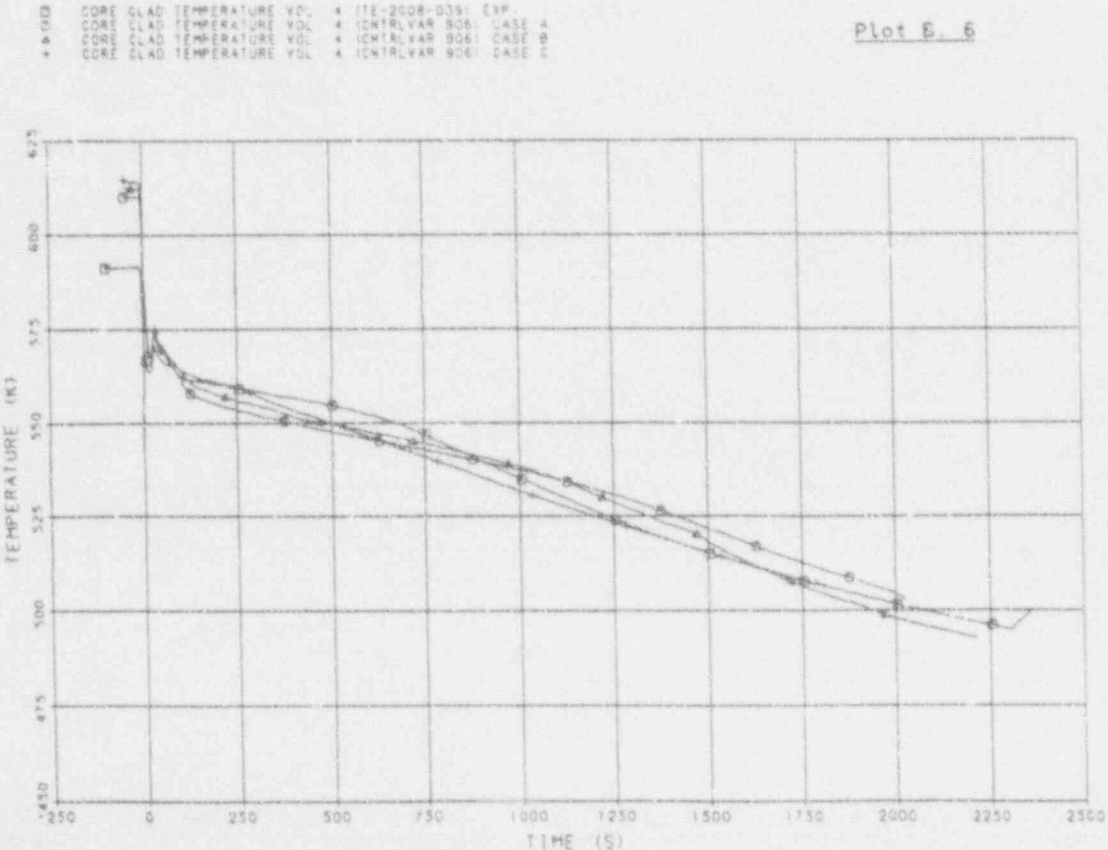
Plot B. 4



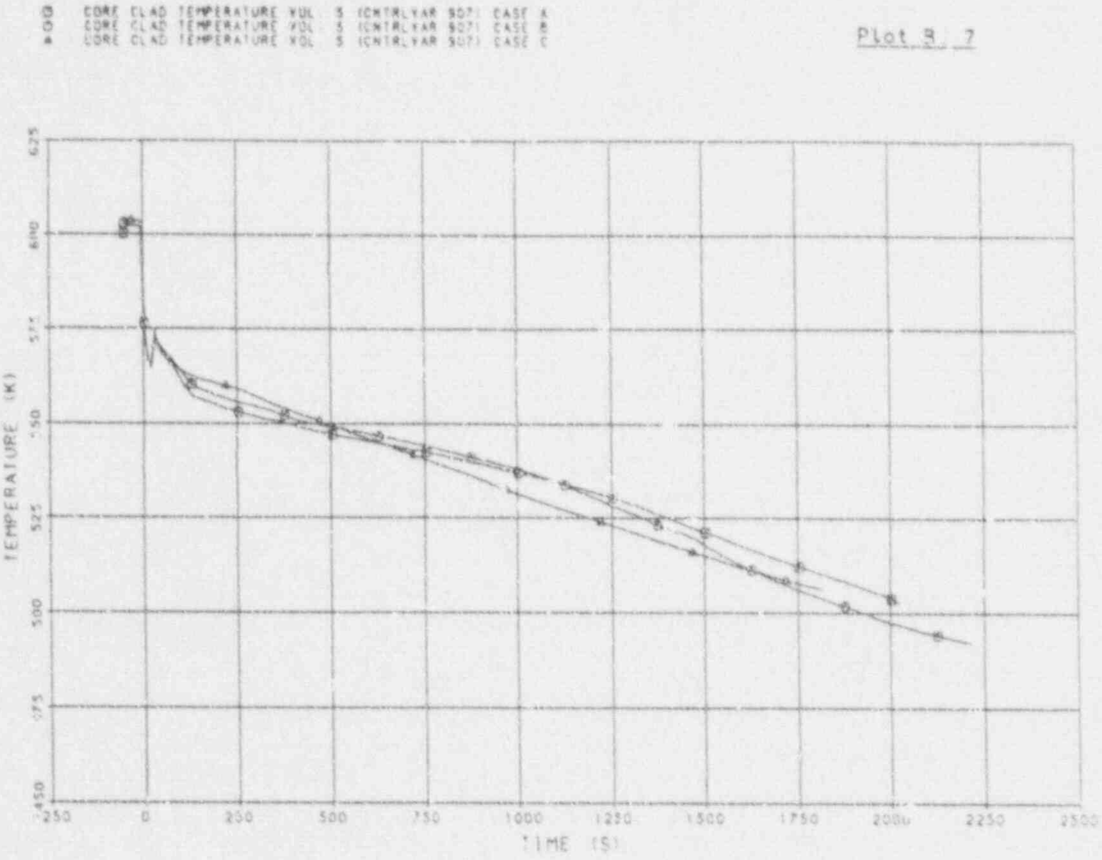
Plot B. 5



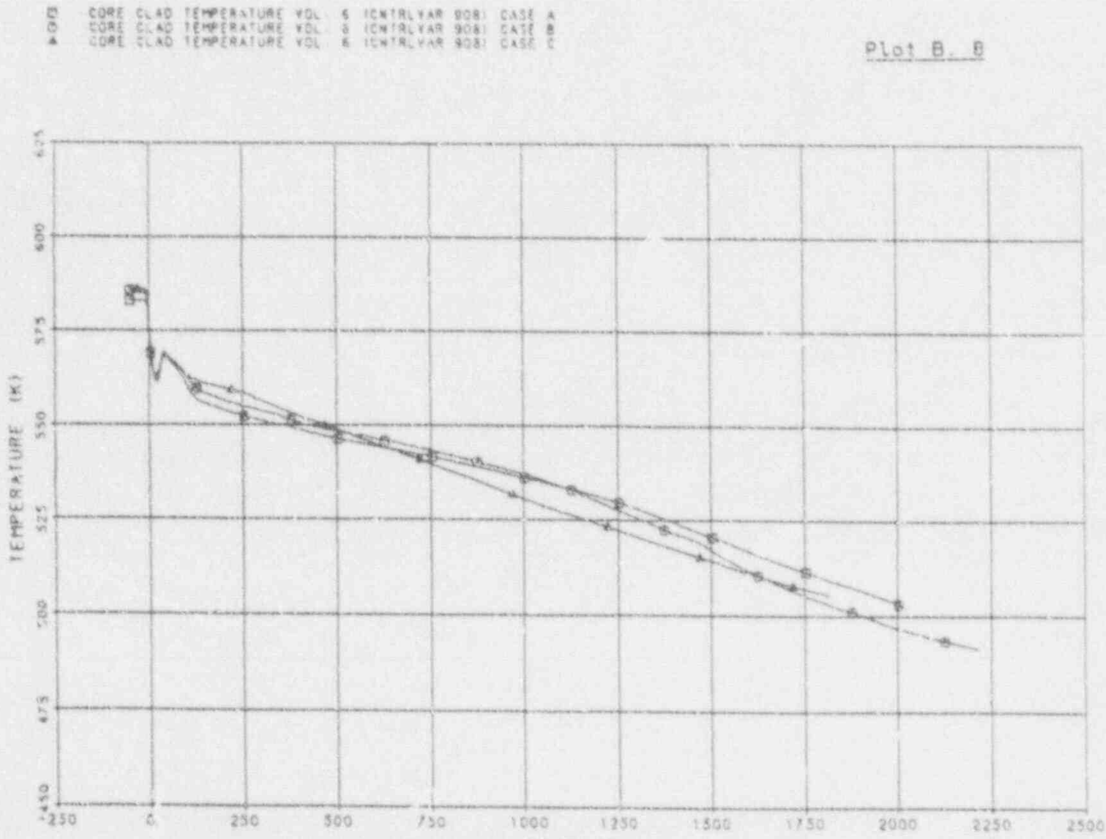
Plot B. 6



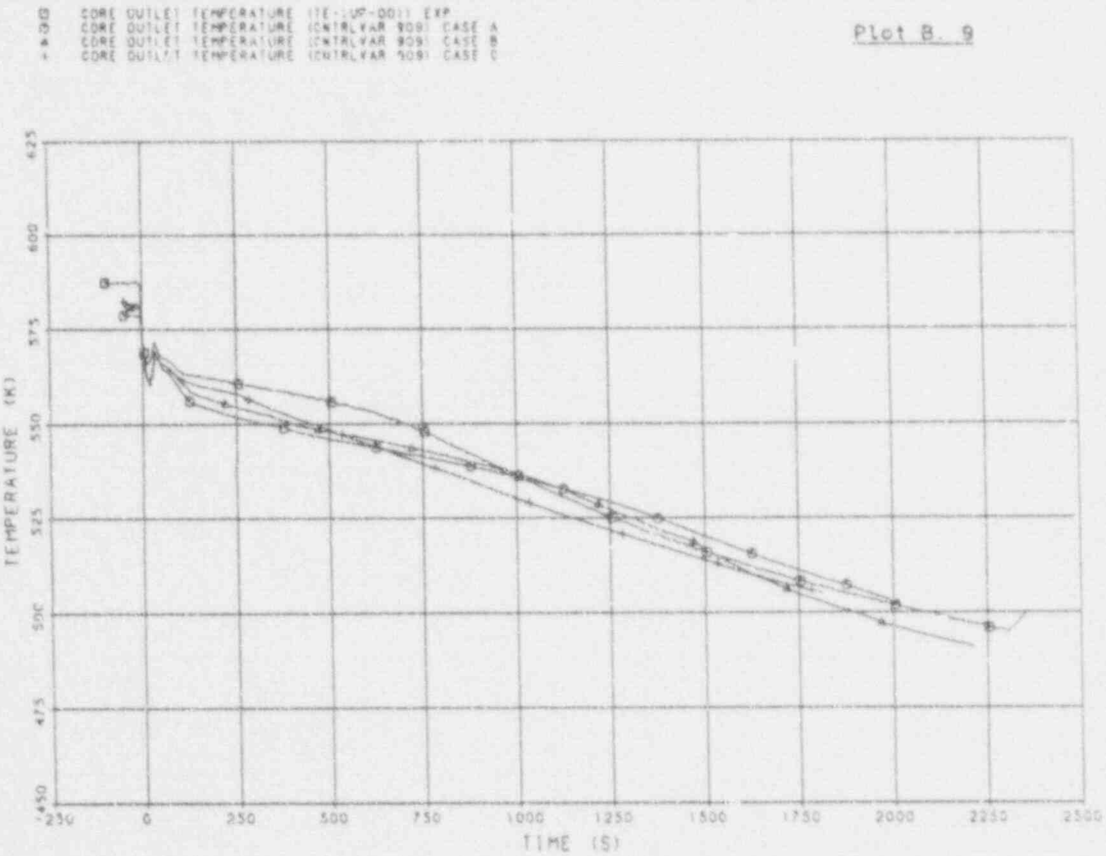
Plot B. 7



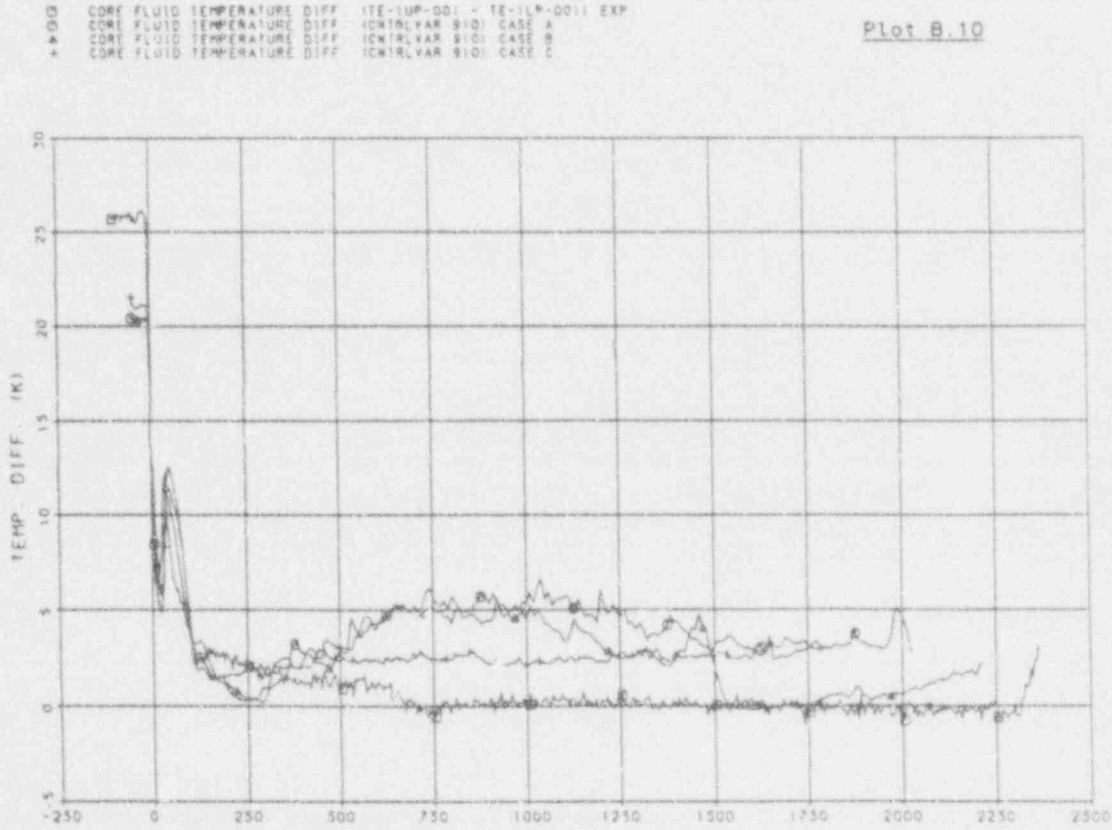
Plot B. 8



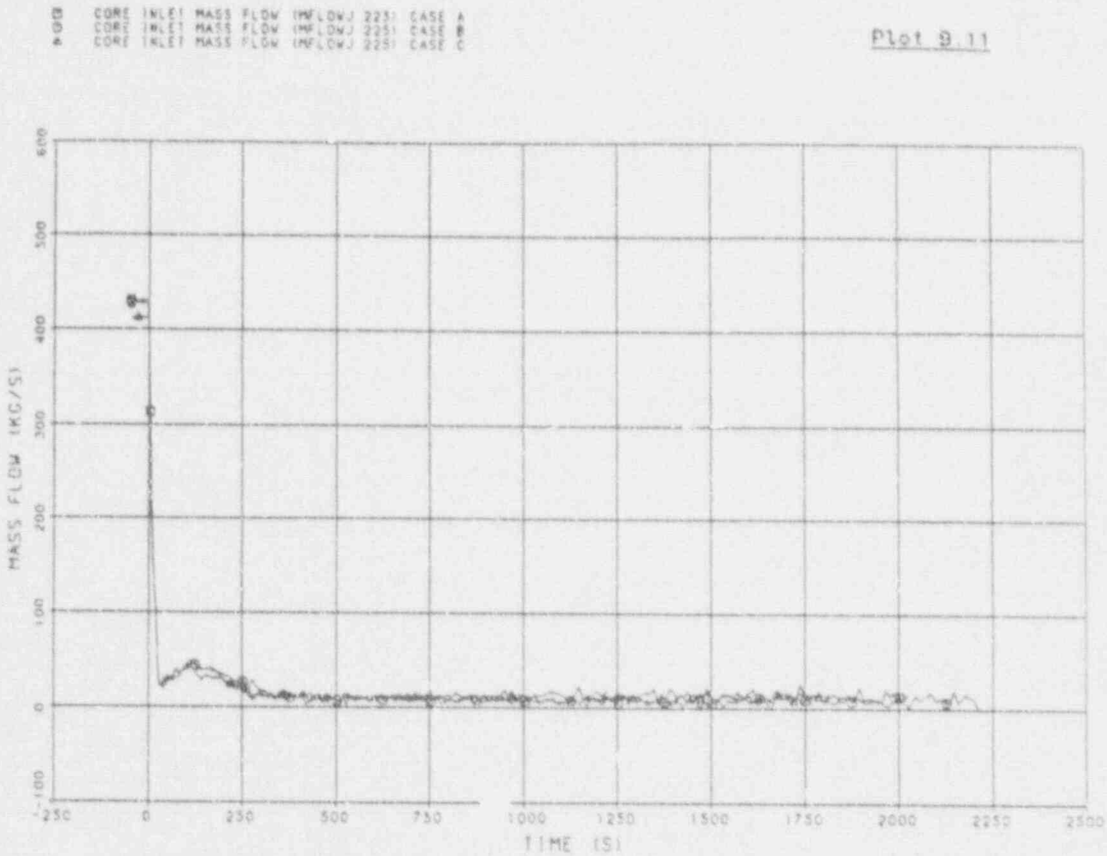
Plot B. 9



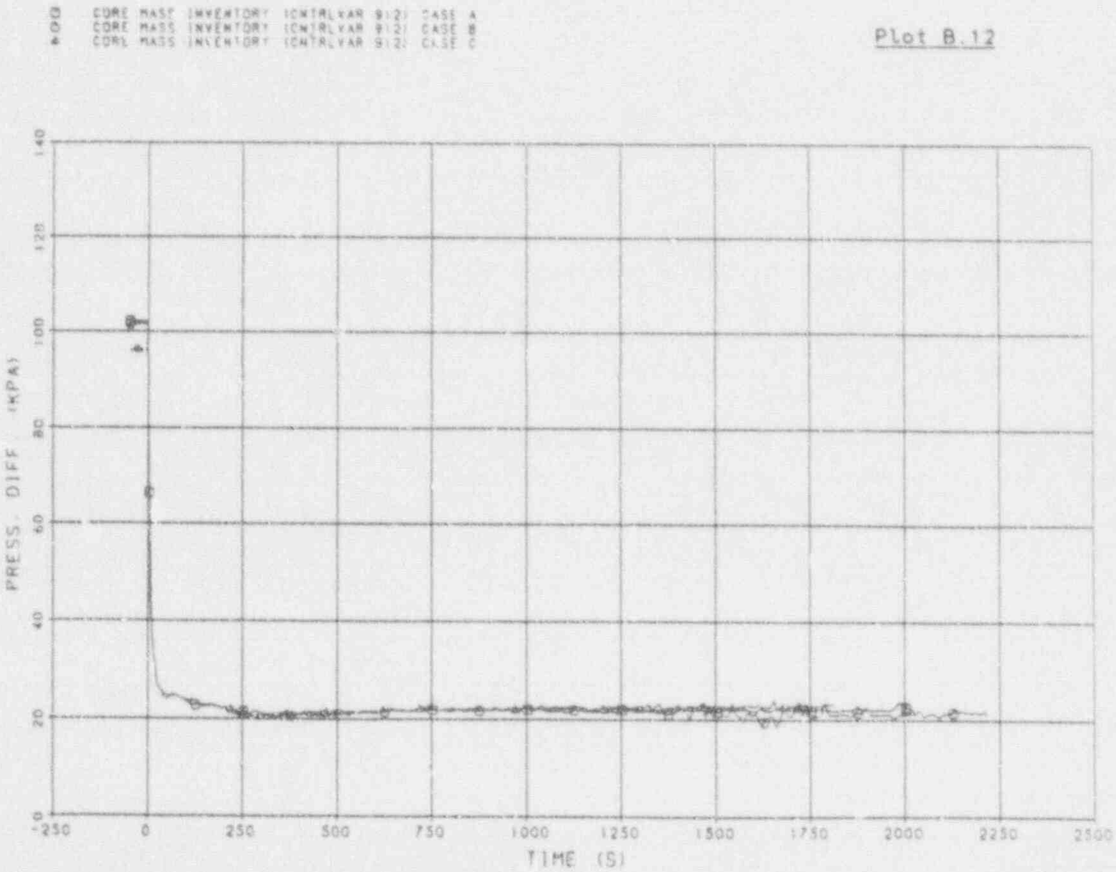
Plot B.10

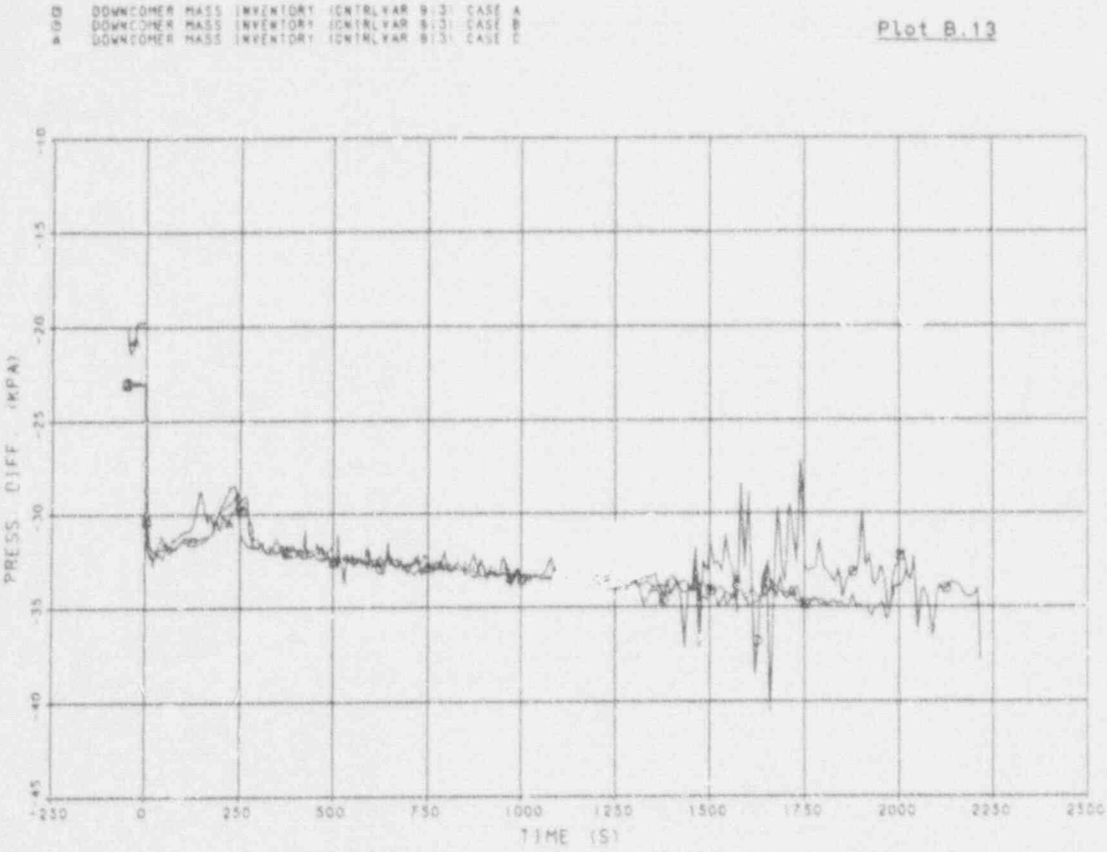


Plot B.11

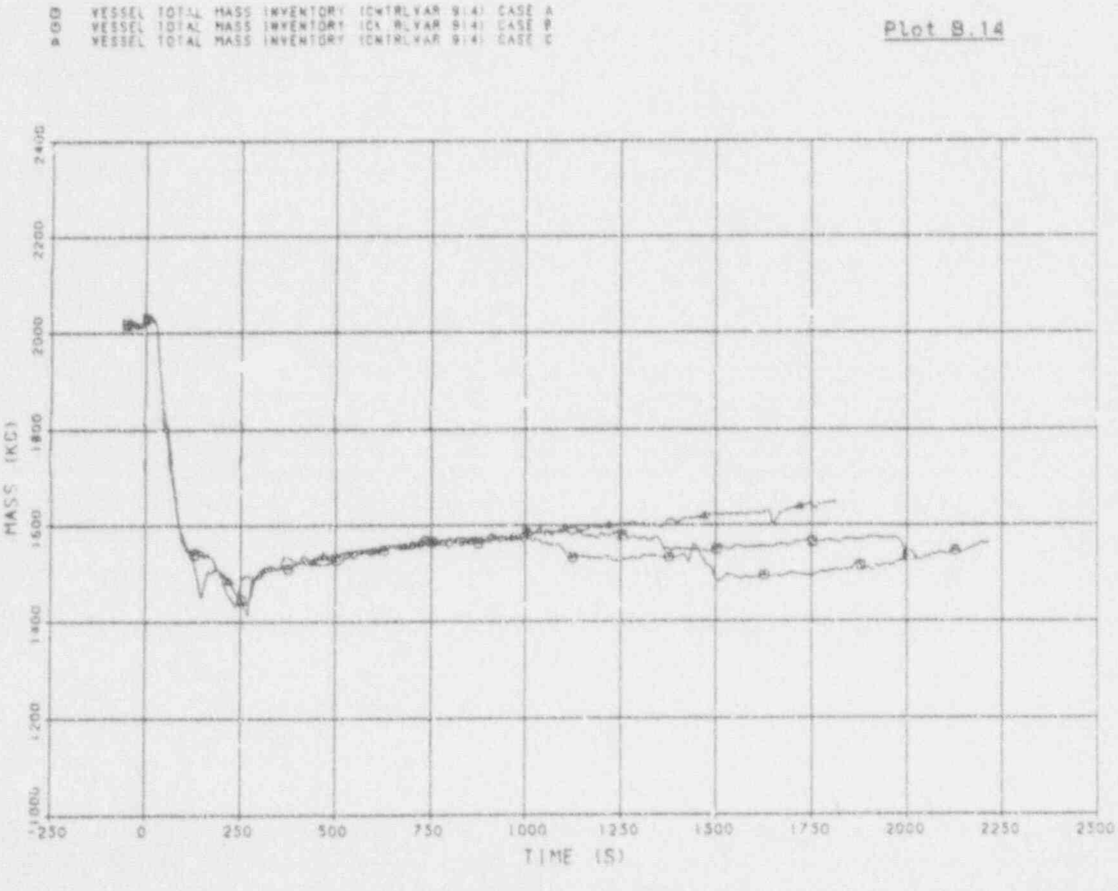


Plot B.12



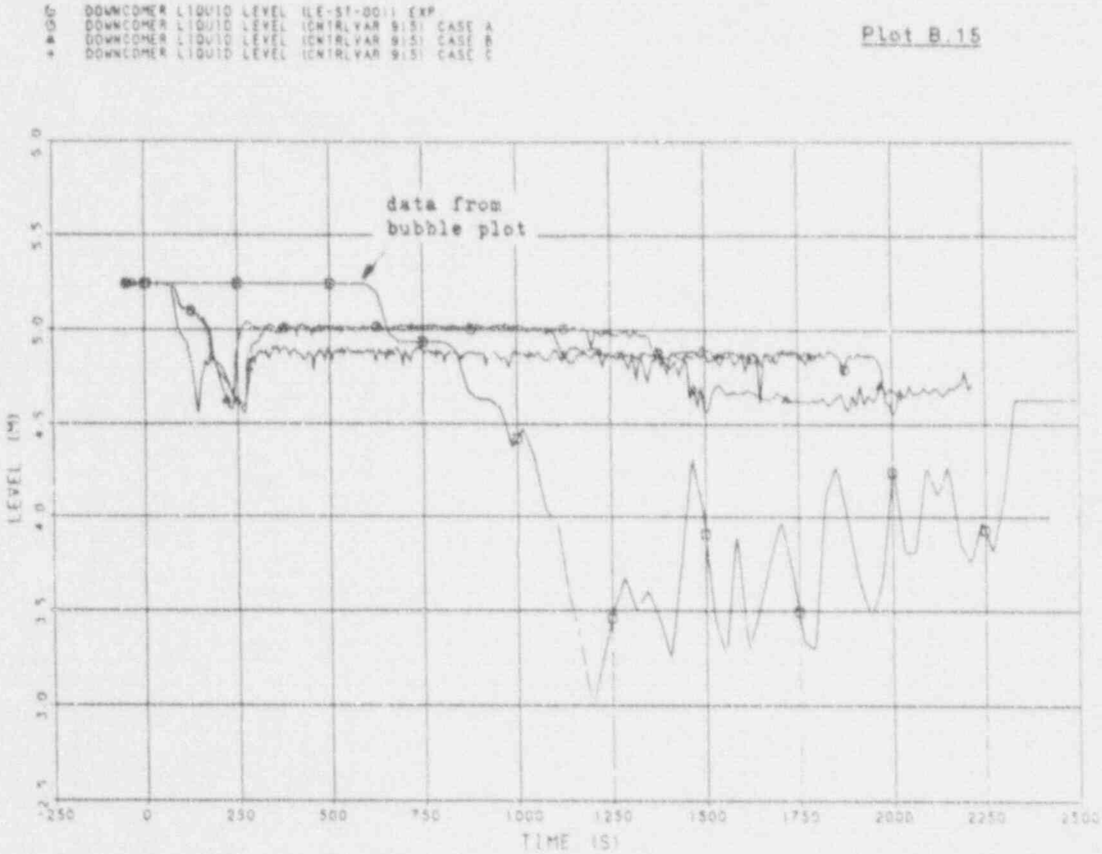


Plot B.13

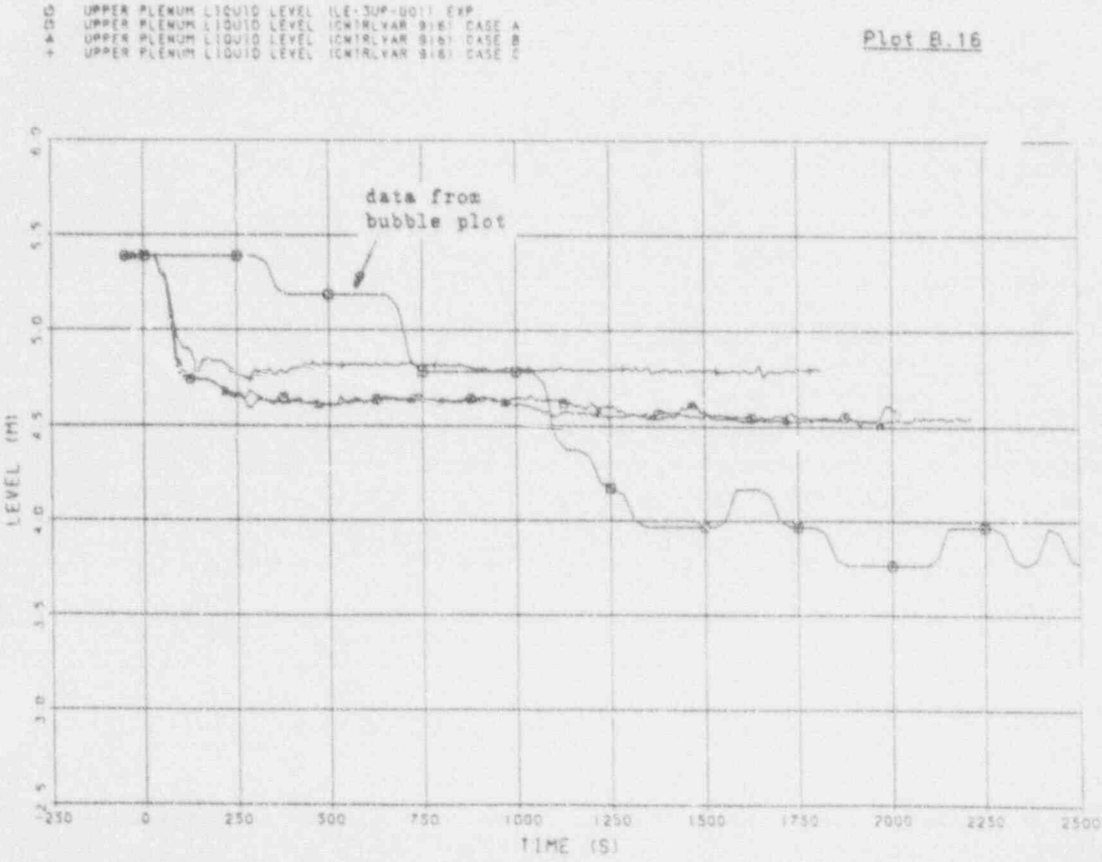


Plot B.14

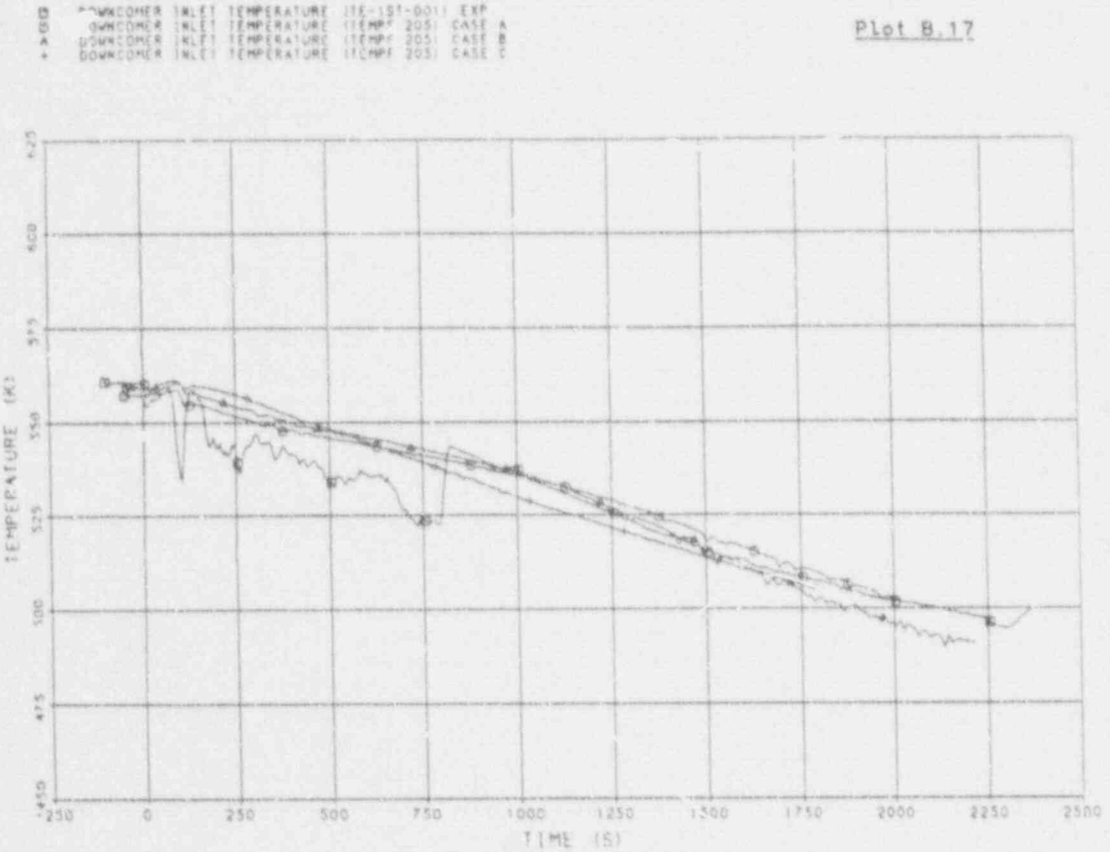
Plot B.15



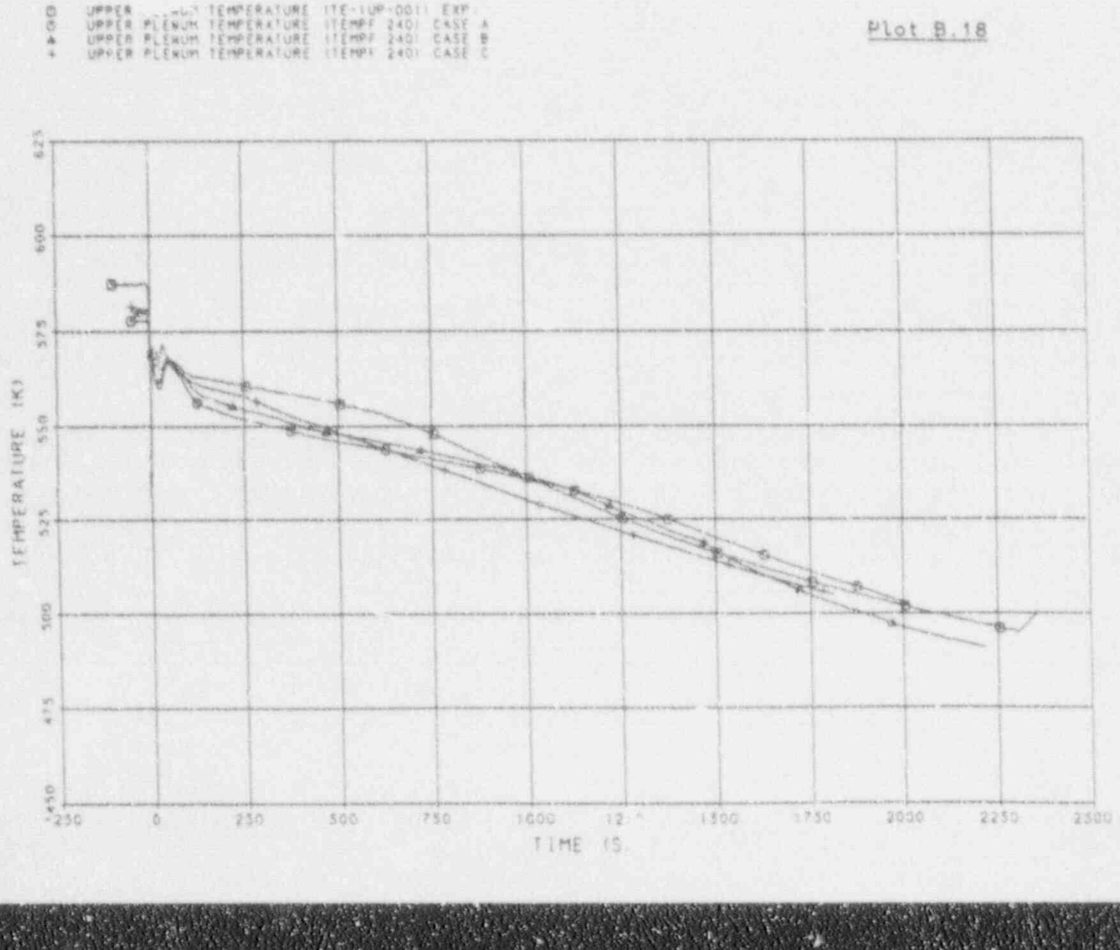
Plot B.16

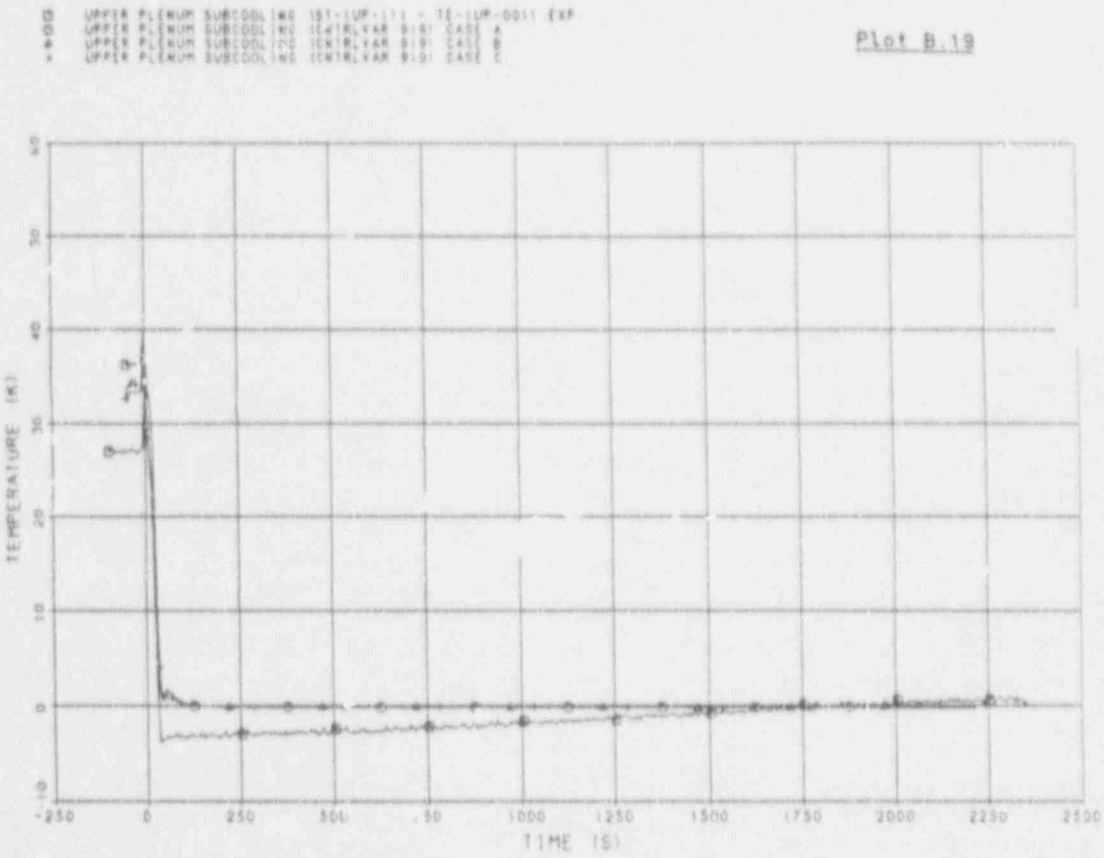


Plot B.17



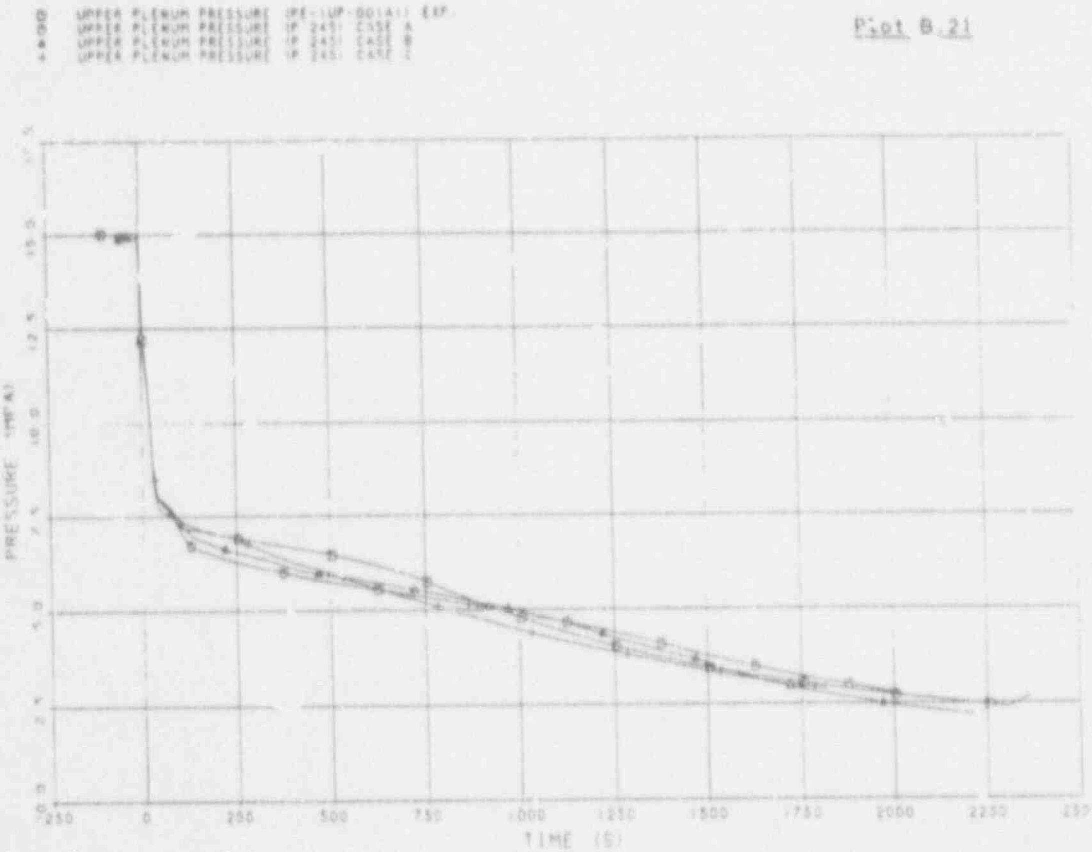
Plot B.18



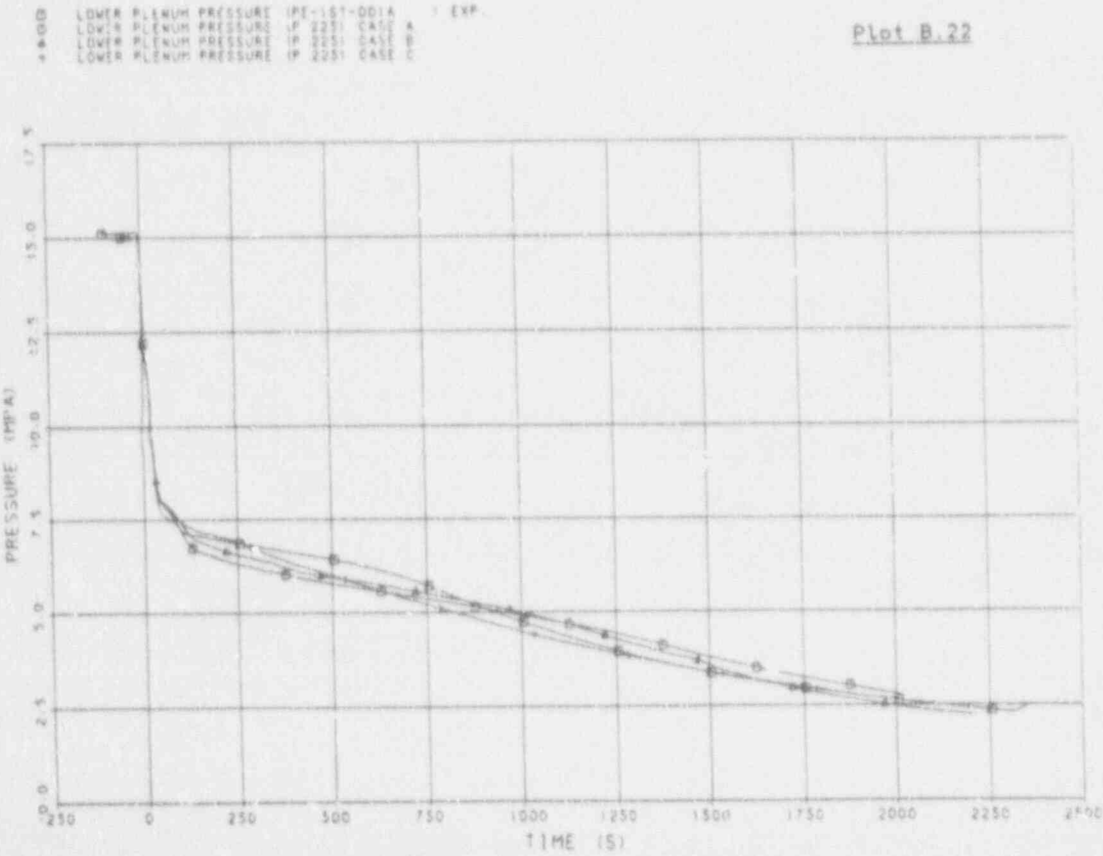


Plot B.19

Plot B.20

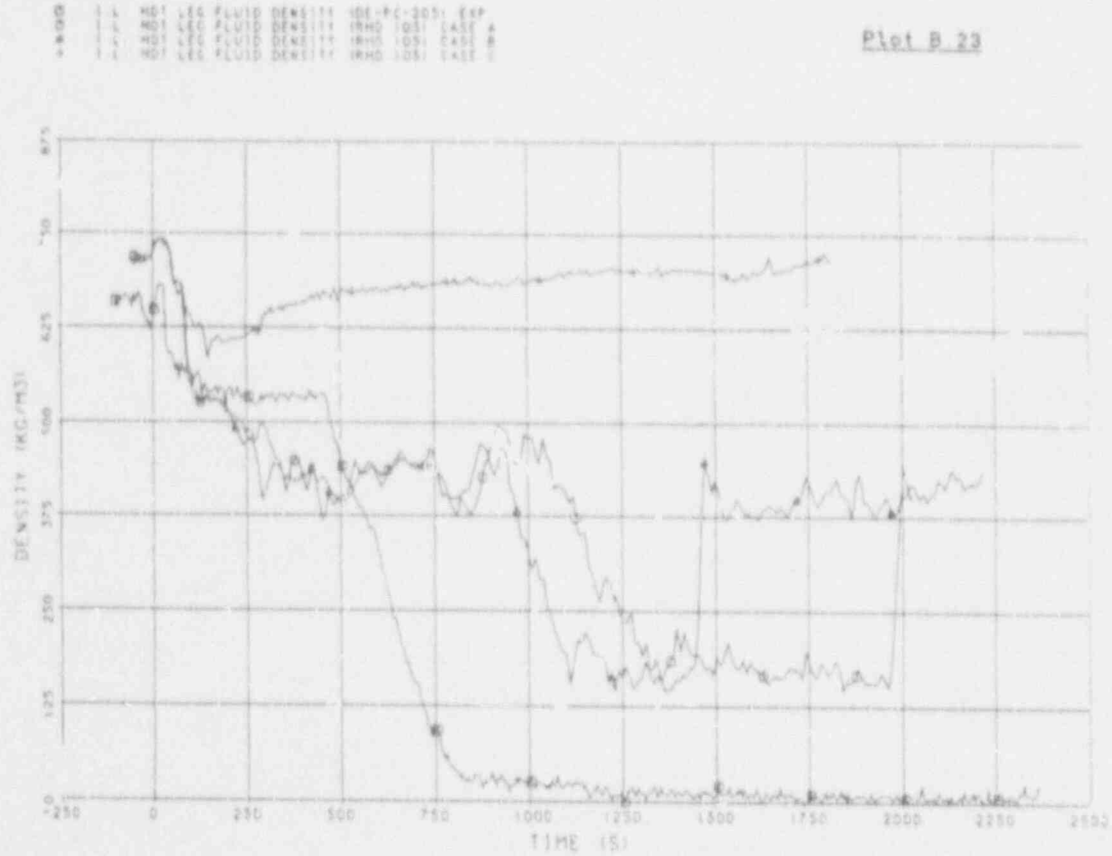


Plot B.21

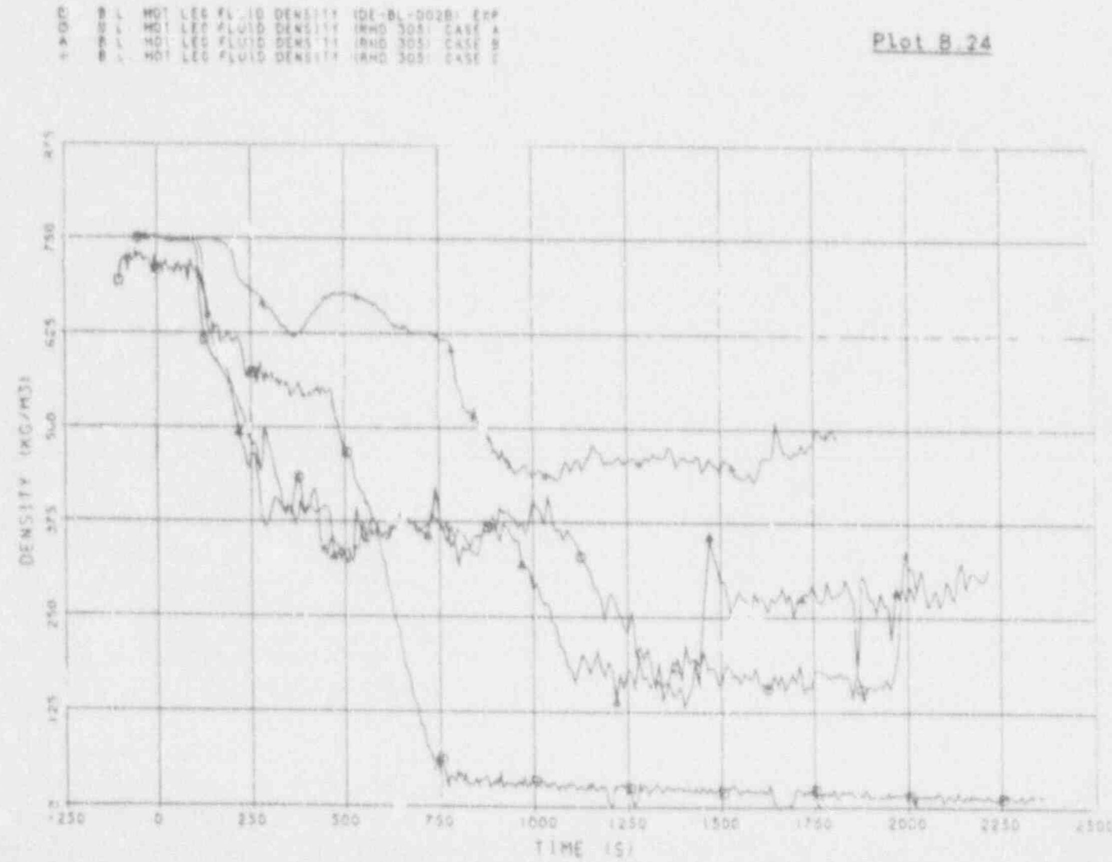


Plot B.22

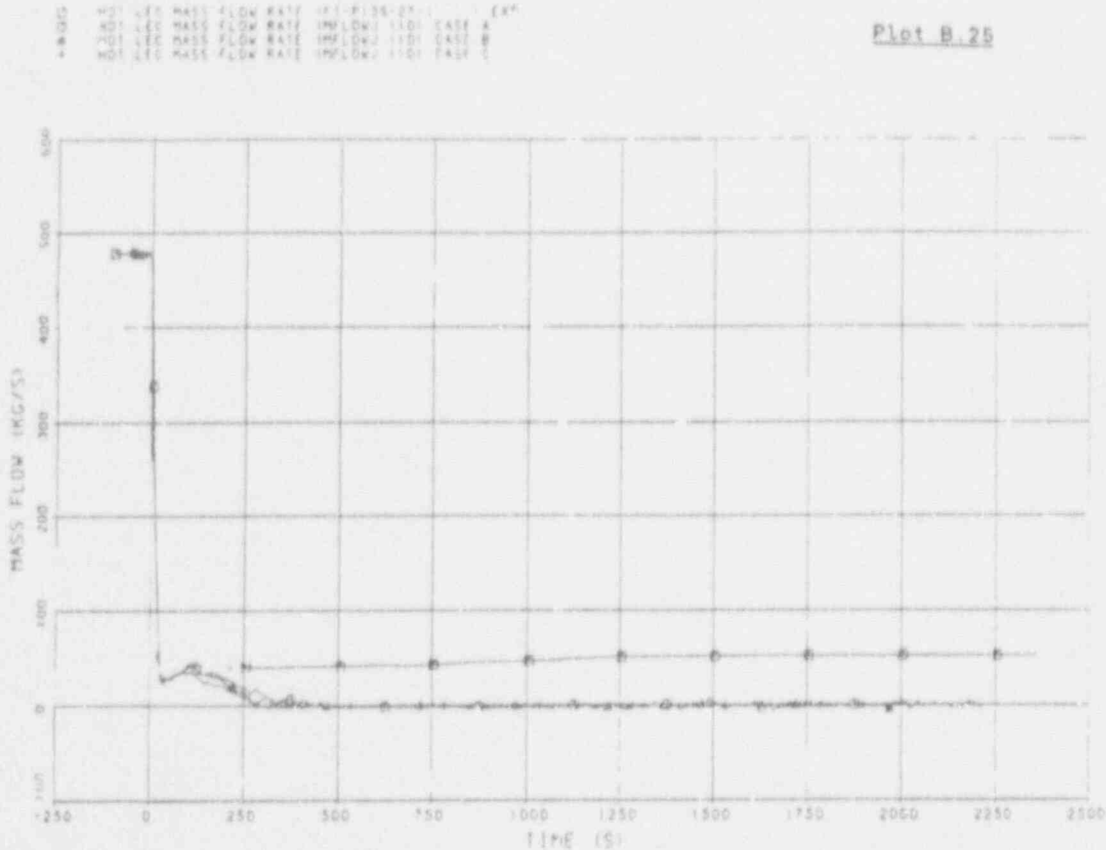
Plot B.23



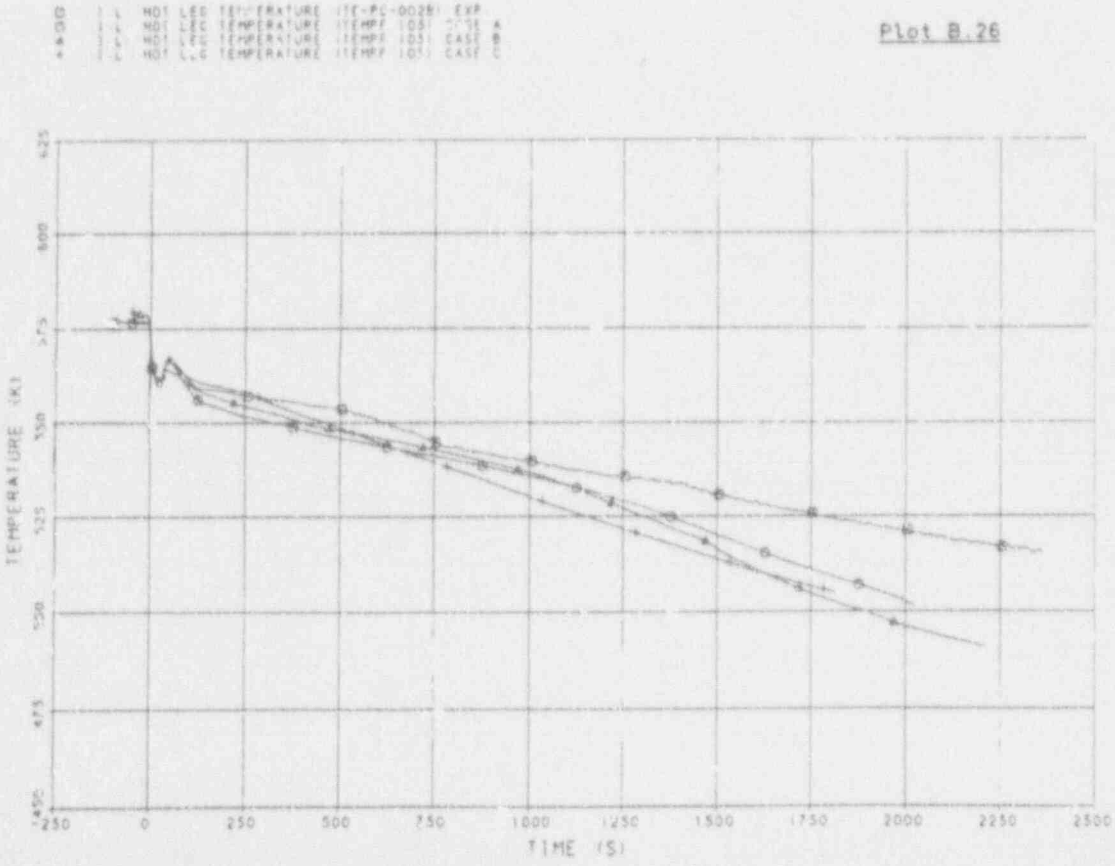
Plot B.24



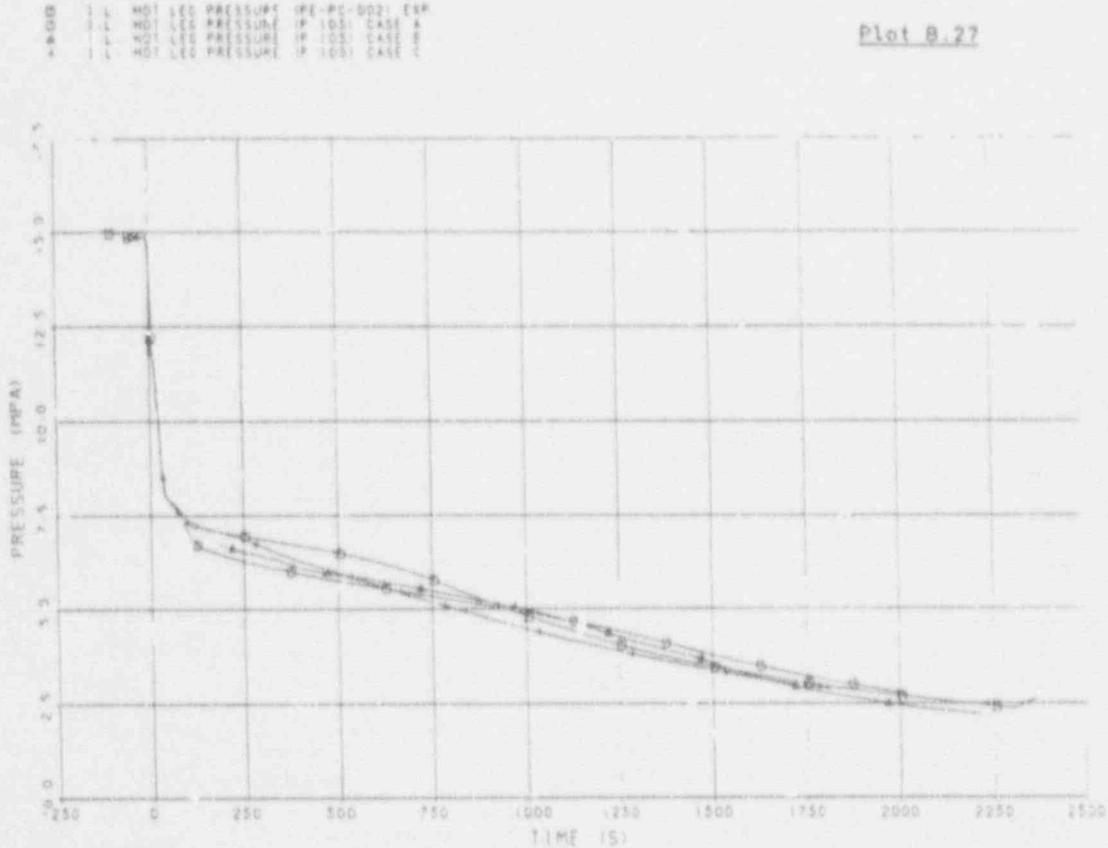
Plot B.25



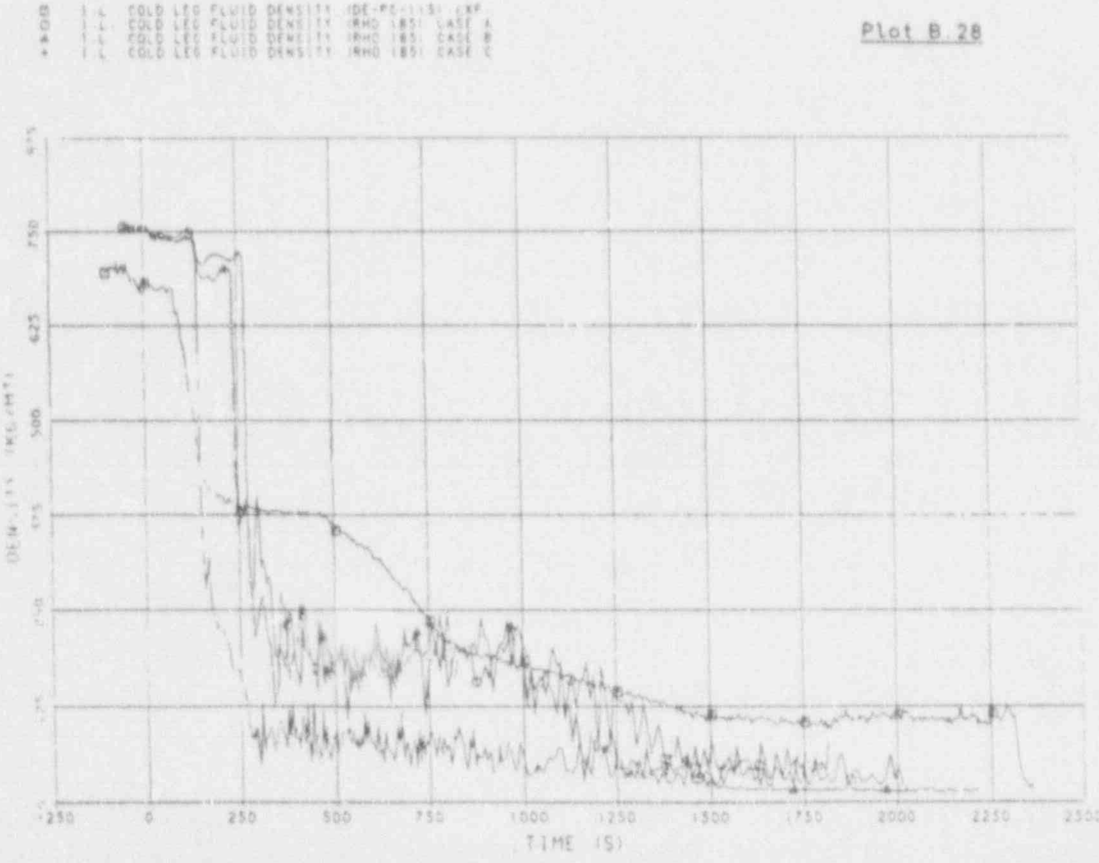
Plot B.26



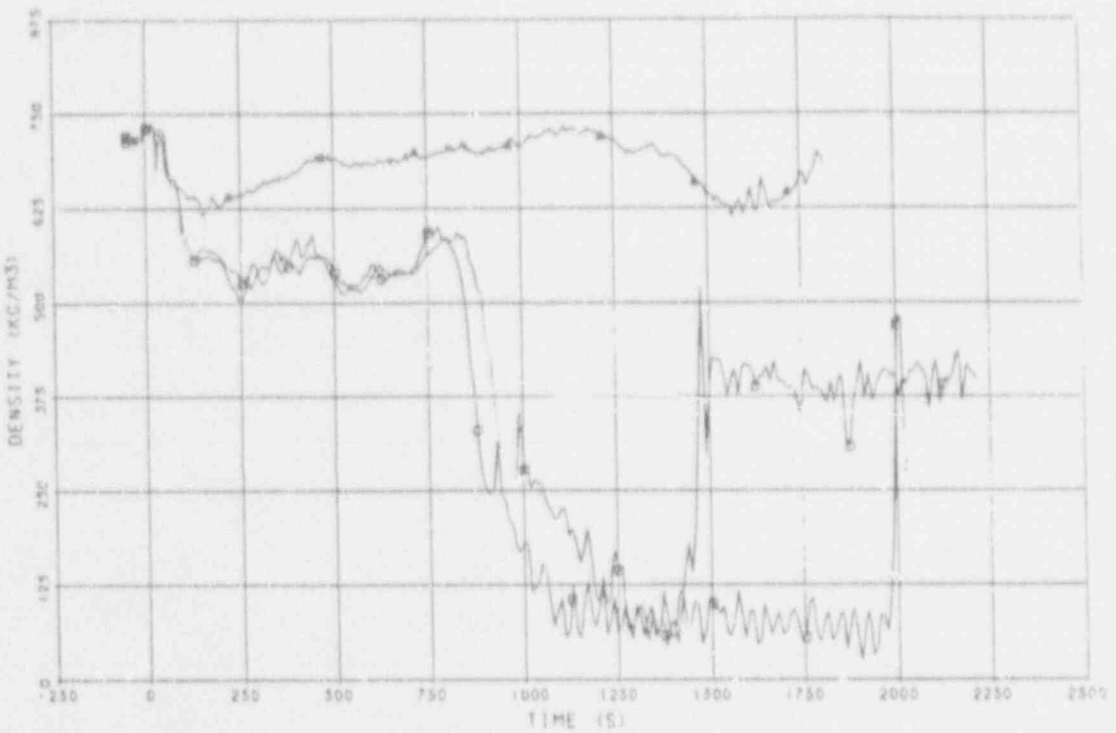
Plot B.27



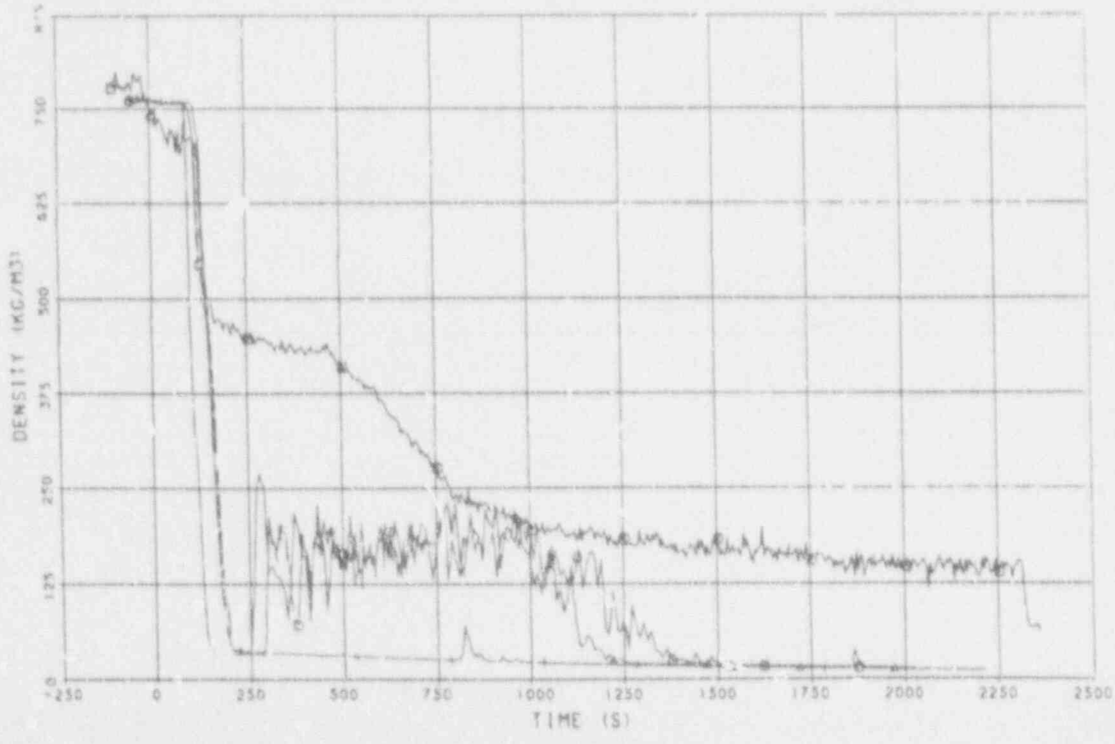
Plot B.28



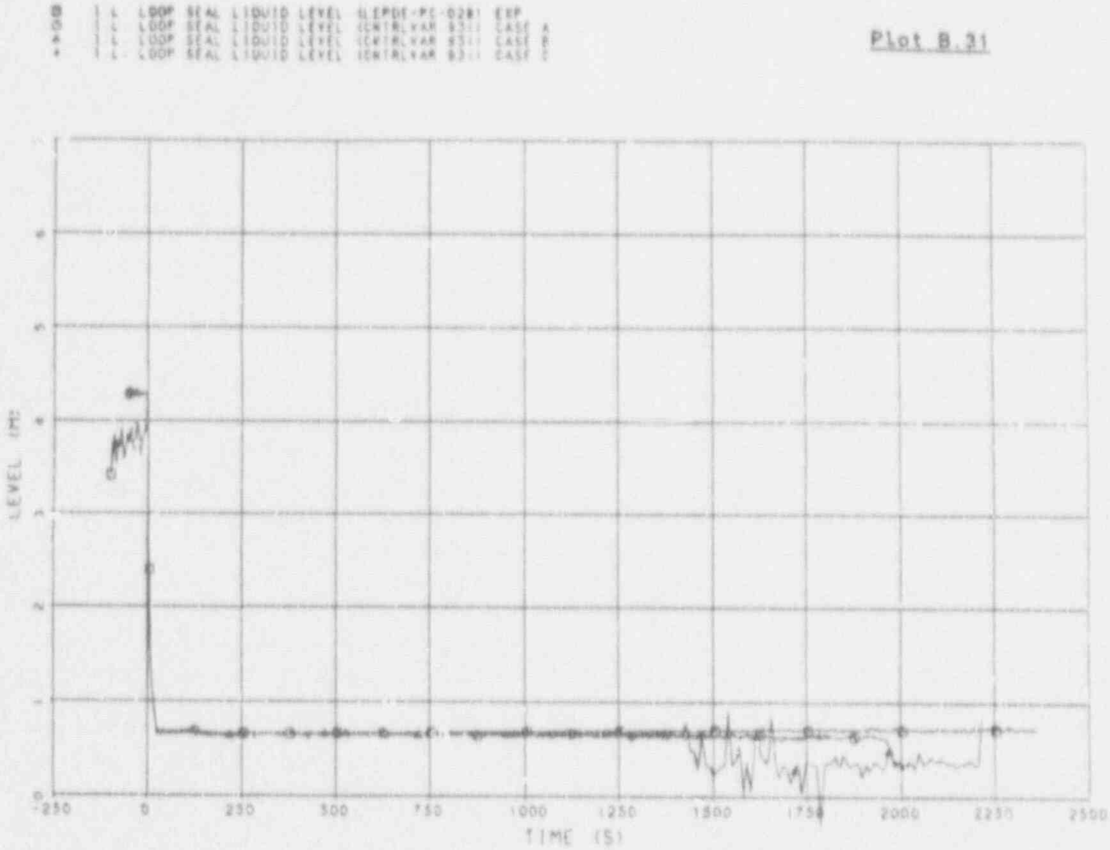
Plot B.29



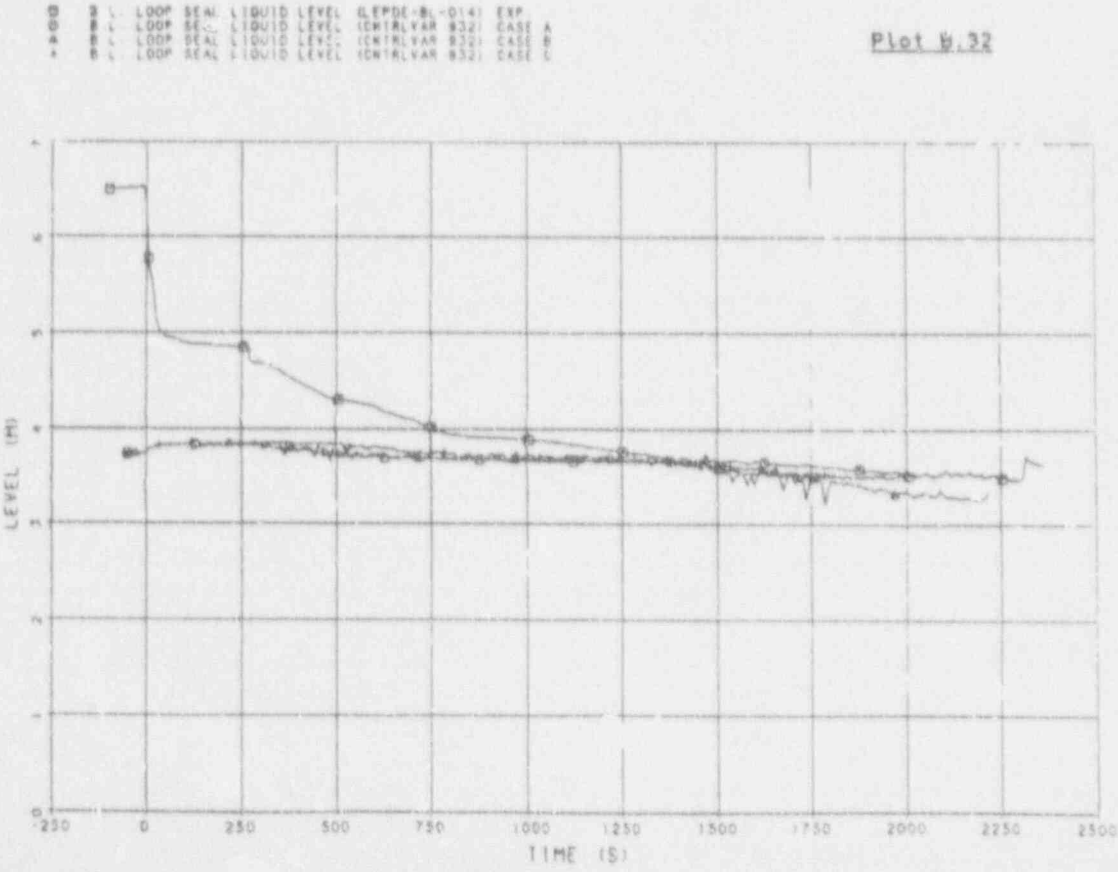
Plot B.30



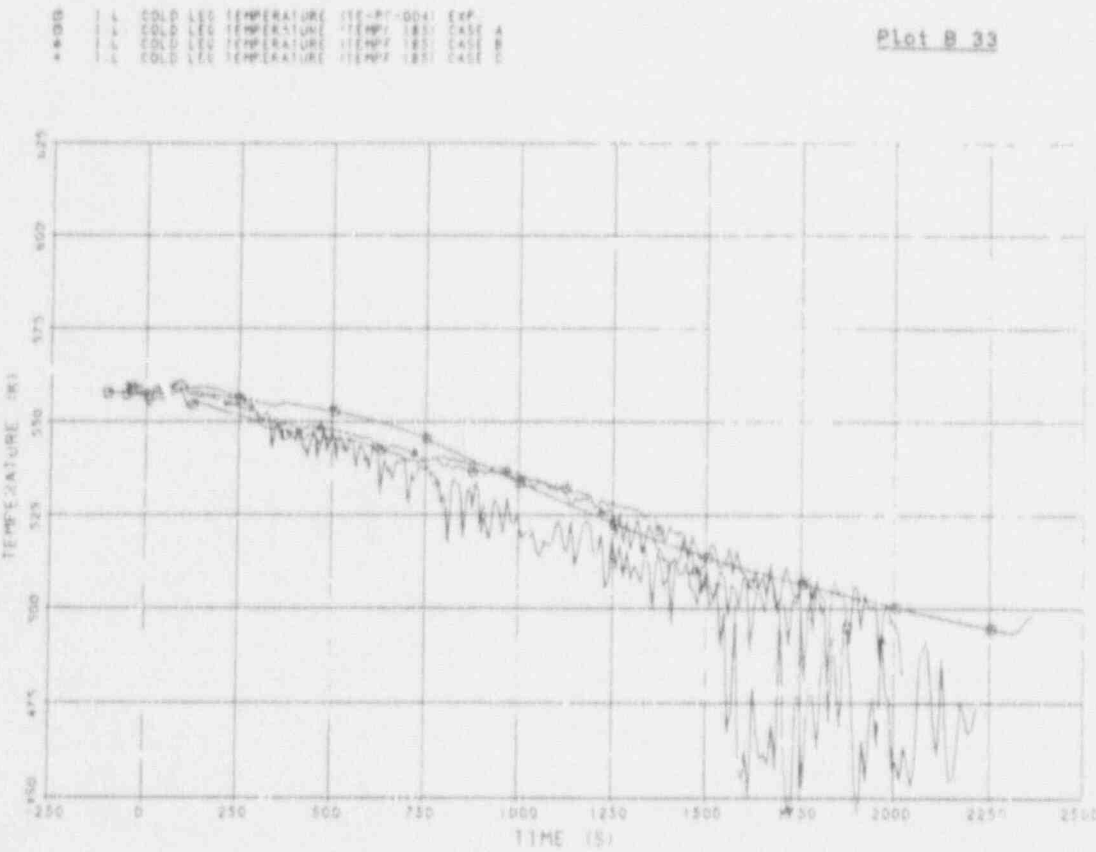
Plot B.31



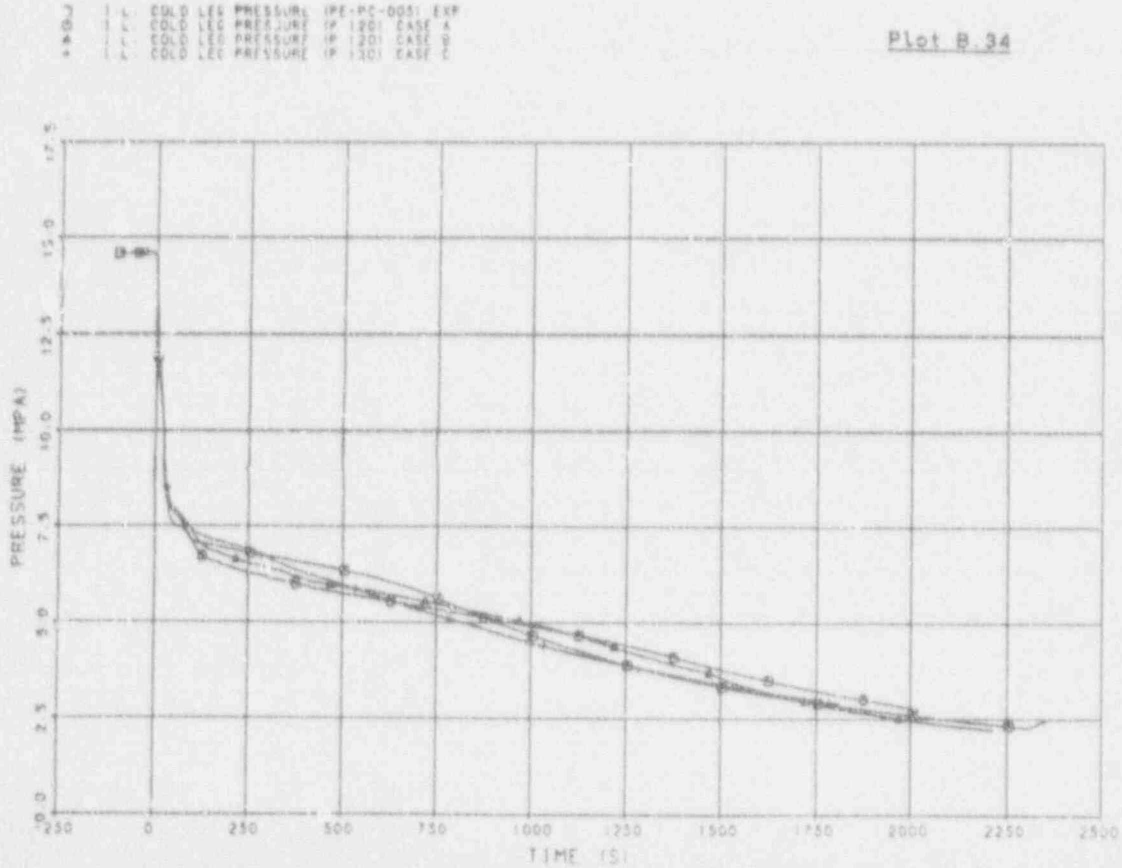
Plot B.32

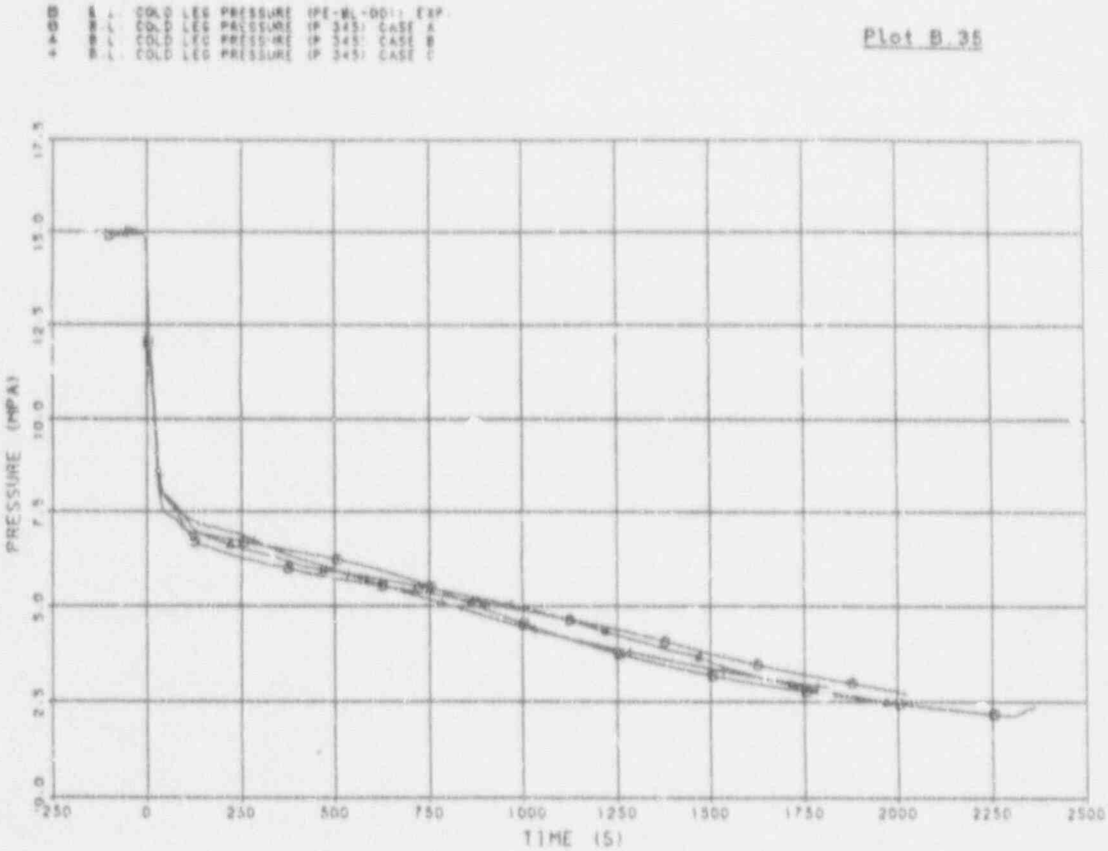


Plot B.33

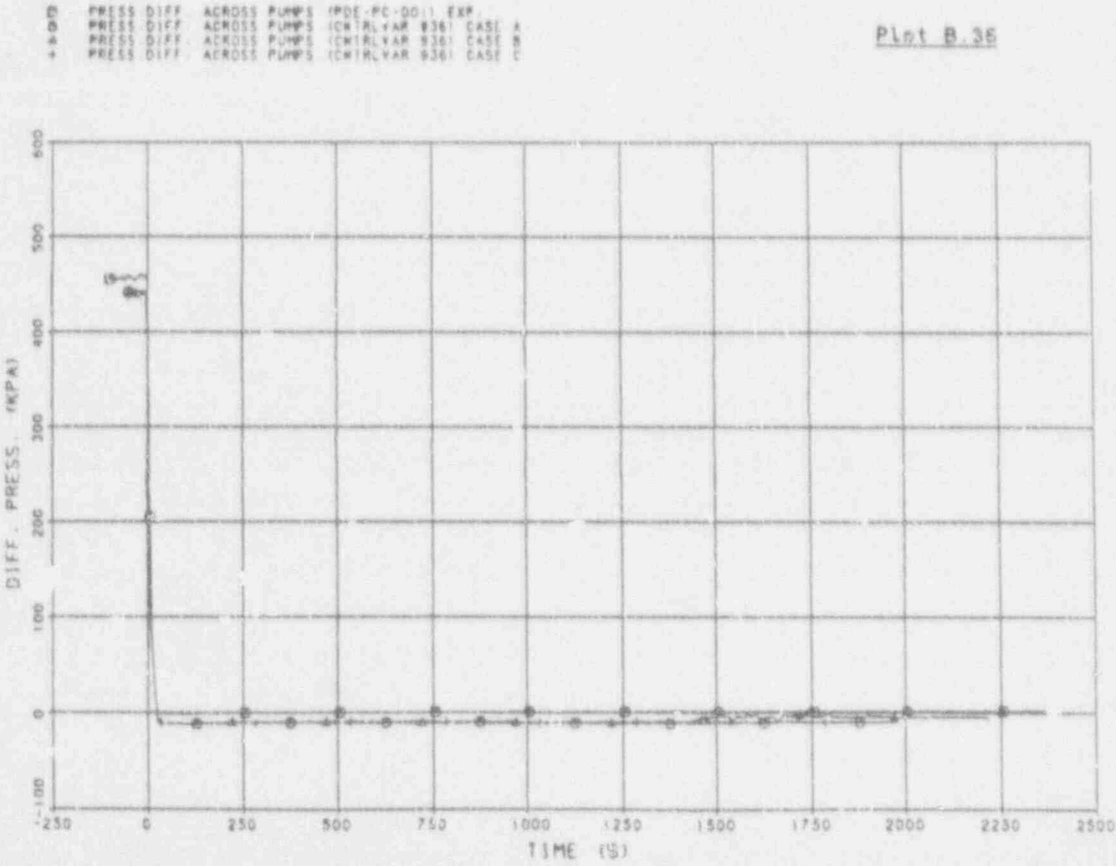


Plot B.34



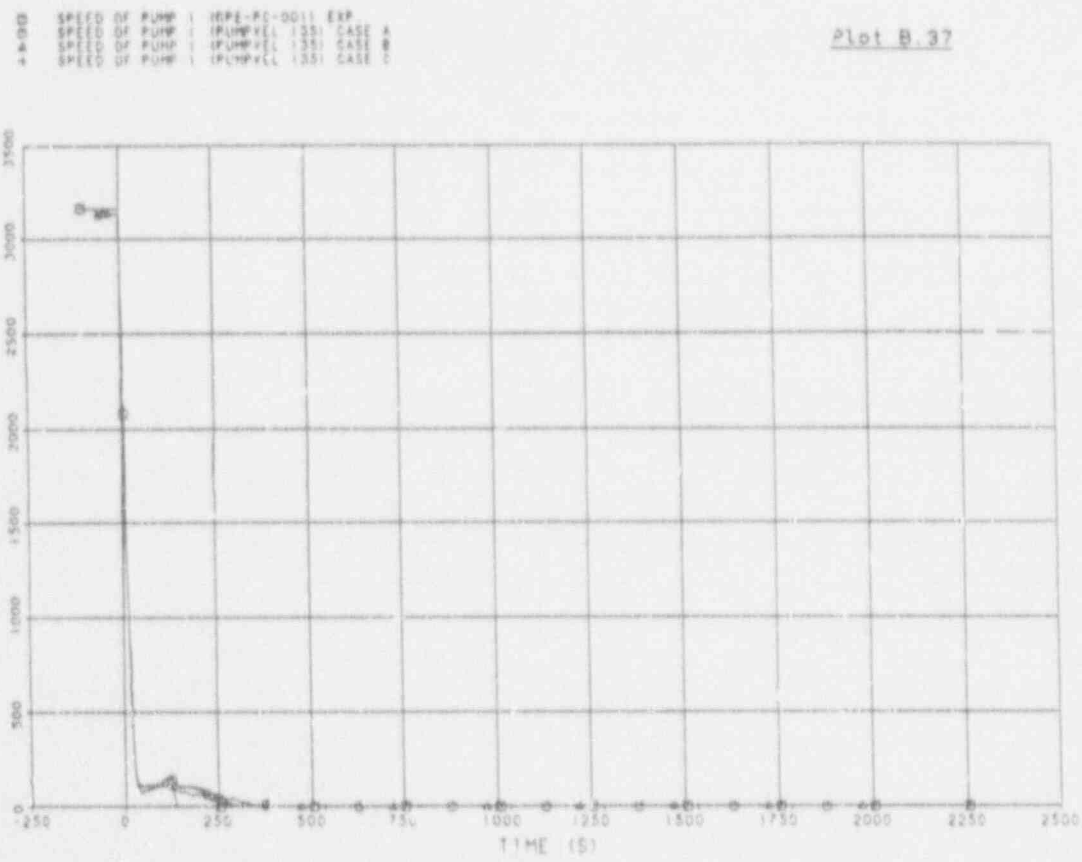


Plot B.35



Plot B.36

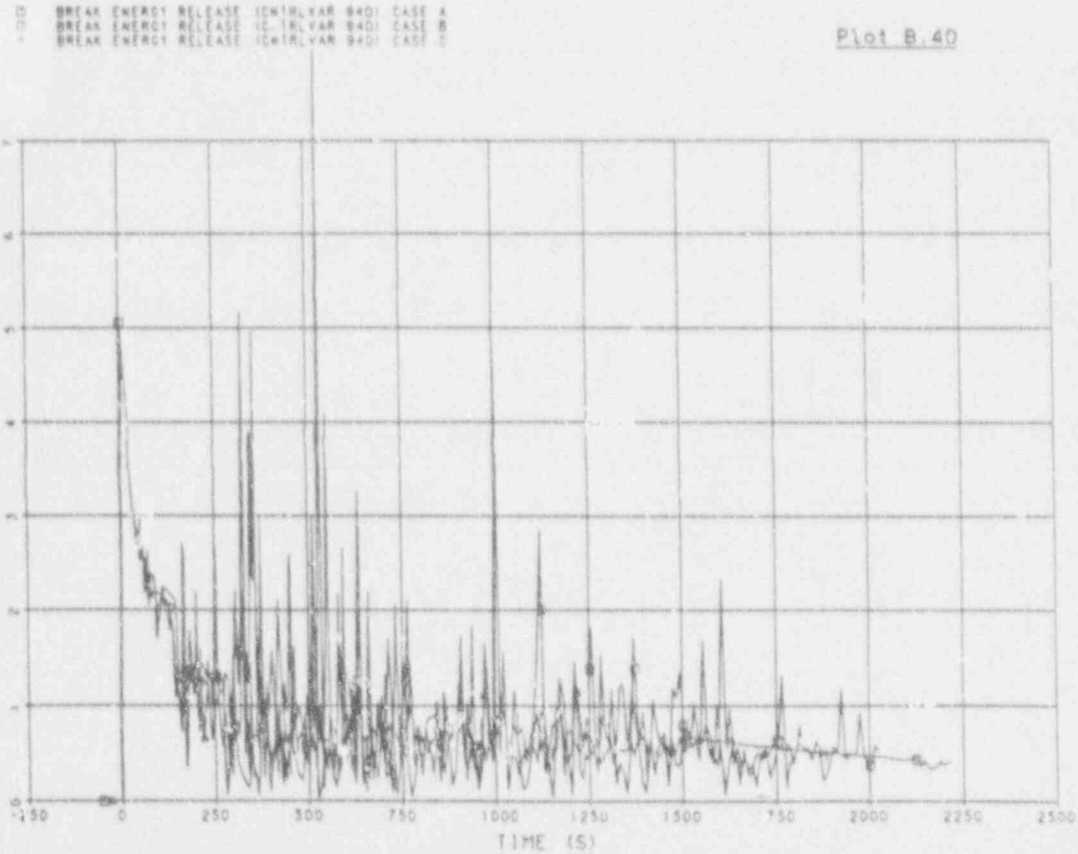
Plot B.37

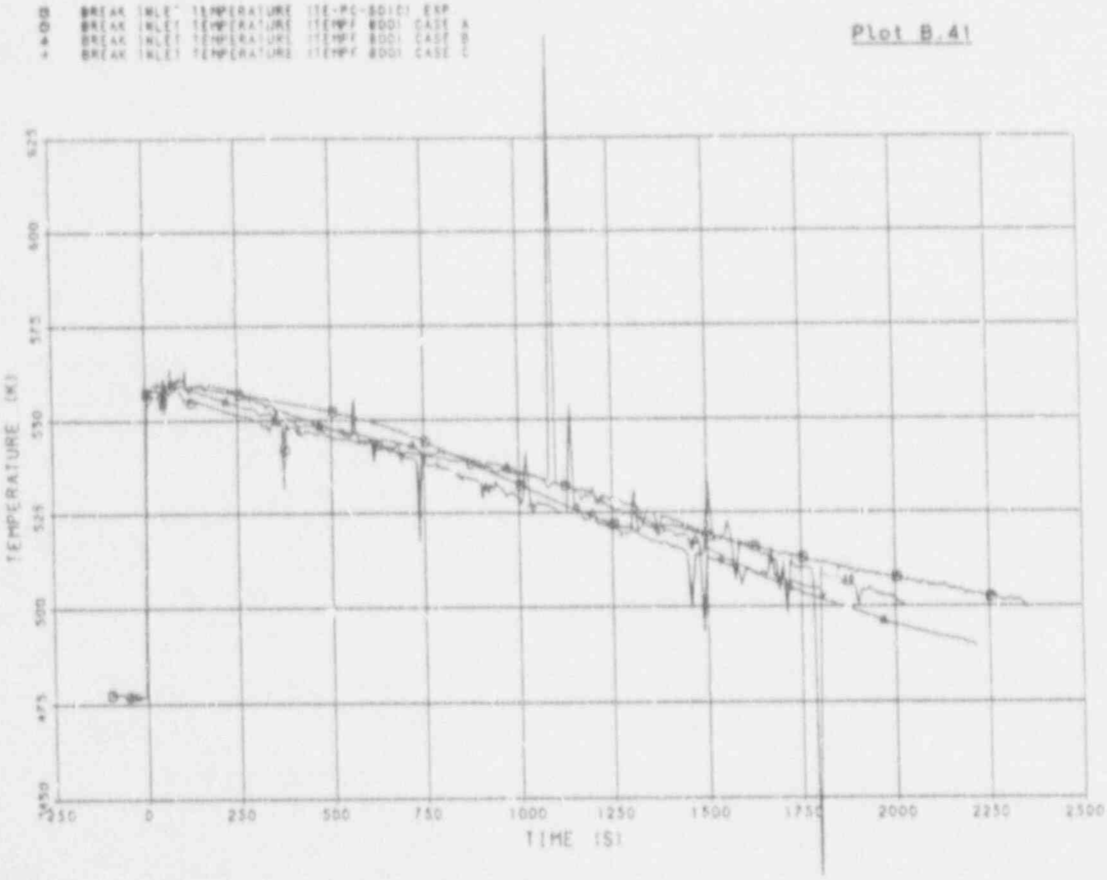


Plot B.38

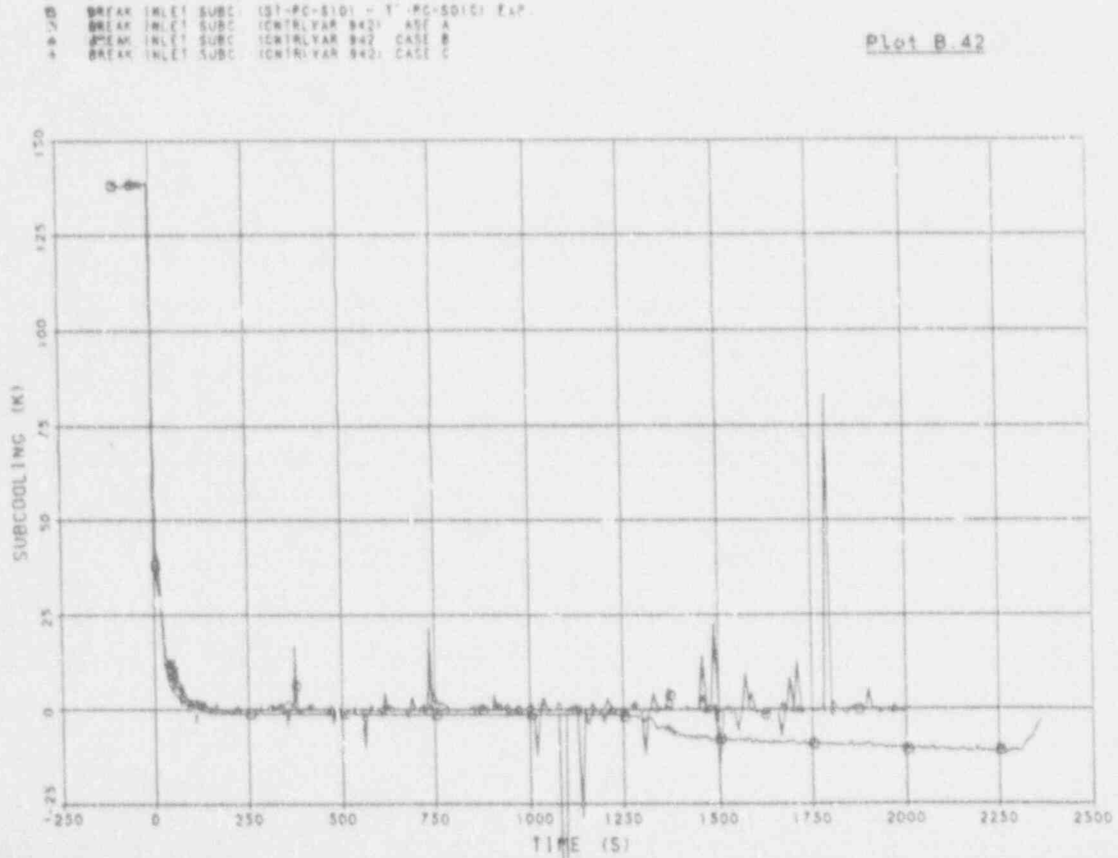
Plot B.39

Plot B.40



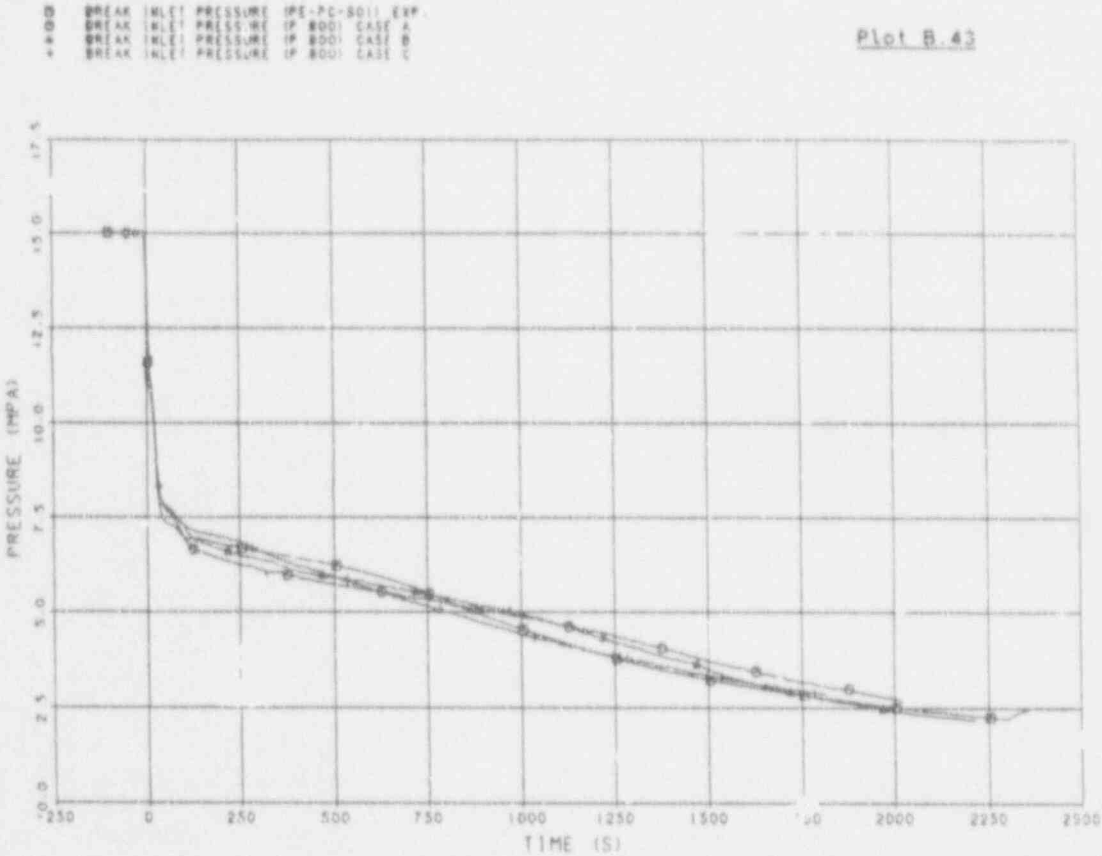


Plot B.41

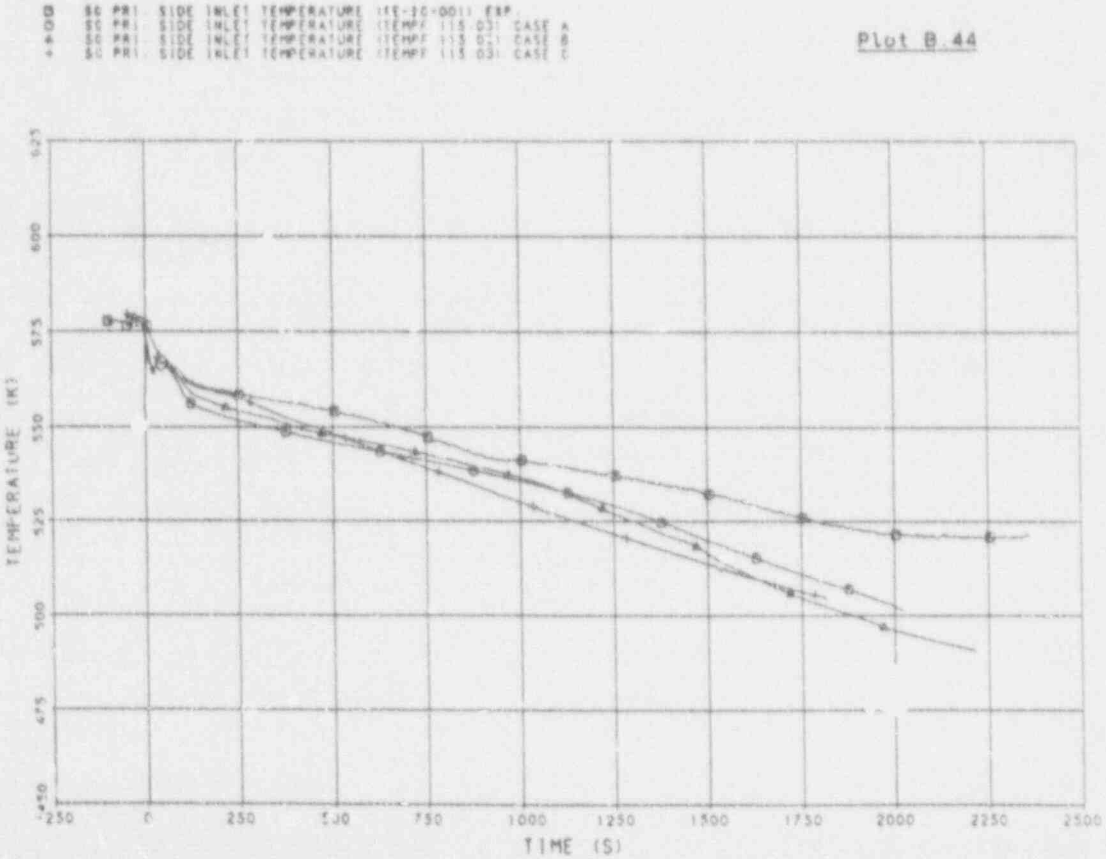


Plot B.42

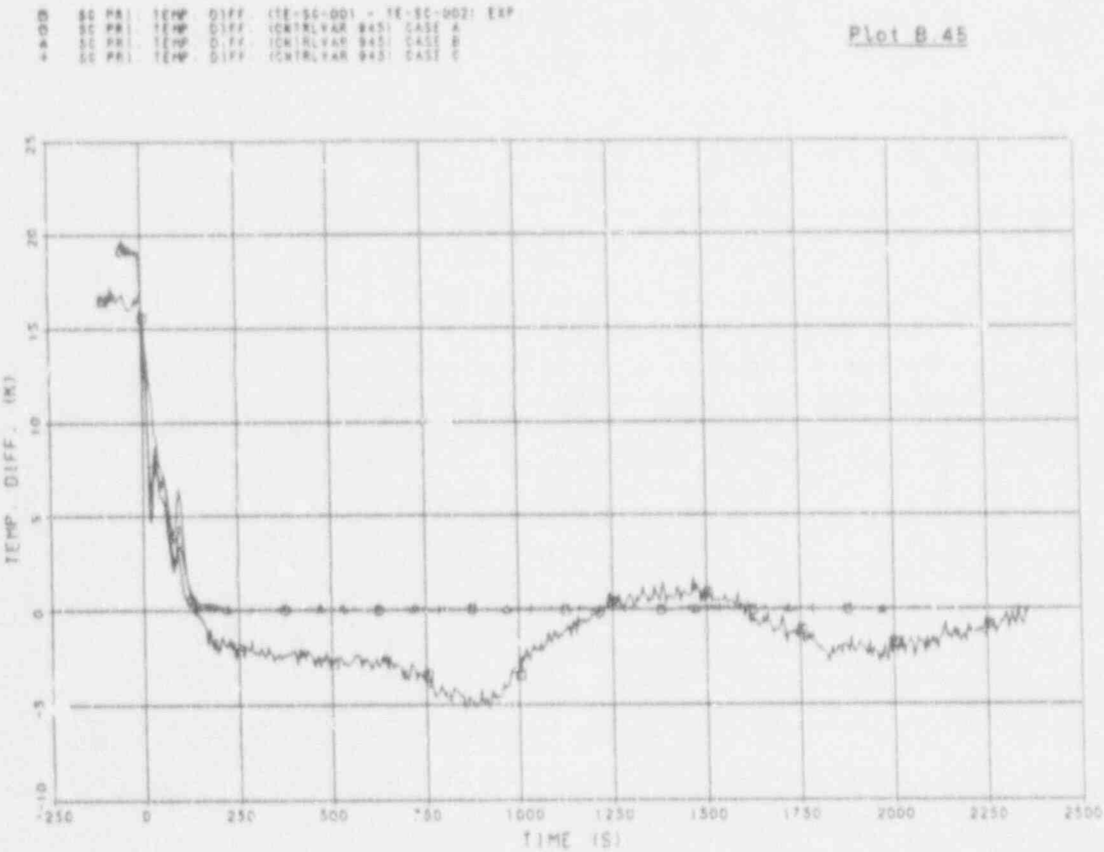
Plot B.43



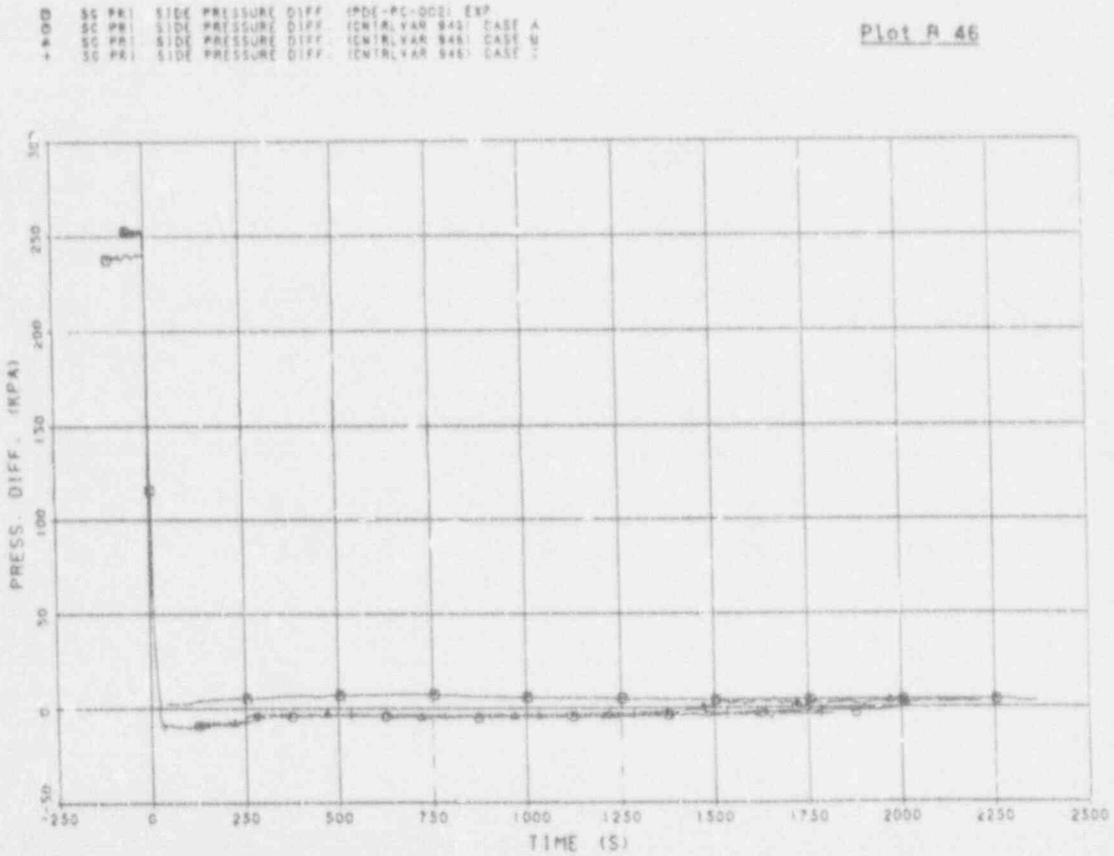
Plot B.44



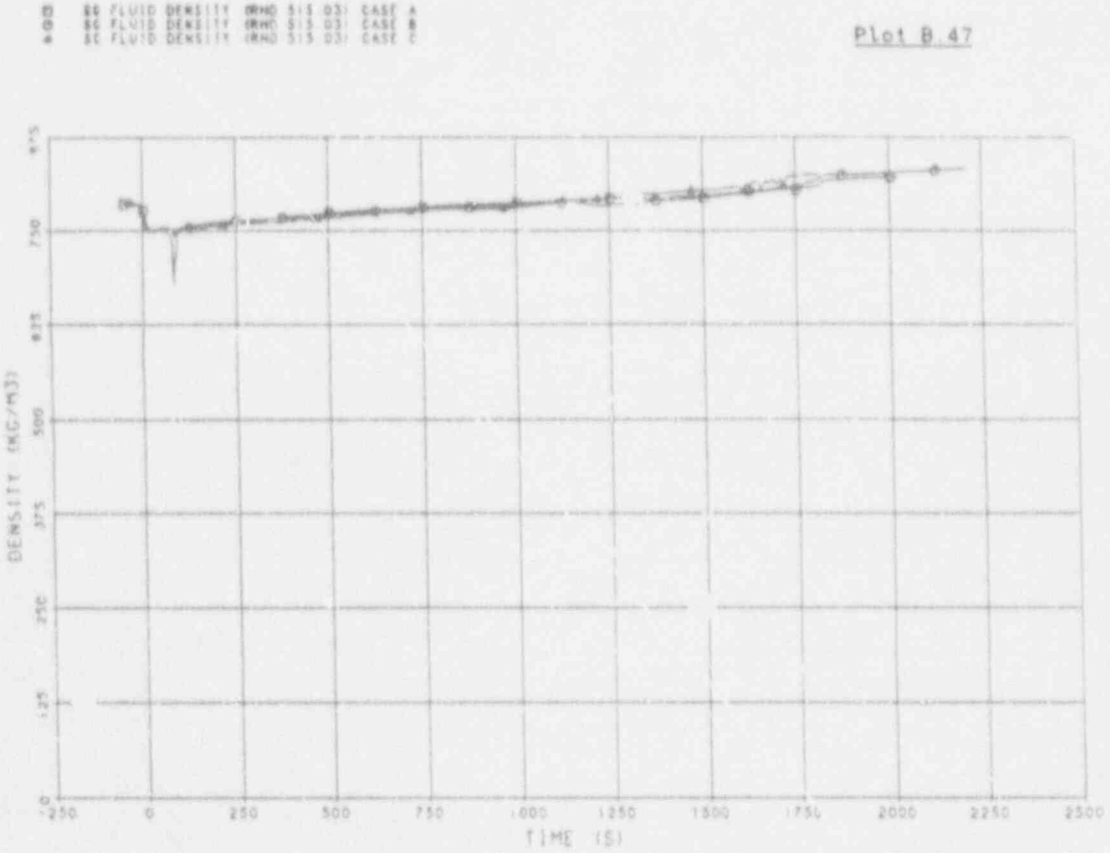
Plot B.45



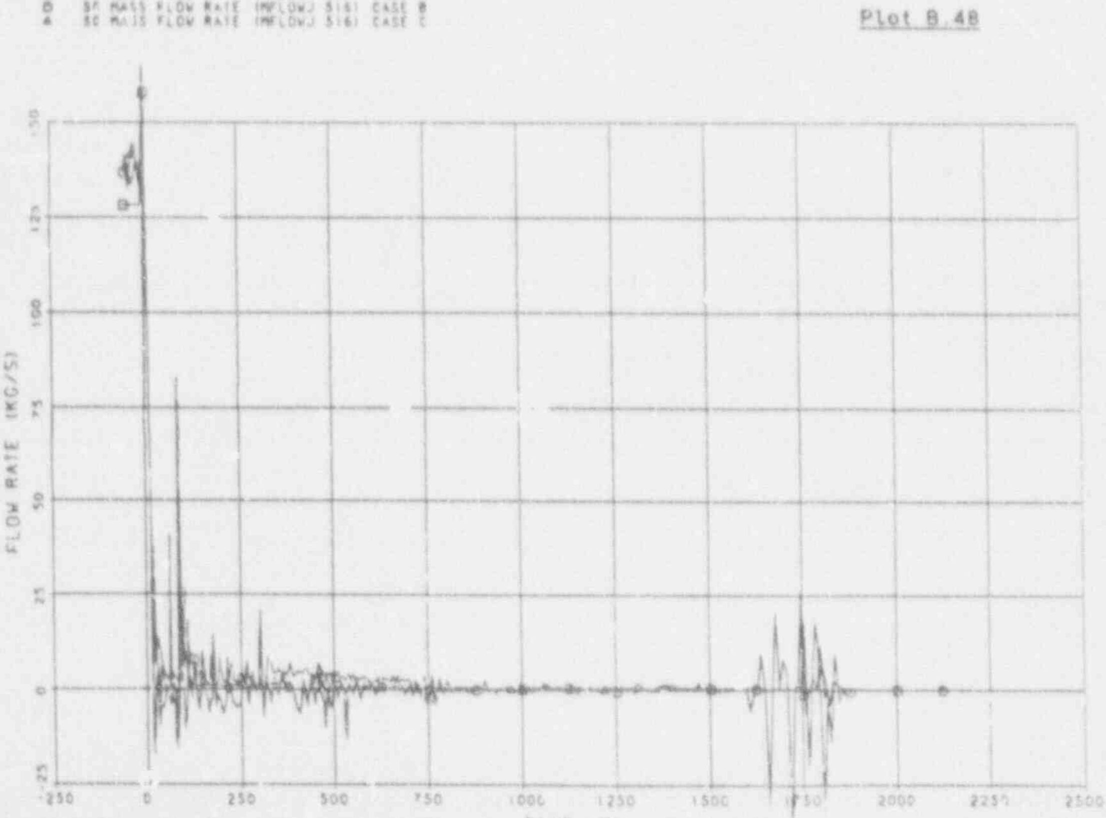
Plot B.46



Plot B.47



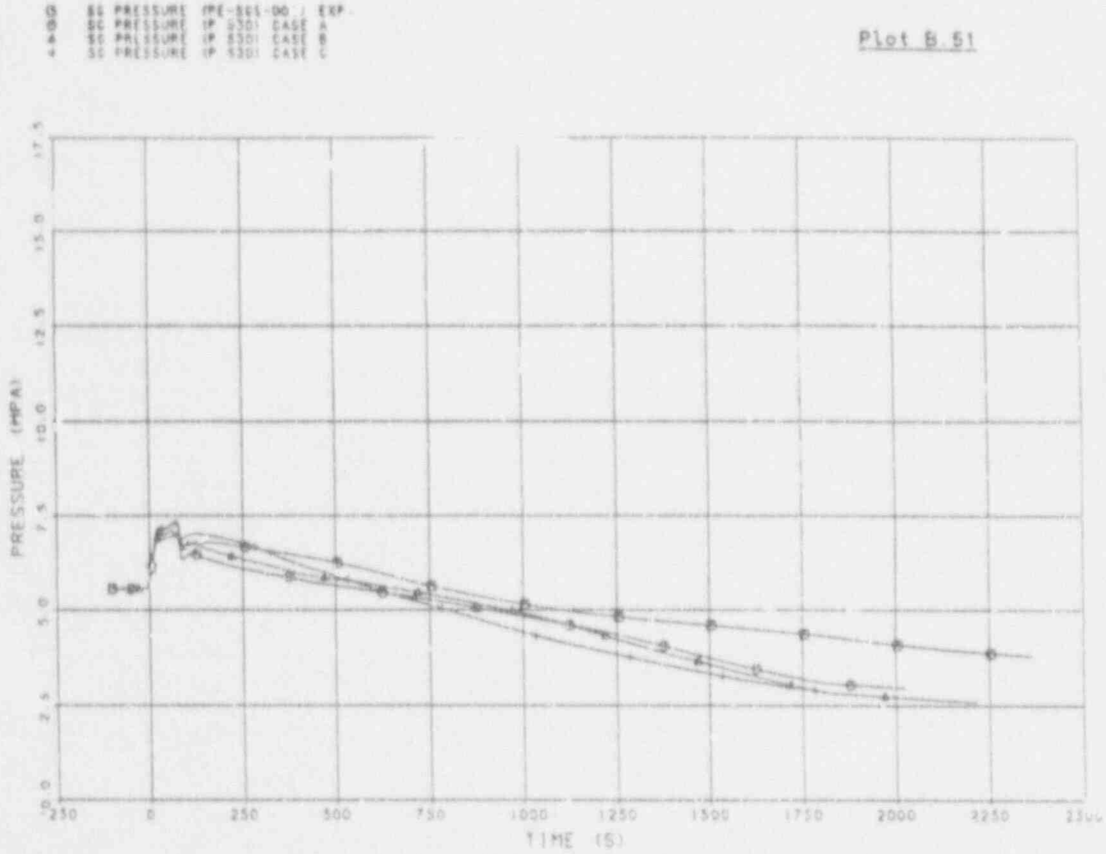
Plot B.48



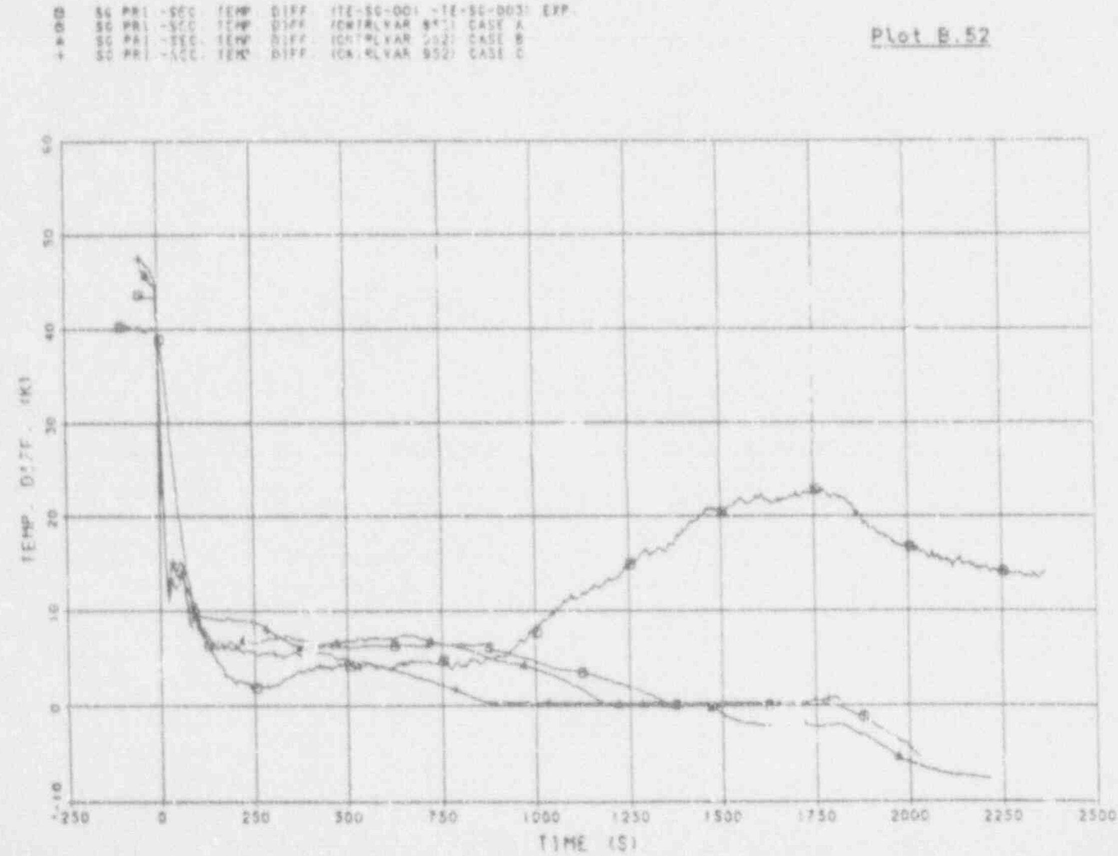
Plot B.49

Plot B.50

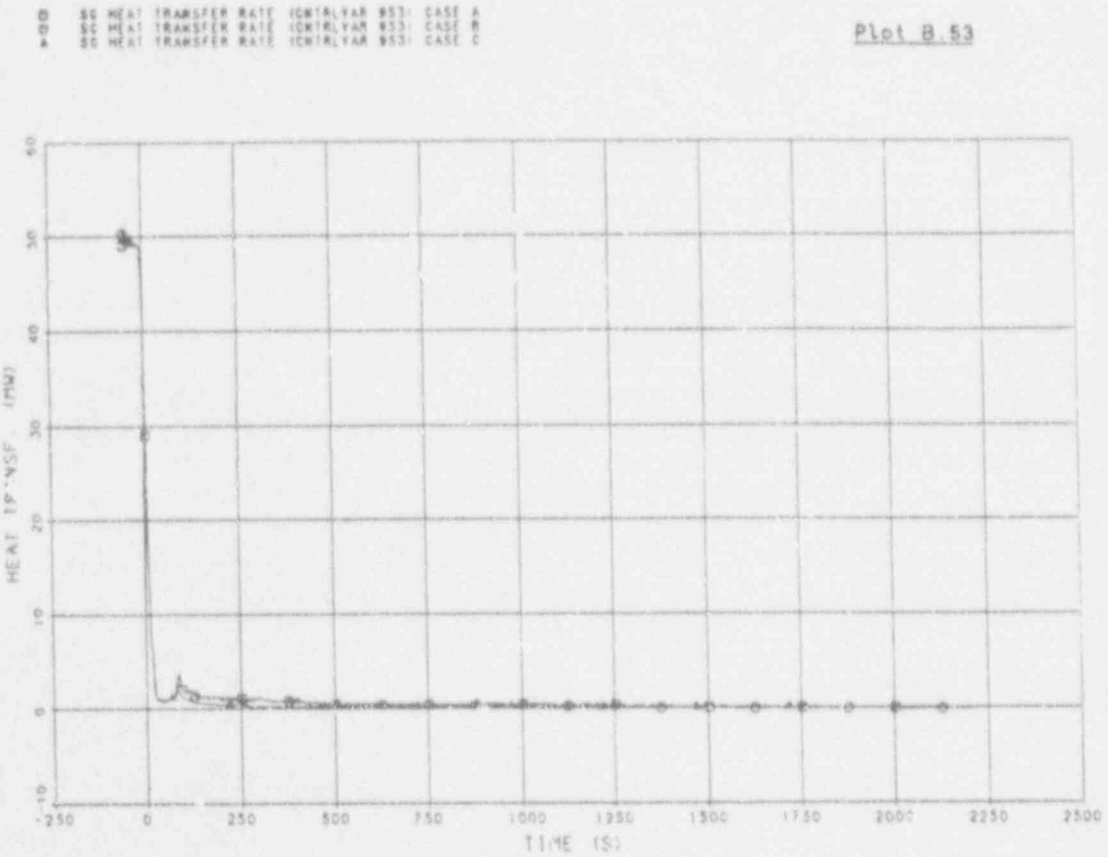
Plot B.51



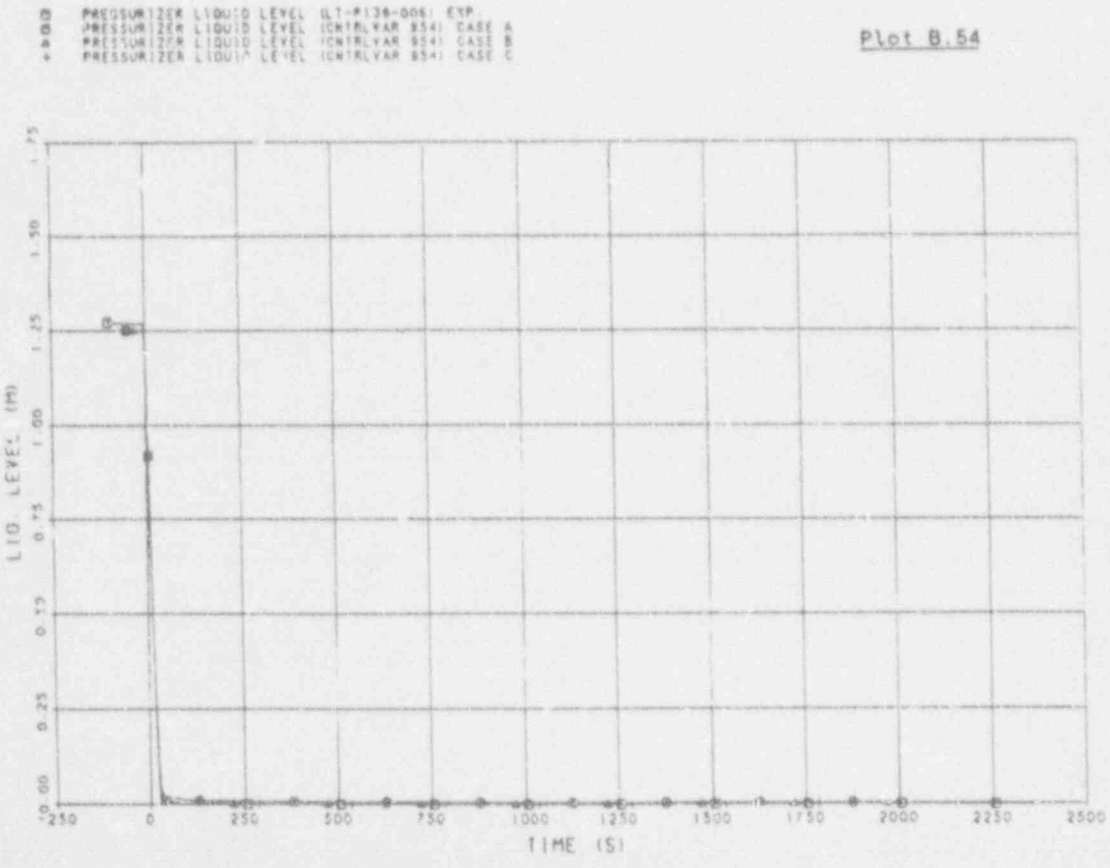
Plot B.52



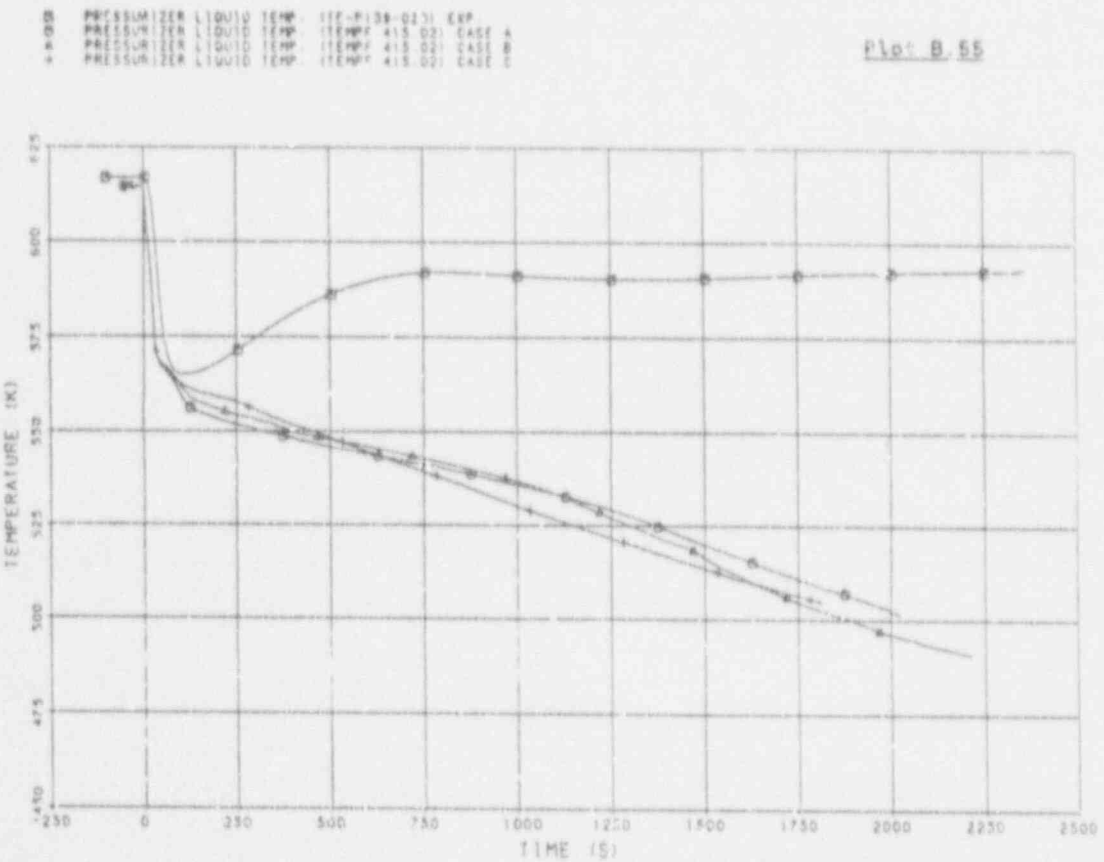
Plot B.53



Plot B.54

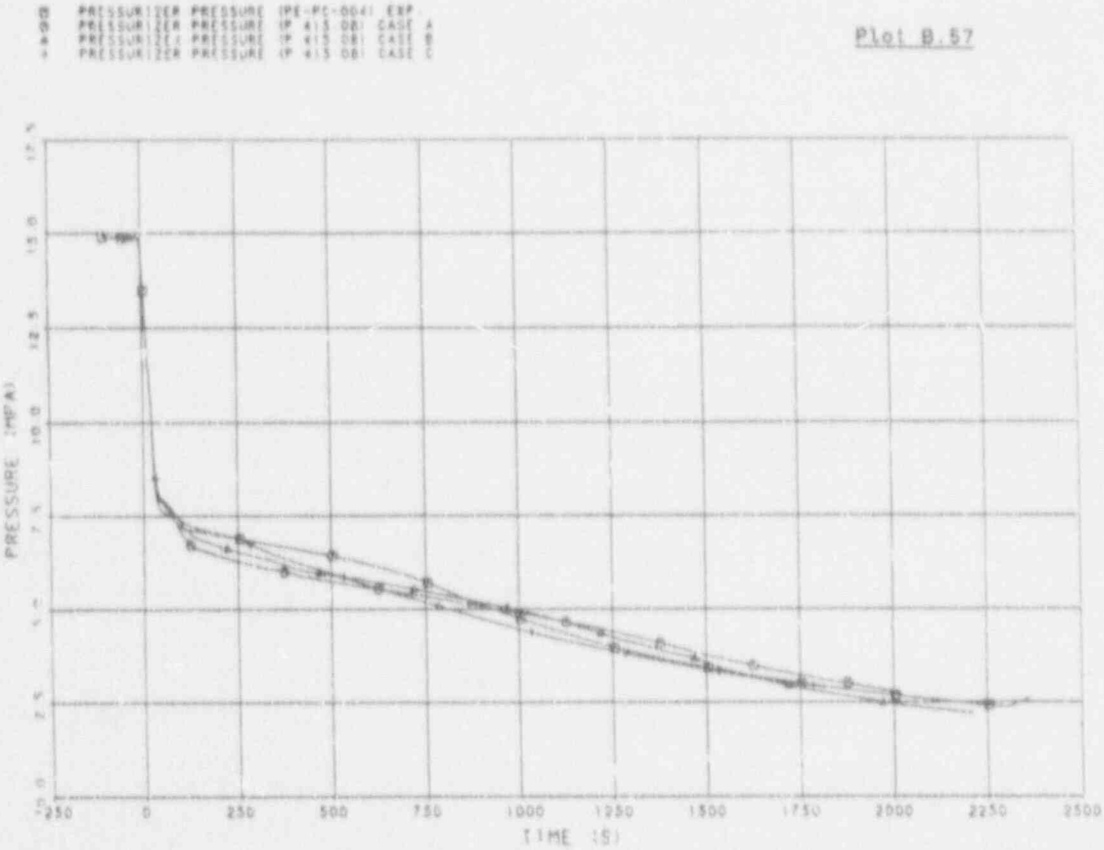


Plot B.55

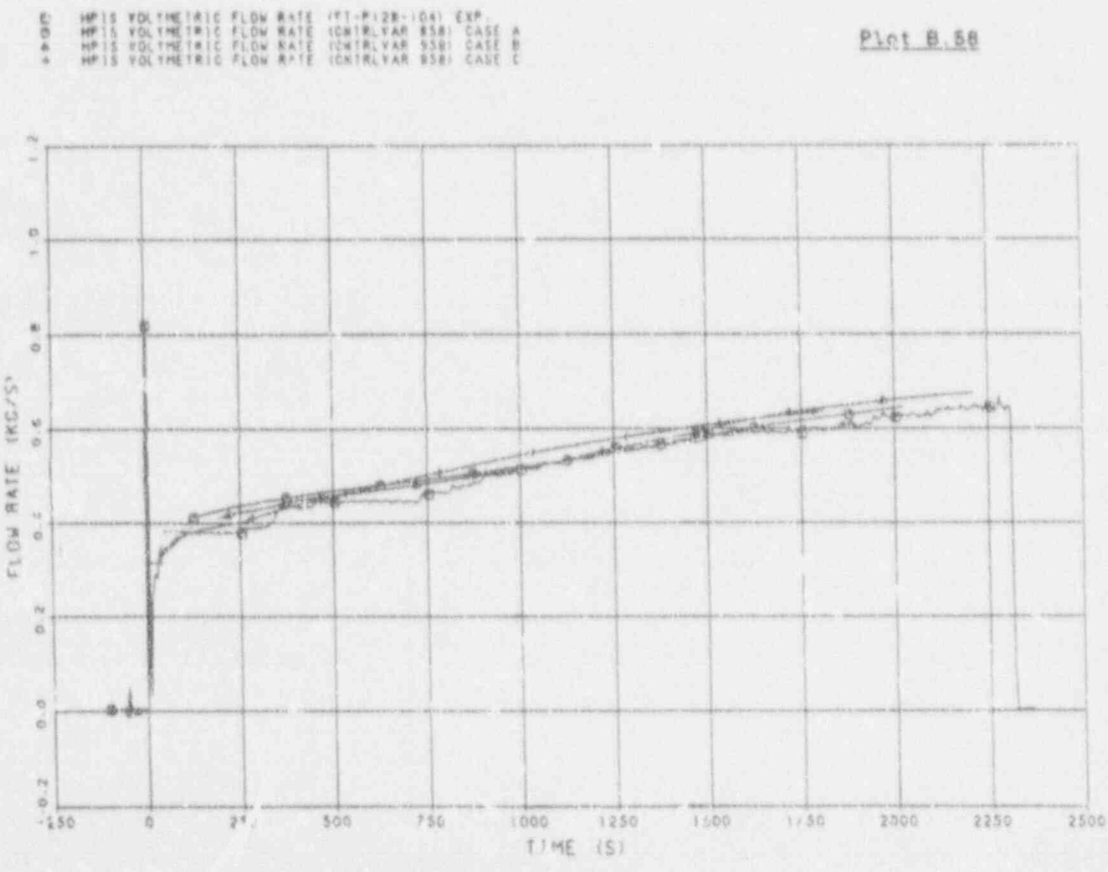


Plot B.56

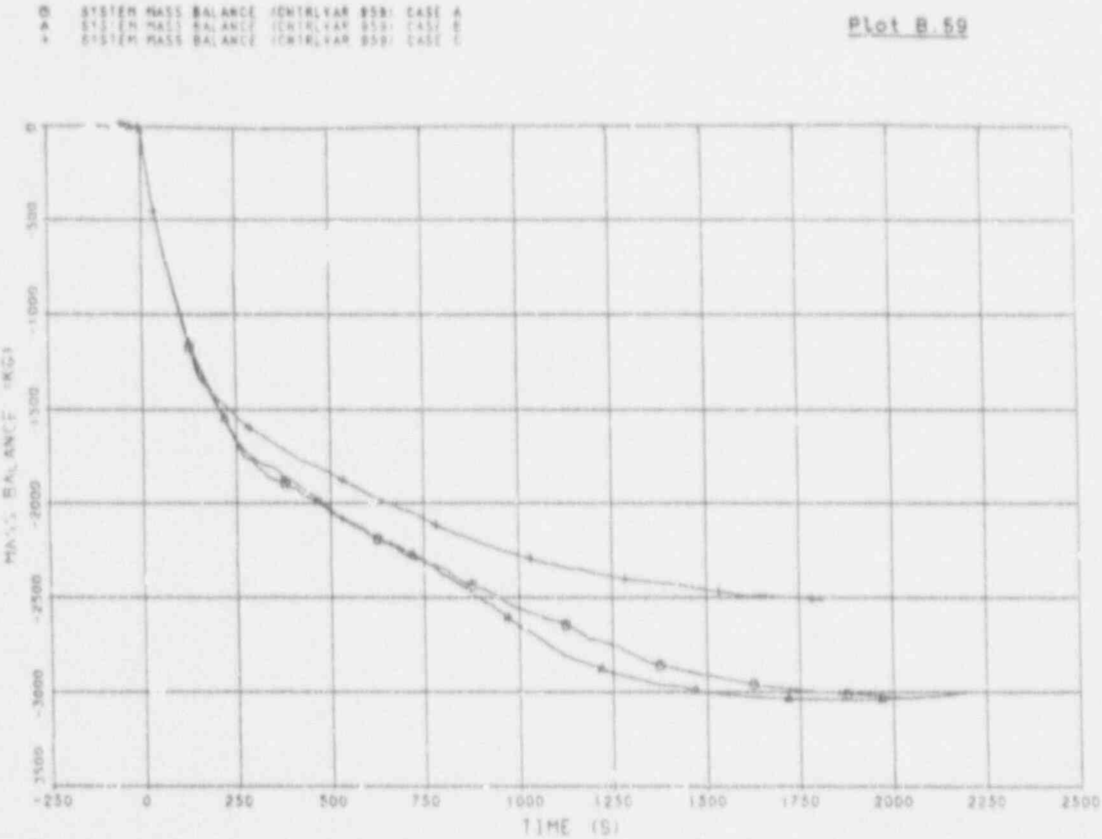
Plot B.57



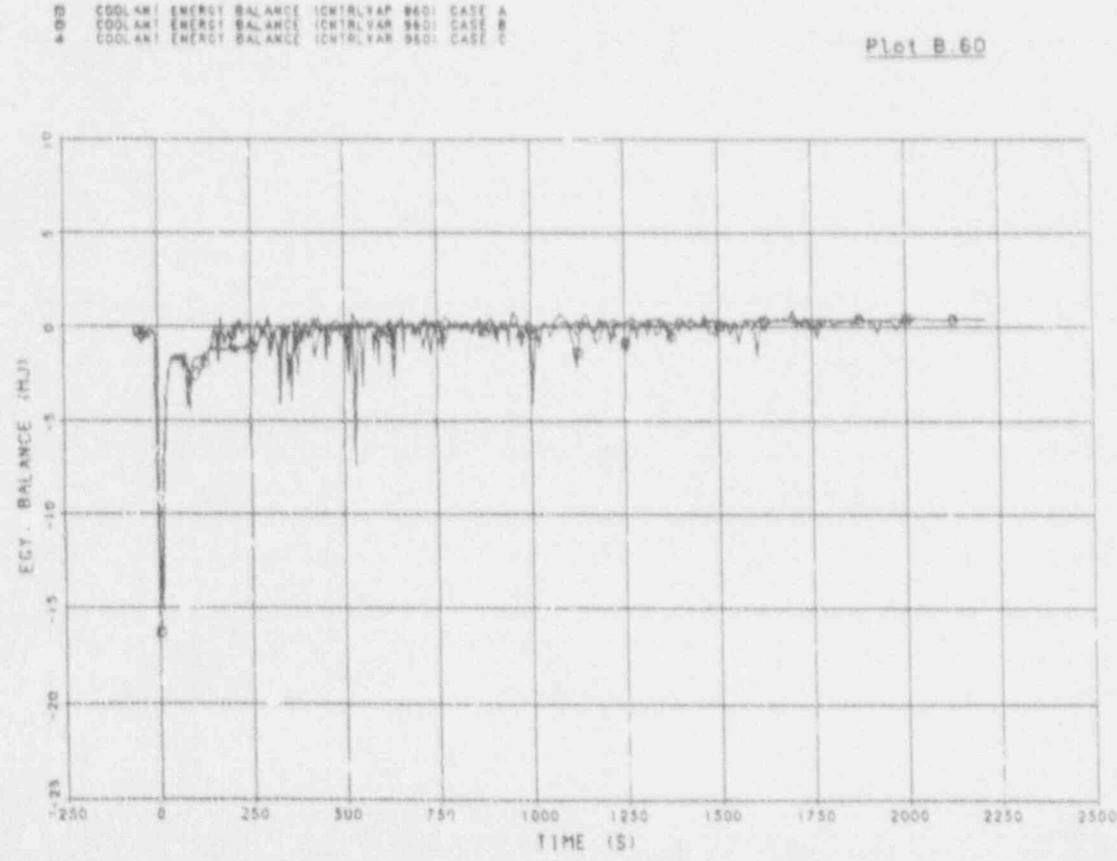
Plot B.58



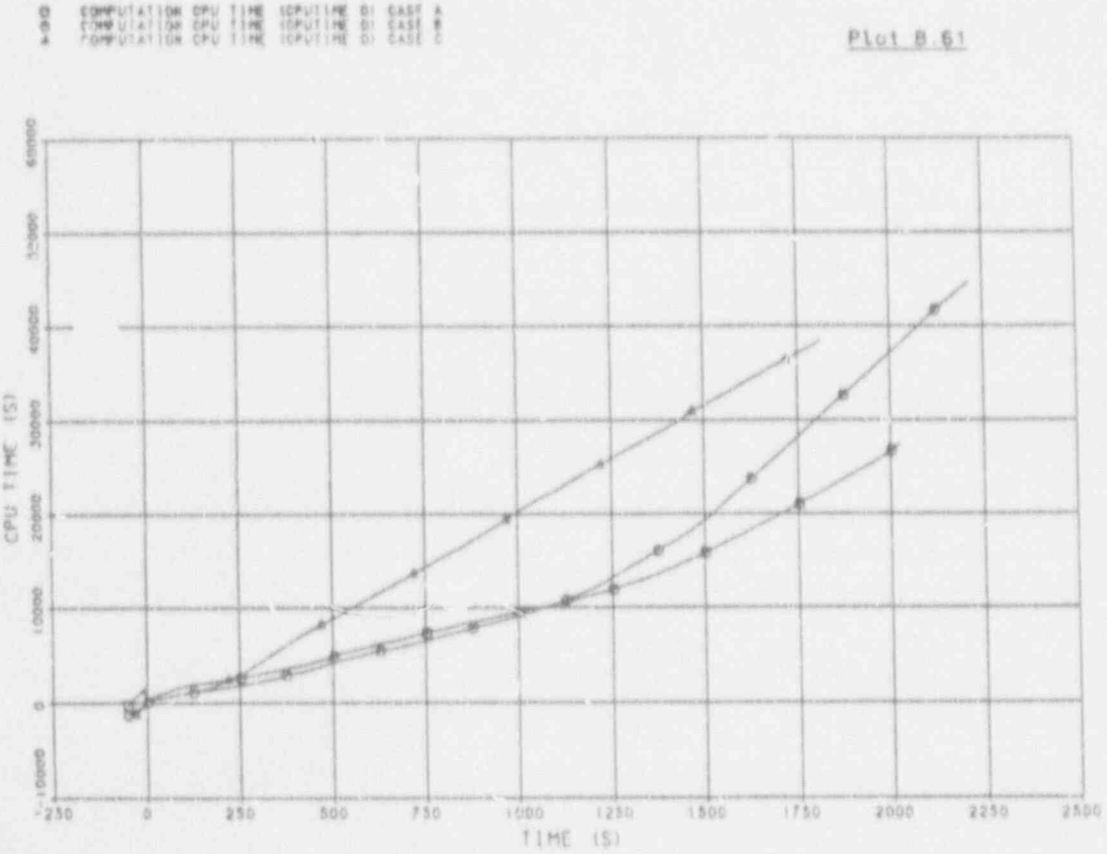
Plot B.59



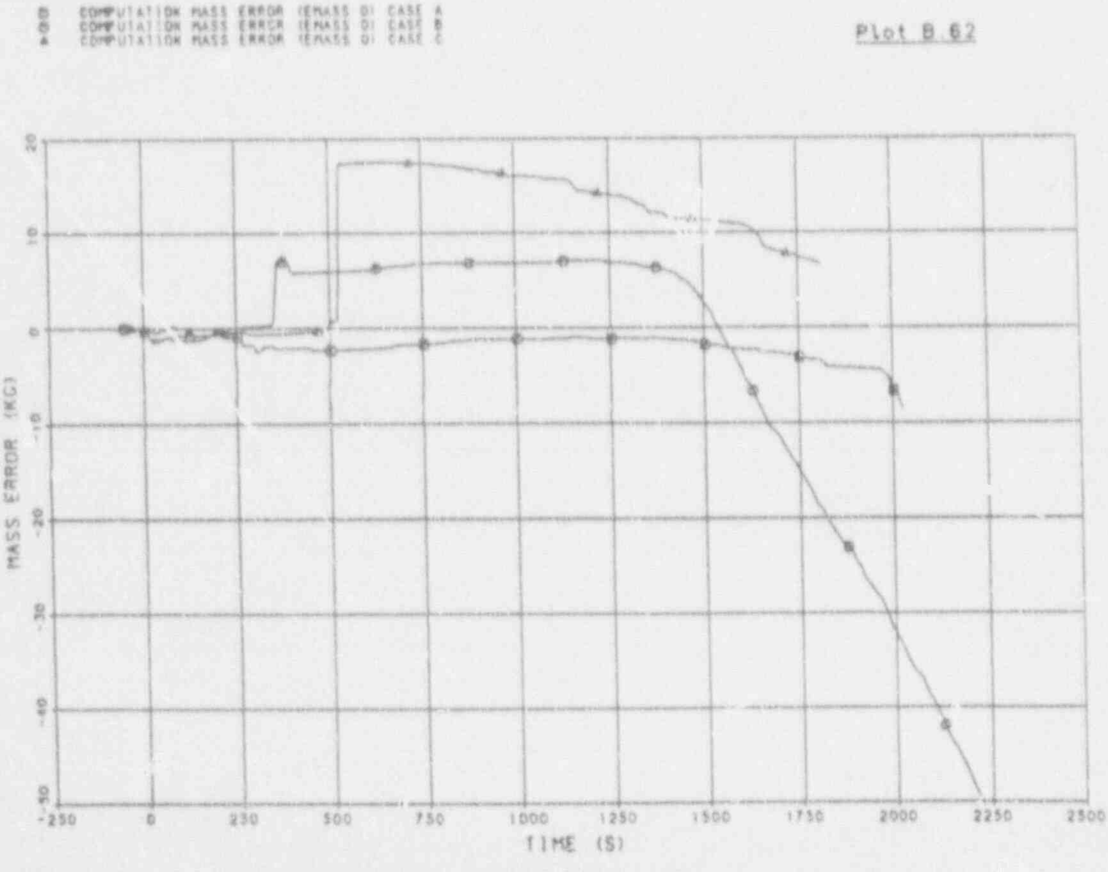
Plot B.60



Plot B.61



Plot B.62



Calculation-to-Experiment Data Uncertaintes

Case A

```
CALCULATION-TO-EXPERIMENT DATA UNCERTAINTY ANALYSIS FOR NRC/ICAP.
*****************************************************************

  FIRST LINE  : DIFFERENCE BETWEEN CALCULATED AND (AVERAGED) EXPERIMENTAL DATA AT END OF THE INTERVAL
  SECOND LINE : MEAN DIFFERENCE OVER THE INTERVAL
  THIRD LINE  : MEAN SIGMA OVER THE INTERVAL  (ROOT MEAN SQUARE OF THE DIFFERENCE)

 - CODES -                          - - - - TIME INTERVAL - - - -
CALC.  EXP.     0.0 - 20.00     - 80.00      - 200.0      - 500.0      - 1000.      - 1500.      - 2000.
----------------------------------------------------------------------------------------------------------

C 3A - C 3X        -6.46         -6.64        -6.66        -8.44         .510        5.08         -.520
                   -6.15         -6.60        -5.25        -7.82        -5.25        3.89         3.17
                    6.22          6.64         5.36         7.85         6.01        4.27         3.41

C 4A - C 4X         3.71          .820        -5.23        -7.30         1.90        5.16         2.42
                    11.4          2.97        -3.25        -6.51        -3.57        5.49         4.71
                    12.2          3.16         3.79         6.53         4.73        5.67         4.82

C 5A - C 5X         1.44          .340        -5.45        -7.64         1.69        6.06         2.55
                    7.76          1.73        -3.61        -6.73        -3.87        5.37         4.59
                    8.45          1.08         4.05         6.79         4.89        5.56         4.70

C 6A - C 6X         2.35          .250        -5.22        -7.29         2.17        6.37         2.79
                    9.57          1.83        -3.25        -6.42        -3.44        5.55         4.74
                    10.4          1.98         3.73         6.45         4.56        5.85         4.85

C 9A - C 9X        -6.25         -3.41        -8.47        -9.80        -.280        4.00         1.06
                   -3.58         -3.76        -6.64        -9.48        -6.22        3.16         2.67
                    3.63          4.18         6.85         9.49         6.94        3.49         2.81

C AA - C AX        -.763          3.17        -1.78         1.76         4.93        2.91         4.32
                    1.49          2.11        -.330         .182         4.48        4.43         3.33
                    1.69          3.98         1.30         1.55         4.65        4.51         3.36

V 5A - V 5X        -3.49          2.47         10.4         11.6        -1.85        3.25         .600
                   -4.50         -1.04         5.53         7.69         6.74        2.86         2.43
                    4.52          1.68         8.84         8.09         10.2        3.27         1.68

V 6A - V 6X        -6.16         -2.63        -8.47        -9.91        -.310        3.96         1.00
                   -3.47         -3.90        -6.48        -9.61        -6.25        3.12         2.61
                    3.61          4.93         6.74         9.52         6.97        3.46         2.76

V 7A - V 7X         7.87          3.76         3.03         2.60         1.77        .842         -.129
                    6.92          5.87         3.24         2.75         2.18        1.17         .743E-01
                    6.97          6.29         3.24         2.76         3.20        1.21         .335

V 8A - V 8X        -5.39         -5.80        -6.70        -12.0        -5.54        .940         -4.41
                   -4.96         -6.01        -6.15        -9.58        -10.7       -1.30         -.721
                    5.01          6.02         6.21         9.60         11.0        2.56         1.39

V 9A - V 9X         .119      -.800E-03       -.882        -.725       .851E-01      .285       .392E-01
                    .366          .193        -.388        -.683        -.377        .308         .175
                    .306          .215         .422         .685         .461        .318         .190

V 2A - V AX         .167       .737E-01       -.496        -.652         .170        .399         .155
                    .394          .256        -.306        -.603        -.310        .393         .283
                    .412          .271         .358         .605         .408        .402         .291

HL1A - HL1X         82.0          96.0        -25.1        -55.9         447.        176.         428.
                    76.5          110.        -7.81        -78.5         280.        266.         170.
                    77.4          113.         25.2         87.9         319.        283.         175.

HL2A - HL2X         37.1          35.3        -56.6        -137.         374.        132.         304.
                    40.9          34.9        -24.4        -133.         216.        233.         157.
                    41.4          35.0         42.3         139.         268.        245.         160.

HL3A - HL3X         15.5         -14.9        -11.5        -42.3        -45.1       -33.4         -47.1
                    12.6         -14.3        -8.29        -31.9        -44.9       -50.5         -52.2
                    13.1          18.1         8.80         33.1         45.0        50.6          52.2

HL4A - HL4X        -1.68          .710        -4.86        -7.18        -4.05       -10.8         -18.7
                    .139          .330        -2.90        -6.40        -4.73       -6.82         -14.6
                    .799          1.81         3.44         6.44         4.97        7.20          14.5

HL5A - HL5X      .710E-01     -.519E-01       -.617        -.749       .797E-01      .281       .720E-01
                    .328          .144        -.425        -.716        -.402        .299         .189
                    .349          .172         .464         .717         .483        .311         .201

CL1A - CL1X         69.7          88.0         318.        -186.         20.4       -40.0         -82.3
                    76.2          72.4         229.        -34.6        -65.6       -28.7         -66.2
                    76.3          72.4         242.         210.         95.5        41.4          67.6

CL3A - CL3X         28.1          67.3        -420.        -256.        -.790       -150.         -133.
                    20.9          40.0        -130.        -321.        -117.       -96.5         -144.
                    21.6          41.4         210.         329.         140.        107.          144.

CL4A - CL4X      .869E-01      .220E-01    -.558E-02    -.536E-02    -.158E-01   -.442E-01      -.401
                    .192       .248E-01     .657E-02    -.106E-01    -.150E-01   -.346E-01    -.861E-01
                    .317       .291E-01     .167E-01     .129E-01     .192E-01    .355E-01      .109

CL5A - CL5X        -1.59         -1.10        -1.03        -.836        -.215      .520E-01    -.290E-02
                   -1.90         -1.18        -1.05        -.799        -.365     -.970E-01     .912E-01
                    1.92          1.19         1.06         .816         .378        .131       .962E-01

CL6A - CL6X        -1.66         -.770        -3.63        -7.14         .980       -.680         -4.22
                   -2.05         -1.15        -2.44        -6.54        -4.74        3.48         -2.05
                    2.10          1.16         2.63         6.76         5.52        3.94          4.65

CL7A - CL7X         .223       .992E-01       -.452        -.602         .228        .428         .165
                    .458          .298        -.273        -.563        -.251        .444         .318
                    .473          .312         .329         .565         .367        .452         .326

CL8A - CL8X         .316          .205        -.363        -.506         .333        .547         .315
                    .557          .367        -.180        -.458        -.148        .556         .439
                    .570          .397         .259         .470         .308        .553         .445

CL9A - CL9X         2.48         -9.86        -10.3        -10.9        -11.9       -11.5         -6.23
                    5.57         -8.56        -10.4        -10.3        -11.2       -12.0         -10.9
                    6.20          8.99         10.4         10.3         11.2        12.0          11.0

CLAA - CLAX         228.         -14.4         95.7     -.443E-02        .124        .633         -1.02
                    147.          4.97         68.5         26.4        -.192       -1.49         -.698
                    151.          56.2         81.5         39.6         .882        2.20          1.32
```

- CODES - CALC. EXP.	0.0 - 20.00	- 60.00	- 200.0	- 600.0	- 1000.	- 1500.	- 2000.
			- - - - TIME INTERVAL - - - -				
BR1A - BR1X	1.00 20.0 22.0	-21.1 -10.8 12.0	461. 204. 279.	20.7 123. 232.	147. 104. 127.	32.9 65.9 112.	16.0 23.9 27.9
BR2A - BR2X	7.16 8.49 8.55	1.55 2.88 3.32	.227 .734 .870	-1.65 -1.19 1.73	-.387E-01 -.932 1.16	-.281 -.946E-01 .557	-.352 -.125 .238
BR4A - BR4X	-1.99 -1.10 2.83	-1.03 -2.06 2.46	-4.72 -3.42 3.65	-6.65 -6.33 6.66	2.73 -2.90 4.19	9.18 3.93 4.56	-6.09 -4.60 11.2
BR5A - BR5X	4.04 4.54 6.54	2.42 4.98 5.19	.798 1.21 1.41	.947 1.29 2.05	1.13 1.25 1.34	-1.43 3.30 4.33	10.2 10.9 14.8
BR6A - BR6X	.276 .511 .528	.149 .331 .340	-.368 -.221 .288	-.602 -.479 .481	.307 -.148 .302	.481 .509 .514	.218 .356 .365
SP1A - SP1X	-8.49 -7.45 7.47	-2.13 -3.48 4.02	-6.21 -5.18 5.29	-8.12 -7.67 7.63	-4.95 -6.33 6.48	-12.7 -8.47 8.73	-19.1 -15.2 15.3
SP2A - SP2X	-5.41 -2.32 2.62	.113 -.888 1.91	2.29 1.65 1.90	2.62 2.31 2.33	3.29 3.65 3.74	-.465 .241 1.17	2.32 1.17 1.56
SP3A - SP3X	-2.66 5.55 10.7	-11.9 -10.7 10.9	-13.7 -12.6 12.9	-10.3 -10.8 11.0	-10.1 -11.0 11.1	-6.59 -9.12 9.17	-4.16 -6.17 6.21
SS3A - SS3X	-.309 -.243 .293	-.129 -.175 .180	-.123 -.879E-01 .353E-01	-.441 -.301 .323	-.341 -.405 .405	-.346 -.306 .307	-.403 -.358 .360
SS4A - SS4X	12.6 5.22 6.99	1.15 5.04 6.47	-10.0 -6.12 6.70	-10.1 -10.3 10.3	-1.94 -7.56 7.98	7.83 4.40 5.39	2.01 6.35 6.67
SS5A - SS5X	-.155E-01 -.179 .192	-.869E-01 .879E-01 .104	-.527 -.369 .386	-.608 -.603 .604	-.319 -.414 .426	-.849 -.514 .539	-1.12 -1.10 1.11
S 1A - S 1X	-21.0 -12.7 13.7	-3.26 -8.52 10.4	3.83 .936 1.98	1.62 2.67 2.74	-3.34 1.27 1.87	-20.6 -12.7 13.6	-20.9 -21.6 21.6
P 1A - P 1X	.821E-01 .602E-01 .649E-01	.126E-01 .284E-01 .376E-01	.679E-02 .881E-02 .897E-02	.486E-02 .589E-02 .592E-02	.371E-02 .474E-02 .474E-02	.368E-02 .391E-02 .392E-02	.314E-02 .315E-02 .316E-02
P 2A - P 2X	-21.2 -12.3 13.4	-2.93 -12.8 15.5	-14.7 -9.35 9.92	-40.0 -28.1 29.0	-55.5 -49.6 49.8	-70.7 -61.8 61.9	-89.7 -80.2 80.4
P 3A - P 3X	-20.9 -13.5 14.2	-4.50 -13.1 15.3	-18.7 -12.3 12.9	-45.3 -33.1 34.0	-60.0 -54.3 54.5	-75.8 -66.6 66.8	-94.8 -85.5 85.7
P 4A - P 4X	.210E-01 .185 .191	.115E-01 .210 .228	-.547 -.357 .402	-.695 -.649 .650	.116 -.343 .434	.342 .350 .359	.796E-01 .220 .231
EC1A - EC1X	.310E-01 -.300E-01 [illegible]66	-.161E-01 -.144E-01 .[illegible]66E-01	.488E-01 .291E-01 .341E-01	.238E-01 .367E-01 .401E-01	.817E-02 .261E-01 .282E-01	-.109E-02 .870E-03 .453E-02	.222E-01 .158E-01 .181E-01

Case B

```
CALCULATION-TO-EXPERIMENT DATA UNCERTAINTY ANALYSIS FOR NRC 'ICAP.
**********************************************************************

  FIRST LINE  : DIFFERENCE BETWEEN CALCULATED AND (AVERAGED) EXPERIMENTAL DATA AT END OF THE INTERVAL
  SECOND LINE : MEAN DIFFERENCE OVER THE INTERVAL
  THIRD LINE  : MEAN SIGMA OVER THE INTERVAL  (ROOT MEAN SQUARE OF THE DIFFERENCE)

 - CODES -                           - - - - TIME INTERVAL - - - -

 CALC.  EXP.    0.0 - 20.00     - 80.00      - 200.0      - 500.0      - 1000.      - 1500.      - 2000.
---------------------------------------------------------------------------------------------------------

 C 3B - C 3X      -3.95          -3.64        -4.03        -6.49         1.57         1.57        -5.04
                  -4.56          -4.86        -2.79        -5.66        -3.53         2.75        -2.22
                   4.72           4.90         2.81         5.64         4.43         2.80         2.88

 C 4B - C 4X       4.38           2.29        -2.71        -5.21         2.71         2.77        -3.79
                  11.5            4.45        -.768        -4.31        -1.10         3.98        -1.04
                  13.3            4.61         1.88         4.41         3.38         3.99         2.05

 C 5B - C 5X       2.78           1.78        -2.90        -5.54         2.52         2.58        -3.79
                   9.09           3.01        -1.12        -4.53        -2.29         3.85        -1.20
                  11.2            3.14         1.96         4.62         3.50         3.86         2.15

 C 6B - C 6X       2.97           1.79        -2.67        -5.25         3.00         2.97        -3.60
                  10.5            3.03        -.767        -4.23        -1.86         4.16        -1.08
                  12.7            3.12         1.79         4.32         3.25         4.17         2.08

 C 9B - C 9X      -4.72          -1.65        -5.88        -7.87         .540         .590        -5.38
                  -2.19          -2.61        -4.14        -7.27        -4.62         1.63        -3.15
                   2.98           3.01         4.38         7.32         5.37         1.67         3.56

 C AB - C AX      -7.18           2.88        -1.51         1.72         4.04         1.95         .218
                   .858           1.28        -.327        -.213E-01     4.22         3.17         .362
                   1.70           3.60         1.30         1.24         4.31         3.27         .614

 V 5B - V 5X      -1.50           4.04        13.0         13.9         -1.04         1.47        -6.01
                  -2.18           .496         8.55        10.0          8.31         1.14        -3.25
                   2.20           1.30        11.6         10.3         11.5          1.32         3.77

 V 6B - V 6X      -4.93          -1.15        -6.88        -7.95         .510         .360        -6.46
                  -1.87          -2.70        -3.98        -7.29        -4.66         1.60        -3.20
                   2.65           3.90         4.30         7.34         5.40         1.63         3.61

 V 7B - V 7X       7.35           3.77         3.05         2.81         1.76         .644        -.118
                   5.71           5.61         3.25         2.75         2.18         1.17         .799E-01
                   6.09           5.95         3.26         2.76         2.20         1.21         .333

 V 8B - V 8X      -2.75          -4.03        -4.37        -9.97        -2.82        -1.50        -6.76
                  -2.72          -3.98        -3.65        -7.28        -8.89        -1.56        -3.57
                   2.79           4.03         3.71         7.55         9.21         1.87         4.06

 V 9B - V 9X       .265           .172        -.325        -.550         .154         .827E-01    -.280
                   .409           .300        -.132        -.473        -.240         .206        -.143
                   .424           .314         .218         .480         .333         .209         .173

 V AB - V AX       .313           .245        -.239        -.478         .238         .194        -.166
                   .437           .363        -.504E-01    -.394        -.173         .291        -.359E-01
                   .451           .373         .177         .403         .289         .292         .101

 HL1B - HL1X      60.3           107.         -26.2        -51.8        295.         418.         401.
                  72.9           108.         -3.26        -91.0        274.         196.         385.
                  73.6           111.         30.5         94.8         309.         212.         385.

 HL2B - HL2X      28.2           36.4         -69.6        -142.        257.         264.         260.
                  41.9           35.9         -7.16        -153.        209.         175.         257.
                  42.4           36.1         39.1         155.         255.         183.         257.

 HL3B - HL3X      10.1           -14.9        -16.0        -43.1        -47.2        -49.5        -52.3
                  10.5           -13.1        -9.68        -35.2        -44.6        -50.5        -52.1
                  11.6           17.4         10.1         35.9         44.7         50.5         52.1

 HL4B - HL4X      -.690           2.25        -2.25        -5.29        -3.22        -14.3        -25.1
                   1.92           1.59        -.394        -4.18        -3.13        -8.34        -20.3
                   2.52           2.35         1.67         4.32         3.38         9.06         20.5

 HL5B - HL5X       .224           .121        -.360        -.575         .149         .753E-01    -.247
                   .372           .252        -.169        -.506        -.265         .198        -.129
                   .387           .260         .239         .512         .353         .200         .158

 CL1B - CL1X      65.3           64.8         286.         -185.        21.3         -77.2        -109.
                  72.0           69.5         215.         -84.8        -60.6        -70.0        -91.0
                  72.1           69.5         226.         185.         54.5         76.3         91.2

 CL3B - CL3X      29.2           68.4         -421.        -245.        -42.5        -153.        -135.
                  21.9           41.1         -75.6        -295.        -109.        -132.        -144.
                  22.8           42.4         181.         304.         134.         137.         145.

 CL4B - CL4X       .602E-01      .240E-01    -.198E-01    -.860E-02    -.521E-02    -.476        -.346
                   .170          .283E-01    -.675E-03    -.139E-01    -.127E-01    -.602E-01    -.3C'
                   .182          .308E-01     .234E-01     .150E-01     .157E-01     .111         .396

 CL5B - CL5X      -1.59          -1.10        -1.^2        -.583        -.197        -.716E-01    -.185
                  -1.90          -1.18        -1.04        -.795        -.359        -.840E-01    -.746E-01
                   1.91           1.19         1.04         .809         .382         .111         .985E-01

 CL6B - CL6X       .240           .060        -1.07        -5.06         1.91        -4.22        -43.5
                   .273           .408         .362        -4.13        -3.22         .582E-01    -33.1
                   .393           .422         .896         4.45         4.24         3.63         35.9

 CL7B - CL7X       .373           .272        -.196        -.427         .297         .219        -.137
                   .504           .405        -.168E-01    -.354        -.114         .341        -.396E-02
                   .514           .415         .170         .363         .260         .343         .968E-01

 CL8B - CL8X       .462           .378        -.106        -.331         .400         .344        -.380E-02
                   .600           .494         .761E-01    -.259        -.110E-01     .453         .122
                   .610           .502         .187         .271         .236         .455         .155

 CL9B - CL9X      -2.80          -9.78        -9.75        -10.8        -12.4        -5.12        -6.27
                   1.92          -8.75        -10.2        -10.1        -11.2        -11.3        -5.70
                  11.9            9.03        10.2         10.1         11.2         11.4          5.86

 CLAB - CLAX      158.           -12.4         54.2        -.443E-02     .124         1.47        -2.74
                  129.           11.8          86.3         15.7        -.192        -1.32        -.616E-02
                  143.           68.1          80.4         29.2         .881         2.20         1.18
```

1987-06-09

- CODES -	- - - - TIME INTERVAL - - - -						
CALC. EXP.	0.0 - 20.00	- 60.00	- 200.0	- 500.0	- 1000.	- 1500.	- 2000.
BR1B - BR1X	-2.40 17.4 20.7	-24.5 -14.5 16.1	400. 184. 255.	-14.4 72.8 176.	565. 110. 136.	6.23 56.5 91.1	4.51 -6.57 6.96
BR2B - BR2X	7.06 7.98 8.09	.689 2.83 3.21	.665 .689 .773	-2.51 -1.41 1.88	-.390 -.887 1.27	-.635 -.167 .388	-.594 -.234 .290
BR4B - BR4X	-.800E-01 .775E-0[illegible] .511	.820 -.838E-01 1.64	-2.18 -.552 1.57	-4.44 -4.08 4.21	2.02 -1.84 3.16	-3.58 4.41 15.2	-12.9 -8.65 8.97
BR5B - BR5X	3.20 3.74 3.89	2.35 3.96 4.30	.774 .858 1.15	.988 1.31 1.44	2.49 1.83 1.68	7.91 1.20 14.5	10.3 8.66 8.66
BR6B - BR6X	.423 .572 .583	.343 .442 .450	-.141 .346E-01 .177	-.324 -.265 .275	.367 -.775E-02 .228	.269 .395 .397	-.105 .255E-01 .995E-01
SP1B - SP1X	-7.65 -5.36 6.51	-.570 -2.07 2.89	-3.61 -2.67 2.00	-6.10 -3.40 6.47	-4.14 -4.73 4.85	-16.1 -10.0 10.5	-25.6 -21.1 21.2
SP2B - SP2X	-6.08 -2.61 3.13	-.985 -1.09 1.93	2.16 1.07 1.43	2.73 2.29 2.31	3.29 3.64 3.73	-.442 .241 1.17	2.37 1.20 1.58
SP3B - SP3X	-4.88 3.48 6.25	-11.6 -10.6 10.8	-13.1 -12.6 12.6	-10.3 -10.2 10.3	-9.63 -10.9 11.0	-2.56 -7.82 8.01	-1.06 -1.56 1.85
SS3B - SS3X	-.269 -.237 .279	-.102 -.103 .109	-.518E-01 -.162E-01 .306E-01	-.340 -.197 .218	-.234 -.297 .299	-.279 -.258 .259	-.344 -.316 .317
SS4B - SS4X	12.6 6.18 7.73	-1.21 4.65 6.31	-7.58 -4.50 4.92	-8.76 -9.01 9.02	-.220 -5.98 6.64	5.19 4.04 4.33	-2.88 2.39 3.61
SS5B - SS5X	.991E-01 -.835E-01 .118	.311 .265 .276	-.263 -.876E-01 .172	-.443 -.401 .406	-.247 -.281 .290	-1.02 -.600 .647	-1.38 -1.32 1.33
S 1B - S 1X	-20.2 -11.5 13.0	.636 -6.72 9.12	3.98 1.83 2.22	2.33 3.62 3.76	-4.24 1.28 2.32	-21.4 -13.9 14.7	-22.5 -23.5 23.5
P 1B - P 1X	.708E-01 .570E-01 .619E-01	.911E-03 .178E-01 .314E-01	-.615E-03 .972E-05 .4[illegible]E-03	-.402E-03 -.285E-03 .344E-03	-.476E-03 .886E-04 .228E-03	.433E-03 .197E-03 .265E-03	.875E-03 .468E-03 .536E-03
P 2B - P 2X	-20.1 -11.9 12.9	-1.36 -11.6 14.7	-12.1 -5.83 7.62	-37.9 -25.8 27.0	-64.7 -48.0 48.2	-74.1 -63.3 63.6	-96.1 -86.1 86.3
P 3B - P 3X	-19.8 -12.9 13.5	-.800E-01 -11.2 14.4	-1.95 -2.41 2.62	-8.54 -4.85 5.56	-16.8 -12.5 12.7	-33.3 -24.3 24.8	-41.7 -38.7 38.7
P 4B - P 4X	.175 .285 .296	.184 .323 .333	-.290 -.100 .196	-.520 -.439 .446	.187 -.205 .310	.136 .248 .250	-.239 -.985E-01 .138
EC1B - EC1X	.310E-01 -.828E-01 .230	-.260E-01 -.198E-01 .321E-01	.339E-01 .141E-01 .218E-01	.131E-01 .245E-01 .282E-01	.830E-02 .181E-01 .203E-01	.115E-01 .677E-02 .919E-02	.407E-01 .344E-01 .359E-01

Case C

```
CALCULATION-TO-EXPERIMENT DATA UNCERTAINTY ANALYSIS FOR NRC/ICAP.
*****************************************************************

  FIRST LINE  : DIFFERENCE BETWEEN CALCULATED AND (AVERAGED) EXPERIMENTAL DATA AT END OF THE INTERVAL
  SECOND LINE : MEAN DIFFERENCE OVER THE INTERVAL
  THIRD LINE  : MEAN SIGMA OVER THE INTERVAL  (ROOT MEAN SQUARE OF THE DIFFERENCE)


 - CODES -                           - - - - TIME INTERVAL - - - -

 CALC.  EXP.     0.0 - 20.00     - 80.00      - 200.0       - 800.0      - 1000.       - 1800
************************************************************************************************

 C 3C - C 3X       -3.53          -2.81        -.960         -6.12        -4.88         -1.28
                   -4.19          -4.21        -.829         -3.43        -6.64         -2.70
                    4.43           4.26         .958          3.85         6.71          2.90

 C 4C - C 4X        6.07           1.91         .440         -5.02        -3.87         -.600E-01
                   12.9            4.29        1.17          -2.13        -5.45         -1.42
                   14.7            4.62        1.32           2.76         5.52          1.04

 C 5C - C 5X        2.88           1.29         .250         -5.24        -4.06         -.130
                    8.84           3.01         .825         -2.35        -5.66         -1.54
                   10.3            3.19         .962          2.93         5.72          1.94

 C 6C - C 6X        3.63           1.27         .480         -4.87        -3.58          .180
                   10.4            3.06        1.17          -2.04        -5.23         -1.23
                   12.0            3.27        1.28           2.69         5.30          1.68

 C 9C - C 9X       -4.20          -2.17       -2.76          -7.51        -6.04         -2.23
                   -1.74          -2.52       -2.17          -5.07        -8.00         -3.77
                    3.49           2.78        2.21           5.34         8.05          3.96

 C AC - C AX       -2.03           .928        -.991          1.08         1.64          2.28
                    1.09           .487        -.914E-01      .356         2.02          2.31
                    1.88           2.69         .838          .771         2.09          2.33

 V 5C - V 5X       -.680           4.98        15.9          14.3          -7.56         -1.25
                   -1.65           1.79        10.3          12.2           4.98         -4.00
                    1.68           2.16        12.7          12.5          10.6           4.25

 V 6C - V 6X       -4.37          -1.64       -2.74          -7.54        -6.07         -2.28
                   -1.29          -2.59       -2.02          -5.09        -8.03         -3.82
                    2.23           3.47        2.08           5.36         8.08          4.01

 V 7C - V 7X        7.87           3.57        3.04           2.58         1.77          .642
                    6.40           5.60        3.24           2.75         2.17          1.17
                    6.49           6.06        3.25           2.76         2.19          1.22

 V 8C - V 8X       -2.35          -2.57       -1.75          -8.92        -8.01         -4.66
                   -2.38          -3.08       -1.93          -5.45       -10.1          -6.13
                    2.43           3.11        2.00           5.93        10.1           6.22

 V 9C - V 9X        .365           .114       -.740E-02      -.511        -.350         -.974E-01
                    .602           .314        .716E-01      -.256        -.513         -.172
                    .619           .353        .924E-01       .309         .521          .189

 V AC - V AX        .412           .188        .784E-01      -.439        -.256          .142E-01
                    .628           .377        .153          -.178        -.446         -.864E-01
                    .645           .408        .162           .249         .455          .123

 HL1C - HL1X       69.5           107.         63.6          213.         651.          692.
                   72.5           103.         70.8          116.         527.          684.
                   73.3           106.         71.9          120.         548.          684.

 HL2C - HL2X       39.3           37.3         120.          207.         405.          409.
                   43.1           37.0         85.2          104.         427.          430.
                   43.5           37.1         92.4          108.         439.          430.

 HL3C - HL3X       14.6          -14.0        -21.1         -42.0        -46.7         -54.1
                   11.7          -13.2        -15.9         -38.3        -44.3         -30.7
                   12.2           17.1         16.0          38.7         44.3          50.8

 HL4C - HL4X       -.220           1.71         .910         -4.56        -9.88         -18.9
                    2.29           1.29        1.55          -1.77        -6.27         -13.6
                    2.78           1.93        1.63           2.88         6.38          13.9

 HL5C - HL5X        .322          .629E-01    -.421E-01      -.836        -.356         -.105
                    .862          .266         .342E-01      -.291        -.538         -.181
                    .883          .310         .637E-01       .337         .546          .200

 CL1C - CL1X       64.6           63.4        -172.         -266.        -126.         -74.1
                   71.3           67.2         37.0         -274.        -181.         -98.8
                   71.4           67.3         182.          277.         189.          101.

 CL3C - CL3X       30.3           69.4        -431.         -384.        -181.         -155.
                   23.1           42.1        -362.         -405.        -261.         -163.
                   23.9           43.8         404.          406.         269.          163.

 CL4C - CL4X      .877E-01       .227E-01     .362E-02      -.276E-01    -.526E-01     -.666E-01
                  .233           .313E-01     .105E-01      -.123E-01    -.257E-01     -.515E-01
                  .266           .370E-01     .141E-01       .148E-01     .275E-01      .633E-01

 CL5C - CL5X      -1.58          -1.10        -1.02          -.472        -.171          .170E-02
                  -1.90          -1.18        -1.04          -.760        -.209         -.862E-01
                   1.91           1.19         1.04           .773         .317          .103

 CL6C - CL6X       1.20           1.50         1.86          -6.21        -8.61         -2.07
                   .930           1.55         1.86          -5.40       -11.0          -5.47
                   .857           1.56         1.88           6.06        11.6           10.3

 CL7C - CL7X       .469           .314         .122          -.389        -.208          .434E-01
                   .590           .419         .187          -.139        -.388         -.360E-01
                   .705           .448         .195          [illegible]   .399          .895E-01

 CL8C - CL8X       .862           .320         .211          -.291        -.103          .163
                   .793           .506         .280          -.432E-01    -.284          .766E-01
                   .807           .532         .285           .172         .300          .114

 CL9C - CL9X       2.22          -9.70        -10.1          -9.56        -10.4         -11.1
                   10.8          -8.33        -9.95          -9.67        -10.1         -10.7
                   14.6           8.94         9.95           9.67         10.1          10.7

 CLAC - CLAX       227.          -8.94         63.7         -.658E-03     .124          .267
                   156.           15.1         40.6           9.91        -.184         -1.54
                   160.           75.4         55.4           9.3          .884          2.21
```

```
 - CODES -                          - - - - TIME INTERVAL - - - -
 CALC.  EXP.    0.0 - 20.00     - 80.00     - 200.0     - 500.0      - 1000.     - 1500.
*****************************************************************************************

 BR1C - BR1X       -4.07         -25.7        68.0        -68.3        -36.5        22.4
                   33.9          -16.9        23.6        -79.1        -3.00        17.4
                   45.9           17.5        94.4         99.5         39.6        28.9

 BR2C - BR2X        7.07          1.40       -1.72        -1.65        -.317       -.804
                    5.46          2.98        .273        -1.91        -.995       -.498
                    6.70          3.31        1.62         1.94         1.12        .637

 BR4C - BR4X        .860          1.37        .930        -4.65        -3.59       -5.65
                   -11.3          1.20        .842        -1.78        -4.90       -1.98
                    17.7          1.23        .974         2.53         5.23        5.40

 BR5C - BR5X        2.99          1.12        .774         1.19         1.19        7.22
                    16.7          2.72        1.32         1.04         1.28        2.25
                    22.1          2.90        1.38         1.06         2.04        5.89

 BR6C - BR6X        .823          .267        .175        -.309        -.180        .114
                    .832          .452        .225       -.656E-01     -.297       .241E-01
                    .861          .476        .233         .178         .312       .803E-01

 SP1C - SP1X       -7.34         -1.10       -.470        -5.73        -10.7       -13.9
                   -5.28         -2.13       -.709        -3.20        -8.13       -15.4
                    5.39          2.72        .802         3.63         8.19        15.6

 SP2C - SP2X       -7.09         -1.55        2.08         2.66         3.35       -.373
                   -2.98         -2.02        .960         2.28         3.64        .312
                    3.61          2.60        1.32         2.30         3.73        1.19

 SP3C - SP3X       -2.77         -11.9       -12.5        -9.92        -9.19       -7.73
                    7.81         -10.4       -13.1        -10.5        -10.4       -8.59
                    13.2          10.7        13.1         10.5         10.4        8.71

 SS3C - SS3X       -.418         -.368       -.340        -.278        -.255       -.241
                   -.364         -.381       -.326        -.315        -.291       -.249
                    .422          .381        .330         .315         .292        .249

 SS4C - SS4X        13.3         -.670       -7.12        -6.24        -3.27        1.26
                    8.83          5.43       -4.15        -6.91        -5.49       -.884
                    9.53          6.85        4.64         6.93         5.67        1.70

 SS5C - SS5X        .267          .223        .142        -.356        -.744       -1.26
                 -.548E-02        .270        .208        -.106        -.538       -.993
                    .102          .271        .212         .195         .647        1.00

 S 1C - S 1X       -20.6         -.427        6.66         .178        -7.80       -20.2
                   -14.1         -7.56        3.44         3.71        -2.60       -14.4
                    14.8          9.45        4.19         4.33         3.48        14.9

 P 1C - P 1X     .820E-01      .120E-02   -.556E-03    -.298E-03    -.476E-03    .453E-03
                 .617E-01      .206E-01    .104E-03    -.269E-03     .692E-04    .197E-03
                 .658E-01      .559E-01    .635E-03     .330E-03     .227E-03    .265E-03

 P 2C - P 2X       -19.7         -1.88       -8.96        -37.6        -61.3       -76.9
                   -11.9         -11.8       -4.87        -23.2        -51.4       -68.7
                    12.8          14.4        5.28         23.2         51.6        68.9

 P 3C - P 3X       -19.3         -1.23        1.47        -11.4        -21.6       -29.7
                   -12.8         -11.6        .174        -4.29        -17.5       -25.3
                    13.4          14.1        1.02         6.02         17.7        25.4

 P 4C - P 4X        .249          .126      .292E-01      -.481        -.318     -.443E-01
                    .302          .330        .103        -.224        -.478       -.130
                    .311          .361        .116         .279         .487        .154

 EC1C - EC1X     .310E-01     -.226E-01    .152E-01     .112E-01     .349E-01    .215E-01
                -.564E-01     -.178E-01    .237E-02     .119E-01     .347E-01    .287E-01
                    .198       .297E-01    .987E-02     .154E-01     .350E-01    .289E-01
```

Description of the Accompanying Data Package

```
STUDSVIK
THIS TAPE CONTAINS DATA FROM THE ICAP PREDICTION CALCULATION
WITH THE RELAP5/MOD2/36.04 FOR THE LOFT EXPERIMENT NO. L3-5.

CONTENTS, FILE  1.            THIS DESCRIPTIVE TEXT
                2.            INPUT CASE A, STEADY STATE
                3.               - " -   B,    - " -
                4.               - " -   C,    - " -
                5.            DATA, EXPERIMENT
                6.            -"- , CASE A
                7.            -"- , CASE B
                8.            -"- , CASE C

I.    COMPUTER
         NAME                 CYBER 170-810
         WORD SIZE            60

II.   TAPE FORMAT
         NUMBER OF TRACKS     9
         PACKING DENSITY      1600 BPI
         RECORD SIZE          80
         BLOCKING FACTOR      64
         CODED                EBCDIC
         CONTROL WORDS        NO

III. DATA FORMAT, FOR EACH OF THE FILES 5 THROUGH 8

       TITLE RECORD(S), (FORMAT I5,A75)
           FIELD 1, THE NUMBER OF DATA CHANNELS ON THE FILE
           FIELD 2, PROBLEM IDENTIFICATION
                    UP TO FIVE ADDITIONAL IDENTIFICATION RECORDS
                    MAY BE ADDED BY 'C' IN COLUMN 1 OF FIELD 1

       DATA SET RECORD 1, (FORMAT 2I5,A60)
           FIELD 1, NUMBER OF DATA POINTS
           FIELD 2, THE ENGINEERING UNIT CODE (EUC) FOR THE
                    VARIABLE
           FIELD 3, IDENTIFYING TEXT OF THE DATA
       REMAINING DATA SET RECORDS FORMAT 5(E16.9)

     EACH DATA CHANNEL SUBMITTED IS GIVEN THROUGH TWO DATA
     SETS, THE FIRST OF WHICH IS THE TIME DATA SET.
     THE TWO SETS HAVE THE SAME NUMBER OF DATA POINTS.
     THE TIME DATA SET IS IDENTIFIED BY EUC=77 (FIELD 2)
     AND THE IDENTIFYING TEXT 'TIME' (FIELD 3).
```

NRC FORM 335
(2-89)
NRCM 1102,
3201, 3202

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

1. REPORT NUMBER
(Assigned by NRC, Add Vol., Supp., Rev., and Addendum Numbers, if any.)

NUREG/IA-0037
STUDSVIK/NP-87/63

2. TITLE AND SUBTITLE

Assessment of RELAP5/MOD2, Cycle 36.04 Against LOFT
Small Break Experiment L3-5

3. DATE REPORT PUBLISHED

MONTH	YEAR
March	1992

4. FIN OR GRANT NUMBER
A4682

5. AUTHOR(S)

J. Eriksson

6. TYPE OF REPORT

7. PERIOD COVERED *(Inclusive Dates)*

8. PERFORMING ORGANIZATION — NAME AND ADDRESS *(If NRC, provide Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address.)*

Swedish Nuclear Power Inspectorate
S-61182 Nykoping
Sweden

9. SPONSORING ORGANIZATION — NAME AND ADDRESS *(If NRC, type "Same as above"; if contractor, provide NRC Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address.)*

Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, DC 20555

10. SUPPLEMENTARY NOTES

11. ABSTRACT *(200 words or less)*

An independent assessment of the RELAP5/MOD2 code was conducted by Studsvik Energiteknik AB. The LOFT small break experiment L3-5 was assessed using the RELAP5/MOD2 code. Three calculations were carried out; one base case calculation and two sensitivity calculations with model changes. The transient predictions compare reasonably well with the experiment as regards firsthand parameters such as system pressures and fluid temperatures. Variations are enumerated and discussed.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

ICAP Program
RELAP5/MOD2 Computer Code
Small Break Experiment

13. AVAILABILITY STATEMENT
Unlimited

14. SECURITY CLASSIFICATION
(This Page)
Unclassified
(This Report)
Unclassified

15. NUMBER OF PAGES

16. PRICE

NRC FORM 335 (2-89)

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

SPECIAL FOURTH-CLASS RATE
POSTAGE & FEES PAID
USNRC
PERMIT No. G-67

120555139531 1 1AN1CI
US NRC-OADM
DIV FOIA & PUBLICATIONS SVCS
TPS-PDR-NUREG
P-223
WASHINGTON DC 20555