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Assessment of RELAP5/MOD3.2 Using LOFT Large Break LOCA Test, LP–02–6

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Abstract

The LOFT experiment LP-02-6 was simulated using the RELAP5/MOD3.2 code to assess its capability to predict the thermal-hydraulic phenomena in LBLOCA of the PWR. The reactor vessel was modeled with two core channels and split downcomer for a base calculation. The results of the base calculation show that the code can not predict the early bottom-up quenching which is a distinguished phenomenon of the experiment LP-02-6, mainly due to the deficiency of break flow model.

The discharge coefficient sensitivity study was performed to show that the calculated subcooled break flow which might significantly affect the early bottom-up quenching is dependent on the coefficient. More detailed modeling of the cross flow in the split downcomer was performed, but, resulted in little improvement on the predictability of bottom-up quenching. Additional calculation using the RELAP5/MOD3.1 instead of RELAP5/MOD3.2 showed that there is no large difference between the versions in the simulation of LBLOCA.

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Executive Summary

This report presents the results of RELAP5/MOD3.2 assessment in the prediction of the thermal-hydraulic behavior under the conditions of Loss of Fluid Test(LOFT) LBLOCA Experiment LP-02-6. The assessment was purposed to determine whether the code can predict the major phenomena of LOFT LP-02-6 and to provide some useful information to code developers and users.

Experiment LP-02-6 was conducted on October 3, 1983. It was the forth experiment conducted in the LOFT facility at the Idaho National Engineering Laboratory(INEL) under the auspices of the OECD. This experiment, which was designed to meet requirements outlined by the USNRC as specified in the OECD LOFT Project Agreement, simulated a double-ended off-set shear of a commercial PWR main coolant inlet pipe coincident with the loss of offsite power. Experiment LP-02-6 addressed the response of a PWR to conditions closely resembling a USNRC "Design Basis Accident" in that prepressurized fuel rods were installed and minimum US emergency coolant injections were used.

A base case calculation using RELAP5/MOD3.2 with the typical LOFT nodalization and default break flow model was conducted. The results of the calculation were compared with the experiment data in terms of loop behavior, ECCS performance, vessel phenomena, and fuel thermal response. It was disclosed from the comparison that the code has poor predictability of the important thermal-hydraulic phenomena such as the early bottom up quenching during the blowdown. A primary cause of this poor prediction was inferred as the overprediction of subcooled break flow. The overprediction of subcooled break flow bring about the early end of subcooled break flow, early core heat up during the blowdown, the early initiation of bottom-up quenching and little amount of bottom-up flow.

To identify the effect of break flow model in the base case calculation, several calculations were performed with changing discharge coefficient. It was concluded that de-

creased discharge coefficient reduces the peak subcooled break flow and it helps the code better predict the early bottom up quenching.

Another sensitivity study was performed to identify the effects of the modeling of cross flow in the split downcomer annulus. All the downcomer volumes of each side were connected by cross flow junctions while only the top volume of downcomer annulus was connected by a cross flow junction in the base case calculation. This change of ...alization resulted in little improvement on the prediction of bottom up quenching, which means that the core thermal-hydraulic behavior is not dependent on the number of cross flow junctions.

Additional calculation using the RELAP5/MOD3.1 was performed to catch the improved features of RELAP5/MOD3.2 compared with RELAP5/MOD3.1. The versions showed nearly identical results, but, RELAP5/MOD3.2 predicted better the thermal behavior in the both end parts of the core than RELAP5/MOD3.1.

1. INTRODUCTION

This report presents the results of code assessment of RELAP5/MOD3.2 using the LOFT experiment LP-02-6. The assessment was performed within the Code Applications and Maintenance Program(CAMP) organized by the U. S. Nuclear Regulatory Commission(NRC).

The experiment LP-02-6 was the first large break LOCA simulation which was designed to represent the design basis accident conditions. The distinguished thermal-hydraulic phenomena of the experiment LP-02-6 is a positive bottom-up core flow, which resulted in bottom-up quench of central fuel assembly during the blowdown period, due to the long-term pump coast down.

The objective of this study is to identify effectiveness and deficiencies of RELAP5/MOD3.2 in predicting thermal-hydraulic phenomenon specific to LBLOCA such as bottom-up quenching. RELAP5/MOD3.2 is a recently released version of RELAP5/MOD3 which was developed by improving the modeling base of RELAP5/MOD2. RELAP5/MOD2 was assessed using the LP-02-6 test data by Lübbesmeyer [2]. He concluded that it could not predict the early bottom-up rewetting which occurred between 4 and 8 seconds of the blowdown phase.

It is well known that RELAP code is very strongly dependent upon user specific input parameters. The discharge coefficient at the break valve affects significantly on the resultant thermal-hydraulic behavior in the analysis of LBLOCA. To find out the influence of discharge coefficient in the calculation of LP-02-6, sensitivity calculations on the discharge coefficient were carried out.

Transversal flow in the downcomer, which has been believed to have effects on the core flow behavior, has been modeled by cross flow junction between downcomer upper volumes of both loop sides. A more detailed modeling of the transversal flow by connecting all the volumes of both loop sides with six cross flow junctions was tried to get better prediction of core flow behavior.

Finally, a calculation using RELAP5/MOD3.1 in place of RELAP5/MOD3.2 was conducted, though it is generally thought that there is no significant change between these versions in the analysis of LBLOCA, to get knowledge of the improved features of RELAP5/MOD3.2.

A brief description of the LOFT system and the LP-02-6 experiment are provided in Chapter 2. The code and modeling basis for the base case calculation is described in Chapter 3. The results of the base case calculation are discussed in Chapter 4. The scope and results of sensitivity studies are presented in Chapter 5. Chapter 6 describes the run statistics for the base case calculation and conclusions and recommendations from this assessment are presented in Chapter 7. The input list for steady-state run and transient run of the base case is attached in Appendix.

2. FACILITY AND TEST DESCRIPTIONS

2.1 LOFT facility

The LOFT(Loss of Fluid Test) facility at Idaho National Engineering Laboratory was designed to simulate the major component and system responses of commercial PWR during LOCA. It is a scaled representation of a commercial PWR of Westinghouse type having 4 loops with a volume ratio of 1/60. The experimental assembly includes five major subsystems which have been instrumented such that system variables can be measured and recorded during a LOCA simulation. The subsystems consist of a reactor vessel with a nuclear core, an intact loop, a broken loop, the blowdown suppression system, and the emergency core coolant system. The entire nuclear core consists of five square and four triangular fuel bundles with a total of 1300 fuel pins each of 1.67 m long and an outside diameter of 10.72 mm. The overall configuration is shown in Figure 2.1 and complete information on this system is provided in Reference 1.

2.2 Experiment LP-02-6

Experiment LP-02-6 was completed on October 3, 1983, in the LOFT facility located at the Idaho National Engineering Laboratory. It was the first large-break LOCA simulation and the fourth experiment conducted under the auspices of the Organization for Economic Cooperation and Development(OECD) LOFT Project. This experiment simulated a double-ended offset shear of a pressurized water reactor(PWR) main coolant inlet pipe, and was initiated from conditions similar to PWR operating conditions.

Prior to the experiment, LOFT facility was set to have a primary system pressure of 15.0 MPa, primary system cold leg and hot leg temperature of 560K, and 590K respectively, and a loop mass flow rate of 248.7 kg/sec. Initial reactor power level was 46

MW with a maximum linear heat generation rate (LHGR) of 48.8 kW/m. Table 2.1 presents a summary of initial conditions of the experiment.

The experiment was initiated by opening both the Quick Opening Blowdown Valves(QOBV) in hot and cold leg. Reactor was scrammed on low hot leg pressure at 0.1 secs and the pumps were tripped at 0.8 secs. The pumps coasted down until 16.5 secs when their rotational speed fell below the trip point and they were decoupled from their flywheels. Flow in the core reversed almost instantaneously with experiment initiation, and the fuel rod cladding temperatures started to increase due to stored thermal energy at 0.9 secs. The entire core heated up until 5.2 secs, when positive core flow was again established due to choking of the flow in the broken cold leg. This positive core flow quenched the lower ~2/3 of the core until ~10 secs when flow in the intact cold leg decreased to below that of the broken cold leg and the core again started to heat up. A partial top-down core quench initiated at 14.8 secs and lasted until 18.6 secs. The lower plenum was filled by 30.7 secs, the core quench was complete by 56 secs, and core reflood was complete by 59 secs. Thermal-hydraulic sequence of main events observed in the experiment is summarized in Table 2.2.

3. CODE AND MODELING DESCRIPTION

RELAP5/MOD3.2 used in this assessment was **the very version(without any modification)** received at October 1995 from USNRC. Since any RELAP5 input specific to LP-02-6 experiment was not obtained from INEL, a reference input was developed by authors based on the input which was used in the previous LP-LB-1 assessment by Lübbesmeyer [3].

3.1 Input Modeling

The base nodalization used to simulate the LOFT experiment LP-02-6 in this study is shown in Figure 3.1. This nodalization and input deck are based on those used to calculate the LP-LB-1 experiment with RELAP5/MOD2 by Lübbesmeyer [3]. Modifications implemented into the original input are as follows : (1) General changes suitable to RELAP5/MOD3(e.g. heat structure), (2) Introduction of ECCMIX component, (3) Changes in the number of volumes of pressurizer (six to twelve), (4) Changes in the number of axial nodes of core channel, (5) LP-02-6 experiment specific modifications

The reactor vessel is modeled by three hydraulic channels representing reactor core(volume 230, 231, and 235), two downcomer channels(volume 200 to 210 and 270 to 280 respectively), lower plenum(volume 220 to 225) and upper plenum with the vessel dome(240-260). Top volumes of each downcomer channel(volume 200 and 270) are connected with single cross flow junction(junction 290) which has energy loss coefficient of 1.8341. Nozzle bypass from intact cold leg to upper plenum is also modeled. The core is modeled by 3 parallel channels; core bypass channel(volume 235) with 3 subvolumes, average and hot core channel(volume 230 and 231) subdivided into 12 equally spaced volumes respectively. It is assumed that the total mass flow rate through the core is shared approximately 79% by the average channel, 16% by the hot channel and 5% by core bypass channel. The heat generated in the fuel pin is transferred to primary coolant by heat structures attached to the hot channel and the average channel. To include the effect of heat capacity of material, heat structures of the downcomer and lower plenum are modeled.

The intact loop consists of twenty volumes with several subvolumes. The pumping system is divided into two pump lines with two individual pumps numbered as 135 and 165 respectively.

The ECC injection system consists of five volumes and one valve. This system is connected to the intact loop cold leg volume modeled by the ECCMIX component(volume 185). The HPIS and LPIS are modeled by time dependent junctions numbered 635 and 625 respectively. Control valve(valve 610) in the accumulator line is to isolate the accumulator when the accumulator is emptied.

The steam generator consists of eight volumes on the primary system and fifteen volumes on the secondary system. Heat is exchanged between primary and secondary side of the steam generator via the u-tubes which is modeled by heat structures. Feed water system and steam condenser are modeled by time dependent volumes(volume 505 and 541, respectively). Feed water flow rate and steam flow rate are controlled by control logic to keep the required secondary pressure and level.

The pressurizer is modeled by surge line(volume 400 and 402), pressurizer vessel(volume 415) and pressurizer dome(volume 420). Pressurizer vessel was divided into twelve subvolumes.

The broken loop hot leg is modeled by four volumes(volume 300 to 315). Component 315 represents steam generator simulator. The broken loop cold leg is modeled by 4 volumes(volume 335 to 344). Reflood assist bypass line is modeled by 2 volumes(volume 370 and 380). The reflood assist bypass valve is modeled by a trip valve which is closed when the break valves are opened. At the end of each broken loop, two break valves which have to be opened by trip signal are placed and connected with the suppression tank modeled by two time dependent volumes(700 and 705). The discharge coefficients of the break valves are 1.0 for the subcooled discharge and the saturated discharge.

In the input modeling delineated above, total number of hydrodynamic volumes, junctions and heat structures are 147, 152, and 47, respectively.

3.2 Initial and Boundary Conditions

To obtain the initial conditions proper to the test conditions over the whole system, a steady state calculation was performed with four steady state controllers and a time dependent volume : two primary coolant pump speed controllers, a charging and letdown controller, a feed water flow rate controller, and a time dependent volume to set pressurizer pressure to a designed value.

The results obtained from the steady state run were compared with the measured initial conditions [4] in Table 2.1. The calculated results generally agree with the experimental conditions except the broken loop hot leg temperature which was estimated lower than the measured data. The reason of such underprediction of the broken loop hot leg temperature was not clear, but, it was believed to have negligible effect on the overall system transient.

Based on the experiment data, the reactor power history, containment pressure and feedwater flow rate after scram were described as time dependent tables. Performance curves for HPSI and LPSI flow rate as function of cold leg pressure were provided in the input. The pump speed after trip was simulated by time dependent speed table. And the steam generator secondary side air-cooled condenser was modeled as a time dependent volume with a constant pressure of 2.069 MPa during the transient. All information of boundary conditions was provided in the steady and transient input deck.

4. RESULTS FROM BASE CASE CALCULATION

The LP-02-6 transient was calculated up to 80 secs from the initial conditions obtained from steady state run. Steady state controllers were deleted in the transient input deck to get proper initial conditions.

The sequence of hydraulic events during the transient calculation was summarized in Table 2.2 and compared with the experiment chronology. In general, the calculated sequence of events show good agreement with the experiment, but, the overall transient was calculated to progress more rapidly than the experiment because of rapid system depressurization.

In this chapter, the predicted important thermal-hydraulic parameters such as system pressure, loop mass flow rates and cladding temperatures are compared with the measured data. Table 4.1 summarizes the list of assessment parameters. It describes the identification of calculated parameters and corresponding instruments in addition to uncertainties of measurements. The corresponding figure numbers are also listed in the table.

4.1 Loop Behavior

The behavior of calculated system pressure in the intact loop hot leg is plotted with corresponding experimental data in Figure 4.1. It is easily found that the system pressure was calculated to be lower than the measured data during overall transient. This underestimation of system pressure might be a result of overprediction of break flow during the blowdown, which will be discussed later.

The calculated mass flow rate in the broken loop cold leg and hot leg are shown in Figure 4.2 and 4.3, respectively. As shown in the figures, the overall trends of mass flow in the broken leg were predicted well. However, the peak values of the mass flow were highly overestimated to be about 741 kg/sec (the measured value is ~550 kg/sec) in the cold leg and 241 kg/sec (the measured value is ~193 kg/sec) in the hot leg. Such an overprediction of mass flow rate in the broken loop in the early period of transient is considered as a deficiency of RELAP5/MOD3.2 critical flow model. This might lead the intact loop to contain less inventory than the experiment.

The calculated mass flow rates in the intact loop cold leg and the intact loop hot leg were compared with the experimental data in Figure 4.4 and 4.5, respectively. It can be found that the calculated mass flow rates followed the trend of the measured data very well with slight underestimation of mass flow rate in the cold leg during the blowdown phase.

The mass flow rate in the broken loop cold leg was predicted to fall below the mass flow rate in the intact loop cold leg at ~3.3 secs as shown in Figure 4.6. The fact that the mass flow rate in the broken loop cold leg is lower than the mass flow rate in the intact loop cold leg means that the flow in the broken loop cold leg is saturated and the core is being filled with fluid from the intact loop cold leg. The phase transition of flow in the broken loop cold leg was observed at ~4 secs after transient initiation in the experiment.

4.2 ECCS Performance

Figure 4.7 shows the calculated accumulator pressure and Figure 4.8 shows the predicted liquid level in the accumulator with corresponding measured data. As shown in these figures, the accumulator injection was initiated at ~14.5 secs while it was started at 17.5 secs in the experiment. This earlier accumulator injection was resulted from rapid system depressurization.

Figure 4.9 shows the calculated LPSI mass flow rate with the measured data. The injection was predicted to be earlier and higher than the measured data. This earlier and higher injection was also due to the underestimation of the primary syst..n pressure during the injection period.

4.3 Vessel Phenomena

Figure 4.10 shows the calculated liquid temperature in the lower plenum. The liquid temperature was underperdicted after ~14 secs when the accumulator injection was initiated ~3 secs earlier than the experiment as stated in the previous section.

Figure 4.11 presents the collapsed liquid level in the two downcomer channels and the two core channels of reactor vessel. Since no experiment data for these collapsed liquid levels were available, the predicted levels are plotted only.

The liquid level in the core decreased rapidly after initiation of break and the core was completely emptied at ~3 secs until bottom up flow was initiated. The filling of the core with the bottom up flow was predicted to make the lower part of the core rewet. And then, the liquid level fell again below the bottom of core and was maintained low level until the ECC injection water reached the bottom of core at ~38 secs. The hot core reflood was completed at 64 secs, ~5 secs latter than the experiment.

In the early blowdown period up to ~3 secs, the liquid level in the broken side downcomer dropped more rapidly than that in the intact side one due to less flow resistance. The liquid level in the broken side downcomer increased for a short time from the end of subcooled blowdown because the break flow was reduced significantly due to saturation while the incoming flow from the intact loop cold leg was still maintained. During the core rewetting period, the liquid levels in the both sides decreased again. The decreasing rate of the broken side liquid level was smaller than that in intact side. This was due to upward water flow from the lower plenum to the broken side downcomer. The level in the intact side downcomer started to increase at ~22 secs mainly due to accumulator injection flow initiated at 14.5 secs. The level in the broken side downcomer also started to increase at ~26 secs.

4.4 Fuel Thermal Response

Calculated cladding temperatures of hot rod at 12 axial hot core nodes are compared with the measured data of corresponding elevation in Figure 4.12 to Figure 4.23. From the comparison of the cladding temperature behavior, following features are observed.

1) The blowdown heat up was relatively well predicted over the core except at the highest node, but, it was calculated to occur little earlier than the measured data.
2) The blowdown heat up was underpredicted at the low heat flux region, and overpredicted at the high heat flux region. In the middle part of the core, the degree of overestimation is ~60K at the hottest elevation.
3) The early bottom-up quenching was predicted to occur at the 1/4 lower part of the core, while it was observed at the ~2/3 lower part of the core in the experiment. Even more, it was calculated to be initiated slightly earlier than the measured data. This prediction of earlier and little amount of bottom up quenching resulted from the overestimated peak mass flow rate in the broken loop cold leg, i.e. cold leg break flow and the early end of subcooled blowdown as mentioned in section 4.1.
4) The calculated second heat up was also calculated to start earlier than the measured data due to earlier bottom-up quenching.

The peak cladding temperature(PCT) during the blowdown phase in the core was calculated to occur at the elevation of 22 to 27.5 inches(node 5) while it was measured at 27 inches from the bottom of core. The calculated PCT is 1121 K, which is ~50 K higher than that measured in the experiment. The calculated maximum cladding temperature during the reflood phase was approximately 960 K while it was 831 K in the experiment. Such an overestimation is a result from the deficiency of RELAP5/MOD3.2 not to be able to predict the early bottom-up quenching in the middle part of the core.

5. SENSITIVITY STUDIES

To investigate the influence of discharge coefficient on the resultant cladding temperature behaviors, two additional calculations were carried out. A brief note of these calculations is as follows :

calculation ID	subcooled discharge coeff.	saturated discharge coeff.
DC1	1.1	1.1
(Base case)	(1.0)	(1.0)
DC2	0.9	0.9

And to find out the effects of the cross flow junction between the intact side downcomer and the broken side downcomer, an additional calculation was performed with six cross flow junctions between all the volumes of both sides. The sum of mass flow through the cross flow junctions before the initiation of transient in the calculation is made to be nearly equal to that in the base case calculation by adjusting the energy loss coefficients of junctions. For the convenience of later discussion, the calculation was named SIXX.

Finally, a calculation using RELAP5/MOD3.1 was conducted to identify the effects of improved features of RELAP5/MOD3.2 for the LBLOCA analysis.

5.1 Influence of Discharge Coefficient

In Figure 5.1 and 5.2, the calculated mass flow rates in the broken loop cold leg and hot leg with various discharge coefficients are presented for comparison. These figures show that the mass flow rate in each broken leg during the blowdown is highly dependent on the discharge coefficient.

Figure 5.3 contains the difference between mass flow rate in the intact loop cold leg and mass flow rate in the broken loop cold leg, and Figure 5.4 presents the calculated bottom-up core mass flux at the hot core inlet junction induced by the mass flow difference. From these figures, it can be found that the bottom-up core flow in the blowdown phase is dominated by the discharge coefficient at the break and the smaller discharge coefficient, in other words, the lower break flow induces the higher bottom-up core flow.

This correlation between the discharge coefficient and the bottom-up core flow can be made clear by Figure 5.5 and 5.6, which show the calculated cladding temperature behaviors at the hot core node 5 and 8, respectively. As shown in the figures, the more break flow rate was estimated in the blowdown phase, the less bottom-up quenching was predicted.

5.2 Influence of Cross Flow Modeling in the Downcomer

Figure 5.7 contains the calculated downcomer liquid levels both in the base case calculation and in the SIXX calculation. From the figure, one can find that the liquid levels of both sides of downcomer predicted in the calculations showed almost similar trend.

The difference between the base case and SIXX calculation for the core bottom-up flow is shown in Figure 5.8 As shown in the figure, the initiation and completion of bottom-up flow in the SIXX calculation was predicted to be little later than those in the base case, and the total bottom-up flow in the SIXX calculation is considered somewhat greater than that calculated in the base case calculation. Such a delayed and larger bottom-up flow resulted in lower and delayed second heat up.

Figure 5.9 shows the mass flux at the outlet of the core. The calculated top-down quenching flow in the base case was higher than that predicted in the SIXX calculation.

However, the cladding temperature behavior predicted in the both calculations didn't show any significant difference because the differences of flow behavior were not so large. The cladding temperature behaviors at hot core node 1, 5, and 10 are presented in Figure 5.10 to 5.12.

In conclusion, the hydraulic and thermal behavior in the core calculated by RELAP5/MOD3.2 was not strongly dependent on the number and position of the cross flow junctions in the downcomer.

5.3 Calculation Using RELAP5/MOD3.1

A calculation similar to the base case using RELAP5/MOD3.1, for which we didn't make any change after it was received at October in 1993 from USNRC , was performed to identify the difference between RELAP5/MOD3.1 and RELAP5/MOD3.2 for LBLOCA analysis.

The calculated hydraulic behavior by RELAP5/MOD3.1 is very similar to that predicted by RELAP5/MOD3.2. The mass flow rates in the broken loop cold leg and hot leg, for instance, showed nearly same trend as shown in Figure 5.13 and Figure 5.14. However, the cladding temperatures predicted by RELAP5/MOD3.1 showed less degree of heat up both in the blowdown phase and the reflood phase than those by RELAP5/MOD3.2. The cladding temperatures calculated by RELAP5/MOD3.1 at several elevations are presented in Figure 5.15 to Figure 5.17 with corresponding data by RELAP5/MOD3.2. More profound studies of these results were not tried because the predicted cladding temperature behavior by RELAP5/MOD3.1 and RELAP5/MOD3.2 showed no dramatic difference.

6. RUN STATISTICS

The computer used in the present calculations was HP9000/K200 workstation at KNFC, with OS Version 10.01.

Figure 6.1 presents the plot of the required CPU time for the transient time in the base case calculation. And the time step sizes are also plotted in Figure 6.2. The user-specified maximum time step was 0.01 sec up to 30 secs in real time and then reduced to 0.002 sec up to 80 secs. The run statistics from the major edit is summarized in Table 6.1 and the grind time can be calculated as follows.

Computer time,	$CPU = 2397.7 - 1 = 2396.7$
Number of time step,	$DT = 28615 - 167 = 28448$
Number of volume,	$C = 147$
Transient real time,	$RT = 80$ *(secs)*

$$Grind\ time = CPU \times 1000 / (C \times DT) = 0.573\ CPU\ m\ sec/vol/step$$

6. CONCLUSIONS AND RECOMMENDATIONS

RELAP5/MOD3 code was assessed using LOFT LP-02-6 test data. A base case calculation using RELAP5/MOD3.2 was carried out as a reference case. Discharge coefficient sensitivity studies were performed to investigate the influence of this user-specific parameter in the analysis of LBLOCA. A more detailed modeling of cross flow in the inlet annulus and downcomer volume was tried to improve the code predictability of early bottom-up quenching in the blowdown phase. As a final case, a calculation using RELAP5/MOD3.1 was performed to identify the differences between RELAP5/MOD3.1 and RELAP5/MOD3.2. Based upon the results from the scope of this study, the following conclusions were made.

1) Using LOFT LBLOCA test data LP-02-6, a base calculation with a standard nodalization was successfully performed and matched relatively well with the experimental data.

2) RELAP5/MOD3.2 with standard nodalization can predict system hydraulic behavior. However the mass flow rates in the broken loop cold leg and hot leg during the subcooled blowdown were largely overestimated.

3) RELAP5/MOD3.2 can predict well the blowdown heat up of the core. However, the calculated blowdown heat up was initiated slightly earlier than the experiment due to the poor prediction of heat transfer in the fuel rod during blowdown. The calculated PCT was predicted to be ~50K higher than the measured data.

4) The bottom-up quenching in the middle part of hot core was not predicted

properly by RELAP5/MOD3.2, therefore, the maximum cladding temperature during the reflood phase was highly overestimated to be about 960 K.

5) RELAP5/MOD3.2 was so sensitive to the discharge coefficient that the resultant behavior of cladding temperatures was greatly varied with small change of discharge coefficient. The development of more accurate break flow model, which is known to be undergoing, should be made to remove the sensitiveness to this user accessible parameter.

6) From our analysis of cross flow modeling in the downcomer volume, it was revealed that the core flow behavior is not dependent on the position and number of cross flow junctions connected. In other words, single cross flow junction with a low energy loss coefficient and multiple cross flow junctions with a high energy loss coefficient might have similar effect on the resultant thermal behavior in the core.

7) Neither of code versions, RELAP5/MOD3.1 and RELAP5/MOD3.2, could predict properly the early bottom-up quenching in the middle part of the core. The only effect of improved features of RELAP5/MOD3.2 could be shown in the lower part of core, where RELAP5/MOD3.2 could predict the blowdown heat up better than RELAP5/MOD3.1.

8) It was revealed that RELAP5/MOD3 can be used as a best estimate tool for analysis of LBLOCA with the improvement of break flow model which has great influence on the predictability of early bottom-up quenching in the LBLOCA.

REFERENCES

[1] LOFT System and Test Description, Reeder, D.G., NUREG/CR-0247 Tree-1208, 1978(update 9/80)

[2] Post-Test-Analysis and Nodalization Studies of OECD LOFT Experiment LP-02-6 with RELAP5/MOD2 cy 36-02, D. Lübbesmeyer, Draft to NUREG Report

[3] Post-Test-Analysis and Nodalization Studies of OECD LOFT Experiment LP-LB-1 with RELAP5/MOD2 cy 36-02, D. Lübbesmeyer, NUREG/IA-0089, October 1992

[4] Quick-Look Report on OECD LOFT Experiment LP-02-6, J.P.Adams, K.G.Condie, D.L.Blatt, OECD LOFT-T-3404, October 1993

[5] RELAP5/MOD3 code manual, The RELAP5 Development Team, NUREG/CR-5535, August 1995

[6] TRAC-PF1/MOD1 Calculation of LOFT Experiment LP-02-6, P.Coddington, C.Gill, NUREG/IA-0027, April 1992

Table 2.1 Initial and boundary conditions for experiment LP-02-6

Parameter	Measured Data	Calculated value
Power(MW)	46.0±1.2	46.0
Temperature Across Core(K)	33.1±1.1	33.57
Hot Leg Pressure(MPa)	15.09±0.08	15.10
Cold Leg Temperature(K)	555.9±1.1	555.98
Mass Flow Rate(Kg/s)	248.7±2.6	248.69
Pressurizer		
Liquid Level(m)	1.04±0.04	1.041
Water Temperature(K)	615.6±5.8	615.76
Pressure(MPa)	15.3±0.11	15.09
Broken Loop		
Cold Leg Temperature(K)	553.0±6.0	555.8
Hot Leg Temperature(K)	560.0±6.0	555.9
Emergency Core cooling System		
Accumulator Liquid Level(m)	2.10±0.0	2.10
Accumulator Pressure(MPa)	4.11±0.06	4.11
Accumulator Liquid Temperature(K)	302. ±6.1	302.
High Pressure Injection Flow Rate(l/s)	1.04±0.04	1.04
High Pressure Injection Liquid Temperature(K)	305. ±7	305.
Low Pressure Injection Flow Rate(l/s)	a	a
Low Pressure Injection Liquid Temperature(K)	305. ±7	305.

a. Depending on pressure difference between LPIS and downcomer

Table 2.2 Chronology of event for experiment LP-02-6

Event	Measured Data (seconds)	Calculated value (seconds)
Blowdown Valve Open	0.0	0.0
Reactor Scrammed	0.1	0.1
Primary Coolant Pumps Tripped	0.8	0.8
Cladding Temperature Initially Deviated from Saturation	0.9	0.5
End of Subcooled Break Flow	4.0	3.3[a]
Blowdown Peak Cladding Temperature Reached	4.9	3.8
Bottom-up Core Rewet Initiated	5.2	3.7
Bottom-up Core Rewet Completed	9.1	13.0
Partial Core Top-down Quench Initiated	14.8	14.5
Pressurizer Empty	15.5	14.0
Accumulator Injection Initiated	17.5	14.05
Partial Core Top-down Quench Completed	18.6	24.6
High Pressure Injection Initiated	21.8	21.8
Lower Plenum Refill Completed	30.7	32.[b]
Low Pressure Injection Initiated	34.8	34.8
Reflood Peak Cladding Temperature Reached	41.0	26.3
Accumulator Injection Completed	57.0	50.0
Core Quench Completed	56.0	60.5
Core Reflood Completed	59.0	64.0

a. This value is based on the time when the junction void fraction in the cold leg break valve is less then 0.1

b. The measured time for complete refill of the lower plenum is based on when the lowest fuel rod cladding quenched.

Table 4.1 List of assessment parameters (LOFT LP-02-6)

Description	Calculation	Measurement	Uncertainty	Figure
Primary System Pressure	p 112-01	PE-PC-002	0.036 MPa	4.1
BLCL Mass Flow Rate	mflowj 340-01	FR-BL-105	Not found	4.2
BLHL Mass Flow Rate	mflowj 305-01	FR-BL-205	"	4.3
ILCL Mass Flow Rate	mflowj 175-01	FR-PC-100	"	4.4
ILHL Mass Flow Rate	mflowj 112-01	FR-PC-205	"	4.5
Downcomer Fluid Temperature	tempf 210-02	TE-1ST-002	5.1 K	4.6
Lower Plenum Fluid Temperature	tempf 220-01	TE-5LP-001	5.1 K	4.7
LPIS Mass Flow Rate	mflowj 630-00	FT-P120-085	0.25 l/s	4.8
Cladding Temperature (Central 2 inches)	httemp 231-01	TE-5H02-002	5.2 K	4.12
Cladding Temperature (Central 5 inches)	httemp 231-01	TE-5I06-005	"	4.12
		TE-5J04-005	"	
Cladding Temperature (Central 8 inches)	httemp 231-02	TE-5H07-008	"	4.13
Cladding Temperature (Central 11 inches)	httemp 231-02	TE-5G06-011	"	4.13
Cladding Temperature (Central 15 inches)	httemp 231-03	TE-5F04-015	"	4.14
		TE-5H05-015	"	
		TE-5M07-015	"	
Cladding Temperature (Central 21 inches)	httemp 231-04	TE-5J04-021	"	4.15
		TE-5J06-021	"	
Cladding Temperature (Central 24 inches)	httemp 231-05	TE-5H06-024	"	4.16
Cladding Temperature (Central 26 inches)	httemp 231-05	TE-5F04-026	"	4.16
		TE-5F08-026	"	
		TE-5I08-026	"	
		TE-5J06-026	"	
		TE-5M07-026	"	
Cladding Temperature (Central 27 inches)	httemp 231-05	TE-5D07-027	"	4.16
		TE-5I04-027	"	
Cladding Temperature (Central 28 inches)	httemp 231-06	TE-5H06-028	"	4.17
Cladding Temperature (Central 30 inches)	httemp 231-06	TE-5G06-030	"	4.17

Table 4.1 List of assessment parameters (Continued)

Description	Calculation	Measurement	Uncertainty	Figure
Cladding Temperature (Central 31 inches)	httemp 231-06	TE-5C07-031	5.2 K	4.17
		TE-5D07-031	"	
Cladding Temperature (Central 32 inches)	httemp 231-06	TE-5F04-032	"	4.17
		TE-5H06-032	"	
		TE-5M07-032	"	
Cladding Temperature (Central 37 inches)	httemp 231-07	TE-5H06-037	"	4.18
Cladding Temperature (Central 39 inches)	httemp 231-08	TE-5I06-039	"	4.19
		TE-5I04-039	"	
Cladding Temperature (Central 41 inches)	httemp 231-08	TE-5H07-041	"	4.19
Cladding Temperature (Central 43.8 inches)	httemp 231-08	TE-5C07-43.8	"	4.19
		TE-5I04-43.8	"	
Cladding Temperature (Central 45 inches)	httemp 231-09	TE-5G06-045	"	4.20
Cladding Temperature (Central 49 inches)	httemp 231-09	TE-5H05-049	"	4.20
Cladding Temperature (Central 54 inches)	httemp 231-10	TE-5I06-054	"	4.21
		TE-5J04-054	"	
Cladding Temperature (Central 58 inches)	httemp 231-11	TE-5H07-058	"	4.22
Cladding Temperature (Central 62 inches)	httemp 231-12	TE-5F04-062	"	4.23
		TE-5G06-062	"	

Table 6.1 Run statistics data in base case

Transient time (sec)	CPU time (sec)	Attempted ADV	Repeated ADV	Last DT	Courant DT
0	1.00	0	0	0.01	0
10	94.46	1011	3	0.01	1.11175-2
20	189.78	2011	3	0.01	9.57746-3
30	291.52	3106	3	0.01	1.17485-2
40	784.41	8613	166	0.002	1.06071-2
50	1229.55	13615	167	0.002	1.84512-2
60	1676.05	18615	167	0.002	1.65845-2
70	1995.11	23615	167	0.002	4.72061-2
80	2397.70	28615	167	0.002	1.38078-2

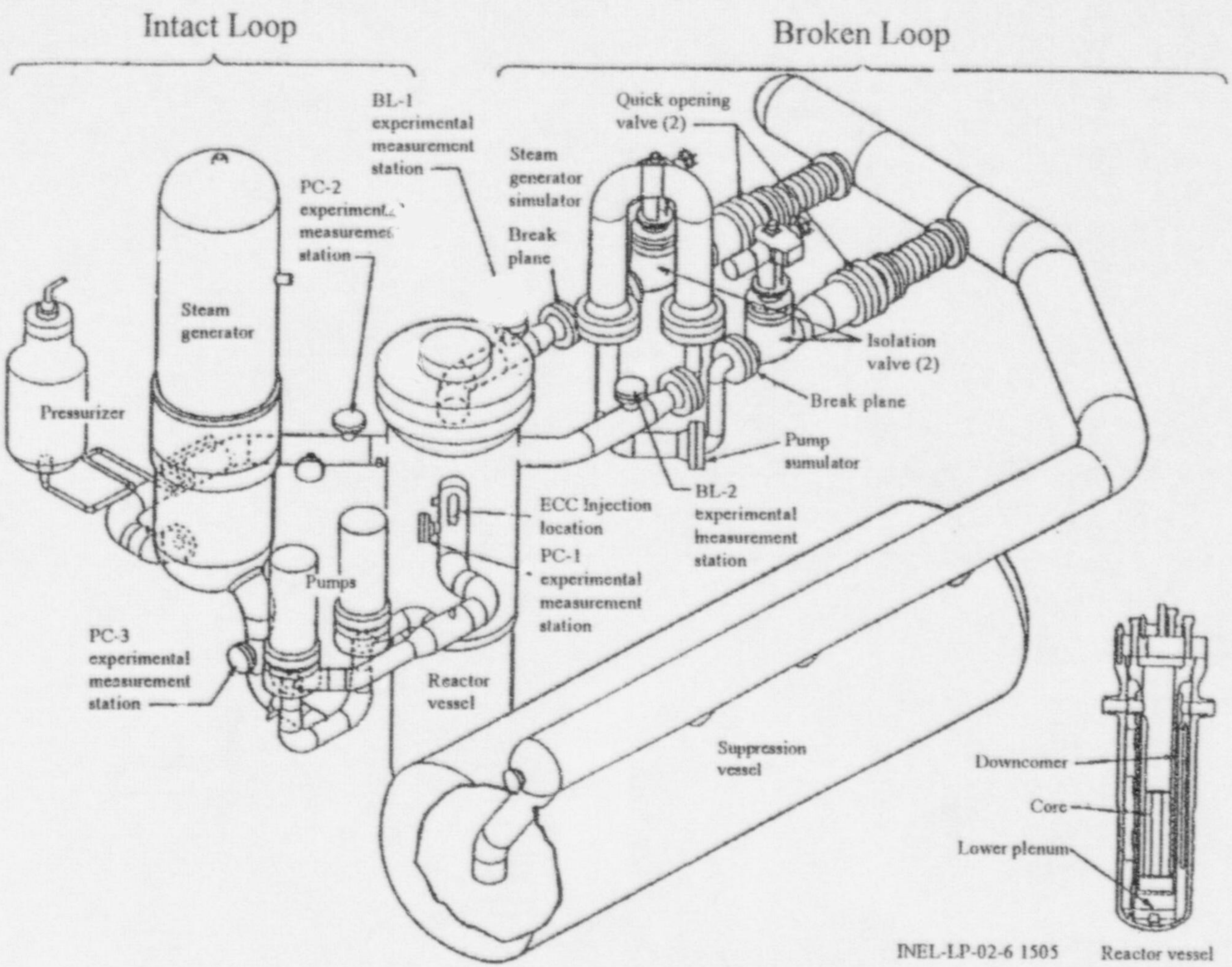

Figure 2.1 LOFT major component

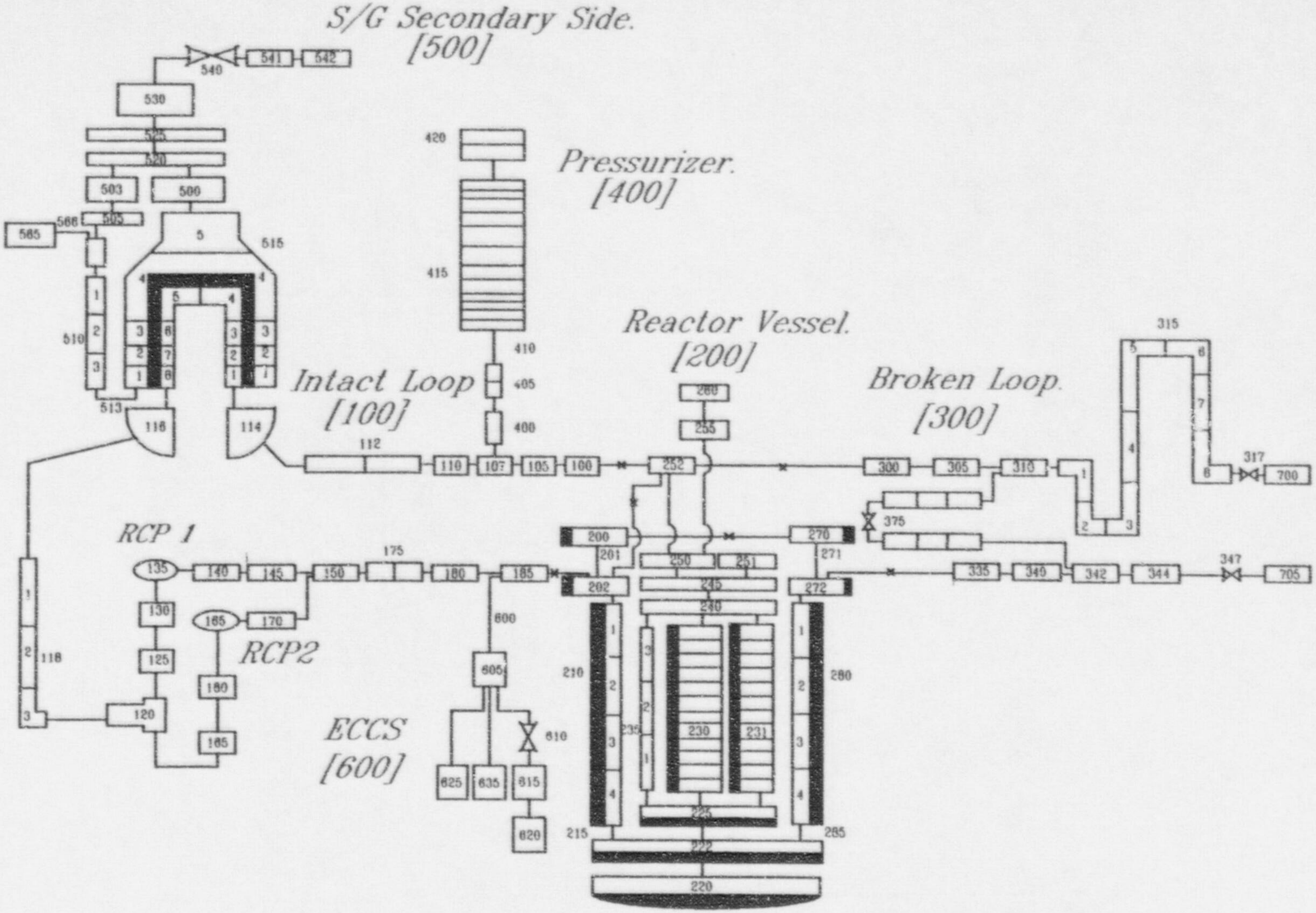

Figure 3.1 Schematic diagram of standard nodalization

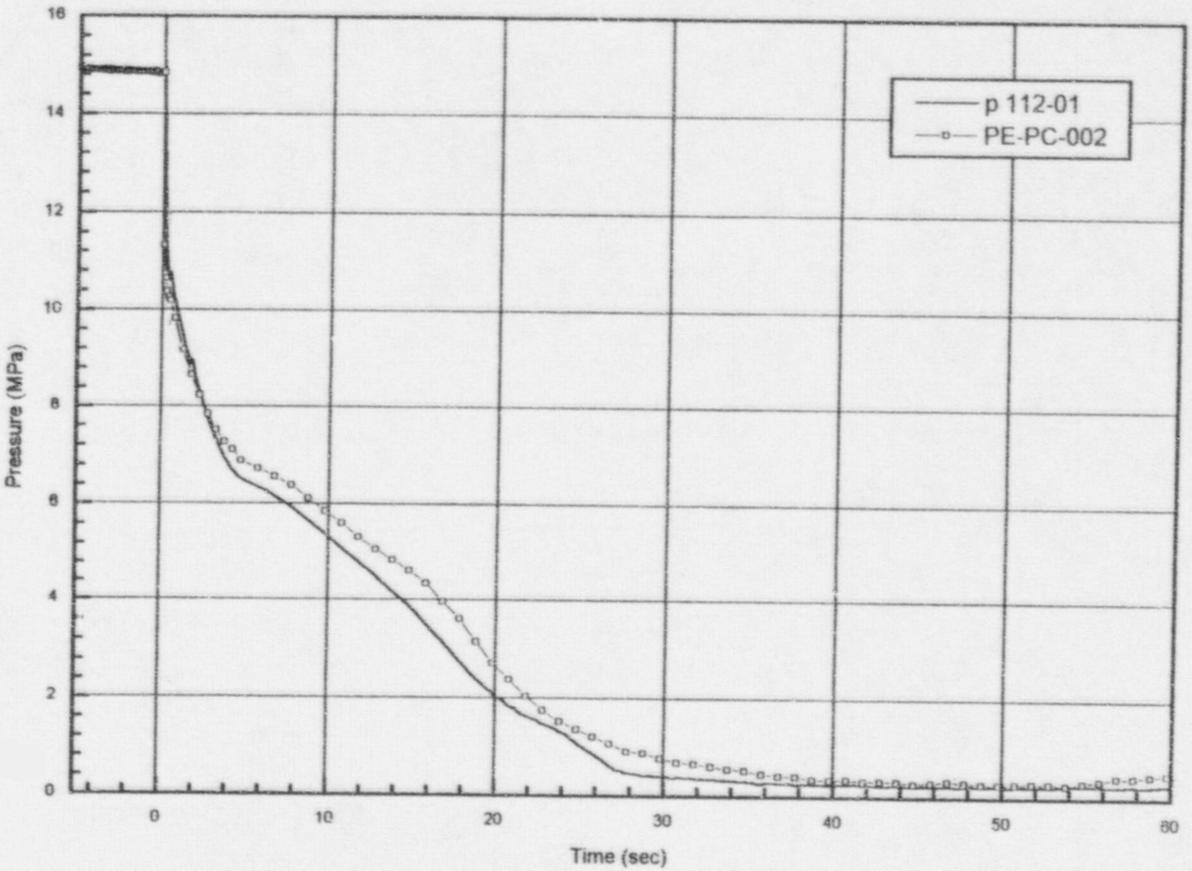

Figure 4.1 System pressure in the intact loop hot leg

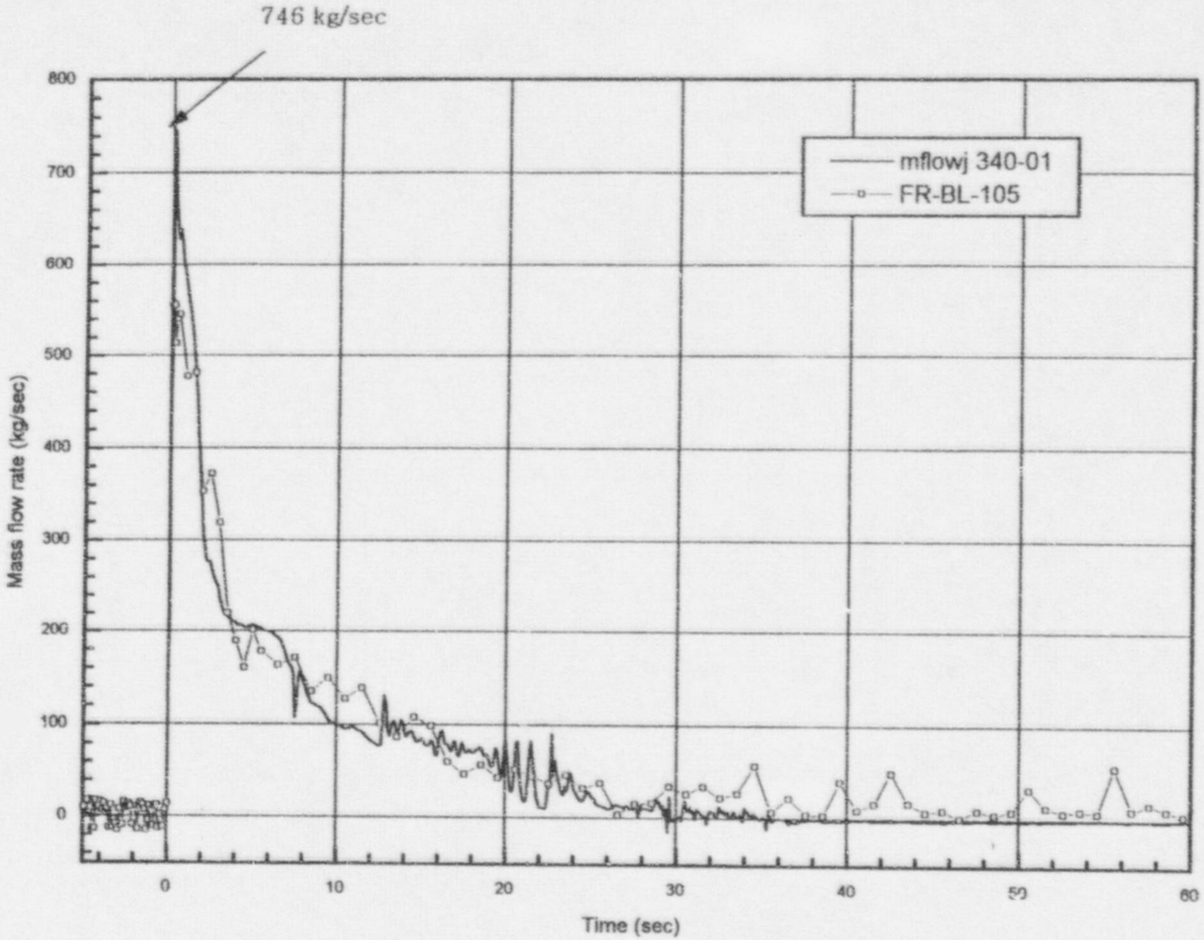

Figure 4.2 Mass flow rate in the broken loop cold leg

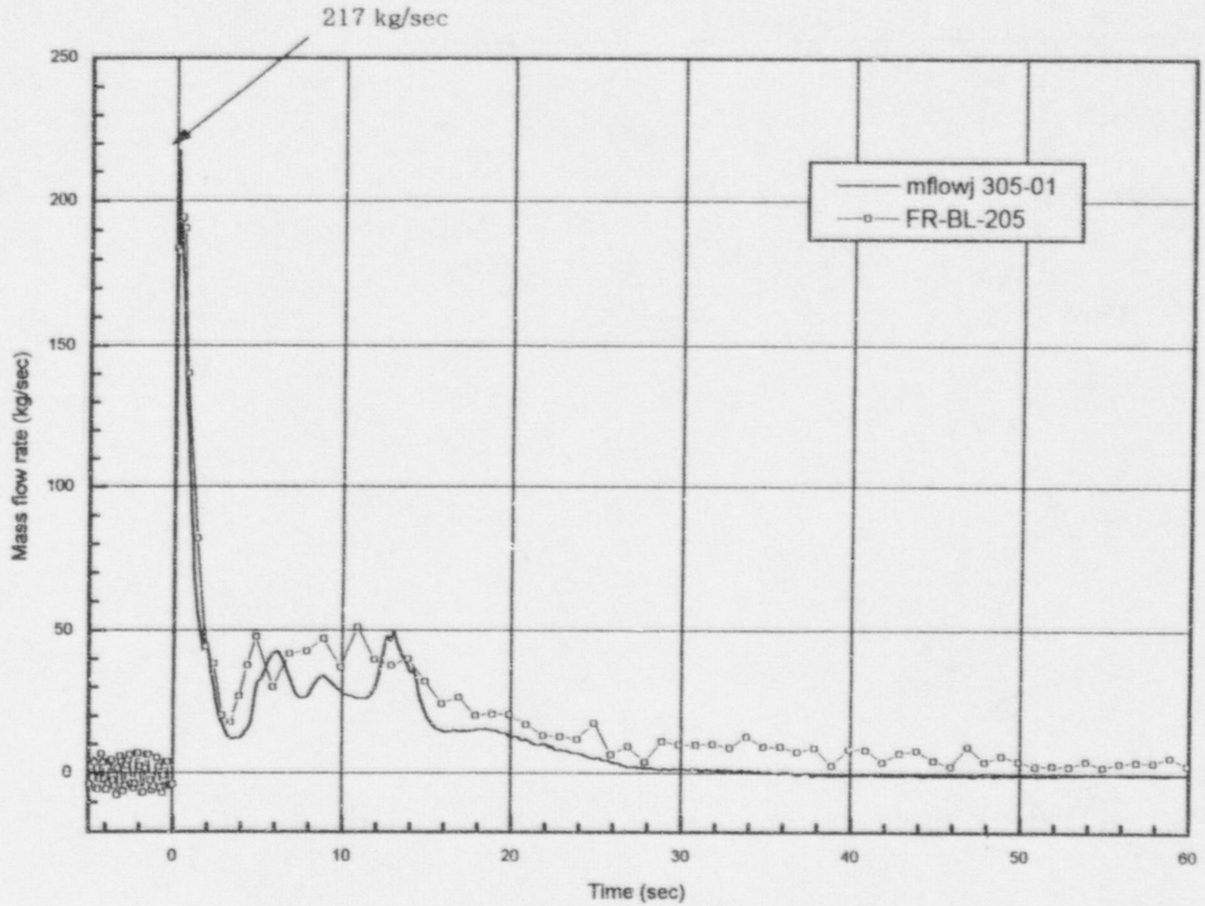

Figure 4.3 Mass flow rate in the broken loop hot leg

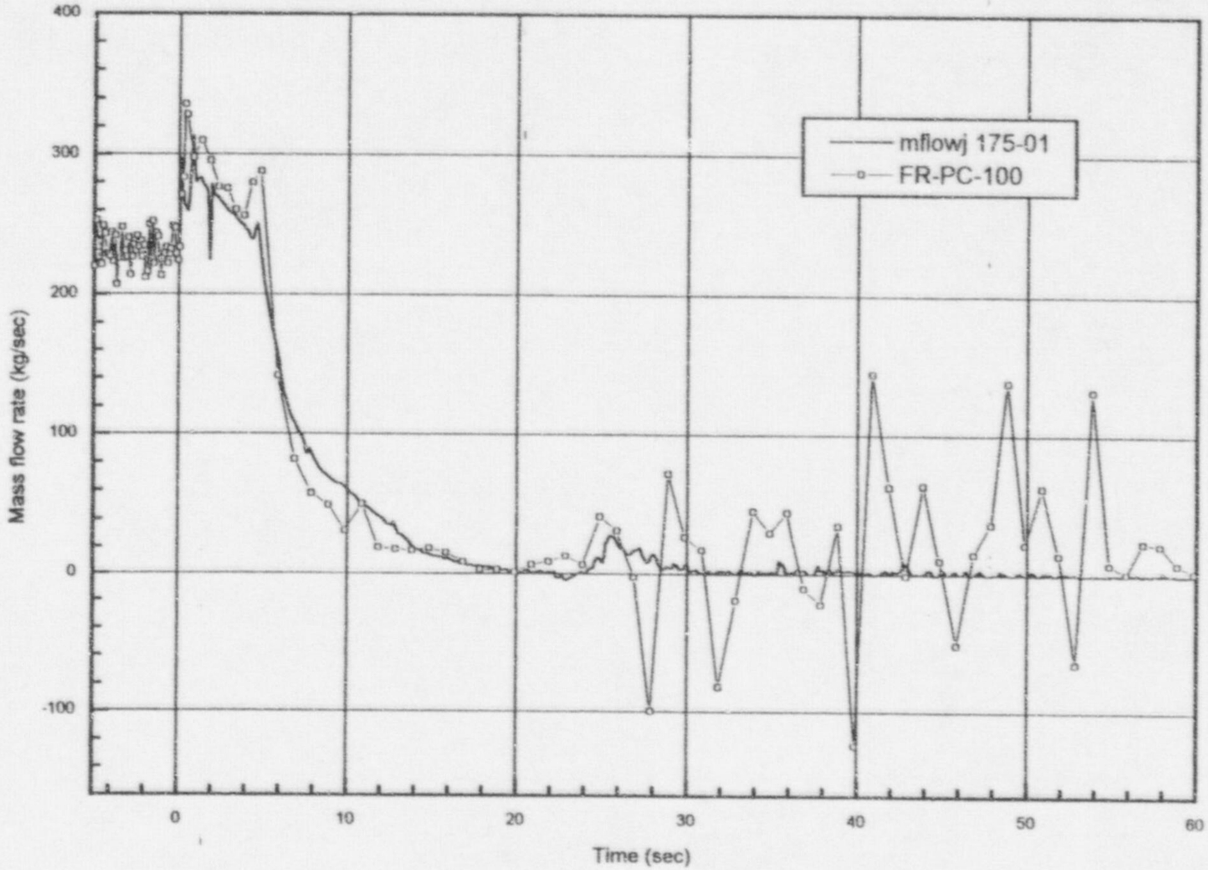

Figure 4.4 Mass flow rate in the intact loop cold leg

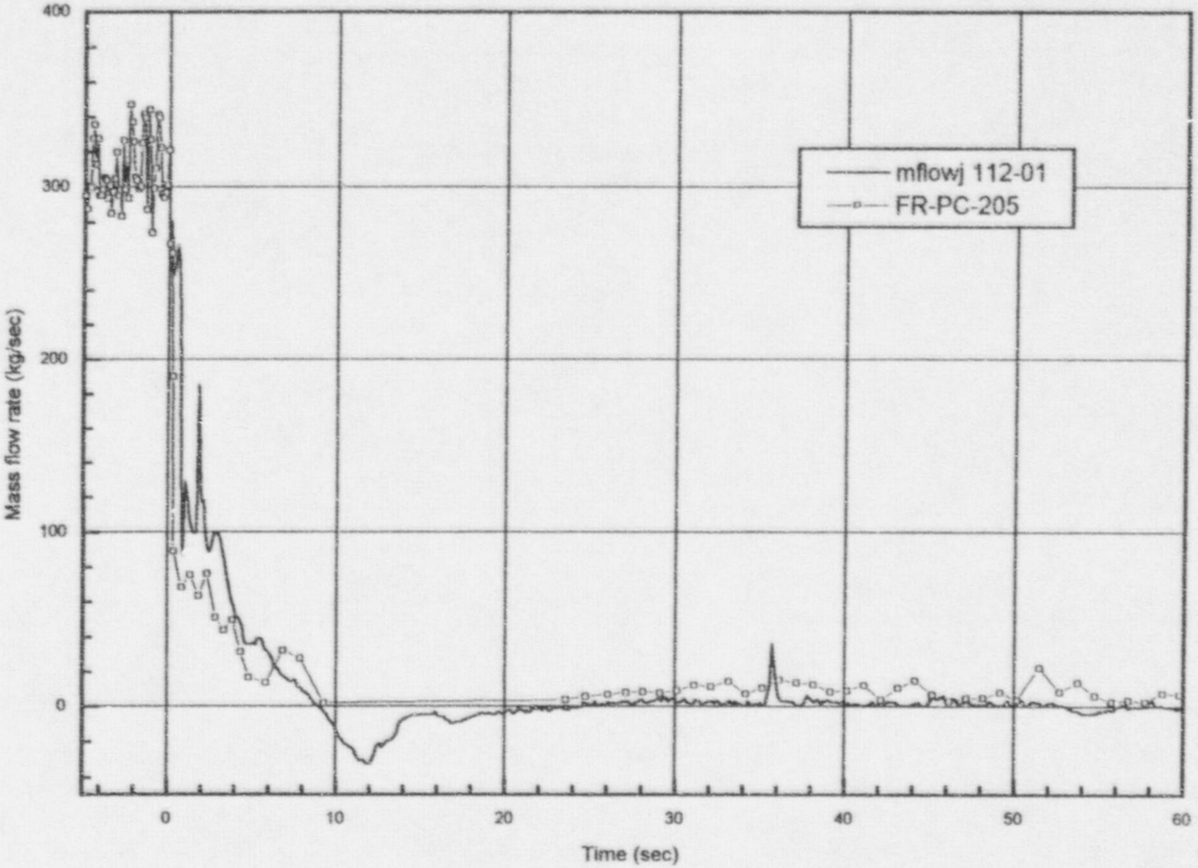

Figure 4.5 Mass flow rate in the intact loop hot leg

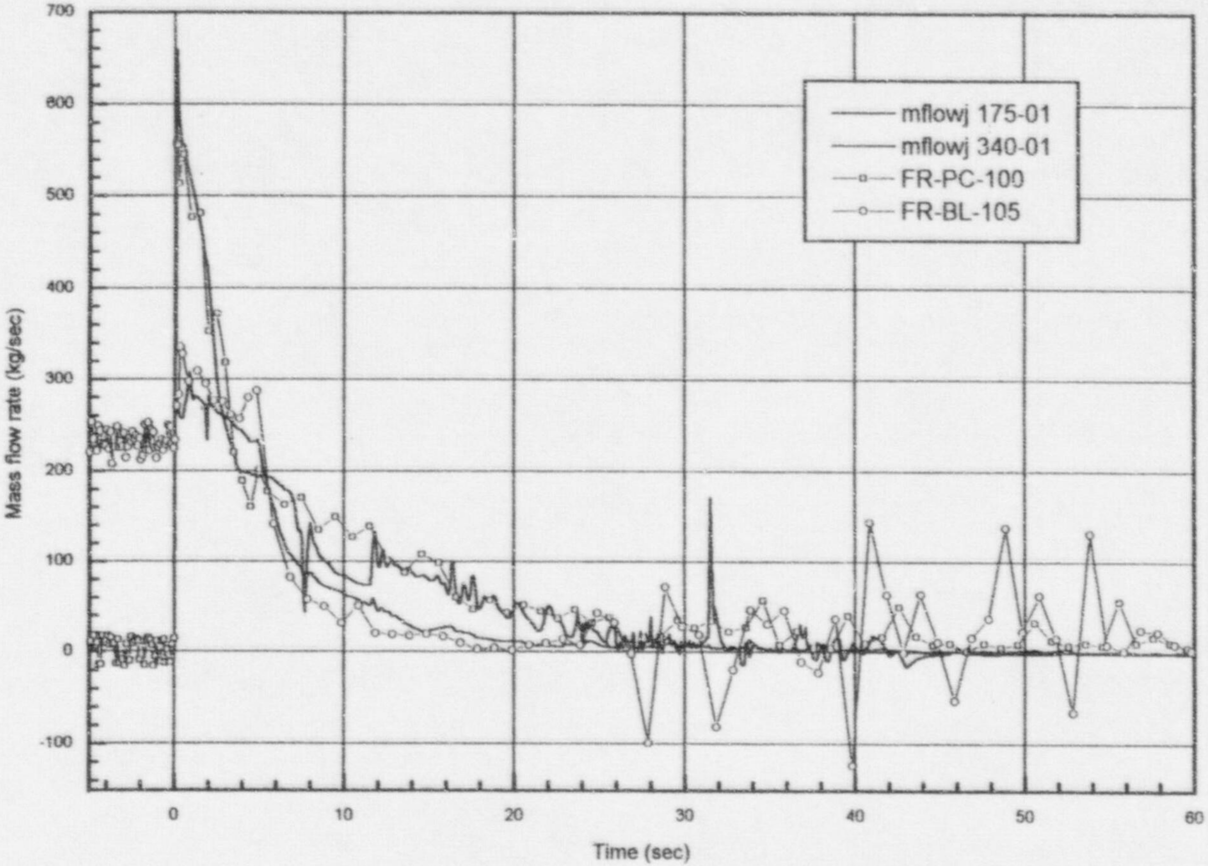

Figure 4.6 Mass flow in the broken loop cold leg and the intact loop cold leg

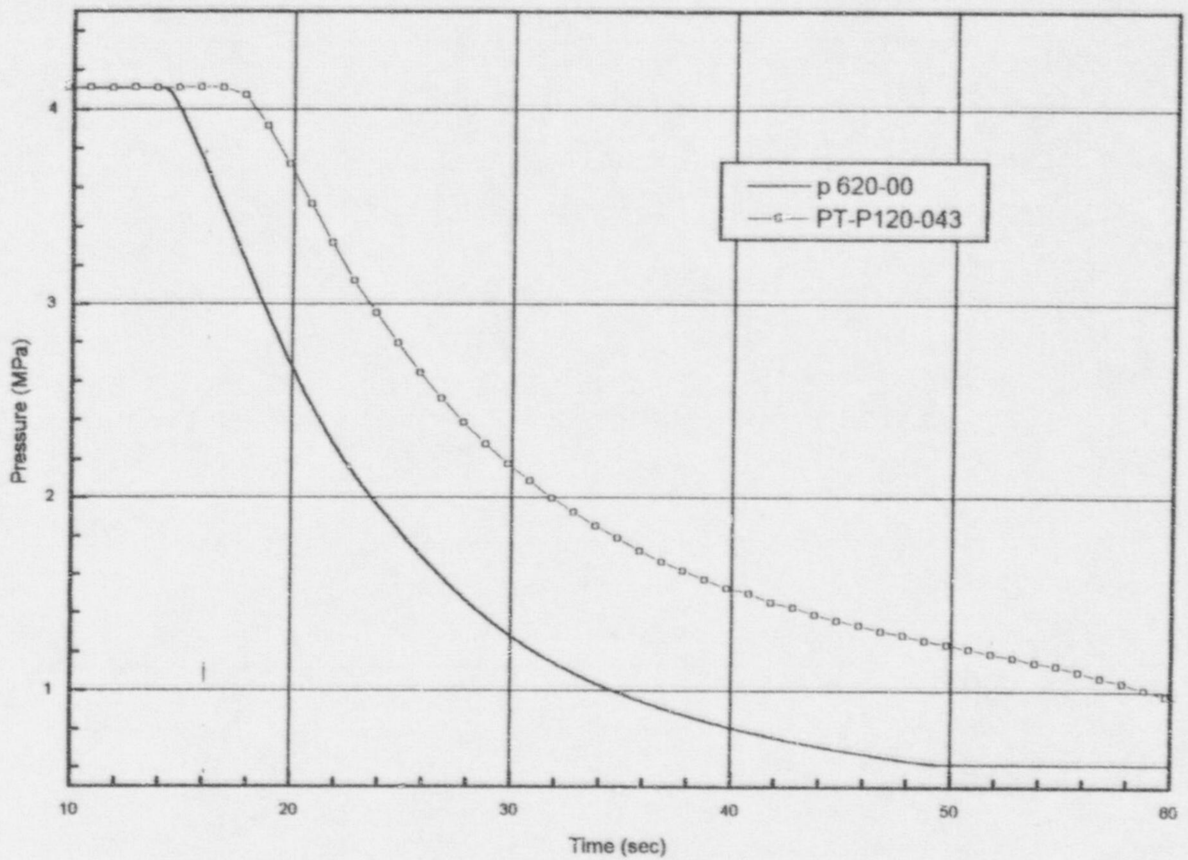

Figure 4.7 Accumulator pressure

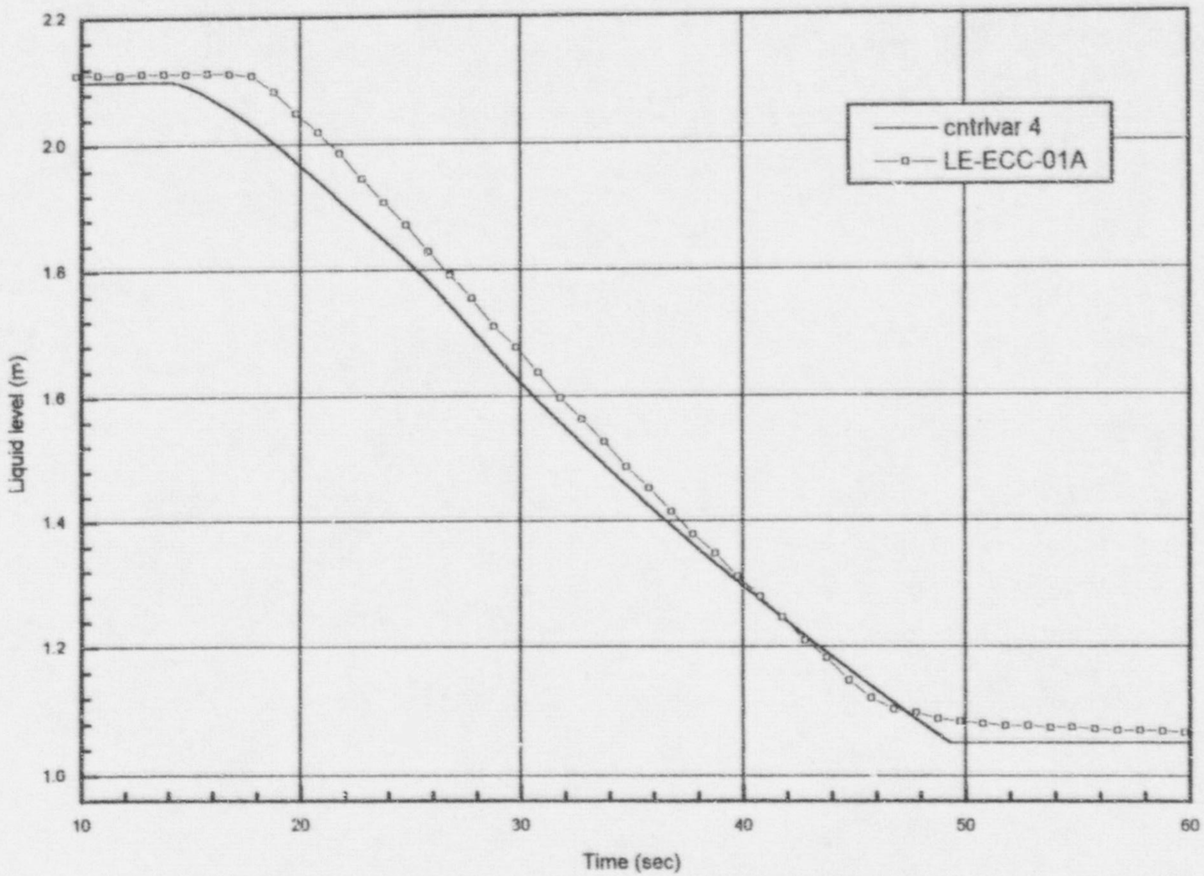

Figure 4.8 Acummulator liquid level

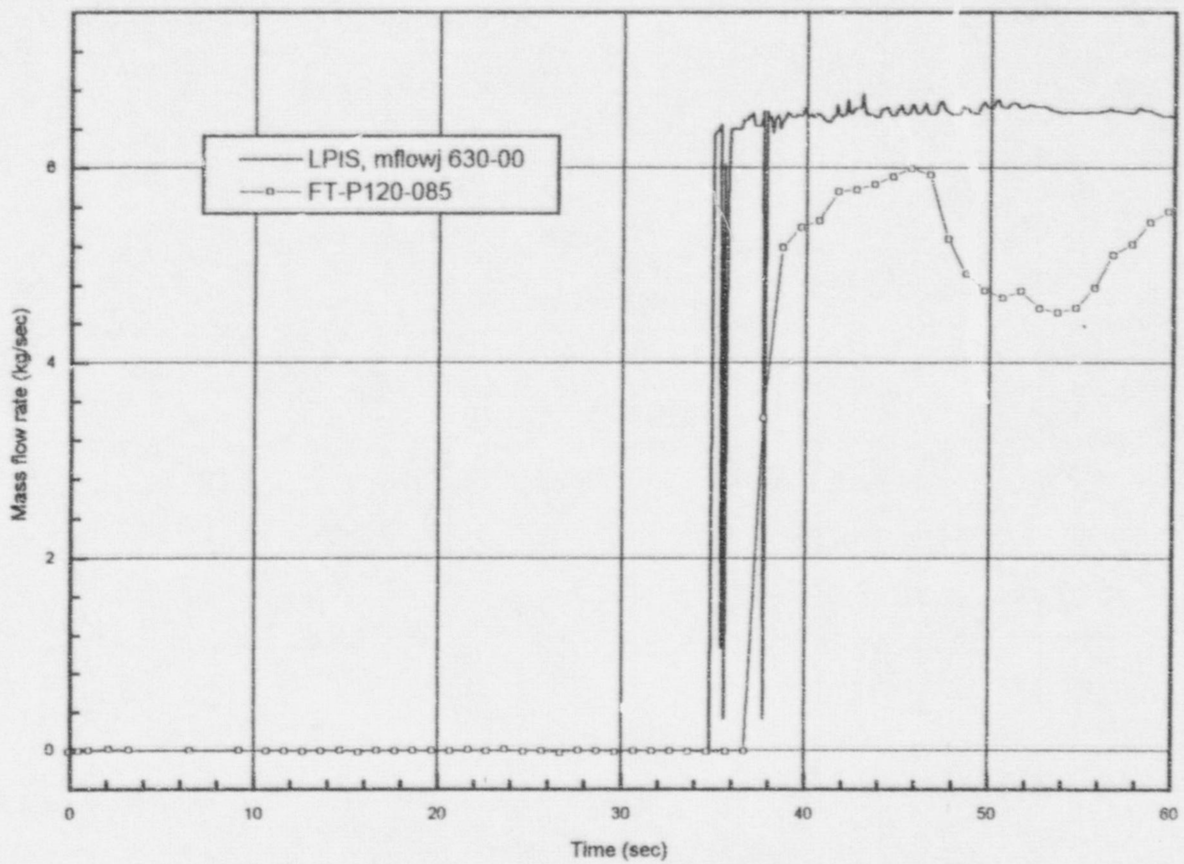

Figure 4.9 LPIS discharge flow rate

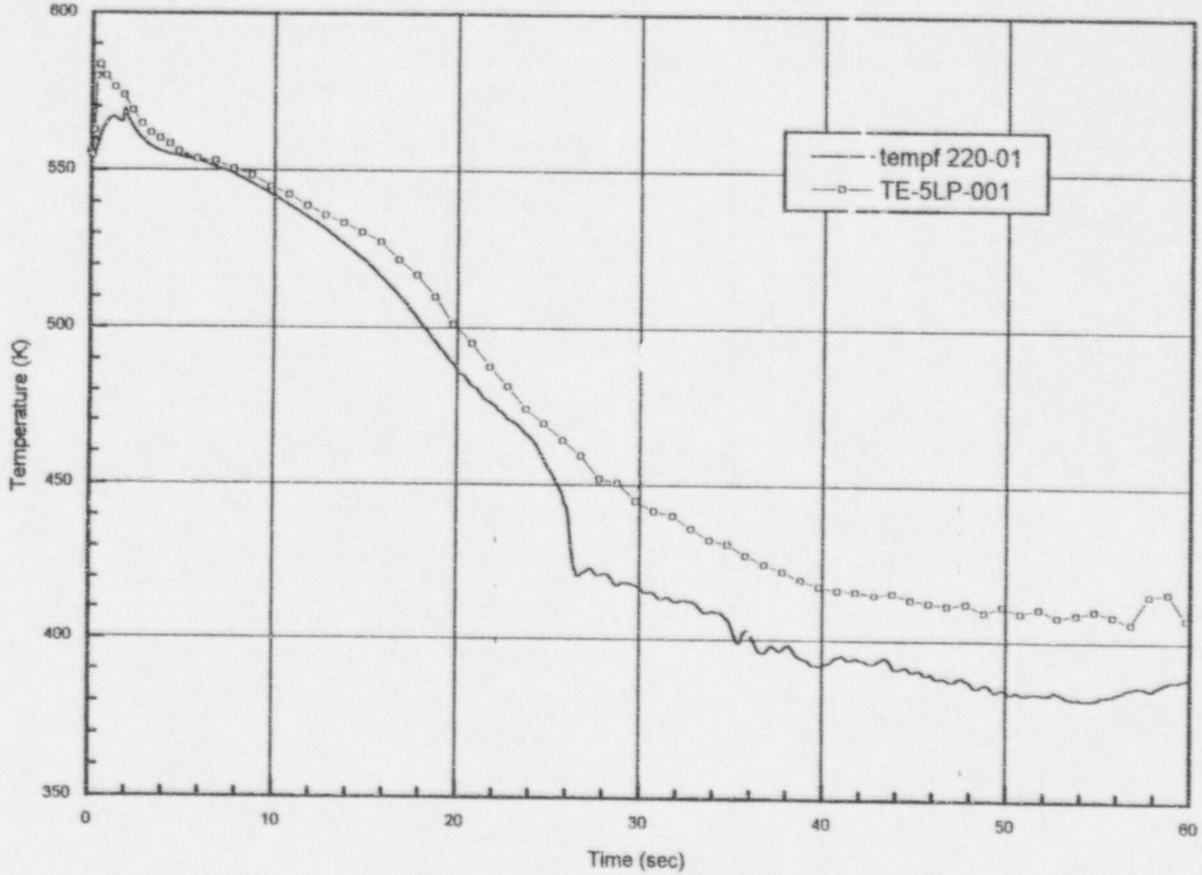

Figure 4.10 Fluid temperature in the lower plenum

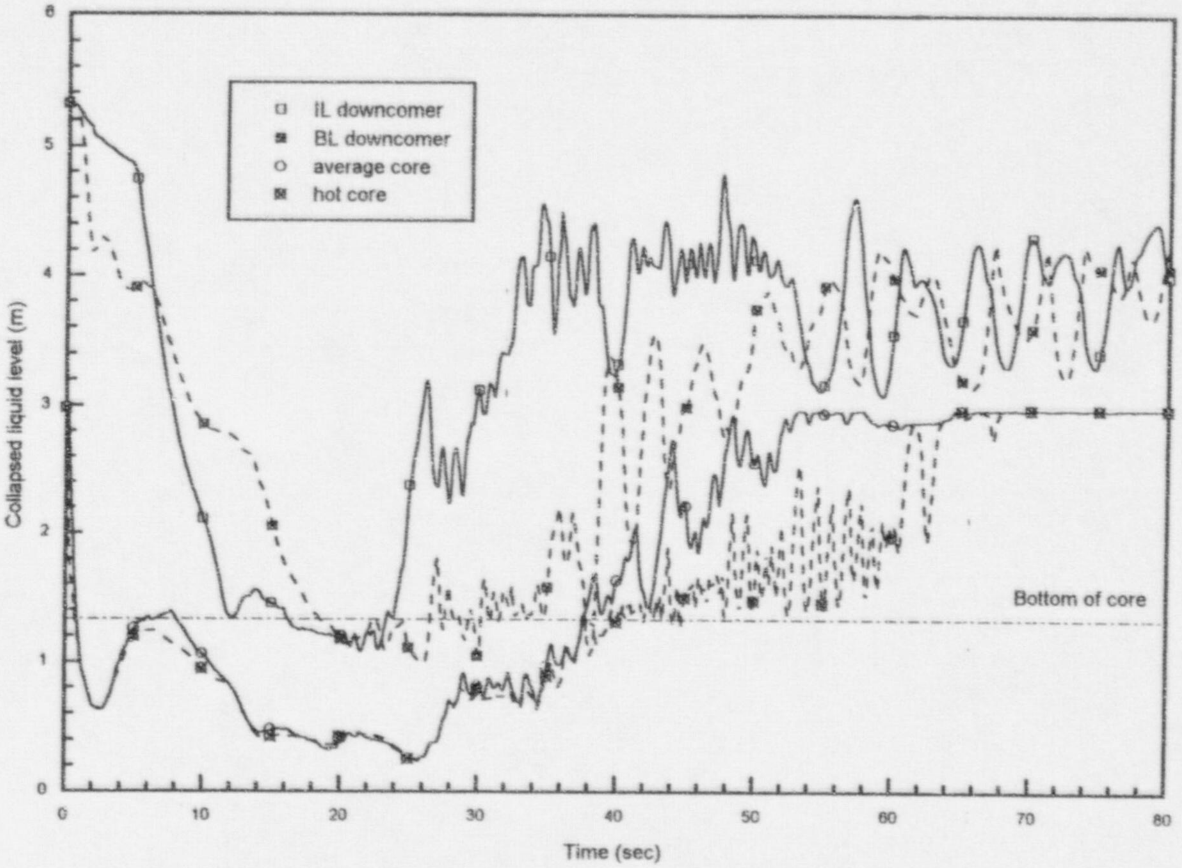

Figure 4.11 Collapsed liquid levels in the downcomer and core channels

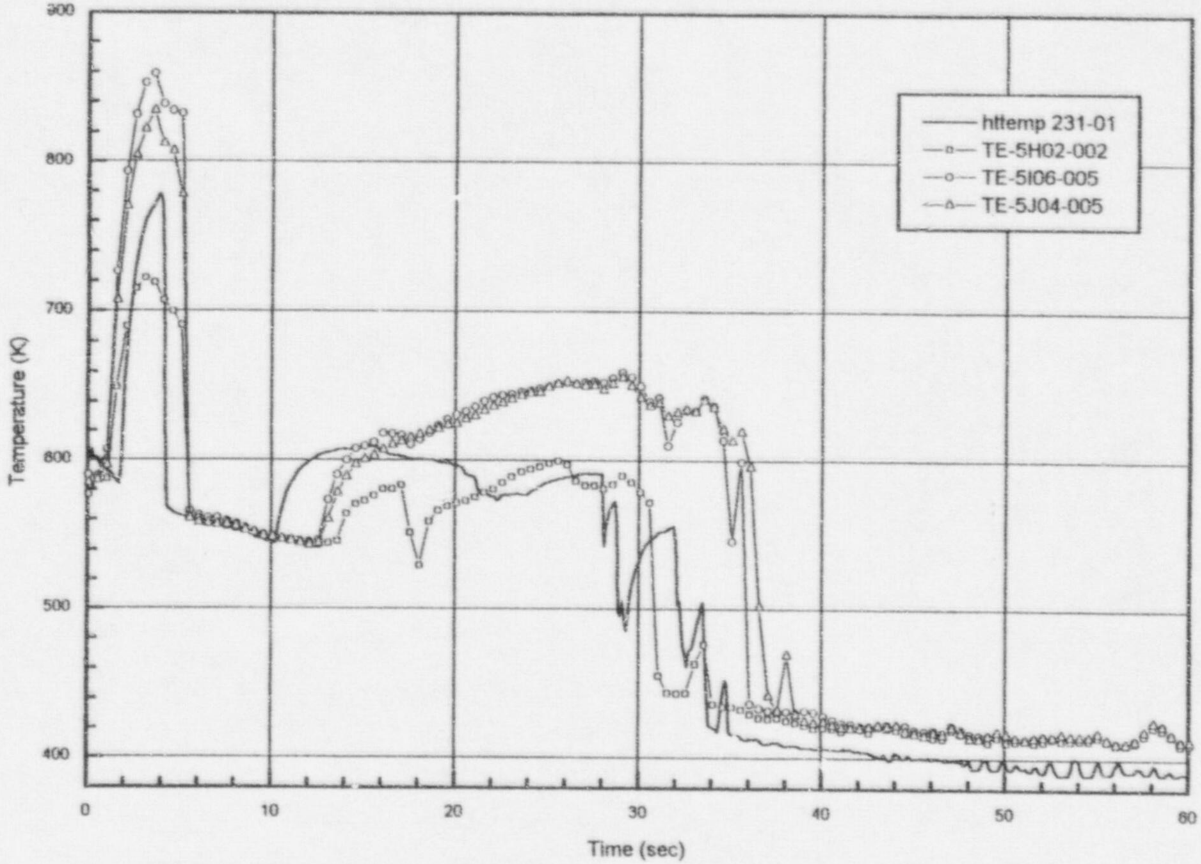

Figure 4.12 Cladding temperature at hot core node 1

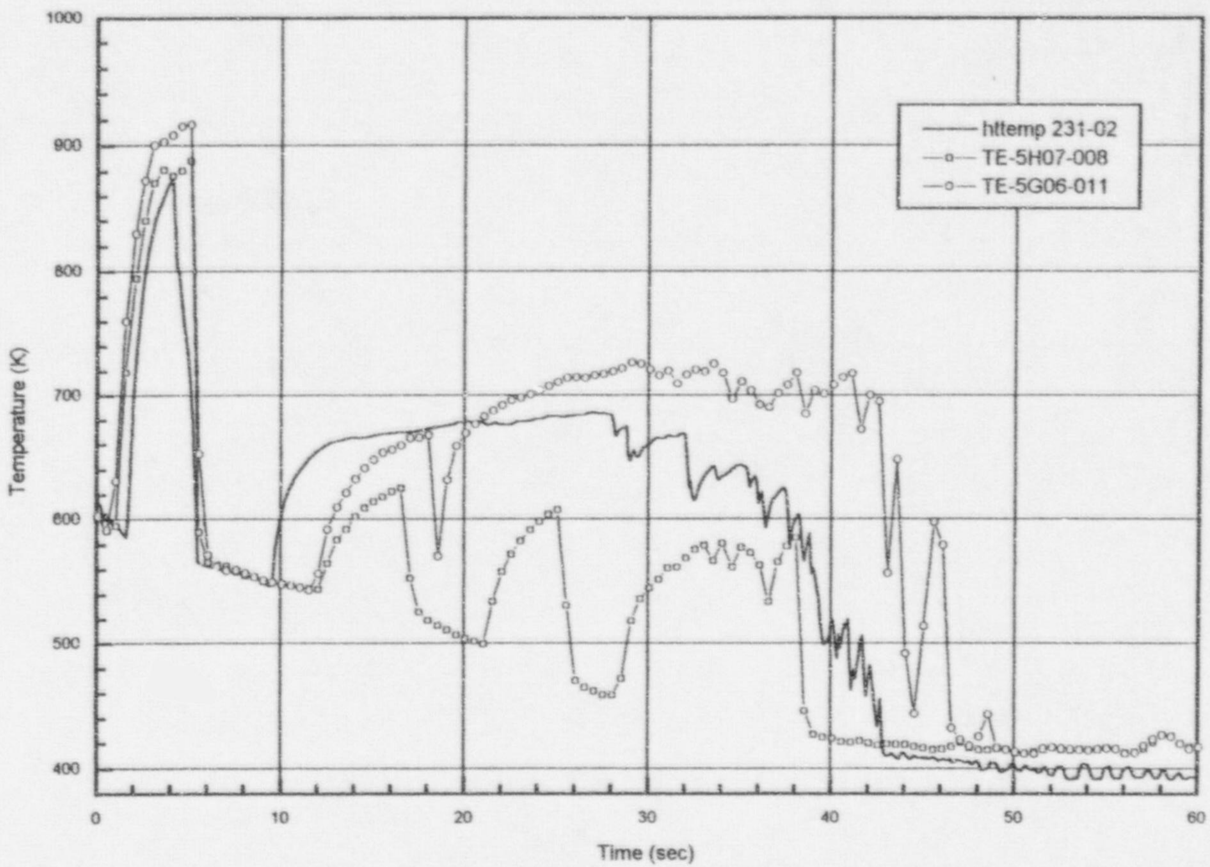

Figure 4.13 Cladding temperature at hot core node 2

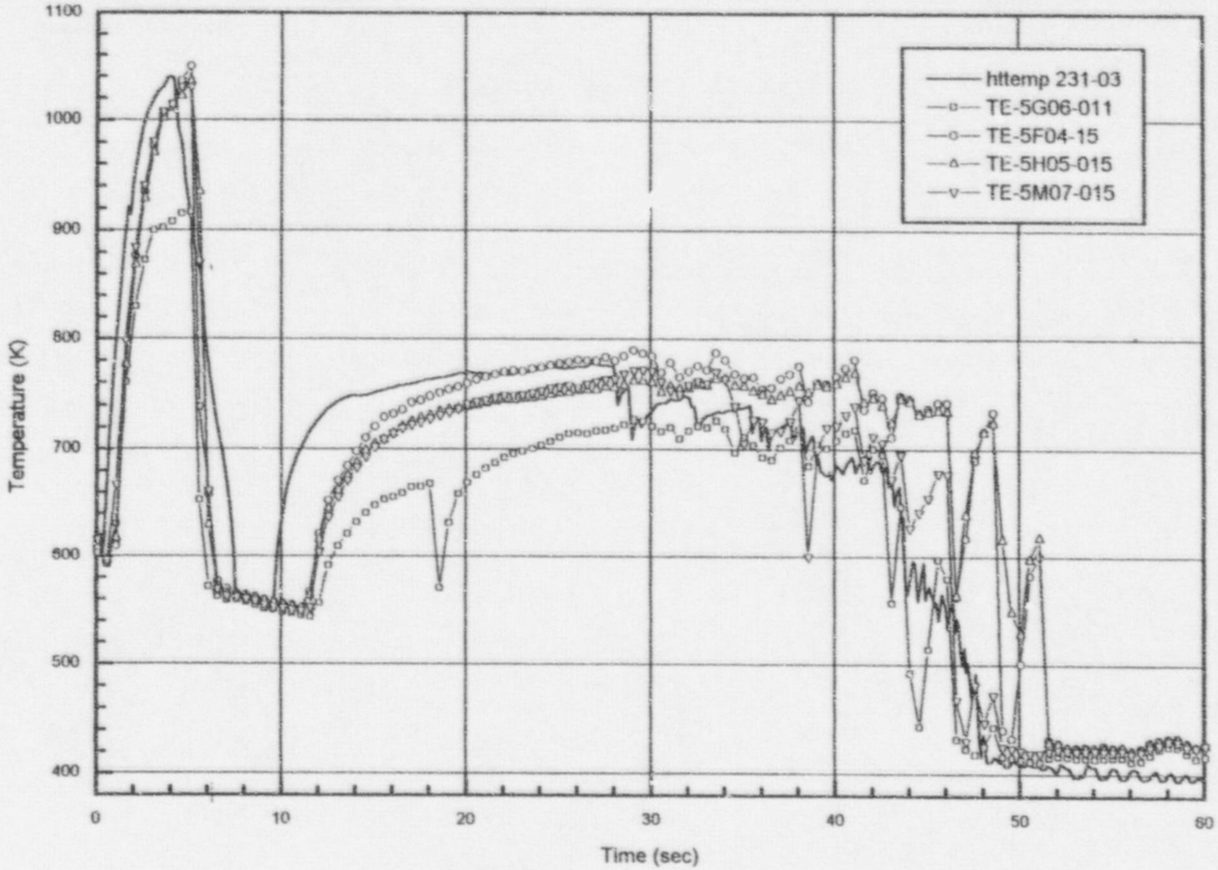

Figure 4.14 Cladding temperature at hot core node 3

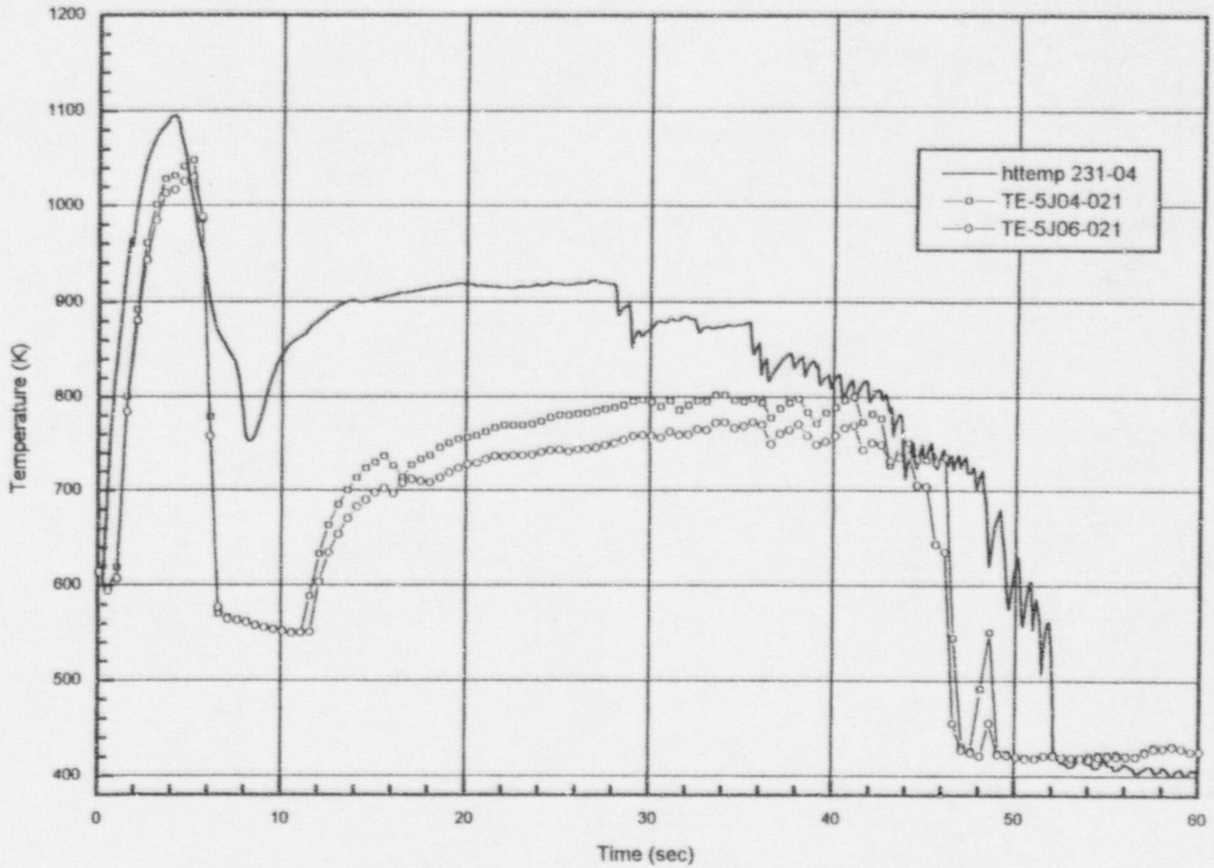

Figure 4.15 Cladding temperature at hot core node 4

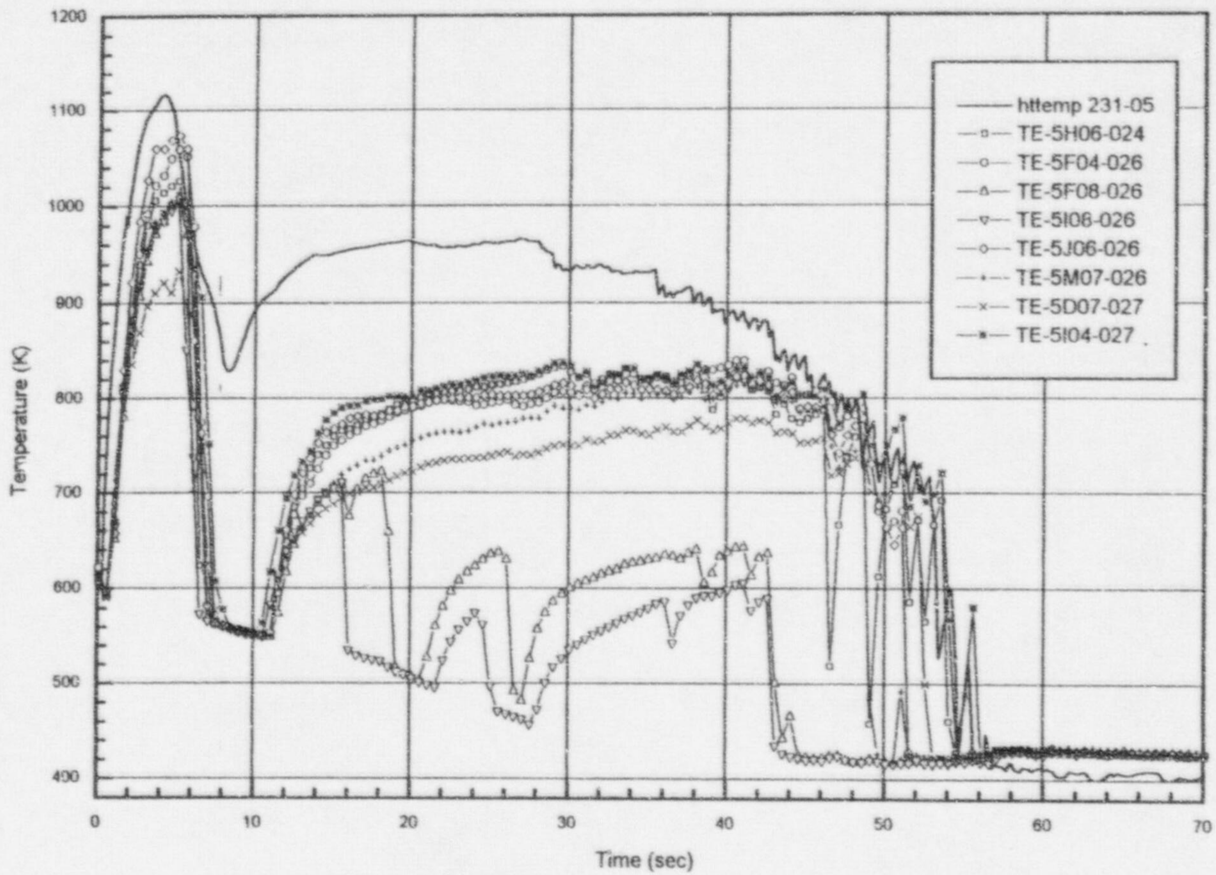

Figure 4.16 Cladding temperature at hot core node 5

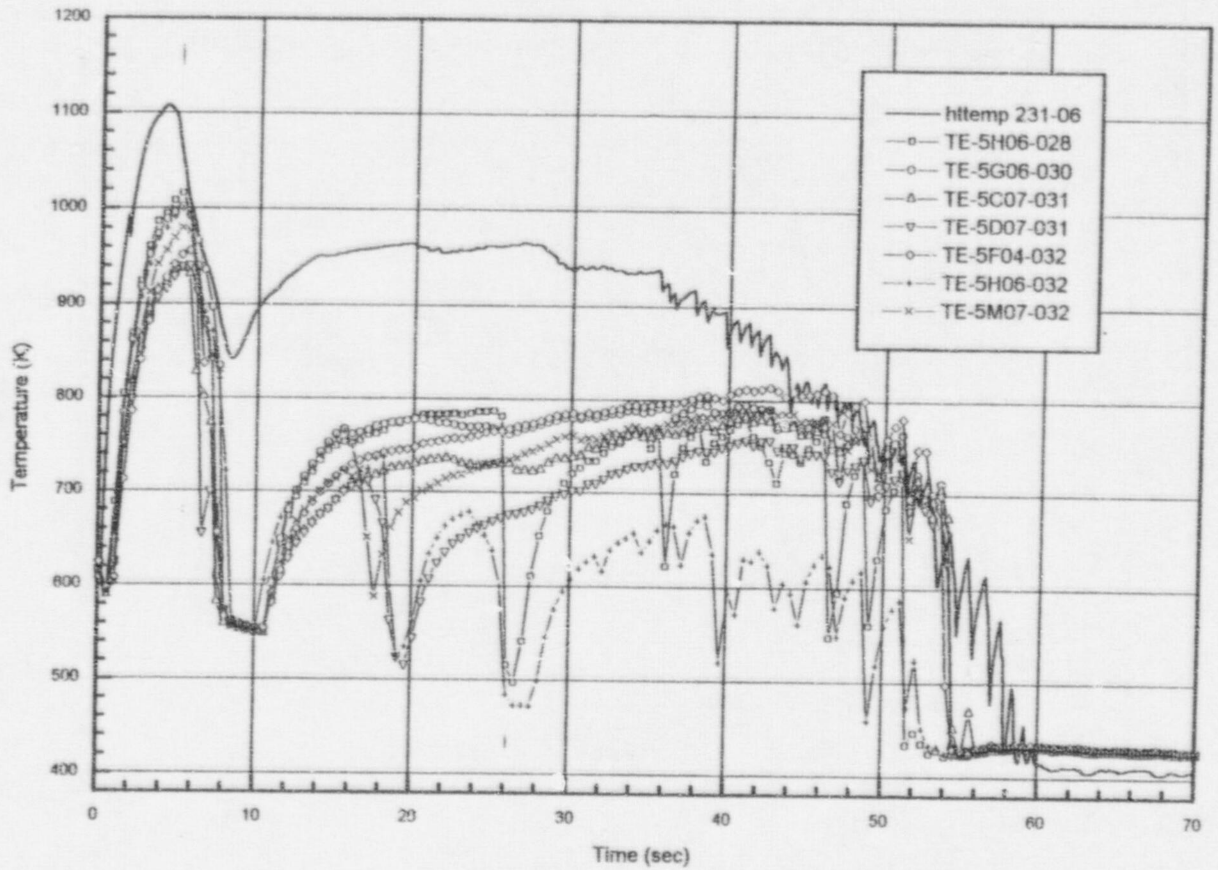

Figure 4.17 Cladding temperature at hot core node 6

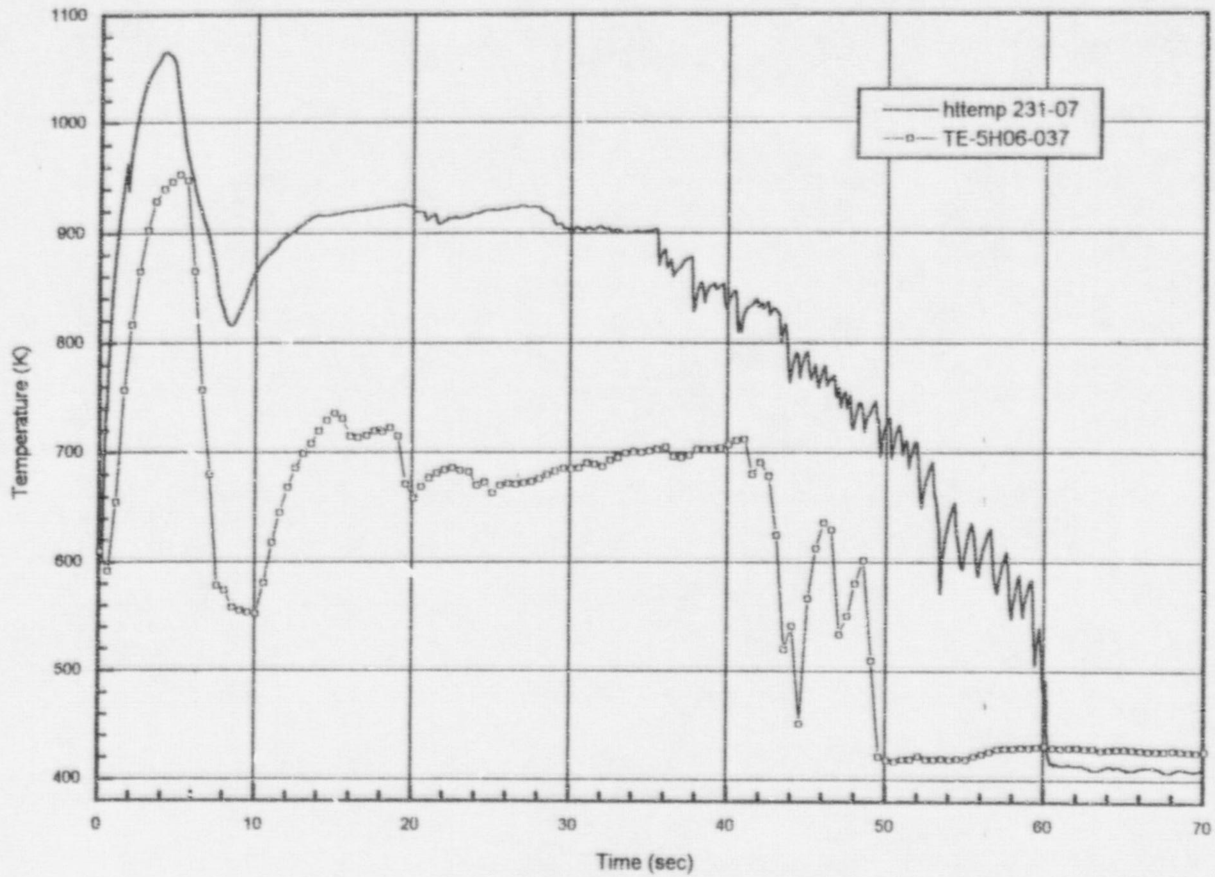

Figure 4.18 Cladding te:nperature at hot core node 7

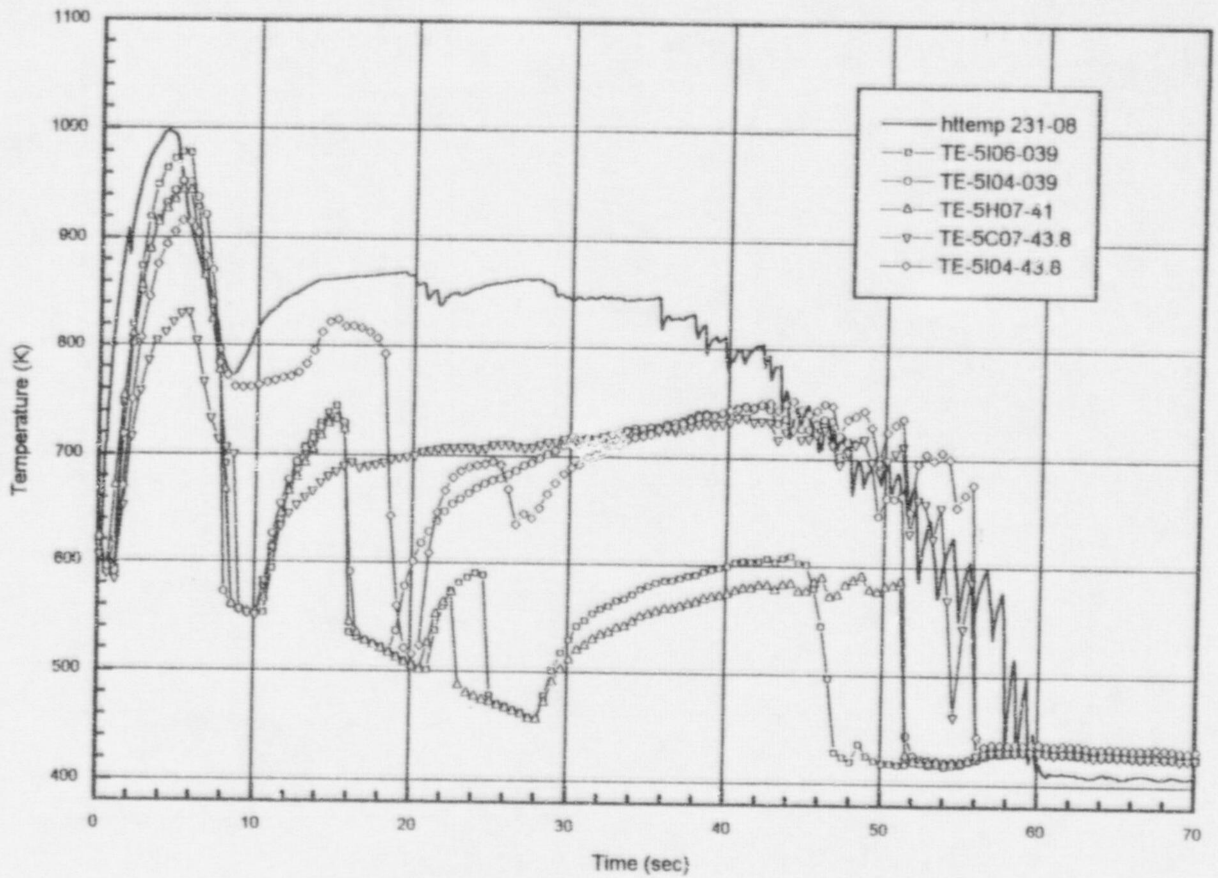

Figure 4.19 Cladding temperature at hot core node 8

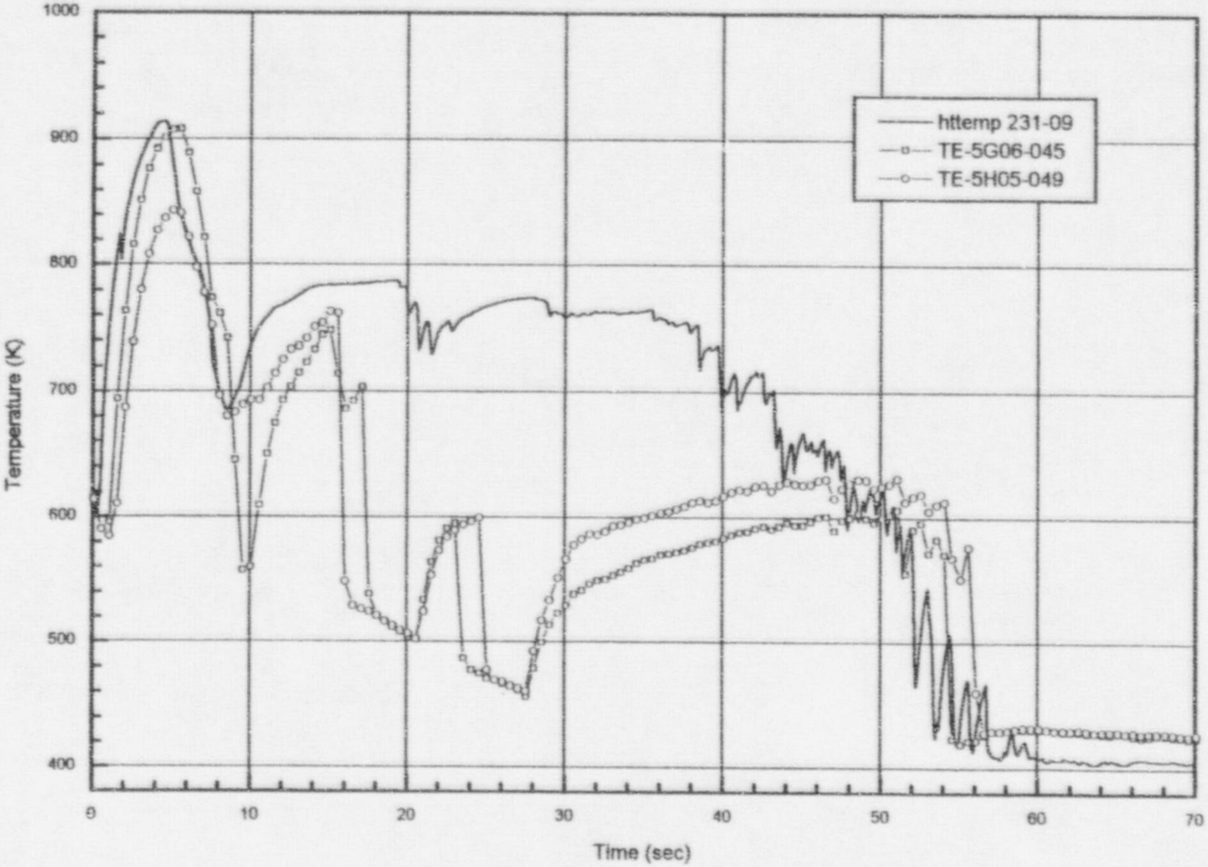

Figure 4.20 Cladding temperature at hot core node 9

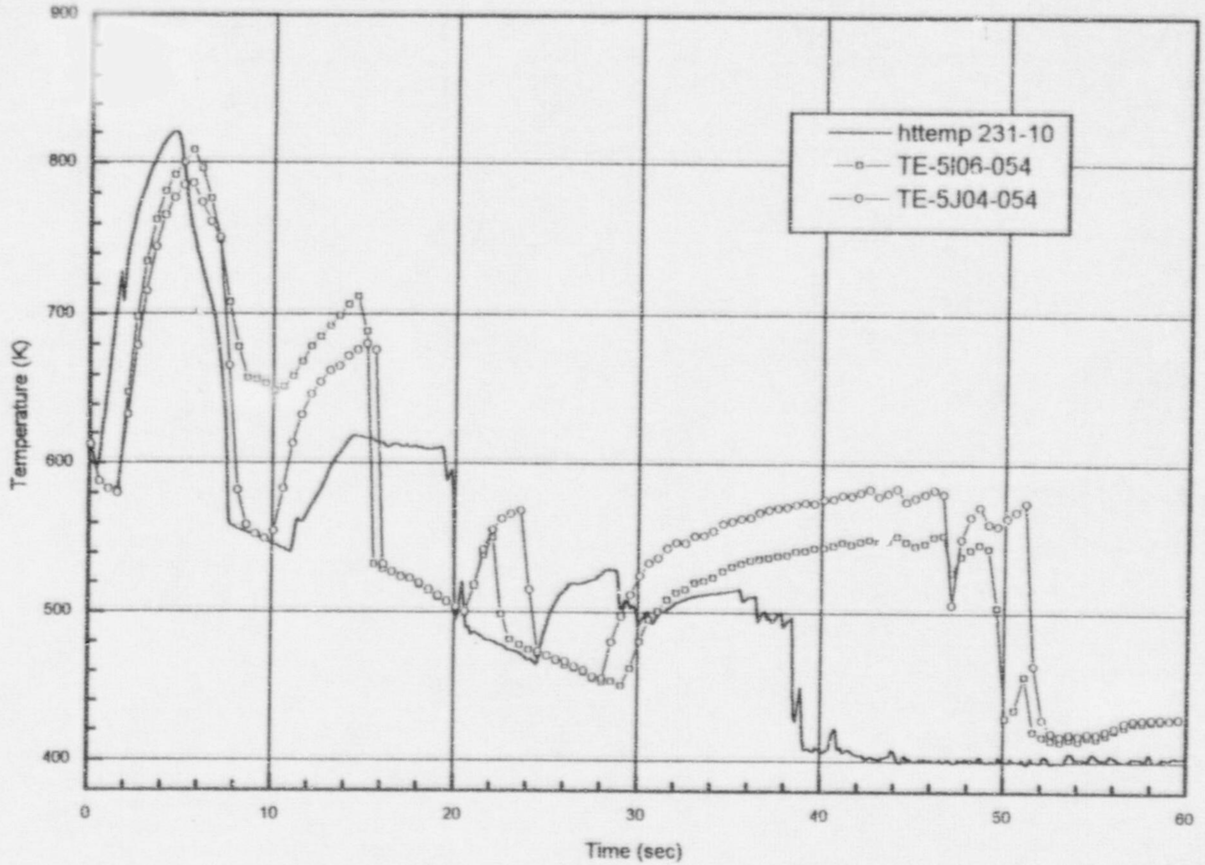

Figure 4.21 Cladding temperature at hot core node 10

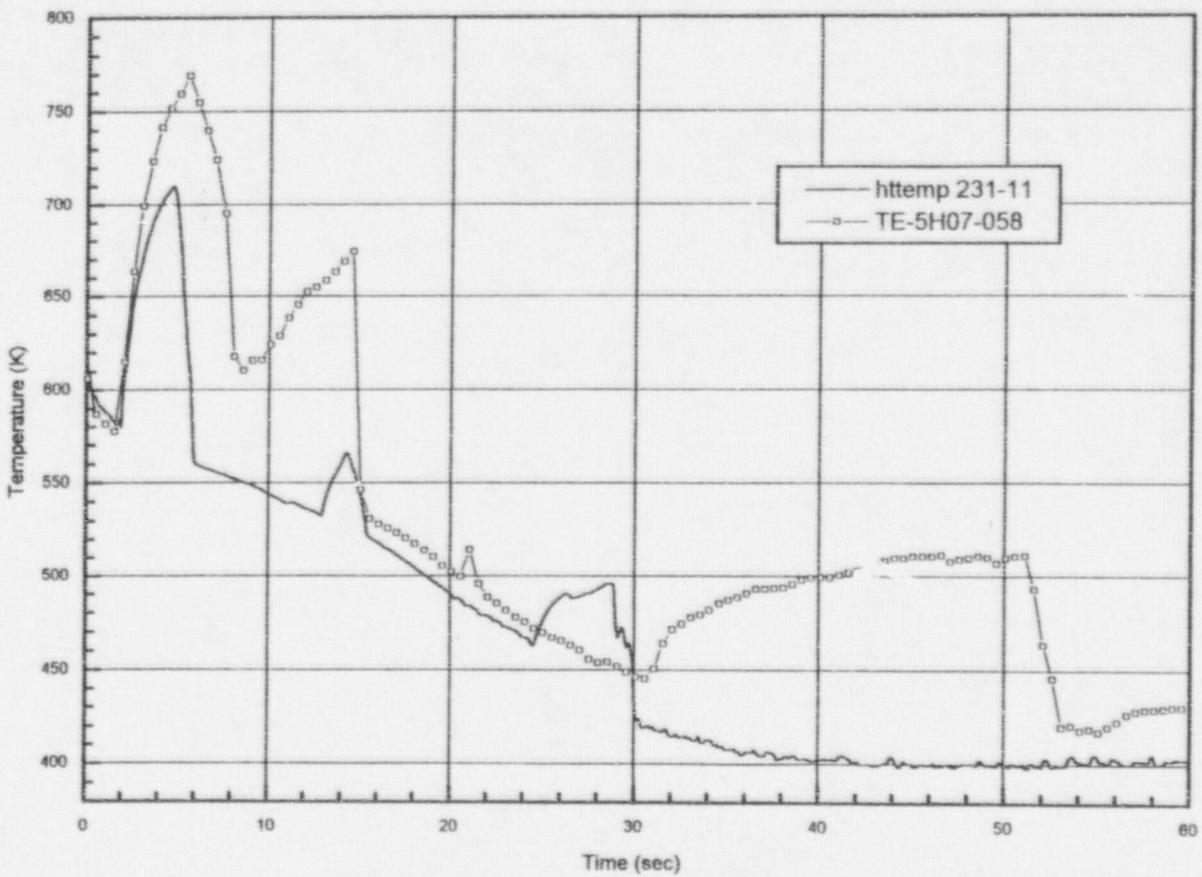

Figure 4.22 Cladding temperature at hot core node 11

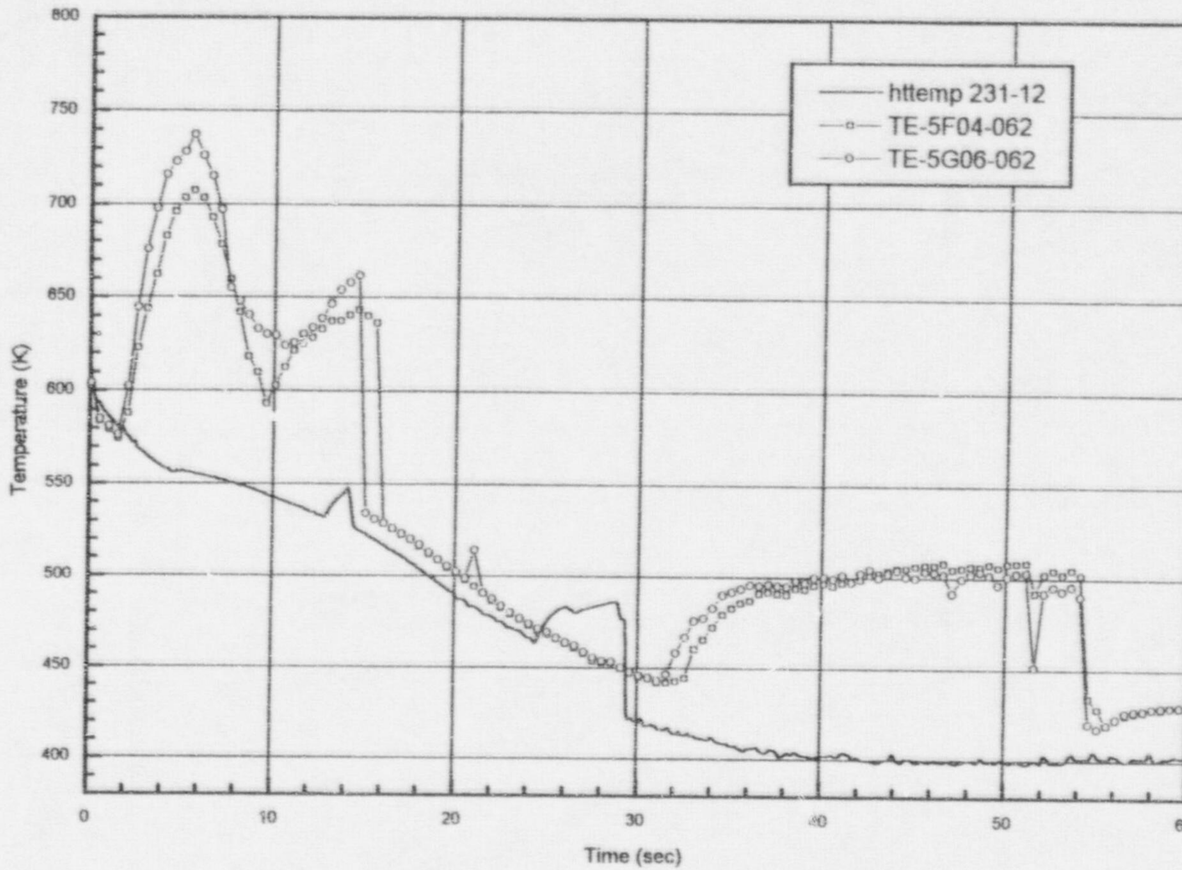

Figure 4.23 Cladding temperature at hot core node 12

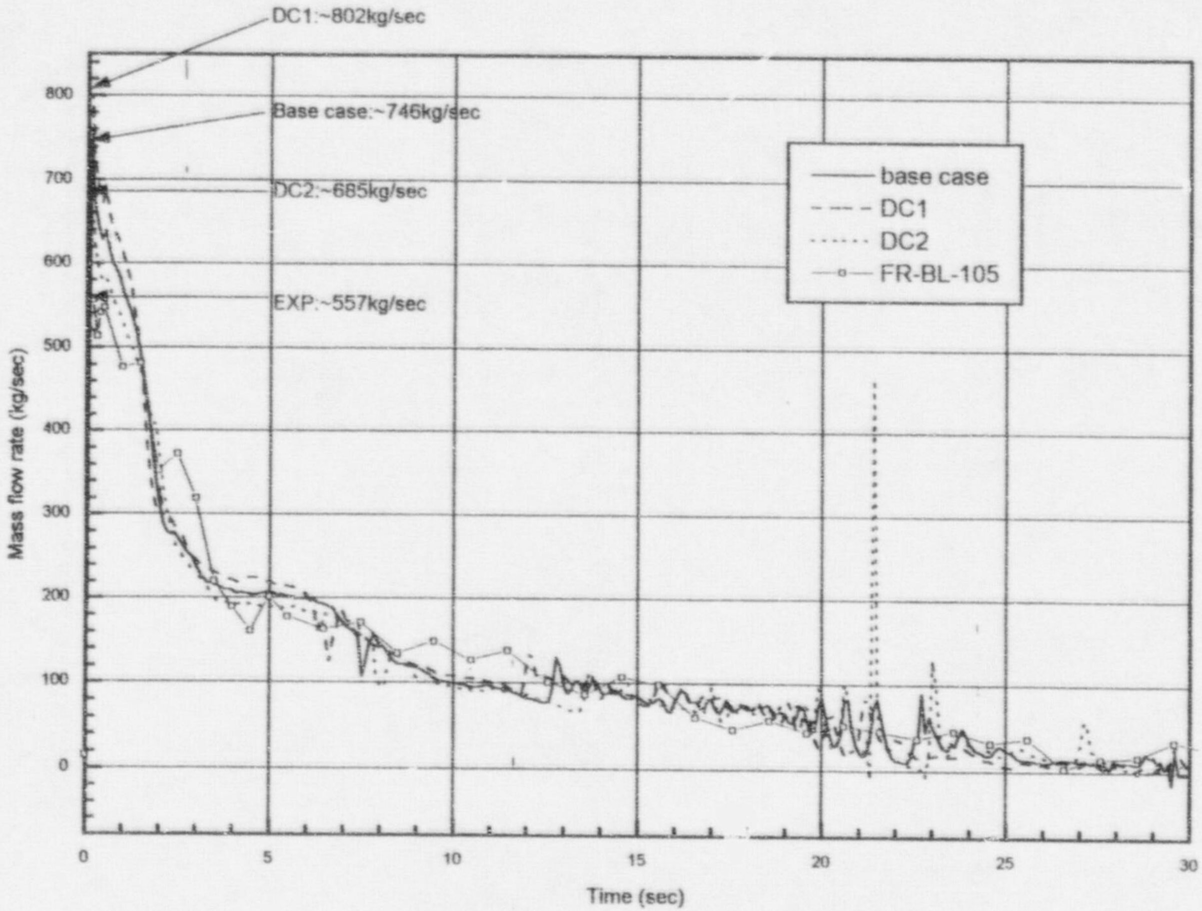

Figure 5.1 Mass flow rate in the broken loop cold leg with various discharge coefficients

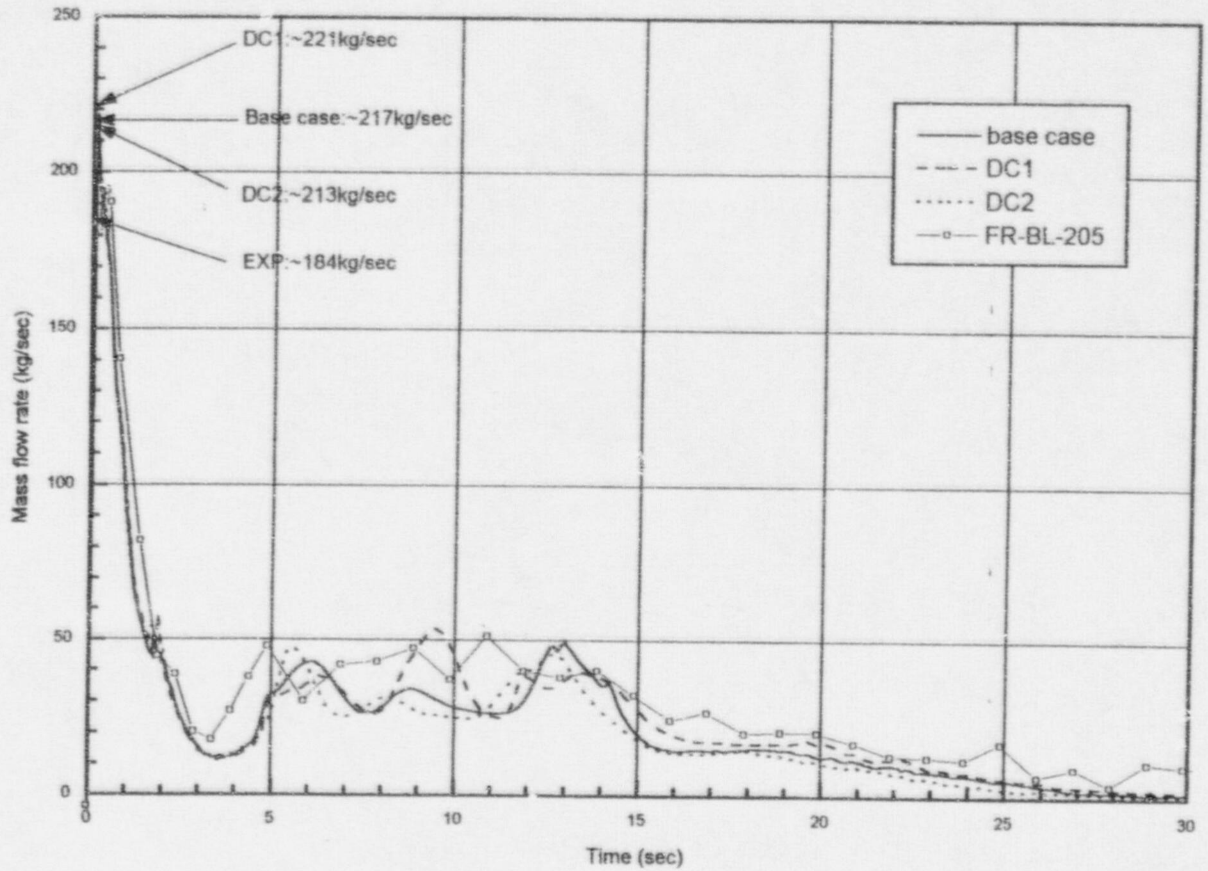

Figure 5.2 Mass flow rate in the broken loop hot leg with various discharge coefficients

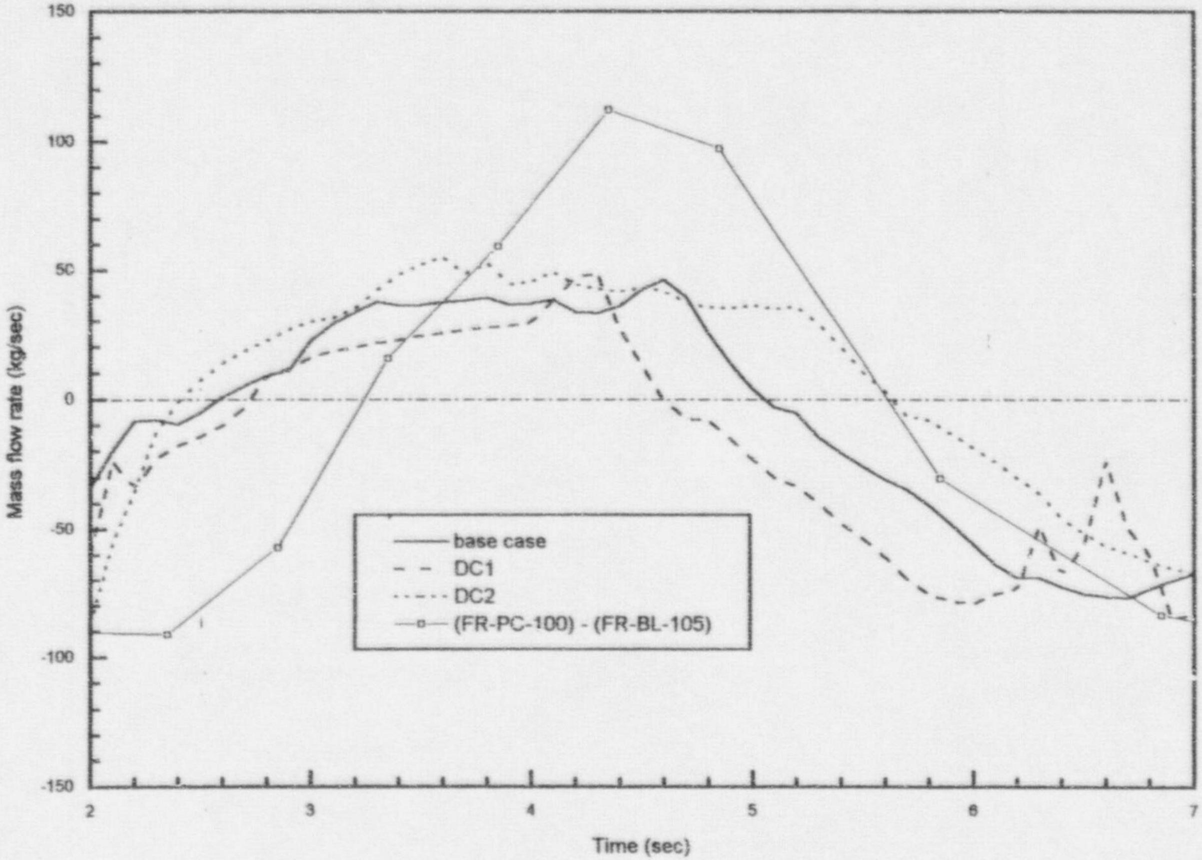

Figure 5.3 Mass flow difference between intact loop cold leg and broken loop cold leg

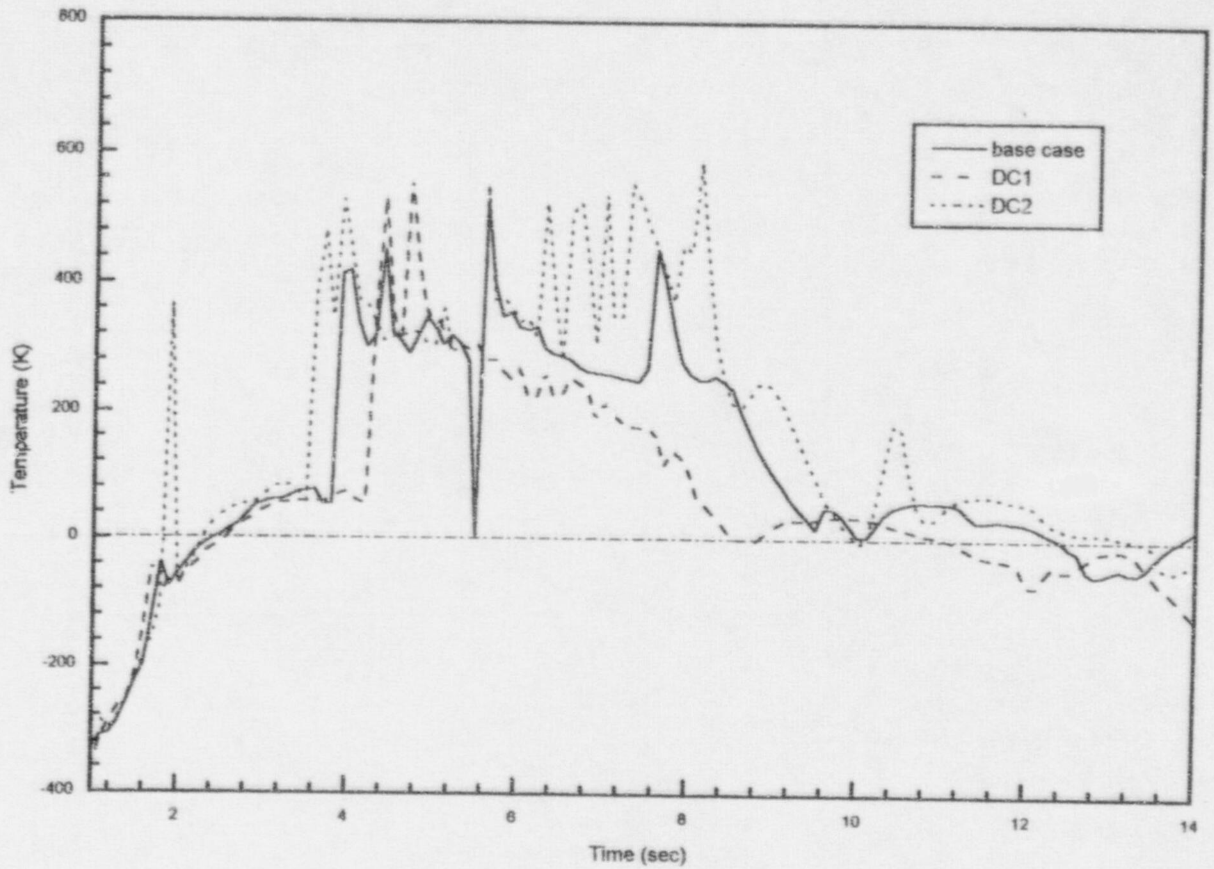

Figure 5.4 Mass flux at the core inlet junction with various discharge coefficients

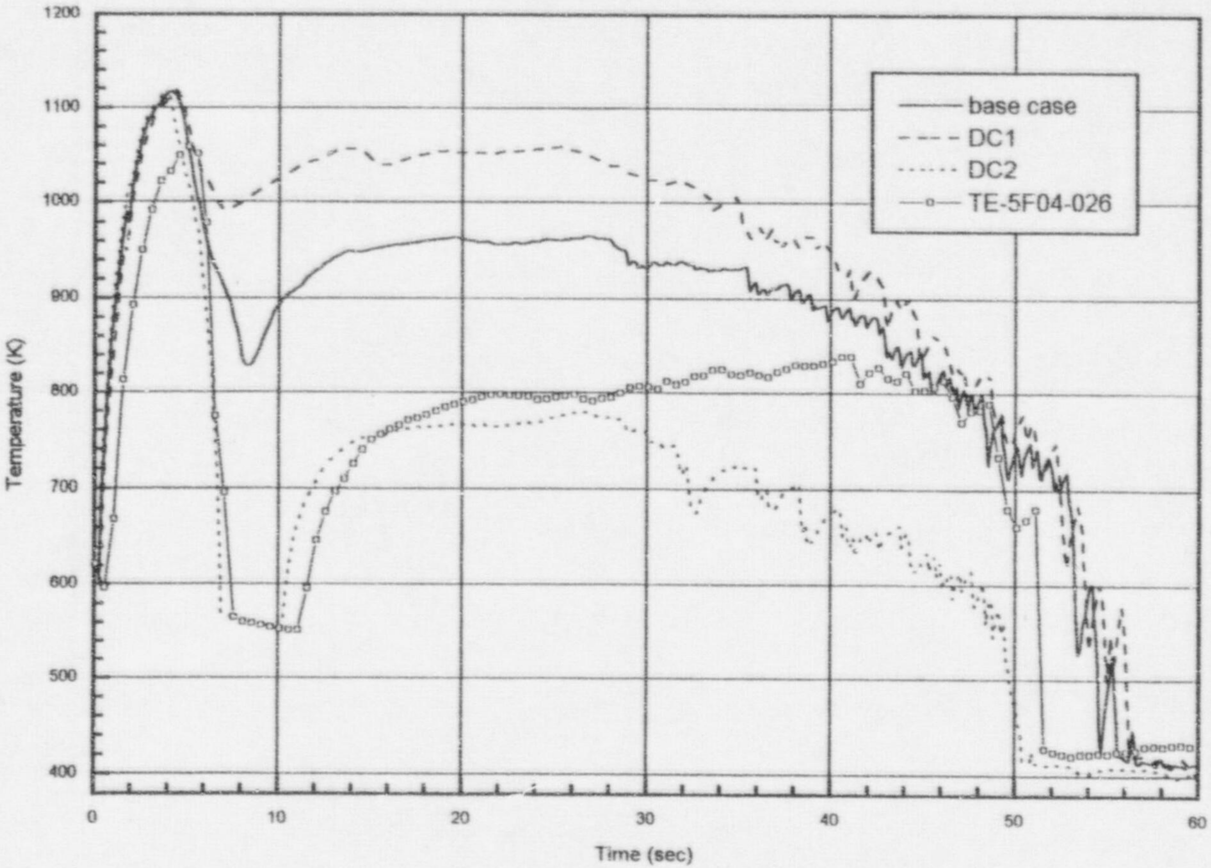

Figure 5.5 Cladding temperature at hot core node 5 with various discharge coefficients

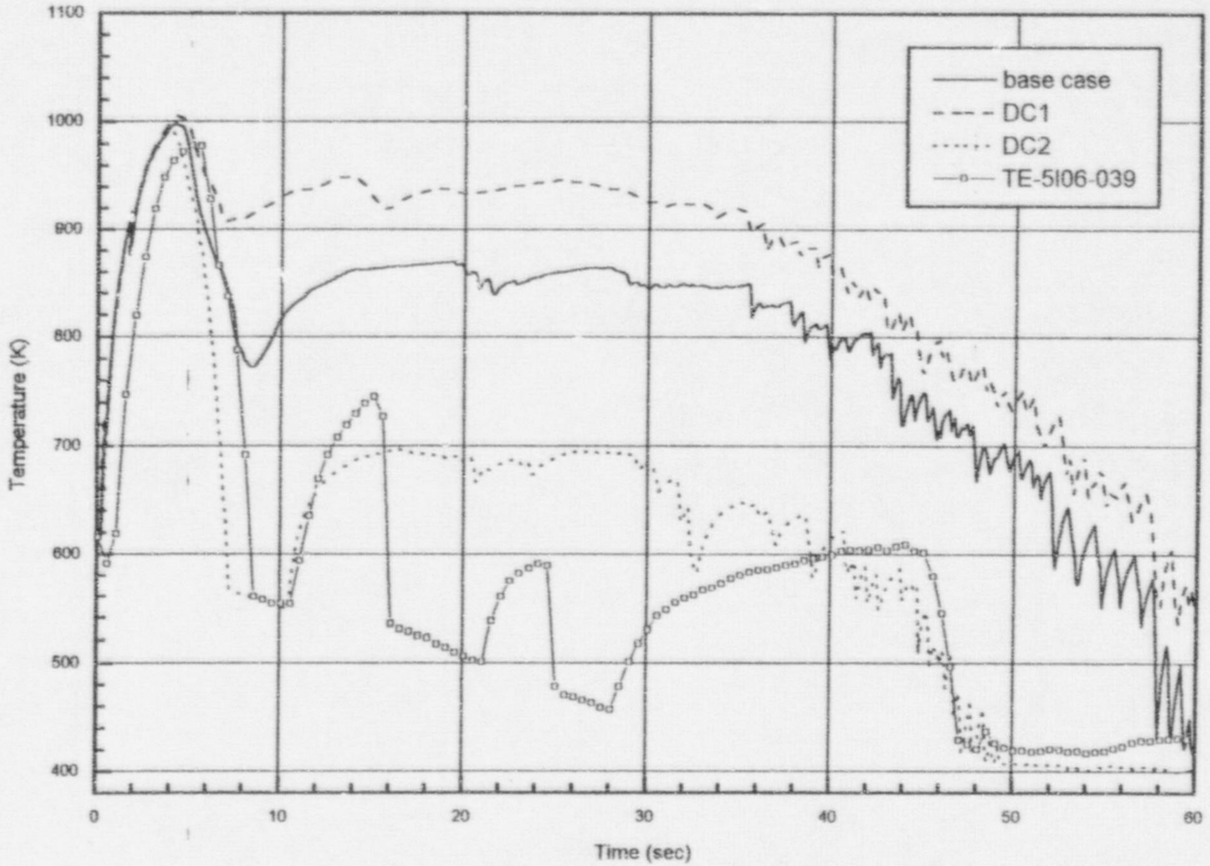

Figure 5.6 Cladding tempeature at hot core node 8 with various discharge coefficients

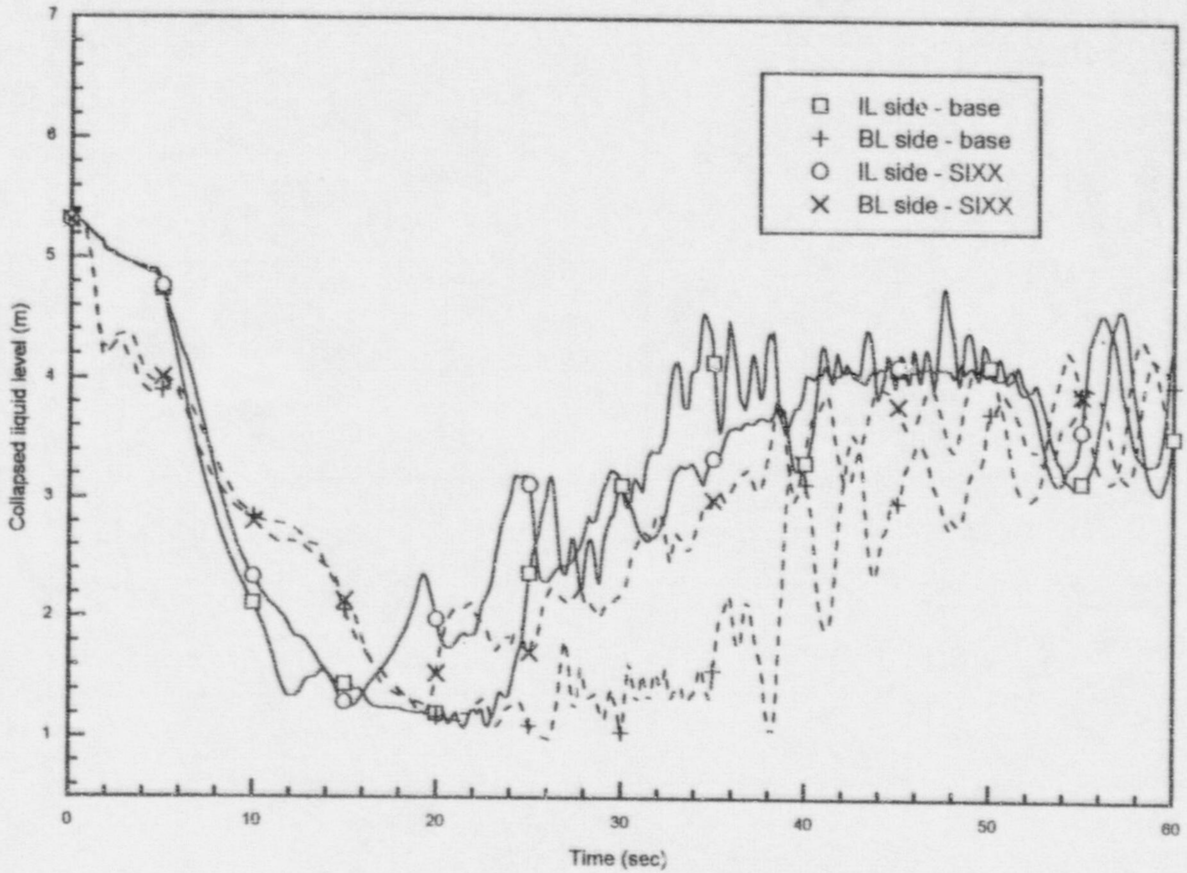

Figure 5.7 Collapsed liquid level in the downcomer from the base case and SIXX calculation

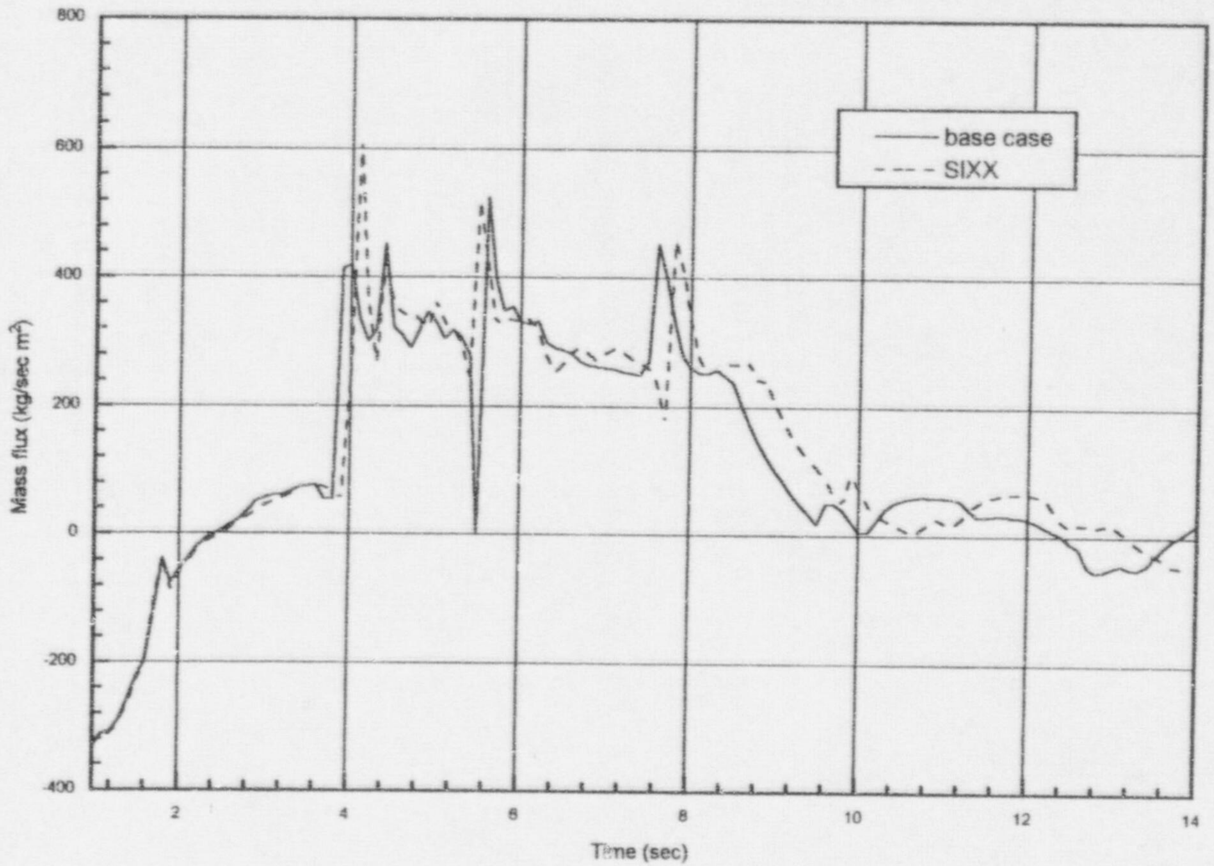

Figure 5.8 Mass flux at the inlet of core in the base case and SIXX calcuiation

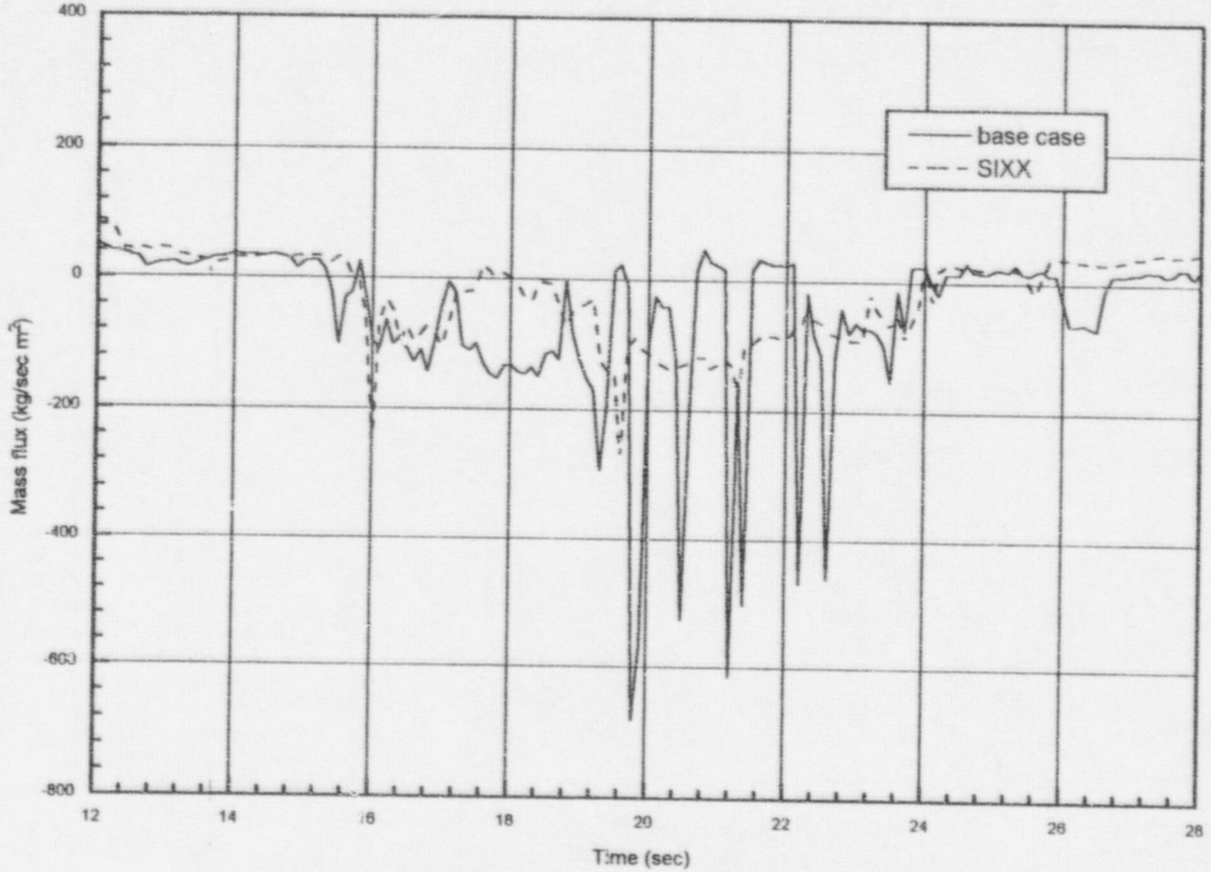

Figure 5.9 Mass flux at the outlet of core in the base case and SIXX calculation

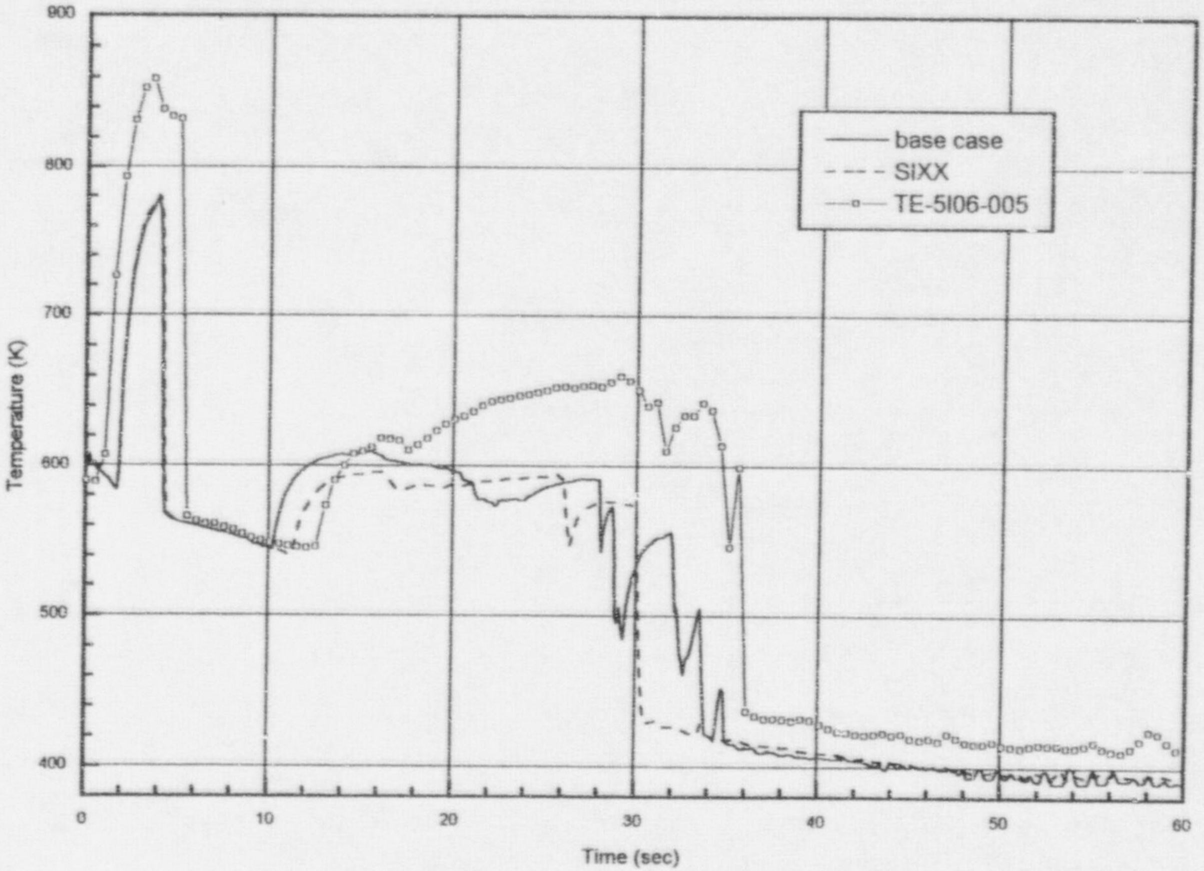

Figure 5.10 Calculated cladding temperature at hot core node 1 in the SIXX calculation

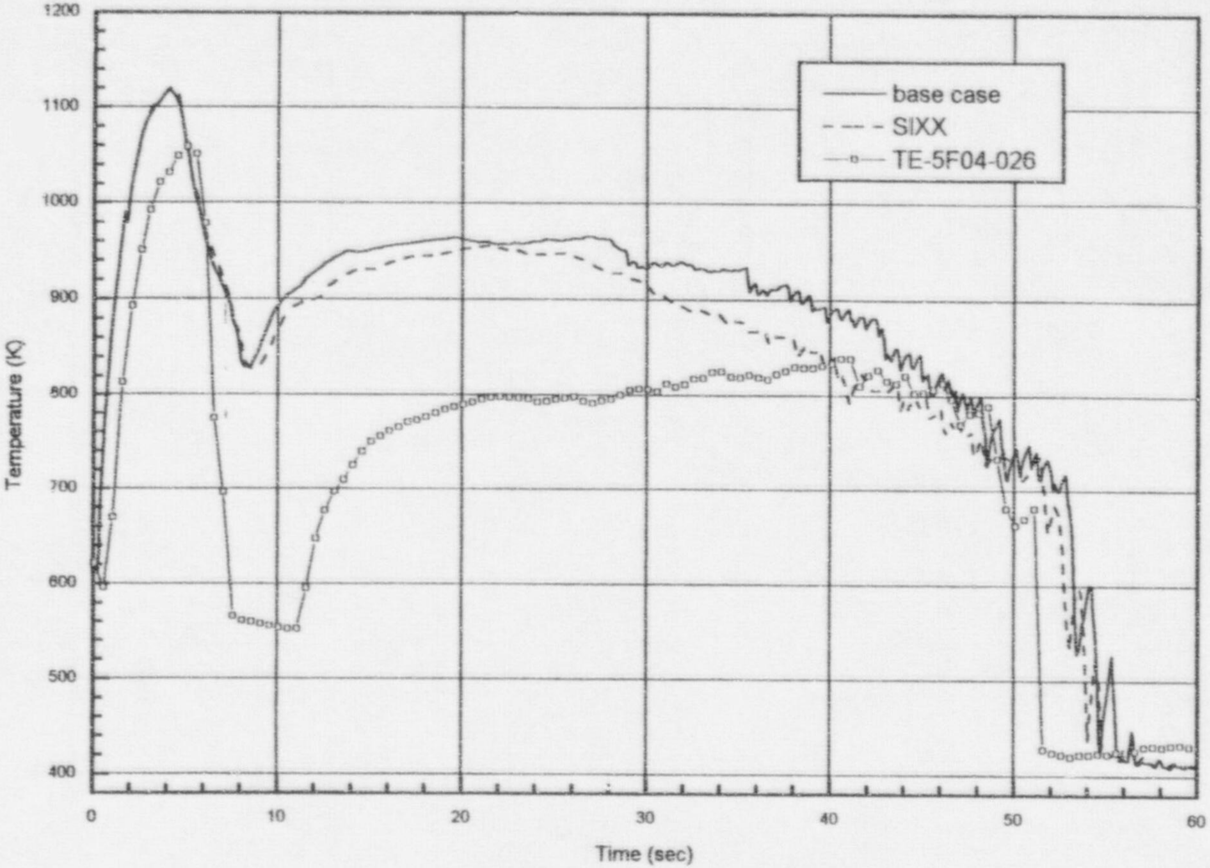

Figure 5.11 Cladding temperature at hot core node 5 in the SIXX calculation

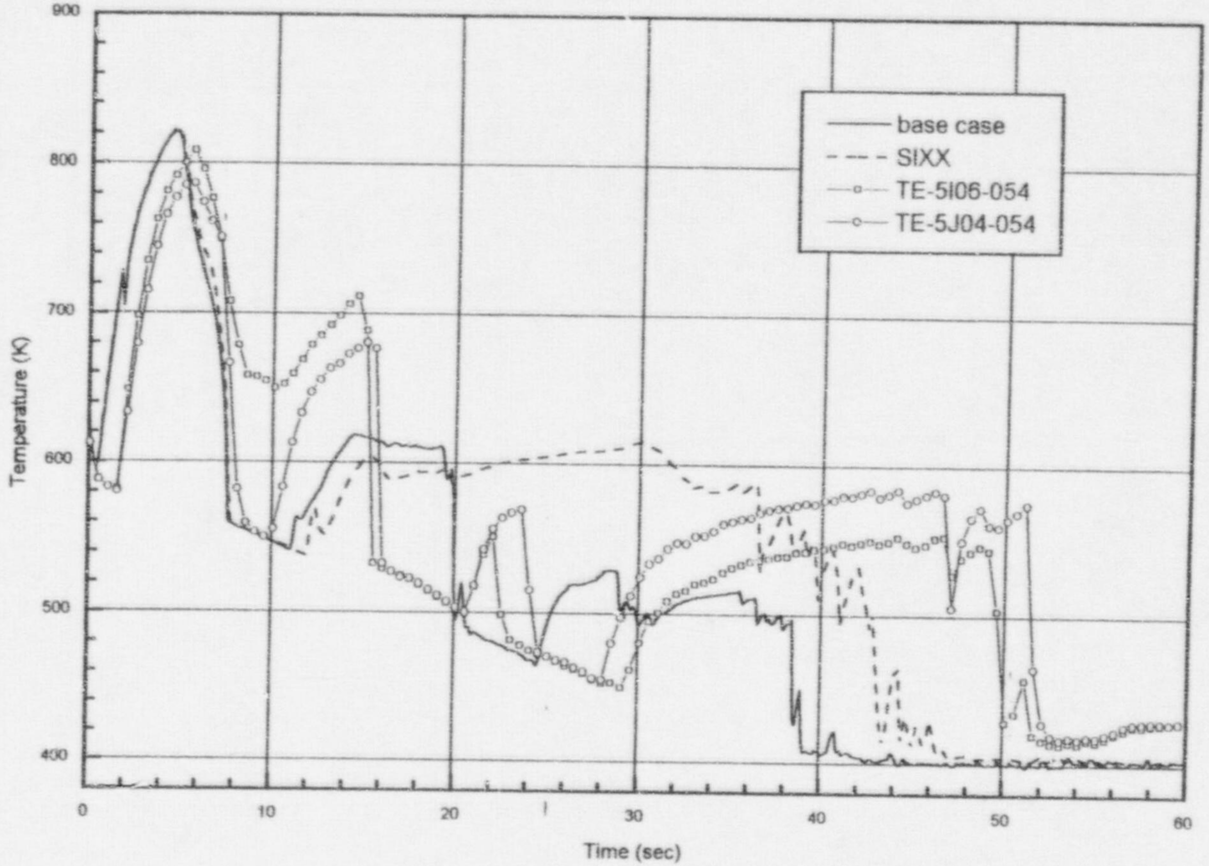

Figure 5.12 Cladding temperature at hot core node 10 in the SIXX calculation

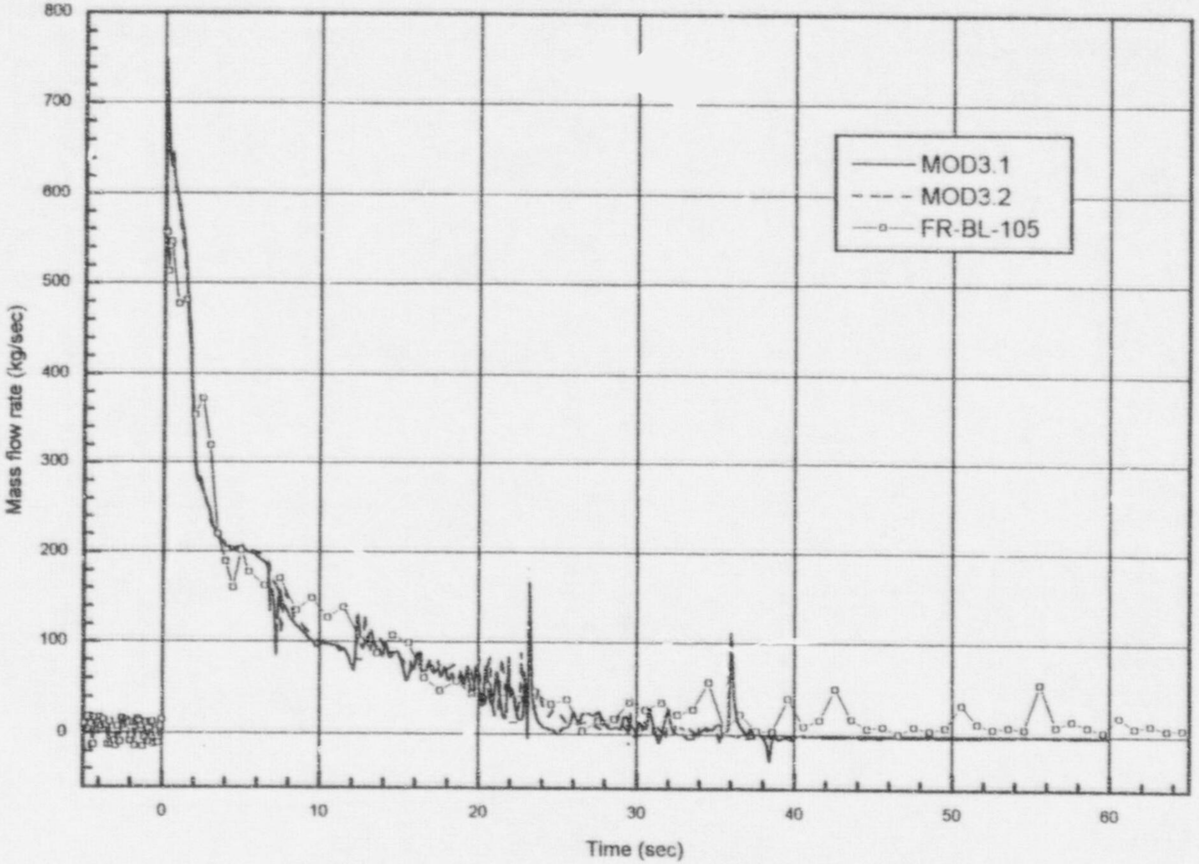

Figure 5.13 Mass flow rate in the broken loop cold leg by MOD3.1 and MOD3.2

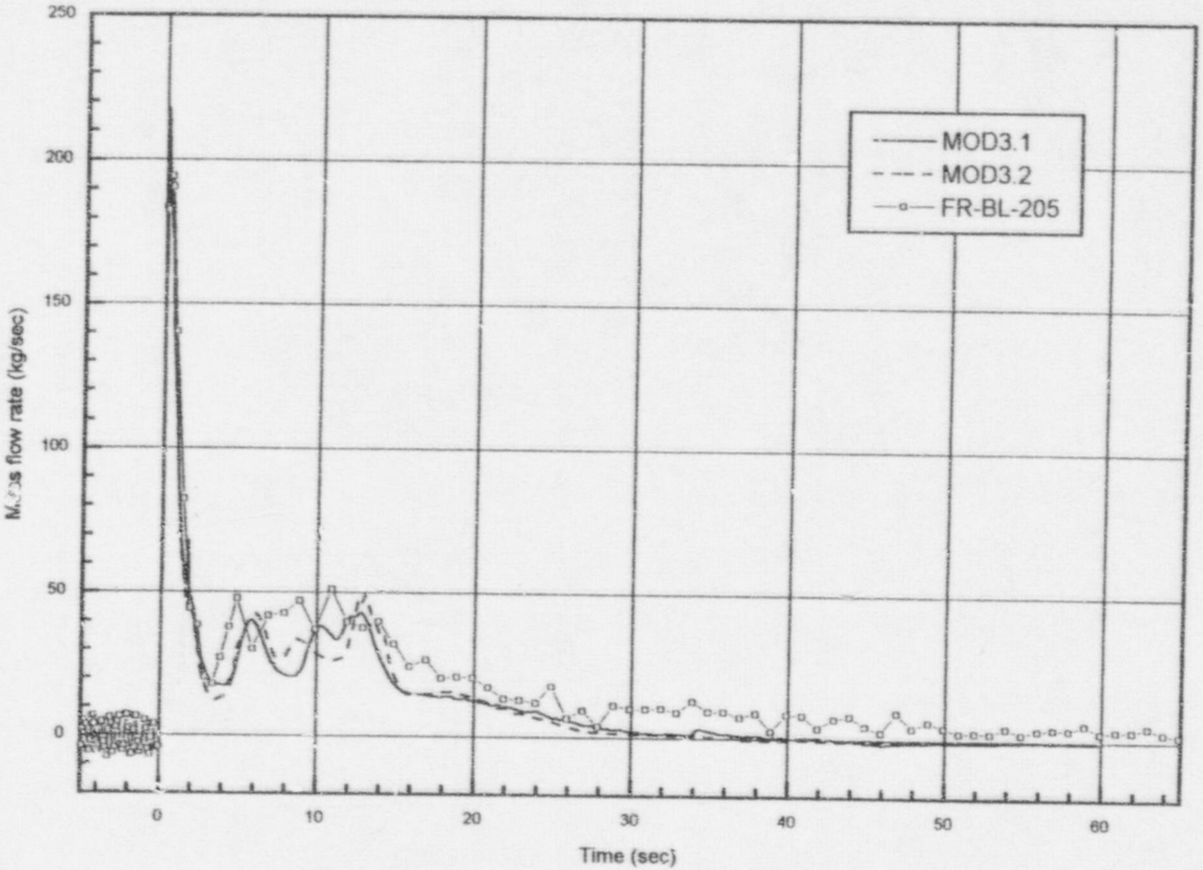

Figure 5.14 Mass flow rate in the broken loop hot leg by MOD3.1 and MOD3.2

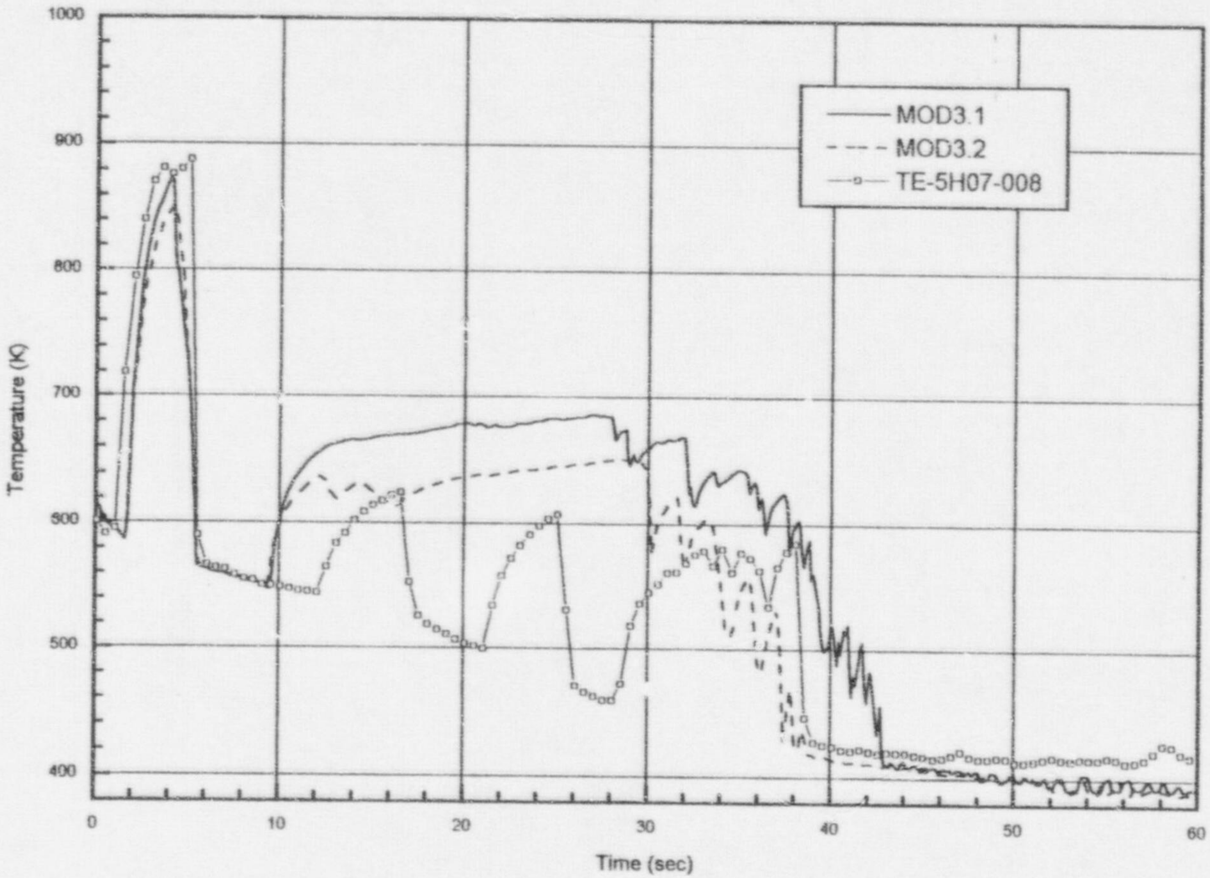

Figure 5.15 Cladding temperature at hot core node 2 by MOD3.1 and MOD3.2

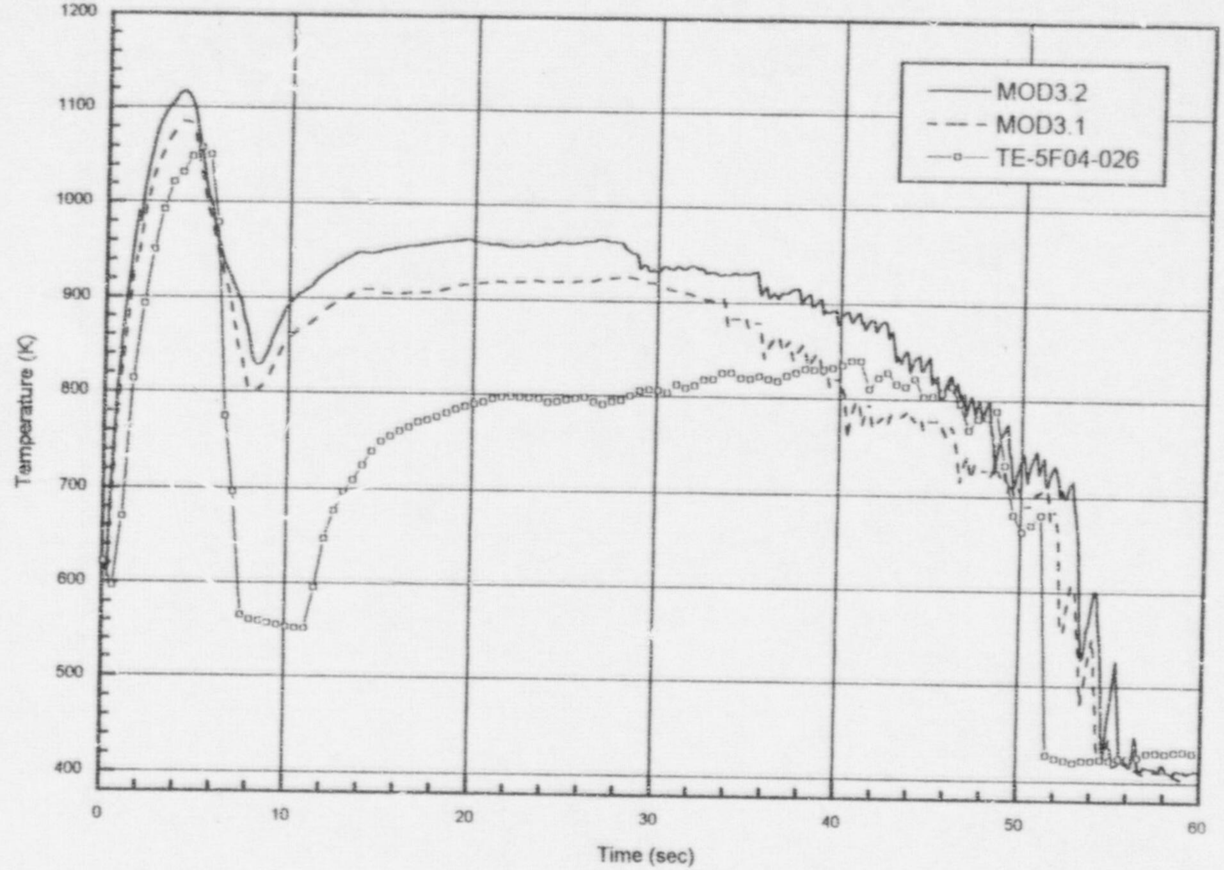

Figure 5.16 Cladding temperature at hot core node 5 by MOD3.1 and MOD3.2

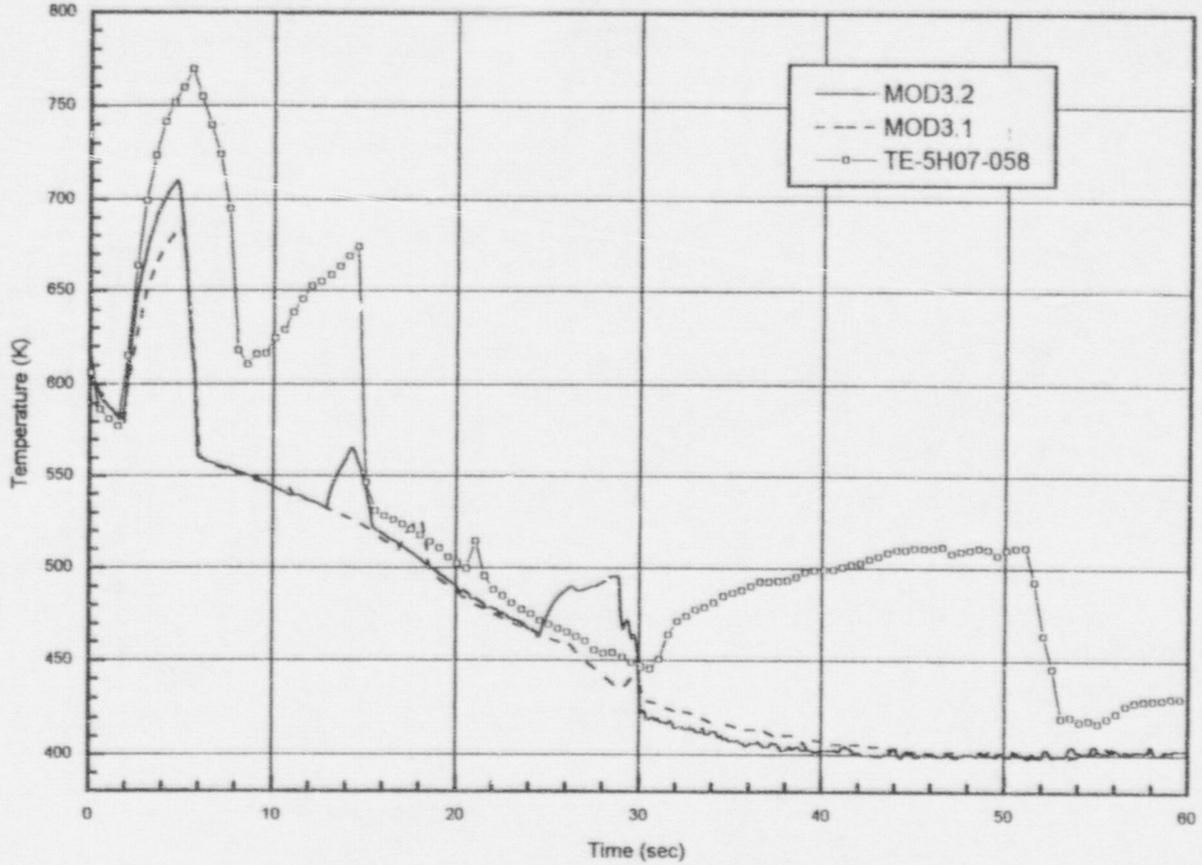

Figure 5.17 Cladding temperature at hot core node 11 by MOD3.1 and MOD3.2

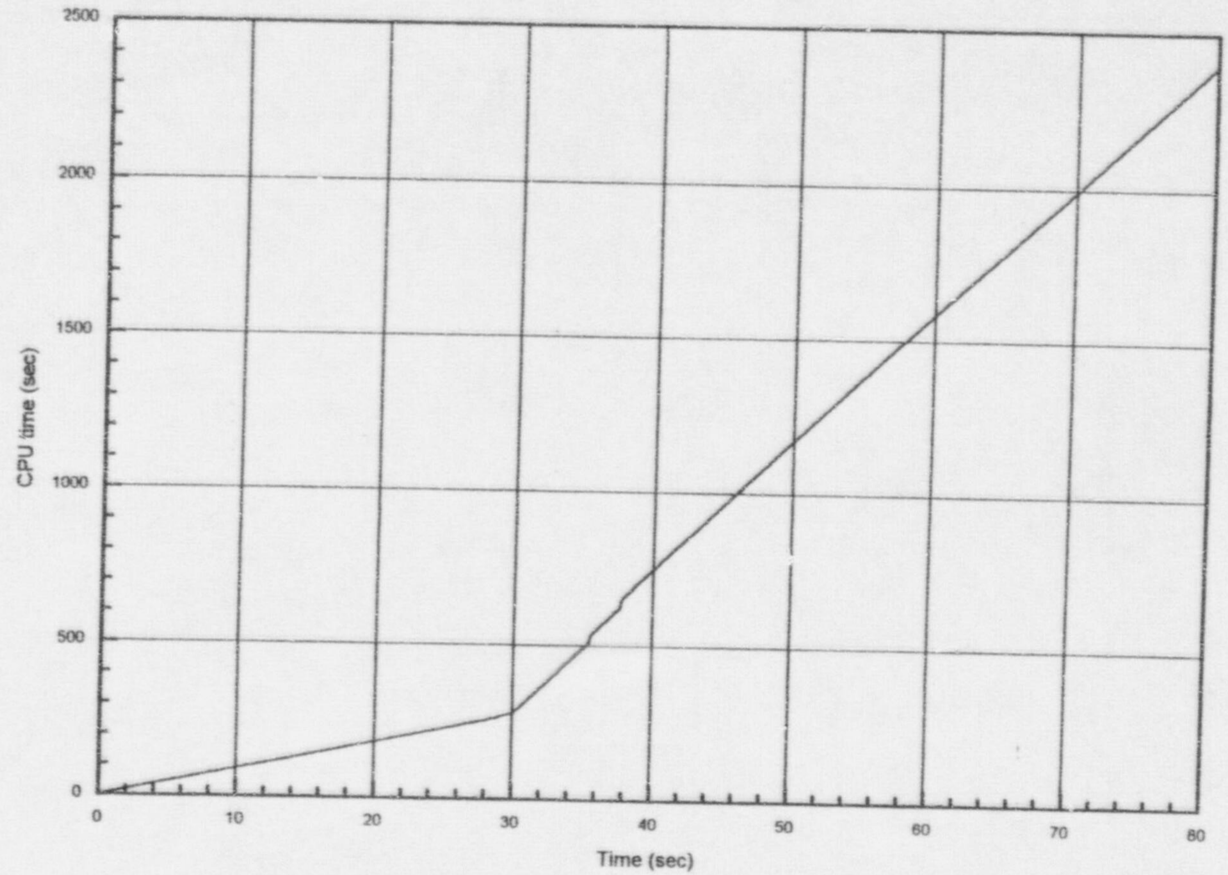

Figure 6.1 The required CPU time in the base case calculation

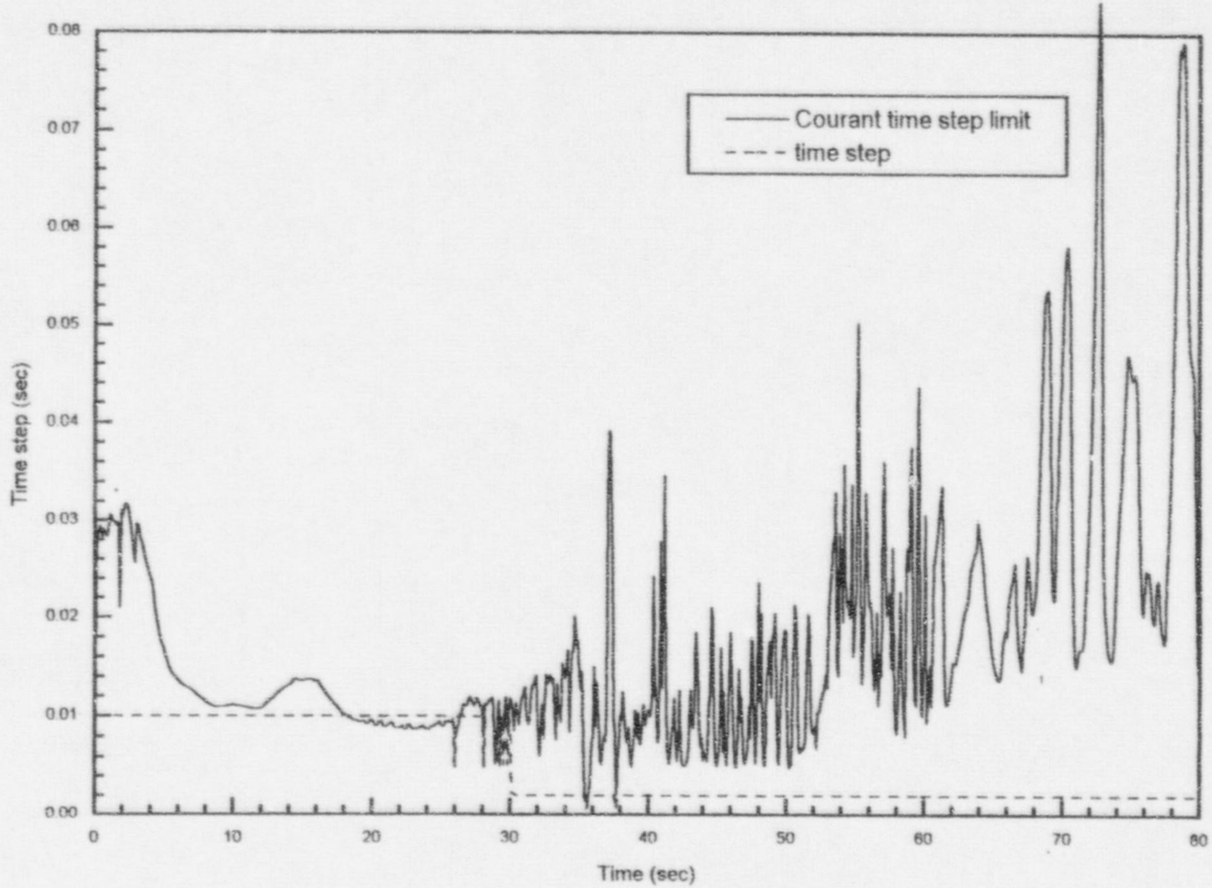

Figure 6.2 Time step size of base case calculation

APPENDIX : INPUT LISTING

```
****************************************************************
*
*     STEADY-STATE INPUT FOR LP-02-6 (Base Case)
*
*       CODE VERSIONS : MOD3.2
*       DISCHARGE COEFFICIENTS AT THE BREAK VALVES: 1.0, 1.0
*
*       MODIFIED AT 6/25/96
*       EDITOR : T. S. CHOI
*
****************************************************************
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
100     new          stdy-st
101     run
105     5.0          10.0        * No CPU time limit
110     nitrogen
*---- ----1---- ----1---- ----1---- ----1---- ----1---- -- -1----
*       time step control cards
*       end time  min dt  max dt  optn    mnr      mjr        rst
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
201       1.+5      1.0-6  0.1      14003  1000     5000       5000
****************************************************************
*
*     trips
*
****************************************************************
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*      500      end of job trip
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
500       time       0          ge  null  0      3000.        l
600       500
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*      501      always true
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
501       time       0          ge    null     0    -1.0       l
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*      501-515  test specific trips
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*      break open
510       time       0          ge null   0          1500.0    l
*
*      scram
511       time       0          ge timeof 510        0.13      l
*      pcp trip
512       time       0          ge timeof 510        0.0       l
*      hpsi on
513       time       0          ge timeof 510        21.8      l
*      broken leg bypass
514       time       0          ge null   0          1.0+9     l
```

```
*       accumulator valve
515       p       620010000    ge p 185010000      0.0        l
*       lpsi on
516       time       0         ge timeof 510       34.8       l
*       reflood
555       time       0         ge timeof 510       1.0+6      l
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
*     difference related trips
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* lt  681  reflood bypass valve               card 3750301
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
681       -510        and        -510      n
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* lt  682  accumulator valve          card 6100301
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
582     cntrlvar      4          lt null   0          1.-3      l
682     -582          and        515       n
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* lt  685-686    steam valve          card 5400301 : L2-5
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* open trip
589     p             530010000 gt null   0          7.12+6    n
590     p             530010000 lt null   0          6.98+6    n
670     685           or         589       n
671     -590                     and       -686       n
685     671                      and       670        n
* close trip
591     p             530010000 gt null   0          6.57+6    n
592     p             530010000 lt null   0          6.50+6    n
672     686           or         592       n
673     -591          and        672       n
674     -685          and        511       n
686     673           and        674       n
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* job termination valve trip
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* open
687       685         or         685       n
* close
688       686         or         686       n
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
****************************************************************
*
*    intact loop [100]
*
```

```
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* reactor vessel nozzle - intact loop hot leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1000000  rvnilhl   branch
1000001  2         0
1000101  0.0       1.58878   0.102752  0.0        0.0        0.0
1000102  4.0-5     0.0       01000
1000200  0         1.51702+7 1415050.  2455780.   0.0
1001101  252010000 100000000 0.0634    0.1        0.1        0002
1002101  100010000 105000000 0.0       0.1        0.1        0000
1001201  5.7156000 6.0302000 0.0
1002201  5.6978000 5.6978000 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pressurizer connection tee reactor vessel side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1050000  pxrtrvs   branch
1050001  1         0
1050101  0.0634444 1.0531192 0.0       0.0        0.0        0.0
1050102  4.0-5     0.0       01000
1050200  0         1.51680+7 1415050.  2457290.   0.0
1051101  105010000 107000000 0.0       0.12       0.12       0000
1051201  5.8282000 5.8282000 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pressurizer connection tee
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1070000  przt      branch
1070001  1         0
1070101  0.0620253 0.2810215 0.0       0.0        0.0        0.0
1070102  4.0-5     0.0       01000
1070200  0         1.51658+7 1415050.  2457350.   0.0
1071101  107010000 110000000 0.0       0.135      0.135      0000
1071201  5.9648000 5.9648000 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pressurizer connection tee steam generator side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1100000  prztsgs   branch
1100001  1         0
1100101  0.0606063 0.9207292 0.0       0.0        0.0        0.0
1100102  4.0-5     0.0       01000
1100200  0         1.51632+7 1415050.  2455890.   0.0
1101101  110010000 112000000 0.0       0.15       0.15       0000
1101201  6.3002000 6.3002000 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* hot leg piping
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1120000  hotlegpp  pipe
1120001  2
1120101  0.0       2
1120201  0.0       1
1120301  1.38893   1
1120302  0.707687  2
1120401  0.0796973 1
1120402  0.0579614 2
1120501  0.0       2
1120601  0.0       1
1120602  90.0      2
1120701  0.0       1
1120702  0.246447  2
1120801  4.0-5     0.0       2
1120901  0.20      0.20      1
1121001  01000     2
1121101  0000      1
1121201  0         1.51590+7 1415050. 2456050.   0.  0.  1
1121202  0         1.51619+7 1415050. 2455980.   0.  0.  2
1121300  0
1121301  6.3002000 6.3002000 0.        1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* sg inlet plenum
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1140000  sginplnm  branch
1140001  2         0
1140101  0.0       0.629795  0.33532   0.0        90.0       0.512
1140102  4.-5      0.0102    01000
1140200  0         1.51362+7 1415050.  2456610.   0.0
1141101  112010000 114000000 0.0512    0.0        0.0        0100
1142101  114010000 115000000 0.0       0.0        0.0        0100
1141201  4.4139000 4.4760000 0.0
1142201  2.3845000 2.6100000 0.0
1142110  0.0102    0.        1.         1.
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* sg u-tubes
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1150000  sgtubes   pipe
1150001  8
1150101  0.0       8
1150201  0.151171  7
1150301  0.902     1
1150302  0.6096    3
1150303  0.462908  5
1150304  0.6096    7
1150305  0.902     8
1150401  0.136356  1
1150402  0.0921538 3
1150403  0.0699783 5
1150404  0.0921538 7
1150405  0.136356  8
1150501  0.0       8
1150601  90.0      4
```

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1150602   -90.0      8
1150701   0.902      1
1150702   0.6096     3
1150703   0.299572   4
1150704   -0.299572  5
1150705   -0.6096    7
1150706   -0.962     8
1150801   1.27-7     0.01022    8
1150901   0.0        0.0        7
1151001   01000      8
1151101   100000     7
1151201   0          1.51270+7  1372420.  2456830.  0.        0.     1
1151202   0          1.51192+7  1338080.  2457020.  0.        0.     2
1151203   0          1.51128+7  1309560.  2457180.  0.        0.     3
1151204   0          1.51077+7  1290670.  2457300.  0.        0.     4
1151205   0          1.51062+7  1274150.  2457340.  0.        0.     5
1151206   0          1.51077+7  1255880.  2457300.  0.        0.     6
1151207   0          1.51101+7  1240550.  2457240.  0.        0.     7
1151208   0          1.51132+7  1227210.  2451600.  0.        0.     8
1151300   0
1151301   2.3324000  2.5621000  0.0       1
1151302   2.2887000  2.5175000  0.0       2
1151303   2.2549000  2.4830000  0.0       3
1151304   2.2335000  2.4610000  0.0       4
1151305   2.2153000  2.4424000  0.0       5
1151306   2.1961000  2.4227000  0.0       6
1151307   2.1803000  2.4066000  0.0       7
1151401   0.01022    0.         1.        1.        1
1151402   0.01022    0.         1.        1.        2
1151403   0.01022    0.         1.        1.        3
1151404   0.01022    0.         1.        1.        4
1151405   0.01022    0.         1.        1.        5
1151406   0.01022    0.         1.        1.        6
1151407   0.01022    0.         1.        1.        7
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* sg outlet plenum
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1160000   sgoutpln   branch
1160001   2          0
1160101   0.0        0.629795   0.33532   0.0       -90.0     -0.512756
1160102   4.-5       0.0102     01000
1160200   0          1.51176+7  1227210.  2457160.  0.0
1161101   115010000  116000000  0.0       0.0       0.0       0100
1162101   116010009  118000000  0.0512    0.0       0.0       01[illegible]
1161201   2.1672000  2.3880000  0.0
1162201   4.0188000  4.1687000  0.0
1161110   0.01022    0.         1.        1.
1162110   0.0102     0.         1.        1.
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----

* pump suction piping
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1180000   pmpsucpp   pipe
1180001   3
1180101   0.0        3
1180201   0.0        2
1180301   0.546638   1
1180302   0.688596   2
1180303   0.558577   3
1180401   0.0445625  1
1180402   0.0445137  2
1180403   0.0354278  3
1180501   0.0        3
1180601   -90.0      3
1180701   -0.498052  1
1180702   -0.688596  2
1180703   -0.355604  3
1180801   4.-5       0.0        3
1180901   0.083      0.083      1
1180902   0.104      0.104      2
1181001   01000      3
1181101   0000       2
1181201   0          1.51001+7  1227210.  2457480.  0.0  0.0  1
1181202   0          1.50998+7  1227210.  2457490.  0.0  0.0  2
1181203   0          1.51020+7  1227210.  2457440.  0.0  0.0  3
1181300   0
1181301   5.0681000  5.3877000  0.0       1
1181302   5.1655000  5.4876000  0.0       2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pump suction tee
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1200000   pmpsuct    branch
1200001   3          0
1200101   0.0        0.759614   0.0487901 0.0       0.0       0.0
1200102   4.0-5      0.0        01000
1200200   0          1.51033+7  1227210.  2457410.  0.0
1201101   118010000  120000000  0.063427  0.0       0.0       0000
1202101   120010000  125000000  0.063427  1.075     1.25      0000
1203101   120010000  155000000  0.063427  1.075     1.25      0000
1201201   5.1654000  5.4874000  0.0
1202201   2.5827000  2.5827000  0.0
1203201   2.5826000  2.5826000  0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pumpl suction tee outlet
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1250000   pmplsctt   branch
1250001   1          0
1250101   0.0        1.00308    0.0640548 0.0       90.0      0.520704
1250102   4.0-5      0.0        01000
```

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1250200    0           1.51059+7 1227210.   2457340.   0.0
1251101    125010000  130000000 0.0         0.13        0.13        0000
1251201    4.2208000 4.4909000 0.
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pump 1 inlet
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1300000    pmp1inlt   snglvol
1300101    0.0         0.457201   0.0177444 0.0          90.0        0.457201
1300102    4.0-5       0.0         01000
1300200    0           1.50969+7 1227210.   2457560.   0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* primary coolant pump 1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1350000    pcpmp1      pump
1350101    0.0366      0.0         0.0991      0.0          90.0        0.317900
1350102    0
1350108    130010000 0.0         0.017       0.017       0000
1350109    140000000 0.0         0.05        0.05        0000
1350200    0           1.51620+7 1227280.   2455980.   0.0
1350201    0           4.4717000 4.7483000 0.
1350202    0           4.4715000 4.4715000 0.
1350301    0    0      0           -1          0            512         0
1350302    369.0       .449573     .3155       96.          500.6       1.431
1350303    613.6       .0          207.433     .0444        19.5987     0.
1350310    0.0         0.0         0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pcp1 pump velocity table
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1356100    501         cntrlvar   902
1356101    0.0         0.0
1356102    369.0       369.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pump 1 outlet pump side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1400000    pmp1outp   snglvol
1400101    0.0         0.502185   0.0183849 0.0          0.0         0.0
1400102    4.0-5       0.0         01000
1400200    0           1.52294+7 1227290.   2454300.   0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pump1 outlet pipe tee side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1450000    pmp1outt   branch
1450001    2           0
1450101    0.0         1.40843     0.0633861 0.0          0.0         0.0
1450102    4.0-5       0.0         01000
1450200    0           1.52317+7 1227290.   2454300.   0.0
1451101    140010000 145000000 0.0         0.0          0.0         0000
1452101    145010000 150000000 0.0         0.57456      0.050347    0000
1451201    4.4741000 4.4741000 0.0
```

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1452201    3.6395000 3.6395000 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pump outlet tee
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1500000    pmpoutt     branch
1500001    1           0
1500101    0.0         0.496511   0.0316011 0.0          0.0         0.0
1500102    4.0-5       0.0         01000
1500200    0           1.52235+7 1227290.   2454300.   0.0
1501101    150010000 175000000 0.063427   0.0          0.0         000000
1501201    5.1648000 5.1648000 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pump 2 suction tee outlet
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1550000    pmp2suct   branch
1550001    1           0
1550101    0.0         1.00308     0.0640548 0.0          90.0        0.520704
1550102    4.0-5       0.0         01000
1550200    0           1.51059+7 1227210.   2457340.   0.0
1551101    155010000 160000000 0.0         0.13         0.13        0000
1551201    4.2207000 4.4907000 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pump 2 inlet pipe
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1600000    pmp2inlt   snglvol
1600101    0.0         0.457201   0.0177444 0.0          90.0        0.457201
1600102    4.0-5       0.0         01000
1600200    0           1.50969+7 1227210.   2457560.   0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* primary coolant pump 2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1650000    pcpmp2      pump
1650101    0.0366      0.0         0.0991      0.0          90.0        0.317900
1650102    0
1650108    160010000 0.0         0.017       0.017        0000
1650109    170000000 0.0         0.1         0.1          0000
1650200    0           1.51618+7 1227280.   2455990.   0.0
1650201    0           4.5461000 4.8246000 0.0
1650202    0           4.5459000 4.5459000 0.0
1650301    135   135   135         -1          0            512         0
1650302    369.        0.449573    .3155       96.          500.6       1.431
1650303    613.6       0.0         207.433     .0444        19.5987     0.
1650310    0.0         0.0         0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pcp2 pump velocity table
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1656100    501         cntrlvar   903
1656101    0.0         0.0
1656102    369.0       369.0
```

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*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pump 2 outlet
*---- -- -1---- ----1---- ----1---- ----1---- ----1---- ----1----
1700000   pmp2outt  branch
1700001   1         0
1700101   0.0       0.514071  0.0192958 0.0       0.0       0.0
1700102   4.0-5     0.0       01000
1700200   0         1.52294+7 1227290.  2454350.  0.0
1701101   170010000 150000000 0.036611  0.3847    0.6316    0000
1701201   4.4738000 4.4738000 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* intact loop cold leg pipe
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1750000   ilclpipe  pipe
1750001   2
1750101   0.0       2
1750201   0.0       1
1750301   0.558577  1
1750302   0.613244  2
1750401   0.035428  1
1750402   0.038895  2
1750501   0.0       2
1750601   0.0       2
1750701   0.0       2
1750801   4.0-5     0.0       2
1750901   0.0       0.0       1
1751001   01000     2
1751101   0000      1
1751201   0         1.52232+7 1227290. 2454500. 0.0  0.0   1
1751202   0         1.52229+7 1227290. 2454510. 0.0  0.0   2
1751300   0
1751301   5.1650000 5.1650000 0.0       1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* ecc connection tee
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1800000   ecct      branch
1800001   1         0
1800101   0.0       1.15189   0.0730598 0.0       0.0       0.0
1800102   4.0-5     0.0       01000
1800200   0         1.52225+7 1227290.  2454520.  0.0
1801101   175010000 180000000 0.0       0.0       0.0       000000
1801201   5.1650000 5.1650000 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* reactor vessel nozzle - intact loop cold leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1850000   mixer     eccmix
1850001   3         0
1850101   0.0       1.00965   0.0644920 0.0       0.0       0.0
1850102   4.0-5     0.0       00000
1850200   0         1.52221+7 1227290.  2454530.  0.0
1851101   605010000 185000000 0.0       0.935     0.935     001000  90.
1852101   180010000 185000000 0.0       0.0       0.0       000000
1853101   185010000 202000000 0.0634    2.8       2.8       000001
1851201   1.99758-3 2.02067-3 0.0
1852201   5.1649000 5.1649000 0.0
1853201   5.1671000 5.1671000 0.0
*
*
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*
*   reactor vessel [200]
*
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* inlet annulus upper volume intact side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2000000   inanupri  annulus
2000001   1
2000101   0.1308530 1
2001601   0.0322690 1
2000301   0.1876129 1
2001801   0.7607831 1
2000401   0.0       1
2000501   0.0       1
2000601   90.0      1
2000801   3.81-6    0.172     1
2002301   3.81-6    0.172     1
2001001   01000     1
2002701   00000     1
2001201   0         15201400. 1227290.  2455030.  .00000000 0.0       1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* junction - upper to lower inlet annulus intact side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2010000   inanmuin  sngljun
2010101   202000000 200000000 0.129467  0.0000    0.0000    0100
2010110   0.172     0.0       1.0       1.0
2010201   0         .731170   .85084    0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* inlet annulus middle volume intact side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2020000   inanmidi  annulus
2020001   1
2020101   0.1308530 1
2021601   0.0490510 1
2020301   0.2851823 1
2021801   0.7607787 1
2020401   0.0       1
```

```
2020501   0.0        1
2020601   -90.0      1
2020801   3.81-6     0.172      1
2022301   3.81-6     0.172      1
2021001   01000      1
2022701   00000      1
2021201   0          15201400.  1227290.   2455030.   0.0        0.0        1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* junction - middle to lower inlet annulus intact side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2050000   inanmlin   sngljun
2050101   202010000  210000000  0.0709408  0.0        0.0        0100
2050110   0.172      0.0        1.0        1.0
2050201   0          1.7724     1.8718     0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* inlet annulus lower volume intact side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2100000   inanlwri   annulus
2100001   4
2100101   0.0710000  1
2101601   0.0258470  1
2101602   0.1550460  2
2101603   0.1286870  3
2101604   0.1100840  4
2100102   0.0        4
2100201   0.0709408  3
2100301   0.2534239  1
2100302   1.5200561  2
2100303   1.2616333  3
2100304   1.0792591  4
2101801   0.6961386  1
2101802   1.0202559  2
2101803   0.9457054  3
2101804   0.8964118  4
2100401   0.0        1
2100402   0.1581866  2
2100403   0.1217000  3
2100404   0.0986806  4
2100501   0.0        4
2100601   -90.0      4
2100801   3.81-6     0.102      4
2102301   3.81-6     0.102      4
2100901   0.0        0.0        3
2101001   01000      4
2102701   00000      4
2101101   100100     3
2101201   0          15201400.  1227290.   2455030.   .00000000  0.0        1
2101202   0          15204900.  1227290.   2454940.   .00000000  0.0        2
2101203   0          15213600.  1227290.   2454730.   .00000000  0.0        3
2101204   0          15221100.  1227290.   2454550.   .00000000  0.0        4
2101300   0
2101301   3.2693     3.5236     0.0        1
2101302   3.2693     3.5236     0.0        2
2101303   3.2692     3.5234     0.0        3
2101401   0.102      0.0        1.0        1.0        1
2101402   0.102      0.0        1.0        1.0        2
2101403   0.102      0.0        1.0        1.0        3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* junction - inlet annulus to downcomer intact side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2150000   inan2dci   sngljun
2150101   210010000  222000000  0.0709408  0.0000     0.0000     100100
2150110   0.102      0.0        1.0        1.0
2150201   0          2.5365     5.1650     0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* lower plenum top volume
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2220000   lwrpltc    branch
2220001   2
2220101   0.         0.3533183  0.2592277  0.         -90.   -0.3533183
2220102   3.81-6     0.0        01000
2220200   0          1.52253+7  1227290.   2454450.   0.0
2221101   222010000  220000000  0.0        0.005      0.005      0000
2222101   222000000  225000000  0.1499     1.5        1.5        0000
2221201   7.17715-7  7.17715-7  0.
2222201   2.1854000  2.4112000  0.
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* lower plenum bottom volume
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2200000   lowplbv    snglvol
2200101   0.         0.3741720  0.29656    0.0        -90.   -0.3741720
2200102   0.         0.0        01000
2200200   0          1.51655+7  1408220.   2455830.   0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* lower core support structure
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2250000   lcoresup   branch
2250001   3          0
2250101   0.2832456  0.5709989  0.0        0.0        90.0       0.5709989
2250102   3.81-6     0.095      01000
2250200   0          1.50018+7  1230920.   2459750.   0.0
2251101   225010000  230000000  9.4301-2   1.5        1.5        0000
2252101   225010000  231000000  1.9099-2   1.5        1.5        0000
2253101   225010000  235000000  0.0        12.        12.        0000
2251201   0.5923840  0.5923840  0.0
2252201   1.5174900  1.5174900  0.0
2253201   0.3590500  0.3590500  0.0
2251110   0.095      0.         1.         1.
```

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2252110   0.095     0.        1.        1.
2253110   0.095     0.        1.        1.
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* active core (average core)
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2300000   avgcore   pipe
2300001   12
2300101   0.152397  2
2300102   0.142439  4
2300103   0.143852  6
2300104   0.142604  8
2300105   0.142578  10
2300106   0.147386  12
2300201   0.141784  3
2300202   0.119747  4
2300203   0.141784  7
2300204   0.119747  8
2300205   0.141784  11
2300301   0.1397017 12
2300401   0.0       12
2300501   0.0       12
2300601   90.0      12
2300801   1.27-7    0.012     12
2300901   0.0       0.0       3
2300902   0.66      0.66      4
2300903   0.0       0.0       7
2300904   0.66      0.66      8
2300905   0.0       0.0       11
2301001   01000     12
2301101   0000      11
2301201   0         15048500. 1263450.  2459550.  .00000000 0.0       02
2301202   0         15045400. 1309480.  2459550.  .00000000 0.0       04
2301203   0         15042500. 1357660.  2459550.  .00000000 0.0       05
2301204   0         15040100. 1394080.  2459550.  .00000000 0.0       06
2301205   0         15037200. 1417170.  2459550.  .00000000 0.0       10
2301206   0         15034300. 1424460.  2459550.  .00000000 0.0       12
2301300   0
2301301   1.4679000 1.4679000 0.0       02
2301302   1.7789000 1.7789000 0.0       04
2301303   1.5425000 1.5425000 0.0       06
2301304   1.8668000 1.8668000 0.0       08
2301305   1.5994000 1.5994000 0.0       11
2301401   0.012     0.        1.        1.        1
2301402   0.012     0.        1.        1.        2
2301403   0.012     0.        1.        1.        3
2301404   0.012     0.        1.        1.        4
2301405   0.012     0.        1.        1.        5
2301406   0.012     0.        1.        1.        6
2301407   0.012     0.        1.        1.        7
2301408   0.012     0.        1.        1.        8
2301409   0.012     0.        1.        1.        9
2301410   0.012     0.        1.        1.        10
2301411   0.012     0.        1.        1.        11
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* active core (hot)
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2310000   hotcore       pipe
2310001   12
2310101   3.08652-2 2
2310102   2.88483-2 4
2310103   2.91345-2 6
2310104   2.88819-2 8
2310105   2.88766-2 10
2310106   2.98503-2 12
2310201   2.87158-2 3
2310202   2.42526-2 4
2310203   2.87158-2 7
2310204   2.42526-2 8
2310205   2.87158-2 11
2310301   0.1397017 12
2310401   0.0       12
2310501   0.0       12
2310601   90.0      12
2310801   1.27-7    0.012     12
2310901   0.0       0.0       3
2310902   0.66      0.66      4
2310903   0.0       0.0       7
2310904   0.66      0.66      8
2310905   0.0       0.0       11
2311001   01000     12
2311101   0000      11
2311201   0         15048500. 1263450.  2459550.  .00000000 0.0       02
2311202   0         15045400. 1309480.  2459550.  .00000000 0.0       04
2311203   0         15042500. 1357660.  2459550.  .00000000 0.0       05
2311204   0         15040100. 1394080.  2459550.  .00000000 0.0       06
2311205   0         15037200. 1417170.  2459550.  .00000000 0.0       10
2311206   0         15034300. 1424460.  2459550.  .00000000 0.0       12
2311300   0
2311301   1.4679000 1.4679000 0.0       02
2311302   1.7789000 1.7789000 0.0       04
2311303   1.5425000 1.5425000 0.0       06
2311304   1.8668000 1.8668000 0.0       08
2311305   1.5994000 1.5994000 0.0       11
2311401   0.012     0.        1.        1.        1
2311402   0.012     0.        1.        1.        2
2311403   0.012     0.        1.        1.        3
2311404   0.012     0.        1.        1.        4
2311405   0.012     0.        1.        1.        5
```

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2311406   0.012      0.         1.         1.         6
2311407   0.012      0.         1.         1.         7
2311408   0.012      0.         1.         1.         8
2311409   0.012      0.         1.         1.         9
2311410   0.012      0.         1.         1.         10
2311411   0.012      0.         1.         1.         11
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* core bypass volume (4 prozent)
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2350000   corebyps   pipe
2350001   3
2350101   0.0129428 3
2350201   0.0        2
2350301   0.5588068 3
2350401   0.0        3
2350501   0.0        3
2350601   90.0       3
2350801   3.81-6     0.003      3
2350901   0.0        0.0        2
2351001   01000      3
2351101   0000       2
2351201   0          1.49951+7 1230900.   2460030.   0.0  0.0  1
2351202   0          1.49899+7 1230870.   2460150.   0.0  0.0  2
2351203   0          1.49846+7 1230840.   2460270.   0.0  0.0  3
2351300   0
2351301   0.6985700 0.7893400 0.0        1
2351302   0.6985700 0.7893600 0.0        2
2351401   0.003      0.         1.         1.         1
2351402   0.003      0.         1.         1.         2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* upper end boxes and support structure
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2400000   uprendbx   branch
2400001   3          0
2400101   0.2423341 0.5867979 0.0        0.0        90.0       0.5867979
2400102   3.81-6     0.145      01000
2400200   0          1.49777+7 1423500.   2460430.   0.0
2401101   230010000 240000000 9.2971-2  1.5        1.5        100000
2402101   231010000 240000000 1.8829-2  1.5        1.5        100000
2403101   235010000 240000000 0.0        12.        12.        100000
2401201   0.5486000 0.5484000 0.0
2402201   1.5486000 1.5484000 0.0
2403201   0.4357900 0.4357900 0.0
2401110   0.012      0.         1.         1.
2402110   0.012      0.         1.         1.
2403110   0.003      0.         1.         1.
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* upper core support structure - cross flow region
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
```

```
2450000   uprcrsup   branch
2450001   2          0
2450101   0.0        0.4933248 0.1280806 0.0        90.0       0.4933248
2450102   3.81-6     0.145      01000
2450200   0          1.51905+7 1420710.   2455290.   0.0
2451101   240010000 245000000 0.0        0.0        0.0        100000
2452101   245010000 251000000 0.0        0.0        0.0        100000
2451201   1.4917000 1.6814000 0.0
2452201   2.34575-6 2.34579-6 0.0
2451110   0.145      0.         1.         1.
2452110   0.145      0.         1.         1.
*---- ----1---- ----1---- ----1---- ----1---- ----!---- ----1----
* upper flow skirt region
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2500000   uflwskrt   branch
2500001   1          0
2500101   0.1547532 0.7850547 0.0        0.0        90.0       0.7850547
2500102   3.81-6     0.131      01000
2500200   0          1.51850+7 1420710.   2455420.   0.0
2501101   245010000 250000000 0.0        0.0        0.0        100000
2501201   2.3359000 2.5642000 0.0
2501110   0.145      0.         1.         1.
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* dead end of fuel modules
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2510000   deflmods   snglvol
2510101   0.0        0.7844123 0.1154214 0.0        90.0       0.7844123
2510102   3.81-6     0.214      01000
2510200   0          1.51872+7 1590340.   2455370.   0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* upper head
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2520000   uprhead    branch
2520001   2          0
2520101   0.2622585 0.2869580 0.0        0.0        90.0       0.2869580
2520102   3.81-6     0.0        01000
2520200   0          1.51825+7 1415050.   2455490.   0.0
2521101   250010000 252000000 0.0        0.006      0.006      100000
2522101   202000000 252010000 0.0        0.90+4     0.90+4     0003
2521201   2.3359000 2.5642000 0.0
2522201   0.053      0.053      0.0
2521110   0.131      0.         1.         1.
2522110   0.172      0.         1.         1.
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* upper plenum bottom volume
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2550000   uprplbot   branch
2550001   2          0
2550101   0.2622585 0.6312304 0.0        0.0        90.0       0.6312304
```

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2550102   3.81-6    0.0       01000
2550200   0         1.51822+7 1539710.  2455490   0.0
2551101   250010000 255000000 0.0       0.006     0.006     100000
2552101   255010000 260000000 0.0       0.03      0.03      100000
2551201   2.16560-5 2.16570-5 0.0
2552201   1.21306-5 0.1789200 0.0
2551110   0.131     0.        1.        1.
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* upper plenum top volume
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2600000   uprpltop  snglvol
2600101   0.0       0.7747094 0.1914909 0.0       90.0      0.7747094
2600102   3.81-6    0.0       01000
2600200   0         1.51787+7 1592880.  2455580.  0.38893
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* inlet annulus upper volume intact side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2700000   inanupri  annulus
2700001   1
2700101   0.1308530 1
2701601   0.0322690 1
2700301   0.1876129 1
2701801   0.7607831 1
2700401   0.0       1
2700501   0.0       1
2700601   90.0      1
2700801   3.81-6    0.172     1
2702301   3.81-6    0.172     1
2701001   01000     1
2702701   00000     1
2701201   0         15201400. 1227290.  2455030.  .00000000 0.0       1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* junction - upper to lower inlet annulus intact side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2710000   inanmuin  sngljun
2710101   272000000 270000000 0.129467  0.0000    0.0000    0100
2710110   0.172     0.0       1.0       1.0
2710201   0         .5        .5        0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* inlet annulus middle volume intact side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2720000   inanmidi  annulus
2720001   1
2720101   0.1308530 1
2721601   0.0490510 1
2720301   0.2851823 1
2721801   0.7607787 1
2720401   0.0       1
2720501   0.0       1
```

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2720601   -90.0     1
2720801   3.81-6    0.172     1
2722301   3.81-6    0.172     1
2721001   01000     1
2022701   00000     1
2721201   0         15201400. 1227290.  2455030.  0.0       0.0       1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* junction - middle to lower inlet annulus intact side
 ---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2750000   inanmlin  sngljun
2750101   272010000 280000000 0.0709408 0.0       0.0       0100
2750110   0.172     0.0       1.0       1.0
2750201   0         0.5       0.5       0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* inlet annulus lower volume intact side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2800000   inanlwri  annulus
2800001   4
2800101   0.0710000 1
2800102   0.0       4
2801601   0.0258470 1
2801602   0.1550460 2
2801603   0.1286870 3
2801604   0.1100840 4
2800201   0.0709408 3
2800301   0.2534239 1
2800302   1.5200561 2
2800303   1.2616333 3
2800304   1.0792591 4
2801801   0.6961386 1
2801802   1.0202559 2
2801803   0.9457054 3
2801804   0.8964118 4
2800401   0.0       1
2800402   0.1581866 2
2800403   0.1217000 3
2800404   0.0986806 4
2800501   0.0       4
2800601   -90.0     4
2800801   3.81-6    0.102     4
2802301   3.81-6    0.102     4
2800901   0.0       0.0       3
2801001   01000     4
2802701   00000     4
2801101   100100    3
2801201   0         15201400. 1227290.  2455030.  .00000000 0.0       1
2801202   0         15204900. 1227290.  2454940.  .00000000 0.0       2
2801203   0         15213600. 1227290.  2454730.  .00000000 0.0       3
2801204   0         15221100. 1227290.  2454550.  .00000000 0.0       4
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```
2801300   0
2801301   0.5     0.5     0.0      1
2801302   0.5     0.5     0.0      2
2801303   0.5     0.5     0.0      3
2801401   0.102        0.0         1.0         1.0        1
2801402   0.102        0.0         1.0         1.0        2
2801403   0.102        0.0         1.0         1.0        3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* junction - inlet annulus to downcomer intact side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2850000   inan2dci  sngljun
2850101   280010000 222000000 0.0709408 0.0000     0.0000     100100
2850110   0.102     0.0       1.0       1.0
2850201   0         0.5       0.5       0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* junction - between inlet annulus top volumes of both sides
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2900000   jbinantv  sngljun
2900101   200010004 270010003 0.0       1.8341     1.8341     0100
2900201   0         0.5       0.5       0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*
*    broken loop
*
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* reactor vessel nozzle - broken loop hot leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3000000   rvnblhl   branch
3000001   2         0
3000101   0.0       0.876303  0.0575410 0.0        0.0        0.0
3000102   4.0-5     0.0       01000
3000200   0         1.51825+7 1237685.  2456050.   0.0
3001101   252010000 300000000 0.067014  0.7385868  1.2309481  0002
3002101   300010000 305000000 0.063426  0.1005     0.1005     0000
3001201   0.        0.        0.0
3002201   0.        0.        0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* hot leg pipe to reflood assist bypass tee
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3050000   hlprabst  branch
3050001   1         0
3050101   0.0       0.698336  0.0442927 0.0        0.0        0.0
3050102   4.0-5     0.0       01000
3050200   0         1.51825+7 1237685.  2456950.   0.0
3051101   305010000 310000000 0.063426  0.1005     0.1005     0000
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3051201   0.        0.        0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* broken loop hot leg contraction
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3100000   blhlcont  branch
3100001   2         0
3100101   0.0       1.50013   0.0678467 0.0        0.0        0.0
3100102   4.0-5     0.0       01000
3100200   0         1.51825+7 1237685.  2456950.   0.0
3101101   380010000 310000000 0.0388    0.84       0.84       0000
3102101   310010000 315000000 8.3647-3  0.553      1.09055    0000
3101201   0.        0.        0.0
3102201   0.        0.        0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* steam generator and pump simulatior
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3150000   sgpmpsim  pipe
3150001   8
3150101   0.0       8
3150201   8.3647-3  1
3150202   1.12-2    2
3150203   0.105626  3
3150204   1.12-2    4
3150205   8.3647-3  7
3150301   0.919969  1
3150302   1.987956  2
3150303   0.849744  4
3150304   1.987956  5
3150305   1.371350  6
3150306   1.365029  7
3150307   1.674812  8
3150401   7.75291-3 1
3150402   0.1721108 2
3150403   8.97552-2 4
3150404   0.1721108 5
3150405   1.82303-2 6
3150406   5.46687-2 7
3150407   1.82489-2 8
3150601   90.0      3
3150602   -90.0     7
3150603   90.0      8
3150701   0.679201  1
3150702   1.987956  2
3150703   0.457202  3
3150704   -0.457202 4
3150705   -1.987956 5
3150707   -1.371350 6
3150708   -0.520701 7
3150709   1.212851  8
```

```
3150801    4.0-5      0.0        8
3150901    0.93596    0.93596    1
3150902    2.0        2.0        2
3150903    0.5        0.5        3
3150904    2.0        2.0        4
3150905    0.23025    0.23025    5
3150906    2.534      2.534      6
3150907    5.069      5.069      7
3151001    01000      8
3151101    0000       7
3151201    0          1.51803+7 1237700. 2456950.  0.0        0.0  1
3151202    0          1.51715+7 1237700. 2456950.  0.0        0.0  2
3151203    0          1.51636+7 1237700. 2456950.  0.0        0.0  3
3151204    0          1.51628+7 1237700. 2486950.  0.0        0.0  4
3151205    0          1.51698+7 1237700. 2456950.  0.0        0.0  5
3151206    0          1.51809+7 1237700. 2456950.  0.0        0.0  6
3151207    0          1.51871+7 1237700. 2456950.  0.0        0.0  7
3151208    0          1.51848+7 1237700. 2456950.  0.0        0.0  8
3151300    0
3151301    0.         0.         0.0        7
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* hot leg break valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3170000    hlbreak    valve
3170101    315010000 700000000 8.3647-3   0.94883    0.94883    0100
3170102    1.0        1.0
3170201    0          0.         0.         0.0
3170300    trpvlv
3170301    510
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* reactor vessel nozzle - broken loop cold leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3350000    rvnblcl    branch
3350001    2          0
3350101    0.0        0.749305   0.047979   0.0        0.0        0.0
3350102    4.0-5      0.0        01000
3350200    0          1.51935+7  1273905.   2456950.   0.0
3351101    272000000 335000000 0.064130   1.455594   0.812933   0002
3352101    335010000 340000000 0.063426   0.1005     0.1005     0000
3351201    0.         0.         0.0
3352201    0.         0.         0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* cold leg pipe to reflood assist bypass tee
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3400000    clprabst   branch
3400001    1          0
3400101    0.0        0.698336   0.0443927 0.0        0.0        0.0
3400102    4.0-5      0.0        01000
3400200    0          1.51935+7  1273905.   2456950.   0.0
3401101    340010000 342000000 0.063426   0.1005     0.1005     0000
3401201    0.         0.         0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* broken loop cold leg rabs to dtt
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3420000    blcl2dtt   branch
3420001    1          0
3420101    0.0        0.5715069 0.0362484 0.0        0.0        0.0
3420102    4.0-5      0.0        01000
3420200    0          1.51935+7  1273905.   2456950.   0.0
3421101    342000000 370000000 0.0388     0.84       0.84       0000
3421201    0.         0.         0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* broken loop cold leg dtt to break plane
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3440000    blcl2brk   branch
3440001    1          0
3440101    0.0        0.9286231 0.0310679 0.0        0.0        0.0
3440102    4.0-5      0.0        01000
3440200    0          1.51935+7  1273905.   2456950.   0.0
3441101    342010000 344000000 0.0540157 6.545      14.05      0000
3441201    0.         0.         0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* cold leg break valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3470000    clbreak    valve
3470101    344010000 705000000 8.3647-3   0.415      0.415      0100
3470102    1.0        1.0
3470201    0          0.         0.         0.0
3470300    trpvlv
3470301    510
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* reflood assist bypass piping - cold leg side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3700000    rabscl     pipe
3700001    3
3700101    0.0388     2
3700102    0.0776     3
3700201    0.0388     2
3700301    0.0        3
3700401    0.0279     1
3700402    0.070      2
3700403    0.1165     3
3700601    90.0       1
3700602    0.0        3
3700701    0.64       1
3700702    0.0        3
3700801    4.0-5      0.0        3
3700901    0.28       0.28       1
```

```
3700902   0.84      0.84      2
3701001   01000     3
3701101   0000      2
3701201   0         1.51912+7 1227350.  2456950.  0.0       0.0  1
3701202   0         1.51889+7 1227350.  2456950.  0.0       0.0  2
3701203   0         1.51889+7 1227350.  2456950.  0.0       0.0  3
3701300   0
3701301   0.        0.        0.0       2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* reflood assist bypass valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3750000   rabsvalv  valve
3750101   370010000 380000000 0.0       0.90+4    0.90+4    1100
3750201   0         .05011390 .05011390 0.0
3750300   trpvlv
3750301   681
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* reflood assist bypass piping - hot leg side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3800000   rabshl    pipe
3800001   3
3800101   0.0776    1
3800102   0.0388    3
3800201   0.0388    2
3800301   0.0       3
3800401   0.0915    1
3800402   0.048     2
3800403   0.0489    3
3800601   0.0       1
3800602   -90.0     2
3800603   0.0       3
3800701   0.0       1
3800702   -0.64     2
3800703   0.0       3
3800801   4.0-5     0.0       3
3800901   0.84      0.84      1
3800902   0.28      0.28      2
3801001   01000     3
3801101   0000      2
3801201   0         1.51783+7 1227350.  2456950.  0.0  0.0  1
3801202   0         1.51804+7 1227350.  2456950.  0.0  0.0  2
3801203   0         1.51825+7 1227350.  2456950.  0.0  0.0  3
3801300   0
3801301   0.        0.        0.0       2
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*
*   pressurizer [400]
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
```

```
* surge line pcs side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
4000000   srglnpcs  branch
4000001   2         0
4000101   1.44561-3 2.30      0.0       0.0       90.0      0.54
4000102   2.3622-5  0.0       01000
4000200   0         1.51639+7 1411430.  2455940.  0.0
4001101   107000000 400000000 1.44561-3 3.9       3.9       0002
4002101   400010000 405000000 1.44561-3 2.85      2.85      1000
4001201   -5.33782-3 -5 33797-3 0.0
4002201   -5.33967-3 -5.57944-3 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pressurizer surge line
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
4050000   srglnpzr  pipe
4050001   2
4050101   1.44561-3 2
4050201   1.44561-3 1
4050301   2.30      2
4050401   0.0       2
4050601   90.0      2
4050701   0.30      2
4050801   2.3622-5  0.0       2
4050901   2.85      2.85      1
4051001   01000     2
4051101   1000      1
4051201   0         1.51610+7 1410220.  2456010.  0.0  0.0  1
4051202   0         1.51589+7 1409520.  2456060.  0.0  0.0  2
4051300   0
4051301   -5.34077-3 -5.58056-3 0.0       1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pressurizer surge line
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
4100000   srgline   sngljun
4100101   405010000 415000000 1.44561-3 0.42      1.00      1000
4100201   0         -5.34114-2 -5.58095-2 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pressurizer vessel
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
4150000   pzrvesse  pipe
4150001   12
4150101   0.0       4
4150102   0.5653    10
4150103   0.0       12
4150201   0.0       11
4150301   0.09075   2
4150302   0.0762    4
4150303   0.19835   6
4150304   0.26445   8
```

```
4150305   0.19835    10
4150306   0.09715    12
4150401   0.0342     2
4150402   0.0419     4
4150403   0.0        10
4150404   0.0366     12
4150501   0.0        12
4150601   90.0       12
4150801   4.0-5      0.0        12
4151001   00000      12
4151101   0000       11
4151201   0          1.51573+7 1409310.  2456100.  0.0       0.0  1
4151202   0          1.51561+7 1413430.  2456120.  0.0       0.0  2
4151203   0          1.51543+7 1426460.  2456170.  0.0       0.0  3
4151204   0          1.51519+7 1483560.  2457710.  0.0       0.0  4
4151205   0          1.51506+7 1591830.  2457060.  0.0       0.0  5
4151206   0          1.51503+7 1591820.  2457680.  0.0       0.0  6
4151207   0          1.51503+7 1591820.  2457680.  0.0       0.0  7
4151208   0          1.51503+7 1591820.  2457680.  0.83002   0.0  8
4151209   0          1.51503+7 1591820.  2457680.  1.0       0.0  9
4151210   0          1.51503+7 1591820.  2457680.  1.0       0.0  10
4151211   0          1.51503+7 1591820.  2457680.  1.0       0.0  11
4151212   0          1.51503+7 1591820.  2457680.  1.0       0.0  12
4151300   0
4151301   0.0        0.0        0.0        1
4151302   0.0        0.0        0.0        2
4151303   0.0        0.0        0.0        3
4151304   0.0        0.0        0.0        4
4151305   0.0        0.0        0.0        5
4151306   0.0        0.0        0.0        6
4151307   0.0        0.0        0.0        7
4151308   0.0        0.0        0.0        8
4151309   0.0        0.0        0.0        9
4151310   0.0        0.0        0.0        10
4151311   0.0        0.0        0.0        11
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pressurizer vessel to top hat
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
4170000   vssltpha   sngljun
4170101   415010000  420000000 0.0        0.0        0.0        000000
4170201   0          0.         0.         0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pressurizer top hat and relief connection
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
4200000   pzrtopha   pipe
4200001   2
4200101   0.0        2
4200201   0.0        1
4200301   0.1104915  2
4200401   0.0139870  2
4200601   90.0       2
4200801   4.-5       0.346066   2
4201001   01000      2
4201101   0000       1
4201201   0          1.51502+7 1591810.  2456810.  1.0  0.0  1
4201202   0          1.51501+7 1591810.  2456440.  1.0  0.0  2
4201300   0
4201301   0.         0.         0.0        1
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*
*   steam generator secondary side [500]
*
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* primary separator
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5000000   separato   separatr
5000001   3          0
5000101   0.0        0.4445     0.2425     0.0        90.0       0.4445
5000102   4.-5       0.2840     00010
5000200   0          5309110.   1166670.   2595050.   0.99473
5001101   500010000  520000000  0.087745   0.0        0.0        0100
5002101   500000000  505000000  0.087745   0.0        0.0        0100
5003101   515010000  500000000  0.29187    0.4        0.4        0100
5001201   0.8619500  0.9768100  0.0
5002201   3.5011000  0.7596900  0.0
5003201   0.2580600  6.2030000  0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* separator bypass
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5030000   sepbypas   branch
5030001   2          0
5030101   0.0        0.4445     0.4384     0.0        90.0       0.4445
5030102   4.-5       0.3678     01000
5030200   0          5307980.   1166570.   2595070.   0.97453
5031101   505000000  503000000  0.98627    0.0        0.0        0100
5032101   503010000  520000000  0.98627    0.8        0.0        0100
5031201   -4.0292-2  0.8901400  0.0
5032201   -2.864400  0.3656600  0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* separator outlet region
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5050000   lwrsepar   branch
5050001   1          0
5050101   0.0        1.2131     1.4850     0.0        -90.0      -1.2131
5050102   4.-5       1.9048     01000
5050200   0          5310820.   1166750.   2595080.   0.40615
```

```
5051101   505010000 508000000 0.0       0.0       0.0       0100
5051201   .33789000 0.1040100 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* feed inlet volume
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5080000   uprdwncm  branch
5080001   1         0
5080101   0.0       0.6096    0.22107   0.0       -90.0     -0.6096
5080102   4.-5      0.163697  01000
5080200   0         5315970.  1079520.  2595080.  3.88358-2
5081101   508010000 510000000 0.0       0.0       0.0       0100
5081201   0.4540600 0.4132800 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* steam generator downcomer
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5100000   dwncmr    annulus
5100001   3
5100101   0.232     3
5100201   0.0       2
5100301   0.6096    3
5100401   0.0       3
5100601   -90.0     3
5100701   -0.6096   3
5100801   4.-5      0.10793   3
5100901   0.0       0.0       2
5101001   01000     3
5101101   0000      2
5101201   0         5320610.  1080220.  2595040.  1.90351-2 0.0     1
5101202   0         5325350.  1080590.  2595010.  1.19284-2 0.0     2
5101203   0         5330120.  1080750.  2594980.  5.50501-3 0.0     3
5101300   0
5101301   0.4454600 0.4298400 0.0       1
5101302   0.4424300 0.4343500 0.0       2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* junction - downcomer to boiler
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5130000   dncmrblr  sngljun
5130101   510010000 515000000 0.0       17.5      17.5      0100
5130201   0         0.4393500 0.8274000 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* steam generator boiler
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5150000   boiler    pipe
5150001   5
5150101   0.2776    4
5150102   0.306294  5
5150201   0.0       4
5150301   1.8288    4
515C302   1.2131    5
5150401   0.0       5
5150601   60.0      4
5150602   90.0      5
5150701   0.6096    4
5150702   1.2131    5
5150801   4.-5      0.0234    4
5150802   4.-5      0.5962    5
5150901   4.05      4.05      4
5151001   01000     5
5151101   0100      4
5151201   0         5329600.  1157240.  2594970.  0.40547 0.0   1
5151202   0         5326070.  1167420.  2594990.  0.57033 0.0   2
5151203   0         5321980.  1167400.  2595010.  0.52116 0.0   3
5151204   0         5317230.  1167120.  2595040.  0.56785 0.0   4
5151205   0         5311570.  1166820.  2595000.  0.49036 0.0   5
5151300   0
5151301   0.5723800 1.5053000 0.0       1
5151302   0.7316200 2.7809000 0.0       2
5151303   0.5858100 4.9086000 0.0       3
5151304   0.5909000 5.8102000 0.0       4
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* lower portion of steam dome
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5200000   lwrstmdm  branch
5200001   1         0
5200101   0.0       0.46956   0.705312  0.0       90.0      0.46956
5200102   4.-5      1.383     01000
5200200   0         5307820.  1166560.  2595020.  1.0
5201101   520010000 525000000 0.0       0.0       0.0       000000
5201201   0.5791000 0.5902800 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* upper portion of steam dome
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5250000   uprstmdm  branch
5250001   1         0
5250101   0.0       0.46956   0.705312  0.0       90.0      0.46956
5250102   4.-5      1.383     01000
5250200   0         5307700.  1166550.  2595030.  1.0
5251101   525010000 530000000 0.0       0.8       0.8       0100
5251201   18.551000 19.133000 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* steam pipe from generator to control valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5300000   steampip  snglvol
5300101   0.04635   25.074    0.0       0.0       0.0       0.0
5300102   4.-5      0.0       01000
5300200   0         5309790.  1166680.  2595120.  1.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* steam flow control valve
```

```
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5400000   cv-p4-10   valve
5400101   530010000  541000000  0.0047772  0.0        0.0        1100
5400201   0          18.813000  19.188000  0.0
5400300   mtrvlv
5400301   687        688        0.05       0.64829    540
20254000  normarea
20254001  0.0        0.0
20254002  9.25-4     9.25-4
20254003  1.0        1.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pipe downstream of steam control valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5410000   condinlt   branch
5410001   1          0
5410101   0.06557    54.44      0.0        0.0        0.0        0.0
5410102   4.-5       0.0        01000
5410200   0          2077680.   915077.    2597730.   1.0
5411101   541010000  542000000  0.0        0.0        0.0        0100
5411201   10.486000  32.894000  0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* air cooled condenser
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5420000   condense   tmdpvol
5420101   0.21677    17.67      0.0        0.0        0.0        0.0
5420102   4.-5       0.02       00000
5420200   2
5420207   0.0        2.069+6    1.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* simplified feed system
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* feed storage tank
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5650000   feedtnk    tmdpvol
5650101   29.81      3.048      0.0        0.0        0.0        0.0
5650102   4.-5       0.0        00000
5650200   3          0
5650201   0.0        7.6+6      477.6 * TC = 555.8
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* feed water
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5660000   feed       tmdpjun
5660101   565000000  508000000  0.05
5660200   1          0          cntrlvar   912
5660201   -100.0     19.017     0.0        0.0
5660202   -1.0       0.0        0.0        0.0
5660203   0.0        0.0        0.0        0.0
5660204   50.0       50.0       0.0        0.0
*
```

```
20591100  sglvlerr   sum        1.0        0.0        1
20591101  3.1293     -1.0       cntrlvar   1
20591200  feedflow   sum        1.0        0.0        1
20591201  0.0        1.0        mflowj     540000000
20591202             48.4       cntrlvar   911
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*
*   ecc system [600]
*
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* eccs header to pcs
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
6050000   eccshead   snglvol
6050101   5.9896-3   1.0        0.0        0.0        90.0       1.0
6050102   4.0-5      0.0        01000
6050200   0          1.52222+7  1227290.   2454520.   0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* accumulator valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
6100000   accumvlv   valve
6100101   615010000  605000000  5.9896-3   6.278      6.278      1100
6100201   0          0.         0.         0.
6100300   trpvlv
6100301   682
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* accumulator pipe
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
6150000   accpipe    snglvol
6150101   0.0        25.997165  0.3327     0.0        0.0        0.0
6150102   4.0-5      0.0        01000
6150200   0          4.11+6     120491.12  2600476.   0.
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* accumulator vessel
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
6200000   accumula   accum
6200101   1.254      1.4151     0.0        0.0        90.0       1.4151
6200102   4.0-5      0.0        00000
6200200   4.11+6     302.0
6201101   615000000  8.2132-3   40.        40.        00000
6202200   1.315      0.0        3.3266     0.8        0.04445    1 0.0 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* bwst lpis
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
6250000   bwstlpis   tmdpvol
6250101   20.44      5.0        0.0        0.0        90.0       5.0
6250102   4.0-5      0.0        00000
6250200   3
6250201   0.0        1.0+5      305.0
```

```
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* low pressure injection system
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
6300000   lpis        tmdpjun
6300101   625000000   605000000  5.9896-3
6300200   1           516        p         605010000
6300201   -1.0        0.0        0.0       0.0
6300202   0.0         0.0        0.0       0.0
6300203   8.483+4     7.045      0.0       0.0
6300204   4.297+5     6.091      0.0       0.0
6300205   7.745+5     5.045      0.0       0.0
6300206   9.448+5     4.313      0.0       0.0
6300207   1.119+6     3.454      0.0       0.0
6300208   1.186+6     3.173      0.0       0.0
6300209   1.257+6     2.673      0.0       0.0
6300210   1.326+6     2.159      0.0       0.0
6300211   1.395+6     1.536      0.0       0.0
6300212   1.464+6     0.7182     0.0       0.0
6300213   1.517+6     0.0        0.0       0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* bwst hpis
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
6350000   bwsthpis    tmdpvol
6350101   20.44       5.0        0.0       0.0       90.0      5.0
6350102   4.0-5       0.0        00000
6350200   3
6350201   0.0         1.0+5      305.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* high pressure injection system
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
6400000   hpis        tmdpjun
6400101   635000000   605000000  5.9896-3
6400200   1           513        p         605010000
6400201   -1.0        0.0        0.0       0.0
6400202   0.0         .75687272  0.0       0.0
6400203   7.72514+6   .75687272  0.0       0.0
6400204   8.3597+6    .31536281  0.0       0.0
6400205   17.2436+6   .31536281  0.0       0.0
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*
*   containment
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* containment broken loop hot leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
7000000   contblhl    tmdpvol
7000101   0.0         1.0        0.1       0.0       0.0       0.0
7000102   0.0         0.0        00000
7000200   2           510
7050201   -1.0        106538.    1.0
7000202   0.0         106538.    1.0
7000203   0.278       108155.    1.0
7000204   0.578       181026.    1.0
7000205   1.078       207760.    1.0
7000206   2.078       186200.    1.0
7000207   10.078      251526.    1.0
7000208   20.378      311353.    1.0
7000209   30.378      284404.    1.0
7000210   40.378      266941.    1.0
7000211   50.378      256484.    1.0
7000212   57.278      253142.    1.0
7000213   65.078      300896.    1.0
7000214   75.978      312754.    1.0
7000215   1.+5        100000.    1.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* containment broken loop cold leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
7050000   contblcl    tmdpvol
7050101   0.0         1.0        0.1       0.0       0.0       0.0
7050102   0.0         0.0        00000
7050200   2           510
7050201   -1.0        106538.    1.0
7050202   0.0         106538.    1.0
7050203   0.278       108155.    1.0
7050204   0.578       181026.    1.0
7050205   1.078       207760.    1.0
7050206   2.078       186200.    1.0
7050207   10.078      251526.    1.0
7050208   20.378      311353.    1.0
7050209   30.378      284404.    1.0
7050210   40.378      266941.    1.0
7050211   50.378      256484.    1.0
7050212   57.278      253142.    1.0
7050213   65.078      300896.    1.0
7050214   75.978      312754.    1.0
7050215   1.+5        100000.    1.0
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*
*   reactor vessel heat structures
*
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* active core
* station 116.91 to 182.94
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* peripheral fuel modules
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
12300000  12          10         2         1         0.0  555  1  8
```

```
12300001  7.869e+6  230120000
12300011  1.0e-6    2.0e-6    0.0       0.0       12
12300100  0         1
12300101  5         4.65564-3
12300102  1         4.75106-3
12300103  3         5.36806-3
12300201  1         5
12300202  -2        6
12300203  -3        9
12300301  1.0       5
12300302  0.0       9
12300401  620.0     10
12300501  0         0         0         1         153.113   12
12300601  230010000 10000     1         1         153.113   12
12300701  900       0.0491863 0.0       0.0       1 * sgtr 36mw
12300702  900       0.0715012 0.0       0.0       2 * sgtr 36mw
12300703  900       0.0876709 0.0       0.0       3 * sgtr 36mw
12300704  900       0.0954000 0.0       0.0       4 * sgtr 36mw
12300705  900       0.0967838 0.0       0.0       5 * sgtr 36mw
12300706  900       0.0912038 0.0       0.0       6 * sgtr 36mw
12300707  900       0.0802690 0.0       0.0       7 * sgtr 36mw
12300708  900       0.0668933 0.0       0.0       8 * sgtr 36mw
12300709  900       0.0533180 0.0       0.0       9 * sgtr 36mw
12300710  900       0.0390090 0.0       0.0       10 * sgtr 36mw
12300711  900       0.0241660 0.0       0.0       11 * sgtr 36mw
12300712  900       0.0093230 0.0       0.0       12 * sgtr 36mw
12300901  0.        10.0  10.0   0.0  0.0  0.0  0.0   1.0    12
*---- ----1---- ----1---- ----1---- -- -1---- ----1---- ----1----
* center fuel module
*---- ----1---- ----1---- ----1---- ----1---- ---1---- ----1----
12310000  12        10        2         1         0.0  555  1  8
12310001  7.869e+6  231120000
12310011  1.0e-6    2.0e-6    0.0       0.0       12
12310100  0         1
12310101  5         4.65564-3
12310102  1         4.75106-3
12310103  3         5.36806-3
12310201  1         5
12310202  -2        6
12310203  -3        9
12310301  1.0       5
12310302  0.0       9
12310401  620.0     10
12310501  0         0         0         1         28.4988   12
12310601  231010000 10000     1         1         28.4988   12
12310701  900       0.0150773 0.0       0.0       1 * sgtr 36mw
12310702  900       0.0219175 0.0       0.0       2 * sgtr 36mw
12310703  900       0.0268865 0.0       0.0       3 * sgtr 36mw
12310704  900       0.0292777 0.0       0.0       4 * sgtr 36mw
12310705  900       0.0296964 0.0       0.0       5 * sgtr 36mw
12310706  900       0.0279639 0.0       0.0       6 * sgtr 36mw
12310707  900       0.0246052 0.0       0.0       7 * sgtr 36mw
12310708  900       0.0205051 0.0       0.0       8 * sgtr 36mw
12310709  900       0.0163438 0.0       0.0       9 * sgtr 36mw
12310710  900       0.0119576 0.0       0.0       10 * sgtr 36mw
12310711  900       0.0074077 0.0       0.0       11 * sgtr 36mw
12310712  900       0.0028578 0.0       0.0       12 * sgtr 36mw
12310901  0.        10.0  10.0   0.0  0.0  0.0  0.0   1.0   12
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*
*   steam generator heat structures
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* tubing
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
11150000  8         8         2         0         0.0051054
11150100  0         1
11150101  7         0.006348984
11150201  6         7
11150301  0.0       7
11150400  0
11150401  557.59    8
11150501  115010000 10000     1         1         1124.71   3
11150502  115040000 10000     1         1         849.063   5
11150503  115060000 10000     1         1         1124.71   8
11150601  515010000 10000     1         1         1124.71   3
11150602  515040000 0         1         1         849.063   4
11150603  515040000 0         1         1         849.063   5
11150604  515030000 -10000    1         1         1124.71   8
11150701  0         0         0         0         8
11150801  0.  10.   10.   0.0   0.0   0.0   0.0   1.0   8
11150901  0.  10.   10.   0.0   0.0   0.0   0.0   1.0   8
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
* volume (200)
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
12000000  1         5         2         0         0.508
12000100  0         1
12000101  4         0.7264
12000201  4         4
12000301  0.0       4
12000400  0
12000401  555.86    5
12000501  200010000 0         1         1         0.09381   1
12000601  0         0         0         1         0.09381   1
12000701  0         0.0       0.0       0.0       1
```

```
12000801  0.0  10.  10.  0.0  0.0  0.0  0.0  1.0  1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
12020000  1         5         2         0         0.508
12020100  0         1
12020101  4         0.7264
12020201  4         4
12020301  0.0       4
12020400  0
12020401  555.89    5
12020501  202010000 0         1         1         0.1426    1
12020601  0         0         0         1         0.1426    1
12020701  0         0.0       0.0       0.0       1
12020801  0.0  10.  10.  0.0  0.0  0.0  0.0  1.0  1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* volume 210
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
12100000  4         5         2         0         0.47
12100100  0         1
12100101  4         0.7264
12100201  1         4
12100301  0.0       4
12100400  0
12100401  555.87    5
12100501  210010000 0         1         1         0.1267    1
12100502  210020000 0         1         1         0.7603    2
12100503  210030000 0         1         1         0.6308    3
12100504  210040000 0         1         1         0.5396    4
12100601  0         0         0         1         0.1267    1
12100602  0         0         0         1         0.7603    2
12100603  0         0         0         1         0.6308    3
12100604  0         0         0         1         0.5396    4
12100701  0         0.0       0.0       0.0       4
12100801  0.0  10.  10.  0.0  0.0  0.0  0.0  1.0  4
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* vloume 220
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
12200000  1         5         2         0         0.47
12200100  0         1
12200101  4         0.7264
12200201  4         4
12200301  0.0       4
12200400  0
12200401  555.98    5
12200501  220010000 0         1         1         0.479     1
12200601  0         0         0         1         0.479     1
12200701  0         0.0       0.0       0.0       1
12200801  0.0  10.  10.  0.0  0.0  0.0  0.0  1.0  1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* volume 222
```

```
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
12220000  1         5         2         0         0.47
12220100  0         1
12220101  4         0.7264
12220201  4         4
12220301  0.0       4
12220400  0
12220401  555.97    5
12220501  222010000 0         1         1         0.36      1
12220601  0         0         0         1         0.36      1
12220701  0         0.0       0.0       0.0       1
12220801  0.0  10.  10.  0.0  0.0  0.0  0.0  1.0  1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* core support structure (volume 225)
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
12250000  1         5         2         0         0.282
12250100  0         1
12250101  4         0.3
12250201  4         4
12250301  0.0       4
12250400  0
12250401  555.81    5
12250501  225010000 0         1         1         0.4269792 1
12250601  0         0         0         1         0.4269792 1
12250701  0         0.0       0.0       0.0       1
12250801  0.0  10.  10.  0.0  0.0  0.0  0.0  1.0  1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* volume 270
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
12700000  1         5         2         0         0.508
12700100  0         1
12700101  4         0.7264
12700201  4         4
12700301  0.0       4
12700400  0
12700401  555.88    5
12700501  270010000 0         1         1         0.09381   1
12700601  0         0         0         1         0.09381   1
12700701  0         0.0       0.0       0.0       1
12700801  0.0  10.  10.  0.0  0.0  0.0  0.0  1.0  1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* volume 272
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
12720000  1         5         2         0         0.508
12720100  0         1
12720101  4         0.7264
12720201  4         4
12720301  0.0       4
12720400  0
```

```
12720401  555.91    5
12720501  272010000 0         1         1         0.1426   1
12720601  0         0         0         1         0.1426   1
12720701  0         0.0       0.0       0.0       1
12720801  0.0  10.  10.  0.0  0.0  0.0  0.0  1.0  1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* volume 280
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
12800000  4         5         2         0         0.47
12800100  0         1
12800101  4         0.7264
12800201  1         4
12800301  0.0       4
12800400  0
12800401  555.83    5
12800501  280010000 0         1         1         0.1267   1
12800502  280020000 0         1         1         0.7603   2
12800503  280030000 0         1         1         0.6308   3
12800504  280040000 0         1         1         0.5396   4
12800601  0         0         0         1         0.1267   1
12800602  0         0         0         1         0.7603   2
12800603  0         0         0         1         0.6308   3
12800604  0         0         0         1         0.5396   4
12800701  0         0.0       0.0       0.0       4
12800801  0.0  10.  10.  0.0  0.0  0.0  0.0  1.0  4
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*
*   heat structure thermal property data
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20100100  tbl/fctn  1         1         * uo2
20100200  tbl/fctn  3         1         * gap
20100300  tbl/fctn  1         1         * zr
20100400  tbl/fctn  1         1         * s-steel
20100500  c-steel
20100600  tbl/fctn  1         1         * inconel 600
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* uo2 - thermal conductivity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20100101  2.7315+2  8.44
20100102  4.1667+2  6.46
20100103  5.3315+2  5.782385
20100104  6.99817+2 4.633177
20100105  8.66483+2 3.880307
20100106  1.03315+3 3.357625
20100107  1.08871+3 3.155129
20100108  1.19982+3 2.983787
20100109  1.28315+3 2.836674
20100110  1.36648+3 2.713792
20100111  1.53315+3 2.521680
20100112  1.61648+3 2.448990
20100113  1.69982+3 2.391870
20100114  1.97759+3 2.289762
20100115  2.25537+3 2.307069
20100116  2.53315+3 2.433413
20100117  2.81093+3 2.661870
20100118  3.08871+3 2.994171
*---- ----1---- --------- ---11---- ----1---- ----1---- ----1----
* uo2 - volumetric heat capacity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20100151  2.73150+2 2.310427+6
20100152  3.23150+2 2.571985+6
20100153  3.73150+2 2.746357+6
20100154  6.7315+2  3.138694+6
20100155  1.37315+3 3.443844+6
20100156  1.77315+3 3.531030+6
20100157  1.97315+3 3.792588+6
20100158  2.17315+3 4.228518+6
20100159  2.37315+3 4.882412+6
20100160  2.67315+3 6.015829+6
20100161  2.77315+3 6.320980+6
20100162  2.87315+3 6.582538+6
20100163  2.97315+3 6.713317+6
20100164  3.11315+3 6.800503+6
20100165  4.69982+3 6.800503+6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* helium(gap) - thermal conductivity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20100201  helium    100.00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* helium(gap) - volumetric heat capacity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20100251  273.15    5.4
20100252  5000.0    5.4
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* zircaloy-4 - thermal conductivity          from matpro
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20100301  360.4     13.6
*20100301  380.4     13.6
20100302  469.3     14.6
20100303  577.6     15.8
20100304  685.9     17.3
20100305  774.8     18.4
20100306  872.0     19.8
20100307  973.2     21.8
20100308  1073.2    23.2
20100309  1123.2    25.4
20100310  1152.3    24.2
```

```
20100311  1232.2    25.5
20100312  1331.2    26.6
20100313  1404.2    28.2
20100314  1576.2    33.0
20100315  1625.2    36.7
20100316  1755.2    41.2
20100317  2273.2    55.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* zircaloy-4 - volumetric heat capacity      from matpro
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20100351  300.0     1.841+6
20100352  400.0     1.978+6
20100353  640.0     2.168+6
20100354  1090.0    2.456+6
20100355  1093.0    3.288+6
20100356  1113.0    3.865+6
20100357  1133.0    4.028+6
20100358  1153.0    4.709+6
20100359  1173.0    5.345+6
20100360  1193.0    5.044+6
20100361  1213.0    4.054+6
20100362  1233.0    3.072+6
20100363  1243.0    2.332+6
20100364  1477.6    2.332+6
20100365  1711.6    2.332+6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* s-steel - thermal conductivity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20100401  273.15    12.98
20100402  1199.82   25.1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* s-steel - volumetric heat capacity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20100451  273.15    3.83+6
20100452  366.5     3.83+6
20100453  477.59    4.190+6
20100454  588.59    4.336+6
20100455  699.82    4.504+6
20100456  810.93    4.639+6
20100457  922.04    4.773+6
20100458  1144.26   5.076+6
20100459  1366.5    5.376+6
20100460  1477.59   5.546+6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* inconel-600 - thermal conductivity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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    26.83
20100608  1144.3    29.42
20100609  1477.6    36.06
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* inconel-600 - volumetric heat capacity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20100651  366.5     3.908+6
20100652  477.6     4.084+6
20100653  588.7     4.260+6
20100654  700.0     4.436+6
20100656  810.9     4.665+6
20100657  922.0     4.929+6
20100658  1033.2    5.105+6
20100659  1477.6    5.727+6
*
*
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*
*        control variables
*
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*  001-006  level calculators
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 001 steam generator level
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20500100  sglvl     sum       1.0       0.0       1
20500101  0.0       0.4445    voidf     503010000
20500102            1.2131    voidf     505010000
20500103            0.6096    voidf     508010000
20500104            0.6096    voidf     510010000
20500105            0.6096    voidf     510020000
20500106            0.6096    voidf     510030000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 002 pressurizer level
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20500200  pzrlvl    sum       1.0       0.0       1
20500201  0.0       0.09075   voidf     415010000
20500202            0.09075   voidf     415020000
20500203            0.0762    voidf     415030000
20500204            0.0762    voidf     415040000
20500205            0.19835   voidf     415050000
20500206            0.19835   voidf     415060000
20500207            0.26445   voidf     415070000
20500208            0.26445   voidf     415080000
20500209            0.19835   voidf     415090000
20500210            0.19835   voidf     415100000
```

```
20500211             0.0975     voidf     415110000
20500212             0.0975     voidf     415120000
20500213             0.19835    voidf     420010000
20500214             0.19835    voidf     420020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 004 accumulator level
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20500400  accmlvl             integral  -4.7764-3 2.1       0
20500401  velfj      610000000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 007 reactor vessel downcomer level intact side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20500700  rvdclvl             sum       1.        5.3137665 0
20500701  0.0        0.1876129 voidf    200010000
20500702             0.2851823 voidf    202010000
20500703             0.2525361 voidf    210010000
20500704             1.5200561 voidf    210020000
20500705             1.2616633 voidf    210030000
20500706             1.0792591 voidf    210040000
20500707             0.3533183 voidf    222010000
20500708             0.3741720 voidf    220010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20500800  rvdclvl             sum       1.        5.3137665 0
20500801  0.0        0.1876129 voidf    270010000
20500802             0.2851823 voidf    272010000
20500803             0.2525361 voidf    280010000
20500804             1.5200561 voidf    280020000
20500805             1.2616333 voidf    280030000
20500806             1.0792591 voidf    280040000
20500807             0.3533183 voidf    222010000
20500808             0.3741720 voidf    220010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 230 level average channel
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20523000  "lvl avg"           sum       1.0       2.975010  0
20523001  0.0        0.1397017 voidf    230010000
20523002             0.1397017 voidf    230020000
20523003             0.1397017 voidf    230030000
20523004             0.1397017 voidf    230040000
20523005             0.1397017 voidf    230050000
20523006             0.1397017 voidf    230060000
20523007             0.1397017 voidf    230070000
20523008             0.1397017 voidf    230080000
20523009             0.1397017 voidf    230090000
20523010             0.1397017 voidf    230100000
20523011             0.1397017 voidf    230110000
20523012             0.1397017 voidf    230120000
*20523013             0.3742720 voidf    220010000
*20523014             0.3533183 voidf    222010000
*20523015             0.5709989 voidf    225010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 231 level hot channel
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20523100  "lvl hot"           sum       1.0       2.975010  0
20523101  0.0        0.1397017 voidf    231010000
20523102             0.1397017 voidf    231020000
20523103             0.1397017 voidf    231030000
20523104             0.1397017 voidf    231040000
20523105             0.1397017 voidf    231050000
20523106             0.1397017 voidf    231060000
20523107             0.1397017 voidf    231070000
20523108             0.1397017 voidf    231080000
20523109             0.1397017 voidf    231090000
20523110             0.1397017 voidf    231100000
20523111             0.1397017 voidf    231110000
20523112             0.1397017 voidf    231120000
*20523113             0.3742720 voidf    220010000
*20523114             0.3533183 voidf    222010000
*20523115             0.5709989 voidf    225010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 090 thermal power - average
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20509000  "pow-avg"           sum       1.        3.57765+7 0
20509001  0.0        1.         q       230010000
20509002             1.         q       230020000
20509003             1.         q       230030000
20509004             1.         q       230040000
20509005             1.         q       230050000
20509006             1.         q       230060000
20509007             1.         q       230070000
20509008             1.         q       230080000
20509009             1.         q       230090000
20509010             1.         q       230100000
20509011             1.         q       230110000
20509012             1.         q       230120000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 091 thermal power - hot
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20509100  "pow-hot"           sum       1.        0.91253+7 0
20509101  0.0        1.         q       231010000
20509102             1.         q       231020000
20509103             1.         q       231030000
20509104             1.         q       231040000
20509105             1.         q       231050000
20509106             1.         q       231060000
20509107             1.         q       231070000
20509108             1.         q       231080000
20509109             1.         q       231090000
```

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20509110          1.       q       231100000
20509111          1.       q       231110000
20509112          1.       q       231120000
*---- ----1---- ---- ---- ----1---- ----1---- ----1---- ----1----
* 235 level bypass channel
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20523500  "lvl vyps"       sum     0.5588068 1.6764202 0
20523501  0.0      1.0     voidf   235010000
20523502           1.0     voidf   235020000
20523503           1.0     voidf   235030000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 071-073 mass loss calculator
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20507100  losscl           integral  1.        0.        0
20507101  mflowj   347000000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20507200  losshl           integral  1.        0.        0
20507201  mflowj   317000000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20507300  lossum           sum     1.          0.        0
20507301  0.0      1.0     cntrlvar  71
20507302           1.0     cntrlvar  72
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 080-801  average values of pumps
*
* 080      average pump speed
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20508000  pmpspeed  sum     1.       209.17993 0
20508001  0.0       0.5     pmpvel   135
20508002            0.5     pmpvel   165
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 081  average pump head
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20508100  avgpmphd  sum     1.       204090.5  0
20508101  0.0       0.5     pmpvel   135
20508102            0.5     pmpvel   165
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 090 thermal power - average
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20509000  "pow-avg"        sum     1.          3.81098+7 0
20509001  0.0      1.      q       230010000
20509002           1.      q       230020000
20509003           1.      q       230030000
20509004           1.      q       230040000
20509005           1.      q       230050000
20509006           1.      q       230060000
20509007           1.      q       230070000
20509008           1.      q       230080000
20509009           1.      q       230090000
20509010           1.      q       230100000
20509011           1.      q       230110000
20509012           1.      q       230120000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 091 thermal power - hot
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20509100  "pow-hot"        sum     1.          1.0559+7  0
20509101  0.0      1.      q       231010000
20509102           1.      q       231020000
20509103           1.      q       231030000
20509104           1.      q       231040000
20509105           1.      q       231050000
20509106           1.      q       231060000
20509107           1.      q       231070000
20509108           1.      q       231080000
20509109           1.      q       231090000
20509110           1.      q       231100000
20509111           1.      q       231110000
20509112           1.      q       231120000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 093 heat sink  (steam generator)
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20509300  "heatsink"       sum     -1.         4.93949+7 0
20509301  0.0      1.      q        115010000
20509302           1.      q        115020000
20509303           1.      q        115030000
20509304           1.      q        115040000
20509305           1.      q        115050000
20509306           1.      q        115060000
20509307           1.      q        115070000
20509308           1.      q        115080000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
*
* 095 - 098  power of structure heat capacity
*
* 095 structure downcomer intact loop
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20509500  "hc intl"        sum     1.          1941.8926 0
20509501  0.0      1.0     q       200010000
20509502           1.0     q       202010000
20509503           1.0     q       210010000
20509504           1.0     q       210020000
20509505           1.0     q       210030000
20509506           1.0     q       210040000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
```

```
* 096 structure downcomer broken loop
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20509600  "hc brkl"            sum      1.        2181.7821 0
20509601  0.0        1.0       q        270010000
20509602             1.0       q        272010000
20509603             1.0       q        280010000
20509604             1.0       q        280020000
20509605             1.0       q        280030000
20509606             1.0       q        280040000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 097 structure core barrel
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20509700  "hc core"            sum      1.        259.08643 0
20509701  0.0        1.0       q        220010000
20509702             1.0       q        222010000
20509703             1.0       q        225010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 098 structure total
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20509800  heatcap              sum      1.        4382.7578 0
20509801  0.0        1.0       cntrlvar  95
20509802             1.0       cntrlvar  96
20509803             1.0       cntrlvar  97
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 510 - 520   trip-sets
*
* 510 blow-down valves
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20551000  blowdown             tripunit  1.        0.        0
20551001  510
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 511 power scram
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20551100  powerscr             tripunit  1.        0.        0
20551101  511
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 512 pump trip
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20551200  pumptrip             tripunit  1.        0.        0
20551201  512
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 513 hpis trip
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20551300  hpistrip             tripunit  1.        0.        0
20551301  513
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
```

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* 536 lpis trip
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20553600  lpistrip             tripunit  1.        0.        0
20553601  516
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 524 accumulator valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20552400  accumulv             tripunit  1.        0.        0
20552401  682
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 514 eccs
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*20551400  eccs                sum       1.        0.        0
*20551401  0.0        .3       cntrlvar  523
*20551402             .7       cntrlvar  524
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 516 steam valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20552600  steamvop             tripunit  1.        0.        0
20552601  685
20552700  steamvcl             tripunit  -1.       0.        0
20552701  686
20551600  steamvlv             sum       1.        0.        0
20551601  0.0        1.0       cntrlvar  526
20551602             1.0       cntrlvar  527
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
*
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
* 401 - 408 mass flux, momentum flux of 225-01
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 401 absolute of velfj 225010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20540100  avl22501             stdfnctn  1.        0.        1
20540101             abs       velfj     225010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 402 absolute of velfj 225010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20540200  avg22501             stdfnctn  1.        0.        1
20540201             abs       velgj     225010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 403 liquid mass flux of junction 225010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20540300  mfl22501             mult      1.        0.        1
20540301  voidfj     225010000 rhofj     225010000
20540302  velfj      225010000
```

```
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 404 void mass flux of junction 225010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20540400  mfg22501            mult     1.       0.       1
20540401  voidgj    225010000 rhogj    225010000
20540402  velgj     225010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 405 mass flux of junction 225010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20540500  mf22501             sum      1.       0.       1
20540501            0.0       1.0      cntrlvar 403
20540502                      1.0      cntrlvar 404
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 406 liquid phase momentum flux of junction 225010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20540600  mml22501            mult     1.       0.       1
20540601  cntrlvar  401       cntrlvar 403
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 407 void phase momentum flux of junction 225010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20540700  mmg22501            mult     1.       0.       1
20540701  cntrlvar  402       cntrlvar 404
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 408 momentum flux of junction 225010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20540800  mmf22501            sum      1.       0.       1
20540801            0.0       1.0      cntrlvar 406
20540802                      1.0      cntrlvar 407
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
* 411 - 418 mass flux, momentum flux of 225-02
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 411 absolute of velfj 225020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20541100  avl22502            stdfnctn 1.       0.       1
20541101            abs       velfj    225020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 412 absolute of velfj 225020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20541200  avg22502            stdfnctn 1.       0.       1
20541201            abs       velgj    225020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 413 liquid mass flux of junction 225020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20541300  mfl22502            mult     1.       0.       1
20541301  voidfj    225020000 rhofj    225020000
20541302  velfj     225020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 414 void mass flux of junction 225020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20541400  mfg22502            mult     1.       0.       1
20541401  voidgj    225020000 rhogj    225020000
20541402  velgj     225020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 415 mass flux of junction 225020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20541500  mf22502             sum      1.       0.       1
20541501            0.0       1.0      cntrlvar 413
20541502                      1.0      cntrlvar 414
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 416 liquid phase momentum flux of junction 225020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20541600  mml22502            mult     1.       0.       1
20541601  cntrlvar  411       cntrlvar 413
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 417 void phase momentum flux of junction 225020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20541700  mmg22502            mult     1.       0.       1
20541701  cntrlvar  412       cntrlvar 414
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 418 momentum flux of junction 225020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20541800  mmf22502            sum      1.       0.       1
20541801            0.0       1.0      cntrlvar 416
20541802                      1.0      cntrlvar 417
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
* 421 - 428 mass flux, momentum flux of 240-01
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 421 absolute of velfj 240010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20542100  avl24001            stdfnctn 1.       0.       1
20542101            abs       velfj    240010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 422 absolute of velfj 240010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20542200  avg24001            stdfnctn 1.       0.       1
20542201            abs       velgj    240010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 423 liquid mass flux of junction 240010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20542300  mfl24001            mult     1.       0.       1
20542301  voidfj    240010000 rhofj    240010000
20542302  velfj     240010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 424 void mass flux of junction 240010000
```

```
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20542400  mfg24001            mult      1.        0.        1
20542401  voidgj    240010000 rhogj     240010000
20542402  velgj     240010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 425 mass flux of junction 240010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20542500  mf24001             sum       1.        0.        1
20542501            0.0       1.0       cntrlvar  423
20542502                      1.0       cntrlvar  424
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 426 liquid phase momentum flux of junction 240010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20542600  mml24001            mult      1.        0.        1
20542601  cntrlvar  421       cntrlvar  423
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 427 void phase momentum flux of junction 240010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20542700  mmg24001            mult      1.        0.        1
20542701  cntrlvar  422       cntrlvar  424
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 428 momentum flux of junction 240010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20542800  mmf24001            sum       1.        0.        1
20542801            0.0       1.0       cntrlvar  426
20542802                      1.0       cntrlvar  427
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
* 431 - 438 mass flux, momentum flux of 240-02
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 431 absolute of velfj 240020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20543100  avl24002            stdfnctn  1.        0.        1
20543101            abs       velfj     240020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 432 absolute of velfj 240020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20543200  avg24002            stdfnctn  1.        0.        1
20543201            abs       velgj     240020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 433 liquid mass flux of junction 240020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20543300  mfl24002            mult      1.        0.        1
20543301  voidfj    240020000 rhofj     240020000
20543302  velfj     240020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 434 void mass flux of junction 240020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20543400  mfg24002            mult      1.        0.        1
20543401  voidgj    240020000 rhogj     240020000
20543402  velgj     240020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 435 mass flux of junction 240020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20543500  mf24002             sum       1.        0.        1
20543501            0.0       1.0       cntrlvar  433
20543502                      1.0       cntrlvar  434
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 436 liquid phase momentum flux of junction 240020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20543600  mml24002            mult      1.        0.        1
20543601  cntrlvar  431       cntrlvar  433
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 437 void phase momentum flux of junction 240020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20543700  mmg24002            mult      1.        0.        1
20543701  cntrlvar  432       cntrlvar  434
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 438 momentum flux of junction 240020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20543800  mmf24002            sum       1.        0.        1
20543801            0.0       1.0       cntrlvar  436
20543802                      1.0       cntrlvar  437
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
* 441 - 448 mass flux, momentum flux of 231-05
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 441 absolute of velfj 231050000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20544100  avl23105            stdfnctn  1.        0.        1
20544101            abs       velfj     231050000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 442 absolute of velfj 231050000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20544200  avg23105            stdfnctn  1.        0.        1
20544201            abs       velgj     231050000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 443 liquid mass flux of junction 231050000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20544300  mfl23105            mult      1.        0.        1
20544301  voidfj    231050000 rhofj     231050000
20544302  velfj     231050000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 444 void mass flux of junction 231050000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20544400  mfg23105            mult      1.        0.        1
```

```
20544401  voidgj    231050000  rhogj    231050000
20544402  velgj     231050000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 445 mass flux of junction 231050000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20544500  mf23105             sum        1.         0.         1
20544501            0.0       1.0        cntrlvar   443
20544502                      1.0        cntrlvar   444
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 446 liquid phase momentum flux of junction 231050000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20544600  mml23105            mult       1.         C.         1
20544601  cntrlvar   441      cntrlvar   443
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 447 void phase momentum flux of junction 231050000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20544700  mmg23105            mult       1.         0.         1
20544701  cntrlvar   442      cntrlvar   444
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 448 momentum flux of junction 231050000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20544800  mmf23105            sum        1.         0.         1
20544801            0.0       1.0        cntrlvar   446
20544802                      1.0        cntrlvar   447
*
*
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*
*   general table data
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
*      table
*      number       description
*      ------       -----------
*
*       900         reactor power vs time after scram
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20290000  power     511        1.0        46.0+6
20290001  -1.0      1.0
20290002  0.0       1.0
20290003  0.048     0.79578             * from LP-02-6 Post test
20290004  0.148     0.56127
20290005  0.248     0.39049
20290006  0.348     0.2725
20290007  0.448     0.19258
20290008  0.548     0.13789
20290009  0.648     0.09961
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20290010  0.848     0.05608
20290011  1.048     0.03441
20290012  1.548     0.01969
20290013  2.048     0.0239
20290014  4.048     0.02201
20290015  6.048     0.02032
20290016  8.048     0.01296
20290017  10.048    0.01464
20290018  15.048    0.02032
20290019  20.048    0.02832
20290020  30.048    0.01338
20290021  40.048    0.01212
20290022  50.048    0.00139
20290023  80.048    0.00203
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*
*   pump 1 data
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* single phase head curves
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351100   1                    1
1351101   0.000000+00          1.403600+00
1351102   1.906100-01          1.363600+00
1351103   3.896300-01          1.318600+00
1351104   5.939600-01          1.232800+00
1351105   7.902000-01          1.133600+00
1351106   1.000000+00          1.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351200   1                    2
1351201   0.000000+00          -6.700000-01
1351202   2.000000-01          -5.000000-01
1351203   4.000000-01          -2.500000-01
1351204   5.755400-01          0.000000+00
1351205   7.443200-01          2.583000-01
1351206   7.734800-01          3.778000-01
1351207   8.631300-01          6.326000-01
1351208   1.000000+00          1.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351300   1                    3
1351301   -1.000000+00         2.472200+00
1351302   -8.057400-01         2.047400+00
1351303   -6.069000-01         1.831000+00
```

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1351304    -4.068300-01          1.624000+00
1351305    -2.001710-01          1.470500+00
1351306    0.000000+00           1.403600+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 4
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351400    1                     4
1351401    -1.000000+00          2.472200+00
1351402    -8.229700-01          1.996800+00
1351403    -6.333200-01          1.589700+00
1351404    -4.553400-01          1.327900+00
1351405    -2.710900-01          1.194900+00
1351406    -1.771600-01          1.060500+00
1351407    -9.073000-02          1.015600+00
1351408    0.000000+00           9.342790-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 5
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351500    1                     5
1351501    0.000000+00           2.500000-01
1351502    2.000000-01           2.800000-01
1351503    4.000000-01           3.400000-01
1351504    4.118000-01           2.768000-01
1351505    5.976300-01           4.584000-01
1351506    7.934670-01           6.992000-01
1351507    1.000000+00           1.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* had curve no. 6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351600    1                     6
1351601    0.000000+00           9.342790-01
1351602    9.109900-02           9.229000-01
1351603    1.865090-01           8.963000-01
1351604    2.717620-01           8.750000-01
1351605    4.558720-01           8.433000-01
1351606    5.744060-01           8.355000-01
1351607    7.405760-01           8.466000-01
1351608    7.666190-01           8.469000-01
1351609    8.714710-01           8.838000-01
1351610    1.000000+00           1.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 7
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351700    1                     7
1351701    -1.000000+00          -1.000000+00
1351702    -8.000000-01          -6.300000-01
1351703    -6.000000-01          -3.000000-01
1351704    -4.000000-01          -5.000000-02
1351705    -2.000000-01          1.500000-01
1351706    0.000000+00           2.500000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 8
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351800    1                     8
1351801    -1.000000+00          -1.000000+00
1351802    -8.000000-01          -9.700000-01
1351803    -6.000000-01          -9.500000-01
1351804    -4.000000-01          -8.800000-01
1351805    -2.000000-01          -8.000000-01
1351806    0.000000+00           -6.700000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* single phase torque data
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351900    2                     1
1351901    0.000000+00           6.032000-01
1351902    1.930000-01           6.325000-01
1351903    3.930000-01           7.369000-01
1351904    5.955200-01           8.331000-01
1351905    7.978200-01           9.229000-01
1351906    1.000000+00           1.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1352000    2                     2
1352001    0.000000+00           -6.700000-01
1352002    4.000000-01           -2.500000-01
1352003    5.000000-01           1.500000-01
1352004    7.372550-01           5.265860-01
1352005    7.680490-01           6.065940-01
1352006    8.672300-01           7.436600-01
1352007    1.000000+00           1.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1352100    2                     3
1352101    -1.000000+00          1.984300+00
1352102    -8.009600-01          1.394000+00
1352103    -6.063800-01          1.097500+00
1352104    -4.068600-01          8.220000-01
1352105    -1.992800-01          6.648000-01
1352106    0.000000+00           6.032000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 4
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1352200    2                     4
1352201    -1.000000+00          1.984300+00
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1352202    -8.223400-01        1.830800+00
1352203    -6.337100-01        1.682400+00
1352204    -4.585300-01        1.557000+00
1352205    -2.670230-01        1.436200+00
1352206    -1.761070-01        1.387900+00
1352207    -8.931000-02        1.348100+00
1352208    0.000000+00         1.233610+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 5
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1352300    2                   5
1352301    0.000000+00         -4.500000-01
1352302    4.000000-01         -2.500000-01
1352303    5.000000-01         0.000000+00
1352304    1.000000+00         3.569000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1352400    2                   6
1352401    0.000000+00         1.233610+00
1352402    9.064300-02         1.196500+00
1352403    1.885690-01         1.109600+00
1352404    2.734700-01         1.041600+00
1352405    4.586690-01         8.958000-01
1352406    5.744800-01         7.807000-01
1352407    7.381600-01         6.134000-01
1352408    7.685200-01         5.849000-01
1352409    8.700570-01         4.877000-01
1352410    1.000000+00         3.569000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 7
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1352500    2                   7
1352501    -1.000000+00        -1.000000+00
1352502    -3.000000-01        -9.000000-01
1352503    -1.000000-01        -5.000000-01
1352504    0.000000+00         -4.500000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 8
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1352600    2                   8
1352601    -1.000000+00        -1.000000+00
1352602    -2.500000-01        -9.000000-01
1352603    -8.000000-02        -8.000000-01
1352604    0.000000+00         -6.700000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* two - phase multiplier data from i3-6 test data
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1353000    0
1353001    0.000000+00         0.000000+00
1353002    1.000000-01         0.000000+00
1353003    2.000000-01         1.000000-01
1353004    3.000000-01         2.000000-01
1353005    3.500000-01         3.000000-01
1353006    4.000000-01         6.000000-01
1353007    5.000000-01         6.000000-01
1353008    6.000000-01         6.000000-01
1353009    7.000000-01         6.000000-01
1353010    8.000000-01         5.000000-01
1353011    9.000000-01         3.000000-01
1353012    1.000000+00         0.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1353100    0
1353101    0.000000+00         0.000000+00
1353102    1.000000-01         0.000000+00
1353103    2.000000-01         1.000000-01
1353104    3.000000-01         3.000000-01
1353105    3.500000-01         5.000000-01
1353106    4.000000-01         7.500000-01
1353107    5.000000-01         7.500000-01
1353108    6.000000-01         7.500000-01
1353109    7.000000-01         7.500000-01
1353110    8.000000-01         7.500000-01
1353111    9.000000-01         5.000000-01
1353112    1.000000+00         0.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pump 2-phase difference data
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354100    1                   1
1354101    0.000000+00         1.000000+00
1354102    1.000000+00         1.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354200    1                   2
1354201    0.000000+00         1.000000+00
1354202    1.000000+00         1.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354300    1                   3
1354301    -1.000000+00        -1.160000+00
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1354302   -9.000000-01      -1.240000+00
1354303   -8.000000-01      -1.770000+00
1354304   -7.000000-01      -2.360000+00
1354305   -6.000000-01      -2.790000+00
1354306   -5.000000-01      -2.910000+00
1354307   -4.000000-01      -2.670000+00
1354308   -2.500000-01      -1.690000+00
1354309   -1.000000-01      -5.000000-01
1354310   0.000000+00       0.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* haed curve no. 4
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354400   1                 4
1354401   -1.000000+00      -1.160000+00
1354402   -9.000000-01      -7.800000-01
1354403   -8.000000-01      -5.000000-01
1354404   -7.000000-01      -3.100000-01
1354405   -6.000000-01      -1.700000-01
1354406   -5.000000-01      -8.000000-02
1354407   -3.500000-01      0.000000+00
1354408   -2.000000-01      5.000000-02
1354409   -1.000000-01      8.000000-02
1354410   0.000000+00       1.100000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 5
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354500   1                 5
1354501   0.000000+00       0.000000+00
1354502   2.000000-01       -3.400000-01
1354503   4.000000-01       -6.500000-01
1354504   6.000000-01       -9.300000-01
1354505   8.000000-01       -1.190000+00
1354506   1.000000+00       -1.470000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354600   1                 6
1354601   0.000000+00       1.100000-01
1354602   1.000000-01       1.300000-01
1354603   2.500000-01       1.500000-01
1354604   4.000000-01       1.300000-01
1354605   5.000000-01       7.000000-02
1354606   6.000000-01       -4.000000-02
1354607   7.000000-01       -2.300000-01
1354608   8.000000-01       -5.100000-01
1354609   9.000000-01       -9.100000-01
1354610   1.000000+00       -1.470000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 7
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354700   1                 7
1354701   -1.000000+00      0.000000+00
1354702   0.000000+00       0.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 8
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354800   1                 8
1354801   -1.000000+00      0.000000+00
1354802   0.000000+00       0.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354900   2                 1
1354901   0.000000+00       1.000000+00
1354906   1.000000+00       1.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355000   2                 2
1355001   0.000000+00       1.000000+00
1355007   1.000000+00       1.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355100   2                 3
1355101   -1.000000+00      1.984300+00
1355102   -8.009600-01      1.394000+00
1355103   -6.063800-01      1.097500+00
1355104   -4.068600-01      8.220000-01
1355105   -1.992800-01      6.648000-01
1355106   0.000000+00       6.032000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 4
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355200   2                 4
1355201   -1.000000+00      1.984300+00
1355202   -8.223400-01      1.830800+00
1355203   -6.337100-01      1.682400+00
1355204   -4.585300-01      1.557000+00
1355205   -2.670230-01      1.436200+00
1355206   -1.761070-01      1.387900+00
1355207   -8.931000-02      1.348100+00
1355208   0.000000+00       1.233610+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 5
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355300   2                 5
1355301   0.000000+00       -4.500000-01
```

```
1355302   4.000000-01         -2.500000-01
1355303   5.000000-01         0.000000+00
1355304   1.000000+00         3.569000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355400   2                   6
1355401   0.000000+00         1.233610+00
1355402   9.064300-02         1.196500+00
1355403   1.885690-01         1.109600+00
1355404   2.734700-01         1.041600+00
1355405   4.586690-01         8.958000-01
1355406   5.744800-01         7.807000-01
1355407   7.331600-01         6.134000-01
1355408   7.685200-01         5.849000-01
1355409   8.,00570-01         4.877000-01
1355410   1.000000+00         3.569000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 7
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355500   2                   7
1355501   -1.000000+00        -1.000000+00
1355502   -3.000000-01        -9.000000-01
1355503   -1.000000-01        -5.000000-01
1355504   0.000000+00         -4.500000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 8
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355600   2                   8
1355601   -1.000000+00        -1.000000+00
1355602   -2.500000-01        -9.000000-01
1355603   -8.000000-02        -8.000000-01
1355604   0.000000+00         -6.700000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
* STEADY STATE CONTROLLER
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
* pcp controller
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* calculate mass flow error
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20590100  msserr    sum       1.0       0.0       1
20590101  248.7     -1.0      mflowj    100020000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pump1 speed
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20590200  pcp1spd   integral  0.34482   165.892   1
20590201  cntrlvar  901
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pump2 speed
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1
20590300  pcp2spd   integral  0.34482   165.901   1
20590301  cntrlvar  901
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
* pressurizer controller
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
4250000   pzrcont   sngljun
4250101   420010000 430000000 0.0       0.0       0.0       0000
4250201   0         0.0       0.0       0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
4300000   pzrtdv    tmdpvol
4300101   10.0      10.0      0.0       0.0       0.0       0.0
4300102   4.e-5     0.0       00000
4300200   2
4300201   0.0       1.509+7   1.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
* charging - letdown controller
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* charging reservior
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
9800000   chrgresr  tmdpvol
9800101   1.0       1.0       0.0       0.0       0.0       0.0
9800102   4.0e-5    0.0       00000
9800200   3
9800201   0.0       2.07+7    559.2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
9850000   chrgvalv  valve
9850101   980000000 185000000 3.85e-5   0.0       0.0       0100
9850201   0         6.08458-4 6.08468-4 0.0
9850300   srvvlv
9850301   905       999
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* charging valve position calculator
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20590500  charge    sum       7.7       0.0       0
+         3         0.0       1.0
20590501  1.04      -1.0      cntrlvar  2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* letdown sink
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
9900000   ltdwnsin  tmdpvol
```

```
9900101   1.0       1.0       0.0       0.0       0.0       0.0
9900102   4.0-5     0.0       0.000
9900200   3
9900201   0.0       1.44+7    559.2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* letdown valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
9950000   ltdwnvlv  valve
9950101   185000000 990000000 2.5-5     0.0       0.0       0100
9950201   0         0.0       0.0       0.0
9950300   srvvlv
9950301   906       999
20299900  normarea
20299901  0.0       0.0
20299902  0.0001    0.0
20299903  1.0       1.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* letdown valve position calculator
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20590600  ltdown    sum       -7.7      0.0       1
+         3         0.0       1.0
20590601  1.04      -1.0      cntrlvar  2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
* steam valve controller
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* changes to steam valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5400000   cv-p4-10  valve
5400101   530010000 541000000 0.0047772 0.0       0.0       1100
5400201   0         17.80400  17.80400  0.0
5400300   srvvlv
5400301   910       540
20254000  normarea
20254001  0.0       0.0
20254002  1.0-4     0
20254003  1.0       1.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* compute delta t error
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20590700  deltat    sum       1.0       0.0       1
20590701  555.9     -1.       tempf     185010000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* filter delta t through deadband
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20590800  deadband  function  1.0       0.0       1
20590801  cntrlvar  907       908
20290800  reac-t
20290801  -100.     -100.
20290802  -0.1      -0.1
20290803  -0.1      0.0
20290804  0.1       0.0
20290805  0.1       0.1
20290806  100.      100.
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* integrate delta t error
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20590900  int-dt    integral  1.0       0.0       1
20590901  cntrlvar  908
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* steam valve position calculator
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20591000  tcontrol  sum       1.0       0.50405   0
+         3         0.40      0.65
20591001  0.50405   -0.0564   cntrlvar  908
20591002            -0.0059   cntrlvar  909
* end of input
```

```
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
*                TRANSIENT INPUT FOR LP-02-6
*
*                PUMP COASTDOWN BY TIME DEPENDENT SPEED TABLE
*                FEEDWATER CUT OFF RATE INCLUDED
*                REMOVE STEADY-STATE CONTROLLERS
*
*                FINAL EDITION : 6. 30. '96.
*                EDITOR : T. S. CHOI
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
100     restart     transnt
101     run
103     6132
105     5.0       10.0          * No CPU time limit
201     30.0    1.0-12    0.01      14003     10     1000    1000
202     80.0    1.0-12    0.002     14003     50     5000    5000
*
*****************************************************************
*    trips
*
*****************************************************************
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*      500      end of job trip
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
500       time      0         ge  null  0          80.       1
600       500
*      break open
510       time      0         ge null   0          0.0       1
*      rcp trip
512       time      0         ge timeof 510        0.8       1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* lt  682  accumulator valve               card 6100301
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
582     cntrlvar     4         lt null   0          1.05137   1
682     -582         and       515       n
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* primary coolant pump 1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1350000   pcpmp1     pump
1350101   0.0366     0.0       0.0991    0.0       90.0      0.317900
1350102   0
1350108   130010000 0.0       0.017     0.017     0000
1350109   140000000 0.0       0.05      0.05      0000
1350200   0          1.51620+7 1227280.  2455980.  0.0
1350201   0          4.4717000 4.7483000 0.
1350202   0          4.4715000 4.4715000 0.
1350301   0    0     0         -1        0         512       0
1350302   369.0      .449573   .3155     96.       500.6     1.431
1350303   613.6      .0        207.433   .0444     19.5987   0.
1350310   0.0        0.0       0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* primary coolant pump 2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1650000   pcpmp2     pump
1650101   0.036      0.0       0.0991    0.0       90.0      0.317900
1650102   0
1650108   160010000 0.0       0.017     0.017     0000
1650109   170000000 0.0       0.1       0.1       0000
1650200   0          1.51618+7 1227280.  2455990.  0.0
1650201   0          4.5461000 4.8246000 0.0
1650202   0          4.5459000 4.5459000 0.0
1650301   135  135   135        -1       0         512        0
1650302   369.       0.449573  .3155     96.       500.6     1.431
1650303   613.6      0.0       207.433   .0444     19.5987   0.
1650310   0.0        0.0       0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 004 accumulator level
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20500400  accmlvl              integral  -4.7764-3 2.1       0
20500401  velfj      610000000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pcp 1 speed table
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1356100   512        time      0
1356101   -0.822     164.56221
1356102   -0.722     164.99904
1356103   0.278      165.18325
1356104   1.278      159.38265
1356105   2.278      151.20768
1356106   3.278      141.78462
1356107   4.278      132.79839
1356108   5.278      127.61883
1356109   6.278      121.87763
1356110   7.278      116.63567
1356111   8.278      111.3313
1356112   9.278      105.09086
1356113   10.278     99.9113
1356114   11.278     93.35885
1356115   12.278     88.05448
1356116   13.278     86.68158
1356117   14.278     81.75164
1356119   15.278     76.57208
1356120   16.278     73.01503
1356121   17.278     72.70301
1356122   18.278     67.96028
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1356123    19.278     64.77766
1356124    20.278     65.15208
1356125    21.278     64.27842
1356126    22.278     60.09733
1356127    23.278     61.34542
1356128    24.278     55.97864
1356129    25.278     56.7275
1356130    26.278     58.10039
1356131    27.278     62.21908
1356132    28.278     58.59963
1356133    29.278     60.97099
1356134    30.278     62.78072
1356135    31.278     59.34848
1356136    32.278     55.66662
1356137    33.278     57.66356
1356138    34.278     57.66356
1356139    35.278     59.6605
1356140    36.278     62.5935
1356141    37.278     60.22214
1356142    38.278     58.47482
1356143    39.278     61.47023
1356144    40.278     59.22367
1356145    41.278     63.27995
1356146    42.278     59.97252
1356147    43.278     62.71831
1356148    44.278     67.08662
1356149    45.278     66.15055
1356150    46.278     61.65744
1356151    47.278     70.20683
1356152    48.278     65.96334
1356153    49.278     75.19918
1356154    50.278     74.0135
1356155    51.278     75.26159
1356156    52.278     83.18694
1356157    53.278     83.62377
1356158    54.278     81.43962
1356159    55.278     76.8217
1356160    56.278     72.6406
1356161    57.278     71.95416
1356162    58.278     69.14596
1356163    59.278     64.15361
1356164    69.278     46.61799
1356165    150.0      20.22095
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pcp 2 speed table
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1656100    512        time      0
1656101    -0.9       164.56221
1656102    -0.722     164.99904
1656103    0.278      165.18625
1656104    1.278      159.38265
1656105    2.278      151.20768
1656106    3.278      141.78462
1656107    4.278      132.79839
1656108    5.278      127.61883
1656109    6.278      121.87763
1656110    7.278      116.63567
1356111    8.278      111.3313
1656112    9.278      105.09086
1656113    10.278     99.9113
1656114    11.278     93.35885
1656115    12.278     88.05448
1656116    13.278     86.68158
1656117    14.278     81.75164
1656119    15.278     76.57208
1356120    16.278     73.01503
1656121    17.278     72.70301
1656122    18.278     67.96028
1656123    19.278     64.77766
1656124    20.278     65.15208
1656125    21.278     64.27842
1356126    22.278     60.09733
1656127    23.278     61.34542
1656128    24.278     55.97864
1656129    25.278     56.7275
1656130    26.278     58.10039
1356131    27.278     62.21908
1656132    28.278     58.59963
1356133    29.278     60.97099
1656134    30.278     62.78072
1656135    31.278     59.34848
1656136    32.278     55.66662
1656137    33.278     57.66356
1356138    34.278     57.66356
1656139    35.278     59.6605
1356140    36.278     62.5935
1656141    37.278     60.22214
1656142    38.278     58.47482
1356143    39.278     61.47023
1656144    40.278     59.22367
1656145    41.278     63.27995
1656146    42.278     59.97252
1656147    43.278     62.71831
1656148    44.278     67.08662
1656149    45.278     66.15055
1656150    46.278     61.65744
1656151    47.278     70.20683
1656152    48.278     65.96334
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1356153   49.278    75.19918
1656154   50.278    74.0135
1656155   51.278    75.26159
1656156   52.278    83.18694
1356157   53.278    83.62377
1656158   54.278    81.43962
1656159   55.278    76.8217
1656160   56.278    72.6406
1656161   57.278    71.95416
1656162   58.278    69.14596
1656163   59.278    64.15361
1656164   69.278    46.61799
1656165   150.0     20.22095
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*
*   pump 1 data
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* single phase head curves
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351100   1                  1
1351101   0.000000+00        1.403600+00
1351102   1.906100-01        1.363600+00
1351103   3.896300-01        1.318600+00
1351104   5.939600-01        1.232800+00
1351105   7.902000-01        1.133600+00
1351106   1.000000+00        1.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351200   [illegible]        2
1351201   0.000000+00        -6.700000-01
1351202   2.000000-01        -5.000000-01
1351203   4.000000-01        -2.500000-01
1351204   5.755400-01        0.000000+00
1351205   7.443200-01        2.583000-01
1351206   7.734800-01        3.778000-01
1351207   8.631300-01        6.326000-01
1351208   1.000000+00        1.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351300   1                  3
1351301   -1.000000+00       2.472200+00
1351302   -8.057400-01       2.047400+00
1351303   -6.069000-01       1.831000+00
1351304   -4.068300-01       1.624000+00
1351305   -2.001710-01       1.470500+00
1351306   0.000000+00        1.403600+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 4
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351400   1                  4
1351401   -1.000000+00       2.472200+00
1351402   -8.229700-01       1.996800+00
1351403   -6.333200-01       1.589700+00
1351404   -4.553400-01       1.327900+00
1351405   -2.710900-01       1.194900+00
1351406   -1.771600-01       1.060500+00
1351407   -9.073000-02       1.015600+00
1351408   0.000000+00        [illegible]42790-01
*---- ----1---- ----1---- ----[illegible]---- ----1---- ----1---- ----1----
* head curve no. 5
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351500   1                  5
1351501   0.000000+00        2.500000-01
1351502   2.000000-01        2.800000-01
1351503   4.000000-01        3.400000-01
1351504   4.118000-01        2.768000-01
1351505   5.976300-01        4.584000-01
1351506   7.934670-01        6.992000-01
1351507   1.000000+00        1.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* had curve no. 6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351600   1                  6
1351601   0.000000+00        9.342790-01
1351602   9.109900-02        9.229000-01
1351603   1.865090-01        8.963000-01
1351604   2.717620-01        8.750000-01
1351605   4.558720-01        8.433000-01
1351606   5.744060-01        8.355000-01
1351607   7.405760-01        8.466000-01
1351608   7.666190-01        8.469000-01
1351609   8.714710-01        8.838000-01
1351610   1.000000+00        1.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 7
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351700   1                  7
1351701   -1.000000+00       -1.000000+00
1351702   -8.000000-01       -6.300000-01
1351703   -6.000000-01       -3.000000-01
1351704   -4.000000-01       -5.000000-02
1351705   -2.000000-01       1.500000-01
1351706   0.000000+00        2.500000-01
```

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*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 8
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351800   1                8
1351801   -1.000000+00     -1.000000+00
1351802   -8.000000-01     -9.700000-01
1351803   -6.000000-01     -9.500000-01
1351804   -4.000000-01     -8.800000-01
1351805   -2.000000-01     -8.000000-01
1351806   0.000000+00      -6.700000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* single phase torque data
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351900   2                1
1351901   0.000000+00      6.032000-01
1351902   1.930000-01      6.325000-01
1351903   3.930000-01      7.369000-01
1351904   5.955200-01      8.331000-01
1351905   7.978200-01      9.229000-01
1351906   1.000000+00      1.000900+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1352000   2                2
1352001   0.000000+00      -6.700000-01
1352002   4.000000-01      -2.500000-01
1352003   5.000000-01      1.500000-01
1352004   7.372550-01      5.265860-01
1352005   7.680490-01      6.065940-01
1352006   8.672300-01      7.436600-01
1352007   1.000000+00      1.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1352100   2                3
1352101   -1.000000+00     1.984300+00
1352102   -8.009600-01     1.394000+00
1352103   -6.063800-01     1.097500+00
1352104   -4.068600-01     8.220000-01
1352105   -1.992800-01     6.648000-01
1352106   0.000000+00      6.032000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 4
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1352200   2                4
1352201   -1.000000+00     1.984300+00
1352202   -8.223400-01     1.830800+00
1352203   -6.337100-01     1.682400+00
1352204   -4.585300-01     1.557000+00
1352205   -2.670230-01     1.436200+00
1352206   -1.761070-01     1.387900+00
1352207   -8.931000-02     1.348100+00
1352208   0.000000+00      1.233610+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 5
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1352300   2                5
1352301   0.000000+00      -4.500000-01
1352302   4.000000-01      -2.500000-01
1352303   5.000000-01      0.000000+00
1352304   1.000000+00      3.569000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1352400   2                6
1352401   0.000000+00      1.233610+00
1352402   9.064300-02      1.196500+00
1352403   1.885690-01      1.109600+00
1352404   2.734700-01      1.041600+00
1352405   4.586690-01      8.958000-01
1352406   5.744800-01      7.807000-01
1352407   7.381600-01      6.134000-01
1352408   7.685200-01      5.849000-01
1352409   8.700570-01      4.877000-01
1352410   1.000000+00      3.569000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 7
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1352500   2                7
1352501   -1.000000+00     -1.000000+00
1352502   -3.000000-01     -9.000000-01
1352503   -1.000000-01     -5.000000-01
1352504   0.000000+00      -4.500000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 8
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1352600   2                8
1352601   -1.000000+00     -1.000000+00
1352602   -2.500000-01     -9.000000-01
1352603   -8.000000-02     -8.000000-01
1352604   0.000000+00      -6.700000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* two - phase multiplier data from 13-6 test data
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
```

```
1353000   0
1353001   0.000000+00       0.000000+00
1353002   1.000000-01       0.000000+00
1353003   2.000000-01       1.000000-01
1353004   3.000000-01       2.000000-01
1353005   3.500000-01       3.000000-01
1353006   4.000000-01       6.000000-01
1353007   5.000000-01       6.000000-01
1353008   6.000000-01       6.000000-01
1353009   7.000000-01       6.000000-01
1353010   8.000000-01       5.000000-01
1353011   9.000000-01       3.000000-01
1353012   1.000000+00       0.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1353100   0
1353101   0.000000+00       0.000000+00
1353102   1.000000-01       0.000000+00
1353103   2.000000-01       1.000000-01
1353104   3.000000-01       3.000000-01
1353105   3.500000-01       5.000000-01
1353106   4.000000-01       7.500000-01
1353107   5.000000-01       7.500000-01
1353108   6.000000-01       7.500000-01
1353109   7.000000-01       7.500000-01
1353110   8.000000-01       7.500000-01
1353111   9.000000-01       5.000000-01
1353112   1.000000+00       0.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pump 2-phase difference data
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354100   1                 1
1354101   0.000000+00       1.000000+00
1354102   1.000000+00       1.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354200   1                 2
1354201   0.000000+00       1.000000+00
1354202   1.000000+00       1.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354300   1                 3
1354301   -1.000000+00      -1.160000+00
1354302   -9.000000-01      -1.240000+00
1354303   -8.000000-01      -1.770000+00
1354304   -7.000000-01      -2.360000+00
1354305   -6.000000-01      -2.790000+00
1354306   -5.000000-01      -2.910000+00
1354307   -4.000000-01      -2.670000+00
1354308   -2.500000-01      -1.690000+00
1354309   -1.000000-01      -5.000000-01
1354310   0.000000+00       0.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* haed curve no. 4
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354400   1                 4
1354401   -1.000000+00      -1.160000+00
1354402   -9.000000-01      -7.800000-01
1354403   -8.000000-01      -5.000000-01
1354404   -7.000000-01      -3.100000-01
1354405   -6.000000-01      -1.700000-01
1354406   -5.000000-01      -8.000000-02
1354407   -3.500000-01      0.000000+00
1354408   -2.000000-01      5.000000-02
1354409   -1.000000-01      8.000000-02
1354410   0.000000+00       1.100000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 5
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354500   1                 5
1354501   0.000000+00       0.000000+00
1354502   2.000000-01       -3.400000-01
1354503   4.000000-01       -6.500000-01
1354504   6.000000-01       -9.300000-01
1354505   8.000000-01       -1.190000+00
1354506   1.000000+00       -1.470000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354600   1                 6
1354601   0.000000+00       1.100000-01
1354602   1.000000-01       1.300000-01
1354603   2.500000-01       1.500000-01
1354604   4.000000-01       1.300000-01
1354605   5.000000-01       7.000000-02
1354606   6.000000-01       -4.000000-02
1354607   7.000000-01       -2.300000-01
1354608   8.000000-01       -5.100000-01
1354609   9.000000-01       -9.100000-01
1354610   1.000000+00       -1.470000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 7
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
```

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1354700   1                 7
1354701   -1.000000+00      0.000000+00
1354702   0.000000+00       0.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 8
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354800   1                 8
1354801   -1.000000+00      0.000000+00
1354802   0.000000+00       0.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354900   2                 1
1354901   0.000000+00       1.000000+00
1354906   1.000000+00       1.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355000   2                 2
1355001   0.000000+00       1.000000+00
1355007   1.000000+00       1.000000+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355100   2                 3
1355101   -1.000000+00      1.984300+00
1355102   -8.009600-01      1.394000+00
1355103   -6.063800-01      1.097500+00
1355104   -4.068600-01      8.220000-01
1355105   -1.992800-01      6.648000-01
1355106   0.000000+00       6.032000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 4
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355200   2                 4
1355201   -1.000000+00      1.984300+00
1355202   -8.223400-01      1.830800+00
1355203   -6.337100-01      1.682400+00
1355204   -4.585300-01      1.557000+00
1355205   -2.670230-01      1.436200+00
1355206   -1.761070-01      1.387900+00
1355207   -8.931000-02      1.348100+00
1355208   0.000000+00       1.233610+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 5
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355300   2                 5
1355301   0.000000+00       -4.500000-01
1355302   4.000000-01       -2.500000-01
1355303   5.000000-01       0.000000+00
1355304   1.000000+00       3.569000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355400   2                 6
1355401   0.000000+00       1.233610+00
1355402   9.064300-02       1.196500+00
1355403   1.885690-01       1.109600+00
1355404   2.734700-01       1.041600+00
1355405   4.586690-01       8.958000-01
1355406   5.744800-01       7.807000-01
1355407   7.381600-01       6.134000-01
1355408   7.685200-01       5.849000-01
1355409   8.700570-01       4.877000-01
1355410   1.000000+00       3.569000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 7
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355500   2                 7
1355501   -1.000000+00      -1.000000+00
1355502   -3.000000-01      -9.000000-01
1355503   -1.000000-01      -5.000000-01
1355504   0.000000+00       -4.500000-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 8
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355600   2                 8
1355601   -1.000000+00      -1.000000+00
1355602   -2.500000-01      -9.000000-01
1355603   -8.000000-02      -8.000000-01
1355604   0.000000+00       -6.700000-01
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
* DELETE STEADY STATE CONTROLLER
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20590100  msserr    delete   0.0  0.0  0.0  0.0  0.0  0.0
20590200  pcp1spd   delete   0.0  0.0  0.0  0.0  0.0  0.0
20590300  pcp2spd   delete   0.0  0.0  0.0  0.0  0.0  0.0
4250000   pzrcont   delete
4300000   pzrtdv    delete
9800000   chrgresr  delete
9850000   chrgvalv  delete
20590500  charge    delete
9900000   ltdwnsin  delete
9950000   ltdwnvlv  delete
20590600  letdown   delete
```

```
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5400000   cv-p4-10  valve
5400101   530010000 541000000 0.0047772 0.0       0.0       1100
5400201   0         19.14     19.55  0.0
5400300   mtrvlv
5400301   687       688       0.05      0.41617   540
20254000  normarea
20254001  0.0       0.0
20254002  9.25-4    9.25-4
20254003  1.0       1.0
20590700  deltat    delete
20590800  deadband  delete
20590900  int-dt    delete
20591000  tcontrol  delete
20591100  sglvlerr  delete
20591200  feedflow  delete
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* change input for feed water system
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5660000   feed      tmdpjun
5660101   565000000 508000000 0.05
5660200   1         511
5660202   0.0       24.32     0.0      0.0
5660203   0.5       2.06      0.0      0.0
5660204   1.0       1.00      0.0      0.0
5660205   1.5       0.61      0.0      0.0
5660206   1.+6      0.50      0.0      0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* 074 mass loss through x-flow junction
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20507400  lossxj              integral  1.        0.        0
20507401  mflowj    290000000
* end of input
```

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S. Smith, NRC Project Manager

11. ABSTRACT *(200 words or less)*

The LOFT experiment LP-02-6 was simulated using the RELAP5/MOD3.2 code to assess its capability to predict the thermal-hydraulic phenomena in LBLOCA of the PWR. The reactor vessel was modeled with two core channels and split downcomer for a base calculation. The results of the base calculation show that the code can not predict the early bottom-up quenching which is a distinguished phenomenon of the experiment LP-02-6, mainly due to the deficiency of break flow model.

The discharge coefficient sensitivity study was performed to show that the calculated subcooled break flow which might significantly affect the early bottom-up quenching is dependent on the coefficient. More detailed modeling of the cross flow in the split downcomer was performed, but, resulted in little improvement on the predictability of bottom-up quenching. Additional calculation using the RELAP5/MOD3.1 instead of RELAP5/MOD3.2 showed that there is no large difference between the versions in the simulation of LBLOCA.

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

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