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International Agreement Report

Assessment of RELAP5/MOD3 With the LOFT L9-1/L3-3 Experiment Simulating an Anticipated Transient With Multiple Failures

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Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
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NOTICE

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Abstract

The RELAP5/MOD3 5m5 code is assessed using the L9-1/L3-3 test carried out in the LOFT facility, a 1/60-scaled experimental reactor, simulating a loss of feedwater accident with multiple failures and the sequentially-induced small break loss-of-coolant accident. The code predictability is evaluated for the four separated sub-periods with respect to the system response; initial heatup phase, spray and power operated relief valve(PORV) cycling phase, blowdown phase and recovery phase. Based on the comparisons of the results from the calculation with the experiment data, it is shown that the overall thermal-hydraulic behavior important to the scenario such as a heat removal between the primary side and the secondary side and a system depressurization can be well-predicted and that the code could be applied to the full-scale nuclear power plant for an anticipated transient with multiple failures within a reasonable accuracy. The minor discrepancies between the prediction and the experiment are identified in reactor scram time, post-scram behavior in the initial heatup phase, excessive heatup rate in the cycling phase, insufficient energy convected out the PORV under the hot leg stratified condition in the saturated blowdown phase and void distribution in secondary side in the recovery phase. This may come from the code uncertainties in predicting the spray mass flow rate, the associated condensation in pressurizer and junction fluid density under stratified condition.

Executive Summary

This report presents the RELAP5/MOD3 code assessment calculation using the test L9-1/L3-3 conducted in the loss of fluid test(LOFT) facility. The LOFT facility was a 1/60-scaled experimental reactor. The experiment L9-1/L3-3 simulated a loss of feedwater accident(LOFA) with multiple failures and a consequentially-induced small break loss of coolant accident(LOCA).

The full period of the test was separated with four sub-periods according to the thermal-hydraulic charateristics ; the initial heatup phase, the spray and power operated relief valve(PORV) cycling phase, the blowdown phase and the recovery phase.

RELAP5/MOD3 calculation successfully simulated the complex sequence of events associated with a LOFA and a consequential LOCA. Based on the comparisons between the calculation results and the experiment data, the overall behavior such as a subcooled heatup and a depressurization in the primary coolant system, and a heat remval after the dryout in steam generator secondary side was well-predicted throughout the four sub-periods. However, the calculation results show the reactor scram earlier than the experiment, resulting in the overestimation of the post-scram cooling, which may due to a code uncertainty in the spray mass flow rate and the associated condensation in the pressurizer. Due to this difference, the predicted initiation and completion times were somewhat delayed. The excessive heatup rate was also found in the spray cycling phase, which may come from the overprediction of discharged flow rate through the PORV during the blowdown phase. And the RELAP5/MOD3 predicted an inaccurate junction fluid density under the hot leg stratified, which resulted in an insufficient energy convected out the PORV. This caused an overprediction in primary system pressure and temperature during the saturated blowdown phase. In the recovery phase, the RELAP5/MOD3 calculation yields an inaccurate void distribution in the SG secondary side. It may be ascribed to the overprediction of the pressure and temperature drop in primary coolant system.

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1. Introduction

The RELAP5/MOD3 code [1] was developed by the Idaho National Engineering Laboratory (INEL) under the sponsorship of US Nuclear Regulatory Commission (NRC), and its frozen version, 5m5 was released at the end of 1990. Through the developmental assessments conducted [2], the code capability was investigated, however, the code predictability for such transients as an anticipated transient with multiple failures was not fully demonstrated. This report summarizes a code assessment using the typical experiment simulating this type of transient, the L9-1/L3-3 [3] conducted in the Loss-of-Fluid-Test (LOFT) facility [4]. The test L9-1/L3-3 composed of two sequential tests; L9-1 and L3-3, which simulated a loss of feedwater accident (LOFA) with multiple failures and a consequentially-induced small bereak loss of coolant accident (SBLOCA) in pressurized water reactor (PWR), respectively.

The major objective of this study was to identify the code capability of the RELAP5/MOD3 5m5 on the prediction of thermal-hydraulic (TH) behavior in primary coolant system (PCS) and secondary coolant system (SCS) during the LOFA with multiple failures and the consequentially-induced LOCA. To achieve this objective, the full period of the test L9-1/L3-3 was separated with four sub-periods with repect to the system response on the accident ; the initial heatup phase, the spray and power operated rief valve(PORV) cycling phase, the blowdown phase and the recovery phase. The programmatic objectives of this study are :

1. to provide RELAP5/MOD3 simulation of the test L9-1/L3-3 for demonstrating the code applicability to this kind of transient in full-scale PWR,
2. to evaluate the accuracy and the discrepancy of the code in predicting the following TH phenomena during the four sub-periods based on the comparison with the experiment,
   - Steam generator (SG) secondary side dry out after a LOFA
   - Post-scram PCS cooling

- PCS heatup in subcooled state and pressurizer liquid level swell
- Pressurizer spray valve actuation and pressure control
- Pressurizer PORV cycling and pressure control
- PCS depressurization due to PCS mass depletion through PORV
- Two-phase break flow through PORV and hot leg stratification
- PCS depressurization due to the secondary side refill and secondary side feed and bleed

3. to identify reasons for the discrepancy evaluated in item 2.

The descriptions of the LOFT system and the test L9-1/L3-3 are given in Chapter 2. The code description, the input modeling and the initial and boundary conditions are given in Chapter 3. The results of the calculation are discussed in Chapter 4 and the run statistics given in Chapter 5. The conclusions obtained throughout the assessment are summarized in Chapter 6.

2. Facility and Test Description

2.1 Facility Description

The LOFT facility is an experimental 50 MWt PWR designed to simulate LOCA's and anticipated transients and to provide data on the thermal-hydraulic phenomena occuring throughout the system [4]. It is a scaled representation of a commercial PWR of Westinghouse type having 4 loops with a volume ratio of 1/60. The LOFT system consists of five major systems : reactor system, primary coolant sysytem, blowdown suppression system, emergency core cooling system and secondary coolant system, and also includes instrumentations. The lengths of the core and reactor vessel are 1.68 and 7 m, respectively. The overall configuration is shown in Fig.1.

The break location for the test L9-1/L3-3 was the experiment PORV located in the pressurizer relief line at the top of the prerssurizer. The experiment PORV was geometrically similar to the commercial PWR PORV's and was steam-scaled by 1.32 x 10^{-2} kg/s/MW. The detailed description was provided in reference [10].

2.2 Test Description

The experiment L9-1/L3-3 composed of two sequential tests. The test L9-1 simulated a LOFA with delayed scram and no auxiliary feedwater injection in PWR. The test L3-3 described the LOFA recovery modes initiated by tripping the PCP and depressurizing the PCS through the PORV in pressurizer. The experiment objectives were as follows [5];

1. For L9-1:
   a. To evaluate uncertainties in predicted primary and secondary thermal hydraulic response associated with steam generator dryout during delayed scram.
   b. To evaluate the adequacy of PORV to provide overpressure protection in a LOFA.
2. For L3-3
   a. To investigate uncertainties in system response during a PORV imposed small break with loss of heat sink.
   b. To assess the adequacy of modelling assumptions which are used in small break performance predictions such as those identified in NUREG-0623 [7].
   c. To assess the effectiveness of steam generator refill on LOFAs following reestablishment of auxiliary feedwater availability.
   d. To assess the relative magnitude of the change in reactor vessel mixture level as a result of primary coolant system shrink during steam generator refill.
   e. To contribute to the NRC relief and safety valve testing program by providing experimental data on PORV performance charateristics over a range of PORV inlet fluid conditions.

Prior to the experiment, the flow rate of the primary system was 479.1 $\pm$ 2.6 kg/sec under the pressure of 14.9 $\pm$ 0.10 MPa. Temperatures at the hot leg and the cold leg in the intact loop were 578.2 $\pm$ 1.8 K and 558.9 $\pm$ 1.3 K, respectively. The important initial conditions including pressure, temperature and liquid level in the intact loop steam generator (SG) secondary side were listed in

Table 1.

Experiment L9-1 was initiated by stopping the main feedwater pump. Due to decrease in heat removal capacity of SG secondary side, the PCS pressure increased and the pressurizer spray valve was open at its setpoint (15.338 MPa), which was observed at 30.0 seconds after initiation of LOFA. As the magnitude of the primary-secondary power mismatch grew, the PCS pressurization exceeded the spray cooling, which caused a delayed scram, simulating a failure of the SG low level trip, on the high pressure of hot leg (15.745 MPa) at 65.4 seconds. Auxiliary feedwater was not activated in order to simulate nonavailability of auxiliary feedwater. The main steam control valve (MSCV) started to close on the scram signal and completed to close at 77.2 seconds. The primary system pressure was decreased on reactor scram and then increased due to the decay heat and the complete loss of heat sink in SG secondary, which caused the pressurizer spray valve open and initiate cycling at 208.9 seconds to control PCS pressure. The open/close setpoints of spray valve were 15.338 and 15.05 MPa, respectively. Spray was allowed to cycle for 900 seconds approximately, whereupon it was manually overriden, allowing PCS pressure to rise to the PORV actuation setpoint (16.20 MPa) at 1468 seconds. Thereafter, the pressurizer came into the liquid-full state. The PORV was allowed to cycle relieving single phase liquid primary coolant as the PCS volume continued to heatup and expand at 1468 seconds. The PORV cycling was ended at the time which the PCS hot leg temperature reached 597 K, 3270 seconds. At that time, the PCPs were deenergized, the PORV was held open and the test L3-3 was initiated. The sequence of important events was presented in Table 2.

As the PORV latch open for 1580 seconds from the initiation of L3-3, the PCS pressure dropped rapidly to saturation and the hot regions of the core and upper plenum flashed. ECCS actuation was inhibited. The depressurization stabilized while the upper plenum and upper head voided whereupon the hot leg stratified. As hot leg voided a higher quality fluid was convected up the surge line, and the pressurizer liquid level receded as the cooler pressuizer fluid was entrained out the PORV. A transition to higher quality PORV mass flow decreased fluid density flowing pressurizer relief line shortly after latching open PORV. This transition resulted in a higher specific energy fluid being discharged out the PORV and resulted in increased energy removal out the break. As break energy removal exceeded decay heat addition, PCS pressure declined steadily. PCS pressure stabilized as the PORV was closed. A steam generator refill was initiated 265 seconds after the PORV-closure. PCS pressure dropped rapidly as the secondary heat sink was restored. When the normal steam generator liquid level was regained at 5746.4 seconds, the SG refill was completed and then a 966 seconds equilibration period was observed to allow the primary and secondary to reach an equilibrium. Subsequently, a secondary steam and makeup operation was initiated at 6712.2 seconds to cool down the primary and recover plant. ECCS injection was not provided throughout the experiment. The experiment was terminated as PCS pressure reached 2.15 MPa. The major sequence was summarized in Table 2.

3. Code and Modeling Description

3.1 Code Description

RELAP5/MOD3 Cycle 5m5 version released by USNRC was used in the present assessment calculation of the test L9-1/L3-3. The changed features from the RELAP5/MOD2 were described in references [1, 2].

3.2 Input Modelling

The original RELAP5/MOD1 input data for simulating the LOFT system and the sequence specific to the test L9-1/L3-3 was received from INEL at January 1991. Based on the original RELAP5/MOD1 input data, some modifications was made during the assessment work. Major changes were as follows :

1. All geometric data except the U-tube heat transfer area and separator in the intact loop SG remain unchanged.
2. Modeling options related to volume, junction, heat structure were properly modified to work with RELAP5/MOD3 [1].
3. The options, 'new transnt' were changed to 'new stdy-st' in order to re-initialize the whole plant conditions under RELAP5/MOD3 models and correlations.
4. For steady state run, three steady state control systems were added ;
   a. PCP speed controllers for controlling a intact loop mass flow rate,
   b. a pressurizer heater controller and a pressurizer spray controller for controlling the PCS pressure, and
   c. a main feedwater controller for controlling the S/G secondary side liquid level.
5. For steady state run, the test specific trips were set not to be activated.
6. A new transient input data was developed with deleting steady state controllers and changing the test specific trips to be activated.
7. The moderator density feedback table in a reactor kinetics input data was appropriately changed from the original one, based on the reference [8].

In the present calculation, the LOFT system was discretized by 125 volumes, 135 junctions and 136 heat structures after implementing the items stated above. Figure 2 shows a RELAP5 nodalization diagram for simulating the test L9-1/L3-3. Table 3 summarizes the nodalization and input modelling. A steady state input deck and a transient input deck were provided in Appendice A and B.

3.2.1 Primary Coolant System Modelling

The PCS composed of an intact loop and a broken loop, the former included a hot leg, a crossover leg, a pump suction tee, two PCPs and a cold leg. The intact loop was modelled by 25 hydrodynamic volumes. All piping metal structures exposed to environmental atmosphere were simulated by the heat structure to consider the associated heat loss. An overall information for the all heat structures was provided in table 4. The broken loop composed of a hot leg, a SG-pump simulator, a reflood assist bypass system (RABS), a cold leg and pipings front of the quick opening blowdown valves (QOBVs). The detailed information can be found in Fig.2, table 3 and table 4. The volume and junction modelling options were set with default options.

3.2.2 Reactor Vessel Modeling

The LOFT reactor vessel was modelled by a downcomer annulus, a lower plenum, an active core, a core-bypass flow path, an upper plenum, an upper head and a filler gap flow path. The filler gap flow path was especially modeled for simulating an upward flow during a natual circulation phase. The active core, the downcomer and the filler gap were modeled by 3 volumes, 6 volumes and 7 volumes stacked vertically, respectively. Totally 26 volumes and 50 heat stuctures were used. The rod bundle interphase friction model option was selected for the active core volumes. The fuel rods were modeled by 3 heat structures representing the central fuel assembly and 3 heat structures representing the peripheral fuel assemblies of LOFT core. The axial power shape was described according to the reference[8]. The reactor kinetics was used for simulating the moderator density and doppler temperature feedback and a scram curve was provided, which was used in the posttest calculation [8]. The ANS-79 model was used for a decay heat simulation, which was changed from ANS-73 model in the posttest calculation [8].

3.2.3 Pressurizer Modeling

The pressurizer system was modeled by a surgeline, a pressurizer vessel, a spray line from cold leg, a spray valve and a experiment PORV. Two volumes for the surge line, nine volumes for the vessel and one volume for the spray line were used, respectively. The spray valve and the PORV were simulated by two trip valves. The associated trip logics were prepared according to the experimental specification [6]. To consider the environmental heat loss from the pressurizer vessel wall, the vessel wall was modeled by nine heat structures.

3.2.4 Steam Generator Modeling

The steam generator consisted of a SG inlet plenum, U-tubes, a outlet plenum, a main feedwater tank and feed line, a auxiliary feedwater tank and feed line, a feedwater inlet annulus, a SG secondary side downcomer, a boiler section, a separator inlet annulus, a separator, a steam dome, a steamline, a MSCV, a MSCV bypass flow path, a MSCV downstream piping and a air-cooled condenser. The numbers of volumes used for each flow path were provided in Table 3 and Fig.2. All of the SG metal wall and U-tubes were described by the proper heat structures. The detailed description can be found in Table 4. The rod bundle interphacial friction option was used for the volumes contacted with the U-tubes heat structures (Volumes 515-4, -5, -6). The separator section in SG was modeled by a branch component (Volume 520) and a SEPARATR component (Volume 500). The separator inlet junction was connected to the bottom of the volume 520, as show in Fig.2.

The heat transfer area of U-tube heat structure in the intact loop SG generally has an impact on the initial conditions in SG secondary side. According to the previous LOFT calculations using RELAP5/MOD2 [9, 10], the predicted pressure in SG secondary side were generally underpredicted by 0.3-0.4 MPa. This discrepancy was considered as a result of underestimation of heat transfer a in the SG U-tube. In the present input data, an increase of heat transfer area by 110 % of the original heat transfer area [8] was made. The whole listing of steady state input data were provided in Appendix A.

3.2.5 Others

The emergency core cooling system (ECCS) in LOFT was also modeled, however, it is not used in the transient calculation. Table 3, Fig 2 and Appendix A provided a detailed information of it. And the containment was also modeled by time-dependent volume with a constant pressure.

3.3 Initial and Boundary conditions

To provide all initial conditions of the whole system prior to transient, a steady state run was carried out with three steady state controllers as stated above. The result obtained from the steady state run was compared with the measured initial conditions in Table 1. The RELAP5 calculated results generally agree with the experiment initial conditions.

Boundary conditions required to simulate the L9-1/L3-3 experiment including the pressures and temperatures at air-cooled condenser, makeup feed storage tank and reactor core power history were almost the same as those used in the posttest calculation [8]. The exact values can be found in the steady state input data.

Test specific sequence to be described are as follows: Main feedwater turned off, Reactor scram, SG MSCV closure, Pressurizer spray valve open/closure, Pressurizer PORV cycling, Pressurizer PORV latched open and closure, PCP coastdown initiation, SG secondary refill initiation/completion, and SG secondary bleed initiation/completion.

All of the sequence were as the same as the original input data [8] and were illustrated with some comments in the Figure 3-a through 3-g. The delay time in the trip logic describing the SG refill initiation (Variable trip 561) was corrected to '265 seconds' after PORV closure according to the reference [5]. The whole list of the transient input data was attached in Appendix B.

4. Calculation and Discussion

A transient calculation using the input modelings, initial conditions and boundary conditions stated above was conducted by RELAP5/MOD3 5m5 code. The transient calculation was terminated at 8106 seconds due to water property failure at the SG secondary side volume 515-06. Since the calculational result up to 8100 seconds contains all of the important phenomena in the L9-1/L3-3 experiment, any additional restart transient calculation was not executed. The foregoing description was, therefore, based on the calculational result up to 8100 seconds. This chapter was devoted to address results from the transient calculation, to compare them with the corresponded measurement data and to identify the code predictability. Table 2 shows a comparison of the predicted sequence of event with the measured chronology. The detailed discussion of the comparison was provided in following sub-chapters. From the test description above, it is shown that the full period of the LOFT L9-1/L3-3 experiment can be divided into four distinguishable sub-phases according to the TH characteristics as follows;

1) Initial heatup phase before spray cycling,
2) Spray and PORV cycling phase until PORV latched open,
3) Blowdown phase until PORV closure, and
4) Recovery phase

The following discussions contain the prediction and its comparison for the important thermal-hydraulic phenomena during these four period, respectively. Table 5 summarizes the comparison plots and their data channels.

The measurement uncertainties for each parameter were also listed in this table, which were from the reference [5].

4.1 Initial Heatup Phase

Figure 4 shows a comparison of the pressure at the intact loop hot leg in PCS with the measured data up to 300 seconds after the test initiation. Fig.5 shows a comparison of the coolant temperature at the intact loop hot leg with the measured data for the same period as in Fig.4. Due to LOFA the heat removal capacity in SG secondary side was degraded, the PCS pressure and temperature was increased. These figures show good agreements between the calculation and the experiment before reactor scram. The calculated reactor scram time (55.8 seconds) was earlier than the experiment (65.4 seconds). This discrepancy may come from a code uncertainty in predicting the mass flow rate through the spray valve and the associated condensation phenomena in the pressurizer. For an illustration of it, the calculation shows the PCS presure was still increased inspite of the second spray actuation at 50 seconds approximately, while the experiment indicated the PCS pressure was slightly decreased at the almost same time and then re-increased. It can be also identified in the first activation of spray (30 seconds), in which the predicted slope of pressure decrease was slower than the predicted one. The underprediction of pressure and temperature after scram was due to the difference in scram time. Figure 6 shows a comparison of the calculated reactor power with the power measured by a neutron detector and with the decay heat reported in reference [5]. The difference in power during time period from 56 to 65 seconds lowered the PCS pressure below 14 MPa and delayed a pressure re-increase until 170 seconds, i.e, an excessive post-scram cooling. This discrepancy also delayed the spray valve activation time until 315 seconds, which was later than the experiment, 208 seconds.

Figures 7 and 8 show comparisons of the pressure and temperature in the SG steam dome and the top of the boiler section with the measured data, respectively. Before the reactor scram the predicted behavior was agreed to the measured one. Due to earlier scram in calculation, the starting time and completion time of MSCV closure predicted by RELAP5/MOD3 were earlier than those in experiment as shown in Table 2. According to the experiment, just after a LOFA, the SCS pressure and temperature were both increased from saturated state until the complete dryout, and then decreased until the MSCV began to reduce the dischaging steam flow on the response to the reactor scram. This reduction yields a decrease in heat rejection from the SCS, therefore, the SCS pressure and temperature were re-increased. Afterwards, the TH behavior of the SCS was dependent on the energy balance between the heat-rejection due to the MSCV leakage flow and the heat addition from the PCS generated by core decay heat. The result from the RELAP5/MOD3 calculation generally shows these TH behavior well, however, shows an overprediction in SCS pressure and temperature after scram. It must due to a difference in the scram time. Inspite of this difference, the slope of increase in pressure after scram was almost the same as that in the experiment. Figure 9 shows a comparison of the collapsed liquid level with the measured data, which indicated a complete dryout in SG secondary side at 60 seconds after a LOFA, approximately and a good agreement between the calculation and the experiment. Figure 10 shows a comparison of the mass flow rate through MSCV. From these comparisons, it, therefore, can be stated that the consequent behavior after scram can be well-predicted if the scram time was correctly predicted.

4.2 Spray and PORV Cycling Phase

Figures 11 and 12 show comparisons of the pressure and temperature at the intact loop hot leg in PCS up to 10000 seconds. The starting time of the spray valve cycling predicted was, as previously mentioned, later than the that measured. The predicted duration of spray cycling was about 1055 seconds (= 1370 - 315), which was similar to the measured duration, 1037 seconds (= 1246 - 209). The slope of temperature increase, i.e, heatup rate was larger than the experiment, however, a saw-tooth behavior in pressure was well predicted during the spray cycling period. One of the reasons of higher heatup rate was also considered as an uncertainty in the spray mass flow rate.

The predicted starting time of PORV cycling was 1795 seconds and also later than the experiment, 1468 seconds. The duration of PORV cycling was about 1390 seconds (= 3185 - 1795) in calculation, which was shorter than the experiment, 1802 seconds (= 3270 - 1468). The heatup rate during the PORV cycling phase was almost same as the experiment. The cycling phase was ended at 3185 sec in calculation. During the spray and PORV cycling period the major contributor to the PCS heatup was considered as the core decay heat and the heat provided by PCP's.

Figures 13 and 14 show comparisons of the pressure and temperature at the same position as in Figures 7 and 8 up to 10000 seconds, respectively. The predicted pressure was monotonously decreased during the spray and PORV cycling phase, which was, however, higher than the experiment throughtout the cycling phase. It was due to a difference in scram time, but the slope of pressure decrease was well agreed to the experiment. The secondary coolant temperature was also overpredicted as shown in Fig.14.

4.3 Blowdown Phase

After the PCS hot leg temperature reached 597 K, the PORV was held open for the consequent 1580 seconds. During this period the primary coolant was discharged through the PORV, which caused a rapid depressurization until the onset time of saturation in PCS. As shown in Fig.11, the calculated pressure drop was almost same as the experiment until the PCS saturation. After the saturation, the calculation shows that the PCS pressure was almost constant until the PORV closure time (4769 seconds), which was quite different from the experiment. The difference in the pressurizer liquid level can be regarded as one reason for the pressure increase during the saturated blowdown period as shown in Fig.15. The calculated liquid level in the pressurizer was almost constant until the SG refill initiation, while the measured level was slowly decreased from the PORV open time. It is also shown that the high heatup rate during the spray cycling period yielded an overprediction in the pressurizer liquid level swell and in the PCS pressure. The over-estimated liquid level also contributed to the overprediction of mass flow rate through the PORV during the two-phase blowdown phase as shown Fig.16.

During the same period, the PCS temperature was also overpredicted, which indicated that the insufficient energy convected out the PORV. According to the reference [8], the effective flow area of PORV was correctly chosen, the reason for the insufficient energy discharged out the PORV, therefore, was a code inaccuracy in calculating the fluid density convected from the hot leg to the pressurizer surge line under the hot leg stratified. As shown in Fig.17, the measured fluid density at the intact loop hot leg was different from the calculated one from 3500 seconds, approximately. The experiment indicated that the intact loop hot leg was stratified shortly sfter holding open PORV, that a higher quality fulid was convected out the break as pressurizer level receded and that the hot leg fluid density significantly decreased. However, RELAP5/MOD3 predicted this phenomena inaccurately, which due to a code weakness in calculating the junction density under the stratified condition.

During the blowdown period, the SCS experienced the similar depressurization to the previous phase as shown in Figures 13 and 14.

4.4 Recovery Phase

After 265 seconds from the closure of PORV, the SG secondary side refill was initiated through the auxiliary feedwater line. The predicted hot leg pressure and temperature were rapidly decreased during the secondary refill period as shown in Figures 11 and 12. However, the magnitudes of drops in pressure and temperature were overpredicted. One of the reason for this overprediction was considered as an difference in the refill duration (1085 seconds in calculation versus 622 seconds in experiment). It is also shown in Fig.17, which presents a comparison of the SG liquid level in long term. The calculated liquid level indicated no jump which was found in the experiment and the predicted refill duration was longer than the experiment. Since the refill duration was strongly dependent on the SG secondary side liquid level, the inaccuracy of the level prediction may extend the refill duration, consequently increase the cooling effect. The major contributor to thein accuracy of level prediction was a void distribution calculated by the code.

After restoring the SCS heat removal capacity, the predicted SCS pressure was increased more rapidly and the predicted peak pressure was higher than the experiment as shown in Fig.13. During the same period the predicted temperature at SG secondary side moved down as shown in Fig.14, which indicates the return from the superheated steam to the saturated state in SG secondary side at 5200 seconds, approximately. The reason for the overprediction of pressure was considered as a propagation from the previous phase. The descending behavior in pressure after saturation was almost similar to the experiment.

During the equilibration period of 966 seconds after the SG refill completion (6119 seconds in prediction), the PCS pressure and temperature were slightly increased. The calculation shows that the SG feed and bleed operation was initiated at 7085 seconds, that the PCS pressure and temperature were both decreased in stepwise manner and that the magnitudes of drops in the pressure and temperature were larger than those measured. It due to the continual feed operation from the auxiliary feedwater valve, which was different from the continous feed operation in the experiment. Since the feed operation is also strongly dependent on the SG secondary side liquid level, the reason for this larger drops than the experiment can be regarded as the inaccuracy of the SG secondary void distribution.

5. Run Statistics

The main frame computer used in the present calculation was a CRAY-2S in System Engineering Research Institute(SERI) in Taejon, Korea under UNICOS as a operating system. Figure 19 presents the plot of the required CPU time for the transient time in the calculation. And the time step size are also plotted in Fig.20. The user-specified maximum time step was 1.0 second up to 1000 seconds, 0.1 second up to 2000 seconds, 0.5 second up to 4000 seconds, 0.1 second up to 8000 seconds and 0.5 second up to 10000 seconds in real time. The grind time can be calculated as follows.

Computer time,	CPU = 7981.4 - 1.9181 = 7979.48 (sec)
Number of time step,	DT = 89332 - 220 = 89112
Number of volume,	C = 125
Transient real time,	RT = 8100 (sec)

Grind time = CPU x 1000 / (C * DT) = 0.71635 CPU m sec/vol/step

6. Conclusions

The RELAP5/MOD3 5m5 code was assessed using the test L9-1/L3-3 simulating a LOFA with multiple failures and the consequentially-induced LOCA. The full period of the test was divided into four sub-periods according to the thermal-hydraulic characteristics ; the initial heatup phase, the spray and PORV cycling phase, the blowdown phase and the recovery phase. The calculation results were compared with the measured data and the evaluation of the code predictability for this type of transient was conducted. The following conclusions are obtained.

1) RELAP5/MOD3 code calculation was successfully executed for the L9-1/L3-3 test and the code applicability to an anticipated transient with multiple failures in PWR was demonstrated.
2) From the fact that the result from the calculation generally shows a good agreement with the experiment data, the overall predictability of the RELAP5/MOD3 was identified and the minor discrepancies were also identified.
3) In the initial heatup phase, the predicted scram time was earlier than the experiment due to a code uncertainty in predicting the spray mass flow rate and the associated condensation phenomena in pressurizer, which caused an excessive heatup rate in the spray cycling phase.
4) In the blowdown phase, the overprediction of PORV-discharged flow was found under the over-estimated pressurizer level, which may come from the excessive heatup in the previous phase. And a code inaccuracy was found in calculating the junction fluid density at the hot leg to the pressurizer surge line under the stratified condition.
5) In the recovery phase, an excessive cooling was predicted both in the steam generator secondary refill phase and in the secondary feed and bleed operation phase due to a poor prediction on void distribution in the SG secondary side.

References

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2. W. Weaver, *Improvement to the RELAP5/MOD3 Choking Model*, EGG-EAST-8822, December 1989.
3. J. Adams, *Quick-Look-Report on LOFT Nuclear Experiment L9-1/L3-3*, EGG-LOFT-5340, April 1981.
4. D. Reeder, *LOFT System and Test Description*, NUREG/CR-0247, July 1978.
5. M.McCormick-Barger, *Experiment Data Report for LOFT Anticipated with Multiple Failures Experiment L9-1 and Small Break Experiment L3-3*, - NUREG/CR-2119, June 1981.
6. R. Beelman, *LOFT Experiment Operating Specification Anticipated Transients With Multiple Failures Test Series L9*, EGG-LOFT-5334, April 1981.
7. B. Sheron, *Generic Assessment of Delayed Reactor Coolant Pump Trip During Small Break Loss-of-Coolant Accident in Pressurized Water Reactors*, NUREG-0623, November 1979.
8. R. Beelman, *RELAP5 Reference Calculation and Posttest Analysis of Anticipated Transient with Multiple Failures Experiment L9-1/L3-3*, EGG-LOFT-5895, September 1982.
9. Y.S. Bang, et al, *Assessment of RELAP5/MOD2 Cycle 36.04 Using LOFT Large Break Experiment L2-5*, NUREG/IA-0032, April 1990.
10. E.J. Lee et al, *ICAP Assessment of RELAP5/MOD2 Cycle 36.05 Against LOFT Small Break Experiment L3-7*, NUREG/IA-0031, April 1990

Table 1. Initial conditions for L9-1/L3-3

Parameter	Measured	Simulated
Primary Coolant System		
Mass flow rate (kg/s)	479.1 ± 2.6	479.34
Hot leg pressure (MPa)	14.9 ± 0.10	14.8905
Cold leg temperature (K)	558.9 ± 1.3	559.132
Hot leg temperature (K)	578.2 ± 1.8	578.327
Reactor		
Power level (MW)	49.6 ± 0.9	49.6
Maximum linear heat generation rate (kW/m)	50.8 ± 3.6	50.8
Steam Generator Secondary Side		
Water level (m)	0.14 ± 0.08	0.1475
Water temperature (K)	545.0 ± 0.8	542.377
Pressure (MPa)	5.67 ± 0.08	5.72
Mass flow rate (kg/s)	27.0 ± 1.0	26.728
Broken Loop		
Hot leg temperature (K)	563.3 ± 2.6	559.137
Cold leg temperature (K)	557.6 ± 2.6	558.381
Pressurizer		
Steam Volume (m^3)	0.43 ± 0.05	---
Liquid volume (m^3)	0.50 ± 0.05	---
Water temperature (K)	614.9 ± 1.3	610.4
Pressure (MPa)	14.93 ± 0.25	14.901
Liquid level (m)	0.92 ± 0.1	0.96

Table 2. Sequence of events in L9-1/L3-3

Event	Description	Measured (sec)	Calculated (sec)
L9-1			
Main feedwater pump off		0.0	0.0
Pressurizer spray activated	$P_{pzr} > 15.338$*	30.0 ± 0.1	28.94
Reactor scram (15.67 MPa) t_{SCRAM}	$P_{ILHL} > 15.745$ $T_{ILHL} > 583.16$*	65.4 ± 0.2	55.8
Steam generator main steam control valve closed	t_{SCRAM} + delay*	77.2 ± 0.2	69.0
Steam generator liquid level reached bottom of range	$L_{S/G} = 0.25$ m	190 ± 20	82.0
Pressurizer spray valve cycling initiated	$P_{pzr} > 15.338$	208.9 ± 0.1	315.0
Pressurizer liquid level reached top of the range	$L_{pzr} = 1.83$ m	1089.7 ± 30	1840.0
Pressurizer spray valve cycling ended	$P_{pzr} > 16.2$	1246.0 ± 0.1	1370.0
PORV cycling initiated	$P_{pzr} > 16.2$	1467.9 ± 0.1	1795.0
L3-3			
PORV latched open (t_{LATCH})	$T_{ILHL} > 597$	3269.9 ± 0.1	3189.0
PCPs tripped off	$T_{ILHL} > 597$	3284.8 ± 0.2	3189.0

(continued)

Event	Description	Measured (sec)	Calculated (sec)
PCP coastdown completed		3304.2 ± 0.8	3220.0
Upper plenum fluid reached saturation pressure		3329.4 ± 0.2	3270.0
PORV closed ($t_{PORV-CLOSE}$)	t_{LATCH} + 1580	4849.7 ± 0.1	4769.0
Steam generator secondary refill initiated	$t_{PORV-CLOSE}$ + 265	5114.6 ± 0.2	5034.0
Natural circulation initiated		5205 ± 10	---
Steam generator secondary refill completed ($t_{REF-COM}$)	$L_{S/G}$ = 2.9464	5746.4 ± 0.2	6119.0
Pressurizer liquid level reached bottom of the range	L_{pzr} = 0.06	5915 ± 5	5460.0
Steam generator secondary feed and bleed initiated	$t_{REF-COM}$ + 966	6712.2 ± 0.2	7822.2
Experiment completed		9517.4 ± 0.2	---

Note --- : not predicted

* : MPa in pressure, K in temperature, and m in level

Table 3. Summary of nodalization

Component	Vol	Jun	H.S
1.Reactor Vessel			
Filler Gap	7	7	14
Downcomer	6	6	18
Lower Plenum	3	5	5
Active Core	3	2	6
Core Bypass	3	2	---
Upper Plenum	3	4	5
Upper Head	1	1	2
2.Primary Coolant System (Intact Loop)			
Hot Leg (included S/G inlet plenum)	6	7	8
S/G U-tube	6	5	6
Loop Seal (included S/G outlet plenum)	4	4	3
Pump Suction Tee	5	6	5
Primary Coolant Pumps	2	4	---
Colg Leg (included pump discharge pipes)	8	12	7
3.Primary Coolant System (Broken Loop)			
Hot Leg	3	4	3
S/G-Pump Simulator	12	12	12
RABS	4	5	4
Cold Leg	5	6	5
QOBV/Line	2	2	---
4.Pressurizer System			
Surge Line/Valve	2	3	---
Pzr Vessel	9	8	10
Spray Line/Valve	1	3	---
Experiment PORV	---	1	---
Heater	---	---	1
5.Secondary Coolant System			
Feedwater Storage	2	2	---
S/G Downcomer	6	6	10
S/G Riser	5	4	12
Separator	1	3	1
Steam Dome/Line	3	2	2
MSCV/Bypass	---	2	---
6.ECCS	6	6	---
7.Others (Letdown/Charging, Containment)	3	1	---
Total	125	135	136

Table 4. Detailed information for heat structure

No	NH	NA	Description	Left Bn.	Right Bn.
60	6	8	SG U-tube	115-4:9	515-4:6
1151	2	4	SG Inlet/Outlet Plenum Wall	115-3,-10	Ambient
1152	2	20	S/G Tube Sheet Periphery Region	115-3,10	515-3
1001	12	11	Intact Loop Piping (Large Pipes)	100, 105, 110, 115-1 115-12,-13 120, 150 150, 175-1, 175-2, 180, 185	Ambient
1002	2	11	S/G Inlet-Cold Leg, Outlet-Hot Leg Connection	115-2, 11	Ambient
1003	7	11	Intact Loop Piping (0.216 m OD)	125, 130, 140, 145, 155, 160, 170	Ambient
1004	2	11	S/G Inlet/Outlet Plena	115-3,10,	Ambient
2000	1	21	Reactor Vessel Filler Block Inlet Annulus Top Volume	200	Insulated
2001	6	11	Core Support Barrel	Insulated 210-1:4	200, 205
2050	1	21	Filler Blocks Inlet Annulus Lower Volume	205-1	223-1
2100	6	21	Downcomer and Lower Plenum	210-1:4, 215, 220	223-2:7

(continued)

No	NH	NA	Description	Left Bn.	Right Bn.
2110	3	11	Reactor Vessel Wall (Mid-Part)	223-1:3	Ambient
2120	5	7	Reactor Vessel Wall (Lower-Part)	223-3:7	Ambient
2200	1	11	Reactor Vessel Bottom Wall	220	Ambient
2250	7	11	Core Flow Skirt-Core Filler Assembly	225, 230-1:3, 240, 245, 246	Insulated
2260	1	7	Lower Core Support Structure, Core Support Barrel Lips, Fuel Module Lower End Box	225	Insulated
2300	3	10	Active Core	230-1:3	Kinetics
2400	1	7	Upper Core Support Stucture	240	Insulated
2460	1	5	Fuel Module Top	245	246
2500	1	11	Core Support Barrel-Upper Plenum Lower Volume	250	Insulated
2510	2	5	Upper Plenum Internals	250	Insulated
2501	1	21	Core Support Barrel-Upper Plenum Upper part	250	Insulated
2550	1	21	Upper Head Top Plate	250	Ambient
3150	2	11	Broken Loop S/G Simulator 1	315-1:2	Ambient
3151	1	11	Broken Loop S/G Simulator 2	315-9	Ambient

(continued)

No	NH	NA	Description	Left Bn.	Right Bn.
3152	1	11	Broken Loop S/G Simulator 3	315-11	Ambient
3153	6	11	Broken Loop S/G Simulator 4	315-3:8	Ambient
3154	1	11	Broken Loop S/G Simulator 5	315-12	Ambient
3155	1	11	Broken Loop S/G Simulator 6	315-10	Ambient
3000	3	11	Broken Loop Hot Leg	300, 305 310	Ambient
2250	3	11	Broken Loop Cold Leg	335, 340, 345	Ambient
3501	1	11	Broken Loop Cold Leg	350-1	Ambient
3502	1	11	Broken Loop Cold Leg	350-2	Ambient
3700	4	11	Reflood Assist Bypass Piping	370, 375, 380, 385	Ambient
4151	1	11	Pressurizer Vessel Bottom	415-1	Ambient
4152	7	11	Pressurizer Vessel (Large Dia.)	415-2:7	Ambient
4162	1	11	Pressurizer Vessel (Small Dia.)	415-8	Ambient
4172	12	9	Pressurizer Backup Heater	415-2	Table 417/8
4201	1	11	Pressurizer Top Wall	420	Ambient
5000	3	4	S/G Shroud Upper Part	500, 505, 510-1	520, 515-8:7
5150	4	4	S/G Shroud Lower Part	510-1:4	515-7:4
5300	8	10	S/G Secondary Vessel Wall	530-1, 525 500, 505 510, 515-1:3	Ambient

Table 5. Summary of data channels and uncertainties in comparison plots

Description	Calculation	Experiment	Uncertainty *	Fig. No
1. Pressure at ILHL	p 100-01	PE-PC-005	0.28 MPa	4, 11
2. Coolant temperature at ILHL	tempf-100-01	TE-PC-02B	3.0 K	5, 12
3. Reactor power	rktpow-0	RE-T-77-A	2.0 MW	6
4. Pressure at SG steam steam dome	p 530-02	PE-SGS-01	0.12 MPa	7, 13
5. Coolant temperature at SG secondary	tempg 515-06	TE-SGS-04	3.0 K	8, 14
6. Liquid level at SG secondary	cntrlvar-1	LT-P004-08B	0.08 m	9, 18
7. Mass flow rate downstream MSCV	mflowj-550	FT-P004-012	0.8 kg/s	10
8. Liquid level at pressurizer	cntrlvar-2	LE-PdEP139-6	0.06 m	15
9. Mass flow rate through PORV	mflowj-425	FR-PC-S231	0.2 kg/s	16
10. Fluid density at the intact loop hot leg	rho-100	DE-PC-02C	0.17 Mg/m3	17

Note * : Measurement uncertainty referred to the reference [5]

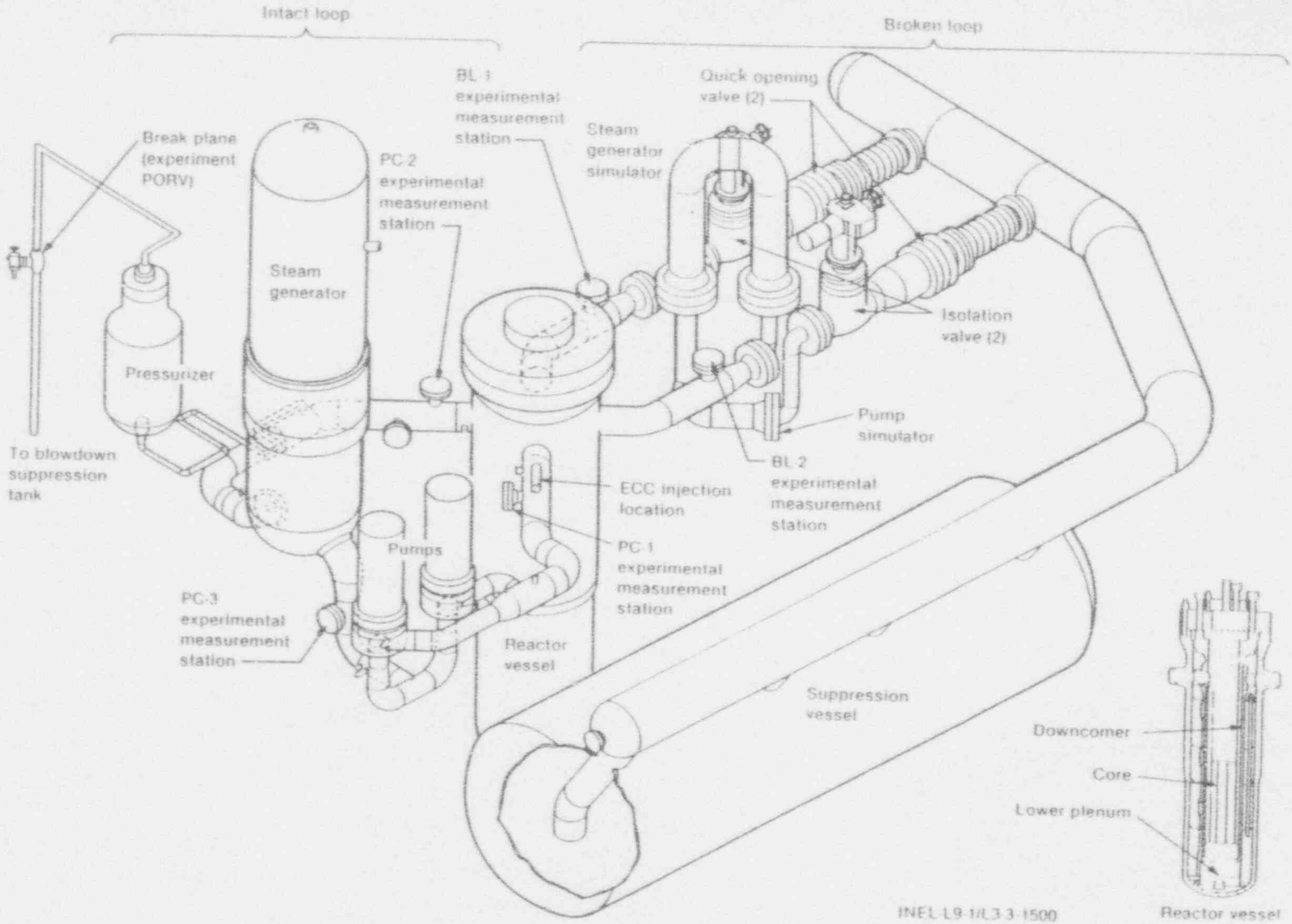

Fig.1 Axonometric configuration of LOFT L9-1/L3-3 test

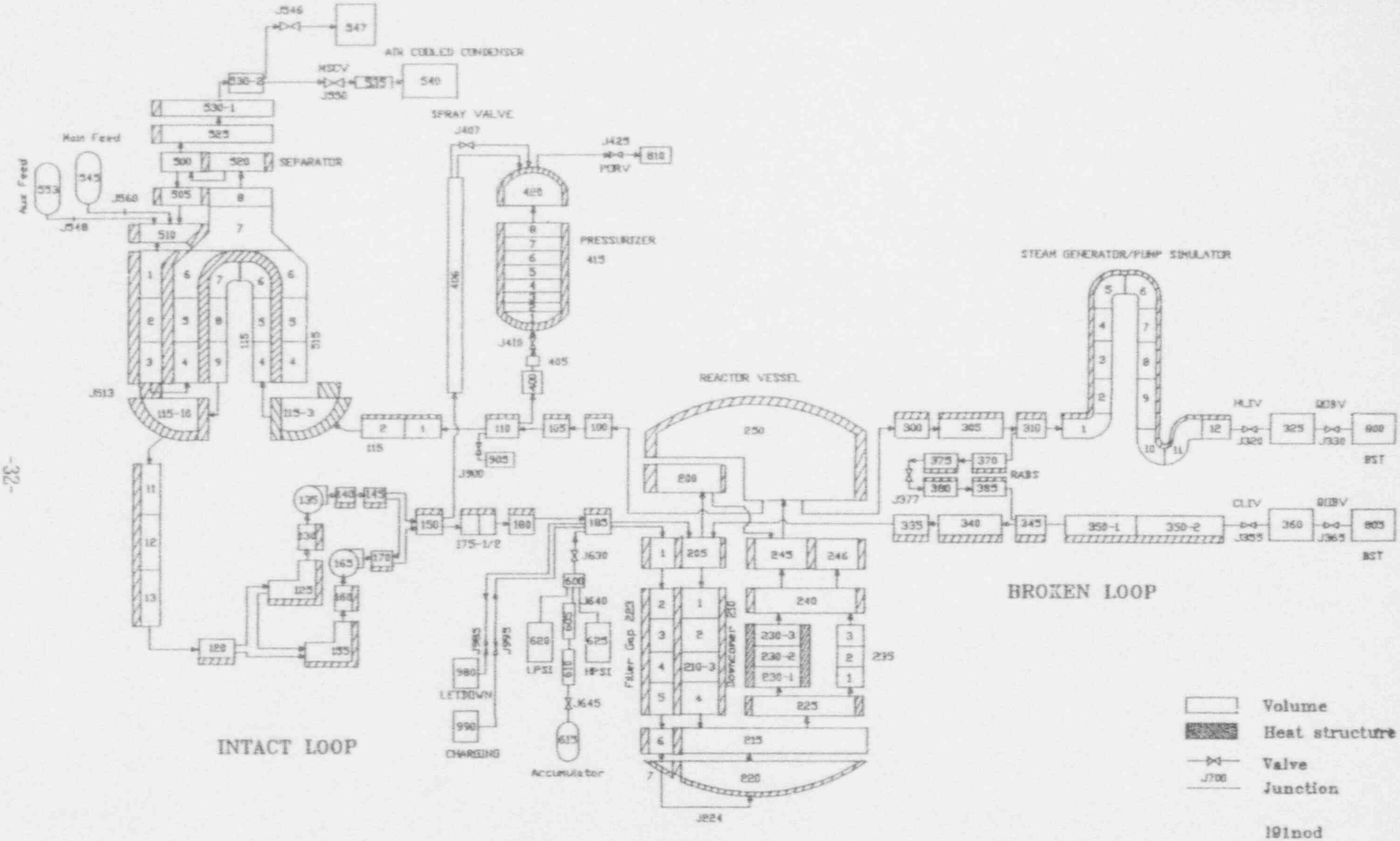

Fig. 2 RELAP5 Nodalization for LOFT Experiment L9-1/L3-3

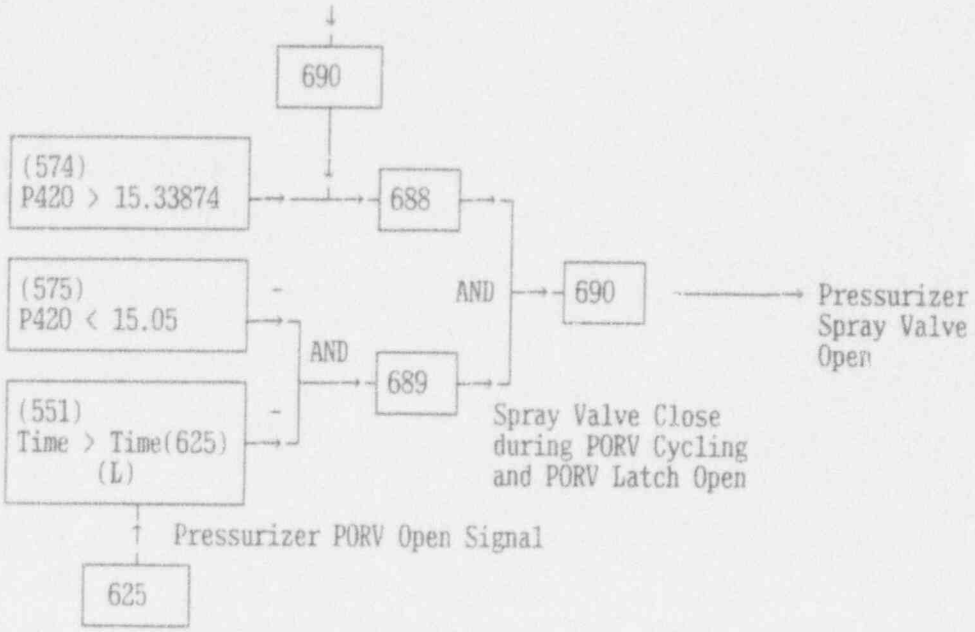

Fig.3-a. Pressurizer spray valve control trip

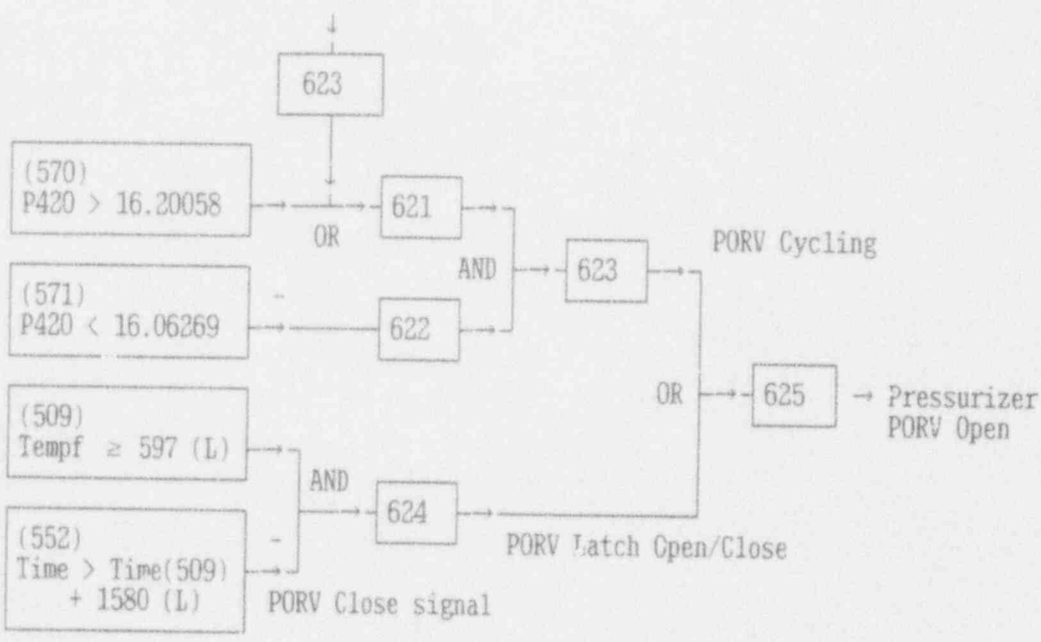

Fig.3-b. Pressurizer PORV control trip

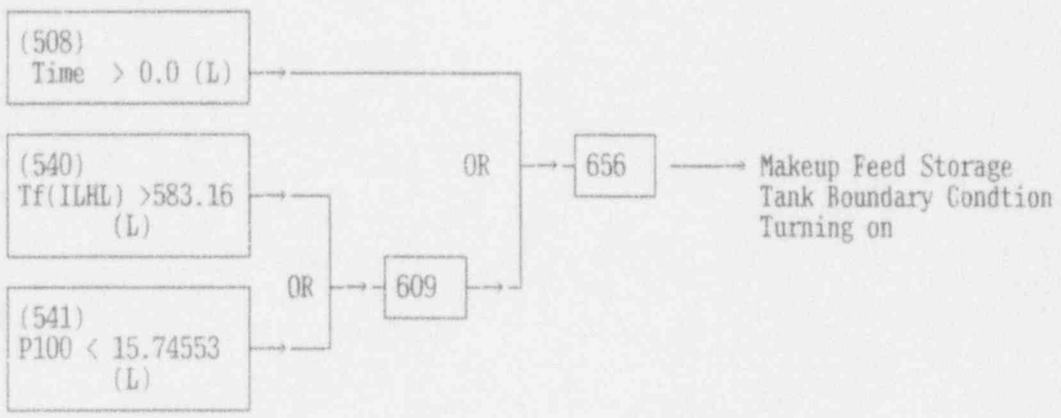

Fig.3-c. Makeup feed storage tank boundary condition trip

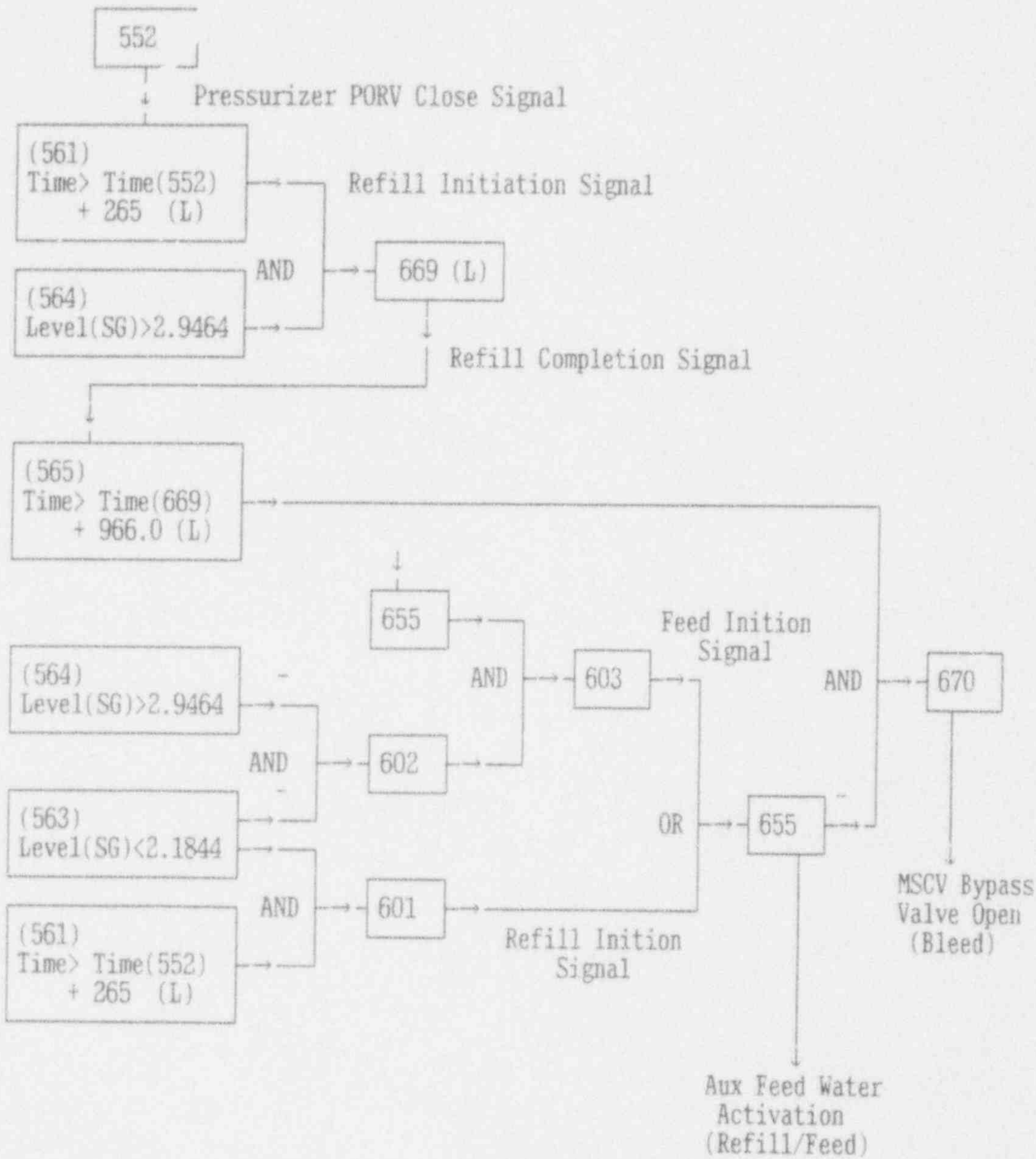

Fig.3-d MSCV byapass valve control trip

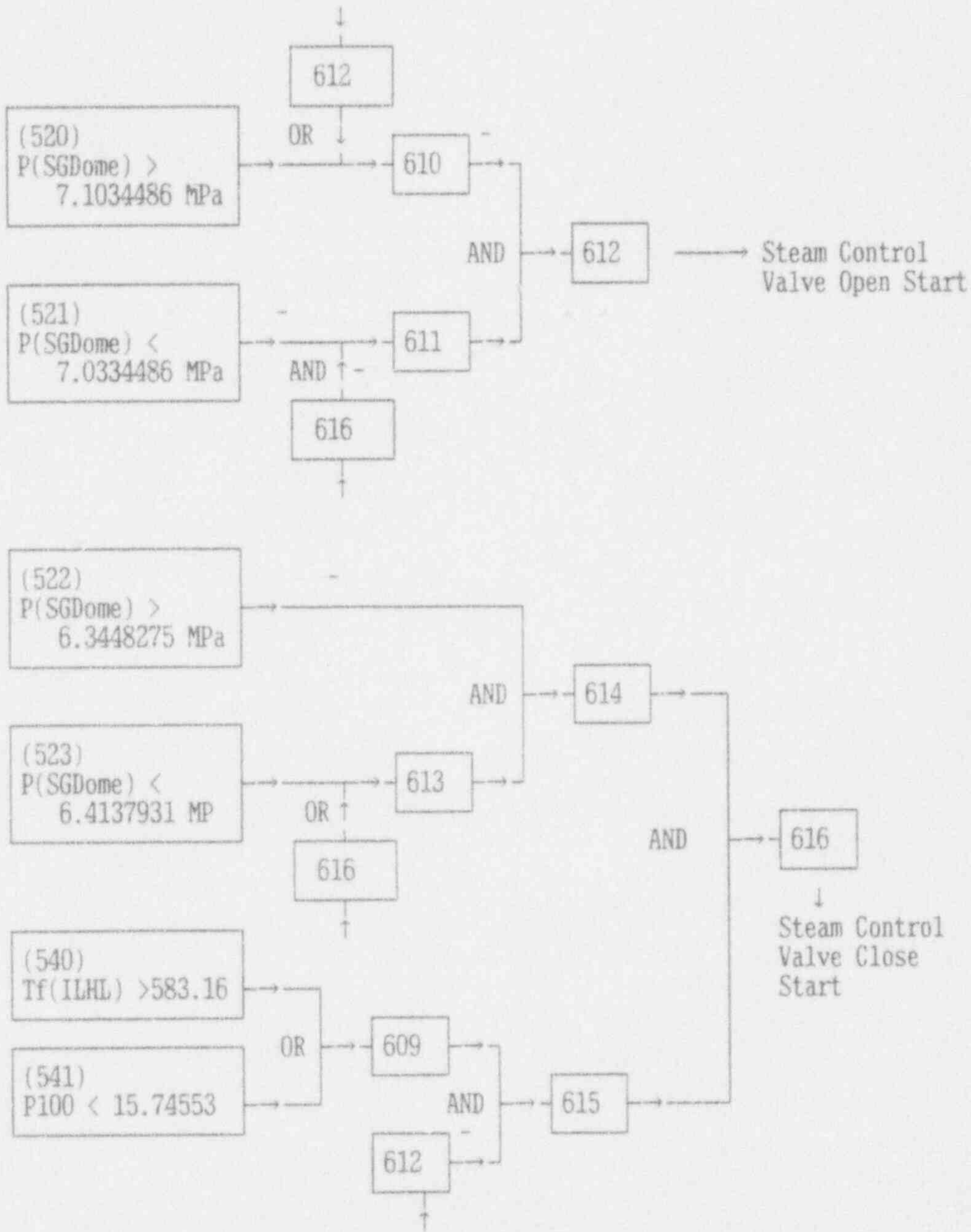

Fig.3-e MSCV open/close control trip

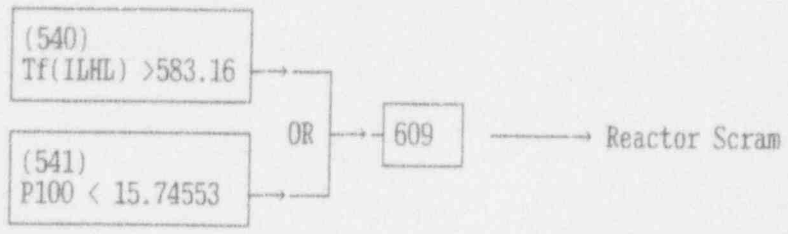

Fig.3-f Reactor scram trip

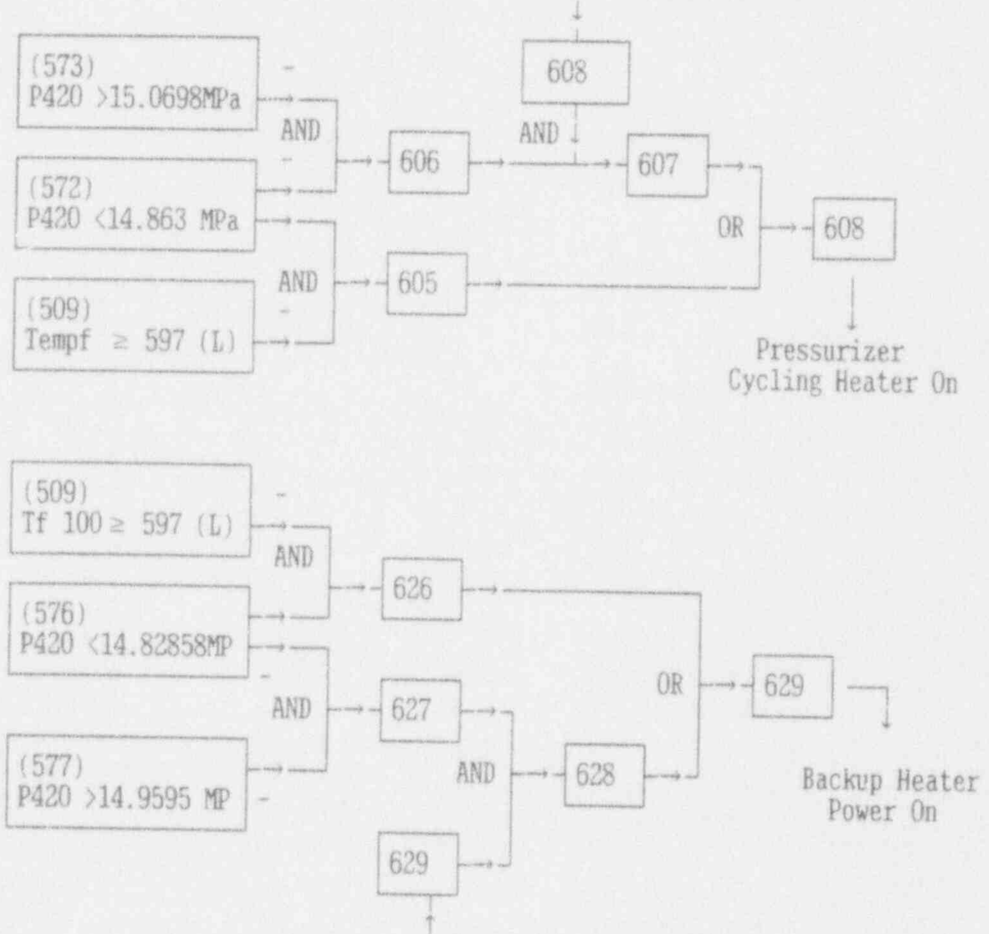

Fig.3-g Pressurizer heater control trip

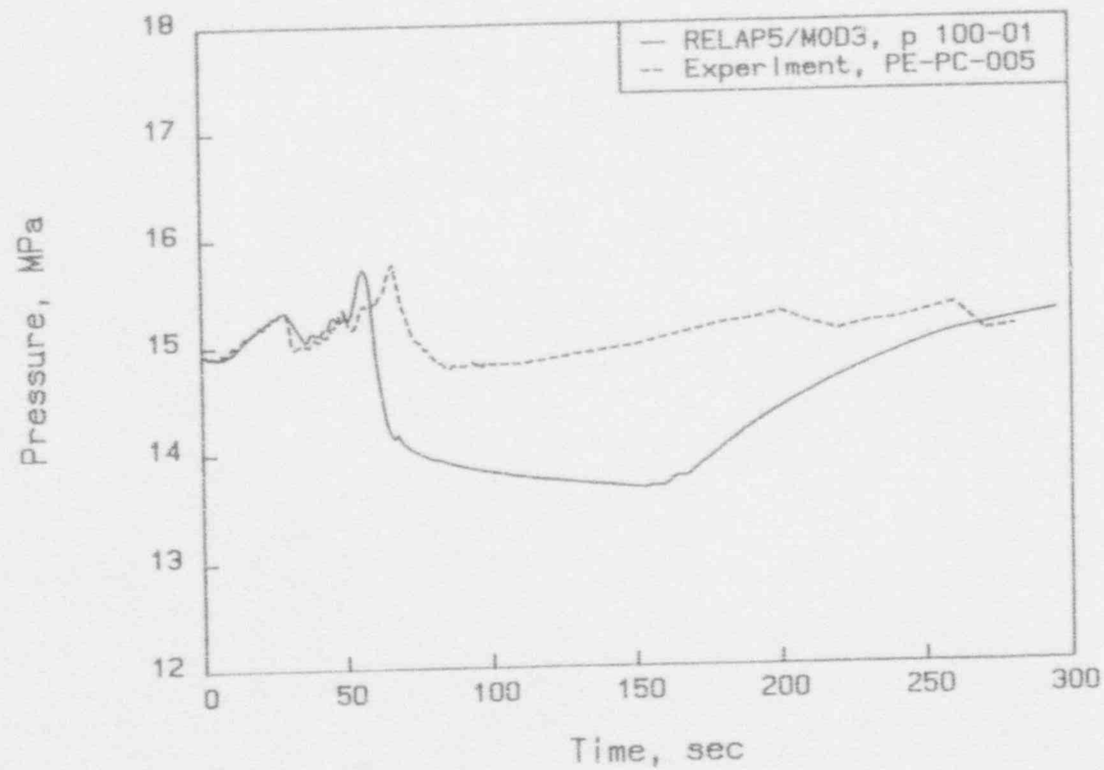

Fig.4 Comparison of pressure at the intact loop hot leg (short term)

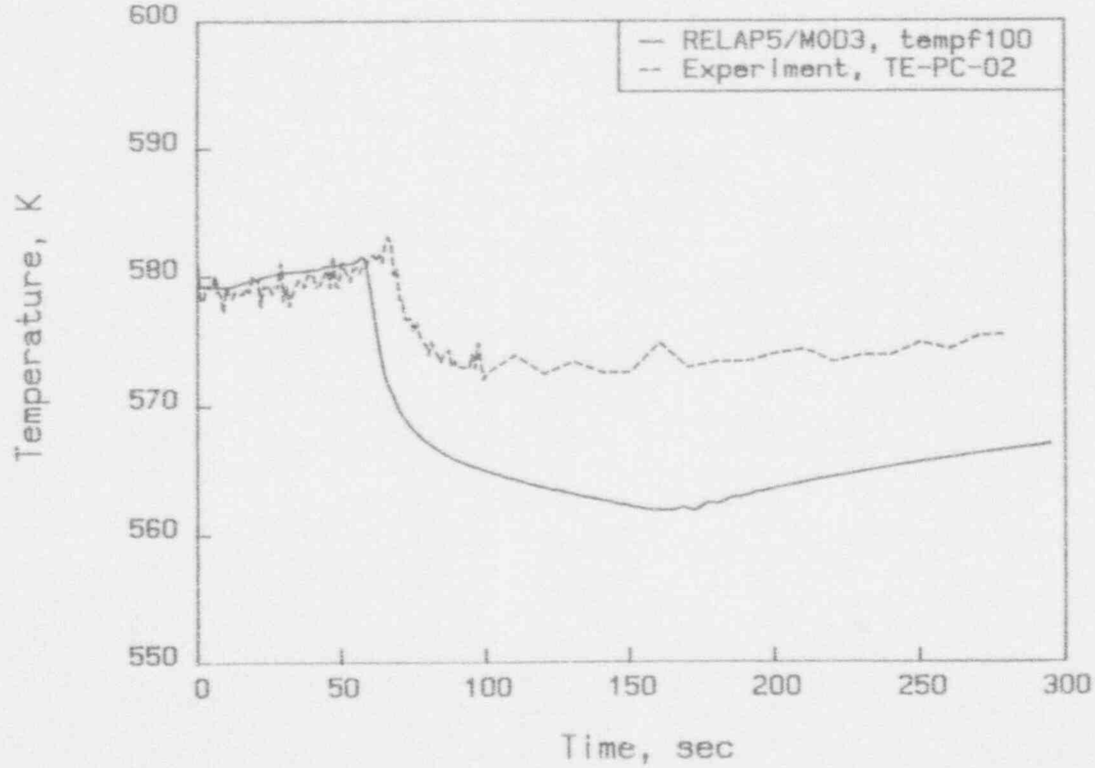

Fig.5 Comparison of coolant temperature at the intact loop hot leg (short term)

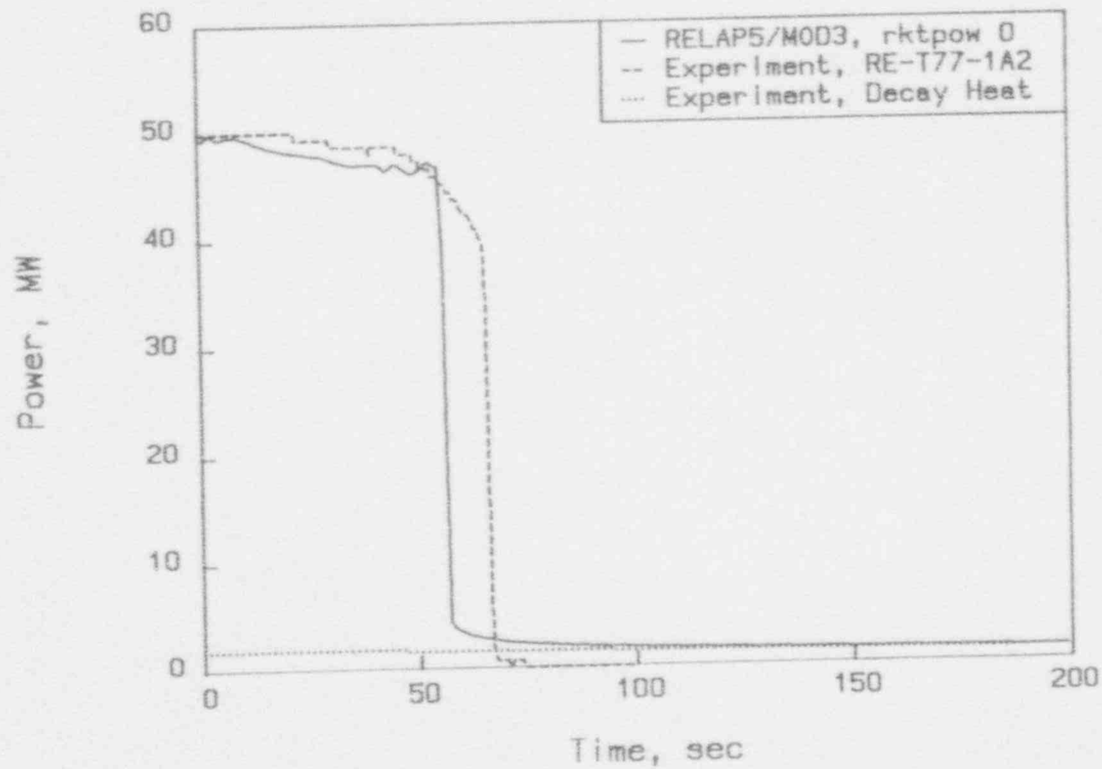

Fig.6 Comparison of reactor power

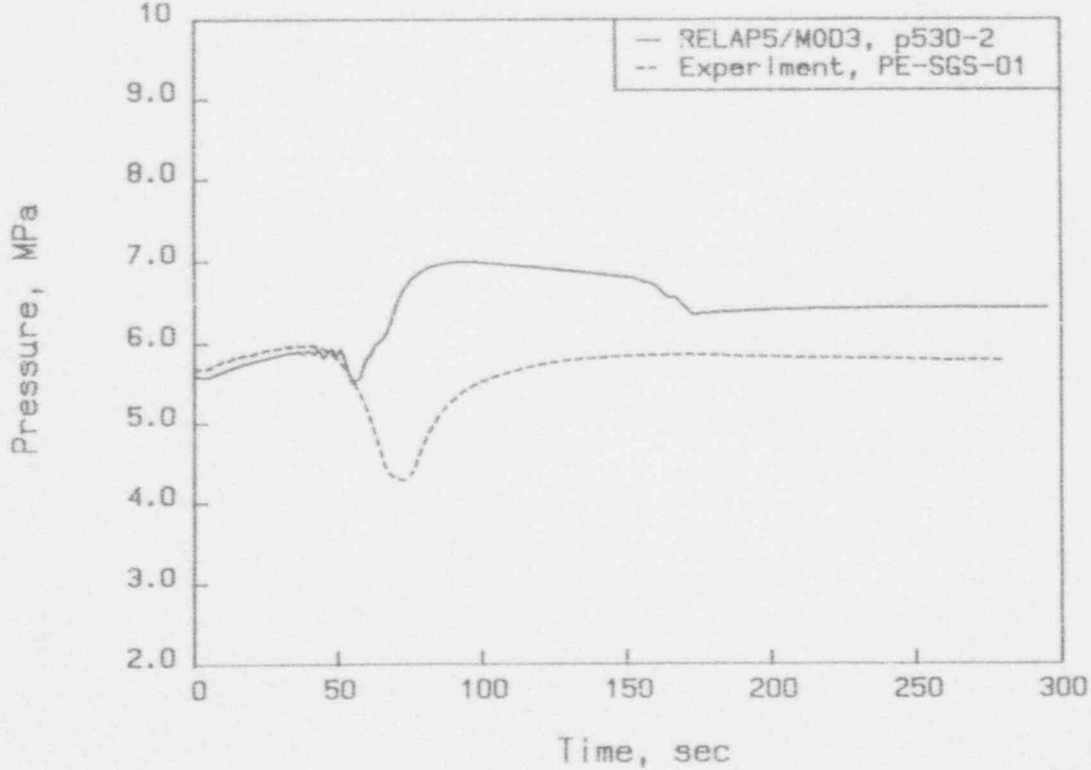

Fig.7 Comparison of pressure at SG steam dome (short term)

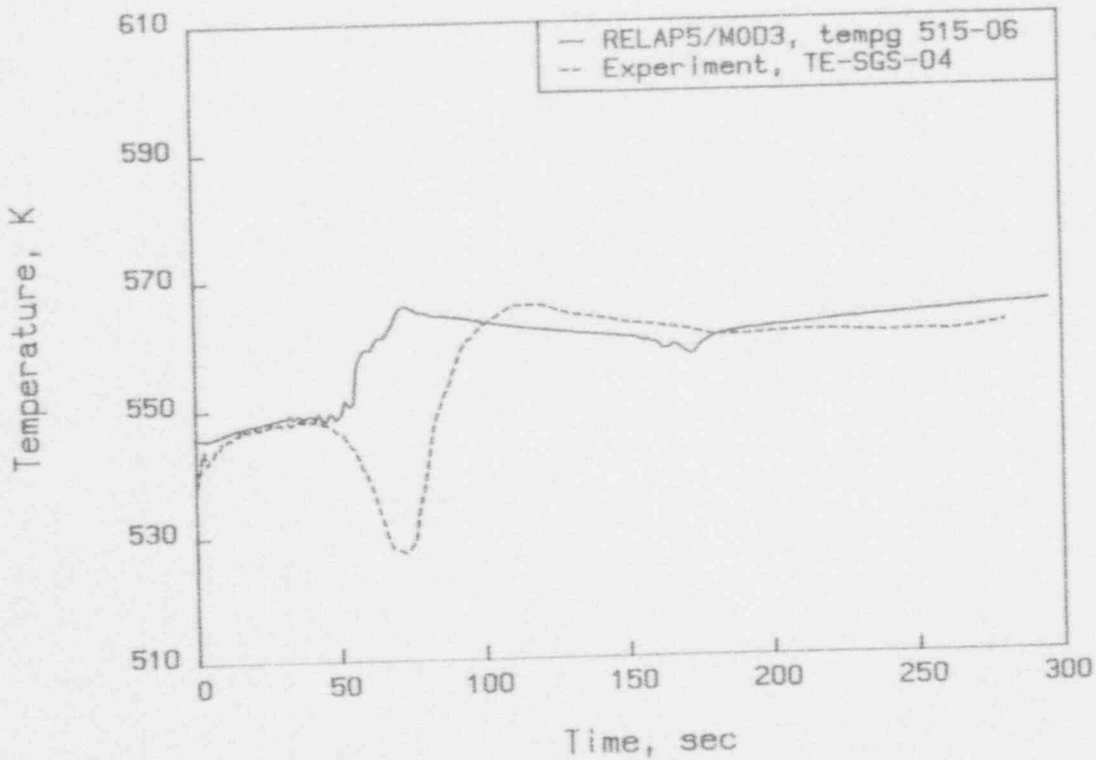

Fig.8 Comparison of coolant temperature at SG secondary side (short term)

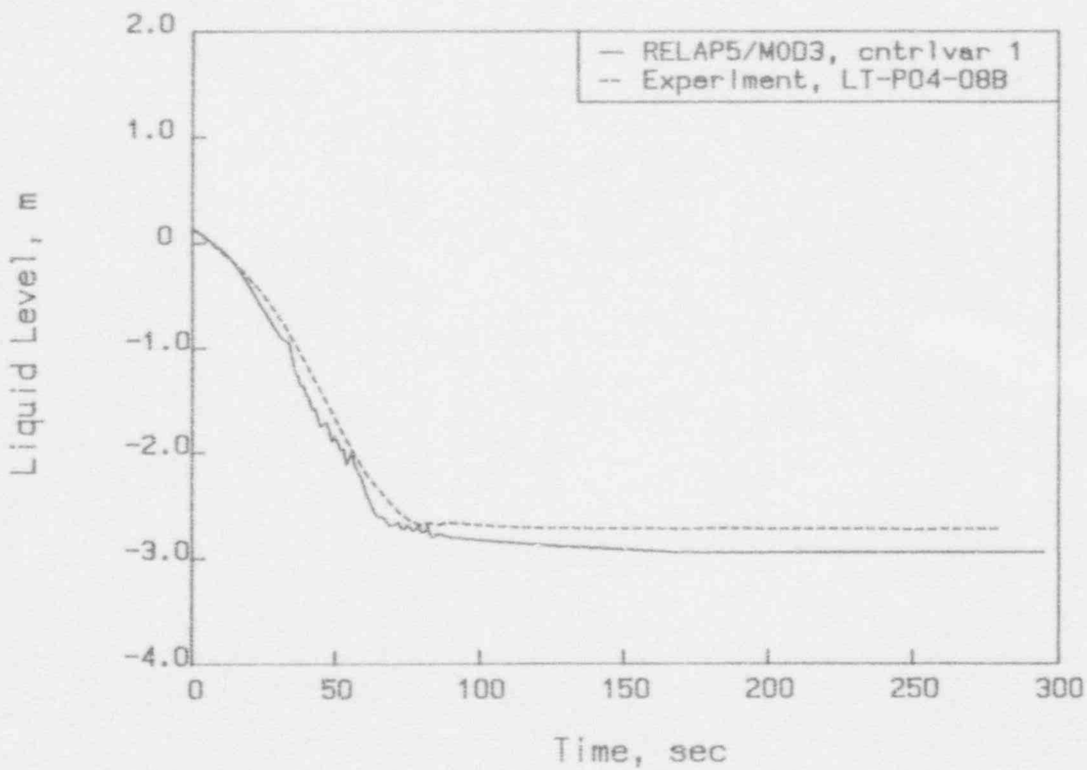

Fig.9 Comparison of SG collapsed liquid level (short term)

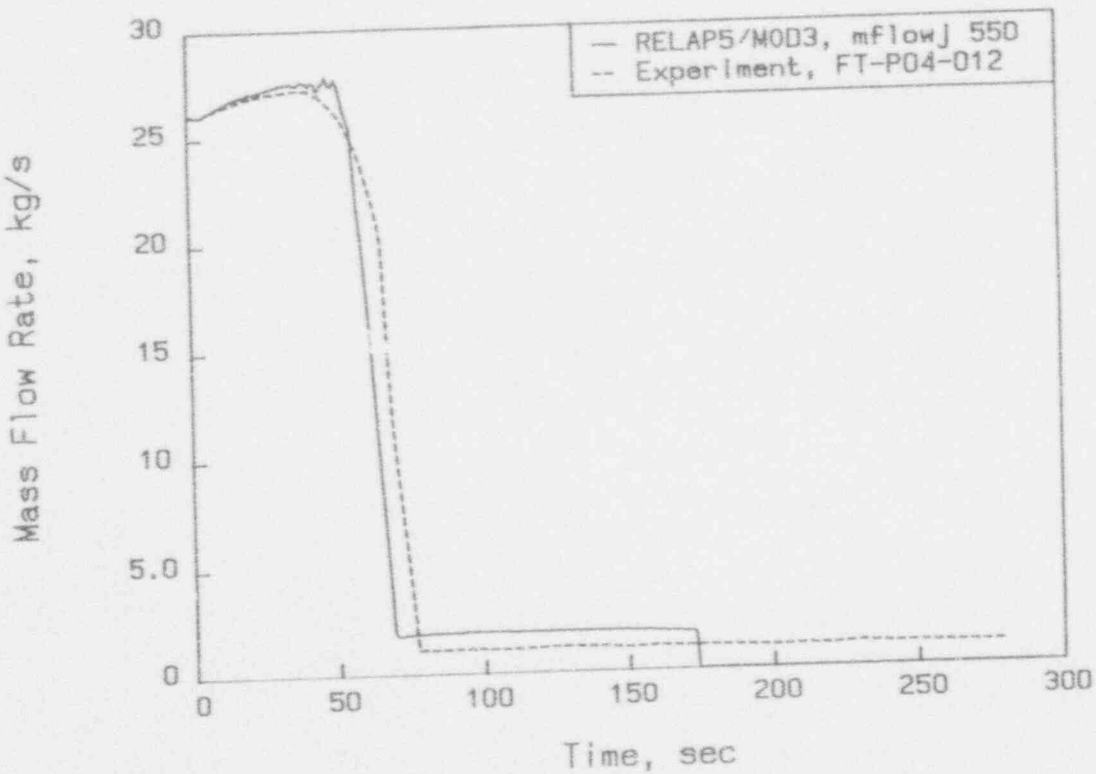

Fig.10 Comparison of mass flow rate through MSCV (short term)

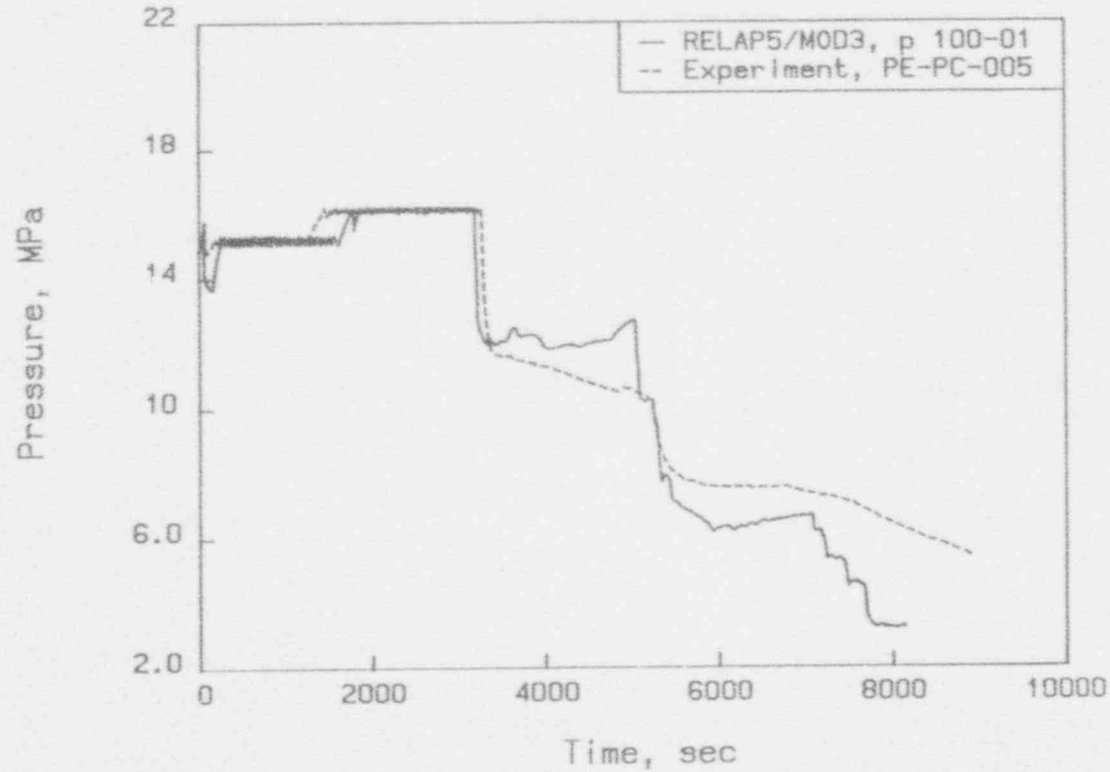

Fig.11 Comparison of pressure at the intact loop hot leg (long term)

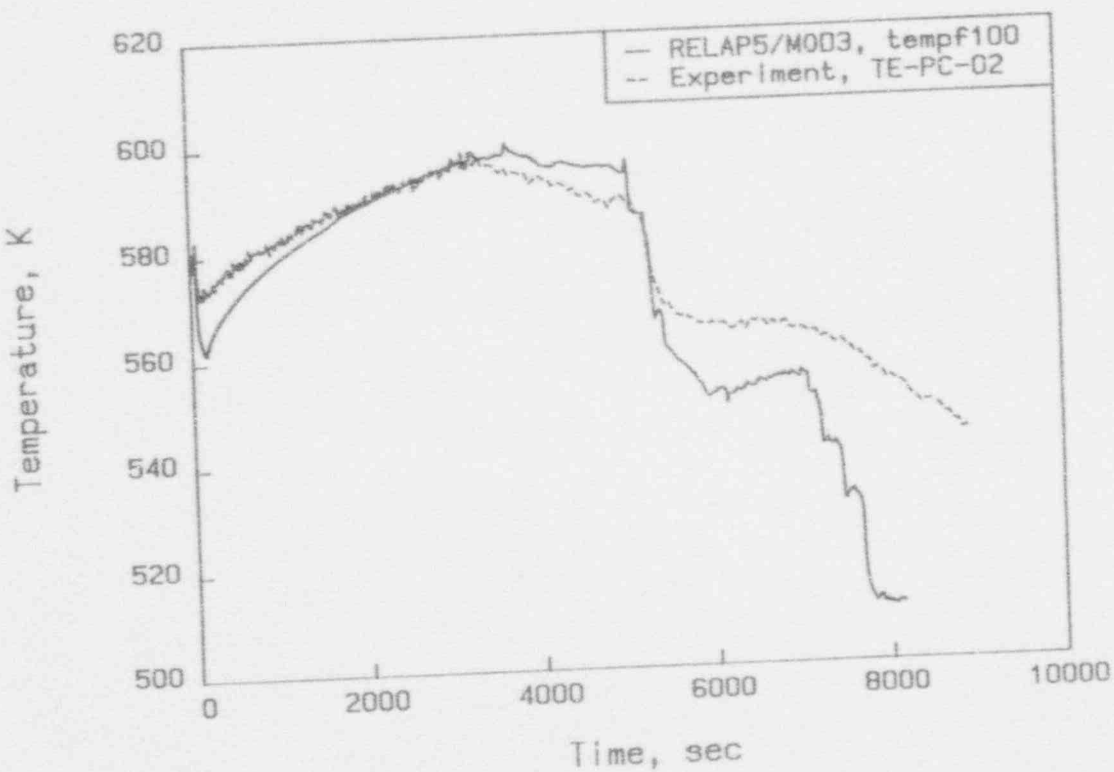

Fig.12 Comparison of coolant temperature at the intact loop hot leg (long term)

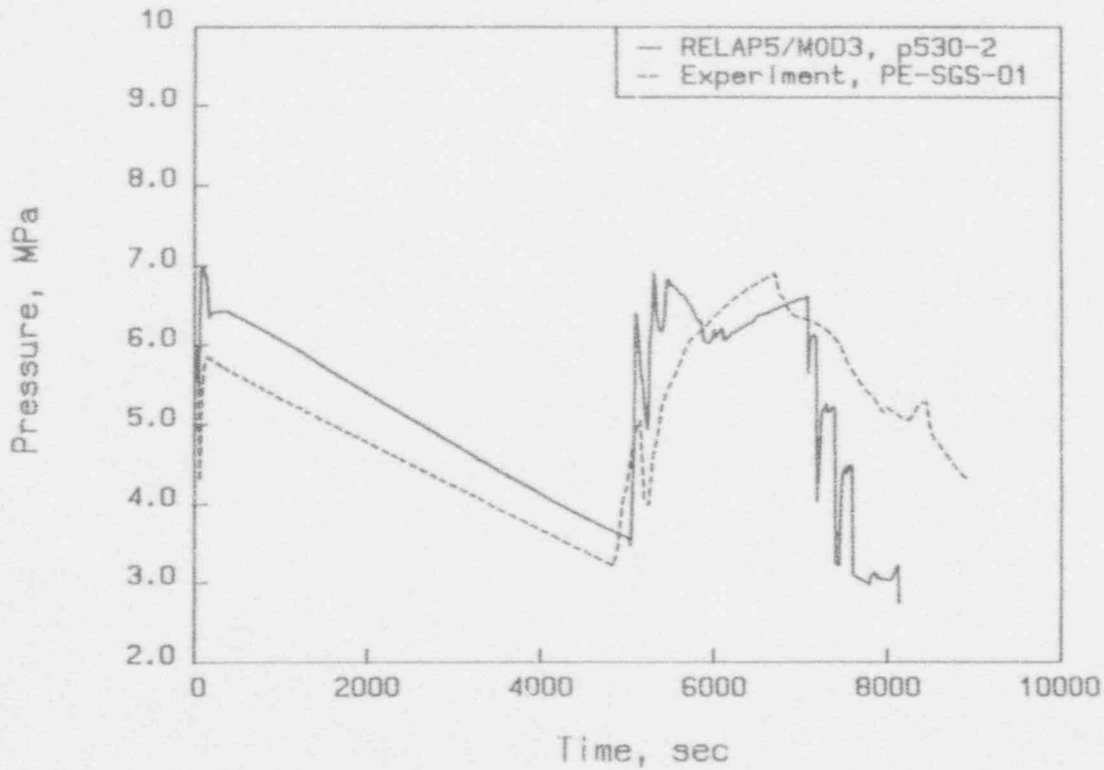

Fig.13 Comparison of pressure at SG steam dome (long term)

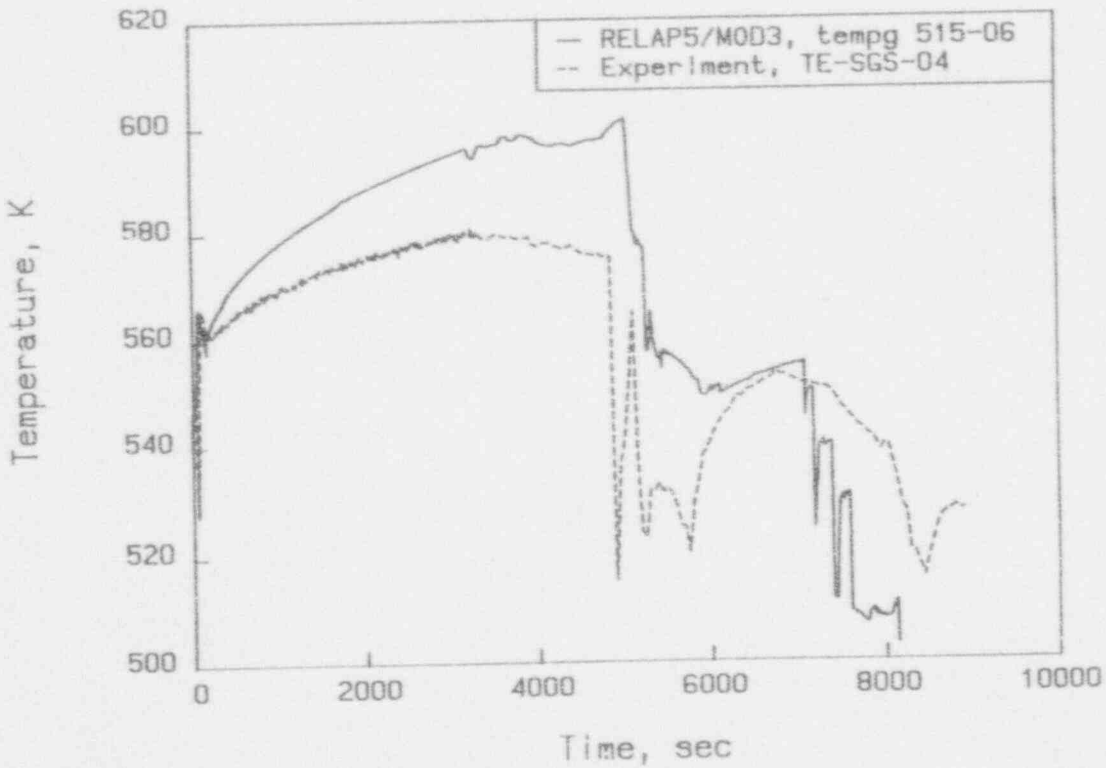

Fig.14 Comparison of coolant temperature at SG secondary side (long term)

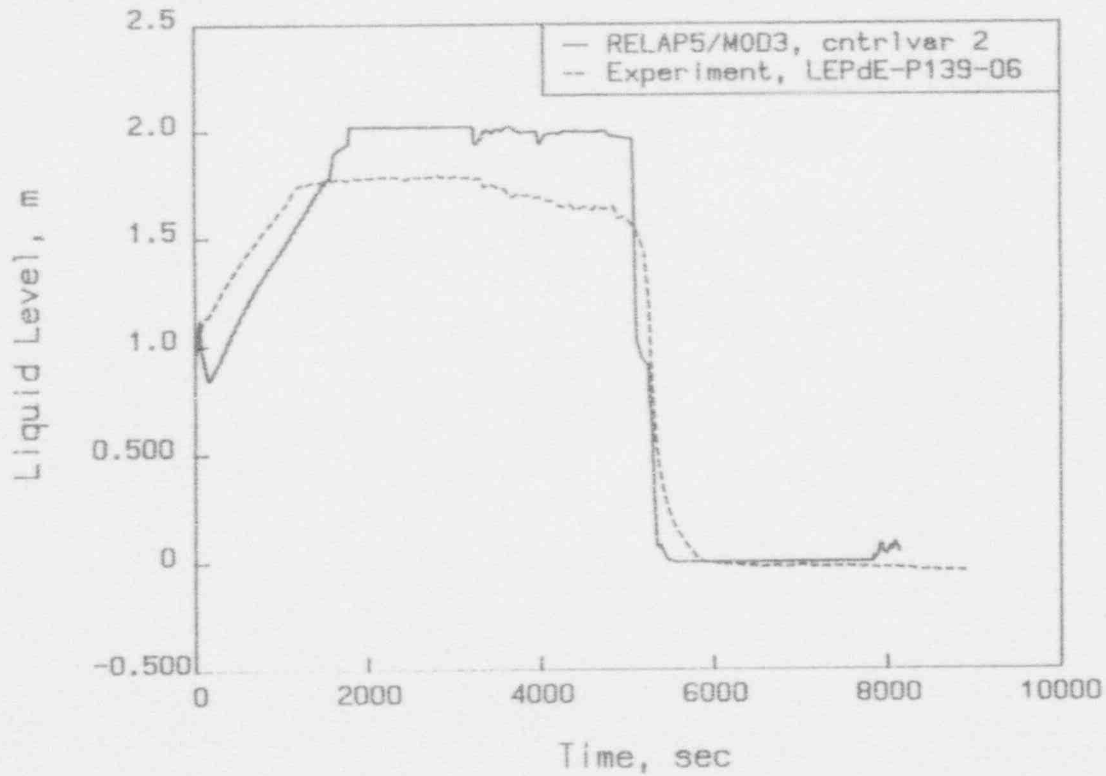

Fig.15 Comparison of pressurizer collapsed liquid level (long term)

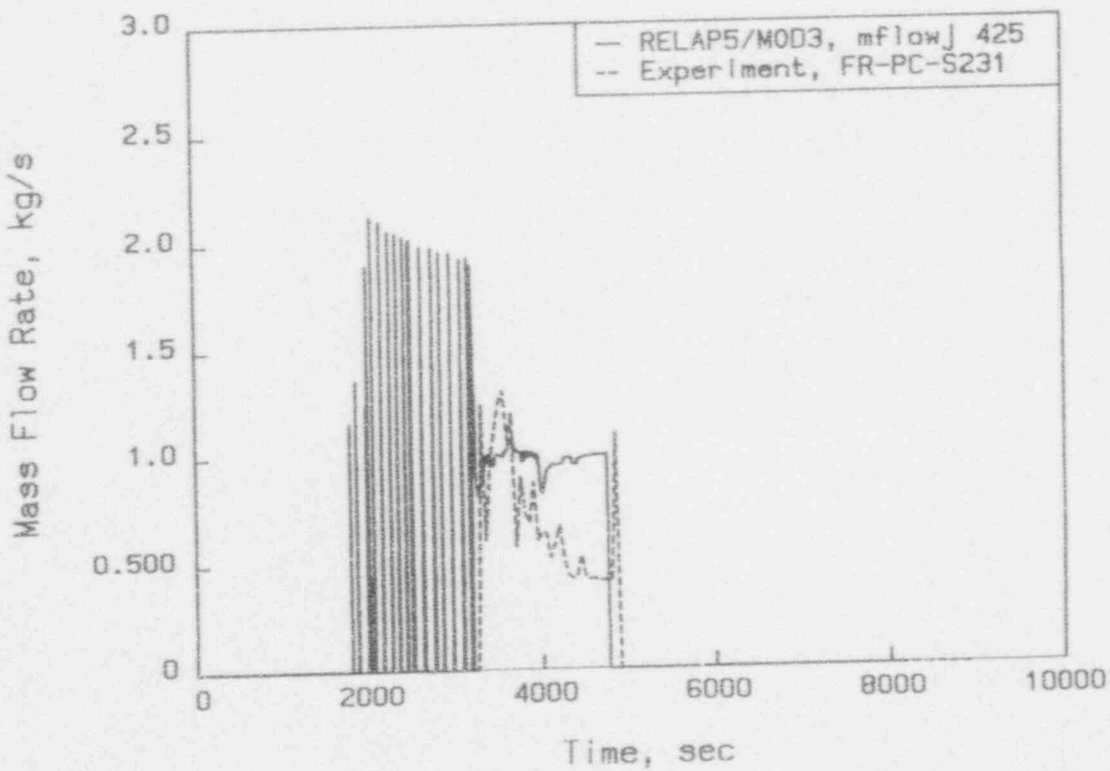

Fig.16 Comparison of mass flow rate through PORV (long term)

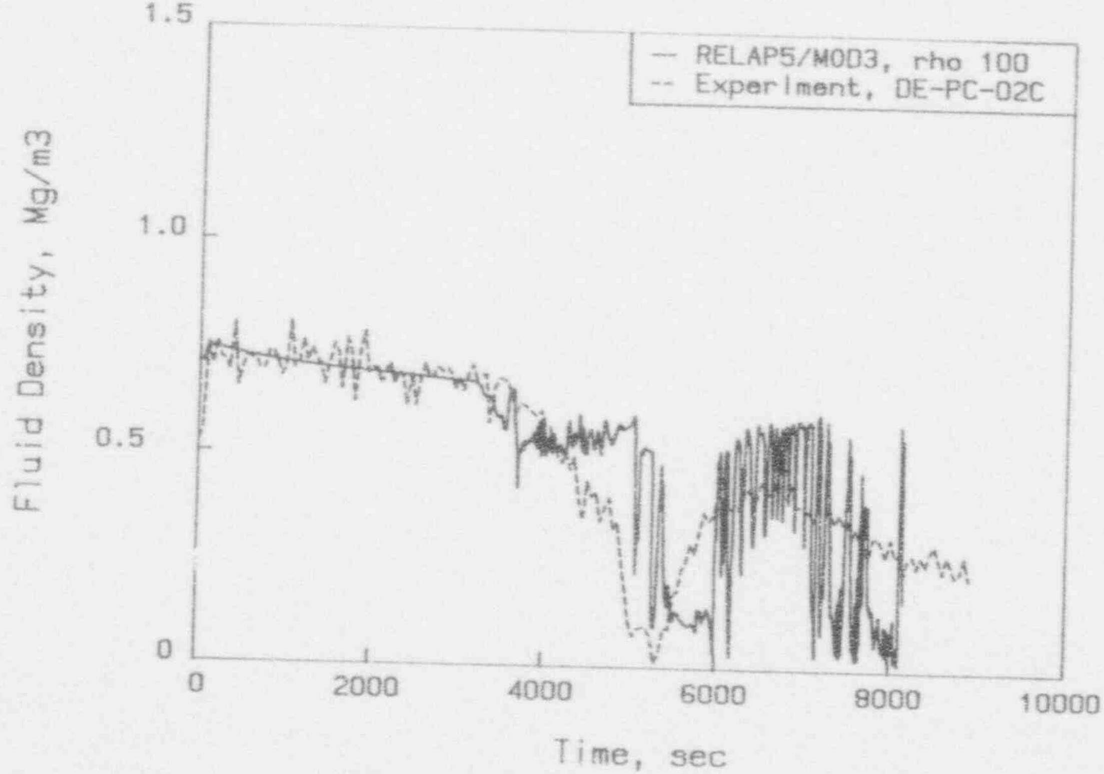

Fig.17 Comparison of fluid density at intact loop hot leg (long term)

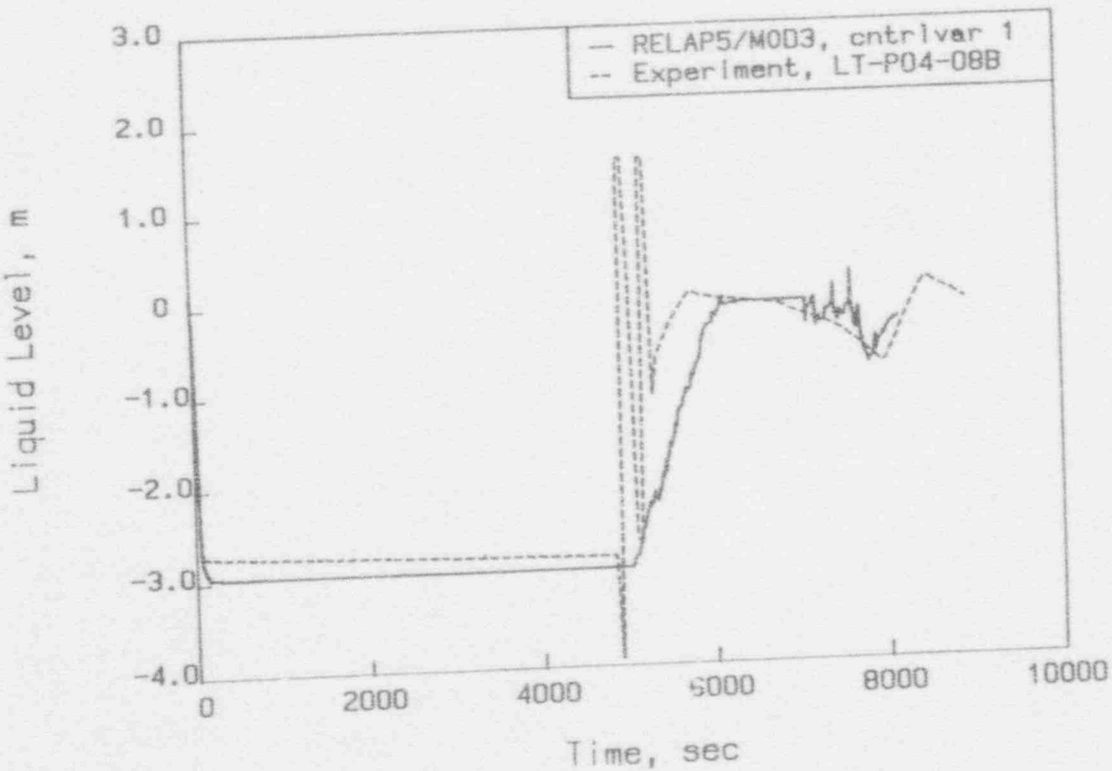

Fig.18 Comparison of SG collapsed liquid level (long term)

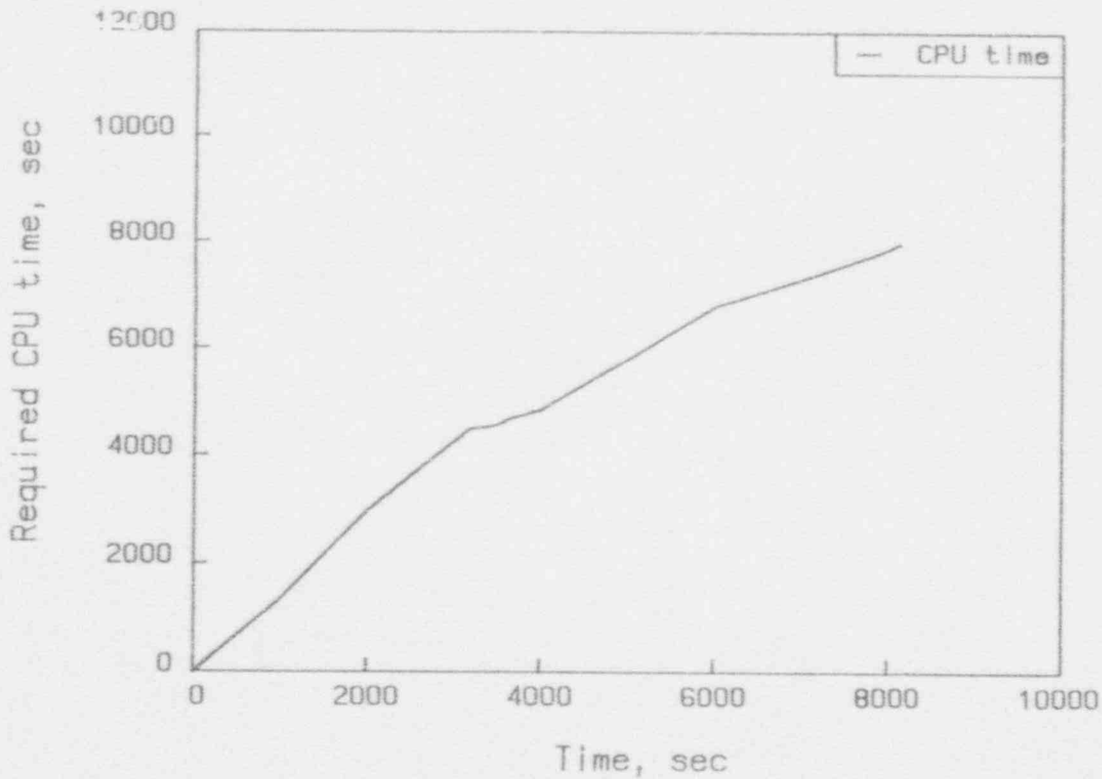

Fig.19 The required CPU time versus the advanced time

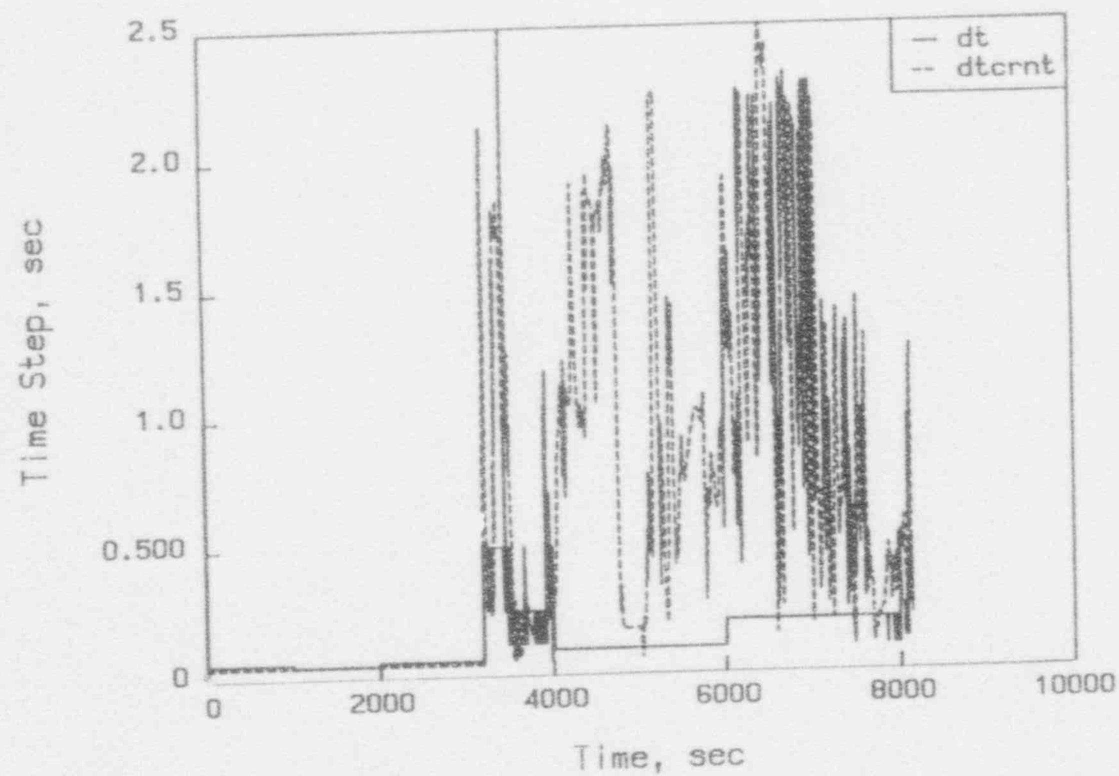

Fig.20 Time step size of base case calculation

Appendix A Input Deck for Steady State Calculation

```
=loft l9-1 post test analysis deck
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*              initial conditions
*
*              core power = 50. mw
*              pcs flow = 479.3 kg/s
*              thot = 578. k
*              tcold = 559.0 k
*
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
0000100   new     stdy-st
0000101   run
0000102   si
0000105   5.      10.
0000110   nitrogen
* time step control cards
*          end time   min dt     max dt   optn mnr   mjr   rst
*0000201   5400.0     1.e-6      0.5       2    4    200   200
*------ ------ ------ ------ ------ ------ ------ ------
*   modification for steady state run at 91/2/8
*------ ------ ------ ------ ------ ------ ------ ------
0000201   1000.0     1.e-6      0.5       2    4    500   200
**************************************************
*
*               minor edit variables
*
**************************************************
* pressure
**************************************************
0000301   p         345010000    * pe-bl-1
0000302   p         310010000    * pe-bl-2
0000303   p         315110000    * pe-bl-3
0000304   p         350010000    * pe-bl-4
0000305   p         315090000    * pe-bl-6
0000306   p         350020000    * pe-bl-8
0000307   p         185010000    * pe-pc-1
0000308   p         100010000    * pe-pc-2
0000309   p         420010000    * porv inlet
0000310   p         110010000    * pt-139-2,3,4
0000311   p         245010000    * pe-1up-1a,1b
0000312   p         215010000    * pe-1st-1a,b/pe-2st-1a,b
0000313   p         200010000    * pe-1st-3a,3b
0000314   p         530020000    * pt-p4-10a
0000315   p         535010000    * pt-p4-85
**************************************************
* temperatures
**************************************************
0000320   tempf     406010000    * spray tempf
0000321   tempf     310010000    * te-bl-2a,2b,2c
0000322   tempf     100010000    * te-pc-2a,2b,2c
0000323   tempf     185010000    * te-pc-1
0000324   tempf     115030000    * te-sg-1
0000325   tempf     115100000    * te-sg-2
0000326   tempf     515040000    * te-sg-3
0000328   tempf     415050000    * pzr volume 5
0000329   tempf     415040000    * te-139-19
0000330   tempf     415030000    * te-139-20
0000331   tempf     315120000    * te-p138-171
0000332   tempf     350020000    * te-p138-170
0000333   tempf     205010000    * te-1st-1/te-2st-1
0000334   tempf     210010000    * te-1st-2/te-2st-2
0000335   tempf     345010000    * te-bl-1
0000336   tempf     210030000    * te-1st-14/te-2st-14
0000337   tempf     210040000    * te-3up-2
0000338   tempf     245010000    * te-1up-6
0000339   tempf     246010000    * te-2up-4
0000340   tempf     250010000    * te-1up-3
**************************************************
* densities
**************************************************
0000341   rho       345010000    * de-bl-1
0000342   rho       310010000    * de-bl-2
0000343   rho       185010000    * de-pc-1
0000344   rho       100010000    * de-pc-2
0000345   rho       115120000    * de-pc-3
0000346   voidgj    400010000    * surge line density
0000347   rho       115040000    * s/g tubes
0000348   rho       115050000    * s/g tubes
0000349   rho       115060000    * s/g tubes
0000350   rho       115070000    * s/g tubes
**************************************************
* velocities
**************************************************
0000351   voidf     100010000    * ilhl nozzle
0000352   velf      100010000    * ilhl nozzle
0000353   velf      115030000    * s/g inlet
0000354   velf      400010000    * surge line
0000355   velfj     425000000    * porv liq vel
0000356   velg      100010000    * ilhl nozzle
0000357   velg      115030000    * s/g inlet
0000358   velg      400010000    * surge line
0000359   velgj     425000000    * porv vap vel
**************************************************
* mass flow rates
**************************************************
0000360   mflowj    100010000    * ilhl nozzle
0000361   mflowj    150010000    * pump outlet
0000362   mflowj    185020000    * dtt-rake ilcl
0000363   mflowj    400010000    * pres. surge line flow
0000364   mflowj    407000000    * pzr spray flow
0000366   mflowj    425000000    * pres. relief valve flow
0000367   mflowj    550000000    * steam flow control valve
0000368   mflowj    548000000    * aux feed
0000369   mflowj    560000000    * main feed
0000370   cntrlvar  1            * s/g level
**************************************************
* cladding temperatures center module
**************************************************
0000371   httemp    230000110    * te-5h5-015
0000372   httemp    230000210    * te-5h5-034
0000373   httemp    230000310    * te-5h5-049
**************************************************
```

```
* peak centerline temperatures                                  *
*****************************************************************
0000374   httemp   230000101        * core lower region
0000375   httemp   230000201        * core middle region
0000376   httemp   230000301        * core upper region
*****************************************************************
* reactor kinetic parameters
*****************************************************************
0000377   rktpow    0             * total reactor power
0000378   rkfipow   0             * fission decay power
0000379   rkgapow   0              * gamma decay power
0000380   rkreac    0             * reactivity
0000381   pmphead   135             * pcp1 head
0000382   pmphead   165             * pcp2 head
0000384   cntrlvar  2             * pzr level
0000385   cntrlvar  3             * rx vessel level
0000386   mflowj    185010000
0000387   mflowj    185030000
0000388   mflowj    200020000
0000389   pmpvel    135
0000390   pmpvel    165
*****************************************************************
*
*      trips
*
*****************************************************************
*      variable trips
*****************************************************************
0000501   p    100010000  le  null    0        14.193103e6  l
*         ecc check valve
0000502   p    600010000  ge  p       185010000 20.e6      n
*         accumulator check valve
0000503   p    615010000  ge  p       185010000 20.e6      n
*         isolation valve hot leg
0000504   time    0       lt  null    0      0.0         l
*         isolation valve cold leg
0000505   time    0       lt  null    0      0.0         l
*         qobv hot leg
0000506   time    0       lt  null    0      0.0         l
*         qobv cold leg
0000507   time    0       lt  null    0      0.0         l
*         check valve surge line pressurizer
0000508   time    0       ge  null    0      0.0         l
*         pressurizer relief valve
0000509   tempf 100010000  ge  null   0       597.0       l
*         steam control valve
0000510   time    0       lt  null    0      0.0         l
*         boundary system valve
0000511   time    0       lt  null    0      0.0         l
*         lpis trip
0000512   time    0       ge  null    0      10000.0     l
*         hpis trip
0000513   time    0       ge  null    0      10000.0     l
*
0000520   p    530020000  gt  null    0      7.103448e6  n
0000521   p    530020000  lt  null    0      7.0344827e6 n
0000522   p    530020000  gt  null    0      6.3448275e6 n
0000523   p    530020000  lt  null    0      6.4137931e6 n
0000530   time    0       ge  null    0      3600.0      n
0000531   p    530020000  gt  p       547010000 0.0      n
0000536   time    0       ge  null    0      10000.0     n
0000540   tempf  100010000  gt  null  0      583.16      l
0000541   p    100010000  gt  null    0      1.574553e7  l
0000550   time    0       ge  null    0      10000.0     l
0000551   time    0       ge  timeof  625    0.0         l
0000552   time    0       ge  timeof  509    1580.       l
0000560   p    100010000  le  null    0      13.15862e6  n
0000561   time    0       ge  timeof  552    265.0       l
0000562   time    0       gt  null    0      5400.0      n
0000563   cntrlvar 1      lt  null    0      2.1844      n
0000564   cntrlvar 1      gt  null    0      2.9464      n
0000565   time    0       ge  timeof  669    966.        l
0000570   p    420010000  gt  null    0      1.620058e7  n
0000571   p    420010000  lt  null    0      1.606269e7  n
0000572   p    420010000  lt  null    0      1.486300e7  n
0000573   p    420010000  gt  null    0      1.506980e7  n
0000574   p    420010000  gt  null    0      1.533874e7  n
0000575   p    420010000  lt  null    0      1.505000e7  n
0000576   p    420010000  lt  null    0      1.482853e7  n
0000577   p    420010000  gt  null    0      1.495950e7  n
*****************************************************************
* logical trips
*****************************************************************
0000600   670
0000601   563      and     561      n
0000602  -563      and    -564      n
0000603   655      and     602      n
0000604   609      or      609      l
0000605   572      and    -509      n
0000606  -572      and    -573      n
0000607   608      and     606      n
0000608   605      or      607      n
*0000609   540     or      541      l
*------ ------ ------ ------ ------ ------ ------ ------
*  modification for steady state run at 91/2/8
*------ ------ ------ ------ ------ ------ ------ ------
0000609   504      or      504      l
0000610   612      or      520      n
0000611  -521      and    -616      n
0000612   611      and     610      n
0000613   616      or      523      n
0000614  -522      and     613      n
0000615  -612      and     609      n
0000616   615      and     614      n
0000617   612      or      616      n
0000618   605      or      607      n
0000621   623      or      570      n
0000622  -571      and    -571      n
0000623   621      and     622      n
0000624   509      and    -552      n
0000625   623      or      624      n
0000626   576      and    -509      n
```

```
0000627  -576   and   -577   n
0000628   629   and    627   n
0000629   626   or     628   n
0000635   504   and    504   n
0000636   509   and   -536   n
0000650  -652   and    550   n
0000651   650   or     652   n
0000652  -509   and    651   n
0000655   601   or     603   n
0000656   508   or     609   n
0000659   561   or     562   n
0000660   504   or     504   n
0000669   561   and    564   l
0000670   565   and   -655   n
0000680   530   or     530   n
0000688   690   or     574   n
0000689  -575   and   -551   n
0000690   688   and    689   n
****************************************************
*
*          intact loop
*
****************************************************
reactor vessel nozzle - intact loop hot leg
****************************************************
1000000  rvnilhl        branch
1000001  2       0
1000101  0.0634  1.5373  0.0   0.0   0.0   0.0
1000102  4.0e-5  0.0     00000
1000200  0       14901000. 1346300.0 2462060.0 0.0
1001101  250000000 100000000 0.0634  0.0  0.0   000100
1002101  100010000 105000000 0.0     0.05 0.05  000100
1001201  10.582000 11.005000 0.0
1002201  10.582000 10.625000 0.0
****************************************************
* pressurizer connection tee reactor vessel side
****************************************************
1050000  pzrtrvs        branch
1050001  1       0
1050101  0.0634  1.634   0.0   0.0   0.0   0.0
1050102  4.0e-5  0.0     00000
1050200  0       1489610. 1346300. 2462190.0 0.0
1051101  105010000 110000000 0.0  0.05  0.05  000100
1051201  13.795000 13.974000 0.0
****************************************************
* steam generator inlet piping
****************************************************
1100000  sginlp         branch
1100001  1       0
1100101  0.0     0.623   0.0303  0.0   0.0   0.0
1100102  4.0e-5  0.0     00000
1100200  0       14857200. 1346340. 24629400.0 .0000000
1101101  110010000 115000000 0.0  0.1   0.1   000100
1101201  13.801000 13.692000 0.0
****************************************************
* steam generator plus piping
```

```
****************************************************
1150000  sgppip         pipe
1150001  13
1150101  0.0      3
1150102  0.151    9
1150103  0.0      12
1150104  0.0634   13
1150201  0.0      1
1150202  0.0512   2
1150203  0.0      9
1150204  0.0512   10
1150205  0.0      12
1150301  1.4385   1
1150302  0.708    2
1150303  0.63     3
1150304  1.067    5
1150305  0.45     7
1150306  1.067    9
1150307  0.63     10
1150308  0.547    11
1150309  0.689    12
1150310  0.559    13
1150401  0.09     1
1150402  0.057    2
1150403  0.335    3
1150404  0.0      9
1150405  0.335    10
1150406  0.0437   11
1150407  0.0462   12
1150408  0.0      13
1150501  0.0      13
1150601  0.0      1
1150602  90.0     6
1150603  -90.0    13
1150701  0.0      1
1150702  0.246    2
1150703  0.513    3
1150704  1.067    5
1150705  0.2865   6
1150706  -0.2865  7
1150707  -1.067   9
1150708  -0.513   10
1150709  -0.498   11
1150710  -0.689   12
1150711  -0.356   13
1150801  4.0e-5   0.0      2
1150802  4.0e-5   0.0102   3
1150803  1.0e-5   0.0103   9
1150804  4.0e-5   0.0102   10
1150805  4.0e-5   0.0      13
1150901  0.15     0.15     1
1150902  0.05     0.05     2
1150903  0.0      0.0      4
1150904  0.1      0.1      5
1150905  0.2      0.2      6
1150906  0.1      0.1      7
```

```
1150907  0.0      0.0      9
1150908  0.05     0.05     11
1150909  0.1      0.1      12
1151001  00000    13
1151101  000100   3
1151102  000000   8
1151103  000100   12
1151201  0     14871600. 1346350.   2462710.0  0.0  0.0 01
1151202  0     14877200. 1346350.   2462600.0  0.0  0.0 02
1151203  0     14793300. 1346370.   2464340.0  0.0  0.0 03
1151204  0     14770000. 1321980.   2464840.0  0.0  0.0 04
1151205  0     14746400. 1301720.   2465340.0  0.0  0.0 05
1151206  0     14729700. 1283950.   2465690.0  0.0  0.0 06
1151207  0     14721700. 1268380.   2465870.0  0.0  0.0 07
1151208  0     14715000. 1254890.   2466020.0  0.0  0.0 08
1151209  0     14707300. 1242570.   2466180.0  0.0  0.0 09
1151210  0     14707600. 1242600.   2466180.0  0.0  0.0 10
1151211  0     14631100. 1242600.   2467720.0  0.0  0.0 11
1151212  0     14621800. 1242600.   2467980.0  0.0  0.0 12
1151213  0     14616700. 1242600.   2468100.0  0.0  0.0 13
1151300  0
1151301  10.728000 10.670000 0.0     01
1151302  8.3370000 8.4284000 0.0     02
1151303  4.4456000 4.7693000 0.0     03
1151304  4.3865000 4.2164000 0.0     04
1151305  4.3407000 4.6700000 0.0     05
1151306  4.3009000 4.6296000 0.0     06
1151307  4.2676000 4.5954000 0.0     07
1151308  4.2398000 4.5671000 0.0     08
1151309  4.2249000 4.5338000 0.0     09
1151310  7.9665000 8.1922000 0.0     10
1151311  9.4925000 9.9460000 0.0     11
1151312  10.040000 10.505000 0.0     12
****************************************************
*
*          pump data
*
****************************************************
* pump suction tee
****************************************************
1200000   pmpsctt         branch
1200001   3        0
1200101   0.0634    0.76      0.0       0.0       0.0       0.0
1200102   4.0e-5    0.0       00000
1200200   0         14613100. 1242600.  2468180.0  0.0
1201101   115010000 120000000 0.0    0.1     0.1     000000
1202101   120010000 125000000 0.0317    0.2  0.2     000100
1203101   120010000 155000000 0.0317    0.2  0.2     000100
1201201   10.040000 10.505000 0.0
1202201   5.2077000 5.2983000 0.0
1203201   5.2071000 5.2944000 0.0
****************************************************
* pump1 suction tee outlet
****************************************************
1250000   pmp1sctt        branch
1250001   2        0
1250101   0.0       1.003     0.0613    0.0      90.0      0.521
1250102   4.0e-5    0.0       00000
1250200   0         14600300. 1242600.  2468180.0  0.0
1251101   125010000 130000000 0.0    0.1     0.1     000100
1252101   125000000 155000000 0.0    0.0     0.0     000100
1251201   7.8711000   8.2528000 0.0
1252201   -.11855000  -.13539000 0.0
****************************************************
* pump 1 inlet
****************************************************
1300000   pmp1nlet        snglvol
1300101   0.0       0.457     0.0189    0.0      90.0      0.457
1300102   4.0e-5    0.0       00000
1300200   0         14578200. 1242600.  2468900.0  0.0
****************************************************
* primary coolant pump 1
****************************************************
1350000   pcpump1         pump
1350101   0.0366    0.0       0.099     0.0      90.0      0.319
1350102   00000
1350108   130010000 0.0       0.0       0.0      000100
1350109   140000000 0.0       0.05      0.05     000100
1350200   0         14818100. 1242890.  2463900.0  0.0
1350201   0         8.8943000 9.2942000 0.0
1350202   0         8.8928000 8.1177000 0.0
*1350301  0    0    0       -1      0        509      0
*------ ------ ------ ------ ------ ------ ------ ------
*   modification for steady state run at 91/2/8
*------ ------ ------ ------ ------ ------ ------ ------
1350301   0    0    0       -1      -1       504      0
1350302   369.00  .90178860 .31550 96.00 500.600  1.4310000
1350303   613.6     0.0       207.0000  0.00400 19.598000 0.0
1350310   0.0       0.0       0.0
*
****************************************************
* single phase head curves
****************************************************
* head curve no. 1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351100   1                 1
1351101   0.000000e+00       1.403600e+00
1351102   1.906100e-01       1.363600e+00
1351103   3.896300e-01       1.318600e+00
1351104   5.939600e-01       1.232800e+00
1351105   7.902000e-01       1.133600e+00
1351106   1.000000e+00       1.000000e+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1351200   1                 2
1351201   0.000000e+00       -6.700000e-01
1351202   2.000000e-01       -5.000000e-01
1351203   4.000000e-01       -2.500000e-01
1351204   5.755400e-01       0.000000e+00
1351205   7.443200e-01       2.583000e-01
1351206   7.734800e-01       3.778000e-01
```

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1351207  8.631300e-01      6.326000e-01
1351208  1.000000e+00      1.000000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* head curve no. 3
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1351300  1                 3
1351301  -1.000000e+00     2.472200e+00
1351302  -8.057400e-01     2.047400e+00
1351303  -6.069000e-01     1.831000e+00
1351304  -4.068300e-01     1.624000e+00
1351305  -2.001710e-01     1.470500e+00
1351306  0.000000e+00      1.403600e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* head curve no. 4
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1351400  1                 4
1351401  -1.000000e+00     2.472200e+00
1351402  -8.229700e-01     1.996800e+00
1351403  -6.333200e-01     1.589700e+00
1351404  -4.553400e-01     1.327900e+00
1351405  -2.710900e-01     1.194900e+00
1351406  -1.771600e-01     1.060500e+00
1351407  -9.073000e-02     1.015600e+00
1351408  0.000000e+00      9.342790e-01
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* head curve no. 5
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1351500  1                 5
1351501  0.000000e+00      2.500000e-01
1351502  2.000000e-01      2.800000e-01
1351503  4.000000e-01      3.400000e-01
1351504  4.118000e-01      2.768000e-01
1351505  5.976300e-01      4.584000e-01
1351506  7.934670e-01      6.992000e-01
1351507  1.000000e+00      1.000000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* head curve no. 6
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1351600  1                 6
1351601  0.000000e+00      9.342790e-01
1351602  9.109900e-02      9.229000e-01
1351603  1.865090e-01      8.963000e-01
1351604  2.717620e-01      8.750000e-01
1351605  4.558720e-01      8.433000e-01
1351606  5.744060e-01      8.355000e-01
1351607  7.405760e-01      8.466000e-01
1351608  7.666190e-01      8.469000e-01
1351609  8.714710e-01      8.838000e-01
1351610  1.000000e+00      1.000000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* head curve no. 7
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1351700  1                 7
1351701  -1.000000e+00     -1.000000e+00
1351702  -8.000000e-01     -6.300000e-01
1351703  -6.000000e-01     -3.000000e-01
1351704  -4.000000e-01     -5.000000e-02
1351705  -2.000000e-01     1.500000e-01
1351706  0.000000e+00      2.500000e-01
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* head curve no. 8
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1351800  1                 8
1351801  -1.000000e+00     -1.000000e+00
1351802  -8.000000e-01     -9.700000e-01
1351803  -6.000000e-01     -9.500000e-01
1351804  -4.000000e-01     -8.800000e-01
1351805  -2.000000e-01     -8.000000e-01
1351806  0.000000e+00      -6.700000e-01
*************************************************************
single phase torque data
*************************************************************
* torque curve no. 1
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1351900  2                 1
1351901  0.000000e+00      6.032000e-01
1351902  1.930000e-01      6.325000e-01
1351903  3.930000e-01      7.369000e-01
1351904  5.955200e-01      8.331000e-01
1351905  7.978200e-01      9.229000e-01
1351906  1.000000e+00      1.000000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* torque curve no. 2
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1352000  2                 2
1352001  0.000000e+00      -6.700000e-01
1352002  4.000000e-01      -2.500000e-01
1352003  5.000000e-01      1.500000e-01
1352004  7.372550e-01      5.265860e-01
1352005  7.680490e-01      6.065940e-01
1352006  8.672300e-01      7.436600e-01
1352007  1.000000e+00      1.000000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* torque curve no. 3
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1352100  2                 3
1352101  -1.000000e+00     1.984300e+00
1352102  -8.009600e-01     1.394000e+00
1352103  -6.063800e-01     1.097500e+00
1352104  -4.068600e-01     8.220000e-01
1352105  -1.992800e-01     6.648000e-01
1352106  0.000000e+00      6.032000e-01
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* torque curve no. 4
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1352200  2                 4
1352201  -1.000000e+00     1.984300e+00
1352202  -8.223400e-01     1.830800e+00
1352203  -6.337100e-01     1.682400e+00
1352204  -4.585300e-01     1.557000e+00
1352205  -2.670230e-01     1.436200e+00
1352206  -1.761070e-01     1.387900e+00
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1352207   -8.931000e-02     1.348100e+00
1352208   0.000000e+00      1.233610e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* torque curve no. 5
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1352300   2                 5
1352301   0.000000e+00      -4.500000e-01
1352302   4.000000e-01      -2.500000e-01
1352303   5.000000e-01      0.000000e+00
1352304   1.000000e+00      3.569000e-01
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* torque curve no. 6
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1352400   2                 6
1352401   0.000000e+00      1.233610e+00
1352402   9.064300e-02      1.196500e+00
1352403   1.885690e-01      1.109600e+00
1352404   2.734700e-01      1.041600e+00
1352405   4.586690e-01      8.958000e-01
1352406   5.744800e-01      7.807000e-01
1352407   7.381600e-01      6.134000e-01
1352408   7.685200e-01      5.849000e-01
1352409   8.700570e-01      4.877000e-01
1352410   1.000000e+00      3.569000e-01
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* torque curve no. 7
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1352500   2                 7
1352501   -1.000000e+00     -1.000000e+00
1352502   -3.000000e-01     -9.000000e-01
1352503   -1.000000e-01     -5.000000e-01
1352504   0.000000e+00      -4.500000e-01
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* torque curve no. 8
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1352600   2                 8
1352601   -1.000000e+00     -1.000000e+00
1352602   -2.500000e-01     -9.000000e-01
1352603   -8.000000e-02     -8.000000e-01
1352604   0.000000e+00      -6.700000e-01
*****************************************************
two - phase multiplier data from l9-1 test data
*****************************************************
* head curve
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1353000   0
1353001   0.000000e+00      0.000000e+00
1353002   2.000000e-02      2.000000e-02
1353003   6.000000e-02      5.000000e-02
1353004   1.000000e-01      1.000000e-01
1353005   2.000000e-01      4.600000e-01
1353006   2.400000e-01      8.000000e-01
1353007   3.000000e-01      9.600000e-01
1353008   4.000000e-01      9.800000e-01
1353009   6.000000e-01      9.700000e-01
1353010   8.000000e-01      9.000000e-01
1353011   9.000000e-01      8.000000e-01
1353012   9.600000e-01      5.000000e-01
1353013   1.000000e+00      0.000000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* torque curve
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1353100   0
1353101   0.000000e+00      0.000000e+00
1353102   1.250000e-01      7.000000e-02
1353103   1.650000e-01      1.250000e-01
1353104   2.400000e-01      5.600000e-01
1353105   8.000000e-01      5.600000e-01
1353106   9.600000e-01      4.500000e-01
1353107   1.000000e+00      0.000000e+00
*****************************************************
pump 2-phase difference data
*****************************************************
* head curve no. 1
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1354100   1                 1
1354101   0.000000e+00      0.000000e+00
1354102   1.000000e-01      8.300000e-01
1354103   2.000000e-01      1.090000e+00
1354104   5.000000e-01      1.020000e+00
1354105   7.000000e-01      1.010000e+00
1354106   9.000000e-01      9.400000e-01
1354107   1.000000e+00      1.000000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* head curve no. 2
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1354200   1                 2
1354201   0.000000e+00      0.000000e+00
1354202   1.000000e-01      -4.000000e-02
1354203   2.000000e-01      0.000000e+00
1354204   3.000000e-01      1.000000e-01
1354205   4.000000e-01      2.100000e-01
1354206   8.000000e-01      6.700000e-01
1354207   9.000000e-01      8.000000e-01
1354208   1.000000e+00      1.000000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* head curve no. 3
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1354300   1                 3
1354301   -1.000000e+00     -1.160000e+00
1354302   -9.000000e-01     -1.240000e+00
1354303   -8.000000e-01     -1.770000e+00
1354304   -7.000000e-01     -2.360000e+00
1354305   -6.000000e-01     -2.790000e+00
1354306   -5.000000e-01     -2.910000e+00
1354307   -4.000000e-01     -2.670000e+00
1354308   -2.500000e-01     -1.690000e+00
1354309   -1.000000e-01     -5.000000e-01
1354310   0.000000e+00      0.000000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* head curve no. 4
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
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1354400  1              4
1354401  -1.000000e+00     -1.160000e+00
1354402  -9.000000e-01     -7.800000e-01
1354403  -8.000000e-01     -5.000000e-01
1354404  -7.000000e-01     -3.100000e-01
1354405  -6.000000e-01     -1.700000e-01
1354406  -5.000000e-01     -8.000000e-02
1354407  -3.500000e-01     0.000000e+00
1354408  -2.000000e-01     5.000000e-02
1354409  -1.000000e-01     8.000000e-02
1354410  0.000000e+00      1.100000e-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 5
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354500  1              5
1354501  0.000000e+00      0.000000e+00
1354502  2.000000e-01      -3.400000e-01
1354503  4.000000e-01      -6.500000e-01
1354504  6.000000e-01      -9.300000e-01
1354505  8.000000e-01      -1.190000e+00
1354506  1.000000e+00      -1.470000e+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354600  1              6
1354601  0.000000e+00      1.100000e-01
1354602  1.000000e-01      1.300000e-01
1354603  2.500000e-01      1.500000e-01
1354604  4.000000e-01      1.300000e-01
1354605  5.000000e-01      7.000000e-02
1354606  6.000000e-01      -4.000000e-02
1354607  7.000000e-01      -2.300000e-01
1354608  8.000000e-01      -5.100000e-01
1354609  9.000000e-01      -9.100000e-01
1354610  1.000000e+00      -1.470000e+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 7
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354700  1              7
1354701  -1.000000e+00     0.000000e+00
1354702  0.000000e+00      0.000000e+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 8
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354800  1              8
1354801  -1.000000e+00     0.000000e+00
1354802  0.000000e+00      0.000000e+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1354900  2              1
1354901  0.000000e+00      6.032000e-01
1354902  1.930000e-01      6.325000e-01
1354903  3.930000e-01      7.369000e-01
1354904  5.955200e-01      8.331000e-01
1354905  7.978200e-01      9.229000e-01
1354906  1.000000e+00      1.000000e+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355000  2              2
1355001  0.000000e+00      -6.700000e-01
1355002  4.000000e-01      -2.500000e-01
1355003  5.000000e-01      1.500000e-01
1355004  7.372550e-01      5.265860e-01
1355005  7.680490e-01      6.065940e-01
1355006  8.672300e-01      7.436600e-01
1355007  1.000000e+00      1.000000e+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355100  2              3
1355101  -1.000000e+00     1.984300e+00
1355102  -8.009600e-01     1.394000e+00
1355103  -6.063800e-01     1.097500e+00
1355104  -4.068600e-01     8.220000e-01
1355105  -1.992800e-01     6.648000e-01
1355106  0.000000e+00      6.032000e-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 4
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355200  2              4
1355201  -1.000000e+00     1.984300e+00
1355202  -8.223400e-01     1.830800e+00
1355203  -6.337100e-01     1.682400e+00
1355204  -4.585300e-01     1.557000e+00
1355205  -2.670230e-01     1.436200e+00
1355206  -1.761070e-01     1.387900e+00
1355207  -8.931000e-02     1.348100e+00
1355208  0.000000e+00      1.233610e+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 5
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355300  2              5
1355301  0.000000e+00      -4.500000e-01
1355302  4.000000e-01      -2.500000e-01
1355303  5.000000e-01      0.000000e+00
1355304  1.000000e+00      3.569000e-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355400  2              6
1355401  0.000000e+00      1.233610e+00
1355402  9.064300e-02      1.196500e+00
1355403  1.885690e-01      1.109600e+00
1355404  2.734700e-01      1.041600e+00
1355405  4.586690e-01      8.958000e-01
1355406  5.744800e-01      7.807000e-01
1355407  7.381600e-01      6.134000e-01
1355408  7.685200e-01      5.849000e-01
1355409  8.700570e-01      4.877000e-01
1355410  1.000000e+00      3.569000e-01
```

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*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 7
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355500   2                 7
1355501   -1.000000e+00        -1.000000e+00
1355502   -3.000000e-01        -9.000000e-01
1355503   -1.000000e-01        -5.000000e-01
1355504   0.000000e+00         -4.500000e-01
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 8
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1355600   2                 8
1355601   -1.000000e+00        -1.000000e+00
1355602   -2.500000e-01        -9.000000e-01
1355603   -8.000000e-02        -8.000000e-01
1355604   0.000000e+00         -6.700000e-01
**************************************************
**********
* pcp1 pump velocity table
**************************************************
*------ ------ ------ ------ ------ ------ ------ ------
*   modification for steady state run at 91/2/8
*------ ------ ------ ------ ------ ------ ------ ------
*1356100   536
*1356101   0.0          0.0
*1356102   1.0          220.
**************************************************
pump 1 outlet pump side
**************************************************
1400000   pmp1outp         snglvol
1400101   0.0366   0.502    0.0      0.0      0.0      0.0
1400102   4.0e-5   0.0      00000
1400200   0        15165000. 1242900.  2458470.  0.0
**************************************************
* pump1 outlet pipe tee side
**************************************************
1450000   pmp1outt         branch
1450001   2        0
1450101   0.0      1.4084   0.0633   0.0      0.0      0.0
1450102   4.0e-5   0.0      00000
1450200   0        15069300. 1242900.  2458230.0  0.0
1451101   140010000 145000000 0.0   0.1     0.1     000100
1452101   145010000 150000000 0.0   0.0     0.0     000100
1451201   8.8901000 8.6110000 0.0
1452201   10.611000 10.694000 0.0
**************************************************
* pump outlet tee
**************************************************
1500000   pmpoutt          branch
1500001   3        0
1500101   0.0634   0.4966   0.0      0.0      0.0      0.0
1500102   4.0e-5   0.0      00000
1500200   0        15048800. 1242900.  2458680.0  0.0
1501101   170010000 150000000 0.0183  0.2   0.2     000100
1502101   150010000 175000000 0.0     0.1   0.1     000100
1503101   150010000 406000000 0.0     0.0   0.0     000100
1501201   4.3528000 5.2611000 0.0
1502201   10.035000 10.103000 0.0
1503201   .08890000 .02735000 0.0
**************************************************
* pump 2 suction tee outlet
**************************************************
1550000   pmp2sctt         branch
1550001   1        0
1550101   0.0      1.003    0.0613   0.0      90.0     0.521
1550102   4.0e-5   0.0      00000
1550200   0        14601200. 1242600.  2468430.0  0.0
1551101   155010000 160000000 0.0  0.1     0.1     000100
1551201   7.5199000 7.8923000 0.0
**************************************************
* pump 2 inlet pipe
**************************************************
1600000   pmp2inet         snglvol
1600101   0.0      0.457    0.0189   0.0      90.0     0.457
1600102   4.0e-5   0.0      00000
1600200   0        14580700. 1242600.  2468050.0  0.0
**************************************************
* primary coolant pump 2
**************************************************
1650000   pcpump2          pump
1650101   0.0366   0.0      0.099    0.0      90.0     0.319
1650102   00000
1650108   160010000 0.0     0.0      0.0      000100
1650109   170000000 0.0     0.1      0.1      000100
1650200   0        14832700. 1242890.  2463590.0  0.0
1650201   0        8.4974000 8.8872000 0.0
1650202   0        8.4959000 6.6507000 0.0
*1650301  135  135  135     -1       135      509      0
*------ ------ ------ ------ ------ ------ ------ ------
*   modification for steady state run at 91/2/8
*------ ------ ------ ------ ------ ------ ------ ------
1650301   135  135  135     -1       -1       504      0
1650302   369.00 .89699187 .31550 96.00 500.60000 1.431
1650303   613.6    0.0      207.433  0.004    19.5980  0.0
1650310   0.0      0.0      0.0
**************************************************
* pump 2 outlet
**************************************************
1700000   pmp2outt         branch
1700001   1        0
1700101   0.0366   0.514    0.0      0.0      0.0      0.0
1700102   4.0e-5   0.0      00000
1700200   0        15089900. 1242900.  2457860.0  0.0
1701101   145010000 170010000 0.0183  0.2   0.2     000100
1701201   -4.140400 -4.242200 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* cold leg pipe to ecc connection tee
**************************************************
1750000   ilclpipe         pipe
1750001   2
1750101   0.0634   2
1750201   0.0      1
```

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1750301   0.559     1
1750302   0.613     2
1750401   0.0       2
1750501   0.0       2
1750601   0.0       2
1750701   0.0       2
1750801   4.0e-5    0.0       2
1750901   0.15      0.15      1
1751001   00000     2
1751101   000100    1
1751201   0      15044100. 1242900.   2458830.0 0.0  0.0 01
1751202   0      15037400. 1242900.   2458990.0 0.0  0.0 02
1751300   0
1751301   10.035000 10.106000 0.0       01
***************************************************
* ecc connection tee pump side
***************************************************
1800000   ecct             branch
1800001   1        0
1800101   0.0634    1.152     0.0       0.0       0.0       0.0
1800102   4.0e-5    0.0       00000
1800200   0         15034000. 1242910.  2259090.0  0.0
1801101   175010000 180000000 0.0   0.05      0.05    000100
1801201   10.035000 10.083000 0.0
***************************************************
* cold leg pipe from ecc connection to reactor vessel
***************************************************
1850000   rvnilcl          branch
1850001   3        0
1850101   0.0634    1.01      0.0       0.0       0.0       0.0
1850102   4.0e-5    0.0       00000
1850200   0         15032100. 1242910.  2459140.0  0.0
1851101   185010000 205000000 0.0634  1.0   1.0     000100
1852101   180010000 185000000 0.0     0.0   0.0     000100
1853101   185010000 223000000 0.0     45.0  45.0    000100
1851201   9.2743000 9.3795000 0.0
1852201   10.035000 10.064000 0.0
1853201   1.6570000 1.7271000 0.0
***************************************************
*
*   reactor vessel
*
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* inlet annulus top volume
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
2000000   inantop          branch
2000001   2        0
2000101   0.0       0.33      0.0855    0.0       90.0      0.33
2000102   4.0e-5    0.178     00000
2000200   0         15017400. 1243540.  2459500.0  0.0
2001101   200000000 205000000 0.0   0.0       0.0     000100
2002101   200000000 245010000 0.001 1800.   1800.   000100
2001201   -.0306700 -.03023076  .0
2002201   .06975000 .07019300  0.0
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* inlet annulus bottom volume
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
2050000   inanbot          branch
2050001   1        0
2050101   0.0       0.424     0.11      0.0       -90.0     -0.424
2050102   4.0e-5    0.172     00000
2050200   0         15018400. 1242920.  2459460.0  0.0
2051101   205010000 210000000 0.0       0.0   0.0     000100
2051201   4.0266000 4.3312000 0.0
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* downcomer
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
2100000   downcomr         annulus
2100001   4
2100101   0.142     4
2100201   0.0       3
2100301   0.958     4
2100401   0.0       4
2100501   0.0       4
2100601   -90.0     4
2100801   4.0e-5    0.102     4
2100901   0.0       0.0       3
2101001   00000     4
2101101   000000    3
2101201   0      15017400. 1242940.  2459500.0  0.0  0.0  01
2101202   0      15023500. 1242960.  2459350.0  0.0  0.0  02
2101203   0      15029700. 1242980.  2459200.0  0.0  0.0  03
2101204   0      15035800. 1243000.  2459050.0  0.0  0.0  04
2101300   0
2101301   4.0266000 4.3398000 0.0       01
2101302   4.0266000 4.3397000 0.0       02
2101303   4.0266000 4.3396000 0.0       03
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* lower plenum top volume
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
2150000   lwrplop          branch
2150001   3        0
2150101   0.74      0.360     0.0       0.0       -90.0     -0.36
2150102   4.0e-5    0.0       00000
2150200   0         15044100. 1242880.  2458850.0  0.0
2151101   210010000 215000000 0.0   0.00   0.00   000100
2152101   215010000 220000000 0.0   0.00   0.00   000100
2153101   215000000 225000000 0.15  0.0    0.0    000100
2151201   4.0265000 4.3184000 0.0
2152201   -.0651070 -.0771765 0.0
2153201   2.4798000 2.5728000 0.0
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* lower plenum bottom volume
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
2200000   lwrplot          snglvol
2200101   0.79      0.37      0.0       0.0       -90.0     -0.37
2200102   4.0e-5    0.0       00000
2200200   0         15046800. 1241150.  2458780.0  0.0
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* core filler bypass
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
2230000   fillegap         annulus
```

```
2230001   7
2230101   2.9110-2  7
2230201   0.0       6
2230301   0.424     1
2230302   0.958     5
2230303   0.36      6
2230304   0.37      7
2230401   0.0       7
2230501   0.0       7
2230601   -90.0     7
2230801   4.0e-5    0.0      7
2230901   0.0       0.0      6
2231001   00000     7
2231101   000000    6
2231201   0       15023600. 1242730.  2459340.0 0.0  0.0  01
2231202   0       15028700  1242320.  2459220.0 0.0  0.0  02
2231203   0       15035700. 1241930.  2459050.0 0.0  0.0  03
2231204   0       15042700. 1241540.  2458880.0 0.0  0.0  04
2231205   0       15049700. 1241160.  2458710.0 0.0  0.0  05
2231206   0       15054500. 1241010.  2458600.0 0.0  0.0  06
2231207   0       15057200. 1240860.  2458530.0 0.0  0.0  07
2231300   0
2231301   1.6569000 1.8115000 0.0       01
2231302   1.6565000 1.8111000 0.0       02
2231303   1.6561000 1.8107000 0.0       03
2231304   1.6558000 1.8103000 0.0       04
2231305   1.6554000 1.8099000 0.0       05
2231306   1.6553000 1.8097000 0.0       06
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* junction from filler gap to lower plenum
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2240000   flirgapp        sngljun
2240101   223010000 220010000 0.0     10.   10.    000100
2240201   0        1.6552000 1.7051000 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* lower core support structure
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2250000   lcoreup         branch
2250001   2       0
2250101   0.25      0.52     0.0      0.0      90.0     0.52
2250102   4.0e-5    0.095    00000
2250200   0       15032600. 1242900.  2459120.0 .0
2251101   225010000 230000000 0.0975  0.3    0.3    000100
2252101   225010000 235000000 0.0     0.0    0.0    000100
2251201   3.3398000 3.6043000 0.0
2252201   2.2306000 2.3976000 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* active core
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2300000   core            pipe
2300001   3
2300101   0.1705    3
2300201   0.1440    2
2300301   0.559     2
2300302   0.657     3
2300401   0.0       3
2300501   0.0       3
2300601   90.0      3
2300801   4.0e-5    0.012    3
2300901   0.5       0.5      2
2301001   00100     3
2301101   000100    2
2301201   0       15009300. 1289110.  2459680.  0.0 0.0  01
2301202   0       14996400. 1339030.  2459990.  0.0 0.0  02
2301203   0       14982500. 1354980.  2460310.  0.0 0.0  03
2301300   0
2301301   3.5187000 3.5227000 0.0       01
2301302   3.6127000 3.6166000 0.0       02
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* core bypass volume
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2350000   corebyps        pipe
2350001   3
2350101   0.015     3
2350201   0.0       2
2350301   0.559     2
2350302   0.657     3
2350401   0.0       3
2350501   0.0       3
2350601   90.0      3
2350801   4.0e-5    0.003    3
2350901   0.0       0.0      2
2351001   00000     3
2351101   000000    2
2351201   0       15021500. 1242940.  2459390.0  0.0  0.0  01
2351202   0       15002400. 1242980.  2459850.0  0.0  0.0  02
2351203   0       14981700. 1243020.  2460330.0  0.0  0.0  03
2351300   0
2351301   2.2307000 2.3978000 0.0       01
2351302   2.2307000 2.3980000 0.0       02
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* upper core support structure
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2400000   ucosst          branch
2400001   2       0
2400101   0.297     1.118    0.0      0.0      90.0     1.118
2400102   4.0e-5    0.145    00000
2400200   0       14966500. 1348980.  2460680.0  0.0
2401101   230010000 240000000 0.12   0.3    0.3    000100
2402101   235010000 240000000 0.0    0.0    0.0    000100
2401201   3.6456000 3.6509000 0.0
2402201   2.3080000 2.3981000 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* upper flow skirt region
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
2450000   ufosre          branch
2450001   1       0
2450101   0.114     0.843    0.0      0.0      90.0     0.843
2450102   4.0e-5    0.131    00000
2450200   0       14945200. 1347660.  2461140.0  0.0
2451101   240010000 245000000 0.0    0.0      0.0    000100
2451201   5.7436    6.0742    0.0
```

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*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* dead end of fuel modules
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
2460000   fumodu          branch
2460001   1       0
2460101   0.183    0.7     0.0     0.0     90.0     0.7
2460102   4.0e-5   0.214   00000
2460200   0        14961800. 1343000. 2460790. 0.0
2461101   240010000 246000000 0.0   0.0    0.0   000100
2461201   -.74932e-5 -.74932e-5 0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* upper plenum lower volume
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
2500000   upllvol         branch
2500001   1       0
2500101   0.268    1.566   0.0     0.0     90.0     1.566
2500102   4.0e-5   0.0     00000
2500200   0        14947600. 1346300. 2461140.0 0.0
2501101   245010000 250000000 0.0   0.0    0.0   000100
2501201   5.8130000 6.1784000 0.0
*****************************************************
*
*   broken loop
*
*****************************************************
* reactor vessel nozzle - broken loop hot leg
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
3000000   rvblhl          branch
3000001   2       0
3000101   0.0634   0.876   0.0     0.0     0.0      0.0
3000102   4.0e-5   0.0     00000
3000200   0        14953100. 1239820. 2460990.0 0.0
3001101   250000000 300000000 0.0634   0.0  0.0   000100
3002101   300010000 305000000 0.0      0.1  0.1   000000
3001201   -.1303100 -.1795200 0.0
3002201   -.1303200 -.1304000 0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* hot leg pipe to reflood assist bypass tee
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
3050000   hlpras          branch
3050001   1       0
3050101   0.0634   0.698   0.0     0.0     0.0      0.0
3050102   4.0e-5   0.0     00000
3050200   0        14953100. 1239750. 2460990.0 0.0
3051101   305010000 310000000 0.0      0.1  0.1   000100
3051201   -.1761300 -.1768800 0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* broken loop hot leg contraction
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
3100000   sgsii           branch
3100001   2       0
3100101   0.0      1.424   0.0668  0.0     0.0      0.0
3100102   4.0e-5   0.0     00000
3100200   0        14953100. 1239700. 2460990.0 0.0
3101101   370010000 310000000 0.0      0.0  0.0   000100
3102101   310010000 315000000 0.0      0.0  0.0   000100
3101201   .21294000 .26136000 0.0
3102201   .00000000 .00320000 0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* steam generator and pump simulatior
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
3150000   sgpsi           pipe
3150001   12
3150101   0.00836   2
3150102   0.108     8
3150103   0.0       10
3150104   0.00836   11
3150105   0.0525    12
3150201   0.0       2
3150202   0.0326    4
3150203   0.108     5
3150204   0.0326    7
3150205   0.0       8
3150206   0.0       9
3150207   0.0081    10
3150208   0.0       11
3150301   0.4054    1
3150302   0.5265    2
3150303   0.362     3
3150304   1.692     4
3150305   0.8495    6
3150306   1.692     7
3150307   0.362     8
3150308   1.346     9
3150309   1.325     10
3150310   1.842     11
3150311   0.667     12
3150401   0.0       8
3150402   0.0162    9
3150403   0.0648    10
3150404   0.0       12
3150601   90.0      5
3150602   -90.0     10
3150603   90.0      11
3150604   0.0       12
3150701   0.127     1
3150702   0.488     2
3150703   0.362     3
3150704   1.692     4
3150705   0.457     5
3150706   -0.457    6
3150707   -1.692    7
3150708   -0.362    8
3150709   -1.143    9
3150710   -0.686    10
3150711   1.214     11
3150712   0.0       12
3150801   4.0e-5    0.0     3
3150802   4.0e-5    0.124   4
3150803   4.0e-5    0.0     6
3150804   4.0e-5    0.124   7
3150805   4.0e-5    0.0     12
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3150901   0.2      0.2      1
3150902   0.0      0.0      2
3150903   93.9     93.9     4
3150904   0.4      0.4      5
3150905   93.9     93.9     7
3150906   0.0      0.0      8
3150907   0.2      0.2      9
3150908   4.1      4.1      10
3150909   0.4      0.4      11
3151001   00000    12
3151101   000000   1
3151102   000100   4
3151103   000000   5
3151104   000100   11
3151201   0     14952600. 1227510.  2461000.0 0.0 0.0 01
3151202   0     14950300. 1216950.  2461050.0 0.0 0.0 02
3151203   0     14947100. 1209830.  2461120.0 0.0 0.0 03
3151204   0     14939500. 1218490.  2461280.0 0.0 0.0 04
3151205   0     14931400. 1222380.  2461450.0 0.0 0.0 05
3151206   0     14931400. 1223780.  2461450.0 0.0 0.0 06
3151207   0     14939400. 1225430.  2461280.0 0.0 0.0 07
3151208   0     14947100. 1223910.  2461120.0 0.0 0.0 08
3151209   0     14952700. 1224050.  2461000.0 0.0 0.0 09
3151210   0     14959500. 1224450.  2460840.0 0.0 0.0 10
3151211   0     14957600. 1224730.  2460910.0 0.0 0.0 11
3151212   0     14953000. 1224840.  2460990.0 0.0 0.0 12
3151300   0
3151301   .0       .0       0.0      01
3151302   .0       .0       0.0      02
3151303   .0       .0       0.0      03
3151304   .0       .0       0.0      04
3151305   .0       .0       0.0      05
3151306   .0       .0       0.0      06
3151307   .0       .0       0.0      07
3151308   .0       .0       0.0      08
3151309   .0       .0       0.0      09
3151310   .0       .0       0.0      10
3151311   .0       .0       0.0      11
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  isolation valve hot leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3200000    isvhl     valve
3200101    315010000 325000000 0.0    0.0    0.0  000100
3200201    1      0.0     0.0    0.0
3200300    trpvlv
3200301    504
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  pipe section between isolat
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3250000    vvolhl     snglvol
3250101    0.0525   0.823    0.0    0.0    0.0    0.0
3250102    4.0e-5   0.0      00000
3250200    3        14.74e6  558.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  quick opening blowdown valve hot leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3300000    qobvhl     valve
3300101    325010000   800000000 0.0466  0.0  0.0  000100
3300201    1         0.0       0.0      0.0
3300300    trpvlv
3300301    506
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* reactor vessel nozzle - broken loop cold leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3350000    rvnbl          branch
3350001    2         0
3350101    0.0634    0.7495    0.0      0.0      0.0      0.0
3350102    4.0e-5    0.0       00000
3350200    0         15018600.  1242920.  2459470.0  0.0
3351101    205000000 335000000 0.0634  1.0    1.0    000100
3352101    335010000 340000000 0.0     0.1    0.1    000000
3351201    .13054000 .15185000 0.0
3352201    .13051000 .13063000 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* cold leg pipe to reflood assist bypass tee
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3400000    ctbarv          branch
3400001    1         0
3400101    0.0634    0.698     0.0      0.0      0.0      0.0
3400102    4.0e-5    0.0       00000
3400200    0         15018600.  1242870.  2459470.0  0.0
3401101    340010000 345000000 0.0     0.1    0.1    000000
3401201    .13049000 .13005000 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* broken loop cold leg contraction to break plane
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3450000    baoet           branch
3450001    2         0
3450101    0.0634    0.974     0.0      0.0      0.0      0.0
3450102    4.0e-5    0.0       00000
3450200    0         15018600.  1242530.  2459470.0  0.0
3451101    345000000 385000000 0.0     0.0    0.0    000100
3452101    345010000 350000000 0.0     0.0    0.0    000100
3451201    .21311000 .19053000 0.0
3452201    .0        .0        0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* ecc tee isolation valve cold leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3500000    etivcl          pipe
3500001    2
3500101    0.0       2
3500201    0.0       1     * break plane
3500301    0.488     1
3500302    1.6085    2
3500401    0.00541   1
3500402    0.07770   2
3500601    0.0       2
3500801    4.0e-5    0.0       1
3500802    4.0e-5    0.0       2
3500901    0.0       0.0       1
3501001    00000     2
3501101    000100    1
```

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3501201  0        15018600. 1067100.  2459470.0  0.0  0.0  01
3501202  0        15018600. 1173730.  2459470.0  0.0  0.0  02
3501300  0
3501301  .0       .0        0.0       01
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* isolation valve cold leg
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
3550000   isvcl    valve
3550101   350010000 360000000  0.0     0.0    0.0  000100
3550201   1        0.0    0.0    0.0
3550300   trpvlv
3550301   505
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*  pipe section between isolation valve and qobv cold leg
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
3600000   vvolcl    snglvol
3600101   0.0525    0.813   0.0    0.0    0.0    0.0
3600102   4.0e-5    0.0     00000
3600200   3         14.74e6 558.
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*  quick opening blowdown cold leg
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
3650000   qobvcl    valve
3650101   360010000  805000000  0.0466  0.0  0.0  000100
3650201   1          0.0   0.0   0.0
3650300   trpvlv
3650301   507
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* reflood assist bypass piping - cold leg side
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
3700000   rabsphl            branch
3700001   1        0
3700101   0.0388    2.203     0.0      0.0       90.0      0.653
3700102   4.0e-5    0.0       00000
3700200   0         14755500. 1239680.0 2460930.0  0.0
3701101   375010000 370000000 0.0     0.0     0.0     000100
3701201   .21294000 .24585000 0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* reflood assist bypass parrel pipes hot leg side
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
3750000   rabphl    snglvol
3750101   0.0776    0.0       0.0858    0.0      0.0       0.0
3750102   4.0e-5    0.0       00000
3750200   0         14957900. 1239760.0 2460880.0   0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* reflood assist bypass valves
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
3770000   rabsvlv            sngljun
3770101   380010000 375000000 0.0  1.4e+4 1.4e+4  000000
3770201   0          .106460   .25646    0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* reflood assist bypass parrel pipes cold leg side
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
3800000   rabppcl   snglvol
3800101   0.0776    0.0       0.0855    0.0      0.0       0.0
3800102   4.0e-5    0.0       00000
3800200   0         15023400. 1240020.0 2459350.0   0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*  reflood assist bypass single pipe cold leg side
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
3850000   rabspcl   branch
3850001   1         0
3850101   0.0388    0.0       0.11802   0.0      -90.0     -0.653
3850102   4.0e-5    0.0       00000
3850200   0         15021000. 1240850.0 2459410.0  0.0
3851101   385010000 380000000 0.0    0.0    0.0    000100
3851201   .212920   .260740   0.0
*************************************************************
*
*   pressurizer
*
*************************************************************
* surge line pcs side
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
4000000   slpcs              branch
4000001   2         0
4000101   0.00145   3.45      0.0       0.0      90.0      0.54
4000102   4.0e-5    0.0       00000
4000200   0         14923700. 1458370.  2461610.0  0.0
4001101   110000000 400000000 0.0    0.93    0.93   000100
4002101   400010000 405000000 0.0    0.93    0.93   000000
4001201   -.17675e-4  -.17772e-4 0.0
4002201   -.17696e-5  -.17696e-5 0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* surge line pressurizer vessel
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
4050000   slprv     snglvol
4050101   0.00145   3.45      0.0       0.0      90.0      0.60
4050102   4.0e-5    0.0       00000
4050200   0         14920000. 1494210.0 2461690.0  0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*  spray line
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
4060000   spray     branch
4060001   1         0
4060101   0.0003363 6.322     0.0       0.0      90.0
4060102   3.161     4.0e-5    0.0       00000
4060200   0         15075000. 1244040.0 2458090.0  0.0
4061101   406010000 420010000 2.4e-6 1.0392 1.0392 000100
4061201   .08890000 .08890000 0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*  spray valve
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
4070000   sprvlv    valve
4070101 406010000 420010000 3.34e-4 1.54e01 1.54e01
+       000100
4070201   0         .000000   .000000   0.0
4070300   trpvlv
4070301   690
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* pressurizer surge line valve
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
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4100000   slvalv   valve
4100101   405010000 415000000 0.0    0.93     0.93    000100
4100201   0          -.17704000 -.1770400 0.0
4100300   trpvlv
4100301   508
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* pressurizer vessel
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
4150000   pzrve         pipe
4150001   8
4150101   0.362     1
4150102   0.565     5
4150103   0.466     7
4150104   0.13      8
4150201   0.0       7
4150301   0.224     1
4150302   0.403     3
4150303   0.207     5
4150304   0.1705    7
4150305   0.118     8
4150401   0.0       8
4150501   0.0       8
4150601   90.0      8
4150801   4.0e-5    0.0       8
4151001   00000     8
4151101   000000    7
4151201   0  14917400. 1511010.  2461750.0  .0         0.0 01
4151202   0  14915500. 1568180. 2461790.0  .1839e-3  0.0 02
4151203   0  14913200. 1558810.  2463620.0  .15145    0.0 03
4151204   0  14912100. 1582630.  2461930.0  .9996500 0.0 04
4151205   0  14911900. 1582620.  2461840.0  .9996400 0.0 05
4151206   0  14911700. 1582560.  2461840.0  .9996000 0.0 06
4151207   0  14911500. 1582300.  2461840.0  .9995300 0.0 07
4151208   0  14911400. 1575760.  2461840.0  1.0       0.0 08
4151300   0
4151301   -.716473e-3  .05388     0.0       01
4151302   -.62376e-3   .3445      0.0       02
4151303   -.27965      .12293e-2  0.0       03
4151304   -.27030      .17636e-3  0.0       04
4151305   -.30526      .20283e-3  0.0       05
4151306   -.28127      .19339e-3  0.0       06
4151307   -.58439      .64379e-3  0.0       07
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* pressurizer top hat and relief connection
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
4200000   toppre    branch
4200001   1       0
4200101   0.13      0.118     0.0       0.0       90.0      0.118
4200102   4.0e-5    0.0       00000
4200200   0         14911300. 1541380.  2461830.0  .99907000
4201101   415010000 420000000 0.0   0.0       0.0     000000
4201201   -.38729     5.44472e-4 0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*  porv
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
4250000   porv      valve
4250101   420010000 810000000 2.4784-5  0.0  0.0     000100
4250201   0         .000000   .00000    0.0
4250300   trpvlv
4250301   625
**************************************************************
*
*   steam generator secondary side
*
**************************************************************
* primary separator
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
5000000   sepaout              separatr
5000001   3       0
5000101   1.273     0.718     0.0  0.0       +90.0     +0.718
5000102   4.e-5     0.7874    00010
5000200   0         5670640.0 1444230.  3000000.0 .19415000
5001101   500010000 525000000 1.272800 0.0 0.0 001100 0.5
5002101   500000000 505000000 0.000000 0.0 0.0 001100  +
+         0.15
5003101   520000000 500000000 0.19600   0.4   0.4   001100
5001201   -0.4175     .75723     0.0
5002201   0.8006    -9.39768e-2  0.0
5003201   1.9086    4.4093       0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* separator outlet region
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
5050000   lwrsep    branch
5050001   1
5050101   1.273     0.718     0.0       0.0       -90.0     -0.718
5050102   4.e-5     0.7874    00000
5050200   0         5672780.0 1183350. 2400000.0 .01138160
5051101   505010000  510000000  0.0      0.0       0.0  000100
5051201   0.21828   -.30041   0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* feed inlet volume
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
5100000   feedinl              branch
5100001   1       0
5100101   0.7525    0.518     0.0       0.0       -90.0     -0.518
5100102   4.e-5     0.10796   00000
5100200   0         5676840.0 1109810. 2400000.0 .408589e-5
5101101   510010000 515000000 0.0    0.0       0.0     000100
5101201   0.6323700  0.632870 0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* steam generator downcomer
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
5150000   dwncmr               annulus
5150001   8
5150101   0.23226   3
5150102   0.27871   8
5150201   0.0       7
5150301   0.7102    3
5150302   1.85075   7
5150303   0.718     8
5150401   0.0       8
5150601   -90.0     3
```

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5150602  21.0     6
5150603  16.0     7
5150604  90.0     8
5150701  -0.7102  3
5150702  0.7102   6
5150703  0.518    7
5150704  0.718    8
5150801  4.e-5    0.10796  3
5150802  4.e-5    0.0305   7
5150803  4.e-5    0.0      8
5150901  0.0      0.0      2
5150902  17.5     17.5     3
5150903  4.2      4.2      4
5150904  8.8      8.8      5
5150905  4.2      4.2      6
5150906  0.0      0.0      7
5151001  00000    3
*
5151002  00100    6
5151003  00000    8
5151101  000000   2
5151102  000100   3
5151103  000000   7
5151201  0  5681540.0  1110180.0  2500000.0  0.0  0.0  01
5151202  0  5681540.0  1110180.0  2500000.0  0.0  0.0  02
5151203  0  5681540.0  1110180.0  2500000.0  0.0  0.0  03
5151205  0  5681540.0  1110180.0  2500000.0  0.0  0.0  05
5151206  0  5681540.0  1110180.0  2500000.0  0.0  0.0  06
5151207  0  5681540.0  1110180.0  2500000.0  0.0  0.0  07
5151208  0  5681540.0  1110180.0  2500000.0  0.0  0.0  08
5151300  0
5151301  .4952    .62274   0.0   01
5151302  .49535   .62294   0.0   02
5151303  .49550   .93962   0.0   03
5151304  .60219   2.772    0.0   04
5151305  1.2396   3.4916   0.0   05
5151306  1.6096   4.6784   0.0   06
5151307  1.5003   4.8023   0.0   07
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* top of the riser
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
5200000  separin           branch
5200001  1        0
5200101  0.27871  0.718    0.0      0.0      90.0     0.718
5200102  4.e-5    0.0      00000
5200200  0        5671640.0 1324220.  2600000.0  .1100800
5201101  515010000 520000000 0.00000  0.0  0.   000100
5201201  0.67145  9.3678   0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* below mist extractor, above top of shroud in steam dome
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
5250000  botstm            branch
5250001  1        0
5250101  1.5886   0.762    0.0      0.0      90.0     0.762
5250102  4.e-5    0.0      00000
5250200  0        5670220.0 1150000.  2591710.0  .9999800
5251101  525010000 530000000 0.0  0.8     0.8     000100
5251201  .7175    .78659   0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* mist extractor and steam generator outlet pipe to scv
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
5300000  stmpipe           pipe
5300001  2
5300101  1.2728   1
5300102  0.04635  2
5300201  0.01365  1
5300301  0.762    1
5300302  25.074   2
5300401  0.0      2
5300601  90.0     1
5300602  0.0      2
5300801  4.e-5    0.0      2
5300901  0.4      0.4      1
5301001  00000    2
5301101  000100   1
5301201  0 5670000.0 1148038.0  2591620.  .9997400 0.0 01
5301202  0 5548250.0 1148038.0  2591620.  .9989700 0.0 02
5301300  0
5301301  20.365   21.619   0.0      01
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* pipe downstream of steam control valve
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
5350000  condint           snglvol
5350101  0.06557  54.44    0.0      0.0      0.0      0.0
5350102  4.e-5    0.0      00000
5350200  0        2079110.0 914598.0  2598620.0  1.00000
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* air cooled condenser
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
5400000  condnsr           tmdpvol
5400101  0.21677  17.67    0.0      0.0      0.0      0.0
5400102  4.e-5    0.02     00000
5400200  2
5400207  0.0      2.069e+6  1.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* feed storage tank
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
5450000  feedtnk           tmdpvol
5450101  29.81    3.048    0.0      0.0      0.0      0.0
5450102  4.e-5    0.0      00000
5450200  1        656
5450201  -1.0     479.62   0.0
5450202  0.0      479.62   0.0
5450203  10.0     479.62   0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*  steam control valve bypass
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
5460000  scvbyp   valve
5460101  530010000 547000000 0.0     0.0  0.0    000000
5460201  0        .000000  .000000  0.0
5460300  trpvlv
5460301  670
```

```
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* air cooled condenser
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
5470000   conders          tmdpvol
5470101   0.21677   17.67     0.0      0.0      0.0      0.0
5470102   4.e-5     0.0       00000
5470200   1         680
5470201   0.0       559.15    0.999
*5470202  18000.    334.15    0.999
*------ ------ ------ ------ ------ ------ ------ ------
*  modification for steady state run at 91/2/8
*------ ------ ------ ------ ------ ------ ------ ------
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* aux feed water
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
5480000   auxfeed          tmdpjun
5480101   553000000 510000000 0.10
5480200   1         655
5480201   -1.0      0.0       0.0       0.0
5480202   0.0       0.0       0.0       0.0
*5480203  0.0       2.5207    0.0       0.0
*------ ------ ------ ------ ------ ------ ------ ------
*  modification for steady state run at 91/2/8
*------ ------ ------ ------ ------ ------ ------ ------
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* steam flow control valve
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
5500000   cv-p4-1          valve
5500101   530010000 535000000 0.0043266 0.0   0.0   000100
5500201   0         19.758    22.082    0.0
5500300   mtrvlv
5500301   612       616       0.05      0.67      550
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* makeup feed tank
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
5530000   demin            tmdpvol
5530101   3.0       10.0      0.0       0.0       0.0       0.0
5530102   3.33e-5   1.0       00011
5530200   1
5530201   0.0       366.5     0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*  flow path to the air cooled condenser
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
5550000   coacco    sngljun
5550101   535010000 540000000 0.0       0.0  0.0      000100
5550201   0         13.171    36.498    0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* main feed water valve
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
5600000   mnfeed           tmdpjun
5600101   545000000 510000000 0.05
5600200   1         656
5600201   0.0       26.533    26.533    0.0
*5600202  0.0       0.0       0.0       0.0
*------ ------ ------ ------ ------ ------ ------ ------
*  modification for steady state run at 91/2/8
```

```
*------ ------ ------ ------ ------ ------ ------ ------
****************************************************
*
*  ecc system
*
****************************************************
*  piping pcs hpis injection point
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
6000000   ppchp     branch
6000001   0         1
6000101   0.009099  8.8776    0.0       0.0       -90.0   -3.2
6000102   4.0e-5    0.0       00000
6000200   0         14081300. 128835.00 2400000.0 .000000
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*  piping accumulator
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
6050000   piac1     branch
6050001   2         0
6050101   0.014582  9.4891    0.0       0.0       0.0       0.0
6050102   4.0e-5    0.0       00000
6050200   0         14065600. 131740.00 260000.0 .000000
6051101   605010000 600000000 0.0   0.8       0.8     000100
6052101   610010000 605000000 0.0   0.7       0.7     000100
6051201   .98481-14 .98481-14 0.0
6052201   -.1251-13 -.1251-13 0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* accumulator pipe
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
6100000   piac2            snglvol
6100101   0.018638  7.55998   0.0       0.0       0.0       0.0
6100102   4.0-5     0.0       00000
6100200   0         14065600. 131744.  2600000.0  0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* accumulator vessel
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
6150000   accumlr          accum
6150101   1.254     2.33      0.0       0.0       90.0      2.33
6150102   4.0-5     0.0       00000
6150200   4.37+6    304.7     0.0
6151101   610000000 0.016817  24.6      24.6      000000
6152200   1.97      0.0       75.13 0.0       0.04445   0 0 0 0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* bwst lpis
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
6200000   bwstlps          tmdpvol
6200101   20.44     5.0       0.0       0.0       90.0      5.0
6200102   4.0e-5    0.0       00000
6200200   3
6200201   0.0       1.0e+5    305.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* bwst hpis
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
6250000   bwsthps          tmdpvol
6250101   20.44     5.0       0.0       0.0       90.0      5.0
6250102   4.0e-5    0.0       00000
6250200   3
```

```
6250201  0.0      1.0e+5   305.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* ecc check valve
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
6300000   eccvlv              valve
6300101   600010000 185000000 0.0       0.0       0.0  000100
6300201   0           .00000000 .00000000 0.0
6300300   trpvlv
6300301   502
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* low pressure injection system
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
6350000   lpis               tmdpjun
6350101   620000000 600000000 0.0
6350200   1          635       p        205010000
6350201   -1.0       0.0       0.0       0.0
6350202   8.483+4    7.045     0.0       0.0
6350203   4.297+5    6.091     0.0       0.0
6350204   7.745+5    5.045     0.0       0.0
6350205   9.448+5    4.313     0.0       0.0
6350206   1.119+6    3.454     0.0       0.0
6350207   1.186+6    3.173     0.0       0.0
6350208   1.257+6    2.673     0.0       0.0
6350209   1.326+6    2.159     0.0       0.0
6350210   1.395+6    1.536     0.0       0.0
6350211   1.464+6    0.7182    0.0       0.0
6350212   1.517+6    0.0       0.0       0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* high pressure injection system
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
6400000   hpis               tmdpjun
6400101   625000000 600000000  0.0
6400200   1          660       p        100010000
6400201   -1.0       0.0       0.0       0.0
6400202   0.0        0.0       0.0       0.0
6400203   0.0        .75687272 0.0       0.0
6400204   .7725144+6 .75687272 0.0       0.0
6400205   8.3597+6   .31536281 0.0       0.0
6400206   17.2436+6  .31536281 0.0       0.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* accumulator valve
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
6450000   accumvl             valve
6450101   615010000 610000000 0.003167  1.6   1.6  000100
6450201   0          0.0       0.0       0.0
6450300   trpvlv
6450301   503
**************************************************
*
*         containment
*
**************************************************
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*  containment broken loop hot leg
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
8000000   cblhl     tmdpvol
8000101   0.0      1.0     0.1      0.0      0.0      0.0
8000102   0.0      0.0     00000
8000200   2
8000201   0.0              0.107e6    1.0
8000202   10000.0          0.107e6    1.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*  containment broken loop cold leg
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
8050000   c805     tmdpvol
8050101   0.0      1.0     0.1      0.0      0.0      0.0
8050102   0.0      0.0     00000
8050200   2
8050201   0.0        1.0e+5     1.0
8050202   10000.0    1.0e+5     1.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*   containment power operated relief valve
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
8100000   cporv    tmdpvol
8100101   0.0       1.0       0.1       0.0       0.0       0.0
8100102   0.0       0.0       00000
8100200   2
8100201   0.0       0.107e+6  1.0
8100201   10000.0   0.107e+6  1.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*   boundary valve intact loop hot leg
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
9000000   bvalv    valve
9000101   110010000 905000000 0.0  0.0       0.0   000100
9000201   0         0.0       0.0       0.0
9000300   trpvlv
9000301   511
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*   boundary volume intact loop hot leg
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
9050000   bvolum    tmdpvol
9050101   0.0       1.0       0.1       0.0       0.0       0.0
9050102   0.0       0.0       00000
9050200   3
9050201   0.0       14.9664e6 577.86
9050202   10000.0   14.9664e6 577.86
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*
*           heat structure input data
*
**************************************************
*
* steam generator heat structures
*
**************************************************
* steam generator tubing
**************************************************
10060000 6        8        2        1        0.0051054
10060100 0        1
10060101 7        0.006348984
10060201 6        7
10060301 0.0      7
```

```
10060401  540.0    8
10060501  115040000  10000     1       1         1687.481  6
10060601  515040000  10000     1       1         1687.481  3
10060602  515060000 -10000     1       1         1687.481  6
10060701  0       0       0       0       6
10060801  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  6 * mod 3
10060901  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  6 * mod 3
************************************************************
* tubesheet central section
************************************************************
11151000  2       4       2       1       5.1054e-3
11151100  0       1
11151101  1       6.35e-3
11151102  2       7.072376e-3
11151201  6       1
11151202  5       3
11151301  0.0     3
11151401  577.0   4
11151501  115030000  70000     1       1         0.25  2
11151601  -939    0       3949    1       0.25  2
11151701  0       0.0     0.0     0.0     2
11151801  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  2 * mod 3
************************************************************
* tube sheet periphery
************************************************************
11152000  2       20      1       1       0.0
11152100  0       1
11152101  19      0.623795
11152201  5       19
11152301  0.0     19
11152401  577.0   20
11152501  115030000 0      1       1       0.1579621  1
11152502  115100000 0      1       1       0.1579621  2
11152601  515030000 0      1       1       0.1579621  2
11152701  0       0.0     0.0     0.0     2
11152801  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  2 * mod 3
11152901  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  2 * mod 3
************************************************************
* intact loop piping
************************************************************
11001000  12      11      2       1       0.142
11001100  0       1
11001101  10      0.1780
11001201  4       10
11001301  0.0     10
11001401  540.0   11
11001501  100010000 0      1       1       1.5373    1
11001502  105010000 0      1       1       1.634     2
11001503  110010000 0      1       1       0.623     3
11001504  115010000 0      1       1       1.4385    4
11001505  115120000 0      1       1       0.689     5
11001506  115130000 0      1       1       0.559     6
11001507  120010000 0      1       1       0.76      7
11001508  150010000 0      1       1       0.4966    8
11001509  175010000 0      1       1       0.559     9
11001510  175020000 0      1       1       0.613     10
11001511  180010000 0      1       1       0.701     11
11001512  185010000 0      1       1       1.461     12
11001601  -939    0       3949    1       1.5373    1
11001602  -939    0       3949    1       1.634     2
11001603  -939    0       3949    1       0.623     3
11001604  -939    0       3949    1       1.4385    4
11001605  -939    0       3949    1       0.689     5
11001606  -939    0       3949    1       0.559     6
11001607  -939    0       3949    1       0.76      7
11001608  -939    0       3949    1       0.4966    8
11001609  -939    0       3949    1       0.559     9
11001610  -939    0       3949    1       0.613     10
11001611  -939    0       3949    1       0.701     11
11001612  -939    0       3949    1       1.461     12
11001701  0       0       0       0       12
11001801  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  1 * mod 3
11001802  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  2 * mod 3
11001803  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  3 * mod 3
11001804  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  4 * mod 3
11001805  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  5 * mod 3
11001806  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  6 * mod 3
11001807  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  7 * mod 3
11001808  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  8 * mod 3.
11001809  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  9 * mod 3
11001810  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0 10 * mod 3
11001811  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  11 * mod3
11001812  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  12 * mod3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* steam generator connections
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
11002000  2       11      2       1       0.1625
11002100  0       1
11002101  10      0.203
11002201  4       10
11002301  0.0     10
11002401  540.0   11
11002501  115020000 0      1       1       0.708     1
11002502  115110000 0      1       1       0.547     2
11002601  -939    0       3949    1       0.708     1
11002602  -939    0       3949    1       0.547     2
11002701  0       0       0       0       2
11002801  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0   1 *mod 3
11002802  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0   2 *mod 3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* .216 meter diameter piping
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
11003000  7       11      2       1       0.108
11003100  0       1
11003101  10      0.1365
11003201  4       10
11003301  0.0     10
11003401  540.0   11
11003501  125010000 0      1       1       1.00      1
11003502  130010000 0      1       1       0.457     2
11003503  140010000 0      1       1       0.502     3
11003504  145010000 0      1       1       1.4084    4
```

```
11003505  155010000 0    1    1    1.003   5
11003506  160010000 0    1    1    0.457   6
11003507  170010000 0    1    1    0.514   7
11003601  -939   0   3949   1   1.00    1
11003602  -939   0   3949   1   0.457   2
11003603  -939   0   3949   1   0.502   3
11003604  -939   0   3949   1   1.4084  4
11003605  -939   0   3949   1   1.003   5
11003606  -939   0   3949   1   0.457   6
11003607  -939   0   3949   1   0.514   7
11003701  0   0   0   0   7
11003801  0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  1 * mod 3
11003802  0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  2 * mod 3
11003803  0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  3 * mod 3
11003804  0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  4 * mod 3
11003805  0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  5 * mod 3
11003806  0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  6 * mod 3
11003807  0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  7 * mod 3
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* steam generator plena
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
11004000  2   11   3   1   0.6858
11004100  0   1
11004101  10   0.7747
11004201  5   10
11004301  0.0   10
11004401  540.0   11
11004501  115030000 0   1   1   0.25   1
11004502  115100000 0   1   1   0.25   2
11004601  -939   0   3949   1   0.25   1
11004602  -939   0   3949   1   0.25   2
11004701  0   0   0   0   2
11004801  0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  1 * mod 3
11004802  0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  2 * mod 3
11004901  0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  2 * mod 3
*******************************************************
* reactor vessel heat structures
*******************************************************
* the reactor vessel wall is not modelled above the nozzles.
* the vessel to filler gap is assumed to insulate the vessel
* from the fillers.  the vessel to filler gap is not modelled
* at this elevation.
* filler blocks inlet annulus top volume
* station 264 to 277
*******************************************************
12000000  1   21   2   1   0.508
12000100  0   1
12000101  20   0.7264
12000201  4   20
12000301  0.0   20
12000401  558.0   21
12000501  200010000 0   1   1   0.33   1
12000601  0   0   0   1   0.33   1
12000701  0   0.0   0.0   0.0   1
12000801  0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  1 * mod 3
*******************************************************
```

```
* core support barrel
* station 96.44 to 277
*******************************************************
12001000  6   11   2   1   0.381
12001100  0   1
12001101  10   0.419
12001201  4   10
12001301  0.0   10
12001401  558.0   11
12001501  0   0   0   1   0.33    1
12001502  0   0   0   1   0.424   2
12001503  0   0   0   1   0.958   3
12001504  0   0   0   1   0.958   4
12001505  0   0   0   1   0.958   5
12001506  0   0   0   1   0.958   6
12001601  200010000 0   1   1   0.33    1
12001602  205010000 0   1   1   0.424   2
12001603  210010000 0   1   1   0.958   3
12001604  210020000 0   1   1   0.958   4
12001605  210030000 0   1   1   0.958   5
12001606  210040000 0   1   1   0.958   6
12001701  0   0.0   0.0   0.0   6
12001901  0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  1 * mod 3
12001902  0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  2 * mod 3
12001903  0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  6 * mod 3
*******************************************************
* filler blocks inlet annulus lower volume
* station 247.3 to 264.0
*******************************************************
12050000  1   21   2   1   0.501
12050100  0   1
12050101  20   0.7264
12050201  4   20
12050301  0.0   20
12050401  558.0   21
12050501  205010000 0   1   1   0.424   1
12050601  223010000 0   1   1   0.424   1
12050701  0   0.0   0.0   0.0   1
12050801  0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  1 * mod 3
12050901  0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  1 * mod 3
*******************************************************
* downcomer and lower plenum
* station 67.7 to 247.3
*******************************************************
12100000  6   21   2   1   0.47
12100100  0   1
12100101  20   0.7264
12100201  4   20
12100301  0.0   20
12100401  558.0   21
12100501  210010000 10000   1   1   0.958   4
12100505  215010000 0   1   1   0.36    5
12100506  220010000 0   1   1   0.37    6
12100601  223020000 0   1   1   0.958   1
12100602  223030000 0   1   1   0.958   2
12100603  223040000 0   1   1   0.958   3
```

```
12100604 223050000 0     1     1     0.958    4
12100605 223060000 0     1     1     0.36     5
12100606 223070000 0     1     1     0.37     6
12100701 0      0.0    0.0    0.0    6
12100801 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 4 * mod 3
12100802 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 5 * mod 3
12100803 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 6 * mod 3
12100901 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 4 * mod 3
12100902 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 5 * mod 3
12100903 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 6 * mod 3
*************************************************
* reactor vessel wall above station 178 - 5.50 inches thick
* station 178 to 258  rv not modelled above bottom of nozzles
*************************************************
12110000 3      11     2      1      0.7328
12110100 0      1
12110101 10     0.8725
12110201 5      10
12110301 0.0    10
12110401 558.0  11
12110501 223010000 0     1     1     0.424    1
12110502 223020000 0     1     1     0.958    2
12110503 223030000 0     1     1     0.6500   3
12110601 -939   0      3949   1     0.424    1
12110602 -939   0      3949   1     0.958    2
12110603 -939   0      3949   1     0.6500   3
12110701 0      0.0    0.0    0.0    3
12110801 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 1 * mod 3
12110802 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 2 * mod 3
12110803 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 3 * mod 3
*************************************************
* reactor vessel wall bellow station 178 - 3.62 inches thick
* station 67.7 to 178
*************************************************
12120000 5      7      2      1      0.7328
12120100 0      1
12120101 6      0.8247
12120201 5      6
12120301 0.0    6
12120401 558.0  7
12120501 223030000 0     1     1     0.308    1
12120502 223040000 10000     1     1     0.958    3
12120503 223060000 0     1     1     0.3600   4
12120504 223070000 0     1     1     0.37     5
12120601 -939   0      3949   1     0.308    1
12120602 -939   0      3949   1     0.958    3
12120603 -939   0      3949   1     0.36     4
12120604 -939   0      3949   1     0.37     5
12120701 0      0.0    0.0    0.0    5
12120801 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 1 * mod 3
12120802 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 3 * mod 3
12120803 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 4 * mod 3
12120804 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 5 * mod 3
*************************************************
* reactor vessel bottom  station 67.7
*************************************************
```

```
12200000 1      11     1      1      0.0
12200100 0      1
12200101 10     0.092
12200201 5      10
12200301 0.0    10
12200401 558.0  11
12200501 220010000 0     1     0     1.68     1
12200601 -939   0      3949   0     1.68     1
12200701 0      0.0    0.0    0.0    1
12200801 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 1 * mod 3
12200901 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 1 * mod 3
*************************************************
* flow skirt - core filler assembly  station 96.44 to 261.13
*************************************************
12250000 7      11     2      1      0.3
12250100 0      1
12250101 10     0.38
12250201 4      10
12250301 0.0    10
12250401 558.0  11
12250501 225010000 0     1     1     0.52     1
12250502 230010000 0     1     1     0.559    2
12250503 230020000 0     1     1     0.559    3
12250504 230030000 0     1     1     0.657    4
12250505 240010000 0     1     1     1.118    5
12250506 245010000 0     1     1     0.42     6
12250507 246010000 0     1     1     0.35     7
12250601 0      0      0      1      0.52     1
12250602 0      0      0      1      0.559    2
12250603 0      0      0      1      0.559    3
12250604 0      0      0      1      0.657    4
12250605 0      0      0      1      1.118    5
12250606 0      0      0      1      0.42     6
12250607 0      0      0      1      0.35     7
12250701 0      0.0    0.0    0.0    7
12250801 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 1 * mod 3
12250802 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 3 * mod 3
12250803 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 4 * mod 3
12250804 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 5 * mod 3
12250805 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 6 * mod 3
12250806 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 7 * mod 3
*************************************************
* lower core support structure station 96.44 to 116.91
* includes core support barrel lip , lower core support
* structure , and fuel module lower end boxes
*************************************************
12260000 1      7      2      1      0.282
12260100 0      1
12260101 6      0.3
12260201 4      6
12260301 0.0    6
12260401 558.0  7
12260501 225010000 0     1     1     0.52     1
12260601 0      0      0      1      0.52     1
12260701 0      0.0    0.0    0.0    1
12260801 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 1 * mod 3
```

```
****************************************************
* active core station 116.91 to 182.94
****************************************************
12300000 3      10      2      1      0.0
12300100 0      1
12300101 5      4.647e-3
12300102 1      4.742e-3
12300103 3      5.359e-3
12300201 1      5
12300202 2      6
12300203 3      9
12300301 1.0    5
12300302 0.0    9
12300401 558.0  10
12300501 0      0      0      1      725.1   3
12300601 230010000 0   1      1      725.1   1
12300602 230020000 0   1      1      725.1   2
12300603 230030000 0   1      1      725.1   3
12300701 1000   0.41209  0.0   0.0   1
12300702 1000   0.44565  0.0   0.0   2
12300703 1000   0.14226  0.0   0.0   3
12300901 0.0124 11.0 11.0 0.0 0.0 0.0 0.0 1.0 3 *mod 3
****************************************************
* upper core support structure station 190.5 to 234.5
****************************************************
12400000 1      7      2      1      0.282
12400100 0      1
12400101 6      0.31
12400201 4      6
12400301 0.0    6
12400401 558.0  7
12400501 240010000 0   1      1      1.118   1
12400601 0      0      0      1      1.118   1
12400701 0      0.0    0.0    0.0    1
12400801 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 1 * mod 3
****************************************************
* fuel modules station 187.6 to 258.4
****************************************************
12460000 1      5      1      1      0.0
12460100 0      1
12460101 4      0.01
12460201 4      4
12460301 0.0    4
12460401 558.0  5
12460501 245010000 0   1      1      1.8     1
12460601 246010000 0   1      1      1.8     1
12460701 0      0.0    0.0    1.8    1
12460801 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 1 * mod 3
12460901 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 1 * mod 3
****************************************************
* core support barrel - upper plenum lower volume
* station 264 to 297.6
* reactor vessel not modelled above bottom of nozzles
* the vessel to filler gap is assumed to insulate the vessel
* from the fillers. the vessel to filler gap is not modelled
* at this elevation.
****************************************************
12500000 1      11     2      1      0.381
12500100 0      1
12500101 10     0.419
12500201 5      10
12500301 0.0    10
12500401 558.0  11
12500501 250010000 0   1      1      0.854   1
12500601 0      0      0      1      0.854   1
12500701 0      0.0    0.0    0.0    1
12500801 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 1 * mod 3
****************************************************
* internals upper plenum
****************************************************
12510000 2      5      1      1      0.0
12510100 0      1
12510101 4      0.005
12510201 4      4
12510301 0.0    4
12510401 558.0  5
12510501 250010000 0   1      1      1.0     1
12510502 250010000 0   1      1      1.0     2
12510601 0      0      0      1      1.0     2
12510701 0      0.0    0.0    0.0    2
12510801 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 2 * mod 3
****************************************************
* core support barrel - upper plenum top volume
* station 297.6 to 325
* reactor vessel not modelled above bottom of nozzles
* the vessel to filler gap is assumed to insulate the vessel
* from the fillers. the vessel to filler gap is not modelled
* at this elevation.
****************************************************
**********
12501000 1      21     2      1      0.381
12501100 0      1
12501101 20     0.728
12501201 5      20
12501301 0.0    20
12501401 558.0  21
12501501 250010000 0   1      1      0.712   1
12501601 0      0      0      1      0.712   1
12501701 0      0.0    0.0    0.0    1
12501801 0.0 11.0 11.0 0.0 0.0 0.0 0.0 1.0 1 * mod 3
****************************************************
* upper head top plate station 325
****************************************************
12550000 1      21     1      1      0.0
12550100 0      1
12550101 20     0.474
12550201 5      20
12550301 0.0    20
12550401 558.0  21
12550501 250010000 0   1      1      0.712   1
12550601 -939   0      3949   1      0.712   1
12550701 0      0.0    0.0    0.0    1
```

```
12550801  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  1 * mod 3
*************************************************************
* broken loop hot leg piping heat structures
*************************************************************
13150000  2        11       2       1        0.0515
13150100  0        1
13150101  10       0.0705
13150201  4        10
13150301  0.0      10
13150401  540.0    11
13150501  315010000 0       1       1        0.4054    1
13150502  315020000 0       1       1        0.5265    2
13150601  -939     0        3979    1        0.4054    1
13150602  -939     0        3979    1        0.5265    2
13150701  0        0        0       0        2
13150801  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  1 * mod 3
13150802  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  2 * mod 3
***********13151000  1        11       2       1
0.0550
13151100  0        1
13151101  10       0.0705
13151201  4        10
13151301  0.0      10
13151401  540.0    11
13151501  315090000 0       1       1        0.0120357 1
13151601  -939     0        3979    1        0.0120357 1
13151701  0        0        0       0        1
13151801  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  1 * mod 3
*********************
13152000  1        11       2       1        0.0660
13152100  0        1
13152101  10       0.0840
13152201  4        10
13152301  0.0      10
13152401  540.0    11
13152501  315110000 0       1       1        0.00836   1
13152601  -939     0        3979    1        0.00836   1
13152701  0        0        0       0        1
13152801  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  1 * mod 3
*********************
13153000  6        11       2       1        0.1835
13153100  0        1
13153101  10       0.2285
13153201  4        10
13153301  0.0      10
13153401  540.0    11
13153501  315030000 10000   1       1        0.108     6
13153601  -939     0        3979    1        0.108     6
13153701  0        0        0       0        6
13153801  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  6 * mod 3
*********************
13154000  1        11       2       1        0.1285
13154100  0        1
13154101  10       0.1620
13154201  4        10
13154301  0.0      10
13154401  540.0    11
13154501  315120000 0       1       1        0.0525    1
13154601  -939     0        3979    1        0.0525    1
13154701  0        0        0       0        1
13154801  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  1 * mod 3
*********************
13155000  1        11       2       1        0.1420
13155100  0        1
13155101  10       0.1780
13155201  4        10
13155301  0.0      10
13155401  540.0    11
13155501  315100000 0       1       1        0.0489057  1
13155601  -939     0        3979    1        0.0489057  1
13155701  0        0        0       0        1
13155801  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  1 * mod 3
*********************
* nozzle piping
*********************
13000000  3        11       2       1        0.1420
13000100  0        1
13000101  10       0.1780
13000201  4        10
13000301  0.0      10
13000401  540.0    11
13000501  300010000 0       1       1        0.876     1
13000502  305010000 0       1       1        0.698     2
13000503  310010000 0       1       1        1.424     3
13000601  -939     0        3979    1        0.876     1
13000602  -939     0        3979    1        0.698     2
13000603  -939     0        3979    1        1.424     3
13000701  0        0        0       0        3
13000801  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  1 * mod 3
13000802  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  2 * mod 3
13000803  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  3 * mod 3
*************************************************************
* broken loop cold leg
*************************************************************
* nozzle piping
*********************
13350000  3        11       2       1        0.1420
13350100  0        1
13350101  10       0.1780
13350201  4        10
13350301  0.0      10
13350401  540.0    11
13350501  335010000 0       1       1        0.7495    1
13350502  340010000 0       1       1        0.698     2
13350503  345010000 0       1       1        0.974     3
13350601  -939     0        3949    1        0.7495    1
13350602  -939     0        3949    1        0.698     2
13350603  -939     0        3949    1        0.974     3
13350701  0        0        0       0        3
13350801  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  1 * mod 3
13350802  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  2 * mod 3
13350803  0.0  11.0  11.0   0.0  0.0  0.0  0.0  1.0  3 * mod 3
```

```
*********************
13501000 1        11       2       1       0.0550
13501100 0        1
13501101 10       0.1780
13501201 4        10
13501301 0.0      10
13501401 540.0    11
13501501 350010000 0       1       1       0.488    1
13501601 -939     0        3949    1       0.488    1
13501701 0        0        0       0       1
13501801 0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  1 * mod 3
*********************
13502000 1        11       2       1       0.0865
13502100 0        1
13502101 10       0.1095
13502201 4        10
13502301 0.0      10
13502401 540.0    11
13502501 350020000 0       1       1       1.6085   1
13502601 -939     0        3949    1       1.6085   1
13502701 0        0        0       0       1
13502801 0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  1 * mod 3
*************************************************
* reflood assist piping and valves [rabvs]
*************************************************
13700000 4        11       2       1       0.111
13700100 0        1
13700101 10       0.1365
13700201 4        10
13700301 0.0      10
13700401 540.0    11
13700501 370010000 0       1       1       2.00     1
13700502 375010000 0       1       1       1.10567  2
13700503 380010000 0       1       1       1.101804 3
13700504 385010000 0       1       1       3.04201  4
13700601 -939     0        3979    1       2.00     1
13700602 -939     0        3979    1       1.10567  2
13700603 -939     0        3949    1       1.101804 3
13700604 -939     0        3949    1       3.04201  4
13700701 0        0        0       0       4
13700801 0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  1 * mod 3
13700802 0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  2 * mod 3
13700803 0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  3 * mod 3
13700804 0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  4 * mod 3
*************************************************
* pressurizer heat structures
*************************************************
* vessel bottom
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
14151000 1        11       1       1       0.0
14151100 0        1
14151101 10       0.0762
14151201 5        10
14151301 0.0      10
14151401 617.0    11
14151501 415010000 0       1       1       0.362    1
14151601 -939     0        3969    1       0.362    1
14151701 0        0        0       0       1
14151801 0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  1 * mod 3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* vessel sides - large diameter section
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
14152000 7        11       2       1       0.42291
14152100 0        1
14152101 10       0.49911
14152201 5        10
14152301 0.0      10
14152401 617.0    11
14152501 415010000 0       1       1       0.224    1
14152502 415020000 10000   1       1       0.403    3
14152503 415040000 10000   1       1       0.207    5
14152504 415060000 10000   1       1       0.1705   7
14152601 -939     0        3969    1       0.224    1
14152602 -939     0        3969    1       0.403    3
14152603 -939     0        3969    1       0.207    5
14152604 -939     0        3969    1       0.1705   7
14152701 0        0        0       0       7
14152801 0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  7 * mod 3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* vessel sides - small diameter section
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
14162000 1        11       2       1       0.2032
14162100 0        1
14162101 10       0.3683
14162201 5        10
14162301 0.0      10
14162401 617.0    11
14162501 415080000 0       1       1       0.118    1
14162601 -939     0        3969    1       0.118    1
14162701 0        0        0       0       1
14162801 0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  1 * mod 3
*************************************************
* pressurizer heaters
*************************************************
14172000 12       9        2       1       0.0
14172100 0        1
14172101 3        4.0132e-3
14172102 2        4.3942e-3
14172103 1        5.6642e-3
14172104 2        8.3820e-3
14172201 7        3
14172202 8        5
14172203 7        6
14172204 4        8
14172301 0.0      3
14172302 1.0      5
14172303 0.0      8
14172401 617.6    9
14172501 0        0        0       1       0.6096   12
14172601 415020000 0       1       1       0.6096   12
14172701 417      1.0      0.0     0.0     9   *cycli
14172702 418      1.0      0.0     0.0     12  *backu
```

```
14172901 1.6764e-2 11. 11.  0.  0.  0.  0.  1.  12 * mod 3
*************************************************
* pressurizer cycling heaters
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* pressurizer backup heaters
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
14201000 1        11       2        1        0.2032
14201100 0        1
14201101 10       0.3683
14201201 5        10
14201301 0.0      10
14201401 617.     11
14201501 420010000 0       1        1        0.118    1
14201601 -939     0        3969     1        0.118    1
14201701 0        0        0        0        1
14201801 0.0 11.0 11.0 0.0 0.0  0.0 0.0 1.0 1 * mod 3
14202000 1        11       1        1        0.0
14202100 0        1
14202101 10       0.18415
14202201 5        10
14202301 0.0      10
14202401 617.     11
14202501 420010000 0       1        1        0.13     1
14202601 -939     0        3969     1        0.13     1
14202701 0        0        0        0        1
14202801 0.0 11.0 11.0  0.0 0.0 0.0 0.0 1.0 1 * mod 3
*************************************************
*   steam generator heat structures
*************************************************
* shroud secondary side steam generator -upper section
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
15000000 3        4        2        1        0.3048
15000100 0        1
15000101 3        0.314325
15000201 5        3
15000301 0.0      3
15000401 540.0    4
15000501 500010000 0       1        1        0.7725   1
15000502 505010000 0       1        1        0.7725   2
15000503 510010000 0       1        1        0.152    3
15000601 520010000 0       1        1        0.7725   1
15000602 515080000 0       1        1        0.7725   2
15000603 515070000 0       1        1        0.152    3
15000701 0        0.0      0.0      0.0      3
15000801 0.0 11.0 11.0  0.0 0.0 0.C 0.0 1.0 3 * mod 3
15000901 0.0 11.0 11.0  0.0 0.0 0.0 0.0 1.0 3 * mod 3
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* shroud - lower section
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
15150000 4        4        2        1        0.6445
15150100 0        1
15150101 3        0.6572
15150201 5        3
15150301 0.0      3
15150401 540.0    4
15150501 510010000 0       1        1        0.152    1
```

```
15150502 515010000 10000   1        1        0.7113   4
15150601 515070000 0       1        1        0.152    1
15150602 515060000 -10000  1        1        0.7113   4
15150701 0        0        0        0        4
15150801 0.0 11.0 11.0  0.0 0.0 0.0 0.0 1.0 4 * mod 3
15150901 0.0 11.0 11.0  0.0 0.0 0.0 0.0 1.0 4 * mod 3
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* vessel wall
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
15300000 8        10       2        1        0.7112
15300100 0        1
15300101 9        0.765165
15300201 5        9
15300301 0.0      9
15300401 530.0    10
15300501 530010000 0       1        1        0.762    1
15300502 525010000 0       1        1        0.762    2
15300503 500010000 0       1        1        0.718    3
15300504 505010000 0       1        1        0.718    4
15300505 510010000 0       1        1        0.518    5
15300506 515010000 10000   1        1        0.7102   8
15300601 -939     0        3959     1        0.762    2
15300602 -939     0        3959     1        0.718    4
15300603 -939     0        3959     1        0.518    5
15300604 -939     0        3959     1        0.7102   8
15300701 0        0.0      0.0      0.0      8
15300801 0.0 11.0 11.0  0.0 0.0 0.0 0.0 1.0 8 * mod 3
*************************************************
*
*   heat structure thermal property data
*
*************************************************
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20100100 tbl/fctn 1        1    * uo2
20100200 tbl/fctn 1        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
20100700 tbl/fctn 1        1    * mgo
20100800 tbl/fctn 1        1    * nicr
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* uo2 - thermal conductivity
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20100101 2.7315e2  8.44
20100102 4.1667e2  6.46
20100103 5.3315e2  5.782385
20100104 6.99817e2 4.633177
20100105 8.66483e2 3.880307
20100106 1.03315e3 3.357625
20100107 1.08871e3 3.155129
20100108 1.19982e3 2.983787
20100109 1.28315e3 2.836674
20100110 1.36648e3 2.713792
20100111 1.53315e3 2.521680
20100112 1.61648e3 2.448990
```

```
20100113  1.69982e3 2.391875
20100114  1.97759e3 2.289762
20100115  2.25537e3 2.307069
20100116  2.53315e3 2.433413
20100117  2.81093e3 2.661870
20100118  3.08871e3 2.994171
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* gap - thermal conductivity
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20100201  273.15    0.14
20100202  590.0     0.24
20100203  810.0     0.29
20100204  1090.0    0.36
20100205  1370.0    0.42
20100206  3260.0    0.75
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* zircaloy-4 - thermal conductivity          from matpro
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
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
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* s-steel - thermal conductivity
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20100401  273.15    12.98
20100402  1199.82   25.1
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* inconel-600 - thermal conductivity
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
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
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* uo2 - volumetric heat capacity
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20100151  2.73150e2 2.310427e6
20100152  3.23150e2 2.571985e6
20100153  3.73150e2 2.746357e6
20100154  6.7315e2  3.138694e6
20100155  1.37315e3 3.443844e6
20100156  1.77315e3 3.531030e6
20100157  1.97315e3 3.792588e6
20100158  2.17315e3 4.228518e6
20100159  2.37315e3 4.882412e6
20100160  2.67315e3 6.015829e6
20100161  2.77315e3 6.320980e6
20100162  2.87315e3 6.582538e6
20100163  2.97315e3 6.713317e6
20100164  3.11315e3 6.800503e6
20100165  4.69982e3 6.800503e6
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* gap - volumetric heat capacity
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20100251  273.15    5.4
20100252  3260.0    5.4
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* zircaloy-4 - volumetric heat capacity      from matpro
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20100351  255.4     1.904e6
20100352  1077.6    2.312e6
20100353  1185.9    5.712e6
20100354  1248.4    2.311e6
20100355  2199.8    2.312e6
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* s-steel - volumetric heat capacity
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20100451  273.15    3.83e6
20100452  366.5     3.83e6
20100453  1366.5    5.376e6
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* inconel-600 - volumetric heat capacity
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
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
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* magnesium oxide - thermal conductivity
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20100701  373.15    0.2451
20100702  422.04    0.2405
20100703  477.59    0.2352
20100704  533.15    0.2300
20100705  588.71    0.2249
20100706  644.26    0.2196
20100707  699.82    0.2143
20100708  755.37    0.2091
20100709  810.93    0.2039
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20100710  866.48    0.1987
20100711  922.04    0.1934
20100712  977.59    0.1882
20100713  1033.15   0.1830
20100714  1088.71   0.1777
20100715  1144.26   0.1725
20100716  1199.82   0.1673
20100717  1255.37   0.1621
20100718  1310.93   0.1568
20100719  1366.48   0.1516
20100720  1422.04   0.1464
20100721  1477.59   0.1412
20100722  1533.15   0.1359
20100723  1588.71   0.1307
20100724  1644.26   0.1255
20100725  1699.82   0.1203
20100726  1755.37   0.1150
20100727  1810.93   0.1098
20100728  1866.48   0.1046
20100729  1922.04   0.0993
20100730  5000.00   0.0993
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* magnesium oxide - volumetric heat capacity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20100751  373.15    2033.52
20100752  422.04    2004.59
20100753  477.59    1917.74
20100754  533.15    1938.87
20100755  588.71    1906.01
20100756  644.26    1873.15
20100757  699.82    1840.29
20100758  755.37    1807.43
20100759  810.93    1774.56
20100760  866.48    1741.70
20100761  922.04    1708.84
20100762  977.59    1675.96
20100763  1033.15   1643.11
20100764  1088.71   1610.25
20100765  1144.26   1577.39
20100766  1199.82   1544.53
20100767  1255.37   1511.67
20100768  1310.93   1478.80
20100769  1366.48   1445.94
20100770  1422.04   1413.08
20100771  1477.59   1380.22
20100772  1533.15   1347.35
20100773  1588.71   1314.49
20100774  1644.26   1281.63
20100775  1699.82   1248.77
20100776  1755.37   1215.90
20100777  1810.93   1183.04
20100778  1866.48   1150.18
20100779  1922.04   1117.32
20100780  5000.00   1117.32
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* nichrome - thermal conductivity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20100801  373.15    1.1163
20100802  1922.04   1.1163
20100803  5000.00   1.1163
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* nichrome - volumetric heat capacity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20100851  373.15    2180.80
20100852  1922.04   2180.80
20100853  5000.00   2180.80
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pressurizer cycling heaters
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20241700  power     608
20241701  0.0       0.0
20241702  60.       4.e3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pressurizer backup haters
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20241800  power     629
20241801  0.0       0.0
20241802  60.       4.e3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* scram reactivity data
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20260900  "reac-t  " 609
20260901  0.0       0.0
20260902  0.5       -0.5
20260903  0.59      -3.13
20260904  0.65      -3.95
20260905  0.75      -6.27
20260906  0.83      -8.72
20260907  0.90      -12.00
20260908  0.97      -17.12
20260909  1.125     -20.67
20260910  1.213     -22.10
20260911  1.3       -22.78
20260912  1.4       -23.17
20260913  1.6       -23.32
20260914  60.0      -23.32
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* reactor power table
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20290000  power
20290001  0.0       48.9e6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* environmental heat loss boundary temperature
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20293900  temp
20293901  0.0       311.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* reactor vessel environmental loss heat xfer coefficient
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20294900  htc-t
20294901  0.0       13.450
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
```

```
* steam generator environmental loss heat xfer coefficient
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
20295900  htc-t
20295901  0.0       3.385
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* pressurizer generator environmental loss heat xfer coefficient
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
20296900  htc-t
20296901  0.0       3.019
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* blhl environmental loss heat xfer coefficient
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
20297900  htc-t     509
20297901  -1.0      0.0
20297902  0.0       13.450
*************************************************
core collapsed liquid level
*************************************************
20255000  normarea  0  1.0  1.0
20255001  0.0       9.25e-4
20255002  9.25e-4   9.25e-4
20255003  1.0  1.0
20290000  power     609
20290001  0.0       48.9e+6
20290002  0.15      43.032e6
20290003  0.3       37.164e6
20290004  0.6       28.362e6
20290005  0.85      8.6064e6
20290006  1.0       5.99538e6
20290007  1.3       4.89e6
20290008  2.0       4.274e6
20290009  4.0       3.7060332e6
20290010  7.0       3.1296e6
20290011  10.0      2.93458e6
20290012  25.0      2.28548e6
20290013  65.0      1.7115e6
20290014  100.0     1.5425994e6
20290015  250.0     1.232769e6
20290016  650.0     0.91932e6
20290017  1000.0    0.80196e6
20290018  1500.0    0.6846e6
20290019  3000.0    0.5379e6
20290020  5000.0    0.44988e6
*************************************************
*         reactor kinetics data
*
*************************************************
30000000  point
30000001  gamma-ac  49.6e+6  0.0   348.43   1.0
0.556
30000002  ans79-1
* ---------- shoud not be changed for transient
*************************************************
* delayed neutron constants
*************************************************
30000101  0.0349    0.01275
30000102  0.2035    0.03177
30000103  0.1848    0.1181
30000104  0.4046    0.3160
30000105  0.1401    1.402
30000106  0.0321    3.914
*************************************************
power history
*************************************************
30000401  4.96e+7   70.   hr
* ---------- should be changer for transient as 4.89e+7
*************************************************
* reactivity curve numbers
*************************************************
30000011  609
*************************************************
moderator density reactivity table
*************************************************
*30000501  0.818    -4.428
*30000502  0.905    -2.249
*30000503  0.955    -1.032
*30000504  1.000     0.000
*30000505  1.044     0.926
*30000506  1.095     1.853
*30000507  1.139     2.589
*30000508  1.213     3.689
*30000509  1.270     4.489
*30000510  1.316     5.212
*************************************************
doppler reactivity table
*************************************************
*30000601  293.16    1.375
*30000602  338.72    1.125
*30000603  422.05    0.682
*30000604  477.60    0.419
*30000605  505.38    0.274
*30000606  570.72    0.000
*30000607  588.72   -0.075
*30000608  695.83   -0.526
*30000609  922.05   -1.386
*30000610  1310.94  -2.543
*30000611  1810.94  -3.865
*30000612  2088.72  -4.502
*30000613  2499.83  -5.392
*30000614  3027.60  -6.417
*************************************************
* moderator density reactivity table
*************************************************
30000501  0.818  0.0
30000502  0.905  0.0
30000503  0.955  0.0
30000504  1.000  0.0
30000505  1.044  0.0
30000506  1.095  0.0
30000507  1.139  0.0
30000508  1.213  0.0
30000509  1.270  0.0
```

```
30000510   1.316  0.0
***************************************************
* doppler reactivity table
***************************************************
30000601    293.16  0.0
30000602    338.72  0.0
30000603    422.05  0.0
30000604    477.60  0.0
30000605    505.38  0.0
30000606    570.72  0.0
30000607    588.72  0.0
30000608    695.83  0.0
30000609    922.05  0.0
30000610   1310.94  0.0
30000611   1810.94  0.0
30000612   2088.72  0.0
30000613   2499.83  0.0
30000614   3027.60  0.0
* ---------  no reactivity feedback for steadt state run
* ---------  shuold be replaced by original one for transient
***************************************************
* volume weighting factors
***************************************************
*   moderator temperature feedback
***************************************************
30000701   230010000  0     0.31493   0.0
30000702   230020000  0     0.31493   0.0
30000703   230030000  0     0.37014   0.0
***************************************************
 doppler feedback
***************************************************
30000801   2300001    0     0.43153   0.0
30000802   2300002    0     0.51686   0.0
30000803   2300003    0     0.05161   0.0
***************************************************
*
*      control variables
*
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*   steam generator downcomer collapsed liquid level
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20500100  sglvl      sum        1.0       0.0       1
20500101  0.0        0.718      voidf     500010000
20500102             0.718      voidf     505010000
20500103             0.518      voidf     510010000
20500104             0.7102     voidf     515010000
20500105             0.7102     voidf     515020000
20500106             0.7102     voidf     515030000
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*  pressurizer collapsed liquid level
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20500200  pzrlvl     sum        1.0       0.0       1
20500201  0.0        0.224      voidf     415010000
20500202             0.403      voidf     415020000
20500203             0.403      voidf     415030000
20500204             0.207      voidf     415040000
20500205             0.207      voidf     415050000
20500206             0.1705     voidf     415060000
20500207             0.1705     voidf     415070000
20500208             0.118      voidf     415080000
20500209             0.118      voidf     420010000
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* core collapsed liquid level
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20500300  rvlvl      sum        1.0       0.0       1
20500301  0.0        0.712      voidf     250010000
20500302             0.854      voidf     250010000
20500303             0.843      voidf     245010000
20500304             1.118      voidf     240010000
20500305             0.657      voidf     230030000
20500306             0.559      voidf     230020000
20500307             0.559      voidf     230010000
20500308             0.520      voidf     225010000
20500309             0.360      voidf     215010000
20500310             0.370      voidf     220010000
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*  hot leg intact loop
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20504100  pcsvol1    sum        1.0       0.0       1
20504101  0.0        .09746482 rho        100010000
20504102             0.1035956 rho        105010000
20504103             3.0300e-2 rho        110010000
20504104             9.0000e-2 rho        115010000
20504105             5.7000e-2 rho        115020000
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* steam generator
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20504200  pcsvol2    sum        1.0       0.0       1
20504201  0.0        0.3350000 rho        115030000
20504202             0.1611170 rho        115040000
20504203             0.1611170 rho        115050000
20504204             6.7950e-2 rho        115060000
20504205             6.7950e-2 rho        115070000
20504206             1.61117-1 rho        115080000
20504207             1.61117-1 rho        115090000
20504208             3.3500e-1 rho        115100000
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* sg-pump piping
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20504300  pcsvol3    sum        1.0       0.0       1
20504301  0.0        4.37000-2 rho        115110000
20504302             4.62000-2 rho        115120000
20504303             3.54406-2 rho        115130000
20504304             4.81840-2 rho        120010000
20504305             6.13000-2 rho        125010000
20504306             1.89000-2 rho        130010000
20504307             6.13000-2 rho        155010000
20504308             1.89000-2 rho        160010000
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* cold leg intact loop
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20500400  pcsvol4    sum        1.0       0.0       1
```

```
20500401  0.0      9.90000-2 rho      135010000
20500402           1.83732-2 rho      140010000
20500403           6.33000-2 rho      145010000
20500404           3.14844-2 rho      150010000
20500405           9.90000-2 rho      165010000
20500406           1.88124-2 rho      170010000
20500407           3.54406-2 rho      175010000
20500408           3.88642-2 rho      175020000
20500409           4.44434-2 rho      180010000
20500410           9.26274-2 rho      185010000
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
*  reactor
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
20500500  pcsvol5   sum      1.0      0.0      1
20500501  0.0      2.66400-1 rho      215010000
20500502           2.92300-1 rho      220010000
20500503           1.30000-1 rho      225010000
20500504           9.53095-2 rho      230010000
20500505           9.53095-2 rho      230020000
20500506           0.1120185 rho      230030000
20500507           8.38500-3 rho      235010000
20500508           8.38500-3 rho      235020000
20500509           9.35500-3 rho      235030000
20500510           3.32046-1 rho      240010000
20500511           9.61020-2 rho      245010000
20500512           1.28100-1 rho      246010000
20500513           2.45952-1 rho      250010000
20500514           1.73728-1 rho      250010000
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* hot leg broken loop
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
20500600  pcsvol6   sum      1.0      0.0      1
20500601  0.0      5.55384-2 rho      300010000
20500602           4.42532-2 rho      305010000
20500603           6.68000-2 rho      310010000
20500604           3.38914-3 rho      315010000
20500605           4.40154-3 rho      315020000
20500606           3.90960-2 rho      315030000
20500607           1.82736-1 rho      315040000
20500608           9.17460-2 rho      315050000
20500609           9.17460-2 rho      315060000
20500610           1.82736-1 rho      315070000
20500611           3.90960-2 rho      315080000
20500612           1.62000-2 rho      315090000
20500613           6.48000-2 rho      315100000
20500614           .01539912 rho      315110000
20500615           3.50175-2 rho      315120000
20500616           8.54764-2 rho      370010000
20500617           8.58000-2 rho      375010000
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* cold leg broken loop
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
20500700  pcsvol7   sum      1.0      0.0      1
20500701  0.0      4.75183-2 rho      335010000
20500702           4.42532-2 rho      340010000
20500703           6.17516-2 rho      345010000
20500704           5.41000-3 rho      350010000
20500705           8.55000-2 rho      380010000
20500706           1.18030-1 rho      385010000
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* pressurizer
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
20500800  pcsvol8   sum      1.0      0.0      1
20500801  0.0      5.00250-3 rho      400010000
20500802           5.00250-3 rho      405010000
20500803           8.10880-2 rho      415010000
20500804           2.27695-1 rho      415020000
20500805           2.27695-1 rho      415030000
20500806           1.16955-1 rho      415040000
20500807           1.16955-1 rho      415050000
20500808           7.94530-2 rho      415060000
20500809           7.94530-2 rho      415070000
20500810           1.53400-2 rho      415080000
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* reactor vessel downcomer mass
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
20500900 dwncrms    sum      1.0      0.0      1
20500901  0.0      8.55000-2 rho      200010000
20500902           1.10000-1 rho      205010000
20500903           1.36036-1 rho      210010000
20500904           1.36036-1 rho      210020000
20500905           1.36036-1 rho      210030000
20500906           1.36036-1 rho      210040000
20500907           1.23426-2 rho      223010000
20500908           2.78874-2 rho      223020000
20500909           2.78874-2 rho      223030000
20500910           2.78874-2 rho      223040000
20500911           2.78874-2 rho      223050000
20500912           1.04796-2 rho      223060000
20500913           1.04796-2 rho      223070000
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
*  pcs mass
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
20501000  pcsmass   sum      1.0      0.0      1
20501001  0.0      1.0      cntrlvar  41
20501002           1.0      cntrlvar  42
20501003           1.0      cntrlvar  43
20501004           1.0      cntrlvar  4
20501005           1.0      cntrlvar  5
20501006           1.0      cntrlvar  6
20501007           1.0      cntrlvar  7
20501008           1.0      cntrlvar  8
20501009           1.0      cntrlvar  9
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* break energy computer
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
20542500  pvfstm    div      1.0      0.0      1
20542501  rhof      420010000 p       420010000
*
20542600  hfstm     sum      1.0      0.0      1
20542601  0.0      1.0      uf       420010000
20542602           1.0      cntrlvar  425
```

```
*
20542700 pvgstm   div      1.0      0.0     1
20542701 rhog     420010000 p       420010000
*
20542800 hgstm    sum      1.0      0.0     1
20542801 0.0      1.0      ug       420010000
20542802          1.0      cntrlvar 427
*
20542900 xhgstm   mult     1.0      0.0     1
20542901 quals    420010000 cntrlvar 428
*
20543000 xhfstm   mult     1.0      0.0     1
20543001 quals    420010000 cntrlvar 426
*
20543100 yhfstm   sum      1.0      0.0     1
20543101 0.0      1.0      cntrlvar 426
20543102          -1.0     cntrlvar 430
*
20543200 hsteam   sum      1.0      0.0     1
20543201 0.0      1.0      cntrlvar 429
20543202          1.0      cntrlvar 431
*
20543300 brkpwr   mult     1.0      0.0     1
20543301 mflowj   425000000 cntrlvar 432
*
20543400 brkflow  integral 1.0      0.0     1
20543401 mflowj   425000000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  011 - 031  heat transfer rate calculator
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  heat added to pcs from core
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20511100 corhttr  sum      1.0      0.0     1
20511101 0.0      24.374   htrnr    230000101
20511102          24.374   htrnr    230000201
20511103          24.374   htrnr    230000301
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  heat removed from pcs at to s/g tubes
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20511200 sghttr   sum      1.0      0.0     1
20511201 0.0      44.824   htrnr    006000100
20511202          44.824   htrnr    006000200
20511203          44.824   htrnr    006000300
20511204          44.824   htrnr    006000400
20511205          44.824   htrnr    006000500
20511206          44.824   htrnr    006000600
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  heat loss from reactor vessel
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20511300 rvheat   sum      1.0      0.0     1
20511301 0.0      2.3244   htrnr    211000101
20511302          5.25183  htrnr    211000201
20511303          3.56335  htrnr    211000301
20511304          1.59598  htrnr    212000101
20511305          4.96411  htrnr    212000201
20511306          4.96411  htrnr    212000301
20511307          1.86543  htrnr    212000401
20511308          1.91724  htrnr    212000501
20511309          1.68000  htrnr    220000101
20511310          0.71200  htrnr    255000101
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  heat loss from pzr
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20511400 pzrheat  sum      1.0      0.0     1
20511401 0.0      0.362    htrnr    415100101
20511402          0.702464 htrnr    415200101
20511403          1.26381  htrnr    415200201
20511404          1.26381  htrnr    415200301
20511405          0.649152 htrnr    415200401
20511406          0.649152 htrnr    415200501
20511407          0.534688 htrnr    415200601
20511408          0.534688 htrnr    415200701
20511409          0.273063 htrnr    416200101
20511410          0.130000 htrnr    420100101
20511411          0.273063 htrnr    420200101
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  heat loss from s/g
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20511500 sgheat   sum      1.0      0.0     1
20511501 0.0      3.5343   htrnr    530000101
20511502          3.5343   htrnr    530000201
20511503          3.33022  htrnr    530000301
20511504          3.33022  htrnr    530000401
20511505          2.40258  htrnr    530000501
20511506          3.29404  htrnr    530000601
20511507          3.29404  htrnr    530000701
20511508          3.29404  htrnr    530000801
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  toal heat loss from major components
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20511600 totheat  sum      1.0      0.0     1
20511601 0.0      1.0      cntrlvar 113
20511602          1.0      cntrlvar 114
20511603          1.0      cntrlvar 115
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  heat loss from broken loop hot leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20511700 blhlheat sum      1.0      0.0     1
20511701 0.0      0.97972  htrnr    300000101
20511702          0.78065  htrnr    300000201
20511703          1.59260  htrnr    300000301
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  heat loss from broken loop cold leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20511800 blclheat sum      1.0      0.0     1
20511801 0.0      0.83825  htrnr    335000101
20511802          0.78065  htrnr    335000201
20511803          1.0893   htrnr    335000301
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  heat loss from rabs piping
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20511900 rabheat  sum      1.0      0.0     1
```

```
20511901  0.0      1.7153    htrnr    370000101
20511902           0.94828   htrnr    370000201
20511903           0.94497   htrnr    370000301
20511904           2.6090    htrnr    370000401
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*   heat loss from intact loop hot leg
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20512000  ilclheat  sum      1.0      0.0      1
20512001  0.0      1.7193    htrnr    100100101
20512002           1.8275    htrnr    100100201
20512003           0.69677   htrnr    100100301
20512004           1.6088    htrnr    100100401
20512005           0.90304   htrnr    100200101
20512006           1.8855    htrnr    100400101
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*   heat loss from intact loop cold leg
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20512100  ilclheat  sum      1.0      0.0      1
20512101  0.0      0.77058   htrnr    100100501
20512102           0.62519   htrnr    100100601
20512103           0.84999   htrnr    100100701
20512104           0.55540   htrnr    100100801
20512105           0.62519   htrnr    100100901
20512106           0.68558   htrnr    100101001
20512107           0.78400   htrnr    100101101
20512108           1.6340    htrnr    100101201
20512109           0.69769   htrnr    100200201
20512110           0.85765   htrnr    100300101
20512111           0.39195   htrnr    100300201
20512112           0.43054   htrnr    100300301
20512113           1.2079    htrnr    100300401
20512114           0.86023   htrnr    100300501
20512115           0.39195   htrnr    100300601
20512116           0.44083   htrnr    100300701
20512117           1.8855    htrnr    100400201
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*   toal heat loss to environment
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20512200  sumhtls   sum      1.0      0.0      1
20512201  0.0      1.0       cntrlvar  116
20512202           1.0       cntrlvar  117
20512203           1.0       cntrlvar  118
20512204           1.0       cntrlvar  119
20512205           1.0       cntrlvar  120
20512206           1.0       cntrlvar  121
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*   metal heating in pzr
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20512300  pzrmtht   sum      1.0      0.0      1
20512301  0.0      0.3620    htrnr    415100100
20512302           0.59522   htrnr    415200100
20512303           1.07086   htrnr    415200200
20512304           1.07086   htrnr    415200300
20512305           0.550045  htrnr    415200400
20512306           0.550045  htrnr    415200500
20512307           0.453056  htrnr    415200600
20512308           0.453056  htrnr    415200700
20512309           0.150656  htrnr    416200100
20512310           0.13000   htrnr    420100100
20512311           0.150656  htrnr    420200100
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*   metal heating in reactor vessel (1st part)
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20525100  rv1       sum      1.0      0.0      1
20525101  0.0      1.05331   htrnr    200000100
20525102           0.79000   htrnr    200100101
20525103           1.01501   htrnr    200100201
20525104           2.29335   htrnr    200100301
20525105           2.29335   htrnr    200100401
20525106           2.29335   htrnr    200100501
20525107           2.29335   htrnr    200100601
20525108           1.33475   htrnr    205000100
20525109           1.93518   htrnr    205000101
20525110           2.82907   htrnr    210000100
20525111           2.82907   htrnr    210000200
20525112           2.82907   htrnr    210000300
20525113           2.82907   htrnr    210000400
20525114           1.06311   htrnr    210000500
20525115           1.09265   htrnr    210000600
20525116           4.37241   htrnr    210000101
20525117           4.37241   htrnr    210000201
20525118           4.37241   htrnr    210000301
20525119           4.37241   htrnr    210000401
20525120           1.64308   htrnr    210000501
*
20525200  rv2       sum      1.0      0.0      1
20525201  0.0      1.68872   htrnr    210000601
20525202           1.95223   htrnr    211000100
20525203           4.41094   htrnr    211000200
20525204           2.99281   htrnr    211000300
20525205           1.41813   htrnr    212000100
20525206           4.41094   htrnr    212000200
20525207           4.41094   htrnr    212000300
20525208           1.65755   htrnr    212000400
20525209           1.70360   htrnr    212000500
20525210           1.6800    htrnr    220000100
*
20525300  rv3       sum      1.0      0.0      1
20525301  0.0      0.695734  htrnr    225000700
20525302           0.921366  htrnr    226000100
20525303           1.98094   htrnr    240000100
20525304           1.80000   htrnr    246000100
20525305           1.80000   htrnr    246000101
20525306           2.04439   htrnr    250000100
20525307           1.00000   htrnr    251000100
20525308           1.00000   htrnr    251000200
20525309           1.70445   htrnr    250100100
20525310           0.71200   htrnr    255000100
20525311           1.68000   htrnr    220000101
20525312           0.980177  htrnr    225000100
20525313           1.05369   htrnr    225000200
20525314           1.05369   htrnr    225000300
```

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20525315          1.23842   htrnr    225000400
20525316          2.10738   htrnr    225000500
20525317          0.791681  htrnr    225000600
20525318          1.0       cntrlvar 251
20525319          1.0       cntrlvar 252
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* metal heating in broken loop   (1st part)
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20512600 bklpmht  sum     1.0     0.0     1
20512601 0.0      0.157878 htrnr   300000100
20512602          0.622764 htrnr   300000200
20512603          1.27051  htrnr   300000300
20512616          0.668713 htrnr   335000100
20512617          0.622764 htrnr   335000200
20512618          0.869015 htrnr   335000300
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* metal heating in broken loop
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20512700 bklpmt   sum     1.0     0.0     1
20512701 0.0      1.39487  htrnr   370000100
20512702          0.771131 htrnr   370000200
20512703          0.768435 htrnr   370000300
20512704          2.12160  htrnr   370000400
20512705          1.0      cntrlvar 126
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* metal heating in intact loop hot leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20512800 ilhlmht  sum     1.0     0.0     1
20512801 0.0      1.3716   htrnr   100100100
20512802          1.45787  htrnr   100100200
20512803          0.55548  htrnr   100100300
20512804          1.28345  htrnr   100100400
20512805          0.72288  htrnr   100200100
20512806          1.4772   htrnr   100400100
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* metal heating in intact loop cold leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20512900 ilclmht  sum     1.0     0.0     1
20512901 0.0      0.614734 htrnr   100100500
20512902          0.498747 htrnr   100100600
20512903          0.678081 htrnr   100100700
20512904          0.443073 htrnr   100100800
20512905          0.498747 htrnr   100100900
20512906          0.546926 htrnr   100101000
20512907          0.625441 htrnr   100101100
20512908          1.30352  htrnr   100101200
20512909          0.558497 htrnr   100200200
20512910          0.678584 htrnr   100300100
20512911          0.310113 htrnr   100300200
20512912          0.340649 htrnr   100300300
20512913          0.955718 htrnr   100300400
20512914          0.680620 htrnr   100300500
20512915          0.310113 htrnr   100300600
20512916          0.348792 htrnr   100300700
20512917          1.4772   htrnr   100400200
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* metal heating in broken loop simulators
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20513000 blhlsim  sum     1.0     0.0     1
20513001 0.0      0.1312   htrnr   315000100
20513002          0.1703   htrnr   315000200
20513003          0.0042   htrnr   315100100
20513004          0.00347  htrnr   315200100
20513005          0.12452  htrnr   315300100
20513006          0.12452  htrnr   315300200
20513007          0.12452  htrnr   315300300
20513008          0.12452  htrnr   315300400
20513009          0.12452  htrnr   315300500
20513010          0.12452  htrnr   315300600
20513011          0.04239  htrnr   315400100
20513012          0.04363  htrnr   315500100
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* metal heating in steam generator
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20555100 sgmth1   sum     1.0     0.0     1
20555101 0.0      1.47943  htrnr   500000100
20555102          1.47943  htrnr   500000200
20555103          0.291097 htrnr   500000300
20555104          1.52566  htrnr   500000101
20555105          1.52566  htrnr   500000201
20555106          0.300194 htrnr   500000301
20555107          0.615526 htrnr   515000100
20555108          2.88042  htrnr   515000200
20555109          2.88042  htrnr   515000300
20555110          2.88042  htrnr   515000400
20555111          0.627655 htrnr   515000101
20555112          2.93718  htrnr   515000201
20555113          2.93718  htrnr   515000301
20555114          2.93718  htrnr   515000401
*
20555200 sgmth2   sum     1.0     0.0     1
20555201 0.0      3.40507  htrnr   530000100
20555202          3.40507  htrnr   530000200
20555203          3.20846  htrnr   530000300
20555204          3.30846  htrnr   530000400
20555205          2.31474  htrnr   530000500
20555206          3.17360  htrnr   530000600
20555207          3.17360  htrnr   530000700
20555208          3.17360  htrnr   530000800
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pcs-tubesheet heat transfer
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20513200 pcstub   sum     1.0     0.0     1
20513201 0.0      56.4226  htrnr   115100100
20513202          56.4226  htrnr   115100200
20513203          0.157962 htrnr   115200100
20513204          0.157962 htrnr   115200200
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* tubesheet-scs heat transfer
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20513300 tushscs  sum     1.0     0.0     1
20513301 0.0      0.157962 htrnr   115200101
```

```
20513302          0.157962  htrnr     115200201
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*  metal hx in rabs
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20517000  rabs      sum       1.0       0.0       1
20517001  0.0       1.39487   htrnr     370000100
20517002            0.77113   htrnr     370000200
20517003            0.77278   htrnr     370000300
20517004            2.12160   htrnr     370000400
*****************************************************
bl total metal hx
*****************************************************
20517100  qbltotal  sum       1.0       0.0       1
20517101  0.0       1.0       cntrlvar  127
*20517102           1.0       cntrlvar  170
20517103            1.0       cntrlvar  130    * only for simula
*****************************************************
* pcs stored energy excluding pressurizer
*****************************************************
20557000  pcsqre sum      1.0       0.0       1
20557001  0.0       1.0       cntrlvar  253    * rv metal heat
20557002            1.0       cntrlvar  113    * rv ambloss
20557003            1.0       cntrlvar  171    * only for simula
20557004            1.0       cntrlvar  117    * blhl ambloss
20557005            1.0       cntrlvar  118    * blcl ambloss
20557006            1.0       cntrlvar  119    * rabv ambloss
20557007            1.0       cntrlvar  128    * ilhl heat
20557008            1.0       cntrlvar  120    * ilhl ambloss
20557009            1.0       cntrlvar  129    * ilcl heat
20557010            1.0       cntrlvar  121    * ilcl ambloss
20557011            1.0       cntrlvar  132    * pcs-tubesheet
20557012            1.0       cntrlvar  133    * tubesheet-scs
*****************************************************
scs stored energy
*****************************************************
20557300  scsqse sum      1.0       0.0       1
20557301  0.0       1.0       cntrlvar  552    * sg heat
20557302            1.0       cntrlvar  115    * sg ambloss
*****************************************************
* heat flow calculations
*****************************************************
ecc energy flow
*****************************************************
20515300  pvecc     div       1.0       0.0       1
20515301            rhofj     630000000 p         600010000
20515400  hecc      sum       1.0       0.0       1
20515401  0.0       1.0       ufj       630000000
20515402            1.0       cntrlvar  153
20515500  mdothecc  mult      1.0       0.0       1
20515501                      mflowj    630000000
20515502                      cntrlvar  154
20515600  qecc/v    mult      0.126646  0.0       1
20515601                      cntrlvar  155
20515700  mdotev mult      0.126646  0.0       1
20515701                      mflowj    630000000
*****************************************************
sg hx per unit pcs volume
*****************************************************
20516000  qsg/v     mult      0.126646  0.0       1
20516001            cntrlvar  112
*****************************************************
* core hx per unit pcs volume
*****************************************************
20516100  qcore/v   mult      0.126646  0.0       1
20516101            cntrlvar  111
*****************************************************
pump power
*****************************************************
20516200  p1edotv   mult      0.04136   0.0       1
20516201            voidgj    135020000
20516202            velgj     135020000
20516203            pmphead   135
20516300  p1edotl   mult      0.04136   0.0       1
20516301            voidfj    135020000
20516302            velfj     135020000
20516303            pmphead   135
20516400  p2edotv   mult      0.04136   0.0       1
20516401            voidgj    165020000
20516402            velgj     165020000
20516403            pmphead   165
20516500  p2edotl   mult      0.04136   0.0       1
20516501            voidfj    165020000
20516502            velfj     165020000
20516503            pmphead   165
20516600  qpmp      sum       1.0       0.0       1
20516601  0.0       1.0       cntrlvar  162
20516602            1.0       cntrlvar  163
20516603            1.0       cntrlvar  164
20516604            1.0       cntrlvar  165
20516700  qpmp/v    mult      0.126646  0.0       1
20516701            cntrlvar  166
*****************************************************
energy to fluid in vessel from structures
*****************************************************
20562000  rvhx      sum       6.2832    0.0       1
20562001  0.0       0.3080    htrnr     205000101
20562002            0.6959    htrnr     210000101
20562003            0.6959    htrnr     210000201
20562004            0.6959    htrnr     210000301
20562005            0.6959    htrnr     210000401
20562006            0.2615    htrnr     210000501
20562007            0.2688    htrnr     210000601
20562008            0.3107    htrnr     211000100
20562009            0.7020    htrnr     211000200
20562010            0.7020    htrnr     212000100
20562011            0.7020    htrnr     212000200
20562012            0.7030    htrnr     212000300
20562013            0.6       htrnr     212000400
20562014            0.2       htrnr     212000500
20562015            1.0       cntrlvar  253
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
*  total vessel hx/v
```

```
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
20562100  rvhx/v    mult      1.0      0.0      1
20562101            cntrlvar  620
**************************************************
* total massless energy flows from pcs excluding qcore and qsg
**************************************************
20562200  qstruc    sum       1.0      0.0      1
20562201  0.0       1.0       cntrlvar  123   * przr
20562202            1.0       cntrlvar  620   * rv
20562203            1.0       cntrlvar  171   * bl
20562204            1.0       cntrlvar  128   * ilhl
20562205            1.0       cntrlvar  129   * ilcl
20562300  qstruc/v  mult      0.126646  0.0     1
20562301            cntrlvar  622
**************************************************
* sum of all massless energy flows from pcs
**************************************************
20562400  de/dt     sum       1.0      0.0      1
20562401  0.0       1.0       cntrlvar  111   * core
20562402            1.0       cntrlvar  112   * sg
20562403            1.0       cntrlvar  622   * structure
20562404            1.0       cntrlvar  166   * pumps
20562500  de/dt/vv  mult      0.126646  0.0     1
20562501            cntrlvar  624
**************************************************
* sum of mass flow energy flows and massless energy flows
**************************************************
20562600  dtqflo sum      1.0      0.0      1
20562601  0.0       1.0       cntrlvar  624   * de/dt
20562602            -1.0      cntrlvar  433   * porv
20562700  dtqf/v mult     0.126646  0.0     1
20562701            cntrlvar  626
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* primary coolant pump speed controllers
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* calculate mass flow error
*---- ----|---- ----|---- ----|----
20590100  msserr    sum       1.0      0.0      1
20590101  479.30    -1.0      mflowj    100010000
*---- ----|---- ----|---- ----|----
* pump 1 speed
*---- ----|---- ----|---- ----|----
20590200  pcp1spd   integral  0.34482   333.7236  1
20590201  cntrlvar  901
*---- ----|---- ----|---- ----|----
* pcp1 pump velocity table
*---- ----|---- ----|---- ----|----
1356100   508       cntrlvar  902
1356101   0.0       0.0
1356102   369.0     369.0
*---- ----|---- ----|---- ----|----
* modify pcp1 pump data
*---- ----|---- ----|---- ----|----
1350301   0   0   0      -1      0      504      0
*---- ----|---- ----|---- ----|----
* pump 2 speed
*---- ----|---- ----|---- ----|----
20590300  pcp2spd   integral  0.34482   331.9524  1
20590301  cntrlvar  901
*---- ----|---- ----|---- ----|----
* pcp2 pump velocity table
*---- ----|---- ----|---- ----|----
1656100   508       cntrlvar  903
1656101   0.0       0.0
1656102   369.0     369.0
*---- ----|---- ----|---- ----|----
* modify pcp2 pump data
*---- ----|---- ----|---- ----|----
1650301   135   135   135      -1      0      504      0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* pressurizer spray valve controller
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* spray valve
*---- ----|---- ----|---- ----|----
4070000   sprvlv        valve
4070101        406010000  420010000  3.3451e-4  1.5432e01
1.5432e01 000100
4070201   0         .00000000 .00000000 0.0
4070300   srvvlv
4070301   904       999
*---- ----|---- ----|---- ----|----
* spray valve position calculator
*---- ----|---- ----|---- ----|----
20590400  sprav     sum       -1.0      0.0      1      * contin
+         3         0.0       1.0
20590401  14.93+6   -1.0      p         420010000
*---- ----|---- ----|---- ----|----
* position vs area table
*---- ----|---- ----|---- ----|----
20299900  normarea
20299901  0.0       0.0
20299902  0.0001    0.0
20299903  1.0       1.0
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* pressurizer level control using charging and letdown
components
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* charging reservior
*---- ----|---- ----|---- ----|----
*9800000  chrg      tmdpvol
*9800101  1.0       1.0       0.0       0.0       0.0       0.0
*9800102  4.0-5     0.0       00000
*9800200  3
*9800201  0.0       2.07+07   558.9
*---- ----|---- ----|---- ----|----
* charging valve
*---- ----|---- ----|---- ----|----
*9850000  chrg      valve
*9850101    980000000 185000000 3.8e-05   0.0       0.0
000100
```

```
*9850201   0          .00000000 .00000000 0.0
*9850300   srvvlv
*9850301   905        999
*---- ----1---- ----1---- ----1----
* charging valve position calculator
*---- ----1---- ----1---- ----1----
*20590500  charge    sum       7.7      0.0      1      *contin
*+          3         0.0       1.0
*20590501  0.92      -1.0      cntrlvar  2
*---- ----1---- ----1---- ----1----
* letdown sink
*---- ----1---- ----1---- ----1----
*9900000   ltdwn       tmdpvol
*9900101   1.0       1.0       0.0      0.0      0.0      0.0
*9900102   4 0-5     0.0       00000
*9900200   3
*9900201   0.0       1.4+7     558.9
*---- ----1---- ----1---- ----1----
* letdown valve
*---- ----1---- ----1---- ----1----
*9950000   ltdwn       valve
*9950101   185000000 990000000  2.5-5    0.0      0.0
000100
*9950201   0          .00000000 .00000000 0.0
*9950300   srvvlv
*9950301   906        999
*---- ----1---- ----1---- ----1----
* letdown valve position calculator
*---- ----1---- ----1---- ----1----
*20590600  letdown   sum       -7.7     0.0      1      *contin
*+          3         0.0       1.0
*20590601  1.10      -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----
*5500201   0         19.758    22.082   0.0
*5500300   srvvlv
*5500301   910       540
*20254000  normarea
*20254001  0.0       0.0
*20254002  0.0001    0.0
*20254003  1.0       1.0
*---- ----1---- ----1---- ----1----
* compute delta t error
*---- ----1---- ----1---- ----1----
*20590700  delta sum      1.0      0.0      1
*20590701  559.0   -1.      tempf     185010000
*---- ----1---- ----1---- ----1----
* filter delta t thru deadband
*---- ----1---- ----1---- ----1----
*20590800  deadband  function  1.0      0.0      1
*20590801  cntrlvar  907       908
*20290800  reac-t
*20290801  -100.     -100.
*20290802  -0.25     -0.25
*20290803  -0.25     0.0
*20290804  0.25      0.0
*20290805  0.25      0.25
*20290806  100.      100.
*---- ----1---- ----1---- ----1----
* integrate delta t error
*---- ----1---- ----1---- ----1----
*20590900  int integral  1.0     0.0      1
*20590901  cntrlvar  908
*---- ----1---- ----1---- ----1----
* steam valve position calculator
*---- ----1---- ----1---- ----1----
*20591000  tcontrol  sum      1.0      0.645229  0     *conti
*+          3         0.6      0.90
*20591001  0.645229  -0.07126  cntrlvar  908
*20591002            -0.01492  cntrlvar  909
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* simplified feed system controller
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20591100  sglvlerr  sum      1.0      0.0      1
20591101  3.09      -1.0     cntrlvar  001
20591200  feedflow  sum      1.0      0.0      1
20591201  0.0       1.0      mflowj   550000000
20591202            48.4     cntrlvar  911
*---- ----1---- ----1---- ----1----
* replace feed junction table
*---- ----1---- ----1---- ----1----
5600200   1         0        cntrlvar  912
5600201   -100.0    25.553   0.0      0.0
5600202   -1.0      0.0      0.0      0.0
5600203   0.0       0.0      0.0      0.0
5600204   50.0      50.0     0.0      0.0
```

Appendix B Input Deck for Transient Calculation

```
=loft l9-1 post test analysis deck
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*              initial conditions
*              pcp pressure = 14.901 mpa
*              core power = 50. mw
*              pcs flow = 479.3 kg/s
*              thot = 578. k
*              tcold = 559.0 k
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
0000100   restart   transnt
0000101   run
0000102   si
*0000103   16006
0000103   6934
0000105   5.     10.
* time step control cards
*         end time   min dt    max dt   optn  mnr   mjr   rst
0000201   200.00     1.e-6     1.0      2     1     30    100
0000202   1000.0     1.e-6     1.0      2     5     300   500
0000203   2000.0     1.e-6     0.1      2     50    3000  5000
0000204   4000.0     1.e-6     0.5      2     10    1000  2000
0000205   8000.0     1.e-6     0.1      2     50    4000  5000
0000206   10000.     1.e-6     0.5      2     10    2000  2000
*****************************************************
*
*              minor edit variables
*
*****************************************************
* pressure
*****************************************************
*0000301   p      345010000    * pe-bl-1
0000301   p      310010000    * pe-bl-2
*0000303   p      315110000    * pe-bl-3
*0000304   p      350010000    * pe-bl-4
*0000305   p      315090000    * pe-bl-6
*0000306   p      350020000    * pe-bl-8
0000302   p      185010000    * pe-pc-1
0000303   p      100010000    * pe-pc-2
0000304   p      420010000    * porv inlet
*0000310   p      110010000    * pt-139-2,3,4
0000305   p      245010000    * pe-1up-1a,1b
0000306   p      215010000    * pe-1st-1a,b/pe-2st-1a,b
*0000313   p      200010000    * pe-1st-3a,3b
0000307   p      530010000    * pe-sgs-01
0000308   p      535010000    * pt-p4-85
*****************************************************
* temperatures
*****************************************************
0000309   tempf   406010000    * spray tempf
0000310   tempf   310010000    * te-bl-2a,2b,2c
0000311   tempf   100010000    * te-pc-2a,2b,2c
0000312   tempf   185010000    * te-pc-1
0000313   tempf   115030000    * te-sg-1
0000314   tempf   115100000    * te-sg-2
0000315   tempf   515070000    * te-sg-4
*0000328   tempf   415050000    * pzr volume 5
0000316   tempf   415040000    * te-139-19
*0000330   tempf   415030000    * te-139-20
*0000331   tempf   315120000    * te-p138-171
*0000332   tempf   350020000    * te-p138-170
*0000333   tempf   205010000    * te-1st-1/te-2st-1
0000317   tempf   210010000    * te-1st-2/te-2st-2
*0000335   tempf   345010000    * te-bl-1
*0000336   tempf   210030000    * te-1st-14/te-2st-14
*0000337   tempf   210040000    * te-3up-2
*0000338   tempf   245010000    * te-1up-6
*0000339   tempf   246010000    * te-2up-4
*0000340   tempf   250010000    * te-1up-3
*****************************************************
* densities
*****************************************************
**********
*0000341   rho     345010000    * de-bl-1
0000318   rho     310010000    * de-bl-2
0000319   rho     185010000    * de-pc-1
0000320   rho     100010000    * de-pc-2
*0000345   rho     115120000    * de-pc-3
0000321   voidgj  400010000    * surge line density
*0000347   rho     115040000    * s/g tubes
*0000348   rho     115050000    * s/g tubes
*0000349   rho     115060000    * s/g tubes
*0000350   rho     115070000    * s/g tubes
*****************************************************
* velocities
*****************************************************
*0000351   voidf   100010000    * ilhl nozzle
*0000352   velf    100010000    * ilhl nozzle
*0000353   velf    115030000    * s/g inlet
*0000354   velf    400010000    * surge line
*0000355   velfj   425000000    * porv liq vel
*0000356   velg    100010000    * ilhl nozzle
*0000357   velg    115030000    * s/g inlet
*0000358   velg    400010000    * surge line
*0000359   velgj   425000000    * porv vap vel
*****************************************************
* mass flow rates
*****************************************************
0000322   mflowj  100010000    * ilhl nozzle
*0000361   mflowj  150010000    * pump outlet
*0000362   mflowj  185020000    * dtt-rake ilcl
0000323   mflowj  400010000    * pres. surge line flow
0000324   mflowj  407000000    * pzr spray flow
0000325   mflowj  425000000    * pres. relief valve flow
0000326   mflowj  550000000    * steam flow control valve
0000327   mflowj  548000000    * aux feed
*0000369   mflowj  560000000    * main feed
*****************************************************
* cladding temperatures center module
*****************************************************
*0000371   httemp  230000110    * te-5h5-015
*0000372   httemp  230000210    * te-5h5-034
```

```
*0000373   httemp    230000310      * te-5h5-049
****************************************************
* peak centerline temperatures
****************************************************
*0000374   httemp    230000101      * core lower region
*0000375   httemp    230000201      * core middle region
*0000376   httemp    230000301      * core upper region
*******************************************
* reactor kinetic parameters
****************************************************
0000328   rktpow   0              * total reactor power
*0000378   rkfipow   0             * fission decay power
*0000379   rkgapow   0              * gamma decay power
*0000380   rkreac   0             * reactivity
*0000381   pmphead   135             * pcp1 head
*0000382   pmphead   165             * pcp2 head
0000329   mflowj   185010000
0000330   mflowj   185030000
*0000388   mflowj   200020000
0000331   pmpvel   135
****************************************************
*      control variable requests
****************************************************
0000332      cntrlvar      001
0000333      cntrlvar      002
0000334      cntrlvar      003
0000335      cntrlvar      041
0000336      cntrlvar      042
0000337      cntrlvar      043
0000338      cntrlvar      004
0000339      cntrlvar      005
0000340      cntrlvar      006
0000341      cntrlvar      007
0000342      cntrlvar      008
0000343      cntrlvar      009
0000344      cntrlvar      010
0000345      cntrlvar      433
0000346      cntrlvar      434
0000347      cntrlvar      111
0000348      cntrlvar      112
0000349      cntrlvar      113
0000350      cntrlvar      114
0000351      cntrlvar      115
0000352      cntrlvar      116
0000353      cntrlvar      117
0000354      cntrlvar      118
0000355      cntrlvar      119
0000356      cntrlvar      120
0000357      cntrlvar      121
0000358      cntrlvar      122
0000359      cntrlvar      123
0000360      cntrlvar      251
0000361      cntrlvar      252
0000362      cntrlvar      253
0000363      cntrlvar      126
0000364      cntrlvar      127
0000365      cntrlvar      128
0000366      cntrlvar      129
0000367      cntrlvar      130
0000368      cntrlvar     551
0000369      cntrlvar     552
0000370      cntrlvar     132
0000371      cntrlvar     133
0000372      cntrlvar     170
0000373      cntrlvar     171
0000374      cntrlvar     570
0000375      cntrlvar     573
0000376      cntrlvar     153
0000377      cntrlvar     154
0000378      cntrlvar     155
0000379      cntrlvar     156
0000380      cntrlvar     157
0000381      cntrlvar     160
0000382      cntrlvar     161
0000383      cntrlvar     166
0000384      cntrlvar     167
0000385      cntrlvar     620
0000386      cntrlvar     621
0000387      cntrlvar     622
0000388      cntrlvar     623
0000389      cntrlvar     624
0000390      cntrlvar     625
0000391      cntrlvar     626
0000392      cntrlvar     627
0000393      tempg       515070000
0000394      rho        420010000
0000395      cputime      0
20800095     dt          0
20800096     dtcrnt      0
****************************************************
*
*
*      trips
*
****************************************************
*      variable trips
*********************************************
0000501   p    100010000  le  null   0        14.193103e6  l
*         ecc check valve
0000502   p    600010000  ge  p      185010000 20.e6       n
*         accumulator check valve
0000503   p    615010000  ge  p      185010000 20.e6       n
*         isolation valve hot leg
0000504   time    0       lt  null   0        0.0          l
*         isolation valve cold leg
0000505   time    0       lt  null   0        0.0          l
*         qobv hot leg
0000506   time    0       lt  null   0        0.0          l
*         qobv cold leg
0000507   time    0       lt  null   0        0.0          l
*         check valve surge line pressurizer
0000508   time    0       ge  null   0        0.0          l
```

```
*         pressurizer relief valve
0000509   tempf 100010000  ge  null   0        597.0       1
*         steam control valve
0000510   time    0        lt  null   0        0.0         1
*         boundary system valve
0000511   time    0        lt  null   0        0.0         1
*         lpis trip
0000512   time    0        ge  null   0        10000.0     1
*         hpis trip
0000513   time    0        ge  null   0        10000.0     1
*
0000520   p     530020000  gt  null   0        7.103448e6   n
0000521   p     530020000  lt  null   0        7.0344827e6  n
0000522   p     530020000  gt  null   0        6.3448275e6  n
0000523   p     530020000  lt  null   0        6.4137931e6  n
0000530   time    0        ge  null   0        3600.0       n
0000531   p     530020000  gt  p      547010000 0.0         n
0000536   time    0        ge  null   0        10000.0      n
0000540   tempf 100010000  gt  null   0        583.16       l
0000541   p     100010000  gt  null   0        1.574553e7   l
0000550   time    0        ge  null   0        10000.0      l
0000551   time    0        ge  timeof 625      0.0          l
0000552   time    0        ge  timeof 509      1580.        l
0000560   p     100010000  le  null   0        13.15862e6   n
0000561   time    0        ge  timeof 552      265.0        l
0000562   time    0        gt  null   0        5400.0       n
0000563   cntrlvar 1       lt  null   0        2.1844       n
0000564   cntrlvar 1       gt  null   0        2.9464       n
0000565   time    0        ge  timeof 669      966.         l
0000570   p     420010000  gt  null   0        1.620058e7   n
0000571   p     420010000  lt  null   0        1.606269e7   n
0000572   p     420010000  lt  null   0        1.486300e7   n
0000573   p     420010000  gt  null   0        1.506980e7   n
0000574   p     420010000  gt  null   0        1.533874e7   n
0000575   p     420010000  lt  null   0        1.505000e7   n
0000576   p     420010000  lt  null   0        1.482853e7   n
0000577   p     420010000  gt  null   0        1.495950e7   n
*****************************************************
* logical trips
*****************************************************
0000600   536
*         modify from 670 in original input
0000601   563     and    561     n
0000602   -563    and    -564    n
0000603   655     and    602     n
0000604   609     or     609     l
0000605   572     and    -509    n
0000606   -572    and    -573    n
0000607   608     and    606     n
0000608   605     or     607     n
0000609   540     or     541     l
0000610   612     or     520     n
0000611   -521    and    -616    n
0000612   611     and    610     n
0000613   616     or     523     n
0000614   -522    and    613     n
```

```
0000615   -612    and    609     n
0000616   615     and    614     n
0000617   612     or     616     n
0000618   605     or     607     n
0000621   623     or     570     n
0000622   -571    and    -571    n
0000623   621     and    622     n
0000624   509     and    -552    n
0000625   623     or     624     n
0000626   576     and    -509    n
0000627   -576    and    -577    n
0000628   629     and    627     n
0000629   626     or     628     n
0000635   504     and    504     n
0000636   509     and    -536    n
0000650   -652    and    550     n
0000651   650     or     652     n
0000652   -509    and    651     n
0000655   601     or     603     n
0000656   508     or     609     n
0000659   561     or     562     n
0000660   504     or     504     n
0000669   561     and    564     l
0000670   565     and    -655    n
0000680   530     or     530     n
0000688   690     or     574     n
0000689   -575    and    -551    n
0000690   688     and    689     n
**** pzr heater delete
14201000  delete
14202000  delete
*---- ----1---- ----1---- ----1
*  control variable 114 re-define
*---- ----1---- ----1---- ----1
20511400  pzrheat  sum   1.0  0.0  1
20511401   0.0   0.362     htrnr  415100101
20511402         0.702464  htrnr  415200101
20511403         1.26381   htrnr  415200201
20511404         1.26381   htrnr  415200301
20511405         0.649152  htrnr  415200401
20511406         0.649152  htrnr  415200501
20511407         0.534688  htrnr  415200601
20511408         0.534688  htrnr  415200701
20511409         0.273063  htrnr  416200101
*---- ----1---- ----1---- ----1
*  control variable 123 redefine
*---- ----1---- ----1---- ----1
20512300   pzr   sum   1.0   0.   1
20512301   0.0   0.362     htrnr  415100100
20512302         0.59522   htrnr  415200100
20512303         1.07086   htrnr  415200200
20512304         1.07086   htrnr  415200300
20512305         0.550045  htrnr  415200400
20512306         0.550045  htrnr  415200500
20512307         0.453056  htrnr  415200600
20512308         0.453056  htrnr  415200700
```

```
20512309         0.150656  htrnr     416200100
****************************************************
* primary coolant pump 1
****************************************************
1350000    pcpump1          pump
1350101   0.0366    0.0         0.099      0.0        90.0       0.319
1350102   00000
1350108   130010000 0.0         0.0        0.0       000100
1350109   140000000 0.0         0.05       0.05      000100
1350200   0          14818100. 1242890.  2463900.0  0.0
1350201   0          8.8943000 9.2942000 0.0
1350202   0          8.8928000 8.1177000 0.0
1350301   0    0     0          -1         0          509        0
1350302   369.00 .90178860 .31550 96.00 500.60  1.4310
1350303   613.6     0.0      207.0000  0.0040000 19.598000 0.0
1350310   0.0       0.0       0.0
*
****************************************************
* single phase head curves
****************************************************
* head curve no. 1
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
1351100    1                  1
1351101   0.000000e+00        1.403600e+00
1351102   1.906100e-01        1.363600e+00
1351103   3.896300e-01        1.318600e+00
1351104   5.939600e-01        1.232800e+00
1351105   7.902000e-01        1.133600e+00
1351106   1.000000e+00        1.000000e+00
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* head curve no. 2
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
1351200    1                  2
1351201   0.000000e+00        -6.700000e-01
1351202   2.000000e-01        -5.000000e-01
1351203   4.000000e-01        -2.500000e-01
1351204   5.755400e-01        0.000000e+00
1351205   7.443200e-01        2.583000e-01
1351206   7.734800e-01        3.778000e-01
1351207   8.631300e-01        6.326000e-01
1351208   1.000000e+00        1.000000e+00
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* head curve no. 3
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
1351300    1                  3
1351301   -1.000000e+00       2.472200e+00
1351302   -8.057400e-01       2.047400e+00
1351303   -6.069000e-01       1.831000e+00
1351304   -4.068300e-01       1.624000e+00
1351305   -2.001710e-01       1.470500e+00
1351306   0.000000e+00        1.403600e+00
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* head curve no. 4
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
1351400    1                  4
1351401   -1.000000e+00       2.472200e+00
1351402   -8.229700e-01       1.996800e+00
1351403   -6.333200e-01       1.589700e+00
1351404   -4.553400e-01       1.327900e+00
1351405   -2.710900e-01       1.194900e+00
1351406   -1.771600e-01       1.060500e+00
1351407   -9.073000e-02       1.015600e+00
1351408   0.000000e+00        9.342790e-01
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* head curve no. 5
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
1351500    1                  5
1351501   0.000000e+00        2.500000e-01
1351502   2.000000e-01        2.800000e-01
1351503   4.000000e-01        3.400000e-01
1351504   4.118000e-01        2.768000e-01
1351505   5.976300e-01        4.584000e-01
1351506   7.934670e-01        6.992000e-01
1351507   1.000000e+00        1.000000e+00
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* head curve no. 6
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
1351600    1                  6
1351601   0.000000e+00        9.342790e-01
1351602   9.109900e-02        9.229000e-01
1351603   1.865090e-01        8.963000e-01
1351604   2.717620e-01        8.750000e-01
1351605   4.558720e-01        8.433000e-01
1351606   5.744060e-01        8.355000e-01
1351607   7.405760e-01        8.466000e-01
1351608   7.666190e-01        8.469000e-01
1351609   8.714710e-01        8.838000e-01
1351610   1.000000e+00        1.000000e+00
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* head curve no. 7
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
1351700    1                  7
1351701   -1.000000e+00       -1.000000e+00
1351702   -8.000000e-01       -6.300000e-01
1351703   -6.000000e-01       -3.000000e-01
1351704   -4.000000e-01       -5.000000e-02
1351705   -2.000000e-01       1.500000e-01
1351706   0.000000e+00        2.500000e-01
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* head curve no. 8
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
1351800    1                  8
1351801   -1.000000e+00       -1.000000e+00
1351802   -8.000000e-01       -9.700000e-01
1351803   -6.000000e-01       -9.500000e-01
1351804   -4.000000e-01       -8.800000e-01
1351805   -2.000000e-01       -8.000000e-01
1351806   0.000000e+00        -6.700000e-01
****************************************************
* single phase torque data
****************************************************
* torque curve no. 1
```

```
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1351900   2                   1
1351901   0.000000e+00        6.032000e-01
1351902   1.930000e-01        6.325000e-01
1351903   3.930000e-01        7.369000e-01
1351904   5.955200e-01        8.331000e-01
1351905   7.978200e-01        9.229000e-01
1351906   1.000000e+00        1.000000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* torque curve no. 2
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1352000   2                   2
1352001   0.000000e+00       -6.700000e-01
1352002   4.000000e-01       -2.500000e-01
1352003   5.000000e-01        1.500000e-01
1352004   7.372550e-01        5.265860e-01
1352005   7.680490e-01        6.065940e-01
1352006   8.672300e-01        7.436600e-01
1352007   1.000000e+00        1.000000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* torque curve no. 3
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1352100   2                   3
1352101   -1.000000e+00       1.984300e+00
1352102   -8.009600e-01       1.394000e+00
1352103   -6.063800e-01       1.097500e+00
1352104   -4.068600e-01       8.220000e-01
1352105   -1.992800e-01       6.648000e-01
1352106   0.000000e+00        6.032000e-01
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* torque curve no. 4
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1352200   2                   4
1352201   -1.000000e+00       1.984300e+00
1352202   -8.223400e-01       1.830800e+00
1352203   -6.337100e-01       1.682400e+00
1352204   -4.585300e-01       1.557000e+00
1352205   -2.670230e-01       1.436200e+00
1352206   -1.761070e-01       1.387900e+00
1352207   -8.931000e-02       1.348100e+00
1352208   0.000000e+00        1.233610e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* torque curve no. 5
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1352300   2                   5
1352301   0.000000e+00       -4.500000e-01
1352302   4.000000e-01       -2.500000e-01
1352303   5.000000e-01        0.000000e+00
1352304   1.000000e+00        3.569000e-01
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* torque curve no. 6
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1352400   2                   6
1352401   0.000000e+00        1.233610e+00
1352402   9.064300e-02        1.196500e+00
1352403   1.885690e-01        1.109600e+00
1352404   2.734700e-01        1.041600e+00
1352405   4.586690e-01        8.958000e-01
1352406   5.744800e-01        7.807000e-01
1352407   7.381600e-01        6.134000e-01
1352408   7.685200e-01        5.849000e-01
1352409   8.700570e-01        4.877000e-01
1352410   1.000000e+00        3.569000e-01
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* torque curve no. 7
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1352500   2                   7
1352501   -1.000000e+00      -1.000000e+00
1352502   -3.000000e-01      -9.000000e-01
1352503   -1.000000e-01      -5.000000e-01
1352504   0.000000e+00       -4.500000e-01
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* torque curve no. 8
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1352600   2                   8
1352601   -1.000000e+00      -1.000000e+00
1352602   -2.500000e-01      -9.000000e-01
1352603   -8.000000e-02      -8.000000e-01
1352604   0.000000e+00       -6.700000e-01
*****************************************************
* two - phase multiplier data from I9-1 test data
*****************************************************
* head curve
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1353000   0
1353001   0.000000e+00        0.000000e+00
1353002   2.000000e-02        2.000000e-02
1353003   6.000000e-02        5.000000e-02
1353004   1.000000e-01        1.000000e-01
1353005   2.000000e-01        4.600000e-01
1353006   2.400000e-01        8.000000e-01
1353007   3.000000e-01        9.600000e-01
1353008   4.000000e-01        9.800000e-01
1353009   6.000000e-01        9.700000e-01
1353010   8.000000e-01        9.000000e-01
1353011   9.000000e-01        8.000000e-01
1353012   9.600000e-01        5.000000e-01
1353013   1.000000e+00        0.000000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* torque curve
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1353100   0
1353101   0.000000e+00        0.000000e+00
1353102   1.250000e-01        7.000000e-02
1353103   1.650000e-01        1.250000e-01
1353104   2.400000e-01        5.600000e-01
1353105   8.000000e-01        5.600000e-01
1353106   9.600000e-01        4.500000e-01
1353107   1.000000e+00        0.000000e+00
******************************************
* pump 2-phase difference data
*****************************************************
```

```
* head curve no. 1
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1354100   1              1
1354101   0.000000e+00      0.000000e+00
1354102   1.000000e-01      8.300000e-01
1354103   2.000000e-01      1.090000e+00
1354104   5.000000e-01      1.020000e+00
1354105   7.000000e-01      1.010000e+00
1354106   9.000000e-01      9.400000e-01
1354107   1.000000e+00      1.000000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* head curve no. 2
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1354200   1              2
1354201   0.000000e+00      0.000000e+00
1354202   1.000000e-01     -4.000000e-02
1354203   2.000000e-01      0.000000e+00
1354204   3.000000e-01      1.000000e-01
1354205   4.000000e-01      2.100000e-01
1354206   8.000000e-01      6.700000e-01
1354207   9.000000e-01      8.000000e-01
1354208   1.000000e+00      1.000000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* head curve no. 3
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1354300   1              3
1354301  -1.000000e+00     -1.160000e+00
1354302  -9.000000e-01     -1.240000e+00
1354303  -8.000000e-01     -1.770000e+00
1354304  -7.000000e-01     -2.360000e+00
1354305  -6.000000e-01     -2.790000e+00
1354306  -5.000000e-01     -2.910000e+00
1354307  -4.000000e-01     -2.670000e+00
1354308  -2.500000e-01     -1.690000e+00
1354309  -1.000000e-01     -5.000000e-01
1354310   0.000000e+00      0.000000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* head curve no. 4
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1354400   1              4
1354401  -1.000000e+00     -1.160000e+00
1354402  -9.000000e-01     -7.800000e-01
1354403  -8.000000e-01     -5.000000e-01
1354404  -7.000000e-01     -3.100000e-01
1354405  -6.000000e-01     -1.700000e-01
1354406  -5.000000e-01     -8.000000e-02
1354407  -3.500000e-01      0.000000e+00
1354408  -2.000000e-01      5.000000e-02
1354409  -1.000000e-01      8.000000e-02
1354410   0.000000e+00      1.100000e-01
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* head curve no. 5
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1354500   1              5
1354501   0.000000e+00      0.000000e+00
1354502   2.000000e-01     -3.400000e-01
1354503   4.000000e-01     -6.500000e-01
1354504   6.000000e-01     -9.300000e-01
1354505   8.000000e-01     -1.190000e+00
1354506   1.000000e+00     -1.470000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* head curve no. 6
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1354600   1              6
1354601   0.000000e+00      1.100000e-01
1354602   1.000000e-01      1.300000e-01
1354603   2.500000e-01      1.500000e-01
1354604   4.000000e-01      1.300000e-01
1354605   5.000000e-01      7.000000e-02
1354606   6.000000e-01     -4.000000e-02
1354607   7.000000e-01     -2.300000e-01
1354608   8.000000e-01     -5.100000e-01
1354609   9.000000e-01     -9.100000e-01
1354610   1.000000e+00     -1.470000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* head curve no. 7
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1354700   1              7
1354701  -1.000000e+00      0.000000e+00
1354702   0.000000e+00      0.000000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* head curve no. 8
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1354800   1              8
1354801  -1.000000e+00      0.000000e+00
1354802   0.000000e+00      0.000000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* torque curve no. 1
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1354900   2              1
1354901   0.000000e+00      6.032000e-01
1354902   1.930000e-01      6.325000e-01
1354903   3.930000e-01      7.369000e-01
1354904   5.955200e-01      8.331000e-01
1354905   7.978200e-01      9.229000e-01
1354906   1.000000e+00      1.000000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* torque curve no. 2
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1355000   2              2
1355001   0.000000e+00     -6.700000e-01
1355002   4.000000e-01     -2.500000e-01
1355003   5.000000e-01      1.500000e-01
1355004   7.372550e-01      5.265860e-01
1355005   7.680490e-01      6.065940e-01
1355006   8.672300e-01      7.436600e-01
1355007   1.000000e+00      1.000000e+00
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
* torque curve no. 3
*---- ----|---- ----|---- ----|---- ----|---- ----|---- ----|----
1355100   2              3
1355101  -1.000000e+00      1.984300e+00
```

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1355102   -8.009600e-01      1.394000e+00
1355103   -6.063800e-01      1.097500e+00
1355104   -4.068600e-01      8.220000e-01
1355105   -1.992800e-01      6.648000e-01
1355106   0.000000e+00       6.032000e-01
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* torque curve no. 4
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
1355200   2                  4
1355201   -1.000000e+00      1.984300e+00
1355202   -8.223400e-01      1.830800e+00
1355203   -6.337100e-01      1.682400e+00
1355204   -4.585300e-01      1.557000e+00
1355205   -2.670230e-01      1.436200e+00
1355206   -1.761070e-01      1.387900e+00
1355207   -8.931000e-02      1.348100e+00
1355208   0.000000e+00       1.233610e+00
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* torque curve no. 5
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
1355300   2                  5
1355301   0.000000e+00       -4.500000e-01
1355302   4.000000e-01       -2.500000e-01
1355303   5.000000e-01       0.000000e+00
1355304   1.000000e+00       3.569000e-01
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* torque curve no. 6
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
1355400   2                  6
1355401   0.000000e+00       1.233610e+00
1355402   9.064300e-02       1.196500e+00
1355403   1.885690e-01       1.109600e+00
1355404   2.734700e-01       1.041600e+00
1355405   4.586690e-01       8.958000e-01
1355406   5.744800e-01       7.807000e-01
1355407   7.381600e-01       6.134000e-01
1355408   7.685200e-01       5.849000e-01
1355409   8.700570e-01       4.877000e-01
1355410   1.000000e+00       3.569000e-01
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* torque curve no. 7
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
1355500   2                  7
1355501   -1.000000e+00      -1.000000e+00
1355502   -3.000000e-01      -9.000000e-01
1355503   -1.000000e-01      -5.000000e-01
1355504   0.000000e+00       -4.500000e-01
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* torque curve no. 8
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
1355600   2                  8
1355601   -1.000000e+00      -1.000000e+00
1355602   -2.500000e-01      -9.000000e-01
1355603   -8.000000e-02      -8.000000e-01
1355604   0.000000e+00       -6.700000e-01
**************************************************
* pcp1 pump velocity table
**************************************************
1356100   536
1356101   0.0        0.0
1356102   1.0        220.
**************************************************
* primary coolant pump 2
**************************************************
1650000   pcpump2          pump
1650101   0.0366   0.0     0.099    0.0     90.0    0.319
1650102   00000
1650108   160010000 0.0     0.0     0.0     000100
1650109   170000000 0.0     0.1     0.1     000100
1650200   0        14832700. 1242890.  2463590.0  0.0
1650201   0        8.4974000 8.8872000 0.0
1650202   0        8.4959000 6.6507000 0.0
1650301   135  135  135     -1      135     509     0
1650302   369.0 .89699187 .31550 96.000 500.60000 1.431
1650303   613.6    0.0     207.433  0.004    19.5980  0.0
1650310   0.0      0.0     0.0
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
*  spray valve
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
4070000   sprvlv   valve
4070101   406010000 420010000 3.3451e-4  15.432  15.432
000100
4070201   0        .000000   .000000   0.0
4070300   trpvlv
4070301   690
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* air cooled condenser
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
5470000   conders          tmdpvol
5470101   0.21677  17.67   0.0     0.0     0.0     0.0
5470102   4.e-5    0.0     00000
5470200   1        680
5470201   0.0      559.15   0.999
5470202   18000.   334.15   0.999
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* aux feed water
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
5480000   auxfeed          tmdpjun
5480101   553000000 510000000 0.10
5480200   1        655
5480201   -1.0     0.0     0.0     0.0
5480202   0.0      0.0     0.0     0.0
5480203   0.0      2.5207  0.0     0.0
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
* steam flow control valve
*---- ----]---- ----]---- ----]---- ----]---- ----]---- ----]----
*5500000   cv-p4-1          valve
*5500101 530010000 535000000 0.0043266 0.0  0.0   000100
*5500201   0       18.276   20.246    0.0
*    initial velocity modified from 21.268, 21.599 in original
one
*5500300   mtrvlv
```

```
*5500301   612        616        0.05       0.7279808       550
*    initial valve position modified from 0.67 in original one
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* main feed water valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5600000   mnfeed                 tmdpjun
5600101   545000000 510000000 0.05
5600200   1          656
5600201   0.0        26.533     26.533     0.0
5600202   0.0        0.0        0.0        0.0
*******************************************************
* core collapsed liquid level
*******************************************************
*20255000  normarea   0  1.0  1.0
*20255001  0.0          9.25e-3
*20255002  9.25e-3      9.25e-3
*20255003  1.0          1.0
********************************************
*
*          reactor kinetics data
*
*******************************************************
30000000   point    separabl
30000001   gamma-ac 49.6e+6 0.0  348.43    1.0       0.556
30000002   ans79-1
*******************************************************
* delayed neutron constants
*******************************************************
30000101   0.0349     0.01275
30000102   0.2035     0.03177
30000103   0.1848     0.1181
30000104   0.4046     0.3160
30000105   0.1401     1.402
30000106   0.0321     3.914
*******
* power history
*******
30000401   4.89e+7     70.        hr
**************************
* reactivity curve numbers
*******************************************************
30000011   609
*******************************************************
* moderator density reactivity table
*******************************************************
30000501   0.62626e+3     -4.4769
30000502   0.66396e+3     -3.2923
30000503   0.71617e+3     -1.5692
30000504   0.76112e+3     -0.1692
30000505   0.76837e+3      0.04615
30000506   0.79157e+3      0.6923
30000507   0.81188e+3      1.2398
30000508   0.86263e+3      2.2415
30000509   0.93804e+3      3.9231
30000510   0.99749e+3      5.1077
*******************************************************
* doppler reactivity table
*******************************************************
30000601   293.16     1.375
30000602   338.72     1.125
30000603   422.05     0.682
30000604   477.60     0.419
30000605   505.38     0.274
30000606   570.72     0.000
30000607   588.72    -0.075
30000608   695.83    -0.526
30000609   922.05    -1.386
30000610   1310.94   -2.543
30000611   1810.94   -3.865
30000612   2088.72   -4.502
30000613   2499.83   -5.392
30000614   3027.60   -6.417
*******************************************************
* volume weighting factors
*******************************************************
*   moderator temperature feedback
*******************************************************
30000701   230010000  0       0.31493   0.0
30000702   230020000  0       0.31493   0.0
30000703   230030000  0       0.37014   0.0
*******************************************************
*   doppler feedback
*******************************************************
30000801   2300001    0       0.43153   0.0
30000802   2300002    0       0.51686   0.0
30000803   2300003    0       0.05161   0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* scram reactivity data
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20260900   *reac-t   * 609
20260901   0.0        0.0
20260902   0.5        -0.5
20260903   0.59       -3.13
20260904   0.65       -3.95
20260905   0.75       -6.27
20260906   0.83       -8.72
20260907   0.90       -12.00
20260908   0.97       -17.12
20260909   1.125      -20.67
20260910   1.213      -22.10
20260911   1.3        -22.78
20260912   1.4        -23.17
20260913   1.6        -23.32
20260914   60.0       -23.32
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10. SUPPLEMENTARY NOTES

11. ABSTRACT (200 words or less)

The RELAP5/MOD3 5m5 code was assessed using the L9-1/L3-3 test carried out in the LOFT facility, a 1/60-scaled experimental reactor, simulating a loss of feedwater accident with multiple failures and the sequentially-induced small break loss-of-coolant accident. The code predictability was evaluated for the four separated sub-periods with respect to the system response; initial heatup phase, spray and PORV cycling phase, blowdown phase and recovery phase. Based on the comparisons of the results from the calculation with the experiment data, it is shown that the overall thermal-hydraulic behavior important to the scenario such as a heat removal between the primary side and the secondary side and a system depressurization was well-predicted and that the code could be applied to the full-scale nuclear power plant for an anticipated transient with multiple failures within a reasonable accuracy. The minor discrepancies between the prediction and the experiment were identified in reactor scram time, post-scram behavior in the initial heatup phase, excessive heatup rate in the cycling phase, insufficient energy convected out the PORV under the hot leg stratified condition in the saturated blowdown phase and void distribution in secondary side in the recovery phase. This may come from the code uncertainties in predicting the spray mass flow rate, the associated condensation in pressurizer and junction fluid density under stratified condition.

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RELAP5/MOD3
Anticipated Transient Loft

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