NUREG/IA-0114

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
Washington, DC 20555-0001

February 1994

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

Published by
U.S. Nuclear Regulatory Commission

Available from

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

and

National Technical Information Service
Springfield, VA 22161

NUREG/IA-0114

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NOTICE

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

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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ACKNOWLEDGEMENTS

This report was completed under the sponsorship of Korean Ministry of Science and Technology(MOST). Dr. Sang Hoon Lee, President of the Korea Institute of Nuclear Safety(KINS), contributed significantly to the administration of the project. Authors expressed a appreciation to Drs. Bub Dong Chung, Euy Joon Lee and Mrs Eun Kyoung Cho in KINS for installating RELAP5/MOD3 code on the CRAY-2S machine and supporting the calculation. Mrs. Eun Kyoung Cho also contributed to prepare the data plots. Authors should express their gratitude to Mr. Dick Schultz and Mr. Hershall Hardy in INEL for managing the ICAP project and for providing the related documents and test data.

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 area 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

1. EG&G, *RELAP5 Input Data Requirements,* Appendix A to RELAP5/MOD3 Code Manual, January 1990.
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]

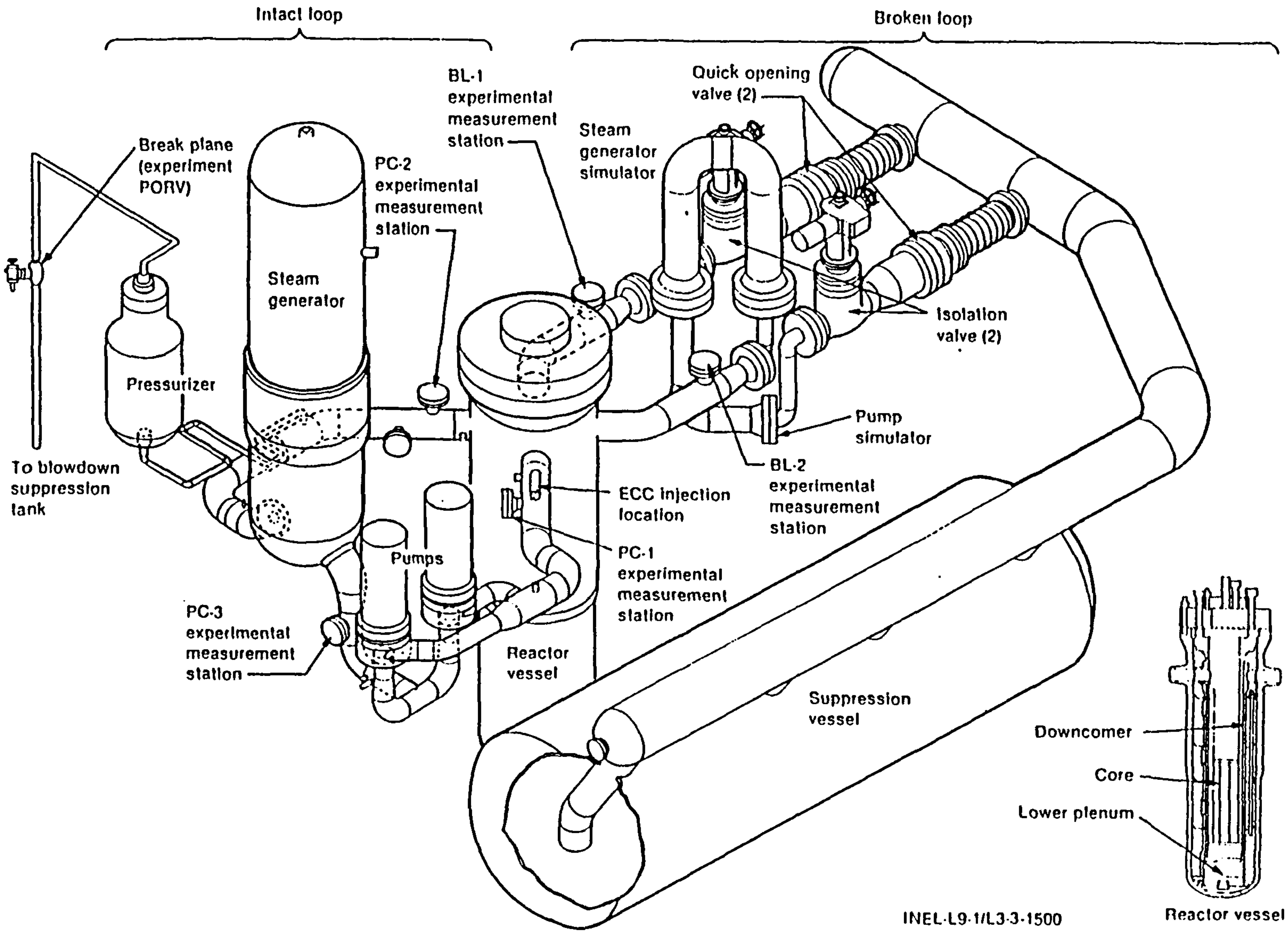

Fig.1 Axonometric configuration of LOFT L9-1/L3-3 test

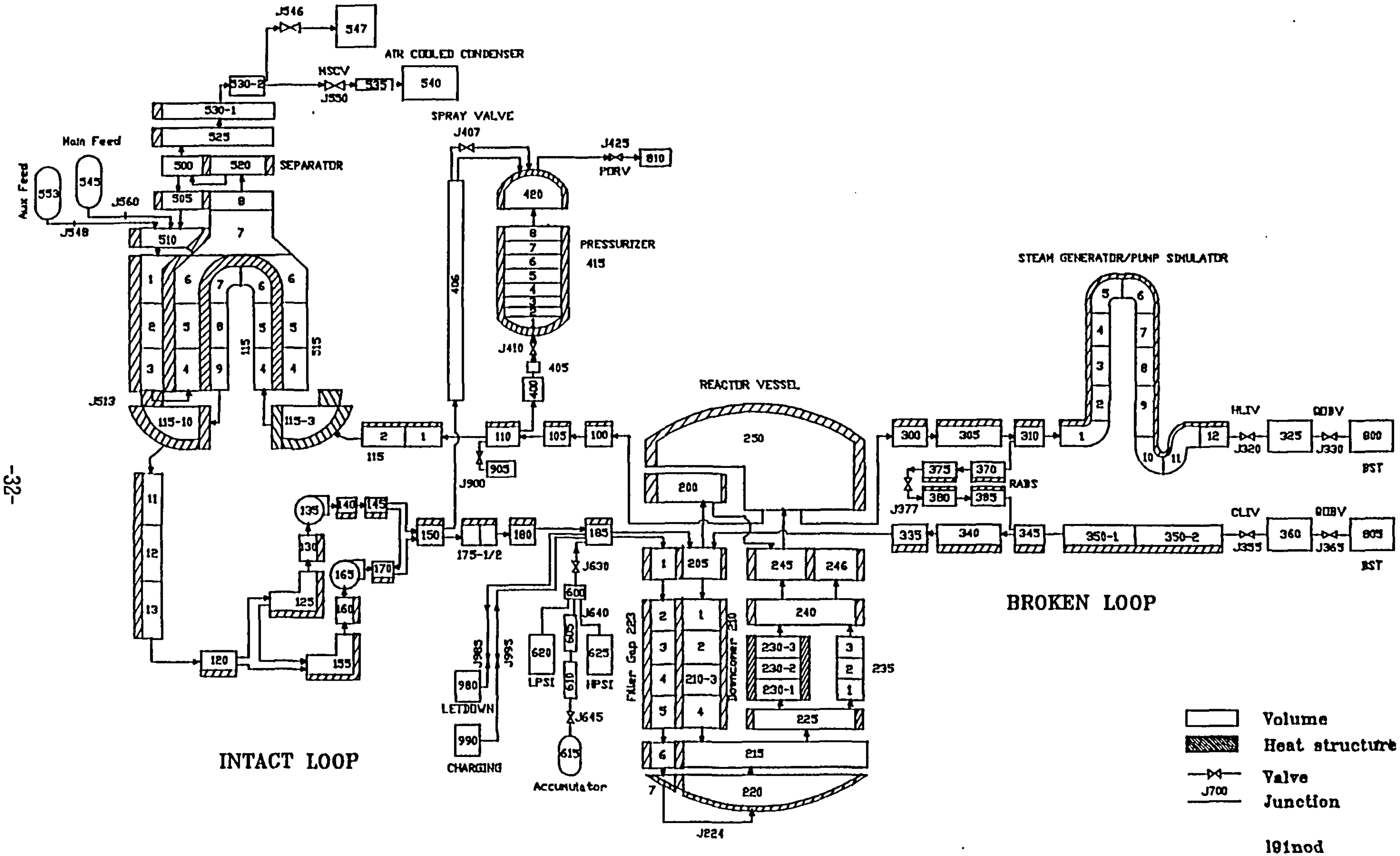

Fig. 2 RELAP5 Nodalization for LOFT Experiment L9-1/L3-3

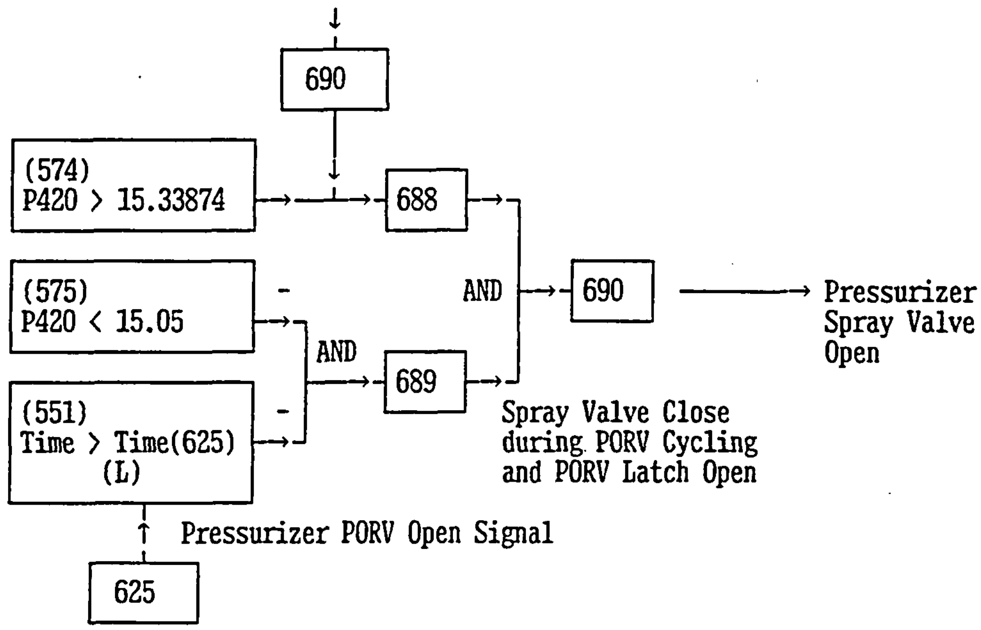

Fig.3-a. Pressurizer spray valve control trip

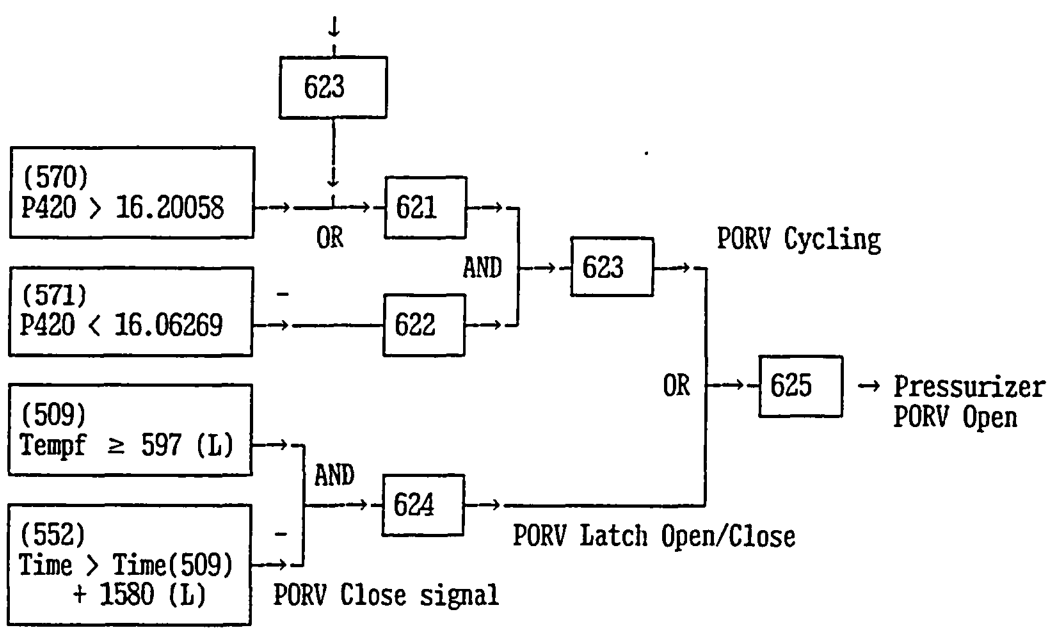

Fig.3-b. Pressurizer PORV control trip

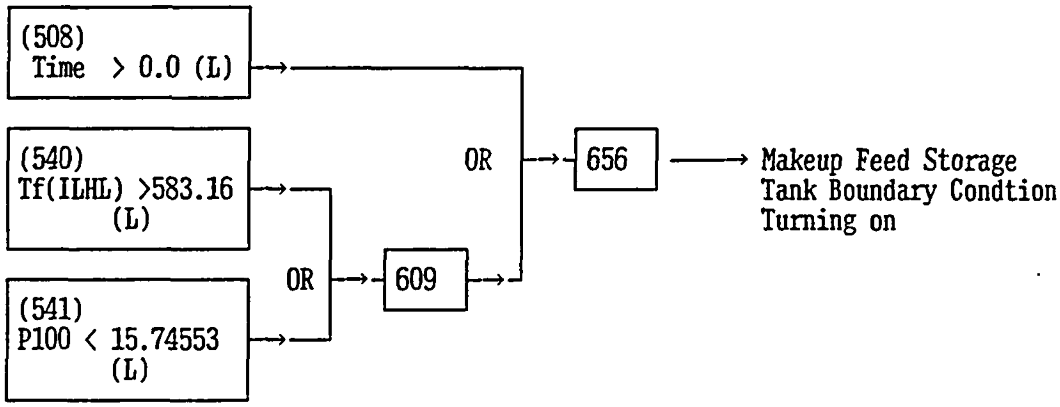

Fig.3-c. Makeup feed storage tank boundary condition trip

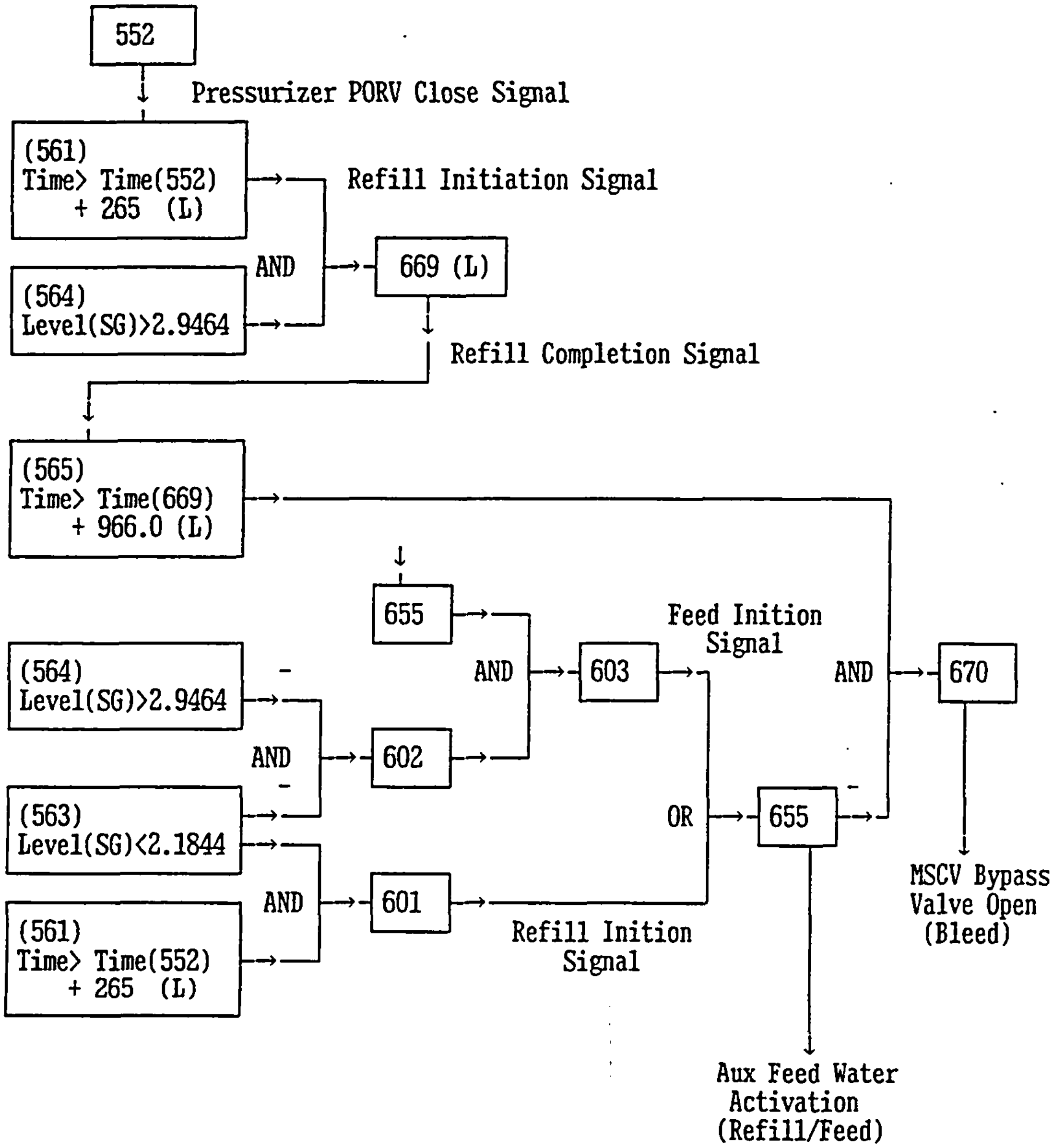

Fig.3-d MSCV byapass valve control trip

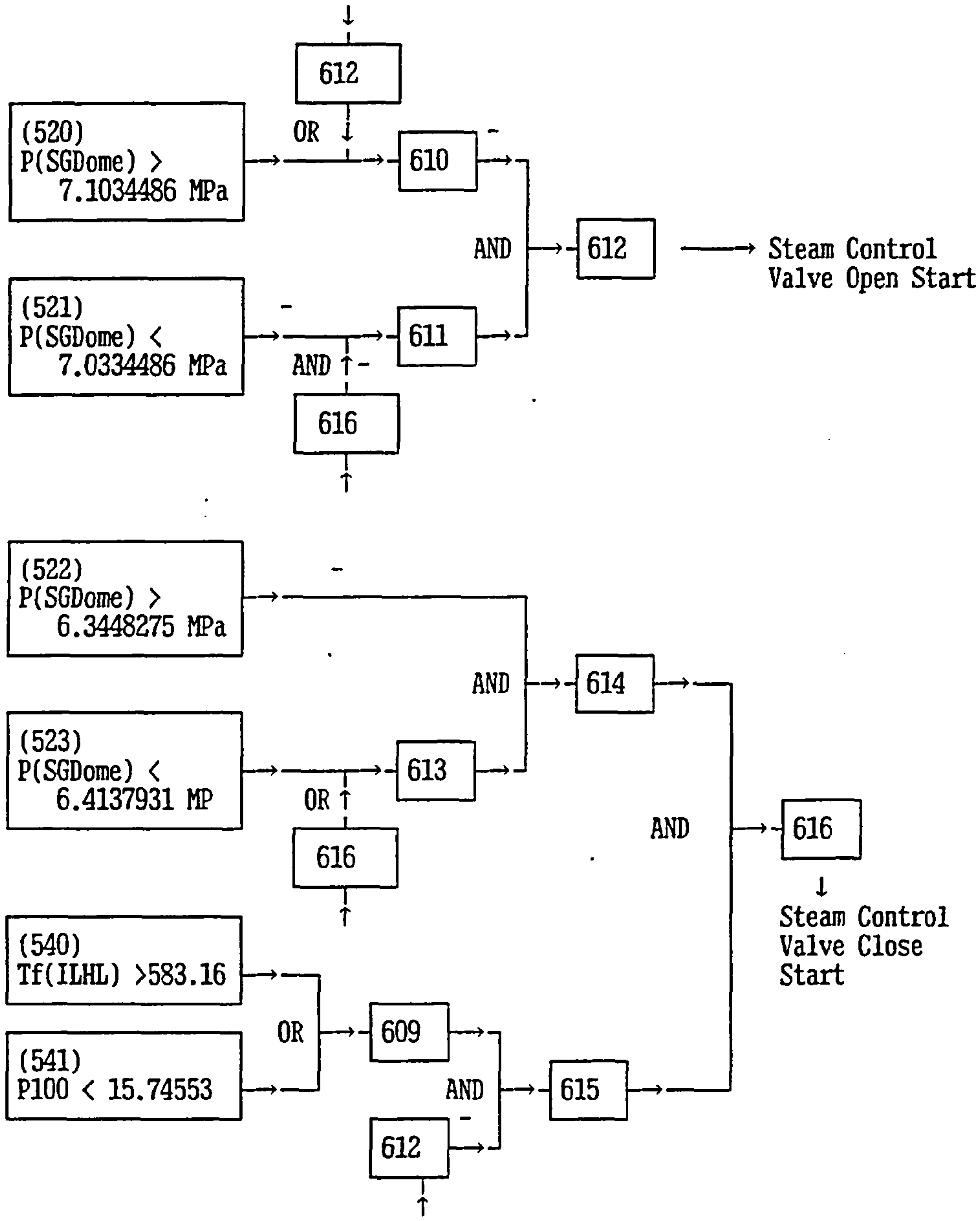

Fig.3-e MSCV open/close control trip

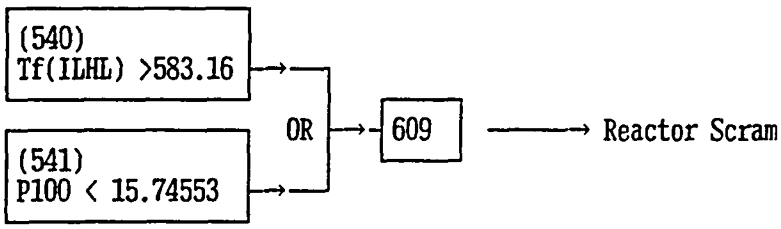

Fig.3-f Reactor scram trip

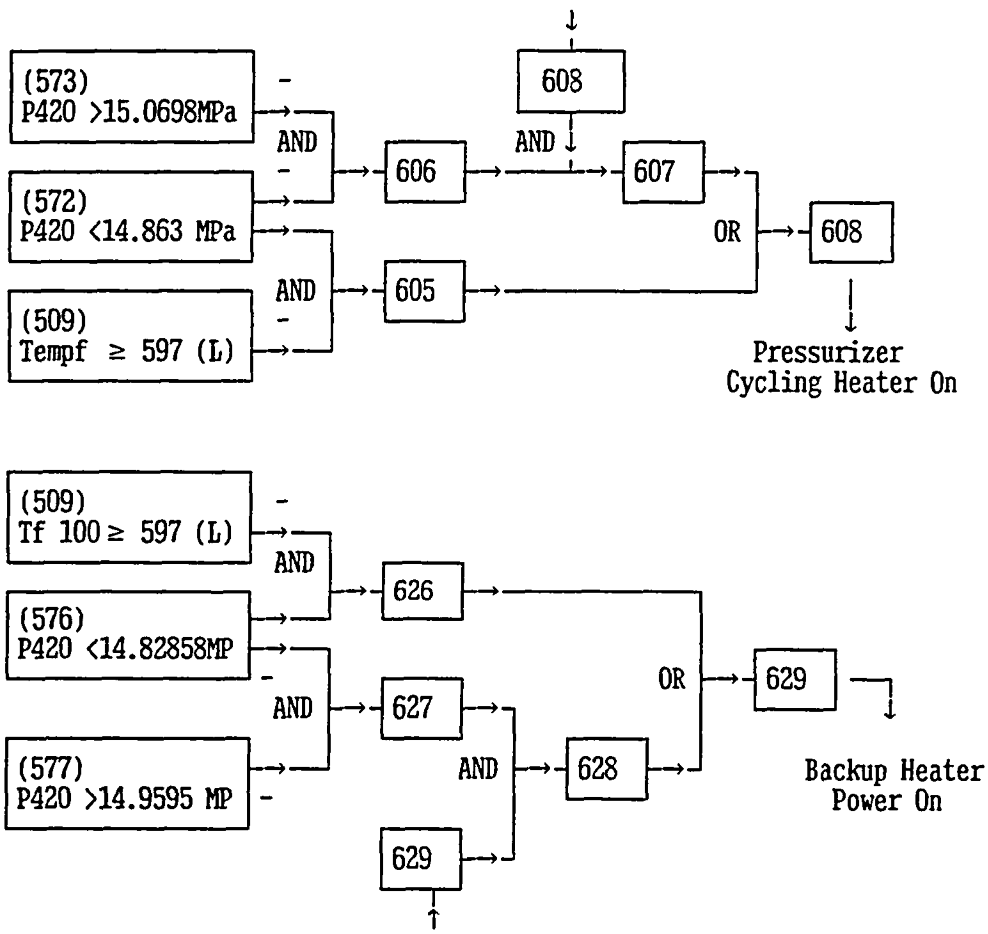

Fig.3-g Pressurizer heater control trip

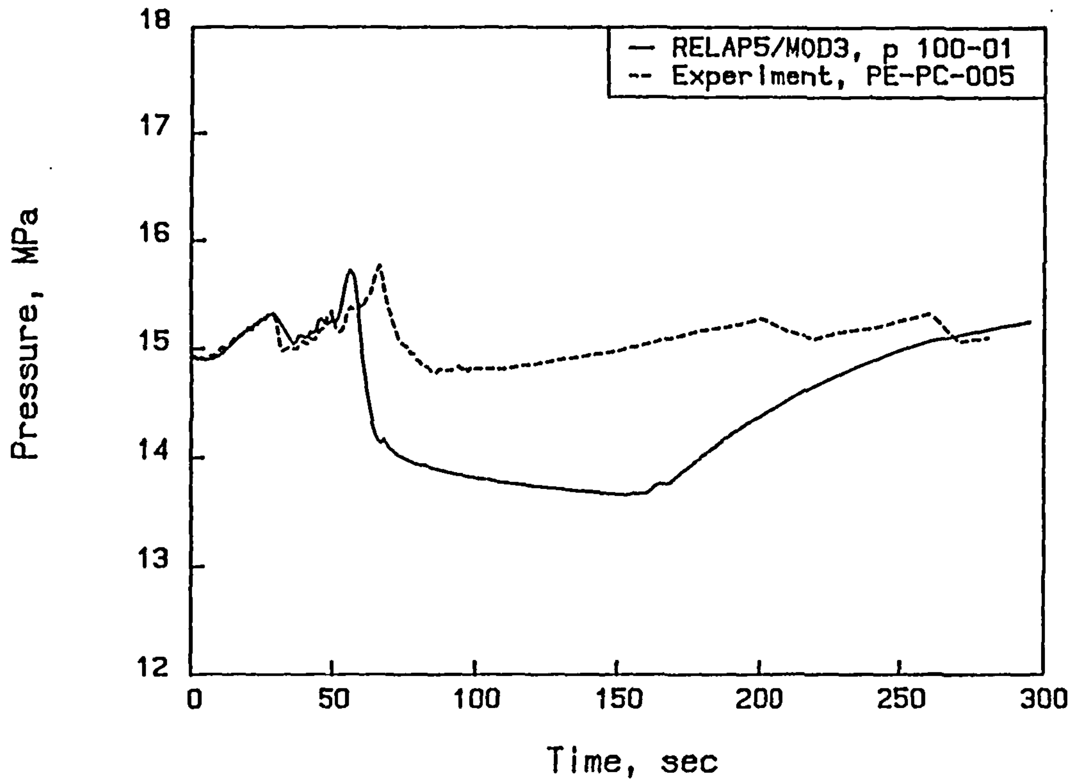

Fig.4 Comparison of pressure at the intact loop hot leg (short term)

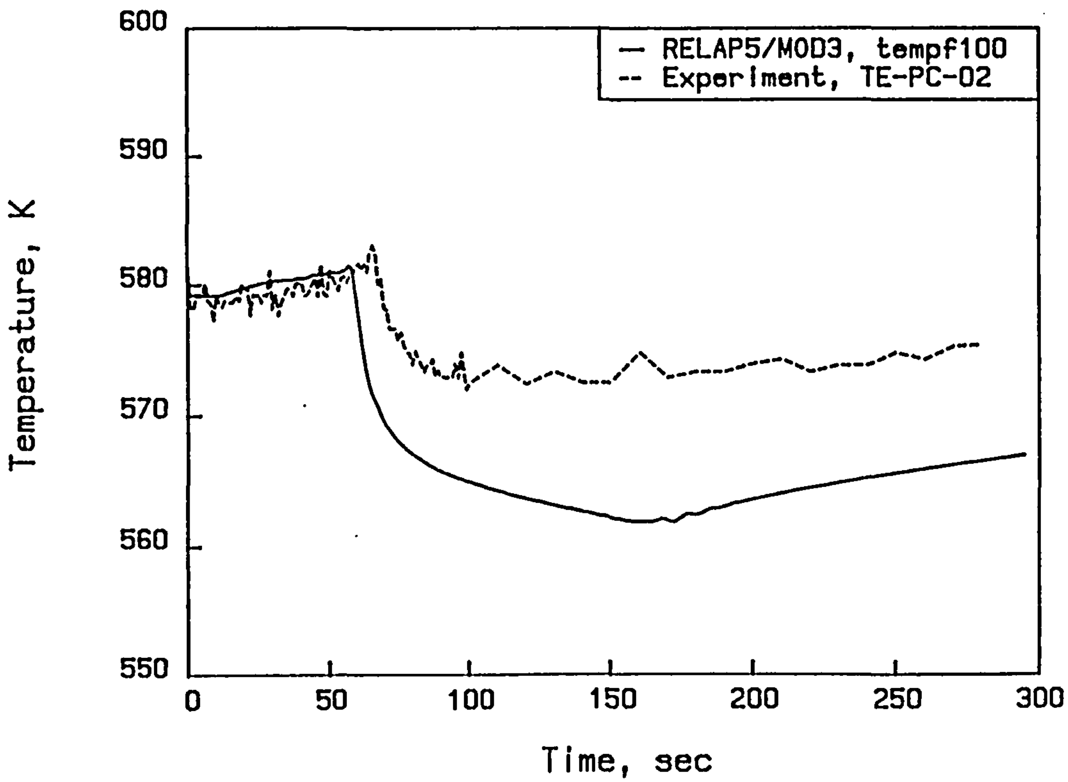

Fig.5 Comparison of coolant temperature at the intact loop hot leg (short term)

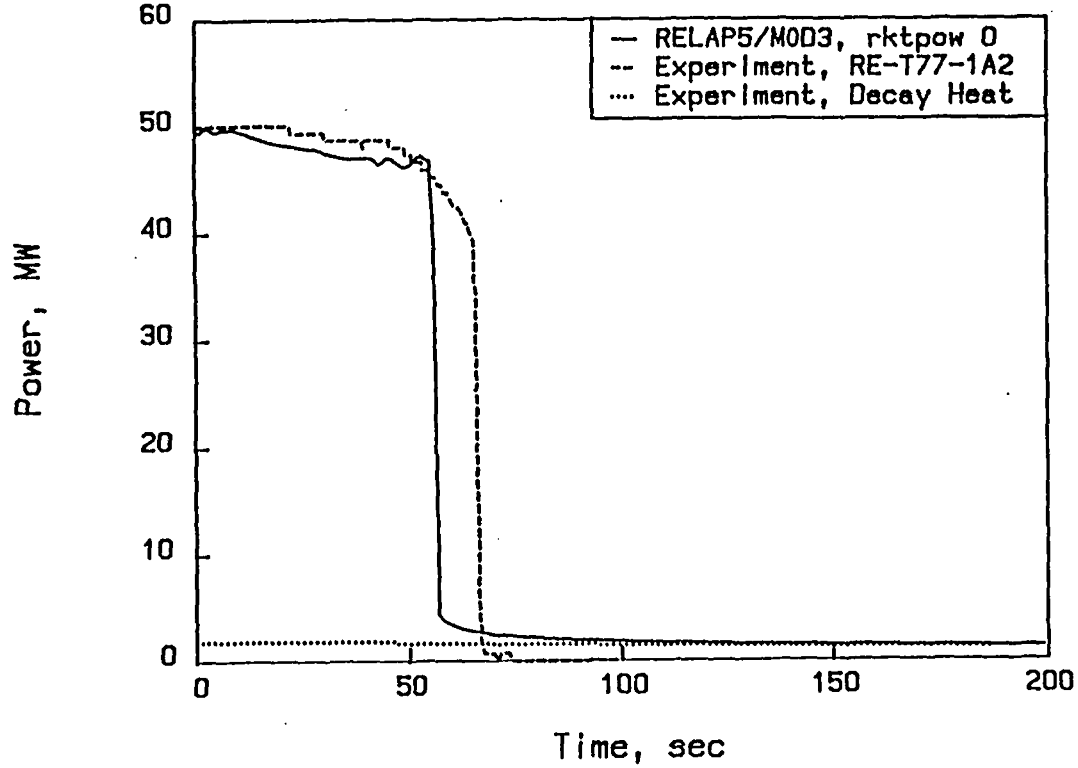

Fig.6 Comparison of reactor power

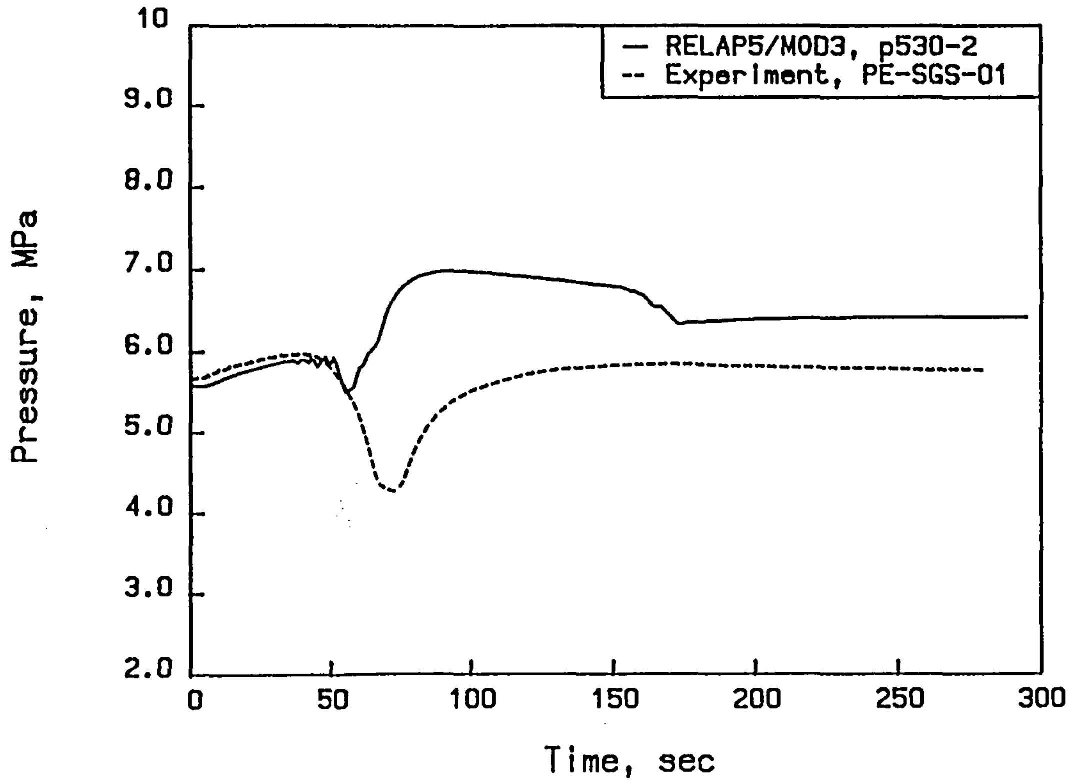

Fig.7 Comparison of pressure at SG steam dome (short term)

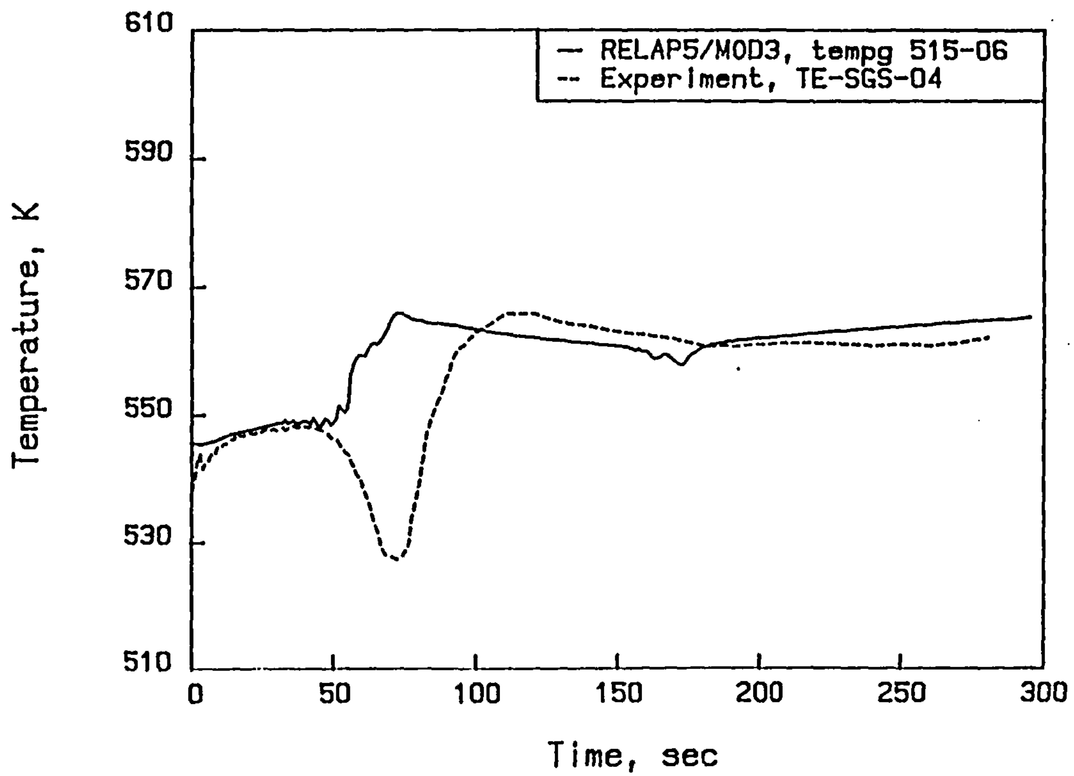

Fig.8 Comparison of coolant temperature at SG secondary side (short term)

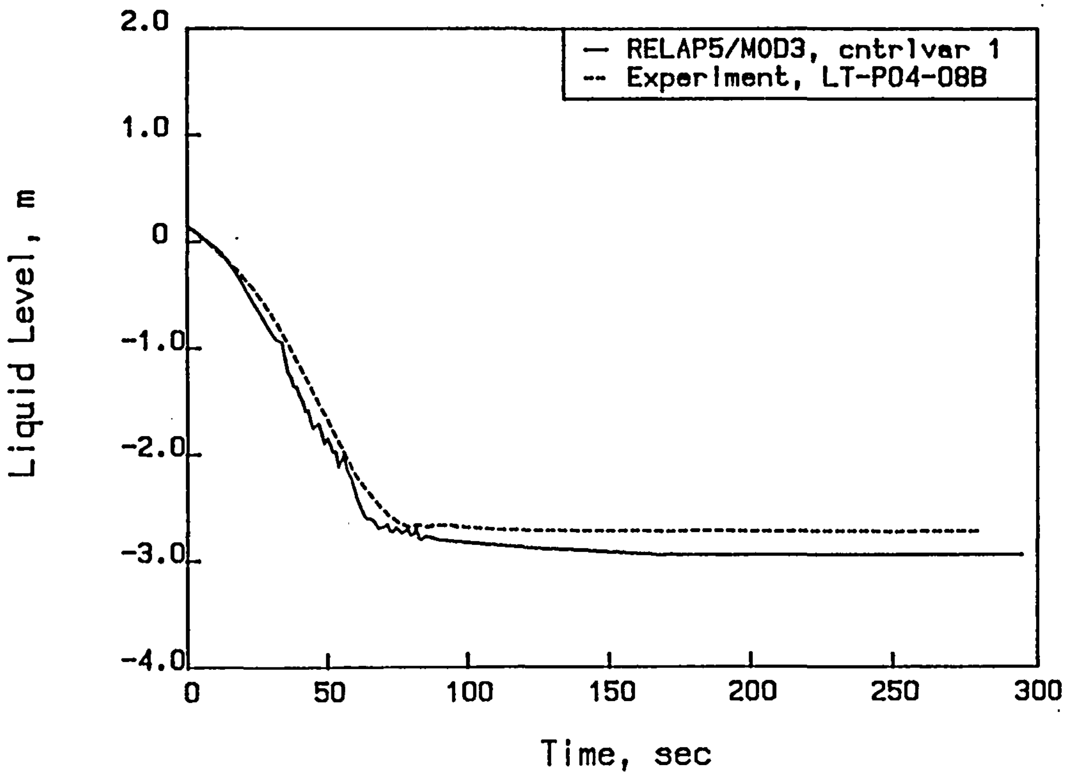

Fig.9 Comparison of SG collapsed liquid level (short term)

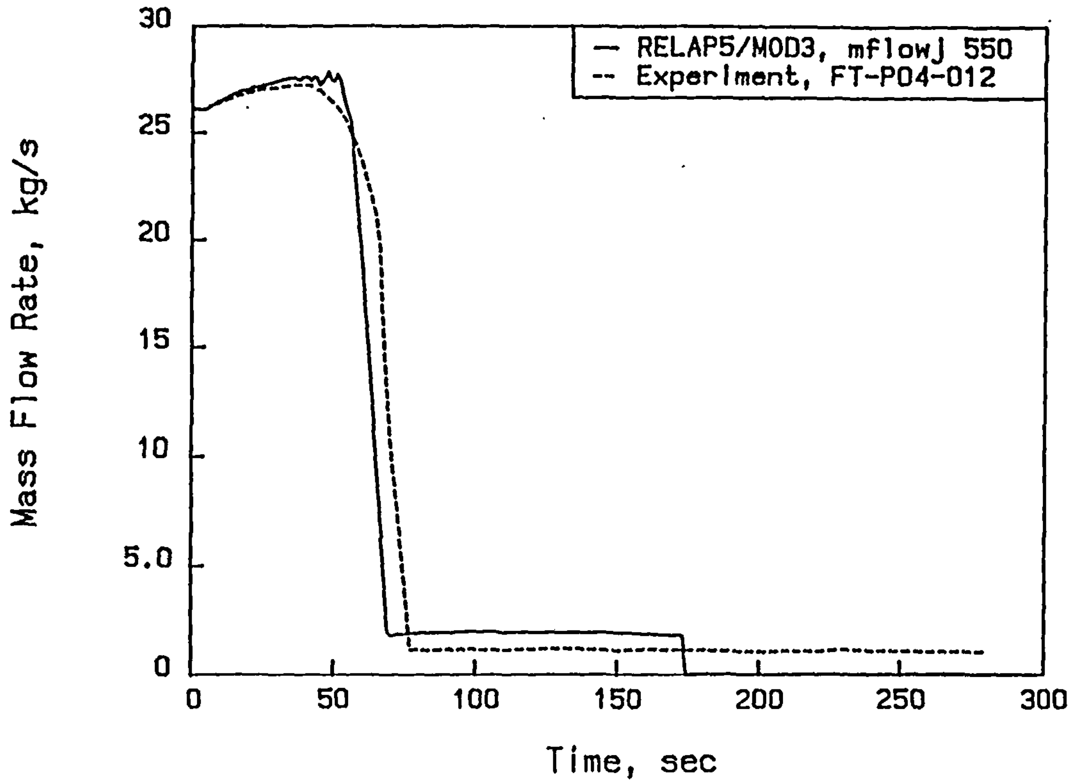

Fig.10 Comparison of mass flow rate through MSCV (short term)

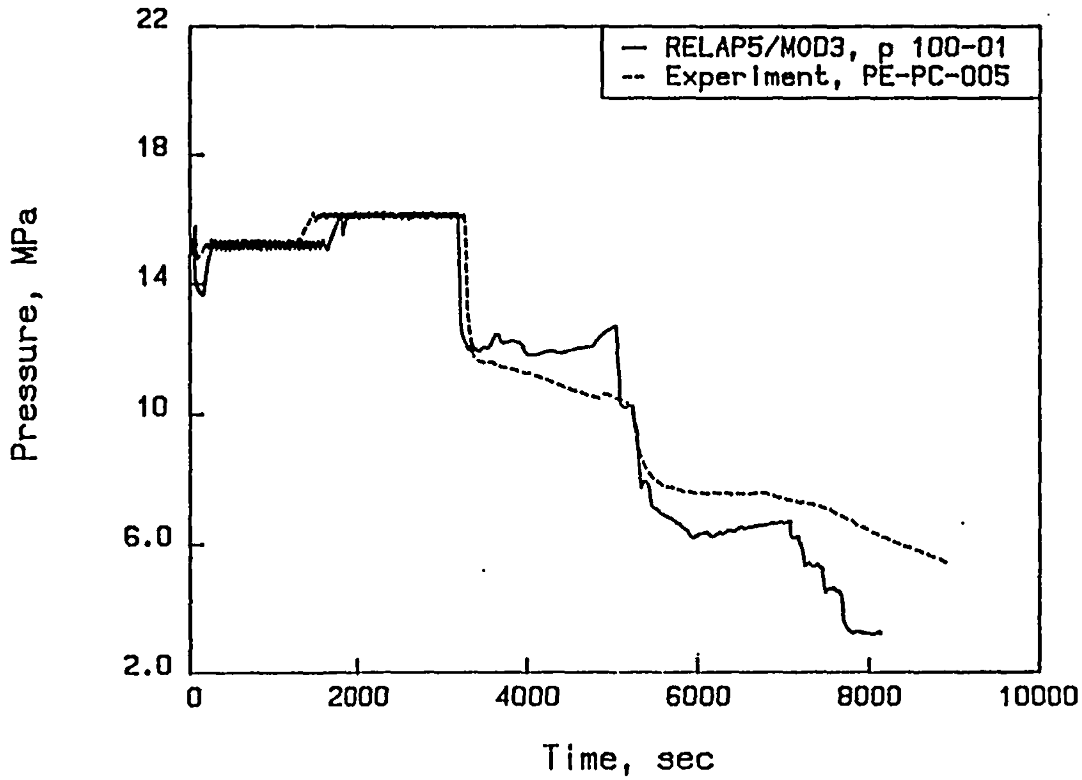

Fig.11 Comparison of pressure at the intact loop hot leg (long term)

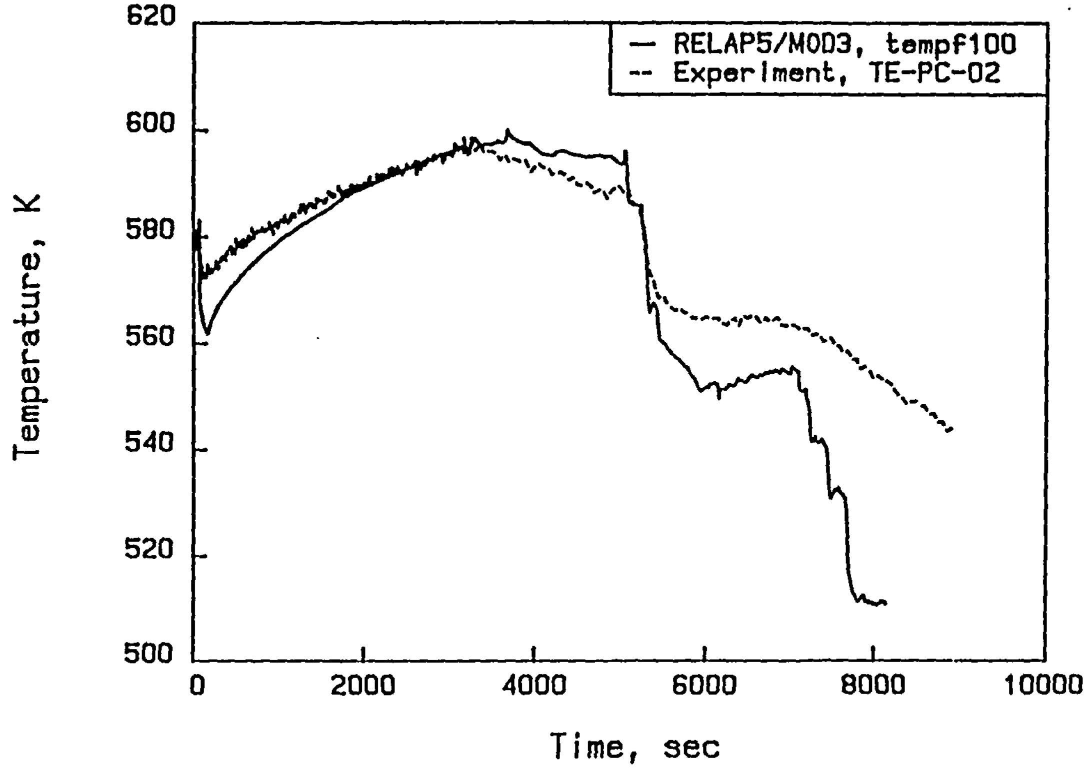

Fig.12 Comparison of coolant temperature at the intact loop hot leg (long term)

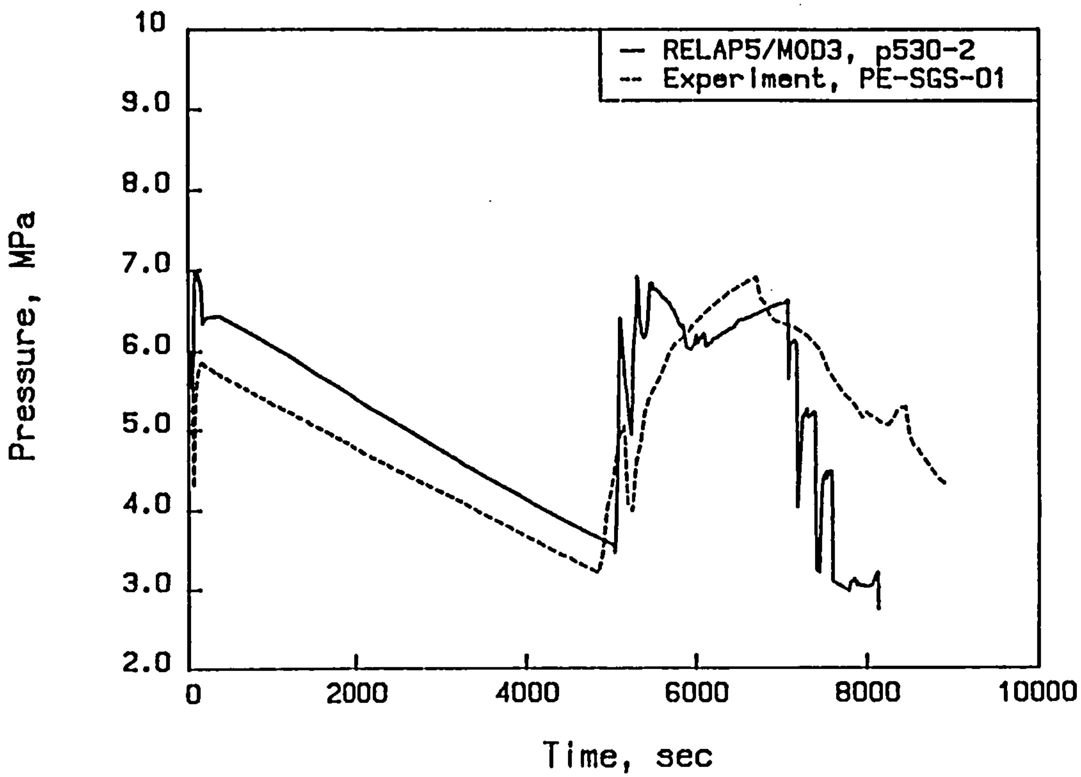

Fig.13 Comparison of pressure at SG steam dome (long term)

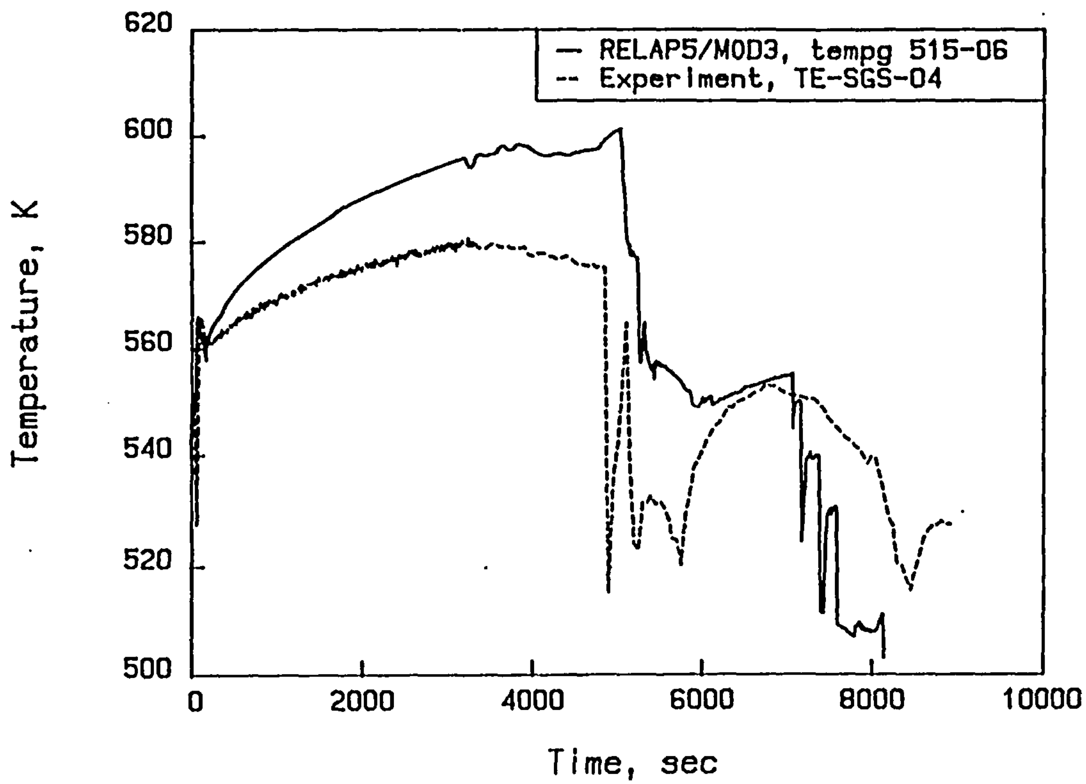

Fig.14 Comparison of coolant temperature at SG secondary side (long term)

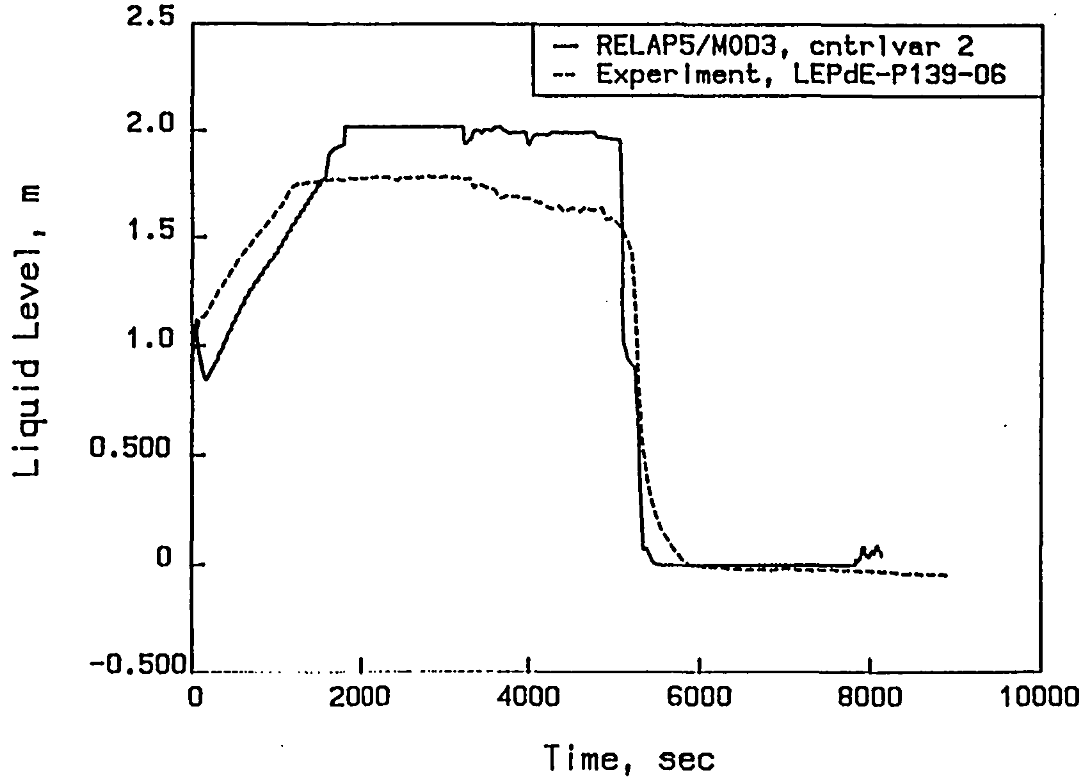

Fig.15 Comparison of pressurizer collapsed liquid level (long term)

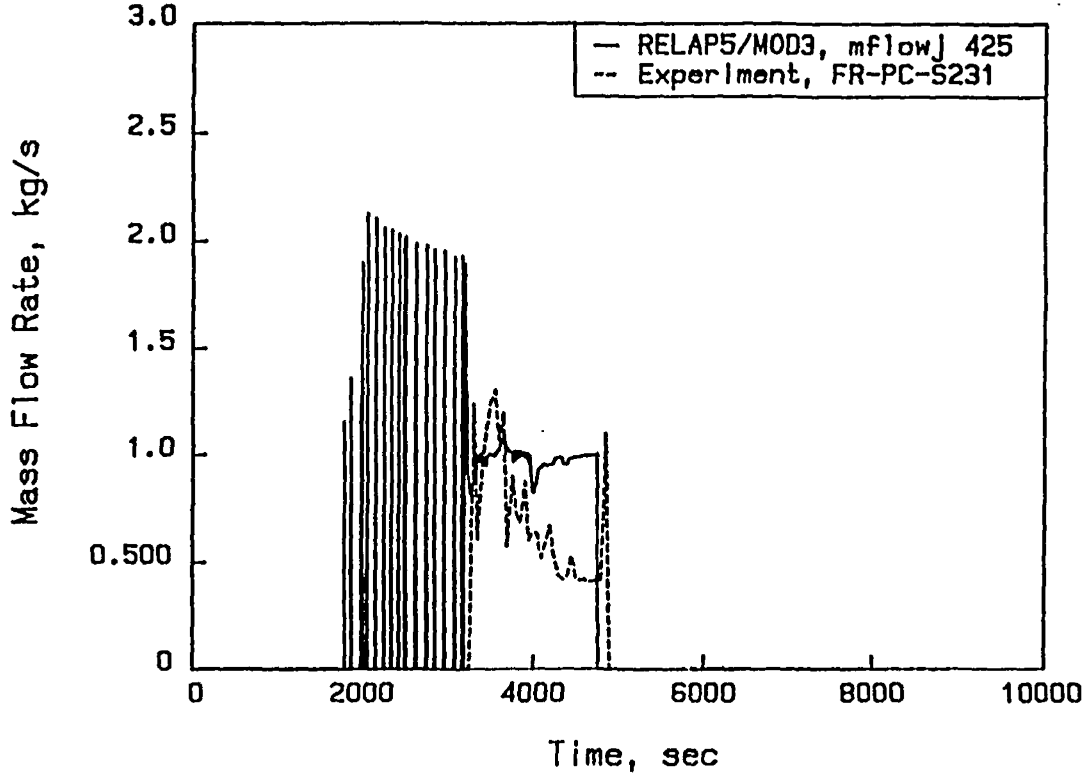

Fig.16 Comparison of mass flow rate through PORV (long term)

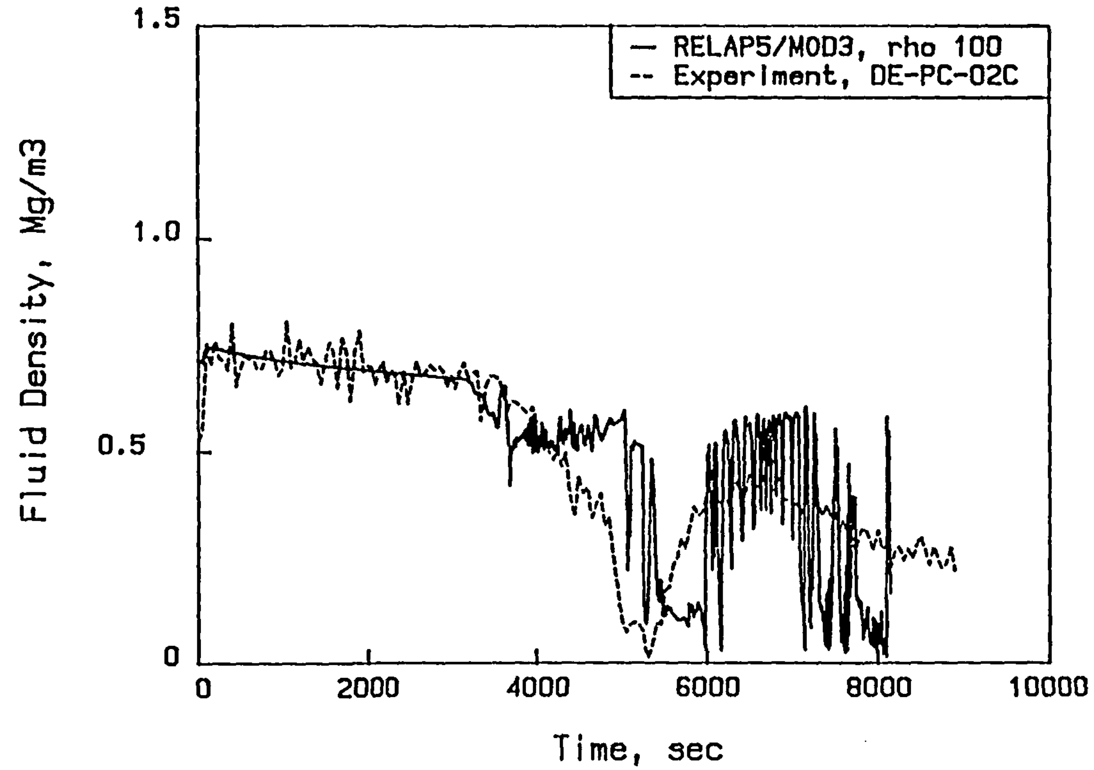

Fig.17 Comparison of fluid density at intact loop hot leg (long term)

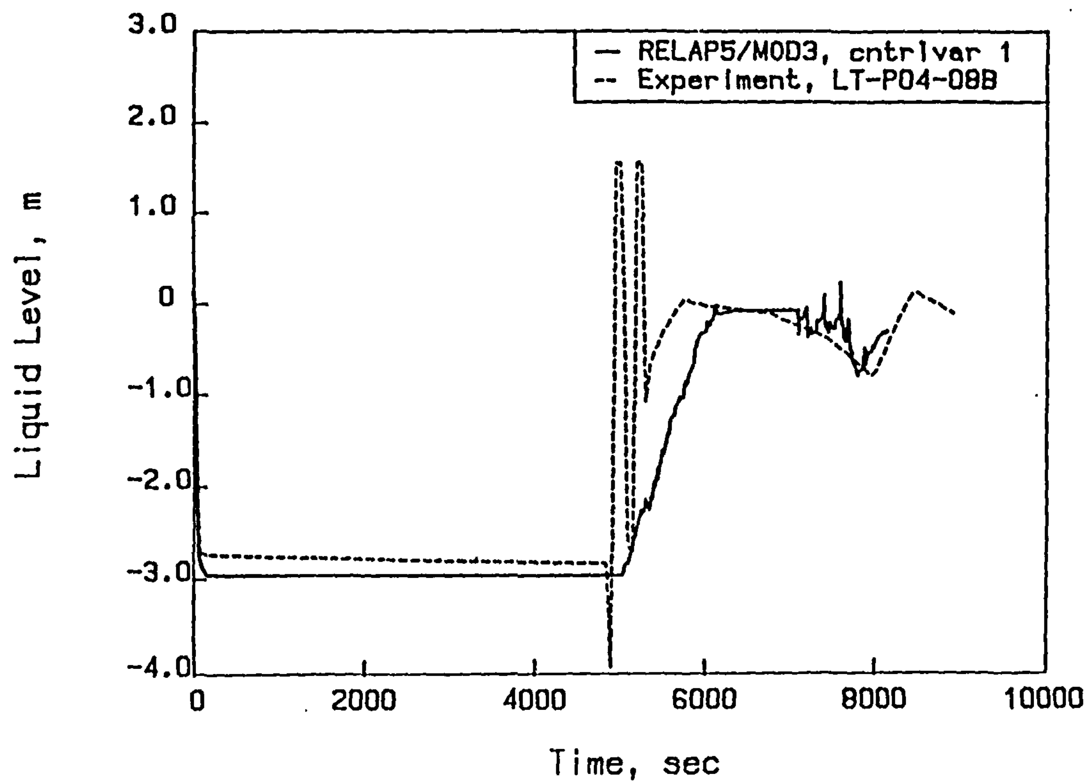

Fig.18 Comparison of SG collapsed liquid level (long term)

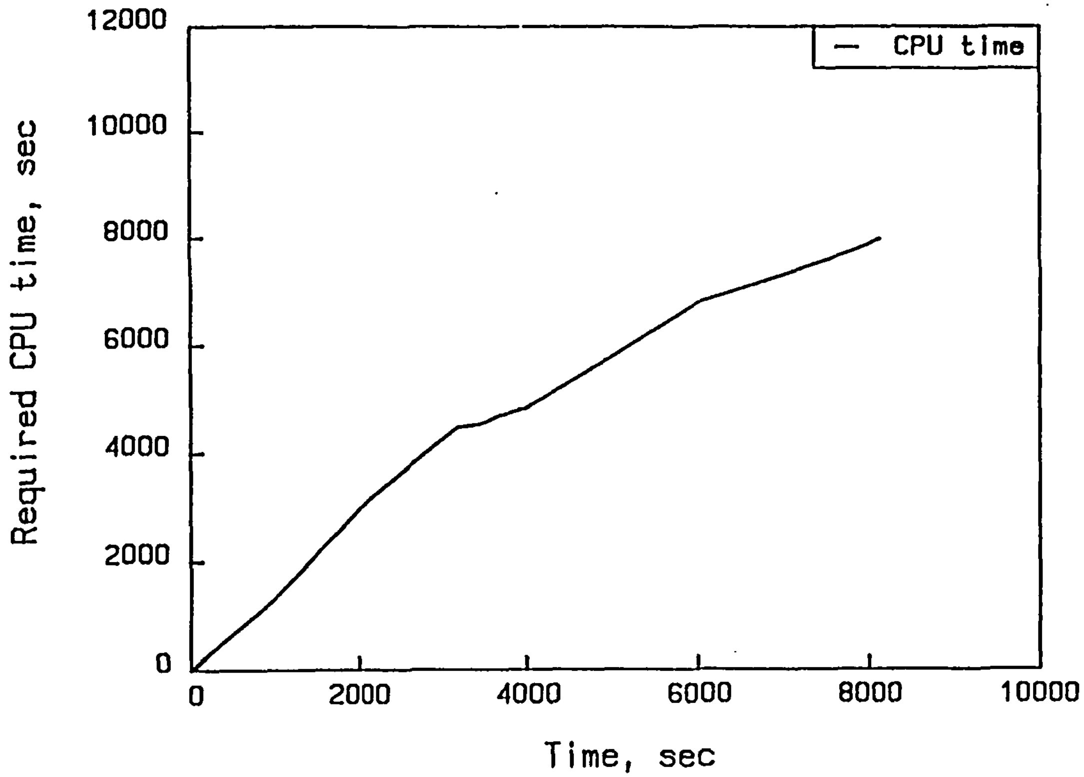

Fig.19 The required CPU time versus the advanced time

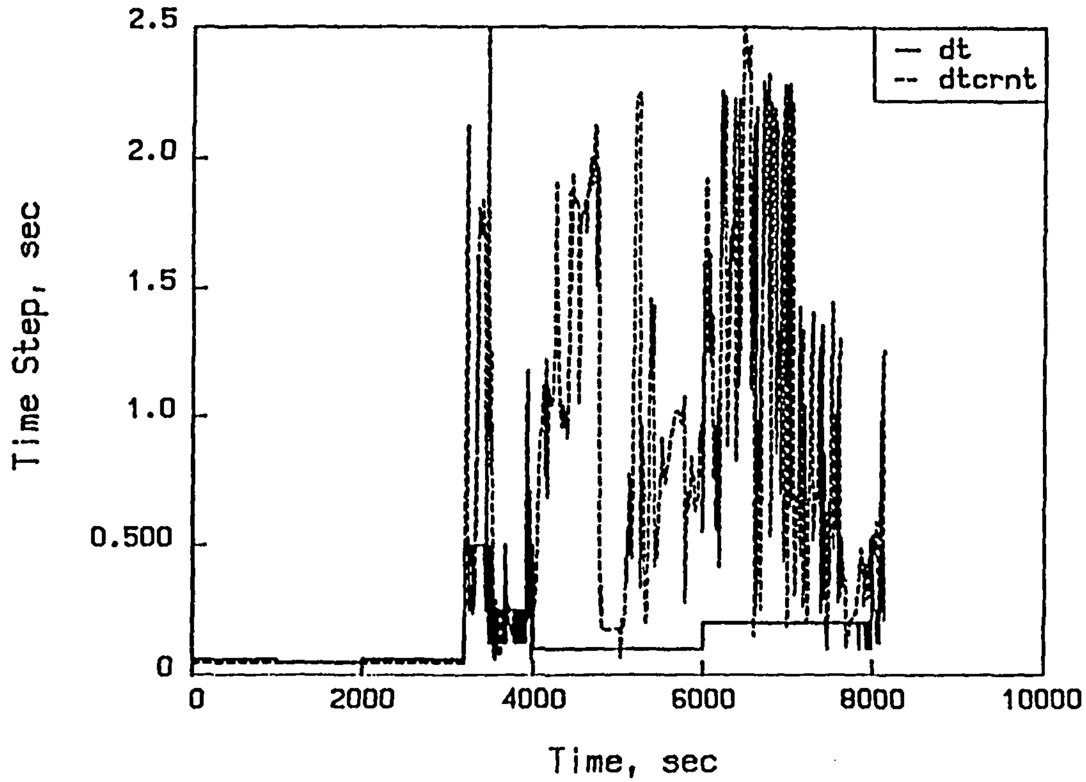

Fig.20 Time step size of base case calculation

Appendix A Input Deck for Steady State Calculation

```
=loft 19-1 post test analysis deck
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*          initial conditions
*
*          core power = 50. mw
*          pcs flow = 479.3 kg/s
*          thot = 578. k
*          tcold = 559.0 k
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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    1
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
```

```
1351207  8.631300e-01     6.326000e-01
1351208  1.000000e+00     1.000000e+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 4
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 5
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 7
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 8
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 4
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 5
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 7
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 8
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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 19-1 test data
*****************************************************
* head curve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 4
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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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
```

```
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
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* inlet annulus top volume
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* inlet annulus bottom volume
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* downcomer
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* lower plenum top volume
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* lower plenum bottom volume
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* core filler bypass
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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  fllrgapp       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
```

```
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* dead end of fuel modules
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* upper plenum lower volume
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* hot leg pipe to reflood assist bypass tee
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* broken loop hot leg contraction
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* steam generator and pump simulatior
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
```

```
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
```

```
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* isolation valve cold leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  pipe section between isolation valve and qobv cold leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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.
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  quick opening blowdown cold leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* reflood assist bypass piping - cold leg side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* reflood assist bypass parrel pipes hot leg side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* reflood assist bypass valves
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
3770000   rabsvlv            sngljun
3770101   380010000 375000000 0.0  1.4e+4  1.4e+4  000000
3770201   0         .106460   .25646    0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* reflood assist bypass parrel pipes cold leg side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  reflood assist bypass single pipe cold leg side
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* surge line pressurizer vessel
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  spray line
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  spray valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
4070000   sprvlv    valve
4070101 406010000 420010000 3.34e-4 1.54e01 1.54e01
+       000100
4070201   0         .000000   .000000   0.0
4070300   trpvlv
4070301   690
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pressurizer surge line valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
```

```
4100000   slvalv   valve
4100101   405010000 415000000 0.0   0.93    0.93   000100
4100201   0        -.17704000 -.1770400 0.0
4100300   trpvlv
4100301   508
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pressurizer vessel
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pressurizer top hat and relief connection
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  porv
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* separator outlet region
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* feed inlet volume
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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   0.6328700 0.632870 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* steam generator downcomer
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* top of the riser
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* below mist extractor, above top of shroud in steam dome
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* mist extractor and steam generator outlet pipe to scv
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pipe downstream of steam control valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* air cooled condenser
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* feed storage tank
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  steam control valve bypass
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5460000  scvbyp   valve
5460101  530010000 547000000 0.0    0.0  0.0    000000
5460201  0        .000000  .000000  0.0
5460300  trpvlv
5460301  670
```

```
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* air cooled condenser
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*------ ------ ------ ------ ------ ------ ------ ------
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* aux feed water
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*------ ------ ------ ------ ------ ------ ------ ------
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* steam flow control valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* makeup feed tank
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  flow path to the air cooled condenser
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
5550000  coacco   sngljun
5550101  535010000 540000000 0.0     0.0  0.0     000100
5550201  0        13.171  36.498  0.0
*---- ----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
*------ ------ ------ ------ ------ ------ ------ ------
*  modification for steady state run at 91/2/8
```

```
*------ ------ ------ ------ ------ ------ ------ ------
*****************************************************
*
*  ecc system
*
*****************************************************
*  piping pcs hpis injection point
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  piping accumulator
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* accumulator pipe
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* accumulator vessel
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* bwst lpis
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* bwst hpis
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* ecc check valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
6300000  eccvlv           valve
6300101  600010000 185000000 0.0     0.0     0.0  000100
6300201  0        .00000000 .00000000 0.0
6300300  trpvlv
6300301  502
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* low pressure injection system
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* high pressure injection system
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* accumulator valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*
**************************************************
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* containment broken loop hot leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* containment broken loop cold leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  containment power operated relief valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  boundary valve intact loop hot leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  boundary volume intact loop hot leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*
*          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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* steam generator plena
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pressurizer backup heaters
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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 0.0 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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* shroud - lower section
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* vessel wall
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*
**************************************************
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* uo2 - thermal conductivity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
```

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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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* gap - thermal conductivity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* zircaloy-4 - thermal conductivity         from matpro
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20100301  380.4    13.6
20100302  469.3    14.6
20100303  577.6    15.8
20100304  685.9    17.3
20100305  774.8    18.4
20100306  872.0    19.8
20100307  973.2    21.8
20100308  1073.2   23.2
20100309  1123.2   25.4
20100310  1152.3   24.2
20100311  1232.2   25.5
20100312  1331.2   26.6
20100313  1404.2   28.2
20100314  1576.2   33.0
20100315  1625.2   36.7
20100316  1755.2   41.2
20100317  2273.2   55.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* s-steel - thermal conductivity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20100401  273.15   12.98
20100402  1199.82  25.1
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* inconel-600 - thermal conductivity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20100601  366.5    13.85
20100602  477.6    15.92
20100603  588.7    18.17
20100604  700.0    20.42
20100605  810.9    22.50
20100606  922.0    24.92
20100607  1033.2   26.83
20100608  1144.3   29.42
20100609  1477.6   36.06
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* uo2 - volumetric heat capacity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* gap - volumetric heat capacity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20100251  273.15   5.4
20100252  3260.0   5.4
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* zircaloy-4 - volumetric heat capacity     from matpro
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* s-steel - volumetric heat capacity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20100451  273.15   3.83e6
20100452  366.5    3.83e6
20100453  1366.5   5.376e6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* inconel-600 - volumetric heat capacity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20100651  366.5    3.908+6
20100652  477.6    4.084+6
20100653  588.7    4.260+6
20100654  700.0    4.436+6
20100656  810.9    4.665+6
20100657  922.0    4.929+6
20100658  1033.2   5.105+6
20100659  1477.6   5.727+6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* magnesium oxide - thermal conductivity
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20295900  htc-t
20295901  0.0       3.385
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pressurizer generator environmental loss heat xfer coefficient
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20296900  htc-t
20296901  0.0       3.019
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* blhl environmental loss heat xfer coefficient
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*   steam generator downcomer collapsed liquid level
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  pressurizer collapsed liquid level
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* core collapsed liquid level
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  hot leg intact loop
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* steam generator
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* sg-pump piping
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* cold leg intact loop
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20500400  pcsvol4   sum      1.0      0.0       1
```

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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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  reactor
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* hot leg broken loop
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* cold leg broken loop
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pressurizer
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* reactor vessel downcomer mass
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pcs mass
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* break energy computer
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
```

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*
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
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20511901 0.0      1.7153    htrnr    370000101
20511902          0.94828   htrnr    370000201
20511903          0.94497   htrnr    370000301
20511904          2.6090    htrnr    370000401
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  heat loss from intact loop hot leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  heat loss from intact loop cold leg
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  toal heat loss to environment
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  metal heating in pzr
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
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20512308          0.453056  htrnr    415200700
20512309          0.150656  htrnr    416200100
20512310          0.13000   htrnr    420100100
20512311          0.150656  htrnr    420200100
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  metal heating in reactor vessel (1st part)
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  metal hx in rabs
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  total vessel hx/v
```

```
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*$*
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* primary coolant pump speed controllers
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* calculate mass flow error
*---- ----1---- ----1---- ----1----
20590100 msserr    sum      1.0     0.0     1
20590101 479.30    -1.0     mflowj   100010000
*---- ----1---- ----1---- ----1----
* pump 1 speed
*---- ----1---- ----1---- ----1----
20590200 pcp1spd  integral 0.34482  333.7236 1
20590201 cntrlvar 901
*---- ----1---- ----1---- ----1----
* pcp1 pump velocity table
*---- ----1---- ----1---- ----1----
1356100  508      cntrlvar  902
1356101  0.0      0.0
1356102  369.0    369.0
*---- ----1---- ----1---- ----1----
* modify pcp1 pump data
*---- ----1---- ----1---- ----1----
1350301  0  0  0     -1     0     504     0
```

```
*---- ----1---- ----1---- ----1----
* pump 2 speed
*---- ----1---- ----1---- ----1----
20590300 pcp2spd  integral 0.34482  331.9524 1
20590301 cntrlvar 901
*---- ----1---- ----1---- ----1----
* pcp2 pump velocity table
*---- ----1---- ----1---- ----1----
1656100  508      cntrlvar  903
1656101  0.0      0.0
1656102  369.0    369.0
*---- ----1---- ----1---- ----1----
* modify pcp2 pump data
*---- ----1---- ----1---- ----1----
1650301  135  135  135    -1     0     504     0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pressurizer spray valve controller
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* spray valve
*---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1----
* spray valve position calculator
*---- ----1---- ----1---- ----1----
20590400 spray    sum     -1.0     0.0     1     * contin
+        3        0.0     1.0
20590401 14.93+6  -1.0    p       420010000
*---- ----1---- ----1---- ----1----
* position vs area table
*---- ----1---- ----1---- ----1----
20299900 normarea
20299901 0.0      0.0
20299902 0.0001   0.0
20299903 1.0      1.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* pressurizer level control using charging and letdown
components
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* charging reservior
*---- ----1---- ----1---- ----1----
*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
*---- ----1---- ----1---- ----1----
* charging valve
*---- ----1---- ----1---- ----1----
*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 19-1 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      1
0000541  p    100010000  gt  null   0        1.574553e7  1
0000550  time    0       ge  null   0        10000.0     1
0000551  time    0       ge  timeof 625      0.0         1
0000552  time    0       ge  timeof 509      1580.       1
0000560  p    100010000  le  null   0        13.15862e6  n
0000561  time    0       ge  timeof 552      265.0       1
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.        1
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    1
0000605  572    and  -509    n
0000606 -572    and  -573    n
0000607  608    and   606    n
0000608  605    or    607    n
0000609  540    or    541    1
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    1
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
*---- ----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
1351207   8.631300e-01       6.326000e-01
1351208   1.000000e+00       1.000000e+00
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 4
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 5
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 7
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 8
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
```

```
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 4
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 5
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 6
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 7
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve no. 8
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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 19-1 test data
*****************************************************
* head curve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* torque curve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 2
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 3
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* head curve no. 4
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----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
*****************************************************
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*  spray valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
4070000  sprvlv  valve
4070101  406010000 420010000 3.3451e-4  15.432  15.432
000100
4070201  0    .000000  .000000  0.0
4070300  trpvlv
4070301  690
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* air cooled condenser
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* aux feed water
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
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
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* steam flow control valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*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
.
```

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

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

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

NUREG/IA-0114
ICAP00196

2. TITLE AND SUBTITLE

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

3. DATE REPORT PUBLISHED

MONTH	YEAR
February	1994

4. FIN OR GRANT NUMBER

L2245

5. AUTHOR(S)

Young Seok Bang, Kwang Won Seul and Hho Jung Kim

6. TYPE OF REPORT

Technical Report

7. PERIOD COVERED (Inclusive Dates)

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

Korea Institute of Nuclear Safety P.O. Box 16, Daeduk-Danji, Daejon, Korea 305-353

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

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

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.

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

ICAP Program
RELAP5/MOD3
Anticipated Transient Loft

13. AVAILABILITY STATEMENT

Unlimited

14. SECURITY CLASSIFICATION

(This Page) Unclassified

(This Report) Unclassified

15. NUMBER OF PAGES

16. PRICE

NRC FORM 335 (2-89)

Printed on recycled paper

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