NUREG/IA-0228

International Agreement Report

Assessment of RELAP5/MOD3.3Beta Code for the LOFT Experiment L9-1/L3-3

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U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

April 2010

Prepared as part of
The Agreement on Research Participation and Technical Exchange
Under the International Code Assessment and Maintenance Program (CAMP)

Published by
U.S. Nuclear Regulatory Commission

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NUREG/IA-0228

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Manuscript Completed: November 2009
Date Published: May 2010

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ABSTRACT

The purpose of this report is to assess the capability of the RELAP5/MOD3.3Beta computer code to simulate thermal-hydraulic behavior associated with the LOFT Experiment L9-1/L3-3. The Experiment L9-1/L3-3 was a simulation of the total loss-of-feedwater accident and its recovery modes. Experiment L9-1 simulated a loss-of-feedwater accident with delayed reactor scram and no auxiliary feedwater injection. The loss-of-feedwater accident led to a loss-of-coolant accident through the PORV cycling operation.

Generally, the RELAP5/MOD3.3Beta calculation results were in good agreement with the L9-1 experimental data. The discrepancies between the calculation and the experiment were also identified in the temperature behaviors of the SG secondary side after dryout of the SG. However, these discrepancies were not considered to be significant, since the SG was in a de-coupled state from the PCS after the dryout of the SG secondary side.

Experiment L3-3 simulated two recovery modes from the loss-of-feedwater accident L9-1 without the aid of the emergency core coolant system. The first recovery mode consisted of turning off the primary coolant pumps and latching open the PORV to depressurize the primary system. The second mode consisted of refilling the SG to restore the secondary heat sink and removing decay heat through the feed-and-bleed operation using the secondary side of the SG.

The general trends observed in Experiment L3-3 were similar to those of the RELAP5/MOD3.3Beta code calculations. In addition, some differences between the code calculations and the L3-3 experimental data were observed. The code predicted excessive swelling of the PCS fluid during the first recovery mode, and predicted excessive cooling during the second recovery mode. The differences during the first recovery mode were due to the code's under-estimation of total discharged energy through the PORV. For the discrepancies during the second recovery mode, the code modeling deficiency of the SG secondary side was presumed to be one of the reasons. However, it is concluded that further investigation into the deviation sources are needed to enhance the code's predictability, since the specific reasons for the deviation were not clearly identified in this assessment.

Sensitivity studies show that several parameters have significant effect on the predicted thermal-hydraulic behaviors. These parameters include the pressurizer spray system loss coefficient, nodalization of the SG secondary side, SG U-tube heat transfer area, heat transfer coefficient from the LOFT main components to the environment, and the PORV discharge coefficient. The first three parameters are significant during the short-term transient phase, while the last two are significant during the long-term transient phase. Therefore, the five parameters listed above should be carefully modeled to obtain appropriate calculation results for transient types such as the total-loss-of feedwater accident and its recovery modes.

FOREWORD

This report is prepared to assess the capability of the RELAP5/MOD3.3Beta computer code to simulate thermal-hydraulic behavior associated with the LOFT Experiment L9-1/L3-3. The RELAP5 computer code has been developed as a highly generic best-estimate code to be used for simulation of a wide variety of hydraulic and thermal transients in LWR systems. As one of the new code version, RELAP5/MOD3.3Beta was released in June 2001 with several new models and improvements to existing models.

The Loss-of-Fluid Test (LOFT) integral experimental facility was a scaled model of a commercial pressurized water reactor (PWR) to model the nuclear, and thermal-hydraulic phenomena expected to occur primarily during a loss-of-coolant accident (LOCA). The Experiment L9-1/L3-3 was performed in 1981 as a part of the LOFT Experimental Program to simulate total loss-of-feedwater accident and its recovery modes.

The code-predicted results were compared with experimental data to assess the code predictability. From the comparisons, it is concluded that the RELAP5/MOD3.3Beta computer code has sufficient capability in predicting the thermal hydraulic phenomena occurred in the LOFT Experiment L9-1/L3-3 because the code-predicted results were generally in agreement with the measured data. However, some discrepancies between the calculation and the experiment were also observed. In addition, major parameters having significant effect on the predicted thermal-hydraulic behaviors were identified through sensitivity studies.

Regarding this report, the authors acknowledge the financial support of the National Research Foundation under the national mid- and long-term nuclear research and development program of the Ministry of Education, Science and Technology of the Republic of Korea. Also, we especially would like to thank Professor M. Ishii of Purdue University and Dr. Won-Jae Lee of the Korea Atomic Energy Research Institute for their comments and review of this report.

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EXECUTIVE SUMMARY

The RELAP5 computer code has been developed as a highly generic best-estimate code to be used for simulation of a wide variety of hydraulic and thermal transients in LWR systems. As one of the new code version of the RELAP5, RELAP5/MOD3.3Beta was released with several new models and improvements to existing models. The purpose of this report is to assess the capability of the RELAP5/MOD3.3Beta computer code to simulate thermal-hydraulic behavior associated with the LOFT Experiment L9-1/L3-3.

The Experiment L9-1/L3-3 was a simulation of the total loss-of-feedwater accident and its recovery modes. In Experiment L9-1, the pressure increase in the primary system due to the power-cooling mismatch was controlled by the cycling operation of the pressurizer spray valve and by the coolant discharge through the power-operated relief valve (PORV). In the subsequent Experiment L3-3, two independent recovery procedures for the removal of the core decay heat during the total loss-of-feedwater accident were investigated. The first recovery procedure was the PORV latching open to depressurize the primary coolant system. The second one was accomplished by refilling the steam generator to restore the secondary side heat sink and removing the decay heat through a feed-and-bleed operation using the steam generator secondary side.

For the assessment calculation, the base input decks were prepared by incorporating the major parameters which were identified through sensitivity studies to have significant effect on the code calculation results. The code-predicted results were compared with the experimental data to assess the code predictability. Major conclusions through this assessment are summarized as follows:

- From the comparisons presented with Figures and Tables, it was shown that the code-predicted results were generally in agreement with the measured data. Therefore, it is concluded that the RELAP5/MOD3.3Beta computer code has sufficient capability in predicting the thermal hydraulic phenomena occurred in the LOFT Experiment L9-1/L3-3.
- However, the discrepancies between the calculation and the experiment were also identified. In Experiment L9-1, the code over-estimated temperature behaviors of the SG secondary side after dryout of the SG. However, these discrepancies were not considered to be significant, since the SG was in a de-coupled state from the PCS after the dryout of the SG secondary side. In Experiment L3-3, the code predicted excessive swelling of the PCS fluid during the first recovery mode, and predicted excessive cooling during the second recovery mode. The differences during the first recovery mode were due to the code's under-estimation of total discharged energy through the

PORV. For the discrepancies during the second recovery mode, the code modeling deficiency of the SG secondary side was presumed to be one of the reasons. However, it is concluded that further investigation into the deviation sources are needed to enhance the code's predictability, since the specific reasons for the deviation were not clearly identified in this assessment.

- Through sensitivity studies, the major parameters were identified to have significant effect on the predicted thermal-hydraulic behaviors. These parameters include the pressurizer spray system loss coefficient, nodalization of the SG secondary side, SG U-tube heat transfer area, heat transfer coefficient from the LOFT main components to the environment, and the PORV discharge coefficient. The first three parameters are significant during the short-term transient phase, while the last two are significant during the long-term transient phase. Therefore, the five parameters listed above should be carefully modeled to obtain appropriate calculation results for transient types such as the total-loss-of feedwater accident and its recovery modes.

1. INTRODUCTION

The RELAP5 computer code has been developed as a highly generic best-estimate code to be used for simulation of a wide variety of hydraulic and thermal transients in LWR systems. As one of the new code version of the RELAP5, RELAP5/MOD3.3Beta was released in June 2001 with several new models and improvements to existing models [1]. The purpose of this report is to assess the capability of the RELAP5/MOD3.3Beta computer code to simulate thermal-hydraulic behavior associated with the LOFT Experiment L9-1/L3-3.

The Loss-of-Fluid Test (LOFT) integral experimental facility was a scaled model of a commercial pressurized water reactor (PWR). The purpose of this facility was to model the nuclear, and thermal-hydraulic phenomena expected to occur primarily during a loss-of-coolant accident (LOCA). In general, coolant volumes and flow areas in the LOFT were scaled using the ratio of the core power of 50 MWth in the LOFT to 3,000 MWth in a commercial PWR.

The Experiment L9-1/L3-3 was performed in 1981 as a part of the LOFT Experimental Program. It was a simulation of the total loss-of-feedwater accident and its recovery modes. The total loss-of-feedwater (TLOFW) accident is a beyond-design-basis-accident initiated by a loss-of-feedwater due to the failure of the main feedwater pump and subsequent no auxiliary feedwater injection. During the total loss-of-feedwater accident, heat removal capability in the secondary side of the steam generator (SG) is completely degraded and pressure and temperature of the primary coolant system (PCS) are increased to the reactor scram set point. Following the reactor scram, the core decay heat should be removed by proper controlling methods to prevent severe core damage. The role of core decay heat removal during the total loss-of-feedwater accident was considered important since it was identified as one of the major contributors to the severe core damage frequency in previous studies such as WASH-1400 [2].

The LOFT Experiment L9-1/L3-3 provided experimental data for several methods of removing the decay heat during the total loss-of-feedwater accident and its recovery phases. In Experiment L9-1, the pressure increase in the primary system due to the power-cooling mismatch was controlled by the cycling operation of the pressurizer spray valve and by the coolant discharge through the power-operated relief valve (PORV). In the subsequent Experiment L3-3, two independent recovery procedures for the removal of the core decay heat during the total loss-of-feedwater accident were investigated. The first recovery procedure was the PORV latching open to depressurize the primary coolant system. The second one was accomplished by refilling the steam generator to restore the secondary side heat sink and removing the decay heat through a feed-and-bleed operation using the steam generator secondary side. During the second procedure, the primary system pressure decreased rapidly after the reestablishment of the steam generator heat removal capability, and the heat generated in the reactor core was transferred to the steam generator by two-phase natural circulation [3]. In short, the LOFT L9-1/L3-3 was an experiment to evaluate the effectiveness of the PORV and the feed-and-bleed operation using the secondary side for removal of decay heat. This experiment has also been used as a means to evaluate the ability of a thermal-hydraulic computer code in predicting major phenomena.

For the assessment calculation, the base input decks were prepared based on available RELAP5 assessment [4] for this experiment. The major parameters, which were identified through sensitivity studies to have the most significant effect on the predicted thermal hydraulic behaviors, were incorporated into the base calculation to improve the code predictability. The code calculation results were then compared with the measured data to assess the code capability of predicting major phenomena.

2. FACILITY AND TEST DESCRIPTION

2.1 Facility Description

The LOFT integral experimental facility was a scale model of a commercial PWR. The purpose of this facility is to model the nuclear, and thermal-hydraulic phenomena expected to occur primarily during a LOCA. In general, coolant volumes and flow areas in the LOFT were scaled with a ratio of the 50 MWth LOFT core to a commercial 3,000 MWth PWR core. Also, components used in the LOFT are similar to those of a commercial PWR [3]. The experimental facility included five major subsystems which had been instrumented such that system variables could be measured and recorded throughout the experiment. The subsystems include (a) the reactor vessel, (b) the intact loop, (c) the broken loop, (d) the blowdown suppression system, and (e) the emergency core cooling system (ECCS) [5]. The major components of the LOFT facility are shown in Figure 1, and a detailed system description is presented in Reference [6].

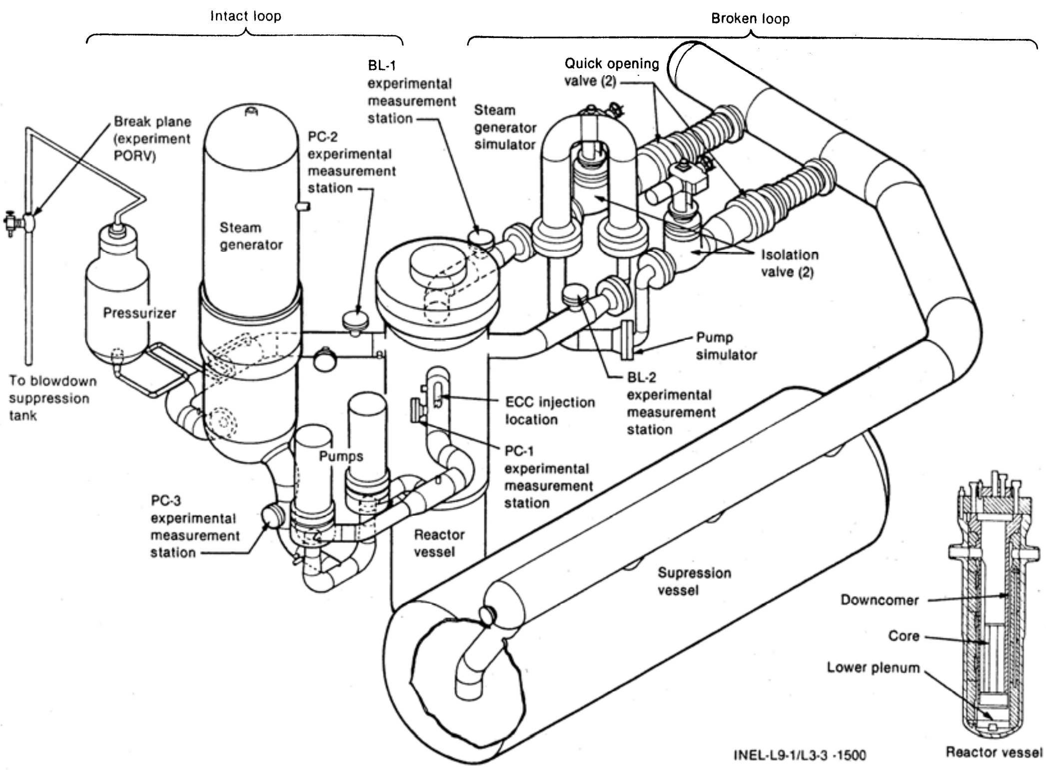

Figure 1. Configuration of LOFT System for Experiment L9-1/L3-3

2.2 Test Description

Since 1976, 43 non-nuclear and nuclear experiments have been performed in the LOFT facility

[3]. The Experiment L9-1/L3-3 [3,5,7] conducted on April 15, 1981, consisted of two sequential tests. Experiment L9-1 was performed as part of the LOFT Experiment Series L9 (anticipated transient with multiple failure), and Experiment L3-3 was performed as part of the LOFT Experiment Series L3 (small break LOCA).

Experiment L9-1 was the first anticipated transient with multiple failures performed in the LOFT, and simulated a loss-of-feedwater accident with delayed reactor scram and no auxiliary feedwater injection. The loss-of-feedwater accident led to a loss-of-coolant accident through the PORV. In Experiment L9-1, the transient was initiated by loss-of-feedwater due to the failure of the main feedwater pump. The reactor scrammed on the indication of high pressure (15.745 MPa) in the intact loop hot leg approximately 65 seconds after the main feedwater pump was tripped. The auxiliary feedwater injection into the steam generator was prevented, as was scram on the indication of low liquid level in the steam generator. The main steam control valve (MSCV) of the steam generator started to close automatically on the reactor scram and finished closing 12.2 seconds later (at 77.2 sec). The pressurizer spray valve cycled automatically at its close (15.05 MPa) and open (15.338 MPa) set points from 30 seconds until it was closed by the operators at the 1,246.0 seconds to allow the PCS pressure to increase to the PORV set point. The PORV started cycling operation at 1,467.9 seconds to control primary system pressure, until it was manually latched open at 3,270 seconds. The open and close set points of the PORV were 16.20 MPa and 16.06 MPa, respectively.

Experiment L3-3 simulated two recovery modes from the loss-of-feedwater accident L9-1 without the aid of emergency core coolant (ECC). The first recovery mode consisted of turning off the primary coolant pumps and latching open the PORV to depressurize the primary system. The second mode consisted of refilling the steam generator to restore the secondary heat sink and removing decay heat through the feed-and-bleed operation using the secondary side of the steam generator. Experiment L3-3 began when the PORV was secured in the open position. The primary coolant pumps were tripped 15 seconds later, with pump coastdown lasting about 20 seconds. Saturation occurred in the upper plenum about 60 seconds after the beginning of Experiment L3-3 at the 3,329.4 seconds. The primary pressure decreased to the saturation pressure of 12.3 MPa. This pressure was below the high pressure safety injection system (HPSI) set point of 13.2 MPa, which would have initiated ECCS injection had it not been purposely locked out. After closing the PORV at 4,849.7 seconds, steam generator refill began at 5,114.6 seconds. Natural circulation was established during steam generator refill which was completed at 5,746.4 seconds. Alternating secondary coolant system feed-and-bleed operations began at the 6,712.2 seconds. The experiment was complete at 9,517.4 seconds. The initial plant operating conditions and the major sequence of events for Experiment L9-1/L3-3 are presented in Table 1 and 2, respectively.

The objectives of the L9-1/L3-3 Experiment were specified as follows [5]:

2.2.1.1 Experiment L9-1 Objectives

- To evaluate uncertainties in predicted primary and secondary thermal hydraulic response associated with steam generator dryout during delayed scram,
- To evaluate the adequacy of PORV to provide overpressure protection in a loss-of-feedwater accident.

2.2.1.2 Experiment L3-3 objectives

- To investigate uncertainties in system response during a PORV imposed small break with loss of secondary heat sink,
- To assess uncertainties in small break performance predictions identified in NUREG-0623 [8],
- To assess the effectiveness of steam generator refill on loss-of-feedwater accidents following reestablishment of auxiliary feedwater availability,
- 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,
- To contribute to the NRC relief and safety valve testing program by providing experimental data on PORV performance characteristics over a range of PORV inlet fluid conditions.

3. CODE AND MODELING

3.1 Code Description

The code version of RELAP5/MOD3.3Beta, into which several new models and improvements were incorporated, was used for this assessment calculation. Some models recommended in the previous RELAP5 versions such as a new steam table and the Henry-Fauske choked flow model were used as default models in this version. In addition, improved or modified models in the RELAP5/MOD3.3Beta include non-condensable gas treatment, wall friction term modification, time-dependent volume correction, CANDU model updates, etc. The descriptions of the RELAP5/MOD3.3Beta code are presented in detail in the code manuals [1].

3.2 Base Input Modeling

For the purpose of the RELAP5/MOD3.3Beta assessment, input decks for the base calculation were prepared based on the reference calculation [4] which was the recent RELAP5 assessment for the LOFT Experiment L9-1/L3-3. The modifications were made to the reference input decks to incorporate the major parameters which were identified through sensitivity studies to have significant effect on the code calculation results. These parameters include loss coefficient of the pressurizer spray system, nodalization of the secondary side of the steam generator, heat transfer area of the steam generator U-tube, heat transfer coefficient from the LOFT main components to the environment, and discharge coefficient of the PORV. The results of the sensitivity studies for the parameters listed above are presented in Section 4.2.

The modifications made to the reference input decks for base input modeling are summarized as follows:

- The mass flow rate into the pressurizer through the pressurizer spray valve was increased by reducing the loss coefficient of the pressurizer spray system

- The bottom node of the steam generator secondary side and associated nodes of the U-tube of the reference calculation were subdivided into four, which implies that the number of nodes of the SG secondary side associated with the U-tube changed into six.

- The heat transfer area of all the nodes of the steam generator U-tube increased by 20% to improve the code-predicted heat transfer phenomena through the SG U-tube.

- The heat transfer coefficient to the environment from the LOFT main components (the reactor vessel, the steam generator, the pressurizer, and primary coolant system) was increased by 40% to have the PCS temperature match with the experimental data during the long-term phase of the transient.

- The discharge coefficient and the thermal non-equilibrium constant of the PORV were set to 0.8 and 0.03 respectively to make the code-calculated mass flow rate through the PORV be in agreement with test data.

- The counter current flow limitation (CCFL) model was applied to the junctions (components 115-3, 400-1, 410-0) for which the flooding phenomena was presumed to occur.

- The additional junction connected to the accumulator was removed, because it was not allowed in the code version of RELAP5/MOD3.3Beta. Since the emergency core cooling system (ECCS) was not injected during Experiment L9-1/L3-3, the junction removal from the accumulator does not affect the calculation results.

- The initial conditions in the reference input decks for some volumes were slightly modified to make the base input decks compatible with the RELAP5/MOD3.3Beta code.

As shown in Figure 2, the LOFT facility was composed of 134 volumes, 143 junctions, and 142 heat structures in the RELAP5 modeling for the base calculation. The intact loop was modeled with 31 hydrodynamic volumes. Environmental heat losses from all the piping metal structures exposed to atmosphere were simulated using the heat structure components. The broken loop was composed of a hot leg, a cold leg, a SG-pump simulator, a reflood assist bypass system (RABS), and quick opening blowdown valves (QOBVs). The volume and junction modeling options were set to the default options. The active core, the downcomer and the filler gap were composed of three volumes, six, and seven vertically stacked volumes, respectively. The rod bundle interphase friction model option was applied to the active core volumes. The fuel rods were modeled using 3 heat structures representing the central fuel assembly and 2 heat structures representing the peripheral fuel assemblies of the LOFT core. The pressurizer system was modeled with a surge line, a pressurizer vessel, a spray line from the cold leg, a spray valve and a PORV. Two volumes for the surge line, nine volumes for the pressurizer vessel and one volume for the spray line were used. The spray valve and the PORV were simulated with two trip valves. The associated trip logic was prepared according to the experimental specification. The SG was modeled using 12 volumes in the primary coolant system and 8 volumes in the SG riser. Heat was exchanged between the primary and secondary sides of the SG through the U-tube, which was modeled using 12 heat structures. The rod bundle interfacial friction option was used for the volumes in contact with the U-tubes heat structures. The emergency core cooling system in the LOFT was also modeled. However, it is not used in the transient calculation. The containment was modeled using a time-dependent volume with constant pressure.

A steady state run was performed to obtain initial conditions of the whole system prior to running the transient case. The initial conditions obtained from the steady state run are presented in Table 1 and compared to the measured data. The RELAP5 results for the steady state run agree well with the experimental initial conditions except for the hot leg temperature of the broken loop. The hot leg temperature of the broken loop deviated from the range of the experimental uncertainty. However, considering that the broken loop does not play an important role from the perspective of the heat removal and the temperature deviation was not significant, it was concluded that the out-of-range value for the broken hot leg temperature would not adversely affect the overall transient calculation.

The boundary conditions and the control trips used in the base calculation were identical to those used in the reference calculation. The information for the boundary conditions and the control trips can be found in the attached input decks. The steady state and the transient input decks for the base calculation are presented in Appendix A and B, respectively.

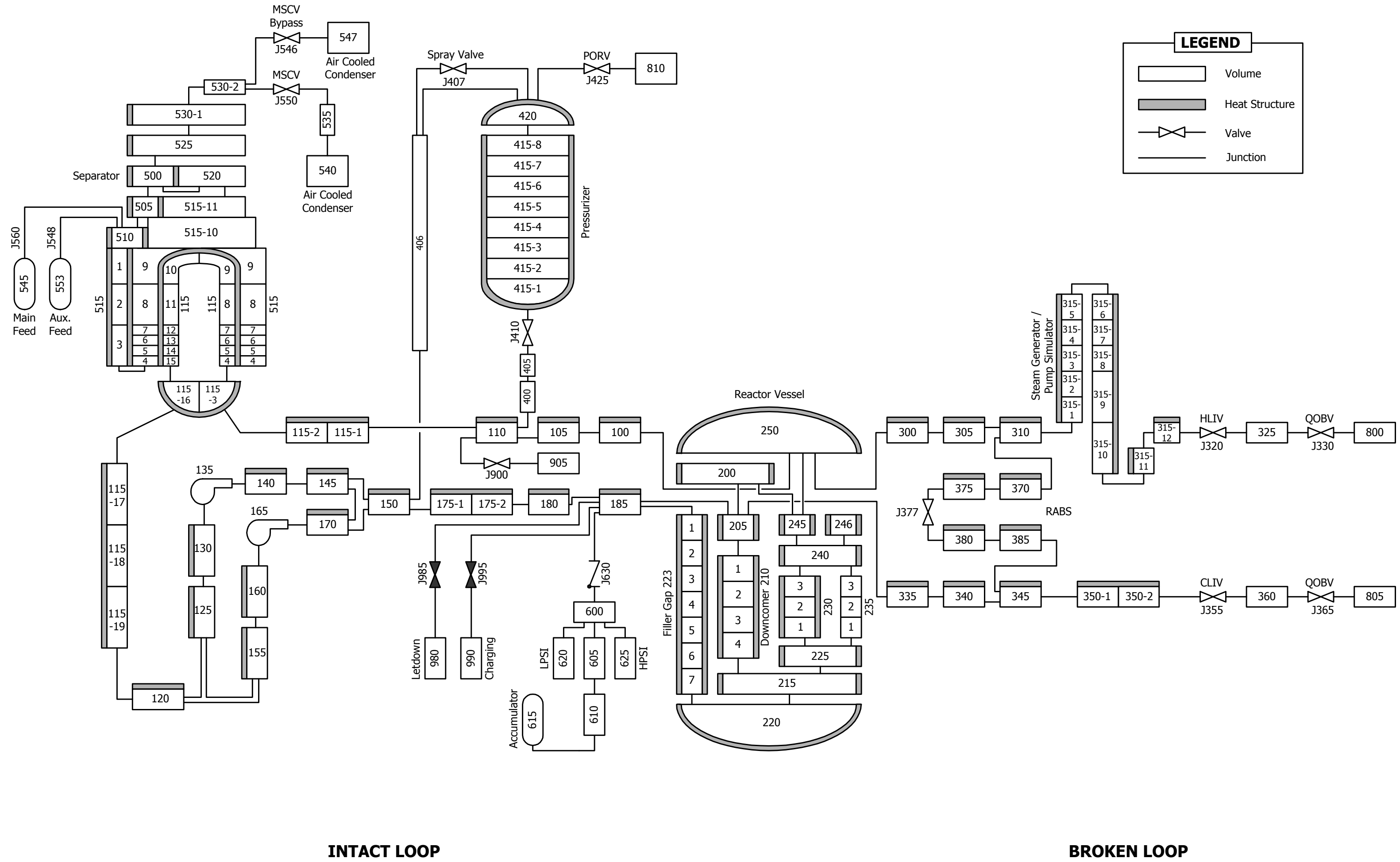

Figure 2. RELAP5 Nodalization for LOFT L9-1/L3-3

Table 1. Initial Condition for Experiment L9-1/L3-3

Parameter	Measured	Calculated
Primary Coolant System		
Mass flow rate (kg/s)	479.1±2.6	479.4
Hot leg pressure (MPa)	14.9±0.10	14.91
Cold leg temperature (K)	558.9±1.3	557.7
Hot leg temperature (K)	578.2±1.8	577.0
Reactor		
Power level (MW)	49.6±0.9	49.6
Steam Generator Secondary Side		
Water level (m)	0.14±0.08	0.14
Water temperature (K)	545.0±0.8	546.1
Pressure (MPa)	5.67±0.08	5.70
Mass flow rate (kg/s)	27.0±1.0	26.1
Broken Loop		
Hot leg temperature (K)	563.3±2.6	556.9
Cold leg temperature (K)	557.6±2.6	557.6
Pressurizer		
Steam Volume (m^3)	0.43±0.05	0.48
Liquid volume (m^3)	0.50±0.05	0.48
Water temperature (K)	614.9±1.3	614.7
Pressure (MPa)	14.93±0.25	14.93
Liquid level (m)	0.92±0.1	0.92

4. RESULTS AND DISCUSSION

4.1 Base Calculation

The results of the base calculation with the RELAP5 modeling described in the previous section are compared with the experimental data in Figures 3 through 13. Figures 3 to 7 are comparisons for short-term responses up to 300 seconds, while Figures 8 to 13 are comparisons for the long-term transient up to 10,000 seconds. In addition, the chronology of the major events for the base calculation is compared with the measured data in Table 2 for the LOFT Experiment L9-1/L3-3.

4.1.1 Short-term Responses

The major thermal-hydraulic phenomena which can be observed during the short-term phase of the transient include, dryout of the SG secondary side, PCS pressurization, PCS pressure controlby the pressurizer spray valve, and decay heat removal following reactor trip, etc.

The pressure trend of the PCS together with that of the SG secondary side is compared with experimental data in Figure 3. As the heat removal capability in the SG secondary side degraded due to the trip of the main feedwater pump, the pressure of the PCS gradually increased. When the PCS pressure reached the set pressure of 15.338 MPa, it was controlled by the pressurizer spray valve activation. As the heat generation in the reactor core exceeded the heat removal capability by both the SG secondary side and the pressurizer spray valve actuation, the PCS pressure continued to increase up to the reactor scram set pressure of 15.745 MPa. Following the scram, the PCS pressure decreased because the power input to the PCS dropped sharply to the decay power level. After that, the pressurization of the PCS due to decay heat was controlled by pressurizer spray actuation and subsequent steam condensation. The pressure of the SG secondary side rose gradually following initiation of the transient due to heating from the primary side. As the secondary side of the SG was drying out, however, the reduced heat removal capability decreased the pressure in the SG. The SG pressure increased again as the main steam control valve (MSCV) started to close on the reactor scram signal. As shown in Figure 3, the code pressure results calculated for both the PCS and the SG secondary side were in agreement with the experimental data.

The temperature comparisons of the calculated and experimental results for the PCS and the SG secondary side are shown in Figure 4. It is shown in the figure that the temperature behavior is predicted well by the code, even though minor discrepancies are shown. However, these differences are not considered significant to affect the later calculation results.

Figure 5 shows a comparison of the calculated reactor power to the experimental data. It is apparent that the predicted behavior of the reactor power is very similar to the experimental data. This implies that the code-predicted heat addition to the PCS during the transient matched well with the experiment.

A comparison of the experimental and calculated mass flow rate through the MSCV is presented in Figure 6. As the pressure in the SG secondary side increased, the mass flow rate through the MSCV increased until the MSCV started to close on the reactor scram signal. From this comparison, it can be stated that the mass flow rate behavior through the MSCV can be predicted very well by the code.

Figure 7 shows a comparison of the calculated and experimental results for the SG collapsed liquid level. The SG secondary collapsed water level is a good indication of SG secondary conditions changing. The water level of the SG secondary side dropped monotonically due to evaporation without feed. As the water level decreased, the heat transfer rate through the SG U-tube degraded and this forced the PCS pressure to increase up to the reactor scram set point. After dryout of the SG secondary side, the heat transfer to the SG secondary side through the U-tube was by vapor natural circulation with a small wall heat transfer coefficient. This implies that the secondary system was de-coupled from the primary side and therefore it could no longer control the PCS pressurization. The calculated dryout rate of the SG secondary side closely resembled the test data as shown in Figure 7.

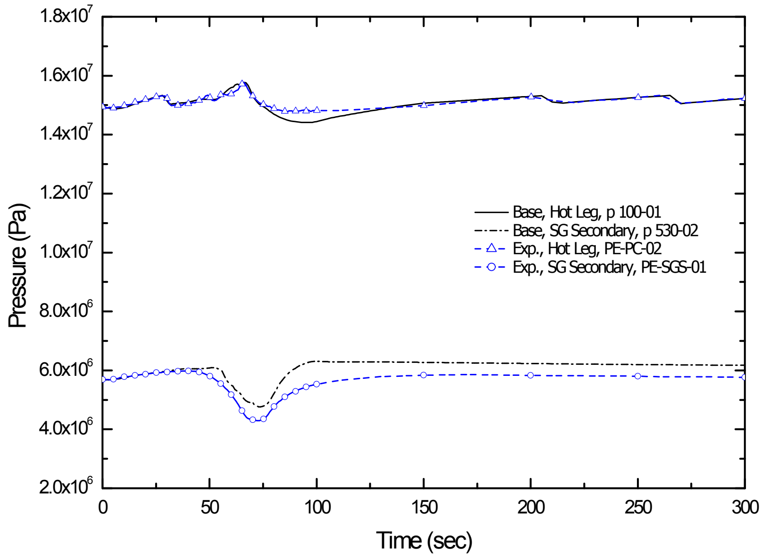

Figure 3. Comparison of Pressure for Short-term Response

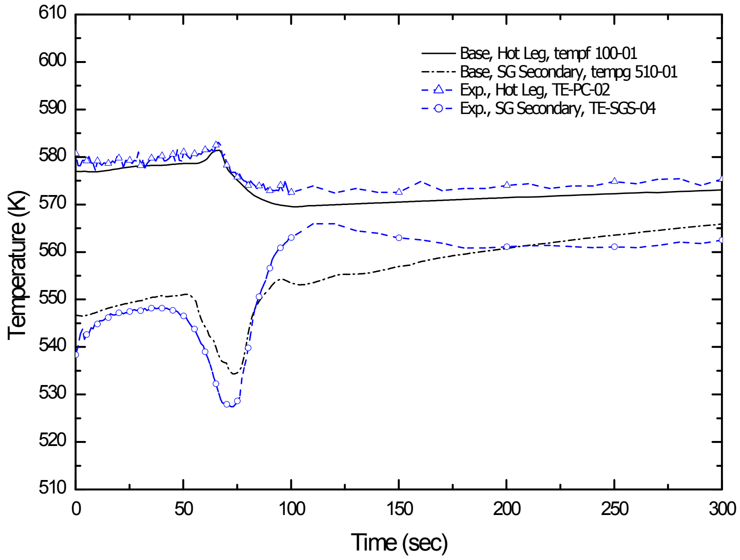

Figure 4. Comparison of Temperature for Short-term Response

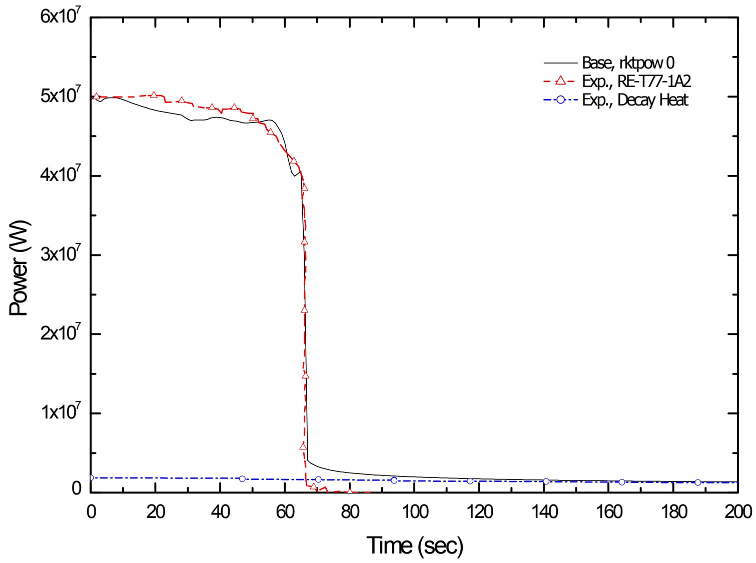

Figure 5. Comparison of Reactor Power for Short-term Response

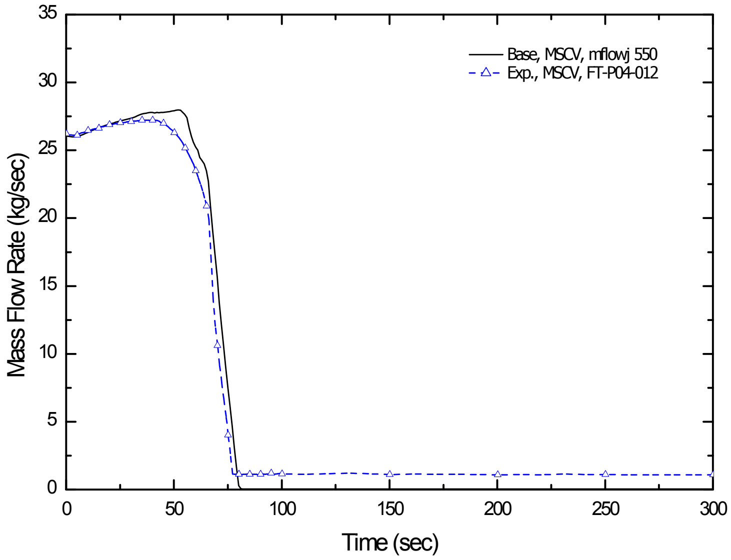

Figure 6. Comparison of Mass Flow Rate through MSCV for Short-term Response

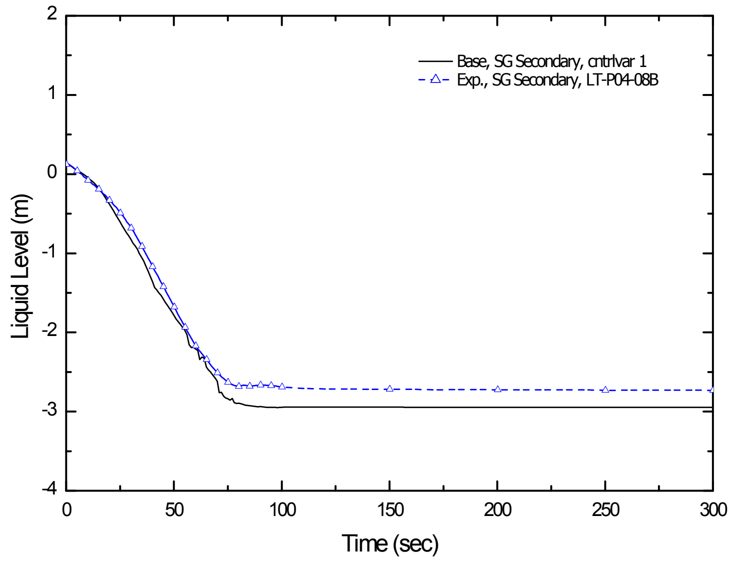

Figure 7. Comparison of SG Liquid Level for Short-term Response

Table 2. Major Sequence of Events for Experiment L9-1/L3-3

Event	Measured (sec)	Calculated (sec)
L9-1		
Main feedwater pump tripped off	0.0	0.0
Pressurizer spray activated	30.0±0.1	29.0
Reactor scram	65.4±0.2	65.0
Steam generator main steam control valve closed	77.2±0.2	80.0
Steam generator liquid level reached bottom of indicating range (0.25 m, above tube sheet)	190	71.0
Pressurizer spray valve cycling initiated	208.9±0.1	205.0
Pressurizer liquid level reached top of indicating range (1.83 m, above bottom)	1089.7±30	1365.0
Pressurizer spray valve cycling ended	1246.0±0.1	1785.0
PORV cycling initiated	1467.9±0.1	1785.0
L3-3		
PORV latched open	3269.9±0.1	3295.1
Primary coolant pumps tripped off	3284.8±0.2	3295.1
Primary coolant pump coastdown completed	3304.2±0.8	3330.1
Upper plenum fluid reached saturation pressure	3329.4±0.2	3405.3
PORV closed	4849.7±0.1	4880.4
Steam generator secondary refill initiated	5114.6±0.2	5145.4
Natural circulation initiated	5205±10	-
Steam generator secondary refill completed	5746.4±0.2	6255.5
Pressurizer liquid level reached bottom of indicating range (0.06 m, above bottom)	5915±5	5570.5
Steam generator secondary feed-and-bleed initiated	6712.2±0.2	7230.4
Experiment completed	9517.4±0.2	-

4.1.2 Long-term Responses

Most of the thermal-hydraulic phenomena during the long-term phase occurred following sub-sequences such as PCS pressure control by PORV cycling and latched open, plant recovery by refilling the SG secondary side, and removing decay heat through a feed-and-bleed operation using the secondary side.

Figure 8 presents a comparison of calculated and experimental pressure value during the long-term transient phase for both the PCS and SG secondary side. The cycling operation of the pressurizer spray valve controlled the PCS pressure from the 30 seconds. In the experiment, the pressurizer spray was closed by an operator at 1,246.0 seconds. For the RELAP5 model, the pressurizer spray was modeled to be terminated on the indication of the PORV actuation. As decay heat added to the PCS exceeded the cooling capability of the pressurizer spray, the PORV cycling operation started to regulate the PCS pressure. The PORV cycling operation continued for about 1,800 seconds until the PORV was latched open. During the cycling operation by both the pressurizer spray valve and the PORV, the pressure of the SG secondary side was decreased monotonously. Figure 8 shows that the code-predicted pressure behavior during this period matched very well with test data.

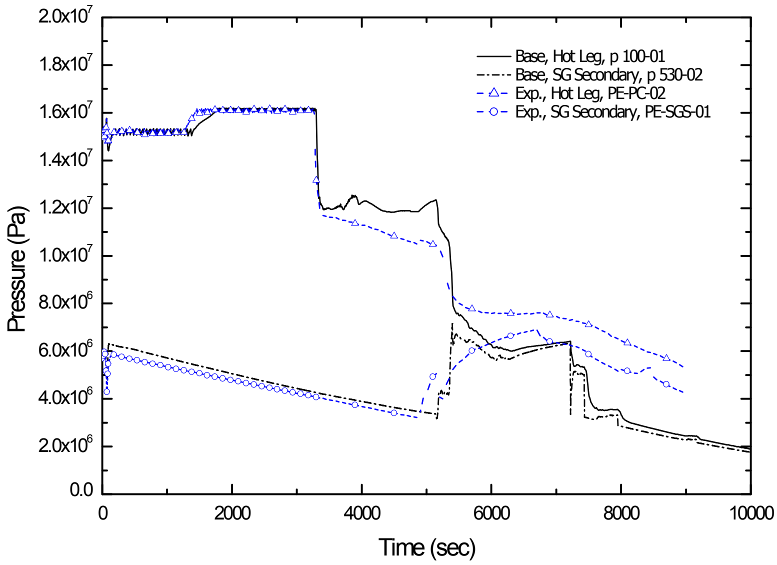

Figure 8. Comparison of Pressure for Long-term Response

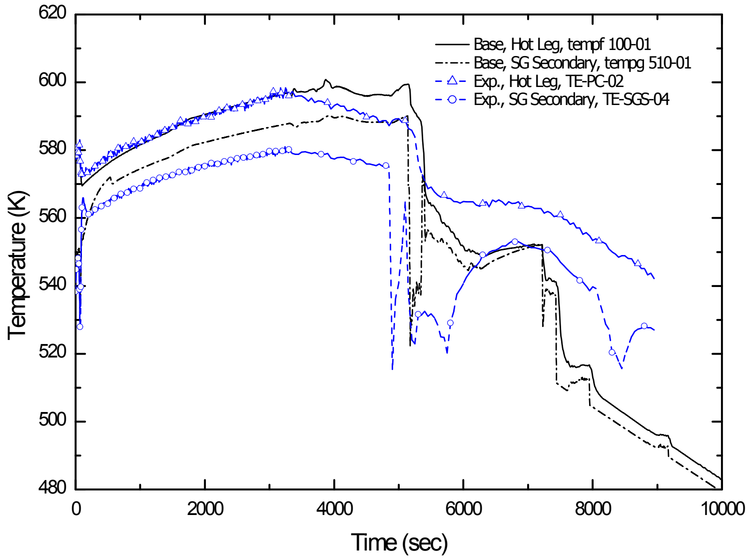

Figure 9. Comparison of Temperature for Long-term Response

The temperature for both the PCS and the SG secondary side during the cycling operation of the pressurizer spray valve and the PORV was increased gradually as presented in Figure 9. The calculated temperature of the PCS was in agreement with test data. The temperature of the SG secondary side, however, was over-estimated by the code. Since the SG was still in a de-coupled state from the PCS, the conservative prediction of the PCS behavior was not considered to be significant.

Figure 10 shows a comparison of pressurizer collapsed liquid level. It appears that the code-calculated liquid level is higher than the level in the experiment, especially during the PORV cycling operation. However, the difference is believed to be due to the fact that the differential pressure detector for water level calculation could not measure the water level over the upper detector location (1.83m, above bottom), while the code calculated the water level at the top of the pressurizer (2.0m, above bottom).

Experiment L3-3 was initiated by the PORV latched open. The LOFT plant recovery during this experiment was by two subsequent recovery procedures. The first recovery procedure was the PORV latched open to depressurize the primary coolant system. The second recovery procedure was by refilling the SG and removing decay heat through a feed-and-bleed operation using the SG secondary side.

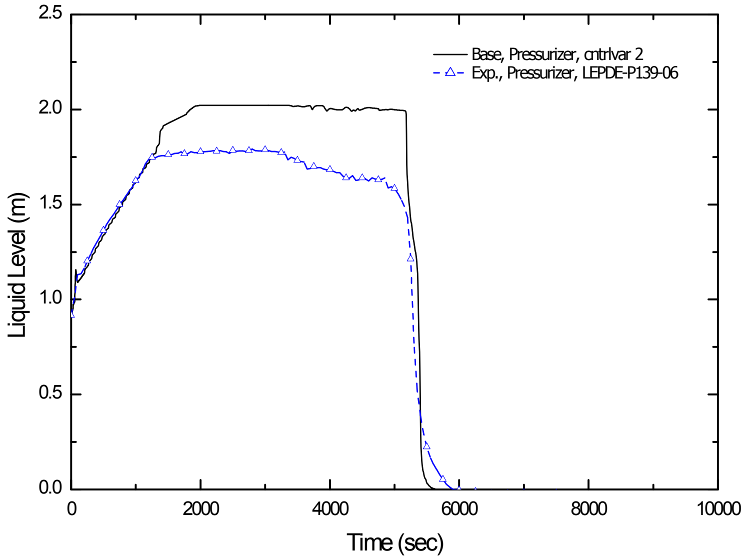

Figure 10. Comparison of Pressurizer Collapsed Liquid Level

The PORV was latched open at the 3,269.9 seconds, and maintained its state to 4849.7 seconds. The PCS pressure and temperature during the PORV latched open period was over-estimated by the code as seen in Figures 8 and 9, respectively. One of the reasons for this discrepancy was that the code-predicted excessive swelling of the PCS fluid during the time the PORV was latched open as noted in the reference calculation [4]. The excessive swelling of the code prediction can be confirmed from the behavior of the pressurizer water level in Figure 10.

The predicted water level during this period remained nearly constant, while the measured level decreased gradually as the fluid discharged through the PORV. This implies that the top of the pressurizer was filled with lower steam quality in the code calculation than in the experiment. Considering that water has much lower enthalpy than steam, the total discharged energy through the PORV would be under-estimated in the code, while the code-predicted mass flow rate through the PORV agreed well with the test data as shown in Figure 11. Therefore, it is concluded that over-estimation of the PCS pressure and temperature during the PORV latched open period is due to the code's under-estimation of total discharged energy through the PORV.

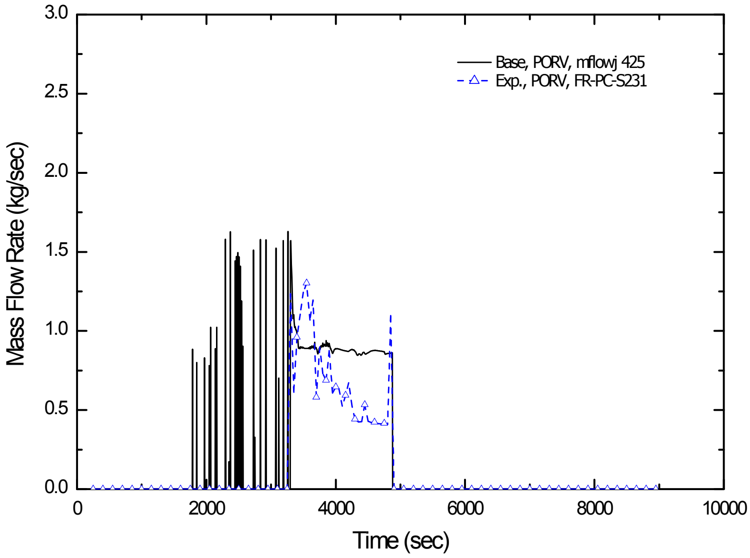

Figure 11. Mass Flow Rate through PORV for Long-term Response

Other important phenomena occurring during the period when the PORV was latched open were the changes in the fluid condition and the mass of the PCS. Figure 12 shows that the PCS fluid rapidly reached saturation conditions when the PORV was latched open, and, as a result, the steam started to be generated. In Figure 13, the change to the PCS system mass during this period is presented. It is apparent from Figure 13 that the code-calculated PCS mass behavior such as the total mass and the decreasing slope were very close to the measured data.

The second recovery procedure was initiated by refilling the SG secondary side through the auxiliary feedwater line, and the plant recovery was completed through feed-and-bleed operation. As the PCS was coupled again with the SG secondary side during the second recovery period, the PCS pressure and temperature decreased rapidly. It can be seen from Figures 8 and 9 that the code-predicted trends of the system pressure and temperature generally agree well with the experimental data, even though the excessive cooling by the code was also shown.

For the code-predicted excessive cooling during the second recovery procedure, the code modeling deficiency of the SG secondary side was presumed to be one of the reasons. However, the specific reasons for the deviation were not clearly identified in this assessment. Therefore, further investigations into the deviation sources are needed to enhance the code's predictability.

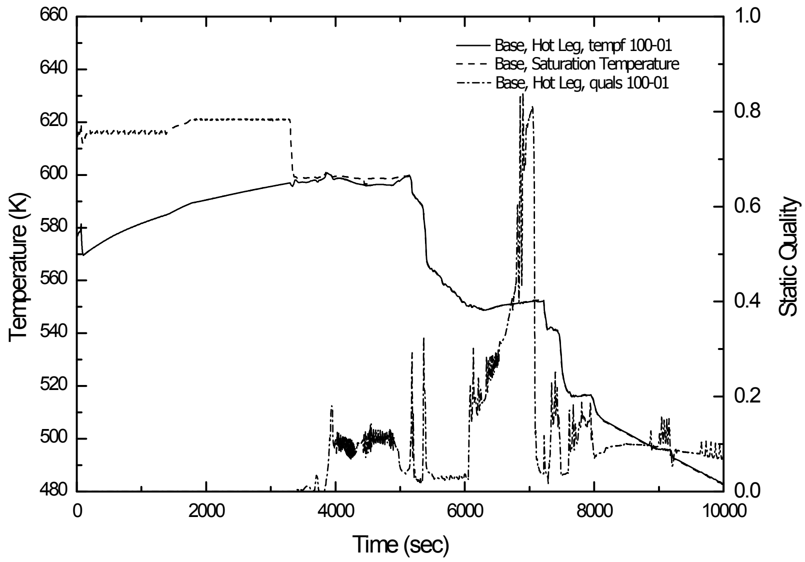

Figure 12. Fluid Conditions of Hot Leg for Long-term Response

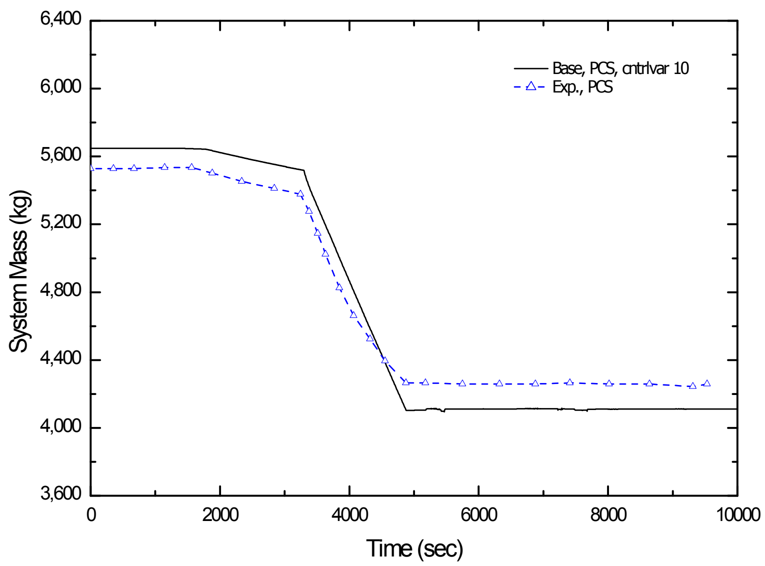

Figure 13. System Mass of PCS for Long-term Response

4.2 Sensitivity Studies

The sensitivity studies were performed to identify parameters having significant effect on the predicted thermal hydraulic behaviors. The cases and the parameters for the sensitivity studies are presented in Table 3. The first three parameters were selected as short-term parameters, while the last two were chosen as parameters which affect the long-term transient behavior. The code-predicted results for each case are compared with both the base calculation and the experimental data in Figures 14 through 17.

Table 3. Matrix for Sensitivity Studies

PARAMETERS \ CASES		Base	Case 1	Case 2	Case 3	Case 4	Case 5
Short-term Parameters	Pressurizer Spray Valve Loss Coefficient	1.0	15.432 (Note 1)	Base	Base	Base	Base
	SG Nodalization	6	Base	3 (Note 1)	Base	Base	Base
	SG U-tube Heat Trans. Area (Cylinder Height)	12149.9 m^2	Base	Base	10124.9 m^2 (Note 1)	Base	Base
Long-term Parameters	Heat Transfer Coefficient to Environment	(Note 2)	Base	Base	Base	(Note 1)	Base
	PORV Discharge Coefficient	0.8	Base	Base	Base	Base	1.0 (Note 1)

Notes:
1. These values are identical to those in NUREG/IA-0114 [4]. The environmental loss heat transfer coefficients for components are as follows:
   Reactor Vessel and Pipe: 13.450 W/m^2K
   Steam Generator: 3.385 W/m^2K
   Pressurizer: 3.019 W/m^2K
2. Compared to those in the NUREG/IA-0114, the environmental loss heat transfer coefficients for these cases are increased by 40% as follows:
   Reactor Vessel and Pipe: 18.830 W/m^2K
   Steam Generator: 4.739 W/m^2K
   Pressurizer: 4.227 W/m^2K

4.2.1 Pressurizer Spray System Loss Coefficient (Case 1)

The pressurizer spray in the LOFT facility was used to regulate the PCS pressure by condensing steam at the top of the pressurizer. The loss coefficient of the pressurizer spray system which determines the amount of the spray flow was known to have a remarkable effect on the RCS pressure behavior [9]. In this sensitivity study, the effect of the mass flow rate through the spray valve was investigated. The mass flow rate was reduced from 1.7 kg/sec to 1.0 kg/sec by increasing the loss coefficient of the spray valve from 1.0 to 15.432 [4]. From the comparison in Figure 14, it is seen that the pressure before reactor scram increased more rapidly than for the base calculation, as the reduced mass flow rate was not sufficient to suppress the pressure increase. The pressure increase after the reactor scram, however, was slower than that for the base calculation because the heat added to the PCS was smaller than in the base calculation due to the earlier reactor trip.

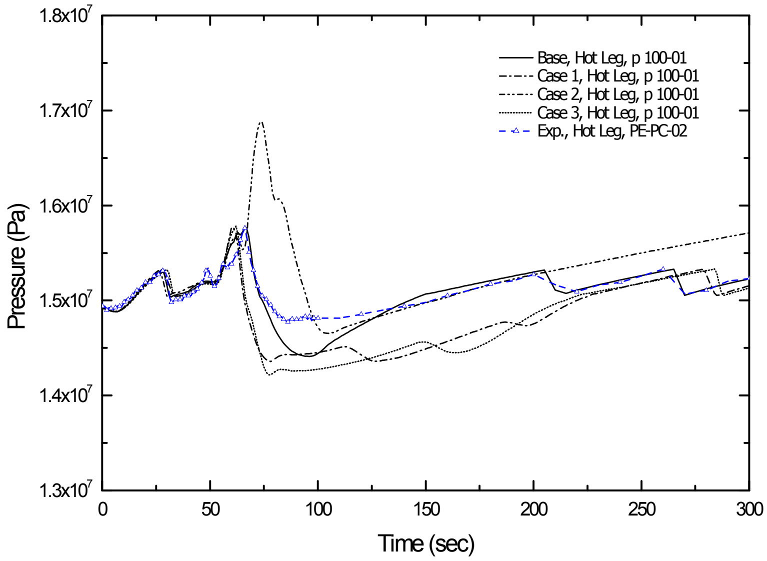

Figure 14. Sensitivity Studies for Short-term Parameters

4.2.2 Steam Generator Nodalization (Case 2)

The heat transfer phenomena through the SG U-tube plays a very important role in this type of transient, because the heat generated in the reactor is mainly removed by the SG secondary side until it is de-coupled after a complete depletion. The SG nodalization is one of the most important parameters which affect the heat transfer phenomena through the SG [9, 10]. The effect of coarse nodalization of the SG was examined for this case. The nodes of the SG U-tube and the SG secondary side associated with the U-tube were reduced from 6 to 3 nodes, which implied that the subdivided four nodes in the base calculation were merged into one node as in the reference calculation [4]. As shown in Figure 14, this modeling change caused completely different results from the base calculation. The PCS pressure surge was not controlled, even though the reactor trip was accomplished on indication of the PCS high pressure. The pressure was not suppressed until it had increased sharply to the PORV actuation set pressure. The reason for this can be deduced from a comparison of the heat transfer rate through the U-tube.

Figure 15 shows that the heat transfer rate during the period of the steep pressure increase after the reactor trip was lower for this case than for the base calculation, which led to the PCS over-pressurization. Therefore, the PCS over-pressurization can be attributed to the coarse nodalization of the SG U-tube and the associated SG secondary side.

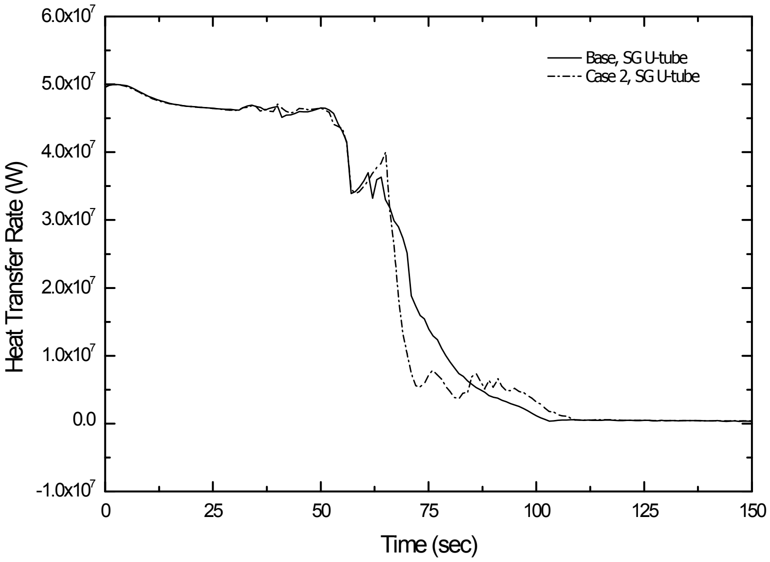

Figure 15. Comparison of Heat Transfer Rate through SG U-tube

4.2.3 Steam Generator U-tube Heat Transfer Area (Case 3)

The heat transfer area of the SG U-tube was generally identified as a factor to have an impact on the initial conditions in the SG secondary side [4, 11]. This implies that the SG U-tube heat transfer area may also affect the SG heat transfer phenomena during the transient phase. Therefore, the SG U-tube heat transfer area also selected as a sensitivity parameter. In this sensitivity study, the heat transfer area of all the nodes of the SG U-tube was reduced to 10,124.886 m^2 [4] from 12,149.864 m^2 in the base calculation. From Figure 14, the PCS pressure behavior for Case 3 is very similar to that in the Case 1, i.e., reduction of the pressurizer spray valve loss coefficient. The reactor tripped earlier due to the reduced heat transfer to the SG secondary side, and the pressure increase after the reactor trip was slower than for the base calculation due to the reduced heat added to the PCS from the reactor core as in Case 1.

4.2.4 Heat Transfer Coefficient to Environment (Case 4)

Generally, the heat losses to the environment from the plant main components after a reactor trip can affect the long-term trend of the transient since the amount of the heat loss to the environment is not negligible compared to the decay heat level. In the previous calculation using RELAP5/MOD1, the PCS fluid heatup rate during the PORV cycling operation was much faster than in the experiment, and the amount of the discharged coolant through the PORV was greater in the calculation than in the experiment [3,7]. This difference was considered due to higher environmental heat losses from the primary system than assumed [3]. In this sensitivity study, the effect of the environmental heat loses was investigated. The values from reference calculation [4] were used as heat transfer coefficients of the major components such as the reactor vessel, the steam generator, the pressurizer, and primary coolant system, as shown in Table 3. This implies that the total heat loss to the environment from the plant main components was decreased by about 40% in this sensitivity study. As shown in Figure 16, the environmental heat loss mainly affected the PCS temperature behavior during the cycling operation period of both the pressurizer spray and the PORV. During this period, the temperature increased more rapidly than for the base calculation as the total heat loss to the environment was reduced. In addition, the steeper temperature increase resulted in the successive key events such as the PORV latched open, the SG refill, and the feed-and-bleed operation to occur earlier than for the base calculation.

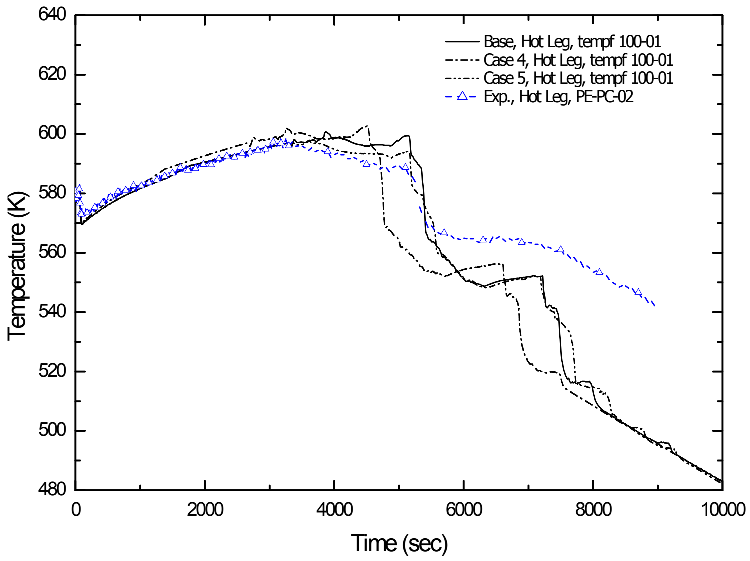

Figure 16. Sensitivity Studies for Long-term Parameters

4.2.5 PORV Discharge Coefficient (Case 5)

The effect of the discharge coefficient and the thermal nonequilibrium constant of the PORV were checked by setting them at 1.0 and 0.14, respectively. The calculated mass flow rates using these setting are compared in Figure 17. Compared to the base calculation, the mass flow rate through the PORV for this sensitivity increased up to 50% during the PORV latched open period as shown in Figure 17. This increased mass flow resulted in a more rapid PCS cooling during the PORV latched open period. However, the PCS temperature behavior during the cycling operation of the PORV was not influenced by the increased mass flow rate through the PORV as shown in Figure 16.

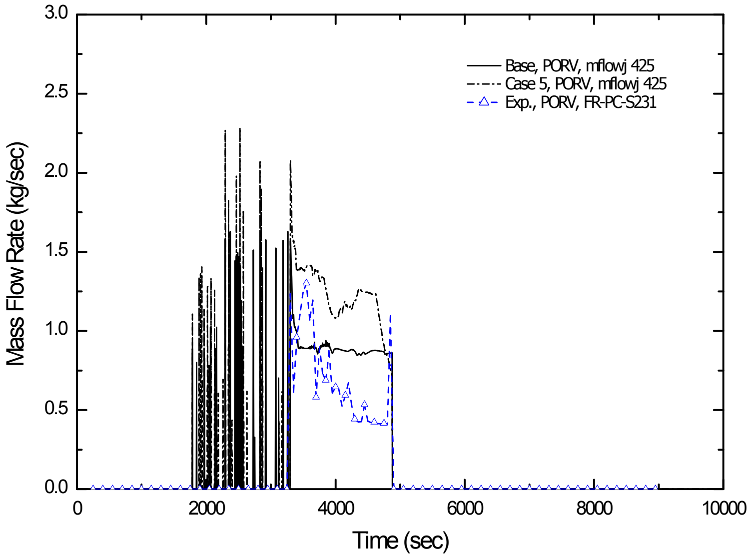

Figure 17.   Sensitivity Study for Mass Flow Rate through PORV

4.3 Run Statistics

An IBM Personal Computer (Pentium III 933 MHz) was used for the present calculations with a DOS operating system. The required CPU time and the time step size with respect to the real transient times for the base calculation are presented in Figures 18 and 19, respectively. Figure 18 shows that the required CPU time up to the real transient time of 10,000 seconds is 2,427.76 seconds, including the input processing time of 3.46 seconds. Therefore, the grind time for the base calculation is calculated as follows:

CPU time, CPU = 2,427.76 - 3.46 = 2424.3 sec

Number of time steps, DT = 125,092

Number of volumes, C = 134

Grind time = CPU $\times$1,000 / (C $\times$DT) = 0.14463 CPU msec/vol/step

In Figure 19, the advanced time step size is compared with the Courant time step size. The maximum time steps specified in the base input decks were 1.0 second up to 1,000 seconds, 0.1 second up to 2,000 seconds, 0.5 second up to 4,000 seconds, 0.1 second up to 8,000 seconds, and 0.5 second up to 10,000 seconds of the real transient time. It is shown in Figure 19 that the advanced time step sizes were below the Courant time step sizes throughout the transient.

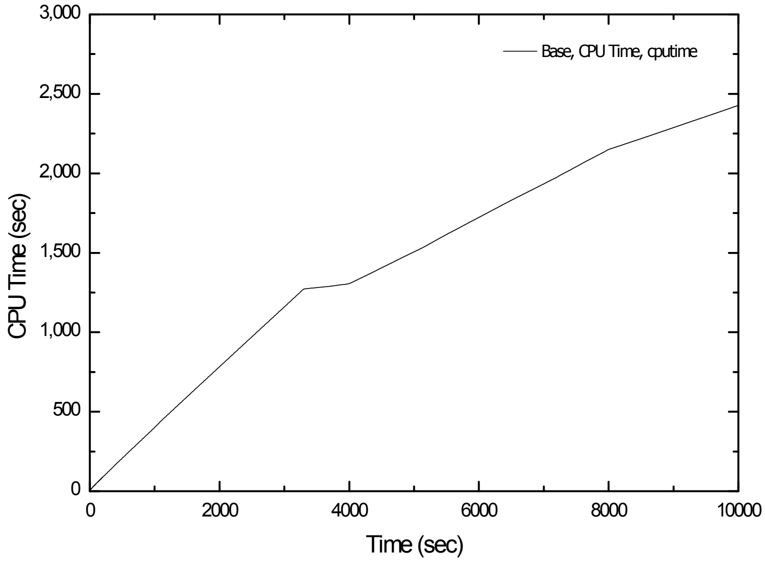

Figure 18.   Required CPU Time of Base Calculation

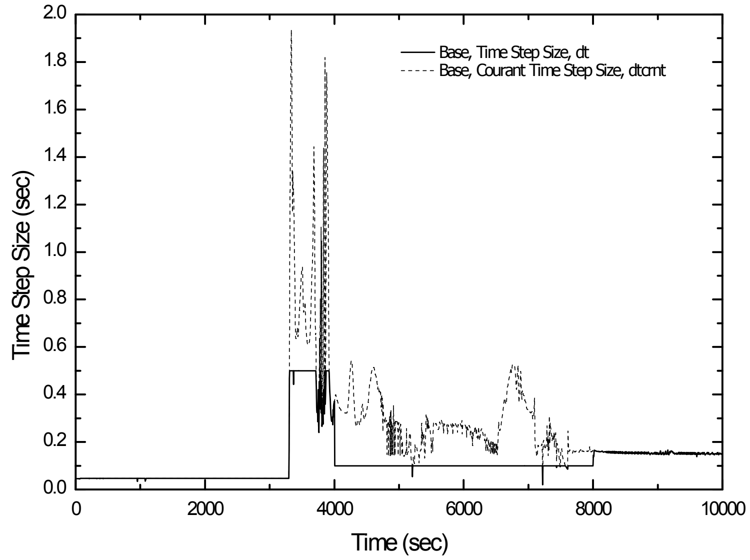

Figure 19.   Time Step Size of Base Calculation

5. CONCLUSIONS

The purpose of this report is to assess the capability of the RELAP5/MOD3.3Beta computer code to simulate thermal-hydraulic behavior associated with the LOFT Experiment L9-1/L3-3. For this purpose, major parameters identified through sensitivity studies to have the most significant effect on the predicted thermal-hydraulic behaviors were incorporated into the base calculation to improve the code predictability. The code-predicted results were compared with the experimental data to assess the code predictability. Major conclusions through this assessment are summarized as follows:

From the comparisons presented with Figures and Tables, it was shown that the code-predicted results were generally in agreement with the measured data. Therefore, it is concluded that the RELAP5/MOD3.3Beta computer code has sufficient capability in predicting the thermal hydraulic phenomena occurred in the LOFT Experiment L9-1/L3-3.

However, the discrepancies between the calculation and the experiment were also identified. In Experiment L9-1, the code over-estimated temperature behaviors of the SG secondary side after dryout of the SG. However, these discrepancies were not considered to be significant, since the SG was in a de-coupled state from the PCS after the dryout of the SG secondary side. In Experiment L3-3, the code predicted excessive swelling of the PCS fluid during the first recovery mode, and predicted excessive cooling during the second recovery mode. The differences during the first recovery mode were due to the code's under-estimation of total discharged energy through the PORV. For the discrepancies during the second recovery mode, the code modeling deficiency of the SG secondary side was presumed to be one of the reasons. However, it is concluded that further investigation into the deviation sources are needed to enhance the code's predictability, since the specific reasons for the deviation were not clearly identified in this assessment.

Through sensitivity studies, the major parameters were identified to have significant effect on the predicted thermal-hydraulic behaviors. These parameters include the pressurizer spray system loss coefficient, nodalization of the SG secondary side, SG U-tube heat transfer area, heat transfer coefficient from the LOFT main components to the environment, and the PORV discharge coefficient. The first three parameters are significant during the short-term transient phase, while the last two are significant during the long-term transient phase. Therefore, the five parameters listed above should be carefully modeled to obtain appropriate calculation results for transient types such as the total-loss-of feedwater accident and its recovery modes.

6. REFERENCES

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Appendix A

Steady State Input Deck for Base Case

```
=loft l9-1 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   1000.0     1.e-6     0.5      3    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    504     or      504     l
0000610    612     or      520     n
0000611   -521     and    -616     n
0000612    611     and     610     n
0000613    616     or      523     n
0000614   -522     and     613     n
0000615   -612     and     609     n
0000616    615     and     614     n
0000617    612     or      616     n
0000618    605     or      607     n
0000621    623     or      570     n
0000622   -571     and    -571     n
0000623    621     and     622     n
0000624    509     and    -552     n
0000625    623     or      624     n
0000626    576     and    -509     n
0000627   -576     and    -577     n
0000628    629     and     627     n
0000629    626     or      628     n
0000635    504     and     504     n
0000636    509     and    -536     n
0000650   -652     and     550     n
0000651    650     or      652     n
0000652   -509     and     651     n
0000655    601     or      603     n
0000656    508     or      609     n
0000659    561     or      562     n
0000660    504     or      504     n
0000669    561     and     564     l
0000670    565     and    -655     n
0000680    530     or      530     n
0000688    690     or      574     n
0000689   -575     and    -551     n
0000690    688     and     689     n
**********************************************************
*
*              intact loop
*
**********************************************************
* reactor vessel nozzle - intact loop hot leg
```

```
************************************************************
1000000     rvnilhl          branch
1000001     2         0
1000101     0.0634    1.5373    0.0       0.0       0.0       0.0
1000102     4.0e-5    0.0       00000
1000200     0         14901000. 1346300.0 2462060.0 0.0
1001101     250000000 100000000 0.0634    0.0       0.0       000100
1002101     100010000 105000000 0.0       0.05      0.05      000100
1001201     10.582000 11.005000 0.0
1002201     10.582000 10.625000 0.0
************************************************************
* pressurizer connection tee reactor vessel side
************************************************************
1050000     pzrtrvs          branch
1050001     1         0
1050101     0.0634    1.634     0.0       0.0       0.0       0.0
1050102     4.0e-5    0.0       00000
1050200     0         14896100. 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     19
1150101     0.0       3
1150102     0.151     15
1150103     0.0       18
1150104     0.0634    19
1150201     0.0       1
1150202     0.0512    2
1150203     0.0       15
1150204     0.0512    16
1150205     0.0       18
1150301     1.4385    1
1150302     0.708     2
1150303     0.63      3
1150304     0.26675   7
1150305     1.067     8
1150306     0.45      10
1150307     1.067     11
1150308     0.26675   15
1150309     0.63      16
1150310     0.547     17
1150311     0.689     18
1150312     0.559     19
1150401     0.09      1
1150402     0.057     2
1150403     0.335     3
1150404     0.0       15
1150405     0.335     16
1150406     0.0437    17
1150407     0.0462    18
1150408     0.0       19
1150501     0.0       19
1150601     0.0       1
1150602     90.0      9
1150603     -90.0     19
1150701     0.0       1
1150702     0.246     2
1150703     0.513     3
1150704     0.26675   7
1150705     1.067     8
1150706     0.2865    9
1150707     -0.2865   10
1150709     -1.067    11
1150710     -0.26675  15
1150711     -0.513    16
1150712     -0.498    17
1150713     -0.689    18
1150714     -0.356    19
1150801     4.0e-5    0.0       2
1150802     4.0e-5    0.0102    3
1150803     1.0e-5    0.0103    15
1150804     4.0e-5    0.0102    16
1150805     4.0e-5    0.0       19
1150901     0.15      0.15      1
1150902     0.05      0.05      2
1150903     0.0       0.0       7
1150904     0.1       0.1       8
1150905     0.2       0.2       9
1150906     0.1       0.1       10
1150907     0.0       0.0       15
1150908     0.05      0.05      16
1150909     0.1       0.1       18
1151001     00000     19
1151101     000100    2
1151102     100100    3
1151103     000000    14
1151104     000100    18
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 07
1151205     0         14746400. 1301720.  2465340.0  0.0  0.0 08
1151206     0         14729700. 1283950.  2465690.0  0.0  0.0 09
1151207     0         14721700. 1268380.  2465870.0  0.0  0.0 10
1151208     0         14715000. 1254890.  2466020.0  0.0  0.0 11
1151209     0         14707300. 1242570.  2466180.0  0.0  0.0 15
1151210     0         14707600. 1242600.  2466180.0  0.0  0.0 16
1151211     0         14631100. 1242600.  2467720.0  0.0  0.0 17
1151212     0         14621800. 1242600.  2467980.0  0.0  0.0 18
1151213     0         14616700. 1242600.  2468100.0  0.0  0.0 19
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       07
1151305     4.3407000 4.6700000 0.0       08
1151306     4.3009000 4.6296000 0.0       09
```

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1151307     4.2676000 4.5954000 0.0          10
1151308     4.2398000 4.5671000 0.0          11
1151309     4.2249000 4.5338000 0.0          15
1151310     7.9665000 8.1922000 0.0          16
1151311     9.4925000 9.9460000 0.0          17
1151312     10.040000 10.505000 0.0          18
1151401   1.0224e-2     0.     1.     1.     18
************************************************************
*
*             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          -1           504          0
1350302     369.00 .90178860 .315500 96.00 500.600 1.43100
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 l9-1 test data
*************************************************************
* head curve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
1353000    0
```

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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
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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.
**********************************************************
* 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
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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         -1         504        0
1650302    369.00 .89699187 .315500 96.00 500.600 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
************************************************************
* 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
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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
```

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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
```

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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
```

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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 0.00145    0.93       0.93
100100
4001110   0.         0.         1.         1.
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 2.40e-6    1.039242   1.039242
000100
4061201   .08890000 .08890000 0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*   spray valve
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*4070000   sprvlv     valve
```

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*4070101 406010000 420010000 3.3451e-4 1.5432e1 1.5432e1 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 0.00145   0.93   0.93   100100
4100110   0.        0.        1.        1.
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  .18395e-3   0.0 02
4151203   0    14913200. 1558810.  2463620.0  .15145      0.0 03
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
4250102   0.8       0.03
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.  1187483.  2592802.0 .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 1187580. 2592788.0 .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 1187774. 2592801.0 .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   11
5150101   0.23226   3
5150102   0.27871   11
```

```
5150201   0.0       10
5150301   0.7102    3
5150302   0.46269   7
5150303   1.85075   10
5150304   0.718     11
5150401   0.0       11
5150601   -90.0     3
5150602   21.0      9
5150603   16.0      10
5150604   90.0      11
5150701   -0.7102   3
5150702   0.17755   7
5150703   0.7102    9
5150704   0.518     10
5150705   0.718     11
5150801   4.e-5     0.10796   3
5150802   4.e-5     0.0305    10
5150803   4.e-5     0.0       11
5150901   0.0       0.0       2
5150902   17.5      17.5      3
5150903   0.0       0.0       6
5150904   4.2       4.2       7
5150905   8.8       8.8       8
5150906   4.2       4.2       9
5150907   0.0       0.0       10
5151001   00000     3
5151002   00100     9
5151003   00000     11
5151101   000000    2
5151102   000100    3
5151103   000000    10
5151201   0   5681540.0   1110180.0   2500000.0   0.0   0.0   11
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   07
5151305   1.2396    3.4916    0.0   08
5151306   1.6096    4.6784    0.0   09
5151307   1.5003    4.8023    0.0   10
*---- ----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   2591620.0 .9997400   0.0   01
5301202   0   5548250.0 1148038.0   2591620.0 .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
```

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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          19.758     22.082     0.0
5500300    mtrvlv
5500301    612        616        0.05       0.70    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
************************************************************
*
*    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                sngIvol
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 0 503
*---- ----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
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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
*
***********************************************************
*   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
***********************************************************
*
*              heat structure input data
*
***********************************************************
*
* steam generator heat structures
*
***********************************************************
* steam generator tubing
***********************************************************
10060000   12          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          627.124    4
10060502   115080000   0           1          1          2508.496   5
10060503   115090000   10000       1          1          1057.940   7
10060504   115110000   0           1          1          2508.496   8
10060505   115120000   10000       1          1          627.124    12
10060601   515040000   10000       1          1          627.124    4
10060602   515080000   0           1          1          2508.496   5
10060603   515090000   0           1          1          1057.940   7
10060604   515080000   0           1          1          2508.496   8
10060605   515070000   -10000      1          1          627.124    12
10060701   0           0           0          0          12
10060801   0.0   11.0   11.0   0.0   0.0   0.0   0.0   1.0   12   * mod 3
10060901   0.0   11.0   11.0   0.0   0.0   0.0   0.0   1.0   12   * 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 130000       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
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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  115160000 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  115180000 0      1      1      0.689      5
11001506  115190000 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  * mod 3
11001812  0.0  11.0  11.0  0.0  0.0  0.0  0.0  1.0  12  * mod 3
*---- ----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  115170000 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  115160000 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
```

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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 11.0  11.0   0.0  0.0  0.0  0.0  1.0  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   515110000 0       1       1       0.7725    2
15000603   515100000 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   515100000 0       1       1       0.152     1
15150602   515090000 0       1       1       0.7113    2
15150603   515080000 0       1       1       0.7113    3
15150604   515060000 0       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
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
```

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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
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
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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           18.83
*---- ----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           4.739
*---- ----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           4.2266
*---- ----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           18.83
************************************************************
* 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
************************************************************
* 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
************************************************************
* 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              0.0402793 rho         115040000
20504203              0.0402793 rho         115050000
20504204              0.0402793 rho         115060000
20504205              0.0402793 rho         115070000
20504206              1.61117-1 rho         115080000
20504207              6.7950e-2 rho         115090000
20504208              6.7950e-2 rho         115100000
20504209              1.61117-1 rho         115110000
20504210              0.0402793 rho         115120000
20504211              0.0402793 rho         115130000
20504212              0.0402793 rho         115140000
20504213              0.0402793 rho         115150000
20504214              3.3500e-1 rho         115160000
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* sg-pump piping
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
```

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20504300   pcsvol3    sum          1.0          0.0          1
20504301   0.0        4.37000-2 rho        115170000
20504302              4.62000-2 rho        115180000
20504303              3.54406-2 rho        115190000
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
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              0.07770    rho        350020000
20500706              8.55000-2 rho        380010000
20500707              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
*
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        20.117     htrnr      006000100
20511202              20.117     htrnr      006000200
20511203              20.117     htrnr      006000300
20511204              20.117     htrnr      006000400
20511205              80.468     htrnr      006000500
20511206              33.937     htrnr      006000600
20511207              33.937     htrnr      006000700
20511208              80.468     htrnr      006000800
20511209              20.117     htrnr      006000900
20511210              20.117     htrnr      006001000
20511211              20.117     htrnr      006001100
20511212              20.117     htrnr      006001200
*---- ----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
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*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*    heat loss from rabs piping
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20511900   rabheat    sum         1.0         0.0         1
20511901   0.0        1.7153      htrnr       370000101
20511902              0.94828     htrnr       370000201
20511903              0.94497     htrnr       370000301
20511904              2.6090      htrnr       370000401
*---- ----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
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
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  1.2     1.2     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

Transient Input Deck for Base Case

```
=loft l9-1 post test analysis deck
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
*                initial conditions
*
*                pcp pressure = 14.901 mpa
*                core power = 50. mw
*                pcs flow = 479.3 kg/s
*                thot = 578. k
*                tcold = 559.0 k
*
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
0000100   restart   transnt
0000101   run
0000102   si
0000103       15808
0000105   5.      10.
0000201   200.00    1.e-6    1.0    3   1    30    100
0000202   1000.0    1.e-6    1.0    3   5   300    500
0000203   2000.0    1.e-6    0.1    3   50  3000  5000
0000204   4000.0    1.e-6    0.5    3   10  1000  2000
0000205   8000.0    1.e-6    0.1    3   50  4000  5000
0000206   10000.    1.e-6    0.5    3   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        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    536
0000601   563      and     561     n
0000602   -563     and     -564    n
0000603   655      and     602     n
0000604   609      or      609     l
0000605   572      and     -509    n
0000606   -572     and     -573    n
0000607   608      and     606     n
0000608   605      or      607     n
0000609   540      or      541     l
0000610   612      or      520     n
0000611   -521     and     -616    n
0000612   611      and     610     n
0000613   616      or      523     n
0000614   -522     and     613     n
```

```
0000615   -612      and      609      n
0000616    615      and      614      n
0000617    612      or       616      n
0000618    605      or       607      n
0000621    623      or       570      n
0000622   -571      and     -571      n
0000623    621      and      622      n
0000624    509      and     -552      n
0000625    623      or       624      n
0000626    576      and     -509      n
0000627   -576      and     -577      n
0000628    629      and      627      n
0000629    626      or       628      n
0000635    504      and      504      n
0000636    509      and     -536      n
0000650   -652      and      550      n
0000651    650      or       652      n
0000652   -509      and      651      n
0000655    601      or       603      n
0000656    508      or       609      n
0000659    561      or       562      n
0000660    504      or       504      n
0000669    561      and      564      l
0000670    565      and     -655      n
0000680    530      or       530      n
0000688    690      or       574      n
0000689   -575      and     -551      n
0000690    688      and      689      n
* pzr heater delete
14201000   delete
14202000   delete
*---- ----1---- ----1---- ----1
*   control variable 114 re-define
*---- ----1---- ----1---- ----1
20511400    pzrheat    sum     1.0    0.0    1
20511401      0.0     0.362    htrnr    415100101
20511402              0.702464   htrnr    415200101
20511403              1.26381    htrnr    415200201
20511404              1.26381    htrnr    415200301
20511405              0.649152   htrnr    415200401
20511406              0.649152   htrnr    415200501
20511407              0.534688   htrnr    415200601
20511408              0.534688   htrnr    415200701
20511409              0.273063   htrnr    416200101
*---- ----1---- ----1---- ----1
*   control variable 123 redefine
*---- ----1---- ----1---- ----1
20512300    pzr    sum    1.0    0.    1
20512301    0.0    0.362      htrnr     415100100
20512302           0.59522    htrnr     415200100
20512303           1.07086    htrnr     415200200
20512304           1.07086    htrnr     415200300
20512305           0.550045    htrnr     415200400
20512306           0.550045   htrnr     415200500
20512307           0.453056   htrnr     415200600
20512308           0.453056   htrnr     415200700
20512309           0.150656   htrnr     416200100
************************************************************ primary coolant pump 1
************************************************************1350000      pcpump1              pump
1350101    0.0366     0.0        0.099      0.0        90.0       0.319
1350102    00000
1350108    130010000 0.0         0.0        0.0       000100
1350109    140000000 0.0         0.05       0.05      000100
```

```
1350200    0           14818100. 1242890.   2463900.0   0.0
1350201    0           8.8943000 9.2942000 0.0
1350202    0           8.8928000 8.1177000 0.0
1350301    0     0     0           -1          0           509          0
1350302   369.000 .90178860 .315500 96.0000 500.600   1.4310000
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 l9-1 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
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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----
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* 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.
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************************************************************ 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    369.00000 .89699187 .31550000 96.000000 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    1.0    1.0       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----
* 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
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30000104   0.4046        0.3160
30000105   0.1401        1.402
30000106   0.0321        3.914
************************************************************ power history
************************************************************30000401   4.89e+7   70.   hr
************************************************************ reactivity curve numbers
************************************************************30000011   609
************************************************************ moderator density reactivity table
************************************************************30000501   0.62626e+3   -4.4769
30000502   0.66396e+3    -3.2923
30000503   0.71617e+3    -1.5692
30000504   0.76112e+3    -0.1692
30000505   0.76837e+3     0.04615
30000506   0.79157e+3     0.6923
30000507   0.81188e+3     1.2398
30000508   0.86263e+3     2.2415
30000509   0.93804e+3     3.9231
30000510   0.99749e+3     5.1077
************************************************************ doppler reactivity table
************************************************************30000601   293.16   1.375
30000602   338.72    1.125
30000603   422.05    0.682
30000604   477.60    0.419
30000605   505.38    0.274
30000606   570.72    0.000
30000607   588.72   -0.075
30000608   695.83   -0.526
30000609   922.05   -1.386
30000610  1310.94   -2.543
30000611  1810.94   -3.865
30000612  2088.72   -4.502
30000613  2499.83   -5.392
30000614  3027.60   -6.417
************************************************************   volume weighting factors
************************************************************   moderator temperature feedback
************************************************************30000701   230010000   0   0.31493   0.0
30000702   230020000   0   0.31493   0.0
30000703   230030000   0   0.37014   0.0
************************************************************   doppler feedback
************************************************************30000801   2300001   0   0.43153   0.0
30000802   2300002    0   0.51686   0.0
30000803   2300003    0   0.05161   0.0
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
* scram reactivity data
*---- ----1---- ----1---- ----1---- ----1---- ----1---- ----1----
20260900  "reac-t  " 609
20260901  0.0      0.0
20260902  0.5      -0.5
20260903  0.59     -3.13
20260904  0.65     -3.95
20260905  0.75     -6.27
20260906  0.83     -8.72
20260907  0.90     -12.00
20260908  0.97     -17.12
20260909  1.125    -20.67
20260910  1.213    -22.10
20260911  1.3      -22.78
20260912  1.4      -23.17
20260913  1.6      -23.32
20260914  60.0     -23.32
.
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