International Agreement Report

RELAP5 Assessment Using LSTF Test Data SB-CL-18

Prepared by
S. Lee, B. D. Chung, H. J. Kim

Korea Institute of Nuclear Safety
Safety Analysis Department
P.O. Box 16, Daeduk-Danji
Taejon, Korea

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Prepared as part of
The Agreement on Research Participation and Technical Exchange
under the International Thermal-Hydraulic Code Assessment
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Abstract

5 % cold leg break test, run SB-CL-18, conducted at the Large Scale Test Facility (LSTF) was analyzed using the RELAP5/MOD2 Cycle 36.04 and the RELAP5/MOD3 Version 5m5 codes.

The test SB-CL-18 was conducted with the main objective being the investigation of the thermal-hydraulic mechanisms responsible for the early core uncover, including the manometric effect due to an asymmetric coolant holdup in the steam generator upflow and downflow side.

The present analysis, carried out with the RELAP5/MOD2 and MOD3 codes, demonstrates the code's capability to predict, with sufficient accuracy, the main phenomena occurring in the depressurization transient, both from a qualitative and quantitative point of view. Nevertheless, several differences regarding the evolution of phenomena and affecting the timing order have to be pointed out in the base calculations.

The sensitivity study on the break flow and the nodalization study in the components of the steam generator U-tubes and the cross-over legs were also carried out. The RELAP5/MOD3 calculation with the nodalization change resulted in good predictions of the major thermal-hydraulic phenomena and their timing order.

Executive Summary

The LSTF test SB-CL-18 has been analyzed using the RELAP5/MOD2 and MOD3 codes to assess the code's ability for a 5 % cold leg break LOCA, to improve common understanding of PWR thermal-hydraulic response during such a transient and to identify areas for desirable model improvements based on comparisons between data and predictions.

The main goal of the calculation is the assessment of the simulation capability of the code for the following phenomena occurring during the small break LOCA experimental test;

- top-down drain of coolant in primary system
- stratified two-phase flow in horizontal legs
- loop seal clearing and concurrently temporary core liquid depression, with influenced residual liquid holdup in steam generator primary side, leading to core heatup
- quick core level recovery after loop seal clearing
- vessel inventory boil-off leading to second core uncover
- core reflooding due to accumulator injection.

The calculated overall trend agreed well with the test data. However, several differences regarding the evolution of phenomena and affecting the timing order have to be pointed out.

In the base calculation with the RELAP5/MOD2, one can observe three fundamental disagreements between calculated and experimental transient

sequences. The first is the underestimation of the calculated two-phase break flow rate (between 100 and 200 seconds) leading to an insufficient mass discharge from the primary system and therefore from the pressure vessel. A sensitivity study on the break flow rate using break flow options, i.e., abrupt area change and smooth area change, and break discharge coefficients of two-phase flow, was carried out. However the results did not give sufficient improvement on predicting the break flow rate. The second and the most important inaccuracy is that the code strongly overestimates the liquid holdup in the upflow side of the steam generator U-tubes, giving rise to a plug effect hindering the loop seal downflow side level decreasing and delaying the loop seal clearance. The third discrepancy of the calculation in comparison with the experiment is that the higher vapor-phase break flow rate after 160 seconds results in a fast primary mass loss and therefore in an anticipated earlier accumulator injection.

In the base calculation with the RELAP5/MOD3, the first and the third disagreements described above were still observed. The liquid holdup in the upflow side of the steam generator U-tubes was predicted well with the experiment, however the complete loop seal clearing was not occurred throughout the transient. This discrepancy was cleared by the nodalization changes in the steam generator U-tubes and the cross-over legs and the calculated results were in good agreement with the experiment in the evolution of the major thermal-hydraulic phenomena and their timing order.

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1. Introduction

The International Code Assessment and Application Program (ICAP) has been conducted by fourteen nations and multinational organizations under the auspices of the USNRC[1]. For the pressurized water reactor analysis, the USNRC selected two best estimate (BE) codes: RELAP5/MOD2 and TRAC/PF1/MOD1[2]. The goal of the program is to assess the prediction capabilities of the current BE thermal hydraulic codes utilizing the available facility test and plant data. At present the ICAP activities in Korea help to quantify uncertainties in the codes so that the codes may be used for regulatory purposes.

This report is a part of the Korean contribution to the ICAP. The RELAP5/MOD2[3] Cycle 36.04 and the RELAP5/MOD3[4] Version 5m5 were used in the present calculations simulating the test SB-CL-18 of the Large Scale Test Facility (LSTF) [5].

The Rig of Safety Assessment No. 4 (ROSA-IV) Program, launched by the Japan Atomic Energy Research Institute (JAERI) in 1980 immediately after the Three Mile Island Unit 2 accident, comprises three major tasks: (1) conducting integral effect tests on PWR small break loss of coolant accidents (SBLOCAs) and transients using the LSTF, (2) conducting separate effects tests using the Two-Phase Flow Test Facility (TPTF), and (3) developing and verifying an advanced thermal-hydraulic code for the analysis of SBLOCAs and transients.

The test SB-CL-18[6], as one of the Integral Effect Test (IET), was

simulated 5 % cold leg break (loop without pressurizer) test and conducted with the main objective being the investigation of the thermal-hydraulic mechanisms responsible for the early core uncover, including the manometric effect due to an asymmetric coolant holdup in the steam generator (SG) upflow and downflow side.

The main goal of the calculation is the assessment of the simulation capability of the code for the following phenomena occurring during the small break LOCA experimental test;

- top-down drain of coolant in primary system
- stratified two-phase flow in horizontal legs
- loop seal clearing and concurrently temporary core liquid depression, with influenced residual liquid holdup in SG primary side, leading to core heatup
- quick core level recovery after loop seal clearing
- vessel inventory boil-off leading to second core uncover
- core reflooding due to accumulator injection.

The report describes the results of the calculation performed by the RELAP5/MOD2 and MOD3 codes and shows the comparisons with the major variables obtained in the experiment. A brief description of the LSTF and SB-CL-18 test is provided in Section 2, and Section 3 describes the features of the RELAP5 code and modelling to be assessed. Section 4 discusses the results of the base calculations with the RELAP5/MOD2 and MOD3. The motivations for the sensitivity and nodalization studies and

their results are included in Section 5. The code efficiency is evaluated in Section 6 through run statistics. The conclusions drawn from this study are given in Section 7.

2. Facility and Test Description

2.1 Facility Description

The LSTF [5] is a 1/48 volumetrically scaled model of a Westinghouse type 3423 MWT four loop Pressurized Water Reactor (PWR). The LSTF has the same major component elevations as the reference PWR to simulate the natural circulation phenomena and large loop pipes (hot and cold legs of 207 mm in diameter) to simulate the two-phase flow regimes and significant phenomena in an actual plant. Fig. 1 and Table 1 show the structure and major dimensions of the LSTF, respectively. The facility is designed to be operated at the same high pressures and temperatures as the reference PWR.

The LSTF facility simulates the major components of the PWR primary system (e.g., pressure vessel, steam generators) and the reactor protection system (e.g., emergency core cooling system, ECCS) that have an impact on the plant behaviour during SBLOCAs and operational transients. Equipment controls allow the test operators to either follow procedures defined in standard plant manual or to follow variations of standard procedures.

Other systems, such as the secondary and various auxiliary systems, are capable of achieving pretest steady-state conditions and simulating the primary to secondary interactions. These systems include feedwater, condensate and steam systems together with component service systems such

as the cooling water, water purification etc.

The fuel assembly dimensions [7], i.e. the fuel rod and the guide thimble diameter, pitch and length, and the ratio of number of fuel rods to number of guide thimbles are designed to be the same as the 17 x 17 fuel assembly of the reference PWR to preserve the heat transfer characteristics of the core. The total number of rod is scaled by 1/48 and is 1064 for the electrically heated and 104 for the unheated rods.

The downcomer, lower plenum and upper plenum design, including the scaled internal structures, maintains, to a practicable extent, the volume and flow resistances typical of the reference PWR.

Three core bypasses, consisting of the downcomer to hot leg leakage, an unintentional leakage between the downcomer and the upper plenum, and the spray nozzle connecting the downcomer to the upper head, are also simulated.

The most important design scaling compromise is the 10 MW maximum core power limitation, 14 % of the scaled reference PWR rated power. The steady state condition is therefore restricted to a core mass flow rate that is 14 % of the scaled value, to simulate the reference PWR temperature distribution in the primary loop.

The steam generators are designed in accordance with the facility scaling requirements, also in consideration that the rated 10 MWt LSTF power capability sets the steady-state flow conditions at 14 % of the scaled reference PWR SG-flow.

The four primary loops of the reference PWRs are represented by two equal-volume loops. The hot and cold legs were sized to conserve the

volume scaling and the ratio of the length to the square root of the pipe diameter, $L/\sqrt{D}$ for the reference PWR, in expectation that the flow regime transitions in the primary loops can be simulated appropriately by taking this scaling approach.

A simulated containment system is available to collect and contain the effluent from simulated breaks. The simulated containment system is designed to ensure that the break flow will always be choked.

2.2 Test Description

The test SB-CL-18 was simulated 5 % cold leg horizontal break and the break point is located in the B-loop (loop without pressurizer) cold leg, between the reactor coolant pump and the reactor pressure vessel, with horizontal nozzle orientation. The test procedures were designed to minimize the effects of LSTF scaling compromises on the transients during the test.

After the break occurs at time zero, the primary system depressurizes quickly. During the first few seconds from the time of break onwards, the pump's speed is intentionally increased to simulate the post-scam hot leg temperature decay in PWR. At a pressurizer pressure of 12.97 MPa the reactor scrams. Since the loss of offsite power concurrent with the reactor scram is assumed, the primary coolant pumps are tripped to begin coastdown and the core power begins to decrease along the programmed decay curve. The power decay used in the test gives a slower decrease than the ANS standard.

The major operational setpoints and ECCS conditions are summarized in Table 2. To simplify the transient it is assumed that the SG auxiliary feedwater system as well as the high pressure charging system and the High Pressure Safety Injection (HPSI) system fail. As a result of the station blackout, concurrent with the auxiliary feedwater failure, the SG secondary side is isolated, allowing, in any case, the steam discharge through the relief valves (cycling between opening and closure). The Accumulator (ACC) system and the Low Pressure Safety Injection (LPSI) system are specified to initiate coolant injection into the primary system at pressures of 4.51 and 1.29 MPa, respectively.

3. Code and Modelling Description

3.1 Code Description

The RELAP5/MOD2 code has been developed for best-estimate transient simulation of PWRs and associated systems. The code is based on a non-homogeneous and non-equilibrium model for one dimensional, two-phase system that is solved by a fast, partially implicit numerical scheme to permit economical evaluation of system transients. Recently, the RELAP5/MOD3 code development program has been initiated to develop a code version suitable for the analysis of all transients and postulated accidents in PWR systems including both large and small break LOCAs as well as the full range of operational transients. Although the emphasis of the RELAP5/MOD3 development is on large break LOCA, improvements to existing code models, based on the results of assessments against small break LOCA and operational transient test data, are also being made. Table 3 is a list of the phenomena and code models, improved from the RELAP5/MOD2, that are being addressed by the RELAP5/MOD3 code program.

The RELAP5/MOD2 Cycle 36.04 and the RELAP5/MOD3 Version 5m5 were used in this assessment.

3.2 Modelling Description

The nodalization used to simulate the LSTF facility of the ROSA-IV program with the RELAP5 code is shown in Fig. 2. The model is based on 162 volumes connected by 169 junctions and 166 heat structures.

In the reactor vessel element (volumes 100 to 156) the volumes corresponding to the downcomer, the lower plenum, the core, the upper plenum, the upper head and the guide thimble channel are defined. In the schematization of the upper part of the LSTF downcomer (volumes 100 and 104), care was taken to correctly simulate the steady-state mass flow rates in the connections with the hot legs (bypasses), the upper plenum (unintentional leak path) and the upper head (spray nozzles) to obtain the requested values, i.e. 0.1 %, 0.085 % and 0.3 % of the core inlet flow rate, respectively. The core is modelled by one channel arranged in 6 hydraulic volumes, in which only one series of heat structures is adopted to simulate the fuel assembly (i.e. a flat radial core power profile is assumed). The reason for this choice resides in the attempt to perform the simplest modelling of the LSTF facility as possible.

A pipe connection (volume 156) between the upper head and the upper plenum of the pressure vessel is introduced in the scheme to simulate the guide thimble channel path existing in the facility. The two loops of the LSTF system are represented by the I-loop (volumes 400 to 499, intact loop) and the B-loop (volumes 200 to 299, broken loop) in an almost symmetrical way. In fact, each of the two loops present the hot leg, the SG inlet and outlet plena, the SG U-tube channel, the loop seal, the

reactor coolant pump, the cold leg. In addition, the pressurizer is connected to the I-loop hot leg by means of the surge line element and the break system is connected to the B-loop cold leg.

In the volumes representing the pressurizer vessel, an additional heat structure is introduced to simulate the effects of the proportional and back-up heaters.

The two steam generator secondary sides (volumes 300 to 399 and 500 to 599) are simulated using an identical schematization. They can be subdivided into the downcomer, the boiling section, the steam separator and the steam dome. The steam and feedwater lines are simulated by using Time Dependent Junctions (i.e. with imposed flow rates) because they must be excluded during the transient phase of the calculation. In fact, in the experimental test, the two mentioned lines are closed in coincidence with the reactor scram signal, few seconds after break opening, to isolate the SG secondary side. Relief and safety valves are also connected to the SG steam dome using valve components in which the operational setpoints and conditions are specified to be the same as the experiment.

The requested volume distributions for the primary and secondary system, including the "active dead volumes" distribution, is taken into account for the determination of the piping cross sectional areas, that result in small area differences between analogous pipes belonging to the two different loops.

The nodalization of the SG secondary side (volumes 328, 332, 528, 532 and 800 to 820) is simulated for the present case, however it could

have been reduced to be simpler.

The steam generators as well as the pressurizer are provided with two systems devoted to the control of the pressure and the liquid level during the steady-state period (200 sec.) and to maintain them at the specified initial values.

The physical boundaries of the entire system, i.e., the reactor containment and the relief and safety discharge tanks, are reproduced by means of Time Dependent Volumes with constant internal conditions during the calculation.

To allow the accumulator injection to start correspondingly to the cold leg pressure specified in the experiment, a valve is arranged on each of the accumulator surge lines.

The choked flow option is specified in the valve simulating the break and to avoid the code calculating mass flow rates to be inconsistent with the experimental data, the subcooled and two-phase discharge coefficient are chosen as close as 1.0 and 1.05, respectively.

4. Base Calculations

During a small break loss of coolant accident, the primary coolant inventory loss will continue until the break flow rate decreases sufficiently, due to break uncover or primary depressurization, to allow the emergency core cooling system to make up the coolant loss. Such coolant inventory depletion will involve concurrent liquid level depressions in the downflow side of the cross-over leg, for each loop, and in the vessel riser section (upper plenum and core). Meanwhile, the upflow side of the cross-over leg, cold leg and downcomer will remain liquid filled up to the break elevation. The core level depressions will continue until the level of the downflow side in the cross-over leg reaches the bottom of the legs and thus allows the vapor to clear the liquid seal in the cross-over legs toward the break. When this liquid clearing (loop seal clearing) initiates, the core liquid level starts to recover. This occurs because the vapor can now reach to the downcomer and allows a manometric flow of the downcomer liquid inventory into the core region[8].

In the present study both the RELAP5/MOD2 and MOD3 codes were used for the base calculations and their results are shown in the figures from 3 to 44. In all figures, the results with the RELAP5/MOD2 and with the RELAP5/MOD3 are represented as "Calculated 1" and "Calculated 2," respectively.

The major initial conditions, as shown in Table 4, and the sequence

of events, summarized in Table 5, are compared with the experiment. The input listing for the base calculation with the RELAP5/MOD3 is attached in Appendix.

4.1 RELAP5/MOD2

The calculated results for the principal events are compared with the experimental values in Table 5. All the main primary phenomena observed during the experiment were reproduced by the code.

i) Primary and Secondary Pressures Response

Figures 3 to 5 show the primary and secondary pressure in comparison with the experimental values. The code predicts well the secondary pressure trend, whereas, despite a good qualitative agreement, it highlights some differences in the behavior of the primary depressurization in the region between 200 and 600 seconds.

The primary pressure depressurization became slower after flashing started in the primary loop hot side. The primary pressure remained higher than the secondary pressure until after the loop seals cleared completely.

In this respect one should point out the strong delay at which the loop seal clearance occur in comparison with the experiment as shown in Figs. 6 to 9. This occurrence results in a delayed beginning of the linear primary pressure decrease, happening moreover with a higher depressurization rate. The mentioned faster pressure decreasing allows

an earlier intervention of the accumulator system as shown in Figs. 10 and 11.

ii) Break Flow Rate

Figs. 12 and 13 show that the break flow rate is first overpredicted by about 30 % for subcooled liquid discharge and is underpredicted as approaching saturation condition. In the region between 50 and 150 seconds, the two-phase break flow rate is definitely underestimated by the code, in such a way that the time integrated mass inventory, escaping from the break in that period, is about one half of the experimental value. The underprediction of liquid and low-quality two-phase break flow rates resulted in a delay of loop seal clearing relative to the experimental result. Loop seal clearing occurred at 195 seconds (vs. 140 seconds in the experiment). Both loop seal cleared at the same time as was the case in the experiment.

iii) SG U-tube differential Pressure

Figures 6 to 9 show the differential pressures in SG U-tubes, upflow and downflow side. The agreement between measured and calculated data is acceptable concerning the downflow side, but the code predicts too strong liquid holdup in the upflow side of the SG U-tubes. This SG liquid holdup was overpredicted tending to enhance the core level depression during loop seal clearing. While considerable amount of liquid remained in the upflow side of the SG U-Tube and SG inlet plenum at the time of loop seal clearing, the hot legs underneath were nearly empty after 130

seconds.

The SG U-tube differential pressure as shown in Fig. 14 increased until it took a maximum of 18 kPa at about 140 seconds. This increase resulted from a redistribution of liquid due to the hydrostatic pressure balance throughout the primary system during flow coastdown. During the flow coastdown, the pressure distribution in the primary loops changed since frictional pressure losses (mainly at the pumps) decreases and the core void fractions increased. At 120 seconds, the vertical legs in the cold side loop was liquid filled whereas the hot side loop contained much void as shown in Figs 15, 16 and 17. Thus, due to the manometric balance between the hot side loop and the cold side loop, including the SGs, more liquid was retained in the SG upflow side than in the downflow side. The calculation overpredicted the peak SG differential pressure, that was reached at the end of two-phase natural circulation.

The SG liquid holdup persisted after loop seal clearing in this calculation. The differential pressure in the SG inlet plenum became zero at 300 seconds (vs. 300 seconds in the experiment) as shown in Figs. 18 and 19. Also the differential pressure in the upflow side of the SG U-tube increased after loop seal clearing while such an increase was not seen or less significant in the experiment. Thus, the liquid level recovery into the upper plenum and hot legs after loop seal clearing was underpredicted or not predicted at all as shown in Fig. 20. Consequently, the second core level drop initiated 320 seconds (vs. 400 seconds in the experiment), i.e., immediately after the level recovery following loop seal clearing.

iv) Core Thermal-Hydraulic Responses

The differential pressures in the core and the upper plenum are presented in Fig. 21 in which the code achieves a good simulation of the core level depression. One can observe, however, that the first core uncover and consequent recovery is delayed about 50 seconds, whereas the second core level depression is anticipated earlier about 60 seconds. The reason for this behavior resides in the simultaneous occurrence of several effects. The duration of the first core heatup, associated with loop seal clearing, was overpredicted because of the underprediction of the core liquid level. The reason for the early second core uncover must be given to the faster linear depressurization predicted by the calculation after loop seal clearing, causing the anticipated vessel mass inventory boil-off.

The core level was depressed manometrically, concurrently with the level drop in cross-over legs, and took a minimum immediately before the loop seal clearing started. This minimum core level was lower than the cross-over leg liquid level which was at the bottom of the leg.

The core inlet flow almost stopped after 150 seconds as shown in Fig. 22. After this, the core was covered by nearly stagnant two-phase mixture until core uncover started at about 170 seconds.

Figs. 23 and 24 show rod surface temperature at the average-power bundles. The core liquid level depression resulted in rod temperature excursions starting from about 150 seconds. The peak cladding temperature was about 750 K (vs. 680 K in the experiment) for the average-powered bundles. After the loop seal clearing, the core liquid

level recovered quickly and heater rods were quenched as shown in Fig. 20. The core differential pressure was generally underpredicted. This was the case even when the core was covered by two-phase mixture. This occurred due to an overprediction of core interfacial drag; a well-known deficiency of the RELAP5/MOD2 interfacial drag models.

v) Transient Behavior of Other Variables

The transient behavior of the other variables are shown in Figs. 25 to 44. The variables, such as flow rates, liquid densities, and fluid temperatures in the primary loops, etc., were in good agreement with the experiment. However large fluctuation of the fluid temperatures in the cold legs of the primary loops was occurred after the accumulator injection.

4.2 Base Calculation with RELAP5/MOD3

The modifications to the RELAP5/MOD2 input deck to accommodate the RELAP5/MOD3 are as follows:

- Countercurrent and Flow Limiting (CCFL) options added at the inlet to the steam generator U-tubes and the 40 degree bend in the hot leg
- Junctions in the core region modified for new interphase drag package (flow area and hydraulic diameters)
- Heat structure cards added for new Critical Heat Flux (CHF) calculation

The calculated results for the principal variables are compared with the experimental values in Table 5.

The trend in the break flow rate is almost same as that with the RELAP5/MOD2. Therefore, in the region between 50 and 150 seconds the two-phase break flow rate is still underestimated as shown in Figs. 12 and 13. Nevertheless, the integrated break flow shows nearly identical to the experiment. Therefore it may be considered that there exists some errors in measuring break flow rate. And the break flow rate with high void fraction was overpredicted after 200 seconds as shown in Fig. 13. The primary pressure decreases nearly same as test data up 250 seconds, however the faster decrease in the pressure after 250 seconds allows an earlier intervention of the accumulator injection as shown in Fig. 10.

It is shown in the figures 6 to 9 that the strong liquid holdup in

the SG upflow side is not occurred unlikely the case with the RELAP5/MOD2. This improvement may be obtained from the implementation of the new interphase drag model in the RELAP5/MOD3. The calculation overpredicted the peak SG differential pressure, that was reached at the end of two-phase natural circulation as shown in Fig. 14.

The significant difference is found in the loop seal clearing phenomena as shown in Figs. 15 and 16. The loop seal clearing was started at 150 seconds, however, was not cleared completely through the transient.

The liquid level and the differential pressure in the heated core length are shown in Figs. 20 and 21, respectively. The first core uncover is occurred at 100 seconds which is earlier than the experiment of 120 seconds and the duration of the first core heatup is nearly same as the experiment even though the core level depression was overpredicted. The second core level drop initiated 165 seconds (vs. 400 seconds in the experiment), i.e., immediately after the level recovery following the loop seal clearing as shown in Fig. 20.

The transient behavior of the other variables are shown in Figs. 22 to 44. The variables, such as flow rates, liquid densities, and fluid temperatures in the primary loops, etc., were in good agreement with the experiment. However large fluctuations of the fluid temperatures and liquid densities in the cold legs of the primary loops were occurred after the accumulator injection.

The major areas of the differences between the RELAP5/MOD2 and the RELAP5/MOD3 are the primary system pressure response, the differential

pressure in the upper plenum, core heatup prediction, core liquid level depression, and the drainage of steam generator inlet plena. These differences may be due to modifications to interphase drag model which affected the liquid holdup in the upper plenum and void distributions in the primary loops. Both calculations predicted trend well, however each differed in prediction of the magnitude and timing of occurrences. In the RELAP5/MOD3 calculations the amount of liquid holdup in the upflow side of the SG U-tubes predicted well, however the complete loop seal clearing was not occurred throughout the transient, which was occurred in the experiment.

5. Sensitivity and Nodalization Studies

The base calculations agreed well with the test data. However the break flow rates and the timing order of the principal phenomena have to be pointed out.

5.1 Break Flows

From the discussions in the previous chapters, it was found that the break flow was overestimated about 30 % at the initiation of the transient and was underpredicted in the region between 50 and 150 seconds. Thus it may be necessary to predict the thermal-hydraulic transient phenomena more accurately by considering the break flow options, i.e., abrupt area change and smooth area change, and break discharge coefficients for the single- and two-phase flows.

In the present calculation with the RELAP5/MOD2, several values of the two phase break discharge coefficients with both abrupt and smooth area change options. For single phase flow, a discharge coefficient was fixed to be 1.0 here.

Figs. 45 to 50 show the effect of two phase break discharge coefficient with both area change options. With the abrupt area change option, the break flow rate was still underestimated in the region between 50 and 150 seconds and the little differences were found for different discharge coefficients. With the smooth area change option,

similar underprediction of break flow was obtained, however it matched better with the experiment in the single phase region, particularly in the region between 50 and 100 seconds.

5.2 Nodalization

In the calculation with the RELAP5/MOD3 the complete loop seal clearing was not occurred, therefore the nodalization study may be necessary to evaluate the effectiveness of the nodalization and to quantify their effects on the loop seal behavior, particularly on the loops from steam generator inlet to reactor coolant pump inlet via the cross-over cold legs. In this calculation with the RELAP5/MOD3 the volumes, stated above, were divided twice than the base case to show the effect of loop seal clearing and related phenomena. This model is based on 204 volumes connected by 211 junctions and 216 heat structures.

The calculated results for the principal variables are compared with the experiment and the base calculation with the RELAP5/MOD3 results in Table 4. The base calculation and the calculation with nodalization change are represented as "Calculated 2" and "Calculated 3", respectively, in Figs. 51 to 70.

The calculated results of the break flow rate, the primary and secondary pressures show almost same trend as those with the RELAP5/MOD3 as shown in Figs. 51 and 55. In Figs. 56 to 57 the differential pressure of the cross-over leg predicts much better than the base calculation with the RELAP5/MOD3 which did not show the complete loop

seal clearing. The liquid in the downflow side of the cross-over leg is emptied after the loop seal clearing, however some liquid in the upflow side of the cross-over leg existed throughout the transient.

The timing order of the first core uncover and the duration of the core heatup is predicted remarkably well with the experiment, however the liquid level depression is still underpredicted and the quick second core level depression was also occurred as shown in Figs. 58 and 59.

6. Run Statistics

CDC 170-875 Series with NOS Version 2.6.1 for calculation using RELAP5/MOD2 Code and CRAY2S/4-128 for calculation using RELAP5/MOD3 Code were used.

Fig. 71 shows the required CPU time vs the transient time in the base calculations. The size of the time step was chosen to be $10E-6$ and $10E-1$ seconds at the minimum and the maximum time step, respectively, for both base calculations. During the RELAP5/MOD3 calculation the water property errors were occurred about at 100, 190, and 320 seconds. Therefore, restart calculation with reduced time step of 0.05 seconds were applied for the next 30 seconds to overcome this. The computational efficiency is summarized in Table 7 from the major edit for base calculations and can be calculated as follows.

Calculation	Computer Time (CPU),sec	Number of Time Step (DT),	Number of Volume (N)	Grind Time, CPU/(N*DT)
RELAP5/MOD2	2351.7	6376	162	0.002276
RELAP5/MOD3	1865.2	15338	162	0.001153

7. Conclusions

The LSTF test SB-CL-18, 5 % cold leg break LOCA, was analyzed using the RELAP5/MOD2 and MOD3 codes. Four major calculations were carried out; two base calculations with the RELAP5/MOD2 and MOD3, one sensitivity calculation with the RELAP5/MOD2 using the break flow options, and one nodalization study with the RELAP5/MOD3 in the areas of the SG U-tubes and the cross-over legs.

The present activity demonstrates the code's capability to predict, with sufficient accuracy, the main phenomena occurring in the depressurization transient, both from a qualitative and quantitative point of view. In the base cases, several differences regarding the evolution of such phenomena and affecting their timing order have to be pointed out.

In the base calculation with the RELAP5/MOD2, one can observe three fundamental disagreements between calculated and experimental transient sequences. The first is the underestimation of the calculated two-phase break flow rate (between 100 and 200 seconds) leading to an insufficient mass discharge from the primary system and therefore from the pressure vessel. A sensitivity study on the break flow rate using break flow options was carried out. However the results did not give sufficient improvement on predicting the break flow rate. The second and the most important inaccuracy is that the code strongly overestimates the liquid holdup in the upflow side of the SG U-tubes, giving rise to a plug effect

hindering the loop seal downflow side level decreasing and delaying the loop seal clearance. The third discrepancy of the calculation in comparison with the experiment is that the higher vapor-phase break flow rate (after 160 seconds) results in a fast primary mass loss and therefore in an anticipated earlier accumulator injection.

In the base calculation with the RELAP5/MOD3, the first and the third disagreements described above were still observed. The liquid holdup in the upflow side of the steam generator U-tubes was predicted well with the experiment, however the complete loop seal clearing was not occurred throughout the transient. This discrepancy was cleared by the nodalization changes in the steam generator U-tubes and the cross-over legs and the calculated results were in good agreement with the experiment in the evolution of the major thermal-hydraulic phenomena and their timing order.

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4. "Appendix A RELAP5 Input Data Requirements," EG&G Idaho Inc., 1990.
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7. "Supplimental Description of ROSA-IV/LSTF with No. 1 Simulated Fuel-Rod Assembly," The ROSA-IV Group, JAERI-M/89-113.
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Tables and Figures

Table 1. Major Design Characteristics of LSTF and PWR

		LSTF	PWR	PWR/LSTF
Pressure	(MPa)	16	16	1
Temperature	(K)	598	598	1
No. of fuel rods		1064	50952	48
Core height	(m)	3.66	3.66	1
Fluid volume, V	(m ³)	7.23	347	48
Core power, P	(MW)	10	3423(t)	342
P/V	(MW/m ³)	1.4	9.9	7.1
Core inlet flow	(t/s)	0.0488	16.7	342
Downcomer gap	(m)	0.053	0.260	4.91
Hot leg, D	(m)	0.207	0.737	3.56
L	(m)	3.69	6.99	1.89
L/√D	(m ^{1/2})	8.15	8.15	1.0
$\pi \frac{1}{4} D^2 L$	(m ³)	0.124	2.98	24.0
No. of loops		2	4	2
No. of tubes in steam generator		141	3382	24
Length of steam generator tube (average)	(m)	20.2	20.2	1.0

Table 2. Specified Operational Setpoints and Conditions for Run SB-CL-18

Reactor scram signal	12.97 MPa
Initiation of RC pump coastdown	with reactor scram
Safety injection (SI) signal	12.27 MPa
High pressure charging	not actuated
Safety injection	not actuated
Accumulator injection	4.51 MPa
Low pressure injection	1.29 MPa
Main feedwater termination	with reactor scram
Turbine throttle valve closure	with reactor scram
Auxiliary feedwater	not actuated
Pressurizer Sparay Valve Bypass Flow Rate	0.011 kg/s
Pressurizer Proportional-Heater off	1 m (PR Liquid Level)
Pressurizer Back-up-heater off	1 m (PR Liquid Level)
Pressurizer Relief Valve Orifice	6.83 mm
Pressurizer Relief Valve on/off	16.20/16.07 MPa
Pressurizer Safety Valve Orifice	14.5 mm
Pressurizer Safety Valve on/off	17.26/17.06 MPa
Downcomer-to-Hot-Leg Leakage	0.049 kg/s/loop
Steam Generator Relief Valve Orifice	19.4 mm
Steam Generator Relief Valve on/off	8.03/7.82 MPa
Steam Generator Safety Valve Orifice	26.6 mm
Steam Generator Safety Valve on/off	8.68/7.69 MPa

Table 3. RELAP5/MOD3 Model Improvements

-
- Counter Current And Flow Limiting
 - Interfacial Friction in Bubbly/Slug Flow Regime
 - Vapor Pullthrough, Liquid Entrainment in Horizontal Pipes
 - Critical Heat Flux
 - Interfacial Condensation on Subcooled ECCS Liquid in Horizontal Pipes
 - Horizontal Stratification Inception Criterion
 - Reflood Heat Transfer
 - Vertical Stratification
 - Metal-Water Reaction
 - Fuel Rod Ballooning and Rupture Model
 - Radiation Heat Transfer Model
 - Non-Condensable Gas Modelling
 - Downcomer Penetration and ECCS Bypass
 - Upper Plenum De-entrainment
-

Table 4. Comparison of Initial Conditions

Parameter	Units	Measured	Calc. 1	Calc. 2
PRIMARY LOOP				
CORE DIFFERENTIAL TEMPERATURE = (HOT-LEG TEMPERATURE) - (COLD-LEG TEMPERATURE)	K	36	35.7	35.0
HOT-LEG PRESSURE	MPa	15.5	15.6	15.5
HOT-LEG TEMPERATURE	K	599	600	599.5
MASS FLOW RATE PER LOOP	kg/s	24.35	24.34	
DOWNCOMER-TO-HOT LEG BYPASS FLOW RATE	kg/s	0.066	0.029	0.029
DOWNCOMER-TO-UPPER PLENUM LEAK FLOW RATE	kg/s	0.041	0.015	0.018
DOWNCOMER-TO-UPPER HEAD BYPASS FLOW RATE	kg/s	0.146	0.041	0.023
PUMP DIFFERENTIAL PRESSURE	kPa	4	2.9	3.0
PUMP ROTATIONAL SPEED	Hz	12.81	12.26	12.71
PRESSURE VESSEL				
CORE POWER	MW	10	10	10
MAXIMUM LINEAR HEAT GENERATION RATE	kW/m		3.926	
CORE DIFFERENTIAL PRESSURE	MPa		0.0277	0.0278
UPPER HEAD TEMPERATURE (TOP/BOTTOM)	K	595	594.8	594.8
LOWER PLENUM TEMPERATURE (MID/BOTTOM)	K		567.3	567.3
PRESSUREIZER				
PRESSURE	MPa	15.5	15.56	15.56
LIQUID LEVEL	m	2.7	2.63	2.63
LIQUID VOLUME	m ³		0.734	0.733
VAPOR VOLUME	m ³		0.413	0.414
TEMPERATURE (BOTTOM)	K		618.2	618.2
PRIMARY SYSTEM TOTAL MASS INVENTORY	kg	5764	5511.7	5511.3
PRIMARY SYSTEM TOTAL VOLUME	m ³	8.106	8.191	8.191

+ Calc. 1 : REALP5/MOD2
Calc. 2 : RELAP5/MOD3

(Table 4 continued)

Parameter	Units	Measured	Calc. 1	Calc. 2
SECONDARY SYSTEM				
SG STEAM DOME PRESSURE	MPa	7.3	7.31	7.31
STEAM FLOW RATE	kg/s	2.7	2.89	2.89
FEEDWATER FLOW RATE	kg/s	2.7	2.89	2.89
FEEDWATER TEMPERATURE	K	494	495	495
DOWNCOMER FLOW RATE	kg/s		16.587	
DOWNCOMER WATER LEVEL (FLOW TOP OF TUBE SHEET)	m	10.8	9.09	9.58
SECONDARY SIDE TOTAL MASS INBENTORY FOR EACH SG (LIQUID/VAPOR)	kg		2570	2570
SECONDARY SIDE TOTAL VOLUME FOR EACH SG	m3	7.003(A) 7.030(B)	6.95(A) 6.95(A)	6.95(A) 6.95(B)
EMERGENCY CORE COOLING SYSTEM				
HOT-ACCUMULATOR PRESSURE	MPa	4.51	4.51	4.51
HOT-ACCUMULATOR LIQUID TEMPERATURE	K	320	320	320
HOT-ACCUMULATOR LIQUID VOLUME	m3	4.189	4.189	4.189
HOT-ACCUMULATOR GAS VOLUME	m3	0.611	0.611	0.611
COLD-ACCUMULATOR PRESSURE	MPa	4.51	4.51	4.51
COLD-ACCUMULATOR LIQUID TEMPERATURE	K	320	320	320
COLD-ACCUMULATOR LIQUID VOLUME	m3	4.676	4.676	4.676
COLD-ACCUMULATOR GAS VOLUME	m3	0.124	0.124	0.124

Table 5. Chronology of Main Events

(unit :second)

	Measures	Cal. 1	Calc. 2	Calc. 3
BREAK VALVE OPENED	0	0	0	0
SCRAM SETPOINT REACHED	9	14	12	12
SAFETY INJECTION SIGNAL GENERATED	9	14	12	12
STEAM LINE VALVE CLOSED	14	19	17	17
SG FEEDWATER TRIPPED	16	19	17	17
STEAM LINE RELIEF VALVE STARTED				
OPEN/CLOSE CYCLING (A/B)		37/36	23/22	23/22
FIRST CORE UNCOVERY STARTED	120	170	100	120
LOOP SEAL CLEARING OCCURRED (A/B)	140/140	195/195	135/135	150/150
PRIMARY/SECONDARY PRESSURE				
REVERSAL OCCURRED	180	210	180	170
REACTOR COOLANT PUMP STOPPED	265	285	285	285
SECOND CORE UNCOVERY STARTED	420	360	300	340
ACCUMULATOR INJECTION STARTED	455	420	365	370
FINAL CORE REFLOODING STARTED	460	430	370	380
FINAL CORE REFLOODING COMPLETE	540	665	430	430
(ANALYSIS TERMINATED)		900	900	(650)

+ Calc. 1 : RELAP5/MOD2

Calc. 2 : RELAP5/MOD3

Calc. 3 : RELAP5/MOD3 (Nodalization Change)

Table 6. Run Statistics Data in Base Case

i) RELAP/MOD2

Transient time (sec)	CPU Time (sec)	Attempted ADV	Repeated ADV
0	1.39	0	0
100	213.72	630	12
200	340.30	978	55
300	730.98	2032	309
400	951.71	2711	340
500	1232.42	3556	431
600	1602.27	4638	551
700	1892.98	5545	556
800	2085.98	6161	563
900	2351.73	6970	594

ii) RELAP/MOD3

Transient time (sec)	CPU Time (sec)	Attempted ADV	Repeated ADV
0	1.3	0	0
100	98.1	830	75
130	427.9	3830	175
190	480.0	4261	283
220*	1123.3	10261	0
320	1245.6	11323	155
420*	1370.6	12375	114
520	1505.3	13534	218
620	1645.2	14738	369
720	1754.9	15689	489
820	1865.2	16639	593
900			

* Restart calculations with reduced time step size to overcome "water property error"

Fig. 1 General Structure of Large Scale Test Facility (LSTF)

Fig. 2 Nodalization of ROSA-IV LSTF for RELAP5/MOD2 Code

Fig.3 Pressurizer Pressure

Fig. 4 SG-I Steam Dome / Line Pressures

Fig. 5 SG-B Steam Dome / Line Pressures

Fig. 6 SG-I Inlet - Tube Top Differential Pressure

Fig. 7 SG-I Outlet - Tube Top Differential Pressure

Fig. 8 SG-B Inlet - Tube Top Differential Pressure

Fig. 9 SG-B Outlet - Tube Top Differential Pressure

Fig. 10 Cold Acc Tank/Hot Acc tank Pressures

Fig.11 Acc Flow Rates

Fig. 12 Break Flow Calculated from Catch Tank Level Rise

Fig. 13 Integrated Break Mass Flow

Fig.14 SG Pressure Difference

Fig. 15 Crossover Leg Downflow Differential Pressure

Fig.16 Crossover Leg Upflow Differential Pressure

Fig.17 Cold Leg-B Differential Pressure

LSTF : 5% SBLOCA

Fig. 18 SG-I Inlet Plenum Differential Pressure

LSTF : 5% SBLOCA

Fig. 19 S6-B Inlet Plenum Differential Pressures

Fig.20 Core Collapsed Liquid Level

Fig.21 Core and Upper Plenum Differential Pressures

Fig. 22 Core Inlet Flow Rate

Fig. 23 Rod Surface Temperatures - A

LSTF : 5% SBLOCA

Fig. 24 Rod Surface Temperatures - B

Fig. 25 Total Core Power

Fig. 26 RCP Rotation Speed in Primary Loop I (1Hz=30RPM)

Fig. 27 RCP Rotation Speed in Primary Loop B (1Hz=30RPM)

Fig. 28 Pressurizer Liquid Level

Fig. 29 Primary Loop I Flow Rate

Fig.30 Primary Loop B Flow Rate

Fig.31 Density in Hot Leg I

Fig.32 Density in Hot Leg B

Fig.33 Hot Leg-I Fluid Temperatures

Fig. 34 Hot Leg-B Fluid Temperatures

Fig. 35 Density in Cold Leg I

Fig.36 Density in Cold Leg B

Fig.37 Cold Leg-I Fluid Temperatures

Fig. 38 Cold Leg-B Fluid Temperatures

Fig.39 RCP Differential Pressure

Fig.40 Upper Plenum - Downcomer Differential Pressure

Fig.4.1 PV Downcomer Differential Pressure

Fig. 42 Steam Generator-I Liquid Levels

Fig.43 Steam Generator-B Liquid Levels

Fig. 44 Primary and Secondary Pressures

Fig. 45 Break Flow Calculated from Catch Tank Level Rise

Fig. 46 Integrated Break Mass Flow

Fig. 47 Pressurizer Pressure

Fig. 48 Break Flow Calculated from Catch Tank Level Rise

Fig. 49 Integrated Break Mass Flow

Fig.50 Pressurizer Pressure

Fig.51 Break Flow Calculated from Catch Tank Level Rise

Fig.52 Integrated Break Mass Flow

Fig.53 Pressurizer Pressure

Fig.54 SG-I Steam Dome / Line Pressures

Fig.55 SG-B Steam Dome / Line Pressures

Fig.56 Crossover Leg Downflow Differential Pressure

Fig. 57 Crossover Leg Upflow Differential Pressure

Fig. 58 Core Collapsed Liquid Level

Fig. 59 Core and Upper Plenum Differential Pressures

Fig.60 SG-I Inlet - Tube Top Differential Pressure

Fig.61 SG-I Outlet - Tube Top Differential Pressure

Fig. 62 SG-B Inlet: -- Tube Top Differential Pressure

Fig. 63 SG-B Outlet - Tube Top Differential Pressure

LSIF : 5% SBLOCA

Fig. 64 SG-I Inlet Plenum Differential Pressure

Fig. 65 SG-B Inlet Plenum Differential Pressures

Fig.66 Cold Leg-B Differential Pressure

LSTF : 5% SBLOCA

Fig. 67 Cold Acc Tank/Hot Acc tank Pressures

Fig.68 Rod Surface Temperatures - A

Fig.69 Rod Surface Temperatures - B

Fig. 70 SG Pressure Difference

Fig. 71 CPU Time in Base Calculations

Appendix


```

*****
*
= lstf test sb-cl-18 base input deck with relap5/mod3
*
*****
*
0000100      new      transnt
*
0000101      run
0000102      si
0000105      5.0      2.0
*
0000110      nitrogen
0000115      1.0
*
0000120      124010000      0.00      water      primary
0000121      504010000      7.9639      water      secndry
0000122      900010000      0.00      water      contain
*
*   time step control
*
*
0000201      200.0      1.0-6      0.05      3      100      2000      2000
0000202      300.0      1.0-6      0.5      3      10      200      200
0000203      330.0      1.0-6      0.01      3      100      2000      2000
*
20800001      sonicj      915000000
20800002      xej      915000000
20800003      sathf      248010000
20800004      sathg      248010000
*
*****
*   minor edits
*****
*
301  p      610010000
302  p      516010000
303  p      316010000
304  p      700010000
305  p      710010000
306  cntrlvar      761
307  cntrlvar      763
308  cntrlvar      758
309  cntrlvar      765
310  cntrlvar      766
311  cntrlvar      767
312  cntrlvar      750
313  cntrlvar      751
314  cntrlvar      768
315  cntrlvar      754
316  cntrlvar      755

```

317	cntrlvar	769
318	cntrlvar	752
319	cntrlvar	753
320	cntrlvar	770
321	cntrlvar	756
322	cntrlvar	757
323	cntrlvar	771
324	cntrlvar	610
325	cntrlvar	128
326	cntrlvar	124
327	cntrlvar	516
328	cntrlvar	316
329	cntrlvar	504
330	cntrlvar	304
**331	tempg	600020000
**332	tempf	600020000
* 333	tempg	148010000
* 334	tempf	148010000
331	sonicj	915000000
332	xej	915000000
333	voidgj	915000000
334	mflowj	120010000
335	tempg	120010000
336	tempf	120010000
337	tempg	128010000
338	tempf	128010000
* 339	tempg	104010000
* 340	tempf	104010000
341	tempg	400010000
342	tempf	400010000
343	tempg	200010000
344	tempf	200010000
345	tempg	452010000
346	tempf	452010000
347	tempg	252010000
348	tempf	252010000
349	httemp	124100109
350	httemp	124100209
351	httemp	124100309
352	httemp	124100409
353	httemp	124100509
354	httemp	124100609
355	cntrlvar	780
356	cntrlvar	790
357	mflowj	915000000
358	mflowj	700010000
359	mflowj	710010000
360	pmpvel	240
361	pmpvel	440
362	cntrlvar	888
363	cputime	0

```

364 voidg      124010000
365 voidg      124020000
366 voidg      124030000
367 voidg      124040000
368 voidg      124050000
369 voidg      124060000
370 mflowj     369000000
371 mflowj     569000000
372 p          244010000
373 p          448010000
374 cntrlvar   772
375 cntrlvar   773
376 cntrlvar   436
377 cntrlvar   236
378 cntrlvar   136
379 cntrlvar   137
380 cntrlvar   138
381 cntrlvar   139
382 cntrlvar   134
383 cntrlvar   105
384 cntrlvar   106
385 cntrlvar   107
386 cntrlvar   500
387 cntrlvar   300
388 cntrlvar   720
389 cntrlvar   740
390 cntrlvar   920
391 floreg     406010000
392 floreg     206010000
393 floreg     452010000
394 floreg     252010000
395 cntrlvar   915
396 voidg      248010000
397 voidg      400010000
*395 cntrlvar  934
*396 cntrlvar  944
*397 cntrlvar  954
*398 cntrlvar  964
*399 cntrlvar  974
*
*****
* variable trips
*****
*
0000501 p      610010000  lt  null 0  1.297e+7  1 *low pres
*
0000502 time      0  ge  null 0  1.e6  1 *power
*
0000505 p      610010000  lt  null 0  1.227e+7  1 *rcp&si
*
0000506 time      0  ge  timeof 505 17.0 1 *lpsi delay

```

```

*
0000507 time          0 ge null 0      1.0e6 n *rcp delay
*
0000510 time          0 ge timeof 505 12.0 1 *il hpi
*
0000512 time          0 ge timeof 505 12.0 n *bl hpi
*
0000514 cntrlvar 30      ge cntrlvar 31 0.0 n *mean temp
0000516 cntrlvar 30      lt cntrlvar 31 0.0 n
*
0000520 p      610010000 ge null 0      1.646e+7 1 *high pres
*
0000522 p      610010000 ge null 0      1.726e+7 n *pzs sfty
*
0000524 p      610010000 ge null 0      1.568e+7 n *pzs spry
*
0000526 p      610010000 gt null 0      1.607e+7 n * porv
0000528 p      610010000 gt null 0      1.620e+7 n
*
0000529 time          0 ge null 0      0.0      1 *pzs prp. htrs
*
0000530 p      610010000 lt null 0      1.540e+7 n *pzs bkup htrs
0000531 p      610010000 lt null 0      1.534e+7 n
*
0000532 cntrlvar 610    lt null 0      0.25656 n *lo nrm pr lvl
*
0000535 time          0 ge null 0      200.0    1 *cl break
*
0000536 time          0 ge null 0      0.0      1 *bl flow
0000537 time          0 lt null 0      0.0      1 *valve
*
0000538 time          0 lt null 0      0.0      1 *il flow
0000539 time          0 lt null 0      0.0      1 *valve
*
0000550 p 610010000 ge null 0 1.297e+7 1 *main feed
*
0000552 time          0 ge timeof 536 10000 0 1 *aux fed
*
0000554 cntrlvar 308    lt null 0      0.44      n *aux feed
0000555 cntrlvar 508    lt null 0      0.44      n
*
0000560 p 316010000 gt null 0      7.82e+6 n *bl sg rel
0000561 p 316010000 gt null 0      8.2e+6 n
*
0000564 p 316010000 gt null 0      7.69e+6 n *bl sg saf
0000565 p 316010000 gt null 0      8.68e+6 n
*
0000568 time          0 lt null 0      0.0      n *bl msiv
0000569 p 316010000 lt null 0      4.235e+6 i
*
0000570 p 516010000 gt null 0      7.82e+6 n *il sg rel

```

```

0000571 p 516010000 gt null 0 8.2e+6 n
*
0000574 p 516010000 gt null 0 7.69e+6 n *il sg saf
0000575 p 516010000 gt null 0 8.68e+6 n
*
0000578 time 0 lt null 0 0.0 n *il msiv
0000579 p 516010000 lt null 0 4.235e+6 l
*
0000580 cntrlvar 308 lt null 0 0.25 l *low sg lev
0000581 cntrlvar 508 lt null 0 0.25 l
*
0000583 time 0 ge null 0 0.0 n *stm hdr vlv
*
0000585 time 0 lt null 0 0.0 n *stm thrtl
*
0000586 time 0 ge null 0 11.0 n * valve
*
0000599 time 0 lt null 0 200.0 n * ss pres
*
*
*****
* logical trips
*****
*
0000601 -603 and 571 n * il sec relief valve
0000602 603 and 570 n
0000603 601 or 602 n
*
0000604 -606 and 575 n * il sec safety valve
0000605 606 and 574 n
0000606 604 or 605 n
*
0000607 -609 and 561 n * b1 sec relief valve
0000608 609 and 560 n
0000609 607 or 608 n
*
0000610 -612 and 565 n * b1 sec safety valve
0000611 612 and 564 n
0000612 610 or 611 n
*
0000613 -615 and 528 n * porv
0000614 615 and 526 n
0000615 613 or 614 n
*
0000620 580 or 581 1 * reactor trip
0000621 520 or 620 1
0000622 621 or 501 1
*
0000623 552 and 554 n * sg aux feed, b1
0000624 552 and 555 n * , il
*

```

```

0000625  -586  or  -586  n * steam sink pressure
*
0000626   579  or   568  1 * hpi
0000627   626  or   505  1
*
0000630  -632  and   531  n * pzs backup heater cntl
0000631   632  and   530  n
0000632   630  or   631  n
*
0000633  -505  and  -532  n * pzs htrs off on sis or low pzs lvl
0000634   632  and   633  n *pzs htrs off on low pzs level
*
*
*****
*  hydrodynamic components
*****
*
*****
*  reactor vessel
*****
1000000      inann1      snglvol
1000101  0.0  1.5684  0.13609  0.0  -90.  -1.5684
1000102  4.57e-5  0.106  00
*1000200  0  15669968. 1262572.3 2443840.8 0.0
1000200 003  15669968. 567.5
*
*****
1040000      inann      branch
1040001  4  0
1040101  0.0  0.600  0.05425  0.0  -90.0  -0.600  4.57e-5
1040102  0.106  00
*1040200  0  15677916. 1259386.1 2443653.5 0.0
1040200 003  15677916. 567.5
1041101  104000000  100010000  0.0  0.0  0.0  0000
1042101  104010000  108000000  0.0  0.0  0.0  0000
1043101  252010000  104000000  0.03365  0.345  0.345  0101
1044101  452010000  104000000  0.03365  0.345  0.345  0101
1041201  3.72622-3 3.72622-3 0.0  * .24192712
1042201  .71183539 .71183539 0.0  * 48.158681
1043201  .96085447 .96085447 0.0  * 24.199945
1044201  .96096109 .96096109 0.0  * 24.200657
*
*****
1080000  downcmer  annulus
1080001  9
1080101  0.09774  9
1080301  0.6757  1
1080302  0.8670  2
1080303  0.610  8
1080304  1.2588  9
1080601  -90.0  9

```

```

1080701 -0.6757 1
1080702 -0.8670 2
1080703 -0.610 8
1080704 -1.2588 9
1080801 4.573e-5 0.106 9
1081001 00 9
1081101 0000 8
*1081201 0 15682417. 1260080.6 2443547.4 0.0 0.0 1
1081201 003 15682417. 567.5 0. 0. 0. 1
*1081202 0 15688051. 1260938.8 2443414.6 0.0 0.0 2
1081202 003 15688051. 567.5 0. 0. 0. 2
*1081203 0 15693443. 1261719.6 2443287.6 0.0 0.0 3
1081203 003 15693443. 567.5 0. 0. 0. 3
*1081204 0 15697895. 1262438.4 2443182.8 0.0 0.0 4
1081204 003 15697895. 567.5 0. 0. 0. 4
*1081205 0 15702346. 1263027.9 2443078.0 0.0 0.0 5
1081205 003 15702346. 567.5 0. 0. 0. 5
*1081206 0 15706796. 1263433.3 2442973.3 0.0 0.0 6
1081206 003 15706796. 567.5 0. 0. 0. 6
*1081207 0 15711245. 1263648.4 2442868.6 0.0 0.0 7
1081207 003 15711245. 567.5 0. 0. 0. 7
*1081208 0 15715694. 1263720.1 2442763.9 0.0 0.0 8
1081208 003 15715694. 567.5 0. 0. 0. 8
*1081209 0 15722509. 1263721.2 2442603.7 0.0 0.0 9
1081209 003 15722509. 567.5 0. 0. 0. 9
1081300 0
1081301 .65871571 .65871571 0.0 1 * 48.158687
1081302 .65898280 .65898280 0.0 2 * 48.158693
1081303 .65922606 .65922606 0.0 3 * 48.158697
1081304 .65945084 .65945084 0.0 4 * 48.158699
1081305 .65963484 .65963484 0.0 5 * 48.158700
1081306 .65976032 .65976032 0.0 6 * 48.158700
1081307 .65982512 .65982512 0.0 7 * 48.158698
1081308 .65984417 .65984417 0.0 8 * 48.158695
*
*****
1120000 lplov1 snglv1
1120101 0.0 0.626 0.1661 0.0 90.0 0.626 4.57e-5
1120102 0.0104 00
*1120200 0 15732812. 1260987.0 2442361.5 0.0
1120200 003 15732812. 567.5
*
*****
1160000 lowrplnm branch
1160001 3 0
1160101 0.0 0.4762 0.0943 0.0 90.0 0.4762 4.57e-5
1160102 0.0104 00
*1160200 0 15728774. 1263722.5 2442456.4 0.0
1160200 003 15728774. 567.5
1161101 108010000 116010000 0.09774 1.0 1.0 0100
1162101 112010000 116000000 0.23623 0.0 0.0 0000

```

```

1163101      116010000  120000000  0.15931      8.34 8.34 0000
* 1162101      112010000  116000000  0.0          0.0 0.0 0000
* 1163101      116010000  120000000  0.1038      8.34 8.34 0000
1161201      .65983851 .65983851 0.0          * 48.158680
1162201      .115004-9 .152679-9 0.0          * 17.0061-9
1163201      .62131130 .62131130 0.0          * 48.158664
1162110      0.0104      1.0      1.0      1.0
1163110      0.0104      1.0      1.0      1.0
*
*****
1200000      corein      branch
1200001      1          0
1200101      0.0      1.2588 0.1821 0.0 90.0 1.2588 4.57e-5
1200102      0.0104      00
*1200200      0          15721639. 1263726.1 2442624.1 0.0
1200200      003      15721639. 567.5
1201101      120010000  124000000  0.13657      0.85 0.85 0000
1201201      .481857      .481857 0.0          * 48.158607
1201110      0.009721      1.0      1.0      1.0
*
*****
1240000      core      pipe
1240001      6
1240101      0.0          6
1240201      0.119868      5
* 1240201      0.06774      5
1240301      0.610          6
1240401      0.07312      6
1240601      90.0          6
1240701      0.610          6
1240801      4.57e-5      0.00832 6
1240901      0.68      0.68 5
1241001      00100          6
1241101      0000          5
*1241201      0          15713996. 1281265.0 2442803.9 0.0          0.0      1
1241201      003      15713996. 573.05 0. 0. 0. 1
*1241202      0          15708831. 1317062.4 2442925.4 0.0          0.0      2
1241202      003      15708831. 578.6 0. 0. 0. 2
*1241203      0          15703749. 1365699.2 2443045.0 0.0          0.0      3
1241203      003      15703749. 584.15 0. 0. 0. 3
*1241204      0          15698764. 1414083.2 2443162.3 0.0          0.0      4
1241204      003      15698764. 589.70 0. 0. 0. 4
*1241205      0          15693863. 1449245.9 2443277.8 0.0          0.0      5
1241205      003      15693863. 595.25 0. 0. 0. 5
*1241206      0          15689012. 1465987.5 2443392.0 0.0          0.0      6
1241206      003      15689012. 600.5 0. 0. 0. 6
1241300      0
1241301      .96034412 .96034412 0.0          1          * 48.158578
1241302      .97815501 .97815501 0.0          2          * 48.158541
1241303      1.0046451 1.0046451 0.0          3          * 48.158496
1241304      1.0341781 1.0341781 0.0          4          * 48.158441

```



```

1241305 1.0577423 1.0577423 0.0 5 * 48.158378
1241401 0.00832 1.0 1.0 1.0 5
*
*****
1280000 creoutlt branch *
1280001 3 0
1280101 0.0 0.867 0.1522 0.0 90.0 0.867 4.57e-5 *
1280102 0.0 00 *
*1280200 0 15680901. 1464738.1 2443583.1 0.0
1280200 003 15680901. 600.5
1281101 124010000 128000000 0.15255 1.272 1.272 0000
1282101 128010000 132000000 0.16737 0.0 0.0 0000
1283101 156010000 128010000 0.085679 420. 420. 0000
* 1281101 124010000 128000000 0.03114 1.272 1.272 0000
* 1282101 128010000 132000000 0.0 0.0 0.0 0000
* 1283101 156010000 128010000 0.1144 420. 420. 0000
1281201 2.3270926 2.3270926 0.0 * 48.158308
1282201 .46385815 .46385815 0.0 * 48.399826
1283201 3.01830-3 3.01830-3 0.0 * .24167236
1281110 0.28097 1.0 1.0 1.0
1282110 0.4063 1.0 1.0 1.0
1283110 0.3078 1.0 1.0 1.0
*
*****
1320000 upplnm snglvol
1320101 0.0 0.6757 0.1060 0.0 90.0 0.6757 4.57e-5
1320102 0.321 00
*1320200 0 15675850. 1463705.5 2443702.1 0.0
1320200 003 15675850. 600.5
*
*****
1360000 upplnm1 branch
1360001 5 0
1360101 0.0 0.600 0.09389 0.0 90.0 0.600 4.57e-5
1360102 0.321 00
1360200 0 15671715. 1462948.6 2443799.6 0.0
1360200 003 15671715. 600.5
1361101 136000000 200000000 0.05520 0.265 0.265 0102
1362101 136000000 400000000 0.05520 0.265 0.265 0102
1363101 132010000 136000000 0.15669 0.0 0.0 0000
1364101 140000000 136010000 0.14305 0.0 0.0 0000
* 1363101 132010000 136000000 0.0 0.0 0.0 0000
* 1364101 140000000 136010000 0.0 0.0 0.0 0000
1365101 104000000 136000000 1.0e-4 40. 40. 0103
1361201 .65833557 .65833557 0.0 * 24.200218
1362201 .65830429 .65830429 0.0 * 24.199069
1363201 .46469046 .46469046 0.0 * 48.399714
1364201 -4.0444-6 -4.0444-6 0.0 * -326.21-6
1365201 0.551075 0.551075 0.0 * 0.041000
1363110 0.321 1.0 1.0 1.0
1364110 0.321 1.0 1.0 1.0

```

```

*
*****
1400000      uptopvol      snglvol
1400101      0.0  0.3674  0.0445  0.0  90.0  0.3674  4.57e-5
1400102      0.321  00
*1400200  0      15668458. 1274378.1 2443876.4 0.0
1400200  003      15668458. 600.5
*
*****
1440000      tophat      snglvol
1440101      0.0  0.897  0.1655  0.0  90.0  0.897  4.57e-5
1440102      0.95  00
*1440200  0      15661376. 1265008.8 2444043.5 0.0
1440200  003      15661376. 595.0
*
*****
1480000      uhmidvol      branch
1480001  2      0
1480101      0.0  0.725  0.1970  0.0  90.0  0.725  4.57e-5
1480102      0.256  00
*1480200  0      15655440. 1263579.0 2444183.5 0.0
1480200  003      15655440. 595.0
1481101      100000000  148000000  9.5e-5  0.0  0.0  0100  * uh/dc leak
1482101      144010000  148000000  0.0  0.0  0.0  0000
1481201      3.73012-3 3.73012-3 0.0      * .24180655
1482201      -356.96-9 -356.92-9 0.0      * -49.179-6
*
*****
1520000      uhtopvol      branch
1520001  2      0
1520101      0.0  0.504  0.1475  0.0  90.0  0.504  4.57e-5
1520102      0.0  00
*1520200  0      15650939. 1262745.7 2444289.7 0.0
1520200  003      15650939. 595.0
1521101      148010000  152000000  0.0  0.0  0.0  0000
1522101      152000000  156000000  0.00199 1.472 1.472 0000
1521201      1.19108-3 1.19108-3 0.0      * .24167128
1522201      .16263527 .16263526 0.0      * .24176700
*
*****
1560000      gdetub      pipe
1560001  2
1560101      0.0  2
1560201      0.0102  1
1560301      1.9260  1
1560302      1.6431  2
1560401      0.06209 1
1560402      0.06286 2
1560601      -90.0  2
1560701      -1.9260 1
1560702      -1.6431 2

```

```

1560801 4.57e-5 0.0 2
1560901 3.34 3.34 1
1561001 00 2
1561101 0000 1
*1561201 0 15659815. 1264980.5 2444080.3 0.0 0.0 1
1561201 003 15659815. 594. 0. 0. 0. 1
*1561202 0 15672498. 1384706.7 2443781.2 0.0 0.0 2
1561202 003 15672498. 597. 0. 0. 0. 2
1561300 0
1561301 .03175404 .03175404 0.0 1 * .24169252
*
*****
* loop without pressurizer (broken loop)
*****
*
2000000 nphotleg snglvol
2000101 0.0337 1.3246 0.0 0.0 0.0 0.0 4.57e-5 0.207 00
*2000200 0 15671308. 1462950.6 2443809.2 0.0
2000200 003 15671308. 600.5
*
*****
2020000 blhlbyps branch
2020001 1 0
2020101 3.53e-4 2.65 0.0 0.0 0.0 0.0 4.57e-5 0.0 00
*2020200 0 15671269. 1462952.3 2443810.1 0.0
2020200 003 15671269. 567.5
2021101 104010000 202000000 3.53e-4 0.0 0.0 0100
2021201 0.0 0.0 0.0
*
*****
2030000 blhlbyp valve
2030101 202010000 204000000 3.53e-4 27.6 27.6 0100
2030201 0 0.913 0.913 0.0
2030300 srvvlv
2030301 203
*
*****
2040000 blhlbyps branch
2040001 1 0
2040101 3.53e-4 1.66 0.0 0.0 90.0 0.30 4.57e-5 0.0 00
*2040200 0 15671269. 1462952.3 2443810.1 0.0
2040200 003 15671269. 567.5
2041101 204010000 200000000 3.53e-4 0.0 0.0 0101
2041201 0.0 0.0 0.0
*
*****
2060000 nphotleg branch
2060001 2 0
2060101 0.0337 1.3843 0.0 0.0 0.0 0.0 4.57e-5 0.207 00
*2060200 0 15671269. 1462952.3 2443810.1 0.0
2060200 003 15671269. 600.5

```

2061101	200010000	206000000	0.0337	0.0	0.0	0000
2062101	206010000	208000000	0.0337	0.0	0.0	0000
2061201	1.0783423	1.0783423	0.0			* 24.200171
2062201	1.0783417	1.0783417	0.0			* 24.200126

*

2080000	wphotleg	pipe				
2080001	2					
2080101	0.0337	2				
2080301	0.7043	1				
2080302	0.5278	2				
2080601	0.0	1				
2080602	50.0	2				
2080701	0.0	1				
2080702	0.4043	2				
2080801	4.57e-5	0.207	2			
2080901	0.05	0.05	1			
2081001	00		2			
2081101	100000		1			
*2081201	0	15671238.	1462953.4	2443810.9	0.0	0.0 1
2081201 003		15671238.	600.5	0.0	0.0	0.1
*2081202	0	15669897.	1462953.9	2443842.5	0.0	0.0 2
2081202 003		15669897.	600.5	0.0	0.0	0.2
2081300	0					
2081301	1.0783412	1.0783412	0.0	1		* 24.200096
2081401	0.	0.	0.55	0.785	1	

*

2090000	nphotleg	sngljun				
2090101	208010000	212000000	0.0337	0.0	0.0	0100
2090201	0	1.0783441	1.0783441	0.0		* 24.200078

*

2120000	npsgin	snglvol				
2120101	0.0	0.706	0.125	0.0	90.0	0.706 4.57e-5
2120102	0.377	00				
*2120200	0	15666381.	1462958.0	2443925.4	0.0	
2120200 003		15666381.	600.5			

*

2130000	npsgfbj	sngljun				
2130101	212010000	216000000	0.2093	0.0	0.0	0000
2130201	0	.17362836	.17362836	0.0		* 24.199962

*

2160000	npsgfb	snglvol				
2160101	0.0	1.1035	0.2323	0.0	90.0	1.1035 4.57e-5
2160102	0.4474	00				
*2160200	0	15660476.	1462958.2	2444064.7	0.0	
2160200 003		15660476.	600.5			

*

```

*****
2170000      npsgin      sngljun
2170101      216010000  220000000  0.0425      0.0      0.0 100100
2170110      0.      0.      0.725      1.
2170201      0      .85507596 .85507596 0.0      * 24.199843
*
*****
2200000      npsgtube      pipe
2200001      8
2200101      0.0425      8
2200301      2.8724      1
2200302      2.5654      3
2200303      2.1728      5
2200304      2.5654      7
2200305      2.8724      8
2200601      90.0      4
2200604      -90.0      8
2200701      2.8724      1
2200702      2.5654      3
2200703      2.0980      4
2200704      -2.0980      5
2200705      -2.5654      7
2200706      -2.8724      8
2200801      1.524-6      0.0196      8
2200901      0.0      0.0      3
2200902      0.006      0.0      4
2200903      0.006      0.006      5
2200904      0.0      0.006      6
2200905      0.0      0.0      7
2201001      00      8
2201101      0000      7
*2201201 0      15646205. 1389454.1 2444401.5 0.0      0.0      1
2201201 003      15646205. 596.83 0. 0. 0. 1
*2201202 0      15626456. 1341291.4 2444868.0 0.0      0.0      2
2201202 003      15626456. 593.17 0. 0. 0. 2
*2201203 0      15607430. 1309854.4 2445317.9 0.0      0.0      3
2201203 003      15607430. 589.50 0. 0. 0. 3
*2201204 0      15589925. 1291367.9 2445732.2 0.0      0.0      4
2201204 003      15589925. 585.83 0. 0. 0. 4
*2201205 0      15589288. 1278668.1 2445747.3 0.0      0.0      5
2201205 003      15589288. 582.17 0. 0. 0. 5
*2201206 0      15605534. 1269039.8 2445362.7 0.0      0.0      6
2201206 003      15605534. 578.50 0. 0. 0. 6
*2201207 0      15623494. 1262856.0 2444938.0 0.0      0.0      7
2201207 003      15623494. 574.83 0. 0. 0. 7
*2201208 0      15642582. 1258768.9 2444487.0 0.0      0.0      8
2201208 003      15642582. 571.17 0. 0. 0. 8
2201300 0
2201301 .81588998 .81588998 0.0      1      * 24.199823
2201302 .79384485 .79384485 0.0      2      * 24.199820
2201303 .78062354 .78062354 0.0      3      * 24.199823

```

2201304	.77326379	.77326379	0.0	4		* 24.199828
2201305	.76829604	.76829604	0.0	5		* 24.199833
2201306	.76462686	.76462686	0.0	6		* 24.199839
2201307	.76231250	.76231250	0.0	7		* 24.199844

*

2210000	npsgout	sngljun				
2210101	220010000	224000000	0.0425	0.0	0.0	0100
2210201	0	.76079645	.76079645	0.0		* 24.199848

*

2240000	npsgfbo	snglvol				
2240101	0.0	1.1035	0.2323	0.0	-90.0	-1.1035 4.57e-5
2240102	0.4474	00				
*2240200	0	15656792.	1258767.5	2444151.6	0.0	
2240200	003	15656792.	567.5			

*

2250000	npsgfbo	sngljun				
2250101	224010000	228000000	0.2093	0.0	0.0	0000
2250201	0	.15448286	.15448286	0.0		* 24.199869

*

2280000	npsgout	snglvol				
2280101	0.0	0.706	0.125	0.0	-90.0	-0.706 4.57e-5
2280102	0.377	00				
*2280200	0	15663429.	1258765.9	2443995.0	0.0	
2280200	003	15663429.	567.5			

*

2290000	npcrsleg	sngljun				
2290101	228010000	232000000	0.0222	0.0	0.0	0100
2290201	0	1.4564407	1.4564407	0.0		* 24.199885

*

2320000	npcrsleg	pipe	
2320001	5		
2320101	0.0222	5	
2320301	0.516	1	
2320302	1.2422	4	
2320303	1.1919	5	
2320601	-50.0	1	
2320602	-90.0	4	
2320603	0.0	5	
2320701	-0.3953	1	
2320702	-1.2422	4	
2320703	0.0	5	
2320801	4.57e-5	0.1682	5
2320901	0.036	0.036	1
2320902	0.0	0.0	3
2320903	0.065	0.065	4

2321001	00	5					
2321101	0000	4					
*2321201	0	15666371.	1258765.7	2443925.6	0.0	0.0	1
2321202	003	15666371.	567.5	0.	0.	0.	1
*2321202	0	15672314.	1258765.3	2443785.5	0.0	0.0	2
2321202	003	15672314.	567.5	0.	0.	0.	2
*2321203	0	15681337.	1258765.0	2443572.8	0.0	0.0	3
2321203	003	15681337.	567.5	0.	0.	0.	3
*2321204	0	15690360.	1258764.6	2443360.3	0.0	0.0	4
2321204	003	15690360.	567.5	0.	0.	0.	4
*2321205	0	15694826.	1258764.2	2443255.1	0.0	0.0	5
2321205	003	15694826.	567.5	0.	0.	0.	5
2321300	0						
2321301	1.4564352	1.4564352	0.0	1		* 24.199886	
2321302	1.4564240	1.4564240	0.0	2		* 24.199890	
2321303	1.4564071	1.4564071	0.0	3		* 24.199894	
2321304	1.4563903	1.4563903	0.0	4		* 24.199899	

2330000	npfcv	valve					
2330101	232010000	236000000	0.0222	0.0	0.0	0100	
2330201	0	1.4563819	1.4563819	0.0			* 24.199903
2330300	mtrvlv						
2330301	536	537	1.4200000	1.0000000	0		

2360000	npcrslgu	pipe					
2360001	4						
2360101	0.0222	4					
2360301	1.3202	1					
2360302	1.1222	2					
2360303	1.1417	3					
2360304	1.1222	4					
2360601	0.0	1					
2360602	90.0	4					
2360701	0.0	1					
2360702	1.1222	4					
2360801	4.57e-5	0.1682	4				
2360901	0.065	0.065	1				
2360902	0.0	0.0	3				
2361001	00	4					
2361101	0000	3					
*2361201	0	15694735.	1258763.5	2443257.2	0.0	0.0	1
2361201	003	15694735.	567.5	0.	0.	0.	1
*2361202	0	15690528.	1258762.9	2443356.3	0.0	0.0	2
2361202	003	15690528.	567.5	0.	0.	0.	2
*2361203	0	15682206.	1258762.1	2443552.4	0.0	0.0	3
2361203	003	15682206.	567.5	0.	0.	0.	3
*2361204	0	15673883.	1258761.3	2443748.5	0.0	0.0	4
2361204	003	15673883.	567.5	0.	0.	0.	4
2361300	0						

2361301	1.4563819	1.4563819	0.0	1	* 24.199907
2361302	1.4563895	1.4563895	0.0	2	* 24.199912
2361303	1.4564048	1.4564048	0.0	3	* 24.199916

*

2400000	nprcpump	pump					
2400101	0.0	0.802	0.0235	0.0	90.0	0.351	0
2400108	236010000	0.0222		0.0	0.0	0000	
2400109	244000000	0.0337		0.0525	0.0525	0000	
*2400200	0	15673807.	1258785.4	2443750.3	0.0		
2400200	003	15673807.	567.5				
2400201	0	1.4564201	1.4564201	0.0			* 24.199921
2400202	0	.95943350	.95943350	0.0			* 24.199925
2400301	0	0	-1	0	0	0	
2400302	188.50000	.424116	.05400000	10.000000	55.200000		
2400303	0.54	750.0	0.0	0.0	0.0	0.0	0.0

*

* single phase head and torque data from lstf sys. description

*

2401100	1	1	0.00	1.36	0.10	1.38	0.24	1.42	0.40	1.41
2401101			0.60	1.32	0.80	1.19	1.00	1.00		
2401200	1	2	0.00	-0.97	0.20	-0.68	0.50	-0.20	0.65	0.07
2401201			0.80	0.40	1.00	1.00				
2401300	1	3	-1.0	3.20	-0.90	2.80	-0.80	2.46	-0.60	1.94
2401301			-0.40	1.57	-0.20	1.41	0.00	1.36		
2401400	1	4	-1.00	3.20	-0.80	2.76	-0.60	2.41	-0.40	2.09
2401401			-0.20	1.81	0.00	1.58				
2401500	1	5	0.00	0.00	1.00	0.00				
2401600	1	6	0.00	0.00	1.00	0.00				
2401700	1	7	-1.00	0.00	0.00	0.00				
2401800	1	8	-1.00	0.00	0.00	0.00				

*

* torque data

*

2401900	2	1	0.00	0.36	0.12	0.38	0.20	0.44	0.30	0.58
2401901			0.50	0.73	0.70	0.81	1.00	1.00		
2402000	2	2	0.00	-1.26	0.10	-0.88	0.30	-0.31	0.50	0.09
2402001			0.65	0.30	0.86	0.63	1.00	1.00		
2402100	2	3	-1.00	2.40	-0.85	1.70	-0.65	1.12	-0.50	0.84
2402101			-0.40	0.69	-0.20	0.59	0.00	0.36		
2402200	2	4	-1.00	2.40	-0.80	2.12	-0.60	1.80	-0.30	1.32
2402201			0.00	0.80						
2402300	2	5	0.00	0.00	1.00	0.00				
2402400	2	6	0.00	0.00	1.00	0.00				
2402500	2	7	-1.00	0.00	0.00	0.00				
2402600	2	8	-1.00	0.00	0.00	0.00				

*

* two phase multiplier tables for head of rc pump 240

*

2403000	0	0.0	0.0
2403001		0.10	0.0

2403002	0.15	0.05
2403003	0.24	0.80
2403004	0.30	0.96
2403005	0.40	0.98
2403006	0.60	0.97
2403007	0.80	0.90
2403008	0.90	0.80
2403009	0.96	0.50
2403010	1.00	0.0

*

* two phase multiplier tables for torque of rc pump 240

*

2403100	0	0.0	0.0
2403101		1.0	0.0

*

* two-phase diff curves from r5 built-in data

* head difference curves

*

2404100	1	1	0.00	0.00	0.10	0.83	0.20	1.09	0.50	1.02
2404101			0.70	1.01	0.90	0.94	1.00	1.00		
2404200	1	2	0.00	0.00	0.10	-0.40	0.20	0.00	0.30	0.10
2404201			0.40	0.21	0.80	0.67	0.90	0.80	1.00	1.00
2404300	1	3	-1.00	-1.16	-0.90	-1.24	-0.80	-1.77	-0.70	-2.36
2404301			-0.60	-2.79	-0.50	-2.91	-0.40	-2.67	-0.25	-1.69
2404302			-0.10	-0.50	0.00	0.00				
2404400	1	4	-1.00	-1.16	-0.90	-0.78	-0.80	-0.50	-0.70	-0.31
2404401			-0.60	-0.17	-0.50	-0.08	-0.35	0.00	-0.20	0.05
2404402			-0.10	0.08	0.00	0.11				
2404500	1	5	0.00	0.00	1.00	0.00				
2404600	1	6	0.00	0.00	1.00	0.00				
2404700	1	7	-1.00	0.00	0.00	0.00				
2404800	1	8	-1.00	0.00	0.00	0.00				

*

* torque difference curves

*

2404900	2	1	0.0	0.0	0.0	0.0
2405000	2	2	0.0	0.0	0.0	0.0
2405100	2	3	0.0	0.0	0.0	0.0
2405200	2	4	0.0	0.0	0.0	0.0
2405300	2	5	0.0	0.0	0.0	0.0
2405400	2	6	0.0	0.0	0.0	0.0
2405500	2	7	0.0	0.0	0.0	0.0
2405600	2	8	0.0	0.0	0.0	0.0

*

* pump coastdown data

*

2406100	501		* norm speed
2406101	0.0	82.93	*
2406102	14.0	160.22	*
2406103	16.0	160.85	*
2406104	17.0	160.22	*

2406105	30.0	74.14	*
2406106	32.0	72.26	*
2406107	45.0	48.59	*
2406108	60.0	34.68	*
2406109	80.0	24.82	*
2406110	100.0	19.29	*
2406111	130.0	14.45	*
2406112	163.0	9.74	*
2406113	200.0	9.93	*
2406114	230.0	9.61	*
2406115	266.0	7.10	
2406116	268.0	0.	
2406117	1000.0	0.	

*

```

*****
2440000      npcolleg      branch
2440001      2      0
2440101      0.0337      0.7348      0.0      0.0      0.0      0.0      4.57e-5      0.207      00
*2440200      0      15677656.      1258785.1      2443659.6      0.0
2440200      003      15677656.      567.5
2441101      244010000      248000000      0.0337      0.0      0.0      0000
2442101      790010000      244010000      0.0060      1.0      0.5      0001
2441201      .95942878      .95942878      0.0      *      24.199929
2442201      .140252-9      .140251-9      0.0      *      .845944-9

```

*

```

*****
2480000      npcolleg      branch
2480001      1      0
2480101      0.0337      0.9429      0.0      0.0      0.0      0.0      4.57e-5      0.207      00
*2480200      0      15677636.      1258784.7      2443660.1      0.0
2480200      003      15677636.      567.5
2482101      248010000      252000000      0.0337      0.0      0.0      0000
2482201      .95942879      .95942879      0.0      *      24.199934

```

*

```

*****
2520000      npcolleg      pipe
2520001      2
2520101      0.0337      2
2520301      0.9752      2
2520601      0.0      2
2520701      0.0      2
2520801      4.57e-5      0.207      2
2521001      00      2
2521101      0000      1
*2521201      0      15677611.      1258784.2      2443660.7      0.0      0.0      1
2521201      003      15677611.      567.5      0.      0.      0.      1
*2521202      0      15677584.      1258783.8      2443661.3      0.0      0.0      2
2521202      003      15677584.      567.5      0.      0.      0.      2
2521300      0
2521301      .95942883      .95942883      0.0      1      *      24.199940

```

*

```

*****
*
* secondary loop for the broken loop
*
*****
3000000 npstgdc annulus
3000001 5
3000101 0.0 1
3000102 0.0296 4
3000103 0.0 5
3000201 0.0 3
3000202 0.005281 4
3000301 2.8965 1
3000302 2.0980 2
3000303 2.5654 4
3000304 3.4395 5
3000401 0.3228 1
3000402 0.0 4
3000403 0.1302 5
3000501 0.0 5
3000601 -90.0 5
3000701 -2.0223 1
3000702 -2.0980 2
3000703 -2.5654 4
3000704 -2.5464 5
3000801 4.57e-5 0.3689 1
3000802 4.57e-5 0.0971 4
3000803 4.57e-5 0.0801 5
3000901 0.0 0.0 4
3001001 00 5
3001101 0000 3
3001102 0100 4
*3001201 0 7110719.4 1200517.1 2580791.9 0.0 0.0 1
3001201 003 7310719. 551. 0. 0. 0. 1
*3001202 0 7125934.5 1200526.7 2580629.2 0.0 0.0 2
3001202 003 7325934. 551. 0. 0. 0. 2
*3001203 0 7143272.8 1200530.5 2580444.0 0.0 0.0 3
3001203 003 7343272. 551. 0. 0. 0. 3
*3001204 0 7162349.3 1200527.5 2580240.7 0.0 0.0 4
3001204 003 7362349. 551. 0. 0. 0. 4
*3001205 0 7171666.9 1202251.3 2580141.6 0.0 0.0 5
3001205 003 7371666. 551. 0. 0. 0. 5
3001300 0
3001301 .61390359 .61390359 0.0 1 * 13.834317
3001302 .61389325 .61389325 0.0 2 * 13.834278
3001303 .61387866 .61387866 0.0 3 * 13.834214
3001304 .61386007 .61386007 0.0 4 * 13.834133
*
*****
3010000 npstgdc snljun
3010101 300010000 304000000 0.0 100.0 100.0 0000

```

3010201 0 .48038520 .69708130 0.0 * 13.833941

*

3040000	blsteamg	pipe					
3040001	5						
3040101	0.2293	3					
3040102	0.0	5					
3040201	0.2293	2					
3040202	0.2323	3					
3040203	0.3138	4					
* 3040201	0.0712	3					
* 3040202	0.0	4					
3040301	2.5464	1					
3040302	2.5654	3					
3040303	2.0980	4					
3040304	2.0223	5					
3040401	0.0	3					
3040402	0.4951	4					
3040403	0.7979	5					
3040501	0.0	5					
3040601	90.0	5					
3040701	2.5464	1					
3040702	2.5654	3					
3040703	2.0980	4					
3040704	2.0223	5					
3040801	4.57e-5	0.036	4				
3040802	4.57e-5	0.219	5				
3040901	1.435	1.435	4				
3041001	00	5					
3041101	0000	3					
3041102	0000	4					
3041201	0	7360485.9	1261112.3	2580244.6	.14219192	0.0	1
3041202	0	7347036.6	1264931.2	2580399.8	.28828728	0.0	2
3041203	0	7334704.9	1264683.5	2580530.3	.28643954	0.0	3
3041204	0	7323302.6	1264128.3	2580649.9	.27887377	0.0	4
3041205	0	7313423.5	1263801.8	2580702.3	.27518532	0.0	5
3041300	0						
3041301	.09940788	.37087476	0.0	1		* 13.810074	
3041302	.11458638	.49504010	0.0	2		* 13.804585	
3041303	.10794204	.71300003	0.0	3		* 13.802420	
3041304	.09899163	.87128853	0.0	4		* 13.799040	
3041401	0.036	1.0	1.0	1.0	3		
3041402	0.1258	1.0	1.0	1.0	4		

*

3080000	npsepar	separatr					
3080001	3	0					
3080101	0.0	2.120	0.572	0.0	90.0	2.120	4.57e-5
3080102	0.2134	00					
3080200	0	7304590.2	1263471.6	2580768.1	.50638217		
3081101	308010000	316000000	0.0615	0.0	0.0	0100	0.2

```

3082101 308000000 300000000 0.03964 100.0 100.0 0000
3083101 304010000 308000000 0.1986 0.0 0.0 0000
3081201 -.3840036 .27406855 0.0 * 2.7469745
3082201 .37743398 -1.777076 0.0 * 11.041964
3083201 .11701332 1.0458935 0.0 * 13.801835

```

*

```

3120000 npsgsbpb branch
3120001 2 0
3120101 0.0 2.120 0.6288 0.0 90.0 2.120 4.57e-5
3120102 0.1242 00
3120200 0 7301893.0 1236857.5 2584233.4 .87891994
3121101 300000000 312000000 0.3164 0.0 0.0 0000
3122101 312010000 316000000 0.0392 1.5 1.5 0000
3121201 30.0480-6 1.1555824 0.0 * 7.23798-3
3122201 -42.50990 -1.5229-3 0.0 * -2.6126-3

```

*

```

3160000 stmdome snglvol
3160101 0.0 3.7778 2.0288 0.0 90.0 3.7778 4.57e-5
3160102 0.7696 00
3160200 0 7299946.7 1262926.9 2580859.5 .99999968

```

*

* blsg steam line

```

3200000 blstmln1 branch
3200001 2 0
3200101 0.0286 5.286 0.0 0.0 0.0 0.0 4.57e-5
3200102 0.1909 00
3200200 0 7299057.2 1262882.9 2580880.3 .99999786
3201101 316010000 320000000 0.0286 0.0 0.0 0100
3202101 320010000 324000000 0.0286 0.0 0.0 0000
3201201 2.4791454 2.5876488 0.0 * 2.7470311
3202201 2.4234202 2.5881767 0.0 * 2.7472440

```

*

```

3240000 blstmln2 branch
3240001 1 0
3240101 0.0286 9.9213 0.0 0.0 0.0 0.0 4.57e-5
3240102 0.1909 00
3240200 0 7298966.1 1262878.4 2580896.2 .99999675
3241101 324010000 328000000 0.00429 0.0 0.0 0000
3241201 14.028836 17.257852 0.0 * 2.7477108

```

*

```

3280000 blstmln3 snglvol
3280101 0.00429 8.3215 0.0 0.0 0.0 0.0 4.57e-5
3280102 0.0739 00
3280200 0 7288063.0 1262339.0 2580962.3 .99998690

```

*

```

*****
3290000 blmsiv valve
3290101 328010000 332000000 0.00429 0.0 0.0 0100
3290201 0 12.637699 17.284590 0.0 * 2.7477202
3290300 mtrvly
3290301 568 501 2.0000000 1.0000000 0
*
*****
3320000 vlvtovlv snglvol
3320101 0.00429 6.446 0.0 0.0 0.0 0.0 4.57e-5
3320102 0.0739 00
3320200 0 7278346.0 1261857.2 2581064.5 .99997696
*
*****
3330000 blchkvl valve
3330101 332010000 804000000 0.00429 0.0 0.0 0000
3330201 0 10.389571 17.310434 0.0 * 2.7477882
3330300 chkvly
3330310 0 0 0.0 0.0
*
*****
3500000 auxfed tmdpv01
3500101 8.0 5.0 0.0 0.0 0.0 0.0 0.0 0 00
3500200 3
3500201 0.0 5.95300e+6 313.0
*
*****
3510000 auxfed tmdpj01
3510101 350000000 300000000 0.004
3510200 1 623
3510201 0.0 0.0 0.0 0.0
3510202 0.01 1.168 0.0 0.0
3510203 5000.0 1.168 0.0 0.0
*
*****
3600000 npstegfw tmdpv01
3600101 0.139 5.0 0.0 0.0 0.0 0.0 0.0 0 00
3600200 3
3600201 0.0 5.83400e+6 495.35
*
*****
3610000 npstegfw tmdpj01
3610101 360000000 300000000 4.00e-3
3610200 1 550 cntrlvar 361
3610201 0.0 0.0 0.0 0.0
3610202 5.0 5.0 0.0 0.0
3610203 7.0 7.0 0.0 0.0
3610204 1000.0 7.0 0.0 0.0
*
*****
* secondary relief and safety valves, intact loop
*****

```

```

*
3690000 blsgrv valve
3690101 320010000 370000000 2.96e-4 0.0149 0.0 0100
3690201 0 0.0 0.0 0.0 * 0.0
3690300 trpvlv
3690301 609
*
*****
3700000 contain tmdpvol
3700101 1.0e+8 10.0 0.0 0.0 0.0 0.0 0.0 0.0 00
3700200 3
3700201 0.0 1.01325e+5 293.15
*
*****
3790000 blsgsv valve
3790101 324010000 380000000 0.00195 0.00055 0.0 0100
3790201 0 0.0 0.0 0.0 * 0.0
3790300 trpvlv
3790301 612
*
*****
3800000 contain tmdpvol
3800101 1.0e+8 10.0 0.0 0.0 0.0 0.0 0.0 0.0 00
3800200 3
3800201 0.0 1.01325e+5 293.15
*
*****
* loop with pressurizer (intact loop)
*****
*
4000000 wphotleg snglvol
4000101 0.0337 1.3246 0.0 0.0 0.0 0.0 4.57e-5 0.207 00
*4000200 0 15671308. 1462950.6 2443809.2 0.0
4000200 003 15671308. 600.5
*
*****
4020000 ilhlbyps branch
4020001 1 0
4020101 3.53e-4 2.65 0.0 0.0 0.0 0.0 4.57e-5 0.0 00
*4020200 0 15671269. 1462952.3 2443810.1 0.0
4020200 003 15671269. 600.5
4021101 104010000 402000000 3.53e-4 0.0 0.0 0100
4021201 0.0 0.0 0.0
*
*****
4030000 blhlbyp valve
4030101 402010000 404000000 3.53e-4 27.6 27.6 0100
4030201 0 0.913 0.913 0.0
4030300 srvvlv
4030301 403
*

```

```

*****
4040000 blhlbyps branch
4040001 1 0
4040101 3.53e-4 1.66 0.0 0.0 90.0 0.30 4.57e-5 0.0 00
*4040200 0 15671269. 1462952.3 2443810.1 0.0
4040200 003 15671269. 600.5
4041101 404010000 400000000 3.53e-4 0.0 0.0 0101
4041201 0.0 0.0 0.0
*
*****
4060000 wphotleg branch
4060001 3 0
4060101 0.0337 1.3195 0.0 0.0 0.0 0.0 4.57e-5 0.207 00
*4060200 0 15671270. 1462955.0 2443810.1 0.0
4060200 003 15671270. 600.5
4062101 400010000 406000000 0.0337 0.0 0.0 0000
4063101 406010000 408000000 0.0337 0.0 0.0 0000
4064101 600010000 406010000 0.00352 1.0 0.5 0001
4062201 1.0782911 1.0782911 0.0 * 24.199021
4063201 1.0783730 1.0783730 0.0 * 24.200785
4064201 791.393-6 791.393-6 0.0 * 1.80819-3
*
*****
4080000 wphotleg pipe
4080001 2
4080101 0.0337 2
4080301 0.7043 1
4080302 0.5278 2
4080601 0.0 1
4080602 50.0 2
4080701 0.0 1
4080702 0.4043 2
4080801 4.57e-5 0.207 2
4080901 0.05 0.05 1
4081001 00 2
4081101 100000 1
*4081201 0 15671238. 1462956.0 2443810.9 0.0 0.0 1
4081201 003 15671238. 600.5 0. 0. 0. 1
*4081202 0 15669897. 1462956.5 2443842.5 0.0 0.0 2
4081202 003 15669897. 600.5 0. 0. 0. 2
4081300 0
4081301 1.0783725 1.0783725 0.0 1 * 24.200756
4081401 0. 0. 0.55 0.785 1
*
*****
4090000 wphotleg sngljun
4090101 408010000 412000000 0.0337 0.0 0.0 0100
4090201 0 1.0783754 1.0783754 0.0 * 24.200738
*
*****
4120000 wpsgin snglv01

```



```

4120101    0.0  0.706  0.125  0.0  90.0  0.706  4.57e-5
4120102    0.377  00
*4120200  0      15666381. 1462960.3 2443925.4 0.0
4120200 003      15666381. 600.5
*
*****
4130000    wpsgfbj    sngljun
4130101    412010000  416000000  0.2093      0.0  0.0  0000
4130201  0      .17363340 .17363340 0.0      * 24.200627
*
*****
4160000    wpsgfb    snglvol
4160101    0.0  1.1035  0.2323  0.0  90.0  1.1035  4.57e-5
4160102    0.4474  00
*4160200  0      15660476. 1462959.7 2444064.7 0.0
4160200 003      15660476. 600.5
*
*****
4170000    wpsgin    sngljun
4170101    416010000  420000000  0.0425      0.0  0.0 100100
4170110    0.  0.  0.725  1.
4170201  0      .85510074 .85510074 0.0      * 24.200519
*
*****
4200000    wpsgtube  pipe
4200001    8
4200101    0.0425  8
4200301    2.8724  1
4200302    2.5654  3
4200303    2.1728  5
4200304    2.5654  7
4200305    2.8724  8
4200601    90.0  4
4200604    -90.0  8
4200701    2.8724  1
4200702    2.5654  3
4200703    2.0980  4
4200704    -2.0980  5
4200705    -2.5654  7
4200706    -2.8724  8
4200801    1.524-6  0.0196  8
4200901    0.0  0.0  3
4200902    0.006  0.0  4
4200903    0.006  0.006  5
4200904    0.0  0.006  6
4200905    0.0  0.0  7
4201001    00  8
4201101    0000  7
*4201201  0      15646206. 1389520.4 2444401.5 0.0      0.0  1
4201201 003      15646206. 596.83 0. 0. 0. 1
*4201202  0      15626457. 1341397.7 2444868.0 0.0      0.0  2

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```

4201202 003      15626457. 593.17 0. 0. 0. 2
*4201203 0      15607432. 1309986.5 2445317.8 0.0      0.0      3
4201203 003      15607432. 589.5 0. 0. 0. 3
*4201204 0      15589928. 1291513.4 2445732.1 0.0      0.0      4
4201204 003      15589928. 585.83 0. 0. 0. 4
*4201205 0      15589291. 1278822.6 2445747.2 0.0      0.0      5
4201205 003      15589291. 582.17 0. 0. 0. 5
*4201206 0      15605536. 1269201.1 2445362.7 0.0      0.0      6
4201206 003      15605536. 578.5 0. 0. 0. 6
*4201207 0      15623494. 1263021.7 2444938.0 0.0      0.0      7
4201207 003      15623494. 574.83 0. 0. 0. 7
*4201208 0      15642580. 1258938.1 2444487.1 0.0      0.0      8
4201208 003      15642580. 571.17 0. 0. 0. 8
4201300 0
4201301 .81594545 .81594545 0.0      1      * 24.200508
4201302 .79391451 .79391451 0.0      2      * 24.200513
4201303 .78069927 .78069927 0.0      3      * 24.200523
4201304 .77334428 .77334428 0.0      4      * 24.200534
4201305 .76837805 .76837805 0.0      5      * 24.200545
4201306 .76470999 .76470999 0.0      6      * 24.200557
4201307 .76239639 .76239639 0.0      7      * 24.200568
*
*****
4210000      wpsgout      sngljun
4210101      420010000      424000000      0.0425      0.0      0.0      0100
4210201 0      .76088108 .76088108 0.0      * 24.200579
*
*****
4240000      wpsgfbo      snglvol
4240101      0.0      1.1035      0.2323      0.0      -90.0      -1.1035      4.57e-5
4240102      0.4474      00
*4240200 0      15656790. 1258936.4 2444151.7 0.0
4240200 003      15656790. 567.5
*
*****
4250000      wpsgfbo      sngljun
4250101      424010000      428000000      0.2093      0.0      0.0      0000
4250201 0      .15450004 .15450004 0.0      * 24.200600
*
*****
4280000      wpsgout      snglvol
4280101      0.0      0.706      0.125      0.0      -90.0      -0.706      4.57e-5
4280102      0.377      00
*4280200 0      15663426. 1258934.9 2443995.1 0.0
4280200 003      15663426. 567.5
*
*****
4290000      wpcrsleg      sngljun
4290101      428010000      432000000      0.0222      0.0      0.0      0100
4290201 0      1.4566026 1.4566026 0.0      * 24.200614
*

```

```

*****
4320000      wpcrsleg      pipe
4320001      5
4320101      0.0222      5
4320301      0.516      1
4320302      1.2422      4
4320303      1.1919      5
4320601      -50.0      1
4320602      -90.0      4
4320603      0.0      5
4320701      -0.3953      1
4320702      -1.2422      4
4320703      0.0      5
4320801      4.57e-5      0.1682      5
4320901      0.036      0.036      1
4320902      0.0      0.0      3
4320903      0.065      0.065      4
4321001      00      5
4321101      0000      4
*4321201      0      15666368. 1258934.7 2443925.7 0.0      0.0      1
4321201      003      15666368. 567.5 0. 0. 0. 1
*4321202      0      15672310. 1258934.3 2443785.6 0.0      0.0      2
4321202      003      15672310. 567.5 0. 0. 0. 2
*4321203      0      15681332. 1258934.0 2443573.0 0.0      0.0      3
4321203      003      15681332. 567.5 0. 0. 0. 3
*4321204      0      15690354. 1258933.7 2443360.4 0.0      0.0      4
4321204      003      15690354. 567.5 0. 0. 0. 4
*4321205      0      15694820. 1258933.3 2443255.2 0.0      0.0      5
4321205      003      15694820. 567.5 0. 0. 0. 5
4321300      0
4321301      1.4565970 1.4565970 0.0      1      * 24.200615
4321302      1.4565858 1.4565858 0.0      2      * 24.200619
4321303      1.4565689 1.4565689 0.0      3      * 24.200622
4321304      1.4565520 1.4565520 0.0      4      * 24.200625
*
*****
4330000      wpfcv      valve
4330101      432010000      436000000      0.0222      0.0      0.0      0100
4330201      0      1.4565435 1.4565435 0.0      * 24.200629
4330300      mtrvlv
4330301      538      539      1.4200000 1.0000000 0
*
*****
4360000      wpcrslgu      pipe
4360001      4
4360101      0.0222      4
4360301      1.1919      1
4360302      1.1222      2
4360303      1.1763      3
4360304      1.1222      4
4360601      0.0      1

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4360602      90.0      4
4360701      0.0      1
4360702      1.1222    4
4360801      4.57e-5    0.1682    4
4360901      0.065     0.065     1
4360902      0.0      0.0      3
4361001      00       4
4361101      0000     3
*4361201  0          15694729. 1258932.7 2443257.4 0.0      0.0      1
4361201 003          15694729. 567.5 0. 0. 0. 1
*4361202  0          15690523. 1258932.1 2443356.4 0.0      0.0      2
4361202 003          15690523. 567.5 0. 0. 0. 2
*4361203  0          15682201. 1258931.4 2443552.5 0.0      0.0      3
4361203 003          15682201. 567.5 0. 0. 0. 3
*4361204  0          15673879. 1258930.6 2443748.6 0.0      0.0      4
4361204 003          15673879. 567.5 0. 0. 0. 4
4361300  0
4361301      1.4565435 1.4565435 0.0      1          * 24.200632
4361302      1.4565512 1.4565512 0.0      2          * 24.200635
4361303      1.4565664 1.4565664 0.0      3          * 24.200639
*
*****
4400000      wprcpump      pump
4400101      0.0 0.802 0.0235 0.0 90.0 0.351 00
4400108      436010000 0.0222 0.0 0.0 0000
4400109      444000000 0.0337 0.0525 0.0525 0000
*4400200  0          15673801. 1258954.9 2443750.5 0.0
4400200 003          15673801. 567.5
4400201  0          1.4565817 1.4565817 0.0          * 24.200642
4400202  0          .95953995 .95953995 0.0          * 24.200645
4400301      240 240 240 -1 0 0 0
4400302      188.50000 .424116 .05400000 10.000000 55.200000
4400303      0.54 750.0 0.0 0.0 0.0 0.0 0.0
*
* pump coastdown data
*
4406100      501          * norm speed
4406101      0.0 82.9
4406102      14.0 157.71
4406103      16.0 160.22
4406104      17.0 157.71
4406105      23.0 126.29
4406106      35.0 57.68
4406107      50.0 42.10
4406108      55.0 37.38
4406109      60.0 34.05
4406110      70.0 28.71
4406111      85.0 23.06
4406112      100.0 19.16
4406113      125.0 14.95
4406114      150.0 12.25

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4406115    165.0    10.81
4406116    200.0    10.05
4406117    230.0     9.86
4406118    266.0     8.61
4406119    267.0     0.
4406120   1000.0     0.
*
*****
4440000    wpcolleg    snglvol
4440101    0.0337    1.0562    0.0    0.0    0.0    0.0    4.57e-5    0.207    00
*4440200    0        15677643. 1258954.6 2443659.9 0.0
4440200 003        15677643. 567.5
*
*****
4480000    wpcolleg    branch
4480001    3        0
4480101    0.0337    1.1945    0.0    0.0    0.0    0.0    4.57e-5    0.207    00
*4480200    0        15677614. 1258954.2 2443660.6 0.0
4480200 003        15677614. 567.5
4481101    444010000    448000000    0.0337    0.0    0.0    0000
4482101    448010000    452000000    0.0337    0.0    0.0    0000
4483101    740010000    448010000    0.0060    1.0    0.5    0001
4481201    .95953524 .95953524 0.0                * 24.200649
4482201    .95953528 .95953528 0.0                * 24.200653
4483201    .394788-9 .394777-9 0.0                * 2.38120-9
*
*****
4520000    wpcolleg    snglvol
4520101    0.0337    1.3125    0.0    0.0    0.0    0.0    4.57e-7    0.207    00
*4520200    0        15677585. 1258953.9 2443661.3 0.0
4520200 003        15677585. 567.5
*
*****
*
* secondary loop for the primary loop with pressurizer
*
*****
5000000    wpstgdcn    annulus
5000001    5
5000101    0.0        1
5000102    0.0296     4
5000103    0.0        5
5000201    0.0        3
5000202    0.005281    4
5000301    2.8965     1
5000302    2.0980     2
5000303    2.5654     4
5000304    3.4395     5
5000401    0.3228     1
5000402    0.0        4
5000403    0.1302     5

```

5000501	0.0	5						
5000601	-90.0	5						
5000701	-2.0223	1						
5000702	-2.0980	2						
5000703	-2.5654	4						
5000704	-2.5464	5						
5000801	4.57e-5	0.3689	1					
5000802	4.57e-5	0.0971	4					
5000803	4.57e-5	0.0801	5					
5000901	0.0	0.0	4					
5001001	00	5						
5001101	0000	3						
5001102	0100	4						
5001201	0	7314312.9	1200751.2	2580753.5	0.0	0.0	1	
5001202	0	7329527.0	1200829.9	2580590.8	0.0	0.0	2	
5001203	0	7346864.0	1200899.7	2580405.7	0.0	0.0	3	
5001204	0	7365938.6	1200941.7	2580202.5	0.0	0.0	4	
5001205	0	7375253.0	1202649.1	2580103.4	0.0	0.0	5	
5001300	0							
5001301	.61387739	.61387739	0.0	1		* 13.832253		
5001302	.61388537	.61388537	0.0	2		* 13.832171		
5001303	.61388694	.61388694	0.0	3		* 13.832038		
5001304	.61387788	.61387788	0.0	4		* 13.831877		
*								

5010000	wpstgdc	sngljun						
5010101	500010000	504000000	0.0	100.0	100.0	0000		
5010201	0	.48039121	.69720931	0.0		* 13.831555		
*								

5040000	wpsteamg	pipe						
5040001	5							
5040101	0.2293	3						
5040102	0.0	5						
5040201	0.2293	2						
5040202	0.2293	3						
5040203	0.3138	4						
* 5040201	0.0712	3						
* 5040202	0.0	4						
5040301	2.5464	1						
5040302	2.5654	3						
5040303	2.0980	4						
5040304	2.0223	5						
5040401	0.0	3						
5040402	0.4951	4						
5040403	0.7979	5						
5040501	0.0	5						
5040601	90.0	5						
5040701	2.5464	1						
5040702	2.5654	3						
5040703	2.0980	4						

```

5040704      2.0223      5
5040801      4.57e-5      0.036      4
5040802      4.57e-5      0.219      5
5040901      1.5      1.5      4
5041001      00      5
5041101      0100      3
5041102      0000      4
5041201      0      7364072.6 1261303.5 2580206.5 .14246717 0.0      1
5041202      0      7350625.7 1265108.6 2580362.4 .28828137 0.0      2
5041203      0      7338293.4 1264860.6 2580492.4 .28643270 0.0      3
5041204      0      7326890.7 1264305.8 2580611.9 .27887426 0.0      4
5041205      0      7317011.3 1263978.6 2580664.8 .27519078 0.0      5
5041300      0
5041301      .09947453 .37096577 0.0      1      * 13.814456
5041302      .11462864 .49520300 0.0      2      * 13.809526
5041303      .10797253 .71294955 0.0      3      * 13.805859
5041304      .09902432 .87101253 0.0      4      * 13.802399
5041401      0.036      1.0      1.0      1.0      3
5041402      0.1258      1.0      1.0      1.0      4
*
*****
5080000      wpsepar      separatr
5080001      3      0
5080101      0.0      2.120      0.572      0.0      90.0      2.120      4.57e-5
5080102      0.2134      00
5080200      0      7308284.2 1263648.5 2580734.6 .52097025
5081101      508010000      516000000      0.0715      0.0      0.0      0100 0.2
5082101      508000000      500000000      0.03964 100.0 100.0      0000
5083101      504010000      508000000      0.1986      0.0      0.0      0000
5081201      -.4037061 .27393586 0.0      * 2.7472266
5082201      .37739895 -1.743057 0.0      * 11.039985
5083201      .11699245 1.0455258 0.0      * 13.799421
*
*****
5120000      wpsgspbp      branch
5120001      2      0
5120101      0.0      2.120      0.6288      0.0      90.0      2.120      4.57e-5
5120102      0.1242      00
5120200      0      7305583.4 1236787.3 2582575.1 .89235283
5121101      500000000      512000000      0.3164      0.0      0.0      0000
5122101      512010000      516000000      0.0392      1.5      1.5      0000
5121201      30.5398-6 1.3297404 0.0      * 7.35566-3
5122201      -46.00500 -1.6715-3 0.0      * -2.8209-3
*
*****
5160000      stmdome      snglvol
5160101      0.0      3.7778      2.0288      0.0      90.0      3.7778      4.57e-5
5160102      0.7696      00
5160200      0      7303731.5 1263114.0 2580824.8 .99999971
*
*****

```

```

*   ilsg steam line
*****
5200000  ilstmln1  branch
5200001  2        0
5200101  0.0286  5.282  0.0  0.0  0.0  0.0  4.57e-5
5200102  0.1909  00
5200200  0        7302807.7 1263069.3 2580824.5 .99991553
5201101  516010000 520000000 0.0286  0.0  0.0  0100
5202101  520010000 524000000 0.0286  0.0  0.0  0000
5201201  1.8244014 2.5842639 0.0          * 2.7450542
5202201  .27793749 2.5848676 0.0          * 2.7455870
*
*****
5240000  ilstmln2  branch
5240001  1        0
5240101  0.0286  8.5867 0.0  0.0  0.0  0.0  4.57e-5
5240102  0.1909  00
5240200  0        7302699.9 1263063.4 2580835.0 .99967266
5241101  524010000 528000000 0.00429 0.0  0.0  0000
5241201  1.5658958 17.236995 0.0          * 2.7466368
*
*****
5280000  ilstmln3  snglvol
5280101  0.00429 10.9965 0.0  0.0  0.0  0.0  4.57e-5
5280102  0.0739  00
5280200  0        7290393.8 1262454.1 2580955.8 .99988240
*
*****
5290000  ilmsiv  valve
5290101  528010000 532000000 0.00429 0.0  0.0  0100
5290201  0        5.7878014 17.263954 0.0          * 2.7467386
5290300  mtrvly
5290301  578      501      2.0000000 1.0000000 0
*
*****
5320000  vlvtoylv  snglvol
5320101  0.00429 5.5275 0.0  0.0  0.0  0.0  4.57e-5
5320102  0.0739  00
5320200  0        7278376.3 1261858.7 2581063.9 .99978697
*
*****
5330000  ilchkvl  valve
5330101  532010000 800000000 0.00429 0.0  0.0  0000
5330201  0        3.7947922 17.296149 0.0          * 2.7468079
5330300  chkvly
5330310  0  0      0.0  0.0
*
*****
5500000  auxfed  tmdpvovl
5500101  8.0      5.0  0.0  0.0  0.0  0.0  0.0  0  00
5500200  3

```



```

5500201      0.0      5.95300e+6      313.0
*
*****
5510000      auxfed      tmdpjun
5510101      550000000      500000000      0.004
5510200      1      624
5510201      0.0      0.0      0.0      0.0
5510202      0.01      1.168      0.0      0.0
5510203      5000.0      1.168      0.0      0.0
*****
5600000      wpstegfw      tmdpv01
5600101      0.139      5.0      0.0      0.0      0.0      0.0      0      00
5600200      3
5600201      0.0      5.83400e+6      495.35
*
*****
5610000      wpstegfw      tmdpjun
5610101      560000000      500000000      4.00e-3
5610200      1      550      cntrlvar      561
5610201      0.0      0.0      0.0      0.0
5610202      5.0      5.0      0.0      0.0
5610203      7.0      7.0      0.0      0.0
5610204      1000.0      7.0      0.0      0.0
*
*****
* secondary relief and safety valves, intact loop
*****
*
5690000      ilsgrv      valve
5690101      520010000      570000000      2.96e-4      0.0164      0.0      0100
5690201      0      0.0      0.0      0.0      * 0.0
5690300      trpvlv
5690301      603
*
*****
5700000      contain      tmdpv01
5700101      1.0e+8      10.0      0.0      0.0      0.0      0.0      0.0      00
5700200      3
5700201      0.0      1.01325e+5      293.15
*
*****
5790000      ilsgsv      valve
5790101      524010000      580000000      0.00195      0.00050      0.0      0100
5790201      0      0.0      0.0      0.0      * 0.0
5790300      trpvlv
5790301      606
*
*****
5800000      contain      tmdpv01
5800101      1.0e+8      10.0      0.0      0.0      0.0      0.0      0.0      00
5800200      3

```

```

5800201  0.0  1.01325e+5  293.15
*
*
*****
* pressurizer
*****
*
6000000  prssurg1  pipe
6000001  3
6000101  3.515e-3  3
6000301  6.7788  1
6000302  9.245  2
6000303  5.4221  3
6000401  0.0  3
6000601  -90.0  3
6000701  -4.4077  1
6000702  -4.995  2
6000703  -2.5768  3
6000801  4.57e-5  0.0669  3
6001001  00  3
6001101  0000  2
6001201  0  15610474. 1556744.0 2445245.8 0.0 0.0 1
6001202  0  15639376. 1533202.1 2444562.7 0.0 0.0 2
6001203  0  15663068. 1499159.9 2444003.5 0.0 0.0 3
6001300  0
6001301  794.073-6 794.073-6 0.0 1 * 1.73199-3
6001302  793.544-6 793.544-6 0.0 2 * 1.76418-3
*
*****
6030000  prssurg1  sngljun
6030101  610010000 600000000 3.515e-3 0.0 0.0 0100
6030201  0 794.821-6 -7.2196-3 0.0 * 1.70555-3
*
*****
6100000  prsrizer  pipe
6100001  8
6100101  0.0  1
6100102  0.2827  6
6100103  0.2731  8
6100201  0.0  7
6100301  0.201  1
6100302  0.470  3
6100303  0.600  4
6100304  0.682  6
6100305  0.5375  8
6100401  0.0325  1
6100402  0.0  8
6100501  0.0  8
6100601  -90.0  8
6100701  -0.201  1
6100702  -0.470  3

```

```

6100703      -0.6          4
6100704      -0.682        6
6100705      -0.5375       8
6100801      4.57e-5      0.3187  1
6100802      4.57e-5      0.600   6
6100803      4.57e-5      0.2949  8
6101001      00          8
6101101      0000        7
6101201      0          15500000. 1607801.4 2445974.9 .99999877 0.0      1
6101202      0          15580442. 1607813.9 2445975.3 .99999675 0.0      2
6101203      0          15580921. 1607831.5 2446061.4 .99999994 0.0      3
6101204      0          15581858. 1596982.5 2446633.1 0.12      0.0      4
6101205      0          15584581. 1584708.6 2445858.7 1.02448-9 0.0      5
6101206      0          15588636. 1581616.9 2445762.7 712.940-9 0.0      6
6101207      0          15592261. 1581131.6 2445676.8 16.3771-6 0.0      7
6101208      0          15595460. 1575430.8 2445601.1 11.8471-6 0.0      8
6101300      0
6101301      .05232152 34.2199-6 0.0      1          * 574.912-6
6101302      .02728026 19.2080-6 0.0      2          * 573.057-6
6101303      2.5326376 18.8555-6 0.0      3          * 572.780-6
6101304      22.5335-6 -3.544149 0.0      4          * 1.03481-3
6101305      6.04839-6 -6.1795-3 0.0      5          * 1.03511-3
6101306      6.39100-6 -.0391352 0.0      6          * 1.04155-3
6101307      8.43805-6 -.0518302 0.0      7          * 1.38226-3
*
*****
*6190000      spryin      sngljun
*6190101      444010000 620000000 0.0      0.0      0.0      00102
*6190201      0          0.0      0.0      0.0
*
*****
*6200000      prsspryl      pipe
*6200001      2
*6200101      3.53e-4      2
*6200301      22.43      2
*6200601      90.0      2
*6200701      8.07975      2
*6200801      4.57e-5      0.0      2
*6201001      00          2
*6201101      0000        1
*6201201      0          15598294. 1258472.7 2445534.0 0.0      0.0      1
*6201202      0          15539928. 1258581.6 2446917.6 0.0      0.0      2
*6201300      0
*6201301      0.0      0.0      0.0      1
*
*****
*6210000      prsspryl      tmdpjun
*6210101      620010000 610000000 0.0
*6210200      1          524      p      610010000
*6210201      0.0      0.0      0.0      0.0
*6210202      15.68e6 0.0      0.0      0.0

```

```

*6210203 16.03e6 0.98 0.0 0.0
*
*****
6500000 porvout tmdpvol
6500101 1.0e+1 10.0 0.0 0.0 0.0 0.0 0 00
6500200 3
6500201 0.0 1.01325e+5 293.15
*
*****
6510000 porv valve
6510101 610000000 650000000 3.66e-5 0.0251 0.0 0100
6510201 0 0.0 0.0 0.0 * 0.0
6510300 trpvlv
6510301 615
*
*****
6600000 prsfvout tmdpvol
6600101 1.0e+8 10.0 0.0 0.0 0.0 0.0 0 00
6600200 3
6600201 0.0 1.01325e+5 293.15
*
*****
6610000 prsfvalv valve
6610101 610000000 660000000 1.54e-4 0.2052 0.0 0100
6610201 0 0.0 0.0 0.0 * 0.0
6610300 trpvlv
6610301 522
*
*****
* eccs
*****
* accumulators not updated
*****
7000000 wpacc accum
* vol of accum eq. 1/2 vol of single lstf accum, full ht.
7000101 0.0 6.6 4.8 0.0 90.0 6.6 3.333e-5 0.0 00
7000200 4.51e+6 320.00
7001101 448000000 7.277e-3 12.674 12.674 0
7002200 0.0 5.76 22.04 2.478 5.2e-2 0 7820. 493.73 0
*
*****
7100000 npacc accum
* vol of accum eq. 1/2 of single lstf accum, full ht.
7100101 0.0 6.6 4.8 0.0 90.0 6.6 3.333e-5 0.0 00
7100200 4.51e+6 320.00
7101101 244000000 1.764e-3 10.107 10.107 0
7102200 0.0 6.43 13.24 2.478 5.2e-2 0 7820. 493.73 0
*
*****
7200000 ilsi tmdpvol
7200101 4.375 10.0 0.0 0.0 0.0 0.0 0.0 00

```

```

7200200      3
7200201      0.0          1.013e+5    310.00

```

*

* eccs flows from zion deck, assume even flow split between loops

*

```

7210000      ilsi      tmdpjun
7210101      720000000  740000000  2.552e-3
7210200      1      506      p      448010000
7210201      -1.0      0.0      0.0      0.0
7210202      0.0      0.0      0.0      0.0
7210203      0.0      0.5965  0.0      0.0
7210204      0.103e+6  0.5965  0.0      0.0
7210205      0.262e+6  0.5900  0.0      0.0
7210206      2.282e+6  0.5245  0.0      0.0
7210207      5.619e+6  0.3935  0.0      0.0
7210208      8.094e+6  0.2620  0.0      0.0
7210209      9.666e+6  0.1310  0.0      0.0
7210210      10.342e+6  0.0      0.0      0.0
7210211      20.684e+6  0.0      0.0      0.0

```

*

```

*7300000      ilchrg      tmdpv01
*7300101      4.375      10.0  0.0  0.0  0.0  0.0  0.0  0.0  00
*7300200      3
*7300201      0.0          1.013e+5    300.00

```

*

```

*7310000      ilchrg      tmdpjun
*7310101      730000000  740000000  2.552e-3
*7310200      1      505      p      448010000
*7310201      -1.0      0.0      0.0      0.0
*7310202      0.0      0.0      0.0      0.0
*7310203      0.0      0.5635  0.0      0.0
*7310204      0.103e+6  0.5635  0.0      0.0
*7310205      2.627e+6  0.5245  0.0      0.0
*7310206      6.433e+6  0.4590  0.0      0.0
*7310207      9.660e+6  0.3935  0.0      0.0
*7310208      12.404e+6  0.3275  0.0      0.0
*7310209      14.569e+6  0.2620  0.0      0.0
*7310210      17.209e+6  0.1310  0.0      0.0
*7310211      18.202e+6  0.0      0.0      0.0
*7310212      20.684e+6  0.0      0.0      0.0

```

*

```

7400000      ileccsln      snglv01
7400101      2.552e-3  16.0  0.0  0.0  0.0  0.0  3.333e-5
7400102      0.0      00
7400200      0          15598371. 83230.665 2445532.2 0.0

```

*

```
*****
7700000    blsi      tmdpvol
7700101    4.375    10.0 0.0  0.0  0.0  0.0  0.0  0.0  00
7700200    3
7700201    0.0      1.013e+5  293.15
*
```

```
*****
* eccs flows from zion deck, assume even flow split between loops
*****
*
```

```
7710000    blsi      tmdpjun
7710101    7700000000 7900000000 2.552e-3
7710200    1 506 p 248010000
7710201    -1.0      0.0  0.0  0.0
7710202    0.0      0.0  0.0  0.0
7710203    0.0      0.5965 0.0  0.0
7710204    0.103e+6 0.5965 0.0  0.0
7710205    0.262e+6 0.5900 0.0  0.0
7710206    2.282e+6 0.5245 0.0  0.0
7710207    5.619e+6 0.3935 0.0  0.0
7710208    8.094e+6 0.2620 0.0  0.0
7710209    9.666e+6 0.1310 0.0  0.0
7710210    10.342e+6 0.0     0.0  0.0
7710211    20.684e+6 0.0     0.0  0.0
*
```

```
*
*****
*7800000    blchrg    tmdpvol
*7800101    4.375    10.0 0.0  0.0  0.0  0.0  0.0  0.0  00
*7800200    3
*7800201    0.0      1.013e+5  293.15
*
```

```
*****
*7810000    blchrg    tmdpjun
*7810101    7800000000 7900000000 2.552e-3
*7810200    1 505 p 248010000
*7810201    -1.0      0.0  0.0  0.0
*7810202    0.0      0.0  0.0  0.0
*7810203    0.0      0.5635 0.0  0.0
*7810204    0.103e+6 0.5635 0.0  0.0
*7810205    2.627e+6 0.5245 0.0  0.0
*7810206    6.433e+6 0.4590 0.0  0.0
*7810207    9.660e+6 0.3935 0.0  0.0
*7810208    12.404e+6 0.3275 0.0  0.0
*7810209    14.569e+6 0.2620 0.0  0.0
*7810210    17.209e+6 0.1310 0.0  0.0
*7810211    18.202e+6 0.0     0.0  0.0
*7810212    20.684e+6 0.0     0.0  0.0
*
```

```
*****
7900000    bleccsln  snglvol
```

```

7900101      9.079e-4  16.0  0.0  0.0  0.0  0.0  3.333e-5
7900102      0.0      00
7900200      0      15598401. 83231.356 2445531.5 0.0
*
*****
*   common steam header to jet condensor
*****
*
8000000  header1  snglv1
8000101  0.00741  3.2  0.0  0.0  0.0  0.0  4.57e-5
8000102  0.0      00
8000200  0      7278063.0 1261843.5 2581117.8 .99983487
*
*****
8010000  headv1v  valve
8010101  800010000  804000000  0.00741  0.0  0.0  0000
8010201  0      2.8818423 10.014497 0.0      * 2.7468959
8010300  trpv1v
8010301  583
*
*****
8030000  trbbpv1v  valve
8030101  800000000  808000000  5.56e-4  0.0  0.0  0100
8030201  0      0.0      0.0      0.0      * 0.0
8030300  srvv1v
8030301  40
*
*****
8040000  header2  snglv1
8040101  0.00741  3.2  0.0  0.0  0.0  0.0  4.57e-5
8040102  0.0      00
8040200  0      7270989.5 1261492.4 2581112.5 .99991458
*
*****
8050000  thrv1v  valve
8050101  804010000  812000000  0.00741  0.0  0.0  0100
8050201  0      8.6399460 20.055846 0.0      * 5.4949115
8050300  srvv1v
8050301  805
*
*****
8080000  trbbpln  snglv1
8080101  0.00741  13.3305  0.0  0.0  0.0  0.0  4.57e-5
8080102  0.0971  00
8080200  0      7288740.0 1262372.2 2580999.5 .99988891
*
*****
8090000  bplnjc  sngljun
8090101  808010000  816000000  0.00741  0.0  0.0  0100
8090201  0      2.13640-3 -237.33-9 0.0      * 1.23347-6
*

```

```

*****
8120000 trbthrln snglvol
8120101 0.00741 8.730 0.0 0.0 0.0 0.0 4.57e-5
8120102 0.0971 00
8120200 0 7006022.4 1248286.1 2583199.0 .99913646
*
*****
8130000 thrlnjc sngljun
8130101 812010000 820000000 0.00741 0.0 0.0 0100
8130201 0 8.3986178 20.802777 0.0 * 5.4948355
*
*****
8160000 jctdvl tmdpvol
8160101 1.0e+8 10.0 0.0 0.0 0.0 0.0 0.0 00
8160200 2
8160201 0.0 7.08874e+6 1.0
*
*****
8200000 jctdv2 tmdpvol
8200101 1.0e+8 10.0 0.0 0.0 0.0 0.0 0.0 00
8200200 2
8200201 0.0 7.0e+6 1.0
*
*****
* containment volume for environmental heat losses
*****
9000000 envsink tmdpvol
9000101 2000. 100. 0.0 0.0 0.0 0.0 0.0 0 10
9000200 4
9000201 0.0 1.034e5 322. 1.
*
*****
* break point - 5% break area
*****
9150000 npcobrv valve
9150101 248010000 920000000 3.976e-4 0.0 0.0 00100 1.0 1.05
9150201 0 0.0 0.0 0.0 * 0.0
9150300 trpvlv
9150301 535
*
*****
9200000 npcolog tmdpvol
9200101 1.0e+8 10.0 0.0 0.0 0.0 0.0 0 00
9200200 3
9200201 0.0 1.01325e+5 293.15
*
*****
* boundary system for steady state
*****
9900000 bdryvol tmdpvol

```



```

9900101 0.255 0.69 0.0 0.0 0.0 0.0 0.0 0.0 0000
9900200 2
9900201 0.0 1.556e+7 1.0
*
9890000 bdryvlv valve
9890101 990000000 610000000 1.0 0.0 0.0 0000
9890201 0 1.62936-3 5.59379-6 0.0 * 575.018-6
9890300 trpvlv
9890301 599
*
*****
* reactor vessel heat structures
*****
*
*****
* 100-1; vessel wall above nozzles, below upper head flange
*****
*
11001000 1 7 2 1 0.320
11001100 0 1
*
* mesh interval
*
11001101 1 0.323
11001102 4 0.476
11001103 1 0.601
*
* heat structure composition
*
11001201 5 1
11001202 6 5
11001203 9 6
*
* heat source distribution
*
11001301 0.0 6
*
* initial temperature flag
*
11001400 0
11001401 562.2 7
*
* left boundary condition
*
11001501 100010000 0 1 1 0.823 1
*
* right boundary condition
*
11001601 900010000 0 1 1 0.823 1
*
* heat source

```

```

*
11001701    0    0    0    0    1
*
* additional left boundary condition
*
11001801    0. 10.0 10.0    0.0 0. 0. 0. 1.    1
*
* additional right boundary condition
*
11001901    0. 10.0 10.0    0.0 0. 0. 0. 1.    1
*
*****
* 104-1; reactor vessel wall below nozzles
*****
*
11041000    12    7    2    1    0.320
11041100    0    1
*
* mesh interval
*
11041101    1    0.323
11041102    4    0.381
11041103    1    0.506
*
* heat structure composition
*
11041201    5    1
11041202    6    5
11041203    9    6
*
* heat source distribution
*
11041301    0.0    6
*
* initial temperature flag
*
11041400    0
11041401    562.2    7
*
* left boundary condition
*
11041501    104010000    0    1    1    0.600    1
11041502    108010000    0    1    1    0.677    2
11041503    108020000    0    1    1    0.867    3
11041504    108030000    10000    1    1    0.610    9
11041510    108090000    0    1    1    1.2588    10
11041511    112010000    0    1    1    0.445    11
11041512    116010000    0    1    1    0.4762    12
*
* right boundary condition
*

```

```

11041601    900010000    0  1  1    0.600  1
11041602    900010000    0  1  1    0.677  2
11041603    900010000    0  1  1    0.867  3
11041604    900010000    0  1  1    0.610  9
11041610    900010000    0  1  1    1.2588 10
11041611    900010000    0  1  1    0.445  11
11041612    900010000    0  1  1    0.4762 12
*
*  heat source
*
11041701    0    0    0    0    12
*
*  additional left boundary condition
*
11041801    0. 10.0 10.0    0.0 0. 0. 0. 1. 12
*
*  additional right boundary condition
*
11041901    0. 10.0 10.0    0.0 0. 0. 0. 1.    12
*
*****
* 112-1: vessel bottom and flange
*****
*
11121000    1    7    1    1    0.0
11121100    0    1
*
*  mesh interval
*
11121101    1    0.003
11121102    4    0.724
11121103    1    0.849
*
*  heat structure composition
*
11121201    5    1
11121202    6    5
11121203    9    6
*
*  heat source distribution
*
11121301    0.0  6
*
*  initial temperature flag
*
11121400    0
11121401    562.2    7
*
*  left boundary condition
*
11121501    112010000    0  1  0    0.686  1

```

```

*
* right boundary condition
*
11121601    900010000    0  1    1    0.686    1
*
* heat source
*
11121701    0    0    0    0    1
*
* additional left boundary condition
*
11121801    0. 10.0 10.0    0.0 0. 0. 0. 1.    1
*
* additional right boundary condition
*
11121901    0. 10.0 10.0    0.0 0. 0. 0. 1.    1
*
*****
* 112-2: heater rods, below heated section
*****
*
11122000    3    4    2    1    0.0
11122100    0    1
*
* mesh interval
*
11122101    1    0.002
11122102    1    0.00295
11122103    1    0.00375
*
* heat structure composition
*
11122201    3    1
11122202    1    2
11122203    4    3
*
* heat source distribution
*
11122301    0.0    3
*
* initial temperature flag
*
11122400    0
11122401    562.2    4
*
* left boundary condition
*
11122501    0    0    0    1    731.2    1
11122502    0    0    0    1    556.2    2
11122503    0    0    0    1    1470.3    3
*

```

```

* right boundary condition
*
11122601    112010000    0  1  1  731.2  1
11122602    116010000    0  1  1  556.2  2
11122603    120010000    0  1  1  1470.3  3
*
* heat source
*
11122701    0    0    0    0    3
*
* additional right boundary condition
*
11122901    0. 10.0    10.0    0.0 0. 0. 1.    3
*
*****
* 120-1: core barrel
*****
*
11201000    12    5    2    1    0.257
11201100    0    1
*
* mesh interval
*
11201101    4    0.267
*
* heat structure composition
*
11201201    5    4
*
* heat source distribution
*
11201301    0.0  4
*
* initial temperature flag
*
11201400    0
11201401    562.2    5
*
* left boundary condition
*
11201501    120010000    0  1  1    1.2588  1
11201502    124010000  10000  1  1    0.610  7
11201503    128010000    0  1  1    0.867  8
11201504    132010000    0  1  1    0.677  9
11201505    136010000    0  1  1    0.600  10
11201506    140010000    0  1  1    0.3674  11
11201507    144010000    0  1  1    0.897  12
*
* right boundary condition
*
11201601    108090000    0  1  1    1.2588  1

```

```

11201602    108080000 -10000    1    1    0.6100    7
11201603    108020000      0    1    1    0.867    8
11201604    108010000      0    1    1    0.677    9
11201605    104010000      0    1    1    0.600   10
11201606    100010000      0    1    1    0.3674  11
11201607    100010000      0    1    1    0.897   12
*
*  heat source
*
11201701      0      0      0      0    12
*
*  additional left boundary condition
*
11201801      0. 10.0    10.0    0.0 0. 0. 0. 1.    12
*
*  additional right boundary condition
*
11201901      0. 10. 10.    0.0    0. 0. 0.0 1. 12
*
*****
* 124-1: heated section of heater rods
*****
*
11241000      6      9      2      1    0.0
11241100      0      1
*
*  fuel rod mesh interval
*
11241101      2      0.00200
11241102      2      0.00260
11241103      2      0.00375
11241104      2      0.00475
*
*  heat structure composition
*
11241201      7      2
11241202      2      4
11241203      1      6
11241204      4      8
*
*  heat source distribution
*
11241301      0.0    2
11241302      1.0    4
11241303      0.0    8
*
*  initial temperature flag
*
11241400      0
*
*  initial temperature

```

```

*
11241401    614.6        9
*
* left boundary condition
*
11241501          0      0  0   1    649.00    6
*
* right boundary condition
*
11241601    124010000  10000  1    1    649.00    6
*
* heat source
*
11241701    888    0.08568    0.0  0.0   1
11241702    888    0.17532    0.0  0.0   2
11241703    888    0.23900    0.0  0.0   3
11241704    888    0.23900    0.0  0.0   4
11241705    888    0.17532    0.0  0.0   5
11241706    888    0.08568    0.0  0.0   6
*
* additional right boundary conditions
*
11241901    0.    0.305    3.355  0.  0.  0.  0.  1.0  1
11241902    0.    0.915    2.745  0.  0.  0.  0.  1.0  2
11241903    0.    1.525    2.135  0.  0.  0.  0.  1.0  3
11241904    0.    2.135    1.525  0.  0.  0.  0.  1.0  4
11241905    0.    2.745    0.915  0.  0.  0.  0.  1.0  5
11241906    0.    3.355    0.305  0.  0.  0.  0.  1.0  6
*
*****
* 124-2: unheated instrument rods
*****
*
11242000    6      6      2      1      0.0
11242100    0      1
*
* fuel rod mesh interval
*
11242101    3      0.00432
11242102    2      0.00612
*
* heat structure composition
*
11242201    1      2
11242202    5      5
*
* heat source distribution
*
11242301    0.0    5
*
* initial temperature flag

```

```

*
11242400    0
*
*  initial temperature
*
11242401    614.6      6
*
*  left boundary condition
*
11242501          0    0    0    1    63.44    6
*
*  right boundary condition
*
11242601    124010000  10000  1    1    63.44    6
*
*  heat source
*
11242701    0    0    0    0    6
*
*  additional right boundary conditions
*
11242901    0.    10.0    10.0  0.  0.    0.0  0.  1.    6
*
*****
* 128-1: upper plenum internals
*****
*
11281000    1    5    1    1    0.0
11281100    0    1
*
*  mesh interval
*
11281101    4    0.023
*
*  heat structure composition
*
11281201    5    4
*
*  heat source distribution
*
11281301    0.0    4
*
*  initial temperature flag
*
11281400    0
11281401    598.2    5
*
*  left boundary condition
*
11281501    128010000    0    1    0    0.773    1
*

```



```

* right boundary condition
*
11281601    128010000      0  1    0    0.773    1
*
* heat source
*
11281701    0    0    0    0    1
*
* additional left boundary condition
*
11281801    0. 10.0  10.0 0. 0.0 0. 0. 1. 1
*
* additional right boundary condition
*
11281901    0. 10.0  10.0 0. 0.0 0. 0. 1. 1
*
*****
* 132-1; guide tubes
*****
*
11321000    5    4    2    1    0.04405
11321100    0    1
*
* fuel rod mesh interval
*
11321101    3    0.04655
*
* heat structure composition
*
11321201    5    3
*
* heat source distribution
*
11321301    0.0  3
*
* initial temperature flag
*
11321400    0
*
* initial temperature
*
11321401    614.6    4
*
* left boundary condition
*
11321501    156020000      0  1    1    5.406    1
11321502    156020000      0  1    1    4.800    2
11321503    156010000      0  1    1    2.939    3
11321504    156010000      0  1    1    7.176    4
11321505    156010000      0  1    1    5.800    5
*

```

```

* right boundary condition
*
11321601  132010000    0  1  1    5.406    1
11321602  136010000    0  1  1    4.800    2
11321603  140010000    0  1  1    2.939    3
11321604  144010000    0  1  1    7.176    4
11321605  148010000    0  1  1    5.800    5
*
* heat source
*
11321701    0    0    0    0    5
*
* additional left boundary conditions
*
11321801    0.  10.0    10.0  0. 0.  0.0 0. 1.  5
*
* additional right boundary conditions
*
11321901    0.  10.0    10.0  0. 0.  0.0 0. 1.  5
*
*****
* 144-1: upper core support plate
*****
*
11441000    1    9    1    1    0.0
11441100    0    1
*
* mesh interval
*
11441101    8    0.304
*
* heat structure composition
*
11441201    5    8
*
* heat source distribution
*
11441301    0.0  8
*
* initial temperature flag
*
11441400    0
11441401   562.2    9
*
* left boundary condition
*
11441501   144010000    0  1    0    0.156    1
*
* right boundary condition
*
11441601   140010000    0  1    0    0.156    1

```

```

*
* heat source
*
11441701    0    0    0    0    1
*
* additional left boundary condition
*
11441801    0. 10.0 10.0 0. 0.0 0. 0. 1. 1
*
* additional right boundary condition
*
11441901    0. 10.0 10.0 0. 0.0 0. 0. 1. 1
*
*****
* 148-1; reactor vessel wall above upper plenum flange
*****
*
11481000    1    7    2    1    0.320
11481100    0    1
*
* mesh interval
*
11481101    1    0.323
11481102    4    0.522
11481103    1    0.647
*
* heat structure composition
*
11481201    5    1
11481202    6    5
11481203    9    6
*
* heat source distribution
*
11481301    0.0 6
*
* initial temperature flag
*
11481400    0
11481401    562.2    7
*
* left boundary condition
*
11481501    148010000    0 1 1 0.404 1
*
* right boundary condition
*
11481601    900010000    0 1 1 0.404 1
*
* heat source
*

```

```

11481701    0    0    0    0    1
*
* additional left boundary condition
*
11481801    0. 10.0 10.0 0. 0.0 0. 0. 1. 1
*
* additional right boundary condition
*
11481901    0. 10.0 10.0 0. 0.0 0. 0. 1. 1
*
*****
* 152-1; reactor vessel upper head
*****
*
11521000    1    7    3    1    0.320
11521100    0    1
*
* mesh interval
*
11521101    1    0.324
11521102    4    0.354
11521103    1    0.479
*
* heat structure composition
*
11521201    5    1
11521202    6    5
11521203    9    6
*
* heat source distribution
*
11521301    0.0  6
*
* initial temperature flag
*
11521400    0
11521401    562.2    7
*
* left boundary condition
*
11521501    152010000    0  1  1  0.5  1
*
* right boundary condition
*
11521601    900010000    0  1  1  0.5  1
*
* heat source
*
11521701    0    0    0    0    1
*
* additional left boundary condition

```

```

*
11521801    0. 10.0  10.0 0. 0.0 0. 0. 1. 1
*
* additional right boundary condition
*
11521901    0. 10.0  10.0 0. 0.0 0. 0. 1. 1
*
*****
*
* loop heat structures
*
$=====
$                ht str no. 212-1  blsg inlet/outlet plnm hemisph
$-----*
*htstr  ht strs  m pts  geom  init  l.coord  refl  b.vol  axl. incr
12121000    2      6      3      1    0.377    0
*
*htstr          mesh locn      mesh fmt
12121100          0          1
*
*htstr          intervals      rt. coord
12121101          1          0.380
12121102          2          0.430
12121103          2          0.555
*
*htstr          compxn no.      interval
12121201          5          1
12121202          6          3
12121203          9          5
*
*htstr          source          interval
12121301          0.0          5
*
*htstr          temp flg
12121400          -1
*
*htstr          temperature distribution for heat structure 01
12121401    597.000    597.000    597.000    597.000    597.000
+
*htstr          temperature distribution for heat structure 02
12121402    557.000    557.000    557.000    557.000    557.000
+
*
*htstr  left vol  incr  b.cond  sa code  area/factor  ht str no.
12121501  212010000  0      1      1      0.1872      1
12121502  228010000  0      1      1      0.1872      2
*
*htstr  right vol  incr  b.cond  sa code  area/factor  ht str no.
12121601  900010000  0      1      1      0.1872      2
*
*htstr  s. type    s. mult    left heat  right heat  ht str no.

```

```

12121701      0      0      0      0      2
*
12121801      0.     10.0  10.0  0.  0.  0.  0.  1.  2
*
12121901      0.     10.0  10.0  0.  0.  0.  0.  1.  2
*
$=====
$          ht str no. 212-2  blsg inlet/outlet plnm walls
$-----*
*htstr  ht strs  m pts  geom  init  l.coord  refl  b.vol  axl. incr
12122000   4      6      2      1    0.365    0
*
*htstr          mesh locn      mesh fmt
12122100           0           1
*
*htstr          intervals      rt. coord
12122101           1          0.368
12122102           2          0.434
12122103           2          0.559
*
*htstr          compxn no.      interval
12122201           5           1
12122202           6           3
12122203           9           5
*
*htstr          source          interval
12122301          0.0           5
*
*htstr          temp flg
12122400          -1
*
*htstr          temperature distribution for heat structure 01
12122401      597.000    597.000    597.000    597.000    597.000
+      597.000
*htstr          temperature distribution for heat structure 02
12122402      557.000    557.000    557.000    557.000    557.000
+      557.000
*
*htstr          temperature distribution for heat structure 03
12122403      597.000    597.000    597.000    597.000    597.000
+      597.000
*htstr          temperature distribution for heat structure 04
12122404      557.000    557.000    557.000    557.000    557.000
+      557.000
*
*htstr  left vol  incr  b.cond  sa code  area/factor  ht str no.
12122501  212010000  0      1      1      0.4237      1
12122502  228010000  0      1      1      0.4237      2
12122503  216010000  0      1      1      1.1035      3
12122504  224010000  0      1      1      1.1035      4
*

```

```

*htstr    right vol    incr b.cond  sa code  area/factor  ht str no.
12122601  900010000      0      1      1      0.4237      2
12122602  900010000      0      1      1      1.1035      4
*
*htstr    s. type      s. mult    left heat  right heat  ht str no.
12122701      0          0          0          0          4
*
12122801      0.        10.0    10.0      0. 0.      0. 0. 1.    2
12122802      0.        10.0    10.0      0. 0.      0. 0. 1.    4
*
12122901      0.        10.0    10.0      0. 0.      0. 0. 1.    4
*
*****
$          ht str no. 220-2  blsg inlet/outlet tube sheet
-----*
*htstr    ht strs  m pts  geom  init  l.coord  refl  b.vol  axl. incr
12202000      2      4      2      1    0.0098      0
*
*htstr          mesh locn      mesh fmt
12202100          0          1
*
*htstr          intervals      rt. coord
12202101          3          0.0163
*
*htstr          compxn no.      interval
12202201          5          3
*
*htstr          source      interval
12202301          0.0          3
*
*htstr          temp flg
12202400          -1
*
*htstr          temperature distribution for heat structure 01
12202401      597.000      597.000      597.000      597.000
*htstr          temperature distribution for heat structure 02
12202402      557.000      557.000      557.000      557.000
*
*htstr    left vol    incr b.cond  sa code  area/factor  ht str no.
12202501  220010000      0      1      1      45.40      1
12202502  220080000      0      1      1      45.40      2
*
*htstr    right vol    incr b.cond  sa code  area/factor  ht str no.
12202601      0          0      0      1      45.40      2
*
*htstr    s. type      s. mult    left heat  right heat  ht str no.
12202701      0          0          0          0          2
*
12202801      0.        10.0    10.0    0. 0. 0.      0. 1.    2
*
*****

```

```

* steam generator in the loop without pressurizer
*****
*
12201000      8      8      2      1      0.00980
12201100      0      1
*
* tube mesh interval
*
12201101      7      0.0127
*
* heat structure composition
*
12201201      5      7
*
* heat source distribution
*
12201301      0.0      7
*
* initial temperature flag
*
12201400      0
12201401      562.4      8
*
* left boundary condition
*
12201501      220010000      0      1      1      359.04      1
12201502      220020000      10000      1      1      361.72      3
12201503      220040000      10000      1      1      306.36      5
12201504      220060000      10000      1      1      361.72      7
12201505      220080000      0      1      1      359.04      8
*
* right boundary condition
*
12201601      304010000      0      1      1      359.04      1
12201602      304020000      10000      1      1      361.72      3
12201603      304040000      0      1      1      306.36      5
12201604      304030000      -10000      1      1      361.72      7
12201605      304010000      0      1      1      359.04      8
*
* heat source
*
12201701      0      0      0      0      8
*
* additional left boundary conditions
*
12201801      0.      10.0      10.0      0.0      0.      0.0      0.      1.      8
*
* additional right boundary conditions
*
12201901      0.      10.0      10.0      0.0      0.      0.0      0.      1.      8
*

```



```

$                ht str no. 300-1    blsg external dc pipe to environ
*-----*
*htstr  ht strs  m pts  geom  init  l.coord  refl  b.vol  axl. incr
13001000    5      5      2      1    0.0486    0
*
*htstr          mesh locn      mesh fmt
13001100          0              1
*
*htstr          intervals      rt. coord
13001101          2              0.0572
13001102          2              0.1572
*
*htstr          compxn no.      interval
13001201          5              2
13001202          9              4
*
*htstr          source          interval
13001301          0.0            4
*
*htstr          temp            mesh pt.
13001401          564.0          5
*
*htstr  left vol  incr  b.cond  sa code  area/factor  ht str no.
13001501 300010000  0      1      1      9.0016      1
13001502 300020000  0      1      1      8.3920      2
13001503 300030000 10000  1      1     10.2616      4
13001504 300050000  0      1      1     10.2380      5
*
*htstr  right vol  incr  b.cond  sa code  area/factor  ht str no.
13001601 900010000  0      1      1      9.0016      1
13001602 900010000  0      1      1      8.3920      2
13001603 900010000  0      1      1     10.2616      4
13001604 900010000  0      1      1     10.2380      5
*
*htstr  s. type    s. mult    left heat  right heat  ht str no.
13001701    0          0          0          0          5
*
13001801    0.        10.0     10.0     0.  0.  0.  0.  1.  5
*
13001901    0.        10.0     10.0     0.  0.  0.  0.  1.  5
*
$=====
$                ht str no. 300-2    blsg upper dc to separator
*-----*
*htstr  ht strs  m pts  geom  init  l.coord  refl  b.vol  axl. incr
13002000    2      2      2      1    0.2514    0
*
*htstr          mesh locn      mesh fmt
13002100          0              1
*
*htstr          intervals      rt. coord

```

```

13002101          1          0.2554
*
*htstr      compxn no.      interval
13002201          5          1
*
*htstr      source          interval
13002301          0.0          1
*
*htstr      temp flg
13002400          0
*
*htstr      temp          mesh pt.
13002401          560.          2
*
*htstr      left vol      incr b.cond sa code area/factor ht str no.
13002501      304050000    0      1      1      0.6461      1
13002502      308010000    0      1      1      2.120        2
*
*htstr      right vol     incr b.cond sa code area/factor ht str no.
13002601      300010000    0      1      1      0.6461      1
13002602      308010000    0      1      1      2.120        2
*
*htstr      s. type       s. mult    left heat right heat ht str no.
13002701          0          0          0          0          2
*
13002801          0.         10.0     10.0      0.      0.      0.      0.      1.  2
*
13002901          0.         10.0     10.0      0.      0.      0.      0.      1.  1
13002902          0.         10.0     10.0      0.      0.      0.      0.      1.  2
*
$=====
$          ht str no. 300-3  blsg upper sg shell to environ
*-----*
*htstr ht strs m pts geom init l.coord refl b.vol axl. incr
13003000      4      6      2      1      0.4375      0
*
*htstr      mesh locn      mesh fmt
13003100          0          1
*
*htstr      intervals      rt. coord
13003101          1          0.4405
13003102          2          0.4785
13003103          2          0.6035
*
*htstr      compxn no.      interval
13003201          5          1
13003202          6          3
13003203          9          5
*
*htstr      source          interval
13003301          0.0          5

```

```

*
*htstr                      temp flg
13003400                    0
*
*htstr          temp          mesh pt.
13003401        530.          6
*
*htstr  left vol  incr  b.cond  sa code  area/factor  ht str no.
13003501 300010000 0      1      1      0.6461      1
13003502 304050000 0      1      1      1.0104      2
13003503 312010000 0      1      1      2.120       3
13003504 316010000 0      1      1      3.4278      4
*
*htstr  right vol  incr  b.cond  sa code  area/factor  ht str no.
13003601 900010000 0      1      1      0.6461      1
13003602 900010000 0      1      1      1.0104      2
13003603 900010000 0      1      1      2.120       3
13003604 900010000 0      1      1      3.4278      4
*
*htstr  s. type  s. mult  left heat  right heat  ht str no.
13003701 0      0      0      0      4
*
13003801 0.      10.0  10.0  0.  0.  0.  0.  1.  1
13003802 0.      10.0  10.0  0.  0.  0.  0.  1.  2
13003803 0.      10.0  10.0  0.  0.  0.  0.  1.  3
13003804 0.      10.0  10.0  0.  0.  0.  0.  1.  4
*
13003901 0.      10.0  10.0  0.  0.  0.  0.  1.  4
*
$=====
$          ht str no. 300-4  blsg lower sg dc to boiler
$-----*
*htstr  ht strs  m pts  geom  init  l.coord  refl  b.vol  axl. incr
13004000 1      2      2      1      0.345  0
*
*htstr          mesh locn  mesh fmt
13004100        0          1
*
*htstr          intervals  rt. coord
13004101        1          0.351
*
*htstr          compxn no.  interval
13004201        5          1
*
*htstr          source      interval
13004301        0.0        1
*
*htstr          temp flg
13004400        0
*
*htstr          temp          mesh pt.

```

```

13004401      560.              2
*
*htstr  left vol  incr b.cond sa code area/factor ht str no.
13004501 304010000 0      1      1      1.0637      1
*
*htstr  right vol incr b.cond sa code area/factor ht str no.
13004601 300050000 0      1      1      1.0637      1
*
*htstr  s. type   s. mult  left heat right heat ht str no.
13004701 0          0          0          0          1
*
13004801 0.        10.0    10.0     0.    0.    0.    0.    1.    1
*
13004901 0.        10.0    10.0     0.    0.    0.    0.    1.    1
*
$=====
$          ht str no. 300-5  blsg lower sg dc wall to environ
$-----
*
*htstr  ht strs  m pts  geom  init  l.coord  refl  b.vol  axl. incr
13005000 1          6      2      1      0.370    0
*
*htstr          mesh locn      mesh fmt
13005100          0              1
*
*htstr          intervals      rt. coord
13005101          1              0.373
13005102          2              0.405
13005103          2              0.530
*
*htstr          compxn no.      interval
13005201          5              1
13005202          6              3
13005203          9              5
*
*htstr          source          interval
13005301          0.0           5
*
*htstr          temp flg
13005400          0
*
*htstr          temp          mesh pt.
13005401          530.         6
*
*htstr  left vol  incr b.cond sa code area/factor ht str no.
13005501 300050000 0      1      1      1.2637      1
*
*htstr  right vol incr b.cond sa code area/factor ht str no.
13005601 900010000 0      1      1      1.2637      1
*
*htstr  s. type   s. mult  left heat right heat ht str no.
13005701 0          0          0          0          1

```

```

*
13005801      0.      10.0    10.0    0.  0.  0.  0.  1.  1
*
13005901      0.      10.0    10.0    0.  0.  0.  0.  1.  1
*
$=====
$              ht str no. 304-1  blsg boiler wall to environ
$-----*
*htstr  ht str  m pts  geom  init  l.coord  refl  b.vol  axl. incr
13041000    5      6      2      1    0.347      0
*
*htstr      mesh locn      mesh fmt
13041100          0          1
*
*htstr      intervals      rt. coord
13041101          1          0.350
13041102          2          0.380
13041103          2          0.505
*
*htstr      compxn no.      interval
13041201          5          1
13041202          6          3
13041203          9          5
*
*htstr      source      interval
13041301      0.0          5
*
*htstr      temp flg
13041400          0
*
*htstr      temp      mesh pt.
13041401      550.          6
*
*htstr  left vol  incr  b.cond  sa code  area/factor  ht str no.
13041501 304010000  0      1      1      1.2827      1
13041502 304020000 10000  1      1      2.5654      3
13041503 304040000  0      1      1      2.098       4
13041504 304050000  0      1      1      0.3658      5
*
*htstr  right vol  incr  b.cond  sa code  area/factor  ht str no.
13041601 900010000  0      1      1      1.2827      1
13041602 900010000  0      1      1      2.5654      3
13041603 900010000  0      1      1      2.098       4
13041604 900010000  0      1      1      0.3658      5
*
*htstr  s. type  s. mult  left heat  right heat  ht str no.
13041701    0      0          0          0          5
*
13041801      0.      10.0    10.0    0.  0.  0.  0.  1.  4
13041802      0.      10.0    10.0    0.  0.  0.  0.  1.  5
*

```

```

13041901      0.      10.0  10.0  0.  0.  0.  0.  1.  5
*
$=====
$          ht str no. 312-1  blsg separator to sep bypass
-----*
*htstr  ht str  m pts  geom  init  l.coord  refl  b.vol  axl. incr
13121000  1      2      2      1      0.2982  0
*
*htstr      mesh locn      mesh fmt
13121100      0          1
*
*htstr      intervals      rt. coord
13121101      1          0.3012
*
*htstr      compxn no.      interval
13121201      5          1
*
*htstr      source      interval
13121301      0.0          1
*
*htstr      temp flg
13121400      0
*
*htstr      temp      mesh pt.
13121401      550.          2
*
*htstr  left vol  incr  b.cond  sa code  area/factor  ht str no.
13121501  308010000  0      1      1      1.7886      1
*
*htstr  right vol  incr  b.cond  sa code  area/factor  ht str no.
13121601  312010000  0      1      1      1.7886      1
*
*htstr  s. type  s. mult  left heat  right heat  ht str no.
13121701  0      0      0      0      1
*
13121801  0.      10.0  10.0  0.  0.  0.  0.  1.  1
*
13121901  0.      10.0  10.0  0.  0.  0.  0.  1.  1
*
$=====
$          ht str no. 316-1  blsg hemisph top to environ
-----*
*htstr  ht str  m pts  geom  init  l.coord  refl  b.vol  axl. incr
13161000  1      6      3      1      0.447  0
*
*htstr      mesh locn      mesh fmt
13161100      0          1
*
*htstr      intervals      rt. coord
13161101      1          0.451
13161102      2          0.473

```

```

13161103          2          0.598
*
*htstr          compxn no.      interval
13161201          5          1
13161202          6          3
13161203          9          5
*
*htstr          source          interval
13161301          0.0          5
*
*htstr          temp flg
13161400          0
*
*htstr          temp          mesh pt.
13161401          550.          6
*
*htstr  left vol  incr  b.cond  sa code  area/factor  ht str no.
13161501 316010000 0    1      1      0.391          1
*
*htstr  right vol  incr  b.cond  sa code  area/factor  ht str no.
13161601 900010000 0    1      1      0.391          1
*
*htstr  s. type    s. mult    left heat  right heat  ht str no.
13161701 0          0          0          0          1
*
13161801 0.          10.0    10.0    0.    0.    0.    0.    1.    1
*
13161901 0.          10.0    10.0    0.    0.    0.    0.    1.    1
*
*-----*
$      primary loop piping heat structures      $
*-----*
$      ht str no. 400-1  il + bl hl heat struct
*-----*
*htstr  ht strs  m pts  geom  init  l.coord  refl  b.vol  axl. incr
14001000 8        5      2      1      0.1035    0
*
*htstr          mesh locn      mesh fmt
14001100          0          1
*
*htstr          intervals      rt. coord
14001101          2          0.1981
14001102          2          0.3231
*
*htstr          compxn no.      interval
14001201          5          2
14001202          9          4
*
*htstr          source          interval
14001301          0.0          4
*

```

```

*htstr                                temp flg
14001400                              0
*
*htstr      temp      mesh pt.
14001401    597.0      5
*
*htstr      left vol    incr  b.cond  sa code  area/factor  ht str no.
14001501    400010000    0      1      1      1.3246      1
14001502    404010000    0      1      1      1.2668      2
14001503    408010000    0      1      1      0.5968      3
14001504    408020000    0      1      1      0.5278      4
14001505    200010000    0      1      1      1.3246      5
14001506    204010000    0      1      1      1.2668      6
14001507    208010000    0      1      1      0.5968      7
14001508    208020000    0      1      1      0.5278      8
*
*htstr      right vol   incr  b.cond  sa code  area/factor  ht str no.
14001601    900010000    0      1      1      1.3246      1
14001602    900010000    0      1      1      1.2668      2
14001603    900010000    0      1      1      0.5968      3
14001604    900010000    0      1      1      0.5278      4
14001605    900010000    0      1      1      1.3246      5
14001606    900010000    0      1      1      1.2668      6
14001607    900010000    0      1      1      0.5968      7
14001608    900010000    0      1      1      0.5278      8
*
*htstr      s. type      s. mult      left heat  right heat  ht str no.
14001701      0          0          0          0          8
*
14001801      0.         10.0    10.0      0.    0.    0.    0.    1.  8
*
14001901      0.         10.0    10.0      0.    0.    0.    0.    1.  8
*
$=====
$          ht str no. 400-2   il + bl col heat struct
$-----*
*htstr  ht strs  m pts  geom  init  l.coord  refl  b.vol  axl. incr
14002000  18      5      2      1    0.0841    0
*
*htstr      mesh locn      mesh fmt
14002100      0          1
*
*htstr      intervals      rt. coord
14002101      2          0.1219
14002102      2          0.2469
*
*htstr      compxn no.      interval
14002201      5          2
14002202      9          4
*
*htstr      source      interval

```



```

14002301      0.0      4
*
*htstr      temp flg
14002400      0
*
*htstr      temp      mesh pt.
14002401      557.      5
*
*htstr      left vol      incr b.cond      sa code      area/factor      ht str no.
14002501      432010000      0      1      1      0.516      1
14002502      432020000      10000      1      1      1.2422      4
14002503      432050000      0      1      1      1.1919      5
14002504      436010000      0      1      1      1.1919      6
14002505      436020000      10000      1      1      1.1222      9
14002506      232010000      0      1      1      0.516      10
14002507      232020000      10000      1      1      1.2422      13
14002508      232050000      0      1      1      1.1919      14
14002509      236010000      0      1      1      1.1919      15
14002510      236020000      10000      1      1      1.1222      18
*
*htstr      right vol      incr b.cond      sa code      area/factor      ht str no.
14002601      900010000      0      1      1      0.516      1
14002602      900010000      0      1      1      1.2422      4
14002603      900010000      0      1      1      1.1919      6
14002604      900010000      0      1      1      1.1222      9
14002605      900010000      0      1      1      0.516      10
14002606      900010000      0      1      1      1.2422      13
14002607      900010000      0      1      1      1.1919      15
14002608      900010000      0      1      1      1.1222      18
*
*htstr      s. type      s. mult      left heat      right heat      ht str no.
14002701      0      0      0      0      18
*
14002801      0.      10.0      10.0      0. 0. 0. 0. 1. 18
*
14002901      0.      10.0      10.0      0. 0. 0. 0. 1. 18
*
$=====
$=====
$
$          ht str no. 400-3      il + bl cl heat struct
$-----*
*htstr      ht strs      m pts      geom      init      l.coord      refl      b.vol      axl. incr
14003000      7      5      2      1      0.1035      0
*
*htstr      mesh locn      mesh fmt
14003100      0      1
*
*htstr      intervals      rt. coord
14003101      2      0.1937
14003102      2      0.3187
*

```

```

*htstr      compxn no.      interval
14003201      5              2
14003202      9              4
*
*htstr      source          interval
14003301      0.0           4
*
*htstr      temp flg
14003400      0
*
*htstr      temp            mesh pt.
14003401      557.0         5
*
*htstr      left vol      incr b.cond sa code area/factor ht str no.
14003501      444010000    0      1      1      1.0562      1
14003502      448010000    0      1      1      1.1067      2
14003503      452010000    0      1      1      1.3125      3
14003504      244010000    0      1      1      0.647       4
14003505      248010000    0      1      1      0.878       5
14003506      252010000    10000  1      1      0.9752      7
*
*htstr      right vol     incr b.cond sa code area/factor ht str no.
14003601      900010000    0      1      1      1.0562      1
14003602      900010000    0      1      1      1.1067      2
14003603      900010000    0      1      1      1.3125      3
14003604      900010000    0      1      1      0.647       4
14003605      900010000    0      1      1      0.878       5
14003606      900010000    0      1      1      0.9752      7
*
*htstr      s. type       s. mult   left heat right heat ht str no.
14003701      0           0         0         0         0         7
*
14003801      0.         10.0    10.0     0.  0.  0.  0.  1.  7
*
14003901      0.         10.0    10.0     0.  0.  0.  0.  1.  7
*
$=====
$          ht str no. 412-1  ilsg inlet/outlet plnm hemisph
$-----*
*htstr ht strs m pts geom init l.coord refl b.vol axl. incr
14121000 2      6      3      1      0.377      0
*
*htstr      mesh locn      mesh fmt
14121100      0              1
*
*htstr      intervals      rt. coord
14121101      1              0.380
14121102      2              0.430
14121103      2              0.555
*
*htstr      compxn no.      interval

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```

14121201      5      1
14121202      6      3
14121203      9      5
*
*htstr      source      interval
14121301      0.0      5
*
*htstr      temp flg
14121400      -1
*
*htstr      temperature distribution for heat structure 01
14121401      597.000      597.000      597.000      597.000      597.000
+      597.000
*htstr      temperature distribution for heat structure 02
14121402      557.000      557.000      557.000      557.000      557.000
+      557.000
*
*htstr      left vol      incr      b.cond      sa code      area/factor      ht str no.
14121501      412010000      0      1      1      0.1872      1
14121502      428010000      0      1      1      0.1872      2
*
*htstr      right vol      incr      b.cond      sa code      area/factor      ht str no.
14121601      900010000      0      1      1      0.1872      2
*
*htstr      s. type      s. mult      left heat      right heat      ht str no.
14121701      0      0      0      0      2
*
14121801      0.      10.0      10.0      0.      0.      0.      0.      1.      2
*
14121901      0.      10.0      10.0      0.      0.      0.      0.      1.      2
*
$=====
$      ht str no. 412-2      ilsg inlet/outlet plnm walls
-----*
*htstr      ht str      m pts      geom      init      l.coord      refl      b.vol      axl. incr
14122000      4      6      2      1      0.365      0
*
*htstr      mesh locn      mesh fmt
14122100      0      1
*
*htstr      intervals      rt. coord
14122101      1      0.368
14122102      2      0.434
14122103      2      0.559
*
*htstr      compxn no.      interval
14122201      5      1
14122202      6      3
14122203      9      5
*
*htstr      source      interval

```

```

14122301      0.0          5
*
*htstr          temp flg
14122400      -1
*
*htstr          temperature distribution for heat structure 01
14122401      597.000      597.000      597.000      597.000      597.000
+
14122402      557.000      557.000      557.000      557.000      557.000
+
14122403      597.000      597.000      597.000      597.000      597.000
+
14122404      557.000      557.000      557.000      557.000      557.000
+
*
*
*htstr  left vol  incr  b.cond  sa code  area/factor  ht str no.
14122501  412010000  0      1      1      0.4237      1
14122502  428010000  0      1      1      0.4237      2
14122503  416010000  0      1      1      1.1035      3
14122504  424010000  0      1      1      1.1035      4
*
*htstr  right vol  incr  b.cond  sa code  area/factor  ht str no.
14122601  900010000  0      1      1      0.4237      2
14122602  900010000  0      1      1      1.1035      4
*
*htstr  s. type    s. mult    left heat  right heat  ht str no.
14122701  0          0          0          0          4
*
14122801  0.        10.0      10.0      0.        0.        0.        0.        1.  2
14122802  0.        10.0      10.0      0.        0.        0.        0.        1.  4
*
14122901  0.        10.0      10.0      0.        0.        0.        0.        1.  4
*
$=====
*****
*          ht str no. 420-1 intact loop sg tubes
*****
*
14201000  8      8      2      1      0.00980
14201100  0      1
*
* tube mesh interval
*
14201101  7      0.0127
*
* heat structure composition
*

```

```

14201201    5    7
*
* heat source distribution
*
14201301    0.0    7
*
* initial temperature flag
*
14201400    0
14201401    562.4    8
*
* left boundary condition
*
14201501    420010000    0    1    1    359.04    1
14201502    420020000    10000    1    1    361.72    3
14201503    420040000    10000    1    1    306.36    5
14201504    420060000    10000    1    1    361.72    7
14201505    420080000    0    1    1    359.04    8
*
* right boundary condition
*
14201601    504010000    0    1    1    359.04    1
14201602    504020000    10000    1    1    361.72    3
14201603    504040000    0    1    1    306.36    5
14201604    504030000    -10000    1    1    361.72    7
14201605    504010000    0    1    1    359.04    8
*
* heat source
*
14201701    0    0    0    0    8
*
* additional left boundary conditions
*
14201801    0.    10.0    10.0    0.0    0.    0.0    0.    1.    8
*
* additional right boundary conditions
*
14201901    0.    10.0    10.0    0.0    0.    0.0    0.    1.    8
*
=====
$          ht str no. 420-2    ilsg inlet/outlet tube sheet
=====
*
*htstr  ht strs  m pts  geom  init  l.coord  refl  b.vol  axl. incr
14202000    2      4      2      1    0.0098    0
*
*htstr          mesh locn      mesh fmt
14202100          0          1
*
*htstr          intervals      rt. coord
14202101          3          0.0163
*

```

```

*htstr      compxn no.      interval
14202201      5              3
*
*htstr      source          interval
14202301      0.0           3
*
*htstr                        temp flg
14202400                        -1
*
*htstr      temperature distribution for heat structure 01
14202401      597.000      597.000      597.000      597.000
*htstr      temperature distribution for heat structure 02
14202402      557.000      557.000      557.000      557.000
*
*htstr      left vol      incr      b.cond      sa code      area/factor      ht str no.
14202501      420010000      0          1          1          45.40          1
14202502      420080000      0          1          1          45.40          2
*
*htstr      right vol      incr      b.cond      sa code      area/factor      ht str no.
14202601      0          0          0          1          45.40          2
*
*htstr      s. type      s. mult      left heat      right heat      ht str no.
14202701      0          0          0          0          2
*
14202801      0.          10.0      10.0      0.  0.  0.  0.  1.  2
*
*-----*
$              ht str no. 500-1      ilsg external dc pipe to environ
*-----*
*htstr      ht strs      m pts      geom      init      l.coord      refl      b.vol      axl. incr
15001000      5          5          2          1          0.0486          0
*
*htstr      mesh locn      mesh fmt
15001100      0          1
*
*htstr      intervals      rt. coord
15001101      2          0.0572
15001102      2          0.1572
*
*htstr      compxn no.      interval
15001201      5          2
15001202      9          4
*
*htstr      source          interval
15001301      0.0          4
*
*htstr      temp          mesh pt.
15001401      564.0          5
*
*htstr      left vol      incr      b.cond      sa code      area/factor      ht str no.
15001501      500010000      0          1          1          9.0016          1

```

15001502	500020000	0	1	1	8.3920	2
15001503	500030000	10000	1	1	10.2616	4
15001504	500050000	0	1	1	10.2380	5
*						
*htstr	right vol	incr	b.cond	sa code	area/factor	ht str no.
15001601	900010000	0	1	1	9.0016	1
15001602	900010000	0	1	1	8.3920	2
15001603	900010000	0	1	1	10.2616	4
15001604	900010000	0	1	1	10.2380	5
*						
*htstr	s. type	s. mult	left heat	right heat	ht str no.	
15001701	0	0	0	0	5	
*						
15001801	0.	10.0	10.0	0.	0.	1. 5
*						
15001901	0.	10.0	10.0	0.	0.	1. 5
*						
\$=====						
\$ ht str no. 500-2 ilsg upper dc to separator						

*htstr	ht strs	m pts	geom	init	l.coord	refl b.vol axl. incr
15002000	2	2	2	1	0.2514	0
*						
*htstr	mesh locn	mesh fmt				
15002100	0	1				
*						
*htstr	intervals	rt. coord				
15002101	1	0.2554				
*						
*htstr	compxn no.	interval				
15002201	5	1				
*						
*htstr	source	interval				
15002301	0.0	1				
*						
*htstr	temp flg					
15002400	0					
*						
*htstr	temp	mesh pt.				
15002401	560.	2				
*						
*htstr	left vol	incr	b.cond	sa code	area/factor	ht str no.
15002501	504050000	0	1	1	0.6461	1
15002502	508010000	0	1	1	2.120	2
*						
*htstr	right vol	incr	b.cond	sa code	area/factor	ht str no.
15002601	500010000	0	1	1	0.6461	1
15002602	508010000	0	1	1	2.120	2
*						
*htstr	s. type	s. mult	left heat	right heat	ht str no.	
15002701	0	0	0	0	2	

```

*
15002801      0.      10.0    10.0    0.  0.  0.  0.  1.  2
*
15002901      0.      10.0    10.0    0.  0.  0.  0.  1.  1
15002902      0.      10.0    10.0    0.  0.  0.  0.  1.  2
*
$=====
$              ht str no. 500-3  ilsg upper sg shell to environ
$-----*
*htstr  ht strs  m pts  geom  init  l.coord  refl  b.vol  axl. incr
15003000    4      6      2      1    0.4375    0
*
*htstr      mesh locn      mesh fmt
15003100          0          1
*
*htstr      intervals      rt. coord
15003101          1          0.4405
15003102          2          0.4785
15003103          2          0.6035
*
*htstr      compxn no.      interval
15003201          5          1
15003202          6          3
15003203          9          5
*
*htstr      source      interval
15003301          0.0          5
*
*htstr      temp flg
15003400          0
*
*htstr      temp      mesh pt.
15003401      530.          6
*
*htstr  left vol  incr  b.cond  sa code  area/factor  ht str no.
15003501  500010000  0      1      1      0.6461          1
15003502  504050000  0      1      1      1.0104          2
15003503  512010000  0      1      1      2.120           3
15003504  516010000  0      1      1      3.4278          4
*
*htstr  right vol  incr  b.cond  sa code  area/factor  ht str no.
15003601  900010000  0      1      1      0.6461          1
15003602  900010000  0      1      1      1.0104          2
15003603  900010000  0      1      1      2.120           3
15003604  900010000  0      1      1      3.4278          4
*
*htstr  s. type  s. mult  left heat  right heat  ht str no.
15003701    0      0      0      0          4
*
15003801      0.      10.0    10.0    0.  0.  0.  0.  1.  1
15003802      0.      10.0    10.0    0.  0.  0.  0.  1.  2

```



```

15003803      0.      10.0    10.0    0.  0.  0.  0.  1.  3
15003804      0.      10.0    10.0    0.  0.  0.  0.  1.  4
*
15003901      0.      10.0    10.0    0.  0.  0.  0.  1.  4
*
$=====
$                ht str no. 500-4  ilsg lower sg dc to boiler
$-----*
*htstr  ht strs  m pts  geom  init  l.coord  refl  b.vol  axl. incr
15004000      1      2      2      1    0.345      0
*
*htstr          mesh locn      mesh fmt
15004100          0              1
*
*htstr          intervals      rt. coord
15004101          1              0.351
*
*htstr          compxn no.      interval
15004201          5              1
*
*htstr          source          interval
15004301          0.0            1
*
*htstr          temp flg
15004400          0
*
*htstr          temp          mesh pt.
15004401          560.          2
*
*htstr  left vol  incr  b.cond  sa code  area/factor  ht str no.
15004501  504010000  0      1      1      1.0637      1
*
*htstr  right vol  incr  b.cond  sa code  area/factor  ht str no.
15004601  500050000  0      1      1      1.0637      1
*
*htstr  s. type    s. mult    left heat  right heat  ht str no.
15004701  0          0          0          0          1
*
15004801      0.      10.0    10.0    0.  0.  0.  0.  1.  1
*
15004901      0.      10.0    10.0    0.  0.  0.  0.  1.  1
*
$=====
$                ht str no. 500-5  ilsg lower sg dc wall to environ
$-----*
*htstr  ht strs  m pts  geom  init  l.coord  refl  b.vol  axl. incr
15005000      1      6      2      1    0.370      0
*
*htstr          mesh locn      mesh fmt
15005100          0              1
*

```

```

*htstr      intervals      rt. coord
15005101      1      0.373
15005102      2      0.405
15005103      2      0.530
*
*htstr      compxn no.      interval
15005201      5      1
15005202      6      3
15005203      9      5
*
*htstr      source      interval
15005301      0.0      5
*
*htstr      temp flg
15005400      0
*
*htstr      temp      mesh pt.
15005401      530.      6
*
*htstr      left vol      incr      b.cond      sa code      area/factor      ht str no.
15005501      500050000      0      1      1      1.2637      1
*
*htstr      right vol      incr      b.cond      sa code      area/factor      ht str no.
15005601      900010000      0      1      1      1.2637      1
*
*htstr      s. type      s. mult      left heat      right heat      ht str no.
15005701      0      0      0      0      1
*
15005801      0.      10.0      10.0      0.      0.      0.      0.      1.      1
*
15005901      0.      10.0      10.0      0.      0.      0.      0.      1.      1
*
$=====
$      ht str no. 504-1      ilsg boiler wall to environ
-----*
*htstr      ht str      m pts      geom      init      l.coord      refl      b.vol      axl. incr
15041000      5      6      2      1      0.347      0
*
*htstr      mesh locn      mesh fmt
15041100      0      1
*
*htstr      intervals      rt. coord
15041101      1      0.350
15041102      2      0.380
15041103      2      0.505
*
*htstr      compxn no.      interval
15041201      5      1
15041202      6      3
15041203      9      5
*

```

```

*htstr      source      interval
15041301    0.0         5
*
*htstr      temp flg
15041400    0
*
*htstr      temp      mesh pt.
15041401    550.      6
*
*htstr      left vol    incr  b.cond  sa code  area/factor  ht str no.
15041501    504010000  0      1      1      1.2827      1
15041502    504020000  10000  1      1      2.5654      3
15041503    504040000  0      1      1      2.098       4
15041504    504050000  0      1      1      0.3658      5
*
*htstr      right vol   incr  b.cond  sa code  area/factor  ht str no.
15041601    900010000  0      1      1      1.2827      1
15041602    900010000  0      1      1      2.5654      3
15041603    900010000  0      1      1      2.098       4
15041604    900010000  0      1      1      0.3658      5
*
*htstr      s. type     s. mult  left heat  right heat  ht str no.
15041701    0          0        0          0          5
*
15041801    0.        10.0     10.0      0.         0.         0.         0.         1.         4
15041802    0.        10.0     10.0      0.         0.         0.         0.         1.         5
*
15041901    0.        10.0     10.0      0.         0.         0.         0.         1.         5
*
$=====
$          ht str no. 512-1  ilsg separator to sep bypass
$-----*
*htstr  ht strs  m pts  geom  init  l.coord  refl  b.vol  axl. incr
15121000  1      2      2      1      0.2982  0
*
*htstr      mesh locn      mesh fmt
15121100    0          1
*
*htstr      intervals      rt. coord
15121101    1          0.3012
*
*htstr      compxn no.      interval
15121201    5          1
*
*htstr      source      interval
15121301    0.0         1
*
*htstr      temp flg
15121400    0
*
*htstr      temp      mesh pt.

```

```

15121401      550.              2
*
*htstr  left vol  incr  o.cond  sa code  area/factor  ht str no.
15121501  508010000  0      1      1      1.7886      1
*
*htstr  right vol  incr  b.cond  sa code  area/factor  ht str no.
15121601  512010000  0      1      1      1.7886      1
*
*htstr  s. type    s. mult    left heat  right heat  ht str no.
15121701      0          0          0          0          1
*
15121801      0.        10.0      10.0  0.  0.  0.  0.  1.  1
*
15121901      0.        10.0      10.0  0.  0.  0.  0.  1.  1
*
$=====
$              ht str no. 516-1  ilsg hemisph top to environ
$-----*
*htstr  ht str  m pts  geom  init  l.coord  refl  b.vol  axl. incr
15161000  1      6      3      1      0.447    0
*
*htstr      mesh locn      mesh fmt
15161100      0          1
*
*htstr      intervals      rt. coord
15161101      1          0.451
15161102      2          0.473
15161103      2          0.598
*
*htstr      compxn no.      interval
15161201      5          1
15161202      6          3
15161203      9          5
*
*htstr      source      interval
15161301      0.0        5
*
*htstr      temp flg
15161400      0
*
*htstr      temp      mesh pt.
15161401      550.        6
*
*htstr  left vol  incr  b.cond  sa code  area/factor  ht str no.
15161501  516010000  0      1      1      0.391      1
*
*htstr  right vol  incr  b.cond  sa code  area/factor  ht str no.
15161601  900010000  0      1      1      0.391      1
*
*htstr  s. type    s. mult    left heat  right heat  ht str no.
15161701      0          0          0          0          1

```

```

*
15161801      0.      10.0   10.0   0.   0.   0.   0.   1.   1
*
15161901      0.      10.0   10.0   0.   0.   0.   0.   1.   1
*
*-----*
$              ht str no. 610-1   prizer wall heat struct
*-----*
*htstr  ht strs  m pts  geom  init  l.coord  refl  b.vol  axl. incr
16101000    7      6      2      1    0.300      0
*
*htstr      mesh locn      mesh fmt
16101100          0          1
*
*htstr      intervals      rt. coord
16101101          1          0.303
16101102          2          0.360
16101103          2          0.485
*
*htstr      compxn no.      interval
16101201          5          1
16101202          6          3
16101203          9          5
*
*htstr      source      interval
16101301          0.0          5
*
*htstr      temp flg
16101400          0
*
*htstr      temp      mesh pt.
16101401          650.          6
*
*htstr  left vol  incr  b.cond  sa code  area/factor  ht str no.
16101501  610020000  10000  1      1      0.475          2
16101502  610040000  0      1      1      0.600          3
16101503  610050000  10000  1      1      0.682          5
16101504  610070000  10000  1      1      0.5375         7
*
*htstr  right vol  incr  b.cond  sa code  area/factor  ht str no.
16101601  900010000  0      1      1      0.475          2
16101602  900010000  0      1      1      0.600          3
16101603  900010000  0      1      1      0.682          5
16101604  900010000  0      1      1      0.5375         7
*
*htstr  s. type  s. mult  left heat  right heat  ht str no.
16101701    0      0          0          0          7
*
16101801      0.      10.0   10.0   0.   0.   0.   0.   1.   5
16101802      0.      10.0   10.0   0.   0.   0.   0.   1.   7
*

```

```

16101901      0.      10.0  10.0   0.   0.   0.   0.  1.  7
*
$=====
$              ht str no. 610-2   prizer top (hemisph) heat struct
*-----*
*htstr  ht strs  m pts  geom  init  l.coord  refl  b.vol  axl. incr
16102000   1      6     3     1    0.323    0
*
*htstr      mesh locn      mesh fmt
16102100          0          1
*
*htstr      intervals      rt. coord
16102101          1          0.326
16102102          2          0.383
16102103          2          0.508
*
*htstr      compxn no.      interval
16102201          5          1
16102202          6          3
16102203          9          5
*
*htstr      source      interval
16102301          0.0          5
*
*htstr      temp flg
16102400          0
*
*htstr      temp      mesh pt.
16102401        650.          5
16102402        650.          6
*
*htstr  left vol  incr  b.cond  sa code  area/factor  ht str no.
16102501  610010000  0     1     1      0.311          1
*
*htstr  right vol  incr  b.cond  sa code  area/factor  ht str no.
16102601  900010000  0     1     1      0.311          1
*
*htstr  s. type    s. mult    left heat  right heat  ht str no.
16102701    0         0         0         0          1
*
16102801      0.      10.0  10.0   0.   0.   0.   0.  1.  1
*
16102901      0.      10.0  10.0   0.   0.   0.   0.  1.  1
*
$=====
$              ht str no. 610-3   prizer bot (flange) heat struct
*-----*
*htstr  ht strs  m pts  geom  init  l.coord  refl  b.vol  axl. incr
16103000   1      6     1     1    0.0      0
*
*htstr      mesh locn      mesh fmt

```

```

16103100          0          1
*
*htstr      intervals      rt. coord
16103101          1          0.003
16103102          2          0.8374
16103103          2          0.9624
*
*htstr      compxn no.      interval
16103201          5          1
16103202          6          3
16103203          9          5
*
*htstr      source          interval
16103301          0.0          5
*
*htstr                      temp flg
16103400                      0
*
*htstr      temp            mesh pt.
16103401      650.          6
*
*htstr      left vol      incr b.cond sa code area/factor ht str no.
16103501      610080000    0      1      1      0.2731      1
*
*htstr      right vol      incr b.cond sa code area/factor ht str no.
16103601      900010000    0      1      1      0.2731      1
*
*htstr      s. type      s. mult      left heat right heat ht str no.
16103701          0          0          0          0          1
*
16103801          0.          10.0      10.0      0.      0.      0.      0.      1.  1
*
16103901          0.          10.0      10.0      0.      0.      0.      0.      1.  1
*
$=====
$          ht str no. 610-4 prizer htrs (prop+bkup) ht struct
$-----*
*htstr ht str m pts geom init l.coord refl b.vol axl. incr
16104000  2      3      2      1      0.0      0
*
*htstr      mesh locn      mesh fmt
16104100          0          1
*
*htstr      intervals      rt. coord
16104101          2          0.0115
*
*htstr      compxn no.      interval
16104201          2          1
16104202          5          2
*
*htstr      source          interval

```

```

16104301      1.0      1
16104302      0.0      2
*
*htstr      temp flg
16104400      0
*
*htstr      temp      mesh pt.
16104401      650.      3
*
*htstr      left vol      incr      b.cond      sa      code      area/factor      ht str no.
16104501      0      0      0      0      0      0      2
*
*htstr      right vol      incr      b.cond      sa      code      area/factor      ht str no.
16104601      610070000      10000      1      1      0.5375      2
*
*htstr      s. type      s. mult      left heat      right heat      ht str no.
16104701      10606      0.5      0.0      0.0      2
*
16104901      0.      10.0      10.0      0.      0.      0.      0.      1.      2
*
*****
* thermal properties
*
*****
*
20100100      tbl/fctn      1      1      * mgo
20100200      tbl/fctn      1      1      * nicr
20100300      tbl/fctn      1      1      * copper
20100400      tbl/fctn      1      1      * inconel
20100500      tbl/fctn      1      1      * stainless steel
20100600      c-steel      * carbon steel
20100700      tbl/fctn      1      1      * al2o3
20100900      tbl/fctn      1      1      * rockwool insulation
*
* thermal conductivity
*
* mgo
*
20100101      293.2      0.814      1273.2      1.047
*
* nicr heater
*
20100201      293.15      8.78      573.15      11.3      773.15      13.81      1073.15      18.83
20100202      1273.15      22.18      1473.15      25.52      10000.0      25.52
*
* copper
*
20100301      373.15      379.      473.15      374.      573.15      369.
20100302      673.15      363.      873.15      353.
*
* inconel 600

```



```

*
20100401    373.15  15.8   573.15  18.9   873.15  23.8  1173.15  29.3
*
*
*stainless steel
20100501    273.15  12.98  1199.82  25.1  10000.0  25.1
*
* aluminum oxide
*
20100701    373.15  25.122  473.15  20.935  573.15  16.748  773.15  12.561
20100702    1073.15  8.374  1473.15  8.374
*
* rockwool insulation
*
20100901    311.15  0.1192  422.15  0.1681  533.15  0.2166
20100902    811.15  0.3448
*
*
* volumetric heat capacity
*
* mgo
20100151    293.15  2.88e6  373.15  3.04e6  473.15  3.15e6
20100152    573.15  3.20e6  673.15  3.25e6  773.15  3.29e6
20100153    873.15  3.34e6  973.15  3.44e6  1073.15  3.53e6
20100154    1173.15  3.63e6
*
* nicr heater
*
20100251    373.15  3.23e+6  573.15  3.62e+6  773.15  4.10e+6
20100252    1073.15  4.61e+6  1173.15  4.73e+6  1273.15  4.95e+6
20100253    1473.15  5.29e+6  10000.0  5.29e+6
* copper
*
20100351    3.43e6
*
* inconel 600
*
20100451    373.15  3.94e+6  573.15  4.18e+6  873.15  4.71e+6
20100452    1173.15  5.17e+6
*
*stainless steel
20100551    273.15  3.83e+6  366.5  3.83e+6  477.59  4.19e+6
20100552    588.59  4.336e+6  699.82  4.504e+6  810.93  4.639e+6
20100553    922.04  4.773e+6  1144.26  5.076e+6  1366.5  5.376e+6
20100554    1477.59  5.546e+6  10000.0  5.546e+6
*
* aluminum oxide
*
20100751    373.15  3.015e+6  473.15  3.482e+6  573.15  3.796e+6
20100752    673.15  3.946e+6  773.15  4.093e+6  873.15  4.239e+6
20100753    973.15  4.384e+6  1073.16  4.373e+6  1173.16  4.529e+6

```

```

20100754  1373.16 4.529e+6  1473.16 4.685e+6
*
*  rockwool
20100951  1.36e+5
*
$=====
*****
*  core power
*****
*
20288800  power  501
20288801    -1.0  10.00e+6
20288802     0.0  10.00e+6
20288803    37.0  10.00e+6
20288804    38.0   9.84e+6
20288805    51.0   8.61e+6
20288806    66.0   7.44e+6
20288807    91.0   5.97e+6
20288808   110.0   5.13e+6
20288809   156.0   3.68e+6
20288810   205.0   2.90e+6
20288811   291.0   2.42e+6
20288812   405.0   1.80e+6
20288813   491.0   1.71e+6
20288814   591.0   1.60e+6
20288815   791.0   1.51e+6
20288816   991.0   1.45e+6
*
*****
*  pressurizer heater power
*****
*
20260000  reac-t          * backup heaters
20260001   15.34e6   1.125e5
20260002   15.40e6   1.125e5
20260003   15.40e6    0.0
*
20260100  reac-t          * proportional heaters
20260101   15.41e6   7.5e3
20260102   15.62e6    0.0
*
*****
*  plot variables
*****
*
*
*
*****
*  control systems
*****
*

```

```

*****
* calculate time step
*****
*
20500100 "time stp"      sum      1.0000000 .20000000 1
20500101 0.0      1.0      time      0
20500102      -1.0      cntrlvar 2
*
20500200 "old time"      mult      1.0000000 0.0      1
20500201 time      0
*
*****
* control system turbine bypass valve control
* during loca calcualtions
* based on mean primary temperature control
*****
*
*****
* calculate il + bl mean temperature and select the larger
*****
*
20503000 "ilmtmp"      sum      1.0000000 580.37388 1
20503001 0.0      0.5      tempf 452010000
20503002      0.5      tempf 400010000
*
20503100 "blmtmp"      sum      1.0000000 580.35764 1
20503101 0.0      0.5      tempf 252010000
20503102      0.5      tempf 200010000
*
20503200 "ilmtmpl"      tripunit 1.0000000 1.0000000 1
20503201 514
*
20503300 "blmtmpl"      tripunit 1.0000000 0.0      1
20503301 516
*
20503400 "cilmtmp "      mult      1.0000000 580.37388 1
20503401 cntrlvar 32      cntrlvar 30
*
20503500 "blmtmpl"      mult      1.0000000 0.0      1
20503501 cntrlvar 33      cntrlvar 31
*
20503600 "pmtmp "      sum      1.0000000 580.37388 1
20503601 0.0      1.0      cntrlvar 34
20503602      1.0      cntrlvar 35
*
*****
* input to tb valve control after core trip-pmt setpt = 564.9 k
*****
*
20503700 "pmterra "      sum      -.0902500 1.1456230 1
20503701 566.3      -1.0      cntrlvar 36

```

```

*
*****
*   check for reactor scram
*****
*
20503800 "arcttrp "      tripunit 1.0000000 0.0      1
20503801   501
*
20503900 "arcttrpc"      mult      1.0000000 0.0      1
20503901   cntrlvar 38   cntrlvar 37
*
*****
*   tb valve control
*****
*
20504000 "tbp area"      sum      1.0000000 0.0      1
+
20504001   0.0          1.0      cntrlvar 39
*
*****
* calculate core collapsed liquid level
*****
*
20512400 "core lvl"      sum      1.0000000 3.6600000 1
20512401   0.0          0.610      voidf      124010000
20512402          0.610      voidf      124020000
20512403          0.610      voidf      124030000
20512404          0.610      voidf      124040000
20512405          0.610      voidf      124050000
20512406          0.610      voidf      124060000
*****
* calculate core collapsed liquid level ---vessel---
*****
*
20512500 "core lvl"      sum      1.0000000 5.8027000 1
20512501   0.0          0.610      voidf      124010000
20512502          0.610      voidf      124020000
20512503          0.610      voidf      124030000
20512504          0.610      voidf      124040000
20512505          0.610      voidf      124050000
20512506          0.610      voidf      124060000
20512507          0.867      voidf      128010000
20512508          0.6757     voidf      132010000
20512509          0.6        voidf      136010000
*
*
*****
* calculate core heat input
*****
*
20512600 "coreheat"      sum      1.00000-6 9.8651798 1

```

20512601	0.0	1.0	q	124010000
20512602		1.0	q	124020000
20512603		1.0	q	124030000
20512604		1.0	q	124040000
20512605		1.0	q	124050000
20512606		1.0	q	124060000

*

* calculate vessel dc collapsed level

*

20510900	"vsldclvl"	sum	1.0000000	3.6600000	1
20510901	0.0 0.610	voidf	108030000		
20510902	0.610	voidf	108040000		
20510903	0.610	voidf	108050000		
20510904	0.610	voidf	108060000		
20510905	0.610	voidf	108070000		
20510906	0.610	voidf	108080000		

*

* energy transferred to generators

*

20530000	"blsgheat"	sum	1.00000-6	4.9783641	1
20530001	0.0 1.0	q	304010000		
20530002	1.0	q	304020000		
20530003	1.0	q	304030000		
20530004	1.0	q	304040000		

*

20550000	"ilsgheat"	sum	1.00000-6	4.9752834	1
20550001	0.0 1.0	q	504010000		
20550002	1.0	q	504020000		
20550003	1.0	q	504030000		
20550004	1.0	q	504040000		

*

\$*****

\$calculate sg recirculation ratios

\$*****

*

20530100	"recircbl"	div	1.0000000	5.0243769	1
20530101	mflowj 308010000	mflowj	301000000		

*

20550100	"recircil"	div	1.0000000	5.0230369	1
20550101	mflowj 508010000	mflowj	501000000		

*

* calculate narrow range sg liquid levels

*

20530800	"ilsgll "	sum	.15390000	.13184474	1
20530801	0.0 0.600	voidf	300010000		

```

20530802      2.12      voidf      312010000
20530803      3.7778     voidf      316010000
*
20550800  "blsgll  "      sum      .15390000 .12746200 1
20550801    0.0      0.600     voidf      500010000
20550802      2.12      voidf      512010000
20550803      3.7778     voidf      516010000

```

```

*
*****
* set bl main feedwater on 9.5 m wide range sg level
*****

```

```

*
20535900  "bl lv er"      sum      1.000000 0.      1
20535901    2570.      -1.0  cntrlvar 309
*
20536100  "bl feed "      sum      1.0000000 2.8000000 1
20536101    0.0      0.5  mflowj 805000000
20536102      2.0  cntrlvar 359

```

```

*
*****
* set il main feedwater on 9.6 m wide range sg level
*****

```

```

*
20555900  "il lv er"      sum      1.000000 0.      1
20555901    2570.      -1.0  cntrlvar 509
*
*
20556100  "il feed "      sum      1.0000000 2.8000000 1
20556101    0.0      0.5  mflowj 805000000
20556102      2.0  cntrlvar 559

```

```

*
$*****
$ pressurizer heater power
$*****

```

```

*
20560000  "pbkuphtr"      function 1.0000000 0.0      1
20560001    p      610010000      600
*
20560100  "pprohtr "      function 1.0000000 836.59446 1
20560101    p      610010000      601
*
20560200  "bkphtrtp"      tripunit 1.0000000 0.0      1
20560201    634
*
20560300  "bkphtrpw"      mult      1.0000000 0.0      1
20560301    cntrlvar 600      cntrlvar 602
*
20560400  "pzrhtrpw"      sum      1.0000000 836.59446 1
20560401    0.0      1.0  cntrlvar 601
20560402      1.0  cntrlvar 603

```

```

20560500 "pzhttrtp"      tripunit  1.0000000 0.0      1
20560501 633
*
20560600 "pzhttrpw"      mult      1.0000000 0.0      1
20560601 cntrlvar 604      cntrlvar 605
*
$*****
$calculate collapsed prssurizer liquid level
$*****
*
20561000 "pzs lev "      sum      1.00000000      2.594213 1
20561001      0.0      0.201      voidf      610010000
20561002      0.470      voidf      610020000
20561003      0.470      voidf      610030000
20561004      0.600      voidf      610040000
20561005      0.682      voidf      610050000
20561006      0.682      voidf      610060000
20561007      0.5375     voidf      610070000
20561008      0.5375     voidf      610080000
*
$*****
$calculate broken loop steam generator mass
$*****
*
20530900 "sgb mass"      sum      1.0000000 2860.9843 1
20530901      0.0      0.3228     rho      300010000
20530902      0.0621     rho      300020000
20530903      0.0759     rho      300030000
20530904      0.0759     rho      300040000
20530905      0.1302     rho      300050000
20530906      0.5839     rho      304010000
20530907      0.5882     rho      304020000
20530908      0.5882     rho      304030000
20530909      0.4951     rho      304040000
20530910      0.7979     rho      304050000
20530911      0.5720     rho      308010000
20530912      0.6288     rho      312010000
20530913      2.0288     rho      316010000
*
$*****
$calculate intact loop steam generator mass
$*****
*
20550900 "sga mass"      sum      1.0000000 2848.8553 1
20550901      0.0      0.3228     rho      500010000
20550902      0.0621     rho      500020000
20550903      0.0759     rho      500030000
20550904      0.0759     rho      500040000
20550905      0.1302     rho      500050000
20550906      0.5839     rho      504010000
20550907      0.5882     rho      504020000

```

20550908	0.5882	rho	504030000
20550909	0.4951	rho	504040000
20550910	0.7979	rho	504050000
20550911	0.5720	rho	508010000
20550912	0.6288	rho	512010000
20550913	2.0288	rho	516010000

*

\$*****

\$calculate intact primary loop mass

\$*****

*

20570000	"ihl mass"	sum	1.0000000	2848.8553	1
20570001	0.0	0.04463902	rho	400010000	
20570002		0.00093545	rho	402010000	
20570003		0.00058598	rho	404010000	
20570004		0.04446715	rho	406010000	
20570005		0.02373491	rho	408010000	
20570006		0.01778686	rho	408020000	
20570007		0.1250	rho	412010000	
20570008		0.2323	rho	416010000	

*

20570100	"isg mass"	sum	1.000000	2500.0	1
20570101	0.0	0.122077	rho	420010000	
20570102		0.109029	rho	420020000	
20570103		0.109029	rho	420030000	
20570104		0.092344	rho	420040000	
20570105		0.092344	rho	420050000	
20570106		0.109029	rho	420060000	
20570107		0.109029	rho	420070000	
20570108		0.122077	rho	420080000	

*

20570200	"ils mass"	sum	1.000000	2500.0	1
20570201	0.0	0.2323	rho	424010000	
20570202		0.125	rho	428010000	
20570203		0.0114552	rho	432010000	
20570204		0.02757684	rho	432020000	
20570205		0.02757684	rho	432030000	
20570206		0.02757684	rho	432040000	
20570207		0.02646018	rho	432050000	
20570208		0.02646018	rho	436010000	
20570209		0.02491284	rho	436020000	
20570210		0.02611386	rho	436030000	
20570211		0.02491284	rho	436040000	

*

20570300	"icl mass"	sum	1.000000	2500.0	1
20570301	0.0	0.0235	rho	440010000	
20570302		0.03559394	rho	444010000	
20570303		0.04025465	rho	448010000	
20570304		0.04423125	rho	452010000	
20570305		0.040832	rho	740010000	


```

*
20570400 "pr mass"      sum      1.000000 2500.0 1
20570401      0.0      0.0325      rho      610010000
20570402      0.132869      rho      610020000
20570403      0.132869      rho      610030000
20570404      0.169620      rho      610040000
20570405      0.192801      rho      610050000
20570406      0.192801      rho      610060000
20570407      0.146791      rho      610070000
20570408      0.146791      rho      610080000
20570409      0.02382748      rho      600010000
20570410      0.03249617      rho      600020000
20570411      0.01905868      rho      600030000
*20570412      0.00791779      rho      620010000
*20570413      0.00791779      rho      620020000
*
20570500 "il mass"      sum      1.000000 2500.0 1
20570501      0.0      1.0      cntrlvar      700
20570502      1.0      cntrlvar      701
20570503      1.0      cntrlvar      702
20570504      1.0      cntrlvar      703
20570505      1.0      cntrlvar      704
*
$*****
$calculate broken primary loop mass
$*****
*
20570600 "bhl mass"      sum      1.0000000 2848.8553 1
20570601      0.0      0.04463902      rho      200010000
20570602      0.00093545      rho      202010000
20570603      0.00058598      rho      204010000
20570604      0.04665091      rho      206010000
20570605      0.02373491      rho      208010000
20570606      0.01778686      rho      208020000
20570607      0.1250      rho      212010000
20570608      0.2323      rho      216010000
*
20570700 "bsg mass"      sum      1.000000 2500.0 1
20570701      0.0      0.122077      rho      220010000
20570702      0.109029      rho      220020000
20570703      0.109029      rho      220030000
20570704      0.092344      rho      220040000
20570705      0.092344      rho      220050000
20570706      0.109029      rho      220060000
20570707      0.109029      rho      220070000
20570708      0.122077      rho      220080000
*
20570800 "bls mass"      sum      1.000000 2500.0 1
20570801      0.0      0.2323      rho      224010000
20570802      0.125      rho      228010000
20570803      0.0114552      rho      232010000

```

20570804		0.02757684	rho	232020000
20570805		0.02757684	rho	232030000
20570806		0.02757684	rho	232040000
20570807		0.02646018	rho	232050000
20570808		0.02930844	rho	236010000
20570809		0.02491284	rho	236020000
20570810		0.02534574	rho	236030000
20570811		0.02491284	rho	236040000
*				
20570900	"bcl mass"	sum	1.000000 2500.0	1
20570901	0.0	0.0235	rho	240010000
20570902		0.02476276	rho	244010000
20570903		0.03177573	rho	248010000
20570904		0.03286424	rho	252010000
20570905		0.03286424	rho	252020000
20570906		0.0145264	rho	790010000
*				
20571000	"bl mass"	sum	1.000000 2500.0	1
20571001	0.0	1.0	cntrlvar	706
20571002		1.0	cntrlvar	707
20571003		1.0	cntrlvar	708
20571004		1.0	cntrlvar	709
*				

* pressure vessel mass				

*				
20571100	"pvd mass"	sum	1.000000 2500.0	1
20571101	0.0	0.136090	rho	100010000
20571102		0.054250	rho	104010000
20571103		0.06604292	rho	108010000
20571104		0.08474058	rho	108020000
20571105		0.0596214	rho	108030000
20571106		0.0596214	rho	108040000
20571107		0.0596214	rho	108050000
20571108		0.0596214	rho	108060000
20571109		0.0596214	rho	108070000
20571110		0.0596214	rho	108080000
20571111		0.123035	rho	108090000
*				
20571200	"pvlpmass"	sum	1.000000 2500.0	1
20571201	0.0	0.1661	rho	112010000
20571202		0.0943	rho	116010000
*				
20571300	"pvc mass"	sum	1.000000 2500.0	1
20571301	0.0	0.1821	rho	120010000
20571302		0.07312	rho	124010000
20571303		0.07312	rho	124020000
20571304		0.07312	rho	124030000
20571305		0.07312	rho	124040000
20571306		0.07312	rho	124050000

20571307		0.07312	rho	124060000
20571308		0.15220	rho	128010000
20571309		0.10600	rho	132010000
20571310		0.09389	rho	136010000
20571311		0.04450	rho	140010000
20571312		0.06209	rho	156010000
20571313		0.06288	rho	156020000
*				
20571400	"pvupmass"	sum	1.000000	2500.0 1
20571401	0.0	0.1655	rho	144010000
20571402		0.1970	rho	148010000
20571403		0.1475	rho	152010000
*				
20571500	"pv mass"	sum	1.000000	2500.0 1
20571501	0.0	1.0	cntrlvar	711
20571502		1.0	cntrlvar	712
20571503		1.0	cntrlvar	713
20571504		1.0	cntrlvar	714
*				

* primary mass				

*				
20572000	"pv mass"	sum	1.000000	2500.0 1
20572001	0.0	1.0	cntrlvar	705
20572002		1.0	cntrlvar	710
20572003		1.0	cntrlvar	715
*				

* differential pressure calculations				

*				
20575000	"dp050d"	sum	1.00000	80000. 1
20575001	0.0	1.0	p	416010000
20575002		-1.0	p	420040000
*				
20575100	"dp060d"	sum	1.00000	80000. 1
20575101	0.0	1.0	p	424010000
20575102		-1.0	p	420050000
*				
20575200	"dpe070"	sum	1.00000	45000. 1
20575201	0.0	1.0	p	424010000
20575202		-1.0	p	436010000
*				
20575300	"dpe080"	sum	1.00000	266000. 1
20575301	0.0	1.0	p	436010000
20575302		-1.0	p	440010000
*				
20575400	"dp190d"	sum	1.00000	80000. 1
20575401	0.0	1.0	p	216010000
20575402		-1.0	p	220040000

*					
20575500	"dp200d"	sum	1.00000	80000.	1
20575501	0.0	1.0	p	224010000	
20575502		-1.0	p	220050000	
*					
20575600	"dpe210"	sum	1.00000	45000.	1
20575601	0.0	1.0	p	224010000	
20575602		-1.0	p	236010000	
*					
20575700	"dpe220"	sum	1.00000	266000.	1
20575701	0.0	1.0	p	236010000	
20575702		-1.0	p	240010000	
*					
* 20575800	"dpe360"	sum	1.00000	61000.	1
* 20575801	0.0	1.0	p	100010000	
* 20575802		-1.0	p	112010000	
*					
20575900	"dpe280"	sum	1.00000	12000.	1
20575901	0.0	1.0	p	112010000	
20575902		-1.0	p	120010000	
*					
20576000	"dpe290"	sum	1.00000	1200.	1
20576001	0.0	1.0	p	120010000	
20576002		-1.0	p	124010000	
*					
20576100	"dpe300"	sum	1.00000	32000.	1
20576101	0.0	1.0	p	124010000	
20576102		-1.0	p	128010000	
*					
*0576200	"dpe310"	sum	1.00000	1900.	1
*0576201	0.0	1.0	p	124060000	
*0576202		-1.0	p	128010000	
*					
20576300	"dpe320"	sum	1.00000	13000.	1
20576301	0.0	1.0	p	128010000	
20576302		-1.0	p	140010000	
*					
20576400	"dpe330"	sum	1.00000	25000.	1
20576401	0.0	1.0	p	140010000	
20576402		-1.0	p	152010000	
*					
20577400	"dpe040"	sum	1.00000	8000.	1
20577401	0.0	1.0	p	416010000	
20577402		-1.0	p	920010000	
*					
20577500	"dpe090"	sum	1.00000	8000.	1
20577501	0.0	1.0	p	440010000	
20577502		-1.0	p	436040000	
*					

```

* control steam valve to give sg pressure of 7.10 mpa.
*****
*
20580300 "pres err"      sum      100.000-9 -5.3342-6 1
+
20580301      -7.10e6      1.0    p      316010000
*
20580400 "del area"      mult      1.0000000 -1.0668-6 1
20580401      cntrlvar    1      cntrlvar    803
*
20580500 "vlv area"      sum      1.0000000 .2300      1
+
20580501      0.0      1.0    cntrlvar    805      0.0      1.0000000
*
*****
* calculate wide range sg liquid levels
*****
*
20531200 "blsglwde"      sum      1.0000000 8.9221049 1
20531201      0.0      2.5464 voidf      304010000
20531202      2.5654 voidf      304020000
20531203      2.5654 voidf      304030000
20531204      2.0980 voidf      304040000
20531205      2.0223 voidf      304050000
20531206      2.1200 voidf      308010000
20531207      3.7778 voidf      316010000
*
20551200 "ilsglwde"      sum      1.0000000 8.8904978 1
20551201      0.0      2.5464 voidf      504010000
20551202      2.5654 voidf      504020000
20551203      2.5654 voidf      504030000
20551204      2.0980 voidf      504040000
20551205      2.0223 voidf      504050000
20551206      2.1200 voidf      508010000
20551207      3.7778 voidf      516010000
*
*****
* set rcp speed to control to loop flow of 24.2 kg/s
*****
*
20523800 "spd err "      sum      2.0000000 158.365-6 1
+
20523801      24.2      -1.0      mflowj      240010000
*
20523900 "delspeed"      mult      1.0000000 31.6731-6 1
20523901      cntrlvar    1      cntrlvar    238
*
20524000 "rcpspeed"      sum      1.0000000 89.403724 1
20524001      0.0      1.0    cntrlvar    239
20524002      1.0    cntrlvar    240
*

```

```

*****
* set hot leg bypass valve areas to 0.0
*****
*
20520300 "blhtlbyp" constant 0.0985
*
20540300 "ilhtlbyp" constant 0.0985
*
*****
* calculate heat transfer from core, sgs, pressurizer & system
*****
*
20584000 "corehttr" sum 1.0000000 10000000. 1
20584001 0.0 19.37068 htrnr 124100101
20584002 19.37068 htrnr 124100201
20584003 19.37068 htrnr 124100301
20584004 19.37068 htrnr 124100401
20584005 19.37068 htrnr 124100501
20584006 19.37068 htrnr 124100601
*
20584200 "ilsghtr" sum 1.0000000 5000000. 1
20584201 0.0 28.6501 htrnr 420100101
20584202 28.8640 htrnr 420100201
20584203 28.8640 htrnr 420100301
20584204 24.4464 htrnr 420100401
20584205 24.4464 htrnr 420100501
20584206 28.8640 htrnr 420100601
20584207 28.8640 htrnr 420100701
20584208 28.6501 htrnr 420100801
*
20584400 "blsghtr" sum 1.0000000 5000000. 1
20584401 0.0 28.6501 htrnr 220100101
20584402 28.8640 htrnr 220100201
20584403 28.8640 htrnr 220100301
20584404 24.4464 htrnr 220100401
20584405 24.4464 htrnr 220100501
20584406 28.8640 htrnr 220100601
20584407 28.8640 htrnr 220100701
20584408 28.6501 htrnr 220100801
*
20584600 "preshttr" sum 1.0000000 0. 1
20584601 0.0 0.03884 htrnr 610400101
20584602 0.03884 htrnr 610400201
*
20584800 "netht tr" sum 1.0000000 0. 1
20584801 0.0 1. cntrlvar 840
20584802 -1. cntrlvar 842
20584803 -1. cntrlvar 844
20584804 1. cntrlvar 846
20584805 -1. q 900010000
*

```

* calculate net flow to secondary

*

20585000	"netsecfl"	sum	1.0000000	0.	1
20585001	0.0	1.	mflowj	361000000	
20585002		1.	mflowj	351000000	
20585003		1.	mflowj	561000000	
20585004		1.	mflowj	551000000	
20585005		-1.	mflowj	805000000	
20585006		-1.	mflowj	803000000	
20585007		-1.	mflowj	369000000	
20585008		-1.	mflowj	379000000	
20585009		-1.	mflowj	569000000	
20585010		-1.	mflowj	579000000	

*

* calculate the overall pressure vessel liquid level

*

20512800	"uh level"	sum	1.000000	10.657100	1
20512801	0.0	0.626	voidf	112010000	
20512802		0.4762	voidf	116010000	
20512803		1.2588	voidf	120010000	
20512804		0.610	voidf	124010000	
20512805		0.610	voidf	124020000	
20512806		0.610	voidf	124030000	
20512807		0.610	voidf	124040000	
20512808		0.610	voidf	124050000	
20512809		0.610	voidf	124060000	
20512810		0.867	voidf	128010000	
20512811		0.6757	voidf	132010000	
20512812		0.600	voidf	136010000	
20512813		0.3674	voidf	140010000	
20512814		0.897	voidf	144010000	
20512815		0.725	voidf	148010000	
20512816		0.504	voidf	152010000	

*

* calculate the steam generator liquid level

*

20551600	"sga lvl"	sum	1.000000	17.695300	1
20551601	0.0	2.5464	voidf	504010000	
20551602		2.5654	voidf	504020000	
20551603		2.5654	voidf	504030000	
20551604		2.0980	voidf	504040000	
20551605		2.0223	voidf	504050000	
20551606		2.120	voidf	508010000	
20551607		3.7778	voidf	516010000	

*

```

20531600 "sgb lvl"      sum      1.000000      17.695300      1
20531601      0.0      2.5464      voidf      304010000
20531602      2.5654      voidf      304020000
20531603      2.5654      voidf      304030000
20531604      2.0980      voidf      304040000
20531605      2.0223      voidf      304050000
20531606      2.120       voidf      308010000
20531607      3.7778      voidf      316010000
*
*****
* calculate the steam generator level in the boiler section
*****
*
20550400 "sga blvl"      sum      1.000000      11.797500      1
20550401      0.0      2.5464      voidf      504010000
20550402      2.5654      voidf      504020000
20550403      2.5654      voidf      504030000
20550404      2.0980      voidf      504040000
20550405      2.0223      voidf      504050000
*
20530400 "sgb blvl"      sum      1.000000      11.797500      1
20530401      0.0      2.5464      voidf      304010000
20530402      2.5654      voidf      304020000
20530403      2.5654      voidf      304030000
20530404      2.0980      voidf      304040000
20530405      2.0223      voidf      304050000
*
*****
* calculate the vapor flow rate in the loop seals
*****
*
20543600 "lsa vflo"      mult      0.0222      24.4      1
20543601      velgj      436020000      rhogj      436020000
20543602      voidgj      436020000
*
20523600 "lsb vflo"      mult      0.0222      24.4      1
20523601      velgj      236020000      rhogj      236020000
20523602      voidgj      236020000
*
*****
* calculate the vapor and liquid flow rates in the hot and cold legs
*****
*
20513600 "hla vflo"      mult      0.05520      24.4      1
20513601      velgj      136020000      rhogj      136020000
20513602      voidgj      136020000
*
20513700 "hla fflo"      mult      0.05520      24.4      1
20513701      velfj      136020000      rhofj      136020000
20513702      voidfj      136020000
*

```



```

20513800 "h1b vflo"      mult      0.05520      24.4      1
20513801 velgj      136010000      rhogj      136010000
20513802 voidgj      136010000
*
20513900 "h1b fflo"      mult      0.05520      24.4      1
20513901 velfj      136010000      rhofj      136010000
20513902 voidfj      136010000
*
20510400 "cla vflo"      mult      0.03365      24.4      1
20510401 velgj      104040000      rhogj      104040000
20510402 voidgj      104040000
*
20510500 "cla fflo"      mult      0.03365      24.4      1
20510501 velfj      104040000      rhofj      104040000
20510502 voidfj      104040000
*
20510600 "clb vflo"      mult      0.03365      24.4      1
20510601 velgj      104030000      rhogj      104030000
20510602 voidgj      104030000
*
20510700 "clb fflo"      mult      0.03365      24.4      1
20510701 velfj      104030000      rhofj      104030000
20510702 voidfj      104030000
*
*****
* core power
*****
*
20588800 "core pow"      function      1.000000      10.020e+6      1
20588801 time      0      888
*
*****
* calculate time-integrated break mass flow
*****
*
20591500 "int bflo"      integral      1.000000      0.000000      1
20591501 mflowj      915000000
*
*****
* calculate accumulator mass
*****
*
20572500 "acca ms"      mult      1.000000      4312.069515      1
20572501 rhof      700010000      acvliq      700
*
20573000 "accb ms"      mult      1.000000      4659.297808      1
20573001 rhof      710010000      acvliq      710
*
***** :*****
* calculate the mass error
*****

```

```

*
20574000 "mass err"      sum      1.000000    0.000000    1
20574001 -14560.577      1.0      cntrlvar    720
20574002                                1.0      cntrlvar    725
20574003                                1.0      cntrlvar    730
20574004                                1.0      cntrlvar    915
*
*****
* calculate the time-integrated break energy flow
*****
*
20591600 "br eflow"      mult      3.976e-4    0.000000    1
20591601      ufj      915000000      velfj      915000000
20591602      rhofj     915000000      voidfj     915000000

20591700 "br eflow"      mult      3.976e-4    0.000000    1
20591701      ugj      915000000      velgj      915000000
20591702      rhogj     915000000      voidgj     915000000
*
20591800 "br eflo"      sum      1.000000    0.000000    1
20591801      0.0      1.0      cntrlvar    916
20591802                                1.0      cntrlvar    917
*
20592000 "int bflo"      integral  1.000000    0.000000    1
20592001      cntrlvar    918
*
*****
* differential pressure calculations
*****
*
20575800 "dpe360"      sum      1.000000    61000.      1
20575801      0.0      1.0      p      112010000
20575802      -1.0     -1.0     p      100010000
*
20576500 "dpe140"      sum      1.000000    5000.      1
20576501      0.0      1.0      p      104010000
20576502      -1.0     -1.0     p      136010000
*
20576600 "dpe056"      sum      1.000000    11000.      1
20576601      0.0      1.0      p      412010000
20576602      -1.0     -1.0     p      416010000
*
20576700 "dpe196"      sum      1.000000    11000.      1
20576701      0.0      1.0      p      212010000
20576702      -1.0     -1.0     p      216010000
*
20576800 "dpe055"      sum      1.000000    2000.      1
20576801      0.0      1.0      p      416010000
20576802      -1.0     -1.0     p      424010000
*
20576900 "dpe195"      sum      1.000000    2000.      1

```

```

20576901      0.0      1.0      p      216010000
20576902      -1.0     -1.0     p      224010000
*
20577000      "dpe090"      sum      1.000000      5000.      1
20577001      0.0      1.0      p      444010000
20577002      -1.0     -1.0     p      440010000
*
20577100      "dpe230"      sum      1.000000      5000.      1
20577101      0.0      1.0      p      244010000
20577102      -1.0     -1.0     p      240010000
*
20577200      "dpe180"      sum      1.000000      3000.      1
20577201      0.0      1.0      p      208010000
20577202      -1.0     -1.0     p      212010000
*
20577300      "dpe180a"      sum      1.000000      3000.      1
20577301      0.0      1.0      p      408010000
20577302      -1.0     -1.0     p      412010000
*
*****
* calculate the accumulator liquid levels
*****
*
20578000      "acca lvl"      sum      1.375001      5.760      1
+      1      0.0
20578001      -0.160385      1.0      acvliq      700
*
20579000      "accb lvl"      sum      1.375001      6.430      1
+      1      0.0
20579001      -0.092247      1.0      acvliq      710
*
*
. zzz

```

END

**DATE
FILMED**

8 / 11 / 93