



International Agreement Report

Assessment of RELAP5/MOD3 With the SNUF Test Simulating Hot Leg Break LOCA in the View of Mass and Energy Release Analysis

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Abstract

SNUF experiment on hot leg break large break loss of coolant accident during post-blowdown was analyzed by RELAP5. As same with the procedure of SNUF experiment, normal operation and blowdown phase were simulated in order, and the initial condition was obtained and compared with the experimental initial condition. The analysis of post-blowdown phase showed that the behavior of primary pressure can be properly simulated by RELAP5 when sufficient heat source is modeled. Resultantly, the release from reactor side broken section and steam generator side broken section were properly predicted. The pressure rise in the second step of pressure behavior was partially well predicted, where the pressure increased by the steam generation in core. The release from the steam generator side broken section was predicted to be little except when there exists large pressure difference between primary system and break boundary. Break size did not affect much on the overall behavior to some degree.

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Executive Summary

This document describes an assessment of beta version of RELAP5/MOD3.2.2 code with Seoul National University Facility (SNUF) test. The SNUF is scaled down model of Young Kwang Nuclear Power Plant Units 3&4 (YGN Units 3&4) with volume ratio 1/1140. And the design was based on the Ishii's three level scaling law. The experiment simulated a hot leg break large break loss-of-coolant accident (LBLOCA) during post-blowdown.

To evaluate the code predictability for specific thermal hydraulic phenomena of hot leg break LBLOCA during post-blowdown, the major thermal hydraulic phenomena observed in the experiment were investigated. Those phenomena include the cold leg refill, steam generation in core and resultant repressurization, and negligible coolant release through the SG side broken section.

The SNUF was modeled as suitable for simulating the experiment, based on the available information on the design and test procedures such as normal operation, drain-down, and post-blowdown. Prior to the preparation of base case input deck, pressure drop test in SNUF was conducted, and the experimental result was reflected in loss coefficient in input deck. The normal operation, the drain-down, and post-blowdown were assessed in order, according to the procedure of experiment.

The base case calculation was executed, the result was compared with the experiment data, and the code predictability on the important thermal hydraulic phenomena was discussed. Sensitivity calculations were attempted to evaluate the effect of modeling of heat structure (Run02), break boundary pressure (Run03), and break size (Run04, Run05). The main parameters for comparison with experiment were system pressure, discharged amount in each broken section, water level in U-tube, and temperature in reactor lower plenum. The analysis results are summarized as follows;

- 1) System pressure was properly predicted, showing the three distinguished steps; first step in which the pressure decreases rapidly, second step in which the pressure slightly increases due to the steam generation in core, and the third step in which the pressure goes stable. The predicted decrease rate of pressure in first step was similar with experiment. In the second step, the predicted pressure increased slightly due to the two

phase pressure drop in break junction, and the pressure increased a little more than experiment. In third step, no more complicated phenomena were shown even though the pressure showed small instability.

- 2) The discharged mass through the reactor side broken section showed good agreement with experiment. In first step, pure steam release was predicted. The timing when the main release began because of two-phase release was predicted to be similar with experiment.
- 3) The discharged mass through the SG side broken section showed roughly similar trend with experiment. In first step, small mass release was predicted because of large pressure difference between system and break boundary. In second step, small mass release was also revealed in calculation because the pressure in second step was predicted to be higher than experiment.
- 4) The water level in U-tube in second step was predicted to be higher than the experiment since the pressure in second step was higher than experiment.
- 5) The cold leg was refilled earlier than reactor vessel as experiment, which was checked by the water level in cold leg and U-tube.
- 6) The temperature in reactor vessel lower plenum showed slightly higher than experiment. However, the temperature near the lower plenum was similar with experiment.
- 7) Sensitivity study indicated that the modeling of heat structure is very important and that the break size is not so decisive to some degree.

I. Introduction

In postulated LBLOCA (Large Break Loss-of-Coolant-Accident), coolant release continues over several phases like as blowdown and post-blowdown phase (refill, reflood and post-reflood phase). During blowdown phase, most of the initial primary coolant is released to containment. However, during post-blowdown, the evaporation of Safety Injection (SI) water in the reactor core can contribute to the containment pressure rise and thus generate the second peak pressure, which will be the criteria of containment design pressure in most nuclear power plants. During that phase, the Steam Generators (SG's) heat removal has different characteristics depending on break locations.

For cold leg break, the steam and entrained water carried out of the core pass through the SG, where the entrained water is evaporated or can be superheated to nearly the temperature of the SG secondary system temperature by reverse heat transfer. Therefore, in conservative licensing analysis, containment can be repressurized during the post-blowdown phase under the assumption of this reverse heat transfer mechanism. However, for hot leg break, majority of coolant from the core is expected to be directly discharged to the containment without passing the SG, since the broken hot leg provides a direct release path [1]. Thus, in the case of hot leg breaks, quantitative analysis for the post-blowdown phase has not been performed usually in the safety analysis report. And it was a general trend that the containment peak pressure occurred during post-blowdown phase for the cold leg break, and the peak pressure was higher than the blowdown peak pressure of the hot leg break. Therefore, the cold leg break case was recognized as a limiting design basis event in the determination for containment design pressure [2].

However, the maximum containment pressure accident was inconsistently reported in preliminary safety analysis report (PSAR) and final safety analysis report (FSAR) of Young Kwang Nuclear Power Plant Units 3&4 (YGN Units 3&4), which is the base of Korean Standard Nuclear Power Plant. Double Ended Discharge Leg Slot Break (DEDLSB) was reported to be such an accident in PSAR, while Double Ended Hot Leg Slot Break (DEHLSB) in FSAR [3]. This is contradictory from previous trends. Therefore, it became very important to investigate the realistic behavior of hot leg break LBLOCA during post-blowdown.

Korea Atomic Energy Research Institute (KAERI) implemented RELAP5 analysis for LBLOCA of YGN Units 3&4 to investigate the realistic behavior of LBLOCA in YGN Units

3&4[4]. However, the predictability of RELAP5 for hot leg break accident has not been sufficiently discussed yet. In Seoul National University, an experimental study for hot leg break LBLOCA during the post-blowdown was carried out to support the regulatory evaluation of this issue with the facility, Seoul National University Facility (SNUF), which simulates YGN Units 3&4 with volume ratio 1/1140 [5]. The objective of SNUF test was to investigate a characteristic feature of hot leg break LBLOCA during post-blowdown phase. The experiment indicated that the SI water refilled the suction part of cold leg first and refilled the core later. Steam generation in core gave rise to the pressure of reactor coolant system and the repressurization forced the coolant in cold leg to flow up to some height of U-tube of SG. However, the time duration that the coolant stayed in U-tube was short, and the resultant coolant release from SG side broken section was negligible such that the SG could be regarded as a minor heat source of coolant release [5].

The objective of this study is to evaluate the predictability of RELAP5/MOD3 on major thermal hydraulic behaviors during the post-blowdown of hot leg break LBLOCA of YGN Units 3&4. Such transient hydraulic behaviors include the cold leg refill, steam generation in core and resultant repressurization, and negligible coolant release through the SG side broken section.

The code used in this study was the standard version of RELAP5/MOD3.2.2 beta, which was known to have the improved features from the previous version of RELAP5/MOD3 [6].

The Chapter II includes a brief description of SNUF, the experimental condition and procedure. The Chapter III describes the modeling of SNUF nodalization. The Chapter IV discusses in detail the calculation results with experimental results. In particular, the discussion involves an assessment of the major phenomena of hot leg break LBLOCA during post blowdown. The code predictability and run statistics are also described in this chapter. The conclusions are derived through present study and summarized in the Chapter V. Finally, input deck for steady state run, drain-down run, and post-blowdown run are attached in Appendices A, B, and C, respectively.

II. Facility and Test Descriptions

II.1 Facility Description

The Seoul National University Facility (SNUF) is a scaled integral experimental test facility of the YGN Units 3&4, one of the Combustion Engineering type Pressurized Water Reactor in Korea. The facility was constructed in the Seoul National University (SNU). Its length scale ratio is 1/6.4, area scale ratio $(1/13.4)^2$, and resultantly, the volume scale ratio 1/1144. Figure 1 shows the configuration of SNUF, and Figure 2 shows its schematic diagram. The design and the scaling were based on the Ishii's three level scaling [5,7]. The important geometric design parameters are presented in Table 1.

The SNUF has appropriate components of primary system and secondary system for mass and energy release experiment. The facility consists of a reactor vessel, two SG's, an intact loop with one cold leg and one hot leg, a broken loop with one hot leg and two cold legs, two discharge tanks, and SI system.

The reactor vessel contains 60 kW electrical heaters to simulate the scaled 2.2% core decay heat power, which is corresponding to the decay heat at 15 seconds after reactor trip plus the heat of inner metal structures. At the lower part of reactor vessel, the drain valve is piped outwardly for primary coolant drain during the drain-down phase.

A SG is equipped in each loop, and each SG contains four U-tubes with the height of 1725 mm, six U-tubes with the height of 1643 mm and six U-tubes with the height of 1562 mm. Inner and outer diameters of U tubes are 19 mm and 21 mm, respectively. The secondary system is composed of SG shell, steam line and feedwater line.

The intact loop has a hot leg and a cold leg. The two cold legs are scaled into a lumped single cold leg to have the similar volume. At the hot leg, a window glass is also installed to observe the behavior of fluid.

The broken loop is composed of one broken hot leg and two cold legs. The broken hot leg is designed to simulate double ended guillotine break, and thus comprises of two broken sections, i.e. the reactor side broken section and the SG side broken section. The broken sections are

simulated using ball valves, and an isolation valve is installed between the two broken sections. Since the isolation valve is instantly closed at the beginning of the experiment, the mass releases from each broken section can be measured independently. Two window glasses are installed in hot leg for the direct visual observation of fluid behavior. A window glass is also installed in cold leg suction part for the sake of direct visual observation of fluid behaviors in the early stage of ECCS injection.

Discharge tanks connected to each broken section simulate the containment. Thus, the size of each discharge tank was determined to be sufficient for the expected discharge amount. The capacity of the reactor vessel side discharge tank is about 150 liter with diameter of 600 mm and height of 700 mm, while that of the SG side discharge tank is 30 liter with diameter of 300 mm and height of 700 mm. Those two discharge tanks were interconnected with each other with 1/2 inch pipes in order to maintain the same pressure. Each discharge tank contains a cooling system to condense the steam immediately, and then the discharge amount can be measured by a level meter.

The SI system is composed of a storage tank, a SI pump and a flow controller. The storage tank is equipped with electrical pre-heaters of 20 kW in order to control the temperature of SI water. The SI line is connected to cold leg.

II.2 Measurement Instruments

The measurement instruments are listed in Table 2 with the uncertainties. Ten thermocouples, one pressure transducer, two level meter and one flow meter were used.

The steam and water which are released through each broken section are condensed or cooled down in each discharge tank and then the water level is measured. The discharged amount is calculated by multiplying the level by the cross sectional area of each tank. The temperatures were measured, as shown in Figure 2. The fluid temperatures in upper and lower parts of each broken section are measured to investigate the stratification, and the temperature at the half height of U tube is to catch up the flowing up of cold SI water into the half height of U tube. The T type thermocouples were used, which is known to have excellent performance in the range of $-200^{\circ}\text{C} \sim 400^{\circ}\text{C}$. The absolute pressure is measured at the reactor top head with PDCR922 and DPI 260 model made in Druck Co.. The flow rate is measured at the SI system

with DP103 wet-wet type. The volumetric flowrate is correlated with the pressure drop across the orifice.

II.3 Experimental Conditions and Procedures

The SNUF experiment simulated the post-blowdown transient of hot leg break LBLOCA. Thus, the initial condition is End-Of-Blowdown (EOB). Initial condition of experiment was carefully established. The result of RELAP5 analysis for YGN Units 3&4 was used as reference initial condition [2,4]. The RELAP5 analysis did not show such an EOB point where the primary pressure became same with the containment pressure. Thus, in this experiment the EOB was assumed to be about 15 seconds elapsed from the initiation of accident. The RELAP5 analysis at this time showed that the primary pressure was decreased close to containment pressure, and that the core was fully voided. Resultantly, the collapsed liquid level of the reactor fell to minimum [2,4].

The experiment was conducted in following procedures as shown in Figure 3; pressure drop test, normal operation, drain-down, and post-blowdown. The result of pressure drop test was to check the characteristics of loop, and it was reflected in the determination of loss coefficients. The results of pressure drop test is listed in Table 3.

In normal operation, the primary system and the secondary system were maintained nearly saturated at 0.8MPa and at 0.5MPa, respectively. The core power was 60kW. Important operation conditions are presented in Table 4. From this condition, the primary water inventory was drained until the water remained only at the lower plenum. This procedure is the drain-down phase. In the drain-down phase, the coolant in the cold leg suction part did not flash up but remained as saturated or subcooled water. Thus, in experiments the coolant was artificially drained. The temperature of secondary system was higher than that of primary system, and the secondary system could play a role of heat source if the injected SI water passed through U tubes. From this drain-down process, the initial condition of experiment was obtained, and it is compared with EOB condition of YGN Units 3&4 in Table 5.

At the commencement of experiment, the SI pump operated, each discharge valve opened to simulate the break, and the isolation valve was closed at the same time. The main power was turned on earlier by 30~40 seconds for preheating than the start of the experiment. The SI

temperature was maintained as 60°C, which was a little higher than that of real plant in order to compensate for the lack of the heat capacity of the RCS metal, and the SI flow rate was maintained constant at the rate of 2.2lit/sec. The core power was set as 60kW.

III. Code and Modeling

III.1 Code Description

The RELAP5 code has been developed as one of the best estimate-codes. The code is based on a non-homogeneous and non-equilibrium two-fluid model and constitutive equations for one dimensional two-phase system. In this study, unmodified released version, RELAP5/MOD3.2.2 beta version, was used, and input decks are prepared based upon the RELAP5/MOD3 [7]. RELAP5/MOD3.2.2 beta version was installed in personal computer of Pentium-III 500 MHz.

III.2 Modeling Description

In the analysis of SNUF experiment, the calculation procedure traced the procedure of experiment; calculation of pressure drop, calculation of normal operation (steady state run), calculation of drain-down (drain-down run) and finally calculation of post-blowdown (post-blowdown run), as shown in Figure 3.

1. Preparation of Input Deck and Steady State Calculation

The base case nodalization for SNUF experiment is shown in Figure 4. This base nodalization is composed of 147 volumes, 151 junctions, and 101 heat structures. All important components like as a reactor vessel, a downcomer, two SG's, an intact loop, a broken loop, and secondary system were modeled. Downcomer and suction leg where rapid transient is expected are noded finely. The downcomer was modeled with separated channel in order to reflect the asymmetric behavior of two loops. All the heat structures of primary system are modeled including electrical heaters. Each leg is connected to reactor vessel or downcomer with cross flow junction.

For the exact simulation of pressure drop over the loop, the results of pressure drop test of Table 3 were reflected through the loss coefficients. The pressure drop experiment was carried out under the condition of atmospheric pressure with 25 °C water. The pressure drop was significant at the inlet and the outlet of the reactor vessel and the SG. Loss coefficients at the other parts were determined referring the fluid handbook [8], since the pressure drops at the other parts were comparatively small.

Reflecting such pressure drops, a steady state was obtained from the calculation of normal operation. The results are presented in Table 4, and compared with the experimental condition. The primary system was 0.8MPa, and nearly saturated. The secondary system was 0.5MPa, and saturated. The core power was 60kW.

2. Simulation of Drain-down and Initial Condition

In the beginning of SNUF experiment, all coolant in primary system was drained except in reactor lower plenum, and the primary pressure was 0.35MPa. To obtain these conditions, drain-down nodalization is used in the Figure 4. Valve junctions J991, J993, J995 and J999 are opened and time dependent volumes C992, C994, C996 and C998 are used. The primary coolant is drained from reactor lower plenum (through J999) and each bottom of cold leg (through J991, J993, J995) as the SNUF experiment. The drain is stopped when the liquid levels of reactor and each cold leg are below 65mm and 20mm, respectively. Even after the drain was complete, dummy calculation was continued for a few ten seconds in order to obtain the stable state of the system. In the calculation, the liquid level is defined as collapsed water level determined from the void fraction in the volumes of reactor vessel and suction legs.

$$L = \sum_i (1 - \alpha_i) \cdot H_i \quad (1)$$

,where L is collapsed water level,

α is void fraction,

H is height of volume.

As a result, initial conditions obtained from this calculation are shown in Table 5, and the results are consistent with initial condition of experiment.

3. Simulation of Post-blowdown

For the simulation of post-blowdown, the drain-down nodalizations (J991, J993, J995, J999, C992, C994, C996, and C998) was removed. The nodalizations for the SI line (C900, C902, C910, C920, C930, J901, J911, J921, and J931) and the breaks were added. The SI water of 60°C is provided from time dependent volume C900, and is branched to each cold leg. The SI flowrate was set constant as 2.2kg/s, and modeled using time dependent junction, J901. The break is modeled as double ended break, and from two broken sections the coolant is released.

The two break boundaries, C954 and C964, are modeled using time dependent volume filled with saturated steam. The isolation valve J411 was also closed. The important conditions are listed in Table 6, compared with experimental conditions.

IV. Results and Discussions

The considered calculation cases are listed in Table 7. Run01 is base case. In the base case, all the heat structures in primary system are modeled including electrical heaters, and the break boundaries filled with saturated steam are maintained as atmospheric pressure. Run02 is same with base case except that only electrical heater and U-tubes are modeled in heat structure in order to evaluate the effect of heat structure modeling. Run03 assumes the pressurization of break boundary according to primary pressure transient. The condition of pressurized break boundary is more faithful to the definition of EOB, since EOB is generally the time when the primary pressure decreases to the containment pressure. Run04 and Run05 are for the evaluation of break size. In Run04, the break size is same with the cross-sectional area of hot leg, and in Run05, it is half of the cross-sectional area of hot leg. The break size of base case is smaller than that of Run04, and larger than that of Run05.

IV.1 Results of Base Case (Run01)

1. Pressure of primary system

Figure 8 shows comparison of the pressure of reactor vessel top head between the calculation and the experiment. In the experiment, the pressure behavior can be classified into three distinguished steps; first step in which the primary system pressure decreases rapidly, second step in which the pressure increases slightly and last third step in which the pressure decreases slowly toward steady state. The first step extends from 0 to 40 seconds, the second step from 40 to 80 seconds, and the third step from 80 seconds to the last [5].

The first step is characterized by rapid decrease of pressure due to the steam release. For this step, the RELAP5 shows the good agreement with experiment, and the rate of pressure decrease is also similar with experiment. However, the timing that the pressure reaches the minimum is earlier than experiment by a few seconds.

Second step is characterized by slight increase of pressure due to the steam generation in core. Run01 could not perfectly predict such a behavior. At about 60 seconds, the pressure in experiment reaches the peak, and the Run01 also shows such a pressure rise. The predicted pressure rise in Run01 is higher than that in experiment. In experiment, since much steam was

generated when the SI water reached the bottom of core, and little steam was generated after the core was fully refilled, the mild increase and decrease of pressure behavior were observed. Whereas, the pressure rise before core refilling was not predicted, however after the mixture level of core increased to the hot leg level and the two-phase mixture began to be released, the pressure rise was induced by the loss coefficient at reactor outlet. The starting point of two-phase mixture release is very close to the time when the discharge amount (integrated break flow) begins to increase drastically, which will be discussed in next section. Consequently, in the second step, RELAP5 seems to predict at least the characteristic feature of pressure behavior.

In third step, no more transient is expected thereafter in experiment. The Run01 shows intermittent increase and decrease of pressure, which is thought to be caused by the unstable direct contact condensation of steam and subcooled water in reactor upper plenum. Figure 6 shows that the void fraction in upper plenum (C21001) is decreased by condensation after 90 seconds, and that the void fraction is decreased rapidly after 105 seconds when the rapid change of pressure appears. Consequently, RELAP5 well predict the overall pressure behavior in third step with intermittent instabilities.

2. Mass and Energy Release

Discharged masses (integrated break flow) through reactor vessel side broken section and SG side broken section are presented in Figures 7 and 8, respectively. The figure for the discharged mass of reactor vessel side broken section shows that there is only steam release during first step of pressure behavior, however, it seems that the steam release in experiment was not sufficiently measured since the release was measured by condensing the steam. The result of RELAP5 analysis revealed that a little steam is released before 10 seconds when the pressure decreases rapidly. However, after 15 seconds, little steam is released, and no increase in discharged mass is revealed.

In experiment, from about 60 seconds, two-phase mixture was initiated to be released. RELAP5 analysis of Figure 7 shows that the release rate is increased slightly before 60 seconds, and that main release is initiated slightly after 60 seconds. The initiation of two-phase release causes the larger pressure drop in reactor vessel outlet, and the pressure of reactor vessel is increased.

After 60 seconds, the experiment shows the stable release, however the RELAP5 shows the

unstable one. It seems caused by the unstable direct contact condensation in reactor vessel upper plenum, as shown in Figure 9. As the Figure 9 shows, it can be seen that the void fraction in C20001 was more unstable than the void fractions in the other volumes.

In Figure 8, the experiment shows nearly zero discharge through the SG side broken section, however the RELAP5 shows some discharge in 15 seconds and 65 seconds. This phenomenon is related with the water level in U-tube, which will be discussed in the next section on water level.

3. Water Level

As discussed in experimental result, the SI water refills the cold leg first. The SI water flows up to the U-tubes by the repressurization of reactor vessel in the second step of pressure behavior as shown in Figure 10. Figure 11 shows the collapsed water level in U-tubes from the RELAP5 calculation. High water level was predicted at about 10 and 60 seconds. In experiment, the water level was detected by measuring the fluid temperature at middle height of U-tubes as shown in Figure 12. The water level reaches the location of thermocouple from the fact that the fluid temperature drops rapidly twice by cold water. The first level rise at 10 seconds in Figure 11 was caused by the large pressure difference between the reactor vessel and break boundary. As the water level increases up to such a height, some of the water is released through the SG side broken section. Resultantly, there was a little coolant release through the SG side broken section, as shown in Figure 8. Consequently, the RELAP5 well predicted the fact that water level in U-tube rose twice at about 10 and 60 seconds, but the predicted water levels were higher than experimental ones. Such a behavior in early transient is largely affected by the boundary pressure, and it will be discussed once more in the analysis of Run03.

In the third step of pressure behavior, the experiment revealed that there was no more water level rise up to the middle height of U-tube. And, the REPALS5 analysis also showed the same result with experiment.

The Figure 13 shows the water level of suction leg in broken loop. In the experiment, the level was identified by the direct observation or taking pictures through the transparent window glass. The experiment revealed that the suction leg was refilled most early and there was slight oscillation only while the leg was being refilled. And, after the suction leg got refilled, the fluid

in the suction leg was stabilized. But, the RELAP5 analysis shows the continuous oscillation in water level as shown in Figure 13. This is caused by the unstable condensation in suction leg, which can be seen in Figure 14.

4. Temperatures

The temperature measured in experiment is local time averaged temperature, and the temperature of RELAP5 is volume averaged and time averaged temperature. In Figure 15, the temperatures of RELAP5 are the liquid temperatures (tempf). The Figure 15 compares the experimental temperature and RELAP5 temperatures near the measured point. The temperature of C13205 is similar with the experimental result, however the temperatures of C16001 and C14205 are higher than experiment's.

The fact that the temperature of C14205 is higher than that of experiment is caused by the distribution of SI water in downcomer as shown in Figure 16. The total SI flow rate was constant as 2.2kg/s. However, the larger SI pipe size of the intact loop than that of broken loop leads to the more injection to the intact loop than broken loop as shown in Figure 17, which induces the more condensation of steam, and the lower pressure in intact side downcomer. Therefore, because of such a pressure gradient between the intact side and broken side in downcomer, the SI water in intact side flow to the broken side along the downcomer wall. Resultantly, most of the SI water is injected through the intact side downcomer as shown in Figure 16, and the temperature of C14205 is predicted higher than that of C13205.

The volume of lower plenum, C16001, contains a little saturated water at the beginning, and as the transient goes on, the water swells to flow up to the core, which heated the water more. Such a swelling can be seen from the behavior of void fraction in Figure 18. The void fraction in C16001 is small at first, and undergoes the increase and decrease in order. Thus, the predicted temperature is revealed higher than the experiment.

Such a temperature difference can be explained related with thermal mixing in reactor lower plenum. According to the study about thermal mixing in reactor lower plenum with SNUF, even in higher mass flow rate the thermal mixing was not prominent [9].

IV.2 Sensitivity Studies

1. Run02 – Effect of Heat Structure

The Figure 19 compares the pressure of reactor top head in Run02 with that in experiment and base case. The pressure in Run02 shows more rapid decrease of pressure than that in experiment and base case in first step. The pressure rise in second step was not well predicted. This fact means that the heat of metal structure is important in the analysis of mass and energy release, as mentioned in FSAR of YGN Units 3&4. Therefore, the modeling of heat structure in the analysis of mass and energy release is very important

Discharge amounts (integrated break flow) through reactor side broken section and SG side broken section in Run02 are presented in Figures 20 and 21, respectively. The Figure 20 shows that the discharge amount in Run02 is similar with that of Run01, however, the Figure 21 shows that Run02 does not predict the second release through SG side broken section because there is no pressure rise in second step. Resultantly, as Figure 22 shows, the water level in U tube in second step does not increase.

2. Run03 – Effect of Boundary Pressure

In Run03, the break boundary is pressurized like as Figure 23, where the boundary pressure is slightly lower than the reactor vessel pressure in first step of experiment. The predicted pressure of reactor top head is shown in Figure 24 comparing with experiment and base case. The pressurization of break boundary led smaller rate of pressure decrease. The release through the reactor side broken section in Figure 25 shows earlier two-phase release than Run01. It is because in the earlier transient, the release through the SG side broken section in Figure 26 is very small compared with Run01, because of the smaller pressure difference between system and boundary. The water level in U tube in first step is also lower than that of Run01 as shown in Figure 27. Consequently, the result of Run03 implies that the effect of boundary pressure does not affect much on the overall behaviors.

3. Run04 and Run05 – Effect of Break Size

Run04 and Run05 are to evaluate the effect of break size. The break area in Run04 is same with the cross-sectional area of hot leg, and that in Run05 is half of the cross-sectional area of hot leg. The pressure in reactor vessel top head shows similar trend with base case in spite of the difference of break area as shown in Figure 28. Discharge amount from each broken section and water level in U-tube are also similar with base case as shown in Figures 29, 30 and 31. From this fact, it can be concluded that the break size in post-blowdown is not so important to some degree.

IV.3 Run Statistics

IBM compatible personal computer of Pentium-III 500 MHz was used in calculation with Microsoft Windows NT 4.0 version. The personal computer has 256 MB main memory.

Calculation in drain-down was attempted to 1200 seconds and, calculation in post-blowdown was attempted from 1200 seconds to 1320 seconds. The base case run was successfully terminated at 1320 seconds. The calculation time is shown in Figure 32, setting 1200 seconds as 0 second, and 1320 seconds as 120 seconds. For 5 seconds from 1200 seconds to 1205 seconds, fine time step was used, and the required calculation time was more than in the other calculation.

The base case run was terminated at 1320 seconds, and the required CPU time in personal computer was 1767.33 seconds including 0.468750 second for input processing. The attempted advancement was 67572 time steps. Therefore, the grind time for the base case can be calculated as follows;

CPU Time,	CP	= 1767.33 – 0.468750 = 1767.33 seconds
Number of Time Step,	DT	= 94766 – 27194 = 67572
Number of Volume,	C	= 134
Transient Real Time,	RT	= 120 seconds
Grind Time,	GT	= (CP*1000)/(C*DT)
		= (1767.33*1000)/(134*67572)
		= 0.1952 m CPU sec/(vol-step)

V. Summary and Conclusion

The RELAP5/MOD3 was assessed using SNUF experiment simulating hot leg break LBLOCA in the view of mass and energy release analysis. In order to evaluate the code predictability on major thermal hydraulic behavior, the calculation results were assessed and compared with the experimental data.

SNUF is scaled down model with volume scale ratio 1/1144 simulating YGN Units 3&4. The SNUF experiment showed that most of injected SI water was released through the core side broken section and thus the release through the SG side broken section was negligible. The remarkable feature is that the SI water refilled the cold leg first, and resultantly the steam generated in core could not be heated directly by SG. Although this experiment showed that the water in cold leg could flow up to a half height of U tubes, the duration time was not sufficiently long for the SG to be taken as a major heat source.

RELAP5 analysis for the SNUF experiment showed that this code can properly predict the important features of hot leg break LBLOCA during post-blowdown, when all the heat structures are modeled. And the releases from reactor side broken section and SG side broken section were also predicted satisfyingly. Especially, the pressure rise in second step of pressure behaviors were predicted partially, and the release from SG side broken section was little except when the pressure difference between the primary system and break boundary is not large in early stage of transient. However, since the unstable direct contact condensation in suction legs resulted in the unstable behavior of water level, they were different from experimental results. Break size did not affect much on the overall behavior to some degree.

References

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Table 1 Geometric design parameters for SNUF and YGN3&4

	UNIT	SNUF	YGN3&4[1]
Vessel			
Height	[mm]	1975	12.7×10^3
Flow area	[mm ²]	74748	13.3×10^6
Hot leg			
Flow length	[mm]	683	4.83×10^3
Flow area	[mm ²]	4990	0.89×10^6
Suction leg			
Flow length	[mm]	1172	7.52×10^3
Flow area	[mm ²]	2579	0.46×10^6
Discharge leg			
Flow length	[mm]	916	5.88×10^3
Flow area	[mm ²]	2579	0.46×10^6
Fuel hydraulic diameter	[mm]	14	3
Fuel conduction depth	[mm]	2.5	2.4

Table 2 Measurement instruments

Sensor ID	Measurement	Uncertainty
TC01	Outer wall of reactor vessel lower plenum	2•
TC02	Fluid temperature of intact hot leg	2•
TC03	Fluid temperature of reactor vessel lower plenum	2•
TC04	Fluid temperature of broken hot leg upper part in reactor side	2•
TC05	Fluid temperature of broken hot leg lower part in reactor side	2•
TC06	Fluid temperature of broken hot leg upper part in SG side	2•
TC07	Fluid temperature of broken hot leg lower part in SG side	2•
TC08	Fluid temperature of secondary system	2•
TC09	Fluid temperature of U-tube entrance	2•
TC10	Fluid temperature of U-tube middle height	2•
PT01	Pressure at reactor vessel top head	0.001MPa
LT01	Discharge amount in reactor side broken section	3.8liter
LT02	Discharge amount in SG side broken section	0.7liter
FT01	Total SI flowrate	0.09kg/sec

Table 3 Experiment for the measurement of pressure drop
(Pressure : 0.1013MPa , Temperature 25 °C , Water)

	Flowrate [kg/sec]	Pressure drop [Pa]
Reactor In/Outlet (C33001~C36001)	1.9112	513
	1.6370	410
	1.2730	317
SG In/Outlet (C37401~C31001)	0.6099	528
	0.5235	407
	0.3955	256

Table 4 Normal operation condition

Parameters	SNUF	RELAP5
Pressure of reactor top head	0.8MPa	0.826MPa
Temperature of primary system	~ Saturated	~ Saturated
Core power	60kW	60kW
Pressure of secondary system	0.5MPa (Sat.)	0.5MPa (Sat.)

Table 5 Initial condition in model and prototype

	SNUF	YGN3&4[4]
Core pressure [MPa]	0.35	0.5
Core temperature	Sat.	Sat.
Mean power [kW]	60.0	60.0×10 ³
Core exit void fraction	100%	100%
Liquid rise velocity [m/sec]	0.0111	0.276

Table 6 Initial conditions of experiment and RELAP5

Parameters	SNUF	RELAP5
Pressure of reactor top head	0.35MPa	0.36MPa
Pressure of secondary system	0.5MPa (Sat.)	0.499MPa(Sat.)
Temperature of reactor lower plenum	142 °C	140 °C
Temperature of U tube entrance	139 °C	137 °C
Temperature of secondary system	154 °C	153 °C
Core power	60 kW	60 kW
Total SI flowrate	2.2 kg/sec	2.2 kg/sec
Temperature of SI	60 °C	60 °C

Table 7 Calculation cases

	Break boundary (C954, C964)	Break area (J951, J961)	Heat structure
Run01	Constant as atmospheric pressure, filled with saturated steam	Break valve area	All Structures of primary systems are modeled
Run02	Constant as atmospheric pressure, filled with saturated steam	Break valve area	<i>Only heaters and U Tubes are modeled</i>
Run03	<i>Pressurized according to primary pressure, filled with saturated steam</i>	Break valve area	All Structures of primary systems are modeled
Run04	Constant as atmospheric pressure, filled with saturated steam	<i>Hot leg cross-sectional area</i>	All Structures of primary systems are modeled
Run05	Constant as atmospheric pressure, filled with saturated steam	<i>1/2 of Hot leg cross-sectional area</i>	All Structures of primary systems are modeled

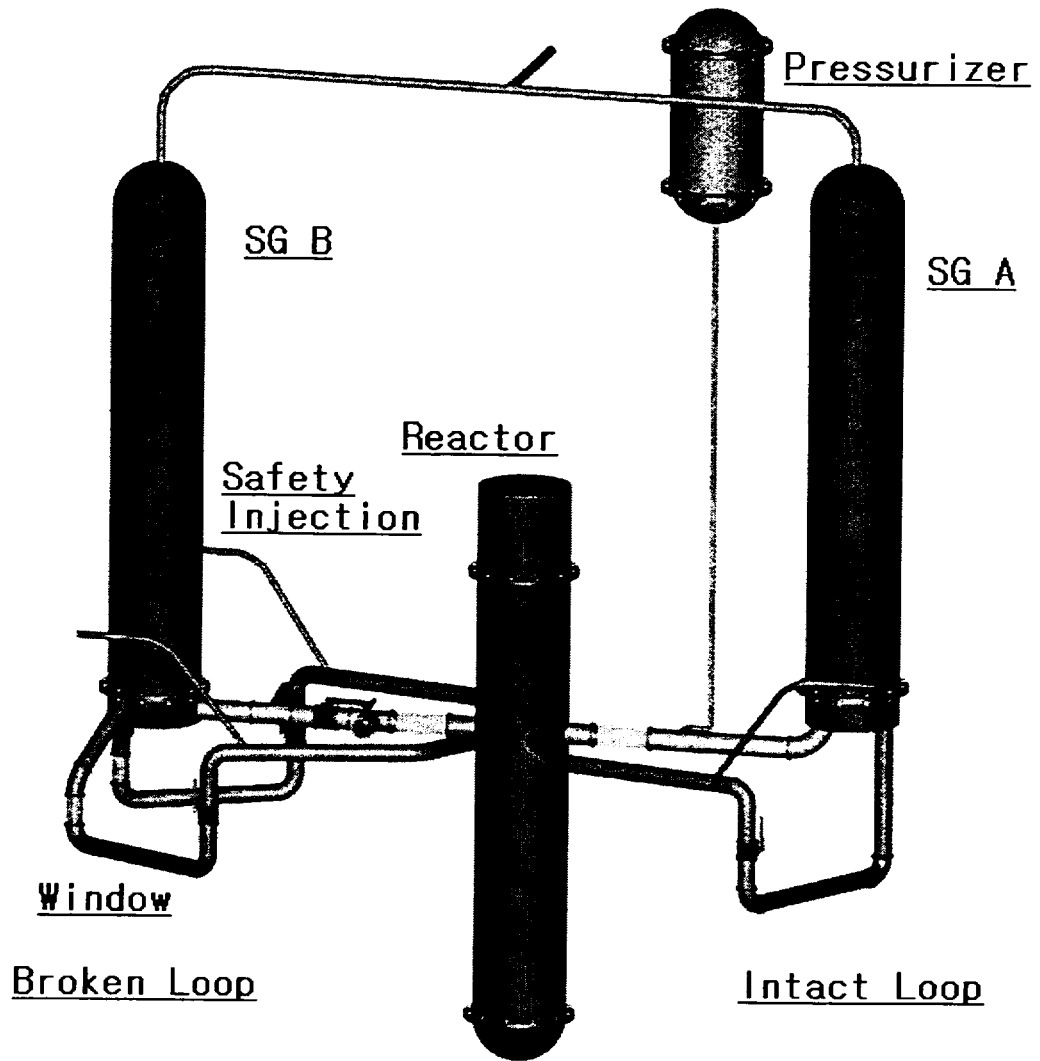


Figure 1 Overview of SNUF

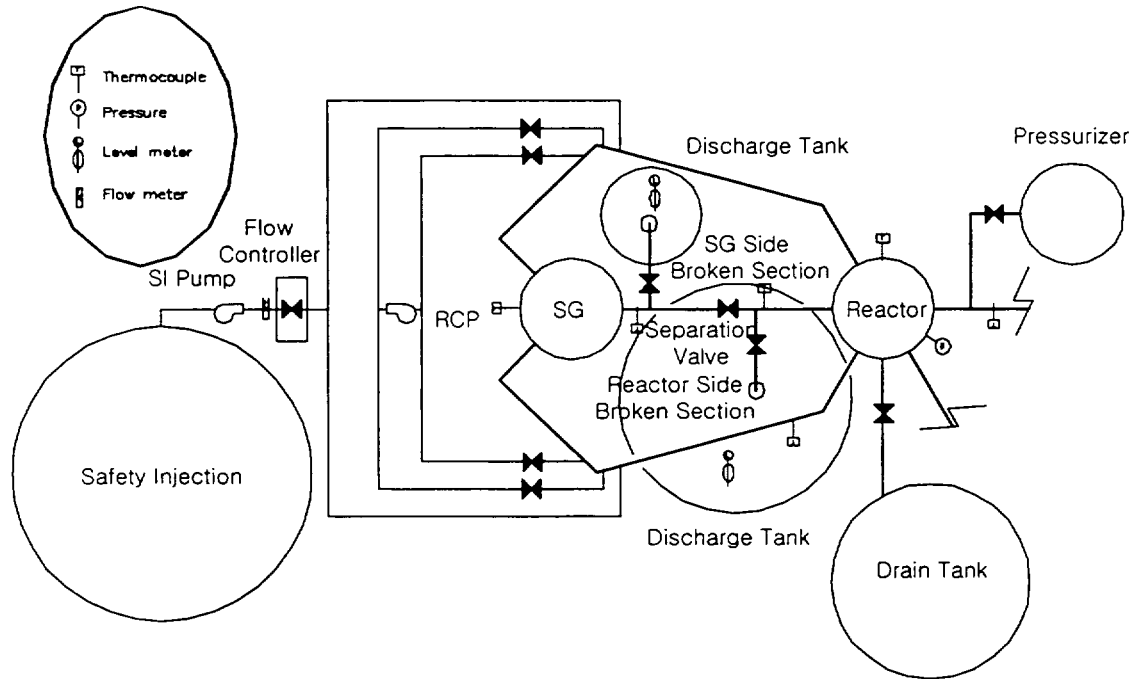


Figure 2 Schematic diagram of SNUF

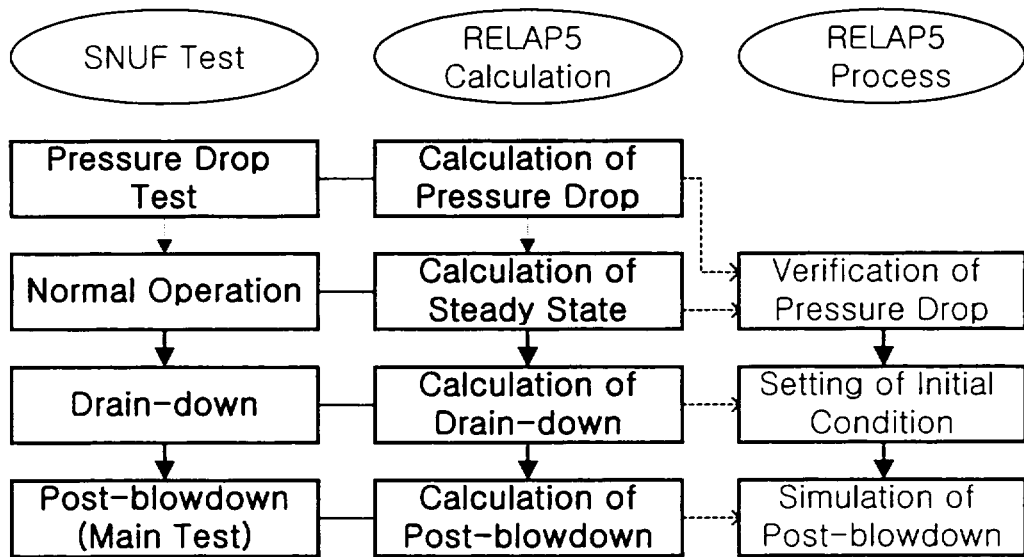
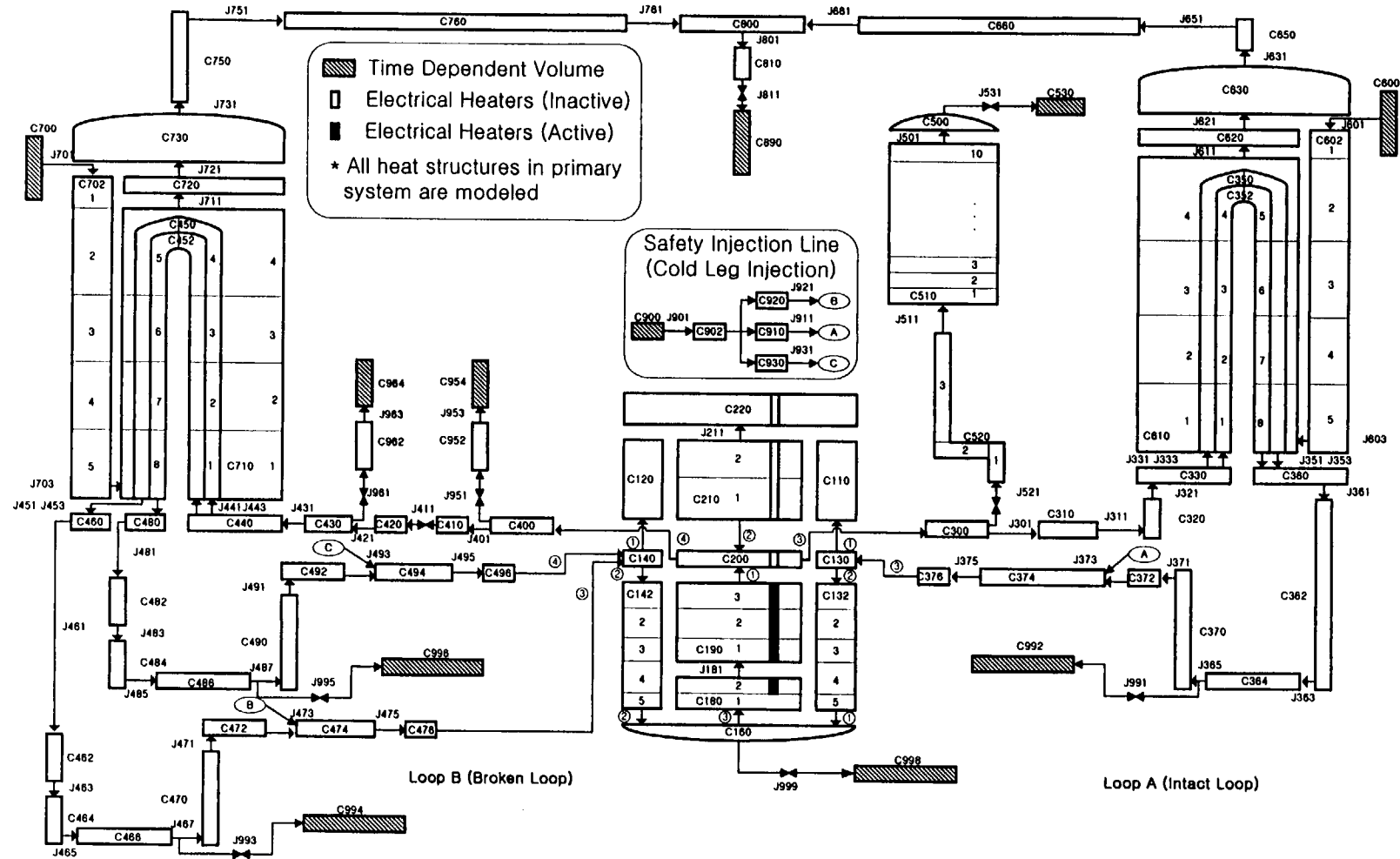


Figure 3 Procedure of SNUF experiment and RELAP5 calculation

Figure 4 Base nodalization of SNUF for RELAP5 analysis



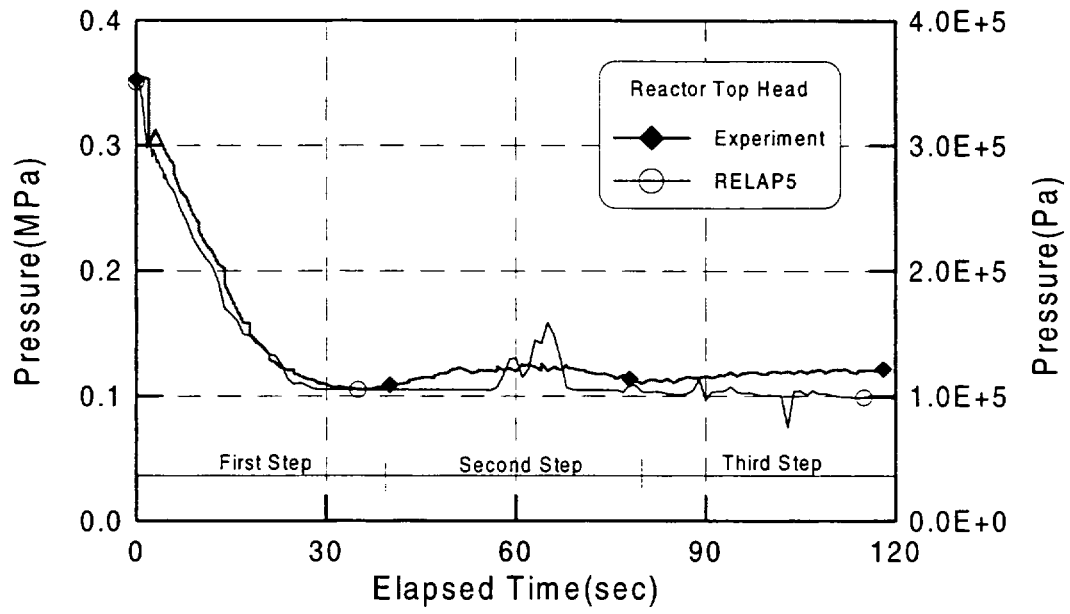


Figure 5 Pressure of reactor vessel top head (Run01)

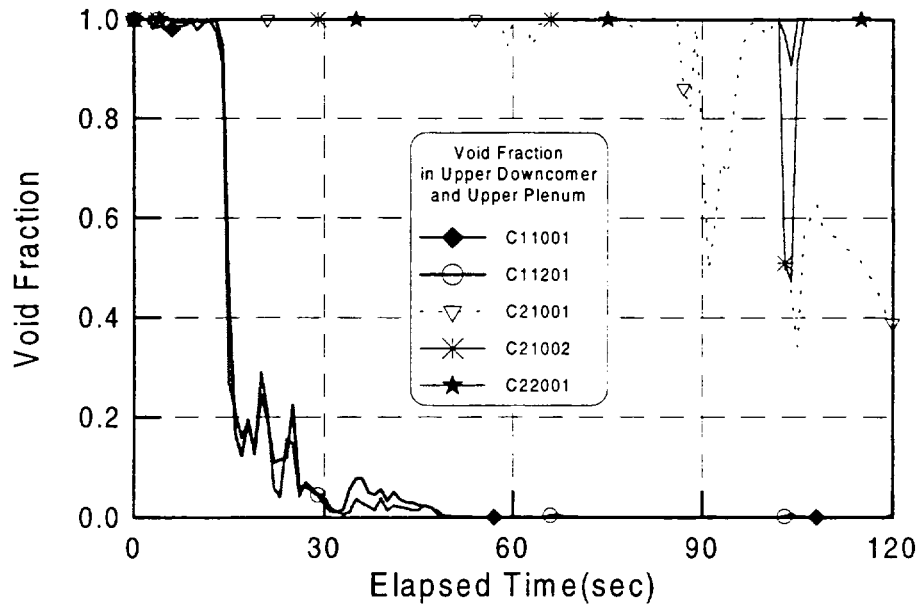


Figure 6 Void fractions in upper downcomer and upper plenum of reactor vessel (Run01)

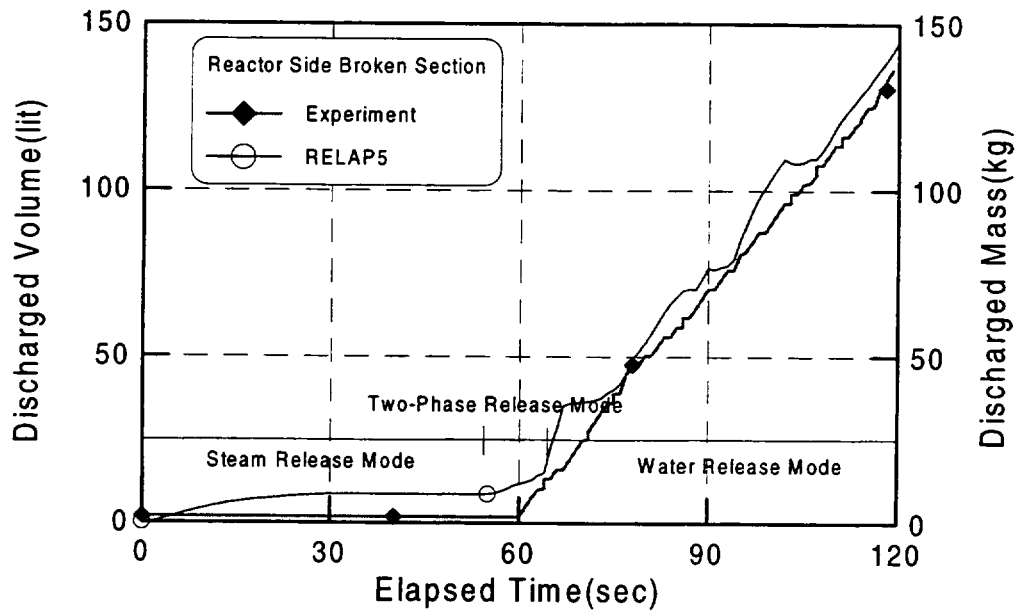


Figure 7 Discharge amount in reactor side broken section (Run01)

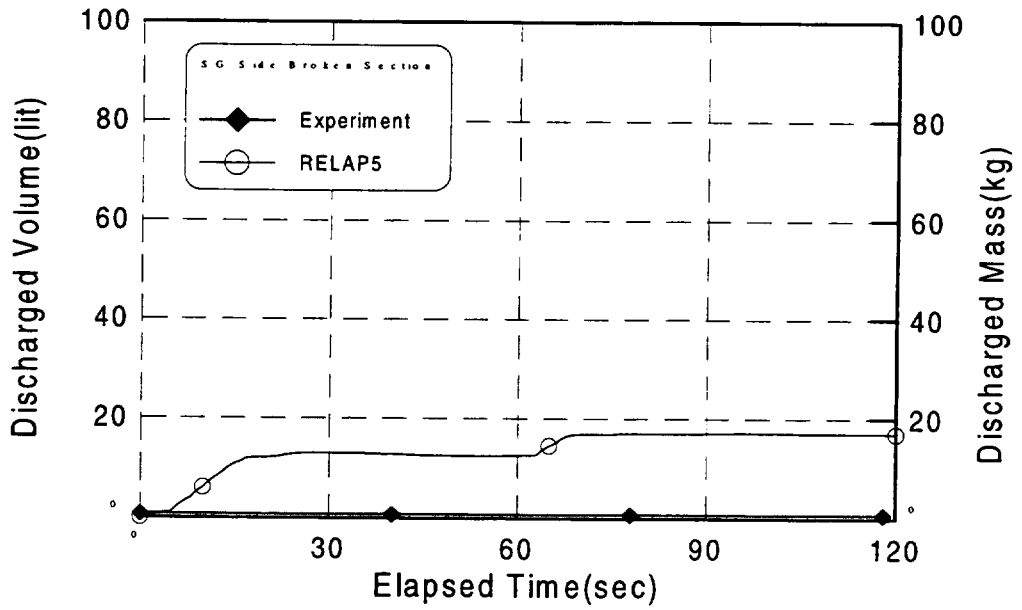


Figure 8 Discharge amount in SG side broken section (Run01)

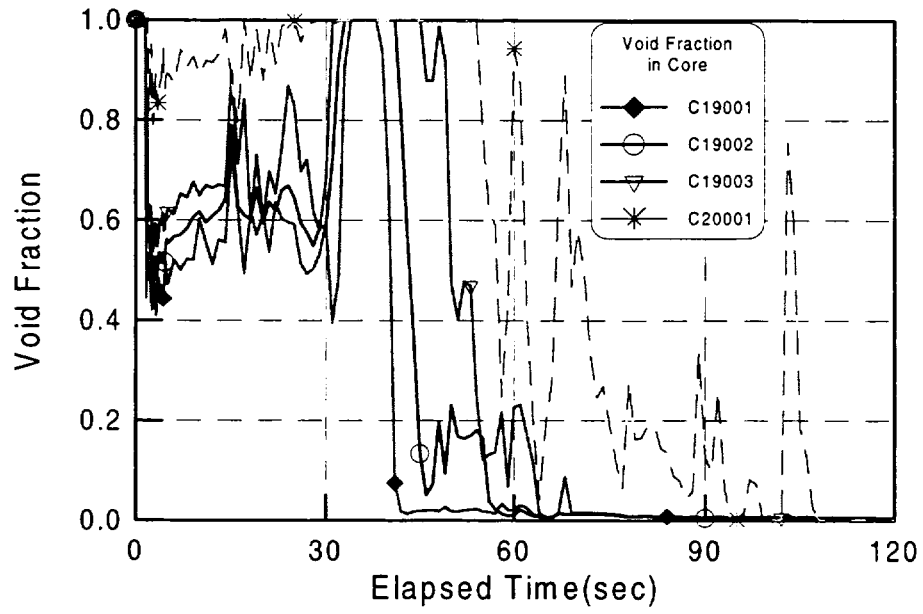


Figure 9 Void fractions in the reactor (Run01)

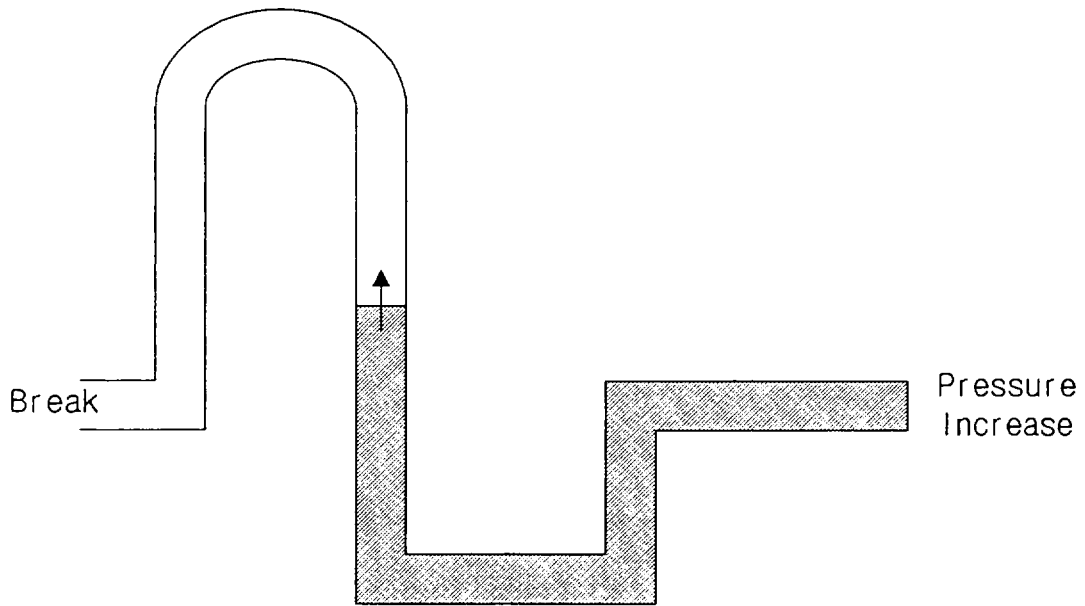


Figure 10 Coolant behavior in cold leg

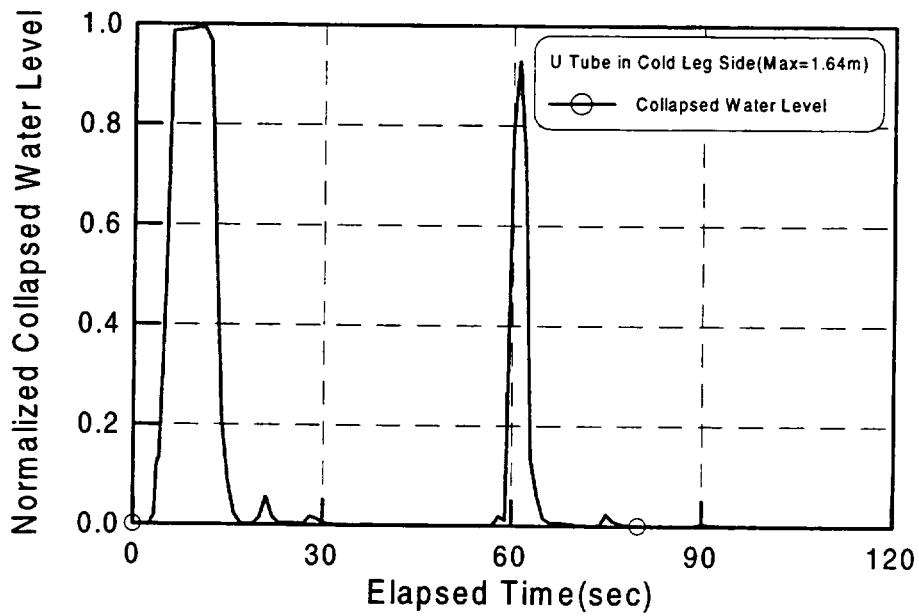


Figure 11 Water level in U Tube (Run01)

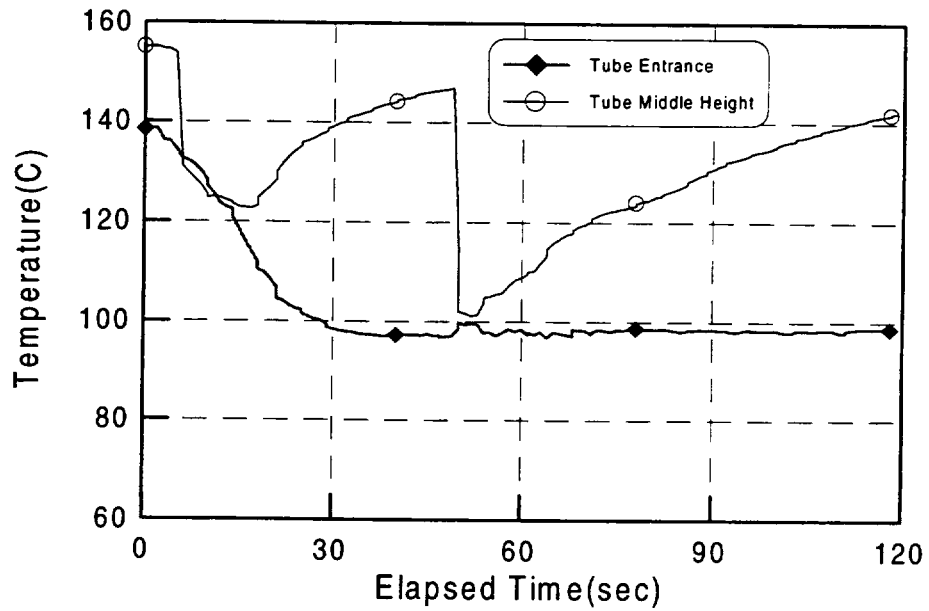


Figure 12 Coolant temperature of U tubes (SNUF experiment)

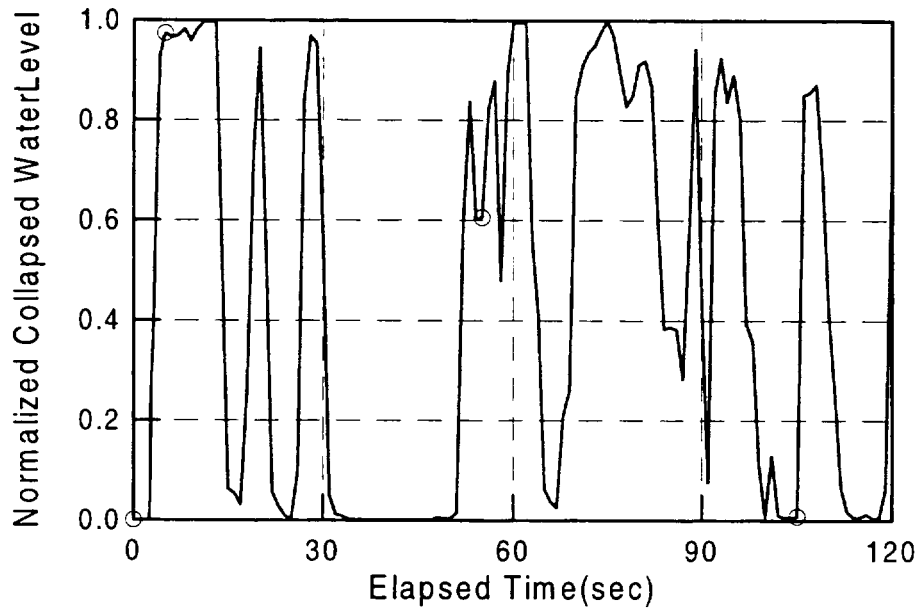


Figure 13 Water level in suction leg of cold leg in broken loop (Run01)

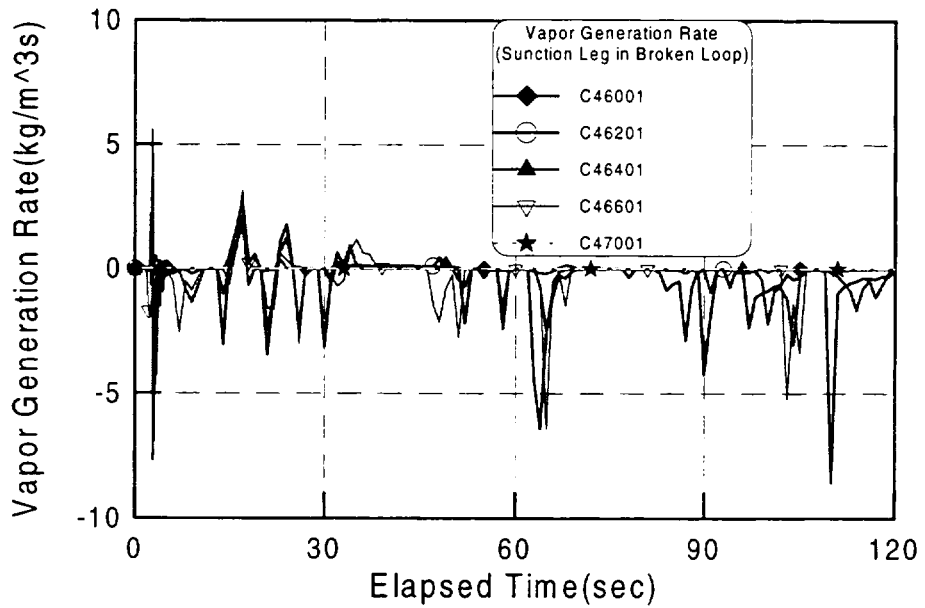


Figure 14 Vapor generation rate at suction leg in broken loop (Run01)

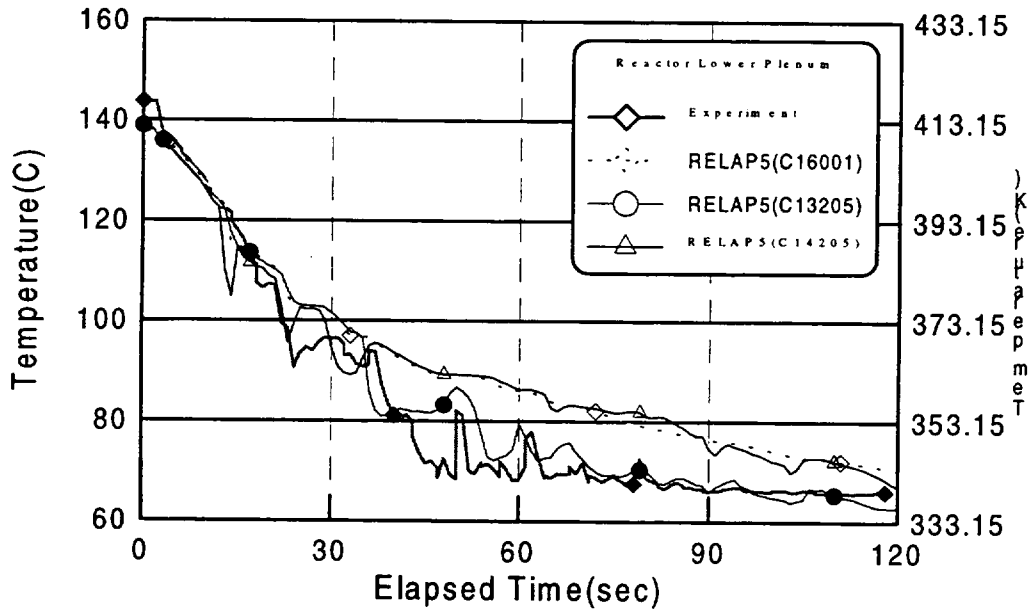


Figure 15 Coolant temperature in reactor lower plenum (Run01)

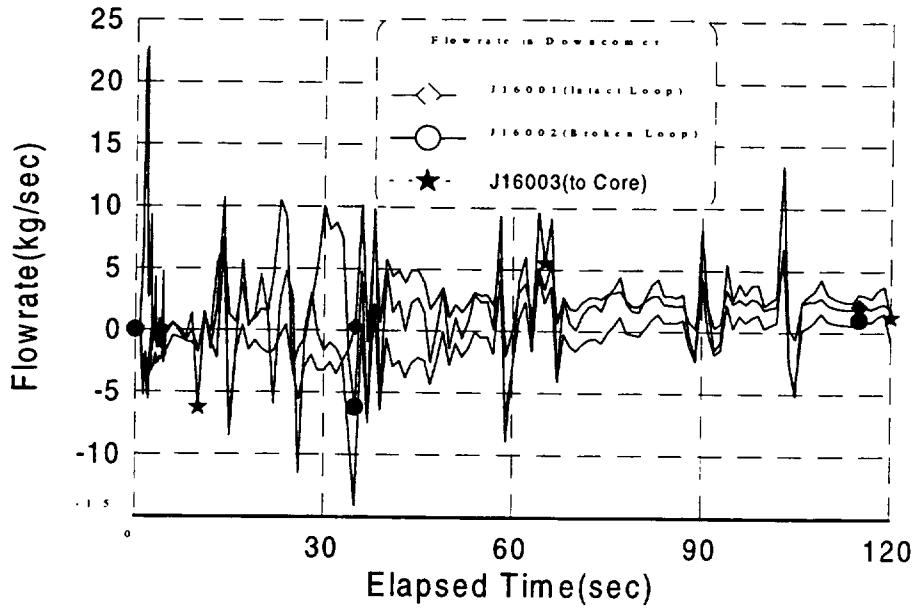


Figure 16 SI flow distribution in downcomer (Run01)

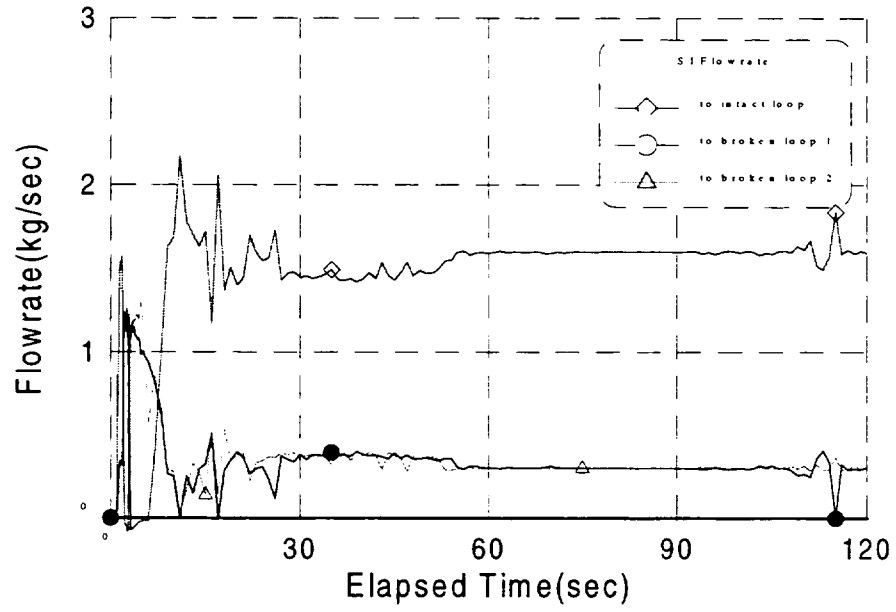


Figure 17 SI flow in SI lines (Run01)

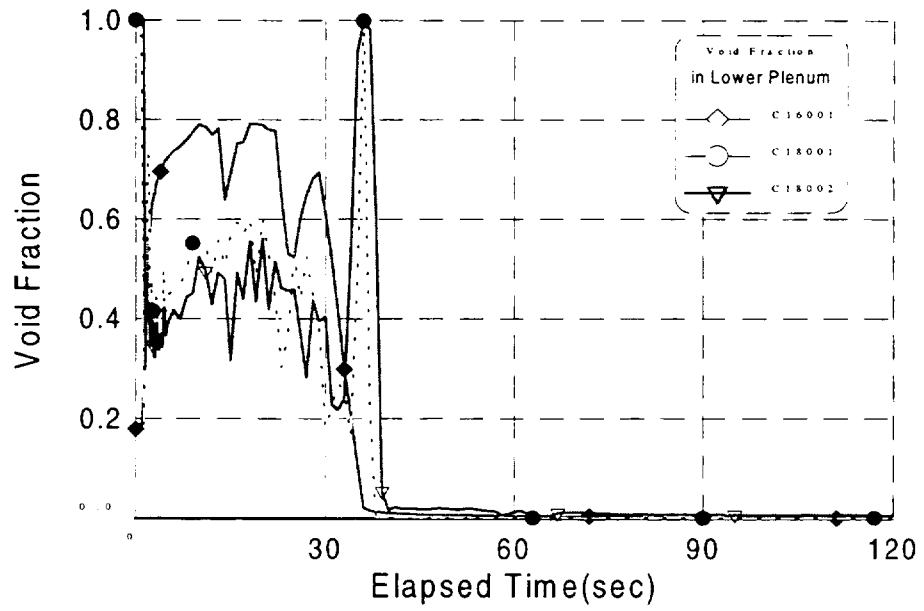


Figure 18 Void fraction in reactor lower part (Run01)

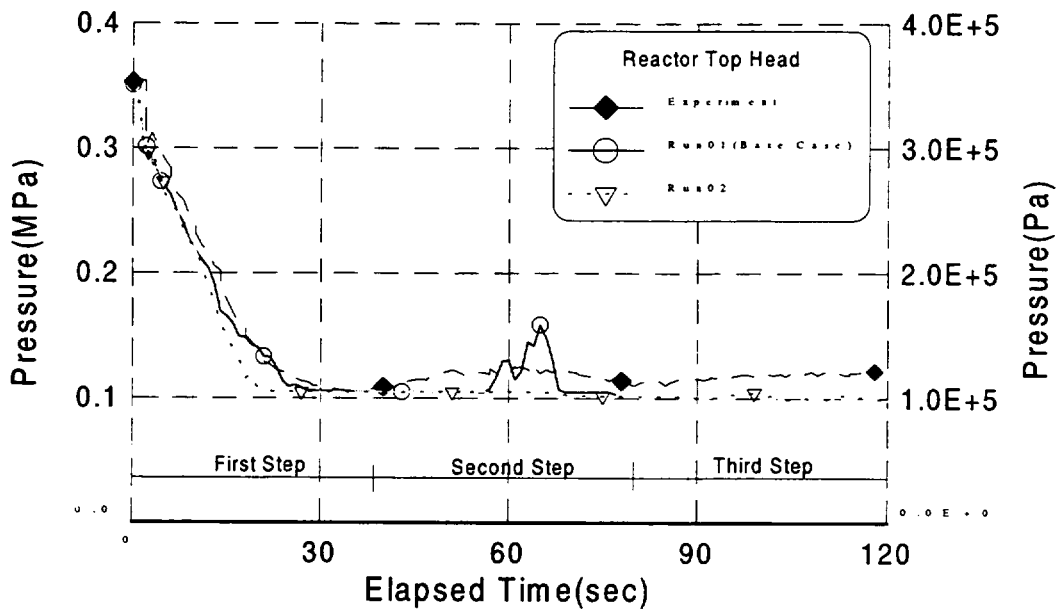


Figure 19 Pressure of reactor top head (Run02)

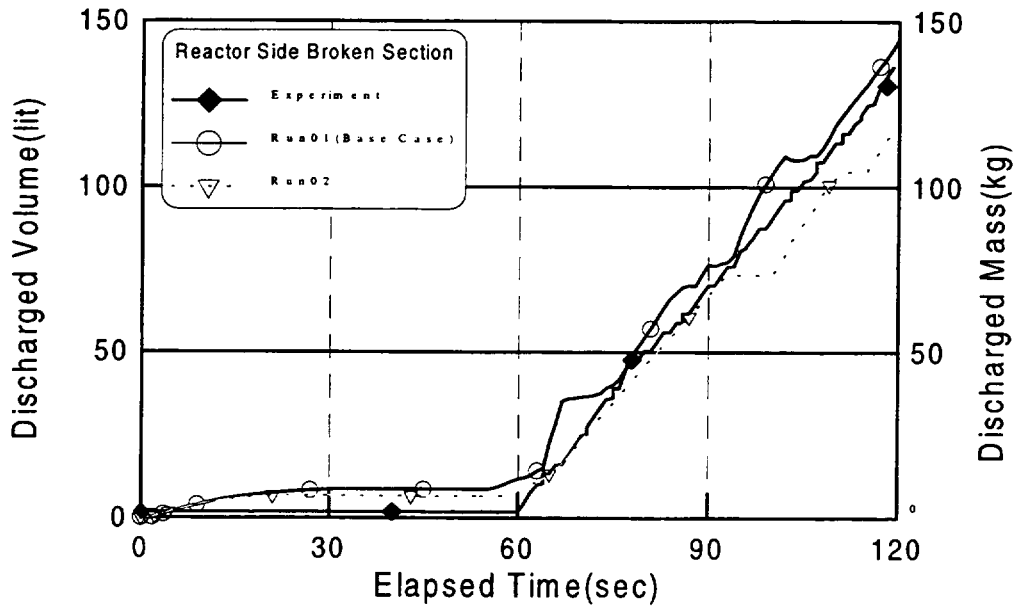


Figure 20 Discharge amount in reactor side broken section (Run02)

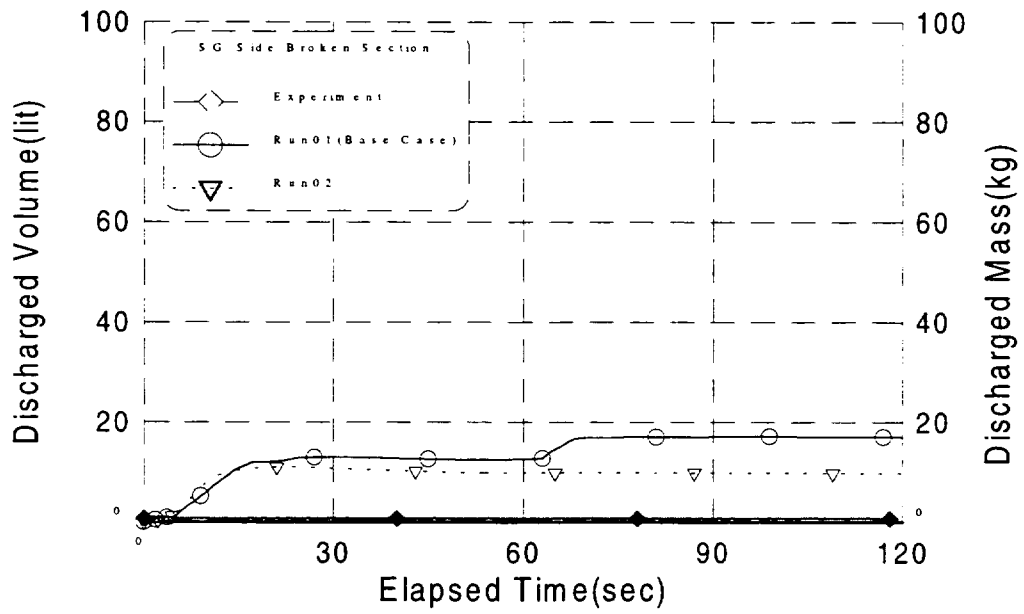


Figure 21 Discharge amount in SG side broken section (Run02)

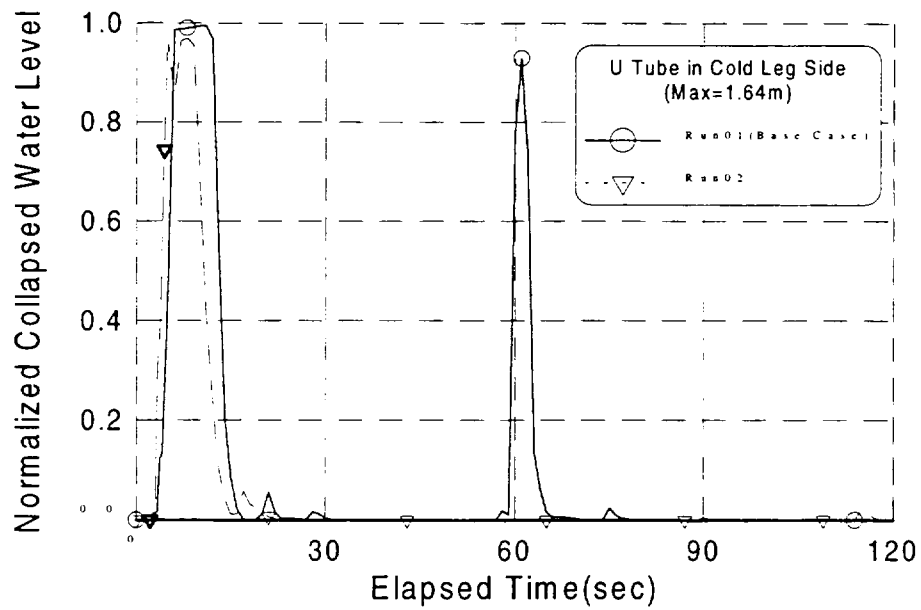


Figure 22 Water level in U Tube (Run02)

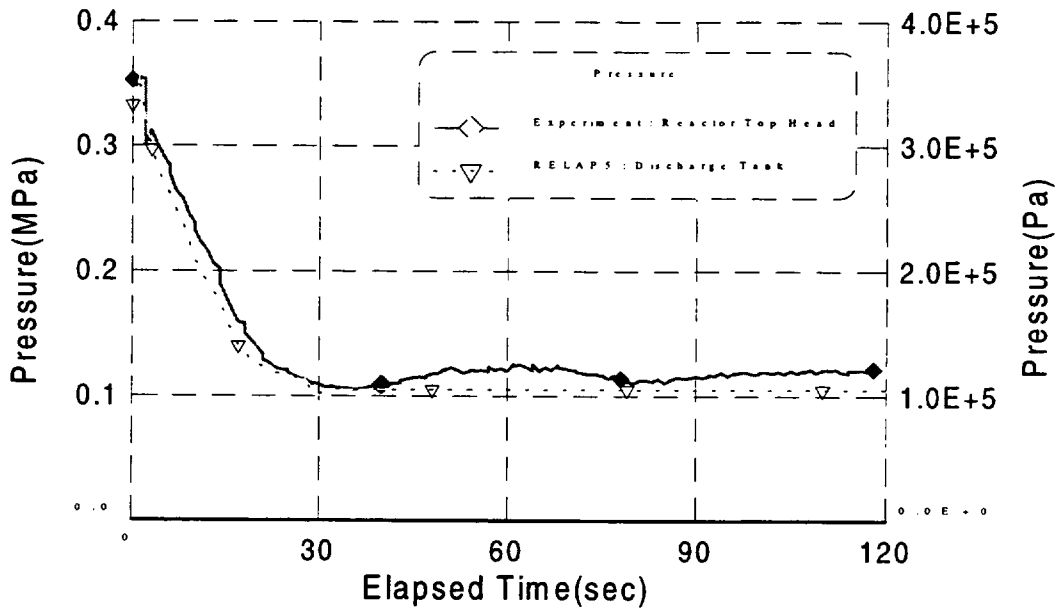


Figure 23 Pressure condition of break boundary in Run03

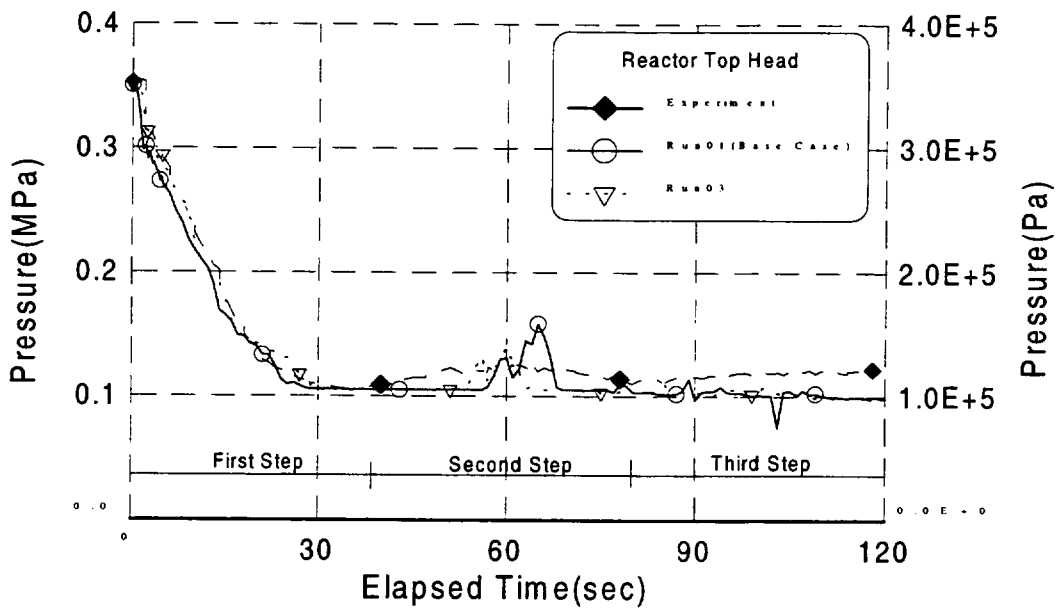


Figure 24 Pressure of reactor top head in Run03

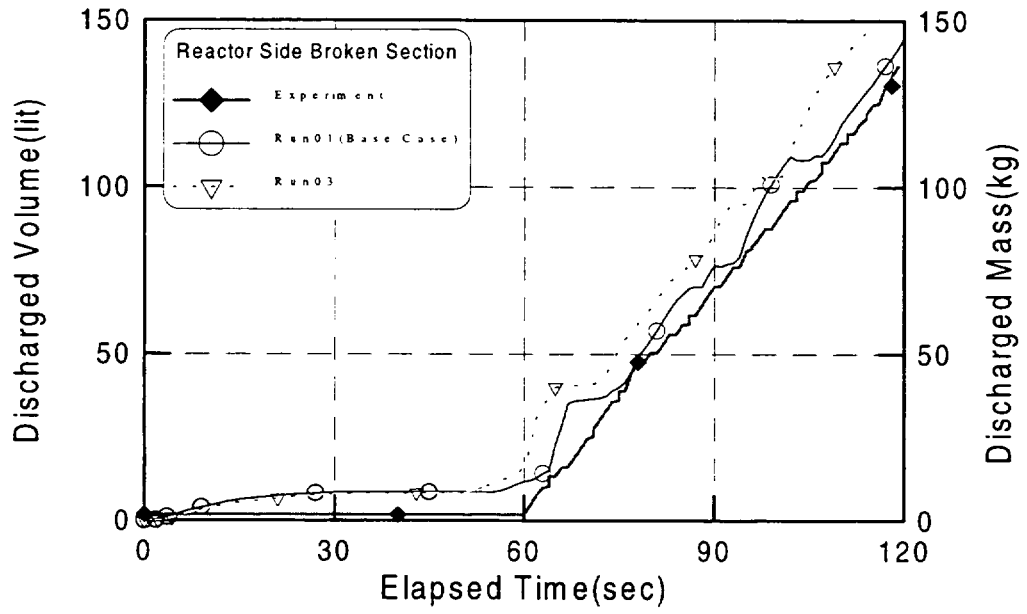


Figure 25 Discharge amount in reactor side broken section (Run03)

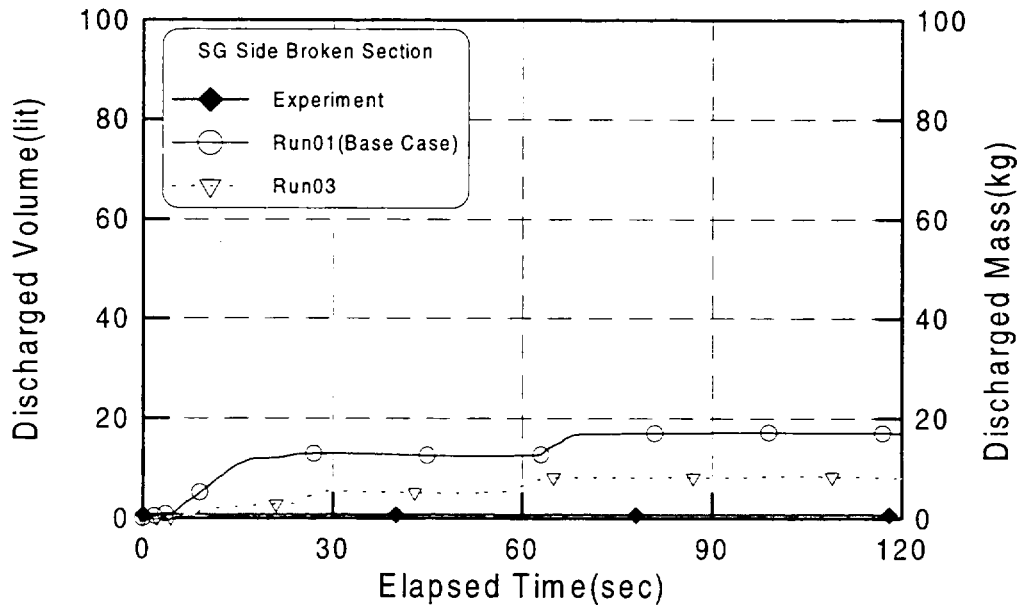


Figure 26 Discharge amount in SG side broken section (Run03)

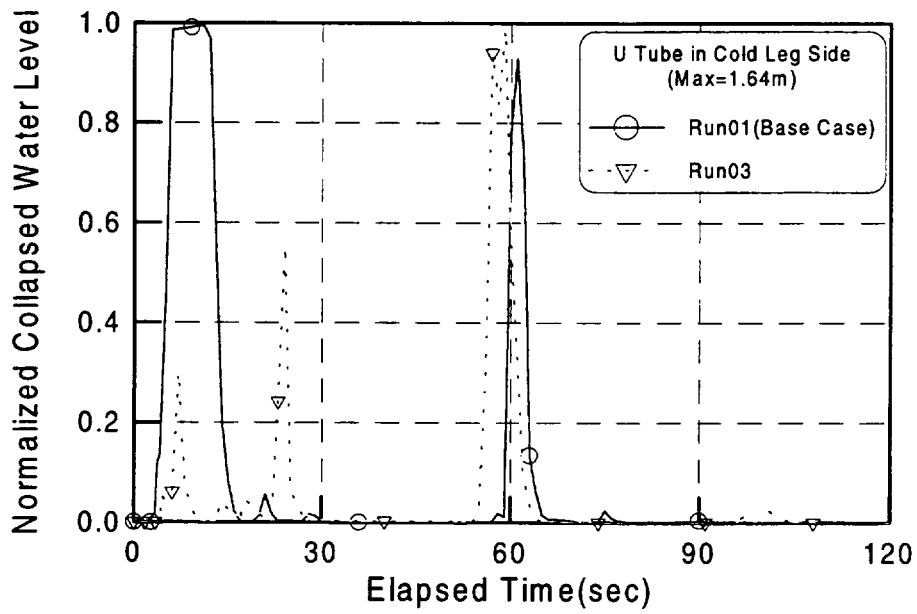


Figure 27 Water level in U Tube (Run03)

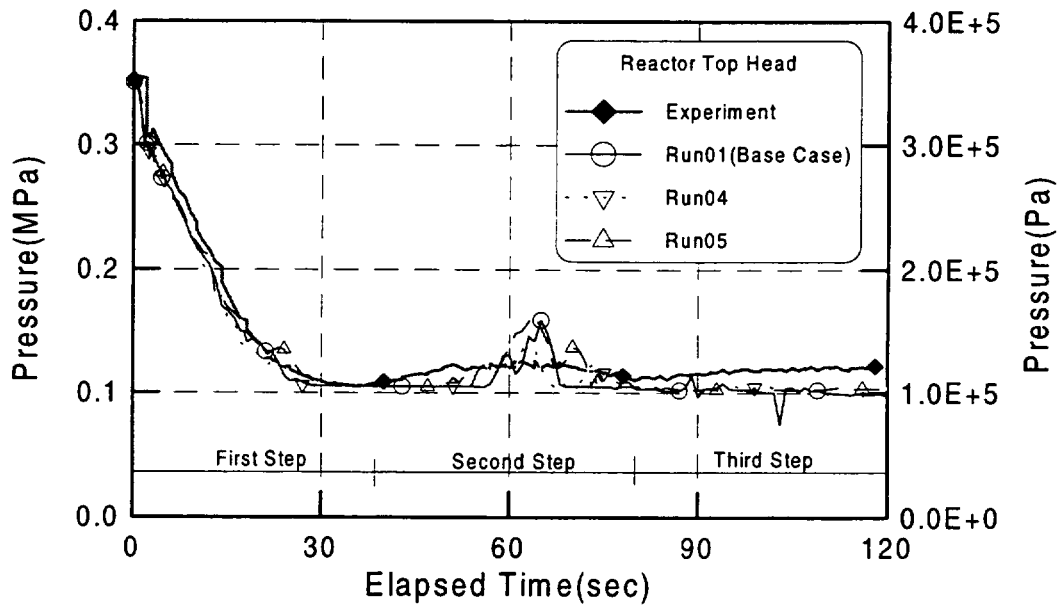


Figure 28 Pressure of reactor top head in Run04 and Run05

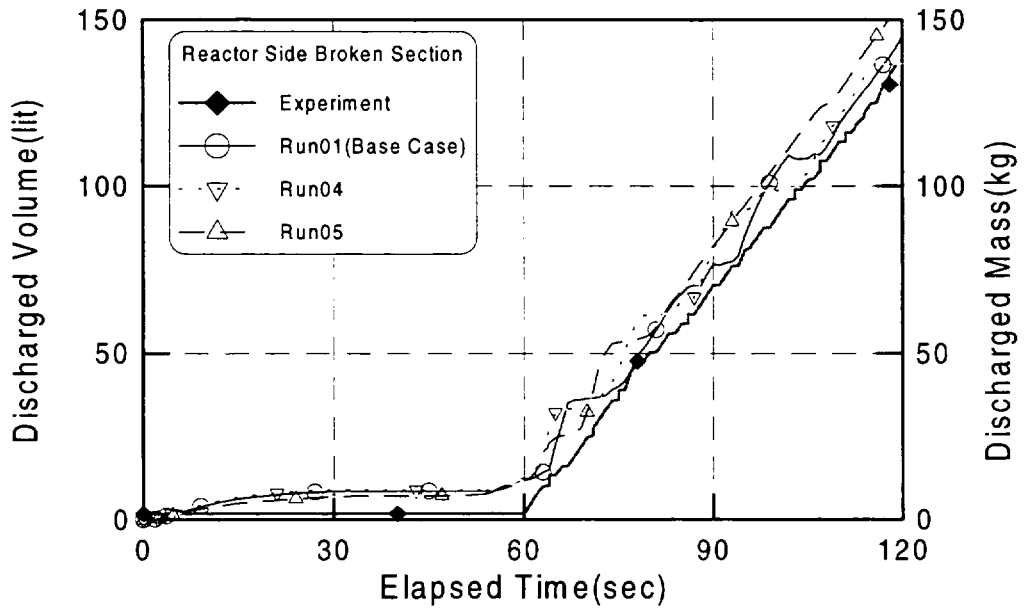


Figure 29 Discharge amount in reactor side broken section (Run04 and Run05)

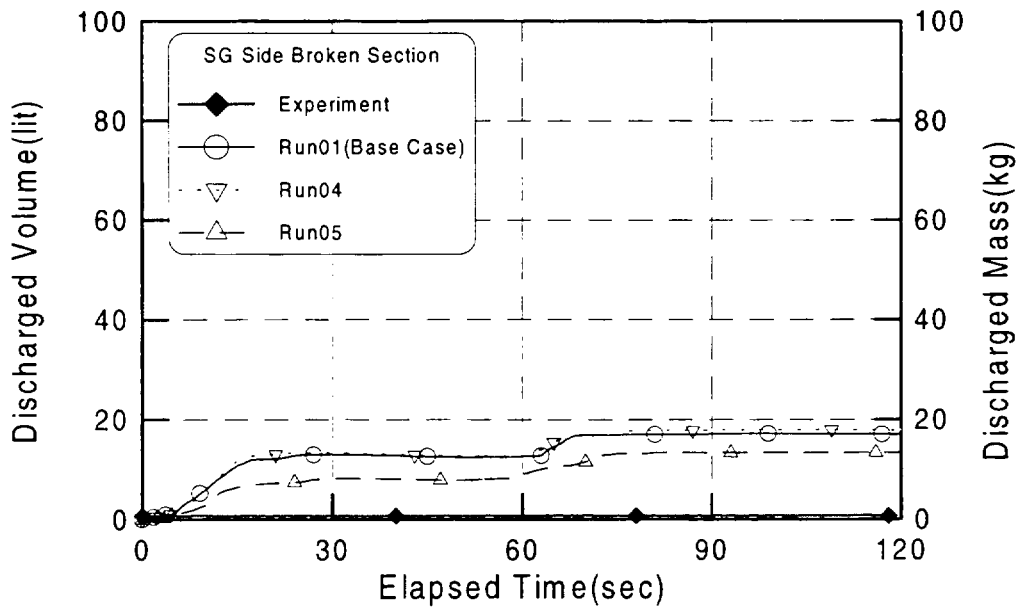


Figure 30 Discharge amount in SG side broken section (Run04 and Run05)

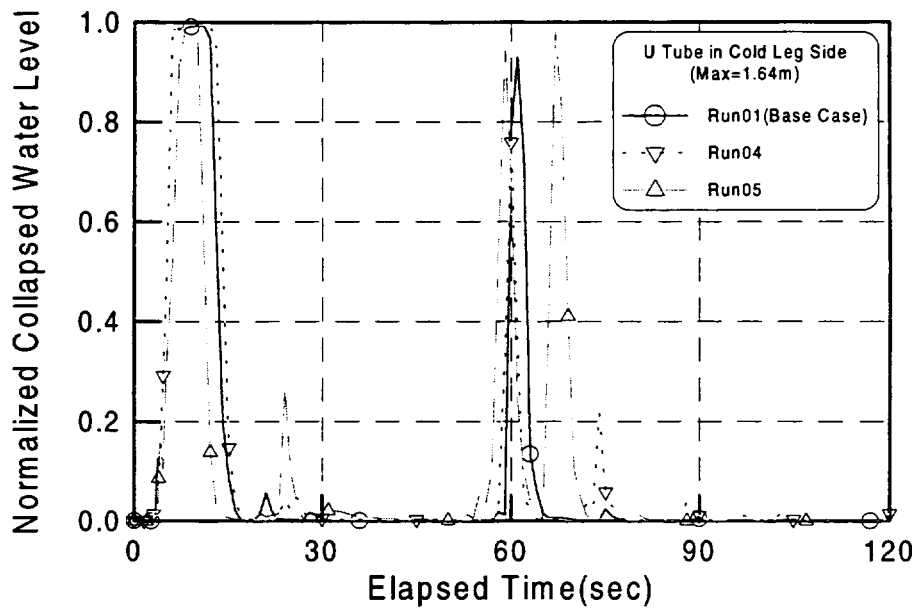


Figure 31 Water level in U Tube (Run04 and Run05)

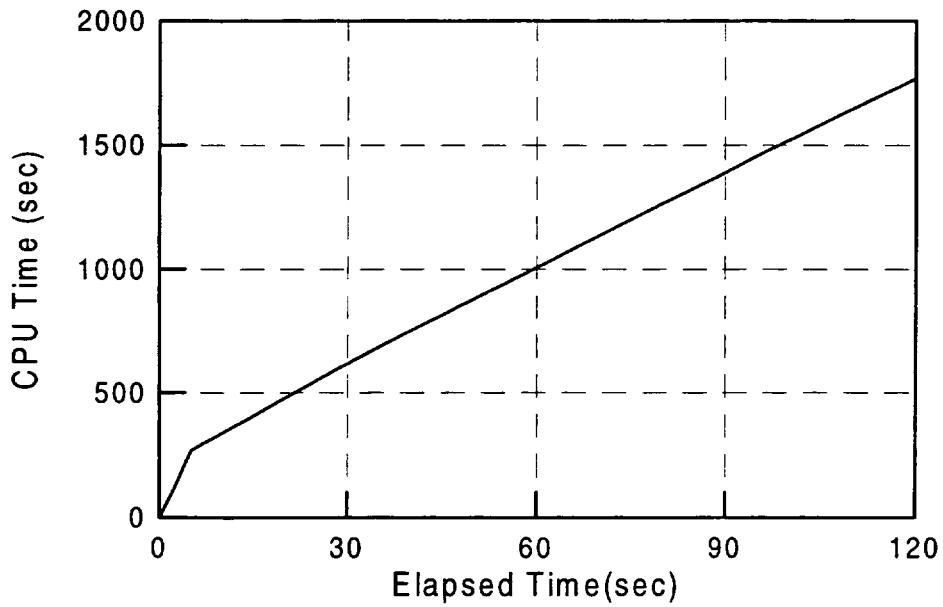


Figure 32 Calculation CPU time in Run01

Appendix A Input Deck for Steady State Calculation (Run01)

```

=====
**
** SNUF Hot Leg Break LOCA Analysis Input Deck with RELAP5/MOD3.1 **
=====
**
*----- simple model -----*
*
* form loss verification input deck
*
0000100 new stdy-st *transnt *
0000101 run
0000102 si si
0000105 5. 6. 30000.
0000110 nitrogen
0000115 1.
0000120 400010000 0.0 h2o primary
0000121 710010000 0.0 h2o second
*0000201 8. 1.-6 5.0e-2 00003 500 400000 2000000000
0000202 20. 1.-6 1.5e-2 00003 500 400000 2000000000
0000203 1500. 1.-6 1.0e-3 00003 5000 400000 2000000000
*
*-----*
* minor edits *
*-----*
*
0000301 p 220010000
0000302 p 372010000 * p1'
0000303 p 330010000 * p2'
0000304 p 360010000 * p3'
0000305 p 364010000 * p4'
0000306 p 472010000 * p1
0000307 p 440010000 * p2
0000308 p 460010000 * p3
0000309 p 466010000 * p4
0000310 p 610010000 * sg a
0000311 p 710010000 * sg b
*
0000320 tempf 372010000 * intact loop discharge
0000321 tempg 372010000 * intact loop discharge
0000322 tempf 364010000 * intact loop suction
0000323 tempg 364010000 * intact loop suction
0000324 tempf 472010000 * broken loop discharge

```

```

0000325 tempg 472010000 * broken loop discharge
0000326 tempf 466010000 * broken loop suction
0000327 tempg 466010000 * broken loop suction
0000328 tempf 492010000 * broken loop discharge
0000329 tempg 492010000 * broken loop discharge
0000330 tempf 486010000 * broken loop suction
0000331 tempg 486010000 * broken loop suction
0000332 tempf 200010000 * core upper
0000333 tempg 200010000 * core upper
*
0000340 mflowj 311000000 * intact loop hot leg flow rate
0000341 mflowj 411000000 * broken loop hot leg flow rate
0000342 mflowj 375000000 * intact loop flow rate
0000343 mflowj 475000000 * broken loop cold leg 1 flow rate
0000344 mflowj 495000000 * broken loop cold leg 1 flow rate
0000345 mflowj 601000000 * to sg a
0000346 mflowj 701000000 * to sg b
0000347 mflowj 811000000 * steam outlet
*
0000360 voidg 364010000
0000361 voidg 466010000
0000362 voidg 486010000
*
*0000370 cntrlvar 001 * pzr normalized water level
0000371 cntrlvar 002 * intact sg normalized water level
0000372 cntrlvar 003 * broken sg normalized water level
*
*-----*
* trip *
*-----*
*
0000501 time 0 ge null 0 0. n -1.0 *
0000502 time 0 lc null 0 60. n * pzr press ctrl
0000503 time 0 ge null 0 1.0e6 n *
*
*-----*
* hydraulic input *
*-----*
*
*-----*
* primary system *
*-----*
*

```



```

*
*****
* component 110 : downcomer upper part at right hand side *
*****
1100000 dc_up_r annulus * name
1100001 1 * number of volume
1100101 0. 1 * flow area of volume
*1100201 no junction * flow area of junction
1100301 5.8e-1 1 * flow length
1100401 1.3637e-2 1 * volume of volume
1100501 0. 1 * azimuthal angle
1100601 90.0 1 * inclination angle
*1100701 elevation change
1100801 4.572-4 5.1e-3 1 * roughness, hyd. dia.
*1100901 no junction * loss coeff.
1101001 00000 1 * flag of volume
*1101101 no junction * flag of junction
1101201 003 800099. 435. 0. 0. 0. 1 * i.c. of volume
*1101300 no junction * i.c. ctrl word of junction
*1101301 no junction * i.c. of junction
*
*****
* component 120 : downcomer upper part at left hand side *
*****
1200000 dc_up_l annulus * name
1200001 1 * number of volume
1200101 0. 1 * flow area of volume
*1200201 no junction * flow area of junction
1200301 5.8e-1 1 * flow length
1200401 1.3637e-2 1 * volume of volume
1200501 0. 1 * azimuthal angle
1200601 90.0 1 * inclination angle
*1200701 elevation change
1200801 4.572-4 5.1e-3 1 * roughness, hyd. dia.
*1200901 no junction * loss coeff.
1201001 00000 1 * flag of volume
*1201101 no junction * flag of junction
1201201 003 800099. 435. 0. 0. 0. 1 * i.c. of volume
*1201300 no junction * i.c. ctrl word of junction
*1201301 no junction * i.c. of junction
*
*****

```

```

* component 130 : downcomer cold leg connector at right side *
*****
1300000 dc_cc_r branch
1300001 3 0
1300101 1.1756e-2 110.0e-3 0.0 0.0 -90. -110.0-3 4.572-4 25.5e-3 00000
1300200 003 800099. 435.15
1301101 130010001 110010001 0.0 0.0 0.0 000000
1302101 130010002 132010001 0.0 0.0 0.0 000101
1303101 376010002 130010003 0.0 0.45 0.3 000101
1301201 0.0 0.0 0.0
1302201 0.0 0.0 0.0
1303201 0.0 0.0 0.0
*
*****
* component 140 : downcomer cold leg connector at left side *
*****
1400000 dc_cc_l branch
1400001 4 0
1400101 1.1756-2 110.0-3 0.0 0.0 -90. -110.0-3 4.572-4 25.5e-3 00000
1400200 003 800099. 435.15
1401101 140010001 120010001 0.0 0.0 0.0 000000
1402101 140010002 142010001 0.0 0.0 0.0 000000
1403101 476010002 140010003 0.0 0.45 0.3 000101
1404101 496010002 140010003 0.0 0.45 0.3 000101
1401201 0.0 0.0 0.0
1402201 0.0 0.0 0.0
1403201 0.0 0.0 0.0
1404201 0.0 0.0 0.0
*
*****
* component 132 : downcomer at right side *
*****
1320000 dc_r annulus * name
1320001 5 * number of volume
1320101 1.1756e-2 5 * flow area of volume
1320201 0. 4 * flow area of junction
1320301 200.0e-3 2 * flow length
1320302 100.0e-3 4
1320303 148.0e-3 5
1320401 0. 5 * volume of volume
1320501 0.0 5 * azimuthal angle
1320601 -90.0 5 * inclination angle
*1320701 elevation change

```

```

1320801 4.572-4 25.5e-3 5 * roughness, hyd. dia.
1320901 0. 0. 4 * loss coeff.
1321001 00000 5 * flag of volume
1321101 000000 4 * flag of junction
1321201 003 800099. 435.15 0. 0. 0. 5 * i.c. of volume
1321300 0 * i.c. ctrl word of junction
1321301 0. 0. 0. 4 * i.c. of junction
*
*****
* component 142 : downcomer at left side *
*****
1420000 dc_r annulus * name
1420001 5
1420101 1.1756e-2 5 * flow area of volume
1420201 0. 4 * flow area of junction
1420301 200.0e-3 2 * flow length
1420302 100.0e-3 4
1420303 148.0e-3 5
1420401 0. 5 * volume of volume
1420501 0.0 5 * azimuthal angle
1420601 -90.0 5 * inclination angle
*1420701 elevation change
1420801 4.572-4 25.5e-3 5 * roughness, hyd. dia.
1420901 0. 0. 4 * loss coeff.
1421001 00000 5 * flag of volume
1421101 000000 4 * flag of junction
1421201 003 800099. 435.15 0. 0. 0. 5 * i.c. of volume
1421300 0 * i.c. ctrl word of junction
1421301 0. 0. 0. 4 * i.c. of junction
*
*****
* component 160 : downcomer lower plenum *
*****
1600000 lowplenn branch
1600001 3 0
1600101 0. 80.0e-3 6.7988e-2 0.0 90. 80.0e-3 4.572-4 319.0e-3 00000
1600200 003 800099. 435.15
1601101 132050002 160010002 0.0 0.4 0.2 010100
1602101 142050002 160010002 0.0 0.4 0.2 010100
1603101 160010002 180010001 0.0 0.2 0.4 010100
1601201 0. 0. 0.0
1602201 0. 0. 0.0
1603201 0. 0. 0.0

```

```

*
*****
* component 180 : core bottom *
*****
1800000 core_bot pipe * name
1800001 2 * number of volume
1800101 2.0204e-2 1 * flow area of volume
1800102 5.3913e-2 2
1800201 0.0 1 * flow area of junction
1800301 148.0e-3 1 * flow length
1800302 100.0e-3 2
1800401 0. 2 * volume of volume
1800501 0. 2 * azimuthal angle
1800601 90.0 2 * inclination angle
*1800701 elevation change
1800801 4.572e-4 35.0e-3 1 * roughness, hyd. dia.
1800802 4.572e-4 262.0e-3 2
1800901 0.04 0.02 1 * loss coeff.
1801001 00000 2 * flag of volume
1801101 000000 1 * flag of junction
1801201 003 800099. 440.15 0.0 0.0 0.0 2 * i.c. of volume
1801300 0 * i.c. ctrl word of junction
1801301 0.0 0.0 0. 1 * i.c. of junction
*
*****
* component 181 : core junction *
*****
*
1810000 core_jun sngljun
1810101 180020002 190010001 0. 0.435 0.2 000100
1810201 0 0. 0. 0.
*
*****
* component 190 : active core *
*****
*
1900000 act_core pipe * name
1900001 3 * number of volume
1900101 5.0143e-2 3 * flow area of volume
1900201 0. 2 * flow area of junction
1900301 100.0e-3 1 * flow length
1900302 200.0e-3 3
1900401 0. 3 * volume of volume

```

```

1900501 0. 3 * azimuthal angle
1900601 90.0 3 * inclination angle
*1900701 elevation change
1900801 4.572e-4 86.0e-3 3 * roughness, hyd. dia.
1900901 0. 0. 2 * loss coeff.
1901001 00000 3 * flag of volume
1901101 000000 2 * flag of junction
1901201 003 750099. 440.15 0. 0. 0. 3 * i.c. of volume
1901300 0 * i.c. ctrl word of junction
1901301 0.0 0.0 0. 2 * i.c. ctrl word of junction
*
*****
* component 200 : core branch *
*****
2000000 core_br branch
2000001 4 0
2000101 5.0143e-2 110.0e-3 0.0 0.0 90. 110.0e-3 4.572e-4 319.0e-3 00000
2000200 003 800099. 440.15
2001101 190030002 200010001 0.0 0. 0. 000000
2002101 200010002 210010001 0. 0. 0. 000000
2003101 200010004 300010001 0. 0.3 0.45 000102 *to intact hotleg
2004101 200010004 400010001 0. 0.3 0.45 000102 *to broken hotleg
2001201 0.0 0.0 0.0
2002201 0.0 0.0 0.0
2003201 0.0 0.0 0.0
2004201 0.0 0.0 0.0
*
*****
* component 210 : core upper *
*****
2100000 core_up pipe * name
2100001 2 * number of volume
2100101 5.0143e-2 2 * flow area of volume
2100201 0. 1 * flow area of junction
2100301 2.9e-01 2 * flow length
2100401 0. 2 * volume of volume
2100501 0. 2 * azimuthal angle
2100601 90. 2 * inclination angle
*2100701 elevation change
2100801 4.572e-4 86.0e-3 2 * roughness, hyd. dia.
2100901 0. 0. 1 * loss coeff.
2101001 00000 2 * flag of volume

```

```

2101101 000000 1 * flag of junction
2101201 003 750099. 435.15 0. 0. 0. 2 * i.c. of volume
2101300 0 * i.c. ctrl word of junction
2101301 0. 0. 0. 1 * i.c. of junction
*
*****
* component 211 : upper plenum junction 1 *
*****
2110000 up_jun1 sngljun
2110101 210020002 220010001 0. 0. 0. 000000
2110201 0 0. 0. 0.
*
*****
* component 220 : upper plenum *
*****
2200000 up_pl snglvol
2200101 0. 2.51e-1 1.6097e-2 0. 90. 2.51e-1 4.572e-4 121.3529e-3 00000
2200200 003 800099. 435.15 0. 0. 0.
*
*****
* component 300 : intact hot leg section 1 *
*****
3000000 ihod1 pipe * name
3000001 1 * number of volume
3000101 0. 1 * flow area of volume
*3000201 no junction * flow area of junction
3000301 5.27e-1 1 * flow length
3000401 2.1744e-3 1 * volume of volume
3000501 0. 1 * azimuthal angle
3000601 0. 1 * inclination angle
*3000701 elevation change
3000801 4.572e-4 7.2352e-2 1 * roughness, hyd. dia.
*3000901 no junction * loss coeff.
3001001 00000 1 * flag of volume
*3001101 no junction * flag of junction
3001201 003 800099. 440.15 0. 0. 0. 1 * i.c. of volume
*3001300 no junction * i.c. ctrl word of junction
*3001301 no junction * i.c. of junction
*
*****
* component 301 : intact hot leg junction 1 *

```

```

*****
*
3010000 ihlj1 sngljun
3010101 300010002 310010001 0. 0.003 0.003 000000
3010201 0 0. 0. 0.
*
*****
* component 310 : intact hot leg junction 2 *
*****
*
3100000 ihot2 pipe * name
3100001 1 * number of volume
3100101 0. 1 * flow area of volume
*3100201 no junction * flow area of junction
3100301 4.38e-1 1 * flow length
3100401 1.6953e-3 1 * volume of volume
3100501 0. 1 * azimuthal angle
3100601 0. 1 * inclination angle
*3100701 elevation change
3100801 4.572e-4 70.2e-3 1 * roughness, hyd. dia.
*3100901 no junction * loss coeff.
3101001 00000 1 * flag of volume
*3101101 no junction * flag of junction
3101201 003 800099. 440.15 0. 0. 0. 1 * i.c. of volume
*3101300 no junction * i.c. ctrl word of junction
*3101301 no junction * i.c. of junction
*
*****
* component 311 : intact hot leg junction 2 *
*****
*
3110000 ihlj2 sngljun
3110101 310010002 320010001 0. 0.1 0.1 000000 *
3110201 0 0. 0. 0.
*
*****
* component 320 : intact hot leg junction 3 *
*****
*
3200000 ihot3 pipe * name
3200001 1 * number of volume
3200101 0. 1 * flow area of volume
*3200201 no junction * flow area of junction
3200301 2.6e-01 1 * flow length

```

```

3200401 1.0063e-3 1 * volume of volume
3200501 0. 1 * azimuthal angle
3200601 90. 1 * inclination angle
*3200701 elevation change
3200801 4.572e-4 70.2e-3 1 * roughness, hyd. dia.
*3200901 no junction * loss coeff.
3201001 00000 1 * flag of volume
*3201101 no junction * flag of junction
3201201 003 800099. 440.15 0. 0. 0. 1 * i.c. of volume
*3201300 no junction * i.c. ctrl word of junction
*3201301 no junction * i.c. of junction
*
*****
* component 321 : intact hot leg junction 3 *
*****
*
3210000 ihlj3 sngljun
3210101 320010002 330010001 0. 0.4 0.2 000100
3210201 0 0. 0. 0.
*
*****
* component 330 : intact loop u tube inlet *
*****
*
3300000 iltube-i pipe * name
3300001 1 * number of volume
3300101 0. 1 * flow area of volume
*330020 no junction * flow area of junction
3300301 100.0e-3 1 * flow length
3300401 3.9961e-3 1 * volume of volume
3300501 0. 1 * azimuthal angle
3300601 90. 1 * inclination angle
*3300701 elevation change
3300801 4.572e-4 194.9139e-3 1 * roughness, hyd. dia.
*3300901 no junction * loss coeff.
3301001 00000 1 * flag of volume
*3301101 no junction * flag of junction
3301201 003 750099. 440.15 0. 0. 0. 1 * i.c. of volume
*3301300 no junction * i.c. ctrl word of junction
*3301301 no junction * i.c. of junction
*
*****
* component 331 : intact u tube inlet junction 1 *
*****

```

3310000 itub_ij1 sngljun
 3310101 330010002 350010001 0. 17. 26. 000100
 3310201 0 0. 0. 0.
 *

 * component 333 : intact u tube inlet junction 2 *

3330000 itub_ij2 sngljun
 3330101 330010002 352010001 0. 17. 26. 000100
 3330201 0 0. 0. 0.
 *

 * component 350 : intact u tube 1 *

3500000 itub1 pipe * name
 3500001 8 * number of volume
 3500101 2.2682e-3 8 * flow area of volume
 3500201 0. 7 * flow area of junction
 3500301 4.1e-1 8 * flow length
 3500401 0. 8 * volume of volume
 3500501 0. 8 * azimuthal angle
 3500601 90. 4 * inclination angle
 3500602 -90. 8

*3500701 elevation change
 3500801 4.572e-4 19.0e-3 8 * roughness, hyd. dia.
 3500901 0. 0. 3 * loss coeff.
 3500902 0.42 0.42 4
 3500903 0. 0. 7
 3501001 00000 8 * flag of volume
 3501101 000000 7 * flag of junction
 3501201 003 800099. 438.15 0. 0. 0. 8 * i.c. of volume
 3501300 0 * i.c. ctrl word of junction
 3501301 0.0 0.0 0. 7 * i.c. of junction
 *

 * component 352 : intact u tube 2 *

 *

3520000 itub2 pipe
 3520001 8 * number of volume
 3520101 2.2682e-3 8 * flow area of volume
 3520201 0. 7 * flow area of junction
 3520301 4.1e-1 8 * flow length

3520401 0. 8 * volume of volume
 3520501 0. 8 * azimuthal angle
 3520601 90. 4 * inclination angle
 3520602 -90. 8

*3520701 elevation change
 3520801 4.572e-4 19.0e-3 8 * roughness, hyd. dia.
 3520901 0. 0. 3 * loss coeff.
 3520902 0.42 0.42 4
 3520903 0. 0. 7
 3521001 00000 8 * flag of volume
 3521101 000000 7 * flag of junction
 3521201 003 800099. 438.15 0. 0. 0. 8 * i.c. of volume
 3521300 0 * i.c. ctrl word of junction
 3521301 0.0 0.0 0. 7 * i.c. of junction
 *

 * component 351 : intact u tube outlet junction 1 *

 *

3510000 itub_oj1 sngljun
 3510101 350080002 360010001 0. 26. 17. 000100
 3510201 0 0. 0. 0.
 *

 * component 353 : intact u tube outlet junction 2 *

 *

3530000 itub_oj2 sngljun
 3530101 352080002 360010001 0. 26. 17. 000100
 3530201 0 0. 0. 0.
 *

 * component 360 : intact loop u tube outlet *

 *

3600000 up_pl1 pipe * name
 3600001 1 * number of volume
 3600101 3.9961e-2 1 * flow area of volume
 *3600201 no junction * flow area of junction
 3600301 100.0e-3 1 * flow length
 3600401 0. 1 * volume of volume
 3600501 0. 1 * azimuthal angle
 3600601 -90. 1 * inclination angle

```

*3600701 elevation change
3600801 4.572e-4 194.9139e-3 1 * roughness, hyd. dia.
*3600901 no junction * loss coeff.
3601001 00000 1 * flag of volume
*3601101 no junction * flag of junction
3601201 003 800099. 435.15 0. 0. 0. 1 * i.c. of volume
*3601300 no junction * i.c. ctrl word of junction
*3601301 no junction * i.c. of junction
*
*****
* component 361 : intact suction leg junction 1 *
*****
3610000 slj1 sngljun
3610101 360010002 362010001 0. 0.2 0.4 000100
3610201 0 0. 0. 0.
*
*****
* component 362 : intact suction leg 1 *
*****
3620000 sl1 pipe * name
3620001 1 * number of volume
3620101 0. 1 * flow area of volume
*3620201 no junction * flow area of junction
3620301 9.1e-1 1 * flow length
3620401 3.5222e-3 1 * volume of volume
3620501 0. 1 * azimuthal angle
3620601 -90. 1 * inclination angle
*3620701 elevation change
3620801 4.572e-4 70.2e-3 1 * roughness, hyd. dia.
*3620901 no junction * loss coeff.
3621001 00000 1 * flag of volume
*3621101 no junction * flag of junction
3621201 003 800099. 435.15 0. 0. 0. 1 * i.c. of volume
*3621300 no junction * i.c. ctrl word of junction
*3621301 no junction * i.c. of junction
*
*****
* component 363 : intact suction leg junction 2 *
*****
3630000 slj2 sngljun
3630101 362010002 364010001 0. 0.05 0.05 000000
3630201 0 0. 0. 0.
*

```

```

*****
* component 364 : intact suction leg 2 *
*****
3640000 sl2 pipe * name
3640001 1 * number of volume
3640101 0. 1 * flow area of volume
*3640201 no junction * flow area of junction
3640301 7.0e-1 1 * flow length
3640401 2.7094e-3 1 * volume of volume
3640501 -135. 1 * azimuthal angle
3640601 0. 1 * inclination angle
*3640701 elevation change
3640801 4.572e-4 70.2e-3 1 * roughness, hyd. dia.
*3640901 no junction * loss coeff.
3641001 00000 1 * flag of volume
*3641101 no junction * flag of junction
3641201 003 800099. 435.15 0. 0. 0. 1 * i.c. of volume
*3641300 no junction * i.c. ctrl word of junction
*3641301 no junction * i.c. of junction
*
*****
* component 365 : intact suction leg junction 3 *
*****
3650000 slj3 sngljun
3650101 364010002 370010001 1.2110e-3 3.05 3.05 000100
3650201 0 0. 0. 0.
*
*****
* component 370 : intact discharge leg 1 *
*****
3700000 dl1 pipe * name
3700001 1 * number of volume
3700101 0. 1 * flow area of volume
*3700201 no junction * flow area of junction
3700301 6.5e-1 1 * flow length
3700401 2.5158e-3 1 * volume of volume
3700501 0. 1 * azimuthal angle
3700601 90. 1 * inclination angle
*3700701 elevation change
3700801 4.572e-4 70.2e-3 1 * roughness, hyd. dia.
*3700901 no junction * loss coeff.
3701001 00000 1 * flag of volume
*3701101 no junction * flag of junction

```

```

3701201 003 830099. 435.15 0. 0. 0. 1 * i.c. of volume
*3701300 no junction * i.c. ctrl word of junction
*3701301 no junction * i.c. of junction
*
*****
* component 370 : intact loop - pump *
*****
**3700000 ipump pump *
**3700101 0. 6.5e-1 2.5158e-3 0. 90. 6.5e-1 00000
**3700108 364010002 0. 0. 0. 000000
**3700109 372010001 1.9e-5 100. 10000. 000100
**3700200 003 800099. 415.15 0.0
**3700201 1 3. 0.0 0.0
**3700202 1 3. 0.0 0.0
**3700301 -1 -1 -2 -1 -1 503 0
**3700302 50. 1.0057 1. 20. 1.1498e3 1.0284e4 990.
*typpwr 124.51 1.0057 16.761 84.43 1.1498e5 1.0284e4 990.
**3700303 0. 0. 3.2541e3 0.0 0.0
*
*****
* component 371 : intact discharge leg junction 1 *
*****
**3710000 dlj1 sngljun
**3710101 370010002 372010001 0. 0.05 0.05 000000
**3710201 0 0. 0. 0.
*
*****
* component 372 : intact discharge leg 2 *
*****
3720000 dl2 pipe * name
3720001 1 * number of volume
3720101 0. 1 * flow area of volume
*3720201 no junction * flow area of junction
3720301 2.9e-1 1 * flow length
3720401 1.1224e-3 1 * volume of volume
3720501 175. 1 * azimuthal angle
3720601 0. 1 * inclination angle
*3720701 elevation change
3720801 4.572e-4 70.2e-3 1 * roughness, hyd. dia.
*3720901 no junction * loss coeff.
3721001 00000 1 * flag of volume
*3721101 no junction * flag of junction
3721201 003 830099. 435.15 0. 0. 0. 1 * i.c. of volume

```

```

*3721300 no junction * i.c. ctrl word of junction
*3721301 no junction * i.c. of junction
*
*****
* component 373 : intact discharge leg junction 2 *
*****
3730000 dlj2 sngljun
3730101 372010002 374010001 0. 0. 0. 000000
3730201 0 0. 0. 0.
*
*****
* component 374 : intact discharge leg 3 *
*****
3740000 dl3 pipe * name
3740001 1 * number of volume
3740101 0. 1 * flow area of volume
*3740201 no junction * flow area of junction
3740301 6.85e-1 1 * flow length
3740401 2.6513e-3 1 * volume of volume
3740501 175. 1 * azimuthal angle
3740601 0. 1 * inclination angle
*3740701 elevation change
3740801 4.572e-4 70.2e-3 1 * roughness, hyd. dia.
*3740901 no junction * loss coeff.
3741001 00000 1 * flag of volume
*3741101 no junction * flag of junction
3741201 003 830099. 435.15 0. 0. 0. 1 * i.c. of volume
*3741300 no junction * i.c. ctrl word of junction
*3741301 no junction * i.c. of junction
*
*****
* component 375 : intact discharge leg junction 3 *
*****
3750000 dlj3 sngljun
3750101 374010002 376010001 0. 0.01 0.01 000000
3750201 0 0. 0. 0.
*
*****
* component 376 : intact discharge leg 4 *
*****
3760000 dl4 pipe * name
3760001 1 * number of volume
3760101 0. 1 * flow area of volume

```

```

*3760201 no junction          * flow area of junction
3760301 2.7e-1 1              * flow length
3760401 1.0450e-3 1          * volume of volume
3760501 -60. 1               * azimuthal angle
3760601 0. 1                 * inclination angle
*3760701 elevation change
3760801 4.572e-4 70.2e-3 1   * roughness, hyd. dia.
*3760901 no junction          * loss coeff.
3761001 00000 1             * flag of volume
*3761101 no junction          * flag of junction
3761201 003 830099. 435.15 0. 0. 0. 1 * i.c. of volume
*3761300 no junction          * i.c. ctrl word of junction
*3761301 no junction          * i.c. of junction
*
*****
* component 400 : broken hot leg section 1
*****
*
4000000 bhot1 pipe           * name
4000001 1                    * number of volume
4000101 0. 1                 * flow area of volume
*4000201 no junction          * flow area of junction
4000301 2.0e-1 1             * flow length
*4000401 8.6901e-4 1          * volume of volume
4000501 180. 1               * azimuthal angle
4000601 0. 1                 * inclination angle
4000701 0. 1                 * elevation change
4000801 4.572e-4 7.4196e-2 1 * roughness, hyd. dia.
*4000901 no junction          * loss coeff.
4001001 00000 1             * flag of volume
*4001101 no junction          * flag of junction
4001201 003 800099. 440.15 0. 0. 0. 1 * i.c. of volume
*4001300 no junction          * i.c. ctrl word of junction
*4001301 no junction          * i.c. ctrl word of junction
*
*****
* component 401 : broken hot leg junction 1
*****
*
4010000 bhj1 sngljun
4010101 400010002 410010001 0. 0.003 0.003 000100
4010201 0 0. 0. 0.
*

```

```

*****
* component 410 : broken hot leg section 2
*****
*
4100000 bhot2 pipe           * name
4100001 1                    * number of volume
4100101 0. 1                 * flow area of volume
*4100201 no junction          * flow area of junction
4100301 9.8e-2 1             * flow length
4100401 3.4638e-4 1          * volume of volume
4100501 180. 1               * azimuthal angle
4100601 0. 1                 * inclination angle
*4100701 elevation change
4100801 4.572e-4 6.703e-2 1 * roughness, hyd. dia.
*4100901 no junction          * loss coeff.
4101001 00000 1             * flag of volume
*4101101 no junction          * flow area of junction
4101201 003 800099. 440.15 0. 0. 0. 1 * i.c. of volume
*4101300 no junction          * i.c. ctrl word of junction
*4101301 no junction          * i.c. ctrl word of junction
*
*****
* component 411 : broken hot leg separation valve
*****
*
4110000 spavlv sngljun
4110101 410010001 420010000 0. 0.01 0.01 000100
4110201 0 0.0 0.0 0.0
*4110300 trpvlv
*4110301 1
*
*****
* component 420 : broken hot leg section 3
*****
*
4200000 bhot3 pipe           * name
4200001 1                    * number of volume
4200101 0. 1                 * flow area of volume
*4200201 no junction          * flow area of junction
4200301 9.7e-2 1             * flow length
4200401 3.1940e-4 1          * volume of volume
4200501 180. 1               * azimuthal angle
4200601 0. 1                 * inclination angle
*4200701 elevation change

```



```

4200801 4.572e-4 6.6997e-2 1 * roughness, hyd. dia.
*4200901 no junction * loss coeff.
4201001 00000 1 * flag of volume
*4201101 no junction * flow area of junction
4201201 003 800099. 440.15 0. 0. 0. 1 * i.c. of volume
*4201300 no junction * i.c. ctrl word of junction
*4201301 no junction * i.c. ctrl word of junction
*
*****
* component 421 : broken hot leg junction 2 *
*****
*
4210000 bhj2 sngljun
4210101 420010002 430010001 0. 0. 0. 000000
4210201 0 0. 0. 0.
*
*
*****
* component 430 : broken hot leg section 4 *
*****
*
4300000 bhot4 pipe * name
4300001 1 * number of volume
4300101 0. 1 * flow area of volume
*4300201 no junction * flow area of junction
4300301 1.3e-1 1 * flow length
4300401 5.0317e-4 1 * volume of volume
4300501 180. 1 * azimuthal angle
4300601 0. 1 * inclination angle
*4300701 elevation change
4300801 4.572e-4 70.2e-3 1 * roughness, hyd. dia.
*4300901 no junction * loss coeff.
4301001 00000 1 * flag of volume
*4301101 no junction * flow area of junction
4301201 003 800099. 440.15 0. 0. 0. 1 * i.c. of volume
*4301300 no junction * i.c. ctrl word of junction
*4301301 no junction * i.c. of junction
*
*****
* component 431 : broken hot leg junction 3 *
*****
*
4310000 bhj3 sngljun

```

```

4310101 430010002 440010003 0. 0.4 0.25 000102
4310201 0 0. 0. 0.
*
*****
* component 440 : broken loop u tube inlet *
*****
*
4400000 bltube-i pipe * name
4400001 1 * number of volume
4400101 3.9961e-2 1 * flow area of volume
*4400201 no junction * flow area of junction
4400301 100.0e-3 1 * flow length
4400401 0. 1 * volume of volume
4400501 0. 1 * azimuthal angle
4400601 0. 1 * inclination angle
4400701 0.0e-3 1
4400801 4.572e-4 194.9139e-3 1 * roughness, hyd. dia.
*4400901 no junction * loss coeff.
4401001 00000 1 * flag of volume
*4401101 no junction * flag of junction
4401201 003 800099. 440.15 0. 0. 0. 1 * i.c. of volume
*4401300 no junction * i.c. ctrl word of junction
*4401301 no junction * i.c. of junction
*
*****
* component 441 : broken u tube inlet junction 1 *
*****
*
4410000 btub_ij1 sngljun
4410101 440010002 450010001 0. 17. 26. 000100
4410201 0 0. 0. 0.
*
*****
* component 443 : broken u tube inlet junction 2 *
*****
*
4430000 btub_ij2 sngljun
4430101 440010002 452010001 0. 17. 26. 000100
4430201 0 0. 0. 0.
*
*****
* component 450 : broken u tube 1 *
*****

```

```

*
4500000 btub1 pipe          * name
4500001 8                   * number of volume
4500101 2.2682e-3 8        * flow area of volume
4500201 0. 7               * flow area of junction
4500301 4.1e-1 8           * flow length
4500401 0. 8               * volume of volume
4500501 0. 8               * azimuthal angle
4500601 90. 4              * inclination angle
4500602 -90. 8
*4500701 elevation change
4500801 4.572e-4 19.0e-3 8 * roughness, hyd. dia.
4500901 0. 0. 3           * loss coeff.
4500902 0.42 0.42 4
4500903 0. 0. 7
4501001 00000 8           * flag of volume
4501101 000000 7          * flag of junction
4501201 003 800099. 438.15 0. 0. 0. 8 * i.c. of volume
4501300 0                   * i.c. ctrl word of junction
4501301 0.0 0.0 0. 7      * i.c. of junction
*
*****
* component 452 : broken u tube 2
*****
*
4520000 btub2 pipe          * name
4520001 8                   * number of volume
4520101 2.2682e-3 8        * flow area of volume
4520201 0. 7               * flow area of junction
4520301 4.1e-1 8           * flow length
4520401 0. 8               * volume of volume
4520501 0. 8               * azimuthal angle
4520601 90. 4              * inclination angle
4520602 -90. 8
*4520701 elevation change
4520801 4.572e-4 19.0e-3 8 * roughness, hyd. dia.
4520901 0. 0. 3           * loss coeff.
4520902 0.42 0.42 4
4520903 0. 0. 7
4521001 00000 8           * flag of volume
4521101 000000 7          * flag of junction
4521201 003 800099. 438.15 0. 0. 0. 8 * i.c. of volume
4521300 0                   * i.c. ctrl word of junction

```

```

4521301 0.0 0.0 0. 7      * i.c. of junction
*
*****
* component 451 : broken u tube outlet junction 1
*****
*
4510000 btub_oj1 sngljun
4510101 450080002 460010001 0. 26. 17. 000100
4510201 0 0. 0. 0.
*
*****
* component 453 : broken u tube outlet junction 2
*****
*
4530000 btub_oj2 sngljun
4530101 452080002 480010001 0. 26. 17. 000100
4530201 0 0. 0. 0.
*
*****
* component 460 : broken loop u tube outlet 1
*****
*
4600000 blub-o1 pipe        * name
4600001 1                   * number of volume
4600101 1.9830e-2 1         * flow area of volume
4600201 no junction         * flow area of junction
4600301 100.0e-3 1         * flow length
4600401 0. 1               * volume of volume
4600501 180. 1             * azimuthal angle
4600601 0. 1               * inclination angle
*4600701 elevation change
4600801 4.572e-4 194.9139e-3 1 * roughness, hyd. dia.
4600901 no junction        * loss coeff.
4601001 00000 1           * flag of volume
4601101 no junction        * flag of junction
4601201 003 800099. 435.15 0. 0. 0. 1 * i.c. of volume
4601300 no junction        * i.c. ctrl word of junction
4601301 no junction        * i.c. of junction
*
*****
* component 461 : broken suction leg junction 1-1
*****
*

```

4610000 slj1-1 sngljun
 4610101 460010004 462010001 0. 0.25 0.40 000102
 4610201 0 0. 0. 0.

*

* component 480 : broken loop u tube outlet 2

*

4800000 bltub-o2 pipe * name
 4800001 1 * number of volume
 4800101 1.9830e-2 1 * flow area of volume
 *4800201 no junction * flow area of junction
 4800301 100.0e-3 1 * flow length
 4800401 0. 1 * volume of volume
 4800501 180. 1 * azimuthal angle
 4800601 0. 1 * inclination angle
 4800701 0.0e-3 1
 4800801 4.572e-4 194.9139e-3 1 * roughness, hyd. dia.
 *4800901 no junction * loss coeff.
 4801001 00000 1 * flag of volume
 *4801101 no junction * flow area of junction
 4801201 003 800099. 435.15 0. 0. 0. 1 * i.c. of volume
 *4801300 no junction * i.c. ctrl word of junction
 *4801301 no junction * i.c. of junction

*

* component 481 : broken suction leg junction 2-1

*

4810000 slj1-1 sngljun
 4810101 480010004 482010001 0. 0.25 0.4 000102
 4810201 0 0. 0. 0.

*

* component 462 : broken loop suction leg 1-1

*

4620000 bsuc1-1 pipe * name
 4620001 1 * number of volume
 4620101 0. 1 * flow area of volume
 *4620201 no junction * flow area of junction
 4620301 2.5456e-1 1 * flow length
 4620401 6.0259e-4 1 * volume of volume

4620501 -135. 1 * azimuthal angle
 4620601 -45. 1 * inclination angle

*4620701 elevation change

4620801 4.572e-4 54.9e-3 1 * roughness, hyd. dia.

*4620901 no junction * loss coeff.

4621001 00000 1 * flag of volume

*4621101 no junction * flow area of junction

4621201 003 800099. 435.15 0. 0. 0. 1 * i.c. of volume

*4621300 no junction * i.c. ctrl word of junction

*4621301 no junction * i.c. of junction

*

* component 463 : broken suction leg junction 1-2

*

4630000 slj1-2 sngljun
 4630101 462010002 464010001 0. 0.001 0.001 000000
 4630201 0 0. 0. 0.

*

* component 464 : broken loop section leg 1-2

*

4640000 bsuc11-2 pipe * name
 4640001 1 * number of volume
 4640101 0. 1 * flow area of volume
 *4640201 no junction * flow area of junction
 4640301 2.45e-1 1 * flow length
 4640401 6.3996e-4 1 * volume of volume
 4640501 0. 1 * azimuthal angle
 4640601 -90. 1 * inclination angle

*4640701 elevation change

4640801 4.572e-4 5.7545e-2 1 * roughness, hyd. dia.

*4640901 no junction * loss coeff.

4641001 00000 1 * flag of volume

*4641101 no junction * flow area of junction

4641201 003 800099. 435.15 0. 0. 0. 1 * i.c. of volume

*4641300 no junction * i.c. ctrl word of junction

*4641301 no junction * i.c. ctrl of junction

*

* component 465 : broken suction leg junction 1-3

```

*
4650000 slj1-3 sngljun
4650101 464010002 466010001 0. 0.05 0.05 000000
4650201 0 0. 0. 0.
*
*****
* component 466 : broken loop suction leg 1-3
*****
*
4660000 bsuc11-3 pipe          * name
4660001 1                      * number of volume
4660101 0.                      * flow area of volume
*4660201 no junction           * flow area of junction
4660301 5.1e-1 1                * flow length
4660401 1.2073e-3 1             * volume of volume
4660501 -45. 1                  * azimuthal angle
4660601 -3.3723 1               * inclination angle
*4660701 elevation change
4660801 4.572e-4 54.9e-3 1      * roughness, hyd. dia.
*4660901 no junction           * loss coeff.
4661001 00000 1                * flag of volume
*4661101 no junction           * flow area of junction
4661201 003 800099. 435.15 0.  * i.c. of volume
*4661300 no junction           * i.c. ctrl word of junction
*4661301 no junction           * i.c. of junction
*
*****
* component 467 : broken suction leg junction 1-4
*****
*
4670000 slj1-4 sngljun
4670101 466010002 470010001 0. 0.05 0.05 000000
4670201 0 0. 0. 0.
*
*****
* component 470 : broken loop pump volume 1
*****
*
4700000 pumpv1 pipe            * name
4700001 1                      * number of volume
4700101 0.                      * flow area of volume
*4700201 no junction           * flow area of junction
4700301 4.55e-1 1              * flow length

```

```

4700401 9.3958e-4 1            * volume of volume
4700501 0. 1                    * azimuthal angle
4700601 90. 1                   * inclination angle
*4700701 elevation change
4700801 4.572e-4 5.2974e-2 1    * roughness, hyd. dia.
*4700901 no junction           * loss coeff.
4701001 00000 1                 * flag of volume
*4701101 no junction           * flag of junction
4701201 003 800099. 435.15 0.  * i.c. of volume
*4701300 no junction           * i.c. ctrl word of junction
*4701301 no junction           * i.c. of junction
*
*****
* component 470 : broken loop - pump 1
*****
**4700000 ipump pump
**4700101 0. 4.55e-1 9.3958e-4 -45. 90. 4.55e-1 00000
**4700108 466010002 0. 0. 0. 000000
**4700109 472010001 1.3e-5 100. 710000. 000100
**4700200 003 800099. 415.15 0.0
**4700201 1 3. 0.0 0.0
**4700202 1 3. 0.0 0.0
**4700301 -1 -1 -2 -1 -1 503 0
**4700302 50. 1.0057 1. 20. 1.1498e3 1.0284e4 990.
*typpwr 124.51 1.0057 16.761 84.43 1.1498e5 1.0284e4 990.
**4700303 0. 0. 3.2541e3 0.0 0.0
*
*****
* component 471 : broken discharge leg junction 1-1
*****
*
**4710000 dlj1-1 sngljun
**4710101 470010002 472010001 0. 0.1 0.1 000000
**4710201 0 0. 0. 0.
*
*****
* component 472 : broken loop discharge leg 1-1
*****
*
4720000 dis1-1 pipe            * name
4720001 1                      * number of volume
4720101 0. 1                    * flow area of volume
*4720201 no junction           * flow area of junction

```

```

4720301 2.95e-1 1 * flow length
4720401 6.9832e-4 1 * volume of volume
4720501 15. 1 * azimuthal angle
4720601 0. 1 * inclination angle
*4720701 elevation change
4720801 4.572e-4 54.9e-3 1 * roughness, hyd. dia.
*4720901 no junction * loss coeff.
4721001 00000 1 * flag of volume
*4721101 no junction * flow area of junction
4721201 003 830099. 435.15 0. 0. 0. 1 * i.c. of volume
*4721300 no junction * i.c. ctrl word of junction
*4721301 no junction * i.c. of junction
*
*****
* component 473 : broken discharge leg junction 1-2 *
*****
*
4730000 dlj1-2 sngljun
4730101 472010002 474010001 0. 0. 0. 000000
4730201 0 0. 0. 0.
*
*****
* component 474 : broken loop discharge leg 1-2 *
*****
*
4740000 disl1-2 pipe * name
4740001 1 * number of volume
4740101 0. 1 * flow area of volume
*4740201 no junction * flow area of junction
4740301 4.15e-1 1 * flow length
4740401 9.8239e-4 1 * volume of volume
4740501 15. 1 * azimuthal angle
4740601 0. 1 * inclination angle
4740701 0. 1 * elevation change
4740801 4.572e-4 54.9e-3 1 * roughness, hyd. dia.
*4740901 no junction * loss coeff.
4741001 00000 1 * flag of volume
*4741101 no junction * flow area of junction
4741201 003 830099. 435.15 0. 0. 0. 1 * i.c. of volume
*4741300 no junction * i.c. ctrl word of junction
*4741301 no junction * i.c. of junction
*
*****
* component 475 : broken discharge leg junction 1-3 *
*****
*
4750000 dlj1-3 sngljun
4750101 474010002 476010001 0. 0.005 0.005 000000
4750201 0 0. 0. 0.
*
*****
* component 476 : broken loop discharge leg 1-3 *
*****
*
4760000 disl1-3 pipe * name
4760001 1 * number of volume
4760101 0. 1 * flow area of volume
*4760201 no junction * flow area of junction
4760301 2.0e-1 1 * flow length
4760401 4.7344e-4 1 * volume of volume
4760501 60. 1 * azimuthal angle
4760601 0. 1 * inclination angle
*4760701 elevation change
4760801 4.572e-4 54.9e-3 1 * roughness, hyd. dia.
*4760901 no junction * loss coeff.
4761001 00000 1 * flag of volume
*4761101 no junction * flow area of junction
4761201 003 830099. 435.15 0. 0. 0. 1 * i.c. of volume
*4761300 no junction * i.c. ctrl word of junction
*4761301 no junction * i.c. of junction
*
*****
* component 482 : broken loop suction leg 2-1 *
*****
*
4820000 bsuc2-1 pipe * name
4820001 1 * number of volume
4820101 0. 1 * flow area of volume
*4820201 no junction * flow area of junction
4820301 2.5456e-1 1 * flow length
4820401 6.0259e-4 1 * volume of volume
4820501 135. 1 * azimuthal angle
4820601 -45. 1 * inclination angle
*4820701 elevation change
4820801 4.572e-4 54.9e-3 1 * roughness, hyd. dia.
*4820901 no junction * loss coeff.

```

```

4821001 (XXXX) 1 * flag of volume
*4821101 no junction * flow area of junction
4821201 003 800099. 435.15 0. 0. 0. 1 * i.c. of volume
*4821300 no junction * i.c. ctrl word of junction
*4821301 no junction * i.c. of junction
*
*****
* component 483 : broken suction leg junction 2-2 *
*****
*
4830000 slj2-2 sngljun
4830101 482010002 484010001 0. 0.001 0.001 000000
4830201 0 0. 0. 0.
*
*****
* component 484 : broken loop section leg 2-2 *
*****
*
4840000 bsuc12-2 pipe * name
4840001 1 * number of volume
4840101 0. 1 * flow area of volume
*4840201 no junction * flow area of junction
4840301 2.45e-1 1 * flow length
4840401 6.3996e-4 1 * volume of volume
4840501 0. 1 * azimuthal angle
4840601 -90. 1 * inclination angle
*4840701 elevation change
4840801 4.572e-4 5.7545e-2 1 * roughness, hyd. dia.
*4840901 no junction * loss coeff.
4841001 (XXXX) 1 * flag of volume
*4841101 no junction * flow area of junction
4841201 003 800099. 435.15 0. 0. 0. 1 * i.c. of volume
*4841300 no junction * i.c. ctrl word of junction
*4841301 no junction * i.c. ctrl of junction
*
*****
* component 485 : broken suction leg junction 2-3 *
*****
*
4850000 slj2-3 sngljun
4850101 484010002 486010001 0. 0.05 0.05 000000
4850201 0 0. 0. 0.
*

```

```

*****
* component 486 : broken loop suction leg 2-3 *
*****
*
4860000 bsuc12-3 pipe * name
4860001 1 * number of volume
4860101 0. 1 * flow area of volume
*860201 no junction * flow area of junction
4860301 5.1e-01 1 * flow length
4860401 1.2073e-3 1 * volume of volume
4860501 -45. 1 * azimuthal angle
4860601 -3.3723 1 * inclination angle
*4860701 elevation change
4860801 4.572e-4 54.9e-3 1 * roughness, hyd. dia.
*4860901 no junction * loss coeff.
4861001 00000 1 * flag of volume
*4861101 no junction * flow area of junction
4861201 003 800099. 435.15 0. 0. 0. 1 * i.c. of volume
*4861300 no junction * i.c. ctrl word of junction
*4861301 no junction * i.c. of junction
*
*****
* component 487 : broken suction leg junction 2-4 *
*****
*
4870000 slj2-4 sngljun
4870101 486010002 490010001 0. 0.05 0.05 000000
4870201 0 0. 0. 0.
*
*****
* component 490 : broken loop pump volume 2 *
*****
*
4900000 pumpv1 pipe * name
4900001 1 * number of volume
4900101 0. 1 * flow area of volume
*4900201 no junction * flow area of junction
4900301 4.55e-1 1 * flow length
4900401 9.3958e-4 1 * volume of volume
4900501 0. 1 * azimuthal angle
4900601 90. 1 * inclination angle
*4900701 elevation change
4900801 4.572e-4 5.2974e-2 1 * roughness, hyd. dia.

```

*4900901 no junction * loss coeff.
 4901001 00000 1 * flag of volume
 *4901101 no junction * flag of junction
 4901201 003 800099. 435.15 0. 0. 0. 1 * i.c. of volume
 *4901300 no junction * i.c. ctrl word of junction
 *4901301 no junction * i.c. of junction

* component 490 : broken loop - pump 2 *

 **4900000 ipump pump
 **4900101 0. 4.55e-1 9.3958e-4 -45. 90. 4.55e-1 00000
 **4900108 486010002 0. 0. 0. 000000
 **4900109 492010001 1.3e-5 100. 10000. 000100
 **4900200 003 800099. 415.15 0.0
 **4900201 1 3. 0.0 0.0
 **4900202 1 3. 0.0 0.0
 **4900301 -1 -1 -2 -1 -1 503 0
 **4900302 50. 1.0057 1. 20. 1.1498e3 1.0284e4 990.
 **4900303 0. 0. 3.2541e3 0.0 0.0

* component 491 : broken discharge leg junction 2-1 *

*
 **4910000 dlj2-1 sngljun
 **4910101 490010002 492010001 0. 0.05 0.05 000000
 **4910201 0 0. 0. 0.

* component 492 : broken loop discharge leg 2-1 *

*
 4920000 disl2-1 pipe * name
 4920001 1 * number of volume
 4920101 0. 1 * flow area of volume
 *4920201 no junction * flow area of junction
 4920301 2.95e-1 1 * flow length
 4920401 6.9832e-4 1 * volume of volume
 4920501 -15. 1 * azimuthal angle
 4920601 0. 1 * inclination angle
 *4920701 elevation change
 4920801 4.572e-4 54.9e-3 1 * roughness, hyd. dia.

*4920901 no junction * loss coeff.
 4921001 00000 1 * flag of volume
 *4921101 no junction * flow area of junction
 4921201 003 830099. 435.15 0. 0. 0. 1 * i.c. of volume
 *4921300 no junction * i.c. ctrl word of junction
 *4921301 no junction * i.c. of junction

* component 493 : broken discharge leg junction 2-2 *

 *
 4930000 dlj2-2 sngljun
 4930101 492010002 494010001 0. 0. 0. 000000
 4930201 0 0. 0. 0.

* component 494 : broken loop discharge leg 2-2 *

*
 4940000 disl2-2 pipe * name
 4940001 1 * number of volume
 4940101 0. 1 * flow area of volume
 *4940201 no junction * flow area of junction
 4940301 4.15e-1 1 * flow length
 4940401 9.8239e-4 1 * volume of volume
 4940501 -15. 1 * azimuthal angle
 4940601 0. 1 * inclination angle
 4940701 0. 1 * elevation change
 4940801 4.572e-4 54.9e-3 1 * roughness, hyd. dia.
 *4940901 no junction * loss coeff.
 4941001 00000 1 * flag of volume
 *4941101 no junction * flow area of junction
 4941201 003 830099. 435.15 0. 0. 0. 1 * i.c. of volume
 *4941300 no junction * i.c. ctrl word of junction
 *4941301 no junction * i.c. of junction

* component 495 : broken discharge leg junction 2-3 *

*
 4950000 dlj2-3 sngljun
 4950101 494010002 496010001 0. 0.005 0.005 000000
 4950201 0 0. 0. 0.

```

*
*****
* component 496 : broken loop discharge leg 2-3
*****
*
4960000 disl1-3 pipe * name
4960001 1 * number of volume
4960101 0. 1 * flow area of volume
*4960201 no junction * flow area of junction
4960301 2.0e-1 1 * flow length
4960401 4.7344e-4 1 * volume of volume
4960501 -60. 1 * azimuthal angle
4960601 0. 1 * inclination angle
*4960701 elevation change
4960801 4.572e-4 54.9e-3 1 * roughness, hyd. dia.
*4960901 no junction * loss coeff.
4961001 00000 1 * flag of volume
*4961101 no junction * flow area of junction
4961201 003 830099. 435.15 0. 0. 0. 1 * i.c. of volume
*4961300 no junction * i.c. ctrl word of junction
*4961301 no junction * i.c. of junction
*
*-----*
* secondary system *
*-----*
*
*****
* component 600 : virtual feedwater volume a
*****
6000000 feed_a tmdpvol
6000101 0.0 100.0 1.0e6 0.0 0. 4.572e-4 0.0 00000
6000200 003
6000201 0.0 550500. 420.
*
*****
* component 601 : feed water pump junction a 1
*****
*
6010000 feed_ja1 tmdpjun
6010101 600010002 602010001 0.
6010200 1 501 cntrlvar 006 * mass flow rate
6010201 0. 0. 0. 0.
6010202 1.0e6 1.0e6 0. 0.

```

```

*
*****
* component 602 : sg downcomer a
*****
*
6020000 sg_dc_a annulus * name
6020001 5 * number of volume
6020101 4.7024e-2 5 * flow area of volume
6020201 4.7024e-2 4 * flow area of junction
6020301 95.0e-3 1 * flow length
6020302 410.0e-3 5
6020401 0. 5 * volume of volume
6020501 0. 5 * azimuthal angle
6020601 -90. 5 * inclination angle
*6020701 elevation change
6020801 4.572e-4 51.0e-3 5 * roughness, hyd. dia.
6020901 0. 0. 4 * loss coeff.
6021001 00000 5 * flag of volume : pybfc
6021101 000000 4 * flag of junction : fvcahs
6021201 003 530500. 420. 0. 0. 0. 5 * i.c. of volume
6021300 0 * i.c. ctrl word of junction
6021301 0.0 0.0 0. 4 * i.c. of junction
*
*****
* component 603 : feed water pump junction a 2
*****
*
6030000 sg_dc_ja sngljun
6030101 602050002 610010001 0. 0.5 0.5 000100
6030201 0 5.0e-3 5.0e-3 0.
*
*****
* component 610 : steam generator a shell
*****
*
6100000 sg-a-sh pipe * name
6100001 4 * number of volume
6100101 4.9376e-2 4 * flow area of volume
6100201 0. 3 * flow area of junction
6100301 4.1e-1 4 * flow length
6100401 0. 4 * volume of volume
6100501 0. 4 * azimuthal angle
6100601 90. 4 * inclination angle

```



```

*6100701 elevation change
6100801 4.572e-4 105.133e-3 4 * roughness, hyd. dia.
6100901 0.5 0.5 3 * loss coeff.
6101001 00000 4 * flag of volume : pvbfe
6101101 000000 3 * flag of junction : fvcchs
6101201 003 530500. 420. 0. 0. 0. 3 * i.c. of volume
6101202 002 530500. 0. 0. 0. 0. 4
6101300 0 * i.c. ctrl word of junction
6101301 0.0 0.0 0. 3 * i.c. of junction
*
*****
* component 611 : steam generator a junction 1 *
*****
6110000 sg_a_j1 sngljun
6110101 610040002 620010001 0. 0.1 0.1 000100
6110201 0 5.0e-3 5.0e-3 0.
*
*****
* component 620 : steam generator a top shell *
*****
6200000 sg-a-tsh pipe * name
6200001 1 * number of volume
6200101 5.3913e-2 1 * flow area of volume
*6200201 no junction * flow area of junction
6200301 95.0e-3 1 * flow length
6200401 0. 1 * volume of volume
6200501 0. 1 * azimuthal angle
6200601 90. 1 * inclination angle
*6200701 elevation change
6200801 4.572e-4 262.0e-3 1 * roughness, hyd. dia.
*6200901 no junction * loss coeff.
6201001 00000 1 * flag of volume
*6201101 no junction * flag of junction
6201201 002 530500. 0. 0. 0. 0. 1 * i.c. of volume
*6201300 no junction * i.c. ctrl word of junction
*6201301 no junction * i.c. of junction
*
*****
* component 621 : steam generator a junction 2 *
*****
*
6210000 sg_a_j2 sngljun
6210101 620010002 630010001 0. 0.1 0.1 000100
6210201 0 0. 0. 0.
*
*****
* component 630 : steam generator a upper plenum 1 *
*****
*
6300000 sg-a-up1 pipe * name
6300001 1 * number of volume
6300101 7.9923e-2 1 * flow area of volume
*6300201 no junction * flow area of junction
6300301 215.0e-3 1 * flow length
6300401 0. 1 * volume of volume
6300501 0. 1 * azimuthal angle
6300601 90. 1 * inclination angle
*6300701 elevation change
6300801 4.572e-4 319.0e-3 1 * roughness, hyd. dia.
*6300901 no junction * loss coeff.
6301001 00000 1 * flag of volume
*6301101 no junction * flag of junction
6301201 002 550500. 0. 0. 0. 0. 1 * i.c. of volume
*6301300 no junction * i.c. ctrl word of junction
*6301301 no junction * i.c. of junction
*
*****
* component 631 : steam generator a exit *
*****
*
6310000 sg_a_ext sngljun
6310101 630010002 650010001 0. 0.2 0.4 000100
6310201 0 0. 0. 0.
*
*****
* component 650 : steam line a 1 *
*****
*
6500000 sline-a1 pipe * name
6500001 1 * number of volume
6500101 6.1575e-4 1 * flow area of volume
*6500201 no junction * flow area of junction
6500301 640.0e-3 1 * flow length
6500401 0. 1 * volume of volume

```

```

6500501 0.      1          * azimuthal angle
6500601 90.     1          * inclination angle
*6500701 elevation change
6500801 4.572e-4 28.0e-3 1      * roughness, hyd. dia.
*6500901 no junction * loss coeff.
6501001 00000 1          * flag of volume
*6501101 no junction * flag of junction
6501201 002 550500. 1.0 0. 0. 0. 1 * i.c. of volume
*6501300 no junction * i.c. ctrl word of junction
*6501301 no junction * i.c. of junction
*
*****
* component 651 : steam line a junction 1 *
*****
*
6510000 sl-a-j1 sngljun
6510101 650010002 660010001 0. 0.05 0.05 000000
6510201 0 0. 0. 0.
*
*****
* component 660 : steam line a 2 *
*****
*
6600000 sline-a2 pipe * name
6600001 1 * number of volume
6600101 6.1575e-4 1 * flow area of volume
*6600201 no junction * flow area of junction
6600301 1.269 1 * flow length
6600401 0. 1 * volume of volume
6600501 180. 1 * azimuthal angle
6600601 0. 1 * inclination angle
*6600701 elevation change
6600801 4.572e-4 28.0e-3 1 * roughness, hyd. dia.
*6600901 no junction * loss coeff.
6601001 00000 1 * flag of volume
*6601101 no junction * flag of junction
6601201 002 550500. 1. 0. 0. 0. 1 * i.c. of volume
*6601300 no junction * i.c. ctrl word of junction
*6601301 no junction * i.c. of junction
*
*****
* component 661 : steam line a junction 2 *
*****

```

```

*
6610000 sl-a-j2 sngljun
6610101 660010002 800010002 0. 0. 0. 000000
6610201 0 0. 0. 0.
*
*****
* component 700 : virtual feedwater volume b *
*****
7000000 feed_b tmdpvol
7000101 0.0 100.0 1.0e6 0.0 0. 0. 4.572e-4 0.0 00000
7000200 003
7000201 0.0 550500. 420.
*
*****
* component 701 : feed water pump junction b 1 *
*****
*
7010000 feed_jb1 tmdpjun
7010101 700010002 702010001 0.
7010200 1 501 ctrlvar 009 * mass flow rate
7010201 0. 0. 0. 0.
7010202 1.0e6 1.0e6 0. 0.
*
*****
* component 702 : sg downcomer b *
*****
7020000 sg_dc_b annulus * name
7020001 5 * number of volume
7020101 4.7024e-2 5 * flow area of volume
7020201 4.7024e-2 4 * flow area of junction
7020301 95.0e-3 1 * flow length
7020302 410.0e-3 5
7020401 0. 5 * volume of volume
7020501 0. 5 * azimuthal angle
7020601 -90. 5 * inclination angle
*7020701 elevation change
7020801 4.572e-4 51.0e-3 5 * roughness, hyd. dia.
7020901 0. 0. 4 * loss coeff.
7021001 00000 5 * flag of volume : pvbfe
7021101 000000 4 * flag of junction : fvcchs
7021201 003 530500. 420. 0. 0. 0. 5 * i.c. of volume
7021300 0 * i.c. ctrl word of junction

```

```

7021301 0.0 0.0 0. 4 * i.c. of junction
*
*****
* component 703 : steam generator downcomer junction *
*****
7030000 sg_dc_jb sngljun
7030101 702050002 710010001 0. 0.5 0.5 000100
7030201 0 5.0e-3 5.0e-3 0.
*
*****
* component 710 : steam generator b shell *
*****
7100000 sg-b-sh pipe * name
7100001 4 * number of volume
7100101 4.9376e-2 4 * flow area of volume
7100201 0. 3 * flow area of junction
7100301 4.1e-1 4 * flow length
7100401 0. 4 * volume of volume
7100501 0. 4 * azimuthal angle
7100601 90. 4 * inclination angle
*7100701 elevation change
7100801 4.572e-4 105.133e-3 4 * roughness, hyd. dia.
7100901 0.5 0.5 3 * loss coeff.
7101001 00000 4 * flag of volume : pvbfe
7101101 000000 3 * flag of junction : fvcchs
7101201 003 530500. 420. 0. 0. 0. 3 * i.c. of volume
7101202 002 530500. 0. 0. 0. 0. 4
7101300 0 * i.c. ctrl word of junction
7101301 0.0 0.0 0. 3 * i.c. of junction
*
*****
* component 711 : steam generator b junction 1 *
*****
7110000 sg_b_j1 sngljun
7110101 710040002 720010001 0. 0.1 0.1 000100
7110201 0 5.0e-3 5.0e-3 0.
*
*****
* component 720 : steam generator b top shell *
*****
7200000 sg-b-tsh pipe * name
7200001 1 * number of volume
7200101 5.3913e-2 1 * flow area of volume

*7200201 no junction * flow area of junction
7200301 95.0e-3 1 * flow length
7200401 0. 1 * volume of volume
7200501 0. 1 * azimuthal angle
7200601 90. 1 * inclination angle
*7200701 elevation change
7200801 4.572e-4 262.0e-3 1 * roughness, hyd. dia.
*7200901 no junction * loss coeff.
7201001 00000 1 * flag of volume
*7201101 no junction * flag of junction
7201201 002 530500. 0. 0. 0. 0. 1 * i.c. of volume
*7201300 no junction * i.c. ctrl word of junction
*7201301 no junction * i.c. of junction
*
*****
* component 721 : steam generator b junction 2 *
*****
7210000 sg_b_j2 sngljun
7210101 720010002 730010001 0. 0.1 0.1 000100
7210201 0 0. 0. 0.
*
*****
* component 730 : steam generator b upper plenum *
*****
7300000 sg-b-up pipe * name
7300001 1 * number of volume
7300101 7.9923e-2 1 * flow area of volume
*7300201 no junction * flow area of junction
7300301 215.0e-3 1 * flow length
7300401 0. 1 * volume of volume
7300501 0. 1 * azimuthal angle
7300601 90. 1 * inclination angle
*7300701 elevation change
7300801 4.572e-4 319.0e-3 1 * roughness, hyd. dia.
*7300901 no junction * loss coeff.
7301001 00000 1 * flag of volume
*7301101 no junction * flag of junction
7301201 002 550500. 0. 0. 0. 0. 1 * i.c. of volume
*7301300 no junction * i.c. ctrl word of junction
*7301301 no junction * i.c. of junction
*
*****
* component 731 : steam generator b exit *

```

```

*****
7310000 sg_a_ext sngljun
7310101 730010002 750010001 0. 0.2 0.4 000100
7310201 0 0. 0. 0.
*
*****
* component 750 : steam line b 1
*****
*
7500000 sline-a1 pipe * name
7500001 1 * number of volume
7500101 6.1575e-4 1 * flow area of volume
*7500201 no junction * flow area of junction
7500301 1050.0e-3 1 * flow length
7500401 0. 1 * volume of volume
7500501 0. 1 * azimuthal angle
7500601 90. 1 * inclination angle
*7500701 elevation change
7500801 4.572e-4 28.0e-3 1 * roughness, hyd. dia.
*7500901 no junction * loss coeff.
7501001 00000 1 * flag of volume
*7501101 no junction * flag of junction
7501201 002 550500. 1. 0. 0. 0. 1 * i.c. of volume
*7501300 no junction * i.c. ctrl word of junction
*7501301 no junction * i.c. of junction
*
*****
* component 751 : steam line b junction 1
*****
*
7510000 sl-b-j1 sngljun
7510101 750010002 760010001 0. 0.05 0.05 000000
7510201 0 0. 0. 0.
*
*****
* component 760 : steam line b 2
*****
*
7600000 sline-b2 pipe * name
7600001 1 * number of volume
7600101 6.1575e-4 1 * flow area of volume
*7600201 no junction * flow area of junction
7600301 913.0e-3 1 * flow length

```

```

7600401 0. 1 * volume of volume
7600501 0. 1 * azimuthal angle
7600601 0. 1 * inclination angle
*7600701 elevation change
7600801 4.572e-4 28.0e-3 1 * roughness, hyd. dia.
*7600901 no junction * loss coeff.
7601001 00000 1 * flag of volume
*7601101 no junction * flag of junction
7601201 002 550500. 1. 0. 0. 0. 1 * i.c. of volume
*7601300 no junction * i.c. ctrl word of junction
*7601301 no junction * i.c. of junction
*
*****
* component 761 : steam line b junction 2
*****
*
7610000 sl-b-j2 sngljun
7610101 760010002 800010001 0. 0. 0. 000000
7610201 0 0. 0. 0.
*
*****
* component 800 : steam header
*****
*
8000000 s-header pipe * name
8000001 1 * number of volume
8000101 6.1575e-4 1 * flow area of volume
*8000201 no junction * flow area of junction
8000301 120.0e-3 1 * flow length
8000401 0. 1 * volume of volume
8000501 0. 1 * azimuthal angle
8000601 0. 1 * inclination angle
*8000701 elevation change
8000801 4.572e-4 28.0e-3 1 * roughness, hyd. dia.
*8000901 no junction. 1 * loss coeff.
8001001 00000 1 * flag of volume
*8001101 no junction * flag of junction
8001201 002 550500. 1. 0. 0. 0. 1 * i.c. of volume
*8001300 no junction * i.c. ctrl word of junction
*8001301 no junction * i.c. of junction
*
*****
* component 801 : steam header junction 1
*****

```

```

*****
*
810000 s-hd-j1 sngljun
8010101 800010004 810010001 0. 0.1 0.1 000002 *fvcahs
8010201 0 0. 0. 0.
*
*****
* component 810 : steam header line *
*****
*
8100000 s-headl pipe * name
8100001 1 * number of volume
8100101 6.1575e-4 1 * flow area of volume
*8100201 no junction * flow area of junction
8100301 5.0 1 * flow length
8100401 0. 1 * volume of volume
8100501 -90. 1 * azimuthal angle
8100601 0. 1 * inclination angle
*8100701 elevation change
8100801 4.572e-4 28.0e-3 1 * roughness, hyd. dia.
*8100901 no junction * loss coeff.
8101001 00000 1 * flag of volume
*8101101 no junction * flag of junction
8101201 002 550500. 1. 0. 0. 0. 1 * i.c. of volume
*8101300 no junction * i.c. ctrl word of junction
*8101301 no junction * i.c. of junction
*
*****
* component 811 : steam header junction 2 *
*****
*
8110000 s-hd-j2 sngljun
8110101 810010002 890010001 0. 0. 0. 000100 *fvcahs
8110201 0 0. 0. 0.
*
*****
* component 811 : steam header junction 2 *
*****
*
**8110000 feed_jb1 tmdpjun
**8110101 810010002 890010001 0.
**8110200 1 501 cntrlvar 010 * mass flow rate
**8110201 -1.0e6 0. 0. 0.

```

```

**8110202 0. 0. 0. 0.
**8110203 1.0e6 1.0e6 0. 0.
*
*****
* component 890 : steam dump volume *
*****
8900000 bdtank tmdpvol
8900101 0.0 100.0 1.0e6 -90.0 0. 0. 4.572e-4 0.0 00000
8900200 002
8900201 0.0 550000. 1.
*
*-----*
* structure input *
*-----*
*
*****
* structure 1100 : downcomer upper part at right hand side *
*****
11100000 1 3 2 0 159.5e-3
11100100 0 1
11100101 1 162.0e-3
11100102 1 165.0e-3
11100201 001 2
11100301 0. 2
11100400 0
11100401 435.0 3
11100501 110010000 0 1 1 290.0e-3 1 * 580 mm x 1/2
11100601 0 0 0 1 290.0e-3 1
11100701 0 0. 0. 0. 1
11100801 0.1878 100. 100. 0. 0. 0. 0. 1. 1
11100901 0.1821 100. 100. 0. 0. 0. 0. 1. 1
*
*****
* structure 1200 : downcomer upper part at left hand side *
*****
11200000 1 3 2 0 159.5e-3
11200100 0 1
11200101 1 162.0e-3
11200102 1 165.0e-3
11200201 001 2
11200301 0. 2
11200400 0
11200401 435.0 3

```

```

11200501 120010000 0 1 1 290.0e-3 1 * 580 mm x 1/2
11200601 0 0 0 1 290.0e-3 1
11200701 0 0 0 0 1
11200801 0.1878 100. 100. 0. 0. 0. 0. 1. 1
11200901 0.1821 100. 100. 0. 0. 0. 0. 1. 1

```

*

* structure 1300 : downcomer cold leg connector at right side *

```

11300000 1 3 2 0 159.5e-3
11300100 0 1
11300101 1 162.0e-3
11300102 1 165.0e-3
11300201 001 2
11300301 0. 2
11300400 0
11300401 435.0 3
11300501 130010000 0 1 1 55.0e-3 1 * 110 mm x 1/2
11300601 0 0 0 1 55.0e-3 1
11300701 0 0 0 0 1
11300801 0.1878 100. 100. 0. 0. 0. 0. 1. 1
11300901 0.1821 100. 100. 0. 0. 0. 0. 1. 1

```

*

* structure 1400 : downcomer cold leg connector at left side *

```

11400000 1 3 2 0 159.5e-3
11400100 0 1
11400101 1 162.0e-3
11400102 1 165.0e-3
11400201 001 2
11400301 0. 2
11400400 0
11400401 435.0 3
11400501 140010000 0 1 1 55.0e-3 1 * 110 mm x 1/2
11400601 0 0 0 1 55.0e-3 1
11400701 0 0 0 0 1
11400801 0.1878 100. 100. 0. 0. 0. 0. 1. 1
11400901 0.1821 100. 100. 0. 0. 0. 0. 1. 1

```

*

* structure 1320 : downcomer at right side *

```

11320000 5 3 2 0 159.5e-3

```

```

11320100 0 1

```

```

11320101 1 162.0e-3

```

```

11320102 1 165.0e-3

```

```

11320201 001 2

```

```

11320301 0. 2

```

```

11320400 0

```

```

11320401 435.0 3

```

```

11320501 132010000 0 1 1 100.0e-3 1 * 200 mm x 1/2

```

```

11320502 132020000 0 1 1 100.0e-3 2 * 200 mm x 1/2

```

```

11320503 132030000 0 1 1 50.0e-3 3 * 100 mm x 1/2

```

```

11320504 132040000 0 1 1 50.0e-3 4 * 100 mm x 1/2

```

```

11320505 132050000 0 1 1 74.0e-3 5 * 148 mm x 1/2

```

```

11320601 0 0 0 1 100.0e-3 1

```

```

11320602 0 0 0 1 100.0e-3 2

```

```

11320603 0 0 0 1 50.0e-3 3

```

```

11320604 0 0 0 1 50.0e-3 4

```

```

11320605 0 0 0 1 74.0e-3 5

```

```

11320701 0 0 0 0 5

```

```

11320801 0.1878 100. 100. 0. 0. 0. 0. 1. 5

```

```

11320901 0.1821 100. 100. 0. 0. 0. 0. 1. 5

```

*

* structure 1420 : downcomer at left side *

```

11420000 5 3 2 0 159.5e-3

```

```

11420100 0 1

```

```

11420101 1 162.0e-3

```

```

11420102 1 165.0e-3

```

```

11420201 001 2

```

```

11420301 0. 2

```

```

11420400 0

```

```

11420401 435.0 3

```

```

11420501 132010000 0 1 1 100.0e-3 1 * 200 mm x 1/2

```

```

11420502 132020000 0 1 1 100.0e-3 2 * 200 mm x 1/2

```

```

11420503 132030000 0 1 1 50.0e-3 3 * 100 mm x 1/2

```

```

11420504 132040000 0 1 1 50.0e-3 4 * 100 mm x 1/2

```

```

11420505 132050000 0 1 1 74.0e-3 5 * 148 mm x 1/2

```

```

11420601 0 0 0 1 100.0e-3 1

```

```

11420602 0 0 0 1 100.0e-3 2

```

```

11420603 0 0 0 1 50.0e-3 3

```

```

11420604 0 0 0 1 50.0e-3 4

```

```

11420605 0 0 0 1 74.0e-3 5

```

```

11420701 0 0 0 0 5
11420801 0.1878 100. 100. 0. 0. 0. 0. 1. 5
11420901 0.1821 100. 100. 0. 0. 0. 0. 1. 5
*
*****
* structure 1600 : downcomer lower plenum *
*****
11600000 1 3 2 0 159.5e-3
11600100 0 1
11600101 1 162.0e-3
11600102 1 165.0e-3
11600201 001 2
11600301 0. 2
11600400 0
11600401 435.0 3
11600501 160010000 0 1 1 80.0e-3 1 * 80 mm
11600601 0 0 0 1 80.0e-3 1
11600701 0 0 0 0. 1
11600801 3.3938 100. 100. 0. 0. 0. 0. 1. 1
11600901 3.2906 100. 100. 0. 0. 0. 0. 1. 1
*
*****
* structure 1601 : downcomer lower plenum structure *
*****
11601000 1 3 2 0 0.
11601100 0 1
11601101 1 50.0e-3
11601102 1 100.0e-3
11601201 001 2
11601301 0. 2
11601400 0
11601401 435.0 3
11601501 0 0 0 1 1. 1 * 1 m
11601601 160010000 0 1 1 1. 1
11601701 0 0 0 0. 1
11601801 0. 100. 100. 0. 0. 0. 0. 1. 1
11601901 5.413 100. 100. 0. 0. 0. 0. 1. 1
*
*****
* structure 1800 : core bottom *
*****
11800000 2 3 2 0 131.0e-3
11800100 0 1

```

```

11800101 1 132.5e-3
11800102 1 134.0e-3
11800201 001 2
11800301 0. 2
11800400 0
11800401 435.0 3
11800501 180010000 0 1 1 148.0e-3 1 * 148 mm
11800502 180020000 0 1 1 100.0e-3 2 * 100 mm
11800601 0 0 0 1 148.0e-3 1
11800602 0 0 0 1 100.0e-3 2
11800701 0 0 0 0. 2
11800801 98.235e-3 100. 100.0. 0. 0. 0. 1. 1
11800802 262.13e-3 100. 100.0. 0. 0. 0. 1. 2
11800901 96.036e-3 100. 100.0. 0. 0. 0. 1. 1
11800902 256.26e-3 100. 100.0. 0. 0. 0. 1. 2
*
*****
* structure 1801 : core active electric heaters *
*****
11801000 1 3 2 0 0.
11801100 0 1
11801101 1 2.5e-3
11801102 1 5.0e-3
11801201 002 1
11801202 001 2
11801301 1.0 2
11801400 0
11801401 440.0 3
11801501 0 0 0 1 2.4 1 * 0.1 m x 12 ea x 2 (u-type)
11801601 180020000 0 1 1 2.4 1
11801701 888 1. 0. 0. 1
11801801 0.0 100. 100. 0. 0. 0. 0. 1. 1
11801901 0.266 100. 100. 0. 0. 0. 0. 1. 1
*
*****
* structure 1802 : core inactive electric heaters *
*****
11802000 1 3 2 0 0.
11802100 0 1
11802101 1 2.5e-3
11802102 1 5.0e-3
11802201 002 1
11802201 001 2

```

```

11802301 0. 2
11802400 0
11802401 500.0 3
11802501 0 0 0 1 2.4 1 *0.1 m x 12 ea x 2(u-type)
11802601 180020000 0 1 1 2.4 1
11802701 0 0. 0. 0. 1
11802801 0.0 100. 100. 0. 0. 0. 0. 1. 1
11802901 0.266 100. 100. 0. 0. 0. 0. 1. 1

```

*

```
*****
* structure 1900 : active core *
```

```
*****
11900000 3 3 2 0 131.0e-3
11900100 0 1
11900101 1 132.5e-3
11900102 1 134.0e-3
11900201 001 2
11900301 0. 2
11900400 0
11900401 435.0 3
11900501 190010000 0 1 1 100.0e-3 1 * 100 mm
11900502 190010000 0 1 1 200.0e-3 2 * 200 mm
11900503 190010000 0 1 1 200.0e-3 3 * 200 mm
11900601 0 0 0 1 100.0e-3 1
11900602 0 0 0 1 200.0e-3 2
11900603 0 0 0 1 200.0e-3 3
11900701 0 0. 0. 0. 3
11900801 0.2438 100. 100. 0. 0. 0. 0. 1. 3
11900901 0.2383 100. 100. 0. 0. 0. 0. 1. 3

```

*

```
*****
* structure 1901 : core active electric heaters *
```

```
*****
11901000 3 3 2 0 0.
11901100 0 1
11901101 1 2.5e-3
11901102 1 5.0e-3
11901201 002 1
11901202 001 2
11901301 1.0 2
11901400 0
11901401 500.0 3
11901501 0 0 0 1 2.4 1 *0.1 m x 12 ea x 2(u-type)

```

```

11901502 0 0 0 1 4.8 2 *0.1 m x 12 ea x 2(u-type)
11901503 0 0 0 1 4.8 3 *0.1 m x 12 ea x 2(u-type)
11901601 190010000 0 1 1 2.4 1
11901602 190020000 0 1 1 4.8 2
11901603 190030000 0 1 1 4.8 3
11901701 888 1. 0. 0. 1
11901702 889 1. 0. 0. 3
11901801 0.0 100. 100. 0. 0. 0. 0. 1. 3
11901901 0.266 100. 100. 0. 0. 0. 0. 1. 3

```

*

```
*****
* structure 1902 : core inactive electric heaters *
```

```
*****
11902000 3 3 2 0 0.
11902100 0 1
11902101 1 2.5e-3
11902102 1 5.0e-3
11902201 002 1
11902202 001 2
11902301 1.0 2
11902400 0
11902401 440.0 3
11902501 0 0 0 1 2.4 1 *0.1 m x 12 ea x 2(u-type)
11902502 0 0 0 1 4.8 2 *0.1 m x 12 ea x 2(u-type)
11902503 0 0 0 1 4.8 3 *0.1 m x 12 ea x 2(u-type)
11902601 190010000 0 1 1 2.4 1
11902602 190020000 0 1 1 4.8 2
11902603 190030000 0 1 1 4.8 3
11902701 0 1. 0. 0. 1
11902702 0 1. 0. 0. 3
11902801 0.0 100. 100. 0. 0. 0. 0. 1. 3
11902901 0.266 100. 100. 0. 0. 0. 0. 1. 3

```

*

```
*****
* structure 2000 : core branch *
```

```
*****
12000000 1 3 2 0 131.0e-3
12000100 0 1
12000101 1 132.5e-3
12000102 1 134.0e-3
12000201 001 2
12000301 0. 2
12000400 0

```


12000401 435.0 3
 12000501 200010000 0 1 1 110.0e-3 1 * 110 mm
 12000601 0 0 0 1 110.0e-3 1
 12000701 0 0. 0. 0. 1
 12000801 0.2438 100. 100. 0. 0. 0. 0. 1. 1
 12000901 0.2383 100. 100. 0. 0. 0. 0. 1. 1

*

* structure 2001 : core branch inactive electric heaters *

12001000 1 3 2 0 0.
 12001100 0 1
 12001101 1 2.5e-3
 12001102 1 5.0e-3
 12001201 002 1
 12001202 001 2
 12001301 1.0 2
 12001400 0
 12001401 440.0 3
 12001501 0 0 0 1 5.28 1 * 0.11 m x 24 ea x 2(u-type)
 12001601 200010000 0 1 1 5.28 1
 12001701 0 1. 0. 0. 1
 12001801 0.0 100. 100. 0. 0. 0. 0. 1. 1
 12001901 0.266 100. 100. 0. 0. 0. 0. 1. 1

*

* structure 2100 : core upper *

12100000 2 3 2 0 131.0e-3
 12100100 0 1
 12100101 1 132.5e-3
 12100102 1 134.0e-3
 12100201 001 2
 12100301 0. 2
 12100400 0
 12100401 435.0 3
 12100501 210010000 0 1 1 290.0e-3 1 * 290 mm
 12100502 210020000 0 1 1 290.0e-3 2 * 290 mm
 12100601 0 0 0 1 290.0e-3 1
 12100602 0 0 0 1 290.0e-3 2
 12100701 0 0. 0. 0. 2
 12100801 0.2438 100. 100. 0. 0. 0. 0. 1. 2
 12100901 0.2383 100. 100. 0. 0. 0. 0. 1. 2

*

* structure 2101 : upper core inactive electric heaters *

12101000 2 3 2 0 0.
 12101100 0 1
 12101101 1 2.5e-3
 12101102 1 5.0e-3
 12101201 002 1
 12101202 001 2
 12101301 1.0 2
 12101400 0
 12101401 440.0 3
 12101501 0 0 0 1 13.92 1 * 0.29 m x 24 ea x 2(u-type)
 12101502 0 0 0 1 13.92 2 * 0.29 m x 24 ea x 2(u-type)
 12101601 210010000 0 1 1 13.92 1
 12101602 210020000 0 1 1 13.92 2
 12101701 0 1. 0. 0. 2
 12101801 0.0 100. 100. 0. 0. 0. 0. 1. 2
 12101901 0.266 100. 100. 0. 0. 0. 0. 1. 2

*

* structure 2200 : upper plenum *

12200000 1 3 2 0 159.5e-3
 12200100 0 1
 12200101 1 162.0e-3
 12200102 1 168.0e-3
 12200201 001 2
 12200301 0. 2
 12200400 0
 12200401 435.0 3
 12200501 210010000 0 1 1 251.0e-3 1 * 251 mm
 12200601 0 0 0 1 251.0e-3 1
 12200701 0 0. 0. 0. 1
 12200801 0.2561 100. 100. 0. 0. 0. 0. 1. 1
 12200901 0.2483 100. 100. 0. 0. 0. 0. 1. 1

*

* structure 2201 : upper plenum inactive electric heaters *

12201000 1 3 2 0 0.
 12201100 0 1

```

12201101 1 2.5e-3
12201102 1 5.0e-3
12201201 002 1
12201202 001 2
12201301 1.0 2
12201400 0
12201401 440.0 3
12201501 0 0 0 1 12.048 1 * 0.251 m x 24 ea x 2(u-type)
12201601 220010000 0 1 1 12.048 1
12201701 0 1. 0. 0. 1
12201801 0.0 100. 100. 0. 0. 0. 0. 1. 1
12201901 0.266 100. 100. 0. 0. 0. 0. 1. 1

```

```

*
*****

```

```

* structure 3000 : intact hot leg section 1 *
*****

```

```

13000000 1 3 2 0 35.1e-3
13000100 0 1
13000101 1 36.5e-3
13000102 1 46.0e-3
13000201 001 2
13000301 0. 2
13000400 0
13000401 435.0 3
13000501 300010000 0 1 1 527.0e-3 1 * 438 mm
13000601 0 0 0 1 527.0e-3 1
13000701 0 0. 0. 0. 1
13000801 70.2e-3 100. 100. 0. 0. 0. 0. 1. 1
13000901 76.3e-3 100. 100. 0. 0. 0. 0. 1. 1

```

```

*
*****

```

```

* structure 3100 : intact hot leg section 2 *
*****

```

```

13100000 1 3 2 0 35.1e-3
13100100 0 1
13100101 1 36.5e-3
13100102 1 39.0e-3
13100201 001 2
13100301 0. 2
13100400 0
13100401 435.0 3
13100501 310010000 0 1 1 438.0e-3 1 * 438 mm
13100601 0 0 0 1 438.0e-3 1

```

```

13100701 0 0. 0. 0. 1
13100801 70.2e-3 100. 100. 0. 0. 0. 0. 1. 1
13100901 76.3e-3 100. 100. 0. 0. 0. 0. 1. 1

```

```

*
*****

```

```

* structure 3200 : intact hot leg section 3 *
*****

```

```

13200000 1 3 2 0 35.1e-3
13200100 0 1
13200101 1 36.5e-3
13200102 1 39.0e-3
13200201 001 2
13200301 0. 2
13200400 0
13200401 435.0 3
13200501 320010000 0 1 1 260.0e-3 1 * 260 mm
13200601 0 0 0 1 260.0e-3 1
13200701 0 0. 0. 0. 1
13200801 70.2e-3 100. 100. 0. 0. 0. 0. 1. 1
13200901 76.3e-3 100. 100. 0. 0. 0. 0. 1. 1

```

```

*
*****

```

```

* structure 3300 : intact loop u tube inlet *
*****

```

```

13300000 1 3 2 0 159.5e-3
13300100 0 1
13300101 1 162.0e-3
13300102 1 165.0e-3
13300201 001 2
13300301 0. 2
13300400 0
13300401 435.0 3
13300501 330010000 0 1 1 100.0e-3 1 * 100 mm
13300601 0 0 0 1 100.0e-3 1
13300701 0 0. 0. 0. 1
13300801 187.8e-3 100. 100. 0. 0. 0. 0. 1. 1
13300901 182.1e-3 100. 100. 0. 0. 0. 0. 1. 1

```

```

*
*****

```

```

* structure 3500 : intact loop u tubes 1 *
*****

```

```

13500000 8 3 2 0 9.5e-3
13500100 0 1

```

```

13500101 1 10.0e-3
13500102 1 10.5e-3
13500201 003 2
13500301 0. 2
13500400 0
13500401 435.0 3
13500501 350010000 0 1 1 3.28 1 * 0.41 m x 8 ea
13500502 350020000 0 1 1 3.28 2
13500503 350030000 0 1 1 3.28 3
13500504 350040000 0 1 1 3.28 4
13500504 350050000 0 1 1 3.28 5
13500504 350060000 0 1 1 3.28 6
13500504 350070000 0 1 1 3.28 7
13500504 350080000 0 1 1 3.28 8
13500601 610010000 0 1 1 3.28 1
13500602 610020000 0 1 1 3.28 2
13500603 610030000 0 1 1 3.28 3
13500604 610040000 0 1 1 3.28 4
13500605 610040000 0 1 1 3.28 5
13500606 610030000 0 1 1 3.28 6
13500607 610020000 0 1 1 3.28 7
13500608 610010000 0 1 1 3.28 8
13500701 0 0. 0. 0. 8
13500801 0.266 100. 100. 0. 0. 0. 0. 1. 8
13500901 0.3742 100. 100. 0. 0. 0. 0. 1. 8
*
*****
* structure 3520 : intact loop u tubes 2 *
*****
13520000 8 3 2 0 9.5e-3
13520100 0 1
13520101 1 10.0e-3
13520102 1 10.5e-3
13520201 003 2
13520301 0. 2
13520400 0
13520401 435.0 3
13520501 352010000 0 1 1 3.28 1 * 0.41 m x 8 ea
13520502 352020000 0 1 1 3.28 2
13520503 352030000 0 1 1 3.28 3
13520504 352040000 0 1 1 3.28 4
13520504 352050000 0 1 1 3.28 5
13520504 352060000 0 1 1 3.28 6

```

```

13520504 352070000 0 1 1 3.28 7
13520504 352080000 0 1 1 3.28 8
13520601 610010000 0 1 1 3.28 1
13520602 610020000 0 1 1 3.28 2
13520603 610030000 0 1 1 3.28 3
13520604 610040000 0 1 1 3.28 4
13520605 610040000 0 1 1 3.28 5
13520606 610030000 0 1 1 3.28 6
13520607 610020000 0 1 1 3.28 7
13520608 610010000 0 1 1 3.28 8
13520701 0 0. 0. 0. 8
13520801 0.266 100. 100. 0. 0. 0. 0. 1. 8
13520901 0.3742 100. 100. 0. 0. 0. 0. 1. 8
*
*****
* structure 3600 : intact loop u tube outlet *
*****
13600000 1 3 2 0 159.5e-3
13600100 0 1
13600101 1 162.0e-3
13600102 1 165.0e-3
13600201 001 2
13600301 0. 2
13600400 0
13600401 435.0 3
13600501 360010000 0 1 1 100.0e-3 1 * 100 mm
13600601 0 0 0 1 100.0e-3 1
13600701 0 0. 0. 0. 1
13600801 187.8e-3 100. 100. 0. 0. 0. 0. 1. 1
13600901 182.1e-3 100. 100. 0. 0. 0. 0. 1. 1
*
*****
* structure 3620 : intact suction leg 1 *
*****
13620000 1 3 2 0 35.1e-3
13620100 0 1
13620101 1 36.5e-3
13620102 1 39.0e-3
13620201 001 2
13620301 0. 2
13620400 0
13620401 435.0 3
13620501 362010000 0 1 1 910.0e-3 1 * 910 mm

```

```

13620601 0 0 0 1 910.0e-3 1
13620701 0 0 0 0 1
13620801 70.2e-3 100. 100. 0. 0. 0. 0. 1. 1
13620901 76.3e-3 100. 100. 0. 0. 0. 0. 1. 1
*
*****
* structure 3640 : intact suction leg 2 *
*****
13640000 1 3 2 0 35.1e-3
13640100 0 1
13640101 1 36.5e-3
13640102 1 39.0e-3
13640201 001 2
13640301 0. 2
13640400 0
13640401 435.0 3
13640501 364010000 0 1 1 700.0e-3 1 * 700 mm
13640601 0 0 0 1 700.0e-3 1
13640701 0 0 0 0 1
13640801 70.2e-3 100. 100. 0. 0. 0. 0. 1. 1
13640901 76.3e-3 100. 100. 0. 0. 0. 0. 1. 1
*
*****
* structure 3700 : intact discharge leg 1 *
*****
13700000 1 3 2 0 35.1e-3
13700100 0 1
13700101 1 36.5e-3
13700102 1 39.0e-3
13700201 001 2
13700301 0. 2
13700400 0
13700401 435.0 3
13700501 370010000 0 1 1 650.0e-3 1 * 650 mm
13700601 0 0 0 1 650.0e-3 1
13700701 0 0 0 0 1
13700801 70.2e-3 100. 100. 0. 0. 0. 0. 1. 1
13700901 76.3e-3 100. 100. 0. 0. 0. 0. 1. 1
*
*****
* structure 3720 : intact discharge leg 2 *
*****
13720000 1 3 2 0 35.1e-3

```

```

13720100 0 1
13720101 1 36.5e-3
13720102 1 39.0e-3
13720201 001 2
13720301 0. 2
13720400 0
13720401 435.0 3
13720501 372010000 0 1 1 290.0e-3 1 * 290 mm
13720601 0 0 0 1 290.0e-3 1
13720701 0 0 0 0 1
13720801 70.2e-3 100. 100. 0. 0. 0. 0. 1. 1
13720901 76.3e-3 100. 100. 0. 0. 0. 0. 1. 1
*
*****
* structure 3740 : intact discharge leg 3 *
*****
13740000 1 3 2 0 35.1e-3
13740100 0 1
13740101 1 36.5e-3
13740102 1 39.0e-3
13740201 001 2
13740301 0. 2
13740400 0
13740401 435.0 3
13740501 374010000 0 1 1 685.0e-3 1 * 685 mm
13740601 0 0 0 1 685.0e-3 1
13740701 0 0 0 0 1
13740801 70.2e-3 100. 100. 0. 0. 0. 0. 1. 1
13740901 76.3e-3 100. 100. 0. 0. 0. 0. 1. 1
*
*****
* structure 3760 : intact discharge leg 4 *
*****
13760000 1 3 2 0 35.1e-3
13760100 0 1
13760101 1 38.5e-3
13760102 1 46.0e-3
13760201 001 2
13760301 0. 2
13760400 0
13760401 435.0 3
13760501 376010000 0 1 1 270.0e-3 1 * 270 mm
13760601 0 0 0 1 270.0e-3 1

```

13760701 0 0. 0. 0. 1
 13760801 70.2e-3 100. 100. 0. 0. 0. 0. 1. 1
 13760901 76.3e-3 100. 100. 0. 0. 0. 0. 1. 1

*

* structure 4000 : broken hot leg section 1 *

14000000 1 3 2 0 35.1e-3

14000100 0 1

14000101 1 42.5e-3

14000102 1 50.0e-3

14000201 001 2

14000301 0. 2

14000400 0

14000401 435.0 3

14000501 400010000 0 1 1 200.0e-3 1 * 200 mm

14000601 0 0 0 1 200.0e-3 1

14000701 0 0. 0. 0. 1

14000801 70.2e-3 100. 100. 0. 0. 0. 0. 1. 1

14000901 76.3e-3 100. 100. 0. 0. 0. 0. 1. 1

*

* structure 4100 : broken hot leg section 2 *

14100000 1 3 2 0 35.1e-3

14100100 0 1

14100101 1 42.5e-3

14100102 1 50.0e-3

14100201 001 2

14100301 0. 2

14100400 0

14100401 435.0 3

14100501 400010000 0 1 1 98.0e-3 1 * 98 mm

14100601 0 0 0 1 98.0e-3 1

14100701 0 0. 0. 0. 1

14100801 70.2e-3 100. 100. 0. 0. 0. 0. 1. 1

14100901 76.3e-3 100. 100. 0. 0. 0. 0. 1. 1

*

* structure 4200 : broken hot leg section 3 *

14200000 1 3 2 0 35.1e-3

14200100 0 1

14200101 1 42.5e-3

14200102 1 50.0e-3

14200201 001 2

14200301 0. 2

14200400 0

14200401 435.0 3

14200501 420010000 0 1 1 98.0e-3 1 * 98 mm

14200601 0 0 0 1 98.0e-3 1

14200701 0 0. 0. 0. 1

14200801 70.2e-3 100. 100. 0. 0. 0. 0. 1. 1

14200901 76.3e-3 100. 100. 0. 0. 0. 0. 1. 1

*

* structure 4300 : broken hot leg section 4 *

14300000 1 3 2 0 35.1e-3

14300100 0 1

14300101 1 42.5e-3

14300102 1 50.0e-3

14300201 001 2

14300301 0. 2

14300400 0

14300401 435.0 3

14300501 430010000 0 1 1 130.0e-3 1 * 130 mm

14300601 0 0 0 1 130.0e-3 1

14300701 0 0. 0. 0. 1

14300801 70.2e-3 100. 100. 0. 0. 0. 0. 1. 1

14300901 76.3e-3 100. 100. 0. 0. 0. 0. 1. 1

*

* structure 4400 : broken loop u tube inlet *

14400000 1 3 2 0 159.5e-3

14400100 0 1

14400101 1 162.0e-3

14400102 1 165.0e-3

14400201 001 2

14400301 0. 2

14400400 0

14400401 435.0 3

14400501 440010000 0 1 1 100.0e-3 1 * 100 mm

14400601 0 0 0 1 100.0e-3 1

14400701 0 0. 0. 0. 1

```

14400801 187.8e-3 100. 100. 0. 0. 0. 0. 1. 1
14400901 182.1e-3 100. 100. 0. 0. 0. 0. 1. 1
*
*****
* structure 4500 : intact loop u tubes 1 *
*****
14500000 8 3 2 0 9.5e-3
14500100 0 1
14500101 1 10.0e-3
14500102 1 10.5e-3
14500201 003 2
14500301 0. 2
14500400 0
14500401 435.0 3
14500501 450010000 0 1 1 3.28 1 * 0.41 m x 8 ea
14500502 450020000 0 1 1 3.28 2
14500503 450030000 0 1 1 3.28 3
14500504 450040000 0 1 1 3.28 4
14500504 450050000 0 1 1 3.28 5
14500504 450060000 0 1 1 3.28 6
14500504 450070000 0 1 1 3.28 7
14500504 450080000 0 1 1 3.28 8
14500601 710010000 0 1 1 3.28 1
14500602 710020000 0 1 1 3.28 2
14500603 710030000 0 1 1 3.28 3
14500604 710040000 0 1 1 3.28 4
14500605 710040000 0 1 1 3.28 5
14500606 710030000 0 1 1 3.28 6
14500607 710020000 0 1 1 3.28 7
14500608 710010000 0 1 1 3.28 8
14500701 0 0. 0. 0. 8
14500801 0.266 100. 100. 0. 0. 0. 0. 1. 8
14500901 0.3742 100. 100. 0. 0. 0. 0. 1. 8
*
*****
* structure 4520 : intact loop u tubes 2 *
*****
14520000 8 3 2 0 9.5e-3
14520100 0 1
14520101 1 10.0e-3
14520102 1 10.5e-3
14520201 003 2
14520301 0. 2

```

```

14520400 0
14520401 435.0 3
14520501 452010000 0 1 1 3.28 1 * 0.41 m x 8 ea
14520502 452020000 0 1 1 3.28 2
14520503 452030000 0 1 1 3.28 3
14520504 452040000 0 1 1 3.28 4
14520504 452050000 0 1 1 3.28 5
14520504 452060000 0 1 1 3.28 6
14520504 452070000 0 1 1 3.28 7
14520504 452080000 0 1 1 3.28 8
14520601 710010000 0 1 1 3.28 1
14520602 710020000 0 1 1 3.28 2
14520603 710030000 0 1 1 3.28 3
14520604 710040000 0 1 1 3.28 4
14520605 710040000 0 1 1 3.28 5
14520606 710030000 0 1 1 3.28 6
14520607 710020000 0 1 1 3.28 7
14520608 710010000 0 1 1 3.28 8
14520701 0 0. 0. 0. 8
14520801 0.266 100. 100. 0. 0. 0. 0. 1. 8
14520901 0.3742 100. 100. 0. 0. 0. 0. 1. 8
*
*****
* structure 4600 : broken loop u tube outlet 1 *
*****
14600000 1 3 2 0 159.5e-3
14600100 0 1
14600101 1 164.0e-3
14600102 1 169.0e-3
14600201 001 2
14600301 0. 2
14600400 0
14600401 435.0 3
14600501 460010000 0 1 1 25.0e-3 1 * 100/4 mm
14600601 0 0 0 1 25.0e-3 1
14600701 0 0. 0. 0. 1
14600801 140.3e-3 100. 100. 0. 0. 0. 0. 1. 1
14600901 145.3e-3 100. 100. 0. 0. 0. 0. 1. 1
*
*****
* structure 4800 : broken loop u tube outlet 2 *
*****
14800000 1 3 2 0 159.5e-3

```

```

14800100 0 1
14800101 1 164.0e-3
14800102 1 169.0e-3
14800201 001 2
14800301 0 2
14800400 0
14800401 435.0 3
14800501 480010000 0 1 1 25.0e-3 1 * 100/4 mm
14800601 0 0 0 1 25.0e-3 1
14800701 0 0 0 0. 1
14800801 140.3e-3 100. 100. 0. 0. 0. 0. 1. 1
14800901 145.3e-3 100. 100. 0. 0. 0. 0. 1. 1

```

```

*
*****
* structure 4620 : broken loop suction leg 1-1 *
*****

```

```

14620000 1 3 2 0 27.45e-3
14620100 0 1
14620101 1 31.5e-3
14620102 1 35.0e-3
14620201 001 2
14620301 0 2
14620400 0
14620401 435.0 3
14620501 462010000 0 1 1 254.6e-3 1 * 254.6 mm
14620601 0 0 0 1 254.6e-3 1
14620701 0 0 0 0. 1
14620801 54.9e-3 100. 100. 0. 0. 0. 0. 1. 1
14620901 60.5e-3 100. 100. 0. 0. 0. 0. 1. 1

```

```

*
*****
* structure 4640 : broken loop suction leg 1-2 *
*****

```

```

14640000 1 3 2 0 27.45e-3
14640100 0 1
14640101 1 31.5e-3
14640102 1 35.0e-3
14640201 001 2
14640301 0 2
14640400 0
14640401 435.0 3
14640501 464010000 0 1 1 245.0e-3 1 * 245 mm
14640601 0 0 0 1 245.0e-3 1

```

```

14640701 0 0 0 0. 1
14640801 54.9e-3 100. 100. 0. 0. 0. 0. 1. 1
14640901 60.5e-3 100. 100. 0. 0. 0. 0. 1. 1

```

```

*
*****
* structure 4660 : broken loop suction leg 1-2 *
*****

```

```

14660000 1 3 2 0 27.45e-3
14660100 0 1
14660101 1 31.5e-3
14660102 1 35.0e-3
14660201 001 2
14660301 0 2
14660400 0
14660401 435.0 3
14660501 466010000 0 1 1 510.0e-3 1 * 510 mm
14660601 0 0 0 1 510.0e-3 1
14660701 0 0 0 0. 1
14660801 54.9e-3 100. 100. 0. 0. 0. 0. 1. 1
14660901 60.5e-3 100. 100. 0. 0. 0. 0. 1. 1

```

```

*
*****
* structure 4700 : broken loop pump volume 1 *
*****

```

```

14700000 1 3 2 0 27.45e-3
14700100 0 1
14700101 1 31.5e-3
14700102 1 35.0e-3
14700201 001 2
14700301 0 2
14700400 0
14700401 435.0 3
14700501 470010000 0 1 1 455.0e-3 1 * 455 mm
14700601 0 0 0 1 455.0e-3 1
14700701 0 0 0 0. 1
14700801 54.9e-3 100. 100. 0. 0. 0. 0. 1. 1
14700901 60.5e-3 100. 100. 0. 0. 0. 0. 1. 1

```

```

*
*****
* structure 4720 : broken loop discharge leg 1-1 *
*****

```

```

14720000 1 3 2 0 27.45e-3
14720100 0 1

```

```

14720101 1 31.5e-3
14720102 1 35.0e-3
14720201 001 2
14720301 0. 2
14720400 0
14720401 435.0 3
14720501 472010000 0 1 1 295.0e-3 1 * 295 mm
14720601 0 0 0 1 295.0e-3 1
14720701 0 0. 0. 0. 1
14720801 54.9e-3 100. 100. 0. 0. 0. 0. 1. 1
14720901 60.5e-3 100. 100. 0. 0. 0. 0. 1. 1

```

```

*
*****

```

```

* structure 4740 : broken loop discharge leg 1-2 *
*****

```

```

14740000 1 3 2 0 27.45e-3
14740100 0 1
14740101 1 31.5e-3
14740102 1 35.0e-3
14740201 001 2
14740301 0. 2
14740400 0
14740401 435.0 3
14740501 474010000 0 1 1 415.0e-3 1 * 415 mm
14740601 0 0 0 1 415.0e-3 1
14740701 0 0. 0. 0. 1
14740801 54.9e-3 100. 100. 0. 0. 0. 0. 1. 1
14740901 60.5e-3 100. 100. 0. 0. 0. 0. 1. 1

```

```

*
*****

```

```

* structure 4760 : broken loop discharge leg 1-3 *
*****

```

```

14760000 1 3 2 0 27.45e-3
14760100 0 1
14760101 1 31.5e-3
14760102 1 35.0e-3
14760201 001 2
14760301 0. 2
14760400 0
14760401 435.0 3
14760501 476010000 0 1 1 200.0e-3 1 * 200 mm
14760601 0 0 0 1 200.0e-3 1
14760701 0 0. 0. 0. 1

```

```

14760801 54.9e-3 100. 100. 0. 0. 0. 0. 1. 1
14760901 60.5e-3 100. 100. 0. 0. 0. 0. 1. 1

```

```

*
*****

```

```

* structure 4820 : broken loop suction leg 2-1 *
*****

```

```

14820000 1 3 2 0 27.45e-3
14820100 0 1
14820101 1 31.5e-3
14820102 1 35.0e-3
14820201 001 2
14820301 0. 2
14820400 0
14820401 435.0 3
14820501 482010000 0 1 1 254.6e-3 1 * 254.6 mm
14820601 0 0 0 1 254.6e-3 1
14820701 0 0. 0. 0. 1
14820801 54.9e-3 100. 100. 0. 0. 0. 0. 1. 1
14820901 60.5e-3 100. 100. 0. 0. 0. 0. 1. 1

```

```

*
*****

```

```

* structure 4840 : broken loop suction leg 2-2 *
*****

```

```

14840000 1 3 2 0 27.45e-3
14840100 0 1
14840101 1 31.5e-3
14840102 1 35.0e-3
14840201 001 2
14840301 0. 2
14840400 0
14840401 435.0 3
14840501 484010000 0 1 1 245.0e-3 1 * 245 mm
14840601 0 0 0 1 245.0e-3 1
14840701 0 0. 0. 0. 1
14840801 54.9e-3 100. 100. 0. 0. 0. 0. 1. 1
14840901 60.5e-3 100. 100. 0. 0. 0. 0. 1. 1

```

```

*
*****

```

```

* structure 4860 : broken loop suction leg 2-2 *
*****

```

```

14860000 1 3 2 0 27.45e-3
14860100 0 1
14860101 1 31.5e-3

```



```

14860102 1 35.0e-3
14860201 001 2
14860301 0. 2
14860400 0
14860401 435.0 3
14860501 486010000 0 1 1 510.0e-3 1 * 510 mm
14860601 0 0 0 1 510.0e-3 1
14860701 0 0. 0. 0. 1
14860801 54.9e-3 100. 100. 0. 0. 0. 0. 1. 1
14860901 60.5e-3 100. 100. 0. 0. 0. 0. 1. 1

```

*

```

*****
* structure 4900 : broken loop pump volume 2 *
*****

```

```

14900000 1 3 2 0 27.45e-3
14900100 0 1
14900101 1 31.5e-3
14900102 1 35.0e-3
14900201 001 2
14900301 0. 2
14900400 0
14900401 435.0 3
14900501 490010000 0 1 1 455.0e-3 1 * 455 mm
14900601 0 0 0 1 455.0e-3 1
14900701 0 0. 0. 0. 1
14900801 54.9e-3 100. 100. 0. 0. 0. 0. 1. 1
14900901 60.5e-3 100. 100. 0. 0. 0. 0. 1. 1

```

*

```

*****
* structure 4920 : broken loop discharge leg 2-1 *
*****

```

```

14920000 1 3 2 0 27.45e-3
14920100 0 1
14920101 1 31.5e-3
14920102 1 35.0e-3
14920201 001 2
14920301 0. 2
14920400 0
14920401 435.0 3
14920501 492010000 0 1 1 295.0e-3 1 * 295 mm
14920601 0 0 0 1 295.0e-3 1
14920701 0 0. 0. 0. 1
14920801 54.9e-3 100. 100. 0. 0. 0. 0. 1. 1

```

```

14920901 60.5e-3 100. 100. 0. 0. 0. 0. 1. 1

```

*

```

*****
* structure 4940 : broken loop discharge leg 2-2 *
*****

```

```

14940000 1 3 2 0 27.45e-3
14940100 0 1
14940101 1 31.5e-3
14940102 1 35.0e-3
14940201 001 2
14940301 0. 2
14940400 0
14940401 435.0 3
14940501 494010000 0 1 1 415.0e-3 1 * 415 mm
14940601 0 0 0 1 415.0e-3 1
14940701 0 0. 0. 0. 1
14940801 54.9e-3 100. 100. 0. 0. 0. 0. 1. 1
14940901 60.5e-3 100. 100. 0. 0. 0. 0. 1. 1

```

*

```

*****
* structure 4960 : broken loop discharge leg 2-3 *
*****

```

```

14960000 1 3 2 0 27.45e-3
14960100 0 1
14960101 1 31.5e-3
14960102 1 35.0e-3
14960201 001 2
14960301 0. 2
14960400 0
14960401 435.0 3
14960501 476010000 0 1 1 200.0e-3 1 * 200 mm
14960601 0 0 0 1 200.0e-3 1
14960701 0 0. 0. 0. 1
14960801 54.9e-3 100. 100. 0. 0. 0. 0. 1. 1
14960901 60.5e-3 100. 100. 0. 0. 0. 0. 1. 1

```

*

```

*-----*
* structure input thermal property *
*-----*

```

*

```

*****
* stainless steel *
*****

```

20100100	tbl/ftm	l	l
*	temperature		thermal conductivity
20100101	294.26		14.8842
20100102	366.48		16.0929
20100103	477.59		17.9993
20100104	588.71		19.5570
20100105	699.82		21.1145
20100106	810.93		22.8466
20100107	922.04		24.2297
20100108	1088.71		26.4788
20100109	100000.0		40.
*			
*	temperature		heat capacity
20100151	294.26		3.8195e6
20100152	366.48		3.9979e6
20100153	477.59		4.2270e6
20100154	588.71		4.3552e6
20100155	699.82		4.4465e6
20100156	810.93		4.5630e6
20100157	922.04		4.6250e6
20100158	1088.71		4.7502e6
20100159	100000.0		1.0e7
*			

* microm heater			

20100200	tbl/ftm	l	l
*	temperature		thermal conductivity
20100201	273.15		8.78
20100202	293.15		8.78
20100203	573.15		11.3
20100204	773.15		13.81
20100205	1073.15		18.83
20100206	1273.15		22.18
20100207	1473.15		25.52
20100208	10000.0		25.52
*			
*	temperature		heat capacity
20100251	273.15		3.23e6
20100252	373.15		3.23e6
20100253	573.15		3.62e6
20100254	773.15		4.10e6
20100255	1073.15		4.61e6

20100256	1173.15		4.73e6
20100257	1273.15		4.95e6
20100258	1473.15		5.29e6
20100259	10000.0		5.29e6
*			

* copper			

20100300	tbl/ftm	l	l
*	temperature		thermal conductivity
20100301	273.15		384.
20100302	373.15		379.
20100303	473.15		374.
20100304	573.15		369.
20100305	673.15		363.
20100306	873.15		353.
*			
*	temperature		heat capacity
20100351	273.15		3.4496e6
20100352	293.15		3.4496e6
20100353	373.15		3.5661e6
20100354	573.15		3.7184e6
20100355	1000.0		3.7184e6
20100356	2000.0		3.7184e6
*			

* general table			

* core heater power at C18002 & c19001			
20288800	power		
20288801	-10.0	0.0e3	
20288802	0.1	0.0e3	
20288803	5.0	10.0e3	
20288804	1000.0	10.0e3	
*			
* core heater power at C19002 & c19003			
20288900	power		
20288901	-10.0	0.0e3	
20288902	0.1	0.0e3	
20288903	5.0	20.0e3	
20288904	1000.0	20.0e3	
*			

```

* control variable *
*-----*
*
*****
* control variable 001 : pressurizer normalized water level *
*****
**20500100 pzmvl sum 1.11111 0.8 1 3 0. 1. *1.11111=1/total lvl
**20500101 0. 90.0e-3 voidf 510010000
**20500102 90.0e-3 voidf 510020000
**20500103 90.0e-3 voidf 510030000
**20500104 90.0e-3 voidf 510040000
**20500105 90.0e-3 voidf 510050000
**20500106 90.0e-3 voidf 510060000
**20500107 90.0e-3 voidf 510070000
**20500108 90.0e-3 voidf 510080000
**20500109 90.0e-3 voidf 510090000
**20500110 90.0e-3 voidf 510100000
*
*****
* control variable 002 : intact loop sg normalized water level *
*****
20500200 sganlvl sum 0.5128205 0.99 1 3 0. 1. *0.5128205=1/total lvl
20500201 0. 4.1e-1 voidf 610010000
20500202 4.1e-1 voidf 610020000
20500203 4.1e-1 voidf 610030000
20500204 4.1e-1 voidf 610040000
20500205 95.0e-3 voidf 620010000
20500206 215.0e-3 voidf 630010000
*
*****
* control variable 003 : broken loop sg normalized water level *
*****
20500300 sgbnlvl sum 0.5128205 0.99 1 3 0. 1. *0.5128205=1/total lvl
20500301 0. 4.1e-1 voidf 710010000
20500302 4.1e-1 voidf 710020000
20500303 4.1e-1 voidf 710030000
20500304 4.1e-1 voidf 710040000
20500305 95.0e-3 voidf 720010000
20500306 215.0e-3 voidf 730010000
*
*-----*
*----- sg a feed water control -----*
*-----*

```

```

*****
* control variable 004 : intact loop sg heat removal amount *
*****
20500400 sgaheat sum 1. 0. 1
20500401 0. 1. q 610010000
20500402 1. q 610020000
20500403 1. q 610030000
20500404 1. q 610040000
*
*****
* control variable 005 : intact loop sg feed water ugj-ufj *
*****
20500500 augj-ufj sum 1. 0. 1
20500501 0. 1. ugj 603000000
20500502 -1. ufj 603000000
*
*****
* control variable 006 : intact loop sg feed water flow rate *
*****
20500600 afeed div 1. 0. 1
20500601 cntrlvar 005
20500602 cntrlvar 004
*
*-----*
*----- sg b feed water control -----*
*-----*
*****
* control variable 007 : broken loop sg heat removal amount *
*****
20500700 sgbheat sum 1. 0. 1
20500701 0. 1. q 710010000
20500702 1. q 710020000
20500703 1. q 710030000
20500704 1. q 710040000
*
*****
* control variable 008 : broken loop sg feed water ugj-ufj *
*****
20500800 bugj-ufj sum 1. 0. 1
20500801 0. 1. ugj 703000000
20500802 -1. ufj 703000000
*

```

```

*****
* control variable 009 : broken loop sg feed water flow rate *
*****
20500900 bfeed div 1. 0. 1
20500901 cntrlvar 008
20500902 cntrlvar 007
*
=====
*----- sg's steam dump control -----*
=====
*
*****
* control variable 010 : steam line steam dump *
*****
20501000 stmdump sum 1. 0. 1
20501001 0. 1. cntrlvar 006
20501002 1. cntrlvar 009
*
*
*.pump---pump---pump---pump---pump---pump---pump---pump---pump---pump---pump---*
* pump simulation *
*---pump---pump---pump---pump---pump---pump---pump---pump---pump---pump---*
*
*-----*
***** delete card *****
*-----*
* 3710000 cold leg in intact loop
* 4710000 cold leg in broken loop
* 4910000 cold leg in broken loop
* 5210000 surge line in intact loop hot leg
*
*-----*
***** intact loop *****
*-----*
*
*****
* component 001 : pump bypass line junction 1 in intact loop *
*****
0010000 apumpj1 sngljun
0010101 364010002 002010001 0. 2.5 2.5 000000
0010201 0 0. 0. 0.
*

```

```

*****
* component 002 : pump bypass line 1 in intact loop *
*****
*
0020000 apmpb1 pipe * name
0020001 4 * number of volume
0020101 1.3136e-3 4 * flow area of volume
0020201 0. 3 * flow area of junction
0020301 650.0e-3 4 * flow length
0020401 0. 4 * volume of volume
0020501 0. 1 * azimuthal angle
0020502 0. 2
0020503 0. 4
0020601 0. 4 * inclination angle
*0020701 elevation change
0020801 4.572e-4 40.89e-3 4 * roughness, hyd. dia.
0020901 0.2 0.2 1 * loss coeff.
0020902 0.2 0.2 2
0020903 0.2 0.2 3
0021001 00000 4 * flag of volume
0021101 00000 3 * flag of junction
0021201 003 850000. 435. 0. 0. 0. 4 * i.c. of volume
0021300 0 * i.c. ctrl word of junction
0021301 0.0 0.0 0. 3 * i.c. of junction
*
*****
* component 003 : pump junction 2 in intact loop *
*****
*
0030000 apumpj2 sngljun
0030101 002040002 004010001 0. 1.0e-6 1.0e-6 000000
0030201 0 0. 0. 0.
*
*****
* component 004 : pump line 1 in intact loop *
*****
*
0040000 apmp1 pipe * name
0040001 1 * number of volume
0040101 1.3136e-3 1 * flow area of volume
*0040201 no junction
0040301 250.0e-3 1 * flow length
0040401 0. 1 * volume of volume

```

```

0040501 0. 1 * azimuthal angle
0040601 0. 1 * inclination angle
*0040701 elevation change
0040801 4.572e-4 40.89e-3 1 * roughness, hyd. dia.
*0040901 no junction
0041001 00000 1 * flag of volume
*0041101 no junction
0041201 003 850000. 435. 0. 0. 0. 1 * i.c. of volume
*0041300 no junction
*0041301 no junction
*
*****
* component 007 : pump junction 4 in intact loop *
*****
*
0070000 apumpj4 tndpjun
0070101 004010002 008010001 0. * 1.0e-6 1.0e-6 000000
0070200 f 501 cntrlvar 011
*
* velf velg
0070201 -1.0e10 -1.0e10 0.0 0.
0070202 -10. -10. 0. 0.
0070203 0. 0. 0. 0.
0070204 10. 10. 0. 0.
0070205 1.0e10 1.0e10 0.0 0.
*
*****
* component 008 : pump line 3 in intact loop *
*****
*
0080000 apinp3 pipe * name
0080001 1 * number of volume
0080101 1.3136e-3 1 * flow area of volume
*0080201 no junction
0080301 250.0e-3 1 * flow length
0080401 0. 1 * volume of volume
0080501 0. 1 * azimuthal angle
0080601 0. 1 * inclination angle
*0080701 elevation change
0080801 4.572e-4 40.89e-3 1 * roughness, hyd. dia.
*0080901 no junction
0081001 00000 1 * flag of volume
*0081101 no junction

```

```

0081201 003 850000. 435. 0. 0. 0. 1 * i.c. of volume
*0081300 no junction
*0081301 no junction
*
*****
* component 009 : pump junction 5 in intact loop *
*****
*
0090000 apumpj5 sngljun
0090101 008010002 010010001 1.3136e-4 1.0 1.0 000100
0090201 0 0.1 0.1 0.
*
*****
* component 010 : pump by pass line 2 in intact loop *
*****
*
0100000 apmp2 pipe * name
0100001 4 * number of volume
0100101 1.3136e-3 4 * flow area of volume
0100201 0. 3 * flow area of junction
0100301 650.0e-3 1 * flow length
0100302 650.0e-3 2
0100303 650.0e-3 4
0100401 0. 4 * volume of volume
0100501 0. 4 * azimuthal angle
0100601 0. 1 * inclination angle
0100602 90. 2
0100603 0. 4
*0100701 elevation change
0100801 4.572e-4 40.89e-3 4 * roughness, hyd. dia.
0100901 0.2 0.2 1 * loss coeff.
0100902 0.2 0.2 2
0100903 0.2 0.2 3
0101001 00000 4 * flag of volume
0101101 000000 3 * flag of junction
0101201 003 900000. 435. 0. 0. 0. 4 * i.c. of volume
0101300 0 * i.c. ctrl word of junction
0101301 0.0 0.0 0. 3 * i.c. of junction
*
*****
* component 011 : pump junction 6 in intact loop *
*****
*

```

```

0110000 apumpj6 sngljun
0110101 010040002 372010001 0. 5. 5. 000100 *K=10.
0110201 0 0. 0. 0.
*
*----- pump -----
*
*****
* component 020 : pump pressure <<SINKER>> in intact loop *
*****
0200000 aoutlet tmdpvol
0200101 2.3672e-3 0. 1.0e6 180.0 0. 0. 4.572e-4 0.0 00000
0200200 003 0 tempf004010000
0200201 0. 830000. 0.
0200202 1000. 830000. 1000.
*
*****
* component 021 : pump pressure sinker junction in intact loop *
*****
0210000 aoutletj sngljun
0210101 004010002 020010001 0. 1.0e-5 1.0e-5 000000
0210201 0 0. 0. 0.
*
*****
* component 022 : pump pressure <<SOURCE>> in intact loop *
*****
0220000 ainlet tmdpvol
0220101 2.3672e-3 0. 1.0e6 180.0 0. 0. 4.572e-4 0.0 00000
0220200 003 0 tempf008010000
0220201 0. 900000. 0
0220202 1000. 900000. 1000.0
*
*****
* component 023 : pump pressure source junction in intact loop *
*****
0230000 ainletj sngljun
0230101 022010002 008010001 0. 1.0e-5 1.0e-5 000000
0230201 0 0. 0. 0.
*
*-----*
***** broken loop *****

```

```

*-----*
*
* cold leg 1 in broken loop -----*
*
*****
* component 031 : pump bypass line junction 1 in broken loop *
*****
0310000 bpumpj1 sngljun
0310101 466010002 032010001 0. 2.5 2.5 000000
0310201 0 0. 0. 0.
*
*****
* component 032 : pump bypass line 1 in broken loop *
*****
0320000 bpmpl pipe * name
0320001 4 * number of volume
0320101 1.3136e-3 4 * flow area of volume
0320201 0. 3 * flow area of junction
0320301 650.0e-3 1 * flow length
0320302 195.0e-3 2
0320303 650.0e-3 4
0320401 0. 4 * volume of volume
0320501 0. 4 * azimuthal angle
0320601 0. 1 * inclination angle
0320602 -90. 2
0320603 0. 4
*0320701 elevation change
0320801 4.572e-4 40.89e-3 4 * roughness, hyd. dia.
0320901 0.2 0.2 1 * loss coeff.
0320902 0.2 0.2 2
0320903 0.2 0.2 3
0321001 00000 4 * flag of volume
0321101 000000 3 * flag of junction
0321201 003 850000. 435. 0. 0. 0. 4 * i.c. of volume
0321300 0 * i.c. ctrl word of junction
0321301 0.0 0.0 0. 3 * i.c. of junction
*
*****
* component 033 : pump junction 2 in broken loop *
*****
*

```

```

0330000 bpumpj2 sngljun
0330101 032040002 004010001 0. 1.0e-6 1.0e-6 000000
0330201 0 0. 0. 0.
*
*****
* component 039 : pump junction 5 in broken loop *
*****
*
0390000 bpumpj5 sngljun
0390101 008010002 040010001 1.3136e-4 1.0 1.0 000100
0390201 0 0.1 0.1 0.
*
*****
* component 040 : pump by pass line 2 in broken loop *
*****
*
0400000 bpmp2 pipe * name
0400001 4 * number of volume
0400101 1.3136e-3 4 * flow area of volume
0400201 0. 3 * flow area of junction
0400301 650.0e-3 1 * flow length
0400302 650.0e-3 2
0400303 650.0e-3 4
0400401 0. 4 * volume of volume
0400501 0. 4 * azimuthal angle
0400601 0. 1 * inclination angle
0400602 90. 2
0400603 0. 4
*0400701 elevation change
0400801 4.572e-4 40.89e-3 4 * roughness, hyd. dia.
0400901 0.2 0.2 1 * loss coeff.
0400902 0.2 0.2 2
0400903 0.2 0.2 3
0401001 00000 4 * flag of volume
0401101 000000 3 * flag of junction
0401201 003 850000. 435. 0. 0. 0. 4 * i.c. of volume
0401300 0 * i.c. ctrl word of junction
0401301 0.0 0.0 0. 3 * i.c. of junction
*
*****
* component 041 : pump junction 6 in broken loop *
*****
*

```

```

0410000 bpumpj6 sngljun
0410101 040040002 472010001 0. 5. 5. 000100
0410201 0 0. 0. 0.
*
* cold leg 2 in broken loop -----*
*
*****
* component 061 : pump bypass line 1 in broken loop *
*****
*
0610000 bpumpj1 sngljun
0610101 486010002 062010001 0. 2.5 2.5 000000
0610201 0 0. 0. 0.
*
*****
* component 062 : pump bypass line 1 in broken loop *
*****
*
0620000 bpmpb1 pipe * name
0620001 4 * number of volume
0620101 1.3136e-3 4 * flow area of volume
0620201 0. 3 * flow area of junction
0620301 650.0e-3 1 * flow length
0620302 195.0e-3 2
0620303 650.0e-3 4
0620401 0. 4 * volume of volume
0620501 0. 4 * azimuthal angle
0620601 0. 1 * inclination angle
0620602 -90. 2
0620603 0. 4
*0620701 elevation change
0620801 4.572e-4 40.89e-3 4 * roughness, hyd. dia.
0620901 0.2 0.2 1 * loss coeff.
0620902 0.2 0.2 2
0620903 0.2 0.2 3
0621001 00000 4 * flag of volume
0621101 000000 3 * flag of junction
0621201 003 850000. 435. 0. 0. 0. 4 * i.c. of volume
0621300 0 * i.c. ctrl word of junction
0621301 0.0 0.0 0. 3 * i.c. of junction
*
*****
* component 063 : pump junction 2 in broken loop *

```

```

*****
*
0630000 bpumpj2 sngljun
0630101 062040002 004010001 0. 1.0e-6 1.0e-6 000000
0630201 0 0. 0. 0.
*
*****
* component 069 : pump junction 5 in broken loop *
*****
*
0690000 bpumpj5 sngljun
0690101 008010002 070010001 1.3136e-4 1.0 1.0 000100
0690201 0 0.1 0.1 0.
*
*****
* component 070 : pump by pass line 2 in broken loop *
*****
*
0700000 bpmp2 pipe * name
0700001 4 * number of volume
0700101 1.3136e-3 4 * flow area of volume
0700201 0. 3 * flow area of junction
0700301 650.0e-3 1 * flow length
0700302 650.0e-3 2
0700303 650.0e-3 4
0700401 0. 4 * volume of volume
0700501 0. 4 * azimuthal angle
0700601 0. 1 * inclination angle
0700602 90. 2
0700603 0. 4
*0700701 elevation change
0700801 4.572e-4 40.89e-3 4 * roughness, hyd. dia.

```

```

0700901 0.2 0.2 1 * loss coeff.
0700902 0.2 0.2 2
0700903 0.2 0.2 3
0701001 00000 4 * flag of volume
0701101 000000 3 * flag of junction
0701201 003 850000. 435. 0. 0. 0. 4 * i.c. of volume
0701300 0 * i.c. ctrl word of junction
0701301 0.0 0.0 0. 3 * i.c. of junction
*
*****
* component 071 : pump junction 6 in broken loop *
*****
*
0710000 bpumpj6 sngljun
0710101 070040002 492010001 0. 5. 5. 000100 * K=10.
0710201 0 0. 0. 0.
*
*
*-----*
***** control variables : for the sake of pump flow rate *
*-----*
*
*****
* control variable 011 : pump flow rate *
*****
20501100 acldvel sum 1. 0. 1
20501101 0. 1. mflowj 009000000
20501102 1. mflowj 039000000
20501103 1. mflowj 069000000
*
.

```


Appendix B Input Deck for Drain-down Calculation (Run01)

```

=====
=====
= SNUTF Hot Leg Break LOCA Analysis Input Deck with RELAP5/MOD3.1 =
=====
=====
*
**** resart input for drain down transient
*
0000100 restart transnt
0000101 run
0000103 1127 * restart number
* time step cards
0000201 28. 1.-6 1.0e-2 00003 1000 50000 2000000
*0000202 55. 1.-6 5.0e-2 00003 100 1000000 20000000
0000203 1200. 1.-6 5.0e-2 00003 1000 1000000 20000000
*0000204 2000. 1.-6 5.0e-2 00003 2000 1000000 20000000
*
*-----*
* minor edits *
*-----*
*
0000301 p 220010000
0000302 p 372010000 * p1'
0000303 p 330010000 * p2'
0000304 p 360010000 * p3'
0000305 p 364010000 * p4'
0000306 p 472010000 * p1
0000307 p 440010000 * p2
0000308 p 460010000 * p3
0000309 p 466010000 * p4
0000310 p 610040000
0000311 p 710040000
*
0000320 tempf 372010000 * intact loop discharge
0000321 tempg 372010000 * intact loop discharge
0000322 tempf 364010000 * intact loop suction
0000323 tempg 364010000 * intact loop suction
0000324 tempf 472010000 * broken loop discharge
0000325 tempg 472010000 * broken loop discharge
0000326 tempf 466010000 * broken loop suction
0000327 tempg 466010000 * broken loop suction
0000328 tempf 492010000 * broken loop discharge
0000329 tempg 492010000 * broken loop discharge
0000330 tempf 486010000 * broken loop suction
0000331 tempg 486010000 * broken loop suction
0000332 tempf 200010000 * core upper

```

```

0000333 tempg 200010000 * core upper
*
0000340 mflowj 311000000 * intact loop hot leg flow rate
0000341 mflowj 411000000 * broken loop hot leg flow rate
0000342 mflowj 375000000 * intact loop flow rate
0000343 mflowj 475000000 * broken loop cold leg 1 flow rate
0000344 mflowj 495000000 * broken loop cold leg 1 flow rate
0000345 mflowj 991000000 * break flow : intact cold leg
0000346 mflowj 993000000 * break flow : broken cold leg 1
0000347 mflowj 995000000 * break flow : broken cold leg 2
0000348 mflowj 997000000 * break flow : reactor lower plenum
*0000349 mflowj 987000000 * sg blowdown flow
*
0000360 voidg 364010000
0000361 voidg 466010000
0000362 voidg 486010000
*
*0000370 cntrlvar 001 * p2r normalized water level
0000371 cntrlvar 002 * intact sg normalized water level
0000372 cntrlvar 003 * broken sg normalized water level
0000373 cntrlvar 021 * suction leg water level in intact loop (C370)
0000374 cntrlvar 022 * suction leg water level in broken loop 1 (C470)
0000375 cntrlvar 023 * suction leg water level in broken loop 2 (C490)
0000376 cntrlvar 024 * reactor water lever under legs (C160+C180+C190+C200)
*
*-----*
* input change *
*-----*
*
*-blowdown---blowdown---blowdown---blowdown---blowdown---blowdown---blowdown---*
* blowdown simulation *
*-blowdown---blowdown---blowdown---blowdown---blowdown---blowdown---blowdown--*
*
*-----*
**** control cards for blowdown phase **
*-----*
*
0000521 p,220010000 ge null 0 0.3507e6 n * intact loop blowdown
0000522 p,220010000 ge null 0 0.3507e6 n * broken loop blowdown 1
0000523 p,220010000 ge null 0 0.3507e6 n * broken loop blowdown 2
0000524 p,220010000 ge null 0 0.3507e6 n * reactor blowdown
0000525 p,220010000 ge null 0 0.39e6 n * power trip(if p>0.37, then power off)
*0000526 p,710010000 ge null 0 0.56e6 n * sg blowdown
*
*-----*

```

```

*
*-----*
*
*-----*
*** delete cards for blowdown phase ***
*-----*
*
0010000 apumpj1 delete
0020000 apmpb1 delete
0030000 apumpj2 delete
0040000 apmp1 delete
0070000 apumpj4 delete
0080000 apmp3 delete
0090000 apumpj5 delete
0100000 apmp2 delete
0110000 apumpj6 delete
*
0200000 aoutlet delete
0210000 aoutletj delete
0220000 ainlet delete
0230000 ainletj delete
*
0310000 bpumpj1 delete
0320000 bpmpb1 delete
0330000 bpumpj2 delete
0390000 bpumpj5 delete
0400000 bpmp2 delete
0410000 bpumpj6 delete
*
0610000 bpumpj1 delete
0620000 bpmpb1 delete
0630000 bpumpj2 delete
0690000 bpumpj5 delete
0700000 bpmp2 delete
0710000 bpumpj6 delete
*
6000000 feed_a delete * secondary system feedwater
6010000 feed_ja1 delete * secondary system feedwater
7000000 feed_b delete * secondary system feedwater
7010000 feed_jb1 delete * secondary system feedwater
8110000 s-hd-j2 delete * secondary system steam dump
8900000 stmdump delete * secondary system steam dump
*
20501100 acldvel delete * control card for pump
*
*-----*

```

```

** addition cards for blowdown phase **
*-----*
*
*****
* component 371 : intact discharge leg junction 1
*****
3710000 dlj1 sngljun
3710101 370010002 372010001 0. 0.05 0.05 020000
3710201 0 0.26086 0.26086 0.
*
*****
* component 471 : broken discharge leg junction 1-1
*****
4710000 dlj1-1 sngljun
4710101 470010002 472010001 0. 0.05 0.05 020000
4710201 0 0.42635 0.42635 0.
*
*****
* component 491 : broken discharge leg junction 2-1
*****
4910000 dlj2-1 sngljun
4910101 490010002 492010001 0. 0.05 0.05 020000
4910201 0 0.42635 0.42635 0.
*
*-----*
***** intact loop blowdown *****
*-----*
*
*****
* component 991 : intact loop blowdown valve
*****
9910000 intbdj valve
9910101 364010002 992010001 3.4e-5 10. 10. 000100
9910201 0 0. 0.
9910300 trpvlv
9910301 521
*
*****
* component 992 : intact loop blowdown boundary
*****
9920000 intbd tmdpvvl
9920101 1.0e6 2. 0. 0. 90. 2. 4.572e-4 0.0 00000

```

```

9920200 002
9920201 0. 120000. 1.
9920202 1.0e6 120000. 1.
*
*-----*
***** broken loop blowdown *****
*-----*
*
*****
* component 993 : broken loop blowdown valve 1 *
*****
9930000 intbdj valve
9930101 466010002 994010001 3.3e-5 2. 2. 000100
9930201 0 0. 0. 0.
9930300 trpvlv
9930301 522
*
*****
* component 994 : broken loop blowdown bounday 1 *
*****
9940000 intbd tmdpvvl
9940101 1.0e6 2. 0. 0. 90. 2. 4.572e-4 0.0 00000
9940200 002
9940201 0. 120000. 1.
9940202 1.0e6 120000. 1.
*
*****
* component 995 : broken loop blowdown valve 2 *
*****
9950000 intbdj valve
9950101 486010002 996010001 3.3e-5 2. 2. 000100
9950201 0 0. 0. 0.
9950300 trpvlv
9950301 523
*
*****
* component 996 : broken loop blowdown bounday 2 *
*****
9960000 intbd tmdpvvl
9960101 1.0e6 2. 0. 0. 90. 2. 4.572e-4 0.0 00000
9960200 002
9960201 0. 120000. 1.
9960202 1.0e6 120000. 1.
*

```

```

*-----*
***** reactor blowdown *****
*-----*
*
*****
* component 997 : reactor blowdown valve *
*****
9970000 rxbdj valve
9970101 160010001 998010001 3.52e-5 2. 2. 000100
9970201 0 0. 0. 0.
9970300 trpvlv
9970301 524
*
*****
* component 998 : reactor blowdown boundary *
*****
9980000 rxbd tmdpvvl
9980101 1.0e6 2. 0. 0. 90. 2. 4.572e-4 0.0 00000
9980200 002
9980201 0. 120000. 1.
9980202 1.0e6 120000. 1.
*
*-----*
*** sg blowdown for pressure control *** This will be deleted soon after blowdown
*-----*
*****
* component 987 : sg blowdown valve *
*****
**9870000 sgbdj valve
**9870101 810010001 988010001 0.29e-4 2. 2. 000100
**9870201 0 0. 0. 0.
**9870300 trpvlv
**9870301 526
*
*****
* component 988 : sg blowdown boundary *
*****
**9880000 sgbd tmdpvvl
**9880101 1.0e6 2. 0. 0. 90. 2. 4.572e-4 0.0 00000
**9880200 002
**9880201 0. 120000. 1.
**9880202 1.0e6 120000. 1.
*
*-----*

```

* general table *

* core heater power at C18002 & C19001

20288800	power		
20288801	-10.0	0.0e3	
20288802	0.1	0.0e3	
20288803	5.0	0.0e3	
20288804	7.0	0.0e3	
20288805	8.0	0.0e3	
20288806	1000.0	0.0e3	

*

* core heater power at C19002 & C19003

20288900	power		
20288901	-10.0	0.0e3	
20288902	0.1	0.0e3	
20288903	5.0	10.0e3	
20288904	7.0	10.0e3	
20288905	8.0	0.0e3	
20288906	1000.0	0.0e3	

*

*

***** control variables : for the sake of blowdown phase *

*

* control variable 021 : suction leg water level in intact loop (C370) *

20502100	intlvl	sum	1.	0.65	1
20502101	0.	0.65	voidf	370010000	

*

* control variable 022 : suction leg water level in broken loop 1 (C470) *

20502200	brklvl	sum	1.	0.455	1
20502201	0.	0.455	voidf	470010000	

*

* control variable 023 : suction leg water level in broken loop 2 (C490) *

20502300	brklvl	sum	1.	0.455	1
20502301	0.	0.455	voidf	490010000	

*

* control variable 024 : reactor water level under legs (C160+C180+C190+C200) *

20502400	rxlvl	sum	1.	0.928	1
20502401	0.	0.08	voidf	160010000	
20502402		0.148	voidf	180010000	
20502403		0.1	voidf	180020000	
20502404		0.1	voidf	190010000	
20502405		0.2	voidf	190020000	
20502406		0.2	voidf	190030000	
20502407		0.1	voidf	200010000	

*

.

.

Appendix C Input Deck for Post-blowdown Calculation (Run01)

```

=====
=====
= SNUTP Hot Leg Break LOCA Analysis Input Deck with RELAP5/MOD3.1 =
=====
=====
*
***** restart input for post blowdown in hot leg break transient
*
0000100 restart transnt
0000101 run
0000103 27194 * restart number
* time step cards
0000201 28. 1.-6 1.0e-2 00003 1000 50000 2000000
0000202 1200. 1.-6 5.0e-2 00003 1000 1000000 20000000
0000204 1205. 1.0e-6 5.0e-4 00003 200 2000000 20000000
0000205 1250. 1.0e-6 2.0e-3 00003 500 20000 20000000
0000206 1320. 1.0e-6 2.0e-3 00003 500 20000 20000000
*
*-----*
* trip *
*-----*
0000531 time 0 ge null 0 1200.0 n -1.0 * break
0000532 time 0 ge null 0 1200.0 n -1.0 * SI Initiation
0000533 time 0 gt null 0 1.0e6 n * motor valve close
*
*-----*
* minor edits *
*-----*
*
0000301 p 220010000 * reactor top head
0000302 p 720010000 * sg top head
0000303 p 730010000 * sg top head
0000304 p 954010000 * discharge tank
*
0000310 tempf 400010000 * rx side broken section
0000311 tempg 400010000 * rx side broken section
0000312 tempf 430010000 * sg side broken section
0000313 tempg 430010000 * sg side broken section
0000314 tempf 160010000 * rx lower plenum
0000315 tempg 160010000 * rx lower plenum
*
0000330 mflowj 951000000 * reactor side broken section
0000331 mflowj 961000000 * sg side broken section
0000332 mflowj 475000000 * broken loop cold leg 1

```

```

0000333 mflowj 471000000 * broken loop cold leg 1
0000334 mflowj 495000000 * broken loop cold leg 2
0000335 mflowj 491000000 * broken loop cold leg 2
0000336 mflowj 301000000 * intact loop hot leg
0000337 mflowj 375000000 * intact loop hot leg
0000338 mflowj 901000000 * total si flowrate
0000339 mflowj 902010000 * si flowrate to intact loop
0000340 mflowj 902020000 * si flowrate to broken loop 1
0000341 mflowj 902030000 * si flowrate to broken loop 2
*
0000360 cntrlvar 021 * intact loop cold leg water level
0000361 cntrlvar 022 * broken loop cold leg water level
0000362 cntrlvar 023 * broken loop cold leg water level
0000363 cntrlvar 024 * reactor water level
0000364 cntrlvar 025 * broken loop u tube water level 1
0000365 cntrlvar 026 * broken loop u tube water level 2
0000366 cntrlvar 027 * broken loop suction leg water level 1
0000367 cntrlvar 028 * broken loop suction leg water level 2
0000368 cntrlvar 029 * cntrlvar 025 + cntrlvar 027
0000369 cntrlvar 030 * cntrlvar 026 + cntrlvar 028
0000370 cntrlvar 031 * discharge amount through reactor side broken section
0000371 cntrlvar 032 * discharge amount through sg side broken section
0000372 cntrlvar 002 * intact loop sg nonnormalized water level
0000373 cntrlvar 003 * broken loop sg normalized water level
*
*(0000380 htemp 190010103
*
*-----*
* delete or addition *
*-----*
*
** delete cards for post blowdown phase **
*-----*
*
9910000 intbdj delete
9920000 intbd delete
9930000 intbdj delete
9940000 intbd delete
9950000 intbdj delete
9960000 intbd delete
9970000 rxbdj delete
9980000 rxbd delete
*
4110000 btub_ij1 delete * delete means separation valve close

```

```

*-----*
** addition cards for post blowdown phase **
*-----*
*****
* component 111 : downcomer connection between left and right
*****
1110000 decon sngljun
1110101 110010003 120010004 0. 10. 10. 000003
1110201 0 0. 0. 0.
*-----*
*               input change               *
*-----*
*
*--- post blowdown ---- post blowdown ---- post blowdown ---- post blowdown --*
*               post blowdown simulation               *
*--- post blowdown ---- post blowdown ---- post blowdown ---- post blowdown --*
*-----*
*               break simulation               *
*-----*
*
*-----*
***** reactor side broken section *****
*-----*
*****
* component 951 : reactor side break (simulate break valve)
*****
9510000 rxbreakj valve
9510101 400010002 952010001 3.2928e-3 1. 1. 000102
9510201 0 0. 0. 0.
9510300 mtrvlv
9510301 531 533 0.25 0. 100 * 0.25=1/4 sec
*-----*
* component 952 : break pipe in reactor side
*****
9520000 brkpipe1 pipe * name
9520001 3 * number of volume
9520101 3.2928e-3 1 * flow area of volume
9520102 3.8705e-3 3

```

```

9520201 0. 2 * flow area of junction
9520301 200.0e-3 3 * flow length
9520401 0. 3 * volume of volume
9520501 -90. 3 * azimuthal angle
9520601 0. 2 * inclination angle
9520601 -90. 3
*9520701 elevation change
9520801 4.572e-4 70.2e-3 3 * roughness, hyd. dia.
9520901 0. 0. 2 * loss coeff.
9521001 00000 3 * flag of volume
9521101 000000 2 * flag of junction
9521201 002 1.03325e5 1. 0. 0. 0. 3 * i.c. of volume
9521300 0 * i.c. ctrl word of junction
9521301 0.0 0.0 0. 2 * i.c. of junction
*
*****
* component 953 : break junction in reactor side
*****
9530000 brkjun1 sngljun
9530101 952030002 954010001 0. 2. 0.5 000000
9530201 0 0. 0. 0.
*
*****
* component 954 : reactor side break
*****
9540000 rxbreak tmdpv01
9540101 0. 1. 1.0e6 0. -90. -1. 4.572e-4 0.0 00000
9540200 002
9540201 0. 1.05025e5 1.
*-----*
***** sg side broken section *****
*-----*
*****
* component 961 : steam generator side break (simulate break valve)
*****
9610000 sgbreakj valve
9610101 430010001 962010001 3.2928e-3 1. 1. 000102
9610201 0 0. 0. 0.
9610300 mtrvlv
9610301 531 533 0.25 0. 100 * 0.25=1/4 sec
*-----*
* component 962 : break pipe in steam generator side
*****

```



```

9620000 brkpipe1 pipe * name
9620001 5 * number of volume
9620101 3.2928e-3 1 * flow area of volume
9620102 3.8705e-3 5
9620201 0. 4 * flow area of junction
9620301 100.0e-3 1 * flow length
9620302 300.0e-3 2
9620303 400.0e-3 3
9620304 300.0e-3 4
9620305 100.0e-3 5
9620401 0. 5 * volume of volume
9620501 90. 1 * azimuthal angle
9620502 0. 2
9620503 0. 3
9620504 90. 4
9620505 0. 5
9620601 0. 1 * inclination angle
9620602 0. 2
9620603 -90. 3
9620604 0. 4
9620605 -90. 5
*9620701 elevation change
9620801 4.572e-4 70.2e-3 5 * roughness, hyd. dia.
9620901 0.05 0.05 4 * loss coeff.
9621001 00000 5 * flag of volume
9621101 000000 4 * flag of junction
9621201 002 1.03325e5 1. 0. 0. 0. 5 * i.c. of volume
9621300 0 * i.c. ctrl word of junction
9621301 0.0 0.0 0. 4 * i.c. of junction
*
*****
* component 963 : break junction in steam generator side *
*****
9630000 brkjun1 sngljun
9630101 962050002 964010001 0. 2. 0.5 000000
9630201 0 0. 0. 0.
*
*****
* component 964 : steam generator side break *
*****
9640000 sgbreak tmdpvol
9640101 0. 1. 1.0e6 0. -90. -1. 4.572e-4 0.0 00000
9640200 002
9640201 0. 1.05025e5 1.
*
*-----*

```

```

***** safety injection *****
*-----*
*
*****
* component 900 : si water source *
*****
9000000 siwater tmdpvol
9000101 3.2928e-3 0. 1.0e6 0. 0. 0. 4.572e-4 0.0 00000
9000200 003 0 p 902010000
9000201 0. 0. 333.15
9000202 1.0e12 1.0e12 333.15
*
*****
* component 901 : si junction *
*****
*
9010000 sijnun tmdpjun
9010101 900010002 902010001 0.
9010200 1 532
9010201 0. 0. 0. 0.
9010202 3. 2.5 0. 0.
9010203 1210. 2.5 0. 0.
9010204 1.0e6 2.5 0. 0.
*
*****
* component 902 : si line *
*****
9020000 siline branch
9020001 3 0
9020101 1.3132e-3 500.0e-3 0. 0. 0. 0. 4.572e-4 40.89e-3 00000
9020200 002 350000. 1.
9021101 902010002 910010001 0. 2. 1000. 000100
9022101 902010002 920010001 0. 1. 1000. 000100
9023101 902010002 930010001 0. 1. 1000. 000100
9021201 0. 0. 0.
9022201 0. 0. 0.
9023201 0. 0. 0.
*
*----- to intact loop -----
*
*****
* component 910 : si pipe l in broken loop *
*****
*
9100000 sitoa pipe * name
9100001 2 * number of volume

```

```

9100101 9.6486e-4 2 * flow area of volume
9100201 0. 1 * flow area of junction
9100301 100.0e-3 2 * flow length
9100401 0. 2 * volume of volume
9100501 180. 2 * azimuthal angle
9100601 -60. 2 * inclination angle
*9100701 elevation change
9100801 4.572e-4 35.05e-3 2 * roughness, hyd. dia.
9100901 1. 1000. 1 * loss coeff.
9101001 00000 2 * flag of volume
9101101 000000 1 * flag of junction
9101201 002 350000. 1. 0. 0. 0. 2 * i.c. of volume
9101300 0 * i.c. ctrl word of junction
9101301 0.0 0.0 0. 1 * i.c. of junction
*
*****
* component 911 : si initiation valve to intact loop *
*****
9110000 sivilva valve
9110101 910020002 374010001 0. 0.5 1000. 000100
9110201 0 0. 0. 0.
9110300 trpvlv
9110301 532
*
*----- to broken loop 1 -----
*
*****
* component 920 : si pipe 1 in broken loop *
*****
9200000 si2b1 pipe * name
9200001 2 * number of volume
9200101 3.4402e-4 1 * flow area of volume
9200102 1.9602e-4 2
9200201 0. 1 * flow area of junction
9200301 100.0e-3 2 * flow length
9200401 0. 2 * volume of volume
9200501 0. 2 * azimuthal angle
9200601 -60. 2 * inclination angle
*9200701 elevation change
9200801 4.572e-4 20.929e-3 1 * roughness, hyd. dia.
9200802 4.572e-4 15.798e-3 2
9200901 1. 1000. 1 * loss coeff.
9201001 00000 2 * flag of volume
9201101 000100 1 * flag of junction
9201201 002 350000. 1. 0. 0. 0. 2 * i.c. of volume

```

```

9201300 0 * i.c. ctrl word of junction
9201301 0.0 0.0 0. 1 * i.c. of junction
*
*****
* component 921 : si initiation valve to broken loop 1 *
*****
9210000 sivilvb1 valve
9210101 920020002 474010001 0. 0.5 1000. 000100
9210201 0 0. 0. 0.
9210300 trpvlv
9210301 532
*
*----- to broken loop 2 -----
*
*****
* component 930 : si pipe 2 in broken loop *
*****
9300000 si2b2 pipe * name
9300001 2 * number of volume
9300101 3.4402e-4 1 * flow area of volume
9300102 1.9602e-4 2
9300201 0. 1 * flow area of junction
9300301 100.0e-3 2 * flow length
9300401 0. 2 * volume of volume
9300501 0. 2 * azimuthal angle
9300601 -60. 2 * inclination angle
*9300701 elevation change
9300801 4.572e-4 20.929e-3 1 * roughness, hyd. dia.
9300802 4.572e-4 15.798e-3 2
9300901 1. 1000. 1 * loss coeff.
9301001 00000 2 * flag of volume
9301101 000100 1 * flag of junction
9301201 002 350000. 1. 0. 0. 0. 2 * i.c. of volume
9301300 0 * i.c. ctrl word of junction
9301301 0.0 0.0 0. 1 * i.c. of junction
*
*****
* component 931 : si initiation valve to broken loop 2 *
*****
9310000 sivilvb1 valve
9310101 930020002 494010001 0. 0.5 1000. 000100
9310201 0 0. 0. 0.
9310300 trpvlv
9310301 532
*

```

```

*-----*
* general table *
*-----*
* break valve stem vs open area
20210000 normarea
20210001 -1. 0.
20210002 0. 0.
20210003 0.1 0.001
20210004 0.2 0.01
20210005 0.3 0.03
20210006 0.4 0.175
20210007 0.5 0.5
20210008 0.6 0.7
20210009 0.7 0.96
20210010 0.8 0.99
20210011 0.9 0.999
20210012 1.0 1.0
*
* core heater power at C18002 &C19001
20288800 power
20288801 -10.0 15.0e3
20288802 0.1 15.0e3
20288803 5.0 15.0e3
20288804 6000.0 15.0e3
*
* core heater power at C19002 &C19003
20288900 power
20288901 -10.0 15.0e3
20288902 0.1 15.0e3
20288903 5.0 15.0e3
20288904 6000.0 15.0e3
*
*-----*
***** control variables : for the sake of blowdown phase *
*-----*
*
*****
* control variable 024 : rx normalized water level (C160+C180+C190+C200) *
*****
20502400 rxlvl sum 1.0776 0.1 * 1.0776=1/0.928
20502401 0. 0.08 voidf 160010000
20502402 0.148 voidf 180010000
20502403 0.1 voidf 180020000
20502404 0.1 voidf 190010000
20502405 0.2 voidf 190020000
20502406 0.2 voidf 190030000

```

```

20502407 0.1 voidf 200010000
*
*****
* control variable 025 : u tube normalized water level 1 in broken loop *
*****
20502500 utublvl1 sum 6.0976e-1 0.1 *6.0976e-1=1/(0.82*2)
20502501 0. 4.1e-1 voidf 450080000
20502502 4.1e-1 voidf 450070000
20502503 4.1e-1 voidf 450060000
20502504 4.1e-1 voidf 450050000
*
*****
* control variable 026 : u tube normalized water level 2 in broken loop *
*****
20502600 utublvl2 sum 6.0976e-1 0.1 *6.0976e-1=1/(0.82*2)
20502601 0. 4.1e-1 voidf 452040000
20502602 4.1e-1 voidf 452030000
20502603 4.1e-1 voidf 452060000
20502604 4.1e-1 voidf 452050000
*
*****
* control variable 027 : suction leg normalized water level 1 in broken loop *
*****
20502700 sleglvl1 sum 1.9048 0.1 *1.9048=1/(0.1+0.18+0.245)
20502701 0. 100.0e-3 voidf 460010000
20502702 1.8e-1 voidf 462010000
20502705 2.45e-1 voidf 464010000
*
*****
* control variable 028 : suction leg normalized water level 2 in broken loop *
*****
20502800 sleglvl2 sum 1.9048 0.1 *1.9048=1/(0.1+0.18+0.245)
20502801 0. 100.0e-3 voidf 480010000
20502802 1.8e-1 voidf 482010000
20502805 2.45e-1 voidf 484010000
*
*****
* control variable 029 : suction leg + u tube normalized lvl 2 in broken loop *
*****
20502900 leglvl2 sum 4.6189e-1 0.1 *4.6189e-1=1/(1.64+0.525)
20502901 0. 1.64 cntrlvar 025
20502902 0.525 cntrlvar 027
*
*****
* control variable 030 : suction leg + u tube normalized lvl 2 in broken loop *
*****

```

```

20503000 leglv2 sum 4.6189e-1 0. 1 *4.6189e-1=1/(1.64+0.525)
20503001 0. 1.64 cntrlvar 026
20503002 1.525 cntrlvar 028
*
*****
* control variable 031 : discharge amount through reactor side broken section *
*****
20503100 rxdisch integral 1. 0. 1
20503101 mflowj 951000000
*
*****
* control variable 032 : discharge amount through sg side broken section *
*****
20503200 sgdisch integral 1. 0. 1
20503201 mflowj 961000000
*
*****
* control variable 033 : si water source pressure setting *
*****
20503300 sipres sum 1. 300000. 0
20503301 5000. 1. p 220010000
*
*****
* control variable 034 : heat to the fluid in core *
*****
20503400 qtocore sum 1. 60000. 0
20503401 0. 1. q 180020000
20503402 1. 1. q 190010000
20503403 1. 1. q 190020000
20503404 1. 1. q 190030000
*

```

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11. ABSTRACT (200 words or less)

SNUF experiment on hot leg break large break loss of coolant accident during post-blowdown was analyzed by RELAP5. As same with the procedure of SNUF experiment, normal operation and blowdown phase were simulated in order, and the initial condition was obtained and compared with the experimental initial condition. The analysis of post-blowdown phase showed that the behavior of primary pressure can be properly simulated by RELAP5 when sufficient heat source is modeled. Resultantly, the release from reactor side broken section and steam generator side broken section were properly predicted. The pressure rise in the second step of pressure behavior was partially well predicted, where the pressure increased by the steam generation in core. The release from the steam generator side broken section was predicted to be little except when there exists large pressure difference between primary system and break boundary. Break size did not affect much on the overall behavior to some degree.

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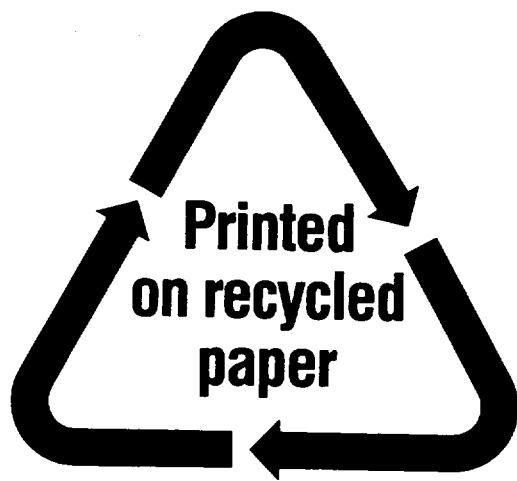
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