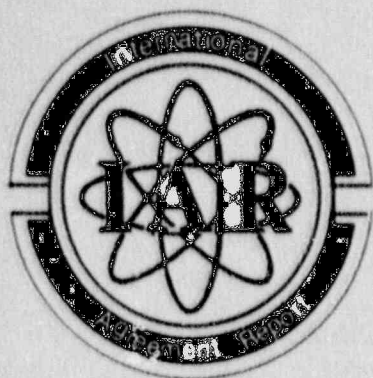




International Agreement Report

Assessment of RELAP5/MOD2 Code Using Loss of Offsite Power Transient Data of KNU #1 Plant

Prepared by
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**Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, DC 20555**

April 1990

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

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Abstract

This report presents a code assessment study based on a real plant transient that occurred on June 9, 1981 at the KNU #1 (Korea Nuclear Unit Number 1). KNU #1 is a two-loop Westinghouse PWR plant of 587 Mwe. The loss of offsite power transient occurred at the 77.5 % reactor power with 0.5 %/hr power ramp. The real plant data were collected from available on-line plant records and computer diagnostics.

The transient was simulated by RELAP5/MOD2/36.05 and the results were compared with the plant data to assess the code weaknesses and strengths. Some nodalization studies were performed to contribute to developing a guideline for PWR nodalization for the transient analysis.

Executive Summary

This report presents a code assessment study based on a real plant transient that has occurred on June 9, 1981 at the KNU #1 (Korea Nuclear Unit Number 1). KNU #1 is a two-loop Westinghouse PWR plant of 587 Mwe. The loss of offsite power transient occurred at the 77.5 % reactor power with 0.5 %/hr power ramp. The real plant data were collected from available on-line plant recording and computer diagnostics.

The transient was simulated by RELAP5/MOD2/36.05 and compared with the plant data to assess the code weakness and strengths. Some nodalization studies were performed to develop the guideline of PWR nodalization for the transient analysis.

It was found that the code gives stable steady-state results and accurate predictions of the plant behavior for the transient, indicating the excellent capability of the code for this type of transients. In particular, the calculated primary thermal behavior closely follows the plant data and this validates that the relevant thermal-hydraulic and decay power model using previous power history data in the RELAP5/MOD2 are correctly describing the actual phenomena.

In the nodalization sensitivity study it was found that S/G noding with junctions between bypass plenum and steam dome is preferred to simulate the S/G water level decreasing and avoid the spurious level peak at turbine trip.

The pressurizer pressure increase is sensitive to the insurge flow. It is believed that the interfacial heat transfer in a horizontal stratified flow regime may be estimated low and the compression effect due to insurge flow may be high.

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1. Introduction

The plant transient following a loss of offsite power have a relatively high probability of occurrence and many studies were performed about the accident sequence initiated by loss of offsite power. We have experience of this event in 1981 at KNU # 1 PWR plant. The event was initiated by loss of feedwater in one of two steam generators. During the transient, the major plant data was recorded by on-line computer data logging system and by strip charts. Although the collected data is very limited according to the frequency of data processing during the accident, the plant data is very useful for code assessments because the scaling problem would be eliminated.

The loss of offsite power transient was simulated by RELAP5/MOD2/36.05. The main objectives of simulation are to check the code capability for such event and to give the guideline of PWR nodalization for transient analysis.

The plant characteristics and the event of transient are described in Section 2 and 3. The plant simulation model and nodalization are included in section 4. The base case results are discussed in section 5 and the nodalization studies are discussed in section 6. A run statics are included in section 7.

2. Plant Description

This section provides a description of the plant and principal system relevant to understanding KNU # 1 loss of offsite power transient. Kori Unit 1 is a Westinghouse 2-loop PWR rated at 587 Mwe and commissioned in 1978, for which BECTHEL was the architect/engineer [1].

2.1 Reactor Coolant System

A flow schematic of the reactor coolant system (RCS) is presented in Fig. 1. As shown in Figure 1 the RCS is equipped with 2 reactor coolant loops (A and B) composing each steam generator (PCSG1,PCSG2) and main coolant pump (2P1A,2P1B). A 144 inches active core consists of 121 fuel assembly with 179 fuel rods per assembly. The nominal core power is 1723.5 Mwt.

The reactor vessel has two inlet and outlet nozzles located in a horizontal plane just below the reactor flange but above the top of the core. Coolant enters the vessel through the inlet nozzles and flows down the core barrel-vessel wall annulus, turns at bottom and flows through the core to the outlet nozzles.

Two steam generators are vertical Westinghouse U-type Model 51. The reactor coolant flows through the inverted U-tubes, entering and leaving through the nozzle located in the hemispheric bottom head of the steam generators. Steam is generated on the shell side and flows upward through the moisture separator to the outlet nozzle at the top of the vessel.

The reactor coolant pumps are identical single-speed centrifugal units driven by air-cooled, three phase induction motors. The type of pump is the Westinghouse Model W93-A. A flywheel the inertia of which is 82,000 lb-ft² provides additional inertia to extend pump coast down. The reactor coolant loop piping is specified in sizes consistent with system requirements. The hot leg inside diameter is 29 inches and the the inside diameter of the cold leg return line to the reactor vessel is 27.5 inches. The piping between the steam generator and the pump suction is increased to 31 inches inside diameter to reduce the pressure drop and improve flow conditions to the pump suction.

The pressurizer is a vertical, cylindrical vessel with hemispheric top and bottom heads and its total free volume is about 1000 ft.³. Electrical heaters the maximum capacity of which capacity is 1,000 Kw, was installed through the bottom head of the vessel while the spray nozzle, relief and safety valve connections are located in the top of the vessel.

2.2 Configuration of Secondary System

The auxiliary feedwater system consists of two separate sections to ensure delivery of auxiliary feedwater. One section has two electric motor-driven pumps and the other section a single steam turbine-driven pump. The motor-driven pumps start automatically upon receipt of two-out-of-three low-low water level signal in both steam generators. The design flow of one pump is 215 gpm. The turbine-driven pump will be operated upon the same logic of motor-driven pump, but only if one of the motor-driven pumps does not operate. The design flow is about 410 gpm.

The steam supply line to the auxiliary feedwater pump turbine are connected to the upstream of the main steam stop valves to provide a dependable steam supply.

The steam dump system enables the nuclear supply system to follow load changes which exceed 10 percent step or 5 percent per minute. The steam dump system is designed to have a flow capacity of 40 percent of the full load steam flow at full load steam pressure.

2.3. Plant Diagnostics and Uncertainty Bands

There are three type of digital recordings from plant computer; the computer daily logging sheet [2], pre-post trip review record [3] and sequence record of event [4]. Besides of these digital recording, there are analog strip chart recordings the speed of which is 2 cm/hr. The processing interval of daily logging system is 1 hour. The trip review record system keeps the data started from 2 minute before the reactor trip to 3 minute after reactor trip. The processing frequency of the

trip review record is 10 seconds during the above period.

It is believed that the short time behavior is more useful for the loss of offsite power transient. Therefore the available data for code assessment are pre-post trip review record and sequence of event record. Trip review record contains important thermal-hydraulics parameters measured in primary and secondary systems. The recorded parameter of primary system are the reactor neutronic power, loop averaged temperature, loop temperature difference, hot leg temperature, cold leg temperature, pressurizer pressure, pressurizer level, loop flowrate, and system pressure. The recorded secondary system parameters are steam flowrates, feedwater flowrates, steam pressure, narrow and wide range water level of steam generators, and feedwater temperatures.

The evaluation of measurement uncertainty is quite difficult because it contains the calibration error caused by the human error. But in the rough precision of engineering sense, the uncertainty band of temperature sensors is estimated as 2.22 deg-K and that of pressure sensors is estimated as 2.1 bars.

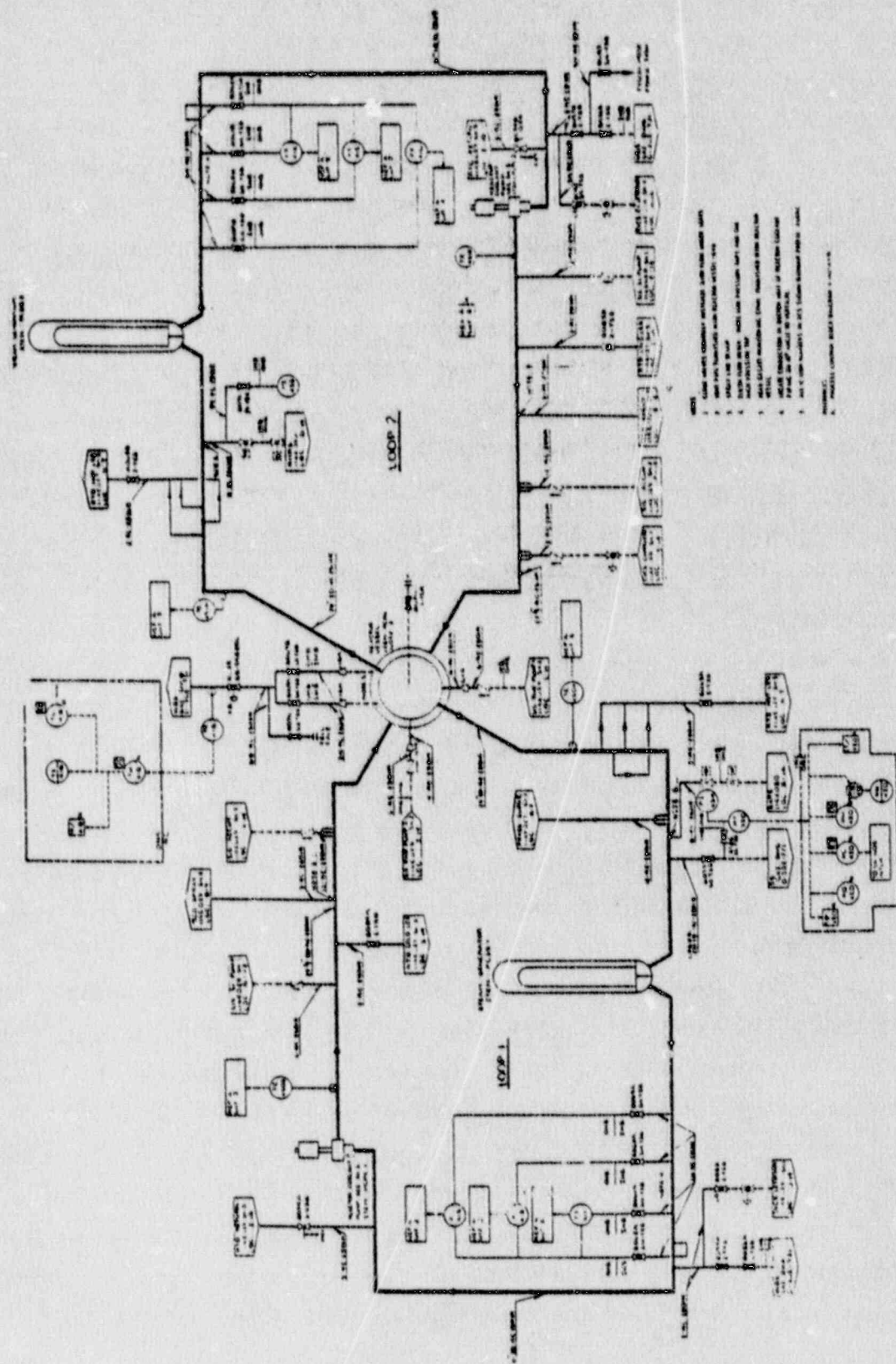


Fig.1 Schematic Diagram of Reactor Coolant System for KNU 81

3. Plant Transient Description

Plant transient sequence is based upon the sequence of events record from digital plant computer records. At around 11:00 AM on June 9, 1981, while operating at 77.5% reactor power and 447 MWe generator power, the I/I converter (LM-461A) of the S/G-A level control system mal-functioned generating a spurious signal that indicated high S/G-A water level. This signal activated the closure of the S/G-A main feedwater control valve (IFV-466) which subsequently caused the steam/water flow mismatch signal to be generated. The resulting S/G low level signal brought about the reactor/turbine trip at 11:05.20 AM. The turbine-generator continued to operate for 30 seconds, as designed, and then tripped at 11:05.50 AM. At the moment the generator trips, automatic transfer to the offsite power supply (154KV) should have occurred. However, both the automatic and the manual transfer of Bus-A failed, whereas Bus-B succeeded in automatic transfer to the offsite power initially but also failed after 31 seconds. Both buses were open at 11:06.21 AM.

Failure of Bus-A caused the RCP-A to trip at 11:05.55 AM immediately followed by the actuation of the diesel generator-A (D/G-A) which provides emergency power to safeguard Bus-A. The failure of Bus-B after the initial successful transfer caused a loss of offsite power transient for about 6 minutes from 11:06.21 AM. The failure of Bus-B caused the RCP-B to trip at 11:06.23 AM and the D/G-B to begin supplying power to safeguard Bus-B. After 6 minutes into the loss of offsite power transient, at 11:11.52 AM, Bus-B recovered the offsite power and subsequently the D/G-B was manually tripped. Despite the recovery of offsite power in Bus-B, the RCP-B continued to remain tripped until it was manually activated at 11:32 AM. Recovery of offsite power to Bus-A was achieved much later and the RCP-A was re-activated at 19:16.

In summary, from 11:06.23 to 11:32, both RCPs were not in operation causing a complete loss of reactor coolant flow accident for 26 minutes, and from 11:05.51 to 11:06.21 and also from 11:32 to 19:16, only one RCP was operating causing a partial loss of reactor coolant flow accident. Major sequence of events of the transient is summarized in Table 1.

Table 1. Sequence of Events for Plant Transient Simulation

Real Time (Hr.Min.Sec.)	Elapsed Time (sec)	Recorded Events	Remarks
-	0.0	-77.5% Power Operation (0.5% /hr increase)	Steady State Calculation
-	50.0	-Mal-function of I/I converter -S/G-A MFVCV start to close	Accident Starts
11.05.20.	100.0	-S/G-A Low Level & Flow mismatch cause Reactor/Turbine Trip	Simulation as input time
11.05.51.	131.0	-Unit on line Breaker 52/MT-345 Open	Loss of Onsite Power (345KV)
11.05.52.	132.0	-Safegard Bus-B operation	Transfer to Offsite Power (154KV)
11.05.55	135.0	-RCP #1 Trip Due to Transfer Fail in Bus-A	Simulation as input time
11.05.57	137.0	-Safegard Bus-A Operation	Start of Station Blackout Sequence Loading
11.06.23	163.0	-RCP #2 Trip Due to Transfer Fail in Bus-B	Simulation as input time
-	300.0		Calculation Stop
11.11.52	392.0	-Restore the failure of Offsite Power Transfer	

4. Code and Input Model Description for Plant Simulation

The Code used was RELAP5/MOD2/CY36.05 and was processed on a CDC machine CYBER 170-875. The input deck was prepared by KAERI in cooperation with a utility company of KNU #1. The nodalization philosophy is based on the guideline of RELAP5 code manual [5] and the detailed data for specific volumes and junctions are based on the design or drawing values for KNU # 1.

The resulted nodalization is shown in Fig. 2. The nodalization divides the whole system into 114 volumes including 11 boundary volumes, 124 junctions and 79 heat slabs. Each steam generator is modeled with 8 heat slabs for U-tubes and 13 volumes including a steam separator. The outlets of both S/Gs are connected to form a single volume, 'steam head', which is then connected to two time-dependent volumes that act as the pressure boundary conditions for the steam generators.

The steady-state calculations were carried out to provide the initial conditions for the transient analyses. The transient was occurred at 77.5 % power condition. However plant conditions needed for starting a calculation are not known. Meanwhile the design values based on the full load condition are available. Thus it is necessary to calculate the steady state for the full power condition first, and next for the 77.5 % power condition by reducing the power from full load condition.

The simulated initial conditions along with the desired plant steady-state data for both power cases are summarized in Table 2 and Table 3. Generally the simulated values are in excellent agreement with the desired values. In the process of obtaining the desired value, it was necessary to adjust the total heat transfer area of steam generators.

During the transient the most thermal hydraulic parameters were determined by calculation but some parameters were taken from boundary conditions.

One of these is the feedwater. In the initial stages of the plant transient, the main feedwater flow rate was automatically controlled by the MFWCV(Main Feed Water Control Valve) following the mal-function of the S/G level indicator. Since the actual automatic operation of the MFWCV is difficult to identify, the feedwater flowrate shown in Fig. 3

is assumed based on the plant data so as to correctly simulate the plant thermal hydraulic behavior.

The decay power strongly depends on the history of power operation. The transient occurred during the escalation of power after the performance test. Thus the 4-day power history prior to reactor trip was used as input values, shown in Fig. 4. The resulted decay power is estimated as 94 % of decay power for infinite operation.

Table. 2 Simulated Initial Conditions for Full Load Condition

Parameters		Simulated	Desired
Core Thermal Power	(MW)	1,723.0	1,723.5
PZR Pressure	(MPa)	15.51	15.50
PZR Level	(%)	47.60	47.60
Hot Leg Temperature	(K)	589.45	589.36
Cold Leg Temperature	(K)	556.06	555.89
Loop Coolant Flowrate	(kg/sec)	4,686.50	4,687.50
Main Feedwater Flowrate	(kg/sec)	473.00	473.00
Feedwater Temperature	(K)	496.30	496.30
Steam Flowrate	(kg/sec)	472.64	473.10
S/G Pressure	(MPa)	5.52	5.55
S/G Narrow Range Level	(%)	44.01	44.00
S/G Mass Inventory	(kg)	44,612.3	44,776.7
U-tube Heat Transfer Area	(m ²)	5,214.4	4,784.5
U-tube Heat Transfer Rate	(MW)	1,728.8	1,728.5
Recirculation Ratio		2.50	2.50

Table. 3 Simulated Initial Conditions for 77.5 % Power Condition

Parameters		Simulated	Desired
Core Thermal Power	(MW)	1,334.8	1,334.8
PZR Pressure	(MPa)	15.51	15.41
PZR Level	(%)	41.61	41.60
Hot Leg Temperature	(K)	583.06	583.10
Cold Leg Temperature	(K)	556.88	556.80
Loop Coolant Flowrate	(kg/sec)	4,688.28	4,686.50
Main Feedwater Flowrate	(kg/sec)	356.75	356.70
Feedwater Temperature	(K)	484.80	484.80
Steam Flowrate	(kg/sec)	357.00	356.70
S/G Pressure	(MPa)	5.896	-
S/G Narrow Range Level	(%)	44.02	44.00
S/G Mass Inventory	(kg)	49,783.4	-
U-tube Heat Transfer Area	(m ²)	5,214.4	4,784.5
U-Tube Heat Transfer Rate	(MW)	1,340.9	1,339.8
Recirculation Ratio		3.36	-

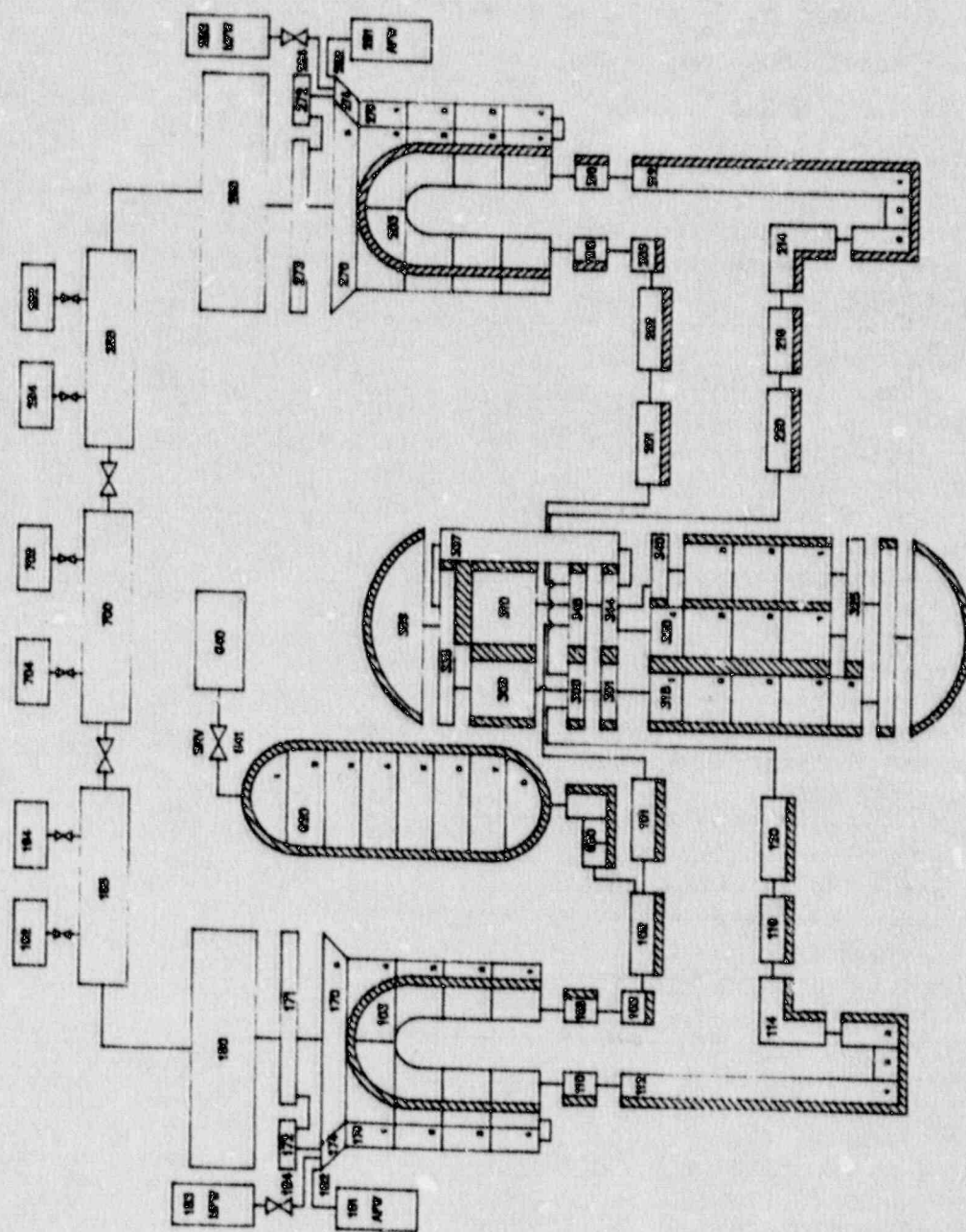


Fig.2 Modalization of KNU #1 Power Plant

KNU #1 Loss of Offsite Power Transient

REALP5/MOD2/CY36.05 Simulation

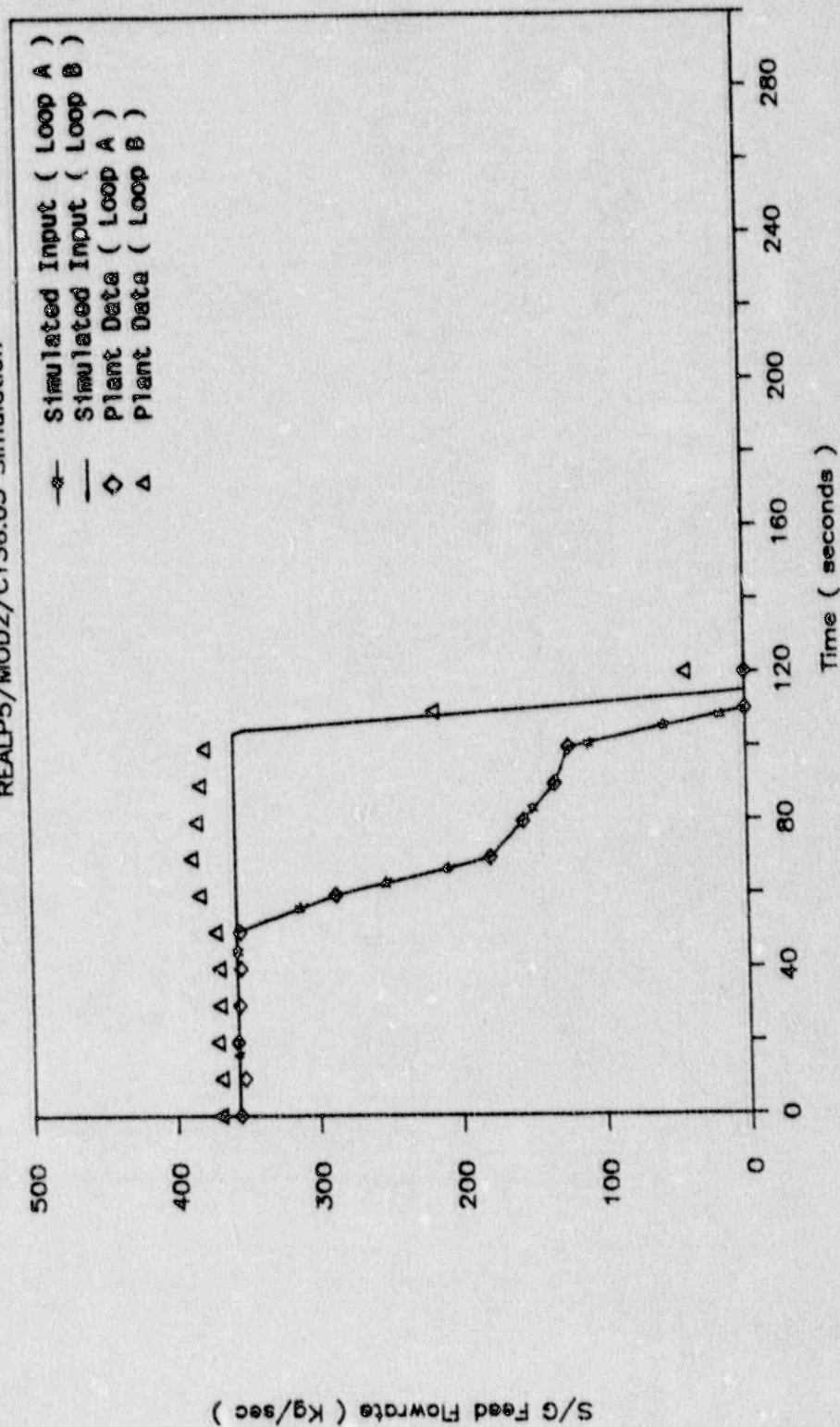


Fig.3 S/G Main Feedwater Flowrate and Simulated Boundary Condition

KNU #1 Loss of Offsite Power Transient

RELAP5/MOD2/CY36.05 Simulation

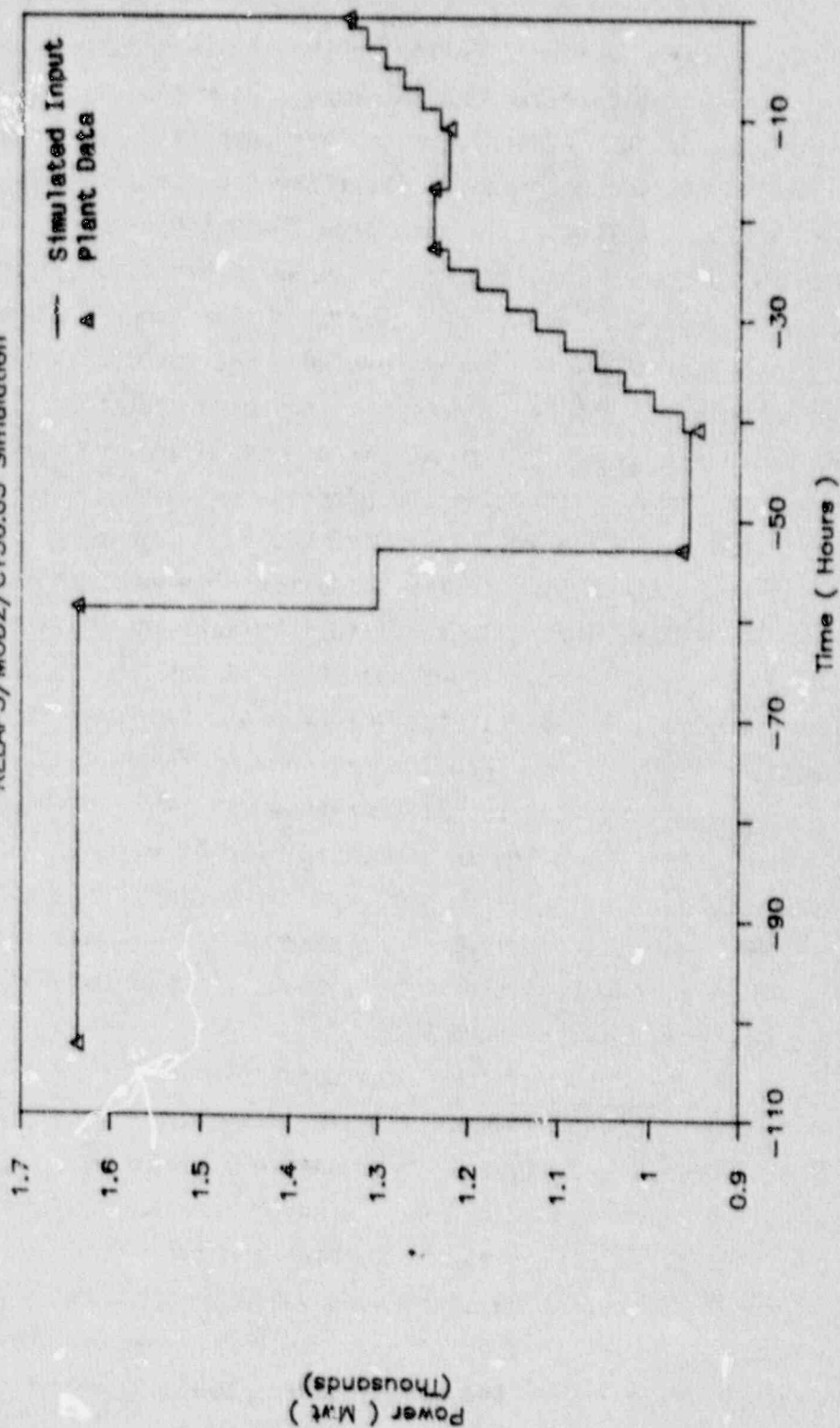


Fig.4 Power History prior to Reactor Trip and Simulated Input

5. Base Case Results and Discussions

Analyses were performed following the sequence described in Table 1. During the simulation time (300 seconds), the major events of sequence were the reactor trip and reactor coolant pump trip, which are not related to thermal hydraulic phenomena. Therefore the time of major events were treated as input values. The simulated thermal-hydraulic parameters are compared with the plant transient data, which are deduced from the computer trip review sheet. The plant transient occurred during power escalation, and hence most parameters were not in stabilized condition which led to difficulties in deciding the appropriate initial value. Hence, the unreasonable plant data were ignored and the initial values were chosen either by an averaging process, or in some cases, from the design values specified in the FSAR of KNU #1.

As can be seen in Fig. 3, the feedwater flow was decreased by malfunction of the level detector, and it result in the water level decreasing. The S/G water level was obtained not by the pressure difference method, as used in the actual plant measurement, but by calculating the collapsed water volume deduced from the void fraction. This is because the pressure difference method, when used in the simulation, often gave rise to a doubtful level oscillation. The calculated S/G water levels do not agree with the plant data as shown in Fig. 5. Moreover the spurious level peak was calculated at the turbine trip. This was caused by the nodalization of steam generator, and the details are discussed in section 6.

Since the two loops of the S/G secondary side are connected via a single common head and because the main steam isolation valve (MSIV) does not operate in these analyses, the pressure variations in S/G-A and B are identical as shown in Fig. 6. Following the reactor/turbine trip, the S/G pressure rapidly increases as the turbine stop valve closes. Normally, the turbine trip causes the steam dump valve to open, but in this transient, due to the loss of offsite power it remains closed. In the plant transient analysis, the S/G pressure starts to decrease as the supply of the auxiliary feedwater, actuated by the S/G low-low level signal, reaches its maximum capacity (155.94 sec) so that the secondary

heat removal capability begins to overcome the reactor decay power. The calculated S/G pressure variation up to the peak pressure agrees quite well with the plant data. In the analyses, PORVs(Power Operated Relief Valves) were simulated to open at 7.033 MPa (1020 psia). But the supply of the auxiliary feedwater alone provides sufficient secondary heat removal capability without the operation of the PORVs.

The primary loop coolant flowrate versus time is shown in Fig. 7, and as shown in Table 1 and Table 2, the reactor coolant pump-A(RCP-A) was tripped at 135sec and the RCP-B at 163sec. A rapid reduction in the RCS flowrate in the loop-A due to the pump trip caused the frictional resistance of the reactor vessel to decrease. Consequently the loop-B coolant flowrate increased until the subsequent trip of the RCP-B leading to the rapid reduction of loop-B flowrate. Meanwhile, the loop-A flowrate increases, due to the same reason as described above, just before flow reversal occurred and then decreased slowly. After 200 second, both loops showed an identical trend in the flow coastdown, and the natural circulation began to be established due to the hot-cold leg temperature difference. The overall trend in the calculated loop flowrates is in excellent agreement with the plant data as can be seen in Fig. 7.

Fig. 8 shows the RCS temperature variations and one can note that the hot leg temperature variations for both loops are identical in spite of different RCP trip times. This is reasonable since the present simulation is based on a single channel model for the core, allowing complete liquid mixing. Immediately after the reactor/turbine trips the hot leg temperature decreases rapidly, whereas the cold leg temperature increased due to the reduction in the heat removal capability of the S/G secondary side. After the RCP-A trip, loop-A hot leg temperature has little effect on the cold leg temperature due to delay in fluid transport, and hence the cold leg temperature stays at the saturation temperature corresponding to the S/G-A pressure. Similarly, the loop-B cold leg temperature also ceases its increase following the RCP-B trip. Afterwards, the cold leg temperatures slowly decrease as the S/G pressure decreases. The flow coastdown due to both RCP trips and the decay heat increase the hot-cold leg temperature difference until the establishment

of the natural circulation in the primary side. As this hot-cold temperature difference increases a driving force for heat transfer from primary to the secondary side increases. Recognizing above trend in the temperature variations, one can note that the hot leg temperature increases until the stable natural circulation is fully established, and afterwards it decreases along with the cold leg temperature. The simulated cold leg temperature agrees well with the plant data whereas the hot leg temperature behavior is rapid. It is caused by the plant measurement method which use RTD system. The RTD measurement depends strongly on the coolant flowrate, thus measurement was delayed by the pump coastdown. For comparison purpose the lag measure unit was simulated and the output from this unit showed good agreements with the data. For a time constant of a lag unit, it was estimated as 20 seconds.

The pressurizer level, shown in Fig. 9, is higher compared with the plant data. One of the causes may be a difficulty with calculating the accurate volume of the PZR bottom, in which the complex structures and PZR heaters are located. Another cause is a difficulty with predicting upper head temperature of reactor vessel. It is believed that the upper head temperature is between the hot leg temperature and the cold leg temperature due to 3 dimensional flow distribution in the upper part of the core. Using one dimensional code such as RELAP5, it is impossible to predict the upper head temperature correctly. If we consider the bypass flow through upper head nozzles, the predicted temperature should be same as the cold leg temperature. Thus the contraction effect due to RCS cool down may be under predicted and it results in the overprediction of pressurizer level.

The pressurizer pressure, shown in Fig. 10, has a similar trend as the pressurizer level and is higher also as compared with plant data. But the slope of pressure increase in the heatup phase is much higher. It may be due to the treatment of pressurizer vessel wall. If we consider the heat losses to atmosphere through the pressurizer vessel wall, the improved result was obtained. The details will be discussed in section 6.

KNU #1 Loss of Offsite Power Transient

RELAP5/MOD2/CY36.05 Simulation

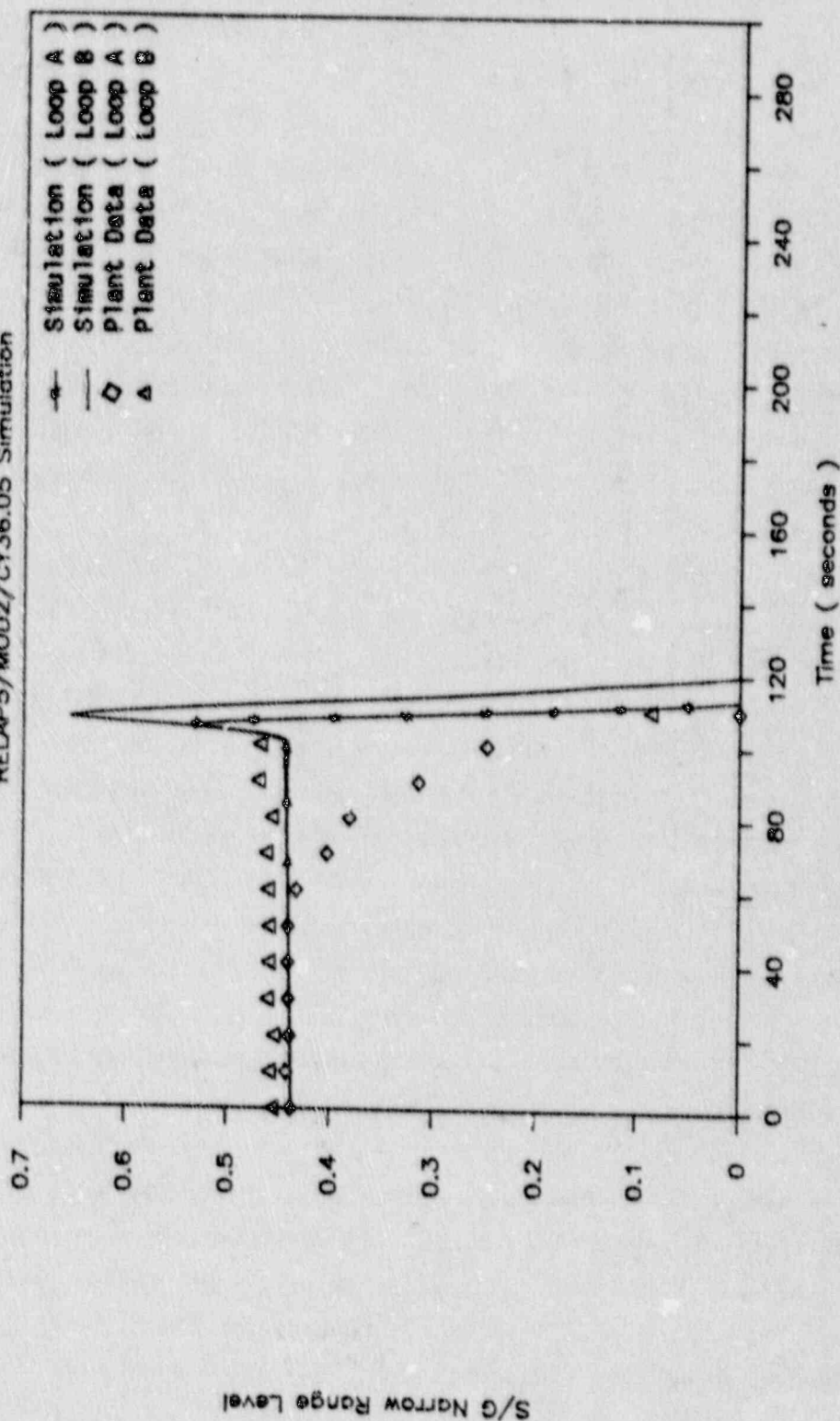


Fig.5 S/G Narrow Range Water Level versus Time

KNU #1 Loss of Offsite Power Transient

RELAP5/MOD2/CY36.05 Simulation

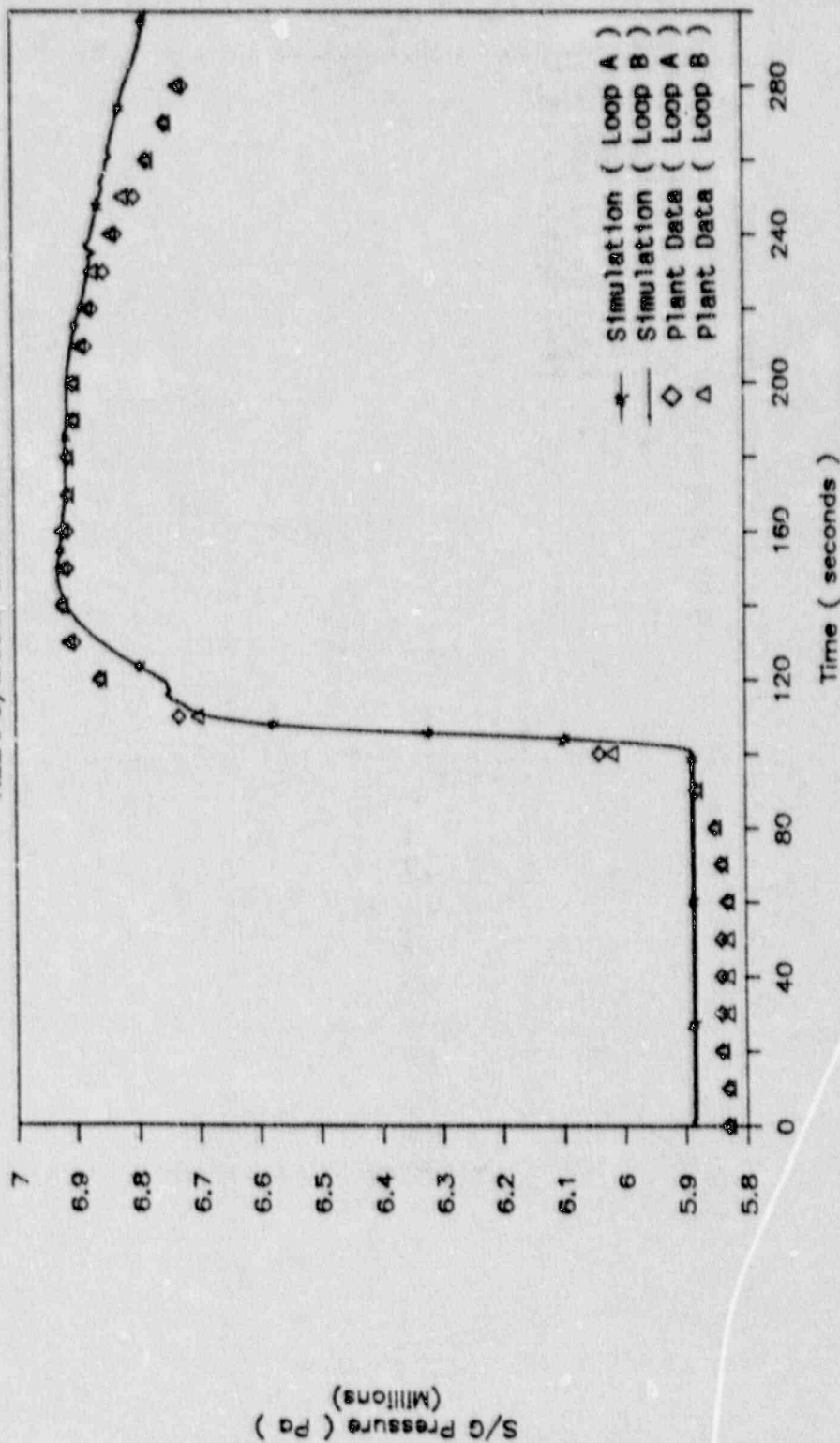


Fig.6 S/G Pressure versus Time

KNU #1 Loss of Offsite Power Transient

RELAP5/MOD2/CY36.05 Simulation

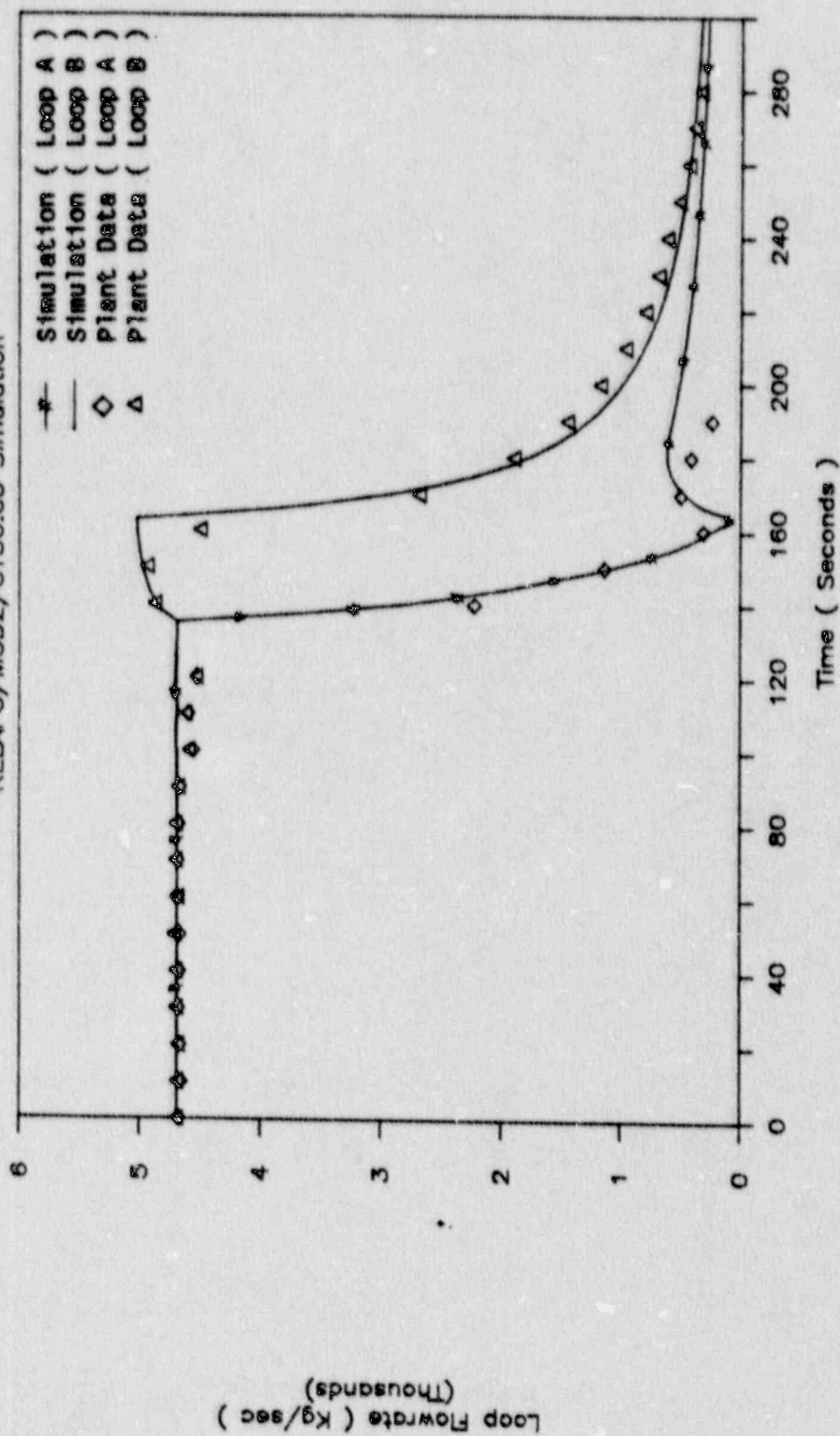


Fig.7 Loop Flowrate versus Time

KNU #1 Loss of Offsite Power Transient

REALP5/MOD2/CY36.05 Simulation

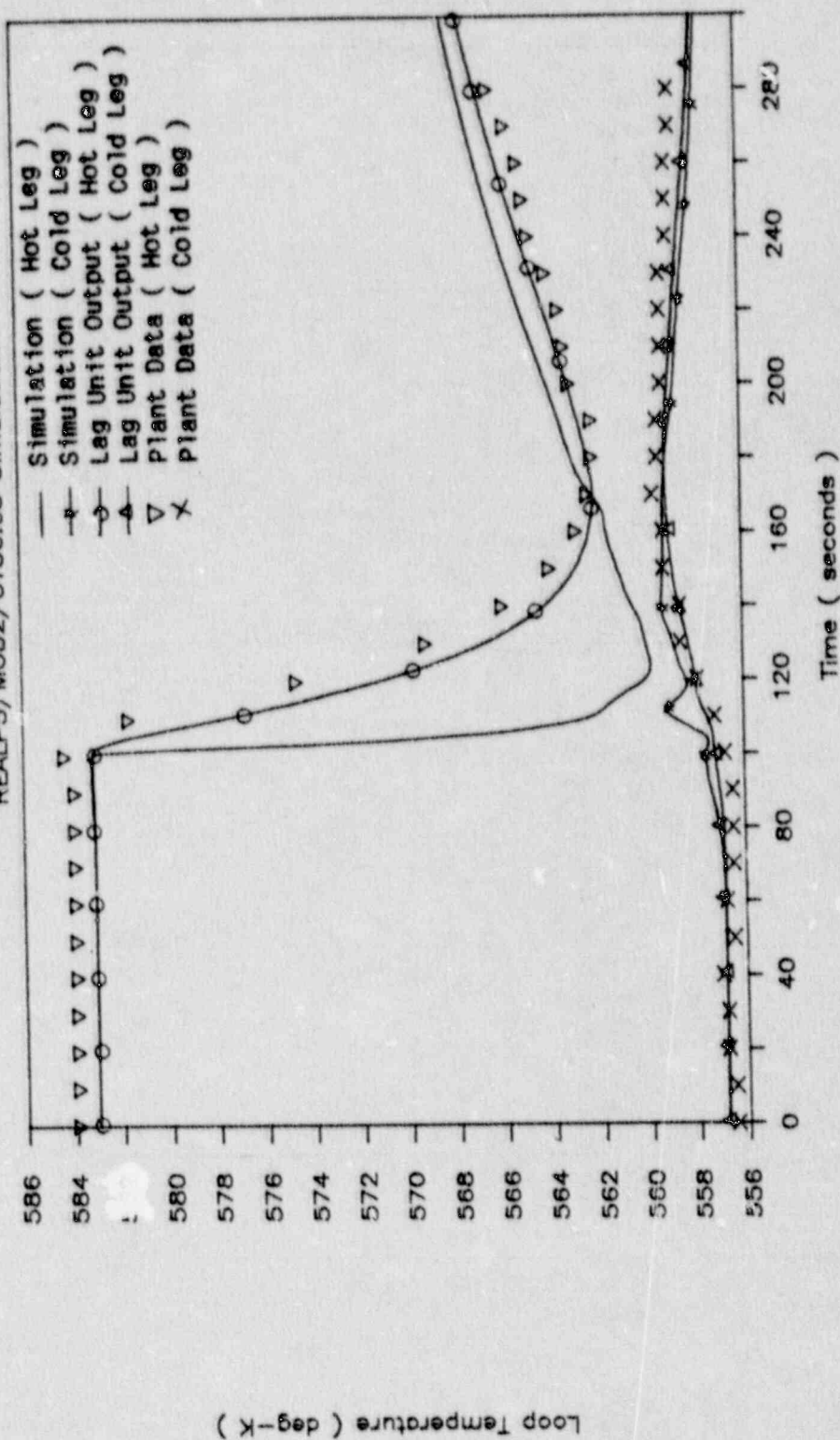


Fig.8 Loop Temperature versus Time

KNU #1 Loss of Offsite Power Transient

RELAP5/MOD2/CY36.05 Simulation

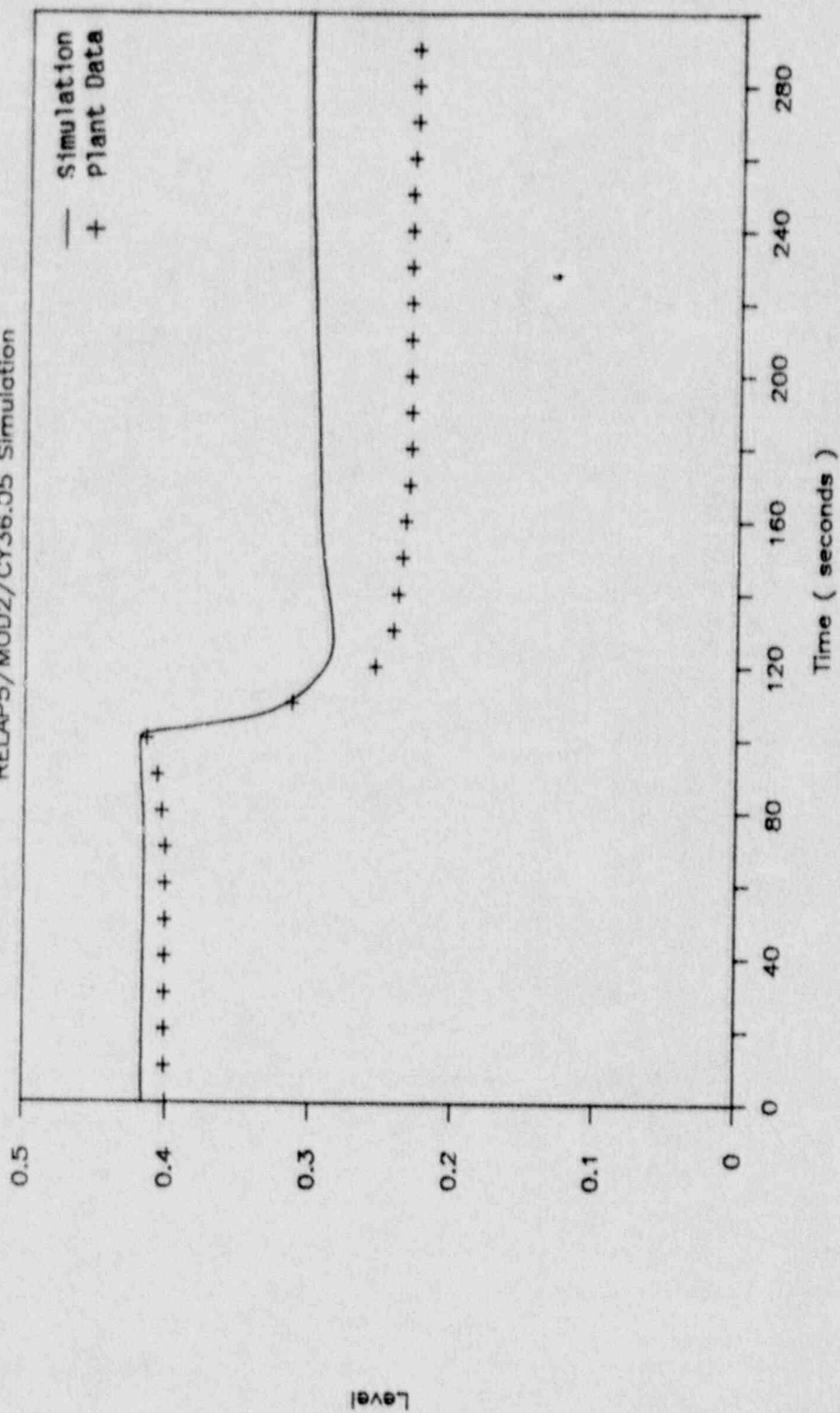


Fig.9 Collapsed PZR Water Level versus Time

KNU #1 Loss of Offsite Power Transient

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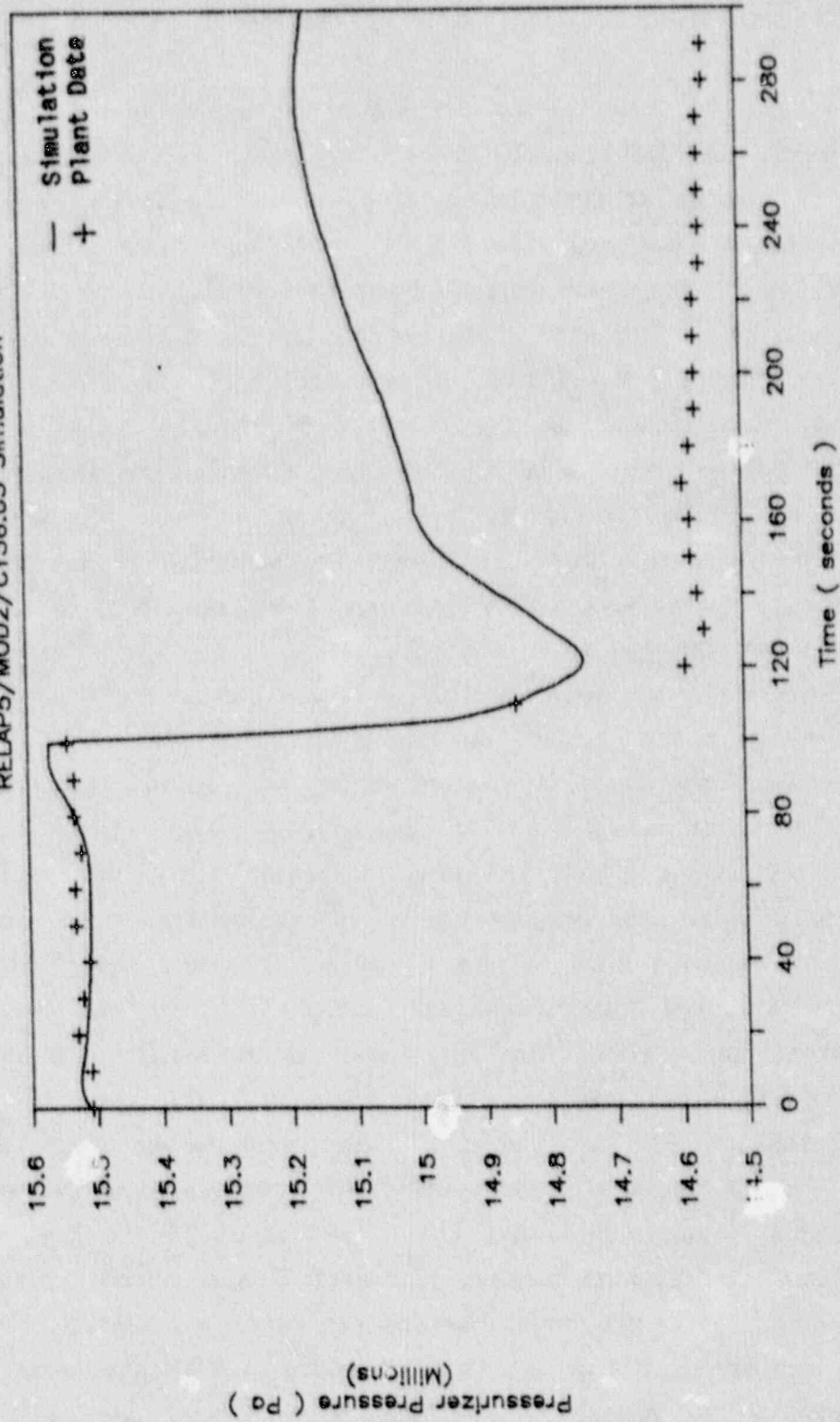


Fig.10 PZR Pressure versus Time

6. Discussion on the result of nodalization study

As shown in Fig. 5, the calculated S/G water levels did not decrease although the feedwater was decreasing. Moreover the spurious level peak was calculated at the turbine trip. The calculation results may have depended on the nodalization of steam generator, thus a study of nodalization for steam generator was performed.

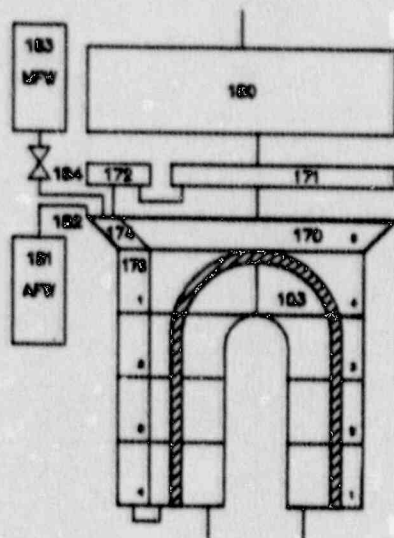
As shown in Fig. 11, there was no junctions between bypass plenum (volume 172) and steam dome (volume 180) in the base case (Case 1). So there was no steam pass for feedback of pressure spike at the turbine trip, and the pressure buildup at steam dome (volume 180) drove the flow of liquid into the volume 172 through separator (volume 171). This resulted in a spurious level peak. The water level decrease following decrease of feedwater flow was not simulated well because the flow stagnation occurred in volume 172.

Three different nodalizations (Case2, Case3, and Case4) were tested to evaluate the effect of junction orientation. As shown in Fig. 12, the effect of the junction orientation is negligible, and thus the comparisons of case 2 with the base case were done in this paper.

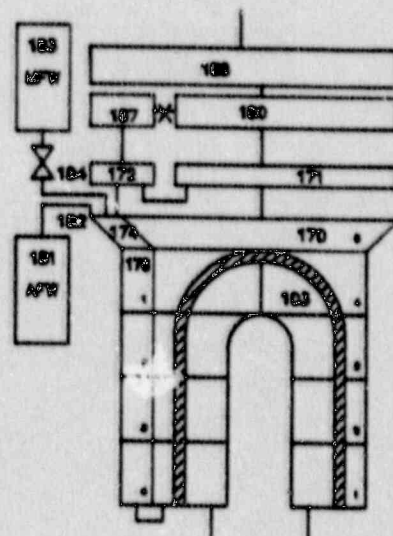
As shown in Fig. 13, the level decreasing is well predicted and the spurious level peak disappeared by connecting the cross flow junctions between bypass plenum volume (volume 187) and steam dome volume (volume 180). The case 2 nodalization had a little effect on the pressure of steam generators (Fig. 14), and no effect on the primary side parameters.

As shown in Fig. 10, the pressurizer pressure was predicted high. The main reason is the high prediction of pressurizer water level as described in section 5. But the other reason is the treatment of the heat losses through the pressurizer vessel wall. At the normal operating condition, the proportional heaters are partially kept on to compensate the heat losses. The amount is estimated as 167 KW. As shown in Fig. 15, the pressurizer heater is simulated as heat slab and shut off at the time of loss of offsite power. The heat loss through wall is simulated as boundary condition of the wall heat slab and remains constant during the whole transient. As in Fig. 16 the pressure increase due to the insurge flow is much higher than the plant data, although the improved

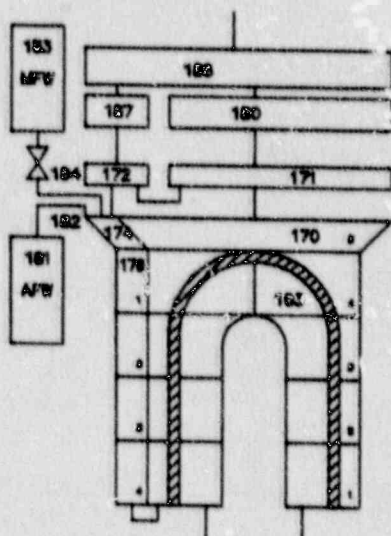
result was obtained compared with the base case. It is believed that the interface heat transfer in horizontal stratified flow regime may be estimated low, and thus the compression effect may be high.



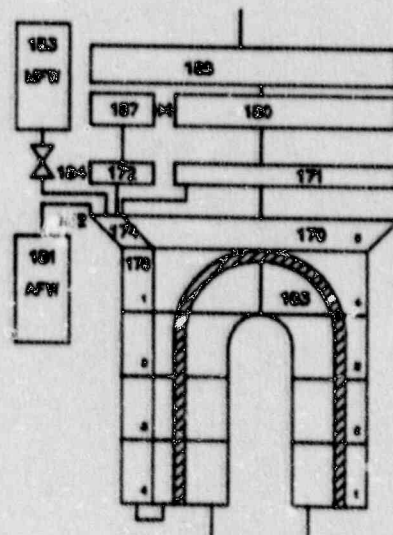
(CASE 1)



(CASE 2)



(CASE 3)



(CASE 4)

Fig.11 S/G Nodalization for Sensitivity Study

KNU #1 Loss of Offsite Power Transient

RELAP5/MOD2/CY36.05 Simulation

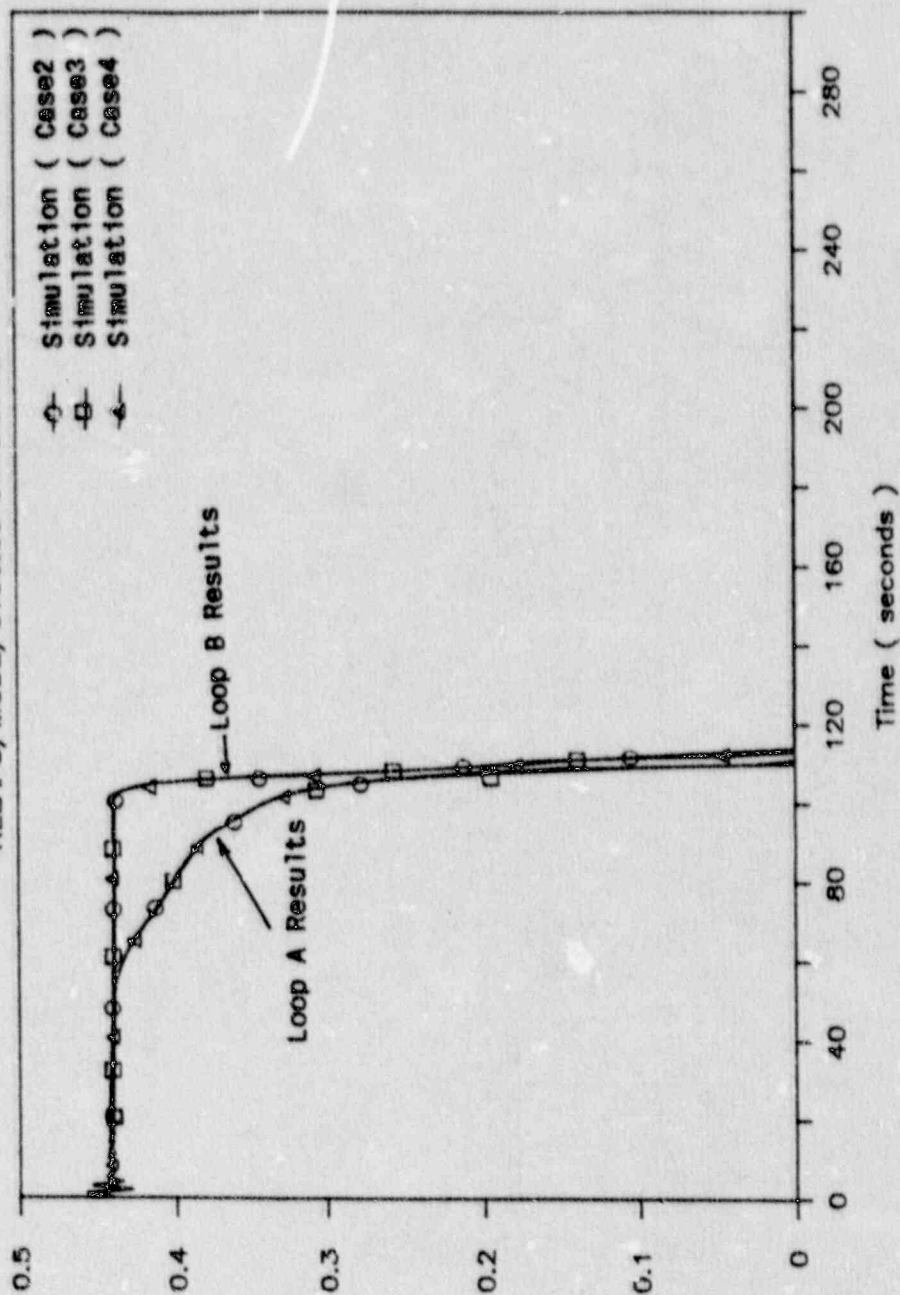


Fig.12 S/G Narrow Range Water Level (case 2, case3, case4)

S/G Narrow Range Level

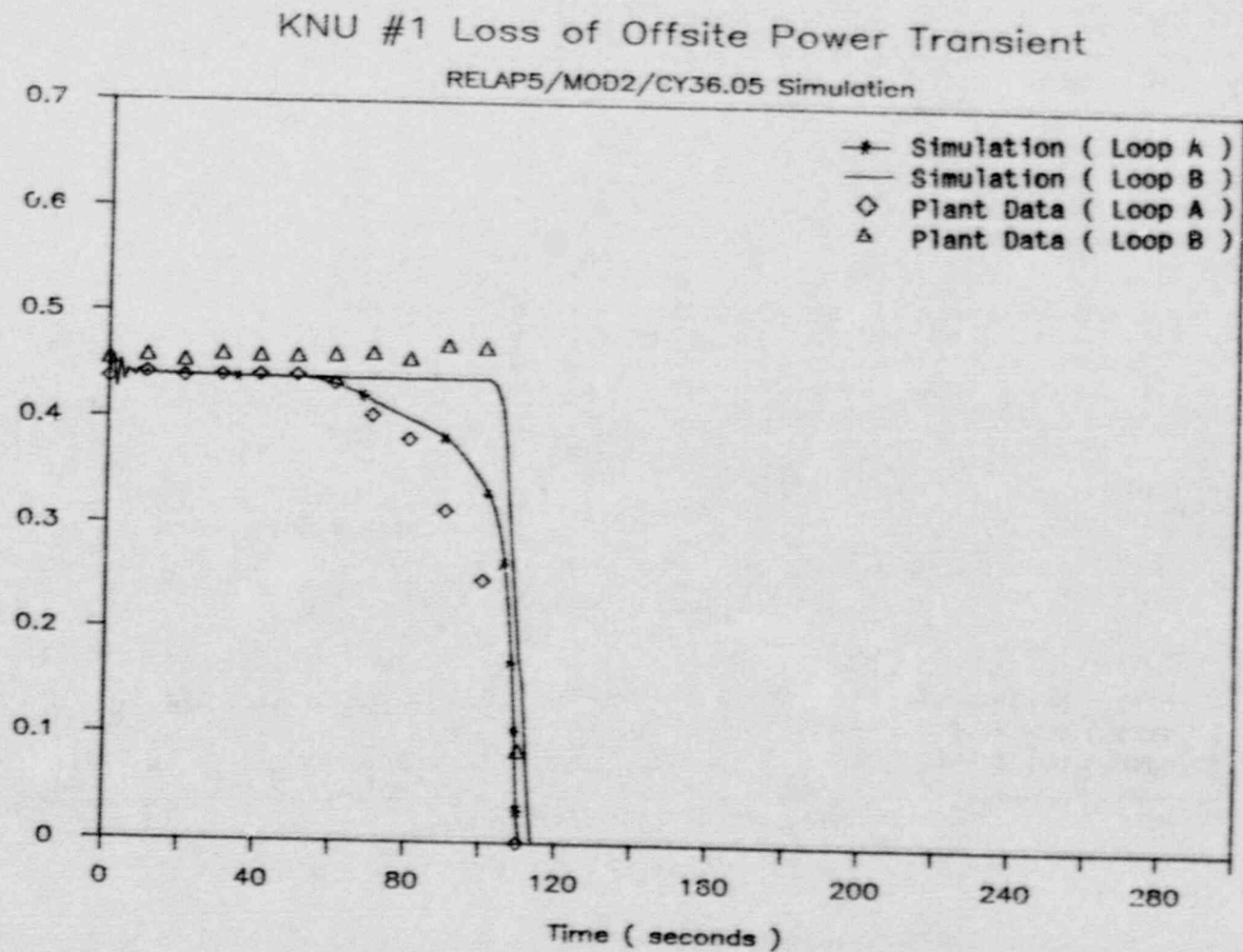


Fig.13 S/G Narrow Range Water Level versus Time (case2)

KNU #1 Loss of Offsite Power Transient

RELAP5/MOD2/CY36.05 Simulation

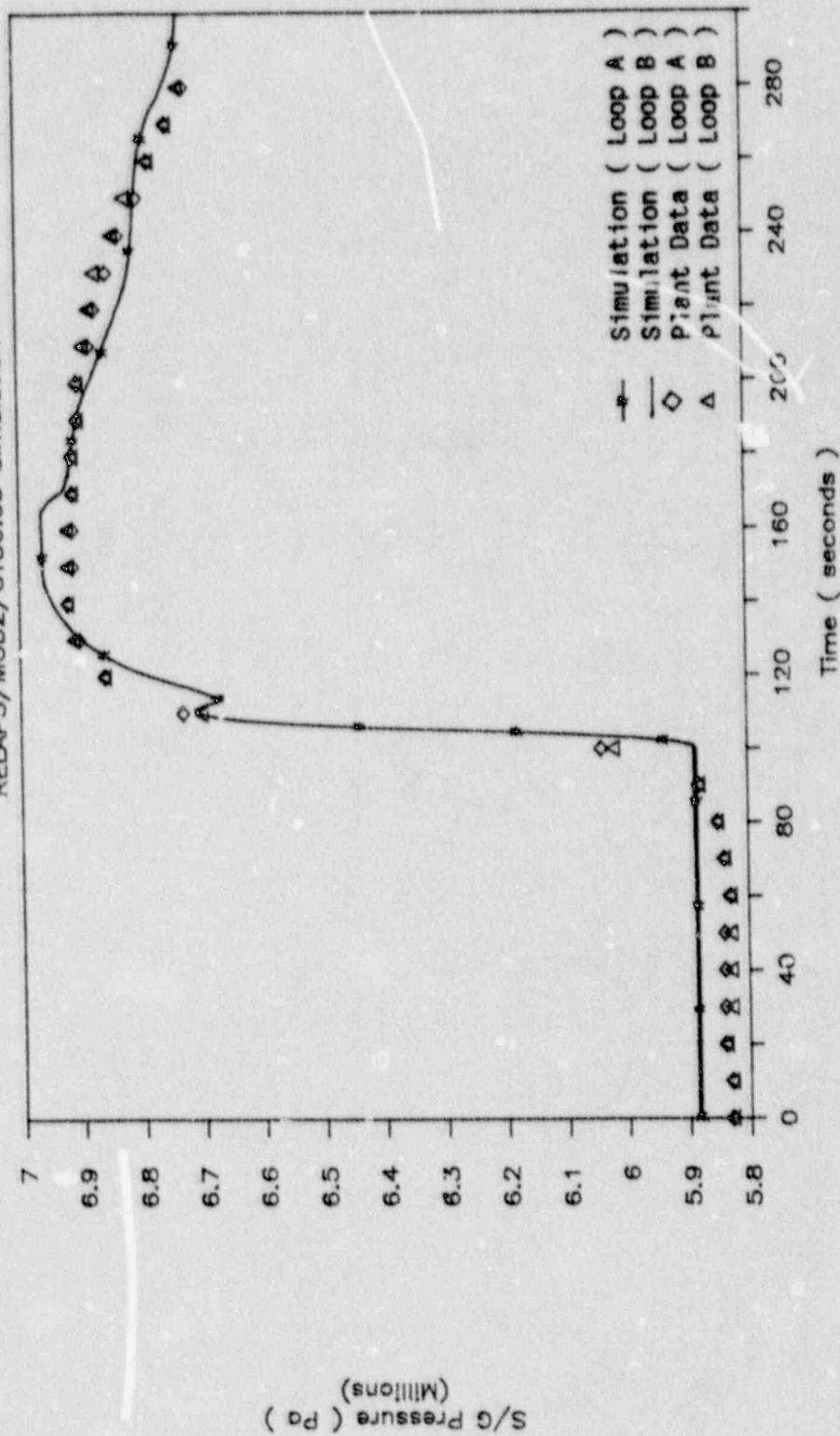


Fig.14 S/G Pressure versus Time (case2)

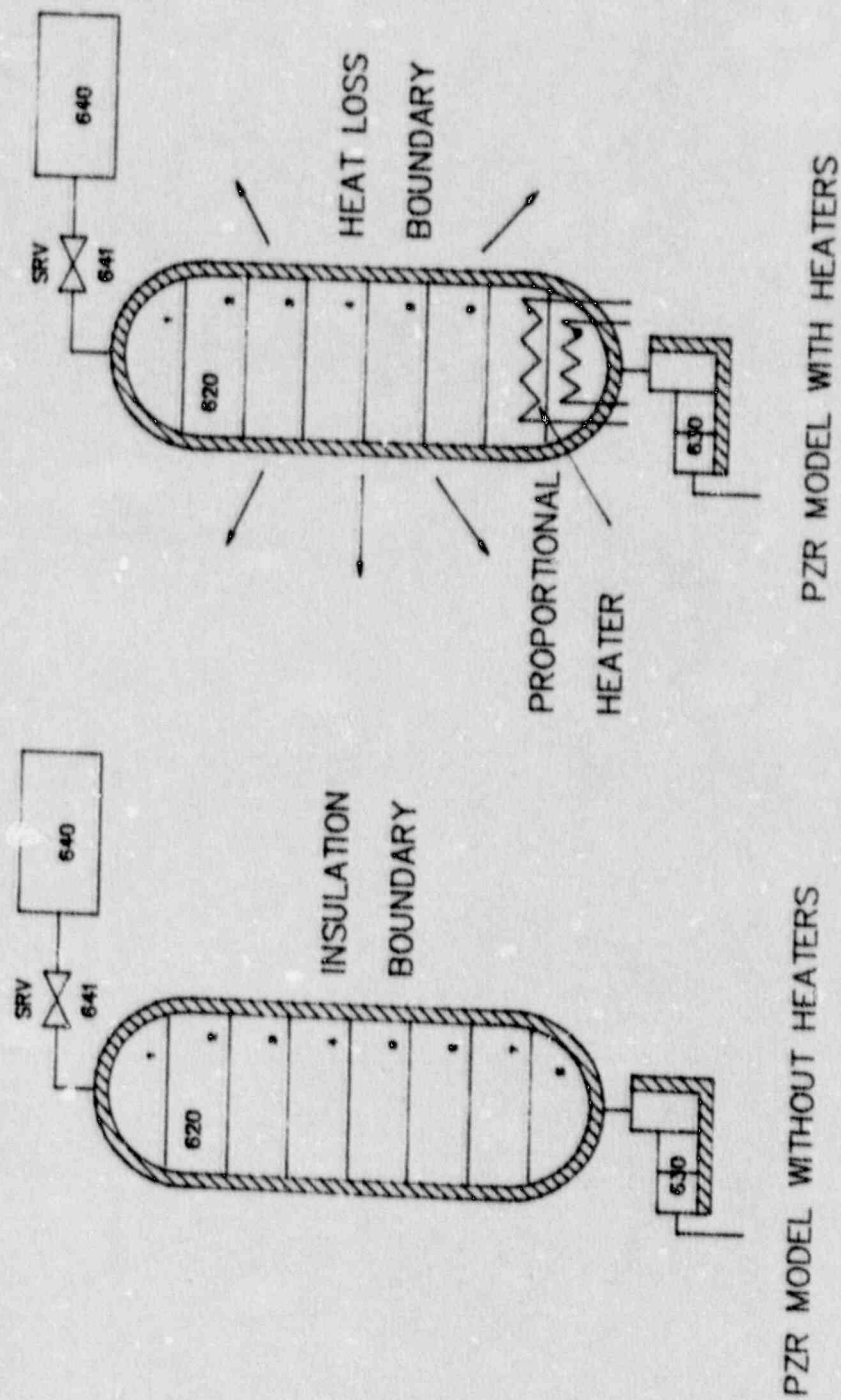


Fig.15 Pressurizer Model with Heat Loss

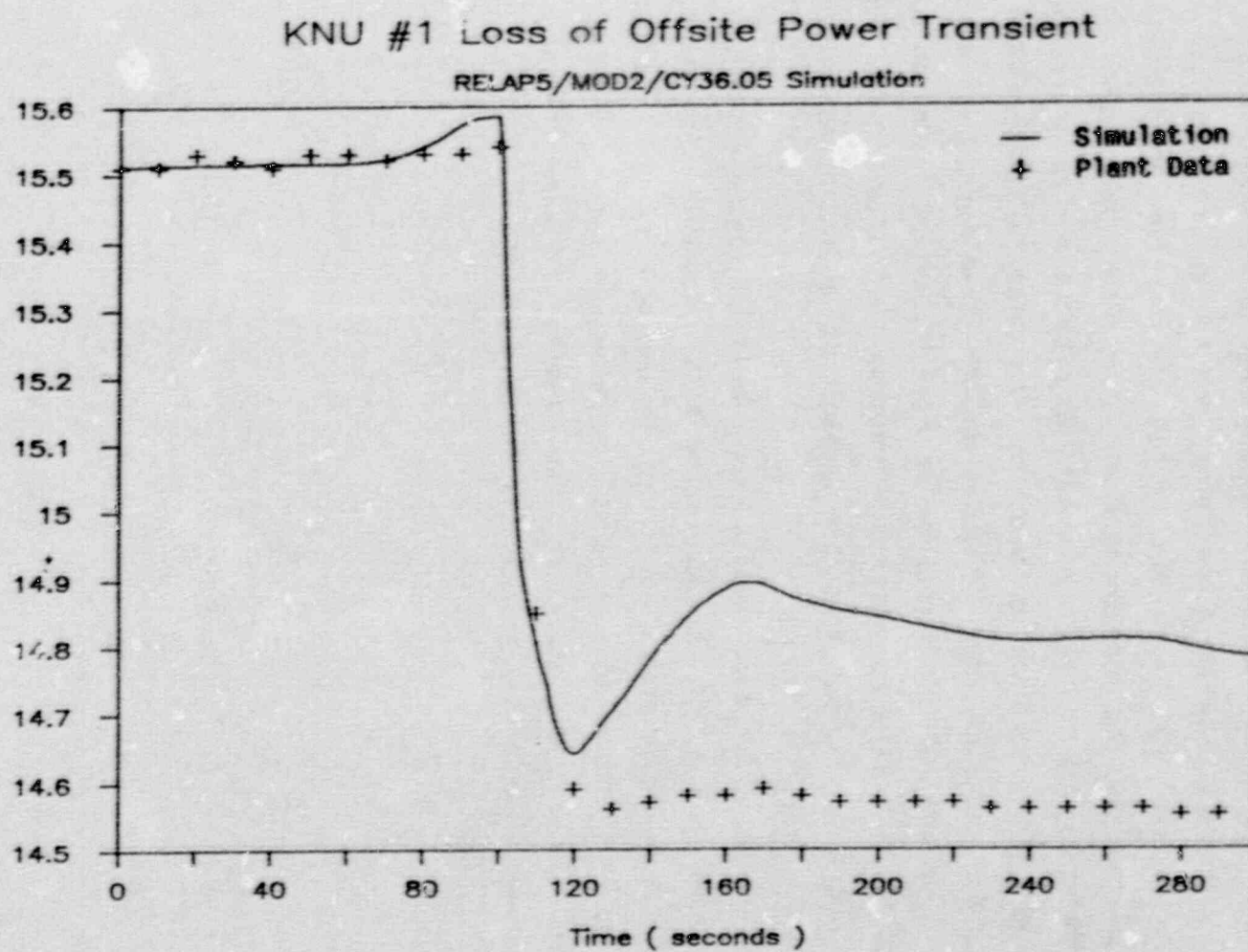
Pressurizer Pressure (Pa)
(Millions)

Fig.16 PZR Pressure versus Time with Heat Loss through Wall

7. Run Statistics

In order to compare the run times with other organization it should be mentioned that the computer type used is CDC CYBER 170-875 which has one unified extended memory unit, and the operating system is the NOS 2.6.1 level 700. As shown in Fig. 17 the time step size is mainly governed by the minimum Courant limit time. The Courant limit time increases due to the flow coastdown after the trip of reactor coolant pumps. The requested maximum time step size is 1.0 second. Thus the time step varies between the maximum time step and the Courant limit.

The total CPU time is shown in Fig. 18. In the figure it runs faster than the real time after the coastdown of flow. It is due to the increase of Courant time limit resulting in an increase of time step size as shown in Fig. 17.

The total CPU time required for simulation of the whole transient 300 seconds is 455.276 seconds and the total number of time steps is 3095. The input processing time is 7.87 second and the number of volumes is 118. Thus the grind time is 1.22 milli-second ; the grind time = (total CPU time - Input processing time)/(Number of time step X Nunmer of Volume) = $(455.276 - 7.87) / (3095 \times 118) = 0.00122$.

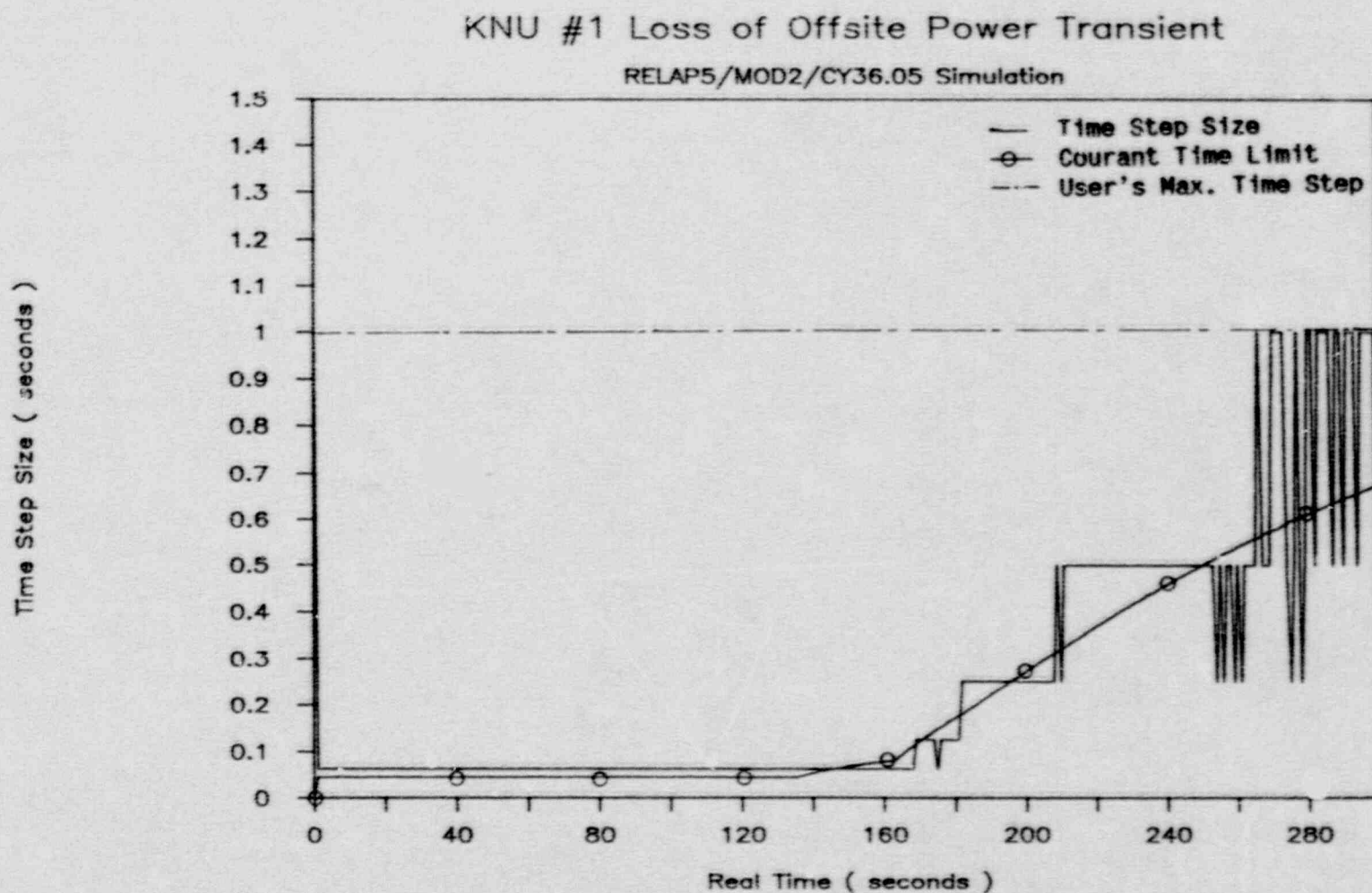


Fig.17 Time Step Size and Courant Time Limit versus Real Time

KNU #1 Loss of Offsite Power Transient

RELAP5/MOD2/CY36.05 Simulation

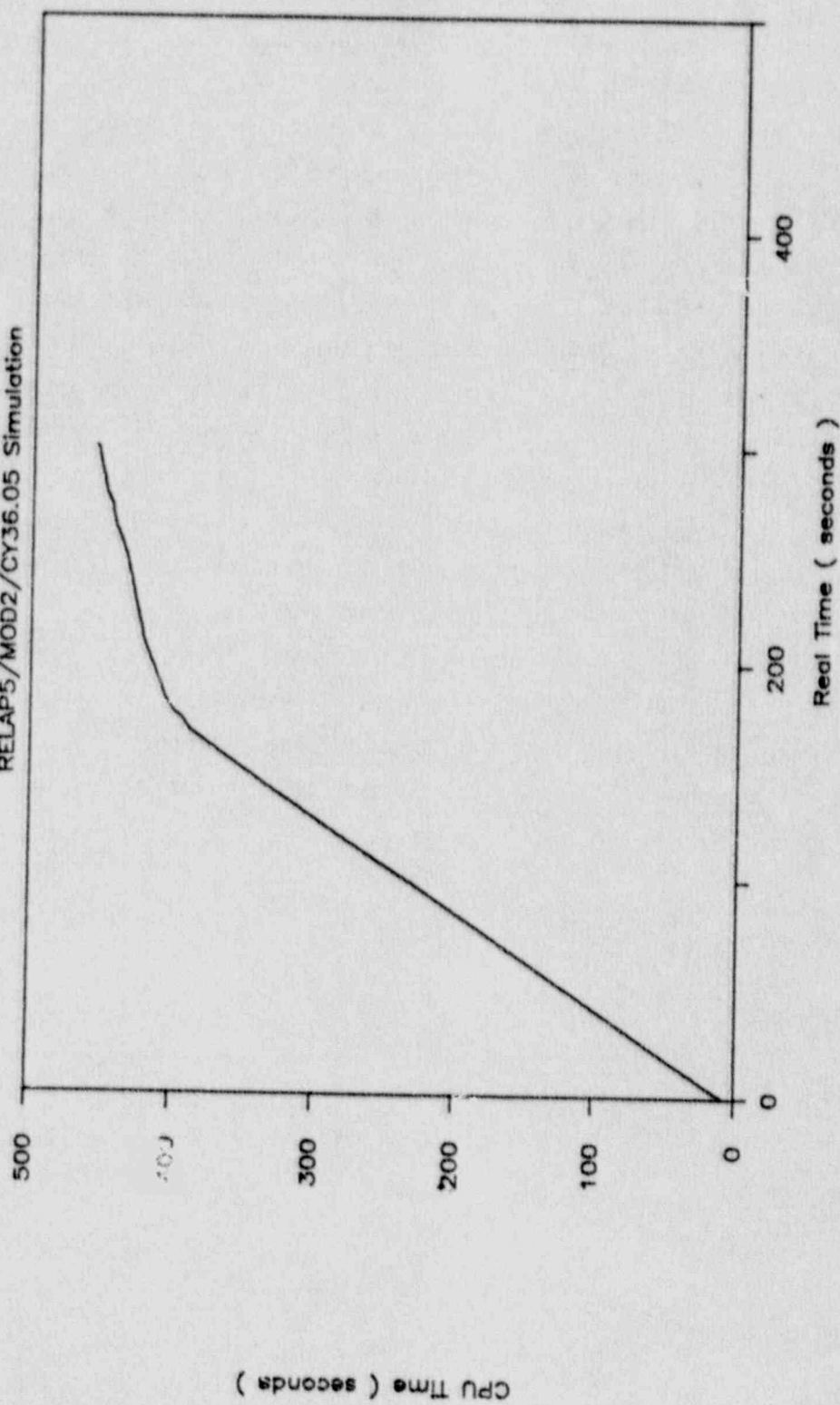


Fig. 18 Total required CPU Time versus Real Time

6. Conclusion

An analysis of KNU #1 Loss of Offsite Power transient was carried out using the RELAP5/MOD2. It was found that the code gives stable steady-state results and accurate predictions for most of the plant behavior associated with the transient, indicating the excellent capability of the code for this type of transients. The establishment of stable natural circulation due to the hot-cold leg temperature difference after both reactor trips is confirmed. In particular, the calculated primary thermal behavior closely follows the plant data and this validates that the relevant thermal-hydraulic and decay power model in the RELAP5/MOD2 correctly describes the actual phenomena.

In the nodalization sensitivity study it was found that S/G noding with junctions between bypass plenum and steam dome is preferred. This nodalization allowed the simulation of the S/G water level decrease and avoided the spurious level peak at turbine trip.

The pressurizer pressure increase is sensitive to the insurge flow. It is believed that the interfacial heat transfer in a horizontal stratified flow regime may be estimated low and that the compression effect due to insurge flow may be high.

9. Reference

1. "Final Safety Analysis Report, Kori Nuclear Power Plant Unit No.1", Korea Electric Company.
2. Computed Daily Log Sheet of KNU1, on June 9, 1981.
3. Computed Post Trip Review Sheet of KNU1, 11:00 on June 9, 1981.
4. Computer Sequence of Events Record of KNU1, 11:00 on June 9, 1981.
5. Ransom, V.H., et al., "RELAP5/MOD2 Code Manual ; Volume 2 ", NUREG/CR-4312, EGG-2396, December 1985.

Appendix

The input file for steady/transient run of KNU #1 Loss of Offsite Power Transient is given. The geometric data and performance data was prepared in cooperation with the utility company (KEPCO) of KNU #1 Plant. The input file is the CASE2 input which contains the specific steam generator nodalization as discussed in section 6. The job control card at the top of input file is for KAERI computer system (CDC CYBER-170, NOS operating system).

```

/JOB
BRUN,T777.
/USER
ATTACH,REL36KX.
ATTACH,STH2XT.
RFL,CM=350000,EC=200.
REDUCE(-)
FILE,RSTPLT,SBF=NO.
FILE,RSTIN,SBF=NO.
DEFINE,PLOTFL=BBASEP2.
REL36KX(*,PL=90000)
SKIP,JOB4.
EXIT.
ENDIF,JOB4.
DAYFILE,DAYLEE.
REPLACE,DAYLEE.
/EOR
=KORI UNIT 1 STATION BLACK-OUT AT 77.5% POWER TRANSIENT
(14/NOV/1981)

```

```

*-----*
*  FILENAME IS  "BBASE2" (1985.DEC.10) - BASE CAL. BY LEE
*  ORIGINAL LOSS COEFF.  BUT MODIFICATION OF PUMP DATA
*  ATTACH PZR PRESSURE, & CORE KINETIS DATA
*  S/G NODALIZATION STUDY 2 (CASE 2)
*-----*

```

```

*-----*
*  STANDALONE REACTOR
*-----*

```

```

*-----*
*  MISCELANOUS CONTROL CARDS
*-----*

```

```

*  PROBLEM TYPE OPSTDY-ST/TRANSNT
100  NEW          TRANSNT
*  INP-CHK/RUN
101  RUN
*  INP-UNIT      OUT-UNIT      OUTPUT-UNIT
102  BRITISH     BRITISH
104  NOACTION
*  TIME 1        TIME 2
105  1.0         2.0

```

```

*-----*
*  TIME STEP CONTROL CARDS
*-----*

```

```

*  EDND.T  MIN.DT  MAX.DT  CNTL  MINOR.ED  MAJOR.ED  RESTRT
201  300.0  1.E-7  1.00  14003  1        050      4000
*202  800.0  1.E-7  1.00    2    1        100      4000

```

```

*-----*
*  MINOR EDIT REQUEST
*-----*

```

```

301  P          301010000

```


302	TEMPF	301010000
303	P	356010000
304	TEMPF	356010000
305	P	335010000
306	TEMPF	335010000
307	P	335020000
308	TEMPF	335020000
309	P	335030000
310	TEMPF	335030000
311	P	620010000
312	TEMPF	220010000
313	TEMPF	201010000
314	MFLOWJ	300010000
315	MFLOWJ	300020000
316	MFLOWJ	325010000
317	MFLOWJ	325020000
318	MFLOWJ	355030000
319	MFLOWJ	345010000
320	MFLOWJ	355020000
321	MFLOWJ	220020000
322	MFLOWJ	120020000
323	MFLOWJ	621000000
324	RKTPOW	0
325	RKFIPOW	0
326	RKGAPOW	0
327	RKREAC	0
328	CNTRLVAR,051	
329	CNTRLVAR,052	
330	CNTRLVAR,057	
331	CNTRLVAR,058	
332	CNTRLVAR,061	
333	CNTRLVAR,062	
334	CNTRLVAR,067	
335	CNTRLVAR,068	
336	CNTRLVAR,060	
337	CNTRLVAR,070	
338	CNTRLVAR,122	
339	CNTRLVAR,300	
340	CNTRLVAR,401	
341	CNTRLVAR,402	
342	CNTRLVAR,403	
343	CNTRLVAR,404	

*-----
* TRIP DATA
*-----

501	TIME 0	GE	NULL	0	9999.0	L * CPU LIMIT
502	TIME 0	GE	NULL	0	0.0	L * INITIALIZATION
503	TIME 0	GE	NULL	0	50.00	L * ACCIDENT ACTUATION
504	TIME 0	GE	NULL	0	9999.0	L * MSIV CLOSURE
*588	CNTRLVAR 057	LE	NULL	0	0.25	L * RX/TBN TRIP

```

* REPLACE RX TRIP BY TIME 89.2.18
588 TIME,0 GE NULL,0 100.00 L * RX/TBN TRIP
589 CNTRLVAR 057 LE NULL 0 0.11 L *S/G L-L (AUX. FEED)
590 CNTRLVAR 101 LE NULL 0 554. L *MAIN FEED ISOLATION
592 TIME 0 GE TIMEOF 589 9999.0 L *STEAM DUMP
601 588 AND 503 L
594 TIME 0 GE TIMEOF 601 35. L * BROKEN LOOP PUMP TRIP
595 TIME 0 GE TIMEOF 601 63. L * INTACT LOOP PUMP TRIP

```

```

* === CORE COMPONENTS ===

```

```

* HYDRODYNAMIC COMPONENT

```

```

* COMPONENT 300: REACTOR UPPER DOWNCOMER BRANCH

```

```

3000000 RX-U-DO BRANCH
3000001 2 1
3000101 21.559 1.965 0. 0. -90. -1.965 0. 1.347 00
3000200 3 2299.7 542.71
3001101 300000000 308000000 21.559 0.4 0.4 0000
3002101 300010000 301000000 21.559 0.3 0.3 0000
3001201 63.597 0.0 0.0
3002201 20611.0 0.0 0.0

```

```

* COMPONENT 301: REACTOR MID DOWNCOMER BRANCH

```

```

3010000 RX-M-DO BRANCH
3010001 1 1
3010101 18.6475 2.0 0. 0. -90. -2. 0. 0.591 00
3010200 3 2298.9 542.71
3011101 301010000 315000000 18.6475 0.3 0.3 0000
3011201 20611.0 0.0 0.0

```

```

* COMPONENT 315: REACTOR LOWER DOWNCOMER ANNULUS

```

```

3150000 RX-L-DO PIPE
3150001 5
3150101 17.934 5
3150201 17.934 4
3150301 1.08 1
3150302 4.0 4
3150303 3.239 5
3150601 -90.0 5
3150701 -1.08 1
3150702 -4.0 4
3150703 -3.239 5
3150801 0.0 0.568 5
3150901 0.3 0.3 4
3151001 00 5

```

3151101	0000		4				
3151201	3	2298.3	542.71	0.	0.	0.	1
3151202	3	2298.1	542.71	0.	0.	0.	2
3151203	3	2298.4	542.71	0.	0.	0.	3
3151204	3	2298.6	542.71	0.	0.	0.	4
3151205	3	2298.8	542.71	0.	0.	0.	5
3151300	1						
3151301	20611.0	0.0	0.0	4			

* COMPONENT 322: REACTOR MID LOWER PLENUM *

3220000	RX-M-LP	BRANCH					
3220001	3	1					
3220101	79.639	2.8	0.0	-90.	-2.8	0.0	00
3220200	3	2297.8	542.71				
3221101	315010000	322000000	17.934	1.32	1.32	0100	
3222101	322000000	325000000	46.684	3.200	3.200	0100	
3223101	322010000	321000000	31.118	0.0	0.0	0000	
3221201	20611.0	0.0	0.0				
3222201	20611.0	0.0	0.0				
3223201	0.0	0.0	0.0				

* COMPONENT 321: REACTOR BOTTOM LOWER PLENUM *

3210000	RX-B-LP	SNGLVOL					
3210101	31.118	2.283	0.0	-90.	-2.283	0.0	1.219 00
3210200	3	2298.7	542.55				

* COMPONENT 325: REACTOR TOP LOWER PLENUM *

3250000	RX-T-LP	BRANCH					
3250001	2	1					
3250101	46.684	3.239	0.0	90.	3.239	0.0	1.753 00
3250200	3	2295.0	542.70				
3251101	325010000	335000000	26.938	4.1	5.4	0100	
3252101	325010000	320000000	0.834	7.0970	7.0970	0100	
3251201	19995.0	0.0	0.0				
3252201	616.65	0.0	0.0				

* COMPONENT 335: ACTIVE CORE *

3350000	CORE	PIPE	
3350001	3		
3350101	0.0		3
3350301	4.0		3
3350401	108.092		3
3350601	90.0		3
3350701	4.0		3
3350801	5.E-5	0.0402	3
3350901	2.0	2.0	2

3351001	00				3			
3351101	0000				2			
3351201	3	2286.2	559.49		0	0	0.	1
3351202	3	2276.5	575.63		0	0	0.	2
3351203	3	2272.7	591.04		0	0	0.	3
3351300	1							
3351301		19995.0	0.0	0.0	1			
3351302		19995.0	0.0	0.0	2			

* COMPONENT 340: CORE TOP

3400000	CORE-TOP	BRANCH						
3400001	2	1						
3400101	36.582	1.08	0.0	90.	1.08	0.	0.0402	00
3400200	3	2263.4	590.95					
3401101	335010000	340000000	26.938	5.4	4.6		0100	
3402101	340010000	344000000	36.582	1.0	1.0		0100	
3401201	19995.0	0.0	0.0					
3402201	19995.0	0.0	0.0					

* COMPONENT 320: CORE BYPASS

3200000	CORE-BYP	PIPE						
3200001	4							
3200101	11.9274	4						
3200201	0.834	3						
3200301	4.0	3						
3200302	1.08	4						
3200601	90.0	4						
3200701	4.0	3						
3200702	1.08	4						
3200801	0.0	0.124						
3200901	7.0970	7.0970						
3201001	00	4						
3201101	0000	3						
3201201	3	2291.7	545.48	0.0	0.0	0.0	1	
3201202	3	2283.0	550.41	0.0	0.0	0.0	2	
3201203	3	2271.2	556.96	0.0	0.0	0.0	3	
3201204	3	2265.8	558.59	0.0	0.0	0.0	4	
3201300	1							
3201301	616.65	0.0	0.0				3	

* COMPONENT 344: BOTTOM UPPER PLENUM

3440000	RX-B-UP	BRANCH						
3440001	3							
3440101	49.7375	2.0	0.0	90.	2.0	0.0	0.7626	00
3440200	3	2262.3	589.97					
3441101	320010000	344000000	0.834	7.0970	7.0970		0100	
3442101	344010000	345000000	49.7345	0.0	0.0		0000	

3443101	337010000	344000000	1.267	0.86	0.86	0100
3441201	616.65	0.0	0.0			
3442201	20675.0	0.0	0.0			
3443201	63.574	0.0	0.0			

* COMPONENT 345: MID UPPER PLENUM *

3450000	RX-M-UP	BRANCH				
3450001	3	1				
3450101	54.657	1.965	0.0	90.1.965	0	0.838 00
3450200	3	2261.8	589.97			
3451101	345010000	310000000	54.657	0.0	0.0	0000
3452101	345010000	101000000	4.587	0.05	0.05	0100
3453101	345010000	201000000	4.587	0.05	0.05	0100
3451201	0.0	0.0	0.0			
3452201	10334.0	0.0	0.0			
3453201	10334.0	0.0	0.0			

* COMPONENT 310: REACTOR TOP UPPER PLENUM *

3100000	RX-T-UP	SNGLVOL				
3100101	54.659	5.804	0.0	90.5.804	0.0.836	00
3100200	3	2260.9	575.19			

* COMPONENT 308: REACTOR TOP DOWNCOMER *

3080000	RX-T-DO	SNGLVOL				
3080101	26.004	6.146	0.0	90.6.146	0.1.625	00
3080200	3	2300.4	543.70			

* COMPONENT 355: REACTOR UPPER HEAD *

3550000	RX-U-HD	BRANCH				
3550001	3	1				
3550101	69.927	2.476	0.0	90.0.2.476	0.0	2.309 00
3550200	3	2259.4	543.89			
3551101	308010000	355000000	0.0247	11.0	11.0	0100
3552101	355010000	355010000	40.016	0.0	0.0	0000
3553101	355010000	337000000	.267	0.86	0.86	0100
3551201	63.563	0.0	0.0			
3552201	0.0	0.0	0.0			
3553201	63.563	0.0	0.0			

* COMPONENT 337: REACTOR GUIDE TUBES *

3370000	GID-TUB	SNGLVOL				
3370101	1.267	12.587	0.0	-90.-12.587	0.0.221	00
3370200	3	2261.0	545.90			

* COMPONENT 356: REACTOR UPPER HEAD DOME *

```

*-----
3560000 RX-UH-D SNGLVOL
3560101 40.016 2.804 0. 0. -90. -2.804 0. 7.1379 00
3560200 3 2259.5 588.09
*-----

```

*-----
 * HEAT STRUCTURE INPUT
 *-----

* HEAT STRUCTURE 301: REACTOR VESSEL WALL (DOWNCOMER) *

```

*-----
13010000 8 3 2 1 5.5
13010100 0 1
13010101 1 5.513
13010102 1 6.052
13010201 5 1
13010202 6 2
13010301 0.0 2
13010401 541.2 3
13010501 308010000 0 1 1 6.146 1
13010502 300010000 0 1 1 1.965 2
13010503 301010000 0 1 1 2.0 3
13010504 315010000 0 1 1 1.08 4
13010505 315020000 0 1 1 4.0 5
13010506 315030000 0 1 1 4.0 6
13010507 315040000 0 1 1 4.0 7
13010508 315050000 0 1 1 3.239 8
13010601 0 0 0 1 6.146 1
13010602 0 0 0 1 1.965 2
13010603 0 0 0 1 2.0 3
13010604 0 0 0 1 1.08 4
13010605 0 0 0 1 4.0 7
13010606 0 0 0 1 3.239 8
13010701 0 0.0 0.0 0.0 8
13010801 0 1.62 3.010 6.146 1
13010802 0 1.347 2.495 1.965 2
13010803 0 0.591 2.158 2.0 3
13010804 0 0.568 2.0758 1.08 4
13010805 0 0.568 2.0758 4.0 7
13010806 0 0.568 2.0758 3.239 8
*-----

```

* HEAT STRUCTURE 300: CORE BARREL *

```

*-----
13000000 8 2 2 1 4.5417
13000100 0 1
13000101 1 4.6875
13000201 5 1
13000301 0.0 1
13000401 541.26 2
13000501 310010000 0 1 1 6.146 1
13000502 348010000 0 1 1 1.965 2

```


13000503	344010000	0	1	1	2.0	3
13000504	320040000	0	1	1	1.08	4
13000505	320030000	0	1	1	4.0	5
13000506	320020000	0	1	1	4.0	6
13000507	320010000	0	1	1	4.0	7
13000508	325010000	0	1	1	3.239	8
13000601	308010000	0	1	1	6.146	1
13000602	300010000	0	1	1	1.965	2
13000603	301010000	0	1	1	2.0	3
13000604	315010000	0	1	1	1.08	4
13000605	315020000	0	1	1	4.0	5
13000606	315030000	0	1	1	4.0	6
13000607	315040000	0	1	1	4.0	7
13000608	315050000	0	1	1	3.239	8
13000701	0	0.0	0.0	0.0		8
13000801	0	0.836	7.662	6.146		1
13000802	0	0.838	7.661	1.965		2
13000803	0	0.763	6.971	2.0		3
13000804	0	0.028	0.321	1.08		4
13000805	0	0.028	0.321	4.0		7
13000806	0	1.753	6.544	3.239		8
13000901	0	1.62	3.532	6.146		1
13000902	0	1.347	2.928	1.965		2
13000903	0	0.591	2.533	2.0		3
13000904	0	0.568	2.436	1.08		4
13000905	0	0.568	2.436	4.0		7
13000906	0	0.568	2.436	3.239		8

* HEAT STRUCTURE 320: BYPASS (CORE BAFFLE AND GUIDE THIMBLES) *

13200000	4	2	2	1	0.0910846	
13200100	0				1	
13200101	1				0.09625	
13200201	5				1	
13200301	0.0				1	
13200401	550.0				2	
13200501	335010000	0	1	0	1214.96	1
13200502	335020000	0	1	0	1214.96	2
13200503	335030000	0	1	0	1214.96	3
13200504	340010000	0	1	0	328.039	4
13200601	320010000	0	1	0	1283.86	1
13200602	320020000	0	1	0	1283.86	2
13200603	320030000	0	1	0	1283.86	3
13200604	320040000	0	1	0	346.642	4
13200701	0	0.0	0.0	0.0		4
13200801	0	0.040	0.376	4.0		1
13200802	0	0.040	0.376	4.0		2
13200803	0	0.040	0.376	4.0		3
13200804	0	0.040	0.376	1.08		4
13200901	0	0.123	0.157	4.0		1

13200902	0	0.123	0.157	4.0	2
13200903	0	0.123	0.157	4.0	3
13200904	0	0.123	0.157	1.08	4

*-----
* HEAT STRUCTURE 333: ACTIVE CORE

13330000	3	8	2	1	0.0	
13330100	0	1				
13330101	3		0.015246			
13330102	1		0.015558			
13330103	3		0.017583			
13330201	1			3		
13330202	2			4		
13330203	3			7		
13330301	0.955			1		
13330302	1.085			2		
13330303	1.275			3		
13330304	0.0			7		
13330401	2361.0			1		
13330402	2159.0			2		
13330403	1607.0			3		
13330404	874.0			4		
13330405	730.0			5		
13330406	651.0			8		
13330501	0	0	0	0	0.0	3
13330601	335010000	0	1	0	9571.488	1
13330602	335020000	0	1	0	9571.488	2
13330603	335030000	0	1	0	9571.488	1
13330701	1000	0.33333	0.0	0.0		1
13330702	1000	0.33334	0.0	0.0		2
13330703	1000	0.33333	0.0	0.0		3
13330901	0	0.0402	0.04503	4.0		3

*-----
* HEAT STRUCTURE 356: UPPER HEAD DOME

13560000	1	3	3	1	5.526	
13560100	0	1				
13560101	2				5.97396	
13560201	5				1	
13560202	6				2	
13560301	0.0				2	
13560401	590.0				3	
13560501	356010000	0	1	1	0.27	1
13560601	0	0	0	1	0.27	1
13560701	0	0.0	0.0	0.0		1
13560801	0	7.1379	7.1379	2.804		1

*-----
* HEAT STRUCTURE 355: UPPER HEAD

13550000	1	3	2	1	5.00833
----------	---	---	---	---	---------

13550100	0	1				
13550101	2				5.5510	
13550201	5				1	
13550202	6				2	
13550301	0.0				2	
13550401	590.0				3	
13550501	355010000	0	1	1	2.476	1
13550601	0	0	0	1	2.476	1
13550701	0	0.0	0.0	0.0		1
13550801	0	2.3089	10.454	2.476		1

* HEAT STRUCTURE 310: UPPER CORE SUPPORT PLATE *

13100000	1	2	1	1	0.0	
13100100	0	1				
13100101	1				0.3417	
13100201	5				1	
13100301	0.0				1	
13100401	600.0				2	
13100501	310010000	0	1	0	56.397	1
13100601	355010000	0	1	0	56.397	1
13100701	0	0.0	0.0	0.0		1
13100801	0	2.3089	2.8795	7.51		1
13100901	0	0.836	2.251	7.51		1

* HEAT STRUCTURE 337: GUIDE TUBES WALL *

13370000	4	2	2	1	0.11055	
13370100	0	1				
13370101	1				0.3119437	
13370201	5				1	
13370301	0.0				1	
13370401	590.0				2	
13370501	337010000	0	1	0	64.594	1
13370502	337010000	0	1	0	133.039	2
13370503	337010000	0	1	0	45.042	3
13370504	337010000	0	1	0	45.844	4
13370601	355010000	0	1	0	182.268	1
13370602	310010000	0	1	0	375.402	2
13370603	345010000	0	1	0	127.097	3
13370604	344010000	0	1	0	129.36	4
13370701	0	0.0	0.0	0.0		4
13370801	0	0.2211	0.2211	2.818		1
13370802	0	0.2211	0.2211	5.804		2
13370803	0	0.2211	0.2211	1.965		3
13370804	0	0.2211	0.2211	2.0		4
13370901	0	2.3089	4.3245	2.818		1
13370902	0	0.836	3.3803	5.804		2
13370903	0	0.83806	3.3801	1.965		3
13370904	0	0.7626	3.0757	2.0		4

* HEAT STRUCTURE 321: BOTTOM LOWER PLENUM

* (VESSEL WALL AND INTERNAL)

13210000	1	3	3	1	5.526	
13210100	0	1				
13210101	2				5.86979	
13210201	5				1	
13210202	6				2	
13210301	0.0				2	
13210401	543.667				3	
13210501	321010000	0	1	1	0.265	1
13210601	0		0	0	1	0.265
13210701	0		0.0	0.0	0.0	1
13210801	0		1.219	1.219	2.283	1

* HEAT STRUCTURE 322: TOP LOWER PLENUM

* (VESSEL WALL AND INTERNAL)

13220000	1	3	3	1	5.526	
13220100	0	1				
13220101	2				5.86979	
13220201	5				1	
13220202	6				2	
13220301	0.0				2	
13220401	543.667				3	
13220501	322010000	0	1	1	0.317	1
13220601	0		0	0	1	0.317
13220701	0		0.0	0.0	0.0	1
13220801	0		2.795	2.795	2.80	1

* STANDALONE STEAM GENERATOR (BROKEN LOOP-A)

* MINOR EDIT REQUEST

351	P	170010000
352	P	170050000
353	P	171010000
354	P	172010000
355	P	174010000
356	P	185010000
357	P	285010000
358	P	700010000
359	TEMPF	120010000
360	TEMPF	220010000
361	MFLOWJ	191000000
362	MFLOWJ	291000000

363	MFLOWJ	185010000
364	MFLOWJ	285010000
365	MFLOWJ	701000000
366	MFLOWJ	703000000
367	MFLOWJ	102030000
368	MFLOWJ	171010000
369	MFLOWJ	171020000
370	MFLOWJ	171030000
371	MFLOWJ	174010000
372	MFLOWJ	174020000
373	MFLOWJ	178000000
374	MFLOWJ	170020000
375	VOIDG	170010000
376	VOIDG	171010000
377	VOIDG	172010000
378	MFLOWJ	184000000
379	MFLOWJ	271010000
380	MFLOWJ	271020000
381	MFLOWJ	271030000
382	MFLOWJ	274010000
383	MFLOWJ	274020000
384	MFLOWJ	278000000
385	MFLOWJ	270020000
386	VOIDG	270010000
387	VOIDG	271010000
388	VOIDG	272010000
389	MFLOWJ	284000000
393	CNTRLVAR	121
394	CNTRLVAR	101
395	CNTRLVAR	102
396	MFLOWJ	182000000
397	MFLOWJ	282000000
398	MFLOWJ	186000000
399	MFLOWJ	286000000

*

* HYDRODYNAMIC COMPONENT

*

* COMPONENT 105: BROKEN LOOP STEAM GENERATOR INLET PLENUM *

*

1050000	B-SG-IP	SNGLVOL						
1050101	24.0015	6.7417	0.0	0.90	1.704	0.0	0.000	00
1050200	3	2239.9	589.85					

*

* COMPONENT 106: BROKEN LOOP STEAM GENERATOR INLET PLENUM
* TO PRIMARY TUBE JUNCTION *

*

1060000	B-IP-TUB	SNGLJUN						
1060101	105010000	108000000	11.0988	0.69	0.69	0.00		
1060201	1	10334.0	0.0	0.0				

```

*-----*
* COMPONENT 108: BROKEN LOOP STEAM GENERATOR TUBES *
*-----*
1080000      B-SG-TUB      PIPE
1080001      8
1080101      11.0988      8
1080201      11.0988      7
1080301      9.91      3
1080302      3.449      F
1080303      9.91      8
1080401      0.0      8
1080601      30.0      3
1080602      40.0      4
1080603      -40.0      5
1080604      -90.0      8
1080701      9.91      3
1080702      2.196      4
1080703      -2.196      5
1080704      -9.91      8
1080801      0.0      0.0646      8
1080901      0.0      0.0      7
1081001      00      8
1081101      0000      3
1081102      0000      4
1081103      0000      7
1081201      3      2232.4      576.83      0.0      0.0      0.      1
1081202      3      2225.5      567.20      0.0      0.0      0.      2
1081203      3      2218.7      559.91      0.0      0.0      0.      3
1081204      3      2214.3      557.48      0.0      0.0      0.      4
1081205      3      2213.0      555.25      0.0      0.0      0.      5
1081206      3      2212.5      550.29      0.0      0.0      0.      6
1081207      3      2212.1      545.96      0.0      0.0      0.      7
1081208      3      2211.7      542.22      0.0      0.0      0.      8
1081300      1
1081301      10334.0      0.0      0.0      7
*-----*
* COMPONENT 109: BROKEN LOOP STEAM GENERATOR PRIMARY TUBES *
* TO PRIMARY OUTLET PLENUM *
*-----*
1090000      B-TU-OP      SNGLJUN
1090101      108010000      110000000      11.0988      0.69      0.69      0100
1090201      1      10334.0      0.0      0.0
*-----*
* COMPONENT 110: BROKEN LOOP STEAM GENERATOR OUTLET PLENUM *
*-----*
1100000      B-SG-OP      SNGLVOL
1100101      24.0015      6.7417      0.0      0.      -90.      -1.704      0.      0.      00
1100200      3      2211.4      542.22
*-----*
* COMPONENT 111: BROKEN LOOP STEAM GENERATOR OUTLET PLENUM *

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*                               TO PUMP SUCTION LEG                               *
*-----*
1110000    B-SG-O-P    SNGLJUN
1110101    110010000    112000000    5.2414 0.000 0.000    0100
1110201    1    10334.0    0.0 0.0
*-----*
* COMPONENT 174: BROKEN LOOP STEAM GENERATOR MID DOWNCOMER *
*-----*
1740000    BSG-M-DO    BRANCH
1740001    2
1740101    60.3  5.752  0. 0. -90. -6.752 2.42189E-5 0.    00
1740200    3    857.37  501.730
1741101    172000000  174000000  60.3    1.0    1.0    0000
1742101    174010000  176000000  19.352  0.1    0.1    0000
1741201    1.7223 -4.2282 0.0
1742201    3.6356  3.6356 0.0
*-----*
* COMPONENT 176: BROKEN LOOP STEAM GENERATOR BOTTOM DOWNCOMER *
*-----*
1760000    BSG-B-DO    PIPE
1760001    4
1760101    19.352                                1
1760102    7.0965                                4
1760201    7.0965                                3
1760301    2.196                                  1
1760302    9.91                                  4
1760401    0.0                                    4
1760601    -90.0                                 4
1760701    -2.196    1
1760702    -9.91    4
1760801    5.E-5    0.0                                4
1760901    0.1    0.1                                3
1761001    00                                             4
1761101    0000                                           3
1761201    3    858.84  501.740    0  0  0  1
1761202    3    860.39  501.740    0  0  0  2
1761203    3    863.68  501.760    0  0  0  3
1761204    3    866.98  501.770    0  0  0  4
1761301    9.9140  9.9140  0.0                                1
1761302    9.9139  9.9139  0.0                                2
1761303    9.9139  9.9139  0.0                                3
*-----*
* COMPONENT 178: BROKEN LOOP STEAM GENERATOR BOTTOM DOWNCOMER *
* TO RISER JUNCTION *
*-----*
1780000    BSG-D-RI    SNGLJUN
1780101    176010000  170000000  2.8700  1.000  1.000  0100
1780201    0    9.9146  11.069  0.0
*-----*
* COMPONENT 170: BROKEN LOOP STEAM GENERATOR EVAPORATOR RISER *

```

1700000	B-SG-RIS	PIPE					
1700001	5						
1700101	54.893			3			
1700102	47.164			4			
1700103	77.79			5			
1700201	54.893			2			
1700202	47.164			4			
1700301	9.91			3			
1700302	2.196			4			
1700303	6.752			5			
1700401	0.0			5			
1700601	90.0			5			
1700801	5.E-5	0.0		5			
1700901	2.5	2.5		3			
1700902	1.0	1.0		4			
1701001	00			5			
1701101	0000			4			
1701201	0	860.41	512.17	1115.8	0.32765	0.0	1
1701202	0	858.74	516.09	1114.6	0.72765	0.0	2
1701203	0	857.84	516.37	1114.2	0.83908	0.0	3
1701204	0	857.26	516.30	1114.1	0.84332	0.0	4
1701205	0	856.94	516.25	1114.0	0.83804	0.0	5
1701301	1.8407	6.0283	0.0			1	
1701302	4.1842	6.1268	0.0			2	
1701303	7.5892	9.3246	0.0			3	
1701304	7.5386	10.473	0.0			4	

* COMPONENT 171: BROKEN LOOP STEAM GENERATOR SEPERATOR

1710000	B-SG-SEP	SEPARATR					
1710001	3						
1710101	97.070	6.937	0.0	90.0	6.937	0.0	4.667 01
1710200	0	855.70	516.05	1113.9	.500		
1711101	171010000	180000000	63.8	0.864	0.864	1020	0.00
1712101	171000000	172000000	30.000	0.0	0.0	1000	0.00
1713101	170010000	171000000	77.790	21.0	21.0	1000	
1711201	6.7470	6.7470	0.0				
1712201	1.9472	7.5366	0.0				
1713201	4.5731	6.6075	0.0				

* COMPONENT 172: BROKEN LOOP STEAM GENERATOR TOP DOWNCOMER

1720000	BSG-T-DO	SNGLVOL					
1720101	88.87	6.937	0.0	90.0	6.937	0.0	4.014 01
1720200	0	855.70	516.05	1113.9	.500		

* COMPONENT 180: BROKEN LOOP STEAM GENERATOR STEAM DOME

1800000	B-SG-DOM	PIPE					

1800001	1								
1800101	63.80000			1					
1800301	7.2095			1					
1800401	0.0			1					
1800601	90.0			1					
1800701	7.2095			1					
1800801	0.0	0.0		1					
1801001	00			1					
1801201	2	855.10	1.0000	0.0	0.0	0.0	1		

*-----

1870000 B-SG-DOM BRANCH

1870001	2	1							
1870101	50.0	7.2095	0.	0.	90.	7.2095	0.	0.	00
1870200	2	855.10	1.0						
1871101	172010000	187000000	50.0	0.	0.	0000			
1872101	187000000	180000000	204.0	0.	0.	0003			
1871201	0.0	0.0	0.0						
1872201	0.0	0.0	0.0						

*-----

1880000 B-SG-DOM BRANCH

1880001	1	1							
1880101	63.8	7.2095	0.	0.	90.	7.2095	0.	0.	00
1880200	2	855.00	1.0						
1881101	180010000	188000000	63.8	0.0	0.0	0000			
1881201	0.0	786.65	0.0						

*-----

* COMPONENT 185: STEAM LINE

*-----

1850000 B-SG-SL BRANCH

1850001	1	1							
1850101	5.585	137.0	0.	0.	0.	0.	2.667	00	
1850200	2	853.64	1.0000						
1851101	188010000	185000000	5.585	0.0	0.0	0000			
1851201	0.0000	786.65	0.0						

*-----

* COMPONENT 186: MAIN STEAM ISOLATION VALVE

*-----

1860000 B-MSIV VALVE

1860101	185010000	700000000	5.585	0.0	0.0	00			
1860201	1	0.0	786.65	0.0					
1860300	MTRVLV								
1860301	501	504	0.2	1.0	0.0				

*-----

* COMPONENT 191: PORV

*-----

1910000 B-PORV TMDPJUN

1910101	185000000	192000000	1.0						
1910200	1	503 P	185010000						
1910201	0.0	0.0	0.0	0.0					
1910202	1019.0	0.0	0.0	0.0					

1910203 1221.0 0.0 109.7 0.0

*

1920000 B-PORV TMDPVOL

1920101 1.0 0.0 100.0 0.0 0.0 0.0 0.0 0.0 00

1920200 3

1920201 0.0 14.7 100.0

*

* COMPONENT 193 SAFETY VALVES *

1930000 B-SRV TMDPJUN

1930101 185000000 194000000 1.0

1930200 1 0 P 185010000

1930201 0.0 0.0 0.0 0.0

1930202 1089.0 0.0 0.0 0.0

1930203 1091.0 0.0 219.4 0.0

1930204 1102.0 0.0 219.4 0.0

1930205 1104.0 0.0 443.0 0.0

1930206 1116.0 0.0 443.0 0.0

1930207 1118.0 0.0 670.8 0.0

1930208 1129.0 0.0 670.8 0.0

1930209 1131.0 0.0 901.3 0.0

1930210 1143.0 0.0 901.3 0.0

1930211 1145.0 0.0 1134.7 0.0

*

1940000 B-SRV TMDPVOL

1940101 1.0 0.0 100.0 0.0 0.0 0.0 0.0 0.0 00

1940200 3

1940201 0.0 14.7 100.0

* COMPONENT 183: BROKEN LOOP MAIN FEEDWATER SOURCE VOLUME *

1830000 B-MFW TMDPVOL

1830101 10.0 0.0 100.0 0.0 0.0 0.0 0.0 00

1830200 3

1830201 0.0 500.0 413.0

* COMPONENT 184: BROKEN LOOP MAIN FEEDWATER JUNCTION *

1840000 B-MFW-J TMDPJUN

1840101 183000000 174000000 5.0

1840200 1 503

1840201 -1.0 786.65 0.0 0.0

1840202 0.000 786.65 0.0 0.0

1840203 10.0 630.00 0.0 0.0

1840204 20.0 391.20 0.0 0.0

1840205 30.0 340.00 0.0 0.0

1840206 40.0 290.70 0.0 0.0

1840207	50.0	270.00	0.0	0.0
1840208	60.0	0.00	0.0	0.0
1840209	70.0	0.00	0.0	0.0
1840210	81.10	0.00	0.0	0.0
1840211	10000.00	0.00	0.0	0.0

* COMPONENT 181: BROKEN LOOP AUXILIARY FEEDWATER

* SOURCE VOLUME

1810000	B-AFEED	TMDPVGL		
1810101	1.0	0.0	100.0	0. 0. 0. 0. 00
1810200	3			
1810201	0.0	500.0	100.0	

* COMPONENT 182: BROKEN AUX-FEED WATER JUNCTION

* MOTOR DRIVEN + TBN DRIVEN

1820000	B-FEED-J	TMDPJUN		
1820101	181000000	174000000	1.0	
1820200	1	589		
1820201	0.0	0.0	0.0	0.0
1820202	20.0	0.0	0.0	0.0
1820203	50.0	58.08	0.0	0.0

* HEAT STRUCTURE INPUT

* HEAT STRUCTURE 108: STEAM GENERATOR U-TUBES

11081000	8	4	2	1	0.032292		
11081100	0	1					
11081101	3	0.036458					
11081201	4	3					
11081301	0.0	3					
11081401	520.0	4					
11081501	108010000	0	1	0	8382.1469	1	
11081502	108020000	0	1	0	8382.1469	2	
11081503	108030000	0	1	0	8382.1469	3	
11081504	108040000	0	1	0	2917.1839	4	
11081505	108050000	0	1	0	2917.1839	5	
11081506	108060000	0	1	0	8382.1469	6	
11081507	108070000	0	1	0	8382.1469	7	
11081508	108080000	0	1	0	8382.1469	8	
11081601	170010000	0	1	0	9463.5300	1	
11081602	170020000	0	1	0	9463.5300	2	
11081603	170030000	0	1	0	9463.5300	3	
11081604	170040000	0	1	0	3293.5306	4	
11081605	170040000	0	1	0	3293.5306	5	
11081606	170030000	0	1	0	9463.5300	6	

11081607	170020000	0	1	0	9463.5300	7
11081608	170010000	0	1	0	9463.5300	8
11081701	0	0.0	0.0	0.0		8
11081801	0	0.0646	0.0646	9.91		3
11081802	0	0.0646	0.0646	3.449		5
11081803	0	0.0646	0.0646	0.91		8
11081901	0	0.12618	0.12618	9.91		3
11081902	0	0.119	0.1215	3.449		5
11081903	0	0.12618	0.12618	9.91		8

* CONTROL VARIABLE 51 BROKEN LOOP STEAM GENERATOR *

* SECONDARY SIDE MASS INVENTORY *

20505100	BSG-MAS	SUM	0.062428	0.0	1	
20505101	0.0	544.0	RHO 170010000	544.0	RHO 170020000	
20505102		544.0	RHO 170030000	103.572	RHO 170040000	
20505103		525.252	RHO 170050000	608.83	RHO 171010000	
20505104		616.5	RHO 172010000	407.145	RHO 174010000	
20505105		42.498	RHO 176010000	70.3265	RHO 176020000	
20505106		70.3265	RHO 176030000	70.3265	RHO 176040000	
20505107		1611.200	RHO 180010000			

* CONTROL VARIABLE 52: BROKEN LOOP STEAM GENERATOR *

* SECONDARY SIDE WATER VOLUME INVENTORY *

20505200	IBG-VOF	SUM	1.000000	0.0	1	
20505201	0.0	544.0	VOIDF 170010000	544.0	VOIDF 170020000	
20505202		544.0	VOIDF 170030000	103.572	VOIDF 170040000	
20505203		525.252	VOIDF 170050000	608.83	VOIDF 171010000	
20505204		616.5	VOIDF 172010000	407.145	VOIDF 174010000	
20505205		42.498	VOIDF 176010000	70.3265	VOIDF 176020000	
20505206		70.3265	VOIDF 176030000	70.3265	VOIDF 176040000	
20505207		1611.200	VOIDF 180010000			

* CONTROL VARIABLE 53: BROKEN LOOP STEAM GENERATOR *

* WIDE RANGE SECONDARY SIDE WATER VOLUME INVENTORY *

20505300	WBWRVOF	SUM	1.000000	0.0	1	
20505301	0.0	616.5	VOIDF 172010000	407.145	VOIDF 174010000	
20505302		42.498	VOIDF 176010000	70.3265	VOIDF 176020000	
20505303		70.3265	VOIDF 176030000	70.3265	VOIDF 176040000	
20505304		1611.200	VOIDF 180010000			

* CONTROL VARIABLE 54: BROKEN LOOP STEAM GENERATOR *

* NARROW RANGE SECONDARY SIDE WATER VOLUME INVENTORY *

20505400	BNR-VOF	SUM	1.000000	0.0	1	
20505401	0.0	616.5	VOIDF 172010000	108.178	VOIDF 174010000	


```

*
*-----
20505500  XXC3  SUM  1.3797-03  0.8  1  3  0.0  1.0
20505501  -552.33  1.00  CNTRLVAR,53
*-----
20505600  XXC4  SUM  1.3797-03  0.44  1  3  0.0  1.0
20505601  0.000    1.00  CNTRLVAR,54
*-----
* NARROW RANGE LEVEL REDUCED FROM WIDE RANGE WATER VOLUME
20505700  BWR-LEVL FUNCTION  1.0  0.44  1  3  0.0  1.0
20505701  CNTRLVAR,55  501
*-----
* NARROW RANGE LEVEL REDUCED FROM NARROW RANGE WATER VOLUME
20505800  BNR-LEVL FUNCTION  1.0  0.44  1  3  0.0  1.0
20505801  CNTRLVAR,56  501
*-----
* S/G FLUID VOLUME FROM BOTTOM
20505900  BSGVOL  SUM  0.0003498  0.66  1
20505901  0.0    1.0    CNTRLVAR,52
*-----
* S/G WATER LEVEL FROM BOTTOM
20506000  BSGVLV  FUNCTION  44.942  39.2  1
20506001  CNTRLVAR,59  502
*-----
*
*-----
*          G E N E R A L   T A B L E   D E C K
*-----
* NARROW RANGE WATER LEVEL VERSUS NR WATER VOLUME
20250100  NORMAREA
20250101  0.0    0.0
20250102  0.149  0.1500
20250103  1.00   0.730
*-----
* S/G VOLUME VS. LEVEL
20250200  NORMAREA
20250201  0.0    0.0
20250202  0.215  0.662
20250203  0.266  0.710
20250204  0.592  0.860
20250205  1.0    1.0
*-----
*
*-----
*          S T A N D A L O N E   S T E A M   G E N E R A T O R   ( I N T A C T   L O O P - B )
*-----
*
*-----
*          M I N O R   E D I T   R E Q U E S T

```

```

*-----*
*-----*
*      HYDRODYNAMIC COMPONENT      *
*-----*
*-----*
* COMPONENT 205: INTACT LOOP STEAM GENERATOR INLET PLENUM *
*-----*
2050000    I-SG-IP      SNGLVOL
2050101    24.0015  6.7417  0.0  0. 90. 1.704  0. 0.000  00
2050200    3  2239.9  589.85
*-----*
* COMPONENT 206: INTACT LOOP STEAM GENERATOR INLET PLENUM *
*      TO PRIMARY TUBE JUNCTION      *
*-----*
2060000    I-IP-TUB      SNGLJUN
2060101    205010000  208000000  11.0988  0.69 0.69  0100
2060201    1    10334.0  0.0  0.0
*-----*
* COMPONENT 208: INTACT LOOP STEAM GENERATOR TUBES      *
*-----*
2080000    I-SG-TUB      PIPE
2080001    8
2080101    11.0908      8
2080201    11.0986      7
2080301    9.91      3
2080302    3.449      5
2080303    9.91      8
2080401    0.0      8
2080501    90.0      3
2080602    40.0      4
2080603    -40.0      5
2080604    -90.0      6
2080701    9.91      3
2080702    2.196      4
2080703    -2.196      5
2080704    -9.91      8
2080801    0.0  0.0646      8
2080901    0.0  0.0      7
2081001    00      8
2081101    0000      3
2081102    0000      4
2081103    0000      7
2081201    3  2232.4  576.83  0.0  0.0 0.0  1
2081202    3  2225.5  567.20  0.0  0.0 0.0  2
2081203    3  2218.7  559.91  0.0  0.0 0.0  3
2081204    3  2214.3  557.48  0.0  0.0 0.0  4
2081205    3  2213.0  555.25  0.0  0.0 0.0  5
2081206    3  2212.5  550.29  0.0  0.0 0.0  6
2081207    3  2212.1  545.96  0.0  0.0 0.0  7
2081208    3  2211.7  542.22  0.0  0.0 0.0  8

```

```

2081300      1
2081301      10334.0      0.0  0.0   7
*-----
* COMPONENT 209: INTACT LOOP STEAM GENERATOR PRIMARY TUBES      *
*          TO PRIMARY OUTLET PLENUM                                *
*-----
2090000      I-TU-OP      SNGLJUN
2090101      208010000      210000000  11.0988  0.69  0.69  0100
2090201      1      10334.0  0.0  0.0
*-----
* COMPONENT 210: INTACT LOOP STEAM GENERATOR OUTLET PLENUM      *
*-----
2100000      I-SG-OP      SNGLVOL
2100101      24.0015  6.7417  0.0  0. -90. -1.704 0. 0.  00
2100200      3      2211.4      542.22
*-----
* COMPONENT 211: INTACT LOOP STEAM GENERATOR OUTLET PLENUM      *
*          TO PUMP SUCTION LEG                                    *
*-----
2110000      I-SG-O-P      SNGLJUN
2110101      210010000      212000000  5.2414  0.000  0.000  0100
2110201      1      10334.0  0.0  0.0
*-----
* COMPONENT 274: BROKEN LOOP STEAM GENERATOR MID DOWNCOMER      *
*-----
2740000      BSG-M-DO      BRANCH
2740001      2
2740101      60.3  6.752  0. 0. -90. -6.752 2.42189E-5 0.  00
2740200      3      857.37  501.730
2741101      272000000  274000000  60.3  1.0  1.0  0000
2742101      274010000  276000000  19.352  0.1  0.1  0000
2741201      1.7223 -4.2282  0.0
2742201      3.6356  3.6356  0.0
*-----
* COMPONENT 276: BROKEN LOOP STEAM GENERATOR BOTTOM DOWNCOMER  *
*-----
2760000      BSG-B-DO      PIPE
2760001      4
2760101      19.352      1
2760102      7.0965      4
2760201      7.0965      3
2760301      2.196      1
2760302      9.91      4
2760401      0.0      4
2760601      -90.0      4
2760701      -2.196      1
2760702      -9.91      4
2760801      5.E-5  0.0      4
2760901      0.1  0.1      3
2761001      00      4

```


2761101	0000			3				
2761201	3	858.84	501.740	0	0	0	1	
2761202	3	860.39	501.740	0	0	0	2	
2761203	3	863.68	501.760	0	0	0	3	
2761204	3	866.98	501.770	0	0	0	4	
2761301	9.9140	9.9140	0.0				1	
2761302	9.9139	9.9139	0.0				2	
2761303	9.9139	9.9139	0.0				3	

* COMPONENT 278: BROKEN LOOP STEAM GENERATOR BOTTOM DOWNCOMER TO RISER JUNCTION *

2780000	BSG-D-RI	SNGLJUN					
2780101	276010000	2700000000	2.9700	1.000	1.000	0100	
2780201	0	9.9146	11.069	0.0			

* COMPONENT 270: BROKEN LOOP STEAM GENERATOR EVAPORATOR RISER *

2700000	B-SG-RIS	PIPE					
2700001	5						
2700101	54.893		3				
2700102	47.164		4				
2700103	77.79		5				
2700201	54.893		2				
2700202	47.164		4				
2700301	9.91		3				
2700302	2.196		4				
2700303	6.752		5				
2700401	0.0		5				
2700601	90.0		5				
2700801	5.E-5	0.0	5				
2700901	2.5	2.5	3				
2700902	1.0	1.0	4				
2701001	00		5				
2701101	0000		4				
2701201	0	860.41	512.17	1115.8	0.32765	0.0	1
2701202	0	858.74	516.09	1114.6	0.72765	0.0	2
2701203	0	857.84	516.37	1114.2	0.83908	0.0	3
2701204	0	857.26	516.30	1114.1	0.84332	0.0	4
2701205	0	856.94	516.25	1114.0	0.83804	0.0	5
2701301	1.8407	6.0283	0.0				1
2701302	4.1842	6.1268	0.0				2
2701303	7.5892	9.3246	0.0				3
2701304	7.5386	10.473	0.0				4

* COMPONENT 271: BROKEN LOOP STEAM GENERATOR SEPERATOR *

2710000	B-SG-SEP	SEPARATR					
2710001	3						
2710101	97.070	6.937	0.0	90.0	6.937	0.0	4.667 01

2710200	0	855.70	516.05	1113.9	.500		
2711101	271010000	280000000	63.8	0.864	0.864	1020	0.00
2712101	271000000	272000000	30.000	0.0	0.0	1000	0.00
2713101	270010000	271000000	77.790	21.0	21.0	1000	
2711201	6.7470	6.7470	0.0				
2712201	1.9472	7.5366	0.0				
2713201	4.5731	6.6075	0.0				

* COMPONENT 272: BROKEN LOOP STEAM GENERATOR TOP DOWNCOMER *

2720000	BSG-T-D0	SNGLVOL					
2720101	88.87	6.937	0.0	90.6	6.937	0.4014	01
2720200	0	855.70	516.05	1113.9	.500		

* COMPONENT 280: BROKEN LOOP STEAM GENERATOR STEAM DOME *

2800000	B-SG-DOM	PIPE					
2800001	1						
2800101	63.80000			1			
2800301	7.2095			1			
2800401	0.0			1			
2800601	90.0			1			
2800701	7.2095			1			
2800801	0.0	0.0		1			
2801001	00			1			
2801201	2	855.10	1.0000	0.0	0.0	0.0	1

2870000 B-SG-DOM BRANCH

2870001	2	1					
2870101	50.0	7.2095	0.0	90.7	7.2095	0.0	00
2870200	2	855.10	1.0				
2871101	272010000	287000000	50.0	0.0	0.0	0000	
2872101	287000000	280000000	204.0	0.0	0.0	0003	
2871201	0.0	0.0	0.0				
2872201	0.0	0.0	0.0				

*

2880000 B-SG-DOM BRANCH

2880001	1	1					
2880101	63.8	7.2095	0.0	90.7	7.2095	0.0	00
2880200	2	855.00	1.0				
2881101	280010000	288000000	63.8	0.0	0.0	0000	
2881201	0.0	786.65	0.0				

* COMPONENT 285: STEAM LINE *

2850000	I-SG-SL	BRANCH					
2850001	1	1					
2850101	5.585	137.0	0.0	0.0	0.0	2.667	00
2850200	2	853.64	1.0000				
2851101	288010000	285000000	5.585	0.0	0.0	0000	

2851201 0.0000 786.65 0.0

*

* COMPONENT 286: MAIN STEAM ISOLATION VALVE *

*

2860000 I-MSIV VALVE

2860101 285010000 700000000 5.585 0.0 0.0 0100

2860201 1 0.00 786.65 0.0

2860300 MTRVLV

2860301 501 504 0.2 1.0 0.0

*

* COMPONENT 291: PORV *

*

2910000 I-PORV TMDPJUN

2910101 185000000 292000000 1.0

2910200 1 503 P 185010000

2910201 0.0 0.0 0.0 0.0

2910202 1019.0 0.0 0.0 0.0

2910203 1021.0 0.0 109.7 0.0

*

*

2920000 I-PORV TMDPVOL

2920101 1.0 0.0 100.0 0.0 0.0 0.0 0.0 0.0 00

2920200 3

2920201 0.0 14.7 100.0

*

*

* COMPONENT 293 SAFETY VALVES *

*

2930000 I-SRV TMDPJUN

2930101 185000000 294000000 1.0

2930200 1 0 P 185010000

2930201 0.0 0.0 0.0 0.0

2930202 1089.0 0.0 0.0 0.0

2930203 1091.0 0.0 219.4 0.0

2930204 1102.0 0.0 219.4 0.0

2930205 1104.0 0.0 443.0 0.0

2930206 1116.0 0.0 443.0 0.0

2930207 1118.0 0.0 670.8 0.0

2930208 1129.0 0.0 670.8 0.0

2930209 1131.0 0.0 901.3 0.0

2930210 1143.0 0.0 901.3 0.0

2930211 1145.0 0.0 1134.7 0.0

*

*

2940000 I-SRV TMDPVOL

2940101 1.0 0.0 100.0 0.0 0.0 0.0 0.0 0.0 00

2940200 3

2940201 0.0 14.7 100.0

*

* COMPONENT 283: INTACT LOOP MAIN FEEDWATER SOURCE VOLUME *


```

*-----
2830000      I-MFW      TMDPVOL
2830101      10.0  0.0  100.0  0.  0.  0.  0.  00
2830200      3
2830201      0.0      500.0  413.0
*-----

```

* COMPONENT 284: INTACT LOOP MAIN FEEDWATER JUNCTION *

```

*-----
2840000      I-MFW-J      TMDPJUN
2840101      2830000000  2740000000  5.0
2840200      1  590
2840201      -1.00  786.650  0.0  0.0
2840202      0.0  786.65  0.0  0.0
2840203      10.0      0.0  0.0  0.0
2840204      10000.      0.0  0.0  0.0
*-----

```

* COMPONENT 281: INTACT LOOP AUXILIARY FEEDWATER
SOURCE VOLUME *

```

*-----
2810000      I-AFEED      TMDPVOL
2810101      1.0  0.0  100.0  0.  0.  0.  0.  00
2810200      3
2810201      0.0  500.0  100.0
*-----

```

* COMPONENT 282: INTACT AUX-FEED WATER JUNCTION *

* MOTOR DRIVEN + TBN DRIVEN *

```

2820000      I-FEED-J      TMDPJUN
2820101      2810000000  2740000000  1.0
2820200      1  589
2820201      0.0  0.0  0.0  0.0
2820202      20.0  0.0  0.0  0.0
2820203      50.0  58.08  0.0  0.0
*-----

```

* HEAT STRUCTURE INPUT *

* HEAT STRUCTURE 208: STEAM GENERATOR U-TUBES *

```

12081000      8  4  2  1  0.032292
12081100      0  1
12081101      3  0.036458
12081201      4      3
12081301      0.0      3
12081401      520.0  4
12081501      208010000  0      1  0  8382.1469  1
12081502      208020000  0      1  0  8382.1469  2
12081503      208030000  0      1  0  8382.1469  3
12081504      208040000  0      1  0  2917.1839  4

```

12081505	208050000	0	1	0	2917.1839	5
12081506	208060000	0	1	0	8382.1469	6
12081507	208070000	0	1	0	8382.1409	7
12081508	208080000	0	1	0	8382.1469	8
12081601	270010000	0	1	0	9463.5300	1
12081602	270020000	0	1	0	9463.5300	2
12081603	270030000	0	1	0	9463.5300	3
12081604	270040000	0	1	0	3293.5306	4
12081605	270040000	0	1	0	3293.5306	5
12081606	270030000	0	1	0	9463.5300	6
12081607	270020000	0	1	0	9463.5300	7
12081608	270010000	0	1	0	9463.5300	8
12081701	0	0.0	0.0	0.0		8
12081801	0	0.0646	0.0646	9.91		3
12081802	0	0.0646	0.0646	3.449		5
12081803	0	0.0646	0.0646	9.91		8
12081901	0	0.12618	0.12618	9.91		3
12081902	0	0.119	0.1215	3.449		5
12081903	0	0.12618	0.12618	9.91		8

*

* CONTROL VARIABLE 300 : U-TUBE HEAT TRANSFER RATE *

20530000	UT-HEAT	SUM	1.0E-6	0.0	1
20530001	0.0	1.0	Q	108010000	
20530002		1.0	Q	108020000	
20530003		1.0	Q	108030000	
20530004		1.0	Q	108040000	
20530005		1.0	Q	108050000	
20530006		1.0	Q	108060000	
20530007		1.0	Q	108070000	
20530008		1.0	Q	108080000	
20530009		1.0	Q	208010000	
20530010		1.0	Q	208020000	
20530011		1.0	Q	208030000	
20530012		1.0	Q	208040000	
20530013		1.0	Q	208050000	
20530014		1.0	Q	208060000	
20530015		1.0	Q	208070000	
20530016		1.0	Q	208080000	

*

* LOOP A-B INTERCONNECTION *

* COMPONENT 700 ; STEAM HEAD *

7000000	STHEAD	SNGLVOL							
7000101	5.585	0.0	100.0	0.	0.	0.	0.	0.	10
7000200	2	849.39	1.0						

*

* COMPONENT 701; TURBINE STOP VALVE

```

*-----
7010000      TBNSTOP  VALVE
7010101      700010000  702000000  5.585  0.  0.  0100
7010201      1  0.0  1573.3  0.0
7010300      MTRVLV
7010301      501  601  0.2  1.0  0.0
*-----

```

* COMPONENT 702; TBN

```

*-----
7020000      TBN  TMDPVOL
7020101      5.585  0.0  100.0  0.  0.  0.  0.  0.  00
7020200      2
7020201      0.0  850.00  1.0
*-----

```

* CONTROL SYSTEM INPUT DATA

* CONTROL VARIABLE 61: INTACT LOOP STEAM GENERATOR
* SECONDARY SIDE MASS INVENTORY *

```

*-----
20506100      ISG-MAS      SUM  0.062428  0.0  1
20506101      0.0  544.0  RHO 270010000  544.0  RHO 270020000
20506102      544.0  RHO 270030000  103.572  RHO 270040000
20506103      525.252  RHO 270050000  608.83  RHO 271010000
20506104      616.5  RHO 272010000  407.145  RHO 274010000
20506105      42.498  RHO 276010000  70.3265  RHO 276020000
20506106      70.3265  RHO 276030000  70.3265  RHO 276040000
20506107      1611.200  RHO 280010000
*-----

```

* CONTROL VARIABLE 62: INTACT LOOP STEAM GENERATOR
* SECONDARY SIDE WATER VOLUME INVENTORY *

```

*-----
20506200      ISG-VOF      SUM  1.000000  0.0  1
20506201      0.0  544.0  VOIDF 270010000  544.0  VOIDF 270020000
20506202      544.0  VOIDF 270030000  103.572  VOIDF 270040000
20506203      525.252  VOIDF 270050000  608.83  VOIDF 271010000
20506204      616.5  VOIDF 272010000  407.145  VOIDF 274010000
20506205      42.498  VOIDF 276010000  70.3265  VOIDF 276020000
20506206      70.3265  VOIDF 276030000  70.3265  VOIDF 276040000
20506207      1611.200  VOIDF 280010000
*-----

```

* CONTROL VARIABLE 63: INTACT LOOP STEAM GENERATOR
* WIDE RANGE SECONDARY SIDE WATER VOLUME INVENTORY *

```

*-----
20506300      IWR-VOF      SUM  1.000000  0.0  1
20506301      0.0  616.5  VOIDF 272010000  407.145  VOIDF 274010000
20506302      42.498  VOIDF 276010000  70.3265  VOIDF 276020000
20506303      70.3265  VOIDF 276030000  70.3265  VOIDF 276040000

```



```

20506304      1611.200 VOIDF 280010000
*-----*
* CONTROL VARIABLE 64: INTACT LOOP STEAM GENERATOR      *
*      NARROW RANGE SECONDARY SIDE WATER VOLUME INVENTORY *
*-----*
20506400      INR-VOF      SUM      1.000000      0.0      1
20506401      0.0      616.5      VOIDF 272010000      108.178 VOIDF 274010000
*-----*
20506500      XXC3      SUM      1.3797-03      0.8      1      3      0.0      1.0
20506501      -552.33      1.00      CNTRLVAR,63
*-----*
20506600      XXC4      SUM      1.3797-03      0.44      1      3      0.0      1.0
20506601      0.000      1.00      CNTRLVAR,64
*-----*
* NARROW RANGE LEVEL REDUCED FROM WIDE RANGE WATER VOLUME
20506700      IWR-LEVL FUNCTION      1.0      0.44      1      3      0.0      1.0
20506701      CNTRLVAR,65      501
*-----*
* NARROW RANGE LEVEL REDUCED FROM NARROW RANGE WATER VOLUME
20506800      INR-LEVL FUNCTION      1.0      0.44      1      3      0.0      1.0
20506801      CNTRLVAR,66      501
*-----*
* S/G LIQUID VOLUME FROM BOTTOM
20506900      ISGVOL      SUM      0.0003498      0.66      1
20506901      0.0      1.0      CNTRLVAR,62
*-----*
* S/G WATER LEVEL FROM BOTTOM
20507000      ISGLVL      FUNCTION      44.942      39.2      1
20507001      CNTRLVAR,69      502
*-----*
*-----*
*-----*
* REACTOR COOLANT SYSTEM *
*-----*
*-----*
* COMPONENT 101; BROKEN LOOP HOT LEG #1 VOLUME *
*-----*
1010000      B-HL-1      SNGLVOL
1010101      4.587      0.0      39.6824      0.0      0.0      0.0      2.417      00
1010200      3      2244.0      589.86
*-----*
* COMPONENT 102; BROKEN LOOP HOT LEG #2 VOLUME *
*-----*
1020000      B-HL-2      BRANCH
1020001      3      1

```

1020101	4.587	0.0	40.0	0.0	0.0	0.0	2.417	00
1020200	3	2243.7	589.87					
1021101	1010100C0	102000000	4.587	0.0	0.0	0.0	0000	
1022101	102010000	103000000	4.587	0.2	0.2	0.0	0000	
1023101	630010000	102000000	0.7854	1.92	1.70	0.100		
1021201	10334.0	0.0	0.0					
1022201	10334.0	0.0	0.0					
1023201	0.0000	0.0	0.0					
-----*								
* COMPONENT 103; BROKEN LOOP HOT LEG #3 VOLUME *								
-----*								
1030000	B-HL-3	SNGLVOL						
1030101	4.587	0.0	31.8933	0.	90.0	5.144	0.	2.417 00
1030200	3	2240.3	589.85					
-----*								
* COMPONENT 104; BROKEN LOOP HOT LEG 3 TO INLET PLENUM *								
-----*								
1040000	B-HL-IP	SNGLJUN						
1040101	103010000	105000000	4.587	0.25	0.25	0.100		
1040201	1	10334.0	0.0	0.0				
-----*								
* COMPONENT 112; BROKEN LOOP PUMP SUCTION LEG *								
-----*								
1120000	B-P-SUC	PIPE						
1120001	3							
1120101	5.2414	3						
1120201	5.2414	2						
1120301	15.456	1						
1120302	11.886	2						
1120303	4.5	3						
1120401	0.0	3						
1120601	-90.0	1						
1120602	0.0	2						
1120603	90.0	3						
1120701	-15.456	1						
1120702	0.0	2						
1120703	4.5	3						
1120801	0.0	2.583	3					
1120901	0.0	0.0	2					
1121001	00	3						
1121101	0000	2						
1121201	3	2202.4	542.18	0.0	0.0	0.0	1	
1121202	3	2204.7	542.20	0.0	0.0	0.0	2	
1121203	3	2203.8	542.19	0.0	0.0	0.0	3	
1121300	1							
1121301	10334.0	0.0	0.0	2				
-----*								
* COMPONENT 114; BROKEN LOOP REACTOR COOLANT PUMP VOLUME *								
-----*								
1140000	B-PUMP	PUMP						

1140101	0.0	5.812	57.0				
1140102	0.0	90.0	5.812				
1140103	00						
1140108	112010000	5.2414	0.0	0.0	0100		
1140109	116000000	4.1247	0.0	0.0	0100		
1140200	3	2258.3	542.53				
1140201	1	10334.0	0.0	0.0			
1140202	1	10334.0	0.0	0.0			
1140301	0	0	-1	-1	594	0	
1140302	1190.0	1.0	98214.00	314.93	32668.85	82000.0	
1140303	0.0	0.0	1925.0	0.0	0.0	0.0	
1140310	1.0E6	1190.0	-1.0				

* COMPONENT 116; BROKEN LOOP COLD LEG PIPING 1

1160000	B-CL-1	SNGLVOL					
1160101	4.1247	0.0	19.6843	0.0	0.0	0.0	2.292 00
1160200	3	2293.2	542.68				

* COMPONENT 120; BROKEN LOOP COLD LEG PIPING 2

1200000	B-CL-2	BRANCH					
1200001	2	1					
1200101	4.1247	0.0	56.4362	0.0	0.0	0.0	2.292 00
1200200	3	2292.8	542.68				
1201101	116010000	120000000	4.1247	0.0	0.0	0000	
1202101	120010000	300000000	4.1247	0.0044	0.0044	0100	
1201201	10334.0	0.0	0.0				
1202201	10334.0	0.0	0.0				

* COMPONENT 201; INTACT LOOP HOT LEG #1 VOLUME

2010000	I-HL-1	SNGLVOL					
2010101	4.587	0.0	39.6824	0.0	0.0	0.0	2.417 00
2010200	3	2244.0	589.86				

* COMPONENT 202; INTACT LOOP HOT LEG #2 VOLUME

2020000	I-HL-2	BRANCH					
2020001	2	1					
2020101	4.587	0.0	40.0	0.0	0.0	0.0	2.417 00
2020200	3	2243.7	589.87				
2021101	201010000	202000000	4.587	0.0	0.0	0000	
2022101	202010000	203000000	4.587	0.2	0.2	0000	
2021201	10334.0	0.0	0.0				
2022201	10334.0	0.0	0.0				

* COMPONENT 203; INTACT LOOP HOT LEG #3 VOLUME

2030000	I-HL-3	SNGLVOL					
---------	--------	---------	--	--	--	--	--

2030101	4.587	0.0	31.8933	0.	90.0	5.144	0.	2.417	00
2030200	3	2240.3	589.85						
-----*									
* COMPONENT 204; INTACT LOOP HOT LEG 3 TO INLET PLENUM *									
-----*									
2040000	I-HL-IP	SNGLJUN							
2040101	203010000	2050000000	4.587	0.25	0.25	0100			
2040201	1	10334.0	0.0	0.0					
-----*									
* COMPONENT 212; INTACT LOOP PUMP SUCTION LEG *									
-----*									
2120000	I-P-SUC	PIPE							
2120001	3								
2120101	5.2414	3							
2120201	5.2414	2							
2120301	15.456	1							
2120302	11.886	2							
2120303	4.5	3							
2120401	0.0	3							
2120601	-90.0	1							
2120602	0.0	2							
2120603	90.0	3							
2120701	-15.456	1							
2120702	0.0	2							
2120703	4.5	3							
2120801	0.0	2.583	3						
2120901	0.0	0.0	2						
2121001	00		3						
2121101	0000		2						
2121201	3	2202.4	542.18	0.0	0.0	0.0	1		
2121202	3	2204.7	542.20	0.0	0.0	0.0	2		
2121203	3	2203.8	542.19	0.0	0.0	0.0	3		
2121300	1								
2121301	10334.0	0.0	0.0	2					
-----*									
* COMPONENT 214; INTACT LOOP REACTOR COOLANT PUMP VOLUME *									
-----*									
2140000	I-PUMP	PUMP							
2140101	0.0	5.812	57.0						
2140102	0.0	90.0	5.812						
2140103	00								
2140108	212010000	5.2414	0.0	0.0	0100				
2140109	2160000000	4.1247	0.0	0.0	0100				
2140200	3	2258.3	542.53						
2140201	1	10334.0	0.0	0.0					
2140202	1	10334.0	0.0	0.0					
2140301	114	114	114	-1	-1	595	0		
2140302	1190.0	1.0	98214.00	314.93	32668.85	82000.0			
2140303	0.0	0.0	1925.0	0.0	0.0	0.0			
2140310	1.0E6	1190.0	-1.0						

```

*-----*
* COMPONENT 216; INTACT LOOP COLD LEG PIPIG 1
*-----*
2160000    I-CL-1    SNGLVOL
2160101    4.1247  0.0  19.6843  0. 0. 0. 0.  2.292  00
2160200    3      2293.2  542.68
*-----*
* COMPONENT 220; INTACT LOOP COLD LEG PIPING 2
*-----*
2200000    I-CL-2    BRANCH
2200001    2      1
2200101    4.1247  0.0  56.4362  0. 0. 0. 0.  2.292  00
2200200    3      2292.8  542.68
2201101    216010000 220000000 4.1247  0.0  0.0  0000
2202101    220010000 300000000 4.1247  0.0044 0.0044  0100
2201201    10334.0   0.0   0.0
2202201    10334.0   0.0   0.0
*-----*
* COMPONENT 620; PRESSURIZER (LOCATED AT BROKEN LOOP)
*      CHECK #1023101
*-----*
6200000    PREZ      PIPE
6200001    8
6200101    24.926           1
6200102    36.794           7
6200103    24.926           8
6200301    3.94            1
6200302    3.64      7
6200303    3.94      8
6200401    0.0             8
6200601    -90.0           8
6200801    0.0  0.000       8
6200901    0.0  0.0        7
6201001    00             8
6201101    0000           7
6201201    2      2250.1   1.0  0.0  0.0  0.0  1
6201202    2      2250.3   1.0  0.0  0.0  0.0  2
6201203    2      2250.4   1.0  0.0  0.0  0.0  3
6201204    2      2250.6   1.0  0.0  0.0  0.0  4
6201205    2      2250.9  0.1484 0.0  0.0  0.0  5
6201206    2      2251.7   0.0  0.0  0.0  0.0  6
6201207    2      2252.6   0.0  0.0  0.0  0.0  7
6201208    2      2253.6   0.0  0.0  0.0  0.0  8
6201300    1
6201301    0.0  0.0  0.0  7
*-----*
* COMPONENT 621; PRESSURIZER TO SURGELINE JUNCTION
*-----*
6210000    PRZ-SUR    SNGLJUN
6210101    620010000 630000000 0.7854  6.19  7.655  0100

```

6210201 1 0.0 0.0 0.0

* COMPONENT 630; PRESSURIZER SURGE LINE

6300000 PRZ-SUR PIPE

6300001 3

6300101 0.7854 3

6300301 8.125 1

6300302 22.567 3

6300401 0.0 3

6300601 -90.0 1

6300602 0.0 3

6300701 -8.125 1

6300702 0.0 3

6300801 0.0 1.0 3

6301001 00 3

6301101 0000 2

6301201 3 2255.2 636.66 0.0 0.0 0.0 1

6301202 3 2256.3 624.03 0.0 0.0 0.0 2

6301203 3 2256.3 609.74 0.0 0.0 0.0 3

6301300 1

6301301 0.0 0.0 0.0 2

* TIME DEPENDENT VOLUME FOR PRESSURIZER SAFETY VALVE

6400000 PZRSRV TMDPVOL

6400101 1.0 0.0 100.0 0.0 0.0 0.0 00

6400200 3

6400201 0.0 14.700 100.0

* TIME DEPENDENT JUNCTION FOR PZR SAFETY VALVES

6410000 PZRSRV TMDPJUN

6410101 640000000 620000000 1.0

6410200 1 0 P 620010000

6410201 0.0 0.0 0.0 0.0

6410202 2499.0 0.0 0.0 0.0

6410203 2501.0 211.2 0.0 0.0

*6400000 SS-VOL TMDPVOL

*6400101 1.0 0.0 100.0 0.0 0.0 0.0 00

*6400200 2

*6400201 0.0 2250.0 1.000

*6410000 SS-JUN SNGLJUN

*6410101 640000000 620000000 1.0 0.0 0.0 0000

*6410201 1 0.0 0.0 0.0

* HEAT STRUCTURE INPUT


```

*-----*
*-----*
* HEAT STRUCTURE 101: INTACT LOOP HOT LEG *
*-----*
11010000    1  2  2  1  2.417
11010100    0      1
11010101    1      3.2833
11010201    5      1
11010301    0.0    1
11010401    601.45  2
11010501    101010000  0  1  1  8.6506  1
11010601    0      0  0  1  8.6506  1
11010701    0      0.0  0.0  0.0    1
11010801    0      2.417  2.417  8.6506  1
*-----*
* HEAT STRUCTURE 102: INTACT LOOP HOT LEG 2 *
*-----*
11020000    1  2  2  1  2.417
11020100    0      1
11020101    1      2.8854
11020201    5      1
11020301    0.0    1
11020401    601.45  2
11020501    102010000  0  1  1  8.7203  1
11020601    0      0  0  1  8.7203  1
11020701    0      0.0  0.0  0.0    1
11020801    0      2.417  2.417  8.7203  1
*-----*
* HEAT STRUCTURE 103: INTACT LOOP HOT LEG 3 *
*-----*
11030000    1  2  2  1  2.417
11030100    0      1
11030101    1      2.8524
11030201    5      1
11030301    0.0    1
11030401    601.45  2
11030501    103010000  0  1  1  6.953  1
11030601    0      0  0  1  6.953  1
11030701    0      0.0  0.0  0.0    1
11030801    0      2.417  2.417  6.953  1
*-----*
* HEAT STRUCTURE 105: INTACT LOOP S/G INLET PLENUM *
*-----*
11050000    1  2  3  1  5.2342
11050100    0      1
11050101    1      5.7342
11050201    5      1
11050301    0.0    1
11050401    601.41  2
11050501    105010000  0  1  1  0.25  1

```

11050601	0		0	0	1	0.25	1
11050701	0	0.0	0.0	0.0			1
11050801	0	5.5281	5.5281	6.7417	1		

* HEAT STRUCTURE 110: INTACT LOOP S/G OUTLET PLENUM

11100000	1	2	3	1	5.2342		
11100100	0			1			
11100101	1			5.7342			
11100201	5			1			
11100301	0.0			1			
11100401	540.99	2					
11100501	110010000	0	1	1	0.25	1	
11100601	0		0	0	1	0.25	1
11100701	0	0.0	0.0	0.0			1
11100801	0	5.5281	5.5281	6.7417	1		

* HEAT STRUCTURE 112: INTACT LOOP PUMP SUCTION LEG

11120000	3	2	2	1	2.583		
11120100	0			1			
11120101	1			3.038			
11120201	5			1			
11120301	0.0			1			
11120401	541.0	2					
11120501	112010000	0	1	1	16.456	1	
11120502	112020000	0	1	1	11.886	2	
11120503	112030000	0	1	1	4.5	3	
11120601	0		0	0	1	15.456	1
11120602	0		0	0	1	11.886	2
11120603	0		0	0	1	4.5	3
11120701	0	0.0	0.0	0.0			3
11120801	0	2.583	2.583	15.456			1
11120802	0	2.583	2.583	11.886			2
11120803	0	2.583	2.583	4.5			3

* HEAT STRUCTURE 116: INTACT LOOP COLD LEG 1

11160000	1	2	2	1	2.2917		
11160100	0			1			
11160101	1			2.7396			
11160201	5			1			
11160301	0.0			1			
11160401	541.2	2					
11160501	116010000	0	1	1	4.7723	1	
11160601	0		0	0	1	4.7723	1
11160701	0	0.0	0.0	0.0			1
11160801	0	2.292	2.292	4.7723			1

* HEAT STRUCTURE 120: INTACT LOOP COLD LEG 2

```

*-----*
11200000    1  2  2  1  2.2917
11200100    0          1
11200101    1          3.0006
11200201    5          1
11200301    0.0        1
11200401    541.2      2
11200501    120010000  0  1  1  13.6825  1
11200601    0          0  0  1  13.6825  1
11200701    0          0.0  0.0  0.0      1
11200801    0  2.292  2.292  13.6825      1
*-----*
* HEAT STRUCTURE 201: BROKEN LOOP HOT LEG 1
*-----*
12010000    1  2  2  1  2.417
12010100    0          1
12010101    1          3.2833
12010201    5          1
12010301    0.0        1
12010401    601.45     2
12010501    201010000  0  1  1  8.6506  1
12010601    0          0  0  1  8.6506  1
12010701    0          0.0  0.0  0.0      1
12010801    0          2.417  2.417  8.6506  1
*-----*
* HEAT STRUCTURE 202: BROKEN LOOP HOT LEG 2
*-----*
12020000    1  2  2  1  2.417
12020100    0          1
12020101    1          2.8854
12020201    5          1
12020301    0.0        1
12020401    601.45     2
12020501    202010000  0  1  1  8.7203  1
12020601    0          0  0  1  8.7203  1
12020701    0          0.0  0.0  0.0      1
12020801    0          2.417  2.417  8.7203  1
*-----*
* HEAT STRUCTURE 203: BROKEN LOOP HOT LEG 3
*-----*
12030000    1  2  2  1  2.417
12030100    0          1
12030101    1          2.8524
12030201    5          1
12030301    0.0        1
12030401    601.45     2
12030501    203010000  0  1  1  6.953  1
12030601    0          0  0  1  6.953  1
12030701    0          0.0  0.0  0.0      1
12030801    0          2.417  2.417  6.953  1

```

* HEAT STRUCTURE 205: BROKEN LOOP S/G INLET PLENUM *

12050000	1	2	3	1	5.2342	
12050100	0			1		
12050101	1			5.7342		
12050201	5			1		
12050301	0.0			1		
12050401	606.41		2			
12050501	205010000	0	1	1	0.25	1
12050601	0		0	0	1	0.25
12050701	0	0.0	0.0	0.0		1
12050801	0	5.5281	5.5281	6.7417	1	

* HEAT STRUCTURE 210: BROKEN LOOP S/G OUTLET PLENUM *

12100000	1	2	3	1	5.2342	
12100100	0			1		
12100101	1			5.7342		
12100201	5			1		
12100301	0.0			1		
12100401	540.99		2			
12100501	210010000	0	1	1	0.25	1
12100601	0		0	0	1	0.25
12100701	0	0.0	0.0	0.0		1
12100801	0	5.5281	5.5281	6.7417	1	

* HEAT STRUCTURE 212: BROKEN LOOP PUMP SUCTION LEG *

12120000	3	2	2	1	2.583	
12120100	0			1		
12120101	1			3.038		
12120201	5			1		
12120301	0.0			1		
12120401	541.0		2			
12120501	212010000	0	1	1	15.456	1
12120502	212020000	0	1	1	11.886	2
12120503	212030000	0	1	1	4.5	3
12120601	0		0	0	1	15.456
12120602	0		0	0	1	11.886
12120603	0		0	0	1	4.5
12120701	0	0.0	0.0	0.0		3
12120801	0	2.583	2.583	15.456	1	
12120802	0	2.583	2.583	11.886	2	
12120803	0	2.583	2.583	4.5	3	

* HEAT STRUCTURE 216: BROKEN LOOP COLD LEG 1 *

12160000	1	2	2	1	2.2917	
12160100	0			1		

12160101	1	2.7396				
12160201	5	1				
12160301	0.0	1				
12160401	541.2	2				
12160501	216010000	0	1	1	4.7723	1
12160601	0		0	0	1	4.7723
12160701	0	0.0	0.0	0.0		1
12160801	0	2.292	2.292	4.7723		1

* HEAT STRUCTURE 220: BROKEN LOOP COLD LEG 2

12200000	1	2	2	1	2.2917	
12200100	0			1		
12200101	1			3.0006		
12200201	5			1		
12200301	0.0			1		
12200401	541.2			2		
12200501	220010000	0	1	1	13.6825	1
12200601	0		0	0	1	13.6825
12200701	0	0.0	0.0	0.0		1
12200801	0	2.292	2.292	13.6825		1

* HEAT STRUCTURE 620: PRESSURIZER

16200000	8	2	2	1	7.625	
16200100	0			1		
16200101	1			8.0		
16200201	5			1		
16200301	0.0			1		
16200401	652.5			2		
16200501	620010000	0		1	1	3.94
16200502	620020000	0		1	1	3.64
16200503	620030000	0		1	1	3.64
16200504	620040000	0		1	1	3.64
16200505	620050000	0		1	1	3.64
16200506	620060000	0		1	1	3.64
16200507	620070000	0		1	1	3.64
16200508	620080000	0		1	1	3.94
16200601	0		0	0	1	3.94
16200602	0		0	0	1	3.64
16200603	0		0	0	1	3.64
16200604	0		0	0	1	3.64
16200605	0		0	0	1	3.64
16200606	0		0	0	1	3.64
16200607	0		0	0	1	3.64
16200608	0		0	0	1	3.94
16200701	0	0.0	0.0	0.0		8
16200801	0	0.000	0.000	3.94		1
16200802	0	0.0	0.0	3.64	7	
16200803	0	0.0	0.0	3.94	8	

* HEAT STRUCTURE 630: PRESSURIZER SURGE LINE *

16300000	3	2	2	1	1.0		
16300100	0			1			
16300101	1			1.1			
16300201	5			1			
16300301	0.0			1			
16300401	635.0		2				
16300501	630010000	0	1	1	8.125	1	
16300502	630020000	0	1	1	22.567	2	
16300503	630030000	0	1	1	22.567	3	
16300601	0	0	0	1	8.125	1	
16300602	0	0	0	1	22.567	2	
16300603	0	0	0	1	22.567	3	
16300701	0	0.0	0.0	0.0		3	
16300801	0	1.0	1.0	8.125		1	
16300802	0	1.0	1.0	22.567		2	
16300803	0	1.0	1.0	22.567		3	

* CALCULATING TIME STEP INTERVAL

20500100	T1	MULT	1.0	0.0	0
20500101	TIME	0			

20500200	DELT	SUM	1.0	0.0	0
20500201	0.0	1.0	CNTRLVAR 001	-1.0	CNTRLVAR 999

20599900	TO	MULT	1.0	0.0	0
20599901	CNTRLVAR	001			

* TRIP DATA

591	CNTRLVAR 103	GE	NULL	0	-1.0E-6	N
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* MEASURED PZR LEVEL - BASED ON VOID FRACTION

20512100	PZRLVL	SUM	0.166667	0.4762	0	3	0.	1.
20512101	0.0	1.0	VOIDF	620020000	1.0	VOIDF	620030000	
20512102		1.0	VOIDF	620040000	1.0	VOIDF	620050000	
20512103		1.0	VOIDF	620060000	1.0	VOIDF	620070000	

* MEASURED PZR WATER VOLUME

20512200	PZRVOF	SUM	1.0	476.2	0		
20512201	0.0	98.2084	VOIDF	620010000	133.93	VOIDF	620020000
20512202		133.93	VOIDF	620030000	133.93	VOIDF	620040000
20512203		133.93	VOIDF	620050000	133.93	VOIDF	620060000
20512204		133.93	VOIDF	620070000	98.2084	VOIDF	620080000

* TO CALCULATE AUCTIONEERED T AVERAGE


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*-----
20510100    TAVG-A  SUM  1.0  574.0  0
20510101    -459.67      0.9  TEMPF 101010000
20510102      0.9  TEMPF 116010000
*
20510200    TAVG-B  SUM  1.0  574.0  0
20510201    -459.67      0.9  TEMPF 201010000
20510202      0.9  TEMPF 216010000
*
20510300    HTX1    SUM  1.0  0.0  0
20510301    0.0      1.0  CNTRLVAR  101
20510302      -1.0  CNTRLVAR  102
*
*
20510400    HTX2    TRIPUNIT  1.0  1.0  0
20510401    591
*
20510500    HTX3    SUM  1.0  0.0  0
20510501    1.0 -1.0  CNTRLVAR  104
*
20510600    HTX4    MULT  1.0  0.0  0
20510601    CNTRLVAR  104      CNTRLVAR  101
*
20510700    HTX5    MULT  1.0  574.0  0
20510701    CNTRLVAR  105      CNTRLVAR  102
*
20510800    TAVG-H  SUM  1.0  574.0  0
20510801    0.0      1.0  CNTRLVAR  106
20510802      1.0  CNTRLVAR  107
*
20510900    DELTEM  SUM  1.0  0.0  0
20510901    -574.0  1.0  CNTRLVAR  108
*-----
*          STEAM DUMP CONTROL
*-----
*          TURBINE TRIP
*-----
* STEAM DUMP SIGNAL BY TURBINE TRIP
*-----
* AUCTIONEERED TEMPERATURE LEAD LAG UNIT
*-----
20531100    DENOM SUM  1.0  1.0  0
20531101    1.0      0.5  CNTRLVAR  002
*
20531200    DT/2A   SUM  1.0  0.0  0
20531201    0.0      0.5  CNTRLVAR  002
*
20531300    VV      SUM  1.0  0.0  0
20531301    0.0      3.0  CNTRLVAR  109  1.0  CNTRLVAR  326
*

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20531400 VV1 SUM 1.0 0.0 0
20531401 0.0 1.0 CNTRLVAR 324 1.0 CNTRLVAR 109
*
20531500 V-YO SUM 1.0 0.0 0
20531501 0.0 1.0 CNTRLVAR 314 -1.0 CNTRLVAR 325
*
20531600 NUMER MULT 1.0 0.0 0
20531601 CNTRLVAR 312 CNTRLVAR 315
*
20531700 NUMERT SUM 1.0 0.0 0
20531701 0.0 1.0 CNTRLVAR 313 1.0 CNTRLVAR 316
*
20531800 LEADLAG DIV 1.0 0.0 0
20531801 CNTRLVAR 311 CNTRLVAR 317
*
20531900 VVV SUM 1.0 0.0 0
20531901 0.0 1.0 CNTRLVAR 324 1.0 CNTRLVAR 109
*
20532000 YY SUM 1.0 0.0 0
20532001 0.0 -1.0 CNTRLVAR 318 -1.0 CNTRLVAR 325
*
20532100 DEL SUM 1.0 0.0 0
20532101 0.0 1.0 CNTRLVAR 319 1.0 CNTRLVAR 320
*
20532200 DELI MULT 1.0 0.0 0
20532201 CNTRLVAR 321 CNTRLVAR 312
*
20532300 I1 SUM 1.0 0.0 0
20532301 0.0 1.0 CNTRLVAR 326 1.0 CNTRLVAR 322
*
20532400 VO MULT 1.0 0.0 0
20532401 CNTRLVAR 109
*
20532500 YO MULT 1.0 0.0 0
20532501 CNTRLVAR 318
*
20532600 IO MULT 1.0 0.0 0
20532601 CNTRLVAR 323
*
20532700 LEADAUC SUM 1.0 574.0 0
20532701 574.0 1.0 CNTRLVAR 318
*
-----
* REFERENCE AVERAGE TEMPERATURE
*
-----
20533100 TAV TRIPUNIT 1.0 0.0 0
20533101 588
*
20533200 TAVER SUM 1.0 574.0 0
20533201 574.0 -27.0 CNTRLVAR 331
*
-----

```

* TEMPERATURE ERROR (BROKEN LOOP)

20534100 TEMERR SUM 0.037037 0.0 0 3 0.0 1.0
 20534101 0.0 1.0 CNTRLVAR 327 -1.0 CNTRLVAR 332

* FACTOR TO DETERMINE STEAM DUMP FLOWRATE

20534200 STM-P MULT 1.45037E-4 805.0 0
 20534201 P 700010000

20534300 DELP SUM 1.26534E-3 1.0 0
 20534301 -14.7 1.0 CNTRLVAR 342

20534400 DELPFNC STDFNCTN 1.0 1.0 0
 20534401 SQRT CNTRLVAR 343

20534500 FACTOR MULT 1.0 0.0 0 3 0.0 1.0
 20534501 CNTRLVAR 341 CNTRLVAR 344

* LAG= 20.0 SEC OF T-COLD OR T-HOT / LOOP A AND B

20540100 TCOLDA LAG 1.0 557.0 1
 20540101 20.00 TEMPF 120010000
 20540200 TCOLDB LAG 1.0 557.0 1
 20540201 20.00 TEMPF 220010000
 20540300 THOT-A LAG 1.0 583.0 1
 20540301 20.00 TEMPF 101010000
 20540400 THOT-B LAG 1.0 583.0 1
 20540401 20.00 TEMPF 201010000

* COMPONENT 703: STEAM DUMP VALVE

7030000 DUMP-V TMDPJUN
 7030101 700010000 704000000 5.585
 7030200 1 592 CNTRLVAR 345
 7030201 0.0 0.0 0.0 0.0
 7030202 1.0 0.0 834.56 0.0

* COMPONENT 704: CONDENSER

7040000 CONDEN TMDPVOL
 7040101 1.0 0.0 100.0 0.0 0.0 0.0 00
 7040200 2
 7040201 1.0 14.7 1.0

* REACTIVITY DATA

* TOTAL POWER VS. TIME

* SCRAM TABLE

* DENSITY REACTIVITY TABLE

* 30000501	DENSITY	REACTIVITY (DOLLAR)		
30000501	42.2817	-1.700		
30000502	42.9136	-1.198		
30000503	43.7370	-0.599		
30000504	44.4981 0.0 44.5070	0.000	44.5159	0.0
30000505	44.6939	0.150		
30000506	44.7028	0.291		
30000507	45.0544	0.396		
30000508	45.2325	0.484		
30000509	45.4060	0.564		
30000510	45.5796	0.643		
30000511	45.7532	0.722		
30000512	45.9179	0.802		
30000513	46.0870	0.872		
30000514	46.2517	0.942		
30000515	46.4119	1.013		
30000516	46.5721	1.075		
30000517	46.7324	1.127		
30000518	46.8881	1.145		
30000519	49.4517	2.037		
30000520	53.9692	3.358		
30000521	57.4496	4.018		
30000522	60.1601	4.415		
30000523	62.0116	4.767		
*30000501	0.95	0.000		
*30000502	1.00	0.000		
*30000503	1.39	0.000		
**				
30000701	335010000	0	0.3333	0.
30000702	335020000	0	0.3334	0.
30000703	335030000	0	0.3333	0.

* DOPPLER REACTIVITY TABLE

* 30000601	TEMPERATURE (FUEL)	REACTIVITY (DOLLAR)
30000601	545.	2.13
30000602	586.5	2.00
30000603	628.0	1.95
30000604	669.5	1.74
30000605	711.0	1.62
30000606	752.5	1.48
30000607	794.0	1.37
30000608	835.5	1.25
30000609	877.0	1.13
30000610	918.5	1.02
30000611	960.0	0.92
30000612	1001.0	0.82
30000613	1043.0	0.72

30000614	1084.5	0.62
30000615	1126.0	0.53
30000616	1167.5	0.43
30000617	1209.0	0.33
30000618	1250.5	0.19
30000619	1292.0	0.16
30000620	1333.5	0.07
30000621	1375.0	0.00
30000622	1400.0	-0.04
30000623	1500.0	-0.21
30000624	1600.0	-0.69
*30000601	545.0	0.00
*30000602	1375.0	0.00
*30000603	1600.0	0.00

30000801	3330001	0	0.3333	0.
30000802	3330002	0	0.3334	0.
30000803	3330003	0	0.3333	0.

*-----
* HEAT STRUCTURE THERMAL PROPERTY DATA
*-----

*-----
* COMPOSITION TYPE AND DATA FORMAT
*-----

20100100	TBL/FCTN	1	1	* CORE FUEL
20100200	TBL/FCTN	1	1	* CORE FUEL GAP
20100300	TBL/FCTN	1	1	* CORE FUEL CLADDING
20100400	TBL/FCTN	1	1	* INCONEL
20100500	TBL/FCTN	1	1	* STAINLESS STEEL
20100600	TBL/FCTN	1	1	* CARBON STEEL

*-----
* THERMAL CONDUCTIVITY DATA (BTU/SEC-FT/DEG F) AND
* VOLUMETRIC HEAT CAPACITY DATA (BTU/FT**3-DEG F)
*-----

*-----
* CORE FUEL
*-----

*-----	TEMP	THERMAL CONDUCTIVITY
20100101	188.6	1.284E-3
20100102	332.6	1.1235E-3
20100103	440.6	9.951E-4
20100104	500.0	9.2806E-4
20100105	650.0	7.4194E-4
20100106	800.0	7.4361E-4
20100107	950.0	6.7750E-4
20100108	1100.0	6.2278E-4
20100109	1250.0	5.7722E-4
20100110	1400.0	5.3889E-4
20100111	1500.0	5.0639E-4
20100112	1700.0	4.7889E-4

20100113	1850.0	4.5528E-4
20100114	2000.0	4.3556E-4
20100115	2150.0	4.1861E-4
20100116	2300.0	4.0472E-4
20100117	2450.0	3.9306E-4
20100118	2600.0	3.8389E-4
20100119	3100.0	3.6750E-4
20100120	3600.0	3.7028E-4
20100121	4100.0	3.9056E-4
20100122	4600.0	4.2722E-4
20100123	5100.0	4.8056E-4

*
* TEMP HEAT CAPACITY
*

20100151	32.0	34.45
20100152	122.0	38.35
20100153	212.0	40.95
20100154	392.0	43.55
20100155	752.0	46.80
20100156	2012.0	51.35
20100157	2732.0	52.65
20100158	3092.0	56.55
20100159	3452.0	63.05
20100160	3812.0	72.80
20100161	4352.0	89.70
20100162	4532.0	94.25
20100163	4712.0	98.15
20100164	4892.0	100.10
20100165	5144.0	101.40
20100166	8000.0	101.40

*-----
* CORE FUEL GAP *
*-----
*
* TEMP THERMAL CONDUCTIVITY
*

20100201	32.0	3.0487788E-4
20100202	5400.0	3.0487788E-4

*
* TEMP HEAT CAPACITY
20100251 32.0 0.000075
20100252 5400.0 0.000075
*-----

* FUEL CLADDING *
*-----
*
* TEMP THERMAL CONDUCTIVITY
*

20100301	32.0	1.9267E-3
20100302	392.0	1.9267E-3

20100303	752.0	2.2478E-3
20100304	1112.0	2.7297E-3
20100305	1472.0	3.0508E-3
20100306	1832.0	3.5325E-3
20100307	2192.0	4.0142E-3
20100308	2552.0	4.8169E-3
20100309	2912.0	5.7803E-3
20100310	3272.0	7.0647E-3
20100311	3632.0	8.8311E-3
20100312	3992.0	1.0918E-3

*

*

*

	TEMP	HEAT CAPACITY
20100351	0.0	28.392
20100352	1480.3	34.476
20100353	1675.0	85.176
20100354	1787.5	34.370
20100355	3500.0	34.476

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INCONEL

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TEMP

THERMAL CONDUCTIVITY

20100401	32.0	2.1167E-3
20100402	1050.0	4.0394E-3

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STAINLESS STEEL

*

TEMP

THERMAL CONDUCTIVITY

20100501	32.0	2.0833E-3
20100502	1700.0	4.0294E-3
20100503	10000.0	4.0294E-3

*

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*

TEMP

HEAT CAPACITY

20100551	200.0	57.114
20100552	300.0	59.118
20100553	400.0	61.122
20100554	500.0	63.126
20100555	600.0	64.629

20100556	700.0	66.130
20100557	800.0	67.134
20100558	1000.0	69.138
20100559	2000.0	80.160
20100560	10000.0	80.160

* CARBON STEEL *

	TEMP	THERMAL CONDUCTIVITY
20100601	80.0	0.01126
20100602	440.33	0.01009
20100603	800.33	0.00908
20100604	1160.33	0.00824
20100605	1520.33	0.00756
20100606	1880.33	0.00705
20100607	2240.33	0.00670
20100608	2600.33	0.00652
20100609	2960.33	0.00649

	TEMP	HEAT CAPACITY
20100651	80.0	57.29
20100652	200.03	57.29
20100653	1600.07	82.04
20100654	2600.33	104.71
20100655	2960.33	112.49

* PUMP INPUT DATA *

	CURVE TYPE	CURVE REGIME	HAN
1141100	1	1	
*	V/A	H/A2	
1141101	0.0	1.75	
1141102	0.05	1.71	
1141103	0.2	1.61	
1141104	0.4	1.36	
1141105	0.6	1.27	
1141106	0.8	1.24	
1141107	1.0	1.00	
*	TYPE	REGIME	BAN
1141200	2	1	
*	V/A	B/A2	
1141201	0.0	0.95	
1141202	0.05	0.95	
1141203	0.2	0.95	
1141204	0.4	0.95	
1141205	0.6	0.97	

1141206	0.8	1.02	
1141207	1.0	1.0	
*	TYPE	REGIME	HVN
1141300	1	2	
*	A/V	H/V2	
1141301	0.0	-1.55	
1141302	0.05	-1.46	
1141303	0.1	-1.37	
1141304	0.2	-1.13	
1141305	0.4	-0.65	
1141306	0.54	-0.3	
1141307	0.58	-0.2	
1141308	0.64	-0.05	
1141309	0.66	0.0	
1141310	0.68	0.05	
1141311	0.8	0.35	
1141312	0.9	0.65	
1141313	1.0	1.0	
*	TYPE	REGIME	BVN
1141400	2	2	
*	A/V	B/V2	
1141401	0.0	-1.46	
1141402	0.05	-1.3	
1141403	0.1	-1.15	
1141404	0.2	-0.87	
1141405	0.4	-0.4	
1141406	0.54	-0.05	
1141407	0.58	0.03	
1141408	0.64	0.15	
1141409	0.66	0.2	
1141410	0.68	0.25	
1141411	0.8	0.54	
1141412	0.9	0.75	
1141413	1.0	1.0	
*	TYPE	REGIME	HAD
1141500	1	3	
*	V/A	H/A2	
1141501	-1.0	4.25	
1141502	-0.8	3.58	
1141503	-0.6	3.02	
1141504	-0.4	2.50	
1141505	-0.2	2.05	
1141506	-0.05	1.8	
1141507	0.0	1.75	
*	TYPE	REGIME	BAD
1141600	2	3	
*	V/A	B/A2	
1141601	-1.0	3.10	
1141602	-0.8	2.5	
1141603	-0.6	1.92	

1141604	-0.4	1.38	
1141605	-0.2	1.16	
1141606	-0.05	0.95	
1141607	0.0	0.95	
*	TYPE	REGIME	HVD
1141700	1	4	
*	A/V	H/V2	
1141701	-0.8	3.58	
1141702	-0.6	2.95	
1141703	-0.4	2.4	
1141704	-0.2	1.95	
1141705	-0.1	1.75	
1141706	-0.05	1.70	
1141707	0.0	1.65	
*	TYPE	REGIME	BVD
1141800	2	4	
*	A/V	B/V2	
1141801	-0.8	2.55	
1141802	-0.6	2.09	
1141803	-0.4	1.75	
1141804	-0.2	1.55	
1141805	-0.1	1.5	
1141806	-0.05	1.49	
1141807	0.0	1.48	
*	EXTRAP INDIC		
1143000	0		
*	VOID FRACTION	HEAD MULT.	
1143001	0.0	0.0	
1143002	0.15	0.0	
1143003	0.2	0.3	
1143004	0.4	0.8	
1143005	0.45	1.0	
1143006	0.8	1.0	
1143007	0.9	0.8	
1143008	1.0	0.0	
*			
*	EXTRAP.INDIC		
1143100	0		
*	VOID	TORQUE MULT.	
1143101	0.0	0.0	
1143102	0.3	0.0	
1143103	0.4	0.4	
1143104	0.5	1.0	
1143105	0.8	1.0	
1143106	0.9	0.8	
1143107	1.0	0.0	
*			
*	TYPE	REGIME	HAN
1144100	1	1	
*	V/A	H/A2	

1144101	0.0	1.0	
1144102	0.03	1.0	
1144103	0.2	1.11	
1144104	0.4	1.06	
1144105	0.6	1.07	
1144106	0.8	1.08	
1144107	1.0	0.9	
*	TYPE	REGIME	HVN
1144200	1	2	
*	A/V	H/V2	
1144201	0.0	0.0	
1144202	0.1	0.05	
1144203	0.2	0.17	
1144204	0.4	0.25	
1144205	0.6	0.25	
1144206	0.66	0.26	
1144207	0.8	0.3	
1144208	0.9	0.58	
1144209	1.0	0.9	
*	TYPE	REGIME	BAN
1144300	2	1	
*	V/A	B/A2	
1144301	0.0	0.55	
1144302	0.4	0.55	
1144303	0.6	0.52	
1144304	0.8	0.52	
1144305	1.0	0.45	
*	TYPE	REGIME	BVN
1144400	2	2	
*	A/V	B/V2	
1144401	0.0	0.0	
1144402	0.2	0.03	
1144403	0.4	0.04	
1144404	0.6	0.07	
1144405	0.66	0.08	
1144406	0.8	0.14	
1144407	1.0	0.45	

 * SEMISCALE TWO PHASE DIFFERENCE CURVES FOR HAD HVD BAD BND *

*	TYPE	REGIME	HAD
1144500	1	3	
*	V/A	V/A2	
1144501	-1.0	-1.16	
1144502	-0.9	-1.24	
1144503	-0.8	-1.77	
1144504	-0.7	-2.36	
1144505	-0.6	-2.79	
1144506	-0.5	-2.91	
1144507	-0.4	-2.67	

1144508	-0.25	-1.69	
1144509	-0.1	-0.5	
1144510	0.0	0.0	
*	TYPE	REGIME	HVD
1144600	1	4	
*	A/V	H/V2	
1144601	-1.0	-1.16	
1144602	-0.9	-0.78	
1144603	-0.8	-0.5	
1144604	-0.7	-0.31	
1144605	-0.6	-0.17	
1144606	-0.5	-0.08	
1144607	-0.35	0.0	
1144608	-0.2	0.05	
1144609	-0.1	0.08	
1144610	0.0	0.11	
*	TYPE	REGIME	BAD
1144700	2	3	
*	V/A	B/A2	
1144701	-1.0	0.62	
1144702	-0.8	0.68	
1144703	-0.6	0.53	
1144704	-0.4	0.46	
1144705	-0.2	0.49	
1144706	0.0	0.54	
*	TYPE	REGIME	BVD
1144800	2	4	
*	A/V	B/V2	
1144801	-1.0	0.62	
1144802	-0.8	0.53	
1144803	-0.6	0.46	
1144804	-0.4	0.42	
1144805	-0.2	0.39	
1144806	0.0	0.36	

* TERMINATION CARD

* PLOT DATA

20300100	P	185010000	* S/G A PRESS.
20300200	P	285010000	* S/G B PRESS.
20300300	CNTRLVAR	57	* S/G A WIDE RANGE LEVEL
20300400	CNTRLVAR	67	* S/G B WIDE RANGE LEVEL
20300500	CNTRLVAR	58	* S/G A NARROW RANGE LEVEL
20300600	CNTRLVAR	68	* S/G B NARROW RANGE LEVEL
20300700	MFLOWJ	184000000	* S/G A FEED FLOW
20300800	MFLOWJ	284000000	* S/G B FEED FLOW
20300900	MFLOWJ	185010000	* S/G A STEAM FLOW
20301000	MFLOWJ	285010000	* S/G B STEAM FLOW
20301100	P	620010000	* PZR PRESS.

20301200 CNTRLVAR 121
 20301300 TEMPF 120010000
 20301400 TEMPF 220010000
 20301500 CNTRLVAR 101
 20301600 CNTRLVAR 102
 20301700 RKTPOW 0
 20301800 MFLOWJ 182000000
 20301900 P 700010000
 20302000 MFLOWJ 701000000
 20302100 MFLOWJ 703000000
 20302200 MFLOWJ 191000000
 20302300 MFLOWJ 291000000
 20302400 MFLOWJ 120020000
 20302500 MFLOWJ 220020000
 20302600 TEMPF 101010000
 20302700 TEMPF 201010000
 20302800 CNTRLVAR 401
 20302900 CNTRLVAR 402
 20303000 CNTRLVAR 403
 20303100 CNTRLVAR 404
 * TERMINATION CARD

* PZR LEVEL (%)
 * LOOP-A T-COLD
 * LOOP-B T-COLD
 * LOOP-A T-AVG
 * LOOP-B T-AVG
 * POWER
 * AUX. FEEDWATER FLOW
 * STEAM HEADER PRESSURE
 * STEAM FLOW TO TURBINE
 * STEAM DUMP FLOW
 * S/G A PORV
 * S/G B PORV
 * LOOP-A RCS FLOW
 * LOOP-B RCS FLOW
 * LOOP-A T-HOT
 * LOOP-B T-HOT
 * LOOP-A T-COLD
 * LOOP-B T-COLD
 * LOOP-A T-HOT
 * LOOP-B T-HOT

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10. SUPPLEMENTARY NOTES

11. ABSTRACT (200 words or less)

This report presents a code assessment study based on a real plant transient that occurred on June 9, 1981 at the KNU #1 (Korea Nuclear Unit Number 1). KNU #1 is a two-loop Westinghouse PWR plant of 587 Mwe. The Loss of offsite power transient occurred at the 77.5% reactor power with 0.5 %/hr power ramp. The real plant data were collected from available on-line plant records and computer diagnostics.

The transient was simulated by RELAP5/MOD2/36.05 and the results were compared with the plant data to assess the code weaknesses and strengths. Some nodalization studies were performed to contribute to developing a guideline for PWR nodalization for the transient analysis.

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