NUREG/IA-0005

International Agreement Report

Assessment of RELAP5/MOD 2, Cycle 36, Against FIX-II Split Break Experiment No. 3027

Prepared by
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Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
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Prepared as part of
The Agreement on Research Participation and Technical Exchange
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John Eriksson

Swedish Nuclear Power Inspectorate

ICAP
Assessment of RELAP5/MOD2, Cycle 36, Against FIX-II Split Break Experiment No 3027

ABSTRACT

The FIX-II split break experiment No. 3027 has been analyzed using the RELAP5/Mod2 code. The code version used, Cycle 36, is a frozen version of the code.

Four different prediction calculations were carried out to study the sensitivity on various parameters to changes of break discharge, initial coolant mass, and passive heat structures. The differences between the calculations and the experiment have been quantified over intervals in real time for a number of variables available from the measurements during the experiment.

The core inventory expressed by the differential pressure over the core was generally underpredicted. Dryout times were generally overpredicted, probably due to differences in the used dryout correlation.

Approved by- Eric Hellstrand

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APPENDICES

1. INTRODUCTION

There is a growing interest in modifying existing rules for reactor licensing and safety thermal-hydraulic calculation away from those stated in Appendix K (1) towards procedures based on best estimate types of calculations. Although Appendix K furnishes a set of skillfully and simply phrased rules, its present and inherent conservatism on safety has been partly regarded as in growing contradiction to the increasing knowledge gained from experimental programs. The many advanced best estimate thermal-hydraulic reactor codes in existence today demonstrate this.

When the simply formulated older calculation rules were replaced by best estimate type calculation procedures another measure of reliability had to be found to replace the earlier conservatism. To intentionally fulfill that aspect of a code the natural course will be an assurance of a reasonable reliability of the predicted data. Plans for conducting code assessments for the purpose of determining the accuracy and the validity of advanced LWR system codes were proposed some years ago (2). Today the International Code Assessment Program (ICAP) is in progress, under the auspices of the USNRC (3).

The calculations presented in this report is a Swedish contribution to the ICAP. The contribution is funded by the Swedish Nuclear Power Inspectorate.

In the present study the frozen version of RELAP5/MOD2 is assessed against LOCA experiment No. 3027, carried out the FIX-II test facility at Studsvik. The experiment is one of a test series, see Table 1, conducted in 1984. This test was conducted to check the reproducibility of Test 3025, which had been used as a "double-blind" international standard problem (ISP-15).

A description of the test facility and this particular test is provided in Chapter 2. A description of the input model is given in Chapter 3. The base case and sensitivity calculations are discussed in Chapters 4 and 5. Run statistics are given in Chapter 6. General conclusions are drawn in Chapter 7.

Appendix A contains the complete input lists. The data comparison plots are inclided in Appendix B. Finally, results of the statistical analyses of differences between experiment and predictions for discrete time intervals are included in Appendix C.

2. FACILITY AND TEST DESCRIPTION

The FIX-II integral test facility was completed at the end of 1981. It is run by Studsvik Energiteknik AB under contract to the Swedish Nuclear Power Inspectorate. The experimental program comprises investigations of the fuel-to-coolant heat transfer. Various blow-down and pump trip situations conceivable in Swedish BWR's are simulated.

2.1 Test facility

The test facility itself, which is assumed to be stripped from gear not involved in the present experiment, is shown in Figure 1. The volume scaling is 1:777 of the Oskarshamn-II reactor, which is of the ASEA-ATOM external recirculation pump design. An exhaustive description of the FIX-II test facility may be obtained from Ref 4, which also provides additional references where various problems pertaining to the construction period are discussed. Therefore, only some fundamental aspects of the facility will be presented here.

The core model involves a full length rod bundle, which in the geometry is closely related to a fuel element of the ASEA-ATOM design and electrically heated by DC. Here, however, there are only 6 x 6 rod simulators instead of the 8 x 8 rods in a fuel element. Figures 2 and 3a show details from the core simulator design. As seen, filler bodies are placed between the square-section fuel channel and the circular-section pressure vessel to reduce the water-filled volume, which otherwise may influence the test by the leakage of steam to the upper plenum. The water surrounding the fillers is externally recirculated and cooled by 200 to 250 kW.

The upper part of the pressure vessel, Figure 3b, holds the steam separator and the steam condenser volume with its three sprinklers. During steady state power operation the steam outlet is closed. The turbine power is modelled by the partial circulation of water from the downcomer through an external 6 MW cooler with feedback to the sprinklers of the steam condenser and into the upper part of the downcomer. The flow rate in the two branches with cooled water is adjusted to control the pressure and the inlet subcooling. The remaining downcomer flow, representing the recirculation coolant flow in the reference reactor, splits at the lower downcomer end into two loops. One loop represents three of the intact recirculation lines of the reference reactor, while the other loop, representing a fourth recirculation line, incorporates the break devices. Both loops have a recirculation pump. The intact loop pump speed is regulated according to a predetermined speed history.

The FIX-II has, as part of the core model, an external bypass simulator through which about 12 % of the recirculation mass flow branches out through a regulation valve. This bypass is heated separately to represent the channel wall heat transfer. At the lower end of the bypass, Figure 3c, there is a stagnant water volume to simulate the reference reactor area for the control rod guide tubes.

Since the FIX-II facility has been designed for blowdown experiments only, no emergency core cooling equipment is installed.

The data collection system is constructed around a signal processor controlling 192 measurement channels. The selection of measurements is made in a signal exchange terminal. A multipurpose minicomputer transfers the raw-data of measured parameters to a magnetic tape. From this tape, the final analysis at the central computer gives the desired tables and plots from an experiment. The data acquisition system includes measurements to obtain:

- pressures (PT)
- differential pressures (dPT)
- temperatures of fluids (TE)
- mass flow (dPT, PT, TE)
- electric currents (I) and voltages (U)
- pump speeds (nT)
- water level positions (CE)
- valve positions

at places shown in the instrumentation diagram, Figure 4.

For recording clad temperatures there were about 100 thermocouples engaged at 16 axial levels of the heated length in the 36-rod bundle.

2.2 The experiment

The preparation of the experiment is initiated several hours before the actual experiment. For the heat-up of the facility, a 200 kW preheater is involved for a period lasting about 5 h. The recirculation pumps are running during this period too. Initial conditions are then established by switching the power supplies to the bundle and the bypass with the 6 MW cooler and the condenser spray in operation. The preheater is now disconnected. For about 10 to 30 minutes, the electric power to the rod bundle and the bypass heating is gradually increased until the initial test conditions are reached. Necessary calibrations are made, and once the equilibrium conditions are finally approved, the sequency control equipment is activated for break opening, valve manoeuvres, power reduction, pump speed changes and so forth, according to a programmed scheme for the test. For the split break test No. 3027, the transient ends 85 s after opening of the break.

In the present FIX-II experiment, the speed of the pump on the intact recirculation line decreased from the break time to about 20 % of the initial speed at end of the transient. The speed of the broken recirculation line pump was not adjusted.

The break flow escaping through the fast opening break valve, Figure 1, is discharged into the receiving tank, T2. Initially, the tank is partly filled with cold water for efficient pool condensation of the break flow.

The split break assembly consists of a T-piece on the line from pump P2 to the lower plenum. A break flow limiting orifice, downstream of the break isolation valve, consists of an exchangeable conical inlet part followed by a restriction pipe. In experiment No. 3027, the restriction pipe and flange diameter was 12 mm corresponding to a 31 % area of one recirculation line.

Apart from the heat removal from the filler body space, see Chapter 2.1, some 100 kW are also lost by the non-perfect insulation encapsulating the recirculation lines and the pressure vessel. The magnitude of the steady state heat losses was one argument for not performing experiments with very small break areas at FIX-II. For BWR plants, the break size used is more interesting than small leakages.

The main measured parameters for the steady state before break are reproduced from Ref 3 in Table 4. The test performance chronology, related to the programming of the sequence control equipment, is given in Table 5.

Experimental raw data were collected for the whole period of the transient. However, internal flows were then only evaluated until about 30 s due to uncertainties expected with the two-phase flow rate measurements.

A summary of the main results (including event times, maximum cladding temperatures and some peak mass flows) is given in Table 6, see also Ref 5.

2.3 Measurement uncertainty

To obtain estimates for the accuracy of the measured data, test procedures were adapted within the experimental program. Probable errors and errors corresponding to a 95 % confidence level as derived from these tests are summarized in Table 2a. The probable errors of derived quantities, foremost mass flows, are given in Table 2b. The pump speeds are measured and controlled using a tachometer of a 1 r/s accuracy. The pump characteristics, on the other hand, were verified against the manufacturer's data for cold water single phase operation, however, no tests of an in-loop hot water performance were conducted (private comm L Nilsson).

3. CODE AND MODEL DESCRIPTIONS

The assessment calculation for the FIX-II experiment No. 3027 was done using the RELAP5/Mod 2, Cycle 36, code received at the beginning of February 1985. The descriptive document available for this code at the time of preparing the calculation input was the rather detailed code manual (7) also explicitly containing an input data requirements manual. The code features are discussed in Chapter 3.1.

Due to the close relation to the RELAP5/Mod1 code, which has been extensively used at STUDSVIK, an existing input for the FIX-II test No. 3025 (6, 8), the previous ISP-15 exercise, formed the basis for the present RELAP5/Mod2 input. Details of the input are discussed in Chapter 3.2. Here the steady state calculation is assumed to be part of the input preparation.

3.1 The Code Features

An extensive code description for the RELAP5/Mod2 is given in the Ref 7. The main characteristics of the code are summarized in Table 3.

Since the RELAP5/Mod2 code is primarily developed for pressure reactor application, the question arises whether some important features are missing from the code for a BWR-type application like the present FIX-II experiment. A key peculiarity in this respect, is the absence in the FIX-II facility of a core top spray cooling due to the fact that facility is designed for experiments until end of blow-down only. The steady state cooling, however, is accomplished by a cold water injection at the top of an internal condenser space above the core and the steam separator. The condenser space is voluminous; it results in about three quarters of the total system space being above the core top level. Thus, it is assumed that the condenser spray vaporizes without impact on the core behaviour during normal operation. Deficient sophistication in modelling droplet flows in RELAP5/Mod2 should, therefore, be far less important when predicting the present experiment than in the case of an experiment also including core cooling by refill and core top spray.

3.2 The calculation Input Model

The model geometry used in the present calculations is closely related to geometries used in several previous calculations for FIX-II experiments using previous RELAP5/Mod1 code versions (6 and 8). The nodalization diagram for the geometric modelling used is shown in Figure 5. Figures 6 and 7 account for the modelling in the geometry of the test facility.

To reproduce fundamental measured steady state quantities, see Table 4, the input for the steady state search run was modified by some additional components and regulating control systems:

I To obtain the steady state dome pressure, a time dependent volume outside of the opened steam relief valve was added. This volume had the experimentally measured dome pressure rather than the atmospheric outside pressure later during the transient.

II The speed of the pumps P1 and P2 was regulated using the RELAP5 control system to fulfill the measured mass flows.

III To branch off the correct mass flow into the core bypass, the junction from the lower plenum was modelled as a motor valve. By trip logic, the opening of that valve was regulated to give the experimental bypass mass flow. When entering into the transient calculation, the valve setting was logically latched.

IV The measured steam separator collapsed level was satisfied by connecting an auxiliary time dependent volume to the top of the steam separator. The connecting junction was modelled to regulate the collapsed level by water phase flow rate, depending on the level height error.

V The calculation was performed using the RELAP5/Mod2 steady-state option.

Evidently, some non-zero flows (points I and IV) will remain in the junctions from the pressure- and level regulating time dependent volumes. These flows are quite small and are influenced by the system heat balance.

The input for the steady state calculation is given in the Appendix A.

4. THE BASE CASE CALCULATION

The transient calculation of the base case (called Case A) was based on the restart-plot file obtained from the previously discussed steady state calculation. The additional components and regulators discussed in Chapter 3.2 were deleted, see the transient restart input in Appendix A.10. The calculation was performed under the transient calculation option. In addition, when verifying the quality of the steady state, the opening of the break was delayed.

The calculation of the transient itself was carried out without any particular problems. The smooth lapse of the CPU-time, Plot B.34 and of the computation mass error, Plot B.35, again indicate this.

4.1 Base case calculation results

A set of results from the base case calculation and the sensitivity calculations were selected to fulfil the requirement on assessment parameters given in Table 3 of Ref 3. Those parameters plotted are listed in the Table 8 and the corresponding plots reproduced in Appendix B. Since some of the parameters are not available from the experimental measurements, only the comparisons between the different calculations are shown in the plots, compare Table 8. As regards the mass flow comparisons, it must again be pointed out that the experimental data are not reliable after voiding has begun which for most measurement positions occurs about 20 s after the break time.

The system boundary conditions concerning the total mass inventory are the shutting of the spray flow and the feed water valves, which take place very soon after the break occurs. There is a good correlation between calculation and experiment in the mass flow rate through the steam relief valve, plot B.27. However, the break mass flow which in the experiment is measured by the increasing content of a flow receiving tank, plot B.30, has been obviously underestimated in the base case calculation. Plot B.29, where the experimental curve is derived from the receiving tank content, shows the same break flow underestimation from the calculation, particularly up to 30 s. Plot B.29 shows a pronounced peak in the measured mass flow during the very first seconds after the break on account of steam accumulating in the tubes leading from the break to the condenser receiving tank, where previously only water was present. This results in a measured superimposed volume equivalent to a water mass of about 20 kg from about 3 s from the end of the test. At the end of the test, the break valve is closed causing the receiving tank mass content to reduce with the superimposed steam volume, see Plot B.30. In the light of this correction to the total experimental break loss, the base case calculation underestimated the break loss by about 30 kg until end of the test. The calculated mass inventory in the system, Plot B.26, obviously has the opposite time elapse to that of the integrated break loss.

The thermal-hydraulic conditions in the system are also partly controlled by heat exchange with the core and other boundary structures. Plot B.3 shows the calculated heat exchange with all the passive wall structures in the loop except for the separate filler body space with a known cooling power of about 260 kW in steady state operation. As Plot B.3 shows, the heat returning from the passives does exceed the decay core heating from about 30 s on. Thereby, the structure wall thickness was generally selected at 0.09 times the tube inner diameter, also compensating for flanges and other extras.

System pressures, Plots B.20, B.21 and B.33 were well predicted over the whole transient for the base case. The cycling of the steam relief valve, compare Plot B.27, dominates the behaviour of the system pressure.

From the experiment, evaluated in-loop main recirculation flows are available at the bypass inlet, at the pressure sides of the two main pumps and also at the broken loop between break and vessel inlet, see Plots B.22, B.23, B.24 and B.25. Two additional measurements valid for in-loop mass flows are the differential pressures over the orifice in the steam separator, Plot B.17, and over the core inlet restriction, Plot B.2. As mentioned before, the mass flows evaluated from the experiment, i.e. plots B.22 through B.25, are not reliable after the formation of steam has started. On the plots, the time for initiating steam formation is clearly seen to range between 20 and 25 s as enhancing flow oscillations. Up to that time, the predicted base case flow rates essentially compare well with the measurements. The most conspicuous differences are that the mass flows at the broken loop pump and at the broken loop vessel inlet, plots B.24 and B.25, are underestimated in their magnitude thus showing an underestimation in the break flow.

Plots B.1, B.13 and B.28 show calculated fluid densities at the core bottom, at the reactor vessel bottom and upstream of the break. Fluid densities were not directly measured in the experiment.

Several fluid temperature measurements were carried out in the experiment. At the break, plot B.31, there is a good agreement between the base case calculation and the experiment, similarly also after about 15 s at the downcomer bottom, Plot B.19. The difference in the calculated and the experimental fluid temperatures at the downcomer bottom before 15 s is due to the amount of void. In the experiment, the measured two-phase level did not reach the downcomer bottom until about 13 s (5), see also Plot B.14. The temperatures at the core inlet, Plot B.10, at the core outlet, Plot B.11, and in the upper plenum, Plot B.18, all show underestimations in the calculation after some 50 s, although the system pressure compares well with the experiment. The calculated temperature is still typically that of saturation at the high void while in the experiment, slightly superheated pure steam fills the vessel.

The fluid inventories of the core, Plot B.12, the upper plenum, Plot B.16, the downcomer, Plot B.14, and of the lower plenum, Plot B.15, are compared in the quantity of differential pressures as directly measured in the experiment. The differential pressure over the core, Plot B.12, is underpredicted during the period between 2.3 and 12 s when the steam relief valve is closed. In the calculation, the main part of this differential pressure is due to the dynamic two-phase wall friction. As the core boundary mass flows compare reasonably well in the time interval, the difference in the core differential pressure is most likely caused by a strong wall friction dependance on the void fraction profile in the core. The differential pressure in the lower plenum, Plot B.15, is overpredicted in the base case after about 30 s. Comparison with Plot B.13 shows the dependance of the differential pressure on the fluid density at the bottom of the vessel.

The comparisons of the rod clad temperatures are done at the clad inner surface which is most closely equivalent to the thermocouple positions of the heated rods in the experiment. The rod calculated clad temperatures, Plots B.4 through B.9, agree reasonably well at various levels of the core with the measurements in the experiment until dryout conditions occur. Above the core midplane, levels 9, 12 and 15, the dryouts are predicted to occur definitely later than in the experiment. Actually, the calculated dryout of all levels was delayed until the void was .985 or higher. In RELAP5/Mod2 the critical heat flux is calculated according to a modified Zuber correlation using $1.-\alpha$ (α is the steam void) as a factor. This should be compared with the corresponding RELAP5/ Mod1 correlation using $.96-\alpha$ as a factor in the critical heat flux expression, also in a modified Zuber correlation. The delay in the outset of the calculated dryouts is probably a result of the critical heat flux correlation rather than of errors in the core voids.

5. SNESITIVITY RESULTS AND DISCUSSION

The base case calculation (Case A) compared well with the experiment on many parameters, however, in the important heater rod temperatures after dryout, a better prediction was desired. Consequently, with the aim of lowering the core void, the break discharge coefficient, having been .85 in the base case, was assumed to be 1.0 in a first sensitivity calculation, Case B. Actually, Plots B.5 through B.8 show a better agreement in the clad temperatures at the high power levels of the model rod. At the low power levels at the bottom and at the top of the core the comparison was no better. Looking at hydraulic quantities the differential pressure over the core, Plot B.12, the system pressure, Plot B.20, and the reversed broken loop cold leg flow at the vessel inlet, Plot B.25, changed for the worse. However, the most striking evidence that the increase of the break mass flow had been constructive was the far better agreement in the mass loss, Plot B.30.

A source of uncertainty regarding the experiment is the amount of initial fluid in the facility before the break. The water volume in the experiment was accounted for by the water level in the downcomer part of the steam condenser (5). In the steady state calculation, that same level had been satisfied using a regulating system for an auxilliary flow between the loop and a time dependent volume containing saturated water. Examination of data from other FIX-II tests indicated that the initial mass of about 285 Kg, obtained by leveling off the downcomer water level according to measurement, might be a lower limit of the mass in the system. Differences between the initial masses in the calculation and in the experiment arise from water in the spray, the feedwater, the cooling return lines and some additional short blind lines ending in valves which are closed in the experiment. The mass of water in those lines is estimated at about 4 kg. Another potential source of initial mass difference is the amount of liquid in droplet form in the steam condenser. Since the volume of the condenser is about .6 m^3, an actual void fraction of ~ .90 in the experiment instead of ~ .96 in the calculation means a mass difference of about 26 kg. Actually, the calculated droplet - water falling velocity of 1.2 M/s in the steady state is too high. According to the spray nozzle manufacturers specification, the spray mean droplet diameter at the actual water flow should be about .9 mm or some 1.0 mm after steam condensation. With this droplet size, the droplet falling velocity is only about .8 m/s relative to the upward velocity of steam of .2 m/s. The conclusion must be drawn that the calculation greatly underestimates the condenser water mass estimates. In a second sensitivity calculation, Case C, again with a discharge coefficient of 1.0, the calculating was done using an initial mass of 315 kg instead of 285 kg. Plot B.30 now shows a good agreement between the predicted break mass loss and the final experimental mass accumulated in the break receiver after closing the break. Fluid temperatures, Plots B.10, B.11, B.18, B.19 and B.31, which had worsened by the sole increase in the discharge coefficient in Case B, again agreed with the experiment in the Case C run. As a consequence, the same statement also applies to the system pressures, Plots B.20, B.21 and B.33.

On the other hand, the pressure drops in the downcomer and in the lower plenum, Plots B.14 and B.15, do indicate same overestimatation in the system fluid mass. The prediction of the heated rod clad temperatures remained the same as in the base case and the Case B calculation.

The amount heat returning from the passive structures, Plot B.3, is essential during the later part of the transient. Though the structure wall thicknesses were chosen by a simple rule of thumb, the structure modelling is believed to be reasonably reliable. To quantify the effect of the structure heat exchange on the system, a calculation, case D, was performed using the larger discharge coefficient and the larger initial mass but removing all passives. Fluid temperatures such as at the core inlet, Plot B.10, naturally decreased more rapidly towards the end of the transient. An interesting discovery is the close simliarity in the system pressure between calculation Case B and Case D. This similarity may be explained in terms of the system that is, if it is due to the heat structures or if it is due to an amount coolant that has been added itself. From about 30 s until the end of the transient, the heat returning from the structures was about 12 MWs, see Plot B.3. In the Case B calculation, Plot B.26 shows a decrease at the same time, of the calculated mass content from 110.5 to 35.2 kg. In case D, the decrease is from 132.5 to 50.75 kg. Reading the system pressures of 4.7 MPa at 30 s and 1.9 MPa at 75 s from Plot B.20 and using approximate changes in the enthalphy obtained from the water data, Case B shows about 11 MWs less enthalpy increase than Case D due to differences in mass content. This is close to the 12 MWs missing with the heat structures absent in the Case D calculation.

6. RUN STATISTICS

The transient calculation model used with the base case RELAP5/Mod2 prediction for the FIX-II test No. 3027 was modelled by:

58	volumes
60	junctions
70	heat structures

The volumes number includes two pump components and five time dependent volumes and among the junctions there are two valve components and four time dependent junctions.

The computer efficiency is summarized in Table 7 from the Major Edit print outs, see also Plot B.34. The table also gives the number of time step reductions from requested time steps forced by the current transport limit in the interval from the previous Major Edit. Actually the requested maximum time steps, as input values, were set high, thereby forcing the code to establish its own time steps.

The transient calculation needs were:

computer time	CPU = 828.3-118.1=710.2 s
number of time steps	DT = 972-200=782
number of volumes	C = 58
transient real time	RT = 75. s

from which also a code efficiency factor of

$$\frac{\text{CPU x } 10^3}{\text{C x DT}} = 15.7$$

is obtained, compare Ref 3. The computer used was a Cyber 180-835.

7. CONCLUSIONS

The calculation for the FIX-II No. 3027 split break and a calculation for the LOBI ISP-18 test carried out at the same time, were the first assessments done at Studsvik using the RELAP5/Mod2 code. As a lot of experience on preceeding RELAP codes had already been gained there were no particular problems in getting along with the RELAP5/Mod2. The difficulty with problems in a calculation like this, lies in making sure that the specifications for the two thousand lines of input are as correct as possible.

Although the results may seem to be credable from the calculations, there are some parameters which do cast doubt on the prediction quality. A key parameter among these being the pressure difference over the core which was underestimated. This example also emphasizes the problem of reading the information of coolant mass distribution in the experiment. In the experiment there were no in-system void measurements and the orifice mass flow measurements were also unreliable after flashing had begun. The cause of the lack of agreement in the core head therefore remains undetermined.

Important differences between experimental and calculated dryout times at various elevations were noted. This could have beed caused by inability to predict the core inventory or by an inadequate dryout correlation. It is noted that dryout was calculated only for very high void fractions. It might therefore be suspected that the discrepancies are mainly caused by the dryout correlation.

In the present calculation, the RELAP5/Mod2 code was not faced with a core top spray. However, the condenser in-loop spray cooling caused trouble because the code is only capable of describing the condenser hydraulics by using the vertical slug flow regime available. Because of this the water content in the condenser was underestimated by a factor of about two.

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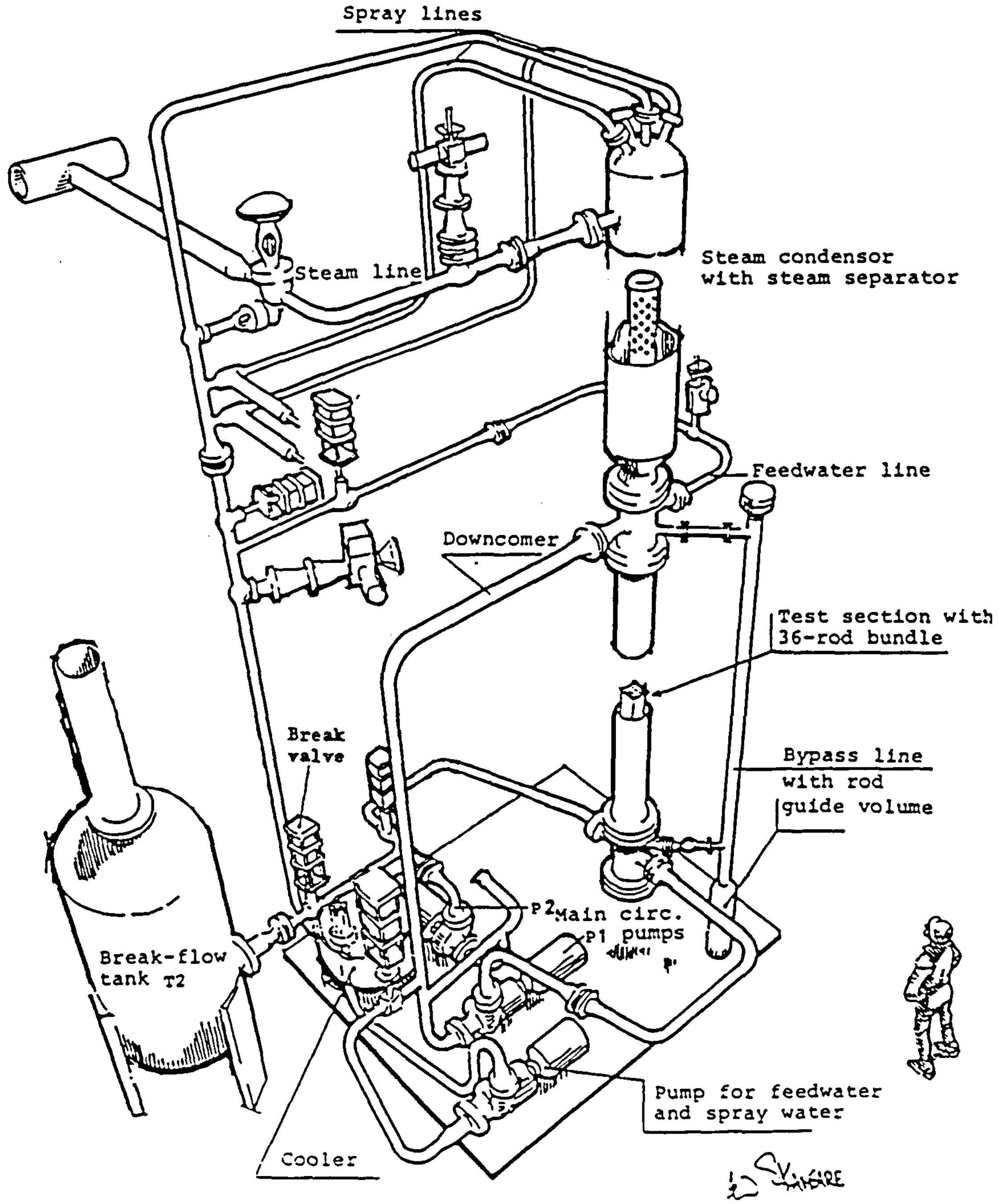
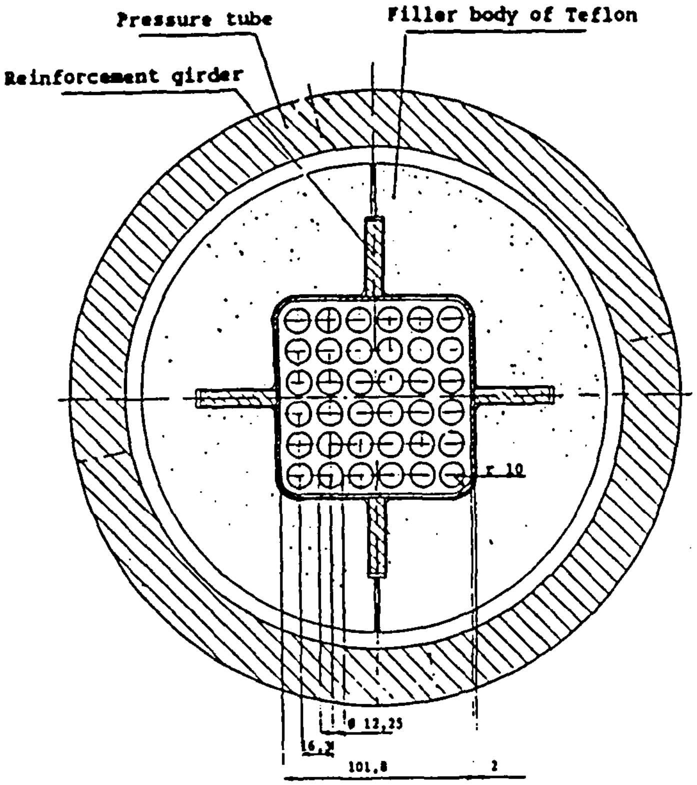


Figure 1

View of the FIX-II facility, condition for split break experiments.



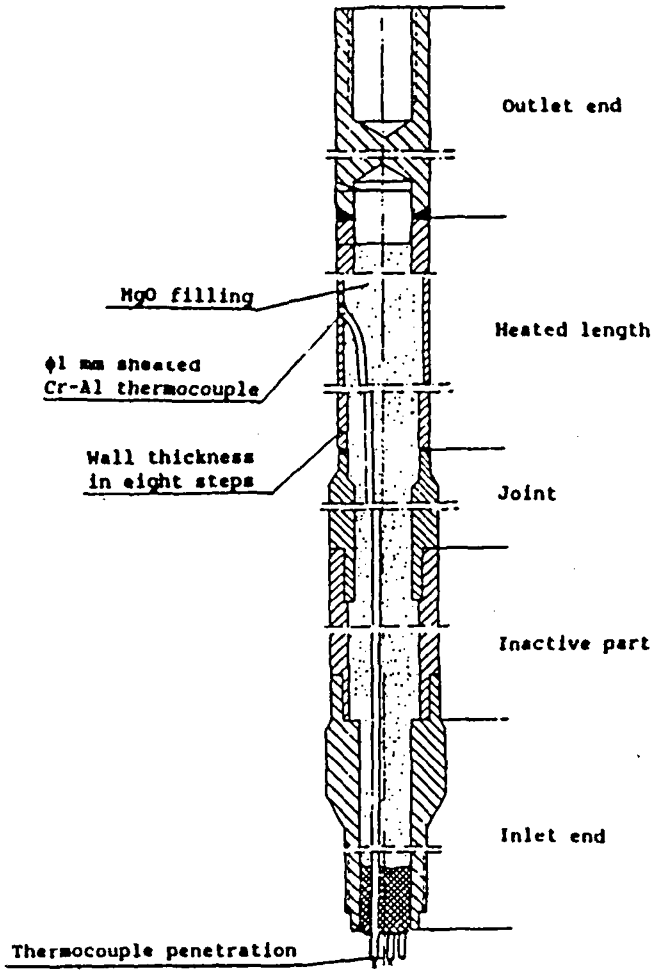


Figure 2.A

Cross section of pressure vessel and rod bundle

Figure 2.B

Design of a fuel rod simulator

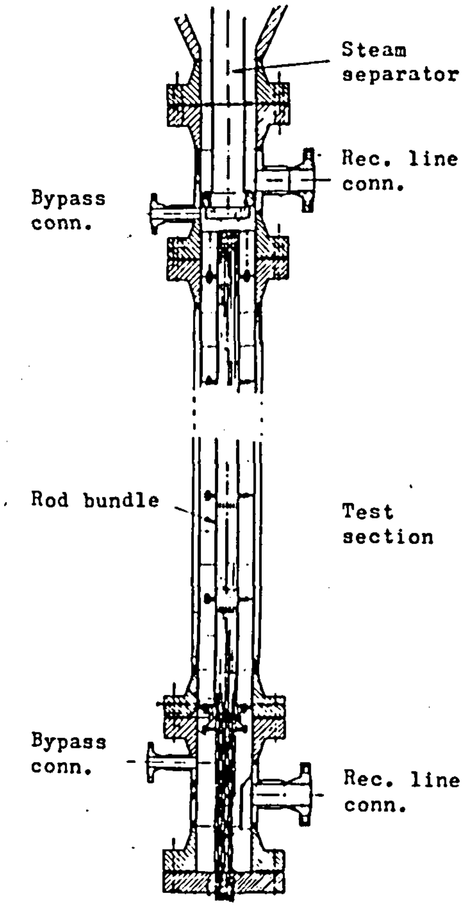


Figure 3.A

Lower plenum and core region

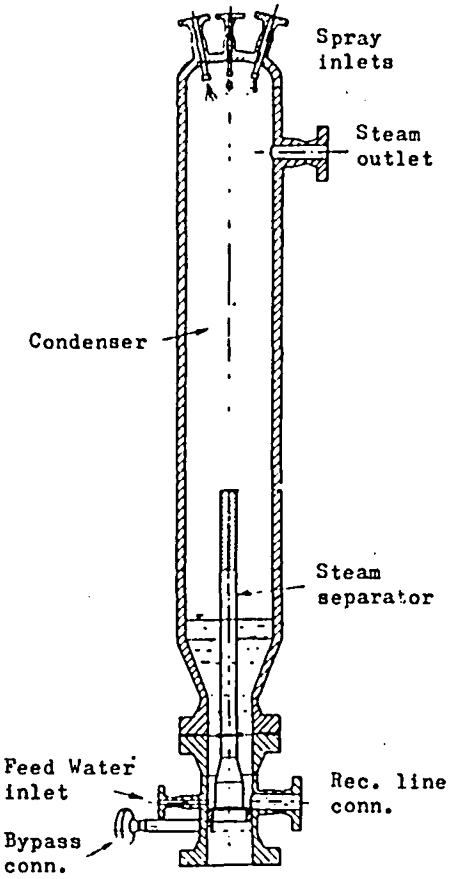


Figure 3.B

Steam separator and steam condenser

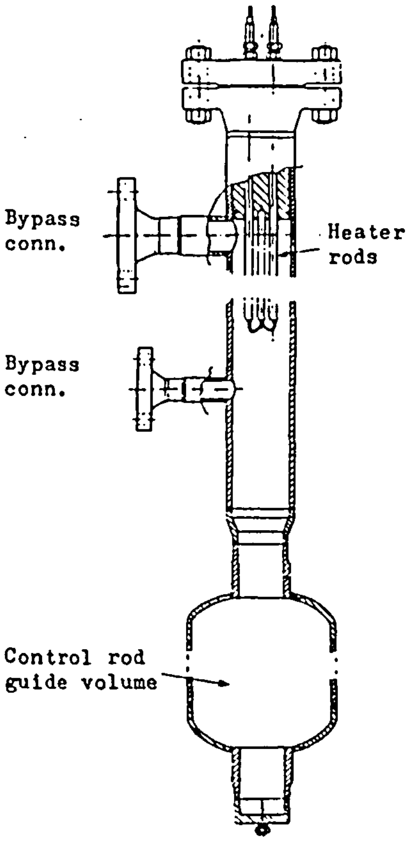


Figure 3.C

The external core bypass

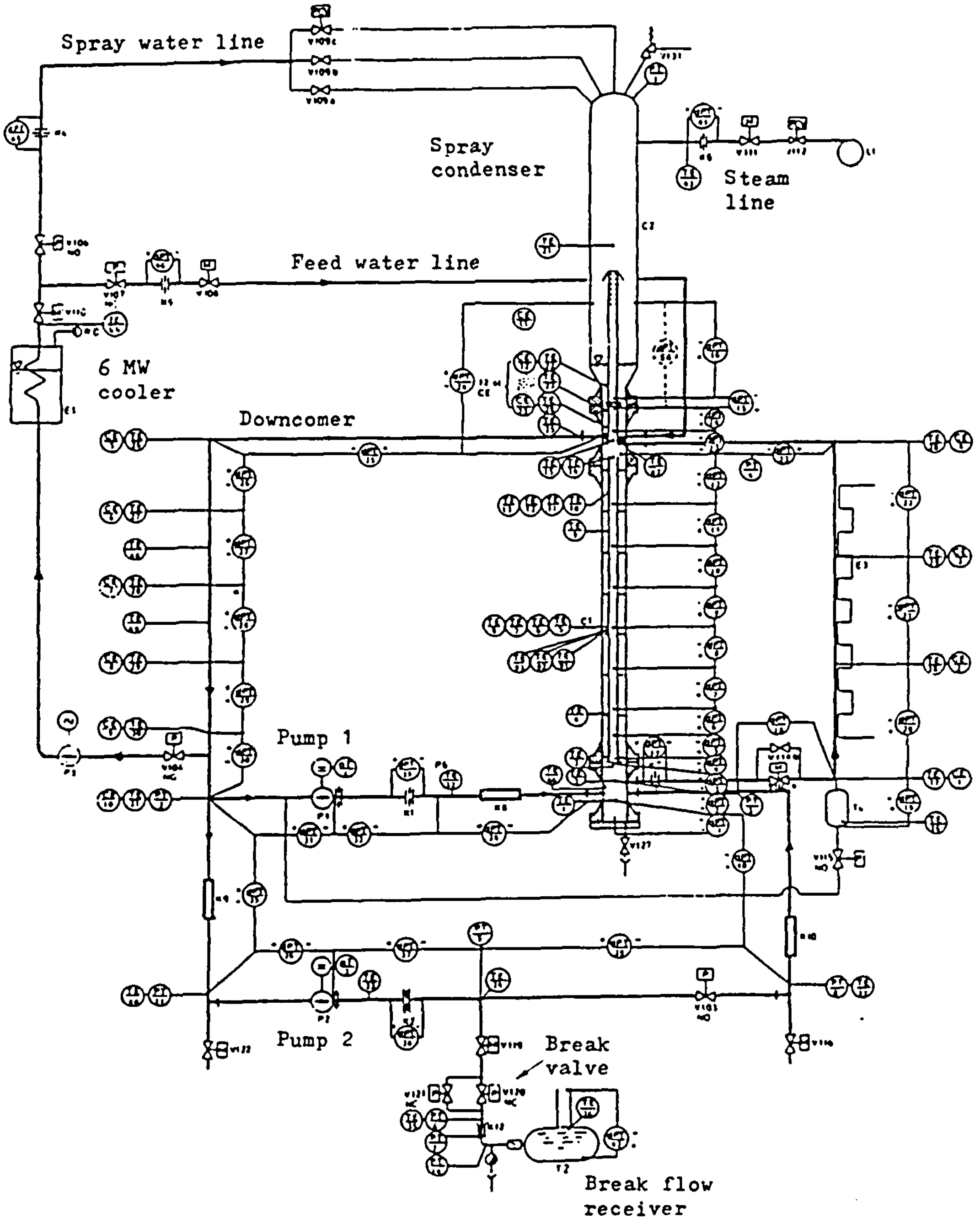


Figure 4

Instrumentation diagram for FIX-II

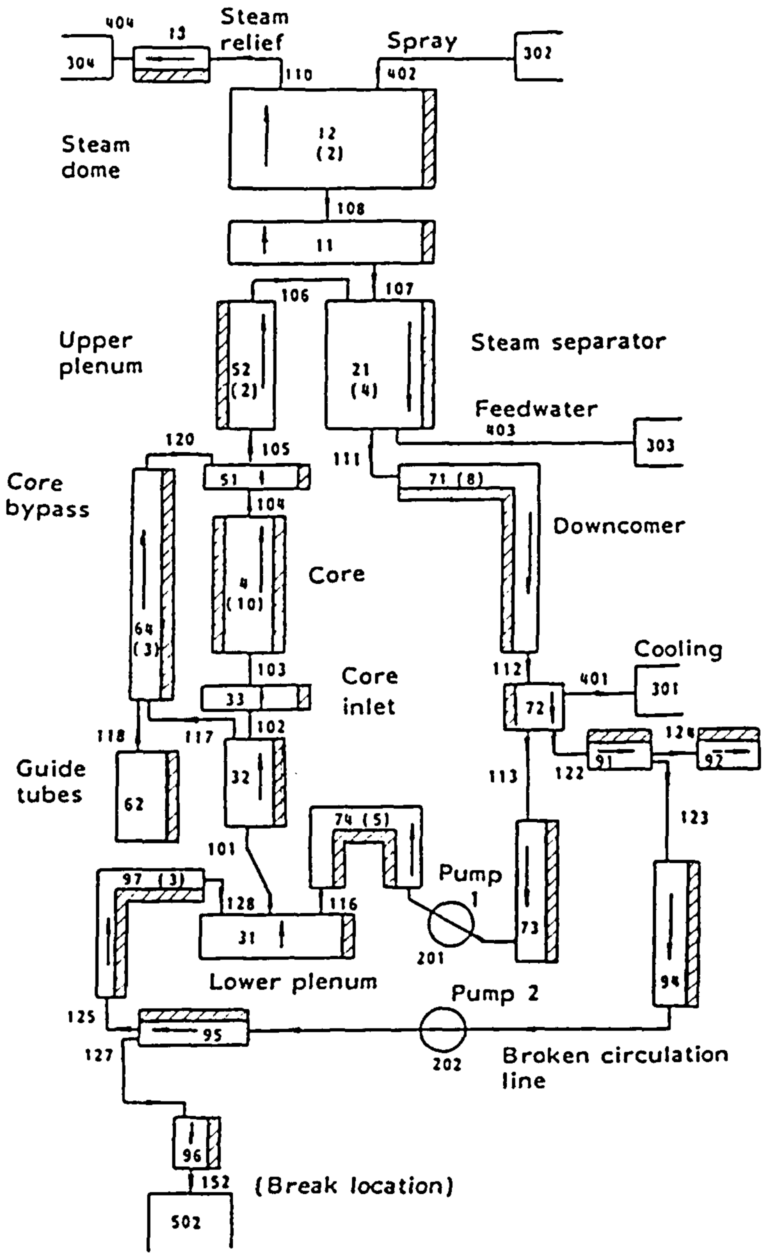


Figure 5

The nodalization diagram for FIX-II

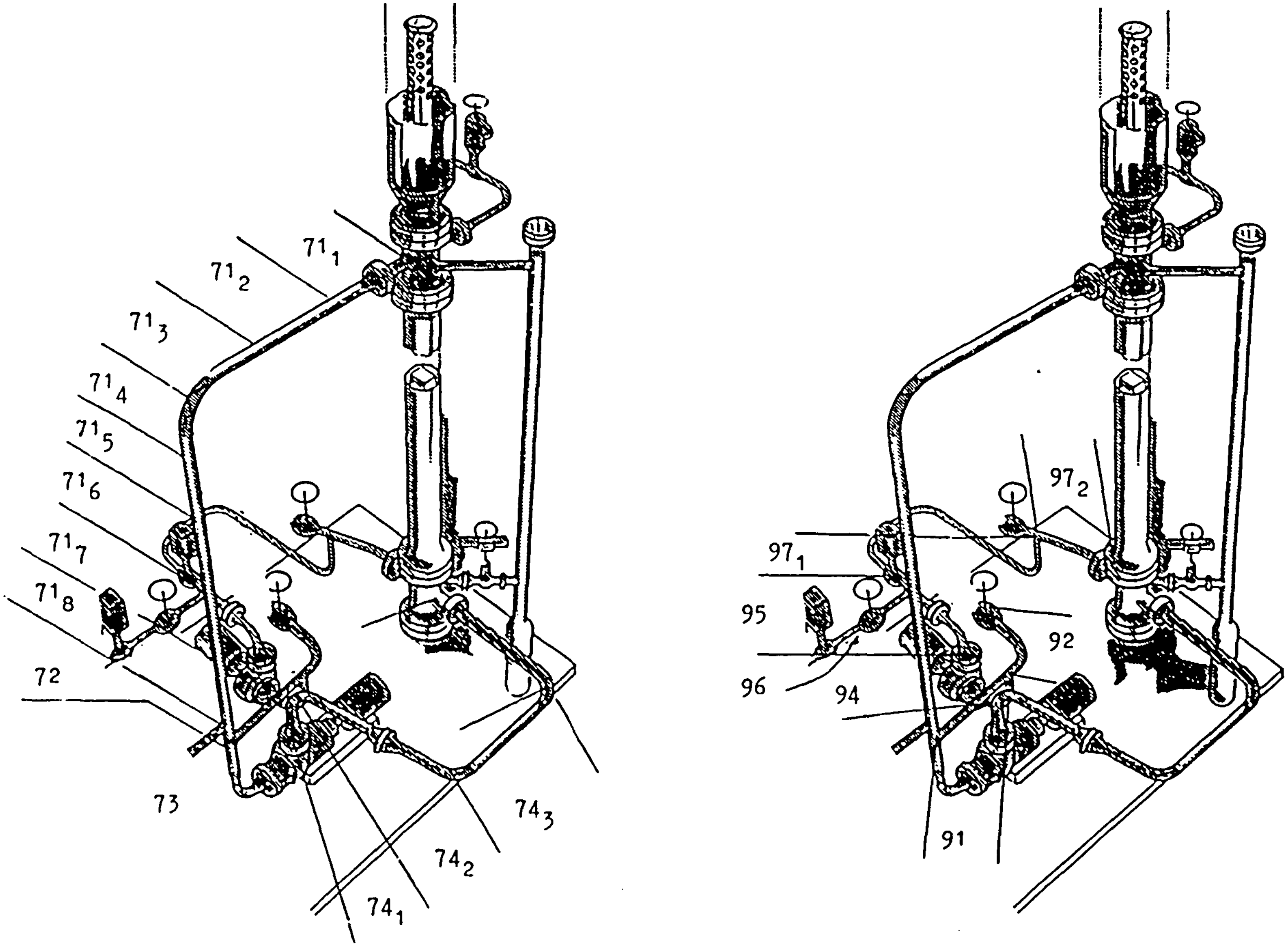


Figure 6

Nodalization of the recirculation lines

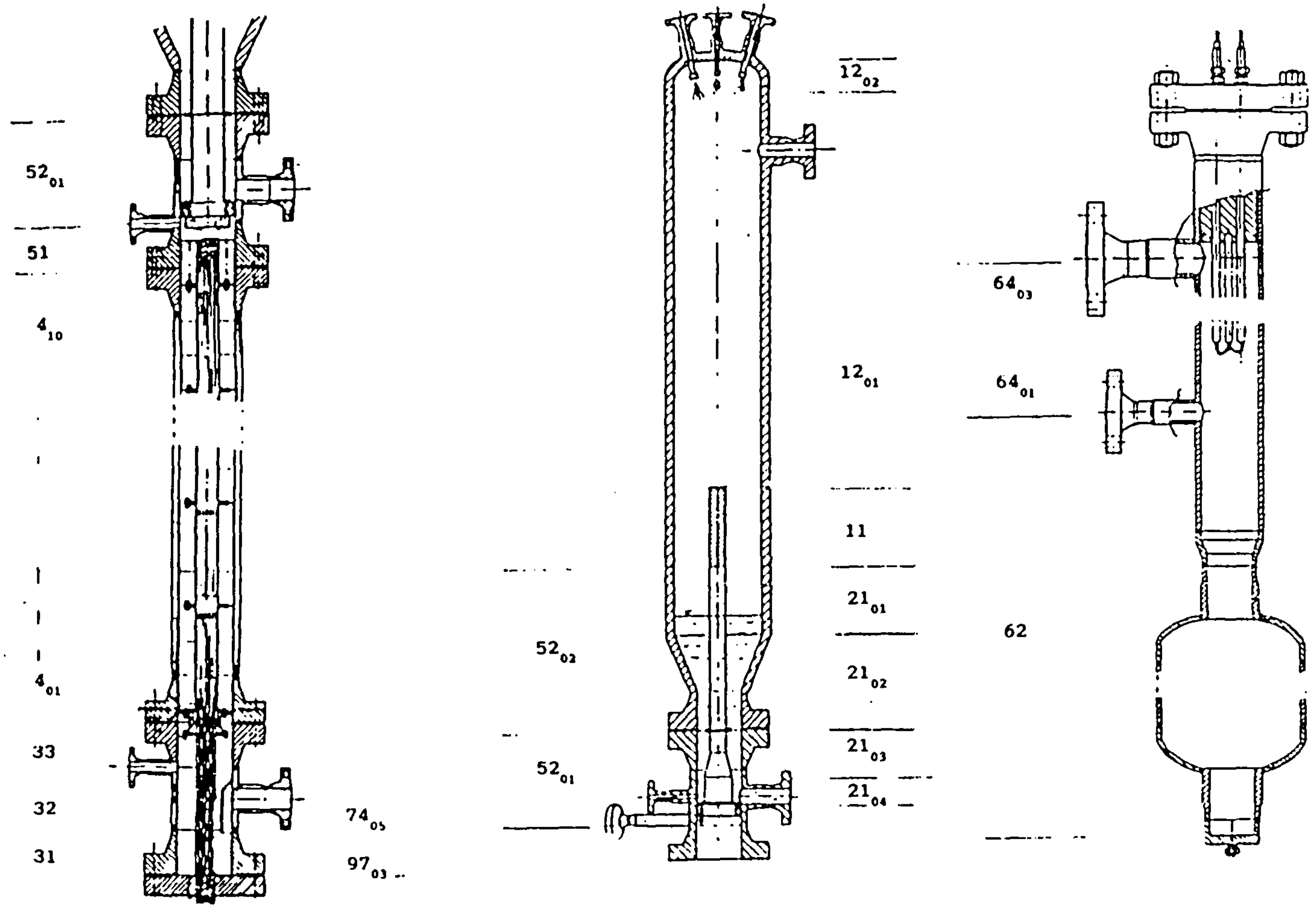


Figure 7

Nodalization of the main volumes of the FIX-II (compare Figure 3).

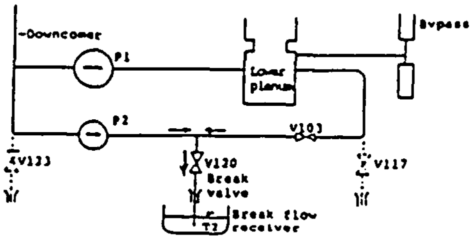
Table 1

The test matrix for the first FIX-II LOCA experimental period. Test No. 3027 is one matrix No. 2 experiment.

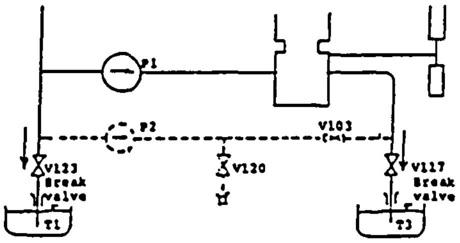
Test matrix No.	1	2	3	4	5	6
Break classification	Split breaks				Guillotine breaks	
Type of simulation (see Figure 17)	A				B	C
Break I.D. (mm)	12.0	12.0	15.0	30.5	16.0+ 21.6	21.6+ 21.6
Relative break area (%)*	31	31	48	200	155	200
Initial bundle power (MW)						
- hot channel		3.35	3.35			3.35
- average	2.35			2.35	2.35	

* Refers to the scaled down flow area of one main recirculation pipe in FIX-II compared with the Oskarshamn 2 reactor.

Break type A
Split break



Break type B
Simplified guillotine break



Break type C
Guillotine break

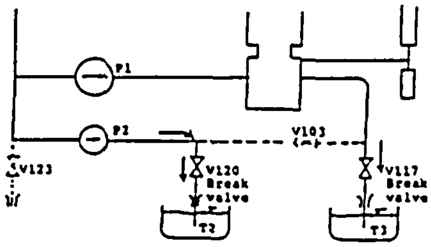


Table 2.A

Evaluated measurement errors

Quantity	Probable error	Error corresponding to 95 % confidence level
Pressures	0.014 MPa	0.04 MPa
Fluid temperatures	1°C	2°C
Cladding temperatures	1.6°C	3.2°C
Small range differential pressures (5 to 7.5 kPa)	0.13 kPa	0.3 kPa
Medium range differential pressures (25 to 50 kPa)	0.22 kPa	0.5 kPa
High range differential pressures (100 to 700 kPa)	0.26 kPa	0.65 kPa

Table 2.B

Errors in derived quantities

Quantity	Probable error
Mass flow rate in orifice meter K1 (P1)	0.2 kg/s
Mass flow rate in orifice meter K2 (P2)	0.14 kg/s
Mass flow rate in orifice meter K6 (steam flow)	~10 % of actual value
Mass flow rate in orifice meter K7 (Bypass)	~10 % of actual value
Break mass flow rate	~10 % of actual value
Electric power to bundle and bypass heaters	1 % of max value

Table 3

RELAP5/Mod 2 code features

COMPUTATION PROCESSING FEATURES

- Several problem type and execution control options as
  - a. steady state initialisation using fictitious structure heat capacities for faster convergence
  - b. transient calculation
  - c. strip type execution, to select requested parameters from a restart file
  - d. trip system, to decide on actions during calculation due to reaching specified conditions in calculation parameters.
  - e. ability to delete or add hydrodynamic components, structure components and control variables at a restart of calculation.

CLASSIFICATION OF HYDRODYNAMIC MODEL

- One-dimensional, with provisions for
  - a. choked flow model
  - b. abrupt area change model
  - c. cross flow junctions.

- Two-fluid, six equation, space-time numerical solution scheme.

- flow regime oriented field characteristics depending on mass flux and void fraction for
  - a. horizontal flow with bubbly, slug, mist and stratified fields
  - b. vertical flow with bubbly, slug, annular-mist (and stratified) fields
  - c. high mixing flow with bubbly and mist fields (for pumps).

Table 3 con't

HYDRODYNAMIC COMPONENENTS (Input systematics)

- Volume type components
  - a. single volume
  - b. pipe and annulus, for condensed input of several similar single volumes
  - c. time dependent volume, for defining a boundary source with a time dependent fluid state
  - d. branch, a volume capable of two or more connecting junctions at either end
  - e. pump, characterized by rated values for flow, head, torque, density and moment of inertia. The single phase homologous curve, two-phase multipliers and phase difference tables to model the dynamic pump behaviour
  - f. special system components for steam separator, jetmixer, turbine and accumulator.

- Junction type components
  - a. single junction
  - b. time dependent junction, for a time dependent junction flow whith a time dependent or controlled flow state
  - c. cross-flow junction, to model a small cross flow, a tee branch or a small leak flow
  - d. valve, various operation characteristics available for check valve, trip valve, inertial valve and relief valve.

INTERPHASE CONSTITUTIVE EQUATIONS

- Interphase drag
  - a. steady drag due to viscous shear depending on flow regime. Semi-empirical mechanisms to describe flow regime transitions
  - b. dynamic drag due to virtual mass effect.

- Interphase mass and heat transfer depending on flow regime and the fluid fields to saturation temperature differences

Table 3 con't

FLUID TO WALL CONSTITUTIVE EQUATIONS

- Wall friction due to wall shear effects formulated for flow regimes and based on a two-phase multiplier approach.

- Wall heat transfer depending on flow characteristics defined for

  a. single-phase forced convection (Dittus-Boelter)

  b. saturated nucleate boiling (Chen)

  c. subcooled nucleate boiling (modified Chen)

  d. critical heat flux (Biasi or modified Zuber)

  e. transition film boiling (Chen)

  f. film boiling (Bromley-Pomeranz and Dougall-Rohsenow)

  g. condensation (partly Dittus-Boelter).

- Interfacial mass transfer at the wall depending on wall, fluid and saturation temperatures for

  a. subcooled and saturated boiling

  b. transition film and film boiling

  c. condensation.

HEAT STRUCTURES

These may be rectangular, cylindrical or spherical in shape. The structure position is defined through component numbers of left and right hand side hydraulic components. A structure is physically defined by the geometry and the temperature dependent conductivity and volumetric heat capacity data. The structure model is further specified by the number of internal mesh points in the direction of heat flow.

CONTROL COMPONENTS

By these new (control) variables are defined from calculated parameters using algebra, standard functions, trip type operands or integrals.

Table 4

Initial conditions, measured for test No. 3027 and predicted (Data for test No. 3025 within parenthesis).

		Test		Prediction
Pressure in the steam dome	MPa	6.96	(7.00)	6.98
Power to the 36-rod bundle (incl connections)	MW	3.425	(3.385)	3.385
Power to the bypass heaters	kW	65.7	(57.4)	57.4
Cooling power in the filler body space	kW	264	(196)	207
Mass flow rate through pump P1	kg/s	4.85	(4.56)	475
Mass flow rate through pump P2	kg/s	1.60	(1.55)	1.49
Mass flow rate in the bypass	kg/s	78	(.71)	.61
Mass flow rate in the 36-rod bundle	kg/s	5.67	(5.40)	5.62
Mass flow rate in teh spray line	kg/s	5.10	(5.36)	5.36
Mass flow rate in the feed water line	kg/s	2.54	(2.49)	2.49
Temperature of water at the bundle inlet (TE2)	°C	267	(269)	268
Temperature of feed and spray water	°C	179	(181)	180
Water level in the spray condenser (Fig 6)	m	.791	(.815)	.825
Rotational speed of pump P1	/s	27.16	(25.46)	26.89
Rotational speed of pump P2	/s	35.57	(33.42)	35.32

Table 5

List of events in test No. 3027 and in prediction case A (Data for Test No. 3025 within parenthesis).

			Time (s)		
Event	Imposed action		System reaction		Prediction
The break occurs (Valve V120 starts to open)	0	0		0	
Start of coast down of pump P1	0.0	(0.0)			0.0
Flow reversal in the samll RCL between break and LP			0.0	(0.0)	0.0
Start of power decay in rod bundle	0.0				0.0
Start of power decay in bypass heaters	0.1	(1.1)			0.0
The SRV starts to open	0.5	(0.4)			0.4
The SRV is fully open	1.0	(1.0)			1.0
The first dryout occurs (level 16 to 12, several rods)			1.2-2.2	(1.4)	not seen
The SRV starts to close	1.6	(1.6)			1.6
Minimum in steam dome pressure occurs (6.69 MPa)			1.9	(1.8)	1.8
The spray flow is closed	2.1	(1.8)			1.9
The feed water flow is closed	2.1	(1.9)			2.0
Valve V104 to the evaporation cooler is closed	2.1	(2.0)			2.0
The SRV is closed	2.5	(2.3)			2.3
Rewetting of the first dryout			3.5	(3.6)	not seen

Table 5 con't

Event	Imposed action		Time (s) System reaction		Prediction
Maximum in steam domw pressure (7.31 MPa)			7.4	(7.8)	8.1
The SRV starts to open	12.0	(11.8)			12.3
The SRV is fully open	12.7-78.7	(12.3-75.3)			12.8
The water (two phase) level reaches lowermost part of the downcomer			14.1	(13.9)	13.5
Cavitation in pump P2 in the broken RCL			14.7	(14.7)	15.3
Flow reversal at the bundle inlet			15.0		15.4
Flow reversal in part of the intact RCL			24.4	(21.)	22.2
Flasning starts in the LP			23-24	(22.)	21.
Level swell (recovery) in lower and middle part of the downcomer			24-30	(23-31)	236-29.4
Flashing starts in the bypass guide tubes volume			24.3	(25)	25.6
Peak in teh bypass flow into the UP			25.3	(26.7)	20.4 and 31.0
Core uncovery begins at rod level 16			45.	(49.)	63.
Core uncovery begins at rod level 7			51.	(51.)	61.
Core uncovery begins at rod level			67.	(62)	not seen
Tripping of the bundle power (stop signal of test)			70.5	(75.2)	75.

Table 6

Main results measured for the test No. 3027 and predicted (Data for the test 3025 within parenthesis).

Simple-value parameter		Experiment		Prediction (Case A)
Time to				
- (first) dryout	(s)	1.2	(1.4)	-
- max rod temperature	"	2.7	(3.6)	-
- rewetting, max	"	3.5	(3.6)	-
- bundle uncovery	"	45	(49)	62
- 2.0 MPa dome pressure	"	80.5	(79)	~ 78.5
- end of break discharge	"	78.5	(75.6)	75
<u>Dome pressure</u>				
- max after the break	(MPa)	7.31	(7.34)	7.35
- at end of break discharge	"	2.09	(2.15)	2.15
<u>Max break mass flow</u>				
- through break	(kg/s)	8.2	7.4	6.8
- through pump P2	"	~4.1	3.6	3.3
- from lower plenum	"	~4.5	-	3.5
<u>Integrated mass flow</u>				
- through break	(kg)	222	(214)	195
- through steam relief valve	"	40	(39.7)	39.8

Table 6 con't

Simple-value parameter		Experiment	Prediction (Case A)
Max rod temperature			
- during dryout	(°C)	360 (389)	-
- at end of break discharge	"	382 (352)	~303
Position of max rod temp			
- during dryout	(rod/level)	10/14 (16/14)	-
- at end of discharge	"	14/11 (22/7)	/5

Table 7

Run statistics data (Case A)

Transient time (s)	Computer CPU time (s)	Number of time steps	Number of reduced current	Number of reduced mass
-5	0.	0		
0	118.1	200	100*	0
10	229.1	384	90	0
20	227.6	455	19	0
30	353.9	533	7	1
40	437.1	612	6	0
50	517.6	695	13	2
60	569.3	759	11	0
70	766.8	928	1	63**
75	828.3	982	0	10

* All current limit time step reductions was caused by core flows

** Mass error limitation occuring in downcomer lower part

Table 8

Parameters plotted and used in the assessment comparison.

COMPONENT	CONTINOUS PARAMETER *	EXPERIMENT (IDENTIFIER)	PREDICTION (MINOR EDIT)	PLOT IDENTIF.		PLOT NO.
				EXP.	CALC.	
CORE	FLUID DENSITY, BOTTOM	***	RHO 04.01		RH1?	B. 1
	MASS FLOW RATE, INLET *	DPT 4	P 33.01 - P04.01	D 4	PD4?	B. 2
	HEATING POWER	X 801	CNTRLVAR 57	X801	HP1?	B. 3
	CLAD TEMPERATURE, LEVEL 1	TE 191, TE 206, TE 211, TE 246	HTTEMP 4.0100	TC 1	HT1?	B. 4
	-"- , LEVEL 3	TE 108, TE183, TE 243, TE 248	HTTEMP 4.0300	TC 3	HT2?	B. 5
	-"- , LEVEL 5	TE 202, TE 227, TE 232, TE 237, TE 252	HTTEMP 4.0400	TC 5	HT3?	B. 6
	-"- , LEVEL 9	TE 102, TE 137, TE 167, TE 172, TE 187, TE 197, TE 272	HTTEMP 4.0600	TC 9	HT4?	B. 7
	-"- , LEVEL 12	TE 118, TE 123, TE 128, TE 148, TE 223	HTTEMP 4.0700	TC12	HT5?	B. 8
	-"- , LEVEL 15	TE 175, TE 190, TE 275	HTTEMP 4.1000	TC15	HT6?	B. 9
	INLET TEMPERATURE	TE 3	TEMPF 33.01	T 3	TF1?	B.10
	OUTLET TEMPERATURE	TE 14	TEMPF 51.01	T 14	TF2?	B.11
	CORE INVENTORY *	DPT 5 + DPT 6+ DPT 7 + DPT 8+ DPT 9 + DPT 10+ DPT 11 + DPT 12	P 04.01- P 51.01 **	D CO	PDC?	B.12
VESSEL	FLUID DENSITY, BOTTOM	***	RHO 31.01		RH2?	B.13
	DOWNCOMER MASS INVENTORY *	DPT 27 + DPT 28 + DPT 29 + DPT 30	P 71.03 - P 72.01 **	D DC	PDD?	B.14
	LOWER PLENUM MASS INVENTORY *	DP 2 + DP3 - DP 1	P 31.01 - P 32.01 **	D LP	PDL?	B.15
	UPPER PLENUM MASS INVENTORY *	DP 13 + DP 14	P 51.01 - P 52.01 **	D UP	PDU?	B.16
	PRESSURE LOSS, S.S. ORIFICE	DP 56	P 52.01 - P 52.02	D 56	PDS?	B.17
	UPPER PLENUM TEMPERATURE	TE 15	TEMPF 52.01	T 15	TF4?	B.18
	DOWNCOMER TEMPERATURE, BOTTOM	TE 31	TEMPF 71.08	T 31	TF3?	B.19
	LOWER PLENUM PRESSURE	PT 3	P 31.01	P 3	P 1?	B.20
	UPPER PLENUM PRESSURE	PT 4	P 52.01	P 4	P 2?	B.21
	MASS FLOW RATE, BYPASS	X 602	MFLOWJ 117	X602	MF1?	B.22

COMPONENT	CONTINOUS PARAMETER *	EXPERIMENT	PREDICTION	PLOT IDENTIF.		PLOT
		(IDENTIFIER)	(MINOR EDIT)	EXP.	CALC.	NO.
RECIRCULATION LINE	MASS FLOW RATE, I. L. PUMP (ORIFICE K1)	X 603	MFLOWJ 201.02	X603	MF2?	B.23
	MASS FLOW RATE, B. L. PUMP (ORIFICE K2)	X 604	MFLOWJ 202.02	X604	MF3?	B.24
	MASS FLOW RATE, B. L. VESSEL INLET (SPOOL PIECE K10)	X 610	MFLOWJ 97.02	X610	MF4?	B.25
SYSTEM	MASS INVENTORY	***	TMASS		MAT?	B.26
	MASS FLOW RATE, STEAM RELIEF	X 607	MFLOWJ 404	X607	MF5?	B.27
	HEAT LOSS, PASSIVES	***	CNTRLVAR 53		HL1?	B. 3
BREAK	FLUID DENSITY	***	RHO 96.01		RH3?	B.28
	MASS FLOW RATE	X 636	MFLOWJ 152	X636	MF6?	B.29
	MASS FLOW RATE, INTEGRATED	X 661	CNTRLVAR 55	X661	ML1?	B.30
	INLET TEMPERATURE	TE 34	TEMPF 96.01	T 34	TF5?	B.31
	INLET SUBCOOLING	***	TEMPG 96.01 - TEMPF 96.01		TSU?	B.32
	INLET PRESSURE	PT 6	P 96.01	P 6	P 3?	B.33
RELAP5/MOD2	COMPUTAION CPU TIME	***	CPUTIME		CPU?	B.34
	COMPUTATION MASS ERROR	***	EMASS		MAE?	B.35

* THE COMPARISON PARAMETERS ARE THOSE REPORTED AS DIRECTLY MEASURED OR AS COMPUTED RESULTS FROM THE EXPERIMENT.
PRESSURE DIFFERENCE INSTEAD OF MASS FLOW RATE OR OF MASS INVENTORY.

** CORRECTIONS APPLIED TO RESUME THE CORRECT PRESSURE SENSOR LEVELS.

*** NO DATA AVAILABEL FROM THE EXPERIMENT.

```
*        INPUT FOR RELAP5/MOD2
*       FIX-II SPLIT BREAK STEADY-STATE (PRECALCULATION)
*    ****CHANGES BY DLC FOR 3027 SIMULATION.  MARCH 85
*  24APR85  DLC  CORE ROUGHNESS CHANGED TO 1E-4 FROM 0.0
*  24APR85  DLC  JUNC 5201 K CHANGED FROM 2.34 TO 1.70
*  24APR85  DLC  JUCH 103 KF CHANGED FROM 0.43 TO 0.34
*  24APR85  DLC  ABOVE CHANGES MADE TO GET RS DP TO AGREE WITH 3027 DP
*    ***CHANGE CARDS ADDED AT END OF DECK  ****
*        100 O/O POWER MEAN CORE CHANNEL
0000100  NEW  STDY-ST
0000101  RUN
0000105  10.        20.
0000203 24.0  1.0E-6    8.0E-2    00001     3  100   1000
*
*
0000302  P         032010000  *PRESSURE LOWER PLENUM VOL 2
0000303  P         004010000  *PRESSURE CORE VOL 1
0000312  P         004100000  *PRESSURE CORE VOL 10
0000315  P         051010000  *PRESSURE UPPER PLENUM
0000316  P         011010000  *PRESSURE STEAM DOME VOL11
0000317  P         012010000  *PRESSURE STEAM DOME VOL12-1
0000318  P         021040000  *PRESSURE DC ANNULUS VOL4
0000320  CNTRLVAR  041        *LIQUID LEVEL IN DC ANNULUS
0000321  VLVAREA   000000117  *VALVE AREA BY-PASS INLET
0000331  VOIDG     004010000  *VOID CORE VOL 1
0000332  VOIDG     004020000  *VOID CORE VOL 2
0000333  VOIDG     004030000  *VOID CORE VOL 3
0000334  VOIDG     004040000  *VOID CORE VOL 4
0000335  VOIDG     004050000  *VOID CORE VOL 5
0000336  VOIDG     004060000  *VOID CORE VOL 6
0000337  VOIDG     004070000  *VOID CORE VOL 7
0000338  VOIDG     004080000  *VOID CORE VOL 8
0000339  VOIDG     004090000  *VOID CORE VOL 9
0000340  VOIDG     004100000  *VOID CORE VOL 10
0000341  VOIDG     064030000  *VOID BY-PASS OUTLET
0000342  VOIDG     052020000  *VOID RISER TOP
0000343  VOIDG     011010000  *VOID STEAM DOME VOL11
0000344  VOIDG     012010000  *VOID STEAM DOME VOL12-1
0000345  VOIDG     012020000  *VOID STEAM DOME VOL12-2
0000346  VOIDG     021010000  *VOID DC ANNULUS VOL1
0000347  VOIDG     021020000  *VOID DC ANNULUS VOL2
0000348  VOIDG     021030000  *VOID DC ANNULUS VOL3
0000349  VOIDG     021040000  *VOID DC ANNULUS VOL 4
0000350  VOIDG   064010000  *VOID BYPASS VOL1
0000351  VOIDG   062010000  *VOID GUID TUBE VOL
0000352  VOIDG   032010000  *VOID LOWER PLENUM VOL2
0000353  VOIDG   031010000  *VOID LOWER PLENUM VOL1
0000354  VOIDG   096010000  *VOID BREAK VOLUME
0000355  QUALS   013010000  *QUALITY STEAM LINE
0000356  VOIDG   073010000  *VOID PUMP P1 SUCTION LINE
0000357  VOIDG   094010000  *VOID PUMP P2 SUCTION LINE
0000359  MFLOWJ   404000000  *MASS FLOW STEAM VALVE
0000360  MFLOWJ  110000000   *MASS FLOW STEAM RELIEF
0000361  MFLOWJ    103000000  *MASS FLOW CORE INLET
0000362  MFLOWJ    004020000  *MASS FLOW CORE JUN 2
0000363  MFLOWJ    004040000  *MASS FLOW CORE JUN 4
0000364  MFLOWJ    004060000  *MASS FLOW CORE JUN 6
0000365  MFLOWJ    004080000  *MASS FLOW CORE JUN 8
```

```
0000366  MFLOWJ    104000000  *MASS FLOW CORE OUTLET
0000367  MFLOWJ    117000000  *MASS FLOW BY-PASS INLET
0000368  MFLOWJ    120000000  *MASS FLOW BY-PASS OUTLET
0000369  MFLOWJ    106000000  *MASS FLOW FROM RISER
0000370  MFLOWJ    107000000  *MASS FLOW FROM STEAM DOME VOL11
0000371  MFLOWJ    108000000  *MASS FLOW FROM STEAM DOME VOL12-1
0000372  MFLOWJ    012010000  *MASS FLOW FROM STEAM DOME VOL12-2
0000373  MFLOWJ    021010000  *MASS FLOW DC ANNULUS JUN 1
0000374  MFLOWJ    021020000  *MASS FLOW DC ANNULUS JUN 2
0000375  MFLOWJ    021030000  *MASS FLOW DC ANNULUS JUN 3
0000376  MFLOWJ    201020000  *MASS FLOW PUMP1 OUTLET
0000377  PMPVEL    000000201  *PUMP1 VELOCITY (RAD/S)
0000378  MFLOWJ   -202020000  *MASS FLOW PUMP2 OUTLET
0000379  PMPVEL    000000202  *PUMP2 VELOCITY (RAD/S)
0000380  CNTRLVAR 53        *STRUCTURE HEAT LOSS
0000381  CNTRLVAR 54        *STRUCTURE HEAT LOSS,INTEGRATED
0000383  CNTRLVAR 55        *INTEGRATED BREAK LOSS
0000384  CNTRLVAR 56     * BOX-HEAT LOSS
0000385  CNTRLVAR 57     * COR-POWER
0000386  CNTRLVAR 58     * BY-PASS POWER
0000387  CNTRLVAR 59     * TOTAL POWER
0000389  CNTRLVAR 113    * AUXIL. HEAT LOSS
0000391  CNTRLVAR  042        *LIQUID LEVEL IN UPPER PLENUM
0000392  CNTRLVAR  043        *LIQUID LEVEL IN CORE
0000393  CNTRLVAR  044        *LIQUID LEVEL IN LOWER PLENUM
*0000394  CNTRLVAR  014        *FLOW QUAL CORE VOL5
*0000395  CNTRLVAR  015        *FLOW QUAL CORE VOL6
*0000396  CNTRLVAR  016        *FLOW QUAL CORE VOL7
*0000397  CNTRLVAR  017        *FLOW QUAL CORE VOL8
*0000398  CNTRLVAR  018        *FLOW QUAL CORE VOL9
*0000399  CNTRLVAR  019        *FLOW QUAL CORE VOL10
*
*        PUMP DUMMY TRIP
0000501  TIME      0          GT   NULL 0    0.     L *USED AT STEADY S
*        BY-PASS VALVE TRIPS
0000502  MFLOWJ    117000000  GT   NULL 0    0.601   N *STEADY STATE
0000503  MFLOWJ    117000000  LT   NULL 0    0.599   N *STEADY STATE
*         RUPTURE TRIPS
0000504  TIME      0          GT   NULL 0  1000.    L *STEADY STATE CAR
0000505  TIME      0          LT   NULL 0    0.     L
*
*
***********************
*
0310000  VOL31     BRANCH
0310001  0
0310101  0.   0.151     0.00743  0.   90.  0.151     0.   0.0573    00
***********************
*
0320000  VOL32     BRANCH
0320001  0
0320101  0.   0.125     0.01147  0.   90.  0.325     0.   0.0562    00
***********************
*
0330000  VOL33     SNGLVOL
0330101  0.   0.271     0.01250  0.   90.  0.271     0.   0.0573    00
***********************
*
```

```
0040000  VOL4      PIPE
0040001  10
0040101  0.0 10
0040301  0.368 10
0040401  0.0022344 10
0040601  90. 10
0040801  0.  0.0136  10
0040901  0.65 0.65  2   0.00 0.00  3   0.65 0.65  7   0.00 0.00  8
0040902  0.65 0.65  9
0041001  00   10
0041101  1000  9
***********************
* _
0510000  VOL51     BRANCH
0510001  0
0510101  0.   0.159     0.00525  0.   90.  0.159     0.   0.0817    00
***********************
*
0520000  VOL52     PIPE
0520001  2
0520101  0.0  2
0520201  0.002734   1
0520301  0.525     1    0.953      2
0520401  0.00835   1    0.007485   2
0520601  90.  2
0520801  0.   0.   2
0520901  2.54   2.54   1
0521001  00   2
0521101  0000 1
***********************
*
0110000  VOL11     ANNULUS
0110001  1
0110101  0.0  1
0110301  0.463 1
0110401  0.08970 1
0110601  90.  1
0110801  0.   0.   1
0111001  00 1
***********************
*
0120000  VOL12     PIPE
0120001  2
0120101  0.0  2
0120301  2.200     1    0.130      2
0120401  0.43200   1    0.02418    2
0120601  90.  2
0120801  0.   0.   2
0121001  00   1    01   2
0121101  1000 1
***********************
*
0130000  VOL13     SNGLVOL
0130101  0.   3.854     0.01831   0. 90.  3.854 0. 0. 00  *STEADY STATE CA
***********************
*
0210000  VOL21     ANNULUS
0210001  4
```

The stady state input

```
0210101   0.0  4
0210201   0.   1     0.035137   2    0.    3
0210301   0.406 1    0.549 2   0.286 3   0.146 4
0210401   0.07509 1       0.04285 2      0.01250 3       0.00527 4
0210601   -90. 4
0210801   0. 0.3960 1     0. 0.2692 2     0. 0.1516 3     0. 0.1117 4
0210901   0.   0.   1   0.96   0.96   2   0.   0.   3
0211001   00 4
0211101   1000 3
***********************
*
0710000   VOL71      PIPE
0710001   8
0710101   0.0  8
0710301   0.9907 3   0.8198 8
0710401   0.009146 3 0.007726 8
0710601   0. 3 -90. 8
0710801   0. 0. 8
0710901   0.00 0.00 2    0.10 0.10 3    0.00 0.00 7
0711001   00 8
0711101   1000  7
***********************
*
0720000   VOL72      BRANCH
0720001   0
0720101   0.   0.300      0.002025  0.  -90. -0.300      0.    0.          00
***********************
*
0730000   VOL73      SNGLVOL
0730101   0.   1.240      0.01129    0.  -90. -0.750      0.    0.    00
***********************
*
0740000   VOL74      PIPE
0740001   5
0740101   0.00 5
0740201   0.   1     0.001385  2    0.    4
0740301   0.553 1    1.117 2   2.874 3   1.580 4    0.215 5
0740401   0.00360 1 0.00475 2 0.01225 3 0.00823 4 0.00226 5
0740601   90. 1      0. 4     -90. 5
0740801   0. 0. 4    0. 0.0015 5
0740901   0.17 0.17 1     0.79 0.79 2     0.22 0.22 3     1.00 1.00 4
0741001   00 5
0741101   1000  1   1000  2    1000  3    1000  4
***********************
*
0620000   VOL62      SNGLVOL
0620101   0.   1.221      0.03227   0.  -90. -1.221      0.    0.          00
***********************
*
0640000   VOL64      PIPE
0640001   3
0640101   0.0 3
0640301   1.467 1    1.335 2     1.308 3
0640401   0.01181 1 0.00963 2 0.01157 3
0640601   90.  3
0640801   0. 0.0690 1     0. 0.0672 2     0.     0.0629 3
0640901   0.00 0.00 2
0641001   00 3
```

```
0641101   1000 2
*
* BROKEN CIRCULATION LINE
***********************
*
0910000   VOL91      BRANCH
0910001   0
0910101   0.   1.246      0.00570   0.    0.    0.    0.    0.    00
***********************
*
0920000   VOL92      SNGLVOL
0920101   0.   1.339      0.00580   0.    0.    0.    0.    0.    00
***********************
*
0940000   VOL94      SNGLVOL
0940101   0.   1.180      0.00256   0.  -45. -0.820      0.    0.    00
***********************
*
0950000   VOL95      BRANCH
0950001   0
0950101   0.   1.690      0.00336       0.    14.3   0.417   0.    0.    00
***********************
*
0960000   VOL96      BRANCH
0960001   0
0960101   0.   1.475      0.00629   0.    0.    0.    0.    0.    00
***********************
*
0970000   VOL97      PIPE
0970001   3
0970101   0.0   3
0970301   2.789       1     1.622      2      0.215      3
0970401   0.00530     1.    0.00757    2      0.00226    3
0970601   5.4   1     0.    2   -90.  3
0970701   0.261       1     0.             2     -0.215      3
0970801   0.    0.    2     0.    0.006042   3
0970901   1.43   1.43   1    1.08   1.08    2
0971001   00    3
0971101   0000 1     0000 2
*
***********************
*
2010000   PUMP1      PUMP
2010101   0.            0.750      0.01010    0.    16.4 0.283       0
2010108   073010000     0.00427   0.17        0.37       0000
2010109   074000000     0.000908  3.00        3.00       0000
2010201   1     4.56   0.    0.
2010202   1     4.56   0.    0.
2010301   0     0     0    -1    0     0     0
2010302   303.69   0.540356    0.0383     50.    81.7    1.    1000.
2010303   0.    0.    0.    0.    0.
*  NYA HOMOLOGA PUMPKURVOR. DATA KOMMER FRAN ASEA-ATOMS GOBLIN-BER.
*  TORQUE-KURVORNA SAKNAR BETYDELSE I DETTA FALL OCH HAR DARFOR INTE
* KONTROLLERATS. KALLAN FOR EN DEL DATA AR OKAND.
2011100   1     1
2011101   0.00,1.181      0.27,1.180      0.47,1.160
2011102   0.64,1.130      1.00,1.000
2011200   2     1
```

```
2011201   0.00,0.86        0.09,0.87        0.19,0.89
2011202   0.38,0.92        0.59,0.962       0.80,0.99        1.00,1.00
2011300   1     2
2011301   0.0,-0.560     0.41,-0.16     0.51,-0.05      0.76,0.48
2011302   1.00,1.00
2011400   2     2
2011401   0.0,-1.16        0.5,0.00        0.68,0.38        1.00,1.00
2011500   1     3
2011501     -1.00,2.00     -0.95,1.81     -0.62,1.52     -0.50,1.39
2011502       0.00,1.18
2011600   1     4
2011601     -1.00,2.00     -0.79,1.53     -0.63,1.25     -0.30,0.93
2011602       0.00,0.72
2011700   2     3
2011701     -1.00,3.31     -0.83,2.78     -0.68,2.29     -0.56,1.95
2011702     -0.37,1.49     -0.22,1.19     -0.10,0.99      0.00,0.84
2011800   2     4
2011801     -1.00,3.31     -0.79,2.78     -0.59,2.37     -0.41,2.06
2011802     -0.21,1.78      0.00,1.55
* TWO PHASE MULTIPLIER TABLES
2013000    0
2013001  0.0,0.0  0.1,0.0  0.15,0.05  0.24,0.8  0.3,0.96  0.4,0.98
2013002  0.6,0.97  0.8,0.9  0.9,0.8  0.96,0.5  1.0,0.0
2013100    0
2013101  0.0,0.0  0.1,0.0  0.15,0.05  0.24,0.8  0.3,0.96  0.4,0.98
2013102  0.6,0.97  0.8,0.9  0.9,0.8  0.96,0.5  1.0,0.0
* TWO PHASE DIFFERENCE FOR PUMP HEAD (SEMISCALE)
2014100    1   1
2014101 0.0,0.0  0.1,0.83  0.2,1.09  0.5,1.02  0.7,1.01 0.9,0.94 1.0,1.0
2014200    1   2
2014201 0.0,0.0  0.1,-0.04  0.2,0.0  0.3,0.1  0.4,0.21  0.8,0.67
2014202 0.9,0.80  1.0,1.0
2014300    1   3
2014301 -1.0,-1.16  -0.9,-1.24  -0.8,-1.77  -0.7,-2.36  -0.6,-2.79
2014302 -0.5,-2.91  -0.4,-2.67  -0.25,-1.69  -0.1,-0.5  0.0,0.0
2014400    1   4
2014401 -1.0,-1.16  -0.9,-0.78  -0.8,-0.5  -0.7,-0.31  -0.6,-0.17
2014402 -0.5,-0.08  -0.35,0.0  -0.2,0.05  -0.1,0.08  0.0,0.11
* TWO PHASE DIFFERENCE FOR PUMP TORQUE (= SINGLE PHASE, WHICH MEANS
* THAT FULLY DEGRADED TORQUE IS ZERO)
2014900    2     1
2014901   0.00,0.86        0.09,0.87        0.19,0.89
2014902   0.38,0.92        0.59,0.962       0.80,0.99        1.00,1.00
2015000    2     2
2015001   0.0,-1.16        0.5,0.00         0.68,0.38        1.00,1.00
2015100    2     3
2015101     -1.00,3.31     -0.83,2.78     -0.68,2.29     -0.56,1.95
2015102     -0.37,1.49     -0.22,1.19     -0.10,0.99      0.00,0.84
2015200    2     4
2015201     -1.00,3.31     -0.79,2.78     -0.59,2.37     -0.41,2.04
2015202     -0.21,1.78      0.00,1.55
** PUMP1 REGULATOR                                      *STEADY STATE CAND
2016100    501        CNTRLVAR  003                     *STEADY STATE CAND
2016101    0.    0.          1000.      1000.           *STEADY STATE CAND
** PUMP1 CONTROL SYSTEM                                  *STEADY STATE CAND
20500100  MASSDIFF1  SUM        100.     0.         0   *STEADY STATE CAND
20500101  4.56      -1.0        MFLOWJ    201020000     *STEADY STATE CA
20500200  INTEGRAL1  INTEGRAL  1.         0.         0   *STEADY STATE CAND
```

```
20500201  CNTRLVAR  001                                *STEADY STATE CARD
20500300  VELDIFF1   SUM       1.        0.        1   *STEADY STATE CARD
20500301  184.54   1.0      CNTRLVAR  002             *STEADY STATE CAR
*
***********************
*
2020000    PUMP2      PUMP
2020101    0.         0.700      0.00500    0.   72.0 0.228      0
2020108    094010000     0.0019    0.35      0.35      0000
2020109    095000000     0.000380   3.00      3.00     0000
2020201    1     1.55 0.   0.
2020202    1     1.55 0.   0.
2020301    0     0     -1    -1    0     0     0
2020302    383.69     0.730054   0.01056    25.        13.2       1.           1000.
2020303    0.    0.    0.    0.    0.
2021100    1     1
2021101    0.0   1.136       0.2  1.135      0.4  1.120
2021102    0.6   1.100       0.8  1.055      1.0  1.000
2021200    2     1
2021201    0.0   0.51        1.0  1.00
2021300    1     2
2021301    0.0  -0.560       0.2 -0.385      0.4 -0.180      0.5 -0.055
2021302    0.6   0.145       0.8  0.565      1.0  1.000
2021400    2     2
2021401    0.0  -0.47        0.2 -0.21       0.4  0.07
2021402    0.6   0.35        0.8  0.66       1.0  1.00
2021500    1     3
2021501     -1.00,2.00     -0.95,1.81     -0.62,1.52     -0.50,1.39
2021502      0.00,1.136
2021600    1     4
2021601    .-1.00,2.00     -0.79,1.53     -0.63,1.25     -0.30,0.93
2021602      0.00,0.72
2021700    2     3
2021701     -1.00,3.31     -0.83,2.78     -0.68,2.29     -0.56,1.95
2021702     -0.37,1.49     -0.22,1.19     -0.10,0.99      0.00,0.51
2021800    2     4
2021801     -1.00,3.31     -0.79,2.78     -0.59,2.37     -0.41,2.04
2021802     -0.21,1.78      0.00,1.55
2023000    0
2023001    0.0 0.00  0.1 0.00  0.2 0.05  0.3 0.80  0.4 0.96  0.5 0.98
2023002    0.6 0.97  0.7 0.90  0.8 0.80  0.9 0.50  1.0 0.00
2023100    0
2023101    0.0 0.00  0.1 0.10  0.2 0.15  0.3 0.26  0.4 0.30  0.5 0.40
2023102    0.6 0.60  0.7 0.80  0.8 0.90  0.9 0.96  1.0 1.00
** PUMP2 REGULATOR                                      *STEADY STATE CA
2026100    501-      CNTRLVAR  006                     *STEADY STATE CARD
2026101    0.    0.          1000.      1000.           *STEADY STATE CARD
** PUMP2 CONTROL SYSTEM                                 *STEADY STATE CA!
20500400  MASSDIFF2  SUM        100.      0.        0   *STEADY STATE CARI
20500401  1.55      -1.0       MFLOWJ     202020000     *STEADY STATE CA
20500500  INTEGRAL2  INTEGRAL  1.         0.        0   *STEADY STATE CAHI
20500501  CNTRLVAR   004                                *STEADY STATE CARD
20500600  VELDIFF2    SUM       1.         0.        1   *STEADY STATE CAR!
20500601  221.07     1.0       CNTRLVAR  005            *STEADY STATE CA
*
***********************
*
1010000    JUN31-32  SNGLJUN
```

```
1010101    031010000 032000000 0.          0.          0.          1100
1010201    1         6.11      0.          0.
***********************
*
1020000    JUN32-33  SNGLJUN
1020101    032010000 033000000 0.          0.          0.          1100
1020201    1         5.51      0.          0.
***********************
*
1030000    JUN33-41  SNGLJUN
1030101    033010000 004000000 0.000473    0.430       0.200       0000
1030201    1         5.51      0.          0.
***********************
*
1040000    JUN41-51 SNGLJUN
1040101    004010000 051000000 0.          0.10        0.10        0100
1040201    1         3.75      1.76        0.
***********************
*
1050000    JUN51-52  SNGLJUN
1050101    051010000 052000000 0.          0.          0.          1100
1050201    1         4.35      1.76        0.
***********************
*
1060000    JUN52-21  SNGLJUN
1060101    052010000 021000000 0.03318     1.          1.          1020
1060201    1         4.35      1.76        0.
***********************
*
1070000    JUN11-21  SNGLJUN
1070101    011000000 021000000 0.0         0.0         0.0         1000
1070201    1         7.12      -1.76       0.
***********************
*
1080000    JUN12-11  SNGLJUN
1080101    012000000 011010000 0.          0.          0.          1000
1080201    1         7.12      -1.76       0.
***********************
*
1100000    JUN12-13  SNGLJUN
1100101    012010000 013000000 0.001432    0.95    0.95    1000     *STEADY ST
1100201    1         0.        0.          0.
***********************
*
1110000    JUN21-71  SNGLJUN
1110101    021010000 071000000 0.          1.00        1.00        1100
1110201    1         13.96      0.          0.
***********************
*
1120000    JUN71-72  SNGLJUN
1120101    071010000 072000000 0.          0.          0.          1000
1120201    1         11.96      0.          0.
***********************
*
1130000    JUN72-73  SNGLJUN
1130101    072010000 073000000 0.00        0.          0.          1000
1130201    1         4.56      0.          0.
***********************
```

```
*
1160000    JUN74-31  SNGLJUN
1160101    074010000 031010000 0.          0.00        0.00        1100
1160201    1         4.56      0.          0.
*
***********************
*
1170000    BY-PASS   VALVE
1170101    032010000 064000000 0.000581  0.          0.              0000
1170201    1         0.60      0.        0.
1170300    MTRVLV    *    MOTORVALVE IN BY-PASS INLET
1170301    0000503   0000502   0.02      0.1924
1170400    1.0  34.20
1170401    .000 .000 .000 .125 .0906 .0906 .200 .1301 .1301
1170402    .500 .1955 .1955 1.00 .2037 .2037
***********************
*
1180000    JUN64-62  SNGLJUN
1180101    064000000 062000000 0.00474   0.          0.          1100
1180201    1         0.        0.        0.
***********************
*
1200000    JUN64-51  SNGLJUN
1200101    064010000 051010000 0.001790  2.00        2.00        0000
1200201    1         0.60      0.        0.
***********************
*
1220000    JUN72-91  SNGLJUN
1220101    072010000 091000000 0.        0.00        0.00        0100
1220201    1         1.55      0.        0.
***********************
*
1230000    JUN91-94  SNGLJUN
1230101    091010000 094000000 0.        0.00        0.00        0100
1230201    1         1.55      0.        0.
***********************
*
1240000    JUN91-92  SNGLJUN
1240101    091010000 092000000 0.        0.00        0.00        0000
1240201    1         0.        0.        0.
***********************
*
1250000    JUN95-97  SNGLJUN
1250101    095010000 097000000 19.0E-4   12.5    12.5    0000
1250201    1         1.55      0.        0.
***********************
*
*1260000    JUN951-96 SNGLJUN
*1260101    095000000 096000000 0.        1.00        1.00        0100
*1260201    1         0.        0.        0.
***********************
*
1270000    JUN950-96 SNGLJUN
1270101    095010000 096000000 0.        1.00        1.00        0100
1270201    1         0.        0.        0.
***********************
*
1280000    JUN97-31  SNGLJUN
```

```
1280101   097010000 031010000 0.      0.00     0.00     0100
1280201   1         1.55      0.      0.
*
* COOLING SYSTEM
***********************
*
3010000   COOLING        TMDPVOL
3010101   0.003959  1.   0.   0.   0.   0.   0.   0.       10
3010200   2
3010201   0.        7000000.  0.
***********************
*
4010000   COOLING        TMDPJUN
4010101   072000000      301000000      0.
4010200   1     504
4010201   0.   7.85    0.   0.   1.78 7.85   0.   0.   2.0  0.   0.   0.
***********************
*
3020000   SPRAYFLOW      TMDPVOL
3020101   0.002525  1.   0.   0.  90.   1.   0.   0.02576   10
3020200   3
3020201   0.        7500000.  454.0
***********************
*
4020000   SPRAYFLOW      TMDPJUN
4020101   302000000      012010000      0.
4020200   1  504
4020201   0.   5.36    0.   0.   1.65 5.36   0.   0.   1.9  0.   0.   0.
***********************
*
3030000   SUBCOOLING     TMDPVOL
3030101   0.000531  1.   0.   0.   0.   0.   0.   0.       10
3030200   3
3030201   0.        7500000.  454.0
***********************
*
4030000   SUBCOOLING     TMDPJUN
4030101   303000000      021010000      0.
4030200   1   504
4030201   0.   2.4900 0.   0.   1.9  2.4900 0.   0.   2.0  0.   0.   0.
*
* STEAM RELIEF
***********************
*
3040000   RELIEF    TMDPVOL
3040101   0.00636   1.   0.    0.  90.   1.   0.   0.   00   *STEADY STATE
3040200   2
3040201   0.        7000000.   1.0   *STEADY STATE CARD
*
*4040000   RELIEF    VALVE                                  *OLD MODEL
*4040101   013010000 304000000 0.000094  0.   0.   0100     *OLD MODEL
*4040201   1    0.    0.   0.                               *OLD MODEL
*4040300   MTRVLV   *MOTORVALVE                             *OLD MODEL
*4040301   0000602   0000604   3.33  0.                     *OLD MODEL
*
***********************
*
4040000   DOMECNTRL SNGLJUN    *STEADY STATE CARD
```

```
4040101   013010000      304000000      0.   0.   0.  1000  *STEADY S
4040201   1    0.   0.   0.   *STEADY STATE CARD
*
* DUMP VOLUMES
***********************
*
5020000   DUMP3     TMDPVOL
5020101   1.00      1.00      0.   0.   0.   0.   0.   0.   00
5020200   2
5020201   0.   100000.   1.0
*
* SPLIT RUPTURE IN CIRCULATION LINE
***********************
*
1520000   BREAK     VALVE
1520101   096010000 502000000   0.0001131 0.   0.   0100  0.85  0.85 *
1520201   1    0.   0.   0.
1520300   MTRVLV
1520301   0000504   0000505   5.00      0.0   *OPENING TIME .20 SEC
*
*
* HEAT STRUCTURES
14010000          1     7    2    1    0.          * CORE
14010100        0     1
14010101        4  0.004725    2  0.006125
14010201        1  4          -2  6
14010301        0.0 4          1.0 6
14010400        0
14010401        570. 7
14010501        0           0    0    1    13.248    1
14010601        004010000 0    1    1    13.248    1
14010701        1    0.0764    0.   0.   1
14010901        10  0.01742   0.   0.   1
14020000        1    7    2    1    0.
14020100        0    1
14020101        4  0.005175    2  0.006125
14020201        1  4          -2  6
14020301        0.0 4          1.0 6
14020400        4010
14020501        0           0    0    1    13.248    1
14020601        004020000 0    1    1    13.248    1
14020701        1    0.1030    0.   0.   1
14020901        10  0.01742   0.   0.   1
14030000        1    7    2    1    0.
14030100        0    1
14030101        4  0.005275    2  0.006125
14030201        1  4          -2  6
14030301        0.0 4          1.0 6
14030400        4010
14030501        0           0    0    1    13.248    1

14030601        004030000 0    1    1    13.248    1
14030701        1    0.1138    0.   0.   1
14030901        10  0.01742   0.   0.   1
14040000        1    7    2    1    0.
14040100        0    1
14040101        4  0.005375    2  0.006125
14040201        1  4          -2  6
```

```
14040301        0.0 4          1.0 6
14040400        4010
14040501        0           0    0    1    13.248    1
14040601        004040000 0    1    1    13.248    1
14040701        1    0.1200    0.   0.   1
14040901        10  0.01742   0.   0.   1
14050000        1    7    2    1    0.
14050100        4040
14050400        4010
14050501        0           0    0    1    13.248    1
14050601        004050000 0    1    1    13.248    1
14050701        1    0.1190    0.   0.   1
14050901        10  0.01742   0.   0.   1
14060000        1    7    2    1    0
14060100        4030
14060400        4010
14060501        0           0    0    1    13.248    1
14060601        004060000 0    1    1    13.248    1
14060701        1    0.1133    0.   0.   1
14060901        10  0.01742   0.   0.   1
14070000        1    7    2    1    0.
14070100        4030
14070400        4010
14070501        0           0    0    1    13.248    1
14070601        004070000 0    1    1    13.248    1
14070701        1    0.1130    0.   0.   1
14070901        10  0.01742   0.   0.   1
14080000        1    7    2    1    0
14080100        4020
14080400        4010
14080501        0           0    0    1    13.248    1
14080601        004080000 0    1    1    13.248    1
14080701        1    0.1024    0.   0.   1
14080901        10  0.01742   0.   0.   1
14090000        1    7    2    1    0.
14090100        0    1
14090101        4  0.004975    2  0.006125
14090201        1  4          -2  6
14090301        0.0 4          1.0 6
14090400        4010
14090501        0           0    0    1    13.248    1
14090601        004090000 0    1    1    13.248    1
14090701        1    0.0877    0.   0.   1
14090901        10   0.01742   0.   0.   1
14100000        1    7    2    1    0.
14100100        0    1
14100101        4  0.001825    2  0.006125
14100201        1  4          -2  6
14100301        0.0 4          1.0 6
14100400        4010
14100501        0           0    0    1    13.248    1
14100601        004100000 0    1    1    13.248    1
14100701        1    0.0514    0.   0.   1
14100901        10  0.01742   0.   0.   1
*
10640000        1    7    2    1    0.    *  BY PASS
10640100        0    1
10640101        1    0.006125
```

```
10640201       2    1
10640301       1.0 1
10640400       0
10640401       570. 2
10640501       0          0    0    1    2.67      1
10640601       064010000 0    1    1    2.67      1
10640701       2    0.25      0.        0.        1
10640901       0    0.          0.        0.        1
*    HYDR DIA IN HEAT AND HYDR STRUCTURE THE SAME
10650000       1    2    2    1    0.
10650100       0640
10650400       0640
10650501       0          0    0    1    2.67      1
10650601       064020000 0    1    1    2.67      1
10650701       2    0.48      0.        0.        1
10650901       0    0.01742    0.        0.        1
10660000       1    2    2    1    0.
10660100       0640
10660400       0640
10660501       0          0    0    1    2.67      1
10660601       064030000 0    1    1    2.67      1
10660701       2    0.27      0.        0.        1
10660901       0    0.01742    0.        0.        1
*
*
* BOX WALL TO ACCOUNT FOR HEAT LOSSES
14000000   10   2   1   1   0.
14000100    0   1
14000101    1   0.002
14000201    3   1
14000301    0.  1
14000401  450.  1
14000402  540.  2
14000501  -401              -1  3400   0   0.15      10
14000601   004010000  010000     1   0   0.15      10
14000701    0   0.   0.   0.      10
14000901    0   0.   0.   0.      10
*
*  GENERAL TABLE GIVING HEAT TRANSFER COEFF. AT OUTSIDE OF BOX WALL.
*
20240000   HTC-T
20240001   0.    1.7213E3  * HTC DETERMINED TO GIVE HEAT LOSS OF APP
*
*  GENERAL TABLES GIVING THE TEMPERATURES AT THE OUTSIDE OF THE
*  BOX WALL. TEMPERATURE IS SUPPOSED TO VARY LINEARLY BETWEEN 403 K
*  AT INLET TO 493 K AT OUTLET.
*
20240100   TEMP
20240101   0.    407.5
*
20240200   TEMP
20240201   0.    416.5
*
20240300   TEMP
20240301   0.    425.5
*
20240400   TEMP
20240401   0.    434.5
```

```
20240500   TEMP
20240501   0.    443.5
*
20240600   TEMP
20240601   0.    452.5
*
20240700   TEMP
20240701   0.    461.5
*
20240800   TEMP
20240801   0.    470.5
*
20240900   TEMP
20240901   0.    479.5
*
20241000   TEMP
20241001   0.    488.5
*
*
13100000  1    4    1    1    0.00
13100100  0    2
13100101  0.005  1   0.015  2   0.00  3
13100201  3    3
13100301  .0   3
13100401  560.   4
13100501  31010000  0    1    0    .179    1
13100601 -13   0  3014   0     .179   1
13100701  0    .0    .0    .0    1
13100801  0    .0    .0    .0    1
*
13200000  1    4    2    1    .132
13200100  0    2
13200101  0.005   1   0.015  2   0.01  3
13200201  3    3
13200301  .0   3
13200401  560.   4
13200501  32010000  0    1    1    .325    1
13200601 -13   0  3014   1     .325   1
13200701  0    .0    .0    .0    1
13200801  0    .0    .0    .0    1
*
13300000  1    4    2    1    .132
13300100  0    2
13300101  0.005  1   0.015  2   0.03  3
13300201  3    3
13300301  .0   3
13300401  560.   4
13300501  33010000  0    1    1    .271    1
13300601 -13   0  3014   1     .271   1
13300701  0    .0    .0    .0    1
13300801  0    .0    .0    .0    1
*
15100000  1    3    2    1    .132
15100100  0    1
15100101  2    .162
15100201  3    2
15100301  .0   2
```

```
15100401  560.   3
15100501  51010000  0    1    1    .179    1
15100601 -13   0  3014   1     .179   1
15100701  0    .0    .0    .0    1
15100801  0    .0    .0    .0    1
*
15210000  1    3    2    1    .063
15210100  0    1
15210101  2    .065
15210201  3    2
15210301  .0   2
15210401  560.   3
15210501  52010000  0    1    1    .437    1
15210601  0    0    0    1    .437   1
15210701  0    .0    .0    .0    1
15210801  0    .0    .0    .0    1
*
15220000  1    3    2    1    .050
15220100  0    1
15220101  2    .052
15220201  3    2
15220301  .0   2
15220401  560.   3
15220501  52020000  0    1    1    .953    1
15220601  0    0    0    1    .953   1
15220701  0    .0    .0    .0    1
15220801  0    .0    .0    .0    1
*
11100000  1    4    2    1    .250
11100100  0    2
11100101  0.005  1   0.015  2   0.033  3
11100201  3    3
11100301  .0   3
11100401  560.   4
11100501  11010000  0    1    1    .458    1
11100601 -13   0  3014   1     .458   1
11100701  0    .0    .0    .0    1
11100801  0    .0    .0    .0    1
*
11210000  1    4   2    1    .250
11210100  0    2
11210101  0.005  1   0.015  2   0.033  3
11210201  3    3
11210301  .0   3
11210401  560.   4
11210501  12010000  0    1    1    2.200    1
11210601 -13   0  3014   1     2.200   1
11210701  0    .0    .0    .0    1
11210801  0    .0    .0    .0    1
*
11220000  1    4    1    1    0.00
11220100  0    2
11220101  0.005  1   0.015  2   0.033  3
11220201  3    3
11220301  .0   3
11220401  560.   4
11220501  12020000  0    1    0    .400      1
11220601 -13   0  3014   0     .400   1
```

```
11220701  0   .0   .0   .0   1
11220801  0   .0   .0   .0   1
*
12110000  1   4   2   1   .250
12110100  0   2
12110101  0.005  1   0.015  2   0.033  3
12110201  3   3
12110301  .0  3
12110401  560.   4
12110501  21010000   0   1   1   .404   1
12110601 -13   0  3014  1    .404   1
12110701  0   .0   .0   .0   1
12110801  0   .0   .0   .0   1
*
12120000  1   4   2   1   .170
12120100  0   2
12120101  0.005  1   0.015  2   0.033  3
12120201  3   3
12120301  .0  3
12120401  560.   4
12120501  21020000   0   1   1   .549   1
12120601 -13   0  3014  1    .549   1
12120701  0   .0   .0   .0   1
12120801  0   .0   .0   .0   1
*
12130000  1   4   2   1   .132
12130100  0   2
12130101  0.005  1   0.015  2   0.01   3
12130201  3   3
12130301  .0  3
12130401  560.   4
12130501  21030000   0   1   1   .286   1
12130601 -13   0  3014  1    .286   1
12130701  0   .0   .0   .0   1
12130801  0   .0   .0   .0   1
*
12140000  1   4   2   1   .132
12140100  0   2
12140101  0.005  1   0.015  2   0.01   3
12140201  3   3
12140301  .0  3
12140401  560.   4
12140501  21040000   0   1   1   .146   1
12140601 -13   0 3014   1    .146   1
12140701  0   .0   .0   .0   1
12140801  0   .0   .0   .0   1
*
17100000  8   3   2   1   .0548
17100100  0   1
17100101  2   .0707
17100201  3   2
17100301  .0  2
17100401  560.   3
17100501  71010000  010000   1   1   0.998   3
17100502  71040000  010000   1   1   0.820   8
17100601 -13   0  3014  1   0.998   3
17100602 -13   0  3014  1   0.820   8
17100701  0   .0   .0   .0   8
```

```
17100801  0   .0   .0   .0   8
*
17200000  1   3   2   1   .0548
17200100  0   1
17200101  2   .0707
17200201  3   2
17200301  .0  2
17200401  560.   3
17200501  72010000   0   1   1   .300   1
17200601 -13   0  3014  1    .300   1
17200701  0   .0   .0   .0   1
17200801  0   .0   .0   .0   1
*
17300000  1   3   2   1   .0548
17300100  0   1
17300101  2   .0707
17300201  3   2
17300301  .0  2
17300401  560.   3
17300501  73010000   0   1   1   .716   1
17300601  -13  0  3014  1    .716   1
17300701  0   .0   .0   .0   1
17300801  0   .0   .0   .0   1
*
17400000  4   3   2   1   .0369
17400100  0   1
17400101  2   .0445
17400201  3   2
17400301  .0  2
17400401  560.   3
17400501  74010000   0   1   1   .573   1
17400502  74020000   0   1   1   1.117  2
17400503  74030000   0   1   1   2.874  3
17400504  74040000   0   1   1   1.580  4
17400601 -13   0   3014  1    .573   1
17400602 -13   0   3014  1    1.117  2
17400603 -13   0   3014  1    2.874  3
17400604 -13   0   3014  1    1.580  4
17400701  0   .0   .0   .0   4
17400801  0   .0   .0   .0   4
*
17450000  1   3   1   1   0.00
17450100  0   1
17450101  2   .003
17450201  3   2
17450301  .0  2
17450401  560.   3
17450501  74050000   0   1   0   .055   1
17450601 -13   0   3014  0    .055   1
17450701  0   .0   .0   .0   1
17450801  0   .0   .0   .0   1
*
16200000  1   3   2   1   .0875
16200100  0   1
16200101  2   .0995
16200201  3   2
16200301  .0  2
16200401  560.   3
```

```
16200501  62010000   0   1   1   1.221   1
16200601  -13  0  3014  1    1.221   1
16200701  0   .0   .0   .0   1
16200801  0   .0   .0   .0   1
*
16400000  3   3   2   1   .0486
16400100  0   1
16400101  2   .0572
16400201  3   2
16400301  .0  2
16400401  560.   3
16400501  64010000   0   1   1   1.440   1
16400502  64020000   0   1   1   1.335   2
16400503  64030000   0   1   1   1.363   3
16400601 -13   0  3014  1    1.440   1
16400602 -13   0  3014  1    1.335   2
16400603 -13   0  3014  1    1.363   3
16400701  0   .0   .0   .0   3
16400801  0   .0   .0   .0   3
*
19100000  1   3   2   1   .0369
19100100  0   1
19100101  2   ..0445
19100201  3   2
19100301  .0  2
19100401  560.   3
19100501  91010000   0   1   1   1.246   1
19100601 -13   0   3014 1    1.246   1
19100701  0   .0   .0   .0   1
19100801  0   .0   .0   .0   1
*
19200000  1   3   2   1    .0369
19200100  0   1
19200101  2   .0445
19200201  3   2
19200301  .0  2
19200401  560.   3
19200501  92010000    0   1   1   1.339   1
19200601 -13      0    3014   1   1.339   1
19200701  0           0.  0.  0.          1
19200801  0           0.  0.  0.          1
*
19400000  1   3   2   1   .0246
19400100  0   1
19400101  2   .0301
19400201  3   2
19400301  .0  2
19400401  560.   3
19400501  94010000   0   1   1   1.188  1
19400601 -13   0  3014  1    1.188   1
19400701  0   .0   .0   .0   1
19400801  0   .0   .0   .0   1
*
19500000  1   3   2   1   .0246
19500100  0   1
19500101  2   .0301
19500201  3   2
19500301  .0  2
```

```
19500401  560.  3
19500501  95010000  0   1   1   1.683   1
19500601 -13   0  3014  1    1.683   1
19500701  0   .0   .0   .0   1
19500801  0   .0   .0   .0   1
*
19600000  1   3   2   1   .0369
19600100  0   1
19600101  2   .0445
19600201  3   2
19600301  .0  2
19600401  560.0   3
19600501  96010000   0   1   1   1.475   1
19600601  -13      0  3014  1   1.475   1
19600701  0            0.  0.  0.         1
19600801  0            0.  0.  0.         1
*
19710000  1   3   2   1   .0246
19710100  0   1
19710101  2   .0301
19710201  3   2
19710301  .0  2
19710401  560.  3
19710501  97010000  0   1   1   2.780   1
19710601  -13  0  3014  1    2.780   1
19710701  0   .0   .0   .0   1
19710801  0   .0   .0   .0   1
*
19720000  1   3   2   1   .0406
19720100  0   1
19720101  2   .050
19720201  3   2
19720301  .0  2
19720401  560.  3
19720501  97020000  0   1   1   1.420   1
19720601 -13   0  3014  1    1.420   1
19720701  0   .0   .0   .0   1
19720401  0   .0   .0   .0   1
*
19730000  1   3   1   1   0.00
19730100  0   1
19730101  2   .003
19730201  3   2
19730301  .0  2
19730401  560.  3
19730501  97030000  0   1   0   .055   1
19730601  -13  0  3014  0    .055   1
19730701  0   .0   .0   .0   1
19730801  0   .0   .0   .0   1
*
12010000  1   3   1   1   0.00
12010100  0   1
12010101  2   .020
12010201  3   2
12010301  .0  2
12010401  560.  3
12010501  201010000  0   1   0   0.50    1
12010601 -13   0  3014  0    0.50    1
```

```
12010701  0   .0   .0   .0   1
12010801  0   .0   .0   .0   1
*
12020000  1   3   1   1   0.00
12020100  0   1
12020101  2   .020
12020201  3   2
12020301  .0  2
12020401  560.  3
12020501  202010000  0   1   0   0.300  1
12020601  -13  0  3014  0    0.30   1
12020701  0   .0   .0   .0   1
12020801  0   .0   .0   .0   1
*
13110000        3    6    2    1    0.          * COPPER HODS
13110100        0    1
13110101        3  0.0045    2  0.0070
13110201        1  3           4  5
13110301        0.0 5
13110400        0
13110401        570. 6
13110501        0          0    0    1    5.40     1
13110502        0          0    0    1   11.70     2
13110503        0          0    0    1    9.80     3
13110601        031010000 0  1    1   5.40    1
13110602        032010000 0  1    1  11.70    2
13110603        033010000 0  1    1   9.80    3
13110701        0    0.00    0.   0.   3
13110901        00  0.01742   0.   0.   3
15110000        1    5    2    1    0.          * COPPEH CABLES
15110100        0    1
15110101        4  0.004
15110201        4  4
15110301        0.0 4
15110400        0
15110401        570. 5
15110501        0          0    0    1    7.40     1
15110601        051010000 0  1    1   7.40    1
15110701        0    0.00    0.   0.   1
15110901        00  0.01742   0.   0.   1
*
*
*
20100100  TBL/FCTN  1   -1     *  MO O
20100101        473. 5.50      573. 4.65      673. 3.75      773. 3.10
20100102        873. 2.75      973. 2.50     1073. 2.30
20100151        3300000.  3300000.  3328000.  3465000.
20100152        3630000.  3713000.  3740000.
*
20100200  TBL/FCTN  2    2    *  INCONEL 600
20100201  293. 1088.     10.974    0.0122    0.000002862 0. 0. 0. 0.
20100251  293. 1088.     2665370.  4173.5   -1.7262       0. 0. 0. 0.
*
20100300  S-STEEL
*
20100400  TBL/FCTN    1  1      * COPPER
20100401  390.0
20100451  3.48E+06
```

```
*
*
* CORE POWER REDUCTION
20200100  POWER   504          1.          3.385E6
20200101  .0.00 1.000  0.25 0.995  2.00 0.721  5.00 0.462
20200102   7.50 0.337  10.0 0.232  12.5 0.165  15.0 0.125 20.0 0.083
20200103  25.00 0.067 30.00 0.062 50.00 0.060 75.00 0.055 200.0 0.055
* BY-PASS POWER REDUCTION
20200200  POWER   504          1.          57.4E3
20200201   0.00 1.000  1.00 0.552  2.00 0.469  5.00 0.402
20200202  10.00 0.286 15.00 0.052 20.00 0.016 25.00 0.012 200.00 0.012
*
*
*LIQUID LEVEL IN DOME DC ANNULUS AND DOWNCOMER TO BREAK
*HEIGHT OF LIQUID = FCT OF LIQUID VOID
20201100  NORMAREA        *VOL21-2
20201101  0.   0.   .2960      .2740      1.0        0.549
20201200  NORMAREA        *VOL21-3
20201201  0.   0.   0.498      0.150      1.0        0.286
20201300     TEMP
20201301   0.      290.
20201400   HTC-T
20201401    0.      16.64      * \\ AUXILIARY HEAT TRANSFER COEFF.
20501100  LIQH21-2         FUNCTION  1.   0.   1
20501101  VOIDF      021020000       011
20501200  LIQH21-3         FUNCTION  1.   0.   1
20501201  VOIDF      021030000       012
20504100  LIQLEVDC         SUM       1.   0.   1
20504101  1.115    0.300             VOIDF      072010000
20504102  0.820            VOIDF      071080000
20504103  0.820            VOIDF      071070000
20504104  0.820            VOIDF      071060000
20504105  0.820            VOIDF      071050000
20504106  0.820            VOIDF      071040000
20504107  .146             VOIDF      021040000
20504108  1.               CNTRLVAR   012
20504109  1.               CNTRLVAR   011
20504110           0.404   VOIDF      021010000
*LIQUID LEVEL IN UPPER PLENUM AND STEAM PIPE
*HEIGHT OF LIQUID = FCT OF LIQUID VOID
20202100  NORMAREA        *VOL52-1
20202101  0.   0.   0.150      0.023      0.336      0.080
20202102  0.654     0.239      0.875      0.389      1.0        0.525
20502100  LIQH52-1         FUNCTION  1.   0.   1
20502,01  VOIDF      052010000       021
20504200  LIQLEVUP         SUM       1.   0.   1
20504201  0.   0.178       VOIDF      051010000
20504202  1.0              CNTRLVAR   021
20504203  0.952            VOIDF      052020000
*LIQUID LEVEL IN CORE
20504300  LIQLCORE         SUM       0.368      0.   1
20504301  0.   1.    VOIDF      004010000
20504302  1.         VOIDF      004020000
20504303  1.         VOIDF      004030000
20504304  1.         VOIDF      004040000
20504305  1.         VOIDF      004050000
20504306  1.         VOIDF      004060000
20504307  1.         VOIDF      004070000
```

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20504308  1.          VOIDF       004080000
20504309  1.          VOIDF       004090000
20504310  1.          VOIDF       004100000
*LIQUID LEVEL IN LOWER PLENUM
20504400  LIQLEVLP         SUM          1.   0.   1
20504401  0.   0.150       VOIDF        031010000
20504402  0.325            VOIDF       32010000
20504403  0.271            VOIDF       33010000
*
*ROD CLADDING TEMP SAVE UP
20506100  CLADTEMP1        MULT         1.   0.   1
20506101  HTTEMP     401000105          *ROD CLADDING INNER TEMP VOL1
20506200  CLADTEMP2        MULT         1.   0.   1
20506201  HTTEMP     402000105          *ROD CLADDING INNER TEMP VOL2
20506300  CLADTEMP3        MULT         1.   0.   1
20506301  HTTEMP     403000105          *ROD CLADDING INNER TEMP VOL3
20506400  CLADTEMP4        MULT         1.   0.   1
20506401  HTTEMP     404000105          *ROD CLADDING INNER TEMP VOL4
20506500  CLADTEMP5        MULT         1.   0.   1
20506501  HTTEMP     405000105          *ROD CLADDING INNER TEMP VOL5
20506600  CLADTEMP6        MULT         1.   0.   1
20506601  HTTEMP     406000105          *ROD CLADDING INNER TEMP VOL6
20506700  CLADTEMP7        MULT         1.   0.   1
20506701  HTTEMP     407000105          *ROD CLADDING INNER TEMP VOL7
20506800  CLADTEMP8        MULT         1.   0.   1
20506801  HTTEMP     408000105          *ROD CLADDING INNER TEMP VOL8
20506900  CLADTEMP9        MULT         1.   0.   1
20506901  HTTEMP     409000105          *ROD CLADDING INNER TEMP VOL9
20507000  CLADTEMP10       MULT         1.   0.   1
20507001  HTTEMP     410000106          *ROD CLADDING MIDDLE TEMP VOL10
*
*HEAT TRANSFER COEFF (HEAT RATE/(SURFACE TEMP-FLUID TEMP))
20508100  HTCOEF1   SUM        1.   0.   1
20508101     0.    1.             HTHTC      401000101
20508200  HTCOEF2   SUM        1.   0.   1
20508201     0.    1.             HTHTC      402000101
20508300  HTCOEF3   SUM        1.   0.   1
20508301     0.    1.             HTHTC      403000101
20508400  HTCOEF4   SUM        1.   0.   1
20508401     0.    1.             HTHTC      404000101
20508500  HTCOEF5   SUM        1.   0.   1
20508501     0.    1.             HTHTC      405000101
20508600  HTCOEF6   SUM        1.   0.   1
20508601     0.    1.             HTHTC      406000101
20508700  HTCOEF7   SUM        1.   0.   1
20508701     0.    1.             HTHTC      407000101
20508800  HTCOEF8   SUM        1.   0.   1
20508801     0.    1.             HTHTC      408000101
20508900  HTCOEF9   SUM        1.   0.   1
20508901     0.    1.             HTHTC      409000101
20509000  HTCOEF10  SUM        1.   0.   1
20509001     0.    1.             HTHTC      410000101
* LIQUID LEVEL CONTROL SYSTEM FOR DC (STEADY STATE ONLY)
3050000   LEVCTHVOL    TMDPVOL
3050101   1.   1.   0.   0.   0.   0.   0.   0.    00
3050200   2
3050201   0.     7.0E6   0.
4050000   LEVCTRJUN    TMDPJUN
```

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4050101   305000000   021010000   0.2
4050200   0      0     CNTRLVAR  049
4050201   -0.2     -0.2      0.   0.
4050202    0.2      0.2      0.   0.
20504900   LEVCTR    SUM    2.   0.    0
20504901   6.340    -1.     CNTRLVAR  041
*
*
*
20505000       STR-HTLOSS     SUM      1.     0.      0
20505001    0.    .17900     HTRNR    310000100
20505002          .26955     HTRNR    320000100
20505003          .22476     HTRNR    330000100
20505004          .14046     HTRNR    510000100
20505005          .17298     HTRNR    521000100
20505006          .29939     HTRNR    522000100
20505007          .71943     HTRNR    110000100
20505008         3.45575     HTRNR    121000100
20505009          .40000     HTRNR    122000100
20505010          .63460     HTRNR    211000100
20505011          .58641     HTRNR    212000100
20505012          .23721     HTRNR    213000100
20505013          .12109     HTRNR    214000100
20505014          .34363     HTRNR    710000100
20505015          .34363     HTRNR    710000200
20505016          .34363     HTRNR    710000300
20505017          .28234     HTRNR    710000400
20505018          .28234     HTRNR    710000500
20505019          .28234     HTRNR    710000600
20505020          .28234     HTRNR    710000700
20505100     STR-HTLOSS    SUM   1.    0.   0
20505101   0.     .28234     HTRNR    710000800
20505102          .10330     HTRNR    720000100
20505103          .24653     HTRNR    730000100
20505104          .13285     HTRNR    740000100
20505105          .25898     HTRNR    740000200
20505106          .66634     HTRNR    740000300
20505107          .36632     HTRNR    740000400
20505108          .55000     HTRNR    745000100
20505109          .67128     HTRNR    620000100
20505110          .43972     HTRNR    640000100
20505111          .40766     HTRNR    640000200
20505112          .41621     HTRNR    640000300
*20505113           .20889     HTRNR    910000100
20505113          .14445     HTRNR    910000100
20505114          .50000     HTRNR    201000100
20505115          .49514     HTRNR    920000100
20505116   0.24   HTRNR   311000101
20505117   0.51   HTRNR   311000201
20505118   0.43   HTRNR   311000301
20505119   0.20   HTRNR   511000101
20505120          .30000     HTRNR    202000100
*
20505200     STR-HTLOSS    SUM   1.    0.   0
20505201   0.     .31045     HTRNR    920000100
20505202          .34108     HTRNR    960000100
20505300   TOTAL    SUM    1.    0.    0
20505301   0.    1.    CNTRLVAR 50
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20505302          1.    CNTRLVAR 51
20505303          1.    CNTRLVAR 52
*
20505400    STR-HTINT    INTEGRAL    1.    0.    0
20505401    CNTRLVAR  50
*
20505500    BREAK-LOSS    INTEGRAL    1.    0.    0
20505501    MFLOWJ    152000000
*
20505600     BOX-HTLOSS      SUM     1.      0.     0
20505601     0.    .150       HTRNR       400000100
20505602           .150       HTRNR       400000200
20505603           .150       HTRNR       400000300
20505604           .150       HTRNR       400000400
20505605           .150       HTRNR       400000500
20505606           .150       HTRNR       400000600
20505607           .150       HTRNR       400000700
20505608           .150       HTRNR       400000800
20505609           .150       HTRNR       400000900
20505610           .150       HTRNR       400001000
*
20505700     COR-POW         FUNCTION     1.            0.     0
20505701     TIME    0        001
*
20505800     BYPASS-POW    FUNCTION     1.           0.     0
20505801     TIME      0        002
*
20505900     TOT-POW        SUM     1.     0.     0
20505901     0.           1.     CNTRLVAR 57
20505902                  1.     CNTRLVAR 58
20511000      AUX-HTLOSS     SUM      1.     0.      0
20511001    0.     .17900     HTRNR    310000101
20511002           .33081     HTRNR    320000101
20511003           .30990     HTRNR    330000101
20511004           .18220     HTRNR    510000101
20511007           .07194     HTRNR    110000101
20511008         4.08837      HTRNR    121000101
20511009           .40000     HTRNR    122000101
20511010           .76914     HTRNR    211000101
20511011           .76923     HTRNR    212000101
20511012           .29111     HTRNR    213000101
20511013           .14861     HTRNR    214000101
20511014           .44333     HTRNR    710000101
20511015           .44333     HTRNR    710000201
20511016           .44333     HTRNR    710000301
20511017           .36426     HTRNR    710000401
20511018           .36426     HTRNR    710000501
20511019           .36426     HTRNR    710000601
20511020           .36426     HTRNR    710000701
*
20511100     AUX-HTLOSS    SUM    1.    0.    0
20511101    0.     .36426     HTRNR    710000801
20511102           .13327     HTRNR    720000101
20511103           .31806     HTRNR    730000101
20511104           .16021     HTRNR    740000101
20511105           .31232     HTRNR    740000201
20511106           .00358     HTRNR    740000301
20511107           .44179     HTRNR    740000401
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20511108         .05500    HTRNR   745000101
20511109         .76336    HTRNR   620000101
20511110         .51753    HTRNR   640000101
20511111         .47980    HTRNR   640000201
20511112         .40986    HTRNR   640000301
20511113         .34038    HTRNR   910000101
20511114         .22468    HTRNR   940000101
20511115         .31830    HTRNR   950000101
20511116         .52576    HTRNR   971000101
20511117         .44611    HTRNR   972000101
20511118         .05500    HTRNR   973000101
20511119         .50000    HTRNR   201000101
20511120         .30000    HTRNR   202000101
*
20511200    AUX-HTLOSS   SUM   1.    0.    0
20511201   0.      .37439   HTRNR   920000101
20511202           .41241   HTRNR   960000101
*
20511300    TT-AUX-HTL   SUM    1.     0.     0
20511301    0.     1.    CNTRLVAR 110
20511302           1.    CNTRLVAR 111
20511303           1.    CNTRLVAR 112
*
*
************ INITIAL VALUES
*
0310200   3    7117380.  541.74
0320200   3    7115560.  541.77
0330200   3    7113300.  541.80
0510200   2    7038120.  0.18041
0130200   2    7000700.  1.0
0720200   3    7041360.  541.79
0730200   3    7045300.  541.78
0620200   3    7073580.  540.48
0910200   3    7042680.  541.71
0920200   3    7042750.  541.62
0940200   3    7045350.  541.65
0950200   3    7124900.  541.65
0960200   3    7123710.  538.77
2010200   3    7112300.  541.83
2020200   3    7104330.  541.70
0041201   3    7072590.  550.04     0.       0.       0.   1
0041202   2    7069340.  0.004216   0.       0.       0.   2
0041203   2    7066310.  0.022467   0.       0.       0.   3
0041204   2    7063500.  0.039025   0.       0.       0.   4
0041205   2    7059940.  0.055152   0.       0.       0.   5
0041206   2    7056080.  0.070705   0.       0.       0.   6
0041207   2    7051950.  0.093267   0.       0.       0.   7
0041208   2    7047590.  0.13705    0.       0.       0.   8
0041209   2    7044210.  0.16761    0.       0.       0.   9
0041210   2    7039500.  0.25524    0.       0.       0.   10
0521201   2    7036870.  0.069336   0.       0.       0.    1
0521202   2    7002170.  0.29212    0.       0.       0.    2
0111201   2    7002930.  0.54092    0.       0.       0.    1
0121201   2    7002080.  0.52087    0.       0.       0.    1
0121202   2    7001350.  0.41925    0.       0.       0.    2
0211201   2    7003220.  0.44877    0.       0.       0.    1
0211202   2    7003550.  0.04018    0.       0.       0.    2
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0211203   3    7009840.  558.91    0.      0.      0.   3
0211204   3    7011500.  541.94    0.      0.      0.   4
0711201   3    7010000.  541.83    0.      0.      0.   8
0741201   3    7120000.  541.75    0.      0.      0.   5
0641201   3    7063530.  545.99    0.      0.      0.   1
0641202   3    7053240.  553.89    0.      0.      0.   2
0641203   3    7043500.  558.02    0.      0.      0.   3
0971201   3    7116000.  541.65    0.      0.      0.   3
*
*   JUNCTION INITIAL VALUES
0041300    0
0041301   1.198      1.382    0.    1    1.319     1.701    0.    2
0041302   1.699      3.817    0.    3    2.006     5.219    0.    4
0041303   2.278      6.435    0.    5    2.512     7.534    0.    6
0041304   2.862      8.385    0.    7    3.691     8.707    0.    8
0041305   4.251      9.297    0.    9
0521300   1
0521301   4.35       1.76      0.   1
0121300   1
0121301  -7.12       1.76    0.   1
0211300   1
0211301   11.47    0.     0.   3
0711300   1
0711301   13.96    0.   0.   7
0741300   1
0741301   4.56   0.   0.   4
0641300   1
0641301   0.60     0.   0.  2
0971300   1
0971301   1.55     0.   0.     2
*
*   **** CHANGE CARDS TO GET CORE PRESSURE DROP  ***
0040801   1.E-4 0.0136  10
0520901   1.70   1.70   1
1030101   033010000 004000000 0.000473   0.340     0.200     0000
```

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*          INPUT FOR RELAP5/MOD2
*          FIX-II SPLIT BREAK TRANSIENT / STEADY STATE TO 5 S
*          100 0/0 POWER MEAN CORE CHANNEL
0000100    RESTART  TRANSNT
0000101    RUN
0000103    601
0000105    10.        20.
0000201    5.0  1.0E-6   0.05       00002      5   100   100
0000203    80.  1.0E-6    0.2        00002       1    50    50
*
0000502    TIME       0            LT   NULL 0    0.     L
0000503    TIME       0            LT   NULL 0    0.     L
0000504    TIME       0            GE   NULL 0    5.      L
*
*
*
0130000    VOL13      SNGLVOL
0130101    0.   3.854     0.01831   0.   0.   0.       0.   0.       00
0130200    2     7000700.    1.
***********************
*
1100000    JUN12-13   SNGLJUN
1100101    012010000 013000000 0.001432  0.95      0.95      0000
1100201    1          0.        0.        0.
***********************
*
1170000    BY-PASS    VALVE
1170101    032010000 064000000 0.000581  0.          0.          0000
1170201    1          0.60      0.        0.
1170300    MTHVLV     *    CONSTANT AREA DURING THE TRANSIENT
1170301    0000503    0000502   0.02      0.1788
1170400    1.0  34.20
1170401    .000 .000 .000 .125 .0906 .0906 .200 .1301 .1301
1170402    .500 .1955 .1955 1.00 .2037 .2037
***********************
*
3040000    RELIEF     TMDPVOL
3040101    0.00636    1.   0.   0.   0.   0.   0.   0.        00
3040200    2
3040201    0.         100000.   1.0
***********************
*
4040000    RELIEF     TMDPJUN
4040101    013010000 304000000 0.00009400
4040200    1   0   CNTRLVAR   100
4040201    0.   0.   0.   0.
4040202    1.E6 0.   1.E6 0.
***********************
*
*
2010000    PUMP1      PUMP
2010101    0.         0.750      0.01010   0.   16.4 0.283     0
2010108    073010000    0.00427   0.17      0.37      0000
2010109    074000000    0.000908  3.00      3.00      0000
2010200    3   7.11264E+06   541.75
2010201    1     4.56   0.    0.
2010202    1     4.56   0.    0.
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2010301    0     0     0    -1     0     0     0
2010302    303.69   0.556291   0.0383    50.   81.7    1.   1000.
2010303    0.    0.    0.    0.    0.
*  NYA HOMOLOGA PUMPKURVOR. DATA KOMMER FRÅN ASEA-ATOMS GOBLIN-BER.
*  TORQUE-KURVORNA SAKNAR BETYDELSE I DETTA FALL OCH HAR DÄRFÖR INTE
* KONTROLLERATS. KÄLLAN FÖR EN DEL DATA ÄR OKÄND.
2011100    1     1
2011101    0.00,1.101      0.27,1.180      0.47,1.160
2011102    0.64,1.130      1.00,1.000
2011200    2     1
2011201    0.00,0.84       0.09,0.87       0.19,0.89
2011202    0.38,0.92       0.59,0.962      0.80,0.99      1.00,1.00
2011300    1     2
2011301    0.0,-0.560     0.41,-0.16     0.51,-0.05     0.76,0.48
2011302    1.00,1.00
2011400    2     2
2011401    0.0,-1.16       0.5,0.00       0.68,0.38      1.00,1.00
2011500    1     3
2011501     -1.00,2.00     -0.95,1.81     -0.62,1.52     -0.50,1.39
2011502      0.00,1.18
2011600    1     4
2011601     -1.00,2.00     -0.79,1.53     -0.63,1.25     -0.30,0.93
2011602      0.00,0.72
2011700    2     3
2011701     -1.00,3.31     -0.83,2.78     -0.68,2.29     -0.56,1.95
2011702     -0.37,1.49     -0.22,1.19     -0.10,0.99      0.00,0.84
2011800    2     4
2011801     -1.00,3.31     -0.79,2.78     -0.59,2.37     -0.41,2.04
2011802     -0.21,1.78      0.00,1.55
* TWO PHASE MULTIPLIER TABLES
2013000    0
2013001  0.0,0.0  0.1,0.0  0.15,0.05  0.24,0.8  0.3,0.96  0.4,0.98
2013002  0.6,0.97  0.8,0.9  0.9,0.8  0.96,0.5  1.0,0.0
2013100    0
2013101  0.0,0.0  0.1,0.0  0.15,0.05  0.24,0.8  0.3,0.96  0.4,0.98
2013102  0.6,0.97  0.8,0.9  0.9,0.8  0.96,0.5  1.0,0.0
* TWO PHASE DIFFERENCE FOR PUMP HEAD (SEMISCALE)
2014100    1   1
2014101 0.0,0.0  0.1,0.83  0.2,1.09  0.5,1.02  0.7,1.01 0.9,0.94 1.0,1.0
2014200    1   2
2014201 0.0,0.0  0.1,-0.04  0.2,0.0  0.3,0.1  0.4,0.21  0.8,0.67
2014202 0.9,0.80  1.0,1.0
2014300    1   3
2014301 -1.0,-1.16  -0.9,-1.24  -0.8,-1.77  -0.7,-2.36  -0.6,-2.79
2014302 -0.5,-2.91  -0.4,-2.67  -0.25,-1.69  -0.1,-0.5  0.0,0.0
2014400    1   4
2014401 -1.0,-1.16  -0.9,-0.78  -0.8,-0.5  -0.7,-0.31  -0.6,-0.17
2014402 -0.5,-0.08  -0.35,0.0  -0.2,0.05  -0.1,0.08  0.0,0.11
* TWO PHASE DIFFERENCE FOR PUMP TORQUE (= SINGLE PHASE, WHICH MEANS
* THAT FULLY DEGRADED TORQUE IS ZERO)
2014900    2     1
2014901    0.00,0.84       0.09,0.87       0.19,0.89
2014902    0.38,0.92       0.59,0.962      0.80,0.99      1.00,1.00
2015000    2     2
2015001    0.0,-1.16       0.5,0.00       0.68,0.38      1.00,1.00
2015100    2     1
2015101     -1.00,3.31     -0.83,2.78     -0.68,2.29     -0.56,1.95
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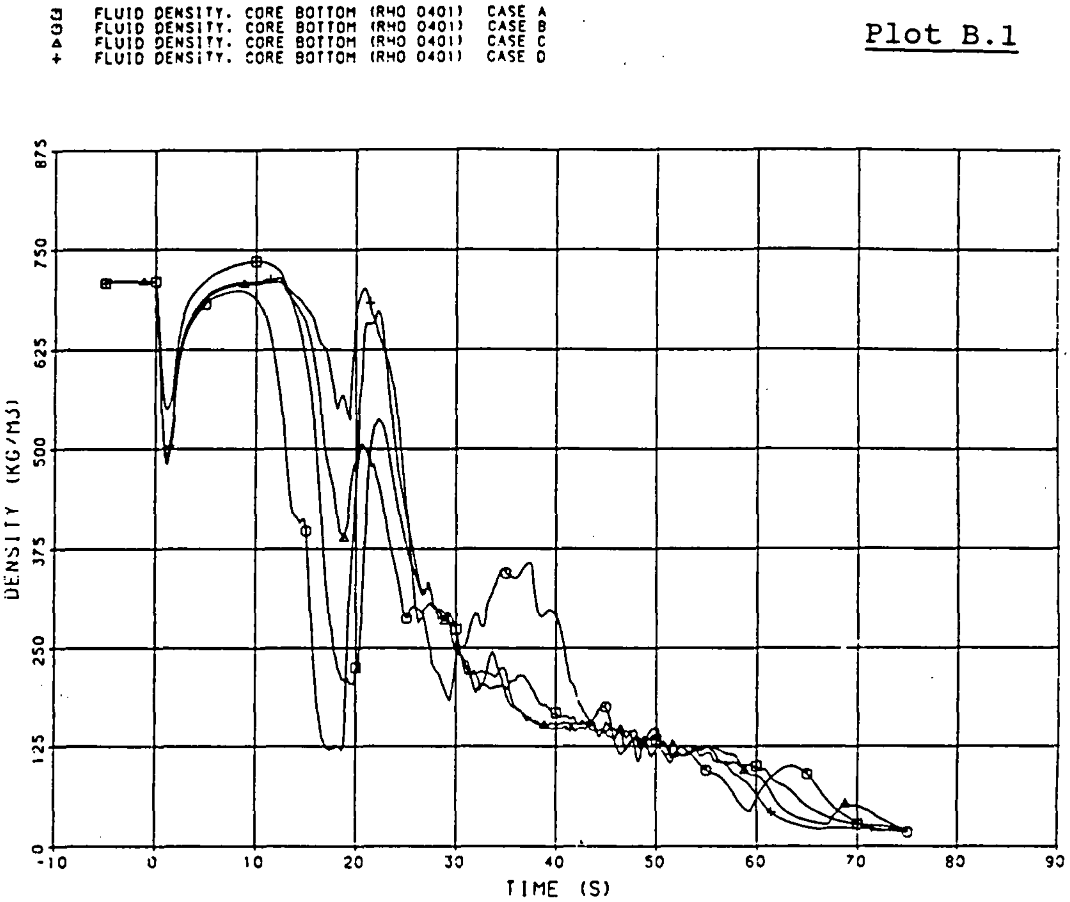
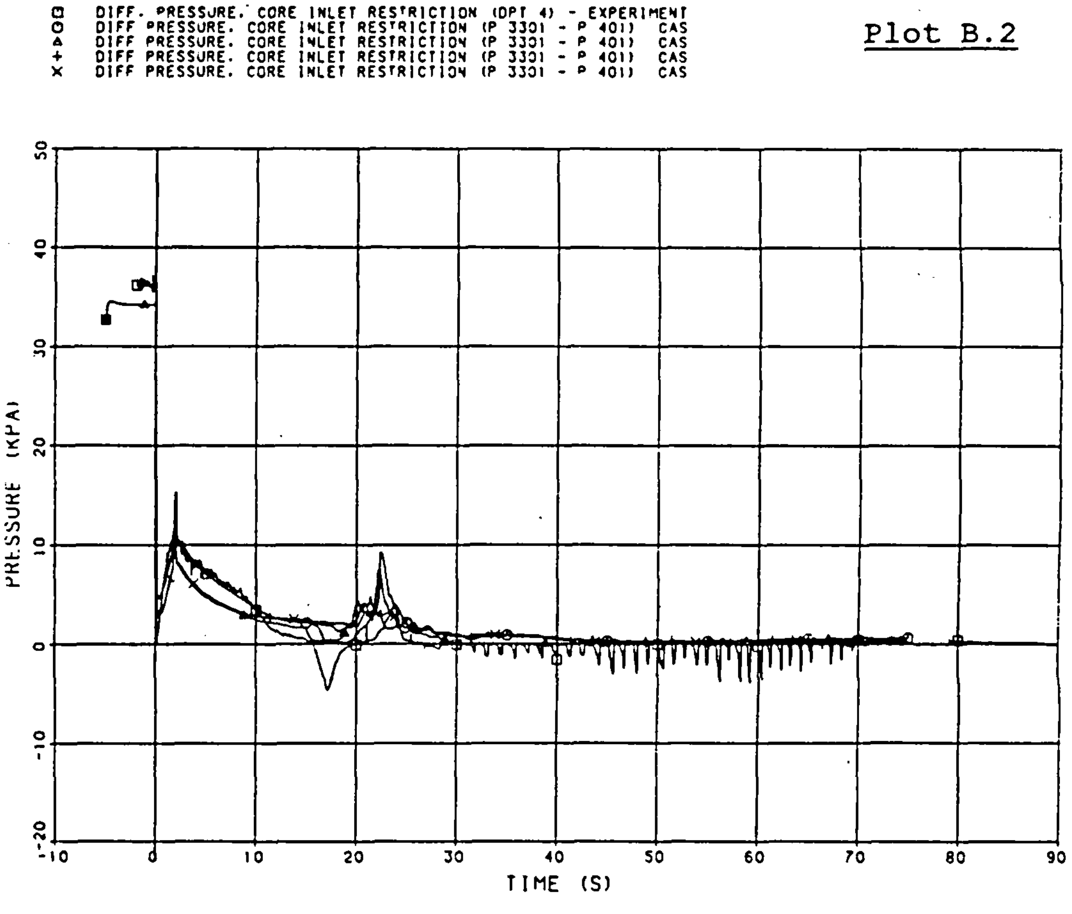
2015102     -0.37,1.49     -0.22,1.19     -0.10,0.99      0.00,0.84
2015200    2     4
2015201     -1.00,3.31     -0.79,2.78     -0.59,2.37     -0.41,2.04
2015202     -0.21,1.78      0.00,1.55
** PUMP1 SPEED
2016100    504
2016101     0.00       164.11     0.58       159.68
2016102     2.00       144.00     4.71       124.70   10.00        97.31
2016103    15.00        79.39    17.46        55.24   26.44        45.27
2016104    37.86        37.49    48.55        34.29   53.00        29.57
2016105    100.0        29.57
*
***********************
*
2020000    PUMP2      PUMP
2020101    0.         0.700      0.00500    0.    72.0 0.228      0
2020108    094010000    0.0019     0.35      0.35      0000
2020109    095000000    0.000380   3.08      3.08      0000
2020200    3    7.10523E+06   541.46
2020201    1     1.55 0.    0.
2020202    1     1.55 0.    0.
2020301    0     0     -1    -1    0     0     0
2020302    303.69     0.755244  0.01056   25.        13.2       1.          1000.
2020303    0.    0.    0.    0.    0.
2021100    1     1
2021101    0.0   1.136      0.2  1.135      0.4  1.120
2021102    0.6   1.100      0.8  1.055      1.0  1.000
2021200    2     1
2021201    0.0   0.51       1.0  1.00
2021300    1     2
2021301    0.0 -0.560      0.2 -0.385      0.4 -0.180      0.5 -0.055
2021302    0.6  0.145      0.8  0.565      1.0  1.000
2021400    2     2
2021401    0.0 -0.47       0.2 -0.21       0.4  0.07
2021402    0.6  0.35       0.8  0.66       1.0  1.00
2021500    1     3
2021501     -1.00,2.00     -0.95,1.81     -0.62,1.52     -0.50,1.39
2021502      0.00,1.178
2021600    1     4
2021601     -1.00,2.00     -0.79,1.53     -0.63,1.25     -0.30,0.93
2021602      0.00,0.72
2021700    2     3
2021701     -1.00,3.31     -0.83,2.78     -0.68,2.29     -0.56,1.95
2021702     -0.37,1.49     -0.22,1.19     -0.10,0.99      0.00,0.91
2021800    2     4
2021801     -1.00,3.31     -0.79,2.78     -0.59,2.37     -0.41,2.04
2021802     -0.21,1.78      0.00,1.55
2023000    0
2023001    0.0 0.00  0.1 0.00  0.2 0.05  0.3 0.80  0.4 0.96  0.5 0.98
2023002    0.6 0.97  0.7 0.90  0.8 0.80  0.9 0.50  1.0 0.00
2023100    0
2023101    0.0 0.00  0.1 0.10  0.2 0.15  0.3 0.24  0.4 0.30  0.5 0.40
2023102    0.6 0.60  0.7 0.80  0.8 0.90  0.9 0.96  1.0 1.00
** PUMP2 SPEED
2026100    0
2026101    0.0  221.94
***********************
```

```
*
*STEAM RELIEF FLOW MODEL
20509300   RHOP   MULT   1.   0.   0
20509301   RHOG   013010000   P   013010000
*
20509400   SQRT   POWERR   1.   0.   0
20509401   CNTRLVAR   093   0.5
*
20209300   NORMAREA
20209301   0.      0.      0.6    0.      1.0    1.
20209302   1.60    1.      2.30   0.      12.05  0.
20209303   12.65   1.
*
20509500   TBREAK   TRIPDLAY  1.   0.   0
20509501   504
*
20509600   "T-TBREAK"   SUM   1.   0.   0
20509601    0.    1.    TIME   0
20509602          -1.   CNTRLVAR  095
*
20509700    TRPTEST    TRIPUNIT   1.   0.   0
20509701   504
*
20509800    ATIME    MULT   1.   0.  0
20509801    CNTRLVAR   096
20509802    CNTRLVAR   097
*
20509900   VLVAREA   FUNCTION   1.0340E-4   0.   0
20509901   CNTRLVAR   098     093
*
20510000   MSSFLOW   MULT   0.6636   0.   0
20510001   CNTRLVAR   099   CNTRLVAR   094
*
*
20500100   MASSDIFF1   DELETE
20500200   INTEGRAL1   DELETE
20500300   VELDIFF1    DELETE
20500400   MASSDIFF2   DELETE
20500500   INTEGRAL2   DELETE
20500600   VELDIFF2    DELETE
*
3050000   LEVCTRVOL    DELETE
4050000   LEVCTRJUN    DELETE
20504900  LEVCTR       DELETE
*
*  END
```

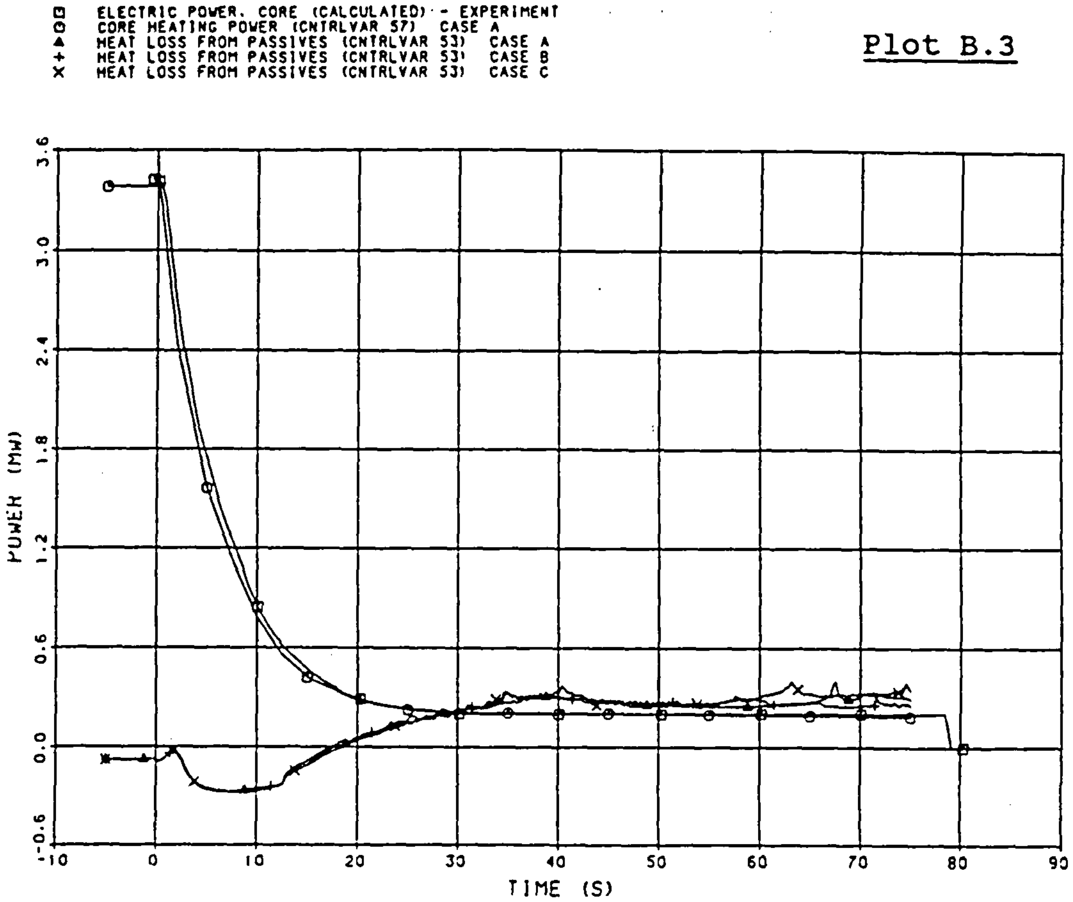
Plot B.1



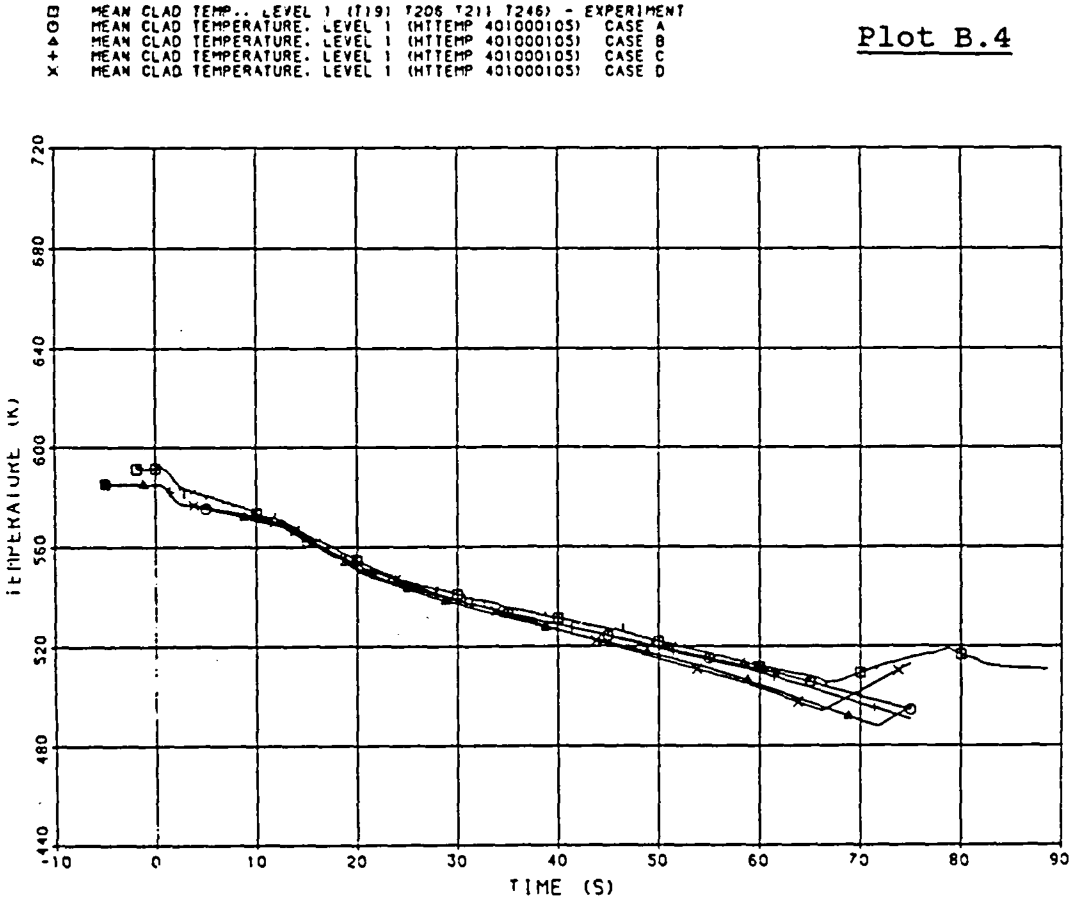
Plot B.2



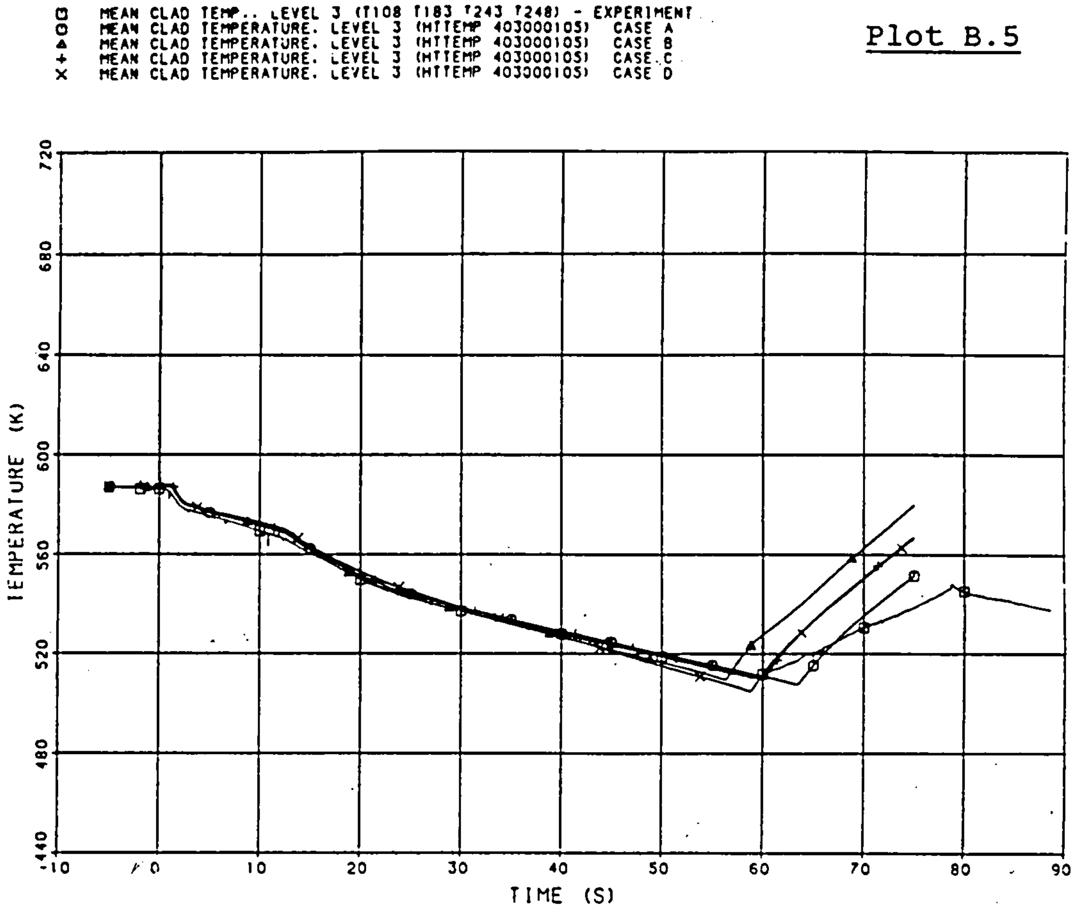
Plot B.3



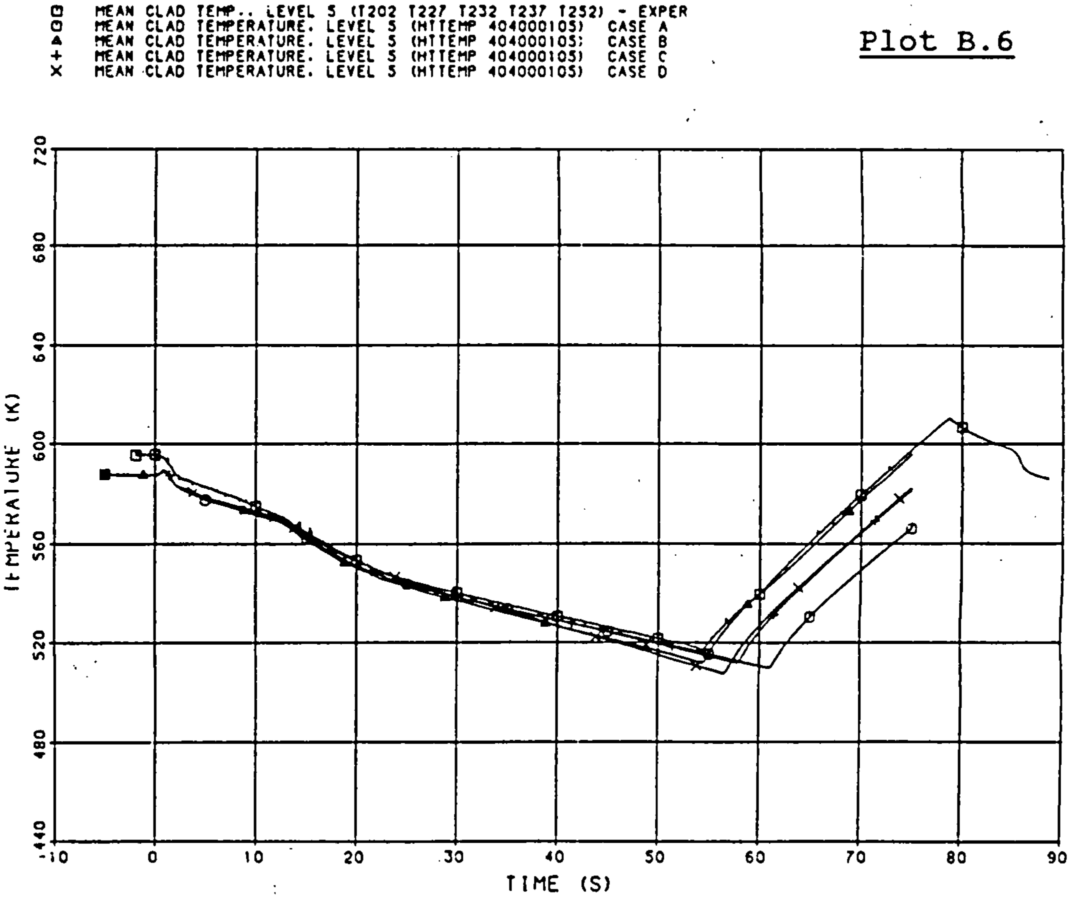
Plot B.4



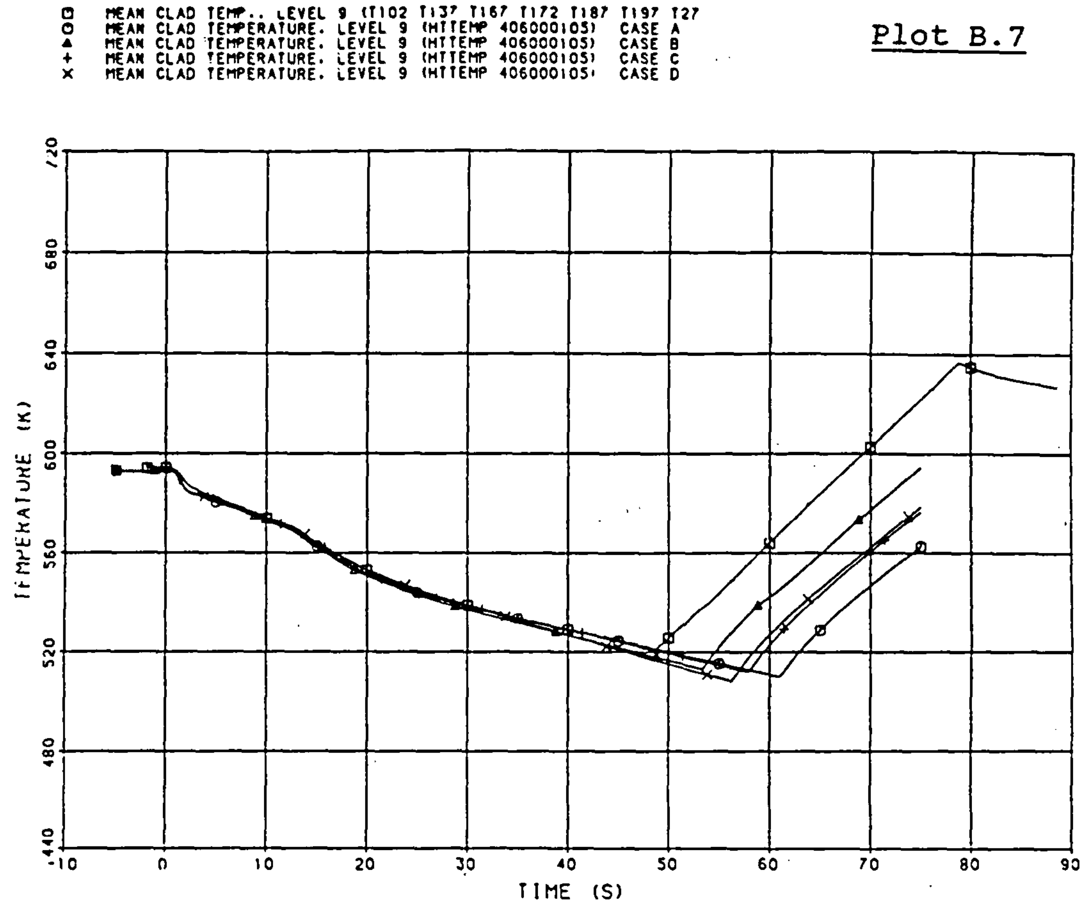
Plot B.5



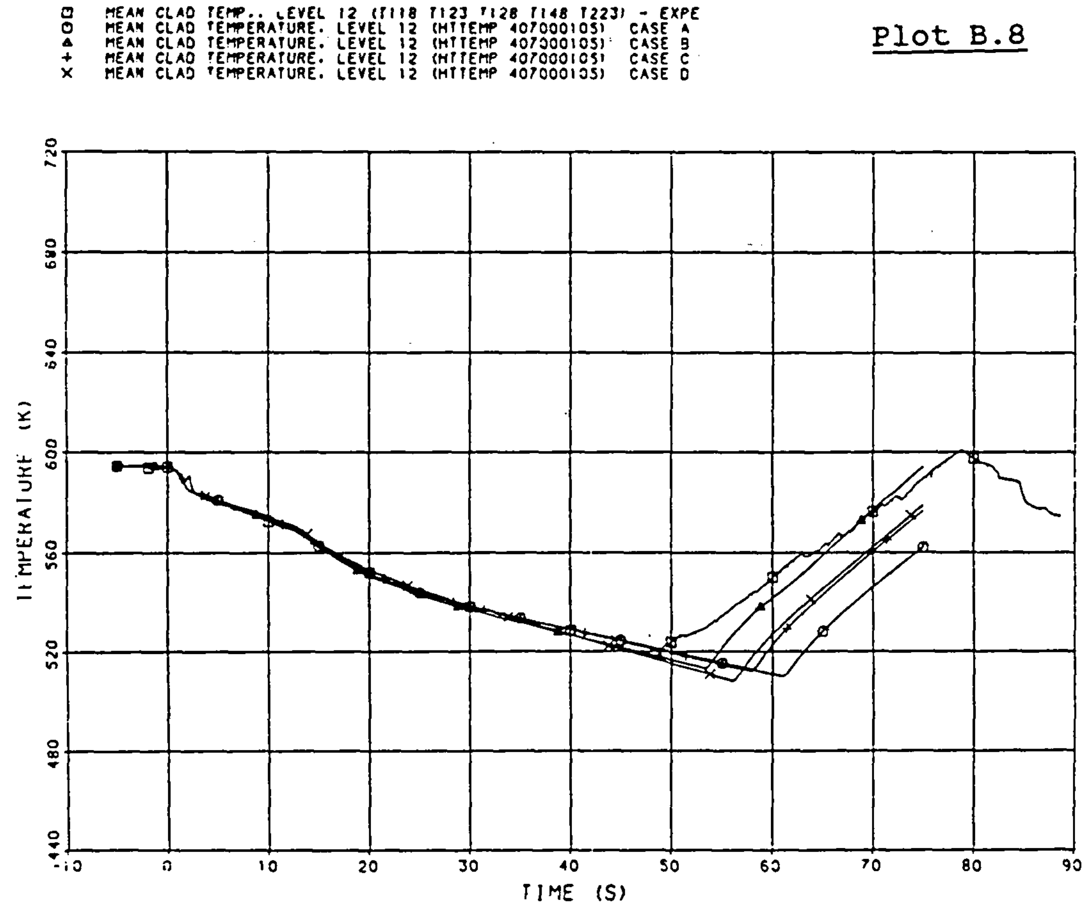
Plot B.6



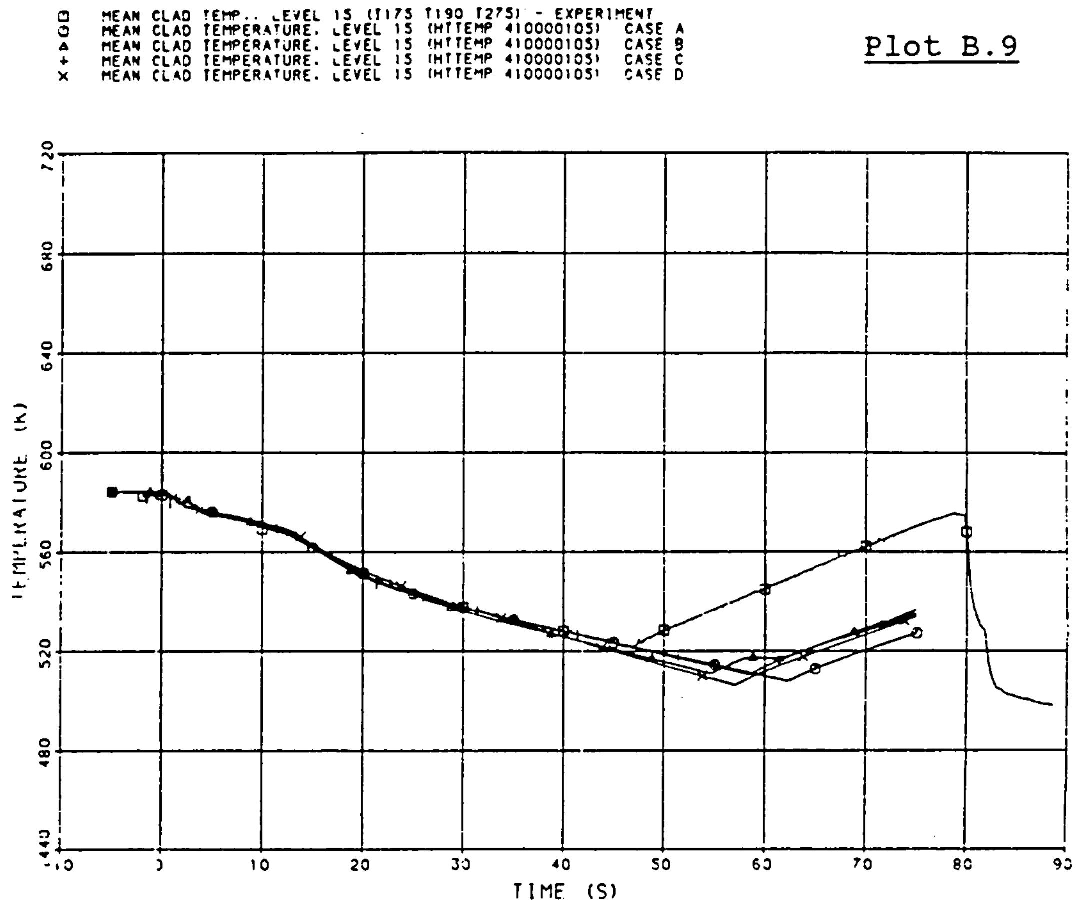
Plot B.7



Plot B.8

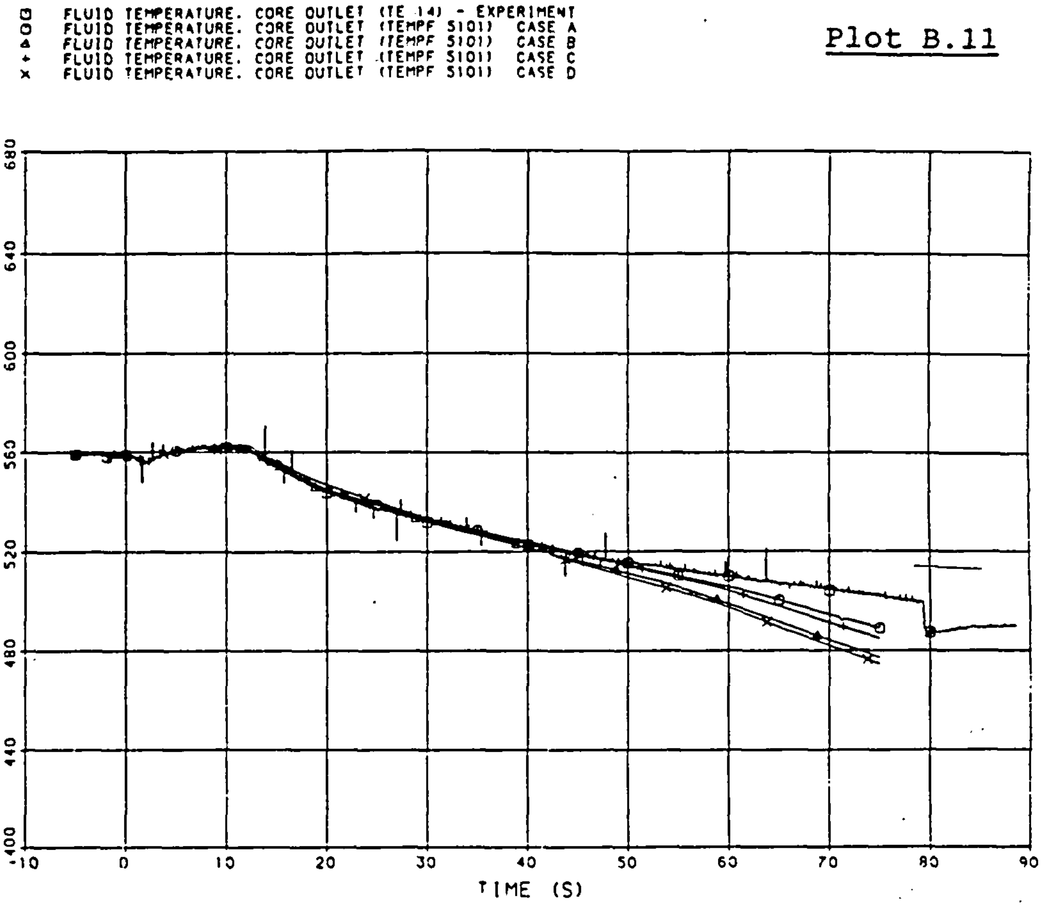


Plot B.9

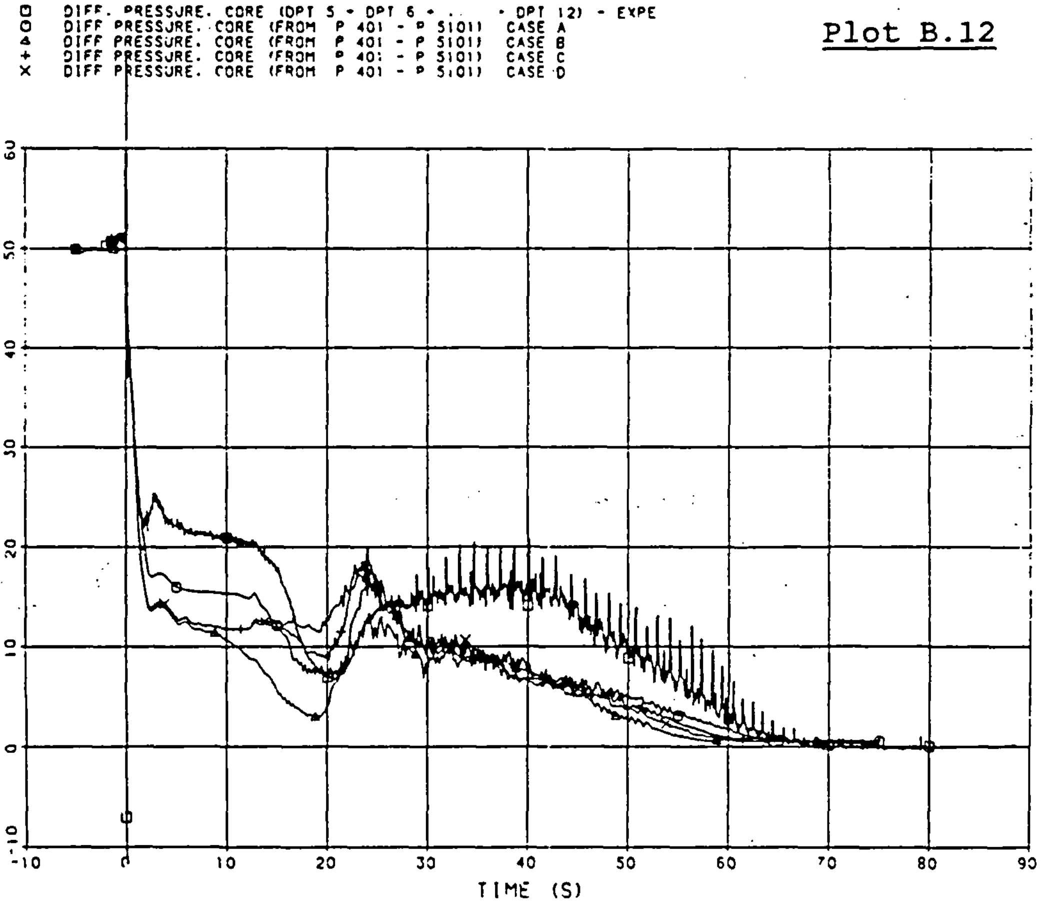


Plot B.10

Plot B.11

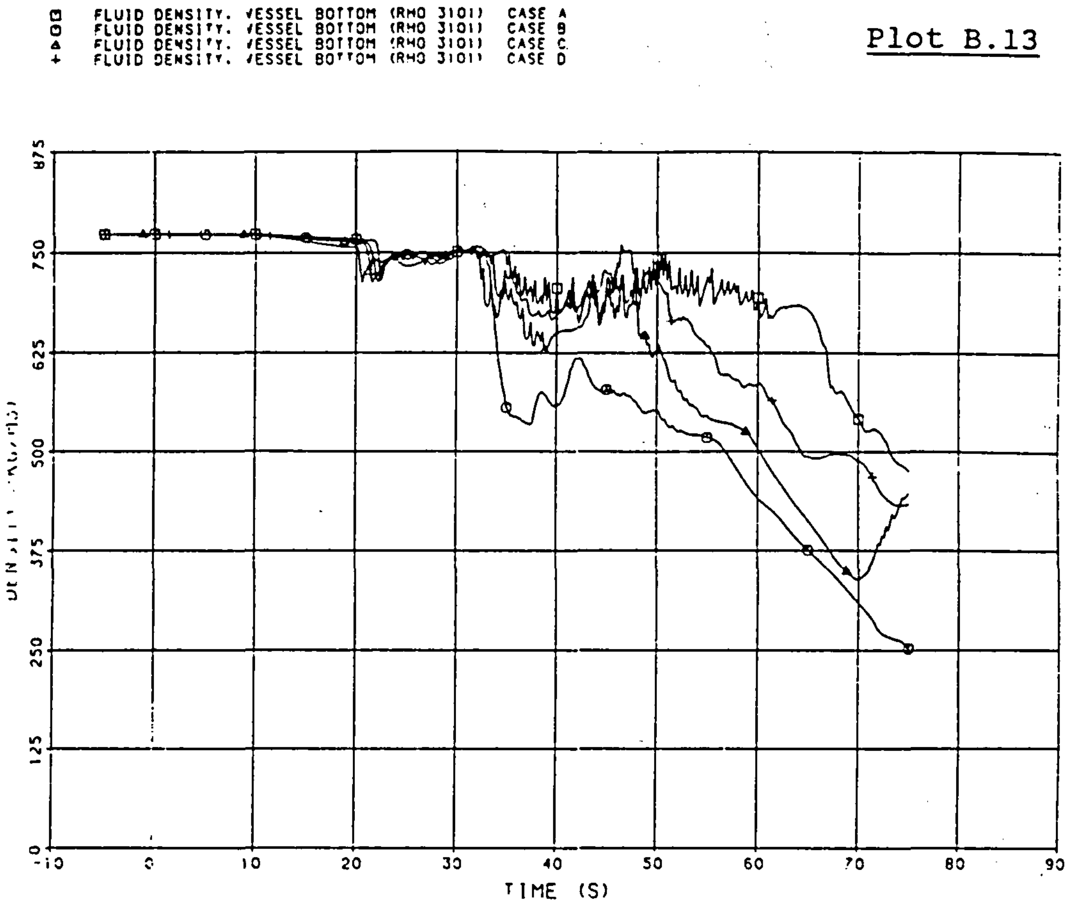


Plot B.12

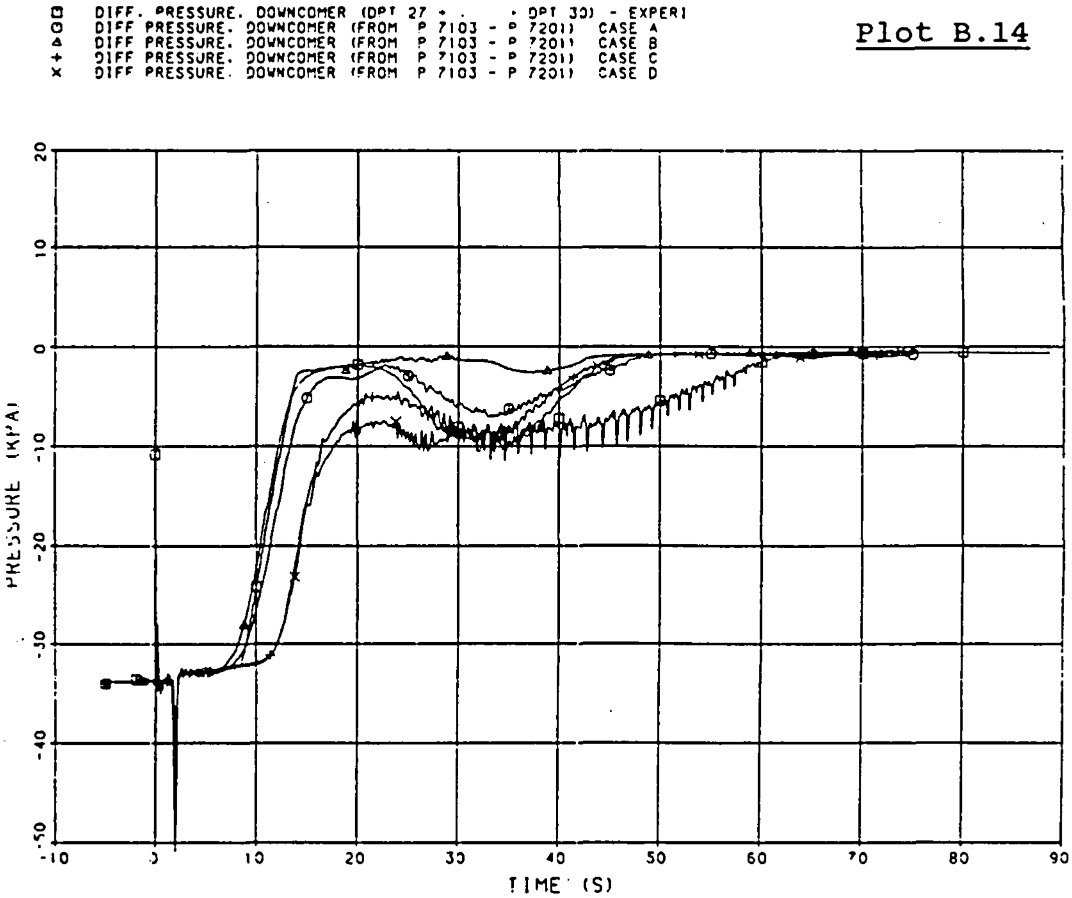


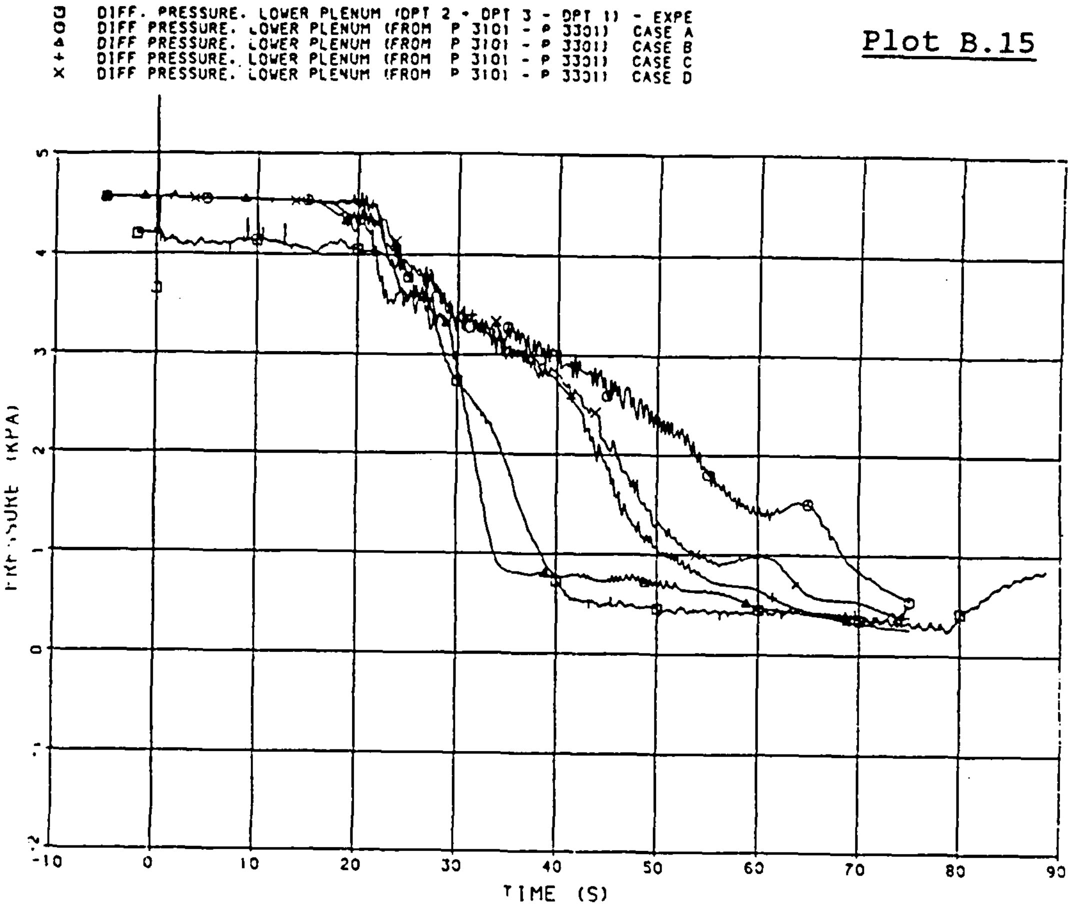
RELAP5/MOD2 CALCULATION FOR FIX-II. EXP 3027

Plot B.13

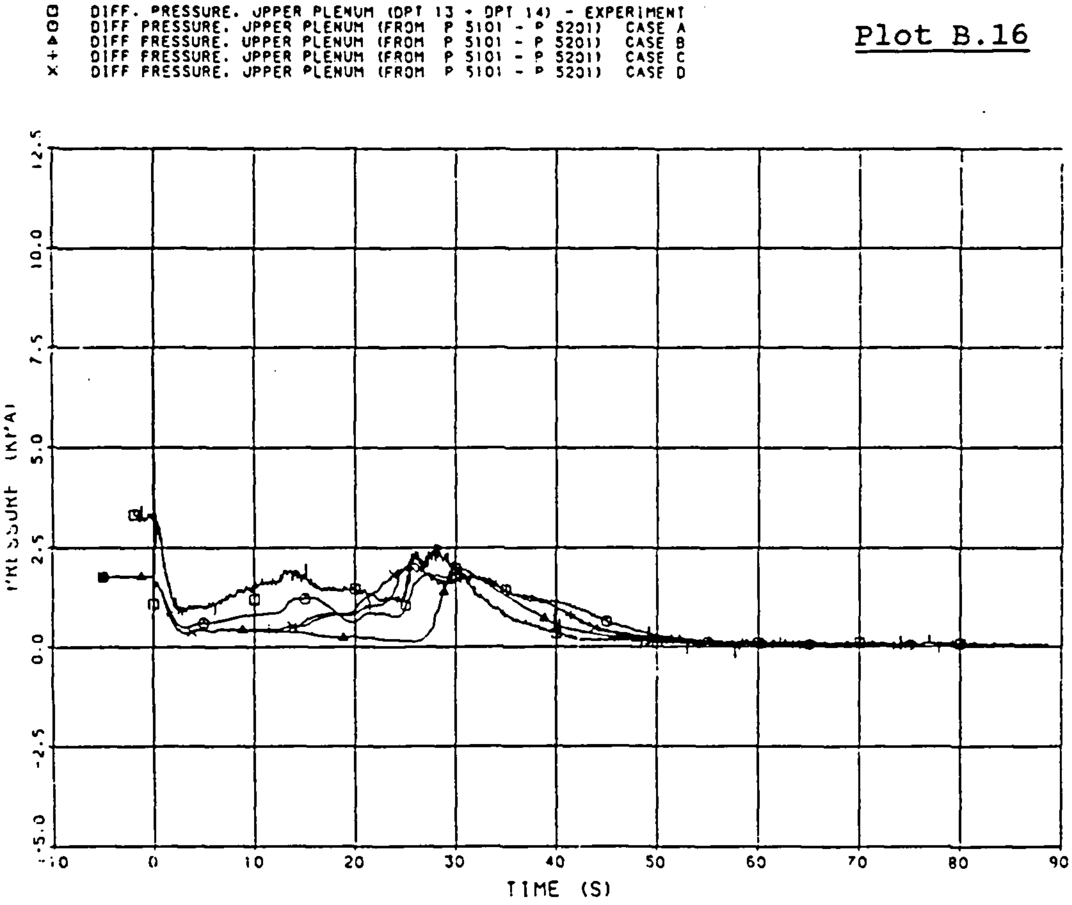


Plot B.14



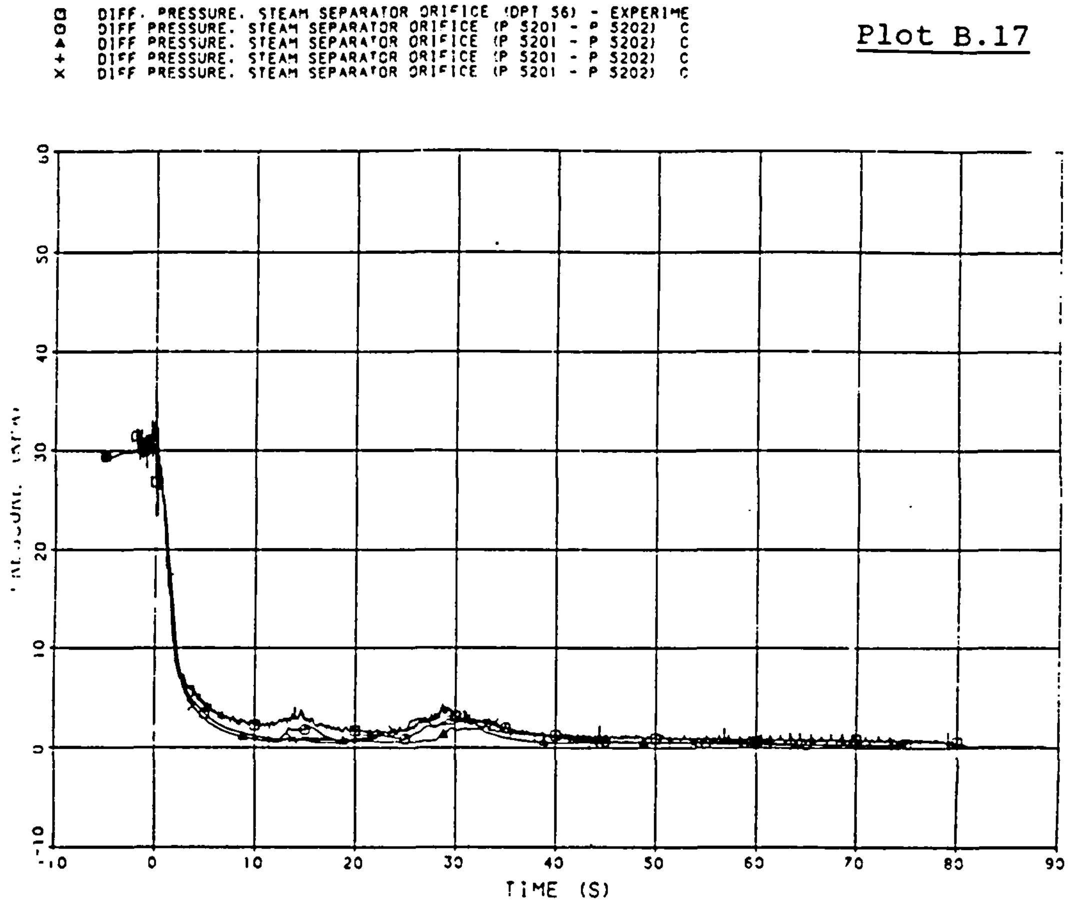


Plot B.15

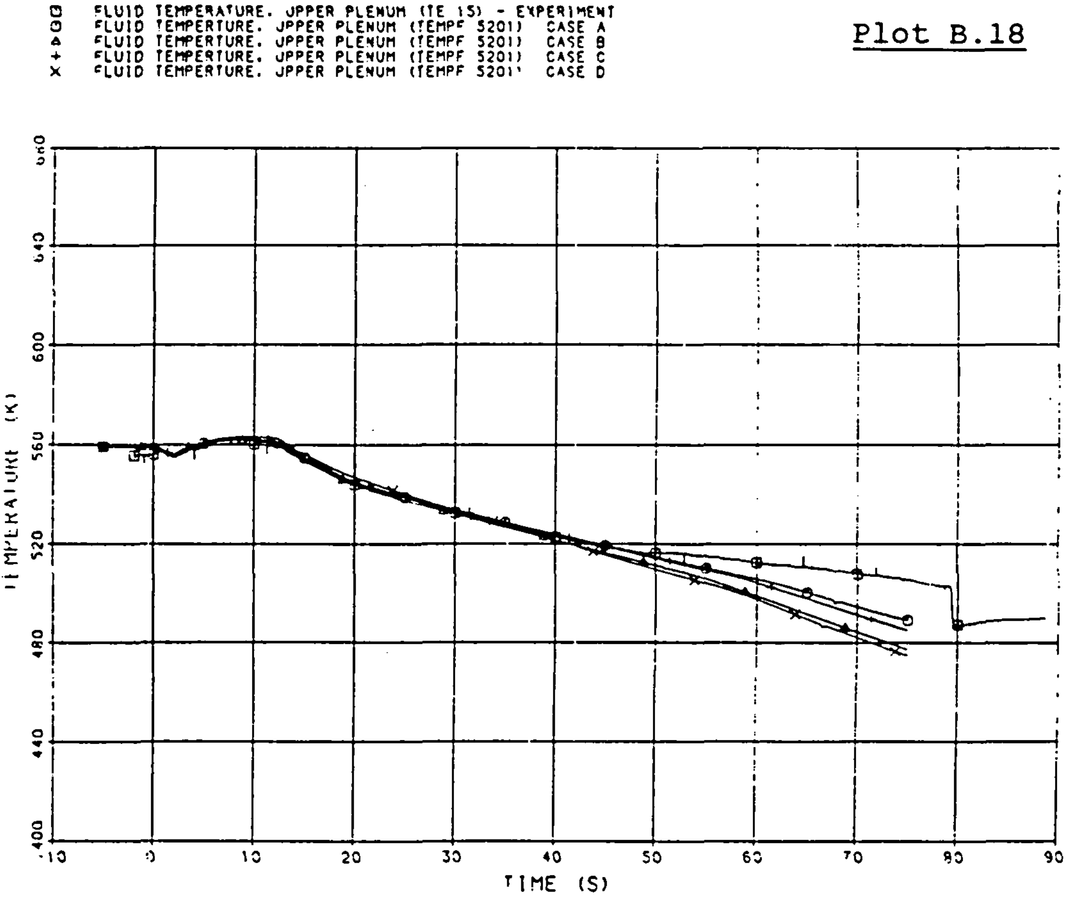


Plot B.16

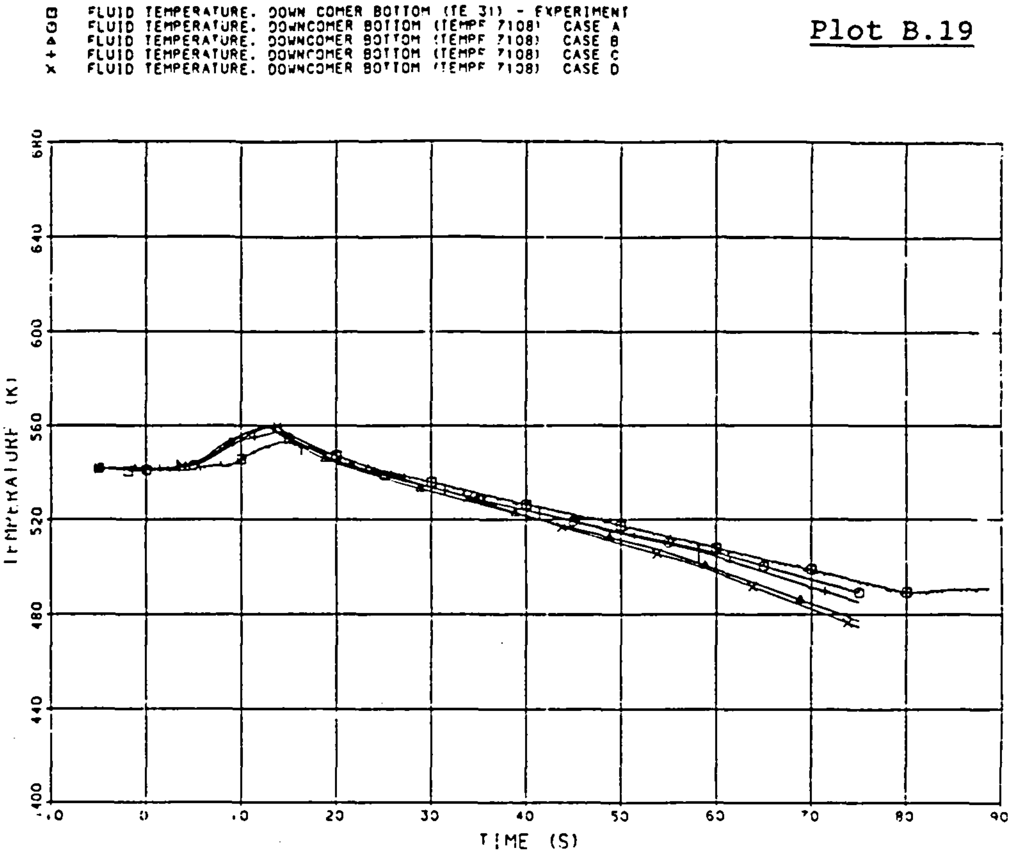
Plot B.17



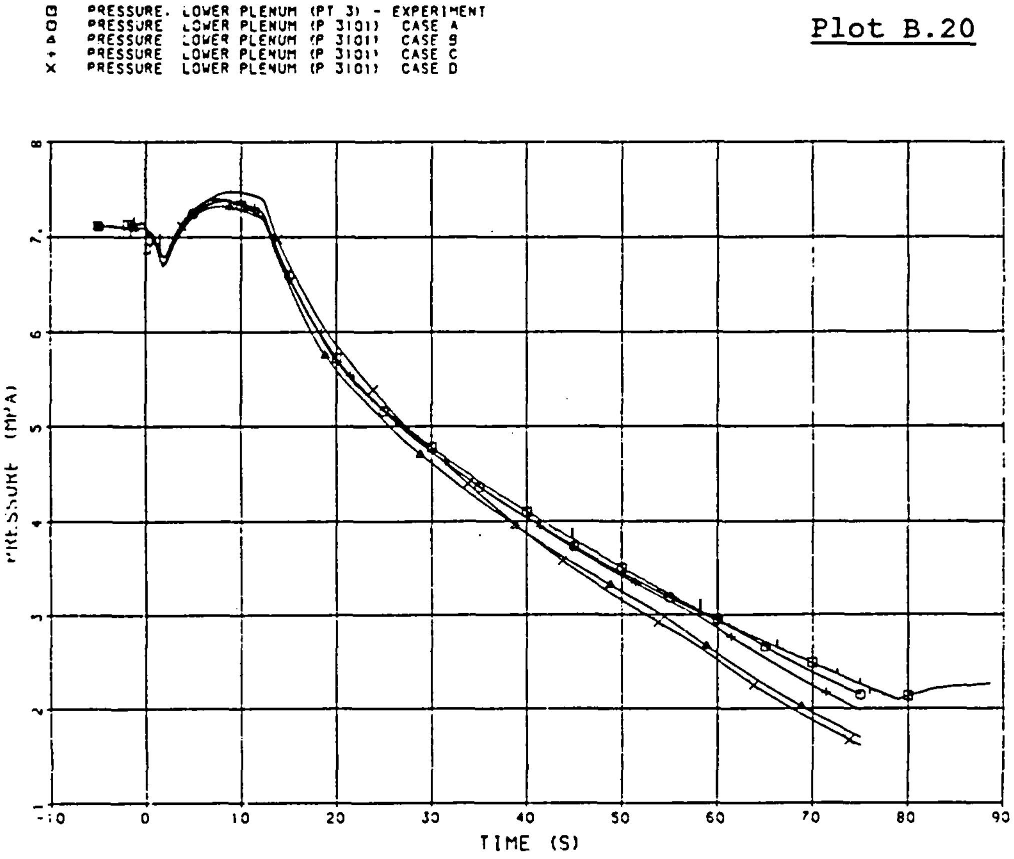
Plot B.18



Plot B.19

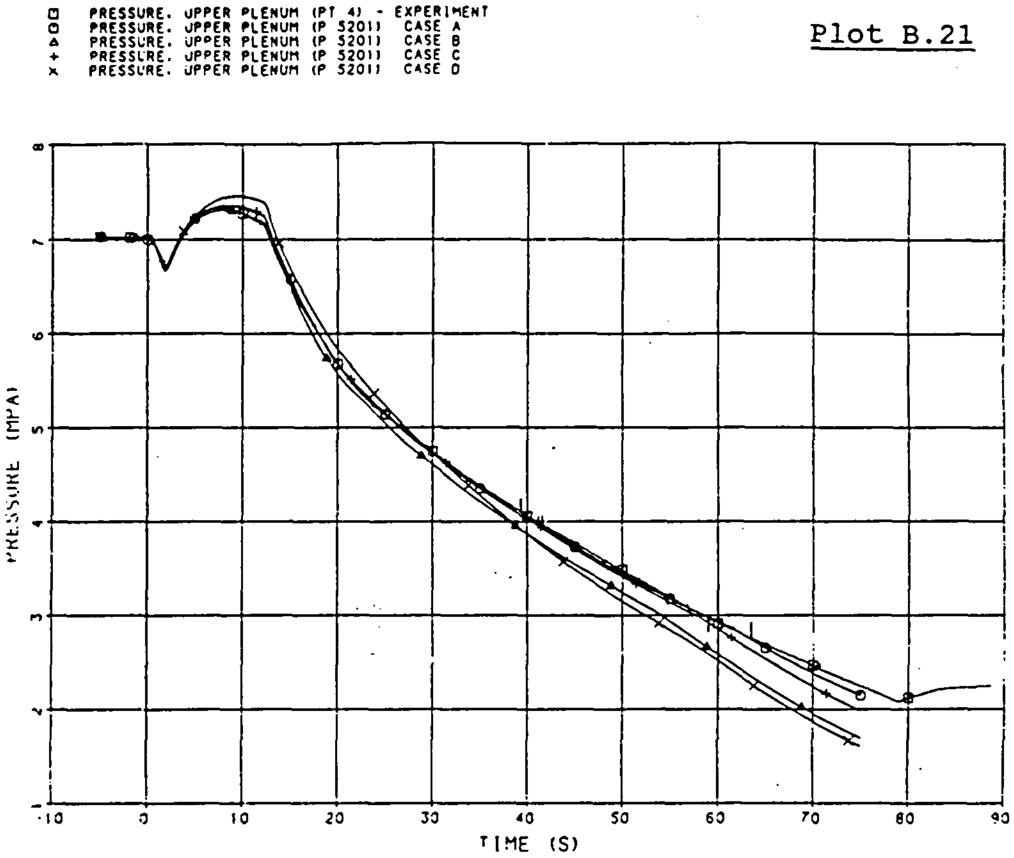


Plot B.20

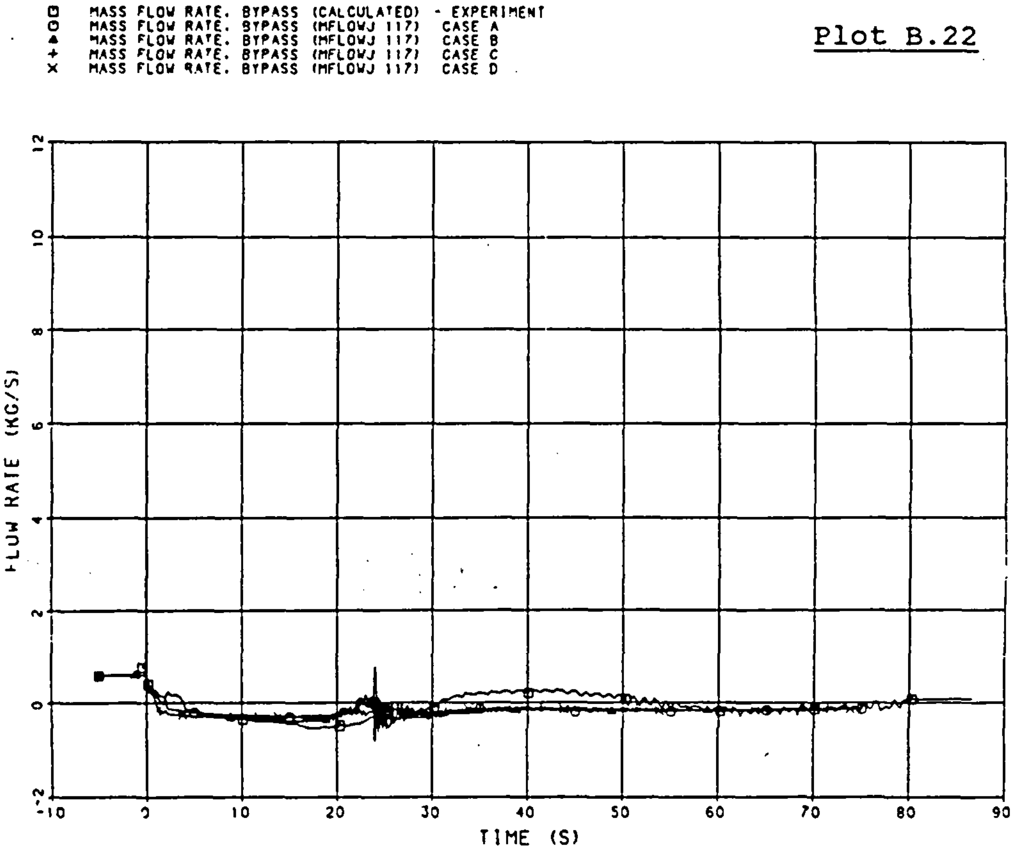


RELAP5/MOD2 CALCULATION FOR FIX-II, EXP 3027

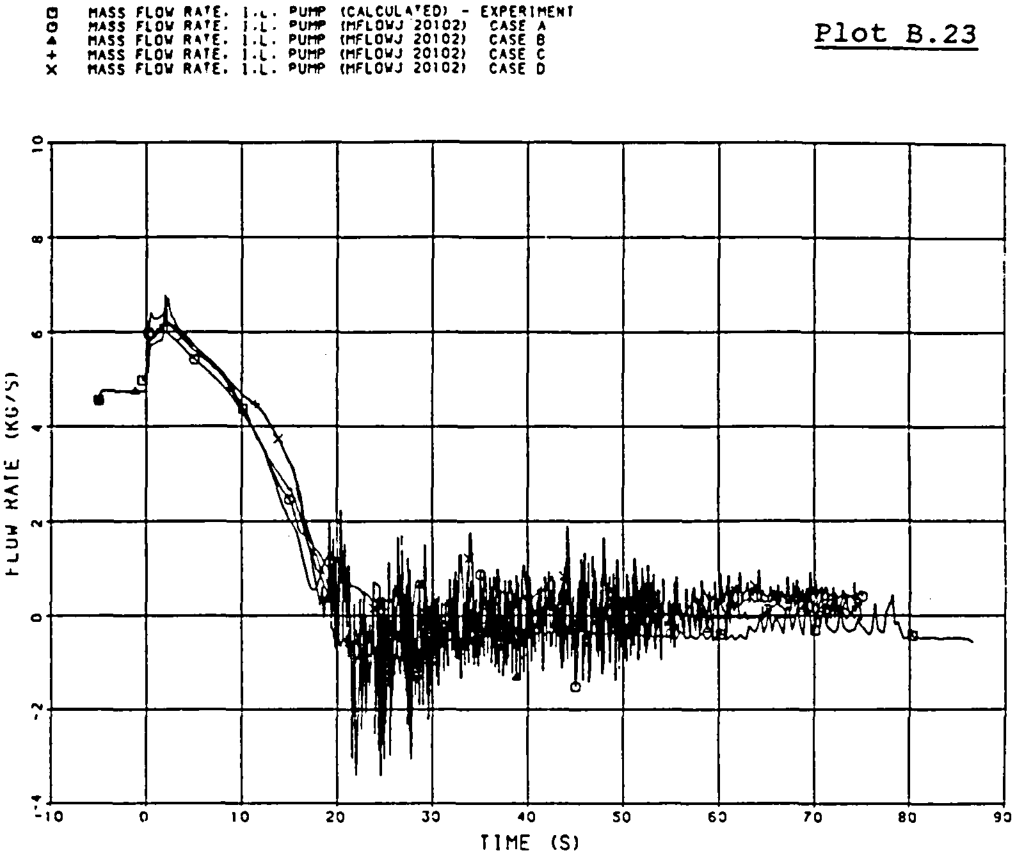
Plot B.21



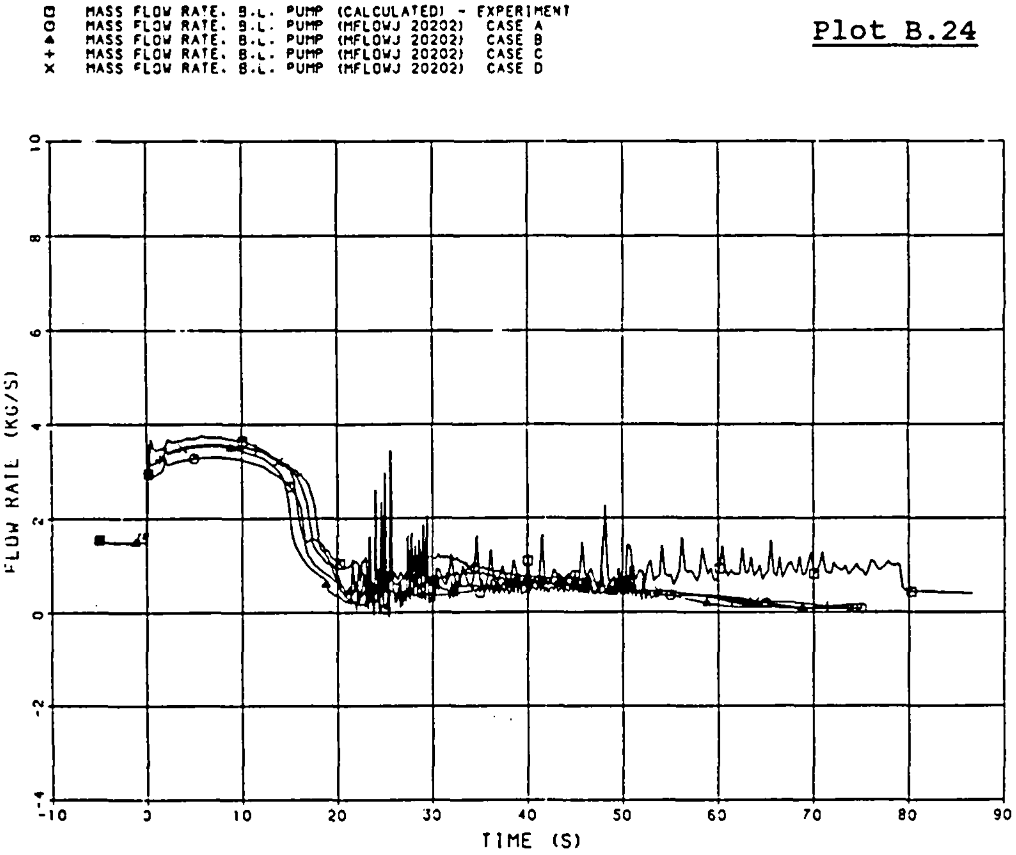
Plot B.22



Plot B.23

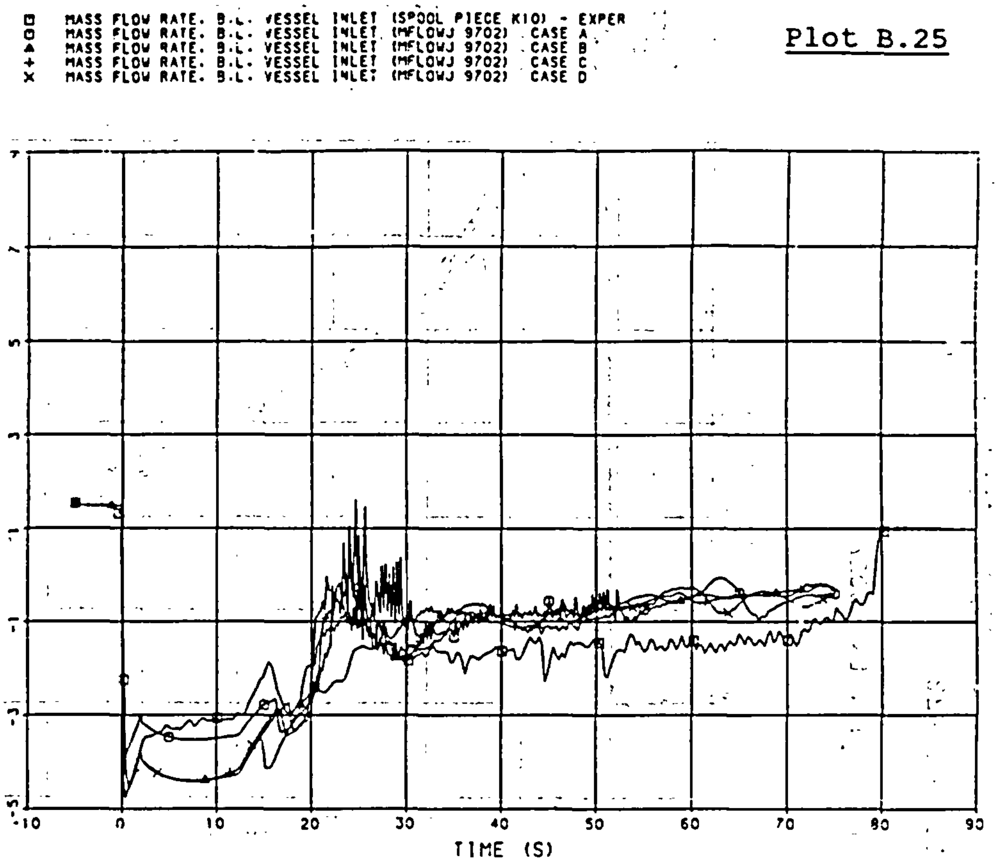


Plot B.24

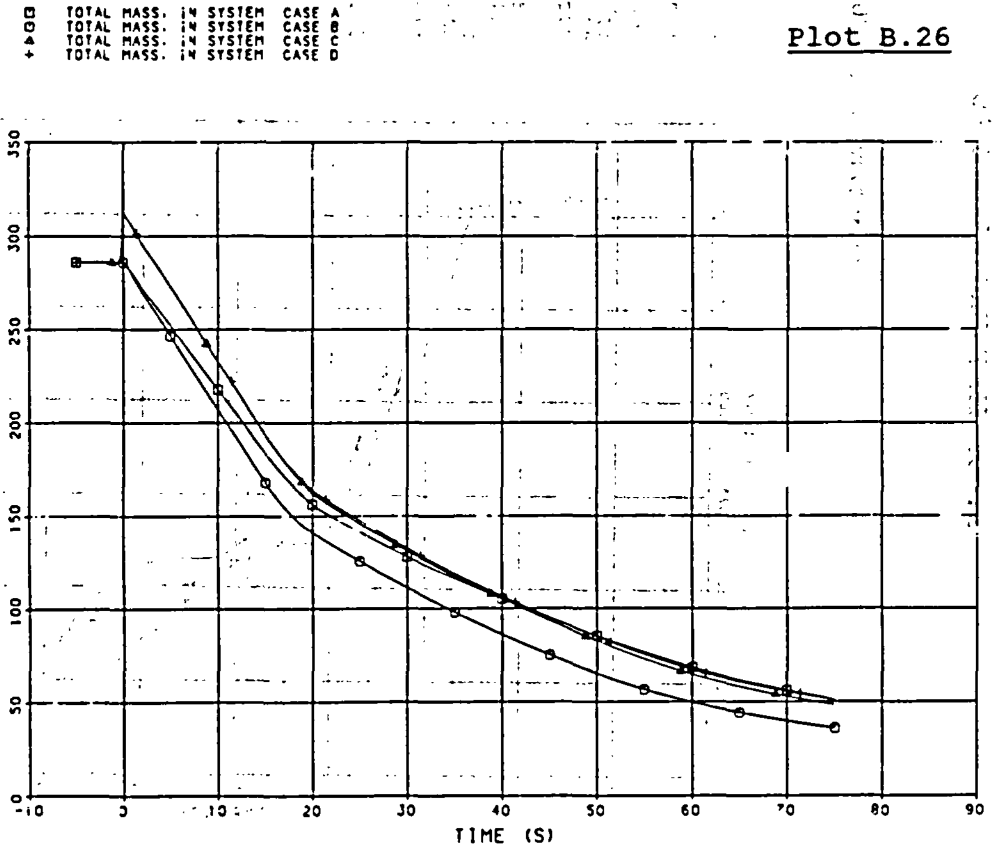


RELAP5/MOD2 CALCULATION FOR FIX-II, EXP 3027

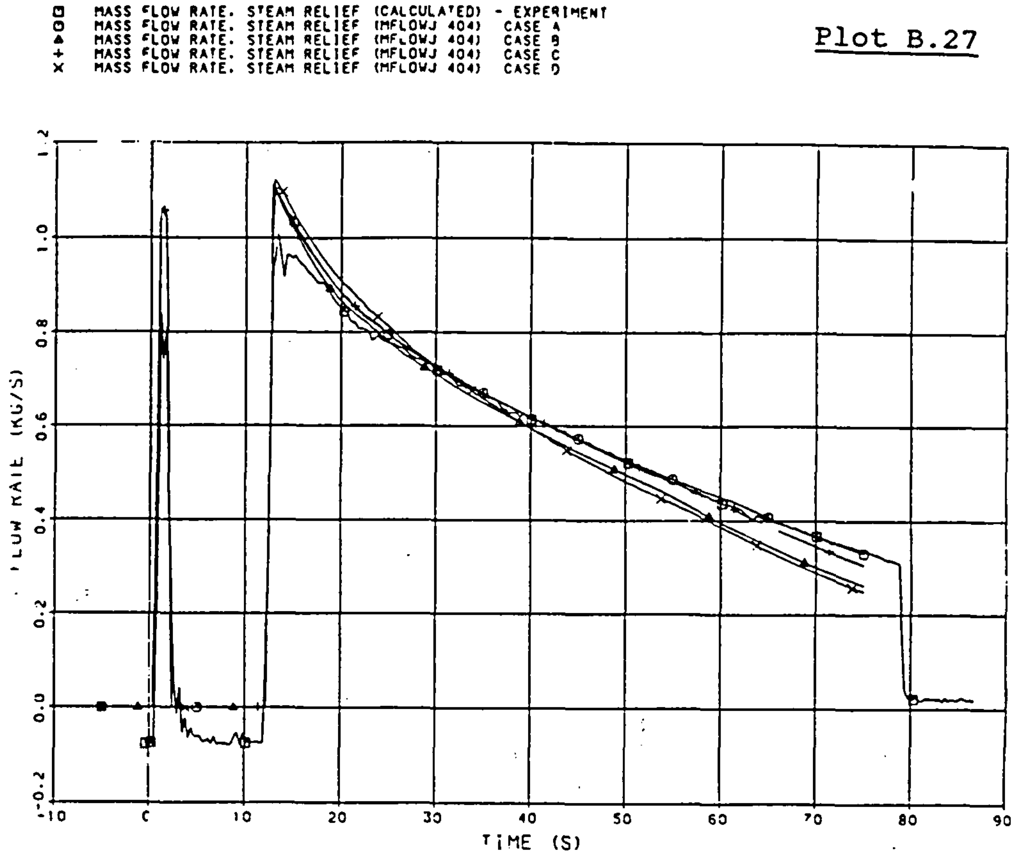
Plot B.25



Plot B.26

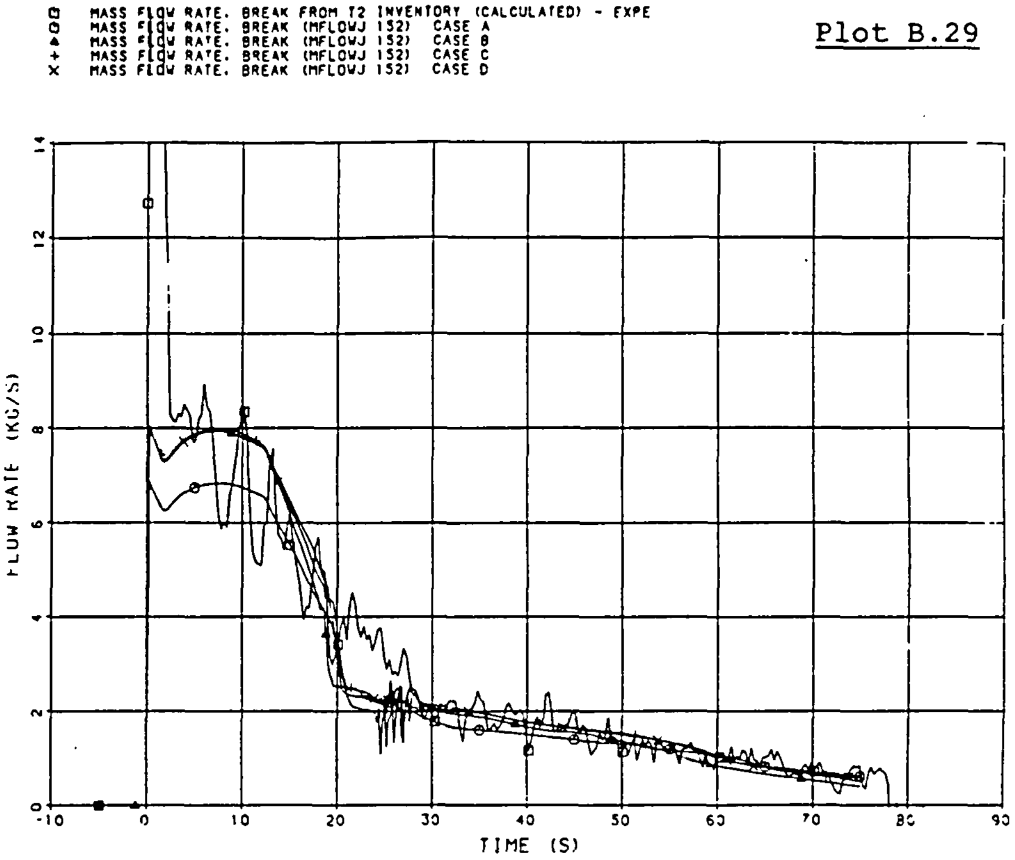


Plot B.27

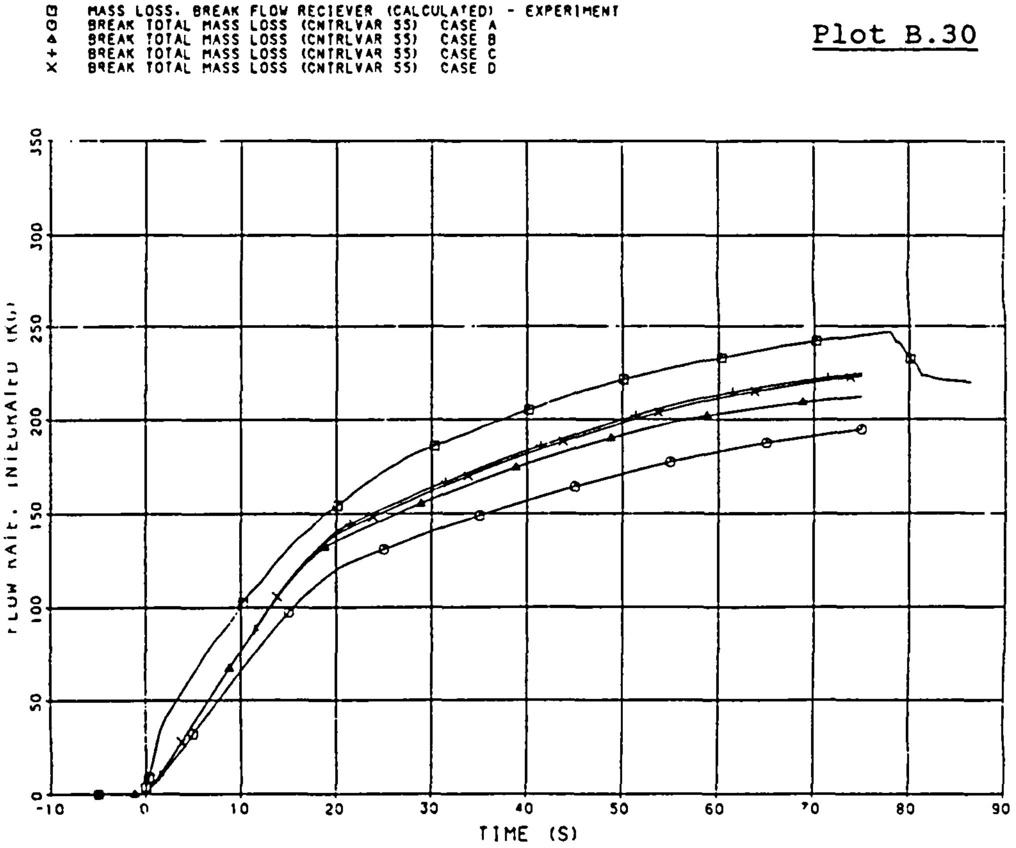


Plot B.28

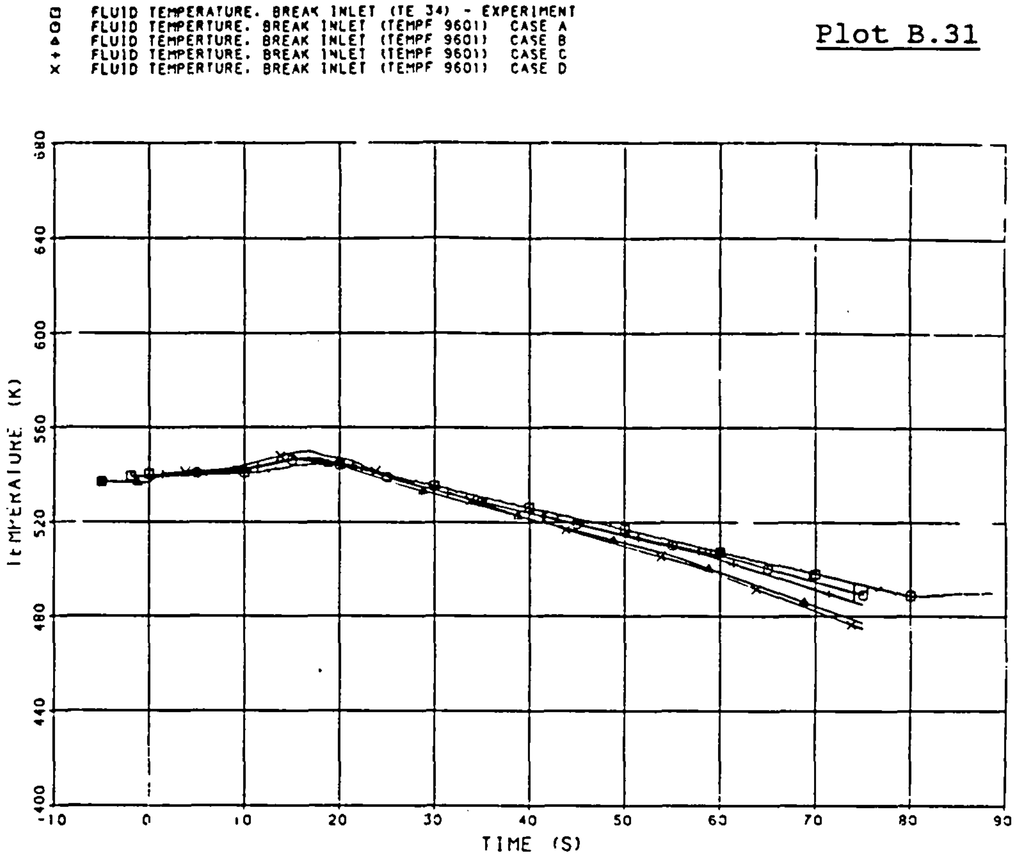
Plot B.29



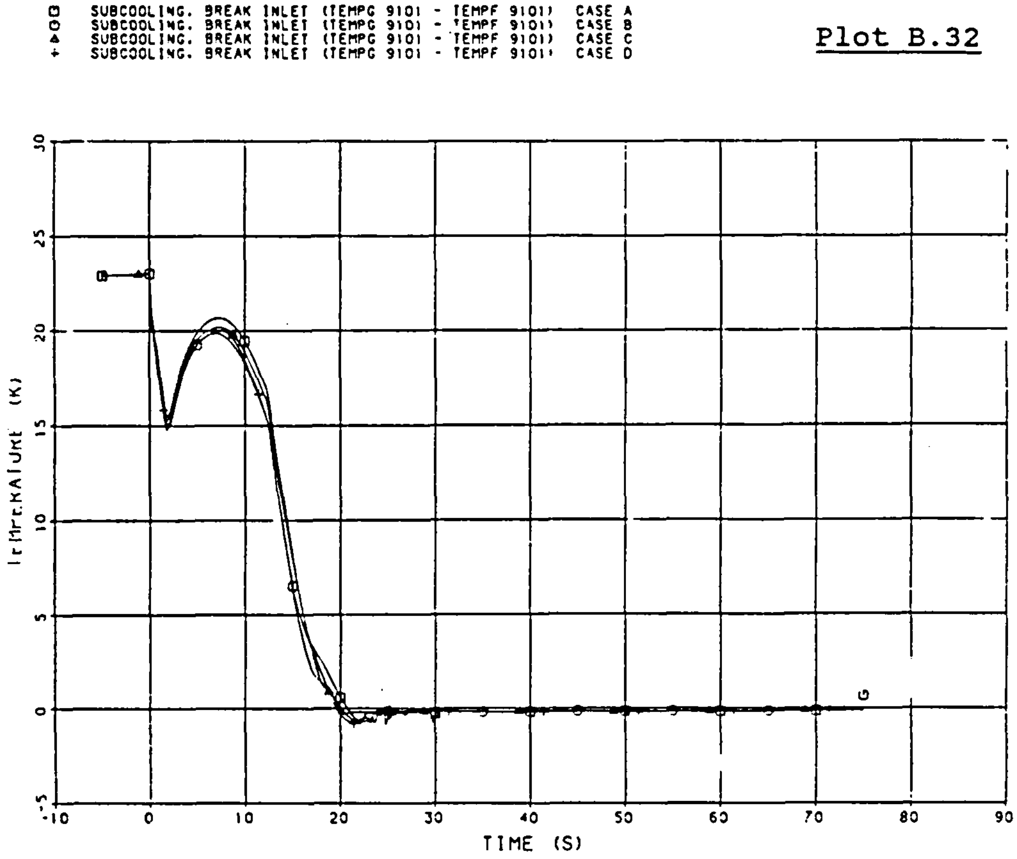
Plot B.30



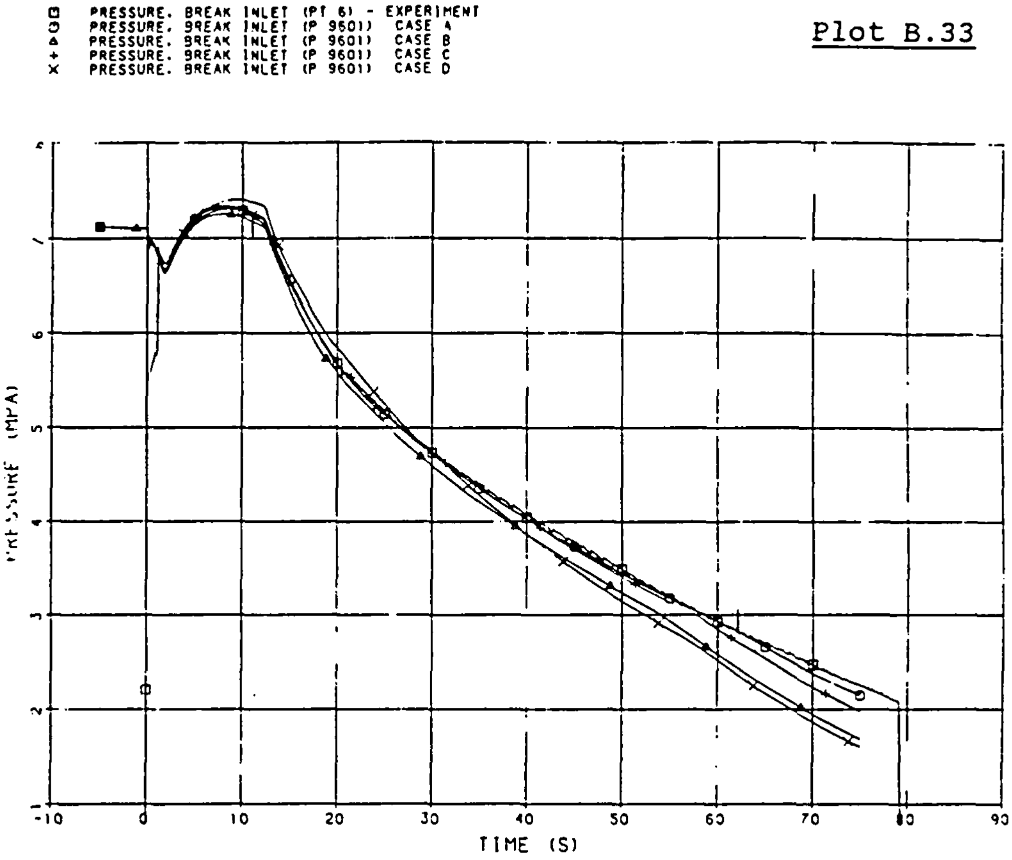
Plot B.31



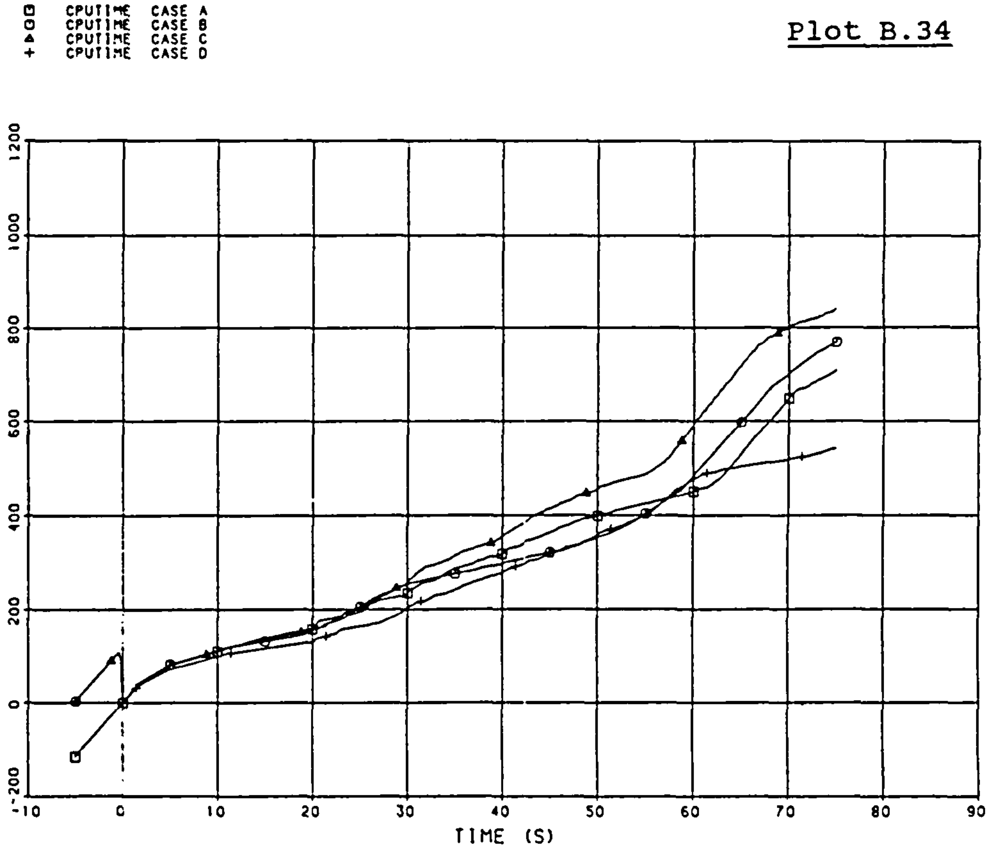
Plot B.32



Plot B.33

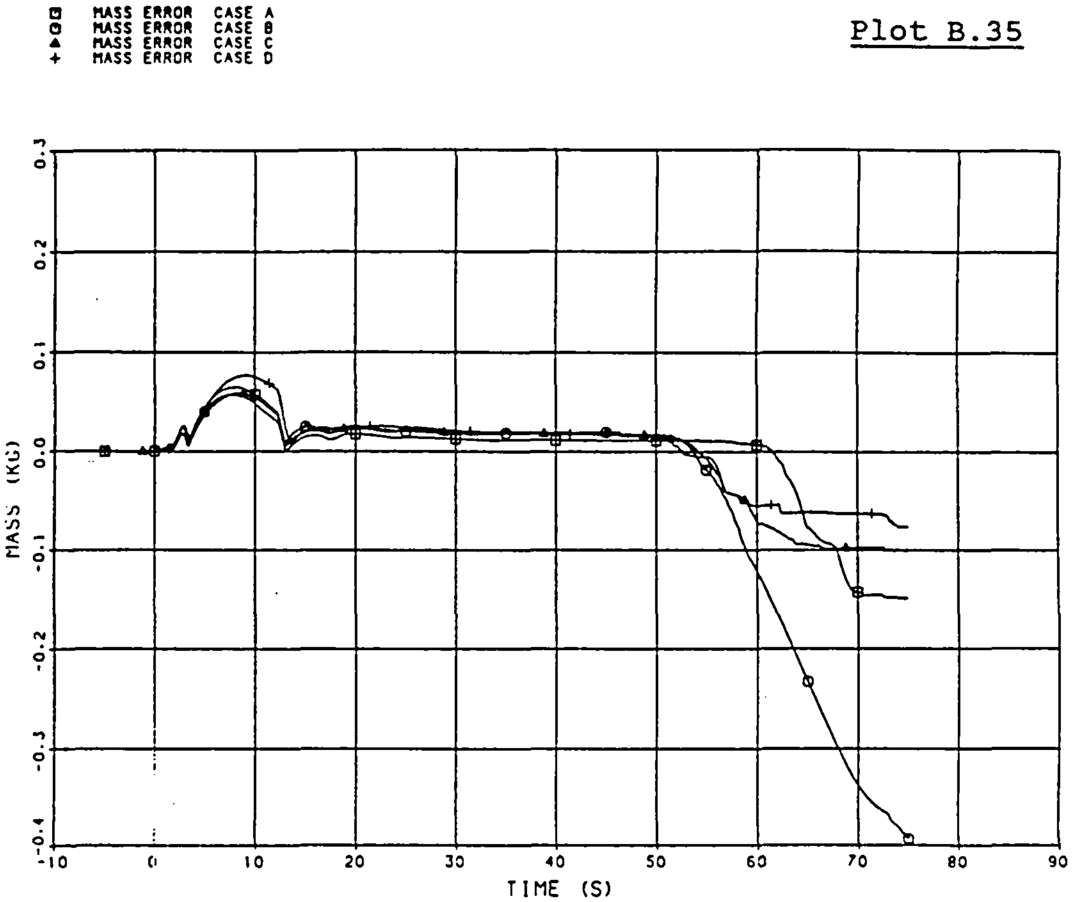


Plot B.34



RELAP5/MOD2 CALCULATION FOR FIX-II. EXP 3027

Plot B.35



Calculation to experiment data uncertainty

Case A

```
CODE CALCULATION-TO-EXPERIMENT DATA UNCERTAINTY ANALYSIS FOR NRC/ICAAP.
**********************************************************************

  FIRST LINE  : DIFFERENCE BETWEEN CALCULATED AND (AVERAGED) EXPERIMENTAL DATA AT END OF THE INTERVAL
  SECOND LINE : MEAN DIFFERENCE OVER THE INTERVAL
  THIRD LINE  : MEAN SIGMA OVER THE INTERVAL  (ROOT MEAN SQUARE OF THE DIFFERENCE)


 - CODES -                                - - - - TIME INTERVAL - - - -

CALC.  EXP.     0.0 - 6.000     - 12.00     - 18.00     - 24.00     - 30.00     - 45.00     - 60.00     - 75.00
-----------------------------------------------------------------------------------------------------------------

P 1A  - P  3    -.663E-01     .532E-01    .104E-01    .135E-01   -.301E-01   -.622E-01   -.127E-01   -.165
                -.609E-01     .664E-03    .543E-01   -.511E-02   -.241E-01   -.518E-01   -.384E-01   -.621E-01
                 .693E-01     .321E-01    .612E-01    .156E-01    .311E-01    .525E-01    .429E-01    .724E-01

P 2A  - P  4    -.281E-01     .802E-01    .432E-01    .368E-01   -.129E-01   -.330E-01    .119E-01   -.866E-01
                -.230E-01     .406E-01    .686E-01    .207E-01   -.167E-02   -.240E-01   -.150E-01   -.450E-01
                 .305E-01     .514E-01    .923E-01    .231E-01    .161E-01    .260E-01    .224E-01    .585E-01

P 3A  - P  5    -.340E-01     .646E-01    .183E-01    .372E-01   -.650E-02   -.546E-01    .780E-02   -.102
                 .255         .112E-01    .656E-01    .197E-01    .349E-02   -.296E-01   -.198E-01   -.511E-01
                 .772         .323E-01    .714E-01    .300E-01    .240E-01    .328E-01    .278E-01    .644E-01

PD4A  - D  4    -.565        1.41        2.20         .217        .786        .342        .461        .531
                 .687         .829E-01   2.36        2.03        1.49         .981        .839        .590
                5.37          .613       2.61        2.76        1.55        1.07        1.18         .807

PDLA  - D LP     .446         .419        .365        .121        .491       2.28         .970        .251
                 .407         .422        .451        .262        .347       1.67        1.65         .726
                 .430         .423        .453        .282        .382       1.79        1.70         .789

PDCA  - D CO   -5.97        -5.58        -.954       3.31       -5.07       -7.97       -1.20         .643
               -4.06        -5.61       -4.52         .943      -1.00       -7.24       -4.31        -.357E-01
                5.44         5.62        4.67        1.76        3.25        7.38        4.66         .743

PDUA  - D UP    -.468        -.784       -.496       -.469       -.446        .496       -.333E-01   -.511E-01
                -.665        -.652       -.566       -.571       -.477        .572        .111       -.413E-01
                 .913         .661        .597        .594        .499        .614        .183        .465E-01

PDDA  - D DC    -.254       -4.78       -1.04         .964       1.94        5.23         .920        .183
                -.737       -1.49       -3.01        -.506       2.43        3.33        3.81         .119E-01
                1.44         2.45        3.43         .952       2.58        3.58        4.12         .259

PDSA  - D 56   -1.08        -1.60       -1.09        -.549       -.736       -.282       -.172       -.167
                 .520       -1.15       -1.12        -.801       -.972        .516E-01   -.368       -.388
                2.18         1.16        1.20         .858       1.01         .332        .384        .412

MF1A  - X602    -.102E-01     .116        .208        .202       -.149       -.362       -.424E-01    .440E-01
                -.136         .620E-01    .140        .232        .143       -.369       -.186        .723E-02
                 .183         .693E-01    .142        .252        .217        .375        .223        .483E-01

MF2A  - X603    -.245         .269E-01    .333       -.842        .520        .884        .680        .745
                -.397        -.144        .346       -.775       -.404        .332        .374        .404
                 .431         .166        .421       1.03        1.16         .650        .653        .490

MF3A  - X634    -.474        -.373       -.540       -.654       -.340       -.555E-01   -.338       -.822
                -.446        -.410       -.248       -.409        .129       -.265       -.421       -.783
                 .484         .410        .361        .562        .700        .351        .550        .806

MF5A  - X607     .705E-01     .739E-01    .368E-01    .208E-01    .751E-02    .345E-02    .881E-02   -.402E-02
                 .931E-01     .712E-01    .642E-01    .322E-01    .108E-01    .483E-02    .530E-02    .334E-02
                 .160         .716E-01    .852E-01    .324E-01    .121E-01    .641E-02    .651E-02    .719E-02

MF4A  - X610    -.232        -.371       -.295       1.41         .659       1.17         .840        .574
                 .231        -.363       -.510        .628       1.38         .694        .851        .872
                 .567         .368        .533       1.14        1.51         .734        .890        .933

MF6A  - X636   -2.14         1.50       -1.28       -1.47       -.140E-01    -.619       -.950E-02   -.218
               -5.31         -.179        .560E-01  -1.02        -.893       -.320       -.201E-01   -.534E-01
                7.30         1.14         .667       1.36        1.10         .410        .195        .178

TF1A  - T  3    2.42         2.91        5.53        3.85        3.65         .800      -2.93       -11.6
                1.95         3.16        3.71        5.97        3.40        1.37       -1.79        -6.25
                2.00         3.39        3.61        6.07        3.41        1.99        1.89         6.78

TF2A  - T 14     .250        -.690        .750       1.54         .530        .370      -4.18       -12.8
                -.417E-01     .282       1.17        1.11        1.36        1.15       -1.73        -8.49
                 .750         .580       1.32        1.18        1.74        1.34        2.40         8.91

TF4A  - T 15     .960        2.42        1.41        1.71        1.23         .820      -6.66       -16.3
                1.26         1.70        1.66        1.25        1.20        1.15       -3.12       -11.7
                1.39         1.77        1.67        1.27        1.23        1.17        3.92        12.0

TF3A  - T 31    1.63         8.14        -.320      -1.69       -1.93       -2.61       -1.00        -4.73
                1.02         6.42        3.40       -1.64       -1.99       -2.36       -2.46        -3.29
                1.15         6.80        4.56        1.71        2.02        2.38        2.53         3.42

TF5A  - T 34     .960        2.31        1.35        -.700E-01  -1.25       -2.01       -1.63        -3.96
                 .299        1.29        2.36         .317      -1.27       -1.91       -1.94        -2.72
                1.05         1.34        2.39         .546       1.36        1.92        1.96         2.89
```

```
 - CODES -                                   - - - - TIME INTERVAL - - - -

 CALC.  EXP.     0.0 - 6.000      - 12.00      - 18.00      - 24.00      - 30.00      - 45.00      - 60.00      - 75.00
-----------------------------------------------------------------------------------------------------------------------

 HT1A - TC 1       -4.99         -2.50        -1.84        -2.70        -2.34        -2.67        -1.31        -21.0
                   -4.17         -3.43        -2.41        -2.15        -2.34        -2.31        -2.09        -7.02
                    6.23          3.53         2.43         2.19         2.36         2.33         2.14         9.51

 HT2A - TC 3        1.10          2.56         2.60         1.74         1.44         1.30        -.570         12.4
                    1.94          2.00         2.11         1.68         1.64         1.32         1.29         .839
                    2.08          2.02         2.13         1.68         1.65         1.34         1.33         6.70

 HT3A - TC 5       -4.95         -2.54        -2.00        -1.72        -1.49        -1.68        -28.6        -31.9
                   -4.92         -3.73        -2.23        -1.75        -1.74        -1.65        -6.84        -31.4
                    5.03          3.80         2.24         1.78         1.75         1.65         10.8         31.4

 HT4A - TC 9       -.850         -1.20        -1.46        -.830        -.190        -.130        -53.0        -59.8
                   -1.39         -1.19        -1.08        -.868        -.432        -.117        -19.4        -56.6
                    1.48          1.20         1.12         .985         .463         .197         26.0         56.6

 HT5A - TC12        1.45          .470         .450         .440         .140         .600E-01    -38.9        -28.0
                    .301          .914         .344         .268         .352E-01     .877E-01    -13.3        -33.4
                    1.66          1.00         .421         .349         .219         .168         18.2         33.8

 HT6A - TC15        1.46          .410         .640         .840        0.           -.800E-01    -34.9        -43.6
                    .289          .576         .444         .217         .983E-01    -.543E-01    -15.6        -41.2
                    1.60          .640         .508         .372         .330         .176         19.2         41.2

 HL1A - X661       -35.0         -35.1        -34.8        -40.3        -45.2        -50.0        -50.1        -50.8
                   -25.7         -34.9        -34.1        -35.9        -43.3        -47.3        -50.1        -50.4
                    27.0          34.9         34.1         36.0         43.3         47.3         50.1         50.4

 HP1A - X801       -.127        -.435E-01    -.145E-01    -.440E-03     .616E-02     .224E-02    -.679E-02    -.169E-01
                   -.161        -.803E-01    -.386E-01    -.498E-02    -.194E-03     .461E-02    -.177E-02    -.119E-01
                    .169         .844E-01     .408E-01     .655E-02     .373E-02     .483E-02     .316E-02     .122E-01
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Case B

```
CODE CALCULATION-TO-EXPERIMENT DATA UNCERTAINTY ANALYSIS FOR NRC/ICAAP.
************************************************************************

  FIRST LINE  : DIFFERENCE BETWEEN CALCULATED AND (AVERAGED) EXPERIMENTAL DATA AT END OF THE INTERVAL
  SECOND LINE : MEAN DIFFERENCE OVER THE INTERVAL
  THIRD LINE  : MEAN SIGMA OVER THE INTERVAL  (ROOT MEAN SQUARE OF THE DIFFERENCE)


 - CODES -                             - - - - TIME INTERVAL - - - -

CALC.  EXP.     0.0 - 6.000      - 12.00      - 18.00      - 24.00      - 30.00      - 45.00      - 60.00      - 75.00
----------------------------------------------------------------------------------------------------------------------

P 1P - P  3     -.850E-01    -.168E-01    -.123        -.749E-01    -.142        -.251        -.360        -.619
                -.853E-01    -.542E-01    -.421E-01    -.100        -.130        -.203        -.273        -.476
                 .937E-01     .604E-01     .653E-01     .103         .132         .205         .274         .480

P 2H - P  4     -.614E-01     .164E-01    -.661E-01    -.460E-01    -.174        -.218        -.333        -.539
                -.422E-01    -.105E-01    -.301E-02    -.707E-01    -.103        -.173        -.246        -.457
                 .491E-01     .243E-01     .534E-01     .745E-01     .106         .175         .248         .461

P 3F - P  6     -.960E-01    -.274E-01    -.116        -.527E-01    -.117        -.245        -.343        -.558
                 .210        -.665E-01    -.479E-01    -.764E-01    -.111        -.184        -.256        -.468
                 .748         .716E-01     .656E-01     .813E-01     .115         .187         .258         .472

PO4H - P  4     -2.78         .860        2.41        -1.68          .150         .924E-01     .304        -.968E-03
                -1.34        -1.38        1.75         1.64          .721         .413         .794         .159
                 5.55         1.73        2.20         2.41          .903         .570        1.16          .600

POLP - D LP      .443         .415         .291        -.131         .292         .225         .400E-01    -.709E-01
                 .405         .419         .432         .418E-01     .682E-01    -.301         .210        -.268E-01
                 .428         .419         .435         .256         .197         .575         .219         .447E-01

POCH - D CO     -9.20        -11.3        -5.07          .640E-01   -5.88        -9.23        -2.23          .321
                -7.12        -9.95        -10.4        -1.83        -3.61        -7.75        -6.23         -.200
                 8.18         9.96        10.6          2.97         4.13         7.85         6.47          .876

POUP - D UP     -.714        -1.25        -1.19        -1.06         -.245         .819E-01    -.389E-01    -.724E-01
                -.797        -.995        -1.33        -1.13        -1.39          .311        -.238E-01    -.509E-01
                 .987         1.01         1.33         1.13         1.51          .342         .581E-01     .556E-01

PODR - D DC     -.161         .654        -.108E-01     1.98         6.95         6.63          .917         .165
                -.183         1.19        -.210          .446        5.23         6.59         4.00          .250
                 1.66         1.37         .652          .753        5.56         6.64         4.38          .297

POSH - D 56     -1.54        -1.66        -1.47         -.946       -1.08         -.556        -.388        -.353
                -.158        -1.52        -1.96        -1.06        -1.84         -.638        -.472        -.493
                 1.89         1.53         1.99         1.07         1.91          .673         .484         .508

MF1R - XA02     -.794E-01     .553E-01     .152          .144        -.897E-01    -.374        -.436E-01     .677E-01
                -.246        -.107E-02     .765E-01      .179         .874E-01    -.359        -.197         .286E-01
                 .285         .325E-01     .841E-01      .186         .159         .365         .234         .555E-01

MF2R - XA03     -.646E-01     .571E-01    -.486E-01      .374         .544         .808         .465         .150
                -.229        -.222E-01     .460        -1.28          .268         .429E-01     .348         .240
                 .298         .533E-01     .523         1.57         1.22          .484         .590         .313

MF3C - XA04     -.231        -.189        -.674         -.494        -.216         .118E-01    -.526        -.829
                -.229        -.192        -.501         -.694        -.219        -.247        -.497        -.856
                 .267         .192         .596          .710         .318         .353         .598         .871

MF5R - XA07      .705E-01     .739E-01     .183E-01      .801E-02    -.862E-02    -.251E-01    -.442E-01    -.728E-01
                 .928E-01     .712E-01     .495E-01      .168E-01    -.551E-02    -.176E-01    -.304E-01    -.597E-01
                 .160         .716E-01     .737E-01      .176E-01     .889E-02     .188E-01     .308E-01     .605E-01

MF6R - X610     -1.11        -1.22        -.281          .987        -.657E-01    1.18          .852         .694
                -.578        -1.23        -1.27          .773         .247         .603         .936         .955
                 .839         1.23         1.36          .948         .507         .721         .956         .965

MF6R - XA36     -1.02         2.53        -1.17        -1.26          .174        -.470        -.229        -.427
                -4.26         .904         .709       -1.20         -.624        -.111        -.277E-01    -.233
                 4.63         1.44         1.02         1.29          .807         .284         .190         .285

TF1R - T  3      2.44         2.90         7.98         2.17         1.98        -3.76        -9.73        -23.4
                 1.96         3.17         5.28         5.84         2.02        -.938        -5.97        -15.6
                 2.00         3.40         5.52         6.26         2.05         2.03         6.19         16.1

TF2R - T 14     -.300        -1.32        -.730          .440        -.920        -2.60        -11.0        -24.7
                -.257        -.248         .185        -.375E-02     .733E-02    -1.02        -5.87        -17.9
                 .820         .561         .671          .478        1.09          1.28         6.45         18.3

TF4F - T 15      1.01         1.81        -.900E-01      .710        -.230        -2.17        -13.4        -28.1
                 1.28         1.37         .715          .161        -.166        -1.05        -7.24        -21.0
                 1.41         1.42         .863          .402         .388         1.17         7.99         21.5

TF3C - T 31      2.22         8.88        -1.76        -2.73        -3.58        -5.61        -7.89        -16.5
                 1.17         7.63         2.64        -2.72        -3.38        -4.62        -6.60        -12.7
                 1.33         8.02         4.46         2.74         3.40         4.66         6.67         12.9

TF5R - T 34      1.05         2.87         .420        -1.59        -2.99        -5.06        -8.58        -15.9
                 .408         1.59         2.33         -.635       -2.80        -4.19        -6.19        -12.3
                 1.08         1.66         2.46         1.02         2.85         4.22         6.26         12.5
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```
 - CODES -                                     - - - - TIME INTERVAL - - - -

 CALC.  EXP.    0.0 - 6.000     - 12.00     - 18.00     - 24.00     - 30.00     - 45.00     - 60.00     - 75.00
------------------------------------------------------------------------------------------------------------------

 HT1B - TC 1       -4.66         -2.56       -1.96       -3.00       -3.68       -5.51       -7.47       -20.4
                   -6.13         -3.42       -2.41       -3.48       -3.51       -4.43       -5.95       -14.7
                    6.19          3.51        2.43        3.54        3.54        4.47        5.99        15.8

 HT2B - TC 3        1.44          2.35        .660        .930       .100E+00    -1.57        15.3        40.7
                    2.45          2.06        1.45        .579       .443        -.784        .181        27.7
                    2.65          2.07        1.58        .640       .566         .956        5.13        28.7

 HT3B - TC 5       -4.21         -2.73       -3.28       -2.53       -2.81       -4.56       -.430       -2.20
                   -4.53         -3.52       -2.93       -2.81       -2.94       -3.74       -4.00       -2.45
                    4.65          3.56        2.96        2.83        2.95        3.77        4.32        2.51

 HT4B - TC 6       -1.23         -1.39       -2.67       -1.83       -1.51       -2.99       -22.4       -27.9
                   -1.46         -1.30       -1.74       -1.84       -1.61       -2.14       -14.7       -25.3
                    1.73          1.32        1.62        1.93        1.63        2.18        17.0        25.3

 HT6F - TC12        1.03          .350       -.720       -.360       -1.18       -2.77       -8.77        4.10
                   .654E-01       .715       -.235       -.639       -1.14       -1.93       -8.85       -1.82
                    1.55          .755        .531        .711        1.17        1.98        9.96        4.97

 HT4F - TC15        1.24          .370       -.150        .160       -1.42       -2.69       -27.8       -34.3
                    .752          .620        .193       -.538       -.893       -2.04       -16.7       -32.3
                    1.26          .655        .498        .619        1.03        2.08        18.9        32.3

 ML1B - X661       -28.8         -22.4       -16.1       -24.7       -28.1       -29.8       -29.9       -33.3
                   -22.6         -25.3       -18.9       -20.3       -26.8       -28.4       -29.4       -31.7
                    23.7          25.4        18.9        20.4        26.8        28.4        29.4        31.7

 HP1F - X801       -.127      -.435E-01   -.145E-01   -.440E-03    .616E-02    .224E-02   -.679E-02   -.169E-01
                   -.161      -.803E-01   -.366E-01   -.498E-02   -.194E-03    .461E-02   -.177E-02   -.119E-01
                    .169       .844E-01    .408E-01    .655E-02    .373E-02    .483E-02    .316E-02    .122E-01
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Case C

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CODE CALCULATION-TO-EXPERIMENT DATA UNCERTAINTY ANALYSIS FOR NRC/ICAAP.
======================================================================

  FIRST LINE  : DIFFERENCE BETWEEN CALCULATED AND (AVERAGED) EXPERIMENTAL DATA AT END OF THE INTERVAL
  SECOND LINE : MEAN DIFFERENCE OVER THE INTERVAL
  THIRD LINE  : MEAN SIGMA OVER THE INTERVAL  (ROOT MEAN SQUARE OF THE DIFFERENCE)


 - CODES -                               - - - - TIME INTERVAL - - - -

CALC.  EXP.    0.0 - 6.000     - 12.00      - 18.00      - 24.00      - 30.00      - 45.00      - 60.00      - 75.00
---------------------------------------------------------------------------------------------------------------------

P 1C - P  1    -.554E-01     .591E-01     .320E-02     .308E-01     -.260E-01    -.875E-01    -.887E-01    -.327
               -.599E-01     .172E-02     .403E-01     .121E-01     -.142E-01    -.536E-01    -.768E-01    -.192
                .666E-01     .385E-01     .515E-01     .233E-01      .273E-01     .558E-01     .776E-01     .201

P 2C - P  4    -.324E-01     .894E-01     .329E-01     .529E-01     -.960E-02    -.568E-01    -.627E-01    -.248
               -.172E-01     .461E-01     .729E-01     .348E-01      .762E-02    -.254E-01    -.517E-01    -.174
                .221E-01     .594E-01     .819E-01     .384E-01      .210E-01     .298E-01     .525E-01     .183

P 3C - P  6    -.666E-01     .501E-01     .111E-01     .541E-01      .280E-02    -.821E-01    -.702E-01    -.266
                .235        -.108E-01     .414E-01     .327E-01      .754E-02    -.335E-01    -.599E-01    -.184
                .766         .390E-01     .485E-01     .431E-01      .279E-01     .391E-01     .618E-01     .194

PD4C - D  4    -2.52         1.37         3.68        -.644          .972         .250         .469         .220
               -1.14        -1.08         2.81         2.36         1.40          .954         .827         .336
                5.46         1.59         3.25         2.80         1.47         1.05         1.17          .680

PDLC - D LP     .444          .420         .394         .229         .572        1.43          .215         .173
                .405          .421         .453         .368         .377        1.45          .555         .405E-01
                .429          .422         .454         .389         .402        1.53          .633         .809E-01

PDCC - D CO    -8.81        -8.80          .262        5.04         -4.37        -8.56        -2.06          .454
               -6.91        -8.99        -4.88         3.62          -.478       -7.47        -5.04         -.210
                7.94         8.99         5.67         4.17          3.36         7.66         5.29          .973

PDUC - D UP    -.701        -1.20         -.590         .112         -.484         .233        -.478E-01    -.622E-01
               -.793         -.968       -1.02         -.374         -.188         .501         .376E-01    -.457E-01
                .985          .983        1.07          .450          .486         .547         .960E-01     .504E-01

PDGC - D GC    -.160        -17.8         -6.03        -2.16          -.744        6.03          .784        -.147
               -.161         -5.17       -13.6         -3.51          -.190        2.50         3.96         -.127
               1.66           7.96        14.5          3.65          1.11         3.54         4.35          .273

PD5C - D 56    -1.60         -1.64        -1.11         -.357         -.330        -.459        -.375        -.252
               -.233         -1.53        -1.74         -.708         -.301         .704E-01    -.412        -.467
               1.82           1.54         1.80          .760          .694         .427         .425         .484

MF1C - X602    -.723E-01     .849E-01     .196          .282         -.231         -.383        -.604E-01     .464E-01
               -.240         .111E-01     .147          .299          .166         -.358        -.192         .103E-01
                .288         .408E-01     .155          .318          .297          .364         .227         .485E-01

MF2C - X603     .319E-01     .735         .747        -1.10          -.207          .452         .669         .564
               -.164         .223        1.05          -.682         -.871E-01      .593         .639         .577
                .264         .306        1.06           .963         1.06           .793         .629         .608

MF3C - X604    -.201        -.444E-01     .367         -.473          .524E-01     .100        -.402        -.731
               -.206        -.129         .369         -.316         -.323E-01    -.737E-01    -.419        -.799
                .249         .133         .639          .389          .523         .255         .528         .817

MF5C - X607     .705E-01     .739E-01     .352E-01      .235E-01      .795E-02    -.600E-04    -.231E-02    -.288E-01
                .934E-01     .712E-01     .588E-01      .340E-01      .118E-01     .445E-02    -.482E-03    -.160E-01
                .161         .716E-01     .802E-01      .342E-01      .133E-01     .681E-02     .283E-02     .183E-01

MF4C - X610    -1.11        -1.13        -.779E-01     1.16           .171         .983         .801         .742
               -.585        -1.22        -.868          .623          .622         .625         .843         .926
                .845         1.22        1.00          1.15           .887         .685         .880         .933

MF6C - X636    -.969         2.59        -.460        -1.20           .244        -.378        -.587E-01    -.327
               -4.23          .962       1.03          -.630         -.599        -.207E-01     .151        -.102
                6.62         1.48        1.23          1.15           .840         .260         .235         .192

TF1C - T  3     2.45         2.98        4.13          3.80          3.72        -1.23         -4.35        -15.6
                1.96         3.21        3.57          4.44          3.52         1.30         -2.45         -9.08
                2.01         3.44        3.60          4.45          3.53         2.03          2.57          9.65

TF2C - T 14     .200E-01     -.620        .640         1.78           .570        -.100E-01    -5.59        -16.8
               -.130E-01      .220       1.02          1.29          1.48          1.13         -2.38        -11.3
                .725          .572       1.17          1.37          1.84          1.31          3.02         11.8

TF4C - T 15     1.23         2.50        1.25          2.00          1.27          .400         -8.07        -20.3
                1.50         1.89        1.55          1.42          1.35         1.12          -3.75        -14.5
                1.61         1.95        1.58          1.46          1.39         1.15           4.54         14.9

TF3C - T 31     2.31         5.60        -.290        -1.36         -1.87         -3.03         -2.39         -8.67
                1.21         6.33        2.78         -1.36         -1.82         -2.36         -3.09         -6.12
                1.38         6.56        3.48          1.41          1.85          2.39          3.13          6.32

TF5C - T 34     1.07         2.80        2.37          -.220        -1.42         -2.45         -3.15         -8.07
                .418         1.61        2.53           .862        -1.27         -1.98         -2.66         -5.68
                1.09         1.68        2.54          1.12          1.37          2.01          2.67          5.90
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 - MODES -                              - - - - TIME INTERVAL - - - -

 CALC.  EXP.    0.0 - 6.000      - 12.00      - 18.00      - 24.00      - 30.00      - 45.00      - 60.00      - 75.00
------------------------------------------------------------------------------------------------------------------------

 HT1C - TC 1        -4.65          -2.22        -2.92        -2.03        -2.31        -2.97        -2.46        -24.7
                    -5.96          -3.07        -2.66        -2.59        -2.26        -2.30        -2.68        -9.58
                     6.03           3.20         2.70         2.62         2.28         2.32         2.70         11.9

 HT2C - TC 3         1.60           2.88         1.79         1.94         1.49         .980        -1.83         27.9
                     2.58           2.44         2.04         1.71         1.72         1.34         .677         15.3
                     2.77           2.45         2.09         1.72         1.73         1.36         .786         17.4

 HT3C - TC 5        -4.11          -2.18        -2.15        -1.46        -1.44        -2.00        -16.1        -16.6
                    -4.39          -3.17        -2.28        -1.71        -1.66        -1.63        -6.50        -15.7
                     4.54           3.24         2.30         1.73         1.67         1.64         9.29         15.7

 HT4C - TC 9        -.960          -.670        -1.73        -.620        -.140        -.450        -42.1        -45.7
                    -1.43          -.805        -1.01        -.870        -.322        -.890E-01    -19.2        -42.2
                     1.52           .860         1.13         1.00         .361         .200         25.2         42.3

 HT5C - TC12         1.30           1.04         .138         .450         .190        -.250        -28.2        -13.4
                     .282           1.21         .408         .245         .136         .111        -13.1        -18.4
                     1.61           1.22         .658         .338         .264         .209         17.4         19.0

 HT6C - TC15         1.38           .860         .480         .870         .400E-01    -.320        -31.7        -35.9
                     .467           .949         .514         .223         .187        -.555E-01    -16.0        -33.2
                     1.55           .960         .705         .368         .358         .202         19.4         33.2

 ML1C - X661        -28.6          -21.9        -15.7        -18.8        -21.9        -22.3        -19.7        -21.2
                    -22.6          -25.0        -17.8        -15.4        -20.9        -21.6        -20.7        -20.5
                     23.6           25.0         17.9         15.5         20.9         21.6         20.8         20.5

 MP1C - X801        -.127          -.435E-01    -.145E-01    -.440E-03     .616E-02     .224E-02    -.679E-02    -.169E-01
                    -.161          -.803E-01    -.366E-01    -.498E-02    -.194E-03     .461E-02    -.177E-02    -.119E-01
                     .169           .844E-01     .408E-01     .655E-02     .373E-02     .483E-02     .316E-02     .122E-01
```

Case D

```
CODE CALCULATION-TO-EXPERIMENT DATA UNCERTAINTY ANALYSIS FOR NRC/ICAAP.
*************************************************************************

  FIRST LINE  : DIFFERENCE BETWEEN CALCULATED AND (AVERAGED) EXPERIMENTAL DATA AT END OF THE INTERVAL
  SECOND LINE : MEAN DIFFERENCE OVER THE INTERVAL
  THIRD LINE  : MEAN SIGMA OVER THE INTERVAL  (ROOT MEAN SQUARE OF THE DIFFERENCE)


 - CODES -                              - - - - TIME INTERVAL - - - -

CALC.  EXP.    0.0 - 6.000    - 12.00     - 18.00     - 24.00     - 30.00     - 45.00     - 60.00     - 75.00
---------------------------------------------------------------------------------------------------------------

P 10 - P  3    -.930E-02     .193        .153        .131       -.227E-01   -.303       -.425       -.704
               -.491E-01     .941E-01    .162        .153        .360E-01   -.168       -.354       -.556
                .593E-01     .114        .164        .153        .620E-01    .187        .355        .560

P 20 - P  4     .137E-01     .223        .180        .152       -.630E-02   -.272       -.399       -.624
               -.663E-02     .139        .214        .173        .588E-01   -.140       -.329       -.538
                .230E-01     .152        .216        .174        .758E-01    .162        .338        .542

P 30 - P  4    -.205E-01     .164        .156        .156        .121E-01   -.295       -.404       -.640
                .246         .812E-01    .163        .174        .586E-01   -.146       -.336       -.545
                .765         .103        .164        .176        .776E-01    .169        .337        .549

PD40 - D  4    -2.51         1.38        4.10       -.604        .940        .176        .509        .236
               -1.07        -1.10        2.95        2.26        1.19         .962        .790        .437
                5.43         1.60        3.41        2.68        1.31        1.05        1.16         .725

PDLP - D LP     .442         .416        .412        .387        .536       1.62         .534        .547E-01
                .405         .419        .448        .370        .238       1.53         .818        .229
                .428         .419        .449        .377        .299       1.61         .890        .278

PDCO - D CO    -8.75        -8.71        2.74        5.60       -4.42       -8.96       -2.29         .351
               -6.81        -8.94       -4.20        5.77       -1.21       -7.47       -5.47        -.318
                7.85         8.94        5.42        5.97        3.02        7.71        5.70         .981

PDUD - D UP    -.699        -1.21        -.631        .611       -.502        .201       -.577E-01   -.751E-01
               -.788         -.968      -1.07        -.141       -.170        .482        .871E-02   -.576E-01
                .981          .964       1.11         .445        .498        .531        .799E-01    .615E-01

PDDC - D DC    -.870E-01   -17.8         -7.74       -4.30       -1.13        5.77         .685        .140
               -.138        -5.04       -14.6        -5.97       -2.78        1.44        3.89        -.300E-01
                1.64         7.90        15.3         6.02        3.34        3.03        4.28         .249

PD56 - D 56    -1.63        -1.66        -1.18        .220       -.142       -.471       -.437       -.343
               -.210        -1.56        -1.83       -.521       -.264        .861E-01   -.496       -.503
                1.84         1.57         1.67        .658        .380        .436        .507        .518

MF10 - X602    -.702E-01     .868E-01     .242        .282       -.210       -.425       -.627E-01    .403E-01
               -.237         .119E-01     .156        .278        .929E-02   -.360       -.201        .740E-02
                .277         .413E-01     .166        .283        .188        .366        .237        .483E-01

MF20 - X603     .252E-01     .707         .653       -.196       -.615       -.242        .838        .434
               -.171         .207         .599       -.826       -.255        .552        .518        .611
                .266         .291        1.01        1.06        1.25         .729        .675        .680

MF30 - X604    -.204        -.674E-01    -.195       -.132        .600        .253       -.366       -.834
               -.214        -.138         .182       -.368        .186        .118       -.387       -.760
                .256         .140         .420        .407        .283        .300        .512        .780

MF50 - X607     .705E-01     .739E-01     .590E-01    .399E-01    .868E-02   -.343E-01   -.536E-01   -.851E-01
                .934E-01     .712E-01     .795E-01    .567E-01    .206E-01   -.131E-01   -.431E-01   -.707E-01
                .161         .716E-01     .990E-01    .570E-01    .234E-01    .194E-01    .433E-01    .715E-01

MF40 - X610    -1.11        -1.12         -.420        .990        .845       1.09        1.05         .550
               -.562        -1.23         -.890        .908        .468        .803        .832        .804
                .831         1.23          .954       1.38         .532        .830        .876        .840

MF60 - X636    -.992         2.57         -.753      -1.21         .290       -.390        .560E-02   -.241
               -4.26          .967         .867       -.791       -.588       -.117E-01    .148       -.676E-01
                6.64         1.48         1.13        1.17         .838        .264        .232        .182

TF10 - T  3     2.58         3.28         4.26        5.34        3.77       -4.65       -11.1       -25.9
                2.01         3.42         3.90        4.61        4.32        -.400       -7.44      -17.7
                2.06         3.64         3.93        4.62        4.37        2.66         7.63       18.2

TF20 - T 14     .320          .730        2.24        2.98         .620       -3.46       -12.3       -27.1
                .537E-01      .920        2.47        2.87        2.12        -.580       -7.38      -19.9
                .729         1.11         2.53        2.91        2.43        1.43         7.87       20.4

TF40 - T 15     1.63         3.75         2.65        3.24        1.33       -3.03       -14.8       -30.6
                1.50         2.75         3.00        3.02        2.00        -.595       -8.75      -23.1
                1.61         2.82         3.01        3.03        2.09        1.39         9.41       23.5

TF30 - T 31     3.09         8.25         1.33        -.130      -1.83       -6.43       -9.14       -19.0
                1.47         8.35         4.66         .273      -1.15       -4.05       -8.09       -14.7
                1.69         8.64         5.30         .481       1.32        4.27        8.15        14.9

TF50 - T 34     1.75         4.85         4.03         .920      -1.28       -5.83       -9.77       -18.3
                .893         2.82         5.14        2.53        -.669      -3.63       -7.59       -14.2
                1.46         2.95         5.15        2.71        1.01        3.87        7.65        14.4
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 - COOFS -                                 - - - - TIME INTERVAL - - - -

 CALC.  EXP.    0.0 - 6.000     - 12.00       - 18.00       - 24.00      - 30.00      - 45.00      - 60.00      - 75.00
-------------------------------------------------------------------------------------------------------------------------

 HT1D - TC 1       -4.35          -1.15         -1.43         -.700        -2.05        -6.16        -8.79        -3.03
                   -5.91          -2.36         -1.36        -1.31        -1.43        -3.72        -7.36        -8.53
                    5.99           2.61          1.42         1.38         1.54         3.94         7.39         8.92

 HT2D - TC 3        1.89           3.98          3.29         3.29         1.69        -2.27        -.940         27.6
                    2.63           3.16          3.37         3.20         2.51        -.153        -3.80         15.4
                    2.80           3.19          3.39         3.21         2.57         1.21         3.90         17.1

 HT3D - TC 5       -3.86          -1.09         -.600        -.100        -1.24        -5.26        -13.5        -15.8
                   -4.35          -2.46         -.944        -.185        -.855        -3.13        -9.52        -14.8
                    4.50           2.61          .993         .302         .947         3.33         10.6         14.8

 HT4D - TC 9       -.640           .410         -.180         .720         .700E-01    -3.67        -37.9        -43.7
                   -1.36          -.931E-01      .342         .609         .489        -1.57        -21.8        -39.9
                    1.46           .515          .526         .765         .650         1.91         26.1         40.0

 HT5D - TC12        1.62           2.11          1.65         1.71         .400        -3.46        -23.7        -11.2
                    .352           1.92          1.77         1.69         .938        -1.36        -15.7        -16.0
                    1.67           1.93          1.81         1.70         1.04         1.77         18.4         16.6

 HT6D - TC15        1.63           1.95          1.94         2.15         .290        -3.48        -33.4        -36.9
                    .516           1.64          1.86         1.74         1.03        -1.47        -20.0        -35.0
                    1.60           1.65          1.90         1.76         1.18         1.87         22.8         35.0

 ML1D - XA61       -28.8          -22.0         -16.7        -20.8        -23.9        -24.1        -21.6        -22.5
                   -22.7          -25.1         -18.2        -17.1        -22.8        -23.3        -22.7        -22.1
                    23.7           25.2          18.3         17.1         22.9         23.3         22.7         22.1

 MP1D - XA01       -.127          -.435E-01     -.146E-01    -.440E-03     .616E-02     .224E-02    -.679E-02    -.169E-01
                   -.161          -.803E-01     -.386E-01    -.498E-02    -.194E-03     .461E-02    -.177E-02    -.119E-01
                    .169           .844E-01      .408E-01     .655E-02     .373E-02     .483E-02     .316E-02     .122E-01
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P 1A      PRESSURE  LOWER PLENUM (P 3101)  CASE A
P 2A      PRESSURE, UPPER PLENUM (P 5201)  CASE A
P 3A      PRESSURE, BREAK INLET (P 9601)  CASE A
PD4A      DIFF PRESSURE, CORE INLET RESTRICTION (P 3301 - P 401)  CAS
PDCA      DIFF PRESSURE, CORE (FROM  P 401 - P 5101)  CASE A
PDDA      DIFF PRESSURE, DOWNCOMER (FROM  P 7103 - P 7201)  CASE A
PDLA      DIFF PRESSURE, LOWER PLENUM (FROM  P 3101 - P 3301)  CASE A
PDUA      DIFF PRESSURE, UPPER PLENUM (FROM  P 5101 - P 5201)  CASE A
PDSA      DIFF PRESSURE, STEAM SEPARATOR ORIFICE (P 5201 - P 5702)  C
TSUA      SUBCOOLING, BREAK INLET (TEMPG 9101 - TEMPF 9101)  CASE A
HP1A      CORF HEATING POWER (CNTRLVAR 57)  CASE A
HL1A      HEAT LOSS FROM PASSIVES (CNTRLVAR 53)  CASE A
MF1A      MASS FLOW RATE, BYPASS (MFLOWJ 117)  CASE A
MF2A      MASS FLOW RATE, I.L. PUMP (MFLOWJ 20102)  CASE A
MF3A      MASS FLOW RATE, B.L. PUMP (MFLOWJ 20202)  CASE A
MF4A      MASS FLOW RATE, B.L. VESSEL INLET (MFLOWJ 9702)  CASE A
MF5A      MASS FLOW RATE, STEAM RELIEF (MFLOWJ 404)  CASE A
MF6A      MASS FLOW RATE, BREAK (MFLOWJ 152)  CASE A
RH1A      FLUID DENSITY, CORE BOTTOM (RHO 0401)  CASE A
RH2A      FLUID DENSITY, VESSEL BOTTOM (RHO 3101)  CASE A
RH3A      FLUID DENSITY, BREAK (RHO 9601)  CASE A
HT1A      MEAN CLAD TEMPERATURE, LEVEL 1 (HTTEMP 401000105)  CASE A
HT2A      MEAN CLAD TEMPERATURE, LEVEL 3 (HTTEMP 403000105)  CASE A
HT3A      MEAN CLAD TEMPERATURE, LEVEL 5 (HTTEMP 404000105)  CASE A
HT4A      MEAN CLAD TEMPERATURE, LEVEL 9 (HTTEMP 406000105)  CASE A
HT5A      MEAN CLAD TEMPERATURE, LEVEL 12 (HTTEMP 407000105)  CASE A
HT6A      MEAN CLAD TEMPERATURE, LEVEL 15 (HTTEMP 410000105)  CASE A
TF1A      FLUID TEMPERATURE, CORE INLET (TEMPF 3301)  CASE A
TF2A      FLUID TEMPERATURE, CORE OUTLET (TEMPF 5101)  CASE A
TF3A      FLUID TEMPERATURE, DOWNCOMER BOTTOM (TEMPF 7108)  CASE A
TF4A      FLUID TEMPERTURE, UPPER PLENUM (TEMPF 5201)  CASE A
TF5A      FLUID TEMPERTURE, BREAK INLET (TEMPF 9601)  CASE A
CPUA      CPUTIME  CASE A
MATA      TOTAL MASS, IN SYSTEM  CASE A
MAEA      MASS ERROR  CASE A
ML1A      BREAK TOTAL MASS LOSS (CNTRLVAR 55)  CASE A
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P   3     PRESSURE, LOWER PLENUM (PT 3) - EXPERIMENT
P   4     PRESSURE, UPPER PLENUM (PT 4) - EXPERIMENT
P   6     PRESSURE, BREAK INLET (PT 6) - EXPERIMENT
D   4     DIFF. PRESSURE, CORE INLET RESTRICTION (DPT 4) - EXPERIMENT
D 56      DIFF. PRESSURE, STEAM SEPARATOR ORIFICE (DPT 56) - EXPERIME
D LP      DIFF. PRESSURE, LOWER PLENUM (DPT 2 + DPT 3 - DPT 1) - EXPE
D CO      DIFF. PRESSURE, CORE (DPT 5 + DPT 6 + .... + DPT 12) - EXPE
D UP      DIFF. PRESSURE, UPPER PLENUM (DPT 13 + DPT 14) - EXPERIMENT
D DC      DIFF. PRESSURE, DOWNCOMER (DPT 27 + .... + DPT 30) - EXPERI
X602      MASS FLOW RATE, BYPASS (CALCULATED) - EXPERIMENT
X603      MASS FLOW RATE, I.L. PUMP (CALCULATED) - EXPERIMENT
X604      MASS FLOW RATE, H.L. PUMP (CALCULATED) - EXPERIMENT
X607      MASS FLOW RATE, STEAM RELIEF (CALCULATED) - EXPERIMENT
X610      MASS FLOW RATE, B.L. VESSEL INLET (SPOOL PIECE K10) - EXPER
X636      MASS FLOW RATE, BREAK FROM T2 INVENTORY (CALCULATED) - EXPE
X661      MASS LOSS, BREAK FLOW RECIEVER (CALCULATED) - EXPERIMENT
X801      ELECTRIC POWER, CORE (CALCULATED) - EXPERIMENT
T   3     FLUID TEMPERATURE, CORE INLET (TE 3) - EXPERIMENT
T  14     FLUID TEMPERATURE, CORE OUTLET (TE 14) - EXPERIMENT
T  15     FLUID TEMPERATURE, UPPER PLENUM (TE 15) - EXPERIMENT
T  31     FLUID TEMPERATURE, DOWN COMER BOTTOM (TE 31) - EXPERIMENT
T  34     FLUID TEMPERATURE, BREAK INLET (TE 34) - EXPERIMENT
TC  1     MEAN CLAD TEMP., LEVEL 1 (T191 T206 T211 T246) - EXPERIMENT
TC  3     MEAN CLAD TEMP., LEVEL 3 (T108 T183 T243 T248) - EXPERIMENT
TC  5     MEAN CLAD TEMP., LEVEL 5 (T202 T227 T232 T237 T252) - EXPER
TC  9     MEAN CLAD TEMP., LEVEL 9 (T102 T137 T167 T172 T187 T197 T27
TC12      MEAN CLAD TEMP., LEVEL 12 (T118 T123 T128 T148 T223) - EXPE
TC15      MEAN CLAD TEMP., LEVEL 15 (T175 T190 T275) - EXPERIMENT
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Split Break Experiment No. 3027

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John Eriksson

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11a. TYPE OF REPORT
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13. ABSTRACT *(200 words or less)*

The FIX-II split break experiment No. 3027 has been analyzed using the RELAP5/Mod2 code. The code version used, Cycle 36, is a frozen version of the code.

Four different prediction calculations were carried out to study the sensitivity on various parameters to changes of break discharge, initial coolant mass, and passive heat structures. The differences between the calculations and the experiment have been quantified over intervals in real time for a number of variables available from the measurements during the experiment.

The core inventory expressed by the differential pressure over the core was generally underpredicted. Dryout times were generally overpredicted, probably due to differences in the used dryout correlation.

14. DOCUMENT ANALYSIS – a. KEYWORDS/DESCRIPTORS
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ASSESSMENT OF RELAP5/MOD 2, CYCLE 36, AGAINST FIX-II SPLIT BREAK EXPERIMENT NO. 3027

SEPTEMBER 1986