MOL.19990928.0239

# OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
# CALCULATION COVER SHEET

1. QA: QA

Page: 1 Of: 30

2. Calculation Title
Sensitivity Study of Reactivity Consequences to Waste Package Egress Area

MOL.19990928.0239

3. Document Identifier (including Revision Number)
CAL-EBS-NU-000001 REV 00

| 4. Total Attachments | 5. Attachment Numbers - Number of pages in each |
|---|---|
| 4 | I-3, II-8, III-21, IV-3 |

| | Print Name | Signature | Date |
|---|---|---|---|
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9. Remarks

**Revision History**

| 10. Revision No. | 11. Description of Revision |
|---|---|
| 00 | Initial Issue |

## CONTENTS

**FIGURES**

**Page**

## TABLES

**Page**

## 1. PURPOSE

The criticality consequence analysis for pressurized water reactor (PWR) waste packages (WP) (Civilian Radioactive Waste Management System [CRWMS] Management and Operating Contractor [M&O] 1997) focused on results obtained by maximizing postulated rates of reactivity insertion to assure no synergistic reactions could occur among waste packages from hypothetical criticality events. Other variables potentially influencing the criticality consequences were held constant during the above referenced analysis. One of those variables that may affect results is the exit area of the leakage paths from the WP. If the leakage area through the WP wall is sufficiently small, inflow rates will be restricted; lengthening the time required for flooding the WP and thus delaying potential criticality events, which require flooded conditions. However, if a criticality event does occur, a limited leakage area will reduce the exit flow volume. The immediate effect on the system from a limited leakage area is to reduce the negative reactivity effect of voiding the WP because the water/vapor escape rate may be lowered. This, in turn, leads to higher heat output, higher internal pressure, and higher temperatures. The higher pressure and density of the water vapor will increase the mass flow out of the waste package, so that eventually the negative reactivity from voiding the system becomes dominant, and the criticality event shuts down.

The purpose of this calculation is to determine the relation between reduction in the leakage area and possible increases in peak pressures and temperatures for such hypothetical criticality events. This calculation was performed under the AP3.12Q Revision 0, ICN 0 Procedure and will support WP design and analysis activities.

## 2. METHOD

The method for analyzing criticality consequences involving intact PWR spent nuclear fuel (SNF) in a degraded WP has been documented previously (CRWMS M&O 1997). The same methodology was followed for calculations to determine the sensitivity to variations in the rate of reactivity addition and to variations in the leakage area of the WP to the external drift of WP parameters important for assessing criticality consequences. The analysis deck from the initial consequence analysis was used as the basis for this calculation with parameters varied to determine their effect. The light water reactor (LWR) transient analysis code, RELAP5/MOD3.2 (NRC 1995a) was used to calculate the time evolution of the power level and other characteristics of a criticality event involving PWR SNF. The calculation was performed for time scales corresponding to a rapid reactivity insertion rate of 0.158 $/s and a much slower rate of 0.0004 $/s. The maximum insertion rate was derived from the time required ($\cong$ 90 seconds) for a spherical particle of $Fe_2O_3$ to fall one meter in water at a Reynolds number of $\cong$ 1.0 (CRWMS M&O 1997, Attachment III, Spreadsheet RLP5GEOM-1.xls, Sheet "Non-Fuel Vol"). This time provides an upper bound on the rate that reactivity in the WP can be increased through absorber redistribution. The low reactivity insertion rate approximates a more likely gradual shift in conditions conducive to criticality. The simulated criticality event is driven, in each case, by a linear rate of reactivity insertion up to a maximum of 14.18 $ (CRWMS M&O 1997, Section 7) and held constant thereafter. Consequences of a transient criticality event are evaluated in terms of the capacity of the WP to remain in a safe condition after such a hypothetical event.

## ASSUMPTIONS

No additional assumptions beyond those given in the referenced consequence analysis (CRWMS M&O 1997, Section 4.3) were necessary for this calculation.

## 4. USE OF COMPUTER SOFTWARE AND MODELS

### 4.1 SOFTWARE APPROVED FOR QUALITY ASSURANCE (QA) WORK

#### 4.1.1 RELAP5/MOD3.2

Title: RELAP5/MOD3.2
Version/Revision Number: V1.0

The transient simulation of criticality events is performed using the transient thermal-hydraulic code RELAP5/MOD3.2 (U.S. Nuclear Regulatory Commission (NRC) 1995a, NRC 1995b, CRWMS M&O 1999b, CRWMS M&O 1999c, CRWMS M&O 1999d, CRWMS M&O 1999e, CRWMS M&O 1999f, CRWMS M&O 1999g). RELAP5/MOD3.2 was developed for the U.S. Nuclear Regulatory Commission for simulations of operational transients in PWR systems such as loss of coolant. The transient criticality events involving PWR SNF within a waste package are similar to the situations for which RELAP5/MOD3.2 was developed to analyze. The software specifications are as follow:

- Software name: RELAP5/MOD3.2
- Software version/revision number: Version V1.0
- Software activity number: LV-1999-047
- Software tracking number: 10091-1.0-00
- Software media number: 10091-MED-1.0-00
- Computer type: Hewlett Packard (HP) 9000 Series Workstations
- Computer processing unit number: Software is installed on the (CRWMS M&O) workstation Bloom.

The RELAP5/MOD3.2 software used is: (a) appropriate for the application of WP transient criticality consequence calculations, (b) used within the range of the software validation, (c) and obtained from the Software Configuration Secretariat in accordance with appropriate procedures.

## 4.2 SOFTWARE ROUTINES

### 4.2.1 Excel

Title: Excel
Version/Revision Number: Microsoft Excel 97

The Excel spreadsheet program was used to generate graphical representations of various parameters calculated by RELAP5/MOD3.2 and to identify maximum values. No additional calculations were performed on the data files.

### 4.2.2 Strip

Title: Strip
Version/Revision Number: V00

The RELAP5/MOD3.2 program writes two files as output:

(1) A formatted print file containing "major edits" at specified times.

(2) A binary "restart" file to enable a case to resume.

The RELAP5/MOD3.2 code also has an option to collect minor edits (a history of particular variables) at each time point from the restart file and put them into a formatted strip file. The FORTRAN-90 program, "Strip", reads a RELAP5/MOD3.2 strip file and writes the information in a series of more compact files for use in later analysis. The output of the code can be readily checked against the strip files by visual inspection. The source code with sample input and output files are included in Attachment II. The source and executable code are included as part of the electronic data on a compact disk (CD) (CRWMS M&O 1999a).

## 4.3 MODELS

There were no models used in this calculation.

# 5. CALCULATION

As stated in Section 1, the purpose of this calculation is to determine the relation between reduction in the WP leakage area and increase in peak pressure and temperature for hypothetical criticality events. The calculation was performed for hypothetical criticality events where a reactivity insertion rate of 0.158 $/s was used to approximate the maximum rate of change in the available reactivity due to absorber redistribution within the WP and a much slower insertion rate of 0.0004 $/s to approximate a gradual shift in the system reactivity.

The basic RELAP5/MOD3.2 analysis input file from the initial consequence analysis (CRWMS M&O 1997, Attachment IV, CD file c103cbas.dk) was used for this calculation and is listed in Attachment III of this document. The area of the junction component (RELAP5 nomenclature) exiting the WP (Junction Label: J250) was varied for this calculation. Transport options set for this junction were homogeneous flow without momentum flux as recommended (NRC 1995b, p. 2-11).

The RELAP5/MOD3.2 reactivity consequence input data contained two void reactivity descriptions, one based on the change in the criticality factor, $k_{eff}$, with total WP density variations and the second based on MCNP calculations of $k_{eff}$ versus decreasing water level in the WP. The $k_{eff}$ versus water level data was used for the original analysis since this method of calculating void reactivity feedback conservatively did not activate until there was sufficient vapor generation in the WP to cause pressurization and subsequent voiding of the WP. Expected results from decreasing the exit junction area were an increase in pressure, delaying or possibly suppressing the void formation (and the subsequent WP inventory loss) necessary to terminate the criticality event. Thus, the $k_{eff}$ versus water level method of calculating feedback reactivity was considered overly conservative for this calculation and the WP density reactivity data were used instead. To identify differences between calculations using the two reactivity feedback representations, results from this calculation are compared with the original consequence case (Cases: r5wp2d.c103c and c103x1hbv.test; Excel file: c103xmdl.xls, Sheet: "Conseq-vs-Sens.pr", "c103x1hbv.dat", and "c103c.dat"). The pressures calculated from these two cases are shown in Figure 5-1. Maximum values from the two cases are of the same order although the shapes differ. The fission energy generated using the density reactivity feedback data was slightly greater than that generated using the water level reactivity data (5.05E+07 J versus 4.95E+07 J at 20 seconds).

Unqualified data were used in the development of the results presented in this section.

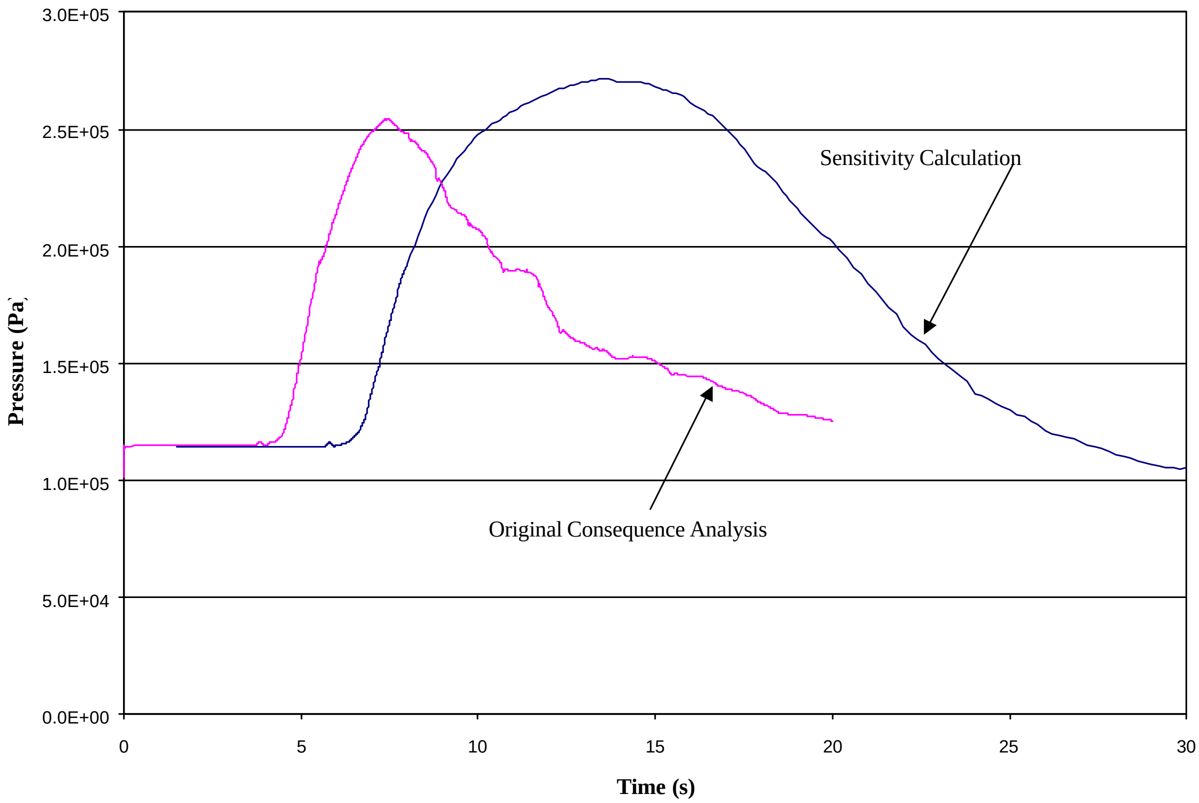


Figure 5-1. Pressure Response from Reactivity Consequence Analysis and Sensitivity Calculation for 100-$cm^2$ Junction Area

Frictional effects are important in the hydraulic calculations to maintain computational stability. These effects were simulated in the basis RELAP5/MOD3.2 representation of WP volumes containing SNF by applying loss coefficients in the connecting junctions. Frictional effects in other volumes were simulated allowing choked flow in their connecting junctions since relatively high pressures and mass flow rates were expected. Much lower pressures and mass flow rates were expected to occur during this sensitivity study with correspondingly minimal choking effects expected, especially for the cases with the low reactivity insertion rate. Thus, frictional effects in these junctions were simulated with loss coefficients, also. A value of 20 was used for these loss coefficients, based primarily on maintaining computational stability, but results from these calculations were not expected to be sensitive to the exact value. Doubling the value of the loss coefficients and comparing results checked the sensitivity of results to the value of the loss coefficient (Cases: r5wp2d.c230d and r5wp2d.c230d1; Excel File: c230junx.xls, Sheet "c230d.dat"). As shown in Figure 5-2 for volume pressure and in Figure 5-3 for the WP moderator inventory, results were insensitive to the loss coefficient value.

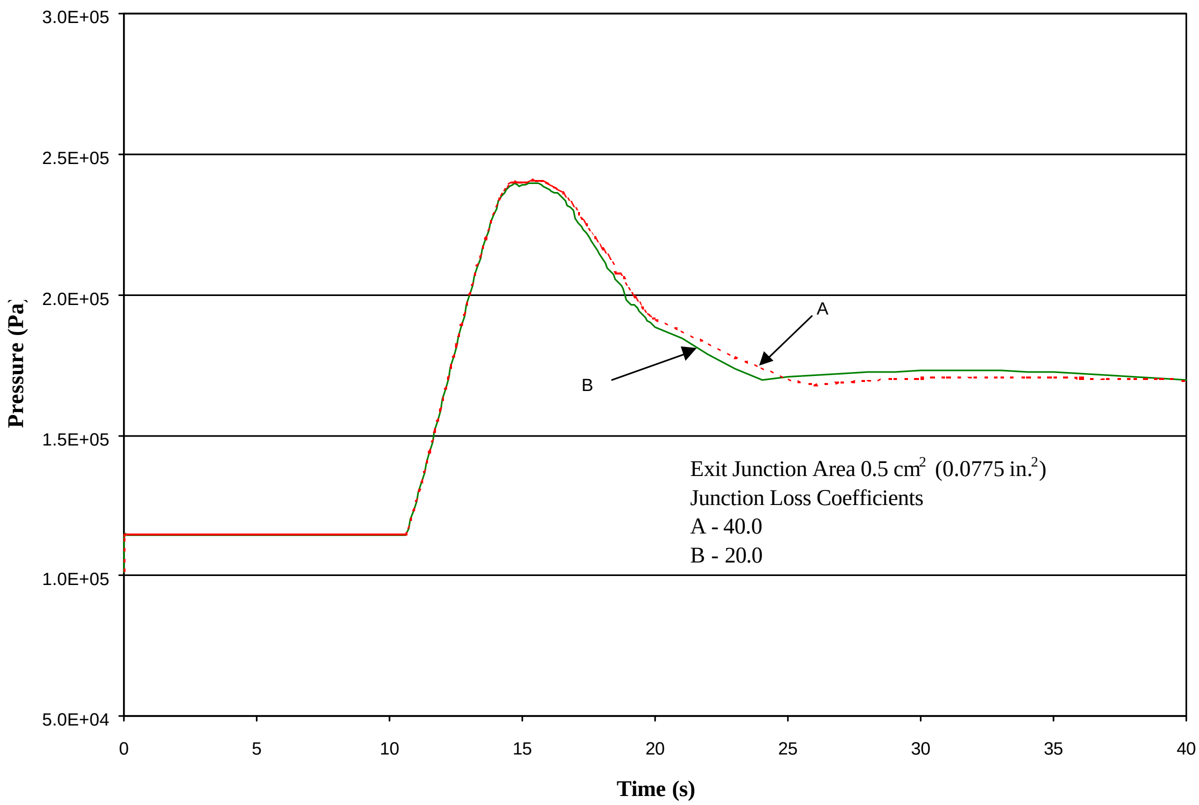


Figure 5-2. Sensitivity of WP Pressure to Loss Coefficient Value in Moderator Volumes

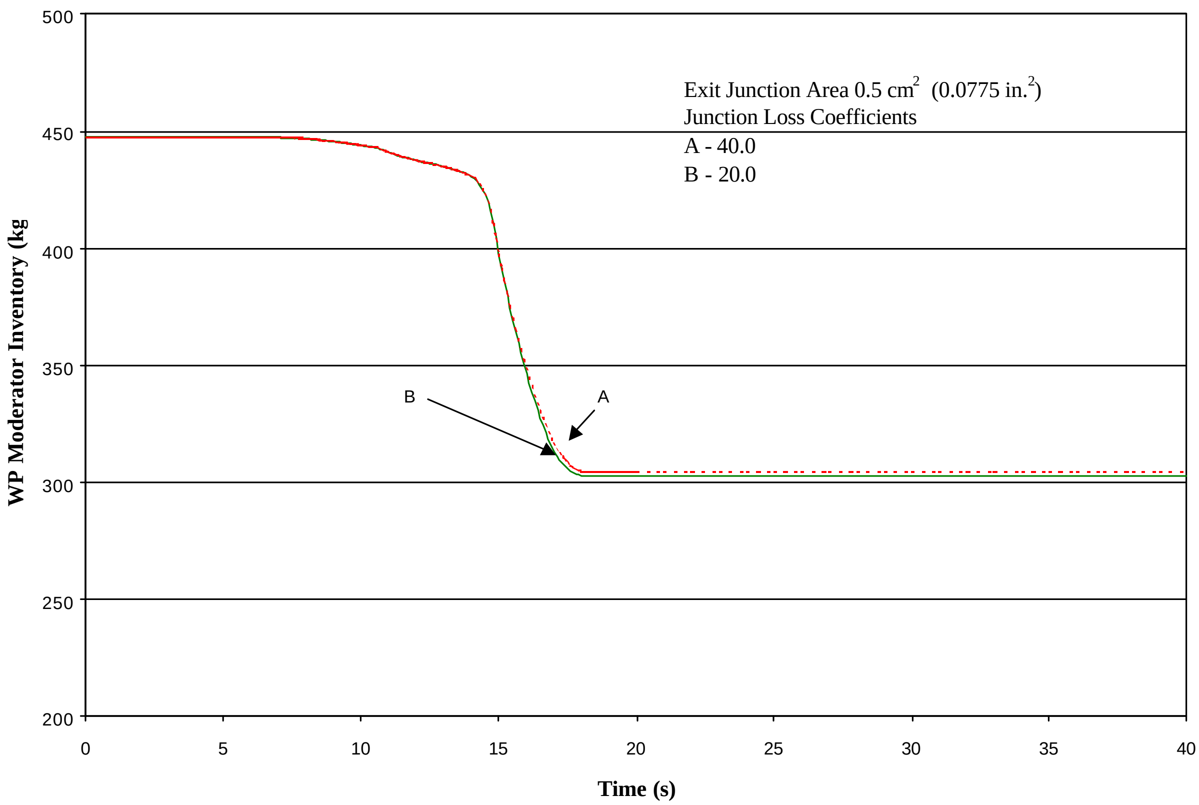


Figure 5-3. Sensitivity of WP Moderator Inventory to Loss Coefficient Value in Moderator Volumes

RELAP5/MOD3.2 input data parameters in this calculation modified from the basis calculation are listed in Table 5-1.

Table 5-1. RELAP5/MOD3.2 Parameters Modified for Sensitivity Calculation

| Parameters | Options | Value Used |
|---|---|---|
| WPexit junction area ($cm^2$) | Variable | 0.1 - 10.0, 100.0 |
| Loss coefficients for interior junctions | Variable | 40, 20 |
| Transport equation in exit junction | Momentum flux<br>(a) On<br>(b) Off | Off |
| Choked flow calculation for exit junction | (a) Homogeneous<br>(b) Non-equilibrium | Homogeneous |
| Void reactivity calculation | (a) $k_{eff}$ versus liquid level<br>(b) $k_{eff}$ versus WP density | $k_{eff}$ versus WP density |

# 6. RESULTS

The criterion for determining where the exit junction area becomes influential in criticality consequences is where the exit mass flow becomes sufficiently restricted to limit the contribution of the void reactivity in terminating the event due to moderator mass loss. The initial power rise in criticality events with large reactivity insertion rates is halted by the Doppler reactivity feedback with significant void or density reactivity feedback (ultimately from voiding the WP) required to completely terminate the criticality (CRWMS M&O 1997, Section 7). As the exit junction area is decreased sufficiently, the exit mass flow rate becomes restricted, resulting in higher pressures and temperatures, which partially determine criticality consequences (CRWMS M&O 1997, Section 7). For sufficiently slow events, where the Doppler and moderator density reactivity feedback effects can terminate the criticality event without the necessity of a large void generation due to boiling (with subsequent moderator mass loss from internal pressurization), varying the exit junction area has little effect on the criticality consequences since internal pressures and exit flow rates remain low.

Unqualified data were used in the development of the results presented in this section.

## 6.1 RAPID REACTIVITY INSERTION RATE

A series of cases having a rapid reactivity insertion rate were run with decreasing exit junction area as a variable parameter. The reactivity insertion rate for these cases was 0.158 $/s corresponding to the maximum reactivity of 14.18 $ (CRWMS M&O 1997, p. 28) added in 90 seconds. As expected, peak values of the system pressure and fuel temperature were insensitive to the junction area until the exit flow area was decreased to sufficiently small values. The results for these variables are summarized in Table 6-1 (Excel File c230junx.xls: Sheet "Summary") with the pressure variation shown in Figure 6-1 and the temperature variation shown in Figure 6-2.

Table 6-1. Maximum Temperature and Pressure Values for a Reactivity Insertion Rate of 0.158 $/s

| Exit Junction Area ($cm^2$) | Temperature (K) | Temperature ($^oF$) | Pressure (Pa) | Pressure (psi) |
|---|---|---|---|---|
| 10.0 | 437.3 | 327.5 | 1.326E+05 | 19.2 |
| 5.0 | 437.3 | 327.5 | 1.326E+05 | 19.2 |
| 1.5 | 437.3 | 327.5 | 1.405E+05 | 20.4 |
| 0.5 | 437.4 | 327.7 | 2.399E+05 | 34.8 |
| 0.375 | 440.5 | 333.2 | 4.005E+05 | 58.1 |
| 0.25 | 505.9 | 451.0 | 1.951E+06 | 283.0 |

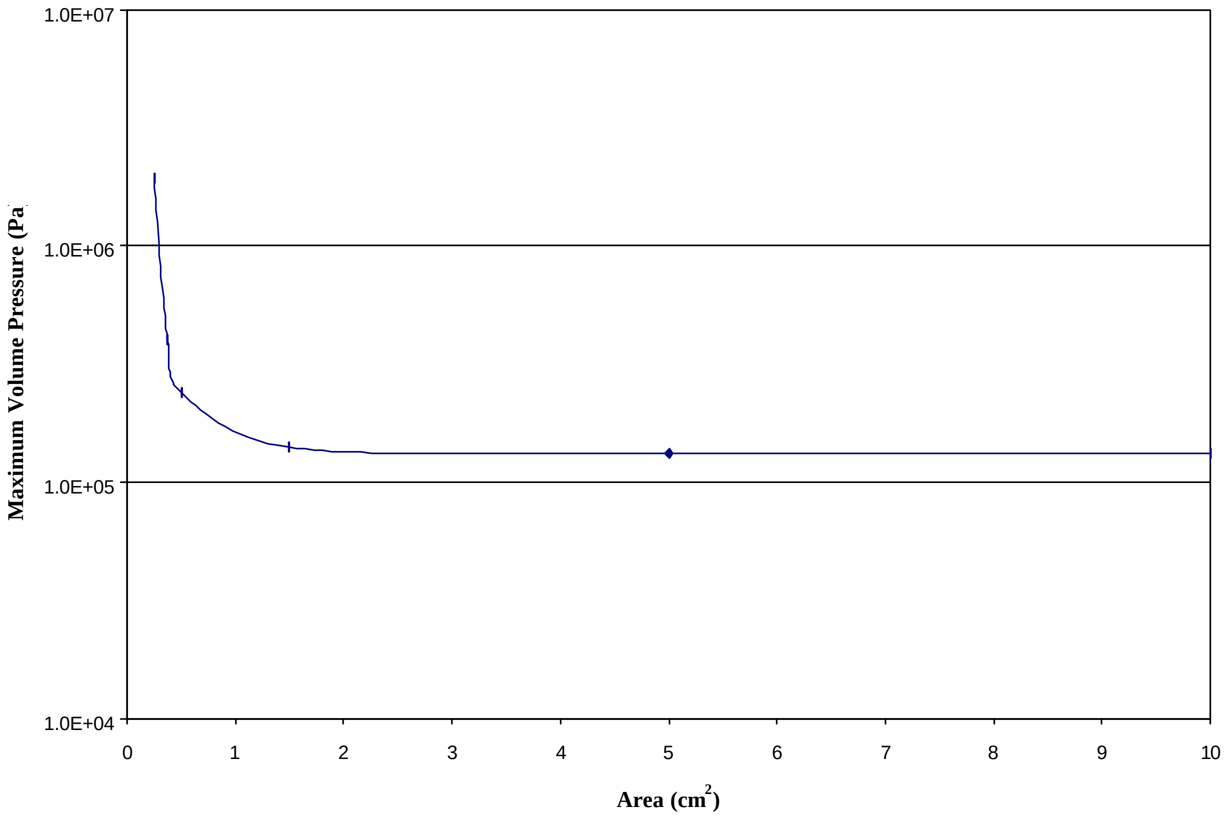


Figure 6-1. Peak WP Pressures versus WP Egress Junction Area for 0.158-$/s Reactivity Insertion Rate

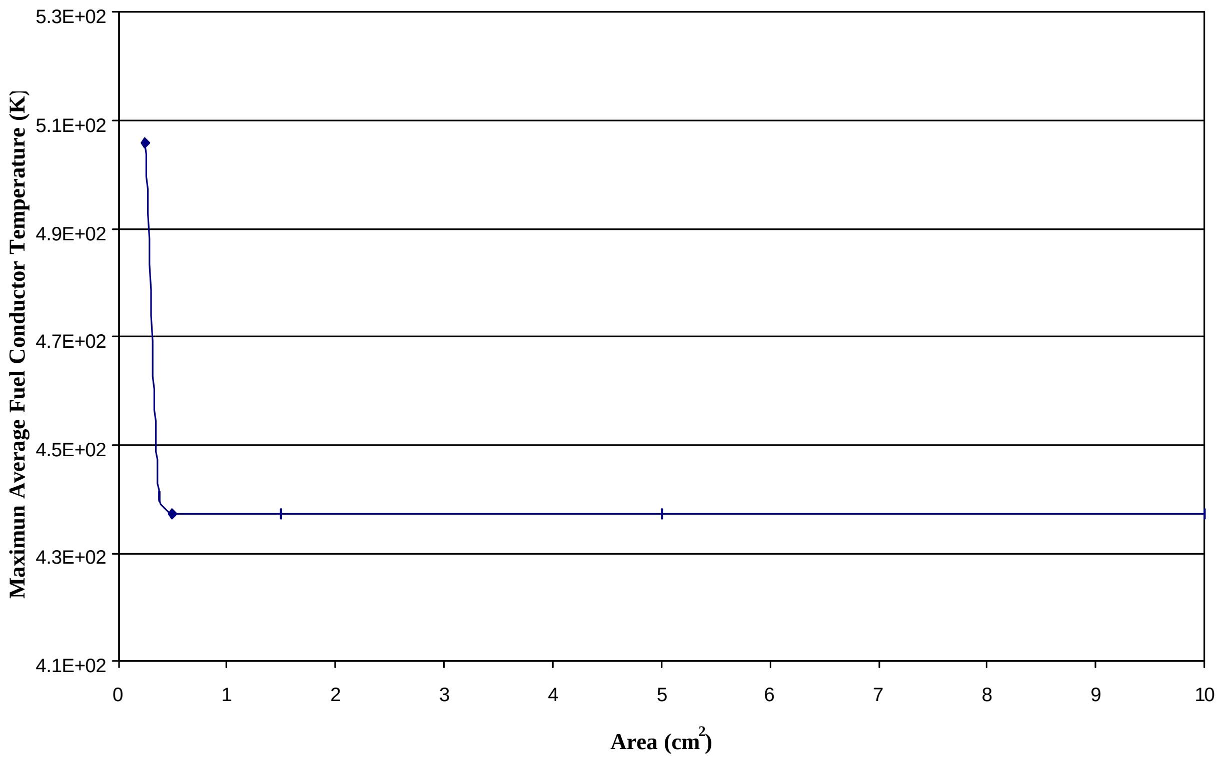


Figure 6-2. Peak Average Fuel Temperature for SNF versus WP Egress Junction Area for 0.158-$/s Reactivity Insertion Rate

Detailed histories for a number of parameters affecting the criticality consequences are shown in Figures 6-3 through 6-9 with the exit junction area as a parameter (Case IDs: r5wp2d.c230a, r5wp2d.c230b, r5wp2d.c230c, r5wp2d.c230d, r5wp2d.c230f, and r5wp2d.c230e, respectively). In each case, the pressures and temperatures reached maximum values prior to ending the calculation. Figure 6-3 (Excel file: c230junx.xls; Sheet "V150-pres") shows the pressure histories for a representative (since variation in parameter values among components was small) interior volume of the WP and Figure 6-4 (Excel file: c230junx.xls; Sheet "Cond080-Temp") shows the temperature histories for a representative SNF assembly. Figure 6-5 (Excel file: c230junx.xls; Sheet "Norm-Powr") shows the fission power for the various cases; Figure 6-6 (Excel file: c230junx.xls; Sheet "WP-Inventory") shows the WP moderator inventory; and Figure 6-9 (Excel file: c230junx.xls; Sheet "Jun250-W") shows the exit junction mass flow rates. Figure 6-7 (Excel file: c230junx.xls; "Sheet c230a-$-Cmp") and Figure 6-8 (Excel file: c230junx.xls; Sheet "c230f-$-Cmp") show reactivity components for exit junction areas of 10.0 $cm^2$ and 0.375 $cm^2$, respectively. The increase in magnitude of the void reactivity components correlates with the decrease in the respective WP fluid inventories.

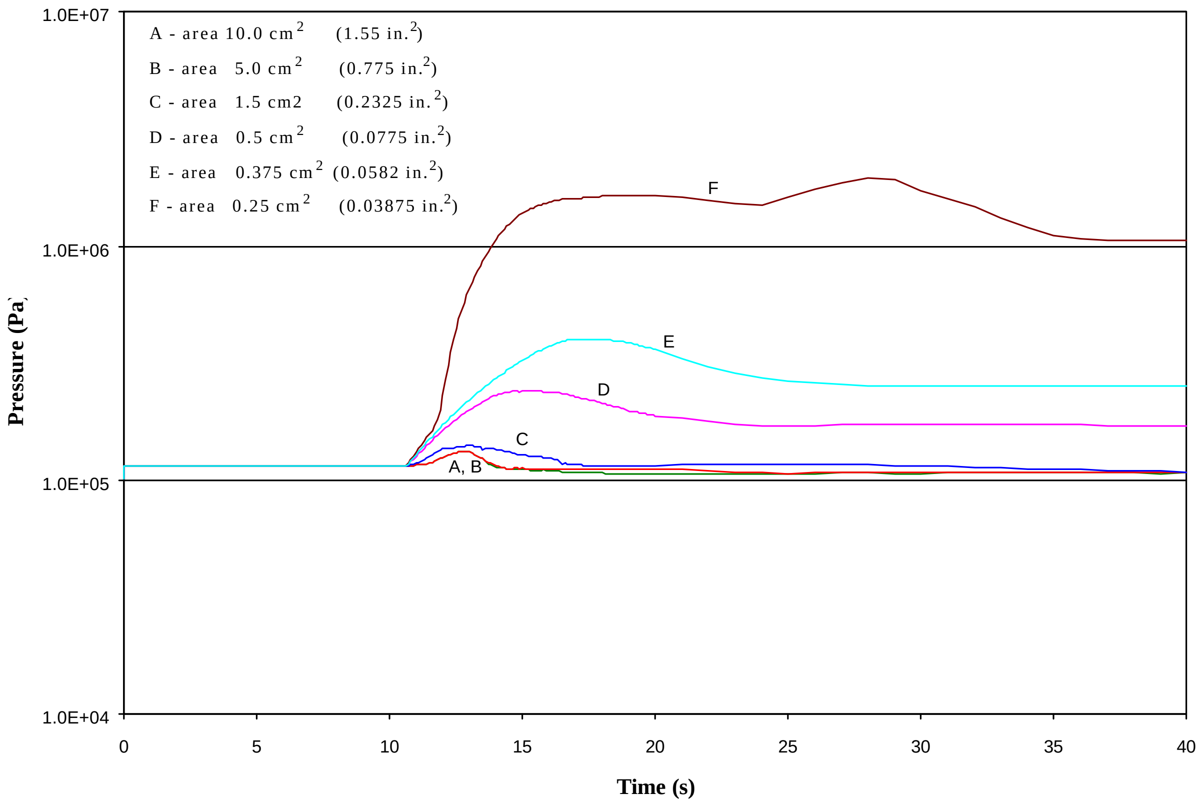


Figure 6-3. WP Pressure Histories for a Range of Egress Junction Areas for 0.158-$/s Reactivity Insertion Rate

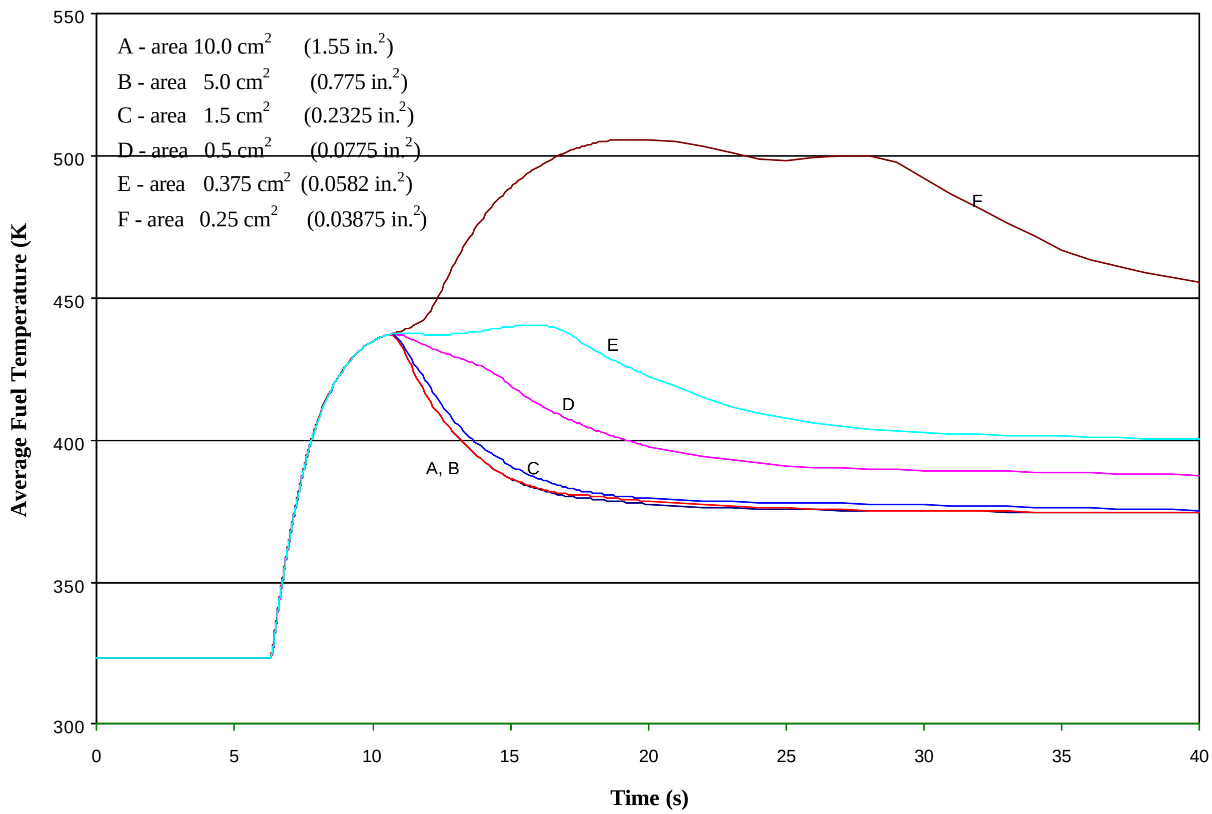


Figure 6-4. Fuel Temperature Histories for 0.158-$/s Reactivity Insertion Rate Parameterized by Egress Junction Area

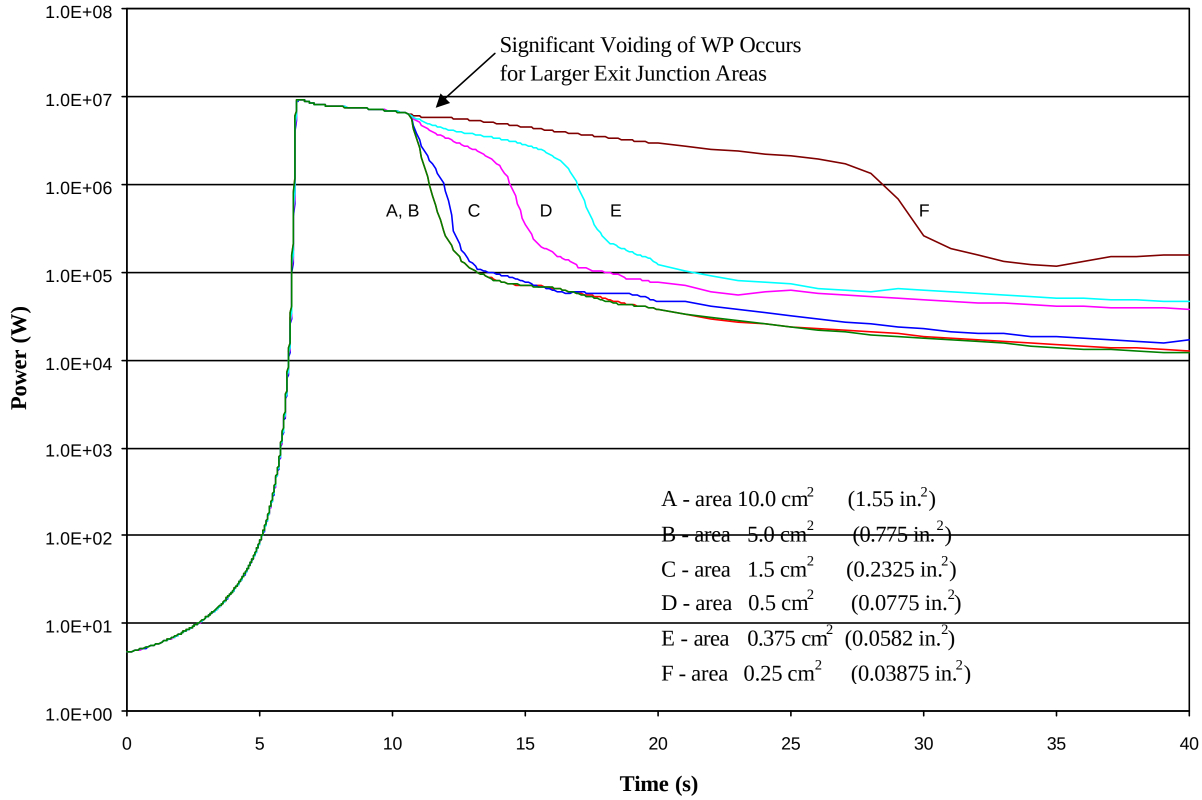


Figure 6-5. Fission Power Histories for 0.158-$/s Reactivity Insertion Rate Parameterized by Egress Junction Area

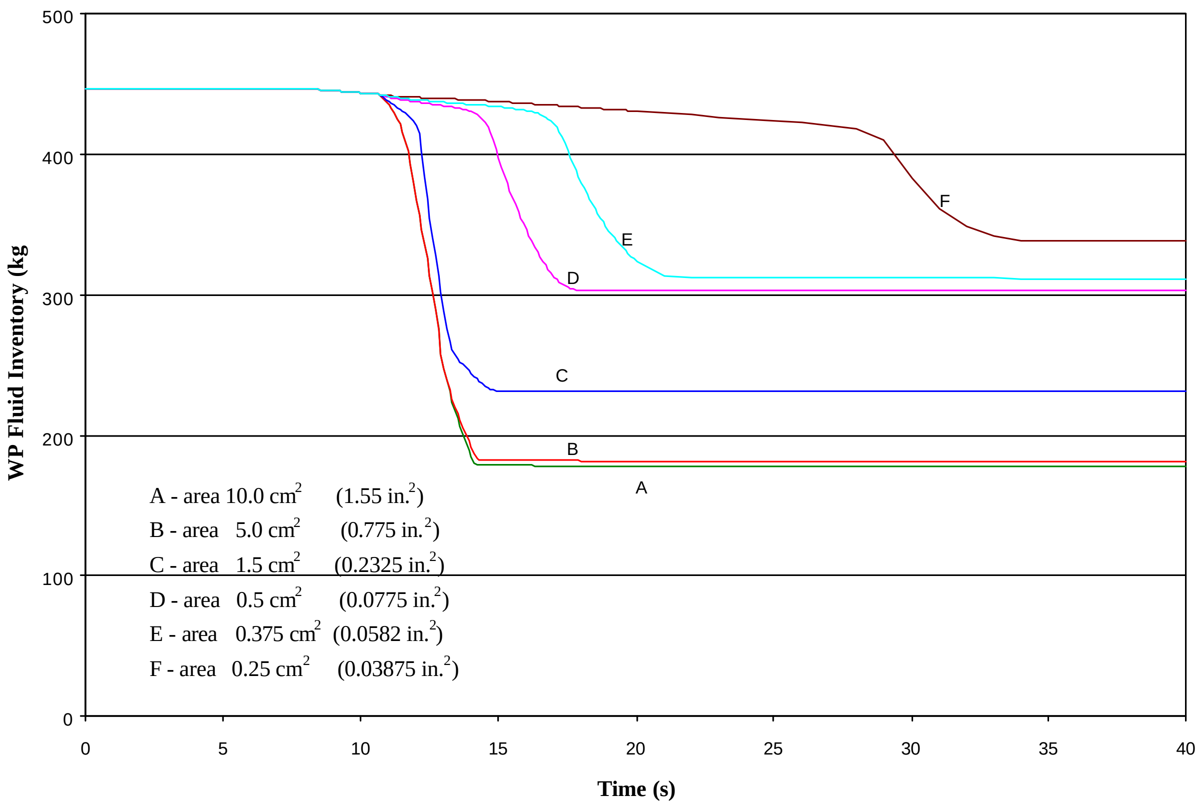


Figure 6-6. WP Moderator Inventory Histories for 0.158-$/s Reactivity Insertion Rate Parameterized by Egress Junction Area

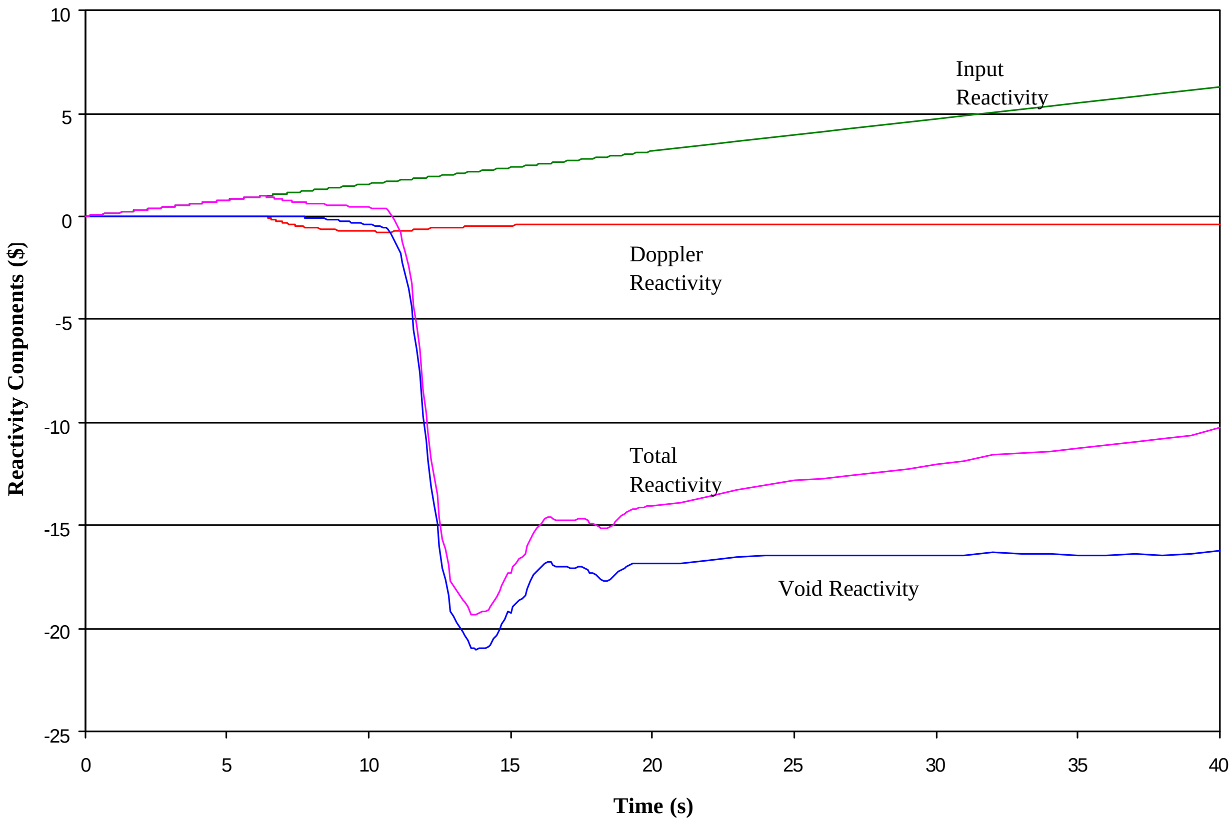


Figure 6-7. Reactivity Component Histories for 0.158-\$/s Reactivity Insertion Rate with 10.0-cm$^2$ Egress Junction Area

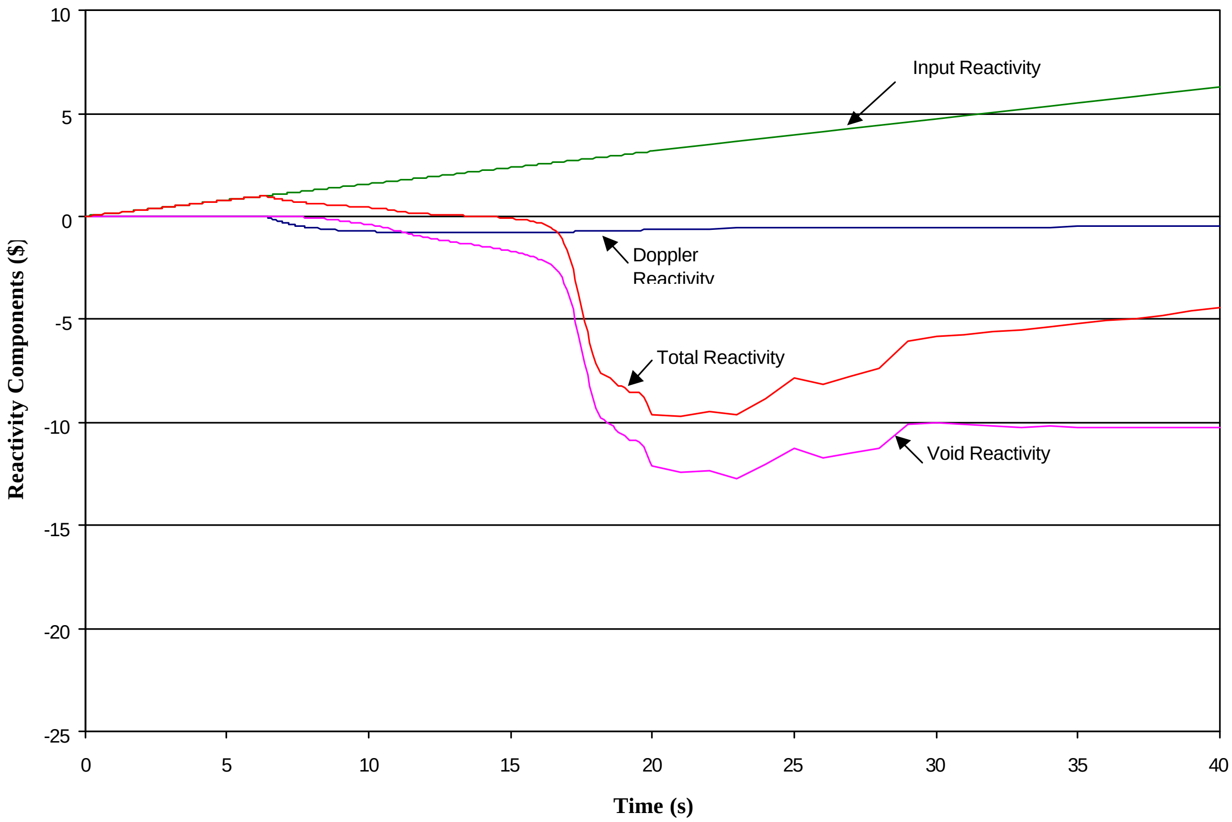


Figure 6-8. Reactivity Component Histories for 0.158-$/s Reactivity Insertion Rate with 0.375-$cm^2$ Egress Junction Area

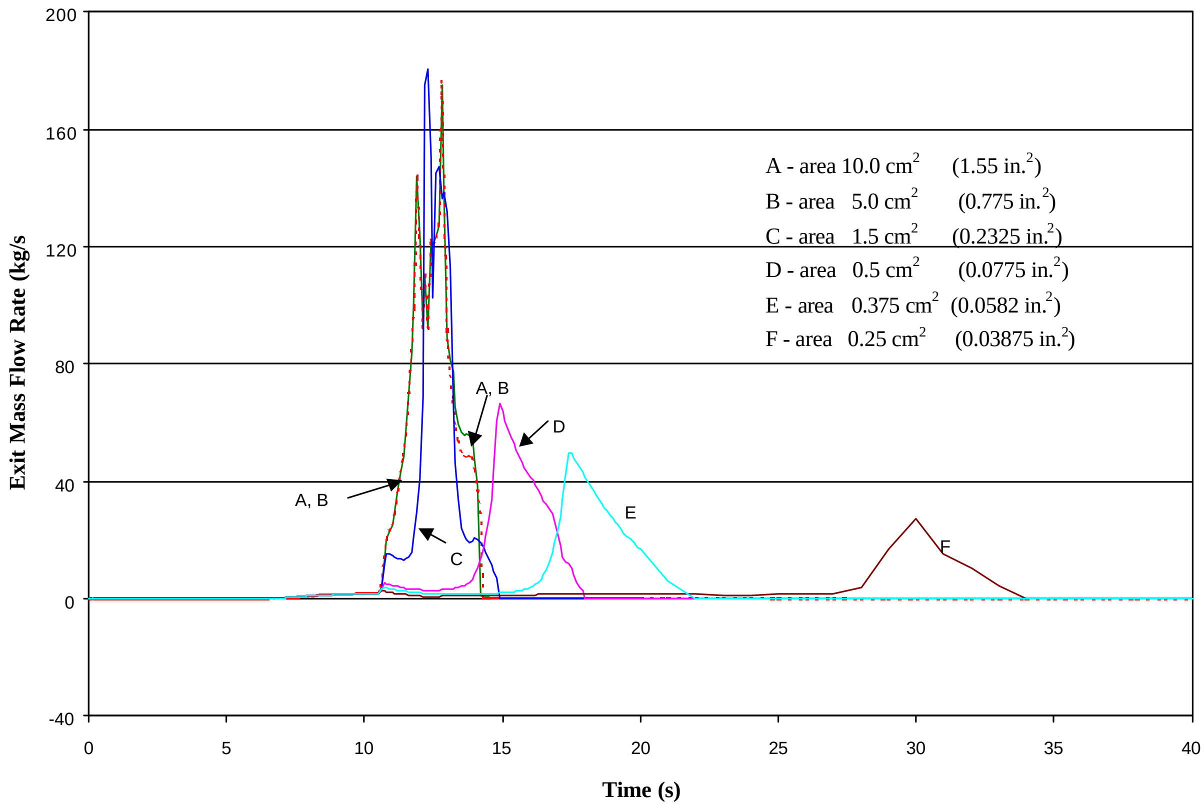


Figure 6-9. WP Egress Junction Mass Flow Rate Histories for 0.158-$/s Reactivity Insertion Rate Parameterized by Egress Junction Area

## 6.2 SLOW REACTIVITY INSERTION RATE

The slow criticality event evaluated for exit area sensitivity used the PWR SNF basis WP description (CRWMS M&O 1997) with a reactivity addition rate of 0.0004 $/s. Junction areas for these cases ranged from 5.0 $cm^2$ to 0.1 $cm^2$ (Case IDs: r5wp2d.c221a, r5wp2d.c221a, r5wp2d.c221b, r5wp2d.c221c, r5wp2d.c221d, r5wp2d.c221e, and r5wp2d.c221f, respectively). No discernable differences are apparent in the results from these cases as shown in Figures 6-10 through 6-15. These figures include only the results from cases having the largest and smallest exit junction area (Excel file: c230junx.xls, Sheet "C221a.data" and "C221f.data") as results from the intermediate area cases were essentially identical. Thus, for this slow reactivity insertion rate, the exit junction area had no effect on the results. The negative reactivity from the change in fuel temperature and bulk density was sufficient to compensate the slow reactivity rate without vapor generation as shown in Figure 6-10 where the maximum SNF assembly fuel temperatures are below the vaporization level. Differential pressure histories associated with the corresponding temperature histories are shown in Figure 6-11. Differential values are shown since the change in pressure is small with respect to the absolute pressure. The normalized fission power history is given in Figure 6-12; the WP moderator inventory history in Figure 6-13; the reactivity components in Figure 6-14, and the exit junction mass flow rates in Figure 6-15. The total reactivity in these cases oscillates around zero (Figure 6-14) with the void reactivity gradually increasing as the moderator inventory decreases (Figure 6-13).

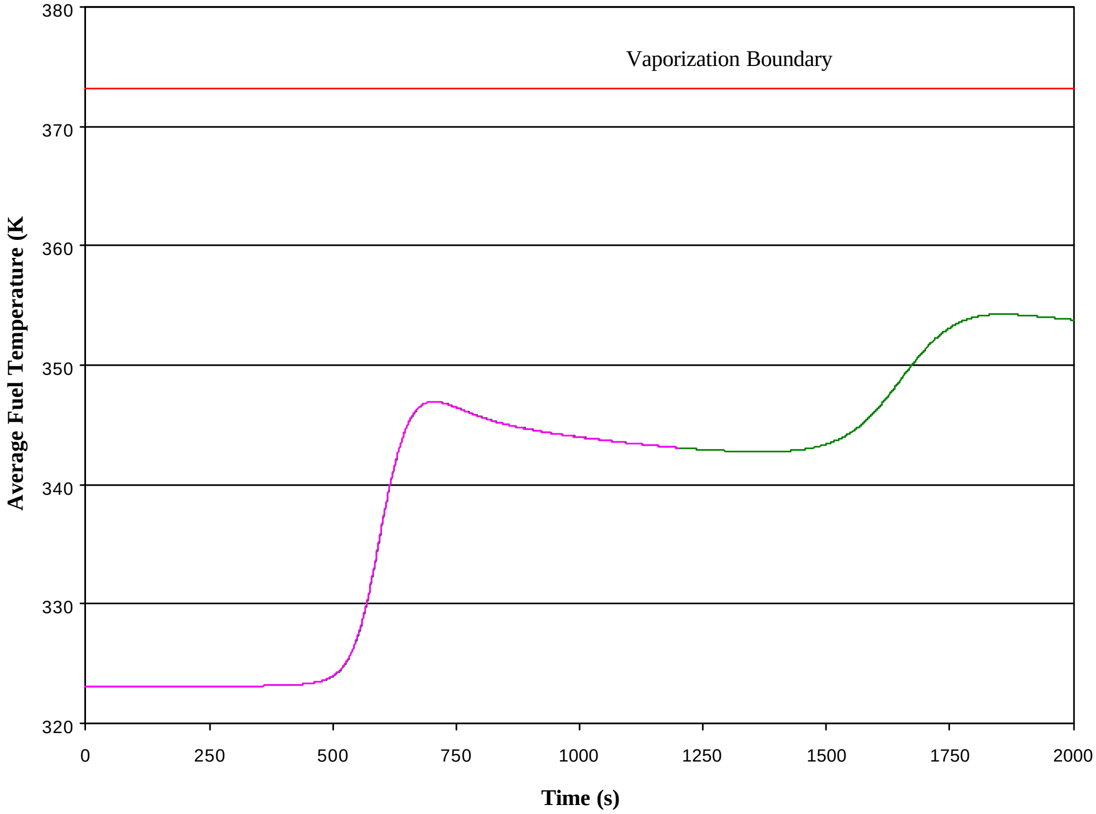


Figure 6-10. Fuel Temperature Histories for 0.1- and 5.0-cm$^2$ Egress Junction Areas and a 0.0004-$/s Reactivity Insertion Rate

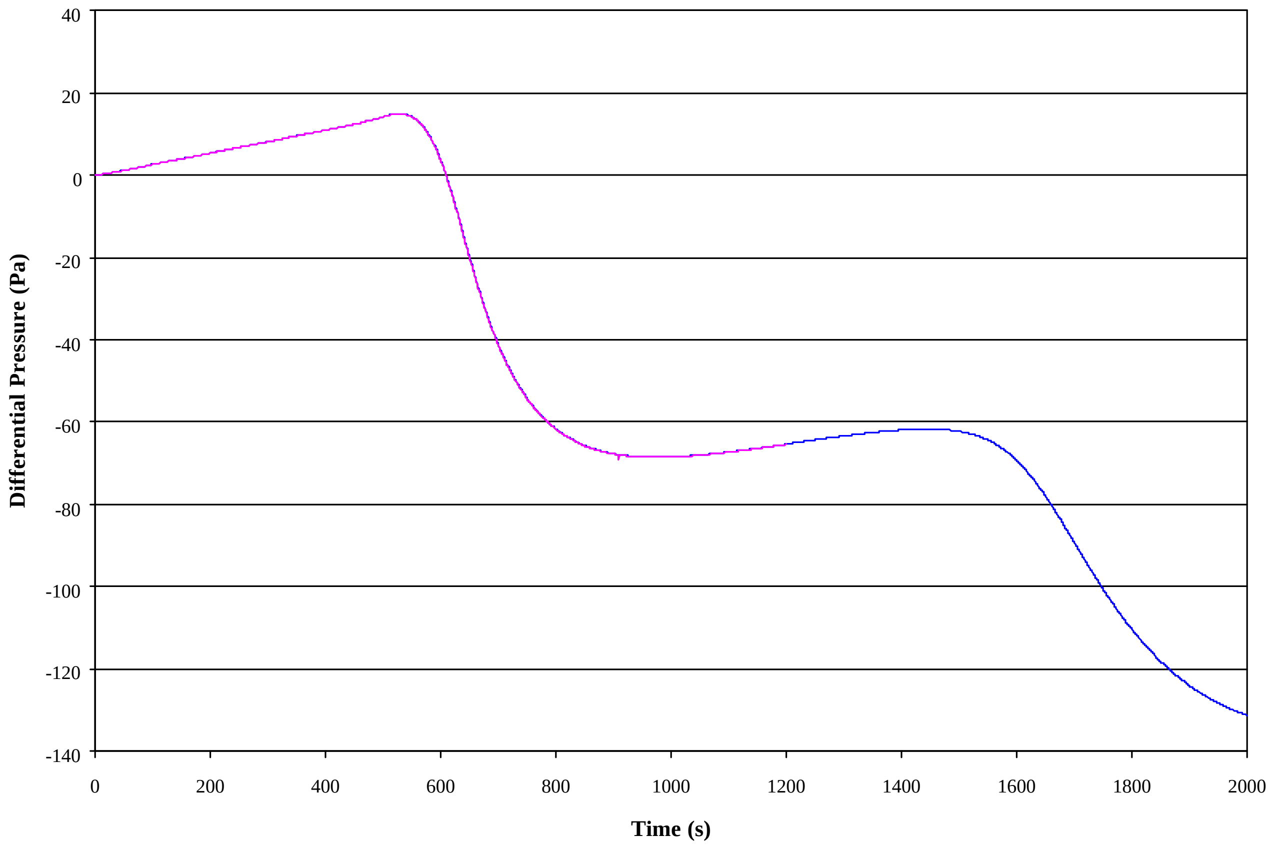


Figure 6-11. Pressure Histories for 0.1- and 5.0-cm$^2$ Egress Junction Areas and a 0.0004-$/s Reactivity Insertion Rate

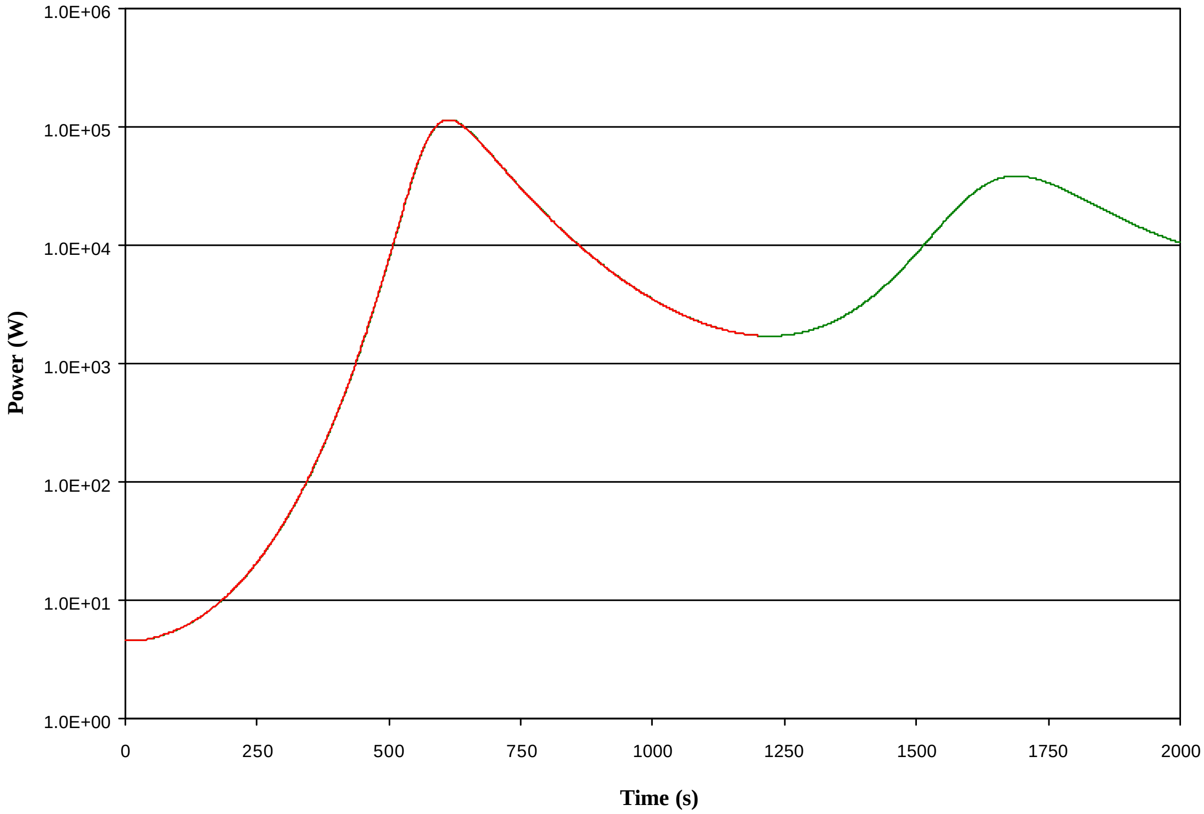


Figure 6-12. Fission Power Histories for 0.1- and 5.0-cm$^2$ Egress Junction Areas and a 0.0004-$/s Reactivity Insertion Rate

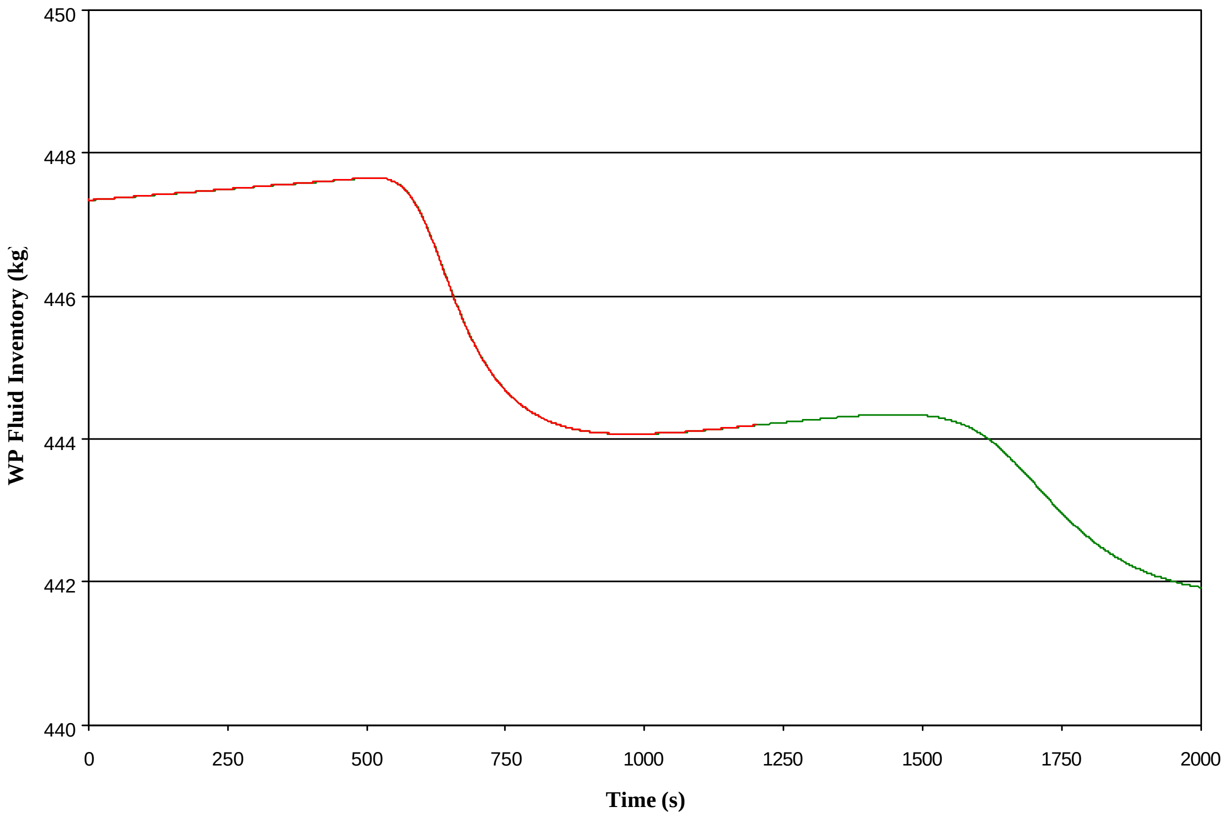


Figure 6-13. WP Moderator Inventory Histories for 0.1- and 5.0-cm$^2$ Egress Junction Areas and a 0.0004-$/s Reactivity Insertion Rate

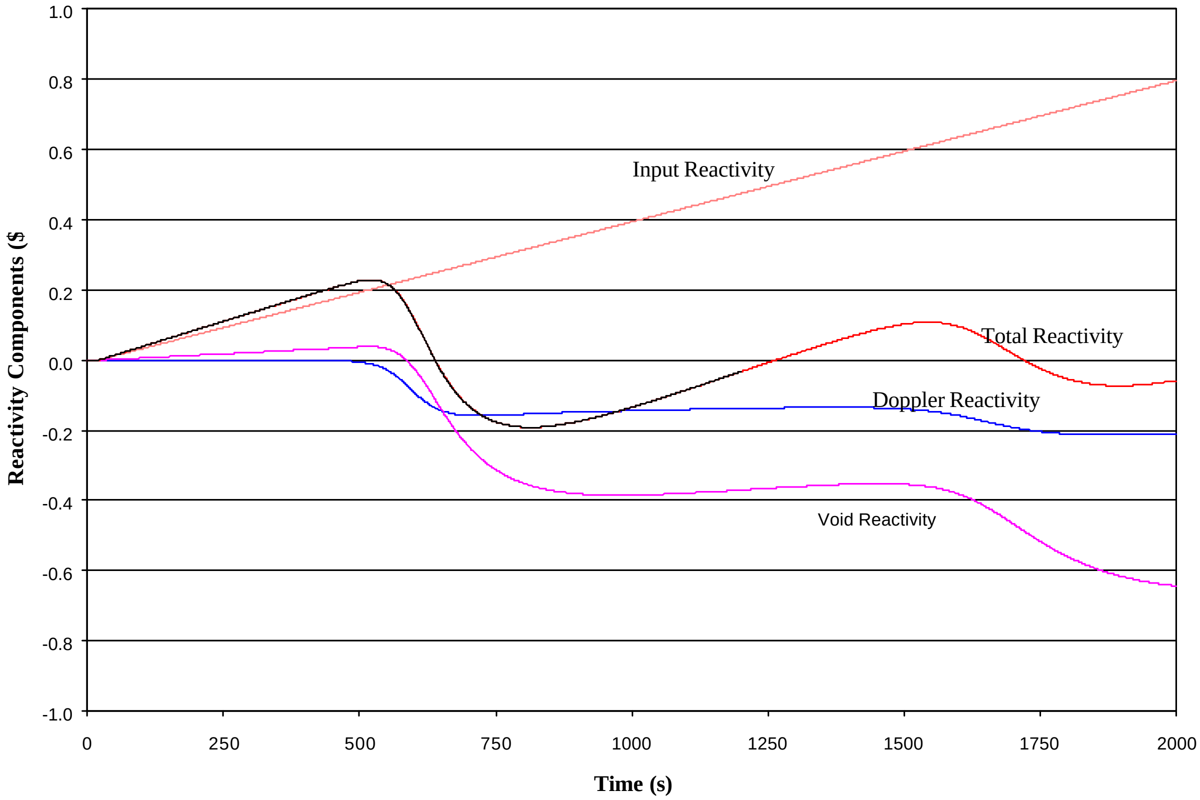


Figure 6-14. Reactivity Histories for 0.1- and 5.0-cm$^2$ Egress Junction Areas and a 0.0004-$/s Reactivity Insertion Rate

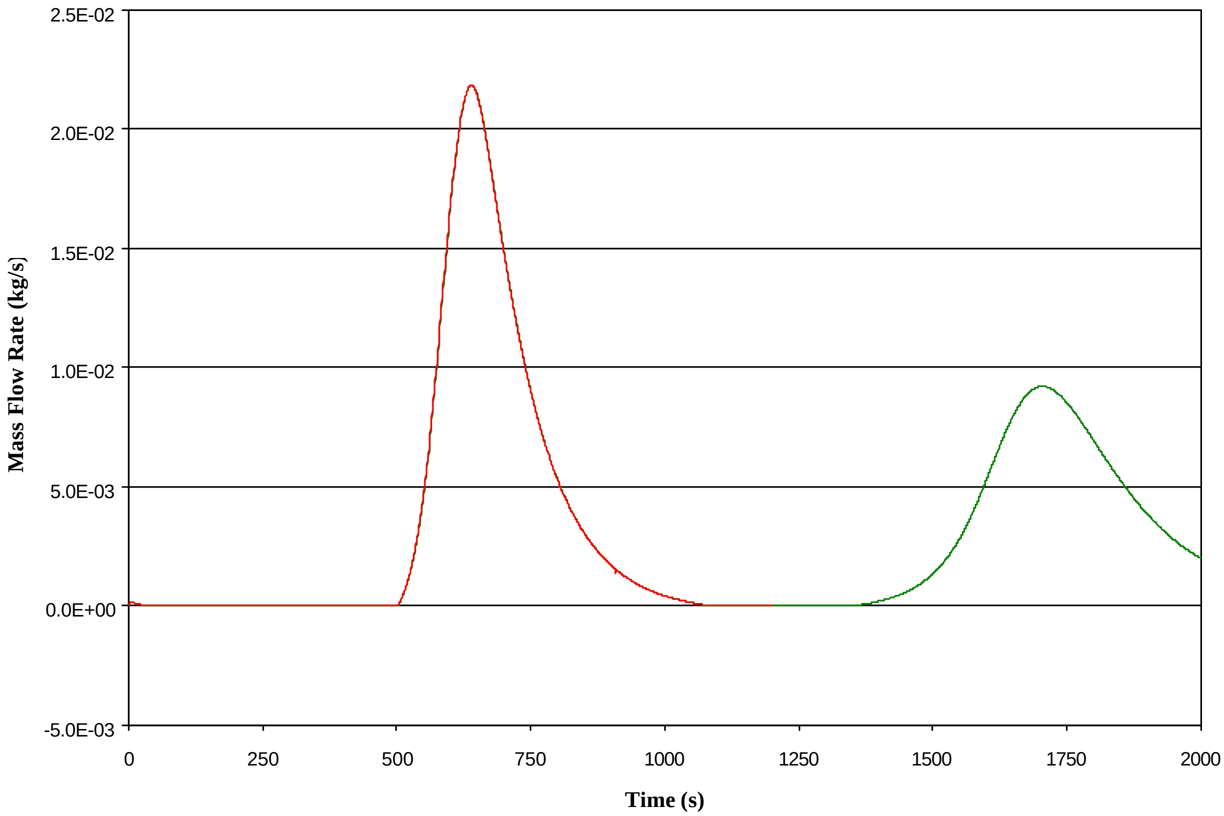


Figure 6.15. WP Egress Junction Mass Flow Rate Histories for 0.1- and 5.0-$cm^2$ Egress Junction Areas and a 0.0004-$/s Reactivity Insertion Rate

# 7. ATTACHMENTS

Hardcopy attachments are listed in Table 7-1. Electronic data files are provided on a CD (CRWMS M&O 1999a).

Table 7-1. List of Attachments

| Attachment Number | Description | Number of Pages |
|---|---|---|
| I | Document Input Reference Sheets (DIRS) | 3 |
| II | STRIP FORTRAN Source with Sample Input and Output Files | 8 |
| III | Base RELAP5/MOD3.2 Data File | 21 |
| IV | Directory List of Files on CD (CRWMS M&O 1999a) | 3 |

## 8. REFERENCES

1. Civilian Radioactive Waste Management System (CRWMS) Management & Operating Contractor (M&O) 1997. *Criticality Consequence Analysis Involving Intact PWR SNF in a Degraded 21 PWR Assembly Waste Package*. BBA000000-01717-0200-00057 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980106.0331.

2. Nuclear Regulatory Commission (NRC) 1995a. *RELAP5/MOD3 Code Manual, Volume I: Code Structure, System Models, and Solution Methods.* NUREG/CR-5535. Washington, D.C.: NRC. TIC: 238741.

3. NRC 1995b. *RELAP5/MOD3 Code Manual, Vol. 2, Users's Guide and Input Requirements*. NUREG/CR-5535. Washington, D.C.: NRC. TIC: 243017.

4. CRWMS M&O 1999a. *Electronic Data for Sensitivity Study of Reactivity Consequences to Waste Package Egress Area, CAL-EBS-NU-000001 REV 00*. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990923.0240.

5. CRWMS M&O 1999b. *Installation Test Plan (ITP) for RELAP5/MOD3.2 V1.0.* Las Vegas, Nevada: CRWMS M&O. SDN: 10091-ITP-1.0-00. ACC: MOL.19990929.0035.

6. CRWMS M&O 1999c. *Validation Test Plan (VTP) for RELAP5/MOD3.2 V1.0.* Las Vegas, Nevada: CRWMS M&O. SDN: 10091-VTP-1.0-00. ACC: MOL.19990929.0034.

7. CRWMS M&O 1999d. *Software Activity Plan (SAP) for RELAP5/MOD3.2 V1.0.* Las Vegas, Nevada: CRWMS M&O. SDN: 10091-SAP-1.0-00. ACC: MOL.19990929.0031.

8. CRWMS M&O 1999e. *Software Requirements Document (RD) for RELAP5/MOD3.2 V1.0.* Las Vegas, Nevada: CRWMS M&O. SDN: 10091-RD-1.0-00. ACC: MOL.19990929.0032.

9. CRWMS M&O 1999f. *Software Design Document (DD) for RELAP5/MOD3.2 V1.0.* Las Vegas, Nevada: CRWMS M&O. SDN: 10091-DD-1.0-00. ACC: MOL.19990929.0033.

10. CRWMS M&O 1999g. *Validation Test Report (VTR) for RELAP5/MOD3.2 V1.0.* Las Vegas, Nevada: CRWMS M&O. SDN: 10091-VTR-1.0-00. ACC: MOL.19990929.0036.

ATTACHMENT I

## OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
## DOCUMENT INPUT REFERENCE SHEET

| 1. Document Identifier No./Rev.: CAL-EBS-NU-000001 REV 00 | | | Change: N/A | Title: Sensitivity Study of Reactivity Consequences to Waste Package Egress Area | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Input Document | | | 4. Input Status | 5. Section Used in | 6. Input Description | 7. TBV/TBD Priority | 8. TBV Due To | | |
| 2. Technical Product Input Source Title and Identifier(s) with Version | | 3. Section | | | | | Unqual. | From Uncontrolled Source | Un-confirmed |
| 2a | | | | | | | | | |
| 1 | Civilian Radioactive Waste Management System (CRWMS) Management & Operating Contractor (M&O) 1997. *Criticality Consequence Analysis Involving Intact PWR SNF in a Degraded 21 PWR Assembly Waste Package*. BBA000000-01717-0200-00057 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980106.0331. | Sect. 4.3 | TBV-3292 | Sect. 3 | List of Assumptions in Initial Reactivity Consequence Analysis<br>Resolved by peer review | 3 | / | N/A | N/A |
| 2 | Nuclear Regulatory Commission (NRC) 1995a. *RELAP5/MOD3 Code Manual, Volume I: Code Structure, SystemModels, and Solution Methods.* NUREG/CR-5535. Washington, D.C.: NRC. TIC: 238741. | Entire | N/A | Sect. 5, 6 | Software Documentation | N/A | N/A | N/A | N/A |
| 3 | NRC 1995b. *RELAP5/MOD3 Code Manual, Vol. 2, Users's Guide and Input Requirements*. NUREG/CR-5535. Washington, D.C.: NRC. TIC: 243017. | Entire | N/A | Sect. 5, 6 | Software Documentation | N/A | N/A | N/A | N/A |

## OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
## DOCUMENT INPUT REFERENCE SHEET

| 1. Document Identifier No./Rev.: CAL-EBS-NU-000001 REV 00 | | | Change: N/A | Title: Sensitivity Study of Reactivity Consequences to Waste Package Egress Area | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Input Document | | | 4. Input Status | 5. Section Used in | 6. Input Description | 7. TBV/TBD Priority | 8. TBV Due To | | |
| | 2. Technical Product Input Source Title and Identifier(s) with Version | 3. Section | | | | | Unqual. | From Uncontrolled Source | Un-confirmed |
| 4 | CRWMS M&O 1999a. *Electronic Data for Sensitivity Study of Reactivity Consequences to Waste Package Egress Area, CAL-EBS-NU-000001 REV 00.* Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990923.0240. | N/A | TBV-3293 | Sect. 5, 6 | Data Files on Compact Disk (CD)<br>Resolved by peer review | 3 | *I* | N/A | N/A |
| 5 | CRWMS M&O 1999b. *Installation Test Plan (ITP) for RELAP5/MOD3.2 V1.0.* Las Vegas, Nevada: CRWMS M&O. SDN: 10091-ITP-1.0-00 ACC: MOL.19990929.0035. | Entire | N/A | Sect. 5, 6 | Software Documentation | N/A | N/A | N/A | N/A |
| 6 | CRWMS M&O 1999c. *Validation Test Plan (VTP) for RELAP5/MOD3.2 V1.0.* Las Vegas, Nevada: CRWMS M&O. SDN: 10091-VTP-1.0-00. ACC: MOL.19990929.0034. | Entire | N/A | Sect. 5, 6 | Software Documentation | N/A | N/A | N/A | N/A |
| 7 | CRWMS M&O 1999d. *Software Activity Plan (SAP) for RELAP5/MOD3.2 V1.0.* Las Vegas, Nevada: CRWMS M&O. SDN: 10091-SAP-1.0-00. ACC: MOL.19990929.0031. | Entire | N/A | Sect. 5, 6 | Software Documentation | N/A | N/A | N/A | N/A |
| 8 | CRWMS M&O 1999e. *Software Requirements Document (RD) for RELAP5/MOD3.2 V1.0.* Las Vegas, Nevada: CRWMS M&O. SDN: 10091-RD-1.0-00. ACC: MOL.19990929.0032. | Entire | N/A | Sect. 5, 6 | Software Documentation | N/A | N/A | N/A | N/A |

## OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
## DOCUMENT INPUT REFERENCE SHEET

| 1. Document Identifier No./Rev.: CAL-EBS-NU-000001 REV 00 | | | Change: N/A | Title: Sensitivity Study of Reactivity Consequences to Waste Package Egress Area | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Input Document | | | 4. Input Status | 5. Section Used in | 6. Input Description | 7. TBV/TBD Priority | 8. TBV Due To | | |
| 2. Technical Product Input Source Title and Identifier(s) with Version | | 3. Section | | | | | Unqual. | From Uncontrolled Source | Un-confirmed |
| 9 | CRWMS M&O 1999f. *Software Design Document (DD) for RELAP5/MOD3.2 V1.0.* Las Vegas, Nevada: CRWMS M&O. SDN: 10091-DD-1.0-00. ACC: MOL.19990929.0033. | Entire | N/A | Sect. 5, 6 | Software Documentation | N/A | N/A | N/A | N/A |
| 10 | CRWMS M&O 1999g. *Validation Test Report (VTR) for RELAP5/MOD3.2 V1.0.* Las Vegas, Nevada: CRWMS M&O. SDN: 10091-VTR-1.0-00. ACC: MOL.19990929.0036. | Entire | N/A | Sect. 5, 6 | Software Documentation | N/A | N/A | N/A | N/A |

ATTACHMENT II

STRIP Program

The RELAP5/MOD3.2 program writes two files as output:

1) a formatted print file containing "major edits" at specified times, a list periodically of the minor edit variables, and
2) a binary "restart" file to enable a case to resume.

The major edits form periodic snapshots of the problem variables. Minor edits form histories of particular problem variables and can thus be displayed graphically. The RELAP5/MOD3.2 code also has an option to collect all the minor edit variables at each time point from the restart file and put them into a formatted "strip" file. The FORTRAN-90 program, "Strip", reads a RELAP5/MOD3.2 strip file, pairs the time variable with each minor edit variable and writes the information in a series of more compact files for use in later analysis. The output of the code can be readily checked against the strip files by visual inspection.

1. STRIP Source

```
C     Last change:  T    25 Jun 99   10:45 am
      program strip
c
      implicit REAL*8  (a-h,o-z)
c
c     program to read RELAP strip files and align into columns for use
c     with Excel or Psiplot for plotting.
c
c
c     units
c     50     = data input
c     55     = spread sheet output
c     60     = print file
c
      dimension              plotdat(75)
      INTEGER*4              scrno, scrni, ital1, isprd
      LOGICAL*4              isfopn, isfdef, skipr
      CHARACTER*10           headr1, headr2, headr3
      CHARACTER*1            alf(27)
      CHARACTER*1            num(10), noyes, yes
      CHARACTER*120          iomsg
      CHARACTER*80           card
      CHARACTER*15           filenam, outfile, avar, tmpnam, dum1, dum2
      CHARACTER*10           alfvar(75), numvar(75)
      CHARACTER*13           cblnk
      CHARACTER*7            chdir(2)
c
      data cblnk /'             '/
      data headr1 /'plotinf   '/, headr2 /'plotalf   '/,
     *     headr3 /'plotrec   '/
      data yes   /'y'/
```

```
c
      data num /'0', '1', '2', '3', '4', '5', '6', '7', '8', '9'/
      data maxpts /1500/, maxvar /75/
      data delt20 /2.0d0/
      DATA zero   /0.0e0/
c
c     define files and open them
c
      scrni  = 5
      scrno  = 6
      ital1  = 50
      iout   = 60
      WRITE (UNIT=scrno, FMT=2041)
2041  FORMAT (' input data file name = ':)
      read (UNIT=scrni, FMT=3001) filenam
      WRITE (UNIT=scrno, FMT=2042)
2042  FORMAT (' input final time = ':)
      read (scrni, '(e12.5)') fintim
c
3001  FORMAT (a15)
3002  FORMAT (a4)
      inquire (file=filenam, exist=isfdef, err=1001, iostat=ierr)
      if (.not.isfdef) then
         write (scrno, 2005) filenam
         GO TO 2000
      end if
2005  format (' data file ',a15,' does not exist'/' exit called')
      open (unit=ital1, file=filenam, status='old', form='formatted',
     *      access='sequential', err=1005, iostat=ierr)
c
c     count records in filenam - mrec
      irec   = 1
      mrec   = 0
10    read  (UNIT=ital1, FMT=1107) card
      dum1   = ADJUSTL(card(1:10))
      if (dum1(1:7) .ne. headr3(1:7))go to 10
      mrec   = mrec + 1
      read (card(16:30), '(e15.6)') timdat
      if (timdat .lt. fintim) go to 10
      rewind (UNIT=ital1)
c
      skipr  = .false.
      write (UNIT=scrno, FMT=2044) mrec
2044  format (' Input file has ',i5, 'records'/
     *        ' set skip flag to reduce number y or n' :)
      read (scrni, '(a1)') noyes
      if (noyes .eq. yes) then
         skipr = .true.
         write (UNIT=scrno, FMT=2046)
         read (scrni, '(i6)') numskp
      END if
2046  format (' number of records to skip = ':)
c
25    write (UNIT=scrno, FMT=2045)
2045  format (' Continue data procesing - y or n ':)
```

```
      READ (scrni, '(a1)') noyes
      if (noyes .ne. yes) go to 2000
c
c     read two records, skip first record - title records
      read  (UNIT=ital1, FMT=1107) card
      read  (UNIT=ital1, FMT=1107) card
1107  format (a80)
c     look for plot information record
30    read  (UNIT=ital1, FMT=1107) card
      DO 40 i=1,80
      m = i
      IF (card(i:i) .ne. ' ') GO TO 45
40    continue
c     blank card - read next one
      go to 30
45    IF (card(m:m+6) .eq. headr1(1:7)) then
         read (card(11:20), '(i10)') numdat
      END if
      IF (numdat .GT. maxvar) then
         WRITE (UNIT=scrno, FMT=1023)
         GO TO 2000
      END if
1023  FORMAT (' number of minor edits exceeds max allowed'/
     *        ' exit called')
      numdat = numdat - 1
c     read minor edit variable headings
      read (UNIT=ital1, FMT=1020) avar, (alfvar(k), k=1,numdat)
      read (UNIT=ital1, FMT=1020) avar, (numvar(k), k=1,numdat)
1020  format (8a10)
c
c     select the record to plot
c
      ivarl = irec + 1
      IF (ivarl .GT. numdat) then
         WRITE (UNIT=scrno, FMT=1022)
         GO TO 2000
      END if
1022  FORMAT (' list of minor edits exceeded')
      do 75 n=ivarl,numdat
      write (UNIT=scrno, FMT=2022) alfvar(n), numvar(n)
      READ (scrni, '(a1)') noyes
      irec = n
      IF (noyes .EQ. yes) GO TO 80
75    continue
c     check for more files
      go to 25
c
c     read the data records - terminate with EOF
c
2022  format (1x,a10,2x,a10,' ':)
c
80    continue
c
      dum1    = ADJUSTL(alfvar(irec))
      dum2    = ADJUSTL(numvar(irec))
```

```
      DO 84 j=1,8
      IF (dum1(j:j) .EQ. ' ') GO TO 84
      jdx = j
84    continue
      DO 86 j=1,8
      IF (dum2(j:j) .EQ. ' ') GO TO 86
      kdx = j
86    continue
      jdx     = min0(jdx,5)
      kdx     = 8-jdx
      tmpnam = dum1(1:jdx)//dum2(1:kdx)
      outfile = tmpnam(1:(jdx+kdx))//'.dat'
c
c      CALL SYSTEM ('dir')
c      pause
      call SYSTEM ('cd temp')
c      CALL SYSTEM ('dir')
c      WRITE (UNIT=scrno, FMT=9031) outfile
9031  FORMAT (' file name = ',a12)
c      pause
      inquire (file=outfile, exist=isfdef, err=1001, iostat=ierr)
      if (isfdef) then
         open (unit=iout, file=outfile, status='old',
     *   form='formatted', access='sequential', err=1010,
     *   iostat=ierr)
         close (UNIT=iout,STATUS='delete')
      end if
c
      open (unit=iout, file=outfile, status='new',
     *      form='formatted', access='sequential', err=1010,
     *      iostat=ierr)
c
      WRITE (UNIT=iout, FMT=2020) filenam
2020  FORMAT (5x,'data from file - ',a15/)
      WRITE (UNIT=iout, FMT=2015) alfvar(1),
     * alfvar(irec), numvar(irec)
2015  format (5x,a10,5x,a10/5x,' (sec)   ',4x,a10/)
      IF (skipr) then
         nrec   = numskp
      else
         nrec  = 1
      end if
c      WRITE (UNIT=scrno, FMT=9010) nrec
9010  FORMAT (' nrec to skip = ',i6)
      kcnt   = 0
      ctim   = zero
      lrecno = 0
      call system ('cd ..')
c      CALL SYSTEM ('dir')
c      pause
90    continue
c     read the first record of strip file
      read (UNIT=ital1, FMT=2001, END=2090, ERR=1001) avar,
     * (plotdat(k), k=1,numdat)
      IF (.not. skipr) GO TO 96
```

```
      IF (kcnt .EQ. 0) GO TO 96
      if (plotdat(1) .le. 200.0d0) then
         lrecno = kcnt
         kcnt = kcnt + 1
            IF (plotdat(1).LT.(ctim+2.0)) then
              GO TO 90
            else
              ctim = plotdat(1)
              GO TO 96
            END if
      else
c     skip nrec-1 records
         nxtrec = lrecno + nrec -1
c         WRITE (UNIT=scrno, FMT=9021) nxtrec
      end if
9021  FORMAT (' nxtrec = ', i6)
95    kcnt = kcnt + 1
      if (kcnt .lt. nxtrec) then
        GO TO 2090
      end if
2001  format (a15, 4e15.6/(5e15.6))
2010  FORMAT (1p,2e15.6)
      lrecno = kcnt
96    continue
      call system ('cd temp')
      WRITE (UNIT=iout, FMT=2010) plotdat(1), plotdat(irec)
      if (kcnt .eq. 0) kcnt = 1
      call system ('cd ..')
c      call system ('cd juveni~1')
2090  continue
      IF (plotdat(1) .lt. fintim) GO TO 90
      rewind (UNIT=ital1)
      CALL SYSTEM ('cd temp')
      CLOSE (UNIT=iout, STATUS='keep')
      call system ('cd ..')
c      call system ('cd juveni~1')
      go to 25
c
c     error messages
c
1001  write (scrno, 1002) ierr, filenam
1002  format (' error = ',i8,' encountered attempting to access file ',
     * a20)
      go to 2000
c
1005  write (scrno, 1006) ierr, filenam
1006  format (' error = ',i8,' encountered attempting to open file ',
     * a20)
      go to 2000
c
1010  write (scrno, 1006) ierr, outfile
c
2000  continue
      end
```

2. Sample Input Strip File

```
  RELAP5/3.2            strip file              24-Jun-1999
  relap5/mod2  waste package c103x1hbv.test.strp
  plotinf         55         0
  plotalf   time      p         p         p         p         p         p
  p         p         hvmix     hvmix     sonicj    vapgen    vapgen
vapgen
  vapgen    vapgen    vapgen    tmass     tmassv    tmassv    tmassv
tmassv
  tmassv    tmassv    tmassv    tmassv    tmassv    tmassv    tmassv
mflowj
  mflowj    mflowj    mflowj    mflowj    mflowj    mflowj    mflowj
mflowj
  mflowj    mflowj    mflowj    htvat     rkfipow   rkgapow   rkreac
cntrlvar
  cntrlvar  cntrlvar  cntrlvar  cntrlvar  cntrlvar  cntrlvar  cntrlvar
  plotnum          0 150010000  60010000  70010000  80010000  90010000
100010000
 250010000 240010000  90010000 250010000 250010000 150010000  60010000
70010000
  80010000  90010000 100010000         0 260010000 150010000  60010000
70010000
  80010000  90010000 100010000 220010000 230010000 240010000 250010000
80010000
  80020000  70010000  70020000 240010000 230010000 230020000 250010000
220010000
 220020000  20010000  20020000   3301008         0         0         0
81
       14        56        60        65        70        75        80
  plotrec          .000000E+00   1.013254E+05   1.013254E+05   1.013254E+05
   1.013254E+05   1.013254E+05   1.013254E+05   1.013254E+05   1.013254E+05
    .000000E+00    .000000E+00    .000000E+00    .000000E+00    .000000E+00
    .000000E+00    .000000E+00    .000000E+00    .000000E+00   4.490972E+02
    .000000E+00   6.368977E+00   1.967957E+01   1.967957E+01   1.967957E+01
   1.967957E+01   1.967957E+01   2.415648E+01   2.415648E+01   1.376029E+01
   3.502303E+01    .000000E+00    .000000E+00    .000000E+00    .000000E+00
    .000000E+00    .000000E+00    .000000E+00    .000000E+00    .000000E+00
    .000000E+00    .000000E+00    .000000E+00   3.231511E+02   4.634700E+00
   3.653000E-01    .000000E+00    .000000E+00    .000000E+00    .000000E+00
    .000000E+00    .000000E+00    .000000E+00    .000000E+00    .000000E+00
  plotrec         1.000000E-02   1.075159E+05   1.060990E+05   1.038763E+05
   1.015874E+05   9.924545E+04   9.686730E+04   9.374152E+04   9.516440E+04
    .000000E+00    .000000E+00    .000000E+00    .000000E+00    .000000E+00
    .000000E+00    .000000E+00    .000000E+00    .000000E+00   4.490874E+02
    .000000E+00   6.368994E+00   1.967962E+01   1.967960E+01   1.967958E+01
   1.967956E+01   1.967954E+01   2.415642E+01   2.415642E+01   1.376026E+01
   3.501335E+01   3.410194E-02   2.372985E-03   2.627495E-02   3.793676E-03
   6.202511E-02   5.451060E-02  -2.357969E-02   2.478254E+00   4.129710E-02
  -1.562832E-02   1.348391E-02   1.050594E-03   3.231511E+02   4.651265E+00
   3.653010E-01   3.553265E-03    .000000E+00  -1.459565E-10  -1.171647E-03
   4.726666E-03   3.555020E-03   5.008634E-02    .000000E+00   7.100000E-01
  plotrec         2.000000E-02   1.046268E+05   1.032420E+05   1.011549E+05
   9.907315E+04   9.699584E+04   9.492212E+04   9.210218E+04   9.337293E+04
    .000000E+00    .000000E+00    .000000E+00    .000000E+00    .000000E+00
```

```
  .000000E+00   .000000E+00   .000000E+00   .000000E+00  4.490737E+02
  .000000E+00  6.368986E+00  1.967959E+01  1.967957E+01  1.967956E+01
 1.967954E+01  1.967952E+01  2.415640E+01  2.415640E+01  1.376025E+01
 3.500011E+01  1.121941E-03 -2.055325E-05  5.532075E-04 -2.973859E-05
 6.016500E-03  5.328805E-03 -1.381403E-03  2.883632E+00  3.447919E-03
-4.805961E-04  2.801862E-04 -1.327511E-05  3.231511E+02  4.665872E+00
 3.653039E-01  6.650467E-03   .000000E+00 -1.975029E-11 -2.797694E-03
 9.453333E-03  6.655639E-03  1.003265E-01   .000000E+00  7.100000E-01
plotrec        3.000000E-02  1.030670E+05  1.016796E+05  9.958141E+04
 9.748258E+04  9.538323E+04  9.328374E+04  9.043707E+04  9.172116E+04
  .000000E+00   .000000E+00   .000000E+00   .000000E+00   .000000E+00
  .000000E+00   .000000E+00   .000000E+00   .000000E+00  4.490573E+02
  .000000E+00  6.368982E+00  1.967958E+01  1.967956E+01  1.967954E+01
 1.967953E+01  1.967951E+01  2.415638E+01  2.415638E+01  1.376024E+01
 3.498396E+01  3.957219E-03  2.322828E-04  2.791887E-03  3.424082E-04
 1.097558E-02  9.389635E-03 -3.279840E-03  3.393939E+00  6.364134E-03
-1.647311E-03  1.425709E-03  9.158744E-05  3.231511E+02  4.679066E+00
 3.653085E-01  9.416994E-03   .000000E+00  2.848080E-10 -4.753726E-03
 1.418000E-02  9.426274E-03  1.507059E-01   .000000E+00  7.100000E-01
plotrec        4.000000E-02  1.015588E+05  1.001717E+05  9.807489E+04
 9.597816E+04  9.388151E+04  9.178519E+04  8.894152E+04  9.022409E+04
  .000000E+00   .000000E+00   .000000E+00   .000000E+00   .000000E+00
  .000000E+00   .000000E+00   .000000E+00   .000000E+00  4.490383E+02
  .000000E+00  6.368978E+00  1.967957E+01  1.967955E+01  1.967953E+01
 1.967951E+01  1.967949E+01  2.415637E+01  2.415637E+01  1.376023E+01
 3.496519E+01  3.526008E-03  2.458410E-04  2.495895E-03  3.359990E-04
 1.018977E-02  8.453297E-03 -2.934241E-03  3.850954E+00  5.489125E-03
-1.321726E-03  1.270948E-03  9.147199E-05  3.231511E+02  4.690910E+00
 3.653145E-01  1.187258E-02   .000000E+00  7.489204E-10 -7.020047E-03
 1.890667E-02  1.188662E-02  2.012105E-01   .000000E+00  7.100000E-01
plotrec        5.000000E-02  1.001984E+05  9.881131E+04  9.671442E+04
 9.461755E+04  9.252073E+04  9.042416E+04  8.758023E+04  8.886284E+04
  .000000E+00   .000000E+00   .000000E+00   .000000E+00   .000000E+00
  .000000E+00   .000000E+00   .000000E+00   .000000E+00  4.490168E+02
  .000000E+00  6.368974E+00  1.967955E+01  1.967954E+01  1.967952E+01
 1.967950E+01  1.967948E+01  2.415635E+01  2.415635E+01  1.376022E+01
 3.494398E+01  3.133709E-03  2.562385E-04  2.224622E-03  3.285738E-04
 9.479837E-03  7.613232E-03 -2.623204E-03  4.272640E+00  4.721612E-03
-1.038623E-03  1.129399E-03  9.080387E-05  3.231511E+02  4.701482E+00
 3.653218E-01  1.403956E-02   .000000E+00  1.356153E-09 -9.574360E-03
 2.363333E-02  1.405897E-02  2.518272E-01   .000000E+00  7.100000E-01
```

3. STRIP Sample Output File

```
     data from file - 103x1hbv.s02

       time           tmass
      (sec)             0

 0.000000E+00  4.490972E+02
 1.000000E-02  4.490874E+02
 2.000000E-02  4.490737E+02
 3.000000E-02  4.490573E+02
```

```
4.000000E-02   4.490383E+02
5.000000E-02   4.490168E+02
6.000000E-02   4.489931E+02
7.000000E-02   4.489673E+02
8.000000E-02   4.489395E+02
9.000000E-02   4.489084E+02
1.000000E-01   4.488697E+02
2.000000E-01   4.435170E+02
3.000000E-01   4.425587E+02
4.000000E-01   4.425541E+02
5.000000E-01   4.425543E+02
```

ATTACHMENT III. Base RELAP5/MOD3.2 Data File

```
= relap5/mod2  waste package (b & w  15 by 15  21 fa)
*-----------------------------------------------------------
*
*
* { this is /kappa/jrw/lv/relap/r5wp2d.in
*
* the input is a transition from tmi-1 power uprate lbloca
* to waste package (near field) criticality excursion consequences
* with 4.90 wt.% u-235 , 34,000 mwd/mtu burnup and  25,000 year decay
*
*  b & w   heavy isotope actinide contribution }
*
*
*------------------ base description ----------------------
*
*     fti  document 32-1244460-00
*     by: ks pacheco
*
* the base deck for the tmi-1 model was taken from 2772base1.in
* contained in 32-1234886-00.  /kappa/ksp/tmipug/base/tmibase.in
*
*  21fa, 208-pins/fa, 16-guide tubes/fa, 1-instrument tube/fa
*        one-fifth length model - Power into Assembly is 5 Watts
*        for Full Length assemblies
*
*---**---**---**---**---**---**---**---**---**---**---**---**---*
*
*   deck obtained from tuck w. (lynchburg) 07/31/97
*   07/31/97 modifiation - jam (lv)
*     delete most of the $$$ cards from deck
*     convert to mod3 format
*     junction control flag - change from 3xxxx to 0xxxx
*                            no horizontal stratification
*     heat structure cards ...8xx and ...9xx - CHF Changes
*                            MOD2 - 5 wds, MOD3 - 9 wds
*     add Time-Dependent Vol and Time-Dependent Junction to input
*     InFlow Conditions
*     Add Minor Edits
*   Case 001 Using small time steps to make sure case runs ok
*   Case 002 Match Tuck Worsham's data (Fax memo - 08/04/97
*   Case 003 Use short time steps through power peak
*   Case 004 Add Doppler Weight Factors to activate Fuel Temp Feedback
*            B&W Relap5 has been modified to compute Doppler Weights
*            internally if none supplied.
*            Add Avg Fuel Temp To Minor Edits
*            Add variable Void Weight Factors porportional to Control
*            Volume relative size
*   Case 005 Rerun Case C003 with Doppler Weights
*   Case 006 Add Reactivity Control Blocks to Edit Components to Case 004
*   Case 101 Switch to Implicit Numerics
*            Shorten time steps to avoid zero mass in control volumes
```

```
*            around 5.8 sec, turn on the choking model for junctions in
*            non-fuelled volumes.
*   Case 111 Similar to Case 101: reduce reactivity ramp by 50%;
*                                 increase refill rate by 50%;
*                                 change minor edits;
*                                 adjust minor edit frequencirs to 0.05 sec
*   Case 102 Try Case 101 with automatic T.S. control to cut down on
*            number of minor edit points
*            Redo case 102 to include fission and decay heat power,
*            add reactivity table vs mixture level
*   Case 102a review short T.S. case again
*        102b check for T.S. convergence (more stable than case 102a
*        102c check further for T.S. convergence
*        103a actually add mixture level calc - limit to top fuelled row
*             delete void reactivity table
*        103b 08/20/97 - revise case c103a and rerun
*             revise MCNP void reactivity table to use delta rho
*             and include all restart time steps, remove mixture level flgs
*        103c reinstate the mixture level model in vols 21001, 05001, 10001,
*             20001
*
*
*---**---**---**---**---**---**---**---**---**---**---**---**---*
*
100   new   transnt
101   run
* 101   inp-chk
102   british   british
105   150.  160.
*
*  noncondensible gas
110   "nitrogen"
*
*---**---**---**---**---**---**---**---**---**---**---**---**---*
*
* time step control
*      end     min     max    time  minor  major  restart
*     time    delt    time    step  edit   edit    point
*     (sec)   (sec)   step    optn  freq   freq    freq
*
*  Case 103a time steps
  201   0.1      1.0-8   1.0-4    07   100    1000    1000
  202   1.5      1.0-8   1.0-3    07   100    100     100
  203   4.0      1.0-8   5.0-5    07   1000   10000   10000
  204  20.0      1.0-8   5.0-5    07   10000  20000   20000
*
*  Case c103a.rst01 time steps
  205  30.0      1.0-8   5.0-5    07   10000  20000   20000
*
*  Case c103a.rst02 time steps
  206  40.0      1.0-8   1.0-4    07   1000   10000   10000
*
*  Case c103a.rst03 time steps
  207  80.0      1.0-8   1.0-4    07   1000   10000   10000
*
```

```
*  Case c103a.rst04 time steps
  208  360.0     1.0-8   1.0-3    07   1000   10000   10000
*
*  Case c103a.rst05 time steps
  209  1800.0    1.0-8   1.0-2    07   200    1000    1000
*
*
*---**---**---**---**---**---**---**---**---**---**---**---**---*
*
*
*        general tables
*
*
*---**---**---**---**---**---**---**---**---**---**---**---**---*
*
*  reactivity insertion
*
20200100  reac-t
20200101  0.0  0.0  30.0  14.18  1.0+10  14.18
*  20200101  0.0  0.0  30.0   7.09  1.0+10   7.09
*
*
*   average fuel temperature vs. reactivity
*
20200200  reac-t
*
*          fuel temp. K      reactivity, dollars     density lb/ft**3
*
20200201    273.16              +0.1719079
20200202    300.01              +0.1719079
20200203    323.16               0.0
20200204    373.16              -0.3488604
20200205    433.16              -0.7295469
20200206    543.16              -1.3918144
20200207    813.16              -2.8696928
*
*  moderator density reactivity feedback
*
20200500  reac-t
*
*          density  kg/m**3    reactivity, dollars     fuel temp. f
*
20200501      701.470834         -22.8341124           *  1004
20200502      726.523364         -20.0375898           *  1004
20200503      751.575895         -17.4413905           *  1004
20200504      776.628425         -15.0255317           *  1004
20200505      801.680954         -12.7766726           *  1004
20200506      826.733484         -10.6782739           *  1004
20200507      851.786013         -08.7187079           *  1004
20200508      876.838543         -06.8856192           *  1004
20200509      901.891072         -05.1688975           *   518
20200510      921.933098         -03.9010990           *   518
20200511      941.975121         -02.6972060           *   518
20200512      960.112521         -01.6592902           *   518
20200513      975.044461         -00.8234196           *   212
```

```
20200514      990.260409          00.00                *   122
20200515     1002.101192         +00.6225345           *   122
20200516     1043.387881         +00.6225345           *    80.33
*
*
*     MCNP mixture level reactivity table (beta = 0.005)
*     Row 5 of fueled assemblies
*     Ref: W.D. reactor physics book + J. Massari Doc
*
*        Mixture level (ft)    Reactivity ($)
*
20201000  reac-t
*
20201001    0.0                 -30.902
20201002    0.04399             -30.902
20201003    0.18933             -16.660
20201004    0.23657             -14.959
20201005    0.28415             -12.911
20201006    0.71                  0.0
*
*---**---**---**---**---**---**---**---**---**---**---**---**---*
*
*
*     minor edits
*
*
*---**---**---**---**---**---**---**---**---**---**---**---**---*
*
*
*     pressure
*
301   "p"          150010000            * Vol Pressure
302   "p"          060010000            * Vol Pressure
303   "p"          070010000            * Vol Pressure
304   "p"          080010000            * Vol Pressure
305   "p"          090010000            * Vol Pressure
306   "p"          100010000            * Vol Pressure
307   "p"          250010000            * Vol Pressure
*
*     enthalpy
*
315   "hvmix"      090010000           * Vol Enthalpy
317   "hvmix"      250010000           * Vol Enthalpy
*
*
*     volume vapor generation/unit vol
*
321   "vapgen"     150010000           * Vol vapor gen rate
322   "vapgen"     060010000           * Vol vapor gen rate
323   "vapgen"     070010000           * Vol vapor gen rate
324   "vapgen"     080010000           * Vol vapor gen rate
325   "vapgen"     090010000           * Vol vapor gen rate
326   "vapgen"     100010000           * Vol vapor gen rate
*
*
```

```
*     Volume Mass
*
329   "tmass"      0                   * Fluid Inventory
330   "tmassv"     260010000           * Vol Mass
331   "tmassv"     150010000           * Vol Mass
332   "tmassv"     060010000           * Vol Mass
333   "tmassv"     070010000           * Vol Mass
334   "tmassv"     080010000           * Vol Mass
335   "tmassv"     090010000           * Vol Mass
336   "tmassv"     100010000           * Vol Mass
337   "tmassv"     220010000           * Vol Mass
338   "tmassv"     230010000           * Vol Mass
339   "tmassv"     240010000           * Vol Mass
340   "tmassv"     250010000           * Vol Mass
*
*     mass flow
*
341   "mflowj"     080010000           * Jun Flow
342   "mflowj"     080020000           * Jun Flow
343   "mflowj"     070010000           * Jun Flow
344   "mflowj"     070020000           * Jun Flow
345   "mflowj"     240010000           * Jun Flow
346   "mflowj"     230010000           * Jun Flow
347   "mflowj"     230020000           * Jun Flow
348   "mflowj"     250010000           * Jun Flow
349   "mflowj"     220010000           * Jun Flow
351   "mflowj"     220020000           * Jun Flow
352   "mflowj"     020010000           * Jun Flow
353   "mflowj"     020020000           * Jun Flow
*
*
*     average fuel temperature
*
361   "htvat"      3301008             * Avg Metal Temp
*
*   control variables
*
*   kinetics parameters
*
389   "rkfipow"    0           * "fission" "power"
390   "rkgapow"    0           * "decay heat" "power"
391   "rkreac"     0           * "total" "reactivi"
392   "cntrlvar"   081         * "MCNP void Reactivity
393   "cntrlvar"   014         * "doppler reac
394   "cntrlvar"   056         * "void reactivity
395   "cntrlvar"   060         * "ramp reactivity
396   "cntrlvar"   065         * "total calc reac
397   "cntrlvar"   070         * "assembly energy
398   "cntrlvar"   075         * "Sum (Heat slab vapor gen rate)
*
*
*---**---**---**---**---**---**---**---**---**---**---**---**---*
*
*
*   waste package
```

```
*
*
* modeling begins with central planar region
*
*
*---**---**---**---**---**---**---**---**---**---**---**---**---*
*
* bottom of cylinder
*
1400000   "bot-watr"  "branch"
*       no. of jun  jun cntrl
1400001   2         0
*       aflow(norm)  len       vol    angle(az) inclin  elev change
1400101    0.00     .2293299  .2075716   0.0   -90.0   -.2293299
*       wall rough  hyd dia   cntrl
1400102   4.1667-5   1.0+10    00
*       vol cntrl   press      temp
1400200   003        14.696    122.00
*       from vol    to vol     ajun      k(f)   k(r)   jun cntrl
1401101   140000000 010010000  .2038375  72.0   72.0   01000
*       liq vel    vap vel    interface vel
1401201   0.0       0.0        0.0
*       from vol    to jun     ajun      k(f)   k(r)   jun cntrl
1402101   140000000 150000000  .5419829   0.0    0.0   01003
*       liq vel    vap vel    interface vel
1402201   0.0       0.0        0.0
*
* bottom side of cylinder
*
1500000   "bos-watr"  "branch"
1500001   1         0
1500101    0.00     .2293299  .2276341   0.0   -90.0   -.2293299
*                         cntrl (therm-off, mix-off, pack-on,
*                               vert strat-on,  interphase fric-pipe,
*                               wall-xdir, non-eq)
1500102   4.1667-5   1.0+10    0000000
1500200   003        14.696    122.00
1501101   150000000 060010000  .4076750  72.0   72.0   01000
1501201   0.0       0.0        0.0
*
* side of cylinder fuel level 1
*
1600000   "s1-watr"   "branch"
1600001   1         0
1600101    0.00     .71       .7989270   0.0   -90.0   -.71
1600102   4.1667-5   1.0+10    00
1600200   003        14.696    122.00
1601101   160000000 110010000  .4076750  72.0   72.0   01000
1601201   0.0       0.0        0.0
*
* side of cylinder fuel level 2
*
1700000   "s2-watr"   "branch"
1700001   1         0
1700101    0.00     .71          .5438773    0.0   -90.0   -.71
```

```
1700102   4.1667-5   1.0602200    00
1700200   003        14.696       122.00
1701101   170000000 180000000     1.1080708  0.0    0.0   01000
1701201   0.0       0.0           0.0
*
* side of cylinder fuel level 3
*
1800000   "s3-watr"   "branch"
1800001   1         0
1800101    0.00     .71          .8980821    0.0    90.0    .71
1800102   4.1667-5   2.1134025    00
1800200   003        14.696       122.00
1801101   180010000 190000000     1.3339422  0.0    0.0   01000
1801201   0.0       0.0           0.0
*
* side of cylinder fuel level 4
*
1900000   "s4-watr"   "branch"
1900001   1         0
1900101    0.00     .71          .8738187    0.0    90.0    .71
1900102   4.1667-5   2.0432176    00
1900200   003        14.696       122.00
1901101   190010000 210000000     1.0380308  0.0    0.0   01000
1901201   0.0       0.0           0.0
*
* side of cylinder - fuel level 5
*
2100000   "s5-watr"   "branch"
2100001   1         0
2100101    0.00     .71          .7822260    0.0    90.0    .71
2100102   4.1667-5   1.6252320    0100000
2100200   003        14.696       122.00
*  2101101   210010000 240000000     1.0380308  0.0    0.0   01000
   2101101   210010000 240000000     1.0380308  0.0    0.0   00000
2101201   0.0       0.0           0.0
*
* 21 fuel assemblies
*
* half symmetry gives 13 planar fuel areas
*
* modeling begins with central fuel length,
*
* center fuel column,  at the cylinder bottom
*
* hydraulic dia. based on flow around fuel-clad, guide tubes, inst. tube
*
*---**---**---**---**---**---**---**---**---**---**---**---*
*
* column  1
*
0100000   "fuel-010"  "branch"
0100001   2         0
0100101    0.00     .71          .3516846   0.0   -90.0   -.71
0100102   3.133-6   .04168514     00
0100200   003        14.696       122.00
```

```
0101101   010000000 020010000     .2038375  72.0   72.0   01000
0101201   0.0       0.0           0.0
0102101   010000000 060000000     .4076750  72.0   72.0   01003
0102201   0.0       0.0           0.0
*
0200000   "fuel-020"  "branch"
0200001   2         0
0200101    0.00     .71          .3516846   0.0   -90.0   -.71
0200102   3.133-6   .04168514     00
0200200   003        14.696       122.00
0201101   020000000 030000000     .2038375  72.0   72.0   01000
0201201   0.0       0.0           0.0
0202101   020000000 070000000     .4076750  72.0   72.0   01003
0202201   0.0       0.0           0.0
*
0300000   "fuel-030"  "branch"
0300001   2         0
0300101    0.00     .71          .3516846   0.0    90.0    .71
0300102   3.133-6   .04168514     00
0300200   003        14.696       122.00
0301101   030010000 040000000     .2038375  72.0   72.0   01000
0301201   0.0       0.0           0.0
0302101   030000000 080000000     .4076750  72.0   72.0   01003
0302201   0.0       0.0           0.0
*
0400000   "fuel-040"  "branch"
0400001   2         0
0400101    0.00     .71          .3516846   0.0    90.0    .71
0400102   3.133-6   .04168514     00
0400200   003        14.696       122.00
0401101   040010000 050000000     .2038375  72.0   72.0   01000
0401201   0.0       0.0           0.0
0402101   040000000 090000000     .4076750  72.0   72.0   01003
0402201   0.0       0.0           0.0
*
0500000   "fuel-050"  "branch"
0500001   2         0
0500101    0.00     .71          .3516846   0.0    90.0    .71
*                           cntrl (therm-off, mix-on, pack-on,
*                                 vert strat-on,  interphase fric-pipe,
*                                 wall-xdir, non-eq)
0500102   3.133-6   .04168514     0100000
0500200   003        14.696       122.00
0501101   050010000 220000000     .2038375  72.0   72.0   01000
0501201   0.0       0.0           0.0
0502101   050000000 100000000     .4076750  72.0   72.0   01003
0502201   0.0       0.0           0.0
*
*---**---**---**---**---**---**---**---**---**---**---**---*
*
* column  2
*
0600000   "fuel-060"  "branch"
0600001   2         0
0600101    0.00     .71          .7033692   0.0   -90.0   -.71
```

```
0600102   3.133-6   .04168514     00
0600200   003        14.696       122.00
0601101   060000000 070010000     .4076750  72.0   72.0   01000
0601201   0.0       0.0           0.0
0602101   060000000 160000000     .4076750  72.0   72.0   01003
0602201   0.0       0.0           0.0
*
0700000   "fuel-070"  "branch"
0700001   2         0
0700101    0.00     .71          .7033692   0.0   -90.0   -.71
0700102   3.133-6   .04168514     00
0700200   003        14.696       122.00
0701101   070000000 080000000     .4076750  72.0   72.0   01000
0701201   0.0       0.0           0.0
0702101   070000000 110000000     .4076750  72.0   72.0   01003
0702201   0.0       0.0           0.0
*
0800000   "fuel-080"  "branch"
0800001   2         0
0800101    0.00     .71          .7033692   0.0    90.0    .71
0800102   3.133-6   .04168514     00
0800200   003        14.696       122.00
0801101   080010000 090000000     .4076750  72.0   72.0   01000
0801201   0.0       0.0           0.0
0802101   080000000 120000000     .4076750  72.0   72.0   01003
0802201   0.0       0.0           0.0
*
0900000   "fuel-090"  "branch"
0900001   2         0
0900101    0.00     .71          .7033692   0.0    90.0    .71
0900102   3.133-6   .04168514     00
0900200   003        14.696       122.00
0901101   090010000 100000000     .4076750  72.0   72.0   01000
0901201   0.0       0.0           0.0
0902101   090000000 130000000     .4076750  72.0   72.0   01003
0902201   0.0       0.0           0.0
*
1000000   "fuel-100"  "branch"
1000001   2         0
1000101   0.00      .71          .7033692   0.0    90.0    .71
1000102   3.133-6   .04168514     0100000
1000200   003        14.696       122.00
1001101   100010000 230000000     .4076750  72.0   72.0   01000
1001201   0.0       0.0           0.0
1002101   100000000 200000000     .4076750  72.0   72.0   01003
1002201   0.0       0.0           0.0
*
*---**---**---**---**---**---**---**---**---**---**---**---*
*
* column  3
*
1100000   "fuel-110"  "branch"
1100001   2         0
1100101    0.00     .71          .7033692   0.0   -90.0   -.71
1100102   3.133-6   .04168514     00
```

```
1100200   003        14.696       122.00
1101101   110000000 120000000     .4076750  72.0   72.0   01000
1101201   0.0       0.0           0.0
1102101   110000000 170000000     .4076750  72.0   72.0   01003
1102201   0.0       0.0           0.0
*
1200000   "fuel-120"  "branch"
1200001   2         0
1200101    0.00     .71          .7033692   0.0    90.0    .71
1200102   3.133-6   .04168514     00
1200200   003        14.696       122.00
1201101   120010000 130000000     .4076750  72.0   72.0   01000
1201201   0.0       0.0           0.0
1202101   120000000 180000000     .4076750  72.0   72.0   01003
1202201   0.0       0.0           0.0
*
1300000   "fuel-130"  "branch"
1300001   2         0
1300101    0.00     .71          .7033692   0.0    90.0    .71
1300102   3.133-6   .04168514     00
1300200   003        14.696       122.00
1301101   130010000 200000000     .4076750  72.0   72.0   01000
1301201   0.0       0.0           0.0
1302101   130000000 190000000     .4076750  72.0   72.0   01003
1302201   0.0       0.0           0.0
*
* water - column  3
*
*---**---**---**---**---**---**---**---**---**---**---**---*
*
2000000   "ts-watr"   "branch"
2000001   2         0
2000101    0.00     .71          .8633786   0.0    90.0    .71
2000102   4.1667-5   1.0+10      0100000
2000200   003        14.696      122.00
*  2001101   200010000 240000000    .7540857   0.0    0.0   01000
   2001101   200010000 240000000    .7540857   0.0    0.0   00000
2001201   0.0       0.0          0.0
*  2002101   200000000 210000000   1.7958536   0.0    0.0   01003
   2002101   200000000 210000000   1.7958536   0.0    0.0   00003
2002201   0.0       0.0          0.0
*
* top of cylinder
*
*
* three water columns
*
*
2200000   "c1-watr"   "branch"
2200001   2         0
2200101    0.00     .3484394     .8633786   0.0    90.0    .3484394
2200102   4.1667-5   1.0+10      00
2200200   003        14.696      122.00
*  2201101   220010000 250000000    .2038375   0.0    0.0   01000
   2201101   220010000 250000000    .2038375   0.0    0.0   00000
```

```
2201201   0.0       0.0          0.0
*  2202101   220000000 230000000    .8234784   0.0    0.0   01003
   2202101   220000000 230000000    .8234784   0.0    0.0   00003
2202201   0.0       0.0          0.0
*
2300000   "c2-watr"   "branch"
2300001   2         0
2300101    0.00     .3484394     .8633786   0.0    90.0    .3484394
2300102   4.1667-5   1.0+10      00
2300200   003        14.696      122.00
*  2301101   230010000 250000000    .4076750   0.0    0.0   01000
   2301101   230010000 250000000    .4076750   0.0    0.0   00000
2301201   0.0       0.0          0.0
*  2302101   230000000 240000000    .8234784   0.0    0.0   01003
   2302101   230000000 240000000    .8234784   0.0    0.0   00003
2302201   0.0       0.0          0.0
*
2400000   "c3-watr"   "branch"
2400001   1         0
2400101    0.00     .3484394     .4918077   0.0    90.0    .3484394
2400102   4.1667-5  1.6908844    00
2400200   003        14.696      122.00
*  2401101   240010000 250000000    .9732914   0.0    0.0   01000
   2401101   240010000 250000000    .9732914   0.0    0.0   00000
2401201   0.0       0.0          0.0
*
* top plenum
*
2500000   "tp-watr"   "branch"
2500001   1         0
2500101    0.00     .5249344    1.2517607   0.0    90.0    .5249344
2500102   4.1667-5  1.3256083    00
2500200   003        14.696      122.00
* 2501101   250010000 260000000    .1076391   0.0    0.0   01000
  2501101   250010000 260000000    .1076391   0.0    0.0   00000
2501201   0.0       0.0          0.0
*
* outside of waste package,
*
* drift at 14.696 psia
*
2600000   "drift"     "tmdpvol"
2600101   238.46  1.0  0.0  0.0  90.0  1.0  1.0e-6  0.0  0010
2600200   003
2600201   0.0        14.696      220.00
*
* drift inflow volume
*
3600000    "gnd-watr"  "tmdpvol"
3600101    238.46  1.0  0.0  0.0  90.0  1.0  1.0e-6 0.0  0010
3600200    103
3600201    0.0    14.696     122.0
*
* Time-Dependent Junction for inflow
*
```

```
3700000    "in-flow"  "tmdpjun"
3700101    360010000   250000000    1.0
3700200    1           0
3700201    0.0         1.381e-3     0.0       0.0
*  3700201    0.0         2.762e-3     0.0       0.0
*
*---**---**---**---**---**---**---**---**---**---**---**---*
***
***
***                  heat structure input
***
***
***
*---**---**---**---**---**---**---**---**---**---**---**---*
*
*     waste package wall
*
13121000   9   20   1   1   0.0
13121100   0   2
13121101   10.0     19
13121201   6   19
13121301   0.0 19
13121400   0
13121401   122. 20
13121501   140010000   10000000   1     1   1.73  9
13121601   0           0          0     1   1.73  9
13121701   0   0.0   0.0   0.0   9
* 13121801   0   0.0   0.0   0.0   9
* 13121901   0   0.0   0.0   0.0   9
  13121801   0.0   10.0   10.0   0.0   0.0  0.0   0.0  1.0  9
  13121901   0.0   10.0   10.0   0.0   0.0  0.0   0.0  1.0  9
*
*---**---**---**---**---**---**---**---**---**---**---**---*
*
*     fuel assembly clad, guide tubes, & inst-tube in fuel region
*
13481000   13    3    2   1   0.01570833
13481100   0     1
13481101   2     0.01791112
13481201   5     2
13481301   0.0   2
13481400   0
13481401   122.  3
*                              225  *2.3633333 = 531.75  ft
*                              112.5*2.3633333 = 265.875 ft
13481501   010010000  10000000      1     1     265.8750   5
13481502   060010000  10000000      1     1     531.7500   13
13481601   010010000  10000000      1     1     265.8750   5
13481602   060010000  10000000      1     1     531.7500   13
13481701   0   0.0   0.0   0.0   13
* 13481801   0   0.0   0.0   0.0   13
* 13481901   0   0.0   0.0   0.0   13
  13481801   0.0   10.0   10.0   0.0   0.0  0.0   0.0  1.0  13
  13481901   0.0   10.0   10.0   0.0   0.0  0.0   0.0  1.0  13
*  13481801   0   0.05360754   0.05360754   0.0   13
```

```
*  13481901   0   0.04701465   0.04701465   0.0   13
*
*---**---**---**---**---**---**---**---**---**---**---**---*
*
*      fuel assembly pellets - water in gap region
*
13301000   13     10    2    1     0.0
13301100   0     1
*  13301101   6     0.01535833   1     0.01570833  2   0.01791667
13301101   9     0.01535833
*  13301201   3     6    -4     7     -5    9
13301201   3     9
*  13301301   1.0   6     0.0   7     0.0   9
13301301   1.0   9
13301400   -1
13301401   122.  122.  122.  122. 122. 122. 122. 122. 122. 122.
13301402   122.  122.  122.  122. 122. 122. 122. 122. 122. 122.
13301403   122.  122.  122.  122. 122. 122. 122. 122. 122. 122.
13301404   122.  122.  122.  122. 122. 122. 122. 122. 122. 122.
13301405   122.  122.  122.  122. 122. 122. 122. 122. 122. 122.
13301406   122.  122.  122.  122. 122. 122. 122. 122. 122. 122.
13301407   122.  122.  122.  122. 122. 122. 122. 122. 122. 122.
13301408   122.  122.  122.  122. 122. 122. 122. 122. 122. 122.
13301409   122.  122.  122.  122. 122. 122. 122. 122. 122. 122.
13301410   122.  122.  122.  122. 122. 122. 122. 122. 122. 122.
13301411   122.  122.  122.  122. 122. 122. 122. 122. 122. 122.
13301412   122.  122.  122.  122. 122. 122. 122. 122. 122. 122.
13301413   122.  122.  122.  122. 122. 122. 122. 122. 122. 122.
13301501   0   0    0     0     0.0   13
*
* length of fuel pin = #pins/ass'y * 141.8/(5 * 12)
*                    = 208 * 2.363 = 491.57333
*
13301601   010010000  10000000      1     1     245.78667   5
13301602   060010000  10000000      1     1     491.57333   13
13301701   1000     0.1        0.0        0.0   5
13301702   1000     0.2        0.0        0.0   13
* 13301801   0        0.0        0.0        0.0   13
* 13301901   0        0.05492351 0.05492351 0.0   13
13301801    0.0   10.0     10.0    0.0    0.0    0.0    0.0    1.0    13
13301901    0.0   10.0     10.0    0.0    0.0    0.0    0.0    1.0    13
*
*---**---**---**---**---**---**---**---**---**---**---**---*
*
***
***
***   reactor vessel heat structures
***
***
*
*
*      lower plenum of reactor vessel
*
*
*
```

```
*---**---**---**---**---**---**---**---**---**---**---**---*
*
*
* heat structure composition type
*
*
*---**---**---**---**---**---**---**---**---**---**---**---*
*
* fuel   ( uo2 )
*
20100300  "tbl/fctn"  1         1
*---**---**---**---**---**---**---**---**---**---**---**---*
*
* gap    (hot channel)
*
20100400  "tbl/fctn"  3         1
*---**---**---**---**---**---**---**---**---**---**---**---*
*
* clad   ( zr-4)
*
20100500  "tbl/fctn"  1         1
*---**---**---**---**---**---**---**---**---**---**---**---*
*
* base metal  ( carbon steel )
*
20100600  "tbl/fctn"  1         1
*---**---**---**---**---**---**---**---**---**---**---**---*
*
* cladding  ( stainless steel )
*
20100700  "tbl/fctn"  1         1
*---**---**---**---**---**---**---**---**---**---**---**---*
*
*$$$ *$$$ *
*$$$ *$$$ * gap    (avg channel)
*$$$ *$$$ *
*$$$ *$$$ 20100900  "tbl/fctn"  3         1
*$$$ *
*---**---**---**---**---**---**---**---**---**---**---**---*
*
*
*     heat structure thermal conductivities
*
*
*---**---**---**---**---**---**---**---**---**---**---**---*
*
*    fuel     ( uo2 )
*
20100301    70.0     1.237e-3      200.0     1.237e-3
20100302   400.0     1.022e-3      800.0     0.745e-3
20100303  1200.0     0.592e-3     1600.0     0.492e-3
20100304  2000.0     0.430e-3     2400.0     0.395e-3
20100305  2800.0     0.383e-3     3200.0     0.367e-3
20100306  3600.0     0.370e-3     4000.0     0.380e-3
20100307  4400.0     0.405e-3     5000.0     0.470e-3
```

```
*
*    gap      ( bol )
*
20100401  "helium"     0.989748
20100402  "nitrogen"   0.008098
20100403  "oxygen"     0.002153
20100404  "krypton"    0.000000
20100405  "xenon"      0.000002
*
*    clad      (zr-4)
*
20100501     70.0   2.333e-3    200.0   2.333e-3    400.0   2.458e-3
20100502    800.0   2.805e-3   1200.0   3.278e-3   1600.0   3.805e-3
20100503   1800.0   4.112e-3   2000.0   4.445e-3   2100.0   4.667e-3
20100504   2200.0   4.945e-3   2800.0   7.000e-3
*
*    thermal conductivity     base metal   ( carbon steel )
*
20100601  0.0       .00728    2000.0    .00728
*
*    thermal conducitvity     cladding   ( stainless steel )
*
20100701  0.0       .00311    2000.0    .00311
*
*---**---**---**---**---**---**---**---**---**---**---**---**---*
*
*
*     heat structure volumetric heat capacities
*
*
*---**---**---**---**---**---**---**---**---**---**---**---**---*
*
* volumetric heat capacity  fuel     ( uo2 )
*
20100351    77.0   33.8    200.0   40.62    400.0   43.87
20100352   600.0   45.82   800.0   47.12   1000.0   48.10
20100353  1200.0   48.88  1600.0   49.92   2000.0   50.37
20100354  2400.0   51.35  2800.0   53.62   3200.0   58.17
20100355  3600.0   66.30  4000.0   78.97   4400.0   90.80
20100356  4800.0   99.12  5100.0  101.40
*
* volumetric  heat  capacity   gap   (hot channel)
*
20100451  32.0   0.000075    5400.0    0.000075
*
* volumetric  heat  capacity   clad
*
20100551    32.0   28.346  1062.0    33.232   1140.0   35.432
20100552  1480.0   35.432  1510.0    49.440   1530.0   56.440
20100553  1560.0   58.916  1590.0    61.800   1610.0   66.332
20100554  1620.0   76.220  1650.0    80.340   1680.0   78.28
20100555  1700.0   74.16   1780.0    35.432   3000.0   35.432
*
* volumetric  heat  capacity   base metal   (carbon steel)
*
```

```
20100651  0.0       64.4      2000.0    64.4
*
* volumemetric heat capacity   cladding   (stainless steel)
*
20100751  0.0       64.4      2000.0    64.4
*
*---**---**---**---**---**---**---**---**---**---**---**---*
*
*
*        general tables
*
*
*---**---**---**---**---**---**---**---**---**---**---**---*
*
*  test power insertion
*
* 20200100  power
* 20200101  0.0  0.0  5.0  0.0  25.0  1.0-2
*
*---**---**---**---**---**---**---**---**---**---**---**---*
*
*
*        control varialbes
*
*
*---**---**---**---**---**---**---**---**---**---**---**---*
*
* 20547400  "hcpwr"    "constant"  3.15e6
* 20547400  "hcpwr"    "function"  3.15e4  0.0  0
* 20547401  time  0  1
*
*---**---**---**---**---**---**---**---**---**---**---**---*
***
***
***                  reactor kinetics
***
***
*---**---**---**---**---**---**---**---**---**---**---**---*
*
*  power in watts per assembly
*
30000000  "point"   "separabl"
30000001 "gamma-ac"  5.00000  .00000 .28637e+03   1.0  1.0
30000002  "ans73"   0.0   1.0
30000301  0.3230  0.000491  0.2910  0.00000341
*
*---**---**---**---**---**---**---**---**---**---**---**---*
*
*  general table for waste package reactivity insertion  ttt = 1
*
30000011  1
30000012  10081
*
*---**---**---**---**---**---**---**---**---**---**---**---*
*
```

```
*  moderator density reactivity feedback
*
*  beff = 0.005
*
*          density  lf/ft**3    reactivity, dollars     fuel temp. f
*
30000501      43.6995724          -22.8341124           *  1004
30000502      45.2602714          -20.0375898           *  1004
30000503      46.8209705          -17.4413905           *  1004
30000504      48.3816695          -15.0255317           *  1004
30000505      49.9423685          -12.7766726           *  1004
30000506      51.5030675          -10.6782739           *  1004
30000507      53.0637665          -08.7187079           *  1004
30000508      54.6244655          -06.8856192           *  1004
30000509      56.1851645          -05.1688975           *   518
30000510      57.4337238          -03.9010990           *   518
30000511      58.6822830          -02.6972060           *   518
30000512      59.8121897          -01.6592902           *   518
30000513      60.7424057          -00.8234196           *   212
30000514      61.6903146           00.00                *   122
30000515      62.4279606          +00.6225345           *   122
30000516      65.0000000          +00.6225345           *    80.33
*
*  control volume weighting  - modified from Original deck with uniform
weights
*
30000701   010010000   0   .02191015   0.0
30000702   020010000   0   .02191015   0.0
30000703   030010000   0   .02191015   0.0
30000704   040010000   0   .02191015   0.0
30000705   050010000   0   .02191015   0.0
30000706   060010000   0   .04382030   0.0
30000707   070010000   0   .04382030   0.0
30000708   080010000   0   .04382030   0.0
30000709   090010000   0   .04382030   0.0
30000710   100010000   0   .04382030   0.0
30000711   110010000   0   .04382030   0.0
30000712   120010000   0   .04382030   0.0
30000713   130010000   0   .04382030   0.0
30000714   140010000   0   .01293183   0.0
30000715   150010000   0   .01418173   0.0
30000716   160010000   0   .04977361   0.0
30000717   170010000   0   .03388387   0.0
30000718   180010000   0   .05595103   0.0
30000719   190010000   0   .05443940   0.0
30000720   200010000   0   .05378898   0.0
30000721   210010000   0   .04873313   0.0
30000722   220010000   0   .05378898   0.0
30000723   230010000   0   .05378898   0.0
30000724   240010000   0   .03063990   0.0
30000725   250010000   0   .07798541   0.0
*
30000501
30000502
30000503
```

```
30000504
30000505
30000506
30000507
30000508
30000509
30000510
30000511
30000512
30000513
30000514
30000515
30000516
30000701
30000702
30000703
30000704
30000705
30000706
30000707
30000708
30000709
30000710
30000711
30000712
30000713
30000714
30000715
30000716
30000717
30000718
30000719
30000720
30000721
30000722
30000723
30000724
30000725
*---**---**---**---**---**---**---**---**---**---**---**---**---*
*
*   average fuel temperature vs. reactivity
*
*
*          fuel temp. f      reactivity, dollars     density lb/ft**3
*
30000601     32.0               +0.1719079          *  62.4279606
30000602     80.33              +0.1719079          *  62.4279606
30000603    122.0                0.0                *  61.6903146
30000604    212.0               -0.3488604          *  61.6903146
30000605    320.0               -0.7295469          *  60.7424057
30000606    518.0               -1.3918144          *  60.7424057
30000607   1004.0               -2.8696928          *  56.1851645
*
*
*
```

```
*  heat structure weighting - (added to deck - B&W code does weights
*                              internally)
*
30000801   3301001   0   .04762000   0.0
30000802   3301002   0   .04761900   0.0
30000803   3301003   0   .04761900   0.0
30000804   3301004   0   .04761900   0.0
30000805   3301005   0   .04761900   0.0
30000806   3301006   0   .09523800   0.0
30000807   3301007   0   .09523800   0.0
30000808   3301008   0   .09523800   0.0
30000809   3301009   0   .09523800   0.0
30000810   3301010   0   .09523800   0.0
30000811   3301011   0   .09523800   0.0
30000812   3301012   0   .09523800   0.0
30000813   3301013   0   .09523800   0.0
*
*   Control Blocks
*
20500000   999
20500100   cntrlvar   function  0.04762  0.0    0
20500101   htvat    3301001    002
20500200   cntrlvar   function  0.04761  0.0    0
20500201   htvat    3301002    002
20500300   cntrlvar   function  0.04761  0.0    0
20500301   htvat    3301003    002
20500400   cntrlvar   function  0.04761  0.0    0
20500401   htvat    3301004    002
20500500   cntrlvar   function  0.04761  0.0    0
20500501   htvat    3301005    002
20500600   cntrlvar   function  0.095238 0.0    0
20500601   htvat    3301006    002
20500700   cntrlvar   function  0.095238 0.0    0
20500701   htvat    3301007    002
20500800   cntrlvar   function  0.095238 0.0    0
20500801   htvat    3301008    002
20500900   cntrlvar   function  0.095238 0.0    0
20500901   htvat    3301009    002
20501000   cntrlvar  function  0.095238 0.0    0
20501001   htvat    3301010    002
20501100   cntrlvar  function  0.095238 0.0    0
20501101   htvat    3301011    002
20501200   cntrlvar  function  0.095238 0.0    0
20501201   htvat    3301012    002
20501300   cntrlvar  function  0.095238 0.0    0
20501301   htvat    3301013    002
20501400   cntrlvar  sum       1.0      0.0    0
20501401  -6.63322e-5  1.0  cntrlvar 1 1.0  cntrlvar 2  1.0    cntrlvar 3
20501402         1.0  cntrlvar 4  1.0   cntrlvar 5   1.0    cntrlvar 6
20501403         1.0  cntrlvar 7  1.0   cntrlvar 8   1.0    cntrlvar 9
20501404         1.0  cntrlvar 10 1.0   cntrlvar 11  1.0    cntrlvar 12
20501405         1.0  cntrlvar 13
*
*
20502000   cntrlvar  function   0.02191015  0.0    0
```

```
20502001   "rho"     010010000  005
20502100   cntrlvar  function   0.02191015  0.0    0
20502101   "rho"     020010000  005
20502200   cntrlvar  function   0.02191015  0.0    0
20502201   rho      030010000  005
20502300   cntrlvar  function   0.02191015  0.0    0
20502301   rho      040010000  005
20502400   cntrlvar  function   0.02191015  0.0    0
20502401   rho      050010000  005
20502500   cntrlvar  function   0.0438203   0.0    0
20502501   rho      060010000  005
20502600   cntrlvar  function   0.0438203   0.0    0
20502601   rho      070010000  005
20502700   cntrlvar  function   0.0438203   0.0    0
20502701   rho      080010000  005
20502800   cntrlvar  function   0.0438203   0.0    0
20502801   rho      090010000  005
20502900   cntrlvar  function   0.0438203   0.0    0
20502901   rho      100010000  005
20503000   cntrlvar  function   0.0438203   0.0    0
20503001   rho      110010000  005
20503100   cntrlvar  function   0.0438203   0.0    0
20503101   rho      120010000  005
20503200   cntrlvar  function   0.0438203   0.0    0
20503201   rho      130010000  005
20503300   cntrlvar  function   0.01293183   0.0    0
20503301   rho      140010000  005
20503400   cntrlvar  function   0.01418173   0.0    0
20503401   rho      150010000  005
20503500   cntrlvar  function   0.04977361   0.0    0
20503501   rho      160010000  005
20503600   cntrlvar  function   0.03388387   0.0    0
20503601   rho      170010000  005
20503700   cntrlvar  function   0.05595103   0.0    0
20503701   rho      180010000  005
20503800   cntrlvar  function   0.05443940   0.0    0
20503801   rho      190010000  005
20503900   cntrlvar  function   0.05378898   0.0    0
20503901   rho      200010000  005
20504000   cntrlvar  function   0.04873313   0.0    0
20504001   rho      210010000  005
20504100   cntrlvar  function   0.05378898   0.0    0
20504101   rho      220010000  005
20504200   cntrlvar  function   0.05378898   0.0    0
20504201   rho      230010000  005
20504300   cntrlvar  function   0.03063990   0.0    0
20504301   rho      240010000  005
20504400   cntrlvar  function   0.07798541   0.0    0
20504401   rho      250010000  005
*
20505000   cntrlvar  sum       1.0      0.0   0
20505001   0.0  1.0  cntrlvar 20  1.0  cntrlvar 21  1.0   cntrlvar 22
20505002        1.0  cntrlvar 23  1.0  cntrlvar 24  1.0   cntrlvar 25
20505003        1.0  cntrlvar 26  1.0  cntrlvar 27  1.0   cntrlvar 28
20505004        1.0  cntrlvar 29  1.0  cntrlvar 30  1.0   cntrlvar 31
```

```
*
20505500   cntrlvar  sum       1.0      0.0   0
20505501   0.0  1.0  cntrlvar 32  1.0  cntrlvar 33  1.0   cntrlvar 34
20505502        1.0  cntrlvar 35  1.0  cntrlvar 36  1.0   cntrlvar 37
20505503        1.0  cntrlvar 38  1.0  cntrlvar 39  1.0   cntrlvar 40
20505504        1.0  cntrlvar 41  1.0  cntrlvar 42  1.0   cntrlvar 43
20505505        1.0  cntrlvar 44
*
20505600   cntrlvar  sum       1.0      0.0   0
20505601   0.1185681   1.0   cntrlvar 50  1.0   cntrlvar 55
*
20506000   cntrlvar  function   1.0    0.0   0
20506001   time      0          001
20506500   cntrlvar   sum        1.0    0.0  0
20506501   0.0  1.0  cntrlvar 14  1.0   cntrlvar 56  1.0  cntrlvar  60
*
20507000   cntrlvar  integral   1.0    0.0   0
20507001   rktpow    0
*
20507500   cntrlvar  sum    6.22971e-2    0.0   0
20507501   0.0    1.0  htgamw  312100100  1.0  htgamw  312100200
20507502          1.0  htgamw  312100300  1.0  htgamw  312100400
20507503          1.0  htgamw  312100500  1.0  htgamw  312100600
20507504          1.0  htgamw  312100700  1.0  htgamw  312100700
20507505          1.0  htgamw  312100900
*
*              scale factor = 1/area sum
20508000   cntrlvar  sum   0.26289886    0.0     0
20508001   0.0    0.3516846 voidf  050010000  0.7033692  voidf 100010000
20508002          0.8633786 voidf  200010000  0.7822260  voidf 210010000
*
20508100   cntrlvar  function  1.0    0.0    0
20508101   cntrlvar  80        010
. * end of data
```

ATTACHMENT IV

The directory of files on the electronic media (CD) for this calculation is given in Table IV-1. Files from the HP-9000 workstation directory were copied first to a personal computer (PC), then to the CD. File names and sizes in bytes are listed as given on the originating hardware. The RELAP5/MOD3.2 program uses and creates a number of data files. Many of these files are intermediate in nature and thus are important but may not be directly referenced either as initial input data files or as resource files for tabular and/or graphical display of results from the calculation. File connections (traceability) for a particular dataset are listed in the appropriate spreadsheet giving the PC data files and RELAP5/MOD3.2 files.

Table IV-1. Directory of Files on Compact Disk

| File Name | Date Created | File Size | File Type |
|---|---|---|---|
| c221a.s04 | 07-05-99 12:58p | 3,504,018 | PC-ASCII Data |
| c221b.s02 | 07-03-99 2:23p | 1,839,186 | PC-ASCII Data |
| c221c.s02 | 07-03-99 4:28p | 1,839,186 | PC-ASCII Data |
| c221d.s02 | 07-03-99 4:29p | 1,839,186 | PC-ASCII Data |
| c221e.s02 | 07-05-99 9:53a | 1,839,186 | PC-ASCII Data |
| c221f.s02 | 07-05-99 11:08a | 1,839,186 | PC-ASCII Data |
| c230a.s01 | 06-30-99 9:35a | 616,978 | PC-ASCII Data |
| c230b.s01 | 06-30-99 9:36a | 616,978 | PC-ASCII Data |
| c230c.s01 | 06-30-99 9:36a | 616,978 | PC-ASCII Data |
| c230d.s01 | 06-30-99 4:51p | 616,978 | PC-ASCII Data |
| c230d1.s02 | 07-02-99 8:17a | 616,978 | PC-ASCII Data |
| c230e.s01 | 07-01-99 2:21p | 616,978 | PC-ASCII Data |
| c230f.s01 | 07-02-99 8:54a | 616,978 | PC-ASCII Data |
| c230junx.xls | 07-07-99 2:29p | 6,398,464 | PC-Binary Data |
| c103xmdl.xls | 09-20-99 10:24a | 5,004,288 | PC-Binary Data |
| RLP5GEOM-1.xls | 09-16-99 10:19a | 63,488 | PC-Binary Data |
| strip.for | 06-25-99 10:45a | 7,556 | FORTRAN-90 Source |
| strip.exe | 06-25-99 10:47a | 20,095 | PC-Binary Program |
| c221a.r01 | 07/07/99 2:49 PM | 4926 | HP-ASCII Data |
| c221a.r01.lst | 07/07/99 2:50 PM | 4457263 | HP-ASCII Data |
| c221a.r02 | 07/07/99 2:50 PM | 5039 | HP-ASCII Data |
| c221a.r02.lst | 07/07/99 2:50 PM | 7292526 | HP-ASCII Data |
| c221a.strip | 07/07/99 2:50 PM | 6767 | HP-ASCII Data |
| c230a.r01 | 07/07/99 3:07 PM | 5155 | HP-ASCII Data |
| c230a.r01.lst | 07/07/99 3:07 PM | 593883 | HP-ASCII Data |
| c230a.strp | 07/07/99 3:07 PM | 7186 | HP-ASCII Data |
| c230a.strp.lst | 07/07/99 3:07 PM | 25744 | HP-ASCII Data |
| c230a.strp.set01 | 07/07/99 3:07 PM | 608821 | HP-ASCII Data |
| c230b.r01 | 07/07/99 3:07 PM | 5207 | HP-ASCII Data |
| c230b.r01.lst | 07/07/99 3:07 PM | 594097 | HP-ASCII Data |
| c230b.strp | 07/07/99 3:07 PM | 7185 | HP-ASCII Data |
| c230b.strp.lst | 07/07/99 3:07 PM | 25744 | HP-ASCII Data |
| c230b.strp.set01 | 07/07/99 3:07 PM | 608821 | HP-ASCII Data |
| c230c.r01 | 07/07/99 3:07 PM | 5262 | HP-ASCII Data |
| c230c.r01.lst | 07/07/99 3:07 PM | 594204 | HP-ASCII Data |
| c230c.strp | 07/07/99 3:07 PM | 7185 | HP-ASCII Data |
| c230c.strp.lst | 07/07/99 3:07 PM | 25744 | HP-ASCII Data |
| c230c.strp.set01 | 07/07/99 3:07 PM | 608821 | HP-ASCII Data |

| File Name | Date Created | File Size | File Type |
|---|---|---|---|
| c230d.r01 | 07/07/99 3:07 PM | 5301 | HP-ASCII Data |
| c230d.r01.lst | 07/07/99 3:07 PM | 594311 | HP-ASCII Data |
| c230d.strp | 07/07/99 3:07 PM | 7239 | HP-ASCII Data |
| c230d.strp.lst | 07/07/99 3:07 PM | 25851 | HP-ASCII Data |
| c230d.strp.set01 | 07/07/99 3:07 PM | 608821 | HP-ASCII Data |
| c230d1.strp | 07/07/99 3:07 PM | 7302 | HP-ASCII Data |
| c230d1.strp.lst | 07/07/99 3:07 PM | 25958 | HP-ASCII Data |
| c230d1.strp.set02 | 07/07/99 3:07 PM | 608821 | HP-ASCII Data |
| c230e.r01 | 07/07/99 3:07 PM | 5355 | HP-ASCII Data |
| c230e.r01.lst | 07/07/99 3:07 PM | 594418 | HP-ASCII Data |
| c230e.strp | 07/07/99 3:07 PM | 7293 | HP-ASCII Data |
| c230e.strp.lst | 07/07/99 3:07 PM | 25958 | HP-ASCII Data |
| c230e.strp.set01 | 07/07/99 3:07 PM | 608821 | HP-ASCII Data |
| c230f.r01 | 07/07/99 3:07 PM | 5409 | HP-ASCII Data |
| c230f.r01.lst | 07/07/99 3:07 PM | 594525 | HP-ASCII Data |
| c230f.strp | 07/07/99 3:07 PM | 7354 | HP-ASCII Data |
| c230f.strp.lst | 07/07/99 3:07 PM | 26065 | HP-ASCII Data |
| c230f.strp.set01 | 07/07/99 3:07 PM | 608821 | HP-ASCII Data |
| r5wp2d.c221a | 07/07/99 2:50 PM | 44800 | HP-ASCII Data |
| r5wp2d.c221a.lst | 07/07/99 2:50 PM | 8588538 | HP-ASCII Data |
| r5wp2d.c221a.rst | 07/07/99 14:51 PM | 35238016 | HP-Binary Data |
| r5wp2d.c221a.strip | 07/07/99 2:51 PM | 7389 | HP-ASCII Data |
| r5wp2d.c221a.strip.lst | 07/07/99 2:51 PM | 26172 | HP-ASCII Data |
| r5wp2d.c221a.strip.set04 | 07/07/99 2:51 PM | 3457691 | HP-ASCII Data |
| r5wp2d.c221b | 07/07/99 2:51 PM | 44868 | HP-ASCII Data |
| r5wp2d.c221b.lst | 07/07/99 2:52 PM | 8588645 | HP-ASCII Data |
| r5wp2d.c221b.rst | 07/07/99 14:52 PM | 16572368 | HP-Binary Data |
| r5wp2d.c221b.strip | 07/07/99 2:52 PM | 7417 | HP-ASCII Data |
| r5wp2d.c221b.strip.lst | 07/07/99 2:52 PM | 26279 | HP-ASCII Data |
| r5wp2d.c221b.strip.set02 | 07/07/99 2:52 PM | 1814870 | HP-ASCII Data |
| r5wp2d.c221c | 07/07/99 2:52 PM | 44937 | HP-ASCII Data |
| r5wp2d.c221c.lst | 07/07/99 2:52 PM | 8588752 | HP-ASCII Data |
| r5wp2d.c221c.rst | 07/07/99 14:52 PM | 16572368 | HP-Binary Data |
| r5wp2d.c221c.strip | 07/07/99 2:52 PM | 7445 | HP-ASCII Data |
| r5wp2d.c221c.strip.lst | 07/07/99 2:52 PM | 26386 | HP-ASCII Data |
| r5wp2d.c221c.strip.set02 | 07/07/99 2:52 PM | 1814870 | HP-ASCII Data |
| r5wp2d.c221d | 07/07/99 2:52 PM | 45137 | HP-ASCII Data |
| r5wp2d.c221d.lst | 07/07/99 2:52 PM | 8589073 | HP-ASCII Data |
| r5wp2d.c221d.rst | 07/07/99 14:53 PM | 16572368 | HP-Binary Data |
| r5wp2d.c221d.strip | 07/07/99 2:53 PM | 7473 | HP-ASCII Data |
| r5wp2d.c221d.strip.lst | 07/07/99 2:53 PM | 26493 | HP-ASCII Data |
| r5wp2d.c221d.strip.set02 | 07/07/99 2:53 PM | 1814870 | HP-ASCII Data |
| r5wp2d.c221e | 07/07/99 2:53 PM | 45207 | HP-ASCII Data |
| r5wp2d.c221e.lst | 07/07/99 2:53 PM | 8589180 | HP-ASCII Data |
| r5wp2d.c221e.rst | 07/07/99 14:53 PM | 16572368 | HP-Binary Data |
| r5wp2d.c221e.strip | 07/07/99 2:53 PM | 7501 | HP-ASCII Data |
| r5wp2d.c221e.strip.lst | 07/07/99 2:53 PM | 26600 | HP-ASCII Data |
| r5wp2d.c221e.strip.set01 | 07/07/99 2:53 PM | 1814870 | HP-ASCII Data |
| r5wp2d.c221f | 07/07/99 2:53 PM | 45404 | HP-ASCII Data |
| r5wp2d.c221f.lst | 07/07/99 2:53 PM | 8589501 | HP-ASCII Data |
| r5wp2d.c221f.rst | 07/07/99 14:54 PM | 16572368 | HP-Binary Data |
| r5wp2d.c221f.strip | 07/07/99 2:54 PM | 7529 | HP-ASCII Data |
| r5wp2d.c221f.strip.lst | 07/07/99 2:54 PM | 26707 | HP-ASCII Data |

| File Name | Date Created | File Size | File Type |
|---|---|---|---|
| r5wp2d.c221f.strip.set02 | 07/07/99 2:54 PM | 1814870 | HP-ASCII Data |
| r5wp2d.c230a | 07/07/99 3:07 PM | 44428 | HP-ASCII Data |
| r5wp2d.c230a.lst | 07/07/99 3:07 PM | 7564836 | HP-ASCII Data |
| r5wp2d.c230a.rst | 07/07/99 15:07 PM | 21439144 | HP-Binary Data |
| r5wp2d.c230b | 07/07/99 3:07 PM | 44620 | HP-ASCII Data |
| r5wp2d.c230b.lst | 07/07/99 3:08 PM | 7565157 | HP-ASCII Data |
| r5wp2d.c230b.rst | 07/07/99 15:08 PM | 21439144 | HP-Binary Data |
| r5wp2d.c230c | 07/07/99 3:08 PM | 44806 | HP-ASCII Data |
| r5wp2d.c230c.lst | 07/07/99 3:08 PM | 7565478 | HP-ASCII Data |
| r5wp2d.c230c.rst | 07/07/99 15:08 PM | 21439144 | HP-Binary Data |
| r5wp2d.c230d | 07/07/99 3:08 PM | 45000 | HP-ASCII Data |
| r5wp2d.c230d.lst | 07/07/99 3:09 PM | 7565799 | HP-ASCII Data |
| r5wp2d.c230d.rst | 07/07/99 15:09 PM | 21439144 | HP-Binary Data |
| r5wp2d.c230d1 | 07/07/99 3:09 PM | 45117 | HP-ASCII Data |
| r5wp2d.c230d1.lst | 07/07/99 3:09 PM | 8177637 | HP-ASCII Data |
| r5wp2d.c230d1.rst | 07/07/99 15:10 PM | 10567976 | HP-Binary Data |
| r5wp2d.c230e | 07/07/99 3:10 PM | 45204 | HP-ASCII Data |
| r5wp2d.c230e.lst | 07/07/99 3:10 PM | 7566120 | HP-ASCII Data |
| r5wp2d.c230e.rst | 07/07/99 15:10 PM | 21439144 | HP-Binary Data |
| r5wp2d.c230f | 07/07/99 3:10 PM | 45409 | HP-ASCII Data |
| r5wp2d.c230f.lst | 07/07/99 3:11 PM | 7566441 | HP-ASCII Data |
| r5wp2d.c230f.rst | 07/07/99 15:11 PM | 21439144 | HP-Binary Data |
| runxrlp5 | 07/07/99 3:36 PM | 2829 | HP-ASCII Data |
| runxstrp | 07/07/99 3:37 PM | 524 | HP-ASCII Data |
| c103cbas.dk | 07/27/99 10:59 AM | 45,042 | HP-ASCII Data |
| c103x1hbv.test.lst | 09/20/99 4:11 PM | 6,429,401 | HP-ASCII Data |
| c10cx1hbv.test | 09/20/99 4:10 PM | 49,137 | HP-ASCII Data |