2-

**MELT-I, A SIMPLIFIED MELTDOWN CODE
FOR FAST REACTOR SAFETY ANALYSIS**

DECEMBER 1968

**AEC RESEARCH &
DEVELOPMENT REPORT**

NAME	PROJECT	SECTION	EXPIRATION DATE
AK Bestina	30679	2217	
DL Stange	33627	26d	MAR 15 1969 APR 2 1969
RD Johnson	33520	209E	APR 24 1969 MAY 2 1969
Alan J. W.	65008	703	
Ed Whitcomb	35401	703	

LEGAL NOTICE

This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:

A. Makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or

B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission, or employee of such contractor, to the extent that such employee or contractor of the Commission, or employee of such contractor prepares, disseminates, or provides access to, any information pursuant to his employment or contract with the Commission, or his employment with such contractor.

PACIFIC NORTHWEST LABORATORY

RICHLAND, WASHINGTON

operated by

BATTELLE MEMORIAL INSTITUTE

for the

UNITED STATES ATOMIC ENERGY COMMISSION UNDER CONTRACT AT(45-1)-1830

3 3679 00061 2129

BNWL-944
UC-80, Reactor
Technology

MELT-I, A SIMPLIFIED MELTDOWN CODE
FOR FAST REACTOR SAFETY ANALYSIS

By

Alan E. Waltar

Reactor Physics and Operation Department
FFTF Project

FIRST UNRESTRICTED
DISTRIBUTION MADE

JAN 23 '69

December 1968

BATTELLE MEMORIAL INSTITUTE
PACIFIC NORTHWEST LABORATORY
RICHLAND, WASHINGTON 99352

Printed in the United States of America
Available from
Clearinghouse for Federal Scientific and Technical Information
National Bureau of Standards, U.S. Department of Commerce
Springfield, Virginia 22151
Price: Printed Copy \$3.00; Microfiche \$0.65

MELT-I, A SIMPLIFIED CORE MELTDOWN CODE
FOR FAST REACTOR SAFETY ANALYSIS

Alan E. Waltar

ABSTRACT

MELT-I is a coupled neutronics - heat transfer code for use in estimating gross core behavior during major fast reactor excursions. The unique feature of the code is the treatment of positive reactivity feedbacks due to fuel collapse and sodium voiding. Although the feedback models and the method of obtaining core temperatures are quite simplified, the ability of the code to couple the feedback terms to the driving function in the point kinetics equations allows one to make reasonable estimates of core conditions just prior to the start of core disassembly.

The core model consists of a maximum of 10 radial channels, 40 axial segments, and 8 radial fuel nodes plus a clad and a coolant node for each pin. Running time, although highly problem dependent, is roughly three minutes for a representative case on a UNIVAC 1108. All programming is in FORTRAN-IV.

TABLE OF CONTENTS

ABSTRACT	iii
I. INTRODUCTION	1
II. CORE MODEL	2
III. NEUTRONICS MODEL	4
IV. HEAT TRANSFER MODEL	7
V. REACTIVITY FEEDBACK MODELS	11
Temperature Feedback (Linear Expansion and Doppler)	12
Fuel Collapse	14
Sodium Voiding	15
REFERENCES	17
APPENDIX A: PROGRAM FLOW DIAGRAM	A-1
APPENDIX B: TIME STEP LOGIC	B-1
APPENDIX C: PRINTOUT LOGIC	C-1
APPENDIX D: INPUT INSTRUCTIONS	D-1
APPENDIX E: SAMPLE PROBLEM	E-1
APPENDIX F: LISTING OF CODE	F-1

MELT-I, A SIMPLIFIED CORE MELTDOWN CODE
FOR FAST REACTOR SAFETY ANALYSIS

Alan E. Waltar

I. INTRODUCTION

The behavior of a fast reactor core during a transient so severe that gross fuel melting occurs is not well understood. Several very detailed coupled neutronics-heat transfer codes have been written to follow reactor transients up to some failure point, but no geometric changes in the core are allowed in the calculational models. Conversely, there exist numerous core disassembly codes which normally proceed from initial conditions which consist of a homogeneous mixture of molten fuel with other core materials. Quite simplified geometry is then used in analyzing the manner in which core disassembly occurs.

Very few models have been constructed for the midrange of a major accident. A reasonable description of the core behavior during this time (just prior to the point where core disassembly begins) is crucial because of the pronounced influence on the total energy release exercised by the initial condition of a disassembly calculation. Although a prompt negative Doppler feedback (in the case of an oxide or a carbide core) or a fuel expansion (e.g., metal core) serve to limit the consequences of the postulated initiating mechanism, it is possible that fuel compaction and/or sodium voiding could significantly aggravate the accident prior to core disassembly.

MELT-I represents a first generation attempt to follow severe power transients all the way from inception up to the time the core is nearing a disassembly condition, i.e., the point where fuel temperatures become high enough that a disassembly driving force begins to manifest itself. Although the temperature calculations are accomplished in a very simplified manner (using a projection scheme which requires the assumption of constant thermal conductivity), the capability of the code to couple the reactivity feedback from fuel collapse and/or sodium voiding to the kinetics equations which govern the transient is believed to be significant. This coupling, i.e., the influence of early melting patterns on subsequent melting and voiding, is an aspect almost impossible to estimate from static calculations alone.

Running time of the MELT-I code, as would be expected, is highly problem dependent. The code uses a variable time step which can be limited either by the core geometry or the power increase, although in nearly all cases the check in power increase is the governing factor. For a case using 10 radial channels, 18 axial segments, 7 radial fuel segments, and using both fuel collapse and sodium voiding feedback routines, running time on a UNIVAC 1108 is roughly 3 minutes.

II. CORE MODEL

The core geometry assumed by the MELT-I code is illustrated in Figure 2.1. As indicated, the model allows the core to be divided into a maximum of 10 radial channels (rings) and 40 axial segments. Within each channel, temperatures and power density are calculated for one fuel pin which is considered to be characteristic of all fuel pins within the channel. The

FIGURE 2.1. Core Geometry Used in the Meltdown Model

fuel region within the pin may be divided into a maximum of eight radial nodes, and the cladding and coolant are each assigned a single node. After melting occurs, fuel segment temperatures remain fixed at the melting point until sufficient energy has been generated to provide the latent heat of fusion.

III. NEUTRONICS MODEL

The core power is assumed to be space-time separable in which the time dependence is characterised by the lumped parameter kinetics equations;

$$\frac{dP}{dt} = \frac{\rho - \beta}{\Lambda} P + \sum_I^G \lambda^i C^i \quad , \quad (3.1)$$

and

$$\frac{dC^i}{dt} = \frac{\beta^i P}{\Lambda} - \lambda^i C^i \quad , \quad (3.2)$$

where:

ρ = Reactivity

P = Power density (W/cm^3)

C^i = Precursor density for group i (W/cm^3)

λ^i = Decay constant for group i (sec^{-1})

β^i = Delayed neutron fraction for group i

β = Total delayed neutron fraction

Λ = Neutron generation time (sec)

G = Number of precursor groups.

The method of solution utilizes a variable time step march-out algorithm

developed by Little^(1, 2). Basically, the method is built around the exponential nature of the neutron and precursor densities. In determining a new time step, two approximations to the power density are calculated and compared to see whether a specified error criterion is satisfied.

Explicitly, the method proceeds as follows. First, one defines approximations to the instantaneous period at time mesh j for the power density and precursor densities, i.e.,

$$\omega_j = \frac{\rho_j - \beta}{\Lambda} + \frac{1}{P_j} \sum_{i=1}^G \lambda^i C_j^i \quad (3.3)$$

$$\gamma_j^i = \frac{\beta^i P_j}{\Lambda C_j^i} - \lambda_i \quad (3.4)$$

Now if $-\omega P(t)$ and $-\gamma_j^i C^i(t)$ are respectively subtracted from both sides of Equations (3.1) and (3.2), integration from t_j to t_{j+1} yields

$$P_{j+1} = e^{\omega_j h} \left[P_j + \int_0^h d\xi \left\{ \frac{\rho(\xi) - \rho_j}{\Lambda} P(\xi) e^{-\omega_j \xi} + \sum_{i=1}^G \lambda_j^i \left(C^i(\xi) - C_j^i \frac{P(\xi)}{P_j} \right) e^{-\omega_j \xi} \right\} \right], \quad (3.5)$$

and

$$C_{j+1}^i = e^{\gamma_j^i h} \left[C_j^i + \int_0^h d\xi e^{-\gamma_j^i \xi} \left\{ \frac{\beta^i}{\Lambda} \left(P(\xi) - \frac{P_j}{C_j^i} C^i(\xi) \right) \right\} \right], \quad (3.6)$$

where:

h = mesh spacing

j = time index.

To evaluate the integrals in Equations (3.5) and (3.6), the first approximations

$$P(\xi) = e^{\omega_j \xi} P_j \quad (3.7)$$

and

$$C^i(\xi) = e^{\gamma_j^i \xi} C_j^i \quad (3.8)$$

are placed in the integrals, and the integration is performed using the trapezoidal rule. This leads to the final (second approximation) march-out algorithm

$$P_{j+1} = e^{\omega_j h} \left[P_j \left(1 + \frac{h}{2\Lambda} \left\{ \rho_{j+1} - \rho_j \right\} \right) + \sum_1^G \lambda^i C_j^i \cdot \left\{ \frac{e^{h(\gamma_j^i - \omega_j)} - 1}{\gamma_j^i - \omega_j} - h \right\} \right] \quad (3.9)$$

$$C_{j+1}^i = e^{\gamma_j^i h} \left[C_j^i + \frac{P_j \beta^i}{\Lambda} \left\{ \frac{e^{h(\omega_j - \gamma_j^i)} - 1}{\omega_j - \gamma_j^i} - h \right\} \right]. \quad (3.10)$$

The variable time step, h , is determined by the requirement that the first approximation for P_{j+1} , Equation (3.7), agree with the second approximation, Equation (3.9), within a prescribed tolerance. That is,

$$\frac{P_{j+1}^{(2)} - P_{j+1}^{(1)}}{P_{j+1}^{(1)}} \leq \epsilon, \quad (3.11)$$

where epsilon is an input parameter.

Note that the convergence criterion does not restrict the fractional power increase which can occur during a time step. The major difference between the two calculations for power arises from the reactivity change during the time step, and for cases in which both the programmed and the feedback reactivity are small, rather large time steps are permitted. MELT-I evaluates P_{j+1} in Equation (3.9) by summing the programmed reactivity with the temperature feedback reactivity (obtained by calculating the core temperature using the first approximation, Equation 3.7, for the power). Collapse and void feedback reactivity are accounted for one time step later.

The spatial power distribution, $PS(r,z)$, is normally computed by the relationship

$$PS(r,z) = P_j N(r,z) \quad (3.12)$$

where

$N(r,z)$ = Input spatial distribution.

After collapse begins, however, the power density of those nodes which move downward in the core is adjusted by interpolation of $N(r,z)$ to allow for a changing neutron flux which a moving fuel mass would physically encounter.

IV. HEAT TRANSFER MODEL

In this first generation macro-core code, a detailed heat transfer balance is calculated only for an average location in the reactor, i.e.,

for the average axial heat generation location within the pin situated at a core radius which corresponds to the radial average heat generation rate. All other temperatures are obtained using a space-time separable projection scheme similar to Equation (3.12), except when the melting point is reached. At this time, the local power densities are used to delay local temperature increases until the heat of fusion has been deposited. Although such a technique can certainly give rise to significant errors in the temperature estimations, especially for fuel which has a sizeable variation in thermal conductivity with temperature, the technique is very rapid and allows one to use the code for parametric purposes. Further, the temperature estimations from MELT-I were compared with those of a more elaborate fixed-geometry code for particular cases and the temperature estimations appear quite adequate for the purposes intended.

A schematic diagram of the heat transfer model for the average core location is shown in Figure 4.1. The equations, identical to those used in K-III⁽¹⁾, are listed as follows. In the fuel and cladding regions, the time dependent temperature is computed using the equation

$$V_i(\rho C_p)_j \frac{\partial T_i}{\partial t} = \gamma_j P V_i + (hA)_{i-1} (T_{i-1} - T_i) - (hA)_i (T_i - T_{i+1}) \quad (4.1)$$

where:

i = Interval index

j = Region index

T_i = Temperature of interval i ($^{\circ}\text{K}$)

V_i = Volume of interval i (cm^3)

$(\rho C_p)_j$ = Heat capacity in region j ($\text{joules/cm}^3 - ^{\circ}\text{K}$)

FIGURE 4.1. Schematic Diagram of Fuel Pin Heat Transfer Model

$\gamma_j P$ = Power density in region j (W/cm^3)

$(hA)_i$ = Heat transfer coefficient x area for interval i ($W/^\circ K$)

t = Time (sec).

The energy balance equation for the coolant, or third region, is more complex. Let K denote the interval number for Region 3. An energy balance yields the equation

$$V_K(\rho C_p)_3 \frac{\partial T_K}{\partial t} = \gamma_3 P V_K + (hA)_{K-1} (T_{K-1} - T_K) - \omega C_{p3} (T_{out} - T_{in}), \quad (4.2)$$

where:

ωC_p = Flow rate x C_p ($W/^\circ K$)

T_{in} = Inlet coolant temperature ($^\circ K$)

T_{out} = Outlet coolant temperature ($^\circ K$)

If we now assume that

$$T_K = \frac{1}{2}(T_{out} + T_{in}), \quad (4.3)$$

Equation (4.2) can be rewritten in the form

$$V_K(\rho C_p)_3 \frac{\partial T_K}{\partial t} = \gamma_3 P V_K + (hA)_{K-1} (T_{K-1} - T_K) - (hA)_K (T_K - T_{in}), \quad (4.4)$$

where $(hA)_K$ is defined as

$$(hA)_K = 2\omega C_p. \quad (4.5)$$

The code computes the time variation in T_K using Equation (4.5); $(hA)_K$ and T_{in} are input parameters. The quantity $V_K(\rho C_p)_3 / (hA)_K$ can be considered simply as the time constant for Region 3.

Perhaps a few words on the constants used in Equations (4.1) and (4.2) are in order. In the interior of each region, the heat transfer coefficient from interval to interval is assumed to be the conductivity divided by the mesh width, whereas in going from region to region, the heat transfer coefficients are input parameters. Observe that the thermal properties, such as conductivity and heat capacity, are assumed to be independent of temperature.

In the temperature projection scheme, temperatures of nodes which move during fuel collapse are calculated as though they still occupied their original core position. The change in power density during collapse, as briefly discussed in Section III, allows for faster or slower melting times, but for the rapid transients usually considered in MELT-I the temperature response considerably lags the power changes.

V. REACTIVITY FEEDBACK MODELS

Input reactivity can be programmed according to a step, ramp, or parabola between any specified number of time steps. The total reactivity is then obtained by combining the input drive terms with the feedback terms, i.e.,

$$\rho(t) = a + bt + ct^2 + \sum_i \rho_i(t) \quad (5.1)$$

where a , b , and c are input parameters. The feedback terms include linear and Doppler contributions (due to temperature increase), and collapse and

void (due to fuel compaction and sodium voiding). The models used for the various feedback terms will be treated separately.

5.1 Temperature Feedback (Linear and Doppler)

Prior to any fuel melting, an average fuel temperature for use in the linear and Doppler feedback terms is calculated at the end of each time step using the equation

$$\bar{T}^1(t) = \frac{\sum_{i=1}^{I1} T_i(t) V_i}{\sum_{i=1}^{I1} V_i} \quad (5.2)$$

where

$\bar{T}^1(t)$ = Average temperature in Region 1 ($^{\circ}\text{K}$) ,

$I1$ = Number of fuel nodes in pin,

V_i = Volume of fuel node i .

Since only one node each is assigned to cladding and coolant, the cladding and coolant temperatures are used directly for temperature feedback effects in Regions 2 and 3.

The temperature feedback reactivity associated with each of the three regions is then computed from the equation

$$\frac{d\rho_j(t)}{dt} = \frac{1}{(RTC)_j} \left[R_1^j (\bar{T}^j - \bar{T}_o^j) + R_2^j \ln \left(\frac{\bar{T}^j}{\bar{T}_o^j} \right) - \rho_j(t) \right] \quad (5.3)$$

if $RTC_j > 0$, or

$$\rho_j(t) = R_1^j (\bar{T}^j - \bar{T}_o^j) + R_2^j \ln \left(\frac{\bar{T}^j}{\bar{T}_o^j} \right) \quad (5.4)$$

if $(RTC)_j = 0$. In the above equations,

$\rho_j(t)$ = Temperature feedback reactivity of region j

RTC_j = Time delay (relaxation time) associated with ρ_j (sec)

R_1^j = Linear temperature coefficient region j ($^{\circ}K^{-1}$)

R_2^j = Doppler coefficient ($T dk/dT$) in region j

T_0^j = Initial temperature in region j.

After fuel melting begins, the average fuel (Region 1) temperature is calculated by volume weighting fuel segment temperatures throughout the core, i.e.,

$$\bar{T}_{core}^1(t) = \frac{\sum_{L=1}^{LUPPER} \sum_{M=1}^{MUPPER} \sum_{N=1}^{I1} T(N,M,L,t) V(N,M,L)}{\sum_{L=1}^{LUPPER} \sum_{M=1}^{MUPPER} \sum_{N=1}^{I1} V(N,M,L)} \quad (5.5)$$

where

$I1$ = Number of fuel nodes in pin,

$MUPPER$ = Number of axial nodes in core,

$LUPPER$ = Number of radial channels in core.

Thus, $\bar{T}_{core}^1(t)$ will always be lower in magnitude than $\bar{T}^1(t)$ due to the local isotherm which occurs while fuel is undergoing melting. A check is made on the temperature projection scheme normalization during the steady state calculation to insure that

$$\frac{\bar{T}_{core}^1(o) - \bar{T}^1(o)}{\bar{T}^1(o)} \leq \text{specified criteria.} \quad (5.6)$$

5.2 Fuel Collapse

The basic assumption employed in the fuel collapse model is that no significant fuel relocation can occur until cladding failure occurs. Cladding failure is assumed by the code whenever any one of the following four mechanisms occur:

1. The cladding reaches its normal melting point;
2. Fuel in the outer node adjacent to the cladding melts (and, hence, comes into direct contact with the cladding);
3. The centerline fuel pin temperature becomes hot enough to characterize a high enough pressure inside the cladding to cause cladding rupture; and
4. The coolant on the outer side of the cladding reaches its vaporization point.

Once the cladding has failed, all fuel above that point is allowed to slump according to the following equation of motion:

$$\frac{d^2H}{dt^2} + \xi \frac{dH}{dt} = -G \quad (5.7)$$

where ξ represents a viscous factor and G is the driving function (normally the gravitation constant, although any value can be used). Below the failure point, however, local cladding failure must occur before the fuel is allowed to slump. Whenever fuel motion takes place, the reactivity feedback resulting from collapse is determined by the total displacement down a fuel worth curve, i.e.,

$$\rho_j(\text{collapse}) = \sum_{L=1}^{\text{LUPPER}} \sum_{M=1}^{\text{MUPPER}} \left[w_j^{M,L} - w_o^{M,L} \right] S^{M,L} \quad (5.8)$$

where

$$\begin{aligned} W_j^{M,L} &= \text{fuel worth at time } t_j \text{ and position } R_j^{M,L} \left(\frac{\delta k}{\text{kg}} \right) \\ R_j^{M,L} &= \text{spatial position of node } M,L \text{ at time } t_j \text{ (cm)} \\ S^{M,L} &= \text{fuel mass of node } M,L \text{ (kg)} . \end{aligned}$$

Since the input fuel worth curve is not allowed to change its spatial shape as a function of time, only a limited amount of collapse can be tolerated before the assumed perturbation model becomes invalid. Early use of the code has indicated, however, that fuel temperatures characteristic of an explosive core are generated before a sizeable amount of fuel movement has occurred.

5.3 Sodium Voiding

A simple piston model is used to estimate the reactivity feedback due to sodium voiding. Once boiling begins at a particular point of a core channel, the vapor-liquid interface is assumed to propagate in both axial directions from that point according to a predetermined equation of motion, i.e.,

$$X_{\text{up}} = X_0 + A_1 + A_2 (t-t_{A2}) + A_3 (t-t_{A3})^2 + A_4 (t-t_{A4})^3 \quad (5.9)$$

$$X_{\text{down}} = X_0 - B_1 - B_2 (t-t_{B2}) - B_3 (t-t_{B3})^2 - B_4 (t-t_{B4})^3$$

where X_0 is the axial location of initial voiding. The constants are input parameters selected to approximate the type of voiding scheme postulated.

Reactivity feedback caused by such voiding is then computed in a manner identical to Equation (5.8) except that all worths, positions, etc., are

for sodium (sodium void worth) and the $W_O^{M,L}$ term does not appear (since local flashing is assumed to result in complete removal of that sodium from the core).

The location of initial voiding (X_O) in each channel can be determined by the local coolant temperature or by local failure of the cladding.

REFERENCES

1. W. W. Little, Jr., K-III- A Three Region Kinetics Code in FORTRAN-IV, BNWL-252 (June, 1966).
2. K. F. Hansen, B. V. Koen, and W. W. Little, Jr., "Stable Numerical Solutions to the Reactor Kinetics Equations," Nucl. Sci. and Eng., Vol. 22, pp. 51-59, (May, 1965).

APPENDIX A

FLOW DIAGRAM

APPENDIX A

FLOW DIAGRAM

Figure A.1 shows the calling sequence of all subroutines. A brief description of the function of each subroutine is given below.

MAIN	Overall control routine
INPUT	Reads program control and neutronics variables
INPUT2	Reads and prints heat transfer and reactivity coefficients
ADDINP	Computes initial constants
CIT	Computes initial temperature distribution for average core location
TEMDIS	Prints geometry specifications and temperature distribution for average core location
SETUP	Determines constants used in heat transfer calculations
CONST	Reads and prints current reactivity status
SUBRHO	Calculates new average core location temperatures and overall reactivity
SUBNEU	Computes the new power using the old and new reactivity
PRECUR	Computes precursor densities and sets indicies
MELTIN	Reads and prints core constants needed for collapse and voiding feedback, and calculates and prints initial core power and temperature distributions
CALC	Determines the time step, controls the calculational calling sequence, and manipulates the printout options
MELTQ	Checks to see if melting or coolant vaporization has begun
CORTEM	Computes core temperatures and local power densities during the transient
COLLAP	Calculates new fuel segment positions and the reactivity feedback resulting from collapse
VOIDQ	Checks to see if voiding has begun

VOID	Computes a sodium voiding pattern according to a simple piston model and then evaluates the reactivity consequences due to such voiding
NATEM	Computes the coolant temperatures for use in subroutine void
NAMOD	Modifies the read in values for sodium worth
ENERGY	Keeps a running tab on the average energy (w/cc of fuel) generated from time zero
PCMELT	Keeps a running account of the energy contained in the molten fuel, computes a volume weighted fuel temperature associated with the molten fuel
TEMAP	Prints out the average core temperature, power, reactivity values and ramp rates at a time when the core is nearing a disassembly condition
PRINTF	Yields a full print. Variables printed include the current axial positions of the fuel segments, the fuel temperatures in all nodes, the cladding and coolant temperatures, the power density in all segments, and the core volume weighted temperature versus the temperature calculated for the average core location
PRINTK	Computes and prints the updated reactivity values for the end of the current time step
PRINTM	Prints out the average molten fuel temperature, per cent of fuel actually molten, and per cent of fuel partially molten (nodes in or above fusion)
PRINTP	Yields a partial print. Variables printed include the fuel centerline and outer node temperatures
PRINTV	Prints the sodium voiding distribution

FIGURE A.1. Program Flow Diagram

APPENDIX B

TIME STEP LOGIC

FIGURE B.1. Time Step Logic Used in Melt-I

BNWL-944

APPENDIX C

PRINTOUT LOGIC

APPENDIX C

PRINTOUT LOGIC

In order to reduce running time, only the temperatures in the average core location are computed prior to the start of fuel melting, unless a printout is desired. This, combined with the fuel collapse and sodium voiding interactions which can occur, result in some fairly involved logic in the CALC subroutine. Hence, in order to understand that portion of the code, Figure C.1 has been drawn to illustrate the logic used.

FIGURE C.1. Printout Logic Used in Subroutine CALC

BNWL-944

APPENDIX D

INPUT INSTRUCTIONS

APPENDIX D

INPUT INSTRUCTIONS

<u>Variable</u>	<u>Columns</u>	<u>Format</u>	<u>Description</u>
<u>CARD 1</u> (To run a series of cases, repeat from this card)			
HOL(I)	2-72	12A6	Identification card.
<u>CARD 2</u>			
M	1-6	I6	Number of precursor groups ($1 < M < 6$).
NMAX	7-12	I6	Maximum number of time steps ($< 99,999$).
NPRT	13-18	I6	Number of time steps between short prints: e.g., NPRT = 1, print every step, NPRT = 2, print every second step.
NSTART	19-24	I6	Precursor option: = 0, code computes initial precursor densities, = 1, precursor densities read into code -- see Card 5'.
NTEQ	25-30	I6	Temperature option: = 0, code computes initial pin temperature distribution, = 1, pin temperature distribution read into code -- see Card 11'.
NCYC	31-36	I6	Number of time zones ($NCYC \geq 1$).
IG	37-42	I6	Geometry (use 1 only, i.e. cylindrical).
I1	43-48	I6	Number of fuel regions (8 maximum).
I2	49-54	I6	Number of clad regions (use 1 only).
IDOP	55-60	I6	Doppler control: = 0, use fuel temperatures from entire core, = 1, use average pin only.

<u>Variable</u>	<u>Columns</u>	<u>Format</u>	<u>Description</u>
<u>CARD 3</u>			
B(1)	1-12	E12	Delay fraction for first precursor group.
B(2)	13-24	E12	Delay fraction for second precursor group.
:			
<u>CARD 4</u>			
AL(1)	1-12	E12	Decay constant for first precursor group.
AL(2)	13-24	E12	Decay constant for second precursor group.
:			
<u>CARD 5</u>			
AN(1)	1-12	E12	Initial power density (W/cm^3).
R1	13-24	E12	Initial reactivity (absolute units).
ALIFE	25-36	E12	Neutron generation time (sec).
HMAX	37-48	E12	Maximum allowable time step (sec). If HMAX = 0.0, code computes HMAX.
ERROR	49-60	E12	Convergence criterion on march-out algorithm (~ 0.001).
<u>CARD 5'</u> (If NSTART = 1)			
C(1)	1-12	E12	Initial concentration of first precursor group (W/cm^3).
C(2)	13-24	E12	Initial concentration of second precursor group (W/cm^3).
:			
<u>CARD 6</u>			
RC(1,1)	1-12	E12	Linear temperature coefficient (dk/dT) for fuel region ($^{\circ}\text{K}^{-1}$).

<u>Variable</u>	<u>Columns</u>	<u>Format</u>	<u>Description</u>
RC(1,2)	13-24	E12	Doppler coefficient (Tdk/dT) for fuel region.
RTC(1)	25-36	E12	Time delay associated with reactivity feedback in fuel region (sec).
PGAM(1)	37-48	E12	Fraction of total power deposited in fuel region (i.e. power density = $AN \times PGAM$).

CARD 7

Same as Card 6 for cladding.

CARD 8

Same as Card 6 for coolant.

CARD 9

RCP(1)	1-12	E12	Heat capacity ($\rho_J C_p$) for fuel region ($J/cm^3-^{\circ}K$).
COND(1)	13-24	E12	Conductivity for fuel ($J/cm-sec-^{\circ}K$).
HAI(1)	25-36	E12	Heat transfer coefficient (h) across outside boundary of fuel ($J/cm^2-sec-^{\circ}K$).
RAD(1)	37-48	E12	Radius of fuel region (cm).

CARD 10

Same as Card 9 for cladding.

CARD 11

RCP(3)	1-12	E12	Heat capacity for coolant ($J/cm^3-^{\circ}K$).
HA(3)	13-24	E12	Coefficient for heat removed in coolant. See Equation 4.5.
TZERO	25-36	E12	Inlet coolant temperature ($^{\circ}K$).
VOL(3)	37-48	E12	Volume of coolant region (cm^3).

<u>Variable</u>	<u>Columns</u>	<u>Format</u>	<u>Description</u>
CARD 11' (If NTEQ = '1)			
TP(1)	1-12	E12	Initial temperature of radial interval 1 of average fuel pin, °K (average axial location).
TP(2)	13-24	E12	Initial temperature of radial interval 2 of average fuel pin, °K (average axial location).
:			
:			
<u>CARD 12</u>			
NUPPER	1-6	I6	Number of pin radial nodes (includes clad and coolant).
MUPPER	7-12	I6	Number of core axial nodes.
LUPPER	13-18	I6	Number of core radial channels.
NPDA	19-24	I6	Axial power profile: = 0, cosine, = 1, input.
NPDR	25-30	I6	Radial power profile: = -1, flat = 0, parabolic, = 1, input.
MF	31-36	I6	Axial fuel node checked for beginning of fuel collapse.
MC	37-42	I6	Axial sodium node checked for beginning of fuel collapse.
MPRT	43-48	I6	Number of short prints per long print.
ITYPE	49-54	I6	Type of long print: = 0, partial, = 1, full.
NCOL	55-60	I6	Limit for total axial segments of collapse.

<u>Variable</u>	<u>Columns</u>	<u>Format</u>	<u>Description</u>
IDEN	61-66	I6	Fuel Density per channel flag: = 0, constant, = 1, variable.
IWRITE	67-72	I6	Print control in long print: = 0, complete, = 1, partial.
<u>CARD 13</u>			
LVOID	1-6	I6	Channel number of hottest sodium.
IVOID	7-12	I6	Sodium voiding trip: = 0, normal, i.e. search all points, = 1, preselected.
MUX	13-18	I6	Axial node for start of void.
NVOD	19-24	I6	Sodium voiding switch: = 0, no voiding, = 1, voiding allowed.
NCPS	25-30	I6	Fuel collapse switch: = 0, no collapse, = 1, collapse allowed.
INA	31-36	I6	Switch to call subroutine NAMOD = 0, no, = 1, yes.
IVODCO	37-42	I6	Trip for voiding to start at time and point of collapse: = 0, no, = 1, yes.
NMPRT	43-48	I6	Number of short prints per molten fuel temperature print.

<u>Variable</u>	<u>Columns</u>	<u>Format</u>	<u>Description</u>
<u>CARD 14</u>			
DL(1)	1-6	E6	Radial distance from core center of channel 1 (cm).
DL(2)	7-12	E6	Radial distance from core center of channel 2 (cm).
.			
.			
.			
<u>CARD 15</u>			
AHIGH	1-6	E6	Core height (cm).
RADIUS	7-12	E6	Core radius (cm).
PEAKR	13-18	E6	Peak to average radial power.
PEAKA	19-24	E6	Peak to average axial power.
EXTRAP	25-30	E6	Axial half length including extrapolation distance (cm).
EPSDOP	31-36	E6	Allowed fractional temperature difference between TEMP and TEMA.
DENSEF	37-42	E6	Fuel density (g/cm^3).
DENSEE	43-48	E6	Cladding density (g/cm^3).
DENSEC	49-54	E6	Coolant density (g/cm^3).
FRACF	55-60	E6	Fissile fuel density (Kg fissile fuel/ cm^3 of core material).
CHI	61-66	E6	Viscosity term in collapse routine (SEC^{-1}).
GRAV	67-72	E6	Forcing function in collapse routine (cm/sec^2).
<u>CARD 16</u>			
TIMEC	1-6	E6	Printout interval after start of collapse (sec).
TCOLM	7-12	E6	Running time allowed after start of collapse (sec).

<u>Variable</u>	<u>Columns</u>	<u>Format</u>	<u>Description</u>
NADEN	13-18	E6	Sodium density used in voiding routine (kg/cm^3).
TIMEV	19-24	E6	Printout interval after start of voiding (sec).
TEMAW	25-30	E6	Value of core average fuel temperature for calling subroutine TEMAP ($^{\circ}\text{K}$).
TEMAD	31-36	E6	Running time allowed after calling subroutine TEMAP (sec).
FNAMOD	37-42	E6	Factor used to modify sodium worth input values.
FUELV	43-48	E6	Total core volume of fuel (cm^3).
<u>CARD 17</u>			
TFUSEF	1-12	E12	Melting temperature of fuel ($^{\circ}\text{K}$).
TFUSEE	13-24	E12	Melting temperature of clad ($^{\circ}\text{K}$).
TFUSEC	25-36	E12	Melting temperature of coolant ($^{\circ}\text{K}$).
TBOILC	37-48	E12	Boiling temperature of coolant ($^{\circ}\text{K}$).
FUSEF	49-60	E12	Latent heat of fusion of fuel (J/g).
FUSEE	61-72	E12	Latent heat of fusion of cladding (J/g).
<u>CARD 18</u>			
FUSEC	1-12	E12	Latent heat of fusion of coolant (J/g).
VAPC	13-24	E12	Latent heat of vaporization of coolant (J/g).
<u>CARD 19</u>			
TRIPF	1-12	E12	Centerline fuel temperature which causes cladding failure ($^{\circ}\text{K}$).
TRIPFO	13-24	E12	Outer fuel node temperature which causes cladding failure ($^{\circ}\text{K}$).

<u>Variable</u>	<u>Columns</u>	<u>Format</u>	<u>Description</u>
TRIPC	25-36	E12	Coolant temperature which causes cladding failure ($^{\circ}\text{K}$).
TRIFE	37-48	E12	Cladding temperature which causes cladding failure ($^{\circ}\text{K}$).
<u>CARD 19</u> (IF IDEN = 1)			
VARDEN(1)	1-12	E12	Fissile fuel density in channel 1 (kg/cm^3).
VARDEN(2)	13-24	E12	Fissile fuel density in channel 2 (kg/cm^3).
.			
.			
.			
<u>CARD 20</u>			
TRIPX(1)	1-12	E12	Sodium void trip temperature in axial node MUX of channel 1.
TRIPX(2)	13-24	E12	Sodium void trip temperature in axial node MUX of channel 2.
.			
.			
.			
<u>CARD 21</u>			
A1	1-12	E12	Constant term in upward sodium void equation of motion.
A2	13-24	E12	Linear term in upward sodium void equation of motion.
A3	25-36	E12	Quadratic term in upward sodium void equation of motion.
A4	37-48	E12	Cubic term in upward sodium void equation of motion.

<u>Variable</u>	<u>Columns</u>	<u>Format</u>	<u>Description</u>
TA2	49-60	E12	Delay for linear term in upward sodium void equation of motion (sec).
TA3	61-72	E12	Delay for quadratic term in upward sodium void equation of motion (sec).
<u>CARD 22</u>			
TA4	1-12	E12	Delay term for cubic term in upward sodium void equation of motion (sec).
<u>CARD 23</u>			
B1	1-12	E12	Constant term in downward sodium void equation of motion.
B2	13-24	E12	Linear term in downward sodium void equation of motion.
B3	25-36	E12	Quadratic term in downward sodium void equation of motion.
B4	37-48	E12	Cubic term in downward sodium void equation of motion.
TB2	49-60	E12	Delay for linear term in downward sodium void equation of motion (sec).
TB3	61-72	E12	Delay for quadratic term in downward sodium void equation of motion (sec).
<u>CARD 24</u>			
TB4	1-12	E12	Delay for cubic term in downward sodium void equation of motion (sec).
<u>CARD 24'</u> (If NPDR=1)			
AINR(1)	1-12	E12	Relative temperature in channel 1.
AINR(2)	13-24	E12	Relative temperature in channel 2.

<u>Variable</u>	<u>Columns</u>	<u>Format</u>	<u>Description</u>
CARD 24" (If NPDR=1)			
PIN(1)	1-12	E12	Relative power in channel 1.
PIN(2)	13-24	E12	Relative power in channel 2.
.			
.			
.			
CARD 24''' (If NPDA=1)			
PPP(1)	1-12	E12	Relative power in axial node 2.
PPP(2)	13-24	E12	Relative power in axial node 2.
.			
.			
.			
CARD 24"" (If NPDA=1)			
TTT(1)	1-12	E12	Relative temperature in axial node 1.
TTT(2)	13-24	E12	Relative temperature in axial node 2.
.			
.			
.			
CARD 25			
WF(1,1)	1-12	E12	Fuel worth in axial node 1 of channel 1 ($\delta k/Kg$ fissile fuel).
WF(2,1)	13-24	E12	Fuel worth in axial node 2 of channel 1 ($\delta k/Kg$ fissile fuel).
.			
.			
.			

<u>Variable</u>	<u>Columns</u>	<u>Format</u>	<u>Description</u>
<u>CARD 26</u>			
WC(1,1)	1-12	E12	Sodium void worth in axial node 1 of channel 1 ($\delta k/Kg$).
WC(2,1)	13-24	E12	Sodium void worth in axial node 2 of channel 1 ($\delta k/Kg$).
<u>CARD 27</u>			
TMAX	1-12	E12	Terminal time of first time zone (sec).
R2	13-24	E12	Reactivity ramp in first time zone ($\delta k/sec$).
R3	25-36	E12	Quadratic coefficient for reactivity in first time zone ($\delta k/sec^2$).

CARD 27'

Same as Card 27 for second time zone.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80																				
<div style="text-align: center;">HOL (1) IDENTIFICATION CARD</div>																																																																																																			
<div style="text-align: center;"><u>M</u> NUMBER OF PRECURSOR GROUPS 1 ≤ M ≤ 6</div>										<div style="text-align: center;"><u>NMAX</u> MAXIMUM NUMBER OF TIME STEPS ≤ 99,999</div>										<div style="text-align: center;"><u>NPRT</u> NUMBER OF STEPS BETWEEN K3 PRINTS</div>										<div style="text-align: center;"><u>NSTART</u> PRECURSOR OPTION -0, COMPUTE -1, INPUT</div>										<div style="text-align: center;"><u>NTEQ</u> TEMPERATURE OPTION -0, COMPUTE -1, INPUT</div>										<div style="text-align: center;"><u>NCYC</u> NUMBER OF TIME ZONES</div>										<div style="text-align: center;"><u>IG</u> GEOMETRY (USE 1 ONLY)</div>										<div style="text-align: center;"><u>I1</u> FUEL REGIONS (8 MAX)</div>										<div style="text-align: center;"><u>I2</u> CLAD REGIONS (1 ONLY)</div>										<div style="text-align: center;"><u>IDOP</u> DOPPLER CONTROL - 0, MELT - 1, AVE. PIN</div>									
<div style="text-align: center;"><u>B(1)</u> DELAYED NEUTRON FRACTION FOR FIRST PRECURSOR GROUP</div>												<div style="text-align: center;"><u>B(2)</u> DELAYED NEUTRON FRACTION FOR SECOND PRECURSOR GROUP</div>												• • •																																																																											
<div style="text-align: center;"><u>AL(1)</u> DECAY CONSTANT FOR FIRST PRECURSOR GROUP</div>												<div style="text-align: center;"><u>AL(2)</u> DECAY CONSTANT FOR SECOND PRECURSOR GROUP</div>												• • •																																																																											
<div style="text-align: center;"><u>AN(1)</u> INITIAL POWER DENSITY (WATTS/CC)</div>												<div style="text-align: center;"><u>R1</u> (INITIAL REACTIVITY ABSOLUTE UNITS)</div>												<div style="text-align: center;"><u>ALIFE</u> NEUTRON GENERATION TIME (SEC)</div>										<div style="text-align: center;"><u>HMAX</u> MAXIMUM ALLOWABLE TIME STEP (SEC)</div>										<div style="text-align: center;"><u>ERROR</u> CONVERGENCE CRITERION ON MARCH OUT (1~.001)</div>																																																							
<div style="text-align: center;"><u>C(1)</u> INITIAL CONCENTRATION OF FIRST PRECURSOR GROUP (W/CC)</div>												<div style="text-align: center;"><u>C(2)</u> INITIAL CONCENTRATION OF SECOND PRECURSOR GROUP (W/CC)</div>												• • •																																																																											
<div style="text-align: center;"><u>RC(1,1)</u> LINEAR TEMPERATURE COEFFICIENT (dK/dT) FOR FUEL REGION</div>												<div style="text-align: center;"><u>RC(1,2)</u> DOPPLER COEFFICIENT (T dK/dT) FOR FUEL REGION</div>												<div style="text-align: center;"><u>RTC(1)</u> TIME DELAY FOR FEEDBACK IN FUEL REGION</div>										<div style="text-align: center;"><u>PGAM(1)</u> FRACTION OF TOTAL POWER DEPOSITED IN FUEL REGION</div>																																																																	
<div style="text-align: center;"><u>RC(2,1)</u> " " FOR CLAD</div>												<div style="text-align: center;"><u>RC(2,2)</u> " " FOR CLAD</div>												<div style="text-align: center;"><u>RTC(2)</u> " " FOR CLAD</div>										<div style="text-align: center;"><u>PGAM(2)</u> " " FOR CLAD</div>																																																																	
<div style="text-align: center;"><u>RC(3,2)</u> " " FOR COOLANT</div>												<div style="text-align: center;"><u>RC(3,2)</u> " " FOR COOLANT</div>												<div style="text-align: center;"><u>RTC(3)</u> " " FOR COOLANT</div>										<div style="text-align: center;"><u>PGAM(3)</u> " " FOR COOLANT</div>																																																																	
12												24												36										48										60										72										80																																			

D-12

BNWL-944

●	1 2 3 4 5 6 7 8 9 10 11 12												13 14 15 16 17 18 19 20 21 22 23 24												25 26 27 28 29 30 31 32 33 34 35 36												37 38 39 40 41 42 43 44 45 46 47 48												49 50 51 52 53 54 55 56 57 58 59 60												61 62 63 64 65 66 67 68 69 70 71 72												73 74 75 76 77 78 79 80											
	RCP(1) HEAT CAPACITY FOR FUEL (J/CC-K)												COND(1) CONDUCTIVITY FOR FUEL (J/CM-SEC-K)												HA(1) HEAT TRANSFER COEFF. ACROSS OUTSIDE FUEL BOUNDARY (J/CM ² -SEC-K)												RAD(1) RADIUS OF FUEL REGION (CM)																																															
	RCP(2) HEAT CAPACITY FOR CLADDING (J/CC-K)												COND(2) CONDUCTIVITY FOR CLADDING (J/CM-SEC-K)												HA(2) FILM COEFF. BETWEEN CLADDING AND COOLANT (J/CM ² -SEC-K)												RAD(2) RADIUS OF CLADDING REGION (CM)																																															
	RCP(3) HEAT CAPACITY FOR COOLANT (J/CC-K)												HA(3) COEFF. FOR HEAT REMOVAL BY COOLANT (SEE EQ. 4.5)												TZERO INLET COOLANT TEMPERATURE (K)												VOL(3) VOLUME OF COOLANT REGION (CC)																																															
	TP(1) INITIAL TEMPERATURE OF INTERVAL 1 (K)												TP(2) INITIAL TEMPERATURE OF INTERVAL 2 (K)												● ● ●																																																											
	NUPPER NUMBER OF FUEL PIN NODES		MUPPER NUMBER OF CORE AXIAL NODES		LUPPER NUMBER OF CORE RADIAL CHANNELS		NPDA AXIAL POWER PROFILE (Q/I = COSINE/INPUT)		NPDR RADIAL POWER PROFILE (-1/Q/I = FLAT/ PARABOLA/INPUT)		MF AXIAL FUEL NODE CHECKED FOR COLLAPSE		MC AXIAL NA NODE CHECKED FOR COLLAPSE		MPRT NO. SHORT PRINTS PER LONG PRINT		ITYPE TYPE OF LONG PRINT (Q/I = P/F)		NCOL LIMIT FOR TOTAL SEG. COLLAPSE		IDEN FUEL DENSITY FLAG (Q/I = CONST./VAR.)		IWRITE PRINTF CONTROL (Q/I = ALL/P)																																																													
	LVOID CHAN. NO. OF HOTTEST SODIUM		IVOID VOIDING TRIP (Q/I = NORM./SEL.)		MUX AXIAL NODE FOR VOID START		NVOD VOIDING SWITCH (Q/I = NO VOID/VOID)		NCPS COLLAPSE SWITCH (Q/I = NONE/COLLAP.)		INA SWITCH TO CALL NAMOD (Q/I = NO/YES)		LVODCO VOIDING AT TIME OF COLLAP. (Q/I = N/Y)		NMPRT NO. SHORT PRINTS PER PRINTM PRINT																																																																					
	DL(1) RADIAL POSITION OF CHANNEL 1		DL(2) RADIAL POSITION OF CHANNEL 2		● ● ●																																																																															
	AHIGH CORE HEIGHT		RADIUS CORE RADIUS		PEAKR PEAK TO AVE. RADIAL POWER		PEAKA PEAK TO AVE. AXIAL POWER		EXTRAP AXIAL HALF LENGTH WITH EXTRAPOLATION		EPSDOP ALLOWED DIFF. BETWEEN TEMP AND TEMA		DENSEF FUEL DENSITY		DENSEE CLAD DENSITY		DENSEC COOLANT DENSITY		FRACF FISSILE FUEL DENSITY		CHI VISCOSITY TERM IN COLLAPSE		GRAV FORCING FUNCTION IN COLLAPSE																																																													
	12												24												36												48												60												72																							

1	2	3	4	5	6	7	8	9	10	11	12																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
<u>TIMEC</u> PRINTOUT INTERVAL AFTER COLLAPSE						<u>TCOLM</u> RUNNING TIME ALLOWED AFTER COLLAPSE START						<u>NADEN</u> SODIUM DENSITY FOR VOIDING						<u>TIMEV</u> PRINTOUT INTERVAL AFTER VOID						<u>TEMAW</u> TEMA VALUE FOR CALLING TEMAP						<u>TEMAD</u> RUNNING TIME ALLOWED AFTER CALLING TEMAP						<u>FNAMOD</u> FACTOR TO MULTIPLY SODIUM WORTHS						<u>FUELV</u> TOTAL CORE VOLUME OF FUEL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
<u>TFUSEF</u> MELTING TEMPERATURE OF FUEL												<u>TFUSEE</u> MELTING TEMPERATURE OF CLAD												<u>TFUSEC</u> MELTING TEMPERATURE OF COOLANT												<u>TBOILC</u> BOILING TEMPERATURE OF COOLANT												<u>FUSEF</u> LATENT HEAT OF FUSION OF FUEL												<u>FUSEE</u> LATENT HEAT OF FUSION OF CLAD																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
<u>FUSEC</u> LATENT HEAT OF FUSION OF COOLANT												<u>VAPC</u> LATENT HEAT OF VAPORIZATION OF COOLANT																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
<u>TR1PE</u> CENTERLINE FUEL TEMP. FOR CLAD FAILURE												<u>TR1PFO</u> OUTER FUEL NODE TEMP. FOR CLAD FAILURE												<u>TR1PC</u> COOLANT TEMP. FOR CLAD FAILURE												<u>TR1PE</u> CLAD TEMP. FOR CLAD FAILURE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
<u>VARDEN(1)</u> FISSILE FUEL DENSITY IN CHANNEL 1												<u>VARDEN(2)</u> FISSILE FUEL DENSITY IN CHANNEL 2												• • •																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
<u>TR1PX(1)</u> NA VOID TRIP TEMP. IN AXIAL NODE MUX OF CHAN. 1												<u>TR1PX(2)</u> NA VOID TRIP TEMP. IN AXIAL NODE MUX OF CHAN. 2												• • •																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
<u>A1</u> CONSTANT TERM IN UPWARD NA VOID												<u>A2</u> LINEAR TERM IN UPWARD NA VOID												<u>A3</u> QUADRATIC TERM IN UPWARD NA VOID												<u>A4</u> CUBIC TERM IN UPWARD NA VOID												<u>TA2</u> DELAY FOR LINEAR TERM IN UPWARD NA VOID												<u>TA3</u> DELAY FOR QUADRATIC TERM IN UPWARD NA VOID																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
<u>TA4</u> DELAY FOR CUBIC TERM IN UPWARD NA VOID																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
<u>B1</u> CONSTANT TERM IN DOWNWARD NA VOID												<u>B2</u> LINEAR TERM IN DOWNWARD NA VOID												<u>B3</u> QUADRATIC TERM IN DOWNWARD NA VOID												<u>B4</u> CUBIC TERM IN DOWNWARD NA VOID												<u>TB2</u> DELAY FOR LINEAR TERM IN DOWNWARD NA VOID												<u>TB3</u> DELAY FOR QUADRATIC TERM IN DOWNWARD NA VOID																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
											12												24																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					

D-14

BNWL-944

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80				
	<u>TB4</u> DELAY FOR CUBIC TERM IN DOWNWARD NA VOID																																																																																			
IF NPDR = 1	<u>AINR(1)</u> RELATIVE TEMPERATURE IN CHANNEL 1												<u>AINR(2)</u> RELATIVE TEMPERATURE IN CHANNEL 2												• • •																																																											
	<u>PIN(1)</u> RELATIVE POWER IN CHANNEL 1												<u>PIN(2)</u> RELATIVE POWER IN CHANNEL 2												• • •																																																											
IF NPDA = 1	<u>PPP(1)</u> RELATIVE POWER IN AXIAL NODE 1												<u>PPP(2)</u> RELATIVE POWER IN AXIAL NODE 2												• • •																																																											
	<u>TTT(1)</u> RELATIVE TEMPERATURE IN AXIAL NODE 1												<u>TTT(2)</u> RELATIVE TEMPERATURE IN AXIAL NODE 2												• • •																																																											
	<u>WF(1, 1)</u> FUEL WORTH IN AXIAL NODE 1 OF CHANNEL 1												<u>WF(2, 1)</u> FUEL WORTH IN AXIAL NODE 2 OF CHANNEL 1												• • •												<u>WF(1, 2)</u> FUEL WORTH IN AXIAL NODE 1 OF CHANNEL 2												<u>WF(2, 2)</u> FUEL WORTH IN AXIAL NODE 2 OF CHANNEL 2												• • •																							
	<u>WC(1, 1)</u> SODIUM VOID WORTH IN AXIAL NODE 1 OF CHANNEL 2												<u>WC(2, 1)</u> SODIUM VOID WORTH IN AXIAL NODE 2 OF CHANNEL 2												• • •												<u>WC(1, 2)</u> SODIUM VOID WORTH IN AXIAL NODE 1 OF CHANNEL 1												<u>WC(2, 2)</u> SODIUM VOID WORTH IN AXIAL NODE 2 OF CHANNEL 1												• • •																							
	<u>TMAX</u> TERMINAL TIME OF FIRST TIME ZONE												<u>R2</u> REACTIVITY RAMP IN FIRST TIME ZONE												<u>R3</u> QUADRATIC REACTIVITY COEFF. IN FIRST TIME ZONE																																																											
OPTIONAL	SAME FORMAT AS PREVIOUS CARD FOR SECOND AND SUCCEEDING TIME ZONES																																																																																			
	12												24												36												48												60												72												80											

APPENDIX E

SAMPLE PROBLEM

APPENDIX E.1

SAMPLE CODE INPUT AND OUTPUT

The input data (first two pages) and computer printout for the sample case are listed on the following pages.

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

6	9999	50	0	0	2	1	7	1		
.000114	.000840	.000649	.000986	.000306	.000106					
.0129	.0311	.134	.331	1.26	3.21					
1300.	.0	3.5-07	.0	.001						
.0	-.004	.0	1.0							
.0	.0	.0	.0							
3.930	.0240	.85	.27686							
4.180	.2080	17.0	.3175							
1.296	50.	561.	.12128							
9	18	10	0	1	10	10	500	0	10	1
3	1	9	1	1	1	1	1			
0.	13.0	23.0	31.5	40.0	47.0	51.0	57.0	62.5	66.0	
85.0	66.0	1.00	1.25	58.9	.001	10.5	2.00	0.9.00052	0.	981.
.010	.025.00034	.005	2760.	.010	1.03.0+05					
3000.	1623.	371.	1153.	280.	110.					
115.	1800.									
4000.	3000.	1153.	1623.							
.000260	.000468	.000468	.000468	.000468	.000468					
.000579	.000579	.000579	.000579	.000579	.000579					
340.0	778.4	819.5	819.5	772.6	728.5					
806.5	686.2	580.3	524.0							
.0	.0	5000.	.0	.0	.0					
.0	.0	2000.	.0	.0	.0					
.0	.0									
.460	1.070	1.130	1.130	1.062	1.000					
1.111	.942	.793	.715							
.460	1.070	1.130	1.130	1.062	1.000					
1.111	.942	.793	.715							
.4500-3	.6650-3	.8800-3	1.1000-3	1.2800-3	1.4500-3					
1.5900-3	1.6900-3	1.7500-3	1.7500-3	1.6900-3	1.5900-3					
1.4500-3	1.2800-3	1.1000-3	.8800-3	.6650-3	.4500-3					
.4603-3	.6802-3	.9001-3	1.1251-3	1.3093-3	1.4831-3					
1.6263-3	1.7286-3	1.7900-3	1.7900-3	1.7286-3	1.6263-3					
1.4831-3	1.3093-3	1.1251-3	.9001-3	.6802-3	.4603-3					
.4886-3	.7220-3	.9554-3	1.1943-3	1.3897-3	1.5743-3					
1.7263-3	1.8349-3	1.9000-3	1.9000-3	1.8349-3	1.7263-3					
1.5743-3	1.3897-3	1.1943-3	.9554-3	.7220-3	.4886-3					
.5014-3	.7410-3	.9806-3	1.2257-3	1.4263-3	1.6157-3					
1.7717-3	1.8832-3	1.9500-3	1.9500-3	1.8832-3	1.7717-3					
1.6157-3	1.4263-3	1.2257-3	.9806-3	.7410-3	.5014-3					
.4474-3	.6612-3	.8750-3	1.0937-3	1.2727-3	1.4417-3					
1.5809-3	1.6804-3	1.7400-3	1.7400-3	1.6804-3	1.5809-3					
1.4417-3	1.2727-3	1.0937-3	.8750-3	.6612-3	.4474-3					
.3754-3	.5548-3	.7342-3	.9177-3	1.0679-3	1.2097-3					

1.3265-3	1.4100-3	1.4600-3	1.4600-3	1.4100-3	1.3265-3
1.2097-3	1.0679-3	.9177-3	.7342-3	.5548-3	.3754-3
.3137-3	.4636-3	.6135-3	.7669-3	.8923-3	1.0109-3
1.1085-3	1.1782-3	1.2200-3	1.2200-3	1.1782-3	1.1085-3
1.0109-3	.8923-3	.7669-3	.6135-3	.4636-3	.3137-3
.2391-3	.3534-3	.4677-3	.5846-3	.6802-3	.7706-3
.8450-3	.8981-3	.9300-3	.9300-3	.8981-3	.8450-3
.7706-3	.6802-3	.5846-3	.4677-3	.3534-3	.2391-3
.1697-3	.2508-3	.3319-3	.4149-3	.4827-3	.5469-3
.5997-3	.6374-3	.6600-3	.6600-3	.6374-3	.5997-3
.5469-3	.4827-3	.4149-3	.3319-3	.2508-3	.1697-3
.1390-3	.2050-3	.2717-3	.3391-3	.3950-3	.4470-3
.4902-3	.5215-3	.5400-3	.5400-3	.5215-3	.4902-3
.4470-3	.3950-3	.3391-3	.2717-3	.2050-3	.1390-3
-7.0-5	-5.8-5	-4.6-5	-3.2-5	-1.6-5	0.2-5
1.9-5	3.1-5	3.7-5	3.7-5	3.1-5	1.9-5
0.2-5	-1.6-5	-3.2-5	-4.6-5	-5.8-5	-7.0-5
-4.2-5	-3.0-5	-1.3-5	0.3-5	1.8-5	3.2-5
4.4-5	5.0-5	5.5-5	5.5-5	5.0-5	4.4-5
3.2-5	1.8-5	0.3-5	-1.3-5	-3.0-5	-4.2-5
-5.3-5	-4.8-5	-1.6-5	0.9-5	3.2-5	5.1-5
6.7-5	7.7-5	8.3-5	8.3-5	7.7-5	6.7-5
5.1-5	3.2-5	0.9-5	-1.6-5	-4.8-5	-5.3-5
-5.6-5	-5.0-5	-2.2-5	0.4-5	2.8-5	4.7-5
6.2-5	7.3-5	7.8-5	7.8-5	7.3-5	6.2-5
4.7-5	2.8-5	0.4-5	-2.2-5	-5.0-5	-5.6-5
-5.6-5	-5.0-5	-2.6-5	-0.4-5	1.6-5	3.3-5
4.6-5	5.6-5	6.1-5	6.1-5	5.6-5	4.6-5
3.3-5	1.6-5	-0.4-5	-2.6-5	-5.0-5	-5.6-5
-5.6-5	-5.0-5	-2.8-5	-1.0-5	0.9-5	2.3-5
3.5-5	4.3-5	4.7-5	4.7-5	4.3-5	3.5-5
2.3-5	0.9-5	-1.0-5	-2.8-5	-5.0-5	-5.6-5
-5.1-5	-4.4-5	-2.9-5	-1.5-5	-0.1-5	1.1-5
2.1-5	2.7-5	3.1-5	3.1-5	2.7-5	2.1-5
1.1-5	-0.1-5	-1.5-5	-2.9-5	-4.4-5	-5.1-5
-4.5-5	-4.6-5	-3.9-5	-3.4-5	-2.9-5	-2.5-5
-2.1-5	-1.9-5	-1.8-5	-1.8-5	-1.9-5	-2.1-5
-2.5-5	-2.9-5	-3.4-5	-3.9-5	-4.6-5	-4.5-5
-3.7-5	-4.5-5	-5.1-5	-5.5-5	-5.9-5	-6.3-5
-6.6-5	-6.8-5	-6.8-5	-6.8-5	-6.8-5	-6.6-5
-6.3-5	-5.9-5	-5.5-5	-5.1-5	-4.5-5	-3.7-5
-3.4-5	-4.7-5	-5.6-5	-6.4-5	-7.3-5	-8.0-5
-8.5-5	-8.9-5	-9.1-5	-9.1-5	-8.9-5	-8.5-5
-8.0-5	-7.3-5	-6.4-5	-5.6-5	-4.7-5	-3.4-5
.400	.012	.0			
.600	.012	.0			

* * M E L T - I A S I M P L I F I E D C O R E M E L T D O W N M O D E L * *

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

NUMBER OF PRECURSOR GROUPS	6
MAXIMUM NUMBER OF TIME STEPS	9999
NUMBER OF INTERVALS BETWEEN PRINT OUT	50
THE NUMBER OF REACTIVITY ZONES	2
GEOMETRY(0/1/2=SPHERE/CYLINDER/PLANE)	1
INITIAL NEUTRON DENSITY(PER CC)	1.3000+03
INITIAL REACTIVITY (CENTS)	0.0000
GENERATION TIME(SEC)	3.5000-07
MAXIMUM TIME STEP(SEC)	0.0000
CONVERGENCE CRITERION	1.0000-03
TOTAL PRECURSOR FRACTION	3.0010-03

GROUP	B(I)	LAMBDA(I)	C(I)
1	1.1400-04	1.2900-02	3.2824+07
2	8.4000-04	3.1100-02	1.0032+08
3	6.4900-04	1.3400-01	1.7989+07
4	9.8600-04	3.3100-01	1.1064+07
5	3.0600-04	1.2600+00	9.0204+05
6	1.0600-04	3.2100+00	1.2265+05

E-4

BMTL-944

REACTIVITY AND HEAT TRANSFER COEFFICIENTS FOR THE THREE REGIONS

PARAMETER	REGION 1	REGION 2	REGION 3
LINEAR TEMP COEF(PER DEG K)	0.0000	0.0000	-0.0000
DOPPLER COEFFICIENT (T DK/DT)	-4.0000-03	0.0000	-0.0000
REACTIVITY DELAY(SEC)	0.0000	0.0000	-0.0000
INITIAL TEMP(DEG K)	1.3507+03	5.9182+02	5.6726+02
ENERGY DEPOSITION FRACTION	1.0000+00	0.0000	-0.0000
VOLUME (CC)	2.4081-01	7.5884-02	1.2128-01
HEAT CAPACITY (JOULES/CC-DEGK)	3.9300+00	4.1800+00	1.2960+00
H.T.C. X AREA (JOULES/SEC-DEGK)	1.4786+00	3.3913+01	5.0000+01
K(J/CM-SEC-DEGK) AND T(INLET)	2.4000-02	2.0800-01	5.6100+02

SAMPLE CASE RR = 4%/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

GEOMETRY SPECIFICATIONS AND TEMPERATURE DISTRIBUTION LISTED BELOW

I	ZONE	RADIUS(CM)	AVG RADIUS(CM)	AREA(CM2)	VOLUME(CC)	TEMPERATURE(DEG K)
1	1	3.955-02	1.978-02	2.485-01	4.914-03	1.859+03
2	1	7.910-02	5.933-02	4.970-01	1.474-02	1.817+03
3	1	1.187-01	9.888-02	7.455-01	2.457-02	1.732+03
4	1	1.582-01	1.384-01	9.940-01	3.440-02	1.605+03
5	1	1.978-01	1.780-01	1.243+00	4.423-02	1.435+03
6	1	2.373-01	2.175-01	1.491+00	5.406-02	1.224+03
7	1	2.769-01	2.571-01	1.740+00	6.389-02	9.694+02
8	2	3.175-01	2.972-01	1.995+00	7.588-02	5.918+02
9	3	0.000	0.000	0.000	1.213-01	5.673+02

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

INPUT FOR MELTDOWN, COLLAPSE, AND VOID ROUTINES

NUMBER OF FUEL PIN NODES	(NUPPER)	= 9
NUMBER OF CORE AXIAL NODES	(MUPPER)	= 18
NUMBER OF CORE RADIAL CHANNELS	(LUPPER)	= 10
AXIAL PEAK TO AVERAGE POWER	(NPDA)	= 0
RADIAL PEAK TO AVERAGE POWER	(NPDR)	= 1
AXIAL FUEL NODE CHECKED FOR COLLAPSE	(MF)	= 10
AXIAL NA NODE CHECKED FOR COLLAPSE	(MC)	= 10
NUMBER OF K3 PRINTS PER MELT PRINT	(MPRT)	= 500
TYPE OF MELT PRINT (0/1=PARTIAL/FULL)	(ITYPE)	= 0
LIMIT FOR TOTAL SEGMENTS OF COLLAPSE	(NCOL)	= 10
FUEL DENSITY FLAG (0/1 = CONST./VAR.)	(IDEN)	= 1
PRINTF CONTROL (0/1=ALL/CL AND OUTER)	(IWRITE)	= 1
CHANNEL NUMBER OF HOTTEST SODIUM	(LVOID)	= 3
VOIDING TRIP (0/1=NORMAL/PRESELECTED)	(IVOID)	= 1
AXIAL NODE FOR VOID START (IF IVOID=1)	(MUX)	= 9
DOPPLER FEEDBACK (0/1=MELT/K3)	(IDOP)	= -0
VOIDING SWITCH (0/1=NO VOID/VOID)	(NVOID)	= -0
COLLAPSE SWITCH (0/1=NO COLLAP/COLLAP)	(NCPS)	= 1
SWITCH TO CALL NAMOD (0/1=NO/YES)	(INA)	= -0
VOIDING AT TIME OF COLLAPSE (0/1=N/Y)	(IVODCO)	= 1
NUMBER OF K3 PRINTS PER PRINTM PRINT	(NMPRT)	= 1

CORE HEIGHT (CM)	=	85.00000
CORE RADIUS (CM)	=	66.00000
RADIAL PEAK TO AVERAGE TEMPERATURE	=	1.00000
AXIAL PEAK TO AVERAGE TEMPERATURE	=	1.25000
AXIAL LENGTH (INCLUDING EXTRAP)	=	58.90000
EPSDOP,FRACT.DIFF.OF TEMP AND TEMA	=	.00100
DENSITY OF FUEL (GRAMS/CC)	=	10.50000
DENSITY OF CLAD (GRAMS/CC)	=	2.00000
DENSITY OF COOLANT (GRAMS/CC)	=	.90000

MELTING TEMPERATURE OF FUEL (K) = .30000+04
 MELTING TEMPERATURE OF CLAD (K) = .16230+04
 MELTING TEMPERATURE OF COOLANT (K) = .37100+03
 BOILING TEMPERATURE OF COOLANT (K) = .11530+04
 LATENT HEAT OF FUSION OF FUEL (J/G) = .28000+03
 LATENT HEAT OF FUSION OF CLAD (J/G) = .11000+03
 LATENT HEAT OF FUSION OF COOLANT (J/G) = .11500+03
 LATENT HEAT OF VAPORIZATION OF COOLANT (J/G) = .18000+04
 TEMP. OF CENTERLINE FUEL AT WHICH CLAD FAILS = .40000+04
 TEMP. OF OUTER NODE FUEL AT WHICH CLAD FAILS = .30000+04
 TEMP. OF COOLANT AT WHICH CLAD FAILS = .11530+04
 TEMP. OF CLAD AT WHICH CLAD FAILS = .16230+04
 FRACF (VOLUME FRACTION OF PU-239) = .52000-03
 GRAV (FORCING FUNCTION IN EQUATION OF MOTION) = .98100+03
 CHI (VISCOSITY TERM IN EQUATION OF MOTION) = .00000
 TIMEC (PRINTOUT INTERVAL AFTER START OF COL) = .10000-01
 TCOLM (TOTAL RUNNING TIME AFTER START OF COL) = .25000-01
 NADEN (NA DENSITY(KG/CC CORE VOLUME)FOR VOID) = .34000-03
 TIMEV (PRINTOUT INTERVAL AFTER START OF VOID) = .50000-02
 TEMAW (VALUE OF TEMA FOR CALLING TEMAP SUB.) = 2760.00000
 TEMAD (TIME BEYOND TEMAW WHEN PROGRAM HALTED) = .10000-01
 FNAMEOD (FACTOR BY WHICH WC(MU,L) IS MULT.) = .10000+01
 FUELTV (TOTAL CORE VOLUME OF FUEL, CC) = .30000+06

CHANNEL FUEL DENSITIES .2600-03 .4680-03 .4680-03 .4680-03 .4680-03 .4680-03 .5790-03 .5790-03 .5790-03 .5790-03

CHANNEL NA VOID TRIPS .3400+03 .7784+03 .8195+03 .8195+03 .7726+03 .7285+03 .8065+03 .6862+03 .5803+03 .5240+03

A1,A2,A3,A4,TA2,TA3,TA4 .0000 .0000 .5000+04 .0000 .0000 .0000 .0000

B1,B2,B3,B4,TB2,TB3,TB4 .0000 .0000 .2000+04 .0000 .0000 .0000 .0000

E-8

BNWL-944

CORE AVERAGE TEMPERATURE = .13496+04
K-III AVERAGE TEMPERATURE = .13507+04

E-9

BNWL-944

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

CURRENT AXIAL POSITIONS OF THE VARIOUS FUEL SEGMENTS

I	ORIGINAL	ORIG.	ORIG.	1	2	3	4	5	6	7	8	9	10
	CENTERLINE	LOWER	UPPER	.000	13.000	23.000	31.500	40.000	47.000	51.000	57.000	62.500	66.000
18	82.639	80.278	85.000	.8500+02	.8500+02	.8500+02	.8500+02	.8500+02	.8500+02	.8500+02	.8500+02	.8500+02	.8500+02
17	77.917	75.556	80.278	.8028+02	.8028+02	.8028+02	.8028+02	.8028+02	.8028+02	.8028+02	.8028+02	.8028+02	.8028+02
16	73.194	70.833	75.556	.7556+02	.7556+02	.7556+02	.7556+02	.7556+02	.7556+02	.7556+02	.7556+02	.7556+02	.7556+02
15	68.472	66.111	70.833	.7083+02	.7083+02	.7083+02	.7083+02	.7083+02	.7083+02	.7083+02	.7083+02	.7083+02	.7083+02
14	63.750	61.389	66.111	.6611+02	.6611+02	.6611+02	.6611+02	.6611+02	.6611+02	.6611+02	.6611+02	.6611+02	.6611+02
13	59.028	56.667	61.389	.6139+02	.6139+02	.6139+02	.6139+02	.6139+02	.6139+02	.6139+02	.6139+02	.6139+02	.6139+02
12	54.306	51.944	56.667	.5667+02	.5667+02	.5667+02	.5667+02	.5667+02	.5667+02	.5667+02	.5667+02	.5667+02	.5667+02
11	49.583	47.222	51.944	.5194+02	.5194+02	.5194+02	.5194+02	.5194+02	.5194+02	.5194+02	.5194+02	.5194+02	.5194+02
10	44.861	42.500	47.222	.4722+02	.4722+02	.4722+02	.4722+02	.4722+02	.4722+02	.4722+02	.4722+02	.4722+02	.4722+02
9	40.139	37.778	42.500	.4250+02	.4250+02	.4250+02	.4250+02	.4250+02	.4250+02	.4250+02	.4250+02	.4250+02	.4250+02
8	35.417	33.056	37.778	.3778+02	.3778+02	.3778+02	.3778+02	.3778+02	.3778+02	.3778+02	.3778+02	.3778+02	.3778+02
7	30.694	28.333	33.056	.3306+02	.3306+02	.3306+02	.3306+02	.3306+02	.3306+02	.3306+02	.3306+02	.3306+02	.3306+02
6	25.972	23.611	28.333	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02
5	21.250	18.889	23.611	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02
4	16.528	14.167	18.889	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02
3	11.806	9.444	14.167	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02
2	7.083	4.722	9.444	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01
1	2.361	.000	4.722	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01

2-20

BWL-944

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

FUEL CENTERLINE TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL	1	2	3	4	5	6	7	8	9	10
	CENTERLINE	.000	13.000	23.000	31.500	40.000	47.000	51.000	57.000	62.500	66.000
18	82.639	.5128+03	.1193+04	.1260+04	.1260+04	.1184+04	.1115+04	.1239+04	.1050+04	.8841+03	.7971+03
17	77.917	.6266+03	.1457+04	.1539+04	.1539+04	.1447+04	.1362+04	.1513+04	.1283+04	.1080+04	.9739+03
16	73.194	.7304+03	.1699+04	.1794+04	.1794+04	.1686+04	.1588+04	.1764+04	.1496+04	.1259+04	.1135+04
15	68.472	.8226+03	.1914+04	.2021+04	.2021+04	.1899+04	.1788+04	.1987+04	.1685+04	.1418+04	.1279+04
14	63.750	.9019+03	.2098+04	.2215+04	.2215+04	.2082+04	.1961+04	.2178+04	.1847+04	.1555+04	.1402+04
13	59.028	.9668+03	.2249+04	.2375+04	.2375+04	.2232+04	.2102+04	.2335+04	.1980+04	.1667+04	.1503+04
12	54.306	.1016+04	.2364+04	.2497+04	.2497+04	.2347+04	.2210+04	.2455+04	.2081+04	.1752+04	.1580+04
11	49.583	.1050+04	.2442+04	.2579+04	.2579+04	.2424+04	.2283+04	.2536+04	.2150+04	.1810+04	.1632+04
10	44.861	.1067+04	.2482+04	.2621+04	.2621+04	.2463+04	.2319+04	.2577+04	.2185+04	.1839+04	.1658+04
9	40.139	.1067+04	.2482+04	.2621+04	.2621+04	.2463+04	.2319+04	.2577+04	.2185+04	.1839+04	.1658+04
8	35.417	.1050+04	.2442+04	.2579+04	.2579+04	.2424+04	.2283+04	.2536+04	.2150+04	.1810+04	.1632+04
7	30.694	.1016+04	.2364+04	.2497+04	.2497+04	.2347+04	.2210+04	.2455+04	.2081+04	.1752+04	.1580+04
6	25.972	.9668+03	.2249+04	.2375+04	.2375+04	.2232+04	.2102+04	.2335+04	.1980+04	.1667+04	.1503+04
5	21.250	.9019+03	.2098+04	.2215+04	.2215+04	.2082+04	.1961+04	.2178+04	.1847+04	.1555+04	.1402+04
4	16.528	.8226+03	.1914+04	.2021+04	.2021+04	.1899+04	.1788+04	.1987+04	.1685+04	.1418+04	.1279+04
3	11.806	.7304+03	.1699+04	.1794+04	.1794+04	.1686+04	.1588+04	.1764+04	.1496+04	.1259+04	.1135+04
2	7.083	.6266+03	.1457+04	.1539+04	.1539+04	.1447+04	.1362+04	.1513+04	.1283+04	.1080+04	.9739+03
1	2.361	.5128+03	.1193+04	.1260+04	.1260+04	.1184+04	.1115+04	.1239+04	.1050+04	.8841+03	.7971+03

E-11

BNWL-944

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

FUEL NODE NO.2 TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL	1	2	3	4	5	6	7	8	9	10
	CENTERLINE	.000	13.000	23.000	31.500	40.000	47.000	51.000	57.000	62.500	66.000
18	82.639	.5011+03	.1166+04	.1231+04	.1231+04	.1157+04	.1089+04	.1210+04	.1026+04	.8639+03	.7789+03
17	77.917	.6123+03	.1424+04	.1504+04	.1504+04	.1414+04	.1331+04	.1479+04	.1254+04	.1056+04	.9517+03
16	73.194	.7137+03	.1660+04	.1753+04	.1753+04	.1648+04	.1552+04	.1724+04	.1462+04	.1230+04	.1109+04
15	68.472	.8039+03	.1870+04	.1975+04	.1975+04	.1856+04	.1748+04	.1942+04	.1646+04	.1386+04	.1250+04
14	63.750	.8813+03	.2050+04	.2165+04	.2165+04	.2035+04	.1916+04	.2129+04	.1805+04	.1519+04	.1370+04
13	59.028	.9448+03	.2198+04	.2321+04	.2321+04	.2181+04	.2054+04	.2282+04	.1935+04	.1629+04	.1469+04
12	54.306	.9933+03	.2310+04	.2440+04	.2440+04	.2293+04	.2159+04	.2399+04	.2034+04	.1712+04	.1544+04
11	49.583	.1026+04	.2387+04	.2520+04	.2520+04	.2369+04	.2231+04	.2478+04	.2101+04	.1769+04	.1595+04
10	44.861	.1043+04	.2425+04	.2561+04	.2561+04	.2407+04	.2266+04	.2518+04	.2135+04	.1797+04	.1620+04
9	40.139	.1043+04	.2425+04	.2561+04	.2561+04	.2407+04	.2266+04	.2518+04	.2135+04	.1797+04	.1620+04
8	35.417	.1026+04	.2387+04	.2520+04	.2520+04	.2369+04	.2231+04	.2478+04	.2101+04	.1769+04	.1595+04
7	30.694	.9933+03	.2310+04	.2440+04	.2440+04	.2293+04	.2159+04	.2399+04	.2034+04	.1712+04	.1544+04
6	25.972	.9448+03	.2198+04	.2321+04	.2321+04	.2181+04	.2054+04	.2282+04	.1935+04	.1629+04	.1469+04
5	21.250	.8813+03	.2050+04	.2165+04	.2165+04	.2035+04	.1916+04	.2129+04	.1805+04	.1519+04	.1370+04
4	16.528	.8039+03	.1870+04	.1975+04	.1975+04	.1856+04	.1748+04	.1942+04	.1646+04	.1386+04	.1250+04
3	11.806	.7137+03	.1660+04	.1753+04	.1753+04	.1648+04	.1552+04	.1724+04	.1462+04	.1230+04	.1109+04
2	7.083	.6123+03	.1424+04	.1504+04	.1504+04	.1414+04	.1331+04	.1479+04	.1254+04	.1056+04	.9517+03
1	2.361	.5011+03	.1166+04	.1231+04	.1231+04	.1157+04	.1089+04	.1210+04	.1026+04	.8639+03	.7789+03

E-12

BMTL-944

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

FUEL NODE NO.3 TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1 .000	2 13.000	3 23.000	4 31.500	5 40.000	6 47.000	7 51.000	8 57.000	9 62.500	10 66.000
18	82.639	.4778+03	.1111+04	.1174+04	.1174+04	.1103+04	.1039+04	.1154+04	.9784+03	.8236+03	.7426+03
17	77.917	.5837+03	.1358+04	.1434+04	.1434+04	.1348+04	.1269+04	.1410+04	.1195+04	.1006+04	.9073+03
16	73.194	.6805+03	.1583+04	.1672+04	.1672+04	.1571+04	.1479+04	.1643+04	.1393+04	.1173+04	.1058+04
15	68.472	.7664+03	.1783+04	.1883+04	.1883+04	.1769+04	.1666+04	.1851+04	.1569+04	.1321+04	.1191+04
14	63.750	.8402+03	.1954+04	.2064+04	.2064+04	.1940+04	.1827+04	.2029+04	.1721+04	.1448+04	.1306+04
13	59.028	.9007+03	.2095+04	.2213+04	.2213+04	.2079+04	.1958+04	.2175+04	.1845+04	.1553+04	.1400+04
12	54.306	.9470+03	.2203+04	.2326+04	.2326+04	.2186+04	.2059+04	.2287+04	.1939+04	.1632+04	.1472+04
11	49.583	.9782+03	.2275+04	.2403+04	.2403+04	.2258+04	.2126+04	.2363+04	.2003+04	.1686+04	.1520+04
10	44.861	.9939+03	.2312+04	.2442+04	.2442+04	.2295+04	.2161+04	.2401+04	.2035+04	.1713+04	.1545+04
9	40.139	.9939+03	.2312+04	.2442+04	.2442+04	.2295+04	.2161+04	.2401+04	.2035+04	.1713+04	.1545+04
8	35.417	.9782+03	.2275+04	.2403+04	.2403+04	.2258+04	.2126+04	.2363+04	.2003+04	.1686+04	.1520+04
7	30.694	.9470+03	.2203+04	.2326+04	.2326+04	.2186+04	.2059+04	.2287+04	.1939+04	.1632+04	.1472+04
6	25.972	.9007+03	.2095+04	.2213+04	.2213+04	.2079+04	.1958+04	.2175+04	.1845+04	.1553+04	.1400+04
5	21.250	.8402+03	.1954+04	.2064+04	.2064+04	.1940+04	.1827+04	.2029+04	.1721+04	.1448+04	.1306+04
4	16.528	.7664+03	.1783+04	.1883+04	.1883+04	.1769+04	.1666+04	.1851+04	.1569+04	.1321+04	.1191+04
3	11.806	.6805+03	.1583+04	.1672+04	.1672+04	.1571+04	.1479+04	.1643+04	.1393+04	.1173+04	.1058+04
2	7.083	.5837+03	.1358+04	.1434+04	.1434+04	.1348+04	.1269+04	.1410+04	.1195+04	.1006+04	.9073+03
1	2.361	.4778+03	.1111+04	.1174+04	.1174+04	.1103+04	.1039+04	.1154+04	.9784+03	.8236+03	.7426+03

E-13

BNWL-944

SAMPLE CASE RR = 4%/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

FUEL NODE NO.4 TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL	1	2	3	4	5	6	7	8	9	10
	CENTERLINE	.000	13.000	25.000	31.500	40.000	47.000	51.000	57.000	62.500	66.000
18	82.639	.4427+03	.1030+04	.1047+04	.1087+04	.1022+04	.9624+03	.1069+04	.9066+03	.7632+03	.6881+03
17	77.917	.5409+03	.1258+04	.1329+04	.1329+04	.1249+04	.1176+04	.1306+04	.1108+04	.9325+03	.8407+03
16	73.194	.6305+03	.1467+04	.1549+04	.1549+04	.1456+04	.1371+04	.1523+04	.1291+04	.1087+04	.9801+03
15	68.472	.7102+03	.1652+04	.1745+04	.1745+04	.1640+04	.1544+04	.1715+04	.1454+04	.1224+04	.1104+04
14	63.750	.7786+03	.1811+04	.1913+04	.1913+04	.1797+04	.1693+04	.1880+04	.1594+04	.1342+04	.1210+04
13	59.028	.8346+03	.1941+04	.2050+04	.2050+04	.1927+04	.1814+04	.2016+04	.1709+04	.1439+04	.1297+04
12	54.306	.8775+03	.2041+04	.2156+04	.2156+04	.2026+04	.1908+04	.2119+04	.1797+04	.1513+04	.1364+04
11	49.583	.9064+03	.2108+04	.2227+04	.2227+04	.2093+04	.1970+04	.2189+04	.1856+04	.1563+04	.1409+04
10	44.861	.9210+03	.2142+04	.2202+04	.2262+04	.2126+04	.2002+04	.2224+04	.1886+04	.1588+04	.1432+04
9	40.139	.9210+03	.2142+04	.2202+04	.2262+04	.2126+04	.2002+04	.2224+04	.1886+04	.1588+04	.1432+04
8	35.417	.9064+03	.2108+04	.2227+04	.2227+04	.2093+04	.1970+04	.2189+04	.1856+04	.1563+04	.1409+04
7	30.694	.8775+03	.2041+04	.2156+04	.2156+04	.2026+04	.1908+04	.2119+04	.1797+04	.1513+04	.1364+04
6	25.972	.8346+03	.1941+04	.2050+04	.2050+04	.1927+04	.1814+04	.2016+04	.1709+04	.1439+04	.1297+04
5	21.250	.7786+03	.1811+04	.1913+04	.1913+04	.1797+04	.1693+04	.1880+04	.1594+04	.1342+04	.1210+04
4	16.528	.7102+03	.1652+04	.1745+04	.1745+04	.1640+04	.1544+04	.1715+04	.1454+04	.1224+04	.1104+04
3	11.806	.6305+03	.1467+04	.1549+04	.1549+04	.1456+04	.1371+04	.1523+04	.1291+04	.1087+04	.9801+03
2	7.083	.5409+03	.1258+04	.1329+04	.1329+04	.1249+04	.1176+04	.1306+04	.1108+04	.9325+03	.8407+03
1	2.361	.4427+03	.1030+04	.1047+04	.1087+04	.1022+04	.9624+03	.1069+04	.9066+03	.7632+03	.6881+03

E-14

BNWL-944

SAMPLE CASE RR = 45/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

FUEL NODE NO.5 TEMPERATURES IN VARIOUS RADIAL CHANNELS

1	ORIGINAL	1	2	3	4	5	6	7	8	9	10
	CENTERLINE	.000	13.000	23.000	31.500	40.000	47.000	51.000	57.000	62.500	66.000
18	82.639	.3960+03	.9210+03	.9727+03	.9727+03	.9141+03	.8608+03	.9563+03	.8108+03	.6826+03	.6154+03
17	77.917	.4838+03	.1125+04	.1188+04	.1188+04	.1117+04	.1052+04	.1168+04	.9907+03	.8340+03	.7520+03
16	73.194	.5639+03	.1312+04	.1385+04	.1385+04	.1302+04	.1226+04	.1362+04	.1155+04	.9722+03	.8766+03
15	68.472	.6352+03	.1477+04	.1560+04	.1560+04	.1466+04	.1381+04	.1534+04	.1301+04	.1095+04	.9873+03
14	63.750	.6963+03	.1620+04	.1711+04	.1711+04	.1608+04	.1514+04	.1682+04	.1426+04	.1200+04	.1082+04
13	59.028	.7465+03	.1736+04	.1834+04	.1834+04	.1723+04	.1623+04	.1803+04	.1529+04	.1287+04	.1160+04
12	54.306	.7848+03	.1826+04	.1928+04	.1928+04	.1812+04	.1706+04	.1895+04	.1607+04	.1353+04	.1220+04
11	49.583	.8107+03	.1886+04	.1991+04	.1991+04	.1872+04	.1762+04	.1958+04	.1660+04	.1398+04	.1260+04
10	44.861	.8237+03	.1916+04	.2024+04	.2024+04	.1902+04	.1791+04	.1990+04	.1687+04	.1420+04	.1280+04
9	40.139	.8237+03	.1916+04	.2024+04	.2024+04	.1902+04	.1791+04	.1990+04	.1687+04	.1420+04	.1280+04
8	35.417	.8107+03	.1886+04	.1991+04	.1991+04	.1872+04	.1762+04	.1958+04	.1660+04	.1398+04	.1260+04
7	30.694	.7848+03	.1826+04	.1928+04	.1928+04	.1812+04	.1706+04	.1895+04	.1607+04	.1353+04	.1220+04
6	25.972	.7465+03	.1736+04	.1834+04	.1834+04	.1723+04	.1623+04	.1803+04	.1529+04	.1287+04	.1160+04
5	21.250	.6963+03	.1620+04	.1711+04	.1711+04	.1608+04	.1514+04	.1682+04	.1426+04	.1200+04	.1082+04
4	16.528	.6352+03	.1477+04	.1560+04	.1560+04	.1466+04	.1381+04	.1534+04	.1301+04	.1095+04	.9873+03
3	11.806	.5639+03	.1312+04	.1385+04	.1385+04	.1302+04	.1226+04	.1362+04	.1155+04	.9722+03	.8766+03
2	7.083	.4838+03	.1125+04	.1188+04	.1188+04	.1117+04	.1052+04	.1168+04	.9907+03	.8340+03	.7520+03
1	2.361	.3960+03	.9210+03	.9727+03	.9727+03	.9141+03	.8608+03	.9563+03	.8108+03	.6826+03	.6154+03

SAMPLE CASE RR = 4%/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

FUEL NODE NO.6 TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1	2	3	4	5	6	7	8	9	10
18	82.639	.3375+03	.7851+03	.8291+03	.8291+03	.7792+03	.7337+03	.8152+03	.6912+03	.5819+03	.5246+03
17	77.917	.4124+03	.9592+03	.1013+04	.1013+04	.9521+03	.8965+03	.9960+03	.8445+03	.7109+03	.6410+03
16	73.194	.4807+03	.1118+04	.1181+04	.1181+04	.1110+04	.1045+04	.1161+04	.9844+03	.8287+03	.7472+03
15	68.472	.5414+03	.1259+04	.1330+04	.1330+04	.1250+04	.1177+04	.1308+04	.1109+04	.9334+03	.8416+03
14	63.750	.5936+03	.1381+04	.1458+04	.1458+04	.1370+04	.1290+04	.1434+04	.1216+04	.1023+04	.9226+03
13	59.028	.6363+03	.1480+04	.1503+04	.1563+04	.1469+04	.1383+04	.1537+04	.1303+04	.1097+04	.9891+03
12	54.306	.6690+03	.1556+04	.1643+04	.1643+04	.1544+04	.1454+04	.1616+04	.1370+04	.1153+04	.1040+04
11	49.583	.6911+03	.1607+04	.1698+04	.1698+04	.1595+04	.1502+04	.1669+04	.1415+04	.1191+04	.1074+04
10	44.861	.7022+03	.1633+04	.1725+04	.1725+04	.1621+04	.1526+04	.1696+04	.1438+04	.1210+04	.1091+04
9	40.139	.7022+03	.1633+04	.1725+04	.1725+04	.1621+04	.1526+04	.1696+04	.1438+04	.1210+04	.1091+04
8	35.417	.6911+03	.1607+04	.1698+04	.1698+04	.1595+04	.1502+04	.1669+04	.1415+04	.1191+04	.1074+04
7	30.694	.6690+03	.1556+04	.1643+04	.1643+04	.1544+04	.1454+04	.1616+04	.1370+04	.1153+04	.1040+04
6	25.972	.6363+03	.1480+04	.1503+04	.1563+04	.1469+04	.1383+04	.1537+04	.1303+04	.1097+04	.9891+03
5	21.250	.5936+03	.1381+04	.1458+04	.1458+04	.1370+04	.1290+04	.1434+04	.1216+04	.1023+04	.9226+03
4	16.528	.5414+03	.1259+04	.1330+04	.1330+04	.1250+04	.1177+04	.1308+04	.1109+04	.9334+03	.8416+03
3	11.806	.4807+03	.1118+04	.1181+04	.1181+04	.1110+04	.1045+04	.1161+04	.9844+03	.8287+03	.7472+03
2	7.083	.4124+03	.9592+03	.1013+04	.1013+04	.9521+03	.8965+03	.9960+03	.8445+03	.7109+03	.6410+03
1	2.361	.3375+03	.7851+03	.8291+03	.8291+03	.7792+03	.7337+03	.8152+03	.6912+03	.5819+03	.5246+03

E-16

BNWL-944

SAMPLE CASE RR = 4%/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

FUEL OUTER NODE TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL	1	2	3	4	5	6	7	8	9	10
	CENTERLINE	.000	13.000	23.000	31.500	40.000	47.000	51.000	57.000	62.500	66.000
18	82.639	.2674+03	.6220+03	.6569+03	.6569+03	.6173+03	.5813+03	.6458+03	.5476+03	.4610+03	.4156+03
17	77.917	.3267+03	.7600+03	.8026+03	.8026+03	.7543+03	.7102+03	.7891+03	.6691+03	.5632+03	.5078+03
16	73.194	.3809+03	.8859+03	.9356+03	.9356+03	.8793+03	.8279+03	.9198+03	.7799+03	.6566+03	.5920+03
15	68.472	.4290+03	.9978+03	.1054+04	.1054+04	.9903+03	.9325+03	.1036+04	.8784+03	.7395+03	.6667+03
14	63.750	.4703+03	.1094+04	.1155+04	.1155+04	.1086+04	.1022+04	.1136+04	.9630+03	.8107+03	.7310+03
13	59.028	.5041+03	.1173+04	.1238+04	.1238+04	.1164+04	.1096+04	.1218+04	.1032+04	.8691+03	.7836+03
12	54.306	.5300+03	.1233+04	.1302+04	.1302+04	.1224+04	.1152+04	.1280+04	.1085+04	.9137+03	.8238+03
11	49.583	.5475+03	.1274+04	.1345+04	.1345+04	.1264+04	.1190+04	.1322+04	.1121+04	.9438+03	.8510+03
10	44.861	.5563+03	.1294+04	.1367+04	.1367+04	.1284+04	.1209+04	.1344+04	.1139+04	.9590+03	.8647+03
9	40.139	.5563+03	.1294+04	.1367+04	.1367+04	.1284+04	.1209+04	.1344+04	.1139+04	.9590+03	.8647+03
8	35.417	.5475+03	.1274+04	.1345+04	.1345+04	.1264+04	.1190+04	.1322+04	.1121+04	.9438+03	.8510+03
7	30.694	.5300+03	.1233+04	.1302+04	.1302+04	.1224+04	.1152+04	.1280+04	.1085+04	.9137+03	.8238+03
6	25.972	.5041+03	.1173+04	.1238+04	.1238+04	.1164+04	.1096+04	.1218+04	.1032+04	.8691+03	.7836+03
5	21.250	.4703+03	.1094+04	.1155+04	.1155+04	.1086+04	.1022+04	.1136+04	.9630+03	.8107+03	.7310+03
4	16.528	.4290+03	.9978+03	.1054+04	.1054+04	.9903+03	.9325+03	.1036+04	.8784+03	.7395+03	.6667+03
3	11.806	.3809+03	.8859+03	.9356+03	.9356+03	.8793+03	.8279+03	.9198+03	.7799+03	.6566+03	.5920+03
2	7.083	.3267+03	.7600+03	.8026+03	.8026+03	.7543+03	.7102+03	.7891+03	.6691+03	.5632+03	.5078+03
1	2.361	.2674+03	.6220+03	.6569+03	.6569+03	.6173+03	.5813+03	.6458+03	.5476+03	.4610+03	.4156+03

E-17

BNWL-944

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

CLAD TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1	2	3	4	5	6	7	8	9	10
18	82.639	.1632+03	.3797+03	.4010+03	.4010+03	.3769+03	.3549+03	.3943+03	.3343+03	.2814+03	.2537+03
17	77.917	.1995+03	.4640+03	.4900+03	.4900+03	.4605+03	.4336+03	.4817+03	.4085+03	.3438+03	.3100+03
16	73.194	.2325+03	.5408+03	.5712+03	.5712+03	.5368+03	.5055+03	.5616+03	.4761+03	.4008+03	.3614+03
15	68.472	.2619+03	.6092+03	.6433+03	.6433+03	.6046+03	.5693+03	.6325+03	.5363+03	.4515+03	.4071+03
14	63.750	.2871+03	.6678+03	.7053+03	.7053+03	.6628+03	.6241+03	.6934+03	.5879+03	.4949+03	.4463+03
13	59.028	.3078+03	.7159+03	.7560+03	.7560+03	.7106+03	.6691+03	.7433+03	.6303+03	.5306+03	.4784+03
12	54.306	.3236+03	.7527+03	.7949+03	.7949+03	.7470+03	.7034+03	.7815+03	.6626+03	.5578+03	.5029+03
11	49.583	.3342+03	.7775+03	.8211+03	.8211+03	.7717+03	.7266+03	.8073+03	.6845+03	.5762+03	.5195+03
10	44.861	.3396+03	.7900+03	.8343+03	.8343+03	.7841+03	.7383+03	.8203+03	.6955+03	.5855+03	.5279+03
9	40.139	.3396+03	.7900+03	.8343+03	.8343+03	.7841+03	.7383+03	.8203+03	.6955+03	.5855+03	.5279+03
8	35.417	.3342+03	.7775+03	.8211+03	.8211+03	.7717+03	.7266+03	.8073+03	.6845+03	.5762+03	.5195+03
7	30.694	.3236+03	.7527+03	.7949+03	.7949+03	.7470+03	.7034+03	.7815+03	.6626+03	.5578+03	.5029+03
6	25.972	.3078+03	.7159+03	.7560+03	.7560+03	.7106+03	.6691+03	.7433+03	.6303+03	.5306+03	.4784+03
5	21.250	.2871+03	.6678+03	.7053+03	.7053+03	.6628+03	.6241+03	.6934+03	.5879+03	.4949+03	.4463+03
4	16.528	.2619+03	.6092+03	.6433+03	.6433+03	.6046+03	.5693+03	.6325+03	.5363+03	.4515+03	.4071+03
3	11.806	.2325+03	.5408+03	.5712+03	.5712+03	.5368+03	.5055+03	.5616+03	.4761+03	.4008+03	.3614+03
2	7.083	.1995+03	.4640+03	.4900+03	.4900+03	.4605+03	.4336+03	.4817+03	.4085+03	.3438+03	.3100+03
1	2.361	.1632+03	.3797+03	.4010+03	.4010+03	.3769+03	.3549+03	.3943+03	.3343+03	.2814+03	.2537+03

E-18

BNNI-944

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

COOLANT TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1 .000	2 13.000	3 23.000	4 31.500	5 40.000	6 47.000	7 51.000	8 57.000	9 62.500	10 66.000
18	82.639	.1565+03	.3640+03	.3844+03	.3844+03	.3612+03	.3402+03	.3779+03	.3204+03	.2697+03	.2432+03
17	77.917	.1912+03	.4447+03	.4696+03	.4696+03	.4414+03	.4156+03	.4617+03	.3915+03	.3296+03	.2972+03
16	73.194	.2229+03	.5184+03	.5475+03	.5475+03	.5145+03	.4845+03	.5383+03	.4564+03	.3842+03	.3464+03
15	68.472	.2510+03	.5839+03	.6166+03	.6166+03	.5795+03	.5457+03	.6062+03	.5140+03	.4327+03	.3902+03
14	63.750	.2752+03	.6401+03	.6760+03	.6760+03	.6353+03	.5982+03	.6646+03	.5635+03	.4744+03	.4277+03
13	59.028	.2950+03	.6862+03	.7247+03	.7247+03	.6811+03	.6413+03	.7125+03	.6041+03	.5086+03	.4585+03
12	54.306	.3101+03	.7214+03	.7619+03	.7619+03	.7160+03	.6742+03	.7491+03	.6351+03	.5347+03	.4821+03
11	49.583	.3204+03	.7452+03	.7870+03	.7870+03	.7396+03	.6965+03	.7738+03	.6561+03	.5523+03	.4980+03
10	44.861	.3255+03	.7572+03	.7997+03	.7997+03	.7515+03	.7077+03	.7862+03	.6666+03	.5612+03	.5060+03
9	40.139	.3255+03	.7572+03	.7997+03	.7997+03	.7515+03	.7077+03	.7862+03	.6666+03	.5612+03	.5060+03
8	35.417	.3204+03	.7452+03	.7870+03	.7870+03	.7396+03	.6965+03	.7738+03	.6561+03	.5523+03	.4980+03
7	30.694	.3101+03	.7214+03	.7619+03	.7619+03	.7160+03	.6742+03	.7491+03	.6351+03	.5347+03	.4821+03
6	25.972	.2950+03	.6862+03	.7247+03	.7247+03	.6811+03	.6413+03	.7125+03	.6041+03	.5086+03	.4585+03
5	21.250	.2752+03	.6401+03	.6760+03	.6760+03	.6353+03	.5982+03	.6646+03	.5635+03	.4744+03	.4277+03
4	16.528	.2510+03	.5839+03	.6166+03	.6166+03	.5795+03	.5457+03	.6062+03	.5140+03	.4327+03	.3902+03
3	11.806	.2229+03	.5184+03	.5475+03	.5475+03	.5145+03	.4845+03	.5383+03	.4564+03	.3842+03	.3464+03
2	7.083	.1912+03	.4447+03	.4696+03	.4696+03	.4414+03	.4156+03	.4617+03	.3915+03	.3296+03	.2972+03
1	2.361	.1565+03	.3640+03	.3844+03	.3844+03	.3612+03	.3402+03	.3779+03	.3204+03	.2697+03	.2432+03

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

POWER DENSITY AT VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1 .000	2 13.000	3 25.000	4 31.500	5 40.000	6 47.000	7 51.000	8 57.000	9 62.500	10 66.000
18	82.639	.3586+03	.8341+03	.8809+03	.8809+03	.8279+03	.7795+03	.8661+03	.7343+03	.6182+03	.5574+03
17	77.917	.4381+03	.1019+04	.1076+04	.1076+04	.1012+04	.9525+03	.1058+04	.8972+03	.7553+03	.6810+03
16	73.194	.5107+03	.1188+04	.1255+04	.1255+04	.1179+04	.1110+04	.1234+04	.1046+04	.8805+03	.7939+03
15	68.472	.5752+03	.1338+04	.1413+04	.1413+04	.1328+04	.1251+04	.1389+04	.1178+04	.9917+03	.8941+03
14	63.750	.6306+03	.1467+04	.1549+04	.1549+04	.1456+04	.1371+04	.1523+04	.1291+04	.1087+04	.9802+03
13	59.028	.6761+03	.1573+04	.1661+04	.1661+04	.1561+04	.1470+04	.1633+04	.1384+04	.1165+04	.1051+04
12	54.306	.7108+03	.1653+04	.1746+04	.1746+04	.1641+04	.1545+04	.1717+04	.1456+04	.1225+04	.1105+04
11	49.583	.7342+03	.1708+04	.1804+04	.1804+04	.1695+04	.1596+04	.1773+04	.1504+04	.1266+04	.1141+04
10	44.861	.7460+03	.1735+04	.1833+04	.1833+04	.1722+04	.1622+04	.1802+04	.1528+04	.1286+04	.1160+04
9	40.139	.7460+03	.1735+04	.1833+04	.1833+04	.1722+04	.1622+04	.1802+04	.1528+04	.1286+04	.1160+04
8	35.417	.7342+03	.1708+04	.1804+04	.1804+04	.1695+04	.1596+04	.1773+04	.1504+04	.1266+04	.1141+04
7	30.694	.7108+03	.1653+04	.1746+04	.1746+04	.1641+04	.1545+04	.1717+04	.1456+04	.1225+04	.1105+04
6	25.972	.6761+03	.1573+04	.1661+04	.1661+04	.1561+04	.1470+04	.1633+04	.1384+04	.1165+04	.1051+04
5	21.250	.6306+03	.1467+04	.1549+04	.1549+04	.1456+04	.1371+04	.1523+04	.1291+04	.1087+04	.9802+03
4	16.528	.5752+03	.1338+04	.1413+04	.1413+04	.1328+04	.1251+04	.1389+04	.1178+04	.9917+03	.8941+03
3	11.806	.5107+03	.1188+04	.1255+04	.1255+04	.1179+04	.1110+04	.1234+04	.1046+04	.8805+03	.7939+03
2	7.083	.4381+03	.1019+04	.1076+04	.1076+04	.1012+04	.9525+03	.1058+04	.8972+03	.7553+03	.6810+03
1	2.361	.3586+03	.8341+03	.8809+03	.8809+03	.8279+03	.7795+03	.8661+03	.7343+03	.6182+03	.5574+03

SAMPLE CASE RR = 4\$/SEC, DOPPLEK = -.004, FUEL COLLAPSE ONLY

FUEL AXIAL WORTHS IN VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1 .000	2 13.000	3 23.000	4 31.500	5 40.000	6 47.000	7 51.000	8 57.000	9 62.500	10 66.000
18	82.639	.4500-03	.4603-03	.4886-03	.5014-03	.4474-03	.3754-03	.3137-03	.2391-03	.1697-03	.1390-03
17	77.917	.6650-03	.6802-03	.7220-03	.7410-03	.6612-03	.5548-03	.4636-03	.3534-03	.2508-03	.2050-03
16	73.194	.8800-03	.9001-03	.9554-03	.9806-03	.8750-03	.7342-03	.6135-03	.4677-03	.3319-03	.2717-03
15	68.472	.1100-02	.1125-02	.1194-02	.1226-02	.1094-02	.9177-03	.7669-03	.5846-03	.4149-03	.3391-03
14	63.750	.1280-02	.1309-02	.1390-02	.1426-02	.1273-02	.1068-02	.8923-03	.6802-03	.4827-03	.3950-03
13	59.028	.1450-02	.1483-02	.1574-02	.1616-02	.1442-02	.1210-02	.1011-02	.7706-03	.5469-03	.4470-03
12	54.306	.1590-02	.1626-02	.1726-02	.1772-02	.1581-02	.1326-02	.1108-02	.8450-03	.5997-03	.4902-03
11	49.583	.1690-02	.1729-02	.1835-02	.1883-02	.1680-02	.1410-02	.1178-02	.8981-03	.6374-03	.5215-03
10	44.861	.1750-02	.1790-02	.1900-02	.1950-02	.1740-02	.1460-02	.1220-02	.9300-03	.6600-03	.5400-03
9	40.139	.1750-02	.1790-02	.1900-02	.1950-02	.1740-02	.1460-02	.1220-02	.9300-03	.6600-03	.5400-03
8	35.417	.1690-02	.1729-02	.1835-02	.1883-02	.1680-02	.1410-02	.1178-02	.8981-03	.6374-03	.5215-03
7	30.694	.1590-02	.1626-02	.1726-02	.1772-02	.1581-02	.1326-02	.1108-02	.8450-03	.5997-03	.4902-03
6	25.972	.1450-02	.1483-02	.1574-02	.1616-02	.1442-02	.1210-02	.1011-02	.7706-03	.5469-03	.4470-03
5	21.250	.1280-02	.1309-02	.1390-02	.1426-02	.1273-02	.1068-02	.8923-03	.6802-03	.4827-03	.3950-03
4	16.528	.1100-02	.1125-02	.1194-02	.1226-02	.1094-02	.9177-03	.7669-03	.5846-03	.4149-03	.3391-03
3	11.806	.8800-03	.9001-03	.9554-03	.9806-03	.8750-03	.7342-03	.6135-03	.4677-03	.3319-03	.2717-03
2	7.083	.6650-03	.6802-03	.7220-03	.7410-03	.6612-03	.5548-03	.4636-03	.3534-03	.2508-03	.2050-03
1	2.361	.4500-03	.4603-03	.4886-03	.5014-03	.4474-03	.3754-03	.3137-03	.2391-03	.1697-03	.1390-03

SAMPLE CASE RR = 45/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

COOLANT AXIAL WORTHS IN VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1 .000	2 13.000	3 23.000	4 31.500	5 40.000	6 47.000	7 51.000	8 57.000	9 62.500	10 66.000
18	82.639-	.7000-04-	.4200-04-	.5300-04-	.5600-04-	.5600-04-	.5600-04-	.5100-04-	.4500-04-	.3700-04-	.3400-04
17	77.917-	.5800-04-	.3900-04-	.4800-04-	.5000-04-	.5000-04-	.5000-04-	.4400-04-	.4600-04-	.4500-04-	.4700-04
16	73.194-	.4600-04-	.1300-04-	.1600-04-	.2200-04-	.2600-04-	.2800-04-	.2900-04-	.3900-04-	.5100-04-	.5600-04
15	68.472-	.3200-04	.3000-05	.9000-05	.4000-05-	.4000-05-	.1000-04-	.1500-04-	.3400-04-	.5500-04-	.6400-04
14	63.750-	.1600-04	.1800-04	.3200-04	.2800-04	.1600-04	.9000-05-	.1000-05-	.2900-04-	.5900-04-	.7300-04
13	59.028	.2000-05	.3200-04	.5100-04	.4700-04	.3300-04	.2300-04	.1100-04-	.2500-04-	.6300-04-	.8000-04
12	54.306	.1900-04	.4400-04	.6700-04	.6200-04	.4600-04	.3500-04	.2100-04-	.2100-04-	.6600-04-	.8500-04
11	49.583	.3100-04	.5000-04	.7700-04	.7300-04	.5600-04	.4300-04	.2700-04-	.1900-04-	.6800-04-	.8900-04
10	44.861	.3700-04	.5500-04	.8300-04	.7800-04	.6100-04	.4700-04	.3100-04-	.1800-04-	.6800-04-	.9100-04
9	40.139	.3700-04	.5500-04	.8300-04	.7800-04	.6100-04	.4700-04	.3100-04-	.1800-04-	.6800-04-	.9100-04
8	35.417	.3100-04	.5000-04	.7700-04	.7300-04	.5600-04	.4300-04	.2700-04-	.1900-04-	.6800-04-	.8900-04
7	30.694	.1900-04	.4400-04	.6700-04	.6200-04	.4600-04	.3500-04	.2100-04-	.2100-04-	.6600-04-	.8500-04
6	25.972	.2000-05	.3200-04	.5100-04	.4700-04	.3300-04	.2300-04	.1100-04-	.2500-04-	.6300-04-	.8000-04
5	21.250-	.1600-04	.1800-04	.3200-04	.2800-04	.1600-04	.9000-05-	.1000-05-	.2900-04-	.5900-04-	.7300-04
4	16.528-	.3200-04	.3000-05	.9000-05	.4000-05-	.4000-05-	.1000-04-	.1500-04-	.3400-04-	.5500-04-	.6400-04
3	11.806-	.4600-04-	.1300-04-	.1600-04-	.2200-04-	.2600-04-	.2800-04-	.2900-04-	.3900-04-	.5100-04-	.5600-04
2	7.083-	.5800-04-	.3000-04-	.4800-04-	.5000-04-	.5000-04-	.5000-04-	.4400-04-	.4600-04-	.4500-04-	.4700-04
1	2.361-	.7000-04-	.4200-04-	.5300-04-	.5600-04-	.5600-04-	.5600-04-	.5100-04-	.4500-04-	.3700-04-	.3400-04

E-22

BNWL-944

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

REACTIVITY INPUT DATA LISTED BELOW . . .

THE CURRENT TIME (SEC) = 0.0000

THE CURRENT REACTIVITY (CENTS) = 0.0000

LINEAR COEFFICIENT (CENTS/SEC) = 3.9987+02

QUADRATIC COEFFICIENT (CENTS/SEC²) = 0.0000

E-23

BNWL-944

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

SOLUTION OF KINETICS EQUATIONS BELOW

I	TIME(SEC)/VOID	POWER/COL	RHO(CENTS)/E	RHO 1/C1	RHO 2/C2	RHO 3/C3	TEMP 1/C4	TEMP 2/C5	TEMP 3/C6	TEMA/Q(MW SEC)
1	0.00000	1.3000+03	.0000	.0000	.0000	.0000	1.3507+03	5.9182+02	5.6726+02	1.3496+03
	.0000	.0000	0.0000	3.282+07	1.003+08	1.799+07	1.106+07	9.020+05	1.227+05	0.00000
50	1.26838-02	1.3688+03	5.0612	-.0167	.0000	.0000	1.3508+03	5.9182+02	5.6726+02	1.3496+03
	.0000	.0000	5.0753+00	3.282+07	1.003+08	1.799+07	1.107+07	9.024+05	1.228+05	0.00000
100	2.62931-02	1.4520+03	10.4659	-.0478	.0000	.0000	1.3512+03	5.9183+02	5.6726+02	1.3496+03
	.0000	.0000	1.1831+01	3.282+07	1.003+08	1.799+07	1.107+07	9.037+05	1.232+05	0.00000
150	4.24184-02	1.5645+03	16.8313	-.1304	.0000	.0000	1.3520+03	5.9185+02	5.6727+02	1.3496+03
	.0000	.0000	1.0122+01	3.283+07	1.003+08	1.800+07	1.108+07	9.066+05	1.242+05	0.00000
200	5.96240-02	1.7053+03	23.5704	-.2713	.0000	.0000	1.3535+03	5.9191+02	5.6728+02	1.3496+03
	.0000	.0000	2.0551+01	3.283+07	1.003+08	1.801+07	1.109+07	9.114+05	1.258+05	0.00000
250	7.69460-02	1.8737+03	30.2907	-.4774	.0000	.0000	1.3556+03	5.9199+02	5.6729+02	1.3496+03
	.0000	.0000	3.5838+01	3.283+07	1.004+08	1.803+07	1.112+07	9.185+05	1.281+05	0.00000
300	9.47595-02	2.0838+03	37.1219	-.7693	.0000	.0000	1.3585+03	5.9212+02	5.6732+02	1.3496+03
	.0000	.0000	4.0396+01	3.283+07	1.004+08	1.805+07	1.115+07	9.285+05	1.313+05	0.00000
350	1.16221-01	2.4043+03	45.2193	-1.2537	.0000	.0000	1.3635+03	5.9235+02	5.6736+02	1.3496+03
	.0000	.0000	6.0800+01	3.284+07	1.004+08	1.808+07	1.121+07	9.452+05	1.367+05	0.00000
400	1.40885-01	2.9065+03	54.2922	-2.0430	.0000	.0000	1.3716+03	5.9273+02	5.6744+02	1.3496+03
	.0000	.0000	8.0345+01	3.285+07	1.005+08	1.815+07	1.130+07	9.724+05	1.452+05	0.00000
450	1.68769-01	3.7543+03	64.1274	-3.3579	.0000	.0000	1.3852+03	5.9337+02	5.6756+02	1.3496+03
	.0000	.0000	1.0794+02	3.287+07	1.007+08	1.825+07	1.145+07	1.018+06	1.595+05	0.00000
500	2.06783-01	5.8689+03	76.3475	-6.3384	.0000	.0000	1.4165+03	5.9483+02	5.6785+02	1.3496+03
	.0000	.0000	1.0135+02	3.291+07	1.010+08	1.848+07	1.181+07	1.122+06	1.922+05	0.00000
550	2.67210-01	1.4760+04	89.4758	-17.3726	.0000	.0000	1.5387+03	6.0030+02	5.6891+02	1.3496+03
	.0000	.0000	3.3525+02	3.307+07	1.022+08	1.941+07	1.319+07	1.531+06	3.203+05	0.00000
600	3.25624-01	2.4121+04	91.9040	-38.3026	.0000	.0000	1.8037+03	6.1360+02	5.7153+02	1.8001+03
	.0000	.0000	6.6631+02	3.343+07	1.048+08	2.142+07	1.621+07	2.412+06	5.911+05	2.70239+00
600	3.25624-01	TEMMOL =	3000.00000	PCMT =	.30639	PCMX =	1.95962			
648	4.00000-01	3.6463+04	92.8248	-67.1221	.0000	.0000	2.2988+03	6.4094+02	5.7702+02	2.2341+03
	.0000	.0000	1.3426+03	3.411+07	1.098+08	2.524+07	2.191+07	4.028+06	1.060+06	8.23363+01
648	4.00000-01	TEMMOL =	3020.14060	PCMT =	8.93977	PCMX =	18.53489			

E-2L

BNWL-944

SAMPLE CASE RR = 4%/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

CURRENT AXIAL POSITIONS OF THE VARIOUS FUEL SEGMENTS

I	ORIGINAL CENTERLINE	ORIG. LOWER	ORIG. UPPER	1	2	3	4	5	6	7	8	9	10
				.000	13.000	23.000	31.500	40.000	47.000	51.000	57.000	62.500	66.000
18	82.639	80.278	85.000	.8500+02	.8500+02	.8500+02	.8500+02	.8500+02	.8500+02	.8500+02	.8500+02	.8500+02	.8500+02
17	77.917	75.556	80.278	.8028+02	.8028+02	.8028+02	.8028+02	.8028+02	.8028+02	.8028+02	.8028+02	.8028+02	.8028+02
16	73.194	70.833	75.556	.7556+02	.7556+02	.7556+02	.7556+02	.7556+02	.7556+02	.7556+02	.7556+02	.7556+02	.7556+02
15	68.472	66.111	70.833	.7083+02	.7083+02	.7083+02	.7083+02	.7083+02	.7083+02	.7083+02	.7083+02	.7083+02	.7083+02
14	63.750	61.389	66.111	.6611+02	.6611+02	.6611+02	.6611+02	.6611+02	.6611+02	.6611+02	.6611+02	.6611+02	.6611+02
13	59.028	56.667	61.389	.6139+02	.6139+02	.6139+02	.6139+02	.6139+02	.6139+02	.6139+02	.6139+02	.6139+02	.6139+02
12	54.306	51.944	56.667	.5667+02	.5667+02	.5667+02	.5667+02	.5667+02	.5667+02	.5667+02	.5667+02	.5667+02	.5667+02
11	49.583	47.222	51.944	.5194+02	.5194+02	.5194+02	.5194+02	.5194+02	.5194+02	.5194+02	.5194+02	.5194+02	.5194+02
10	44.861	42.500	47.222	.4722+02	.4722+02	.4722+02	.4722+02	.4722+02	.4722+02	.4722+02	.4722+02	.4722+02	.4722+02
9	40.139	37.778	42.500	.4250+02	.4250+02	.4250+02	.4250+02	.4250+02	.4250+02	.4250+02	.4250+02	.4250+02	.4250+02
8	35.417	33.056	37.778	.3778+02	.3778+02	.3778+02	.3778+02	.3778+02	.3778+02	.3778+02	.3778+02	.3778+02	.3778+02
7	30.694	28.333	33.056	.3306+02	.3306+02	.3306+02	.3306+02	.3306+02	.3306+02	.3306+02	.3306+02	.3306+02	.3306+02
6	25.972	23.611	28.333	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02
5	21.250	18.889	23.611	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02
4	16.528	14.167	18.889	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02
3	11.806	9.444	14.167	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02
2	7.083	4.722	9.444	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01
1	2.361	.000	4.722	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

FUEL CENTERLINE TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1 .000	2 13.000	3 25.000	4 31.500	5 40.000	6 47.000	7 51.000	8 57.000	9 62.500	10 66.000
18	82.639	.7905+03	.1839+04	.1942+04	.1942+04	.1825+04	.1718+04	.1909+04	.1619+04	.1363+04	.1229+04
17	77.917	.9658+03	.2247+04	.2372+04	.2372+04	.2230+04	.2100+04	.2333+04	.1978+04	.1665+04	.1501+04
16	73.194	.1126+04	.2619+04	.2766+04	.2766+04	.2599+04	.2447+04	.2719+04	.2306+04	.1941+04	.1750+04
15	68.472	.1268+04	.2950+04	.3000+04	.3000+04	.2928+04	.2757+04	.3000+04	.2597+04	.2186+04	.1971+04
14	63.750	.1390+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.2847+04	.2397+04	.2161+04
13	59.028	.1490+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.2569+04	.2316+04
12	54.306	.1567+04	.3000+04	.3133+04	.3133+04	.3000+04	.3000+04	.3060+04	.3000+04	.2701+04	.2435+04
11	49.563	.1618+04	.3042+04	.3259+04	.3259+04	.3024+04	.3000+04	.3187+04	.3000+04	.2790+04	.2516+04
10	44.861	.1644+04	.3114+04	.3313+04	.3313+04	.3078+04	.3000+04	.3259+04	.3000+04	.2835+04	.2556+04
9	40.139	.1644+04	.3114+04	.3313+04	.3313+04	.3078+04	.3000+04	.3259+04	.3000+04	.2835+04	.2556+04
8	35.417	.1618+04	.3042+04	.3259+04	.3259+04	.3024+04	.3000+04	.3187+04	.3000+04	.2790+04	.2516+04
7	30.694	.1567+04	.3000+04	.3133+04	.3133+04	.3000+04	.3000+04	.3060+04	.3000+04	.2701+04	.2435+04
6	25.972	.1490+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.2569+04	.2316+04
5	21.250	.1390+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.2847+04	.2397+04	.2161+04
4	16.528	.1268+04	.2950+04	.3000+04	.3000+04	.2928+04	.2757+04	.3000+04	.2597+04	.2186+04	.1971+04
3	11.806	.1126+04	.2619+04	.2766+04	.2766+04	.2599+04	.2447+04	.2719+04	.2306+04	.1941+04	.1750+04
2	7.083	.9658+03	.2247+04	.2372+04	.2372+04	.2230+04	.2100+04	.2333+04	.1978+04	.1665+04	.1501+04
1	2.361	.7905+03	.1839+04	.1942+04	.1942+04	.1825+04	.1718+04	.1909+04	.1619+04	.1363+04	.1229+04

E-26

BNWL-944

SAMPLE CASE RR = 4%/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

FUEL OUTER NODE TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1 .000	2 13.000	3 25.000	4 31.500	5 40.000	6 47.000	7 51.000	8 57.000	9 62.500	10 66.000
18	82.639	.4947+03	.1151+04	.1215+04	.1215+04	.1142+04	.1075+04	.1195+04	.1013+04	.8529+03	.7690+03
17	77.917	.6045+03	.1406+04	.1485+04	.1485+04	.1396+04	.1314+04	.1460+04	.1238+04	.1042+04	.9395+03
16	73.194	.7046+03	.1639+04	.1731+04	.1731+04	.1627+04	.1532+04	.1702+04	.1443+04	.1215+04	.1095+04
15	68.472	.7936+03	.1846+04	.1950+04	.1950+04	.1832+04	.1725+04	.1917+04	.1625+04	.1368+04	.1234+04
14	63.750	.8700+03	.2024+04	.2157+04	.2137+04	.2009+04	.1891+04	.2101+04	.1782+04	.1500+04	.1352+04
13	59.028	.9327+03	.2170+04	.2291+04	.2291+04	.2153+04	.2028+04	.2253+04	.1910+04	.1608+04	.1450+04
12	54.306	.9806+03	.2281+04	.2409+04	.2409+04	.2264+04	.2132+04	.2368+04	.2008+04	.1690+04	.1524+04
11	49.583	.1013+04	.2356+04	.2488+04	.2488+04	.2339+04	.2202+04	.2446+04	.2074+04	.1746+04	.1574+04
10	44.861	.1029+04	.2394+04	.2528+04	.2528+04	.2376+04	.2237+04	.2486+04	.2108+04	.1774+04	.1600+04
9	40.139	.1029+04	.2394+04	.2528+04	.2528+04	.2376+04	.2237+04	.2486+04	.2108+04	.1774+04	.1600+04
8	35.417	.1013+04	.2356+04	.2488+04	.2488+04	.2339+04	.2202+04	.2446+04	.2074+04	.1746+04	.1574+04
7	30.694	.9806+03	.2281+04	.2409+04	.2409+04	.2264+04	.2132+04	.2368+04	.2008+04	.1690+04	.1524+04
6	25.972	.9327+03	.2170+04	.2291+04	.2291+04	.2153+04	.2028+04	.2253+04	.1910+04	.1608+04	.1450+04
5	21.250	.8700+03	.2024+04	.2157+04	.2137+04	.2009+04	.1891+04	.2101+04	.1782+04	.1500+04	.1352+04
4	16.528	.7936+03	.1846+04	.1950+04	.1950+04	.1832+04	.1725+04	.1917+04	.1625+04	.1368+04	.1234+04
3	11.806	.7046+03	.1639+04	.1731+04	.1731+04	.1627+04	.1532+04	.1702+04	.1443+04	.1215+04	.1095+04
2	7.083	.6045+03	.1406+04	.1485+04	.1485+04	.1396+04	.1314+04	.1460+04	.1238+04	.1042+04	.9395+03
1	2.361	.4947+03	.1151+04	.1215+04	.1215+04	.1142+04	.1075+04	.1195+04	.1013+04	.8529+03	.7690+03

E-27

BNWL-944

SAMPLE CASE RR = 4%/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

CLAD TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1	2	3	4	5	6	7	8	9	10
18	82.639	.1768+03	.4112+03	.4343+03	.4343+03	.4082+03	.3843+03	.4270+03	.3620+03	.3048+03	.2748+03
17	77.917	.2160+03	.5025+03	.5306+03	.5306+03	.4987+03	.4696+03	.5217+03	.4424+03	.3724+03	.3358+03
16	73.194	.2518+03	.5857+03	.6186+03	.6186+03	.5813+03	.5474+03	.6082+03	.5157+03	.4341+03	.3914+03
15	68.472	.2836+03	.6597+03	.6967+03	.6967+03	.6548+03	.6165+03	.6850+03	.5808+03	.4889+03	.4408+03
14	63.750	.3109+03	.7232+03	.7638+03	.7638+03	.7178+03	.6759+03	.7510+03	.6367+03	.5360+03	.4833+03
13	59.028	.3333+03	.7753+03	.8188+03	.8188+03	.7695+03	.7246+03	.8050+03	.6826+03	.5746+03	.5181+03
12	54.306	.3504+03	.8151+03	.8608+03	.8608+03	.8090+03	.7618+03	.8463+03	.7176+03	.6041+03	.5447+03
11	49.583	.3620+03	.8420+03	.8892+03	.8892+03	.8357+03	.7869+03	.8743+03	.7413+03	.6240+03	.5626+03
10	44.861	.3678+03	.8556+03	.9035+03	.9035+03	.8492+03	.7996+03	.8883+03	.7532+03	.6341+03	.5717+03
9	40.139	.3678+03	.8556+03	.9035+03	.9035+03	.8492+03	.7996+03	.8883+03	.7532+03	.6341+03	.5717+03
8	35.417	.3620+03	.8420+03	.8892+03	.8892+03	.8357+03	.7869+03	.8743+03	.7413+03	.6240+03	.5626+03
7	30.694	.3504+03	.8151+03	.8608+03	.8608+03	.8090+03	.7618+03	.8463+03	.7176+03	.6041+03	.5447+03
6	25.972	.3333+03	.7753+03	.8188+03	.8188+03	.7695+03	.7246+03	.8050+03	.6826+03	.5746+03	.5181+03
5	21.250	.3109+03	.7232+03	.7638+03	.7638+03	.7178+03	.6759+03	.7510+03	.6367+03	.5360+03	.4833+03
4	16.528	.2836+03	.6597+03	.6967+03	.6967+03	.6548+03	.6165+03	.6850+03	.5808+03	.4889+03	.4408+03
3	11.806	.2518+03	.5857+03	.6186+03	.6186+03	.5813+03	.5474+03	.6082+03	.5157+03	.4341+03	.3914+03
2	7.083	.2160+03	.5025+03	.5306+03	.5306+03	.4987+03	.4696+03	.5217+03	.4424+03	.3724+03	.3358+03
1	2.361	.1768+03	.4112+03	.4343+03	.4343+03	.4082+03	.3843+03	.4270+03	.3620+03	.3048+03	.2748+03

E-28

BMTL-944

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

COOLANT TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL	1	2	3	4	5	6	7	8	9	10
	CENTERLINE	.000	13.000	23.000	31.500	40.000	47.000	51.000	57.000	62.500	66.000
18	82.639	.1592+03	.3702+03	.3910+03	.3910+03	.3675+03	.3460+03	.3844+03	.3259+03	.2744+03	.2474+03
17	77.917	.1945+03	.4524+03	.4777+03	.4777+03	.4490+03	.4228+03	.4697+03	.3982+03	.3352+03	.3023+03
16	73.194	.2267+03	.5273+03	.5569+03	.5569+03	.5234+03	.4928+03	.5475+03	.4642+03	.3908+03	.3524+03
15	68.472	.2553+03	.5939+03	.6272+03	.6272+03	.5895+03	.5551+03	.6167+03	.5229+03	.4402+03	.3969+03
14	63.750	.2799+03	.6511+03	.6876+03	.6876+03	.6462+03	.6085+03	.6761+03	.5732+03	.4826+03	.4351+03
13	59.028	.3001+03	.6980+03	.7371+03	.7371+03	.6928+03	.6523+03	.7247+03	.6145+03	.5173+03	.4664+03
12	54.306	.3155+03	.7338+03	.7750+03	.7750+03	.7283+03	.6858+03	.7619+03	.6460+03	.5439+03	.4904+03
11	49.583	.3259+03	.7580+03	.8005+03	.8005+03	.7524+03	.7084+03	.7871+03	.6673+03	.5618+03	.5065+03
10	44.861	.3311+03	.7702+03	.8134+03	.8134+03	.7645+03	.7198+03	.7997+03	.6781+03	.5708+03	.5147+03
9	40.139	.3311+03	.7702+03	.8134+03	.8134+03	.7645+03	.7198+03	.7997+03	.6781+03	.5708+03	.5147+03
8	35.417	.3259+03	.7580+03	.8005+03	.8005+03	.7524+03	.7084+03	.7871+03	.6673+03	.5618+03	.5065+03
7	30.694	.3155+03	.7338+03	.7750+03	.7750+03	.7283+03	.6858+03	.7619+03	.6460+03	.5439+03	.4904+03
6	25.972	.3001+03	.6980+03	.7371+03	.7371+03	.6928+03	.6523+03	.7247+03	.6145+03	.5173+03	.4664+03
5	21.250	.2799+03	.6511+03	.6876+03	.6876+03	.6462+03	.6085+03	.6761+03	.5732+03	.4826+03	.4351+03
4	16.528	.2553+03	.5939+03	.6272+03	.6272+03	.5895+03	.5551+03	.6167+03	.5229+03	.4402+03	.3969+03
3	11.806	.2267+03	.5273+03	.5569+03	.5569+03	.5234+03	.4928+03	.5475+03	.4642+03	.3908+03	.3524+03
2	7.083	.1945+03	.4524+03	.4777+03	.4777+03	.4490+03	.4228+03	.4697+03	.3982+03	.3352+03	.3023+03
1	2.361	.1592+03	.3702+03	.3910+03	.3910+03	.3675+03	.3460+03	.3844+03	.3259+03	.2744+03	.2474+03

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

POWER DENSITY AT VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1 .000	2 13.000	3 23.000	4 31.500	5 40.000	6 47.000	7 51.000	8 57.000	9 62.500	10 66.000
18	82.639	.1006+05	.2340+05	.2471+05	.2471+05	.2322+05	.2186+05	.2429+05	.2060+05	.1734+05	.1563+05
17	77.917	.1229+05	.2858+05	.3019+05	.3019+05	.2837+05	.2671+05	.2968+05	.2517+05	.2118+05	.1910+05
16	73.194	.1433+05	.3332+05	.3519+05	.3519+05	.3307+05	.3114+05	.3460+05	.2934+05	.2470+05	.2227+05
15	68.472	.1613+05	.3753+05	.3903+05	.3963+05	.3725+05	.3508+05	.3897+05	.3304+05	.2781+05	.2508+05
14	63.750	.1769+05	.4114+05	.4345+05	.4345+05	.4084+05	.3845+05	.4272+05	.3622+05	.3049+05	.2749+05
13	59.028	.1896+05	.4411+05	.4658+05	.4658+05	.4378+05	.4122+05	.4580+05	.3883+05	.3269+05	.2947+05
12	54.306	.1994+05	.4637+05	.4897+05	.4897+05	.4602+05	.4334+05	.4815+05	.4082+05	.3437+05	.3099+05
11	49.583	.2059+05	.4790+05	.5059+05	.5059+05	.4754+05	.4477+05	.4974+05	.4217+05	.3550+05	.3201+05
10	44.861	.2092+05	.4867+05	.5140+05	.5140+05	.4831+05	.4549+05	.5054+05	.4285+05	.3607+05	.3252+05
9	40.139	.2092+05	.4867+05	.5140+05	.5140+05	.4831+05	.4549+05	.5054+05	.4285+05	.3607+05	.3252+05
8	35.417	.2059+05	.4790+05	.5059+05	.5059+05	.4754+05	.4477+05	.4974+05	.4217+05	.3550+05	.3201+05
7	30.694	.1994+05	.4637+05	.4897+05	.4897+05	.4602+05	.4334+05	.4815+05	.4082+05	.3437+05	.3099+05
6	25.972	.1896+05	.4411+05	.4658+05	.4658+05	.4378+05	.4122+05	.4580+05	.3883+05	.3269+05	.2947+05
5	21.250	.1769+05	.4114+05	.4345+05	.4345+05	.4084+05	.3845+05	.4272+05	.3622+05	.3049+05	.2749+05
4	16.528	.1613+05	.3753+05	.3903+05	.3963+05	.3725+05	.3508+05	.3897+05	.3304+05	.2781+05	.2508+05
3	11.806	.1433+05	.3332+05	.3519+05	.3519+05	.3307+05	.3114+05	.3460+05	.2934+05	.2470+05	.2227+05
2	7.083	.1229+05	.2858+05	.3019+05	.3019+05	.2837+05	.2671+05	.2968+05	.2517+05	.2118+05	.1910+05
1	2.361	.1006+05	.2340+05	.2471+05	.2471+05	.2322+05	.2186+05	.2429+05	.2060+05	.1734+05	.1563+05

CORE AVERAGE TEMPERATURE = .22341+04
K-III AVERAGE TEMPERATURE = .22988+04
CORE AVERAGE TEMPERATURE DOES NOT AGREE WITH K-III TEMPERATURE WITHIN EPSDOP

E-31

BMTL-944

SAMPLE CASE RR = 4%/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

GEOMETRY SPECIFICATIONS AND TEMPERATURE DISTRIBUTION LISTED BELOW

I	ZONE	RADIUS(CM)	AVG RADIUS(CM)	AREA(CM2)	VOLUME(CC)	TEMPERATURE(DEG K)
1	1	3.955-02	1.978-02	2.485-01	4.914-03	2.866+03
2	1	7.910-02	5.933-02	4.970-01	1.474-02	2.823+03
3	1	1.187-01	9.888-02	7.455-01	2.457-02	2.738+03
4	1	1.582-01	1.384-01	9.940-01	3.440-02	2.610+03
5	1	1.978-01	1.780-01	1.243+00	4.423-02	2.435+03
6	1	2.373-01	2.175-01	1.491+00	5.406-02	2.192+03
7	1	2.769-01	2.571-01	1.740+00	6.389-02	1.794+03
8	2	3.175-01	2.972-01	1.995+00	7.588-02	6.409+02
9	3	0.000	0.000	0.000	1.213-01	5.770+02

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

REACTIVITY INPUT DATA LISTED BELOW . . .

THE CURRENT TIME (SEC) = 4.0000-01

THE CURRENT REACTIVITY (CENTS) = 9.2825+01

LINEAR COEFFICIENT (CENTS/SEC) = 3.9987+02

QUADRATIC COEFFICIENT (CENTS/SEC²) = 0.0000

E-33

BNWL-944

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

SOLUTION OF KINETICS EQUATIONS BELOW

I	TIME(SEC)/VOID	POWER/COL	RHO(CENTS)/E	RHO 1/C1	RHO 2/C2	RHO 3/C3	TEMP 1/C4	TEMP 2/C5	TEMP 3/C6	TEMA/Q(MW SEC)
1	4.00000-01	3.6463+04	92.8248	-67.1221	.0000	.0000	2.2988+03	6.4094+02	5.7702+02	2.2341+03
	.0000	.0000	1.3426+03	3.411+07	1.098+08	2.524+07	2.191+07	4.028+06	1.060+06	8.23363+01
50	4.34360-01	4.5064+04	93.0947	-83.5918	.0000	.0000	2.6190+03	6.5798+02	5.8042+02	2.4709+03
	.0000	.0000	1.7654+03	3.455+07	1.131+08	2.773+07	2.561+07	5.064+06	1.354+06	2.18854+02
50	4.34360-01	TEMNOL =	3137.43210	PCMT =	20.65886	PCMX =	31.79249			

E-34

BMTL-944

SAMPLE CASE RR = 4%/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

CURRENT AXIAL POSITIONS OF THE VARIOUS FUEL SEGMENTS

TIME AFTER BEGINNING OF COLLAPSE = .752 MSEC

I	ORIGINAL	ORIG.		1	2	3	4	5	6	7	8	9	10
	CENTERLINE	LOWER	UPPER	.000	13.000	23.000	31.500	40.000	47.000	51.000	57.000	62.500	66.000
18	82.639	80.278	85.000	.8500+02	.8500+02	.8500+02	.8500+02	.8500+02	.8500+02	.8500+02	.8500+02	.8500+02	.8500+02
17	77.917	75.556	80.278	.8028+02	.8028+02	.8028+02	.8028+02	.8028+02	.8028+02	.8028+02	.8028+02	.8028+02	.8028+02
16	73.194	70.833	75.556	.7556+02	.7556+02	.7556+02	.7556+02	.7556+02	.7556+02	.7556+02	.7556+02	.7556+02	.7556+02
15	68.472	66.111	70.833	.7083+02	.7083+02	.7083+02	.7083+02	.7083+02	.7083+02	.7083+02	.7083+02	.7083+02	.7083+02
14	63.750	61.389	66.111	.6611+02	.6611+02	.6611+02	.6611+02	.6611+02	.6611+02	.6611+02	.6611+02	.6611+02	.6611+02
13	59.028	56.667	61.389	.6139+02	.6139+02	.6139+02	.6139+02	.6139+02	.6139+02	.6139+02	.6139+02	.6139+02	.6139+02
12	54.306	51.944	56.667	.5667+02	.5667+02	.5667+02	.5667+02	.5667+02	.5667+02	.5667+02	.5667+02	.5667+02	.5667+02
11	49.583	47.222	51.944	.5194+02	.5194+02	.5194+02	.5194+02	.5194+02	.5194+02	.5194+02	.5194+02	.5194+02	.5194+02
10	44.861	42.500	47.222	.4722+02	.4722+02	.4722+02	.4722+02	.4722+02	.4722+02	.4722+02	.4722+02	.4722+02	.4722+02
9	40.139	37.778	42.500	.4250+02	.4250+02	.4250+02	.4250+02	.4250+02	.4250+02	.4250+02	.4250+02	.4250+02	.4250+02
8	35.417	33.056	37.778	.3778+02	.3778+02	.3778+02	.3778+02	.3778+02	.3778+02	.3778+02	.3778+02	.3778+02	.3778+02
7	30.694	28.333	33.056	.3306+02	.3306+02	.3306+02	.3306+02	.3306+02	.3306+02	.3306+02	.3306+02	.3306+02	.3306+02
6	25.972	23.611	28.333	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02
5	21.250	18.889	23.611	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02
4	16.528	14.167	18.889	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02
3	11.806	9.444	14.167	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02
2	7.083	4.722	9.444	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01
1	2.361	.000	4.722	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01

E-35

BNWL-944

SAMPLE CASE RR = 4%/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

FUEL CENTERLINE TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1 .000	2 13.000	3 25.000	4 31.500	5 40.000	6 47.000	7 51.000	8 57.000	9 62.500	10 66.000
18	82.639	.9121+03	.2122+04	.2241+04	.2241+04	.2106+04	.1983+04	.2203+04	.1868+04	.1572+04	.1418+04
17	77.917	.1114+04	.2592+04	.2738+04	.2738+04	.2573+04	.2423+04	.2692+04	.2282+04	.1921+04	.1732+04
16	73.194	.1299+04	.3000+04	.3000+04	.3000+04	.2999+04	.2824+04	.3000+04	.2660+04	.2240+04	.2019+04
15	68.472	.1463+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.2996+04	.2522+04	.2274+04
14	63.750	.1604+04	.3010+04	.3229+04	.3229+04	.3000+04	.3000+04	.3159+04	.3000+04	.2765+04	.2493+04
13	59.028	.1720+04	.3280+04	.3511+04	.3511+04	.3259+04	.3020+04	.3442+04	.3000+04	.2964+04	.2673+04
12	54.306	.1808+04	.3493+04	.3725+04	.3725+04	.3463+04	.3209+04	.3643+04	.3000+04	.3000+04	.2810+04
11	49.583	.1868+04	.3622+04	.3871+04	.3871+04	.3599+04	.3341+04	.3789+04	.3109+04	.3000+04	.2903+04
10	44.861	.1898+04	.3703+04	.3935+04	.3935+04	.3663+04	.3412+04	.3870+04	.3169+04	.3000+04	.2950+04
9	40.139	.1898+04	.3703+04	.3935+04	.3935+04	.3663+04	.3412+04	.3870+04	.3169+04	.3000+04	.2950+04
8	35.417	.1868+04	.3622+04	.3871+04	.3871+04	.3599+04	.3341+04	.3789+04	.3109+04	.3000+04	.2903+04
7	30.694	.1808+04	.3493+04	.3725+04	.3725+04	.3463+04	.3209+04	.3643+04	.3000+04	.3000+04	.2810+04
6	25.972	.1720+04	.3280+04	.3511+04	.3511+04	.3259+04	.3020+04	.3442+04	.3000+04	.2964+04	.2673+04
5	21.250	.1604+04	.3010+04	.3229+04	.3229+04	.3000+04	.3000+04	.3159+04	.3000+04	.2765+04	.2493+04
4	16.528	.1463+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.2996+04	.2522+04	.2274+04
3	11.806	.1299+04	.3000+04	.3000+04	.3000+04	.2999+04	.2824+04	.3000+04	.2660+04	.2240+04	.2019+04
2	7.083	.1114+04	.2592+04	.2738+04	.2738+04	.2573+04	.2423+04	.2692+04	.2282+04	.1921+04	.1732+04
1	2.361	.9121+03	.2122+04	.2241+04	.2241+04	.2106+04	.1983+04	.2203+04	.1868+04	.1572+04	.1418+04

SAMPLE CASE RR = 4%/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

FUEL OUTER NODE TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL	1	2	3	4	5	6	7	8	9	10
	CENTERLINE	.000	13.000	23.000	31.500	40.000	47.000	51.000	57.000	62.500	66.000
18	82.639	.5880+03	.1368+04	.1445+04	.1445+04	.1358+04	.1278+04	.1420+04	.1204+04	.1014+04	.9140+03
17	77.917	.7185+03	.1671+04	.1765+04	.1765+04	.1659+04	.1562+04	.1735+04	.1471+04	.1239+04	.1117+04
16	73.194	.8375+03	.1948+04	.2057+04	.2057+04	.1934+04	.1821+04	.2023+04	.1715+04	.1444+04	.1302+04
15	68.472	.9433+03	.2194+04	.2317+04	.2317+04	.2178+04	.2051+04	.2278+04	.1932+04	.1626+04	.1466+04
14	63.750	.1034+04	.2406+04	.2540+04	.2540+04	.2388+04	.2248+04	.2498+04	.2118+04	.1783+04	.1607+04
13	59.028	.1109+04	.2579+04	.2723+04	.2723+04	.2559+04	.2410+04	.2678+04	.2270+04	.1911+04	.1723+04
12	54.306	.1166+04	.2711+04	.2863+04	.2863+04	.2691+04	.2534+04	.2815+04	.2387+04	.2009+04	.1812+04
11	49.583	.1204+04	.2801+04	.2958+04	.2958+04	.2780+04	.2617+04	.2908+04	.2466+04	.2076+04	.1871+04
10	44.861	.1223+04	.2846+04	.3000+04	.3000+04	.2824+04	.2659+04	.2955+04	.2505+04	.2109+04	.1902+04
9	40.139	.1223+04	.2846+04	.3000+04	.3000+04	.2824+04	.2659+04	.2955+04	.2505+04	.2109+04	.1902+04
8	35.417	.1204+04	.2801+04	.2958+04	.2958+04	.2780+04	.2617+04	.2908+04	.2466+04	.2076+04	.1871+04
7	30.694	.1166+04	.2711+04	.2863+04	.2863+04	.2691+04	.2534+04	.2815+04	.2387+04	.2009+04	.1812+04
6	25.972	.1109+04	.2579+04	.2723+04	.2723+04	.2559+04	.2410+04	.2678+04	.2270+04	.1911+04	.1723+04
5	21.250	.1034+04	.2406+04	.2540+04	.2540+04	.2388+04	.2248+04	.2498+04	.2118+04	.1783+04	.1607+04
4	16.528	.9433+03	.2194+04	.2317+04	.2317+04	.2178+04	.2051+04	.2278+04	.1932+04	.1626+04	.1466+04
3	11.806	.8375+03	.1948+04	.2057+04	.2057+04	.1934+04	.1821+04	.2023+04	.1715+04	.1444+04	.1302+04
2	7.083	.7185+03	.1671+04	.1765+04	.1765+04	.1659+04	.1562+04	.1735+04	.1471+04	.1239+04	.1117+04
1	2.361	.5880+03	.1368+04	.1445+04	.1445+04	.1358+04	.1278+04	.1420+04	.1204+04	.1014+04	.9140+03

SAMPLE CASE RR = 4%/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

CLAD TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1	2	3	4	5	6	7	8	9	10
18	82.639	.1828+03	.4252+03	.4490+03	.4490+03	.4220+03	.3973+03	.4415+03	.3743+03	.3151+03	.2841+03
17	77.917	.2233+03	.5195+03	.5486+03	.5486+03	.5156+03	.4855+03	.5394+03	.4573+03	.3850+03	.3471+03
16	73.194	.2603+03	.6055+03	.6395+03	.6395+03	.6010+03	.5659+03	.6287+03	.5331+03	.4488+03	.4046+03
15	68.472	.2932+03	.6820+03	.7203+03	.7203+03	.6769+03	.6374+03	.7082+03	.6004+03	.5055+03	.4558+03
14	63.750	.3214+03	.7477+03	.7896+03	.7896+03	.7421+03	.6988+03	.7764+03	.6583+03	.5541+03	.4996+03
13	59.028	.3446+03	.8016+03	.8405+03	.8465+03	.7956+03	.7491+03	.8323+03	.7057+03	.5941+03	.5356+03
12	54.306	.3623+03	.8427+03	.8900+03	.8900+03	.8364+03	.7876+03	.8750+03	.7419+03	.6245+03	.5631+03
11	49.563	.3742+03	.8705+03	.9193+03	.9193+03	.8640+03	.8136+03	.9039+03	.7664+03	.6451+03	.5817+03
10	44.861	.3803+03	.8845+03	.9341+03	.9341+03	.8779+03	.8266+03	.9184+03	.7787+03	.6555+03	.5911+03
9	40.139	.3803+03	.8845+03	.9341+03	.9341+03	.8779+03	.8266+03	.9184+03	.7787+03	.6555+03	.5911+03
8	35.417	.3742+03	.8705+03	.9193+03	.9193+03	.8640+03	.8136+03	.9039+03	.7664+03	.6451+03	.5817+03
7	30.694	.3623+03	.8427+03	.8900+03	.8900+03	.8364+03	.7876+03	.8750+03	.7419+03	.6245+03	.5631+03
6	25.972	.3446+03	.8016+03	.8405+03	.8465+03	.7956+03	.7491+03	.8323+03	.7057+03	.5941+03	.5356+03
5	21.250	.3214+03	.7477+03	.7896+03	.7896+03	.7421+03	.6988+03	.7764+03	.6583+03	.5541+03	.4996+03
4	16.528	.2932+03	.6820+03	.7203+03	.7203+03	.6769+03	.6374+03	.7082+03	.6004+03	.5055+03	.4558+03
3	11.806	.2603+03	.6055+03	.6395+03	.6395+03	.6010+03	.5659+03	.6287+03	.5331+03	.4488+03	.4046+03
2	7.083	.2233+03	.5195+03	.5486+03	.5486+03	.5156+03	.4855+03	.5394+03	.4573+03	.3850+03	.3471+03
1	2.361	.1828+03	.4252+03	.4490+03	.4490+03	.4220+03	.3973+03	.4415+03	.3743+03	.3151+03	.2841+03

E-38

BWLT-944

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

COOLANT TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1 .000	2 13.000	3 25.000	4 31.500	5 40.000	6 47.000	7 51.000	8 57.000	9 62.500	10 66.000
18	82.639	.1604+03	.3730+03	.3939+03	.3939+03	.3702+03	.3486+03	.3873+03	.3284+03	.2764+03	.2493+03
17	77.917	.1959+03	.4558+03	.4813+03	.4813+03	.4523+03	.4259+03	.4732+03	.4012+03	.3378+03	.3045+03
16	73.194	.2284+03	.5313+03	.5611+03	.5611+03	.5273+03	.4965+03	.5516+03	.4677+03	.3937+03	.3550+03
15	68.472	.2572+03	.5984+03	.6319+03	.6319+03	.5939+03	.5592+03	.6213+03	.5268+03	.4435+03	.3999+03
14	63.750	.2820+03	.6560+03	.6928+03	.6928+03	.6511+03	.6131+03	.6811+03	.5775+03	.4862+03	.4384+03
13	59.028	.3023+03	.7032+03	.7427+03	.7427+03	.6980+03	.6572+03	.7302+03	.6191+03	.5212+03	.4699+03
12	54.306	.3178+03	.7393+03	.7808+03	.7808+03	.7338+03	.6910+03	.7677+03	.6509+03	.5479+03	.4940+03
11	49.583	.3283+03	.7637+03	.8066+03	.8066+03	.7580+03	.7138+03	.7930+03	.6724+03	.5660+03	.5103+03
10	44.861	.3336+03	.7760+03	.8195+03	.8295+03	.7702+03	.7253+03	.8058+03	.6832+03	.5751+03	.5186+03
9	40.139	.3336+03	.7760+03	.8195+03	.8195+03	.7702+03	.7253+03	.8058+03	.6832+03	.5751+03	.5186+03
8	35.417	.3283+03	.7637+03	.8066+03	.8066+03	.7580+03	.7138+03	.7930+03	.6724+03	.5660+03	.5103+03
7	30.694	.3178+03	.7393+03	.7808+03	.7808+03	.7338+03	.6910+03	.7677+03	.6509+03	.5479+03	.4940+03
6	25.972	.3023+03	.7032+03	.7427+03	.7427+03	.6980+03	.6572+03	.7302+03	.6191+03	.5212+03	.4699+03
5	21.250	.2820+03	.6560+03	.6928+03	.6928+03	.6511+03	.6131+03	.6811+03	.5775+03	.4862+03	.4384+03
4	16.528	.2572+03	.5984+03	.6319+03	.6319+03	.5939+03	.5592+03	.6213+03	.5268+03	.4435+03	.3999+03
3	11.806	.2284+03	.5313+03	.5611+03	.5611+03	.5273+03	.4965+03	.5516+03	.4677+03	.3937+03	.3550+03
2	7.083	.1959+03	.4558+03	.4813+03	.4813+03	.4523+03	.4259+03	.4732+03	.4012+03	.3378+03	.3045+03
1	2.361	.1604+03	.3730+03	.3939+03	.3939+03	.3702+03	.3486+03	.3873+03	.3284+03	.2764+03	.2493+03

SAMPLE CASE RR = 45/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

POWER DENSITY AT VARIOUS RADIAL CHANNELS

I	ORIGINAL	1	2	3	4	5	6	7	8	9	10
	CENTERLINE	.000	13.000	25.000	31.500	40.000	47.000	51.000	57.000	62.500	66.000
18	82.639	.1288+05	.2996+05	.3164+05	.3164+05	.2974+05	.2800+05	.3111+05	.2638+05	.2221+05	.2002+05
17	77.917	.1574+05	.3661+05	.3866+05	.3866+05	.3633+05	.3421+05	.3801+05	.3223+05	.2713+05	.2446+05
16	73.194	.1835+05	.4267+05	.4507+05	.4507+05	.4235+05	.3988+05	.4431+05	.3757+05	.3163+05	.2852+05
15	68.472	.2066+05	.4806+05	.5076+05	.5076+05	.4770+05	.4492+05	.4991+05	.4231+05	.3562+05	.3212+05
14	63.750	.2265+05	.5269+05	.5565+05	.5565+05	.5230+05	.4925+05	.5471+05	.4639+05	.3905+05	.3521+05
13	59.028	.2428+05	.5649+05	.5965+05	.5965+05	.5606+05	.5279+05	.5865+05	.4973+05	.4186+05	.3775+05
12	54.306	.2553+05	.5939+05	.6272+05	.6272+05	.5894+05	.5550+05	.6166+05	.5228+05	.4401+05	.3968+05
11	49.583	.2637+05	.6135+05	.6479+05	.6479+05	.6089+05	.5733+05	.6370+05	.5401+05	.4546+05	.4099+05
10	44.861	.2680+05	.6233+05	.6583+05	.6583+05	.6187+05	.5825+05	.6472+05	.5488+05	.4620+05	.4165+05
9	40.139	.2680+05	.6233+05	.6583+05	.6583+05	.6187+05	.5825+05	.6472+05	.5488+05	.4620+05	.4165+05
8	35.417	.2637+05	.6135+05	.6479+05	.6479+05	.6089+05	.5733+05	.6370+05	.5401+05	.4546+05	.4099+05
7	30.694	.2553+05	.5939+05	.6272+05	.6272+05	.5894+05	.5550+05	.6166+05	.5228+05	.4401+05	.3968+05
6	25.972	.2428+05	.5649+05	.5965+05	.5965+05	.5606+05	.5279+05	.5865+05	.4973+05	.4186+05	.3775+05
5	21.250	.2265+05	.5269+05	.5565+05	.5565+05	.5230+05	.4925+05	.5471+05	.4639+05	.3905+05	.3521+05
4	16.528	.2066+05	.4806+05	.5076+05	.5076+05	.4770+05	.4492+05	.4991+05	.4231+05	.3562+05	.3212+05
3	11.806	.1835+05	.4267+05	.4507+05	.4507+05	.4235+05	.3988+05	.4431+05	.3757+05	.3163+05	.2852+05
2	7.083	.1574+05	.3661+05	.3866+05	.3866+05	.3633+05	.3421+05	.3801+05	.3223+05	.2713+05	.2446+05
1	2.361	.1288+05	.2996+05	.3164+05	.3164+05	.2974+05	.2800+05	.3111+05	.2638+05	.2221+05	.2002+05

E-40

BMWL-944

CORE AVERAGE TEMPERATURE = .25334+04
 K-III AVERAGE TEMPERATURE = .27053+04
 CORE AVERAGE TEMPERATURE DOES NOT AGREE WITH K-III TEMPERATURE WITHIN EPSDOP
 61 4.42637-01 4.6696+04 93.0915 -83.9223 .0000 .0000 2.7053+03 6.6263+02 5.8136+02 2.5334+03
 .0000 .0178 1.8793+03 3.467+07 1.139+08 2.841+07 2.661+07 5.341+06 1.432+06 2.66226+02
 61 4.42637-01 TEMMOL = 3177.16010 PCMT = 24.01508 PCMX = 35.61774

E-41

BWJL-944

SAMPLE CASE RR = 4%/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

CURRENT AXIAL POSITIONS OF THE VARIOUS FUEL SEGMENTS

TIME AFTER BEGINNING OF COLLAPSE = 10.181 MSEC

I	ORIGINAL CENTERLINE	ORIG. LOWER	ORIG. UPPER	1	2	3	4	5	6	7	8	9	10
18	82.639	80.278	85.000	.8500+02	.8500+02	.8495+02	.8495+02	.8500+02	.8500+02	.8498+02	.8500+02	.8500+02	.8500+02
17	77.917	75.556	80.278	.8028+02	.8028+02	.8023+02	.8023+02	.8028+02	.8028+02	.8026+02	.8028+02	.8028+02	.8028+02
16	73.194	70.833	75.556	.7556+02	.7556+02	.7550+02	.7550+02	.7556+02	.7556+02	.7554+02	.7556+02	.7556+02	.7556+02
15	68.472	66.111	70.833	.7083+02	.7083+02	.7078+02	.7078+02	.7083+02	.7083+02	.7082+02	.7083+02	.7083+02	.7083+02
14	63.750	61.389	66.111	.6611+02	.6611+02	.6606+02	.6606+02	.6611+02	.6611+02	.6609+02	.6611+02	.6611+02	.6611+02
13	59.028	56.667	61.389	.6139+02	.6139+02	.6134+02	.6134+02	.6139+02	.6139+02	.6137+02	.6139+02	.6139+02	.6139+02
12	54.306	51.944	56.667	.5667+02	.5667+02	.5662+02	.5662+02	.5667+02	.5667+02	.5665+02	.5667+02	.5667+02	.5667+02
11	49.583	47.222	51.944	.5194+02	.5194+02	.5189+02	.5189+02	.5194+02	.5194+02	.5193+02	.5194+02	.5194+02	.5194+02
10	44.861	42.500	47.222	.4722+02	.4722+02	.4717+02	.4717+02	.4722+02	.4722+02	.4720+02	.4722+02	.4722+02	.4722+02
9	40.139	37.778	42.500	.4250+02	.4250+02	.4245+02	.4245+02	.4250+02	.4250+02	.4248+02	.4250+02	.4250+02	.4250+02
8	35.417	33.056	37.778	.3778+02	.3778+02	.3773+02	.3773+02	.3778+02	.3778+02	.3776+02	.3778+02	.3778+02	.3778+02
7	30.694	28.333	33.056	.3306+02	.3306+02	.3304+02	.3304+02	.3306+02	.3306+02	.3305+02	.3306+02	.3306+02	.3306+02
6	25.972	23.611	28.333	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02	.2833+02
5	21.250	18.889	23.611	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02
4	16.528	14.167	18.889	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02
3	11.806	9.444	14.167	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02
2	7.083	4.722	9.444	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01
1	2.361	.000	4.722	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01

E-42

BNWL-944

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

FUEL CENTERLINE TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL	1	2	3	4	5	6	7	8	9	10
	CENTERLINE	.000	13.000	23.000	31.500	40.000	47.000	51.000	57.000	62.500	66.000
18	82.639	.9465+03	.2202+04	.2325+04	.2325+04	.2185+04	.2058+04	.2286+04	.1938+04	.1632+04	.1471+04
17	77.917	.1156+04	.2690+04	.2841+04	.2841+04	.2670+04	.2514+04	.2793+04	.2368+04	.1994+04	.1797+04
16	73.194	.1348+04	.3000+04	.3000+04	.3000+04	.3000+04	.2931+04	.3000+04	.2761+04	.2324+04	.2095+04
15	68.472	.1518+04	.3000+04	.3006+04	.3006+04	.3000+04	.3000+04	.3000+04	.3000+04	.2617+04	.2360+04
14	63.750	.1665+04	.3150+04	.3378+04	.3378+04	.3130+04	.3000+04	.3305+04	.3000+04	.2870+04	.2587+04
13	59.028	.1784+04	.3431+04	.3670+04	.3670+04	.3409+04	.3160+04	.3599+04	.3000+04	.3000+04	.2774+04
12	54.306	.1876+04	.3652+04	.3892+04	.3892+04	.3620+04	.3357+04	.3807+04	.3118+04	.3000+04	.2916+04
11	49.583	.1938+04	.3785+04	.4044+04	.4044+04	.3762+04	.3494+04	.3959+04	.3253+04	.3000+04	.3000+04
10	44.861	.1969+04	.3869+04	.4111+04	.4111+04	.3828+04	.3568+04	.4043+04	.3315+04	.3000+04	.3000+04
9	40.139	.1969+04	.3869+04	.4111+04	.4111+04	.3828+04	.3568+04	.4043+04	.3315+04	.3000+04	.3000+04
8	35.417	.1938+04	.3785+04	.4044+04	.4044+04	.3762+04	.3494+04	.3959+04	.3253+04	.3000+04	.3000+04
7	30.694	.1876+04	.3652+04	.3892+04	.3892+04	.3620+04	.3357+04	.3807+04	.3118+04	.3000+04	.2916+04
6	25.972	.1784+04	.3431+04	.3670+04	.3670+04	.3409+04	.3160+04	.3599+04	.3000+04	.3000+04	.2774+04
5	21.250	.1665+04	.3150+04	.3378+04	.3378+04	.3130+04	.3000+04	.3305+04	.3000+04	.2870+04	.2587+04
4	16.528	.1518+04	.3000+04	.3006+04	.3006+04	.3000+04	.3000+04	.3000+04	.3000+04	.2617+04	.2360+04
3	11.806	.1348+04	.3000+04	.3000+04	.3000+04	.3000+04	.2931+04	.3000+04	.2761+04	.2324+04	.2095+04
2	7.083	.1156+04	.2690+04	.2841+04	.2841+04	.2670+04	.2514+04	.2793+04	.2368+04	.1994+04	.1797+04
1	2.361	.9465+03	.2202+04	.2325+04	.2325+04	.2185+04	.2058+04	.2286+04	.1938+04	.1632+04	.1471+04

E-43

BNWL-944

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

FUEL OUTER NODE TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1 .000	2 13.000	3 25.000	4 31.500	5 40.000	6 47.000	7 51.000	8 57.000	9 62.500	10 66.000
18	82.639	.6148+03	.1430+04	.1510+04	.1510+04	.1419+04	.1337+04	.1485+04	.1259+04	.1060+04	.9557+03
17	77.917	.7512+03	.1747+04	.1845+04	.1845+04	.1734+04	.1633+04	.1814+04	.1538+04	.1295+04	.1168+04
16	73.194	.8757+03	.2037+04	.2151+04	.2151+04	.2022+04	.1904+04	.2115+04	.1793+04	.1510+04	.1361+04
15	68.472	.9863+03	.2294+04	.2423+04	.2423+04	.2277+04	.2144+04	.2382+04	.2020+04	.1700+04	.1533+04
14	63.750	.1081+04	.2515+04	.2656+04	.2656+04	.2496+04	.2351+04	.2612+04	.2214+04	.1864+04	.1681+04
13	59.028	.1159+04	.2696+04	.2847+04	.2847+04	.2676+04	.2520+04	.2800+04	.2374+04	.1998+04	.1802+04
12	54.306	.1219+04	.2835+04	.2994+04	.2994+04	.2813+04	.2649+04	.2943+04	.2496+04	.2101+04	.1894+04
11	49.583	.1259+04	.2928+04	.3050+04	.3000+04	.2906+04	.2737+04	.3000+04	.2578+04	.2170+04	.1957+04
10	44.861	.1279+04	.2975+04	.3050+04	.3000+04	.2953+04	.2781+04	.3000+04	.2619+04	.2205+04	.1988+04
9	40.139	.1279+04	.2975+04	.3050+04	.3000+04	.2953+04	.2781+04	.3000+04	.2619+04	.2205+04	.1988+04
8	35.417	.1259+04	.2928+04	.3050+04	.3000+04	.2906+04	.2737+04	.3000+04	.2578+04	.2170+04	.1957+04
7	30.694	.1219+04	.2835+04	.2994+04	.2994+04	.2813+04	.2649+04	.2943+04	.2496+04	.2101+04	.1894+04
6	25.972	.1159+04	.2696+04	.2847+04	.2847+04	.2676+04	.2520+04	.2800+04	.2374+04	.1998+04	.1802+04
5	21.250	.1081+04	.2515+04	.2656+04	.2656+04	.2496+04	.2351+04	.2612+04	.2214+04	.1864+04	.1681+04
4	16.528	.9863+03	.2294+04	.2423+04	.2423+04	.2277+04	.2144+04	.2382+04	.2020+04	.1700+04	.1533+04
3	11.806	.8757+03	.2037+04	.2151+04	.2151+04	.2022+04	.1904+04	.2115+04	.1793+04	.1510+04	.1361+04
2	7.083	.7512+03	.1747+04	.1845+04	.1845+04	.1734+04	.1633+04	.1814+04	.1538+04	.1295+04	.1168+04
1	2.361	.6148+03	.1430+04	.1510+04	.1510+04	.1419+04	.1337+04	.1485+04	.1259+04	.1060+04	.9557+03

E-44

BNWL-944

SAMPLE CASE RR = 4%/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

CLAD TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1 .000	2 13.000	3 23.000	4 31.500	5 40.000	6 47.000	7 51.000	8 57.000	9 62.500	10 66.000
18	82.639	.1843+03	.4288+03	.4528+03	.4528+03	.4256+03	.4007+03	.4452+03	.3775+03	.3178+03	.2865+03
17	77.917	.2252+03	.5239+03	.5532+03	.5532+03	.5200+03	.4896+03	.5439+03	.4612+03	.3882+03	.3501+03
16	73.194	.2625+03	.6107+03	.6449+03	.6449+03	.6061+03	.5707+03	.6341+03	.5376+03	.4526+03	.4081+03
15	68.472	.2957+03	.6878+03	.7204+03	.7264+03	.6827+03	.6428+03	.7142+03	.6055+03	.5098+03	.4596+03
14	63.750	.3242+03	.7540+03	.7903+03	.7963+03	.7484+03	.7047+03	.7829+03	.6638+03	.5588+03	.5039+03
13	59.028	.3475+03	.8083+03	.8537+03	.8537+03	.8023+03	.7555+03	.8393+03	.7116+03	.5991+03	.5402+03
12	54.306	.3654+03	.8498+03	.8975+03	.8975+03	.8435+03	.7942+03	.8824+03	.7482+03	.6298+03	.5679+03
11	49.583	.3774+03	.8779+03	.9271+03	.9271+03	.8713+03	.8204+03	.9115+03	.7729+03	.6506+03	.5866+03
10	44.861	.3835+03	.8920+03	.9420+03	.9420+03	.8853+03	.8336+03	.9262+03	.7853+03	.6611+03	.5961+03
9	40.139	.3835+03	.8920+03	.9420+03	.9420+03	.8853+03	.8336+03	.9262+03	.7853+03	.6611+03	.5961+03
8	35.417	.3774+03	.8779+03	.9271+03	.9271+03	.8713+03	.8204+03	.9115+03	.7729+03	.6506+03	.5866+03
7	30.694	.3654+03	.8498+03	.8975+03	.8975+03	.8435+03	.7942+03	.8824+03	.7482+03	.6298+03	.5679+03
6	25.972	.3475+03	.8083+03	.8537+03	.8537+03	.8023+03	.7555+03	.8393+03	.7116+03	.5991+03	.5402+03
5	21.250	.3242+03	.7540+03	.7903+03	.7963+03	.7484+03	.7047+03	.7829+03	.6638+03	.5588+03	.5039+03
4	16.528	.2957+03	.6878+03	.7204+03	.7264+03	.6827+03	.6428+03	.7142+03	.6055+03	.5098+03	.4596+03
3	11.806	.2625+03	.6107+03	.6449+03	.6449+03	.6061+03	.5707+03	.6341+03	.5376+03	.4526+03	.4081+03
2	7.083	.2252+03	.5239+03	.5532+03	.5532+03	.5200+03	.4896+03	.5439+03	.4612+03	.3882+03	.3501+03
1	2.361	.1843+03	.4288+03	.4528+03	.4528+03	.4256+03	.4007+03	.4452+03	.3775+03	.3178+03	.2865+03

E-45

BNWL-944

SAMPLE CASE RR = 4%/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

COOLANT TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1	2	3	4	5	6	7	8	9	10
		.000	13.000	23.000	31.500	40.000	47.000	51.000	57.000	62.500	66.000
18	82.639	.1607+03	.3737+03	.3947+03	.3947+03	.3709+03	.3493+03	.3881+03	.3290+03	.2770+03	.2497+03
17	77.917	.1963+03	.4566+03	.4822+03	.4822+03	.4532+03	.4268+03	.4741+03	.4020+03	.3384+03	.3051+03
16	73.194	.2288+03	.5323+03	.5621+03	.5621+03	.5283+03	.4975+03	.5527+03	.4686+03	.3945+03	.3557+03
15	68.472	.2577+03	.5995+03	.6331+03	.6331+03	.5950+03	.5603+03	.6225+03	.5278+03	.4443+03	.4006+03
14	63.750	.2826+03	.6573+03	.6941+03	.6941+03	.6524+03	.6143+03	.6825+03	.5786+03	.4871+03	.4392+03
13	59.028	.3029+03	.7046+03	.7441+03	.7441+03	.6993+03	.6585+03	.7316+03	.6203+03	.5222+03	.4708+03
12	54.306	.3185+03	.7408+03	.7823+03	.7823+03	.7352+03	.6923+03	.7691+03	.6522+03	.5490+03	.4950+03
11	49.583	.3290+03	.7652+03	.8081+03	.8081+03	.7595+03	.7151+03	.7945+03	.6737+03	.5671+03	.5113+03
10	44.861	.3343+03	.7775+03	.8211+03	.8211+03	.7717+03	.7266+03	.8073+03	.6845+03	.5762+03	.5196+03
9	40.139	.3343+03	.7775+03	.8211+03	.8211+03	.7717+03	.7266+03	.8073+03	.6845+03	.5762+03	.5196+03
8	35.417	.3290+03	.7652+03	.8081+03	.8081+03	.7595+03	.7151+03	.7945+03	.6737+03	.5671+03	.5113+03
7	30.694	.3185+03	.7408+03	.7823+03	.7823+03	.7352+03	.6923+03	.7691+03	.6522+03	.5490+03	.4950+03
6	25.972	.3029+03	.7046+03	.7441+03	.7441+03	.6993+03	.6585+03	.7316+03	.6203+03	.5222+03	.4708+03
5	21.250	.2826+03	.6573+03	.6941+03	.6941+03	.6524+03	.6143+03	.6825+03	.5786+03	.4871+03	.4392+03
4	16.528	.2577+03	.5995+03	.6331+03	.6331+03	.5950+03	.5603+03	.6225+03	.5278+03	.4443+03	.4006+03
3	11.806	.2288+03	.5323+03	.5621+03	.5621+03	.5283+03	.4975+03	.5527+03	.4686+03	.3945+03	.3557+03
2	7.083	.1963+03	.4566+03	.4822+03	.4822+03	.4532+03	.4268+03	.4741+03	.4020+03	.3384+03	.3051+03
1	2.361	.1607+03	.3737+03	.3947+03	.3947+03	.3709+03	.3493+03	.3881+03	.3290+03	.2770+03	.2497+03

E-46

BWLT-944

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

POWER DENSITY AT VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1 .000	2 13.000	3 23.000	4 31.500	5 40.000	6 47.000	7 51.000	8 57.000	9 62.500	10 66.000
18	82.639	.1880+05	.4373+05	.4629+05	.4629+05	.4340+05	.4087+05	.4544+05	.3850+05	.3241+05	.2922+05
17	77.917	.2297+05	.5343+05	.5652+05	.5652+05	.5303+05	.4994+05	.5551+05	.4704+05	.3960+05	.3570+05
16	73.194	.2678+05	.6229+05	.6586+05	.6586+05	.6182+05	.5821+05	.6470+05	.5483+05	.4616+05	.4162+05
15	68.472	.3016+05	.7015+05	.7416+05	.7416+05	.6963+05	.6556+05	.7286+05	.6176+05	.5199+05	.4688+05
14	63.750	.3306+05	.7691+05	.8128+05	.8128+05	.7633+05	.7188+05	.7987+05	.6771+05	.5700+05	.5139+05
13	59.028	.3544+05	.8245+05	.8711+05	.8711+05	.8183+05	.7705+05	.8562+05	.7258+05	.6110+05	.5509+05
12	54.306	.3726+05	.8668+05	.9157+05	.9157+05	.8603+05	.8101+05	.9001+05	.7631+05	.6424+05	.5792+05
11	49.583	.3849+05	.8954+05	.9457+05	.9457+05	.8887+05	.8368+05	.9297+05	.7883+05	.6636+05	.5983+05
10	44.861	.3911+05	.9098+05	.9608+05	.9608+05	.9030+05	.8503+05	.9447+05	.8010+05	.6743+05	.6079+05
9	40.139	.3911+05	.9098+05	.9607+05	.9607+05	.9030+05	.8503+05	.9446+05	.8010+05	.6743+05	.6079+05
8	35.417	.3849+05	.8954+05	.9455+05	.9455+05	.8887+05	.8368+05	.9297+05	.7883+05	.6636+05	.5983+05
7	30.694	.3726+05	.8668+05	.9154+05	.9154+05	.8603+05	.8101+05	.9000+05	.7631+05	.6424+05	.5792+05
6	25.972	.3544+05	.8245+05	.8707+05	.8707+05	.8183+05	.7705+05	.8561+05	.7258+05	.6110+05	.5509+05
5	21.250	.3306+05	.7691+05	.8122+05	.8122+05	.7633+05	.7188+05	.7986+05	.6771+05	.5700+05	.5139+05
4	16.528	.3016+05	.7015+05	.7409+05	.7409+05	.6963+05	.6556+05	.7284+05	.6176+05	.5199+05	.4688+05
3	11.806	.2678+05	.6229+05	.6578+05	.6578+05	.6182+05	.5821+05	.6467+05	.5483+05	.4616+05	.4162+05
2	7.083	.2297+05	.5343+05	.5643+05	.5643+05	.5303+05	.4994+05	.5548+05	.4704+05	.3960+05	.3570+05
1	2.361	.1880+05	.4373+05	.4618+05	.4618+05	.4340+05	.4087+05	.4541+05	.3850+05	.3241+05	.2922+05

E-47

BNWL-944

CORE AVERAGE TEMPERATURE = .26170+04
 K-III AVERAGE TEMPERATURE = .28205+04
 CORE AVERAGE TEMPERATURE DOES NOT AGREE WITH K-III TEMPERATURE WITHIN EPSDOP
 103 4.52065-01 6.8157+04 96.1713 -88.2102 .0000 .0000 2.8205+03 6.6824+02 5.8247+02 2.6170+03
 .0000 3.6155 2.0299+03 3.483+07 1.151+08 2.930+07 2.794+07 5.715+06 1.539+06 3.36515+02
 103 4.52065-01 TEMMOL = 3235.75720 PCMT = 28.50857 PCMX = 40.18525

E-48

BNWL-944

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

THE CORE IS NEARING A DISASSEMBLY CONDITION

TEMA (CORE AVERAGE TEMPERATURE)	=	2778.554	DEGREES KELVIN
TIME AFTER BEGINNING OF TRANSIENT	=	.4601-00	SECONDS
POWER	=	.2026+06	WATTS/CC OF FUEL
NET REACTIVITY	=	100.772	CENTS
COLLAPSE FEEDBACK	=	13.091	CENTS
VOID FEEDBACK	=	.000	CENTS
COLLAPSE RAMP RATE	=	16.323	DOLLARS/SEC
VOID RAMP RATE	=	.000	DOLLARS/SEC
TOTAL RAMP RATE (INCLUDING INITIATING RR)=		20.322	DOLLARS/SEC
AVERAGE TEMPERATURE OF MOLTEN FUEL	=	3352.296	DEGREES KELVIN
PORTION OF THE FUEL IN THE MOLTEN STATE	=	37.196	PER CENT
PORTION OF THE FUEL NODES PART MOLTEN	=	50.569	PER CENT

E-419

BWML-944

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

CURRENT AXIAL POSITIONS OF THE VARIOUS FUEL SEGMENTS

TIME AFTER BEGINNING OF COLLAPSE = 20.036 MSEC

I	ORIGINAL	ORIG.	ORIG.	1	2	3	4	5	6	7	8	9	10
	CENTERLINE	LOWER	UPPER	.000	13.000	23.000	31.500	40.000	47.000	51.000	57.000	62.500	66.000
18	82.639	80.278	85.000	.8500+02	.8496+02	.8480+02	.8480+02	.8497+02	.8500+02	.8488+02	.8500+02	.8500+02	.8500+02
17	77.917	75.556	80.278	.8028+02	.8024+02	.8008+02	.8008+02	.8025+02	.8027+02	.8015+02	.8028+02	.8028+02	.8028+02
16	73.194	70.833	75.556	.7556+02	.7552+02	.7536+02	.7536+02	.7553+02	.7555+02	.7543+02	.7556+02	.7556+02	.7556+02
15	68.472	66.111	70.833	.7083+02	.7079+02	.7064+02	.7064+02	.7080+02	.7083+02	.7071+02	.7083+02	.7083+02	.7083+02
14	63.750	61.389	66.111	.6611+02	.6607+02	.6591+02	.6591+02	.6608+02	.6611+02	.6599+02	.6611+02	.6611+02	.6611+02
13	59.028	56.667	61.389	.6139+02	.6135+02	.6119+02	.6119+02	.6136+02	.6138+02	.6127+02	.6139+02	.6139+02	.6139+02
12	54.306	51.944	56.667	.5667+02	.5663+02	.5647+02	.5647+02	.5664+02	.5666+02	.5654+02	.5667+02	.5667+02	.5667+02
11	49.583	47.222	51.944	.5194+02	.5191+02	.5175+02	.5175+02	.5191+02	.5194+02	.5182+02	.5194+02	.5194+02	.5194+02
10	44.861	42.500	47.222	.4722+02	.4718+02	.4703+02	.4703+02	.4719+02	.4722+02	.4710+02	.4722+02	.4722+02	.4722+02
9	40.139	37.778	42.500	.4250+02	.4246+02	.4230+02	.4230+02	.4247+02	.4250+02	.4238+02	.4250+02	.4250+02	.4250+02
8	35.417	33.056	37.778	.3778+02	.3774+02	.3758+02	.3758+02	.3775+02	.3777+02	.3765+02	.3778+02	.3778+02	.3778+02
7	30.694	28.333	33.056	.3306+02	.3303+02	.3293+02	.3293+02	.3304+02	.3305+02	.3298+02	.3306+02	.3306+02	.3306+02
6	25.972	23.611	28.333	.2833+02	.2833+02	.2829+02	.2829+02	.2833+02	.2833+02	.2831+02	.2833+02	.2833+02	.2833+02
5	21.250	18.889	23.611	.2361+02	.2361+02	.2360+02	.2360+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02	.2361+02
4	16.528	14.167	18.889	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02	.1889+02
3	11.806	9.444	14.167	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02	.1417+02
2	7.083	4.722	9.444	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01	.9444+01
1	2.361	.000	4.722	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01	.4722+01

E-50

BNWL-944

SAMPLE CASE RR = 4%/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

FUEL CENTERLINE TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1 .000	2 13.000	3 25.000	4 31.500	5 40.000	6 47.000	7 51.000	8 57.000	9 62.500	10 66.000
18	82.639	.1041+04	.2422+04	.2558+04	.2558+04	.2404+04	.2263+04	.2515+04	.2132+04	.1795+04	.1618+04
17	77.917	.1272+04	.2959+04	.3000+04	.3000+04	.2937+04	.2765+04	.3000+04	.2605+04	.2193+04	.1977+04
16	73.194	.1483+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.2556+04	.2305+04
15	68.472	.1670+04	.3147+04	.3379+04	.3379+04	.3113+04	.3000+04	.3303+04	.3000+04	.2879+04	.2596+04
14	63.750	.1831+04	.3538+04	.3786+04	.3786+04	.3514+04	.3264+04	.3707+04	.3022+04	.3000+04	.2846+04
13	59.028	.1963+04	.3846+04	.4108+04	.4108+04	.3821+04	.3548+04	.4030+04	.3302+04	.3000+04	.3000+04
12	54.306	.2064+04	.4088+04	.4353+04	.4353+04	.4053+04	.3765+04	.4260+04	.3502+04	.3000+04	.3000+04
11	49.583	.2132+04	.4236+04	.4520+04	.4520+04	.4209+04	.3916+04	.4427+04	.3650+04	.3000+04	.3000+04
10	44.861	.2166+04	.4328+04	.4594+04	.4594+04	.4282+04	.3996+04	.4518+04	.3718+04	.3000+04	.3000+04
9	40.139	.2166+04	.4328+04	.4594+04	.4594+04	.4282+04	.3996+04	.4518+04	.3718+04	.3000+04	.3000+04
8	35.417	.2132+04	.4236+04	.4520+04	.4520+04	.4209+04	.3916+04	.4427+04	.3650+04	.3000+04	.3000+04
7	30.694	.2064+04	.4088+04	.4353+04	.4353+04	.4053+04	.3765+04	.4260+04	.3502+04	.3000+04	.3000+04
6	25.972	.1963+04	.3846+04	.4108+04	.4108+04	.3821+04	.3548+04	.4030+04	.3302+04	.3000+04	.3000+04
5	21.250	.1831+04	.3538+04	.3786+04	.3786+04	.3514+04	.3264+04	.3707+04	.3022+04	.3000+04	.2846+04
4	16.528	.1670+04	.3147+04	.3379+04	.3379+04	.3113+04	.3000+04	.3303+04	.3000+04	.2879+04	.2596+04
3	11.806	.1483+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.2556+04	.2305+04
2	7.083	.1272+04	.2959+04	.3000+04	.3000+04	.2937+04	.2765+04	.3000+04	.2605+04	.2193+04	.1977+04
1	2.361	.1041+04	.2422+04	.2558+04	.2558+04	.2404+04	.2263+04	.2515+04	.2132+04	.1795+04	.1618+04

E-51

BMTL-944

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

FUEL OUTER NODE TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL	1	2	3	4	5	6	7	8	9	10
	CENTERLINE	.000	13.000	23.000	31.500	40.000	47.000	51.000	57.000	62.500	66.000
18	82.639	.7003+03	.1629+04	.1720+04	.1720+04	.1617+04	.1522+04	.1691+04	.1434+04	.1207+04	.1089+04
17	77.917	.8557+03	.1990+04	.2102+04	.2102+04	.1976+04	.1860+04	.2067+04	.1752+04	.1475+04	.1330+04
16	73.194	.9975+03	.2320+04	.2450+04	.2450+04	.2303+04	.2168+04	.2409+04	.2043+04	.1720+04	.1550+04
15	68.472	.1123+04	.2613+04	.2760+04	.2760+04	.2594+04	.2442+04	.2713+04	.2301+04	.1937+04	.1746+04
14	63.750	.1232+04	.2865+04	.3000+04	.3000+04	.2844+04	.2678+04	.2975+04	.2522+04	.2123+04	.1914+04
13	59.028	.1320+04	.3000+04	.3000+04	.3000+04	.3000+04	.2870+04	.3000+04	.2704+04	.2276+04	.2052+04
12	54.306	.1388+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.2843+04	.2393+04	.2158+04
11	49.583	.1434+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.2936+04	.2472+04	.2229+04
10	44.861	.1457+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.2984+04	.2512+04	.2265+04
9	40.139	.1457+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.2984+04	.2512+04	.2265+04
8	35.417	.1434+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.2936+04	.2472+04	.2229+04
7	30.694	.1388+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.3000+04	.2843+04	.2393+04	.2158+04
6	25.972	.1320+04	.3000+04	.3000+04	.3000+04	.3000+04	.2870+04	.3000+04	.2704+04	.2276+04	.2052+04
5	21.250	.1232+04	.2865+04	.3000+04	.3000+04	.2844+04	.2678+04	.2975+04	.2522+04	.2123+04	.1914+04
4	16.528	.1123+04	.2613+04	.2760+04	.2760+04	.2594+04	.2442+04	.2713+04	.2301+04	.1937+04	.1746+04
3	11.806	.9975+03	.2320+04	.2450+04	.2450+04	.2303+04	.2168+04	.2409+04	.2043+04	.1720+04	.1550+04
2	7.083	.8557+03	.1990+04	.2102+04	.2102+04	.1976+04	.1860+04	.2067+04	.1752+04	.1475+04	.1330+04
1	2.361	.7003+03	.1629+04	.1720+04	.1720+04	.1617+04	.1522+04	.1691+04	.1434+04	.1207+04	.1089+04

E-52

BNWL-944

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

CLAD TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL	1	2	3	4	5	6	7	8	9	10
	CENTERLINE	.000	13.000	25.000	31.500	40.000	47.000	51.000	57.000	62.500	66.000
18	82.639	.1865+03	.4339+03	.4582+03	.4582+03	.4306+03	.4055+03	.4505+03	.3820+03	.3215+03	.2899+03
17	77.917	.2279+03	.5301+03	.5598+03	.5598+03	.5261+03	.4954+03	.5504+03	.4667+03	.3929+03	.3542+03
16	73.194	.2657+03	.6179+03	.6526+03	.6526+03	.6133+03	.5775+03	.6416+03	.5440+03	.4580+03	.4129+03
15	68.472	.2992+03	.6960+03	.7350+03	.7350+03	.6908+03	.6504+03	.7226+03	.6127+03	.5158+03	.4651+03
14	63.750	.3280+03	.7630+03	.8058+03	.8058+03	.7573+03	.7131+03	.7922+03	.6717+03	.5655+03	.5099+03
13	59.028	.3516+03	.8179+03	.8638+03	.8638+03	.8118+03	.7644+03	.8493+03	.7201+03	.6062+03	.5466+03
12	54.306	.3697+03	.8599+03	.9082+03	.9082+03	.8535+03	.8037+03	.8929+03	.7571+03	.6373+03	.5746+03
11	49.583	.3819+03	.8883+03	.9381+03	.9381+03	.8817+03	.8302+03	.9223+03	.7820+03	.6583+03	.5936+03
10	44.861	.3880+03	.9026+03	.9532+03	.9532+03	.8958+03	.8435+03	.9372+03	.7946+03	.6689+03	.6031+03
9	40.139	.3880+03	.9026+03	.9532+03	.9532+03	.8958+03	.8435+03	.9372+03	.7946+03	.6689+03	.6031+03
8	35.417	.3819+03	.8883+03	.9381+03	.9381+03	.8817+03	.8302+03	.9223+03	.7820+03	.6583+03	.5936+03
7	30.694	.3697+03	.8599+03	.9082+03	.9082+03	.8535+03	.8037+03	.8929+03	.7571+03	.6373+03	.5746+03
6	25.972	.3516+03	.8179+03	.8638+03	.8638+03	.8118+03	.7644+03	.8493+03	.7201+03	.6062+03	.5466+03
5	21.250	.3280+03	.7630+03	.8058+03	.8058+03	.7573+03	.7131+03	.7922+03	.6717+03	.5655+03	.5099+03
4	16.528	.2992+03	.6960+03	.7350+03	.7350+03	.6908+03	.6504+03	.7226+03	.6127+03	.5158+03	.4651+03
3	11.806	.2657+03	.6179+03	.6526+03	.6526+03	.6133+03	.5775+03	.6416+03	.5440+03	.4580+03	.4129+03
2	7.083	.2279+03	.5301+03	.5598+03	.5598+03	.5261+03	.4954+03	.5504+03	.4667+03	.3929+03	.3542+03
1	2.361	.1865+03	.4339+03	.4582+03	.4582+03	.4306+03	.4055+03	.4505+03	.3820+03	.3215+03	.2899+03

SAMPLE CASE RR = 4%/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

COOLANT TEMPERATURES IN VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1	2	3	4	5	6	7	8	9	10
18	82.639	.1611+03	.3747+03	.3957+03	.3957+03	.3719+03	.3501+03	.3890+03	.3298+03	.2777+03	.2504+03
17	77.917	.1968+03	.4578+03	.4834+03	.4834+03	.4543+03	.4278+03	.4753+03	.4030+03	.3393+03	.3059+03
16	73.194	.2294+03	.5336+03	.5635+03	.5635+03	.5296+03	.4987+03	.5541+03	.4698+03	.3955+03	.3566+03
15	68.472	.2584+03	.6010+03	.6347+03	.6347+03	.5965+03	.5617+03	.6240+03	.5291+03	.4454+03	.4016+03
14	63.750	.2833+03	.6589+03	.6958+03	.6958+03	.6540+03	.6158+03	.6841+03	.5801+03	.4883+03	.4403+03
13	59.028	.3037+03	.7063+03	.7459+03	.7459+03	.7011+03	.6601+03	.7334+03	.6218+03	.5235+03	.4720+03
12	54.306	.3192+03	.7426+03	.7842+03	.7842+03	.7370+03	.6940+03	.7711+03	.6538+03	.5504+03	.4962+03
11	49.583	.3298+03	.7671+03	.8101+03	.8101+03	.7614+03	.7169+03	.7965+03	.6753+03	.5685+03	.5126+03
10	44.861	.3351+03	.7794+03	.8231+03	.8231+03	.7736+03	.7284+03	.8093+03	.6862+03	.5777+03	.5208+03
9	40.139	.3351+03	.7794+03	.8231+03	.8231+03	.7736+03	.7284+03	.8093+03	.6862+03	.5777+03	.5208+03
8	35.417	.3298+03	.7671+03	.8101+03	.8101+03	.7614+03	.7169+03	.7965+03	.6753+03	.5685+03	.5126+03
7	30.694	.3192+03	.7426+03	.7842+03	.7842+03	.7370+03	.6940+03	.7711+03	.6538+03	.5504+03	.4962+03
6	25.972	.3037+03	.7063+03	.7459+03	.7459+03	.7011+03	.6601+03	.7334+03	.6218+03	.5235+03	.4720+03
5	21.250	.2833+03	.6589+03	.6958+03	.6958+03	.6540+03	.6158+03	.6841+03	.5801+03	.4883+03	.4403+03
4	16.528	.2584+03	.6010+03	.6347+03	.6347+03	.5965+03	.5617+03	.6240+03	.5291+03	.4454+03	.4016+03
3	11.806	.2294+03	.5336+03	.5635+03	.5635+03	.5296+03	.4987+03	.5541+03	.4698+03	.3955+03	.3566+03
2	7.083	.1968+03	.4578+03	.4834+03	.4834+03	.4543+03	.4278+03	.4753+03	.4030+03	.3393+03	.3059+03
1	2.361	.1611+03	.3747+03	.3957+03	.3957+03	.3719+03	.3501+03	.3890+03	.3298+03	.2777+03	.2504+03

E-54

BNWL-944

SAMPLE CASE RR = 4\$/SEC, DOPPLER = -.004, FUEL COLLAPSE ONLY

POWER DENSITY AT VARIOUS RADIAL CHANNELS

I	ORIGINAL CENTERLINE	1 .000	2 13.000	3 25.000	4 31.500	5 40.000	6 47.000	7 51.000	8 57.000	9 62.500	10 66.000
18	82.639	.7823+05	.1823+06	.1939+06	.1939+06	.1809+06	.1701+06	.1900+06	.1602+06	.1349+06	.1216+06
17	77.917	.9558+05	.2226+06	.2304+06	.2364+06	.2209+06	.2078+06	.2318+06	.1957+06	.1648+06	.1486+06
16	73.194	.1114+06	.2594+06	.2751+06	.2751+06	.2574+06	.2422+06	.2700+06	.2282+06	.1921+06	.1732+06
15	68.472	.1255+06	.2921+06	.3095+06	.3095+06	.2899+06	.2728+06	.3038+06	.2570+06	.2163+06	.1951+06
14	63.750	.1376+06	.3202+06	.3330+06	.3390+06	.3178+06	.2991+06	.3329+06	.2817+06	.2372+06	.2138+06
13	59.028	.1475+06	.3432+06	.3631+06	.3631+06	.3406+06	.3206+06	.3567+06	.3020+06	.2543+06	.2292+06
12	54.306	.1551+06	.3608+06	.3814+06	.3814+06	.3581+06	.3371+06	.3748+06	.3175+06	.2673+06	.2410+06
11	49.583	.1602+06	.3726+06	.3937+06	.3937+06	.3698+06	.3482+06	.3870+06	.3280+06	.2761+06	.2490+06
10	44.861	.1627+06	.3786+06	.3998+06	.3998+06	.3757+06	.3538+06	.3931+06	.3333+06	.2806+06	.2530+06
9	40.139	.1627+06	.3785+06	.3995+06	.3995+06	.3757+06	.3538+06	.3929+06	.3333+06	.2806+06	.2530+06
8	35.417	.1602+06	.3725+06	.3931+06	.3931+06	.3697+06	.3482+06	.3867+06	.3280+06	.2761+06	.2490+06
7	30.694	.1551+06	.3607+06	.3807+06	.3807+06	.3580+06	.3371+06	.3744+06	.3175+06	.2673+06	.2410+06
6	25.972	.1475+06	.3431+06	.3623+06	.3623+06	.3405+06	.3206+06	.3562+06	.3020+06	.2543+06	.2292+06
5	21.250	.1376+06	.3200+06	.3330+06	.3380+06	.3176+06	.2991+06	.3323+06	.2817+06	.2372+06	.2138+06
4	16.528	.1255+06	.2919+06	.3083+06	.3083+06	.2897+06	.2728+06	.3031+06	.2570+06	.2163+06	.1951+06
3	11.806	.1114+06	.2592+06	.2737+06	.2737+06	.2572+06	.2422+06	.2691+06	.2282+06	.1921+06	.1732+06
2	7.083	.9558+05	.2223+06	.2348+06	.2348+06	.2207+06	.2078+06	.2309+06	.1957+06	.1648+06	.1486+06
1	2.361	.7823+05	.1820+06	.1922+06	.1922+06	.1806+06	.1701+06	.1889+06	.1602+06	.1349+06	.1216+06

CORE AVERAGE TEMPERATURE = .28567+04
 K-III AVERAGE TEMPERATURE = .31525+04
 CORE AVERAGE TEMPERATURE DOES NOT AGREE WITH K-III TEMPERATURE WITHIN EPSDOP
 143 4.61920-01 2.8361+05 101.1304 -99.8999 .0000 .0000 3.1525+03 6.7618+02 5.8391+02 2.8567+03
 .0000 16.3235 2.4384+03 3.527+07 1.183+08 3.179+07 3.167+07 6.829+06 1.899+06 5.73336+02
 143 4.61920-01 TEMMOL = 3407.08510 PCMT = 41.35629 PCMX = 55.03194
 193 4.66874-01 4.0789+05 98.3650 -115.3350 .0000 .0000 3.6295+03 6.8410+02 5.8517+02 3.2079+03
 .0000 27.0122 3.9114+03 3.589+07 1.229+08 3.531+07 3.700+07 8.451+06 2.443+06 9.92806+02
 193 4.66874-01 TEMMOL = 3667.63990 PCMT = 58.49853 PCMX = 69.03678

THE TRANSIENT HAS PROGRESSED .10-5-01 SECONDS BEYOND THE DISASSEMBLY CONDITION

APPENDIX E.2

PLOTTED OUTPUT

The primary purpose of the sample problem is to demonstrate the use of the MELT-I code rather than to characterize an actual core response to a 4\$/sec reactivity ramp input. Hence, the results for this case should be viewed only as representative of the type behavior which might exist during a massive fuel melting accident.

Figure E.2.1 illustrates the reactivity components which control the kinetics of the sample problem excursion. When an unbounded 4\$/sec reactivity ramp is imposed, the net reactivity is seen to follow this external input until the rising fuel temperatures cause a sizeable Doppler feedback component to appear. Net reactivity then remains at slightly below prompt critical until fuel adjacent to the clad in the hottest fuel channel begins to melt which allows fuel collapse to begin. This positive collapse feedback boosts the reactor above prompt critical and causes a dramatic upswing in the rate of power generation, as evidenced by Figure E.2.2. A large core temperature rise follows and the corresponding negative Doppler feedback then turns the power trace over. The subsequent oscillatory behavior of the net reactivity (and power) is caused by the interplay of the continuing input ramp and the Doppler feedback.

Figure E.2.3 is a pictorial representation of the core melting pattern. The sample case uses a core subdivision of 10 radial channels and 18 axial segments. Hence, each "picture" is an R-Z cross section of the core in which the times given indicate the time lapse from the beginning of collapse.

FIGURE E.2.1. Reactivity Components of Sample Case
 (Zoned Core, Ramp Rate = 4 \$/sec)

FIGURE E.2.2. Core Response in Sample Case (Zoned Core, Ramp Rate = 4 \$/sec)

Sample case: Initiating Ramp Rate = 4 $^{\circ}$ /sec;
 $T \frac{dk}{dT} = -0.004$

FIGURE E.2.3. Melting Pattern in Sample Case
 (Zoned Core, Ramp Rate = 4 $^{\circ}$ /sec)

The region within the heavy black lines represents the portion of the core melted (actually, it represents the boundary corresponding to outer fuel node temperatures at or above melting, i.e., 3000 °K). As a further indication of the progression of the transient, the solid black designation corresponds to regions of the core where fuel temperatures in excess of 4000 °K exist, and the double cross hatched region contains fuel temperatures in excess of 5000 °K. The two hot spots are a result of radial power peaking for the particular zoned core chosen. A relative cold test zone in the core center accounts for the slow melting pattern in that region. It should be noted that once fuel temperatures reach the vicinity of 4000 °K significant vapor pressures appear and a negative feedback due to disassembly should be included. Hence, core disassembly would occur prior to the conditions depicted in the latter two or three time sequences of Figure E.2.3.

BNWL-944

APPENDIX F

LISTING OF CODE

-ITL	PDP	INCL/CODE	INCL/CODE				
ABC*	FCOPY						
	DIMENSION	AAR(10,10),	AARP(10),	AINR(10),			INCL0001
1		AL(6),	ALPH(6),	AMASSF(10),			INCL0002
2		AN(2),	AR(30),	AREAV(10),			INCL0003
3		B(6),	C(6,2),	COLK(40,10),			INCL0004
4		COLLK(10),	COND(2),	DELTEM(10,40,10),			INCL0005
5		DEN(10),	DL(10),	FUSE(10),			INCL0006
6		GAM(6),	HA(3),	HAI(2),			INCL0007
7		HHA(30),	HOL(12),	ICHAN(40,10),			INCL0008
8		ICHANL(10),	ICHANV(40,10),	ICHANX(10)			INCL0009
	DIMENSION	ITEMF(10,40,10),	IXDOWN(10),	IXUP(10),			INCL0010
1		IXX(10),	MUPRL(10),	MVOID(10),			INCL0011
2		NSET(2),	NSETV(40,10),	NUM(10),			INCL0012
3		NUMB(40),	PGAM(3),	PIN(10),			INCL0013
4		POW(40,10),	POWB(40,10),	POWI(40,10),			INCL0014
5		POWT(40,10),	PPR(40),	PPR(10),			INCL0015
6		PUDEN(10),	QLOCAL(10,40,10),	RAD(30),			INCL0016
7		RADA(30),	RADI(2),	RC(3,2),			INCL0017
8		RCNT(3,2),	RCP(3),	REACOL(2)			INCL0018
	DIMENSION	REAVOD(2),	RH(2),	RNOR(3),			INCL0019
1		RTC(3),	T(2),	TEM(10,40,10),			INCL0020
2		TEMA(2),	TEMI(10,40,10),	TEMN(40,10),			INCL0021
3		TEMP(3,2),	TEMPA(3,2),	TFAIL(10),			INCL0022
4		TP(31,2),	TPI(10),	TRIPX(10),			INCL0023
5		TSEG(40,10),	TSEGX(10),	TTT(40),			INCL0024
6		VARDEN(10),	VOIDK(10),	VOL(3),			INCL0025
7		VOLL(1),	VOLOC(10,10),	VOLP(10),			INCL0026
8		VR(30),	WC(40,10),	WCAD(10)			INCL0027
	DIMENSION	WCAU(10),	WF(40,10),	WFT(40,10),			INCL0028
1		XDOWN(10),	XOD(10),	XOU(10),			INCL0029
2		XUP(10),	XXDO(10),	XXUP(10),			INCL0030
3		ZC(31,3),	ZH(41,10),	ZMID(40),			INCL0031
4		ZMIDT(40,10),	ZOH(41),	ZUP(40)			INCL0032
	COMMON	AAR, AARP, AHIGH, AINR, AL, ALIFE, ALPH,					INCL0033
1		AMASSF, AN, ANI, ANZ, AR, AREAV, ASEG,					INCL0034
2		A1, A2, A3, A4, B, BB, BMUP,					INCL0035
3		B1, B2, B3, B4, C, CHI, COLAPK,					INCL0036
4		COLK, COLLK, COND, DELTEM, DEN, DENSEC, DENSEE,					INCL0037
5		DENSEF, DL, ENER, ENERP, ENR1, EPSDOP, ERROR,					INCL0038
6		EXTRAP, FNAMEOD, FRACF, FUEL, FUSE, FUSEC, FUSEE,					INCL0039
7		FUSEF, GAM, GRAV, H, HA, HAI, HHA,					INCL0040
8		HMAX, HOL, IBAU, ICHAN, ICHANL, ICHANV, ICHANX,					INCL0041
	COMMON	ICOLT, IDEN, IDOP, IFLAG, IG, IMELT, INA,					INCL0042
1		IT, ITEMA, ITEMF, ITYPE, IVODCO, IVOID, IVOIDQ,					INCL0043
2		IWRITE, IXDOWN, IXUP, IXX, I1, I2, J,					INCL0044
3		LUPPER, LVOID, M, MC, MF, MPRT, MUPPER,					INCL0045
4		MUPRL, MUX, MVOID, NADFN, NCLAD, NCOL, NCPS,					INCL0046
5		NCYC, NIT, NMAX, NMPRT, NOT, NPDA, NPDR,					INCL0047
6		NPRT, NSET, NSETV, NSTART, NTEG, NUM, NUMB,					INCL0048
7		NUPPER, NVOD, NWWL, PCMT, PCMX, PEAKA, PEAKR,					INCL0049
8		PGAM, PIN, POW, POWB, POWI, POWT, PPP,					INCL0050
	COMMON	PPR, PUDEN, QLOCAL, QMOL, RAD, RADA, RADI,					INCL0051
1		RADIUS, RC, RCNT, RCP, REACOL, REAVOD, RH,					INCL0052
2		RNOR, RTC, R1, R2, R3, STEPM, STORC,					INCL0053
3		STORI, STORN, STORV, T, TA2, TA3, TA4,					INCL0054
4		TBOILC, TB2, TB3, TB4, TCOL, TCOLM, TEM,					INCL0055
5		TEMA, TEMAD, TEMAT, TEMAW, TEMI, TEMMOL, TEMN,					INCL0056
6		TEMP, TEMPA, TFAIL, TFUSEC, TFUSEE, TFUSEF, TIMEC,					INCL0057

```

7      TIMER, TIMEV, TIMEF, TVAX, TP, TPI, TRIPC, INCL0059
8      TRIPF, TRIPV, TRIPFQ, TRIPX, TSEC, TSEFX, TTT, INCL0060
COMMON
9      TVOID, TZERO, VAP, VARDEN, VOCK, VOIX, VOL, INCL0061
1     VOLL, VOLCC, VLF, VR, W, WC, WCAU, INCL0062
2     WCAU, WF, WFI, XDOUN, XOD, XOL, XOP, INCL0063
3     XXDU, XAP, ZC, ZF, ZMID, ZMIT, ZOH, INCL0064
4     ZUP
      END
      INCL0065
      INCL0066

```

- ELT MAIN,1,680717, 6072
INCLUDE ABC

C		MAIN0001
C		MAIN0002
C		MAIN0003
C	* * * * DESCRIPTION OF SUBROUTINES * * * *	MAIN0004
C		MAIN0005
C		MAIN0006
C	MAIN	OVERALL CONTROL ROUTINE--IDENTIFIES TAPES AND CALLS INPUT, MAIN0007
C		INPUT2, TEMDIS, SETUP, MELTIN, CONST, AND CALC. MAIN0008
C		MAIN0009
C	INPUT	READS PROGRAM CONTROL AND NEUTRONICS VARIABLES. MAIN0010
C		MAIN0011
C	INPUT2	READS AND PRINTS HEAT TRANSFER AND REACTIVITY COEFFICIENTS. MAIN0012
C		INPUT2 CALLS ADDINP AND CIT. MAIN0013
C		MAIN0014
C	ADDINP	COMPUTES INITIAL CONSTANTS. MAIN0015
C		MAIN0016
C	CIT	COMPUTES INITIAL TEMPERATURE DISTRIBUTION FOR AVERAGE CORE MAIN0017
C		LOCATION. MAIN0019
C		MAIN0020
C	TEMDIS	PRINTS GEOMETRY SPECIFICATIONS AND TEMPERATURE DISTRIBUTION MAIN0021
C		FOR AVERAGE CORE LOCATION. MAIN0022
C		MAIN0023
C	SETUP	DETERMINES CONSTANTS USED IN HEAT TRANSFER CALCULATIONS. MAIN0024
C		MAIN0025
C	CONST	READS AND PRINTS CURRENT REACTIVITY STATUS. MAIN0026
C		MAIN0027
C	SUBRHO	CALCULATES NEW AVERAGE CORE LOCATION TEMPERATURES AND MAIN0028
C		OVERALL REACTIVITY. MAIN0029
C		MAIN0030
C	SUBNEU	COMPUTES THE NEW POWER USING THE OLD AND NEW REACTIVITY. MAIN0031
C		MAIN0032
C	PRECUR	COMPUTES PRECURSOR DENSITIES AND SETS INDICIES. PRECUR MAIN0033
C		CALLS ENERGY. MAIN0034
C		MAIN0035
C	MELTIN	READS AND PRINTS CORE CONSTANTS NEEDED FOR COLLAPSE AND MAIN0036
C		VOIDING FEEDBACK, AND CALCULATES AND PRINTS INITIAL CORE MAIN0037
C		POWER AND TEMPERATURE DISTRIBUTIONS. MELTIN CALLS NAMOD. MAIN0038
C		MAIN0039
C	CALC	DETERMINES THE TIME STEP, CONTROLS THE CALCULATIONAL MAIN0040
C		CALLING SEQUENCE, AND MANIPULATES THE PRINTOUT OPTIONS. MAIN0041
C		CALC CALLS SUBRHO, SUBNEU, PRECUR, VOIDQ, MELTQ, NATEM, MAIN0042
C		VOID, CORTEM, COLLAP, TEMAP, PRINTF, PRINTK, PRINTP, MAIN0043
C		AND PRINTV. MAIN0044
C		MAIN0045
C	MELTQ	CHECKS TO SEE IF MELTING OR COOLANT VAPORIZATION HAS BEGUN. MAIN0046
C		MAIN0047
C	CORTEM	COMPUTES CORE TEMPERATURES AND LOCAL POWER DENSITIES DURING MAIN0048
C		THE TRANSIENT. CORTEM CALLS PCMELT. MAIN0049
C		MAIN0050
C	COLLAP	CALCULATES NEW FUEL SEGMENT POSITIONS AND THE REACTIVITY MAIN0051
C		FEEDBACK DUE TO COLLAPSE. MAIN0052
C		MAIN0053
C	VOIDQ	CHECKS TO SEE IF VOIDING HAS BEGUN. MAIN0054
C		MAIN0055
C	VOID	COMPUTES A SODIUM VOIDING PATTERN ACCORDING TO A SIMPLE MAIN0056
C		PISTON MODEL AND THEN EVALUATES THE REACTIVITY CONSEQUENCES MAIN0057
C		DUE TO SUCH VOIDING. MAIN0059
C		MAIN0060

C	NATEM	COMPUTES THE COOLANT TEMPERATURES FOR USE IN SUBROUTINE	MAIN0061
C		VOID.	MAIN0062
C			MAIN0063
C	NAMOD	MODIFIES THE READ IN VALUES FOR SODIUM WORTH.	MAIN0064
C			MAIN0065
C	ENERGY	KEEPS A RUNNING TAB ON THE AVERAGE ENERGY (W/CC OF FUEL)	MAIN0066
C		GENERATED FROM TIME ZERO.	MAIN0067
C			MAIN0068
C	PCMELT	KEEPS A RUNNING ACCOUNT OF THE ENERGY CONTAINED IN THE	MAIN0069
C		MOLTEN FUEL. FURTHER, IT COMPUTES A VOLUME WEIGHTED FUEL	MAIN0070
C		TEMPERATURE ASSOCIATED WITH THE MOLTEN FUEL.	MAIN0071
C			MAIN0072
C	TEMAP	PRINTS OUT THE AVERAGE CORE TEMPERATURE, POWER, REACTIVITY	MAIN0073
C		VALUES AND RAMP RATES AT A TIME WHEN THE CORE IS NEARING A	MAIN0074
C		DISASSEMBLY CONDITION.	MAIN0075
C			MAIN0076
C	PRINTF	YIELDS A FULL PRINT. VARIABLES PRINTED INCLUDE THE CURRENT	MAIN0077
C		AXIAL POSITIONS OF THE FUEL SEGMENTS, THE FUEL TEMPERATURES	MAIN0078
C		IN ALL NODES, THE CLAD AND COOLANT TEMPERATURES, THE POWER	MAIN0079
C		DENSITY IN ALL SEGMENTS, AND THE CORE VOLUME WEIGHTED	MAIN0080
C		TEMPERATURE VS THE TEMPERATURE CALCULATED FOR THE AVERAGE	MAIN0081
C		CORE LOCATION.	MAIN0082
C			MAIN0083
C	PRINTK	COMPUTES AND PRINTS THE UPDATED REACTIVITY VALUES FOR THE	MAIN0084
C		END OF THE CURRENT TIME STEP. PRINTK CALLS PRINTM.	MAIN0085
C			MAIN0086
C	PRINTM	PRINTS OUT THE AVERAGE MOLTEN FUEL TEMPERATURE, PER CENT OF	MAIN0087
C		FUEL ACTUALLY MOLTEN, AND PER CENT OF FUEL PARTIALLY MOLTEN	MAIN0088
C		(NODES IN OR ABOVE FUSION).	MAIN0089
C			MAIN0090
C	PRINTP	YIELDS A PARTIAL PRINT. VARIABLES PRINTED INCLUDE THE FUEL	MAIN0091
C		CENTERLINE AND OUTER NODE TEMPERATURES.	MAIN0092
C			MAIN0093
C	PRINTV	PRINTS THE SODIUM VOIDING DISTRIBUTION.	MAIN0094
C			MAIN0095
C			MAIN0096
C			MAIN0097
C			MAIN0098
C			MAIN0099
C			MAIN0100
C	AHIGH	CORE HEIGHT (CM)	MAIN0101
C	ALIFE	NEUTRON GENERATION TIME (SEC)	MAIN0102
C	ANI	INITIAL CORE AVERAGE POWER DENSITY (WATTS/CC)	MAIN0103
C	ANZ	PREDICTED POWER DENSITY (WATTS/CC)	MAIN0104
C	ASEG	LENGTH OF AXIAL SEGMENT (CM)	MAIN0105
C	A1	CONSTANT TERM IN UPWARD NA EJECTION EQ.OF MO.(CM)	MAIN0106
C	A2	LINEAR TERM IN UPWARD NA EJECTION EQ.OF MO.(CM/SEC)	MAIN0107
C	A3	QUADRATIC TERM IN UPWARD NA EJECTION EQ.OF MO.(CM/SEC**2)	MAIN0108
C	A4	CUBIC TERM IN UPWARD NA EJECTION EQ.OF MO.(CM/SEC**3)	MAIN0109
C	BB	DELAYED NEUTRON FRACTION	MAIN0110
C	BMUP	NUMBER OF CORE AXIAL NODES (= MUPPER)	MAIN0111
C	B1	CONSTANT TERM IN DNWARD NA EJECTION EQ.OF MO.(CM)	MAIN0112
C	B2	LINEAR TERM IN DNWARD NA EJECTION EQ.OF MO.(CM/SEC)	MAIN0113
C	B3	QUADRATIC TERM IN DNWARD NA EJECTION EQ.OF MO.(CM/SEC**2)	MAIN0114
C	B4	CUBIC TERM IN DNWARD NA EJECTION EQ.OF MO.(CM/SEC**3)	MAIN0115
C	CHI	VISCOSITY TERM IN EQUATION OF MOTION	MAIN0116
C	COLAPK	TOTAL REACTIVITY CONTRIBUTION OF COLLAPSE (DELTA K)	MAIN0117
C	DENSEC	DENSITY OF COOLANT (GRAMS/CC)	MAIN0118
C	DENSEE	DENSITY OF CLAD (GRAMS/CC)	MAIN0119

* * * * * VARIABLES * * * * *

C	DNSEF	DENSITY OF FUEL (GRAMS/CC)	MAIN0120
C	ENER	CORE AVE. ENERGY DENSITY FROM TIME ZERO (W-SEC/CC)	MAIN0121
C	ENERP	ENERGY GENERATED FROM TIME ZERO (MW-SEC)	MAIN0122
C	ENR1	POWER DENSITY AT THE PREVIOUS TIME STEP (WATTS/CC)	MAIN0123
C	EPSDOP	FRACTIONAL DIFFERENCE ALLOWED BETWEEN TEMP AND TEMA	MAIN0124
C	ERROR	ERROR CRITERION(CONVERGENCE ON MARCH-OUT ALOGRITHM)	MAIN0125
C	EXTRAP	AXIAL HALF LENGTH (INCLUDING EXTRAPOLATION LENGTH),CM	MAIN0126
C	FNAMOD	FACTOR BY WHICH WC(MU,L) IS MULT.	MAIN0127
C	FRACF	FISSILE FUEL DENSITY (KG/CC)	MAIN0128
C	FUELV	TOTAL CORE VOLUME OF FUEL, CC	MAIN0129
C	FUSEC	LATENT HEAT OF FUSION OF COOLANT (J/G)	MAIN0130
C	FUSEE	LATENT HEAT OF FUSION OF CLAD (J/G)	MAIN0131
C	FUSEF	LATENT HEAT OF FUSION OF FUEL (J/G)	MAIN0132
C	GRAV	FORCING FUNCTION IN EQUATION OF MOTION (CM/SEC**2)	MAIN0133
C	H	TIME STEP (SEC)	MAIN0134
C	HMAX	MAXIMUM TIME STEP (SEC)	MAIN0135
C	I1	NUMBER OF INTERVALS IN FUEL	MAIN0136
C	I2	NUMBER OF INTERVALS IN CLAD	MAIN0137
C	IBAD	SWITCH TO TERMINATE PROBLEM (0/1=NO/YES)	MAIN0138
C	ICOLT	SWITCH FOR START OF COLLAPSE (0/1=NO/YES)	MAIN0139
C	IDEN	FUEL DENSITY FLAG (0/1 = CONST./VAR.)	MAIN0140
C	IDOP	DOPPLER FEEDBACK (0/1=MELT/K3)	MAIN0141
C	IFLAG	SWITCH TO TERMINATE PROBLEM UPON SUBCRITICALITY (0/1=N/Y)	MAIN0142
C	IG	GEOMETRY INDEX (0/1/2=SPHERE,CYLINDER,PLANE), USE 1 ONLY	MAIN0143
C	IMELT	SWITCH FOR START OF MELTING (0/1=NO/YES)	MAIN0144
C	INA	SWITCH TO CALL NAMOD (0/1=NO/YES)	MAIN0145
C	IT	I1 + I2 + I3	MAIN0146
C	ITEMA	SWITCH TO CONTROL TEMAP PRINTOUT ROUTINE	MAIN0147
C	ITYPE	TYPE OF MELT PRINT (0/1=PARTIAL/FULL)	MAIN0148
C	IVODOO	VOIDING AT TIME OF COLLAPSE (0/1=NO/YES)	MAIN0149
C	IVOID	VOIDING TRIP (0/1=NORMAL/PRESELECTED)	MAIN0150
C	IVOIDQ	SWITCH FOR START OF SODIUM VOIDING (0/1=NO/YES)	MAIN0151
C	IWRITE	PRINTF CONTROL (0/1=ALL/CL AND OUTER)	MAIN0152
C	J	TIME STEP INDEX	MAIN0153
C	LUPPER	NUMBER OF CORE RADIAL CHANNELS	MAIN0154
C	LVOID	CHANNEL NUMBER OF HOTTEST SODIUM	MAIN0155
C	M	NUMBER OF PRECURSOR GROUPS	MAIN0156
C	MC	AXIAL NA NODE CHECKED FOR COLLAPSE	MAIN0157
C	MF	AXIAL FUEL NODE CHECKED FOR COLLAPSE	MAIN0158
C	MPRT	NUMBER OF K3 PRINTS PER MELT PRINT	MAIN0159
C	MUPPER	NUMBER OF CORE AXIAL NODES	MAIN0160
C	MUX	AXIAL NODE FOR VOID START(IF IVOID=1)	MAIN0161
C	NADEN	SODIUM DENSITY (KG/CORE VOLUME) FOR VOID	MAIN0162
C	NCLAD	RADIAL NODE NUMBER FOR CLAD	MAIN0163
C	NCOL	LIMIT FOR TOTAL SEGMENTS OF COLLAPSE	MAIN0164
C	NCPS	COLLAPSE SWITCH (0/1=NO COLLAP/COLLAP)	MAIN0165
C	NCYC	NUMBER OF TIME SECTORS	MAIN0166
C	NIT	NUMBER FOR INPUT TAPE	MAIN0167
C	NMAX	MAXIMUM NUMBER OF TIME STEPS	MAIN0168
C	NMPRT	NUMBER OF K3 PRINTS PER PRINTM PRINT	MAIN0169
C	NOT	NUMBER FOR OUTPUT TAPE	MAIN0170
C	NPDA	AXIAL POWER AND TEMP. DIST. (0/1 = COSINE/INPUT)	MAIN0171
C	NPDR	RADIAL POWER AND TEMP. DIST.(-1/0/1=FLAT/PARABOLIC/INPUT)	MAIN0172
C	NPRT	NUMBER OF STEPS BETWEEN K3 PRINTS	MAIN0173
C	NSTART	INITIAL PRECURSOR OPTION CONTROL (0/1=COMPUTE/READ IN)	MAIN0174
C	NTEQ	INITIAL TEMP OPTION CONTROL(0/1=CODE COMPUTE/READ IN)	MAIN0175
C	NUPPER	NUMBER OF FUEL PIN NODES	MAIN0176
C	NVOD	VOIDING SWITCH (0/1=NO VOID/VOID)	MAIN0177
C	NWWL	CONTROL INDEX FOR K3 PRINTOUT	MAIN0178

C	PCMT	PER CENT OF CORE FUEL MOLTEN	MAIN0179
C	PCMX	PER CENT OF CORE FUEL NODES WHICH HAVE BEGUN TO MELT	MAIN0180
C	PEAKA	AXIAL PEAK TO AVERAGE POWER	MAIN0181
C	PEAKR	RADIAL PEAK TO AVERAGE POWER	MAIN0182
C	QMOL	ENERGY IN MOLTEN FUEL (MW-SEC)	MAIN0183
C	R1	INITIAL REACTIVITY (DELTA K)	MAIN0184
C	R2	RAMP REACTIVITY RATE (DELTA K/SEC)	MAIN0185
C	R3	QUADRATIC COEFFICIENT FOR REACTIVITY (DELTA K/SEC**2)	MAIN0186
C	RADIUS	CORE RADIUS (CM)	MAIN0187
C	STEMP	STEP MULTIPLIER	MAIN0188
C	STORC	COLLAPSE REACTIVITY FEEDBACK (PREVIOUS TIME STEP),CENTS	MAIN0189
C	STORI	INPUT REACTIVITY (PREVIOUS TIME STEP),CENTS	MAIN0190
C	STORN	NET REACTIVITY (PREVIOUS TIME STEP),CENTS	MAIN0191
C	STORV	VOID REACTIVITY FEEDBACK (PREVIOUS TIME STEP),CENTS	MAIN0192
C	TA2	DELAY FOR LINEAR TERM IN UPWARD NA EJCT.EQ.OF MO.(SEC)	MAIN0193
C	TA3	DELAY FOR QUADRATIC TERM IN UPWARD NA EJCT.EQ.OF MO.(SEC)	MAIN0194
C	TA4	DELAY FOR CUBIC TERM IN UPWARD NA EJCT.EQ.OF MO.(SEC)	MAIN0195
C	TB2	DELAY FOR LINEAR TERM IN DNWARD NA EJCT.EQ.OF MO.(SEC)	MAIN0196
C	TB3	DELAY FOR QUADRATIC TERM IN DNWARD NA EJCT.EQ.OF MO.(SEC)	MAIN0197
C	TB4	DELAY FOR CUBIC TERM IN DNWARD NA EJCT.EQ.OF MO.(SEC)	MAIN0198
C	TBOILC	BOILING TEMPERATURE OF COOLANT (K)	MAIN0199
C	TCOL	RUNNING TIME FROM START OF INITIAL COLLAPSE (SEC)	MAIN0200
C	TCOLM	TOTAL RUNNING TIME AFTER START OF COLLAPSE (SEC)	MAIN0201
C	TEMAD	TIME BEYOND TEMAW WHEN PROGRAM HALTED (SEC)	MAIN0202
C	TEMAT	TERMINATION TIME FOR PROBLEM (AUTO. CUTOFF NEAR DIS.),SEC	MAIN0203
C	TEMAW	VALUE OF TEMA FOR CALLING TEMAP SUB. (K)	MAIN0204
C	TEMMOL	AVERAGE TEMPERATURE OF MOLTEN FUEL (K)	MAIN0205
C	TFUSEC	MELTING TEMPERATURE OF COOLANT (K)	MAIN0206
C	TFUSEE	MELTING TEMPERATURE OF CLAD (K)	MAIN0207
C	TFUSEF	MELTING TEMPERATURE OF FUEL (K)	MAIN0208
C	TIMFC	PRINTOUT INTERVAL AFTER START OF COLLAPSE (SEC)	MAIN0209
C	TIMER	PRINTOUT TIME AFTER START OF COLLAPSE (SEC)	MAIN0210
C	TIMEV	PRINTOUT INTERVAL AFTER START OF VOID (SEC)	MAIN0211
C	TIMEX	PRINTOUT TIME AFTER START OF SODIUM VOIDING (SEC)	MAIN0212
C	TMAX	TERMINAL TIME (SEC)	MAIN0213
C	TRIPC	TEMP. OF COOLANT AT WHICH CLAD FAILS (K)	MAIN0214
C	TRIPE	TEMP. OF CLAD AT WHICH CLAD FAILS (K)	MAIN0215
C	TRIPF	TEMP. OF CENTERLINE FUEL AT WHICH CLAD FAILS (K)	MAIN0216
C	TRIPFO	TEMP. OF OUTER NODE FUEL AT WHICH CLAD FAILS (K)	MAIN0217
C	TVOID	RUNNING TIME FROM START OF SODIUM VOIDING (SEC)	MAIN0218
C	TZERO	INITIAL AVERAGE CORE TEMPERATURE (K)	MAIN0219
C	VAPC	LATENT HEAT OF VAPORIZATION OF COOLANT (J/G)	MAIN0220
C	VODK	TOTAL REACTIVITY CONTRIBUTION OF SODIUM VOIDING(DELTA K)	MAIN0221
C	W	INSTANTANEOUS PERIOD (1/SEC)	MAIN0222
C			MAIN0223
C			MAIN0224
C	*****	SUBSCRIPTED VARIABLES *****	MAIN0225
C			MAIN0226
C			MAIN0227
C	AAR(N,L)	TEMP IN FUEL NODE N,CHAN L USED IN PROJECTION SCHEME	MAIN0228
C	AARP(N)	TEMP IN FUEL NODE N,USED IN PROJECTION SCHEME	MAIN0229
C	AINR(L)	RELATIVE TEMPERATURE IN CHANNEL L (INPUT)	MAIN0230
C	AL(6)	DECAY CONSTANTS	MAIN0231
C	ALPH(6)	EXPONENTIAL ARGUMENT IN POWER CALCULATIONS	MAIN0232
C	AMASSF(L)	MASS OF FUEL IN CHANNEL L	MAIN0233
C	AN(2)	CORE AVE. POWER DENSITY (WATTS/CC)	MAIN0234
C	AR(I,2)	AREA PER UNIT LENGTH IN FUEL PIN (FUEL,CLAD),CM**2.	MAIN0235
C	AREAV(L)	AREA OF CHANNEL L	MAIN0236
C	B(6)	DELAYED NEUTRON FRACTIONS	MAIN0237

C	C(6,2)	PRECURSOR DENSITIES	MAIN0238
C	COLK(M,L)	CHANGE IN REACTIVITY DUE TO COLLAPSE OF NODE M,L	MAIN0239
C	COLLK(L)	CHANGE IN REACTIVITY DUE TO COLLAPSE OF CHANNEL L	MAIN0240
C	COND(2)	THERMAL CONDUCTIVITY FOR FUEL,CLAD (J/CM-SEC-K)	MAIN0241
C	DELTEM(N,M,L)	PSEUDO CHANGE IN TEMP IN NODE N,M,L DURING MELTING	MAIN0242
C	DEN(L)	MACRO FUEL DENSITY IN CHANNEL L (G/CC)	MAIN0243
C	DL(L)	RADIAL DISTANCE FROM CORE CENTER OF CHANNEL L (CM)	MAIN0244
C	FUSE(N)	HEAT OF FUSION OF MATERIAL IN RADIAL NODE L(J/G-K)	MAIN0245
C	GAM(6)	INSTANTANEOUS PERIOD FOR PRECURSOR DENSITIES	MAIN0246
C	HA(3)	RESISTANCE USED IN HEAT TRANSFER CALCULATIONS	MAIN0247
C	HAI(2)	HEAT TRANSFER COEFFICIENT	MAIN0248
C	HHA(30)	CONDUCTANCE USED IN HEAT TRANSFER CALCULATIONS	MAIN0249
C	HOL(12)	IDENTIFICATION	MAIN0250
C	ICHAN(M,L)	SWITCH FOR CLAD FAILURE IN NODE M,L (0/1=NO/YES)	MAIN0251
C	ICHANV(M,L)	SWITCH FOR VOIDING IN NODE M,L (0/1=NO/YES)	MAIN0252
C	ICHANX(L)	SWITCH FOR START OF VOIDING IN CHANNEL L(0/1=NO/YES)	MAIN0253
C	ITEMF(N,M,L)	SWITCH FOR END OF COMPLETE MELTING (0/1=NO/YES)	MAIN0254
C	IXDOWN(L)	SWITCH FOR END OF DNWARD CHAN VOIDING (0/1=NO/YES)	MAIN0255
C	IXUP(L)	SWITCH FOR END OF UPWARD CHAN VOIDING (0/1=NO/YES)	MAIN0256
C	IXX(L)	SWITCH FOR COMPLETION OF CHANNEL VOIDING(0/1=NO/YES)	MAIN0257
C	MUPRL(L)	UPPER AXIAL NODE FOR CLAD FAILURE SEARCH IN COLLAP	MAIN0258
C	MVOID(L)	AXIAL NODE FOR START OF VOIDING IN CHANNEL L	MAIN0259
C	NSET(2)	VOIDING PRINTOUT NOTATION	MAIN0260
C	NSETV(M,L)	VOIDING PRINTOUT NOTATION (111111/0 =NO VOID/VOID)	MAIN0261
C	NUM(L)	NUMBERING VARIABLE USED IN PRINTOUT	MAIN0262
C	NUMB(M)	NUMBERING VARIABLE USED IN PRINTOUT	MAIN0263
C	PGAM(3)	FRACTION OF POWER GENERATED IN FUEL,CLAD,COOLANT	MAIN0264
C	PIN(L)	RELATIVE POWER IN CHANNEL L (INPUT)	MAIN0265
C	POW(M,L)	POWER IN NODE M,L (WATTS/CC)	MAIN0266
C	POWER(M,L)	POWER IN NODE M,L (PREVIOUS TIME STEP)	MAIN0267
C	POWI(M,L)	INITIAL POWER IN NODE M,L (WATTS/CC)	MAIN0268
C	POWT(M,L)	POWER IN NODE M,L AT POSITION ZMIDT(M,L)	MAIN0269
C	PPP(M)	RELATIVE AXIAL POWER DENSITY (INPUT)	MAIN0270
C	PPR(L)	PEAK AXIAL POWER IN CHANNEL L (WATTS/CC)	MAIN0271
C	PUDEN(L)	FISSILE FUEL DENSITY IN CHANNEL L (G/CC)	MAIN0272
C	QLOCAL(N,M,L)	ENERGY GENERATED IN NODE N,M,L AFTER MELTING BEGINS	MAIN0273
C	RAD(I)	RADIUS OF FUEL PIN NODES	MAIN0274
C	RADA(I)	AVERAGE RADIUS OF FUEL PIN NODES	MAIN0275
C	RADI(I)	RADIUS OF PIN REGION I (FUEL,CLAD),CM	MAIN0276
C	RC(3,2)	TEMPERATURE FEEDBACK COEFFICIENTS	MAIN0277
C	RCNT(3,2)	REACTIVITY FEEDBACK FOR EACH ZONE OF FUEL PIN	MAIN0278
C	RCP(3)	HEAT CAPACITY FOR FUEL, CLAD, COOLANT (J/CC-K)	MAIN0279
C	REACOL(2)	COLLAPSE REACTIVITY FEEDBACK (CENTS)	MAIN0280
C	REAVOD(2)	VOID REACTIVITY FEEDBACK (CENTS)	MAIN0281
C	RH(2)	NET REACTIVITY (CENTS)	MAIN0282
C	RNOR(3)	BASE USED IN REACTIVITY TEMP FEEDBACK CALCULATIONS	MAIN0283
C	RTC(3)	TIME DELAY OF REACT FDBACK IN FUEL,CLAD,COOLANT(SEC)	MAIN0284
C	TEM(N,M,L)	TEMPERATURE IN FUEL NODE N, AXIAL NODE M, CHANNEL L	MAIN0285
C	TEMA(2)	CORE AVERAGE FUEL TEMPERATURE (K)	MAIN0286
C	TEMI(N,M,L)	INIT TEMP IN FUEL NODE N,AXIAL NODE M, CHANNEL L	MAIN0287
C	TEMN(M,L)	AVERAGE FUEL TEMPERATURE IN AXIAL NODE M, CHANNEL L	MAIN0288
C	TEMP(3,2)	ZONE AVERAGED TEMPERATURES IN K3 CALCULATION	MAIN0289
C	TEMPA(3,2)	CORE AVG TEMP OF FUEL, CLAD, COOLANT BY K3 (K)	MAIN0290
C	TFAIL(N)	MELTING TEMP OF MATERIAL IN RADIAL NODE N (K)	MAIN0291
C	TP(31,2)	TEMP IN FUEL NODES, CLAD, COOLANT BY K3	MAIN0292
C	TPI(N)	INITIAL K3 TEMPS IN FUEL NODES, CLAD, COOLANT	MAIN0293
C	TRIPX(L)	NA VOID TRIP TEMPS IN AXIAL NODE MUX OF CHAN L(K)	MAIN0294
C	TSEG(M,L)	RUNNING TIME FROM START OF COLLAPSE OF NODE M,L	MAIN0295
C	TSEGX(L)	RUNNING TIME FROM START OF VOIDING IN CHANNEL L	MAIN0296

C	TTT(M)	RELATIVE AXIAL TEMPERATURE DISTRIBUTION (INPUT)	MAIN0297
C	T(2)	ABSOLUTE TIME (SEC)	MAIN0298
C	VARDEN(L)	FISSILE FUEL DENSITY IN CHANNEL L (KG/CC)	MAIN0299
C	VOIDK(L)	TOTAL REACTIVITY CONTRIB OF NA VOIDING IN CHANNEL L	MAIN0300
C	VOL(3)	VOLUME PER UNIT LENGTH OF FUEL,CLAD,COOLANT (K3)	MAIN0301
C	VOLL(1)	VOLUME OF REACTOR CORE ONE AXIAL SEGMENT HIGH	MAIN0302
C	VOLOC(N,L)	VOLUME OF FUEL IN RADIAL PIN NODE N,CHANNEL L(CC)	MAIN0303
C	VOLP(L)	VOLUME OF CORE AXIAL SEGMENT IN CHANNEL L	MAIN0304
C	VR(30)	VOL/UNIT LENGTH OF FUEL,CLAD,COOLANT IN NODE N(K3)	MAIN0305
C	WC(M,L)	NA WORTH IN AXIAL NODE M, CHANNEL L (DELTA K/KG NA)	MAIN0306
C	WCAD(L)	SODIUM VOID WORTH AT POSITION XXDO(L)	MAIN0307
C	WCAU(L)	SODIUM VOID WORTH AT POSITION XXUP(L)	MAIN0308
C	WF(M,L)	FUEL WORTH IN AXIAL NODE M,CHAN L(DEL K/KG FUEL)	MAIN0309
C	WFT(M,L)	FUEL WORTH AT POSITION ZMIDT(M,L)	MAIN0310
C	XDOWN(L)	AXIAL POS OF DNWARD NA VOID FRONT (CHANNEL L)	MAIN0311
C	XOD(L)	AXIAL POS OF DNWARD NA VOID FRONT(PREV TIME STEP)	MAIN0312
C	XOU(L)	AXIAL POS OF UPWARD NA VOID FRONT(PREV TIME STEP)	MAIN0313
C	XUP(L)	AXIAL POS OF UPWARD NA VOID FRONT (CHANNEL L)	MAIN0314
C	XXDO(L)	AVG POS OF DOWNWARD NA VOID FRONT DURING TIME STEP	MAIN0315
C	XXUP(L)	AVG POS OF UPWARD NA VOID FRONT DURING TIME STEP	MAIN0316
C	ZC(31,3)	GROUPING OF CONSTANTS FOR HEAT TRANSFER EQUATIONS	MAIN0317
C	ZH(M,L)	TOP OR BOTTOM POS OF NODE M,L DURING COLLAPSE	MAIN0318
C	ZMID(L)	INITIAL AXIAL POS OF CLAD FAILURE (CHANNEL L)	MAIN0319
C	ZMIDT(M,L)	CENTRAL AXIAL POS OF NODE M,L DURING COLLAPSE	MAIN0320
C	ZOH(M)	ORIGINAL BOTTOM OR TOP POSITIONS OF AXIAL NODES	MAIN0321
C	ZUP(M)	ORIGINAL MIDPOINTS OF AXIAL NODES	MAIN0322
C			MAIN0323
C			MAIN0324
	NIT = 5		MAIN0325
	NOT = 6		MAIN0326
	STEPM = 1.5		MAIN0327
10	CONTINUE		MAIN0328
	CALL INPUT		MAIN0329
	CALL INPUT2		MAIN0330
	CALL TEMDIS		MAIN0331
	CALL SETUP		MAIN0332
	CALL MELTIN		MAIN0333
	DO W IJK = 1, NCYC		MAIN0334
	CALL CONST		MAIN0335
	CALL CALC		MAIN0336
	CALL TEMDIS		MAIN0337
	IF (IRAD) 20, 20, 30		MAIN0338
20	IF (NMAX) 30, 30, 60		MAIN0339
30	KK = IJK + 1		MAIN0340
	IF (KK - NCYC) 40, 40, 10		MAIN0341
40	DO 50 K = KK,NCYC		MAIN0342
50	CALL CONST		MAIN0343
	GO TO 10		MAIN0344
60	CONTINUE		MAIN0345
	GO TO 10		MAIN0346
	END		MAIN0347

```

- ELT INPUT,1,680717, 6079
  SUBROUTINE INPUT
  INCLUDE ABC
C   THIS SUBROUTINE READS PROGRAM CONTROL AND NEUTRONICS VARIABLES.
  READ (NIT,10)(HOL(I),I=1,12)
10  FORMAT (12A6)
  WRITE (NOT,20)
20  FORMAT (1H1,15X,99H ** M E L T - I A S I M P L I F I
1E D C O R E M E L T D O W N M O D E L ** )
  WRITE (NOT,30)(HOL(I),I=1,12)
30  FORMAT (1H0//12A6///)
  READ (NIT,40)M,NMAX,NPRT,NSTART, NTEQ,NCYC ,IG,I1,I2,IDOP
40  FORMAT (12I6)
  IT = I1 + I2
  WRITE (NOT,50)M,NMAX,NPRT,NCYC,IG
50  FORMAT (29HNUMBER OF PRECURSOR GROUPS ,25X,I2//
131H MAXIMUM NUMBER OF TIME STEPS ,20X,I5//
2 40H NUMBER OF INTERVALS BETWEEN PRINT OUT ,13X,I3//
336H THE NUMBER OF REACTIVITY ZONES ,17X,I3//
4 38H GEOMETRY(0/1/2=SPHERE/CYLINDER/PLANE),15X,I3//)
60  FORMAT (6E12.4)
  READ (NIT,60)(B(I),I=1,M)
  READ (NIT,60)(AL(I),I=1,M)
  READ (NIT,60) AN(1), R1, ALIFE, HMAX, ERROR
  BB = .0
  DO 70 I = 1, M
70  BB = BB + B(I)
  R1 = 100.*R1/BB
  IF (NSTART) 90, 90, 80
80  READ (NIT,60)(C(I,1),I=1,M)
  GO TO 110
90  DO 100 I=1,M
100 C(I,1) = AN(1)*B(I)/(ALIFE* AL(I))
110 CONTINUE
  WRITE (NOT,120) AN(1), R1, ALIFE ,HMAX,ERROR ,BB
120 FORMAT (35H INITIAL NEUTRON DENSITY(PER CC) , 5X,1PE16.4//
130H INITIAL REACTIVITY (CENTS) ,10X,1PE16.4//
3 23H GENERATION TIME(SEC) ,17X,1PE16.4//
2 25H MAXIMUM TIME STEP(SEC) ,15X,1PE16.4//
125H CONVERGENCE CRITERION ,15X,1PE16.4//
5 27H TOTAL PRECURSOR FRACTION ,13X,1PE16.4//
6 48H GROUP B(I) LAMBDA(I) C(I)///)
  DO 130 I=1,M
  WRITE (NOT,150)I,B(I),AL(I),C(I,1)
130 WRITE (NOT,140)
140 FORMAT (1H )
150 FORMAT (I3,1P3E16.4)
  H = 100.* ALIFE
  T(1) = .0
  RH(1) = .01*RR*R1
  RETURN
  END

```

INPUT001
 INPUT002
 INPUT003
 INPUT004
 INPUT005
 INPUT006
 INPUT007
 INPUT008
 INPUT009
 INPUT010
 INPUT011
 INPUT012
 INPUT013
 INPUT014
 INPUT015
 INPUT016
 INPUT017
 INPUT018
 INPUT019
 INPUT020
 INPUT021
 INPUT022
 INPUT023
 INPUT024
 INPUT025
 INPUT026
 INPUT027
 INPUT028
 INPUT029
 INPUT030
 INPUT031
 INPUT032
 INPUT033
 INPUT034
 INPUT035
 INPUT036
 INPUT037
 INPUT038
 INPUT039
 INPUT040
 INPUT041
 INPUT042
 INPUT043
 INPUT044
 INPUT045
 INPUT046
 INPUT047
 INPUT048
 INPUT049
 INPUT050
 INPUT051

```

- ELT INPUT2,1,680717, 6084
  SUBROUTINE INPUT2
  INCLUDE ABC
  THIS SUBROUTINE READS AND PRINTS HEAT TRANSFER AND REACTIVITY
  COEFFICIENTS.
  DO 10 I = 1,3
    READ (NIT,20) RC(I,1), RC(I,2), RTC(I), PGAM(I)
  10 CONTINUE
  20 FORMAT (6E12.4)
  DO 30 I = 1,2
    READ (NIT,20) RCP(I), COND(I), HAI(I), RAD(I)
  30 CONTINUE
  READ (NIT,20) RCP(3), HA(3), TZERO, VOL(3)
  CALL ADDINP
  CALL CIT
  BEGIN PRINT.
  WRITE (NOT, 40)
  40 FORMAT (64H1REACTIVITY AND HEAT TRANSFER COEFFICIENTS FOR THE THREE
  1E REGIONS////11H PARAMETER 28X,39H REGION 1      REGION 2      R
  2REGION 3////)
  WRITE (NOT,50) ((RC(I,1), I = 1,3), (RC(I,2), I=1,3), (RTC(I), I
  1= 1,3), (TEMP(I,1), I=1,3), (PGAM(I), I=1,3), (VOL(I), I=1,3),
  2(RCP(I), I = 1,3), (HA(I), I=1,3),(COND(I), I=1,2), TZERO)
  50 FORMAT (28H LINEAR TEMP COEF( PER DEG K), 6X, 1P3E15.4//
  1 30H DOPPLER COEFFICIENT (T DK/DT), 4X, 1P3E15.4//
  2 22H REACTIVITY DELAY(SEC),12X, 1P3E15.4//
  3 20H INITIAL TEMP(DEG K), 14X, 1P3E15.4//
  4 28H ENERGY DEPOSITION FRACTION , 6X, 1P3E15.4//
  5 12H VOLUME (CC), 22X, 1P3E15.4//
  6 31H HEAT CAPACITY (JOULES/CC-DEGK), 3X, 1P3E15.4//
  3 32H H.T.C. X AREA (JOULES/SEC-DEGK), 2X, 1P3E15.4//
  7 30H K(J/CM-SEC-DEGK) AND T(INLET), 4X, 1P3E15.4////)
  DO 70 I = 1,3
    RC(I,1) = 100.*RC(I,1)/BB
    RC(I,2) = 100.*RC(I,2)/BB
  60 RNOR(I) = - ( RC(I,1) * TEMP(I,1) + RC(I,2) * ALOG(TEMP(I,1)))
    RCNT(I,1) = .0
    RCNT(I,2) = .0
  70 CONTINUE
  RETURN
  END

```

```

INPT2001
INPT2002
INPT2003
INPT2004
INPT2005
INPT2006
INPT2007
INPT2008
INPT2009
INPT2010
INPT2011
INPT2012
INPT2013
INPT2014
INPT2015
INPT2016
INPT2017
INPT2018
INPT2019
INPT2020
INPT2021
INPT2022
INPT2023
INPT2024
INPT2025
INPT2026
INPT2027
INPT2028
INPT2029
INPT2030
INPT2031
INPT2032
INPT2033
INPT2034
INPT2035
INPT2036
INPT2037
INPT2038
INPT2039
INPT2040

```

```

- ELT ADDINP,1,680717, 6090
  SUBROUTINE ADDINP
  INCLUDE ABC
C   THIS SUBROUTINE COMPUTES INITIAL CONSTANTS.
    G = I1
    DEL = RAD(1)/G
    RAD(1) = DFL
    RADA(1) = DEL/2.
    IF (I1 - 1) 30,30,10
10  DO 20 I = 2,I1
    RAD(I) = RAD(I-1) + DEL
20  RADA(I) = RADA(I-1) + DEL
30  CONTINUE
    G = I2
    DEL = (RAD(2) - RAD(1))/G
    KG = I1 + 1
    RAD(KG) = RAD(I1) + DEL
    RADA(KG) = RAD(I1) + DEL/2.
    IF (I2 - 1) 60,60,40
40  KG = I1 + 2
    DO 50 I = KG,IT
    RAD(I) = RAD(I-1) + DEL
50  RADA(I) = RADA(I-1) + DEL
60  CONTINUE
    PI = 3.141592
    IF (IG - 1) 70,90,110
70  AR(1) = 4.*PI*RAD(1)**2
    VR(1) = 1.33333*PI*RAD(1)**3
    DO 80 I = 2,IT
    AR(I) = 4.*PI*RAD(I)**2
80  VR(I) = 1.33333*PI*(RAD(I)**3 - RAD(I-1)**3)
    GO TO 130
90  AR(1) = 2.*PI*RAD(1)
    VR(1) = PI*RAD(1)**2
    DO 100 I = 2,IT
    AR(I) = 2.*PI*RAD(I)
100 VR(I) = PI*(RAD(I)**2 - RAD(I-1)**2)
    GO TO 130
110 AR(1) = 1.0
    VR(1) = RAD(1)
    DO 120 I = 2,IT
    AR(I) = 1.0
120 VR(I) = RAD(I) - RAD(I-1)
130 CONTINUE
    VOL(1) = .0
    DO 140 I = 1,I1
140 VOL(1) = VOL(1) + VR(I)
    HAI(1) = AR(I1) * HAI(1)
    VOL(2) = .0
    KG = I1 + 1
    DO 150 I = KG,IT
150 VOL(2) = VOL(2) + VR(I)
    HAI(2) = AR(IT) * HAI(2)
    DEL = .5*(RAD(I1+1) - RAD(I1))
    G = 1./HAI(1) + RADA(1)/COND(1) + DEL/COND(2)
    HHA(I1) = AR(I1)/G
    G = 1.0/HAI(2) + DEL/COND(2)
    HHA(IT) = AR(IT)/G
    IF (I1 - 1) 180,180,160

```

ADINP001
 ADINP002
 ADINP003
 ADINP004
 ADINP005
 ADINP006
 ADINP007
 ADINP008
 ADINP009
 ADINP010
 ADINP011
 ADINP012
 ADINP013
 ADINP014
 ADINP015
 ADINP016
 ADINP017
 ADINP018
 ADINP019
 ADINP020
 ADINP021
 ADINP022
 ADINP023
 ADINP024
 ADINP025
 ADINP026
 ADINP027
 ADINP028
 ADINP029
 ADINP030
 ADINP031
 ADINP032
 ADINP033
 ADINP034
 ADINP035
 ADINP036
 ADINP037
 ADINP038
 ADINP039
 ADINP040
 ADINP041
 ADINP042
 ADINP043
 ADINP044
 ADINP045
 ADINP046
 ADINP047
 ADINP048
 ADINP049
 ADINP050
 ADINP051
 ADINP052
 ADINP053
 ADINP054
 ADINP055
 ADINP056
 ADINP057
 ADINP058

```
160 KG = I1 - 1
    DO 170 I = 1, KG
170 HHA(I) = AR(I)*COND(1)/RAD(1)
180 IF (I2 - 1) 210,210,190
190 KG = I1 + 1
    KGG = IT - 1
    DO 200 I = KG,KGG
200 HHA(I) = AR(I) * COND(2)/(RAD(I1+1) - RAD(I1))
210 CONTINUE
    RETURN
    END
```

```
ADINP059
ADINP060
ADINP061
ADINP062
ADINP063
ADINP064
ADINP065
ADINP066
ADINP067
ADINP068
ADINP069
```



```

- ELT CIT,1,680717, 6096
  SUBROUTINE CIT
  INCLUDE ABC
C   THIS SUBROUTINE COMPUTES THE INITIAL TEMPERATURE DISTRIBUTION FOR
C   THE AVERAGE CORE LOCATION.
  IF (NTEQ) 30,30,10
10  CONTINUE
    KG = IT + 1
    READ (NIT,20)(TP(I,1),I=1,KG)
    TEMP(3,1) = TP(KG,1)
20  FORMAT (6E12.4)
    GO TO 90
30  G = .0
    DO 40 I = 1,3
40  G = G + VOL(I) * PGAM(I)
    TEMP(3,1) = TZERO + AN(1) * G/HA(3)
    KG = IT + 1
    TP(KG,1)=TEMP(3,1)
    G = AN(1)*(VOL(1)*PGAM(1) + VOL(2)*PGAM(2))
    TP(IT,1) = TP(KG,1) + G/HHA(IT)
    DO 80 K = 2,IT
      I = IT - K + 1
      IF (I - I1) 50,60,60
50  GG = PGAM(1)
      GO TO 70
60  GG = PGAM(2)
70  G = G - GG*AN(1)*VR(I+1)
80  TP(I,1) = TP(I+1,1) + G/HHA(I)
90  CONTINUE
    TEMP(1,1) = .0
    DO 100 I = 1,I1
100  TEMP(1,1) = TEMP(1,1) + VR(I)*TP(I,1)
    TEMP(1,1) = TEMP(1,1)/VOL(1)
    KG = I1 + 1
    TEMP(2,1) = .0
    DO 110 I = KG,IT
110  TEMP(2,1) = TEMP(2,1) + VR(I)*TP(I,1)
    TEMP(2,1) = TEMP(2,1)/VOL(2)
    RETURN
  END

```

CIT00001
 CIT00002
 CIT00003
 CIT00004
 CIT00005
 CIT00006
 CIT00007
 CIT00008
 CIT00009
 CIT00010
 CIT00011
 CIT00012
 CIT00013
 CIT00014
 CIT00015
 CIT00016
 CIT00017
 CIT00018
 CIT00019
 CIT00020
 CIT00021
 CIT00022
 CIT00023
 CIT00024
 CIT00025
 CIT00026
 CIT00027
 CIT00028
 CIT00029
 CIT00030
 CIT00031
 CIT00032
 CIT00033
 CIT00034
 CIT00035
 CIT00036
 CIT00037
 CIT00038
 CIT00039

```

- ELT TEMDIS,1,680717, 6101
  SUBROUTINE TEMDIS
  INCLUDE ABC
C   THIS SUBROUTINE PRINTS GEOMETRY SPECIFICATIONS AND THE TEMPERATURE
C   DISTRIBUTION FOR THE AVERAGE CORE LOCATION.
  WRITE (NOT,10) (HOL(I), I=1,12)
10 FORMAT (1H1,12A6/// 66H GEOMETRY SPECIFICATIONS AND TEMPERATURE D
1STRIBUTION LISTED BELOW///94H  I      ZONE      RADIUS(CM)      AVG RATE
2DIUS(CM)      AREA(CM2)      VOLUME(CC)      TEMPERATURE(DEG K)///)
20 FORMAT (15,I6, 1P5E15.3)
  JK = 1
  DO 30 I = 1,I1
  WRITE (NOT,20) I,JK,RAD(I),RADA(I),AR(I),VR(I),TP(I,1)
30 CONTINUE
  JK = 2
  JKP = I1 + 1
  DO 40 I = JKP,IT
  WRITE (NOT,20) I,JK,RAD(I),RADA(I),AR(I),VR(I),TP(I,1)
40 CONTINUE
  JK = 3
  G = .0
  JKP = IT + 1
  WRITE (NOT,20) JKP,JK,G,G,G,VOL(3),TP(JKP,1)
  RETURN
  END

```

TEMDS001
 TEMDS002
 TEMDS003
 TEMDS004
 TEMDS005
 TEMDS006
 TEMDS007
 TEMDS008
 TEMDS009
 TEMDS010
 TEMDS011
 TEMDS012
 TEMDS013
 TEMDS014
 TEMDS015
 TEMDS016
 TEMDS017
 TEMDS018
 TEMDS019
 TEMDS020
 TEMDS021
 TEMDS022
 TEMDS023
 TEMDS024

-	ELT	SETUP,1,680717, 6106	
		SUBROUTINE SETUP	SETUP001
		INCLUDE ABC	SETUP002
C		THIS SUBROUTINE DETERMINES CONSTANTS USED IN HEAT TRANSFER	SETUP003
C		CALCULATIONS.	SETUP004
		ZC(1,1) = PGAM(1)/RCP(1)	SETUP005
		ZC(1,2) = .0	SETUP006
		ZC(1,3) = HHA(1)/(VR(1)*RCP(1))	SETUP007
		IF (I1 - 1) 30,30,10	SETUP008
10	DO	20 I = 2,I1	SETUP009
		ZC(I,1) = PGAM(1)/RCP(1)	SETUP010
		ZC(I,2) = HHA(I-1)/(VR(I)*RCP(1))	SETUP011
20		ZC(I,3) = HHA(I)/(VR(I)*RCP(1))	SETUP012
30	KG	= I1 + 1	SETUP013
	DO	40 I = KG,IT	SETUP014
		ZC(I,1) = PGAM(2)/RCP(2)	SETUP015
		ZC(I,2) = HHA(I-1)/(VR(I)*RCP(2))	SETUP016
40		ZC(I,3) = HHA(I)/(VR(I)*RCP(2))	SETUP017
	KG	= IT + 1	SETUP018
		ZC(KG,1) = PGAM(3)/RCP(3)	SETUP019
		ZC(KG,2) = HHA(IT)/(VOL(3)*RCP(3))	SETUP020
		ZC(KG,3) = HA(3)/(VOL(3)*RCP(3))	SETUP021
		IF (HMAX) 50,50,100	SETUP022
50	G	= .0	SETUP023
	DO	90 I = 1,KG	SETUP024
		IF (G - ZC(I,2)) 60,70,70	SETUP025
60	G	= ZC(I,2)	SETUP026
70	IF	(G - ZC(I,3)) 80,90,90	SETUP027
80	G	= ZC(I,3)	SETUP028
90	CONTINUE		SETUP029
	HMAX	= .5/G	SETUP030
100	CONTINUE		SETUP031
	IF	(H - HMAX) 120,120,110	SETUP032
110	H	= HMAX	SETUP033
120	CONTINUE		SETUP034
	RETURN		SETUP035
	END		SETUP036

```

- ELT CONST,1,680717, 6112
  SUBROUTINE CONST
C    THIS SUBROUTINE READS AND PRINTS THE CURRENT REACTIVITY STATUS.
  WRITE (NOT,10) (HOL(I), I=1,12)
10  FORMAT (1H1//12A6////)
  READ (NIT,20) TMAX, R2, R3
20  FORMAT (6E12.4)
  RH(1) = 100.*RH(1)/BB
  R2 = 100.*R2/BB
  R3 = 100.*R3/BB
  WRITE (NOT,30) T(1), RH(1), R2, R3
30  FORMAT (41H<REACTIVITY INPUT DATA LISTED BELOW . . .////
126H THE CURRENT TIME (SEC) = 1PE16.4//
134H THE CURRENT REACTIVITY (CENTS) = 1PE16.4//
234H LINEAR COEFFICIENT (CENTS/SEC) = 1PE16.4//
338H QUADRATIC COEFFICIENT (CENTS/SEC2) = 1PE16.4//
  WRITE (NOT,40) (HOL(I), I=1,12)
40  FORMAT (1H1//12A6// 37H SOLUTION OF KINETICS EQUATIONS BELOW//
1128H 1 TIME(SEC)/VOID POWER/COL RHO(CENTS)/E RHO 1/C1 RHO 2/C
22  RHO 3/C3 TEMP 1/C4 TEMP 2/C5 TEMP 3/C6 TEMA/Q(MW SEC)
3//)
  I = 1
  WRITE (NOT,50) I, T(I), AN(I), RH(I), (RCNT(J,I), J=1,3),
1  (TEMP(K,I), K=1,3), TEMA(1), REAVOD(1), REACOL(1), ENERP,(C(K,I),
2  K=1,M), QMOL
50  FORMAT (15, 1PE12.5,1PE12.4,0P4F12.4,1P4E12.4/5X,0P2F12.4,1PE12.4,
11P6E12.3,1PE12.5)
  RH(1) = .01*BB*RH(1)
  R2 = .01*BB*R2
  R3 = .01*BB*R3
  RETURN
END

```

CONST001
CONST002
CONST003
CONST004
CONST005
CONST006
CONST007
CONST008
CONST009
CONST010
CONST011
CONST012
CONST013
CONST014
CONST015
CONST016
CONST017
CONST018
CONST019
CONST020
CONST021
CONST022
CONST023
CONST024
CONST025
CONST026
CONST027
CONST028
CONST029
CONST030
CONST031
CONST032

```

- ELT SUBRHO,1,680717, 6118
  SUBROUTINE SUBRHO
  INCLUDE ABC
  THIS SUBROUTINE CALCULATES NEW AVERAGE CORE LOCATION TEMPERATURES
  AND OVERALL REACTIVITY.
  G = AN(1)
  GG = TP(1,1) - TP(2,1)
  TP(1,2) = TP(1,1) + H*(ZC(1,1)*G - ZC(1,3)*GG)
  DO 10 I = 2,IT
  GG = TP(I-1,1) - TP(I,1)
  GGG = TP(I,1) - TP(I+1,1)
  10 TP(I,2) = TP(I,1) + H*(ZC(I,1)*G + ZC(I,2)*GG - ZC(I,3)*GGG)
  KG = IT + 1
  GG = TP(KG,1) - TZERO
  GGG = TP(IT,1) - TP(KG,1)
  TP(KG,2) = TP(KG,1) + H*(ZC(KG,1)*G + ZC(KG,2)*GGG - ZC(KG,3)*GG)
  G = .5*(AN(1) + ANZ)
  DO 30 K = 1,3
  GG = .5*(TP(1,1) + TP(1,2) - TP(2,1) - TP(2,2))
  TP(1,2) = TP(1,1) + H*(ZC(1,1)*G - ZC(1,3)*GG)
  DO 20 I = 2,IT
  GG = .5*(TP(I-1,1) + TP(I-1,2) - TP(I,1) - TP(I,2))
  GGG = .5*(TP(I,1) + TP(I,2) - TP(I+1,1) - TP(I+1,2))
  20 TP(I,2) = TP(I,1) + H*(ZC(I,1)*G + ZC(I,2)*GG - ZC(I,3)*GGG)
  GG = .5*(TP(KG,1) + TP(KG,2)) - TZERO
  GGG = .5*(TP(IT,1) + TP(IT,2) - TP(KG,1) - TP(KG,2))
  TP(KG,2) = TP(KG,1) + H*(ZC(KG,1)*G + ZC(KG,2)*GGG - ZC(KG,3)*GG)
  30 CONTINUE
  C CALCULATION OF AVERAGE TEMPERATURES.
  TEMP(1,2) = .0
  DO 40 I = 1,I1
  40 TEMP(1,2) = TEMP(1,2) + VR(I)*TP(I,2)
  TEMP(1,2) = TEMP(1,2)/VOL(1)
  TEMP(2,2) = .0
  KG = I1 + 1
  DO 50 I = KG,IT
  50 TEMP(2,2) = TEMP(2,2) + VR(I)*TP(I,2)
  TEMP(2,2) = TEMP(2,2)/VOL(2)
  TEMP(3,2) = TP(IT + 1,2)
  C CALCULATION OF TEMPERATURE FEEDBACK REACTIVITY.
  RFACOL(2) = COLAPK/(.01*BB)
  RFAVOD(2) = VODK/(.01*BB)
  IF (IDOP) 60,60,80
  60 IF (IMELT) 80,80,70
  C
  C NOTE THAT THE NEW AVERAGE FUEL TEMPERATURE IS HERE ONLY ESTIMATED.
  C THIS AVOIDS CALLING CORTEM DURING EACH TIME STEP DETERMINATION
  C ITERATION (WOULD FURTHER REQUIRE CHANGING THE ENERGY INDICES).
  C
  70 TEMPA(1,2) = TEMA(1)*TEMP(1,2)/TEMP(1,1)
  TEMPA(2,2) = TEMP(2,2)
  TEMPA(3,2) = TEMP(3,2)
  GO TO 100
  80 DO 90 I=1,3
  TEMPA(I,2) = TEMP(I,2)
  90 CONTINUE
  100 DO 180 I=1,3
  IF (RTC(I) - .000001) 170,170,110
  110 IF (IMELT) 130,130,120

```

```

120 TEMPA(1,1) = TEMA(1) SUBRO059
    TEMPA(2,1) = TEMP(2,1) SUBRO060
    TEMPA(3,1) = TEMP(3,1) SUBRO061
    GO TO 150 SUBRO062
130 DO 140 II=1,3 SUBRO063
140 TEMPA(II,1) = TEMP(II,1) SUBRO064
150 G = RNOR(I) + RC(I,1)*TEMPA(I,1) + RC(I,2)*ALOG(TEMPA(I,1))-RCNT(I,1) SUBRO065
    RCNT(I,2) = RCNT(I,1) + H*G/RTC(I) SUBRO066
    DO 160 KKL = 1,3 SUBRO067
    GG = RNOR(I) + RC(I,1)*TEMPA(I,2) + RC(I,2)*ALOG(TEMPA(I,2)) - SUBRO068
    RCNT(I,2) SUBRO069
    RCNT(I,2) = RCNT(I,1) + .5*H*(G + GG)/RTC(I) SUBRO070
160 CONTINUE SUBRO071
    GO TO 180 SUBRO072
170 RCNT(I,2) = RNOR(I) + RC(I,1)*TEMPA(I,2) + RC(I,2)*ALOG(TEMPA(I,2)) SUBRO073
180 CONTINUE SUBRO074
C  CALCULATION OF TOTAL REACTIVITY. SUBRO075
    G = .0 SUBRO076
    DO 190 I = 1,3 SUBRO077
190 G = G + RCNT(I,2) - RCNT(I,1) SUBRO078
    G = G + REACOL(2) - REACOL(1) SUBRO079
    G = G + REAVOD(2) - REAVOD(1) SUBRO080
    RH(2) = RH(1) + R2*H + R3*( 2.*T(1)*H + H*H) + .01*G*BB SUBRO081
    IF (IFLAG) 230,230,200 SUBRO082
200 IF (RH(2)) 210,230,230 SUBRO083
210 IBAD = 1 SUBRO084
    WRITE (NOT,220) SUBRO085
220 FORMAT (10X,23H REACTOR IS SUBCRITICAL) SUBRO086
230 CONTINUE SUBRO087
    RETURN SUBRO088
    END SUBRO089

```

```

- ELT SURNEU,1,680717, 6123
  SUBROUTINE SURNEU
  INCLUDE ABC
  C THIS SUBROUTINE COMPUTES THE NEW POWER USING THE OLD AND NEW
  C REACTIVITY.
  G = .0
  DO 30 I=1,M
    IF(ABS (ALPH(I)*H) - .01) 10,20,20
  10 G = G + AL(I)*C(I,1 )*.5*H*H*(-ALPH(I) + H*ALPH(I)**2/3. -
    1 H*H*ALPH(I)**3/12.)
    GO TO 30
  20 G = G + AL(I)*C(I,1 )*((1.-EXP (-H*ALPH(I)))/ALPH(I) - H)
  30 CONTINUE
    AN(2) = EXP (W*H)*(AN(1 )*(1+.5*H*(RH(2)-RH(1 ))/ALIFE) + G )
    RETURN
  END

```

SUBNU001
 SUBNU002
 SUBNU003
 SUBNU004
 SUBNU005
 SUBNU006
 SUBNU007
 SUBNU008
 SUBNU009
 SUBNU010
 SUBNU011
 SUBNU012
 SUBNU013
 SUBNU014
 SUBNU015

```

- ELT PRECUR,1,680717, 6128
  SUBROUTINE PRECUR
C    THIS SUBROUTINE COMPUTES PRECURSOR DENSITIES AND SETS INDICIES.
    DO 30 I=1,M
      IF(ABS (ALPH(I)*H) - .4) 20,10,10
10    C(I,2) = EXP (GAM(I)*H)*(C(I,1) + AN(1) *B(I)*((EXP (H*ALPH(I))
      1 - 1.)/ALPH(I) - H)/ALIFE)
      GO TO 30
20    C(I,2) = EXP (H*GAM(I))*(C(I,1) + AN(1) *B(I)*H**H*ALPH(I)*
      1 (1. + ALPH(I)*H/3. + (ALPH(I)*H)**2/12. + (ALPH(I)*H)**3/60.)
      2 /(2.*ALIFE))
30    CONTINUE
      RH(1) = RH(2)
      ENR1 = AN(1)
      AN(1) = AN(2)
      CALL ENERGY
      T(1) = T(2)
      DO 40 I = 1,3
        TEMP(I,1) = TEMP(I,2)
        RCNT(I,1) = RCNT(I,2)
40    CONTINUE
      REACOL(1) = REACOL(2)
      REAVOD(1) = REAVOD(2)
      DO 50 K = 1,M
50    C(K,1) = C(K,2)
      KG = IT + 1
      DO 60 I = 1,KG
60    TP(I,1) = TP(I,2)
      RETURN
      END

```

```

PRECR001
PRECR002
PRECR003
PRECR004
PRECR005
PRECR006
PRECR007
PRECR008
PRECR009
PRECR010
PRECR011
PRECR012
PRECR013
PRECR014
PRECR015
PRECR016
PRECR017
PRECR018
PRECR019
PRECR020
PRECR021
PRECR022
PRECR023
PRECR024
PRECR025
PRECR026
PRECR027
PRECR028
PRECR029
PRECR030

```



```

- ELT MELTN,1,680717, 6140
  SUBROUTINE MELTN
C   THIS SUBROUTINE READS AND PRINTS CORE CONSTANTS NEEDED FOR
C   COLLAPSE AND VOIDING FEEDBACK, AND CALCULATES AND PRINTS INITIAL
C   CORE POWER AND TEMPERATURE DISTRIBUTIONS.
  INCLUDE ABC
  REAL NADEN
  WRITE (NOT,1270)(HOL(I),I=1,12)
  WRITE (NOT,10)
10 FORMAT (20X,48H INPUT FOR MELTDOWN, COLLAPSE, AND VOID ROUTINE
1S//)
  READ (NIT,20)NUPPER,MUPPER,LUPPER,NPDA,NPDR,MF,MC,MPRT,ITYPE,NCOL
  1,IDEN,IWRITE,LVOID,IVOID,MUX,NVOD,NCPS,INA,IVODCO,NMPRT
20 FORMAT (12I6)
  READ (NIT,30)(DL(I),I=1,LUPPER)
30 FORMAT (12E6.2)
  READ (NIT,30)AHIGH,RADIUS,PEAKR,PEAKA,EXTRAP,EPDOP,DENSEF,DENSEM
1E,DENSEC,FRACF,CHI,GRAV,TIMEC,TCOLM,NADEN,TIMEV,TEMAW,TEMAD,FNAMOD
2,FUELV
  WRITE (NOT,40) NUPPER
  WRITE (NOT,50) MUPPER
  WRITE (NOT,60) LUPPER
  WRITE (NOT,70) NPDA
  WRITE (NOT,80) NPDR
  WRITE (NOT,90) MF
  WRITE (NOT,100) MC
  WRITE (NOT,110) MPRT
  WRITE (NOT,120) ITYPE
  WRITE (NOT,130) NCOL
  WRITE (NOT,140) IDEN
  WRITE (NOT,150) IWRITE
  WRITE (NOT,160) LVOID
  WRITE (NOT,170) IVOID
  WRITE (NOT,180) MUX
  WRITE (NOT,190) IDOP
  WRITE (NOT,200) NVOD
  WRITE (NOT,210) NCPS
  WRITE (NOT,220) INA
  WRITE (NOT,230) IVODCO
  WRITE (NOT,240) NMPRT
40 FORMAT (49H NUMBER OF FUEL PIN NODES (NUPPER) =,I3)MELTN040
50 FORMAT (49H NUMBER OF CORE AXIAL NODES (MUPPER) =,I3)MELTN041
60 FORMAT (49H NUMBER OF CORE RADIAL CHANNELS (LUPPER) =,I3)MELTN042
70 FORMAT (49H AXIAL PEAK TO AVERAGE POWER (NPDA) =,I3)MELTN043
80 FORMAT (49H RADIAL PEAK TO AVERAGE POWER (NPDR) =,I3)MELTN044
90 FORMAT (49H AXIAL FUEL NODE CHECKED FOR COLLAPSE (MF) =,I3)MELTN045
100 FORMAT (49H AXIAL NA NODE CHECKED FOR COLLAPSE (MC) =,I3)MELTN046
110 FORMAT (49H NUMBER OF K3 PRINTS PER MELT PRINT (MPRT) =,I3)MELTN047
120 FORMAT (49H TYPE OF MELT PRINT (0/1=PARTIAL/FULL) (ITYPE) =,I3)MELTN048
130 FORMAT (49H LIMIT FOR TOTAL SEGMENTS OF COLLAPSE (NCOL) =,I3)MELTN049
140 FORMAT (49H FUEL DENSITY FLAG (0/1 = CONST./VAR.) (IDEN) =,I3)MELTN050
150 FORMAT (49H PRINTF CONTROL (0/1=ALL/CL AND OUTER) (IWRITE) =,I3)MELTN051
160 FORMAT (49H CHANNEL NUMBER OF HOTTEST SODIUM (LVOID) =,I3)MELTN052
170 FORMAT (49H VOIDING TRIP (0/1=NORMAL/PRESELECTED) (IVOID) =,I3)MELTN053
180 FORMAT (49H AXIAL NODE FOR VOID START(IF IVOID=1) (MUX) =,I3)MELTN054
190 FORMAT (49H DOPPLER FEEDBACK (0/1=MELT/K3) (IDOP) =,I3)MELTN055
200 FORMAT (49H VOIDING SWITCH (0/1=NO VOID/VOID) (NVOD) =,I3)MELTN056
210 FORMAT (49H COLLAPSE SWITCH (0/1=NO COLLAP/COLLAP) (NCPS) =,I3)MELTN057
220 FORMAT (49H SWITCH TO CALL NAMOD (0/1=NO/YES) (INA) =,I3)MELTN058

```

```

230 FORMAT (49H VOIDING AT TIME OF COLLAPSE (0/1=N/Y) (IVODCO) =,I3)MELTN059
240 FORMAT (49H NUMBER OF K3 PRINTS PER PRINTM PRINT (NMPRT) =,I3)MELTN060
WRITE (NOT,250) AHIGH MELTN061
250 FORMAT (//38H CORE HEIGHT (CM) = ,F10.5) MELTN062
WRITE (NOT,260) RADIUS MELTN063
260 FORMAT (38H CORE RADIUS (CM) = ,F10.5) MELTN064
WRITE (NOT,270) PEAKR MELTN065
270 FORMAT (38H RADIAL PEAK TO AVERAGE TEMPERATURE = ,F10.5) MELTN066
WRITE (NOT,280) PEAKA MELTN067
280 FORMAT (38H AXIAL PEAK TO AVERAGE TEMPERATURE = ,F10.5) MELTN068
WRITE (NOT,290) EXTRAP MELTN069
290 FORMAT (38H AXIAL LENGTH (INCLUDING EXTRAP) = ,F10.5) MELTN070
WRITE (NOT,300) EPSDOP MELTN071
WRITE (NOT,300) DENSEF MELTN072
300 FORMAT (38H DENSITY OF FUEL (GRAMS/CC) = ,F10.5) MELTN073
WRITE (NOT,310) DENSEE MELTN074
310 FORMAT (38H DENSITY OF CLAD (GRAMS/CC) = ,F10.5) MELTN075
WRITE (NOT,320) DENSEC MELTN076
320 FORMAT (38H DENSITY OF COOLANT (GRAMS/CC) = ,F10.5) MELTN077
330 FORMAT (38H EPSDOP,FRACF,DIFF.OF TEMP AND TEMA = ,F10.5) MELTN078
READ (NIT,340) TFUSEF,TFUSEE,TFUSEC,TBOILC,FUSEF,FUSEE,FUSEC,VAPCMELTN079
340 FORMAT (6E12.4) MELTN080
READ (NIT,340) TRIPF,TRIPFO,TRIPC,TRIFE MELTN081
WRITE (NOT,350) TFUSEF MELTN082
350 FORMAT (48H MELTING TEMPERATURE OF FUEL (K) = ,E10.5)MELTN083
WRITE (NOT,360) TFUSEE MELTN084
360 FORMAT (48H MELTING TEMPERATURE OF CLAD (K) = ,E10.5)MELTN085
WRITE (NOT,370) TFUSEC MELTN086
370 FORMAT (48H MELTING TEMPERATURE OF COOLANT (K) = ,E10.5)MELTN087
WRITE (NOT,380) TBOILC MELTN088
380 FORMAT (48H BOILING TEMPERATURE OF COOLANT (K) = ,E10.5)MELTN089
WRITE (NOT,390) FUSEF MELTN090
390 FORMAT (48H LATENT HEAT OF FUSION OF FUEL (J/G) = ,E10.5)MELTN091
WRITE (NOT,400) FUSEE MELTN092
400 FORMAT (48H LATENT HEAT OF FUSION OF CLAD (J/G) = ,E10.5)MELTN093
WRITE (NOT,410) FUSEC MELTN094
410 FORMAT (48H LATENT HEAT OF FUSION OF COOLANT (J/G) = ,E10.5)MELTN095
WRITE (NOT,420) VAPC MELTN096
420 FORMAT (48H LATENT HEAT OF VAPORIZATION OF COOLANT (J/G) = ,E10.5)MELTN097
WRITE (NOT,430) TRIPF MELTN098
430 FORMAT (48H TEMP. OF CENTERLINE FUEL AT WHICH CLAD FAILS = ,E10.5)MELTN099
WRITE (NOT,440) TRIPFO MELTN100
440 FORMAT (48H TEMP. OF OUTER NODE FUEL AT WHICH CLAD FAILS = ,E10.5)MELTN101
WRITE (NOT,450) TRIPC MELTN102
450 FORMAT (48H TEMP. OF COOLANT AT WHICH CLAD FAILS = ,E10.5)MELTN103
WRITE (NOT,460) TRIFE MELTN104
460 FORMAT (48H TEMP. OF CLAD AT WHICH CLAD FAILS = ,E10.5)MELTN105
WRITE (NOT,470) FRACF MELTN106
470 FORMAT (48H FRACF (VOLUME FRACTION OF PU-239) = ,E10.5)MELTN107
WRITE (NOT,480) GRAV MELTN108
480 FORMAT (48H GRAV (FORCING FUNCTION IN EQUATION OF MOTION)= ,E10.5)MELTN109
WRITE (NOT,490) CHI MELTN110
490 FORMAT (48H CHI (VISCOSITY TERM IN EQUATION OF MOTION) = ,E10.5)MELTN111
WRITE (NOT,500) TIMEC MELTN112
WRITE (NOT,510) TCOLM MELTN113
WRITE (NOT,520) MADEN MELTN114
WRITE (NOT,530) TIMEV MELTN115
WRITE (NOT,540) TEMAW MELTN116
WRITE (NOT,550) TEMAD MELTN117

```

```

WRITE (NOT,560) FNAMOD                                MELTN118
WRITE (NOT,570) FUELTV                                MELTN119
500 FORMAT (48H TIMEC (PRINTOUT INTERVAL AFTER START OF COL) = ,E10.5) MELTN120
510 FORMAT (48H TCOLM (TOTAL RUNNING TIME AFTER START OF COL) = ,E10.5) MELTN121
520 FORMAT (48H NADEN (NA DENSITY(KG/CC CORE VOLUME)FOR VOID) = ,E10.5) MELTN122
530 FORMAT (48H TIMEV (PRINTOUT INTERVAL AFTER START OF VOID) = ,E10.5) MELTN123
540 FORMAT (48H TEMAW (VALUE OF TEMA FOR CALLING TEMAP SUB.) = ,F10.5) MELTN124
550 FORMAT (48H TEMAD (TIME BEYOND TEMAW WHEN PROGRAM HALTED) = ,E10.5) MELTN125
560 FORMAT (48H FNAMOD (FACTOR BY WHICH WC(MU,L) IS MULT.) = ,E10.5) MELTN126
570 FORMAT (48H FUELTV (TOTAL CORE VOLUME OF FUEL, CC) = ,E10.5) MELTN127
    IF (IDEN) 610, 610, 580                                MELTN128
580 READ (NIT,590) (VARDEN(L),L=1,LUPPER)                MELTN129
590 FORMAT (6E12.2)                                MELTN130
    WRITE (NOT,600) (VARDEN(L), L=1,LUPPER)                MELTN131
600 FORMAT (/24H CHANNEL FUEL DENSITIES ,(10(E9.4)))        MELTN132
610 CONTINUE                                            MELTN133
C                                                        MELTN134
    READ (NIT,590) (TRIPX(L),L=1,LUPPER)                MELTN135
    WRITE (NOT,620) (TRIPX(L),L=1,LUPPER)                MELTN136
620 FORMAT (/24H CHANNEL NA VOID TRIPS ,(10(E9.4)))        MELTN137
    READ (NIT,590) A1,A2,A3,A4,TA2,TA3,TA4                MELTN138
    READ (NIT,590) B1,B2,B3,B4,TB2,TB3,TB4                MELTN139
    WRITE (NOT,630) A1,A2,A3,A4,TA2,TA3,TA4                MELTN140
    WRITE (NOT,640) B1,B2,B3,B4,TB2,TB3,TB4                MELTN141
630 FORMAT (/24H A1,A2,A3,A4,TA2,TA3,TA4,(10(E9.4)))        MELTN142
640 FORMAT (/24H B1,B2,B3,B4,TB2,TB3,TB4,(10(E9.4)))        MELTN143
C                                                        MELTN144
    ASSIGN FAILURE THRESHOLDS.                            MELTN145
C                                                        MELTN146
    DO 650 N=1,I1                                MELTN147
    DEN(N) = DENSEF                                MELTN148
    FUSE(N) = FUSEF                                MELTN149
650 TFAIL(N) = TFUSEF                                MELTN150
    I11 = I1 + 1                                MELTN151
    DEN(I11) = DENSEF                                MELTN152
    FUSE(I11) = FUSEF                                MELTN153
    TFAIL(I11) = TFUSEF                                MELTN154
    DEN(NUPPER) = DENSEC                                MELTN155
    FUSE(NUPPER) = FUSEC                                MELTN156
    TFAIL(NUPPER) = TBOILC                            MELTN157
C                                                        MELTN158
C    SETUP FOR TEMPERATURE AND POWER CALCULATIONS.        MELTN159
C                                                        MELTN160
    ICT = 0                                            MELTN161
C                                                        MELTN162
    IF (NPDR) 660,690,730                            MELTN163
C                                                        MELTN164
C    RADIAL TEMPERATURE AND POWER ARE FLAT.                MELTN165
C                                                        MELTN166
660 DO 680 L=1,LUPPER                                MELTN167
    PPR(L) = PEAKA*AN(1)                                MELTN168
    DO 670 N=1,NUPPER                                MELTN169
670 AAR(N,L) = PEAKA*TP(N,1)                            MELTN170
680 CONTINUE                                            MELTN171
    GO TO 790                                            MELTN172
C                                                        MELTN173
C    RADIAL TEMPERATURE AND POWER ARE PARABOLIC.            MELTN174
C                                                        MELTN175
690 D = RADIUS*SQRT(1./(3.*(1.-1./PEAKR)))                MELTN176
    DO 700 N=1,NUPPER                                MELTN177

```

700	AARP(N) = PEAKA*PEAKR*TP(N,1)	MELTN177
	DO 720 L=1,LUPPER	MELTN178
	PPR(L) = PEAKA*PEAKR*AN(1)*(1. - (DL(L)*DL(L))/(D*D))	MELTN179
	DO 710 N=1,NUPPER	MELTN180
710	AAR(N,L) = AARP(N)*(1.-(DL(L)*DL(L))/(D*D))	MELTN181
720	CONTINUE	MELTN182
	GO TO 700	MELTN183
C		MELTN184
C	RADIAL TEMPERATURE AND POWER ARE READ IN.	MELTN185
C		MELTN186
730	READ (NIT,740) (AINR(L),L=1,LUPPER)	MELTN187
740	FORMAT (6E12.2)	MELTN188
	READ (NIT,740) (PIN(L),L=1,LUPPER)	MELTN189
	DO 750 L = 1,LUPPER	MELTN190
750	PPR(L) = PEAKA*PEAKR*AN(1)*PIN(L)	MELTN191
	DO 760 N=1,NUPPER	MELTN192
760	AARP(N) = PEAKA*PEAKR*TP(N,1)	MELTN193
	DO 780 L=1,LUPPER	MELTN194
	DO 770 N=1,NUPPER	MELTN195
770	AAR(N,L) = AINR(L)*AARP(N)	MELTN196
780	CONTINUE	MELTN197
C		MELTN198
C		MELTN199
790	AMUP = MUPPER	MELTN200
	ASEG = AHIGH/AMUP	MELTN201
	PAI = 3.14159	MELTN202
	IF (FLOAT(MUPPER)/2.0 - MUPPER/2) 800,820,800	MELTN203
800	IMID = MUPPER/2 + 1	MELTN204
	ZUP(IMID)=0.	MELTN205
	IMIE=IMID + 1	MELTN206
	DO 810 I=IMIE,MUPPER	MELTN207
	J=I-1	MELTN208
810	ZUP(I) = ZUP(J) + ASEG	MELTN209
	GO TO 840	MELTN210
820	IMIDE = MUPPER/2 + 1	MELTN211
	IMID = IMIDE	MELTN212
	ZUP(IMIDE) = ASEG/2	MELTN213
	IMIDEE = IMIDE + 1	MELTN214
	DO 830 I= IMIDEE,MUPPER	MELTN215
	J = I - 1	MELTN216
830	ZUP(I) = ZUP(J) + ASEG	MELTN217
C		MELTN218
C		MELTN219
840	ZMID(1) = ASEG/2.	MELTN220
	DO 850 MU=2,MUPPER	MELTN221
	MU1 = MU - 1	MELTN222
850	ZMID(MU) = ZMID(MU1) + ASEG	MELTN223
	DO 860 L=1,LUPPER	MELTN224
860	ZH(1,L) = 0.	MELTN225
	MTOP = MUPPER + 1	MELTN226
	DO 870 MU = 2,MTOP	MELTN227
	DO 870 L=1,LUPPER	MELTN228
	MU2 = MU - 1	MELTN229
870	ZH(MU,L) = ZH(MU2,L) + ASEG	MELTN230
	MUP = MUPPER + 1	MELTN231
	DO 880 MU=1,MUP	MELTN232
880	ZOH(MU) = ZH(MU,1)	MELTN233
C		MELTN234
	IF (NPDA) 940,940,890	MELTN235

C	890 READ (NIT,900) (PPP(MU),MU=1,MUPPER)	MELTN236
	READ (NIT,900) (TTT(MU),MU=1,MUPPER)	MELTN237
	900 FORMAT (6E12.2)	MELTN238
C		MELTN239
C	TEMPERATURE AND POWER CALCULATIONS.	MELTN240
C		MELTN241
	910 IF (NPDA) 940,940,920	MELTN242
C		MELTN243
	920 DO 930 L=1,LUPPER	MELTN244
	DO 930 MU=1,MUPPER	MELTN245
	POW(MU,L) = PPR(L)*PPP(MU)	MELTN246
	DO 930 N=1,NUPPER	MELTN247
	TEM(N,MU,L) = AAR(N,L)*TTT(MU)	MELTN248
	930 CONTINUE	MELTN249
	GO TO 960	MELTN250
C		MELTN251
C		MELTN252
	940 DO 950 L=1,LUPPER	MELTN253
	DO 950 MU= IMID,MUPPER	MELTN254
	MUL = MUPPER + 1 - MU	MELTN255
	POW(MU,L) = PPR(L)*COS((ZUP(MU)*PAI)/(2.0*EXTRAP))	MELTN256
	POW(MUL,L) = POW(MU,L)	MELTN257
	DO 950 N=1,NUPPER	MELTN258
	TEM(N,MU,L) = AAR(N,L)*COS((ZUP(MU)*PAI)/(2.0*EXTRAP))	MELTN259
	TEM(N,MUL,L) = TEM(N,MU,L)	MELTN260
	950 CONTINUE	MELTN261
C		MELTN262
C		MELTN263
	960 DO 1000 L = 1,LUPPER	MELTN264
C	CHECK TO SEE IF PEAK FUEL SEGMENT IS MOLTEN.	MELTN265
	IF (TEM(1,MF,L)-TFUSEF) 970,980,980	MELTN266
C	CHECK TO SEE IF PEAK COOLANT SEGMENT IS VAPORIZED.	MELTN267
	970 IF (TEM(NUPPER,MC,L)-TBOILC) 1000,980,980	MELTN268
C	FUEL MELTING OR COOLANT VAPORIZATION HAS BEGUN.	MELTN269
	980 WRITE (NOT,990)	MELTN270
	990 FORMAT (10X,54H FUEL MELTING OR COOLANT VAPORIZATION EXISTS INITIA	MELTN271
	1LLY)	MELTN272
	GO TO 1700	MELTN273
	1000 CONTINUE	MELTN274
C		MELTN275
C	CALCULATE VOLUME WEIGHTED TEMPERATURE OF EACH FUEL SEGMENT.	MELTN276
C		MELTN277
	DO 1010 L=1,LUPPER	MELTN278
	DO 1010 MU=1,MUPPER	MELTN279
	TEMN(MU,L) = 0.	MELTN280
	DO 1010 N=1,I1	MELTN281
	1010 TEMN(MU,L) = TEMN(MU,L) + TEM(N,MU,L)*VR(N)	MELTN282
	DO 1020 L=1,LUPPER	MELTN283
	DO 1020 MU=1,MUPPER	MELTN284
	1020 TEMN(MU,L) = TEMN(MU,L)/VOL(1)	MELTN285
C		MELTN286
C	CALCULATE CORE AVERAGE FUEL TEMPERATURE.	MELTN287
C		MELTN288
	LUP = LUPPER - 1	MELTN289
	DO 1080 L=1,LUPPER	MELTN290
	IF (L-1) 1030,1030,1040	MELTN291
	1030 ROL = (DL(1) + DL(2))/2.0	MELTN292
	RIL = 0.	MELTN293
		MELTN294

```

      VOLL(1) = 0.
      GO TO 1070
1040 IF (L - LUP) 1050,1050,1060
1050 J = L + 1
      ROL = (DL(J) + DL(L))/2.0
      I = L - 1
      RIL = (DL(I) + DL(L))/2.0
      GO TO 1070
1060 ROL = RADIUS
      I = L - 1
      RIL = (DL(I) + DL(L))/2.0
1070 VOLP(L) = PAI*(ROL*ROL - RIL*RIL)*ASEG
1080 VOLL(1) = VOLL(1) + VOLP(L)
      BMUP = MUPPER
      TEMA(1) = 0.
      DO 1090 L=1,LUPPER
      DO 1090 MU=1,MUPPER
1090 TEMA(1)=TEMA(1)+TEMN(MU,L)*VOLP(L)
      TEMA(1) = TEMA(1)/(BMUP*VOLL(1))
C
C   COMPARE CALCULATED CORE TEMPERATURE WITH K-III TEMPERATURE.
C
      IF (ICT) 1100,1100,1120
1100 WRITE (NOT,1110) TEMA(1)
1110 FORMAT (1H1,28H CORE AVERAGE TEMPERATURE = E10.5)
      GO TO 1140
1120 WRITE (NOT,1130) TEMA(1)
1130 FORMAT (1X,28H CORE AVERAGE TEMPERATURE = E10.5)
1140 WRITE (NOT,1150) TEMP(1,1)
1150 FORMAT (1X,29H K-III AVERAGE TEMPERATURE = E10.5)
      ETEMP = (TEMP(1,1)-TEMA(1))/TEMP(1,1)
      IF (ABS(ETEMP) - EPSDOP) 1230,1230,1160
1160 WRITE (NOT,1170)
1170 FORMAT (1X,77H CORE AVERAGE TEMPERATURE DOES NOT AGREE WITH K-III
1TEMPERATURE WITHIN EPSDOP)
      ICT1 = ICT + 1
1180 WRITE (NOT,1190) ICT1
1190 FORMAT (1X,33H NUMBER OF CYCLES THROUGH LOOP = ,I2//)
      ICT = ICT + 1
      IF (ICT - 10) 1210,1210,1200
1200 CALL EXIT
1210 DO 1220 L=1,LUPPER
      PPR(L) = PPR(L)*(TEMP(1,1)/TEMA(1))
      DO 1220 N = 1,NUPPER
1220 AAR(N,L) = AAR(N,L)*(TEMP(1,1)/TEMA(1))
      GO TO 910
1230 CONTINUE
C
C   READ IN FUEL AND COOLANT WORTH DISTRIBUTIONS.
C
      READ (NIT,1240) ((WF(MU,L),MU=1,MUPPER),L=1,LUPPER)
1240 FORMAT (6E12.4)
      READ (NIT,1240) ((WC(MU,L),MU=1,MUPPER),L=1,LUPPER)
      IF (INA) 1260, 1260, 1250
1250 CALL NAMOD
1260 CONTINUE
C
C   PRINT OUT DETAILED NODAL RESULTS.
C

```

MELTN295
 MELTN296
 MELTN297
 MELTN298
 MELTN299
 MELTN300
 MELTN301
 MELTN302
 MELTN303
 MELTN304
 MELTN305
 MELTN306
 MELTN307
 MELTN308
 MELTN309
 MELTN310
 MELTN311
 MELTN312
 MELTN313
 MELTN314
 MELTN315
 MELTN316
 MELTN317
 MELTN318
 MELTN319
 MELTN320
 MELTN321
 MELTN322
 MELTN323
 MELTN324
 MELTN325
 MELTN326
 MELTN327
 MELTN328
 MELTN329
 MELTN330
 MELTN331
 MELTN332
 MELTN333
 MELTN334
 MELTN335
 MELTN336
 MELTN337
 MELTN338
 MELTN339
 MELTN340
 MELTN341
 MELTN342
 MELTN343
 MELTN344
 MELTN345
 MELTN346
 MELTN347
 MELTN348
 MELTN349
 MELTN350
 MELTN351
 MELTN352
 MELTN353

```

      WRITE (NOT,1270)(HOL(I),I=1,12)
1270 FORMAT (1H1//12A6/)
      WRITE (NOT,1280)
1280 FORMAT (10X,53H CURRENT AXIAL POSITIONS OF THE VARIOUS FUEL SEGMENT
1TS)
      NUM(1) = 1
      DO 1290 I = 2,LUPPER
      J = I - 1
1290 NUM(I) = NUM(J) + 1
      WRITE (NOT,1300)(NUM(I),I=1,LUPPER)
1300 FORMAT (/3H I ,2X,21HORIGINAL ORIG. ORIG.,(10(5X,I2,2X)))
      WRITE (NOT,1310)(DL(I),I=1,LUPPER)
1310 FORMAT (26H CENTERLINE LOWER UPPER,(10(1X,F8.3)))
      NUMB(1) = 1
      DO 1320 I = 2,MUPPER
      J=I-1
1320 NUMB(I) = NUMB ( J ) + 1
      DO 1330 MU=MUPPER,1,-1
      MUU = MU + 1
1330 WRITE (NOT,1340) (NUMB(MU),ZMID(MU),ZOH(MU),ZOH(MUU),(ZH(MUU,L),
1L=1,LUPPER))
1340 FORMAT (I3,2X,3F7.3,(10(E9.4)))
      ICLAD = I1 + 1
      DO 1500 N = 1,NUPPER
      WRITE (NOT,1270)(HOL(I),I=1,12)
      INODE = N
      IF (N - 1) 1370,1370,1350
1350 IF (N - I1)1390,1410,1360
1360 IF (N - ICLAD) 1430,1430,1450
1370 WRITE (NOT,1380)
1380 FORMAT (10X,56H FUEL CENTERLINE TEMPERATURES IN VARIOUS RADIAL CHAMELTN384
1NNELS)
      GO TO 1470
1390 WRITE (NOT,1400) INODE
1400 FORMAT (10X,14H FUEL NODE NO.,I1,1X,40H TEMPERATURES IN VARIOUS RAMELTN388
1DIAL CHANNELS)
      GO TO 1470
1410 WRITE (NOT,1420)
1420 FORMAT (10X,56H FUEL OUTER NODE TEMPERATURES IN VARIOUS RADIAL CHAMELTN392
1NNELS)
      GO TO 1470
1430 WRITE (NOT,1440)
1440 FORMAT (10X,45H CLAD TEMPERATURES IN VARIOUS RADIAL CHANNELS)
      GO TO 1470
1450 WRITE (NOT,1460)
1460 FORMAT (10X,48H COOLANT TEMPERATURES IN VARIOUS RADIAL CHANNELS)
      GO TO 1470
1470 WRITE (NOT,1480)(NUM(I),I = 1,LUPPER)
1480 FORMAT (/3H I ,1X,9H ORIGINAL,(10(4X,I2,3X)))
      WRITE (NOT,1490)(DL(I),I=1,LUPPER)
1490 FORMAT (13H CENTERLINE,(10(F8.3,1X)))
      DO 1500 MU=MUPPER,1,-1
1500 WRITE (NOT,1510) (NUMB(MU),ZMID(MU),(TEM(N,MU,L),L=1,LUPPER))
1510 FORMAT (I3,2X,F7.3,(10(F9.4)))
      WRITE (NOT,1270)(HOL(I),I=1,12)
      WRITE (NOT,1520)
1520 FORMAT (10X,41H POWER DENSITY AT VARIOUS RADIAL CHANNELS)
      WRITE (NOT,1480)(NUM(I),I=1,LUPPER)
      WRITE (NOT,1490)(DL(I),I=1,LUPPER)

```

DO 1530 MU=MUPPER,1,-1	MELTN413
1530 WRITE (NOT,1510) (NUMB(MU),ZMID(MU),(POW(MU,L),L=1,LUPPER))	MELTN414
WRITE (NOT,1270) (HOL(I),I=1,12)	MELTN415
WRITE (NOT,1540)	MELTN416
1540 FORMAT (10X,45H FUEL AXIAL WORTHS IN VARIOUS RADIAL CHANNELS)	MELTN417
WRITE (NOT,1480) (NUM(I),I=1,LUPPER)	MELTN418
WRITE (NOT,1490) (DL(I),I=1,LUPPER)	MELTN419
DO 1550 MU=MUPPER,1,-1	MELTN420
1550 WRITE (NOT,1510) (NUMB(MU),ZMID(MU),(WF(MU,L),L=1,LUPPER))	MELTN421
WRITE (NOT,1270) (HOL(I),I=1,12)	MELTN422
WRITE (NOT,1560)	MELTN423
1560 FORMAT (10X,48H COOLANT AXIAL WORTHS IN VARIOUS RADIAL CHANNELS)	MELTN424
WRITE (NOT,1480) (NUM(I),I=1,LUPPER)	MELTN425
WRITE (NOT,1490) (DL(I),I=1,LUPPER)	MELTN426
DO 1570 MU=MUPPER,1,-1	MELTN427
1570 WRITE (NOT,1510) (NUMB(MU),ZMID(MU),(WC(MU,L),L=1,LUPPER))	MELTN428
C	MELTN429
C CALCULATE POWER AND TEMPERATURE PROFILES FOR USE IN SUB. CORTEM.	MELTN430
C	MELTN431
DO 1580 L=1,LUPPER	MELTN432
DO 1580 MU=1,MUPPER	MELTN433
POWI(MU,L) = POW(MU,L)	MELTN434
DO 1580 N=1,NUPPER	MELTN435
TEMI(N,MU,L) = TEM(N,MU,L)	MELTN436
ITEMF(N,MU,L) = 0	MELTN437
1580 CONTINUE	MELTN438
ANI = AN(1)	MELTN439
DO 1590 N=1,NUPPER	MELTN440
1590 TPI(N) = TP(N,1)	MELTN441
DO 1600 L=1,LUPPER	MELTN442
DO 1600 MU=1,MUPPER	MELTN443
ZMIDT(MU,L) = ZMID(MU)	MELTN444
1600 CONTINUE	MELTN445
DO 1610 L=1,LUPPER	MELTN446
DO 1610 MU=1,MUPPER	MELTN447
DO 1610 N=1,NUPPER	MELTN448
QLOCAL(N,MU,L) = 0.	MELTN449
1610 DELTEM(N,MU,L) = 0.	MELTN450
DO 1620 L=1,LUPPER	MELTN451
DO 1620 N=1,11	MELTN452
1620 VOLOC(N,L) = (VR(N)/(VOL(1)*BMUP))*(VOLP(L)/VOLL(1))*FUELV	MELTN453
C	MELTN454
C CALCULATE PARAMETERS NEEDED IN SUBROUTINE COLLAP.	MELTN455
C	MELTN456
DO 1630 L=1,LUPPER	MELTN457
ICHANL(L) = 0	MELTN458
MUPRL(L) = MUPPER	MELTN459
AMASSF(L) = VOLP(L)*DENSEF*FRACF	MELTN460
COLLK(L) = 0.	MELTN461
DO 1630 MU = 1,MUPPER	MELTN462
ICHAN(MU,L) = 0	MELTN463
1630 TSEG(MU,L) = 0.	MELTN464
REACOL(1) = 0.	MELTN465
REACOL(2) = 0.	MELTN466
COLAPK = 0.	MELTN467
NCLAD = NUPPER - 1	MELTN468
TCOL = 0.	MELTN469
TIMER = 0.	MELTN470
ICOLT = 0	MELTN471

C	IRAD = 0	MELTN472
	IMELT = 0	MELTN473
	IFLAG = 0	MELTN474
C		MELTN475
	IF (IDEN) 1640,1640,1660	MELTN476
1640	DO 1650 L=1,LUPPER	MELTN477
1650	PUDEN(L) = FRACF	MELTN478
	GO TO 1680	MELTN479
1660	DO 1670 L=1,LUPPER	MELTN480
1670	PUDEN(L) = VARDEN(L)	MELTN481
1680	CONTINUE	MELTN482
C		MELTN483
C		MELTN484
C	CALCULATE PARAMETERS NEEDED IN SUBROUTINE VOID.	MELTN485
C		MELTN486
	IVOIDO = 0	MELTN487
	DO 1690 L=1,LUPPER	MELTN488
	MVOID(L) = 0	MELTN489
	ICHANX(L) = 0	MELTN490
	IXUP(L) = 0	MELTN491
	IXDOWN(L) = 0	MELTN492
	IXX(L) = 0	MELTN493
	TSEGX(L) = 0.	MELTN494
	XUP(L) = 0.	MELTN495
	XDOWN(L) = 0.	MELTN496
	VOIDK(L) = 0.	MELTN497
	AREAV(L) = VOLP(L)/ASEG	MELTN498
	DO 1690 MU=1,MUPPER	MELTN499
	ICHANV(MU,L) = 0	MELTN500
1690	CONTINUE	MELTN501
	TVOID = 0.	MELTN502
	VODK = 0.	MELTN503
	TIMEX = 0.	MELTN504
	REAVOD(1) = 0.	MELTN505
	REAVOD(2) = 0.	MELTN506
C		MELTN507
C		MELTN508
	ITEMA = 0	MELTN509
	ENER = 0.	MELTN510
C		MELTN511
C		MELTN512
	1700 CONTINUE	MELTN513
	RETURN	MELTN514
	END	MELTN515
		MELTN516

```

- ELT CALC,1,680717, 6148
  SUBROUTINE CALC
  INCLUDE ABC
  THIS SUBROUTINE DETERMINES THE TIME STEP, CONTROLS THE
  CALCULATIONAL CALLING SEQUENCE, AND MANIPULATES THE PRINTOUT
  OPTIONS.
  IEND = 0
  JKL = 1
  JIG = 0
  NWWL = 1
  JPRINT = 1
  DO 750 J=2,NMAX
  GC = .0
  DO 10 I=1,M
10 GC = GC + AL(I)*C(I,1)
  W = (RH(1) - BB)/ALIFE + GC/AN(1)
  DO 20 I=1,M
  GAM(I) = B(I)*AN(I)/(ALIFE*C(I,1)) - AL(I)
20 ALPH(I) = W - GAM(I)
30 G = W*H
40 ANZ = AN(1)*EXP(G)
50 T(2) = T(1) + H
  CALL SUBRHO
  CALL SUBNEU
  JIG = JIG + 1
  IF (JIG - 150) 60,150,150
60 IF (ABS (ANZ - AN(2))/ANZ - ERROR) 70,70,120
70 IF (H - HMAX) 80, 190,170
80 IF (JIG-1) 90,90,110
90 LMOD = J - 2
  LMOD = MOD(LMOD,10)
  IF (LMOD) 100,100,190
100 NNS = 1
  HSTO = H
  ANSTO = AN(2)
  RHSTO = RH(2)
  H = H*STPEM
  GO TO 30
110 IF(NNS) 190,190,100
120 IF(JIG - 1) 130,130,140
130 NNS = 0
  H = H/STPEM
  GO TO 30
140 IF(NNS) 130,130,180
150 WRITE (NOT,160)H
160 FORMAT (23HNO CONVERGENCE H = 1PE16.4)
  GO TO 760
170 H = HMAX
  CALL SUBRHO
  CALL SUBNEU
  GO TO 190
180 H = HSTO
  AN(2) = ANSTO
  ANZ = AN(2)
  T(2) = T(1) + H
  CALL SUBRHO
190 JIG = 0
  IF (AN(2) - 10.**22 ) 210,210,200
200 IFND = 1

```

```

CALC0001
CALC0002
CALC0003
CALC0004
CALC0005
CALC0006
CALC0007
CALC0008
CALC0009
CALC0010
CALC0011
CALC0012
CALC0013
CALC0014
CALC0015
CALC0016
CALC0017
CALC0018
CALC0019
CALC0020
CALC0021
CALC0022
CALC0023
CALC0024
CALC0025
CALC0026
CALC0027
CALC0028
CALC0029
CALC0030
CALC0031
CALC0032
CALC0033
CALC0034
CALC0035
CALC0036
CALC0037
CALC0038
CALC0039
CALC0040
CALC0041
CALC0042
CALC0043
CALC0044
CALC0045
CALC0046
CALC0047
CALC0048
CALC0049
CALC0050
CALC0051
CALC0052
CALC0053
CALC0054
CALC0055
CALC0056
CALC0057
CALC0058

```

210	T(2) = T(1) + H	CALC0059
	IF(T(2) - TMAX) 230,220,220	CALC0060
220	T(2) = TMAX	CALC0061
	IEND = 1	CALC0062
	H = TMAX - T(1)	CALC0063
	CALL SUBRHO	CALC0064
	CALL SUBNEU	CALC0065
230	CONTINUE	CALC0066
	CALL PRECUR	CALC0067
C		CALC0068
C		CALC0069
C	NEW TIME STEP, POWER, TEMPERATURES, ETC. HAVE BEEN ESTABLISHED.	CALC0070
C	CODE NOW BEGINS THE SEARCH FOR COLLAPSE OR VOID FEEDBACKS.	CALC0071
C		CALC0072
C		CALC0073
C	CHECK TO SEE IF THE VOIDING ROUTINE IS BEING CONSIDERED.	CALC0074
C		CALC0075
	IF (NVOD) 410,410,240	CALC0076
240	IF (IVOIDQ) 250,250,260	CALC0077
250	CALL VOIDQ	CALC0078
	IF (IVOIDQ) 410,410,260	CALC0079
C		CALC0080
C	VOIDING HAS STARTED.	CALC0081
C		CALC0082
260	IF (IMELT) 270,270,300	CALC0083
270	CALL MELTQ	CALC0084
	IF (IMELT) 280,280,300	CALC0085
280	CALL NATEM	CALC0086
	CALL VOID	CALC0087
C		CALC0088
C	CHECK TO SEE IF VOID PRINTOUT IS DESIRED.	CALC0089
C		CALC0090
	IF (TVOID - TIMEX) 430,290,290	CALC0091
290	TIMEX = TIMEX + TIMEV	CALC0092
	CALL PRINTV	CALC0093
	IF (IEND) 770,450,770	CALC0094
300	CALL CORTEM	CALC0095
	CALL VOID	CALC0096
C		CALC0097
C	CHECK TO SEE IF VOID PRINTOUT IS DESIRED.	CALC0098
C		CALC0099
	IF (TVOID - TIMEX) 320,310,310	CALC0100
310	TIMEX = TIMEX + TIMEV	CALC0101
	CALL PRINTV	CALC0102
	IPRV = 1	CALC0103
320	CALL COLLAP	CALC0104
C		CALC0105
C	CHECK TO SEE IF COLLAPSE PRINTOUT IS DESIRED.	CALC0106
C		CALC0107
	IF (ICOLT) 360,330,360	CALC0108
330	IF (IPRV - 1) 340,350,350	CALC0109
340	IF (IEND) 770,440,770	CALC0110
350	IPRV = 0	CALC0111
	IF (IEND) 770,450,770	CALC0112
360	IF (TCOL - TIMER) 330,370,370	CALC0113
370	TIMER = TIMER + TIMEC	CALC0114
	IF (TCOL - TCOLM) 400,400,380	CALC0115
380	IRAD = 1	CALC0116
	WRITE (NOT,390) TCOLM	CALC0117

```

390 FORMAT (46H TIME FROM BEGINNING OF COLLAPSE HAS EXCEEDED ,1PE12.5CALC0118
1,8H SECONDS)                                CALC0119
RETURN                                         CALC0120
400 IPRV = 0                                  CALC0121
CALL PRINTF                                  CALC0122
JKL = 0                                       CALC0123
CALL PRINTK                                  CALC0124
IF (IEND) 650,650,800                        CALC0125
C                                              CALC0126
C CHECK TO SEE IF MELTING HAS OCCURRED.      CALC0127
C                                              CALC0128
410 IF (IMELT) 420,420,520                    CALC0129
420 CALL MELTO                                CALC0130
IF (IMELT) 430,430,520                        CALC0131
430 IF (IEND) 770,440,770                     CALC0132
C                                              CALC0133
C DETERMINE WHETHER K3 PRINTOUT IS DESIRED (500=NO,6200=YES) CALC0134
C                                              CALC0135
440 JKL = JKL + 1                             CALC0136
IF (JKL - MPRT) 650,450,450                   CALC0137
450 JKL = 0                                    CALC0138
CALL PRINTK                                  CALC0139
C                                              CALC0140
C DETERMINE WHETHER MELT PRINTOUT IS DESIRED (490=NO,6250=YES) CALC0141
C                                              CALC0142
460 JPRINT = JPRINT + 1                       CALC0143
IF (JPRINT - MPRT) 620,470,470                 CALC0144
470 JPRINT = 0                                 CALC0145
NWVL = 0                                       CALC0146
IF (IMELT) 490,480,490                         CALC0147
480 CALL CORTEM                               CALC0148
C                                              CALC0149
C DETERMINATION OF WHETHER A FULL OR PARTIAL PRINT IS DESIRED. CALC0150
C                                              CALC0151
490 IF (ITYPE) 510,500,510                     CALC0152
500 CALL PRINTP                               CALC0153
GO TO 630                                       CALC0154
510 CALL PRINTF                               CALC0155
GO TO 630                                       CALC0156
C                                              CALC0157
C MELTING HAS OCCURRED.                       CALC0158
C                                              CALC0159
520 CALL CORTEM                               CALC0160
IF (IBAD) 540,540,530                         CALC0161
530 RETURN                                    CALC0162
540 CALL COLLAP                              CALC0163
550 IF (IEND) 770,560,770                     CALC0164
C                                              CALC0165
C CHECK TO SEE IF COLLAPSE PRINTOUT IS DESIRED. CALC0166
C                                              CALC0167
560 IF (ICOLT) 570,440,570                     CALC0168
570 IF (TCOL - TIMER) 440,580,580               CALC0169
580 TIMER = TIMER + TIMEC                     CALC0170
IF (TCOL - TCOLM) 610,610,590                 CALC0171
590 IBAD = 1                                  CALC0172
WRITE (NOT,600) TCOLM                         CALC0173
600 FORMAT (46H TIME FROM BEGINNING OF COLLAPSE HAS EXCEEDED ,1PE12.5CALC0174
1,8H SECONDS)                                CALC0175
RETURN                                         CALC0176

```

```

610 CALL PRINTF                                CALC0177
    GO TO 450                                CALC0178
620 NWWL = NWWL + 1                            CALC0179
    IF (NWWL - 17) 650,650,630                CALC0180
630 NWWL = 0                                    CALC0181
    WRITE (NOT,640) (HOL(I), I= 1,12)          CALC0182
640 FORMAT (1H1/12A6///)                       CALC0183
    1128H  I  TIME(SEC)/VOID POWER/COL RHO(CENTS)/E RHO 1/C1    RHO 2/CCALC0184
    22    RHO 3/C3    TEMP 1/C4    TEMP 2/C5    TEMP 3/C6    TEMA/Q(MW SEC)CALC0185
    3///)
650 IF (ITEMA(1) - TEMAW) 750,660,660          CALC0186
660 IF (ITEMA) 670,670,680                     CALC0187
670 STORC = REACOL(1)                          CALC0188
    STORV = REAVOD(1)                          CALC0189
    STORN = RH(1)                             CALC0190
    STORI = R2*T(1) + R3*T(1)*T(1)             CALC0191
    ITEMA = 1                                 CALC0192
    GO TO 750                                 CALC0193
680 IF (ITEMA - 1) 690,690,700                 CALC0194
690 CALL TEMAP                                CALC0195
    TEMAT = T(1) + TEMAD                      CALC0196
    ITEMA = 2                                 CALC0197
    GO TO 750                                 CALC0198
700 IF (T(1) - TEMAT) 730,710,710             CALC0199
710 IBAD = 1                                  CALC0200
    WRITE (NOT,720) TEMAD                     CALC0201
720 FORMAT (1X,30H THE TRANSIENT HAS PROGRESSED ,E8.4,41H SECONDS BEYOCCALC0202
    1ND THE DISASSEMBLY CONDITION)            CALC0203
    RETURN                                    CALC0204
730 IF (IBAD) 750,750,740                     CALC0205
740 RETURN                                    CALC0206
750 CONTINUE                                  CALC0207
760 CONTINUE                                  CALC0208
C    TIME IS AT TMAX.                         CALC0209
    NMAX = 0                                  CALC0210
770 CONTINUE                                  CALC0211
    CALL PRINTK                                CALC0212
    IF (IMELT) 790,780,790                    CALC0213
780 CALL CORTEM                                CALC0214
790 CALL PRINTF                                CALC0215
800 CONTINUE                                  CALC0216
    RETURN                                    CALC0217
    END                                        CALC0218
                                           CALC0219

```

- ELT	MELTQ,1,680717, 6154	
	SUBROUTINE MELTQ	MELTQ001
C	THIS SUBROUTINE CHECKS TO SEE IF MELTING OR COOLANT VAPORIZATION	MELTQ002
C	HAS BEGUN.	MELTQ003
	INCLUDE ABC	MELTQ004
C		MELTQ005
	DO 20 L=1,LUPPER	MELTQ006
C		MELTQ007
C	CHECK TO SEE IF PEAK FUEL SEGMENT IS MOLTEN.	MELTQ008
C		MELTQ009
	TEM(1,MF,L) = (TEMI(1,MF,L)*TP(1,1))/TPI(1)	MELTQ010
	IF (TEM(1,MF,L)-TFUSEF) 10,30,30	MELTQ011
C		MELTQ012
C	CHECK TO SEE IF PEAK COOLANT SEGMENT IS VAPORIZED.	MELTQ013
C		MELTQ014
	10 TEM(NUPPER,MC,L) = (TEMI(NUPPER,MC,L)*TP(NUPPER,1))/TPI(NUPPER)	MELTQ015
	IF (TEM(NUPPER,MC,L)-TBOILC) 20,30,30	MELTQ016
	20 CONTINUE	MELTQ017
	GO TO 40	MELTQ018
C		MELTQ019
C	FUEL MELTING OR COOLANT VAPORIZATION HAS BEGUN.	MELTQ020
C		MELTQ021
	30 IMELT = 1	MELTQ022
	IFLAG = 1	MELTQ023
	40 CONTINUE	MELTQ024
	RETURN	MELTQ025
	END	MELTQ026

```

- ELT CORTEM,1,684717, 6161
SUBROUTINE CORTEM
C THIS SUBROUTINE COMPUTES CORE TEMPERATURES AND LOCAL POWER
C DENSITIES DURING THE TRANSIENT.
INCLUDE ABC
DO 10 L=1,LUPPER
DO 10 MU=1,MUPPER
10 POWB(MU,L) = POW(MU,L)
IF (IMELT) 20,20,40
20 DO 30 L=1,LUPPER
DO 30 MU=1,MUPPER
POW(MU,L) = (POWI(MU,L)*AN(1))/ANI
DO 30 N=1,NUPPER
TEM(N,MU,L) = (TEMI(N,MU,L)*TP(N,1))/TPI(N)
30 CONTINUE
GO TO 230

C
C CALCULATION OF POWER IN COLLAPSED FUEL COLUMNS.
C
40 ICOL = 0
DO 100 L=1,LUPPER
DO 100 MU=1,MUPPER
DO 60 MUI=MU,1,-1
IF ((ZMID(MUI)-ZMIDT(MU,L))-ASEG) 70,70,50
50 ICOL = ICOL + 1
IF (ICOL-NCOL) 60,60,110
60 CONTINUE
70 ICOL = 0
MI = MUI - 1
IF (MUI - 1) 80,80,90
80 MI = 1
90 POWT(MU,L) = POWI(MI,L) + (POWI(MUI,L)-POWI(MI,L))*(ZMIDT(MU,L) -
1ZMID(MI))/ASEG
POW(MU,L) = (POWT(MU,L)*AN(1))/ANI
DO 100 N=1,NUPPER
TEM(N,MU,L) = (TEMI(N,MU,L)*TP(N,1))/TPI(N)
100 CONTINUE
GO TO 130
110 WRITE (NOT,120)NCOL
120 FORMAT (23H COLLAPSE HAS EXCEEDED ,I2,59H TOTAL SEGMENTS. PERTURBA
TION THEORY MAY NO LONGER BE VALID)
IRAD = 1
130 DO 190 L=1,LUPPER
DO 190 MU=1,MUPPER
DO 190 N=1,NUPPER
IF (TEM(N,MU,L)-TFAIL(N)) 190,140,140
140 IF (DELTEM(N,MU,L)) 150,150,180
150 QLOCAL(N,MU,L) = QLOCAL(N,MU,L) + ((POW(MU,L)+POWR(MU,L))/2.0)*H
IF (QLOCAL(N,MU,L) - FUSE(N)*DEN(N)) 160,160,170
160 TEM(N,MU,L) = TFAIL(N)
GO TO 190
170 DELTEM(N,MU,L) = TEM(N,MU,L) - TFAIL(N)
TEM(N,MU,L) = TFAIL(N)
ITEMF(N,MU,L) = 1
GO TO 190
180 TEM(N,MU,L) = TEM(N,MU,L) - DELTEM(N,MU,L)
190 CONTINUE
CALL PCMELT
TGRASS = 100.*TFAIL(1)

```

CORTM001
 CORTM002
 CORTM003
 CORTM004
 CORTM005
 CORTM006
 CORTM007
 CORTM008
 CORTM009
 CORTM010
 CORTM011
 CORTM012
 CORTM013
 CORTM014
 CORTM015
 CORTM016
 CORTM017
 CORTM018
 CORTM019
 CORTM020
 CORTM021
 CORTM022
 CORTM023
 CORTM024
 CORTM025
 CORTM026
 CORTM027
 CORTM028
 CORTM029
 CORTM030
 CORTM031
 CORTM032
 CORTM033
 CORTM034
 CORTM035
 CORTM036
 CORTM037
 CORTM038
 CORTM039
 CORTM040
 CORTM041
 CORTM042
 CORTM043
 CORTM044
 CORTM045
 CORTM046
 CORTM047
 CORTM048
 CORTM049
 CORTM050
 CORTM051
 CORTM052
 CORTM053
 CORTM054
 CORTM055
 CORTM056
 CORTM057
 CORTM058

IF (TEM(1,MF,1) - TGROSS) 220,220,200	CORTM059
200 WRITE (NOT,210)	CORTM060
210 FORMAT (50H FUEL TEMPERATURES HAVE EXCEEDED 100 TIMES FAILURE)	CORTM061
IBAD = 1	CORTM062
220 CONTINUE	CORTM063
C	CORTM064
C CALCULATE THE CORE AVERAGED TEMPERATURE.	CORTM065
C	CORTM066
230 DO 240 L=1,LUPPER	CORTM067
DO 240 MU=1,MUPPER	CORTM068
TEMN(MU,L) = 0.	CORTM069
DO 240 N=1,I1	CORTM070
240 TEMN(MU,L) = TEMN(MU,L) + TEM(N,MU,L)*VR(N)	CORTM071
DO 250 L=1,LUPPER	CORTM072
DO 250 MU=1,MUPPER	CORTM073
250 TEMN(MU,L) = TEMN(MU,L)/VOL(1)	CORTM074
TEMA(1) = 0.	CORTM075
DO 260 L=1,LUPPER	CORTM076
DO 260 MU=1,MUPPER	CORTM077
260 TEMA(1) = TEMA(1) + TEMN(MU,L)*VOLP(L)	CORTM078
TEMA(1) = TEMA(1)/(BMUP*VOLL(1))	CORTM079
RETURN	CORTM080
END	CORTM081


```

- ELT COLLAP,1,680717, 6167
SUBROUTINE COLLAP
C THIS SUBROUTINE CALCULATES NEW FUEL SEGMENT POSITIONS AND THE
C REACTIVITY FEEDBACK DUE TO COLLAPSE.
INCLUDE ABC
C
C CHECK TO SEE IF COLLAPSE ROUTINE IS TO BE USED.
C
IF (NCPS) 240,240,10
10 DO 210 L=1,LUPPER
MUPR = MUPRL(L)
DO 200 MU=1,MUPR
IF (ICHAN(MU,L)) 20,20,70
C
C NO COLLAPSE HAS YET OCCURRED.
C
20 IF (TEM(1,MU,L) - TRIPF) 30,60,60
30 IF (TEM(11,MU,L) - TRIPFO) 40,60,60
40 IF (TEM(INCLAD,MU,L) - TRIPE) 50,60,60
50 IF (TEM(NUPPER,MU,L) - TRIPC) 200,60,60
C
C COLLAPSE HAS STARTED.
C
60 ICHAN(MU,L) = 1
70 MMELT = MU
C
C SWITCH FOR START OF COLLAPSE.
C
ICOLT = 1
IF (CHI) 80,80,100
C
C NO VISCOUS DAMPING.
C
80 DO 90 MZ=MMELT,MUPPER
TSEG(MZ,L) = TSEG(MZ,L) + H
ZMIDT(MZ,L) = ZMID(MZ) - (GRAV/2.0)*TSEG(MZ,L)*TSEG(MZ,L)
MUU = MZ + 1
ZH(MUU,L) = ZMIDT(MZ,L) + ASEG/2.0
ZH(MZ,L) = ZMIDT(MZ,L) - ASEG/2.0
90 CONTINUE
GO TO 120
C
C VISCOUS DAMPING INCLUDED.
C
100 DO 110 MZ=MMELT,MUPPER
TSEG(MZ,L) = TSEG(MZ,L) + H
ZMIDT(MZ,L) = ZMID(MZ) - (GRAV/CHI)*TSEG(MZ,L) - (GRAV/(CHI*CHI)
1)*(EXP(-CHI*TSEG(MZ,L)) - 1.0)
MUU = MZ + 1
ZH(MUU,L) = ZMIDT(MZ,L) + ASEG/2.0
ZH(MZ,L) = ZMIDT(MZ,L) - ASEG/2.0
110 CONTINUE
120 CONTINUE
C
C CALCULATION OF REACTIVITY FEEDBACK DUE TO COLLAPSE.
C
130 DO 180 MZ=MMELT,MUPPER
DO 140 MUI=MZ,1,-1
IF ((ZMID(MUI)-ZMIDT(MZ,L))-ASEG) 150,150,140

```

COLAP001
COLAP002
COLAP003
COLAP004
COLAP005
COLAP006
COLAP007
COLAP008
COLAP009
COLAP010
COLAP011
COLAP012
COLAP013
COLAP014
COLAP015
COLAP016
COLAP017
COLAP018
COLAP019
COLAP020
COLAP021
COLAP022
COLAP023
COLAP024
COLAP025
COLAP026
COLAP027
COLAP028
COLAP029
COLAP030
COLAP031
COLAP032
COLAP033
COLAP034
COLAP035
COLAP036
COLAP037
COLAP038
COLAP039
COLAP040
COLAP041
COLAP042
COLAP043
COLAP044
COLAP045
COLAP046
COLAP047
COLAP048
COLAP049
COLAP050
COLAP051
COLAP052
COLAP053
COLAP054
COLAP055
COLAP056
COLAP057
COLAP058

140	CONTINUE	COLAP059
150	MI = MUI - 1	COLAP060
	IF (MUI - 1) 160,160,170	COLAP061
160	MI = 1	COLAP062
170	WFT(MZ,L) = WF(MI,L) + (WF(MUI,L) - WF(MI,L))*(ZMIDT(MZ,L)-ZMID(MI	COLAP063
	1))/ASEG	COLAP064
	COLK(MZ,L) = (WFT(MZ,L) - WF(MZ,L))*VOLP(L)*PUDEN(L)	COLAP065
180	CONTINUE	COLAP066
	COLLK(L) = 0.	COLAP067
	DO 190 MZ=MMELT,MUPPER	COLAP068
190	COLLK(L) = COLLK(L) + COLK(MZ,L)	COLAP069
	MUPRL(L) = MMELT	COLAP070
	GO TO 210	COLAP071
200	CONTINUE	COLAP072
	COLLK(L) = 0.	COLAP073
210	CONTINUE	COLAP074
	COLAPK = 0.	COLAP075
	DO 220 L=1,LUPPER	COLAP076
220	COLAPK = COLAPK + COLLK(L)	COLAP077
C		COLAP078
	IF (ICOLT) 240,240,230	COLAP079
C		COLAP080
C	RUNNING ACCOUNT OF TIME FROM BEGINNING OF COLLAPSE.	COLAP081
C		COLAP082
230	ICOL = ICOL + H	COLAP083
240	CONTINUE	COLAP084
	RETURN	COLAP085
	END	COLAP086

```

- ELT VOIDQ,1,680717, 6172
SUBROUTINE VOIDQ
C THIS SUBROUTINE CHECKS TO SEE IF VOIDING HAS BEGUN.
INCLUDE ABC
IF (IVODCO) 30, 30, 10
C
C VOIDING BEGINS AT THE PLACE AND TIME THAT COLLAPSE BEGINS.
C
10 IF (ICOLT) 80, 80, 20
20 IVOIDQ = 1
GO TO 80
30 IF (IVOID) 40, 40, 60
C
C NORMAL CASE, CHECK ALL AXIAL NODES IN CHANNEL LVOID.
C
40 DO 50 MU=1,MUPPER
TEM(NUPPER,MU,LVOID) = (TEMI(NUPPER,MU,LVOID)*TP(NUPPER,1))/TPI(NU
1PPER)
IF (TEM(NUPPER,MU,LVOID)-TRIPX(LVOID)) 50, 50, 70
50 CONTINUE
GO TO 80
C
C SPECIAL CASE, ONLY PARTICULAR AXIAL POSITION IS MONITORED (USEFUL
C FOR PREDETERMINED POINT OF SODIUM VOIDING)
C
60 TEM(NUPPER,MUX,LVOID) = (TEMI(NUPPER,MUX,LVOID)*TP(NUPPER,1))/TPI(
1NUPPER)
IF (TEM(NUPPER,MUX,LVOID)-TRIPX(LVOID)) 80, 80, 70
C
C VOIDING HAS BEGUN.
C
70 IVOIDQ = 1
80 CONTINUE
RETURN
END

```

```

VOIDQ001
VOIDQ002
VOIDQ003
VOIDQ004
VOIDQ005
VOIDQ006
VOIDQ007
VOIDQ008
VOIDQ009
VOIDQ010
VOIDQ011
VOIDQ012
VOIDQ013
VOIDQ014
VOIDQ015
VOIDQ016
VOIDQ017
VOIDQ018
VOIDQ019
VOIDQ020
VOIDQ021
VOIDQ022
VOIDQ023
VOIDQ024
VOIDQ025
VOIDQ026
VOIDQ027
VOIDQ028
VOIDQ029
VOIDQ030
VOIDQ031
VOIDQ032
VOIDQ033
VOIDQ034

```

```

- ELT VOID,1,680717, 6179
  SUBROUTINE VOID                                VOID0001
C   THIS SUBROUTINE COMPUTES A SODIUM VOIDING PATTERN ACCORDING TO A VOID0002
C   SIMPLE PISTON MODEL AND THEN EVALUATES THE REACTIVITY CONSEQUENCESVOID0003
C   DUE TO SUCH VOIDING.                          VOID0004
C   INCLUDE ABC                                  VOID0005
C   REAL NADEN                                  VOID0006
10  DO 570 L=1,LUPPER                            VOID0007
    IF (IVODCO) 70, 70, 20                        VOID0008
C   VOIDING BEGINS AT THE PLACE AND TIME THAT COLLAPSE BEGINS. VOID0009
C   VOID0010
C   VOID0011
20  IF (IXX(L)) 30, 30, 570                        VOID0012
30  IF (ICHANX(L)) 40, 40, 180                    VOID0013
40  DO 50 MU=1,MUPPER                            VOID0014
    IF (ICHAN(MU,L)) 50, 50, 60                  VOID0015
50  CONTINUE                                    VOID0016
    GO TO 570                                    VOID0017
60  MVOID(L) = MU                                VOID0018
    ICHANX(L) = 1                                VOID0019
    GO TO 180                                    VOID0020
70  CONTINUE                                    VOID0021
    IF (IXX(L)) 80, 80, 570                      VOID0022
80  IF (IVOID) 90, 90, 140                      VOID0023
C   VOID0024
C   IVOID = 0, CHECK ALL AXIAL NODES FOR POSSIBLE VOIDING. VOID0025
C   VOID0026
C   90 IF (ICHANX(L)) 100, 100, 130              VOID0027
100 DO 110 MU=1,MUPPER                           VOID0028
    IF ( TEM(NUPPER,MU,L)-TRIPX(L) ) 110, 120, 120 VOID0029
110 CONTINUE                                    VOID0030
    GO TO 570                                    VOID0031
120 MVOID(L) = MU                                VOID0032
    ICHANX(L) = 1                                VOID0033
130 CONTINUE                                    VOID0034
    GO TO 180                                    VOID0035
C   VOID0036
C   IVOID = 1, AXIAL POSITION OF VOIDING IS PREDETERMINED. VOID0037
C   VOID0038
140 IF (ICHANX(L)) 150, 150, 170                VOID0039
150 IF( TEM(NUPPER,MUX,L)-TRIPX(L) ) 1570, 160, 160 VOID0040
160 ICHANX(L) = 1                                VOID0041
    MVOID(L) = MUX                                VOID0042
170 CONTINUE                                    VOID0043
C   VOID0044
C   EQUATION OF MOTION FOR SODIUM VOIDING.        VOID0045
C   VOID0046
180 IF (IXUP(L)) 190,190,300                    VOID0047
190 MMM = MVOID(L)                              VOID0048
    TSEGX(L) = TSEGX(L) + H                      VOID0049
    IF (XUP(L)) 200,200,210                      VOID0050
200 XOU(L) = ZMID(MMM)                          VOID0051
    GO TO 220                                    VOID0052
210 XOU(L) = XUP(L)                              VOID0053
220 XUP(L) = ZMID(MMM) + A1                      VOID0054
    IF (TSEGX(L).GE.TA2.AND.A2.GT.0) GO TO 230  VOID0055
    GO TO 240                                    VOID0056
230 XUP(L) = XUP(L) + A2*(TSEGX(L)-TA2)        VOID0057
240 IF (TSEGX(L).GE.TA3.AND.A3.GT.0) GO TO 250  VOID0058

```

```

      GO TO 260
250 XUP(L) = XUP(L) + A3*((TSEGX(L) - TA3)**2.)
260 IF (TSEGX(L).GE.TA4.AND.A4.GT.0) GO TO 270
      GO TO 280
270 XUP(L) = XUP(L) + A4*((TSEGX(L)-TA4)**3.)
280 CONTINUE
      IF (XUP(L) - AHIGH) 300,300,290
290 XUP(L) = AHIGH
      XOU(L) = AHIGH
      IXUP(L) = 1
300 IF (IXDOWN(L)) 310,310,450
310 MMM = MVOID(L)
      IF (IXUP(L)) 330,330,320
320 TSEGX(L) = TSEGX(L) + H
330 IF (XDOWN(L)) 340,340,350
340 XOD(L) = ZMID(MMM)
      GO TO 360
350 XOD(L) = XDOWN(L)
360 XDOWN(L) = ZMID(MMM) - B1
      IF (TSEGX(L).GE.TB2.AND.B2.GT.0) GO TO 370
      GO TO 380
370 XDOWN(L) = XDOWN(L) - B2*(TSEGX(L)-TB2)
380 IF (TSEGX(L).GE.TB3.AND.B3.GT.0) GO TO 390
      GO TO 400
390 XDOWN(L) = XDOWN(L) - B3*((TSEGX(L)-TB3)**2.)
400 IF (TSEGX(L).GE.TB4.AND.B4.GT.0) GO TO 410
      GO TO 420
410 XDOWN(L) = XDOWN(L) - B4*((TSEGX(L)-TB4)**3.)
420 CONTINUE
430 IF (XDOWN(L)) 440,440,470
440 XDOWN(L)=0.
      XOD(L) = 0.
      IXDOWN(L) = 1
450 IF (IXUP(L).GT.0.AND.IXDOWN(L).GT.0) GO TO 460
      GO TO 470
460 IXX(L) = 1
470 CONTINUE
C
C   CALCULATION OF REACTIVITY FEEDBACK DUE TO SODIUM VOIDING.
C
480 MSTART = MVOID(L)
      XXUP(L) = (XUP(L) + XOU(L))/2.
      DO 510 MZ=MSTART,MUPPER
490 IF (XXUP(L) - ZMID(MZ)) 520,500,500
500 ICHANV(MZ,L) = 1
510 CONTINUE
520 MZZ = MZ - 1
      WCAU(L) = WC(MZZ,L)+(WC(MZ,L)-WC(MZZ,L))*(XXUP(L)-ZMID(MZZ))/ASEG
      VOIDK(L)=VOIDK(L) + WCAU(L)*(XUP(L)-XOU(L))*AREAV(L)*NADEN
      XXDO(L) = (XDOWN(L) + XOD(L))/2.
      DO 550 MZ=MSTART,1,-1
530 IF (XXDO(L) - ZMID(MZ)) 540,540,560
540 ICHANV(MZ,L) = 1
550 CONTINUE
560 MZZ = MZ + 1
      WCAD(L) = WC(MZZ,L)+(WC(MZ,L)-WC(MZZ,L))*(ZMID(MZZ)-XXDO(L))/ASEG
      VOIDK(L) = VOIDK(L) + WCAD(L)*(XOD(L)-XDOWN(L))*AREAV(L)*NADEN
570 CONTINUE
      VODK = 0.

```

```

VOID0059
VOID0060
VOID0061
VOID0062
VOID0063
VOID0064
VOID0065
VOID0066
VOID0067
VOID0068
VOID0069
VOID0070
VOID0071
VOID0072
VOID0073
VOID0074
VOID0075
VOID0076
VOID0077
VOID0078
VOID0079
VOID0080
VOID0081
VOID0082
VOID0083
VOID0084
VOID0085
VOID0086
VOID0087
VOID0088
VOID0089
VOID0090
VOID0091
VOID0092
VOID0093
VOID0094
VOID0095
VOID0096
VOID0097
VOID0098
VOID0099
VOID0100
VOID0101
VOID0102
VOID0103
VOID0104
VOID0105
VOID0106
VOID0107
VOID0108
VOID0109
VOID0110
VOID0111
VOID0112
VOID0113
VOID0114
VOID0115
VOID0116
VOID0117

```

```
DO 580 L=1,LUPPER
580 VODK = VODK + VOIDK(L)
C
C   RUNNING ACCOUNT OF TIME FROM BEGINNING OF SODIUM VOIDING.
C
TVOID = TVOID + H
RETURN
END
```

```
VOID0118
VOID0119
VOID0120
VOID0121
VOID0122
VOID0123
VOID0124
VOID0125
-
```

```
- ELT NATEM,1,680717, 6184
SUBROUTINE NATEM
C THIS SUBROUTINE COMPUTES THE COOLANT TEMPERATURES FOR USE IN
C SUBROUTINE VOID.
INCLUDE ABC
DO 10 L=1,LUPPER
DO 10 MU=1,MUPPER
10 TEM(NUPPER,MU,L) = (TEMI(NUPPER,MU,L)*TP(NUPPER,1))/TPI(NUPPER)
RETURN
END
```

NATEM001
NATEM002
NATEM003
NATEM004
NATEM005
NATEM006
NATEM007
NATEM008
NATEM009

- ELT NAMOD,1,680717, 6190
SUBROUTINE NAMOD

C
C SUBROUTINE NAMOD MODIFIES THE READ IN VALUES FOR SODIUM WORTH.
C
INCLUDE ABC
DO 10 L=1,LUPPER
DO 10 MU=1,MUPPER
WC(MU,L) = WC(MU,L)*FNAMOD
10 CONTINUE
RETURN
END

NAMOD001
NAMOD002
NAMOD003
NAMOD004
NAMOD005
NAMOD006
NAMOD007
NAMOD008
NAMOD009
NAMOD010
NAMOD011
-

- ELT ENERGY,1,680717, 6194
SUBROUTINE ENERGY

C		ENRGY001
C		ENRGY002
C	THIS SUBROUTINE KEEPS A RUNNING TAB ON THE AVERAGE ENERGY (W/CC OF	ENRGY003
C	FUEL) GENERATED FROM TIME ZERO.	ENRGY004
C		ENRGY005
	INCLUDE ABC	ENRGY006
	ENER = ENER + ((AN(1) + ENR1)/2.)*H	ENRGY007
	ENERP = ENER*FUELV/1000000.	ENRGY008
	RETURN	ENRGY009
	END	ENRGY010

```

- ELT PCMELT,1,680717, 6200
  SUBROUTINE PCMELT
C
C   THIS SUBROUTINE KEEPS A RUNNING ACCOUNT OF THE ENERGY CONTAINED
C   IN THE MOLTEN FUEL.  FURTHER, IT COMPUTES A VOLUME WEIGHTED FUEL
C   TEMPERATURE ASSOCIATED WITH THE MOLTEN FUEL.
C
    INCLUDE ABC
    DO 20 L=1,LUPPER
    DO 20 MU=1,MUPPER
    DO 20 N=1,I1
    IF (ITEMF(N,MU,L)) 20, 20, 10
10  QLOCAL(N,MU,L) = QLOCAL(N,MU,L) + ((POW(MU,L) + POWB(MU,L))/2.0)*HPC
20  CONTINUE
    QMOL = 0.
    TEMMOL = 0.
    VOLMOL = 0.
    VOLMAX = 0.
    DO 50 L=1,LUPPER
    DO 50 MU=1,MUPPER
    DO 50 N=1,I1
    QMOL = QMOL + QLOCAL(N,MU,L)*VOLOC(N,L)
    IF (TEM(N,MU,L) - TFAIL(N)) 50, 40, 30
30  TEMMOL = TEMMOL + TEM(N,MU,L)*VOLOC(N,L)
    VOLMOL = VOLMOL + VOLOC(N,L)
    VOLMAX = VOLMAX + VOLOC(N,L)
    GO TO 50
40  VOLFRA = QLOCAL(N,MU,L)/(FUSE(N)*DEN(N))
    TEMMOL = TEMMOL + TEM(N,MU,L)*VOLOC(N,L)*VOLFRA
    VOLMOL = VOLMOL + VOLOC(N,L)*VOLFRA
    VOLMAX = VOLMAX + VOLOC(N,L)
50  CONTINUE
    TEMMOL = TEMMOL/VOLMOL
    PCMT = (VOLMOL/FUELV)*100.
    PCMX = (VOLMAX/FUELV)*100.
    QMOL = QMOL/1000000.
    RETURN
  END

```

PCMLT001
 PCMLT002
 PCMLT003
 PCMLT004
 PCMLT005
 PCMLT006
 PCMLT007
 PCMLT008
 PCMLT009
 PCMLT010
 PCMLT011
 PCMLT012
 PCMLT013
 PCMLT014
 PCMLT015
 PCMLT016
 PCMLT017
 PCMLT018
 PCMLT019
 PCMLT020
 PCMLT021
 PCMLT022
 PCMLT023
 PCMLT024
 PCMLT025
 PCMLT026
 PCMLT027
 PCMLT028
 PCMLT029
 PCMLT030
 PCMLT031
 PCMLT032
 PCMLT033
 PCMLT034
 PCMLT035
 PCMLT036
 PCMLT037

```

- ELT TEMAP,1,680717, 6205
  SUBROUTINE TEMAP
C   THIS SUBROUTINE PRINTS OUT THE AVERAGE CORE TEMPERATURE, POWER,
C   AND REACTIVITY VALUES AND RAMP RATES AT A TIME WHEN THE CORE IS
C   NEARING A DISASSEMBLY CONDITION.
    INCLUDE ABC
    BACK1 = REACOL(1)
    BACK2 = REAVOD(1)
    BACK3 = RH(1)
    REACOL(1) = COLAPK/(.01*BB)
    REAVOD(1) = VODK/(.01*BB)
    RH(1) = 100.*RH(1)/BB
    RH(1) = RH(1) + REACOL(1) - BACK1 + REAVOD(1) - BACK2
    RRCOL = (REACOL(1) - BACK1)/(H*100.)
    RRVOD = (REAVOD(1) - BACK2)/(H*100.)
    RREXT = (R2*T(1) + R3*T(1)*T(1) - STORI)/(H*BB)
    RRTOT = RRCOL + RRVOD + RREXT
    WRITE (NOT,10) (HOL(I),I=1,12)
    WRITE (NOT,20)
    WRITE (NOT,30)
10  FORMAT (1H1///12A6/)
20  FORMAT (120H *****
1 *****
2 *****/)
30  FORMAT (40X,44H THE CORE IS NEARING A DISASSEMBLY CONDITION///)
    WRITE (NOT,40) TEMA(1)
    WRITE (NOT,50) T(1)
    WRITE (NOT,60) AN(1)
    WRITE (NOT,70) RH(1)
    WRITE (NOT,80) REACOL(1)
    WRITE (NOT,90) REAVOD(1)
    WRITE (NOT,100) RRCOL
    WRITE (NOT,110) RRVOD
    WRITE (NOT,120) RRTOT
40  FORMAT (20X,44H TEMA (CORE AVERAGE TEMPERATURE) = ,F10.3
1,18H DEGREES KELVIN //)
50  FORMAT (20X,44H TIME AFTER BEGINNING OF TRANSIENT = ,E10.4
1,18H SECONDS //)
60  FORMAT (20X,44H POWER = ,E10.4
1,18H WATTS/CC OF FUEL//)
70  FORMAT (20X,44H NET REACTIVITY = ,F10.3
1,18H CENTS //)
80  FORMAT (20X,44H COLLAPSE FEEDBACK = ,F10.3
1,18H CENTS //)
90  FORMAT (20X,44H VOID FEEDBACK = ,F10.3
1,18H CENTS ///)
100 FORMAT (20X,44H COLLAPSE RAMP RATE = ,F10.3
1,18H DOLLARS/SEC //)
110 FORMAT (20X,44H VOID RAMP RATE = ,F10.3
1,18H DOLLARS/SEC //)
120 FORMAT (20X,44H TOTAL RAMP RATE (INCLUDING INITIATING RR)= ,F10.3
1,18H DOLLARS/SEC )
    WRITE (NOT,130) TEMMOL
    WRITE (NOT,140) PCMT
    WRITE (NOT,150) PCMX
130 FORMAT (///20X,44H AVERAGE TEMPERATURE OF MOLTEN FUEL = ,F10.3
10.3,18H DEGREES KELVIN )
140 FORMAT (20X,44H PORTION OF THE FUEL IN THE MOLTEN STATE = ,F10.3
1,18H PER CENT )

```

TEMAP001
 TEMAP002
 TEMAP003
 TEMAP004
 TEMAP005
 TEMAP006
 TEMAP007
 TEMAP008
 TEMAP009
 TEMAP010
 TEMAP011
 TEMAP012
 TEMAP013
 TEMAP014
 TEMAP015
 TEMAP016
 TEMAP017
 TEMAP018
 TEMAP019
 TEMAP020
 TEMAP021
 TEMAP022
 TEMAP023
 TEMAP024
 TEMAP025
 TEMAP026
 TEMAP027
 TEMAP028
 TEMAP029
 TEMAP030
 TEMAP031
 TEMAP032
 TEMAP033
 TEMAP034
 TEMAP035
 TEMAP036
 TEMAP037
 TEMAP038
 TEMAP039
 TEMAP040
 TEMAP041
 TEMAP042
 TEMAP043
 TEMAP044
 TEMAP045
 TEMAP046
 TEMAP047
 TEMAP048
 TEMAP049
 TEMAP050
 TEMAP051
 TEMAP052
 TEMAP053
 TEMAP054
 TEMAP055
 TEMAP056
 TEMAP057
 TEMAP058

```
150 FORMAT (20X,44H PORTION OF THE FUEL NODES PART MOLTEN = ,F10.3)
1,18H PER CENT )
WRITE (NOT,20)
WRITE (NOT,160)
160 FORMAT (1H1)
REACOL(1) = BACK1
REAVOD(1) = BACK2
RH(1) = BACK3
RETURN
END
```

TEMAP059
TEMAP060
TEMAP061
TEMAP062
TEMAP063
TEMAP064
TEMAP065
TEMAP066
TEMAP067
TEMAP068

```

- ELT PRINTF,1,680717, 6210
SUBROUTINE PRINTF                                PRINF001
C THIS SUBROUTINE YIELDS A FULL PRINT. VARIABLES PRINTED INCLUDE THEPRINF002
C CURRENT AXIAL POSITIONS OF THE FUEL SEGMENTS, THE FUEL TEMPERATUREPRINF003
C S IN ALL NODES, THE CLAD AND COOLANT TEMPERATURES, THE POWER DENSIPRINF004
C TY IN ALL SEGMENTS, AND THE CORE VOLUME WEIGHTED TEMPERATURE VS PRINF005
C THE TEMPERATURE CALCULATED FOR THE AVERAGE CORE LOCATION. PRINF006
INCLUDE ABC PRINF007
WRITE (NOT,10)(HOL(I),I=1,12) PRINF008
10 FORMAT (1H1//12A6/) PRINF009
IF (ICOLT - 1) 20,40,40 PRINF010
20 WRITE (NOT,30) PRINF011
30 FORMAT (10X,53H CURRENT AXIAL POSITIONS OF THE VARIOUS FUEL SEGMENTPRINF012
1TS) PRINF013
GO TO 60 PRINF014
40 TCOLM = TCOL*1000. PRINF015
WRITE (NOT,50) TCOLM PRINF016
50 FORMAT (10X, 96H CURRENT AXIAL POSITIONS OF THE VARIOUS FUEL SEGMENTPRINF017
1NTS TIME AFTER BEGINNING OF COLLAPSE = ,F8.3, 5H MSEC) PRINF018
60 WRITE (NOT,70)(NUM(I),I=1,LUPPER) PRINF019
70 FORMAT (/3H I ,2X,21HORIGINAL ORIG. ORIG.,(10(5X,I2,2X))) PRINF020
WRITE (NOT,80)(OL(I),I=1,LUPPER) PRINF021
80 FORMAT (26H CENTERLINE LOWER UPPER,(10(1X,F8.3))) PRINF022
DO 90 MU=MUPPER,1,-1 PRINF023
MUU = MU + 1 PRINF024
90 WRITE (NOT,100) (NUMB(MU),ZMID(MU),ZOH(MU),ZOH(MUU),(ZH(MUU,L),LPRINF025
1=1,LUPPER)) PRINF026
100 FORMAT (13,2X,3F7.3,(10(E9.4))) PRINF027
ICLAD = I1 + 1 PRINF028
DO 300 N = 1,NUPPER PRINF029
INODE = N PRINF030
IF (N - 1) 140,140,120 PRINF031
120 IF (N - 11) 160, 200, 130 PRINF032
130 IF (N - ICLAD) 220,220,240 PRINF033
140 WRITE (NOT,10)(HOL(I),I=1,12) PRINF034
WRITE (NOT,150) PRINF035
150 FORMAT (10X,56H FUEL CENTERLINE TEMPERATURES IN VARIOUS RADIAL CHAPRINF036
1NNELS) PRINF037
GO TO 260 PRINF038
160 IF (1WRITE - 1) 180,170,170 PRINF039
170 GO TO 300 PRINF040
180 WRITE (NOT,10)(HOL(I),I=1,12) PRINF041
WRITE (NOT,190) INODE PRINF042
190 FORMAT (10X,14H FUEL NODE NO.,I1,1X,40H TEMPERATURES IN VARIOUS RAPRINF043
1DIAL CHANNELS) PRINF044
GO TO 260 PRINF045
200 WRITE (NOT,10)(HOL(I),I=1,12) PRINF046
WRITE (NOT,210) PRINF047
210 FORMAT (10X,56H FUEL OUTER NODE TEMPERATURES IN VARIOUS RADIAL CHAPRINF048
1NNELS) PRINF049
GO TO 260 PRINF050
220 WRITE (NOT,10)(HOL(I),I=1,12) PRINF051
WRITE (NOT,230) PRINF052
230 FORMAT (10X,45H CLAD TEMPERATURES IN VARIOUS RADIAL CHANNELS) PRINF053
GO TO 260 PRINF054
240 WRITE (NOT,10)(HOL(I),I=1,12) PRINF055
WRITE (NOT,250) PRINF056
250 FORMAT (10X,48H COOLANT TEMPERATURES IN VARIOUS RADIAL CHANNELS) PRINF057
GO TO 260 PRINF058

```

```

260 WRITE (NOT,270)(NUM(I),I = 1,LUPPER) PRINF059
270 FORMAT (/3H I ,1X,9H ORIGINAL,(10(4X,12,3X))) PRINF060
    WRITE (NOT,280)(DL(I),I=1,LUPPER) PRINF061
280 FORMAT (13H CENTERLINE,(10(F8.3,1X))) PRINF062
    DO 290 MU=MUPPER,1,-1 PRINF063
290 WRITE (NOT,310) (NUMB(MU),ZMID(MU),(TEM(N,MU,L),L=1,LUPPER)) PRINF064
300 CONTINUE PRINF065
310 FORMAT (13,2X,F7.3,(10(E9.4))) PRINF066
    WRITE (NOT,10)(HOL(I),I=1,12) PRINF067
    WRITE (NOT,320) PRINF068
320 FORMAT (10X,41H POWER DENSITY AT VARIOUS RADIAL CHANNELS) PRINF069
    WRITE (NOT,270)(NUM(I),I=1,LUPPER) PRINF070
    WRITE (NOT,280)(DL(I),I=1,LUPPER) PRINF071
    DO 330 MU=MUPPER,1,-1 PRINF072
330 WRITE (NOT,310)(NUMB(MU),ZMID(MU),(POW(MU,L),L=1,LUPPER)) PRINF073
    WRITE (NOT,340) TEMA(1) PRINF074
340 FORMAT (1H1,28H CORE AVERAGE TEMPERATURE = E10.5) PRINF075
    WRITE (NOT,350) TEMP(1,1) PRINF076
350 FORMAT (1X,29H K-III AVERAGE TEMPERATURE = E10.5) PRINF077
    ETEMP = (TEMP(1,1)-TEMA(1))/TEMP(1,1) PRINF078
    IF (ABS(ETEMP) - EPSDOP) 380,380,360 PRINF079
360 WRITE (NOT,370) PRINF080
370 FORMAT (1X,77H CORE AVERAGE TEMPERATURE DOES NOT AGREE WITH K-III PRINF081
    1TEMPERATURE WITHIN EPSDOP) PRINF082
380 CONTINUE PRINF083
    RETURN PRINF084
    END PRINF085

```

```

- ELT PRINTK,1,680717, 6215
SUBROUTINE PRINTK
C THIS SUBROUTINE COMPUTES THE UPDATED REACTIVITY VALUES FOR THE END
C OF THE CURRENT TIME STEP AND PRINTS THEM OUT.
C FURTHER, THIS ROUTINE DECIDES WHEN TO CALL PRINTM.
INCLUDE ABC
10 BACK1 = REACOL(1)
BACK2 = REAVOD(1)
BACK3 = RH(1)
REACOL(1) = COLAPK/(.01*BB)
REAVOD(1) = VODK/(.01*BB)
RH(1) = 100.*RH(1)/BB
RH(1) = RH(1) + REACOL(1) - BACK1 + REAVOD(1) - BACK2
JZ = J
I = 1
WRITE (NOT,20) JZ, T(I), AN(I), RH(I), (RCNT(K,I), K=1,3),
1(TEMP(K,I), K=1,3),TEMA(1), REAVOD(1), REACOL(1), ENERP,(C(K,I),
2K=1,M), QMOL
20 FORMAT (I5, 1PE12.5,1PE12.4,0P4F12.4,1P4E12.4/5X,0P2F12.4,1PE12.4,
11P6E12.3,1PE12.5)
30 REACOL(1) = BACK1
REAVOD(1) = BACK2
RH(1) = BACK3
IF (IMELT) 60,60,40
40 JJJ = JJJ + 1
IF (JJJ - NMPRT) 60,50,50
50 JJJ = 0
CALL PRINTM
60 CONTINUE
RETURN
END

```

PRINK001
 PRINK002
 PRINK003
 PRINK004
 PRINK005
 PRINK006
 PRINK007
 PRINK008
 PRINK009
 PRINK010
 PRINK011
 PRINK012
 PRINK013
 PRINK014
 PRINK015
 PRINK016
 PRINK017
 PRINK018
 PRINK019
 PRINK020
 PRINK021
 PRINK022
 PRINK023
 PRINK024
 PRINK025
 PRINK026
 PRINK027
 PRINK028
 PRINK029
 PRINK030

```

- ELT PRINTM,1,680717, 6220
  SUBROUTINE PRINTM
C                                     PRINM001
C                                     PRINM002
C   THIS SUBROUTINE PRINTS OUT AVERAGE MOLTEN FUEL TEMPERATURE, PRINM003
C   PER CENT OF FUEL ACTUALLY MOLTEN, AND PER CENT OF FUEL PARTIALLY PRINM004
C   MOLTEN (NODES IN OR ABOVE FUSION) PRINM005
C   INCLUDE ABC PRINM006
C   JZ = J PRINM007
C   I = 1 PRINM008
C   WRITE (NOT,10) JZ,T(I),TEMMOL,PCMT,PCMX PRINM009
10 FORMAT (/15, 1PE12.5,12H TEMMOL = ,0PF12.5,12H PCMT = ,0PF12 PRINM010
1.5,12H PCMX = ,0PF12.5,/) PRINM011
  RETURN PRINM012
  END PRINM013

```



```

- ELT PRINTP,1,680717, 6225
SUBROUTINE PRINTP
C THIS SUBROUTINE YIELDS A PARTIAL PRINT. VARIABLES PRINTED INCLUDE
C THE FUEL CENTERLINE AND OUTER NODE TEMPERATURES.
INCLUDE ABC
WRITE (NOT,10)(HOL(I),I=1,12)
10 FORMAT (1H1//12A6/)
WRITE (NOT,20)
20 FORMAT (10X,56H FUEL CENTERLINE TEMPERATURES IN VARIOUS RADIAL CHAP
1NNELS)
WRITE (NOT,30)(NUM(I),I=1,LUPPER)
30 FORMAT (/3H I ,1X,9H ORIGINAL,(10(4X,I2,3X)))
WRITE (NOT,40)(DL(I),I=1,LUPPER)
40 FORMAT (13H CENTERLINE,(10(F8.3,1X)))
DO 50 MU=MUPPER,1,-1
50 WRITE (NOT,60) (NUMB(MU),ZMID(MU),(TEM(1,MU,L),L=1,LUPPER))
60 FORMAT (13,2X,F7.3,(10(E9.4)))
WRITE (NOT,10)(HOL(I),I=1,12)
WRITE (NOT,70)
70 FORMAT (10X,56H FUEL OUTER NODE TEMPERATURES IN VARIOUS RADIAL CHAP
1NNELS)
WRITE (NOT,30)(NUM(I),I=1,LUPPER)
WRITE (NOT,40)(DL(I),I=1,LUPPER)
DO 80 MU=MUPPER,1,-1
80 WRITE (NOT,60) (NUMB(MU),ZMID(MU),(TEM(1,MU,L),L=1,LUPPER))
WRITE (NOT,10)(HOL(I),I=1,12)
WRITE (NOT,90)
90 FORMAT (10X,48H COOLANT TEMPERATURES IN VARIOUS RADIAL CHANNELS)
WRITE (NOT,30)(NUM(I),I=1,LUPPER)
WRITE (NOT,40)(DL(I),I=1,LUPPER)
DO 100 MU=MUPPER,1,-1
100 WRITE (NOT,60) (NUMB(MU),ZMID(MU),(TEM(NUPPER,MU,L),L=1,LUPPER))
RETURN
END

```

PRINP001
 PRINP002
 PRINP003
 PRINP004
 PRINP005
 PRINP006
 PRINP007
 PRINP008
 PRINP009
 PRINP010
 PRINP011
 PRINP012
 PRINP013
 PRINP014
 PRINP015
 PRINP016
 PRINP017
 PRINP018
 PRINP019
 PRINP020
 PRINP021
 PRINP022
 PRINP023
 PRINP024
 PRINP025
 PRINP026
 PRINP027
 PRINP028
 PRINP029
 PRINP030
 PRINP031
 PRINP032
 PRINP033

```

- ELT PRINTV,1,680717, 6230
  SUBROUTINE PRINTV
C    THIS SUBROUTINE PRINTS THE SODIUM VOIDING DISTRIBUTION.
    INCLUDE ABC
    WRITE (NOT,10) (HOL(I),I=1,12)
10  FORMAT (1H1//12A6/)
    TVO = TVOID*1000.
    WRITE (NOT,20) TVO
20  FORMAT (10X,96H SODIUM VOIDING PATTERN (1111111 = NA IN, 0000000 =
1 VOID) TIME AFTER BEGINNING OF VOIDING = ,F8.3, 5H MSEC)
    WRITE (NOT,30) (NUM(I),I=1,LUPPER)
30  FORMAT (/3H I ,1X,9H ORIGINAL,(10(4X,I2,3X)))
    WRITE (NOT,40) (DL(I),I=1,LUPPER)
40  FORMAT (13H CENTERLINE,(10(F8.3,1X)))
    NSET(1) = 1111111
    NSET(2) = 0000000
    DO 50 L=1,LUPPER
    DO 50 MU=1,MUPPER
    NVOI = ICHANV(MU,L) + 1
50  NSETV(MU,L) = NSET(NVOI)
    DO 60 MU=MUPPER,1,-1
60  WRITE (NOT,70) (NUM(MU),ZMID(MU),(NSETV(MU,L),L=1,LUPPER))
70  FORMAT (13,2X,F7.3,(10(2X,I7)))
    NWWL = 0
    WRITE (NOT,80) (HOL(I), I=1,12)
80  FORMAT (1H1/12A6///
1128H I TIME(SEC)/VOID POWER/COL RHO(CENTS)/E RHO 1/C1 RHO 2/C
22 RHO 3/C3 TEMP 1/C4 TEMP 2/C5 TEMP 3/C6 TEMA/Q(MW SEC)
3///)
    RETURN
    END

```

```

PRINV001
PRINV002
PRINV003
PRINV004
PRINV005
PRINV006
PRINV007
PRINV008
PRINV009
PRINV010
PRINV011
PRINV012
PRINV013
PRINV014
PRINV015
PRINV016
PRINV017
PRINV018
PRINV019
PRINV020
PRINV021
PRINV022
PRINV023
PRINV024
PRINV025
PRINV026
PRINV027
PRINV028
PRINV029
PRINV030

```

DISTRIBUTIONNo. of
CopiesOFFSITE

30	<u>AEC Division of Reactor Development and Technology</u> M. Shaw, Director, RDT Asst Dir for Nuclear Safety Analysis & Evaluation Br, RDT:NS Environmental & Sanitary Engineering Branch, RDT:NS Research & Development Br, RDT:NS Asst Dir for Plant Engineering Branch, RDT Applications & Facilities Branch, RDT:PE Components Branch, RDT:PE Instrumentation & Control Br, RDT:PE Liquid Metal Systems Branch, RDT:PE Asst Dir for Program Analysis, RDT Asst Dir for Project Management, RDT Liquid Metals Projects Branch, RDT:PM FFTF Project Manager, RDT:PM (3) Asst Dir for Reactor Engineering Control Mechanisms Branch, RDT:RE Core Design Branch, RDT:RE (2) Fuel Fabrication Branch, RDT:RE Fuel Handling Branch, RDT:RE Reactor Vessels Branch, RDT:RE Asst Dir for Reactor Technology Coolant Chemistry, RDT Fuel Recycle Branch, RDT Fuels & Materials Branch, RDT:RT Reactor Physics, RDT:RT Special Technology Branch, RDT:RT Asst Dir for Engrg Standards
265	<u>AEC Division of Technical Information Extension</u>
1	<u>AEC Chicago Patent Group</u> G. H. Lee, Chief
1	<u>AEC Idaho Operations Office</u> <u>Nuclear Technology Division</u> C. W. Bills, Director

No. of
Copies

1	<u>AEC San Francisco Operations Office</u> Director, Reactor Division
4	<u>AEC Site Representatives</u> Argonne National Laboratory Atomics International Atomic Power Development Associates, Inc. General Electric Company
2	<u>Argonne National Laboratory</u> R. A. Jaross LMFBR Program Office
1	<u>Atomic Power Development Associates, Inc.</u> Document Librarian
7	<u>Atomics International</u> D. J. Cockeram (5) Liquid Metal Information Center J. J. Droher (2)
2	<u>Babcock & Wilcox Company (AEC)</u> S. H. Esleeck G. B. Garton
5	<u>Bechtel Corporation</u> Project Administrator, FFTF J. J. Teachnor
1	<u>Combustion Engineering</u> 1000 MW _e Follow-On Study W. P. Staker, Project Manager
5	<u>General Electric Company</u> Advanced Products Operation Karl Cohen (3) Betram Wolfe Nuclear Systems Programs D. H. Ahmann

No. of
Copies

2	<u>Gulf General Atomic Inc.</u> <u>General Atomic Division</u> D. Coburn
1	<u>Idaho Nuclear Corporation</u> D. R. deBoisblanc
1	<u>Pacific Northwest Laboratory Representative</u> N. A. Hill (ZPR-III)
1	<u>Stanford University</u> <u>Nuclear Division</u> Division of Mechanical Engineering R. Sher
1	<u>United Nuclear Corporation</u> <u>Research and Engineering Center</u> R. F. DeAngelis
10	<u>Westinghouse Electric Corporation</u> J. C. R. Kelly

ONSITE-HANFORD

1	<u>AEC Chicago Patent Group</u> R. K. Sharp (Richland)
4	<u>AEC RDT Site Representative</u> P. G. Holsted
4	<u>AEC Richland Operations Office</u> C. L. Robinson J. M. Shivley (3)
3	<u>Battelle Memorial Institute</u>
1	<u>Bechtel Corporation</u> D. H. Weiss (Richland)
1	<u>Westinghouse Electric Corporation</u> R. Strzelecki (Richland)

No. of
Copies

117

Battelle-Northwest

S. O. Arneson	J. E. Hanson	W. D. Richmond
E. R. Astley	R. W. Hardie	W. E. Roake
Q. L. Baird	R. A. Harris	A. R. Schade
R. A. Bennett	H. Harty	L. E. Schwendiman
K. L. Berrett	R. A. Harvey	F. H. Shadel
D. C. Boyd	B. R. Hayward	J. R. Sheff
C. L. Brown	R. E. Heineman	D. E. Simpson
W. L. Bunch	R. J. Hennig	R. J. Squires
S. H. Bush	P. L. Hofmann	C. C. Steele
J. J. Cadwell	B. M. Johnson	D. D. Stepnewski
C. M. Cantrell	H. G. Johnson	D. H. Stewart
J. R. Carrell	R. L. Junkins	C. D. Swanson
W. E. Cawley	E. M. Johnston	J. C. Tobin
W. L. Chase	R. B. Kidman	K. G. Toyoda
P. D. Cohn	D. D. Lanning	R. C. Walker
D. L. Condotta	W. W. Little	A. E. Waltar (20)
R. R. Cone	C. E. Love	J. H. Westsik
E. A. Evans	W. B. McDonald	J. F. Wett
C. L. Fies	L. L. Maas	T. W. Withers
L. M. Finch	C. A. Munro	N. G. Wittenbrock
G. L. Fox	C. R. Nash	M. R. Wood
E. E. Garrett	L. D. O'Dell	FFTF Reference
S. M. Gill	A. Padilla	File
V. W. Gustafson	M. G. Patrick	FFTF Record
J. P. Hale	R. D. Peak	File (10)
J. W. Hagan	R. E. Peterson	Tech. Pubs. (2)
G. H. Strong	O. W. Priebe	Tech. Info. (2)
J. C. Cochran	J. S. McMahon	Legal (2)