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MELT-II-- A Two-Dimensional Neutronics-Heat Transfer Program for Fast Reactor Safety Analysis

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MELT-II
A TWO-DIMENSIONAL NEUTRONICS-HEAT TRANSFER PROGRAM
FOR FAST REACTOR SAFETY ANALYSIS

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ABSTRACT

The MELT-II program is a multichannel neutronics-heat transfer digital computer program developed to investigate the transient behavior of fast reactors for overpower or loss of flow accident conditions. Reactivity feedback due to Doppler broadening, coolant density change and voiding, and fuel movement are taken into account.

The core model consists of a maximum of 10 radial channels, 20 axial segments, and 12 radial fuel nodes plus a gap, cladding, and coolant node for each pin. Typical running times, for the UNIVAC 1108, are approximately 4 minutes for an overpower transient and 8 minutes for a loss of flow accident. These times correspond to cases with a substantial amount of printed output plus plotting. Although all programming is in FORTRAN-V, the program is somewhat dependent on system subroutines unique to the UNIVAC 1108 at Richland, Washington.

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I. INTRODUCTION

During the past several years, increased emphasis has been focused on methods to analyze the course of major fast reactor excursions. In particular, there has existed a need to characterize core behavior from the inception of some definable accident condition up through the point where gross geometric changes occur and hydrodynamic forces become important. The proper treatment of fuel feedback phenomena such as Doppler broadening, coolant voiding, and fuel movement is known to be vital in depicting the actual course of the accident. Conversely, it is important to be able to demonstrate in an analytically tractable fashion, that inherent shutdown features of particular reactor systems can, in many cases, terminate a transient with little or no damage to the core.

The computer program MELT-I⁽¹⁾ was one of the earliest attempts addressed to this need. Although much has been learned regarding the potential magnitudes of selected accidents through the use of this program, it soon became clear that a more realistic model was required.

The two-dimensional neutronics-heat transfer computer program MELT-II represents a new generation update of the previous version. Although it is based on the same goals, i.e., to simulate core behavior up to the point of potential core disassembly, it incorporates a substantially improved heat-transfer package and contains several new and more detailed feedback models. Fuel temperature distributions, both radially and axially, can be simulta-

neously computed in as many as 10 pins located at specified locations throughout the core. The assumption is normally made that all of the pins at the same radial distance from the center of the core behave identically. Variable conductivity for the fuel and variable specific heat for the fuel, cladding and coolant can be specified. Bulk inlet coolant temperature can be programmed as a function of time and coolant flow can be independently specified as a function of time for each channel.

Although the basic heat-transfer and neutronic formulations are fairly rigid, the program has been constructed to allow a very flexible set of feedback routines to be used. This was intentionally done in recognition of the rapidly developing understanding associated with fuel/coolant motion and interaction phenomenology. Because of the almost day-to-day changes which are being made to update the feedback routines, a question arose as to which program version should be published. The basic program has been in operation for over two years and for at least the past year has been rather extensively field tested by several institutions. In the interest of providing to the widest spectrum of potential users a fairly compact, well tested program, it was decided to publish, at this time, essentially that version sent out for field testing approximately a year ago. A second version, reflecting the updates under development, will be published at a later date.

Three fuel movement models and three coolant voiding models are contained in the as-published version of the program. Fuel movement prior to melting is allowed as the result of axial expansion of the cladding or the fuel matrix itself; and after cladding failure occurs, the fuel can slump according to a constant force such as gravity or can squirt into the coolant channel under

the force of fission gas. Coolant voiding is assumed to occur in a slug-type fashion in which the void growth is dictated by the driving pressure, the initial momentum of the moving liquid column, and pressure losses in the channel. The driving force may be coolant vapor due to flashing, fission gas release, or coolant vapor generated in a molten fuel-coolant interaction.

Doppler feedback is computed according to a spatial weighting scheme which is sensitive to temperature skewing that may occur during a transient, and to spectrum hardening effects during gross coolant voiding situations.

To facilitate continuity in the analytical investigation of major fast reactor excursions, the MELT-II program has been constructed to directly interface the VENUS two-dimensional hydrodynamic disassembly program⁽²⁾. If disassembly conditions are established, the fine structure temperature information is integrated to conform to the R-Z spatial mesh structure used in VENUS and this input, along with the power distribution and all reactivity feedback components, is used directly as the starting point for the disassembly phase in VENUS. In addition, the core is scanned for liquid sodium content to determine the effective Doppler coefficient and to establish whether a sodium-in or sodium-out equation-of-state should be employed at each particular VENUS mesh point.

The neutronics package is based upon point kinetics and uses an algorithm which allows a variable time step. Also the program is constructed to allow the use of the zero lifetime approximation over those ranges of the excursion where the net reactivity is fairly low and power variations are occurring slowly. This option allows a very substantial savings of

computation time for many cases.

The program is written in FORTRAN-V for use on a UNIVAC-1108 computer (~50K useable memory). A typical running time for a case using 6 radial channels, 18 axial segments, and 10 radial nodes within each pin, would be approximately 4 minutes for a reactivity insertion excursion and 8 minutes for a loss-of-flow accident. These times correspond to cases with a substantial amount of printed output plus plotting. Significant savings can be accomplished by reducing the request for output detail.

Storage requirements can be reduced to approximately 45K of core memory for program execution. However, wrapup and plotting features are included in the program to provide a convenient chronological printed and plotted summary of the specified quantities of interest. If these options are used, additional storage is required. A 1.2 million word fast access drum, currently used for this purpose, is sufficient to store approximately 300 time steps of information.

II. CORE MODEL

Typical fast reactors of interest consist of a packed array of hexagonal subassemblies, each containing a few hundred pins, arranged to form essentially a right circular cylinder as shown at the top of Figure 1. The core is surrounded by a blanket and/or a reflector in both the radial and axial directions.

In attempting to simulate reactor behavior throughout a major excursion, judicious attention must be given to the detail required for particular phases of the accident. Since the major interest in developing the program was to investigate large accidents, many details regarding the myriads of microprocesses that occur in the tens of thousands of individual pins in a large fast reactor must be sacrificed in order that the major features of the excursion can be investigated within reasonable computation times. Accordingly, detailed heat-transfer calculations are limited to 10 typical pins in the core, each of which is normally selected as representative of all the pins within a particular ring of subassemblies. As illustrated in Figure 1, each pin analyzed is considered to be composed of up to 20 axial segments and a radial structure consisting of fuel, gap (or bond), cladding, and associated coolant. The latter three constituents are each assigned a single node, but up to 12 mesh intervals can be used to describe the fuel region to account for the characteristically steep temperature gradients associated with oxide fueled cores.

This geometric formulation renders the overall calculation insensitive to pin-to-pin time-failure incoherency within a given subassembly, but does allow time failure incoherency between rings of subassemblies. Because of

Figure 1. Core Model

the high spatial dependence of fuel material and sodium-void reactivity worths, a multichannel calculation is considered essential. Specifications of the fuel worth distribution and the Doppler weighting function are limited to the core proper, but sodium-void worths can be included for the axial blanket and/or reflector regions as well in order to account for the important reactivity effects associated with gross channel voiding.

III. HEAT TRANSFER MODEL

Heat transfer calculations are carried out for each fuel pin representing one of the channels in the reactor. The radial nodal structure used in the calculations is shown in Figure 2. The node boundaries are specified as input and the centroids are calculated internally. A bond or gap can be specified between the fuel and cladding. In the first case, the thermal properties of the bond material are specified and in the latter case, the interfacial heat transfer coefficient of the gap is specified (only a single phase bond composition is treated). The cladding node can be connected to the coolant at any axial location between the bottom and top of the coolant node. Axial heat conduction within the fuel pin is neglected, but all axial positions are linked by means of heat convection through the coolant channel.

Based on the conservation of energy, a heat balance on the n-th radial node at the j-th axial level can be written as:

$$\begin{aligned} (V\rho C_p)_{n,j} \frac{dT_{n,j}}{dt} = & Q_{n,j}^* \\ & + U_{n-1,j} [T_{n-1,j} - T_{n,j}] - U_{n,j} [T_{n,j} - T_{n+1,j}] \\ & - (WC_p)_{n,j} [T_{n,j+1/2} - T_{n,j-1/2}] \end{aligned} \quad (3-1)$$

where:

V = volume
ρ = density
C_p = specific heat
T = temperature
Q* = energy deposited in node
U = thermal admittance
W = mass flow rate

TOP VIEW

SIDE VIEW

DIRECTION OF FLOW

Figure 2. Radial Pin Structure

The left side of the equation represents the change in stored energy due to time-dependent temperature changes. On the right side of the equation, the first term represents the energy deposited in the node, and the second and third terms represent the energy exchange with adjacent nodes. The last term represents the convective transport of energy if the node is a coolant node.

For nodes within the fuel pin, the numerical approximation used at the time step $k+1$ is:

$$\begin{aligned}
 \frac{(V\rho C)_p}{h} \left[T_{n,j}^{k+1} - T_{n,j}^k \right] &= \frac{Q_{n,j}^{*k+1} + Q_{n,j}^{*k}}{2} + \frac{U_{n-1,j}^{k+1}}{2} \left[T_{n-1,j}^{k+1} - T_{n,j}^{k+1} \right] \\
 &+ \frac{U_{n-1,j}^k}{2} \left[T_{n-1,j}^k - T_{n,j}^k \right] - \frac{U_{n,j}^{k+1}}{2} \left[T_{n,j}^{k+1} - T_{n+1,j}^{k+1} \right] \\
 &- \frac{U_{n,j}^k}{2} \left[T_{n,j}^k - T_{n+1,j}^k \right] .
 \end{aligned} \tag{3-2}$$

As noted from the formulation, an average between the k -th and $k+1$ -th time steps is used on the right side of the equation. For the coolant node ($n=co$, $n-1 = cl$), the numerical approximation is:

$$\begin{aligned}
\frac{(V\rho C_p)_{co,j}}{h} \left[T_{co,j}^{k+1} - T_{co,j}^k \right] &= \frac{Q_{co}^{*k+1} + Q_{co}^{*k}}{2} + \frac{U_{cl,j}^{k+1}}{2} \left[T_{cl,j}^{k+1} - T_{co,j}^{k+1} \right] \\
&+ \frac{U_{cl,j}^k}{2} \left[T_{cl,j}^k - T_{co,j}^k \right] - \frac{1}{2} \left(WC_p \right)_{co,j}^{k+1} \left[T_{co,j+1/2}^{k+1} - T_{co,j-1/2}^{k+1} \right] \\
&- \frac{1}{2} \left(WC_p \right)_{co,j}^k \left[T_{co,j+1/2}^k - T_{co,j-1/2}^k \right] .
\end{aligned} \tag{3.3}$$

The coolant node is given by:

$$T_{co,j} = f \left(T_{co,j+1/2} - T_{co,j-1/2} \right) + T_{co,j-1/2} \tag{3-4}$$

where the input parameter f (must be between 0 and 1) determines the axial location of the coolant node. Equations (3-2) and (3-3) are solved implicitly by a Gaussian elimination scheme in order to avoid instability problems associated with geometric constraints on the maximum size of time steps (See Appendix A-1).

Variable thermal conductivity for the fuel and variable specific heat for the fuel, cladding, and coolant can be specified. Prior to computing new temperatures, a temperature extrapolation procedure is used to obtain the new temperature dependent property, and then actual temperatures are compared to the extrapolated values and tested for acceptance prior to completion of the time step. The present model requires constant gap and film coefficients, although the local film coefficient can be automatically dropped to a specified value once local coolant voiding has occurred.

IV. NEUTRONICS MODEL

The standard point-kinetics formulation, with up to six groups of delayed neutrons, is utilized to describe the neutron kinetics of the reactor. It is assumed that the reactor power distribution $Q(r,z,t)$ can be expressed as follows:

$$Q(r,z,t) = P(t) \psi(r,z) \quad (4-1)$$

where the shape function, $\psi(r,z)$, is input and is assumed independent of time. The quantity $P(t)$ is the total power and is the solution of the familiar lumped parameter kinetics equations,

$$\frac{dP}{dt} = \frac{\rho^* - \beta}{\Lambda} P + \sum_{i=1}^G \lambda^i C^i \quad (4-2)$$

$$\frac{dC^i}{dt} = \frac{\beta^i P}{\Lambda} - \lambda^i C^i \quad (4-3)$$

where: G = number of precursor groups
 P = power density
 ρ^* = reactivity (starred to distinguish it from the symbol, ρ , used to denote material density)
 β = total delayed neutron fraction
 Λ = prompt neutron generation time
 λ^i = decay constant for group i
 β^i = delayed neutron fraction for group i
 C^i = precursor density for group i .

Of the several numerical methods which have been shown to successfully solve Equations (4-2) and (4-3), one developed by Hansen et al.^(3,4) appears particularly adaptable for super-prompt critical reactor excursion analyses. This method has proved quite successful when power changes occur rapidly,

but is less efficient when the power varies slowly. For this situation, a zero neutron lifetime approximation has been formulated and works very well in allowing large time steps for many fast reactor accidents of interest. The finite difference representation of Equations (4-2) and (4-3), where the details of derivation are left to Appendix A-2, can be written as

$$P_{k+1} = e^{\omega_k h} \left[P_k \left(1 + \frac{h}{2\Lambda} \left\{ \rho_{k+1}^* - \rho_k^* \right\} \right) + \sum_1^G \lambda^i C_k^i \cdot \left\{ \frac{e^{h(\gamma_k^i - \omega_k)} - 1}{\gamma_k^i - \omega_k} - h \right\} \right] \quad (4-4)$$

$$C_{k+1}^i = e^{\gamma_k^i h} \left[C_k^i + \frac{n_k \beta^i}{\Lambda} \left\{ \frac{e^{h(\omega_k - \gamma_k^i)} - 1}{\omega_k - \gamma_k^i} - h \right\} \right], \quad (4-5)$$

where h is the time step, and ω_k and γ_k^i are the instantaneous periods for the total power and precursor densities, respectively.

V. REACTIVITY FEEDBACK MODELS

Perhaps the most difficult part of simulating large reactor excursions is to develop appropriate models for the reactivity feedback mechanisms. The problem is not so much that of determining the reactivity consequences resulting from coolant density change or fuel motion, but rather to establish the basic phenomenology governing the space-time motions of coolant or fuel. Many important feedback mechanisms, such as molten-fuel motion, fuel-coolant interactions, and fission-gas-release effects, are currently so ill-defined that model construction is exceedingly difficult. The present approach, therefore, has been to formulate models for all major feedback phenomena wherein sufficient simplicity and flexibility is contained to allow the sensitivity of each mechanism on the overall energy release to be evaluated. Reactivity feedback due to structural bowing, however, has not been modeled since that mechanism is normally a strong function of reactor design and is unique to each reactor system.

Total reactivity, as required in solving Equation (4-1), is obtained by combining the programmed reactivity with the feedback terms, i.e.,

$$\rho^*(t) = \rho_p^*(t) + \sum_i \rho_i^*(t) \quad , \quad (5-1)$$

where $\rho_p^*(t)$ is the programmed reactivity (such as a step, ramp, or any other specified function of time), and the $\rho_i^*(t)$ terms represent the individual feedback contributions. The feedback models are treated separately below where, for simplicity in notation, the time dependence is suppressed.

It might be mentioned that for quick scoping purposes, lumped parameter

feedbacks for changes in the average fuel, cladding, or coolant temperature can be used. However, in most instances, the slight additional computation time required for the spatial feedback models is quite justified. Sodium density changes, for example, are often treated by using a lumped reactivity coefficient associated with an average core increase in coolant temperature. However, due to the strong spatial variation of sodium worth, quite different results are often obtained by calculating the reactivity feedback based on local density changes, and the latter option is strongly recommended if the transient is such that coolant density changes are important.

A. Doppler

In a mixed-oxide fast reactor, the Doppler effect is perhaps the only reliable, prompt, negative-reactivity feedback mechanism that exists. Hence, proper treatment of this effect is of utmost concern. The reactivity change with respect to average fuel-temperature changes can be generally written as follows:

$$\frac{d\rho^*_{\text{Doppler}}}{dT} = aT^{-3/2} + bT^{-1} + cT^{(m-1)} \quad (5-2)$$

where a , b , and c are parameters determined from experimental or other neutronic calculations, and m is an integer. Since the quantity $T \frac{dk}{dT}$ appears to be fairly constant over a wide temperature range for most ceramic-fueled cores of interest, the present version of the code assumes the quantities a and c to be zero and sets $b = K_D = T \frac{dk}{dT}$, i.e., the constant normally referred to as the Doppler constant. Integrating this reduced equation with respect

to T and applying the statistical weighting factor, the total reactivity feedback contribution of Doppler broadening can be written

as:

$$\begin{aligned} \rho_{\text{Doppler}}^* &= \left[\frac{\sum_{i,j} W(i,j) V(i,j) \left[K_D \ln \frac{T(i,j)}{T_o(i,j)} \right]}{\sum_{i,j} W(i,j) V(i,j)} \right] \text{ for } T_o(i,j) \leq T(i,j) \leq T_1(i,j) \\ &= A + \left[\frac{\sum_{i,j} F W(i,j) V(i,j) \left[K_D \ln \frac{T(i,j)}{T_1(i,j)} \right]}{\sum_{i,j} W(i,j) V(i,j)} \right] \text{ for } T_1(i,j) < T(i,j) \end{aligned} \quad (5-3)$$

where: $W(i,j)$ = local Doppler statistical weighting factor,

$V(i,j)$ = local nodal fuel volume,

$T(i,j)$ = local nodal fuel temperature,

$T_o(i,j)$ = original local nodal fuel temperature,

$T_1(i,j)$ = local nodal fuel temperature at the time local voiding occurs,

F = Doppler coefficient correction factor for spectrum hardening due to sodium voiding,

A = feedback reactivity evaluated at $T = T_1$,

i = radial channel location

j = axial level

The statistical weighting factor, $W(i,j)$, is important during the phases of an accident where spatial skewing of the fuel temperatures may occur, as in a flow coastdown accident. The quantity F , which is based on calculated values of the spectrum variation resulting from large sodium-density changes, represents a means of estimating reductions in the Doppler feedback once coolant voiding occurs..

For many large voiding accidents, the latter effect can be substantial. The calculation for ρ_{Doppler}^* switches to the second formulation of equation (5-3) when voiding has occurred over one complete axial segment.

B. Sodium Expulsion

The reactivity feedback effects associated with sodium expulsion are dependent not only on the radial and axial location of voiding initiation but also on the type of flow regime and rate of voiding. Although several types of flow regimes during voiding have been postulated, experimental data at Ispra⁽⁵⁾ and Argonne⁽⁶⁾ with sodium and potassium and with fluids such as Freon which simulate sodium have shown that voiding can occur from the growth of a single bubble which occupies the entire channel and expands in a slug- or piston-type manner. A slug-type flow regime may be more appropriate than a two-phase flow regime⁽⁷⁾, particularly if voiding is initiated by boiling of superheated sodium or rapid release of high-pressure fission gases. Therefore, a simplified sodium expulsion model assuming a slug-type flow regime is utilized. However, the mass fraction of vapor in the expanding void can be specified arbitrarily.

The geometry associated with the sodium expulsion model is illustrated in Figure 3. Assuming one-dimensional incompressible flow, the equation of motion for expulsion of the sodium can be written as:

$$\frac{\partial u}{\partial t} = - \frac{1}{\rho} \frac{\partial P}{\partial z} - u \frac{\partial u}{\partial z} - \frac{1}{\rho} \frac{\partial \tau}{\partial z} + g \quad (5-4)$$

rate of momentum increase	pressure force	rate of mom- entum increase by con- vection	viscous force	gravitational force

Since $u = W/\rho A$, integration from z_1 to z_2 gives:

$$\dot{W} = \frac{1}{\int_{z_1}^{z_2} \frac{dz}{A}} \left\{ (P_1 - P_2) - \frac{m^2}{2\rho} \left[\int_{z_1}^{z_2} d\left(\frac{1}{A^2}\right) + \int_{z_1}^{z_2} \frac{f}{D_h A^2} dz \right] + \rho g(z_2 - z_1) \right\} \quad (5-5)$$

where: W = mass flow rate
 $\dot{W}$ = time rate of change of mass flow rate
 A = cross-sectional area for coolant flow
 z_1 = axial location of void-liquid interface
 z_2 = axial location of slug extremity
 f = friction factor
 D_h = hydraulic diameter
 ρ = liquid density
 g = acceleration of gravity

The solution of Equation (5-5) requires specification of the geometry between the void and the slug extremity to calculate the momentum and frictional losses. Equation (5-5) is integrated numerically (see

Figure 3. Sodium Voiding Model

For rapid power excursions, where both molten fuel and fission gases may be expected to be released through the cladding rupture into the coolant flow channels, the flow impedance from the plenum through the fuel may be very large and it may be more reasonable to use only the fission gases available in the fuel matrix. In this case, the length of the fission gas plenum can be specified as some fictitiously small value.

(3) Molten fuel-sodium interaction

For rapid power excursions (e.g., reactivity insertions of a few \$/sec), fuel melting leads to cladding failure and it is possible for molten fuel to be expelled into the coolant flow channel and mix with the sodium. It has been postulated that under certain conditions, energy can be transferred very rapidly from the molten fuel to the sodium and result in a violent thermal interaction.

Although such energetic interactions have indeed been observed in the laboratory⁽⁹⁾, recent in-pile TREAT experiments⁽¹⁰⁾ indicate that such a mechanism may not occur under actual reactor conditions--at least in a massive sense. If the fission gases released with the molten fuel prevent energy transfer between the molten fuel and sodium, the model discussed in the previous section can be used.

The molten fuel-sodium interaction model assumes that the sodium in one axial layer of the R-Z core simulation is heated to some peak temperature and pressure very rapidly, and then

the sodium vapor expands adiabatically. The peak pressure can be arbitrarily specified. The adiabatic expansion of the sodium assumes that the molten fuel is essentially vapor-blanketed once the expansion begins. Based on other calculations, it had been found that the isentropic (adiabatic and reversible) expansion of sodium can be approximated very closely by an isothermal expansion of an ideal gas. Therefore, the model is programmed to incorporate this isothermal expansion rather than allowing use of an arbitrary expansion coefficient.

C. Fuel Motion

Fuel motion prior to disassembly has classically been a matter of concern, primarily because fast reactor cores are characteristically not arranged in their most reactive configuration during normal operation. Although most large accident analyses have been associated with gross movement of molten fuel, reactivity effects of fuel motion prior to the time of cladding failure may also be significant. Neither mode of fuel motion is particularly well understood at present.

(1) Fuel Motion Prior to Cladding Failure

Two closely related models have been incorporated to estimate axial fuel motion prior to cladding failure. The basic model assumes the pins to be rigidly fastened at the bottom but free to expand in the vertical direction. In one case the fuel is assumed to elongate as a result of internal

heating, and in the other case the fuel is assumed to move with the axially expanding cladding. Mathematically, reactivity feedback resulting from such motion is computed (see Appendix A-4 for details) according to the following equation:

$$\begin{aligned} \rho_{\text{Axial Expansion}}^* &= \sum_{i=1}^I \left[\sum_{j=1}^J M_f(i,j) W_f(i,j) \left\{ \frac{\sum_{n=1}^{j-1} \alpha \Delta T(i,n)}{1 + \alpha \Delta T(i,j-1)} - \frac{\sum_{n=1}^j \alpha \Delta T(i,n)}{1 + \alpha \Delta T(i,j)} \right\} \right. \\ &\quad \left. + M_f(i,J) \frac{\sum_{j=1}^J \alpha \Delta T(i,j)}{1 + \alpha \Delta T(i,J)} \left\{ W_f(i,J) + \left[W_f(i,J) - W_f(i,J-1) \right] \left[\frac{1}{2} + \frac{\sum_{j=1}^J \alpha \Delta T(i,j)}{2} \right] \right\} \right] \quad (5-7) \end{aligned}$$

where: α = thermal expansion coefficient (fuel or cladding)

$W_f(i,j)$ = fuel worth at node (i,j) ($\delta\rho^*$ /unit fuel mass)

$M_f(i,j)$ = fuel mass at node (i,j)

$\Delta T(i,j)$ = change in temperature from initial condition (average nodal fuel or cladding).

I = number of radial channels

J = number of axial segments

Axial fuel elongation caused by internal thermal expansion is perhaps the major feedback mechanism for a metal-fueled core, but its effectiveness may be limited in oxide cores due to cracking, etc. Fuel movements with the cladding may occur if the fuel-cladding gap should vanish or if mechanical means are incorporated into the design to force fuel and cladding to move as a unit.

(2) Gross Fuel Movement Following Cladding Failure

The possibility of gross fuel motion following cladding failure has received considerable attention in the past, although a viable basis for establishing anything more than a bounding type calculation is still scant. Information from the TREAT facility and the Capsule Driver Core is now rapidly accumulating and a pattern is beginning to take shape. However, only quite simplified models are contained in the present program version. A simple slumping model incorporated in the present system does relax earlier restrictions⁽¹¹⁾ by allowing for radial-feedback incoherence according to actual radial-temperature distributions, but the model still assumes that the major driving force can be represented by some linear forcing function, such as gravity. The equation of motion may be simply written as

$$\frac{d^2H}{dt^2} + \xi \frac{dH}{dt} = -G \quad , \quad (5-8)$$

where ξ represents a viscous factor, G is the driving function, and H is the axial displacement. Consistent with pin support only at the core base, once local cladding failure occurs all of the fuel above that point is assumed to fall according to Equation (5-8), but below that point local cladding failure must occur before fuel is allowed to slump. As the fuel moves, the reactivity consequences of such movement are computed by simply dropping the fuel through a predetermined

worth curve, i.e.,

$$\rho_{\text{collapse}}^* = \sum_{i,j} [W_f(i,j) - W_{fo}(i,j)] M_f(i,j) \quad (5-9)$$

where $W_f(i,j)$ and $M_f(i,j)$ have the same meaning as in Equation (5-7), and $W_{fo}(i,j)$ is the fuel worth at node i,j prior to slumping.

Another model, yet in very preliminary form, exists in the present version of the program. This model assumes a molten column of fuel to flow, unimpeded, through the cladding rupture point and displace the coolant. Fission gas in the upper plenum is assumed to be the driving force. Substantial improvements are currently underway which accommodate different fuel failure mechanisms and fuel motion patterns, both prior to and following cladding failure. It is anticipated that work in this area will constitute one of the major updates in the next program version.

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VII. ACKNOWLEDGMENTS

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APPENDIX A

NUMERICAL SCHEMES AND DETAILS

APPENDIX A-1

NUMERICAL TECHNIQUE EMPLOYED IN THE HEAT TRANSFER CALCULATIONS

Throughout most of the MELT-II program listing, sufficient comment statements are included and the flow of calculations are sufficiently straight forward that detailed logic diagrams and equation structure delineations are not deemed necessary. Subroutine CORTEM, however, in which all temperature calculations are made, may be difficult to follow without a bit more explanation. This appendix is included to help the interested reader better understand the scheme used to solve the heat transfer equations.

A. Actual Equations Solved

1. Within the fuel pin:

Using the indexing notation of Figure 2 and Figure A1.1, and suppressing the axial level j index for clarity, equation (3-2), applicable within the fuel pin, becomes

$$\begin{aligned} \pi L (R_{n+1}^2 - R_n^2) \rho C_p \frac{[T_n^{k+1} - T_n^k]}{h} &= \frac{Q_n^{k+1} + Q_n^k}{2} \\ &+ \frac{2\pi L (RM_n - RM_{n-1})}{2\ell n \left(\frac{RM_n}{RM_{n-1}} \right)} \kappa_{n-1 \rightarrow n}^{k+1} \frac{[T_{n-1}^{k+1} - T_n^{k+1}]}{[RM_n - RM_{n-1}]} \\ &+ \frac{2\pi L (RM_n - RM_{n-1})}{2\ell n \left(\frac{RM_n}{RM_{n-1}} \right)} \kappa_{n-1 \rightarrow n}^k \frac{[T_{n-1}^k - T_n^k]}{[RM_n - RM_{n-1}]} \end{aligned}$$

Figure A1.1. Nomenclature Used in Pin Heat Transfer Calculations

$$\begin{aligned}
& - \frac{2\pi L (RM_{n+1} - RM_n)}{2\ell n \left(\frac{RM_{n+1}}{RM_n} \right)} \kappa_{n \rightarrow n+1}^{k+1} \frac{[T_n^{k+1} - T_{n+1}^{k+1}]}{[RM_{n+1} - RM_n]} \\
& - \frac{2\pi L (RM_{n+1} - RM_n)}{2\ell n \left(\frac{RM_{n+1}}{RM_n} \right)} \kappa_{n \rightarrow n+1}^k \frac{[T_n^k - T_{n+1}^k]}{[RM_{n+1} - RM_n]}
\end{aligned} \tag{A-1-1}$$

where: L = segment length

R_{n+1} = outer radius of node n

RM_n = centroid radius of node n

ρ = density

C_p = specific heat

Q = energy density

$\kappa_{n-1 \rightarrow n}$ = average thermal conductivity between nodes $n-1$ and n

T_n = temperature in node n

h = time step

k = old time

$k+1$ = new time.

Dividing equation (A-1-1) by πL and making the further definitions, corresponding to actual computer variable names,

$$RLOG_n = \ell n \left(\frac{RM_{n+1}}{RM_n} \right)$$

$$HCAPDT_n = \frac{\rho C_p (R_{n+1}^2 - R_n^2)}{h}$$

$$U_s^{k+1} = \kappa_{n-1 \rightarrow n}^{k+1} / RLOG_n$$

$$U_B^{k+1} = \kappa_{n \rightarrow n+1}^{k+1} / RLOG_{n+1}$$

PN^{k+1} = power generated in entire core

POW_n = fraction of power in node $n/2\pi L$,

$$\begin{aligned} HCAPDT_n [T_n^{k+1} - T_n^k] &= (PN^{k+1})(POW_n) + (PN^k)(POW_n) \\ &+ U_s^{k+1} [T_{n-1}^{k+1} - T_n^{k+1}] + U_s^k [T_{n-1}^k - T_n^k] \\ &- U_B^{k+1} [T_n^{k+1} - T_{n+1}^{k+1}] - U_B^k [T_n^k - T_{n+1}^k] \end{aligned} \quad (A-1-2)$$

From this equation, it is clear that at the end of a new time step, $k+1$, temperatures for three adjacent nodes are related according to the equation

$$a_n T_{n-1}^{k+1} + b_n T_n^{k+1} + c_n T_{n+1}^{k+1} = d_n \quad (A-1-3)$$

where:

$$a_n = -U_s^{k+1}$$

$$b_n = HCAPDT_n + U_s^{k+1} + U_B^{k+1}$$

$$c_n = -U_B^{k+1}$$

$$d_n = (HCAPDT_n)(T_n^k) + (PN^{k+1})(POW_n) + (PN^k)(POW_n)$$

$$+ U_s^k [T_{n-1}^k - T_n^k] - U_B^k [T_n^k - T_{n+1}^k] \end{aligned}$$

2. Cladding node:

For the previous section, the subscript n was used to denote a typical fuel node. If we then denote N as the total number of radial nodes in the entire pin, the coolant node is designated N and the cladding node $N-1$. Using this, plus the other notation of the pre-

vious section, the appropriate equation for the cladding becomes

$$\begin{aligned}
 \text{HCAPDT}_{N-1} [T_{N-1}^{k+1} - T_{N-1}^k] &= (PN^{k+1})(POW_{N-1}) + (PN^k)(POW_{N-1}) \\
 &+ U_s^{k+1} [T_{N-2}^{k+1} - T_{N-1}^{k+1}] + U_s^k [T_{N-2}^k - T_{N-1}^k] \\
 &- U_B^{k+1} [T_{N-1}^{k+1} - (f_u)(T_{N,Up}^{k+1}) - (f_D)(T_{N,DOWN}^{k+1})] \\
 &- U_B^k [T_{N-1}^k - (f_u)(T_{N,Up}^{k+1}) - (f_D)(T_{N,DOWN}^k)] \quad (A-1-4)
 \end{aligned}$$

where: $T_N = (f_u)(T_{N,Up}) + (f_D)(T_{N,DOWN})$

and $T_{N,Up}$ = coolant upstream temperature

$T_{N,DOWN}$ = coolant downstream temperature

f_u = fractional weight given to upstream coolant temperature

f_D = fractional weight given to down stream coolant temperature ($f_u + f_D = 1.0$). NOTE: For rapidly rising coolant temperatures, f_D should be set equal to unity.

As before, the above equation can be written as

$$a_{N-1} T_{N-2}^{k+1} + b_{N-1} T_{N-1}^{k+1} + c_{N-1} T_{N,DOWN}^{k+1} = d_{N-1} \quad (A-1-5)$$

where: $a_{N-1} = -U_s^{k+1}$

$$b_{N-1} = \text{HCAPDT}_{N-1} + U_s^{k+1} + U_B^{k+1}$$

$$c_{N-1} = -(U_B^{k+1})(f_D)$$

$$d_{N-1} = (\text{HCAPDT}_{N-1})T_{N-1}^k + (PN^{k+1})(POW_{N-1}) + (PN^k)(POW_{N-1})$$

$$+ U_s^k [T_{N-2}^k - T_{N-1}^k] + (U_B^{k+1})(f_u)(T_{N,Up}^{k+1})$$

$$- U_B^k [T_{N-1}^k - (f_u)(T_{N,Up}^k) - (f_D)(T_{N,DOWN}^k)] .$$

3. Coolant node:

Finally, the coolant node, N, equation becomes

$$\begin{aligned}
 \text{HCAPDT}_N & [(f_u)(T_{N,Up}^{k+1}) + (f_D)(T_{N,DOWN}^{k+1}) - (f_u)(T_{N,Up}^k) - (f_D)(T_{N,DOWN}^k)] \\
 &= (PN^{k+1})(POW_N) + (PN^k)(POW_N) \\
 &+ U_s^{k+1} [T_{N-1}^{k+1} - (f_u)(T_{N,Up}^{k+1}) - (f_D)(T_{N,DOWN}^{k+1})] \\
 &+ U_s^k [T_{N-1}^k - (f_u)(T_{N,Up}^k) - (f_D)(T_{N,DOWN}^k)] \\
 &- U_B^{k+1} [T_{N,DOWN}^{k+1} - T_{N,Up}^{k+1}] \\
 &- U_B^k [T_{N,DOWN}^k - T_{N,Up}^k]
 \end{aligned} \tag{A-1-6}$$

where, in this case,

$$U_B = \frac{1}{2\pi L} (WC_p)$$

W = mass flow rate of coolant

C_p = specific heat of coolant.

Parallel to previous reformulations, the above equation can be rewritten as

$$a_N T_{N-1}^{k+1} + b_N T_{N,DOWN}^{k+1} = d_N \tag{A-1-7}$$

where: $a_N = -U_s^{k+1}$

$$b_N = (\text{HCAPDT}_N)(f_D) + (U_s^{k+1})(f_D) + (U_B^{k+1})$$

$$\begin{aligned}
d_N = & -(\text{HCAPDT}_N)(f_u)(T_{N,\text{Up}}^{k+1}) + (\text{HCAPDT}_N)(f_u)(T_{N,\text{Up}}^k) \\
& + (\text{HCAPDT}_N)(f_D)(T_{N,\text{DOWN}}^k) + (\text{PN}^{k+1})(\text{POW}_N) + (\text{PN}^k)(\text{POW}_N) \\
& - (U_s^{k+1})(f_u)(T_{N,\text{Up}}^{k+1}) + U_s^k[T_{N-1}^k - (f_u)(T_{N,\text{Up}}^k) - (f_D)(T_{N,\text{DOWN}}^k)] \\
& + (U_B^{k+1})(T_{N,\text{Up}}^{k+1}) - U_B^k[T_{N,\text{DOWN}}^k - T_{N,\text{Up}}^k].
\end{aligned}$$

B. Equation Solution Method

From the previous section (e.g., equations A-1-3, A-1-5, and A-1-7), it is noted that the pin temperature at any axial level of any radial channel can be written according to the following set of equations:

$$\begin{array}{llll}
\text{innermost:} & b_1 T_1 + c_1 T_2 & & = d_1 \\
\text{node} & & & \\
& a_2 T_1 + b_2 T_2 + c_2 T_3 & & = d_2 \\
& & & \\
& a_3 T_2 + b_3 T_3 + c_3 T_4 & & = d_3 \\
& & & \cdot \\
& & & \cdot \\
& & & \cdot \\
& a_n T_{n-1} + b_n T_n + c_n T_{n+1} & & = d_n \\
& & & \cdot \\
& & & \cdot \\
& & & \cdot \\
\text{cladding:} & a_{N-1} T_{N-2} + b_{N-1} T_{N-1} + c_{N-1} T_N & & = d_{N-1} \\
\text{coolant:} & & a_N T_{N-1} + b_N T_N & = d_N
\end{array}$$

(A-1-8)

where, for clarity, the superscript $k+1$ denoting the new time step temperature is suppressed. The important thing to note is that the coefficients in the above equations all contain known quantities. The constants at the right of the equal sign basically contain known information from the previous time step plus the power generated in the current step. The final two coefficients, d_{N-1} and d_N , contain upstream coolant temperatures at the current time step, but these are known if the sequence of solution proceeds from the inlet axial level to subsequent axial levels in the downstream direction. The a , b , and c coefficients contain material property constants which are temperature dependent and, therefore, are not known prior to solution for the current temperature. However, a linear extrapolation procedure is used in the program to estimate temperatures at the end of the current step for use in evaluating the material properties. After proceeding with solution of the actual temperatures, a check is made to assure agreement between the extrapolated and actual temperatures within a specified tolerance.

Since the system of equations represented above is a tri-diagonal matrix, simultaneous solution of all temperatures can be simply obtained in the following manner:

$$T_1 = A_1 T_2 + D_1 \quad (A-1-9)$$

where: $A_1 = \frac{-c_1}{b_1}$

$$D_1 = \frac{d_1}{b_1} .$$

Using the above nomenclature, the second equation in (A-1-8) can be solved as

$$T_2 = A_2 T_3 + D_2 \quad (A-1-10)$$

where

$$A_2 = \frac{-c_2}{b_2 + a_2 A_1}$$

$$D_2 = \frac{d_2 - a_2 D_1}{b_2 + a_2 A_1} .$$

From repetition of this procedure, it is quickly noted that a general recursion relation can be developed as follows:

$$T_n = A_n T_{n+1} + D_n \quad (A-1-11)$$

where

$$A_n = \frac{-c_n}{b_n + a_n A_{n-1}}$$

$$D_n = \frac{d_n - a_n D_{n-1}}{b_n + a_n A_{n-1}} .$$

As a special case, the coolant temperature can be obtained by combining the final equation from (A-1-8) with equation (A-1-11) for the case of $n = N-1$, with the following result:

$$T_N = \frac{d_N - a_N D_{N-1}}{b_N + a_N A_{N-1}} . \quad (A-1-12)$$

Having now determined all the A_n and D_n values and the downstream coolant temperature T_N , all the remaining radial pin temperatures can be determined by cycling backwards through the recursion relationship, equation (A-1-11). Note that this implicit solution scheme assures a temperature solution free from nodal geometry or time step constraints.

C. Procedure Used in CORTEM Subroutine

To rephrase the previous equations into the form actually utilized in the CORTEM subroutine calculational procedure, we proceed as follows:

From equation (A-1-9),

$$A_1 = \frac{{}_1U_B^{\text{New}}}{\text{HCAPDT}_1 + {}_1U_s^{\text{New}} + {}_1U_B^{\text{New}}} \quad (\text{A-1-13})$$

$$D_1 = \frac{\text{DSAVE}_1 + (\text{PN}^{\text{New}})(\text{POW}_1) + (\text{HCAPDT}_1)(T_1^{\text{Old}})}{\text{HCAPDT}_1 + {}_1U_s^{\text{New}} + {}_1U_B^{\text{New}}} \quad (\text{A-1-14})$$

where

$$\text{DSAVE}_1 \equiv (\text{PN}^{\text{Old}})(\text{POW}_1) - ({}_1U_s^{\text{Old}})(T_1^{\text{Old}}) - {}_1U_B^{\text{Old}}(T_1^{\text{Old}} - T_2^{\text{Old}}) \quad (\text{A-1-15})$$

New = k+1

Old = k

Subscript 1 denotes quantities associated with the inner fuel node.

From equation (A-1-10),

$$A_2 = \frac{{}_2U_B^{\text{New}}}{\text{HCAPDT}_2 + {}_2U_B^{\text{New}} + {}_2U_s^{\text{New}}(1-A_1)} \quad (\text{A-1-16})$$

$$D_2 = \frac{\text{DSAVE}_2 + (\text{PN}^{\text{New}})(\text{POW}_2) + (\text{HCAPDT}_2)(T_2^{\text{Old}}) + ({}_2U_s^{\text{New}})(D_1)}{\text{HCAPDT}_2 + {}_2U_B^{\text{New}} + {}_2U_s^{\text{New}}(1-A_1)} \quad (\text{A-1-17})$$

where

$$DSAVE_2 \equiv (PN^{Old})(POW_2) + {}_2U_s^{Old}(T_1^{Old} - T_2^{Old}) - {}_2U_B^{Old}(T_2^{Old} - T_3^{Old}). \quad (A-1-18)$$

Using the recursion relation (A-1-11), it follows that

$$A_n = \frac{{}_nU_B^{New}}{HCAPDT_n + {}_nU_B^{New} + {}_nU_s^{New}(1-A_{n-1})} \quad (A-1-19)$$

$$D_n = \frac{DSAVE_n + (PN^{New})(POW_n) + (HCAPDT_n)(T_n^{Old}) + ({}_nU_s^{New})(D_{n-1})}{HCAPDT_n + {}_nU_B^{New} + {}_nU_s^{New}(1-A_{n-1})} \quad (A-1-20)$$

where

$$DSAVE_n \equiv (PN^{Old})(POW_n) + {}_nU_s^{Old}(T_{n-1}^{Old} - T_n^{Old}) - {}_nU_B^{Old}(T_n^{Old} - T_{n+1}^{Old}). \quad (A-1-21)$$

For the cladding node:

$$A_{N-1} = \frac{({}_{N-1}U_B^{New})(f_D)}{HCAPDT_{N-1} + {}_{N-1}U_B^{New} + {}_{N-1}U_s^{New}(1 - A_{N-2})} \quad (A-1-22)$$

$$D_{N-1} = \frac{DSAVE_{N-1} + (PN^{New})(POW_{N-1}) + (HCAPDT_{N-1})(T_{N-1}^{Old}) + ({}_{N-1}U_N^{New})(f_u)(T_{N,Up}^{New}) + ({}_{N-1}U_s^{New})(D_{N-2})}{HCAPDT_{N-1} + {}_{N-1}U_B^{New} + {}_{N-1}U_s^{New}(1 - A_{N-2})} \quad (A-1-23)$$

where

$$DSAVE_{N-1} \equiv (PN^{Old})(POW_{N-1}) + {}_{N-1}U_s^{Old}(T_{N-2}^{Old} - T_{N-1}^{Old}) - {}_{N-1}U_B^{Old}[T_{N-1}^{Old} - (f_u)(T_{N,Up}^{Old}) - (f_D)(T_{N,DOWN}^{Old})]. \quad (A-1-24)$$

For the coolant node:

$$\begin{aligned}
 T_{N,DOWN} = & \left[(HCAPDT_N) \left\{ (f_u)(T_{N,Up}^{Old}) + (f_D)(T_{N,DOWN}^{Old}) - (f_u)(T_{N,Up}^{New}) \right\} \right. \\
 & + (PN^{New})(POW_N) + (PN^{Old})(POW_N) - (N_s^{New})(f_u)(T_{N,Up}^{New}) \\
 & + N_s^{Old} \left\{ T_{N-1}^{Old} - (f_u)(T_{N,Up}^{Old}) - (f_D)(T_{N,DOWN}^{Old}) \right\} \\
 & \left. + (N_B^{New})(T_{N,Up}^{New}) - N_B^{Old} \left\{ T_{N,DOWN}^{Old} - T_{N,Up}^{Old} \right\} + N_s^{New} D_{N-1} \right] \\
 & \frac{(HCAPDT_N)(f_D) + N_B^{New} + (N_s^{New})(f_D - A_{N-1})}{(A-1-25)}
 \end{aligned}$$

For fuel nodes, the small and large thermal admittance term, U_s and U_B , are defined below equation (A-1-1). In order to complete this appendix, some special cases should also be defined:

Outer fuel node to gap (N-3→N-2):

If gas is in the gap,

$$N-3 U_B = N-2 U_s = \frac{1}{\frac{RLOG_{N-3}}{\kappa_{N-3}^+} + \frac{0.5}{(R_{N-2})(KNA_g)}}, \quad (A-1-26)$$

If dense material is in the gap,

$$N-3 U_B = N-2 U_s = \frac{1}{\frac{RLOG_{N-3}}{\kappa_{N-3}^+} + \frac{RLOG_{N-2}}{KNA_b}}, \quad (A-1-27)$$

where: κ_{N-3}^+ = thermal conductivity in the outer half of the outer fuel node, N-3

KNA_g = KNA (gap coefficient)

$KNA_b = KNA$ (thermal conductivity of bond material) .

Gap to cladding (N-2 to N-1):

If gas is in the gap,

$$N-2 U_B = N-1 U_s = \frac{1}{\frac{0.5}{(R_{N-2})(KNA_2)} + \frac{RLOG_N}{\kappa_{N-1}}} , \quad (A-1-28)$$

If dense material is in the gap,

$$N-2 U_B = N-1 U_s = \frac{1}{\frac{RLOG_{N-1}}{KNA_b} + \frac{RLOG_N}{\kappa_{N-1}}} . \quad (A-1-29)$$

Cladding to coolant (N-1 to N):

$$N-1 U_B = N U_s = \frac{1}{\frac{RLOG_{N+1}}{\kappa_{N-1}} + \frac{1}{(R_N)(HTCOE)}} \quad (A-1-30)$$

where HTCOE = film coefficient.

Coolant (N):

$$N U_B = \frac{1}{2\pi L} (WC_p) \quad (A-1-31)$$

where: L = axial segment length

W = mass flow rate of coolant

C_p = specific heat of coolant.

APPENDIX A-2

NUMERICAL TECHNIQUE EMPLOYED IN THE NEUTRONICS CALCULATIONS

APPENDIX A-2

NUMERICAL TECHNIQUE EMPLOYED IN THE NEUTRONICS CALCULATIONS

A. General Formulation

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

$$\frac{dP}{dt} = \frac{\rho^* - \beta}{\Lambda} P + \sum_i^G \lambda^i C^i, \quad (A-2-1)$$

and

$$\frac{dC^i}{dt} = \frac{\beta^i}{\Lambda} P - \lambda^i C^i, \quad (A-2-2)$$

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 = Prompt neutron generation time (sec)
 G = Number of precursor groups.

The method of solution utilizes a variable time step march-out algorithm developed by Little^(A-2-1,A-2-2). 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.

(A-2-1) K.F. Hansen, B.V. Koen, and W.W. Little Jr., Nucl. Sci. and Eng., 22, pp. 51-59 (May 1965).

(A-2-2) W.W. Little, Jr., K-III - A Three Region Kinetics Code in FORTRAN-IV, BNWL-252, Battelle Northwest Laboratory, June 1966.

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.,

$$\omega_j = \frac{\rho_j^* - \beta}{\Lambda} + \frac{1}{P_j} \sum_1^G \lambda_j^i C_j^i \quad (\text{A-2-3})$$

$$\gamma_j^i = \frac{\beta^i P_j}{\Lambda C_j^i} - \lambda_j^i \quad (\text{A-2-4})$$

Now, if $-\omega P(t)$ and $-\gamma_j^i C_j^i(t)$ are respectively subtracted from both sides of Equations A-2-1 and A-2-2, integration from t_j to t_{j+1} yields

$$P_{j+1} = e^{\omega_j h} \left[P_j + \int_0^h d\xi \left\{ \frac{\rho_j^*(\xi) - \rho_j^*}{\Lambda} P(\xi) e^{-\omega_j \xi} + \sum_1^G \lambda_j^i \left(C_j^i(\xi) - C_j^i \frac{P(\xi)}{P_j} \right) e^{-\omega_j \xi} \right\} \right] \quad (\text{A-2-5})$$

and

$$C_{j+1}^i = e^{\gamma_j^i h} \left[C_j^i + \int_0^h d\xi e^{-\gamma_j^i \xi} \left\{ \frac{\beta^i}{\Lambda} \left(P(\xi) - \frac{P_j}{C_j^i} C_j^i(\xi) \right) \right\} \right] \quad (\text{A-2-6})$$

where: h = mesh spacing

j = time index.

To evaluate the integrals in Equations A-2-5 and A-2-6, the first approximations

$$P(\xi) = e^{\omega_j \xi} P_j \quad (\text{A-2-7})$$

and

$$C^i(\xi) = e^{\gamma_j^i \xi} P_j \quad (\text{A-2-8})$$

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

$$P_{j+1} = e^{\omega_j h} \left[P_j \left(1 + \frac{h}{2\Lambda} \left\{ \rho_{j+1}^* - \rho_j^* \right\} \right) + \sum_1^G \lambda^i C_j^i \cdot \left\{ \frac{e^{h(\gamma_j^i - \omega_j)} - 1}{\gamma_j^i - \omega_j} - h \right\} \right] \quad (\text{A-2-9})$$

$$C_{j+1}^i = e^{\gamma_j^i h} \left[C_j^i + \frac{P_j \beta^i}{\Lambda} \left\{ \frac{e^{h(\omega_j - \gamma_j^i)} - 1}{\omega_j - \gamma_j^i} - h \right\} \right] . \quad (\text{A-2-10})$$

The variable time step, h , is determined by the requirement that the first approximation for P_{j+1} , Equation A-2-7, agree with the second approximation, Equation A-2-9, within a prescribed tolerance. That is,

$$\frac{P_{j+1}^{(2)} - P_{j+1}^{(1)}}{P_{j+1}^{(1)}} \leq \epsilon, \quad (\text{A-2-11})$$

where epsilon is an input parameter.

In order to evaluate the new power P_{j+1} in expression A-2-9, the reactivity ρ_{j+1}^* at the end of the new time step must be known. But it cannot be computed until the new power is available since it depends upon new temperatures. Hence, an extrapolation procedure is used to obtain a guess for ρ_{j+1}^* and after Equation A-2-11 is satisfied, the new temperatures and resulting feedback are computed. At the completion of a time step, the power is recomputed, and if it differs from the original calculation by more than a preset value, the entire time step computation is recycled.

It is worth noting that the convergence criterion of Equation A-2-11 does not restrict the fractional power increase which can occur during a time step. When the reactivity is high and changing slowly, the power is nearly exponential in shape and very large time steps are possible. No geometric constraints are attached to the magnitude of the time step because an implicit scheme is used for the temperature calculations. For low values of net reactivity, however, the power varies slowly and the method, as outlined above, requires very small time steps for convergence. To offset this difficulty, a zero neutron lifetime method, as outlined below, was developed to perform the neutronics calculations for relatively slow portions of the transient.

B. Zero Neutron Lifetime Approximation

For reactivities less than about 90¢, a useful approximation to Equation A-2-1 and A-2-2 is

$$P = \frac{\sum_{i=1}^G \lambda_i \bar{C}_i}{\beta - \rho^*} \quad (\text{A-2-12})$$

and

$$\bar{C}_i = \beta_i P - \lambda_i \bar{C}_i \quad (\text{A-2-13})$$

where here $\bar{C}_i = \Lambda C_i$.

The important gain in using this formulation is that the very short lifetime is removed from the equation and the time step is governed by the slowly changing precursor densities. Working through by analogy to Equations A-2-3 ff, the final march-out algorithm becomes, in this case,

$$\bar{C}_{j+1}^i = e^{\gamma_j^i h} \left[\bar{C}_j^i + \frac{\beta_j^i h}{2} \left\{ \frac{\sum_m \lambda_m \bar{C}_j^m e^{(\gamma_j^m - \gamma_j^i)h}}{\beta - \rho_{j+1}^*} - P_j \right\} \right] \quad (\text{A-2-14})$$

and a similar convergence criterion is used.

For convenience, a "mixed mode" option is available in the code which allows the zero neutron lifetime method to be used so long as the net reactivity is below a specified value and so long as the precursors are within a specified fraction from equilibrium with the power density. This option has been particularly useful for loss of flow transients and for certain power transients when the net reactivity is held relatively low during certain portions of the transient.

APPENDIX A-3

NUMERICAL TECHNIQUE EMPLOYED IN THE COOLANT EXPULSION CALCULATIONS

APPENDIX A-3

NUMERICAL TECHNIQUE EMPLOYED IN THE COOLANT EXPULSION CALCULATIONS

A. General Formulation

The equation for coolant motion, repeated here for convenience, is:

$$\dot{W} = \frac{1}{\int_{z_1}^{z_2} \frac{dz}{A}} \left\{ (P_1 - P_2) - \frac{m^2}{2\rho} \left[\int_{z_1}^{z_2} d\left(\frac{1}{A^2}\right) + \int_{z_1}^{z_2} \frac{f}{D_h A^2} dz \right] + \rho g(z_2 - z_1) \right\}. \quad (A-3-1)$$

This equation is applied to the upper and lower slugs at each time step to determine the changes in motion.

The pressures, P_2 , at the slug extremities are assumed to remain constant during the expulsion process and are the same for all the channels. The driving pressure P_1 , depends on which of the three models for coolant expulsion is specified.

1. Sodium Boiling

After initiation of boiling, the driving pressure for coolant expulsion is obtained by using the cladding temperature at the point of boiling initiation to calculate a pressure according to the sodium vapor pressure equation of Stone, et al.^(A-3-1):

$$P_1 = \frac{6.8817602 \times 10^6}{.61344} e^{(-22981.96/T_{clad})} \quad (A-3-2)$$

(A-3-1) J. P. Stone, et al., High Temperature Properties of Sodium, NRL Report, 6241 (September 24, 1965).

where T_{clad} is in degrees Rankine. Superheat is approximated by specifying a desired temperature increment beyond the saturation temperature and suppressing boiling until that temperature is attained. The rate of rise of T_{clad} , and therefore P_1 , can be controlled within certain limits by specification of an effective film coefficient after boiling initiation. However, the coolant flow rate and temperature in contact with the cladding after boiling initiation are fictitious.

2. Fission Gas Release and Expansion

The initial volume of gas V_0 is determined by the product of the specified length of fission gas plenum and the cross-sectional area based on the inner cladding radius. The rate of pressure decrease is determined by the ideal-gas-law relationship:

$$P_1 = \frac{P_0 V_0^\gamma}{V_1^\gamma}, \quad (\text{A-3-3})$$

where P_0 is the specified fission gas plenum pressure. For $\gamma = C_p/C_v$, the expansion is adiabatic; for $\gamma = 1$, the expansion is isothermal. The volume V_1 is determined by:

$$V_1 = V_0 + A_{\text{flow}} (Z_{1,\text{upper}} - Z_{2,\text{lower}}). \quad (\text{A-3-4})$$

3. Sodium-Fuel Interaction

The initial volume for expansion V_0 is assumed to be one axial layer of the R-Z core simulation. The rate of pressure decrease is determined by the isothermal expansion relationship for an ideal gas:

$$P_1 = \frac{P_o V_o}{V_1} , \quad (A-3-5)$$

where P_o is the specified initial pressure and V_1 is determined from Equation (A-3-4).

B. Geometry and Parameters

The coolant expulsion calculations are carried out only within the fuel bundle and therefore the distance of the core from the ends of fuel bundle must be specified. The flow characteristics within the fuel bundle are determined by the friction factor relationship:

$$F = \frac{f_1}{\left(\frac{D_h W}{A_{flow} \mu} \right)^{f_2}} \quad (A-3-6)$$

where: D_h = hydraulic diameter
 μ = absolute coolant viscosity
 W = mass flow rate
 A_{flow} = coolant flow average
 f_1 = constant
 f_2 = constant (exponent for Reynolds number)

For smooth surfaces, $f_1 = 0.184$ and $f_2 = 0.20$; however, f_1 and f_2 can be determined from experimental data.

The flow characteristics beyond the fuel bundle are specified by parameters associated with Equation (A-3-1). For example, the inertia term is divided into two parts:

$$\int_{z_1}^{z_2} \frac{dz}{A} = \frac{(z_{fuel\ bundle} - z)}{A_{flow}} + \left[\frac{z}{A} \right]_{fuel\ bundle}^{exit} \quad (A-3-7)$$

where the latter term must be specified as input. Since the flow area is assumed to be constant within the fuel bundle, the momentum loss term applies only outside the fuel bundle and is specified by input in terms of the number of "velocity heads" based on flow within the fuel bundle and includes the sudden change in flow area at the end of the fuel bundle. For the top and bottom slugs, the input parameters are DPTOP1 and DPBOT1, respectively. The frictional losses from the end of the fuel bundle to the exit, ΔP_f , are also specified in terms of the frictional losses within the fuel bundle and the total frictional loss is given by:

$$\frac{m^2}{2\rho} \int_{Z_1}^{Z_2} \frac{f}{D_h A^2} dZ = \frac{m^2}{2\rho D_h A_{flow}^2} f(Z_{fuel\ bundle} - Z) + \Delta P_f . \quad (A-3-8)$$

For the top and bottom slugs, the input parameters for ΔP_f are DPTOP2 and DPBOT2, respectively. The gravitational loss term is absorbed in the specific exit pressure P_2 . At the present time, this pressure is the same for all channels and is constant during the coolant expulsion process.

C. Operation

Voiding can be initiated by four mechanisms:

- When the coolant or cladding temperature at any axial location reaches a specified value,
- When the coolant or cladding temperature at a specified axial location reaches a specified value,
- When fuel pin collapse due to fuel melting begins,
- When a sodium bubble starts passing through the core at the same velocity as normal coolant flow.

The coolant expulsion calculations cover the first three mechanisms, and the last mechanism is handled entirely by input data. Even for the first three mechanisms, the motion of the upper and lower voiding interfaces can be specified by input parameters to a cubic equation.

Two options are available for both loss-of-flow accidents and power excursion accidents. For loss-of-flow accidents, coolant expulsion can be driven by sodium boiling or release and expansion of fission gases. For power excursion accidents, coolant expulsion can be driven by a sodium-fuel interaction or the release and expansion of fission gases.

APPENDIX A-4

MODEL FOR AXIAL FUEL EXPANSION PRIOR TO CLADDING FAILURE

APPENDIX A-4

MODEL FOR AXIAL FUEL EXPANSION PRIOR TO CLADDING FAILURE

In Chapter V-C reference was made to the model used to describe axial fuel expansion prior to cladding failure. Details of that model are included in this section.

Figure A4.1 illustrates the physical model used. The pin is assumed to be rigidly fixed at the core base but free to expand in the vertical direction. Hence, the solid horizontal lines represent the original axial location of the pin nodes and the dashed lines correspond to the expanded locations if a Lagrangian (constant mass) coordinate system was used. Since the program is based on a Eulerian coordinate system, mass is allowed to flow past the original boundaries and the approach, therefore, is to compute the effective densities, as a function of time, of the fuel within the original mesh structure. If fuel expansion is assumed to be the result of increasing fuel temperatures, a volume weighted average fuel temperature is used for each axial segment. If such expansion is assumed to be effected by expanding cladding, the cladding temperature is used.

After increases in the temperature along the fuel pin, in segment j , the mean density ($\bar{\rho}_j$) in that segment becomes

$$\bar{\rho}_j = \rho_{j0} \left[\frac{1 - \sum_{n=1}^{j-1} \alpha \Delta T_n}{1 + \alpha \Delta T_j} + \frac{\sum_{n=1}^{j-1} \alpha \Delta T_n}{1 + \alpha \Delta T_{j-1}} \right] \quad (A-4-1)$$

where: ρ_{j0} = original density of fuel in segment j at reference temperature T_0 ,

ΔT_n = change in mean temperature in segment n

Figure A4.1. Fuel Density Change Due to Axial Expansion of Fuel in One Element

and

α = coefficient of linear axial expansion.

Hence, the density change ($\delta\rho_j$) in segment j is

$$\delta\rho_j = \bar{\rho}_j - \rho_{jo} = \left[\frac{\sum_{n=1}^j \alpha \Delta T_n}{1 + \alpha \Delta T_j} + \frac{\sum_{n=1}^{j-1} \alpha \Delta T_n}{1 + \alpha \Delta T_{j-1}} \right]. \quad (\text{A-4-2})$$

The original mass (M_o) of fuel in the segment is given by

$$M_o = LA\rho_{jo}, \quad (\text{A-4-3})$$

where: L = length of the segment

and A = cross sectional area of the segment.

Hence, the change in the fuel mass (ΔM_j) in segment j is

$$\begin{aligned} \Delta M_j &= M_j - M_o = LA\delta\rho_j \\ &= M_o \left[\frac{\sum_{n=1}^{j-1} \alpha \Delta T_n}{1 + \alpha \Delta T_{j-1}} - \frac{\sum_{n=1}^j \alpha \Delta T_n}{1 + \alpha \Delta T_j} \right]. \end{aligned} \quad (\text{A-4-4})$$

The reactivity feedback (ρ_j^*) from segment j is then

$$\rho_j^* = M_o W_f(j) \left[\frac{\sum_{n=1}^{j-1} \alpha \Delta T_n}{1 + \alpha \Delta T_{j-1}} - \frac{\sum_{n=1}^j \alpha \Delta T_n}{1 + \alpha \Delta T_j} \right], \quad (\text{A-4-5})$$

where

$W_f(j)$ = fuel worth in segment j .

The worth (W_A) of the fuel that has expanded above the original core top is estimated by linear extrapolation as

$$W_A = W_f(J) + \left\{ W_f(J) - W_f(J-1) \right\} \left\{ 1/2 + \frac{\sum_{j=1}^J \alpha \Delta T_j}{2} \right\}, \quad (A-4-6)$$

where J represents the top segment of the fuel.

The mass (M_A) of the fuel expanded above the original core top is

$$M_A = \left(\sum_{j=1}^J \alpha \Delta T_j \right) \left(LA \frac{\rho_{j0}}{1 + \alpha \Delta T_J} \right) = M_O \frac{\sum_{j=1}^J \alpha \Delta T_j}{1 + \alpha \Delta T_J} \quad (A-4-7)$$

Hence, the reactivity feedback (ρ_A^*) due to fuel expansion above the original core top is

$$\rho_A^* = M_O \frac{\sum_{j=1}^J \alpha \Delta T_j}{1 + \alpha \Delta T_J} \left[W_f(J) + \left\{ W_f(J) - W_f(J-1) \right\} \left\{ 1/2 + \frac{\sum_{j=1}^J \alpha \Delta T_j}{2} \right\} \right]. \quad (A-4-8)$$

The total reactivity feedback due to axial expansion, summed over all radial channels, is then computed as follows:

$$\begin{aligned}
\rho_{\text{axial expansion}}^* &= \sum_{i=1}^I \left[\sum_{j=1}^J M_f(i,j) W_f(i,j) \left\{ \frac{\sum_{n=1}^{j-1} \alpha \Delta T(i,n)}{1 + \alpha \Delta T(i,j-1)} - \frac{\sum_{n=1}^j \alpha \Delta T(i,n)}{1 + \alpha \Delta T(i,j)} \right\} \right. \\
&\quad \left. + M_f(i,J) \frac{\sum_{j=1}^J \alpha \Delta T(i,j)}{1 + \alpha \Delta T(i,J)} \left\{ W_f(i,J) + \left[W_f(i,J) - W_f(i,J-1) \right] \left[1/2 + \frac{\sum_{j=1}^J \alpha \Delta T(i,j)}{2} \right] \right\} \right]
\end{aligned}$$

(A-4-9)

where, in summary,

i = core radial channel variable ($i=1,I$)

j = core axial segment variable ($j=1,J$)

α = thermal expansion coefficient (fuel or cladding)

$W_f(i,j)$ = fuel worth at node (i,j) ($\delta\rho^*/\text{unit fuel mass}$)

$M_f(i,j)$ = fuel mass at node (i,j)

$\Delta T(i,j)$ = change in temperature from initial condition
(average nodal fuel or cladding).

APPENDIX B

PROGRAM LOGISTICS

APPENDIX B-1

FLOW DIAGRAM

Figures B1.1 and B1.2 illustrate the calling sequence of all the sub-routines and Figure B1.3 contains a very brief logic diagram. A brief description of the function of each subroutine is given below.

BOX	(Plotting) Draws a box around plot packages.
CHECK	(Finite Lifetime) Evaluates acceptability of completed time step, contains problem termination controls, and establishes small, big, and VENUS outputs.
CHECKO	(Zero Lifetime) Evaluates acceptability of completed time step, contains problem termination controls, and establishes small, big, and VENUS outputs.
COLAPS	Computes reactivity feedback due to gross molten fuel motion.
CORTEM	Computes new core temperatures.
CURVE	Interpolates linearly between point input data.
DOPTM	Computes all reactivity feedback except sodium voiding and molten fuel motion.
DRAW	(Plotting) Controls all plotting routines.
LOGAXS	(Plotting) Computes ordinate for a semilog plot.
MAIN	Overall control routine. Most initialization accomplished here.
MODE	Determines whether to use finite or zero neutron lifetime approximation (operable only when IKINET = 2).
NEWTIM	(Finite Lifetime) Establishes new time step
NEXT	(Finite Lifetime) Updates new and old indices; establishes conditions to begin new time step.
NEXTO	(Zero Lifetime) Updates new and old indices; establishes conditions to begin new time step.

NUMPLO	(Plotting) Determines data to be plotted using a 6 inch abscissa.
OUTBIG	Prints a comprehensive output at intervals controlled by time printout library or after every DELTOT seconds after coolant voiding or molten fuel motion begins. Also writes drum for later retrieval by subroutine WRAPUP or plotting routines.
OUTSML	Prints out a small output every DELSTP time steps.
OUTSTD	Prints out steady state core temperature distributions.
PLOT 1	(Plotting) Plots power on a semilog scale.
PLOT 2	(Plotting) Plots power on a linear scale.
PLOT 3	(Plotting) Plots energy generated and energy removed.
PLOT 4	(Plotting) Plots average fuel temperature.
PLOT 5	(Plotting) Plots temperature and energy contained in molten fuel.
PLOT 6	(Plotting) Plots the fraction of fuel molten.
PLOT 7	(Plotting) Plots the kilograms of molten fuel.
PLOT 8	(Plotting) Plots the reactivity components which govern the transient.
PLOT 9	(Plotting) Plots reactivity after molten fuel motion or coolant voiding begins.
PLOT 10	(Plotting) Plots power after molten fuel motion or coolant voiding begins.
QUAD	Interpolates quadratically between point input data.
REPLAY	Prints out all input data.
RUNGE	Fourth order Runge-Kutta FUNCTION.
SOCOOL	Computes the rate of coolant expulsion from the core, assuming a plug-type model, and determines the location of the liquid-void interfaces.
SUBNEU	Computes new power based on algorithm.

TDRAW1	(Plotting) Plots center node, outer node, cladding and coolant temperatures for the particular channel and axial level specified.
TIME	System routine to read maximum run time on run card and compare it to the input variable MAXTIM.
TIMNEW	(Zero Lifetime) Establishes new time step.
TIMPLO	(Plotting) Determines, for plotting purposes, the time at which molten fuel motion or coolant voiding begins.
TUMPLO	(Plotting) Determines data to be plotted using an 8 inch abscissa.
VOID	Computes a coolant voiding pattern according to a simple piston model and evaluates the reactivity consequences.
WRAPUP	Reads drum and writes information in an ordered chronological fashion.

SYSTEM ROUTINES

AXIS	(Plotting) Plots an annotated axis with tic marks and title.
CPLOT	(Plotting) Controls the formatting of all plotting data and handles all output to the tape. It buffers and controls the output without user intervention.
CPLOTS	(Plotting) Opens the logical output device, defines a buffer area and the size of the buffer area.
CSCALE	(Plotting) Computes factors to scale data from user units to plotter units
DOY	Routine to record the days of year in the format DY:MON:YR
LINE	(Plotting) Scales and plots arrays of data with a choice of line and/or point mode.
NUMBER	(Plotting) Plots computed variables with user control over format.
NTRAN	Routine to buffer input/output in parallel with computing.
SETDR	Routine to allow user to equate specific areas of the drum with any logical unit. This is used as follows: CALL SETDR (L1, L2, L3, L4) where L1 = logical unit L2 = first drum address L3 = length of the drum file L4 = name of the 7 word array to be used for the drum file
SETNL	Routine to allow user to set the length of the image to be used by namelist input routines.
SYMBOL	(Plotting) Plots alphanumeric characters and special symbols.
TOD	Routine to record the time of day in the format HR:MN:SEC.

Figure B1.1. Subroutine Calling Sequence of MELT-II Program

Figure B1.2. Subroutine Calling Sequence for Plotting in MELT-II Program

Figure B1.3. Logic Diagram for the MELT-II Computer Program

APPENDIX B-2

TIME STEP LOGIC

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APPENDIX B-2

TIME STEP LOGIC

The MELT-II program has been designed to allow substantial flexibility in determining the appropriate time step. Basically, the approach is to select time steps commensurate with the accuracy required, i.e., allow large steps over the slow portions of the transient but reduce the step size when temperatures are changing rapidly.

As in any transient calculation of the type performed by this program, it is necessary to calculate a power for the end of the new time step based on some type of feedback extrapolation from previous steps. The actual feedback, of course, cannot be determined until new temperatures and new feedbacks thereby arising can be calculated. In order to insure accuracy, therefore, a final check is made after temperatures and feedback have been calculated, and if the power computed using the actual feedback differs from that using the extrapolated feedback by more than a specified value, the program automatically recycles back and does the time step calculation all over. Figures B2.1 and B2.2 contain a block logic diagram for the finite and zero neutron lifetime modes.

One difficulty of formulating the programs to maximize the size of the time steps is that all failure thresholds for reactivity feedbacks are temperature related, and it is quite possible that such failure points can be "overshot" during a large time step. For some accident situations, this overshoot in time could cause signified errors in simulating the real time-failure incoherencies which actually exist. To prevent this difficulty, the feedback routines contain checks such that if any failure threshold is

Figure B2.1. Time Step Logic Diagram for Finite Neutron Lifetime Calculation

Figure B2.2. Time Step Logic Diagram for Zero Neutron Lifetime Calculation

triggered during a step, a modified time step is calculated and the program iterates until the time step coincides (within a specified range) with the controlling failure time. This logic is also contained in Figures B2.1 and B2.2.

External controls on the time step can be made via the specification of a maximum step size (HMAX), by the BIG printout library, and by the input variable DELTOT which controls the BIG printout (and, therefore, maximum step size) whenever fuel collapse or coolant expulsion is taking place. The BIG printout routine forces time step sizes such that calculations are made at specified points in time. Information is printed out by the OUTBIG routine and it is information gathered at these time intervals that is stored for a subsequent wrapup or plot. Figure B2.3 illustrates the timing of BIG printouts for a particular example.

BIG PRINTOUT CONTROL SCHEME

EXAMPLE FOR $TPLIB(1) = 0., 1.0, 1.0, 2.0$
                    $PLIB(1) = 0.2, 0.2, 0.1, 0.1$
                    $DELTOT = 0.02$

Figure B2.3. Example of Large Printout Sequencing Using BIG Printout Library and DELTOT Controls.

APPENDIX B-3

DRUM STORAGE ALLOCATION

APPENDIX B-3

DRUM STORAGE ALLOCATION

A wrapup feature is included in the MELT-II program to provide the user a convenient chronological summary of the specified quantities of interest. A fast access drum, of approximately 1.2 million word capacity, is used for storing these quantities during the transient. This same storage area is interrogated for plotting purposes.

Seven separate drum areas are specified for the purposes listed in Table B3.I. The current version is set up to store a minimum of 221 time steps of information for all quantities specified in Table B3.I. This can be increased to 300 steps if NUPPER, the number of radial pin nodes, is 10 or less. Figures B3.1 to B3.7 contain pictorial representations of how the data is actually stored in each of the drum areas. These figures, along with Table B3.I, should provide useful guidance to the user who has less drum or disc area readily available. Most problems can be adequately summarized in far less than 300 printout steps.

The drum is written in the MAIN program and in subroutine OUTBIG. The drum is read in subroutine WRAPUP.

Table B3.I

Drum Storage Allocations

<u>Drum #</u>	<u>Contents</u>	<u>Drum Length (Words)</u>	<u>Minimum Number of Time Steps Stored</u>	<u>Maximum Number of Time Steps Stored</u>
23	Global Core Parameters	3600	300	300
24	Reactivity Components	3900	300	300
25	Core Temperatures	840,000	221	$4200 / (NUPPER + 4)$
26	Coolant Velocities	4200	300	$4200 / (LUPPER + 4)$
27	Coolant Inlet & Outlet Temperatures	4500	300	$4500 / (LUPPER + 5)$
28	Fuel Collapse Pattern	61,000	300	$\frac{61500}{(MUPPER * LUPPER) + 5}$
29	Coolant Voiding Pattern	7500	300	$\frac{7500}{(2 * LUPPER) + 5}$

Figure B3.1. DRUM 23 - Global Core Parameters

Figure B3.2. DRUM 24 - Reactivity Components

Figure B3.3. DRUM 25 - Core Temperatures

Figure B3.4. DRUM 26 - Coolant Velocities

Figure B3.5. DRUM 27 - Coolant Inlet and Outlet Temperatures

Figure B3.6. DRUM 28 - Fuel Collapse Pattern

Figure B3.7. DRUM 29 - Coolant Voiding Pattern

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APPENDIX B-4

TAPE USAGE FOR DRUM CONTENT STORAGE, RESTART, OR PLOTTING

APPENDIX B-4

TAPE USAGE FOR DRUM CONTENT STORAGE, RESTART, OR PLOTTING

Three options are available in the MELT-II program to allow the user to permanently store information on tape. The first option permits storage of drum data for later wrapup or plotting purposes, the second option permits the computer core to be dumped on tape at specified intervals for later program RESTART use, and the third option permits storage of plotting information.

As indicated in Table B3.I, the largest block of drum area is required for temperature storage. This is primarily because all temperatures calculated during the specified times are stored. The user may choose to print out only those temperatures of immediate interest and store the drum quantities on tape for later retrieval of more detailed printed or plotting information. This may be accomplished by specifying $IWRAP \geq 2$ and mounting Tape C. This tape will then be written in subroutine WRAPUP. An auxiliary program, entitled MPLOT, has been written to retrieve this data from tape and is available upon request.

Since the program is often used to perform parametric calculations after the start of fuel collapse or coolant voiding, a RESTART option is contained to allow such calculations to be optimally performed. By specifying $IDUMP = 1$ and mounting Tape B, the computer core contents will be dumped to Tape B at every BIG printout (such times as illustrated in Figure B2.3) up to the start of fuel collapse or coolant voiding. Actual tape writing is accomplished in subroutines CHECK or CHECKO (the tape is also written in MAIN if the program is in an error mode). By mounting Tape B for a later run and specifying the word "RESTART", starting in column 1 of the title card, the

MAIN routine will read Tape B, accept new parametric data for the fuel motion or voiding routines, and continue the calculation from that point. Tape D may be mounted for plotting purposes.

APPENDIX C

PROGRAM USE

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APPENDIX C-1

LIST OF VARIABLES

The following pages contain an alphabetical listing of the prime variables used in the program. Both external (data input) and internal (program) variables are included in the listing to aid the interested reader in following the FORTRAN logic.

Data input variables are listed according to subject categories in Appendix C-2.

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C      * * * * * DESCRIPTION OF VARIABLES * * * * *
C
C      * * NOMENCLATURE * *
C
C      COLUMN 1      C      (FOR COMMENT CARD)
C
C      COLUMN 3      I = INTEGER
C                      L = LOGICAL
C                      BLANK = REAL
C
C      COLUMN 5      P = INTERNAL PROGRAM VARIABLE
C                      BLANK = INPUT DATA
C
C
C      P A(15)      = LINEAR COEFFICIENT USED IN GAUSSIAN SCHEME TO
C                      COMPUTE TEMPERATURES
C      A1            = CONST TERM IN UPWARD SODIUM EJECTION EQUATION
C                      OF MOTION
C      A2            = LINEAR TERM IN UPWARD SODIUM EJECTION EQUATION
C                      OF MOTION
C      A3            = QUAD TERM IN UPWARD SODIUM EJECTION EQUATION
C                      OF MOTION
C      A4            = CUBIC TERM IN UPWARD SODIUM EJECTION EQUATION
C                      OF MOTION
C      P AEW        = INTERNAL ENERGY OF MOLTEN FUEL WHICH IS JUST
C                      THROUGH FUSION, JOULES/GRAM
C      P AFLOW      = FLOW AREA IN COOLANT CHANNEL, CM**2
C      A HIGH       = CORE HEIGHT, CM
C      P AID        = ASEG*FUELF/VPINFL*1.E-6 , 1/CM
C      AL(6)        = DECAY CONSTANT FOR PRECURSOR GROUP I (I=1,6), 1/SEC
C      ALIFE        = PROMPT NEUTRON GENERATION TIME, SEC
C      P ALPHA(6)   = W - GAM(I), 1/SEC
C      P AN(2)      = NEUTRONIC POWER, MW-SEC
C      ANI          = INITIAL NEUTRONIC POWER, MEGAWATTS
C      ANIC         = CONSTANT HEAT SOURCE, MEGAWATTS
C      P ANSCRM     = POWER LEVEL FOR SCRAM TRIP, MEGAWATTS
C      P ANZ        = POWER CALCULATED USING ALGORITHM WITH ACTUAL
C                      FEEDBACK, MW
C      P AP(2)      = HOLLERITH DATA USED IN PLOTTING ROUTINES
C      P ARHO       = FLOW AREA * COOLANT DENSITY, G/CM
C      ARPLOT(50)   = MACROSCOPIC CORE PLOT CONTROLS (5 ENTRIES PER PLOT)
C                      N + 1 = PLOT NUMBER (1. THROUGH 10.)
C                      N + 2 = XORIGN
C                      N + 3 = XINCR
C                      N + 4 = YORIGN
C                      N + 5 = YINCR
C

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C	P	ASEG	=	HEIGHT OF AXIAL PIN SEGMENT, CM
C	P	ASQRHO	=	AFLOW * ARHO, G-CM
C	I	AX	=	AXIAL NODE EDITED IN SMALL PRINTOUT
C	I	AX1	=	LOWER AXIAL NODE EDITED IN BIG PRINTOUT
C	I	AX2	=	UPPER AXIAL NODE EDITED IN BIG PRINTOUT
C		AXLAUG	=	AXIAL POWER EXTRAP. DISTANCE (IF CHANPF(1)=0.), CM
C		AXPF(20)	=	RELATIVE POWER IN AXIAL SEGMENT M (M=1,20)
C		B(6)	=	RELATIVE FRACTION OF DELAYED NEUTRONS IN GROUP I (I=1,6)
C		B1	=	CONST TERM IN DOWNWARD SODIUM EJECTION EQUATION OF MOTION
C		B2	=	LINEAR TERM IN DOWNWARD SODIUM EJECTION EQUATION OF MOTION
C		B3	=	QUAD TERM IN DOWNWARD SODIUM EJECTION EQUATION OF MOTION
C		B4	=	CUBIC TERM IN DOWNWARD SODIUM EJECTION EQUATION OF MOTION
C	P	BASEC	=	BASE VALUE FOR COOLANT REACTIVITY FEEDBACK, DELTA K
C	P	BASEE	=	BASE VALUE FOR CLADDING REACT. FEEDBACK, DELTA K
C	P	BASEF	=	BASE VALUE FOR FUEL REACTIVITY FEEDBACK, DELTA K
C		BASICT(50)	=	TEMPERATURE LIBRARY FOR FUEL THERMAL CONDUCTIVITY, DEG. K
C		BB	=	TOTAL DELAYED NEUTRON FRACTION
C	P	BB0100	=	100./BB
C	P	BOTTOM	=	2*PI*ASEG
C	P	BOUT	=	TIME INTERVAL FOR NEXT BIG PRINTOUT, SEC
C	P	BP(2)	=	HOLLERITH DATA USED IN PLOTTING ROUTINES
C	P	C(6,2)	=	PRECURSOR DENSITIES
C		CCOE	=	LINEAR REACTIVITY TEMP. COEFF. OF COOLANT, DEL. K/DEG. K
C		CFUSE	=	HEAT OF FUSION OF COOLANT, J/G
C	I	CH1	=	INNER CHANNEL EDITED IN BIG PRINTOUT
C	I	CH2	=	OUTER CHANNEL EDITED IN BIG PRINTOUT
C		CHANPF(10)	=	RELATIVE POWER IN RADIAL CHANNEL L (L=1,10)
C		CHI	=	IF GT-1., VISCOUS TERM IN FUEL E-O-M, 1/SEC
C			=	IF LT-1., PRESSURE FOR MOLTEN FUEL SQUIRTING ROUTINE, DYNES/CM**2
C	P	CLINEK(2)	=	REACTIVITY FEEDBACK DUE TO COOLANT DENSITY CHANGE, DELTA K
C	P	CMELTH	=	CMELTL + 10 DEGREES KELVIN
C		CMELTL	=	MELTING TEMPERATURE OF COOLANT (AND BOND), DEG.K
C		COEEEX	=	LINEAR EXPANSION TEMP. COEFF. OF CLAD, 1/DEG.K
C		COEFFX	=	LINEAR EXPANSION TEMP. COEFF. OF FUEL, 1/DEG.K
C	L	P COFF	=	SWITCH FOR WHETHER FUEL IS MOVING, T/F = NO/YES
C	P	COLAPK(2)	=	REACTIVITY FEEDBACK FROM FUEL MOVEMENT, DELTA K
C		CONDUCT(50)	=	FUEL THERMAL CONDUCTIVITY, J/CM-SEC-K
C	P	COOL(10)	=	RATIO OF CHANNEL/PIN FLOW AREA*PI*ASEG, CM
C		COOLFR	=	VOLUME FRACTION OF COOLANT IN CORE

C P CP300(12) = ENERGY IN FUEL NODE(N) AT 300K, JOULES
 C P CPMH(12) = ENERGY IN FUEL NODE(N) WHEN IT IS JUST THROUGH
 C FUSION, JOULES
 C P CPML(12) = ENERGY IN FUEL NODE(N) AT MELTING TEMPERATURE,
 C JOULES
 C CXC0E1 = CONST. TERM FOR COOLANT AND BOND HEAT CAP. BELOW
 C MELTING POINT, J/G-K
 C CXC0E2 = CONST. TERM FOR COOLANT AND BOND HEAT CAP. ABOVE
 C MELTING POINT, J/G-K
 C CXC0E3 = CONSTANT TERM FOR COOLANT VISCOSITY, G/CM-SEC
 C CYC0E1 = T COEFF. FOR COOLANT AND BOND HEAT CAP. BELOW
 C MELTING POINT
 C CYC0E2 = T COEFF. FOR COOLANT AND BOND HEAT CAP. ABOVE
 C MELTING POINT
 C CYC0E3 = T COEFFICIENT FOR COOLANT VISCOSITY
 C CZC0E1 = T**2 COEFF. FOR COOLANT AND BOND HEAT CAPACITY
 C BELOW MELTING POINT
 C CZC0E2 = T**2 COEFF. FOR COOLANT AND BOND HEAT CAPACITY
 C ABOVE MELTING POINT
 C CZC0E3 = T**2 COEFFICIENT FOR COOLANT VISCOSITY
 C P D(15) = CONSTANT TERM USED IN GAUSSIAN SCHEME TO COMPUTE
 C TEMPERATURES
 C I DELSTP = NUMBER OF TIME STEPS BETWEEN SHORT PRINTOUTS
 C DELTOT = PRINTOUT INTERVAL AFTER START OF COLLAPSE OR VOID,
 C SEC
 C DENCOL(10) = TEMPERATURE DEPENDANT COOLANT DENSITY, G/CC
 C P DENMUL = ASEG*.001*COOLFR
 C DENSE = DENSITY OF FUEL, G/CC
 C DENSEB = DENSITY OF BOND, G/CC
 C DENSEC = DENSITY OF COOLANT, G/CC
 C DENSEE = DENSITY OF CLADDING, G/CC
 C DENVOD = VOID FRACTION OF SODIUM BUBBLE
 C DE0 = HYDRAULIC DIAMETER, CM
 C P DIVIDE(15) = ENERGY/PI*LENGTH*TEMP FOR MATERIAL JUST THROUGH
 C FUSION, J/CM-K
 C DKIN(50) = REACTIVITY INPUT LIBRARY, DEL. K
 C DKOUT(50) = REACTIVITY SCRAM LIBRARY, DEL. K
 C DOPCOE = DOPPLER COEFFICIENT, TDK/DT
 C P DOPPK(2) = REACTIVITY FEEDBACK FROM DOPPLER BROADENING, DEL. K
 C DOPPW(20,10) = DOPPLER WEIGHTING FACTORS (AXIAL,CHANNEL)
 C P DOPSAV(20,10) = DOPPLER FEEDBACK (AXIAL,CHAN) AT TIME LOCAL VOIDING
 C OCCURS, DELTA K
 C P DOPSUB(20,10) = AVE. FUEL TEMP. BASE (AXIAL,CHAN) FOR SPATIAL
 C DOPPLER FEEDBACK, DEG. K
 C P DOPVD = EFFECTIVE DOPPLER COEFFICIENT DUE TO SPECTRAL
 C HARDENING
 C DPBOT1 = EQUIVALENT NUMBER OF VELOCITY HEADS FOR MOMENTUM
 C LOSSES BELOW CORE, CM

C DPBOT2 = EQUIVALENT LENGTH OF FUEL BUNDLE FOR FRICTION
 C LOSSES BELOW FUEL BUNDLE, CM
 C DPTOP1 = EQUIVALENT NUMBER OF VELOCITY HEADS FOR MOMENTUM
 C LOSSES ABOVE CORE, CM
 C DPTOP2 = EQUIVALENT LENGTH OF FUEL BUNDLE FOR FRICTION
 C LOSSES ABOVE FUEL BUNDLE, CM
 C P DSAVE(15,20,10,2) = SUMMATION OF OLD VALUES IN HEAT TRANSFER
 C EQUATIONS
 C DSEP(10) = DISTANCE BETWEEN TOP AND BOTTOM OF SODIUM BUBBLE,
 C CM
 C I P DUMP = EQUAL TO IDUMP
 C DZABOT = SUM OF LENGTH/AREA FROM BOTTOM OF FUEL BUNDLE TO
 C CHANNEL INLET, 1/CM
 C DZATOP = SUM OF LENGTH/AREA FROM TOP OF FUEL BUNDLE TO
 C CHANNEL OUTLET, 1/CM
 C ECOE = LINEAR REACTIVITY TEMP. COEFF. OF CLADDING,
 C DEL.K/DEG.K
 C EFUSE = HEAT OF FUSION OF CLADDING, J/G
 C P ELINEK(2) = REACTIVITY FEEDBACK DUE TO AXIAL CLADDING EXPANSION
 C , DELTA K
 C P EMELTH = EMELTL + 10 DEGREES KELVIN
 C EMELTL = MELTING TEMPERATURE OF CLADDING, DEG. K
 C ENDPOW = OVERPOWER FACTOR FOR SCRAM TRIP
 C P ENERMO = ENERGY REQUIRED TO ELEVATE ONE AXIAL LEVEL OF FUEL
 C FROM 300K THROUGH MELTING, JOULES
 C P ENERST = ENERGY REQUIRED TO ELEVATE ONE AXIAL LEVEL OF FUEL
 C FROM 300K TO MELTING, JOULES
 C ERROR = ERROR CRITERION FOR ORIGINAL POWER MATCH
 C ERROR1 = ERROR CRITERION FOR OUTER LOOP POWER MATCH
 C ERROR2 = FRACT. ERROR IN POWER WHEN SWITCHING LIFETIME MODES
 C EXCOE1 = CONST. TERM FOR CLADDING HEAT CAPACITY BELOW
 C MELTING POINT, J/G-K
 C EXCOE2 = CONST. TERM FOR CLADDING HEAT CAPACITY ABOVE
 C MELTING POINT, J/G-K
 C P EXPO(6) = EXPONENTIALS USED IN ZERO LIFETIME APPROXIMATION
 C EYCOE1 = T COEFF. FOR CLADDING HEAT CAPACITY BELOW MELT. PT.
 C EYCOE2 = T COEFF. FOR CLADDING HEAT CAPACITY ABOVE MELT. PT.
 C EZCOE1 = T**2 COEFF. FOR CLADDING HEAT CAPACITY BELOW
 C MELTING POINT
 C EZCOE2 = T**2 COEFF. FOR CLADDING HEAT CAPACITY ABOVE
 C MELTING POINT
 C FCOE = LINEAR REACTIVITY TEMP. COEFF. OF FUEL, DEL.K/DEG.K
 C FDOP = VALUE BY WHICH DOPPLER COEFF. IS MULTIPLIED UPON
 C VOIDING
 C P FLINEK(2) = REACTIVITY FEEDBACK DUE TO AXIAL FUEL EXPANSION,
 C DELTA K
 C FLOW(50,10) = COOLANT FLOW LIBRARY (TIME,CHANNEL), G/SEC
 C P FLOW2(10,2) = FLOW OF DOWNWARD COOLANT SLUG

C I	FR1	= INNER FUEL NODE EDITED IN BIG PRINTOUT
C I	FR2	= OUTER FUEL NODE EDITED IN 3IG PRINTOUT
C	FRACTB	= FRACTION OF POWER DEPOSITED IN BOND
C	FRACTC	= FRACTION OF POWER DEPOSITED IN CLADDING
C	FRACTD	= COOLANT NODE PLACEMENT (FRACT. DISTANCE FROM INLET)
C	FRACTF	= FRACTION OF POWER DEPOSITED IN FUEL
C	FRACTS	= FRACTION OF POWER DEPOSITED IN COOLANT
C	FRICT1	= NUMERATOR IN FRICTION CORRELATION FOR FUEL BUNDLE
C	FRICT2	= REYNOLDS NUMBER EXPONENT IN FRICTION CORRELATION FOR FUEL BUNDLE
C	P FRICT3	= HYDRAULIC DIAMETER/(FLOW AREA * VISCOSITY), SEC/G
C	FUELF	= VOLUME FRACTION OF FUEL IN CORE
C	P FUELT	= CORE AVERAGE FUEL TEMPERATURE
C	P FUSE(15)	= (0.1)(HEAT OF FUSION)(DENSITY)(NODE AREA)/PI, JOULES/CM
C	P GAM(6)	= INSTANTANEOUS PERIOD FOR THE PRECURSOR DENSITIES
C	GAMMA	= RATIO OF SPECIFIC HEATS FOR FISSION GAS (CP/CV)
C	P GMSHOL	= MASS OF MOLTEN FUEL, KG
C L	P GOING	= SWITCH FOR START OF FUEL COLLAPSE, T/F = YES/NO
C	GRAV	= FORCING FUNCTION IN FUEL E-O-M, CM/SEC**2
C	P GROCHI	= GRAV/CHI
C	P GROCH2	= GRAV/CHI**2
C	P H(2)	= TIME STEP (1/2=OLD/NEW), SEC
C	P HAFGRV	= 0.5*GRAV
C	P HCAP(15)	= DENSITY*AREA/PI FOR MATERIAL NODES, G/CM
C	P HCAPDT(15)	= POWER/(PI*LENGTH*TEMPERATURE) FOR MATERIAL NODES, WATTS/CM-K
C	HFUSE	= HEAT OF FUSION OF FUEL, J/G
C	HMAX	= MAXIMUM TIME STEP, SECONDS
C	HTCOE	= FILM COEFFICIENT, J/SEC-CM**2-K
C	P HTRIP	= TIME STEP DETERMINED BY FEEDBACK TRIP POINT
C	HTVOID	= FILM COEFFICIENT AFTER VOIDING, J/SEC-CM**2-K
C I	P ICATCH	= SWITCH FOR PROGRAM RECYCLE ON FEEDBACK TRIP
C I	P ICHAN(10)	= AXIAL LEVEL FOR BEGINNING OF MOLTEN FUEL MOVEMENT
C I	P ICHANX(10)	= SWITCH FOR START OF CHANNEL VOIDING (0/1=NO/YES)
C I	ICOLPS	= COLLAPSE SWITCH, 0/1 = COLLAPSE ALLOWED/NO COLLAPSE
C I	ICOLTG	= OPTION TO STOP AT START OF FUEL COLLAPSE, 0/1 = NO/YES
C I	IDOP	= SWITCH FOR DOPPLER WEIGHTING, 0/1 = AVE. TEMP/LOCAL
C I	IDOPCH	= SWITCH FOR DOPPLER CHANGE, 0/1 = NONE/DROP UPON VOIDING
C	IDUMP	= RESTART OPTION, 0/1=NO/DUMP AT SPECIFIED INTERVALS
C I	IEOSIN	= VENUS EQUATION OF STATE INDEX FOR SODIUM IN
C I	IEOSOT	= VENUS EQUATION OF STATE INDEX FOR SODIUM OUT
C I	P IFIN	= FLAG FOR END OF CORE VOIDING, 0/1=NO/YES
C I	IFLOW	= SWITCH FOR VOIDING DURING LOSS-OF-FLOW ACCIDENTS (0/1 = NO/YES)
C		
C I	IGAS	= SWITCH FOR NA EJECT, 0/1=FUEL-NA INTER/GAS RELEASE

C I P IJKLM	= LENGTH OF STORAGE FOR CORE DUMP
C I IKINET	= KINETICS MODEL USED, 0/1/2/3 = FINITE/ZERO/MIXED/
C	POWER
C I IPLOT	= PLOTTING OPTION, 0/1 = NO/PLOT
C I IPOWER	= SWITCH FOR VOIDING DURING POWER TRANSIENT ACCIDENTS
C	(0/1 = NO/YES)
C I P IRHO	= MIXED MODE KINETICS SWITCH, 0/1 = FINITE / ZERO
C	LIFETIME
C I P ITAB(49)	= DRUM ADDRESS CONTROL
C I ITRIP	= FUEL NODE TO BE MONITORED FOR TRIPFO
C I IVOID	= VOID START, 0/1/2/3=CHECK ALL/PREDET./COLLAP/BUBBLE
C I IVOID0	= OPTION TO STOP AT START OF COOLANT VOIDING,
C	0/1 = NO/YES
C I IVOIDS	= VOIDING SWITCH, 0/1=VOIDING ALLOWED/NO VOIDING
C I IWRAP	= WRAPUP OPTION, 0/1/2/3 = NO/WRAP/WRAP + TAPE/TAPE
C I P IXDOWN(10)	= SWITCH FOR COMPLETION OF DOWNWARD VOIDING (0/1 =
C	NO/YES)
C I P IXUP(10)	= SWITCH FOR COMPLETION OF UPWARD VOIDING(0/1=NO/YES)
C I P IXX(10)	= SWITCH FOR COMPLETION OF VOIDING IN CHANNEL (0/1 =
C	NO/YES)
C I P JRHO	= NUMBER OF TIME STEPS BEFORE SWITCHING TO ZERO
C	LIFETIME KINETICS
C I P JTIMES	= NUMBER OF BIG PRINTOUTS
C L P JUMPC	= COOLANT DENSITY SWITCH, T/F = CONSTANT/VARIABLE
C L P JUMPC1	= SWITCH FOR VARIABLE COOLANT HEAT CAPACITY BELOW
C	MELTING, TRUE/FALSE = CONSTANT/VARIABLE
C L P JUMPC2	= SWITCH FOR VARIABLE COOLANT HEAT CAPACITY ABOVE
C	MELTING, TRUE/FALSE = CONSTANT/VARIABLE
C L P JUMPE1	= SWITCH FOR VARIABLE CLADDING HEAT CAPACITY BELOW
C	MELTING, TRUE/FALSE = CONSTANT/VARIABLE
C L P JUMPE2	= SWITCH FOR VARIABLE CLADDING HEAT CAPACITY ABOVE
C	MELTING, TRUE/FALSE = CONSTANT/VARIABLE
C L P JUMPF1	= SWITCH FOR VARIABLE FUEL HEAT CAPACITY BELOW
C	MELTING, TRUE/FALSE = CONSTANT/VARIABLE
C L P JUMPF2	= SWITCH FOR VARIABLE FUEL HEAT CAPACITY ABOVE
C	MELTING, TRUE/FALSE = CONSTANT/VARIABLE
C KCLAD	= CONDUCTIVITY OF CLADDING, J/CM-SEC-K
C P KINSRT(2)	= EXTERNAL REACTIVITY INSERTED, DELTA K
C KNA	= GAP COEFFICIENT, J/SEC-CM**2-K (IF DENSEB = 0)
C	= CONDUCTIVITY OF BOND, J/CM-SEC-K (IF DENSEB =
C	FINITE)
C I P KPRINT	= NUMBER OF PRINTOUTS OF COOLANT VOIDING PATTERN
C P KWTHDR(2)	= EXTERNAL REACTIVITY WITHDRAWN (SCRAM), DELTA K
C I P LINESL	= LINES PRINTOUT CONTROL FOR SMALL PRINTOUT ROUTINE
C I LISTA(20)	= LIST OF AXIAL SEGMENTS TO BE EDITED BY WRAPUP
C I LISTC(10)	= LIST OF CHANNELS TO BE EDITED BY WRAPUP
C I P LPRINT	= NUMBER OF PRINTOUTS OF FUEL COLLAPSE PATTERN
C I P LUP	= CH2 - CH1 + 1

C I	LUPPER	=	NUMBER OF CORE RADIAL CHANNELS
C I	M	=	NUMBER OF DELAYED NEUTRON GROUPS
C I	MAXTIM	=	RESERVED RUN TIME FOR FINAL WRAPUP AND PLOTS, SEC
C I P	MMM	=	AXIAL NODE FOR START OF COOLANT VOIDING
C	P MOVE(20,10)	=	AXIAL MOVEMENT OF FUEL FROM ORIGINAL LOCATION, CM
C I P	MUP	=	$AX2 - AX1 + 1$
C I	MUPPER	=	NUMBER OF CORE AXIAL NODES
C I	MUX	=	PREDETERMINED AXIAL NODE FOR START OF VOIDING
C I P	MVOID(10)	=	AXIAL LOCATION OF INITIAL VOIDING, CM
C	P NBUFF(100)	=	TEMPORARY STORAGE FOR PLOTTING ROUTINES
C I P	NEW	=	FLAG FOR NEW TIME STEP
C I P	NIT	=	INPUT TAPE
C I	NMELTR(10)	=	LAST MELT-II RADIAL CHANNEL PER VENUS ZONE
C I	NMELTZ(10)	=	LAST MELT-II AXIAL LEVEL PER VENUS ZONE
C I P	NOT	=	OUTPUT TAPE
C I P	NOTALL	=	WRAPUP TAPE
C I P	NOTD	=	CORE DUMP TAPE
C I P	NPLOT(10)	=	PLOT NUMBER
C I	NR(10)	=	NUMBER OF VENUS RADIAL NODES PER MELT-II NODE
C I P	NUP	=	$FR2 - FR1 + 1$
C I P	NUPM1	=	CLADDING NODE
C I P	NUPM2	=	GAP NODE
C I P	NUPM3	=	OUTER FUEL NODE
C I P	NUPM4	=	NEXT TO OUTER FUEL NODE
C I	NUPPER	=	NUMBER OF PIN RADIAL NODES
C I	NVENR	=	NUMBER OF VENUS CORE RADIAL ZONES
C I	NVENZ	=	NUMBER OF VENUS CORE AXIAL ZONES
C I	NZ(20)	=	NUMBER OF VENUS AXIAL NODES PER MELT-II NODE
C I P	OLD	=	FLAG FOR OLD TIME STEP
C	P ORD(300)	=	ORDINATE FOR SEMILOG POWER PLOT
C	P OUT(30)	=	TEMPORARY STORAGE FOR READING DRUM
C I	PAIRS1	=	NUMBER OF ENTRIES IN FUEL CONDUCTIVITY LIBRARY
C I	PAIRS2	=	NUMBER OF ENTRIES IN REACTIVITY INPUT LIBRARY
C I	PAIRS3	=	NUMBER OF ENTRIES IN REACTIVITY SCRAM LIBRARY
C I	PAIRS4	=	NUMBER OF ENTRIES IN INLET COOLANT TEMP. LIBRARY
C I	PAIRS5	=	NUMBER OF ENTRIES IN COOLANT FLOW LIBRARY
C I	PAIRS6	=	NUMBER OF TIME ENTRIES IN BIG PRINTOUT LIBRARY
C I P	PAIRS7	=	MUPPER+1(USED TO ALLOCATE SODIUM VOID WORTH CURVES)
C I	PAIRS8	=	NUMBER OF ENTRIES IN COOLANT DENSITY-TEMP. LIBRARY
C	P PCMELT	=	PER CENT OF FUEL IN CORE MOLTEN
C	PERIOD	=	PERIOD SCRAM TRIP
C	PEXIT	=	PRESSURE AT CHANNEL OUTLET DURING VOIDING, ATM
C	PGAS	=	PRESSURE IN FISSION GAS PLENUM, ATM
C	PINLET	=	PRESSURE AT CHANNEL INLET DURING VOIDING, ATM
C	P PINTEN(20,10)	=	AVERAGE FUEL TEMP. (AXIAL*CHAN), DEG. K
C	PLIB(50)	=	TIME BETWEEN BIG PRINTOUTS IN INTERVAL TPLIB
C	P PN(2)	=	TOTAL POWER (NEUTRONIC + F.P. HEATING), MW

C PNA = INITIAL PRESSURE FOR FUEL-SODIUM INTERACTION, ATM
 C P POW(15,20,10) = FRACTION OF TOTAL POWER GENERATED IN NODE (N,AXIAL,
 C CHAN)/2*PI*ASEG
 C PQUIT = MULTIPLE OF INITIAL POWER TERMINATION POINT
 C P PQUITC = POWER LEVEL FOR PROGRAM TERMINATION, MW
 C P PVD = NUMERATOR FOR ISENTROPIC PRESSURE EXPANSION EQ.
 C P PVOID(10) = DRIVING PRESSURE IN EACH CHANNEL, ATM
 C P QCOOL(10,2) = RATE OF ENERGY REMOVAL BY COOLANT, JOULES/SEC
 C P QGEN(2) = TOTAL ENERGY GENERATED DURING EXCURSION, MW
 C P QMOL = ENERGY CONTAINED IN MOLTEN FUEL, MW-SEC
 C P QOUT(2) = TOTAL ENERGY REMOVED BY COOLANT DURING EXCURSION,
 C MW
 C R(16) = OUTER RADIUS OF PIN NODE N (N=1,16), CM
 C RADAUG = RADIAL POWER EXTRAP. DISTANCE (IF CHANPF(1)=0.), CM
 C RCHAN(10) = OUTER RADIUS OF CHANNEL L (L=1,10), CM
 C REDUCE = FACTOR USED TO INCREASE OR REDUCE TIME STEP
 C I P RESTAR = VARIABLE TO DETERMINE WHETHER CASE IS RESTART
 C RFPD(15) = RELATIVE POWER DEPOSITION IN RADIAL FUEL NODE N (N=
 C 1,12)
 C P RH(2) = NET REACTIVITY, DELTA K
 C P RHO = NET REACTIVITY, DELTA K
 C RHOTEM(10) = TEMPERATURE LIBRARY FOR COOLANT DENSITY
 C RHOSWZ = REACTIVITY SWITCHING LEVEL FOR ZERO LIFE APPROX.,
 C CENTS
 C P RLOG(16) = NATURAL LOG RATIOS OF RADII USED IN HEAT TRANSFER
 C CALCULATIONS
 C P RM(15) = ROOT MEAN SQUARE RADIUS OF PIN MATERIAL NODE USED
 C IN HEAT TRANSFER, CM
 C RMIN = MINIMUM REACTIVITY TERMINATION, DELTA K
 C P RSLOPE = SLOPE OF EXTRAPOLATED REACTIVITY FEEDBACK,
 C DELTA K/SEC
 C L P SCRAM = SWITCH FOR REACTIVITY SCRAM, TRUE/FALSE=YES/NO
 C I P STATUS = FLAG USED IN SYSTEM ROUTINE NTRAN
 C I P STEP = CURRENT TIME STEP
 C I P STEPOT = NEXT TIME AT WHICH SHORT PRINTOUT IS DESIRED
 C P SUBBR(15) = ENERGY/PI*LENGTH*TEMP. FOR MATERIAL AT MELTING
 C POINT, J/CM-K
 C P T(2) = ACTUAL TIME (NEW/OLD = PRESENT TIME/LAST TIME), SEC
 C TA2 = DELAY IN LINEAR TERM IN UPWARD NA EJECT. E-O-M, SEC
 C TA3 = DELAY IN QUAD TERM IN UPWARD NA EJECT. E-O-M, SEC
 C TA4 = DELAY IN CUBIC TERM IN UPWARD NA EJECT. E-O-M, SEC
 C TB2 = DELAY IN LINEAR TERM IN DOWNWARD NA EJECT. E-O-M, SEC
 C TB3 = DELAY IN QUAD TERM IN DOWNWARD NA EJECT. E-O-M, SEC
 C TB4 = DELAY IN CUBIC TERM IN DOWNWARD NA EJECT. E-O-M, SEC
 C P TCCLP(2) = TIME SINCE THE START OF FUEL COLLAPSE, SEC
 C TCQUIT = TIME TO TERMINATION AFTER START OF COLLAPSE, SEC
 C TDELAY = TIME DELAY BETWEEN SCRAM TRIP AND REACT. INSERT.,
 C SEC

C P TOISAS = CURRENT CORE AVE. FUEL TEMP. FOR DISASSEMBLY PRINT.
 C DEG.K
 C TEMAD = CORE AVE. FUEL TEMP. ENDING DISASSEMBLY PRINTS.
 C DEG.K
 C TEMAW = CORE AVE. FUEL TEMP. INDICATING CORE DISASSEMBLY.
 C DEG.K
 C TEMIN(50) = TEMPERATURE LIBRARY FOR INLET COOLANT TEMPERATURES.
 C DEG. K
 C P TEMOL = AVERAGE TEMPERATURE OF MOLTEN FUEL, DEG.K
 C P TEMP(15) = TEMPORARY STORAGE
 C P TEMPER(15,20,10,2) = TEMPERATURE (RADIAL PIN, AXIAL LEVEL, RADIAL
 C CHANNEL, NEW OR OLD), DEG. K
 C TEMSRM = COOLANT OUTLET TEMPERATURE FOR SCRAM TRIP, DEG.K
 C TENTRY(10) = TIME FOR ENTRY OF BUBBLE INTO CHANNEL L, SEC
 C TERROR = TEMP. ERROR ALLOWED IN CONDUCTIVITY INTERPOLATION.
 C DEG. K
 C P TEST1(15) = MELTING TEMPERATURE OF MATERIAL, DEG. K
 C P TEST2(15) = TEMPERATURE OF MATERIAL WHEN JUST THROUGH FUSION.
 C DEG. K
 C P TFOUGT(20,10) = INITIAL FUEL AVERAGE TEMPERATURE AT NODE (AXIAL,
 C CHANNEL), DEG. K
 C TSGUESS = INITIAL TEMPERATURE GUESS, DEG. K
 C THQUIT = HIGH FUEL TEMPERATURE TERMINATION, DEG. K
 C TIMEIN(50) = TIME LIBRARY FOR REACTIVITY INPUT
 C TIMFLO(50) = TIME LIBRARY FOR COOLANT FLOW, SEC
 C TIMIN(50) = TIME LIBRARY FOR INLET COOLANT TEMPERATURES, SEC
 C TIMOUT(50) = TIME LIBRARY FOR REACTIVITY SCRAM
 C P TIN(2) = COOLANT INLET TEMPERATURE (DUMMY VARIABLE), DEG. K
 C TINCRT = DEG. K INCREMENT TO TEMAW FOR MORE DISASSEMBLY
 C PRINTS
 C I P TITLE(14) = RUN TITLE (80 ALPHANUMERIC CHARACTERS)
 C A P TITLEP(40) = PLOT TITLE (40 ALPHANUMERIC CHARACTERS)
 C TLOUIT = LOW FUEL TEMPERATURE TERMINATION, DEG. K
 C TMELT = MELTING TEMPERATURE OF FUEL, DEG. K
 C P TMELTH = TMELT + 10.
 C P TMELTL = TMELT
 C TMQUIT = MAXIMUM TRANSIENT RUN TIME FOR PROBLEM, SECONDS
 C P TNAWGT(21,10) = REACTIVITY CONTRIBUTION OF VOIDING COOLANT SEGMENT.
 C DELTA K/COOLANT SEGMENT
 C P TNOUGT(20,10) = INITIAL CLADDING TEMPERATURE AT NODE (AXIAL,
 C CHANNEL), DEG. K
 C P TOUT = CURRENT TIME FOR NEXT BIG PRINTOUT
 C TPLIB(50) = TIME EXTREMITY FOR BIG PRINTOUT TIME INTERVALS

C TPL0T(400) = TEMPERATURE PLOT CONTROLS (7 ENTRIES PER PLOT)
 C N + 1 = PLOT NUMBER (ONLY 1.0 CURRENTLY AVAILABLE)
 C N + 2 = CHANNEL NUMBER
 C N + 3 = AXIAL SEGMENT NUMBER
 C N + 4 = XORIGN
 C N + 5 = XINCR
 C N + 6 = YORIGN
 C N + 7 = YINCR
 C P TQUIT = TIME TO TERMINATE PROBLEM, SECONDS
 C TRIPC = COOLANT TEMP. AT AT WHICH CLADDING FAILS, DEG. K
 C TRIPC V = CLADDING TEMP. FOR START OF VOIDING
 C TRIPE = CLADDING TEMP. AT WHICH CLADDING FAILS, DEG. K
 C TRIPF = FUEL CENTERLINE TEMP. AT WHICH CLAD FAILS, DEG. K
 C TRIPFO = TEMP. AT WHICH FUEL NODE ITRIP CAUSES CLAD FAILURE,
 C DEG. K
 C TRIPX = COOLANT TEMP. FOR START OF VOIDING (IVOID=0), DEG.K
 C P TSCRAM(2) = TIME REMAINING PRIOR TO SCRAM (NEGATIVE), SEC
 C P TSEG(20,10,2) = TIME SINCE THE START OF FUEL MOVEMENT FOR EACH
 C SEGMENT, SEC
 C P TSEGX(10,2) = TIME SINCE THE START OF COOLANT VOIDING IN EACH
 C CHANNEL, SEC
 C TSQUIT = COOLANT OUTLET TEMPERATURE TERMINATION, DEG. K
 C P TVOID(2) = TIME SINCE THE START OF COOLANT VOIDING, SEC
 C TVQUIT = TIME TO TERMINATION AFTER START OF VOIDING, SECONDS
 C P TWFGT(21,10) = REACTIVITY WORTH OF AXIAL FUEL SEGMENT, DELTA K/
 C FUEL AXIAL SEGMENT
 C P U(15) = HEAT TRANSFER ADMITTANCE, J/SEC-CM**2-K
 C P UVOID = HEAT TRANSFER ADMITTANCE TO COOLANT, J/SEC-CM**2-K
 C P VO = VOLUME OF FISSION GAS PLENUM, CC
 C P VCHAN(10) = AREA OF RADIAL CHANNEL (L=1,10), CM**2
 C P VCOLP(10) = MASS OF FUEL IN CORE SEGMENT, KG
 C P VDOPTL = DENOMINATOR OF DOPPLER FEEDBACK EXPRESSION
 C P VELB(10) = COOLANT VELOCITY IN EACH CHANNEL, CM/SEC
 C I VENUS = VENUS CARD PUNCH SIGNAL, 0/1/2 = NO/OLD/NEW
 C L P VGOING = SWITCH FOR START OF COOLANT VOIDING, T/F = YES/NO
 C L P VOFF = SWITCH FOR WHETHER COOLANT VOIDING IS PROCEEDING,
 C TRUE/FALSE = NO/YES
 C P VOIDK(2) = REACTIVITY FEEDBACK FROM COOLANT VOIDING, DELTA K
 C P VOLUME(15) = AREA/PI OF EACH PIN NODE, CM**2
 C P VPINFL = PIN FUEL AREA/PI, CM**2
 C P VTOTAL = TOTAL CORE VOLUME, CM**3
 C P W = INSTANTANEOUS VALUE OF THE REACTOR PERIOD, 1/SEC
 C WC(20,10) = SODIUM VOID WORTH (AXIAL, CHANNEL), DEL.K/KG
 C WF(20,10) = CORE FUEL WORTH (AXIAL, CHANNEL), DEL.K/KG
 C P X(300) = ABSCISSA IN PLOTTING ROUTINES
 C XCOE1 = CONST. TERM FOR FUEL HEAT CAPACITY BELOW MELT. PT.,
 C J/G-K

C XCOE2 = CONST. TERM FOR FUEL HEAT CAPACITY ABOVE MELT. PT.,
 C J/G-K
 C P XDOWN(10,2) = POSITION OF LOWER VOIDING SLUG IN COOLANT CHANNEL,
 C CM
 C P XINCR(10) = ABSCISSA INCREMENT IN PLOTTING ROUTINES
 C P XORIG(10) = ABSCISSA ORIGIN IN PLOTTING ROUTINES
 C P XUP(10,2) = POSITION OF UPPER VOIDING SLUG IN COOLANT CHANNEL,
 C CM
 C P XXX(300) = ABSCISSA IN PLOTS 9 AND 10
 C P Y(300,20) = ORDINATE IN PLOTTING ROUTINES
 C YCOE1 = T COEFF. FOR FUEL HEAT CAPACITY BELOW MELT. PT.
 C YCOE2 = T COEFF. FOR FUEL HEAT CAPACITY ABOVE MELT. PT.
 C P YINCR(10) = ORDINATE INCREMENT IN PLOTTING ROUTINES
 C P YORIG(10) = ORDINATE ORIGIN IN PLOTTING ROUTINES
 C P YY(800) = ORDINATE IN PLOTS 9 AND 10
 C P Z(21) = REACTOR AXIAL LEVELS FOR SODIUM VOID WORTH, CM
 C ZBOT = START ELEVATION OF NA VOID WORTHS REL. TO CORE
 C BOTTOM, CM
 C ZBOTOM = BOTTOM OF CORE TO BOTTOM OF FUEL BUNDLE, CM
 C ZCOE1 = T**2 COEFF. FOR FUEL HEAT CAPACITY BELOW MELT. PT.
 C ZCOE2 = T**2 COEFF. FOR FUEL HEAT CAPACITY ABOVE MELT. PT.
 C P ZMAX = BOTTOM OF CORE TO TOP OF FUEL BUNDLE, CM
 C P ZMID(20) = MIDPCINT OF AXIAL SEGMENTS, CM
 C P ZMIN = -ZBOTOM
 C ZPLEN = LENGTH OF FISSION GAS PLENUM, CM
 C ZSEG = AXIAL DISTANCE BETWEEN NA VOID WORTH POINTS, CM
 C ZTOP = TOP OF CORE TO TOP OF FUEL BUNDLE, CM

APPENDIX C-2

PROGRAM INPUT

1

2

3

4

APPENDIX C-2

PROGRAM INPUT

The MELT-II program utilizes a NAMELIST free format scheme for handling data input. Data may be read in any order by simply naming the variable and equating it to the value desired. Because of the free order, a variable may be redesignated several times in the data deck but only the last entry is used. This feature is particularly convenient when making parametric runs since the parameter being varied can simply be respecified on a card at the end of the data deck. Also, if it is desired to process several cases in the same run, only those quantities which change from case to case need be specified in the expanded data deck.

The input for MELT-II consists of five different card types:

Card Type 1	80 columns of Hollerith information which will appear as the run title at the top of each page of output
Card Type 2	40 columns of Hollerith information which will appear as a title for all plots
Card Type 3	\$NAM (starting in column 2)
Card Type 4 (Data Cards)	All data is input in the Namelist Format. Start each card in column 2 or greater and place a comma between all entries.
Card Type 5	\$ (column 2)

A typical data deck for processing two cases is outlined as follows:

Column 1 ↓ Column 2	Card Type
OVERPOWER TRANSIENT CASE NUMBER 1, DOPPLER COEFF. = -.005	1
OVERPOWER TRANS. NO. 1, DOPPLER = -.005	2
\$NAM	3
HMAX=0.1,REDUCE=0.8,ICOLTQ=0,IVOIDQ=0,MAXTIM=120,	4 (data)
.	
.	
.	
.	
IDOP=1,IDOPCH=1,FDOP=0.5,DOPCOE=.005,BB=.003,	5
\$	
OVERPOWER TRANSIENT CASE NUMBER 2, DOPPLER COEFF. = -.004	
OVERPOWER TRANS. NO. 2, DOPPLER = -.004	
\$NAM	
DOPCOE = .004,	Case #2
\$	

The only rigid format which must be observed is that the data list must start with \$NAM and end with \$, and in both cases the \$ must appear in column 2. All data may start in any column except column 1. In general, data entries should terminate in column 72, although a special system routine has been used on the UNIVAC 1108 version to allow data entries through column 80. Blanks may be used between data entries, in addition to the commas, if so desired.

Appendix C-1 contained the list of all major program variables in alphabetical order. For purposes of convenience, the data input list is reproduced here according to subject classification. This closely parallels the order of data printout by subroutine REPLAY. An I, preceding the variable, denotes an integer value.

-----CODE OPTIONS AND OUTPUT CONTROLS-----

(I)	VENUS	VENUS CARD PUNCH SIGNAL (0/1/2 = NO PUNCH/OLD VENUS PUNCH/ NEW VENUS PUNCH)--NOTE: USE OPTION 2 FOR INTERFACING WITH VENUS VERSION CURRENTLY COMPATIBLE WITH MELT-II. OPTION 0 SHUTS OFF ALL VENUS TERMINATION CONTROLS.
(I)	NR	NUMBER OF VENUS RADIAL NODES PER MELT-II RADIAL CHANNEL.
(I)	NZ	NUMBER OF VENUS AXIAL NODES PER MELT-II AXIAL NODE.
(I)	NVENR	NUMBER OF VENUS CORE RADIAL ZONES.
(I)	NMELTR	LAST MELT-II RADIAL CHANNEL PER VENUS RADIAL ZONE.
(I)	NVENZ	NUMBER OF VENUS CORE AXIAL ZONES.
(I)	NMELTZ	LAST MELT-II AXIAL LEVEL PER AXIAL VENUS ZONE.
(I)	IEOSIN	VENUS EQUATION OF STATE INDEX FOR SODIUM-IN.
(I)	IEOSOT	VENUS EQUATION OF STATE INDEX FOR SODIUM-OUT.
(I)	IWRAP	WRAPUP OPTION (0/1/2/3 = NONE/WRAPUP ONLY/WRAPUP PLUS TAPE/ TAPE ONLY.
(I)	IPLOT	PLOTTING OPTION (0/1 = NO PLOTTING/PLOT BEFORE STORING WRAPUP ON TAPE).
(I)	IDUMP	RESTART OPTION (0/1 = NO CORE DUMP/CORE DUMP AT SPECIFIED INTERVALS).
(I)	DELSTP	NUMBER OF TIME STEPS BETWEEN SHORT PRINTOUTS.
(I)	AX	AXIAL NODE EDITED IN SMALL PRINTOUT.
(I)	FR1	INNER FUEL NODE EDITED IN BIG PRINTOUT.
(I)	FR2	OUTER FUEL NODE EDITED IN BIG PRINTOUT.
(I)	AX1	LOWER AXIAL NODE EDITED IN BIG PRINTOUT
(I)	AX2	UPPER AXIAL NODE EDITED IN BIG PRINTOUT.
(I)	CH1	INNER CHANNEL EDITED IN BIG PRINTOUT.
(I)	CH2	OUTER CHANNEL EDITED IN BIG PRINTOUT.
(I)	LISTC	LIST OF CHANNELS TO BE EDITED BY WRAPUP.
(I)	LISTA	LIST OF AXIAL SEGMENTS TO BE EDITED BY WRAPUP.
(I)	PAIRS6	NUMBER OF TIME ENTRIES IN BIG PRINTOUT LIBRARY.
	TPLIB	TIME EXTREMITY FOR BIG PRINTOUT TIME INTERVALS.
	PLIB	TIME BETWEEN PRINTOUTS IN INTERVAL TPLIB.

-----TIME, TERMINATION, AND CONVERGENCE CONTROLS-----

	HMAX	MAXIMUM TIME STEP (SECONDS).
	REDUCE	FACTOR USED TO INCREASE OR DECREASE TIME STEP.
(I)	ICOLTQ	OPTION TO TERMINATE AT START OF FUEL COLLAPSE (0/1 = NO/YES).
(I)	IVOIDQ	OPTION TO TERMINATE AT START OF COOLANT VOIDING (0/1 = NO/YES).
(I)	MAXTIM	RESERVED RUN TIME FOR FINAL WRAPUP AND PLOTS (SECONDS).
	TMQUIT	MAXIMUM TRANSIENT RUN TIME FOR PROBLEM (SECONDS).
	TEMAD	CORE AVERAGE FUEL TEMPERATURE ENDING DISASSEMBLY PRINTS (DEGREES KELVIN)
	TEMAW	CORE AVERAGE FUEL TEMPERATURE INDICATING CORE DISASSEMBLY (DEGREES KELVIN).
	TINCRT	DEG. K INCREMENT TO TEMAW FOR MORE DISASSEMBLY PRINTS
	THQUIT	HIGH FUEL TEMPERATURE TERMINATION (DEGREES KELVIN)
	TLQUIT	LOW FUEL TEMPERATURE TERMINATION (DEGREES KELVIN)
	TSQUIT	COOLANT OUTLET TEMPERATURE TERMINATION (DEGREES KELVIN)
	PQUIT	MULTIPLE OF INITIAL POWER TERMINATION POINT
	RMIN	MINIMUM REACTIVITY TERMINATION (DELTA K)
	TCQUIT	TIME TO TERMINATION AFTER START OF COLLAPSE (SECONDS)
	TVQUIT	TIME TO TERMINATION AFTER START OF VOIDING (SECONDS)
	DELTOT	TIME BETWEEN PRINTOUTS AFTER START OF EITHER COLLAPSE OR VOIDING
	ERROR	ERROR CRITERIA FOR ORIGINAL POWER MATCH
	ERROR1	ERROR CRITERIA FOR OUTER LOOP POWER MATCH
	TERROR	TEMPERATURE ERROR ALLOWED IN THERMAL CONDUCTIVITY INTERPOLATION (DEGREES KELVIN)

-----GEOMETRY SPECIFICATIONS-----

(I)	NUPPER	NUMBER OF PIN RADIAL NODES
(I)	MUPPER	NUMBER OF CORE AXIAL NODES
(I)	LUPPER	NUMBER OF CORE RADIAL CHANNELS
	AHIGH	CORE HEIGHT (CM)
	FUELF	VOLUME FRACTION OF FUEL IN CORE
	COOLFR	VOLUME FRACTION OF COOLANT IN CORE

RCHAN(L) OUTER RADIUS OF CHANNEL L (CM)
 R(N) OUTER RADIUS OF RADIAL PIN NODE N (CM)

-----HEAT TRANSFER SPECIFICATIONS-----

KNA GAP COEFFICIENT (J/SEC-CM**2-K) (IF DENSEB = 0)
 CONDUCTIVITY OF BOND (J/SEC-CM-K) (IF DENSEB = FINITE)
 HTC OE FILM COEFFICIENT (J/SEC-CM**2-K)
 HTVOID FILM COEFFICIENT AFTER VOIDING (J/SEC-CM**2-K)
 FRACTD COOLANT NODE PLACEMENT (FRACT. DISTANCE FROM INLET) (SUGGEST
 1.0 IF COOLANT TEMPERATURE RISES RAPIDLY IN ONE TIME STEP)
 T GUESS INITIAL TEMPERATURE GUESS (DEG. K)

-----MATERIAL PROPERTIES-----

KNA THERMAL CONDUCTIVITY OF BOND (J/CM-SEC-K)
 KCLAD THERMAL CONDUCTIVITY OF CLAD (J/CM-SEC-K)
 XCOE1 CONSTANT TERM FOR FUEL HEAT CAPACITY BELOW MELTING POINT
 (J/G-K)
 YCOE1 T COEFFICIENT FOR FUEL HEAT CAPACITY BELOW MELTING POINT
 ZCOE1 T**2 COEFFICIENT FOR FUEL HEAT CAPACITY BELOW MELTING POINT
 XCOE2 CONSTANT TERM FOR FUEL HEAT CAPACITY ABOVE MELTING POINT
 (J/G-K)
 YCOE2 T COEFFICIENT FOR FUEL HEAT CAPACITY ABOVE MELTING POINT
 ZCOE2 T**2 COEFFICIENT FOR FUEL HEAT CAPACITY ABOVE MELTING POINT
 EXCOE1 CONSTANT TERM FOR CLAD HEAT CAPACITY BELOW MELTING POINT
 (J/G-K)
 EYCOE1 T COEFFICIENT FOR CLAD HEAT CAPACITY BELOW MELTING POINT
 EZCOE1 T**2 COEFFICIENT FOR CLAD HEAT CAPACITY BELOW MELTING POINT
 EXCOE2 CONSTANT TERM FOR CLAD HEAT CAPACITY ABOVE MELTING POINT
 (J/G-K)
 EYCOE2 T COEFFICIENT FOR CLAD HEAT CAPACITY ABOVE MELTING POINT
 EZCOE2 T**2 COEFFICIENT FOR CLAD HEAT CAPACITY ABOVE MELTING POINT
 CXCOE1 CONSTANT TERM FOR COOLANT (AND BOND) HEAT CAPACITY BELOW
 MELTING POINT (J/G-K)
 CYCOE1 T COEFFICIENT FOR COOLANT (AND BOND) HEAT CAPACITY BELOW
 MELTING POINT
 CZCOE1 T**2 COEFFICIENT FOR COOLANT (AND BOND) HEAT CAPACITY BELOW
 MELTING POINT

CXCOE2	CONSTANT TERM FOR COOLANT (AND BOND) HEAT CAPACITY ABOVE MELTING POINT (J/G-K)
CYCOE2	T COEFFICIENT FOR COOLANT (AND BOND) HEAT CAPACITY ABOVE MELTING POINT
CZCOE2	T**2 COEFFICIENT FOR COOLANT (AND BOND) HEAT CAPACITY ABOVE MELTING POINT
CXCOE3	CONSTANT TERM FOR COOLANT VISCOSITY (G/CM-SEC)
CYCOE3	T COEFFICIENT FOR COOLANT VISCOSITY
CZCOE3	T**2 COEFFICIENT FOR COOLANT VISCOSITY
DENSE	DENSITY OF FUEL(G/CC)
DENSEB	DENSITY OF BOND (G/CC)
DENSEE	DENSITY OF CLAD (G/CC)
DENSEC	DENSITY OF COOLANT (G/CC)
TMELT	MELTING TEMPERATURE OF FUEL (DEG. K)
EMELTL	MELTING TEMPERATURE OF CLAD (DEG. K)
CMELTL*	MELTING TEMPERATURE OF COOLANT (AND BOND) (DEG. K)
HFUSE	HEAT OF FUSION OF FUEL (J-G)
CFUSE	HEAT OF FUSION OF COOLANT (AND BOND) (J/G)
EFUSE	HEAT OF FUSION OF CLAD (J/G)
(I) PAIRS1	NUMBER OF ENTRIES IN FUEL CONDUCTIVITY LIBRARY
CONDC	FUEL THERMAL CONDUCTIVITY (J/CM-SEC-K)
BASICT	TEMPERATURE LIBRARY FOR FUEL THERMAL CONDUCTIVITY

-----COOLANT FLOW AND TEMPERATURE CONDITIONS-----

(I) PAIRS4	NUMBER OF ENTRIES IN INLET COOLANT TEMPERATURE LIBRARY
TIMIN	TIME LIBRARY FOR INLET COOLANT TEMPERATURE (SEC)
TEMIN	TEMPERATURE LIBRARY FOR INLET COOLANT TEMPERATURE (DEG. K)
(I) PAIRS5	NUMBER OF ENTRIES IN COOLANT FLOW LIBRARY
TIMFLO	TIME LIBRARY FOR COOLANT FLOW (SEC)
FLOW	COOLANT FLOW LIBRARY (TIME, CHANNEL) (G/SEC)
(I) PAIRS8	NUMBER OF ENTRIES IN COOLANT DENSITY-TEMPERATURE LIBRARY
RHOTEM	TEMPERATURE LIBRARY FOR COOLANT DENSITY (DEG. K)
DENGOL	TEMPERATURE DEPENDENT COOLANT DENSITY (G/CC)

---

* Use high temperature here and enter molten coolant properties as solid input

-----POWER CONDITIONS-----

ANI	INITIAL NEUTRONIC POWER (MEGAWATTS)
ANIC	CONSTANT HEAT SOURCE (MEGAWATTS)
FRACTF	FRACTION OF POWER DEPOSITED IN FUEL
FRACTB	FRACTION OF POWER DEPOSITED IN BOND
FRACTC	FRACTION OF POWER DEPOSITED IN CLAD
FRACTS	FRACTION OF POWER DEPOSITED IN COOLANT
AXLAUG	AXIAL EXTRAPOLATION DISTANCE (CM)
RADAUG	RADIAL EXTRAPOLATION DISTANCE (CM)
AXPF(M)	RELATIVE POWER IN AXIAL SEGMENT M
CHANPF(L)	RELATIVE POWER IN RADIAL CHANNEL L
RFPD(N)	RELATIVE POWER DEPOSITED IN RADIAL FUEL NODE N

-----BASIC NEUTRONICS-----

(I)	IKINET	KINETICS MODEL USED (0/1/2/3 = FINITE/ZERO/MIXED/POWER)
(I)	M	NUMBER OF DELAYED NEUTRON GROUPS
	ALIFE	PROMPT NEUTRON GENERATION TIME (SEC)
	RHOSWZ	REACTIVITY SWITCHING LEVEL FOR ZERO APPROX (CENTS)
	ERROR2	FRACTIONAL ERROR ALLOWED IN POWER WHEN SWITCHING LIFETIME MODES
	BB	TOTAL DELAYED NEUTRON FRACTION
	B(I)	RELATIVE FRACTION OF DELAYED NEUTRONS IN GROUP I
	AL(I)	DECAY CONSTANT FOR PRECURSOR GROUP I (1/SEC)

-----REACTIVITY INPUT AND FEEDBACK-----

FCOE	LINEAR REACTIVITY TEMPERATURE COEFFICIENT OF FUEL (DEL.K/DEG.K)
COEFFX	LINEAR EXPANSION TEMP. COEFF. OF FUEL (1/DEG.K)
ECOE	LINEAR REACTIVITY TEMPERATURE COEFFICIENT OF CLAD (DEL.K/DEG.K)
COEEEX	LINEAR EXPANSION TEMP. COEFF. OF CLAD (1/DEG.K)
CCOE	LINEAR REACTIVITY TEMPERATURE COEFFICIENT OF COOLANT (DEL.K/DEG.K)

(I)	IDOP	SWITCH FOR DOPPLER WEIGHTING (0/1 = AVE.TEMP/LOCAL WEIGHTING)
(I)	IDOPCH	SWITCH FOR DOPPLER CHANGE (0/1 = NONE/FDOP*DOPCOE UPON VOIDING)
	FDOP	VALUE BY WHICH DOPPLER COEFFICIENT IS MULTIPLIED AFTER VOIDING OCCURS
	DOPCOE	DOPPLER COEFFICIENT -(T DK/DT)
	DOPPW	DOPPLER WEIGHTING FACTORS (AXIAL, CHANNEL)
	ENDPOW	OVERPOWER FACTOR FOR SCRAM TRIP
	PERIOD	PERIOD SCRAM TRIP
	TEMSRM	COOLANT OUTLET TEMPERATURE FOR SCRAM TRIP (DEG.K)
	TDELAY	TIME DELAY BETWEEN SCRAM TRIP AND REACTIVITY INSERTION (SEC)
(I)	PAIRS2	NUMBER OF ENTRIES IN REACTIVITY INPUT LIBRARY
	TIMEIN	TIME LIBRARY FOR REACTIVITY INPUT (SEC)
	DKIN	REACTIVITY INPUT LIBRARY (DEL.K)
(I)	PAIRS3	NUMBER OF ENTRIES IN REACTIVITY SCRAM LIBRARY
	TIMOUT	TIME LIBRARY FOR REACTIVITY SCRAM (SEC)
	DKOUT	REACTIVITY SCRAM LIBRARY (DEL.K)

-----COLLAPSE FEEDBACK-----

(I)	ICOLPS	COLLAPSE SWITCH (0/1 = COLLAPSE ALLOWED/NO COLLAPSE)
	GRAV	FORCING FUNCTION IN FUEL EQUATION OF MOTION (CM/SEC**2)
	CHI	IF GT - 1., VISCOUS TERM IN EQUATION OF MOTION (1/SEC) IF LT - 1., PRESSURE FOR MOLTEN FUEL SQUIRTING ROUTINE, DYNES/ CM**2
	TRIPF	FUEL CENTERLINE TEMPERATURE AT WHICH CLAD FAILS (DEGREES K)
(I)	ITRIP	FUEL NODE TO BE MONITORED FOR TRIPFO
	TRIPFO	TEMPERATURE AT WHICH FUEL NODE ITRIP CAUSES CLAD FAILURE (DEG.K)
	TRIFE	CLAD TEMPERATURE AT WHICH CLAD FAILS (DEGREES K)
	TRIPC	COOLANT TEMPERATURE AT WHICH CLAD FAILS (DEGREES K)
	WF	FUEL WORTH THROUGHOUT THE CORE (AXIAL, CHANNEL) (DEL.K/KG)

-----SODIUM VOIDING FEEDBACK-----

(I)	IVOIDS	VOIDING SWITCH (0/1 = VOIDING ALLOWED/NO VOIDING)
(I)	IVOID	VOIDING START (0/1/2/3 = CHECK ALL NODES/PREDETERMINED/ COLLAPSE/BUBBLE)
(I)	MUX	PREDETERMINED AXIAL NODE FOR START OF VOIDING
(I)	IFLOW	SWITCH FOR VOIDING DURING LOSSOF-FLOW ACCIDENTS (0/1 = NO/YES)
(I)	IPOWER	SWITCH FOR VOIDING DURING POWER TRANSIENT ACCIDENTS (0/1 = NO/YES)
(I)	IGAS	SWITCH FOR SODIUM EJECTION (0/1 = FUEL-NA INTER/GAS RELEASE)
	TRIPX	COOLANT TEMPERATURE FOR START OF VOIDING (DEG.K) (IVOID=0)
	TRIPCV	CLAD TEMPERATURE FOR START OF VOIDING (DEG. K)
	DENVOD	RELATIVE FRACTION OF COMPLETE VOID IN SODIUM BUBBLE
	A1	CONSTANT TERM IN UPWARD SODIUM EJECTION EQUATION OF MOTION
	A2	LINEAR TERM IN UPWARD SODIUM EJECTION EQUATION OF MOTION
	A3	QUADRATIC TERM IN UPWARD SODIUM EJECTION EQUATION OF MOTION
	A4	CUBIC TERM IN UPWARD SODIUM EJECTION EQUATION OF MOTION
	TA2	DELAY IN LINEAR TERM IN UPWARD SODIUM EJECTION EQUATION OF MOTION (SEC)
	TA3	DELAY IN QUADRATIC TERM IN UPWARD SODIUM EJECTION EQUATION OF MOTION (SEC)
	TA4	DELAY IN CUBIC TERM IN UPWARD SODIUM EJECTION EQUATION OF MOTION (SEC)
	B1	CONSTANT TERM IN DOWNWARD SODIUM EJECTION EQUATION OF MOTION
	B2	LINEAR TERM IN DOWNWARD SODIUM EJECTION EQUATION OF MOTION
	B3	QUADRATIC TERM IN DOWNWARD SODIUM EJECTION EQUATION OF MOTION
	B4	CUBIC TERM IN DOWNWARD SODIUM EJECTION EQUATION OF MOTION
	TB2	DELAY IN LINEAR TERM IN DOWNWARD SODIUM EJECTION EQUATION OF MOTION (SEC)
	TB3	DELAY IN QUADRATIC TERM IN DOWNWARD SODIUM EJECTION EQUATION OF MOTION (SEC)
	TB4	DELAY IN CUBIC TERM IN DOWNWARD SODIUM EJECTION EQUATION OF MOTION (SEC)
	WC	SODIUM VOID WORTH (AXIAL, CHANNEL) (DEL.K/KG)

ZBOT   STARTING ELEVATION OF SODIUM WORTHS RELATIVE TO CORE BOTTOM
              (CM)

ZSEG   AXIAL DISTANCE BETWEEN SODIUM VOID WORTH POINTS (CM)

DSEP(L)   DISTANCE BETWEEN TOP AND BOTTOM OF SODIUM BUBBLE IN CHANNEL
              L (IVOID=3), CM

TENTRY(L)   TIME FOR ENTRY OF BUBBLE INTO CHANNEL L (IVOID=3), SEC

-----PRESSURE DROP SPECIFICATIONS FOR VOIDING-----

ZTOP   DISTANCE FROM TOP OF CORE TO TOP OF FUEL BUNDLE (CM)

ZBOTOM   DISTANCE FROM BOTTOM OF CORE TO BOTTOM OF FUEL BUNDLE (CM)

ZPLEN   LENGTH OF FISSION GAS PLENUM (CM)

PEXIT   PRESSURE AT CHANNEL OUTLET DURING VOIDING (ATM)

PINLET   PRESSURE AT CHANNEL INLET DURING VOIDING (ATM)

PNA   INITIAL PRESSURE FOR FUEL-SODIUM INTERACTION (ATM)

PGAS   PRESSURE IN FISSION GAS PLENUM (ATM)

GAMMA   RATIO OF SPECIFIC HEATS FOR FISSION GAS (CP/CV)

DEQ   HYDRAULIC DIAMETER (CM)

FRICT1   CONSTANTS IN THE FRICTION FACTOR CORRELATION FOR THE FUEL
              BUNDLE:

FRICT2 $FRICT = FRICT1/RE^{**}FRICT2$ (= 0.184/RE**0.2 FOR SMOOTH TUBES)

DZATOP   SUM OF LENGTH/AREA FROM TOP OF FUEL BUNDLE TO CHANNEL OUT-
              LET (1/CM)

DZABOT   SUM OF LENGTH/AREA FROM BOTTOM OF FUEL BUNDLE TO CHANNEL
              INLET (1/CM)

DPTOP1   EQUIVALENT NUMBER OF VELOCITY HEADS FOR MOMENTUM LOSSES ABOVE
              CORE (CM)

DPTOP2   EQUIVALENT LENGTH OF FUEL BUNDLE FOR FRICTION LOSSES ABOVE
              FUEL BUNDLE (CM)

DPBOT1   EQUIVALENT NUMBER OF VELOCITY HEADS FOR MOMENTUM LOSSES BELOW
              CORE (CM)

DPBOT2   EQUIVALENT LENGTH OF FUEL BUNDLE FOR FRICTION LOSSES BELOW
              FUEL BUNDLE (CM)

APPENDIX C-3

PLOTTING INSTRUCTIONS

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APPENDIX C-3

PLOTTING INSTRUCTIONS

Routines have been developed to utilize the CALCOMP plotter for plotting most of the output quantities of interest. At present, 10 routines are available for plotting macroscopic core quantities as follows:

- PLOT 1 Power (semilog scale)
- PLOT 2 Power (linear scale)
- PLOT 3 Energy generated and energy removed by coolant
- PLOT 4 Average fuel temperature
- PLOT 5 Temperature and energy of the molten fuel
- PLOT 6 Fraction of the core molten
- PLOT 7 Kilograms of molten fuel
- PLOT 8 Reactivity components which govern the transient
- PLOT 9 Reactivity after collapse or voiding begins (enlarged scale)
- PLOT 10 Power after collapse or voiding begins (enlarged scale)

One temperature plotting routine, TDRAW 1, is currently available. It plots the center and outer fuel node temperature along with the clad and coolant temperature versus time for any specified channel and axial level.

Two options are available in each of the routines. Option A allows the user to completely specify the abscissa and ordinate scales, whereas option B instructs the computer to choose appropriate scales such that all the data is plotted. Option B is recommended for routine cases where one is not sure of the time span or magnitude of the transient. However, these plots are occasionally hard to read because of the scales selected.

To allow one to exercise Option B during the problem run and yet be able to replot with Option A without re-executing, a separate wrapup and

plotting code, MPLOT, was developed. To utilize this capability, one must specify IWRAP=2 or 3 and hang tape C. This directs the MELT-II code to write all quantities of interest on tape C at time intervals specified in the big printout time library. Batch cases may be run in this manner since the MPLOT code is capable of retrieving and plotting data from up to nine files.

The plotting instructions for plots 1 → 10 are set up in an array called ARPLOT. Five instructions, all floating point, are required per plot as follows:

- # 1: plot number (1.0 through 10.0)
- # 2: X axis origin
- # 3: X axis increment per inch (seconds)
- # 4: Y axis origin^a
- # 5: Y axis increment per inch^b

Option A is accomplished by specifying finite values for instructions #3 and #5. Option B is accomplished by inserting zeros in these two entries. The following is an example of instructing the code to make PLOT1, PLOT4, and PLOT8.

ARPLOT(1) = 1.0,0.,.05,2.0,0.3, 4.0,0.,.05,0.,1000., 8.0,0.,.05,-2.0,0.5,

The temperature plotting instructions are included in an array called TPLOT. Seven instructions are required for each plot as follows:

---

^a For PLOT1 this entry is the power of 10. for the semilog origin.

^b For PLOT1 this entry is the number of cycles per inch (since the Y axis for PLOT1 is 10 inches high, an entry of 0.3 will result in a 3 cycle ordinate).

- # 1: Plot number (1.0 only--space reserved for future plot types).
- # 2: Channel number (1.0 → 10.0)
- # 3: Axial level
- # 4: X axis origin
- # 5: X axis increment per inch (seconds)
- # 6: Y axis origin
- # 7: Y axis increment per inch

As in the case for the macro-core plots, Option A is accomplished by specifying finite values in entires 5 and 7 whereas Option B is accomplished by inserting zeros.

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APPENDIX C-4

SAMPLE PROBLEM

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APPENDIX C-4

SAMPLE PROBLEM

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

The primary purpose of the sample problem is to provide an illustrative example of some of the capabilities of the MELT-II program, rather than a safety analysis of a particular system. Hence, the selection of the reactivity driving function, the core data used, and the reactivity feedback options and models selected should be considered arbitrary.

A brief interpretation of the numerical results of the sample problem, including output from the plotting routine, is included following the listing of the computer printout.

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE
SAMPLE CASE, 1\$/SEC RAMP

[illegible]

JUNE 9, 1972

RFPD(1)=1.0,1.0,1.0,1.0,1.0,1.0,1.0,
IKINET=2,M=6,ALIFE=5.0E-7,RHOSWZ=90.0,ERRORZ=.05,88=.003,
B(1)=.00008,.00063,.00057,.00107,.00049,.00017,
AL(1)=.0130,.0316,.136,.344,1.33,3.61,
FCOE=0.,ECOE=0.,CCOE=0.,IDOP=1,IDOPCH=1,FDOP=0.5,DOPCOE=.005,
DOPPW(1,1) =.380,.405,.503,.620,.720,.820,.902,.960,.990,.990,.960,
DOPPW(12,1)=.902,.820,.720,.620,.503,.405,.380,
DOPPW(1,2) =.3646,.3886,.4827,.5949,.6909,.7869,.8656,.9212,.9500,
DOPPW(10,2)=.9500,.9212,.8656,.7869,.6909,.5949,.4827,.3886,.3646,
DOPPW(1,3) =.3224,.3436,.4268,.5261,.6109,.6958,.7653,.8145,.8400,
DOPPW(10,3)=.8400,.8145,.7653,.6958,.6109,.5261,.4268,.3436,.3224,
DOPPW(1,4) =.2687,.2864,.3557,.4384,.5091,.5798,.6378,.6788,.7000,
DOPPW(10,4)=.7000,.6788,.6378,.5798,.5091,.4384,.3557,.2864,.2687,
DOPPW(1,5) =.1881,.2005,.2490,.3069,.3564,.4059,.4464,.4752,.4900,
DOPPW(10,5)=.4900,.4752,.4464,.4059,.3564,.3069,.2490,.2005,.1881,
DOPPW(1,6) =.1305,.1391,.1727,.2129,.2473,.2816,.3098,.3297,.3400,
DOPPW(10,6)=.3400,.3297,.3098,.2816,.2473,.2129,.1727,.1391,.1305,
ENDPOW=1.0E6,PERIOD=1.0E6,TEMSPM=3000.,TDELAY=0.,
PAIRS2=2,TIMEIN(1)=0.,10.,DKIN(1)=0.,.06,
PAIRS3=2,TIMOUT(1)=0.,1000.,DKOUT(1)=0.,0.,
ICOLPS=0,GRAV=981.,CHI=C.,TRIPF=4000.,ITRIP=5,TRIPFC=3040.,
TRIFE=1623.,TRIPC=1153.,
WF(1,1) =10.04E-5,12.51E-5,15.56E-5,18.24E-5,21.01E-5,23.40E-5,
WF(7,1) =25.55E-5,27.19E-5,27.84E-5,27.84E-5,27.19E-5,25.55E-5,
WF(13,1) =23.40E-5,21.01E-5,18.24E-5,15.56E-5,12.51E-5,10.04E-5,
WF(1,2) = 9.66E-5,12.03E-5,14.97E-5,17.55E-5,20.21E-5,22.51E-5,
WF(7,2) =24.58E-5,26.15E-5,26.78E-5,26.78E-5,26.15E-5,24.58E-5,
WF(13,2) =22.51E-5,20.21E-5,17.55E-5,14.97E-5,12.03E-5, 9.66E-5,
WF(1,3) = 8.77E-5,10.93E-5,13.60E-5,15.94E-5,18.36E-5,20.45E-5,
WF(7,3) =22.33E-5,23.76E-5,24.33E-5,24.33E-5,23.76E-5,22.33E-5,
WF(13,3) =20.45E-5,18.36E-5,15.94E-5,13.60E-5,10.93E-5, 8.77E-5,
WF(1,4) = 7.37E-5, 9.18E-5,11.42E-5,13.39E-5,15.43E-5,17.18E-5,
WF(7,4) =18.76E-5,19.96E-5,20.44E-5,20.44E-5,19.96E-5,18.76E-5,
WF(13,4) =17.18E-5,15.43E-5,13.39E-5,11.42E-5, 9.18E-5, 7.37E-5,
WF(1,5) = 8.48E-5,10.56E-5,13.14E-5,15.40E-5,17.74E-5,19.76E-5,
WF(7,5) =21.58E-5,22.96E-5,23.51E-5,23.51E-5,22.96E-5,21.58E-5,
WF(13,5) =19.76E-5,17.74E-5,15.40E-5,13.14E-5,10.56E-5, 8.48E-5,
WF(1,6) = 5.44E-5, 5.78E-5, 8.43E-5, 9.89E-5,11.39E-5,12.68E-5,
WF(7,6) =13.85E-5,14.74E-5,15.09E-5,15.09E-5,14.74E-5,13.85E-5,
WF(13,6) =12.68E-5,11.39E-5, 9.89E-5, 8.43E-5, 5.78E-5, 5.44E-5,
IVCIDS=0,IVOID=2,MUX=18,IFLOW=0,IPOWER=1,IGAS=1,TRIPX=1253.,
TRIPCV=1300.,DENVOD=1.0,
ZROT=-22.85,ZSEG=7.62,
ZTOP=106.68, ZBOTOM=21.84, ZPLEN=91.44,

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PEXIT=1.62, PINLET=8.16, PGAS=34.0, PNA=700.0, GAMMA=1.4,
DEQ=0.3033, FRICT1=0.184, FRICT2=0.20, DZATOP=563.7, DZABOT=71.01,
DPTOP1=2.0, DPTOP2=0.0, DPROT1=2.0, DPROT2=0.0,

ARPLOT(1)= 1.0,0.0,0.0,0.0,0.0,
2.0,0.0,0.0,0.0,0.0,
3.0,0.0,0.0,0.0,0.0,
4.0,0.0,0.0,0.0,0.0,
5.0,0.0,0.0,0.0,0.0,
6.0,0.0,0.0,0.0,0.0,
7.0,0.0,0.0,0.0,0.0,
8.0,0.0,0.0,0.0,0.0,
9.0,0.0,0.0,0.0,0.0,
10.0,0.0,0.0,0.0,0.0,

TPLOT(1) = 1.0,1.0,10.0,0.0,0.0,0.0,1.0,1.0,18.0,0.0,0.0,0.0,
1.0,2.0,10.0,0.0,0.0,0.0,1.0,2.0,18.0,0.0,0.0,0.0,
1.0,6.0,10.0,0.0,0.0,0.0,1.0,6.0,18.0,0.0,0.0,0.0,

TIMEIN(1)=0.0,10.0,DKIN(1)=0.0,0.030,DELTOT=.003,

WC(1, 1) =-.1808-04,-.3030-04,-.5873-04,-.5939-04,-.1873-04, .2499-04,
WC(7, 1) = .6091-04, .9005-04, .1045-03, .1045-03, .9005-04, .6091-04,
WC(13, 1) = .2499-04,-.1873-04,-.5939-04,-.5873-04,-.3030-04,-.1808-04,
WC(1, 2) =-.1775-04,-.2939-04,-.5696-04,-.5817-04,-.1956-04, .2207-04,
WC(7, 2) = .5630-04, .8408-04, .9784-04, .9784-04, .8408-04, .5630-04,
WC(13, 2) = .2207-04,-.1956-04,-.5817-04,-.5696-04,-.2939-04,-.1775-04,
WC(1, 3) =-.1689-04,-.2706-04,-.5261-04,-.5526-04,-.2175-04, .1467-04,
WC(7, 3) = .4463-04, .6892-04, .8094-04, .8094-04, .6892-04, .4463-04,
WC(13, 3) = .1467-04,-.2175-04,-.5526-04,-.5261-04,-.2706-04,-.1689-04,
WC(1, 4) =-.1544-04,-.2339-04,-.4661-04,-.5176-04,-.2528-04, .3366-05,
WC(7, 4) = .2675-04, .4563-04, .5495-04, .5495-04, .4563-04, .2675-04,
WC(13, 4) = .3366-05,-.2528-04,-.5176-04,-.4661-04,-.2339-04,-.1544-04,
WC(1, 5) =-.1332-04,-.1820-04,-.3840-04,-.4655-04,-.3177-04,-.1723-04,
WC(7, 5) =-.5647-05, .3635-05, .8206-05, .8206-05, .3635-05,-.5647-05,
WC(13, 5) =-.1723-04,-.3177-04,-.4655-04,-.3840-04,-.1820-04,-.1332-04,
WC(1, 6) =-.1057-04,-.1144-04,-.2577-04,-.3965-04,-.4129-04,-.4343-04,
WC(7, 6) =-.4523-04,-.4669-04,-.4741-04,-.4741-04,-.4669-04,-.4523-04,
WC(13, 6) =-.4343-04,-.4129-04,-.3965-04,-.2577-04,-.1144-04,-.1057-04,

IPL0T=1,

TEMAD=2700.,DELTOT=.005,

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M E L T - I I

A T W O D I M E N S I O N A L

N E U T R O N I C S - H E A T T R A N S F E R C O D E

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C-37

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE DATE 12 JUN 72 TIME 05:15:04

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

INPUT DATA

*** CODE OPTIONS AND OUTPUT CONTROLS

VENUS VENUS INPUT SIGNAL (0/1/2 = NO PUNCH/OLD VENUS PUNCH/NEW VENUS PUNCH) = 2
 VENUS RADIAL NODES PER MELT2 NODE - NR(CHAN) 1 2 2 2 2 2
 VENUS AXIAL NODES PER MELT2 NODE - NZ(AXIAL) 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 NVENR VENUS CORE RADIAL ZONES 2
 NMELTR LAST MELT2 RADIAL NODE PER VENUS ZONE 4 6
 NVENZ VENUS CORE AXIAL ZONES 1
 NMELTZ LAST MELT2 AXIAL NODE PER VENUS ZONE 18
 IEOSIN VENUS EQUATION OF STATE CODE FOR SODIUM IN 5
 IEOSOT VENUS EQUATION OF STATE CODE FOR SODIUM OUT 4

IWRAP WRAPUP OPTION (0/1/2/3 = NONE/WRAPUP ONLY/WRAPUP PLUS TAPE/TAPE ONLY) = 1
 IPLOT PLOTTING OPTION (0/1 = NO PLOTTING/PLOT BEFORE STORING WRAPUP ON TAPE) = 1
 IDUMP RESTART OPTION (0/1 = NO CORE DUMP/CORE DUMP AT SPECIFIED INTERVALS) = 0

DELSTP NUMBER OF TIME STEPS BETWEEN SHORT PRINTOUTS (INTEGER) = 5
 AX AXIAL NODE EDITED IN SMALL PRINTOUT (INTEGER) = 10
 FR1 INNER FUEL NODE EDITED IN BIG PRINTOUT (INTEGER) = 1
 FR2 OUTER FUEL NODE EDITED IN BIG PRINTOUT (INTEGER) = 7
 AX1 LOWER AXIAL NODE EDITED IN BIG PRINTOUT (INTEGER) = 9
 AX2 UPPER AXIAL NODE EDITED IN BIG PRINTOUT (INTEGER) = 12
 CH1 INNER CHANNEL EDITED IN BIG PRINTOUT (INTEGER) = 1
 CH2 OUTER CHANNEL EDITED IN BIG PRINTOUT (INTEGER) = 6
 LISTC LIST OF CHANNELS TO BE EDITED BY WRAPUP = 1, 2, 6,
 LISTA LIST OF AXIAL SEGMENTS TO BE EDITED BY WRAPUP = 1, 9, 10, 12, 15, 18,
 PAIRS6 NUMBER OF TIME ENTRIES IN BIG PRINTOUT LIBRARY (INTEGER) = 4

BIG PRINTOUT TIME LIBRARY
 TPLIB = INTERVAL FOR TIME PRINTOUTS PLIB = TIME BETWEEN PRINTOUTS IN INTERVAL TPLIB

TPLIB	0.000	1.000+00	1.000+00	1.000+01
PLIB	2.000-01	2.000-01	1.000-01	1.000-01

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

INPUT DATA

*** TIME, TERMINATION, AND CONVERGENCE CONTROLS

HMAX	MAXIMUM TIME STEP (SECONDS)	= 2.000-01
REDUCE	FACTOR USED TO INCREASE OR DECREASE TIME STEP	= .800
ICOLTQ	OPTION TO TERMINATE AT START OF FUEL COLLAPSE (0/1 = NO/YES)	= 0
IVOIDQ	OPTION TO TERMINATE AT START OF COOLANT VOIDING (0/1 = NO/YES)	= 0
MAXTIM	RESERVED RUN TIME FOR FINAL WRAPUP AND PLOTS (SECONDS)	= 120
TMQUIT	MAXIMUM TRANSIENT RUN TIME THIS PROBLEM (SECONDS)	= 3.000+02
TEMA0	CORE AVERAGE FUEL TEMPERATURE ENDING DISASSEMBLY PRINTS (DEGREES KELVIN)	= 2700.
TEMAW	CORE AVERAGE FUEL TEMPERATURE INDICATING CORE DISASSEMBLY (DEGREES KELVIN)	= 2500.
TINCRT	DEG. K INCREMENT TO TEMAW FOR MORE DISASSEMBLY PRINTS	= 100.
THQUIT	HIGH FUEL TEMPERATURE TERMINATION (DEGREES KELVIN)	= 1.000+04
TLQUIT	LOW FUEL TEMPERATURE TERMINATION (DEGREES KELVIN)	= 4.000+02
TSQUIT	COOLANT OUTLET TEMPERATURE TERMINATION (DEGREES KELVIN)	= 3.000+03
PQUIT	MULTIPLE OF INITIAL POWER TERMINATION POINT	= 1.000+20
RMIN	MINIMUM REACTIVITY TERMINATION (DELTA K)	= -9.000-03
TCQUIT	TIME TO TERMINATION AFTER START OF COLLAPSE (SECONDS)	= 5.000-01
TVQUIT	TIME TO TERMINATION AFTER START OF VOIDING (SECONDS)	= 5.000-01
DELTOT	TIME BETWEEN PRINTOUTS AFTER START OF EITHER COLLAPSE OR VOIDING	= 5.000-03
ERROR	ERROR CRITERIA FOR ORIGINAL POWER MATCH	= 1.000-03
ERROR1	ERROR CRITERIA FOR OUTER LOOP POWER MATCH	= 1.000-02
TERROR	TEMPERATURE ERROR ALLOWED IN THERMAL CONDUCTIVITY INTERPOLATION	= 2.00

SAMPLE CASE: 1\$/SEC RAMP WITH FISSION GAS RELEASE

INPUT DATA

***

GEOMETRY SPECIFICATIONS

NUPPER NUMBER OF PIN RADIAL NODES = 10
MUPPER NUMBER OF CORE AXIAL NODES = 18
LUPPER NUMBER OF CORE RADIAL CHANNELS = 6

AHIGH CORE HEIGHT (CM) = 9.144+01
FUELFR VOLUME FRACTION OF FUEL IN CORE = .3000
COOLFR VOLUME FRACTION OF COOLANT IN CORE = .3900

RCHAN(L) OUTER RADIUS OF CHANNEL L (CM)
5.450+00 1.636+01 2.727+01 3.818+01 4.909+01
6.000+01

R(R) OUTER RADIUS OF RADIAL PIN NODE N (CM)
3.000-02 5.800-02 8.600-02 1.140-01 1.415-01 1.769-01
2.123-01 2.565-01 2.565-01 2.921-01 3.747-01

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HEAT TRANSFER SPECIFICATIONS

KNA GAP COEFFICIENT (J/SEC-CM**2-K) (FLOATING POINT) = 8.517-01
HTCOE FILM COEFFICIENT (J/SEC-CM**2-K) = 1.704+01
HTVOID FILM COEFFICIENT AFTER VOIDING (J/SEC-CM**2-K) = 0.000

FRACTL COOLANT NODE PLACEMENT (FRACT. DISTANCE FROM INLET) = .500
TGUESS INITIAL TEMPERATURE GUESS (DEG. K) = 1.200+03

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

INPUT DATA

*** MATERIAL PROPERTIES

KNA	THERMAL CONDUCTIVITY OF BOND (J/CM-SEC-K) (FLOATING POINT)	= 8.517-01
KCLAD	THERMAL CONDUCTIVITY OF CLAD (J/CM-SEC-K) (FLOATING POINT)	= 1.962-01
XCOE1	CONSTANT TERM FOR FUEL HEAT CAPACITY BELOW MELTING POINT (J/G-K)	= 3.884-01
YCOE1	T COEFFICIENT FOR FUEL HEAT CAPACITY BELOW MELTING POINT	= -1.619-04
ZCOE1	T**2 COEFFICIENT FOR FUEL HEAT CAPACITY BELOW MELTING POINT	= 8.781-08
XCOE2	CONSTANT TERM FOR FUEL HEAT CAPACITY ABOVE MELTING POINT (J/G-K)	= 5.480-01
YCOE2	T COEFFICIENT FOR FUEL HEAT CAPACITY ABOVE MELTING POINT	= 0.000
ZCOE2	T**2 COEFFICIENT FOR FUEL HEAT CAPACITY ABOVE MELTING POINT	= 0.000
EXCOE1	CONSTANT TERM FOR CLAD HEAT CAPACITY BELOW MELTING POINT (J/G-K)	= 4.920-01
EYCOE1	T COEFFICIENT FOR CLAD HEAT CAPACITY BELOW MELTING POINT	= 3.634-05
EZCOE1	T**2 COEFFICIENT FOR CLAD HEAT CAPACITY BELOW MELTING POINT	= 0.000
EXCOE2	CONSTANT TERM FOR CLAD HEAT CAPACITY ABOVE MELTING POINT (J/G-K)	= 5.740-01
EYCOE2	T COEFFICIENT FOR CLAD HEAT CAPACITY ABOVE MELTING POINT	= 0.000
EZCOE2	T**2 COEFFICIENT FOR CLAD HEAT CAPACITY ABOVE MELTING POINT	= 0.000
CXCOE1	CONSTANT TERM FOR COOLANT (AND BOND) HEAT CAPACITY BELOW MELTING POINT (J/G-K)	= 1.629+00
CYCOE1	T COEFFICIENT FOR COOLANT (AND BOND) HEAT CAPACITY BELOW MELTING POINT	= -8.329-04
CZCOE1	T**2 COEFFICIENT FOR COOLANT (AND BOND) HEAT CAPACITY BELOW MELTING POINT	= 4.625-07
CXCOE2	CONSTANT TERM FOR COOLANT (AND BOND) HEAT CAPACITY ABOVE MELTING POINT (J/G-K)	= 1.631+00
CYCOE2	T COEFFICIENT FOR COOLANT (AND BOND) HEAT CAPACITY ABOVE MELTING POINT	= -8.335-04
CZCOE2	T**2 COEFFICIENT FOR COOLANT (AND BOND) HEAT CAPACITY ABOVE MELTING POINT	= 4.676-07
CXCOE3	CONSTANT TERM FOR COOLANT VISCOSITY (G/CM-SEC)	= 1.508-03
CYCOE3	T COEFFICIENT FOR COOLANT VISCOSITY	= 0.000
CZCOE3	T**2 COEFFICIENT FOR COOLANT VISCOSITY	= 0.000
DENSE	DENSITY OF FUEL (G/CC)	= 1.000+01
DENSEB	DENSITY OF BOND (G/CC)	= 0.000
DENSEC	DENSITY OF CLAD (G/CC)	= 8.026+00
DENSEC	DENSITY OF COOLANT (G-CC)	= 8.500-01
TMELT	MELTING TEMPERATURE OF FUEL (DEG. K)	= 3040.
EMELTL	MELTING TEMPERATURE OF CLAD (DEG. K)	= 1623.
CMELTL	MELTING TEMPERATURE OF COOLANT (AND BOND) (DEG. K)	= 10000.
HFUSE	HEAT OF FUSION OF FUEL (J-G)	= 2.800+02
CFUSE	HEAT OF FUSION OF COOLANT (AND BOND) (J/G)	= 1.133+02
EFUSE	HEAT OF FUSION OF CLAD (J/G)	= 1.100+02
PAIRS1	NUMBER OF ENTRIES IN FUEL CONDUCTIVITY LIBRARY	= 12
	CONDC = FUEL CONDUCTIVITY (J/CM-SEC-K)	
		BASICT = TEMPERATURE (K)

BASICT	2.730+02	4.730+02	6.730+02	8.730+02	1.073+03	1.273+03	1.473+03	1.673+03	1.873+03	2.000+03
CONDOC	5.080-02	4.160-02	3.360-02	2.700-02	2.280-02	2.050-02	1.900-02	1.770-02	1.680-02	1.650-02
BASICT	2.100+03	1.000+05								
CONDOC	2.300-02	2.300-02								

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

INPUT DATA

*** COOLANT FLOW AND TEMPERATURE CONDITIONS

PAIRS4 NUMBER OF ENTRIES IN INLET COOLANT TEMPERATURE LIBRARY = 2

TIMIN = TIME (SEC) TEMIN = TEMP. (K)

TIMIN	0.000	1.000+03
TEMIN	5.890+02	5.890+02

PAIRS5 NUMBER OF ENTRIES IN COOLANT FLOW LIBRARY = 2

TIMFLO = TIME (SEC) FLOW(TIME,CHANNEL) = G/SEC

TIMFLO (SEC)	FLOW (G/SEC)					
	1	2	3	CHANNEL 4	5	6
0.000	1.123+02	1.119+02	1.070+02	9.687+01	1.070+02	8.235+01
1.000+03	1.123+02	1.119+02	1.070+02	9.687+01	1.070+02	8.235+01

PAIRS8 NUMBER OF ENTRIES IN COOLANT DENSITY-TEMPERATURE LIBRARY = 0
RHOTEM = TEMPERATURE (K) DENCOL = DENSITY (G/CC)

SAMPLE CASE, 15/SEC RAMP WITH FISSION GAS RELEASE

INPUT DATA

*** POWER CONDITIONS

ANI INITIAL NEUTRONIC POWER (MEGAWATTS) = 3.800+02
 ANIC CONSTANT HEAT SOURCE (MEGAWATTS) = 2.000+01
 FRACTF FRACTION OF POWER DEPOSITED IN FUEL = .958
 FRACTB FRACTION OF POWER DEPOSITED IN BOND = .000
 FRACTC FRACTION OF POWER DEPOSITED IN CLAD = .021
 FRACTS FRACTION OF POWER DEPOSITED IN COOLANT = .021
 AXLAUG AXIAL EXTRAPOLATION DISTANCE (CM) = 0.000
 RADAUG RADIAL EXTRAPOLATION DISTANCE (CM) = 0.000

AXIAL FLUX PROFILE, AXPF(M)

6.000-01 7.550-01 8.500-01 9.400-01 1.030+00 1.110+00 1.170+00 1.215+00 1.240+00 1.240+00
 1.215+00 1.170+00 1.110+00 1.030+00 9.400-01 8.500-01 7.550-01 6.900-01

RADIAL FLUX PROFILE, CHANPF(L)

1.355+00 1.325+00 1.204+00 1.080+00 1.134+00 7.200-01

RELATIVE FUEL POWER DEPOSITION, RFPD(N)

1.000+00 1.000+00 1.000+00 1.000+00 1.000+00 1.000+00 1.000+00

C-45

*** BASIC NEUTRONICS

IKINET KINETICS MODEL USED (0/1/2/3 = FINITE/ZERO/MIXED/POWER) = 2
 M NUMBER OF DELAYED NEUTRON GROUPS = 6
 ALIFE PROMPT NEUTRON GENERATION TIME (SEC) = 5.000-07
 RHOSWZ INPUT REACTIVITY SWITCHING LEVEL FOR ZERO APPROX (CENTS) = 90.0000
 ERROR2 FRACTIONAL ERROR ALLOWED IN POWER WHEN SWITCHING MODE = .0500
 BB TOTAL DELAYED NEUTRON FRACTION = .00300

GROUP	B(I) = FRACTION	AL(I) = DECAY CONSTANT (1/SEC)
1	.00008	1.300-02
2	.00063	3.160-02
3	.00057	1.360-01
4	.00107	3.440-01
5	.00049	1.330+00
6	.00017	3.610+00

***

REACTIVITY INPUT AND FEEDBACK

FCOE LINEAR REACTIVITY TEMPERATURE COEFFICIENT OF FUEL (DEL.K/DEG.K) = 0.000
 ECOE LINEAR REACTIVITY TEMPERATURE COEFFICIENT OF CLAD (DEL.K/DEG.K) = 0.000
 CCOE LINEAR REACTIVITY TEMPERATURE COEFFICIENT OF COOLANT (DEL.K/DEG.K) = 0.000
 IDOP SWITCH FOR DOPPLER WEIGHTING (0/1 = AVE.TEMP/LOCAL WEIGHTING) = 1
 IDOPCH SWITCH FOR DOPPLER CHANGE (0/1 = NONE/FDOP*DOPCOE UPON VOIDING) = 1
 FDOP VALUE BY WHICH DOPPLER COEFFICIENT IS MULTIPLIED AFTER VOIDING OCCURS = 5.000-01
 DOPCOE DOPPLER COEFFICIENT = 5.000-03
 DOPPW DOPPLER WEIGHTING FACTORS(AXIAL,CHANNEL)

AXIAL SEGMENT	CHANNEL					
	1	2	3	4	5	6
18	3.800-01	3.646-01	3.224-01	2.687-01	1.881-01	1.305-01
17	4.050-01	3.886-01	3.436-01	2.864-01	2.005-01	1.391-01
16	5.030-01	4.827-01	4.268-01	3.557-01	2.490-01	1.727-01
15	6.200-01	5.949-01	5.261-01	4.384-01	3.069-01	2.129-01
14	7.200-01	6.909-01	6.109-01	5.091-01	3.564-01	2.473-01
13	8.200-01	7.869-01	6.958-01	5.798-01	4.059-01	2.816-01
12	9.020-01	8.656-01	7.653-01	6.378-01	4.464-01	3.098-01
11	9.600-01	9.212-01	8.145-01	6.788-01	4.752-01	3.297-01
10	9.900-01	9.500-01	8.400-01	7.000-01	4.900-01	3.400-01
9	9.900-01	9.500-01	8.400-01	7.000-01	4.900-01	3.400-01
8	9.600-01	9.212-01	8.145-01	6.788-01	4.752-01	3.297-01
7	9.020-01	8.656-01	7.653-01	6.378-01	4.464-01	3.098-01
6	8.200-01	7.869-01	6.958-01	5.798-01	4.059-01	2.816-01
5	7.200-01	6.909-01	6.109-01	5.091-01	3.564-01	2.473-01
4	6.200-01	5.949-01	5.261-01	4.384-01	3.069-01	2.129-01
3	5.030-01	4.827-01	4.268-01	3.557-01	2.490-01	1.727-01
2	4.050-01	3.886-01	3.436-01	2.864-01	2.005-01	1.391-01
1	3.800-01	3.646-01	3.224-01	2.687-01	1.881-01	1.305-01

ENDPOW OVERPOWER FACTOR FOR SCRAM TRIP = 1.000+06
 PERIOD PERIOD SCRAM TRIP = 1.000+06
 TEMSRM COOLANT OUTLET TEMPERATURE FOR SCRAM TRIP (DEG.K) = 3000.
 TDELAY TIME DELAY BETWEEN SCRAM TRIP AND REACTIVITY INSERTION (SEC) = 0.000
 PAIRS2 NUMBER OF ENTRIES IN REACTIVITY INPUT LIBRARY = 2
 TIMEIN = TIME (SEC) DKIN = DEL.K

TIMEIN 0.000 1.000+01
 DKIN 0.000 .0300

PAIRS3 NUMBER OF ENTRIES IN REACTIVITY SCRAM LIBRARY = 2
 TIMOUT = TIME (SEC) DKOUT = DEL.K

TIMOUT 0.000 1.000+03
 DKOUT 0.000 .0000

C-46

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

INPUT DATA

***

COLLAPSE FEEDBACK

ICOLPS COLLAPSE SWITCH (0/1 = COLLAPSE ALLOWED/NO COLLAPSE) = 0
 GRAV FORCING FUNCTION IN EQUATION OF MOTION (CM/SEC**2) = 9.810+02
 CHI VISCOUS TERM IN EQUATION OF MOTION (1/SEC) = 0.000
 TRIPF FUEL CENTERLINE TEMPERATURE AT WHICH CLAD FAILS (DEGREES K) = 4000.
 ITRIP FUEL NODE TO BE MONITORED FOR TRIPFO = 5
 TRIPFO TEMPERATURE AT WHICH FUEL NODE ITRIP CAUSES CLAD FAILURE = 3040.
 TRIPE CLAD TEMPERATURE AT WHICH CLAD FAILS (DEGREES K) = 1623.
 TRIPC COOLANT TEMPERATURE AT WHICH CLAD FAILS (DEGREES K) = 1153.

WF FUEL WORTH THROUGHOUT THE CORE (DEL.K/KG)

AXIAL SEGMENT	CHANNEL					
	1	2	3	4	5	6
18	1.004-04	9.660-05	8.770-05	7.370-05	8.480-05	5.440-05
17	1.251-04	1.203-04	1.093-04	9.180-05	1.056-04	6.780-05
16	1.556-04	1.497-04	1.360-04	1.142-04	1.314-04	9.430-05
15	1.824-04	1.755-04	1.594-04	1.339-04	1.540-04	9.890-05
14	2.101-04	2.021-04	1.836-04	1.543-04	1.774-04	1.139-04
13	2.340-04	2.251-04	2.045-04	1.718-04	1.976-04	1.268-04
12	2.555-04	2.458-04	2.233-04	1.876-04	2.158-04	1.385-04
11	2.719-04	2.615-04	2.376-04	1.996-04	2.296-04	1.474-04
10	2.784-04	2.678-04	2.433-04	2.044-04	2.351-04	1.509-04
9	2.784-04	2.678-04	2.433-04	2.044-04	2.351-04	1.509-04
8	2.719-04	2.615-04	2.376-04	1.996-04	2.296-04	1.474-04
7	2.555-04	2.458-04	2.233-04	1.876-04	2.158-04	1.385-04
6	2.340-04	2.251-04	2.045-04	1.718-04	1.976-04	1.268-04
5	2.101-04	2.021-04	1.836-04	1.543-04	1.774-04	1.139-04
4	1.824-04	1.755-04	1.594-04	1.339-04	1.540-04	9.890-05
3	1.556-04	1.497-04	1.360-04	1.142-04	1.314-04	8.430-05
2	1.251-04	1.203-04	1.093-04	9.180-05	1.056-04	6.780-05
1	1.004-04	9.660-05	8.770-05	7.370-05	8.480-05	5.440-05

SAMPLE CASE: 1\$/SEC RAMP WITH FISSION GAS RELEASE

INPUT DATA

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SODIUM VOIDING FEEDBACK

IVOIDS	VOIDING SWITCH (0/1 = VOIDING ALLOWED/NO VOIDING)	= 0
IVOID	VOIDING START (0/1/2/3 = CHECK ALL NODES/PREDETERMINED/COLLAPSE/BUBBLE)	= 2
MUX	PREDETERMINED AXIAL NODE FOR START OF VOIDING	= 18
IFLOW	SWITCH FOR VOIDING DURING LOSS-OF-FLOW ACCIDENTS (0/1 = NO/YES)	= 0
IPOWER	SWITCH FOR VOIDING DURING POWER TRANSIENT ACCIDENTS (0/1 = NO/YES)	= 1
IGAS	SWITCH FOR VOIDING DUE TO EXPANSION OF FISSION GAS (0/1 = NO/YES)	= 1
TRIPX	COOLANT TEMPERATURE FOR START OF VOIDING (K) (IVOID=0)	= 1253.
TRIPCV	CLAD TEMPERATURE FOR START OF VOIDING	= 1300.
DENVOD	RELATIVE FRACTION OF COMPLETE VOID	= 1.00
A1	CONSTANT TERM IN UPWARD SODIUM EJECTION EQUATION OF MOTION	= 0.000
A2	LINEAR TERM IN UPWARD SODIUM EJECTION EQUATION OF MOTION	= 0.000
A3	QUADRATIC TERM IN UPWARD SODIUM EJECTION EQUATION OF MOTION	= 0.000
A4	CUBIC TERM IN UPWARD SODIUM EJECTION EQUATION OF MOTION	= 0.000
TA2	DELAY IN LINEAR TERM IN UPWARD SODIUM EJECTION EQUATION OF MOTION (SEC)	= 0.000
TA3	DELAY IN QUADRATIC TERM IN UPWARD SODIUM EJECTION EQUATION OF MOTION (SEC)	= 0.000
TA4	DELAY IN CUBIC TERM IN UPWARD SODIUM EJECTION EQUATION OF MOTION (SEC)	= 0.000
B1	CONSTANT TERM IN DOWNWARD SODIUM EJECTION EQUATION OF MOTION	= 0.000
B2	LINEAR TERM IN DOWNWARD SODIUM EJECTION EQUATION OF MOTION	= 0.000
B3	QUADRATIC TERM IN DOWNWARD SODIUM EJECTION EQUATION OF MOTION	= 0.000
B4	CUBIC TERM IN DOWNWARD SODIUM EJECTION EQUATION OF MOTION	= 0.000
TB2	DELAY IN LINEAR TERM IN DOWNWARD SODIUM EJECTION EQUATION OF MOTION (SEC)	= 0.000
TB3	DELAY IN QUADRATIC TERM IN DOWNWARD SODIUM EJECTION EQUATION OF MOTION (SEC)	= 0.000
TB4	DELAY IN CUBIC TERM IN DOWNWARD SODIUM EJECTION EQUATION OF MOTION (SEC)	= 0.000
WC	SODIUM VOIDING WORTH (DEL.K/KG)	
HEIGHT	CHANNEL	
CM		
110.49	1 -1.808-05 2 -1.775-05 3 -1.689-05 4 -1.544-05 5 -1.332-05 6 -1.057-05	
102.87	-3.039-05 -2.939-05 -2.706-05 -2.339-05 -1.820-05 -1.144-05	
95.25	-5.873-05 -5.696-05 -5.261-05 -4.661-05 -3.840-05 -2.577-05	
87.63	-5.939-05 -5.817-05 -5.526-05 -5.176-05 -4.655-05 -3.965-05	
80.01	-1.873-05 -1.956-05 -2.175-05 -2.528-05 -3.177-05 -4.129-05	
72.39	2.499-05 2.207-05 1.467-05 3.366-06 -1.723-05 -4.343-05	
64.77	6.091-05 5.630-05 4.463-05 2.675-05 -5.647-06 -4.523-05	
57.15	9.005-05 8.408-05 6.892-05 4.563-05 3.635-06 -4.669-05	
49.53	1.045-04 9.784-05 8.094-05 5.495-05 8.206-06 -4.741-05	
41.91	1.045-04 9.784-05 8.094-05 5.495-05 8.206-06 -4.741-05	
34.29	9.005-05 8.408-05 6.892-05 4.563-05 3.635-06 -4.669-05	
26.67	6.091-05 5.630-05 4.463-05 2.675-05 -5.647-06 -4.523-05	
19.05	2.499-05 2.207-05 1.467-05 3.366-06 -1.723-05 -4.343-05	

11.43	-1.673-05	-1.956-05	-2.175-05	-2.528-05	-3.177-05	-4.129-05	
3.81	-5.939-05	-5.817-05	-5.526-05	-5.176-05	-4.655-05	-3.965-05	
-3.81	-5.873-05	-5.696-05	-5.251-05	-4.661-05	-3.840-05	-2.577-05	
-11.43	-3.030-05	-2.930-05	-2.706-05	-2.339-05	-1.820-05	-1.144-05	
-10.05	-1.608-05	-1.775-05	-1.659-05	-1.544-05	-1.332-05	-1.057-05	
ZBOI	STARTING ELEVATION OF SODIUM WORTHS RELATIVE TO CORE BOTTOM (CM)						= -22.80
ZSLC	AXIAL DISTANCE BETWEEN NORTH POINTS (CM)						= 7.62

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

INPUT DATA

*** PRESSURE DROP SPECIFICATIONS FOR VOIDING

ZTOP	DISTANCE FROM TOP OF CORE TO TOP OF FUEL BUNDLE (CM)	= 1.067+02
ZBOTOM	DISTANCE FROM BOTTOM OF CORE TO BOTTOM OF FUEL BUNDLE (CM)	= 2.184+01
ZPLEN	LENGTH OF FISSION GAS PLENUM (CM)	= 9.144+01
PEXIT	PRESSURE AT CHANNEL OUTLET DURING VOIDING (ATM)	= 1.620+00
PINLET	PRESSURE AT CHANNEL INLET DURING VOIDING (ATM)	= 8.160+00
PNA	INITIAL PRESSURE FOR FUEL-SODIUM INTERACTION (ATM)	= 7.000+02
PGAS	PRESSURE IN FISSION GAS PLENUM (ATM)	= 3.400+01
GAMMA	RATIO OF SPECIFIC HEATS FOR FISSION GAS (CP/CV)	= 1.400+00
DEQ	HYDRAULIC DIAMETER (CM)	= 3.033-01
FRICT1	CONSTANTS IN THE FRICTION FACTOR CORRELATION FOR THE FUEL BUNDLE:	= 1.840-01
FRICT2	FRIC = FRICT1/RE**FRICT2 (= 0.184/RE**0.2 FOR SMOOTH TUBES)	= 2.000-01
DZATOP	SUM OF LENGTH/AREA FROM TOP OF FUEL BUNDLE TO CHANNEL OUTLET (1/CM)	= 5.637+02
DZABOT	SUM OF LENGTH/AREA FROM BOTTOM OF FUEL BUNDLE TO CHANNEL INLET (1/CM)	= 7.101+01
DPTOP1	EQUIVALENT NUMBER OF VELOCITY HEADS FOR MOMENTUM LOSSES ABOVE CORE (CM)	= 2.000+00
DPTOP2	EQUIVALENT LENGTH OF FUEL BUNDLE FOR FRICTION LOSSES ABOVE FUEL BUNDLE (CM)	= 0.000
DPBOT1	EQUIVALENT NUMBER OF VELOCITY HEADS FOR MOMENTUM LOSSES BELOW CORE (CM)	= 2.000+00
DPBOT2	EQUIVALENT LENGTH OF FUEL BUNDLE FOR FRICTION LOSSES BELOW FUEL BUNDLE (CM)	= 0.000

SAMPLE CASE, 1%/SEC RAMP WITH FISSION GAS RELEASE

INPUT DATA

**, PLOTTING SPECIFICATIONS

MACROSCOPIC CORE PLOTS

	PLOT NO.	XORIGN	XINCR	YORIGN	YINCR
ARPLOT(1) =	1.000	0.000	0.000	0.000	0.000
ARPLOT(6) =	2.000	0.000	0.000	0.000	0.000
ARPLOT(11) =	3.000	0.000	0.000	0.000	0.000
ARPLOT(16) =	4.000	0.000	0.000	0.000	0.000
ARPLOT(21) =	5.000	0.000	0.000	0.000	0.000
ARPLOT(26) =	6.000	0.000	0.000	0.000	0.000
ARPLOT(31) =	7.000	0.000	0.000	0.000	0.000
ARPLOT(36) =	8.000	0.000	0.000	0.000	0.000
ARPLOT(41) =	9.000	0.000	0.000	0.000	0.000
ARPLOT(46) =	10.000	0.000	0.000	0.000	0.000

TEMPERATURE PLOTS

	PLOT NO.	CHAN NO.	AXIAL NO.	XORIGN	XINCR	YORIGN	YINCR
TPLOT(1) =	1.000	1.000	10.000	0.000	0.000	0.000	0.000
TPLOT(8) =	1.000	1.000	18.000	0.000	0.000	0.000	0.000
TPLOT(15) =	1.000	2.000	10.000	0.000	0.000	0.000	0.000
TPLOT(22) =	1.000	2.000	18.000	0.000	0.000	0.000	0.000
TPLOT(29) =	1.000	6.000	10.000	0.000	0.000	0.000	0.000
TPLOT(36) =	1.000	6.000	18.000	0.000	0.000	0.000	0.000

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

SEGMENT	STARTING SEGMENT HEIGHTS (CM)			CENTERLINE RADIUS OF CHANNEL (CM)					
	BOTTOM OF SEGMENT	CENTER OF SEGMENT	TOP OF SEGMENT	1	2	3	4	5	6
18	86.360	88.900	91.440	3.854	12.193	22.487	33.177	43.975	54.817
17	81.280	83.820	86.360						
16	76.200	78.740	81.280						
15	71.120	73.660	76.200						
14	66.040	68.580	71.120						
13	60.960	63.500	66.040						
12	55.880	58.420	60.960						
11	50.800	53.340	55.880						
10	45.720	48.260	50.800						
9	40.640	43.180	45.720						
8	35.560	38.100	40.640						
7	30.480	33.020	35.560						
6	25.400	27.940	30.480						
5	20.320	22.860	25.400						
4	15.240	17.780	20.320						
3	10.160	12.700	15.240						
2	5.080	7.620	10.160						
1	.000	2.540	5.080						

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

STEADY STATE CONDITIONS

CHANNEL 1

FUEL NODE	AXIAL SEGMENT 1---> 18																	
1	1572.	1711.	1909.	2094.	2234.	2372.	2450.	2553.	2620.	2642.	2619.	2558.	2471.	2371.	2259.	2148.	2014.	1903.
2	1536.	1671.	1861.	2052.	2192.	2327.	2402.	2503.	2569.	2591.	2569.	2510.	2426.	2328.	2221.	2114.	1971.	1864.
3	1473.	1599.	1775.	1955.	2115.	2244.	2315.	2412.	2476.	2498.	2478.	2423.	2343.	2251.	2150.	2046.	1893.	1794.
4	1387.	1500.	1658.	1820.	1991.	2127.	2192.	2264.	2346.	2368.	2350.	2300.	2226.	2143.	2052.	1922.	1786.	1698.
5	1267.	1363.	1496.	1632.	1776.	1908.	2014.	2100.	2158.	2180.	2166.	2122.	2057.	1963.	1854.	1747.	1635.	1564.
6	1106.	1179.	1279.	1381.	1489.	1588.	1669.	1736.	1783.	1805.	1799.	1770.	1726.	1661.	1585.	1511.	1432.	1382.
7	912.	955.	1015.	1076.	1141.	1202.	1251.	1293.	1325.	1343.	1347.	1338.	1321.	1291.	1255.	1218.	1178.	1153.
8	711.	731.	757.	783.	810.	837.	862.	884.	904.	919.	931.	938.	942.	942.	939.	935.	929.	927.
9	613.	623.	636.	649.	664.	680.	696.	712.	728.	743.	758.	772.	785.	796.	806.	815.	822.	829.
10	597.	607.	617.	629.	642.	656.	670.	685.	701.	716.	732.	746.	760.	773.	785.	796.	806.	814.

CHANNEL 2

FUEL NODE	AXIAL SEGMENT 1---> 18																	
1	1543.	1678.	1871.	2056.	2204.	2341.	2418.	2502.	2567.	2589.	2566.	2508.	2423.	2343.	2226.	2115.	1977.	1867.
2	1509.	1639.	1825.	2012.	2163.	2297.	2371.	2454.	2517.	2539.	2518.	2461.	2378.	2302.	2188.	2081.	1935.	1829.
3	1448.	1569.	1742.	1916.	2088.	2216.	2285.	2365.	2427.	2449.	2429.	2376.	2297.	2226.	2120.	2007.	1859.	1762.
4	1364.	1474.	1623.	1785.	1951.	2102.	2165.	2240.	2299.	2321.	2304.	2255.	2183.	2121.	2013.	1886.	1755.	1663.
5	1248.	1341.	1471.	1602.	1743.	1872.	1975.	2060.	2115.	2137.	2124.	2082.	2018.	1926.	1821.	1717.	1609.	1539.
6	1092.	1163.	1261.	1360.	1465.	1562.	1640.	1705.	1751.	1772.	1766.	1739.	1696.	1633.	1560.	1488.	1412.	1363.
7	904.	946.	1005.	1064.	1127.	1187.	1235.	1276.	1307.	1325.	1328.	1320.	1303.	1274.	1239.	1204.	1165.	1141.
8	708.	727.	753.	779.	806.	832.	856.	878.	897.	913.	924.	931.	935.	935.	932.	928.	923.	921.
9	612.	623.	635.	648.	663.	678.	694.	709.	725.	740.	755.	768.	781.	792.	802.	810.	818.	825.
10	597.	606.	617.	628.	641.	654.	669.	684.	699.	714.	729.	744.	757.	770.	782.	792.	802.	810.

CHANNEL 3

FUEL NODE	AXIAL SEGMENT 1---> 18																	
1	1432.	1549.	1725.	1894.	2065.	2188.	2272.	2357.	2390.	2400.	2387.	2353.	2293.	2201.	2101.	1982.	1831.	1734.
2	1403.	1515.	1685.	1847.	2020.	2148.	2230.	2313.	2344.	2355.	2342.	2311.	2252.	2163.	2065.	1939.	1794.	1701.
3	1349.	1454.	1612.	1763.	1925.	2074.	2152.	2232.	2262.	2273.	2262.	2233.	2178.	2095.	1985.	1861.	1727.	1641.
4	1276.	1371.	1513.	1648.	1794.	1932.	2042.	2119.	2146.	2157.	2148.	2124.	2075.	1978.	1864.	1754.	1635.	1560.
5	1174.	1255.	1376.	1489.	1612.	1729.	1824.	1898.	1950.	1970.	1959.	1922.	1867.	1787.	1695.	1605.	1508.	1446.
6	1037.	1100.	1191.	1277.	1369.	1458.	1530.	1588.	1629.	1648.	1644.	1621.	1564.	1500.	1467.	1404.	1335.	1291.
7	872.	911.	964.	1017.	1073.	1127.	1174.	1211.	1239.	1256.	1259.	1253.	1239.	1214.	1183.	1152.	1117.	1090.
8	697.	715.	739.	763.	788.	812.	835.	855.	873.	888.	898.	906.	910.	910.	908.	905.	901.	899.
9	610.	620.	632.	644.	658.	672.	687.	702.	717.	731.	745.	758.	770.	781.	790.	798.	805.	812.
10	597.	606.	615.	626.	638.	651.	665.	679.	693.	708.	722.	736.	749.	761.	772.	782.	791.	799.

CHANNEL 4
FUEL NODE

AXIAL	SEGMENT 1---> 18																	
1	1324.	1425.	1577.	1729.	1883.	2029.	2120.	2191.	2230.	2244.	2232.	2198.	2145.	2067.	1952.	1827.	1698.	1616.
2	1298.	1396.	1542.	1689.	1837.	1980.	2081.	2151.	2189.	2204.	2192.	2160.	2109.	2028.	1910.	1790.	1666.	1587.
3	1252.	1344.	1480.	1617.	1755.	1889.	1997.	2079.	2116.	2130.	2119.	2090.	2037.	1942.	1833.	1722.	1608.	1536.
4	1189.	1272.	1395.	1518.	1642.	1763.	1862.	1943.	1997.	2018.	2006.	1967.	1908.	1824.	1728.	1630.	1529.	1465.
5	1101.	1172.	1277.	1382.	1486.	1588.	1674.	1743.	1791.	1811.	1804.	1773.	1727.	1659.	1581.	1501.	1418.	1366.
6	984.	1038.	1118.	1198.	1278.	1355.	1422.	1476.	1514.	1532.	1530.	1513.	1483.	1437.	1383.	1327.	1268.	1231.
7	841.	875.	925.	972.	1022.	1070.	1112.	1149.	1176.	1192.	1197.	1193.	1182.	1161.	1136.	1108.	1078.	1060.
8	686.	703.	725.	748.	771.	795.	816.	836.	853.	868.	878.	886.	891.	893.	892.	891.	887.	887.
9	608.	618.	629.	642.	655.	669.	683.	698.	713.	727.	741.	754.	766.	776.	786.	794.	802.	809.
10	597.	605.	615.	626.	638.	650.	664.	678.	692.	707.	721.	734.	747.	759.	770.	780.	789.	797.

CHANNEL 5
FUEL NODE

AXIAL NODE	AXIAL SEGMENT 1---> 18																	
1	1371.	1478.	1638.	1797.	1961.	2098.	2188.	2250.	2300.	2319.	2300.	2253.	2199.	2115.	2012.	1879.	1740.	1651.
2	1343.	1446.	1601.	1754.	1912.	2057.	2148.	2208.	2257.	2277.	2258.	2213.	2160.	2080.	1967.	1839.	1705.	1620.
3	1294.	1390.	1535.	1677.	1824.	1965.	2074.	2132.	2180.	2199.	2182.	2140.	2091.	2003.	1886.	1767.	1644.	1566.
4	1226.	1314.	1444.	1571.	1703.	1831.	1934.	2017.	2071.	2090.	2075.	2033.	1969.	1877.	1774.	1669.	1560.	1491.
5	1133.	1207.	1318.	1425.	1537.	1644.	1733.	1805.	1852.	1871.	1861.	1828.	1776.	1702.	1618.	1532.	1443.	1386.
6	1007.	1064.	1148.	1230.	1314.	1396.	1463.	1519.	1557.	1574.	1571.	1550.	1516.	1466.	1408.	1347.	1283.	1243.
7	854.	890.	940.	990.	1042.	1091.	1134.	1171.	1198.	1213.	1217.	1211.	1197.	1174.	1146.	1116.	1083.	1063.
8	691.	708.	730.	753.	776.	799.	820.	840.	857.	870.	880.	887.	891.	892.	890.	887.	882.	881.
9	609.	618.	629.	641.	654.	667.	681.	695.	709.	723.	736.	748.	759.	769.	778.	786.	793.	799.
10	596.	605.	614.	624.	635.	647.	660.	673.	687.	701.	714.	727.	739.	751.	761.	771.	779.	787.

CHANNEL 6
FUEL NODE

AXIAL SEGMENT 1--> 18																		
1	1031.	1091.	1181.	1270.	1364.	1452.	1525.	1585.	1628.	1645.	1637.	1609.	1567.	1505.	1434.	1364.	1291.	1244.
2	1017.	1075.	1161.	1247.	1339.	1424.	1494.	1552.	1594.	1610.	1603.	1577.	1537.	1477.	1410.	1343.	1273.	1228.
3	991.	1045.	1126.	1207.	1292.	1372.	1438.	1493.	1532.	1548.	1542.	1519.	1482.	1428.	1366.	1304.	1239.	1198.
4	955.	1004.	1077.	1151.	1228.	1301.	1361.	1411.	1448.	1463.	1459.	1440.	1408.	1361.	1305.	1251.	1194.	1157.
5	905.	948.	1010.	1073.	1139.	1201.	1254.	1298.	1330.	1345.	1344.	1329.	1305.	1266.	1221.	1176.	1129.	1099.
6	837.	871.	920.	968.	1019.	1068.	1109.	1145.	1172.	1185.	1187.	1179.	1164.	1137.	1106.	1074.	1041.	1020.
7	753.	776.	807.	839.	872.	904.	932.	956.	974.	987.	992.	992.	987.	976.	962.	947.	930.	920.
8	654.	667.	682.	699.	716.	732.	748.	763.	776.	787.	796.	803.	808.	811.	811.	811.	810.	811.
9	602.	610.	618.	628.	638.	649.	660.	671.	683.	694.	705.	715.	724.	733.	741.	747.	753.	759.
10	595.	602.	609.	618.	627.	637.	648.	659.	670.	681.	692.	703.	713.	722.	731.	739.	745.	752.

C-54

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

	TIME(SEC)/	POWER(MW)/	CORE TEMP/	MOL TEMP/	% MELT/	MW SEC/
STEP	NET RHO/ C1	PROGRAMED/ C2	SCRAM/ C3	DOPPLER/ C4	COLLAPSE/ C5	VOI V/ C6
5	1.7989-03 .180	3.8075+02 .180	1.3633+03 - .000	0.0000 - .000	0.0000 .000	6.8432-01 .000
	4.6614+06	1.5102+07	3.1747+06	2.3561+06	2.7907+05	3.5671+04
10	1.0917-01 10.652	4.2690+02 10.917	1.3654+03 - .000	0.0000 - .265	0.0000 .000	4.3952+01 .000
	2.3309+00	7.5523+00	1.5887+00	1.1806+00	1.4068-01	1.8205-02

AXIAL SEGMENT 10

	FUEL CENTER	FUEL OUTER NODE	CLAD	COOLANT
CHANNEL				
1	2642.	1343.	743.	716.
2	2589.	1325.	740.	714.
3	2400.	1256.	731.	708.
4	2244.	1192.	727.	707.
5	2319.	1213.	723.	701.
6	1645.	987.	694.	661.
1	2644.	1347.	744.	717.
2	2591.	1328.	741.	714.
3	2403.	1259.	732.	708.
4	2247.	1195.	728.	707.
5	2322.	1216.	723.	701.
6	1646.	989.	694.	661.

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

TIME(SEC)	POWER(MW)	CORE TEMP	MOL TEMP	% MELT	MW-SEC GEN	MW-SEC OUT	MOLTEN MW-SEC	KILOS MOLTEN FUEL
2.0000-01	4.7539+02	1.3707+03	0.0000	0.0000	8.4858+01	7.9165+01	0.0000	0.0000
NET RHO	PROGRAMED	SCRAM	DOPPLER	COLLAPSE	VOID	LINEAR-FUEL	CLAD	COOLANT
19.071	20.000	-.000	-.929	.000	.000	.000	.000	.000
C1	C2	C3	C4	C5	C6			
2.3314+00	7.5563+00	1.5923+00	1.1873+00	1.4352-01	1.9043-02	EFF DOPP =	-.038172	VOID DOPP = -.005000

SEGMENT 9

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	2628.	2577.	2485.	2355.	2168.	1795.	1337.	
2	2575.	2526.	2436.	2309.	2126.	1763.	1319.	
3	2398.	2352.	2270.	2154.	1961.	1640.	1250.	
4	2238.	2197.	2123.	2007.	1801.	1524.	1186.	
5	2308.	2266.	2188.	2080.	1862.	1567.	1208.	
6	1635.	1600.	1539.	1455.	1338.	1179.	981.	

SEGMENT 10

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	2650.	2599.	2507.	2378.	2190.	1817.	1355.	
2	2597.	2547.	2457.	2330.	2147.	1784.	1336.	
3	2409.	2363.	2281.	2165.	1981.	1659.	1266.	
4	2252.	2212.	2138.	2027.	1821.	1542.	1202.	
5	2327.	2285.	2208.	2099.	1881.	1585.	1223.	
6	1651.	1617.	1555.	1471.	1353.	1193.	993.	

SEGMENT 11

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	2627.	2577.	2487.	2360.	2176.	1810.	1358.	
2	2574.	2526.	2437.	2313.	2134.	1778.	1340.	
3	2395.	2350.	2270.	2156.	1970.	1655.	1270.	
4	2239.	2200.	2127.	2015.	1813.	1541.	1206.	
5	2308.	2266.	2190.	2084.	1871.	1581.	1226.	
6	1643.	1610.	1549.	1467.	1351.	1194.	999.	

SEGMENT 12

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	2566.	2519.	2431.	2309.	2132.	1782.	1349.	
2	2516.	2469.	2384.	2264.	2092.	1750.	1331.	
3	2361.	2319.	2241.	2131.	1933.	1632.	1263.	
4	2205.	2167.	2097.	1976.	1783.	1522.	1202.	
5	2261.	2221.	2147.	2042.	1837.	1560.	1220.	
6	1615.	1583.	1526.	1447.	1336.	1186.	998.	

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SAMPLE CASE, 1%/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

STEP	TIME(SEC)/ NET RHO/ C1	POWER(MW)/ PROGRAMED/ C2	CORE TEMP/ SCRAM/ C3	MOL TEMP/ DOPPLER/ C4	% MELT/ COLLAPSE/ C5	MW SEC/ VOID/ C6
15	2.2640-01	4.0142+02	1.3730+03	0.0000	0.0000	9.7621+01
	21.434	22.640	-1.000	-1.206	.000	.000
	2.3316+00	7.5580+00	1.5939+00	1.1901+00	1.4469-01	1.9376-02
20	3.5841-01	5.8715+02	1.3897+03	0.0000	0.0000	1.6852+02
	32.589	35.841	-1.000	-3.252	.000	.000
	2.3333+00	7.5710+00	1.6054+00	1.2112+00	1.5323-01	2.1654-02

AXIAL SEGMENT 10

CHANNEL	FUEL CENTER	FUEL OUTER NODE	CLAD	COOLANT
1	2653.	1358.	746.	716.
2	2600.	1340.	743.	716.
3	2411.	1269.	733.	710.
4	2255.	1204.	729.	708.
5	2330.	1226.	725.	702.
6	1653.	995.	695.	682.
1	2671.	1383.	750.	722.
2	2619.	1363.	747.	720.
3	2430.	1290.	737.	713.
4	2273.	1224.	733.	712.
5	2348.	1246.	729.	706.
6	1670.	1008.	698.	685.

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

TIME(SEC)	POWER(MW)	CORE TEMP	MOL TEMP	% MELT	MW-SEC GEN	MW-SEC OUT	MOLTEN MW-SEC	KILOS MOLTEN FUEL
4.0000-01	6.2328+02	1.3970+03	0.0000	0.0000	1.9368+02	1.5956+02	0.0000	0.0000
NET RHO	PROGRAMED	SCRAM	DOPPLER	COLLAPSE	VOID	LINEAR-FUEL	CLAD	COOLANT
35.852	40.000	-.000	-4.148	.000	.000	.000	.000	.000
C1	C2	C3	C4	C5	C6			
2.3340+00	7.5768+00	1.6106+00	1.2207+00	1.5694-01	2.2597-02	EFF DOPP =	-.005082	VOID DOPP = -.005000

SEGMENT 9

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	2658.	2608.	2517.	2390.	2203.	1841.	1374.	
2	2606.	2557.	2468.	2344.	2164.	1805.	1355.	
3	2427.	2382.	2300.	2182.	2003.	1681.	1283.	
4	2266.	2226.	2151.	2043.	1837.	1561.	1216.	
5	2338.	2296.	2220.	2113.	1899.	1605.	1239.	
6	1660.	1626.	1565.	1482.	1365.	1205.	1002.	

SEGMENT 10

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	2680.	2630.	2539.	2409.	2217.	1869.	1393.	
2	2627.	2578.	2490.	2365.	2185.	1825.	1373.	
3	2438.	2393.	2311.	2194.	2023.	1699.	1300.	
4	2281.	2240.	2166.	2062.	1857.	1579.	1232.	
5	2357.	2315.	2238.	2129.	1920.	1623.	1255.	
6	1677.	1643.	1581.	1497.	1380.	1218.	1014.	

SEGMENT 11

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	2656.	2607.	2518.	2392.	2207.	1858.	1395.	
2	2604.	2556.	2469.	2347.	2171.	1819.	1375.	
3	2424.	2380.	2299.	2184.	2011.	1694.	1303.	
4	2267.	2227.	2154.	2050.	1848.	1576.	1236.	
5	2337.	2296.	2221.	2116.	1907.	1618.	1258.	
6	1668.	1635.	1575.	1493.	1378.	1220.	1019.	

SEGMENT 12

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	2596.	2549.	2463.	2343.	2169.	1822.	1385.	
2	2545.	2499.	2416.	2298.	2128.	1790.	1366.	
3	2390.	2347.	2269.	2158.	1973.	1670.	1295.	
4	2233.	2194.	2123.	2011.	1817.	1557.	1231.	
5	2289.	2249.	2177.	2075.	1872.	1596.	1250.	
6	1640.	1608.	1551.	1472.	1362.	1210.	1018.	

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SAMPLE CASE, 1%/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

	TIME(SEC)/	POWER(MW)/	CORE TEMP/	MOL TEMP/	% MELT/	MW SEC/
ST, P	NET RHO/	PROGRAMED/	SCRAM/	DOPPLER/	COLLAPSE/	VOID/
	C1	C2	C3	C4	C5	C6
25	4.8896-01	7.1355+02	1.4169+03	0.0000	0.0000	2.5304+02
	42.365	48.396	-0.000	-6.531	.000	.000
	2.3360+00	7.5928+00	1.6248+00	1.2462+00	1.6680-01	2.5323-02

AXIAL SEGMENT 10

	FUEL	FUEL		
	CENTER	OUTER	CLAD	COOLANT
CHANNEL		NODE		
1	2703.	1422.	757.	728.
2	2650.	1399.	753.	725.
3	2461.	1324.	744.	718.
4	2303.	1254.	739.	717.
5	2379.	1278.	735.	711.
6	1697.	1030.	703.	689.

SAMPLE CASE, 1s/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

TIME(SEC)	POWER(MW)	CORE TEMP	MOL TEMP	% MELT	MW-SEC GEN	MW-SEC OUT	MOLTEN MW-SEC	KILOS MOLTEN FUEL
6.0000-01	8.5096+02	1.4505+03	0.0000	0.0000	3.3966+02	2.4360+02	0.0000	0.0000
N _E T RHO	PROGRAMED	SCRAM	DOPPLER	COLLAPSE	VOID	LINEAR-FUEL	CLAD	COOLANT
49.510	60.000	-0.000	-10.490	.000	.000	.000	.000	.000
C1	C2	C3	C4	C5	C6			
2.3396+00	7.6205+00	1.6493+00	1.2902+00	1.8331-01	2.8921-02	EFF DOPP =	-0.005070	VOID DOPP = -0.005000

SEGMENT 9

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	2721.	2673.	2583.	2454.	2258.	1949.	1449.	
2	2670.	2622.	2536.	2414.	2230.	1901.	1426.	
3	2489.	2445.	2363.	2249.	2084.	1761.	1348.	
4	2326.	2286.	2214.	2113.	1912.	1634.	1275.	
5	2400.	2359.	2282.	2170.	1984.	1683.	1300.	
6	1715.	1681.	1621.	1538.	1421.	1257.	1043.	

SEGMENT 10

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	2742.	2693.	2602.	2471.	2273.	1975.	1470.	
2	2690.	2643.	2556.	2432.	2243.	1928.	1445.	
3	2500.	2456.	2376.	2263.	2101.	1779.	1365.	
4	2341.	2301.	2230.	2128.	1932.	1652.	1291.	
5	2418.	2376.	2298.	2184.	2006.	1701.	1316.	
6	1731.	1697.	1637.	1553.	1435.	1271.	1055.	

SEGMENT 11

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	2718.	2670.	2582.	2454.	2261.	1963.	1470.	
2	2667.	2620.	2536.	2415.	2232.	1916.	1446.	
3	2485.	2441.	2362.	2250.	2089.	1773.	1367.	
4	2326.	2287.	2216.	2117.	1922.	1648.	1294.	
5	2398.	2357.	2281.	2171.	1991.	1694.	1318.	
6	1721.	1688.	1629.	1548.	1432.	1271.	1060.	

SEGMENT 12

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	2658.	2612.	2528.	2409.	2229.	1918.	1454.	
2	2608.	2563.	2482.	2368.	2199.	1874.	1432.	
3	2449.	2406.	2328.	2216.	2055.	1748.	1358.	
4	2289.	2251.	2180.	2082.	1889.	1627.	1287.	
5	2349.	2310.	2239.	2137.	1948.	1668.	1309.	
6	1691.	1660.	1603.	1525.	1415.	1260.	1057.	

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SAMPLE CASE, 1%/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

STEP	TIME(SEC)/ NET RHO/ C1	POWER(MW)/ PROGRAMED/ C2	CORE TEMP/ SCRAM/ C3	MOL TEMP/ DOPPLER/ C4	% MELT/ COLLAPSE/ C5	MW SEC/ VOID/ C6
00	6.3450-01	9.0081+02	1.4632+03	0.0000	0.0000	3.6938+02
	51.484	83.450	-1.000	-11.965	.000	.000
	2.3409+00	7.6311+00	1.6587+00	1.3070+00	1.8952-01	3.0349-02

AXIAL SEGMENT 10

CHANNEL	FUEL CENTER	FUEL OUTER NODE	CLAD	COOLANT
1	2757.	1487.	768.	730.
2	2705.	1462.	765.	735.
3	2515.	1380.	754.	727.
4	2355.	1305.	749.	720.
5	2432.	1331.	745.	720.
6	1744.	1065.	711.	696.

SAMPLE CASE, 1S/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

TIME(SEC)	POWER(MW)	CORE TEMP	MOL TEMP	% MELT	MW-SEC GEN	MW-SEC OUT	MOLTEN MW-SEC	KILOS MOLTEN FUEL
8.0000-01	1.1777+03	1.5414+03	0.0000	0.0000	5.4108+02	3.3469+02	0.0000	0.0000
NET RHO	PROGRAMED	SCRAM	DOPPLER	COLLAPSE	VOID	LINEAR-FUEL	CLAD	COOLANT
59.272	80.000	-0.000	-20.728	.000	.000	.000	.000	.000
C1	C2	C3	C4	C5	C6			
2.3495+00	7.6985+00	1.7180+00	1.4124+00	2.2748-01	3.8820-02		EFF DOPP = -.005052	VOID DOPP = -.005000

SEGMENT 9

CHANNEL	FUEL NODE	1	---	7
1	2829.	2782.	2694.	2566.
2	2779.	2733.	2649.	2525.
3	2597.	2554.	2478.	2369.
4	2431.	2392.	2319.	2212.
5	2505.	2464.	2387.	2278.
6	1810.	1777.	1718.	1635.

SEGMENT 10

CHANNEL	FUEL NODE	1	---	7
1	2848.	2800.	2711.	2583.
2	2798.	2752.	2666.	2542.
3	2607.	2566.	2490.	2382.
4	2445.	2406.	2333.	2227.
5	2521.	2479.	2403.	2294.
6	1825.	1793.	1733.	1650.

SEGMENT 11

CHANNEL	FUEL NODE	1	---	7
1	2824.	2777.	2690.	2565.
2	2774.	2729.	2645.	2524.
3	2590.	2549.	2474.	2368.
4	2429.	2390.	2319.	2214.
5	2501.	2460.	2384.	2278.
6	1814.	1782.	1724.	1643.

SEGMENT 12

CHANNEL	FUEL NODE	1	---	7
1	2764.	2719.	2637.	2517.
2	2714.	2672.	2592.	2477.
3	2551.	2510.	2436.	2331.
4	2388.	2351.	2282.	2181.
5	2452.	2413.	2341.	2236.
6	1782.	1751.	1695.	1618.

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SAMPLE CASE, 1%/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

TIME(SEC)	POWER(MW)	CORE TEMP	MOL TEMP	% MELT	MA-SEC GEN	MW-SEC OUT	MOLTEN MW-SEC	KILOS MOLTEN FUEL
1.0000+00	1.5890+03	1.6771+03	0.0000	0.0000	8.1715+02	4.3737+02	0.0000	0.0000
INIT RHO	PROGRAMED	SCRAM	DOPLER	COLLAPSE	VOID	LINEAR-FUEL	CLAD	COOLANT
05.140	100.000	-0.000	-34.860	.000	.000	.000	.000	.000
C1	C2	C3	C4	C5	C6			
2.3654+00	7.8228+00	1.8267+00	1.6034+00	2.9347-01	5.2748-02	EFF DOPP =	-0.005026	VOID DOPP = -0.005000

SEGMENT 9

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	2969.	2944.	2861.	2742.	2567.	2300.	1741.	
2	2940.	2896.	2810.	2699.	2526.	2264.	1714.	
3	2758.	2718.	2644.	2536.	2371.	2115.	1613.	
4	2586.	2546.	2478.	2378.	2226.	1953.	1515.	
5	2602.	2623.	2551.	2447.	2285.	2022.	1551.	
6	1955.	1923.	1865.	1744.	1663.	1481.	1213.	

SEGMENT 10

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3006.	2960.	2877.	2759.	2583.	2315.	1764.	
2	2957.	2913.	2832.	2715.	2543.	2282.	1733.	
3	2768.	2729.	2656.	2548.	2384.	2132.	1631.	
4	2599.	2561.	2492.	2392.	2239.	1973.	1532.	
5	2676.	2637.	2565.	2461.	2298.	2041.	1569.	
6	1969.	1938.	1880.	1798.	1677.	1495.	1227.	

SEGMENT 11

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	2980.	2936.	2854.	2738.	2565.	2303.	1760.	
2	2932.	2889.	2809.	2695.	2525.	2268.	1731.	
3	2749.	2710.	2636.	2532.	2369.	2120.	1630.	
4	2581.	2544.	2475.	2377.	2227.	1963.	1533.	
5	2654.	2616.	2545.	2443.	2284.	2028.	1567.	
6	1956.	1925.	1868.	1748.	1669.	1491.	1230.	

SEGMENT 12

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	2920.	2878.	2799.	2686.	2518.	2266.	1737.	
2	2872.	2831.	2755.	2644.	2478.	2229.	1711.	
3	2706.	2667.	2596.	2493.	2333.	2086.	1613.	
4	2557.	2501.	2434.	2338.	2195.	1927.	1519.	
5	2604.	2567.	2498.	2399.	2247.	1989.	1551.	
6	1920.	1890.	1836.	1758.	1644.	1473.	1223.	

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SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

TIME(SEC)	POWER(MW)	CORE TEMP	MOL TEMP	% MELT	MW-SEC GEN	MW-SEC OUT	MOLTEN MW-SEC	KILOS MOLTEN FUEL
1.2000+00	2.0600+03	1.8559+03	3.0427+03	3.9943-02	1.1815+03	5.5699+02	3.4698-01	1.2392+00
NET RHO	PROGRAMED	SCRAM	DOPPLER	COLLAPSE	VOID	LINEAR-FUEL	CLAD	COOLANT
68.277	120.000	-0.000	-51.723	.000	.000	.000	.000	.000
C1	C2	C3	C4	C5	C6			
2.3883+00	8.0016+00	1.9820+00	1.8729+00	3.8203-01	7.0252-02	EFF DOPP =	-0.004994	VOID DOPP = -0.005000

SEGMENT 9

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3045.	3043.	3041.	2967.	2797.	2503.	2000.	
2	3043.	3042.	3029.	2927.	2758.	2469.	1967.	
3	2968.	2931.	2861.	2760.	2603.	2347.	1828.	
4	2790.	2755.	2688.	2591.	2440.	2204.	1704.	
5	2868.	2832.	2764.	2663.	2510.	2269.	1747.	
6	2143.	2116.	2064.	1982.	1857.	1659.	1348.	

SEGMENT 10

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3045.	3044.	3041.	2979.	2811.	2518.	2022.	
2	3044.	3042.	3040.	2941.	2772.	2484.	1989.	
3	2978.	2941.	2872.	2771.	2615.	2356.	1851.	
4	2802.	2767.	2701.	2604.	2454.	2221.	1723.	
5	2881.	2845.	2776.	2677.	2524.	2284.	1766.	
6	2155.	2128.	2078.	1996.	1871.	1673.	1363.	

SEGMENT 11

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3045.	3043.	3040.	2960.	2792.	2504.	2016.	
2	3043.	3042.	3021.	2919.	2753.	2469.	1983.	
3	2956.	2919.	2851.	2751.	2598.	2345.	1846.	
4	2781.	2747.	2681.	2586.	2438.	2209.	1722.	
5	2858.	2822.	2754.	2656.	2506.	2270.	1763.	
6	2140.	2114.	2063.	1982.	1860.	1667.	1364.	

SEGMENT 12

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3043.	3041.	3010.	2908.	2744.	2465.	1987.	
2	3041.	3038.	2969.	2866.	2705.	2432.	1953.	
3	2909.	2873.	2806.	2707.	2557.	2316.	1819.	
4	2735.	2700.	2637.	2543.	2398.	2173.	1704.	
5	2805.	2770.	2704.	2608.	2461.	2232.	1741.	
6	2102.	2076.	2025.	1947.	1830.	1645.	1355.	

SAMPLE CASE, 1%/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

TIME(SEC)	POWER(MW)	CORE TEMP	MOL TEMP	% MELT	MW-SEC GEN	MW-SEC OUT	MOLTEN MW-SEC	KILOS MOLTEN FUEL
1.3000+00	2.3227+03	1.9597+03	3.0446+03	1.9578-01	1.4008+03	6.2489+02	1.7007+00	6.0741+00
NET RHO	PROGRAMED	SCRAM	DOPPLER	COLLAPSE	VOID	LINEAR-FUEL	CLAD	COOLANT
09.285	130.000	-0.000	-60.715	.000	.000	.000	.000	.000
C1	C2	C3	C4	C5	C6			
2.4027+00	8.1138+00	2.0789+00	2.0394+00	4.3479-01	8.0235-02	EFF DOPP =	-0.004956	VOID DOPP = -0.005000

SEGMENT 9

CHANNEL	FUEL NODE	1	---	7
1	3049.	3047.	3044.	3041.
2	3047.	3046.	3043.	3039.
3	3041.	3040.	2986.	2888.
4	2909.	2874.	2810.	2716.
5	2988.	2953.	2887.	2790.
6	2251.	2224.	2175.	2103.

SEGMENT 10

CHANNEL	FUEL NODE	1	---	7
1	3050.	3048.	3045.	3041.
2	3048.	3046.	3043.	3040.
3	3042.	3041.	2996.	2898.
4	2920.	2886.	2822.	2728.
5	3000.	2965.	2899.	2803.
6	2263.	2236.	2187.	2115.

SEGMENT 11

CHANNEL	FUEL NODE	1	---	7
1	3049.	3047.	3044.	3041.
2	3047.	3045.	3043.	3031.
3	3041.	3039.	2975.	2878.
4	2898.	2864.	2801.	2709.
5	2976.	2941.	2876.	2781.
6	2246.	2220.	2172.	2101.

SEGMENT 12

CHANNEL	FUEL NODE	1	---	7
1	3046.	3045.	3042.	3021.
2	3045.	3043.	3041.	2987.
3	3027.	2992.	2927.	2832.
4	2849.	2816.	2755.	2664.
5	2921.	2888.	2824.	2731.
6	2206.	2181.	2134.	2063.

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

FUEL COLLAPSE HAS STARTED

CORE AVERAGE TEMPERATURE = 2071. DEGREES KELVIN

TIME SINCE BEGINING OF TRANSIENT = 1.400+00 SECONDS

POWER = 2.608+03 MEGAWATTS

NET REACTIVITY = 70.059 CENTS

RAMP RATE = 1.000 DOLLARS/SEC

AVERAGE TEMPERATURE OF MOLTEN FUEL = 3054. DEGREES KELVIN

PERCENT OF CORE MOLTEN = .76 PERCENT

FUEL COLLAPSE HAS STARTED AT AXIAL SEGMENT 9 OF CHANNEL 1

SAMPLE CASE, 1%/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

TIME(SEC)	POWER(MW)	CORE TEMP	MOL TEMP	% MELT	MW-SEC GEN	MW-SEC OUT	MOLTEN MW-SEC	KILOS MOLTEN FUEL
1.4000+00	2.6076+03	2.0715+03	3.0538+03	7.5794-01	1.6477+03	6.9909+02	6.6905+00	2.3515+01
N.T RHO	PROGRAMED	SCRAM	DOPPLER	COLLAPSE	VOID	LINEAR-FUEL	CLAD	COOLANT
70.212	140.000	-0.000	-69.788	.000	.000	.000	.000	.000
C1	C2	C3	C4	C5	C6			
2.4192+00	8.2430+00	2.1902+00	2.2293+00	4.9365-01	9.1143-02	EFF DOPP =	-0.004905	VOID DOPP = -0.005000

SEGMENT 9

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3201.	3150.	3049.	3045.	3040.	2774.	2245.	
2	3131.	3064.	3048.	3044.	3011.	2738.	2219.	
3	3045.	3044.	3042.	3017.	2868.	2592.	2105.	
4	3038.	3005.	2943.	2851.	2703.	2443.	1966.	
5	3042.	3041.	3018.	2926.	2774.	2504.	2022.	
6	2369.	2343.	2295.	2222.	2107.	1882.	1514.	

SEGMENT 10

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3224.	3166.	3050.	3045.	3040.	2787.	2261.	
2	3150.	3088.	3048.	3044.	3021.	2752.	2235.	
3	3046.	3044.	3042.	3025.	2878.	2605.	2124.	
4	3040.	3015.	2954.	2862.	2715.	2455.	1988.	
5	3043.	3041.	3029.	2938.	2786.	2517.	2042.	
6	2380.	2355.	2306.	2233.	2120.	1897.	1530.	

SEGMENT 11

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3178.	3125.	3049.	3044.	3035.	2771.	2255.	
2	3104.	3050.	3047.	3043.	3003.	2735.	2229.	
3	3045.	3044.	3041.	3007.	2859.	2590.	2118.	
4	3025.	2993.	2932.	2841.	2697.	2442.	1983.	
5	3042.	3041.	3006.	2915.	2766.	2502.	2035.	
6	2363.	2337.	2289.	2218.	2106.	1887.	1531.	

SEGMENT 12

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3079.	3049.	3047.	3043.	2994.	2728.	2231.	
2	3049.	3048.	3045.	3042.	2961.	2693.	2205.	
3	3043.	3042.	3040.	2964.	2815.	2552.	2091.	
4	2975.	2943.	2883.	2795.	2654.	2409.	1955.	
5	3040.	3016.	2955.	2864.	2719.	2462.	2007.	
6	2320.	2296.	2249.	2180.	2068.	1859.	1518.	

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SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

TIME(SEC)	POWER(MW)	CORE TEMP	MOL TEMP	% MELT	MW-SEC GEN	MW-SEC OUT	MOLTEN MW-SEC	KILOS MOLTEN FUEL
1.4050+00	2.6381+03	2.0771+03	3.0549+03	8.0457-01	1.6608+03	7.0298+02	7.1172+00	2.4962+01
NET RHO	PROGRAMED	SCRAM	DOPPLER	COLLAPSE	VOID	LINEAR-FUEL	CLAD	COOLANT
70.977	140.500	-.000	-70.230	.020	.687	.000	.000	.000
C1	C2	C3	C4	C5	C6			
2.4201+00	8.2500+00	2.1961+00	2.2395+00	4.9676-01	9.1712-02	EFF DOPP =	-.004872	VOID DOPP = -.005000

SEGMENT 9

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3211.	3160.	3050.	3045.	3040.	2780.	2251.	
2	3140.	3077.	3048.	3044.	3017.	2745.	2225.	
3	3046.	3044.	3042.	3022.	2875.	2599.	2111.	
4	3040.	3011.	2949.	2857.	2710.	2449.	1972.	
5	3042.	3041.	3024.	2933.	2781.	2510.	2028.	
6	2375.	2349.	2301.	2228.	2114.	1888.	1519.	

SEGMENT 10

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3234.	3176.	3055.	3045.	3040.	2793.	2266.	
2	3160.	3100.	3048.	3044.	3027.	2759.	2240.	
3	3046.	3045.	3042.	3030.	2885.	2612.	2131.	
4	3040.	3021.	2960.	2869.	2722.	2462.	1994.	
5	3043.	3042.	3034.	2944.	2793.	2524.	2048.	
6	2387.	2361.	2312.	2240.	2127.	1903.	1535.	

SEGMENT 11

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3188.	3135.	3049.	3045.	3040.	2778.	2260.	
2	3114.	3051.	3047.	3043.	3009.	2742.	2234.	
3	3045.	3044.	3042.	3013.	2866.	2597.	2125.	
4	3032.	2999.	2939.	2848.	2704.	2449.	1989.	
5	3042.	3041.	3013.	2922.	2772.	2508.	2042.	
6	2368.	2343.	2295.	2224.	2113.	1893.	1535.	

SEGMENT 12

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3089.	3049.	3047.	3043.	3000.	2735.	2236.	
2	3049.	3048.	3045.	3042.	2967.	2700.	2210.	
3	3044.	3042.	3040.	2971.	2822.	2558.	2097.	
4	2981.	2949.	2890.	2801.	2661.	2415.	1962.	
5	3040.	3022.	2962.	2871.	2725.	2469.	2013.	
6	2326.	2301.	2255.	2186.	2074.	1864.	1522.	

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SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

DO,WARD MOTION OF SEGMENTS (CM)

TIME SINCE START OF COLLAPSE =

5.000 MILLI SEC

	CHANNEL					
SEGMENT	1	2	3	4	5	6
18	.012	.000	.000	.000	.000	.000
17	.012	.000	.000	.000	.000	.000
16	.012	.000	.000	.000	.000	.000
15	.012	.000	.000	.000	.000	.000
14	.012	.000	.000	.000	.000	.000
13	.012	.000	.000	.000	.000	.000
12	.012	.000	.000	.000	.000	.000
11	.012	.000	.000	.000	.000	.000
10	.012	.000	.000	.000	.000	.000
9	.012	.000	.000	.000	.000	.000
8	.000	.000	.000	.000	.000	.000
7	.000	.000	.000	.000	.000	.000
6	.000	.000	.000	.000	.000	.000
5	.000	.000	.000	.000	.000	.000
4	.000	.000	.000	.000	.000	.000
3	.000	.000	.000	.000	.000	.000
2	.000	.000	.000	.000	.000	.000
1	.000	.000	.000	.000	.000	.000

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CURRENT COLLAPSE RAMP RATE = .0392 DOLLARS/SEC

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

VOIDING PATTERN AT 5.000 MILLI SECONDS AFTER START OF VOIDING

	CHANNEL					
SEGMENT	1	2	3	4	5	6
18						
17						
16						
15						
14						
13						
12						
11						
10						
9						
8						
7						
6						
5						
4						
3						
2						
1						

0/-C

CURRENT VOID RAMP RATE = 1.3745 DOLLARS/SEC

SAMPLE CASE, 1%/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

TIME(SEC)	POWER(MW)	CORE TEMP	MOL TEMP	% MELT	MW-SEC GEN	MW-SEC OUT	MOLTEN MW-SEC	KILOS MOLTEN FUEL
1.4100+00	2.7891+03	2.0831+03	3.0564+03	8.5495-01	1.6744+03	7.0690+02	7.5844+00	2.6525+01
NET RHO	PROGRAMED	SCRAM	DOPPLER	COLLAPSE	VOID	LINEAR-FUEL	CLAD	COOLANT
72.732	141.000	-.000	-70.700	.078	2.353	.000	.000	.000
C1	C2	C3	C4	C5	C6			
2.4210+00	8.2572+00	2.2023+00	2.2501+00	5.0007-01	9.2350-02		EFF DOPP = -.004877	VOID DOPP = -.005000

SEGMENT 9

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3222.	3170.	3050.	3045.	3040.	2787.	2256.	
2	3150.	3089.	3048.	3044.	3023.	2752.	2230.	
3	3046.	3044.	3042.	3029.	2882.	2606.	2119.	
4	3040.	3018.	2957.	2865.	2717.	2456.	1980.	
5	3043.	3042.	3031.	2940.	2788.	2518.	2036.	
6	2382.	2356.	2307.	2234.	2121.	1895.	1524.	

SEGMENT 10

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3245.	3186.	3070.	3046.	3041.	2800.	2272.	
2	3170.	3112.	3049.	3044.	3033.	2766.	2246.	
3	3046.	3045.	3043.	3036.	2892.	2619.	2138.	
4	3041.	3028.	2968.	2876.	2729.	2469.	2002.	
5	3043.	3042.	3040.	2952.	2800.	2531.	2056.	
6	2393.	2367.	2319.	2246.	2134.	1910.	1540.	

SEGMENT 11

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3199.	3146.	3049.	3045.	3040.	2785.	2266.	
2	3124.	3064.	3048.	3044.	3015.	2749.	2240.	
3	3045.	3044.	3042.	3019.	2873.	2604.	2132.	
4	3038.	3006.	2946.	2855.	2711.	2455.	1997.	
5	3042.	3041.	3019.	2929.	2780.	2515.	2049.	
6	2375.	2349.	2302.	2230.	2120.	1900.	1540.	

SEGMENT 12

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3100.	3050.	3047.	3043.	3006.	2742.	2242.	
2	3049.	3048.	3046.	3042.	2974.	2707.	2216.	
3	3044.	3043.	3041.	2977.	2829.	2566.	2104.	
4	2988.	2956.	2897.	2808.	2668.	2421.	1969.	
5	3041.	3029.	2969.	2878.	2732.	2476.	2021.	
6	2332.	2308.	2261.	2162.	2081.	1871.	1527.	

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

DOWNWARD MOTION OF SEGMENTS (CM)

TIME SINCE START OF COLLAPSE =

10.000 MILLI SEC

SEGMENT	CHANNEL					
	1	2	3	4	5	6
18	.049	.000	.000	.000	.000	.000
17	.049	.000	.000	.000	.000	.000
16	.049	.000	.000	.000	.000	.000
15	.049	.000	.000	.000	.000	.000
14	.049	.000	.000	.000	.000	.000
13	.049	.000	.000	.000	.000	.000
12	.049	.000	.000	.000	.000	.000
11	.049	.000	.000	.000	.000	.000
10	.049	.000	.000	.000	.000	.000
9	.049	.000	.000	.000	.000	.000
8	.000	.000	.000	.000	.000	.000
7	.000	.000	.000	.000	.000	.000
6	.000	.000	.000	.000	.000	.000
5	.000	.000	.000	.000	.000	.000
4	.000	.000	.000	.000	.000	.000
3	.000	.000	.000	.000	.000	.000
2	.000	.000	.000	.000	.000	.000
1	.000	.000	.000	.000	.000	.000

CURRENT COLLAPSE RAMP RATE =

.1177 DOLLARS/SEC

C-72

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

VOIDING PATTERN AT 10,000 MILLI SECONDS AFTER START OF VOIDING

	CHANNEL					
SEGMENT	1	2	3	4	5	6
18						
17						
16						
15						
14						
13						
12						
11						
10	VOID					
9	VOID					
8						
7						
6						
5						
4						
3						
2						
1						

C-73

CURRENT VOID RAMP RATE = 3.3324 DOLLARS/SEC

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

TIME(SEC)	POWER(MW)	CORE TEMP	MOL TEMP	% MELT	MW-SEC GEN	MW-SEC OUT	MOLTEN MW-SEC	KILOS MOLTEN FUEL
1.4150+00	3.1012+03	2.0899+03	3.0578+03	9.1443-01	1.6892+03	7.1082+02	8.1332+00	2.8370+01
NET RHO	PROGRAMED	SCRAM	DOPPLER	COLLAPSE	VOID	LINEAR-FUEL	CLAD	COOLANT
74.380	141.500	-.000	-71.227	.177	3.931	.000	.000	.000
C1	C2	C3	C4	C5	C6			
2.4220+00	8.2651+00	2.2092+00	2.2619+00	5.0395-01	9.3181-02	EFF DOPP =	-.004874	VOID DOPP = -.004997

SEGMENT 9

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3234.	3182.	3057.	3046.	3041.	2795.	2263.	
2	3162.	3103.	3048.	3044.	3030.	2760.	2237.	
3	3046.	3045.	3043.	3035.	2890.	2615.	2127.	
4	3040.	3026.	2964.	2873.	2725.	2464.	1988.	
5	3043.	3042.	3038.	2948.	2796.	2526.	2044.	
6	2389.	2363.	2314.	2241.	2129.	1902.	1529.	

SEGMENT 10

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3257.	3198.	3086.	3046.	3041.	2808.	2279.	
2	3182.	3125.	3049.	3045.	3039.	2774.	2253.	
3	3046.	3045.	3043.	3040.	2901.	2628.	2146.	
4	3041.	3035.	2975.	2884.	2737.	2476.	2010.	
5	3043.	3042.	3040.	2959.	2808.	2539.	2064.	
6	2400.	2374.	2326.	2253.	2141.	1917.	1546.	

SEGMENT 11

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3210.	3158.	3050.	3045.	3040.	2793.	2273.	
2	3135.	3078.	3048.	3044.	3022.	2757.	2247.	
3	3046.	3044.	3042.	3025.	2881.	2612.	2140.	
4	3040.	3014.	2953.	2863.	2718.	2463.	2005.	
5	3042.	3041.	3026.	2937.	2787.	2523.	2057.	
6	2382.	2356.	2309.	2237.	2127.	1907.	1546.	

SEGMENT 12

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3111.	3050.	3047.	3043.	3013.	2751.	2249.	
2	3050.	3048.	3046.	3042.	2981.	2715.	2223.	
3	3044.	3043.	3041.	2985.	2837.	2574.	2113.	
4	2995.	2964.	2904.	2816.	2676.	2428.	1978.	
5	3041.	3036.	2976.	2886.	2740.	2484.	2029.	
6	2339.	2315.	2268.	2199.	2089.	1878.	1533.	

C-74

SAMPLE CASE, 1%/SEC RAMP WITH FISSION GAS RELEASE

DOWNWARD MOTION OF SEGMENTS (CM)

TIME SINCE START OF COLLAPSE =

15.000 MILLI SEC

	CHANNEL					
SEGMENT	1	2	3	4	5	6
18	.110	.000	.000	.000	.000	.000
17	.110	.000	.000	.000	.000	.000
16	.110	.000	.000	.000	.000	.000
15	.110	.000	.000	.000	.000	.000
14	.110	.000	.000	.000	.000	.000
13	.110	.000	.000	.000	.000	.000
12	.110	.000	.000	.000	.000	.000
11	.110	.000	.000	.000	.000	.000
10	.110	.000	.000	.000	.000	.000
9	.110	.000	.000	.000	.000	.000
8	.000	.000	.000	.000	.000	.000
7	.000	.000	.000	.000	.000	.000
6	.000	.000	.000	.000	.000	.000
5	.000	.000	.000	.000	.000	.000
4	.000	.000	.000	.000	.000	.000
3	.000	.000	.000	.000	.000	.000
2	.000	.000	.000	.000	.000	.000
1	.000	.000	.000	.000	.000	.000

C-75

CURRENT COLLAPSE RAMP RATE =

.2276 DOLLARS/SEC

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

VOIDING PATTERN AT 15.000 MILLI SECONDS AFTER START OF VOIDING

	CHANNEL					
SEGMENT	1	2	3	4	5	6
18						
17						
16						
15						
14						
13						
12	VOID					
11	VOID					
10	VOID					
9	VOID					
8	VOID					
7						
6						
5						
4						
3						
2						
1						

CURRENT VOID RAMP RATE = 2.6951 DOLLARS/SEC

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

TIME(SEC)	POWER(MW)	CORE TEMP	MOL TEMP	% MELT	MW-SEC GEN	MW-SEC OUT	MOLTEN MW-SEC	KILOS MOLTEN FUEL
1.4200+00	3.2946+03	2.0974+03	3.0591+03	9.8545-01	1.7051+03	7.1477+02	8.7858+00	3.0574+01
NET RHO	PROGRAMED	SCRAM	DOPPLER	COLLAPSE	VOID	LINEAR-FUEL	CLAD	COOLANT
79.566	142.000	-0.000	-71.810	.471	8.905	.000	.000	.000
C1	C2	C3	C4	C5	C6			
2.4232+00	8.2739+00	2.2168+00	2.2751+00	5.0839-01	9.4199-02	EFF DOPP =	-0.004864	VOID DOPP = -0.004992

SEGMENT 9

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3247.	3194.	3074.	3046.	3041.	2804.	2271.	
2	3174.	3117.	3049.	3045.	3037.	2770.	2245.	
3	3046.	3045.	3043.	3040.	2899.	2624.	2136.	
4	3041.	3034.	2973.	2881.	2734.	2472.	1998.	
5	3043.	3042.	3040.	2957.	2805.	2535.	2054.	
6	2396.	2371.	2322.	2249.	2137.	1910.	1536.	

SEGMENT 10

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3270.	3211.	3102.	3046.	3041.	2817.	2287.	
2	3195.	3138.	3049.	3045.	3040.	2783.	2261.	
3	3047.	3045.	3043.	3040.	2909.	2637.	2155.	
4	3041.	3040.	2984.	2893.	2746.	2485.	2020.	
5	3044.	3042.	3040.	2968.	2817.	2548.	2074.	
6	2408.	2382.	2333.	2261.	2149.	1926.	1553.	

SEGMENT 11

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3223.	3170.	3050.	3046.	3041.	2801.	2281.	
2	3148.	3093.	3048.	3044.	3030.	2767.	2255.	
3	3046.	3045.	3042.	3033.	2890.	2621.	2149.	
4	3040.	3022.	2962.	2872.	2727.	2472.	2014.	
5	3043.	3042.	3034.	2945.	2796.	2532.	2067.	
6	2389.	2364.	2316.	2245.	2135.	1915.	1553.	

SEGMENT 12

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3123.	3063.	3048.	3044.	3021.	2760.	2257.	
2	3050.	3049.	3046.	3043.	2989.	2724.	2231.	
3	3044.	3043.	3041.	2993.	2846.	2583.	2122.	
4	3003.	2972.	2913.	2824.	2684.	2437.	1987.	
5	3041.	3040.	2985.	2894.	2749.	2492.	2038.	
6	2347.	2322.	2276.	2207.	2097.	1885.	1539.	

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

DOWNWARD MOTION OF SEGMENTS (CM)

TIME SINCE START OF COLLAPSE =

20.000 MILLI SEC

SEGMENT	CHANNEL					
	1	2	3	4	5	6
18	.196	.012	.000	.000	.000	.000
17	.196	.012	.000	.000	.000	.000
16	.196	.012	.000	.000	.000	.000
15	.196	.012	.000	.000	.000	.000
14	.196	.012	.000	.000	.000	.000
13	.196	.012	.000	.000	.000	.000
12	.196	.012	.000	.000	.000	.000
11	.196	.012	.000	.000	.000	.000
10	.196	.012	.000	.000	.000	.000
9	.196	.000	.000	.000	.000	.000
8	.000	.000	.000	.000	.000	.000
7	.000	.000	.000	.000	.000	.000
6	.000	.000	.000	.000	.000	.000
5	.000	.000	.000	.000	.000	.000
4	.000	.000	.000	.000	.000	.000
3	.000	.000	.000	.000	.000	.000
2	.000	.000	.000	.000	.000	.000
1	.000	.000	.000	.000	.000	.000

CURRENT COLLAPSE RAMP RATE = .5886 DOLLARS/SEC

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

VOIDING PATTERN AT 20.000 MILLI SECONDS AFTER START OF VOIDING

	CHANNEL					
SEGMENT	1	2	3	4	5	6
18						
17						
16						
15						
14						
13	VOID					
12	VOID					
11	VOID					
10	VOID					
9	VOID					
8	VOID					
7	VOID					
6	VOID					
5						
4						
3						
2						
1						

C-79

CURRENT VOID RAMP RATE = 9.9478 DOLLARS/SEC

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

TIME(SEC)	POWER(MW)	CORE TEMP	MOL TEMP	% MELT	MW-SEC GEN	MW-SEC OUT	MOLTEN MW-SEC	KILOS MOLTEN FUEL
1.4250+00	7.8262+03	2.1117+03	3.0609+03	1.1225+00	1.7317+03	7.1874+02	1.0043+01	3.4826+01
NET RHO	PROGRAMED	SCRAM.	DOPPLER	COLLAPSE	VOID	LINEAR-FUEL	CLAD	COOLANT
89.739	142.500	-.000	-72.906	1.111	19.035	.000	.000	.000
C1	C2	C3	C4	C5	C6			
2.4251+00	8.2892+00	2.2304+00	2.2994+00	5.1793-01	9.6970-02	EFF DOPP =	-.004840	VOID DOPP = -.004947

SEGMENT 9

CHANNEL	FUEL NODE	1	---	7
1	3270.	3216.	3100.	3046.
2	3197.	3140.	3049.	3045.
3	3047.	3045.	3043.	3040.
4	3041.	3040.	2988.	2896.
5	3044.	3042.	3041.	2972.
6	2410.	2384.	2336.	2263.

SEGMENT 10

CHANNEL	FUEL NODE	1	---	7
1	3292.	3233.	3127.	3047.
2	3217.	3161.	3050.	3045.
3	3047.	3046.	3044.	3041.
4	3041.	3040.	2998.	2908.
5	3044.	3043.	3041.	2983.
6	2421.	2395.	2347.	2275.

SEGMENT 11

CHANNEL	FUEL NODE	1	---	7
1	3246.	3191.	3071.	3046.
2	3170.	3116.	3049.	3045.
3	3046.	3045.	3043.	3040.
4	3041.	3036.	2976.	2887.
5	3043.	3042.	3040.	2960.
6	2402.	2377.	2330.	2259.

SEGMENT 12

CHANNEL	FUEL NODE	1	---	7
1	3144.	3087.	3048.	3044.
2	3072.	3049.	3047.	3043.
3	3045.	3044.	3041.	3007.
4	3017.	2986.	2927.	2839.
5	3041.	3040.	2999.	2909.
6	2359.	2335.	2289.	2220.

C-80

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

DOWNWARD MOTION OF SEGMENTS (CM)

TIME SINCE START OF COLLAPSE =

25.000 MILLI SEC

	CHANNEL					
SEGMENT	1	2	3	4	5	6
18	.307	.049	.000	.000	.000	.000
17	.307	.049	.000	.000	.000	.000
16	.307	.049	.000	.000	.000	.000
15	.307	.049	.000	.000	.000	.000
14	.307	.049	.000	.000	.000	.000
13	.307	.049	.000	.000	.000	.000
12	.307	.049	.000	.000	.000	.000
11	.307	.049	.000	.000	.000	.000
10	.307	.049	.000	.000	.000	.000
9	.307	.012	.000	.000	.000	.000
8	.012	.000	.000	.000	.000	.000
7	.000	.000	.000	.000	.000	.000
6	.000	.000	.000	.000	.000	.000
5	.000	.000	.000	.000	.000	.000
4	.000	.000	.000	.000	.000	.000
3	.000	.000	.000	.000	.000	.000
2	.000	.000	.000	.000	.000	.000
1	.000	.000	.000	.000	.000	.000

CURRENT COLLAPSE RAMP RATE = 1.5665 DOLLARS/SEC

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

VOIDING PATTERN AT 25,000 MILLI SECONDS AFTER START OF VOIDING

	CHANNEL					
SEGMENT	1	2	3	4	5	6
18						
17						
16						
15						
14	VOID					
13	VOID					
12	VOID					
11	VOID	VOID				
10	VOID	VOID				
9	VOID					
8	VOID					
7	VOID					
6	VOID					
5	VOID					
4	VOID					
3						
2						
1						

CURRENT VOID RAMP RATE = 21.7216 DOLLARS/SEC

C-82

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

STEP	TIME(SEC)/	POWER(MW)/	CORE TEMP/	MOL TEMP/	% MELT/	MW SEC/
	NET RHO/	PROGRAMED/	SCRAM/	DOPPLER/	COLLAPSE/	VOID/
	C1	C2	C3	C4	C5	C6
65	1.4262+00	9.4982+03	2.1180+03	3.0616+03	1.1845+00	1.7424+03
	92.388	142.621	-.000	-73.378	1.315	21.831
	4.8514+06	1.6588+07	4.4690+06	4.6140+06	1.0422+06	1.9591+05
70	1.4268+00	1.0047+04	2.1216+03	3.0619+03	1.2206+00	1.7486+03
	93.829	142.684	-.000	-73.648	1.429	23.364
	4.8523+06	1.6595+07	4.4755+06	4.6258+06	1.0472+06	1.9751+05
75	1.4278+00	1.1470+04	2.1275+03	3.0628+03	1.2794+00	1.7586+03
	95.421	142.778	-.000	-74.091	1.607	25.127
	4.8534+06	1.6603+07	4.4831+06	4.6398+06	1.0531+06	1.9941+05
80	1.4290+00	1.4207+04	2.1369+03	3.0639+03	1.3764+00	1.7743+03
	97.343	142.901	-.000	-74.787	1.859	27.370
	4.8556+06	1.6621+07	4.4988+06	4.6687+06	1.0655+06	2.0342+05

C-83

AXIAL SEGMENT 10

CHANNEL	FUEL	FUEL	CLAD	COOLANT
	CENTER	OUTER		
1	3302.	2316.	993.	828.
2	3226.	2289.	940.	866.
3	3047.	2183.	905.	856.
4	3042.	2048.	894.	853.
5	3044.	2102.	886.	842.
6	2426.	1574.	826.	800.
1	3307.	2322.	996.	825.
2	3232.	2294.	943.	867.
3	3047.	2188.	905.	857.
4	3042.	2053.	894.	854.
5	3044.	2107.	887.	842.
6	2429.	1578.	827.	801.
1	3316.	2331.	1000.	822.
2	3240.	2303.	947.	865.
3	3048.	2196.	907.	858.
4	3042.	2061.	895.	855.
5	3044.	2116.	888.	843.
6	2435.	1585.	827.	801.
1	3331.	2345.	1006.	820.
2	3254.	2317.	954.	858.
3	3048.	2210.	908.	860.
4	3042.	2075.	897.	856.
5	3045.	2130.	889.	845.
6	2443.	1596.	828.	802.

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

TIME(SEC)	POWER(MW)	CORE TEMP	MOL TEMP	% MELT	MW-SEC GEN	MW-SEC OUT	MOLTEN MW-SEC	KILOS MOLTEN FUEL
1.4300+00	1.7417+04	2.1462+03	3.0651+03	1.4793+00	1.7899+03	7.2274+02	1.3340+01	4.5896+01
NET RHO	PROGRAMED	SCRAM	DOPPLER	COLLAPSE	VOID	LINEAR-FUEL	CLAD	COOLANT
98.867	143.000	-.000	-75.474	2.073	29.267	.000	.000	.000
C1	C2	C3	C4	C5	C6			
4.8578+06	1.6638+07	4.5142+06	4.6971+06	1.0778+06	2.0745+05	EFF DOPP =	-.004759	VOID DOPP = -.004823

SEGMENT 9

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3323.	3268.	3155.	3048.	3042.	2864.	2344.	
2	3248.	3191.	3063.	3046.	3041.	2830.	2316.	
3	3048.	3046.	3044.	3041.	2952.	2684.	2206.	
4	3042.	3041.	3020.	2931.	2787.	2530.	2067.	
5	3044.	3043.	3041.	3006.	2858.	2594.	2124.	
6	2440.	2414.	2367.	2295.	2185.	1963.	1590.	

SEGMENT 10

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3345.	3286.	3181.	3048.	3042.	2876.	2359.	
2	3268.	3212.	3088.	3046.	3042.	2843.	2331.	
3	3048.	3047.	3045.	3042.	2962.	2697.	2223.	
4	3042.	3041.	3031.	2942.	2798.	2543.	2088.	
5	3045.	3044.	3042.	3016.	2870.	2607.	2143.	
6	2451.	2425.	2378.	2307.	2196.	1978.	1606.	

SEGMENT 11

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3297.	3242.	3125.	3047.	3042.	2860.	2352.	
2	3220.	3167.	3050.	3046.	3041.	2826.	2324.	
3	3047.	3046.	3044.	3041.	2943.	2680.	2216.	
4	3042.	3041.	3009.	2921.	2779.	2528.	2082.	
5	3044.	3043.	3041.	2994.	2849.	2590.	2135.	
6	2432.	2407.	2360.	2290.	2182.	1967.	1605.	

SEGMENT 12

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3194.	3138.	3049.	3045.	3041.	2818.	2326.	
2	3121.	3051.	3047.	3044.	3039.	2783.	2299.	
3	3046.	3044.	3042.	3040.	2898.	2641.	2189.	
4	3040.	3017.	2959.	2873.	2735.	2492.	2054.	
5	3042.	3041.	3031.	2943.	2801.	2549.	2106.	
6	2389.	2364.	2319.	2251.	2144.	1935.	1590.	

C-24

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

DOWNWARD MOTION OF SEGMENTS (CM)

TIME SINCE START OF COLLAPSE =

30.000 MILLI SEC

SEGMENT	1	2	3	4	5	6
18	.441	.110	.000	.000	.000	.000
17	.441	.110	.000	.000	.000	.000
16	.441	.110	.000	.000	.000	.000
15	.441	.110	.000	.000	.000	.000
14	.441	.110	.000	.000	.000	.000
13	.441	.110	.000	.000	.000	.000
12	.441	.110	.000	.000	.000	.000
11	.441	.110	.000	.000	.000	.000
10	.441	.110	.000	.000	.000	.000
9	.441	.049	.000	.000	.000	.000
8	.049	.012	.000	.000	.000	.000
7	.002	.000	.000	.000	.000	.000
6	.000	.000	.000	.000	.000	.000
5	.000	.000	.000	.000	.000	.000
4	.000	.000	.000	.000	.000	.000
3	.000	.000	.000	.000	.000	.000
2	.000	.000	.000	.000	.000	.000
1	.000	.000	.000	.000	.000	.000

CURRENT COLLAPSE RAMP RATE = 2.2144 DOLLARS/SEC

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

VOIDING PATTERN AT 30,000 MILLI SECONDS AFTER START OF VOIDING

	CHANNEL					
SEGMENT	1	2	3	4	5	6
18						
17						
16	VOID					
15	VOID					
14	VOID					
13	VOID					
12	VOID	VOID				
11	VOID	VOID				
10	VOID	VOID				
9	VOID	VOID				
8	VOID					
7	VOID					
6	VOID					
5	VOID					
4	VOID					
3	VOID					
2						
1						

CURRENT VOID RAMP RATE = 19.4180 DOLLARS/SEC

C-86

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

STEP	TIME(SEC)/ NET RHO/	POWER(MW)/ PROGRAMED/	CORE TEMP/ SCRAM/	MOL TEMP/ DOPPLER/	% MELT/ COLLAPSE/	MW SEC/ VOID/
	C1	C2	C3	C4	C5	C6
85	1.4302+00	1.9420+04	2.1489+03	3.0655+03	1.5102+00	1.7944+03
	99.191	143.025	-.000	-75.670	2.129	29.708
	4.8584+06	1.6643+07	4.5185+06	4.7052+06	1.0814+06	2.0861+05
90	1.4315+00	2.4560+04	2.1655+03	3.0676+03	1.7092+00	1.8218+03
	99.972	143.154	-.000	-76.878	2.432	31.265
	4.8620+06	1.6671+07	4.5435+06	4.7515+06	1.1017+06	2.1535+05
95	1.4326+00	3.1070+04	2.1836+03	3.0696+03	1.9484+00	1.8519+03
	101.421	143.262	-.000	-77.630	2.726	33.062
	4.8664+06	1.6706+07	4.5751+06	4.8102+06	1.1278+06	2.2408+05
100	1.4337+00	4.0492+04	2.2067+03	3.0713+03	2.2906+00	1.8906+03
	101.862	143.371	-.000	-79.816	3.055	35.251
	4.8718+06	1.6748+07	4.6134+06	4.8817+06	1.1597+06	2.3482+05

C-87

AXIAL SEGMENT 10

CHANNEL	FUEL CENTER	FUEL OUTER NODE	CLAD	COOLANT
1	3349.	2363.	1012.	816.
2	3272.	2335.	960.	852.
3	3048.	2227.	911.	862.
4	3042.	2092.	898.	858.
5	3045.	2147.	891.	847.
6	2453.	1609.	830.	804.
1	3374.	2389.	1020.	813.
2	3297.	2361.	967.	855.
3	3049.	2252.	914.	865.
4	3043.	2116.	901.	861.
5	3045.	2171.	894.	849.
6	2467.	1629.	831.	805.
1	3402.	2418.	1026.	812.
2	3324.	2389.	974.	853.
3	3049.	2279.	917.	868.
4	3043.	2142.	903.	863.
5	3046.	2198.	897.	852.
6	2483.	1650.	833.	807.
1	3438.	2455.	1034.	812.
2	3359.	2425.	982.	852.
3	3050.	2313.	921.	873.
4	3044.	2176.	907.	867.
5	3046.	2232.	900.	856.
6	2502.	1678.	835.	810.

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

TIME(SEC)	POWER(MW)	CORE TEMP	MOL TEMP	% MELT	MW-SEC GEN	MW-SEC OUT	MOLTEN MW-SEC	KILOS MOLTEN FUEL
1.4350+00	5.5719+04	2.2428+03	3.0745+03	2.9089+00	1.9521+03	7.2681+02	2.6680+01	9.0247+01
NET RHO	PROGRAMED	SCRAM	DOPPLER	COLLAPSE	VOID	LINEAR-FUEL	CLAD	COOLANT
102.462	143.500	-.000	-82.326	3.522	37.767	.000	.000	.000
C1	C2	C3	C4	C5	C6			
4.8803+06	1.6815+07	4.6731+06	4.9932+06	1.2097+06	2.5176+05	EFF DOPP =	-.004669	VOID DOPP = -.004760

SEGMENT 9

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3473.	3418.	3305.	3081.	3045.	2984.	2497.	
2	3395.	3337.	3213.	3049.	3044.	2950.	2468.	
3	3070.	3049.	3047.	3044.	3040.	2803.	2352.	
4	3044.	3043.	3042.	3026.	2889.	2646.	2209.	
5	3047.	3046.	3044.	3042.	2962.	2711.	2268.	
6	2523.	2499.	2453.	2384.	2277.	2067.	1706.	

SEGMENT 10

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3495.	3436.	3330.	3102.	3045.	2995.	2512.	
2	3415.	3358.	3237.	3049.	3044.	2962.	2482.	
3	3085.	3049.	3047.	3044.	3041.	2815.	2368.	
4	3045.	3044.	3042.	3037.	2900.	2658.	2228.	
5	3047.	3046.	3044.	3042.	2972.	2724.	2285.	
6	2533.	2509.	2463.	2395.	2288.	2082.	1722.	

SEGMENT 11

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3444.	3389.	3273.	3053.	3045.	2978.	2502.	
2	3364.	3310.	3180.	3049.	3044.	2944.	2473.	
3	3050.	3049.	3046.	3044.	3040.	2797.	2358.	
4	3044.	3043.	3042.	3015.	2880.	2642.	2220.	
5	3046.	3045.	3043.	3041.	2951.	2706.	2275.	
6	2514.	2490.	2445.	2378.	2273.	2069.	1719.	

SEGMENT 12

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	3335.	3279.	3149.	3048.	3044.	2935.	2473.	
2	3258.	3191.	3064.	3047.	3043.	2900.	2444.	
3	3048.	3047.	3045.	3042.	2999.	2756.	2328.	
4	3042.	3042.	3040.	2966.	2834.	2604.	2189.	
5	3045.	3044.	3042.	3037.	2902.	2663.	2243.	
6	2469.	2446.	2402.	2337.	2234.	2035.	1700.	

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SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

DOWNWARD MOTION OF SEGMENTS (CM)

TIME SINCE START OF COLLAPSE =

35.000 MILLI SEC

	CHANNEL					
SEGMENT	1	2	3	4	5	6
18	.601	.196	.008	.000	.001	.000
17	.601	.196	.008	.000	.001	.000
16	.601	.196	.008	.000	.001	.000
15	.601	.196	.008	.000	.001	.000
14	.601	.196	.008	.000	.001	.000
13	.601	.196	.008	.000	.001	.000
12	.601	.196	.008	.000	.001	.000
11	.601	.196	.008	.000	.001	.000
10	.601	.196	.008	.000	.001	.000
9	.601	.110	.007	.000	.001	.000
8	.110	.049	.003	.000	.000	.000
7	.024	.014	.001	.000	.000	.000
6	.006	.003	.000	.000	.000	.000
5	.000	.000	.000	.000	.000	.000
4	.000	.000	.000	.000	.000	.000
3	.000	.000	.000	.000	.000	.000
2	.000	.000	.000	.000	.000	.000
1	.000	.000	.000	.000	.000	.000

C-89

CURRENT COLLAPSE RAMP RATE = 3.9787 DOLLARS/SEC

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

VOIDING PATTERN AT 35.000 MILLI SECONDS AFTER START OF VOIDING

	CHANNEL					
SEGMENT	1	2	3	4	5	6
18						
17	VOID					
16	VOID					
15	VOID					
14	VOID	VOID				
13	VOID	VOID				
12	VOID	VOID				
11	VOID	VOID				
10	VOID	VOID				
9	VOID	VOID				
8	VOID	VOID				
7	VOID	VOID				
6	VOID					
5	VOID					
4	VOID					
3	VOID					
2	VOID					
1	VOID					

CURRENT VOID RAMP RATE = 19.9096 DOLLARS/SEC

C-90

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

STEP	TIME(SEC)/ NET RHO/ C1	POWER(MW)/ PROGRAMED/ C2	CORE TEMP/ SCRAM/ C3	MOL TEMP/ DOPPLER/ C4	% MELT/ COLLAPSE/ C5	MW SEC/ VOID/ C6
105	1.4353+00	6.0090+04	2.2532+03	3.0754+03	3.1034+00	1.9694+03
	103.020	143.530	-.000	-82.542	3.633	38.399
	4.8846+06	1.6849+07	4.7041+06	5.0510+06	1.2358+06	2.6061+05

110	1.4361+00	8.1028+04	2.2858+03	3.0791+03	3.7866+00	2.0266+03
	103.798	143.612	-.000	-84.731	3.999	40.918
	4.8913+06	1.6902+07	4.7520+06	5.1405+06	1.2761+06	2.7435+05

115	1.4371+00	1.0895+05	2.3363+03	3.0860+03	5.0510+00	2.1178+03
	103.954	143.708	-.000	-88.517	4.492	44.270
	4.9025+06	1.6990+07	4.8313+06	5.2889+06	1.3433+06	2.9729+05

120	1.4381+00	1.5100+05	2.4071+03	3.0982+03	7.2972+00	2.2521+03
	104.866	143.813	-.000	-93.004	5.084	48.973
	4.9236+06	1.7156+07	4.9816+06	5.5703+06	1.4710+06	3.4099+05

125	1.4391+00	2.1582+05	2.4973+03	3.1249+03	1.0780+01	2.4326+03
	105.556	143.913	-.000	-98.482	5.684	54.440
	4.9473+06	1.7343+07	5.1503+06	5.8864+06	1.6147+06	3.9026+05

AXIAL SEGMENT 10

CHANNEL	FUEL CENTER	FUEL OUTER NODE	CLAD	COOLANT
1	3511.	2529.	1048.	816.
2	3431.	2499.	995.	859.
3	3099.	2344.	929.	881.
4	3045.	2244.	914.	875.
5	3048.	2301.	908.	864.
6	2542.	1734.	840.	815.
1	3564.	2581.	1056.	820.
2	3483.	2550.	1004.	862.
3	3147.	2433.	934.	887.
4	3046.	2291.	919.	880.
5	3048.	2350.	913.	870.
6	2570.	1775.	843.	819.
1	3649.	2661.	1068.	828.
2	3566.	2630.	1016.	865.
3	3222.	2510.	943.	897.
4	3047.	2366.	927.	889.
5	3050.	2425.	921.	879.
6	2615.	1838.	848.	824.
1	3775.	2773.	1085.	840.
2	3688.	2742.	1032.	879.
3	3334.	2618.	955.	912.
4	3049.	2470.	938.	902.
5	3148.	2532.	933.	893.
6	2678.	1929.	855.	833.
1	3943.	2915.	1106.	859.
2	3854.	2883.	1053.	901.
3	3483.	2755.	972.	931.
4	3136.	2603.	953.	920.
5	3289.	2667.	949.	911.
6	2760.	2046.	865.	845.

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

THE CORE IS NEARING A DISASSEMBLY CONDITION

CORE AVERAGE TEMPERATURE = 2564. DEGREES KELVIN
TIME AFTER BEGINNING OF TRANSIENT = 1.440+00 SECONDS
POWER = 2.667+05 MEGAWATTS
NET REACTIVITY = 105.249 CENTS
COLLAPSE FEEDBACK = 6.040 CENTS
VOID FEEDBACK = 57.643 CENTS
COLLAPSE RAMP RATE = 6.131 DOLLARS/SEC
VOID RAMP RATE = 55.215 DOLLARS/SEC
TOTAL RAMP RATE = 62.347 DOLLARS/SEC
AVERAGE TEMPERATURE OF MOLTEN FUEL = 3152. DEGREES KELVIN
PORTION OF THE FUEL IN THE MOLTEN STATE = 13.743 PER CENT
KILOGRAMS OF MOLTEN FUEL = 4.264+02

VELOS INPUT

1.43971+00 1.43913+00 1.84176+09 -2.95445-03 -3.07212-03

-2.528099928+001 7.257690990+001 -5.209120821+001

4.95311+12 1.73882+13 5.19137+12 5.96334+12 1.64966+12 4.02276+11

6.92440+00 1.55002+01 4.65984+01 7.55213+01 1.22883+02 1.71129+02

3.66630+02 3.15748-03

2653.2 2619.4 2483.7 2346.4 2396.8 1859.8

2759.4 2730.6 2594.7 2450.1 2504.0 1942.3

2866.6 2847.9 2742.3 2596.8 2655.4 2060.3

3041.3 3040.3 2840.1 2723.3 2773.6 2166.0

3044.8 3043.8 2905.7 2814.6 2854.1 2266.5

3047.8 3046.7 3042.5 2871.9 2907.9 2350.7

3057.5 3049.0 3044.5 3040.0 3041.8 2408.7

3142.7 3079.1 3045.8 3041.2 3043.1 2448.3

3182.3 3117.6 3046.5 3041.8 3043.8 2464.8

3165.6 3101.0 3046.2 3041.5 3043.5 2453.7

3092.5 3049.6 3045.1 3040.4 3042.3 2414.2

3048.6 3047.5 3043.1 2869.7 3040.5 2351.8

3045.8 3044.8 3040.6 2818.4 2857.5 2270.6

3042.2 3041.3 2839.9 2726.5 2779.7 2163.1

2856.7 2837.6 2738.3 2590.8 2660.4 2038.9

2751.6 2724.5 2592.2 2434.5 2503.0 1909.9

2582.9 2549.2 2410.2 2260.7 2326.0 1768.5

2441.1 2408.9 2275.8 2132.3 2195.6 1665.9

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PURCHED TEMPERATURE ORDER

2.44108+03 2.40887+03 2.40887+03 2.27580+03 2.27580+03 2.13234+03

2.13234+03 2.58295+03 2.54923+03 2.54923+03 2.41021+03 2.41021+03

2.26066+03 2.26066+03 2.75163+03 2.72446+03 2.72446+03 2.59220+03

2.59220+03 2.43453+03 2.43453+03 2.85673+03 2.83761+03 2.83761+03

2.73830+03 2.73830+03 2.59078+03 2.59078+03 3.04221+03 3.04125+03

3.04125+03 2.83988+03 2.83988+03 2.72655+03 2.72655+03 3.04584+03

3.04484+03 3.04484+03 3.04060+03 3.04060+03 2.81843+03 2.81843+03

3.04857+03 3.04747+03 3.04747+03 3.04308+03 3.04308+03 2.86971+03

2.86971+03 3.09250+03 3.04963+03 3.04963+03 3.04507+03 3.04507+03

3.04040+03 3.04040+03 3.16557+03 3.10099+03 3.10099+03 3.04621+03

3.04621+03 3.04149+03 3.04149+03 3.18231+03 3.11757+03 3.11757+03

3.04648+03 3.04648+03 3.04176+03 3.04176+03 3.14271+03 3.07908+03

3.07908+03 3.04581+03 3.04581+03 3.04122+03 3.04122+03 3.05752+03

3.04895+03 3.04895+03 3.04448+03 3.04448+03 3.04000+03 3.04000+03

3.04784+03 3.04671+03 3.04671+03 3.04251+03 3.04251+03 2.87185+03

2.87185+03 3.04476+03 3.04378+03 3.04378+03 2.90566+03 2.90566+03

2.81462+03 2.81462+03 3.04129+03 3.04034+03 3.04034+03 2.84015+03

2.84015+03 2.72325+03 2.72325+03 2.86664+03 2.84786+03 2.84786+03

2.74226+03 2.74226+03 2.59685+03 2.59685+03 2.75943+03 2.73063+03

2.73063+03 2.59405+03 2.45012+03 2.45012+03 2.65324+03 2.65324+03

2.61935+03 2.61935+03 2.48367+03 2.48367+03 2.34645+03 2.34645+03

2.19564+03 2.19564+03 1.66592+03 1.66592+03 2.32603+03 2.32603+03

C-94

[illegible][illegible]

SAMPLE CASE, 1\$/SEC RAMP WITH FISSILE GAS RELEASE

THE CORE IS NEARING A DISASSEMBLY CONDITION

CORE AVERAGE TEMPERATURE = 2602. DEGREES KELVIN

TIME AFTER BEGINNING OF TRANSIENT = 1.440+00 SECONDS

POWER = 2.943+05 MEGAWATTS

NET REACTIVITY = 104.916 CENTS

COLLAPSE FEEDBACK = 6.220 CENTS

VOID FEEDBACK = 59.208 CENTS

COLLAPSE RAMP RATE = 6.123 DOLLARS/SEC

VOID RAMP RATE = 53.294 DOLLARS/SEC

TOTAL RAMP RATE = 60.417 DOLLARS/SEC

AVERAGE TEMPERATURE OF MOLTEN FUEL = 3171. DEGREES KELVIN

PORTION OF THE FUEL IN THE MOLTEN STATE = 15.572 PER CENT

KILOGRAMS OF MOLTEN FUEL = 4.831+02

VELOS INPUT

1.44000+00 1.43989+00 1.92369+09 -3.11182-03 -3.13538-03

-3.952411388+001 1.136619990+002 -8.163281142+001
 4.98312+12 1.76246+13 5.40512+12 6.36409+12 1.93216+12 4.64984+11
 9.07035+00 2.01521+01 5.89878+01 9.33241+01 1.46210+02 1.95200+02
 3.31376+02 3.14747-03
 2692.7 2658.6 2521.9 2383.3 2434.5 1890.9
 2793.7 2765.6 2633.6 2488.3 2543.0 1975.0
 2891.8 2872.9 2777.0 2636.7 2695.7 2095.1
 3042.4 3041.4 2866.5 2759.0 2805.5 2202.6
 3046.0 3045.0 3040.9 2846.6 2880.0 2304.6
 3049.2 3048.0 3043.7 2897.9 3041.1 2390.1
 3129.1 3066.4 3045.7 3041.1 3043.0 2449.0
 3217.2 3151.8 3047.1 3042.4 3044.4 2489.2
 3258.9 3191.8 3047.8 3042.9 3045.0 2506.3
 3242.1 3175.2 3047.5 3042.7 3044.7 2495.3
 3166.8 3103.8 3046.4 3041.6 3043.5 2455.9
 3050.0 3048.8 3044.3 2898.6 3041.7 2393.2
 3047.2 3046.1 3041.8 2846.9 2885.6 2311.6
 3043.4 3042.5 2867.6 2763.9 2814.1 2203.2
 2885.6 2865.5 2773.9 2634.9 2701.5 2077.7
 2786.2 2761.8 2636.6 2477.8 2546.9 1947.2
 2627.6 2593.6 2453.6 2302.6 2368.7 1803.7
 2485.0 2452.5 2318.2 2173.2 2237.2 1699.4

PUNCHED TEMPERATURE ORDER

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2.48499+03 2.45252+03 2.45252+03 2.31823+03 2.31823+03 2.17318+03
 2.17318+03 2.62757+03 2.59363+03 2.59363+03 2.45358+03 2.45358+03
 2.30262+03 2.30262+03 2.78624+03 2.76184+03 2.76184+03 2.63663+03
 2.63663+03 2.47779+03 2.47779+03 2.88563+03 2.86553+03 2.86553+03
 2.77392+03 2.77392+03 2.63489+03 2.63489+03 3.04345+03 3.04246+03
 3.04246+03 2.86762+03 2.86762+03 2.76391+03 2.76391+03 3.04717+03
 3.04614+03 3.04614+03 3.04178+03 3.04178+03 2.84689+03 2.84689+03
 3.04997+03 3.04884+03 3.04884+03 3.04433+03 3.04433+03 2.89860+03
 2.89860+03 3.16682+03 3.10382+03 3.10382+03 3.04636+03 3.04636+03
 3.04155+03 3.04155+03 3.24212+03 3.17516+03 3.17516+03 3.04753+03
 3.04753+03 3.04268+03 3.04268+03 3.25894+03 3.19184+03 3.19184+03
 3.04780+03 3.04780+03 3.04295+03 3.04295+03 3.21717+03 3.15178+03
 3.15178+03 3.04711+03 3.04711+03 3.04238+03 3.04238+03 3.12912+03
 3.06638+03 3.06638+03 3.04572+03 3.04572+03 3.04111+03 3.04111+03
 3.04917+03 3.04801+03 3.04801+03 3.04370+03 3.04370+03 2.89791+03
 2.89791+03 3.04599+03 3.04499+03 3.04499+03 3.04088+03 3.04088+03
 2.84660+03 2.84660+03 3.04241+03 3.04144+03 3.04144+03 2.86649+03
 2.86649+03 2.75897+03 2.75897+03 2.89183+03 2.87294+03 2.87294+03
 2.77701+03 2.77701+03 2.63670+03 2.63670+03 2.79367+03 2.76565+03
 2.76565+03 2.63357+03 2.63357+03 2.48833+03 2.48833+03 2.69267+03
 2.65859+03 2.65859+03 2.52194+03 2.52194+03 2.38331+03 2.38331+03
 2.23722+03 2.23722+03 1.69938+03 1.69938+03 2.36867+03 2.36867+03

1.80367+03	1.80367+03	2.54687+03	2.54687+03	1.94717+03	1.94717+03
2.70154+03	2.70154+03	2.07771+03	2.07771+03	2.81413+03	2.81413+03
2.20316+03	2.20316+03	2.88559+03	2.88559+03	2.31157+03	2.31157+03
3.04166+03	3.04166+03	2.39322+03	2.39322+03	3.04353+03	3.04353+03
2.45590+03	2.45590+03	3.04472+03	3.04472+03	2.49535+03	2.49535+03
3.04500+03	3.04500+03	2.50630+03	2.50630+03	3.04435+03	3.04435+03
2.48925+03	2.48925+03	3.04296+03	3.04296+03	2.44902+03	2.44902+03
3.04107+03	3.04107+03	2.39010+03	2.39010+03	2.87996+03	2.87996+03
2.30465+03	2.30465+03	2.80553+03	2.80553+03	2.20261+03	2.20261+03
2.69573+03	2.69573+03	2.09514+03	2.09514+03	2.54303+03	2.54303+03
1.97505+03	1.97505+03	2.43450+03	2.43450+03	1.89088+03	1.89088+03

PUNCHED KT ORDER

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SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

TIME(SEC)	POWER(MW)	CORE TEMP	MOL TEMP	% MELT	MW-SEC GEN	MW-SEC OUT	MOLTEN MW-SEC	KILOS MOLTEN FUEL
1.4400+00	2.9432+05	2.6019+03	3.1710+03	1.5572+01	2.6548+03	7.3107+02	1.6776+02	4.8312+02
NET RHO	PROGRAMED	SCRAM	DOPPLER	COLLAPSE	VOID	LINEAR-FUEL	CLAD	COOLANT
1.4.916	144.000	-0.000	-104.513	6.220	59.208	.000	.000	.000
C1	C2	C3	C4	C5	C6			
4.9831+06	1.7625+07	5.4051+06	6.3641+06	1.8322+06	4.6498+05	EFF DOPP =	-0.004482	VOID DOPP = -0.004547

SEGMENT 9

CHANNEL	FUEL NODE	1	---	7
1	4130.	4074.	3959.	3740.
2	4037.	3978.	3853.	3643.
3	3653.	3585.	3478.	3327.
4	3285.	3237.	3158.	3050.
5	3444.	3386.	3287.	3171.
6	2848.	2827.	2789.	2731.

SEGMENT 10

CHANNEL	FUEL NODE	1	---	7
1	4151.	4092.	3984.	3761.
2	4057.	3999.	3877.	3665.
3	3668.	3604.	3494.	3337.
4	3302.	3250.	3171.	3059.
5	3463.	3398.	3301.	3184.
6	2856.	2836.	2798.	2740.

SEGMENT 11

CHANNEL	FUEL NODE	1	---	7
1	4087.	4032.	3914.	3699.
2	3993.	3938.	3808.	3606.
3	3614.	3548.	3427.	3297.
4	3252.	3207.	3130.	3049.
5	3404.	3350.	3256.	3142.
6	2834.	2814.	2776.	2719.

SEGMENT 12

CHANNEL	FUEL NODE	1	---	7
1	3955.	3898.	3768.	3573.
2	3864.	3796.	3670.	3490.
3	3500.	3444.	3339.	3216.
4	3159.	3118.	3050.	3048.
5	3295.	3244.	3166.	3054.
6	2785.	2765.	2728.	2673.

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SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

DOWNWARD MOTION OF SEGMENTS (CM)   TIME SINCE START OF COLLAPSE =   40.001 MILLI SEC

SEGMENT	CHANNEL					
	1	2	3	4	5	6
18	.785	.307	.040	.012	.019	.000
17	.785	.307	.040	.012	.019	.000
16	.785	.307	.040	.012	.019	.000
15	.785	.307	.040	.012	.019	.000
14	.785	.307	.040	.012	.019	.000
13	.785	.307	.040	.012	.019	.000
12	.785	.307	.040	.012	.019	.000
11	.785	.307	.040	.012	.019	.000
10	.785	.307	.040	.012	.019	.000
9	.785	.196	.037	.012	.019	.000
8	.196	.110	.028	.021	.015	.000
7	.070	.052	.019	.008	.021	.000
6	.034	.028	.012	.006	.007	.000
5	.015	.013	.006	.003	.004	.000
4	.007	.006	.003	.001	.002	.000
3	.004	.003	.001	.000	.001	.000
2	.001	.001	.000	.000	.000	.000
1	.001	.000	.000	.000	.000	.000

CURRENT COLLAPSE RAMP RATE =   6.1233 DOLLARS/SEC

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

VOIDING PATTERN AT 40.001 MILLI SECONDS AFTER START OF VOIDING

CHANNEL

SEGMENT	1	2	3	4	5	6
18						
17	VOID					
16	VOID					
15	VOID	VOID				
14	VOID	VOID				
13	VOID	VOID				
12	VOID	VOID				
11	VOID	VOID	VOID			
10	VOID	VOID	VOID			
9	VOID	VOID				
8	VOID	VOID				
7	VOID	VOID				
6	VOID	VOID				
5	VOID	VOID				
4	VOID					
3	VOID					
2	VOID					
1	VOID					

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CURRENT VOID RAMP RATE = 53.2937 DOLLARS/SEC

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

STEP	TIME(SEC)/ NET RHO/ C1	POWER(MW)/ PROGRAMED/ C2	CORE TEMP/ SCRAM/ C3	MOL TEMP/ DOPPLER/ C4	% MELT/ COLLAPSE/ C5	MW SEC/ VOID/ C6
130	1.4403+00	3.1929+05	2.6386+03	3.1904+03	1.7453+01	2.7357+03
	104.457	144.026	-.000	-106.556	6.380	60.606
	4.9962+06	1.7728+07	5.4983+06	6.5388+06	1.9117+06	4.9234+05

AXIAL SEGMENT 10

CHANNEL	FUEL CENTER	FUEL OUTER NODE	CLAD	COOLANT
1	4227.	3042.	1138.	892.
2	4131.	3042.	1085.	931.
3	3735.	2965.	1001.	959.
4	3362.	2808.	978.	949.
5	3526.	2875.	974.	942.
6	2890.	2229.	881.	864.

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

THE CORE IS NEARING A DISASSEMBLY CONDITION

CORE AVERAGE TEMPERATURE = 2703. DEGREES KELVIN
TIME AFTER BEGINNING OF TRANSIENT = 1.441+00 SECONDS
POWER = 3.570+05 MEGAWATTS
NET REACTIVITY = 103.472 CENTS
COLLAPSE FEEDBACK = 6.630 CENTS
VOID FEEDBACK = 62.816 CENTS
COLLAPSE RAMP RATE = 5.852 DOLLARS/SEC
VOID RAMP RATE = 52.061 DOLLARS/SEC
TOTAL RAMP RATE = 58.914 DOLLARS/SEC
AVERAGE TEMPERATURE OF MOLTEN FUEL = 3228. DEGREES KELVIN
PORTION OF THE FUEL IN THE MOLTEN STATE = 23.733 PER CENT
KILOGRAMS OF MOLTEN FUEL = 6.432+02

VE,US INPUT

1.44069+00 1.44058+00 2.14684+09 -3.27466-03 -3.30130-03
 -1.291567734+001 3.696103240+001 -2.644507145+001
 5.02016+12 1.79163+13 5.66883+12 6.85848+12 2.05738+12 5.42417+11
 1.10290+01 2.42999+01 6.91141+01 1.06680+02 1.61116+02 2.09073+02
 2.48927+02 3.10415-03
 2789.5 2760.5 2624.2 2481.9 2535.2 1974.4
 2874.0 2850.6 2738.4 2590.4 2647.2 2062.9
 3041.6 3040.6 2861.0 2741.7 2792.9 2188.6
 3045.5 3044.5 3040.4 2845.5 2883.1 2300.6
 3049.4 3048.3 3043.9 2914.5 3041.3 2406.6
 3194.1 3131.0 3046.9 3042.2 3044.1 2495.3
 3326.1 3258.9 3049.1 3044.2 3046.2 2556.5
 3421.8 3351.8 3083.6 3045.6 3047.7 2598.6
 3467.8 3396.0 3122.6 3046.2 3048.4 2616.9
 3451.0 3379.3 3108.8 3045.9 3048.1 2606.5
 3371.4 3303.8 3049.9 3044.7 3046.9 2567.1
 3245.5 3182.8 3047.7 3042.8 3044.9 2503.8
 3091.6 3049.7 3045.0 3040.3 3042.3 2420.9
 3046.8 3045.8 3041.4 2852.3 2890.4 2310.3
 3042.4 3041.4 2859.9 2745.2 2799.8 2181.6
 2869.3 2850.8 2746.7 2593.1 2663.7 2047.0
 2739.4 2709.7 2569.2 2414.6 2482.4 1898.1
 2601.9 2568.8 2431.4 2282.3 2348.3 1789.4

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PUNCHED TEMPERATURE ORDER

2.60194+03 2.56881+03 2.56881+03 2.43144+03 2.43144+03 2.28233+03
 2.28233+03 2.73942+03 2.70966+03 2.73966+03 2.56915+03 2.56915+03
 2.41464+03 2.41464+03 2.86931+03 2.85076+03 2.85076+03 2.74669+03
 2.74669+03 2.59307+03 2.59307+03 3.04241+03 3.04142+03 3.04142+03
 2.85989+03 2.85989+03 2.74520+03 2.74520+03 3.04683+03 3.04577+03
 3.04577+03 3.04145+03 3.04145+03 2.85228+03 2.85228+03 3.09165+03
 3.04970+03 3.04970+03 3.04502+03 3.04502+03 3.04029+03 3.04029+03
 3.24551+03 3.18283+03 3.18283+03 3.04774+03 3.04774+03 3.04279+03
 3.04279+03 3.37140+03 3.30377+03 3.30377+03 3.04991+03 3.04991+03
 3.04474+03 3.04474+03 3.45097+03 3.37934+03 3.37934+03 3.10884+03
 3.10884+03 3.04593+03 3.04593+03 3.46780+03 3.39604+03 3.39604+03
 3.12258+03 3.12258+03 3.04620+03 3.04620+03 3.42182+03 3.35184+03
 3.35184+03 3.08358+03 3.08358+03 3.04556+03 3.04556+03 3.32611+03
 3.25891+03 3.25891+03 3.04914+03 3.04914+03 3.04418+03 3.04418+03
 3.19410+03 3.13096+03 3.13096+03 3.04694+03 3.04694+03 3.04223+03
 3.04223+03 3.04938+03 3.04830+03 3.04830+03 3.04389+03 3.04389+03
 2.91449+03 2.91449+03 3.04550+03 3.04446+03 3.04446+03 3.04043+03
 3.04043+03 2.84555+03 2.84555+03 3.04157+03 3.04062+03 3.04062+03
 2.86105+03 2.86105+03 2.74173+03 2.74173+03 2.87397+03 2.85058+03
 2.85058+03 2.73839+03 2.73839+03 2.59043+03 2.59043+03 2.78949+03
 2.76046+03 2.76046+03 2.62418+03 2.62418+03 2.48186+03 2.48186+03
 2.34826+03 2.34826+03 1.78938+03 1.78938+03 2.48239+03 2.48239+03

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SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

ALL TEMPERATURES IN DEGREES K, ALL REACTIVITIES IN CENTS

TIME(SEC)	POWER(MW)	CORE TEMP	MOL TEMP	% MELT	MW-SEC GEN	MW-SEC OUT	MOLTEN MW-SEC	KILOS MOLTEN FUEL
1.4407+00	3.5698+05	2.7026+03	3.2283+03	2.0733+01	2.8785+03	7.3169+02	2.4343+02	6.4324+02
NLT RHO	PROGRAMED	SCRAM	DOPPLER	COLLAPSE	VOID	LINEAR-FUEL	CLAD	COOLANT
1.3.472	144.069	-.000	-110.043	6.630	62.816	.000	.000	.000
C1	C2	C3	C4	C5	C6			
5.0202+06	1.7916+07	5.6688+06	6.8585+06	2.0574+06	5.4242+05		EFF DOPP = -.004370	VOID DOPP = -.004498

SEGMENT 9

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	4339.	4284.	4169.	3949.	3669.	3333.	3045.	
2	4241.	4163.	4058.	3848.	3600.	3271.	3044.	
3	3839.	3771.	3664.	3513.	3330.	3049.	3040.	
4	3452.	3404.	3325.	3213.	3050.	3044.	2884.	
5	3619.	3561.	3462.	3346.	3165.	3046.	2953.	
6	2940.	2921.	2884.	2830.	2745.	2581.	2297.	

SEGMENT 10

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	4361.	4302.	4193.	3970.	3685.	3347.	3045.	
2	4262.	4204.	4082.	3870.	3613.	3286.	3044.	
3	3854.	3790.	3680.	3523.	3342.	3050.	3040.	
4	3469.	3417.	3338.	3226.	3054.	3045.	2898.	
5	3638.	3574.	3476.	3359.	3178.	3047.	2965.	
6	2949.	2929.	2893.	2838.	2753.	2592.	2310.	

SEGMENT 11

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	4293.	4237.	4119.	3904.	3635.	3308.	3044.	
2	4193.	4138.	4009.	3807.	3568.	3246.	3044.	
3	3796.	3730.	3610.	3479.	3300.	3049.	3039.	
4	3416.	3371.	3294.	3184.	3049.	3044.	2880.	
5	3576.	3522.	3428.	3314.	3136.	3046.	2947.	
6	2925.	2906.	2870.	2816.	2733.	2573.	2297.	

SEGMENT 12

CHANNEL	FUEL NODE	1	2	3	4	5	6	7
1	4152.	4095.	3966.	3771.	3540.	3223.	3043.	
2	4057.	3989.	3863.	3683.	3476.	3162.	3042.	
3	3675.	3619.	3514.	3392.	3214.	3047.	2997.	
4	3316.	3276.	3202.	3097.	3048.	3043.	2838.	
5	3461.	3409.	3331.	3220.	3050.	3045.	2903.	
6	2876.	2857.	2822.	2769.	2687.	2530.	2264.	

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SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

DOWNWARD MOTION OF SEGMENTS (CM)

TIME SINCE START OF COLLAPSE = 40.686 MILLI SEC

SEGMENT	CHANNEL					
	1	2	3	4	5	6
18	.812	.324	.047	.016	.024	.000
17	.812	.324	.047	.016	.024	.000
16	.812	.324	.047	.016	.024	.000
15	.812	.324	.047	.016	.024	.000
14	.812	.324	.047	.016	.024	.000
13	.812	.324	.047	.016	.024	.000
12	.812	.324	.047	.016	.024	.000
11	.812	.324	.047	.016	.024	.000
10	.812	.324	.047	.016	.024	.000
9	.812	.210	.043	.016	.024	.000
8	.210	.121	.033	.026	.019	.000
7	.079	.059	.024	.011	.026	.000
6	.040	.033	.016	.008	.010	.000
5	.019	.017	.009	.005	.006	.000
4	.010	.009	.005	.003	.004	.000
3	.006	.005	.003	.001	.002	.000
2	.003	.002	.001	.000	.000	.000
1	.002	.001	.000	.000	.000	.000

CURRENT COLLAPSE RAMP RATE = 5.8524 DOLLARS/SEC

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

VOIDING PATTERN AT 40.686 MILLI SECONDS AFTER START OF VOIDING

	CHANNEL					
SEGMENT	1	2	3	4	5	6
18						
17	VOID					
16	VOID					
15	VOID	VOID				
14	VOID	VOID				
13	VOID	VOID				
12	VOID	VOID				
11	VOID	VOID	VOID			
10	VOID	VOID	VOID			
9	VOID	VOID				
8	VOID	VOID				
7	VOID	VOID				
6	VOID	VOID				
5	VOID	VOID				
4	VOID					
3	VOID					
2	VOID					
1	VOID					

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CURRENT VOID RAMP RATE = 52.0612 DOLLARS/SEC

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

CORE QUANTITIES

TIME (SECONDS)	TOTAL CORE POWER (MW)	NUCLEAR ENERGY ADDITION TO CORE SINCE TIME ZERO (MW-SECONDS)	NET ENERGY REMOVAL FROM CORE SINCE TIME ZERO (MW-SECONDS)	ENERGY CONTAINED IN MOLTEN FUEL (MW-SECONDS)	TEMPERATURE OF MOLTEN FUEL (DEG. KELVIN)	EXTENT OF FUEL MELTING (PER CENT)	KILOGRAMS OF MOLTEN FUEL	CORE AVERAGED FUEL TEMPERATURE (DEG. KELVIN)
0.000	3.803+02	0.000	0.000	0.000	0.000	0.000	0.000	1.363+03
2.000-01	4.754+02	8.486+01	7.917+01	0.000	0.000	0.000	0.000	1.371+03
4.000-01	6.233+02	1.937+02	1.596+02	0.000	0.000	0.000	0.000	1.397+03
6.000-01	8.513+02	3.397+02	2.436+02	0.000	0.000	0.000	0.000	1.450+03
8.000-01	1.178+03	5.411+02	3.347+02	0.000	0.000	0.000	0.000	1.541+03
1.000+00	1.589+03	8.171+02	4.374+02	0.000	0.000	0.000	0.000	1.677+03
1.200+00	2.060+03	1.182+03	5.570+02	3.470-01	3.043+03	3.994-02	1.239+00	1.856+03
1.300+00	2.323+03	1.401+03	6.249+02	1.701+00	3.045+03	1.958-01	6.074+00	1.960+03
1.400+00	2.608+03	1.648+03	6.991+02	6.691+00	3.054+03	7.579-01	2.351+01	2.071+03
1.405+00	2.638+03	1.661+03	7.030+02	7.117+00	3.055+03	8.046-01	2.496+01	2.077+03
1.410+00	2.789+03	1.674+03	7.069+02	7.584+00	3.056+03	8.549-01	2.652+01	2.083+03
1.415+00	3.101+03	1.689+03	7.108+02	8.133+00	3.058+03	9.144-01	2.837+01	2.090+03
1.420+00	3.295+03	1.705+03	7.148+02	8.786+00	3.059+03	9.855-01	3.057+01	2.097+03
1.425+00	7.826+03	1.732+03	7.187+02	1.004+01	3.061+03	1.123+00	3.483+01	2.112+03
1.430+00	1.742+04	1.790+03	7.227+02	1.334+01	3.065+03	1.479+00	4.590+01	2.146+03
1.435+00	5.572+04	1.952+03	7.268+02	2.668+01	3.075+03	2.909+00	9.025+01	2.243+03
1.440+00	2.943+05	2.655+03	7.311+02	1.678+02	3.171+03	1.557+01	4.831+02	2.602+03
1.441+00	3.570+05	2.879+03	7.317+02	2.434+02	3.228+03	2.073+01	6.432+02	2.703+03

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

REACTIVITY CONTRIBUTIONS (CENTS)

TIME (SECONDS)	NET	PROGRAMED	SCRAM	DOPPLER	COLLAPSE	VOID	FUEL EXPANSION	CLAD EXPANSION	COOLANT DENSITY
0.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
2.000-01	19.071	20.000	-.000	-.929	.000	.000	.000	.000	.000
4.000-01	35.852	40.000	-.000	-4.148	.000	.000	.000	.000	.000
6.000-01	49.510	60.000	-.000	-10.490	.000	.000	.000	.000	.000
8.000-01	59.272	80.000	-.000	-20.728	.000	.000	.000	.000	.000
1.000+00	65.140	100.000	-.000	-34.860	.000	.000	.000	.000	.000
1.200+00	68.277	120.000	-.000	-51.723	.000	.000	.000	.000	.000
1.300+00	69.285	130.000	-.000	-60.715	.000	.000	.000	.000	.000
1.400+00	70.212	140.000	-.000	-69.788	.000	.000	.000	.000	.000
1.405+00	70.977	140.500	-.000	-70.230	.020	.687	.000	.000	.000
1.410+00	72.732	141.000	-.000	-70.700	.078	2.353	.000	.000	.000
1.415+00	74.380	141.500	-.000	-71.227	.177	3.931	.000	.000	.000
1.420+00	79.566	142.000	-.000	-71.810	.471	8.905	.000	.000	.000
1.425+00	89.739	142.500	-.000	-72.906	1.111	19.035	.000	.000	.000
1.430+00	98.867	143.000	-.000	-75.474	2.073	29.267	.000	.000	.000
1.435+00	102.462	143.500	-.000	-82.326	3.522	37.767	.000	.000	.000
1.440+00	104.916	144.000	-.000	-104.513	6.220	59.208	.000	.000	.000
1.441+00	103.472	144.069	-.000	-110.043	6.630	62.816	.000	.000	.000

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

PIN TEMPERATURES (DEGREES KELVIN)

CHANNEL 1

AXIAL SECTION 1

TIME	NODE	NODE	NODE	NODE	NODE	NODE	NODE	NODE	BOND			
S:CONDS	1	2	3	4	5	6	7	(GAP)	CLAD	COOLANT		
0.000	1572.	1536.	1473.	1387.	1267.	1106.	912.	711.	613.	597.		
2.000-01	1579.	1544.	1481.	1395.	1275.	1114.	918.	713.	613.	598.		
4.000-01	1606.	1571.	1509.	1423.	1304.	1142.	939.	720.	614.	598.		
6.000-01	1664.	1630.	1568.	1483.	1364.	1197.	978.	733.	617.	599.		
8.000-01	1766.	1733.	1672.	1587.	1465.	1288.	1045.	755.	621.	601.		
1.000+00	1921.	1888.	1829.	1744.	1618.	1426.	1144.	785.	627.	603.		
1.200+00	2122.	2094.	2039.	1952.	1821.	1609.	1275.	825.	635.	606.		
1.300+00	2236.	2209.	2157.	2080.	1941.	1717.	1351.	847.	640.	608.		
1.400+00	2361.	2334.	2283.	2206.	2081.	1837.	1436.	872.	645.	610.		
1.405+00	2368.	2340.	2289.	2212.	2088.	1843.	1440.	873.	645.	610.		
1.410+00	2374.	2347.	2296.	2219.	2095.	1850.	1445.	874.	645.	610.		
1.415+00	2382.	2355.	2304.	2226.	2103.	1857.	1451.	876.	646.	610.		
1.420+00	2390.	2363.	2312.	2234.	2112.	1865.	1457.	878.	646.	610.		
1.425+00	2404.	2377.	2326.	2249.	2128.	1881.	1473.	883.	647.	611.		
1.430+00	2435.	2409.	2359.	2283.	2163.	1920.	1514.	901.	659.	600.		
1.435+00	2522.	2497.	2449.	2376.	2262.	2031.	1638.	945.	679.	604.		
1.440+00	2861.	2840.	2800.	2740.	2644.	2456.	2133.	1127.	729.	651.		
1.441+00	2958.	2937.	2899.	2842.	2752.	2575.	2270.	1209.	743.	667.		

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

PIN TEMPERATURES (DEGREES KELVIN)

CHANNEL 1

AXIAL SECTION 9

TIME	NODE	NODE	NODE	NODE	NODE	NODE	NODE	NODE	BOND			
S, CONDS	1	2	3	4	5	6	7	(GAP)	CLAD	COOLANT		
0.000	2620.	2569.	2476.	2346.	2158.	1783.	1325.	904.	728.	701.		
2.000-01	2628.	2577.	2485.	2355.	2168.	1795.	1337.	908.	729.	702.		
4.000-01	2658.	2608.	2517.	2390.	2203.	1841.	1374.	922.	736.	707.		
6.000-01	2721.	2673.	2583.	2454.	2258.	1949.	1449.	949.	748.	718.		
8.000-01	2829.	2782.	2694.	2566.	2378.	2100.	1570.	994.	768.	735.		
1.000+00	2989.	2944.	2861.	2742.	2567.	2300.	1741.	1056.	798.	759.		
1.200+00	3045.	3043.	3041.	2967.	2797.	2503.	2000.	1144.	838.	792.		
1.300+00	3049.	3047.	3044.	3041.	2924.	2634.	2132.	1192.	861.	812.		
1.400+00	3201.	3150.	3049.	3045.	3040.	2774.	2245.	1308.	897.	838.		
1.405+00	3211.	3160.	3050.	3045.	3040.	2780.	2251.	1311.	899.	839.		
1.410+00	3222.	3170.	3050.	3045.	3040.	2787.	2256.	1314.	901.	841.		
1.415+00	3234.	3182.	3057.	3046.	3041.	2795.	2263.	1319.	905.	838.		
1.420+00	3247.	3194.	3074.	3046.	3041.	2804.	2271.	1336.	925.	816.		
1.425+00	3270.	3216.	3100.	3046.	3041.	2821.	2291.	1356.	946.	804.		
1.430+00	3323.	3268.	3155.	3048.	3042.	2864.	2344.	1389.	971.	787.		
1.435+00	3473.	3418.	3305.	3081.	3045.	2984.	2497.	1460.	1005.	790.		
1.440+00	4130.	4074.	3959.	3740.	3460.	3123.	3041.	1685.	1090.	861.		
1.441+00	4339.	4284.	4169.	3949.	3669.	3333.	3045.	1703.	1114.	886.		

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SAMPLE CASE, 1%/SEC RAMP WITH FISSION GAS RELEASE

PIN TEMPERATURES (DEGREES KELVIN)

CHANNEL 1

AXIAL SECTION 10

TIME SECONDS	NODE 1	NODE 2	NODE 3	NODE 4	NODE 5	NODE 6	NODE 7	BOND (GAP)	CLAD	COOLANT
0.000	2642.	2591.	2498.	2368.	2180.	1805.	1343.	919.	743.	716.
2.000-01	2650.	2599.	2507.	2378.	2190.	1817.	1355.	924.	745.	718.
4.000-01	2680.	2630.	2539.	2409.	2217.	1869.	1393.	938.	752.	724.
6.000-01	2742.	2693.	2602.	2471.	2273.	1975.	1470.	967.	765.	735.
8.000-01	2848.	2800.	2711.	2583.	2396.	2121.	1590.	1013.	787.	754.
1.000+00	3006.	2960.	2877.	2759.	2583.	2315.	1764.	1077.	819.	781.
1.200+00	3045.	3044.	3041.	2979.	2811.	2518.	2022.	1168.	863.	818.
1.300+00	3050.	3048.	3045.	3041.	2936.	2649.	2151.	1230.	889.	840.
1.400+00	3224.	3166.	3050.	3045.	3040.	2787.	2261.	1336.	930.	871.
1.405+00	3234.	3176.	3055.	3045.	3040.	2793.	2266.	1339.	932.	873.
1.410+00	3245.	3186.	3070.	3046.	3041.	2800.	2272.	1342.	934.	875.
1.415+00	3257.	3198.	3086.	3046.	3041.	2808.	2279.	1353.	946.	862.
1.420+00	3270.	3211.	3102.	3046.	3041.	2817.	2287.	1369.	966.	847.
1.425+00	3292.	3233.	3127.	3047.	3041.	2834.	2307.	1390.	987.	828.
1.430+00	3345.	3286.	3181.	3048.	3042.	2876.	2359.	1422.	1011.	817.
1.435+00	3495.	3436.	3330.	3102.	3045.	2995.	2512.	1492.	1045.	815.
1.440+00	4151.	4092.	3984.	3761.	3476.	3137.	3041.	1712.	1130.	883.
1.441+00	4361.	4302.	4193.	3970.	3685.	3347.	3045.	1730.	1153.	909.

SAMPLE CASE, 1%/SEC RAMP WITH FISSION GAS RELEASE

PIN TEMPERATURES (DEGREES KELVIN)

CHANNEL 1

AXIAL SECTION 12

TIME S, CONDS	NODE 1	NODE 2	NODE 3	NODE 4	NODE 5	NODE 6	NODE 7	BOND (GAP)	CLAD	COOLANT
0.000	2558.	2510.	2423.	2300.	2122.	1770.	1338.	938.	772.	746.
2.000-01	2566.	2519.	2431.	2309.	2132.	1782.	1349.	942.	774.	748.
4.000-01	2596.	2549.	2463.	2343.	2169.	1822.	1385.	956.	781.	754.
6.000-01	2658.	2612.	2528.	2409.	2229.	1918.	1454.	984.	796.	768.
8.000-01	2764.	2719.	2637.	2517.	2337.	2070.	1571.	1032.	821.	790.
1.000+00	2920.	2878.	2799.	2686.	2518.	2266.	1737.	1098.	857.	822.
1.200+00	3043.	3041.	3010.	2908.	2744.	2465.	1987.	1192.	908.	867.
1.300+00	3046.	3045.	3042.	3021.	2869.	2591.	2116.	1245.	937.	893.
1.400+00	3079.	3049.	3047.	3043.	2994.	2728.	2231.	1364.	984.	932.
1.405+00	3089.	3049.	3047.	3043.	3000.	2735.	2236.	1368.	987.	934.
1.410+00	3100.	3050.	3047.	3043.	3006.	2742.	2242.	1371.	989.	936.
1.415+00	3111.	3050.	3047.	3043.	3013.	2751.	2249.	1375.	992.	943.
1.420+00	3123.	3063.	3048.	3044.	3021.	2760.	2257.	1385.	1003.	931.
1.425+00	3144.	3087.	3048.	3044.	3035.	2777.	2276.	1405.	1023.	888.
1.430+00	3194.	3138.	3049.	3045.	3041.	2818.	2326.	1436.	1045.	869.
1.435+00	3335.	3279.	3149.	3048.	3044.	2935.	2473.	1503.	1077.	870.
1.440+00	3955.	3898.	3768.	3573.	3342.	3050.	3019.	1725.	1157.	931.
1.441+00	4152.	4095.	3966.	3771.	3540.	3223.	3043.	1748.	1179.	955.

SAMPLE CASE, 1%/SEC RAMP WITH FISSION GAS RELEASE

PIN TEMPERATURES (DEGREES KELVIN)

CHANNEL 1

AXIAL SECTION 15

TIME	NODE	NODE	NODE	NODE	NODE	NODE	NODE	NODE	BOND			
SECONDS	1	2	3	4	5	6	7	(GAP)	CLAD	COOLANT		
0.000	2259.	2221.	2150.	2052.	1854.	1585.	1255.	939.	806.	785.		
2.000-01	2267.	2228.	2158.	2060.	1863.	1595.	1264.	943.	807.	787.		
4.000-01	2294.	2256.	2187.	2091.	1896.	1629.	1293.	956.	815.	794.		
6.000-01	2352.	2315.	2246.	2146.	1971.	1699.	1350.	982.	831.	809.		
8.000-01	2450.	2413.	2343.	2243.	2098.	1819.	1446.	1027.	859.	835.		
1.000+00	2596.	2560.	2494.	2399.	2251.	2009.	1588.	1092.	900.	873.		
1.200+00	2790.	2756.	2693.	2601.	2460.	2241.	1777.	1178.	955.	924.		
1.300+00	2903.	2870.	2809.	2720.	2581.	2347.	1904.	1233.	989.	956.		
1.400+00	3026.	2995.	2936.	2848.	2708.	2464.	2039.	1295.	1030.	995.		
1.405+00	3032.	3001.	2942.	2854.	2715.	2471.	2045.	1298.	1033.	998.		
1.410+00	3039.	3008.	2949.	2861.	2721.	2477.	2052.	1302.	1036.	1000.		
1.415+00	3040.	3015.	2956.	2869.	2729.	2485.	2060.	1306.	1038.	1000.		
1.420+00	3040.	3023.	2964.	2877.	2737.	2494.	2070.	1310.	1041.	1009.		
1.425+00	3041.	3036.	2979.	2892.	2753.	2510.	2088.	1322.	1052.	1003.		
1.430+00	3042.	3041.	3010.	2925.	2788.	2549.	2134.	1359.	1068.	993.		
1.435+00	3044.	3043.	3041.	3016.	2885.	2658.	2265.	1451.	1094.	979.		
1.440+00	3232.	3188.	3113.	3049.	3046.	3041.	2762.	1648.	1159.	1007.		
1.441+00	3390.	3347.	3272.	3165.	3049.	3044.	2897.	1702.	1177.	1023.		

SAMPLE CASE, 1%/SEC RAMP WITH FISSION GAS RELEASE

PIN TEMPERATURES (DEGREES KELVIN)

CHANNEL 1

AXIAL SECTION 18

TIME SECONDS	NODE 1	NODE 2	NODE 3	NODE 4	NODE 5	NODE 6	NODE 7	BOND (GAP)	CLAD	COOLANT
0.000	1903.	1864.	1794.	1698.	1564.	1382.	1153.	927.	829.	814.
2.000-01	1909.	1870.	1801.	1705.	1571.	1390.	1160.	930.	831.	816.
4.000-01	1933.	1895.	1820.	1731.	1598.	1416.	1182.	941.	838.	823.
6.000-01	1984.	1946.	1879.	1786.	1653.	1469.	1227.	965.	854.	838.
8.000-01	2071.	2037.	1971.	1880.	1749.	1561.	1302.	1005.	882.	865.
1.000+00	2196.	2167.	2113.	2028.	1893.	1698.	1414.	1065.	925.	906.
1.200+00	2367.	2339.	2287.	2211.	2096.	1883.	1563.	1145.	983.	962.
1.300+00	2468.	2441.	2390.	2316.	2202.	2002.	1651.	1193.	1018.	996.
1.400+00	2580.	2553.	2504.	2430.	2315.	2131.	1751.	1247.	1059.	1035.
1.405+00	2586.	2559.	2509.	2436.	2321.	2137.	1757.	1249.	1061.	1037.
1.410+00	2592.	2565.	2516.	2442.	2327.	2144.	1762.	1252.	1063.	1039.
1.415+00	2598.	2572.	2522.	2449.	2334.	2151.	1769.	1256.	1066.	1043.
1.420+00	2606.	2579.	2530.	2456.	2342.	2159.	1776.	1259.	1068.	1043.
1.425+00	2618.	2592.	2543.	2470.	2356.	2174.	1791.	1265.	1071.	1045.
1.430+00	2646.	2620.	2572.	2500.	2388.	2209.	1829.	1282.	1082.	1046.
1.435+00	2725.	2700.	2653.	2584.	2476.	2304.	1942.	1322.	1099.	1042.
1.440+00	3032.	3011.	2971.	2913.	2822.	2678.	2380.	1523.	1146.	1080.
1.441+00	3042.	3042.	3041.	3006.	2921.	2784.	2502.	1569.	1160.	1094.

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SAMPLE CASE, 1s/SEC RAMP WITH FISSION GAS RELEASE

PIN TEMPERATURES (DEGREES KELVIN)

CHANNEL 2

AXIAL SECTION 1

TIME SECONDS	NODE 1	NODE 2	NODE 3	NODE 4	NODE 5	NODE 6	NODE 7	BOND (GAP)	CLAD	COOLANT
0.000	1543.	1509.	1448.	1364.	1248.	1092.	904.	708.	612.	597.
2.000-01	1551.	1516.	1455.	1372.	1256.	1100.	910.	710.	613.	598.
4.000-01	1577.	1544.	1483.	1400.	1284.	1127.	931.	717.	614.	598.
6.000-01	1635.	1601.	1542.	1459.	1343.	1181.	969.	730.	616.	599.
8.000-01	1735.	1703.	1644.	1561.	1443.	1271.	1034.	751.	621.	601.
1.000+00	1888.	1856.	1798.	1716.	1593.	1406.	1131.	781.	627.	603.
1.200+00	2090.	2061.	2005.	1922.	1793.	1586.	1259.	820.	635.	606.
1.300+00	2203.	2176.	2125.	2046.	1911.	1692.	1334.	842.	639.	608.
1.400+00	2327.	2300.	2250.	2174.	2047.	1809.	1417.	866.	644.	609.
1.405+00	2333.	2307.	2256.	2180.	2054.	1815.	1422.	868.	644.	609.
1.410+00	2340.	2313.	2263.	2187.	2062.	1822.	1426.	869.	644.	610.
1.415+00	2347.	2321.	2270.	2194.	2070.	1829.	1432.	871.	645.	610.
1.420+00	2355.	2329.	2279.	2202.	2079.	1838.	1439.	873.	645.	610.
1.425+00	2369.	2343.	2293.	2217.	2095.	1853.	1454.	877.	646.	611.
1.430+00	2401.	2375.	2325.	2250.	2130.	1891.	1494.	889.	649.	614.
1.435+00	2487.	2462.	2415.	2343.	2228.	2001.	1616.	923.	657.	624.
1.440+00	2825.	2804.	2764.	2705.	2609.	2423.	2105.	1075.	692.	674.
1.441+00	2921.	2901.	2863.	2807.	2716.	2541.	2241.	1173.	704.	690.

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

PIN TEMPERATURES (DEGREES KELVIN)

CHANNEL 2

AXIAL SECTION 9

TIME	NODE	NODE	NODE	NODE	NODE	NODE	NODE	NODE	BOND			
SECONDS	1	2	3	4	5	6	7	(GAP)	CLAD	COOLANT		
0.000	2567.	2517.	2427.	2299.	2115.	1751.	1307.	897.	725.	699.		
2.000-01	2575.	2526.	2436.	2309.	2126.	1763.	1319.	901.	727.	700.		
4.000-01	2606.	2557.	2468.	2344.	2164.	1805.	1355.	915.	733.	705.		
6.000-01	2670.	2622.	2536.	2414.	2230.	1901.	1426.	941.	745.	715.		
8.000-01	2779.	2733.	2649.	2525.	2339.	2062.	1546.	986.	765.	732.		
1.000+00	2940.	2896.	2816.	2699.	2526.	2264.	1714.	1047.	794.	756.		
1.200+00	3043.	3042.	3029.	2927.	2758.	2469.	1967.	1133.	833.	789.		
1.300+00	3047.	3046.	3043.	3039.	2886.	2598.	2099.	1181.	856.	808.		
1.400+00	3131.	3064.	3048.	3044.	3011.	2738.	2219.	1286.	889.	832.		
1.405+00	3140.	3077.	3048.	3044.	3017.	2745.	2225.	1291.	891.	833.		
1.410+00	3150.	3089.	3048.	3044.	3023.	2752.	2230.	1297.	893.	835.		
1.415+00	3162.	3103.	3048.	3044.	3030.	2760.	2237.	1304.	895.	837.		
1.420+00	3174.	3117.	3049.	3045.	3037.	2770.	2245.	1308.	897.	839.		
1.425+00	3197.	3140.	3049.	3045.	3040.	2787.	2264.	1316.	901.	842.		
1.430+00	3248.	3191.	3063.	3046.	3041.	2830.	2316.	1347.	921.	832.		
1.435+00	3395.	3337.	3213.	3049.	3044.	2950.	2468.	1417.	956.	830.		
1.440+00	4037.	3978.	3853.	3643.	3395.	3065.	3032.	1648.	1040.	898.		
1.441+00	4241.	4183.	4058.	3848.	3600.	3271.	3044.	1667.	1063.	924.		

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

PIN TEMPERATURES (DEGREES KELVIN)

CHANNEL 2

AXIAL SECTION 10

TIME	NODE	NODE	NODE	NODE	NODE	NODE	NODE	NODE	BOND		
SECONDS	1	2	3	4	5	6	7	(GAP)	CLAD	COOLANT	
0.000	2589.	2539.	2449.	2321.	2137.	1772.	1325.	913.	740.	714.	
2.000-01	2597.	2547.	2457.	2330.	2147.	1784.	1336.	917.	742.	716.	
4.000-01	2627.	2578.	2490.	2365.	2185.	1825.	1373.	930.	748.	721.	
6.000-01	2690.	2643.	2556.	2432.	2243.	1928.	1445.	958.	761.	732.	
8.000-01	2798.	2752.	2666.	2542.	2356.	2082.	1565.	1004.	783.	751.	
1.000+00	2957.	2913.	2832.	2715.	2543.	2282.	1733.	1067.	815.	778.	
1.200+00	3044.	3042.	3040.	2941.	2772.	2484.	1989.	1156.	858.	814.	
1.300+00	3048.	3046.	3043.	3040.	2899.	2613.	2120.	1206.	883.	836.	
1.400+00	3150.	3088.	3048.	3044.	3021.	2752.	2235.	1322.	921.	865.	
1.405+00	3160.	3100.	3048.	3044.	3027.	2759.	2240.	1325.	923.	866.	
1.410+00	3170.	3112.	3049.	3044.	3033.	2766.	2246.	1328.	926.	868.	
1.415+00	3182.	3125.	3049.	3045.	3039.	2774.	2253.	1332.	928.	870.	
1.420+00	3195.	3138.	3049.	3045.	3040.	2783.	2261.	1336.	930.	872.	
1.425+00	3217.	3161.	3050.	3045.	3041.	2801.	2280.	1345.	935.	872.	
1.430+00	3268.	3212.	3088.	3046.	3042.	2843.	2331.	1377.	959.	853.	
1.435+00	3415.	3358.	3237.	3049.	3044.	2962.	2482.	1447.	993.	857.	
1.440+00	4057.	3999.	3877.	3665.	3408.	3080.	3040.	1675.	1077.	923.	
1.441+00	4262.	4204.	4082.	3870.	3613.	3286.	3044.	1693.	1100.	947.	

SAMPLE CASE, 1%/SEC RAMP WITH FISSION GAS RELEASE

PIN TEMPERATURES (DEGREES KELVIN)

CHANNEL 2

AXIAL SECTION 12

TIME SECONDS	NODE 1	NODE 2	NODE 3	NODE 4	NODE 5	NODE 6	NODE 7	BOND (GAP)	CLAD	COOLANT
0.000	2508.	2461.	2370.	2255.	2082.	1739.	1320.	931.	768.	744.
2.000-01	2516.	2469.	2364.	2264.	2092.	1750.	1331.	935.	770.	745.
4.000-01	2545.	2499.	2416.	2298.	2128.	1790.	1366.	949.	777.	751.
6.000-01	2608.	2563.	2482.	2368.	2199.	1874.	1432.	976.	792.	764.
8.000-01	2714.	2672.	2592.	2477.	2300.	2032.	1547.	1023.	816.	786.
1.000+00	2872.	2831.	2755.	2644.	2478.	2229.	1711.	1088.	852.	818.
1.200+00	3041.	3038.	2969.	2866.	2705.	2432.	1953.	1180.	902.	862.
1.300+00	3045.	3043.	3041.	2987.	2831.	2555.	2084.	1232.	931.	887.
1.400+00	3049.	3048.	3045.	3042.	2961.	2693.	2205.	1336.	973.	923.
1.405+00	3049.	3048.	3045.	3042.	2967.	2700.	2210.	1343.	975.	925.
1.410+00	3049.	3048.	3046.	3042.	2974.	2707.	2216.	1349.	978.	927.
1.415+00	3050.	3048.	3046.	3042.	2981.	2715.	2223.	1357.	981.	930.
1.420+00	3050.	3049.	3046.	3043.	2989.	2724.	2231.	1364.	984.	932.
1.425+00	3072.	3049.	3047.	3043.	3004.	2741.	2249.	1373.	989.	935.
1.430+00	3121.	3051.	3047.	3044.	3039.	2783.	2299.	1404.	1011.	906.
1.435+00	3258.	3191.	3064.	3047.	3043.	2900.	2444.	1470.	1043.	910.
1.440+00	3864.	3796.	3670.	3490.	3282.	3048.	2987.	1691.	1122.	968.
1.441+00	4057.	3989.	3863.	3683.	3476.	3162.	3042.	1723.	1144.	990.

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SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

PIN TEMPERATURES (DEGREES KELVIN)

CHANNEL 2

AXIAL SECTION 15

TIME	NODE	NODE	NODE	NODE	NODE	NODE	NODE	NODE	BOND			
SECONDS	1	2	3	4	5	6	7	(GAP)	CLAD	COOLANT		
0.000	2226.	2188.	2120.	2013.	1821.	1560.	1239.	932.	802.	782.		
2.000-01	2234.	2196.	2127.	2022.	1830.	1570.	1248.	936.	803.	783.		
4.000-01	2260.	2222.	2153.	2055.	1863.	1603.	1277.	949.	811.	790.		
6.000-01	2316.	2279.	2212.	2117.	1933.	1671.	1333.	974.	826.	805.		
8.000-01	2414.	2378.	2309.	2209.	2062.	1789.	1427.	1018.	853.	830.		
1.000+00	2559.	2524.	2459.	2365.	2222.	1973.	1566.	1082.	894.	868.		
1.200+00	2752.	2719.	2656.	2565.	2425.	2208.	1751.	1167.	948.	918.		
1.300+00	2865.	2832.	2772.	2683.	2546.	2319.	1872.	1220.	982.	949.		
1.400+00	2987.	2956.	2898.	2811.	2673.	2432.	2008.	1280.	1021.	986.		
1.405+00	2994.	2962.	2904.	2817.	2679.	2439.	2015.	1283.	1023.	988.		
1.410+00	3000.	2969.	2911.	2824.	2686.	2445.	2022.	1287.	1025.	990.		
1.415+00	3007.	2976.	2918.	2832.	2694.	2453.	2030.	1291.	1028.	993.		
1.420+00	3015.	2984.	2926.	2840.	2702.	2461.	2039.	1295.	1031.	995.		
1.425+00	3029.	2998.	2941.	2855.	2717.	2477.	2057.	1302.	1034.	1005.		
1.430+00	3040.	3029.	2972.	2888.	2752.	2516.	2103.	1317.	1040.	1006.		
1.435+00	3043.	3042.	3040.	2979.	2849.	2624.	2233.	1420.	1063.	1014.		
1.440+00	3165.	3125.	3052.	3048.	3045.	3040.	2727.	1615.	1128.	1047.		
1.441+00	3320.	3280.	3207.	3104.	3048.	3043.	2861.	1669.	1145.	1062.		

SAMPLE CASE, 1%/SEC RAMP WITH FISSION GAS RELEASE

PIN TEMPERATURES (DEGREES KELVIN)

CHANNEL 2

AXIAL SECTION 18

TIME	NODE	NODE	NODE	NODE	NODE	NODE	NODE	NODE	BOND			
SECONDS	1	2	3	4	5	6	7	(GAP)	CLAD	COOLANT		
0.000	1867.	1829.	1762.	1669.	1539.	1363.	1141.	921.	825.	810.		
2.000-01	1874.	1836.	1768.	1676.	1546.	1370.	1147.	924.	826.	812.		
4.000-01	1897.	1860.	1793.	1701.	1572.	1396.	1169.	935.	833.	818.		
6.000-01	1948.	1912.	1846.	1755.	1627.	1449.	1213.	957.	849.	833.		
8.000-01	2036.	2001.	1938.	1849.	1721.	1538.	1286.	997.	876.	860.		
1.000+00	2162.	2133.	2079.	1992.	1863.	1673.	1397.	1056.	919.	900.		
1.200+00	2332.	2304.	2253.	2179.	2062.	1855.	1543.	1135.	976.	955.		
1.300+00	2433.	2406.	2356.	2283.	2172.	1968.	1630.	1182.	1010.	988.		
1.400+00	2544.	2517.	2469.	2396.	2283.	2097.	1727.	1234.	1050.	1026.		
1.405+00	2549.	2523.	2474.	2402.	2289.	2104.	1732.	1237.	1052.	1028.		
1.410+00	2555.	2529.	2480.	2408.	2295.	2111.	1738.	1240.	1054.	1030.		
1.415+00	2562.	2536.	2487.	2415.	2302.	2118.	1744.	1243.	1056.	1033.		
1.420+00	2569.	2543.	2495.	2423.	2310.	2126.	1751.	1246.	1059.	1035.		
1.425+00	2582.	2556.	2507.	2436.	2323.	2141.	1766.	1252.	1062.	1037.		
1.430+00	2610.	2584.	2536.	2466.	2355.	2175.	1804.	1265.	1066.	1040.		
1.435+00	2688.	2663.	2617.	2549.	2443.	2271.	1915.	1299.	1077.	1055.		
1.440+00	2994.	2973.	2934.	2877.	2788.	2643.	2349.	1494.	1119.	1096.		
1.441+00	3041.	3041.	3025.	2970.	2885.	2748.	2470.	1540.	1132.	1113.		

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SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

PIN TEMPERATURES (DEGREES KELVIN)

CHANNEL 6

AXIAL SECTION 1

TIME	NODE	NODE	NODE	NODE	NODE	NODE	NODE	NODE	BOND			
SECONDS	1	2	3	4	5	6	7	(GAP)	CLAD	COOLANT		
0.000	1031.	1017.	991.	955.	905.	837.	753.	654.	602.	595.		
2.000-01	1035.	1021.	995.	959.	910.	842.	756.	656.	603.	595.		
4.000-01	1052.	1037.	1011.	975.	925.	856.	767.	660.	603.	596.		
6.000-01	1086.	1071.	1045.	1009.	957.	885.	789.	668.	605.	597.		
8.000-01	1148.	1133.	1106.	1067.	1013.	934.	824.	681.	608.	598.		
1.000+00	1245.	1229.	1200.	1160.	1099.	1008.	877.	699.	612.	600.		
1.200+00	1380.	1364.	1333.	1288.	1219.	1111.	948.	724.	617.	602.		
1.300+00	1463.	1446.	1414.	1366.	1292.	1174.	990.	738.	620.	603.		
1.400+00	1556.	1538.	1504.	1454.	1375.	1244.	1038.	753.	623.	605.		
1.405+00	1561.	1543.	1509.	1459.	1379.	1248.	1041.	754.	623.	605.		
1.410+00	1566.	1548.	1514.	1463.	1384.	1252.	1043.	755.	623.	605.		
1.415+00	1571.	1553.	1520.	1469.	1389.	1256.	1047.	756.	624.	605.		
1.420+00	1578.	1560.	1526.	1475.	1394.	1261.	1050.	757.	624.	605.		
1.425+00	1588.	1570.	1536.	1485.	1405.	1271.	1059.	760.	624.	606.		
1.430+00	1612.	1595.	1561.	1510.	1429.	1296.	1083.	767.	626.	608.		
1.435+00	1680.	1663.	1629.	1579.	1500.	1369.	1156.	789.	630.	614.		
1.440+00	1956.	1941.	1911.	1866.	1794.	1674.	1474.	883.	651.	645.		
1.441+00	2038.	2023.	1994.	1951.	1882.	1766.	1570.	910.	657.	655.		

SAMPLE CASE, 14/SEC RAMP WITH FISSION GAS RELEASE

PIN TEMPERATURES (DEGREES KELVIN)

CHANNEL 6

AXIAL SECTION 9

TIME	NODE	NODE	NODE	NODE	NODE	NODE	NODE	NODE	BOND			
SECONDS	1	2	3	4	5	6	7	(GAP)	CLAD	COOLANT		
0.000	1628.	1594.	1532.	1448.	1330.	1172.	974.	776.	683.	670.		
2.000-01	1635.	1600.	1539.	1455.	1338.	1179.	981.	779.	684.	671.		
4.000-01	1660.	1626.	1565.	1482.	1365.	1205.	1002.	788.	688.	674.		
6.000-01	1715.	1681.	1621.	1538.	1421.	1257.	1043.	805.	696.	682.		
8.000-01	1810.	1777.	1718.	1635.	1517.	1346.	1111.	834.	711.	695.		
1.000+00	1955.	1923.	1865.	1784.	1663.	1481.	1213.	876.	733.	714.		
1.200+00	2143.	2116.	2064.	1982.	1857.	1659.	1348.	932.	762.	740.		
1.300+00	2251.	2224.	2175.	2103.	1974.	1764.	1427.	965.	779.	755.		
1.400+00	2369.	2343.	2295.	2222.	2107.	1882.	1514.	1000.	798.	771.		
1.405+00	2375.	2349.	2301.	2228.	2114.	1888.	1519.	1002.	799.	772.		
1.410+00	2382.	2356.	2307.	2234.	2121.	1895.	1524.	1004.	800.	773.		
1.415+00	2389.	2363.	2314.	2241.	2129.	1902.	1529.	1006.	801.	774.		
1.420+00	2396.	2371.	2322.	2249.	2137.	1910.	1536.	1008.	802.	775.		
1.425+00	2410.	2384.	2336.	2263.	2151.	1926.	1551.	1013.	804.	777.		
1.430+00	2440.	2414.	2367.	2295.	2185.	1963.	1590.	1025.	807.	781.		
1.435+00	2523.	2499.	2453.	2384.	2277.	2067.	1706.	1059.	816.	791.		
1.440+00	2848.	2827.	2789.	2731.	2642.	2469.	2168.	1250.	855.	836.		
1.441+00	2940.	2921.	2884.	2830.	2745.	2581.	2297.	1303.	867.	851.		

SAMPLE CASE, 1s/SEC RAMP WITH FISSION GAS RELEASE

PIN TEMPERATURES (DEGREES KELVIN)

CHANNEL 6

AXIAL SECTION 10

TIME S. CONDS	NODE 1	NODE 2	NODE 3	NODE 4	NODE 5	NODE 6	NODE 7	BOND (GAP)	CLAD	COOLANT
0.000	1645.	1610.	1548.	1463.	1345.	1185.	987.	787.	694.	681.
2.000-01	1651.	1617.	1555.	1471.	1353.	1193.	993.	790.	695.	682.
4.000-01	1677.	1643.	1581.	1497.	1380.	1218.	1014.	799.	699.	686.
6.000-01	1731.	1697.	1637.	1553.	1435.	1271.	1055.	817.	709.	694.
8.000-01	1825.	1793.	1733.	1650.	1531.	1360.	1124.	846.	724.	708.
1.000+00	1969.	1938.	1880.	1798.	1677.	1495.	1227.	891.	748.	729.
1.200+00	2155.	2128.	2078.	1996.	1871.	1673.	1363.	948.	780.	758.
1.300+00	2263.	2236.	2187.	2115.	1988.	1779.	1443.	983.	799.	775.
1.400+00	2380.	2355.	2306.	2233.	2120.	1897.	1530.	1020.	819.	793.
1.405+00	2387.	2361.	2312.	2240.	2127.	1903.	1535.	1021.	820.	794.
1.410+00	2393.	2367.	2319.	2246.	2134.	1910.	1540.	1023.	821.	795.
1.415+00	2400.	2374.	2326.	2253.	2141.	1917.	1546.	1026.	823.	796.
1.420+00	2408.	2382.	2333.	2261.	2149.	1926.	1553.	1028.	824.	798.
1.425+00	2421.	2395.	2347.	2275.	2163.	1941.	1567.	1033.	826.	799.
1.430+00	2451.	2425.	2378.	2307.	2196.	1978.	1606.	1045.	829.	803.
1.435+00	2533.	2509.	2463.	2395.	2288.	2082.	1722.	1079.	839.	814.
1.440+00	2856.	2836.	2796.	2740.	2651.	2481.	2181.	1275.	877.	859.
1.441+00	2949.	2929.	2893.	2838.	2753.	2592.	2310.	1322.	889.	873.

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SAMPLE CASE, 1s/SEC RAMP WITH FISSION GAS RELEASE

PIN TEMPERATURES (DEGREES KELVIN)

CHANNEL 6

AXIAL SECTION 12

TIME	NODE	NODE	NODE	NODE	NODE	NODE	NODE	BOND		
S. CONDS	1	2	3	4	5	6	7	(GAP)	CLAD	COOLANT
0.000	1609.	1577.	1519.	1440.	1329.	1179.	992.	803.	715.	703.
2.000-01	1615.	1583.	1526.	1447.	1336.	1186.	998.	806.	716.	704.
4.000-01	1640.	1608.	1551.	1472.	1362.	1210.	1018.	815.	721.	708.
6.000-01	1691.	1660.	1603.	1525.	1415.	1260.	1057.	833.	731.	718.
8.000-01	1782.	1751.	1695.	1618.	1506.	1345.	1124.	863.	749.	734.
1.000+00	1920.	1890.	1836.	1758.	1644.	1473.	1223.	909.	775.	758.
1.200+00	2102.	2076.	2025.	1947.	1830.	1645.	1355.	969.	812.	792.
1.300+00	2206.	2131.	2134.	2063.	1940.	1746.	1432.	1005.	834.	812.
1.400+00	2320.	2296.	2249.	2180.	2068.	1859.	1518.	1044.	857.	834.
1.405+00	2326.	2301.	2255.	2186.	2074.	1864.	1522.	1046.	859.	835.
1.410+00	2332.	2308.	2261.	2192.	2081.	1871.	1527.	1048.	860.	836.
1.415+00	2339.	2315.	2266.	2199.	2089.	1878.	1533.	1050.	861.	838.
1.420+00	2347.	2322.	2276.	2207.	2097.	1885.	1539.	1053.	863.	839.
1.425+00	2359.	2335.	2289.	2220.	2112.	1900.	1553.	1058.	865.	841.
1.430+00	2389.	2364.	2319.	2251.	2144.	1935.	1590.	1069.	868.	845.
1.435+00	2469.	2446.	2402.	2337.	2234.	2035.	1700.	1102.	877.	855.
1.440+00	2785.	2765.	2728.	2673.	2586.	2421.	2140.	1271.	914.	897.
1.441+00	2876.	2857.	2822.	2769.	2687.	2530.	2264.	1334.	925.	911.

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

PIN TEMPERATURES (DEGREES KELVIN)

CHANNEL 6

AXIAL SECTION 15

TIME	NODE	NODE	NODE	NODE	NODE	NODE	NODE	NODE	BOND			
SECONDS	1	2	3	4	5	6	7	(GAP)	CLAD	COOLANT		
0.000	1434.	1410.	1366.	1305.	1221.	1106.	962.	811.	741.	731.		
2.000-01	1439.	1415.	1371.	1311.	1227.	1112.	967.	814.	741.	732.		
4.000-01	1460.	1436.	1392.	1332.	1248.	1132.	983.	822.	746.	736.		
6.000-01	1503.	1479.	1436.	1376.	1291.	1173.	1015.	838.	757.	747.		
8.000-01	1581.	1557.	1514.	1454.	1367.	1242.	1071.	867.	776.	765.		
1.000+00	1700.	1676.	1634.	1573.	1483.	1349.	1155.	911.	806.	793.		
1.200+00	1863.	1840.	1797.	1735.	1641.	1494.	1268.	971.	847.	832.		
1.300+00	1960.	1937.	1894.	1832.	1736.	1581.	1336.	1006.	871.	855.		
1.400+00	2066.	2045.	2003.	1939.	1841.	1677.	1411.	1046.	899.	881.		
1.405+00	2072.	2050.	2008.	1945.	1846.	1682.	1415.	1048.	900.	883.		
1.410+00	2077.	2056.	2014.	1951.	1852.	1687.	1419.	1050.	902.	884.		
1.415+00	2083.	2062.	2021.	1957.	1858.	1693.	1424.	1052.	903.	885.		
1.420+00	2090.	2069.	2028.	1964.	1865.	1700.	1430.	1055.	905.	887.		
1.425+00	2102.	2081.	2040.	1977.	1878.	1713.	1442.	1059.	907.	889.		
1.430+00	2128.	2108.	2067.	2005.	1906.	1743.	1473.	1070.	910.	892.		
1.435+00	2202.	2182.	2143.	2083.	1988.	1829.	1565.	1098.	918.	901.		
1.440+00	2496.	2478.	2445.	2393.	2311.	2175.	1944.	1210.	948.	935.		
1.441+00	2580.	2564.	2532.	2482.	2404.	2274.	2053.	1243.	957.	946.		

SAMPLE CASE, 1s/SEC RAMP WITH FISSION GAS RELEASE

PIN TEMPERATURES (DEGREES KELVIN)

CHANNEL 6

AXIAL SECTION 18

C-127

TIME	NODE	NODE	NODE	NODE	NODE	NODE	NODE	NODE	BOND		
S. CONDS	1	2	3	4	5	6	7	(GAP)	CLAD	COOLANT	
0.000	1244.	1228.	1198.	1157.	1099.	1020.	920.	811.	759.	752.	
2.000-01	1249.	1232.	1202.	1161.	1104.	1024.	923.	813.	760.	752.	
4.000-01	1264.	1248.	1218.	1177.	1119.	1039.	935.	819.	764.	757.	
6.000-01	1298.	1281.	1252.	1210.	1152.	1069.	960.	834.	774.	767.	
8.000-01	1357.	1341.	1311.	1269.	1208.	1122.	1002.	859.	793.	785.	
1.000+00	1450.	1434.	1403.	1360.	1297.	1203.	1068.	899.	823.	814.	
1.200+00	1580.	1563.	1532.	1487.	1420.	1316.	1159.	954.	866.	856.	
1.300+00	1659.	1642.	1610.	1564.	1494.	1384.	1213.	987.	892.	881.	
1.400+00	1747.	1730.	1698.	1651.	1578.	1461.	1275.	1024.	920.	909.	
1.405+00	1752.	1735.	1703.	1655.	1582.	1465.	1278.	1026.	922.	910.	
1.410+00	1757.	1740.	1707.	1660.	1587.	1469.	1281.	1028.	923.	912.	
1.415+00	1762.	1745.	1713.	1665.	1592.	1474.	1285.	1030.	925.	913.	
1.420+00	1768.	1751.	1719.	1671.	1598.	1479.	1290.	1033.	927.	915.	
1.425+00	1778.	1761.	1729.	1681.	1608.	1489.	1299.	1037.	929.	917.	
1.430+00	1801.	1783.	1752.	1705.	1631.	1513.	1323.	1045.	932.	920.	
1.435+00	1864.	1847.	1816.	1770.	1698.	1582.	1394.	1068.	938.	927.	
1.440+00	2120.	2105.	2077.	2036.	1972.	1867.	1694.	1159.	960.	953.	
1.441+00	2195.	2181.	2154.	2115.	2053.	1952.	1784.	1186.	967.	961.	

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

COOLANT VELOCITY (G/SEC-CM**2)

TIME (SECONDS)	1	2	3	4	5	6
0.000	6.490+02	6.465+02	6.184+02	5.596+02	6.184+02	4.757+02
2.000-01	6.490+02	6.465+02	6.184+02	5.596+02	6.184+02	4.757+02
4.000-01	6.490+02	6.465+02	6.184+02	5.596+02	6.184+02	4.757+02
6.000-01	6.490+02	6.465+02	6.184+02	5.596+02	6.184+02	4.757+02
8.000-01	6.490+02	6.465+02	6.184+02	5.596+02	6.184+02	4.757+02
1.000+00	6.490+02	6.465+02	6.184+02	5.596+02	6.184+02	4.757+02
1.200+00	6.490+02	6.465+02	6.184+02	5.596+02	6.184+02	4.757+02
1.300+00	6.490+02	6.465+02	6.184+02	5.596+02	6.184+02	4.757+02
1.400+00	6.490+02	6.465+02	6.184+02	5.596+02	6.184+02	4.757+02
1.405+00	6.490+02	6.465+02	6.184+02	5.596+02	6.184+02	4.757+02
1.410+00	6.490+02	6.465+02	6.184+02	5.596+02	6.184+02	4.757+02
1.415+00	6.490+02	6.465+02	6.184+02	5.596+02	6.184+02	4.757+02
1.420+00	6.490+02	6.465+02	6.184+02	5.596+02	6.184+02	4.757+02
1.425+00	6.490+02	6.465+02	6.184+02	5.596+02	6.184+02	4.757+02
1.430+00	6.490+02	6.465+02	6.184+02	5.596+02	6.184+02	4.757+02
1.435+00	6.490+02	6.465+02	6.184+02	5.596+02	6.184+02	4.757+02
1.440+00	6.490+02	6.465+02	6.184+02	5.596+02	6.184+02	4.757+02
1.441+00	6.490+02	6.465+02	6.184+02	5.596+02	6.184+02	4.757+02

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

COOLANT TEMPERATURES (DEGREES KELVIN)

TIME (SECONDS)	COOLANT INLET TEMPERATURE	COOLANT OUTLET TEMPERATURES CHANNEL					
		1	2	3	4	5	6
0.000	589.	814.	810.	799.	797.	787.	752.
2.000-01	589.	816.	812.	800.	798.	788.	752.
4.000-01	589.	823.	818.	807.	804.	794.	757.
6.000-01	589.	838.	833.	821.	818.	808.	767.
8.000-01	589.	865.	860.	846.	842.	831.	785.
1.000+00	589.	906.	900.	884.	879.	868.	814.
1.200+00	589.	962.	955.	937.	931.	918.	856.
1.300+00	589.	996.	988.	968.	961.	948.	881.
1.400+00	589.	1035.	1026.	1003.	995.	981.	909.
1.405+00	589.	1037.	1028.	1005.	997.	983.	910.
1.410+00	589.	1039.	1030.	1007.	999.	984.	912.
1.415+00	589.	1043.	1033.	1009.	1001.	986.	913.
1.420+00	589.	1043.	1035.	1011.	1003.	988.	915.
1.425+00	589.	1045.	1037.	1013.	1005.	991.	917.
1.430+00	589.	1046.	1040.	1018.	1010.	995.	920.
1.435+00	589.	1042.	1055.	1029.	1019.	1005.	927.
1.440+00	589.	1080.	1096.	1071.	1057.	1045.	953.
1.441+00	589.	1094.	1113.	1087.	1068.	1056.	961.

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

COLLAPSE PATTERN

NUMBERS REPRESENT DOWNWARD AXIAL DISPLACEMENT, CM, OF FUEL NODES FROM ORIGINAL POSITION

TIME FROM START OF TRANSIENT (SECONDS)	TIME FROM START OF COLLAPSE (SECONDS)	AXIAL SEGMENT	CHANNEL					
			1	2	3	4	5	6
1.405+00	5.000-03	18	.012	.000	.000	.000	.000	.000
		17	.012	.000	.000	.000	.000	.000
		16	.012	.000	.000	.000	.000	.000
		15	.012	.000	.000	.000	.000	.000
		14	.012	.000	.000	.000	.000	.000
		13	.012	.000	.000	.000	.000	.000
		12	.012	.000	.000	.000	.000	.000
		11	.012	.000	.000	.000	.000	.000
		10	.012	.000	.000	.000	.000	.000
		9	.012	.000	.000	.000	.000	.000
		8	.000	.000	.000	.000	.000	.000
		7	.000	.000	.000	.000	.000	.000
		6	.000	.000	.000	.000	.000	.000
		5	.000	.000	.000	.000	.000	.000
		4	.000	.000	.000	.000	.000	.000
		3	.000	.000	.000	.000	.000	.000
		2	.000	.000	.000	.000	.000	.000
		1	.000	.000	.000	.000	.000	.000
1.410+00	1.000-02	18	.049	.000	.000	.000	.000	.000
		17	.049	.000	.000	.000	.000	.000
		16	.049	.000	.000	.000	.000	.000
		15	.049	.000	.000	.000	.000	.000
		14	.049	.000	.000	.000	.000	.000
		13	.049	.000	.000	.000	.000	.000
		12	.049	.000	.000	.000	.000	.000
		11	.049	.000	.000	.000	.000	.000
		10	.049	.000	.000	.000	.000	.000
		9	.049	.000	.000	.000	.000	.000
		8	.000	.000	.000	.000	.000	.000
		7	.000	.000	.000	.000	.000	.000
		6	.000	.000	.000	.000	.000	.000
		5	.000	.000	.000	.000	.000	.000
		4	.000	.000	.000	.000	.000	.000
		3	.000	.000	.000	.000	.000	.000
		2	.000	.000	.000	.000	.000	.000
		1	.000	.000	.000	.000	.000	.000

C-130

SAMPLE CASE, 13/SEC RAMP WITH FISSION GAS RELEASE

COLLAPSE PATTERN

NUMBERS REPRESENT DOWNWARD AXIAL DISPLACEMENT, CM, OF FUEL NODES FROM ORIGINAL POSITION

TIME FROM START OF TRANSIENT (SECONDS)	TIME FROM START OF COLLAPSE (SECONDS)	AXIAL SEGMENT	CHANNEL					
			1	2	3	4	5	6
C-131 1.415+00	1.500-02	18	.110	.000	.000	.000	.000	.000
		17	.110	.000	.000	.000	.000	.000
		16	.110	.000	.000	.000	.000	.000
		15	.110	.000	.000	.000	.000	.000
		14	.110	.000	.000	.000	.000	.000
		13	.110	.000	.000	.000	.000	.000
		12	.110	.000	.000	.000	.000	.000
		11	.110	.000	.000	.000	.000	.000
		10	.110	.000	.000	.000	.000	.000
		9	.110	.000	.000	.000	.000	.000
		8	.000	.000	.000	.000	.000	.000
		7	.000	.000	.000	.000	.000	.000
		6	.000	.000	.000	.000	.000	.000
		5	.000	.000	.000	.000	.000	.000
		4	.000	.000	.000	.000	.000	.000
		3	.000	.000	.000	.000	.000	.000
		2	.000	.000	.000	.000	.000	.000
		1	.000	.000	.000	.000	.000	.000
1.420+00	2.000-02	18	.196	.012	.000	.000	.000	.000
		17	.196	.012	.000	.000	.000	.000
		16	.196	.012	.000	.000	.000	.000
		15	.196	.012	.000	.000	.000	.000
		14	.196	.012	.000	.000	.000	.000
		13	.196	.012	.000	.000	.000	.000
		12	.196	.012	.000	.000	.000	.000
		11	.196	.012	.000	.000	.000	.000
		10	.196	.012	.000	.000	.000	.000
		9	.196	.000	.000	.000	.000	.000
		8	.000	.000	.000	.000	.000	.000
		7	.000	.000	.000	.000	.000	.000
		6	.000	.000	.000	.000	.000	.000
		5	.000	.000	.000	.000	.000	.000
		4	.000	.000	.000	.000	.000	.000
		3	.000	.000	.000	.000	.000	.000
		2	.000	.000	.000	.000	.000	.000
		1	.000	.000	.000	.000	.000	.000

SAMPLE CASE, 1%/SEC RAMP WITH FISSI, N GAS RELEASE

COLLAPSE PATTERN

NUMBERS REPRESENT DOWNWARD AXIAL DISPLACEMENT, CM, OF FUEL NODES FROM ORIGINAL POSITION

TIME FROM START OF TRANSIENT (SECONDS)	TIME FROM START OF COLLAPSE (SECONDS)	AXIAL SEGMENT	CHANNEL					
			1	2	3	4	5	6
1.425+00	2.500-02	18	.307	.049	.000	.000	.000	.000
		17	.307	.049	.000	.000	.000	.000
		16	.307	.049	.000	.000	.000	.000
		15	.307	.049	.000	.000	.000	.000
		14	.307	.049	.000	.000	.000	.000
		13	.307	.049	.000	.000	.000	.000
		12	.307	.049	.000	.000	.000	.000
		11	.307	.049	.000	.000	.000	.000
		10	.307	.049	.000	.000	.000	.000
		9	.307	.012	.000	.000	.000	.000
		8	.012	.000	.000	.000	.000	.000
		7	.000	.000	.000	.000	.000	.000
		6	.000	.000	.000	.000	.000	.000
		5	.000	.000	.000	.000	.000	.000
		4	.000	.000	.000	.000	.000	.000
		3	.000	.000	.000	.000	.000	.000
		2	.000	.000	.000	.000	.000	.000
		1	.000	.000	.000	.000	.000	.000
		18	.441	.110	.000	.000	.000	.000
		17	.441	.110	.000	.000	.000	.000
		16	.441	.110	.000	.000	.000	.000
		15	.441	.110	.000	.000	.000	.000
		14	.441	.110	.000	.000	.000	.000
		13	.441	.110	.000	.000	.000	.000
		12	.441	.110	.000	.000	.000	.000
		11	.441	.110	.000	.000	.000	.000
		10	.441	.110	.000	.000	.000	.000
		9	.441	.049	.000	.000	.000	.000
		8	.049	.012	.000	.000	.000	.000
		7	.002	.000	.000	.000	.000	.000
		6	.000	.000	.000	.000	.000	.000
		5	.000	.000	.000	.000	.000	.000
		4	.000	.000	.000	.000	.000	.000
		3	.000	.000	.000	.000	.000	.000
		2	.000	.000	.000	.000	.000	.000
		1	.000	.000	.000	.000	.000	.000

C-132

1.430+00 3.000-02

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

COLLAPSE PATTERN

NUMBERS REPRESENT DOWNWARD AXIAL DISPLACEMENT, CM, OF FUEL NODES FROM ORIGINAL POSITION

TIME FROM START OF TRANSIENT (SECONDS)	TIME FROM START OF COLLAPSE (SECONDS)	AXIAL SEGMENT	CHANNEL					
			1	2	3	4	5	6
C-133	1.435+00 3.500-02	18	.001	.196	.008	.000	.001	.000
		17	.001	.196	.008	.000	.001	.000
		16	.001	.196	.008	.000	.001	.000
		15	.001	.196	.008	.000	.001	.000
		14	.001	.196	.008	.000	.001	.000
		13	.001	.196	.008	.000	.001	.000
		12	.001	.196	.008	.000	.001	.000
		11	.001	.196	.008	.000	.001	.000
		10	.001	.196	.008	.000	.001	.000
		9	.001	.110	.007	.000	.001	.000
		8	.110	.049	.003	.000	.000	.000
		7	.024	.014	.001	.000	.000	.000
		6	.006	.003	.000	.000	.000	.000
		5	.000	.000	.000	.000	.000	.000
		4	.000	.000	.000	.000	.000	.000
		3	.000	.000	.000	.000	.000	.000
		2	.000	.000	.000	.000	.000	.000
		1	.000	.000	.000	.000	.000	.000
	1.440+00 4.000-02	18	.785	.307	.040	.012	.019	.000
		17	.785	.307	.040	.012	.019	.000
		16	.785	.307	.040	.012	.019	.000
		15	.785	.307	.040	.012	.019	.000
		14	.785	.307	.040	.012	.019	.000
		13	.785	.307	.040	.012	.019	.000
		12	.785	.307	.040	.012	.019	.000
		11	.785	.307	.040	.012	.019	.000
		10	.785	.307	.040	.012	.019	.000
		9	.785	.196	.037	.012	.019	.000
		8	.196	.110	.028	.021	.015	.000
		7	.070	.052	.019	.008	.021	.000
		6	.034	.028	.012	.006	.007	.000
		5	.015	.013	.006	.003	.004	.000
		4	.007	.006	.003	.001	.002	.000
		3	.004	.003	.001	.000	.001	.000
		2	.001	.001	.000	.000	.000	.000
		1	.001	.000	.000	.000	.000	.000

SAMPLE CASE, 1%/SEC RAMP WITH FISSION GAS RELEASE

COLLAPSE PATTERN

NUMBERS REPRESENT DOWNWARD AXIAL DISPLACEMENT, CM, OF FUEL NODES FROM ORIGINAL POSITION

TIME FROM START OF TRANSIENT (SECONDS)	TIME FROM START OF COLLAPSE (SECONDS)	AXIAL SEGMENT	1	2	3	4	5	6
1.441+00	4.069-02	18	.812	.324	.047	.016	.024	.000
		17	.812	.324	.047	.016	.024	.000
		16	.812	.324	.047	.016	.024	.000
		15	.812	.324	.047	.016	.024	.000
		14	.812	.324	.047	.016	.024	.000
		13	.812	.324	.047	.016	.024	.000
		12	.812	.324	.047	.016	.024	.000
		11	.812	.324	.047	.016	.024	.000
		10	.812	.324	.047	.016	.024	.000
		9	.812	.210	.043	.016	.024	.000
		8	.210	.121	.033	.026	.019	.000
		7	.079	.059	.024	.011	.026	.000
		6	.040	.033	.016	.008	.010	.000
		5	.019	.017	.009	.005	.006	.000
		4	.010	.009	.005	.003	.004	.000
		3	.006	.005	.003	.001	.002	.000
		2	.003	.002	.001	.000	.000	.000
		1	.002	.001	.000	.000	.000	.000

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

VOIDING PATTERN

UPWARD INTERFACE/DOWNWARD INTERFACE (AXIAL DISTANCE, CM, RELATIVE TO CORE BOTTOM)

TIME FROM START OF TRANSIENT (SECONDS)	TIME FROM START OF VOIDING (SECONDS)	CHANNEL					
		1	2	3	4	5	6
1.405+00	5.000-03	5.119+01	0.000	0.000	0.000	0.000	0.000
		4.482+01	0.000	0.000	0.000	0.000	0.000
1.410+00	1.000-02	5.933+01	0.000	0.000	0.000	0.000	0.000
		3.643+01	0.000	0.000	0.000	0.000	0.000
1.415+00	1.500-02	6.905+01	5.080+01	0.000	0.000	0.000	0.000
		2.438+01	5.080+01	0.000	0.000	0.000	0.000
1.420+00	2.000-02	7.949+01	5.630+01	0.000	0.000	0.000	0.000
		1.144+01	5.015+01	0.000	0.000	0.000	0.000
1.425+00	2.500-02	9.015+01	6.454+01	0.000	0.000	0.000	0.000
		-1.080+00	4.235+01	0.000	0.000	0.000	0.000
1.430+00	3.000-02	1.007+02	7.443+01	0.000	0.000	0.000	0.000
		-1.273+01	3.089+01	0.000	0.000	0.000	0.000
1.435+00	3.500-02	1.111+02	8.508+01	5.521+01	4.572+01	5.186+01	0.000
		-2.287+01	1.847+01	5.063+01	4.572+01	5.143+01	0.000
1.440+00	4.000-02	1.111+02	9.597+01	6.301+01	5.071+01	5.802+01	4.081+01
		-2.287+01	6.363+00	4.352+01	4.436+01	4.854+01	4.079+01
1.441+00	4.069-02	1.111+02	9.746+01	6.425+01	5.164+01	5.909+01	4.126+01
		-2.287+01	4.761+00	4.215+01	4.351+01	4.757+01	4.099+01

THE PROGRAM HAS ENTERED THE PLOTTING PHASE

PLOT1 (SEMILOG POWER) HAS BEEN MADE

PLOT2 (LINEAR POWER) HAS BEEN MADE

PLOT3 (ENERGY) HAS BEEN MADE

PLOT4 (AVE. FUEL TEMPERATURE) HAS BEEN MADE

PLOT5 (TEMP. AND ENER. OF MOLT. FUEL) HAS BEEN MADE

PLOT6 (FRACTION OF MOLTEN FUEL) HAS BEEN MADE

PLOT7 (KILOGRAMS OF MOLTEN FUEL) HAS BEEN MADE

PLOT8 (REACTIVITY COMPONENTS) HAS BEEN MADE

IPLO = 10

NX = 9

XXX(10) = .5000-02

XXX(11) = .1000-01

XXX(12) = .1500-01

XXX(13) = .2000-01

XXX(14) = .2500-01

XXX(15) = .3000-01

XXX(16) = .3500-01

XXX(17) = .4000-01

XXX(18) = .4069-01

XXX(19) = .0000

XXX(20) = .8000-02

PLOT9 (REACTIVITY AFTER COLLAPSE) HAS BEEN MADE

PLOT10 (POWER AFTER COLLAPSE) HAS BEEN MADE

.0000	.2642+04	.1343+04	.7434+03	.7164+03
.2000-00	.2650+04	.1355+04	.7451+03	.7179+03
.4000-00	.2680+04	.1393+04	.7517+03	.7235+03
.6000-00	.2742+04	.1470+04	.7651+03	.7349+03
.8000-00	.2848+04	.1590+04	.7872+03	.7538+03
.1000+01	.3006+04	.1764+04	.8192+03	.7812+03
.1200+01	.3045+04	.2022+04	.8630+03	.8183+03
.1300+01	.3050+04	.2151+04	.8893+03	.8402+03
.1400+01	.3224+04	.2261+04	.9296+03	.8713+03
.1405+01	.3234+04	.2266+04	.9316+03	.8730+03
.1410+01	.3245+04	.2272+04	.9336+03	.8747+03
.1415+01	.3257+04	.2279+04	.9464+03	.8817+03
.1420+01	.3270+04	.2287+04	.9664+03	.8469+03
.1425+01	.3292+04	.2307+04	.9872+03	.8284+03
.1430+01	.3345+04	.2359+04	.1011+04	.8171+03
.1435+01	.3495+04	.2512+04	.1045+04	.8152+03
.1440+01	.4151+04	.3041+04	.1130+04	.8831+03
.1441+01	.4361+04	.3045+04	.1153+04	.9088+03

TORAW1 (TRANSIENT PIN TEMPERATURES) HAS BEEN MADE

.0000	.1903+04	.1153+04	.8295+03	.8145+03
.2000-00	.1909+04	.1160+04	.8309+03	.8158+03
.4000-00	.1933+04	.1182+04	.8380+03	.8228+03
.6000-00	.1984+04	.1227+04	.8539+03	.8381+03
.8000-00	.2071+04	.1302+04	.8820+03	.8651+03
.1000+01	.2196+04	.1414+04	.9248+03	.9061+03

.1200+01	.2367+04	.1563+04	.9828+03	.9616+03
.1300+01	.2468+04	.1651+04	.1018+04	.9955+03
.1400+01	.2580+04	.1751+04	.1059+04	.1035+04
.1405+01	.2586+04	.1757+04	.1061+04	.1037+04
.1410+01	.2592+04	.1762+04	.1063+04	.1039+04
.1415+01	.2598+04	.1769+04	.1066+04	.1043+04
.1420+01	.2606+04	.1776+04	.1068+04	.1043+04
.1425+01	.2618+04	.1791+04	.1071+04	.1045+04
.1430+01	.2646+04	.1829+04	.1082+04	.1046+04
.1435+01	.2725+04	.1942+04	.1099+04	.1042+04
.1440+01	.3032+04	.2380+04	.1146+04	.1080+04
.1441+01	.3042+04	.2502+04	.1160+04	.1094+04

TDRAW1 (TRANSIENT PIN TEMPERATURES) HAS BEEN MADE

.0000	.2589+04	.1325+04	.7404+03	.7141+03
.2000-00	.2597+04	.1336+04	.7421+03	.7155+03
.4000-00	.2627+04	.1373+04	.7485+03	.7211+03
.6000-00	.2690+04	.1445+04	.7614+03	.7321+03
.8000-00	.2798+04	.1565+04	.7833+03	.7507+03
.1000+01	.2957+04	.1733+04	.8150+03	.7779+03
.1200+01	.3044+04	.1969+04	.8580+03	.8143+03
.1300+01	.3048+04	.2120+04	.8830+03	.8357+03
.1400+01	.3150+04	.2235+04	.9213+03	.8646+03
.1405+01	.3160+04	.2240+04	.9235+03	.8663+03
.1410+01	.3170+04	.2246+04	.9256+03	.8681+03
.1415+01	.3182+04	.2253+04	.9278+03	.8699+03
.1420+01	.3195+04	.2261+04	.9300+03	.8720+03
.1425+01	.3217+04	.2280+04	.9346+03	.8718+03
.1430+01	.3268+04	.2331+04	.9587+03	.8527+03
.1435+01	.3415+04	.2482+04	.9926+03	.8569+03
.1440+01	.4057+04	.3040+04	.1077+04	.9229+03
.1441+01	.4262+04	.3044+04	.1100+04	.9468+03

TDRAW1 (TRANSIENT PIN TEMPERATURES) HAS BEEN MADE

.0000	.1867+04	.1141+04	.8249+03	.8103+03
.2000-00	.1874+04	.1147+04	.8263+03	.8116+03
.4000-00	.1897+04	.1169+04	.8333+03	.8185+03
.6000-00	.1948+04	.1213+04	.8489+03	.8335+03
.8000-00	.2036+04	.1286+04	.8764+03	.8599+03
.1000+01	.2162+04	.1397+04	.9186+03	.9004+03
.1200+01	.2332+04	.1543+04	.9757+03	.9549+03
.1300+01	.2433+04	.1630+04	.1010+04	.9883+03
.1400+01	.2544+04	.1727+04	.1050+04	.1026+04
.1405+01	.2549+04	.1732+04	.1052+04	.1028+04
.1410+01	.2555+04	.1738+04	.1054+04	.1030+04
.1415+01	.2562+04	.1744+04	.1056+04	.1033+04
.1420+01	.2569+04	.1751+04	.1059+04	.1035+04
.1425+01	.2582+04	.1766+04	.1062+04	.1037+04
.1430+01	.2610+04	.1804+04	.1066+04	.1040+04
.1435+01	.2688+04	.1915+04	.1077+04	.1055+04
.1440+01	.2994+04	.2349+04	.1119+04	.1096+04

.1441+01 .3041+04 .2470+04 .1132+04 .1113+04
TDRAW1 (TRANSIENT PIN TEMPERATURES) HAS BEEN MADE

.0000 .1645+04 .9860+03 .6939+03 .6811+03
.2000-00 .1651+04 .9933+03 .6950+03 .6820+03
.4000-00 .1677+04 .1014+04 .6994+03 .6860+03
.0000-00 .1731+04 .1055+04 .7087+03 .6943+03
.0000-00 .1825+04 .1124+04 .7243+03 .7083+03
.1000+01 .1969+04 .1227+04 .7479+03 .7295+03
.1200+01 .2155+04 .1363+04 .7797+03 .7580+03
.1300+01 .2263+04 .1443+04 .7985+03 .7749+03
.1400+01 .2380+04 .1530+04 .8192+03 .7934+03
.1405+01 .2387+04 .1535+04 .8203+03 .7944+03
.1410+01 .2393+04 .1540+04 .8214+03 .7954+03
.1415+01 .2400+04 .1546+04 .8226+03 .7965+03
.1420+01 .2408+04 .1553+04 .8238+03 .7976+03
.1425+01 .2421+04 .1567+04 .8256+03 .7995+03
.1430+01 .2451+04 .1606+04 .8292+03 .8033+03
.1435+01 .2533+04 .1722+04 .8386+03 .8138+03
.1440+01 .2856+04 .2161+04 .8770+03 .8590+03
.1441+01 .2949+04 .2310+04 .8893+03 .8734+03

TDRAW1 (TRANSIENT PIN TEMPERATURES) HAS BEEN MADE

.0000 .1244+04 .9197+03 .7589+03 .7518+03
.2000-00 .1249+04 .9233+03 .7597+03 .7525+03
.4000-00 .1264+04 .9354+03 .7640+03 .7567+03
.0000-00 .1298+04 .9600+03 .7744+03 .7669+03
.0000-00 .1357+04 .1002+04 .7933+03 .7854+03
.1000+01 .1450+04 .1068+04 .8232+03 .8145+03
.1200+01 .1580+04 .1159+04 .8657+03 .8559+03
.1300+01 .1659+04 .1213+04 .8916+03 .8810+03
.1400+01 .1747+04 .1275+04 .9204+03 .9089+03
.1405+01 .1752+04 .1278+04 .9219+03 .9104+03
.1410+01 .1757+04 .1281+04 .9235+03 .9119+03
.1415+01 .1762+04 .1285+04 .9250+03 .9135+03
.1420+01 .1768+04 .1290+04 .9267+03 .9150+03
.1425+01 .1778+04 .1299+04 .9286+03 .9170+03
.1430+01 .1801+04 .1323+04 .9316+03 .9201+03
.1435+01 .1864+04 .1394+04 .9379+03 .9269+03
.1440+01 .2120+04 .1694+04 .9604+03 .9527+03
.1441+01 .2195+04 .1784+04 .9673+03 .9607+03

TDRAW1 (TRANSIENT PIN TEMPERATURES) HAS BEEN MADE

SAMPLE CASE, 1\$/SEC RAMP WITH FISSION GAS RELEASE

DATE 12 JUN 72

TIME 05:17:29

For the sample case, an unbounded ramp rate of one dollar per second was inserted into a core operating at about a 400 MW power level. As noted from the plots (Figures C4.1 through C4.8), the power increased moderately until fuel failure in Channel 1 was attained at 1.4 seconds. Escaping fission gas then caused flow reversal and, since the pin failure was assumed to occur near the axial center of the core, the reactivity consequences associated with sodium voiding were positive. This, augmented slightly by fuel slumping, was sufficient to bring the core to a prompt critical condition (Figures C4.9 and C4.10) and disassembly conditions were soon attained. Figures C4.11 through C4.16 contain transient temperature plots at selected points in the core.

C-150

C-152

C-154

APPENDIX C-5

PROGRAM LISTING

2 ELT DEF,7,720604, 49830

ABC* FCOPY

DIMENSION CORE(21037)

INTEGER	AX,	AX1,	AX2,	AXIAL,	CH1,	CH2,
1	CHAN,	DELSTP,	DUMP,	FR1,	FR2,	FRAD,
2	OLD,	PAIRS1,	PAIRS2,	PAIRS3,	PAIRS4,	PAIRS5,
3	PAIRS6,	PAIRS7,	PAIRS8,	RESTAR,	STATUS,	STEP,
4	STEPOT,	TITLE,	VENUS			
REAL	KCLAD,	KINSRT,	KNA,	KWTHDR,	MOVE	
LOGICAL	COFF,	GOING,	JUMPC,	JUMPC1,	JUMPC2,	JUMPE1,
1	JUMPE2,	JUMPF1,	JUMPF2,	SCRAM,	VGOING,	VOFF
COMMON	A(15),	A1,	A2,	A3,	A4,	
1	AEW,	AFLOW,	AHIGH,	AID,	AL(6),	ALIFE,
2	ALPH(6),	AN(2),	ANI,	ANIC,	ANSCRH,	ANZ,
3	ARATIO,	ARHO,ARPLT(50),	ASEG,	ASGRHO,	AX,	
4	AX1,	AX2,	AXLAUG,	AXPF(20),	B(6),	B1,
5	B2,	B3,	B4,	BASEC,	BASEE,	BASEF,
6	BASICT(50),	BB,	BB0100,	BOTTOM,	BOUT,	C(6,2),
7	CCOE,	CFUSE,	CH1,	CH2,CHANPF(10),	CHI,	
8	CLINEK(2),	CMELTH,	CMELTL,	COEEEX,	COEFFX,	COFF,
9	COLAPK(2),CONDUCT(50),	COOL(10),	COOLFR,	CP3CO(12),	CPMH(12),	
1	CPML(12),	CXCOE1,	CXCOE2,	CXCOE3,	CYCOE1,	CYCOE2,
2	CYCOE3,	CZCOE1,	CZCOE2,	CZCOE3,	D(15),	DELSTP,
3	DELTOT,DENCOL(10),	DENMUL,	DENSE,	DENSEB,	DENSEC,	
4	DENSEE,	DENVOD,	DEQ,DIVIDE(15),	DKIN(50),	DKOUT(50),	
5	DOPCOE,	DOPPK(2),	DOPPW(20,10),	DOPSAV(20,10),		
6	DOPSUB(20,10),	DOPVD,	DPBOT1,	DPBOT2,	DPTOP1,	
7	DPTOP2,	OSAVE(15,20,10,2),	DSEP(10),	DUMP,	DZABOT,	
8	DZATOP					
COMMON	ECOE,	EFUSE,	ELINEK(2),	EMELTH,	EMELTL,	
1	ENDPOW,	ENERMO,	ENERST,	ERROR,	ERROR1,	ERROR2,
2	EXCOE1,	EXCOE2,	EXPO(6),	EYCOE1,	EYCOE2,	EZCOE1,
3	EZCOE2,	FCOE,	FDOP,	FLINEK(2),	FLOW(50,10),	
4	FLOW2(10,2),	FR1,	FR2,	FRACTB,	FRACTC,	
5	FRACTD,	FRACTF,	FRACTS,	FRACTU,	FRICT1,	FRICT2,
6	FRICT3,	FUELF,	FUELT,	FUSE(15),	GAM(6),	GAMMA,
7	GMSMOL,	GOING,	GRAV,	GROCHI,	GROCH2,	H(2),
8	HAFGRV,	HCAP(15),HCAPDT(15),	HFUSE,	HMAX,	HTCOE,	
9	HTRIP,	HTVOID,	IBLOW,	ICATCH,	ICHAN(10),ICHANX(10),	
1	ICOLPS,	ICOLTQ,	IDIR,	IDOP,	IDOPCH,	IDUMP,
2	IEOSIN,	IEOSOT,	IFIN,	IFLOW,	IGAS,	IJKLM,
3	IKINET,	IPLT,	IPOWER,	IRHO,	ISOFUE,	ITAB(49),
4	ITRIP,	IVOID,	IVOIDQ,	IVOIDS,	IWRAP,IXDOWN(10),	
5	IXUP(10),	IXX(10),	JRHO,	JTIMES,	JUMPC,	JUMPC1,
6	JUMPC2,	JUMPE1,	JUMPE2,	JUMPF1,	JUMPF2,	KCLAD,
7	KINSRT(2),	KNA,	KPRINT,	KWTHDR(2),	LINESL,	LISTA(20),
8	LISTC(10),	LPRINT,	LUP,	LUPPER		
COMMON M,	MAXTIM,	MMM,	MOVE(20,10),	MUP,		
1	MUPPER,	MUX,MVOID(10),	NBUFF(1000),	NEW,		
2	NIT,NMELTR(10),NMELTZ(10),	NOT,	NOTALL,	NOTD,		
3	NR(10),	NUP,	NUPM1,	NUPM2,	NUPM3,	NUPM4,
4	NUPPER,	NVENR,	NVENZ,	NZ(20),	OLD,	PAIRS1,
5	PAIRS2,	PAIRS3,	PAIRS4,	PAIRS5,	PAIRS6,	PAIRS7,
6	PAIRS8,	PCMELT,	PERIOD,	PEXIT,	PGAS,	PINLET,
7	PINTEM(20,10),	PLIB(50),	PN(2),	PNA,	PQW	
8(15,20,10),	PQUIT,	PQUITC,	PVD,	PVOID(10),	Q	
9COOL(10,2),	QGEN(2),	QMOL,	QOUT(2),	R(16),	RADAUG,	
1 RCHAN(10),	REDUCE,	RESTAR,	RFPD(15),	RH(2),	RHO,	
2RHOTEM(10),	RHOSWZ,	RLOG(16),	RM(15),	RMIN,	RSLOPE,	
3	SCRAM,	STATUS,	STEP,	STEPOT,	SUBBR(15),	T(2),
4	TA2,	TA3,	TA4,	TB2,	TB3,	TB4,

```

5 TCOLP(2), TCQUIT, TDELAY, TDISAS, TEMAD, TEMAW,
6 TEMIN(50), TEMOL, TEMP(15), TEMPER(15,20,10,2), TEMSRM,
7 TENTRY(10), TERROR, TEST1(15), TEST2(15), TFOUGT(20,10),
8 THQUIT, TIMEIN(50), TIMFLO(50), TIMIN(50), TIMOUT(50)
COMMON TIN(2), TINCRT, TITLE(14), TITLEP(40), TLQUIT,
1 TMELT, TMELTH, TMELTL, TMQUIT, TNAWGT(21,10),
2 TNOUGT(20,10), TOUT, TPLIB(50), TPLOT(400), TQUIT,
3 TRIPC, TRIPCV, TRIPE, TRIPF, TRIPFO, TRIPX,
4 TSCRAM(2), TSEG(20,10,2), TSEGX(10,2), TSQUIT,
5 TVOID(2), TVQUIT, U(15), UVOID, VC, VCHAN(10),
6 VCOLP(10), VDOPTL, VELB(10), VENUS, VGOING, VOFF,
7 VOIDK(2), VOLUME(15), VPINFL, VTOTAL, W, WC(20,10),
8 WF(20,10), XCOE1, XCOE2, XDOWN(10,2), XUP(10,2),
9 YCOE1, YCOE2, Z(21), ZBOT, ZBOTOM, ZCOE1,
1 ZCOE2, ZMAX, ZMID(20), ZMIN, ZPLEN, ZSEG,
2 ZTOP
EQUIVALENCE(CORE(1),A(1))
END

```

@ ELT INCL/CODE2.7.720604. 49831

DEF* FCOPY

DIMENSION AP(2), BP(2), NPL0T(10), ORD(300), OUT(30),

1 X(300), XINCR(10), XORIG(10), XXX(300), Y(300,20), YINCR(10),

2 YORIG(10), YY(800)

EQUIVALENCE (IBEG,DSAVE(1,13,4,2)), (IENDP,DSAVE(1,15,4,2)),

1 (II,DSAVE(1,12,4,2)), (IPL0,DSAVE(1,10,4,2)),

2 (IREAD,DSAVE(1,9,4,2)), (NPL0T(1),DSAVE(1,4,4,2)),

3 (NX,DSAVE(1,16,4,2)), (ORD(1),DSAVE(1,11,2,2)),

4 (OUT(1),DSAVE(1,1,4,2)), (X(1),DSAVE(1,1,1,2)),

5 (XINCR(1),DSAVE(1,6,4,2)), (XORIG(1),DSAVE(1,5,4,2)),

6 (XXX(1),DSAVE(1,17,4,2)), (XZEROP,DSAVE(1,11,4,2)),

7 (Y(1),TEMPER(1,1,1,1)), (YINCR(1),DSAVE(1,8,4,2)),

8 (YORIG(1),DSAVE(1,7,4,2)), (YY(1),DSAVE(1,1,7,2))

COMMON/AXISLB/AP,BP

END

```

@ ELT TIME,1,700226, 71763
. CALL TIME(I,$N)
. IF TIME REMAINING FOR EXECTION IS LE I (SEC), TRANSFER TO $N
  NBPR      .
MCR$B EQU   07320
TIME*  L     AO,MCR$+12
      L     A1,MCR$B
      DSL   A1,36
      DI,M  A1,5000
      TZ    AO
      AN    AO,A1
      AN    AO,*0.811
      TG    AO,(0)
      J     3.811
      J     *1.811
      END

```

@ ELT MAP.1.701008. 77662
ALL SEG MAIN-SYS-AXISLB-(*A.**WRAPUP)
SYS SEG NERRS-ALOGS-SYSSM-NIERS-EXPS-NOUTS-NTRANS-NFOUTS-SQRTS-SETDRS;
-DOY-TOD-PLOTS-SINS-NLINPS-NINPTS-NRWND\$-NSTOPS
A SEG SETNLS-REPLAY-MODE-TIMNEW-TIME-NEXTO-CURVE-CHECKO-OUTSML-OUTBIG;
-NEXT-NEWTIM-SUBNEU-QUAD-CHECK-VOID-SOCOOL-RUNGE-COLAPS-OUTSTD;
-DOPTM-CORTEM
BLK AXISLB

```

@ ELT MAIN,1,720604, 49870
  INCLUDE ABC
  INCLUDE DEF
C
C MAIN IS THE PRIMARY CALLING PROGRAM AND EXERCISES OVERALL CONTROL.
C INITIALIZATION IS DONE IN THIS ROUTINE.
C SUBROUTINES CALLED ARE REPLAY,CORTEM,COPTM,CUTSTD,NEXT,
C COLAPS,VOID,CHECK,MODE,WRAPUP,NEXTO,CHECKO, AND CURVE.
C SYSTEM SUBROUTINES CALLED ARE SETDR,D0Y,TOD,NTRAN,SETNL,AND CLOTSMAIN
C
  DIMENSION ACCEL(10,2),VELOC(10,2),DIST(10,2),TWFWGT(21,10)
  EQUIVALENCE (TSEG(1,1,1),ACCEL(1,1)),(TSEG(1,2,1),VELOC(1,1)),
1(TSEG(1,3,1),DIST(1,1)),(TSEG(1,4,1),AREAR),(TSEG(2,4,1),POVERD),
2(TSEG(1,9,1),TWFWGT(1,1))
  DIMENSION DATE(4)
C
  NAMEDLIST /NAM/LUPPER,MUPPER,NUPPER,FRACTD,AHIGH,DENSEC,TMELT,HCAPSM
1,HCAPF,DENSE,HFUSE,HCAPC,DENSEB,HCAPB,KNA,KCLAD,HTCOE,FRACTF,FRAC
2B,FRACTC,FRACTS,AXLAUG,RADAUG,PAIRS4,IKINET,ANI,ALIFE,BB,IDOP,DELS
3TP,ICOLPS,IVOIDS,PAIRS5,PAIRS1,DOPCOE,TRIPF,TRIPFO,TRIFE,TRIPC,CHIM
4,GRAV,IVOID,IVOIDQ,MUX,HMAX,PAIRS2,PAIRS3,TDELAY,ERROR,ERROR1,TEMS
5RM,ENDPOW,MAXTIM,ICOLTQ, TVQUIT,TCQUIT,RMIN,THQUIT,TLQUIT,TSQMA
6UIT, REDUCE,M,AX,AX1,AX2,FRI,FR2,CH1,CH2,TRIPX,A1,A2,A3,A4,TA2MA
7X,TA3,TA4,B1,B2,B3,B4,TB2,TB3,TB4,TGUESS,DENSEE,DELTOT,
8YFCOE,EFCOE,CCOE,TERROR,FUELF,TEMAD,TEMAW,IWRAP,TMQUIT,IDUMP,PAIRS6
9Z,IPL0T,PERIOD,PQUIT,PLIB,TPLIB,LISTC,LISTA,CXCOE3,CYCOE3,CZCOE3,
10RCHAN,R,DOPPW,TEMIN,TIMIN,B,AL,TIMFLO,FLOW,BASICT,CONDC,TIMAIN
11MEIN,DKIN,TIMOUT,DKOUT,Wf,Wc,AXPF,CHANPF,ARPL0T,CMELTL,EMELTL,XCOE
12MAIN 91,YCOE1,ZCOE1,XCOE2,YCOE2,ZCOE2,CXCOE1,CYCOE1,CZCOE1,CXCOE2,CYCOE2
13A,CZCOE2,EXCOE1,EYCOE1,EZCOE1,EXCOE2,EYCOE2,EZCOE2,CFUSE,EFUSE,
14BRHOTM,DENCOL,PAIRS8,PFPD,RHOSWZ,TPL0T,ANIC,EPROR2,COOLFR,NVENR,
15CNVENZ,NMELTR,NMELTZ,TINCRT,ZBOT,ZSEG,ITRIP,IEOSIN,IEOSOT,TRIPCV,
16DIDOPCH,FDOF,COEEEX,VENUS,NR,NZ,HTVOID,DENVOD,TENTRY,DSEP,COEFFX,
17EIFLOW,IPOWER,IGAS,ZTOP,ZBOTOM,ZPLEN,PEXIT,PINLET,PCAS,PNA,GAMMA,
18FDEQ,FRICT1,FRICT2,DZATOP,DZABOT,DPTOP1,DPTOP2,DPBOT1,DPBOT2
19
20DO 10 I=1,15
21  10 RFPD(I)=1.
22  DATA RESTAR/6HRESTAR/
23
24C OUTPUT
25  NOT=6
26
27C INPUT
28  NIT=5
29
30C CORE DUMP - TAPE B
31  NOTD=3
32
33C WRAPUP TAPE - TAPE C
34  NOTALL=13
35
36C SET CORE DUMP LENGTH
37  IJKLM = 21037
38  NOTP=7
39  JPLOT=0
40
41C
42C SPECIFY DRUM STORAGE LOCATION
43
44CALL SETDR(23,132000,3600,ITAB)
45CALL SETDR(24,135600,3900,ITAB(8))
46CALL SETDR(25,139500,840000,ITAB(15))
47CALL SETDR(26,979500,4200,ITAB(22))
48CALL SETDR(27,983700,4500,ITAB(29))
49CALL SETDR(28,988200,61500,ITAB(36))
50CALL SETDR(29,1049700,7500,ITAB(43))

```


REWIND 28	MAIN 121
REWIND 29	MAIN 122
IF(CHI.GT.-1.) GO TO 45	MAIN 123
POVERD=-CHI/DENSE	MAIN 124
AREAR=FUELFR/COOLFR	MAIN 125
45 CONTINUE	MAIN 126
CMELTH=CMELTL+10.	MAIN 127
EMELTH=EMELTL+10.	MAIN 128
JTIMES=0	MAIN 129
TDISAS=TEMAW	MAIN 130
KPRINT=0	MAIN 131
LPRINT=0	MAIN 132
HAFGRV=.5*GRAV	MAIN 133
GROCHI=GRAV/CHI	MAIN 134
GROCH2=GROCHI/CHI	MAIN 135
FRACTU=1.-FRACTD	MAIN 136
ASEG=AHIGH/FLOAT(MUPPER)	MAIN 137
NUPM1=NUPPER-1	MAIN 138
NUPM2=NUPPER-2	MAIN 139
NUPM3=NUPPER-3	MAIN 140
NUPM4=NUPPER-4	MAIN 141
NUP=FR2-FR1+1	MAIN 142
MUP=AX2-AX1+1	MAIN 143
LUP=CH2-CH1+1	MAIN 144
ABLE=0.0	MAIN 145
C	MAIN 146
DO 50 CHAN=1,LUPPER	MAIN 147
BAKER=3.14159*RCHAN(CHAN)**2	MAIN 148
VCHAN(CHAN)=BAKER-ABLE	MAIN 149
50 ABLE=BAKER	MAIN 150
ABLE=R(1)**2	MAIN 151
VPINFL=0.0	MAIN 152
DO 55 FRAD=1,NUPM3	MAIN 153
BAKER=R(FRAD+1)**2	MAIN 154
VOLUME(FRAD)=BAKER-ABLE	MAIN 155
VPINFL=VPINFL+VOLUME(FRAD)	MAIN 156
55 ABLE=BAKER	MAIN 157
DO 60 FRAD=NUPM2,NUPPER	MAIN 158
BAKER=R(FRAD+1)**2	MAIN 159
VOLUME(FRAD)=BAKER-ABLE	MAIN 160
60 ABLE=BAKER	MAIN 161
C	MAIN 162
AID=ASEG*FUELFR/VPINFL*1.E-6	MAIN 163
VTOTAL=0.0	MAIN 164
VDOPTL=0.0	MAIN 165
C	MAIN 166
DO 70 CHAN=1,LUPPER	MAIN 167
SUM=0.0	MAIN 168
DO 65 AXIAL=1,MUPPER	MAIN 169
65 SUM=SUM+DOPPW(AXIAL,CHAN)	MAIN 170
VDOPTL=VDOPTL+SUM*VCHAN(CHAN)	MAIN 171
70 VTOTAL=VTOTAL+VCHAN(CHAN)	MAIN 172
VTOTAL=VTOTAL*FLOAT(MUPPER)	MAIN 173
C	MAIN 174
DO 75 CHAN=1,LUPPER	MAIN 175
75 VCOLP(CHAN)=VCHAN(CHAN)*DENSE*ASEG*.CC1*FUELFR	MAIN 176
Z(1)=ZBOT	MAIN 177
ABLE=.5*ASEG	MAIN 178
C	MAIN 179
DO 80 AXIAL=1,MUPPER	MAIN 180

	ZMID(AXIAL)=ABLE	MAIN 181
	ABLE=ABLE+ASEG	MAIN 182
80	Z(AXIAL+1)=Z(AXIAL)+ZSEG	MAIN 183
C		MAIN 184
C	INTEGRATION OF SODIUM VOID WORTH CURVE	MAIN 185
C		MAIN 186
	PAIRS7=MUPPER+1	MAIN 187
	ABLE=DENSEC*ZSEG*.001*COOLFR	MAIN 188
	DENMUL=ASEG*.001*COOLFR	MAIN 189
	DO 85 CHAN=1,MUPPER	MAIN 190
	TNAWGT(1,CHAN)=0.0	MAIN 191
	BAKER=ABLE*VCHAN(CHAN)	MAIN 192
	DO 85 AXIAL=1,MUPPER	MAIN 193
	85 TNAWGT(AXIAL+1,CHAN)=TNAWGT(AXIAL,CHAN)+BAKER*WC(AXIAL,CHAN)	MAIN 194
C		MAIN 195
C	INTEGRATION OF FUEL WORTH CURVE	MAIN 196
C		MAIN 197
	IF(CHI.GT.-1.) GO TO 95	MAIN 198
	ABLE=DENSE*ASEG*.001*FUELF	MAIN 199
	DO 90 CHAN=1,MUPPER	MAIN 200
	TWFWGT(1,CHAN)=0.0	MAIN 201
	BAKER=ABLE*VCHAN(CHAN)	MAIN 202
	DO 90 AXIAL=1,MUPPER	MAIN 203
	90 TWFWGT(AXIAL+1,CHAN)=TWFWGT(AXIAL,CHAN)+BAKER*WF(AXIAL,CHAN)	MAIN 204
	95 CONTINUE	MAIN 205
C		MAIN 206
C	WRITE OUT PROGRAM INPUT	MAIN 207
C		MAIN 208
	CALL REPLAY(TGUESS)	MAIN 209
C		MAIN 210
C	IF RESTART CASE JUMP TO NEXT OR NEXTO	MAIN 211
C		MAIN 212
	GO TO (100,325,345).J	MAIN 213
C		MAIN 214
C	STEADY STATE START	MAIN 215
C		MAIN 216
	100 TMELTL=TMELT	MAIN 217
	TMELTH=TMELT+10.	MAIN 218
	BOTTOM=6.28318*ASEG	MAIN 219
	SCRAM=.FALSE.	MAIN 220
	VGOING=.FALSE.	MAIN 221
	GOING=.FALSE.	MAIN 222
	VOFF=.TRUE.	MAIN 223
	COFF=.TRUE.	MAIN 224
	AEW = TMELTH*(XCOE2+TMELTH*(YCOE2/2.+TMELTH*ZCOE2/3.))	MAIN 225
	STEPOT=DELSTP	MAIN 226
	IRHO=0	MAIN 227
	JRHO=0	MAIN 228
	IFIN = 0	MAIN 229
	IF(RHOSWZ.EQ.0) RHOSWZ=90.0	MAIN 230
	STEP=0	MAIN 231
	TOUT=PLIB(1)	MAIN 232
	DUMP=IDUMP	MAIN 233
	H(1)=RFPD(NUPM2)+RFPD(NUPM1)+RFPD(NUPPER)	MAIN 234
	DO 105 FRAD=1,NUPM3	MAIN 235
	H(1)=H(1)+RFPD(FRAD)	MAIN 236
	HCAP(FRAD)=DENSE*VOLUME(FRAD)	MAIN 237
105	FUSE(FRAD)=HFUSE*DENSE*VOLUME(FRAD)*.1	MAIN 238
C		MAIN 239
C	CONSTANTS FOR VENUS INPUT TEMPERATURES	MAIN 240

C	ENERST=0.	MAIN 241
	ENERMO=0.	MAIN 242
	G = 0.	MAIN 243
	PIASEG=3.14159*ASEG	MAIN 244
	DO 110 FRAD=1,NUPM3	MAIN 245
	CP300(FRAD) = (300.*(XCOE1 + 300.*(YCOE1/2. + 300.*ZCOE1/3.)))	MAIN 246
	1*(DENSE *VOLUME(FRAD)*PIASEG)	MAIN 247
	CPML(FRAD) = (TMELTL*(XCOE1+TMELTL*(YCOE1/2.+TMELTL*ZCOE1/3.)))	MAIN 248
	1*(DENSE *VOLUME(FRAD)*PIASEG)	MAIN 249
	CPMH(FRAD) = DENSE *VOLUME(FRAD)*AEW*PIASEG	MAIN 250
	G = G + FUSE(FRAD)*10.*PIASEG	MAIN 251
110	ENERST = ENERST + CPML(FRAD) - CP300(FRAD)	MAIN 252
	ENERMO = ENERST + G	MAIN 253
C		MAIN 254
	HCAP(NUPPER)=DENSEC*VOLUME(NUPPER)	MAIN 255
	FUSE(NUPPER)=CFUSE*HCAP(NUPPER)*.1	MAIN 256
	HCAP(NUPM2)=DENSEB*VOLUME(NUPM2)	MAIN 257
	FUSE(NUPM2)=CFUSE*.1*HCAP(NUPM2)	MAIN 258
	HCAP(NUPM1)=DENSEE*VOLUME(NUPM1)	MAIN 259
	FUSE(NUPM1)=EFUSE*.1*HCAP(NUPM1)	MAIN 260
C		MAIN 261
	ABLE=XCOE2+TMELTH*(YCOE2+TMELTH*ZCOE2)	MAIN 262
	BAKER=XCOE1+TMELTL*(YCOE1+TMELTL*ZCOE1)	MAIN 263
	DO 115 FRAD=1,NUPM3	MAIN 264
	DIVIDE(FRAD)=ABLE*HCAP(FRAD)	MAIN 265
	SUBBR(FRAD)=BAKER*HCAP(FRAD)	MAIN 266
	TEST1(FRAD)=TMELTL	MAIN 267
115	TEST2(FRAD)=TMELTH	MAIN 268
	DIVIDE(NUPPER)=(CXCOE2+CMELTH*(CYCOE2+CMELTH*CZCOE2))*HCAP(NUPPER)	MAIN 269
	SUBBR(NUPPER)=(CXCOE1+CMELTL*(CYCOE1+CMELTL*CZCOE1))*HCAP(NUPPER)	MAIN 270
	TEST1(NUPPER)=CMELTL	MAIN 271
	TEST2(NUPPER)=CMELTH	MAIN 272
	DIVIDE(NUPM2)=DIVIDE(NUPPER)*HCAP(NUPM2)/HCAP(NUPPER)	MAIN 273
	SUBBR(NUPM2)=SUBBR(NUPPER)*HCAP(NUPM2)/HCAP(NUPPER)	MAIN 274
	TEST1(NUPM2)=CMELTL	MAIN 275
	TEST2(NUPM2)=CMELTH	MAIN 276
	DIVIDE(NUPM1)=(EXCOE2+EMELTH*(EYCOE2+EZCOE2*EMELTH))*HCAP(NUPM1)	MAIN 277
	SUBBR(NUPM1)=HCAP(NUPM1)*(EXCOE1+EMELTL*(EYCOE1+EMELTL*EZCOE1))	MAIN 278
	TEST1(NUPM1)=EMELTL	MAIN 279
	TEST2(NUPM1)=EMELTH	MAIN 280
C		MAIN 281
C	ESTABLISH SWITCHES FOR CONSTANT OR VARIABLE HEAT CAPACITY	MAIN 282
C		MAIN 283
	JUMPF1=.TRUE.	MAIN 284
	JUMPF2=.TRUE.	MAIN 285
	JUMPC1=.TRUE.	MAIN 286
	JUMPC2=.TRUE.	MAIN 287
	JUMPE1=.TRUE.	MAIN 288
	JUMPE2=.TRUE.	MAIN 289
	IF(YCOE1.NE.0.0.OR.ZCOE1.NE.0.0) JUMPF1=.FALSE.	MAIN 290
	IF(YCOE2.NE.0.0.OR.ZCOE2.NE.0.0) JUMPF2=.FALSE.	MAIN 291
	IF(CYCOE1.NE.0.0.OR.CZCOE1.NE.0.0) JUMPC1=.FALSE.	MAIN 292
	IF(CYCOE2.NE.0.0.OR.CZCOE2.NE.0.0) JUMPC2=.FALSE.	MAIN 293
	IF(EYCOE1.NE.0.0.OR.EZCOE1.NE.0.0) JUMPE1=.FALSE.	MAIN 294
	IF(EYCOE2.NE.0.0.OR.EZCOE2.NE.0.0) JUMPE2=.FALSE.	MAIN 295
C		MAIN 296
C	COMPUTE LOG MEAN RADII WITHIN PIN	MAIN 297
C		MAIN 298
	DO 120 I=1,NUPPER	MAIN 299
		MAIN 300

120	RM(I)=SQRT(.5*(R(I)**2+R(I+1)**2))	MAIN	301
	DO 125 I=1,NUPM4	MAIN	302
125	RLOG(I)=ALOG(R(I+1)/RM(I))+ALOG(R(I+1)/R(I+1))	MAIN	303
	RLOG(NUPM3)=ALOG(R(NUPM2)/RM(NUPM3))	MAIN	304
	RLOG(NUPM2)=ALOG(R(NUPM2)/R(NUPM2))	MAIN	305
	RLOG(NUPM1)=ALOG(R(NUPM1)/RM(NUPM2))	MAIN	306
	RLOG(NUPPER)=ALOG(R(NUPM1)/R(NUPM1))	MAIN	307
	RLOG(NUPPER+1)=ALOG(R(NUPPER)/RM(NUPM1))	MAIN	308
C		MAIN	309
C	COMPUTE THERMAL ADMITTANCES FOR GAP AND CLADDING	MAIN	310
C		MAIN	311
	IF(HCAP(NUPM2)) 130,130,135	MAIN	312
130	RLOG(NUPM2)=.5/R(NUPM2)	MAIN	313
	RLOG(NUPM1)=RLOG(NUPM2)	MAIN	314
135	U(NUPM2)=1./((RLOG(NUPM1)/KNA+RLOG(NUPPER)/KCLAD)	MAIN	315
	U(NUPM1)=1./((RLOG(NUPPER+1)/KCLAD+1./((R(NUPPER)*HTCOE))	MAIN	316
	IF(HTVOID.GT.C.) GO TO 140	MAIN	317
	UVOID=0.	MAIN	318
	GO TO 145	MAIN	319
140	UVOID=1./((RLOG(NUPPER+1)/KCLAD+1./((R(NUPPER)*HTVOID))	MAIN	320
145	CONTINUE	MAIN	321
C		MAIN	322
C	ESTABLISH FRACTION OF POWER GENERATED IN EACH RADIAL PIN NODE	MAIN	323
C		MAIN	324
	DO 150 FRAD=1,NUPM3	MAIN	325
150	TEMP(FRAD)=VOLUME(FRAD)/VPINFL*RFPD(FRAD)/H(1)*FRACTF	MAIN	326
	TEMP(NUPM2)=FRACTB*RFPD(NUPM2)/H(1)	MAIN	327
	TEMP(NUPM1)=FRACTC*RFPD(NUPM1)/H(1)	MAIN	328
	TEMP(NUPPER)=FRACTS*RFPD(NUPPER)/H(1)	MAIN	329
C		MAIN	330
C	ESTABLISH POWER GENERATION IN AXIAL AND RADIAL NODES	MAIN	331
C		MAIN	332
	SUM=0.0	MAIN	333
	IF(CHANPF(1).GT.0.0) GO TO 170	MAIN	334
C		MAIN	335
C	POWER DISTRIBUTIONS ARE CHOPPED COSINE IN RADIAL AND AXIAL DIRECT.	MAIN	336
C		MAIN	337
	DOE=0.0	MAIN	338
	AXIAL=ZMID(1)+AXLAUG	MAIN	339
	ABLE=1.570795/(RCHAN(LUPPER)+RADAUG)	MAIN	340
	BAKER=3.14159/(AHIGH+?.*AXLAUG)	MAIN	341
	DO 165 CHAN=1,LUPPER	MAIN	342
	EASY=.5*RCHAN(CHAN)**2	MAIN	343
	CHANLF=COS(SQRT(EASY+DOE)*ABLE)	MAIN	344
	DOE=EASY	MAIN	345
	CHANF=CHANLF	MAIN	346
	SUM1=0.0	MAIN	347
	AXL=AXIAL	MAIN	348
	DO 150 AXIAL=1,MUPPER	MAIN	349
	AXF=SIN(AXL*BAKER)	MAIN	350
	DO 155 FRAD=1,NUPPER	MAIN	351
	POW(FRAD,AXIAL,CHAN)=TEMP(FRAD)*AXF*CHANF	MAIN	352
155	SUM1=SUM1+POW(FRAD,AXIAL,CHAN)	MAIN	353
160	AXL=AXL+ASEG	MAIN	354
165	SUM=SUM+SUM1*VCHAN(CHAN)	MAIN	355
	GO TO 185	MAIN	356
C		MAIN	357
C	POWER DISTRIBUTIONS SPECIFIED IN INPUT	MAIN	358
C		MAIN	359
170	DO 180 CHAN=1,LUPPER	MAIN	360

ABLE=CHANPF(CHAN)	MAIN 361
SUM1=0.0	MAIN 362
DO 175 AXIAL=1,MUPPER	MAIN 363
BAKER=ABLE*AXPF(AXIAL)	MAIN 364
DO 175 FRAD=1,NUPPER	MAIN 365
POW(FRAD,AXIAL,CHAN)=TEMP(FRAD)*BAKER	MAIN 366
175 SUM1=SUM1+POW(FRAD,AXIAL,CHAN)	MAIN 367
180 SUM=SUM+SUM1*VCHAN(CHAN)	MAIN 368
185 SUM=.5E+6*VPINFL/(SUM*FUELF*ASEG)	MAIN 369
DO 190 CHAN=1,LUPPER	MAIN 370
DO 190 AXIAL=1,MUPPER	MAIN 371
DO 190 FRAD=1,NUPPER	MAIN 372
190 POW(FRAD,AXIAL,CHAN)=POW(FRAD,AXIAL,CHAN)*SUM	MAIN 373
C	MAIN 374
C SET FLAG FOR ZERO FLOW CONDITIONS	MAIN 375
C	MAIN 376
ABLE=1.	MAIN 377
IF(FLOW(1,1).GT.0.0) ABLE=-1.	MAIN 378
C	MAIN 379
C INITIALIZE	MAIN 380
C	MAIN 381
DO 195 CHAN=1,LUPPER	MAIN 382
COOL(CHAN)=VCHAN(CHAN)/VPINFL*FUELF*ASEG	MAIN 383
ICHAN(CHAN)=0	MAIN 384
ICHANX(CHAN)=0	MAIN 385
TSEGX(CHAN,1)=0.0	MAIN 386
TSFGX(CHAN,2)=0.0	MAIN 387
IXX(CHAN)=0	MAIN 388
IXUP(CHAN)=0	MAIN 389
IXDOWN(CHAN)=0	MAIN 390
MVOID(CHAN)=0	MAIN 391
DO 195 AXIAL=1,MUPPER	MAIN 392
DOPSUB(AXIAL,CHAN)=0.0	MAIN 393
DOPSAV(AXIAL,CHAN)=0.0	MAIN 394
MOVE(AXIAL,CHAN)=0.0	MAIN 395
DO 195 FRAD=1,NUPPER	MAIN 396
TEMPER(FRAD,AXIAL,CHAN,1)=ABLE*TGUESS	MAIN 397
DSAVE(FRAD,AXIAL,CHAN,1)=0.0	MAIN 398
DSAVE(FRAD,AXIAL,CHAN,2)=0.0	MAIN 399
195 TEMPER(FRAD,AXIAL,CHAN,2)=0.0	MAIN 400
C	MAIN 401
IF(CHI.GT.-1.) GO TO 205	MAIN 402
C	MAIN 403
C INITIALIZE FOR FUEL SQUIRTING ROUTINE	MAIN 404
C	MAIN 405
DO 200 I=1,2	MAIN 406
DO 200 CHAN=1,LUPPER	MAIN 407
ACCEL(CHAN,I)=0.0	MAIN 408
VELOC(CHAN,I)=0.0	MAIN 409
200 DIST(CHAN,I)=0.0	MAIN 410
GO TO 215	MAIN 411
C	MAIN 412
C INITIALIZE FOR FUEL COLLAPSE ROUTINE	MAIN 413
C	MAIN 414
205 DO 210 I=1,2	MAIN 415
DO 210 CHAN=1,LUPPER	MAIN 416
XUP(CHAN,I)=0.0	MAIN 417
XDOWN(CHAN,I)=0.0	MAIN 418
DO 210 AXIAL=1,MUPPER	MAIN 419
210 TSEG(AXIAL,CHAN,I)=0.0	MAIN 420

215	CONTINUE	MAIN	421
C		MAIN	422
C	INITIALIZE	MAIN	423
C		MAIN	424
	DO 220 I=1,2	MAIN	425
	FLINEK(I)=0.0	MAIN	426
	ELINEK(I)=0.0	MAIN	427
	CLINEK(I)=0.0	MAIN	428
	H(I)=0.0	MAIN	429
	RH(I)=0.0	MAIN	430
	VVOIDK(I)=0.0	MAIN	431
	COLAPK(I)=0.0	MAIN	432
	TCOLP(I)=0.0	MAIN	433
	TVOID(I)=0.0	MAIN	434
	TSCRAM(I)=0.0	MAIN	435
	GFEN(I)=0.0	MAIN	436
	QOUT(I)=0.0	MAIN	437
	KWTHDR(I)=0.0	MAIN	438
	KINSRT(I)=0.0	MAIN	439
220	T(I)=0.0	MAIN	440
	AN(2)=0.0	MAIN	441
	AN(1)=ANI	MAIN	442
	PN(1)=ANI + ANIC	MAIN	443
	PN(2)=0.0	MAIN	444
	B301CO=100./BB	MAIN	445
	W=0.0	MAIN	446
	RHO=0.0	MAIN	447
	RSLOPE=0.0	MAIN	448
	BASEF=0.0	MAIN	449
	BASEC=0.0	MAIN	450
	BASEE=0.0	MAIN	451
C		MAIN	452
C	CALCULATE DELAYED NEUTRON FRACTION	MAIN	453
C		MAIN	454
	SUM=0.0	MAIN	455
	DO 225 I=1,M	MAIN	456
225	SUM=SUM+B(I)	MAIN	457
	SUM=BB/SUM	MAIN	458
	DO 230 I=1,M	MAIN	459
230	B(I)=B(I)*SUM	MAIN	460
C		MAIN	461
	TIN(1)=TEMIN(1)	MAIN	462
	TIN(2)=0.0	MAIN	463
C		MAIN	464
C	CALCULATE PRECURSOR DENSITIES	MAIN	465
C		MAIN	466
	IF(IKINET.EQ.1) GO TO 240	MAIN	467
	DO 235 I=1,M	MAIN	468
	C(I,1)=ANI*B(I)/(ALIFE*AL(I))	MAIN	469
	C(I,2)=C(I,1)	MAIN	470
	GAM(I)=0.0	MAIN	471
235	ALPH(I)=0.0	MAIN	472
	GO TO 250	MAIN	473
240	DO 245 I=1,M	MAIN	474
	C(I,1)=ANI*B(I)/AL(I)	MAIN	475
245	C(I,2)=C(I,1)	MAIN	476
C		MAIN	477
250	NEW=1	MAIN	478
	OLD=2	MAIN	479
C		MAIN	480

C	BYPASS STEADY STATE TEMPERATURE CALCULATION IF ZERO INITIAL FLOW	MAIN 481
C		MAIN 482
C	IF(ABLE.GT.0.0) GO TO 255	MAIN 483
C		MAIN 484
	CALL CORTEM(\$350)	MAIN 485
255	CALL DOPTTEM(\$350)	MAIN 486
C		MAIN 487
	BASEF=FLINEK(NEW)	MAIN 488
	BASEE=ELINEK(NEW)	MAIN 489
	BASEC=CLINEK(NEW)	MAIN 490
	FLINEK(NEW)=0.0	MAIN 491
	CLINEK(NEW)=0.0	MAIN 492
	ELINEK(NEW)=0.0	MAIN 493
C		MAIN 494
C	STORE INITIAL CLAD AND FUEL AVERAGE TEMPS. FOR AXIAL FEEDBACK CALC	MAIN 495
C		MAIN 496
	DO 260 CHAN=1,LUPPER	MAIN 497
	DO 260 AXIAL=1,MUPPER	MAIN 498
	DO 260 FRAD=1,NUPPER	MAIN 499
	TNOUGT(AXIAL,CHAN)=TEMPER(NUPPER-1,AXIAL,CHAN,1)	MAIN 500
	TFOUGT(AXIAL,CHAN) = PINTEM(AXIAL,CHAN)	MAIN 501
260	TEMPER(FRAD,AXIAL,CHAN,2)=TEMPER(FRAD,AXIAL,CHAN,1)	MAIN 502
C		MAIN 503
C	ESTABLISH INITIAL CONDITIONS FOR DOPPLER FEEDBACK CALCULATIONS	MAIN 504
C		MAIN 505
	IF(IDOP.GT.0) GO TO 265	MAIN 506
	DOPSUB(1,1)=ALOG(FUELT)	MAIN 507
	GO TO 275	MAIN 508
265	DO 270 CHAN=1,LUPPER	MAIN 509
	DO 270 AXIAL=1,MUPPER	MAIN 510
270	DOPSUB(AXIAL,CHAN)=ALOG(PINTEM(AXIAL,CHAN))	MAIN 511
275	DOPPK(1)=0.0	MAIN 512
	DOPPK(2)=0.0	MAIN 513
C		MAIN 514
C	WRITE STEADY STATE OUTPUT	MAIN 515
C		MAIN 516
	CALL OUTSTD	MAIN 517
	IF(IWRAP.EQ.0) GO TO 290	MAIN 518
C		MAIN 519
C	WRITE DRUM WITH INITIAL CONDITIONS FOR WRAPUP	MAIN 520
C		MAIN 521
	JTIMES=1	MAIN 522
	WRITE(23) T(NEW),ANI,0GEN(NEW),0QOUT(NEW),0QMOL,TEMOL,PCMELT,GMSMOL,	MAIN 523
	IFUELT	MAIN 524
	WRITE(24) T(NEW),RH(NEW),KINSRT(NEW),KWTHDR(NEW),DOPPK(NEW),COLAPK,	MAIN 525
	1(NEW),VOIDK(NEW),FLINEK(NEW),ELINEK(NEW),CLINEK(NEW)	MAIN 526
	ISTART=ITAB(17)+NUPPER+4	MAIN 527
	IADD=4200-NUPPER-4	MAIN 528
	ITAB(17)=ITAB(17)-IADD	MAIN 529
	DO 280 CHAN=1,LUPPER	MAIN 530
	DO 280 AXIAL=1,MUPPER	MAIN 531
	ITAB(17)=ITAB(17)+IADD	MAIN 532
280	WRITE(25) T(NEW),(TEMPER(FRAD,AXIAL,CHAN,NEW),FRAD=1,NUPPER)	MAIN 533
	ITAB(17)=ISTART	MAIN 534
	ABLE=1./(3.14159*VOLUME(NUPPER))	MAIN 535
	DO 285 CHAN=1,LUPPER	MAIN 536
	CALL CURVE (TEMP(CHAN),T(NEW),TIMFLO,FLOW(1,CHAN),PAIRSS,\$285)	MAIN 537
285	TEMP(CHAN)=TEMP(CHAN)*ABLE	MAIN 538
	WRITE(26) T(NEW),(TEMP(CHAN),CHAN=1,LUPPER)	MAIN 539
	WRITE(27) T(NEW),TIN(NEW),(TEMPER(NUPPER,MUPPER,CHAN,NEW),CHAN=1,	MAIN 540

1LUPPER)	MAIN 541
290 IF (IKINET-1) 325,335,325	MAIN 542
C	MAIN 543
C CYCLE BELOW HERE FOR REST OF PROBLEM	MAIN 544
C	MAIN 545
295 CALL CORTEM(\$350)	MAIN 546
OLDOLD=DOPPK(NEW)	MAIN 547
CALL DOPTEM(\$350)	MAIN 548
IF (ICOLPS) 300,300,305	MAIN 549
300 CALL COLAPS(\$350)	MAIN 550
305 IF (IVOIDS) 310,310,315	MAIN 551
310 CALL VOID (\$350)	MAIN 552
315 IF (IKINET-1) 320,330,340	MAIN 553
320 CALL CHECK(\$295,\$345,\$350,\$365,IVEN,OLDOLD)	MAIN 554
325 CALL NEXT(\$295,\$350)	MAIN 555
330 CALL CHECK0(\$295,\$345,\$350,\$365,IVEN,OLDOLD)	MAIN 556
335 CALL NEXT0(\$295,\$350)	MAIN 557
340 IIIII=IRHC+1	MAIN 558
GO TO (320,330),IIIII	MAIN 559
345 CALL MODE(\$325,\$335,IVEN)	MAIN 560
C	MAIN 561
C PROGRAM IS IN ERROR MODE. SUMMARIZE AND TERMINATE	MAIN 562
C	MAIN 563
350 IF (JTIMES.LT.2.OR.IWRAP.EQ.0) GO TO 355	MAIN 564
CALL WRAPUP	MAIN 565
355 IF (IDUMP.GT.0) CALL NTRAN (NOTD,11)	MAIN 566
IF (IPLOT.GT.0) CALL CPLOT(10.0,0.0,-999)	MAIN 567
IF (IWRAP.GT.2) CALL NTRAN (NOTALL,11)	MAIN 568
CALL DOY(DATE)	MAIN 569
CALL TOD(DATE(3))	MAIN 570
WRITE(NOT,1015) TITLE,DATE	MAIN 571
CALL EXIT	MAIN 572
C	MAIN 573
360 WRITE(NOT,1030)	MAIN 574
1030 FORMAT(1H0/1H0/24HCFORGOT \$ AT END OF DATA)	MAIN 575
GO TO 350	MAIN 576
C	MAIN 577
C NORMAL TERMINATION OF ONE CASE. SUMMARIZE AND PROCEED TO NEXT CASE	MAIN 578
C	MAIN 579
365 IF (IWRAP.EQ.0) GO TO 370	MAIN 580
CALL WRAPUP	MAIN 581
370 CALL DOY(DATE)	MAIN 582
CALL TOD(DATE(3))	MAIN 583
WRITE(NOT,1015) TITLE,DATE	MAIN 584
GO TO 15	MAIN 585
END	MAIN 586

2	ELT CORTEM,1,720604, 4987F	
	SUBROUTINE CORTEM (IERROR)	CORTE 1
C		CORTE 2
C	SUBROUTINE CORTEM COMPUTES NEW CORE TEMPERATURES.	CORTE 3
C	SUBROUTINE CURVE IS CALLED.	CORTE 4
C		CORTE 5
	INCLUDE ABC	CORTE 6
	DIMENSION HCAPN(15),GMELT(15)	CORTE 7
C		CORTE 8
C	HCAPN(N)=ENERGY/(PI*SEGMENT LENGTH*DEG.K) (J/CM-K)	CORTE 9
C	GMELT(N) OF 1/2/3 = BELOW MELT/IN MELT/ABOVE MELT	CORTE 10
C		CORTE 11
	PN(NEW)=AN(NEW)+ANIC	CORTE 12
	LOGICAL OKAY,JUMPD	CORTE 13
	INTEGER GMELT	CORTE 14
	JUMPD=.FALSE.	CORTE 15
	IF(H(NEW).GT.D.D) JUMPD=.TRUE.	CORTE 16
	CALL CURVE (TIN(NEW),T(NEW),TIMIN,TEMIN,PAIRS4,\$225)	CORTE 17
C		CORTE 18
C		CORTE 19
	CO 220 CHAN=1,LUPPER	CORTE 20
	CALL CURVE (FLO,T(NEW),TIMFLO,FLOW(1,CHAN),PAIRS5,\$230)	CORTE 21
	FLO=FLO/BOTTOM	CORTE 22
	TPREV=TIN(NEW)	CORTE 23
	TPREV=TIN(OLD)	CORTE 24
	DO 215 AXIAL=1,MUPPER	CORTE 25
	DO 25 FRAD=1,NUPPER	CORTE 26
C		CORTE 27
C	SET FLAGS FOR WHETHER MATERIAL IS BELOW, IN, OR ABOVE MELTING	CORTE 28
C		CORTE 29
	IF(TEMPER(FRAD,AXIAL,CHAN,OLD).LE.TEST1(FRAD)) GO TO 10	CORTE 30
	IF(TEMPER(FRAD,AXIAL,CHAN,OLD).GE.TEST2(FRAD)) GO TO 15	CORTE 31
	GMELT(FRAD)=2	CORTE 32
	GO TO 20	CORTE 33
10	GMELT(FRAD)=1	CORTE 34
	GO TO 20	CORTE 35
15	GMELT(FRAD)=3	CORTE 36
20	CONTINUE	CORTE 37
C		CORTE 38
C	NEW ESTIMATE FOR TEMPERATURES BASED ON LINEAR EXTRAP (FIXED STEP)	CORTE 39
C		CORTE 40
	25 TEMP(FRAD)=2.*TEMPER(FRAD,AXIAL,CHAN,OLD)-TEMPER(FRAD,AXIAL,CHAN,NCORTE 41	
	1EW)	CORTE 42
C		CORTE 43
C	FUEL	CORTE 44
C		CORTE 45
	DO 40 FRAD=1,NUPM3	CORTE 46
	IF(TEMPER(FRAD,AXIAL,CHAN,OLD).LT.TMELTL) GO TO 30	CORTE 47
	IF(TEMPER(FRAD,AXIAL,CHAN,OLD).GT.TMELTH) GO TO 35	CORTE 48
	HCAPN(FRAD)=FUSE(FRAD)	CORTE 49
	GO TO 40	CORTE 50
30	HCAPN(FRAD)=XC0E1*HCAP(FRAD)	CORTE 51
	IF(JUMPF1) GO TO 40	CORTE 52
	HCAPN(FRAD)=HCAPN(FRAD)+HCAP(FRAD)*TEMP(FRAD)*(YC0E1+ZC0E1*TEMP(FRCORTE 53	
	1AD))	CORTE 54
	GO TO 40	CORTE 55
35	HCAPN(FRAD)=XC0E2*HCAP(FRAD)	CORTE 56
	IF(JUMPF2) GO TO 40	CORTE 57
	HCAPN(FRAD)=HCAPN(FRAD)+HCAP(FRAD)*TEMP(FRAD)*(YC0E2+ZC0E2*TEMP(FRCORTE 58	
	1AD))	CORTE 59
40	HCAPDT(FRAD)=HCAPN(FRAD)/H(NEW)	CORTE 60

C		CORTE 61
C	BOND AND COOLANT	CORTE 62
C		CORTE 63
	DO 55 FRAD=NUPM2,NUPPER,2	CORTE 64
	IF(TEMPER(FRAD,AXIAL,CHAN,OLD).LT.CMELTL) GO TO 45	CORTE 65
	IF(TEMPER(FRAD,AXIAL,CHAN,OLD).GT.CMELTH) GO TO 50	CORTE 66
	HCAPN(FRAD)=FUSE(FRAD)	CORTE 67
	GO TO 55	CORTE 68
45	HCAPN(FRAD)=CXCOE1*HCAP(FRAD)	CORTE 69
	IF(JUMPC1) GO TO 55	CORTE 70
	HCAPN(FRAD)=HCAPN(FRAD)+HCAP(FRAD)*TEMP(FRAD)*(CYCOE1+CZCOE1*TEMP(FRAD))	CORTE 71
	GO TO 55	CORTE 72
50	HCAPN(FRAD)=CXCOE2*HCAP(FRAD)	CORTE 73
	IF(JUMPC2) GO TO 55	CORTE 74
	HCAPN(FRAD)=HCAPN(FRAD)+HCAP(FRAD)*TEMP(FRAD)*(CYCOE2+CZCOE2*TEMP(FRAD))	CORTE 75
	GO TO 55	CORTE 76
55	HCAPDT(FRAD)=HCAPN(FRAD)/H(NEW)	CORTE 77
	HCAPNA=FLO*HCAPN(NUPPER)/HCAP(NUPPER)	CORTE 78
C		CORTE 79
C	CLADDING	CORTE 80
C		CORTE 81
	IF(TEMPER(NUPM1,AXIAL,CHAN,OLD).LT.EMELTL) GO TO 60	CORTE 82
	IF(TEMPER(NUPM1,AXIAL,CHAN,OLD).GT.EMELTH) GO TO 65	CORTE 83
	HCAPN(NUPM1)=FUSE(NUPM1)	CORTE 84
	GO TO 70	CORTE 85
60	HCAPN(NUPM1)=HCAP(NUPM1)*EXCOE1	CORTE 86
	IF(JUMPE1) GO TO 70	CORTE 87
	HCAPN(NUPM1)=HCAPN(NUPM1)+HCAP(NUPM1)*TEMP(NUPM1)*(EYCOE1+EZCOE1*TEMP(NUPM1))	CORTE 88
	GO TO 70	CORTE 89
65	HCAPN(NUPM1)=HCAP(NUPM1)*EXCOE2	CORTE 90
	IF(JUMPE2) GO TO 70	CORTE 91
	HCAPN(NUPM1)=HCAPN(NUPM1)+HCAP(NUPM1)*TEMP(NUPM1)*(EYCOE2+EZCOE2*TEMP(NUPM1))	CORTE 92
	GO TO 70	CORTE 93
70	HCAPDT(NUPM1)=HCAPN(NUPM1)/H(NEW)	CORTE 94
C		CORTE 95
	LOOP=C	CORTE 96
C		CORTE 97
C		CORTE 98
C		CORTE 99
C	BEGIN LOOP TO OBTAIN TEMPERATURES USING CORRECT MATERIAL PROP.	CORTE100
C		CORTE101
C		CORTE102
C		CORTE103
75	LOOP=LOOP+1	CORTE104
	IF(LOOP.GT.15) GO TO 255	CORTE105
	DO 80 FRAD=1,NUPPER	CORTE106
80	TEMPER(FRAD,AXIAL,CHAN,NEW)=TEMP(FRAD)	CORTE107
C		CORTE108
C	OBTAIN THERMAL CONDUCT. BASED ON EXPECTED AVE TEMP BETWEEN NODES.	CORTE109
C	THEN CALCULATE THERMAL ADMITTANCES FOR FUEL NODES.	CORTE110
C		CORTE111
	DO 85 FRAD=1,NUPM4	CORTE112
	CALL CURVE (ANSWER,.5*(TEMP(FRAD)+TEMP(FRAD+1)),BASICT,CONDUCT,PAIR	CORTE113
	1S1,\$235)	CORTE114
85	U(FRAD)=ANSWER/RLOG(FRAD)	CORTE115
C		CORTE116
C	DETERMINE FUEL SURFACE TEMP, TEMPF8, BY LINEAR EXTRAPOLATION	CORTE117
C		CORTE118
	TEMPF8=TEMP(NUPM3)-((TEMP(NUPM4)-TEMP(NUPM3))*(R(NUPM3+1)-RM(NUPM3))	CORTE119
1	)/(RM(NUPM3)-RM(NUPM4))	CORTE120

	CALL CURVE(ANSWER,.5*(TEMP(NUPM3)+TEMPFB),BASICT,CONDOC,PAIRS1,	CORTE121
1	\$250)	CORTE122
	U(NUPM3)=1./((RLOG(NUPM3)/ANSWER+RLOG(NUPM2)/KNA)	CORTE123
C		CORTE124
C	DETERMINE CONSTANTS TO BE USED IN GAUSSIAN REDUCTION PROCESS	CORTE125
C		CORTE126
	APREV=0.0	CORTE127
	DPREV=0.0	CORTE128
	DO 90 FRAD=1,NUPM2	CORTE129
	DENOM=HCAPDT(FRAD)+U(FRAD)+APREV	CORTE130
	A(FRAD)=U(FRAD)/DENOM	CORTE131
	D(FRAD)=(DPREV+PN(NEW)*POW(FRAD,AXIAL,CHAN)+HCAPDT(FRAD)*TEMPER(FRCORTE132	
	1AD,AXIAL,CHAN,OLD)+DSAVE(FRAD,AXIAL,CHAN,OLD))/DENOM	CORTE133
	APREV=(1.-A(FRAD))*U(FRAD)	CORTE134
90	DPREV=D(FRAD)*U(FRAD)	CORTE135
C		CORTE136
	IF(ICHANX(CHAN)) 100,100,95	CORTE137
95	IF(XUP(CHAN,NEW).GE.ZMID(AXIAL)+.5*ASEG.AND.XDOWN(CHAN,NEW).LE.ZMICORTE138	
	1D(AXIAL)-.5*ASEG) GO TO 105	CORTE139
C		CORTE140
C	COOLANT TEMP CALCULATION IF LOCAL SEGMENT IS NOT VOIDED	CORTE141
C		CORTE142
100	DENOM=HCAPDT(NUPM1)+U(NUPM1)+APREV	CORTE143
	A(NUPM1)=FRACTD*U(NUPM1)/DENOM	CORTE144
	D(NUPM1)=(DPREV+PN(NEW)*POW(NUPM1,AXIAL,CHAN)+HCAPDT(NUPM1)*TEMPERCORTE145	
	1(NUPM1,AXIAL,CHAN,OLD)+DSAVE(NUPM1,AXIAL,CHAN,OLD)+FRACTU*U(NUPM1)CORT	CORTE146
	2*TPREV)/DENOM	CORTE147
	TEMP(NUPPER)=(TPREV*(HCAPNA-FRACTU*(U(NUPM1)+HCAPDT(NUPPER)))+PN(NCORT	CORTE148
	1EW)*POW(NUPPER,AXIAL,CHAN)+HCAPDT(NUPPER)*(FRACTU*TPREVO+FRACTD*TECORT	CORTE149
	2MPER(NUPPER,AXIAL,CHAN,OLD))+D(NUPM1)*U(NUPM1)+DSAVE(NUPPER,AXIAL,CORT	CORTE150
	3CHAN,OLD))/((FRACTD*HCAPDT(NUPPER)+U(NUPM1)*(FRACTD-A(NUPM1))+HCAPCORT	CORTE151
	4NA)	CORTE152
	GO TO 110	CORTE153
C		CORTE154
C	COOLANT TEMP CALCULATION IF LOCAL SEGMENT IS VOIDED	CORTE155
C		CORTE156
105	DENOM=HCAPDT(NUPM1)+UVOID+APREV	CORTE157
	A(NUPM1)=FRACTD*UVOID/DENOM	CORTE158
	D(NUPM1)=(DPREV+PN(NEW)*POW(NUPM1,AXIAL,CHAN)+HCAPDT(NUPM1)*TEMPERCORTE159	
	1(NUPM1,AXIAL,CHAN,OLD)+DSAVE(NUPM1,AXIAL,CHAN,OLD)+FRACTU*UVOID	CORTE160
	2*TPREV)/DENOM	CORTE161
	TEMP(NUPPER)=(TPREV*(HCAPNA-FRACTU*(UVOID+HCAPDT(NUPPER)))+PN(NEW)CORT	CORTE162
	1*POW(NUPPER,AXIAL,CHAN)+HCAPDT(NUPPER)*(FRACTU*TPREVO+FRACTD*CORTE163	
	2TEMPER(NUPPER,AXIAL,CHAN,OLD))+D(NUPM1)*UVOID+DSAVE(NUPPER,AXIAL,CORTE164	
	3CHAN,OLD))/((FRACTD*HCAPDT(NUPPER)+UVOID*(FRACTD-A(NUPM1))+HCAPNA)CORT	CORTE165
110	CONTINUE	CORTE166
C		CORTE167
C	GAUSSIAN METHOD TO DETERMINE NEW NODAL TEMPERATURES	CORTE168
C		CORTE169
	DO 115 FRAD=NUPM1,1,-1	CORTE170
115	TEMP(FRAD)=A(FRAD)*TEMP(FRAD+1)+D(FRAD)	CORTE171
C		CORTE172
	OKAY=.TRUE.	CORTE173
C		CORTE174
C	RECHECK EFFECTIVE SPECIFIC HEAT FOR MATERIALS MELTING OR FREEZING	CORTE175
C		CORTE176
	DO 180 FRAD=1,NUPPER	CORTE177
	IF(FRAD.EQ.NUPM2.AND.DENSEB.LT.1.E-5) GO TO 180	CORTE178
	KIJ=EMELT(FRAD)	CORTE179
	IF(TEMP(FRAD).GT.TEST1(FRAD)) GO TO 135	CORTE180

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      GO TO (120,125,130),KIJ                                CORTE181
120 IF (ABS(TEMP(FRAD)-TEMPER(FRAD,AXIAL,CHAN,NEW)).GT.TERROR) CKAY=.FACORTE182
      ELSE.                                                    CORTE183
      GO TO 180                                                CORTE184
C                                                                CORTE185
C      COOLING.  STARTS IN FUSION AND ENDS UP BELOW          CORTE186
C                                                                CORTE187
125 ABLE=TEST1(FRAD)+((TEMPER(FRAD,AXIAL,CHAN,OLD)-TEST1(FRAD))*FUSE(FCORTE188
      1RAD)-HCAPN(FRAD)*(TEMPER(FRAD,AXIAL,CHAN,OLD)-TEMP(FRAD)))/SUBBR(FCORTE189
      2RAD)                                                    CORTE190
      GO TO 165                                                CORTE191
C                                                                CORTE192
C      COOLING.  STARTS ABOVE FUSION AND ENDS UP BELOW      CORTE193
C                                                                CORTE194
130 ABLE=TEST2(FRAD)+(HCAPN(FRAD)*(TEMP(FRAD)-TEMPER(FRAD,AXIAL,CHAN,OCORTE195
      1LD))-(TEST2(FRAD)-TEMPER(FRAD,AXIAL,CHAN,OLD))*DIVIDE(FRAD))/FUSE(CORTE196
      2FRAD)                                                    CORTE197
      IF(ABLE.GE.TEST1(FRAD)) GO TO 165                        CORTE198
      ABLE=TEST1(FRAD)+(10.*FUSE(FRAD)+DIVIDE(FRAD)*(TEMPER(FRAD,AXIAL,CCORTE199
      1HAN,OLD)-TEST2(FRAD))-HCAPN(FRAD)*(TEMPER(FRAD,AXIAL,CHAN,CLD)-TEMCCORTE200
      2P(FRAD)))/SUBBR(FRAD)                                    CORTE201
      GO TO 165                                                CORTE202
135 IF(TEMP(FRAD).GT.TEST2(FRAD)) GO TO 150                  CORTE203
      GO TO (140,120,145),KIJ                                CORTE204
C                                                                CORTE205
C      HEATING.  STARTS BELOW FUSION AND ENDS UP IN FUSION CORTE206
C                                                                CORTE207
140 ABLE=TEST1(FRAD)+(HCAPN(FRAD)*(TEMP(FRAD)-TEMPER(FRAD,AXIAL,CHAN,OCORTE208
      1LD))-(TEST1(FRAD)-TEMPER(FRAD,AXIAL,CHAN,OLD))*SUBBR(FRAD))/FUSE(CORTE209
      2FRAD)                                                    CORTE210
      GO TO 165                                                CORTE211
C                                                                CORTE212
C      COOLING.  STARTS ABOVE FUSION AND ENDS UP IN FUSION CORTE213
C                                                                CORTE214
145 ABLE=TEST2(FRAD)+(DIVIDE(FRAD)*(TEMPER(FRAD,AXIAL,CHAN,OLD)-TEST2(CORTE215
      1F-AD))-(TEMPER(FRAD,AXIAL,CHAN,CLD)-TEMP(FRAD))*HCAPN(FRAD))/FUSE(CORTE216
      2FRAD)                                                    CORTE217
      GO TO 165                                                CORTE218
150 GO TO (155,160,120),KIJ                                CORTE219
C                                                                CORTE220
C      HEATING.  STARTS BELOW FUSION AND ENDS UP ABOVE      CORTE221
C                                                                CORTE222
155 ABLE=TEST1(FRAD)+(HCAPN(FRAD)*(TEMP(FRAD)-TEMPER(FRAD,AXIAL,CHAN,OCORTE223
      1LD))-(TEST1(FRAD)-TEMPER(FRAD,AXIAL,CHAN,OLD))*SUBBR(FRAD))/FUSE(FCORTE224
      2RAD)                                                    CORTE225
      IF(ABLE.LE.TEST2(FRAD)) GO TO 165                        CORTE226
      ABLE=TEST2(FRAD)+(HCAPN(FRAD)*(TEMP(FRAD)-TEMPER(FRAD,AXIAL,CHAN,OCORTE227
      1LD))-10.*FUSE(FRAD)-(TEST1(FRAD)-TEMPER(FRAD,AXIAL,CHAN,OLD))*SUBBCORTE228
      2P(FRAD))/DIVIDE(FRAD)                                    CORTE229
      GO TO 165                                                CORTE230
C                                                                CORTE231
C      HEATING.  STARTS IN FUSION AND ENDS UP ABOVE         CORTE232
C                                                                CORTE233
160 ABLE=TEST2(FRAD)+(HCAPN(FRAD)*(TEMP(FRAD)-TEMPER(FRAD,AXIAL,CHAN,OCORTE234
      1LD))-(TEST2(FRAD)-TEMPER(FRAD,AXIAL,CHAN,OLD))*FUSE(FRAD))/DIVIDE(CORTE235
      2FRAD)                                                    CORTE236
C                                                                CORTE237
C      CHECK CORRECTED TEMPERATURE WITH PREVIOUSLY CALCULATED VALUE CORTE238
C                                                                CORTE239
165 IF (ABS(ABLE-TEMP(FRAD)).GT.TERROR)  CKAY=.FALSE.        CORTE240

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C		CORTE241
C	DETERMINE MULTIPLICATION FACTOR TO CORRECT EFFECTIVE SPECIFIC HEAT	CORTE242
C	AMULT=(TEMP(FRAD)-TEMPER(FRAD,AXIAL,CHAN,OLD))/(ABLE-TEMPER(FRAD,	CORTE243
	1AXIAL,CHAN,OLD))	CORTE244
	IF (LOOP.GT.10) GO TO 170	CORTE245
	GO TO 175	CORTE246
	170 WRITE (NOT,1000) HCAPN(FRAD),AMULT,KIJ,TEMP(FRAD),TEMPER(FRAD,AXIAL	CORTE247
	1,CHAN,OLD),ABLE,CHAN,AXIAL,FRAD	CORTE248
1000	FORMAT(2X,7HHCAPN =,E10.3,7H AMULT=,E10.3,5H KIJ=,I3,6H TEMP=,E10.	CORTE249
	13,13H TEMPER(OLD)=,E10.3,6H ABLE=,E10.3,6H CHAN=,I2,7H AXIAL=,I2,6	CORTE250
	2H FRAD=,I2)	CORTE251
	AMULT = 0.5 + 0.5*AMULT	CORTE252
		CORTE253
C		CORTE254
C	OBTAIN NEW EFFECTIVE SPECIFIC HEAT FOR NEXT PASS THROUGH LOOP	CORTE255
C		CORTE256
	175 HCAPN(FRAD) = HCAPN(FRAD)*AMULT	CORTE257
	HCAPDT(FRAD)=HCAPDT(FRAD)*AMULT	CORTE258
	TEMP(FRAD)=ABLE	CORTE259
	180 CONTINUE	CORTE260
C		CORTE261
	HCAPNA=FLO*HCAPDT(NUPPER)*H(NEW)/HCAP(NUPPER)	CORTE262
	IF(JUMP0) GO TO 185	CORTE263
	HCAPNA=FLO*CXC0E1	CORTE264
	IF(JUMPC1) GO TO 185	CORTE265
	HCAPNA=HCAPNA+FLO*TEMP(NUPPER)*(CYC0E1+TEMP(NUPPER)*CZC0E1)	CORTE266
	185 CONTINUE	CORTE267
	IF(.NOT.OKAY) GO TO 75	CORTE268
C		CORTE269
C		CORTE270
C	END OF MATERIAL PROPERTY LOOP. NEW TEMPERATURES ARE VALID	CORTE271
C		CORTE272
C		CORTE273
	TSTART=0.0	CORTE274
C	FOR NEXT TIME STEP	CORTE277
C		CORTE278
	DO 190 FRAD=1,NUPM2	CORTE279
	TEND=U(FRAD)*(TEMP(FRAD)-TEMP(FRAD+1))	CORTE280
	OSAVE(FRAD,AXIAL,CHAN,NEW)=PN(NEW)*POW(FRAD,AXIAL,CHAN)+TSTART-TENC	CORTE281
	10	CORTE282
	TEMPER(FRAD,AXIAL,CHAN,NEW)=TEMP(FRAD)	CORTE283
190	TSTART=TEND	CORTE284
	TEMPER(NUPM1,AXIAL,CHAN,NEW)=TEMP(NUPM1)	CORTE285
	IF (ICHANX(CHAN)) 200,200,195	CORTE286
195	IF(XUP(CHAN,NEW).GE.ZMID(AXIAL)+.5*ASEG.AND.XDOWN(CHAN,NEW).LE.ZMIC	CORTE287
	10(AXIAL)-.5*ASEG) GO TO 205	CORTE288
200	TEND=U(NUPM1)*(TEMP(NUPM1)-FRACTU*TPREV-FRACTD*TEMP(NUPPER))	CORTE289
	GO TO 210	CORTE290
205	TEND=UVOID*(TEMP(NUPM1)-FRACTU*TPREV-FRACTD*TEMP(NUPPER))	CORTE291
210	CONTINUE	CORTE292
C	STORE NEW TEMPERATURES AND ESTABLISH HEAT TRANSFER CONSTANTS	CORTE276
C		CORTE275
	OSAVE(NUPM1,AXIAL,CHAN,NEW)=TSTART-TEND*PN(NEW)*POW(NUPM1,AXIAL,CH	CORTE293
	1AN)	CORTE294
	TEMPER(NUPPER,AXIAL,CHAN,NEW)=TEMP(NUPPER)	CORTE295
	OSAVE(NUPPER,AXIAL,CHAN,NEW)=PN(NEW)*POW(NUPPER,AXIAL,CHAN)+HCAPNA	CORTE296
	1*(TPREV-TEMP(NUPPER))+TEND	CORTE297
	TPREV=TEMP(NUPPER)	CORTE298
215	TPREVO=TEMPER(NUPPER,AXIAL,CHAN,OLD)	CORTE299
220	QCOOL(CHAN,NEW)=HCAPNA*(TEMP(NUPPER)-TIN(NEW))*COOL(CHAN)	CORTE300

C		CORTE301
C		CORTE302
	RETURN	CORTE303
C		CORTE304
C	WRITE DIAGNOSTIC MESSAGES WHEN IN ERROR MODE	CORTE305
C		CORTE306
	225 WRITE(NOT,1005) T(NEW),TIMIN(PAIRS4)	CORTE307
	1005 FORMAT(14H1CURRENT TIME 1PE9.3,22H EXCEEDS MAXIMUM TIME E9.3,22H I	CORTE308
	IN INLET-TIME LIBRARY)	CORTE309
	GO TO 245	CORTE310
	230 WRITE(NOT,1010) T(NEW),TIMFLO(PAIRS5)	CORTE311
	1010 FORMAT(14H1CURRENT TIME 1PE9.3,22H EXCEEDS MAXIMUM TIME E9.3,21H I	CORTE312
	IN FLOW-TIME LIBRARY)	CORTE313
	GO TO 245	CORTE314
	235 TSTART=.5*(TEMP(FRAD)+TEMP(FRAD+1))	CORTE315
	240 WRITE(NOT,1015) TSTART,FRAD,AXIAL,CHAN,BASICT(PAIRS1)	CORTE316
	1015 FORMAT(21H1CURRENT TEMPERATURE 1PE9.3,10H IN NODE (I2,1H,I2,1H,I2,	CORTE317
	129H) EXCEEDS MAXIMUM TEMPERATUREE9.4,36H IN CONDUCTIVITY-TEMPERATU	CORTE318
	2RE LIBRARY)	CORTE319
	245 RETURN 1	CORTE320
	250 TSTART=TEMP(NUPM3)	CORTE321
	GO TO 240	CORTE322
	255 WRITE(NOT,1020)	CORTE323
	1020 FORMAT(18H1LOOPING IN CORTEM)	CORTE324
	GO TO 245	CORTE325
	END	CORTE326

3	ELT	DOPTEM,1.720604, 4988C	
		SUBROUTINE DOPTEM(IERROR)	DOPTE 1
C			DOPTE 2
C		SUBROUTINE DOPTEM COMPUTES ALL REACTIVITY FEEDBACKS EXCEPT SODIUM	DOPTE 3
C		VOIDING AND FUEL COLLAPSE. SUBROUTINE CURVE IS CALLED.	DOPTE 4
C			DOPTE 5
		INCLUDE ABC	DOPTE 6
		EQUIVALENCE (TEMP(1),FOX),(TEMP(2),GEORGE),(TEMP(3),SUM8),	DOPTE 7
		1(TEMP(4),EASY),(TEMP(5),EXPAND),(TEMP(6),HOW)	DOPTE 8
		EQUIVALENCE (TEMP(7),Z1),(TEMP(8),Z2),(TEMP(9),WEIGH1),	DOPTE 9
		1(TEMP(10),WEIGH2)	DOPTE 10
C			DOPTE 11
		EXPAND=0.0	DOPTE 12
		FOX=ASEG*FUELF*DENSE*1.E-3	DOPTE 13
		QMOL=0.0	DOPTE 14
		FUEL=0.0	DOPTE 15
		PCMELT=0.0	DOPTE 16
		TEMOL=0.0	DOPTE 17
		CLADT=0.0	DOPTE 18
		COOLT=0.0	DOPTE 19
		SUM7=0.0	DOPTE 20
		SUM9=0.0	DOPTE 21
C			DOPTE 22
C			DOPTE 23
		DO 35 CHAN=1,LUPPER	DOPTE 24
		Z1=0.0	DOPTE 25
		CALL CURVE(WEIGH1,Z1,Z,TNAWT(1,CHAN),PAIRS7,\$190)	DOPTE 26
		ABLE=AID*VCHAN(CHAN)	DOPTE 27
		GEORGE=VCHAN(CHAN)*FOX	DOPTE 28
		SUM8=0.0	DOPTE 29
		EASY=0.0	DOPTE 30
		SUM6=0.0	DOPTE 31
		SUM5=0.0	DOPTE 32
		SUM=0.0	DOPTE 33
		SUM1=0.0	DOPTE 34
		SUM2=0.0	DOPTE 35
		SUM3=0.0	DOPTE 36
		SUM4=0.0	DOPTE 37
		DO 30 AXIAL=1,MUPPER	DOPTE 38
		PINTEM(AXIAL,CHAN)=0.0	DOPTE 39
		DO 15 FRAD=1,NUPM3	DOPTE 40
		CHARLY=TEMPER(FRAD,AXIAL,CHAN,NEW)-TMELTL	DOPTE 41
		IF(CHARLY.LE.0.0) GO TO 15	DOPTE 42
		IF(CHARLY.GE.10.) GO TO 10	DOPTE 43
		SUM5=SUM5+FUSE(FRAD)*(TEMPER(FRAD,AXIAL,CHAN,NEW)-TMELTL)	DOPTE 44
		DOG=VOLUME(FRAD)*CHARLY*.1	DOPTE 45
		SUM1=SUM1+DOG	DOPTE 46
		SUM2=SUM2+DOG*TEMPER(FRAD,AXIAL,CHAN,NEW)	DOPTE 47
		GO TO 15	DOPTE 48
10		GG = (TEMPER(FRAD,AXIAL,CHAN,NEW)*(XCOE2+TEMPER(FRAD,AXIAL,CHAN,	DOPTE 49
		INNEW))*(YCOE2/2.+TEMPER(FRAD,AXIAL,CHAN,NEW)*ZCOE2/3.)) - AEW)	DOPTE 50
		SUM5 = SUM5 + 10.*FUSE(FRAD) + GG*HCAP(FRAD)	DOPTE 51
		SUM1=SUM1+VOLUME(FRAD)	DOPTE 52
		SUM2=SUM2+VOLUME(FRAD)*TEMPER(FRAD,AXIAL,CHAN,NEW)	DOPTE 53
15		PINTEM(AXIAL,CHAN)=PINTEM(AXIAL,CHAN)+TEMPER(FRAD,AXIAL,CHAN,NEW)*	DOPTE 54
		VOLUME(FRAD)	DOPTE 55
		PINTEM(AXIAL,CHAN)=PINTEM(AXIAL,CHAN)/VPINFL	DOPTE 56
		SUM3=SUM3+TEMPER(NUPPER,AXIAL,CHAN,NEW)	DOPTE 57
		SUM4=SUM4+TEMPER(NUPPER-1,AXIAL,CHAN,NEW)	DOPTE 58
C			DOPTE 59
C		SPATIAL EXPANSION OF FUEL WITHIN ORIGINAL CORE LENGTH	DOPTE 60

C	IF(COEFFX.GT.1.E-30) GO TO 20	DOPT 61
	HOW=COEFFX*(TEMPER(NUPPER-1,AXIAL,CHAN,NEW)-TNOUGT(AXIAL,CHAN))	DOPT 62
	GO TO 25	DOPT 63
20	HOW=COEFFX*(PINTEM(AXIAL,CHAN)-TFOUGT(AXIAL,CHAN))	DOPT 64
25	CONTINUE	DOPT 65
	EXPAND=EXPAND+GEORGE*WF(AXIAL,CHAN)*(SUM8/EASY-(SUM8+HOW)/(1.+HOW))	DOPT 66
	1)	DOPT 67
	EASY=1.+HOW	DOPT 68
	SUM8=SUM8+HOW	DOPT 69
C		DOPT 70
	IF(JUMPC) GO TO 30	DOPT 71
C		DOPT 72
C	SPATIAL COOLANT DENSITY REACTIVITY FEEDBACK	DOPT 73
C		DOPT 74
	Z1=Z1+ASEG	DOPT 75
	CALL CURVE(WEIGH2,Z1,Z,TNAWGT(1,CHAN),PAIRS7,*190)	DOPT 76
	CALL CURVE(DEN,TEMPER(NUPPER,AXIAL,CHAN,NEW),RHOTEM,DENCOL,PAIRS7,*180)	DOPT 77
	1,*180)	DOPT 78
	SUM6=SUM6-DEN*(WEIGH2-WEIGH1)	DOPT 79
	WEIGH1=WEIGH2	DOPT 80
C		DOPT 81
30	SUM=SUM+PINTEM(AXIAL,CHAN)	DOPT 82
	PCMELT=PCMELT+SUM1*VCHAN(CHAN)	DOPT 83
	SUM9=SUM9+SUM1*VCHAN(CHAN)	DOPT 84
	TEMOL=TEMOL+SUM2*VCHAN(CHAN)	DOPT 85
	COOLT=COOLT+SUM3*VCHAN(CHAN)	DOPT 86
	SUM7=SUM7+SUM6-DEN*(TNAWGT(PAIRS7,CHAN)-WEIGH1)	DOPT 87
	CLADT=CLADT+SUM4*VCHAN(CHAN)	DOPT 88
	QMOL=QMOL+ABLE*SUM5	DOPT 89
C		DOPT 90
C	SPATIAL EXPANSION OF FUEL ABOVE ORIGINAL CORE LENGTH	DOPT 91
C		DOPT 92
	SUM8=.5*SUM9	DOPT 93
	EXPAND=EXPAND+2.*SUM8/EASY*GEORGE*(WF(MUPPER,CHAN)*(1.5+SUM8)-WF(MUPPER-1,CHAN)*(SUM8+.5))	DOPT 94
C		DOPT 95
35	FUELT=FUELT+SUM*VCHAN(CHAN)	DOPT 96
C		DOPT 97
C		DOPT 98
	FUELT=FUELT/VTOTAL	DOPT 99
	CLADT=CLADT/VTOTAL	DOPT 100
	COOLT=COOLT/VTOTAL	DOPT 101
	TEMOL=TEMOL/SUM9	DOPT 102
	PCMELT=100.*PCMELT/(VTOTAL*VPINFL)	DOPT 103
	SMOL=VTOTAL*ASEG*FUELF*PCMELT*1.E-5*DENSE	DOPT 104
	FLINEK(NEW)=FCOE*FUELT-BASEF	DOPT 105
	IF(JUMPC) GO TO 40	DOPT 106
	CLINEK(NEW)=SUM7-BASEC	DOPT 107
	GO TO 45	DOPT 108
40	CLINEK(NEW)=CCOE*COOLT-BASEC	DOPT 109
45	ELINEK(NEW)=ECCOE*CLADT-BASEE	DOPT 110
	IF(COEFFX.GT.1.E-30) FLINEK(NEW)=EXPAND	DOPT 111
	IF(COEFFX.GT.1.E-30) ELINEK(NEW)=EXPAND	DOPT 112
C		DOPT 113
	IF(IDOP.GT.D) GO TO 75	DOPT 114
C		DOPT 115
C	DOPPLER EVALUATION USING AVERAGE CORE TEMPERATURE	DOPT 116
C		DOPT 117
	IF(IDOPCH.GT.D) GO TO 55	DOPT 118
		DOPT 119
		DOPT 120

50	DOPPK(NEW) = - DOPCOE * (ALOG(FUEL) - DOPSUB(1,1))	DOPTE121
	GO TO 165	DOPTE122
55	IF(VGOING) GO TO 60	DOPTE123
	GO TO 50	DOPTE124
60	IF(IFIN.GT.0) GO TO 70	DOPTE125
	DO 65 CHAN=1,LUPPER	DOPTE126
	IF(IXX(CHAN).GT.0) GO TO 65	DOPTE127
	GO TO 50	DOPTE128
65	CONTINUE	DOPTE129
	IFIN = 1	DOPTE130
	DOPSAV(1,1) = -DOPCOE*(ALOG(FUEL)-DOPSUB(1,1))	DOPTE131
	DOPSUB(1,1) = ALOG(FUEL)	DOPTE132
	DOPPK(NEW) = DOPSAV(1,1)	DOPTE133
	GO TO 165	DOPTE134
70	DOPPK(NEW) = DOPSAV(1,1) - FDOP*DOPCOE*(ALOG(FUEL) - DOPSUB(1,1))	DOPTE135
	GO TO 165	DOPTE136
C		DOPTE137
C	DOPPLER EVALUATION USING SPATIAL WEIGHTING	DOPTE138
C		DOPTE139
75	DOPPK(NEW) = 0.0	DOPTE140
	IF(IDOPCH.GT.0) GO TO 95	DOPTE141
80	DO 90 CHAN = 1,LUPPER	DOPTE142
	SUM = 0.0	DOPTE143
	DO 85 AXIAL = 1,MUPPER	DOPTE144
85	SUM = SUM + DOPPW(AXIAL,CHAN) * (ALOG(PINTEM(AXIAL,CHAN))	DOPTE145
	1 - DOPSUB(AXIAL,CHAN))	DOPTE146
90	DOPPK(NEW) = DOPPK(NEW) + SUM * VCHAN(CHAN)	DOPTE147
	GO TO 150	DOPTE148
95	IF(VGOING) GO TO 100	DOPTE149
	GO TO 80	DOPTE150
100	SUMNT = 0.	DOPTE151
	SUMDT = 0.	DOPTE152
C		DOPTE153
	DO 145 CHAN=1,LUPPER	DOPTE154
	SUM = 0.0	DOPTE155
	SUMN = 0.	DOPTE156
	IF(ICHANX(CHAN).EQ.1) GO TO 110	DOPTE157
C		DOPTE158
C	VOIDING IN CHANNEL HAS NOT BEGUN	DOPTE159
C		DOPTE160
	DO 105 AXIAL = 1,MUPPER	DOPTE161
	SUM = SUM + DOPPW(AXIAL,CHAN) * (ALOG(PINTEM(AXIAL,CHAN))	DOPTE162
	1 - DOPSUB(AXIAL,CHAN))	DOPTE163
105	SUMN = SUMN + DOPPW(AXIAL,CHAN)	DOPTE164
	GO TO 140	DOPTE165
110	IF(IXX(CHAN).EQ.1.AND.DOPSAV(1,CHAN).NE.0.) GO TO 130	DOPTE166
C		DOPTE167
C	VOIDING IN CHANNEL IS NOT YET COMPLETE	DOPTE168
C		DOPTE169
	DO 125 AXIAL = 1,MUPPER	DOPTE170
C		DOPTE171
C	CHECK TO SEE IF NODE IS VOIDED	DOPTE172
C		DOPTE173
	IF(XUP(CHAN,NEW).GE.ZMID(AXIAL)+.5*ASEG.AND.XDOWN(CHAN,NEW).LE.ZMID	DOPTE174
	1D(AXIAL)-.5*ASEG) GO TO 115	DOPTE175
	SUM = SUM + DOPPW(AXIAL,CHAN) * (ALOG(PINTEM(AXIAL,CHAN))	DOPTE176
	1 - DOPSUB(AXIAL,CHAN))	DOPTE177
	SUMN = SUMN + DOPPW(AXIAL,CHAN)	DOPTE178
	GO TO 125	DOPTE179
115	IF(DOPSAV(AXIAL,CHAN).NE.0) GO TO 120	DOPTE180

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SUM = SUM + DOPPW(AXIAL,CHAN) * (ALOG(PINTEM(AXIAL,CHAN)))      DOPTE131
1 - DOPSUB(AXIAL,CHAN))                                          DOPTE132
DOPSAV(AXIAL,CHAN) = DOPPW(AXIAL,CHAN) * (ALOG(PINTEM(AXIAL,CHAN))) DOPTE133
1 - DOPSUB(AXIAL,CHAN))                                          DOPTE134
DOPSUB(AXIAL,CHAN) = ALOG(PINTEM(AXIAL,CHAN))                    DOPTE135
SUMN = SUMN + DOPPW(AXIAL,CHAN)                                  DOPTE136
GO TO 125                                                         DOPTE137
120 SUM = SUM + DOPSAV(AXIAL,CHAN) + DOPPW(AXIAL,CHAN) * FDOP * (ALOG DOPTE138
1 (PINTEM(AXIAL,CHAN)) - DOPSUB(AXIAL,CHAN))                    DOPTE139
SUMN = SUMN + DOPPW(AXIAL,CHAN)*FDOP                             DOPTE140
125 CONTINUE                                                     DOPTE141
GO TO 140                                                         DOPTE142
130 DO 135 AXIAL = 1,MUPPER                                       DOPTE143
SUM = SUM + DOPSAV(AXIAL,CHAN) + DOPPW(AXIAL,CHAN) * FDOP * (ALOG DOPTE144
1 (PINTEM(AXIAL,CHAN)) - DOPSUB(AXIAL,CHAN))                    DOPTE145
SUMN = SUMN + DOPPW(AXIAL,CHAN)*FDOP                             DOPTE146
135 CONTINUE                                                     DOPTE147
140 DOPPK(NEW) = DOPPK(NEW) + SUM * VCHAN(CHAN)                 DOPTE148
145 SUMNT = SUMNT + SUMN*VCHAN(CHAN)                              DOPTE149
C                                                                    DOPTE150
150 DOPPK(NEW) = - DOPPK(NEW) * DOPCOE/VDOP TL                 DOPTE151
DO 160 CHAN=1,LUPPER                                             DOPTE152
SUMD = 0.                                                         DOPTE153
DO 155 AXIAL=1,MUPPER                                             DOPTE154
155 SUMD = SUMD + DOPPW(AXIAL,CHAN)                              DOPTE155
160 SUMDT = SUMDT + SUMD*VCHAN(CHAN)                             DOPTE156
DOPVD = -DOPCOE*SUMNT/SUMDT                                       DOPTE157
IF (.NOT.VGOING) DOPVD = -DOPCOE                                DOPTE158
165 SUM=0.0                                                       DOPTE159
C                                                                    DOPTE160
C DETERMINE ENERGY REMOVAL BY COOLANT                           DOPTE161
C                                                                    DOPTE162
DO 170 CHAN=1,LUPPER                                             DOPTE163
170 SUM=SUM+GCCOL(CHAN,NEW)+GCCOL(CHAN,OLD)                     DOPTE164
QOUT(NEW)=QOUT(OLD)+H(NEW)*SUM*1.E-6                             DOPTE165
QGEN(NEW)=QGEN(OLD)+.5*H(NEW)*(AN(OLD)+AN(NEW))                 DOPTE166
175 RETURN                                                         DOPTE167
C                                                                    DOPTE168
180 WRITE(UNIT,1000) AXIAL,CHAN,RHOTEM(PAIRS8)                 DOPTE169
1000 FORMAT(38H1000 COOLANT TEMPERATURE AT AXIAL SEGMENT I2,I2H IN CHANNEL DOPTE170
1I2,40H EXCEEDS MAXIMUM LIBRARY TEMPERATURE OF F9.0)           DOPTE171
185 RETURN                                                         DOPTE172
190 WRITE(UNIT,1005) Z1                                           DOPTE173
1005 FORMAT(100H1005 DO SODIUM WEIGHT INTERPOLATION IN DOPTEM AT HEIGHT DOPTE174
1F10.2)                                                           DOPTE175
GO TO 185                                                         DOPTE176
END                                                                DOPTE177

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@	ELT	MODE,1.720604, 49882		
		SUBROUTINE MODE (IFINIT, IZERO, IVEN)	MODE	1
C			MODE	2
C		SUBROUTINE MODE DETERMINES WHETHER TO USE FINITE OR ZERO LIFETIME	MODE	3
C		APPROXIMATION (OPERABLE ONLY WHEN IKINET=2).	MODE	4
C			MODE	5
		INCLUDE ABC	MODE	6
		IF (IKINET-1) 10,15,20	MODE	7
10		RETURN 1	MODE	8
15		RETURN 2	MODE	9
20		IF (IKINET.GT.2) GO TO 10	MODE	10
		G=RH(NEW)*BB0100	MODE	11
		IF (IRHO) 25,25,65	MODE	12
25		IF (G-RHOSWZ) 30,60,60	MODE	13
C			MODE	14
C		REACTOR IS IN FINITE MODE BUT NET REACTIVITY IS LOW ENOUGH TO	MODE	15
C		ALLOW SWITCH TO ZERO APPROXIMATION (SUCH A SITUATION MUST EXIST	MODE	16
C		FOR 5 TIME STEPS TO PREVENT UNDUE OSCILLATIONS NEAR THE SWITCH	MODE	17
C		POINT). ALSO, PSEUDO EQUILIBRIUM MUST EXIST TO PREVENT A SIZABLE	MODE	18
C		STEP CHANGE IN POWER.	MODE	19
30		JRHO=JRHO+1	MODE	20
		IF (JRHO-5) 35,40,40	MODE	21
35		RETURN 1	MODE	22
40		SUM=0.	MODE	23
		DO 45 I=1,M	MODE	24
45		SUM=SUM+C(I,NEW)*AL(I)	MODE	25
		PCHECK = ALIFE*SUM/(BB-RH(NEW))	MODE	26
		IF (ABS((AN(NEW)-PCHECK)/AN(NEW)).LT.ERROR2) GO TO 50	MODE	27
		JRHO=0	MODE	28
		RETURN 1	MODE	29
50		IRHO=1	MODE	30
		IVEN=1	MODE	31
		DO 55 I=1,M	MODE	32
		C(I,NEW)=C(I,NEW)*ALIFE	MODE	33
55		C(I,OLD)=C(I,OLD)*ALIFE	MODE	34
		RETURN 2	MODE	35
C			MODE	36
C		REACTOR IS IN FINITE MODE AND MUST STAY THAT WAY.	MODE	37
60		JRHO=0	MODE	38
		RETURN 1	MODE	39
65		IF (G-RHOSWZ) 70,75,75	MODE	40
C			MODE	41
C		REACTOR IS IN ZERO MODE AND IS ALLOWED TO STAY THAT WAY.	MODE	42
70		RETURN 2	MODE	43
C			MODE	44
C		REACTOR IS IN ZERO MODE BUT NET REACTIVITY EXCEEDS SWITCH POINT.	MODE	45
C		HENCE, THE FINITE MODE MUST BE USED.	MODE	46
75		IRHO=0	MODE	47
		IVEN=0	MODE	48
		DO 80 I=1,M	MODE	49
		C(I,NEW)=C(I,NEW)/ALIFE	MODE	50
80		C(I,OLD)=C(I,OLD)/ALIFE	MODE	51
		RETURN 1	MODE	52
		END	MODE	53

2	ELT NEXT,1.720604, 49885		
	SUBROUTINE NEXT (IPACK,IEPROR)	NEXT	1
C		NEXT	2
C	SUBROUTINE NEXT (FINITE LIFETIME) UPDATES NEW AND OLD INDICIES,	NEXT	3
C	CALCULATES CURRENT PRECURSOR DENSITIES AND REACTOR PERIOD.	NEXT	4
C	SUBROUTINES CALLED ARE NEWTIM AND TIME.	NEXT	5
C		NEXT	6
	INCLUDE ABC	NEXT	7
	IF(IKINET.EQ.3) GO TO 55	NEXT	8
	SUM=0.0	NEXT	9
C		NEXT	10
C	CALCULATE PRECURSOR DENSITIES BEFORE NEW TIME STEP TAKEN	NEXT	11
C		NEXT	12
	DO 20 I=1,M	NEXT	13
	ABLE=ALPH(I)*H(NEW)	NEXT	14
	IF(ABS(ABLE)-.4) 15,10,10	NEXT	15
10	C(I,NEW)=EXP(GAM(I)*H(NEW))*(C(I,OLD)+AN(OLD)*B(I)*((EXP(ABLE)-1.)	NEXT	16
	1/ALPH(I)-H(NEW))/ALIFE)	NEXT	17
	GO TO 20	NEXT	18
15	C(I,NEW)=EXP(GAM(I)*H(NEW))*(C(I,OLD)+AN(OLD)*B(I)*H(NEW)*ABLE*(1.	NEXT	19
	1+ABLE*(1./3.+ABLE*(1./12.+ABLE/60.)))/(2.*ALIFE))	NEXT	20
20	SUM=SUM+AL(I)*C(I,NEW)	NEXT	21
C		NEXT	22
C	CALCULATE REACTOR PERIOD	NEXT	23
C		NEXT	24
	W=(RHO-BB)/ALIFE+SUM/AN(NEW)	NEXT	25
	DO 25 I=1,M	NEXT	26
	GAM(I)=B(I)*AN(NEW)/(ALIFE*C(I,NEW))-AL(I)	NEXT	27
25	ALPH(I)=W-GAM(I)	NEXT	28
C		NEXT	29
	IF(H(NEW)) 30,30,35	NEXT	30
30	H(NEW)=HMAX	NEXT	31
	GO TO 55	NEXT	32
C		NEXT	33
C	CHECK FOR SCRAM CONDITIONS	NEXT	34
C		NEXT	35
35	IF(SCRAM) GO TO 55	NEXT	36
	IF(AN(NEW).LT.ANSCRM) GO TO 45	NEXT	37
40	SCRAM=.TRUE.	NEXT	38
	TSCRAM(NEW)=-TDELAY	NEXT	39
	GO TO 55	NEXT	40
45	DO 50 CHAN=1,LUPPER	NEXT	41
	IF(TEMPER(NUPPER,MUPPER,CHAN,NEW).GT.TEM SRM) GO TO 40	NEXT	42
50	CONTINUE	NEXT	43
	IF((ALOG(AN(NEW)/AN(OLD))/H(NEW)).GE.PERIOD) GO TO 40	NEXT	44
C		NEXT	45
C	UPDATE NEW AND OLD INDICIES (CYCLE EACH TIME STEP)	NEXT	46
C		NEXT	47
55	GO TO (60,65),OLD	NEXT	48
60	OLD=2	NEXT	49
	NEW=1	NEXT	50
	GO TO 70	NEXT	51
65	OLD=1	NEXT	52
	NEW=2	NEXT	53
70	CALL NEWTIM(\$90)	NEXT	54
	CALL TIME(MAXTIM,\$75)	NEXT	55
	RETURN 1	NEXT	56
75	TQUIT=T(OLD)	NEXT	57
	RETURN 1	NEXT	58
80	RETURN 2	NEXT	59
	END	NEXT	60

2	ELT NEWTIM,1,720606, 73447	
	SUBROUTINE NEWTIM(IERROR)	NEWTI 1
C		NEWTI 2
C	SUBROUTINE NEWTIM (FINITE LIFETIME) ESTABLISHES NEW TIME STEP.	NEWTI 3
C	SUBROUTINES CALLED ARE SUBNEU, QUAD, AND CURVE.	NEWTI 4
C		NEWTI 5
	INCLUDE ABC	NEWTI 6
	IF(IKINET.EQ.3) GO TO 70	NEWTI 7
	JINGO=1	NEWTI 8
	IF(ICATCH.EQ.0) GO TO 10	NEWTI 9
	HH=HTRIP	NEWTI 10
	GO TO 15	NEWTI 11
10	HH=H(OLD)	NEWTI 12
15	DKD=0.0	NEWTI 13
	ABLE=TOUT-T(OLD)	NEWTI 14
	IF(HH.GT.ABLE) HH=ABLE	NEWTI 15
20	TT=T(OLD)+HH	NEWTI 16
C		NEWTI 17
C	COMPUTE POWER AS PURE EXPONENTIAL INCREASE	NEWTI 18
C		NEWTI 19
	ANN=AN(OLD)*EXP(W*HH)	NEWTI 20
C		NEWTI 21
	CALL CURVE(DKU,TT,TIMEIN,DKIN,PAIRS2,\$55)	NEWTI 22
	IF(.NOT.SCRAM) GO TO 25	NEWTI 23
	TTT=TSCRAM(OLD)+HH	NEWTI 24
	IF(TTT.LT.0.0) GO TO 25	NEWTI 25
	CALL CURVE (DKD,TTT,TIMOUT,DKOUT,PAIRS3,\$65)	NEWTI 26
C		NEWTI 27
C	CALCULATE EXPECTED NET REACTIVITY DURING NEW TIME STEP (USE LINEAR	NEWTI 28
C	EXTRAPOLATION)	NEWTI 29
C		NEWTI 30
25	RHO=DOPPK(OLD)+VOIDK(OLD)+COLAPK(OLD)+DKU-DKD+FLINEK(OLD)+CLINEK(ONEWTI 31	
	ILD)+ELINEK(OLD)+RSLOPE*HH	NEWTI 32
C		NEWTI 33
	H(NEW)=HH	NEWTI 34
C		NEWTI 35
C	CALCULATE POWER BASED ON ALGORITHM USING EXTRAPOLATED REACTIVITY	NEWTI 36
C		NEWTI 37
	CALL SUBNEU	NEWTI 38
	IF(ABS((ANN-ANZ)/ANZ).LT.ERROR) GO TO 35	NEWTI 39
	GO TO (30,50),JINGO	NEWTI 40
30	HH=HH*REDUCE	NEWTI 41
	GO TO 20	NEWTI 42
C		NEWTI 43
C	STORE PARAMETERS IN CASE NEXT PASS THROUGH INNER LOOP VIOLATES	NEWTI 44
C	ERROR CRITERION	NEWTI 45
C		NEWTI 46
35	RH(NEW)=RHO	NEWTI 47
	AN(NEW)=ANZ	NEWTI 48
	HSTO=HH	NEWTI 49
	H(NEW)=HH	NEWTI 50
	KINSRT(NEW)=DKU	NEWTI 51
	KWTHDR(NEW)=DKD	NEWTI 52
	TSCRAM(NEW)=TTT	NEWTI 53
	T(NEW)=TT	NEWTI 54
	IF(ICATCH.EQ.1) GO TO 50	NEWTI 55
C		NEWTI 56
	IF(H(NEW)-ABLE) 40,50,40	NEWTI 57
40	IF(H(NEW)-HMAX) 45,50,45	NEWTI 58
45	JINGO =2	NEWTI 59
	HH=AMIN1(HMAX,ABLE,HH/REDUCE)	NEWTI 60

GO TO 20	NEWTI 61
50 H(NEW)=HSTC	NEWTI 62
RETURN	NEWTI 63
C	NEWTI 64
55 WRITE(NOT,1000) TT,TIMEIN(PAIRS2)	NEWTI 65
1000 FORMAT(14HICURRENT TIME 1PE9.4,22H EXCEEDS MAXIMUM TIME E9.4,25H	IN NEWTI 66
1N TIME-K INSERT LIBRARY)	NEWTI 67
60 RETURN	NEWTI 68
65 WRITE(NOT,1005) TTT,TIMOUT(PAIRS3)	NEWTI 69
1005 FORMAT(14HICURRENT TIME 1PE9.4,22H EXCEEDS MAXIMUM TIME E9.4,27H	IN NEWTI 70
1N TIME-K WITHDRAW LIBRARY)	NEWTI 71
GO TO 60	NEWTI 72
C	NEWTI 73
C READ PROGRAMMED POWER (IKINET=3)	NEWTI 74
C	NEWTI 75
70 ABLE=TOUT-T(OLD)	NEWTI 76
IF(ABLE.GT.HMAX) ABLE=HMAX	NEWTI 77
T(NEW)=T(OLD)+ABLE	NEWTI 78
H(NEW) = ABLE	NEWTI 79
TT=T(NEW)	NEWTI 80
TTT=TT	NEWTI 81
CALL QUAD(ABLE,T(NEW),TIMEIN,DKIN,PAIRS2+PAIRS3,\$75)	NEWTI 82
AN(NEW)=ANI*ABLE	NEWTI 83
RETURN	NEWTI 84
75 IF(TT.GT.TIMEIN(PAIRS2)) GO TO 65	NEWTI 85
GO TO 55	NEWTI 86
END	NEWTI 87

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@ ELT CHECK,1,720606, 73454
  SUBROUTINE CHECK (IBACK,ION,IERROR,ITHRU,IVEN,OLDOLD) CHECK 1
C CHECK 2
C SUBROUTINE CHECK (FINITE LIFETIME) EVALUATES ACCEPTABILITY OF CHECK 3
C COMPLETED TIME STEP, CONTAINS PROBLEM TERMINATION CONTROLS, AND CHECK 4
C ESTABLISHES SMALL, BIG, AND VENUS OUTPUTS. SUBROUTINES CALLED ARE CHECK 5
C SUBNEU, NEWTIM, OUTSML, OUTBIG, AND CURVE. CHECK 6
C SYSTEM SUBROUTINE NTRAN IS CALLED. CHECK 7
C CHECK 8
  INCLUDE ABC CHECK 9
  DIMENSION KT(15) CHECK 10
  DIMENSION INDV(11,18) CHECK 11
  DIMENSION VTEM(20,10) CHECK 12
  EQUIVALENCE (TEMP,KT) CHECK 13
  DOUBLE PRECISION GGGG1,GGGG2,GGGG3 CHECK 14
  NPT = -3 CHECK 15
C CHECK 16
  IF(IKINET.EQ.3) GO TO 15 CHECK 17
C CHECK 18
  CALCULATE ACTUAL REACTIVITY FEEDBACK OCCURING DURING TIME STEP CHECK 19
C CHECK 20
  RSLOPE=(DOPPK(NEW)-DOPPK(OLD)+VOIDK(NEW)-VOIDK(OLD)+COLAPK(NEW)-COCHECK 21
1LAPK(OLD)+FLINEK(NEW)-FLINEK(OLD)+ELINEK(NEW)-ELINEK(OLD)+CLINEK(NEW)-CHECK 22
2EW)-CLINEK(OLD))/H(NEW) CHECK 23
  RHO=DOPPK(NEW)+VOIDK(NEW)+COLAPK(NEW)+FLINEK(NEW)+CLINEK(NEW)+ELINCHECK 24
1EK(NEW)-KWTHDR(NEW)+KINSRT(NEW) CHECK 25
  RH(NEW)=RHO CHECK 26
C CHECK 27
  CALCULATE POWER BASED ON ACTUAL NET REACTIVITY DURING TIME STEP CHECK 28
C CHECK 29
  CALL SUBNEU CHECK 30
  IF(ABS((AN(NEW)-ANZ)/ANZ).LT.ERROR1.AND.ICATCH.EQ.0) GO TO 15 CHECK 31
C CHECK 32
  TIME STEP NOT ACCEPTABLE. START OVER WITH BETTER ESTIMATE FOR CHECK 33
C ACTUAL NET REACTIVITY. CHECK 34
C CHECK 35
  CALL NEWTIM ($10) CHECK 36
  RETURN1 CHECK 37
10 RETURN3 CHECK 38
C CHECK 39
  TIME STEP IS ACCEPTABLE CHECK 40
C CHECK 41
15 STEP=STEP+1 CHECK 42
  IF(FUELT.LT.TDISAS) GO TO 150 CHECK 43
C CHECK 44
  DISASSEMBLY CONDITIONS ARE ESTABLISHED. WRITE OUT CORE CONDITIONSCHECK 45
C CHECK 46
  BAKER=(VOIDK(NEW)-VOIDK(OLD))*BB0100/H(NEW) CHECK 47
  CHARLY=(COLAPK(NEW)-COLAPK(OLD))*BB0100/H(NEW) CHECK 48
  ABLE = BAKER+CHARLY+(KINSRT(NEW)-KINSRT(OLD))*BB0100/H(NEW)+(KWTHDCHECK 49
1R(NEW)-KWTHDR(OLD))*BB0100/H(NEW) CHECK 50
  DOG=RH(NEW)*BB0100 CHECK 51
  EASY=VOIDK(NEW)*BB0100 CHECK 52
  FOX=COLAPK(NEW)*BB0100 CHECK 53
  WRITE(NOT,1000) (TITLE(I),I=1,14),FUELT,T(NEW),AN(NEW),DOG,FOX,EASCHECK 54
1Y,CHARLY,BAKER,ABLE,TEMOL,PCMELT,GMSMOL CHECK 55
1000 FORMAT(1H113A6,A2///40X,43HTHE CORE IS NEARING A DISASSEMBLY CONDICHECK 56
1TION///1H035X,26HCORE AVERAGE TEMPERATURE =F7.0,16H DEGREES KELVICHECK 57
2N/1H026X,35HTIME AFTER BEGINNING OF TRANSIENT =IPE9.3,9H SECONDS/CHECK 58
314054X,7HPOWER =E9.3,11H MEGAWATTS/1H045X,16HNET REACTIVITY =DPF8CHECK 59
4.3,7H CENTS/1H042X,19HCOLLAPSE FEEDBACK =F8.3,7H CENTS/1H046X,15CHECK 60

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54VOID FEEDBACK =F8.3.7H CENTS/1H041X.20HCOLLAPSE RAMP RATE =-2PF8CHECK 61
6.3.13H DOLLARS/SEC/1H045X.16HVOID RAMP RATE =F8.3.13H DOLLARS/SECHECK 62
XC CHECK 63
7/1H044X.17HTOTAL RAMP RATE =F8.3.13H DOLLARS/SEC/1H025X.36HAVERAGCHECK 64
95 TEMPERATURE OF MOLTEN FUEL =OPF7.0.16H DEGREES KELVIN/1H020X.41CHECK 65
9HPORTION OF THE FUEL IN THE MOLTEN STATE =F7.3.10H PER CENT/1H035CHECK 66
AX.26HKILOGRAMS OF MOLTEN FUEL =1PE9.3) CHECK 67
C CHECK 68
IF(VENUS.EQ.0) GO TO 145 CHECK 69
C CHECK 70
VENUS INPUT DATA IS REQUESTED CHECK 71
C CHECK 72
TEMP(1)=1.E+6*(QGEN(NEW)-QOUT(NEW)) CHECK 73
TEMP(2)=T(OLD)-H(OLD) CHECK 74
GGGG1 =(OLDOLD-DOPPK(NEW)-(OLDOLD-DOPPK(OLD))*(TEMP(2)-T(NEW))/(T(NEW)-T(OLD))) CHECK 75
GGGG2 =(OLDOLD-DOPPK(OLD))/(TEMP(2)-T(OLD))-GGGG1 *(TEMP(2)+T(OLD)) CHECK 76
GGGG3 =OLDOLD-(GGGG2 +GGGG1 *TEMP(2))*TEMP(2) CHECK 77
WRITE(NOT,1005) T(NEW),T(OLD),TEMP(1),DOPPK(OLD),DOPPK(NEW) CHECK 78
1005 FORMAT('1VENUS INPUT'/(1P5E12.5/)) CHECK 79
WRITE(NOT,1010) GGGG1,GGGG2,GGGG3 CHECK 80
1010 FORMAT(1P3D20.9) CHECK 81
WRITE (NPT,1015) FUEL CHECK 82
WRITE (NPT,1015) T(NEW),T(OLD),TEMP(1),DOPPK(OLD),DOPPK(NEW) CHECK 83
WRITE (NPT,1020) GGGG1,GGGG2,GGGG3 CHECK 84
20 IF(IVEN.NE.1) GO TO 30 CHECK 85
DO 25 I=1,M CHECK 86
25 TEMP(I)=C(I,NEW)*1.E+6/ALIFE CHECK 87
GO TO 40 CHECK 88
30 DO 35 I=1,M CHECK 89
35 TEMP(I)=C(I,NEW)*1.E+6 CHECK 90
40 WRITE(NOT,1015) (TEMP(I),I=1,M) CHECK 91
WRITE (NPT,1015) (TEMP(I),I=1,M) CHECK 92
1015 FORMAT(1P6E12.5) CHECK 93
1020 FORMAT(1P3D20.9) CHECK 94
C CHECK 95
45 IF(VENUS.EQ.2) GO TO 50 CHECK 96
C CHECK 97
PRINT AND PUNCH REACTIVITY INFORMATION FOR OLD VENUS VERSION CHECK 98
C CHECK 99
TEMP(1)=RH(OLD)/(1.+RH(OLD)) CHECK 100
TEMP(2)=RH(NEW)/(1.+RH(NEW)) CHECK 101
WRITE(NOT,1015) H(NEW),TEMP(1),TEMP(2) CHECK 102
WRITE (NPT,1015) H(NEW),TEMP(1),TEMP(2) CHECK 103
GO TO 55 CHECK 104
C CHECK 105
PRINT AND PUNCH REACTIVITY INFORMATION FOR NEW VENUS VERSION CHECK 106
C CHECK 107
50 WRITE(NOT,1015) (GAM(I),I=1,M) CHECK 108
WRITE (NPT,1015) (GAM(I),I=1,M) CHECK 109
WRITE(NOT,1015) W,RH(NEW) CHECK 110
WRITE (NPT,1015) W,RH(NEW) CHECK 111
C CHECK 112
ENERGY WEIGHT PIN TEMPERATURES FOR VENUS INPUT CHECK 113
C CHECK 114
55 CONTINUE CHECK 115
PIASEG=3.14159*ASEG CHECK 116
DO 90 CHAN=1,LUPPER CHECK 117
DO 85 AXIAL=1,MUPPER CHECK 118
CHECK 119
CHECK 120

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	ENERV=0.	CHECK121
	DO 70 FRAD=1,NUPM3	CHECK122
	IF (TEMPER(FRAD,AXIAL,CHAN,NEW).LE.TMELTL) GO TO 60	CHECK123
	IF (TEMPER(FRAD,AXIAL,CHAN,NEW).GE.TMELTH) GO TO 65	CHECK124
C		CHECK125
C	FUEL IS MELTING	CHECK126
C		CHECK127
	ENERV = ENERV + CPML(FRAD) - CP300(FRAD) + (TEMPER(FRAD,AXIAL,CHAN,NEW) - TMELTL)* FUSE(FRAD)*PIASEG	CHECK128
	GO TO 70	CHECK129
C		CHECK130
C	FUEL IS BELOW MELTING	CHECK131
C		CHECK132
	60 ENERV = ENERV + DENSE*VOLUME(FRAD)*PIASEG*	CHECK133
	1(TEMPER(FRAD,AXIAL,CHAN,NEW)*(XCOE1 +	CHECK134
	2 TEMPER(FRAD,AXIAL,CHAN,NEW)*(YCOE1/2. +	CHECK135
	3 TEMPER(FRAD,AXIAL,CHAN,NEW)*ZCOE1/3.))) - CP300(FRAD)	CHECK136
	GO TO 70	CHECK137
C		CHECK138
C	FUEL IS ABOVE MELTING	CHECK139
C		CHECK140
	65 ENERV = ENERV + CPML(FRAD) - CP300(FRAD) + FUSE(FRAD)*10.*PIASEG +	CHECK141
	1DENSE*VOLUME(FRAD)*PIASEG*	CHECK142
	1(TEMPER(FRAD,AXIAL,CHAN,NEW)*(XCOE2 +	CHECK143
	2 TEMPER(FRAD,AXIAL,CHAN,NEW)*(YCOE2/2. +	CHECK144
	3 TEMPER(FRAD,AXIAL,CHAN,NEW)*ZCOE2/3.))) - CPMH(FRAD)	CHECK145
C		CHECK146
	70 CONTINUE	CHECK147
	IF (ENERV.LE.ENERST) GO TO 75	CHECK148
	IF (ENERV.GE.ENERMO) GO TO 80	CHECK149
	VTEM(AXIAL,CHAN) = TMELTL + (ENERV - ENERST)/(HFUSE*DENSE*	CHECK150
	1VPINFL*PIASEG*0.1)	CHECK151
	GO TO 85	CHECK152
	75 VTEM(AXIAL,CHAN) = PINTEN(AXIAL,CHAN)	CHECK153
	GO TO 85	CHECK154
	80 VTEM(AXIAL,CHAN) = TMELTH + (ENERV - ENERMO)/(DENSE*VPINFL*XCOE2*	CHECK155
	1PIASEG)	CHECK156
	85 CONTINUE	CHECK157
	90 CONTINUE	CHECK158
C		CHECK159
C	WRITE ENERGY WEIGHTED TEMPERATURES	CHECK160
C		CHECK161
	DO 95 I=MUPPER,1,-1	CHECK162
	WRITE(NOT,1025) (VTEM(I,J), J=1,LUPPER)	CHECK163
	1025 FORMAT(1X,15F8.1)	CHECK164
	95 CONTINUE	CHECK165
C		CHECK166
C	WRITE AND PUNCH ENERGY WEIGHTED TEMPERATURES IN VENUS FORMAT	CHECK167
C		CHECK168
	WRITE(NOT,1030)	CHECK169
	1030 FORMAT(*OPUNCHED TEMPERATURE ORDER*)	CHECK170
	IHR=0	CHECK171
	DO 110 K=1,NVENR	CHECK172
	ILR=IHR+1	CHECK173
	IHR=NMELTR(K)	CHECK174
	IHZ=C	CHECK175
	DO 110 L=1,NVENZ	CHECK176
	ILZ=IHZ+1	CHECK177
	IHZ=NMELTZ(K)	CHECK178
	KARD=0	CHECK179
		CHECK180

DO 105 J=ILZ,IHZ	CHECK181
LIM=NZ(J)	CHECK182
DO 105 JJ=1,LIM	CHECK183
DO 105 I=ILR,IHR	CHECK184
LIMM=NR(I)	CHECK185
DO 100 II=1,LIMM	CHECK186
KARD=KARD+1	CHECK187
TEMP(KARD)=VTEM(J,I)	CHECK188
IF(KARD.NE.6) GO TO 100	CHECK189
WRITE (NPT,1015) (TEMP(N),N=1,6)	CHECK190
WRITE(NOT,1035) (TEMP(N),N=1,6)	CHECK191
1035 FORMAT(1P6E12.5)	CHECK192
KARD=0	CHECK193
100 CONTINUE	CHECK194
105 CONTINUE	CHECK195
IF(KARD.EQ.0) GO TO 110	CHECK196
WRITE (NPT,1015) (TEMP(N),N=1,KARD)	CHECK197
WRITE(NOT,1035) (TEMP(N),N=1,KARD)	CHECK198
110 CONTINUE	CHECK199
C	CHECK200
C WRITE AND PUNCH EQUATION OF STATE INDICIES IN VENUS FORMAT	CHECK201
C	CHECK202
WRITE(NOT,1040)	CHECK203
1040 FORMAT('OPUNCHED KT ORDER')	CHECK204
IHR=0	CHECK205
DO 140 K=1,NVENR	CHECK206
IAN=0	CHECK207
ILR=IHR+1	CHECK208
IHR=NMELTR(K)	CHECK209
IHZ=0	CHECK210
DO 140 L=1,NVENZ	CHECK211
ILZ=IHZ+1	CHECK212
IHZ=NMELTZ(K)	CHECK213
KARD=0	CHECK214
DO 135 AXIAL=ILZ,IHZ	CHECK215
LIM=NZ(AXIAL)	CHECK216
DO 135 JJ=1,LIM	CHECK217
IRN=0	CHECK218
IF(K-2)125,115,115	CHECK219
115 IKK=K-1	CHECK220
KK=NMELTR(IKK)	CHECK221
DO 120 IK=1,KK	CHECK222
IRN=IRN+NR(IK)	CHECK223
120 CONTINUE	CHECK224
125 CONTINUE	CHECK225
IAN=IAN+1	CHECK226
DO 135 CHAN=ILR,IHR	CHECK227
LIMM=NR(CHAN)	CHECK228
IJI=IEOSIN	CHECK229
IF(XUP(CHAN,NEW).GE.ZMID(AXIAL)+.5*ASEG.AND.XDOWN(CHAN,NEW).LE.ZMICHECK230	
10(AXIAL)-.5*ASEG) IJI=IEOSOT	CHECK231
DO 130 II=1,LIMM	CHECK232
IRN=IRN+1	CHECK233
KARD=KARD+1	CHECK234
KT(KARD)=IJI	CHECK235
INDV(IRN,IAN)=KT(KARD)	CHECK236
IF(KARD.NE.12) GO TO 130	CHECK237
WRITE (NPT,1045) (KT(N),N=1,12)	CHECK238
1045 FORMAT(12I6)	CHECK239
WRITE(NOT,1050) (KT(N),N=1,12)	CHECK240

1050	FORMAT(12I6)	CHECK241
	KARD=0	CHECK242
130	CONTINUE	CHECK243
135	CONTINUE	CHECK244
	IF(KARD.EQ.0) GO TO 140	CHECK245
	WRITE (NPT,1045) (KT(N),N=1,KARD)	CHECK246
	WRITE(NOT,1050) (KT(N),N=1,KARD)	CHECK247
140	CONTINUE	CHECK248
	WRITE(NOT,1055)	CHECK249
1055	FORMAT(2X*INDEX OF EQUATION OF STATE*)	CHECK250
	DO 1060 IAN=18,1,-1	CHECK251
	WRITE(NOT,1060) (INDV(IRN,IAN),IRN=1,11)	CHECK252
1060	FORMAT (2X35I2)	CHECK253
C		CHECK254
C		CHECK255
145	CONTINUE	CHECK256
	LINESL=0	CHECK257
	TDISAS=TDISAS+TINCRT	CHECK258
150	CONTINUE	CHECK259
	JQUIT=1	CHECK260
C		CHECK261
C	CHECK FOR PROGRAM TERMINATING CONDITIONS	CHECK262
C		CHECK263
	IF(AN(NEW).GE.PQUITC) GO TO 165	CHECK264
	IF(ICOLTQ.GT.0.AND.GOING) GO TO 165	CHECK265
	IF(IVOIDQ.GT.0.AND.VGOING) GO TO 165	CHECK266
	IF(T(NEW).GT.TQUIT) GO TO 165	CHECK267
	IF(FUELT.GE.7EMAD) GO TO 165	CHECK268
	IF(TVOID(NEW).GT.TVQUIT) GO TO 165	CHECK269
	IF(TCOLP(NEW).GT.TCQUIT) GO TO 165	CHECK270
	DO 155 CHAN=1,LUPPER	CHECK271
	DO 155 AXIAL=1,MUPPER	CHECK272
	IF(TEMPER(1,AXIAL,CHAN,NEW).GT.THQUIT) GO TO 165	CHECK273
	IF(TEMPER(NUPM3,AXIAL,CHAN,NEW).LT.TLQUIT) GO TO 165	CHECK274
155	CONTINUE	CHECK275
	DO 160 CHAN=1,LUPPER	CHECK276
	IF(TEMPER(NUPPER,MUPPER,CHAN,NEW).GT.TSQUIT) GO TO 165	CHECK277
160	CONTINUE	CHECK278
	IF(RH(NEW).LT.RMIN) GO TO 165	CHECK279
	GO TO 170	CHECK280
165	JQUIT=2	CHECK281
C		CHECK282
C	CHECK FOR PRINTOUT CONTROLS ON TIME STEP	CHECK283
C		CHECK284
170	IF(T(NEW).EQ.TOUT.OR.JQUIT.EQ.2) GO TO 175	CHECK285
	IF(TCOLP(NEW).LT.1.E-20.AND.GOING.OR.TVOID(NEW).LT.1.E-20.AND.VGOING) GO TO 220	CHECK286
	IF(STEP.NE.STEPOT) RETURN 2	CHECK287
C		CHECK288
C	PRINT SMALL OUTPUT	CHECK289
C		CHECK290
	STEPOT=STEPOT+DELSTP	CHECK291
	CALL OUTSML	CHECK292
	RETURN 2	CHECK293
C		CHECK294
175	CALL CURVE(BOU,T(NEW),TPLIB,PLIB,PAIRS6,\$215)	CHECK295
C		CHECK296
C	SET NEXT BIG PRINTOUT TIME INCREMENT = DELTOT IF VOIDING OR	CHECK297
C	COLLAPSE IS IN PROCESS. OTHERWISE USE PRINTOUT TIME LIBRARY.	CHECK298
C		CHECK299
		CHECK300

IF(VOFF.AND.COFF) GO TO 185	CHECK301
180 BOUT=DELTOT	CHECK302
185 CONTINUE	CHECK303
TOUT=TOUT+BOUT	CHECK304
IF(STEP.EQ.STEPOT) STEPOT=STEPOT+DELSTP	CHECK305
C	CHECK306
C PRINT BIG OUTPUT	CHECK307
C	CHECK308
CALL OUTBIG	CHECK309
C	CHECK310
190 IF(DUMP.E9.0) GO TO 210	CHECK311
C	CHECK312
C DUMP CORE FOR LATER RESTART	CHECK313
C	CHECK314
CALL NTRAN(NOTD,1,IJKLM,CORE,STATUS)	CHECK315
IF(GOING.OR.VGOING) DUMP=0	CHECK316
195 STATUS=STATUS	CHECK317
IF(STATUS+1) 200,195,205	CHECK318
200 WRITE(NOT,1065)	CHECK319
1065 FORMAT(34HDEVICE ERROR IN TRANSMITTING DATA)	CHECK320
RETURN 3	CHECK321
205 CALL NTRAN(NOTD,10)	CHECK322
C	CHECK323
210 IF(JQUIT.E9.2) RETURN 4	CHECK324
RETURN 2	CHECK325
C	CHECK326
215 WRITE(NOT,1070) T(NEW),TPLIB(PAIRS6)	CHECK327
1070 FORMAT(13HDCURRENT TIME 1PE9.3,21H EXCEEDS MAXIMUM TIME E9.3,22H I	CHECK328
IN TIME-PRINT LIBRARY)	CHECK329
GO TO 10	CHECK330
C	CHECK331
C GET SMALL PRINTOUT AND POSSIBLE CORE DUMP WHEN VOIDING OR	CHECK332
C COLLAPSE BEGINS	CHECK333
C	CHECK334
220 IF(STEP.NE.STEPOT) GO TO 190	CHECK335
CALL OUTSML	CHECK336
STEPOT=STEPOT+DELSTP	CHECK337
GO TO 190	CHECK338
END	CHECK339

Q	ELT	SUBNEU,1.720604, 49883	
		SUBROUTINE SUBNEU	SUBNE 1
C			SUBNE 2
C		SUBROUTINE SUBNEU COMPUTES NEW POWER BASED ON ALGORITHM	SUBNE 3
C			SUBNE 4
		INCLUDE ABC	SUBNE 5
		SUM=0.0	SUBNE 6
		DO 20 I=1,M	SUBNE 7
		ABLE=H(NEW)*ALPH(I)	SUBNE 8
		IF (ABS(ABLE)-.01) 10,15,15	SUBNE 9
	10	SUM=SUM+AL(I)*C(I,OLD)*.5*H(NEW)*ABLE*(-1.+ABLE*(1./3.-ABLE/12.))	SUBNE 10
		GO TO 20	SUBNE 11
	15	SUM=SUM+AL(I)*C(I,OLD)*((1.-EXP(-ABLE))/ALPH(I)-H(NEW))	SUBNE 12
	20	CONTINUE	SUBNE 13
		ANZ=EXP(W*H(NEW))*(AN(OLD)*(1.+.5*H(NEW)*(RHO-RH(OLD))/ALIFE)+SUM)	SUBNE 14
		RETURN	SUBNE 15
		END	SUBNE 16

Q	ELT COLAPS,1,720606, 73445	
	SUBROUTINE COLAPS (IERROR)	COLAP 1
C		COLAP 2
C	SUBROUTINE COLAPS COMPUTES REACTIVITY FEEDBACK DUE TO GROSS MOLTEN	COLAP 3
C	FUEL MOTION. *NOTE* FUEL WORTH IS EXTRAPOLATED LINEARLY TO ZERO	COLAP 4
C	FROM VALUE AT CENTER OF BOTTOM SEGMENT TO A POINT 1/2 SEGMENT	COLAP 5
C	LENGTH BELOW CORE BASE. SUBROUTINE CURVE IS CALLED.	COLAP 6
C		COLAP 7
	INCLUDE ABC	COLAP 8
	DIMENSION ACCEL(10,2),VELOC(10,2),DIST(10,2),TWFWGT(21,10)	COLAP 9
	EQUIVALENCE (TSEG(1,1,1),ACCEL(1,1)),(TSEG(1,2,1),VELOC(1,1)),	COLAP 10
	1(TSEG(1,3,1),DIST(1,1)),(TSEG(1,4,1),AREAR),(TSEG(2,4,1),POVERD),	COLAP 11
	2(TSEG(1,9,1),TWFWGT(1,1))	COLAP 12
	COLAPK(NEW)=0.0	COLAP 13
	ICATCH=0	COLAP 14
C		COLAP 15
	DO 235 CHAN=1,LUPPER	COLAP 16
C		COLAP 17
C	CHECK ON USE OF COLLAPSE OR SQUIPTING ROUTINE	COLAP 18
C		COLAP 19
	IF(CHI.GT.-1.) GO TO 10	COLAP 20
	IF(ICHAN(CHAN).NE.0) GO TO 170	COLAP 21
10	CONTINUE	COLAP 22
	SUM=0.0	COLAP 23
C		COLAP 24
C	CHECK FOR FUEL FAILURE LOCATION	COLAP 25
C		COLAP 26
	DO 70 AXIAL=1,MUPPER	COLAP 27
C	..... CHECK FOR TRIP ON CENTERLINE TEMPERATURE	COLAP 28
	IF(TEMPER(1,AXIAL,CHAN,NEW) - TRIPF) 20, 80, 15	COLAP 29
15	IF(ICHAN(CHAN).GT.0) GO TO 80	COLAP 30
	HTRIP = H(NEW)*(TRIPF - TEMPER(1,AXIAL,CHAN,OLD))/	COLAP 31
	1(TEMPER(1,AXIAL,CHAN,NEW) - TEMPER(1,AXIAL,CHAN,OLD))	COLAP 32
	IF(ABS(H(NEW) - HTRIP).LE.DELTOT) GO TO 80	COLAP 33
	ICATCH = 1	COLAP 34
	GO TO 240	COLAP 35
C		COLAP 36
20	IF((TEMPER(1,AXIAL,CHAN,NEW) - TEMPER(1,AXIAL,CHAN,OLD)).LE.0.)	COLAP 37
1	GO TO 25	COLAP 38
	HTRIP = H(NEW)*(TRIPF - TEMPER(1,AXIAL,CHAN,OLD))/	COLAP 39
	1(TEMPER(1,AXIAL,CHAN,NEW) - TEMPER(1,AXIAL,CHAN,OLD))	COLAP 40
	IF(HTRIP.LE.DELTOT) GO TO 80	COLAP 41
C	..... CHECK FOR TRIP ON NODE ITRIP (ALLOWS FOR MELTING)	COLAP 42
25	CONTINUE	COLAP 43
	TFICT = TEMPER(ITRIP,AXIAL,CHAN,NEW)	COLAP 44
	IF (TEMPER(ITRIP,AXIAL,CHAN,NEW).GT.TMELTL.AND.TEMPER(ITRIP,AXIAL,	COLAP 45
	1CHAN,OLD).LT.TMELTL) TFICT = TMELTL + FUSE(ITRIP)*(TEMPER(ITRIP,	COLAP 46
	2P,AXIAL,CHAN,NEW)-TMELTL)/SUBBR(ITRIP)	COLAP 47
C		COLAP 48
	IF (TEMPER(ITRIP,AXIAL,CHAN,NEW) - TRIPFO) 35, 80, 30	COLAP 49
30	IF(ICHAN(CHAN).GT.0) GO TO 80	COLAP 50
	HTRIP = H(NEW)*(TRIPFO - TEMPER(ITRIP,AXIAL,CHAN,OLD))/	COLAP 51
	1(TFICT - TEMPER(ITRIP,AXIAL,CHAN,OLD))	COLAP 52
	IF(ABS(H(NEW) - HTRIP).LE.DELTOT) GO TO 80	COLAP 53
	ICATCH = 1	COLAP 54
	GO TO 240	COLAP 55
C		COLAP 56
35	IF ((TEMPER(ITRIP,AXIAL,CHAN,NEW) - TEMPER(ITRIP,AXIAL,CHAN,OLD))	COLAP 57
1	.LE.0.) GO TO 40	COLAP 58
	HTRIP = H(NEW)*(TRIPFO - TEMPER(ITRIP,AXIAL,CHAN,OLD))/	COLAP 59
	1(TFICT - TEMPER(ITRIP,AXIAL,CHAN,OLD))	COLAP 60

IF (HTRIP.LE.DELTOT) GO TO 80	COLAP 61
C ..... CHECK FOR TRIP ON CLADDING TEMPERATURE	COLAP 62
40 CONTINUE	COLAP 63
IF (TEMPER(NUPM1,AXIAL,CHAN,NEW) - TRIPE) 50, 80, 45	COLAP 64
45 IF (ICHAN(CHAN).GT.0) GO TO 80	COLAP 65
HTRIP = H(NEW)*(TRIPE - TEMPER(NUPM1,AXIAL,CHAN,OLD)) /	COLAP 66
1(TEMPER(NUPM1,AXIAL,CHAN,NEW) - TEMPER(NUPM1,AXIAL,CHAN,OLD))	COLAP 67
IF (ABS(H(NEW) - HTRIP).LE.DELTOT) GO TO 80	COLAP 68
ICATCH = 1	COLAP 69
GO TO 240	COLAP 70
C	COLAP 71
50 IF ((TEMPER(NUPM1,AXIAL,CHAN,NEW) - TEMPER(NUPM1,AXIAL,CHAN,OLD))	COLAP 72
1.LE.0.) GO TO 55	COLAP 73
HTRIP = H(NEW)*(TRIPE - TEMPER(NUPM1,AXIAL,CHAN,OLD)) /	COLAP 74
1(TEMPER(NUPM1,AXIAL,CHAN,NEW) - TEMPER(NUPM1,AXIAL,CHAN,OLD))	COLAP 75
IF (HTRIP.LE.DELTOT) GO TO 80	COLAP 76
C ..... CHECK FOR TRIP ON COOLANT TEMPERATURE	COLAP 77
55 CONTINUE	COLAP 78
IF (TEMPER(NUPPER,AXIAL,CHAN,NEW) - TRIPC) 65, 80, 60	COLAP 79
60 IF (ICHAN(CHAN).GT.0) GO TO 80	COLAP 80
HTRIP = H(NEW)*(TRIPC - TEMPER(NUPPER,AXIAL,CHAN,OLD)) /	COLAP 81
1(TEMPER(NUPPER,AXIAL,CHAN,NEW) - TEMPER(NUPPER,AXIAL,CHAN,OLD))	COLAP 82
IF (ABS(H(NEW) - HTRIP).LE.DELTOT) GO TO 80	COLAP 83
ICATCH = 1	COLAP 84
GO TO 240	COLAP 85
C	COLAP 86
65 IF ((TEMPER(NUPPER,AXIAL,CHAN,NEW) - TEMPER(NUPPER,AXIAL,CHAN,OLD))	COLAP 87
1).LE.0.) GO TO 70	COLAP 88
HTRIP = H(NEW)*(TRIPC - TEMPER(NUPPER,AXIAL,CHAN,OLD)) /	COLAP 89
1(TEMPER(NUPPER,AXIAL,CHAN,NEW) - TEMPER(NUPPER,AXIAL,CHAN,OLD))	COLAP 90
IF (HTRIP.LE.DELTOT) GO TO 80	COLAP 91
70 CONTINUE	COLAP 92
GO TO 235	COLAP 93
C	COLAP 94
75 IF (CHI) 120,120,145	COLAP 95
C	COLAP 96
C FIRST PASS CHECK ON USE OF COLLAPSE OR SQUIRTING ROUTINE	COLAP 97
C	COLAP 98
80 IF (CHI.GT.-1.) GO TO 85	COLAP 99
ICHAN(CHAN)=AXIAL	COLAP100
GO TO 90	COLAP101
C	COLAP102
C CHECK TO SEE IF NEW FAILURE POINT IS BELOW INITIAL FAILURE POINT	COLAP103
C	COLAP104
85 IF (ICHAN(CHAN).NE.AXIAL.AND.ICHAN(CHAN).NE.0) GO TO 100	COLAP105
IF (ICHAN(CHAN).NE.0) GO TO 75	COLAP106
ICHAN(CHAN)=AXIAL	COLAP107
90 CONTINUE	COLAP108
IF (GOING) GO TO 95	COLAP109
C	COLAP110
C PRINTOUT OF START OF MOLTEN FUEL MOTION	COLAP111
C	COLAP112
COFF=.FALSE.	COLAP113
ABLE=TOUT-BOUT	COLAP114
BAKER=(1.+AINT((T(NEW)-ABLE)/DELTOT))*DELTOT+ABLE	COLAP115
IF (BAKER.LT.TOUT) TOUT=BAKER	COLAP116
BOUT=DELTOT	COLAP117
ABLE=RH(NEW)*BB0100	COLAP118
BAKER = (KINSRT(NEW)-KINSRT(OLD)+KWITHDR(NEW)-KWITHDR(OLD)+COLAPK(NE	COLAP119
1W)-COLAPK(OLD)+VOIDK(NEW)-VOIDK(OLD))*BB0100/H(NEW)	COLAP120

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      WRITE(NOT,1000) (TITLE(I),I=1,14),FUELT,T(NEW),AN(NEW),ABLE,BAKER,COLAP121
      1 TEMOL,PCMELT COLAP122
1000 FORMAT(1H113A6,A2///50X,25HFUEL COLLAPSE HAS STARTED///1H035X,26HCCOLAP123
      10RE AVERAGE TEMPERATURE =F6.0,15H DEGREES KELVIN/1H027X,34HTIME SICOLAP124
      2NCE BEGINING OF TRANSIENT =IPE9.3,8H SECONDS/1H054X,7HPOWER =E9.3,COLAP125
      310H MEGAWATTS/1H045X,16HNET REACTIVITY =OPF9.3,6H CENTS/1H050X,11HCOLAP126
      4RAMP RATE =-2PF9.3,12H DOLLARS/SEC/1H025X,36HAVERAGE TEMPERATURE COLAP127
      5F MOLTEN FUEL =OPF6.0,15H DEGREES KELVIN/1H037X,24HPERCENT OF CORECOLAP128
      6 MOLTEN =F6.2,8H PERCENT) COLAP129
      WRITE(NOT,1005) AXIAL,CHAN COLAP130
1005 FORMAT(1H031X,42HFUEL COLLAPSE HAS STARTED AT AXIAL SEGMENT I3,11HCOLAP131
      1 OF CHANNEL I3) COLAP132
      LINESL=0 COLAP133
      95 GOING=.TRUE. COLAP134
      GO TO 235 COLAP135
C COLAP136
C MOTION OF FUEL BELOW INITIAL FAILURE POINT COLAP137
C COLAP138
C COLAP139
100 IDOWN=AXIAL COLAP139
      IUP=ICHAN(CHAN)-1 COLAP140
      IF(CHI.GT.C.C) GO TO 125 COLAP141
C COLAP142
C CHI=C., MOTION OF FUEL BELOW INITIAL FAILURE POINT COLAP143
C COLAP144
      DO 115 I=IDOWN,IUP COLAP145
      TSEG(I,CHAN,NEW)=TSEG(I,CHAN,OLD)+H(NEW) COLAP146
      ZH=ZMID(I)-HAFGRV*TSEG(I,CHAN,NEW)**2 COLAP147
      MOVE(I,CHAN)=ZMID(I)-ZH COLAP148
      CALL CURVE(WGT,ZH,ZMID,WF(1,CHAN),MUPPER,$105) COLAP149
      GO TO 115 COLAP150
105 IF(ZH.LE.-ZMID(1)) GO TO 110 COLAP151
      WGT=WF(1,CHAN)*.5*(ZH+ZMID(1))/ZMID(1) COLAP152
      GO TO 115 COLAP153
110 WGT=0. COLAP154
C COLAP155
C CHI=0., REACTIVITY FEEDBACK FROM FUEL SLUMPING BELOW INITIAL COLAP156
C FAILURE POINT COLAP157
C COLAP158
115 SUM=SUM+(WGT-WF(I,CHAN)) COLAP159
C COLAP160
C CHI=C., MOTION OF FUEL ABOVE INITIAL FAILURE POINT COLAP161
C COLAP162
120 IDOWN=ICHAN(CHAN) COLAP163
      TSEG(IDOWN,CHAN,NEW)=TSEG(IDOWN,CHAN,OLD)+H(NEW) COLAP164
      DZH=-HAFGRV*TSEG(IDOWN,CHAN,NEW)**2 COLAP165
      GO TO 150 COLAP166
C COLAP167
C CHI=FINITE, MOTION OF FUEL BELOW INITIAL FAILURE POINT COLAP168
C COLAP169
C COLAP170
125 DO 140 I=IDOWN,IUP COLAP170
      TSEG(I,CHAN,NEW)=TSEG(I,CHAN,OLD)+H(NEW) COLAP171
      ZH=ZMID(I)-GROCHI*TSEG(I,CHAN,NEW)-GROCH2*(EXP(-CHI*TSEG(I,CHAN,NECOLAP172
      1W))-1.) COLAP173
      MOVE(I,CHAN)=ZMID(I)-ZH COLAP174
      CALL CURVE(WGT,ZH,ZMID,WF(1,CHAN),MUPPER,$130) COLAP175
      GO TO 140 COLAP176
130 IF(ZH.LE.-ZMID(1)) GO TO 135 COLAP177
      WGT=WF(1,CHAN)*.5*(ZH+ZMID(1))/ZMID(1) COLAP178
      GO TO 140 COLAP179
135 WGT=0. COLAP180

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C		COLAP181
C	CHI=FINITE, REACTIVITY FEEDBACK FROM FUEL SLUMPING BELOW INITIAL	COLAP182
C	FAILURE POINT	COLAP183
C		COLAP184
C	140 SUM=SUM+(WGT-WF(I,CHAN))	COLAP185
C		COLAP186
C	CHI=FINITE, MOTION OF FUEL ABOVE INITIAL FAILURE POINT	COLAP187
C		COLAP188
C	145 IDOWN=ICHAN(CHAN)	COLAP189
	TSEG(IDOWN,CHAN,NEW)=TSEG(IDOWN,CHAN,OLD)+H(NEW)	COLAP190
	DZH=-GROCHI*TSEG(IDOWN,CHAN,NEW)-GROCH2*(EXP(-CHI*TSEG(IDOWN,CHAN,	COLAP191
	NEW))-1.)	COLAP192
C		COLAP193
C	COMPUTE DOWNWARD MOVEMENT OF COLLAPSED FUEL SEGMENTS ABOVE	COLAP194
C	INITIAL FAILURE POINT	COLAP195
C		COLAP196
C	150 DO 165 I=IDOWN,MUPPER	COLAP197
	ZH=ZMID(I)+DZH	COLAP198
	MOVE(I,CHAN)=ZMID(I)-ZH	COLAP199
	CALL CURVE(WGT,ZH,ZMID,WF(1,CHAN),MUPPER,\$155)	COLAP200
	GO TO 165	COLAP201
	155 IF(ZH.LE.-ZMID(1)) GO TO 160	COLAP202
	WGT=WF(1,CHAN)*.5*(ZH+ZMID(1))/ZMID(1)	COLAP203
	GO TO 165	COLAP204
	160 WGT=0.	COLAP205
C		COLAP206
C	COMPUTE TOTAL REACTIVITY FEEDBACK DUE TO FUEL SLUMPING	COLAP207
C		COLAP208
C	165 SUM=SUM+(WGT-WF(I,CHAN))	COLAP209
C		COLAP210
	TCOLP(NEW)=TCOLP(OLD)+H(NEW)	COLAP211
	COLAPK(NEW)=COLAPK(NEW)+SUM*VCOLP(CHAN)	COLAP212
	GO TO 235	COLAP213
C		COLAP214
C	FUEL SQUIRTING ROUTINE	COLAP215
C		COLAP216
C	170 DMAX=AHIGH-FLOAT(ICHAN(CHAN)-1)*ASEG	COLAP217
	ACCEL(CHAN,NEW)=POVERD/DMAX	COLAP218
	VELOC(CHAN,NEW)=VELOC(CHAN,OLD)+H(NEW)*.5*(ACCEL(CHAN,NEW)+ACCEL(CCOLAP219	
	CHAN,OLD))	COLAP220
	DIST(CHAN,NEW)=DIST(CHAN,OLD)+H(NEW)*.5*(VELOC(CHAN,NEW)+VELOC(CHACOLAP221	
	UN,OLD))	COLAP222
	CALL CURVE(WGT,AHIGH-AMINI(DIST(CHAN,NEW),DMAX),Z,TWFWGT(1,CHAN),	COLAP223
	1PAIRS7,\$175)	COLAP224
	GO TO 180	COLAP225
	175 WRITE(UNIT,1010) DMAX	COLAP226
1010	FORMAT('COLAPS TROUBLES, DISTANCE='1PE10.3)	COLAP227
	RETURN	COLAP228
	180 CALL CURVE(TGW,AHIGH,Z,TWFWGT(1,CHAN),PAIRS7,\$185)	COLAP229
	185 COLAPK(NEW)=COLAPK(NEW)+WGT-TGW	COLAP230
	CDIST=ASEG*FLOAT(ICHAN(CHAN))	COLAP231
	ADD=.5*DIST(CHAN,NEW)*AREAR	COLAP232
	CALL CURVE(WGT,CDIST+ADD,Z,TWFWGT(1,CHAN),PAIRS7,\$190)	COLAP233
	GO TO 195	COLAP234
	190 WGT=TWFWGT(PAIRS7,CHAN)	COLAP235
	195 CALL CURVE(TGW,CDIST+ADD,Z,TWFWGT(1,CHAN),PAIRS7,\$200)	COLAP236
	GO TO 205	COLAP237
	200 TGW=0.0	COLAP238
	205 COLAPK(NEW)=COLAPK(NEW)+(WGT-TGW)/AREAR	COLAP239
	TCOLP(NEW)=TCOLP(OLD)+H(NEW)	COLAP240

IDOWN=ICHAN(CHAN)	CGLAP241
DO 210 I=MUPPER,IDOWN,-1	COLAP242
210 MOVE(I,CHAN)=CIST(CHAN,NEW)	COLAP243
IF(DIST(CHAN,NEW).LE.DMAX) GO TO 235	COLAP244
ADD=.5*AREAR*(DIST(CHAN,NEW)-DMAX)	COLAP245
CALL CURVE(WGT,CDIST+ADD,Z,TWFWGT(1,CHAN),PAIRS7,\$215)	COLAP246
GO TO 220	COLAP247
215 WGT=TWFWGT(PAIRS7,CHAN)	COLAP248
220 CALL CURVE(TGW,CDIST-ADD,Z,TWFWGT(1,CHAN),PAIRS7,\$225)	COLAP249
GO TO 230	COLAP250
225 TGW=0.0	COLAP251
230 COLAPK(NEW)=COLAPK(NEW)-(WGT-TGW)/AREAR	COLAP252
C	COLAP253
235 CONTINUE	COLAP254
C	COLAP255
240 CONTINUE	COLAP256
RETURN	COLAP257
END	COLAP258

Q	ELT VOID,1,720606, 73437		
	SUBROUTINE VOID (IERROR)	VOID	1
C		VOID	2
C	SUBROUTINE VOID COMPUTES A SODIUM VOIDING PATTERN ACCORDING TO A	VOID	3
C	SIMPLE PISTON MODEL AND THEN EVALUATES THE REACTIVITY CONSEQUENCES	VOID	4
C	DUE TO SUCH VOIDING. SUBROUTINES SOCOOL AND CURVE ARE CALLED.	VOID	5
C		VOID	6
	INCLUDE ABC	VOID	7
	DIMENSION FLOW1(10,2)	VOID	8
	EQUIVALENCE(TSEGX, FLOW1)	VOID	9
	VOIDK(NEW)=0.0	VOID	10
	VOFF=.TRUE.	VOID	11
C		VOID	12
C		VOID	13
	10 DO 235 L=1,LUPPER	VOID	14
	SUM=0.0	VOID	15
	IF (IXX(L).EQ.0) GO TO 15	VOID	16
C		VOID	17
C	CHANNEL IS COMPLETELY VOIDED	VOID	18
C		VOID	19
	TVOID(NEW)=TVOID(OLD)+H(NEW)	VOID	20
	VOIDK(NEW)=VOIDK(NEW)+TNAWGT(PAIRS7,L)	VOID	21
	XUP(L,NEW)=XUP(L,OLD)	VOID	22
	XDOWN(L,NEW)=XDOWN(L,OLD)	VOID	23
	IF (XDOWN(L,NEW).GE.Z(PAIRS7)) VOIDK(NEW)=VOIDK(NEW)-TNAWGT(PAIRS7	VOID	24
	1,L)	VOID	25
	GO TO 235	VOID	26
C		VOID	27
	15 CONTINUE	VOID	28
	IF (IVOID-1) 50,110,20	VOID	29
C		VOID	30
C	VOIDING BEGINS AT THE PLACE AND TIME THAT COLLAPSE BEGINS	VOID	31
C		VOID	32
	20 IF (IVOID.EQ.3) GO TO 165	VOID	33
	IF (ICHANX(L)) 25,25,185	VOID	34
	25 IF (ICHAN(L).EQ.0) GO TO 235	VOID	35
	MVOID(L)=ICHAN(L)	VOID	36
	MU=ICHAN(L)	VOID	37
	VOFF=.FALSE.	VOID	38
	ZMAX = ZTOP + AHIGH	VOID	39
	ZMIN = -ZBOTOM	VOID	40
	IF (ZMAX.LT.Z(PAIRS7)) ZMAX=Z(PAIRS7)	VOID	41
	IF (ZMIN.GT.ZBOT) ZMIN=ZBOT	VOID	42
	AFLOW = 3.1416*(R(NUPPER+1)**2-R(NUPPER)**2)	VOID	43
	VISCNA = CXCOE3 + CYCOE3*TEMPER(NUPPER,MU,L,NEW)	VOID	44
	1 + CZCOE3*TEMPER(NUPPER,MU,L,NEW)**2	VOID	45
	FRICT3 = DEG/(AFLOW*VISCNA)	VOID	46
	ARHO = AFLOW*DENSEC	VOID	47
	ASGRHO = AFLOW*ARHO	VOID	48
	IF (IGAS.EQ.1) GO TO 30	VOID	49
	V0 = AFLOW*ASEG	VOID	50
	PVO = PNA*V0	VOID	51
	PVOID(L) = PNA	VOID	52
	GO TO 35	VOID	53
	30 AGAS = 3.1416*R(NUPM1)**2	VOID	54
	V0 = AGAS*ZPLEN	VOID	55
	PVG = PGAS*V0**GAMMA	VOID	56
	PVOID(L) = PGAS	VOID	57
	35 CONTINUE	VOID	58
	CALL CURVE(FLO,T(NEW),TIMFLO, FLOW(1,L),PAIRS5,\$245)	VOID	59
	FLOW1(L,OLD) = FLO	VOID	60

FLOW1(L,NEW) = FLO	VOID	61
FLOW2(L,OLD) = FLO	VOID	62
FLOW2(L,NEW) = FLO	VOID	63
XUP(L,OLD) = MU*ASEG	VOID	64
XUP(L,NEW) = XUP(L,OLD)	VOID	65
XDOWN(L,OLD) = XUP(L,OLD)	VOID	66
XDOWN(L,NEW) = XUP(L,OLD)	VOID	67
IF(GCING.OR.VGCING) GO TO 45	VOID	68
C	VOID	69
C WRITE OUT CORE CONDITIONS AT THE START OF VOIDING	VOID	70
C	VOID	71
40 ABLE=TOUT-BOUT	VOID	72
BAKER=(1.+AINT((T(NEW)-ABLE)/DELTOT))*DELTOT+ABLE	VOID	73
IF(BAKER.LT.TOUT) TOUT=BAKER	VOID	74
BOUT=DELTOT	VOID	75
ABLE=RH(NEW)*BB0100	VOID	76
BAKER = (KINSRT(NEW)-KINSRT(OLD)+KWTHDR(NEW)-KWTHDR(OLD)+COLAPK(NEW)-	VOID	77
1W)-COLAPK(OLD)+VOIDK(NEW)-VOIDK(OLD))*BB0100/H(NEW)	VOID	78
WRITE(UNIT,1000) (TITLE(I),I=1,14),FUELT,T(NEW),AN(NEW),ABLE,BAKER,VOID	VOID	79
1 TEMOL,PCMELT	VOID	80
1000 FORMAT(1H113A6,A2///50X,19HVOIDING HAS STARTED///1H035X, 25HVOID	VOID	81
10RE AVERAGE TEMPERATURE =F6.0,15H DEGREES KELVIN/1H027X,34HTIME SINVOID	VOID	82
2CE BEGINING OF TRANSIENT =1PE9.3,3H SECONDS/1H054X,7HPOWER =E9.3, VOID	VOID	83
310H MEGAWATTS/1H045X,16HNET REACTIVITY =DPF9.3,6H CENTS/1H050X,11HVOID	VOID	84
4RAMP RATE =-2PF9.3,12H DOLLARS/SEC/1H025X,36HAVERAGE TEMPERATURE OVOID	VOID	85
5F MOLTEN FUEL =DPF6.0,15H DEGREES KELVIN/1H037X,24HPERCENT OF COREVOID	VOID	86
6 MOLTEN =F6.2,3H PERCENT	VOID	87
WRITE(UNIT,1005) MVOID(L),L	VOID	88
1005 FORMAT(1H034X,36HVOIDING HAS STARTED AT AXIAL SEGMENT I3,11H OF CHVOID	VOID	89
1ANNEL I3)	VOID	90
LINESL=0	VOID	91
45 VGOING=.TRUE.	VOID	92
ICHANX(L) = 1	VOID	93
GO TO 235	VOID	94
C	VOID	95
C IVOID = 0, CHECK ALL AXIAL NODES FOR POSSIBLE VOIDING	VOID	96
C	VOID	97
50 IF (ICHANX(L)) 55,55,185	VOID	98
55 DO 35 MU=1,MUPPER	VOID	99
C ..... CHECK FOR TRIP ON COOLANT TEMPERATURE	VOID	100
IF(TEMPER(NUPPER,MUX,L,NEW) - TRIPX) 65, 90, 60	VOID	101
60 HTRIP = H(NEW)*(TRIPX - TEMPER(NUPPER,MUX,L,OLD))/	VOID	102
1(TEMPER(NUPPER,MUX,L,NEW) - TEMPER(NUPPER,MUX,L,OLD))	VOID	103
IF(ABS(H(NEW) - HTRIP).LE.DELTOT) GO TO 90	VOID	104
ICATCH = 1	VOID	105
GO TO 240	VOID	106
65 HTRIP = H(NEW)*(TRIPX - TEMPER(NUPPER,MUX,L,OLD))/	VOID	107
1(TEMPER(NUPPER,MUX,L,NEW) - TEMPER(NUPPER,MUX,L,OLD))	VOID	108
IF(HTRIP.LE.DELTOT) GO TO 90	VOID	109
C ..... CHECK FOR TRIP ON CLADDING TEMPERATURE	VOID	110
70 IF(TEMPER(NUPM1,MUX,L,NEW) - TRIPCV) 80, 90, 75	VOID	111
75 HTRIP = H(NEW)*(TRIPCV - TEMPER(NUPM1,MUX,L,OLD))/	VOID	112
1(TEMPER(NUPM1,MUX,L,NEW) - TEMPER(NUPM1,MUX,L,OLD))	VOID	113
IF(ABS(H(NEW) - HTRIP).LE.DELTOT) GO TO 90	VOID	114
ICATCH = 1	VOID	115
GO TO 240	VOID	116
80 HTRIP = H(NEW)*(TRIPCV - TEMPER(NUPM1,MUX,L,OLD))/	VOID	117
1(TEMPER(NUPM1,MUX,L,NEW) - TEMPER(NUPM1,MUX,L,OLD))	VOID	118
IF(HTRIP.LE.DELTOT) GO TO 90	VOID	119
85 CONTINUE	VOID	120

GO TO 235	VOID 121
90 MVOID(L) = MU	VOID 122
VOFF=.FALSE.	VOID 123
ZMAX = ZTOP + AHIGH	VOID 124
ZMIN = -ZBOTOM	VOID 125
IF (ZMAX.LT.Z(PAIRS7)) ZMAX=Z(PAIRS7)	VOID 126
IF (ZMIN.GT.ZBOT) ZMIN=ZBOT	VOID 127
AFLOW = 3.1416*(R(NUPPER+1)**2-R(NUPPER)**2)	VOID 128
VISCNA = CXCOE3 + CYCOE3*TEMPER(NUPPER,MU,L,NEW)	VOID 129
1 + CZCOE3*TEMPER(NUPPER,MU,L,NEW)**2	VOID 130
FRICT3 = DEQ/(AFLOW*VISCNA)	VOID 131
ARHO = AFLOW*DENSEC	VOID 132
ASQRHO = AFLOW*ARHO	VOID 133
IF (IGAS.EQ.1) GO TO 95	VOID 134
TR2 = 1.3*TEMPER(NUPM1,MU,L,NEW)	VOID 135
PVOID(L) = (6.8817602E6/(TR2**.61344))*EXP(-22981.96/TR2)	VOID 136
GO TO 100	VOID 137
95 AGAS = 3.1416*R(NUPM1)**2	VOID 138
VO = AGAS*ZPLEN	VOID 139
PVO = PGAS*VO**GAMMA	VOID 140
PVOID(L) = PGAS	VOID 141
100 CONTINUE	VOID 142
CALL CURVE(FLO,T(NEW),TIMFLO,FLOW(1,L),PAIRS5,5245)	VOID 143
FLOW1(L,OLD) = FLO	VOID 144
FLOW1(L,NEW) = FLO	VOID 145
FLOW2(L,OLD) = FLO	VOID 146
FLOW2(L,NEW) = FLO	VOID 147
XUP(L,OLD) = MU*ASEG	VOID 148
XUP(L,NEW) = XUP(L,OLD)	VOID 149
XDOWN(L,OLD) = XUP(L,OLD)	VOID 150
XDOWN(L,NEW) = XUP(L,OLD)	VOID 151
IF(.NOT.VGOING) GO TO 40	VOID 152
ABLE=TOUT-BOU	VOID 153
BAKER=(1.+AINT((T(NEW)-ABLE)/DELTOT))*DELTOT+ABLE	VOID 154
IF(BAKER.LT.TOUT) TOUT=BAKER	VOID 155
BOUT=DELTOT	VOID 156
ICHANX(L) = 1	VOID 157
105 CONTINUE	VOID 158
GO TO 235	VOID 159
C	VOID 160
C IVOID = 1, AXIAL POSITION OF VOIDING IS PREDETERMINED	VOID 161
C	VOID 162
110 IF (ICHANX(L)) 115,115,185	VOID 163
C ..... CHECK FOR TRIP ON COOLANT TEMPERATURE	VOID 164
115 IF(TEMPER(NUPPER,MUX,L,NEW) - TRIPX) 125, 145, 120	VOID 165
120 HTRIP = H(NEW)*(TRIPX - TEMPER(NUPPER,MUX,L,OLD))/	VOID 166
1(TEMPER(NUPPER,MUX,L,NEW) - TEMPER(NUPPER,MUX,L,OLD))	VOID 167
IF(ABS(H(NEW) - HTRIP).LE.DELTOT) GO TO 145	VOID 168
ICATCH = 1	VOID 169
GO TO 240	VOID 170
125 HTRIP = H(NEW)*(TRIPX - TEMPER(NUPPER,MUX,L,OLD))/	VOID 171
1(TEMPER(NUPPER,MUX,L,NEW) - TEMPER(NUPPER,MUX,L,OLD))	VOID 172
IF(HTRIP.LE.DELTOT) GO TO 145	VOID 173
C ..... CHECK FOR TRIP ON CLADDING TEMPERATURE	VOID 174
130 IF(TEMPER(NUPM1,MUX,L,NEW) - TRIPCV) 140, 145, 135	VOID 175
135 HTRIP = H(NEW)*(TRIPCV - TEMPER(NUPM1,MUX,L,OLD))/	VOID 176
1(TEMPER(NUPM1,MUX,L,NEW) - TEMPER(NUPM1,MUX,L,OLD))	VOID 177
IF(ABS(H(NEW) - HTRIP).LE.DELTOT) GO TO 145	VOID 178
ICATCH = 1	VOID 179
GO TO 240	VOID 180

140	HTRIP = H(NEW)*(TRIPCV - TEMPER(NUPM1,MUX,L,OLD))/	VOID 181
	1*(TEMPER(NUPM1,MUX,L,NEW) - TEMPER(NUPM1,MUX,L,OLD))	VOID 182
	IF(HTRIP.LE.DELTCT) GO TO 145	VOID 183
	GO TO 235	VOID 184
145	MVOID(L)=MUX	VOID 185
	VOFF=.FALSE.	VOID 186
	ZMAX = ZTOP + AHIGH	VOID 187
	ZMIN = -ZBOTOM	VOID 188
	IF (ZMAX.LT.Z(PAIRS7)) ZMAX=Z(PAIRS7)	VOID 189
	IF (ZMIN.GT.ZBOT) ZMIN=ZBOT	VOID 190
	AFLOW = 3.1416*(R(NUPPER+1)**2-R(NUPPER)**2)	VOID 191
	VISCNA = CXCOE3 + CYCOE3*TEMPER(NUPPER,MUX,L,NEW)	VOID 192
1	+ CZCOE3*TEMPER(NUPPER,MUX,L,NEW)**2	VOID 193
	FRICT3 = DEG/(AFLOW*VISCNA)	VOID 194
	ARHO = AFLOW*DENSEC	VOID 195
	ASGRHO = AFLOW*ARHO	VOID 196
	IF (IGAS.EQ.1) GO TO 150	VOID 197
C		VOID 198
C	DETERMINE VAPOR PRESSURE FOR EXPULSION DUE TO BOILING	VOID 199
C		VOID 200
	TR2 = 1.8*TEMPER(NUPM1,MUX,L,NEW)	VOID 201
	PVOID(L) = (6.8817602E6/(TR2**.61344))*EXP(-22981.96/TR2)	VOID 202
	GO TO 155	VOID 203
C		VOID 204
C	DETERMINE INITIAL CONDITION FOR EXPULSION DUE TO GAS RELEASE	VOID 205
C		VOID 206
150	AGAS = 3.1416*R(NUPM1)**2	VOID 207
	VO = AGAS*ZPLEN	VOID 208
	PVO = PGAS*VO**GAMMA	VOID 209
	PVOID(L) = PGAS	VOID 210
155	CONTINUE	VOID 211
	CALL CURVE(FLO,T(NEW),TIMFLO,FLOW(1,L),PAIRS5,\$245)	VOID 212
	FLOW1(L,OLD) = FLO	VOID 213
	FLOW1(L,NEW) = FLO	VOID 214
	FLOW2(L,OLD) = FLO	VOID 215
	FLOW2(L,NEW) = FLO	VOID 216
	XUP(L,OLD) = MUX*ASEG	VOID 217
	XUP(L,NEW) = XUP(L,OLD)	VOID 218
	XDOWN(L,OLD) = XUP(L,OLD)	VOID 219
	XDOWN(L,NEW) = XUP(L,OLD)	VOID 220
	IF(.NOT.VGOING) GO TO 40	VOID 221
	ABLE=TOUT-BOUT	VOID 222
	BAKER=(1.+AINT((T(NEW)-ABLE)/DELTOT))*DELTOT+ABLE	VOID 223
	IF(BAKER.LT.TOUT) TOUT=BAKER	VOID 224
	BOUT=DELTOT	VOID 225
	ICHANX(L)=1	VOID 226
160	CONTINUE	VOID 227
	GO TO 235	VOID 228
C		VOID 229
C	IVOID=3, SODIUM BUBBLE PASSING THROUGH CORE	VOID 230
C		VOID 231
165	IF(ICHANX(L)) 170,170,180	VOID 232
170	IF(T(NEW)-TENTRY(L)) 235,175,175	VOID 233
175	XUP(L,NEW)=Z(1)	VOID 234
	XDOWN(L,NEW)=XUP(L,NEW)-DSEP(L)	VOID 235
	CALL CURVE(FLO,T(NEW),TIMFLO,FLOW(1,L),PAIRS5,\$245)	VOID 236
	VELB(L)=FLO/(VOLUME(NUPPER)*3.14159*DENSEC)	VOID 237
	VOFF=.FALSE.	VOID 238
	IF(.NOT.VGOING) GO TO 40	VOID 239
	ABLE=TOUT-BOUT	VOID 240

BAKER=(1.+AINT((T(NEW)-ABLE)/DELTOT))*DELTOT+ABLE	VOID 241
IF (BAKER.LT.TOUT) TOUT=BAKER	VOID 242
BOUT=DELTOT	VOID 243
ICHANX(L)=1	VOID 244
GO TO 235	VOID 245
C	VOID 246
C EQUATION OF MOTION FOR SODIUM BUBBLE PASSING THROUGH CORE	VOID 247
C	VOID 248
180 TSEGX(L,NEW) = TSEGX(L,OLD) + H(NEW)	VOID 249
XUP(L,NEW)=TSEGX(L,NEW)*VELB(L)+Z(1)	VOID 250
XDOWN(L,NEW)=XUP(L,NEW)-DSEP(L)	VOID 251
GO TO 205	VOID 252
C	VOID 253
C EQUATION OF MOTION FOR SODIUM VOIDING	VOID 254
C	VOID 255
185 CONTINUE	VOID 256
IF (XUP(L,NEW).GE.Z(PAIRS7) .AND. XDOWN(L,NEW).LE.ZBOT)	VOID 257
1 GO TO 200	VOID 258
IF (IFLOW.EQ.0 .AND. IPOWER.EQ.0) GO TO 190	VOID 259
MMM = MVOID(L)	VOID 260
CALL SOCOOL(L)	VOID 261
GO TO 200	VOID 262
C	VOID 263
C EQUATION OF MOTION IS SPECIFIED BY INPUT FITTING PARAMETERS	VOID 264
C	VOID 265
190 XUP(L,NEW)=ZMID(MMM)+A1	VOID 266
TSEGX(L,NEW)=TSEGX(L,OLD)+H(NEW)	VOID 267
IF (TSEGX(L,NEW).GT.TA2.AND.A2.NE.Q.0) XUP(L,NEW)=XUP(L,NEW)+A2*	VOID 268
1(TSEGX(L,NEW)-TA2)	VOID 269
IF (TSEGX(L,NEW).GT.TA3.AND.A3.NE.Q.0) XUP(L,NEW)=XUP(L,NEW)+A3*	VOID 270
1(TSEGX(L,NEW)-TA3)**2	VOID 271
IF (TSEGX(L,NEW).GT.TA4.AND.A4.NE.Q.0) XUP(L,NEW)=XUP(L,NEW)+A4*	VOID 272
1(TSEGX(L,NEW)-TA4)**3	VOID 273
195 XDOWN(L,NEW)=ZMID(MMM)-B1	VOID 274
IF (TSEGX(L,NEW).GT.TB2.AND.B2.NE.Q.0) XDOWN(L,NEW)=XDOWN(L,NEW)-B2	VOID 275
1*(TSEGX(L,NEW)-TB2)	VOID 276
IF (TSEGX(L,NEW).GT.TB3.AND.B3.NE.Q.0) XDOWN(L,NEW)=XDOWN(L,NEW)-B3	VOID 277
1*(TSEGX(L,NEW)-TB3)**2	VOID 278
IF (TSEGX(L,NEW).GT.TB4.AND.B4.NE.Q.0) XDOWN(L,NEW)=XDOWN(L,NEW)-B4	VOID 279
1*(TSEGX(L,NEW)-TB4)**3	VOID 280
C	VOID 281
C CALCULATION OF REACTIVITY FEEDBACK DUE TO SODIUM VOIDING	VOID 282
C	VOID 283
200 MSTART = MVOID(L)	VOID 284
205 CONTINUE	VOID 285
C	VOID 286
C RUNNING ACCOUNT OF TIME FROM BEGINNING OF SODIUM VOIDING	VOID 287
C	VOID 288
TVOID(NEW)=TVOID(OLD)+H(NEW)	VOID 289
CALL CURVE(WGT,XUP(L,NEW),Z,TNAWGT(1,L),PAIRS7,\$210)	VOID 290
GO TO 215	VOID 291
210 WGT=TNAWGT(PAIRS7,L)	VOID 292
IXUP(L)=1	VOID 293
IXX(L)=IXUP(L)*IXDOWN(L)	VOID 294
215 SUM = WGT*DENVOD	VOID 295
CALL CURVE(WGT,XDOWN(L,NEW),Z,TNAWGT(1,L),PAIRS7,\$220)	VOID 296
GO TO 230	VOID 297
220 IXDOWN(L)=1	VOID 298
WGT=0.0	VOID 299
IF (XDOWN(L,NEW).GE.Z(PAIRS7)) WGT=TNAWGT(PAIRS7,L)	VOID 300

IF(IVOID.NE.3) GO TO 225	VOID 301
IXDOWN(L)=0	VOID 302
IF(XDOWN(L,NEW).GE.Z(PAIRS7)) IXDOWN(L)=1	VOID 303
225 IXX(L)=IXUP(L)*IXDOWN(L)	VOID 304
230 SUM = SUM - WGT*DENVOD	VOID 305
VOFF=.FALSE.	VOID 306
235 VOIDK(NEW)=VOIDK(NEW)+SUM	VOID 307
240 CONTINUE	VOID 308
C	VOID 309
C	VOID 310
RETURN	VOID 311
C	VOID 312
245 WRITE(1010) T(NEW),TIMEFLO(PAIRS5)	VOID 313
1C10 FORMAT(14H1CURRENT TIME 1PE9.3,22H EXCEEDS MAXIMUM TIME E9.3,21H	VOID 314
1N FLOW-TIME LIBRARY)	VOID 315
250 RETURN 1	VOID 316
END	VOID 317


```

3 ELT SOC00L.1.720606. 73440
  SUBROUTINE SOC00L(L)
C
C SOC00L COMPUTES THE RATE OF SODIUM EXPULSION FROM THE CORE ASSUMING
C PLUG-TYPE GEOMETRY AND DETERMINES THE LOCATION OF THE UPPER AND LOWER
C VOIDING INTERFACES
C
C FOR LOSS-OF-FLOW ACCIDENTS          IFLOW = 1          IPOWER = 0
C   VOIDING IS ASSUMED TO BE FROM SODIUM BOILING
C   VOIDING IS ASSUMED TO BE FROM EXPANSION OF FISSION GAS
C
C FOR POWER TRANSIENT ACCIDENTS      IPOWER = 1          IFLOW = 0
C   VOIDING IS ASSUMED TO BE FROM FUEL-SODIUM INTERACTION
C   VOIDING IS ASSUMED TO BE FROM EXPANSION OF FISSION GAS
C
C INCLUDE ABC
C DIMENSION FLOW1(10,2)
C EQUIVALENCE (TSEGX, FLOW1)
C INTEGER RUNGE
C DIMENSION Y(4), F(4)
C
C ..... INITIALIZE PARAMETERS .....
C IPSAT = 0
C X = TVOID(OLD)
C DX = H(NEW)
C Y(1) = FLOW1(L,OLD)
C Y(2) = FLOW2(L,OLD)
C Y(3) = XUP(L,OLD)
C Y(4) = XDOWN(L,OLD)
C
C ..... CALL ON FOURTH-ORDER RUNGE-KUTTA FUNCTION .....
10 K = RUNGE( 4, Y, F, X, DX )
C IF (Y(3).GE.ZMAX) Y(3)=ZMAX + .01
C IF (Y(4).LE.ZMIN) Y(4)=ZMIN - .01
C
C ..... WHENEVER K=1, COMPUTE DERIVATIVE VALUES
C IF ( K.NE.1 ) GO TO 50
C
C PRESSURE FOR VOIDING
C IF ( IGAS.EQ.1 ) GO TO 20
C IF ( IPOWER.EQ.1 ) GO TO 15
C
C SODIUM BOILING
C IF ( IPSAT.EQ.1 ) GO TO 25
C TR2 = 1.9*TEMPER(NUPM1,MMM,L,NEW)
C PSAT2 = (6.8817602E6/(TR2**.61344))*EXP (-22981.96/TR2)
C PVOID(L) = PSAT2
C IPSAT = 1
C GO TO 25
C
C FUEL-SODIUM INTERACTION
15 V2 = VD + AFLOW*( Y(3)-Y(4) )
C PVOID(L) = PVC/V2
C GO TO 25
C
C EXPANSION OF FISSION GAS
20 V2 = VD + AFLOW*( Y(3)-Y(4) )
C PVOID(L) = PVC/(V2**GAMMA)
C
C FLOW DERIVATIVE -- UPWARD VOIDING

```

25 IF (Y(3).LT.ZMAX) GO TO 30	SOC00 61
F(1) = 0.	SOC00 62
F(3) = 0.	SOC00 63
GO TO 35	SOC00 64
30 DZA1 = (ZMAX-Y(3))/AFLOW + DZATOP	SOC00 65
Y1ABS = ABS(Y(1))	SOC00 66
FRICT = FRICT1/(FRICT3*Y1ABS)**FRICT2	SOC00 67
F(1) = ((PVOID(L)-PEXIT)*1013278. - (DPTOP1+FRICT*(ZMAX-Y(3)+	SOC00 68
1 DPTOP2)/DEG)*0.5*Y(1)*Y1ABS/ASQRHO)/DZA1	SOC00 69
C	SOC00 70
C INTERFACE DERIVATIVE -- UPWARD VOIDING	SOC00 71
F(3) = Y(1)/ARHO	SOC00 72
C	SOC00 73
C FLOW DERIVATIVE -- DOWNWARD VOIDING	SOC00 74
35 IF (Y(4).GT.ZMIN) GO TO 40	SOC00 75
F(2) = 0.	SOC00 76
F(4) = 0.	SOC00 77
GO TO 45	SOC00 78
40 DZA2 = (Y(4)-ZMIN)/AFLOW + DZAPOT	SOC00 79
Y2ABS = ABS(Y(2))	SOC00 80
FRICT = FRICT1/(FRICT3*Y2ABS)**FRICT2	SOC00 81
F(2) = ((PINLET-PVOID(L))*1013278. - (DPBOT1+FRICT*(Y(4)-ZMIN+	SOC00 82
1 DPBOT2)/DEG)*0.5*Y(2)*Y2ABS/ASQRHO)/DZA2	SOC00 83
C	SOC00 84
C INTERFACE DERIVATIVE -- DOWNWARD VOIDING	SOC00 85
F(4) = Y(2)/ARHO	SOC00 86
C	SOC00 87
45 GO TO 10	SOC00 88
C	SOC00 89
50 CONTINUE	SOC00 90
FLOW1(L,NEW) = Y(1)	SOC00 91
FLOW2(L,NEW) = Y(2)	SOC00 92
XUP(L,NEW) = Y(3)	SOC00 93
XDOWN(L,NEW) = Y(4)	SOC00 94
C	SOC00 95
RETURN	SOC00 96
C	SOC00 97
END	SOC00 98

```

@ ELT RUNGE,1,701110, 63224
  FUNCTION RUNGE( N, Y, F, X, H )
C
C   THE FUNCTION RUNGE EMPLOYS THE FOURTH-ORDER RUNGE-KUTTA METHOD
C   WITH RUNGE'S COEFFICIENTS TO INTEGRATE A SYSTEM OF N SIMULTANEOUS
C   FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS  $F(J)=DY(J)/DX$ ,
C   ( $J=1,2,\dots,N$ ), ACROSS ONE STEP OF LENGTH H IN THE INDEPENDENT
C   VARIABLE X, SUBJECT TO INITIAL CONDITIONS  $Y(J)$ , ( $J=1,2,\dots,N$ ).
C   EACH  $F(J)$ , THE DERIVATIVE OF  $Y(J)$ , MUST BE COMPUTED FOUR TIMES
C   PER INTEGRATION STEP BY THE CALLING PROGRAM. THE FUNCTION MUST
C   BE CALLED FIVE TIMES PER STEP (PASS(1)...PASS(5)) SO THAT THE
C   INDEPENDENT VARIABLE VALUE (X) AND THE SOLUTION VALUES
C   ( $Y(1)\dots Y(N)$ ) CAN BE UPDATED USING THE RUNGE-KUTTA ALGORITHM.
C   M IS THE PASS COUNTER. RUNGE RETURNS AS ITS VALUE 1.0 TO
C   SIGNAL THAT ALL DERIVATIVES (THE  $F(J)$ ) BE EVALUATED OR 0.0 TO
C   SIGNAL THAT THE INTEGRATION PROCESS FOR THE CURRENT STEP IS
C   FINISHED. SAVEY(J) IS USED TO SAVE THE INITIAL VALUE OF  $Y(J)$ 
C   AND PHI(J) IS THE INCREMENT FUNCTION FOR THE J(TH) EQUATION.
C   AS WRITTEN, N MAY BE NO LARGER THAN 5
C
  INTEGER RUNGE
  DIMENSION PHI(5), SAVEY(5), Y(N), F(N)
C
  M = M + 1
  GO TO (10,15,25,35,45), M
C
  ..... PASS 1 .....
10 RUNGE = 1
  RETURN
C
  ..... PASS 2 .....
15 DO 20 J = 1, N
    SAVEY(J) = Y(J)
    PHI(J) = F(J)
20 Y(J) = SAVEY(J) + 0.5*H*F(J)
  X = X + 0.5*H
  RUNGE = 1
  RETURN
C
  ..... PASS 3 .....
25 DO 30 J = 1, N
    PHI(J) = PHI(J) + 2.0*F(J)
30 Y(J) = SAVEY(J) + 0.5*H*F(J)
  RUNGE = 1
  RETURN
C
  ..... PASS 4 .....
35 DO 40 J = 1, N
    PHI(J) = PHI(J) + 2.0*F(J)
40 Y(J) = SAVEY(J) + H*F(J)
  X = X + 0.5*H
  RUNGE = 1
  RETURN
C
  ..... PASS 5 .....
45 DO 50 J = 1, N
50 Y(J) = SAVEY(J) + (PHI(J) + F(J))*H/6.0
  M = 0
  RUNGE = 0
  RETURN
C

```

END

RUNGE 61

@	ELT	NEXT0,1,720606, 73456	NEXT0	1
		SUBROUTINE NEXT0 (IBACK,IERROR)	NEXT0	2
C			NEXT0	3
C		SUBROUTINE NEXT0 (ZERO LIFETIME) UPDATES NEW AND OLD INDICES	NEXT0	4
C		AND COMPUTES INSTANTANEOUS MODIFIED PRECURSOR DENSITY PERIODS.	NEXT0	5
C		SUBROUTINES CALLED ARE TIMNEW AND TIME.	NEXT0	6
C			NEXT0	7
		INCLUDE A9C	NEXT0	8
		SUM=0.0	NEXT0	9
		SUM1 = 0.	NEXT0	10
		DO 10 I=1,M	NEXT0	11
		SUM1 = SUM1 + AL(I)*C(I,NEW)/ALIFE	NEXT0	12
10		GAM(I)=B(I)*AN(NEW)/C(I,NEW)-AL(I)	NEXT0	13
		W = (RHO-BB)/ALIFE + SUM1/AN(NEW)	NEXT0	14
		DO 15 I=1,M	NEXT0	15
15		ALPH(I) = W - GAM(I)	NEXT0	16
C			NEXT0	17
		IF(H(NEW)) 20,20,25	NEXT0	18
20		H(NEW) = HMAX	NEXT0	19
		GO TO 45	NEXT0	20
C			NEXT0	21
C		CHECK FOR SCRAM CONDITIONS	NEXT0	22
C			NEXT0	23
25		IF(SCRAM) GO TO 45	NEXT0	24
		IF(AN(NEW).LT.ANSCRM) GO TO 35	NEXT0	25
30		SCRAM=.TRUE.	NEXT0	26
		TSCRAM(NEW)=-TDELAY	NEXT0	27
		GO TO 45	NEXT0	28
35		DO 40 CHAN=1,LUPPER	NEXT0	29
		IF(TEMPER(NUPPER,MUPPER,CHAN,NEW).GT.TEMSRM) GO TO 30	NEXT0	30
40		CONTINUE	NEXT0	31
		IF((ALOG(AN(NEW)/AN(OLD))/H(NEW)).GE.PERIOD) GO TO 30	NEXT0	32
C			NEXT0	33
C		UPDATE NEW AND OLD INDICES (CYCLE EACH TIME STEP)	NEXT0	34
C			NEXT0	35
45		GO TO (50,55),OLD	NEXT0	36
50		OLD=2	NEXT0	37
		NEW=1	NEXT0	38
		GO TO 60	NEXT0	39
55		OLD=1	NEXT0	40
		NEW=2	NEXT0	41
60		CALL TIMNEW(\$70)	NEXT0	42
		CALL TIME(MAXTIM,\$65)	NEXT0	43
		RETURN1	NEXT0	44
65		TQUIT=T(OLD)	NEXT0	45
		RETURN1	NEXT0	46
70		RETURN2	NEXT0	47
		END		

2	ELT TIMNEW,1.720606, 73449	
	SUBROUTINE TIMNEW (IEPROP)	TIMNE 1
C		TIMNE 2
C	SUBROUTINE TIMNEW (ZERO LIFETIME) ESTABLISHES NEW TIME STEP.	TIMNE 3
C	SUBROUTINE CURVE IS CALLED.	TIMNE 4
C		TIMNE 5
	INCLUDE ABC	TIMNE 6
	DIMENSION CC(6),CNI(6)	TIMNE 7
	JINGO = 1	TIMNE 8
	IF(ICATCH.EQ.0) GO TO 10	TIMNE 9
	HH=HTRIP	TIMNE 10
	GO TO 15	TIMNE 11
10	HH=H(OLD)	TIMNE 12
15	DKD=0.0	TIMNE 13
	ABLE = TOUT - T(OLD)	TIMNE 14
	IF(HH.GT.ABLE) HH=ABLE	TIMNE 15
20	TT = T(OLD) + HH	TIMNE 16
C		TIMNE 17
C	COMPUTE MODIFIED PRECURSOR DENSITY INCREASE BASED ON PURE	TIMNE 18
C	EXPONENTIAL.	TIMNE 19
C		TIMNE 20
	DO 25 I=1,M	TIMNE 21
25	CNI(I) = C(I,OLD)*EXP(GAM(I)*HH)	TIMNE 22
C		TIMNE 23
	CALL CURVE(DKU,TT,TIMEIN,DKIN,PAIRS2,\$85)	TIMNE 24
	IF(.NOT.SCRAM) GO TO 30	TIMNE 25
	TTT = TSCRAM(OLD) + HH	TIMNE 26
	IF(TTT.LT.0.0) GO TO 30	TIMNE 27
	CALL CURVE(DKD,TTT,TIMEOUT,DKOUT,PAIRS3,\$95)	TIMNE 28
C		TIMNE 29
C	CALCULATE EXPECTED NET REACTIVITY DURING NEW TIME STEP	TIMNE 30
C	(USE LINEAR EXTRAPOLATION)	TIMNE 31
C		TIMNE 32
30	RHO = DOPPK(OLD) + VQIDK(OLD) + COLAPK(OLD) + DKU - DKD + FLINEX(OLD)	TIMNE 33
	ILD) + CLINEX(OLD) + ELINEX(OLD) + RSLOPE*HH	TIMNE 34
	H(NEW) = HH	TIMNE 35
C		TIMNE 36
	IF(RHO.GE.BB) GO TO 100	TIMNE 37
C		TIMNE 38
35	SUM=0.0	TIMNE 39
	DO 40 I=1,M	TIMNE 40
	EXPO(I)=EXP(GAM(I)*H(NEW))	TIMNE 41
40	SUM=SUM+AL(I)*C(I,OLD)*EXPO(I)	TIMNE 42
	SUM=SUM/(BB-RHO)	TIMNE 43
	SUM1=0.0	TIMNE 44
C		TIMNE 45
C	COMPUTE MODIFIED PRECURSOR DENSITY INCREASE BASED ON ALGORITHM	TIMNE 46
C	USING EXTRAPOLATED REACTIVITY.	TIMNE 47
C		TIMNE 48
	DO 45 I=1,M	TIMNE 49
	CC(I) = C(I,OLD)*EXPO(I) + H(NEW)*B(I)*.5*(SUM-EXPO(I)*AN(OLD))	TIMNE 50
	IF(ABS((CNI(I)-CC(I))/CNI(I)).GT.ERROR) GO TO 50	TIMNE 51
45	SUM1 = SUM1 + CC(I)*AL(I)	TIMNE 52
	ANN = SUM1 / (BB-RHO)	TIMNE 53
	GO TO 60	TIMNE 54
50	GO TO (55, 80),JINGO	TIMNE 55
55	HH = HH*REDUCE	TIMNE 56
	GO TO 20	TIMNE 57
C		TIMNE 58
C	STORE PARAMETERS IN CASE NEXT PASS THROUGH INNER LOOP VIOLATES	TIMNE 59
C	ERROR CRITERION	TIMNE 60

C	60 RH(NEW) = RHO	TIMNE 61
	HSTO = HH	TIMNE 62
	AN(NEW) = ANN	TIMNE 63
	KINSRT(NEW) = DKU	TIMNE 64
	KWTHDR(NEW) = DKD	TIMNE 65
	TSCRAM(NEW) = TTT	TIMNE 66
	T(NEW) = TT	TIMNE 67
C		TIMNE 68
	DO 65 I=1,M	TIMNE 69
	65 C(I,NEW) = CC(I)	TIMNE 70
C		TIMNE 71
	IF(ICATCH.EQ.1) GO TO 80	TIMNE 72
C		TIMNE 73
	IF(H(NEW)-ABLE) 70, 80, 70	TIMNE 74
	70 IF(H(NEW)-HMAX) 75, 80, 75	TIMNE 75
	75 JINGO = 2	TIMNE 76
	HH = AMIN1(HMAX,ABLE,HH/PEDUCE)	TIMNE 77
	GO TO 20	TIMNE 78
	80 H(NEW) = HSTO	TIMNE 79
	RETURN	TIMNE 80
C		TIMNE 81
	85 WRITE(NOT,1000) T(NEW),TIMEIN(PAIRS2)	TIMNE 82
	1000 FORMAT(14H1CURRENT TIME 1PE9.4,22H EXCEEDS MAXIMUM TIME E9.4,25H	TIMNE 83
	IN TIME-K INSERT LIBRARY)	TIMNE 84
	90 RETURN 1	TIMNE 85
	95 WRITE(NOT,1005) TSCRAM(NEW),TIMEOUT(PAIRS3)	TIMNE 86
	1005 FORMAT(14H1CURRENT TIME 1PE9.4,22H EXCEEDS MAXIMUM TIME E9.4,27H	TIMNE 87
	IN TIME-K WITHDRAW LIBRARY)	TIMNE 88
	GO TO 90	TIMNE 89
	100 WRITE(NOT,1010)	TIMNE 90
	1010 FORMAT(69H000 NOT USE ZERO LIFE METHOD ON A CASE THAT CAN REACH PR	TIMNE 91
	10MPT CRITICAL)	TIMNE 92
	WRITE(NOT,1015) RHO,BB,DOPPK(OLD),VOIDK(OLD),COLAPK(OLD),DKU,DKD,	TIMNE 93
	1 RSLOPE,HH	TIMNE 94
	1015 FORMAT (' RHO='1PE9.3,'BB='E9.3,'DOPPK='E9.3,'VOIDK='E9.3,	TIMNE 95
	1 'COLAPK='E9.3,'DKU='E9.3,'DKD='E9.3,'RSLOPE='E9.3,'HH='E9.3)	TIMNE 96
	GO TO 35	TIMNE 97
	END	TIMNE 98
		TIMNE 99

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3 ELT CHECKO,1,720606, 73462
SUBROUTINE CHECKO (IBACK,ION,IERROR,ITHRU,IVEN,OLDOLD) CHECK 1
C CHECK 2
C SUBROUTINE CHECKO (ZERO LIFETIME) EVALUATES ACCEPTABILITY OF CHECK 3
C COMPLETED TIME STEP, CONTAINS PROBLEM TERMINATION CONTROLS, AND CHECK 4
C ESTABLISHES SMALL, BIG, AND VENUS OUTPUTS. CHECK 5
C SUBROUTINES CALLED ARE TIMNEW, OUTSML, OUTBIG, AND CURVE. CHECK 6
C SYSTEM SUBROUTINE NTRAN IS CALLED. CHECK 7
C CHECK 8
C INCLUDE ABC CHECK 9
C DIMENSION KT(15) CHECK 10
C DIMENSION INDV(11,19) CHECK 11
C DIMENSION VTEM(20,10) CHECK 12
C EQUIVALENCE (TEMP,KT) CHECK 13
C DIMENSION CC(6) CHECK 14
C DOUBLE PRECISION GSGG1,GSGG2,GSGG3 CHECK 15
C NPT = -3 CHECK 16
C CHECK 17
C CALCULATE ACTUAL REACTIVITY OCCURING DURING TIME STEP CHECK 18
C CHECK 19
C RSLOPE=(DOPPK(NEW)-DOPPK(OLD)+VOIDK(NEW)-VCIK(OLD)+COLAPK(NEW)-COCHECK 20
1LAPK(OLD)+FLINEK(NEW)-FLINEK(OLD)+ELINEK(NEW)-ELINEK(OLD)+CLINEK(NCHECK 21
2EW)-CLINEK(OLD))/H(NEW) CHECK 22
C RHO=DOPPK(NEW)+VOIDK(NEW)+COLAPK(NEW)+FLINEK(NEW)+CLINEK(NEW)+ELINCHECK 23
1EK(NEW)-KWITHDR(NEW)+KINSRT(NEW) CHECK 24
C RH(NEW)=RHO CHECK 25
C SUM = 0.0 CHECK 26
C CHECK 27
C CALCULATE MODIFIED PRECURSOR DENSITY INCREASE USING ACTUAL NET CHECK 28
C REACTIVITY DURING TIME STEP CHECK 29
C CHECK 30
C DO 10 I=1,M CHECK 31
C EXPO(I) = EXP(GAM(I)*H(NEW)) CHECK 32
10 SUM = SUM + AL(I)*C(I,OLD)*EXPO(I) CHECK 33
C SUM = SUM/(BB-RHO) CHECK 34
C SUM1 = 0.0 CHECK 35
C DO 15 I=1,M CHECK 36
C CC(I) = C(I,OLD)*EXPO(I) + H(NEW)*B(I)*.5*(SUM-EXPO(I)*AN(OLD)) CHECK 37
C IF (ABS((C(I,NEW)-CC(I))/C(I,NEW)).GT.ERROR1.OR.ICATCH.EQ.1) CHECK 38
1 GO TO 225 CHECK 39
15 CONTINUE CHECK 40
C CHECK 41
20 CONTINUE CHECK 42
C STEP=STEP+1 CHECK 43
C IF(FUELT.LT.TDISAS) GO TO 155 CHECK 44
C CHECK 45
C DISASSEMBLY CONDITIONS ARE ESTABLISHED. WRITE OUT CORE CONDITIONSCHECK 46
C CHECK 47
C BAKER=(VOIDK(NEW)-VOIDK(OLD))*BB0100/H(NEW) CHECK 48
C CHARLY=(COLAPK(NEW)-COLAPK(OLD))*BB0100/H(NEW) CHECK 49
C ABLE = BAKER+CHARLY+(KINSRT(NEW)-KINSRT(OLD))*BE0100/H(NEW)+(KWITHDCHECK 50
1R(NEW)-KWITHDR(OLD))*BB0100/H(NEW) CHECK 51
C DOG=RH(NEW)*BB0100 CHECK 52
C EASY=VOIDK(NEW)*BB0100 CHECK 53
C FOX=COLAPK(NEW)*BB0100 CHECK 54
C WRITE (NOT,1000) (TITLE(I),I=1,14),FUELT,T(NEW),AN(NEW),DOG,FOX,EASCHECK 55
1Y,CHARLY,BAKER,ABLE,TEMOL,PCMELT,GMSMOL CHECK 56
1000 FORMAT(1H113A6,A2///40X,43HTHE CORE IS NEARING A DISASSEMBLY CONDICHECK 57
1TION///1H035X,26HCORE AVERAGE TEMPERATURE =F7.0,16H DEGREES KELVICHECK 58
2N/1H026X,35HTIME AFTER BEGINNING OF TRANSIENT =1PE9.3,9H SECONDS/CHECK 59
31H054X,7HPCWER =E9.3,11H MEGAWATTS/1HL45X,16HNET REACTIVITY =OPF8CHECK 60

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4.3,7H CENTS/1H042X,19HCOLLAPSE FEEDBACK =F8.3,7H CENTS/1H046X,15CHECK 61
5HVOID FEEDBACK =F8.3,7H CENTS/1H041X,20HCOLLAPSE RAMP RATE =-2PF8CHECK 62
6.3,13H DOLLARS/SEC/1H045X,16HVOID RAMP RATE =F8.3,13H DOLLARS/SECHECK 63
XC CHECK 64
7/1H044X,17HTOTAL RAMP RATE =F8.3,13H DOLLARS/SEC/1H025X,36HAVERAGCHECK 65
8E TEMPERATURE OF MOLTEN FUEL =DPF7.C,16H DEGREES KELVIN/1H020X,41CHECK 66
9HPORTION OF THE FUEL IN THE MOLTEN STATE =F7.3,10H PER CENT/1H035CHECK 67
AX,26HKILOGRAMS OF MOLTEN FUEL =1PE9.3) CHECK 68
C IF (VENUS.EQ.0) GO TO 150 CHECK 69
C CHECK 70
C VENUS INPUT DATA IS REQUESTED CHECK 71
C CHECK 72
C TEMP(1)=1.E+6*(QGEN(NEW)-QOUT(NEW)) CHECK 73
TEMP(2)=T(OLD)-H(OLD) CHECK 74
GGGG1 =(OLDOLD-DOPPK(NEW)-(OLDOLD-DOPPK(OLD))*(TEMP(2)-T(NEW))/(T(NEW)-T(OLD)) CHECK 75
1EMP(2)-T(OLD)))/(TEMP(2)-T(NEW))/(T(NEW)-T(OLD)) CHECK 76
GGGG2 =(OLDOLD-DOPPK(OLD))/(TEMP(2)-T(OLD))-GGGG1 *(TEMP(2)+T(OLD)) CHECK 77
2D)) CHECK 78
GGGG3 =OLDOLD-(GGGG2 +GGGG1 *TEMP(2))*TEMP(2) CHECK 79
WRITE (NOT,1005) T(NEW),T(OLD),TEMP(1),DOPPK(OLD),DOPPK(NEW) CHECK 80
1005 FORMAT('1VENUS INPUT',(1P5E12.5/)) CHECK 81
WRITE (NOT,1010) GGGG1,GGGG2,GGGG3 CHECK 82
1010 FORMAT(1P3D20.9) CHECK 83
WRITE (NPT,1015) FUELT CHECK 84
WRITE (NPT,1015) T(NEW),T(OLD),TEMP(1),DOPPK(OLD),DOPPK(NEW) CHECK 85
WRITE (NPT,1020) GGGG1,GGGG2,GGGG3 CHECK 86
25 IF (IVEN.NE.1) GO TO 35 CHECK 87
DO 30 I=1,M CHECK 88
30 TEMP(I)=C(I,NEW)*1.E+6/ALIFE CHECK 89
GO TO 45 CHECK 90
35 DO 40 I=1,M CHECK 91
40 TEMP(I)=C(I,NEW)*1.E+6 CHECK 92
45 WRITE (NOT,1015) (TEMP(I),I=1,M) CHECK 93
WRITE (NPT,1015) (TEMP(I),I=1,M) CHECK 94
1015 FORMAT(1P6E12.5) CHECK 95
1020 FORMAT(1P3D20.9) CHECK 96
C CHECK 97
C 50 IF (VENUS.EQ.2) GO TO 55 CHECK 98
C CHECK 99
C PRINT AND PUNCH REACTIVITY INFORMATION FOR OLD VENUS VERSION CHECK100
C CHECK101
TEMP(1)=RH(OLD)/(1.+RH(OLD)) CHECK102
TEMP(2)=RH(NEW)/(1.+RH(NEW)) CHECK103
WRITE (NOT,1015) H(NEW),TEMP(1),TEMP(2) CHECK104
WRITE (NPT,1015) H(NEW),TEMP(1),TEMP(2) CHECK105
GO TO 60 CHECK106
C CHECK107
C PRINT AND PUNCH REACTIVITY INFORMATION FOR NEW VENUS VERSION CHECK108
C CHECK109
55 WRITE (NOT,1015) (GAM(I),I=1,M) CHECK110
WRITE (NPT,1015) (GAM(I),I=1,M) CHECK111
WRITE (NOT,1015) W,RH(NEW) CHECK112
WRITE (NPT,1015) W,RH(NEW) CHECK113
C CHECK114
C ENERGY WEIGHT PIN TEMPERATURES FOR VENUS INPUT CHECK115
C CHECK116
C CHECK117
EO CONTINUE CHECK118
PIASEG=3.14159*ASEG CHECK119
DO 95 CHAN=1,LUPPER CHECK120

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DO 90 AXIAL=1,MUPPER	CHECK121
ENERV=0.	CHECK122
DO 75 FRAD=1,NUPM3	CHECK123
IF (TEMPER(FRAD,AXIAL,CHAN,NEW).LE.TMELTL) GO TO 65	CHECK124
IF (TEMPER(FRAD,AXIAL,CHAN,NEW).GE.TMELTH) GO TO 70	CHECK125
C FUEL IS MELTING	CHECK126
C	CHECK127
C	CHECK128
ENERV = ENERV + CPML(FRAD) - CP300(FRAD) + (TEMPER(FRAD,AXIAL,CHAN,NEW) - TMELTL)* FUSE(FRAD)*PIASEG	CHECK129
GO TO 75	CHECK130
C	CHECK131
C FUEL IS BELOW MELTING	CHECK132
C	CHECK133
C	CHECK134
65 ENERV = ENERV + DENSE*VOLUME(FRAD)*PIASEG*	CHECK135
1(TEMPER(FRAD,AXIAL,CHAN,NEW)*(XCOE1 +	CHECK136
2 TEMPER(FRAD,AXIAL,CHAN,NEW)*(YCOE1/2. +	CHECK137
3 TEMPER(FRAD,AXIAL,CHAN,NEW)*ZCOE1/3.))) - CP300(FRAD)	CHECK138
GO TO 75	CHECK139
C	CHECK140
C FUEL IS ABOVE MELTING	CHECK141
C	CHECK142
70 ENERV = ENERV + CPML(FRAD) - CP300(FRAD) + FUSE(FRAD)*10.*PIASEG +	CHECK143
1DENSE*VOLUME(FRAD)*PIASEG*	CHECK144
1(TEMPER(FRAD,AXIAL,CHAN,NEW)*(XCOE2 +	CHECK145
2 TEMPER(FRAD,AXIAL,CHAN,NEW)*(YCOE2/2. +	CHECK146
3 TEMPER(FRAD,AXIAL,CHAN,NEW)*ZCOE2/3.))) - CPMH(FRAD)	CHECK147
C	CHECK148
75 CONTINUE	CHECK149
IF (ENERV.LE.ENERST) GO TO 80	CHECK150
IF (ENERV.GE.ENERMO) GO TO 85	CHECK151
VTEM(AXIAL,CHAN) = TMELTL + (ENERV - ENERST)/(HFUSE*DENSE*	CHECK152
1VPINFL*PIASEG*0.1)	CHECK153
GO TO 90	CHECK154
80 VTEM(AXIAL,CHAN) = PITEM(AXIAL,CHAN)	CHECK155
GO TO 90	CHECK156
85 VTEM(AXIAL,CHAN) = TMELTH + (ENERV - ENERMO)/(DENSE*VPINFL*XCOE2*	CHECK157
1PIASEG)	CHECK158
90 CONTINUE	CHECK159
95 CONTINUE	CHECK160
C	CHECK161
C WRITE ENERGY WEIGHTED TEMPERATURES	CHECK162
C	CHECK163
DO 100 I=MUPPER,1,-1	CHECK164
WRITE(NOT,1025) (VTEM(I,J), J=1,LUPPER)	CHECK165
1025 FORMAT(1X,15F8.1)	CHECK166
C	CHECK167
C WRITE AND PUNCH ENERGY WEIGHTED TEMPERATURES IN VENUS FORMAT	CHECK168
C	CHECK169
100 CONTINUE	CHECK170
WRITE(NOT,1030)	CHECK171
1030 FORMAT('GPUNCHED TEMPERATURE ORDER')	CHECK172
IHR=0	CHECK173
DO 115 K=1,NVENR	CHECK174
ILR=IHR+1	CHECK175
IHR=NMELTR(K)	CHECK176
IHZ=0	CHECK177
DO 115 L=1,NVENZ	CHECK178
ILZ=IAHZ+1	CHECK179
IHZ=NMELTZ(K)	CHECK180

KARD=0	CHECK181
DO 110 J=ILZ,IHZ	CHECK182
LIM=NZ(J)	CHECK183
DO 110 JJ=1,LIM	CHECK184
DO 110 I=ILR,IHR	CHECK185
LIMM=NR(I)	CHECK186
DO 105 II=1,LIMM	CHECK187
KARD=KARD+1	CHECK188
TEMP(KARD)=VTEM(J,I)	CHECK189
IF(KARD.NE.6) GO TO 105	CHECK190
WRITE (NPT,1015) (TEMP(N),N=1,6)	CHECK191
WRITE(NOT,1035) (TEMP(N),N=1,6)	CHECK192
1035 FORMAT(1P6E12.5)	CHECK193
KARD=0	CHECK194
105 CONTINUE	CHECK195
110 CONTINUE	CHECK196
IF(KARD.EQ.0) GO TO 115	CHECK197
WRITE (NPT,1015) (TEMP(N),N=1,KARD)	CHECK198
WRITE(NOT,1035) (TEMP(N),N=1,KARD)	CHECK199
115 CONTINUE	CHECK200
C	CHECK201
C WRITE AND PUNCH EQUATION OF STATE INDICIES IN VENUS FORMAT	CHECK202
C	CHECK203
WRITE(NOT,1040)	CHECK204
1040 FORMAT('DPUNCHED XT ORDER')	CHECK205
IHR=0	CHECK206
DO 145 K=1,NVENR	CHECK207
IAN=0	CHECK208
ILR=IHR+1	CHECK209
IHR=NMELTR(K)	CHECK210
IHZ=0	CHECK211
DO 145 L=1,NVENZ	CHECK212
ILZ=IHZ+1	CHECK213
IHZ=NMELTZ(K)	CHECK214
KARD=0	CHECK215
DO 140 AXIAL=ILZ,IHZ	CHECK216
LIM=NZ(AXIAL)	CHECK217
DO 140 JJ=1,LIM	CHECK218
IRN=0	CHECK219
IF(K-2)130,120,120	CHECK220
120 IKK=K-1	CHECK221
KK=NMELTR(IKK)	CHECK222
DO 125 IK=1,KK	CHECK223
IRN=IRN+NR(IK)	CHECK224
125 CONTINUE	CHECK225
130 CONTINUE	CHECK226
IAN=IAN+1	CHECK227
DO 140 CHAN=ILR,IHR	CHECK228
LIMM=NR(CHAN)	CHECK229
IJI=IEOSIN	CHECK230
IF(XUP(CHAN,NEW).GE.ZMID(AXIAL)+.5*ASEG.AND.XDOWN(CHAN,NEW).LE.ZMICHECK231	CHECK231
10(AXIAL)-.5*ASEG) IJI=IEOSOT	CHECK232
DO 135 II=1,LIMM	CHECK233
IRN=IRN+1	CHECK234
KARD=KARD+1	CHECK235
KT(KARD)=IJI	CHECK236
INDV(IRN,IAN)=KT(KARD)	CHECK237
IF(KARD.NE.12) GO TO 135	CHECK238
WRITE (NPT,1045) (KT(N),N=1,12)	CHECK239
1045 FORMAT(12I6)	CHECK240

WRITE(NOT,1050) (KT(N),N=1,12)	CHECK241
1050 FORMAT(12I6)	CHECK242
KARD=0	CHECK243
135 CONTINUE	CHECK244
140 CONTINUE	CHECK245
IF(KARD.EQ.0) GO TO 145	CHECK246
WRITE (NPT,1045) (KT(N),N=1,KARD)	CHECK247
WRITE(NOT,1050) (KT(N),N=1,KARD)	CHECK248
145 CONTINUE	CHECK249
WRITE(NOT,1055)	CHECK250
1055 FORMAT(2X'INDEX OF EQUATION OF STATE')	CHECK251
DO 1060 IAN=18,1,-1	CHECK252
WRITE(NCT,1060) (INDV(IRN,IAN),IRN=1,11)	CHECK253
1060 FORMAT (2X35I2)	CHECK254
C	CHECK255
C	CHECK256
150 CONTINUE	CHECK257
LINESL=0	CHECK258
TOISAS=TDISAS+TINCRT	CHECK259
155 CONTINUE	CHECK260
JQUIT=1	CHECK261
C	CHECK262
C	CHECK263
C	CHECK264
IF(AN(NEW).GE.PQUITC) GO TO 170	CHECK265
IF(ICOLTQ.GT.0.AND.GOING) GO TO 170	CHECK266
IF(IVOIDQ.GT.0.AND.VGOING) GO TO 170	CHECK267
IF(T(NEW).GT.TQUIT) GO TO 170	CHECK268
IF(FUELT.GE.TEMAD) GO TO 180	CHECK269
IF(TVOID(NEW).GT.TVQUIT) GO TO 170	CHECK270
IF(TCOLP(NEW).GT.TCQUIT) GO TO 170	CHECK271
IF(RH(NEW).LT.RMIN) GO TO 170	CHECK272
DO 160 CHAN=1,LUPPER	CHECK273
DO 160 AXIAL=1,MUPPER	CHECK274
IF(TEMPER(1,AXIAL,CHAN,NEW).GT.THQUIT) GO TO 170	CHECK275
IF(TEMPER(NUPM3,AXIAL,CHAN,NEW).LT.TLQUIT) GO TO 170	CHECK276
150 CONTINUE	CHECK277
DO 165 CHAN=1,LUPPER	CHECK278
IF(TEMPER(NUPPER,MUPPER,CHAN,NEW).GT.TSQUIT) GO TO 170	CHECK279
165 CONTINUE	CHECK280
IF (RH(NEW).LT.RMIN) GO TO 170	CHECK281
GO TO 175	CHECK282
170 JQUIT=2	CHECK283
C	CHECK284
C	CHECK285
C	CHECK286
175 IF(T(NEW).EQ.TOUT.OR.JQUIT.EQ.2) GO TO 180	CHECK287
IF(TCOLP(NEW).LT.1.E-20.AND.GOING.OR.TVOID(NEW).LT.1.E-20.AND.VGOING)	CHECK288
GO TO 235	CHECK289
IF(STEP.NE.STEPOT) RETURN 2	CHECK290
C	CHECK291
C	CHECK292
C	CHECK293
STEPOT=STEPOT+DELSTP	CHECK294
CALL OUTSML	CHECK295
RETURN2	CHECK296
C	CHECK297
180 CALL CURVE(BOUT,T(NEW),TPLIB,PLIB,PAIRS6,\$230)	CHECK298
C	CHECK299
C	CHECK300
SET NEXT BIG PRINTOUT TIME INCREMENT = DELTOT IF VOIDING OR	

C	COLLAPSE IS IN PROCESS. OTHERWISE USE PRINTOUT TIME LIBRARY	CHECK301
C	IF(VOFF.AND.COFF) GO TO 190	CHECK302
185	BOUT=DELTOT	CHECK303
190	CONTINUE	CHECK304
	TOUT=TOUT+BOUT	CHECK305
	IF(STEP.EQ.STEPOT) STEPOT=STEPOT+DELSTP	CHECK306
C		CHECK307
C	PRINT BIG OUTPUT	CHECK308
C		CHECK309
	CALL OUTBIG	CHECK310
195	IF(DUMP.EQ.0) GO TO 220	CHECK311
C		CHECK312
C	DUMP CORE FOR LATER RESTART	CHECK313
C		CHECK314
	CALL NTRAN(NOTD,1,IJKLM,CORE,STATUS)	CHECK315
	IF(GOING.OR.VGOING) DUMP=0	CHECK316
200	STATUS=STATUS	CHECK317
	IF(STATUS+1) 205,200,215	CHECK318
205	WRITE(NOT,1065)	CHECK319
1065	FORMAT(34HODEVICE ERROR IN TRANSMITTING DATA)	CHECK320
210	RETURN3	CHECK321
215	CALL NTRAN(NOTD,10)	CHECK322
C		CHECK323
220	IF(JQUIT.EQ.2)RETURN 4	CHECK324
	RETURN 2	CHECK325
C		CHECK326
C	ADJUST TIME STEP USING BETTER GUESS ON ACTUAL REACTIVITY DURING	CHECK327
C	NEW TIME STEP	CHECK328
C		CHECK329
225	CALL TIMNEW(\$210)	CHECK330
	RETURN1	CHECK331
230	WRITE(NOT,1070) T(NEW),TPLIB(PAIRS6)	CHECK332
1070	FORMAT(13HOCURRENT TIME 1PE9.3,21H EXCEEDS MAXIMUM TIME E9.3,22H IC	CHECK333
	IN TIME-PRINT LIBRARY)	CHECK334
	GO TO 210	CHECK335
C		CHECK336
C	GET SMALL PRINTOUT AND POSSIBLE CORE DUMP WHEN VOIDING OR	CHECK337
C	COLLAPSE BEGINS	CHECK338
C		CHECK339
235	IF(STEP.NE.STEPOT) GO TO 195	CHECK340
	CALL OUTSML	CHECK341
	STEPOT=STEPOT+DELSTP	CHECK342
	GO TO 195	CHECK343
	END	CHECK344
		CHECK345

a	ELT	OUTSTD,1,720604, 49896	
		SUBROUTINE OUTSTD	OUTST 1
C			OUTST 2
C		SUBROUTINE OUTSTD PRINTS OUT STEADY STATE CORE TEMPERATURE	OUTST 3
C		DISTRIBUTIONS. OPTIMAL DATA PACK OUTPUT FORMAT IS SELECTED.	OUTST 4
C			OUTST 5
		INCLUDE ABC	OUTST 6
		WRITE(NOT,1000) (TITLE(I),I=1,14)	OUTST 7
1000		FORMAT(1H113A6,A2)	OUTST 8
		ABLE=0.0	OUTST 9
C			OUTST 10
		DO 10 CHAN=1,LUPPER	OUTST 11
		BAKER=.5*ACHAN(CHAN)**2	OUTST 12
		TEMP(CHAN)=SQRT(BAKER+ABLE)	OUTST 13
10		ABLE=BAKER	OUTST 14
C			OUTST 15
		WRITE(NOT,1005) (I,I=1,LUPPER)	OUTST 16
1005		FORMAT(1H09X,29HSTARTING SEGMENT HEIGHTS (CM)15X,33HCENTERLINE RAD	OUTST 17
		1IUS OF CHANNEL (CM)/10X,28HBOTTOM OF CENTER OF TOP OF I6,9I9)	OUTST 18
		WRITE(NOT,1010) (TEMP(I),I=1,LUPPER)	OUTST 19
1010		FORMAT(38H SEGMENT SEGMENT SEGMENT SEGMENT 10F9.3)	OUTST 20
C			OUTST 21
		DO 15 AXIAL=MUPPER,1,-1	OUTST 22
		ABLE=ZMID(AXIAL)-.5*ASEG	OUTST 23
		BAKER=ZMID(AXIAL)+.5*ASEG	OUTST 24
		WRITE(NOT,1015) AXIAL,ABLE,ZMID(AXIAL),BAKER	OUTST 25
1015		FORMAT(15,3X,3F10.3)	OUTST 26
15		CONTINUE	OUTST 27
C			OUTST 28
		WRITE(NOT,1020) TITLE	OUTST 29
1020		FORMAT(1H113A6,A2/1H050X,23HSTEADY STATE CONDITIONS)	OUTST 30
		LINESL=44	OUTST 31
		IF(LUPPER-MUPPER) 20,20,30	OUTST 32
20		IF(MUPPER-NUPPER) 40,40,25	OUTST 33
25		IF(LUPPER-NUPPER) 90,90,115	OUTST 34
30		IF(LUPPER-NUPPER) 65,65,35	OUTST 35
35		IF(NUPPER-MUPPER) 140,140,165	OUTST 36
C			OUTST 37
C		..... NUPPER .GE. MUPPER .GE. LUPPER	OUTST 38
C			OUTST 39
40		DO 60 CHAN=1,LUPPER	OUTST 40
		IF(LINESL-MUPPER-2) 45,50,50	OUTST 41
45		WRITE(NOT,1025)	OUTST 42
1025		FORMAT(1H1)	OUTST 43
		LINESL=48	OUTST 44
50		WRITE(NOT,1030) CHAN,NUPPER	OUTST 45
1030		FORMAT(8HCHANNEL I3,7X,7HSEGMENT5X,16HFUEL NCDE 1 --->I3)	OUTST 46
		DO 55 AXIAL=MUPPER,1,-1	OUTST 47
		WRITE(NOT,1035) AXIAL,(TEMP(I,AXIAL,CHAN,NEW),I=1,NUPPER)	OUTST 48
1035		FORMAT(20X,I2,15F7.0)	OUTST 49
55		CONTINUE	OUTST 50
60		LINESL=LINESL-MUPPER-2	OUTST 51
		GO TO 190	OUTST 52
C			OUTST 53
C		..... NUPPER .GE. LUPPER .GT. MUPPER	OUTST 54
C			OUTST 55
65		DO 85 AXIAL=1,MUPPER	OUTST 56
		IF(LINESL-LUPPER-2) 70,70,75	OUTST 57
70		WRITE(NOT,1025)	OUTST 58
		LINESL=48	OUTST 59
75		WRITE(NOT,1040) AXIAL,NUPPER	OUTST 60

1040	FORMAT(8H0SEGMENTI3,7X,7HCHANNEL5X,16HFUEL NODE 1 --->I3)	OUTST 61
	DO 80 CHAN=1,LUPPER	OUTST 62
	WRITE(NOT,1035) CHAN,(TEMPER(I,AXIAL,CHAN,NEW),I=1,NUPPER)	OUTST 63
90	CONTINUE	OUTST 64
85	LINESL=LINESL-LUPPER-2	OUTST 65
	GO TO 190	OUTST 66
C		OUTST 67
C	..... MUPPER .GT. NUPPER .GE. LUPPER	OUTST 68
C		OUTST 69
90	DO 110 CHAN=1,LUPPER	OUTST 70
	IF(LINESL-NUPPER-3) 95,95,100	OUTST 71
95	WRITE(NOT,1025)	OUTST 72
	LINESL=48	OUTST 73
100	WRITE(NOT,1045) CHAN,MUPPER	OUTST 74
1045	FORMAT(8H0CHANNELI3/10H FUEL NODE8X19HAXIAL SEGMENT 1--->I3)	OUTST 75
	DO 105 FRAD=1,NUPPER	OUTST 76
	WRITE(NOT,1050) FRAD,(TEMPER(FRAD,I,CHAN,NEW),I=1,MUPPER)	OUTST 77
1050	FORMAT(15,6X,20F6.0)	OUTST 78
105	CONTINUE	OUTST 79
110	LINESL=LINESL-NUPPER-3	OUTST 80
	GO TO 190	OUTST 81
C		OUTST 82
C	..... MUPPER .GE. LUPPER .GT. NUPPER	OUTST 83
C		OUTST 84
115	DO 135 FRAD=1,NUPPER	OUTST 85
	IF(LINESL-LUPPER-3) 120,125,125	OUTST 86
120	WRITE(NOT,1025)	OUTST 87
	LINESL=48	OUTST 88
125	WRITE(NOT,1055) FRAD,MUPPER	OUTST 89
1055	FORMAT(10H0FUEL NODEI3/8H CHANNEL10X19HAXIAL SEGMENT 1--->I3)	OUTST 90
	DO 130 CHAN=1,LUPPER	OUTST 91
	WRITE(NOT,1050) CHAN,(TEMPER(FRAD,I,CHAN,NEW),I=1,MUPPER)	OUTST 92
130	CONTINUE	OUTST 93
135	LINESL=LINESL-LUPPER-2	OUTST 94
	GO TO 190	OUTST 95
C		OUTST 96
C	..... LUPPER .GT. MUPPER .GE. NUPPER	OUTST 97
C		OUTST 98
140	DO 160 FRAD=1,NUPPER	OUTST 99
	IF(LINESL-MUPPER-2) 145,150,150	OUTST100
145	WRITE(NOT,1025)	OUTST101
	LINESL=48	OUTST102
150	WRITE(NOT,1060) FRAD,LUPPER	OUTST103
1060	FORMAT(10H0FUEL NODEI3,5X,7HSEGMENT,5X,14HCHANNEL 1 --->I3)	OUTST104
	DO 155 AXIAL=1,MUPPER	OUTST105
	WRITE(NOT,1035) AXIAL,(TEMPER(FRAD,AXIAL,I,NEW),I=1,LUPPER)	OUTST106
155	CONTINUE	OUTST107
160	LINESL=LINESL-MUPPER-2	OUTST108
	GO TO 190	OUTST109
C		OUTST110
C	..... LUPPER .GT. NUPPER .GT. MUPPER	OUTST111
C		OUTST112
165	DO 185 AXIAL=1,MUPPER	OUTST113
	IF(LINESL-NUPPER-2) 170,175,175	OUTST114
170	WRITE(NOT,1025)	OUTST115
	LINESL=48	OUTST116
175	WRITE(NOT,1065) AXIAL,LUPPER	OUTST117
1065	FORMAT(8H0SEGMENTI3,5X,9HFUEL NODE,5X,14HCHANNEL 1 --->I3)	OUTST118
	DO 180 FRAD=1,NUPPER	OUTST119
	WRITE(NOT,1035) FRAD,(TEMPER(FRAD,AXIAL,I,NEW),I=1,LUPPER)	OUTST120

180 CONTINUE
185 LINESL=LINESL-NUPPER-2
C
190 LINESL=0
RETURN
END

OUTST121
OUTST122
OUTST123
OUTST124
OUTST125
OUTST126


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2 ELT REPLAY,1,720604, 49893
  SUBROUTINE REPLAY(TGUESS)
C
C   SUBROUTINE REPLAY PRINTS OUT ALL INPUT DATA
C
C   INCLUDE ABC
C
C PAGE 1
C
  WRITE(NOT,1000) (TITLE(I),I=1,14)
1000 FORMAT(1H113A6,A2/1H060X,10HINPUT DATA/4H0***6X,32HCODE OPTIONS AN
  10 OUTPUT CONTROLS/1H )
  IF(VENUS.EQ.0) GO TO 10
  WRITE(NOT,1005) VENUS
1005 FORMAT(1H09X5HVENUSSX*VENUS INPUT SIGNAL (0/1/2 = NO PUNCH/OLD VEN
  10 PUNCH/NEW VENUS PUNCH) =*I2)
  WRITE(NOT,1010) (NR(I),I=1,LUPPER)
1010 FORMAT(20X,*VENUS RADIAL NODES PER MELT2 NODE - NR(CHAN) *10I3)
  WRITE(NOT,1015) (NZ(I),I=1,MUPPER)
1015 FORMAT(20X,*VENUS AXIAL NODES PER MELT2 NODE - NZ(AXIAL) *20I3)
  WRITE(NOT,1020) NVENR
1020 FORMAT(10X5HNVENR5X*VENUS CORE RADIAL ZONES*5XI3)
  WRITE(NOT,1025) (NMELTR(I),I=1,NVENR)
1025 FORMAT(10X6HNMELTR4X*LAST MELT2 RADIAL NODE PER VENUS ZONE *10I3)
  WRITE(NOT,1030) NVENZ
1030 FORMAT(10X5HNVENZ5X*VENUS CORE AXIAL ZONES*5XI3)
  WRITE(NOT,1035) (NMELTZ(I),I=1,NVENZ)
1035 FORMAT(10X6HNMELTZ4X*LAST MELT2 AXIAL NODE PER VENUS ZONE *10I3)
  WRITE(NOT,1040) IEOSIN
1040 FORMAT(10X6HIEOSIN4X*VENUS EQUATION OF STATE CODE FOR SODIUM IN
  1I2)
  WRITE(NOT,1045) IEOSOT
1045 FORMAT(10X6HIEOSOT4X*VENUS EQUATION OF STATE CODE FOR SODIUM OUT
  1I2)
  10 CONTINUE
  WRITE(NOT,1050) IWRAP
1050 FORMAT(1H09X,5HIWRAP5X,72HWRAPUP OPTION (0/1/2/3 = NONE/WRAPUP ONL
  1Y/WRAPUP PLUS TAPE/TAPE ONLY =I2)
  WRITE(NOT,1055) IPLOT
1055 FORMAT(1H09X,5HIPL0T5X,72HPL0TTING OPTION (0/1 = NO PLOTTING/PLOT
  1BEFORE STORING WRAPUP ON TAPE) =I2)
  WRITE(NOT,1060) IDUMP
1060 FORMAT(1H09X,5HIDUMP5X,72HRESTART OPTION (0/1 = NO CORE DUMP/CORE
  1DUMP AT SPECIFIED INTERVALS) =I2)
  WRITE(NOT,1065) DELSTP
1065 FORMAT(1H /1H09X,6HDELSTP4X,44HNUMBER OF TIME STEPS BETWEEN SHORT
  1PRINTOUTS6X,9H(INTEGER)12X,1H=I4)
  WRITE(NOT,1070) AX
1070 FORMAT(1H09X,2HAX8X,35HAXIAL NODE EDITED IN SMALL PRINTOUT 15X,9H
  1INTEGER)12X,1H=I2)
  WRITE(NOT,1075) FR1
1075 FORMAT(1H09X,3HFR17X,38HINNER FUEL NODE EDITED IN BIG PRINTOUT12X,
  19H(INTEGER)12X,1H=I2)
  WRITE(NOT,1080) FR2
1080 FORMAT(1H09X,3HFR27X,38HOUTER FUEL NODE EDITED IN BIG PRINTOUT12X,
  19H(INTEGER)12X,1H=I2)
  WRITE(NOT,1085) AX1
1085 FORMAT(1H09X,3HAX17X,39HLOWER AXIAL NODE EDITED IN BIG PRINTOUT11X
  1,9H(INTEGER)12X,1H=I2)
  WRITE(NOT,1090) AX2
1090 FORMAT(1H09X,3HAX27X,39HUPPER AXIAL NODE EDITED IN BIG PRINTOUT11X

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1,9H(INTEGER)12X,1H=I2) REPLA 61
WRITE(NOT,1095) CH1 REPLA 62
1095 FORMAT(1H09X,3HCH17X,36HINNER CHANNEL EDITED IN BIG PRINTOUT14X,9HREPLA 63
1(INTEGER)12X,1H=I2) REPLA 64
WRITE(NOT,1100) CH2 REPLA 65
1100 FORMAT(1H09X,3HCH27X,36HOUTER CHANNEL EDITED IN BIG PRINTOUT14X,9HREPLA 66
1(INTEGER)12X,1H=I2) REPLA 67
I=0 REPLA 68
DO 15 J=1,10 REPLA 69
IF(LISTC(J).GT.0) I=I+1 REPLA 70
15 CONTINUE REPLA 71
WRITE(NOT,1105) (LISTC(J),J=1,I) REPLA 72
1105 FORMAT(1H09X,5HLISTC5X,39HLIST OF CHANNELS TO BE EDITED BY WRAPUP REPLA 73
132X,1H=10(I2,1H,)) REPLA 74
I=0 REPLA 75
DO 20 J=1,20 REPLA 76
IF(LISTA(J).GT.0) I=I+1 REPLA 77
20 CONTINUE REPLA 78
WRITE(NOT,1110) (LISTA(J),J=1,I) REPLA 79
1110 FORMAT(1H09X,5HLISTA5X,45HLIST OF AXIAL SEGMENTS TO BE EDITED BY WRAPUP REPLA 80
1RAPUP26X,1H=10(I2,1H,)/92X,10(I2,1H,)) REPLA 81
WRITE(NOT,1115) PAIRS6 REPLA 82
1115 FORMAT(1H09X,6HPAIRS64X,46HNUMBER OF TIME ENTRIES IN BIG PRINTOUT REPLA 83
1LIBRARY 4X,9H(INTEGER)12X,1H=I2) REPLA 84
WRITE(NOT,1120) REPLA 85
1120 FORMAT(1H052X,25HBIG PRINTOUT TIME LIBRARY/20X,87HTPLIB = INTERVAL REPLA 86
1 FOR TIME PRINTOUTS PLIB = TIME BETWEEN PRINTOUTS IN INTERVAL REPLA 87
2TPLIB) REPLA 88
J1=1 REPLA 89
J2=10 REPLA 90
25 IF(J2.GT.PAIRS6) J2=PAIRS6 REPLA 91
WRITE(NOT,1125) (TPLIB(J),J=J1,J2) REPLA 92
1125 FORMAT(1H016X,6HTPLIB 7X,1P10E9.3) REPLA 93
WRITE(NOT,1130) (PLIB(J),J=J1,J2) REPLA 94
1130 FORMAT(17X,6HPLIB 7X,1P10E9.3) REPLA 95
J1=J2+1 REPLA 96
J2=J2+10 REPLA 97
IF(J1.LE.PAIRS6) GO TO 25 REPLA 98
C REPLA 99
C PAGE 2 REPLA100
C REPLA101
WRITE(NOT,1135) (TITLE(I),I=1,14) REPLA102
1135 FORMAT(1H113A6,A2/1H0FOX,10HINPUT DATA/4H0***6X,43HTIME, TERMINAT REPLA103
ION, AND CONVERGENCE CONTROLS/1H ) REPLA104
WRITE(NOT,1140) HMAX REPLA105
1140 FORMAT(1H09X,4HHMAX6X,27HMAXIMUM TIME STEP (SECONDS)53X,1H=1PE9.3) REPLA106
WRITE(NOT,1145) REDUCE REPLA107
1145 FORMAT(1H09X,6HREDUCE4X,45HFACTOR USED TO INCREASE OR DECREASE TIM REPLA108
1E STEP35X,1H=F5.3) REPLA109
WRITE(NOT,1150) ICOLT0 REPLA110
1150 FORMAT(1H /1H09X,6HICOLT04X,60HOPTION TO TERMINATE AT START OF FUE REPLA111
1L COLLAPSE (0/1 = NO/YES)20X,1H=I2) REPLA112
WRITE(NOT,1155) IVOID0 REPLA113
1155 FORMAT(1H09X,6HIVOID04X,62HOPTION TO TERMINATE AT START OF COOLANT REPLA114
1 VOIDING (0/1 = NO/YES)18X,1H=I2) REPLA115
WRITE (NOT,1160) MAXTIM REPLA116
1160 FORMAT (1H09X,6HMAXTIM4X,54HRESERVED RUN TIME FOR FINAL WRAPUP AND REPLA117
1 PLOTS (SECONDS) 26X,1H=I4) REPLA118
WRITE(NOT,1165) TMQUIT REPLA119
1165 FORMAT(1H09X,6HTMQUIT4X,49HMAXIMUM TRANSIENT RUN TIME THIS PROBLEM REPLA120

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1 (SECONDS)31X,1H=1PE9.3) REPLA121
WRITE(NOT,1170) TEMAD REPLA122
1170 FORMAT(1H09X,5HTEMAD5X, 75HCORE AVERAGE FUEL TEMPERATURE ENDING DIREPLA123
1SASSEMBLY PRINTS (DEGREES KELVIN) 5X,1H=F5.0) REPLA124
WRITE(NOT,1175) TEMAW REPLA125
1175 FORMAT(1H09X,5HTEMAW5X, 75HCORE AVERAGE FUEL TEMPERATURE INDICATINREPLA126
1G CORE DISASSEMBLY (DEGREES KELVIN) 5X,1H=F6.0) REPLA127
WRITE(NOT,1180) TINCRT REPLA128
1180 FORMAT(10X6HTINCRT4X*DEG. K INCREMENT TO TEMAW FOR MORE DISASSEMBLREPLA129
1Y PRINTS *27X*='F5.0) REPLA130
WRITE(NOT,1185) THQUIT REPLA131
1185 FORMAT(1H09X,6HTHQUIT4X,50HHIGH FUEL TEMPERATURE TERMINATION (DEGRREPLA132
1EES KELVIN)30X,1H=1PE9.3) REPLA133
WRITE(NOT,1190) TLQUIT REPLA134
1190 FORMAT(1H09X,6HTLQUIT4X,49HLOW FUEL TEMPERATURE TERMINATION (DEGREREPLA135
1ES KELVIN)31X,1H=1PE9.3) REPLA136
WRITE(NOT,1195) TSQUIT REPLA137
1195 FORMAT(1H09X,6HTSQUIT4X,55HCOOLANT OUTLET TEMPERATURE TERMINATION REPLA138
1(DEGREES KELVIN)25X,1H=1PE9.3) REPLA139
WRITE(NOT,1200) PQUIT REPLA140
1200 FORMAT(1H09X,5HPQUIT 5X,43HMULTIPLE OF INITIAL POWER TERMINATION PREPLA141
10INT37X,1H=1PE9.3) REPLA142
WRITE(NOT,1205) RMIN REPLA143
1205 FORMAT(1H09X,4HRMIN6X,40HMINIMUM REACTIVITY TERMINATION (DELTA K)4REPLA144
10X,1H=1PE9.3) REPLA145
WRITE(NOT,1210) TCQUIT REPLA146
1210 FORMAT(1H /1H09X,6HTCQUIT4X,53HTIME TO TERMINATION AFTER START OF REPLA147
1COLLAPSE (SECONDS)27X,1H=1PE9.3) REPLA148
WRITE(NOT,1215) TVQUIT REPLA149
1215 FORMAT(1H09X,6HTVQUIT4X,52HTIME TO TERMINATION AFTER START OF VOIDREPLA150
1ING (SECONDS)28X,1H=1PE9.3) REPLA151
WRITE(NOT,1220) DELTCT REPLA152
1220 FORMAT(1H09X,6HDELTCT4X,64HTIME BETWEEN PRINTOUTS AFTER START OF EREPLA153
1ITHER COLLAPSE OR VOIDING16X,1H=,1PE9.3) REPLA154
WRITE(NOT,1225) ERROR REPLA155
1225 FORMAT(1H /1H09X,5HERROR5X,39HERROR CRITERIA FOR ORIGINAL POWER MAREPLA156
1TCH41X,1H=1PE9.3) REPLA157
WRITE(NOT,1230) ERROR1 REPLA158
1230 FORMAT(1H09X,6HERROR14X,41HERROR CRITERIA FOR OUTER LOOP POWER MATREPLA159
1CH39X,1H=1PE9.3) REPLA160
WRITE(NOT,1235) TERROR REPLA161
1235 FORMAT(1H09X,6HTERROR4X,63HTEMPERATURE ERROR ALLOWED IN THERMAL COREPLA162
1INDUCTIVITY INTERPOLATION17X,1H=F5.2) REPLA163
C REPLA164
C PAGE 3 REPLA165
C REPLA166
WRITE(NOT,1240) (TITLE(I),I=1,14) REPLA167
1240 FORMAT(1H113A6,A2/1H060X,10HINPUT DATA/4H0**10X,23HGEOMETRY SPECIREPLA168
1IFICATIONS/1H ) REPLA169
WRITE(NOT,1245) NUPPER REPLA170
1245 FORMAT(1H040X,6HNUPPER4X,26HNUMBER OF PIN RADIAL NODES14X,1H=I3) REPLA171
WRITE(NOT,1250) MUPPER REPLA172
1250 FORMAT(1H040X,6HMUPPER4X,26HNUMBER OF CORE AXIAL NODES14X,1H=I3) REPLA173
WRITE(NOT,1255) LUPPER REPLA174
1255 FORMAT(1H040X,6HLUPPER4X,30HNUMBER OF CORE RADIAL CHANNELS10X,1H=IREPLA175
13) REPLA176
WRITE(NOT,1260) AHIGH REPLA177
1260 FORMAT(1H /1H340X,5HAHIGH5X,16HCORE HEIGHT (CM)24X,1H=1PE9.3) REPLA178
WRITE(NOT,1265) FUELFP REPLA179
1265 FORMAT(1H040X,6HFUELFR4X,31HVOLUME FRACTION OF FUEL IN CORE9X,1H=FREPLA180

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16.4) REPLA181
WRITE(NOT,1270) COOLFR REPLA182
1270 FORMAT(1H040X,6HCOOLFR4X,34HVOLUME FRACTION OF COOLANT IN CORE6X,1REPLA183
1H=F6.4) REPLA184
WRITE(NOT,1275) (RCHAN(I),I=1,LUPPER) REPLA185
1275 FORMAT(1H /1H040X,8HRCAN(L)2X,30HOUTER RADIUS OF CHANNEL L (CM)/1REPLA186
1H043X,1P5E9.3/44X,1P5E9.3) REPLA187
J=NUPPER+1 REPLA188
WRITE(NOT,1280) (R(I),I=1,J) REPLA189
1280 FORMAT(1H /1H040X,48HR(N) OUTER RADIUS OF RADIAL PIN NODE N (REPLA190
1CM)/1H043X,1P6E9.3/44X,1P5E9.3) REPLA191
WRITE(NOT,1285) REPLA192
1285 FORMAT(1H /4H0***6X,2PHHEAT TRANSFER SPECIFICATIONS) REPLA193
WRITE(NOT,1290) KNA REPLA194
1290 FORMAT(1H027X,3HKNA7X,31HGAP COEFFICIENT (J/SEC-CM**2-K)2X,16H(FLOREPLA195
1ATING POINT)3X,1H=1PE9.3) REPLA196
WRITE(NOT,1295) HTC0E REPLA197
1295 FORMAT(1H027X,5HHTC0E5X,32HFILM COEFFICIENT (J/SEC-CM**2-K)20X,1H=REPLA198
11PE9.3) REPLA199
WRITE(NOT,1300) HTVOID REPLA200
1300 FORMAT(1H/27X,6HHTVOID4X,46HFILM COEFFICIENT AFTER VOIDING (J/SEC-REPLA201
1CM**2-K)6X,1H=1PE9.3) REPLA202
WRITE(NOT,1305) FRACTD REPLA203
1305 FORMAT(1H /1H027X,6HFRACTD4X,53HCOOLANT NODE PLACEMENT (FRACT. DISREPLA204
TANCE FROM INLET) =F5.3) REPLA205
WRITE(NOT,1310) TGUESS REPLA206
1310 FORMAT(1H027X,6HTGUESS4X,34HINITIAL TEMPERATURE GUESS (DEG. K)18X,REPLA207
114=1PE9.3) REPLA208
C REPLA209
C PAGE 4 REPLA210
C REPLA211
WRITE(NOT,1315) (TITLE(I),I=1,14) REPLA212
1315 FORMAT(1H113A6,A2/1H060X,10HINPUT DATA/4H0*** 6X,19HMATERIAL PROPEREPLA213
1RTIES/1H ) REPLA214
WRITE(NOT,1320) KNA REPLA215
1320 FORMAT(21X,3HKNA7X,58HTHEPMAL CONDUCTIVITY OF BOND (J/CM-SEC-K) (FREPLA216
1LOATING POINT) 21X,1H=1PE9.3) REPLA217
WRITE(NOT,1325) KCLAD REPLA218
1325 FORMAT(21X,5HKCLAD5X,58HTHERMAL CONDUCTIVITY OF CLAD (J/CM-SEC-K) REPLA219
1(FLOATING POINT) 21X,1H=1PE9.3) REPLA220
WRITE(NOT,1330) XCOE1 REPLA221
1330 FORMAT(1H020X,5HXCOE15X,64HCONSTANT TERM FOR FUEL HEAT CAPACITY BEREPLA222
1LOW MELTING POINT (J/G-K) 15X,1H=1PE9.3) REPLA223
WRITE(NOT,1335) YCOE1 REPLA224
1335 FORMAT(21X,5HYCOE15X,56HT COEFFICIENT FOR FUEL HEAT CAPACITY BELOWREPLA225
1 MELTING POINT 23X,1H=1PE9.3) REPLA226
WRITE(NOT,1340) ZCOE1 REPLA227
1340 FORMAT(21X,5HZCOE15X,59HT**2 COEFFICIENT FOE FUEL HEAT CAPACITY BEREPLA228
1LOW MELTING POINT 20X,1H=1PE9.3) REPLA229
WRITE(NOT,1345) XCOE2 REPLA230
1345 FORMAT(21X,5HXCOE25X,64HCONSTANT TERM FOR FUEL HEAT CAPACITY ABOVEREPLA231
1 MELTING POINT (J/G-K) 15X,1H=1PE9.3) REPLA232
WRITE(NOT,1350) YCOE2 REPLA233
1350 FORMAT(21X,5HYCOE25X,56HT COEFFICIENT FOR FUEL HEAT CAPACITY ABOVEREPLA234
1 MELTING POINT 23X,1H=1PE9.3) REPLA235
WRITE(NOT,1355) ZCOE2 REPLA236
1355 FORMAT(21X,5HZCOE25X,59HT**2 COEFFICIENT FOR FUEL HEAT CAPACITY ABREPLA237
1OVE MELTING POINT 20X,1H=1PE9.3) REPLA238
WRITE(NOT,1360) EXCOE1 REPLA239
1360 FORMAT(1H020X,6HEXCOE14X,64HCONSTANT TERM FOR CLAD HEAT CAPACITY BREPLA240

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1ELOW MELTING POINT (J/G-K) 15X,1H=1PE9.3) REPLA241
WRITE(NOT,1365) EYCOE1 REPLA242
1365 FORMAT(21X,6HEYCOE14X,56HT COEFFICIENT FOR CLAD HEAT CAPACITY BELOW MELTING POINT 23X,1H=1PE9.3) REPLA243
WRITE(NOT,1370) EZCOE1 REPLA244
1370 FORMAT(21X,6HEZCOE14X,59HT**2 COEFFICIENT FOR CLAD HEAT CAPACITY BELOW MELTING POINT 20X,1H=1PE9.3) REPLA245
WRITE(NOT,1375) EXCOE2 REPLA246
1375 FORMAT(21X,6HEXCOE24X,64HCONSTANT TERM FOR CLAD HEAT CAPACITY ABOVE MELTING POINT (J/G-K) 15X,1H=1PE9.3) REPLA247
WRITE(NOT,1380) EYCOE2 REPLA248
1380 FORMAT(21X,6HEYCOE24X,56HT COEFFICIENT FOR CLAD HEAT CAPACITY ABOVE MELTING POINT 23X,1H=1PE9.3) REPLA249
WRITE(NOT,1385) EZCOE2 REPLA250
1385 FORMAT(21X,6HEZCOE24X,59HT**2 COEFFICIENT FOR CLAD HEAT CAPACITY ABOVE MELTING POINT 20X,1H=1PE9.3) REPLA251
WRITE(NOT,1390) CXCOE1 REPLA252
1390 FORMAT(14D20X,6HCXCOE14X,80HCONSTANT TERM FOR COOLANT (AND BOND) HEAT CAPACITY BELOW MELTING POINT (J/G-K) =1PE9.3) REPLA253
WRITE(NOT,1395) CYCOE1 REPLA254
1395 FORMAT(21X,6HCYCOE14X,70HT COEFFICIENT FOR COOLANT (AND BOND) HEAT CAPACITY ABOVE MELTING POINT 9X,1H=1PE9.3) REPLA255
WRITE(NOT,1400) CZCOE1 REPLA256
1400 FORMAT(21X,6HCZCOE14X,73HT**2 COEFFICIENT FOR COOLANT (AND BOND) HEAT CAPACITY ABOVE MELTING POINT 6X,1H=1PE9.3) REPLA257
WRITE(NOT,1405) CXCOE2 REPLA258
1405 FORMAT(21X,6HCXCOE24X,80HCONSTANT TERM FOR COOLANT (AND BOND) HEAT CAPACITY BELOW MELTING POINT (J/G-K) =1PE9.3) REPLA259
WRITE(NOT,1410) CYCOE2 REPLA260
1410 FORMAT(21X,6HCYCOE24X,70HT COEFFICIENT FOR COOLANT (AND BOND) HEAT CAPACITY BELOW MELTING POINT 9X,1H=1PE9.3) REPLA261
WRITE(NOT,1415) CZCOE2 REPLA262
1415 FORMAT(21X,6HCZCOE24X,73HT**2 COEFFICIENT FOR COOLANT (AND BOND) HEAT CAPACITY ABOVE MELTING POINT 6X,1H=1PE9.3) REPLA263
WRITE(NOT,1420) CXCOE3 REPLA264
1420 FORMAT(14D20X,6HCXCOE34X,46HCONSTANT TERM FOR COOLANT VISCOSITY (G/CM-SEC) 33X,1H=1PE9.3) REPLA265
WRITE(NOT,1425) CYCOE3 REPLA266
1425 FORMAT(21X,6HCYCOE34X,35HT COEFFICIENT FOR COOLANT VISCOSITY 44X,1H=1PE9.3) REPLA267
WRITE(NOT,1430) CZCOE3 REPLA268
1430 FORMAT(21X,6HCZCOE34X,38HT**2 COEFFICIENT FOR COOLANT VISCOSITY 41X,1H=1PE9.3) REPLA269
WRITE(NOT,1435) DENSE REPLA270
1435 FORMAT(14D20X,5HDENSE5X,22HDENSITY OF FUEL (G/CC) 57X,1H=1PE9.3) REPLA271
WRITE(NOT,1440) DENSEB REPLA272
1440 FORMAT(21X,6HDENSEB4X,22HDENSITY OF BOND (G/CC) 57X,1H=1PE9.3) REPLA273
WRITE(NOT,1445) DENSEE REPLA274
1445 FORMAT(21X,6HDENSEE4X,22HDENSITY OF CLAD (G/CC) 57X,1H=1PE9.3) REPLA275
WRITE(NOT,1450) DENSEC REPLA276
1450 FORMAT(21X,6HDENSEC4X,25HDENSITY OF COOLANT (G-CC) 54X,1H=1PE9.3) REPLA277
WRITE(NOT,1455) TMELT REPLA278
1455 FORMAT(14D20X,5HTMELT5X,36HMELTING TEMPERATURE OF FUEL (DEG. K) 43X,1H=FA.0) REPLA279
WRITE(NOT,1460) EMELTL REPLA280
1460 FORMAT(21X,6HEMELTL4X,36HMELTING TEMPERATURE OF CLAD (DEG. K) 43X,1H=FA.0) REPLA281
WRITE(NOT,1465) CMELTL REPLA282
1465 FORMAT(21X,6HCMELTL4X,50HMELTING TEMPERATURE OF COOLANT (AND BOND) (DEG. K) 29X,1H=FA.0) REPLA283

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      WRITE(NOT,1470) HFUSE
1470 FORMAT(1H020X,5HHFUSE5X,28HHEAT OF FUSION OF FUEL (J-G) 51X,1H=1PEREPLA301
      19.3)
      WRITE(NOT,1475) CFUSE
1475 FORMAT(21X,5HCFUSE5X,42HHEAT OF FUSION OF COOLANT (AND BOND) (J/G) REPLA302
      1 37X,1H=1PE9.3)
      WRITE(NOT,1480) EFUSE
1480 FORMAT(21X,5HEFUSE5X,28HHEAT OF FUSION OF CLAD (J/G) 51X,1H=1PE9.3 REPLA303
      1)
      WRITE(NOT,1485) PAIRS1
1485 FORMAT(1H020X,6HPAIRS14X,46HNUMBER OF ENTRIES IN FUEL CONDUCTIVITY REPLA304
      1 LIBRARY 33X,1H=I3)
      WRITE(NOT,1490)
1490 FORMAT( 46X,39HCONDUCT = FUEL CONDUCTIVITY (J/CM-SEC-K)10X,24HBASREPLA305
      IICT = TEMPERATURE (K))
      J1=1
      J2=10
      30 IF(J2.GT.PAIRS1) J2=PAIRS1
      WRITE(NOT,1495) (BASICT(J),J=J1,J2)
1495 FORMAT(1H016X,6HBASICT 7X,1P10E9.3)
      WRITE(NOT,1500) (CONDUCT(J),J=J1,J2)
1500 FORMAT(17X,6HCONDUCT 7X,1P10E9.3)
      J1=J2+1
      J2=J2+10
      IF(J1.LE.PAIRS1) GO TO 30
C
C PAGE 5
C
      WRITE(NOT,1505) (TITLE(I),I=1,14)
1505 FORMAT(1H113A6,A2/1H060X,10HINPUT DATA/4H0***6X,39HCOOLANT FLOW ANREPLA306
      10 TEMPERATURE CONDITIONS/1H )
      WRITE(NOT,1510) PAIRS4
1510 FORMAT(1H09X,6HPAIRS44X,56HNUMBER OF ENTRIES IN INLET COOLANT TEMPREPLA307
      1ERATURE LIBRARY =I3)
      WRITE(NOT,1515)
1515 FORMAT(1H019X,37HTIMIN = TIME (SEC) TEMIN = TEMP. (K))
      J1=1
      J2=10
      35 IF(J2.GT.PAIRS4) J2=PAIRS4
      WRITE(NOT,1520) (TIMIN(J),J=J1,J2)
1520 FORMAT(1H019X,5HTIMIN 5X,1P10E9.3)
      WRITE(NOT,1525) (TEMIN(J),J=J1,J2)
1525 FORMAT(20X,5HTEMIN 5X,1P10E9.3)
      J1=J2+1
      J2=J2+10
      IF(J1.LE.PAIRS4) GO TO 35
      WRITE(NOT,1530) PAIRS5
1530 FORMAT(1H /1H09X,6HPAIRS54X,43HNUMBER OF ENTRIES IN COOLANT FLOW LREPLA308
      1IBRARY =I3)
      WRITE(NOT,1535)
1535 FORMAT(1H019X,47HTIMFLO = TIME (SEC) FLOW(TIME,CHANNEL) = G/SEC) REPLA309
      WRITE(NOT,1540) (J,J=1,LUPPER)
1540 FORMAT(1H /1H041X,12HFLOW (G/SEC)/8H TIMFLO36X,7HCHANNEL/7H (SECREPLA310
      1)I8,9I11)
      DO 40 I=1,PAIRS5
      WRITE(NOT,1545) TIMFLO(I),(FLOW(I,CHAN),CHAN=1,LUPPER)
1545 FORMAT(1P2E9.3,9E11.3)
      40 CONTINUE
      WRITE(NOT,1550) PAIRS8
1550 FORMAT(1H09X,6HPAIRS84X,58HNUMBER OF ENTRIES IN COOLANT DENSITY-TEREPLA311

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TEMPERATURE LIBRARY = I3)	REPLA361
WRITE(NOT,1555)	REPLA362
1555 FORMAT(20X,24HRHOTEM = TEMPERATURE (K) 11X,23HDENCOL = DENSITY (G/	REPLA363
1CC))	REPLA364
IF(PAIRS8.LE.0) GO TO 50	REPLA365
J1=1	REPLA366
J2=10	REPLA367
45 IF(J2.GT.PAIRS8) J2=PAIRS8	REPLA368
WRITE(NOT,1560) (RHOTEM(J),J=J1,J2)	REPLA369
1560 FORMAT(20X,6HRHOTEM4X,1P10E9.3)	REPLA370
WRITE(NOT,1565) (DENCOL(J),J=J1,J2)	REPLA371
1565 FORMAT(20X,6HDENCOL4X,1P10E9.3)	REPLA372
J1=J2+1	REPLA373
J2=J2+10	REPLA374
IF(J1.LE.PAIRS8) GO TO 45	REPLA375
50 CONTINUE	REPLA376
C	REPLA377
C PAGE 6	REPLA378
C	REPLA379
WRITE(NOT,1570) (TITLE(I),I=1,14)	REPLA380
1570 FORMAT(1H113A6,A2/1HCF0X,10HINPUT DATA/4H0***6X,16HPOWER CONDITION	REPLA381
1S/1H)	REPLA382
WRITE(NOT,1575) ANI	REPLA383
1575 FORMAT(1H09X,3HANI7X,35HINITIAL NEUTRONIC POWER (MEGAWATTS)4X,1H=1	REPLA384
1PE9.3)	REPLA385
WRITE(NOT,1580) ANIC	REPLA386
1580 FORMAT(1H09X,4HANIC6X,35HCONSTANT HEAT SOURCE (MEGAWATTS) 4X,1H=	REPLA387
11PE9.3)	REPLA388
WRITE(NOT,1585) FRACTF	REPLA389
1585 FORMAT(1H /1H 9X,6HFRACTF4X,35HFRACTION OF POWER DEPOSITED IN FUEL	REPLA390
14X,1H=F5.3)	REPLA391
WRITE(NOT,1590) FRACTB	REPLA392
1590 FORMAT(1H 9X,6HFRACTB4X,35HFRACTION OF POWER DEPOSITED IN BOND4X,1	REPLA393
1H=F5.3)	REPLA394
WRITE(NOT,1595) FRACTC	REPLA395
1595 FORMAT(10X,6HFRACTC4X,35HFRACTION OF POWER DEPOSITED IN CLAD4X,1H=	REPLA396
1F5.3)	REPLA397
WRITE(NOT,1600) FRACTS	REPLA398
1600 FORMAT(10X,6HFRACTS4X,40HFRACTION OF POWER DEPOSITED IN COOLANT =	REPLA399
15.3)	REPLA400
WRITE(NOT,1605) AXLAUG	REPLA401
1605 FORMAT(1H09X,6HAXLAUG4X,33HAXIAL EXTRAPOLATION DISTANCE (CM)6X,1H=	REPLA402
11PE9.3)	REPLA403
WRITE(NOT,1610) RADAUG	REPLA404
1610 FORMAT(10X,6HRADAUG4X,34HRADIAL EXTRAPOLATION DISTANCE (CM)5X,1H=	REPLA405
1PE9.3)	REPLA406
WRITE(NOT,1615)	REPLA407
1615 FORMAT(1H050X,27HAXIAL FLUX PROFILE, AXPFI(M))	REPLA408
WRITE(NOT,1620) (AXPFI(I),I=1,MUPPER)	REPLA409
1620 FORMAT((15X,1P10E10.3))	REPLA410
WRITE(NOT,1625)	REPLA411
1625 FORMAT(1H /1H049X,30HRADIAL FLUX PROFILE, CHANPFI(L))	REPLA412
WRITE(NOT,1630) (CHANPFI(I),I=1,LUPPER)	REPLA413
1630 FORMAT(15X,1P10E10.3)	REPLA414
WRITE(NOT,1635)	REPLA415
1635 FORMAT(1H045X,39HRELATIVE FUEL POWER DEPOSITION, RFPDI(N))	REPLA416
WRITE(NOT,1640) (RFPDI(I),I=1,NUPM3)	REPLA417
1640 FORMAT(15X,1P10E10.3)	REPLA418
WRITE(NOT,1645)	REPLA419
1645 FORMAT (/4H0***6X,16HBASIC NEUTRONICS)	REPLA420

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WRITE(NOT,1650) IKINET REPLA421
1650 FORMAT(1H09X,6HIKINET4X,57H KINETICS MODEL USED (0/1/2/3 = FINITE/ZREPLA422
1ERO/MIXED/POWER) =I2) REPLA423
WRITE(NOT,1655) M REPLA424
1655 FORMAT(10X,1HM9X,32HNUMBER OF DELAYED NEUTRON GROUPS24X,1H=I2) REPLA425
WRITE(NOT,1660) ALIFE REPLA426
1660 FORMAT(1H09X,5HALIFE5X,36HPROMPT NEUTRON GENERATION TIME (SEC)20X,REPLA427
11H=1PE9.3) REPLA428
IF (IKINET.EQ.2) GO TO 55 REPLA429
GO TO 60 REPLA430
55 WRITE(NOT,1665) RHOSWZ REPLA431
1665 FORMAT(10X,6HPHOSWZ4X,56HINPUT REACTIVITY SWITCHING LEVEL FOR ZERO REPLA432
1 APPROX (CENTS),1H=F8.4) REPLA433
WRITE(NOT,1670) ERROR2 REPLA434
1670 FORMAT(10X,6HERROR24X,56HFRACTIONAL ERROR ALLOWED IN POWER WHEN SW REPLA435
1ITCHING MODE ,1H=F8.4) REPLA436
60 WRITE(NOT,1675) B8 REPLA437
1675 FORMAT(10X,2HBB9X,30HTOTAL DELAYED NEUTRON FRACTION26X,1H=F7.5) REPLA438
WRITE(NOT,1680) REPLA439
1680 FORMAT(1H036X,5HGROUP4X,15HB(I) = FRACTION4X,30HAL(I) = DECAY CONS REPLA440
1TANT (1/SEC)) REPLA441
DO 65 I=1,M REPLA442
WRITE(NOT,1685) I,B(I),AL(I) REPLA443
1685 FORMAT(39X,I1,9X,0PF7.5,15X,1PE9.3) REPLA444
65 CONTINUE REPLA445
C REPLA446
C PAGE 7 REPLA447
C REPLA448
WRITE(NOT,1690) REPLA449
1690 FORMAT(4H1***6X,29HREACTIVITY INPUT AND FEEDBACK/1H ) REPLA450
IF(COEFFX.LT.1.E-30) GO TO 70 REPLA451
WRITE(NOT,1695) COEFFX REPLA452
1695 FORMAT(10X,6HCOEFFX4X,58HLINEAR EXPANSION TEMPERATURE COEFFICIENT REPLA453
1OF FUEL (1/DEG.K) 12X,1H=1PE9.3) REPLA454
GO TO 75 REPLA455
70 WRITE(NOT,1700) FCOE REPLA456
1700 FORMAT(1H09X,4HFCOE6X,63HLINEAR REACTIVITY TEMPERATURE COEFFICIENT REPLA457
1 OF FUEL (DEL.K/DEG.K)7X,1H=1PE9.3) REPLA458
75 CONTINUE REPLA459
IF(COEEX.LT.1.E-30) GO TO 80 REPLA460
WRITE(NOT,1705) COEEX REPLA461
1705 FORMAT(10X,6HCOEEX4X,58HLINEAR EXPANSION TEMPERATURE COEFFICIENT REPLA462
1OF CLAD (1/DEG.K) 12X,1H=1PE9.3) REPLA463
GO TO 85 REPLA464
80 WRITE(NOT,1710) ECOE REPLA465
1710 FORMAT(10X,4HECOE6X,63HLINEAR REACTIVITY TEMPERATURE COEFFICIENT REPLA466
1F CLAD (DEL.K/DEG.K)7X,1H=1PE9.3) REPLA467
85 WRITE(NOT,1715) CCOE REPLA468
1715 FORMAT(10X,4HCCOE6X,66HLINEAR REACTIVITY TEMPERATURE COEFFICIENT REPLA469
1F COOLANT (DEL.K/DEG.K)4X,1H=1PE9.3) REPLA470
IF(JUMPC) GO TO 90 REPLA471
WRITE(NOT,1720) REPLA472
1720 FORMAT(20X,66HCOOLANT REACTIVITY CHANGES CALCULATED FROM TABLES DE REPLA473
1NCOL,RHOTEM,WC) REPLA474
90 CONTINUE REPLA475
WRITE(NOT,1725) IDOP REPLA476
1725 FORMAT(10X,4HIDOP6X,61H SWITCH FOR DOPPLER WEIGHTING (0/1 = AVE. TEM REPLA477
1P/LOCAL WEIGHTING)9X,1H=I2) REPLA478
WRITE(NOT,1730) IDOPCH REPLA479
1730 FORMAT(10X,6HIDOPCH4X,71H SWITCH FOR DOPPLER CHANGE (0/1 = NONE/FD REPLA480

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1F*DOPCOE UPON VOIDING)          =I2)          REPLA481
WRITE(NOT,1735) FDOOP              REPLA482
1735 FORMAT(10X,6HFDOP 4X,71HVALUE BY WHICH DOPPLER COEFFICIENT IS MULREPLA483
1TIPLIED AFTER VOIDING OCCURS =1PE9.3)          REPLA484
WRITE(NOT,1740) DOPCOE              REPLA485
1740 FORMAT(10X,6HDOPCOE4X,19HDOPPLEP COEFFICIENTS1X,1H=1PE9.3)    REPLA486
WRITE(NOT,1745) (J,J=1,LUPPER)      REPLA487
1745 FORMAT(10X,5HDOPPW5X,40HDOPPLER WEIGHTING FACTORS(AXIAL,CHANNEL)/2REPLA488
10X,5HAXIAL38X,7HCHANNEL/19X,7HSEGMENT17,9I9)    REPLA489
DO 95 AXIAL=MUPPER,1,-1              REPLA490
WRITE(NOT,1750) AXIAL,(DOPPW(AXIAL,CHAN),CHAN=1,LUPPER)    REPLA491
1750 FORMAT(21X,I2,1PE13.3,9E9.3)    REPLA492
95 CONTINUE                          REPLA493
WRITE(NOT,1755) ENDPow              REPLA494
1755 FORMAT(1HD9X,6HENDPow4X,31H0VERPOWER FACTOR FOR SCRAM TRIP39X1H=1PREPLA495
1E9.3)                                REPLA496
WRITE(NOT,1760) PERIOD              REPLA497
1760 FORMAT(10X,6HPERIOD4X,17HPERIOD SCRAM TRIPS3X,1H=1PE9.3)    REPLA498
WRITE(NOT,1765) TEMSRM              REPLA499
1765 FORMAT(10X,6HTEMSRM4X,49HCOOLANT OUTLET TEMPERATURE FOR SCRAM TRIPREPLA500
1 (DEG.K)21X,1H=F6.0)              REPLA501
WRITE(NOT,1770) TDELAY              REPLA502
1770 FORMAT(10X,6HTDELAY4X,60HTIME DELAY BETWEEN SCRAM TRIP AND REACTIVREPLA503
ITY INSERTION (SEC)10X,1H=1PE9.3)    REPLA504
WRITE(NOT,1775) PAIRS2              REPLA505
1775 FORMAT(10X,6HPAIRS24X,45HNUMBER OF ENTRIES IN REACTIVITY INPUT LIBREPLA506
RARY25X,1H=I3)                      REPLA507
WRITE(NOT,1780)                    REPLA508
1780 FORMAT(20X,19HTIMEIN = TIME (SEC)10X,12HDKIN = DEL.K)    REPLA509
J1=1                                  REPLA510
J2=13                                 REPLA511
100 IF(J2.GT.PAIRS2) J2=PAIRS2      REPLA512
WRITE(NOT,1785) (TIMEIN(J),J=J1,J2)    REPLA513
1735 FORMAT(1H03X,6HTIMEIN5X,1P13E9.3)    REPLA514
WRITE(NOT,1790) (DKIN(J),J=J1,J2)    REPLA515
1790 FORMAT(5X,4HDKIN6X,1PE9.3,0PF7.4,12F9.4)    REPLA516
J1=J2+1                              REPLA517
J2=J2+13                             REPLA518
IF(J1.LE.PAIPS2) GO TO 100           REPLA519
I=PAIRS2-13                          REPLA520
IF(I.LT.0) I=1                       REPLA521
J=PAIRS3-13                          REPLA522
IF(J.LT.0) J=1                       REPLA523
IF((19+3*(I+J)+MUPPER).LE.48) GO TO 105    REPLA524
WRITE(NOT,1795)                    REPLA525
1795 FORMAT(1H1)                    REPLA526
105 WRITE(NOT,1800) PAIRS3           REPLA527
1800 FORMAT(1H09X,6HPAIRS34X,45HNUMBER OF ENTRIES IN REACTIVITY SCRAM LREPLA528
IBRARY25X,1H=I3)                    REPLA529
WRITE(NOT,1805)                    REPLA530
1805 FORMAT(20X,19HTIMOUT = TIME (SEC)10X,13HDKOUT = DEL.K)    REPLA531
J1=1                                  REPLA532
J2=13                                 REPLA533
110 IF(J2.GT.PAIRS3) J2=PAIRS3      REPLA534
WRITE(NOT,1810) (TIMOUT(J),J=J1,J2)    REPLA535
1810 FORMAT(1H03X,6HTIMOUT5X,1P13E9.3)    REPLA536
WRITE(NOT,1815) (DKOUT(J),J=J1,J2)    REPLA537
1815 FORMAT(4X,5HDKOUT5X,1PE9.3,0PF7.4,12F9.4)    REPLA538
J1=J2+1                              REPLA539
J2=J2+13                             REPLA540

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IF (J1.LE.PAIRS3) GO TO 110	REPLA541
C	REPLA542
C PAGE 8	REPLA543
C	REPLA544
WRITE(NOT,1820) (TITLE(I),I=1,14)	REPLA545
1820 FORMAT(1H113A6,A2/1H060X,10HINPUT DATA/4H0***6X,17HCOLLAPSE FEEDBACK	REPLA546
1CK/1H)	REPLA547
WRITE(NOT,1825) ICOLPS	REPLA548
1825 FORMAT(1CX,6HICOLPS4X,51HCOLLAPSE SWITCH (0/1 = COLLAPSE ALLOWED/N	REPLA549
10 COLLAPSE9X,1H=I2)	REPLA550
IF (CHI.GT.-1) GO TO 115	REPLA551
ABLE=-CHI	REPLA552
WRITE(NOT,1830) ABLE	REPLA553
1830 FORMAT(1H09X3HCHI7X36HFUEL EJECTION PRESSURE (DYNES/CM**2) 24X**'	REPLA554
A1PE9.3)	REPLA555
GO TO 120	REPLA556
115 CONTINUE	REPLA557
WRITE(NOT,1835) GRAV	REPLA558
1835 FORMAT(1H09X,4HGRAV6X,50HFORCING FUNCTION IN EQUATION OF MOTION (C	REPLA559
1M/SEC**2)10X,1H=1PE9.3)	REPLA560
WRITE(NOT,1840) CHI	REPLA561
1840 FORMAT(1CX,3HCHI7X,42HVISCOUS TERM IN EQUATION OF MOTION (1/SEC)18	REPLA562
1X,1H=1PE9.3)	REPLA563
120 CONTINUE	REPLA564
WRITE(NOT,1845) TRIPF	REPLA565
1845 FORMAT(1H09X,5HTRIPF5X,59HFUEL CENTERLINE TEMPERATURE AT WHICH CL	REPLA566
1D FAILS (DEGREES K)1X,1H=F7.0)	REPLA567
WRITE(NOT,1850) ITRIP	REPLA568
1850 FORMAT(10X5HITRIP5X36HFUEL NODE TO BE MONITORED FOR TRIPFO 24X**'	REPLA569
1I3)	REPLA570
WRITE(NOT,1855) TRIPFO	REPLA571
1855 FORMAT(10X6HTRIPFO4X56HTEMPERATURE AT WHICH FUEL NODE ITRIP CAUSE	REPLA572
1 CLAD FAILURE 4X**='F7.0)	REPLA573
WRITE(NOT,1860) TRIPE	REPLA574
1860 FORMAT(10X,5HTRIPE5X,48HCLAD TEMPERATURE AT WHICH CLAD FAILS (DEGR	REPLA575
1EES K)12X,1H=F7.0)	REPLA576
WRITE(NOT,1865) TRIPC	REPLA577
1865 FORMAT(10X,5HTRIPC5X,51HCOOLANT TEMPERATURE AT WHICH CLAD FAILS (D	REPLA578
1EGREES K)9X,1H=F7.0)	REPLA579
WRITE(NOT,1870)	REPLA580
1870 FORMAT(1H09X,2HWF8X,41HFUEL WORTH THROUGHOUT THE CORE (DEL.K/KG))	REPLA581
WRITE(NOT,1875) (J,J=1,LUPPER)	REPLA582
1875 FORMAT(13X,5HAXIAL25X,7HCHANNEL/12X,7HSEGMENTI6,9I9)	REPLA583
DO 125 AXIAL=MUPPER,1,-1	REPLA584
WRITE(NOT,1880) AXIAL,(WF(AXIAL,CHAN),CHAN=1,LUPPER)	REPLA585
1880 FORMAT(14X,12,1PE12.3,9E9.3)	REPLA586
125 CONTINUE	REPLA587
C	REPLA588
C PAGE 9	REPLA589
C	REPLA590
WRITE(NOT,1885) (TITLE(I),I=1,14)	REPLA591
1885 FORMAT(1H113A6,A2/61X,10HINPUT DATA/4H ***6X,23HSODIUM VOIDING FE	REPLA592
1DBACK/1H)	REPLA593
WRITE(NOT,1890) IVOIDS	REPLA594
1890 FORMAT(10X,6HIVOID5X,49HVOIDING SWITCH (0/1 = VOIDING ALLOWED/NO	REPLA595
1VOIDING)29X,1H=I3)	REPLA596
WRITE(NOT,1895) IVOID	REPLA597
1895 FORMAT(10X,5HIVOID5X,71HVOIDING START (0/1/2/3 = CHECK ALL NODES/P	REPLA598
1REDETERMINED/COLLAPSE/BUBBLE) 6X,1H=I3)	REPLA599
WRITE(NOT,1900) MUX	REPLA600

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1900 FORMAT(10X,3HMUX7X,45HPREDETERMINED AXIAL NODE FOR START OF VOIDINGREPLA601
1G32X,1H=I3) REPLA602
WRITE(NOT,1905) IFLOW REPLA603
1905 FORMAT(1H09X,6HIFLOW 4X,73H SWITCH FOR VOIDING DURING LOSS-OF-FLOW REPLA604
1ACCIDENTS (0/1 = NO/YES) =I3) REPLA605
WRITE(NOT,1910) IPOWER REPLA606
1910 FORMAT(10X, 6HIPOWER4X,78H SWITCH FOR VOIDING DURING POWER TRANSIEREPLA607
1NT ACCIDENTS (0/1 = NO/YES) =I3) REPLA608
WRITE(NOT,1915) IGAS REPLA609
1915 FORMAT(10X, 6HIGAS 4X,78H SWITCH FOR VOIDING DUE TO EXPANSION OF REPLA610
1FISSION GAS (0/1 = NO/YES) =I3) REPLA611
WRITE(NOT,1920) TRIPX REPLA612
1920 FORMAT(1H09X,5HTRIPX5X,55HCOOLANT TEMPERATURE FOR START OF VOIDINGREPLA613
1 (K) (I VOID=0)22X,1H=F7.0) REPLA614
WRITE(NOT,1925) TRIPCV REPLA615
1925 FORMAT(' *9X6HTRIPCV4X*CLAD TEMPERATURE FOR START OF VOIDING*40X*'=REPLA616
1F7.0) REPLA617
WRITE(NOT,1930) DENVOD REPLA618
1930 FORMAT(1H09X,6HDENVOD4X,34HRELATIVE FRACTION OF COMPLETE VOID43X,REPLA619
11H=F7.2) REPLA620
WRITE(NOT,1935) A1 REPLA621
1935 FORMAT(1H09X,2HA18X,58HCONSTANT TERM IN UPWARD SODIUM EJECTION EQUAREPLA622
1ATION OF MOTION19X,1H=1PE9.3) REPLA623
WRITE(NOT,1940) A2 REPLA624
1940 FORMAT(10X,2HA28X,56HLINEAR TERM IN UPWARD SODIUM EJECTION EQUATIOREPLA625
1N OF MOTION21X,1H=1PE9.3) REPLA626
WRITE(NOT,1945) A3 REPLA627
1945 FORMAT(10X,2HA38X,59HQUADRATIC TERM IN UPWARD SODIUM EJECTION EQUAREPLA628
1TION OF MOTION18X,1H=1PE9.3) REPLA629
WRITE(NOT,1950) A4 REPLA630
1950 FORMAT(10X,2HA48X,55HCUBIC TERM IN UPWARD SODIUM EJECTION EQUATIONREPLA631
1 OF MOTION22X,1H=1PE9.3) REPLA632
WRITE(NOT,1955) TA2 REPLA633
1955 FORMAT(10X,3HTA27X,71HDELAY IN LINEAR TERM IN UPWARD SODIUM EJECTIREPLA634
1ON EQUATION OF MOTION (SEC)6X,1H=1PE9.3) REPLA635
WRITE(NOT,1960) TA3 REPLA636
1960 FORMAT(10X,3HTA37X,78HDELAY IN QUADRATIC TERM IN UPWARD SODIUM EJEEREPLA637
1CTION EQUATION OF MOTION (SEC) =1PE9.3) REPLA638
WRITE(NOT,1965) TA4 REPLA639
1965 FORMAT(10X,3HTA47X,70HDELAY IN CUBIC TERM IN UPWARD SODIUM EJECTIONREPLA640
1N EQUATION OF MOTION (SEC)7X,1H=1PE9.3) REPLA641
WRITE(NOT,1970) B1 REPLA642
1970 FORMAT(1H09X,2HB18X,60HCONSTANT TERM IN DOWNWARD SODIUM EJECTION EREPLA643
1QUATION OF MOTION17X,1H=1PE9.3) REPLA644
WRITE(NOT,1975) B2 REPLA645
1975 FORMAT(10X,2HB28X,58HLINEAR TERM IN DOWNWARD SODIUM EJECTION EQUATREPLA646
1ION OF MOTION19X,1H=1PE9.3) REPLA647
WRITE(NOT,1980) B3 REPLA648
1980 FORMAT(10X,2HB38X,61HQUADRATIC TERM IN DOWNWARD SODIUM EJECTION EOREPLA649
1UATION OF MOTION16X,1H=1PE9.3) REPLA650
WRITE(NOT,1985) B4 REPLA651
1985 FORMAT(10X,2HB48X,57HCUBIC TERM IN DOWNWARD SODIUM EJECTION EQUATIREPLA652
1ON OF MOTION20X,1H=1PE9.3) REPLA653
WRITE(NOT,1990) TB2 REPLA654
1990 FORMAT(10X,3HTB27X,73HDELAY IN LINEAR TERM IN DOWNWARD SODIUM EJEEREPLA655
1TION EQUATION OF MOTION (SEC)4X,1H=1PE9.3) REPLA656
WRITE(NOT,1995) TB3 REPLA657
1995 FORMAT(10X,3HTB37X,78HDELAY IN QUADRATIC TERM IN DOWNWARD SODIUM EEREPLA658
1JECTION EQUATION OF MOTION (SEC) =1PE9.3) REPLA659
WRITE(NOT,2000) TB4 REPLA660

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2000 FORMAT(10X,3HTB47X,72HDELAY IN CUBIC TERM IN DOWNWARD SODIUM EJECT REPLA661
      ION EQUATION OF MOTION (SEC)5X,1H=1PE9.3) REPLA662
      IF (IVOID.NE.3) GO TO 130 REPLA663
      WRITE(NOT,2005) REPLA664
2005 FORMAT('D'19X*PARAMETERS FOR BUBBLE PASSING THROUGH CORE*) REPLA665
      WRITE(NOT,2010) REPLA666
2010 FORMAT(42X*CHANNEL*) REPLA667
      WRITE(NOT,2015) (J,J=1,LUPPER) REPLA668
2015 FORMAT(17X,I9,9I10) REPLA669
      WRITE(NOT,2020) (TENTRY(L),L=1,LUPPER) REPLA670
2020 FORMAT(9X*TENTRY(L)'1PE13.3,9E10.3) REPLA671
      WRITE(NOT,2025) (DSEP(L),L=1,LUPPER) REPLA672
2025 FORMAT(9X*DSEP(L)'1PE13.3,9E10.3) REPLA673
      130 WRITE(NOT,2030) REPLA674
2030 FORMAT('D'9X*WC*8X*SODIUM VOIDING WORTH (DEL.K/KG)*) REPLA675
      WRITE(NOT,2035) (J,J=1,LUPPER) REPLA676
2035 FORMAT(13X6HHEIGHT24X7HCHANNEL/15X2HCM19,9I10) REPLA677
      ABLE=Z(MUPPER+1)-.5*ZSEG REPLA678
      DO 135 AXIAL=MUPPER,1,-1 REPLA679
      WRITE(NOT,2040) ABLE,(WC(AXIAL,CHAN),CHAN=1,LUPPER) REPLA680
2040 FORMAT(OPF19,2,1PE13.3,9E10.3) REPLA681
      135 ABLE=ABLE-ZSEG REPLA682
      WRITE(NOT,2045) ZBOT REPLA683
2045 FORMAT(10X4HZBOT6X64HSTARTING ELEVATION OF SODIUM WORTHS RELATIVE REPLA684
      ITO CORE BOTTOM (CM) 13X*='F7.2) REPLA685
      WRITE(NOT,2050) ZSEG REPLA686
2050 FORMAT(10X4HZSEG6X40HAXIAL DISTANCE BETWEEN WORTH POINTS (CM) 37X, REPLA687
      1*='F7.2) REPLA688
C REPLA689
C PAGE 10 REPLA690
C REPLA691
      WRITE(NOT,2055) (TITLE(I),I=1,14) REPLA692
2055 FORMAT(1H113A6,A2/1HDECX,10HINPUT DATA/4H0*** 6X,40HPRESSURE DROP REPLA693
      1SPECIFICATIONS FOR VOIDING/1H ) REPLA694
      WRITE(NOT,2060) ZTOP REPLA695
2060 FORMAT(1H019X,4HZTOP6X,52HDISTANCE FROM TOP OF CORE TO TOP OF FUEL REPLA696
      1 BUNDLE (CM)28X,1H=1PE9.3) REPLA697
      WRITE(NOT,2065) ZBOTOM REPLA698
2065 FORMAT(1H019X,6HZBOTOM4X,58HDISTANCE FROM BOTTOM OF CORE TO BOTTOM REPLA699
      1 OF FUEL BUNDLE (CM)22X,1H=1PE9.3) REPLA700
      WRITE(NOT,2070) ZPLEN REPLA701
2070 FORMAT(1H019X,5HZPLEN5X,33HLENGTH OF FISSION GAS PLENUM (CM)47X,1H REPLA702
      1=1PE9.3) REPLA703
      WRITE(NOT,2075) PEXIT REPLA704
2075 FORMAT(1H019X,5HPEXIT5X,47HPRESSURE AT CHANNEL OUTLET DURING VOID REPLA705
      1NG (ATM)33X,1H=1PE9.3) REPLA706
      WRITE(NOT,2080) PINLET REPLA707
2080 FORMAT(1H019X,6HPINLET4X,46HPRESSURE AT CHANNEL INLET DURING VOID REPLA708
      1NG (ATM)34X,1H=1PE9.3) REPLA709
      WRITE(NOT,2085) PNA REPLA710
2085 FORMAT(1H019X,3HPNA7X,50HINITIAL PRESSURE FOR FUEL-SODIUM INTERACT REPLA711
      1ION (ATM)30X,1H=1PE9.3) REPLA712
      WRITE(NOT,2090) PGAS REPLA713
2090 FORMAT(1H019X,4HPGAS6X,35HPRESSURE IN FISSION GAS PLENUM (ATM)44X, REPLA714
      1H=1PE9.3) REPLA715
      WRITE(NOT,2095) GAMMA REPLA716
2095 FORMAT(1H019X,5HGAMMA5X,47HRTIO OF SPECIFIC HEATS FOR FISSION GAS REPLA717
      1 (CP/CV)33X,1H=1PE9.3) REPLA718
      WRITE(NOT,2100) DEQ REPLA719
2100 FORMAT(1H019X,3HDEQ7X,23HHYDRAULIC DIAMETER (CM)57X,1H=1PE9.3) REPLA720

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      WRITE(NOT,2105) FRICT1 REPLA721
2105 FORMAT(1H019X,6HFRICT14X,65HCONSTANTS IN THE FRICTION FACTOR CORREPLA722
      ILATION FOR THE FUEL BUNDLE:15X,1H=1PE9.3) REPLA723
      WRITE(NOT,2110) FRICT2 REPLA724
2110 FORMAT(1H019X,6HFRICT24X,63HFRICT = FRICT1/PE**FRICT2 ( = 0.184/PEREPLA725
      1**0.2 FOR SMOOTH TUBES )17X,1H=1PE9.3) REPLA726
      WRITE(NOT,2115) DZATOP REPLA727
2115 FORMAT(1H019X,6HDZATOP4X,57HSUM OF LENGTH/AREA FROM TOP OF FUEL BUREPLA728
      INOLE TO CHANNEL OUTLET (1/CM)13X,1H=1PE9.3) REPLA729
      WRITE(NOT,2120) DZABOT REPLA730
2120 FORMAT(1H019X,6HDZABOT4X,69HSUM OF LENGTH/AREA FROM BOTTOM OF FUELREPLA731
      1 BUNCLE TO CHANNEL INLET (1/CM)11X,1H=1PE9.3) REPLA732
      WRITE(NOT,2125) DPTOP1 REPLA733
2125 FORMAT(1H019X,6HDPTOP14X,71HEQUIVALENT NUMBER OF VELOCITY HEADS FOREPLA734
      1R MOMENTUM LOSSES ABOVE CORE (CM)9X,1H=1PE9.3) REPLA735
      WRITE(NOT,2130) DPTOP2 REPLA736
2130 FORMAT(1H019X,6HDPTOP24X,75HEQUIVALENT LENGTH OF FUEL BUNDLE FOR FREPLA737
      1RICTION LOSSES ABOVE FUEL BUNDLE (CM)5X,1H=1PE9.3) REPLA738
      WRITE(NOT,2135) DPBOT1 REPLA739
2135 FORMAT(1H019X,6HDPBOT14X,71HEQUIVALENT NUMBER OF VELOCITY HEADS FOREPLA740
      1R MOMENTUM LOSSES BELOW CORE (CM)9X,1H=1PE9.3) REPLA741
      WRITE(NOT,2140) DPBOT2 REPLA742
2140 FORMAT(1H019X,6HDPBOT24X,75HEQUIVALENT LENGTH OF FUEL BUNDLE FOR FREPLA743
      1RICTION LOSSES BELOW FUEL BUNDLE (CM)5X,1H=1PE9.3) REPLA744
C REPLA745
C PAGE 11 REPLA746
C REPLA747
      WRITE(NOT,2145) (TITLE(I),I=1,14) REPLA748
2145 FORMAT(1H113A6,A2/61X,1CHINPUT DATA/4H ***6X,23HPLOTTING SPECIFICAREPLA749
      ITIONS/1H0) REPLA750
      WRITE(NOT,2150) REPLA751
2150 FORMAT(10X,22HMACROSCOPIC CORE PLOTS//33X,50H PLOT NO. XORIGN REPLA752
      1 XINCR YORIGN YINCR ) REPLA753
      DO 140 J=1,50,5 REPLA754
      IF(ARPL0T(J).EQ.0.) GO TO 145 REPLA755
      NTPL0T = J REPLA756
      WRITE(NOT,2155) NTPL0T,ARPL0T(J),ARPL0T(J+1),ARPL0T(J+2),ARPL0T(J+REPLA757
      13),ARPL0T(J+4) REPLA758
2155 FORMAT(20X,7HARPL0T(I2,4H) = F10.3,1PE10.3,3E10.3) REPLA759
      140 CONTINUE REPLA760
      145 CONTINUE REPLA761
      WRITE(NOT,2160) REPLA762
2160 FORMAT(1H ) REPLA763
      WRITE(NOT,2165) REPLA764
2165 FORMAT(10X,17HTEMPERATURE PLOTS//33X,70H PLOT NO. CHAN NO. AXIALREPLA765
      1 NO. XORIGN XINCR YORIGN YINCR ) REPLA766
      DO 150 J=1,800,7 REPLA767
      IF(TPL0T(J).EQ.0.) GO TO 155 REPLA768
      NTPL0T = J REPLA769
      WRITE(NOT,2170) NTPL0T,TPL0T(J),TPL0T(J+1),TPL0T(J+2),TPL0T(J+3),TREPLA770
      1PL0T(J+4),TPL0T(J+5),TPL0T(J+6) REPLA771
2170 FORMAT(20X,6HTPL0T(I3,4H) = 3F10.3,1PE10.3,3E10.3) REPLA772
      150 CONTINUE REPLA773
      155 CONTINUE REPLA774
      RETURN REPLA775
      END REPLA776

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a ELT OUTSML*1.720604* 49898
  SUBROUTINE OUTSML
C
C   SUBROUTINE OUTSML PRINTS A SMALL OUTPUT EVERY DELSTP TIME STEPS
C
  INCLUDE ABC
  ANZ=AN(NEW)
  TEMP(1)=RH(NEW)*880100
  TEMP(2)=KINSRT(NEW)*880100
  TEMP(3)=-KWTHDR(NEW)*880100
  TEMP(4)=DOPPK(NEW)*880100
  TEMP(5)=COLAPK(NEW)*880100
  TEMP(6)=VOIDK(NEW)*880100
C
  IF(LINESL.GT.LUPPER) GO TO 10
C
  WRITE(NOT,1000) (TITLE(I),I=1,14),AX
1000 FORMAT(1H113A6,A2/57H)ALL TEMPERATURES IN DEGREES K. ALL REACTIVITOUTSM 17
  IES IN CENTS33X,13HAXIAL SEGMENTI4/
  X          69HQ      TIME(SEC)/ POWER(MW)/ CORE TEMP/ MOL TEMP/ OUTSM 19
  2 % MELT/      MW SEC/30X,4HFUEL/67H      NET RHO/  PROGRAMED/  SCROUTSM 20
  3AM/          DOPPLER/ COLLAPSE/  VOID/24X,12HFUEL  OUTER/65H STEP  COUTSM 21
  41           C2      C3      C4      C5      C614X,38HCHAOUTSM 22
  5NNEL  CENTER  NODE  CLAC  COOLANT)
  LINESL=41
C
  10 WRITE(NOT,1005) STEP,T(NEW),ANZ,FUELT,TEMOL,PCMELT,QGEN(NEW),TEMPEOUTSM 26
  1R(1,AX,1,NEW),TEMPER(NUPM3,AX,1,NEW),TEMPER(NUPM1,AX,1,NEW),TEMPEROUTSM 27
  2(NUPPER,AX,1,NEW)
  1005 FORMAT(15,1PE10.4,5E11.4,13X,1H15X,OP4F7.0)
  WRITE(NOT,1010) (TEMP(I),I=1,6),TEMPER(1,AX,2,NEW),TEMPER(NUPM3,AX,OUTSM 30
  1,2,NEW),TEMPER(NUPM1,AX,2,NEW),TEMPER(NUPPER,AX,2,NEW)
  1010 FORMAT(3X,6F11.3,14X,1H25X,4F7.0)
  WRITE(NOT,1015) (C(I,NEW),I=1,6),TEMPER(1,AX,3,NEW),TEMPER(NUPM3,AOUTSM 33
  1X,3,NEW),TEMPER(NUPM1,AX,3,NEW),TEMPER(NUPPER,AX,3,NEW)
  1015 FORMAT(4X,1PE11.4,13X,1H35X,OP4F7.0)
  LINESL=LINESL-3
  J=LUPPER-3
  IF(J.LE.0) GO TO 20
C
  DO 15 CHAN=4,LUPPER
  WRITE(NOT,1020) CHAN,TEMPER(1,AX,CHAN,NEW),TEMPER(NUPM3,AX,CHAN,NEOUTSM 41
  1W),TEMPER(NUPM1,AX,CHAN,NEW),TEMPER(NUPPER,AX,CHAN,NEW)
  1020 FORMAT(82X,I2,5X,4F7.0)
  15 CONTINUE
C
  LINESL=LINESL-LUPPER+3
  20 LINESL=LINESL-1
  WRITE(NOT,1025)
  1025 FORMAT(1H )
  RETURN
  END

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@ ELT OUTBIG,1,720604, 49902
  SUBROUTINE OUTBIG
C
C   SUBROUTINE OUTBIG PRINTS A COMPREHENSIVE OUTPUT AT INTERVALS
C   CONTROLLED BY THE TIME PRINTOUT LIBRARY OR AT EVERY DELTOT SECONDS
C   AFTER COOLANT VOIDING OR FUEL COLLAPSE BEGINS. ALSO, OUTBIG
C   WRITES THE DRUM WITH INFORMATION LATER RETRIEVED BY WRAPUP.
C   SUBROUTINE CURVE IS CALLED.
C
  INCLUDE ABC
  DATA BLANK/1H /,VOID/6H VOID /
  WRITE(NOT,1000) (TITLE(I),I=1,14)
1000 FORMAT(1H113A6,A2/57HALL TEMPERATURES IN DEGREES K, ALL REACTIVIT
1IES IN CENTS/80HC TIME(SEC) POWER(MW) CORE TEMP MOL TEMP % OUTBI 12
2MELT MW-SEC GEN MW-SEC OUT2X,13HMOLTEN MW-SEC3X,17HKILOS MOLTEOUTBI 14
3N FUEL)
  TEMP(7)=FLINEK(NEW)*BB0100
  TEMP(8)=FLINEK(NEW)*BB0100
  TEMP(9)=CLINEK(NEW)*BB0100
  TEMP(1)=RH(NEW)*BB0100
  TEMP(2)=KINSRT(NEW)*BB0100
  TEMP(3)=-KWTHDR(NEW)*BB0100
  TEMP(4)=DOPPK(NEW)*BB0100
  TEMP(5)=COLAPK(NEW)*BB0100
  TEMP(6)=VOIDK(NEW)*BB0100
C
C   COMPUTE EFFECTIVE DOPPLER COEFFICIENT
C
  IF (FUELTO/FUELTO.LE..1) FUELTO=FUEL-1.
  DOPEFF = (DOPPK(NEW)-DOPPKS)/(ALOG(FUEL/FUELTO))
  DOPPKS = DOPPK(NEW)
  FUELTO = FUEL
C
C   WRITE INTERNAL CORE QUANTITIES
C
  WRITE(NOT,1005) T(NEW),AN(NEW),FUEL,TEMOL,PCMELT,GEN(NEW),GOUT(NOUTBI 35
1EW),QMOL,GMSMOL
1005 FORMAT(2X,1P7E11.4,E13.4,E19.4/97H NET RHO PROGRAMED SCRAM OUTBI 37
1 DOPPLER COLLAPSE VOID LINEAR-FUEL CLAD COOLANT)OUTBI 38
  WRITE(NOT,1010) (TEMP(I),I=1,9)
1010 FORMAT(F9.3,8F11.3/7X,2HC19X,2HC29X,2HC39X,2HC49X,2HC59X,2HC6) OUTBI 40
  WRITE(NOT,1015) (C(I,NEW),I=1,6), DOPEFF, DOPVD
1015 FORMAT(2X,1P6E11.4,5X,10HEFF DOPP =,DPPF10.6,12H VOID DOPP =,F10.6)OUTBI 42
C
C   WRITE REQUESTED TEMPERATURES IN MOST COMPACT FORM
C
  LINESL=40
  IF(NUP.GT.LUP.AND.NUP.GT.MUP) GO TO 120
  IF( LUP-MUP ) 10,10,15
  10 IF( NUP-LUP ) 20,20,45
  15 IF( NUP-MUP ) 70,70,95
C
C   ..... AXIAL LEVELS .GE. CHANNELS .GE. RADIAL PIN NODES .....
C
  20 DO 40 FRAD=FR1,FR2
  IF(LINESL-LUP-3) 25,30,30
  25 WRITE(NOT,1020)
1020 FORMAT(1H1)
  LINESL=48
  30 WRITE(NOT,1025) FRAD,AX1,AX2
1025 FORMAT(1CHGFUEL NODEI3/8H CHANNEL1CX,16HAXIAL SEGMENT I2,4H--->IOUTBI 60

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13)	DO 35 CHAN=CH1,CH2	OUTBI 61
	WRITE(NOT,1035) CHAN,(TEMPER(FRAD,I,CHAN,NEW),I=AX1,AX2)	OUTBI 62
1030	FORMAT(20X,I2,15F7.0)	OUTBI 63
1035	FORMAT(15,6X,20F6.0)	OUTBI 64
35	CONTINUE	OUTBI 65
40	LINESL=LINESL-LUP-3	OUTBI 66
	GO TO 175	OUTBI 67
C		OUTBI 68
C	..... AXIAL LEVELS .GE. RADIAL PIN NODES .GT. CHANNELS	OUTBI 69
C		OUTBI 70
45	DO 65 CHAN=CH1,CH2	OUTBI 71
	IF(LINESL-NUP-3) 50,55,55	OUTBI 72
50	WRITE(NOT,1020)	OUTBI 73
	L+NESL=48	OUTBI 74
55	WRITE(NOT,1040) CHAN,AX1,AX2	OUTBI 75
1040	FORMAT(8HCHANNEL I3/10H FUEL NODE3X,16HAXIAL SEGMENT I2,4H--->I3)	OUTBI 76
1)		OUTBI 77
	DO 60 FRAD=FR1,FR2	OUTBI 78
	WRITE(NOT,1035) FRAD,(TEMPER(FRAD,I,CHAN,NEW),I=AX1,AX2)	OUTBI 79
60	CONTINUE	OUTBI 80
65	LINESL=LINESL-NUP-3	OUTBI 81
	GO TO 175	OUTBI 82
C		OUTBI 83
C	..... CHANNELS .GT. AXIAL LEVELS .GE. RADIAL PIN NODES	OUTBI 84
C		OUTBI 85
70	DO 90 FRAD=FR1,FR2	OUTBI 86
	IF(LINESL-MUP-2) 75,75,80	OUTBI 87
75	WRITE(NOT,1020)	OUTBI 88
	LINESL=48	OUTBI 89
80	WRITE(NOT,1045) FRAD,CH1,CH2	OUTBI 90
1045	FORMAT(10HOFUEL NODEI3,5X,7HSEGMENT5X,10HCHANNEL I2,5H --->I3)	OUTBI 91
	DO 85 IX=AX2,AX1,-1	OUTBI 92
	WRITE(NOT,1030) IX,(TEMPER(FRAD,IX,CHAN,NEW),CHAN=CH1,CH2)	OUTBI 93
85	CONTINUE	OUTBI 94
90	LINESL=LINESL-MUP-2	OUTBI 95
	GO TO 175	OUTBI 96
C		OUTBI 97
C	..... CHANNELS .GT. RADIAL PIN NODES .GT. AXIAL LEVELS	OUTBI 98
C		OUTBI 99
95	DO 115 IX=AX2,AX1,-1	OUTBI100
	IF(LINESL-NUP-2) 100,100,105	OUTBI101
100	WRITE(NOT,1020)	OUTBI102
	LINESL=48	OUTBI103
105	WRITE(NOT,1050) IX,CH1,CH2	OUTBI104
1050	FORMAT(8H0SEGMENTI3,5X,10HFUEL NODE,5X,10HCHANNEL I2,5H -->I3)	OUTBI105
	DO 110 FRAD=FR1,FR2	OUTBI106
	WRITE(NOT,1030) FRAD,(TEMPER(FRAD,IX,CHAN,NEW),CHAN=CH1,CH2)	OUTBI107
110	CONTINUE	OUTBI108
115	LINESL=LINESL-NUP-2	OUTBI109
	GO TO 175	OUTBI110
120	IF(LUP-MUP) 125,125,150	OUTBI111
C		OUTBI112
C	..... RADIAL PIN NODES .GT. AXIAL LEVELS .GE. CHANNELS	OUTBI113
C		OUTBI114
125	DO 145 CHAN=CH1,CH2	OUTBI115
	IF(LINESL-LUP-2) 130,135,135	OUTBI116
130	WRITE(NOT,1020)	OUTBI117
	LINESL=48	OUTBI118
135	WRITE(NOT,1055) CHAN,FR1,FR2	OUTBI119
		OUTBI120

1055	FORMAT(8H0CHANNEL I3,7X,7HSEGMENT 5X, 12HFUEL NODE I2,5H --->I3)	OUTBI121
	DO 140 IX=AX2,AX1,-1	OUTBI122
	WRITE(NOT,1030) IX,(TEMPER(I,IX,CHAN,NEW),I=FR1,FR2)	OUTBI123
140	CONTINUE	OUTBI124
145	LINESL=LINESL-LUP-2	OUTBI125
	GO TO 175	OUTBI126
C		OUTBI127
C	..... RADIAL PIN NODES .GT. CHANNELS .GT. AXIAL LEVELS	OUTBI128
C		OUTBI129
150	DO 170 IX=AX1,AX2	OUTBI130
	IF(LINESL-MUP-2) 155,160,160	OUTBI131
155	WRITE(NOT,1020)	OUTBI132
	LINESL=48	OUTBI133
160	WRITE(NOT,1060) IX,FR1,FR2	OUTBI134
1060	FORMAT(8H0SEGMENT I3,7X,7HCHANNEL 5X,12HFUEL NODE I2,5H --->I3)	OUTBI135
	DO 165 CHAN=CH1,CH2	OUTBI136
	WRITE(NOT,1030) CHAN,(TEMPER(I,IX,CHAN,NEW),I=FR1,FR2)	OUTBI137
165	CONTINUE	OUTBI138
170	LINESL=LINESL-MUP-2	OUTBI139
175	CONTINUE	OUTBI140
180	IF(IWRAP.EQ.C) GO TO 200	OUTBI141
C		OUTBI142
C	WRITE DRUM FOR LATER RETRIEVAL BY WRAPUP	OUTBI143
C		OUTBI144
	JTIMES=JTIMES+1	OUTBI145
C		OUTBI146
C	..... WRITE DRUM WITH CORE QUANTITIES	OUTBI147
C		OUTBI148
	WRITE(23) T(NEW),AN(NEW),QGEN(NEW),QOUT(NEW),QMOL,TEMOL,PCMELT,GMS	OUTBI149
	1MOL,FUEL	OUTBI150
C		OUTBI151
C	..... WRITE DRUM WITH REACTIVITY CONTRIBUTIONS	OUTBI152
C		OUTBI153
	WRITE(24) T(NEW),(TEMP(I),I=1,9)	OUTBI154
C		OUTBI155
C	..... WRITE DRUM WITH PIN TEMPERATURES	OUTBI156
C		OUTBI157
	IADD=4200-NUPPER-4	OUTBI158
	ISTART=ITAB(17)+NUPPER+4	OUTBI159
	ITAB(17)=ITAB(17)-IADD	OUTBI160
	DO 190 CHAN=1,LUPPER	OUTBI161
	DO 185 AXIAL=1,MUPPER	OUTBI162
	ITAB(17)=ITAB(17)+IADD	OUTBI163
185	WRITE(25) T(NEW),(TEMPER(FRAD,AXIAL,CHAN,NEW),FRAD=1,NUPPER)	OUTBI164
190	CONTINUE	OUTBI165
C		OUTBI166
C	..... WRITE DRUM WITH COOLANT VELOCITIES	OUTBI167
C		OUTBI168
	ITAB(17)=ISTART	OUTBI169
	ABLE=1./(3.14159*VOLUME(NUPPER))	OUTBI170
	DO 195 CHAN=1,LUPPER	OUTBI171
	CALL CURVE(TEMP(CHAN),T(NEW),TIMFLO,FLW(1,CHAN),PAIRS5,\$195)	OUTBI172
195	TEMP(CHAN)=TEMP(CHAN)*ABLE	OUTBI173
	WRITE(26) T(NEW),(TEMP(CHAN),CHAN=1,LUPPER)	OUTBI174
C		OUTBI175
C	..... WRITE DRUM WITH COOLANT OUTLET TEMPERATURES	OUTBI176
C		OUTBI177
	WRITE(27) T(NEW),TIN(NEW),(TEMPER(NUPPER,MUPPER,CHAN,NEW),CHAN=1,	OUTBI178
	1LUPPER)	OUTBI179
200	IF(TCOLP(NEW).GT.0.0) GO TO 205	OUTBI180

C	GO TO 220	OUTBI181
C	..... WRITE DOWNWARD MOTION OF FUEL SEGMENTS	OUTBI182
C		OUTBI183
	205 WRITE(NOT,1065) (TITLE(I),I=1,14),TCOLP(NEW)	OUTBI184
	1065 FORMAT(1H113A6,A2/33HCDOWNWARD MOTION OF SEGMENTS (CM)10X,30HTIME	OUTBI185
	1SINCE START OF COLLAPSE = 3PF10.3,10H MILLI SEC/1H050X,7HCHANNEL)	OUTBI186
	WRITE(NOT,1070) (I,I=1,LUPPER)	OUTBI187
	1070 FORMAT(8H SEGMENT10I10)	OUTBI188
	DO 210 AXIAL=MUPPER,1,-1	OUTBI189
	WRITE(NOT,1075) AXIAL,(MOVE(AXIAL,CHAN),CHAN=1,LUPPER)	OUTBI190
	1075 FORMAT(15,5X,10F10.3)	OUTBI191
	210 CONTINUE	OUTBI192
	ABLE=(COLAPK(NEW)-COLAPK(OLD))*BB0100/H(NEW)	OUTBI193
	WRITE(NOT,1080) ABLE	OUTBI194
	1080 FORMAT(29HCCURRENT COLLAPSE RAMP RATE =-2PF10.4,12H DOLLARS/SEC)	OUTBI195
	IF(IWRAP.EQ.0) GO TO 220	OUTBI196
C		OUTBI197
C	..... WRITE DRUM WITH FUEL COLLAPSE PATTERN	OUTBI198
C		OUTBI199
	LPRINT=LPRINT+1	OUTBI200
	WRITE(28) T(NEW),TCOLP(NEW),(MOVE(MUPPER,CHAN),CHAN=1,LUPPER)	OUTBI201
	MM1=MUPPER-1	OUTBI202
	DO 215 AXIAL=MM1,1,-1	OUTBI203
	WRITE(28) (MOVE(AXIAL,CHAN),CHAN=1,LUPPER)	OUTBI204
	215 CONTINUE	OUTBI205
	220 IF(TVOID(NEW).GT.0.0) GO TO 225	OUTBI206
	GO TO 255	OUTBI207
C		OUTBI208
C	..... WRITE COOLANT VOIDING PATTERN	OUTBI209
C		OUTBI210
	225 WRITE(NOT,1085) (TITLE(I),I=1,14),TVOID(NEW),(J,J=1,LUPPER)	OUTBI211
	1085 FORMAT(14H113A6,A2/19HCOVOIDING PATTERN AT 3PF10.3,37H MILLI SECONDS	OUTBI212
	1 AFTER START OF VOIDING/1H033X,7HCHANNEL/8H0SEGMENT2X,10I6)	OUTBI213
	DO 250 AXIAL=MUPPER,1,-1	OUTBI214
	DO 245 CHAN=1,LUPPER	OUTBI215
	IF(ICHANX(CHAN)) 230,230,235	OUTBI216
	230 TEMP(CHAN)=BLANK	OUTBI217
	GO TO 245	OUTBI218
	235 IF(XUP(CHAN,NEW).GE.Z(AXIAL+1).AND.XDOWN(CHAN,NEW).LE.Z(AXIAL))	OUTBI219
	1 GO TO 240	OUTBI220
	GO TO 230	OUTBI221
	240 TEMP(CHAN)=VOID	OUTBI222
	245 CONTINUE	OUTBI223
	WRITE(NOT,1090) AXIAL,(TEMP(I),I=1,LUPPER)	OUTBI224
	1090 FORMAT(15,7X,10A6)	OUTBI225
	250 CONTINUE	OUTBI226
	ABLE=(VOIDK(NEW)-VOIDK(OLD))/H(NEW)*BB0100	OUTBI227
	WRITE(NOT,1095) ABLE	OUTBI228
	1095 FORMAT(25HCCURRENT VOID RAMP RATE =-2PF10.4,12H DOLLARS/SEC)	OUTBI229
	IF(IWRAP.EQ.0) GO TO 255	OUTBI230
C		OUTBI231
C	..... WRITE DRUM WITH COOLANT VOIDING PATTERN	OUTBI232
C		OUTBI233
	KPRINT=KPRINT+1	OUTBI234
	WRITE(29) T(NEW),TVOID(NEW),(XUP(CHAN,NEW),CHAN=1,LUPPER),(XDOWN(CHAN,NEW),CHAN=1,LUPPER)	OUTBI235
	255 LINESL=0	OUTBI236
	RETURN	OUTBI237
	END	OUTBI238
		OUTBI239
		OUTBI240

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@ ELT WRAPUP,1,720604, 49906
SUBROUTINE WRAPUP
C
C SUBROUTINE WRAPUP READS FROM DRUM THE INFORMATION STORED AT
C SELECTED TIMES DURING THE TRANSIENT AND WRITES THIS INFORMATION
C IN AN ORDERED CHRONOLOGICAL FASHION. SUBROUTINE DRAW IS CALLED.
C
INCLUDE ABC
DIMENSION HEAD1(14),HEAD2(14),REST2(4),OUT(30)
EQUIVALENCE (TEMPER(1,1,1,1),OUT(1))
DATA HEAD1/6HD TI,2HME,12*5H NODE/
DATA HEAD2/6H SECC,3HNDS,4H 1,4H 2,4H 3,4H 4,4H 5,4H
16,4H 7,4H 8,4H 9,4H 10,4H 11,4H 12/
DATA REST1/5H BOND/
DATA REST2/6H (GAP),5H CLAD,6HCOOLAN,1HT/
C
..... REWIND THE DRUMS .....
REWIND 23
REWIND 24
REWIND 25
REWIND 26
REWIND 27
REWIND 28
REWIND 29
IF (IWRAP.EQ.3) GO TO 80
C
C ..... WRITE CORE QUANTITIES .....
C
WRITE(NOT,1000) (TITLE(I),I=1,14)
1000 FORMAT(1H113A6,A2/1H056X,15H CORE QUANTITIES/1H030X,38HNUCLEAR ENERWRAPU 28
1GY NET ENERGY ENERGY/21X,5HTOTAL6X,97H ADDITION TO REMOVAL WRAPU 29
2FROM CONTAINED TEMPERATURE EXTENT KILOGRAMS COREWRAPU 30
3 AVERAGED/22X,4H CORE7X,37H CORE SINCE CORE SINCE IN MOLTEN9X,WRAPU 31
42HOF12X,24OF11X,24OF12X,4HFUEL/8X,4HTIME9X,5HPOWER7X,23HTIME ZERO WRAPU 32
5 TIME ZERO8X,4HFUEL7X,53HMOLTEN FUEL FUEL MELTING MOLTEN FUEWRAPU 33
6L TEMPERATURE/6X,9H(SECONDS)7X,4H(MW)6X,67H(MW-SECONDS) (MW-SECWRAPU 34
7ONDS) (MW-SECONDS) (DEG. KELVIN) (PER CENT)16X,13H(DEG. KELVIN)WRAPU 35
8) WRAPU 36
LINESL=39 WRAPU 37
DO 10 I=1,JTIMES WRAPU 38
READ(23) (OUT(J),J=1,9) WRAPU 39
WRITE(NOT,1005) (OUT(J),J=1,9) WRAPU 40
1005 FORMAT(1P9E14,3) WRAPU 41
LINESL=LINESL-1 WRAPU 42
IF (LINESL.GT.0) GO TO 10 WRAPU 43
WRITE(NOT,1010) WRAPU 44
1010 FORMAT(1H1) WRAPU 45
LINESL=47 WRAPU 46
10 CONTINUE WRAPU 47
C WRAPU 48
C ..... WRITE REACTIVITY CONTRIBUTIONS ..... WRAPU 49
C WRAPU 50
WRITE(NOT,1015) (TITLE(I),I=1,14) WRAPU 51
1015 FORMAT(1H113A6,A2/1H049X,32H REACTIVITY CONTRIBUTIONS (CENTS)/1H04XWRAPU 52
1,4HTIME87X,4HFUEL9X,4HCLAD8X,7HCCOLANT/11H (SECONDS)7X,3HNET9X,9HWRAPU 53
XPROGRAMED4X, 5HWRAPU 54
2SCRAM7X,7HDOPPLER5X,8HCOLLAPSE8X,4HVOID7X,9HEXPANSION4X,9HEXPANSIOWRAPU 55
3NSX,7HDENSITY) WRAPU 56
LINESL=42 WRAPU 57
DO 15 I=1,JTIMES WRAPU 58
READ(24) (OUT(J),J=1,10) WRAPU 59
WRITE(NOT,1020) (OUT(J),J=1,10) WRAPU 60

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1020	FORMAT(1PE10.3,DP9F13.3)	WRAPU 61
	LINESL=LINESL-1	WRAPU 62
	IF(LINESL.GT.0) GO TO 15	WRAPU 63
	WRITE(NOT,1010)	WRAPU 64
	LINESL=47	WRAPU 65
15	CONTINUE	WRAPU 66
C		WRAPU 67
C	..... WRITE PIN TEMPERATURES	WRAPU 68
C		WRAPU 69
	IADD=4200-JTIMES*(NUPPER+4)	WRAPU 70
	ITAB(17)=ITAB(17)-IADD	WRAPU 71
	IUP=NUPPER+1	WRAPU 72
	IC=1	WRAPU 73
	DO 40 CHAN=1,LUPPER	WRAPU 74
	IF(LISTC(IC).EQ.CHAN) GO TO 20	WRAPU 75
	ITAB(17)=ITAB(17)+MUPPER*4200	WRAPU 76
	GO TO 40	WRAPU 77
20	IC=IC+1	WRAPU 78
	IA=1	WRAPU 79
	DO 35 AXIAL=1,MUPPER	WRAPU 80
	IF(LISTA(IA).EQ.AXIAL) GO TO 25	WRAPU 81
	ITAB(17)=ITAB(17)+4200	WRAPU 82
	GO TO 35	WRAPU 83
25	IA=IA+1	WRAPU 84
	WRITE(NOT,1025) (TITLE(I),I=1,14),CHAN,AXIAL	WRAPU 85
1025	FORMAT(1H113A6,A2/1H048X,33HP IN TEMPERATURES (DEGREES KELVIN)/1H0	WRAPU 86
	159X,7HCHANNELI3/1H057X,13HAXIAL SECTIONI3)	WRAPU 87
	WRITE(NOT,1030) (HEAD1(J),J=1,NUPM1),REST1	WRAPU 88
1030	FORMAT(22A6)	WRAPU 89
	WRITE(NOT,1030) (HEAD2(J),J=1,NUPM1),(REST2(J),J=1,4)	WRAPU 90
	LINESL=38	WRAPU 91
	ITAB(17)=ITAB(17)+IADD	WRAPU 92
	DO 30 I=1,JTIMES	WRAPU 93
	READ(25) (OUT(J),J=1,IUP)	WRAPU 94
	WRITE(NOT,1035) (OUT(J),J=1,IUP)	WRAPU 95
1035	FORMAT(1PE10.3,DP15F6.0)	WRAPU 96
	LINESL=LINESL-1	WRAPU 97
	IF(LINESL.GT.0) GO TO 30	WRAPU 98
	WRITE(NOT,1010)	WRAPU 99
	LINESL=47	WRAPU100
30	CONTINUE	WRAPU101
35	CONTINUE	WRAPU102
40	CONTINUE	WRAPU103
C		WRAPU104
C	..... WRITE COOLANT VELOCITIES	WRAPU105
C		WRAPU106
	LP1=LUPPER+1	WRAPU107
	WRITE(NOT,1040) (TITLE(I),I=1,14),(J,J=1,LUPPER)	WRAPU108
1040	FORMAT(1H113A6,A2/1H049X,30HCOOLANT VELOCITY (G/SEC-CM**2)/1H03X,4	WRAPU109
	2HTIME53X,7HCHANNEL/2X,9H(SECONDS)1X,10(5X,I2,5X))	WRAPU110
	LINESL=41	WRAPU111
	DO 45 I=1,JTIMES	WRAPU112
	READ(26) (OUT(J),J=1,LP1)	WRAPU113
	WRITE(NOT,1045) (OUT(J),J=1,LP1)	WRAPU114
1045	FORMAT(1PE10.3,10E12.3)	WRAPU115
	LINESL=LINESL-1	WRAPU116
	IF(LINESL.GT.0) GO TO 45	WRAPU117
	WRITE(NOT,1010)	WRAPU118
	LINESL=47	WRAPU119
45	CONTINUE	WRAPU120

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C                                     WRAPU121
C      ..... WRITE OUTLET COOLANT TEMPERATURES .....      WRAPU122
C                                                                WRAPU123
C      LP2=LUPPER+2                                          WRAPU124
C      WRITE(NOT,1050) (TITLE(I),I=1,14),(J,J=1,LUPPER)    WRAPU125
1050 FORMAT(1H113A6,A2/1H046X,37HCOOLANT TEMPERATURES (DEGREES KELVIN)/WRAPU126
      11H013X,7HCOOLANT31X,27HCOOLANT OUTLET TEMPERATURES/4X,4HTIME6X,5HIWRAPU127
      2NLET42X,7HCHANNEL/1X,9H(SECONDS)1X,11HTEMPERATUPE10(4X,I2,5X)) WRAPU128
C      LINESL=41                                          WRAPU129
C      DO 50 I=1,JTIMES                                  WRAPU130
C      READ(27) (OUT(J),J=1,LP2)                          WRAPU131
C      WRITE(NOT,1055) (OUT(J),J=1,LP2)                   WRAPU132
1055 FORMAT(1PE10.3,OPF9.0,10F11.0)                        WRAPU133
C      LINESL=LINESL-1                                    WRAPU134
C      IF(LINESL.GT.0) GO TO 50                            WRAPU135
C      WRITE(NOT,1010)                                     WRAPU136
C      LINESL=47                                          WRAPU137
C      50 CONTINUE                                         WRAPU138
C      IF(LPRINT.EQ.0) GO TO 70                            WRAPU139
C                                                                WRAPU140
C      ..... WRITE FUEL COLLAPSE PATTERN .....      WRAPU141
C                                                                WRAPU142
C      LTIMES=38/MUPPER                                     WRAPU143
C      KTIMES=0                                           WRAPU144
C      MM1=MUPPER-1                                       WRAPU145
C      55 CONTINUE                                         WRAPU146
C      WRITE(NOT,1060) (TITLE(I),I=1,14),(J,J=1,LUPPER)    WRAPU147
1060 FORMAT(1H113A6,A2/1H057X,16HCOLLAPSE PATTERN/1H021X,97HNUMBERS REPWRAPU148
      1PRESENT DOWNWARD AXIAL DISPLACEMENT, CM, OF FUEL NODES FROM ORIGINAWRAPU149
      2L POSITION/21H0TIME FROM TIME FROM/20H START OF START OF25X,7HCWRAPU150
      3CHANNEL/29H TRANSIENT COLLAPSE AXIAL/30H (SECONDS) (SECONDS) WRAPU151
      4SEGMENT1X,I4,9I7) WRAPU152
C      DO 65 I=1,LTIMES                                  WRAPU153
C      KTIMES=KTIMES+1                                    WRAPU154
C      IF(KTIMES.GT.LPRINT) GO TO 70                      WRAPU155
C      READ(28) (OUT(J),J=1,LP2)                          WRAPU156
C      WRITE(NOT,1065) (OUT(J),J=1,2),MUPPER,(OUT(J),J=3,LP2) WRAPU157
1065 FORMAT(1PE10.3,E11.3,I6,OPF9.3,9F7.3)                WRAPU158
C      DO 60 AXIAL=MM1,1,-1                                WRAPU159
C      READ(28) (OUT(J),J=1,LUPPER)                       WRAPU160
C      WRITE(NOT,1070) AXIAL,(OUT(J),J=1,LUPPER)          WRAPU161
1070 FORMAT(21X,I6,F9.3,9F7.3)                             WRAPU162
C      60 CONTINUE                                         WRAPU163
C      WRITE(NOT,1075)                                     WRAPU164
1075 FORMAT(1H )                                           WRAPU165
C      55 CONTINUE                                         WRAPU166
C      GO TO 55                                             WRAPU167
C      70 IF(KPRINT.EQ.0) GO TO 80                        WRAPU168
C                                                                WRAPU169
C      WRITE COOLANT VOIDING PATTERN .....      WRAPU170
C                                                                WRAPU171
C      WRITE(NOT,1080) (TITLE(I),I=1,14),(J,J=1,LUPPER)    WRAPU172
1080 FORMAT(1H113A6,A2/1H057X,15HVOIDING PATTERN/1H020X,81HUPWARD INTERWRAPU173
      1FACE/DOWNWARD INTERFACE (AXIAL DISTANCE, CM, RELATIVE TO CORE BOTTWRAPU174
      3OM)/21H0TIME FROM TIME FROM/20H START OF START OF/20H TRANSIENTWRAPU175
      4 VOIDING24X,7HCHANNEL/21H (SECONDS) (SECONDS)I7,9I11) WRAPU176
C      LINESL=38                                          WRAPU177
C      LP3=LP2+1                                          WRAPU178
C      LP4=2*LUPPER+2                                     WRAPU179
C      DO 75 I=1,KPRINT                                   WRAPU180

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READ(29) (OUT(J),J=1,LP4)	WRAPU181
WRITE(NOT,1085) (OUT(J),J=1,LP2)	WRAPU182
1085 FORMAT(1PE10.3,11E11.3)	WRAPU183
WRITE(NOT,1090) (OUT(J),J=LP3,LP4)	WRAPU184
1090 FORMAT(21X,1P1GE11.3)	WRAPU185
LINESL=LINESL-2	WRAPU186
IF(LINESL.GT.1) GO TO 75	WRAPU187
WRITE(NOT,1010)	WRAPU188
LINESL=47	WRAPU189
75 CONTINUE	WRAPU190
C	WRAPU191
C	WRAPU192
C	WRAPU193
80 IF(IPL0T.GT.0) CALL DPAW	WRAPU194
C	WRAPU195
C	WRAPU196
C	WRAPU197
IF (IWRAP.LT.2) RETURN	WRAPU198
C	WRAPU199
C	WRAPU200
C	WRAPU201
85 REWIND 23	WRAPU202
REWIND 24	WRAPU203
REWIND 25	WRAPU204
REWIND 26	WRAPU205
REWIND 27	WRAPU206
REWIND 28	WRAPU207
REWIND 29	WRAPU208
WRITE(NOTALL) (TITLE(I),I=1,14)	WRAPU209
WRITE(NOTALL) JTIMES,KPRINT,LPRINT,LUPPER,MUPPER,NUPPER,ICOLPS,	WRAPU210
IIV0IDS	WRAPU211
C	WRAPU212
DO 90 I=1,JTIMES	WRAPU213
READ(23) (OUT(J),J=1,9)	WRAPU214
WRITE(NOTALL) (OUT(J),J=1,9)	WRAPU215
90 CONTINUE	WRAPU216
C	WRAPU217
DO 95 I=1,JTIMES	WRAPU218
READ(24) (OUT(J),J=1,10)	WRAPU219
WRITE(NOTALL) (OUT(J),J=1,10)	WRAPU220
95 CONTINUE	WRAPU221
C	WRAPU222
IADD=4200-JTIMES*(NUPPER+4)	WRAPU223
ITAB(17)=ITAB(17)-IADD	WRAPU224
IUP=NUPPER+1	WRAPU225
DO 110 CHAN=1,LUPPER	WRAPU226
DO 105 AXIAL=1,MUPPER	WRAPU227
ITAB(17)=ITAB(17)+IADD	WRAPU228
DO 100 I=1,JTIMES	WRAPU229
READ(25) (OUT(J),J=1,IUP)	WRAPU230
WRITE(NOTALL) (OUT(J),J=1,IUP)	WRAPU231
100 CONTINUE	WRAPU232
105 CONTINUE	WRAPU233
110 CONTINUE	WRAPU234
C	WRAPU235
LP1=LUPPER+1	WRAPU236
DO 115 I=1,JTIMES	WRAPU237
READ(26) (OUT(J),J=1,LP1)	WRAPU238
WRITE(NOTALL) (OUT(J),J=1,LP1)	WRAPU239
115 CONTINUE	WRAPU240

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C      LP2=LUPPER+2
      DO 120 I=1,JTIMES
      READ(27) (OUT(J),J=1,LP2)
      WRITE(NOTALL) (OUT(J),J=1,LP2)
120  CONTINUE
C
      IF(LPRINT.EQ.0) GO TO 135
      MM1=MUPPER-1
      DO 130 I=1,LPRINT
      READ(28) (OUT(J),J=1,LP2)
      WRITE(NOTALL) OUT(1),OUT(2),MUPPER,(OUT(J),J=3,LP2)
      DO 125 AXIAL=MM1,1,-1
      READ(28) (OUT(J),J=1,LUPPER)
      WRITE(NOTALL) AXIAL,(OUT(J),J=1,LUPPER)
125  CONTINUE
130  CONTINUE
C
135  IF(KPRINT.EQ.0) GO TO 145
      LP4=2*LUPPER+2
      DO 140 I=1,KPRINT
      READ(29) (OUT(J),J=1,LP4)
      WRITE(NOTALL) (OUT(J),J=1,LP2)
      WRITE(NOTALL) (OUT(J),J=LP3,LP4)
140  CONTINUE
C
145  END FILE NOTALL
C
      RETURN
      END

```

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WRAPU241
WRAPU242
WRAPU243
WRAPU244
WRAPU245
WRAPU246
WRAPU247
WRAPU248
WRAPU249
WRAPU250
WRAPU251
WRAPU252
WRAPU253
WRAPU254
WRAPU255
WRAPU256
WRAPU257
WRAPU258
WRAPU259
WRAPU260
WRAPU261
WRAPU262
WRAPU263
WRAPU264
WRAPU265
WRAPU266
WRAPU267
WRAPU268
WRAPU269
WRAPU270

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@ ELT	DRAW,1,720F04, 49908	
	SUBROUTINE DRAW	DRAW 1
C		DRAW 2
C	SUBROUTINE DRAW CONTROLS ALL PLOTTING ROUTINES. SUBROUTINES	DRAW 3
C	CALLED ARE PLOT1, PLOT2, PLOT3, PLOT4, PLOT5, PLOT6, PLOT7,	DRAW 4
C	PLOT8, PLOT9, PLOT10, AND TOPAW1.	DRAW 5
C		DRAW 6
	INCLUDE ABC	DRAW 7
	INCLUDE DEF	DRAW 8
	WRITE(NOT,1000)	DRAW 9
1000	FORMAT(1H110X,42H THE PROGRAM HAS ENTERED THE PLOTTING PHASE,1H)	DRAW 10
	IREAD=0	DRAW 11
	REWIND 23	DRAW 12
	REWIND 24	DRAW 13
	REWIND 28	DRAW 14
	REWIND 29	DRAW 15
	DATA(AP(I),I=1,2)/12H TIME, SEC /	DRAW 16
	DATA(BP(I),I=1,2)/12H POWER, MW /	DRAW 17
	DO 10 I=1,JTIMES	DRAW 18
	READ(23) (OUT(J),J=1,9)	DRAW 19
	X(I) = OUT(1)	DRAW 20
	Y(I,1) = OUT(2)	DRAW 21
	Y(I,2) = OUT(3)	DRAW 22
	Y(I,3) = OUT(4)	DRAW 23
	Y(I,4) = OUT(5)	DRAW 24
	Y(I,5) = OUT(6)	DRAW 25
	Y(I,6) = OUT(7)	DRAW 26
	Y(I,7) = OUT(8)	DRAW 27
	Y(I,8) = OUT(9)	DRAW 28
10	CONTINUE	DRAW 29
	DO 15 I=1,JTIMES	DRAW 30
	READ(24) (OUT(J),J=1,10)	DRAW 31
	Y(I, 9) = OUT(2)/100.	DRAW 32
	Y(I,10) = OUT(3)/100.	DRAW 33
	Y(I,11) = OUT(4)/100.	DRAW 34
	Y(I,12) = OUT(5)/100.	DRAW 35
	Y(I,13) = OUT(6)/100.	DRAW 36
	Y(I,14) = OUT(7)/100.	DRAW 37
	Y(I,15) = OUT(8)/100.	DRAW 38
	Y(I,16) = OUT(9)/100.	DRAW 39
	Y(I,17) = OUT(10)/100.	DRAW 40
15	CONTINUE	DRAW 41
	ICYCLE = 0	DRAW 42
	DO 75 I=1,10	DRAW 43
	J = ICYCLE + 1	DRAW 44
	NPLOT(I) = IFIX(ARPLOT(J))	DRAW 45
	II = I	DRAW 46
	XORIG(II) = ARPLOT(J+1)	DRAW 47
	XINCP(II) = ARPLOT(J+2)	DRAW 48
	YORIG(II) = ARPLOT(J+3)	DRAW 49
	YINCR(II) = ARPLOT(J+4)	DRAW 50
	ICYCLE = ICYCLE + 5	DRAW 51
	NP = NPLOT(I) + 1	DRAW 52
	GO TO (20,25,30,35,40,45,50,55,60,65,70),NP	DRAW 53
20	GO TO 75	DRAW 54
25	CALL PLOT1	DRAW 55
	GO TO 75	DRAW 56
30	CALL PLOT2	DRAW 57
	GO TO 75	DRAW 58
35	CALL PLOT3	DRAW 59
	GO TO 75	DRAW 60

40 CALL PLOT4	DRAW 61
GO TO 75	DRAW 62
45 CALL PLOT5	DRAW 63
GO TO 75	DRAW 64
50 CALL PLOT6	DRAW 65
GO TO 75	DRAW 66
55 CALL PLOT7	DRAW 67
GO TO 75	DRAW 68
60 CALL PLOT8	DRAW 69
GO TO 75	DRAW 70
65 IF (LPRINT.EQ.0.AND.KPRINT.EQ.0) GO TO 75	DRAW 71
CALL PLOT9	DRAW 72
GO TO 75	DRAW 73
70 IF (LPRINT.EQ.0.AND.KPRINT.EQ.0) GO TO 75	DRAW 74
CALL PLOT10	DRAW 75
GO TO 75	DRAW 76
75 CONTINUE	DRAW 77
DO 85 J=1,800,7	DRAW 78
IF (TPLOT(J).EQ.0.) GO TO 90	DRAW 79
NTPLT = IFIX(TPLOT(J))	DRAW 80
II = J	DRAW 81
GO TO (80),NTPLT	DRAW 82
80 CALL TDRAW1	DRAW 83
GO TO 85	DRAW 84
85 CONTINUE	DRAW 85
90 CONTINUE	DRAW 86
RETURN	DRAW 87
END	DRAW 88

@ ELT	TUMPL0,1,720604, 49910	
	SUBROUTINE TUMPL0	TUMPL 1
C		TUMPL 2
C	SUBROUTINE TUMPL0 DETERMINES THE DATA WHICH IS TO BE PLOTTED	TUMPL 3
C	USING AN 8 INCH ABSCISSA	TUMPL 4
C		TUMPL 5
	INCLUDE ABC	TUMPL 6
	INCLUDE DEF	TUMPL 7
	DO 10 I=1,JTIMES	TUMPL 8
	IF(X(I) - XORIG(II)) 10, 15, 15	TUMPL 9
10	CONTINUE	TUMPL 10
15	IBEG = I	TUMPL 11
	G = XORIG(II) + 8.*XINCR(II)	TUMPL 12
	DO 20 I=IBEG,JTIMES	TUMPL 13
	IF(X(I) - G) 20, 25, 30	TUMPL 14
20	CONTINUE	TUMPL 15
25	IENDP = I	TUMPL 16
	GO TO 35	TUMPL 17
30	IENDP = I-1	TUMPL 18
35	NX = IENDP - IBEG + 1	TUMPL 19
	RETURN	TUMPL 20
	END	TUMPL 21

@ ELT NUMPLO,1,720604, 49912
SUBROUTINE NUMPLO

C
C SUBROUTINE NUMPLO DETERMINES THE DATA WHICH IS TO BE PLOTTED
C USING A 6 INCH ABSCISSA
C

INCLUDE ABC
INCLUDE DEF
DO 10 I=1,JTIMES
IF(X(I) - XORIG(II)) 10, 15, 15
10 CONTINUE
15 IBEG = I
G = XORIG(II) + 6.*XINCR(II)
DO 20 I=IBEG,JTIMES
IF(X(I) - G) 20, 25, 30
20 CONTINUE
25 IENDP = I
GO TO 35
30 IENDP = I-1
35 NX = IENDP - IBEG + 1
RETURN
END

NUMPL 1
NUMPL 2
NUMPL 3
NUMPL 4
NUMPL 5
NUMPL 6
NUMPL 7
NUMPL 8
NUMPL 9
NUMPL 10
NUMPL 11
NUMPL 12
NUMPL 13
NUMPL 14
NUMPL 15
NUMPL 16
NUMPL 17
NUMPL 18
NUMPL 19
NUMPL 20
NUMPL 21

3	ELT	TIMPL0,1,720604, 49913	
		SUBROUTINE TIMPLC	TIMPL 1
C			TIMPL 2
C		SUBROUTINE TIMPLO DETERMINES, FOR PLOTTING PURPOSES, THE TIME	TIMPL 3
C		AT WHICH FUEL COLLAPSE OR COOLANT VOIDING BEGINS	TIMPL 4
C			TIMPL 5
		INCLUDE ABC	TIMPL 6
		INCLUDE DEF	TIMPL 7
		IF(ICOLPS.EQ.0.AND.LPRINT.NE.0) GO TO 10	TIMPL 8
		G1=1000.	TIMPL 9
		G2=1000.	TIMPL 10
		GO TO 15	TIMPL 11
10		READ(28) OUT(1),OUT(2)	TIMPL 12
		G1 = OUT(1)	TIMPL 13
		G2 = OUT(2)	TIMPL 14
15		IF(IVCIDS.EQ.0.AND.KPRINT.NE.0) GO TO 20	TIMPL 15
		GG1=1000.	TIMPL 16
		GG2=1000.	TIMPL 17
		GO TO 25	TIMPL 18
20		READ(29) OUT(1),OUT(2)	TIMPL 19
		GG1 = OUT(1)	TIMPL 20
		GG2 = OUT(2)	TIMPL 21
25		IF(G1 - GG1) 30,30,35	TIMPL 22
30		TPL01 = G1	TIMPL 23
		TPL02 = G2	TIMPL 24
		GO TO 40	TIMPL 25
35		TPL01 = GG1	TIMPL 26
		TPL02 = GG2	TIMPL 27
40		DO 45 I=1,JTIMES	TIMPL 28
		J = I	TIMPL 29
		IF(X(I)-TPL01) 45, 50, 50	TIMPL 30
45		CONTINUE	TIMPL 31
50		IREAD = 1	TIMPL 32
		IPLO = J	TIMPL 33
		XZEROP = TPL01 - TPL02	TIMPL 34
		RETURN	TIMPL 35
		END	TIMPL 36

Q	ELT	PLOT1,1,720604, 49915	
		SUBROUTINE PLOT1	PLOT1 1
C			PLOT1 2
C		SUBROUTINE PLOT1 PLOTS THE POWER ON A SEMILOG SCALE	PLOT1 3
C		SUBROUTINES CALLED ARE BOX, LOGAXS, AND NUMPLO	PLOT1 4
C		SYSTEM SUBROUTINES CALLED ARE CPLOT, AXIS, CSIZE, LINE, AND SYMBOL	PLOT1 5
C			PLOT1 6
		INCLUDE ABC	PLOT1 7
		INCLUDE DEF	PLOT1 8
		CALL CPLOT(0.0,0.0,-3)	PLOT1 9
		CALL BOX(0.0,0.0,6.0,10.0)	PLOT1 10
		IF(XINCR(II).EQ.0.AND.YINCR(II).EQ.0) GO TO 15	PLOT1 11
		X(JTIMES+1) = XORIG(II)	PLOT1 12
		X(JTIMES+2) = XINCR(II)	PLOT1 13
		Y(JTIMES+1,1) = YORIG(II)	PLOT1 14
		Y(JTIMES+2,1) = YINCR(II)	PLOT1 15
		CALL AXIS(0.0,0.0,AP,12,6.0,0.0,X(JTIMES+1),X(JTIMES+2))	PLOT1 16
		CALL LOGAXS(0.0,0.0,BP,12,10.101,90.0,Y(JTIMES+1,1),Y(JTIMES+2,1))	PLOT1 17
		CALL NUMPLO	PLOT1 18
		NXX = IBEG+NX-1	PLOT1 19
		DO 10 I=IBEG,NXX	PLOT1 20
		ORD(I) = ALOG10(Y(I,1))	PLOT1 21
		J = I	PLOT1 22
10		CONTINUE	PLOT1 23
		ORD(J+1) = YORIG(II)	PLOT1 24
		ORD(J+2) = YINCR(II)	PLOT1 25
		I = IBEG	PLOT1 26
		CALL LINE(X(I),ORD(I),NX,1,1,1)	PLOT1 27
		GO TO 75	PLOT1 28
15		CALL CSIZE(X(1),6.0,JTIMES,1)	PLOT1 29
		CALL AXIS(0.0,0.0,AP,12,6.0,0.0,X(JTIMES+1),X(JTIMES+2))	PLOT1 30
C		FIND MAXIMUM AND MINIMUM Y POINTS TO ESTABLISH SIMILOG SCALE	PLOT1 31
		YMAX=Y(1,1)	PLOT1 32
		YMIN=Y(1,1)	PLOT1 33
		DO 35 I=1,JTIMES	PLOT1 34
		IF(Y(I,1)-YMAX) 25,25,20	PLOT1 35
20		YMAX=Y(I,1)	PLOT1 36
25		IF(Y(I,1)-YMIN) 30,35,35	PLOT1 37
30		YMIN=Y(I,1)	PLOT1 38
35		CONTINUE	PLOT1 39
		DO 45 I=1,31	PLOT1 40
		NN=I-11	PLOT1 41
		YBASE=10.**NN	PLOT1 42
		IF(YBASE-YMIN) 45,40,40	PLOT1 43
40		ORD(JTIMES+1)=FLOAT(NN-1)	PLOT1 44
		GO TO 50	PLOT1 45
45		CONTINUE	PLOT1 46
		WRITE(NOT,1000)	PLOT1 47
1000		FORMAT(27H1YMIN IS GREATER THAN 10E20)	PLOT1 48
50		DO 60 I=1,31	PLOT1 49
		MM=I-11	PLOT1 50
		YUPPER=10.**MM	PLOT1 51
		IF(YUPPER-YMAX) 60,55,55	PLOT1 52
55		NEXP=MM-NN+1	PLOT1 53
		ORD(JTIMES+2)=FLOAT(NEXP)/10.	PLOT1 54
		GO TO 65	PLOT1 55
60		CONTINUE	PLOT1 56
		WRITE(NOT,1005)	PLOT1 57
1005		FORMAT(27H1YMAX IS GREATER THAN 10E20)	PLOT1 58
65		DO 70 I=1,JTIMES	PLOT1 59
		ORD(I)=ALOG10(Y(I,1))	PLOT1 60

70	CONTINUE	PLOT1 61
	CALL LOGAXS(C.O.O.O,8P,12,10.1,90.O,ORD(JTIMES+1),ORD(JTIMES+2))	PLOT1 62
	CALL LINE(X(1),ORD(1),JTIMES,1,1,1)	PLOT1 63
75	CALL SYMBOL(O.4,9.O,O.15,TITLEP,O.O,40)	PLOT1 64
	CALL CPLOT(10.O,O.O,-3)	PLOT1 65
	WRITE(NCT,1010)	PLOT1 66
1010	FORMAT(20X,51HPLOT1 (SEMILOG POWER) HAS BEEN MADE	PLOT1 67
	RETURN	PLOT1 68
	END	PLOT1 69

a	ELT	PLOT2,1,720604, 49917	
		SUBROUTINE PLOT2	PLOT2 1
C			PLOT2 2
C		SUBROUTINE PLOT2 PLOTS THE POWER ON A LINEAR SCALE	PLOT2 3
C		SUBROUTINES CALLED ARE BOX AND NUMPLO	PLOT2 4
C		SYSTEM SUBROUTINES CALLED ARE CPLOT,AXIS,NUMBER,SYMBOL,LINE,CSCALE	PLOT2 5
C			PLOT2 6
		INCLUDE ABC	PLOT2 7
		INCLUDE DEF	PLOT2 8
		CALL CPLOT(0.0,1.0,-3)	PLOT2 9
		CALL BOX(0.0,0.0,6.0,8.0)	PLOT2 10
		IF(XINCR(II).EQ.0.AND.YINCR(II).EQ.0) GO TO 15	PLOT2 11
		X(JTIMES+1) = XORIG(II)	PLOT2 12
		X(JTIMES+2) = XINCR(II)	PLOT2 13
		Y(JTIMES+1,1) = YORIG(II)	PLOT2 14
		Y(JTIMES+2,1) = YINCR(II)	PLOT2 15
		CALL AXIS(0.0,0.0,AP,-12.6,0.0,0,X(JTIMES+1),X(JTIMES+2))	PLOT2 16
		YTITL = YORIG(II)	PLOT2 17
C		PLOT Y AXIS	PLOT2 18
		Z = 0.	PLOT2 19
		CALL CPLOT(0.0,Z,3)	PLOT2 20
		CALL CPLOT(0.0,Z,2)	PLOT2 21
		CALL CPLOT(-.1,Z,2)	PLOT2 22
		CALL NUMBER(-0.7,Z,0.10,Y(JTIMES+1,1),0.0,-1)	PLOT2 23
		DO 10 I=1,8	PLOT2 24
		CALL CPLOT(0.0,Z,3)	PLOT2 25
		CALL CPLOT(0.0,Z,2)	PLOT2 26
		CALL CPLOT(0.0,Z+0.5,2)	PLOT2 27
		CALL CPLOT(-.1,Z+0.5,2)	PLOT2 28
		CALL CPLOT(0.0,Z+0.5,2)	PLOT2 29
		CALL CPLOT(0.0,Z+1.0,2)	PLOT2 30
		CALL CPLOT(-.1,Z+1.0,2)	PLOT2 31
		Z = Z + 1.0	PLOT2 32
		YTITL = YTITL + YINCR(II)	PLOT2 33
		CALL NUMBER(-0.7,Z,0.10,YTITL,0.0,-1)	PLOT2 34
10		CONTINUE	PLOT2 35
		CALL SYMBOL(-0.8,3.1,0.14,8P,90.0,12)	PLOT2 36
C		PLOT CURVE	PLOT2 37
		CALL NUMPLO	PLOT2 38
		I = IBEG	PLOT2 39
		CALL LINE(X(I),Y(I,1),NX,1,1,1)	PLOT2 40
		GO TO 20	PLOT2 41
15		CALL CSCALE(X(1),6.0,JTIMES,1)	PLOT2 42
		CALL CSCALE(Y(1,1),8.0,JTIMES,1)	PLOT2 43
		CALL AXIS(0.0,0.0,AP,-12.6,0.0,0,X(JTIMES+1),X(JTIMES+2))	PLOT2 44
		CALL AXIS(0.0,0.0,8P,12.8,0,90.0,Y(JTIMES+1,1),Y(JTIMES+2,1))	PLOT2 45
		CALL LINE(X(1),Y(1,1),JTIMES,1,1,1)	PLOT2 46
20		CALL SYMBOL(0.4,7.5,0.15,TITLEP,0.0,40)	PLOT2 47
		CALL CPLOT(10.0,-1.0,-3)	PLOT2 48
		WRITE(NOT,1000)	PLOT2 49
1000		FORMAT(20X,51HPLOT2 (LINEAR POWER) HAS BEEN MADE	PLOT2 50
		RETURN	PLOT2 51
		END	PLOT2 52

@	ELT	PLOT3,1.720604, 49920	
		SUBROUTINE PLOT3	PLOT3 1
C			PLOT3 2
C		SUBROUTINE PLOT3 PLOTS THE ENERGY GENERATED AND ENERGY REMOVED	PLOT3 3
C		DURING THE TRANSIENT	PLOT3 4
C		SUBROUTINES CALLED ARE BOX AND NUMPLO	PLOT3 5
C		SYSTEM SUBROUTINES CALLED ARE CPLOT,AXIS,NUMBER,SYMBOL,LINE,CSCALE	PLOT3 6
C			PLOT3 7
		INCLUDE ABC	PLOT3 8
		INCLUDE DEF	PLOT3 9
		CALL CPLOT(0.0,1.0,-3)	PLOT3 10
		CALL BOX(0.0,0.0,6.0,3.0)	PLOT3 11
		IF(XINCR(II).EQ.0.AND.YINCR(II).EQ.0) GO TO 15	PLOT3 12
		X(JTIMES+1) = XORIG(II)	PLOT3 13
		X(JTIMES+2) = XINCR(II)	PLOT3 14
		Y(JTIMES+1,2) = YORIG(II)	PLOT3 15
		Y(JTIMES+2,2) = YINCR(II)	PLOT3 16
		CALL AXIS(0.0,0.0,AP,-12.6,0.0,0.0,X(JTIMES+1),X(JTIMES+2))	PLOT3 17
		YTITL = YORIG(II)	PLOT3 18
C		PLOT Y AXIS	PLOT3 19
		Z = 0.	PLOT3 20
		CALL CPLOT(0.0,Z,3)	PLOT3 21
		CALL CPLOT(0.0,Z,2)	PLOT3 22
		CALL CPLOT(-.1,Z,2)	PLOT3 23
		CALL NUMBER(-0.7,Z,0.10,Y(JTIMES+1,2),0.0,-1)	PLOT3 24
		DO 10 I=1,8	PLOT3 25
		CALL CPLOT(0.0,Z,3)	PLOT3 26
		CALL CPLOT(0.0,Z,2)	PLOT3 27
		CALL CPLOT(0.0,Z+0.5,2)	PLOT3 28
		CALL CPLOT(-.1,Z+0.5,2)	PLOT3 29
		CALL CPLOT(0.0,Z+0.5,2)	PLOT3 30
		CALL CPLOT(0.0,Z+1.0,2)	PLOT3 31
		CALL CPLOT(-.1,Z+1.0,2)	PLOT3 32
		Z = Z + 1.0	PLOT3 33
		YTITL = YTITL + YINCR(II)	PLOT3 34
		CALL NUMBER(-0.7,Z,0.10,YTITL,0.0,-1)	PLOT3 35
10		CONTINUE	PLOT3 36
		CALL SYMBOL(-0.8,3.1,0.14,14HENERGY, MW-SEC,90.0,14)	PLOT3 37
C		PLOT CURVES	PLOT3 38
		CALL NUMPLO	PLOT3 39
		I = IBEG	PLOT3 40
		CALL LINE(X(I),Y(I,2),NX,1,1,1)	PLOT3 41
		Y(JTIMES+1,3) = YORIG(II)	PLOT3 42
		Y(JTIMES+2,3) = YINCR(II)	PLOT3 43
		CALL LINE(X(I),Y(I,3),NX,1,1,2)	PLOT3 44
		GO TO 30	PLOT3 45
15		CALL CSCALE(X(1),6.0,JTIMES,1)	PLOT3 46
		ISTORE = -JTIMES	PLOT3 47
		DO 25 J=2,3	PLOT3 48
		ISTORE = ISTORE + JTIMES	PLOT3 49
		DO 20 IJ=1,JTIMES	PLOT3 50
		I = ISTORE + IJ	PLOT3 51
20		YY(I) = Y(IJ,J)	PLOT3 52
25		CONTINUE	PLOT3 53
		NXX = 2*JTIMES	PLOT3 54
		CALL CSCALE(YY(1),8.0,NXX,1)	PLOT3 55
		CALL AXIS(0.0,0.0,AP,-12.6,0.0,0.0,X(JTIMES+1),X(JTIMES+2))	PLOT3 56
		CALL AXIS(0.0,0.0,14HENERGY, MW-SEC,14,8.0,90.0,YY(NXX+1),	PLOT3 57
		1YY(NXX+2))	PLOT3 58
		Y(JTIMES+1,2) = YY(NXX+1)	PLOT3 59
		Y(JTIMES+2,2) = YY(NXX+2)	PLOT3 60

CALL LINE(X(1),Y(1,2),JTIMES,1,1,1)	PLOT3 61
Y(JTIMES+1,3) = YY(NXX+1)	PLOT3 62
Y(JTIMES+2,3) = YY(NXX+2)	PLOT3 63
CALL LINE(X(1),Y(1,3),JTIMES,1,1,2)	PLOT3 64
30 CALL SYMBOL(D.4,7.5,D.15,TITLEP,D.0,40)	PLOT3 65
CALL SYMBOL(C.5,7.0,D.10,1,0.0,-1)	PLOT3 66
CALL SYMBOL(D.7,6.95,D.10,18H= MW-SEC GENERATED,D.0,18)	PLOT3 67
CALL SYMBOL(D.5,6.7,D.10,2,0.0,-1)	PLOT3 68
CALL SYMBOL(D.7,6.65,D.10,16H= MW-SEC REMOVED,D.0,16)	PLOT3 69
CALL CPLOT(10.0,-1.0,-3)	PLOT3 70
WRITE(NOT,1000)	PLOT3 71
1000 FORMAT(20X,51HPLOT3 (ENERGY) HAS BEEN MADE	PLOT3 72
RETURN	PLOT3 73
END	PLOT3 74

@	ELT	PLOT4,1,720604, 49922	
		SUBROUTINE PLOT4	PLOT4 1
C			PLOT4 2
C		SUBROUTINE PLOT4 PLOTS THE AVERAGE FUEL TEMPERATURE	PLOT4 3
C		SUBROUTINES CALLED ARE BOX AND NUMPLO	PLOT4 4
C		SYSTEM SUBROUTINES CALLED ARE CPLOT,AXIS,NUMBER,SYMBOL,LINE,CSCALE	PLOT4 5
C			PLOT4 6
		INCLUDE ABC	PLOT4 7
		INCLUDE DEF	PLOT4 8
		CALL CPLOT(0.0,1.0,-3)	PLOT4 9
		CALL BOX(0.0,0.0,6.0,8.0)	PLOT4 10
		IF(XINCR(II).EQ.0.AND.YINCR(II).EQ.0) GO TO 15	PLOT4 11
		X(JTIMES+1) = XORIG(II)	PLOT4 12
		X(JTIMES+2) = XINCR(II)	PLOT4 13
		Y(JTIMES+1,8) = YORIG(II)	PLOT4 14
		Y(JTIMES+2,8) = YINCR(II)	PLOT4 15
		CALL AXIS(0.0,0.0,AP,-12.6,0.0,0,X(JTIMES+1),X(JTIMES+2))	PLOT4 16
		YTITL = YORIG(II)	PLOT4 17
C		PLOT Y AXIS	PLOT4 18
		Z = 0.	PLOT4 19
		CALL CPLOT(0.0,Z,3)	PLOT4 20
		CALL CPLOT(0.0,Z,2)	PLOT4 21
		CALL CPLOT(-.1,Z,2)	PLOT4 22
		CALL NUMBER(-0.7,Z,0.10,Y(JTIMES+1,8),0.0,-1)	PLOT4 23
		DO 10 I=1,8	PLOT4 24
		CALL CPLOT(0.0,Z,3)	PLOT4 25
		CALL CPLOT(0.0,Z,2)	PLOT4 26
		CALL CPLOT(0.0,Z+0.5,2)	PLOT4 27
		CALL CPLOT(-.1,Z+0.5,2)	PLOT4 28
		CALL CPLOT(0.0,Z+0.5,2)	PLOT4 29
		CALL CPLOT(0.0,Z+1.0,2)	PLOT4 30
		CALL CPLOT(-.1,Z+1.0,2)	PLOT4 31
		Z = Z + 1.0	PLOT4 32
		YTITL = YTITL + YINCR(II)	PLOT4 33
		CALL NUMBER(-0.7,Z+0.10,YTITL,0.0,-1)	PLOT4 34
10		CONTINUE	PLOT4 35
		CALL SYMBOL(-0.8,3.1,0.14,27HAVERAGE FUEL TEMPERATURE, K,90.0,27)	PLOT4 36
C		PLOT CURVE	PLOT4 37
		CALL NUMPLO	PLOT4 38
		I = ISEG	PLOT4 39
		CALL LINE(X(I),Y(I,8),NX,1,1,1)	PLOT4 40
		GO TO 20	PLOT4 41
15		CALL CSCALE(X(1),6.0,JTIMES,1)	PLOT4 42
		CALL CSCALE(Y(1,8),8.0,JTIMES,1)	PLOT4 43
		CALL AXIS(0.0,0.0,AP,-12.6,0.0,0,X(JTIMES+1),X(JTIMES+2))	PLOT4 44
		CALL AXIS(0.0,0.0,27HAVERAGE FUEL TEMPERATURE, K,27.8,0,90.0,	PLOT4 45
		1Y(JTIMES+1,8),Y(JTIMES+2,8))	PLOT4 46
		CALL LINE(X(1),Y(1,8),JTIMES,1,1,1)	PLOT4 47
20		CALL SYMBOL(0.4,7.5,0.15,TITLEP,0.0,40)	PLOT4 48
		CALL CPLOT(10.0,-1.0,-3)	PLOT4 49
		WRITE(NOT,1000)	PLOT4 50
1000		FORMAT(20X,51HPLOT4 (AVE. FUEL TEMPERATURE) HAS BEEN MADE	PLOT4 51
		RETURN	PLOT4 52
		END	PLOT4 53

@ ELT	PLOTS,1,720604, 49924	
	SUBROUTINE PLOTS	PLOTS 1
C		PLOTS 2
C	SUBROUTINE PLOTS PLOTS THE TEMPERATURE AND ENERGY OF THE MOLTEN	PLOTS 3
C	FUEL GENERATED	PLOTS 4
C	SUBROUTINES CALLED ARE BOX AND NUMPLO	PLOTS 5
C	SYSTEM SUBROUTINES CALLED ARE CPLOT, AXIS, NUMBER, SYMBOL, LINE, CSCALE	PLOTS 6
C		PLOTS 7
	INCLUDE ARC	PLOTS 8
	INCLUDE DEF	PLOTS 9
	CALL CPLOT(0.0,1.0,-3)	PLOTS 10
	CALL BOX(0.0,0.0,6.0,8.0)	PLOTS 11
	IF(XINCR(II).EQ.0.AND.YINCR(II).EQ.0) GO TO 15	PLOTS 12
	X(JTIMES+1) = XORIG(II)	PLOTS 13
	X(JTIMES+2) = XINCR(II)	PLOTS 14
	Y(JTIMES+1,5) = YORIG(II)	PLOTS 15
	Y(JTIMES+2,5) = YINCR(II)	PLOTS 16
	CALL AXIS(0.0,0.0,AP,-12,6.0,0.0,X(JTIMES+1),X(JTIMES+2))	PLOTS 17
	YTITL = YORIG(II)	PLOTS 18
C	PLOT Y AXIS	PLOTS 19
	Z = 0.	PLOTS 20
	CALL CPLOT(0.0,Z,3)	PLOTS 21
	CALL CPLOT(0.0,Z,2)	PLOTS 22
	CALL CPLOT(-.1,Z,2)	PLOTS 23
	CALL NUMBER(-0.7,Z,0.10,Y(JTIMES+1,5),0.0,-1)	PLOTS 24
	DO 10 I=1,8	PLOTS 25
	CALL CPLOT(0.0,Z,3)	PLOTS 26
	CALL CPLOT(0.0,Z,2)	PLOTS 27
	CALL CPLOT(0.0,Z+0.5,2)	PLOTS 28
	CALL CPLOT(-.1,Z+0.5,2)	PLOTS 29
	CALL CPLOT(0.0,Z+0.5,2)	PLOTS 30
	CALL CPLOT(0.0,Z+1.0,2)	PLOTS 31
	CALL CPLOT(-.1,Z+1.0,2)	PLOTS 32
	Z = Z + 1.0	PLOTS 33
	YTITL = YTITL + YINCR(II)	PLOTS 34
	CALL NUMBER(-0.7,Z,0.10,YTITL,0.0,-1)	PLOTS 35
10	CONTINUE	PLOTS 36
	CALL SYMBOL(-0.8,0.2,0.14,51HTEMPERATURE AND ENERGY OF MOLTEN FUEL	PLOTS 37
	1, K AND MW-SEC,90.0,51)	PLOTS 38
C	PLOT CURVES	PLOTS 39
	CALL NUMPLO	PLOTS 40
	I = IBEG	PLOTS 41
	CALL LINE(X(I),Y(I,5),NX,1,1,1)	PLOTS 42
	Y(JTIMES+1,4) = YORIG(II)	PLOTS 43
	Y(JTIMES+2,4) = YINCR(II)	PLOTS 44
	CALL LINE(X(I),Y(I,4),NX,1,1,2)	PLOTS 45
	GO TO 30	PLOTS 46
15	CALL CSCALE(X(1),6.0,JTIMES,1)	PLOTS 47
	ISTORE = -JTIMES	PLOTS 48
	DO 25 J=4,5	PLOTS 49
	ISTORE = ISTORE + JTIMES	PLOTS 50
	DO 20 IJ=1,JTIMES	PLOTS 51
	I = ISTORE + IJ	PLOTS 52
20	YY(I) = Y(IJ,J)	PLOTS 53
25	CONTINUE	PLOTS 54
	NXX = 2*JTIMES	PLOTS 55
	CALL CSCALE(YY(1),8.0,NXX,1)	PLOTS 56
	CALL AXIS(0.0,0.0,AP,-12,6.0,0.0,X(JTIMES+1),X(JTIMES+2))	PLOTS 57
	CALL AXIS(0.0,0.0,51HTEMPERATURE AND ENERGY OF MOLTEN FUEL, K AND	PLOTS 58
	1MW-SEC,51,8.0,90.0,YY(NXX+1),YY(NXX+2))	PLOTS 59
	Y(JTIMES+1,5) = YY(NXX+1)	PLOTS 60

Y(JTIMES+2,5) = YY(NXX+2)	PLOT5 61
CALL LINE(X(1),Y(1,5),JTIMES,1,1,1)	PLOT5 62
Y(JTIMES+1,4) = YY(NXX+1)	PLOT5 63
Y(JTIMES+2,4) = YY(NXX+2)	PLOT5 64
CALL LINE(X(1),Y(1,4),JTIMES,1,1,2)	PLOT5 65
30 CALL SYMBOL(0.4,7.5,0.15,TITLEP,0.0,40)	PLOT5 66
CALL SYMBOL(0.5,7.0,0.10,1,0.0,-1)	PLOT5 67
CALL SYMBOL(0.7,6.95,0.10,25H= MOLTEN FUEL TEMPERATURE,0.0,25)	PLOT5 68
CALL SYMBOL(0.5,6.7,0.10,2,0.0,-1)	PLOT5 69
CALL SYMBOL(0.7,6.65,0.10,20H= MOLTEN FUEL ENERGY,0.0,20)	PLOT5 70
CALL CPlot(10.0,-1.0,-3)	PLOT5 71
WRITE(OUT,1000)	PLOT5 72
1000 FC-MAT(20X,51HPLOT5 (TEMP. AND ENER. OF MOLT. FUEL) HAS BEEN MADE)	PLOT5 73
RETURN	PLOT5 74
END	PLOT5 75

3	ELT	PLOT6,1,720604, 49927	
		SUBROUTINE PLOT6	PLOT6 1
C			PLOT6 2
C		SUBROUTINE PLOT6 PLOTS THE FRACTION OF MOLTEN FUEL	PLOT6 3
C		SUBROUTINES CALLED ARE BOX AND NUMPLO	PLOT6 4
C		SYSTEM SUBROUTINES CALLED ARE CPLOT,AXIS,NUMBER,SYMBOL,LINE,CSCALE	PLOT6 5
C			PLOT6 6
		INCLUDE ABC	PLOT6 7
		INCLUDE DEF	PLOT6 8
		CALL CPLOT(0.0,1.0,-3)	PLOT6 9
		CALL BOX(0.0,0.0,6.0,8.0)	PLOT6 10
		IF(XINCR(II).EQ.0.AND.YINCR(II).EQ.0) GO TO 15	PLOT6 11
		X(JTIMES+1) = XORIG(II)	PLOT6 12
		X(JTIMES+2) = XINCR(II)	PLOT6 13
		Y(JTIMES+1,6) = YORIG(II)	PLOT6 14
		Y(JTIMES+2,6) = YINCR(II)	PLOT6 15
		CALL AXIS(0.0,0.0,AP,-12,6.0,0.0,X(JTIMES+1),X(JTIMES+2))	PLOT6 16
		YTITL = YORIG(II)	PLOT6 17
C		PLOT Y AXIS	PLOT6 18
		Z = 0.	PLOT6 19
		CALL CPLOT(0.0,Z,3)	PLOT6 20
		CALL CPLOT(0.0,Z,2)	PLOT6 21
		CALL CPLOT(-.1,Z,2)	PLOT6 22
		CALL NUMBER(-0.7,Z,0.10,Y(JTIMES+1,6),0.0,-1)	PLOT6 23
		DO 10 I=1,8	PLOT6 24
		CALL CPLOT(0.0,Z,3)	PLOT6 25
		CALL CPLOT(0.0,Z,2)	PLOT6 26
		CALL CPLOT(0.0,Z+0.5,2)	PLOT6 27
		CALL CPLOT(-.1,Z+0.5,2)	PLOT6 28
		CALL CPLOT(0.0,Z+0.5,2)	PLOT6 29
		CALL CPLOT(0.0,Z+1.0,2)	PLOT6 30
		CALL CPLOT(-.1,Z+1.0,2)	PLOT6 31
		Z = Z + 1.0	PLOT6 32
		YTITL = YTITL + YINCR(II)	PLOT6 33
		CALL NUMBER(-0.7,Z,0.10,YTITL,0.0,-1)	PLOT6 34
10		CONTINUE	PLOT6 35
		CALL SYMBOL(-0.8,2.1,0.14,26HFRACTION OF FUEL MOLTEN, 1,90.0,26)	PLOT6 36
C		PLOT CURVE	PLOT6 37
		CALL NUMPLO	PLOT6 38
		I = IBEG	PLOT6 39
		CALL LINE(X(I),Y(I,6),NX,1,1,1)	PLOT6 40
		GO TO 20	PLOT6 41
15		CALL CSCALE(X(1),6.0,JTIMES,1)	PLOT6 42
		CALL CSCALE(0.0,8.0,JTIMES,1)	PLOT6 43
		CALL AX+SUCOTO.0,APT-12,6.0,0.0,X(JTIMES+1),X(JTIMES+2))	PLOT6 44
		CALL AXIS(0.0,0.0,26HFRACTION OF FUEL MOLTEN, 1,26,8.0,90.0,	PLOT6 45
		1Y(JTIMES+1,6),Y(JTIMES+2,6))	PLOT6 46
		CALL LINE(X(1),Y(1,6),JTIMES,1,1,1)	PLOT6 47
20		CALL SYMBOL(0.4,7.5,0.15,TITLEP,0.0,40)	PLOT6 48
		CALL CPLOT(10.0,-1.0,-3)	PLOT6 49
		WRITE(NOT,1000)	PLOT6 50
1000		FORMAT(20X,51HPLOT6 (FRACTION OF MOLTEN FUEL) HAS BEEN MADE	PLOT6 51
		RETURN	PLOT6 52
		END	PLOT6 53

Q	ELT	PLOT7,1,720604, 49929	
		SUBROUTINE PLOT7	PLOT7 1
C			PLOT7 2
C		SUBROUTINE PLOT7 PLOTS THE KILOGRAMS OF MOLTEN FUEL	PLOT7 3
C		SUBROUTINES CALLED ARE BOX AND NUMPLO	PLOT7 4
C		SYSTEM SUBROUTINES CALLED ARE CPLOT,AXIS,NUMBER,SYMBOL,LINE,CSCALE	PLOT7 5
C			PLOT7 6
		INCLUDE A9C	PLOT7 7
		INCLUDE DEF	PLOT7 8
		CALL CPLOT(0.0,1.0,-3)	PLOT7 9
		CALL BOX(0.0,0.0,6.0,8.0)	PLOT7 10
		IF(XINCR(II).EQ.0.AND.YINCR(II).EQ.0) GO TO 15	PLOT7 11
		X(JTIMES+1) = XORIG(II)	PLOT7 12
		X(JTIMES+2) = XINCR(II)	PLOT7 13
		Y(JTIMES+1,7) = YORIG(II)	PLOT7 14
		Y(JTIMES+2,7) = YINCR(II)	PLOT7 15
		CALL AXIS(0.0,0.0,AP,-12.6,0.0,0.0,X(JTIMES+1),X(JTIMES+2))	PLOT7 16
		YTITL = YORIG(II)	PLOT7 17
C		PLOT Y AXIS	PLOT7 18
		Z = 0.	PLOT7 19
		CALL CPLOT(0.0,Z,3)	PLOT7 20
		CALL CPLOT(0.0,Z,2)	PLOT7 21
		CALL CPLOT(-.1,Z,2)	PLOT7 22
		CALL NUMBER(-0.7,Z,0.10,Y(JTIMES+1,7),0.0,-1)	PLOT7 23
		DO 10 I=1,8	PLOT7 24
		CALL CPLOT(0.0,Z,3)	PLOT7 25
		CALL CPLOT(0.0,Z,2)	PLOT7 26
		CALL CPLOT(0.0,Z+0.5,2)	PLOT7 27
		CALL CPLOT(-.1,Z+0.5,2)	PLOT7 28
		CALL CPLOT(0.0,Z+0.5,2)	PLOT7 29
		CALL CPLOT(0.0,Z+1.0,2)	PLOT7 30
		CALL CPLOT(-.1,Z+1.0,2)	PLOT7 31
		Z = Z + 1.0	PLOT7 32
		YTITL = YTITL + YINCR(II)	PLOT7 33
		CALL NUMBER(-0.7,Z,0.10,YTITL,0.0,-1)	PLOT7 34
		10 CONTINUE	PLOT7 35
		CALL SYMBOL(-0.8,2.1,0.14,24HKILOGRAMS OF FUEL MOLTEN,90.0,24)	PLOT7 36
C		PLOT CURVE	PLOT7 37
		CALL NUMPLO	PLOT7 38
		I = IBEG	PLOT7 39
		CALL LINE(X(I),Y(I,7),NX,1,1,1)	PLOT7 40
		GO TO 20	PLOT7 41
		15 CALL CSCALE(X(1),6.0,JTIMES,1)	PLOT7 42
		CALL CSCALE(Y(1,7),8.0,JTIMES,1)	PLOT7 43
		CALL AXIS(0.0,0.0,AP,-12.6,0.0,0.0,X(JTIMES+1),X(JTIMES+2))	PLOT7 44
		CALL AXIS(0.0,0.0,24HKILOGRAMS OF FUEL MOLTEN,24,8.0,90.0,	PLOT7 45
		1Y(JTIMES+1,7),Y(JTIMES+2,7))	PLOT7 46
		CALL LINE(X(1),Y(1,7),JTIMES,1,1,1)	PLOT7 47
		20 CALL SYMBOL(0.4,7.5,0.15,TITLEP,0.0,40)	PLOT7 48
		CALL CPLOT(10.0,-1.0,-3)	PLOT7 49
		WRITE(NOT,1000)	PLOT7 50
1000		FORMAT(20X,51HPLOT7 (KILOGRAMS OF MOLTEN FUEL) HAS BEEN MADE	PLOT7 51
		RETURN	PLOT7 52
		END	PLOT7 53

2	ELT	PLOT8,1,720604, 49932	
		SUBROUTINE PLOT8	PLOT8 1
C			PLOT8 2
C		SUBROUTINE PLOT8 PLOTS THE REACTIVITY COMPONENTS WHICH GOVERN THE	PLOT8 3
C		TRANSIENT	PLOT8 4
C		SUBROUTINES CALLED ARE BOX AND NUMPLO	PLOT8 5
C		SYSTEM SUBROUTINES CALLED ARE CPLOT,AXIS,NUMBER,SYMBOL,LINE,CSCALE	PLOT8 6
C			PLOT8 7
		INCLUDE ABC	PLOT8 8
		INCLUDE DEF	PLOT8 9
		CALL CPLOT(0.0,1.0,-3)	PLOT8 10
		CALL BOX(0.0,0.0,6.0,8.0)	PLOT8 11
		IF(XINCR(II).EQ.0.AND.YINCR(II).EQ.0) GO TO 15	PLOT8 12
		X(JTIMES+1) = XORIG(II)	PLOT8 13
		X(JTIMES+2) = XINCR(II)	PLOT8 14
		Y(JTIMES+1,9) = YORIG(II)	PLOT8 15
		Y(JTIMES+2,9) = YINCR(II)	PLOT8 16
		CALL AXIS(0.0,0.0,AP,-12.6,0.0,0.0,X(JTIMES+1),X(JTIMES+2))	PLOT8 17
		YTITL = YORIG(II)	PLOT8 18
C		PLOT Y AXIS	PLOT8 19
		Z = 0.	PLOT8 20
		CALL CPLOT(0.0,Z,3)	PLOT8 21
		CALL CPLOT(0.0,Z,2)	PLOT8 22
		CALL CPLOT(-.1,Z,2)	PLOT8 23
		CALL NUMBER(-0.7,Z,0.10,Y(JTIMES+1,9),0.0,2)	PLOT8 24
		DO 10 I=1,8	PLOT8 25
		CALL CPLOT(0.0,Z,3)	PLOT8 26
		CALL CPLOT(0.0,Z,2)	PLOT8 27
		CALL CPLOT(0.0,Z+0.5,2)	PLOT8 28
		CALL CPLOT(-.1,Z+0.5,2)	PLOT8 29
		CALL CPLOT(0.0,Z+0.5,2)	PLOT8 30
		CALL CPLOT(0.0,Z+1.0,2)	PLOT8 31
		CALL CPLOT(-.1,Z+1.0,2)	PLOT8 32
		Z = Z + 1.0	PLOT8 33
		YTITL = YTITL + YINCR(II)	PLOT8 34
		CALL NUMBER(-0.7,Z,0.10,YTITL,0.0,2)	PLOT8 35
10		CONTINUE	PLOT8 36
		CALL SYMBOL(-0.8,3.1,0.14,19HREACTIVITY, DOLLARS,90.0,19)	PLOT8 37
		CALL CPLOT(0.0,4.0,-3)	PLOT8 38
C		PLOT CURVES	PLOT8 39
		CALL NUMPLO	PLOT8 40
		I = IBEG	PLOT8 41
		Y(JTIMES+1,9) = 0.0	PLOT8 42
		Y(JTIMES+2,9) = YINCR(II)	PLOT8 43
		CALL LINE(X(I),Y(I,9),NX,1,1,1)	PLOT8 44
		Y(JTIMES+1,12) = 0.0	PLOT8 45
		Y(JTIMES+2,12) = YINCR(II)	PLOT8 46
		CALL LINE(X(I),Y(I,12),NX,1,1,0)	PLOT8 47
		Y(JTIMES+1,13) = 0.0	PLOT8 48
		Y(JTIMES+2,13) = YINCR(II)	PLOT8 49
		CALL LINE(X(I),Y(I,13),NX,1,1,2)	PLOT8 50
		Y(JTIMES+1,14) = 0.0	PLOT8 51
		Y(JTIMES+2,14) = YINCR(II)	PLOT8 52
		CALL LINE(X(I),Y(I,14),NX,1,1,3)	PLOT8 53
		Y(JTIMES+1,10) = 0.0	PLOT8 54
		Y(JTIMES+2,10) = YINCR(II)	PLOT8 55
		CALL LINE(X(I),Y(I,10),NX,1,1,4)	PLOT8 56
		Y(JTIMES+1,11) = 0.0	PLOT8 57
		Y(JTIMES+2,11) = YINCR(II)	PLOT8 58
		CALL LINE(X(I),Y(I,11),NX,1,1,5)	PLOT8 59
		GO TO 30	PLOT8 60

15 CALL CSCALE(X(1),6.0,JTIMES,1)	PLOT8 61
ISTORE = -JTIMES	PLOT8 62
DO 25 J=9,14	PLOT8 63
ISTORE = ISTORE + JTIMES	PLOT8 64
DO 20 IJ=1,JTIMES	PLOT8 65
I = ISTORE + IJ	PLOT8 66
20 YY(I) = Y(IJ,J)	PLOT8 67
25 CONTINUE	PLOT8 68
NXX = 6*JTIMES	PLOT8 69
CALL CSCALE(YY(1),8.0,NXX,1)	PLOT8 70
CALL AXIS(0.0,0.0,AP,-12,6.0,0.0,X(JTIMES+1),X(JTIMES+2))	PLOT8 71
CALL AXIS(0.0,0.0,19HREACTIVITY, DOLLARS,19,8.0,90.0,YY(NXX+1),	PLOT8 72
1YY(NXX+2))	PLOT8 73
Y(JTIMES+1,9) = YY(NXX+1)	PLOT8 74
Y(JTIMES+2,9) = YY(NXX+2)	PLOT8 75
CALL LINE(X(1),Y(1,9),JTIMES,1,1,1)	PLOT8 76
Y(JTIMES+1,12) = YY(NXX+1)	PLOT8 77
Y(JTIMES+2,12) = YY(NXX+2)	PLOT8 78
CALL LINE(X(1),Y(1,12),JTIMES,1,1,0)	PLOT8 79
Y(JTIMES+1,13) = YY(NXX+1)	PLOT8 80
Y(JTIMES+2,13) = YY(NXX+2)	PLOT8 81
CALL LINE(X(1),Y(1,13),JTIMES,1,1,2)	PLOT8 82
Y(JTIMES+1,14) = YY(NXX+1)	PLOT8 83
Y(JTIMES+2,14) = YY(NXX+2)	PLOT8 84
CALL LINE(X(1),Y(1,14),JTIMES,1,1,3)	PLOT8 85
Y(JTIMES+1,10) = YY(NXX+1)	PLOT8 86
Y(JTIMES+2,10) = YY(NXX+2)	PLOT8 87
CALL LINE(X(1),Y(1,10),JTIMES,1,1,4)	PLOT8 88
Y(JTIMES+1,11) = YY(NXX+1)	PLOT8 89
Y(JTIMES+2,11) = YY(NXX+2)	PLOT8 90
CALL LINE(X(1),Y(1,11),JTIMES,1,1,5)	PLOT8 91
CALL SYMBOL(0.4,2.1,0.15,TITLEP,0.0,40)	PLOT8 92
CALL SYMBOL(0.5,1.7,0.10,1,0.0,-1)	PLOT8 93
CALL SYMBOL(0.7,1.65,0.10,16H= NET REACTIVITY,0.0,16)	PLOT8 94
CALL SYMBOL(0.5,1.45,0.10,0,0.0,-1)	PLOT8 95
CALL SYMBOL(0.7,1.40,0.10,2CH= DOPPLER (NEGATIVE),0.0,20)	PLOT8 96
CALL SYMBOL(0.5,1.20,0.10,2,0.0,-1)	PLOT8 97
CALL SYMBOL(0.7,1.15,0.10,10H= COLLAPSE,0.0,10)	PLOT8 98
CALL SYMBOL(0.5,0.95,0.10,3,0.0,-1)	PLOT8 99
CALL SYMBOL(0.7,0.90,0.10,6H= VOID,0.0,6)	PLOT8100
CALL SYMBOL(0.5,0.70,0.10,4,0.0,-1)	PLOT8101
CALL SYMBOL(0.7,0.65,0.10,16H= PROGRAMMED NET,0.0,16)	PLOT8102
CALL SYMBOL(0.5,0.45,0.10,5,0.0,-1)	PLOT8103
CALL SYMBOL(0.7,0.40,0.10,7H= SCRAM,0.0,7)	PLOT8104
CALL CPLOT(10.0,-1.0,-3)	PLOT8105
GO TO 35	PLOT8106
30 CALL SYMBOL(0.4,3.6,0.15,TITLEP,0.0,40)	PLOT8107
CALL SYMBOL(0.5,3.2,0.10,1,0.0,-1)	PLOT8108
CALL SYMBOL(0.7,3.15,0.10,16H= NET REACTIVITY,0.0,16)	PLOT8109
CALL SYMBOL(0.5,2.95,0.10,0,0.0,-1)	PLOT8110
CALL SYMBOL(0.7,2.90,0.10,20H= DOPPLER (NEGATIVE),0.0,20)	PLOT8111
CALL SYMBOL(0.5,2.70,0.10,2,0.0,-1)	PLOT8112
CALL SYMBOL(0.7,2.65,0.10,10H= COLLAPSE,0.0,10)	PLOT8113
CALL SYMBOL(0.5,2.45,0.10,3,0.0,-1)	PLOT8114
CALL SYMBOL(0.7,2.40,0.10,6H= VOID,0.0,6)	PLOT8115
CALL SYMBOL(0.5,2.20,0.10,4,0.0,-1)	PLOT8116
CALL SYMBOL(0.7,2.15,0.10,16H= PROGRAMMED NET,0.0,16)	PLOT8117
CALL SYMBOL(0.5,1.95,0.10,5,0.0,-1)	PLOT8118
CALL SYMBOL(0.7,1.90,0.10,7H= SCRAM,0.0,7)	PLOT8119
CALL CPLOT(10.0,-5.0,-3)	PLOT8120

35 CONTINUE
WRITE(10T,1000)
1000 FORMAT(20X,51HPLOT8 (REACTIVITY COMPONENTS) HAS BEEN MADE
RETURN
END

PLOT8121
PLOT8122
PLOT8123
PLOT8124
PLOT8125

0	ELT	PLOT9,1,720604, 49935	
		SUBROUTINE PLOT9	PLOT9 1
C			PLOT9 2
C		THIS SUBROUTINE PLOTS REACTIVITY VS TIME AFTER COLLAPSE OR	PLOT9 3
C		VOIDING BEGINS	PLOT9 4
C		SUBROUTINES CALLED ARE BOX AND TIMPLC	PLOT9 5
C		SYSTEM SUBROUTINES CALLED ARE CPLOT, AXIS, NUMBER, SYMBOL, LINE, CSCALE	PLOT9 6
C			PLOT9 7
		INCLUDE ABC	PLOT9 8
		INCLUDE DEF	PLOT9 9
		CALL CPLOT(0.0,1.0,-3)	PLOT9 10
		CALL BOX(0.0,0.0,6.0,8.0)	PLOT9 11
10	IF(IREAD)	15, 15, 20	PLOT9 12
15	CALL	TIMPLC	PLOT9 13
20	CONTINUE		PLOT9 14
	IF(XORIG(II))	30, 30, 25	PLOT9 15
25	XZERP	= 0.	PLOT9 16
30	DO 35 I=	IPLO, JTIMES	PLOT9 17
35	XXX(I)	= X(I) - XZERP	PLOT9 18
	NX	= JTIMES - IPLO + 1	PLOT9 19
	IF(XINCR(II).EQ.0.AND.YINCR(II).EQ.0)	GO TO 45	PLOT9 20
	XXX(JTIMES+1)	= XORIG(II)	PLOT9 21
	XXX(JTIMES+2)	= XINCR(II)	PLOT9 22
	Y(JTIMES + 1,9)	= YORIG(II)	PLOT9 23
	Y(JTIMES + 2,9)	= YINCR(II)	PLOT9 24
	CALL AXIS(0.0,0.0,40,TIME FROM START OF COLLAPSE OR VOID, SEC,-40,		PLOT9 25
	16.0,0.0,XXX(JTIMES+1),XXX(JTIMES+2))		PLOT9 26
	YTITL	= YORIG(II)	PLOT9 27
C	PLOT	Y AXIS	PLOT9 28
	Z	= 0.	PLOT9 29
	CALL CPLOT(0.0,Z,3)		PLOT9 30
	CALL CPLOT(0.0,Z,2)		PLOT9 31
	CALL CPLOT(-.1,Z,2)		PLOT9 32
	CALL NUMBER(-0.7,Z,0.10,Y(JTIMES+1,9),0.0,2)		PLOT9 33
	DO 40 I=	1,8	PLOT9 34
	CALL CPLOT(0.0,Z,3)		PLOT9 35
	CALL CPLOT(0.0,Z,2)		PLOT9 36
	CALL CPLOT(0.0,Z+0.5,2)		PLOT9 37
	CALL CPLOT(-.1,Z+0.5,2)		PLOT9 38
	CALL CPLOT(0.0,Z+0.5,2)		PLOT9 39
	CALL CPLOT(0.0,Z+1.0,2)		PLOT9 40
	CALL CPLOT(-.1,Z+1.0,2)		PLOT9 41
	Z	= Z + 1.0	PLOT9 42
	YTITL	= YTITL + YINCR(II)	PLOT9 43
	CALL NUMBER(-0.7,Z,0.10,YTITL,0.0,2)		PLOT9 44
40	CONTINUE		PLOT9 45
	CALL SYMBOL(-0.8,3.1,0.14,19HREACTIVITY, DOLLARS,90.0,19)		PLOT9 46
C	PLOT	CURVES	PLOT9 47
	I	= IPLO	PLOT9 48
	CALL LINE(XXX(I),Y(I,9),NX,1,1,1)		PLOT9 49
	Y(JTIMES+1,13)	= YORIG(II)	PLOT9 50
	Y(JTIMES+2,13)	= YINCR(II)	PLOT9 51
	CALL LINE(XXX(I),Y(I,13),NX,1,1,2)		PLOT9 52
	Y(JTIMES+1,14)	= YORIG(II)	PLOT9 53
	Y(JTIMES+2,14)	= YINCR(II)	PLOT9 54
	CALL LINE(XXX(I),Y(I,14),NX,1,1,3)		PLOT9 55
	GO TO	70	PLOT9 56
45	IPLO=	IPLO	PLOT9 57
	NX=	NX	PLOT9 58
	CALL CSCALE(XXX(IPLO),6.0,NX,1)		PLOT9 59
	WRITE(6,1000)	IPLO	PLOT9 60

1000	FORMAT (12X, 8H IPLO = I4)	PLOT9 61
	WRITE(NOT,1005) NX	PLOT9 62
1005	FORMAT (12X, 8H NX = I4)	PLOT9 63
	IJUP=JTIMES+2	PLOT9 64
	DO 50 I=IPLO,IJUP	PLOT9 65
	WRITE(NOT,1010) I,XXX(I)	PLOT9 66
1010	FORMAT(12X,5H XXX(I3, 4H) = E10.4)	PLOT9 67
	50 CONTINUE	PLOT9 68
	DO 55 IJ=IPLO,JTIMES	PLOT9 69
	55 YY(IJ-IPLO+1) = Y(IJ,9)	PLOT9 70
	NDUM = C	PLOT9 71
	DO 65 J=13,14	PLOT9 72
	NDUM = NDUM + NX	PLOT9 73
	DO 60 IJ=IPLO,JTIMES	PLOT9 74
	60 YY(NDUM+IJ-IPLO+1) = Y(IJ,J)	PLOT9 75
	65 CONTINUE	PLOT9 76
	NNN=3*NX	PLOT9 77
	CALL CSCALE(YY(1),8.0,NNN,1)	PLOT9 78
	CALL AXIS(0.0,0.0,40H TIME FROM START OF COLLAPSE OR VOID, SEC, -40,	PLOT9 79
	16.0,0.0,XXX(JTIMES+1),XXX(JTIMES+2))	PLOT9 80
	CALL AXIS(0.0,0.0,19H REACTIVITY, DOLLARS, 19,8.0,90.0,YY(NNN+1),	PLOT9 81
	1YY(NNN+2))	PLOT9 82
	Y(JTIMES+1,9) = YY(NNN+1)	PLOT9 83
	Y(JTIMES+2,9) = YY(NNN+2)	PLOT9 84
	CALL LINE(XXX(IPLO),Y(IPLO,9),NX,1,1,1)	PLOT9 85
	Y(JTIMES+1,13) = YY(NNN+1)	PLOT9 86
	Y(JTIMES+2,13) = YY(NNN+2)	PLOT9 87
	CALL LINE(XXX(IPLO),Y(IPLO,13),NX,1,1,2)	PLOT9 88
	Y(JTIMES+1,14) = YY(NNN+1)	PLOT9 89
	Y(JTIMES+2,14) = YY(NNN+2)	PLOT9 90
	CALL LINE(XXX(IPLO),Y(IPLO,14),NX,1,1,3)	PLOT9 91
70	CALL SYMBOL(0.4,7.6,0.15,TITLEP,0.0,40)	PLOT9 92
	CALL SYMBOL(0.5,7.2,0.10,1,0.0,-1)	PLOT9 93
	CALL SYMBOL(0.7,7.15,0.10,16H= NET REACTIVITY,0.0,16)	PLOT9 94
	CALL SYMBOL(0.5,6.95,0.10,2,0.0,-1)	PLOT9 95
	CALL SYMBOL(0.7,6.90,0.10,10H= COLLAPSE,0.0,10)	PLOT9 96
	CALL SYMBOL(0.5,6.70,0.10,3,0.0,-1)	PLOT9 97
	CALL SYMBOL(0.7,6.65,0.10,6H= VOID,0.0,6)	PLOT9 98
	CALL CPlot(10.0,-1.0,-3)	PLOT9 99
	WRITE(NOT,1015)	PLOT9 100
1015	FORMAT(20X,51HPLOT9 (REACTIVITY AFTER COLLAPSE) HAS BEEN MADE	PLOT9 101
	RETURN	PLOT9 102
	END	PLOT9 103

a	ELT	PLOT10,1.7206C4, 49937	
		SUBROUTINE PLOT10	PLOT1 1
C			PLOT1 2
C		THIS SUBROUTINE PLOTS THE POWER VS TIME AFTER COLLAPSE OR	PLOT1 3
C		VOIDING BEGINS	PLOT1 4
C		SUBROUTINES CALLED ARE 20X AND TIMPLO	PLOT1 5
C		SYSTEM SUBROUTINES CALLED ARE CPLOT, AXIS, NUMBER, SYMBOL, LINE, CSCALE	PLOT1 6
C			PLOT1 7
		INCLUDE ABC	PLOT1 8
		INCLUDE DEF	PLOT1 9
		CALL CPLOT(0.0,1.0,-3)	PLOT1 10
		CALL 30X(0.0,0.0,6.0,9.0)	PLOT1 11
10		IF(IPFAC) 15, 15, 20	PLOT1 12
15		CALL TIMPLO	PLOT1 13
20		IF(XCRIG(II)) 30, 30, 25	PLOT1 14
25		XZEROP = 0.	PLOT1 15
30		DO 35 I=IPLO,JTIMES	PLOT1 16
35		XXX(I) = X(I) - XZEROP	PLOT1 17
		NX = JTIMES - IPLO + 1	PLOT1 18
		IF(XINCR(II).EQ.0.AND.YINCR(II).EQ.0) GO TO 45	PLOT1 19
		XXX(JTIMES+1) = XCRIG(II)	PLOT1 20
		XXX(JTIMES+2) = XINCR(II)	PLOT1 21
		Y(JTIMES+1,1) = YCRIG(II)	PLOT1 22
		Y(JTIMES+2,1) = YINCR(II)	PLOT1 23
		CALL AXIS(C.C,C.C,40HTIME FROM START OF COLLAPSE OR VOID, SEC,-40,	PLOT1 24
		16.0,0.0,XXX(JTIMES+1),XXX(JTIMES+2))	PLOT1 25
		YTITL = YCRIG(II)	PLOT1 26
C		PLOT Y AXIS	PLOT1 27
		Z = 0.	PLOT1 28
		CALL CPLOT(0.0,Z,3)	PLOT1 29
		CALL CPLOT(0.0,Z,2)	PLOT1 30
		CALL CPLOT(-.1,Z,2)	PLOT1 31
		CALL NUMBER(-0.7,Z,0.10,Y(JTIMES+1,1),0.0,2)	PLOT1 32
		DO 40 I=1,8	PLOT1 33
		CALL CPLOT(0.0,Z,3)	PLOT1 34
		CALL CPLOT(0.0,Z,2)	PLOT1 35
		CALL CPLOT(0.0,Z+0.5,2)	PLOT1 36
		CALL CPLOT(-.1,Z+0.5,2)	PLOT1 37
		CALL CPLOT(0.0,Z+0.5,2)	PLOT1 38
		CALL CPLOT(0.0,Z+1.0,2)	PLOT1 39
		CALL CPLOT(-.1,Z+1.0,2)	PLOT1 40
		Z = Z + 1.0	PLOT1 41
		YTITL = YTITL + YINCR(II)	PLOT1 42
		CALL NUMBER(-0.7,Z,0.10,YTITL,0.0,2)	PLOT1 43
40		CONTINUE	PLOT1 44
		CALL SYMBOL(-0.8,3.5,0.14,9HPOWER, MW,90.0,9)	PLOT1 45
		I = IPLO	PLOT1 46
		CALL LINE(XXX(I),Y(I,1),NX,1,1,1)	PLOT1 47
		GO TO 50	PLOT1 48
45		CALL CSCALE(XXX(IPLO),6.0,NX,1)	PLOT1 49
		CALL CSCALE(Y(IPLO,1),8.0,NX,1)	PLOT1 50
		CALL AXIS(0.0,0.0,40HTIME FROM START OF COLLAPSE OR VOID, SEC,-40,	PLOT1 51
		16.0,0.0,XXX(JTIMES+1),XXX(JTIMES+2))	PLOT1 52
		CALL AXIS(0.0,0.0,9HPOWER, MW,9.8,0.90,0,Y(JTIMES+1,1),Y(JTIMES+2,	PLOT1 53
		11))	PLOT1 54
		CALL LINE(XXX(IPLO),Y(IPLO,1),NX,1,1,1)	PLOT1 55
50		CALL SYMBOL(0.4,7.6,0.15,TITLEP,0.0,40)	PLOT1 56
		CALL CPLOT(10.0,-1.0,-3)	PLOT1 57
		WRITE(NOT,1000)	PLOT1 58
1000		FORMAT(20X,51HPLOT10 (POWER AFTER COLLAPSE) HAS BEEN MADE	PLOT1 59
		RETURN	PLOT1 60

END

PLOT1 61

3	ELT	TDRAW1,1,720604, 49941	
		SUBROUTINE TDRAW1	TDRAW 1
C			TDRAW 2
C		THIS SUBROUTINE PLOTS CENTER NODE, OUTER NODE, CLADDING AND	TDRAW 3
C		COOLANT TEMPERATURES AS A FUNCTION OF TIME FOR THE PARTICULAR	TDRAW 4
C		CHANNEL AND AXIAL LEVEL SPECIFIED.	TDRAW 5
C		SUBROUTINES CALLED ARE BOX AND TUMPLO	TDRAW 6
C		SYSTEM SUBROUTINES CALLED ARE CPlot, AXIS, NUMBER, SYMBOL, LINE, CSCALE	TDRAW 7
C			TDRAW 8
		INCLUDE ABC	TDRAW 9
		INCLUDE DEF	TDRAW 10
		CALL CPlot(0.0,2.0,-3)	TDRAW 11
		CALL BOX(0.0,0.0,8.0,6.0)	TDRAW 12
		REWIND 25	TDRAW 13
		NCHAN = IFIX(TPLOT(II+1))	TDRAW 14
		NAXIAL = IFIX(TPLOT(II+2))	TDRAW 15
		ITAB(17)=ITAB(17)+4200*(MUPPER*(NCHAN-1)+NAXIAL-1)	TDRAW 16
		NUP1=NUPPER+1	TDRAW 17
		DO 10 I=1,JTIMES	TDRAW 18
		READ(25) (OUT(J),J=1,NUP1)	TDRAW 19
		X(I) = OUT(1)	TDRAW 20
		Y(I,1) = OUT(2)	TDRAW 21
		Y(I,2)=OUT(NUPPER-2)	TDRAW 22
		Y(I,3)=OUT(NUPPER)	TDRAW 23
		Y(I,4)=OUT(NUP1)	TDRAW 24
		WRITE (NOT,1000) X(I),Y(I,1),Y(I,2),Y(I,3),Y(I,4)	TDRAW 25
1000		FORMAT(5E10.4)	TDRAW 26
10		CONTINUE	TDRAW 27
		XORIG(II) = TPLOT(II+3)	TDRAW 28
		XINCR(II) = TPLOT(II+4)	TDRAW 29
		YORIG(II) = TPLOT(II+5)	TDRAW 30
		YINCR(II) = TPLOT(II+6)	TDRAW 31
		IF(XINCR(II).EQ.0.AND.YINCR(II).EQ.0) GO TO 20	TDRAW 32
		X(JTIMES+1) = XORIG(II)	TDRAW 33
		X(JTIMES+2) = XINCR(II)	TDRAW 34
		Y(JTIMES+1,1) = YORIG(II)	TDRAW 35
		Y(JTIMES+2,1) = YINCR(II)	TDRAW 36
		CALL AXIS(0.0,0.0,AP,-12,P,C,0.0,X(JTIMES+1),X(JTIMES+2))	TDRAW 37
		YTITL = YORIG(II)	TDRAW 38
C		PLOT Y AXIS	TDRAW 39
		Z = 0.	TDRAW 40
		CALL CPlot(0.0,Z,3)	TDRAW 41
		CALL CPlot(0.0,Z,2)	TDRAW 42
		CALL CPlot(-.1,Z,2)	TDRAW 43
		CALL NUMBER(-0.7,Z,0.10,Y(JTIMES+1,1),0.0,-1)	TDRAW 44
		DO 15 I=1,6	TDRAW 45
		CALL CPlot(0.0,Z,3)	TDRAW 46
		CALL CPlot(0.0,Z,2)	TDRAW 47
		CALL CPlot(0.0,Z+0.5,2)	TDRAW 48
		CALL CPlot(-.1,Z+0.5,2)	TDRAW 49
		CALL CPlot(0.0,Z+0.5,2)	TDRAW 50
		CALL CPlot(0.0,Z+1.0,2)	TDRAW 51
		CALL CPlot(-.1,Z+1.0,2)	TDRAW 52
		Z = Z + 1.0	TDRAW 53
		YTITL = YTITL + YINCR(II)	TDRAW 54
		CALL NUMBER(-0.7,Z,0.10,YTITL,0.0,-1)	TDRAW 55
15		CONTINUE	TDRAW 56
		CALL SYMBOL(-0.8,3.1,0.14,14HTEMPERATURE, K,90.0,14)	TDRAW 57
C		PLOT CURVES	TDRAW 58
		CALL TUMPLO	TDRAW 59
		I=IBEG	TDRAW 60

CALL LINE(X(I),Y(I,1),NX,1,1,1)	TDRAW 61
Y(JTIMES+1,2) = YORIG(II)	TDRAW 62
Y(JTIMES+2,2) = YINCR(II)	TDRAW 63
CALL LINE(X(I),Y(I,2),NX,1,1,2)	TDRAW 64
Y(JTIMES+1,3) = YORIG(II)	TDRAW 65
Y(JTIMES+2,3) = YINCR(II)	TDRAW 66
CALL LINE(X(I),Y(I,3),NX,1,1,3)	TDRAW 67
Y(JTIMES+1,4) = YORIG(II)	TDRAW 68
Y(JTIMES+2,4) = YINCR(II)	TDRAW 69
CALL LINE(X(I),Y(I,4),NX,1,1,4)	TDRAW 70
GO TO 35	TDRAW 71
20 CALL CSCALE(X(1),3.0,JTIMES,1)	TDRAW 72
ISTORE = -JTIMES	TDRAW 73
DO 30 J=1,4	TDRAW 74
ISTORE = ISTORE + JTIMES	TDRAW 75
DO 25 IJ=1,JTIMES	TDRAW 76
I = ISTORE + IJ	TDRAW 77
25 YY(I) = Y(IJ,J)	TDRAW 78
30 CONTINUE	TDRAW 79
NXX = 4*JTIMES	TDRAW 80
CALL CSCALE(YY(1),6.0,NXX,1)	TDRAW 81
CALL AXIS(0.0,0.0,AP,-12.8,0.0,0.0,X(JTIMES+1),X(JTIMES+2))	TDRAW 82
CALL AXIS(0.0,0.0,14HTEMPERATURE, K,14.6,0.0,90.0,YY(NXX+1),	TDRAW 83
1YY(NXX+2))	TDRAW 84
Y(JTIMES+1,1) = YY(NXX+1)	TDRAW 85
Y(JTIMES+2,1) = YY(NXX+2)	TDRAW 86
CALL LINE(X(1),Y(1,1),JTIMES,1,1,1)	TDRAW 87
Y(JTIMES+1,2) = YY(NXX+1)	TDRAW 88
Y(JTIMES+2,2) = YY(NXX+2)	TDRAW 89
CALL LINE(X(1),Y(1,2),JTIMES,1,1,2)	TDRAW 90
Y(JTIMES+1,3) = YY(NXX+1)	TDRAW 91
Y(JTIMES+2,3) = YY(NXX+2)	TDRAW 92
CALL LINE(X(1),Y(1,3),JTIMES,1,1,3)	TDRAW 93
Y(JTIMES+1,4) = YY(NXX+1)	TDRAW 94
Y(JTIMES+2,4) = YY(NXX+2)	TDRAW 95
CALL LINE(X(1),Y(1,4),JTIMES,1,1,4)	TDRAW 96
35 CALL SYMBOL(0.4,5.6,0.15,TITLEP,0.0,40)	TDRAW 97
CALL SYMBOL(0.4,5.3,0.12,26HCHANNEL, AXIAL LEVEL, 0.0,26)	TDRAW 98
CALL NUMBER(1.3,5.3,0.12,TPL0T(II+1),0.0,-1)	TDRAW 99
CALL NUMBER(3.3,5.3,0.12,TPL0T(II+2),0.0,-1)	TDRAW100
CALL SYMBOL(0.5,5.1,0.10,1,0.0,-1)	TDRAW101
CALL SYMBOL(0.7,5.05,0.10,11HCENTER NODE,0.0,11)	TDRAW102
CALL SYMBOL(0.5,4.85,0.10,2,0.0,-1)	TDRAW103
CALL SYMBOL(0.7,4.80,0.10,10HOUTER NODE,0.0,10)	TDRAW104
CALL SYMBOL(0.5,4.6,0.10,3,0.0,-1)	TDRAW105
CALL SYMBOL(0.7,4.55,0.10,4HCLAD,0.0,4)	TDRAW106
CALL SYMBOL(0.5,4.35,0.10,4,0.0,-1)	TDRAW107
CALL SYMROL(0.7,4.3,0.10,7HCOOLANT,0.0,7)	TDRAW108
CALL CPL0T(12.0,-2.0,-3)	TDRAW109
WRITE(NOT,1005)	TDRAW110
1005 FORMAT(20X,51HTDRAW1 (TRANSIENT PIN TEMPERATURES) HAS BEEN MADE	TDRAW111
RETURN	TDRAW112
END	TDRAW113

```

3 ELT LOGAXS,1,701110, 63283
SUBROUTINE LOGAXS(X,Y,LABEL,NC,LENGTH,THETA,MIN,DELTA)
C
C SUBROUTINE LOGAXS COMPUTES THE ORDINATE FOR A SEMILOG PLOT
C
REAL LENGTH,MIN,LOGS,LMAJOR,LMINOR,LS
DIMENSION LOGS(3)
DATA C/.017453293/
DATA (LOGS(I),I=1,3)/.30103,.47712,.60206,.69897,.77815,.84510,
1 .90309,.95424/
DATA LMAJOR,LMINOR/.1,.04/ 3 TIC MARK LENGTHS
COST= COS(THETA*C)
SINT= SIN(THETA*C)
CALL CPLOT(X+LENGTH*COST,Y+LENGTH*SINT,3)
CALL CPLOT(X,Y,2)
C
PUT IN DECADES
N= INT(LENGTH*DELTA)
SIZE= MIN(.14/SQRT(DELTA),.3) 3 SIZE OF NUMBERS
SSIGN = FLOAT(ISIGN(1,NC))
XCOMPJ =-SSIGN*LMAJOR *SINT
C
X COMPONENT LENGTH OF MAJOR TIC MARK
YCOMPJ = SSIGN*LMAJOR*COST
C
Y- COMPONENT LENGTH OF MAJOR TIC MARK
XCOMPN =-SSIGN*LMINOR*SINT
C
X-COMPONENT LENGTH OF MINOR TIC MARK
YCOMPN = SSIGN*LMINOR*COST
C
Y-COMPONENT LENGTH OF MINOR TIC MARK
C
FIND NO. OF DIGITS IN MAX EXPONENT
NN= 0
I=INT(MIN)+N
IF(MIN.LT.0)NN=NN+1
J=MAX0(IABS(INT(MIN)),I)
DO 10 J=1,10
I=I/10
NN=NN+1
IF(I.EQ.0) GO TO 15
10 CONTINUE
15 LS=APAX1(.5*ABS(XCOMPJ), 1.3*ABS(XCOMPJ)-FLOAT(NN)*.6*SIZE)
XTEN = -.7*SIZE*ABS(COST)-((LS+(2+.6*FLOAT(NN))*SIZE) *
1 (.5-SIGN(.5,XCOMPJ)) - (1.3*XCOMPJ)*(1.5+SIGN(.5,XCOMPJ))))*
1ABS(SINT)
C
X- COMPONENT OF LOWER LEFT CORNER OF 10 FROM ORIGIN.
YTEN = -.5*SIZE*ABS(SINT)+ 2.*YCOMPJ + ABS(COST)*SIZE*(-.5+SIGN(
1 .5,YCOMPJ))
C
Y- COMPONENT OF LOWER LEFT CORNER OF 10 FROM ORIGIN.
CALL CPLOT(X+XCOMPJ, Y+YCOMPJ, 2)
CALL SYMBOL(X+XTEN,Y+YTEN, SIZE, 2H10, 0, 2)
CALL NUMBER(X+XTEN+2.*SIZE, Y+YTEN+SIZE, .6*SIZE, MIN, 0, -1)
TSIZE= AMIN1(.14,.8*LENGTH/FLOAT(IABS(NC)))
LS = LENGTH/2.-TSIZE/2.*FLOAT(IABS(NC))
IF (NC.EQ.0) GO TO 20
XLABEL= (XTEN+XTEN*(.1-SIGN(.1,XCOMPJ))-TSIZE*.5*(1.-SIGN(1.,SINT)
1 ) +((2.4+.6*FLOAT(NN))*SIZE+
2 (.5+SIGN(.5,SINT)) *TSIZE)*(1.50+SIGN(.50,XCOMPJ))*ABS(SINT)
YLABEL= (YTEN + (SIZE + SIGN(SIZE,YCOMPJ))
1 *(1+.25/SIZE*TSIZE*(1.-SIGN(1.,COST)))+
1 (.2*YTEN-TSIZE*.5*(1.+SIGN(1.,COST)))*
2(.5-SIGN(.5,YCOMPJ))*ABS(COST)
CALL SYMBOL(LS*COST+XLABEL*X, LS*SINT+YLABEL*Y, TSIZE, LABEL,
1 THETA, IABS(NC))
20 CONTINUE

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XLABEL=X	LOGAX 61
YLABEL=Y	LOGAX 62
DO 30 I=1,N	LOGAX 63
DO 25 J=1,8	LOGAX 64
CALL CPLOT(LOGS(J)*COST/DELTA+XLABEL, LOGS(J)*SINT/DELTA+YLABEL, 3)	LOGAX 65
25 CALL CPLOT(LOGS(J)*COST/DELTA+XCOMPJ+XLABEL,	LOGAX 66
1 LOGS(J)*SINT/DELTA+YCOMPJ+YLABEL, 2)	LOGAX 67
XLABEL=XLABEL+COST/DELTA	LOGAX 68
YLABEL = YLABEL + SINT/DELTA	LOGAX 69
CALL CPLOT(XLABEL, YLABEL, 3)	LOGAX 70
CALL CPLOT(XCOMPJ+XLABEL, YCOMPJ+YLABEL, 2)	LOGAX 71
CALL SYMBOL(XLABEL+XTEN, YLABEL+YTEN, SIZE, 2HID, C, 2)	LOGAX 72
30 CALL NUMBER(XLABEL+XTEN+2.*SIZE, YLABEL+YTEN+SIZE, .6*SIZE,	LOGAX 73
1 MIN +FLOAT(I), C, -1)	LOGAX 74
RETURN	LOGAX 75
END	LOGAX 76

2	ELT	BOX,1,701110, 63289		
		SUBROUTINE BOX(X,Y,DX,DY)	BOX	1
C			BOX	2
C		SUBROUTINE BOX DOUBLE-DRAWS A BOX WITH CORNERS AT (X,Y), (X+DX,Y),	BOX	3
C		(X+DX,Y+DY), AND (X,Y+DY) INCHES	BOX	4
C			BOX	5
C			BOX	6
		CALL CPLOT(X,Y,3)	BOX	7
		DO 10 K=1,2	BOX	8
		DO 10 J=1,2	BOX	9
		DO 10 I=1,2	BOX	10
10		CALL CPLOT(X+DX*FLOAT(2-J),Y+DY*FLOAT(IABS(I-J)),2)	BOX	11
		CALL CPLOT(X,Y,3)	BOX	12
C			BOX	13
		RETURN	BOX	14
		END	BOX	15

3	ELT CURVE,1,701110, 53290	
	SUBROUTINE CURVE (YOUT,XIN,X,Y,NO,IERROR)	CURVE 1
C		CURVE 2
C	SUBROUTINE CURVE INTERPOLATES LINEARLY BETWEEN POINT INPUT DATA.	CURVE 3
C	X = INPUT POINT ABSCISSA DATA	CURVE 4
C	Y = INPUT POINT ORDINATE DATA	CURVE 5
C	NO = NUMBER OF INPUT DATA POINTS	CURVE 6
C	XIN = ABSCISSA VARIABLE	CURVE 7
C	YOUT = ORDINATE VARIABLE (DESIRED OUTPUT)	CURVE 8
C	IERROR = ERROR FLAG	CURVE 9
C		CURVE 10
	DIMENSION X(2),Y(2)	CURVE 11
	IF(XIN.LT.X(1).OR.XIN.GT.X(NO)) RETURN 6	CURVE 12
	DO 10 I=1,NO	CURVE 13
	IF(XIN-X(I)) 20,15,10	CURVE 14
10	CONTINUE	CURVE 15
15	YOUT=Y(I)	CURVE 16
	RETURN	CURVE 17
20	YOUT=Y(I-1)+(Y(I)-Y(I-1))/(X(I)-X(I-1))*(XIN-X(I-1))	CURVE 18
	RETURN	CURVE 19
	END	CURVE 20

2	ELT	QUAD,1,720604, 49942		
		SUBROUTINE QUAD(Y,X,XARRAY,YARRAY,NUM,IERROR)	QUAD	1
C			QUAD	2
C		SUB. QUAD INTERPOLATES QUADRATICALLY BETWEEN POINT INPUT DATA.	QUAD	3
C		XARRAY = INPUT POINT ABSCISSA DATA	QUAD	4
C		YARRAY = INPUT POINT ORDINATE DATA	QUAD	5
C		NUM = NUMBER OF INPUT DATA POINTS	QUAD	6
C		X = ABSCISSA VARIABLE	QUAD	7
C		Y = ORDINATE VARIABLE (DESIRED OUTPUT)	QUAD	8
C		IERROR = ERROR FLAG	QUAD	9
C			QUAD	10
		DIMENSION XARRAY(2),YARRAY(2)	QUAD	11
		DATA JLAST/0/	QUAD	12
		IF(X.GT.XARRAY(NUM).OR.X.LT.XARRAY(1)) RETURN 6	QUAD	13
		DO 10 J=1,NUM	QUAD	14
		IF (XARRAY(J)-X) 10,15,25	QUAD	15
10		CONTINUE	QUAD	16
15		Y=YARRAY(J)	QUAD	17
20		RETURN	QUAD	18
25		IF(J.EQ.NUM) J=J-1	QUAD	19
		IF(J-JLAST) 30,35,30	QUAD	20
30		JLAST=J	QUAD	21
		C=((XARRAY(J+1)-XARRAY(J))*(YARRAY(J)-YARRAY(J-1))-(XARRAY(J)-XARRQUAD	22	
		1AY(J-1))*(YARRAY(J+1)-YARRAY(J)))/((XARRAY(J+1)-XARRAY(J))*(XARRAYQUAD	23	
		2(J)**2-XARRAY(J-1)**2)-(XARRAY(J)-XARRAY(J-1))*(XARRAY(J+1)**2-XARQUAD	24	
		3RAY(J)**2))	QUAD	25
		B=(YARRAY(J)-YARRAY(J-1)-C*(XARRAY(J)**2-XARRAY(J-1)**2))/(XARRAY(QUAD	26	
		1J)-XARRAY(J-1))	QUAD	27
		A=YARRAY(J)-XARRAY(J)*(B+XARRAY(J)*C)	QUAD	28
35		Y=A+X*(B+X*C)	QUAD	29
		GO TO 20	QUAD	30
		END	QUAD	31

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