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GAKIN II: A ONE-DIMENSIONAL

MULTIGROUP DIFFUSION THEORY

REACTOR KINETICS CODE

by

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GAKIN II: A One-dimensional Multigroup Diffusion Theory
Reactor Kinetics Code

by

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ABSTRACT

GAKIN II is a time dependent neutron diffusion code. It solves the time dependent multigroup neutron diffusion equations in one space dimension using the usual finite difference approximation. Time integration is accomplished using an exponential transformation and semi-implicit differencing.

GAKIN II is a revision of the existing code GAKIN. The temporal treatment has been improved, a simplified and more implicit algorithm has been used, and the coding has been improved and simplified.

Table of Contents

	<u>Page</u>
Abstract	2
1. Introduction	5
2. Algorithm Development	6
2.1 The Multigroup Diffusion Equations	6
2.2 Spatial Dependence	10
2.3 Time Dependence	15
2.4 Proof of Consistency	18
2.5 Proof of Stability	20
3. Frequency Prediction	21
4. Automatic Time Step Adjustment	24
5. Steady State Calculation	28
6. Cross Sections and Input Parameters	30
6.1 Definitions of Cross Sections and Input Parameters	30
6.2 Xenon Feedback	31
6.3 Time Dependent Cross Section Variation	33
7. Summary of Changes to GAKIN	35
8. User Information	36
8.1 General	36
8.2 Detailed Input Specifications	37

Table of Contents Continued

	<u>Page</u>
8.3 Short Input Description	51
8.4 Edit Description	69
8.5 How to Alter Previous GAKIN Input Decks	69
8.6 List of Subroutines	71
9. Sample Problems	74
9.1 Prompt Supercritical Transient	74
9.2 Delayed Supercritical Transient	93
Appendix Code Listing	121
References	204

1. INTRODUCTION

GAKIN II is a one-dimensional multigroup diffusion theory kinetics code. The code solves the time dependent multigroup diffusion equations in slab, cylindrical, or spherical geometry. An arbitrary number of space points, regions and energy groups may be used. Optionally, the effects of time dependent cross sections, external sources, and xenon poisoning may be included. Time step adjustment can be automatic. GAKIN II has been written for the IBM System 370, or System 360.

GAKIN II is a revision of GAKIN (Reference 1) designed to decrease the storage requirements and running time of the original code. The iterative frequency predictor in GAKIN has been replaced by an explicit scheme, the steady state initialization calculation has been streamlined, and a large number of programming improvements have been made. As a result, GAKIN II is substantially more economic to use than GAKIN. A complete summary of the changes made to GAKIN can be found in Section 7.

The theoretical basis for GAKIN II is presented in Sections 2 through 5. Section 6 describes some of the terms a user may need, defines the cross sections used, and explains how cross section variation is treated. Section 8 contains necessary user information and section 9 contains two sample problems. The code is listed in the appendix.

2. Algorithm Development

In this section the basic numerical scheme used in GAKIN II is derived. In 2.1 the time dependent multigroup diffusion equations are set forth. Discretization is accomplished by finite differencing of the spatial variable in 2.2 and by exponential transformation of time in 2.3. The resulting system of equations is proven consistent in 2.4 and numerically stable in 2.5.

2.1 The Time Dependent Multigroup Diffusion Equations

Considering only one fissionable isotope and assuming that the neutron energy group velocities are time independent, the time dependent diffusion equation for group g is

$$\begin{aligned}
 v_g \frac{\partial}{\partial t} \phi_g(\underline{r}, t) &= \underline{\nabla} \cdot D_g(\underline{r}, t) \underline{\nabla} \phi_g(\underline{r}, t) \\
 &\quad - \Sigma_{tg}(\underline{r}, t) \phi_g(\underline{r}, t) \\
 &\quad + \sum_{g'=1}^G \Sigma_{sgg'}(\underline{r}, t) \phi_{g'}(\underline{r}, t)
 \end{aligned}
 \tag{1a}$$

$$\begin{aligned}
& + (1-\beta) \chi_g^p \sum_{g'=1}^G v \Sigma_{fg'}(\underline{r}, t) \phi_{g'}(\underline{r}, t) \\
& + \sum_{i=1}^I \chi_{ig}^d \lambda_i c_i(\underline{r}, t) + S_g(\underline{r}, t),
\end{aligned}$$

where,

v_g is the group speed of neutrons in group g ,

$\phi_g(\underline{r}, t)$ is the neutron flux in group g at location $\underline{r}$, and at time t ,

$D_g(\underline{r}, t)$ is the group g diffusion coefficient,

$\beta = \sum_{i=1}^I \beta_i$, where β_i is the fraction of all neutrons produced due to decay of delayed neutron emitters in group i ($i=1, 2, \dots, I$),

χ_g^p is the fractional yield of prompt neutrons into group g ,

ν is the number of neutrons emitted per fission,

$\Sigma_{fg}(\underline{r}, t)$ is the macroscopic fission cross section for neutrons in group g ,

χ_{ig}^d is the fractional yield of delayed neutrons
into group g from emitters in group i ,

λ_i is the decay constant for emitters in group i ,

$c_i(\underline{r}, t)$ is the concentration of delayed neutron
emitters in group i ,

$S_g(\underline{r}, t)$ is the rate at which neutrons are
introduced into group g from extraneous
sources,

$\Sigma_{sgg'}(\underline{r}, t)$ is the macroscopic cross section for
scattering from group g' to group g , and

Σ_{tg} is the total macroscopic cross section for
interaction of neutrons in group g . The
associated equations for the delayed neutron
emitter concentrations are:

$$\frac{\partial c_i(\underline{r}, t)}{\partial t} = \beta_i \sum_{g=1}^G v \Sigma_{fg}(\underline{r}, t) \phi_g(\underline{r}, t) - \lambda_i c_i(\underline{r}, t) \quad (2)$$

for $i = 1, 2, \dots, I$.

By defining the vectors

$$\underline{\phi}(\underline{r}, t) = \text{Column } [\phi_1(\underline{r}, t), \dots, \phi_G(\underline{r}, t)],$$

$$\underline{S}(\underline{r}, t) = \text{Column } [S_1(\underline{r}, t), \dots, S_G(\underline{r}, t)],$$

$$\underline{v\Sigma_f(\underline{r},t)} = \text{Column } [v\Sigma_{f1}(\underline{r},t), \dots, v\Sigma_{fG}(\underline{r},t)],$$

$$\underline{X^p} = \text{Column } [X_1^p, \dots, X_G^p], \text{ and}$$

$$\underline{X_i^d} = \text{Column } [X_{i1}^d, \dots, X_{iG}^d]$$

and the matrices

$$[v] = \text{Diagonal } [v_1, \dots, v_G],$$

$$[D(\underline{r},t)] = \text{Diagonal } [D_1(\underline{r},t), \dots, D_G(\underline{r},t)], \text{ and}$$

$$[A(\underline{r},t)] = \begin{bmatrix} \Sigma_{t1} - \Sigma_{s11} & -\Sigma_{s12} & \dots & -\Sigma_{s1G} \\ & -\Sigma_{s21} & & \\ & & & \\ & & & \\ & & & \\ -\Sigma_{sG1} & \dots & & \Sigma_{tG} - \Sigma_{sGG} \end{bmatrix}$$

where $\Sigma_{tg} = \Sigma_{tg}(\underline{r},t)$ and $\Sigma_{sgg'} = \Sigma_{sgg'}(\underline{r},t)$, it is possible to write the time dependent multigroup diffusion equations in matrix form (Reference 2):

$$\begin{aligned}
[v]^{-1} \frac{\partial}{\partial t} \underline{\phi}(\underline{r}, t) = & \underline{\nabla} \cdot [D(\underline{r}, t)] \underline{\nabla} \underline{\phi}(\underline{r}, t) \\
& - [A(\underline{r}, t)] \underline{\phi}(\underline{r}, t) + (1-\beta) \chi^p \underline{v\Sigma_f}(\underline{r}, t)^T \underline{\phi}(\underline{r}, t) \\
& + \sum_{i=1}^I \lambda_i c_i(\underline{r}, t) \chi_i^d + \underline{S}(\underline{r}, t) \quad (1b)
\end{aligned}$$

2.2 Spatial Dependence

The simplest and most commonly applied method of discretizing the space coordinate in the diffusion equations is to replace (formally) the derivative in the leakage term, $\underline{\nabla} \cdot [D] \underline{\nabla}$ with a finite difference expression and to replace the continuous functions $\phi_g(\underline{r}, t)$ with discrete values $\phi_{gp}(t) = \phi_g(\underline{r}_p, t)$. As a result, the elements of $\underline{\phi}$ must be expanded into vectors.

Let ϕ_{gp} ($g=1, \dots, G$; $p=1, \dots, P$) be the neutron flux in group g at spatial mesh point p . And similarly, let c_{ip} ($i=1, \dots, I$; $p=1, \dots, P$) be the concentration of delayed neutron precursors in group i at point p .

We may now define the following.

(3)

 $\underline{\psi} =$

$$\begin{bmatrix} \phi_{1,1} \\ \phi_{1,2} \\ \cdot \\ \cdot \\ \cdot \\ \phi_{1,P} \\ \phi_{2,1} \\ \cdot \\ \cdot \\ \cdot \\ \phi_{G,P} \\ c_{1,1} \\ c_{1,2} \\ \cdot \\ \cdot \\ \cdot \\ c_{1,P} \\ \cdot \\ \cdot \\ \cdot \\ c_{I,P} \end{bmatrix}$$

$$[\Gamma] = \text{Diagonal } [\Gamma_i], i=1,2, \dots, G+I \quad (4)$$

where,

$$[\Gamma_i] = v_i \{ \Sigma_{sii} + (1-\beta) \chi_i^P v \Sigma_{fi} - \Sigma_{ti} \} [I]$$

for $i \leq G$

$$[\Gamma_i] = -\lambda_i [I]$$

for $G < i \leq G+I$.

[I] is the P by P identity matrix.

$$[H] = \text{Diagonal } [H_i] i=1,2,\dots, G+I$$

where, for a homogeneous reactor,

$$[H_i] = v_i D_i$$

$$D_i = \begin{bmatrix} -a & b & & 0 \\ b & -a & b & \\ & b & -a & \\ & & & \ddots \\ 0 & & & & -a & b \\ & & & & b & -a \end{bmatrix}$$

$$a = \frac{2r^n}{\Delta r^2},$$

$$b = \frac{r^n}{\Delta r^2},$$

$n = 0$ for plane geometry,

1 for cylindrical geometry,

2 for spherical geometry,

and Δr is the mesh spacing.

$$[H_i] = [0] \text{ for } G < i \leq G + I.$$

Note that $[\Gamma] = [\Gamma(t)]$ is diagonal and $[H] = [H(t)]$ is tridiagonal.

$$[L] = \begin{bmatrix} [L_{11}] & \dots & [L_{1,G+I}] \\ \cdot & & \cdot \\ \cdot & & \cdot \\ \cdot & & \cdot \\ [L_{G+I,1}] & \dots & [L_{G+I,G+I}] \end{bmatrix}$$

where

$$[L_{ij}] = [0]$$

for $i \leq j$

and for $G < j < i$,

$$[L_{ij}] = v_i \{ \Sigma_{sij} + (1-\beta) \chi_i^p v \Sigma_{fj} \} [I] \quad [I]$$

for $j < i \leq G$, and

$$[L_{ij}] = (v \Sigma_{fj} \beta_{i-G}) [I]$$

for $j \leq G < i$.

$$[U] = \begin{bmatrix} [U_{11}] & \dots & [U_{1,G+I}] \\ \vdots & & \vdots \\ [U_{G+1,1}] & \dots & [U_{G+I,G+I}] \end{bmatrix} \quad (7)$$

where,

$$[U_{ij}] = [0]$$

for $j \leq i$,

and for $G < i < j$,

$$[U_{ij}] = v_i \{ \Sigma_{sij} + (1-\beta) \chi_i^p v \Sigma_{fj} \} [I]$$

for $i < j \leq G$, and

$$[U_{ij}] = (\chi_{i,j-G}^d \lambda_{j-G}) [I]$$

for $i \leq G < j$.

Note that $[L] = [L(t)]$ is lower triangular, $[U] = [U(t)]$ is upper triangular, and $[U_{ij}]$ and $[L_{ij}]$ are diagonal (if non-zero).

For a reactor composed of more than one region, each with different properties, the non-zero elements of $[H_i]$, $[\Gamma_i]$, $[U_{ij}]$, and $[L_{ij}]$ are no longer identical but depend on the properties at that mesh point. For region interfaces, a more rigorous development yields the proper volume weighting of properties for that point. The band structure of the matrices involved is unchanged.

Finally, using the above definitions, the time dependent multigroup diffusion equations may be written

$$\frac{d}{dt} \underline{\psi}(t) = [B(t)] \underline{\psi}(t) + \underline{S}(t) \quad (8)$$

where

$$[B(t)] = [L(t)] + [U(t)] + [H(t)] + [\Gamma(t)].$$

2.3 Time Dependence

In this section, the temporal variable is discretized by approximating the neutron flux time dependence with an exponential. This approximation is exact when the flux behavior is asymptotic and is expected to be accurate in other cases.

Integration of equation (8) over the interval
 $h = t_{j+1} - t_j$ and rearranging yields:

$$\begin{aligned} \underline{\psi}^{j+1} &= \int_{t_j}^{t_{j+1}} [\Gamma(t)] \underline{\psi}(t) dt - \int_{t_j}^{t_{j+1}} [H(t)] \underline{\psi}(t) dt \\ &= \underline{\psi}^j + \int_{t_j}^{t_{j+1}} [L(t)] \underline{\psi}(t) dt + \int_{t_j}^{t_{j+1}} [U(t)] \underline{\psi}(t) dt \\ &\quad + \int_{t_j}^{t_{j+1}} \underline{S}(t) dt \end{aligned} \quad (9)$$

where,

$$\underline{\psi}^j = \underline{\psi}(t_j) = \text{Column } [\psi_{11}^j, \dots, \psi_{GP}^j]$$

It is reasonably accurate to approximate,

$$\psi_{gp}(t) \approx e^{\omega_{gp}(t-t_j)} \psi_{gp}^j \quad (10)$$

in the interval h .

Numerically, a more manageable approach is to use energy independent frequencies, ω_p , such that

$$\psi_{gp}(t) \approx e^{\omega_p(t-t_j)} \psi_{gp}^j \quad \text{for } g=1, \dots, G. \quad (11)$$

This approximation is physically justifiable if the test energy group for determination of the point dependent frequencies is judiciously chosen (e.g., for a thermal reactor, the behavior of the faster flux groups would be expected to closely follow that of a thermal energy group).

Then substitute

$$\underline{\psi}(t) = e^{(t-t_j)} \cdot [\Omega] \quad \underline{\psi}^j, \quad (12a)$$

where

$$[\Omega] = \text{Diagonal } [\omega_1, \dots, \omega_p, \dots, \omega_1, \dots, \omega_p],$$

into the second integral on the right hand side of equation (9) and

$$\underline{\psi}(t) = e^{(t-t_{j+1})} \cdot [\Omega] \quad \underline{\psi}^{j+1} \quad (12b)$$

into all other integrals involving $\underline{\psi}(t)$ in (9). These substitutions are performed to produce a stable numerical scheme implicit in all terms except the term involving $[U]$. Finally, approximation of $[L]$, $[U]$, $[\Gamma]$, $[H]$, and $[\Omega]$ by constants in the interval h yields the algorithm used in GAKIN II:

$$\begin{aligned}
\{[I] - [H+U][FF2]\} \underline{\psi}^{j+1} = \\
[L][FF2] \underline{\psi}^{j+1} + \{[I]+[U][FF1]\} \underline{\psi}^j \\
+ \int_{t_j}^{t_{j+1}} \underline{S}(t) dt
\end{aligned} \tag{13}$$

The elements of the diagonal matrices [FF1] and [FF2] are given by

$$FF1_p = \frac{e^{\omega_p \cdot h} - 1}{\omega_p} \quad \text{for all } g \tag{14a}$$

$$FF2_p = \frac{1 - e^{-\omega_p \cdot h}}{\omega_p} \quad \text{for all } g \tag{14b}$$

The fact that matrix factorization is performed one group at a time has been used to account for the slowing down source, $[L] \underline{\psi}$ implicitly. Since the external source term, $\underline{S}(t)$ is a known (in GAKIN II, linear) function of time, the final term in equation (13) is easily determined.

2.4 Proof of Consistency

A numerical scheme for solution of a properly posed set of equations must converge to the correct answer as successively smaller time steps are used. Assuming the time dependent multigroup diffusion equations are properly posed, consistency and stability imply

convergence (Reference 3). In this section we will show that the GAKIN II algorithm is consistent and that the truncation error is of order h^2 . The scheme will be proven stable in the next section. Note that these proofs are rigorous only for constant frequencies. However, experience has indicated that the scheme works provided the time step used is not too large.

Neglect the source term and rearrange equation (13) as follows,

$$\underline{\psi}^{j+1} - \underline{\psi}^j = [H+\Gamma+L][FF2] \underline{\psi}^{j+1} + [U][FF1] \underline{\psi}^j \quad (15)$$

or

$$\begin{aligned} \underline{\psi}^{j+1} - \underline{\psi}^j &= [H+\Gamma+L] \{h[I] - O(h^2)\} \underline{\psi}^{j+1} \\ &\quad + [U] \{h[I] + O(h^2)\} \underline{\psi}^j. \end{aligned} \quad (16)$$

Further rearrangements gives,

$$\frac{1}{h} \{\underline{\psi}^{j+1} - \underline{\psi}^j\} = [H+\Gamma+L] \underline{\psi}^{j+1} + [U] \underline{\psi}^j + O(h). \quad (17)$$

Taking the limit of this equation as $h \rightarrow 0$,

$$\frac{d}{dt} \underline{\psi} = [B] \underline{\psi}. \quad (18)$$

The numerical scheme proposed for GAKIN II is therefore consistent with the time dependent multi-group diffusion equations (spatially discretized) for any fixed h .

Equation (16) also shows that the truncation error is of order h^2 by comparison with

$$\underline{\psi}^{j+1} = e^{h[B]} \underline{\psi}^j.$$

2.5 Proof of Stability

In this section the GAKIN II algorithm is proven numerically stable. Unstable error modes cannot dominate the solution and the method will provide convergent results (since it is also consistent).

By ignoring the external source term in equation (13) and rearranging other terms, the GAKIN II algorithm may be written

$$[G_1] \underline{\psi}^{j+1} = [G_2] \underline{\psi}^j$$

where,

$$[G_1] = [I] - \{[H] + [\Gamma]\} [FF2]$$

$$[G_2] = [I] + [U][FF1] + [L][FF2].$$

$[G_2]$ can be shown to be nonnegative for all fixed values of ω_p , h , $[U]$, and $[L]$.

For most physical problems

$$\Sigma_{tg} \geq (1-\beta) \chi_g^p \Sigma_{fg} + \Sigma_{sgg} - 1/v_g \quad \text{for all } g.$$

Therefore, $[G_1]$ is a nonsingular matrix with positive diagonal elements and nonpositive off diagonal elements. Such a matrix can be shown to have a nonnegative inverse (Reference 4). Therefore, $[G_1]^{-1} [G_2]$ is nonnegative and irreducible and by the Perron-Frobenius Theorem has a single largest eigenvalue whose associated eigenvector has positive components. Consequently, the algorithm can be proven numerically stable for all real ω_p and any h (Reference 5).

3. Frequency Prediction

In order to solve for $\underline{\psi}$, some means of predicting the frequencies, ω_p , $p=1,2,\dots$, must be found. GAKIN II is in this sense a predictor-corrector type of algorithm. Three methods have been tested for use in GAKIN II. No completely satisfactory method universally applicable to all problems has been found. However, the method finally

chosen provides acceptable results for most problems. In any case, use of a sufficiently small time step will always provide correct results.

The first predictor tried (Reference 6) uses an approximation to the factors [FF1] and [FF2] (equations (14)). Expansion of the exponential terms in these factors,

$$[\text{FF1}] = h[I] + \frac{h^2}{2} [\Omega] + \dots \quad (21a)$$

$$[\text{FF2}] = h[I] - \frac{h^2}{2} [\Omega] + \dots, \quad (21b)$$

shows that they may be approximated (with error of order h^2) by $h[I]$. The predictor step for this method then consists of applying this approximation to the GAKIN II algorithm in the test energy group, g' ; solving for approximate flux values $\tilde{\psi}_{g',p}^{j+1}$; and computing frequencies, $\omega_p = \frac{1}{h} \ln(\tilde{\psi}_{g',p}^{j+1} / \psi_{g',p}^j)$. These predicted frequencies are then substituted and the corrector step (full GAKIN II algorithm) is carried out. If the designated test energy group is other than group one, it is necessary to approximate the slowing down source at step $j+1$ by $[L] \cdot e^{h \cdot [\Omega]} \cdot \psi^j$ (again with error of order h^2).

In the second predictor tried, the factors [FF1] and [FF2] are calculated explicitly using a frequency

$\omega_p = \frac{1}{h} \ln(\psi_{g',p}^j / \psi_{g',p}^{j-1})$ found from the results of the previous step. This predictor consists of using these values of [FF1] and [FF2] in the GAKIN II algorithm in test group, g' ; solving for approximate flux values $\psi_{g',p}^{j+1}$; and computing predicted frequencies, ω_p , as in the first method. These ω_p are then used in the corrector step. Again, series expansions of [FF1] and [FF2] show that neglecting the change in $[\Omega]$ should result in errors of order h^2 .

The third method tested and the one finally implemented in the current version of GAKIN II calculates frequencies, $\omega_p = \frac{1}{h} \ln(\psi_{g',p}^j / \psi_{g',p}^{j-1})$, from test energy groups, g' , fluxes. These frequencies are then used directly in the full GAKIN II algorithm to calculate the flux and precursor values at the end of time step $j+1$. As before, approximation of $[\Omega]$ should mean that the error is of order h^2 for this scheme.

Testing of the above prediction methods has been conducted using American Nuclear Society Benchmark Problems (Reference 7). Problem X-A3, a prompt supercritical excursion in a three region core and problem X-A2, a delayed supercritical transient in the same core have been solved using the various prediction schemes. In both problems, the initiating mechanism is a decrease in the absorption cross section in a non-central region of

the reactor. Results obtained using the frequency predictor incorporated in the present version of GAKIN II are listed in section 9.

Results for the prompt supercritical problem using all of the frequency predictors demonstrate substantial gains in time step size. Difficulties appear when the methods are applied to the slower transient. Relatively small time steps are necessary for converged solutions with all three methods and numerical instabilities occur when the same time step size is used in the second method.

The third method has been chosen for use in GAKIN II because it is the simplest and the other two methods do not result in savings worth the added computational effort. GAKIN II is an excellent means of solving rapid or moderately slow kinetics problems. However, for very slow transients there are other existing codes which may enable use of larger time step sizes.

4. Automatic Time Step Adjustment

GAKIN II incorporates an option by which the time step size may be automatically adjusted. The method used for this adjustment is based largely on a number of years of code use. Basically, tests are made to determine how rapidly the frequencies are changing in space and

time and the time step is increased or decreased accordingly. Figure 1 is a flow diagram of the time step adjustment logic.

For all space points, p , the maximum frequency $\bar{\omega}$ and the minimum frequency $\underline{\omega}$ are found. The ratio $R_s = \bar{\omega}/\underline{\omega}$ if $\bar{\omega}$ is greater than or equal to zero, or $R_s = \underline{\omega}/\bar{\omega}$ if $\bar{\omega}$ is less than zero is used to define

$$\epsilon_s = \frac{\epsilon_2}{1 - R_s}.$$

a quantity indicative of how rapidly the frequencies are varying in space (ϵ_2 is an input parameter).

In a similar fashion, at each test point, n , (WPT on input card #6), the ratio $R_{nj} = \omega_{nj}/\omega_{nj-1}$ for $|\omega_{nj}| \leq |\omega_{nj-1}|$, or $R_{nj} = \omega_{nj-1}/\omega_n$ for $|\omega_{nj}| > |\omega_{nj-1}|$, where subscript j refers to the time step, is used to define

$$\epsilon_{Tn} = \frac{\epsilon_1}{1 - R_{nj}}$$

(ϵ_1 is an input parameter). The quantity ϵ_T , the maximum over all n of ϵ_{Tn} is then used as an indication of how rapidly the frequencies are changing in time. E_x , the maximum of ϵ_s and ϵ_T (but not less than ϵ_1) and T_6 , the largest $|\omega_p \cdot h|$ are compared to determine if time step

adjustment is necessary. If $E_x \geq 2T_6$ the time step size, h , is increased according to the input parameter TSTINC. If $T_6 > E_x$ and $T_6 > \epsilon_3$ (ϵ_3 is another input parameter) the time step size, h , is decreased.

Recommended values for input constants (card 12) are:

$$\epsilon_1 = 2 \times 10^{-4} \quad (\text{EP1}),$$

$$\epsilon_2 = 1.6 \times 10^{-2} \quad (\text{EP2}),$$

$$\epsilon_3 = 5 \times 10^{-3} \quad (\text{EP3}),$$

$$\text{TSTINC} = 1.05.$$

Figure 1 Automatic Time Step Adjustment Logic

5. Steady State Calculation

The initial flux-precursor vector used in GAKIN II must be the converged solution to a steady state calculation for the initial cross sections. These values may be input by the user (STEADY = 0 on Card 3) or they may be determined by the code (STEADY = 1,2). The method used to search for the steady state ψ is a simple power iteration and is discussed in this section.

Neglecting the derivative and source terms in equation (1) and using the associated precursor concentration equations (2) to define,

$$\bar{\lambda} = (1-\beta) \lambda_p + \sum_{i=1}^I \beta_i \lambda_i, \quad (22)$$

the group diffusion equations become

$$- \nabla \cdot [D(r)] \nabla \phi(r) + [A(r)] \phi(r) = \frac{1}{K_{eff}} \bar{\lambda} \frac{\nu \Sigma_f(r)}{\bar{\lambda}}^T \cdot \phi(r). \quad (23)$$

Discretizing the spatial variable as in section 2.2.1 and splitting [A] such that

$$[A] = [R] - [T],$$

where $[R]$ contains all of the diagonal elements of $[A]$, (23) becomes

$$\{[R] - [v]^{-1}[H]\} \underline{\phi} = [T] \underline{\phi} + \frac{1}{K_{\text{eff}}} \bar{X} \underline{v\Sigma}_f^T \cdot \underline{\phi}. \quad (24)$$

The terms involving the precursors are not considered since they have been accounted for implicitly in $\bar{X}$. Also the division by K_{eff} is actually performed and v is replaced by a new "equilibrium" value. Therefore, K_{eff} is unity after the steady state solution of equation (24) is completed.

$\{[R] - [v]^{-1}[H]\}$ is a nonsingular matrix with positive diagonal elements and nonpositive off diagonal elements. $[T] + \frac{1}{K_{\text{eff}}} \bar{X} \underline{v\Sigma}_f^T$ is nonnegative. Consequently, the Perron-Frobenius theorem applies and the solution, $\underline{\phi}$, corresponding to the largest eigenvalue K_{eff} has positive components.

6. Cross Sections and Input Parameters

6.1 Definitions

In terms of input parameters the variables used in Section 2 are defined in each region, R, as follows.

$$\Sigma_{trG} = SIGT(R,G) \quad = \text{Transport cross section.}$$

$$D_G = 1/3 \Sigma_{trG} \quad = \text{Diffusion coefficient.}$$

$$\Sigma_{fG} = SIGF(R,G) \quad = \text{Fission cross section.}$$

$$\Sigma_{cG} = SIGC(R,G) \quad = \text{Capture cross section.}$$

$$\Sigma_{sGG'} = SIGX(R,G,G') \quad = \text{Transfer cross section from group } G' \text{ to } G.$$

$$\Sigma_{tG'} = \Sigma_{fG'} + \Sigma_{cG'} + \sum_{G=1}^{GRP} \Sigma_{sGG'} \quad \Sigma_{sGG'} = SIGX(R,G',G')$$

= Total interaction cross section in group G' (GRP is the number of neutron groups).

$$\nu_G = NU(G) \quad = \text{Neutrons per fission.}$$

$$v_G = V(G) \quad = \text{Group speed.}$$

$$\chi_G^p = CHI(G) \quad = \text{Prompt neutron yield into group } G.$$

$$\chi_{IG}^d = SDIN(G,I) \quad = \text{Delayed neutron yield from delayed group } I \text{ into neutron group } G.$$

$\beta_I = \text{BETA}(I) = \text{Delay neutron fraction for delayed group } I.$

$\lambda_I = \text{DECAY}(I) = \text{Decay constant for delayed group } I.$

For each space point $P = 1, \dots, PT$

$\phi_{PG} = \text{PSI}(P, G); G=1, \dots, \text{GRP}$

$c_{PI} = \text{PSI}(P, G'); G'=\text{GRP}+I; I=1, \dots, \text{DEL}$

(DEL is the number of delayed neutron groups).

6.2 Xenon Feedback

The time rate of change of xenon can be expressed in the following form

$$\frac{d\chi}{dt} = \gamma_x \sum_{g=1}^G \Sigma_{fg} \phi_g + \lambda_I \underline{I} - \sum_{g=1}^G \sigma_{xg} \phi_g \chi \quad (25)$$

where

- χ : space point vector of xenon concentrations
- ϕ_g : the vector of pointwise fluxes for group g
- σ_{xg} : capture cross section for Xe-135 in group g
- Σ_{fg} : macroscopic fission gross section
- λ_x : xenon decay constant = $2.874 \times 10^{-5} \text{ sec}^{-1}$

λ_I : iodine decay constant = $2.093 \times 10^{-5} \text{ sec}^{-1}$

γ_x : cumulative yield for Xe-135

γ_I : cumulative yield for I-135

$\underline{I}$: space point vector of iodine concentration
whose rate of change is of the form

$$\frac{d\underline{I}}{dt} = \lambda_I \sum_{g=1}^G \Sigma_{fg} \phi_g \lambda_I \underline{I} \quad (26)$$

For each region, r , the vectors $\underline{X}_{j+1}$ and $\underline{I}_{j+1}$ can be computed for space points in r using the results of the previous step.

$$\begin{aligned} \underline{X}_{j+1} = & e^{\alpha_x h} \underline{X}_j + \frac{\lambda_I}{\alpha_x - \lambda_I} (e^{-\lambda_I h} - e^{-\alpha_x h}) \underline{I}_j \\ & + \left(\frac{\gamma_x + \gamma_I}{\alpha_x} \right) (1 - e^{-\alpha_x h}) - \left(\frac{\gamma_I}{\alpha_x - \lambda_I} \right) (e^{-\lambda_I h} - e^{-\alpha_x h}) \bar{S}_f \end{aligned} \quad (27)$$

$$\underline{I}_{j+1} = e^{-\lambda_I h} \underline{I}_j + \left(\frac{1 - e^{-\lambda_I h}}{\lambda_I} \right) \gamma_I \bar{S}_f \quad (28)$$

where

$$\alpha_x = \sum_{g=1}^G \sigma_{xg} \bar{\phi}_{gj+1} + \lambda_x$$

$\bar{\phi}_{g,j}$ is the volume averaged flux over region r for group g and step j .

$$\bar{S}_f = \sum_{g=1}^G [\Sigma_{fg} (\frac{\bar{\phi}_{g,j} - \bar{\phi}_{g,j+1}}{2})]$$

In GAKIN II the xenon concentration, $XENON(R)$ is calculated for each region, R , and the iodine concentration, $IODINE(R)$, is calculated for each region, R .

6.3 Time Dependent Cross Section Variation

The time variation in the cross sections may be either linear or quadratic at the users choice. As assumed in equation (9), the cross sections are constant over the interval of integration. Thus, the cross sections are time dependent step functions calculated in the following manner for each region R :

$$SIGX(R,G,G')_{j+1} = SIGX(R,G,G')_0 + CXL(R) \tau + CXQ(R) \tau^2$$

$$SIGT(R,G)_{j+1} = SIGT(R,G)_0 + CTL(R,G) \tau + CTQ(R,G) \tau^2$$

$$SIGC(R,G)_{j+1} = SIGC(R,G)_0 + CCL(R,G) \tau + CCQ(R,G) \tau^2 +$$

$$XABS(R,G) \cdot XENON(R)$$

$$\text{SIGF}(R,G)_{j+1} = \text{SIGF}(R,G)_0 + \text{CFL}(R,G) \tau + \text{CFQ}(R,G) \tau^2$$

where:

$$\tau = \frac{t - t_z}{\Delta T Z}$$

t_z : time at the beginning of the time zone.

t : time at step j .

$\Delta T Z$: length of the time zone.

$\text{CXL}(R)$, $\text{CXQ}(R)$, $\{\text{CTL}(R,G)$, $\text{CTQ}(R,G)$, $\text{CCL}(R,G)$, $\text{CCQ}(R,G)$, $\text{CFL}(R,G)$, $\text{CFQ}(R,G) \mid G=1, \dots, \text{GRP}\}$, are constants specified for each time zone.

$\text{XENON}(R)$ is the xenon build-up in region R as calculated in equation (27).

$\text{SIGX}(R,G,G')$, $\text{SIGT}(R,G)$, $\text{SIGC}(R,G)$, $\text{SIGF}(R,G)$ are defined as in Section 6.1.

$\text{XABS}(R,G)$ is σ_{xg} in Section 6.2, the xenon capture cross section in group G and region R .

7. Summary of Changes to GAKIN

The most significant change in the original code, GAKIN, as described in Reference 1 is the replacement of the iterative scheme for frequency prediction by an explicit, order h^2 method. The algorithm itself has been altered to account for the slowing down source implicitly. The steady state calculation has been changed to account for the precursor concentrations implicitly and to eliminate calculation of them during flux iteration. A minor alteration has been made to more formally account for the effect of xenon buildup on cross-sections in that the xenon capture cross section has been made group dependent.

A number of programming changes have been made. The present version of GAKIN II has been programmed for use on the IBM-370 model 165 computer with Fortran G or H compiler. Several subroutines have been unified or eliminated in addition to those eliminated pursuant to the changes discussed above. The code has been restructured and object time dimensioning has been incorporated. Consequently, recompilation of only a short MAIN subprogram results in minimal storage costs for a class of problems to be solved. Changes in input format are detailed in Section 8.4.

8. User Information

8.1 General

GAKIN II is presently in load module form compiled in FORTRAN H(opt=2). The current dimensions can accomodate problems with 10 regions (M1), 10 neutron energy groups (M2), 6 delayed neutron groups (M4), 50 test points (M7), and 100 space points (M5). The number of edits for each time zone is limited to fifty. To increase or decrease the dimensions, the user need only recompile the short MAIN program with appropriate dimensions. The number of bytes of core storage necessary for use of the code can be approximated by

$$100,000 + 8[P(G+D) + 2GD + 9G + G(G+1) + 26R + 19RG + RG^2 + 11P + 4PG + 2N + 50]$$

where,

R is the number of regions,

G is the number of neutron energy groups,

D is the number of delayed groups,

P is the number of space points, and

N is the number of test points.

Computation time per step is roughly approximated by $2 \times 10^{-4} [P(G + .3D)]$ seconds.

Input data is checked extensively for errors and execution is prevented if any are found. Problems may be stacked, i.e., the code automatically seeks new input data after completion of a problem. Sections 8.2 and 8.3 describe the input format in detail.

8.2 Detailed Input Specifications

CARD #1 - Problem Title. Printed at the head of each output sequence. (12A6)

CARD #2 - Problem Dimensions and Internal Controls.

{GRP, THG, GF, DEL, REG, NUM, NCOMP, GEOM, BCL, BCR, MTZ, XEN}, (12I6)

GRP: Total number of neutron groups. ($0 < \text{GRP} \leq M2^*$)

THG: Number of the group for which the frequencies are to be calculated and tested. ($0 < \text{THG} < \text{GRP}$). For two group problems the last group is taken to be the thermal group and it is recommended that $\text{THG}=\text{GRP}=2$. In systems with more than one thermal group some experimentation may be required in the selection of THG.

GF: Number of fast groups. GF is used in the standard cross section input card #16. If the fast transfer matrix option, card #16, is not desired enter a zero or blank for GF. ($0 \leq \text{GF} \leq \text{GRP}$).

* See Section 8.1 for dimension limits

DEL: Total number of delayed neutron groups.
(0 $\leq$ DEL $\leq$ M4*)

REG: Total number of homogeneous regions.
(0 < REG $\leq$ M1*)

NUM: Total number of space points at which the frequencies are to be computed and tested. These points are referred to as "test points".
(0 < NUM $\leq$ M7*, NUM $\geq$ REG).

NCOMP: Total number of compositions. (0 < NCOMP).

GEOM: Geometry control
0 - Slab; 1 - Cylinder; 2 - Sphere

BCL: Left (or bottom) boundary condition = 0 - zero flux

BCR: Right (or top) boundary condition = 1 - zero gradient

MTZ: (a) If MTZ > 0 punch restart information
(b) |MTZ| = NTZ = total number of time zones. Each time zone can have unique properties of time dependent cross sections, external sources, time steps and print-out control.

XEN: Is feedback from the buildup in xenon to be computed?
0 - No, 1 - Yes.

CARD #3 - Steady State Calculation and number of space points {STEADY, PUNBAL, TIGHT1, TIGHT2, TIGHT3, PT}, (2I6, 3E12.6, I6)

STEADY: Is there is to be a search for the flux distribution and ν which match the initial cross sections?

* See Section 8.1 for dimension limits.

- 0 - No,
- 1 - Yes, initial estimate entered on card #20,
- 2 - Yes, flat flux initial estimate,
- 3 - No, but initial precursor concentrations are to be calculated from the fluxes entered on card #20.

PUNBAL: If an initializing calculation is to be done ($\text{STEADY} > 1$) should the resulting flux and precursor distribution (steady state distribution) be punched?

0 - No, 1 - Yes,

TIGHT1

TIGHT2 Convergence criterion for the steady state solution.

TIGHT3

In order for the $j+1$ steady state iteration to be acceptable it is necessary that the following be satisfied.

$$0 < |K_{\text{eff}}^{j+1}/K_{\text{eff}}^j - 1.0| < \text{TIGHT1}$$

$$0 < |K_{\text{eff}}^{j+1} - 1.0| < \text{TIGHT2}$$

$$0 < |\psi_q^{j+1}/\psi_q^j - 1.0| < \text{TIGHT3} \text{ for all test points } q.$$

where K_{eff}^j is the K-effective at iteration j and ψ_q^j is the THG group flux at point q and iteration j .

PT: Number of space points (The left hand boundary of the problem is mesh point number one).

CARD #4 - Region boundaries. {PB(R) | R = 1, ..., REG}, (12I6).

PB(R): Number of the mesh point at the right hand boundary of region R. The left hand boundary of region one is assumed to be mesh point number one. (Note that PB(REG) = PT)

CARD #5 - Region Lengths. {LR(R) | R = 1, ..., REG}, (6E12.5).

LR(R): The length of region R (cm).

CARD #6 - Test Points. {WPT(N) | N = 1, NUM}, (12I6)

WPT(N): Space point to be used as test points in the calculation and checking of the frequencies and in testing convergence of the steady state solution.

If DEL = 0 then cards #7, #8, and #9 are not to be included.

CARD #7 - Delay Fraction, {BETA(G') | G' = 1, ..., DEL}, (6E12.5).

BETA(G'): Delay fraction from fission into delay group G'.

CARD #8 - Yield Fraction. {SDIN(G,G') | G' = 1, ..., DEL, G=1, ..., GRP}, (6E12.5) (Start a new card for each neutron group G).

SDIN(G,G'): Fractional yield in group G from delayed group G'.

CARD #9 - Decay Constant. {DECAY(G') | G' = 1,..., DEL}, (6E12.5).

DECAY(G'): Decay constant for delayed group G'.

CARD #10 - Fission Yield. {CHI(G) | G = 1,...,GRP}

CHI(G): Yield from fission in group G.

CARD #11 - Neutron Speed. {V(G) | G = 1,...,GRP}}.

V(G): Average neutron speed for group G (cm/sec). This array should be in descending order with largest value first. All subsequent reference to group indexes assume the same ordering.

CARD #12 - Frequency Prediction and Time Step Adjustment Controls {EP1, EP2, EP3, IEP4, IEP6, TSTINC}, (3E12.5, 2I12, E12.5)

EP1, EP2, EP3: These parameters are explained in Section 4 and are used for testing related to time step adjustment. Recommended values:

$$EP1 = .2 \times 10^{-3}$$

$$EP2 = .16 \times 10^{-1}$$

$$EP3 = .5 \times 10^{-2}$$

IEP4: Set IEP4 = 0 unless the frequencies are to be set to zero and the frequency prediction is to be bypassed (IEP4 = 1).

IEP6: = 0 auto. time step adjustment to be used.
= 1 no time step adjustment

TSTINC: Increase in time step size per time step (Recommended value 1.05).

CARD #13 - Composition Assignments. {NCMP(R) | R = 1, ..., REG}, (12I6).

NCMP(R): Number of the composition assigned to region R. One value for each region. $NCMP(R) \leq NCOMP$ for all R.

The sequence of cards #14 thru #18 is repeated for each composition. The ordering of compositions in this set of cards must be consistent with the numbers used to identify the compositions on card #13.

GAKIN makes no use of the $(n, 2n)$, (n, α) , or (n, p) reaction rates or self-shielding factors, hence these terms are not included in the input.

CARD #14 - Composition I.D. and Transfer Matrix Control. {NUCNAM, I1, I2, I3}, (15A4, 3I4).

NUCNAM: Composition name used as identification during edit.

I1: Not used.

I2: = 0 - No fast and no full transfer matrix available. Do not include cards #16 and #17.

= 1 - Only fast transfer matrix available (i.e., only transfer from G into G' where $G=1, \dots, GRP$ and $G'=G+1, \dots, GF+1$).

= 2 - Full transfer matrix is to be read.

I3: Not used.

Repeat card #15 for each neutron group $G=1, \dots, GRP$.

CARD #15 - Composition Macroscopic Cross Sections. $\{\nu(G), \Sigma^f(G), \Sigma^c(G), \Sigma^{tr}(G), \Sigma(n, 2n)(G), \Sigma(G \rightarrow G+1)\}$, (5E12.5).

- $\nu(G)$: Neutrons per fission.
 $\Sigma^f(G)$: Macroscopic fission cross section.
 $\Sigma^c(G)$: Macroscopic capture cross section.
 $\Sigma^{tr}(G)$: Macroscopic transport cross section.
 $\Sigma^{(n,2n)}(G)$: Not used in GAKIN.
 $\Sigma(G \rightarrow G+1)$: Sum of elastic and inelastic macroscopic scattering cross sections for energy transfer from group G to G+1.

After the data for composition M has been read, then all regions specified, on card #13, to contain composition M (i.e., all R such that $M = \text{NCMP}(R)$) receive the following storage instruction:

$\nu(G) \rightarrow \text{NU}(R,G)$
 $\Sigma^f(G) \rightarrow \text{SIGF}(R,G)$
 $\Sigma^{tr}(G) \rightarrow \text{SIGT}(R,G)$
 $\Sigma^c(G) \rightarrow \text{SIGC}(R,G)$
 $\Sigma(G \rightarrow G') \rightarrow \text{SIGX}(R,G',G)$

CARD #16 - Fast Transfer Matrix (supply this card only if $I2=1$ and $GF \neq 0$). $\{\Sigma(G \rightarrow G') \mid G'=G+1, \dots, GF+1; G=1, \dots, GF\}$, (6E12.5) (Start a new card for each G).

$\Sigma(G \rightarrow G')$: Sum of elastic and inelastic macroscopic scattering cross sections for energy transfer from G to G'.

If $GF=GRP$ then enter a zero for $\Sigma(GF \rightarrow GF+1)$.

CARD #17 - Full Transfer Matrix (supply this card only if I2=2).
 $\{\Sigma(G \rightarrow G') \mid G'=1, \dots, \text{GRP}; G=1, \dots, \text{GRP}\}, (6\text{E}12.5)$
 (Start a new card for each group G).
 $\Sigma(G \rightarrow G')$: Same definition as for card #16.

Supply cards #18 and #19 only if XEN $\neq$ 0.

CARD #18 - Fission Yields. {GAMAX, GAMAI}, (2E12.5)

GAMAX: Fission Yield for Xe-135

GAMAI: Fission Yield for I-135.

CARD #19 - Xenon and Iodine Parameters
 $\{\text{XENON}(R), \text{IODINE}(R), \text{XABS}(R,G), G=1, \dots, \text{GRP}\}.$

XENON(R): Initial Xenon concentration in region R, atoms/cm³. The initial cross sections must reflect the effect of this concentration.

IODINE(R): Initial Iodine concentration in region R atoms/cm³.

XABS(R,G): Xenon capture cross section in region R in group G, barns.

(Start a new card for each region).

CARD #20 - Initial Flux Distribution. $\{\text{PSI}(P,G) \mid P=1, \dots, \text{PT}; G=1, \text{GRP}\}, (6\text{E}12.5).$

The initial flux distribution is read in point-wise for each group (start a new card for each group).

If a steady state calculation is not performed (i.e., STEADY=0) then the initial precursor concentrations are read in immediately following the fluxes.

$\{\text{PSI}(P,G) \mid P=1, \dots, \text{PT}; G=\text{GRP}+1, \dots, \text{GRP}+\text{DEL}\}, (6\text{E}12.5).$

Omit Card #20 if STEADY=2.

The sequence of cards #21 thru #33 must be repeated for each time zone. Start with the first zone and arrange in increasing order. The problem will terminate at the end of time zone NTZ.

CARD #21 - Time Zone Control Card {HBEGIN, IH, TZ, IPRN, NUM2, NTAG, SORCE, IEP4, IEP6}
(E12.5, I12, E12.5 6I6)
IEP4 & IEP6 are repeated here for possible alteration in each time zone (see Card #12).

HBEGIN: Initial time step size (Sec.).

IH: = 0 Time step is kept the same as at the end of the preceding time zone.

= 1 Step size set equal to HBEGIN.

TZ: |TZ| = Time at the end of this zone.
TZ > 0 precursor concentrations printed at each edit time.
TZ < 0 precursor concentrations printed at end of time zone only.

IPRN: In this time zone every IPRNth step will be edited. If IPRN=0 this edit criterion is ignored.

NUM2: (a) If NUM2 < 0 then NUM2 is the number of print times to be read in on card #22.

(b) If NUM2 > 0 then print-outs will occur at NUM2 evenly spaced intervals throughout the time zone. Do not supply card #22.

(c) If NUM2=0 this output option is ignored. Do not supply card #22.

$$(|\text{NUM2}| \leq 50)$$

NTAG: Time dependent cross section control index.

(a) If NTAG=0 then there are no time dependent cross sections in this time zone. Do not supply cards #23 thru #30.

(b) If $NTAG = -1$ then the same time dependent cross section parameters are used for this time zone as in the previous zone. Do not supply cards #23 thru #30.

(c) If $NTAG > 0$ then the time dependent cross section parameters are to be read in for $NTAG$ regions. Only regions with changing cross sections need be considered. The omitted regions will be assumed to have zero change in their cross section.

SORCE: External source control index.

(a) If $SORCE = 0$ then there are no external sources in this time zone. Do not supply cards #31, #32 or #33.

(b) If $SORCE = -1$ then the external source parameters are the same for this time zone as for the previous zone. Do not supply cards #31, #32 or #33.

(c) If $SORCE > 0$ then the external source parameters are to be read in for $SORCE$ regions. Only regions with nonzero sources need be considered. The omitted regions will be assumed to have zero external sources.

CARD #22 - Print Timing (Do not use this card if $NUM2 \geq 0$).
{STPRN(N) | $N=1, -NUM2$ }.

STPRN(N): The program will automatically adjust the time step so that a solution is calculated and printed at the time STPRN(N).

$TZ_0 < STPRN(N) < STPRN(N+1) < TZ_1$, $N=1, \dots, -NUM2$
where TZ_0 is the time at the beginning of the time zone and $TZ_1 = TZ$ is the time at the end of the zone.

The sequence of cards #23 thru #30 should be repeated $NTAG$ times. Supply this sequence of cards only if $NTAG > 0$.

CARD #23 - Time Dependent Cross Section Control Card.
 {R, TAGX(R), TAGT(R), TAGC(R), TAGF(R)},
 (516).

R: Region number for which the following data applies.

TAGX(R): Is the transfer cross section changing with time.

TAGT(R): Is the transport cross section changing with time.

TAGC(R): Is the capture cross section changing with time.

TAGF(R): Is the fission cross section changing with time.

= 0 No.

= 1 Yes - linear change only.

= 2 Yes - linear and quadratic variation with time.

If t_j is the time at step j , TZ_0 and TZ_1 are respectively the time at the beginning and end of the time zone, then the time dependent changes in the cross sections can be expressed as follows:

$$\Delta TZ = TZ_1 - TZ_0 \quad \tau = (t_j - TZ_0) / \Delta TZ$$

$$SIGX(R, G, G')_{j+1} = SIGX(R, G, G')_0 + CXL(R) \tau + CXQ(R) \tau^2$$

$$SIGT(R, G)_{j+1} = SIGT(R, G)_0 + CTRL(R, G) \tau + CTRQ(R, G) \tau^2$$

$$SIGC(R, G)_{j+1} = SIGC(R, G)_0 + CCL(R, G) \tau + CCQ(R, G) \tau^2$$

$$SIGF(R, G)_{j+1} = SIGF(R, G)_0 + CFL(R, G) \tau + CFQ(R, G) \tau^2$$

CARD #24 - Time Variations in the Transfer Cross Section. Supply this card if TAGX(R) = 1 or 2. CXL(R), CXQ(R), (2E12.5).

CXL(R): Total linear change in SIGX(R,G,G') over the time interval ΔT_Z .

CXQ(R): Total quadratic change in SIGX(R,G,G') over the time interval ΔT_Z .

CARD #25 - Linear Variations in the Transport Cross Section. Supply this card if TAGT(R) = 1 or 2. CTRL(R,G)/G=1,...,GRP, (6E12.5).

CTRL(R,G): Total linear change in SIGT(R,G) within the time interval ΔT_Z .

CARD #26 - Quadratic Variations in the Transport Cross Section. Supply this card only if TAGT(R) = 2. CTRQ(R,G)/G=1,...,GRP, (6E12.5).

CTRQ(R,G): Total quadratic change in SIGT(R,G) in the time interval ΔT_Z .

CARD #27 - Linear Variations in the Capture Cross Section. Supply this card if TAGC(R) = 1 or 2. CCL(R,G)/G=1,...,GRP, (6E12.5).

CCL(R,G): Total linear change in SIGC(R,G) in the time interval ΔT_Z .

CARD #28 - Quadratic Variations in the Capture Cross Section. Supply this card only if TAGC(R) = 2. CCQ(R,G)/G=1,...,GRP, (6E12.5).

CCQ(R,G): Total quadratic change in SIGC(R,C) in the time interval ΔT_Z .

CARD #29 - Linear Variation in the Fission Cross Section. Supply this card if TAGF(R) = 1 or 2. CFL(R,G)/G=1,...,GRP, (6E12.5).

CCQ(R,G): Total linear change in SIGF(R,G) in the time interval ΔT_Z .

CARD #30 - Quadratic Variation in the Fission Cross Section. Supply this card only if TAGF(R) = 2. {CFQ(R,G)/G=1,GRP}, (6E12.5).

CFQ(R,G): Total quadratic change in SIGF(R,G) in the time interval ΔT_Z .

The sequence of cards #31 thru #33 is repeated SORCE times. Supply this sequence of cards only if SORCE > 0. The sequence need not be repeated for any region with a zero external source. All omitted regions are assumed to have zero source.

CARD #31 - External Source Input Control Card. {R, SOR(R)}, (2I6).

R: Region for which the following data applies.

SOR(R): = 0 No external source for this region (equivalent to the omission of the sequence for this region).

= 1 Source input for each group and each interior point of the region.

= 2 Source input for each group. The one value is taken to be constant over the interior of the region.

CARD #32 - Pointwise External Source Input. Supply this card only if SOR(R) = 1. {SRCEO(P,G), SRCEL(P,G)/P interior to R in increasing order, G=1,...,GRP}, (6E12.5). (Start a new card for each group).

SRCEO(P,G): Initial external source space point P, group G.

SRCEL(P,G): Total linear change in SRCEO(P,G) in the time interval ΔT_Z .

CARD #33 - Region Constant External Source. Supply this card only if $SOR(R) = 2$. { $SRCEO(R,G)$, $SRCEL(R,G)/G=1, \dots, GRP$ }, (6E12.5). (Three sets of two numbers per card, i.e., three groups per card).

$SRCEO(P,G) = SRCEO(R,G)$, and $SRCEL(P,G) = SRCEL(R,G)$ for all P interior to R .

$SRCEO(P,G)$ and $SRCEL(P,G)$ are the same as defined on card #32.

Card 1

Word	1
Column	2-72
Format	Alpha-Numeric
	Title Card
Symbol	

Card 2

Word	1	2	3	4	5	6
Column	1-6	7-12	13-18	19-24	25-30	31-36
Format	Integer	Integer	Integer	Integer	Integer	Integer
	Number of neutron groups	Test group	Total number of fast groups	Number of delayed groups	Number of regions	Number of test points
Symbol	GRP	THG	GF	DEL	REG	NUM

Card 2
(cont.)

Word	7	8	9	10	11	12
Column	37-42	43-48	49-54	55-60	61-66	67-72
Format	Integer	Integer	Integer	Integer	Integer	Integer
	Number of compositions	Geometry 0 - Slab 1 - Cylinder 2 - Sphere	Left (or bottom) boundary 0 - Zero flux 1 - Zero gradient	Right (or top) boundary	Number of time zones <0 no punch >0 punched output	Xenon feedback 0 - no 1 - yes
Symbol	NCOMP	GEOM	BCL	BCR	MTZ	XEN

Card 3

Word	1	2	3	4	5	6
Column	1-6	7-12	13-24	25-36	37-48	49-54
Format	Integer	Integer	Decimal	Decimal	Decimal	Integer
	Steady state calculation 0 - no 1 - yes 2 - yes 3 - no	Punch steady state fluxes 0 - no 1 - yes	Convergence criterion for steady state calculation			Number of space mesh points
Symbol	STEADY	PUNBAL	TIGHT1	TIGHT2	TIGHT3	PT

Card 4 Twelve words per card.

Word	1	2				REG
Column	1-6	7-12				
Format	Integer	Integer				Integer
	Right hand boundary, first region	Right hand boundary, second region	. . .			Right hand boundary, last region PB (REG) = PT
Symbol	PB (1)	PB (2)				PB (REG)

Card 5 Six words per card.

Word	1	2				REG
Column	1-12	13-24				
Format	Decimal	Decimal				Decimal
	Length of first region (cm)	Length of second region, (cm)	. . .			Length of last region, (cm)
Symbol	LR (1)	LR (2)				LR (REG)

Card 6 Twelve words per card.

Word	1	2		NUM
Column	1-6	7-12		
Format	Integer	Integer		Integer
	First test point	Second test point	. . .	Last test point WPT(NUM) ≤ PT
Symbol	WPT(1)	WPT(2)		WPT(NUM)

Card 7 Supply this card only if DEL>0, six words per card.

Word	1	2		DEL
Column	1-12	13-24		
Format	Decimal	Decimal		Decimal
	Delay fraction first delay group	Delay fraction second delay group	. . .	Delay fraction last group
Symbol	BETA(1)	BETA(2)		BETA(DEL)

Card 8 Supply this card only if DEL > 0, six words per card. Start a new card for each neutron group G. (G = 1,2,...,GRP)

Word	1	2		DEL
Column	1-12	13-24		
Format	Decimal	Decimal		Decimal
	Yield fraction in group G from delayed group 1.	Yield fraction in group G from delayed group 2.	. . .	Yield fraction in group G from delayed group DEL.
Symbol	SDIN(G,1)	SDIN(G,2)		SDIN(G,DEL)

Card 9 Supply this card only if DEL>0, six words per card.

Word	1	2		DEL
Column	1-12	13-24		
Format	Decimal	Decimal		Decimal
	Decay const. for first delayed group	Decay const. for second delayed group	. . .	Decay const. for last delayed group
Symbol	DECAY(1)	DECAY(2)		DECAY(DEL)

Card 10 Six words per card.

Word	1	2		GRP
Column	1-12	13-24		
Format				Decimal
	Fission yield first group	Fission yield second group	. . .	Fission yield last group
Symbol	CHI(1)	CHI(2)		CHI (GRP)

Card 11 Six words per card.

Word	1	2		GRP
Column	1-12	13-24		
Format	Decimal	Decimal		Decimal
	Neutron speed first group (cm/sec)	Neutron speed second group (cm/sec)	. . .	Neutron speed last group (cm/sec)
Symbol	V(1)	V(2)		V (GRP)

Card 12

Word	1	2	3	4	5	6
Column	1-12	13-24	25-36	37-48	149-60	61-72
Format	Decimal	Decimal	Decimal	Integer	Integer	Decimal
	Adjustable time step parameters.			Frequency Prediction: 0 - used 1 - by-passed	Time step: 0 - Adjusted 1 - Constant	Rate of time step increase
Symbol	EP1	EP2	EP3	IEP4	IEP6	TSTINC

Card 13 Twelve words per card.

Word	1	2		REG
Column	1-6	7-12		
Format	Integer	Integer		Integer
	Number of the composition assigned to first region	Number of the composition assigned to second region		Number of the composition assigned to the last region
Symbol	NCMP (1)	NCMP (2)		NCMP (REG)

Card 14 Repeat the sequence #14 thru #18 for each composition.

Word	1		2	3	4
Column	1-6	7-60	61-64	65-68	69-72
Format	A6	Alpha-Numeric	Integer	Integer	Integer
	Composition I.D.	Additional I.D.	Not used	0 - No tran. matrix 1 - Only fast tran. matrix 2 - Full tran. matrix	
Symbol	NUCNAM		I1	I2	I3

Card 15 Supply this card for each group G, (G = 1,2,...,GRP)

Word	1	2	3	4	5	6
Column	1-12	13-24	25-36	37-48	49-60	61-72
Format	Decimal	Decimal	Decimal	Decimal	Decimal	Decimal
	Neutrons per fission	Macroscopic fission	Macroscopic capture	Macroscopic transport	Not used	Macroscopic transfer from G to G+1
Symbol	$\nu(G)$	$\Sigma^f(G)$	$\Sigma^c(G)$	$\Sigma^{tr}(G)$	$\Sigma^{(n,2n)}(G)$	$\Sigma(G \rightarrow G+1)$

Card 16 Supply this card only if I2 = 1. Six words per card. Start a new card for each group G. (G = 1,2,...,GRP).

Word	1	2		
Column	1-12	13-24		
Format	Decimal	Decimal		Decimal
	Macroscopic transfer	Macroscopic transfer	. . .	Macroscopic transfer
Symbol	$\Sigma(G+G+1)$	$\Sigma(G+G+2)$		$\Sigma(G+GF+1)$

Card 17 Full Transfer Matrix. Supply this card only if I2 = 2. Six words per card. Start a new card for each group G. (G = 1,2,...,GRP).

Work	1	2		GRP
Column	1-12	13-24		
Format	Decimal	Decimal		Decimal
			. . .	
Symbol	$\Sigma(G+1)$	$\Sigma(G+2)$		$\Sigma(G+GRP)$

Card 18 Supply this card only if XEN = 1.

Word	1	2	
Column	1-12	13-24	
Format	Decimal	Decimal	
	Fission yield for Xe ¹³⁵	Fission yield for I ¹³⁵	
Symbol	GAMAX	GAMAI	

Card 19 Supply this card only if XEN = 1. Six words per card. Start a new card for each region R. (R = 1,2,...,REG).

Word	1	2	3	4		GRP
Column	1-12	13-24	25-36	37-48		
Format	Decimal	Decimal	Decimal	Decimal		Decimal
	Initial Xe ¹³⁵ concentration	Initial I ¹³⁵ concentration	Xenon capture cross section		. . .	
Symbol	XENON (R)	IODINE (R)	XABS (R, 1)			XABS (R, GRP)

Card 20 Six words per card. Start a new card for each group G. (G = 1,2,...,K).
 K = GRP if STEADY=1,3; K = GRP+DEL if STEADY = 0; Omit card 20 if STEADY=2.

Word	1	2		PT.
Column	1-12	13-24		
Format	Decimal	Decimal		Decimal
	Initial flux group G, point 1	Initial flux group G, point 2	. . .	Initial flux group G point PT
Symbol	PSI(1,G)	PSI(2,G)		PSI(PT,G)

Card 21 Repeat the sequence of cards #21 thru #33 once for each time zone.

Word	1	2	3	4	5	6
Column	1-12	13-24	25-36	37-42	43-48	49-54
Format	Decimal	Integer	Decimal	Integer	Integer	Integer
	Initial time step	Initial time step control 0 - H = HP 1-H=HBEGIN	Time at the end of the time zone. Precursor conc. printed >0, each edit <0, at TZ only	Print every IPRN th step	Number of pring times > 0 Calcul- ate < 0 Read card #22	# of regions with chang- ing cross sections (-1 if same as last time zone.)
Symbol	HBEGIN	IH	TZ	IPRN	NUM2	NTAG

Card 21 (cont.)

Word	7	8	9	
Column	55-60	61-66	67-72	
Format	Integer	Integer	Integer	
	External source con- trol index 0 - No 1 - Yes	See Card #12	See Card #12	
Symbol	SORCE	IEP4	IEP6	

Card 22 Supply this card only if NUM2 < 0. Six words per card.

Word	1	2		NUM2
Column	1-12	13-24		
Format	Decimal	Decimal		
	Print time number one	Print time number two	. . .	Last print time for this time zone
Symbol	STPRN (1)	STPRN (2)		STPRN (NUM2)

Card 23 Repeat the card sequence #23 through #30 NTAG times. If NTAG $\leq$ 0 omit the entire sequence.

Card 25 Omit the entire sequence.

Word	1	2	3	4	5	
Column	1-6	1-12	13-18	19-24	25-30	
Format	Integer	Integer	Integer	Integer	Integer	
	Region for which the following data applies	Time variation in SIGX(R)?	Time variation in SIGT(R)?	Time variation in SIGC(R)?	Time variation in SIGF(R)?	
		0 - no time dependent change; 1 - linear change with time; 2 - quadratic change with time.				
Symbol	R	TAGX(R)	TAGT(R)	TAGC(R)	TAGF(R)	

Card 24 Supply this card only if TAGX(R) = 1 or 2

Word	1	2	
Column	1-12	13-24	
Format	Decimal	Decimal	
	Total linear change in the transfer cross section	Total quadratic change in the transfer cross section	
Symbol	CXL(R)	CXQ(R)	

Card 25 Supply this card only if TAGT(R) = 1 or 2. Six words per card.

Word	1	2		GRP
Column	1-12	13-24		
Format	Decimal	Decimal		Decimal
	Total linear change in the transport cross section.			
	Group #1	Group #2		Last Group, GRP
Symbol	CTRL(R,1)	CTRL(R,2)	. . .	CTRL(R,GRP)

Card 26 Supply this card only if TAGT(R) = 2. Six words per card.

Word	1	2		GRP
Column	1-12	13-24		
Format	Decimal	Decimal		Decimal
	Total quadratic change in the transport cross section.			
	Group #1	Group #2		Last Group, GRP
Symbol	CTRQ(R,1)	CTRQ(R,2)	. . .	CTRQ(R,GRP)

Card 27 Supply this card only if TAGC(R) = 1 or 2. Six words per card.

Word	1	2		GRP
Column	1-12	13-24		
Format	Decimal	Decimal		Decimal
	Total linear change in the capture cross section.			
	Group #1	Group #2		Last Group, #GRP
Symbol	CCL(R,1)	CCL(R,2)	. . .	CCL(R,GRP)

Card 28 Supply this card only if TAGC(R) = 2. Six words per card.

Word	1	2		GRP
Column	1-12	13-24		
Format	Decimal	Decimal		Decimal
	Total quadratic change in the capture cross section.			
	Group #1	Group #2		Last Group, #GRP
Symbol	CCQ(R,1)	CCQ(R,2)	. . .	CCQ(R,GRP)

Card 29 Supply this card only if TAGF(R) = 1 or 2. Six words per card.

Word	1	2		GRP
Column	1-12	13-24		
Format	Decimal	Decimal		Decimal
	Total linear change in the fission cross section.			
	Group #1	Group #2		Last Group, #GRP
Symbol	CFL(R,1)	CFL(R,2)	. . .	CFL(R,GRP)

Card 30 Supply this card only if TAGF(R) = 2. Six words per card.

Word	1	2		GRP
Column	1-12	13-24		
Format	Decimal	Decimal		Decimal
	Total quadratic change in the fission cross section.			
	Group #1	Group #2		Last Group, #GRP
Symbol	CFQ(R,1)	CFQ(R,2)	. . .	CFQ(R,GRP)

Card 31 Repeat the card sequence #31 thru #33 SORCE times. If SORCE = 0 omit the entire sequence.

Word	1	2
Column	1-6	7-12
Format	Integer	Integer
	Region for which the following data applies	= 0: no source for region R = 1: pointwise source read in (Card #32) = 2: constant source for region R (Card #33)
Symbol	R	SOR(R)

Card 32 Supply this card only if SOR(R) = 1. Six words per card.
 $K = PB(R-1) + 1$.

Word	1	2	3	4	
Column	1-12	13-24	25-36	37-48	
Format	Decimal	Decimal	Decimal	Decimal	
	Initial external source point K group G	Total linear change in source point K group G	Initial external source point K+1 group G	Total linear change in the source point K+1 group G	
Symbol	SRCEO(K,G)	SRCEL(K,G)	SRCEO(K+1,G)	SRCEL(K+1,G)	

Card 32 (cont.) Repeat card #32 once for each group G. ($G = 1, 2, \dots, \text{GRP}$)

Word				
Column				
Format		Decimal	Decimal	
		Initial external source point PB(R)-1, group G	Total linear change in the source point PB(R)-1, group G	
Symbol		SRCEO(PB(R)-1,G) SRCEL(PB(R)-1,G)		

Card 33 Supply this card only if $\text{SOR}(R) = 2$. Two words per card. Repeat the card once for each group G. ($G = 1, 2, \dots, \text{GRP}$)

Word	1	2	
Column	1-12	13-24	
Format	Decimal	Decimal	
	Initial external source for region R, group G	Total linear change in source region R, group G	
Symbol	SRCEO(R,G)	SRCEL(R,G)	

8.4 Edit Description

At the intervals specified on Card 21 or 22 the following information will be printed.

- 1) Problem Title.
- 2) Step Number and Time Zone Number.
- 3) Time.
- 4) Time step size (this number will not reflect adjustments made in the time step size necessary to accomodate edit times or time zone endings).
- 5) Frequencies, ω , and $e^{\omega \cdot h}$ at each test point.
- 6) Neutron fluxes at each point in each energy group.
- 7) Precursor concentrations at each point in each group (this output may be suppressed except at the end of time zones by specifying a negative TZ on card 21).
- 8) Region averaged fluxes for each group.
- 9) Region averaged power normalized to initial power in each region.
- 10) Total core averaged power normalized to initial power.

8.5 How to Alter Previous GAKIN Input Decks

Input decks from the original GAKIN (Reference 1) must be altered as follows before use in GAKIN II.

Card 3; Word 6; Columns 49-54; should be PT, an integer, the total number of mesh points.

Card 12; Words 1, 2, and 3; Columns 1-12, 13-24, and 25-36; EP1, EP2, and EP3 are now decimal numbers chosen in accordance with Section 4 for time step adjustment criteria.

Word 4; Columns 37-48; IEP4 should be a 0 or 1 in column 48:

0 - Frequency prediction used

1 - Frequency prediction bypassed (all frequencies set equal to zero).

Word 5; Columns 49-60; IEP6 should be a 0 or 1 in column 60:

0 - Time step adjusted automatically

1 - Time step kept constant.

Card 19; Word 1; Columns 1-12; is now XENON(R) a decimal number equal to the initial Xe^{135} concentration (atoms/cm³) in region R.

Word 2; Columns 13-24; is now IODINE(R) the initial I^{135} concentration (atoms/cm³) in region R.

Word 3; 4, ..., GRP+2; Columns 25-36, 37-48, ...; are now the Xenon capture cross sections in region R for each group, XABS(1), XABS(2), ..., XABS(GRP).

Card 21; Word 1; Columns 1-12; is now HBEGIN (decimal),

the initial time step size in seconds.

Word 2; Columns 13-24; IH should be a 0 or 1
in column 24:

0 - Time step size (H) at the start of
this time zone is equal to the time
step size at the end of the previous
time zone

1 - Time step size, H = HBEGIN.

Word 3; Columns 25-36; TZ may be specified
with a minus sign in order to suppress
printing of precursor concentrations
except at the end of each time zone.

8.6 List of Subprograms

- MAIN: Provides absolute dimensions for all
arrays and calls three subroutines.
- DIRECT: Called by MAIN and with the subroutines
called by it comprises the code. Directs
code execution.
- CALC: Performs one time step calculation.
- AVRAGE: Computes core and region averaged flux
and power values.
- COEF1: Calculates invariant matrix coefficients.
- COEF2: Calculates those matrix elements which
may vary from step to step.
- DEN: Calculates the precursor concentrations
from flux values at a point.

EQPREC: Calculates the steady state precursor concentrations.

ERR: Prints error messages.

FEDBKX: Calculates the xenon concentrations.

FREQ: Predicts the frequencies at each time step and adjusts the time step size.

INEDA: Edits initial input data.

INEDB: Edits input data initially and at each time zone.

INPTA1: Reads cards 1-3. Called by MAIN to provide dimension variables.

INPTA2: Reads cards 4-20. Called only once for each problem.

INPUTB: Reads cards 21-33 (each time zone).

ITER: Performs one steady state iteration.

LHS: Calculates the left hand side (Equation 13) of the GAKIN algorithm.

MATINV: Inverts the left hand side of the steady state and time dependent equations and solves for $[\psi]$.

PREC: Calculates the precursor concentrations at each step.

PRINTA: Prints output edit information.

PROD: Calculates the source (right hand side of equation (24)) for the steady state calculation.

PUN: Punches restart input cards.

RHS: Computes the right hand side of the GAKIN algorithm (Equation 13).

RESCAL: Rescales flux values to keep flux norm constant.

SCALE: Computes flux norm.

SETUP: Directs steady state calculation.

SOURCE: Computes the external source term at each time step.

TEST: Tests for time zone ending, edit times and problem end.

TITLE: Prints problem title and end of problem note.

UPDATE: Recalculates time dependent cross sections before each time step.

9. Sample Problems

9.1 Prompt Supercritical Transient

This is problem X-A3 of the ANS Benchmark Series (Reference 7). The core analyzed consists of one central and two outer regions. The transient is initiated by decreasing the absorption cross section in region 1 (an outer region) by 5% in .01 seconds. Analysis is done with two energy groups and six delayed groups.

CARD 01
BENCHMARK PROBLEM PROMPT SUPERCRITICAL TRANSIENT

CARD 02 2 2 1 6 3 5 2 C C C -1 C

CARD 03 1 00.100000D-060.100000E-060.100000E-06 97

CARD 04, 17 81 97

CARD 05 0.400000D 020.160000D 030.400000D 02

CARD 06 9 33 49 65 89

CARD 07 0.250000D-030.164000D-020.147000D-020.296000D-020.860000D-030.320000D-03

CARD 08 0.100000D 010.100000D 010.100000D 010.100000D 010.100000D 010.100000D 01

CARD 08 0.0 0.0 C.C C.C 0.C 0.0

CARD 09 0.124000D-010.305000D-010.111000D 000.301000D 000.114000D 010.301000D 01

CARD 10 0.100000D 010.0

CARD 11 0.100000D 080.300000D 06

CARD 12 0.200000D-030.160000D-010.500000D 05 0 00.100000D 01

CARD 13 1 2 1

CARD 14 CUTER CORE C 1 0

CARD 15 0.250000D 010.400000D-020.700000D-020.222222D 000.C C.C

CARD 15 0.250000D 010.800000D-010.100000D 000.666667D 000.C C.C

CARD 16 0.150000D-01

CARD 14 INNER CORE C 1 C

CARD 15 0.250000D 010.200000D-020.800000D-020.333333D 000.C C.C

CARD 15 0.250000D 010.396000D-010.404000D-010.666667D 000.C C.C

CARD 16 0.100000D-01

CARD 20 0.0 0.296339D 000.588292D 000.871539D 000.114189D C1C.139534C C1
0.162813D 010.183684D 01C.201835D 01C.217000D 010.228553D C1C.237517C C1
0.242561D 010.244001D 01C.241765D 01C.235688D 01C.225038D C1C.207080C C1
0.192509D 010.179716D 01C.168085D 010.157359D 010.147417D C1C.138184C C1
0.129608D 010.121645D 01C.114256D 01C.107406D 010.101062D 01C.951949C C0
0.897765D 000.847813D 000.801858D 000.755683D 000.721089D 000.685895D C0
0.653934D 000.625056D 000.599124D 000.576017D 000.555625D 000.537853D C0
0.522616D 000.509843D 000.499474D 000.491459D 000.485761D 000.482352D C0
0.481218D 000.482352D 000.485761D 000.491459D 000.455474D 000.505843D C0
0.522616D 000.537853D 000.555625D 000.576017D 000.555124D 000.625056D C0
0.653934D 000.685895D 000.721089D 000.759683D 000.801858D 000.847813D C0
0.897765D 000.951949D 000.101062D 01C.107406D 01C.114256D C1C.121645C C1
0.129608D 010.138184D 010.147417D 01C.157359D 010.168085D C1C.179716C C1
0.192509D 010.207080D 01C.225038D 010.235688D 010.241765D C1C.244001C C1
0.242561D 010.237517D 01C.228553D 01C.217000D 01C.201835D C1C.183684C C1
0.162813D 010.139534D 010.114189D 01C.871539D 000.588292D 000.296339D C0
0.0

CARD 20 0.0 0.245335D-01C.487C40D-01C.721536D-010.945354C-01C.115518C C0
0.134791D 000.152070D 000.167098D 000.179653D 000.189554D 000.196664C C0
0.200924D 000.202462D 000.202036C 000.202884C 000.218305C 000.236648C C0
0.233388D 000.222680D 000.210007C 000.197236D 000.185001C 000.173497C C0
0.162759D 000.152770D 000.143494C 000.134892D 000.126926C 000.119557C C0
0.112752D 000.106479D 000.100707C 000.954101C-010.905631C-C1C.861429C-C1
0.821289D-010.785020D-01C.752452D-C1C.723432C-010.697821C-010.675501C-C1
0.656365D-010.640323D-010.627299D-C1C.617233D-C10.610077C-C1C.605796D-C1
0.604372D-010.605796D-010.610077C-C1C.617233D-010.627299D-C1C.640323D-C1
0.656365D-010.675501D-010.697821C-010.723432C-01C.752452C-010.785020C-C1
0.821289D-010.861429D-010.905631D-01C.954101D-C1C.100707C 000.106479C C0
0.112752D 000.119557D 000.126926D 000.134892D 000.143494C 000.152770C C0
0.162759D 000.173497D 000.185001C 000.197236D 000.210007C 000.222680C C0
0.233388D 000.236648D 000.245335D 000.202884D 000.202036C 000.200924C C0
0.200924D 000.196664D 000.189554C 000.179653D 000.167098D 000.152070C C0
0.134791D 000.115518D 000.945354C-01C.721536C-010.487C40C-C1C.245335C-C1
0.0

*** INPUT EDIT FOR TIME ZONE 1 ***

CARD 21 0.100000D-04 1-.100000C-01 C -2 1 0 C 0

CARD 22 0.100000D-020.500000D-02

CARD 23 1 0 0 1 C

CARD 27 0.0 -.900000D-02

BENCHMARK PROBLEM PROMPT SUPERCRITICAL TRANSIENT

*** INPUT EDIT ***

2 NEUTRON GROUP(S) , 6 DELAYED GROUP(S) , 3 REGION(S) , 2 COMPOSITION(S)

SLAB GEOMETRY , LEFT BOUNDARY ZERO RIGHT BOUNDARY ZERO

IS THERE TO BE END OF PROBLEM PUNCHED OUTPUT NO ,

ARE THE STEADY STATE FLUXES TO BE PUNCHED NO

TEST POINTS FOR FREQUENCY CALCULATION 9 33 49 65 89

GROUP 2 IS SPECIFIED AS THE TEST GROUP FOR THE FREQUENCY CALCULATION

REGION NUMBER	MESH POINT BOUNDARIES	
	LEFT	RIGHT
1	1	17
2	17	81
3	81	97

REGION NUMBER	LENGTH (CM)	MESH SPACING (CM)
1	40.0000	2.5000
2	160.0000	2.5000
3	40.0000	2.5000

FRACTIONAL YIELD FROM DELAYED GROUP I INTO NEUTRON GROUP G						
GROUP	I= 1	I= 2	I= 3	I= 4	I= 5	I= 6
1	0.01240	0.03050	0.11100	0.30100	1.14000	3.01000
2	0.0	0.0	0.0	0.0	0.0	0.0

GROUP NUMBER	AVERAGE NEUTRON SPEED (CM/SEC)	NEUTRONS PER FISSION	FISSION YIELD
1	0.100000 08	0.250000 01	0.100000 01
2	0.300000 06	0.250000 01	0.0

COMPOSITION 1

GROUP NUMBER	DIFFUSION COEFFICIENT	GROUP DEPENDENT CROSS SECTIONS (CAPTURE) (FISSION)	
1	0.150000D 01	0.700000E-02	0.400000D-02
2	0.500000D 00	0.100000E 00	0.800000E-01

SCATTERING MATRIX GP INTO G (THE TOTAL REMOVAL IS COMPUTED AND STORED AS THE DIAGONAL ELEMENTS)

(G) GP= 1 GP= 2

1	0.260000D-010.0
2	0.150000D-010.180000D 00

COMPOSITION 2

GROUP NUMBER	DIFFUSION COEFFICIENT	GROUP DEPENDENT CROSS SECTIONS (CAPTURE) (FISSION)	
1	0.100000D 01	0.800000D-02	0.200000D-02
2	0.500000D 00	0.404000E-01	0.396000D-01

SCATTERING MATRIX GP INTO G (THE TOTAL REMOVAL IS COMPUTED AND STORED AS THE DIAGONAL ELEMENTS)

(G) GP= 1 GP= 2

1	0.200000D-010.0
2	0.100000D-010.800000D-01

COMPOSITION ASSIGNMENT TO REGIONS

REGION	COMPOSITION
1	1
2	2
3	1

NO XENON BUILDUP CONSIDERED IN THIS PROBLEM

ARE STEADY STATE CONDITIONS TO BE CALCULATED ? YES

INPUT FLUX DISTRIBUTION

```

( 1) 0.0 ( 2) 2.963389D-C1( 3) 5.882921D-01( 4) 8.715388D-01( 5) 1.141887D CC( 6) 1.395336D CC
( 7) 1.628134D CC( 8) 1.836836D CC( 9) 2.018354D CC(10) 2.170000D CC(11) 2.289529D CC(12) 2.375165D CC
(13) 2.425611D CC(14) 2.440005D CC(15) 2.417649D CC(16) 2.356881D CC(17) 2.250384D CC(18) 2.070800D CC
(19) 1.925089D CC(20) 1.797160D CC(21) 1.680847D CC(22) 1.573553D CC(23) 1.474167D CC(24) 1.381839D CC
(25) 1.296079D CC(26) 1.216448D CC(27) 1.142558D CC(28) 1.074057D CC(29) 1.010621D CC(30) 9.515485D-C1
(31) 8.977647D-01(32) 8.478128D-C1(33) 8.018577D-C1(34) 7.596828D-C1(35) 7.210891D-01(36) 6.858947D-01
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(97) 0.0 (

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THE INITIAL PRECURSOR CONCENTRATIONS ARE CALCULATED FROM THE STEADY STATE FLUX DISTRIBUTION

ARE THERE ANY TIME DEPENDENT CHANGES IN THE
CROSS SECTION DATA YES

TIME	CROSS SECTION	GROUP	REGION	TOTAL LINEAR	TOTAL QUADRATIC
ZONE				CHANGE	CHANGE
1	CAPTURE	2	1	-.900000D-C2	0.0

ARE THERE ANY TIME DEPENDENT SOURCES ? NO

EQUILIBRIUM NU(G) (1) 0.277307CC C1(2) C.277307CD 01(

EQUILIBRIUM FLUXES

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13)C.2367680D 01(14)0.2387212D 01(15)C.2371878D C1(16)C.232C559D C1(17)C.222E526C C1(18)C.2C7C561C 01
19)C.1937223D C1(20)0.1817865D 01(21)0.1708274D C1(22)0.1606625D C1(23)C.1511952D C1(24)C.1423793D C1
25)C.1341590D C1(26)0.1265016D 01(27)C.1193741D 01(28)C.1127462C C1(29)C.1C659C2C 01(30)C.1CC88C2C C1
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49)C.1033831D-03(	50)0.1035994D-03(	51)C.1042492D-C3(	52)C.1053352D-C3(	53)C.1068620C-C3(	54)C.1088358C-03	
55)C.1112651D-C3(	56)0.1141600D-03(	57)0.1175325C-03(	58)0.1213968C-C3(	59)C.1257691C-C3(	60)C.1306676D-C3	
61)0.1361129D-03(	62)0.1421277D-03(	63)C.1487373D-C3(	64)C.1555691C-C3(	65)C.1638536C-03(	66)0.1724237C-03	
67)0.1817153D-03(	68)0.1917671D-03(	69)C.2026212D-C3(	70)C.2143227D-C3(	71)C.2269200C-C3(	72)C.2404637C-03	
73)C.2550055D-C3(	74)C.2705923D-03(	75)C.2872515C-03(	76)C.3049459C-C3(	77)C.3234821C-C3(	78)C.3421658D-C3	
79)C.3590138D-C3(	80)C.3684820D-03(	81)C.3910545D-C3(	82)0.6894115C-C3(	83)C.6913747C-03(	84)C.6926555C-03	
85)0.6862217C-03(	86)0.6704478D-03(	87)C.6451402D-C3(	88)C.6105609C-C3(	89)C.5671833C-03(	90)C.5156270C-03	
91)C.4566339D-C3(	92)0.3910546D-03(	93)0.3198350C-C3(	94)C.2440022C-C3(	95)C.1646501C-C3(	96)C.8292306C-C4	
97)C.0	(					

BENCHMARK PROBLEM PROMPT SUPERCRITICAL TRANSIENT

TIME ZCNE= 1 STEP NUMBR= 80 TIME=C.1C0C00D-C2 TIME STEP=C.127628D-C4

TEST POINT	MESH POINT	FREQUENCY	EXP(W*F)
1	9	1.0086D C2	1.CCCCC30D CC
2	33	4.5460D C1	1.CCCCC13D CC
3	49	0.0	1.CCCCCC0D CC
4	65	0.0	1.000C00D CC
5	89	0.0	1.CCCCC00D CC

POINT-WISE FLUXES FOR GROUP 1

(1) C.0	(2) 3.029636D-C1	(3) 6.015166D-01	(4) 8.913127D-C1	(5) 1.168133D CC	(6) 1.427946D CC
(7) 1.666968D C0	(8) 1.881719D CC	(9) 2.069C7CD CC	(10) 2.226289D CC	(11) 2.351C84D C0	(12) 2.441628D CC
(13) 2.496576D C0	(14) 2.515040D CC	(15) 2.4964C2D CC	(16) 2.435536D CC	(17) 2.23561CD CC	(18) 2.169044D CC
(19) 2.024854D CC	(20) 1.895926D C0	(21) 1.777814D C0	(22) 1.668553D CC	(23) 1.567111D CC	(24) 1.472822D CC
(25) 1.385176D CC	(26) 1.3C3737D CC	(27) 1.228116D C0	(28) 1.157960D CC	(29) 1.092942D C0	(30) 1.032759D CC
(31) 9.771345D-01	(32) 9.258115D-C1	(33) 8.78554CD-C1	(34) 8.351446D-C1	(35) 7.953843D-01	(36) 7.59C9C9D-01
(37) 7.26C984D-C1	(38) 6.962535D-C1	(39) 6.694238D-01	(40) 6.45484CD-C1	(41) 6.243248D-C1	(42) 6.058492D-C1
(43) 5.899721D-C1	(44) 5.766204D-C1	(45) 5.657319D-01	(46) 5.572556D-C1	(47) 5.511510D-01	(48) 5.473881D-C1
(49) 5.459473D-01	(50) 5.468188D-C1	(51) 5.500C32D-01	(52) 5.55511CD-C1	(53) 5.633626D-01	(54) 5.735887D-C1
(55) 5.862301D-G1	(56) 6.013379D-C1	(57) 6.189736D-01	(58) 6.392C98D-C1	(59) 6.621297D-C1	(60) 6.878283D-C1
(61) 7.164120D-01	(62) 7.479996D-C1	(63) 7.827225D-01	(64) 8.2C7252D-C1	(65) 8.621659D-01	(66) 9.072157D-C1
(67) 9.560676D-01	(68) 1.0C8924D CC	(69) 1.066C05D CC	(70) 1.127549D CC	(71) 1.193814D C0	(72) 1.265C77D CC
(73) 1.341642D C0	(74) 1.423835D CC	(75) 1.512C27D CC	(76) 1.6C6655D CC	(77) 1.7C8298D CC	(78) 1.817885D CC
(79) 1.937240D CC	(80) 2.070574D CC	(81) 2.228537D C0	(82) 2.32C568D CC	(83) 2.371886D CC	(84) 2.387219D CC
(85) 2.367685D C0	(86) 2.313894D CC	(87) 2.2267C3D CC	(88) 2.1C7389D CC	(89) 1.957676D C0	(90) 1.779727D CC
(91) 1.576108D C0	(92) 1.349756D CC	(93) 1.1C3936D CC	(94) 8.421931D-C1	(95) 5.683C28D-C1	(96) 2.862155D-01
(97) C.0					

TOTAL INTEGRATED FLUX FOR REGION 1 GROUP 1 = C.7C365CD C2

TOTAL INTEGRATED FLUX FOR REGION 2 GROUP 1 = C.166478D C3

TOTAL INTEGRATED FLUX FOR REGION 3 GROUP 1 = C.66683FD C2

POINT-WISE FLUXES FOR GROUP 2

(1) 0.0	(2) 2.516062D-C2	(3) 4.995501D-C2	(4) 7.402229D-C2	(5) 9.701212D-02	(6) 1.185898C-01
(7) 1.384412C-01	(8) 1.562773C-01	(9) 1.718385C-01	(10) 1.848588C-01	(11) 1.952707D-C1	(12) 2.028153C-01
(13) 2.074725D-01	(14) 2.093781D-C1	(15) 2.093351C-01	(16) 2.107297C-01	(17) 2.273334D-01	(18) 2.473800D-C1
(19) 2.445604C-01	(20) 2.340340C-01	(21) 2.213260D-C1	(22) 2.084251C-01	(23) 1.960233D-01	(24) 1.843394C-01
(25) 1.734205D-01	(26) 1.632530D-C1	(27) 1.538035D-01	(28) 1.450322C-01	(29) 1.365036D-C1	(30) 1.293777C-01
(31) 1.224212D-01	(32) 1.160022C-01	(33) 1.100914D-01	(34) 1.046616C-01	(35) 9.968796D-02	(36) 9.514789D-C2
(37) 9.102061C-02	(38) 8.728731D-C2	(39) 8.393099D-02	(40) 8.093633C-02	(41) 7.828968D-02	(42) 7.597896C-02
(43) 7.399358C-02	(44) 7.232442D-C2	(45) 7.096377D-02	(46) 6.990527D-C2	(47) 6.914391D-C2	(48) 6.867598C-02
(49) 6.849905D-02	(50) 6.861197D-C2	(51) 6.901484C-02	(52) 6.970901C-02	(53) 7.069705D-C2	(54) 7.198296D-C2
(55) 7.357175C-02	(56) 7.546992D-C2	(57) 7.768522D-02	(58) 8.022675C-02	(59) 8.310501D-C2	(60) 8.633192D-02
(61) 8.992086C-02	(62) 9.388675D-C2	(63) 9.824610D-02	(64) 1.030171D-C1	(65) 1.082196D-C1	(66) 1.138748C-01
(67) 1.200076D-C1	(68) 1.266427D-C1	(69) 1.338080C-01	(70) 1.415329C-01	(71) 1.498493D-C1	(72) 1.587900D-C1
(73) 1.683875D-01	(74) 1.786686D-C1	(75) 1.896400C-01	(76) 2.012489C-01	(77) 2.132758D-C1	(78) 2.250418D-C1
(79) 2.346147C-01	(80) 2.366479D-C1	(81) 2.165077D-C1	(82) 1.995839D-C1	(83) 1.983177C-01	(84) 1.981380C-01
(85) 1.961655D-01	(86) 1.916245D-C1	(87) 1.843835C-01	(88) 1.744987C-01	(89) 1.621009D-01	(90) 1.473660C-01
(91) 1.305057D-C1	(92) 1.117632D-C1	(93) 9.140867C-02	(94) 6.973570C-02	(95) 4.705689D-02	(96) 2.369936D-C2
(97) 0.0					

TOTAL INTEGRATED FLUX FOR REGION 1 GROUP 2 = C.591216D C1

TOTAL INTEGRATED FLUX FOR REGION 2 GROUP 2 = C.205262D C2

TOTAL INTEGRATED FLUX FOR REGION 3 GROUP 2 = C.558751D C1

REGION	NORMALIZED POWER
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1	C.1057022C C1
2	C.1013323C C1
3	C.1000002C C1

TOTAL NORMALIZED POWER = C.1021798D C1

BENCHMARK PROBLEM PROMPT SUPERCRITICAL TRANSIENT

TIME ZCNE= 1 STEP NUMBER= 288 TIME=C.500000D-C2 TIME STEP=C.252695D-C4

TEST POINT	MESH PCINT	FREQUENCY	EXP(W*F)
1	9	3.2554D C2	1.005006D CC
2	33	2.6144D C2	1.004018D CC
3	49	1.5368D C2	1.002360D CC
4	65	3.8046D C1	1.000584D CC
5	89	1.1413D C1	1.000175D CC

POINT-WISE FLUXES FOR GROUP 1

(1) C.0	(2) 7.125541D-C1	(3) 1.414306D CC	(4) 2.094616D CC	(5) 2.743170D CC	(6) 3.350134D CC
(7) 3.906302D CC	(8) 4.403237D CC	(9) 4.833359D CC	(10) 5.190255D CC	(11) 5.468382D CC	(12) 5.663539D CC
(13) 5.772705D CC	(14) 5.794024D CC	(15) 5.726411D CC	(16) 5.567876D CC	(17) 5.306726D CC	(18) 4.874881D CC
(19) 4.504931D CC	(20) 4.174256D CC	(21) 3.872669D CC	(22) 3.595352D CC	(23) 3.335540D CC	(24) 3.103291D CC
(25) 2.885041D CC	(26) 2.683428D CC	(27) 2.497226D CC	(28) 2.325313D CC	(29) 2.166662D CC	(30) 2.020324D CC
(31) 1.885427D CC	(32) 1.761168D CC	(33) 1.646806D CC	(34) 1.541661D CC	(35) 1.445107D CC	(36) 1.356570D CC
(37) 1.275520D CC	(38) 1.201475D CC	(39) 1.133591D CC	(40) 1.072665D CC	(41) 1.017126D CC	(42) 9.670382E-C1
(43) 9.220980D-01	(44) 8.820293D-C1	(45) 8.465840D-01	(46) 8.155400D-C1	(47) 7.886593D-01	(48) 7.658873D-C1
(49) 7.469510D-01	(50) 7.317585D-C1	(51) 7.201579D-01	(52) 7.121764D-C1	(53) 7.076195D-01	(54) 7.064709D-01
(55) 7.086914D-01	(56) 7.142589D-C1	(57) 7.231680D-C1	(58) 7.354256D-C1	(59) 7.510710D-C1	(60) 7.701358D-C1
(61) 7.926838D-01	(62) 8.187912D-C1	(63) 8.485508D-01	(64) 8.820723D-C1	(65) 9.194827D-01	(66) 9.609264D-C1
(67) 1.006566D CC	(68) 1.056584D CC	(69) 1.111180D CC	(70) 1.170577D CC	(71) 1.235017D CC	(72) 1.304766D CC
(73) 1.380115D CC	(74) 1.461386D CC	(75) 1.548942D CC	(76) 1.643217D CC	(77) 1.744754D CC	(78) 1.854608D CC
(79) 1.974507D CC	(80) 2.108769D CC	(81) 2.268213D CC	(82) 2.361064D CC	(83) 2.412578D CC	(84) 2.427578D CC
(85) 2.407209D CC	(86) 2.352097D CC	(87) 2.263117D CC	(88) 2.141567D CC	(89) 1.989201D CC	(90) 1.808213D CC
(91) 1.601205D CC	(92) 1.371158D CC	(93) 1.121380D CC	(94) 8.554664D-C1	(95) 5.772429D-C1	(96) 2.907131D-01
(97) C.0					

TOTAL INTEGRATED FLUX FOR REGION 1 GROUP 1 = C.163238D C3

TOTAL INTEGRATED FLUX FOR REGION 2 GROUP 1 = C.254271D C3

TOTAL INTEGRATED FLUX FOR REGION 3 GROUP 1 = C.677847D C2

POINT-WISE FLUXES FOR GROUP 2

(1) 0.0	(2) 6.010576D-C2	(3) 1.193C05D-C1	(4) 1.766868D-C1	(5) 2.313949D-01	(6) 2.825954D-01
(7) 3.295118D-01	(8) 3.714326D-C1	(9) 4.077224D-01	(10) 4.378318D-C1	(11) 4.6131C3D-C1	(12) 4.778278D-C1
(13) 4.872422D-01	(14) 4.898506D-C1	(15) 4.873938D-01	(16) 4.871CC0C-C1	(17) 5.18CC21D-01	(18) 5.534876D-C1
(19) 5.403078D-01	(20) 5.112783D-C1	(21) 4.782678D-C1	(22) 4.454875D-C1	(23) 4.143547D-01	(24) 3.852738D-01
(25) 3.582870D-01	(26) 3.333122D-01	(27) 3.102293D-01	(28) 2.88911CC-C1	(29) 2.692342D-01	(30) 2.51C834D-C1
(31) 2.343509D-01	(32) 2.189376D-C1	(33) 2.047519D-01	(34) 1.917096D-C1	(35) 1.797332D-01	(36) 1.687516D-C1
(37) 1.586993D-01	(38) 1.495166D-C1	(39) 1.411486D-01	(40) 1.335452D-C1	(41) 1.266607D-01	(42) 1.204535D-C1
(43) 1.148861D-01	(44) 1.099242D-C1	(45) 1.055372D-01	(46) 1.016977D-C1	(47) 9.838123D-C2	(48) 9.556616D-C2
(49) 9.323368D-C2	(50) 9.136751D-C2	(51) 8.995390D-C2	(52) 8.898145D-C2	(53) 8.8441C5D-C2	(54) 8.832585D-C2
(55) 8.863114D-C2	(56) 8.935430D-C2	(57) 9.045484D-C2	(58) 9.2C5428D-C2	(59) 9.403618D-C2	(60) 9.644614D-C2
(61) 9.929177D-C2	(62) 1.025828D-C1	(63) 1.063309D-C1	(64) 1.1C5499D-C1	(65) 1.152559D-C1	(66) 1.2C4670D-C1
(67) 1.262C38D-C1	(68) 1.324891D-C1	(69) 1.393480D-C1	(70) 1.468081D-C1	(71) 1.548992D-C1	(72) 1.636527D-C1
(73) 1.730997D-C1	(74) 1.832659D-C1	(75) 1.941566D-C1	(76) 2.057170D-C1	(77) 2.177229D-C1	(78) 2.294840D-C1
(79) 2.390354D-C1	(80) 2.409414D-C1	(81) 2.203223D-C1	(82) 2.034344D-C1	(83) 2.016793D-C1	(84) 2.014468D-C1
(85) 1.993997D-C1	(86) 1.947491D-01	(87) 1.873613D-01	(88) 1.772936D-C1	(89) 1.646788D-C1	(90) 1.496552D-C1
(91) 1.325579D-01	(92) 1.135132D-C1	(93) 9.283505D-C2	(94) 7.0821C3D-C2	(95) 4.778791D-02	(96) 2.4C6712D-C2
(97) 0.0					

TOTAL INTEGRATED FLUX FOR REGION 1 GROUP 2 = 0.139158D C2

TOTAL INTEGRATED FLUX FOR REGION 2 GROUP 2 = 0.311389D C2

TOTAL INTEGRATED FLUX FOR REGION 3 GROUP 2 = 0.56787CD C1

REGION	NORMALIZED POWER
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1	0.247461CD C1
2	0.1540279D C1
3	0.1016394D C1

TOTAL NORMALIZED POWER = 0.1654793D C1

BENCHMARK PROBLEM PRMPT SUPERCRITICAL TRANSIENT

TIME ZONE= 1 STEP NUMBER= 486 TIME=C.100000D-C1 TIME STEP=C.252695D-C4

TEST PCINT	MESH PCINT	FREQUENCY	EXP(W*H)
1	9	7.7692E 02	1.017167D 00
2	33	7.16C4C C2	1.C15811D 00
3	49	6.3323D C2	1.C1397CD CC
4	65	3.7774C 02	1.C0821CC CC
5	89	1.5345C 02	1.003367D 00

PCINT-WISE FLUXES FOR GROUP 1

(1) 0.0	(2) 9.960839D C0(3) 1.976312D 01(4) 2.525C8CC C1(5) 3.827284D 01(6) 4.668561C C1
(7) 5.435517D 01(8) 6.115937D 01(9) 6.698986D 01(10) 7.175372C C1(11) 7.5375C1D 01(12) 7.775581D C1	
(13) 7.897690D 01(14) 7.889704D C1(15) 7.754818D 01(16) 7.4515CC C1(17) 7.C89311D 01(18) 6.430270C 01	
(19) 5.864968D 01(20) 5.361523D C1(21) 4.905574D 01(22) 4.451C68D C1(23) 4.112181D 01(24) 3.765815C C1	
(25) 3.449C37D 01(26) 3.159264C C1(27) 2.894170C 01(28) 2.651644C C1(29) 2.425755D C1(30) 2.226757D C1	
(31) 2.041033D 01(32) 1.871118D C1(33) 1.715672D 01(34) 1.573469C 01(35) 1.443390C 01(36) 1.324410D 01	
(37) 1.215595C 01(38) 1.116089D C1(39) 1.025113D C1(40) 5.415516C CC(41) 8.655541D C0(42) 7.965249C C0	
(43) 7.331201D CC(44) 6.752434D C0(45) 6.224416C 00(46) 5.743C11C CC(47) 5.3C4446D C0(48) 4.9C5283D CC	
(49) 4.542385C CC(50) 4.212895D CC(51) 3.914227C CC(52) 3.644C07C CC(53) 3.4C0C94D C0(54) 3.18C545C CC	
(55) 2.983599C 00(56) 2.807663D CC(57) 2.651305D CC(58) 2.513235C CC(59) 2.392298D CC(60) 2.287465C CC	
(61) 2.197822D CC(62) 2.122565D CC(63) 2.06C991C CC(64) 2.C12491C CC(65) 1.57655CD C0(66) 1.952734C CC	
(67) 1.940694D CC(68) 1.940157D CC(69) 1.95C926C CC(70) 1.972876C CC(71) 2.C05952D 00(72) 2.C5C171C CC	
(73) 2.105621C CC(74) 2.172464D CC(75) 2.25C951D CC(76) 2.34146CC CC(77) 2.444590D 00(78) 2.561438C CC	
(79) 2.694323D CC(80) 2.848781D C0(81) 3.038985C CC(82) 3.148576C CC(83) 3.2C537CD CC(84) 3.2148C0C CC	
(85) 3.178938D CC(86) 3.09871CD CC(87) 2.975328C 00(88) 2.81C526C CC(89) 2.606596D 00(90) 2.366370D CC	
(91) 2.093190C CC(92) 1.750855D CC(93) 1.463574D CC(94) 1.1159C4C CC(95) 7.526873D-01(96) 3.789838C-01	
(97) 0.0	(

TOTAL INTEGRATED FLUX FOR REGION 1 GRUP 1 = 0.224286C 04

TOTAL INTEGRATED FLUX FOR REGION 2 GRUP 1 = C.208C22D 04

TOTAL INTEGRATED FLUX FOR REGION 3 GRUP 1 = C.893CC7D C2

POINT-WISE FLUXES FOR GROUP 2

(1) C.0	(2) 8.542783D-C1	(3) 1.694960C CC	(4) 2.508666C CC	(5) 3.282443C C0	(6) 4.003576C 0C
(7) 4.661778C 00	(8) 5.245378D C0	(9) 5.745487D CC	(10) 6.154161C CC	(11) 6.464972D CC	(12) 6.673303C 0C
(13) 6.777180D CC	(14) 6.780350C C0	(15) 6.704384C 0C	(16) 6.636956C CC	(17) 6.924807D CC	(18) 7.221613C CC
(19) 6.932234D CC	(20) 6.463639D CC	(21) 5.960859C 0C	(22) 5.473963C CC	(23) 5.018731C C0	(24) 4.598687D CC
(25) 4.213091C C0	(26) 3.859825D CC	(27) 3.536433D CC	(28) 3.240477D CC	(29) 2.969662C C0	(30) 2.721864C CC
(31) 2.495134C CC	(32) 2.287685C CC	(33) 2.097886C CC	(34) 1.924243C CC	(35) 1.765292D C0	(36) 1.620084C CC
(37) 1.487182D C0	(38) 1.365642D C0	(39) 1.254513C 0C	(40) 1.152926C CC	(41) 1.060085D C0	(42) 9.752651D-C1
(43) 8.978031C-01	(44) 8.270937D-C1	(45) 7.625843D-01	(46) 7.037707C-C1	(47) 6.501928C-01	(48) 6.014311C-01
(49) 5.571035C-01	(50) 5.168618D-C1	(51) 4.803893D-01	(52) 4.473980C-C1	(53) 4.176265D-C1	(54) 3.908377C-C1
(55) 3.668170D-01	(56) 3.453704D-C1	(57) 3.263234C-01	(58) 3.095188C-C1	(59) 2.948161D-01	(60) 2.820501C-C1
(61) 2.712295C-01	(62) 2.621368D-C1	(63) 2.547265D-C1	(64) 2.489250C-C1	(65) 2.446698C-01	(66) 2.419089D-01
(67) 2.406000C-01	(68) 2.407107D-C1	(69) 2.422175D-01	(70) 2.451058D-C1	(71) 2.493688D-C1	(72) 2.550070C-C1
(73) 2.620251D-C1	(74) 2.704249D-C1	(75) 2.801861C-01	(76) 2.912133C-C1	(77) 3.031929D-C1	(78) 3.152015D-C1
(79) 3.246392D-01	(80) 3.243222D-C1	(81) 2.945593D-C1	(82) 2.706846C-C1	(83) 2.672876D-01	(84) 2.661025C-01
(85) 2.626657C-01	(86) 2.559286D-C1	(87) 2.457158D-C1	(88) 2.321031C-C1	(89) 2.152634D-C1	(90) 1.954266C-C1
(91) 1.728677D-C1	(92) 1.479004D-C1	(93) 1.208722C-01	(94) 9.215970D-C2	(95) 6.216278D-C2	(96) 3.125551D-C2
(97) C.0					

TCTAL INTEGRATED FLUX FOR REGION 1 GROUP 2 = C.194127D C3

TCTAL INTEGRATED FLUX FOR REGION 2 GROUP 2 = C.249632D C3

TOTAL INTEGRATED FLUX FOR REGION 3 GROUP 2 = 0.746430C 01

PRECURSOR CONCENTRATION FOR DELAYED GROUP 1

(1) C.0	(2) 1.701128D-04	(3) 3.377719D-04	(4) 5.005587C-C4	(5) 6.561253D-C4	(6) 8.022277C-C4
(7) 9.367584D-04	(8) 1.057777D-C3	(9) 1.163539D-03	(10) 1.252522C-C3	(11) 1.323454D-C3	(12) 1.375366C-C3
(13) 1.407718C-03	(14) 1.420909D-C3	(15) 1.418272D-03	(16) 1.414233C-C3	(17) 1.098251D-03	(18) 7.558629C-04
(19) 7.364296C-04	(20) 7.018606D-C4	(21) 6.635274D-04	(22) 6.255061C-C4	(23) 5.891960D-C4	(24) 5.550186C-04
(25) 5.230417D-04	(26) 4.932090D-C4	(27) 4.654240C-04	(28) 4.395811C-C4	(29) 4.155759D-C4	(30) 3.933093C-C4
(31) 3.726886C-04	(32) 3.536277D-C4	(33) 3.360469D-C4	(34) 3.198726C-C4	(35) 3.050370C-C4	(36) 2.914782C-04
(37) 2.791392C-04	(38) 2.679686D-C4	(39) 2.579194D-C4	(40) 2.489497C-C4	(41) 2.410219C-C4	(42) 2.341028C-04
(43) 2.281634D-04	(44) 2.231788D-C4	(45) 2.191283C-04	(46) 2.159948C-C4	(47) 2.137652D-C4	(48) 2.124302D-C4
(49) 2.119841C-C4	(50) 2.124252D-C4	(51) 2.137552C-04	(52) 2.159796C-C4	(53) 2.191079C-C4	(54) 2.231531C-C4
(55) 2.281320C-04	(56) 2.340656D-C4	(57) 2.409787D-C4	(58) 2.489001C-C4	(59) 2.578630D-04	(60) 2.679049C-04
(61) 2.790679C-C4	(62) 2.913986D-C4	(63) 3.049486C-04	(64) 3.197747C-C4	(65) 3.359388D-C4	(66) 3.535086C-C4
(67) 3.725575C-04	(68) 3.931653D-C4	(69) 4.154178C-04	(70) 4.394078C-C4	(71) 4.652342D-04	(72) 4.930012C-C4
(73) 5.228144C-04	(74) 5.547701D-C4	(75) 5.889244D-C4	(76) 6.252095C-C4	(77) 6.632040C-04	(78) 7.015091C-04
(79) 7.360505C-C4	(80) 7.554621D-C4	(81) 1.097645D-C3	(82) 1.413431C-C3	(83) 1.417456D-C3	(84) 1.420082C-C3
(85) 1.406891D-03	(86) 1.374552D-C3	(87) 1.322666C-03	(88) 1.251771C-C3	(89) 1.162839D-03	(90) 1.057138C-C3
(91) 9.361903C-04	(92) 8.017398D-C4	(93) 6.557254D-C4	(94) 5.002531C-C4	(95) 3.375654C-04	(96) 1.700087C-04
(97) C.0					

PRECURSOR CONCENTRATION FOR DELAYED GROUP 2

(1) 0.0	(2) 4.541032D-C4(	(3) 9.016557D-04(	(4) 1.336201C-C3(	(5) 1.751471C-03(	(6) 2.141475D-03
(7) 2.500586C-03(	(8) 2.823625D-C3(	(9) 3.105935D-03(	(10) 3.343450C-C3(	(11) 3.532779C-03(	(12) 3.671328C-03
(13) 3.757663D-03(	(14) 3.792845D-C3(	(15) 3.785772C-03(	(16) 3.774941C-C3(	(17) 2.921440C-03(	(18) 2.017482D-C3
(19) 1.965568D-03(	(20) 1.873264D-C3(	(21) 1.770920C-03(	(22) 1.669412C-C3(	(23) 1.572475C-03(	(24) 1.481234D-C3
(25) 1.395869C-03(	(26) 1.316229D-C3(	(27) 1.242057D-C3(	(28) 1.173070C-C3(	(29) 1.108990D-03(	(30) 1.049551C-03
(31) 9.545064D-04(	(32) 9.436259D-04(	(33) 8.966965C-04(	(34) 8.535217C-C4(	(35) 8.139206D-C4(	(36) 7.777273C-C4
(37) 7.447902D-04(	(38) 7.149713D-C4(	(39) 6.881457C-04(	(40) 6.642010C-C4(	(41) 6.430369D-04(	(42) 6.245647D-C4
(43) 6.087071C-04(	(44) 5.953975D-C4(	(45) 5.845802D-04(	(46) 5.762099C-C4(	(47) 5.702514C-04(	(48) 5.666798C-04
(49) 5.654800C-C4(	(50) 5.666470D-04(	(51) 5.701856D-04(	(52) 5.761105C-C4(	(53) 5.844466D-C4(	(54) 5.952285C-04
(55) 6.085016D-04(	(56) 6.243211D-C4(	(57) 6.427533C-04(	(58) 6.638753C-C4(	(59) 6.877755D-C4(	(60) 7.145538D-C4
(61) 7.443222C-04(	(62) 7.772054D-C4(	(63) 8.133408D-04(	(64) 8.528796C-C4(	(65) 8.959873D-04(	(66) 9.428442C-04
(67) 9.936463D-04(	(68) 1.048606D-03(	(69) 1.107953D-03(	(70) 1.171923C-C3(	(71) 1.240812D-C3(	(72) 1.314866C-03
(73) 1.394378D-03(	(74) 1.479604D-C3(	(75) 1.570693C-03(	(76) 1.667466C-C3(	(77) 1.768798D-C3(	(78) 1.870959D-C3
(79) 1.963081C-03(	(80) 2.014852D-C3(	(81) 2.927470D-C3(	(82) 3.769685C-C3(	(83) 3.780418C-03(	(84) 3.787421C-03
(85) 3.752240C-03(	(86) 3.665988D-C3(	(87) 3.527607D-03(	(88) 3.238528D-C3(	(89) 3.101340C-03(	(90) 2.819432C-03
(91) 2.496859D-C3(	(92) 2.138274D-C3(	(93) 1.748847C-03(	(94) 1.334196C-C3(	(95) 9.003010D-C4(	(96) 4.534205D-04
(97) 0.0	(				

PRECURSOR CONCENTRATION FOR DELAYED GROUP 3

(1) 0.0	(2) 1.122905D-04(	(3) 2.229605D-04(	(4) 3.304129C-C4(	(5) 4.230970D-C4(	(6) 5.295310C-04
(7) 6.183232D-04(	(8) 6.981924D-C4(	(9) 7.679864C-04(	(10) 8.267002C-C4(	(11) 8.734948D-04(	(12) 9.077292D-04
(13) 9.290487C-04(	(14) 9.377154D-C4(	(15) 9.359280D-C4(	(16) 9.331973C-C4(	(17) 7.246054C-04(	(18) 4.986232C-04
(19) 4.857447C-04(	(20) 4.628932D-04(	(21) 4.375665D-04(	(22) 4.124516C-C4(	(23) 3.884706D-C4(	(24) 3.659005C-04
(25) 3.447857D-C4(	(26) 3.250884D-C4(	(27) 3.067447C-04(	(28) 2.896843C-C4(	(29) 2.738282D-C4(	(30) 2.591406D-C4
(31) 2.455300C-04(	(32) 2.329496D-C4(	(33) 2.213463D-C4(	(34) 2.106715C-C4(	(35) 2.008803C-04(	(36) 1.919316C-04
(37) 1.837877C-04(	(38) 1.764145D-04(	(39) 1.697809D-04(	(40) 1.638591C-C4(	(41) 1.586241C-C4(	(42) 1.540540C-04
(43) 1.501296D-C4(	(44) 1.468343D-C4(	(45) 1.441543C-04(	(46) 1.420783C-C4(	(47) 1.405975D-C4(	(48) 1.397057D-C4
(49) 1.393990D-04(	(50) 1.396763D-C4(	(51) 1.405385C-04(	(52) 1.419892C-C4(	(53) 1.440345C-04(	(54) 1.466829D-04
(55) 1.499454C-04(	(56) 1.538357D-C4(	(57) 1.583700D-C4(	(58) 1.635672D-C4(	(59) 1.694491C-C4(	(60) 1.760403C-04
(61) 1.833683D-C4(	(62) 1.914638D-C4(	(63) 2.003607C-C4(	(64) 2.100960C-C4(	(65) 2.207107D-C4(	(66) 2.322490D-C4
(67) 2.447592D-04(	(68) 2.582937D-C4(	(69) 2.729088C-04(	(70) 2.886655C-C4(	(71) 3.056287C-C4(	(72) 3.238668C-C4
(73) 3.434493C-04(	(74) 3.644393D-C4(	(75) 3.868737D-C4(	(76) 4.107079C-C4(	(77) 4.356652C-C4(	(78) 4.608267C-04
(79) 4.835159C-04(	(80) 4.962664D-C4(	(81) 7.210469C-04(	(82) 9.284868C-C4(	(83) 9.311295D-C4(	(84) 9.328541C-C4
(85) 9.241885D-04(	(86) 9.029440D-C4(	(87) 8.688599C-04(	(88) 8.222889C-C4(	(89) 7.638687D-04(	(90) 6.944336D-C4
(91) 6.149830C-04(	(92) 5.266624D-C4(	(93) 4.307456D-C4(	(94) 3.286159C-C4(	(95) 2.217464C-04(	(96) 1.116786C-04
(97) 0.0	(				

PRECURSOR CONCENTRATION FOR DELAYED GROUP 4

(1) 0.0	(2) 8.4168040-C5(	(3) 1.6712030-C4(	(4) 2.4765870-C4(	(5) 3.2461980-C4(	(6) 3.9689200-C4
(7) 4.6343140-C4(	(8) 5.2327700-C4(	(9) 5.7556480-C4(	(10) 6.1954110-C4(	(11) 6.5457710-C4(	(12) 6.8019220-C4
(13) 6.9612100-C4(	(14) 7.0255940-C4(	(15) 7.0115270-C4(	(16) 6.9901470-C4(	(17) 5.4264330-C4(	(18) 3.7329390-C4
(19) 3.6356870-C4(	(20) 3.4639370-C4(	(21) 3.2737700-C4(	(22) 3.0852740-C4(	(23) 2.9053380-C4(	(24) 2.7360240-C4
(25) 2.5776560-C4(	(26) 2.4299450-C4(	(27) 2.2924050-C4(	(28) 2.1645050-C4(	(29) 2.0457230-C4(	(30) 1.9355630-C4
(31) 1.8335600-C4(	(32) 1.7392830-C4(	(33) 1.6523350-C4(	(34) 1.5723470-C4(	(35) 1.4989800-C4(	(36) 1.4319240-C4
(37) 1.3708950-C4(	(38) 1.3156350-C4(	(39) 1.2659100-C4(	(40) 1.2215090-C4(	(41) 1.1822440-C4(	(42) 1.1479490-C4
(43) 1.1184780-C4(	(44) 1.0937060-C4(	(45) 1.0735250-C4(	(46) 1.0578590-C4(	(47) 1.0466310-C4(	(48) 1.0397960-C4
(49) 1.0373240-C4(	(50) 1.0392040-C4(	(51) 1.0454430-C4(	(52) 1.0560660-C4(	(53) 1.0711170-C4(	(54) 1.0906580-C4
(55) 1.1147700-C4(	(56) 1.1435530-C4(	(57) 1.1771280-C4(	(58) 1.2156340-C4(	(59) 1.2592310-C4(	(60) 1.3081030-C4
(61) 1.3624530-C4(	(62) 1.4225080-C4(	(63) 1.4885150-C4(	(64) 1.5607630-C4(	(65) 1.6395400-C4(	(66) 1.7251810-C4
(67) 1.8180430-C4(	(68) 1.9185150-C4(	(69) 2.0270160-C4(	(70) 2.1429970-C4(	(71) 2.2699400-C4(	(72) 2.4053540-C4
(73) 2.5507540-C4(	(74) 2.7066090-C4(	(75) 2.8731930-C4(	(76) 3.0501740-C4(	(77) 3.2354570-C4(	(78) 3.4223380-C4
(79) 3.5908210-C4(	(80) 3.6854970-C4(	(81) 5.3548020-C4(	(82) 6.8953240-C4(	(83) 6.9149410-C4(	(84) 6.9277350-C4
(85) 6.8633730-C4(	(86) 6.7055960-C4(	(87) 6.4524650-C4(	(88) 6.1066110-C4(	(89) 5.6727580-C4(	(90) 5.1571060-C4
(91) 4.5670760-C4(	(92) 3.9111750-C4(	(93) 3.1988630-C4(	(94) 2.4404130-C4(	(95) 1.6467640-C4(	(96) 8.2936290-C5
(97) 0.0					

PRECURSOR CONCENTRATION FOR DELAYED GROUP 5

(1) 0.0	(2) 6.7225170-C6(	(3) 1.3347560-C5(	(4) 1.9779080-C5(	(5) 2.5923830-C5(	(6) 3.1692710-C5
(7) 3.7002090-C5(	(8) 4.1775000-C5(	(9) 4.5942270-C5(	(10) 4.9443620-C5(	(11) 5.2228800-C5(	(12) 5.4259450-C5
(13) 5.5514450-C5(	(14) 5.6009340-C5(	(15) 5.5874570-C5(	(16) 5.5673230-C5(	(17) 4.3177130-C5(	(18) 2.9663560-C5
(19) 2.8862650-C5(	(20) 2.7475300-C5(	(21) 2.5945380-C5(	(22) 2.4421650-C5(	(23) 2.2988290-C5(	(24) 2.1631350-C5
(25) 2.0363090-C5(	(26) 1.9181000-C5(	(27) 1.8081010-C5(	(28) 1.7058710-C5(	(29) 1.6109780-C5(	(30) 1.5220140-C5
(31) 1.4415960-C5(	(32) 1.3663700-C5(	(33) 1.2970070-C5(	(34) 1.2332050-C5(	(35) 1.1746860-C5(	(36) 1.1211950-C5
(37) 1.0724980-C5(	(38) 1.0283830-C5(	(39) 9.8865830-C6(	(40) 9.5314910-C6(	(41) 9.2170080-C6(	(42) 8.9417570-C6
(43) 8.7045300-C6(	(44) 8.5042840-C6(	(45) 8.3401340-C6(	(46) 8.2113510-C6(	(47) 8.1173570-C6(	(48) 8.0577230-C6
(49) 8.0321670-C6(	(50) 8.0405530-C6(	(51) 8.0828870-C6(	(52) 8.1593230-C6(	(53) 8.2701560-C6(	(54) 8.4158310-C6
(55) 8.5969380-C6(	(56) 8.8142160-C6(	(57) 9.0685600-C6(	(58) 9.3610200-C6(	(59) 9.6928050-C6(	(60) 1.0065290-C5
(61) 1.0480030-C5(	(62) 1.0938740-C5(	(63) 1.1443340-C5(	(64) 1.1995930-C5(	(65) 1.2598810-C5(	(66) 1.3254500-C5
(67) 1.3965740-C5(	(68) 1.4735500-C5(	(69) 1.5566980-C5(	(70) 1.6463640-C5(	(71) 1.7429170-C5(	(72) 1.8467480-C5
(73) 1.9582500-C5(	(74) 2.0777830-C5(	(75) 2.2055570-C5(	(76) 2.3413180-C5(	(77) 2.4834870-C5(	(78) 2.6288270-C5
(79) 2.7560830-C5(	(80) 2.8286980-C5(	(81) 4.1098660-C5(	(82) 5.2921850-C5(	(83) 5.3072010-C5(	(84) 5.3169860-C5
(85) 5.2675600-C5(	(86) 5.1464440-C5(	(87) 4.9521540-C5(	(88) 4.6866980-C5(	(89) 4.3537120-C5(	(90) 2.5579510-C5
(91) 3.5051100-C5(	(92) 3.0017190-C5(	(93) 2.4550350-C5(	(94) 1.8729450-C5(	(95) 1.2638420-C5(	(96) 6.3651080-C6
(97) 0.0					

PRECURSOR CONCENTRATION FOR DELAYED GROUP 6

(1) 0.0	(2) 1.030495D-C6	(3) 2.045939D-C6	(4) 3.0315C0C-C6	(5) 3.972782D-C6	(6) 4.856039D-06
(7) 5.668371C-06	(8) 6.397915D-C6	(9) 7.034C24D-C6	(10) 7.567428D-C6	(11) 7.99C415D-C6	(12) 8.297120C-06
(13) 8.484318D-C6	(14) 8.554367D-06	(15) 8.526971C-06	(16) 8.486921D-C6	(17) 6.569284D-C6	(18) 4.5016C9D-06
(19) 4.371582D-C6	(20) 4.154232D-C6	(21) 3.916393C-06	(22) 3.681883C-C6	(23) 3.458767C-C6	(24) 3.249269D-C6
(25) 3.053948C-06	(26) 2.872050D-06	(27) 2.702993D-C6	(28) 2.546C56D-C6	(29) 2.4CC532D-06	(30) 2.265756C-06
(31) 2.141106D-06	(32) 2.026009D-C6	(33) 1.919931C-06	(34) 1.822385C-C6	(35) 1.732921D-C6	(36) 1.651124C-C6
(37) 1.576619D-06	(38) 1.509061D-C6	(39) 1.448138C-06	(40) 1.393568C-C6	(41) 1.345C99D-06	(42) 1.3C25C5D-C6
(43) 1.265587C-06	(44) 1.234171D-C6	(45) 1.20811CD-C6	(46) 1.187278C-C6	(47) 1.171574D-06	(48) 1.160918C-06
(49) 1.155255D-06	(50) 1.154548D-C6	(51) 1.158786D-06	(52) 1.167976C-C6	(53) 1.182149D-C6	(54) 1.2C1356C-06
(55) 1.225671D-06	(56) 1.255188D-C6	(57) 1.29C026C-06	(58) 1.330324C-C6	(59) 1.376247D-06	(60) 1.427983D-C6
(61) 1.485743C-06	(62) 1.549766D-C6	(63) 1.62C316D-C6	(64) 1.697686C-C6	(65) 1.782197C-06	(66) 1.8742C0C-06
(67) 1.974077C-06	(68) 2.082244D-C6	(69) 2.199152D-06	(70) 2.325284D-C6	(71) 2.461161D-C6	(72) 2.607329C-06
(73) 2.764344D-06	(74) 2.932712D-C6	(75) 3.112726C-06	(76) 3.304026C-C6	(77) 3.5C4285D-C6	(78) 3.7C6415D-06
(79) 3.888594D-06	(80) 3.990885D-C6	(81) 5.798247D-06	(82) 7.466124C-C6	(83) 7.487181C-06	(84) 7.5C0881D-06
(85) 7.431064C-06	(86) 7.260129D-C6	(87) 6.98598CD-C6	(88) 6.611453D-C6	(89) 6.141676C-C6	(90) 5.583354C-06
(91) 4.944524D-C6	(92) 4.234393D-C6	(93) 3.463200C-06	(94) 2.642C67C-C6	(95) 1.782823D-C6	(96) 8.578907D-C7
(97) C.0					

REGION

NORMALIZED POWER

1	C.3432872C C2
2	C.1242193C C2
3	0.1337118C C1

TOTAL NORMALIZED POWER = 0.1544125C C2

BENCHMARK PROBLEM PROMPT SUPERCRITICAL TRANSIENT
END OF PROBLEM

9.2 Delayed Supercritical Transient

This problem (Problem X-A1 of Reference 7) involves the same core as in Section 9.1, but with initiation from a 1% decrease in the absorption cross section in region 1 occurring in 1.0 seconds.

CARD 01
BENCHMARK PROBLEM DELAYED SUPERCRITICAL TRANSIENT

CARD 02 2 2 1 6 3 5 2 C C C -2 0

CARD 03 1 00.100000D-060.100000E-060.100000D-C6 57

CARD 04, 17 81 97

CARD 05 0.400000D 020.160000D 030.400000D 02

CARD 06 9 33 49 65 89

CARD 07 0.250000D-030.164000D-020.147000E-020.296000E-020.860000E-C30.320000E-C3

CARD 08 0.100000D 010.100000D 010.100000D 010.100000D 010.100000D 010.100000D 010.100000D 01

CARD 08 0.0 0.0 C.C 0.0 0.0 C.C

CARD 09 0.124000D-010.305000D-010.111000D 000.301000D 000.114000D 010.301000D 01

CARD 10 0.100000D 010.0

CARD 11 0.100000D 080.300000D 06

CARD 12 0.200000D-030.160000D-010.500000E-02 C 00.103000D 01

CARD 13 1 2 1

CARD 14 OUTER CORE C 1 0

CARD 15 0.250000D 010.400000E-020.700000E-020.222222D 000.C C.C

CARD 15 0.250000D 010.800000D-010.100000E 000.666667E 000.C C.C

CARD 16 0.150000D-01

CARD 14 INNER CORE C 1 0

CARD 15 0.250000D 010.200000D-020.800000E-020.222222E 000.C C.C

CARD 15 0.250000D 010.396000D-010.404000D-010.666667E 000.C C.C

CARD 16 C.100000D-01

CARD 20 C.0 0.296339D 000.588292D 000.871539D 000.114189D 010.139534D C1
0.162813D 010.183684D 010.201835D 010.217000D 010.228953D 010.237517D C1
0.242561D 010.244001D 010.241765D 010.235688D 010.225038D 010.207080D C1
0.192509D 010.179716D 010.168085D 010.157359D 010.147417D 010.138184D C1
0.129608D 010.121645D 010.114256D 010.107406D 010.101062D 010.951949D C1
0.897765D 000.847813D 000.801858D 000.759683D 000.721089D 000.685895D C1
0.653934D 000.625056D 000.599124D 000.576017D 000.555625D 000.537853D C1
0.522616D 000.509843D 000.499474D 000.491459D 000.485761D 000.482352D C1
0.481218D 000.482352D 000.485761D 000.491459D 000.499474D 000.509843D C1
0.522616D 000.537853D 000.555625D 000.576017D 000.599124D 000.625056D C1
0.653934D 000.685895D 000.721089D 000.759683D 000.801858D 000.847813D C1
0.897765D 000.951949D 000.101062D 010.107406D 010.114256D 010.121645D C1
0.129608D 010.138184D 010.147417D 010.157359D 010.168085D 010.179716D C1
0.192509D 010.207080D 010.225038D 010.235688D 010.241765D 010.244001D C1
0.242561D 010.237517D 010.228953D 010.217000D 010.201835D 010.183684D C1
0.162813D 010.139534D 010.114189D 010.871539D 000.588292D 000.296339D C1
C.0

CARD 20 C.0 0.245335D-010.487040D-010.721536D-010.945354D-010.115518D C1
0.134791D 000.152070D 000.167098D 000.179653D 000.189554D 000.196664D C1
0.200924D 000.202462D 000.202036D 000.202884D 000.218205D 000.236848D C1
0.233388D 000.222680D 000.210007D 000.197236D 000.185001D 000.173497D C1
0.162759D 000.152770D 000.143494D 000.134892D 000.126926D 000.119557D C1
0.112752D 000.106479D 000.100707D 000.954101D-010.905631D-010.861429D-010.821289D-010.785020D-010.752452D-010.723432D-010.697821D-010.675501D-010.656365D-010.640323D-010.627299D-010.617233D-010.610077D-010.605796D-010.604372D-010.605796D-010.610077D-010.617233D-010.627299D-010.640323D-010.656365D-010.675501D-010.697821D-010.723432D-010.752452D-010.785020D-010.821289D-010.861429D-010.905631D-010.954101D-010.100707D 000.106479D C1
0.112752D 000.119557D 000.126926D 000.134892D 000.143494D 000.152770D C1
0.162759D 000.173497D 000.185001D 000.197236D 000.210007D 000.222680D C1
0.233388D 000.236848D 000.218205D 000.202884D 000.202036D 000.202462D C1
0.200924D 000.196664D 000.189554D 000.179653D 000.167098D 000.152070D C1
0.134791D 000.115518D 000.945354D-010.721536D-010.487040D-010.245335D-010.115518D C1
C.0

*** INPUT EDIT FOR TIME ZONE 1 ***

CARD 21 C.100000D-02 1-100000D 01 0 -2 1 C C C

CARD 22 0.100000D 000.500000D 00

CARD 23 1 0 0 1 C

CARD 27 C.0 -.180000D-02

BENCHMARK PROBLEM DELAYED SUPERCRITICAL TRANSIENT

*** INPUT EDIT ***

2 NEUTRON GROUP(S) , 6 DELAYED GROUP(S) , 3 REGION(S) , 2 COMPOSITION(S)

SLAB GEOMETRY , LEFT BOUNDARY ZERO RIGHT BOUNDARY ZERO

IS THERE TO BE END OF PROBLEM PUNCHED OUTPLT NO

ARE THE STEADY STATE FLUXES TO BE PUNCHED NO

TEST POINTS FOR FREQUENCY CALCULATION 9 33 49 65 85

GROUP 2 IS SPECIFIED AS THE TEST GROUP FOR THE FREQUENCY CALCULATION

REGION NUMBER	MESH POINT BOUNDARIES LEFT RIGHT	
1	1	17
2	17	81
3	81	97

REGION NUMBER	LENGTH (CM)	MESH SPACING (CM)
1	40.0000	2.5000
2	160.0000	2.5000
3	40.0000	2.5000

FRACTIONAL YIELD FROM DELAYED GROUP 1 INTO NEUTRON GROUP G	I= 1	I= 2	I= 3	I= 4	I= 5	I= 6
GROUP 1	0.01240	0.03050	0.11100	0.30100	1.14000	3.01000
2	C.C	0.0	0.0	0.0	C.C	C.C

GROUP NUMBER	AVERAGE NEUTRON SPEED (CM/SEC)	NEUTRONS PER FISSION	FISSION YIELD
1	0.100000 08	0.250000 01	0.100000 01
2	0.300000 06	0.250000 01	0.0

COMPOSITION 1

GROUP NUMBER	DIFFUSION COEFFICIENT	GROUP DEPENDENT CROSS SECTIONS (CAPTURE) (FISSION)	
1	0.15C000D 01	0.7C0C0GC-C2	0.4C0CCCD-C2
2	0.5C0000D C0	0.10000GC CC	0.8C0CCCD-C1

SCATTERING MATRIX GP INTO G (THE TOTAL REMOVAL IS COMPUTED AND STORED AS THE DIAGONAL ELEMENTS)

(G) GP= 1 GP= 2

1	0.260C00D-010.0
2	0.15C0CCD-C10.180C00D 00

COMPOSITION 2

GROUP NUMBER	DIFFUSION COEFFICIENT	GROUP DEPENDENT CROSS SECTIONS (CAPTURE) (FISSION)	
1	0.10CC0CD 01	0.8C0C00C-C2	0.2C00C0C-02
2	0.5C0C0CD C0	0.404C0CC-C1	0.396CCCD-C1

SCATTERING MATRIX GP INTO G (THE TOTAL REMOVAL IS COMPUTED AND STORED AS THE DIAGONAL ELEMENTS)

(G) GP= 1 GP= 2

1	0.200C00D-010.C
2	0.1C0000C-010.800C00D-01

COMPOSITION ASSIGNMENT TO REGIONS

REGION	COMPOSITION
1	1
2	2
3	1

NO XENON BUILDUP CONSIDERED IN THIS PROBLEM

ARE STEADY STATE CONDITIONS TO BE CALCULATED ? YES

INPUT FLUX DISTRIBUTION

(1) 0.0	(2) 2.963389D-C1	(3) 5.882521D-01	(4) 8.715388D-C1	(5) 1.141887D-C0	(6) 1.395336D-00
(7) 1.628134D-00	(8) 1.836836D-C0	(9) 2.018354D-C0	(10) 2.170000D-C0	(11) 2.285525D-C0	(12) 2.375165D-00
(13) 2.425611D-00	(14) 2.440005D-C0	(15) 2.417649D-00	(16) 2.356881D-C0	(17) 2.250384D-C0	(18) 2.070800D-C0
(19) 1.925089D-C0	(20) 1.797160D-C0	(21) 1.680847D-C0	(22) 1.573593D-C0	(23) 1.474167D-C0	(24) 1.381839D-00
(25) 1.296079D-C0	(26) 1.216448D-C0	(27) 1.142558D-C0	(28) 1.074057D-C0	(29) 1.010621D-C0	(30) 9.519489D-01
(31) 8.977647D-01	(32) 8.478128D-01	(33) 8.018577D-01	(34) 7.596828D-C1	(35) 7.210651D-C1	(36) 6.858947D-C1
(37) 6.539338D-01	(38) 6.250557D-C1	(39) 5.991242D-01	(40) 5.760171D-C1	(41) 5.556254D-C1	(42) 5.378531D-C1
(43) 5.226163D-01	(44) 5.098432D-01	(45) 4.994736D-01	(46) 4.914587D-C1	(47) 4.857605D-C1	(48) 4.823524D-01
(49) 4.812181D-01	(50) 4.823524D-01	(51) 4.857605D-01	(52) 4.914587D-C1	(53) 4.994736D-C1	(54) 5.098432D-01
(55) 5.226163D-01	(56) 5.378531D-C1	(57) 5.556254D-01	(58) 5.760171D-C1	(59) 5.991242D-01	(60) 6.250557D-C1
(61) 6.539338D-01	(62) 6.858947D-01	(63) 7.210651D-01	(64) 7.596828D-C1	(65) 8.018577D-01	(66) 8.478128D-01
(67) 8.977647D-01	(68) 9.519489D-01	(69) 1.010621D-C0	(70) 1.074057D-C0	(71) 1.142558D-C0	(72) 1.216448D-C0
(73) 1.296079D-C0	(74) 1.381839D-C0	(75) 1.474167D-C0	(76) 1.573593D-C0	(77) 1.680847D-C0	(78) 1.797160D-C0
(79) 1.925089D-C0	(80) 2.070800D-C0	(81) 2.250384D-C0	(82) 2.356881D-C0	(83) 2.417649D-C0	(84) 2.440005D-C0
(85) 2.425611D-C0	(86) 2.375165D-C0	(87) 2.285525D-C0	(88) 2.170000D-C0	(89) 2.070800D-C0	(90) 1.925089D-C0
(91) 1.628134D-C0	(92) 1.395336D-C0	(93) 1.141887D-C0	(94) 8.715388D-C1	(95) 5.882521D-C1	(96) 2.963389D-C1
(97) 0.0					
(1) 0.0	(2) 2.453354D-C2	(3) 4.870399D-02	(4) 7.215364D-C2	(5) 9.453544D-C2	(6) 1.155182D-01
(7) 1.347913D-C1	(8) 1.520695D-C1	(9) 1.670975D-01	(10) 1.796523D-C1	(11) 1.895535D-C1	(12) 1.966639D-C1
(13) 2.009241D-01	(14) 2.024615D-C1	(15) 2.020363D-C1	(16) 2.028838D-C1	(17) 2.183045D-C1	(18) 2.368475D-01
(19) 2.333879D-01	(20) 2.226800D-C1	(21) 2.100072D-C1	(22) 1.972358D-C1	(23) 1.850011D-C1	(24) 1.734965D-01
(25) 1.627586D-C1	(26) 1.527695D-C1	(27) 1.434938D-01	(28) 1.348922D-C1	(29) 1.269256D-C1	(30) 1.195571D-C1
(31) 1.127521D-01	(32) 1.064786D-C1	(33) 1.007070D-C1	(34) 9.541012D-C2	(35) 9.056306D-C2	(36) 8.614293D-C2
(37) 8.212890D-02	(38) 7.850204D-02	(39) 7.524524D-C2	(40) 7.234317D-C2	(41) 6.978214D-C2	(42) 6.755008D-02
(43) 6.563646D-02	(44) 6.403226D-C2	(45) 6.272593D-02	(46) 6.172331D-C2	(47) 6.100767D-C2	(48) 6.057963D-C2
(49) 6.043717D-02	(50) 6.057963D-C2	(51) 6.100767D-C2	(52) 6.172331D-C2	(53) 6.272593D-C2	(54) 6.403226D-C2
(55) 6.563646D-02	(56) 6.755008D-C2	(57) 6.978214D-C2	(58) 7.234317D-C2	(59) 7.524524D-02	(60) 7.850204D-02
(61) 8.212890D-02	(62) 8.614293D-02	(63) 9.056306D-C2	(64) 9.541012D-C2	(65) 1.007070D-C1	(66) 1.064786D-C1
(67) 1.127521D-01	(68) 1.195571D-C1	(69) 1.269256D-01	(70) 1.348922D-C1	(71) 1.434938D-C1	(72) 1.527695D-C1
(73) 1.627586D-01	(74) 1.734965D-C1	(75) 1.850011D-C1	(76) 1.972358D-C1	(77) 2.100072D-01	(78) 2.226800D-01
(79) 2.333879D-01	(80) 2.368475D-C1	(81) 2.183045D-01	(82) 2.028838D-C1	(83) 2.020363D-C1	(84) 2.024615D-01
(85) 2.009241D-01	(86) 1.966639D-C1	(87) 1.895539D-01	(88) 1.796523D-C1	(89) 1.670975D-C1	(90) 1.520695D-01
(91) 1.347913D-01	(92) 1.155182D-C1	(93) 9.453544D-C2	(94) 7.215364D-C2	(95) 4.870399D-C2	(96) 2.453354D-02
(97) 0.0					

THE INITIAL PRECURSOR CONCENTRATIONS ARE CALCULATED FROM THE STEADY STATE FLUX DISTRIBUTION

ARE THERE ANY TIME DEPENDENT CHANGES IN THE
CROSS SECTION DATA YES

TIME	CROSS SECTION	GROUP	REGION	TOTAL LINEAR	TOTAL QUADRATIC
ZONE				CHANGE	CHANGE
1	CAPTURE	2	1	-0.180000D-C2	0.0

ARE THERE ANY TIME DEPENDENT SOURCES ? NO

EQUILIBRIUM NU(IG) (1) C.277307CD C1(2) C.277307CD C1(

EQUILIBRIUM FLUXES

1)C.0	(2)0.2862154D 00(	3)0.5683025D 00(	4)0.8421926D CC(	5)C.1103935D 01(	6)C.1349755D C1
7)C.1576107D 01(	8)0.1779726D 01(	9)C.1957674D C1(	10)C.2107386D C1(	11)C.2226699D 01(	12)0.2313890D 01
13)C.2367680D 01(	14)0.2387212D 01(	15)C.2371878D C1(	16)C.2320559D C1(	17)C.2228526D C1(	18)0.2070561D 01
19)C.1937223D C1(	20)0.1817865D 01(	21)C.1708274D C1(	22)0.1606625D C1(	23)C.1511592D 01(	24)C.1423793D C1
25)0.1341590D 01(	26)0.1265016D 01(	27)C.1193741D C1(	28)C.1127462D C1(	29)C.1065902D 01(	30)0.1008802D 01
31)C.9559232D 00(	32)0.9070443D 00(	33)C.8619000D CC(	34)C.8204839D CC(	35)C.7824402D CC(	36)C.7476705D CC
37)C.7160292D CC(	38)0.6873840D 00(	39)C.6616150D 00(	40)0.6386144D CC(	41)C.6182860D CC(	42)C.6005446D CC
43)C.5853161D CC(	44)0.5725367D CC(	45)C.5621530D CC(	46)0.5541215D CC(	47)C.5484085D CC(	48)C.5445903D CC
49)C.5438525D CC(	50)0.5449903D 00(	51)C.5484085D CC(	52)C.5541215D CC(	53)C.5621530D 00(	54)C.5725367D CC
55)C.5853161D CC(	56)0.6005446D 00(	57)0.6182860D CC(	58)C.6386144D CC(	59)C.6616150D CC(	60)C.6873840D CC
61)C.7160292D CC(	62)0.7476705D CC(	63)C.7824402D CC(	64)C.8204839D CC(	65)C.8619000D 00(	66)C.9070443D CC
67)0.9559232D CC(	68)0.1008802D 01(	69)C.1065902D C1(	70)C.1127462D C1(	71)C.1193741D 01(	72)0.1265016D 01
73)C.1341590D C1(	74)0.1423793D 01(	75)0.1511992D C1(	76)C.1606625D C1(	77)C.1708274D C1(	78)C.1817865D C1
79)C.1937223D C1(	80)0.2070561D 01(	81)C.2228526D 01(	82)0.2320559D C1(	83)C.2371878D 01(	84)C.2387212D C1
85)0.2367680D 01(	86)C.2313890D 01(	87)C.2226699D C1(	88)C.2107386D C1(	89)C.1957674D 01(	90)0.1779726D C1
91)C.1576107D 01(	92)0.1349755D 01(	93)0.1103935D 01(	94)C.8421926D CC(	95)C.5683025D CC(	96)C.2862154D CC
57)C.0	(2)0.2365936D-01(	3)C.4705688D-C1(	4)C.6973568D-C1(	5)C.9140864D-01(	6)0.1117632D 00
1)0.0	(2)0.2365936D-01(	3)C.4705688D-C1(	4)C.6973568D-C1(	5)C.9140864D-01(	6)0.1117632D 00
7)C.1305057D 00(	8)0.1473659D CC(	9)C.1621000D CC(	10)C.1744985D CC(	11)C.1843833D CC(	12)0.1916242D CC
13)C.1961651D CC(	14)0.1981376D CC(	15)C.1983172D 00(	16)0.1999832D CC(	17)C.2165068D CC(	18)C.2266467D CC
19)C.2346132D CC(	20)0.2250399D CC(	21)C.2132734D CC(	22)0.2012460D CC(	23)C.1896364D CC(	24)C.1786642D CC
25)C.1683822D CC(	26)0.1587837D 00(	27)C.1498417D CC(	28)C.1415239D CC(	29)C.1337972D CC(	30)C.1266300D CC
31)C.1159924D CC(	32)0.1138569D 00(	33)C.1081978D CC(	34)C.1029914D CC(	35)C.9821599D-01(	36)C.9385151D-C1
37)C.8987974D-C1(	38)C.8628404D-01(	39)C.8304938D-C1(	40)C.8016223D-C1(	41)C.7761049D-01(	42)C.7538350D-C1
43)0.7347194D-01(	44)0.7186780D-01(	45)C.7056438D-C1(	46)C.6955623D-C1(	47)C.6883911D-01(	48)C.6841004D-C1
49)C.6826721D-C1(	50)0.6841004D-01(	51)0.6883911D-C1(	52)C.6955623D-C1(	53)C.7056438D-C1(	54)C.7186780D-C1
55)C.7347194D-C1(	56)0.7538350D-01(	57)C.7761049D-01(	58)0.8016223D-C1(	59)C.8304938D-01(	60)C.8628404D-C1
61)C.8987974D-01(	62)0.9385151D-01(	63)C.9821599D-C1(	64)C.1029914D CC(	65)C.1081978D 00(	66)0.1138569D CC
67)C.1159924D CC(	68)0.1266300D 00(	69)0.1337972D CC(	70)C.1415239D CC(	71)C.1498417D CC(	72)C.1587837D CC
73)C.1683822D CC(	74)C.1786642D 00(	75)0.1896364D 00(	76)0.2012460D CC(	77)C.2132734D 00(	78)0.2250399D CC
79)C.2346132D CC(	80)0.2366467D CC(	81)C.2165068D CC(	82)C.1999832D CC(	83)C.1983172D 00(	84)0.1981376D 00
85)C.1961651D CC(	86)0.1916242D CC(	87)C.1843833D CC(	88)0.1744985D CC(	89)C.1621000D CC(	90)C.1473659D CC
91)C.1305057D CC(	92)0.1117632D 00(	93)C.9140864D-01(	94)0.6973568D-C1(	95)C.4705688D-C1(	96)C.2365936D-C1
97)C.0	(				

110.0	(	210.17000760-031	310.33756310-C31	410.50024980-C21	510.65572100-C31	610.80173450-C3
710.93618410-C31		810.10571310-021	910.11628310-021	1010.12517630-C21	1110.13226570-C21	1210.13745420-C2
1310.14068820-C21		1410.14200720-021	1510.14174460-021	1610.14134210-C21	1710.10976370-C21	1810.75545630-C3
1910.73604470-031		2010.70150330-031	2110.66319830-C31	2210.62520380-C31	2310.58891870-031	2410.55476430-C3
2510.52280850-C31		2610.49299510-031	2710.46522800-031	2810.43540130-C31	2910.41541110-031	3010.39315810-C3
3110.37255000-C31		3210.35350060-031	3310.33593030-C31	3410.31976560-C31	3510.30493900-031	3610.29138820-C3
3710.27905670-031		3810.26789290-031	3910.25785000-C31	4010.24888600-C31	4110.24096340-031	4210.23404910-C3
4310.22811410-C31		4410.22313360-031	4510.21908680-031	4610.21555670-C21	4710.21373020-021	4810.21235800-C3
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 43)C.12C2866D-C5(44)0.1176604D-05(45)C.1155264D-05(46)0.1138759C-C5(47)C.1127019D-05(48)C.1115994D-C5
 49)0.1117656D-05(50)0.1115994D-05(51)C.1127C19D-05(52)C.1138759C-C5(53)C.1155264C-05(54)0.1176604C-05
 55)C.1202866D-05(56)0.1234162D-05(57)0.1270622D-05(58)C.1312398C-C5(59)C.1355666D-C5(60)C.1412623C-05
 61)C.1471491D-05(62)0.1536516D-05(63)0.1607970C-05(64)0.1686153C-C5(65)C.1771391D-C5(66)C.1864C4C0-C5
 67)0.1964490D-05(68)0.2C73158D-05(69)C.219C5C0C-05(70)C.2317C03C-C5(71)C.2453189C-05(72)0.2599607D-05
 73)C.2756816D-05(74)0.2925322D-05(75)C.3105421D-C5(76)C.3296756C-C5(77)C.34571C4C-C5(78)C.3699C9C0-05
 79)C.388123C0-C5(80)0.3983589D-05(81)C.578794C0-05(82)0.7453C97C-C5(83)C.7474321D-C5(84)C.7488167D-05
 85)C.7418613D-05(86)0.7248084D-05(87)C.6974489D-C5(88)0.66C0659C-05(89)C.6131712D-05(90)C.5574346D-05
 91)C.4936583D-05(92)0.4227618D-05(93)C.3457676D-C5(94)C.2637862D-C5(95)C.178C0C1D-05(96)0.8964655D-06
 97)C.0 (1)C.0 (2)0.8964655D-06(3)C.17800C1D-05(4)0.2637862D-C5(5)C.3457676D-C5(6)C.4227618D-C5
 7)C.4936583D-C5(8)0.5574346D-05(9)C.6131712D-05(10)C.66C0659C-C5(11)0.6974489D-05(12)0.7248C84D-C5
 13)C.7418613D-05(14)0.7488167D-05(15)C.7474321D-C5(16)C.7453C97D-C5(17)C.578794C0-05(18)C.3983589C-05
 19)C.388123C0-C5(20)0.3699090D-05(21)0.34971C4C-05(22)C.3296756D-C5(23)C.31C5421D-C5(24)C.2525322C-C5
 25)C.2756816D-C5(26)0.2599607D-05(27)0.2453189D-C5(28)0.2317C03C-C5(29)C.219C5C0C-05(30)C.2C73158D-C5
 31)C.1964490D-05(32)0.1864040D-05(33)C.1771391D-05(34)C.1686153C-C5(35)C.16C797C0-05(36)0.1536516C-05
 37)C.1471491D-C5(38)0.1412623D-05(39)C.1359666D-C5(40)C.1312398C-C5(41)C.127C622D-C5(42)C.1234162C-05
 43)C.12C2866D-C5(44)0.1176604D-05(45)C.1155264D-05(46)0.1138759C-C5(47)C.1127019D-05(48)C.1115994D-C5
 49)0.1117656D-05(50)0.1115994D-05(51)C.1127C19D-05(52)C.1138759C-C5(53)C.1155264C-05(54)0.1176604C-05
 55)C.1202866D-05(56)0.1234162D-05(57)0.1270622D-05(58)C.1312398C-C5(59)C.1355666D-C5(60)C.1412623C-05
 61)C.1471491D-05(62)0.1536516D-05(63)0.1607970C-05(64)0.1686153C-C5(65)C.1771391D-C5(66)C.1864C4C0-C5
 67)0.1964490D-05(68)0.2C73158D-05(69)C.219C5C0C-05(70)C.2317C03C-C5(71)C.2453189C-05(72)0.2599607D-05
 73)C.2756816D-05(74)0.2925322D-05(75)C.3105421D-C5(76)C.3296756C-C5(77)C.34571C4C-C5(78)C.3699C9C0-05
 79)C.388123C0-C5(80)0.3983589D-05(81)C.578794C0-05(82)0.7453C97C-C5(83)C.7474321D-C5(84)C.7488167D-05
 85)C.7418613D-05(86)0.7248084D-05(87)C.6974489D-C5(88)0.66C0659C-05(89)C.6131712D-05(90)C.5574346D-05
 91)C.4936583D-05(92)0.4227618D-05(93)C.3457676D-C5(94)C.2637862D-C5(95)C.178C0C1D-05(96)0.8964655D-06
 97)C.0 (1)C.0 (2)0.8964655D-06(3)C.17800C1D-05(4)0.2637862D-C5(5)C.3457676D-C5(6)C.4227618D-C5
 7)C.4936583D-C5(8)0.5574346D-05(9)C.6131712D-05(10)C.66C0659C-C5(11)0.6974489D-05(12)0.7248C84D-C5
 13)C.7418613D-05(14)0.7488167D-05(15)C.7474321D-C5(16)C.7453C97D-C5(17)C.578794C0-05(18)C.3983589C-05
 19)C.388123C0-C5(20)0.3699090D-05(21)0.34971C4C-05(22)C.3296756D-C5(23)C.31C5421D-C5(24)C.2525322C-C5
 25)C.2756816D-C5(26)0.2599607D-05(27)0.2453189D-C5(28)0.2317C03C-C5(29)C.219C5C0C-05(30)C.2C73158D-C5
 31)C.1964490D-05(32)0.1864040D-05(33)C.1771391D-05(34)C.1686153C-C5(35)C.16C797C0-05(36)0.1536516C-05
 37)C.1471491D-C5(38)0.1412623D-05(39)C.1359666D-C5(40)C.1312398C-C5(41)C.127C622D-C5(42)C.1234162C-05
 43)C.12C2866D-C5(44)0.1176604D-05(45)C.1155264D-05(46)0.1138759C-C5(47)C.1127019D-05(48)C.1115994D-C5
 49)0.1117656D-05(50)0.1115994D-05(51)C.1127C19D-05(52)C.1138759C-C5(53)C.1155264C-05(54)0.1176604C-05
 55)C.1202866D-05(56)0.1234162D-05(57)0.1270622D-05(58)C.1312398C-C5(59)C.1355666D-C5(60)C.1412623C-05
 61)C.1471491D-05(62)0.1536516D-05(63)0.1607970C-05(64)0.1686153C-C5(65)C.1771391D-C5(66)C.1864C4C0-C5
 67)0.1964490D-05(68)0.2C73158D-05(69)C.219C5C0C-05(70)C.2317C03C-C5(71)C.2453189C-05(72)0.2599607D-05
 73)C.2756816D-05(74)0.2925322D-05(75)C.3105421D-C5(76)C.3296756C-C5(77)C.34571C4C-C5(78)C.3699C9C0-05
 79)C.388123C0-C5(80)0.3983589D-05(81)C.578794C0-05(82)0.7453C97C-C5(83)C.7474321D-C5(84)C.7488167D-05
 85)C.7418613D-05(86)0.7248084D-05(87)C.6974489D-C5(88)0.66C0659C-05(89)C.6131712D-05(90)C.5574346D-05
 91)C.4936583D-05(92)0.4227618D-05(93)C.3457676D-C5(94)C.2637862D-C5(95)C.178C0C1D-05(96)0.8964655D-06
 97)C.0 (1)C.0 (2)0.8964655D-06(3)C.17800C1D-05(4)0.2637862D-C5(5)C.3457676D-C5(6)C.4227618D-C5
 7)C.4936583D-C5(8)0.5574346D-05(9)C.6131712D-05(10)C.66C0659C-C5(11)0.6974489D-05(12)0.7248C84D-C5
 13)C.7418613D-05(14)0.7488167D-05(15)C.7474321D-C5(16)C.7453C97D-C5(17)C.578794C0-05(18)C.3983589C-05
 19)C.388123C0-C5(20)0.3699090D-05(21)0.34971C4C-05(22)C.3296756D-C5(23)C.31C5421D-C5(24)C.2525322C-C5
 25)C.2756816D-C5(26)0.2599607D-05(27)0.2453189D-C5(28)0.2317C03C-C5(29)C.219C5C0C-05(30)C.2C73158D-C5
 31)C.1964490D-05(32)0.1864040D-05(33)C.1771391D-05(34)C.1686153C-C5(35)C.16C797C0-05(36)0.1536516C-05
 37)C.1471491D-C5(38)0.1412623D-05(39)C.1359666D-C5(40)C.1312398C-C5(41)C.127C622D-C5(42)C.1234162C-05
 43)C.12C2866D-C5(44)0.1176604D-05(45)C.1155264D-05(46)0.1138759C-C5(47)C.1127019D-05(48)C.1115994D-C5
 49)0.1117656D-05(50)0.1115994D-05(51)C.1127C19D-05(52)C.1138759C-C5(53)C.1155264C-05(54)0.1176604C-05
 55)C.1202866D-05(56)0.1234162D-05(57)0.1270622D-05(58)C.1312398C-C5(59)C.1355666D-C5(60)C.1412623C-05
 61)C.1471491D-05(62)0.1536516D-05(63)0.1607970C-05(64)0.1686153C-C5(65)C.1771391D-C5(66)C.1864C4C0-C5
 67)0.1964490D-05(68)0.2C73158D-05(69)C.219C5C0C-05(70)C.2317C03C-C5(71)C.2453189C-05(72)0.2599607D-05
 73)C.2756816D-05(74)0.2925322D-05(75)C.3105421D-C5(76)C.3296756C-C5(77)C.34571C4C-C5(78)C.3699C9C0-05
 79)C.388123C0-C5(80)0.3983589D-05(81)C.578794C0-05(82)0.7453C97C-C5(83)C.7474321D-C5(84)C.7488167D-05
 85)C.7418613D-05(86)0.7248084D-05(87)C.6974489D-C5(88)0.66C0659C-05(89)C.6131712D-05(90)C.5574346D-05
 91)C.4936583D-05(92)0.4227618D-05(93)C.3457676D-C5(94)C.2637862D-C5(95)C.178C0C1D-05(96)0.8964655D-06
 97)C.0 (1)C.0 (2)0.8964655D-06(3)C.17800C1D-05(4)0.2637862D-C5(5)C.3457676D-C5(6)C.4227618D-C5
 7)C.4936583D-C5(8)0.5574346D-05(9)C.6131712D-05(10)C.66C0659C-C5(11)0.6974489D-05(12)0.7248C84D-C5
 13)C.7418613D-05(14)0.7488167D-05(15)C.7474321D-C5(16)C.7453C97D-C5(17)C.578794C0-05

BENCHMARK PROBLEM DELAYED SUPERCRITICAL TRANSIENT

TIME ZCNE= 1 STEP NUMBER= 65 TIME=0.100000D C0 TIME STEP=C.242726D-C2

TEST POINT	MESH POINT	FREQUENCY	EXP(W*H)
1	9	4.4585D-C1	1.000875D CC
2	33	3.3967D-C1	1.000666D CC
3	49	1.7308D-C1	1.000339D CC
4	65	3.446D-C2	1.000068D CC
5	89	0.0	1.000000D CC

POINT-WISE FLUXES FOR GROUP 1

(1) C.0	(2) 3.016838D-C1	(3) 5.99C086D-01	(4) 8.876786D-C1	(5) 1.163523D C0	(6) 1.422556D CC
(7) 1.661034D CC	(8) 1.875513D CC	(9) 2.062892D CC	(10) 2.22C465D CC	(11) 2.345553D CC	(12) 2.437536D CC
(13) 2.493873D CC	(14) 2.514062D CC	(15) 2.497467D CC	(16) 2.442918D CC	(17) 2.345456D CC	(18) 2.178325D CC
(19) 2.037179D CC	(20) 1.910817D CC	(21) 1.794802D CC	(22) 1.6872C9D CC	(23) 1.587C54D CC	(24) 1.453719D CC
(25) 1.406738D CC	(26) 1.325716D CC	(27) 1.25C301D CC	(28) 1.1EC169D CC	(29) 1.115023D CC	(30) 1.054586D CC
(31) 5.986C26D-01	(32) 9.468352D-C1	(33) 8.99C647D-01	(34) 8.55CEEEED-C1	(35) 8.147213D-C1	(36) 7.777913D-C1
(37) 7.441422D-01	(38) 7.136314D-C1	(39) 6.861297D-01	(40) 6.615204D-01	(41) 6.396591D-01	(42) 6.2C5730D-C1
(43) 6.040611D-01	(44) 5.9C0929D-C1	(45) 5.786C9CD-01	(46) 5.6556C4D-C1	(47) 5.629C82D-01	(48) 5.586238D-C1
(49) 5.566885D-01	(50) 5.570933D-01	(51) 5.598395D-01	(52) 5.645377D-C1	(53) 5.724CE8D-C1	(54) 5.822835D-01
(55) 5.946027D-01	(56) 6.094174D-C1	(57) 6.267892D-01	(58) 6.4679C5D-C1	(59) 6.655C45D-01	(60) 6.95C262D-C1
(61) 7.234618D-01	(62) 7.549303D-C1	(63) 7.895631D-01	(64) 8.275048D-C1	(65) 8.689141D-01	(66) 9.139642D-01
(67) 9.628433D-01	(68) 1.015756D CC	(69) 1.072924D CC	(70) 1.1345EEED CC	(71) 1.2C1CC1D CC	(72) 1.272447D CC
(73) 1.349229D CC	(74) 1.431674D CC	(75) 1.520155D CC	(76) 1.61511CC CC	(77) 1.717122D CC	(78) 1.827122D CC
(79) 1.946943D CC	(80) 2.080819D CC	(81) 2.239437D CC	(82) 2.331851D CC	(83) 2.383361D CC	(84) 2.398719D CC
(85) 2.379049D CC	(86) 2.324965D CC	(87) 2.237327D CC	(88) 2.11742CD CC	(89) 1.966576D CC	(90) 1.788167D CC
(91) 1.583572D CC	(92) 1.356140D CC	(93) 1.109152D CC	(94) 8.461696D-C1	(95) 5.7C9846D-C1	(96) 2.875658D-01
(97) C.0					

TOTAL INTEGRATED FLUX FOR REGION 1 GROUP 1 = C.7C2472D C2

TOTAL INTEGRATED FLUX FOR REGION 2 GROUP 1 = 0.168493D C3

TOTAL INTEGRATED FLUX FOR REGION 3 GROUP 1 = 0.670028D C2

POINT-WISE FLUXES FOR GROUP 2

(1) 0.0	(2) 2.500405D-C2	(3) 4.964683D-02	(4) 7.357227C-C2	(5) 5.643469D-C2	(6) 1.179C38C-C1
(7) 1.376693D-C1	(8) 1.554457D-C1	(9) 1.709764C-01	(10) 1.84C376C-C1	(11) 1.544437D-01	(12) 2.C2C568D-C1
(13) 2.068176D-01	(14) 2.088644D-C1	(15) 2.C9C125D-01	(16) 2.1C7C64C-C1	(17) 2.279811C-01	(18) 2.485996D-01
(19) 2.467321D-01	(20) 2.365539D-C1	(21) 2.24C816D-01	(22) 2.113448C-C1	(23) 1.59C555D-C1	(24) 1.874434C-01
(25) 1.765631D-01	(26) 1.664066D-01	(27) 1.569450C-01	(28) 1.481423C-C1	(29) 1.355663D-C1	(30) 1.3238C0D-C1
(31) 1.253526C-01	(32) 1.188543D-C1	(33) 1.126577D-01	(34) 1.C73375C-C1	(35) 1.C227G2C-01	(36) 9.763441C-02
(37) 9.341047C-02	(38) 8.958048D-02	(39) 8.612821D-C2	(40) 8.3C35C1D-C2	(41) 8.C25578C-C2	(42) 7.785890C-02
(43) 7.582614D-02	(44) 7.407271D-02	(45) 7.263112C-02	(46) 7.149522C-C2	(47) 7.C66C15D-C2	(48) 7.C12229D-C2
(49) 6.987930D-02	(50) 6.993008D-C2	(51) 7.027474C-02	(52) 7.C91466C-C2	(53) 7.185244C-02	(54) 7.3C9193D-C2
(55) 7.463826C-02	(56) 7.649786D-02	(57) 7.867844D-C2	(58) 8.1185C8D-C2	(59) 8.404C25D-C2	(60) 8.724385C-02
(61) 5.081323D-02	(62) 9.476331D-02	(63) 9.911C58C-02	(64) 1.C38732D-C1	(65) 1.C9C711D-C1	(66) 1.147260C-C1
(67) 1.208616D-01	(68) 1.275034D-C1	(69) 1.346791C-C1	(70) 1.424186C-C1	(71) 1.5C7535D-C1	(72) 1.557175D-C1
(73) 1.693415C-01	(74) 1.796539D-C1	(75) 1.90661C0-C1	(76) 2.C23C96D-C1	(77) 2.143790C-01	(78) 2.261872C-01
(79) 2.357923D-01	(80) 2.378218D-C1	(81) 2.175697C-01	(82) 2.CC5576D-C1	(83) 1.552775D-C1	(84) 1.55C930C-C1
(85) 1.971074D-01	(86) 1.925416D-C1	(87) 1.852636C-01	(88) 1.753297C-C1	(89) 1.628712D-01	(90) 1.48C651D-C1
(91) 1.311240C-01	(92) 1.12292C0-C1	(93) 5.184C74D-02	(94) 7.CC65C8C-C2	(95) 4.727904C-02	(96) 2.381121C-02
(97) 0.0					

TOTAL INTEGRATED FLUX FOR REGION 1 GROUP 2 = 0.589146C 01

TOTAL INTEGRATED FLUX FOR REGION 2 GROUP 2 = C.2C7988D C2

TOTAL INTEGRATED FLUX FOR REGION 3 GROUP 2 = C.561426D C1

REGION	NORMALIZED POWER
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1	C.1C54041C C1
2	0.1026433C 01
3	0.1004788C C1

TOTAL NORMALIZED POWER = C.1C28C97D C1

BENCHMARK PROBLEM DELAYED SUPERCRITICAL TRANSIENT

TIME ZCNE= 1 STEP NUMBER= 177 TIME=0.500000 C0 TIME STEP=C.523461D-C2

TEST POINT	MESH POINT	FREQUENCY	EXP(W*F)
1	9	8.0829D-01	1.003201D CC
2	33	6.8191D-C1	1.002700D CC
3	49	4.1025D-01	1.001622D CC
4	65	1.3500D-01	1.000534D CC
5	89	6.7972D-C2	1.000265D CC

POINT-WISE FLUXES FOR GROUP 1

(1) C.0	(2) 4.001681D-01	(3) 7.945125D-01	(4) 1.177294D CC	(5) 1.542943D CC	(6) 1.886137D CC
(7) 2.201882D 00	(8) 2.485581D CC	(9) 2.733107D CC	(10) 2.940855D CC	(11) 3.105799D CC	(12) 3.225531D 00
(13) 3.298281D 00	(14) 3.322875D CC	(15) 3.298502D CC	(16) 3.223667D CC	(17) 3.091539D CC	(18) 2.866845D 00
(19) 2.676319D CC	(20) 2.505642D CC	(21) 2.348957D CC	(22) 2.203695D CC	(23) 2.068522D CC	(24) 1.942588D CC
(25) 1.825242D CC	(26) 1.715932D CC	(27) 1.614162D CC	(28) 1.519477D CC	(29) 1.421459D CC	(30) 1.349716D CC
(31) 1.273888D 00	(32) 1.203639D CC	(33) 1.138658D CC	(34) 1.078658D CC	(35) 1.023373D CC	(36) 9.725594D-01
(37) 9.259907D-01	(38) 8.834608D-01	(39) 8.447808D-01	(40) 8.097787D-01	(41) 7.782587D-01	(42) 7.502003D-01
(43) 7.253577D-01	(44) 7.036595D-01	(45) 6.850079D-01	(46) 6.693182D-01	(47) 6.565189D-01	(48) 6.465507D-01
(49) 6.393667D-01	(50) 6.349322D-01	(51) 6.332241D-01	(52) 6.342311D-01	(53) 6.375539D-01	(54) 6.444045D-01
(55) 6.536067D-01	(56) 6.655961D-01	(57) 6.804204D-01	(58) 6.981391D-01	(59) 7.188243D-01	(60) 7.425606D-01
(61) 7.694456D-01	(62) 7.995903D-01	(63) 8.331196D-01	(64) 8.701727D-01	(65) 9.109037D-01	(66) 9.554822D-01
(67) 1.004094D 00	(68) 1.056943D CC	(69) 1.114250D CC	(70) 1.176254D CC	(71) 1.243216D 00	(72) 1.315417D CC
(73) 1.393164D 00	(74) 1.476792D CC	(75) 1.566678D CC	(76) 1.663265D CC	(77) 1.767161D CC	(78) 1.879310D CC
(79) 2.001594D CC	(80) 2.138359D CC	(81) 2.300594D CC	(82) 2.395072D CC	(83) 2.447582D CC	(84) 2.463014D CC
(85) 2.442527D 00	(86) 2.386757D CC	(87) 2.296588D CC	(88) 2.173341D CC	(89) 2.018793D 00	(90) 1.835173D 00
(91) 1.625124D 00	(92) 1.391672D CC	(93) 1.138178D CC	(94) 8.682925D-01	(95) 5.859035D-01	(96) 2.950765D-01
(97) C.0					

TOTAL INTEGRATED FLUX FOR REGION 1 GROUP 1 = C.929578D C2

TOTAL INTEGRATED FLUX FOR REGION 2 GROUP 1 = C.196132D C3

TOTAL INTEGRATED FLUX FOR REGION 3 GROUP 1 = C.687835D C2

POINT-WISE FLUXES FOR GROUP 2

(1) 0.0 (2) 3.329665D-C2(3) 6.610873D-C2(4) 9.795874D-C2(5) 1.283831D-C1(6) 1.569392D-C1
 (7) 1.832112D-C1(8) 2.068170D-C1(9) 2.274132D-C1(10) 2.447010D-C1(11) 2.584327D-C1(12) 2.684248D-C1
 (13) 2.745987D-C1(14) 2.771362D-C1(15) 2.771069D-C1(16) 2.790150D-C1(17) 3.011626D-C1(18) 3.279117D-C1
 (19) 3.242287D-C1(20) 3.102455D-C1(21) 2.933127D-C1(22) 2.760827D-C1(23) 2.594824D-C1(24) 2.438077D-C1
 (25) 2.291251D-C1(26) 2.154196D-C1(27) 2.026492D-C1(28) 1.907640D-C1(29) 1.797142D-C1(30) 1.694517D-C1
 (31) 1.599315D-C1(32) 1.511117D-C1(33) 1.429534D-C1(34) 1.354203D-C1(35) 1.284793D-C1(36) 1.220995D-C1
 (37) 1.162527D-C1(38) 1.109130D-C1(39) 1.060566D-C1(40) 1.016619D-C1(41) 9.770947D-C2(42) 9.418154D-C2
 (43) 9.106237D-C2(44) 8.833795D-C2(45) 8.599600D-C2(46) 8.402591D-C2(47) 8.241868D-C2(48) 8.116686D-C2
 (49) 8.026459D-C2(50) 7.970747D-C2(51) 7.949262D-C2(52) 7.961864D-C2(53) 8.008558D-C2(54) 8.089495D-C2
 (55) 8.204975D-C2(56) 8.355445D-C2(57) 8.541502D-C2(58) 8.763894D-C2(59) 9.023525D-C2(60) 9.321458D-C2
 (61) 9.658917D-C2(62) 1.003730D-C1(63) 1.045816D-C1(64) 1.092326D-C1(65) 1.143453D-C1(66) 1.199410D-C1
 (67) 1.260430D-C1(68) 1.326767D-C1(69) 1.398699D-C1(70) 1.476523D-C1(71) 1.560559D-C1(72) 1.651129D-C1
 (73) 1.748594D-C1(74) 1.853193D-C1(75) 1.965001D-C1(76) 2.083469D-C1(77) 2.206326D-C1(78) 2.326564D-C1
 (79) 2.424236D-C1(80) 2.444159D-C1(81) 2.235300D-C1(82) 2.064132D-C1(83) 2.046508D-C1(84) 2.044314D-C1
 (85) 2.023683D-C1(86) 1.976604D-C1(87) 1.901722D-C1(88) 1.799614D-C1(89) 1.671631D-C1(90) 1.519584D-C1
 (91) 1.345656D-C1(92) 1.152350D-C1(93) 9.424483D-C2(94) 7.189748D-C2(95) 4.851472D-C2(96) 2.442329D-C2
 (97) 0.0 (

TOTAL INTEGRATED FLUX FOR REGION 1 GROUP 2 = 0.782531D C1

TOTAL INTEGRATED FLUX FOR REGION 2 GROUP 2 = 0.242103D C2

TOTAL INTEGRATED FLUX FOR REGION 3 GROUP 2 = 0.576355D C1

REGION	NORMALIZED POWER
1	0.1398077D C1
2	0.1194797D C1
3	0.1031505D C1

TOTAL NORMALIZED POWER = 0.1205954D C1

BENCHMARK PROBLEM DELAYED SUPERCRITICAL TRANSIENT

TIME ZONE= 1 STEP NUMBER= 272 TIME=C.1CCCCOD C1 TIME STEP=C.355353D-C2

TEST POINT	MESH POINT	FREQUENCY	EXP(W*F)
1	9	1.6015C C0	1.001812D 00
2	33	1.4628D CC	1.CC1655D CC
3	49	1.0743D C0	1.CC1215D CC
4	65	5.0491C-01	1.CC0571D CC
5	89	3.1852D-01	1.000360D 00

POINT-WISE FLUXES FOR GROUP 1

(1) 0.0	(2) 6.921405D-01	(3) 1.374115D 00	(4) 2.C259C6D CC	(5) 2.667793D C0	(6) 3.26C495D CC
(7) 3.805305D C0	(8) 4.294220D C0	(9) 4.720058D 00	(10) 5.076561C CC	(11) 5.358489D C0	(12) 5.561687D CC
(13) 5.683121D 00	(14) 5.720813D CC	(15) 5.673434D CC	(16) 5.538536C CC	(17) 5.305359C C0	(18) 4.908603D 00
(19) 4.571807D 00	(20) 4.269854D CC	(21) 3.992677D CC	(22) 3.725795D CC	(23) 3.496856D C0	(24) 3.274306C 00
(25) 3.C66958D CC	(26) 2.873789D C0	(27) 2.693882C 00	(28) 2.526393C CC	(29) 2.27C542D CC	(30) 2.225603D CC
(31) 2.090904C 00	(32) 1.965817D CC	(33) 1.849762D CC	(34) 1.742198C C0	(35) 1.642626D 00	(36) 1.550583D 00
(37) 1.465638C 00	(38) 1.387397D C0	(39) 1.315494D CC	(40) 1.249594D CC	(41) 1.189387D C0	(42) 1.134592C 00
(43) 1.084951D CC	(44) 1.040230D C0	(45) 1.000218C 00	(46) 9.647246C-C1	(47) 9.3358C6D-C1	(48) 9.C66362D-C1
(49) 8.837607D-01	(50) 8.648417D-C1	(51) 8.49785CC-01	(52) 8.385132C-C1	(53) 8.209664C-C1	(54) 8.271010D-C1
(55) 8.268899C-01	(56) 8.303224D-01	(57) 8.374C38D-C1	(58) 8.481555D-C1	(59) 8.626153D-01	(60) 8.8C8372D-01
(61) 9.028915C-01	(62) 9.288657D-C1	(63) 9.58864CC-01	(64) 9.930083C-C1	(65) 1.C31439D C0	(66) 1.074314C CC
(67) 1.121811D CC	(68) 1.174128D CC	(69) 1.231483C 00	(70) 1.294118C C0	(71) 1.362295D C0	(72) 1.4363C3D CC
(73) 1.516457C 00	(74) 1.603106D CC	(75) 1.696643D CC	(76) 1.797539D CC	(77) 1.906425D 00	(78) 2.024320D 00
(79) 2.153234C CC	(80) 2.297821D C0	(81) 2.469865C CC	(82) 2.569957C CC	(83) 2.625144D CC	(84) 2.64C7C2C CC
(85) 2.617894D C0	(86) 2.557411D CC	(87) 2.460207C 00	(88) 2.3277C0C C0	(89) 2.161795D 00	(90) 1.964873D CC
(91) 1.739760C 00	(92) 1.489685D CC	(93) 1.218236D CC	(94) 9.293C88C-C1	(95) 6.270475D-01	(96) 3.157892D-01
(97) 0.0	(				

TOTAL INTEGRATED FLUX FOR REGION 1 GRUP 1 = 0.160288C 03

TOTAL INTEGRATED FLUX FOR REGION 2 GRUP 1 = C.277738C C3

TOTAL INTEGRATED FLUX FOR REGION 3 GRUP 1 = C.737011D C2

POINT-WISE FLUXES FOR GROUP 2

(1) 0.0	(2) 5.787691D-C2(	3) 1.149C37D-C1(	4) 1.7C2428C-C1(	5) 2.230813D-C1(	6) 2.726431D-C1
(7) 3.182C03D-C1(	8) 3.590836D-C1(	9) 3.946529D-C1(	1C) 4.245C68C-C1(	11) 4.48C942D-C1(	12) 4.651365C-C1
(13) 4.754977D-C1(	14) 4.794891D-C1(	15) 4.789348C-C1(	16) 4.814824C-C1(	17) 5.181C45D-C1(	18) 5.618553D-C1
(19) 5.540441D-C1(	20) 5.287981D-C1(	21) 4.986538C-C1(	22) 4.681118C-C1(	23) 4.387378C-C1(	24) 4.110234D-C1
(25) 3.850712C-C1(	26) 3.608456D-C1(	27) 3.382654D-C1(	28) 3.172374C-C1(	29) 2.97668C-C1(	30) 2.794680C-C1
(31) 2.625533D-C1(	32) 2.468457D-C1(	33) 2.32272C-C1(	34) 2.187648C-C1(	35) 2.06261C-C1(	36) 1.947C25D-C1
(37) 1.840355D-C1(	38) 1.742102D-C1(	39) 1.6518C8C-C1(	4C) 1.569C52C-C1(	41) 1.493444C-C1(	42) 1.424633D-C1
(43) 1.362293C-C1(	44) 1.306131D-C1(	45) 1.255681D-C1(	46) 1.2113C6D-C1(	47) 1.172191D-C1(	48) 1.138350C-C1
(49) 1.109618C-C1(	50) 1.085853D-C1(	51) 1.066938C-C1(	52) 1.052775C-C1(	53) 1.043289D-C1(	54) 1.038426C-C1
(55) 1.038150C-C1(	56) 1.042449D-C1(	57) 1.051329C-C1(	58) 1.064817C-C1(	59) 1.082961D-C1(	6C) 1.1C5828C-C1
(61) 1.133506C-C1(	62) 1.166105D-C1(	63) 1.203757D-C1(	64) 1.246613C-C1(	65) 1.294850C-C1(	66) 1.348667C-C1
(67) 1.408286C-C1(	68) 1.473955D-C1(	69) 1.545949C-C1(	7C) 1.624564C-C1(	71) 1.71C125D-C1(	72) 1.8C2571C-C1
(73) 1.903439D-C1(	74) 2.011804D-C1(	75) 2.128124C-C1(	76) 2.251796C-C1(	77) 2.38C375D-C1(	78) 2.5C6331D-C1
(79) 2.608257C-C1(	80) 2.626935D-C1(	81) 2.4CC311D-C1(	82) 2.215C62C-C1(	83) 2.195066C-C1(	84) 2.191853C-C1
(85) 2.169023D-C1(	86) 2.117973D-C1(	87) 2.037247D-C1(	88) 1.527466C-C1(	89) 1.75CC75D-C1(	9C) 1.627C10C-C1
(91) 1.440605D-C1(	92) 1.233531D-C1(	93) 1.008758C-C1(	94) 7.695122C-C2(	95) 5.192253D-C2(	96) 2.614886D-C2
(97) 0.0					

TOTAL INTEGRATED FLUX FOR REGION 1 GROUP 2 = C.135573D C2

TOTAL INTEGRATED FLUX FOR REGION 2 GROUP 2 = 0.342823C 02

TOTAL INTEGRATED FLUX FOR REGION 3 GROUP 2 = C.617601D C1

PRECURSOR CONCENTRATION FOR DELAYED GROUP 1

(1) 0.0	(2) 1.710523D-C4(	3) 3.39637CC-C4(	4) 5.033220C-C4(	5) 6.597458D-C4(	6) 8.066520C-C4
(7) 9.419212C-C4(	8) 1.063602D-C3(	9) 1.16994CC-C3(	1C) 1.2594C5C-C3(	11) 1.33C717C-C3(	12) 1.3829C1D-C3
(13) 1.415417C-C3(	14) 1.428664D-C3(	15) 1.425993D-C3(	16) 1.4219C4D-C3(	17) 1.104172D-C3(	18) 7.599027C-C4
(19) 7.403379C-C4(	20) 7.055599D-C4(	21) 6.665998C-C4(	22) 6.287549C-C4(	23) 5.922319D-C4(	24) 5.57854CC-C4
(25) 5.256894D-C4(	26) 4.956812D-C4(	27) 4.677325C-C4(	28) 4.417367C-C4(	29) 4.175888D-C4(	3C) 3.951890D-C4
(31) 3.744441C-C4(	32) 3.552674D-C4(	33) 3.375785D-C4(	34) 3.213C34C-C4(	35) 3.063739C-C4(	36) 2.927274C-C4
(37) 2.803069D-C4(	38) 2.690602D-C4(	39) 2.5894C2C-C4(	4C) 2.499C46C-C4(	41) 2.415154D-C4(	42) 2.349392C-C4
(43) 2.289468D-C4(	44) 2.239129D-C4(	45) 2.198166C-C4(	46) 2.1664C7C-C4(	47) 2.143717D-C4(	48) 2.13CC3D-C4
(49) 2.125205C-C4(	50) 2.129305D-C4(	51) 2.142318D-C4(	52) 2.164299C-C4(	53) 2.195340C-C4(	54) 2.235571D-C4
(55) 2.285159C-C4(	56) 2.344311D-C4(	57) 2.413276D-C4(	58) 2.492342C-C4(	59) 2.581839C-C4(	6C) 2.682142D-C4
(61) 2.79367C-C4(	62) 2.916890D-C4(	63) 3.052318C-C4(	64) 3.2C0519C-C4(	65) 3.362115D-C4(	66) 3.537780D-C4
(67) 3.728251C-C4(	68) 3.934322D-C4(	69) 4.156855C-C4(	7C) 4.396775C-C4(	71) 4.655072C-C4(	72) 4.932788D-C4
(73) 5.230981C-C4(	74) 5.550611D-C4(	75) 5.892242C-C4(	76) 6.255194C-C4(	77) 6.635251C-C4(	78) 7.018419C-C4
(79) 7.363936D-C4(	80) 7.558089D-C4(	81) 1.098143C-C3(	82) 1.414C66C-C3(	83) 1.418C89D-C3(	84) 1.42C712D-C3
(85) 1.407513C-C3(	86) 1.375156D-C3(	87) 1.323246C-C3(	88) 1.252318C-C3(	89) 1.163245D-C3(	9C) 1.057597C-C3
(91) 9.365966C-C4(	92) 8.020872D-C4(	93) 6.56CC51D-C4(	94) 5.0C4694C-C4(	95) 3.377112D-C4(	96) 1.7C0822C-C4
(97) 0.0					

PRECURSOR CONCENTRATION FOR DELAYED GROUP 2

(1) 0.0	(2) 4.602329D-04	(3) 9.138245D-04	(4) 1.354229D-03	(5) 1.775092D-03	(6) 2.170340D-03
(7) 2.534270D-03	(8) 2.861630D-03	(9) 3.147698D-03	(10) 3.388356D-03	(11) 3.580164D-03	(12) 3.720495D-03
(13) 3.807896D-03	(14) 3.843440D-03	(15) 3.836143D-03	(16) 3.824993D-03	(17) 2.970074D-03	(18) 2.043840D-03
(19) 1.991069D-03	(20) 1.897402D-03	(21) 1.793577D-03	(22) 1.690611D-03	(23) 1.592284D-03	(24) 1.499735D-03
(25) 1.413145D-03	(26) 1.332361D-03	(27) 1.257120D-03	(28) 1.187136D-03	(29) 1.122124D-03	(30) 1.061817D-03
(31) 1.005962D-03	(32) 9.543255D-04	(33) 9.066910D-04	(34) 8.628586D-04	(35) 8.226444D-04	(36) 7.858797D-04
(37) 7.524101D-04	(38) 7.220951D-04	(39) 6.948075D-04	(40) 6.704327D-04	(41) 6.488683D-04	(42) 6.300237D-04
(43) 6.138199D-04	(44) 6.001887D-04	(45) 5.890727D-04	(46) 5.804254D-04	(47) 5.742101D-04	(48) 5.704008D-04
(49) 5.689812D-04	(50) 5.699453D-04	(51) 5.732969D-04	(52) 5.790498D-04	(53) 5.872281D-04	(54) 5.976658D-04
(55) 6.110072D-04	(56) 6.267073D-04	(57) 6.450317D-04	(58) 6.660569D-04	(59) 6.898708D-04	(60) 7.165731D-04
(61) 7.462753D-04	(62) 7.791017D-04	(63) 8.151896D-04	(64) 8.546859D-04	(65) 8.977680D-04	(66) 9.446039D-04
(67) 9.953936D-04	(68) 1.050349D-03	(69) 1.109701D-03	(70) 1.173695D-03	(71) 1.242595D-03	(72) 1.316610D-03
(73) 1.396231D-03	(74) 1.481505D-03	(75) 1.572652D-03	(76) 1.669491D-03	(77) 1.770896D-03	(78) 1.873133D-03
(79) 1.965323D-03	(80) 2.017119D-03	(81) 2.930720D-03	(82) 3.773834D-03	(83) 3.784551D-03	(84) 3.791538D-03
(85) 3.756300D-03	(86) 3.669938D-03	(87) 3.531395D-03	(88) 3.342102D-03	(89) 3.104652D-03	(90) 2.822435D-03
(91) 2.499514D-03	(92) 2.140544D-03	(93) 1.750702D-03	(94) 1.335609D-03	(95) 9.012541D-04	(96) 4.539003D-04
(97) 0.0					

PRECURSOR CONCENTRATION FOR DELAYED GROUP 3

(1) 0.0	(2) 1.176542D-04	(3) 2.336086D-04	(4) 3.461883D-04	(5) 4.537667D-04	(6) 5.547858D-04
(7) 6.477982D-04	(8) 7.314482D-04	(9) 8.045321D-04	(10) 8.659560D-04	(11) 9.149609D-04	(12) 9.507551D-04
(13) 9.730074D-04	(14) 9.819921D-04	(15) 9.800054D-04	(16) 9.770015D-04	(17) 7.584180D-04	(18) 5.216941D-04
(19) 5.080661D-04	(20) 4.840223D-04	(21) 4.574008D-04	(22) 4.310100D-04	(23) 4.058131D-04	(24) 3.820988D-04
(25) 3.599124D-04	(26) 3.392136D-04	(27) 3.195347D-04	(28) 3.020013D-04	(29) 2.853403D-04	(30) 2.698824D-04
(31) 2.555625D-04	(32) 2.423203D-04	(33) 2.300599D-04	(34) 2.188495D-04	(35) 2.085217D-04	(36) 1.990728D-04
(37) 1.904628D-04	(38) 1.826552D-04	(39) 1.756172D-04	(40) 1.693188D-04	(41) 1.637234D-04	(42) 1.588373D-04
(43) 1.546098D-04	(44) 1.510329D-04	(45) 1.480914D-04	(46) 1.457728D-04	(47) 1.440673D-04	(48) 1.429673D-04
(49) 1.424683D-04	(50) 1.425679D-04	(51) 1.432664D-04	(52) 1.445666D-04	(53) 1.464739D-04	(54) 1.489959D-04
(55) 1.521433D-04	(56) 1.559291D-04	(57) 1.603691D-04	(58) 1.654817D-04	(59) 1.712882D-04	(60) 1.778130D-04
(61) 1.850832D-04	(62) 1.931292D-04	(63) 2.019847D-04	(64) 2.116866D-04	(65) 2.222755D-04	(66) 2.337957D-04
(67) 2.462954D-04	(68) 2.598268D-04	(69) 2.744464D-04	(70) 2.902150D-04	(71) 3.071977D-04	(72) 3.254630D-04
(73) 3.450804D-04	(74) 3.661132D-04	(75) 3.885984D-04	(76) 4.124909D-04	(77) 4.375129D-04	(78) 4.627417D-04
(79) 4.854904D-04	(80) 4.982630D-04	(81) 7.239107D-04	(82) 9.321423D-04	(83) 9.347709D-04	(84) 9.364815D-04
(85) 9.277654D-04	(86) 9.064245D-04	(87) 8.721973D-04	(88) 8.254379D-04	(89) 7.667865D-04	(90) 6.970803D-04
(91) 6.173226D-04	(92) 5.286629D-04	(93) 4.323797D-04	(94) 3.298614D-04	(95) 2.225863D-04	(96) 1.121014D-04
(97) 0.0					

PRECURSOR CONCENTRATION FOR DELAYED GROUP 4

(1) 0.0	(2) 9.438311D-05(	(3) 1.873597D-04(	(4) 2.777C31D-C4(	(5) 3.639858D-04(	(6) 4.449986C-04
(7) 5.195686D-C4(	(8) 5.866162D-04(	(9) 6.451711C-04(	(10) 6.543872C-04(	(11) 7.235589D-C4(	(12) 7.621476C-04
(13) 7.798562D-04(	(14) 7.869040D-C4(	(15) 7.851296D-04(	(16) 7.824695C-04(	(17) 6.070706D-04(	(18) 4.172615D-C4
(19) 4.061134C-04(	(20) 3.866704D-C4(	(21) 3.651855D-04(	(22) 3.439114C-04(	(23) 3.236029D-04(	(24) 3.044929C-04
(25) 2.866155D-04(	(26) 2.699370D-04(	(27) 2.544C15D-C4(	(28) 2.355485C-04(	(29) 2.265180D-C4(	(30) 2.140533C-04
(31) 2.025013D-04(	(32) 1.918127D-C4(	(33) 1.819416C-04(	(34) 1.728458C-04(	(35) 1.644862D-04(	(36) 1.568271D-C4
(37) 1.498355C-04(	(38) 1.434815D-C4(	(39) 1.377378D-C4(	(40) 1.325797C-04(	(41) 1.279849D-04(	(42) 1.239338C-04
(43) 1.204087D-04(	(44) 1.173946D-C4(	(45) 1.148783C-04(	(46) 1.128488C-04(	(47) 1.112574D-04(	(48) 1.102171C-04
(49) 1.096031D-C4(	(50) 1.094525D-C4(	(51) 1.097644C-04(	(52) 1.105398C-04(	(53) 1.117818D-C4(	(54) 1.134553D-C4
(55) 1.156873C-04(	(56) 1.183668D-C4(	(57) 1.215448D-C4(	(58) 1.252344C-04(	(59) 1.294511C-04(	(60) 1.342122C-04
(61) 1.395376C-04(	(62) 1.454495D-C4(	(63) 1.519726D-04(	(64) 1.591341D-C4(	(65) 1.669638D-C4(	(66) 1.754945C-04
(67) 1.847618D-04(	(68) 1.948046D-C4(	(69) 2.056646C-04(	(70) 2.173870D-04(	(71) 2.300203D-C4(	(72) 2.436155D-C4
(73) 2.582241D-04(	(74) 2.738935D-C4(	(75) 2.906509C-04(	(76) 3.084627C-04(	(77) 3.271210D-04(	(78) 3.459363D-04
(79) 3.629003C-04(	(80) 3.724114D-C4(	(81) 5.41C198D-C4(	(82) 6.566C44D-C4(	(83) 6.985285D-C4(	(84) 6.997922C-04
(85) 6.932585D-04(	(86) 6.772947D-C4(	(87) 6.517C55C-04(	(88) 6.167553C-04(	(89) 5.729226D-C4(	(90) 5.208329D-C4
(91) 4.612356D-04(	(92) 3.949893D-C4(	(93) 3.23C491C-04(	(94) 2.464519C-04(	(95) 1.662C20D-04(	(96) 8.375468D-C5
(97) 0.0					

PRECURSOR CONCENTRATION FOR DELAYED GROUP 5

(1) 0.0	(2) 9.082536D-C6(	(3) 1.803285C-C5(	(4) 2.672064C-C5(	(5) 3.501543D-05(	(6) 4.28C840D-C5
(7) 4.997417C-05(	(8) 5.641241D-05(	(9) 6.202943D-C5(	(10) 6.674361C-C5(	(11) 7.048698D-05(	(12) 7.320777C-C5
(13) 7.487749C-C5(	(14) 7.551717D-05(	(15) 7.530206C-C5(	(16) 7.458648C-C5(	(17) 5.809593D-C5(	(18) 3.985292C-C5
(19) 3.872816D-C5(	(20) 3.681981D-05(	(21) 3.472258C-05(	(22) 3.264908C-C5(	(23) 3.067179D-C5(	(24) 2.881199C-C5
(25) 2.707249C-05(	(26) 2.544968D-C5(	(27) 2.393785D-C5(	(28) 2.253088C-C5(	(29) 2.122274C-05(	(30) 2.000772C-05
(31) 1.888046C-05(	(32) 1.783599D-C5(	(33) 1.686969C-05(	(34) 1.597727D-C5(	(35) 1.515478D-C5(	(36) 1.439858C-C5
(37) 1.370531D-05(	(38) 1.307188D-C5(	(39) 1.249549C-05(	(40) 1.197357C-C5(	(41) 1.150279D-C5(	(42) 1.108406D-C5
(43) 1.071248C-05(	(44) 1.038740D-C5(	(45) 1.010734D-C5(	(46) 9.871037C-C6(	(47) 9.677407C-06(	(48) 9.525556D-06
(49) 9.414769C-06(	(50) 9.344511D-C6(	(51) 9.314420C-C6(	(52) 9.324309D-C6(	(53) 9.374161C-C6(	(54) 9.464135C-06
(55) 9.594558D-C6(	(56) 9.765932D-C6(	(57) 9.978935C-06(	(58) 1.023442C-C5(	(59) 1.052243D-C5(	(60) 1.087719D-C5
(61) 1.126710C-05(	(62) 1.170477D-C5(	(63) 1.219203C-05(	(64) 1.273088C-C5(	(65) 1.332358D-05(	(66) 1.397259C-05
(67) 1.468062C-05(	(68) 1.545062D-C5(	(69) 1.628580C-C5(	(70) 1.718965D-C5(	(71) 1.816588C-C5(	(72) 1.921845C-05
(73) 2.035136D-05(	(74) 2.156826D-C5(	(75) 2.287125C-05(	(76) 2.425765C-C5(	(77) 2.571111D-C5(	(78) 2.717751D-C5
(79) 2.849924C-05(	(80) 2.923671D-C5(	(81) 4.246185C-C5(	(82) 5.466280C-C5(	(83) 5.480673D-C5(	(84) 5.489669C-C5
(85) 5.438079C-05(	(86) 5.312410D-C5(	(87) 5.111230C-C5(	(88) 4.836916D-C5(	(89) 4.492919D-05(	(90) 4.084241C-05
(91) 3.616757D-05(	(92) 3.097193D-05(	(93) 2.533032C-C5(	(94) 1.922395C-C5(	(95) 1.203923D-C5(	(96) 6.566946C-C6
(97) 0.0					

PRECURSOR CONCENTRATION FOR DELAYED GROUP 6

(1) 0.0	(2) 1.601972D-06	(3) 3.180524D-06	(4) 4.712577D-06	(5) 6.175733D-06	(6) 7.548599D-06
(7) 8.811105D-06	(8) 9.944792D-06	(9) 1.093309D-05	(10) 1.176158D-05	(11) 1.241826D-05	(12) 1.289400D-05
(13) 1.318381D-05	(14) 1.329137D-05	(15) 1.324738D-05	(16) 1.318359D-05	(17) 1.020286D-05	(18) 6.988265D-06
(19) 6.782801D-06	(20) 6.441118D-06	(21) 6.067101D-06	(22) 5.697845D-06	(23) 5.345948D-06	(24) 5.015067D-06
(25) 4.705633D-06	(26) 4.416955D-06	(27) 4.147988D-06	(28) 3.897609D-06	(29) 3.664718D-06	(30) 3.448273D-06
(31) 3.247298D-06	(32) 3.060884D-06	(33) 2.888185D-06	(34) 2.728419D-06	(35) 2.580860D-06	(36) 2.444838D-06
(37) 2.319736D-06	(38) 2.204982D-06	(39) 2.100056D-06	(40) 2.004478D-06	(41) 1.917812D-06	(42) 1.839660D-06
(43) 1.769664D-06	(44) 1.707502D-06	(45) 1.652885D-06	(46) 1.605561D-06	(47) 1.565307D-06	(48) 1.531933D-06
(49) 1.505280D-06	(50) 1.485216D-06	(51) 1.471642D-06	(52) 1.464484D-06	(53) 1.463698D-06	(54) 1.469266D-06
(55) 1.481201D-06	(56) 1.499541D-06	(57) 1.524352D-06	(58) 1.555730D-06	(59) 1.593796D-06	(60) 1.638704D-06
(61) 1.690634D-06	(62) 1.749798D-06	(63) 1.816439D-06	(64) 1.890832D-06	(65) 1.973283D-06	(66) 2.064137D-06
(67) 2.163769D-06	(68) 2.272597D-06	(69) 2.391073D-06	(70) 2.519691D-06	(71) 2.658982D-06	(72) 2.809508D-06
(73) 2.971842D-06	(74) 3.146507D-06	(75) 3.333801D-06	(76) 3.533327D-06	(77) 3.742706D-06	(78) 3.954068D-06
(79) 4.144509D-06	(80) 4.250162D-06	(81) 6.170733D-06	(82) 7.942123D-06	(83) 7.961708D-06	(84) 7.973983D-06
(85) 7.897861D-06	(86) 7.714596D-06	(87) 7.421968D-06	(88) 7.022996D-06	(89) 6.523123D-06	(90) 5.929466D-06
(91) 5.250544D-06	(92) 4.496116D-06	(93) 3.677029D-06	(94) 2.805064D-06	(95) 1.892759D-06	(96) 9.532337D-07
(97) 0.0					

| REGION | NORMALIZED POWER | |--------|------------------| |--------|------------------|

1	0.2417898D 01
2	0.1691876D 01
3	0.1105293D 01

TOTAL NORMALIZED PCWER = 0.1730779D 01

*** INPUT EDIT FOR TIME ZONE 2 ***

CARD 21 0.2500C0D-C2 1-.300000D 01 0 -2 0 0 0 1

CARD 22 0.150000D C10.200C00D 01

ARE THERE ANY TIME DEPENDENT CHANGES IN THE
CROSS SECTION DATA NO

ARE THERE ANY TIME DEPENDENT SOURCES ? NO

BENCHMARK PROBLEM DELAYED SUPERCRITICAL TRANSIENT

TIME ZONE= 2 STEP NUMBER= 200 TIME=0.150000D 01 TIME STEP=0.250000D-02

TEST POINT	MESH POINT	FREQUENCY	EXP(W*H)
1	9	2.3870D-01	1.000597D 00
2	33	2.3162D-01	1.000579D 00
3	49	1.8913D-01	1.000473D 00
4	65	1.1109D-01	1.000278D 00
5	89	8.2628D-02	1.000207D 00

POINT-WISE FLUXES FOR GROUP 1

(1) 0.0	(2) 8.150433D-01	(3) 1.618111D 00	(4) 2.397402D 00	(5) 3.141468D 00	(6) 3.839373D 00
(7) 4.480863D 00	(8) 5.056512D 00	(9) 5.557860D 00	(10) 5.977538D 00	(11) 6.309375D 00	(12) 6.548478D 00
(13) 6.691279D 00	(14) 6.735450D 00	(15) 6.679431D 00	(16) 6.520348D 00	(17) 6.245545D 00	(18) 5.777987D 00
(19) 5.380977D 00	(20) 5.024948D 00	(21) 4.698052D 00	(22) 4.395019D 00	(23) 4.113065D 00	(24) 3.850376D 00
(25) 3.605547D 00	(26) 3.377376D 00	(27) 3.164781D 00	(28) 2.966766D 00	(29) 2.782411D 00	(30) 2.610860D 00
(31) 2.451318D 00	(32) 2.303045D 00	(33) 2.165353D 00	(34) 2.037604D 00	(35) 1.919204D 00	(36) 1.809604D 00
(37) 1.708294D 00	(38) 1.614804D 00	(39) 1.528699D 00	(40) 1.449577D 00	(41) 1.377070D 00	(42) 1.310838D 00
(43) 1.250573D 00	(44) 1.195991D 00	(45) 1.146835D 00	(46) 1.102874D 00	(47) 1.063900D 00	(48) 1.029727D 00
(49) 1.000190D 00	(50) 9.751485D-01	(51) 9.544785D-01	(52) 9.380776D-01	(53) 9.258621D-01	(54) 9.177674D-01
(55) 9.137470D-01	(56) 9.137728D-01	(57) 9.178346D-01	(58) 9.259402D-01	(59) 9.381152D-01	(60) 9.544032D-01
(61) 9.748660D-01	(62) 9.995838D-01	(63) 1.028655D 00	(64) 1.062198D 00	(65) 1.100350D 00	(66) 1.143268D 00
(67) 1.191131D 00	(68) 1.244137D 00	(69) 1.302510D 00	(70) 1.366494D 00	(71) 1.436359D 00	(72) 1.512402D 00
(73) 1.594948D 00	(74) 1.684357D 00	(75) 1.781038D 00	(76) 1.885478D 00	(77) 1.998336D 00	(78) 2.120674D 00
(79) 2.254592D 00	(80) 2.404959D 00	(81) 2.584094D 00	(82) 2.688270D 00	(83) 2.745525D 00	(84) 2.761391D 00
(85) 2.737195D 00	(86) 2.673664D 00	(87) 2.571800D 00	(88) 2.433086D 00	(89) 2.259513D 00	(90) 2.053568D 00
(91) 1.818203D 00	(92) 1.556789D 00	(93) 1.273071D 00	(94) 9.711140D-01	(95) 6.552437D-01	(96) 3.299857D-01
(97) 0.0					

TOTAL INTEGRATED FLUX FOR REGION 1 GROUP 1 = 0.188728D 03

TOTAL INTEGRATED FLUX FOR REGION 2 GROUP 1 = 0.314975D 03

TOTAL INTEGRATED FLUX FOR REGION 3 GROUP 1 = 0.770512D 02

POINT-WISE FLUXES FOR GROUP 2

(1) 0.0 (2) 6.815568D-02(3) 1.353099D-01(4) 2.004760D-01(5) 2.626963D-01(6) 3.210566D-01
 (7) 3.746995D-01(8) 4.228367D-01(9) 4.647613D-01(10) 4.998593D-01(11) 5.276229D-01(12) 5.476772D-01
 (13) 5.598620D-01(14) 5.645441D-01(15) 5.638710D-01(16) 5.668471D-01(17) 6.099298D-01(18) 6.614340D-01
 (19) 6.521300D-01(20) 6.223402D-01(21) 5.867779D-01(22) 5.507426D-01(23) 5.160777D-01(24) 4.833625D-01
 (25) 4.527174D-01(26) 4.241005D-01(27) 3.974163D-01(28) 3.725544D-01(29) 3.494049D-01(30) 3.278621D-01
 (31) 3.078269D-01(32) 2.892067D-01(33) 2.719152D-01(34) 2.558722D-01(35) 2.410033D-01(36) 2.272395D-01
 (37) 2.145168D-01(38) 2.027760D-01(39) 1.919626D-01(40) 1.820261D-01(41) 1.729203D-01(42) 1.646025D-01
 (43) 1.570339D-01(44) 1.501790D-01(45) 1.440055D-01(46) 1.384843D-01(47) 1.335893D-01(48) 1.292971D-01
 (49) 1.255872D-01(50) 1.224416D-01(51) 1.198450D-01(52) 1.177844D-01(53) 1.162494D-01(54) 1.152317D-01
 (55) 1.147257D-01(56) 1.147276D-01(57) 1.152364D-01(58) 1.162528D-01(59) 1.177801D-01(60) 1.198239D-01
 (61) 1.223918D-01(62) 1.254940D-01(63) 1.291427D-01(64) 1.333528D-01(65) 1.381415D-01(66) 1.435286D-01
 (67) 1.495364D-01(68) 1.561900D-01(69) 1.635171D-01(70) 1.715481D-01(71) 1.803161D-01(72) 1.898561D-01
 (73) 2.002027D-01(74) 2.113842D-01(75) 2.234059D-01(76) 2.362046D-01(77) 2.495241D-01(78) 2.625764D-01
 (79) 2.731218D-01(80) 2.749659D-01(81) 2.511569D-01(82) 2.317140D-01(83) 2.295778D-01(84) 2.292066D-01
 (85) 2.267902D-01(86) 2.214282D-01(87) 2.129685D-01(88) 2.014760D-01(89) 1.871016D-01(90) 1.700478D-01
 (91) 1.505581D-01(92) 1.289114D-01(93) 1.054179D-01(94) 8.041401D-02(95) 5.425807D-02(96) 2.732478D-02
 (97) 0.0 (

TOTAL INTEGRATED FLUX FOR REGION 1 GROUP 2 = 0.159631D 02

TOTAL INTEGRATED FLUX FOR REGION 2 GROUP 2 = 0.388800D 02

TOTAL INTEGRATED FLUX FOR REGION 3 GROUP 2 = 0.645693D 01

REGION	NORMALIZED POWER
1	0.2846943D 01
2	0.1518759D 01
3	0.1155555D 01

TOTAL NORMALIZED POWER = 0.1964788D 01

BENCHMARK PROBLEM DELAYED SUPERCRITICAL TRANSIENT

TIME ZONE= 2 STEP NUMBER= 400 TIME=0.200000D 01 TIME STEP=0.250000D-02

TEST POINT	MESH POINT	FREQUENCY	EXP(W*H)
1	9	2.2986D-01	1.000575D 00
2	33	2.2262D-01	1.000557D 00
3	49	1.8154D-01	1.000454D 00
4	65	1.0172D-01	1.000254D 00
5	89	7.1430D-02	1.000179D 00

POINT-WISE FLUXES FOR GROUP 1

(1) 0.0	(2) 9.194184D-01	(3) 1.825324D 00	(4) 2.704401D 00	(5) 3.543730D 00	(6) 4.330974D 00
(7) 5.054563D 00	(8) 5.703860D 00	(9) 6.269321D 00	(10) 6.742633D 00	(11) 7.116834D 00	(12) 7.386408D 00
(13) 7.547328D 00	(14) 7.596572D 00	(15) 7.533584D 00	(16) 7.353926D 00	(17) 7.043731D 00	(18) 6.515997D 00
(19) 6.067810D 00	(20) 5.665826D 00	(21) 5.296681D 00	(22) 4.954431D 00	(23) 4.635937D 00	(24) 4.339151D 00
(25) 4.062488D 00	(26) 3.804590D 00	(27) 3.564236D 00	(28) 3.340303D 00	(29) 3.131749D 00	(30) 2.937607D 00
(31) 2.756980D 00	(32) 2.589029D 00	(33) 2.432976D 00	(34) 2.288099D 00	(35) 2.153726D 00	(36) 2.029234D 00
(37) 1.914044D 00	(38) 1.807623D 00	(39) 1.709476D 00	(40) 1.619146D 00	(41) 1.536213D 00	(42) 1.460290D 00
(43) 1.391023D 00	(44) 1.328087D 00	(45) 1.271188D 00	(46) 1.220059D 00	(47) 1.174457D 00	(48) 1.134167D 00
(49) 1.098997D 00	(50) 1.068778D 00	(51) 1.043365D 00	(52) 1.022632D 00	(53) 1.006476D 00	(54) 9.948142D-01
(55) 9.875838D-01	(56) 9.847420D-01	(57) 9.862654D-01	(58) 9.921503D-01	(59) 1.002412D 00	(60) 1.017086D 00
(61) 1.036226D 00	(62) 1.059907D 00	(63) 1.088222D 00	(64) 1.121286D 00	(65) 1.159235D 00	(66) 1.202224D 00
(67) 1.250434D 00	(68) 1.304064D 00	(69) 1.363341D 00	(70) 1.428514D 00	(71) 1.499858D 00	(72) 1.577677D 00
(73) 1.662306D 00	(74) 1.754114D 00	(75) 1.853522D 00	(76) 1.961034D 00	(77) 2.077332D 00	(78) 2.203515D 00
(79) 2.341762D 00	(80) 2.497123D 00	(81) 2.682382D 00	(82) 2.790085D 00	(83) 2.849133D 00	(84) 2.865275D 00
(85) 2.839893D 00	(86) 2.773746D 00	(87) 2.667877D 00	(88) 2.523824D 00	(89) 2.343653D 00	(90) 2.129942D 00
(91) 1.885752D 00	(92) 1.614575D 00	(93) 1.320293D 00	(94) 1.007116D 00	(95) 6.795260D-01	(96) 3.422117D-01
(97) 0.0	(				

TOTAL INTEGRATED FLUX FOR REGION 1 GROUP 1 = 0.212878D 03

TOTAL INTEGRATED FLUX FOR REGION 2 GROUP 1 = 0.346607D 03

TOTAL INTEGRATED FLUX FOR REGION 3 GROUP 1 = 0.799352D 02

POINT-WISE FLUXES FOR GROUP 2

(1) 0.0	(2) 7.688361D-02	(3) 1.526372D-01	(4) 2.261474D-01	(5) 2.963338D-01	(6) 3.621647D-01
(7) 4.226727D-01	(8) 4.765684D-01	(9) 5.242544D-01	(10) 5.638378D-01	(11) 5.951458D-01	(12) 6.177558D-01
(13) 6.314868D-01	(14) 6.367528D-01	(15) 6.359758D-01	(16) 6.393100D-01	(17) 6.878687D-01	(18) 7.459076D-01
(19) 7.353619D-01	(20) 7.017088D-01	(21) 6.615429D-01	(22) 6.208413D-01	(23) 5.816829D-01	(24) 5.447208D-01
(25) 5.100910D-01	(26) 4.777459D-01	(27) 4.475776D-01	(28) 4.194616D-01	(29) 3.932735D-01	(30) 3.688939D-01
(31) 3.462109D-01	(32) 3.251197D-01	(33) 3.055225D-01	(34) 2.873288D-01	(35) 2.704540D-01	(36) 2.548201D-01
(37) 2.403544D-01	(38) 2.269898D-01	(39) 2.146642D-01	(40) 2.033203D-01	(41) 1.929052D-01	(42) 1.833704D-01
(43) 1.746714D-01	(44) 1.667675D-01	(45) 1.596217D-01	(46) 1.532002D-01	(47) 1.474729D-01	(48) 1.424127D-01
(49) 1.379953D-01	(50) 1.341997D-01	(51) 1.310074D-01	(52) 1.284028D-01	(53) 1.263729D-01	(54) 1.249074D-01
(55) 1.239982D-01	(56) 1.236401D-01	(57) 1.238301D-01	(58) 1.245676D-01	(59) 1.258548D-01	(60) 1.276958D-01
(61) 1.300977D-01	(62) 1.330696D-01	(63) 1.366233D-01	(64) 1.407733D-01	(65) 1.455366D-01	(66) 1.509327D-01
(67) 1.565841D-01	(68) 1.637160D-01	(69) 1.711567D-01	(70) 1.793370D-01	(71) 1.882907D-01	(72) 1.980536D-01
(73) 2.086611D-01	(74) 2.201423D-01	(75) 2.325022D-01	(76) 2.456750D-01	(77) 2.593943D-01	(78) 2.728423D-01
(79) 2.836940D-01	(80) 2.855205D-01	(81) 2.607280D-01	(82) 2.404972D-01	(83) 2.382448D-01	(84) 2.378315D-01
(85) 2.353010D-01	(86) 2.297186D-01	(87) 2.209262D-01	(88) 2.089913D-01	(89) 1.940703D-01	(90) 1.763733D-01
(91) 1.561526D-01	(92) 1.336574D-01	(93) 1.093289D-01	(94) 8.339576D-02	(95) 5.626919D-02	(96) 2.833736D-02
(97) 0.0					

TOTAL INTEGRATED FLUX FOR REGION 1 GROUP 2 = 0.180057D 02

TOTAL INTEGRATED FLUX FOR REGION 2 GROUP 2 = 0.427845D 02

TOTAL INTEGRATED FLUX FOR REGION 3 GROUP 2 = 0.665875D 01

REGION	NORMALIZED POWER
1	0.3211227D 01
2	0.2111448D 01
3	0.1198822D 01

TOTAL NORMALIZED POWER = 0.2163664D 01

BENCHMARK PROBLEM DELAYED SUPERCRITICAL TRANSIENT

TIME ZCNE= 2 STEP NUMBER= 800 TIME=0.300000 01 TIME STEP=0.250000-02

TEST POINT	MESH POINT	FREQUENCY	EXP(W*H)
1	9	2.1020D-01	1.000526D 00
2	33	2.0531D-01	1.000513D 00
3	49	1.7534D-01	1.000438D 00
4	65	1.1004D-01	1.000275D 00
5	89	8.2413D-02	1.000206D 00

POINT-WISE FLUXES FOR GROUP 1

(1) 0.0	(2) 1.149721D 00(3) 2.282538D 00(4) 3.381793D 00(5) 4.431324D 00(6) 5.415700D 00
(7) 6.320445D 00(8) 7.132257D 00(9) 7.839198D 00(10) 8.430870D 00(11) 8.898570D 00(12) 9.235398D 00	
(13) 9.436324D 00(14) 9.498073D 00(15) 9.418454D 00(16) 9.193428D 00(17) 8.805172D 00(18) 8.144696D 00	
(19) 7.583631D 00(20) 7.080289D 00(21) 6.617962D 00(22) 6.189222D 00(23) 5.790140D 00(24) 5.418156D 00	
(25) 5.071287D 00(26) 4.747834D 00(27) 4.446267D 00(28) 4.165178D 00(29) 3.903264D 00(30) 3.659312D 00	
(31) 3.432194D 00(32) 3.220859D 00(33) 3.024331D 00(34) 2.841700D 00(35) 2.672121D 00(36) 2.514808D 00	
(37) 2.369035D 00(38) 2.234125D 00(39) 2.109452D 00(40) 1.994440D 00(41) 1.888553D 00(42) 1.791299D 00	
(43) 1.702226D 00(44) 1.620919D 00(45) 1.546999D 00(46) 1.480120D 00(47) 1.419967D 00(48) 1.366259D 00	
(49) 1.318742D 00(50) 1.277190D 00(51) 1.241405D 00(52) 1.211215D 00(53) 1.186473D 00(54) 1.167057D 00	
(55) 1.152869D 00(56) 1.143833D 00(57) 1.139898D 00(58) 1.141036D 00(59) 1.147240D 00(60) 1.158527D 00	
(61) 1.174935D 00(62) 1.196527D 00(63) 1.223387D 00(64) 1.255623D 00(65) 1.293368D 00(66) 1.336776D 00	
(67) 1.386029D 00(68) 1.441334D 00(69) 1.502924D 00(70) 1.571059D 00(71) 1.646029D 00(72) 1.728155D 00	
(73) 1.817792D 00(74) 1.915334D 00(75) 2.021232D 00(76) 2.136027D 00(77) 2.260454D 00(78) 2.395700D 00	
(79) 2.544126D 00(80) 2.711206D 00(81) 2.910805D 00(82) 3.026774D 00(83) 3.090046D 00(84) 3.106879D 00	
(85) 3.078783D 00(86) 3.006588D 00(87) 2.891431D 00(88) 2.734979D 00(89) 2.539473D 00(90) 2.307705D 00	
(91) 2.042984D 00(92) 1.749091D 00(93) 1.430221D 00(94) 1.090928D 00(95) 7.360571D-01(96) 3.706751D-01	
(97) 0.0	

TOTAL INTEGRATED FLUX FOR REGION 1 GROUP 1 = 0.266167D 03

TOTAL INTEGRATED FLUX FOR REGION 2 GROUP 1 = 0.416870D 03

TOTAL INTEGRATED FLUX FOR REGION 3 GROUP 1 = 0.866450D 02

POINT-WISE FLUXES FOR GROUP 2

(1) 0.0	(2) 9.614179D-02(	(3) 1.908700D-01(	(4) 2.827917D-01(	(5) 3.705554D-01(	(6) 4.528707D-01
(7) 5.285272D-01(	(8) 5.964127D-01(	(9) 6.555296D-01(	(10) 7.050114D-01(	(11) 7.441421D-01(	(12) 7.723928D-01
(13) 7.895378D-01(	(14) 7.960947D-01(	(15) 7.950908D-01(	(16) 7.992188D-01(	(17) 8.598661D-01(	(18) 9.323328D-01
(19) 9.190535D-01(	(20) 8.768818D-01(	(21) 8.265634D-01(	(22) 7.755704D-01(	(23) 7.265018D-01(	(24) 6.801738D-01
(25) 6.367562D-01(	(26) 5.961894D-01(	(27) 5.583380D-01(	(28) 5.230461D-01(	(29) 4.901577D-01(	(30) 4.595234D-01
(31) 4.310023D-01(	(32) 4.044632D-01(	(33) 3.797832D-01(	(34) 3.568485D-01(	(35) 3.355527D-01(	(36) 3.157974D-01
(37) 2.974910D-01(	(38) 2.805489D-01(	(39) 2.648924D-01(	(40) 2.504488D-01(	(41) 2.371513D-01(	(42) 2.249379D-01
(43) 2.137518D-01(	(44) 2.035409D-01(	(45) 1.942575D-01(	(46) 1.858583D-01(	(47) 1.783038D-01(	(48) 1.715585D-01
(49) 1.655906D-01(	(50) 1.603717D-01(	(51) 1.558771D-01(	(52) 1.520849D-01(	(53) 1.489769D-01(	(54) 1.465376D-01
(55) 1.447547D-01(	(56) 1.436187D-01(	(57) 1.431233D-01(	(58) 1.432648D-01(	(59) 1.440424D-01(	(60) 1.454581D-01
(61) 1.475169D-01(	(62) 1.502265D-01(	(63) 1.535976D-01(	(64) 1.576437D-01(	(65) 1.623813D-01(	(66) 1.678300D-01
(67) 1.740126D-01(	(68) 1.809548D-01(	(69) 1.886859D-01(	(70) 1.972382D-01(	(71) 2.066471D-01(	(72) 2.169504D-01
(73) 2.281856D-01(	(74) 2.403832D-01(	(75) 2.535481D-01(	(76) 2.676080D-01(	(77) 2.822734D-01(	(78) 2.966567D-01
(79) 3.082352D-01(	(80) 3.100344D-01(	(81) 2.829684D-01(	(82) 2.609140D-01(	(83) 2.583970D-01(	(84) 2.578903D-01
(85) 2.550981D-01(	(86) 2.490057D-01(	(87) 2.394418D-01(	(88) 2.264795D-01(	(89) 2.102884D-01(	(90) 1.910958D-01
(91) 1.691748D-01(	(92) 1.448382D-01(	(93) 1.184333D-01(	(94) 9.033722D-02(	(95) 6.095116D-02(	(96) 3.069474D-02
(97) 0.0	(				

TOTAL INTEGRATED FLUX FOR REGION 1 GROUP 2 = 0.225128D 02

TOTAL INTEGRATED FLUX FOR REGION 2 GROUP 2 = 0.514575D 02

TOTAL INTEGRATED FLUX FOR REGION 3 GROUP 2 = 0.726131D 01

PRECURSOR CONCENTRATION FOR DELAYED GROUP 1

(1) 0.0	(2) 1.803788D-04(	(3) 3.581517D-04(	(4) 5.307505D-04(	(5) 6.956817D-04(	(6) 8.505627D-04
(7) 9.931559D-04(	(8) 1.121402D-03(	(9) 1.233448D-03(	(10) 1.327679D-03(	(11) 1.402748D-03(	(12) 1.457625D-03
(13) 1.491740D-03(	(14) 1.505514D-03(	(15) 1.502474D-03(	(16) 1.497864D-03(	(17) 1.162755D-03(	(18) 7.998326D-04
(19) 7.789400D-04(	(20) 7.420754D-04(	(21) 7.012570D-04(	(22) 6.607910D-04(	(23) 6.221540D-04(	(24) 5.857889D-04
(25) 5.517652D-04(	(26) 5.200211D-04(	(27) 4.904529D-04(	(28) 4.629466D-04(	(29) 4.373903D-04(	(30) 4.136774D-04
(31) 3.917084D-04(	(32) 3.713907D-04(	(33) 3.526384D-04(	(34) 3.353725D-04(	(35) 3.195200D-04(	(36) 3.050138D-04
(37) 2.917927D-04(	(38) 2.798007D-04(	(39) 2.689872D-04(	(40) 2.593065D-04(	(41) 2.507174D-04(	(42) 2.431838D-04
(43) 2.366736D-04(	(44) 2.311592D-04(	(45) 2.266173D-04(	(46) 2.230284D-04(	(47) 2.203774D-04(	(48) 2.186527D-04
(49) 2.178470D-04(	(50) 2.179567D-04(	(51) 2.189819D-04(	(52) 2.209269D-04(	(53) 2.237994D-04(	(54) 2.276115D-04
(55) 2.323788D-04(	(56) 2.381213D-04(	(57) 2.448627D-04(	(58) 2.526313D-04(	(59) 2.614593D-04(	(60) 2.713837D-04
(61) 2.824459D-04(	(62) 2.946922D-04(	(63) 3.081737D-04(	(64) 3.229467D-04(	(65) 3.390731D-04(	(66) 3.566204D-04
(67) 3.756617D-04(	(68) 3.962769D-04(	(69) 4.185520D-04(	(70) 4.425795D-04(	(71) 4.684588D-04(	(72) 4.962942D-04
(73) 5.261916D-04(	(74) 5.582477D-04(	(75) 5.925184D-04(	(76) 6.289355D-04(	(77) 6.670750D-04(	(78) 7.055304D-04
(79) 7.402049D-04(	(80) 7.596703D-04(	(81) 1.103691D-03(	(82) 1.421156D-03(	(83) 1.425157D-03(	(84) 1.427759D-03
(85) 1.414465D-03(	(86) 1.381925D-03(	(87) 1.329740D-03(	(88) 1.258448D-03(	(89) 1.169027D-03(	(90) 1.062753D-03
(91) 9.411546D-04(	(92) 8.055854D-04(	(93) 6.591940D-04(	(94) 5.028971D-04(	(95) 3.393485D-04(	(96) 1.709065D-04
(97) 0.0	(				

PRECURSOR CONCENTRATION FOR DELAYED GROUP 2

(1) 0.0	(2) 5.202140D-04	(3) 1.032898D-03	(4) 1.530631D-03	(5) 2.006207D-03	(6) 2.452744D-03
(7) 2.863777D-03	(8) 3.233357D-03	(9) 3.556137D-03	(10) 3.827455D-03	(11) 4.043421D-03	(12) 4.201067D-03
(13) 4.298755D-03	(14) 4.337696D-03	(15) 4.328029D-03	(16) 4.313528D-03	(17) 3.346854D-03	(18) 2.300653D-03
(19) 2.239344D-03	(20) 2.132259D-03	(21) 2.013911D-03	(22) 1.896660D-03	(23) 1.784739D-03	(24) 1.679410D-03
(25) 1.580864D-03	(26) 1.488915D-03	(27) 1.403259D-03	(28) 1.323560D-03	(29) 1.249491D-03	(30) 1.180738D-03
(31) 1.117011D-03	(32) 1.058036D-03	(33) 1.003563D-03	(34) 9.533580D-04	(35) 9.072072D-04	(36) 8.649130D-04
(37) 8.262944D-04	(38) 7.911862D-04	(39) 7.594381D-04	(40) 7.309139D-04	(41) 7.054914D-04	(42) 6.830614D-04
(43) 6.635275D-04	(44) 6.468056D-04	(45) 6.328235D-04	(46) 6.215206D-04	(47) 6.128478D-04	(48) 6.067670D-04
(49) 6.032510D-04	(50) 6.022838D-04	(51) 6.038598D-04	(52) 6.079844D-04	(53) 6.146737D-04	(54) 6.239546D-04
(55) 6.358649D-04	(56) 6.504537D-04	(57) 6.677811D-04	(58) 6.879190D-04	(59) 7.109509D-04	(60) 7.369727D-04
(61) 7.660927D-04	(62) 7.984325D-04	(63) 8.341269D-04	(64) 8.733250D-04	(65) 9.161906D-04	(66) 9.629030D-04
(67) 1.013657D-03	(68) 1.068666D-03	(69) 1.128158D-03	(70) 1.192382D-03	(71) 1.261602D-03	(72) 1.336058D-03
(73) 1.416154D-03	(74) 1.502027D-03	(75) 1.593868D-03	(76) 1.691493D-03	(77) 1.793760D-03	(78) 1.896890D-03
(79) 1.989872D-03	(80) 2.041990D-03	(81) 2.966455D-03	(82) 3.819502D-03	(83) 3.830079D-03	(84) 3.836930D-03
(85) 3.801086D-03	(86) 3.713542D-03	(87) 3.573225D-03	(88) 3.381587D-03	(89) 3.141249D-03	(90) 2.855642D-03
(91) 2.528875D-03	(92) 2.165655D-03	(93) 1.771217D-03	(94) 1.351248D-03	(95) 9.118008D-04	(96) 4.592101D-04
(97) 0.0					

PRECURSOR CONCENTRATION FOR DELAYED GROUP 3

(1) 0.0	(2) 1.665688D-04	(3) 3.315071D-04	(4) 4.912201D-04	(5) 6.437829D-04	(6) 7.869747D-04
(7) 9.187114D-04	(8) 1.037075D-03	(9) 1.140345D-03	(10) 1.227019D-03	(11) 1.295849D-03	(12) 1.345883D-03
(13) 1.376598D-03	(14) 1.388380D-03	(15) 1.384455D-03	(16) 1.378700D-03	(17) 1.068238D-03	(18) 7.328779D-04
(19) 7.122372D-04	(20) 6.771659D-04	(21) 6.386074D-04	(22) 6.004748D-04	(23) 5.641021D-04	(24) 5.298817D-04
(25) 4.978663D-04	(26) 4.675896D-04	(27) 4.401475D-04	(28) 4.142275D-04	(29) 3.901191D-04	(30) 3.677175D-04
(31) 3.469245D-04	(32) 3.276485D-04	(33) 3.098047D-04	(34) 2.933144D-04	(35) 2.781048D-04	(36) 2.641088D-04
(37) 2.512646D-04	(38) 2.395153D-04	(39) 2.288091D-04	(40) 2.190984D-04	(41) 2.103402D-04	(42) 2.024955D-04
(43) 1.955294D-04	(44) 1.894108D-04	(45) 1.841123D-04	(46) 1.796100D-04	(47) 1.758834D-04	(48) 1.729157D-04
(49) 1.706929D-04	(50) 1.692046D-04	(51) 1.684433D-04	(52) 1.684049D-04	(53) 1.690882D-04	(54) 1.704952D-04
(55) 1.726311D-04	(56) 1.755039D-04	(57) 1.791251D-04	(58) 1.835092D-04	(59) 1.886740D-04	(60) 1.946408D-04
(61) 2.014340D-04	(62) 2.090817D-04	(63) 2.176157D-04	(64) 2.270715D-04	(65) 2.374883D-04	(66) 2.489097D-04
(67) 2.613833D-04	(68) 2.749613D-04	(69) 2.897005D-04	(70) 3.056621D-04	(71) 3.229121D-04	(72) 3.415203D-04
(73) 3.615575D-04	(74) 3.830884D-04	(75) 4.061500D-04	(76) 4.306948D-04	(77) 4.564325D-04	(78) 4.824023D-04
(79) 5.058079D-04	(80) 5.188490D-04	(81) 7.534894D-04	(82) 9.699449D-04	(83) 9.724587D-04	(84) 9.740579D-04
(85) 9.648415D-04	(86) 9.425220D-04	(87) 9.068278D-04	(88) 8.581271D-04	(89) 7.970855D-04	(90) 7.245729D-04
(91) 6.416308D-04	(92) 5.494526D-04	(93) 4.493651D-04	(94) 3.428091D-04	(95) 2.313182D-04	(96) 1.164976D-04
(97) 0.0					

PRECURSOR CONCENTRATION FOR DELAYED GROUP 4

(1) 0.0	(2) 1.762669D-04	(3) 3.499543D-04	(4) 5.185206D-04	(5) 6.794989D-04	(6) 8.305336D-04
(7) 9.694144D-04	(8) 1.094109D-03	(9) 1.202794D-03	(10) 1.293880D-03	(11) 1.366050D-03	(12) 1.418298D-03
(13) 1.450074D-03	(14) 1.461787D-03	(15) 1.456808D-03	(16) 1.449618D-03	(17) 1.121670D-03	(18) 7.680740D-04
(19) 7.453076D-04	(20) 7.075710D-04	(21) 6.662817D-04	(22) 6.255158D-04	(23) 5.866574D-04	(24) 5.501077D-04
(25) 5.159133D-04	(26) 4.839976D-04	(27) 4.542447D-04	(28) 4.265305D-04	(29) 4.007333D-04	(30) 3.767377D-04
(31) 3.544355D-04	(32) 3.337258D-04	(33) 3.145147D-04	(34) 2.967153D-04	(35) 2.802466D-04	(36) 2.650341D-04
(37) 2.510085D-04	(38) 2.381061D-04	(39) 2.262682D-04	(40) 2.154408D-04	(41) 2.055747D-04	(42) 1.966246D-04
(43) 1.885496D-04	(44) 1.813126D-04	(45) 1.748803D-04	(46) 1.692230D-04	(47) 1.643143D-04	(48) 1.601313D-04
(49) 1.566543D-04	(50) 1.538666D-04	(51) 1.517547D-04	(52) 1.503080D-04	(53) 1.495189D-04	(54) 1.493824D-04
(55) 1.498969D-04	(56) 1.510631D-04	(57) 1.528849D-04	(58) 1.553689D-04	(59) 1.585247D-04	(60) 1.623646D-04
(61) 1.669041D-04	(62) 1.721617D-04	(63) 1.781587D-04	(64) 1.849199D-04	(65) 1.924734D-04	(66) 2.008505D-04
(67) 2.100861D-04	(68) 2.202188D-04	(69) 2.312910D-04	(70) 2.433488D-04	(71) 2.564422D-04	(72) 2.706243D-04
(73) 2.859490D-04	(74) 3.024657D-04	(75) 3.202024D-04	(76) 3.391206D-04	(77) 3.589920D-04	(78) 3.790626D-04
(79) 3.971398D-04	(80) 4.071088D-04	(81) 5.908811D-04	(82) 7.603349D-04	(83) 7.620803D-04	(84) 7.631499D-04
(85) 7.557759D-04	(86) 7.381648D-04	(87) 7.101038D-04	(88) 6.718819D-04	(89) 6.240200D-04	(90) 5.671984D-04
(91) 5.022315D-04	(92) 4.300519D-04	(93) 3.516960D-04	(94) 2.682892D-04	(95) 1.810292D-04	(96) 9.116927D-05
(97) 0.0					

PRECURSOR CONCENTRATION FOR DELAYED GROUP 5

(1) 0.0	(2) 2.104079D-05	(3) 4.177242D-05	(4) 6.189025D-05	(5) 8.109869D-05	(6) 9.911549D-05
(7) 1.156759D-04	(8) 1.305366D-04	(9) 1.434793D-04	(10) 1.543143D-04	(11) 1.628837D-04	(12) 1.690679D-04
(13) 1.728016D-04	(14) 1.741331D-04	(15) 1.734624D-04	(16) 1.725023D-04	(17) 1.333391D-04	(18) 9.117195D-05
(19) 8.836489D-05	(20) 8.379432D-05	(21) 7.881093D-05	(22) 7.389645D-05	(23) 6.921388D-05	(24) 6.480993D-05
(25) 6.068941D-05	(26) 5.684254D-05	(27) 5.325496D-05	(28) 4.991136D-05	(29) 4.679677D-05	(30) 4.389697D-05
(31) 4.119863D-05	(32) 3.868931D-05	(33) 3.635741D-05	(34) 3.419218D-05	(35) 3.218359D-05	(36) 3.032235D-05
(37) 2.859986D-05	(38) 2.700813D-05	(39) 2.553979D-05	(40) 2.418803D-05	(41) 2.294658D-05	(42) 2.180965D-05
(43) 2.077197D-05	(44) 1.982869D-05	(45) 1.897540D-05	(46) 1.820810D-05	(47) 1.752318D-05	(48) 1.691742D-05
(49) 1.638794D-05	(50) 1.593220D-05	(51) 1.554803D-05	(52) 1.523353D-05	(53) 1.498716D-05	(54) 1.480767D-05
(55) 1.469409D-05	(56) 1.464577D-05	(57) 1.466235D-05	(58) 1.474374D-05	(59) 1.489016D-05	(60) 1.510211D-05
(61) 1.538037D-05	(62) 1.572601D-05	(63) 1.614043D-05	(64) 1.662529D-05	(65) 1.718258D-05	(66) 1.781461D-05
(67) 1.852401D-05	(68) 1.931373D-05	(69) 2.018709D-05	(70) 2.114774D-05	(71) 2.219968D-05	(72) 2.334719D-05
(73) 2.459466D-05	(74) 2.594609D-05	(75) 2.740368D-05	(76) 2.896405D-05	(77) 3.060770D-05	(78) 3.227059D-05
(79) 3.376670D-05	(80) 3.457745D-05	(81) 5.014022D-05	(82) 6.448000D-05	(83) 6.459725D-05	(84) 6.466282D-05
(85) 6.401706D-05	(86) 6.250782D-05	(87) 6.011713D-05	(88) 5.686948D-05	(89) 5.280895D-05	(90) 4.799304D-05
(91) 4.249052D-05	(92) 3.638005D-05	(93) 2.974907D-05	(94) 2.269244D-05	(95) 1.531112D-05	(96) 7.710721D-06
(97) 0.0					

PRECURSOR CONCENTRATION FOR DELAYED GROUP 6

(1) 0.0	(2) 3.389853D-06	(3) 6.729870D-06	(4) 9.970947D-06	(5) 1.306543D-05	(6) 1.596783D-05
(7) 1.863548D-05	(8) 2.102915D-05	(9) 2.311368D-05	(10) 2.485846D-05	(11) 2.623810D-05	(12) 2.723331D-05
(13) 2.783357D-05	(14) 2.804667D-05	(15) 2.793701D-05	(16) 2.778023D-05	(17) 2.147059D-05	(18) 1.467811D-05
(19) 1.422397D-05	(20) 1.348609D-05	(21) 1.268187D-05	(22) 1.188883D-05	(23) 1.113319D-05	(24) 1.042246D-05
(25) 9.757400D-06	(26) 9.136421D-06	(27) 8.557201D-06	(28) 8.017264D-06	(29) 7.514188D-06	(30) 7.045673D-06
(31) 6.609563D-06	(32) 6.203845D-06	(33) 5.826641D-06	(34) 5.476208D-06	(35) 5.150923D-06	(36) 4.849280D-06
(37) 4.565881D-06	(38) 4.311432D-06	(39) 4.072732D-06	(40) 3.852675D-06	(41) 3.650237D-06	(42) 3.464478D-06
(43) 3.294531D-06	(44) 3.139605D-06	(45) 2.998974D-06	(46) 2.871982D-06	(47) 2.758030D-06	(48) 2.656583D-06
(49) 2.567160D-06	(50) 2.489336D-06	(51) 2.422737D-06	(52) 2.367042D-06	(53) 2.321979D-06	(54) 2.287321D-06
(55) 2.262892D-06	(56) 2.248560D-06	(57) 2.244237D-06	(58) 2.249881D-06	(59) 2.265495D-06	(60) 2.291126D-06
(61) 2.326865D-06	(62) 2.372848D-06	(63) 2.429256D-06	(64) 2.496316D-06	(65) 2.574303D-06	(66) 2.663539D-06
(67) 2.764395D-06	(68) 2.877293D-06	(69) 3.002707D-06	(70) 3.141163D-06	(71) 3.293238D-06	(72) 3.459553D-06
(73) 3.640743D-06	(74) 3.837392D-06	(75) 4.049816D-06	(76) 4.277507D-06	(77) 4.517590D-06	(78) 4.760624D-06
(79) 4.979199D-06	(80) 5.096911D-06	(81) 7.388660D-06	(82) 9.499793D-06	(83) 9.515526D-06	(84) 9.523926D-06
(85) 9.427764D-06	(86) 9.204620D-06	(87) 8.851849D-06	(88) 8.373061D-06	(89) 7.774745D-06	(90) 7.065362D-06
(91) 6.255028D-06	(92) 5.355315D-06	(93) 4.379077D-06	(94) 3.340263D-06	(95) 2.253719D-06	(96) 1.134969D-06
(97) 0.0					

| REGION | NORMALIZED POWER | |--------|------------------| | 1 | 0.4015066D 01 | | 2 | 0.2539472D 01 | | 3 | 0.1299482D 01 |

TOTAL NORMALIZED POWER = 0.2605205D 01

BENCHMARK PROBLEM DELAYED SUPERCRITICAL TRANSIENT
END OF PROBLEM

IHC900I EXECUTION TERMINATING DUE TO ERROR CCUNT FOR ERROR NUMBER 217

IHC217I FIOCS - END OF DATA SET ON UNIT 5

Appendix Code Listing

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C      MAIN PROGRAM
      IMPLICIT REAL*8 (A-H,O-Z)
      INTEGER RTAG
      INTEGER BCL,BCR,CHANGE,DEL,ONSCAT,TAGX,TESTS,THG,XEN,
1         UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,OUT,
2         P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,
3         SORCE , SORG , SOZ , STEADY , STEP , TAGC , TAGF , TAGT
      REAL*8 ICDINE
      REAL*8 LR,NU,NUSIGF,NX
      COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL
      COMMON /A2/NUM,NCOMP,BCL,BCR,MTZ,NTZ,XEN,STEADY
      COMMON /A3/PUNBAL,SORCE,GEOM,NTAG,NUM2,PUNFRS
      COMMON /A4/TIGHT1,TIGHT2,TIGHT3
      COMMON/A5/IN,OUT,NERR
      COMMON/C1/M1,M2,M4,M5,M7
C      FOR CONSERVATION OF CORE RECOMPILE MAIN WITH THE FOLLOWING DIMENSIONS
C      ALTERED TO ACCOMMODATE THE MAXIMUM EXPECTED PROBLEM SIZE. THE VARIABLE
C      IN ( ) INDICATE THE DIMENSION INFORMATION TO BE PUNCHED ON SUBSEQUENT
C      CARDS, WHERE,
C      GRP IS THE # OF NEUTRON GROUPS
C      REG IS THE # OF REGIONS
C      DEL IS THE # OF DELAYED GROUP
C      PT IS THE # OF SPACE POINTS
C      NUM IS THE # OF TEST POINTS
C      (PT,GRP+DEL)
      DIMENSION PSI(100,16)
C      (GRP,DEL) ***** IF DEL EQUALS 0: (GRP,1) *****
      DIMENSION SD(10,6),SDIN(10,6)
C      (GRP)
      DIMENSION CHI(10),NU(10),NX(10),TD(10),V(10),VINV(10)
      DIMENSION SIGCIN(10),SIGFIN(10),SIGTIN(10)
C      (GRP+1,GRP)
      DIMENSION SIGXIN(11,10)
C      (REG)
      DIMENSION POWREG(10),POWORG(10),REGFR(10),WCOEFL(10),WCOEFR(10)
      DIMENSION NCOMP(10),FUEL(10),CHANGE(10),SOR(10),CXL(10),CXQ(10),

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MAINC001
MAINCC02
MAINC003
MAINC004
MAINC005
MAINC006
MAINC007
MAINCC08
MAINC009
MAINC010
MAINC011
MAINC012
MAINC013
MAINC014
MAINC015
MAINC016
MAINC017
MAINCC18
MAINC019
MAINC020
MAINC021
MAINC022
MAINC023
MAINC024
MAINC025
MAINC026
MAINC027
MAINC028
MAINC029
MAINCC30
MAINC031
MAINC032
MAINC033
MAINCC34
MAINC035
MAINC036

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1DR(10),LR(10),PB(10),IPL(10),IPR(10),XL(10),XR(10),RTAG(10),
2TAGC(10),TAGF(10),TAGT(10),TAGX(10),TI1(10),IODINE(10),XENON(10)
C   (REG,GRP)
   DIMENSION CCL(10,10),CCQ(10,10),CFL(10,10),CFQ(10,10),CTRL(10,10),
1CTRQ(10,10),SIGC(10,10),SIGF(10,10),SIGT(10,10),NUSIGF(10,10),
2DNSCAT(10,10),UPSCAT(10,10),SORG(10,10),D(10,10),XABS(10,10),
3PSIBAR(10,10),PSITGT(10,10),PSIB1(10,10),POWER(10,10)
C   (REG,GRP,GRP)
   DIMENSION SIGX(10,10,10)
C   (PT)
   DIMENSION WHZ(100),WZ(100),FF1(100),FF2(100),WCOEF(100)
   DIMENSION DPSI(100),DD(100),DL(100),DU(100),WA(100),GA(100)
C   (PT,GRP)
   DIMENSION SRCE0(100,10),SRCE1(100,10),CM(100,10),CP(100,10)
C   (NUM)
   DIMENSION WPT(50),PSISTO(50)
C   (NUM2)
   DIMENSION STPRN(50)
C   MAXIMUM # OF PRINT TIMES (NUM2) IS FIXED AT 50
C   M1= MAX # OF REGIONS
C   M1=10
C   M2= MAX # OF NEUTRON GROUPS
C   M2=10
C   M4= MAX # OF DELAYED GROUPS
C   M4=6
C   M5= MAX # OF SPACE POINTS
C   M5=100
C   M7= MAX # OF TEST POINTS (NUM)
C   M7=50
   IN=5
   OUT=6
100 NERR=0
   CALL INPTA1
   CALL DIRECT(PSI,SIGC,SIGF,SIGT,SIGX,NU,SD,SDIN,CHI,NCMP,
1FUEL,XABS,XENON,IODINE,LR,IPL,IPR,PB,XL,XR,DR,WHZ,WZ,WPT,NX,
2NUSIGF,DNSCAT,UPSCAT,REGFR,WCOEF,WCOEFL,WCOEFR,D,CHANGE,CM,CP,

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MAINC037
MAINC038
MAINC039
MAINC040
MAINC041
MAINC042
MAINC043
MAINC044
MAINC045
MAINC046
MAINC047
MAINC048
MAINC049
MAINC050
MAINC051
MAINC052
MAINC053
MAINC054
MAINC055
MAINC056
MAINC057
MAINC058
MAINC059
MAINC060
MAINC061
MAINC062
MAINC063
MAINC064
MAINC065
MAINC066
MAINC067
MAINC068
MAINC069
MAINC070
MAINC071
MAINC072

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3SOR,SORG,SRCEO,SRCE1,STPRN,RTAG,TAGC,TAGF,TAGT,TAGX,CCL,CCQ,CFL,
4CFQ,CTRL,CTRQ,CXL,CXQ,V,VINV,PSITOT,POWREG,POWORG,POWER,PSISIC,
5DD,DL,DU,FF1,FF2,TI1,SIGCIN,SIGFIN,SIGTIN,SIGXIN,PSIB1,TD,
6WA,GA,DPSI,PSIBAR)
CALL TITLE(4)
GO TO 100
END

MAINC073
MAINC074
MAINC075
MAINC076
MAINC077
MAINC078
MAINC079

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SUBROUTINE AVRAGE(PSI,PSIBAR,PSITOT,POWER,WCOEF,WCOEFL,WCOEFR,
IREGFR, IPL, IPR, SIGF, POWREG, POWORG)
IMPLICIT REAL*8 (A-H,O-Z)
INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,
1      UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GC,GL,GU,GRP,GPU,CUT,
2      P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,
3      SORCE , SORG , SOZ , STEADY , STEP , TAGC , TAGF , TAGT
INTEGER RBOUND , RINT
COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL
COMMON /A9/POWTOT,POWBAR
COMMON /B2/NPRT,NZ,ISX,STEP,NZSAVE,PRBEND,IPRN
DIMENSION PSI(PT,GU)
DIMENSION PSIBAR(REG,GRP)
DIMENSION PSITOT(REG,GRP)
DIMENSION POWREG(REG)
DIMENSION POWORG(REG)
DIMENSION POWER(REG,GRP)
DIMENSION IPL(REG),IPR(REG)
DIMENSION IREGFR(REG),WCOEF(PT),WCOEFL(REG),WCOEFR(REG)
DIMENSION SIGF(REG,GRP)
DO 120 R=1,REG
RINT=IPR(R)
LINT=IPL(R)
RBOUND=RINT+1
LBOUND=LINT-1
DO 120 G=1,GRP
X=0.0
DO 110 P=LINT,RINT
110 X=X+PSI(P,G)*WCOEF(P)
X=X+PSI(LBOUND,G)*WCOEFL(R)+PSI(RBOUND,G)*WCOEFR(R)
PSITOT(R,G)=X
PSIBAR(R,G)=X/IREGFR(R)
POWER(R,G)=SIGF(R,G)*X
120 CONTINUE
POWTOT=0.000
DO 130 R=1,REG

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AVRG0001
AVRG0002
AVRG0003
AVRG0004
AVRG0005
AVRG0006
AVRG0007
AVRG0008
AVRG0009
AVRG0010
AVRG0011
AVRG0012
AVRG0013
AVRG0014
AVRG0015
AVRG0016
AVRG0017
AVRG0018
AVRG0019
AVRG0020
AVRG0021
AVRG0022
AVRG0023
AVRG0024
AVRG0025
AVRG0026
AVRG0027
AVRG0028
AVRG0029
AVRG0030
AVRG0031
AVRG0032
AVRG0033
AVRG0034
AVRG0035
AVRG0036

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```
    POWREG(R)=0.000
    DO 125 G=1,GRP
    POWREG(R)=POWREG(R)+POWER(R,G)
125  CONTINUE
    POWTOT=POWTOT+POWREG(R)
    IF(PCWORG(R).EQ.0.000) GO TO 130
    POWREG(R)=PCWREG(R)/PCWORG(R)
130  CONTINUE
    IF(PCWBAR.EQ.0.000) GO TO 140
    POWTCT=POWTCT/PCWBAR
140  RETURN
    END
```

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AVRG0037
AVRG0038
AVRG0039
AVRG0040
AVRG0041
AVRG0042
AVRG0043
AVRG0044
AVRG0045
AVRG0046
AVRG0047
AVRG0048
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SUBROUTINE CALC(PSI,WHZ,WZ,NX,NUSIGF,SIGX,SD,SDIN,STPRN,FUEL,WPT,
1XL,XR,PB,IPL,IPR,VINV,UPSCAT,DNSCAT,SORG,SOR,SRCEO,SRCE1,CP,CM,
2FF1,FF2,TI1,DU,DL,DD,TD,WA,GA,DPSI)
IMPLICIT REAL*8 (A-H,O-Z)
REAL*8 LR,NU,NUSIGF,NX
INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,
1      UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,CUT,
2      P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,
3      SORCE , SORG , SOZ , STEADY , STEP , TAGC , TAGF , TAGT
COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL
COMMON /A2/NUM,NCCMP,BCL,BCR,MTZ,NTZ,XEN,STEADY
COMMON /A3/PUNBAL,SORCE,GEOM,NTAG,NUM2,PUNFRS
COMMON /A7/BETA(6),DECAY(6),BETDCY(6),DECH(6)
COMMON /B1/H,HP,TIME,TZ,ZERC,TZO,TIMZ
DIMENSION PSI(PT,GU)
DIMENSION WHZ(PT)
DIMENSION SIGX(REG,GRP,GRP)
DIMENSION NX(GRP),NUSIGF(REG,GRP)
DIMENSION SD(GRP,IDEL)
DIMENSION SDIN(GRP,IDEL)
DIMENSION STPRN(50)
DIMENSION FUEL(REG)
DIMENSION WPT(NUM)
DIMENSION IPL(REG),IPR(REG),PB(REG),XL(REG),XR(REG)
DIMENSION VINV(GRP)
DIMENSION SOR(REG),SORG(REG,GRP),SRCEO(PT,GRP),SRCE1(PT,GRP)
DIMENSION CM(PT,GRP),CP(PT,GRP)
DIMENSION FF1(PT)
DIMENSION FF2(PT)
DIMENSION TI1(REG)
DIMENSION DD(PT),DL(PT),DU(PT)
DIMENSION DNSCAT(REG,GRP),UPSCAT(REG,GRP)
DIMENSION WZ(PT),WA(PT),GA(PT),TD(GRP)
DIMENSION DPSI(PT)
CALL      FREQ(PSI,WHZ,WZ,FF1,FF2,STPRN,WPT,DPSI,PB)
IGONE=0

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```

CALCC001
CALCC002
CALCC003
CALCC004
CALCC005
CALCC006
CALCC007
CALCC008
CALCC009
CALCC010
CALCC011
CALCC012
CALCC013
CALCC014
CALCC015
CALCC016
CALCC017
CALCC018
CALCC019
CALCC020
CALCC021
CALCC022
CALCC023
CALCC024
CALCC025
CALCC026
CALCC027
CALCC028
CALCC029
CALCC030
CALCC031
CALCC032
CALCC033
CALCC034
CALCC035
CALCC036

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```

      IF (DEL.EQ.0) GO TO 24
      DO 23 II=1,DEL
23    DECH(II)=DEXP(DECAY(II)*H)
      24 DO 150 G=1,GRP
          DO 115 R=1,REG
              T11(R)=NX(G)*NUSIGF(R,G)-SIGX(R,G,G)
              IF (GRP.EQ.1) T11(R)=-SIGX(R,G,G)
115    CONTINUE
          CALL      RHS(G,PSI,FF1,FF2,T11,NX,NUSIGF,VINV,SIGX ,FUEL,SD,
              1XL,XR,PB,IPL,IPR)
120    IF (SORCE) 130,140,130
130    CALL      SOURCE(G,PSI,SORG,SOR,SRCEG,SRCE1,XL,XR,PB,IPL,IPR)
140    CALL      LHS(G,DU,DL,DD,CP,CM,T11,VINV,FF2,XL,XR,IPL,IPR,PB)
          CALL      MATINV(G,PT,GRP,PSI,DU,DL,DD,WA,GA)
150    CONTINUE
          IF (DEL) 160,180,160
160    DO 170 G=GL,GU
          CALL      PREC(G,PSI,NUSIGF,FF2,FUEL,XL,XR,PB,IPL,IPR,TD)
170    CONTINUE
180    CONTINUE
          RETURN
          END

```

```

CALCC037
CALCC038
CALCC039
CALCC040
CALCC041
CALCC042
CALCC043
CALCC044
CALCC045
CALCC046
CALCC047
CALCC048
CALCC049
CALCC050
CALCC051
CALCC052
CALCC053
CALCC054
CALCC055
CALCC056
CALCC057
CALCC058

```

SUBROUTINE COEF1(NX,NUSIGF,CHI,NU,SIGF,SIGC,SIGX,PB,DR,LR,XL,XR,	CF1 C001
1 IPL,IPR,DNSCAT,UPSCAT,WCOEF,WCOEFL,WCOEFR,REGFR)	CF1 C002
IMPLICIT REAL*8 (A-H,O-Z)	CF1 C003
INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,	CF1 C004
1 UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,CUT,	CF1 C005
2 P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,	CF1 C006
3 SORCE , SORG , SOZ , STEADY , STEP , TAGC , TAGF , TAGT	CF1 C007
REAL*8 IODINE	CF1 C008
REAL*8 LR,NU,NUSIGF,NX	CF1 C009
COMMON /A1/GRP,REG,PT,CL,GU,DEL,THG,IDEL	CF1 C010
COMMON /A3/PUNBAL,SORCE,GEOM,NTAG,NUM2,PUNFRS	CF1 C011
COMMON /A7/BETA(6),DECAY(6),BETDCY(6),DECH(6)	CF1 C012
.....	CF1 C013
DIMENSION LR(REG),IPL(REG),IPR(REG),PB(REG),XL(REG),XR(REG)	CF1 C014
DIMENSION REGFR(REG),WCOEF(PT),WCOEFL(REG),WCOEFR(REG)	CF1 C015
DIMENSION CHI(GRP)	CF1 C016
DIMENSION DNSCAT(REG,GRP),UPSCAT(REG,GRP)	CF1 C017
DIMENSION NU(GRP)	CF1 C018
DIMENSION NX(GRP),NUSIGF(REG,GRP)	CF1 C019
DIMENSION SIGC(REG,GRP),SIGF(REG,GRP),SIGX(REG,GRP,GRP)	CF1 C020
DIMENSION DR(REG)	CF1 C021
FLOAT(I)=DFLOAT(I)	CF1 C022
C DO 120 G=1,GRP	CF1 C023
X=0.0	CF1 C024
IF(DEL.EQ.0) GO TO 111	CF1 C025
DO 110 GP=1,DEL	CF1 C026
X=X+BETA(GP)	CF1 C027
110 CONTINUE	CF1 C028
111 NX(G)=CHI(G)*(1.0-X)	CF1 C029
120 CONTINUE	CF1 C030
IF(DEL.EQ.0) GO TO 131	CF1 C031
DO 130 K=1,DEL	CF1 C032
130 BETDCY(K)=BETA(K)/DABS(DECAY(K))	CF1 C033
C	CF1 C034
131 DO 150 R=1,REG	CF1 C035
	CF1 C036

DO 150 G=1,GRP	CF1 0037
NUSIGF(R,G)=NU(G)*SIGF(R,G)	CF1 0038
SIGX(R,G,G)=SIGC(R,G)+SIGF(R,G)	CF1 0039
X=0.0	CF1 0040
DO 140 GP=1,GRP	CF1 0041
140 X=X+SIGX(R,GP,G)	CF1 0042
SIGX(R,G,G)=X	CF1 0043
150 CONTINUE	CF1 0044
C	CF1 0045
C CALCULATION OF SPATIAL INVARIANT IN REGION R	CF1 0046
C	CF1 0047
N=1	CF1 0048
DO 160 R=1,REG	CF1 0049
X=PB(R)-N	CF1 0050
DR(R)=LR(R)/X	CF1 0051
N=PB(R)	CF1 0052
160 CONTINUE	CF1 0053
NL=2	CF1 0054
IF(REG.EQ.1) DR(2)=0.0	CF1 0055
N=REG-1	CF1 0056
IF(GEOM-1) 181,182,186	CF1 0057
181 CONTINUE	CF1 0058
C	CF1 0059
C REGION INTERFACE WEIGHTING FACTORS, SLAB GEOMETRY	CF1 0060
DO 190 R=1,N	CF1 0061
XL(R)=DR(R)/(DR(R)+DR(R+1))	CF1 0062
XR(R)=DR(R+1)/(DR(R)+DR(R+1))	CF1 0063
190 CONTINUE	CF1 0064
C	CF1 0065
GO TO 191	CF1 0066
182 CONTINUE	CF1 0067
C	CF1 0068
C REGION INTERFACE WEIGHTING FACTORS, CYLINDRICAL GEOMERTY	CF1 0069
C	CF1 0070
RAD=LR(1)	CF1 0071
DO 183 R=1,N	CF1 0072

	X1=1/(DR(R)+DR(R+1))	CF1 C073
	X2=1/(4*RAD)	CF1 C074
	XL(R)=DR(R)*X1*(1-DR(R)*X2)	CF1 C075
	XR(R)=DR(R+1)*X1*(1+DR(R+1)*X2)	CF1 C076
	RAD=RAC+LR(R+1)	CF1 C077
183	CONTINUE	CF1 C078
	GO TO 191	CF1 C079
C		CF1 C080
C	REGION INTERFACE WEIGHTING FACTORS, SPHERICAL GEOMETRY	CF1 C081
C		CF1 C082
186	RAD=LR(1)	CF1 C083
	DO 184 R=1,N	CF1 C084
	X1=1/(DR(R)+DR(R+1))	CF1 C085
	X2=1/(2*RAD)	CF1 C086
	X3=1/(12*RAD**2)	CF1 C087
	XL(R)=DR(R)*X1*(1-DR(R)*X2+(DR(R)**2)*X3)	CF1 C088
	XR(R)=DR(R+1)*X1*(1+DR(R+1)*X2+(DR(R+1)**2)*X3)	CF1 C089
184	CONTINUE	CF1 C090
191	CONTINUE	CF1 C091
	XL(REG)=1.0	CF1 C092
	IPL(1)=2	CF1 C093
	IPR(1)=PB(1)-1	CF1 C094
	IF (REG.EQ.1) GO TO 210	CF1 C095
	DO 200 R=2,REG	CF1 C096
	IPL(R)=PB(R-1)+1	CF1 C097
200	IPR(R)=PB(R)-1	CF1 C098
210	CONTINUE	CF1 C099
C	THE ENERGY GROUP BOUNDARIES FOR UP AND DOWN SCATTERING ARE SET	CF1 C100
	DO 330 R=1,REG	CF1 C101
	DO 310 G=1,GRP	CF1 C102
	I2=G-1	CF1 0103
	IF (I2) 220,220,230	CF1 0104
220	DNSCAT(R,G)=0	CF1 0105
	GO TO 260	CF1 0106
230	DO 240 I=1,I2	CF1 0107
	IF (SIGX(R,G,I)) 240,240,250	CF1 0108

```

240 CCNTINUE
    I=0
250 DNSCAT(R,G)=I
260 IF (G-GRP) 280,270,270
270 UPSCAT(R,G)=0
    GO TO 310
280 I2=G+1
    I1=0
    DO 300 I=I2,GRP
        IF (SIGX(R,G,I)) 300,300,290
290 I1=I
300 CCNTINUE
    UPSCAT(R,G)=I1
310 CCNTINUE
    KK=0
    DO 320 G=1,GRP
320 KK=MAX0(KK,DNSCAT(R,G))
    IF (GRP.EQ.1) GO TO 330
    IF (KK.EQ.0) CALL EXIT
330 CCNTINUE
    IF (GEGM-1) 340,370,400
340 DO 360 R=1,REG
    PR=IPR(R)
    PL=IPL(R)
    WCOEFL(R)=DR(R)*0.5
    DO 350 P=PL,PR
350 WCOEF(P)=CR(R)
    WCOEFR(R)=DR(R)*0.5
    REGFR(R)=LR(R)
360 CCNTINUE
    GO TO 430
370 RAD=0.0
    DO 390 R=1,REG
    PR=IPR(R)
    PL=IPL(R)
    WCOEFL(R)=DR(R)*RAD

```

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CF1 0109
CF1 0110
CF1 0111
CF1 0112
CF1 0113
CF1 0114
CF1 0115
CF1 0116
CF1 0117
CF1 0118
CF1 0119
CF1 0120
CF1 0121
CF1 0122
CF1 0123
CF1 0124
CF1 0125
CF1 0126
CF1 0127
CF1 0128
CF1 0129
CF1 0130
CF1 0131
CF1 0132
CF1 0133
CF1 0134
CF1 0135
CF1 0136
CF1 0137
CF1 0138
CF1 0139
CF1 0140
CF1 0141
CF1 0142
CF1 0143
CF1 0144

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```

      DO 380 P=PL,PR
      RAD=RAC+DR(R)
380  WCCEF(P)=2.0*RAC*DR(R)
      WCCEFR(R)=DR(R)*RAD
      RAD=RAC+DR(R)
390  REGFR(R)=2.0*RAC*LR(R)-LR(R)**2
      GO TO 430
400  RAD=0.0
      DO 420 R=1,REG
      PR=IPR(R)
      PL=IPL(R)
      WCCEFL(R)=2.0*CR(R)*RAD**2
      DO 410 P=PL,PR
      RAD=RAC+CR(R)
410  WCCEF(P)=4.0*CR(R)*RAD**2
      RAD=RAC+DR(R)
      WCCEFR(P)=2.0*CR(R)*RAD**2
420  REGFR(R)=(RAD**3-(RAD-LR(R))**3)*4.0/3.0
430  CONTINUE
      RETURN
      END

```

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CF1 0145
CF1 0146
CF1 0147
CF1 0148
CF1 0149
CF1 0150
CF1 0151
CF1 0152
CF1 0153
CF1 0154
CF1 0155
CF1 0156
CF1 0157
CF1 0158
CF1 0159
CF1 0160
CF1 0161
CF1 0162
CF1 0163
CF1 0164
CF1 0165

```

SUBROUTINE COEF2(D,SIGT,CHANGE,PB,DR,LR,CM,CP)	CF2 C001
IMPLICIT REAL*8 (A-H,O-Z)	CF2 C002
INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,	CF2 C003
1 UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,CUT,	CF2 0004
2 P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,	CF2 C005
3 SORCE , SCRG , SCZ , STEADY , STEP , TAGC , TAGF , TAGT	CF2 C006
REAL*8 IODINE	CF2 0007
REAL*8 LR,NU,NUSIGF,NX	CF2 C008
INTEGER PFIRST,PLAST	CF2 C009
COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL	CF2 C010
COMMON /A2/NUM,NCOMP,BCL,BCR,MTZ,NTZ,XEN,STEADY	CF2 0011
COMMON /A3/PUNBAL,SORCE,GEOM,NTAG,NUM2,PUNFRS	CF2 C012
DIMENSION PB(REG),DR(REG),LR(REG)	CF2 C013
DIMENSION CM(PT,GRP),CP(PT,GRP)	CF2 C014
DIMENSION CHANGE(REG)	CF2 C015
DIMENSION D(REG,GRP)	CF2 C016
DIMENSION SIGT(REG,GRP)	CF2 C017
FLOAT(I)=DFLOAT(I)	CF2 C018
DO 120 R=1,REG	CF2 C019
IF (CHANGE(R).EQ.0) GO TO 120	CF2 C020
DO 110 G=1,GRP	CF2 0021
110 D(R,G)=1.0/(3.0*SIGT(R,G))	CF2 C022
120 CONTINUE	CF2 C023
C CALCULATION OF DIFFERENCE COEFICIENTS - CP AND CM	CF2 0024
C	CF2 0025
C IF (GEOM-1) 130,170,220	CF2 C026
C	CF2 C027
C SLAB GEOMETRY	CF2 0028
C	CF2 C029
C	CF2 C030
130 CONTINUE	CF2 0031
PFIRST=2	CF2 C032
DO 160 R=1,REG	CF2 C033
IF (CHANGE(R).EQ.0) GO TO 160	CF2 C034
C	CF2 C035
C NON BOUNDARY POINTS - SLAB	CF2 C036

C

PLAST=PB(R)-1
 DO 140 P=PFIRST,PLAST
 DO 140 G=1,GRP
 $CM(P,G)=D(R,G)/DR(R)**2$
 $CP(P,G)=CM(P,G)$

140 CONTINUE

IF(R.EQ.1) GO TO 144

IF(R.NE.REG) GO TO 143

157 IF(BCR.EQ.1) GO TO 151

DO 152 G=1,GRP

CP(PT,G)=0.0

152 CM(PT,G)=0.0

GO TO 160

151 DO 154 G=1,GRP

CP(PT,G)=0.0

154 CM(PT,G)=2*D(REG,G)/(DR(REG)**2)

153 GO TO 160

C

C

LEFT BOUNDARY

C

144 IF(BCL.EQ.1) GO TO 145

DO 146 G=1,GRP

CP(1,G)=0.

146 CM(1,G)=0.

IF(R.EQ.REG) GO TO 157

GO TO 143

145 DO 148 G=1,GRP

CP(1,G)=2*D(1,G)/(DR(1)**2)

148 CM(1,G)=0.

IF(R.EQ.REG) GO TO 157

GO TO 143

C

C

INTERFACE POINTS SLAB GEOM.

C

143 P=PB(R)

CF2 C037

CF2 C038

CF2 C039

CF2 C040

CF2 C041

CF2 C042

CF2 C043

CF2 C044

CF2 C045

CF2 C046

CF2 C047

CF2 C048

CF2 C049

CF2 C050

CF2 C051

CF2 C052

CF2 C053

CF2 C054

CF2 C055

CF2 C056

CF2 C057

CF2 C058

CF2 C059

CF2 C060

CF2 C061

CF2 C062

CF2 C063

CF2 C064

CF2 C065

CF2 C066

CF2 C067

CF2 C068

CF2 C069

CF2 C070

CF2 C071

CF2 C072

```

      X=(DR(R+1)+DR(R))*0.5
      DO 150 G=1,GRP
      CP(P,G)=D(R+1,G)/(DR(R+1)*X)
      CM(P,G)=D(R,G)/(DR(R)*X)
150  CONTINUE
160  PFIRST=PB(R)+1
      GO TO 270

C
C  CYLINDICAL GEOMETRY
C
170  RAD=0.0
      PFIRST=2
      IF( CHANGE(1).EQ.0 ) GO TO 173
      IF(BCL.EQ.1) GO TO 171
      DO 172 G=1,GRP
      CM(1,G)=0.
172  CP(1,G)=0.
      GO TO 173
171  DO 174 G=1,GRP
      CM(1,G)=0.
174  CP(1,G)=4*D(1,G)/(DR(1)**2)
173  CONTINUE
      DO 210 R=1,REG
      IF (CHANGE(R).EQ.1) GO TO 180
      RAD=RAD+LR(R)
      GO TO 210

C
C  NON BOUNDARY POINTS - CYLINDER
C
180  PLAST=PB(R)-1
      DO 190 P=PFIRST,PLAST
      RAD=RAD+DR(R)
      X=1.0/(DR(R)**2)
      Y=1.0/(2.0*RAD*DR(R))
      DO 190 G=1,GRP
      CM(P,G)=D(R,G)*(X-Y)

```

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CF2 C073
CF2 C074
CF2 C075
CF2 C076
CF2 C077
CF2 C078
CF2 C079
CF2 C080
CF2 C081
CF2 C082
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CF2 C101
CF2 C102
CF2 C103
CF2 C104
CF2 C105
CF2 C106
CF2 C107
CF2 C108

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```

CP(P,G)=D(R,G)*(X+Y)
190 CONTINUE
C
C   BOUNDARY POINT - CYLINDER
C
  IF(R.EQ.REG) GO TO 201
  P=PB(R)
  RAD=RAD+DR(R)
  RADP=RAD+0.5*DR(R)
  RADM=RAD-0.5*DR(R)
  X=RAD*(DR(R+1)+DR(R))*0.5
  DO 200 G=1,GRP
  CP(P,G)=D(R+1,G)*RADP/(DR(R+1)*X)
  CM(P,G)=D(R,G)*RADM/(DR(R)*X)
200 CONTINUE
  GO TO 210
201 IF(BCR.EQ.1) GO TO 202
  DO 203 G=1,GRP
  CM(PT,G)=0.0
203 CP(PT,G)=0.0
  GO TO 210
202 RAD=RAD+DR(REG)
  X=2/(DR(REG)**2)*(1-DR(REG)/(2*RAD))/(1-DR(REG)/(4*RAD))
  DO 204 G=1,GRP
  CP(PT,G)=0
204 CM(PT,G)=D(REG,G)*X
210 PFIRST=PB(R)+1
  GO TO 270
C
C   SPHERICAL GEOMETRY
C
220 RAD=0.0
  PFIRST=2
  DO 260 R=1,REG
  IF (CHANGE(R).EQ.1) GO TO 230
  RAD=RAD+LR(R)

```

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CF2 0109
CF2 0110
CF2 0111
CF2 0112
CF2 0113
CF2 0114
CF2 0115
CF2 0116
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CF2 0140
CF2 0141
CF2 0142
CF2 0143
CF2 0144

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```

      GO TO 260
C
C      NCN BOUNDARY POINTS - SPHERE
C
230 PLAST=PB(R)-1
    DO 240 P=PFIRST,PLAST
      RAD=RAC+DR(R)
      X=1.0/(DR(R)**2)
      Y=1.0/(RAD*DR(R))
      X1=1/(1+.083333*(DR(R)/RAD)**2)
      DO 241 G=1,GRP
        CM(P,G)=D(R,G)*(X-Y)*X1
241 CP(P,G)=D(R,G)*(X+Y)*X1
240 CONTINUE
      IF(R.EQ.REG) GO TO 251
C
C      BOUNDARY POINTS - SPHERE
C
      P=PB(R)
      RAD=RAC+DR(R)
      X=RAD**2*(DR(R)+DR(R+1))*0.5
      RADP2=(RAD+0.5*DR(R))**2
      RADM2=(RAD-0.5*DR(R))**2
      DO 250 G=1,GRP
        CP(P,G)=D(R+1,G)*RADP2/(DR(R+1)*X)
        CM(P,G)=D(R,G)*RADM2/(DR(R)*X)
250 CONTINUE
      GO TO 260
251 IF(BCR.EQ.1) GO TO 252
      DO 253 G=1,GRP
        CP(PT,G)=0.
253 CM(PT,G)=0.
      GO TO 260
252 RAD=RAC+DR(REG)
      X1=DR(REG)/RAD
      X2=(DR(REG)/(2*RAD))**2

```

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CF2 0145
CF2 0146
CF2 0147
CF2 0148
CF2 0149
CF2 0150
CF2 0151
CF2 0152
CF2 0153
CF2 0154
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CF2 0170
CF2 0171
CF2 0172
CF2 0173
CF2 0174
CF2 0175
CF2 0176
CF2 0177
CF2 0178
CF2 0179
CF2 0180

```

X3=(1-X1+X2)/(1-0.5*X1+X2)
X4=2*X3/(DR(REG)**2)
DO 254 G=1,GRP
CP(PT,G)=0.
254 CM(PT,G)=D(REG,G)*X4
260 PFIRST=PB(R)+1
270 CONTINUE
RETURN
END

CF2 0181
CF2 0182
CF2 0183
CF2 0184
CF2 0185
CF2 0186
CF2 0187
CF2 0188
CF2 0189

FUNCTION DEN(M,N,K,PSI,NUSIGF)

IMPLICIT REAL*8 (A-H,O-Z)

INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,

1 UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,CUT,

2 P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,

3 SORCE , SORG , SOZ , STEADY , STEP , TAGC , TAGF , TAGT

REAL*8 LR,NU,NUSIGF,NX

COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL

COMMON /A7/BETA(6),DECAY(6),BETDCY(6),DECH(6)

DIMENSION PSI(PT,GRP)

DIMENSION NUSIGF(REG,GRP)

C THIS FUNCTION CALCULATES THE PRECURSOR CONCENTRATION AT POINT M,
C IN REGION N, AND GROUP K AND TIME CT

T1=0.0

DO 110 I=1,GRP

110 T1=T1+NUSIGF(N,I)*PSI(M,I)

DEN=T1*BETDCY(K)

RETURN

END

DEN C001

DEN C002

DEN C003

DEN C004

DEN C005

DEN C006

DEN C007

DEN C008

DEN C009

DEN C010

DEN C011

DEN C012

DEN C013

DEN C014

DEN C015

DEN C016

DEN C017

DEN C018

DEN C019

```

SUBROUTINE DIRECT(PSI,SIGC,SIGF,SIGT,SIGX,NU,SD,SDIN,CHI,NCMP,
1FUEL,XABS,XENON,IODINE,LR,IPL,IPR,PB,XL,XR,CR,WHZ,WZ,WPT,NX,
2NUSIGF,DNSCAT,UPSCAT,REGFR,WCOEF,WCOEFL,WCOEFR,D,CHANGE,CM,CP,
3SCR,SORG,SRCEO,SRCE1,STPRN,RTAG,TAGC,TAGF,TAGT,TAGX,CCL,CCQ,CFL,
4CFQ,CTRL,CTRQ,CXL,CXQ,V,VINV,PSITOT,POWREG,POWCRG,POWER,PSISTO,
5DD,CL,CU,FF1,FF2,TI1,SIGCIN,SIGFIN,SIGTIN,SIGXIN,PSIB1,TD,
6WA,GA,DPSI,PSIBAR)
  IMPLICIT REAL*8 (A-H,O-Z)
  REAL*8 IODINE
  REAL*8 LR,NU,NUSIGF,NX
  INTEGER GF,GRPLUS
  INTEGER RTAG
  INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,
1      UPSCAT,WPT,FUEL,G,GEOM,GP,GPL,GPR,GC,GL,GU,GRP,GPU,CUT,
2P,PL,PR,PB,PRBEND,PT,PUNBAL,PUNFRS,R,REG,SCR,
3      SORCE , SORG , SCZ , STEADY , STEP , TAGC , TAGF , TAGT
  COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL
  COMMON /A2/NUM,NCOMP,BCL,BCR,MTZ,NTZ,XEN,STEADY
  COMMON /A3/PUNBAL,SORCE,GEOM,NTAG,NUM2,PUNFRS
  COMMON /A4/TIGHT1,TIGHT2,TIGHT3
  COMMON /A5/IN,OUT,NERR
  COMMON /A6/EP1,EP2,EP3,TSTINC,IEP4,IEP6
  COMMON /A7/BETA(6),DECAY(6),BETDCY(6),DECH(6)
  COMMON /A8/GAMAX,GAMAI
  COMMON /A9/POWTGT,POWBAR
  COMMON /B1/H,HP,TIME,TZ,ZERO,TZO,TIMZ
  COMMON /B2/NPRT,NZ,ISX,STEP,NZSAVE,PRBEND,IPRN
  COMMON /C2/GF,GRPLUS
  DIMENSION PSI(PT,GU)
  DIMENSION SIGC(REG,GRP),SIGF(REG,GRP),SIGT(REG,GRP),
1SIGX(REG,GRP,GRP)
  DIMENSION NU(GRP)
  DIMENSION SD(GRP,IDEL)
  DIMENSION SDIN(GRP,IDEL)
  DIMENSION CHI(GRP)
  DIMENSION NCMP(REG)

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```

DIRTCC01
DIRTCC02
DIRTCC03
DIRTCC04
DIRTCC05
DIRTCC06
DIRTCC07
DIRTCC08
DIRTCC09
DIRTCC10
DIRTCC11
DIRTCC12
DIRTCC13
DIRTCC14
DIRTCC15
DIRTCC16
DIRTCC17
DIRTCC18
DIRTCC19
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DIRTCC28
DIRTCC29
DIRTCC30
DIRTCC31
DIRTCC32
DIRTCC33
DIRTCC34
DIRTCC35
DIRTCC36

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DIMENSION FUEL(REG)
 DIMENSION XABS(REG,GRP)
 DIMENSION XENON(REG),IODINE(REG)
 DIMENSION LR(REG),IPL(REG),IPR(REG),PB(REG),XL(REG),XR(REG)
 DIMENSION WHZ(PT)
 DIMENSION WZ(PT)
 DIMENSION WPT(NUM)
 DIMENSION NX(GRP),NUSIGF(REG,GRP)
 DIMENSION DNSCAT(REG,GRP),UPSCAT(REG,GRP)
 DIMENSION REGFR(REG),WCOEF(PT),WCOEFL(REG),WCOEFR(REG)
 DIMENSION D(REG,GRP)
 DIMENSION CHANGE(REG)
 DIMENSION CM(PT,GRP),CP(PT,GRP)
 DIMENSION SOR(REG),SORG(REG,GRP),SRCEO(PT,GRP),SRCE1(PT,GRP)
 DIMENSION STPRN(50)
 DIMENSION RTAG(REG)
 DIMENSION TAGC(REG),TAGF(REG),TAGT(REG),TAGX(REG)
 DIMENSION CCL(REG,GRP),CCQ(REG,GRP),CFL(REG,GRP),CFQ(REG,GRP),
 ICTRL(REG,GRP),CTRQ(REG,GRP),CXL(REG),CXQ(REG)
 DIMENSION V(GRP)
 DIMENSION VINV(GRP)
 DIMENSION PSIBAR(REG,GRP)
 DIMENSION PSITOT(REG,GRP)
 DIMENSION POWREG(REG)
 DIMENSION POWER(REG,GRP)
 DIMENSION DR(REG)
 DIMENSION POWORG(REG)
 DIMENSION PSISTC(NUM)
 DIMENSION DD(PT),DL(PT),DU(PT)
 DIMENSION FF1(PT),FF2(PT)
 DIMENSION TIL(REG)
 DIMENSION SIGCIN(GRP),SIGFIN(GRP),SIGTIN(GRP)
 DIMENSION SIGXIN(GRPLUS,GRP)
 DIMENSION PSIB1(REG,GRP)
 DIMENSION TD(GRP)
 DIMENSION WA(PT),GA(PT),DPSI(PT)

DIRT0037
 DIRT0038
 DIRT0039
 DIRT0040
 DIRT0041
 DIRT0042
 DIRT0043
 DIRT0044
 DIRT0045
 DIRT0046
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 DIRT0065
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 DIRT0069
 DIRT0070
 DIRT0071
 DIRT0072


```

TIME=0.0
TIMZ=0.
TZ=0.0
TZ0=0.0
STEP=0
NZ=1
NZSAVE=1
ZERO=1.00-10
PRBEND=0
POWBAR=0.000
DO 30 R=1,REG
30 POWORG(R)=0.000
DO 50 P=1,PT
WZ(P)=0.0
WHZ(P)=1.0
DO 50 G=1,GU
50 PSI(P,G)=1.000
CALL INPTA2(PSI,SIGF,SIGC,SIGT,SIGX,NU,SD,SDIN,CHI,VINV,V,
INCMP,FUEL,XABS,XENON,IODINE,PB,LR,WPT,SIGCIN,SIGFIN,SIGTIN,SIGXIN)
CALL COEF1(NX,NUSIGF,CHI,NU,SIGF,SIGC,SIGX,PB,DR,LR,XL,XR,
1 IPL,IPR,DNSCAT,UPSCAT,WCOEF,WCOEFL,WCOEFR,REGFR)
DO 120 I=1,REG
120 CHANGE(I)=1
CALL COEF2(D,SIGT,CHANGE,PB,DR,LR,CM,CP)
CALL INPUTB(SOR,SORG,SRCEO,SRCE1,STPRN,IPL,IPR,RTAG,TAGX,
1TAGT,TAGF,TAGC,CXL,CXQ,CTRL,CTRQ,CCL,CCQ,CFL,CFQ)
CALL INECA(PSI,WPT,PB,LR,DR,V,NU,CHI,SD,NCMP,D,SIGC,SIGF,
1SIGX,XENON,IODINE)
CALL INEDB(TAGX,TAGT,TAGC,TAGF,CXL,CXQ,CTRL,CTRQ,CCL,CCQ,
1CFL,CFQ,SOR,SORG,SRCEO,SRCE1,IPL,IPR)
IF (NERR.EQ.1) CALL EXIT
IF (STEADY.LT.1) GO TO 130
CALL SETUP(PSI,WPT,NU,NUSIGF,CM,CP,SIGX,PB,IPR,IPL,XL,XR,
1FUEL,NX,SDIN,UPSCAT,DNSCAT,PSISTO,DD,DL,DU,WA,GA)
130 CONTINUE
DO 131 P=1,PT

```

DIRTC073
DIRTC074
DIRTC075
DIRTC076
DIRTC077
DIRTC078
DIRTC079
DIRTC080
DIRTC081
DIRTC082
DIRTC083
DIRTC084
DIRTC085
DIRTC086
DIRTC087
DIRTC088
DIRTC089
DIRTC090
DIRTC091
DIRTC092
DIRTC093
DIRTC094
DIRTC095
DIRTC096
DIRTC097
DIRTC098
DIRTC099
DIRTC100
DIRTC101
DIRTC102
DIRTC103
DIRTC104
DIRTC105
DIRTC106
DIRTC107
DIRTC108

```

131  DPSI(P)=PSI(P,THG)
      CALL      AVRAGE(PSI,PSIBAR,PSITOT,POWER,WCOEF,WCOEFL,WCEFR,
1REGFR, IPL,IPR,SIGF,POWREG,POWORG)
      DO 140 I=1,REG
      POWORG(I)=POWREG(I)
      IF(POWREG(I).EQ.0.000) GO TO 140
      POWREG(I)=POWREG(I)/POWTOT
140  CONTINUE
      POWBAR=POWTOT
      IF(POWTOT.NE.0.000) POWTOT=1.0
      WRITE(CUT,121)
      WRITE(OUT,122)(R,POWREG(R),R=1,REG)
      WRITE(CUT,123)POWTOT
121  FORMAT(1H0,10X,'REGION',10X,'FRACTIONAL POWER',/)
122  FORMAT(13X,12,12X,E14.7)
123  FORMAT(1H0,10X,'TOTAL NORMALIZED POWER = ',E14.7)
      IF (STEADY.LT.1) GO TO 300
      CALL      UPDAT(TAGT,TAGX,TAGC,TAGF,CHANGE,NUSIGF,PSIBAR,ICDINE,
1XABS,XENON, CTRL,CTRQ,CXL,CXQ,CCL,CCQ,CFL,CFQ,SIGT,SIGX,SIGF,
2SIGC,PSIB1,NU,FUEL)
      CALL      COEF2(D,SIGT,CHANGE,PB,DR,LR,CM,CP)
      GO TO 300
200  IF((DABS(TIME-TZ)).GT.ZERO) GO TO 220
      CALL      INPUTB(SOR,SORG,SRCEO,SRCE1,STPRN,IPL,IPR,RTAG,TAGX,
1TAGT,TAGF,TAGC,CXL,CXQ,CTRL,CTRQ,CCL,CCQ,CFL,CFQ)
      CALL      INEDB(TAGX,TAGT,TAGC,TAGF,CXL,CXQ,CTRL,CTRQ,CCL,CCQ,
1CFL,CFQ,SOR,SORG,SRCEO,SRCE1,IPL,IPR)
220  CALL      UPDAT(TAGT,TAGX,TAGC,TAGF,CHANGE,NUSIGF,PSIBAR,ICDINE,
1XABS,XENON, CTRL,CTRQ,CXL,CXQ,CCL,CCQ,CFL,CFQ,SIGT,SIGX,SIGF,
2SIGC,PSIB1,NU,FUEL)
      CALL      COEF2(D,SIGT,CHANGE,PB,DR,LR,CM,CP)
      IF (NERR.EQ.1) CALL EXIT
300  CALL      CALC(PSI,WHZ,WZ,NX,NUSIGF,SIGX,SD,SDIN,STPRN,FUEL,WPT,
1XL,XR,PB,IPL,IPR,VINV,UPSCAT,DNSCAT,SORG,SOR,SRCEO,SRCE1,CP,CM,
2FF1,FF2,TI1,DU,DL,DD,TD,WA,GA,DPSI)
      CALL      AVRAGE(PSI,PSIBAR,PSITOT,POWER,WCOEF,WCOEFL,WCEFR,

```

```

DIRTC1C9
DIRTO110
DIRTO111
DIRTC112
DIRTO113
DIRTO114
DIRTC115
DIRTO116
DIRTO117
DIRTC118
DIRTO119
DIRTO120
DIRTC121
DIRTC122
DIRTO123
DIRTC124
DIRTC125
DIRTC126
DIRTC127
DIRTC128
DIRTO129
DIRTO130
DIRTC131
DIRTO132
DIRTO133
DIRTC134
DIRTC135
DIRTO136
DIRTC137
DIRTC138
DIRTC139
DIRTC140
DIRTC141
DIRTO142
DIRTO143
DIRTC144

```

1REGFR, IPL, IPR, SIGF, POWREG, POWORG)
CALL TEST(STPRN, PSI, PSITOT, POWREG, WPT, WZ, WHZ)
IF (PRBEND.NE.1) GO TO 200
IF(PUNFRS.EQ.1) CALL PUN(PSI, NU, SIGF, SIGC, SIGT, SIGX, XENCN, ICCINE)
RETURN
END

CIRT0145
DIRTC146
DIRTC147
CIRT0148
DIRTC149
DIRTC150

```

SUBROUTINE EQPREC(PSI,FUEL,NUSIGF,IPL,IPR,XL,XR)
IMPLICIT REAL*8 (A-H,O-Z)
INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,
1      UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,CUT,
2      P,PL,PR,PB, PRBENC , PT , PUNBAL , PUNFRS , R,REG,SOR,
3      SORCE , SORG , SOZ , STEADY , STEP , TAGC , TAGF , TAGT
REAL*8 LR,NU,NUSIGF,NX
COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL
DIMENSION PSI(PT,GU)
DIMENSION IPL(REG),IPR(REG),XL(REG),XR(REG)
DIMENSION FUEL(REG)
DIMENSION NUSIGF(REG,GRP)
C THIS ROUTINE CALCULATES THE EQUILIBRIUM PRECURSOR CONCENTRATIONS
DO 110 G=GL,GU
DO 110 P=1,PT
110 PSI(P,G)=0.0
120 DO 190 R=1,REG
IF (FUEL(R)) 190,190,130
130 PL=IPL(R)
IF (R.EQ.1) PL=1
PR=IPR(R)
IF (R.EQ.REG) PR=PT
DO 180 G=GL,GU
JG=G-GRP
DO 140 P=PL,PR
PSI(P,G)=DEN(P,R,JG,PSI,NUSIGF)
140 CONTINUE
160 M=PL-1
IF(R.NE.1) PSI(M,G)=PSI(M,G)+DEN(M,R,JG,PSI,NUSIGF)*XR(R-1)
170 M=PR+1
IF(R.NE.REG) PSI(M,G)=PSI(M,G)+DEN(M,R,JG,PSI,NUSIGF)*XL(R)
180 CONTINUE
190 CONTINUE
200 CONTINUE
RETURN
END

```

```

EQPCC001
EQPCC002
EQPCC003
EQPCC004
EQPCC005
EQPCC006
EQPCC007
EQPCC008
EQPCC009
EQPCC010
EQPCC011
EQPCC012
EQPCC013
EQPCC014
EQPCC015
EQPCC016
EQPCC017
EQPCC018
EQPCC019
EQPCC020
EQPCC021
EQPCC022
EQPCC023
EQPCC024
EQPCC025
EQPCC026
EQPCC027
EQPCC028
EQPCC029
EQPCC030
EQPCC031
EQPCC032
EQPCC033
EQPCC034
EQPCC035
EQPCC036

```

```

SUBROUTINE ERR(SUB,TYPE,N1,N2)
  INTEGER SUB,TYPE
  INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,
1    UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GD,CL,CU,GRP,GPU,OUT,
2    P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,
3    SORCE , SORG , SOZ , STEADY , STEP , TAGC , TAGF , TAGT
  COMMON/A5/IN,CUT,NERR
  NERR=1
  GO TO (110,150,170), TYPE
110 WRITE(CUT,120)
120 FORMAT(25HOERRORR FOUND IN SUB INPUT)
130 WRITE (OUT,140) N1,N2
140 FORMAT (7HOCARD ,I3,9H  WORD ,I3)
  GO TO 220
150 WRITE (OUT,160) N1
160 FORMAT (15H0 PT>MAXPT, PT=,I6)
  GO TO 220
170 WRITE (OUT,180) N1,N2
180 FORMAT (23HOERROR IN SIGX INPUT G=,I3,4H  I=I3)
  GO TO 220
220 RETURN
C
  END

```

```

ERR C001
ERR C002
ERR C003
ERR C004
ERR C005
ERR C006
ERR C007
ERR C008
ERR C009
ERR C010
ERR C011
ERR C012
ERR C013
ERR C014
ERR C015
ERR C016
ERR C017
ERR C018
ERR C019
ERR C020
ERR C021
ERR C022
ERR C023

```

```

SUBROUTINE FEDBKX(PSIBAR,SIGF,XABS,XENON,IODINE,PSIB1,FUEL)
IMPLICIT REAL*8 (A-H,O-Z)
INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,
1      UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GC,GL,GU,GRP,GPU,OUT,
2      P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,
3      SORCE , SORG , SOZ , STEADY , STEP , TAGC , TAGF , TAGT

```

```

REAL*8 IODINE
REAL*8 LR,NU,NUSIGF,NX
REAL LAMDAI,LAMDAX
COMMON /A1/GRP,REG,PT,CL,GU,DEL,THG,IDEL
COMMON /A8/GAMAX,GAMAI
COMMON /B1/H,HP,TIME,TZ,ZERO,TZO,TIMZ
DIMENSION PSIBAR(REG,GRP)
DIMENSION PSIB1(REG,GRP)
DIMENSION XENON(REG),IODINE(REG)
DIMENSION XABS(REG,GRP)
DIMENSION FUEL(REG)
DIMENSION SIGF(REG,GRP)
EXP(X)=DEXP(X)
FLOAT(I)=DFLOAT(I)
DATA LAMDAI, LAMDAX / 2.874E-5, 2.093E-5/

```

```

C      THIS ROUTINE CALCULATES THE FEEDBACK,BY REGIONS,FOR XENON
C
C
C      CALCULATION OF VOLUME WEIGHTED,REGION AVERAGED FLUX
C

```

```

DO 130 R=1,REG
IF(FUEL(R).EQ.0) GO TO 130
SBAR=0.0
ALPHAX=LAMDAX
DO 120 G=1,GRP
SBAR=SBAR+SIGF(R,G)*(PSIB1(R,G)+PSIBAR(R,G))*0.5
ALPHAX=ALPHAX+XABS(R,G)*PSIBAR(R,G)
120 CONTINUE
Z1=ALPHAX-LAMDAI
Z2=(GAMAX+GAMAI)/ALPHAX

```

```

FDBKC001
FDBKC002
FDBKCC03
FDBK0004
FDBK0005
FDBKCC06
FDBKCC07
FDBK0008
FDBK0009
FDBKCC10
FDBK0011
FDBK0012
FDBKCC13
FDBKCC14
FDBK0015
FDBK0016
FDBK0017
FDBK0018
FDBK0019
FDBKCC20
FDBK0021
FDBK0022
FDBK0023
FDBK0024
FDBK0025
FDBK0026
FDBK0027
FDBK0028
FDBK0029
FDBKCC30
FDBK0031
FDBK0032
FDBKCC33
FDBK0034
FDBK0035
FDBKCC36

```

```

Y1=(-LAMDAI)*H
X1=0.0
IF (Y1.GT.(-88.0)) X1=EXP(Y1)
Y2=(-ALPHAX)*H
X2=0.0
IF (Y2.GT.(-88.0)) X2=EXP(Y2)
C
  IODINE(R)=X1*IODINE(R)+((1.0-X1)/LAMDAI)*GAMAI*SBAR
C
  XENON(R)=X2*XENON(R)+((X1-X2)/Z1)*(LAMDAI*IODINE(R)-GAMAI*SBAR)+Z2
  1*(1.0-X2)*SBAR
130 CONTINUE
  DO 110 R=1,REG
  DO 110 G=1,GRP
110 PSIB1(R,G)=PSIBAR(R,G)
  RETURN
  END

```

```

FDBKC037
FDBKC038
FDBKC039
FDBKC040
FDBKC041
FDBKC042
FDBKC043
FDBKC044
FDBKC045
FDBKC046
FDBKC047
FDBKC048
FDBKC049
FDBKC050
FDBKC051
FDBKC052
FDBKC053

```

```

SUBROUTINE FREQ(PSI,WHZ,WZ,FF1,FF2,STPRN,WPT,DPSI,PB)
IMPLICIT REAL*8 (A-H,O-Z)
INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,
1      UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,CUT,
2      P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,
3      SORCE , SCRG , SCZ , STEADY , STEP , TAGC , TAGF , TAGT
REAL*8 LR,NU,NUSIGF,NX
COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL
COMMON /A2/NUM,NCOMP,BCL,BCR,MTZ,NTZ,XEN,STEADY
COMMON /A3/PUNBAL,SORCE,GEOM,NTAG,NUM2,PUNFRS
COMMON/A6/EP1,EP2,EP3,TSTINC,IEP4,IEP6
COMMON /B1/H,HP,TIME,TZ,ZERO,TZO,TIMZ
COMMON /B2/NPRT,NZ,ISX,STEP,NZSAVE,PRBEND,IPRN
DIMENSION PSI(PT,GU)
DIMENSION DPSI(PT)
DIMENSION FF1(PT)
DIMENSION FF2(PT)
DIMENSION PB(REG)
DIMENSION WZ(PT)
DIMENSION WHZ(PT)
DIMENSION WPT(NUM)
DIMENSION STPRN(50)
ISY=0
IF(IEP4.EQ.1) GO TO 311
PL=1
IF(BCL.EQ.0) PL=2
PR= PB(REG)-1
IF(BCR.EQ.0) GO TO 277
PR=PB(REG)
277 DO 278 P=PL,PR
    WHZ(P)=PSI(P,THG)/DPSI(P)
    DPSI(P)=WZ(P)
    WZ(P)=(DLOG(WHZ(P)))/H
278 CONTINUE
IF(BCL.EQ.0) WHZ(1)=1.0
IF(BCR.EQ.0) WHZ(PT)=1.0

```

```

FREQ0001
FREQ0002
FREQ0003
FREQ0004
FREQ0005
FREQ0006
FREQ0007
FREQ0008
FREQ0009
FREQ0010
FREQ0011
FREQ0012
FREQ0013
FREQ0014
FREQ0015
FREQ0016
FREQ0017
FREQ0018
FREQ0019
FREQ0020
FREQ0021
FREQ0022
FREQ0023
FREQ0024
FREQ0025
FREQ0026
FREQ0027
FREQ0028
FREQ0029
FREQ0030
FREQ0031
FREQ0032
FREQ0033
FREQ0034
FREQ0035
FREQ0036

```



```

311  CCNTINUE
      H=HP
      TIMEP=TIME+H
      IF((TZ-TIMEP).GT.ZERO) GO TO 1
      H =TZ-TIME
      ISY=1
1    CCNTINUE
      IF(NUM2.EQ.0) GO TO 2
      TIMEP=TIME+H
      IF((STPRN(NPRT)-TIMEP).GT.ZERO) GO TO 2
      ISY=1
      H =STPRN(NPRT)-TIME
2    CONTINUE
      IF(ISY.EQ.1) GO TO 397
      IF(IEP6.EQ.1) GO TO 401
      T1=WZ(2)
      T2=WZ(2)
      PL=3
      PR=PT-1
      DO 300 P=PL,PR
      IF(WZ(P).GT.T1) T1=WZ(P)
      IF(WZ(P).LT.T2) T2=WZ(P)
300  CONTINUE
      T4=T1*F
      T5=T2*H
      IF(T1.NE.0.0.AND.T2.NE.0.0) GO TO 303
      ES=EP2
      GO TO 310
303  IF(T1.GT.0.0) GO TO 305
      T3=1.0-T1/T2
      IF(T3.EQ.0.0 ) T3=0.00100
      ES=EP2/T3
      GO TO 310
305  T3=1.0-T2/T1
      IF(T3.EQ.0.0 ) T3=0.00100
      ES=EP2/T3

```

```

FRECC037
FRECC038
FRECC039
FRECC040
FRECC041
FRECC042
FRECC043
FRECC044
FRECC045
FRECC046
FRECC047
FRECC048
FRECC049
FRECC050
FRECC051
FRECC052
FRECC053
FRECC054
FRECC055
FRECC056
FRECC057
FRECC058
FRECC059
FRECC060
FRECC061
FRECC062
FRECC063
FRECC064
FRECC065
FRECC066
FRECC067
FRECC068
FRECC069
FRECC070
FRECC071
FRECC072

```

```

310 T3=0.0
    DO 315 N=1,NUM
    P=WPT(N)
    T1=WZ(P)
    T2=DPSI(P)
    T8=T1
    T9=T2
    IF(T1.NE.0.0.AND.T2.NE.0.0) GO TO 319
    ET=EP1
    GO TO 339
319 IF(DABS(T1).GT.DABS(T2)) GO TO 321
    T2=1.0-T1/T2
    GO TO 323
321 T2=1.0-T2/T1
323 IF(T2.GT.T3) T3=T2
315 CONTINUE
    ET=EP1/T3
339 CONTINUE
340 EX=DMIN1(ES,ET)
    EX=CMAX1(EX,EP1)
    T6=DMAX1(DABS(T4),DABS(T5))
    IF(T6.GT.EX) GO TO 370
    T1=2.0*T6
    IF(T1.LT.EX) GO TO 360
394 HP=H
    GO TO 398
360 HP=H*TSTINC
    GO TO 398
370 IF(T6.LT.EP3) GO TO 394
    T7=DMAX1(EX,EP3)
    H=T7*H/T6
401 HP=H
397 CONTINUE
398 CONTINUE
    DO 30 P=1,PT
    IF(DABS(WZ(P)*H).LT.1.00-5) GO TO 10

```

```

FREQC073
FREQC074
FREQC075
FREQC076
FREQC077
FREQC078
FREQC079
FREQC080
FREQC081
FREQC082
FREQC083
FREQC084
FREQC085
FREQC086
FREQC087
FREQC088
FREQC089
FREQC090
FREQC091
FREQC092
FREQC093
FREQC094
FREQC095
FREQC096
FREQC097
FREQC098
FREQC099
FREQC100
FREQC101
FREQC102
FREQC103
FREQC104
FREQC105
FREQC106
FREQC107
FREQC108

```

```

      WHZ(P)=DEXP(WZ(P)*H)
      FF1(P)=(WHZ(P)-1.0)/WZ(P)
      FF2(P)=FF1(P)/WHZ(P)
      GO TO 30
10    FF1(P)=H
      FF2(P)=H
      WZ(P)=0.000
      WHZ(P)=1.000
30    CONTINUE
      DO 700 P=1,PT
700   DPSI(P)=PSI(P,THG)
602   RETURN
      END

```

```

FREQ0109
FREQ0110
FREQ0111
FREQ0112
FREQ0113
FREQ0114
FREQ0115
FREQ0116
FREQ0117
FREQ0118
FREQ0119
FREQ0120
FREQ0121

```

```

SUBROUTINE INECA(PSI,WPT,PB,LR,DR,V,NU,CHI,SD,NCMP,D,SIGC,SIGF,
1SIGX,XENON,IODINE)
IMPLICIT REAL*8 (A-H,O-Z)
INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,
1      UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GD,CL,GU,GRP,GPU,OUT,
2      P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,
3      SORCE , SORG , SOZ , STEADY , STEP , TAGC , TAGF , TAGT
INTEGER RBCND
REAL*8 IODINE
REAL*8 LR,NU,NUSIGF,NX
COMMON /A1/GRP,REG,PT,CL,GU,DEL,THG,IDEL
COMMON /A2/NUM,NCOMP,BCL,BCR,MTZ,NTZ,XEN,STEADY
COMMON /A3/PUNBAL,SORCE,GEOM,NTAG,NUM2,PUNFRS
COMMON/A5/IN,OUT,NERR
COMMON /A8/GAMAX,GAMA1
DIMENSION PSI(PT,GU)
DIMENSION XENON(REG),IODINE(REG)
DIMENSION V(GRP)
DIMENSION PB(REG),DR(REG),LR(REG)
DIMENSION CHI(GRP)
DIMENSION D(REG,GRP)
DIMENSION NCMP(REG)
DIMENSION SD(GRP,IDEL)
DIMENSION WPT(NUM)
DIMENSION NU(GRP)
DIMENSION SIGC(REG,GRP),SIGF(REG,GRP),SIGX(REG,GRP,GRP)
DIMENSION NOTE1(9),NOTE2(2),NOTE3(6)
DATA NOTE1/4H      ,4H      ,4HSLAB,4H CYL,4HINDR,4HICAL,
14H  S,4HPPER,4HICAL/
DATA NOTE4/4H  I=/
DATA NOTE2/4H NO ,4H YES/
DATA NOTE3/4HZERO,4H      ,4H      ,4HSYMM,4HETRY,4H      /
DATA NOTE5/4H GP=/

CALL TITLE (2)
WRITE (6,300) GRP,DEL,REG,NCOMP

```

```

IEDAC001
IEDAC002
IEDAC003
IEDAC004
IEDAC005
IEDAC006
IEDAC007
IEDAC008
IEDAC009
IEDAC010
IEDAC011
IEDAC012
IEDAC013
IEDAC014
IEDAC015
IEDAC016
IEDAC017
IEDAC018
IEDAC019
IEDAC020
IEDAC021
IEDAC022
IEDAC023
IEDAC024
IEDAC025
IEDAC026
IEDAC027
IEDAC028
IEDAC029
IEDAC030
IEDAC031
IEDAC032
IEDAC033
IEDAC034
IEDAC035
IEDAC036

```

```

NG=GEOM*3+1
LBOND=1+3*BCL
RBOND=1+3*BCR
NPUN=1+PUNFRS
NBAL=1+PUNBAL
WRITE (6,310) NOTE1(NG),NOTE1(NG+1),NOTE1(NG+2),NOTE3(LBOND),
1NOTE3(LBOND+1),NOTE3(LBOND+2),NOTE3(RBOND),NOTE3(RBOND+1),
2NOTE3(RBOND+2),NOTE2(NPUN),NOTE2(NBAL)
WRITE (6,320) (WPT(N),N=1,NUM)
WRITE (6,330) THG
WRITE (6,340)
N1=1
DO 110 R=1,REG
WRITE (6,350) R,N1,PB(R)
110 N1=PB(R)
WRITE (6,360)
WRITE (6,370) ( R,LR(R),DR(R) ,R=1,REG)
WRITE (6,290)
IF (DEL) 120,120,130
120 WRITE (6,380)
GO TO 150
130 WRITE (6,390) ( NOTE4,I ,I=1,DEL)
DO 140 G=1,GRP
WRITE (6,400) G,(SD(G,GP),GP=1,DEL)
140 CONTINUE
WRITE (6,290)
150 WRITE (6,410)
WRITE (6,420) ( G,V(G),NU(G),CHI(G) ,G=1,GRP)
WRITE (6,290)

```

C
C
C
CROSS SECTIONS BY COMPOSITION ORDER

```

N=1
160 DO 200 R=1,REG
IF (NCMP(R).NE.N) GO TO 200
WRITE (6,430) N

```

```

IEDAC037
IEDAC038
IEDAC039
IEDAC040
IEDAC041
IEDAC042
IEDAC043
IEDAC044
IEDAC045
IEDAC046
IEDAC047
IEDAC048
IEDAC049
IEDAC050
IEDAC051
IEDAC052
IEDAC053
IEDAC054
IEDAC055
IEDAC056
IEDAC057
IEDAC058
IEDAC059
IEDAC060
IEDAC061
IEDAC062
IEDAC063
IEDAC064
IEDAC065
IEDAC066
IEDAC067
IEDAC068
IEDAC069
IEDAC070
IEDAC071
IEDAC072

```

```

WRITE (6,440) ( G,D(R,G),SIGC(R,G),SIGF(R,G) ,G=1,GRP)
WRITE (6,290)
WRITE (6,450)
L1=1
L2=GRP
170 L3=GRP
   IF (L2.LE.9) GO TO 180
   L2=L2-9
   L3=L1+8
180 WRITE (6,460) ( NOTE5,G ,G=L1,L3)
   DO 190 GP=1,GRP
190 WRITE (6,520) GP,(SIGX(R,GP,G),G=L1,L3)
   IF (L3.EQ.GRP) GO TO 210
   L1=L3+1
   GO TO 170
200 CONTINUE
   CALL ERR (3,0,0,0)
210 IF (N.EQ.NCCMP) GO TO 220
   N=N+1
   GO TO 160
220 CONTINUE
   WRITE (6,290)
   WRITE (6,470)
   WRITE (6,480) ( R,NCMP(R) ,R=1,REG)
   WRITE (6,290)
   IF (XEN.NE.0) GO TO 230
   WRITE (6,490)
   GO TO 240
230 CONTINUE
   WRITE (6,500)
C
   WRITE (6,510) ( R,XENON(R),IODINE(R),GAMAX,GAMAI ,R=1,REG)
240 CONTINUE
   WRITE (6,290)
   N1=1
   IF (STEADY.GT.0) N1=2

```

```

IEDA0073
IEDA0074
IEDA0075
IEDA0076
IEDA0077
IEDA0078
IEDA0079
IEDACC80
IEDAC081
IECAC082
IECA0083
IEDAC084
IEDA0085
IEDAC086
IEDAC087
IEDAC088
IEDA0089
IEDACC90
IEDACC91
IECAC092
IECAC093
IEDAC094
IEDAC095
IEDAC096
IEDAC097
IEDAC098
IEDA0099
IEDA0100
IEDA0101
IECA0102
IEDA0103
IEDA0104
IEDA0105
IEDA0106
IEDA0107
IEDA0108

```

```

WRITE (6,530) NOTE2(N1)
IF (STEADY.EQ.2) GO TO 280
WRITE (6,540)
DO 250 G=1,GRP
250 WRITE (6,550) (P,PSI(P,G),P=1,PT)
IF (STEADY.EQ.0) GO TO 260
WRITE (6,560)
GO TO 280
260 WRITE (6,570)
DO 270 G=GL,GU
270 WRITE (6,550) (P,PSI(P,G),P=1,PT)
280 CONTINUE

```

C
C

```

290 FORMAT (1H0)
300 FORMAT (1H0/25X,18H*** INPUT EDIT ***//3X,I2,19H NEUTRON GROUP(S)
1,,3X,I2,19H DELAYED GROUP(S) ,,3X,I2,12H REGION(S) ,,3X,I2,15H COM
2POSITION(S)/)
310 FORMAT(2X,3A4,11H GEOMETRY ,,3X,14HLEFT BOUNDARY ,3A4,3X, 15HRIGHT
1 BOUNDARY ,3A4//2X,45HIS THERE TO BE END OF PROBLEM PUNCHED OUTPUT
2 ,A4,3X,1H,/43HOARE THE STEADY STATE FLUXES TO BE PUNCHED ,A4,2X)
320 FORMAT (38HOTEST POINTS FOR FREQUENCY CALCULATION,3X,15I5/(48X,15I
15))
330 FORMAT (8HOGROUP ,I3,61H IS SPECIFIED AS THE TEST GROUP FOR THE F
1FREQUENCY CALCULATION/)
340 FORMAT (1H0/33H REGION MESH POINT BOUNDARIES/26H NUMBER
1 LEFT RIGHT)
350 FORMAT (4X,I3,8X,I3,4X,I3)
360 FORMAT (1H0/4X,6HREGION,4X,6HLENGTH,4X,12HMESH SPACING/4X,6HNUMBER
1,5X,4H(CM),9X,4H(CM))
370 FORMAT (5X,I3,4X,F10.4,4X,F8.4)
380 FORMAT (19H0 NO DELAYED GROUPS)
390 FORMAT (59HOFRACTIONAL YIELD FROM DELAYED GROUP I INTO NEUTRON GRO
1UP G/2X,5HGROUP,3X,10(3X,A4,I2,1X))
400 FORMAT (3X,I3,4X,10(2X,F8.5))
410 FORMAT (4X,5HGROUP,5X,15HAVERAGE NEUTRON,6X,12HNEUTRONS PER,6X,7HF

```

IEDA0109
 IEDAC110
 IECA0111
 IEDA0112
 IEDAC113
 IEDAC114
 IEDA0115
 IEDA0116
 IEDA0117
 IEDA0118
 IEDA0119
 IEDAC120
 IEDA0121
 IEDAC122
 IEDAC123
 IEDA0124
 IEDA0125
 IEDAC126
 IEDA0127
 IECA0128
 IEDA0129
 IEDAC130
 IECA0131
 IEDAC132
 IEDAC133
 IEDAC134
 IEDA0135
 IEDAC136
 IECA0137
 IEDA0138
 IEDAC139
 IEDA0140
 IECA0141
 IEDAC142
 IEDAC143
 IEDA0144

11SSICN/4X,6HNUMBER,4X,14HSPEED (CM/SEC),8X,7HFISSION,11X,5HYIELD)
 420 FORMAT (5X,I3,6X,E12.6,7X,E12.6,5X,E12.6)
 430 FORMAT (14HOCOMPOSITION ,I2/6X,5HGROUP,4X,9HDIFFUSION,6X,3CHGROUP
 1 DEPENDENT CROSS SECTIONS/6X,19HNUMBER COEFFICIENT,6X,9H(CAPTURE)
 2,4X,9H(FISSION))
 440 FORMAT (7X,I3,4X,E12.6,2X,E12.6,2X,E12.6)
 450 FORMAT (7X,97HSCATTERING MATRIX GP INTO G (THE TOTAL REMOVAL IS
 1COMPUTED AND STCRED AS THE DIAGONAL ELEMENTS))
 460 FORMAT (4H (G),1X,9(6X,A4,I2))
 470 FORMAT (34HOCOMPOSITION ASSIGNMENT TO REGIONS/22H REGION COMPOS
 1ITION)
 480 FORMAT (5X,I2,8X,I2)
 490 FORMAT (43HONO XENON BUILDUP CONSIDERD IN THIS PROBLEM)
 500 FORMAT (7HOREGICN,7X,14HCONCENTRATIONS,10X,13HFISSION YIELD/7H NUM
 1BER,4X,5HXENON,8X,6HIODINE,7X,5HXENON,8X,6HIODINE)
 510 FORMAT (3X,I2,1X,4(3X,E10.5))
 520 FORMAT (2X,I2,3X,9E12.6)
 530 FORMAT (48H0ARE STEADY STATE CONDITIONS TO BE CALCULATED ? ,A4)
 540 FORMAT (24H0INPUT FLUX DISTRIBUTION)
 550 FORMAT ((2X,6(1H(,I3,2H) ,1PE12.6)))
 560 FORMAT (92H0THE INITIAL PRECURSOR CONCENTRATIONS ARE CALCULATED FR
 1OM THE STEADY STATE FLUX DISTRIBUTION)
 570 FORMAT (60H0THE INITIAL PRECURSOR CONCENTRATIONS ARE READ IN FROM
 1CARDS)
 RETURN
 END

IEDA0145
 IEDA0146
 IEDA0147
 IEDA0148
 IEDA0149
 IEDA0150
 IEDAC151
 IEDAC152
 IEDA0153
 IEDA0154
 IEDA0155
 IEDA0156
 IEDA0157
 IEDAC158
 IEDAC159
 IEDAC160
 IEDAC161
 IEDA0162
 IEDA0163
 IEDA0164
 IEDAC165
 IEDA0166
 IEDA0167
 IEDAC168
 IEDA0169
 IEDAC170


```

SUBROUTINE INEDB(TAGX,TAGT,TAGC,TAGF,CXL,CXQ,CTRL,CTRQ,CCL,CCQ,
1CFL,CFQ,SOR,SORG,SRCE0,SRCE1,IPL,IPR)
IMPLICIT REAL*8 (A-H,O-Z)
INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,
1      UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,CUT,
2      P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,
3      SRCE , SORG , SCZ , STEADY , STEP , TAGC , TAGF , TAGT
REAL*8 IODINE
REAL*8 LR,NU,NUSIGF,NX
COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL
COMMON /A3/PUNBAL,SRCE,GEOM,NTAG,NUM2,PUNFRS
COMMON/A5/IN,OUT,NERR
COMMON/A6/EP1,EP2,EP3,TSTINC,IEP4,IEP6
COMMON /B1/H,HP,TIME,TZ,ZERO,TZO,TIMZ
COMMON /B2/NPRT,NZ,ISX,STEP,NZSAVE,PRBEND,IPRN

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.....

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DIMENSION IPL(REG),IPR(REG)
DIMENSION SOR(REG),SORG(REG,GRP),SRCE0(PT,GRP),SRCE1(PT,GRP)
DIMENSION TAGC(REG),TAGF(REG),TAGT(REG),TAGX(REG)
DIMENSION CCL(REG,GRP),CCQ(REG,GRP),CFL(REG,GRP),CFQ(REG,GRP),
1CTRL(REG,GRP),CTRQ(REG,GRP),CXL(REG),CXQ(REG)
DIMENSION NOTE2(2)
DATA NOTE2(1),NOTE2(2) /4H NO,4H YES /
N1=1
IF (NTAG.NE.0) N1=2
WRITE (6,250) NOTE2(N1)
IF (NTAG.EQ.0) GO TO 180
WRITE (6,300)
DO 170 R=1,REG
IF (TAGX(R).EQ.0) GO TO 110
WRITE (OUT,270) NZ,R,CXL(R),CXQ(R)
110 IF (TAGT(R).EQ.0) GO TO 130
DO 120 G=1,GRP
IF ((CTRL(R,G).NE.0).OR.(CTRQ(R,G).NE.0)) WRITE (OUT,260) NZ,G,R,C
1TRL(R,G),CTRQ(R,G)

```

```

IEDBCC01
IEDB0002
IEDBCC03
IEDBCC04
IEDBCC05
IEDBCC06
IEDBCC07
IEDBCC08
IEDBCC09
IEDBCC10
IEDBCC11
IEDBCC12
IEDBCC13
IEDBCC14
IEDBCC15
IEDBCC16
IEDBCC17
IEDBCC18
IEDBCC19
IEDBCC20
IEDBCC21
IEDBCC22
IEDBCC23
IEDBCC24
IEDBCC25
IEDBCC26
IEDBCC27
IEDBCC28
IEDBCC29
IEDBCC30
IEDBCC31
IEDBCC32
IEDBCC33
IEDBCC34
IEDBCC35
IEDBCC36

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```

120 CONTINUE
130 IF (TAGC(R).EQ.0) GO TO 150
    DO 140 G=1,GRP
    IF ((CCL(R,G).NE.0.0).OR.(CCQ(R,G).NE.0.0)) WRITE (OUT,280) NZ,G,R
    1,CCL(R,G),CCQ(R,G)
140 CONTINUE
150 IF (TAGF(R).EQ.0) GO TO 170
    DO 160 G=1,GRP
    IF ((CFL(R,G).NE.0.0).OR.(CFQ(R,G).NE.0.0)) WRITE (OUT,290) NZ,G,R
    1,CFL(R,G),CFQ(R,G)
160 CONTINUE
170 CONTINUE
180 CONTINUE
C   EDIT OF SOURCE INPUT
    N1=1
    IF (SORCE.NE.0) N1=2
    WRITE (6,310) NOTE2(N1)
    IF (SORCE.EQ.0) GO TO 240
    WRITE (6,320)
    WRITE (6,330)
    DO 230 R=1,REG
    IF (SOR(R)-1) 230,210,190
190 CONTINUE
C   SPACE DEPENDENT SOURCE ACROSS THE REGION
    PL=IPL(R)
    PR=IPR(R)
    DO 200 G=1,GRP
    IF (SORG(R,G).EQ.0) GO TO 200
    WRITE (6,340) NZ,R,G
    WRITE (6,350) (II,SRCE0(II,G),II=PL,PR)
    WRITE (6,360) (II,SRCE1(II,G),II=PL,PR)
200 CONTINUE
    GO TO 230
210 CONTINUE
C   CONSTANT SOURCE FOR THE REGION
    II=IPR(R)

```

```

IECB0037
IEDBC038
IEDBC039
IECB0040
IEDBC041
IEDBC042
IEDBC043
IEDBC044
IEDBC045
IEDBC046
IEDBC047
IEDBC048
IEDBC049
IECB0050
IEDBC051
IECB0052
IEDBC053
IECB0054
IEDBC055
IEDBC056
IECB0057
IEDBC058
IEDBC059
IEDBC060
IEDBC061
IEDBC062
IECB0063
IEDBC064
IEDBC065
IEDBC066
IEDBC067
IEDBC068
IEDBC069
IEDBC070
IEDBC071
IEDBC072

```

```

DO 220 G=1,GRP
IF (SORG(R,G).EQ.0) GO TO 220
WRITE (6,370) NZ,R,G,SRCE0(II,G),SRCE1(II,G)
220 CONTINUE
230 CONTINUE
240 CONTINUE
RETURN
C
250 FORMAT (44HOARE THERE ANY TIME DEPENDENT CHANGES IN THE/21H CRCS
1SECTION DATA A4)
260 FORMAT (2X,12,7X,9HTRANSPORT,5X,12,6X,12,8X,E11.5,4X,E11.5)
270 FORMAT (2X,12,7X,9HTRANSFER ,13X,12,8X,E11.5,4X,E11.5)
280 FORMAT (2X,12,7X,9H CAPTURE ,5X,12,6X,12,8X,E11.5,4X,E11.5)
290 FORMAT (2X,12,7X,9H FISSION ,5X,12,6X,12,8X,E11.5,4X,E11.5)
300 FORMAT (71HOTIME CROSS SECTION GROUP REGION TOTAL LINEAR
1 TOTAL QUADRATIC/5H ZONE,21X,1H ,7X,1H ,9X,6HCHANGE,8X,6HCHANGE)
310 FORMAT (40HOARE THERE ANY TIME DEPENDENT SOURCES ? ,A4)
320 FORMAT (21HO SCURCE DISTRIBUTION/61H A - UNIFORM SOURCE FOR ALL
1 SPACE POINTS WITHIN THE REGION/49H B - SPACE DEPENDENT SCURCES
2 WITHIN THE REGION)
330 FORMAT (36HOTIME REGION GROUP DISTRIBUTION/5H ZONE)
340 FORMAT (2X,12,6X,12,5X,12,8X,3H(A))
350 FORMAT (43X,14HINITIAL SOURCE4(1X,1H(,12,1H),E10.5 )/(57X,4(1X,1H(
1,12,1H),E10.5)))
360 FORMAT (38X,19HTIME RATE OF CHANGE,4(1X,1H(,12,1H),E10.5)/(57X,4(1
1X,1H(,12,1H),E10.5)))
370 FORMAT (2X,12,6X,12,5X,12,8X,3H(B),17H INITIAL SOURCE=,E10.5/27X,
120HTIME RATE OF CHANGE=)
END

```

```

IEDBC073
IEDBC074
IEDB0075
IEDBC076
IEDBC077
IECB0078
IEDBC079
IEDBC080
IEDB0081
IEDB0082
IEDBC083
IEDBC084
IEDB0085
IEDBC086
IEDBC087
IEDB0088
IEDBC089
IEDBC090
IEDBC091
IEDBC092
IEDBC093
IEDBC094
IEDBC095
IEDBC096
IEDBC097
IEDBC098
IEDB0099
IEDB0100
IEDB0101

```

```

SUBROUTINE INPTA1
  IMPLICIT REAL*8 (A-H,O-Z)
  INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,
1      UPSCAT,WPT,FUEL,G,GEOM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,CUT,
2      P,PL,PR,PB,PRBEND,PT,PUNBAL,PUNFRS,R,REG,SOR,
3      SCRCE,SORG,SOZ,STEADY,STEP,TAGC,TAGF,TAGT
  INTEGER GF,GRPLUS
  REAL*8 LR,NU,NUSIGF,NX
  REAL*8 ICDINE
  COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL
  COMMON /A2/NUM,NCOMP,BCL,BCR,MTZ,NTZ,XEN,STEADY
  COMMON /A3/PUNBAL,SCRCE,GECM,NTAG,NUM2,PUNFRS
  COMMON /A4/TIGHT1,TIGHT2,TIGHT3
  COMMON /A5/IN,OUT,NERR
  COMMON /C1/M1,M2,M4,M5,M7
  COMMON /C2/GF,GRPLUS
  DIMENSION ID(14)
  ABS(X)=DABS(X)
  FLOAT(I)=DFLOAT(I)
C ***** CARD 1 *****
  CALL TITLE (1)
  WRITE (OUT,390)
  CALL TITLE (3)
C ***** CARD 2 *****
  READ (IN,350) GRP,THG,GF,DEL,REG,NUM,NCOMP,GEOM,BCL,BCR,MTZ,XEN
  WRITE (OUT,400) GRP,THG,GF,DEL,REG,NUM,NCOMP,GEOM,BCL,BCR,MTZ,XEN
  IF ((GRP.LT.1).OR.(GRP.GT.M2)) CALL ERR (1,1,2,1)
  IF ((THG.LT.1).OR.(THG.GT.GRP)) CALL ERR (1,1,2,2)
  IF ((GF.LT.0).OR.(GF.GT.GRP)) CALL ERR (1,1,2,3)
  IF ((DEL.LT.0).OR.(DEL.GT.M4)) CALL ERR (1,1,2,4)
  IF ((REG.LT.1).OR.(REG.GT.M1)) CALL ERR (1,1,2,5)
  IF ((NUM.LT.1).OR.(NUM.GT.M7)) CALL ERR (1,1,2,6)
  IF (NUM.LT.REG) CALL ERR (1,1,2,6)
  IF (NCOMP.LT.1) CALL ERR (1,1,2,7)
  IF ((GEOM.LT.0).OR.(GEOM.GT.2)) CALL ERR (1,1,2,8)
  IF ((BCL.NE.0).AND.(BCL.NE.1)) CALL ERR (1,1,2,9)

```

```

IPA10001
IPA10002
IPA10003
IPA10004
IPA10005
IPA10006
IPA10007
IPA10008
IPA10009
IPA10010
IPA10011
IPA10012
IPA10013
IPA10014
IPA10015
IPA10016
IPA10017
IPA10018
IPA10019
IPA10020
IPA10021
IPA10022
IPA10023
IPA10024
IPA10025
IPA10026
IPA10027
IPA10028
IPA10029
IPA10030
IPA10031
IPA10032
IPA10033
IPA10034
IPA10035
IPA10036

```

```

IF ((BCR.NE.0).AND.(BCR.NE.1)) CALL ERR (1,1,2,10)
IF (MTZ.EQ.0) CALL ERR (1,1,2,11)
IF ((XEN.NE.0).AND.(XEN.NE.1)) CALL ERR (1,1,2,12)

```

C

```

PUNFRS=1
IF (MTZ.LT.0) PUNFRS=0
NTZ=IABS(MTZ)
GL=GRP+1
GU=DEL+GRP
GRPLUS=GRP+1
IDEL=DEL

```

C

```

IF (DEL.EQ.0) IDEL=1
***** CARD 3 *****
READ (IN,380) STEADY,PUNBAL,TIGHT1,TIGHT2,TIGHT3,PT
WRITE (OUT,410) STEADY,PUNBAL,TIGHT1,TIGHT2,TIGHT3,PT
DO 1 I=1,4
IF (STEADY.EQ.(I-1)) GO TO 2
1 CONTINUE
CALL ERR(1,1,3,1)
2 CONTINUE
IF ((PUNBAL.NE.0).AND.(PUNBAL.NE.1)) CALL ERR (1,1,3,2)
IF (TIGHT1.LT.0) CALL ERR (1,1,3,3)
IF (TIGHT2.LT.0) CALL ERR (1,1,3,4)
IF (TIGHT3.LT.0) CALL ERR (1,1,3,5)
RETURN

```

```

350 FORMAT (12I6)
380 FORMAT (2I6,3E12.6,I6)
390 FORMAT (10H1CARD 01 )
400 FORMAT (10HOCARD 02 ,2X,12I6)
410 FORMAT (10HOCARD 03 ,2X,2I6,3E12.6,I6)
END

```

```

IPA1CC37
IPA1C038
IPA1C039
IPA1C040
IPA1C041
IPA1C042
IPA1C043
IPA1C044
IPA1C045
IPA1C046
IPA1C047
IPA1C048
IPA1C049
IPA1C050
IPA1C051
IPA1C052
IPA1C053
IPA1C054
IPA1C055
IPA1C056
IPA1C057
IPA1C058
IPA1C059
IPA1C060
IPA1C061
IPA1C062
IPA1C063
IPA1C064
IPA1C065
IPA1C066
IPA1C067

```

```

SUBROUTINE INPTA2(PSI,SIGF,SIGC,SIGT,SIGX,NU,SD,SDIN,CHI,VINV,V,
INCMP,FUEL,XABS,XENON,IODINE,PB,LR,WPT,SIGCIN,SIGFIN,SIGTIN,SIGXIN)
IMPLICIT REAL*8 (A-H,O-Z)
INTEGER GF,GPLUS,GFPLUS,GRPLUS
INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,
1      UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,CUT,
2      P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,
3      SRCCE , SORG , SOZ , STEADY , STEP , TAGC , TAGF , TAGT
REAL*8 IODINE
REAL*8 LR,NU,NUSIGF,NX
COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL
COMMON /A2/NUM,NCOMP,BCL,BCR,MTZ,NTZ,XEN,STEADY
COMMON /A4/TIGHT1,TIGHT2,TIGHT3
COMMON/A5/IN,OUT,NERR
COMMON/A6/EP1,EP2,EP3,TSTINC,IEP4,IEP6
COMMON /A7/BETA(6),DECAY(6),BETDCY(6),DECH(6)
COMMON /A8/GAMAX,GAMAI
COMMON /B1/H,HP,TIME,TZ,ZERO,TZO,TIMZ
COMMON /C2/GF,GRPLUS
DIMENSION PSI(PT,GU)
DIMENSION XABS(REG,GRP)
DIMENSION XENON(REG),IODINE(REG)
DIMENSION VINV(GRP)
DIMENSION V(GRP)
DIMENSION PB(REG),LR(REG)
DIMENSION CHI(GRP)
DIMENSION FUEL(REG)
DIMENSION NCMP(REG)
DIMENSION SD(GRP,IDEL)
DIMENSION SDIN(GRP,IDEL)
DIMENSION WPT(NUM)
DIMENSION NU(GRP)
DIMENSION SIGC(REG,GRP),SIGF(REG,GRP),SIGT(REG,GRP),
1SIGX(REG,GRP,GRP)
DIMENSION SIGCIN(GRP),SIGFIN(GRP),SIGTIN(GRP)
DIMENSION SIGXIN(GRPLUS,GRP)

```

```

IPA2CC01
IPA20002
IPA2CC03
IPA2CC04
IPA2C005
IPA2C006
IPA2C007
IPA20008
IPA2C009
IPA2CC10
IPA2C011
IPA2C012
IPA2C013
IPA2C014
IPA2C015
IPA2C016
IPA2CC17
IPA2C018
IPA2C019
IPA2C020
IPA2C021
IPA2C022
IPA2CC23
IPA2CC24
IPA2C025
IPA2CC26
IPA2CC27
IPA2C028
IPA2C029
IPA2CC30
IPA2C031
IPA2C032
IPA2CC33
IPA2CC34
IPA2C035
IPA2CC36

```

```

DIMENSION IC(14)
ABS(X)=DABS(X)
FLCAT(I)=DFLOAT(I)
C ***** CARD 4 *****
READ (IN,350) (PB(R),R=1,REG)
WRITE (OUT,420) (PB(R),R=1,REG)
IF (REG.EQ.1) GO TO 120
N=REG-1
DO 110 R=1,N
IF (PB(R).GE.PB(R+1)) CALL ERR (1,1,4,R)
110 CONTINUE
C
C
120 IF (PT.NE.PB(REG).OR.PT.LT.1) CALL ERR(1,1, 3,6)
C ***** CARD 5 *****
READ (IN,360) (LR(R),R=1,REG)
WRITE (OUT,430) (LR(R),R=1,REG)
DO 130 R=1,REG
IF (LR(R).LE.0.0) CALL ERR (1,1,5,R)
130 CONTINUE
C ***** CARD 6 *****
READ (IN,350) (WPT(N),N=1,NUM)
WRITE (OUT,440) (WPT(N),N=1,NUM)
DO 140 N=1,NUM
140 IF (WPT(N).GT.PT) CALL ERR (1,2,WPT(N),0)
C
IF (DEL.EQ.0) GO TO 180
C ***** CARD 7 *****
READ (IN,360) (BETA(GP),GP=1,DEL)
WRITE (OUT,450) (BETA(GP),GP=1,DEL)
C
C ***** CARD 8 *****
DO 150 G=1,GRP
READ (IN,360) (SDIN(G,I),I=1,DEL)
WRITE (OUT,460) (SDIN(G,I),I=1,DEL)
150 CONTINUE

```

```

IPA2C037
IPA2C038
IPA2C039
IPA2C040
IPA2C041
IPA2C042
IPA2C043
IPA2C044
IPA2C045
IPA2C046
IPA2C047
IPA2C048
IPA2C049
IPA2C050
IPA2C051
IPA2C052
IPA2C053
IPA2C054
IPA2C055
IPA2C056
IPA2C057
IPA2C058
IPA2C059
IPA2C060
IPA2C061
IPA2C062
IPA2C063
IPA2C064
IPA2C065
IPA2C066
IPA2C067
IPA2C068
IPA2C069
IPA2C070
IPA2C071
IPA2C072

```

C	***** CARD 9 *****	IPA2C073
	READ (IN,360) (DECAY(GP),GP=1,DEL)	IPA2C074
	WRITE (OUT,470) (DECAY(I),I=1,DEL)	IPA2C075
	DO 170 GP=1,DEL	IPA2C076
	DO 160 G=1,GRP	IPA2C077
	160 SD(G,GP)=ABS(SCIN(G,GP)*DECAY(GP))	IPA2C078
	170 DECAY(GP)=-ABS(DECAY(GP))	IPA2C079
C		IPA2C080
	180 CONTINUE	IPA2C081
C	***** CARD 10 *****	IPA20082
	READ (IN,360) (CHI(G),G=1,GRP)	IPA2C083
	WRITE (OUT,480) (CHI(G),G=1,GRP)	IPA2C084
C		IPA20085
C	***** CARD 11 *****	IPA2C086
	READ (IN,360) (V(G),G=1,GRP)	IPA2C087
	WRITE (OUT,490) (V(G),G=1,GRP)	IPA2C088
	DO 190 G=1,GRP	IPA20089
	190 VINV(G)=1.0/V(G)	IPA2C090
C	***** CARD 12 *****	IPA2C091
	READ (IN,660) EP1,EP2,EP3,IEP4,IEP6,TSTINC	IPA20092
	WRITE (OUT,700) EP1,EP2,EP3,IEP4,IEP6,TSTINC	IPA2C093
	IF(EP1.LE.0.0) CALL ERR (1,1,12,1)	IPA2C094
	IF(EP2.LE.0.0) CALL ERR (1,1,12,2)	IPA2C095
	IF(IEP4.NE.0.AND.IEP4.NE.1) CALL ERR(1,1,12,5)	IPA2C096
	IF(IEP6.NE.0.AND.IEP6.NE.1) CALL ERR(1,1,12,6)	IPA2C097
	GFPLUS=GF+1	IPA2C098
C	***** CARD 13 *****	IPA20099
	READ (IN,350) (NCMP(R),R=1,REG)	IPA2C100
	WRITE (OUT,510) (NCMP(R),R=1,REG)	IPA20101
	DO 310 I=1,NCOMP	IPA20102
	DO 200 G=1,GRP	IPA20103
	SIGCIN(G)=0.0	IPA2C104
	SIGFIN(G)=0.0	IPA2C105
	SIGTIN(G)=0.0	IPA2C106
	DO 200 GP=1,GRP	IPA2C107
	200 SIGXIN(GP,G)=0.0	IPA20108

C	***** CARD 14 *****	IPA20109
	READ (IN,370) NUCNAM,(ID(K),K=1,14),I1,I2,I3	IPA20110
	WRITE (OUT,520) NUCNAM,(ID(K),K=1,14),I1,I2,I3	IPA20111
C	***** CARD 15 *****	IPA20112
	DC 210 G=1,GRP	IPA20113
	READ (IN,360) NU(G),SIGFIN(G),SIGCIN(G),SIGTIN(G),XX,SIGXIN(G+1,G)	IPA20114
	WRITE (OUT,530) NU(G),SIGFIN(G),SIGCIN(G),SIGTIN(G),XX,SIGXIN(G+1,	IPA20115
	1G)	IPA20116
210	CONTINUE	IPA20117
	INDX=I2+1	IPA20118
	GO TO (270,220,250), INDX	IPA20119
220	CONTINUE	IPA20120
C	FAST MATRIX	IPA20121
	IF (GF.EQ.0) GO TO 270	IPA20122
	DO 240 G=1,GF	IPA20123
	GPLUS=G+1	IPA20124
	IF (GPLUS.GT.GRP) GO TO 230	IPA20125
C	***** CARD 16 *****	IPA20126
	READ (IN,360) (SIGXIN(GP,G),GP=GPLUS,GFPLUS)	IPA20127
	WRITE (OUT,540) (SIGXIN(GP,G),GP=GPLUS,GFPLUS)	IPA20128
	GO TO 240	IPA20129
230	READ (IN,360) XX	IPA20130
240	CONTINUE	IPA20131
	GO TO 270	IPA20132
250	DO 260 G=1,GRP	IPA20133
C	***** CARD 17 *****	IPA20134
	READ (IN,360) (SIGXIN(GP,G),GP=1,GRP)	IPA20135
	WRITE (OUT,550) (SIGXIN(GP,G),GP=1,GRP)	IPA20136
260	CONTINUE	IPA20137
270	CONTINUE	IPA20138
C		IPA20139
C	ASSIGNMENT OF COMPOSITIONS TO REGIONS	IPA20140
C		IPA20141
	DO 300 R=1,REG	IPA20142
	IF (NCMP(R).NE.1) GO TO 300	IPA20143
	DO 290 G=1,GRP	IPA20144

SIGF(R,G)=SIGFIN(G)	IPA20145
SIGC(R,G)=SIGCIN(G)	IPA20146
SIGT(R,G)=SIGTIN(G)	IPA20147
DO 280 GP=1,GRP	IPA20148
280 SIGX(R,GP,G)=SIGXIN(GP,G)	IPA20149
290 CONTINUE	IPA20150
300 CONTINUE	IPA20151
310 CONTINUE	IPA20152
C	IPA20153
C SET FUEL(R)=0 FOR NON FISSION REGIONS	IPA20154
C	IPA20155
DO 311 R=1,REG	IPA20156
FUEL(R)=0	IPA20157
DO 311 G=1,GRP	IPA20158
IF(ABS(SIGF(R,G)).GT.ZERO) FUEL(R)=1	IPA20159
311 CONTINUE	IPA20160
C	IPA20161
IF (XEN.EQ.0) GO TO 330	IPA20162
C ***** CARD 18 *****	IPA20163
READ (IN,360) GAMAX,GAMAI	IPA20164
WRITE (OUT,560) GAMAX,GAMAI	IPA20165
C ***** CARD 19 *****	IPA20166
DO 320 R=1,REG	IPA20167
READ (IN,360) XENON(R),IODINE(R),(XABS(R,G),G=1,GRP)	IPA20168
WRITE(OUT,570) XENON(R),IODINE(R),(XABS(R,G),G=1,GRP)	IPA20169
320 CONTINUE	IPA20170
330 CONTINUE	IPA20171
IF (STEADY.EQ.2) GO TO 345	IPA20172
IPP=GRP	IPA20173
IF (STEADY.EQ.0) IPP=GU	IPA20174
DO 340 G=1,IPP	IPA20175
C ***** CARD 20 *****	IPA20176
READ (IN,360) (PSI(P,G),P=1,PT)	IPA20177
WRITE (OUT,580) (PSI(P,G),P=1,PT)	IPA20178
340 CONTINUE	IPA20179
345 CONTINUE	IPA20180

RETURN

C

```
350 FORMAT (12I6)
360 FORMAT (6E12.5)
370 FORMAT (15A4,3I4)
420 FORMAT (10HOCARD 04,2X,12I6/(12X,12I6))
430 FORMAT (10HOCARD 05 ,2X,6E12.6/(12X,6E12.6))
440 FORMAT (10HOCARD 06 ,2X,12I6/(12X,12I6))
450 FORMAT (10HOCARD 07 ,2X,6E12.6/(12X,6E12.6))
460 FORMAT (10HOCARD 08 ,2X,6E12.6/(12X,6E12.6))
470 FORMAT (10HOCARD 09 ,2X,6E12.6/(12X,6E12.6))
480 FORMAT (10HOCARD 10 ,2X,6E12.6/(12X,6E12.6))
490 FORMAT (10HOCARD 11 ,2X,6E12.6/(12X,6E12.6))
510 FORMAT (10HOCARD 13 ,2X,12I6/(12X,12I6))
520 FORMAT (10HOCARD 14 ,2X,15A4,3I4)
530 FORMAT (10HOCARD 15 ,2X,6E12.6)
540 FORMAT (10HOCARD 16 ,2X,6E12.6/(12X,6E12.6))
550 FORMAT (10HOCARD 17 ,2X,6E12.6/(12X,6E12.6))
560 FORMAT (10HOCARD 18 ,2X,6E12.6)
570 FORMAT (10HOCARD 19 ,2X,6E12.6)
580 FORMAT (10HOCARD 20 ,2X,6E12.6/(12X,6E12.6))
660 FORMAT (3E12.5,2I12,E12.5)
700 FORMAT (10HOCARD 12 ,2X,3E12.6,2I12,E12.6)
```

C

END

IPA20181
IPA20182
IPA20183
IPA20184
IPA20185
IPA20186
IPA20187
IPA20188
IPA20189
IPA20190
IPA20191
IPA20192
IPA20193
IPA20194
IPA20195
IPA20196
IPA20197
IPA20198
IPA20199
IPA20200
IPA20201
IPA20202
IPA20203
IPA20204
IPA20205

```

SUBROUTINE INPUTB(SOR,SORG,SRCEO ,SRCE1,STPRN,IPL,IPR,RTAG,TAGX,IN
ITAGT,TAGF,TAGC,CXL,CXQ,CTRL,CTRQ,CCL,CCQ,CFL,CFQ)      IN
IMPLICIT REAL*8 (A-H,O-Z)                                IN
INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,    IN
1      UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,CUT,
2      P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,IN
1      UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,CUT,
2      P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,
3      SORCE , SORG , SOZ , STEADY , STEP , TAGC , TAGF , TAGT
INTEGER RTAG
REAL*8 IODINE
REAL*8 LR,NU,NUSIGF,NX
COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL
COMMON /A3/PUNBAL,SORCE,GEOM,NTAG,NUM2,PUNFRS
COMMON/A5/IN,OUT,NERR
COMMON/A6/EP1,EP2,EP3,TSTINC,IEP4,IEP6
COMMON /B1/H,HP,TIME,TZ,ZERO,TZO,TIMZ
COMMON /B2/NPRT,NZ,ISX,STEP,NZSAVE,PRBEND,IPRN
DIMENSION IPL(REG),IPR(REG)
DIMENSION STPRN(50)
DIMENSION SOR(REG),SORG(REG,GRP),SRCEO(PT,GRP),SRCE1(PT,GRP)
DIMENSION RTAG(REG)
DIMENSION TAGC(REG),TAGF(REG),TAGT(REG),TAGX(REG)
DIMENSION CCL(REG,GRP),CCQ(REG,GRP),CFL(REG,GRP),CFQ(REG,GRP),
1CTRL(REG,GRP),CTRQ(REG,GRP),CXL(REG),CXQ(REG)
FLOAT(I)=DFLOAT(I)
TZO=TZ
STEP=0
NPRT=1
DO 11 R=1,REG
TAGX(R)=0
TAGT(R)=0
TAGC(R)=0
TAGF(R)=0
CXQ(R)=0.0
DO 11 G=1,GRP

```

```

IPB C001
IPB C002
IPB C003
IPB C004
IPB C005
IPB C006
IPB C007
IPB C008
IPB C009
IPB C010
IPB C011
IPB C012
IPB C013
IPB C014
IPB C015
IPB C016
IPB C017
IPB C018
IPB C019
IPB C020
IPB C021
IPB C022
IPB C023
IPB C024
IPB C025
IPB C026
IPB C027
IPB C028
IPB C029
IPB C030
IPB C031
IPB C032
IPB C033
IPB C034
IPB C035
IPB C036

```

CTRQ(R,G)=0.0	IPB C037
CCQ(R,G)=0.0	IPB C038
11 CFQ(R,G)=0.0	IPB C039
WRITE (OUT,510) NZ	IPB C040
C ***** CARD 21 *****	IPB C041
READ (IN,650) HBEGIN,IH,TZ,IPRN,NUM2,NTAG,SORCE,IEP4,IEP6	IPB C042
WRITE(OUT,670) HBEGIN,IH,TZ,IPRN,NUM2,NTAG,SORCE,IEP4,IEP6	IPB C043
IF(IH.NE.0.AND.IH.NE.1) CALL ERR(1,1,21,2)	IPB C044
IF(NZ.EQ.1.AND.IH.NE.1) CALL ERR(1,1,21,2)	IPB C045
IF(IH.EQ.0) GO TO 15	IPB C046
H=HBEGIN	IPB C047
HP=HBEGIN	IPB C048
15 CONTINUE	IPB C049
ISX=0	IPB C050
IF(TZ.LE.0.000) ISX=1	IPB C051
TZ=DABS(TZ)	IPB C052
IF (TZ.LT.TZ0) CALL ERR (1,1,21,3)	IPB C053
IF (IPRN.LT.0) CALL ERR (1,1,21,4)	IPB C054
IF(IABS(NUM2).GT.50) CALL ERR (1,1,21,5)	IPB C055
IF ((NTAG.LT.-2).OR.(NTAG.GT.REG)) CALL ERR (1,1,21,6)	IPB C056
IF ((SORCE.LT.-2).OR.(SORCE.GT.REG)) CALL ERR (1,1,21,7)	IPB C057
C IF (NUM2) 110,140,120	IPB C058
110 NUM2=-NUM2	IPB C059
C ***** CARD 22 *****	IPB C060
READ (IN,490) (STPRN(N),N=1,NUM2)	IPB C061
WRITE (OUT,530) (STPRN(N),N=1,NUM2)	IPB C062
STPRN(NUM2+1)=TZ	IPB C063
GO TO 160	IPB C064
120 X=(TZ-TZ0)/NUM2	IPB C065
STPRN(1)=TZ0+X	IPB C066
DO 130 N=2,NUM2	IPB C067
130 STPRN(N)=STPRN(N-1)+X	IPB C068
GO TO 160	IPB C069
140 CONTINUE	IPB C070
DO 150 N=1,50	IPB C071
	IPB C072

150	STPRN(N)=0.0	IPB C073
160	CONTINUE	IPB C074
	DO 170 R=1,REG	IPB C075
170	RTAG(R)=1	IPB C076
	IF (NTAG) 270,240,180	IPB C077
180	CONTINUE	IPB C078
	DO 230 II=1,NTAG	IPB C079
C	***** CARD 23 *****	IPB C080
	READ (IN,480) R,TAGX(R),TAGT(R),TAGC(R),TAGF(R)	IPB C081
	WRITE (OUT,540) R,TAGX(R),TAGT(R),TAGC(R),TAGF(R)	IPB C082
	RTAG(R)=-1	IPB C083
	IF (TAGX(R).EQ.0) GO TO 190	IPB C084
C	***** CARD 24 *****	IPB C085
	READ (IN,490) CXL(R),CXQ(R)	IPB C086
	WRITE (OUT,550) CXL(R),CXQ(R)	IPB C087
C	***** CARD 25 *****	IPB C088
190	IF (TAGT(R).EQ.0) GO TO 200	IPB C089
	IF (TAGT(R).EQ.3) GO TO 195	IPB C090
	READ (IN,490) (CTRL(R,G),G=1,GRP)	IPB C091
	WRITE (OUT,560) (CTRL(R,G),G=1,GRP)	IPB C092
C	***** CARD 26 *****	IPB C093
195	IF (TAGT(R).LT.2) GO TO 200	IPB C094
	READ (IN,490) (CTRQ(R,G),G=1,GRP)	IPB C095
	WRITE (OUT,570) (CTRQ(R,G),G=1,GRP)	IPB C096
C	***** CARD 27 *****	IPB C097
200	IF (TAGC(R).EQ.0) GO TO 210	IPB C098
	IF (TAGC(R).EQ.3) GO TO 205	IPB C099
	READ (IN,490) (CCL(R,G),G=1,GRP)	IPB 0100
	WRITE (OUT,580) (CCL(R,G),G=1,GRP)	IPB 0101
C	***** CARD 28 *****	IPB 0102
205	IF (TAGC(R).LT.2) GO TO 210	IPB 0103
	READ (IN,490) (CCQ(R,G),G=1,GRP)	IPB 0104
	WRITE (OUT,610) (CCQ(R,G),G=1,GRP)	IPB 0105
C	***** CARD 29 *****	IPB 0106
210	IF (TAGF(R).EQ.0) GO TO 220	IPB 0107
	IF (TAGF(R).EQ.3) GO TO 215	IPB 0108

```

      READ (IN,490) (CFL(R,G),G=1,GRP)
      WRITE (OUT,620) (CFL(R,G),G=1,GRP)
C ***** CARD 30 *****
215 IF (TAGF(R).LT.2) GO TO 220
      READ (IN,490) (CFQ(R,G),G=1,GRP)
      WRITE (OUT,630) (CFQ(R,G),G=1,GRP)
220 CONTINUE
230 CONTINUE
240 DO 260 R=1,REG
      IF (RTAG(R).LT.0) GO TO 260
      TAGX(R)=0
      TAGT(R)=0
      TAGC(R)=0
      TAGF(R)=0
      CXL(R)=0.0
      CXQ(R)=0.0
      DO 250 G=1,GRP
        CTRL(R,G)=0.0
        CTRQ(R,G)=0.0
        CCL(R,G)=0.0
        CCQ(R,G)=0.0
        CFL(R,G)=0.0
        CFQ(R,G)=0.0
250 CONTINUE
260 CONTINUE
270 CONTINUE
      DO 280 R=1,REG
280 RTAG(R)=1
      IF (SORCE) 430,440,290
290 DO 400 N=1,SORCE
C ***** CARD 31 *****
      READ (IN,480) R,SOR(R)
      WRITE (OUT,640) R,SOR(R)
      RTAG(R)=-1
      PL=IPL(R)
      PR=IPR(R)

```

```

IPB C109
IPB C110
IPB C111
IPB C112
IPB C113
IPB C114
IPB C115
IPB C116
IPB C117
IPB C118
IPB C119
IPB C120
IPB C121
IPB C122
IPB C123
IPB C124
IPB C125
IPB C126
IPB C127
IPB C128
IPB C129
IPB C130
IPB C131
IPB C132
IPB C133
IPB C134
IPB C135
IPB C136
IPB C137
IPB C138
IPB C139
IPB C140
IPB C141
IPB C142
IPB C143
IPB C144

```

```

      IF (SOR(R)-1) 340,300,320
C ***** CARD 32 *****
300 DO 310 G=1,GRP
      READ (IN,490) ( SRCEO(P,G),SRCE1(P,G) ,P=PL,PR)
      WRITE (OUT,590) ( SRCEO(P,G),SRCE1(P,G) ,P=PL,PR)
310 CONTINUE
      GO TO 370
320 K=PL
C ***** CARD 33 *****
      READ (IN,490) ( SRCEO(K,G),SRCE1(K,G) ,G=1,GRP)
      WRITE (OUT,600) ( SRCEO(K,G),SRCE1(K,G) ,G=1,GRP)
      DO 330 P=PL,PR
      DO 330 G=1,GRP
      SRCEO(P,G)=SRCEO(K,G)
      SRCE1(P,G)=SRCE1(K,G)
330 CONTINUE
      GO TO 370
340 CONTINUE
      DO 350 P=PL,PR
      DO 350 G=1,GRP
350 SRCE1(P,G)=0.0
      DO 360 G=1,GRP
360 SORG(R,G)=0.0
      GO TO 400
370 DO 390 G=1,GRP
      SORG(R,G)=0.0
      DO 380 P=PL,PR
380 IF ((SRCEO(P,G).NE.0).OR.(SRCE1(P,G).NE.0)) SORG(R,G)=1
390 CONTINUE
400 CONTINUE
      DO 420 R=1,REG
      IF (RTAG(R).LT.0) GO TO 420
      PL=IPL(R)
      PR=IPR(R)
      DO 410 G=1,GRP
      SORG(R,G)=0

```

```

IPB 0145
IPB 0146
IPB 0147
IPB 0148
IPB 0149
IPB 0150
IPB 0151
IPB 0152
IPB 0153
IPB 0154
IPB 0155
IPB 0156
IPB 0157
IPB 0158
IPB 0159
IPB 0160
IPB 0161
IPB 0162
IPB 0163
IPB 0164
IPB 0165
IPB 0166
IPB 0167
IPB 0168
IPB 0169
IPB 0170
IPB 0171
IPB 0172
IPB 0173
IPB 0174
IPB 0175
IPB 0176
IPB 0177
IPB 0178
IPB 0179
IPB 0180

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```

      DO 410 P=PL,PR
      SRCEO(P,G)=0.0
410  SRCE1(P,G)=0.0
420  CONTINUE
430  RETURN
440  DO 470 G=1,GRP
      DO 450 P=1,PT
      SRCEO(P,G)=0.0
450  SRCE1(P,G)=0.0
      DO 460 R=1,REG
460  SORG(R,G)=0
470  CONTINUE
      RETURN

```

C

```

480  FORMAT (12I6)
490  FORMAT (6E12.5)
510  FORMAT (1H1,24X,28H*** INPUT EDIT FOR TIME ZONE,I2,4H ***)
530  FORMAT (10HOCARD 22 ,2X,6E12.6/(12X,6E12.6))
540  FORMAT (10HOCARD 23 ,2X,12I6)
550  FORMAT (10HOCARD 24 ,2X,2E12.6)
560  FORMAT (10HOCARD 25 ,2X,6E12.6/(12X,6E12.6))
570  FORMAT (10HOCARD 26 ,2X,6E12.6/(12X,6E12.6))
580  FORMAT (10HOCARD 27 ,2X,6E12.6/(12X,6E12.6))
590  FORMAT (10HOCARD 32 ,2X,6E12.6/(12X,6E12.6))
600  FORMAT (10HOCARD 33 ,2X,2E12.6/(12X,2E12.6))
610  FORMAT (10HOCARD 28 ,2X,6E12.6/(12X,6E12.6))
620  FORMAT (10HOCARD 29 ,2X,6E12.6/(12X,6E12.6))
630  FORMAT (10HOCARD 30 ,2X,6E12.6/(12X,6E12.6))
640  FORMAT (10HOCARD 31 ,2X,2I6)
650  FORMAT (E12.5,I12,E12.5,6I6)
670  FORMAT (10HOCARD 21 ,2X,E12.6,I12,E12.6,6I6)
      END

```

```

IPB 0181
IPB 0182
IPB 0183
IPB 0184
IPB 0185
IPB 0186
IPB 0187
IPB 0188
IPB 0189
IPB 0190
IPB 0191
IPB 0192
IPB 0193
IPB 0194
IPB 0195
IPB 0196
IPB 0197
IPB 0198
IPB 0199
IPB 0200
IPB 0201
IPB 0202
IPB 0203
IPB 0204
IPB 0205
IPB 0206
IPB 0207
IPB 0208
IPB 0209
IPB 0210
IPB 0211
IPB 0212

```

```

SUBROUTINE ITER(PSI,CM,CP,SIGX,PB,IPL,IPR,XL,XR,SDIN,FUEL,
INX,NUSIGF,UPSCAT,DNSCAT,DD,DL,DU,WA,GA)
  IMPLICIT REAL*8 (A-H,O-Z)
  INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,
1      UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GC,GL,GU,GRP,GPU,OUT,
2      P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,
3      SORCE , SORG , SOZ , STEADY , STEP , TAGC , TAGF , TAGT
  REAL*8 LR,NU,NUSIGF,NX
  COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL
  COMMON /A2/NUM,NCOMP,BCL,BCR,MTZ,NTZ,XEN,STEADY
  COMMON /A7/BETA(6),DECAY(6),BETDCY(6),DECH(6)
  COMMON /B2/NPRT,NZ,ISX,STEP,NZSAVE,PRBEND,IPRN
  DIMENSION PSI(PT,GRP)
  DIMENSION IPL(REG),IPR(REG),PB(REG),XL(REG),XR(REG)
  DIMENSION CM(PT,GRP),CP(PT,GRP)
  DIMENSION DD(PT),DL(PT),DU(PT)
  DIMENSION SIGX(REG,GRP,GRP)
  DIMENSION FUEL(REG),NX(GRP)
  DIMENSION SDIN(GRP,IDEL)
  DIMENSION NUSIGF(REG,GRP),UPSCAT(REG,GRP),DNSCAT(REG,GRP)
  DIMENSION WA(PT),GA(PT)
C  THIS ROUTINE PERFORMS 1 FLUX ITERATION
  DO 500 G=1,GRP
200  BAR=0.0
    IF(DEL.EQ.0) GO TO 204
    DO 203 I=1,DEL
203  BAR=BAR+BETA(I)*SDIN(G,I)
204  BAR=BAR+NX(G)
    DO 110 P=1,PT
      DD(P)=CM(P,G)+CP(P,G)
      DU(P)=-CP(P,G)
110  DL(P)=-CM(P,G)
      IF(BCL.EQ.1) GO TO 120
      DD(1)=1.000
      DU(1)=0.0
      GO TO 130

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ITERC001
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ITERC035
ITERC036

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120 DD(1)=CD(1)+SIGX(1,G,G)
130 Z=SIGX(1,G,G)
    PL=2
    PR=IPR(1)
    DO 140 P=PL,PR
140 DD(P)=CD(P)+Z
    I2=PB(1)
    DC(I2)=CD(I2)+Z*XL(1)
    IF(REG-1) 190,190,150
150 DO 170 R=2,REG
    Z=SIGX(R,G,G)
    I1=PB(R-1)
    DD(I1)=CD(I1)+Z*XR(R-1)
    I1=PB(R)
    CD(I1)=CD(I1)+Z*XL(R)
    PL=IPL(R)
    PR=IPR(R)
    DO 160 P=PL,PR
160 DD(P)=CD(P)+Z
170 CONTINUE
    IF(BCR.EQ.1) GO TO 180
    DD(PT)=1.000
    DL(PT)=0.0
    GO TO 190
180 DD(PT)=CD(PT)+SIGX(REG,G,G)
190 CONTINUE
    PL=1
    IF(BCL.EQ.0) PL=2
    DO 400 R=1,REG
    PR=IPR(R)
    IF((R.EQ.REG).AND.(BCR.EQ.1)) PR=PT
    DO 400 P=PL,PR
    PSI(P,G)=PRGD(P,R,G,PSI,NUSIGF,SIGX,FUEL,UPSCAT,DNSCAT,BAR)
400 CONTINUE
    PL=PR+2
450 CONTINUE

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ITERC037
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ITERC070
ITERC071
ITERC072

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      IF(REG.EQ.1) GO TO 460
      DC 455 R=2,REG
      P=PB(R-1)
      JR1=R-1
455   PSI(P,G)=PROD(P,JR1,G,PSI,NUSIGF,SIGX,FUEL,UPSCAT,ONSCAT,BAR)
      1*XL(R-1)+PROD(P, R ,G,PSI,NUSIGF,SIGX,FUEL,UPSCAT,ONSCAT,BAR)*
      2XR(R-1)
460   CONTINUE
      IF(BCL.EQ.0) PSI(1,G)=0.0
      IF(BCR.EQ.0) PSI(PT,G)=0.0
      CALL      MATINV(G,PT,GRP,PSI,DU,DL,DD,WA,GA)
500   CONTINUE
      RETURN
      END

```

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ITERC073
ITERC074
ITERC075
ITERC076
ITERC077
ITERC078
ITERC079
ITERC080
ITERC081
ITERC082
ITERC083
ITERC084
ITERC085
ITERC086

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	SUBROUTINE LHS(G,DU,DL,DD,CP,CM,TI1,VINV,FF2,XL,XR,IPL,IPR,PB)	LHS C001
C	THIS ROUTINE EVALUATES THE TRI-DIAGONAL MATRIX FOR THE LEFT-HAND	LHS C002
C	SIDE OF THE ALGORITHM FOR GROUP G	LHS C003
	IMPLICIT REAL*8 (A-H,O-Z)	LHS C004
	INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,	LHS C005
1	UPSCAT,WPT, FUEL,G,GECM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,CUT,	LHS C006
2	P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,	LHS C007
3	SCRCE , SCRG , SCZ , STEADY , STEP , TAGC , TAGF , TAGT	LHS C008
	REAL*8 LR,NU,NUSIG,NX	LHS C009
	COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL	LHS C010
	COMMON /A2/NUM,NCCMP,BCL,BCR,MTZ,NTZ,XEN,STEADY	LHS C011
	DIMENSION FF2(PT)	LHS C012
	DIMENSION VINV(GRP)	LHS C013
	DIMENSION TI1(REG)	LHS C014
	DIMENSION IPL(REG),IPR(REG),XL(REG),XR(REG)	LHS C015
	DIMENSION PB(REG)	LHS C016
	DIMENSION CM(PT,GRP),CP(PT,GRP)	LHS C017
	DIMENSION DC(PT),CL(PT),CU(PT)	LHS C018
	PL=2	LHS C019
	DO 1 R=1,REG	LHS C020
	PR=IPR(R)	LHS C021
	T1=TI1(R)	LHS C022
	DO 2 P=PL,PR	LHS C023
	DU(P)=-CP(P,G)*FF2(P+1)	LHS C024
	DL(P)=-CM(P,G)*FF2(P-1)	LHS C025
	DD(P)=VINV(G)+(CM(P,G)+CP(P,G)-T1)*	LHS C026
	1FF2(P)	LHS C027
2	CONTINUE	LHS C028
1	PL=PR+2	LHS C029
	DO 3 R=1,REG	LHS C030
	IF(R-1) 5,4,5	LHS C031
4	IF(BCL.EQ.1) GO TO 65	LHS C032
	DD(1)=VINV(G)	LHS C033
	DU(1)=0.0	LHS C034
	GO TO 5	LHS C035
65	DD(1)=VINV(G)+(CM(1,G)+CP(1,G)-	LHS C036

	1TI1(1))*FF2(1)	LHS C037
	DU(1)=-CP(1,G)*FF2(2)	LHS C038
5	IF(R.EQ.REG) GO TO 3	LHS C039
	P=PB(R)	LHS C040
	T1=TI1(R)*XL(R)+TI1(R+1)*XR(R)	LHS C041
	DD(P)=VINV(G)+(CM(P,G)+CP(P,G)-T1)*FF2(P)	LHS C042
	DU(P)=-CP(P,G)*FF2(P+1)	LHS C043
	DL(P)=-CM(P,G)*FF2(P-1)	LHS C044
3	CONTINUE	LHS C045
	IF(BCR.EQ.1) GO TO 33	LHS C046
	DD(PT)=VINV(G)	LHS C047
	DL(PT)=0.0	LHS C048
	GO TO 605	LHS C049
33	DD(PT)=VINV(G)+(CP(PT,G)+CM(PT,G)-	LHS C050
	1TI1(REG))*FF2(PT)	LHS C051
	DL(PT)=-CM(PT,G)*FF2(PT)	LHS C052
605	CONTINUE	LHS C053
	RETURN	LHS C054
	END	LHS C055

```

SUBROUTINE MATINV(G,PT,GRP,PSI,DU,DL,DD,WA,GA)
IMPLICIT REAL*8 (A-H,O-Z)
INTEGER P,G,PT,GRP,PL
DIMENSION PSI(PT,GRP)
DIMENSION DD(PT),DL(PT),DU(PT)
DIMENSION WA(PT),GA(PT)
C THIS ROUTINE EVALUATES THE FUNCTION AT THE NEW TIME BY INVERTING
C THE LEFT-HAND SIDE MATRIX. MATRIX FACTORIZATION IS USED.
C FIRST THE FORWARD ELIMINATION
WA(1)=DU(1)/DD(1)
GA(1)=PSI(1,G)/DD(1)
DO 110 P=2,PT
T1=1.000/(DD(P)-DL(P)*WA(P-1))
IF(P.EQ.PT)GO TO 150
WA(P)=DU(P)*T1
150 GA(P)=(PSI(P,G)-DL(P)*GA(P-1))*T1
110 CCNTINUE
C NOW THE BACK SUBSTITUTION
PSI(PT,G)=GA(PT)
PL=PT-1
DO 120 J=1,PL
P=PT-J
PSI(P,G)=GA(P)-WA(P)*PSI(P+1,G)
120 CCNTINUE
RETURN
END

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MINVC001
MINVC002
MINVC003
MINVC004
MINVC005
MINVC006
MINVC007
MINVC008
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MINVC011
MINVC012
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MINVC014
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MINVC020
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MINVC023
MINVC024
MINVC025
MINVC026

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SUBROUTINE PREC(G,PSI,NUSIGF,FF2,FUEL,XL,XR,PB,IPL,IPR,TD)
IMPLICIT REAL*8 (A-H,O-Z)
INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,
1      UPSCAT,WPT, FUEL,G,GECM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,CUT,
2      P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,
3      SORCE , SORG , SOZ , STEADY , STEP , TAGC , TAGF , TAGT
REAL*8 LR,NU,NUSIGF,NX
COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL
COMMON /A2/NUM,NCOMP,BCL,BCR,MTZ,NTZ,XEN,STEADY
COMMON /A7/BETA(6),DECAY(6),BETDCY(6),DECH(6)
DIMENSION PSI(PT,CU)
DIMENSION FF2(PT)
DIMENSION IPL(REG),IPR(REG),PB(REG),XL(REG),XR(REG)
DIMENSION FUEL(REG)
DIMENSION TD(GRP)
DIMENSION NUSIGF(REG,GRP)
C      THIS ROUTINE CALCULATES THE PRECURSOR CONCENTRATIONS IN THE
C      INTERIOR OF EACH REGION FOR PRECURSOR GROUP G
J=G-GRP
X5=DECAY(J)
X6=DECH(J)
DO 17 R=1,REG
PL=IPL(R)
IF (R.EQ.1) PL=1
PR=IPR(R)
IF (R.EQ.REG) PR=PT
IF(FUEL(R)) 13,11,13
11 DO 12 P=PL,PR
PSI(P,G)=0.0
12 CONTINUE
GO TO 17
13 DO 14 GP=1,GRP
14 TD(GP)=NUSIGF(R,GP)*BETA(J)
DO 16 P=PL,PR
T1=0.0
T2=0.0

```

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PRECC001
PRECC002
PRECC003
PRECC004
PRECC005
PRECC006
PRECC007
PRECC008
PRECC009
PRECC010
PRECC011
PRECC012
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PRECC014
PRECC015
PRECC016
PRECC017
PRECC018
PRECC019
PRECC020
PRECC021
PRECC022
PRECC023
PRECC024
PRECC025
PRECC026
PRECC027
PRECC028
PRECC029
PRECC030
PRECC031
PRECC032
PRECC033
PRECC034
PRECC035
PRECC036

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      DO 15 GP=1,GRP
      Y=FF2(P)
      T2=T2+TD(GP)*PSI(P,GP)*Y
15  CONTINUE
      PSI(P,G)=X6*PSI(P,G)+T2
16  CONTINUE
17  CONTINUE
      IF(BCL.EQ.0) PSI(1,G)=0.0
      IF(BCR.EQ.0) PSI(PT,G)=0.0
C    THIS ROUTINE CALCULATES THE PRECURSOR CONCENTRATIONS AT THE
C    BOUNDARY POINTS OF THE REGIONS IN PRECURSOR GROUP G
      X8=BETA(J)
      IP=REG-1
      DO 160 R=1,IP
      P=PB(R)
      IF (FUEL(R)) 130,110,130
110  IF (FUEL(R+1)) 130,120,130
120  PSI(P,G)=0.0
      GO TO 160
130  X1=XL(R)
      X2=XR(R)
      DO 140 GP=1,GRP
      TD(GP)=(NUSIGF(R,GP)*X1+NUSIGF(R+1,GP)*X2)*X8
140  CONTINUE
      T1=0.0
      T2=0.0
      Y=FF2(P)
      DO 150 GP=1,GRP
      T2=T2+TD(GP)*PSI(P,GP)*Y
150  CONTINUE
      PSI(P,G)=X6*PSI(P,G)+T2
160  CONTINUE
      RETURN
      END

```

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PRECC037
PRECC038
PRECC039
PRECC040
PRECC041
PRECC042
PRECC043
PRECC044
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PRECC046
PRECC047
PRECC048
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PRECC050
PRECC051
PRECC052
PRECC053
PRECC054
PRECC055
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PRECC057
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PRECC060
PRECC061
PRECC062
PRECC063
PRECC064
PRECC065
PRECC066
PRECC067
PRECC068
PRECC069
PRECC070

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SUBROUTINE PRINTA(PSI,PSITOT,POWREG,WPT,WZ,WHZ)	PRINC001
IMPLICIT REAL*8 (A-H,O-Z)	PRINC002
INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,	PRINC003
1 UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,OUT,	PRINC004
2 P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,	PRINC005
3 SORCE , SORG , SOZ , STEADY , STEP , TAGC , TAGF , TAGT	PRINC006
COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL	PRINC007
COMMON /A2/NUM,NCOMP,BCL,BCR,MTZ,NTZ,XEN,STEADY	PRINC008
COMMON/A5/IN,OUT,NERR	PRINC009
COMMON /A9/POWTOT,POWBAR	PRINC010
COMMON /B1/H,HP,TIME,TZ,ZERO,TZO,TIMZ	PRINC011
COMMON /B2/NPRT,NZ,ISX,STEP,NZSAVE,PRBEND,IPRN	PRINC012
DIMENSION PSI(PT,GU)	PRINC013
DIMENSION PSITOT(REG,GRP)	PRINC014
DIMENSION POWREG(REG)	PRINC015
DIMENSION WHZ(PT)	PRINC016
DIMENSION WZ(PT)	PRINC017
DIMENSION WPT(NUM)	PRINC018
WRITE (OUT,140)	PRINC019
CALL TITLE (2)	PRINC020
WRITE (OUT,130) NZ,STEP,TIME,HP	PRINC021
TPRT=TIME	PRINC022
WRITE (OUT,150)	PRINC023
DO 110 N=1,NUM	PRINC024
P=WPT(N)	PRINC025
109 WRITE (OUT,240) N,P,WZ(P),WHZ(P)	PRINC026
110 CONTINUE	PRINC027
IGPT=GU	PRINC028
IF((DABS(TIME-TZ)).LE.ZERO) GO TO 2	PRINC029
IF(ISX.GT.0) IGPT=GRP	PRINC030
2 CONTINUE	PRINC031
DO 120 G=1,IGPT	PRINC032
IF(G.LE.GRP) GO TO 111	PRINC033
IG9=G-GRP	PRINC034
WRITE (OUT,221) IG9	PRINC035
GO TO 112	PRINC036

```

111 WRITE (OUT,220) G
112 WRITE (OUT,230) (P,PSI(P,G),P=1,PT)
    IF(G.GT.GRP) GO TO 120
    WRITE (OUT,222) (R,G,PSITOT(R,G),R=1,REG)
120 CCNTINUE
    WRITE(OUT,121)
    WRITE(OUT,122)(R,POWREG(R),R=1,REG)
    WRITE(OUT,123)PCWTCT
121 FORMAT(1H0,10X,'REGION',10X,'NORMALIZED POWER',/)
122 FORMAT(13X,12,12X,E14.7)
123 FORMAT(1H0,10X,'TCTAL NORMALIZED POWER = ',E14.7)
130 FORMAT (12H0 TIME ZONE=12,14H STEP NUMBER=14,7H TIME=,E12.6,12H
    1 TIME STEP=,E12.6)
140 FORMAT (1H0)
150 FORMAT (1H0/11H TEST POINT,6X,10HMESH POINT,6X,9HFREQUENCY,9X,8HEX
    1P(W*H),1H )
220 FORMAT (30HOPPOINT-WISE FLUXES FOR GROUP ,I3)
221 FORMAT(44HOPRECURSOR CCNCENTRATION FOR DELAYED GROUP ,I2)
222 FORMAT(34HOTOTAL INTEGRATED FLUX FOR REGION ,I2,7H GROUP ,I2,
    13H = ,E12.6)
230 FORMAT ((2X,6(1H(,I3,2H) ,1PE12.6)))
240 FORMAT(4X,I3,13X,I3,9X,1P1E11.4,6X,1P1E13.6,14X,I3)
    RETURN
    END

```

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PRINC037
PRINC038
PRINC039
PRINCC40
PRINCC41
PRINC042
PRINC043
PRINCC44
PRINC045
PRINC046
PRINC047
PRINC048
PRINC049
PRINCC50
PRINC051
PRINC052
PRINC053
PRINC054
PRINC055
PRINC056
PRINCC57
PRINC058
PRINC059
PRINC060

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```

FUNCTION PROD(P, R ,G,PSI,NUSIGF,SIGX,FUEL,UPSCAT,DNSCAT,BAR)
  IMPLICIT REAL*8 (A-H,O-Z)
  INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,
1      UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,CUT,
2      P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,
3      SORCE , SORG , SOZ , STEADY , STEP , TAGC , TAGF , TAGT
  REAL*8 LR,NUSIGF
  COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL
  DIMENSION PSI(PT,GRP)
  DIMENSION DNSCAT(REG,GRP),UPSCAT(REG,GRP)
  DIMENSION FUEL(REG)
  DIMENSION NUSIGF(REG,GRP)
  DIMENSION SIGX(REG,GRP,GRP)
  X=0.0
  IF(FUEL(R).EQ.0) GO TO 215
205  IF(BAR.EQ.0.0) GO TO 215
      DO 210 GP=1,GRP
210  X=X+BAR*NUSIGF(R,GP)*PSI(P,GP)
215  IF(UPSCAT(R,G)) 220,250,220
220  GPL=G+1
      GPU=UPSCAT(R,G)
      DO 230 GP=GPL,GPU
230  X=X+SIGX(R,G,GP)*PSI(P,GP)
250  IF(DNSCAT(R,G)) 255,270,255
255  GPL=DNSCAT(R,G)
      GPU=G-1
      DO 260 GP=GPL,GPU
260  X=X+SIGX(R,G,GP)*PSI(P,GP)
270  PROD=X
      RETURN
      END

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PRC0C001
PRC0C002
PRC0C003
PRC0C004
PRC0C005
PRC0C006
PRC0C007
PRC0C008
PRC0C009
PRC0C010
PRC0C011
PRC0C012
PRC0C013
PRC0C014
PRC0C015
PRC0C016
PRC0C017
PRC0C018
PRC0C019
PRC0C020
PRC0C021
PRC0C022
PRC0C023
PRC0C024
PRC0C025
PRC0C026
PRC0C027
PRC0C028
PRC0C029
PRC0C030
PRC0C031

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SUBROUTINE PUN(PSI,NU,SIGF,SIGC,SIGT,SIGX,XENON,IODINE)
IMPLICIT REAL*8 (A-H,O-Z)
INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,
1      UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,CUT,
2      P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,
3      SORCE , SORG , SOZ , STEADY , STEP , TAGC , TAGF , TAGT
REAL*8 IODINE
REAL*8 LR,NU,NUSIGF,NX
COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL
COMMON /A2/NUM,NCOMP,BCL,BCR,MTZ,NTZ,XEN,STEADY
DIMENSION PSI(PT,GU)
DIMENSION NU(GRP)
DIMENSION XENON(REG),IODINE(REG)
DIMENSION SIGC(REG,GRP),SIGF(REG,GRP),SIGT(REG,GRP),
1SIGX(REG,GRP,GRP)
XX=0.0
I1=0
I2=2
I3=0
ASSIGN 120 TO NSWCH
IF (GRP.EQ.1) ASSIGN 160 TO NSWCH
NGRP=GRP-1
DO 180 R=1,REG
PUNCH 110, R,I1,I2,I3
110 FORMAT (10H REGION ,I3,47X,3I4)
GO TO NSWCH, (120,160)
120 DO 150 G=1,NGRP
PUNCH 190, NU(G),SIGF(R,G),SIGC(R,G),SIGT(R,G),XX,SIGX(R,G+1,G)
DO 130 K=1,GRP
130 SIGX(R,K,K)=0.0
DO 140 K=1,GRP
140 PUNCH 190, (SIGX(R,GP,K),GP=1,GRP)
150 CONTINUE
PUNCH 190, NU(GRP),SIGF(R,GRP),SIGC(R,GRP),SIGT(R,GRP),XX,XX
PUNCH 190, (SIGX(R,GP,GRP),GP=1,NGRP),XX
GO TO 170

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```

PUN 0001
PUN CC02
PUN CC03
PUN CC04
PLN CC05
PUN CC06
PUN CC07
PUN CCC8
PUN CCC9
PUN C010
PUN C011
PUN C012
PUN C013
PUN C014
PUN C015
PUN C016
PUN C017
PLN C018
PUN CC19
PUN C020
PUN C021
PUN C022
PUN C023
PUN C024
PUN C025
PUN C026
PUN C027
PUN C028
PUN C029
PUN C030
PUN C031
PUN C032
PUN C033
PUN 0034
PLN C035
PUN C036

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```

160 PUNCH 190, NU(1),SIGF(R,1),SIGC(R,1),SIGT(R,1),XX,XX
    PUNCH 190, XX
170 CONTINUE
180 CONTINUE
190 FORMAT (6E12.7)
    IF (XEN.EQ.0) GO TO 220
    DO 210 R=1,REG
    IF ((XENON(R).NE.0.0).OR.(IODINE(R).NE.0.0)) PUNCH 200, R,XENON(R)
    1, IODINE(R)
200 FORMAT (I6,6X,2E12.7)
210 CONTINUE
220 DO 230 G=1,GU
    PUNCH 190, (PSI(P,G) ,P=1,PT)
230 CONTINUE
    RETURN
    END

```

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PUN C037
PUN C038
PUN C039
PUN C040
PUN C041
PUN C042
PUN C043
PUN C044
PUN C045
PUN C046
PUN C047
PUN C048
PUN C049
PUN C050
PUN C051
PUN C052

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SUBROUTINE RESCAL(X,PSI)
IMPLICIT REAL*8 (A-H,O-Z)
INTEGER G,GRP,REG,PT,GL,GU,DEL,THG,IDEL,P
COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL
DIMENSION PSI(PT,GRP)
CALL      SCALE(Y,PSI)
Y=X/Y
DO 110 G=1,GRP
DO 110 P=1,PT
110 PSI(P,G)=PSI(P,G)*Y
RETURN
END

```

```

RESCC001
RESCC002
RESCC003
RESCC004
RESCC005
RESCC006
RESCC007
RESCC008
RESCC009
RESCC010
RESCC011
RESCC012

```

```

SUBROUTINE RHS(G,PSI,FF1,FF2,TI1,NX,NUSIGF,VINV,SIGX ,FUEL,SD,
1XL,XR,PB,IPL,IPR)
IMPLICIT REAL*8 (A-H,O-Z)
INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,
1      UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,OUT,
2      P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,
3      SORCE , SORG , SOZ , STEADY , STEP , TAGC , TAGF , TAGT
REAL*8 LR,NU,NUSIGF,NX
COMMON /A1/GRP,REG,PT,CL,GU,DEL,THG,IDEL
COMMON /A2/NUM,NCOMP,BCL,BCR,MTZ,NTZ,XEN,STEADY
DIMENSION PSI(PT,GU)
DIMENSION FF1(PT)
DIMENSION FF2(PT)
DIMENSION VINV(GRP)
DIMENSION TI1(REG)
DIMENSION IPL(REG),IPR(REG),PB(REG),XL(REG),XR(REG)
DIMENSION FUEL(REG)
DIMENSION SD(GRP,IDEL)
DIMENSION NX(GRP),NUSIGF(REG,GRP)
DIMENSION SIGX(REG,GRP,GRP)
C THIS ROUTINE EVALUATES THE RHS OF THE ALGORITHM AT ALL INTERIOR
C POINTS OF EACH REGION IN A GIVEN GROUP
X3=NX(G)
PL=1
IF (BCL.EQ.0) PL=2
DO 20 R=1,REG
PR=IPR(R)
IF((R.EQ.REG).AND.(BCR.EQ.1)) PR=PT
DO 19 P=PL,PR
T1=0.0
T2=0.0
IF(GRP.EQ.1) T2=X3*NUSIGF(R,G)*PSI(P,G)
IF(G.EQ.1) GO TO 12
GPU=G-1
DO 11 GP=1,GPU
11 T1=T1+(X3*NUSIGF(R,GP)+SIGX(R,G,GP))

```

```

RHS C001
RHS C002
RHS C003
RHS C004
RHS C005
RHS C006
RHS C007
RHS C008
RHS C009
RHS C010
RHS C011
RHS C012
RHS C013
RHS C014
RHS C015
RHS C016
RHS C017
RHS C018
RHS C019
RHS C020
RHS C021
RHS C022
RHS C023
RHS C024
RHS C025
RHS C026
RHS C027
RHS C028
RHS C029
RHS C030
RHS C031
RHS C032
RHS C033
RHS C034
RHS C035
RHS C036

```



```

      1*PSI(P,GP)
12  IF(G.EQ.GRP) GO TO 14
      GPL=G+1
      DO 13 GP=GPL,GRP
13   T2=T2+(X3*NUSIGF(R,GP)+SIGX(R,G,GP))*
      1PSI(P,GP)
C    NOW ADD DELAY CONTRIBUTIONS
14   T3=0.0
      IF(DEL) 18,18,15
15   IF(FUEL(R)) 16,18,16
16   DO 17 GP=GL,GU
      GD=GP-GRP
      T3=T3+SD(G,GD)*PSI(P,GP)
17  CONTINUE
      T1=T1*FF2(P)
      T2=T2*FF1(P)
      T3=T3*FF1(P)
18   T4=T1+T2+T3
      PSI(P,G)=VINV(G)*PSI(P,G)+T4
19  CONTINUE
      PL=PR+2
20  CONTINUE
C    THIS ROUTINE EVALUATES THE RHS OF THE ALGORITHM AT ALL REGION
C    BOUNDARY POINTS IN GROUP G
      IP=REG-1
      IF (IP) 220,220,110
110  DO 210 R=1,IP
      JRP=R+1
      P=PB(R)
      X1=XL(R)
      X2=XR(R)
      T1=0.0
      T2=0.0
      IF(GRP.EQ.1) T2=X3*(NUSIGF(R,G)*X1+NUSIGF(R+1,G)*X2)*PSI(P,G)
      IF (G.EQ.1) GO TO 130
      GPU=G-1

```

```

RHS C037
RHS C038
RHS C039
RHS C040
RHS C041
RHS 0042
RHS C043
RHS C044
RHS C045
RHS C046
RHS C047
RHS C048
RHS C049
RHS C050
RHS C051
RHS 0052
RHS C053
RHS C054
RHS C055
RHS C056
RHS C057
RHS C058
RHS C059
RHS C060
RHS C061
RHS C062
RHS C063
RHS C064
RHS C065
RHS C066
RHS C067
RHS C068
RHS C069
RHS C070
RHS C071
RHS 0072

```

```

      DO 120 GP=1, GPU
120  T1=T1+(X3*(NUSIGF(R,GP)*X1+NUSIGF(R+1,GP)
      1*X2)+SIGX(R,G,GP)*X1+SIGX(R+1,G,GP)*
      2X2)*PSI(P,GP)
130  IF (G.EQ.GRP) GO TO 150
      GPL=G+1
      DO 140 GP=GPL, GRP
140  T2=T2+(X3*(NUSIGF(R,GP)*X1+NUSIGF(R+1,GP)
      1*X2)+SIGX(R,G,GP)*X1+SIGX(R+1,G,GP)*
      2X2)*PSI(P,GP)
C    THEN ADD PRECURSOR CONTRIBUTIONS
150  T3=0.
      IF (DEL) 200,200,160
C    WE CHECK FOR ANY FUEL AT THE BOUNDARY POINT
160  IF (FUEL(R)) 180,170,180
170  IF (FUEL(R+1)) 180,200,180
180  DO 190 GP=GL, GU
      GD=GP-GRP
      T3=T3+SD(G,GD)*PSI(P,GP)
190  CONTINUE
      T1=T1*FF2(P)
      T2=T2*FF1(P)
      T3=T3*FF1(P)
200  T4=T1+T2+T3
      PSI(P,G)=VINV(G)*PSI(P,G)+T4
210  CONTINUE
220  RETURN
      END

```

```

RHS C073
RHS C074
RHS C075
RHS C076
RHS C077
RHS C078
RHS C079
RHS C080
RHS C081
RHS C082
RHS C083
RHS C084
RHS C085
RHS C086
RHS C087
RHS C088
RHS C089
RHS C090
RHS C091
RHS C092
RHS C093
RHS C094
RHS C095
RHS C096
RHS C097
RHS C098
RHS C099
RHS C100

```

	SUBROUTINE SCALE(Y,PSI)	SCL C001
	IMPLICIT REAL*8 (A-H,O-Z)	SCL C002
	INTEGER G,GRP,REG,PT,GL,GU,DEL,THG,IDEL,P	SCL C003
	COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL	SCL C004
	DIMENSION PSI(PT,GRP)	SCL C005
C	THIS FUNCTION FINDS THE LENGTH OF THE FLUX VECTOR	SCL C006
	X=0.000	SCL C007
	DO 110 G=1,GRP	SCL C008
	DO 110 P=1,PT	SCL C009
110	X=X+PSI(P,G)*PSI(P,G)	SCL C010
	Y=DSQRT(X)	SCL C011
	RETURN	SCL C012
	END	SCL C013

```

SUBROUTINE SETUP(PSI,WPT,NU,NUSIGF,CM,CP,SIGX,PB,IPR,IPL,XL,XR,
1FUEL,NX,SDIN,UPSCAT,DNSCAT,PSISTO,DD,DL,DU,WA,GA)
IMPLICIT REAL*8 (A-H,O-Z)
INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,
1UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,CUT,
2P,PL,PR,PB,PRBEND,PT,PUNBAL,PUNFRS,R,REG,SCR,
3SORCE , SORG , SOZ , STEADY , STEP , TAGC , TAGF , TAGT
REAL*8 IODINE
REAL*8 LR,NU,NUSIGF,NX
REAL*8 KEFF
COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL
COMMON /A2/NUM,NCOMP,BCL,BCR,MTZ,NTZ,XEN,STEADY
COMMON /A3/PUNBAL,SORCE,GEOM,NTAG,NUM2,PUNFRS
COMMON /A4/TIGHT1,TIGHT2,TIGHT3
COMMON/A5/IN,OUT,NERR
C THIS ROUTINE CORRECTS THE INITIAL ESTIMATES TO AN EXACTLY CRITICAL
C PROBLEM AND CALCULATES THE PRECURSOR CONCENTRATIONS
DIMENSION PSI(PT,GU)
DIMENSION WPT(NUM)
DIMENSION PSISTO(NUM)
DIMENSION NU(GRP)
DIMENSION NUSIGF(REG,GRP)
DIMENSION CM(PT,GRP),CP(PT,GRP)
DIMENSION SIGX(REG,GRP,GRP)
DIMENSION PB(REG),IPL(REG),IPR(REG),XL(REG),XR(REG)
DIMENSION FUEL(REG)
DIMENSION NX(GRP)
DIMENSION SDIN(GRP,IDEL)
DIMENSION UPSCAT(REG,GRP),DNSCAT(REG,GRP)
DIMENSION DD(PT),DL(PT),DU(PT),WA(PT),GA(PT)
ABS(X)=DABS(X)
SQRT(X)=DSQRT(X)
FLOAT(I)=DFLOAT(I)
IF (STEADY.EQ.3) GO TO 201
KEFF=0.
XKK=0.0

```

```

SET CCC1
SET CC02
SET CC03
SET CCC4
SET CC05
SET CC06
SET CC07
SET CCC8
SET CC09
SET CC10
SET CC11
SET CC12
SET CC13
SET CC14
SET CC15
SET CC16
SET CC17
SET CC18
SET CC19
SET CC20
SET CC21
SET CC22
SET CC23
SET CC24
SET CC25
SET CC26
SET CC27
SET CC28
SET CC29
SET CC30
SET CC31
SET CC32
SET CC33
SET CC34
SET CC35
SET CC36

```

```

      Y=0.
      INDX=0
      CALL      SCALE(X,PSI)
110  CONTINUE
      DO 130 N=1,NUM
      P=WPT(N)
      PSISTO(N)=PSI(P,THG)
130  CONTINUE
      CALL      ITER(PSI,CM,CP,SIGX,PB,IPL,IPR,XL,XR,SDIN,FUEL,
      INX,NUSIGF,UPSCAT,DNSCAT,DD,DL,DU,WA,GA)
      CALL      SCALE(Y,PSI)
      KEFF=Y/X
      CALL      RESCAL(X,PSI)
      IF (XKK) 140,140,150
140  XKK=KEFF
      INDX=1
      GO TO 110
150  IF (ABS(KEFF/XKK-1.0)-TIGHT1) 160,160,140
160  CONTINUE
      IF (ABS(KEFF-1.0)-TIGHT2) 190,190,170
170  DO 180 G=1,GRP
      NU(G)=NU(G)/KEFF
      DO 180 R=1,REG
      NUSIGF(R,G)=NUSIGF(R,G)/KEFF
180  CONTINUE
      INDX=2
      GO TO 110
190  CONTINUE
      INDX=3
      DO 200 N=1,NUM
      P=WPT(N)
      IF(DABS(PSISTO(N)/PSI(P,THG)-1.0)-TIGHT3) 200,200,110
200  CONTINUE
201  CONTINUE
      CALL      EQPREC(PSI,FUEL,NUSIGF,IPL,IPR,XL,XR)
      II=GL

```

```

SET C037
SET C038
SET C039
SET C040
SET C041
SET C042
SET C043
SET C044
SET C045
SET C046
SET C047
SET C048
SET C049
SET C050
SET C051
SET C052
SET C053
SET C054
SET C055
SET C056
SET C057
SET C058
SET C059
SET C060
SET C061
SET C062
SET C063
SET C064
SET C065
SET C066
SET C067
SET C068
SET C069
SET C070
SET C071
SET C072

```

IF (STEADY.EQ.3) WRITE (OUT,330)	SET C073
IF (STEADY.EQ.3) GO TO 210	SET C074
II=1	SET C075
WRITE (OUT,270) (G,NU(G),G=1,GRP)	SET C076
WRITE (OUT,280)	SET C077
210 CONTINUE	SET C078
DO 220 G=II,GU	SET C079
220 WRITE (OUT,300) (P,PSI(P,G),P=1,PT)	SET C080
IF (PUNBAL.EQ.1) GO TO 225	SET C081
RETURN	SET C082
225 CONTINUE	SET C083
DO 230 G=1,GRP	SET C084
230 PUNCH 310,NU(G)	SET C085
WRITE (OUT,290)	SET C086
DO 240 G=1,GU	SET C087
240 PUNCH 310,(PSI(P,G),P=1,PT)	SET C088
RETURN	SET C089
270 FORMAT (19H0 EQUILIBRIUM NU(G),3X,4(1H(,I3,1H),E14.7)/22X,(4(1H(,I	SET C090
13,1H),E14.7)))	SET C091
280 FORMAT (20H0 EQUILIBRIUM FLUXES)	SET C092
290 FORMAT (53H0 EQUILIBRIUM NU(G) AND FLUX DISTRIBUTION ARE PUNCHED)	SET C093
300 FORMAT (6(1H(,I3,1H),E13.7))	SET C094
310 FORMAT (6E12.7)	SET C095
330 FORMAT (33H0INITIAL PRECURSOR CONCENTRATIONS)	SET C096
END	SET C097

```

SUBROUTINE SOURCE(G,PSI,SORG,SOR,SRCEO,SRCE1,XL,XR,PB,IPL,IPR)
IMPLICIT REAL*8 (A-H,O-Z)
INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,
1    UPSCAT,WPT, FUEL,G,GEOM,GP,GPL,GPR,GD,GL,GU,GRP,GPU,CUT,
2P,PL,PR,PB,PRBEND,PT,PUNBAL,PUNFRS,R,REG,SOR,
3    SORCE , SORG , SGZ , STEADY , STEP , TAGC , TAGF , TAGT
REAL*8 LR,NU,NUSIGF,NX
INTEGER PLB,PRB
COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL
COMMON /A2/NUM,NCOMP,BCL,BCR,MTZ,NTZ,XEN,STEADY
COMMON /A3/PUNBAL,SORCE,GEOM,NTAG,NUM2,PUNFRS
COMMON /B1/H,HP,TIME,TZ,ZERC,TZO,TIMZ
DIMENSION PSI(PT,GU)
DIMENSION IPL(REG),IPR(REG),PB(REG),XL(REG),XR(REG)
DIMENSION SOR(REG),SORG(REG,GRP),SRCEO(PT,GRP),SRCE1(PT,GRP)
FLOAT(I)=DFLOAT(I)
C THIS ROUTINE EVALUATES THE CONTRIBUTION OF EXTERNAL SOURCES
TI=0.0
DO 320 R=1,REG
IF (SORG(R,G).EQ.0) GO TO 320
IF (R-1) 110,110,140
110 IF (BCL.EQ.1) GO TO 120
PL=2
GO TO 130
120 PL=1
130 PLB=0
GO TO 150
140 PLB=PB(R-1)
PL=PLB+1
150 PR=IPR(R)
PRB=PR+1
IF (R-REG) 170,160,160
160 IF (BCR.EQ.1) PR=PT
PRB=0
170 CONTINUE
180 XI=H

```

```

SRCEC001
SRCECC02
SRCEC003
SRCEC004
SRCECC05
SRCEC006
SRCEC007
SRCECC08
SRCECC09
SRCEC010
SRCEC011
SRCECC12
SRCEC013
SRCEC014
SRCECC15
SRCEC016
SRCEC017
SRCEC018
SRCECC19
SRCEC020
SRCEC021
SRCEC022
SRCEC023
SRCEC024
SRCEC025
SRCEC026
SRCEC027
SRCEC028
SRCEC029
SRCEC030
SRCEC031
SRCEC032
SRCEC033
SRCEC034
SRCEC035
SRCEC036

```

```

      X2=H*H/2.0
      GC TC 200
200   X3=TIME-TI+H/2.0
      IF (SOR(R)-1) 320,270,210
210   LP=PT-1
      X4=H*(SRCEO(LP,G)+SRCE1(LP,G)*X3)
      DO 220 P=PL,PR
220   PSI(P,G) =PSI(P,G) +X4
      IF (PLB) 230,240,230
230   PSI(PLB,G)=PSI(PLB,G)+X4*XL(R)
240   IF (PRB) 250,260,250
250   PSI(PRB,G)=PSI(PRB,G)+X4*XR(R)
260   GC TO 320
270   DO 280 P=PL,PR
      X4=H*(SRCEO(P,G)+SRCE1(P,G)*X3)
      PSI(P,G)=PSI(P,G)+X4
280   CONTINUE
      IF (PLB) 290,300,290
290   X4=H*(SRCEO(PLB,G)+SRCE1(PLB,G)*X3)
      PSI(PLB,G)=PSI(PLB,G)+X4*XL(R)
300   IF (PRB) 310,320,310
310   X4=H*(SRCEO(PLB,G)+SRCE1(PLB,G)*X3)
      PSI(PRB,G)=PSI(PRB,G)+X4*XR(R)
320   CONTINUE
330   RETURN
      END

```

```

SRCEC037
SRCEC038
SRCEC039
SRCEC040
SRCEC041
SRCEC042
SRCEC043
SRCEC044
SRCEC045
SRCEC046
SRCEC047
SRCEC048
SRCEC049
SRCEC050
SRCEC051
SRCEC052
SRCEC053
SRCEC054
SRCEC055
SRCEC056
SRCEC057
SRCEC058
SRCEC059
SRCEC060
SRCEC061
SRCEC062

```



```

SUBROUTINE TEST(STPRN,PSI,PSITOT,POWREG,WPT,WZ,WHZ)
  IMPLICIT REAL*8 (A-H,O-Z)
  REAL*8 IODINE
  INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,
1      UPSCAT,WPT,FUEL,G,GEOM,GP,GPL,GPR,GC,CL,GU,GRP,GPU,CUT,
2      P,PL,PR,PB,PRBEND,PT,PUNBAL,PUNFRS,R,REG,SCR,
3      SORCE,SORG,SOZ,STEADY,STEP,TAGC,TAGF,TAGT
  COMMON /A1/GRP,REG,PT,CL,GU,DEL,THG,IDEL
  COMMON /A2/NUM,NCOMP,BCL,BCR,MTZ,NTZ,XEN,STEADY
  COMMON /A3/PUNBAL,SORCE,GEOM,NTAG,NUM2,PUNFRS
  COMMON /B1/H,HP,TIME,TZ,ZERO,TZO,TIMZ
  COMMON /B2/NPRT,NZ,ISX,STEP,NZSAVE,PRBEND,IPRN
  DIMENSION STPRN(50)
  DIMENSION PSI(PT,GU)
  DIMENSION PSITOT(REG,GRP),PCWREG(REG)
  DIMENSION WHZ(PT),WZ(PT),WPT(NUM)
  IFLAG=0
  STEP=STEP+1
  TIME=TIME+H
  IF (NUM2.EQ.0) GO TO 120
  IF ((DABS(TIME-STPRN(NPRT))).GT.ZERO) GO TO 120
  NPRT=NPRT+1
  IFLAG=1
120  IF ((DABS(TIME-TZ)).LT.ZERO) GO TO 150
  IF (IPRN.EQ.0) GO TO 125
  IF ((MOD(STEP,IPRN)).EQ.0) GO TO 140
125  IF (IFLAG.EQ.1) GO TO 140
130  RETURN
140  CALL PRINTA(PSI,PSITOT,POWREG,WPT,WZ,WHZ)
  GO TO 130
150  CALL PRINTA(PSI,PSITOT,POWREG,WPT,WZ,WHZ)
  NZ=NZ+1
  IF (NZ.GT.NTZ) PRBEND=1
  GO TO 130
END

```

```

TESTC001
TESTC002
TESTC003
TESTC004
TESTC005
TESTC006
TESTC007
TESTC008
TESTC009
TESTC010
TESTC011
TESTC012
TESTC013
TESTC014
TESTC015
TESTC016
TESTC017
TESTC018
TESTC019
TESTC020
TESTC021
TESTC022
TESTC023
TESTC024
TESTC025
TESTC026
TESTC027
TESTC028
TESTC029
TESTC030
TESTC031
TESTC032
TESTC033
TESTC034
TESTC035

```

```

SUBROUTINE TITLE (K)
  INTEGER CUT
  COMMON/A5/IN,OUT,NERR
  C READS AND PRINTS CASE TITLE
  C K=1 TITLE IS READ IN
  C K=2 TITLE IS WRITTEN OUT AT THE TOP OF A NEW PAGE
  C K=3 TITLE IS WRITTEN OUT, NO NEW PAGE
  C
100 FORMAT (15H END OF PROBLEM)
  C
  110 FORMAT (72H
    1
    120 FORMAT (1H1)
  C
  C
    GO TO (130,140,150,145),K
  130 READ (IN,110)
    GO TO 160
  140 WRITE (6,120)
    GO TO 150
  145 WRITE (6,110)
    WRITE (6,100)
    GO TO 160
  150 WRITE (6,110)
  160 RETURN
    END

```

```

TITLC001
TITLC002
TITLC003
TITLC004
TITLC005
TITLC006
TITLC007
TITLC008
TITLC009
TITLC010
TITLC011
TITLC012
TITLC013
TITLC014
TITLC015
TITLC016
TITLC017
TITLC018
TITLC019
TITLC020
TITLC021
TITLC022
TITLC023
TITLC024
TITLC025
TITLC026

```

```

SUBROUTINE UPDAT(TAGT,TAGX,TAGC,TAGF,CHANGE,NUSIGF,PSIBAR,IODINE,
1XABS,XENCN, CTRL,CTRQ,CXL,CXQ,CCL,CCQ,CFL,CFQ,SIGT,SIGX,SIGF,
2SIGC,PSIB1,NU,FUEL)

```

```

IMPLICIT REAL*8 (A-H,O-Z)

```

```

INTEGER BCL,BCR,CHANGE,DEL,DNSCAT,TAGX,TESTS,THG,XEN,

```

```

1      UPSCAT,WPT, FUEL,G,GECM,GP,GPL,GPR,GD,CL,CG,GRP,GPU,OUT,

```

```

2      P,PL,PR,PB, PRBEND , PT , PUNBAL , PUNFRS , R,REG,SOR,

```

```

3      SORCE , SORG , SOZ , STEADY , STEP , TAGC , TAGF , TAGT

```

```

REAL*8 IODINE

```

```

REAL*8 LR,NU,NUSIGF,NX

```

```

COMMON /A1/GRP,REG,PT,GL,GU,DEL,THG,IDEL

```

```

COMMON /A2/NUM,NCOMP,BCL,BCR,MTZ,NTZ,XEN,STEADY

```

```

COMMON /B1/H,HP,TIME,TZ,ZERO,TZO,TIMZ

```

```

COMMON /B2/NPRT,NZ,ISX,STEP,NZSAVE,PRBEND,IPRN

```

```

DIMENSION CHANGE(REG)

```

```

DIMENSION TAGC(REG),TAGF(REG),TAGT(REG),TAGX(REG)

```

```

DIMENSION NUSIGF(REG,GRP)

```

```

DIMENSION SIGC(REG,GRP),SIGF(REG,GRP),SIGT(REG,GRP),

```

```

1SIGX(REG,GRP,GRP)

```

```

DIMENSION CCL(REG,GRP),CCQ(REG,GRP),CFL(REG,GRP),CFQ(REG,GRP),

```

```

1CTRL(REG,GRP),CTRQ(REG,GRP),CXL(REG),CXQ(REG)

```

```

DIMENSION XENCN(REG)

```

```

DIMENSION NU(GRP)

```

```

DIMENSION PSIBAR(REG,GRP),PSIB1(REG,GRP)

```

```

DIMENSION XABS(REG,GRP)

```

```

DIMENSION IODINE(REG)

```

```

DIMENSION FUEL(REG)

```

```

T=TZO

```

```

20 Y=(TIME-TIMZ)/(TZ-T)

```

```

YSQ=Y*(TIME+TIMZ-2*T)/(TZ-T)

```

```

TIMZ=TIME

```

```

IF(XEN.EQ.0) GO TO 40

```

```

CALL      FEDBKX(PSIBAR,SIGF,XABS,XENON,IODINE,PSIB1,FUEL)

```

```

40 CONTINUE

```

```

DO 350 R=1,REG

```

```

UPCT0001

```

```

UPDTC002

```

```

UPDTC003

```

```

UPDTC004

```

```

UPDTC005

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```

UPDTC006

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```

UPDTC007

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UPDTC008

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UPDTC009

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UPDTC010

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UPDTC011

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UPDTC012

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UPDTC013

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UPDTC014

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UPDTC015

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UPDTC016

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UPDTC017

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UPDTC018

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UPDTC019

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UPDTC020

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UPDTC021

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UPDTC022

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UPDTC023

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UPDTC024

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UPDTC025

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UPDTC026

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UPDTC027

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UPDTC028

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UPDTC029

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UPDTC030

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UPDTC031

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UPDTC032

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UPDTC033

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UPDTC034

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```

UPDTC035

```

```

UPDTC036

```

```

      IF (TAGT(R)-1) 160,110,130
110 DO 120 G=1,GRP
120 SIGT(R,G)=SIGT(R,G)+CTRL(R,G)*Y
      GO TO 150
C
130 DO 140 G=1,GRP
140 SIGT(R,G)=SIGT(R,G)+CTRL(R,G)*Y+CTRQ(R,G)*YSQ
150 CHANGE(R)=1
      GO TO 170
160 CHANGE(R)=0
C
170 IF (TAGX(R)-1) 220,180,210
180 X=CXL(R)*Y
190 DO 200 G=1,GRP
      DO 200 GP=1,GRP
200 SIGX(R,G,GP)=SIGX(R,G,GP)*(1.0+X)
      CHANGE(R)=2
      GO TO 220
C
210 X=CXL(R)*Y+CXQ(R)*YSQ
      GO TO 190
C
220 IF (TAGC(R)-1) 270,230,250
230 DO 240 G=1,GRP
240 SIGC(R,G)=SIGC(R,G)+CCL(R,G)*Y
      CHANGE(R)=2
      GO TO 270
C
250 DO 260 G=1,GRP
260 SIGC(R,G)=SIGC(R,G)+CCL(R,G)*Y+CCQ(R,G)*YSQ
      CHANGE(R)=2
C
270 IF (TAGF(R)-1) 320,280,300
280 DO 290 G=1,GRP
      SIGF(R,G)=SIGF(R,G)+CFL(R,G)*Y
      NUSIGF(R,G)=NU(G)*SIGF(R,G)

```

```

UPDTC037
UPDTC038
UPDTC039
UPDTC040
UPDTC041
UPDTC042
UPDTC043
UPDTC044
UPDTC045
UPDTC046
UPDTC047
UPDTC048
UPDTC049
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UPDTC051
UPDTC052
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UPDTC063
UPDTC064
UPDTC065
UPDTC066
UPDTC067
UPDTC068
UPDTC069
UPDTC070
UPDTC071
UPDTC072

```

290 CONTINUE
CHANGE(R)=2
GO TO 320

C

300 DO 310 G=1,GRP
310 SIGF(R,G)=SIGF(R,G)+CFL(R,G)*Y+CFQ(R,G)*YSQ
CHANGE(R)=2
320 IF (((TAGF(R).EQ.0).AND.(TAGC(R).EQ.0)).AND.(TAGX(R).EQ.0)) GO TO
1350

DO 340 G=1,GRP
SIGX(R,G,G)=SIGF(R,G)+SIGC(R,G)
X=0.0

DO 330 GP=1,GRP

330 X=X+SIGX(R,GP,G)

SIGX(R,G,G)=X

340 CONTINUE

C

IF (XEN.EQ.0) GO TO 350

DO 345 G=1,GRP

Z=XABS(R,G)*XENGN(R)

SIGX(R,G,G)=SIGX(R,G,G)+Z

345 SIGC(R,G)=SIGC(R,G)+Z

350 CONTINUE

370 RETURN

END

UPDTC073
UPDTC074
UPDTC075
UPDTC076
UPDTC077
UPDTC078
UPDTC079
UPDTC080
UPDTC081
UPDTC082
UPDTC083
UPDTC084
UPDTC085
UPDTC086
UPDTC087
UPDTC088
UPDTC089
UPDTC090
UPDTC091
UPDTC092
UPDTC093
UPDTC094
UPDTC095
UPDTC096
UPDTC097

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