RFD-1: A 1-D, 4-GROUP CODE TO CALCULATE BURNUP CYCLES USING MECHANICAL SPECTRAL SHIFT

by

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Chapter 1

INTRODUCTION

Today there is an increasing recognition that a more efficient fuel cycle is needed for uranium burning pressurized water reactors (PWR) in order that finite U-235 resources may be better utilized. Such an improvement would serve not only to conserve U-235 resources, but would also result in decreased costs for PWR operation and ultimately the consumer. The Clinch River Breeder Reactor is presently offered as one alternative to the standard PWR. However, escalating costs have left open to doubt whether or not this demonstration project will even be completed. Given the present circumstances, it is doubtful that any proposed system of fast breeder power plants can be economically built in the United States in the foreseeable future.

Another alternative to the standard PWR design is to mechanically control the neutron spectrum so as to maximize the conversion ratio throughout the reactor core lifetime. Standard PWR's produce average conversion ratios on the order of 0.6 (1) with resulting burnups on the order of 10,070 MWD/MTHM between scheduled shutdowns for refueling (2). These shutdowns routinely occur once per year during which about one-third of the core is replaced with fresh fuel. An early study (3) showed that the average core lifetime and conversion ratio can be increased by starting with a relatively hard neutron spectrum (an epithermal reactor) and gradually softening it over the core lifetime through neutron spectrum control. Another study (4) showed that for a tightly packed reactor core lattice using plutonium recycle fuel,

conversion ratios on the average of 0.90 and burnups of 40,000 MWD/MTHM were possible. Increased conversion and burnup are the major advantages of a mechanical spectrum shift control reactor.

Another potential advantage of this design is that a lower initial fissile fuel core enrichment is required over that of a standard PWR. A PWR needs a fairly large built-in excess reactivity to overcome the effects of accumulating fission product poisons. This is achieved by enriching a new core to about 2.8% U-235, resulting in an excess reactivity of about 10% (2). Adjustments in reactivity over the core life can be easily made through changes in the neutron spectrum for a spectral shift reactor, thereby decreasing the need for a high initial excess reactivity. This will result in lower fuel costs. Finally, it is expected that the extra reactivity available to a spectral shift core would result in much longer burnup times between shutdowns for refueling. Higher plant capacity factors resulting from fewer shutdowns will also result in decreased costs in electricity.

To achieve the relatively fast initial neutron energy spectrum, the fuel rods are placed in a closely packed triangular lattice. Previous studies (4),(5) indicate that even for relatively high fuel to water volume ratios (FTWR, defined as the volume of fuel/volume of water for a unit cell of the core lattice), the tight lattice meets Nuclear Regulatory Commission thermal hydraulic requirements. This close packed configuration results in an improved conversion ratio due to increased absorptions in U-238. Reactivity is decreased due to the hardened spectrum, however, because thermal absorptions in U-235 decrease. If the neutron spectrum is gradually softened over time, so that reactivity

is slowly increased while the conversion ratio is slowly decreased, then a much higher burnup can be achieved relative to today's standard PWR design.

A simple method for shifting the neutron energy spectrum is to mechanically change the FTWR over the core lifetime as needed. At the beginning of life a percentage of blank zircaloy rods are placed within the closely packed triangular lattice core. As the fissile fuel is depleted, fission product poisons accumulate resulting in decreased reactivity. When the core can no longer maintain criticality a percentage of the blank rods are removed, increasing the volume fraction of water relative to fuel. This softens the neutron spectrum and increases core reactivity. The process of adding reactivity by mechanically changing the core FTWR is repeated over the core lifetime until all the blank rods have been removed and criticality can no longer be achieved. At shutdown the core is at a minimum FTWR of about 0.5, the value at which standard PWR's operate.

This thesis will verify the effectiveness of increasing conversion and burnup on standard PWR type designs by shifting the neutron energy spectrum through gradual change in the core FTWR. The criticality and depletion code RFD-1 (Rapid Fuel Depletion) has been written to achieve this purpose. The main features of RFD-1 are:

1. A double interpolative scheme to obtain core isotope microscopic cross sections as a function of FTWR and total burnup time.

2. A four group, one dimensional criticality calculation to solve for KEFF and the group neutron fluxes for each of up to six cyclindrical core regions.
3. A fuel depletion section which uses the known group fluxes to solve for changes in isotopic number density.

The relevant reactor core and fuel rod dimensions used as input for RFD-1 were that of a typical PWR core. This allows a more direct comparison of the proposed spectral shift design with that of a standard PWR core.

Chapter 2

ELEMENTS OF RFD-1

2.1 Logic of the Code

RFD-1 was developed to calculate core criticality and fuel depletion over time as the FTWR is decreased. A major problem of performing these calculations is that all of the isotope microscopic cross sections are a function of the neutron spectrum, and therefore change in value as the FTWR is decreased. The neutron spectrum depends also upon how long the core has operated at rated power, but to a lesser extent than its dependence on the FTWR.

The fuel isotopes used in RFD-1 are U-235, U-238, Pu-239, Pu-240, Pu-241, and Pu-242. The relative concentrations of all these isotopes also change during the core lifetime due to constantly changing core conditions. To adequately model core burnup for a variable FTWR reactor, RFD-1 contains three main parts:

1. A tabular data section where the microscopic cross sections of all the core isotopes are assigned as a function of FTWR and total core burnup time using linear interpolations. Updated cross section values are obtained in RFD-1 at the end of every burnup time substep and every time the FTWR is changed. The length of each time substep in RFD-1 can be defined by the user of the code.
2. A criticality calculation using the microscopic cross sections from part 1. as input. This section of RFD-1 solves for the four group normalized neutron flux in

each region of the core, the macroscopic poison cross section needed to make the core just critical, and KEFF of the entire core.

3. A fuel depletion section wherein new isotopic concentrations are found at the end of each time substep. Values of the total core burnup, power density, energy density, conversion ratio, and reaction rate are also calculated in this section.

RFD-1 changes the core FTWR as needed during the core lifetime according to the following scheme:

1. At the start of life the core, which is at its maximum FTWR, contains excess reactivity required to overcome the immediate effect of fission product poisons and to prolong the total core lifetime. Since KEFF may assume values as high as 1.10, a control poison must be used. RFD-1 calculates the overall core value of Σp for the poison. A FTWR of 1.30 is the maximum that can be used in RFD-1. Larger values of FTWR were judged to be unacceptable for envisioned core designs.
2. The numerical value of KEFF decreases slowly after each time substep due to the accumulation of fission products and to the slow decrease in fissile isotopes (since the conversion ratio is less than 1.00). When KEFF drops below 1.000, the FTWR is decreased in each region of the core by an amount defined by the user, usually on the order of 0.1. This results in an increase

in core reactivity. Criticality is again calculated to ensure that KEFF is now greater than 1.000. From this point on the reactor should require no burnable poison, since small increases or decreases in KEFF could be automatically adjusted through corresponding changes in the core's FTWR. The result is a more efficient use of core neutrons through the elimination of parasitic poison capture.

3. After this initial change the FTWR is decreased in RFD-1 only when the reactor has burned sufficiently long for KEFF to have fallen below 1.000 by the same amount as it started above 1.000 when the FTWR was last changed. This means simply that for this given number of time substeps at which the FTWR was a constant, KEFF operated on the average at a value of 1.000. This method allows for the most accurate determination of core burnup papameters over time since "real" cores operate at steady state with KEFF = 1.000 at all times. Burnup steps at a KEFF just above 1.000 underestimate the conversion ratio while steps run at KEFF slightly less than 1.000 overestimate conversion. Keeping KEFF close to 1.000 at all times during core life during an RFD-1 calculation minimizes any possible non-linear effects in calculating burnup when KEFF is above 1.000 as opposed to below it. At the end of each time substep

RFD-1 makes the following test to see if a change in FTWR is required:

Is KEFF (New) $\geq$ [2.0 - KEFF (Old)]?

where KEFF (Old) = the KEFF value calculated following the last change in FTWR

YES → perform another burnup time substep at the same FTWR

NO → Decrease the FTWR and recalculate KEFF to make sure that KEFF $\geq$ 1.000

4. When the core is at its minimum FTWR no more reactivity can be added. Consequently, the reactor must be shut down when KEFF drops below 1.000. The minimum FTWR allowable in RFD-1 is 0.5, the approximate value of standard PWR's.

Figure 2.1.1 flowcharts the logic of RFD-1. A complete listing of RFD-1 is given in Appendix A.

2.2 Microscopic Cross Sections

Perhaps the most difficult problem of this study was involved in attempting to obtain accurate isotopic microscopic group cross sections for use as input in RFD-1. The numerical values of these cross sections depend upon the energy of the entire neutron spectrum. The neutron spectrum is itself a function of both the FTWR and the relative concentrations of fuel isotopes. Finally, the relative concentrations of fuel isotopes depend upon the total burnup time of the core.

The VIM code (6) has been successfully used at Virginia Tech for several years (4),(7). VIM is a code developed by the Argonne

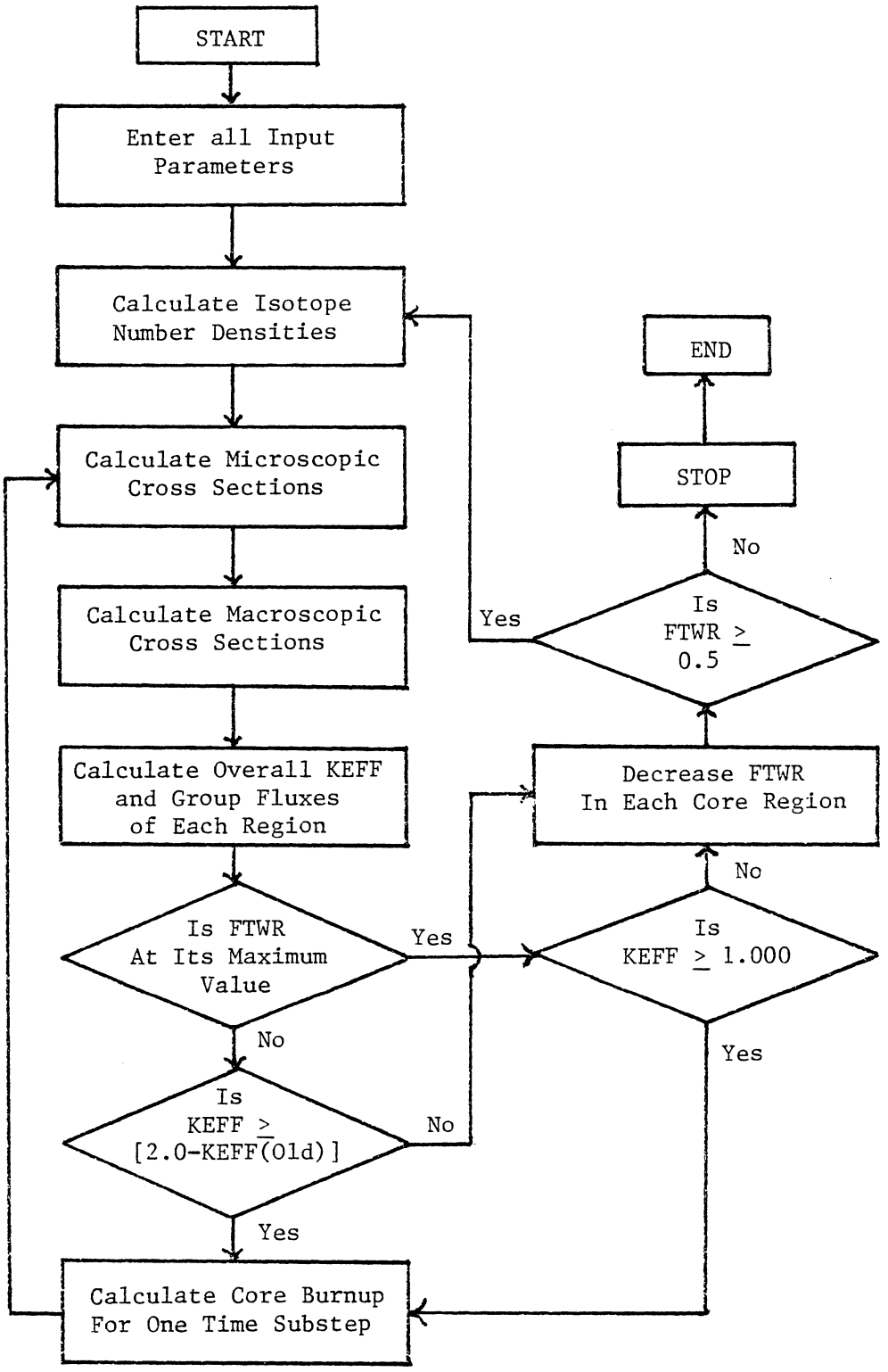


Figure 2.1.1, A Flowchart of the Logic Used in RFD-1

National Laboratory which solves for the individual isotope microscopic cross sections, the normalized group fluxes, and KINF of a smeared, unit cell through Monte Carlo techniques, given the proper core geometry and isotopic concentrations of a core unit cell as input. The most direct method for calculating a complete burnup cycle as the FTWR is changed would ideally require the following steps:

1. Use VIM to generate microscopic cross sections for each region of a new core at the desired FTWR.
2. Perform a criticality calculation, which takes leakage into account, to obtain KEFF of the core, the normalized few group fluxes of each region, and a uniform poison cross section required to make KEFF = 1.000.
3. Follow part 2. with a calculation of depletion and burnup for some given timestep.
4. Use the new isotope number densities as input for new VIM runs for each core region to obtain new microscopic cross sections needed for a new criticality and burnup calculation.
5. Repeat the above for each timestep until the reactor must be shut down.

Unfortunately, VIM is both time consuming and relatively expensive to use. It was apparent very early that it would be impractical to run separate cases through VIM for every conceivable FTWR and burnup substep that would be of interest for this project. As the most reasonable compromise it was decided to use VIM to create tables of four group microscopic cross sections as a function of FTWR and time of

burnup. A recent study by Westinghouse (8) lists four group microscopic cross sections as a function of FTWR and time of burnup. RFD-1 was modified to utilize these cross sections. A typical burnup case was then performed using RFD-1, from which typical relative fuel concentration values were obtained at different times during the complete burnup cycle. Knowing the proper ratio of fuel isotopes as a function of burnup, the VIM code was then used to generate microscopic cross sections at FTWR's of 0.5, 0.9, and 1.3 with burnups of 0.0, 9800.0, and 30800.0 hours. These parameters were chosen to cover the full range of FTWR's and burnup times that would be of interest for any practical designs. Table 2.2.1 lists the isotopes used in RFD-1.

The VIM generated tabulations of microscopic cross sections for all of these isotopes are located in Appendix B. Table 2.2.2 lists the energy range of each group.

The microscopic removal cross sections, defined as the probability per unit length of travel that a neutron will be scattered from energy group K to group K + 1, were derived for RFD-1 using a neutron balance and data from VIM. The neutron balance equations are as follows for an infinite unit cell such as that used for VIM:

$$\chi_1 \sum_{m=1}^{4} \sum_{k=1}^{4} \nu^f_{m,k}\, \sigma^f_{m,k}\, N_m\, \phi_k = \Sigma^R_1\, \phi_1 + \Sigma^a_1\, \phi_1 \qquad (2.2.1)$$

$$\chi_2 \sum_{m=1}^{6} \sum_{k=1}^{4} \nu_{m,k} \sigma^f_{m,k} N_m \phi_k + \Sigma^R_1 \phi_1 = \Sigma^R_2 \phi_2 + \Sigma^a_2 \phi_2 \qquad (2.2.2)$$

$$\Sigma^R_2 \phi_2 = \Sigma^R_3 \phi_3 + \Sigma^a_3 \phi_3 \qquad (2.2.3)$$

$$\Sigma^R_3 \phi_3 = \Sigma^a_4 \phi_4 \qquad (2.2.4)$$

Table 2.2.1, Isotopes Used in RFD-1

Unit Cell Region	Isotopes
Fuel	U-235, U-238, Pu-239, Pu-240, Pu-241, Pu-242, O-16
Cladding	Zircaloy-2
Moderator/Coolant	O-16, H & H2O

Table 2.2.2, Group Energy Levels

Group	Energy Level Upper-Lower
1	10MeV-0.82MeV
2	0.82MeV-5.53KeV
3	5.53KeV-0.625eV
4	0.625eV-1.0E-5eV

where, Σ_k^R = the macroscopic removal cross section from energy group k to k + 1.

χ_k = the ratio of newly fissioned neutrons belonging to energy group k to the total number of newly fissioned neutrons.

$\nu_{m,k}$ = the average number of neutrons released per fission of fuel isotope m at energy group k.

$\sigma_{m,k}^f$ = the microscopic fission cross section of fuel isotope m for energy group k.

Σ_k^a = the macroscopic absorption cross section for energy group k.

ϕ_k = the normalized group k neutron flux obtained from VIM.

From these equations it is apparent that all the Σ_k^R values can easily be found in terms of the group fluxes and macroscopic absorption cross sections. As the neutron spectrum shifts with decreasing FTWR, the values of Σ_k^R change also to add reactivity to the core. The change in Σ_k^R is derived mainly from the change in flux ratios. For example, using equation (2.2.4), $\Sigma_3^R = \Sigma_4^R(\phi_4/\phi_3)$. Experience has shown that as the FTWR decreases, Σ_3^R changes primarily due to the change in (ϕ_4/ϕ_3). The same principle holds for all the other Σ_k^R values as well. RFD-1 uses a tabulation of normalized four group flux values obtained from VIM for use in calculating Σ_k^R just as the other isotopic microscopic cross sections are tabulated. These values are listed as a function of FTWR and burnup time in Appendix B.

This definition of Σ_k^R assumes that neutrons cannot be scattered from energy group k to group k + 2. Neutrons can only be downscattered to the next lowest energy group due to the relatively large energy range of each of the four energy groups. Σ_4^R is equal to zero since neutrons cannot be scattered out of the lowest energy group. χ_3 and χ_4 are also

equal to zero for all cases since all neutrons that have been just fissioned are assumed to have an energy above 5.53 KeV before they undergo their first interaction.

2.3 Fission Products

Various methods have been developed to calculate fission product capture cross sections. Babcock and Wilcox (11), building upon the work of Garrison and Roos (9) and Wilkner and Jaye (10) have developed a method whereby fission product isotopes are classified into three groups according to their absorption characteristics. These are the rapidly saturating, slowly saturating, and non-saturating lumped fission product groups. The 75 total isotopes are those listed in the Garrison and Roos study. As in a previous study (7) done at Virginia Tech, the 75 isotopes were grouped according to their total capture resonance integral. The isotopes comprising each lumped fission product group are given in Appendix C.

The TOAFEW code (12) was used to generate microscopic capture cross sections for each of the fission product isotopes listed in Appendix B. Utilizing the ENDF/B-IV library (13), TOAFEW was used to collapse each fission product isotope into a four group cross section structure. A 148 group normalized flux input, generated by VIM, was used as the input for each TOAFEW run.

The lumped fission product group cross sections were normalized through a yield weighting system, i.e.,

$$\bar{\bar{\sigma}}_{i,k,m} = \frac{\sum_{m=1}^{4} \sum_{k=1}^{4} Y^{g}_{i,k,m} \sigma^{g}_{i,k}}{\sum_{m=1}^{4} \sum_{k=1}^{4} Y^{g}_{i,k,m}}, \qquad (2.3.1)$$

where,

$$\bar{Y}_{i,k,m} = \sum_{k=1}^{4} Y^{g}_{i,k,m} \qquad (2.3.2)$$

and, $\bar{\sigma}_{i,k,m}$ = the normalized capture cross section belonging to fission product group i, for energy group k, due to the fission of fuel isotope m.

$\bar{Y}_{i,k,m}$ = the total yield of isotopes belonging to fission product group i due to the fission of fuel isotope m at energy group k.

$\sigma^{g}_{i,k}$ = the capture cross section of individual fission product isotope g belonging to fission product group i for energy group k.

$Y^{g}_{i,k,m}$ = yield of fission product isotope g belonging to fission product group i due to the fission of fuel isotope m at energy group k.

g = number of isotopes in lumped fission product group i.

m = fuel isotope m, composed of U-235, U-238, Pu-239, and Pu-241.

k = energy group k, with k = 1 through 4.

i = number of lumped fission product groups, i = 1 through 3.

The individual fission product isotopic yields, $Y^{g}_{i,k,m}$, were taken from a compilation performed by General Electric (14).

Xe-135 and Sm-149 are treated separately within RFD-1. Their microscopic capture cross sections were taken directly from the outputs of TOAFEW. The cross sectional tabulations of all the fission product groups as well as Xe-135 and Sm-149 are listed in Appendix B.

2.4 Criticality and Group Flux Determination

To calculate the group fluxes within each core region, RFD-1 uses a slightly modified version of the ODMUG code developed by Thomas (15). This is a one-dimensional criticality program developed at Virginia Tech which solves the following equation:

$$-\nabla\cdot[D_k(r)\nabla\phi_k(r)] + \Sigma_k(r)\phi_k(r) = \chi_k G(r)/\lambda + \Sigma^R_{k-1}(r)\phi_{k-1}(r) \qquad (2.4.1)$$

where, k = energy group 1, 2, 3, or 4 (group 4 is the thermal group).

$D_k(r)$ = diffusion coefficient in group k at position r.

$\Sigma_k(r) = D_k(r)B_k^2(r) + \Sigma^a_k(r) + \Sigma^R_k(r) + \Sigma^p_k(r)$ is the total cross section.

B_k^2 = transverse buckling.

χ_k = fraction of fission neutrons born in group k.

$G(r) = \sum_{k=1}^{4} \nu_k \Sigma^f_k \phi_k$ is the fission source.

λ = eigenvalue related to KEFF.

ODMUG automatically creates a set of linear equations from equation (2.4.1) through finite difference methods. These equations are conveniently set in the matrix form,

$$\underline{\underline{\Gamma}}\ \underline{\phi} = (1/\lambda)\ \underline{\underline{X}}\ \underline{\underline{F}}\ \underline{\phi} + \underline{\underline{R}}\ \underline{\phi} \qquad (2.4.2)$$

whereby the flux vector, $\underline{\phi}$, corresponding to the neutron flux at each spatial point r in the cylindrical reactor, is solved iteratively by Gaussian elimination. Since the matrix $\underline{\underline{\Gamma}}$ is tridiagonal, no inner iterations are required. The outer iterations for eigenvalue convergence are accelerated by use of Chebyshev polynomials.

The criticality solution is the most time consuming portion of RFD-1, since it is a numerical iterative calculation. A new KEFF value is

found after each depletion substep in RFD-1. Also, a criticality and group flux solution must be found every time the FTWR ratio changes in any region of the core.

2.5 Fuel Depletion

The following are the decay chains used in RFD-1 for solving the fuel depletion equations:

$$\begin{aligned} n + \text{U-235} &\rightarrow \text{Fission} \\ &\rightarrow \text{U-236} + \gamma \end{aligned} \tag{2.5.1}$$

$$\begin{aligned} n + \text{U-238} &\rightarrow \text{Fission} \\ &\rightarrow \text{U-239} \rightarrow \text{Np-239} + \beta^- \rightarrow \text{Pu-239} + \beta^- \end{aligned} \tag{2.5.2}$$

$$\begin{aligned} n + \text{Pu-239} &\rightarrow \text{Fission} \\ &\rightarrow \text{Pu-240} + \gamma \end{aligned} \tag{2.5.3}$$

$$\begin{aligned} n + \text{Pu-240} &\rightarrow \text{Fission} \\ &\rightarrow \text{Pu-241} + \gamma \end{aligned} \tag{2.5.4}$$

$$\begin{aligned} n + \text{Pu-241} &\rightarrow \text{Fission} \\ &\rightarrow \text{Pu-242} + \gamma \\ \text{Pu-241} &\rightarrow \text{Am-241} + \beta \end{aligned} \tag{2.5.5}$$

$$\begin{aligned} n + \text{Pu-242} &\rightarrow \text{Fission} \\ &\rightarrow \text{Pu-243} \rightarrow \text{Am-243} + \beta^- \end{aligned} \tag{2.5.6}$$

These decay chains can be written as a set of coupled first order differential equations.

$$dN_{25} / dt = - \left[\sum_{k=1}^{4} \sigma_k^{a,25} \phi_k \right] N_{25} \tag{2.5.7}$$

$$dN_{28} / dt = - \left[\sum_{k=1}^{4} \sigma_k^{a,28} \phi_k \right] N_{28} \tag{2.5.8}$$

$$dN_{40} / dt = \left[\sum_{k=1}^{4} \sigma_k^{c,28} \phi_k \right] N_{28} - \left[\sum_{k=1}^{4} \sigma_k^{a,40} \phi_k \right] N_{49} \qquad (2.5.9)$$

$$dN_{40} / dt = \left[\sum_{k=1}^{4} \sigma_k^{c,49} \phi_k \right] N_{49} - \left[\sum_{k=1}^{4} \sigma_k^{a,40} \phi_k \right] N_{40} \qquad (2.5.10)$$

$$dN_{41} / dt = \left[\sum_{k=1}^{4} \sigma_k^{c,40} \phi_k \right] N40 - \left[\lambda_{41} + \sum_{k=1}^{4} \sigma_k^{a,41} \phi_k \right] N_{41} \qquad (2.5.11)$$

$$dN_{42} / dt = \left[\sum_{k=1}^{4} \sigma_k^{c,41} \phi_k \right] N_{41} - \left[\sum_{k=1}^{4} \sigma_k^{a,42} \phi_k \right] N_{42} \qquad (2.5.12)$$

where, $\sigma_k^{a,m}$ = the microscopic absorption cross section of fuel isotope m for energy group k.

$\sigma_k^{c,m}$ = the microscipic capture cross section of fuel isotope m for energy group k.

N_m = the number density of fuel isotope m in atoms/cubic centimeter.

λ_{41} = decay constant for Pu-241 (all the other fuel isotopes have negligible decay constants).

The neutron energy spectrum in a particular core region can be taken as a constant over sufficiently small time intervals (16). Given this basic assumption, the rate equations outlined above can be solved analytically in terms of the neutron fluence, defined as,

$$\theta = \int_0^t \phi\,(t')dt'$$

where the time period t is defined by the user in RFD-1 and is typically on the order of 700 hours. These non-homogeneous first order differential equations can be solved using standard methods. Their solutions, as listed in reference (16), are given in Appendix D.

Xe-135 and Sm-149 are treated separately within RFD-1. The equilibrium concentration of each isotope is easily obtained by equating production with losses. For Xe-135 the equilibrium concentration is given by,

$$N_{xe} = \frac{\sum_{m=1}^{4} \sum_{k=1}^{4} Y_{k,m}^{xe} N_m \sigma_{k,m}^{f} \phi_k}{\lambda_{xe} + \sum_{k=1}^{4} \sigma_k^{c,xe} \phi_k} \qquad (2.5.13)$$

where N_{xe} = number density of Xe-135

N_m = number density of fuel isotope m

λ_k = the decay constant for Xe-135, which has the value of 2.10197×10^{-5} sec^{-1}

The equilibrium concentration of Sm-149 is given by,

$$N_{SM} = \frac{\sum_{m=1}^{4} \sum_{k=1}^{4} Y_{k,m}^{Sm} N_m \sigma_{k,m}^{f} \phi_k}{\sum_{k=1}^{4} \sigma_k^{c,Sm} \phi_k} \qquad (2.5.14)$$

where all the variable definitions correspond to those used above for Xe-135. Note that Sm-149 has no decay constant, since it is a stable isotope.

The rate of change of the three lumped fission products can be found through use of the following balance equation,

$$dN_i / dt = \sum_{m=1}^{4} \sum_{k=1}^{4} Y_{k,m}^{i} N_m \sigma_{k,m}^{f} \phi_k - \sum_{k=1}^{4} N_i \sigma_k^{c,i} \phi_k \qquad (2.5.15)$$

where, N_i = number of density of lumped fission product group.

$Y_{k,m}$ = number of atoms of fission product group i released per fission of fuel isotope m at energy group k.

The solution to these equations are given in a previous study by Florian (7).

2.6 Unit Cell Calculations

A triangular lattice must be used for any practical reactor core designs having relatively large values of FTWR. RFD-1 uses such an arrangement. Figure 2.6.1 illustrates a typical unit cell.

For a triangular lattice the FTWR can be easily shown to be,

$$\text{FTWR} = \frac{\text{Area of Fuel}}{\text{Total Unit Cell Area - Area of Cladding}} = \frac{\pi/8\ D_f^2}{\sqrt{3}/4 \cdot (S + D_c)^2 - \pi 8/D_c^2} \qquad (2.6.1)$$

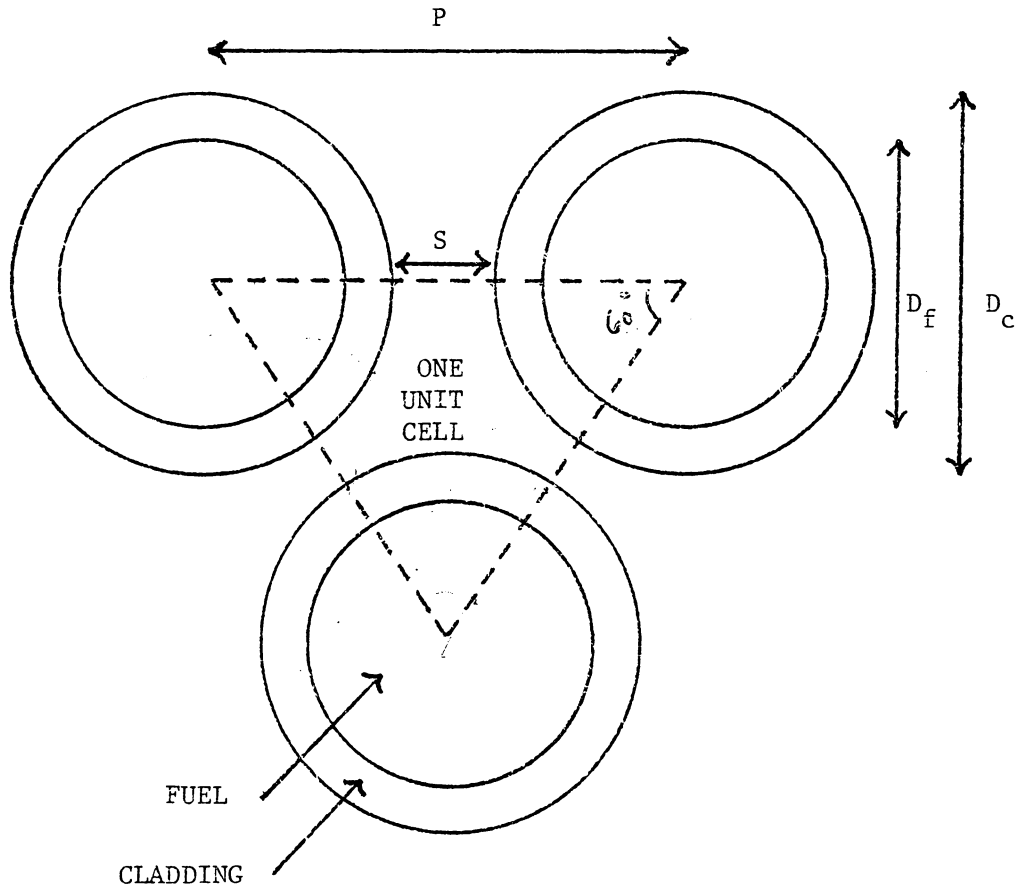
where, D_f = outer diameter of the fuel.

D_c = outer diameter of the cladding.

S = spacing between the fuel rods.

Given these basic dimensions, RFD-1 calculates the total unit cell area, which increases with decreasing FTWR, relative to the fuel rod and cladding areas, which always remain constant. Number densities used in RFD-1 are always smeared over the entire unit cell, and must therefore be recalculated every time the FTWR decreases.

As the FTWR decreases, it is apparent that the unit cell volume increases due to an increase in S, the spacing between fuel rods. In RFD-1 the spacing between all of the core rods is assumed to be equal, before and after changes in FTWR. Physically this assumption of total spatial symmetry between rods means that when the FTWR is



D_c = Diameter of Cladding

D_f = Diameter of Fuel

S = Spacing Between Fuel Rods

P = Pitch = D_c + S

Figure 2.6.1, A Triangular Unit Cell

decreased, a certain percentage of fuel rods are removed from the core. The remaining rods are then symmetrically spaced with an increased value of S. The result is that RFD-1 optimizes core burnup from a neutronics standpoint due to the core's perfect symmetry. This arrangement is acceptable because the purpose of RFD-1 is to allow easy investigation and comparison of burnup cycles for cores with differing dimensions, fuel regions, and initial fissile enrichments. Disadvantage factors, compensating for the probable localized non-symmetrical fuel arrangements of a practical mechanical spectral shift core designs, would have to be added to RFD-1 for each specific case of study.

2.7 Required Input

The input parameters required to run a particular case on RFD-1 are:

BCL,BCR = The boundary flux condition at the outer and the outside of the reactor, 1 for zero current, 1 for zero flux.

NRGNS = Number of core regions. Up to six regions are allowed.

NP = The poison search criterion. If JP=1, perform a poison search to find the macroscopic poison cross section needed to make the overall core just critical. If JP=0, no poison search is performed.

EPS = Convergence criterian for the eigenvalue solution, usually $1.0X10^{-4}$.

DEL(I) = Width of each core region in centimeters, I=1 → NRGNS.

POWER = Thermal power in watts that the group fluxes are normalized to.

PHIB = The ratio of average to peak flux in the axial direction of the cylindrical core.

SUBSTP = Number of hours contained in each depletion timestep between criticality calculations.

DEC = The decrement made in each core region's FTWR when such changes are required.

CHI(I) = The fraction of fission neutrons born in Group I, where I = 1 → 4.

EN5(I), EN8(I), EN9(I), ENϕ(I), EN1(I), EN2(I) = The initial percent enrichment of each fuel isotope within each region I.

SPAC(I) = The spacing in inches between fuel rods in each region I.

FUELOD = The outer diameter of the fuel in inches.

CLADOD = The outer diameter of the cladding in inches.

Table 2.7.1 lists the order in which the above input parameters are read into RFD-1.

Table 2.7.1, Input Parameters of RFD-1

Parameters	Cards Required
BCL, BCR, NRGNS, JP, EPS	1
DEL(I), I = 1, NRGNS	1
POWER, PHIB, HT, SUBSTP, DEL	1
CHI(1), CHI(2), CHI(3), CHI(4)	1
EN5(I), EN8(I), EN9(I), ENQ(I)	1 per region
EN1(I), EN2(I)	
SPAC(I), I = 1, NRGNS	1
Fuelod, CLADOD	1

Chapter 3

RESULTS

3.1 Core Parameters

As discussed previously, the primary usefulness of RFD-1 is that the flexibility of input allows the user to compare core burnup performance for a wide variety of differing core configurations using mechanical spectral shift. The core dimensions used in the following examples are typical of today's standard PWR. These dimensions were used in order that more direct comparisons can be made pertaining to the performance of spectral shift reactors versus that of a PWR. Two specific examples are presented of cases run on RFD-1. These cases are shown to illustrate the general types of results obtained for the spectral shift reactor core modeled by RFD-1. The results suggest the probable feasibility and desirability of converting standard PWR cores to more efficient spectral shift cores in the future.

3.2 Example No. 1

Table 3.2.1 lists the input core parameters at the beginning of core life for Example No. 1. The results of one burnup cycle are listed in Figures 3.2.1, 3.2.2, 3.2.3, 3.2.4, and 3.2.5. Note that the initial average core fissile enrichment is only 2.0%, and that the core operated almost 16,000 hours before shutdown.

Figure 3.2.1 illustrates the improvement in conversion performance over the core lifetime. As expected, the conversion ratio decreased over time as the FTWR was gradually decreased to add reactivity. At the end of life the conversion ratio is similar to that of a standard PWR.

Figure 3.2.2 shows the burnup over time. Almost 22,000 MWD/MTHM is burned in this cycle. With an optimized plan for redistributing the fuel during shutdowns, total burnups significantly exceeding 33,000 MWD/MTHM are expected.

Figure 3.2.3 shows the change in the proportion of each group flux to the total neutron flux over core life. Note that the energy group 2 flux decreases over time, while the thermal flux (group 4) increases by about the same amount. Groups 1 and 3 change little over time and FTWR. This suggests that the main changes in microscopic cross sections are in groups 2 and 4. In the range of FTWR's used as input for RFD-1 (from 1.3 to 0.5), the primary result of decreasing the FTWR is to transfer neutrons from group 2 to group 4 with relatively little change in groups 1 and 3.

Figure 3.2.4 shows the change in peak/average ratio of the total point flux values taken at each core nodal point. These point flux values are proportional to the power density and show that no large power peaking occurs over core life for Example No. 1. Large peak/average values would necessitate in core region size or enrichment to provide a more flat radial flux shape.

Figure 3.2.4 shows how the FTWR was adjusted over time in Example No. 1. Note that the sharp decreases in conversion ratio, shown in Figure 3.2.1, correspond to decreases in the FTWR.

A complete listing of the output provided by RFD-1 for Example No. 1 is given in Appendix E.

Table 3.2.1, Input for Example No. 1

********** INPUT DATA **********

THE CYLINDRICAL REACTOR HAS 4 REGIONS
REGION WIDTHS FROM THE CENTER OUT IN CM ARE:
87.76199 36.35201 27.89400 40.00000
THE REACTOR USES A HEXAGONAL LATTICE
THE FUEL OUTER DIAMETER IS 0.3240 INCHES
THE CLADDING OUTER DIAMETER IS 0.3790 INCHES
THE HEIGHT IS 365.0 CM
THE TRANSVERSE BUCKLING IS 0.74082E-04 CM**2
THE REACTOR POWER IS TO BE SET AT 0.27750E 10 WATTS
THE LENGTH OF EACH TIMESTEP IS 700.00 HOURS
THE CONVERGENCE CRITERION FOR THE EIGENVALUE IS 0.10000E-03
THE REGION VOLUMES ARE : 8831919.00 8831857.00 8831888.00 15779050.00

	ENRICHMENT %						
	U-235	U-238	PU-239	PU-240	PU-241	PU-242	SPACING
REGION 1	1.900	98.100	0.000	0.000	0.000	0.000	0.080
REGION 2	2.000	98.000	0.000	0.000	0.000	0.000	0.080
REGION 3	2.100	97.900	0.000	0.000	0.000	0.000	0.080
REGION 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.19946400E 21	0.20996460E 21	0.22046510E 21	0.00000000E 00
U-238	0.10298640E 23	0.10288270E 23	0.10277880E 23	0.00000000E 00
PU-239	0.00000000E 00	0.00000000E 00	0.00000000E 00	0.00000000E 00
PU-240	0.00000000E 00	0.00000000E 00	0.00000000E 00	0.00000000E 00
PU-241	0.00000000E 00	0.00000000E 00	0.00000000E 00	0.00000000E 00
PU-242	0.00000000E 00	0.00000000E 00	0.00000000E 00	0.00000000E 00
O-16	0.30318970E 23	0.30319210E 23	0.30319430E 23	0.24426610E 23
H&H2O	0.18645500E 23	0.18645500E 23	0.18645500E 23	0.48853220E 23
ZIRC2	0.70738120E 22	0.70738120E 22	0.70738120E 22	0.00000000E 00
FTW RATIO	1.1839	1.1839	1.1839	0.0000

********** END OF INPUT DATA **********

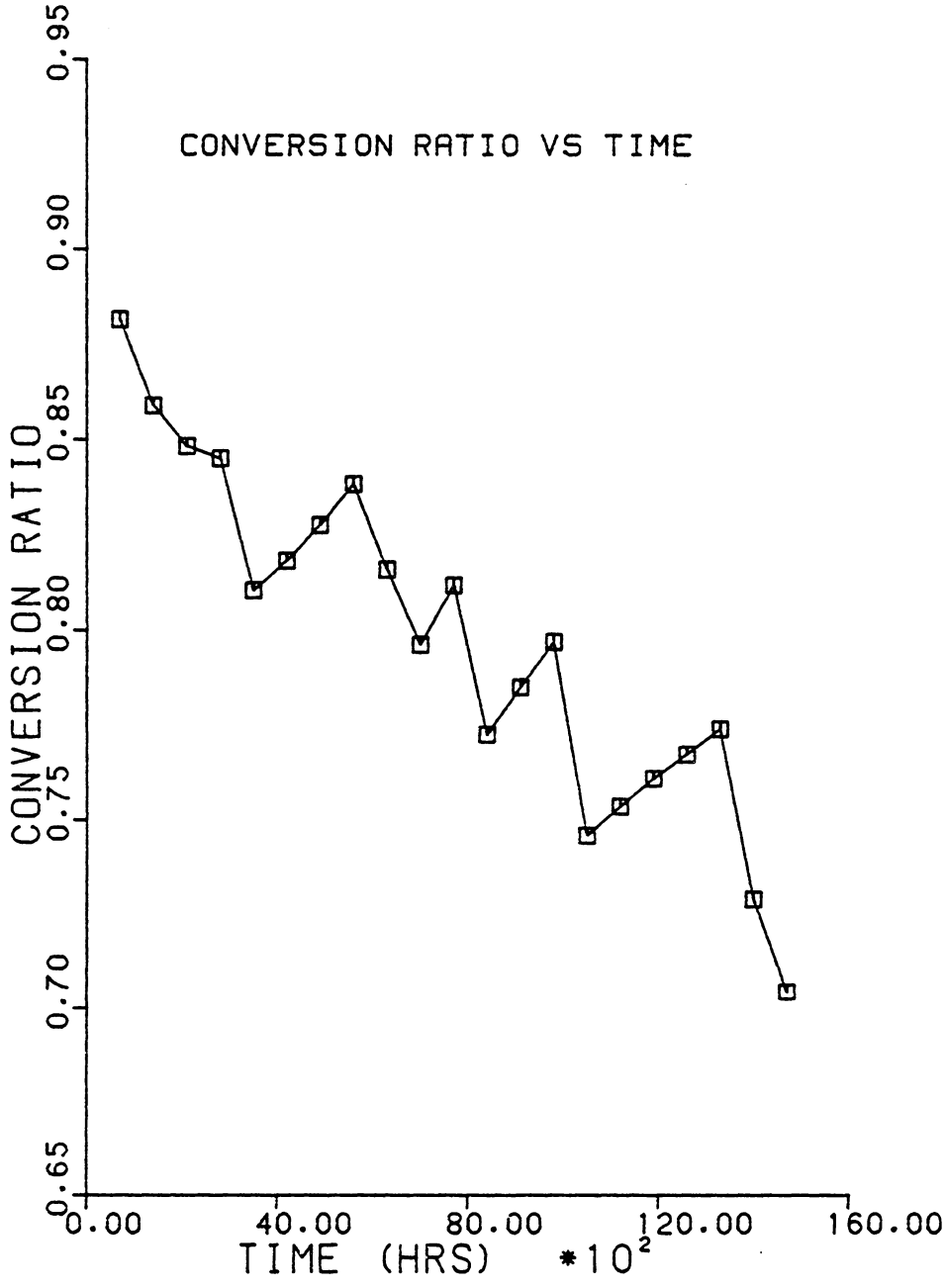


Figure 3.2.1, Conversion Ratio Vs. Time

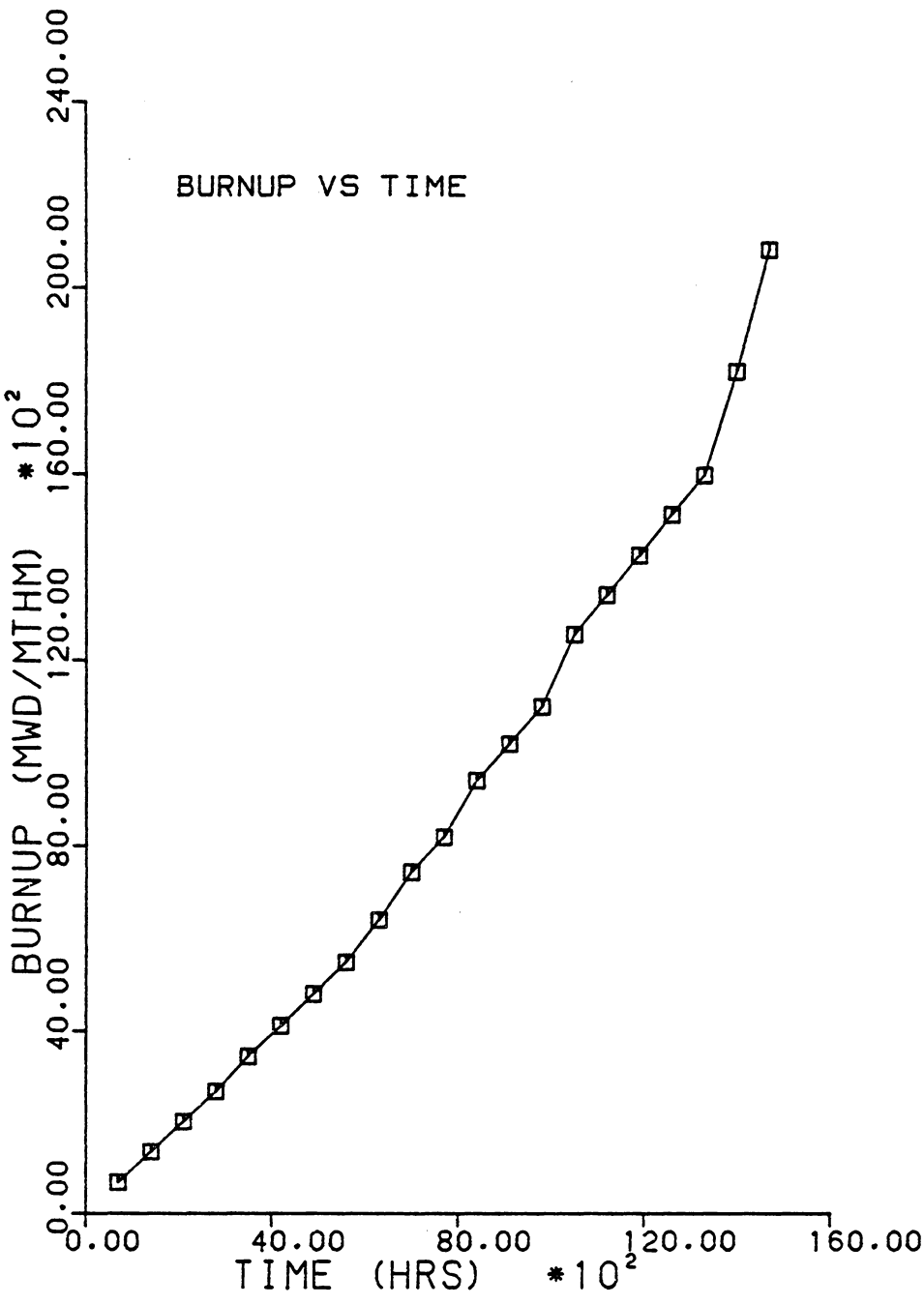


Figure 3.2.2, Burnup Vs. Time

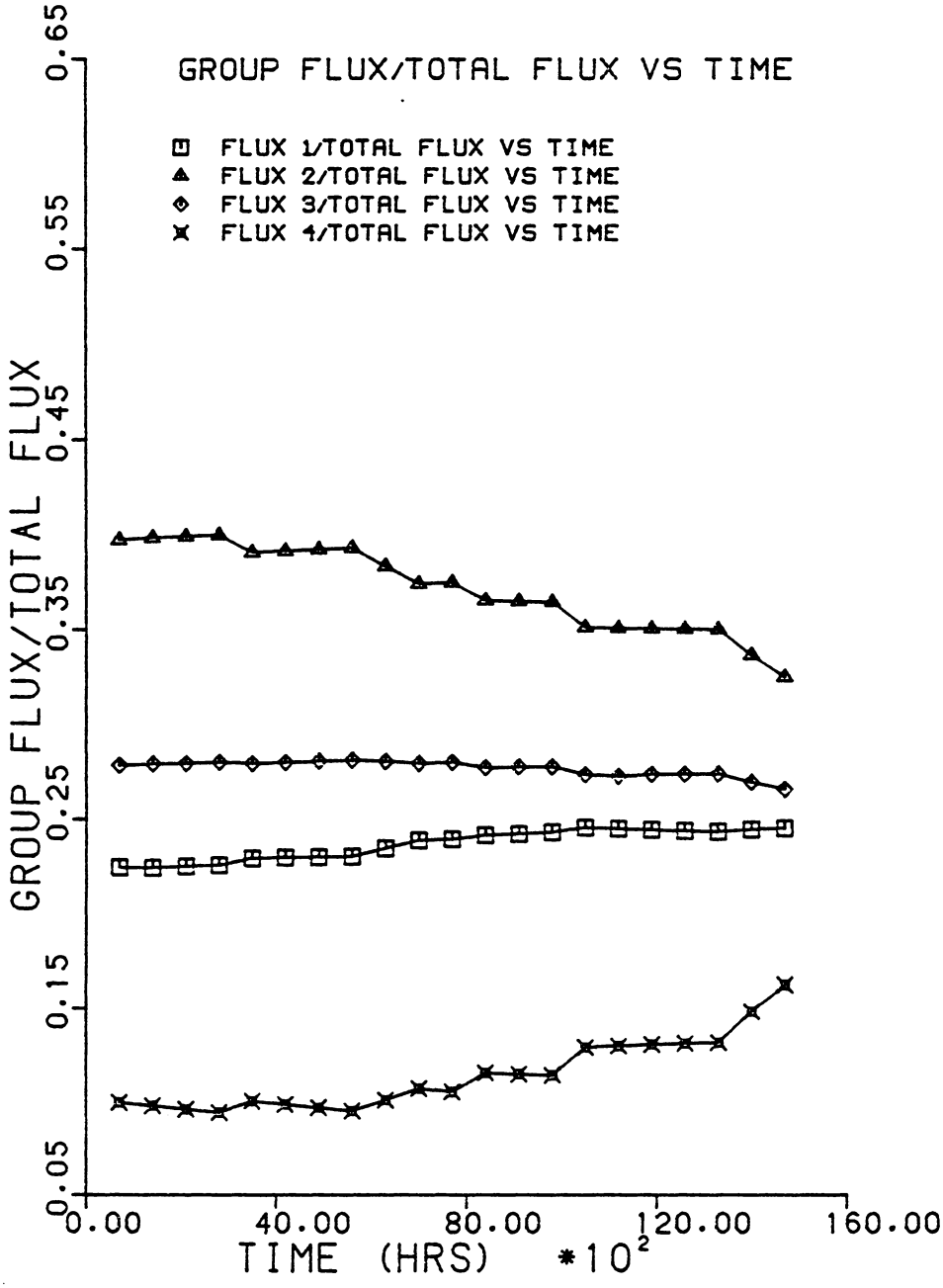


Figure 3.2.3, Group Flux/Total Flux Vs. Time

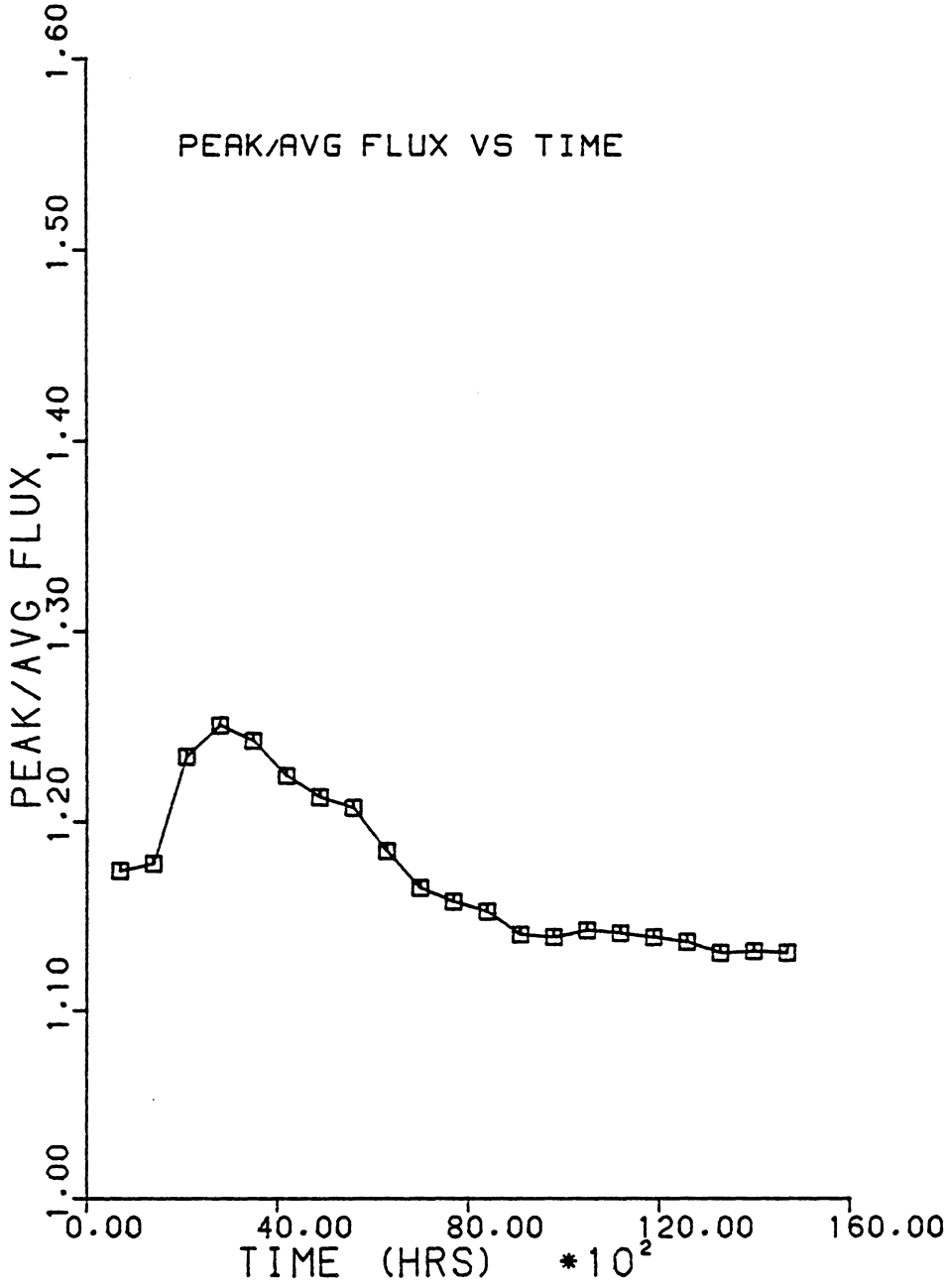


Figure 3.2.4, Peak/Avg Flux Vs. Time

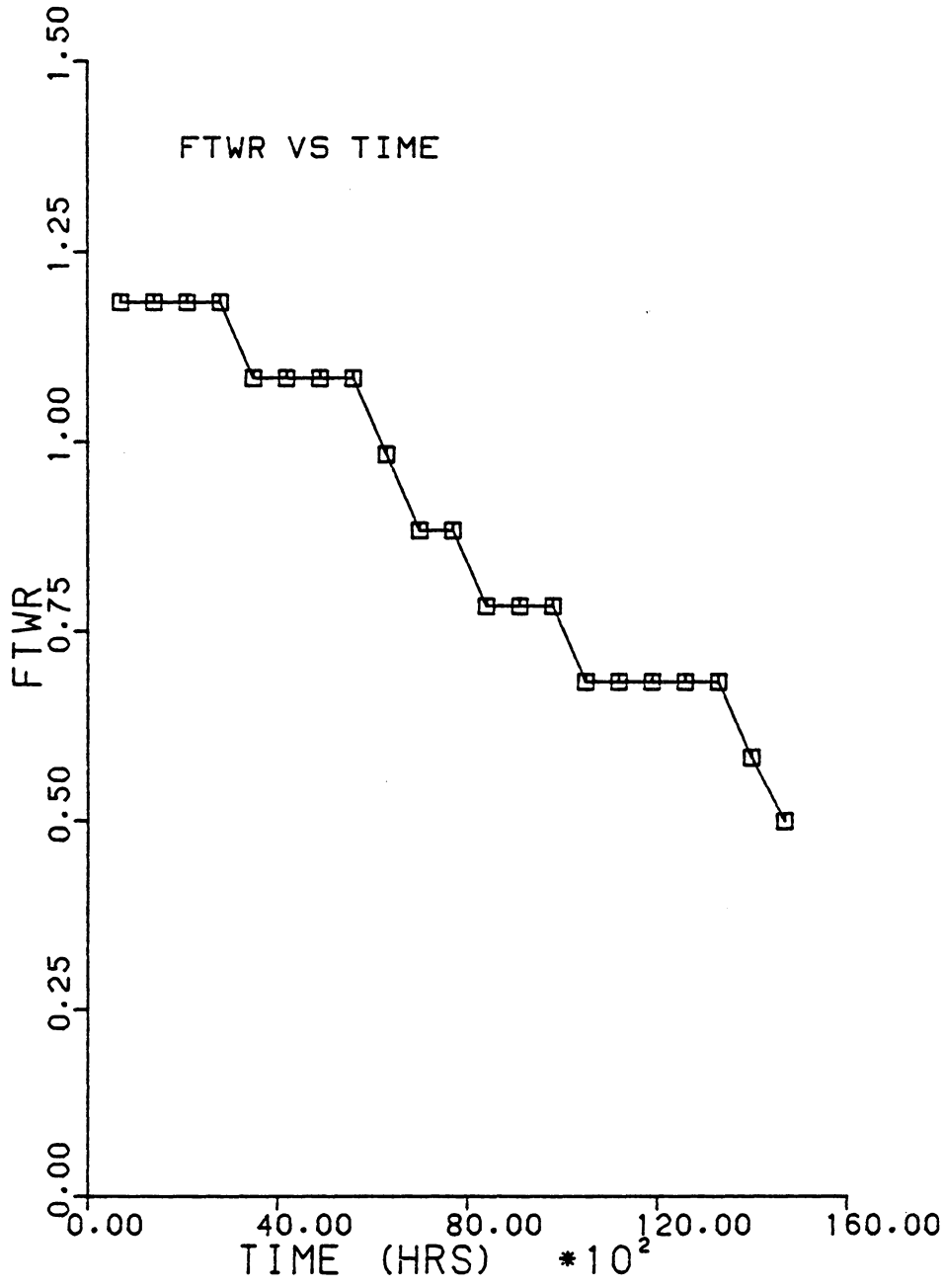


Figure 3.2.5, FTWR Vs. Time

3.3 Example No. 2

A slightly different core configuration is provided as Example No. 2. This core has the same dimensions as that of Example No. 1, but contains only two fuel regions and has a slightly greater initial enrichment. Table 3.3.1 lists all the input parameters.

Figures 3.3.1, 3.3.2, 3.3.3, 3.3.4, and 3.3.5 illustrate the fuel cycle performance for this particular case.

Table 3.3.2, Input for Example No. 2

********** INPUT DATA **********

THE CYLINDRICAL REACTOR HAS 3 REGIONS
REGION WIDTHS FROM THE CENTER OUT IN CM ARE:
107.47990 44.52000 40.00000
THE REACTOR USES A HEXAGONAL LATTICE
THE FUEL OUTER DIAMETER IS 0.3240 INCHES
THE CLADDING OUTER DIAMETER IS 0.3790 INCHES
THE HEIGHT IS 365.0 CM
THE TRANSVERSE BUCKLING IS 0.74082E-04 CM**2
THE REACTOR POWER IS TO BE SET AT 0.27750E 10 WATTS
THE LENGTH OF EACH TIMESTEP IS 700.00 HOURS
THE CONVERGENCE CRITERION FOR THE EIGENVALUE IS 0.10000E-03
THE REGION VOLUMES ARE : 13246390.00 13246480.00 15778330.00

	ENRICHMENT %						
	U-235	U-238	PU-239	PU-240	PU-241	PU-242	SPACING
REGION 1	2.000	98.000	0.000	0.000	0.000	0.000	0.079
REGION 2	2.100	97.900	0.000	0.000	0.000	0.000	0.079
REGION 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	REGION 1	REGION 2	REGION 3
NUMBER DENSITY			
U-235	0.21088250E 21	0.22142900E 21	0.00000000E 00
U-238	0.10333250E 23	0.10322810E 23	0.00000000E 00
PU-239	0.00000000E 00	0.00000000E 00	0.00000000E 00
PU-240	0.00000000E 00	0.00000000E 00	0.00000000E 00
PU-241	0.00000000E 00	0.00000000E 00	0.00000000E 00
PU-242	0.00000000E 00	0.00000000E 00	0.00000000E 00
O-16	0.30344980E 23	0.30345210E 23	0.24426610E 23
H&H2O	0.18513440E 23	0.18513440E 23	0.48853220E 23
ZIRC2	0.71047340E 22	0.71047340E 22	0.00000000E 00
FTW RATIO	1.1976	1.1976	0.0000

********** END OF INPUT DATA **********

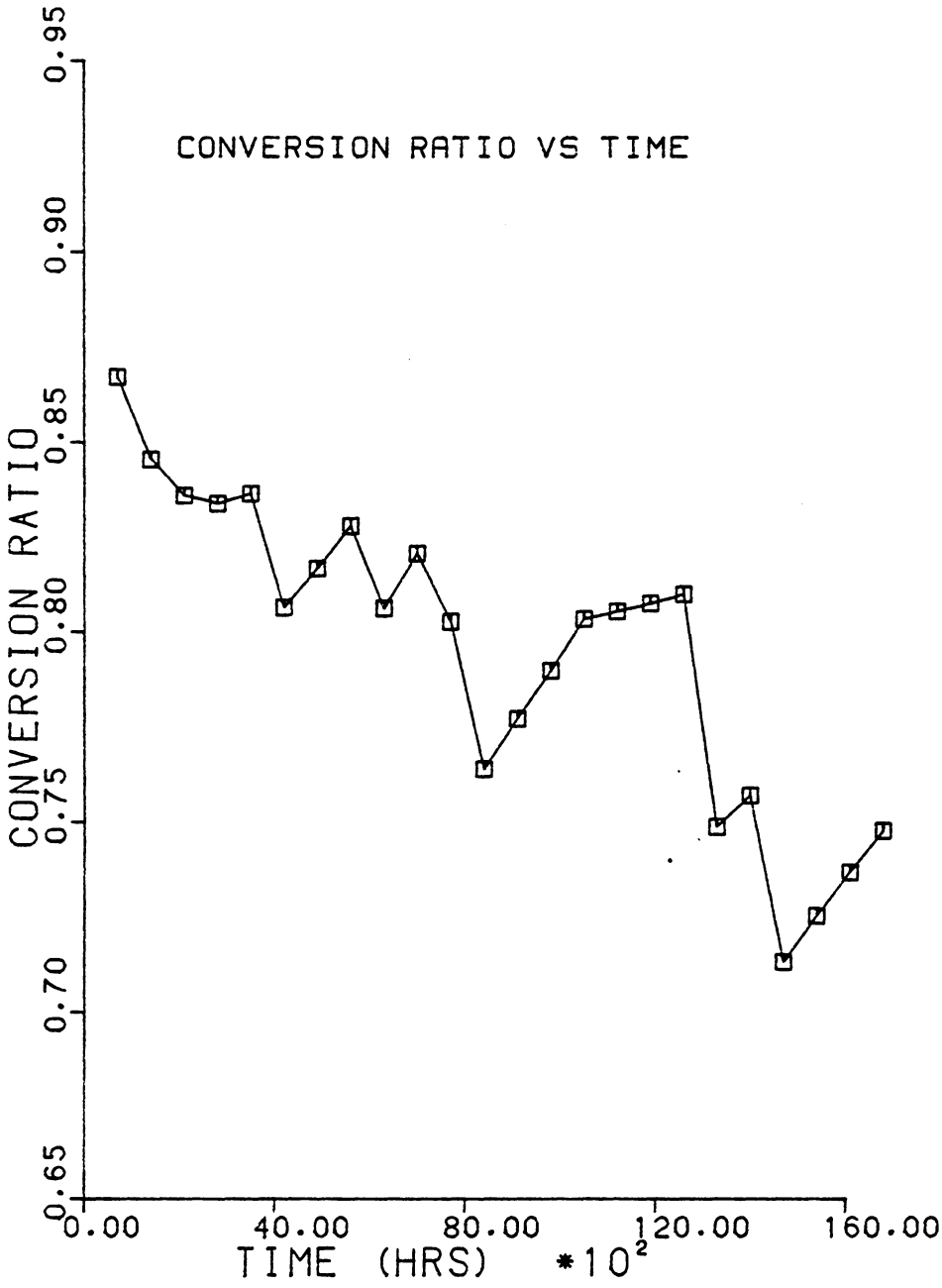


Figure 3.3.1, Conversion Ratio Vs. Time

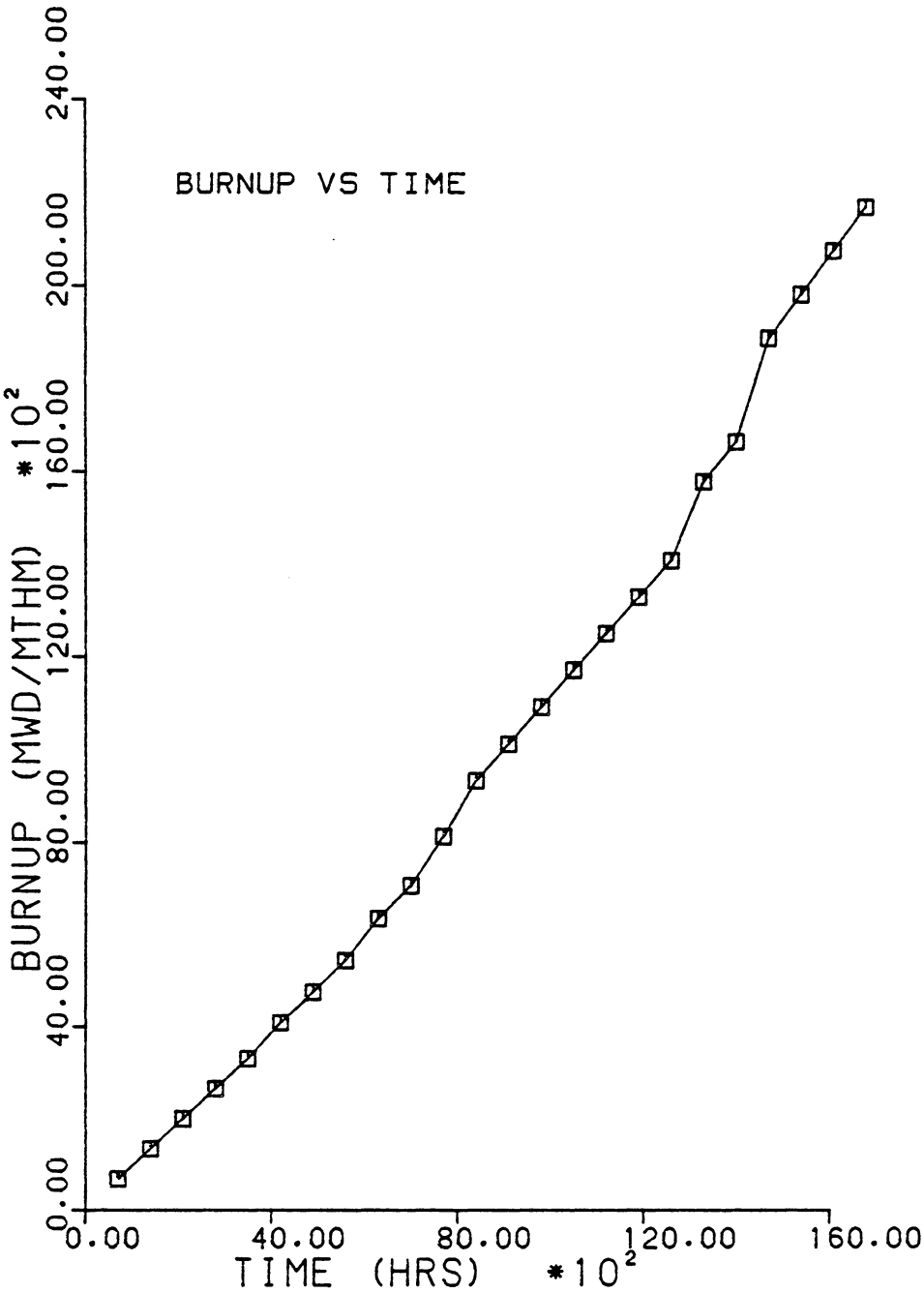


Figure 3.3.2, Burnup Vs. Time

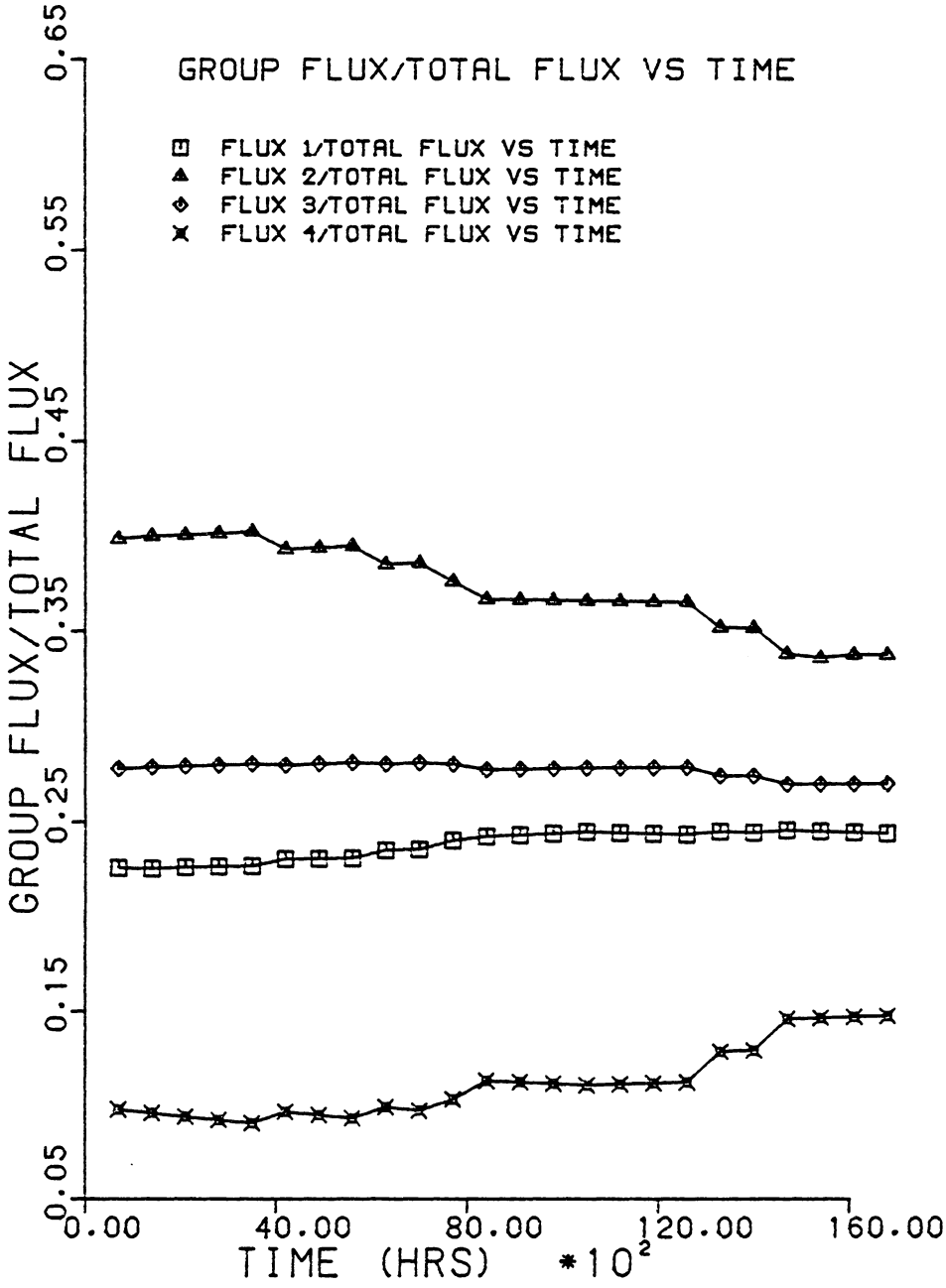


Figure 3.3.3, Group Flux/Total Flux Vs. Time

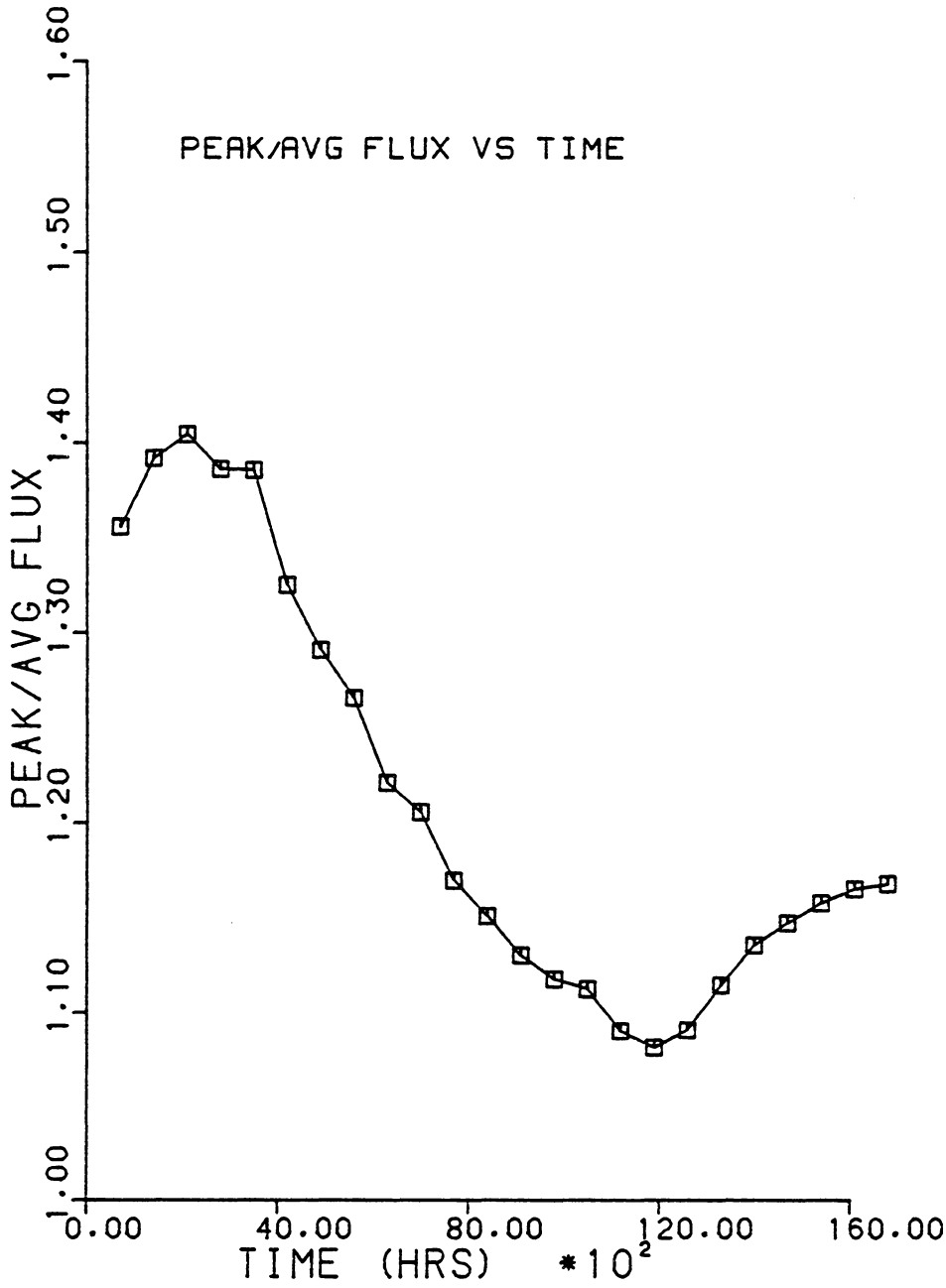


Figure 3.3.4, Peak/Avg Flux Vs. Time

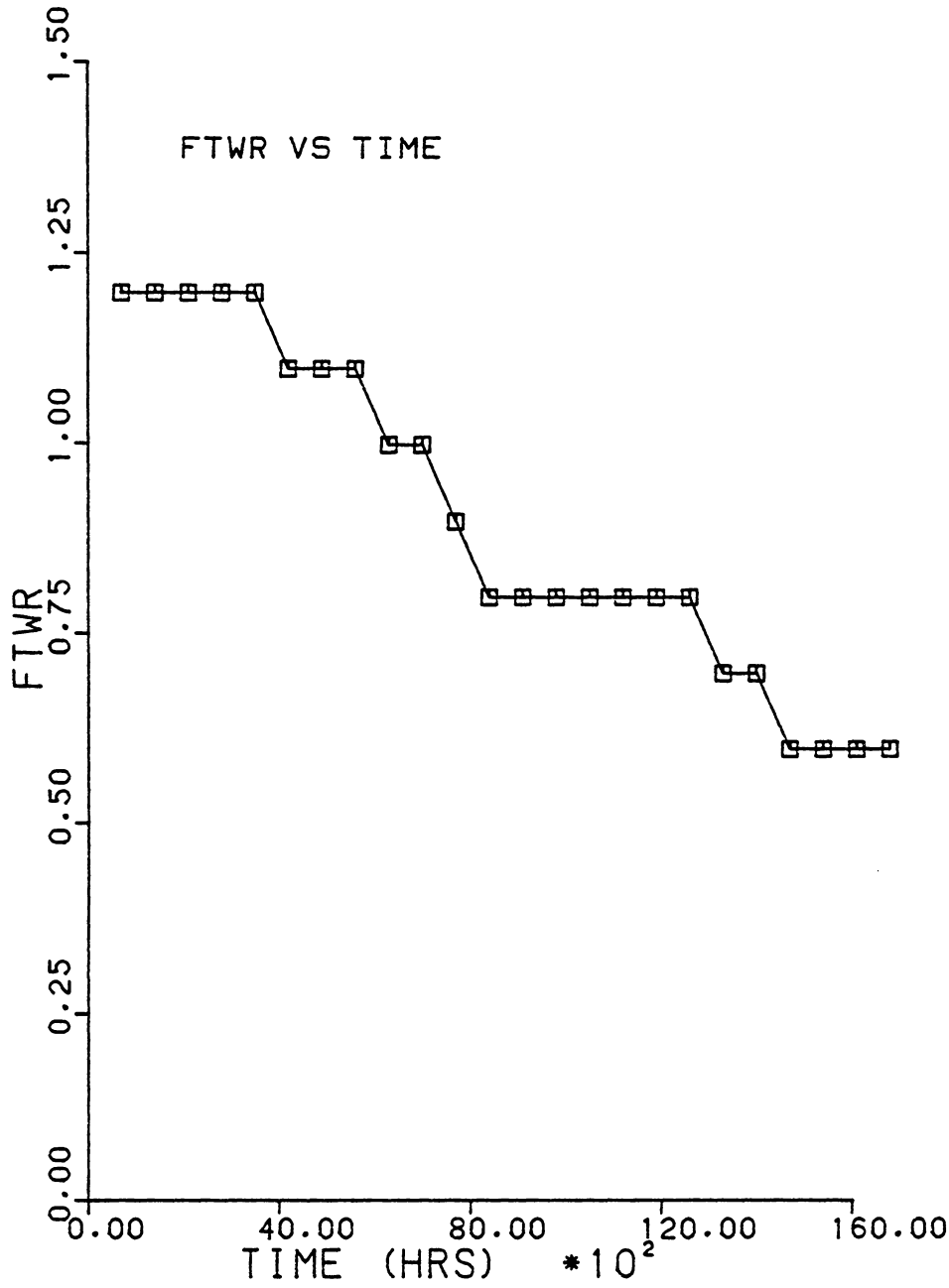


Figure 3.3.5, FTWR Vs. Time

Chapter 4

CONCLUSIONS

RFD-1 was created to allow an investigator to easily examine a wide spectrum of differing cases of burnup cycles for mechanical spectral shift nuclear reactors. This has been accomplished. RFD-1 requires a maximum of twelve lines of input and can handle a wide variety of core configurations. The code is both simple to use and flexible.

A problem presents itself in the fact that there is at the present time no other computer codes available that carry out the functions of RFD-1. Hence, there are no codes available to compare with RFD-1 for accuracy of results. The criticality and fuel depletion sections of RFD-1 incorporate algorithms used previously at Virginia Tech with good results. This leaves the cross section tables utilized by RFD-1 as the largest potential source of errors. VIM has been shown to be accurate for specific cases (4). It is not exactly known how much error is introduced through the linear interpolation scheme of calculating the cross sections. An advantage of RFD-1 is that it would be a relatively simple task to modify the microscopic cross section calculational area of the program if better data becomes available. There are several possible ways that the cross sectional input for RFD-1 could be improved:

1. Run a typical burnup case on RFD-1. Use the relative fuel isotope number densities at various times of burnup as input for VIM runs. From the VIM runs create new cross

section tables. This process could be repeated as many times as desired.

2. Increase the interpolation range by increasing the number of FTWR values and burnup periods for each table. This would require many more cases to be run by VIM.
3. Create additional cross section tables for differing initial core enrichments. Currently, the tables used by RFD-1 are for an initial 2.0% enrichment of U-235. Additional tables for 3.0% and 5% initial enrichment could also be created. Then RFD-1 could be modified to make an additional interpolation between tables when the initial enrichment is between 2% and 3% or 3% and 5%.

The preliminary results using RFD-1 clearly show the desirability of a mechanical spectral shift design. The next logical step is to design and study in great detail the core physics and thermal hydraulic performance of some specific design incorporating mechanical spectral shift. RFD-1 can be used as a first step in developing a workable core configuration. Once this step is accomplished, a final design's performance could be tested using standard analytic and experimental methods. The ultimate goal is to replace the present generation of nuclear reactors with a new generation of more efficient reactors incorporating a mechanical spectral shift design.

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APPENDIX A

PROGRAM LISTING OF RFD-1

```
C*************************************************************************
C*************************************************************************
C
C
C  RAPID FUEL DEPLETION CODE - RFD-1
C
C THIS CODE WAS DEVELOPED AT VIRGINIA TECH BY RUSS SHERMAN
C
C
C*************************************************************************
C*************************************************************************
      REAL LMBDA
      INTEGER G,BCL,BCR,PP
      COMMON /BLOCK1/ SR(4,6),SA(4,6),SF(4,6),DC(4,6),SP(4,6),BUC(4,6),
     1H(60),A(240),D(240),C(240),NOPTS(6),P,NRGNS,G,N,BCL,BCR
      COMMON /BLOCK2/ SRB(4,60),SFB(4,60),SRBM(4,60),SFBM(4,60),PHI(4,60
     1),PH(4,60),B(240),S(240),CHI(4),LMBDA,FLUX(4,6)
      COMMON /BLOCK3/ RES(4,10),THETA(10),EPS,EPS1,SIGB,JS,IT
      COMMON /BLOCK4/ DESEIG,EPS2,SPP
      COMMON /BLOCK5/ DEL(6),POWER,PHIB,HT
      COMMON /OUTPUT/ OPTOUT,NSUM1
      COMMON /MAX/ SMAX,V(240),BAX,TIME
      DIMENSION AA5(6),AA8(6),AA9(6),AA0(6),AA1(6),AA2(6),AN5(6)
     1,AN8(6),AN9(6),AN0(6),AN1(6),AN2(6),AAOX(6),AAH(6),AAZ(6)
     2,CAP8(4,6),CAP9(4,6),CAP0(4,6),CAP1(4,6)
      DIMENSION ABS5(4,6),ABS8(4,6),ABS9(4,6),ABS0(4,6),ABSFP(4,6),
     1ABS1(4,6),ABS2(4,6),ABSOX(4,6),ABSH(4,6),ABSZ(4,6),
     2FIS5(4,6),FIS8(4,6),FIS9(4,6),FIS0(4,6),FIS1(4,6),FIS2(4,6)
      DIMENSION TT(14,3,4,4,3),EN5(6),EN8(6),EN9(6),EN0(6),EN1(6),
     1          EN2(6),FTW(6)
      DIMENSION XABSOX(4,6),XABSZ(4,6),XABSH(4,6),XABSFP(4,6),
     1XABS5(4,6),XABS8(4,6),XABS9(4,6),XABS0(4,6),XABS1(4,6),XABS2(4
     2,6),SPAC(6),ATOT(6),XABS(4,6),ATOT1(6)
      DIMENSION XFIS5(4,6),XFIS8(4,6),XFIS9(4,6),
     1XFIS0(4,6),XFIS1(4,6),XFIS2(4,6),XFIS(4,6)
      DIMENSION FLXNRM(4,6),FLXRAT(4,6),PRR(6),Z1(14,4),Z2(14,4),
     1          Z3(14,4)
      DIMENSION FERCAP(6),FR5(4,6),FR8(4,6),FR9(4,6),FR0(4,6)
     1,FR1(4,6),FR2(4,6),AR5(4,6),AR8(4,6),AR9(4,6),AR0(4,6),AR1(4,6
     2),AR2(4,6),CR5(4,6),CR8(4,6),CR9(4,6),CR0(4,6),CR1(4,6),CR2(4
     3,6),FISABS(6),CR(6),AMTHM(6)
      DIMENSION VOL(6),VO(6),R(6),FLXMAX(6),FLUENC(6)
     1,PD(6),PWR(6),ED(6),AMT(6),BURNUP(6),FLXNRT(6)
      DIMENSION AMU5(6),AMU8(6),AMU9(6),AMU0(6),AMU1(6),
     2AMU2(6),GAM8(6),GAM9(6),GAM0(6),GAM1(6),BET5(6),
     3BET8(6),BET9(6),BET0(6),BET1(6),BET2(6)
      DIMENSION EINT5(6),EINT8(6),EINT9(6),EINT0(6),EINT1(6)
     1,EINT2(6),AAA(6),BBB(6),CCC(6),DDD(6),EEE(6),FFF(6),GGG(6),
     2HHH(6),QQQ(6),RRR(6),SSS(6),TTT(6)
      DIMENSION PFIS5(4,6),PFIS8(4,6),PFIS9(4,6),PFIS0(4,6),
     1PFIS1(4,6),PFIS2(4,6),FTW1(6),AAOX1(6),AAOX0(6)
      DIMENSION XPFIS5(4,6),XPFIS8(4,6),XPFIS9(4,6),
     1          XPFIS0(4,6),XPFIS1(4,6),XPFIS2(4,6)
      DIMENSION AROX(4,6),ARH(4,6),ARZ(4,6),ARFP(4,6),FROX(4,6),
     1          FRH(4,6),FRZ(4,6),FRFP(4,6),PHLUX(4,6)
```

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      DIMENSION AR5T(6),AR8T(6),AR9T(6),AR0T(6),AR1T(6),AR2T(6),
     1          AROXT(6),ARHT(6),ARZT(6),ARFPT(6),FR5T(6),FR8T(6),
     2          FR9T(6),FR0T(6),FR1T(6),FR2T(6),FRT(6),ART(6)
      DIMENSION RS5(6),RS8(6),RS9(6),RS1(6),SS5(6),SS8(6),SS9(6),SS1(6),
     1          ANS5(6),ANS8(6),ANS9(6),ANS1(6),RS(6),SS(6),ANS(6)
      DIMENSION XE5(6),XE8(6),XE9(6),XE1(6),XE(6),XXE5(6),XXE8(6),XXE9(6
     1          ),XXE1(6),SM5(6),SM8(6),SM9(6),SM1(6),SM(6),SSM5(6),
     2          SSM8(6),SSM9(6),SSM1(6)
      DIMENSION ABSRS5(4,6),ABSRS8(4,6),ABSRS9(4,6),ABSRS1(4,6),
     1          ABSSS5(4,6),ABSSS8(4,6),ABSSS9(4,6),ABSSS1(4,6),
     2          ABSNS5(4,6),ABSNS8(4,6),ABSNS9(4,6),ABSNS1(4,6),
     3          ABSXE(4,6),ABSSM(4,6)
      DIMENSION ETRS5(6),ETRS8(6),ETRS9(6),ETRS1(6),
     1          ETSS5(6),ETSS8(6),ETSS9(6),ETSS1(6),
     2          ETNS5(6),ETNS8(6),ETNS9(6),ETNS1(6)
      DIMENSION GAMRS5(6),GAMRS8(6),GAMRS9(6),GAMRS1(6),
     1          GAMSS5(6),GAMSS8(6),GAMSS9(6),GAMSS1(6),
     2          GAMNS5(6),GAMNS8(6),GAMNS9(6),GAMNS1(6)
      DIMENSION CORS5(6),CORS8(6),CORS9(6),CORS1(6),
     1          COSS5(6),COSS8(6),COSS9(6),COSS1(6),
     2          CONS5(6),CONS8(6),CONS9(6),CONS1(6)
      DIMENSION RSIN5(6),RSIN8(6),RSIN9(6),RSIN1(6),
     1          SSIN5(6),SSIN8(6),SSIN9(6),SSIN1(6),
     2          ANSIN5(6),ANSIN8(6),ANSIN9(6),ANSIN1(6)
      DIMENSION TOT5(4,6),TOT8(4,6),TOT9(4,6),TOT1(4,6),TOT0(4,6),
     1          TOT2(4,6),TOTOX(4,6),TOTH(4,6),TOTZ(4,6)
      DIMENSION XTOTOX(4,6),XTOTH(4,6),XTOTZ(4,6),XTOT(4,6),
     1          XXE(4,6),XSM(4,6),XRS(4,6),XSS(4,6),XNS(4,6)
      DIMENSION AB5(4),AB8(4),AB9(4),AB1(4),SORCE(6)
      REAL      YRS5(4) /3*0.096687,0.090759/
      REAL      YRS8(4) /3*0.150947,0.00/
      REAL      YRS9(4) /3*0.169236,0.163154/
      REAL      YRS1(4) /3*0.191095,0.178833/
      REAL      YSS5(4) /3*0.275949,0.286184/
      REAL      YSS8(4) /3*0.259712,0.00/
      REAL      YSS9(4) /3*0.236746,0.248684/
      REAL      YSS1(4) /3*0.223544,0.234556/
      REAL      YNS5(4) /3*1.623606,1.628460/
      REAL      YNS8(4) /3*1.586927,0.00/
      REAL      YNS9(4) /3*1.595649,1.576107/
      REAL      YNS1(4) /3*1.616606,1.578040/
      REAL      YXE5(4) /3*0.064512,0.067233/
      REAL      YXE8(4) /3*0.057477,0.00/
      REAL      YXE9(4) /3*0.074467,0.072198/
      REAL      YXE1(4) /3*0.075241,0.072948/
      REAL      YSM5(4) /3*0.010719,0.010710/
      REAL      YSM8(4) /3*0.018433,0.00/
      REAL      YSM9(4) /3*0.013296,0.012450/
      REAL      YSM1(4) /3*0.015294,0.014307/
C************* START MAIN PROGRAM ********************
      DO 867 I=1,4
      AB5(I)=YRS5(I)+YSS5(I)+YNS5(I)+YXE5(I)+YSM5(I)
      AB8(I)=YRS8(I)+YSS8(I)+YNS8(I)+YXE8(I)+YSM8(I)
      AB9(I)=YRS9(I)+YSS9(I)+YNS9(I)+YXE9(I)+YSM9(I)
      AB1(I)=YRS1(I)+YSS1(I)+YNS1(I)+YXE1(I)+YSM1(I)
```

```
867   CONTINUE
      DO 868 I=1,4
      YRS5(I)=YRS5(I)*2.0/AB5(I)
      IF (I.EQ.4)GO TO 861
      YRS8(I)=YRS8(I)*2.0/AB8(I)
861   YRS9(I)=YRS9(I)*2.0/AB9(I)
      YRS1(I)=YRS1(I)*2.0/AB1(I)
      YSS5(I)=YSS5(I)*2.0/AB5(I)
      IF (I.EQ.4) GO TO 862
      YSS8(I)=YSS8(I)*2.0/AB8(I)
862   YSS9(I)=YSS9(I)*2.0/AB9(I)
      YSS1(I)=YSS1(I)*2.0/AB1(I)
      YNS5(I)=YNS5(I)*2.0/AB5(I)
      IF (I.EQ.4) GO TO 863
      YNS8(I)=YNS8(I)*2.0/AB8(I)
863   YNS9(I)=YNS9(I)*2.0/AB9(I)
      YNS1(I)=YNS1(I)*2.0/AB1(I)
      YXE5(I)=YXE5(I)*2.0/AB5(I)
      IF (I.EQ.4) GO TO 864
      YXE8(I)=YXE8(I)*2.0/AB8(I)
864   YXE9(I)=YXE9(I)*2.0/AB9(I)
      YXE1(I)=YXE1(I)*2.0/AB1(I)
      YSM5(I)=YSM5(I)*2.0/AB5(I)
      IF (I.EQ.4) GO TO 865
      YSM8(I)=YSM8(I)*2.0/AB8(I)
865   YSM9(I)=YSM9(I)*2.0/AB9(I)
      YSM1(I)=YSM1(I)*2.0/AB1(I)
868   CONTINUE
      DO 900 K=1,14
      DO 901 J=1,3
      DO 902 L=1,4
      READ(5,*) ((TT(K,J,L,M,N),N=1,3),M=1,2)
      READ(5,*) ((TT(K,J,L,M,N),N=1,3),M=3,4)
902   CONTINUE
901   CONTINUE
900   CONTINUE
      READ (5,*) BCL,BCR,NRGNS,JP,EPS
C
C     THERE HAS BEEN SOME CONFUSION ABOUT THE BOUNDARY CONDITIONS
C     THAT IS BCL AND BCR.  USE 2 FOR ZERO CURRENT OR 1 FOR ZERO FLUX
C     ALSO NOTE THAT THE LEFT-HAND (BCL) BOUNDARY IS YOUR LINE OF
C     SYMMETRY.
C
C     THE INPUT HAS BEEN CHANGED SO THAT 1. YOU CAN SPECIFY THE NUMBER
C     OF GROUPS (IF LEFT OUT WILL GET 3 IN FORMATED READ ONLY) AND
C     2. IF EPS IS POSITIVE WE
C     GET A SHORT EDIT AND IF NEGATIVE WE GET A LONG EDIT (NOTE THAT
C     IN CONVERGENCE WE USE THE ABS(EPS) ).
C
       G = 4
      OPTOUT=0.0
      IF (EPS.LT.0.0) OPTOUT=1.0
      EPS=ABS(EPS)
      READ (5,*) (DEL(I),I=1,NRGNS)
      READ (5,*) POWER,PHIB,HT,SUBSTP,DEC
```

```
      READ (5,*) (CHI(I),I=1,G)
      INDAC=1
      POOF=1.0
      P=1.0
      DO 206 I=1,NRGNS
      READ (5,*) EN5(I),EN8(I),EN9(I),EN0(I),EN1(I),EN2(I)
206   CONTINUE
      READ (5,*) (SPAC(I),I=1,NRGNS)
      READ (5,*) FUELOD,CLADOD
      PI=3.14159
      TI=1.0E-24
      NRG=NRGNS
      NSSS=0
      NUKIE=1
      INDIC=2
      ROWTER=0.73
      AOK=CLADOD/FUELOD
      ROFUEL=10.412
      DO 149 K=1,G
      DO 3 I=1,NRGNS
      BUC(K,I)=(PI*PI)/(HT*HT)
3     CONTINUE
149   CONTINUE
      TIME=0.0
      DO 1 I=1,NRGNS
      IF (I.EQ.1) GO TO 2
      R(I)=DEL(I)+R(I-1)
      VO(I)=R(I)*R(I)*PI*HT
      VOL(I)=VO(I)-VO(I-1)
      GO TO 1
2     R(I)=DEL(I)
      VO(I)=R(I)*R(I)*PI*HT
      VOL(I)=VO(I)
1     CONTINUE
      CORVOL=0.0
      DO 4 I=1,NRGNS
      IF (SPAC(I).EQ.0.0) GO TO 4
      CORVOL=CORVOL+VOL(I)
4     CONTINUE
      AFUEL=PI*FUELOD*FUELOD/8.0
      ACLAD=PI*CLADOD*CLADOD/8.0
      AV=6.023E+23
      ATNUM5=235.0+32.0
      ATNUM8=238.0+32.0
      ATNUM9=239.0+32.0
      ATNUM0=240.0+32.0
      ATNUM1=241.0+32.0
      ATNUM2=242.0+32.0
7     DO 8 I=1,NRGNS
      IF (SPAC(I).EQ.0.0) GO TO 444
      DEEM=(1.10266*SPAC(I)*SPAC(I))+(2.20532*AOK*FUELOD*SPAC(I))
     1     +(0.10266*AOK*AOK*FUELOD*FUELOD)
      FTW(I)=FUELOD*FUELOD/DEEM
      ATOT(I)=0.433*(CLADOD+SPAC(I))*(CLADOD+SPAC(I))
      ATNUM=EN5(I)*ATNUM5+EN8(I)*ATNUM8+EN9(I)*ATNUM9+
```

```
     1       EN0(I)*ATNUM0+EN1(I)*ATNUM1+EN2(I)*ATNUM2
      AN5(I)=(EN5(I)*ROFUEL*AV*AFUEL)/(ATNUM*ATOT(I))
      AN8(I)=(EN8(I)*ROFUEL*AV*AFUEL)/(ATNUM*ATOT(I))
      AN9(I)=(EN9(I)*ROFUEL*AV*AFUEL)/(ATNUM*ATOT(I))
      AN0(I)=(EN0(I)*ROFUEL*AV*AFUEL)/(ATNUM*ATOT(I))
      AN1(I)=(EN1(I)*ROFUEL*AV*AFUEL)/(ATNUM*ATOT(I))
      AN2(I)=(EN2(I)*ROFUEL*AV*AFUEL)/(ATNUM*ATOT(I))
      AAZ(I)=4.25E+22*(ACLAD-AFUEL)/ATOT(I)
      AAH(I)=ROWTER*AV*(ATOT(I)-ACLAD)*2.0/(18.0*ATOT(I))
      AAOXO(I)=AAH(I)/2.0
      AAOXI(I)=(2.0*ROFUEL*AV*AFUEL)/(ATNUM*ATOT(I))
      AAOX(I)=AAOXI(I)+AAOXO(I)
      GO TO 8
444   AAH(I)=ROWTER*AV*2.0/18.0
      AAOX(I)=AAH(I)/2.0
      AN5(I)=0.0
      AN8(I)=0.0
      AN9(I)=0.0
      AN0(I)=0.0
      AN1(I)=0.0
      AN2(I)=0.0
      AAZ(I)=0.0
      NRG=NRGNS-1
      FTW(I)=0.0
8     CONTINUE
      TFTW=0.0
      DO 171 I=1,NRGNS
      XE(I)=0.0
      SM(I)=0.0
      RS(I)=0.0
      RS5(I)=0.0
      RS8(I)=0.0
      RS9(I)=0.0
      RS1(I)=0.0
      SS(I)=0.0
      SS5(I)=0.0
      SS8(I)=0.0
      SS9(I)=0.0
      SS1(I)=0.0
      ANS(I)=0.0
      ANS5(I)=0.0
      ANS8(I)=0.0
      ANS9(I)=0.0
      ANS1(I)=0.0
      TFTW=TFTW+(FTW(I)*VOL(I)/CORVOL)
171   CONTINUE
      WRITE (6,1000)
      WRITE (6,1001) NRGNS
      WRITE (6,1083)
      WRITE (6,1084) (DEL(I),I=1,NRGNS)
      WRITE (6,1007)
      WRITE (6,1008) FUELOD
      WRITE (6,1009) CLADOD
      WRITE (6,1003) HT
      WRITE (6,1005) BUC(1,1)
```

```
      WRITE (6,1006) POWER
      WRITE (6,1002) SUBSTP
      WRITE (6,1004) EPS
      WRITE (6,1260) (VOL(I),I=1,NRGNS)
      WRITE (6,1010)
      WRITE (6,1011)
      DO 6 I=1,NRGNS
      EN5(I)=EN5(I)*100.0
      EN8(I)=EN8(I)*100.0
      EN9(I)=EN9(I)*100.0
      EN1(I)=EN1(I)*100.0
      EN0(I)=EN0(I)*100.0
      EN2(I)=EN2(I)*100.0
      WRITE (6,1012) I,EN5(I),EN8(I),EN9(I),EN0(I),EN1(I),EN2(I),SPAC(I)
6     CONTINUE
      WRITE (6,932)
932   FORMAT (//)
      IF (NRGNS.EQ.6) WRITE (6,1034)
      IF (NRGNS.EQ.5) WRITE (6,1035)
      IF (NRGNS.EQ.4) WRITE (6,1036)
      IF (NRGNS.EQ.3) WRITE (6,1037)
      IF (NRGNS.EQ.2) WRITE (6,1038)
      IF (NRGNS.EQ.1) WRITE (6,1039)
      WRITE (6,1040)
      WRITE (6,1041) (AN5(I),I=1,NRGNS)
      WRITE (6,1042) (AN8(I),I=1,NRGNS)
      WRITE (6,1043) (AN9(I),I=1,NRGNS)
      WRITE (6,1044) (AN0(I),I=1,NRGNS)
      WRITE (6,1045) (AN1(I),I=1,NRGNS)
      WRITE (6,1046) (AN2(I),I=1,NRGNS)
      WRITE (6,1047) (AAOX(I),I=1,NRGNS)
      WRITE (6,1048) (AAH(I),I=1,NRGNS)
      WRITE (6,1049) (AAZ(I),I=1,NRGNS)
      WRITE (6,1065) (FTW(I),I=1,NRGNS)
      WRITE (6,1016)
150   CONTINUE
C************** INTERPOLATE FOR CROSS SECTIONS HERE **************
C
      DO 111 I=1,NRGNS
      IF (FTW(I).LE.0.90) GO TO 112
      AZ=0.90
      BZ=1.30
      M=2
      GO TO 113
112   AZ=0.5
      BZ=0.90
      M=1
113   IF (TIME.LE.9800.0) GO TO 114
      EZ=30800.0
      DZ=9800.0
      N=2
      GO TO 115
114   EZ=9800.0
      DZ=0.0
      N=1
```

```
115   AIP=(FTW(I)-AZ)/(BZ-AZ)
      BIP=(TIME-DZ)/(EZ-DZ)
      DO 116 K=1,G
      DO 117 MM=1,14
      DO 118 NN=1,4
      Z1(MM,NN)=AIP*(TT(MM,N,K,NN,M+1)-TT(MM,N,K,NN,M))+
     1           TT(MM,N,K,NN,M)
      Z2(MM,NN)=AIP*(TT(MM,N+1,K,NN,M+1)-TT(MM,N+1,K,NN,M))+
     1           TT(MM,N+1,K,NN,M)
      Z3(MM,NN)=(BIP*(Z2(MM,NN)-Z1(MM,NN))+Z1(MM,NN))*TI
      IF (NN.EQ.1.AND.MM.EQ.1) ABS5(K,I)=Z3(MM,NN)
      IF (NN.EQ.2.AND.MM.EQ.1) TOT5(K,I)=Z3(MM,NN)
      IF (NN.EQ.3.AND.MM.EQ.1) FIS5(K,I)=Z3(MM,NN)
      IF (NN.EQ.4.AND.MM.EQ.1) PFIS5(K,I)=Z3(MM,NN)
      IF (NN.EQ.1.AND.MM.EQ.2) ABS8(K,I)=Z3(MM,NN)
      IF (NN.EQ.2.AND.MM.EQ.2) TOT8(K,I)=Z3(MM,NN)
      IF (NN.EQ.3.AND.MM.EQ.2) FIS8(K,I)=Z3(MM,NN)
      IF (NN.EQ.4.AND.MM.EQ.2) PFIS8(K,I)=Z3(MM,NN)
      IF (NN.EQ.1.AND.MM.EQ.3) ABS9(K,I)=Z3(MM,NN)
      IF (NN.EQ.2.AND.MM.EQ.3) TOT9(K,I)=Z3(MM,NN)
      IF (NN.EQ.3.AND.MM.EQ.3) FIS9(K,I)=Z3(MM,NN)
      IF (NN.EQ.4.AND.MM.EQ.3) PFIS9(K,I)=Z3(MM,NN)
      IF (NN.EQ.1.AND.MM.EQ.4) ABS0(K,I)=Z3(MM,NN)
      IF (NN.EQ.2.AND.MM.EQ.4) TOT0(K,I)=Z3(MM,NN)
      IF (NN.EQ.3.AND.MM.EQ.4) FIS0(K,I)=Z3(MM,NN)
      IF (NN.EQ.4.AND.MM.EQ.4) PFIS0(K,I)=Z3(MM,NN)
      IF (NN.EQ.1.AND.MM.EQ.5) ABS1(K,I)=Z3(MM,NN)
      IF (NN.EQ.2.AND.MM.EQ.5) TOT1(K,I)=Z3(MM,NN)
      IF (NN.EQ.3.AND.MM.EQ.5) FIS1(K,I)=Z3(MM,NN)
      IF (NN.EQ.4.AND.MM.EQ.5) PFIS1(K,I)=Z3(MM,NN)
      IF (NN.EQ.1.AND.MM.EQ.6) ABS2(K,I)=Z3(MM,NN)
      IF (NN.EQ.2.AND.MM.EQ.6) TOT2(K,I)=Z3(MM,NN)
      IF (NN.EQ.3.AND.MM.EQ.6) FIS2(K,I)=Z3(MM,NN)
      IF (NN.EQ.4.AND.MM.EQ.6) PFIS2(K,I)=Z3(MM,NN)
      IF (NN.EQ.1.AND.MM.EQ.7) ABSZ(K,I)=Z3(MM,NN)
      IF (NN.EQ.2.AND.MM.EQ.7) TOTZ(K,I)=Z3(MM,NN)
      IF (NN.EQ.1.AND.MM.EQ.8) ABSH(K,I)=Z3(MM,NN)
      IF (NN.EQ.2.AND.MM.EQ.8) TOTH(K,I)=Z3(MM,NN)
      IF (NN.EQ.1.AND.MM.EQ.9) ABSOX(K,I)=Z3(MM,NN)
      IF (NN.EQ.2.AND.MM.EQ.9) TOTOX(K,I)=Z3(MM,NN)
      IF (NN.EQ.1.AND.MM.EQ.10) ABSRS5(K,I)=Z3(MM,NN)
      IF (NN.EQ.2.AND.MM.EQ.10) ABSRS8(K,I)=Z3(MM,NN)
      IF (NN.EQ.3.AND.MM.EQ.10) ABSRS9(K,I)=Z3(MM,NN)
      IF (NN.EQ.4.AND.MM.EQ.10) ABSRS1(K,I)=Z3(MM,NN)
      IF (NN.EQ.1.AND.MM.EQ.11) ABSSS5(K,I)=Z3(MM,NN)
      IF (NN.EQ.2.AND.MM.EQ.11) ABSSS8(K,I)=Z3(MM,NN)
      IF (NN.EQ.3.AND.MM.EQ.11) ABSSS9(K,I)=Z3(MM,NN)
      IF (NN.EQ.4.AND.MM.EQ.11) ABSSS1(K,I)=Z3(MM,NN)
      IF (NN.EQ.1.AND.MM.EQ.12) ABSNS5(K,I)=Z3(MM,NN)
      IF (NN.EQ.2.AND.MM.EQ.12) ABSNS8(K,I)=Z3(MM,NN)
      IF (NN.EQ.3.AND.MM.EQ.12) ABSNS9(K,I)=Z3(MM,NN)
      IF (NN.EQ.4.AND.MM.EQ.12) ABSNS1(K,I)=Z3(MM,NN)
      IF (NN.EQ.1.AND.MM.EQ.13) ABSXE(K,I)=Z3(MM,NN)
      IF (NN.EQ.2.AND.MM.EQ.13) ABSSM(K,I)=Z3(MM,NN)
      IF (NN.EQ.1.AND.MM.EQ.14) PHLUX(K,I)=Z3(MM,NN)
```

```
118   CONTINUE
117   CONTINUE
116   CONTINUE
111   CONTINUE
      DO 426 I=1,NRGNS
      DO 427 K=1,G
      CAP8(K,I)=ABS8(K,I)-FIS8(K,I)
      CAP9(K,I)=ABS9(K,I)-FIS9(K,I)
      CAP0(K,I)=ABS0(K,I)-FIS0(K,I)
      CAP1(K,I)=ABS1(K,I)-FIS1(K,I)
427   CONTINUE
426   CONTINUE
147   CONTINUE
C***************** END OF INTERPOLATION SECTION ******************
C
C****************** START OF MACX SECTION ************************
C     FIND MACABSXSEC OF FISSIONABLE ISOTOPES OVER GROUP AND REGION
      DO 9 I=1,NRGNS
      DO 10 K=1,G
      XABS5(K,I)=AN5(I)*ABS5(K,I)
      XABS8(K,I)=AN8(I)*ABS8(K,I)
      XABS9(K,I)=AN9(I)*ABS9(K,I)
      XABS0(K,I)=AN0(I)*ABS0(K,I)
      XABS1(K,I)=AN1(I)*ABS1(K,I)
      XABS2(K,I)=AN2(I)*ABS2(K,I)
10    CONTINUE
9     CONTINUE
C     FIND MACABSXSEC OF NON-FEUL ISOTOPES OVER GROUP AND REGION
      DO 11 I=1,NRGNS
      DO 12 K=1,G
      XXE(K,I)=XE(I)*ABSXE(K,I)
      XSM(K,I)=SM(I)*ABSSM(K,I)
      XRS(K,I)=RS5(I)*ABSRS5(K,I)+RS8(I)*ABSRS8(K,I)+
     1         RS9(I)*ABSRS9(K,I)+RS1(I)*ABSRS1(K,I)
      XSS(K,I)=SS5(I)*ABSSS5(K,I)+SS8(I)*ABSSS8(K,I)+
     1         SS9(I)*ABSSS9(K,I)+SS1(I)*ABSSS1(K,I)
      XNS(K,I)=ANS5(I)*ABSNS5(K,I)+ANS8(I)*ABSNS8(K,I)+
     1         ANS9(I)*ABSNS9(K,I)+ANS1(I)*ABSNS1(K,I)
      XABSFP(K,I)=XXE(K,I)+XSM(K,I)+XRS(K,I)+XSS(K,I)+XNS(K,I)
      XABSOX(K,I)=AAOX(I)*ABSOX(K,I)
      XABSH(K,I)=AAH(I)*ABSH(K,I)
      XABSZ(K,I)=AAZ(I)*ABSZ(K,I)
12    CONTINUE
11    CONTINUE
C     FIND TOTAL ABSXSEC OF ALL ISOTOPES OVER GROUP AND REGION
      DO 23 I=1,NRGNS
      DO 24 K=1,G
      SA(K,I)=XABS5(K,I)+XABS8(K,I)+XABS9(K,I)+XABS0(K,I)+XABS1(K,I)+
     1XABS2(K,I)+XABSOX(K,I)+XABSH(K,I)+XABSZ(K,I)+XABSFP(K,I)
24    CONTINUE
23    CONTINUE
C     FIND MACTOTXSEC OF ALL ISOTOPES OVER GROUP AND REGION
      DO 5006 I=1,NRGNS
      DO 5007 K=1,G
      XTOT(K,I)=AN5(I)*TOT5(K,I)+AN8(I)*TOT8(K,I)+AN9(I)*TOT9(K,I)+
```

```
     1           AN0(I)*TOT0(K,I)+AN1(I)*TOT1(K,I)+AN2(I)*TOT2(K,I)+
     2           AAOX(I)*TOTOX(K,I)+AAH(I)*TOTH(K,I)+AAZ(I)*TOTZ(K,I)+
     3           XABSFP(K,I)
      XTOTOX(K,I)=AAOX(I)*TOTOX(K,I)
      XTOTH(K,I)=AAH(I)*TOTH(K,I)
      XTOTZ(K,I)=AAZ(I)*TOTZ(K,I)
5007  CONTINUE
5006  CONTINUE
C     FIND MACFISXSEC OF FUEL OVER GROUP AND REGION
      DO 29 I=1,NRGNS
      DO 30 K=1,G
      XFIS5(K,I)=AN5(I)*FIS5(K,I)
      XFIS8(K,I)=AN8(I)*FIS8(K,I)
      XFIS9(K,I)=AN9(I)*FIS9(K,I)
      XFIS0(K,I)=AN0(I)*FIS0(K,I)
      XFIS1(K,I)=AN1(I)*FIS1(K,I)
      XFIS2(K,I)=AN2(I)*FIS2(K,I)
      XFIS(K,I)=XFIS5(K,I)+XFIS8(K,I)+XFIS9(K,I)+XFIS0(K,I)+XFIS1(K,I)
     1          +XFIS2(K,I)
      XPFIS5(K,I)=AN5(I)*PFIS5(K,I)
      XPFIS8(K,I)=AN8(I)*PFIS8(K,I)
      XPFIS9(K,I)=AN9(I)*PFIS9(K,I)
      XPFIS0(K,I)=AN0(I)*PFIS0(K,I)
      XPFIS1(K,I)=AN1(I)*PFIS1(K,I)
      XPFIS2(K,I)=AN2(I)*PFIS2(K,I)
      SF(K,I)=XPFIS5(K,I)+XPFIS8(K,I)+XPFIS9(K,I)+XPFIS0(K,I)+
     1        XPFIS1(K,I)+XPFIS2(K,I)
30    CONTINUE
29    CONTINUE
C     FIND PRODUCTION RATE OF NEUTRONS FOR EACH REGION
      DO 33 I=1,NRGNS
      PRR(I)=0.0
33    CONTINUE
      IF (TIME.EQ.0.0) GO TO 34
      DO 35 I=1,NRGNS
      DO 36 K=1,G
      PRR(I)=PRR(I)+SF(K,I)*FLXNRM(K,I)
36    CONTINUE
35    CONTINUE
34    CONTINUE
37    CONTINUE
C
C     FIND DIFFUSION COEFFICIENT FOR EACH GROUP AND REGION
C
      DO 42 I=1,NRGNS
      DO 43 K=1,G
      DIFF=3.0*XTOT(K,I)-3.0*0.6614*(XTOTH(K,I)-XABSH(K,I))
     1                  -3.0*0.0417*(XTOTOX(K,I)-XABSOX(K,I))
     2                  -3.0*0.0073*(XTOTZ(K,I)-XABSZ(K,I))
      DC(K,I)=1.0/DIFF
43    CONTINUE
42    CONTINUE
C
C     FIND MAC REMOVAL XSEC FROM EACH REGION FOR USE IN ODMUG
C
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      DO 844 I=1,NRGNS
      SORCE(I)=0.0
      DO 845 K=1,G
      SORCE(I)=SORCE(I)+SF(K,I)*PHLUX(K,I)
845   CONTINUE
844   CONTINUE
      DO 201 I=1,NRGNS
      SR(3,I)=(SA(4,I))*PHLUX(4,I)/PHLUX(3,I)
      SR(2,I)=(SA(3,I)+SR(3,I))*PHLUX(3,I)/PHLUX(2,I)
      SR(1,I)=((SA(2,I)+SR(2,I))*PHLUX(2,I)-CHI(2)*SORCE(I))/PHLUX(1,I)
      SR(4,I)=0.0
201   CONTINUE
      WRITE (6,1405) TIME
1405  FORMAT (/,1X,'TIME=',F10.2)
      WRITE(6,223)
223   FORMAT(/,20X,'SA',12X,'NUSF',12X,'SR',13X,'DC')
      DO 220 K=1,G
      WRITE (6,1406) K
1406  FORMAT (/,1X,'GROUP ',I2,/)
      DO 221 L=1,NRGNS
      WRITE (6,222) L,SA(K,L),SF(K,L),SR(K,L),DC(K,L)
222   FORMAT(4X,'REGION ',I1,3X,4(E12.5,3X))
221   CONTINUE
220   CONTINUE
      IF (TIME.EQ.0.0) GO TO 148
C
C     FIND FERTILE CAPTURE AND FISSILE ABSORPTION RATE IN EACH REGION
C     UNITS : CM**-3/SEC
C
      DO 131 I=1,NRGNS
      FERCAP(I)=0.0
      FISABS(I)=0.0
      FR5T(I)=0.0
      FR8T(I)=0.0
      FR9T(I)=0.0
      FROT(I)=0.0
      FR1T(I)=0.0
      FR2T(I)=0.0
      ART(I)=0.0
      AR5T(I)=0.0
      AR8T(I)=0.0
      AR9T(I)=0.0
      AROT(I)=0.0
      AR1T(I)=0.0
      AR2T(I)=0.0
      AROXT(I)=0.0
      ARHT(I)=0.0
      ARZT(I)=0.0
      ARFPT(I)=0.0
      FRT(I)=0.0
131   CONTINUE
      DO 47 I=1,NRGNS
      DO 48 K=1,G
      FN=FLXNRM(K,I)
      FR5(K,I)=XFIS5(K,I)*FN
```

```
      AR5(K,I)=XABS5(K,I)*FN
      FR8(K,I)=XFIS8(K,I)*FN
      AR8(K,I)=XABS8(K,I)*FN
      FR9(K,I)=XFIS9(K,I)*FN
      AR9(K,I)=XABS9(K,I)*FN
      FR0(K,I)=XFIS0(K,I)*FN
      AR0(K,I)=XABS0(K,I)*FN
      FR1(K,I)=XFIS1(K,I)*FN
      AR1(K,I)=XABS1(K,I)*FN
      FR2(K,I)=XFIS2(K,I)*FN
      AR2(K,I)=XABS2(K,I)*FN
      AROX(K,I)=XABSOX(K,I)*FN
      ARZ(K,I)=XABSZ(K,I)*FN
      ARH(K,I)=XABSH(K,I)*FN
      ARFP(K,I)=XABSFP(K,I)*FN
      FROX(K,I)=0.0
      FRH(K,I)=0.0
      FRZ(K,I)=0.0
      FRFP(K,I)=0.0
      FR5T(I)=FR5T(I)+FR5(K,I)
      FR8T(I)=FR8T(I)+FR8(K,I)
      FR9T(I)=FR9T(I)+FR9(K,I)
      FR0T(I)=FR0T(I)+FR0(K,I)
      FR1T(I)=FR1T(I)+FR1(K,I)
      FR2T(I)=FR2T(I)+FR2(K,I)
      AR5T(I)=AR5T(I)+AR5(K,I)
      AR8T(I)=AR8T(I)+AR8(K,I)
      AR9T(I)=AR9T(I)+AR9(K,I)
      AR0T(I)=AR0T(I)+AR0(K,I)
      AR1T(I)=AR1T(I)+AR1(K,I)
      AR2T(I)=AR2T(I)+AR2(K,I)
      AROXT(I)=AROXT(I)+AROX(K,I)
      ARHT(I)=ARHT(I)+ARH(K,I)
      ARZT(I)=ARZT(I)+ARZ(K,I)
      ARFPT(I)=ARFPT(I)+ARFP(K,I)
      CR5(K,I)=AR5(K,I)-FR5(K,I)
      CR8(K,I)=AR8(K,I)-FR8(K,I)
      CR9(K,I)=AR9(K,I)-FR9(K,I)
      CR0(K,I)=AR0(K,I)-FR0(K,I)
      CR1(K,I)=AR1(K,I)-FR1(K,I)
      CR2(K,I)=AR2(K,I)-FR2(K,I)
      FERCAP(I)=FERCAP(I)+CR8(K,I)+CR0(K,I)
      FISABS(I)=FISABS(I)+AR5(K,I)+AR9(K,I)+AR1(K,I)
48    CONTINUE
47    CONTINUE
      DO 771 I=1,NRGNS
      ART(I)=ART(I)+AR5T(I)+AR8T(I)+AR9T(I)+AR0T(I)+AR1T(I)+
     1       AR2T(I)+AROXT(I)+ARHT(I)+ARZT(I)+ARFPT(I)
      FRT(I)=FRT(I)+FR5T(I)+FR8T(I)+FR9T(I)+FR0T(I)+FR1T(I)+FR2T(I)
771   CONTINUE
      ARTT=0.0
      FRTT=0.0
      DO 1415 I=1,NRGNS
      FRTT=FRTT+FRT(I)
      ARTT=ARTT+ART(I)
```

```
1415  CONTINUE
C
C     FIND THE CONVERSION RATIO OF EACH REGION AT END OF
C     THE CURRENT BURNUP STEP
C
      DO 52 I=1,NRG
      CR(I)=FERCAP(I)/FISABS(I)
52    CONTINUE
C
C     CALCULATE FERTILE AND FISSILE ABSORPTIONS OVER ALL
C     GROUPS AND REGIONS OF THE CORE
C
      FTOC=0.0
      FSAB=0.0
      DO 53 I=1,NRG
      FTOC=FTOC+FERCAP(I)*VOL(I)/CORVOL
      FSAB=FSAB+FISABS(I)*VOL(I)/CORVOL
53    CONTINUE
C
C     CALCULATE CONVERSION RATIO OF THE ENTIRE CORE
C
      CONRAT=FTOC/FSAB
      IF (INDIC.EQ.2) GO TO 148
      WRITE (6,1017) NSSS
      WRITE (6,1019) TIME
      IF (NRGNS.EQ.6) WRITE (6,1034)
      IF (NRGNS.EQ.5) WRITE (6,1035)
      IF (NRGNS.EQ.4) WRITE (6,1036)
      IF (NRGNS.EQ.3) WRITE (6,1037)
      IF (NRGNS.EQ.2) WRITE (6,1038)
      IF (NRGNS.EQ.1) WRITE (6,1039)
      WRITE (6,1040)
      WRITE (6,1041) (AN5(I),I=1,NRGNS)
      WRITE (6,1042) (AN8(I),I=1,NRGNS)
      WRITE (6,1043) (AN9(I),I=1,NRGNS)
      WRITE (6,1044) (AN0(I),I=1,NRGNS)
      WRITE (6,1045) (AN1(I),I=1,NRGNS)
      WRITE (6,1046) (AN2(I),I=1,NRGNS)
      WRITE (6,1047) (AAOX(I),I=1,NRGNS)
      WRITE (6,1048) (AAH(I),I=1,NRGNS)
      WRITE (6,1049) (AAZ(I),I=1,NRGNS)
      WRITE (6,1380) (RS(I),I=1,NRGNS)
      WRITE (6,1381) (SS(I),I=1,NRGNS)
      WRITE (6,1384) (ANS(I),I=1,NRGNS)
      WRITE (6,1382) (XE(I),I=1,NRGNS)
      WRITE (6,1383) (SM(I),I=1,NRGNS)
      WRITE (6,1400)
1400  FORMAT (/,1X,'REACTION RATES')
      WRITE (6,1401)
1401  FORMAT (1X,'FISSION THEN ABSORPTION')
      WRITE (6,1041) (FR5T(I),I=1,NRGNS)
      WRITE (6,1041) (AR5T(I),I=1,NRGNS)
      WRITE (6,1042) (FR8T(I),I=1,NRGNS)
      WRITE (6,1042) (AR8T(I),I=1,NRGNS)
      WRITE (6,1043) (FR9T(I),I=1,NRGNS)
```

```
      WRITE (6,1043) (AR9T(I),I=1,NRGNS)
      WRITE (6,1044) (FROT(I),I=1,NRGNS)
      WRITE (6,1044) (AROT(I),I=1,NRGNS)
      WRITE (6,1045) (FR1T(I),I=1,NRGNS)
      WRITE (6,1045) (AR1T(I),I=1,NRGNS)
      WRITE (6,1046) (FR2T(I),I=1,NRGNS)
      WRITE (6,1046) (AR2T(I),I=1,NRGNS)
      WRITE (6,1047) (AROXT(I),I=1,NRGNS)
      WRITE (6,1048) (ARHT(I),I=1,NRGNS)
      WRITE (6,1049) (ARZT(I),I=1,NRGNS)
      WRITE (6,1050) (ARFPT(I),I=1,NRGNS)
      WRITE (6,1403) (FRT(I),I=1,NRGNS)
      WRITE (6,1403) (ART(I),I=1,NRGNS)
1403  FORMAT (2X,'TOTAL',14X,6(E15.8,2X))
      WRITE (6,1053)
      WRITE (6,1054) (FLXNRM(1,I),I=1,NRGNS)
      WRITE (6,1055) (FLXNRM(2,I),I=1,NRGNS)
      WRITE (6,1056) (FLXNRM(3,I),I=1,NRGNS)
      WRITE (6,1051) (FLXNRM(4,I),I=1,NRGNS)
      WRITE (6,1059) (CR(I),I=1,NRG)
      WRITE (6,1060) (BURNUP(I),I=1,NRG)
      WRITE (6,1061) (PD(I),I=1,NRG)
      WRITE (6,1062) (PWR(I),I=1,NRG)
      WRITE (6,1063) (ED(I),I=1,NRG)
      WRITE (6,1064) (FLUENC(I),I=1,NRGNS)
      WRITE (6,1065) (FTW(I),I=1,NRGNS)
      WRITE (6,1020)
      BLUTO=TIME-SUBSTP
      WRITE (6,1021) LMBDA,BLUTO
      WRITE (6,1022) TFTW
      WRITE (6,1052) FLXNRT(4)
      WRITE (6,1023) FLXNRT(3)
      WRITE (6,1024) FLXNRT(2)
      WRITE (6,1025) FLXNRT(1)
      WRITE (6,1026) FLXNRR
      WRITE (6,1420) FRTT
      WRITE (6,1421) ARTT
1420  FORMAT (2X,'TOTAL FISSION REACTION RATE=',E15.8)
1421  FORMAT (2X,'TOTAL ABSORPTION REACTION RATE=',E15.8)
      WRITE (6,1027) EDC
      WRITE (6,1028) PDC
      WRITE (6,1029) PTOT
      WRITE (6,1030) CONRAT
      WRITE (6,1031) TBURN
      IF (JP.EQ.0) GO TO 9991
      WRITE (6,1601) SPP
1601  FORMAT (2X,'POISON MAC CROSS SECTION NEEDED IS ',E15.8)
9991  CONTINUE
      WRITE (6,1033) TIME
      WRITE (6,1018) NSSS
148   CONTINUE
C****************** END OF MACX SECTION **********************
C      DETERMINE NUMBER OF MESH POINTS TO BE USED
C
      DO 55 J=1,NRGNS
```

```
      AABS=0.0
      DO 56 I=1,G
      SP(I,J)=0.0
56    AABS=AABS+SA(I,J)+SP(I,J)
      NOPTS(J)=DEL(J)*AABS+1.0
C
C      NO LESS THAN 10 PER REGION
C
      IF (NOPTS(J).LT.10) NOPTS(J)=10
55    CONTINUE
      NSUM=0
      DO 57 J=1,NRGNS
      NSUM=NSUM+NOPTS(J)
      NSUM1=NSUM
      IF(FTW(J).EQ.0.0) NSUM1=NSUM1-NOPTS(J)
57     CONTINUE
C
C     NO MORE THAN 60 TOTAL
C
      IF (NSUM.LT.60) GO TO 58
      NSUM1=0
      FLT2=NSUM
      DO 59 J=1,NRGNS
      FLT1=NOPTS(J)
      FLT3=FLT1/FLT2*60.0
      NOPTS(J)=FLT3
      IF(FTW(J).EQ.0.0) GO TO 713
      NSUM1=NSUM1+NOPTS(J)
713   CONTINUE
59    CONTINUE
58    CONTINUE
C
C     COMPUTE MESH SPACINGS
C
      J=0
      DO 60 I=1,NRGNS
60    J=J+NOPTS(I)
      N=J+1
      JS=G*N
      NSUM=0
      DO 61 I=1,NRGNS
      NOPT=NOPTS(I)
      IF (I.GT.1) NSUM=NSUM+NOPTS(I-1)
      DO 61 J=1,NOPT
      DE=DEL(I)
      L=NSUM+J
61    H(L)=DE/NOPTS(I)
      H(N)=H(N-1)
C      JP=FLAG FOR EIGENVALUE SEARCH, JP=0 NO SEARCH
C                                     JP=1 POISON SEARCH
C
      IF (JP.EQ.0) GO TO 62
      CALL SEARCH
      IF (IT.GE.200) GO TO 133
62     CALL SYSTEM
```

```
      DO 65 I=1,G
      DO 65 J=1,N
      PH(I,J)=1.0
65    PHI(I,J)=1.0
      LMBDA=1.0
      CALL SOURCE
      CALL SOLVE
      IF (LMBDA.LT.1.0) JP=0
      IF (NUKIE.EQ.1) GO TO 45
      IF (LMBDA.LT.POOF) GO TO 63
      INDAC=INDAC+1
      IF (INDAC.EQ.2) POOF=2.0-LMBDA
      IF (IT.GE.200) GO TO 133
      GO TO 66
45    IF (LMBDA.LT.1.0) GO TO 63
66    CONTINUE
      CALL SUMMER
C
C*************** START BURNUP SECTION *********************************
C
21    CONTINUE
      INDIC=1
      DO 67 I=1,NRG
      ATWT=AN5(I)*ATNUM5+AN8(I)*ATNUM8+AN9(I)*ATNUM9+
     1     AN0(I)*ATNUM0+AN1(I)*ATNUM1+AN2(I)*ATNUM2
      AMTHM(I)=(ATWT*VOL(I))/(AV*1.0E+06)
67    CONTINUE
C     NORMALIZE FLUX FROM ODMUG TO THE GIVEN TOTAL CORE POWER
      W5=3.225E-11
      W8=3.279E-11
      W9=3.356E-11
      W0=3.352E-11
      W1=3.393E-11
      W2=3.428E-11
      TIME=TIME+SUBSTP
      NSSS=NSSS+1
      DENOM=0.0
      DO 68 I=1,NRG
      DO 69 K=1,G
      DENOM=DENOM+(W5*AN5(I)*FIS5(K,I)+W8*AN8(I)*FIS8(K,I)+W9*AN9(I)*
     XFIS9(K,I)+W0*AN0(I)*FIS0(K,I)+W1*AN1(I)*FIS1(K,I)+W2*AN2(I)*
     XFIS2(K,I))*FLUX(K,I)*PHIB*VOL(I)
69    CONTINUE
68    CONTINUE
      PNORM=POWER/DENOM
C     CALCULATE NORMALIZED FLUX IN EACH GROUP AND REGION
C     UNITS:N/CM**2/SEC
      DO 70 I=1,NRGNS
      DO 71 K=1,G
      FLXNRM(K,I)=FLUX(K,I)*PNORM*PHIB
71    CONTINUE
70    CONTINUE
      DO 72 K=1,G
      FLXNRT(K)=0.0
72    CONTINUE
```

```
      DO 73 K=1,G
      DO 74 I=1,NRGNS
      FLXNRT(K)=FLXNRT(K)+FLXNRM(K,I)*VOL(I)/CORVOL
74    CONTINUE
73    CONTINUE
      FLXNRR=FLXNRT(1)+FLXNRT(2)+FLXNRT(3)+FLXNRT(4)
C     SEARCH FOR MAXIMUM NORMALIZED GROUP FLUX IN EACH REGION
      DUM=0.0
      DO 75 I=1,NRGNS
      DO 76 K=1,G
      IF(FLXNRM(K,I).GT.DUM) DUM=FLXNRM(K,I)
76    CONTINUE
      FLXMAX(I)=DUM
      DUM=0.0
75    CONTINUE
C     CALCULATE THE FLUX RATIOS IN EACH REGION
      DO 77 I=1,NRGNS
      DO 78 K=1,G
      FLXRAT(K,I)=FLXNRM(K,I)/FLXMAX(I)
78    CONTINUE
77    CONTINUE
C     CALCULATE THE FLUENCES FOR EACH TIME STEP CORRESPONDING TO
C     MAXIMUM GROUP FLUXES IN EACH REGION
C     TIME STEPS IN SECONDS,FLUENCE IN CM**-2
      ATIME=SUBSTP*3600.0
      DO 79 I=1,NRGNS
      FLUENC(I)=FLXMAX(I)*ATIME
79    CONTINUE
C     CALCULATE CONSTANTS IN FUEL ISOTOPE EQUATIONS FOR EACH REGION
C     UNITS:CM**2
      DO 80 I=1,NRG
      AMU5(I)=0.0
      AMU8(I)=0.0
      GAM8(I)=0.0
      AMU9(I)=0.0
      GAM9(I)=0.0
      AMU0(I)=0.0
      GAM0(I)=0.0
      AMU1(I)=0.0
      GAM1(I)=0.0
      AMU2(I)=0.0
80    CONTINUE
      DO 81 I=1,NRG
      DO 82 K=1,G
      AA=FLXRAT(K,I)
      AMU5(I)=AMU5(I)+ABS5(K,I)*AA
      AMU8(I)=AMU8(I)+ABS8(K,I)*AA
      GAM8(I)=GAM8(I)+CAP8(K,I)*AA
      AMU9(I)=AMU9(I)+ABS9(K,I)*AA
      GAM9(I)=GAM9(I)+CAP9(K,I)*AA
      AMU0(I)=AMU0(I)+ABS0(K,I)*AA
      GAM0(I)=GAM0(I)+CAP0(K,I)*AA
      AMU1(I)=AMU1(I)+ABS1(K,I)*AA
      GAM1(I)=GAM1(I)+CAP1(K,I)*AA
      AMU2(I)=AMU2(I)+ABS2(K,I)*AA
```

```
82     CONTINUE
81     CONTINUE
       DO 83 I=1,NRG
83     AMU2(I)=AMU2(I)+(1.665118E-9)/FLXMAX(I)
C      CALCULATE CONSTANTS FOR THE FUEL ISOTOPE BURNUP EQUATIONS
       DO 84 I=1,NRG
       AAA(I)=AN0(I)+GAM9(I)*GAM8(I)*AN8(I)/((AMU0(I)-AMU9(I))*(AMU9(I)-
      XAMU8(I)))+GAM9(I)*AN9(I)/(AMU9(I)-AMU0(I))+GAM9(I)*GAM8(I)
      X*AN8(I)/((AMU8(I)-AMU0(I))*(AMU9(I)-AMU8(I)))
       BBB(I)=(GAM9(I)/(AMU0(I)-AMU9(I)))*(AN9(I)+GAM8(I)*AN8(I)/
      X(AMU8(I)-AMU9(I)))
       CCC(I)=GAM9(I)*GAM8(I)*AN8(I)/((AMU0(I)-AMU8(I))*(AMU9(I)-AMU8(I))
      X)
       DDD(I)=AN1(I)+(GAM0(I)/(AMU0(I)-AMU1(I)))*AAA(I)+(GAM0(I)/(AMU9(I)
      X-AMU1(I)))*BBB(I)+(GAM0(I)/(AMU8(I)-AMU1(I)))*CCC(I)
       EEE(I)=(GAM0(I)/(AMU1(I)-AMU0(I)))*AAA(I)
       FFF(I)=(GAM0(I)/(AMU1(I)-AMU9(I)))*BBB(I)
       GGG(I)=(GAM0(I)/(AMU1(I)-AMU8(I)))*CCC(I)
       HHH(I)=AN2(I)+(GAM1(I)/(AMU1(I)-AMU2(I)))*DDD(I)+(GAM1(I)/(AMU0(I)
      X-AMU2(I)))*EEE(I)+(GAM1(I)/(AMU9(I)-AMU2(I)))*FFF(I)+(GAM1(I)/
      X(AMU8(I)-AMU2(I)))*GGG(I)
       QQQ(I)=(GAM1(I)/(AMU2(I)-AMU0(I)))*EEE(I)
       RRR(I)=(GAM1(I)/(AMU2(I)-AMU1(I)))*DDD(I)
       SSS(I)=(GAM1(I)/(AMU2(I)-AMU9(I)))*FFF(I)
       TTT(I)=(GAM1(I)/(AMU2(I)-AMU8(I)))*GGG(I)
84     CONTINUE
C      INPUT FUEL ISOTOPE BURNUP EQUATIONS IN EACH REGION
C      UNITS : CM**-3
       DO 85 I=1,NRG
       FLU=FLUENC(I)
       AA5(I)=AN5(I)*EXP((-AMU5(I))*FLU)
       AA8(I)=AN8(I)*EXP((-AMU8(I))*FLU)
       CONST9=AN9(I)+(GAM8(I)*AN8(I)/(AMU8(I)-AMU9(I)))
       AA9(I)=CONST9*EXP((-AMU9(I))*FLU)+(AN9(I)-CONST9)*EXP((-AMU8(I))*F
      XLU)
       AA0(I)=AAA(I)*EXP((-AMU0(I))*FLU)+BBB(I)*EXP((-AMU9(I))*FLU)+
      XCCC(I)*EXP((-AMU8(I))*FLU)
       AA1(I)=DDD(I)*EXP((-AMU1(I))*FLU)+EEE(I)*EXP((-AMU0(I))*FLU)+
      XFFF(I)*EXP((-AMU9(I))*FLU)+GGG(I)*EXP((-AMU8(I))*FLU)
       AA2(I)=HHH(I)*EXP((-AMU2(I))*FLU)+QQQ(I)*EXP((-AMU0(I))*FLU)+
      XRRR(I)*EXP((-AMU1(I))*FLU)+SSS(I)*EXP((-AMU9(I))*FLU)+TTT(I)*
      XEXP((-AMU8(I))*FLU)
85     CONTINUE
C      CALCULATE CONSTANTS NEEDED FOR POWER DENSITY CALCULATIONS IN
C      EACH REGION , UNITS : JOULES*CM**2/FISSION
       W5=3.225E-11
       W8=3.279E-11
       W9=3.356E-11
       W0=3.352E-11
       W1=3.393E-11
       W2=3.428E-11
       DO 86 I=1,NRG
       BET5(I)=0.0
       BET8(I)=0.0
       BET9(I)=0.0
```

```
      BET0(I)=0.0
      BET1(I)=0.0
      BET2(I)=0.0
86    CONTINUE
      DO 87 I=1,NRG
      DO 88 K=1,G
      FLR=FLXRAT(K,I)
      BET5(I)=BET5(I)+FIS5(K,I)*FLR
      BET8(I)=BET8(I)+FIS8(K,I)*FLR
      BET9(I)=BET9(I)+FIS9(K,I)*FLR
      BET0(I)=BET0(I)+FIS0(K,I)*FLR
      BET1(I)=BET1(I)+FIS1(K,I)*FLR
      BET2(I)=BET2(I)+FIS2(K,I)*FLR
88    CONTINUE
87    CONTINUE
      DO 89 I=1,NRG
      BET5(I)=W5*BET5(I)
      BET8(I)=W8*BET8(I)
      BET9(I)=W9*BET9(I)
      BET0(I)=W0*BET0(I)
      BET1(I)=W1*BET1(I)
      BET2(I)=W2*BET2(I)
89    CONTINUE
C     CALCULATE POWER DENSITY IN EACH REGION , UNITS : WATTS/CM**3
      PDC=0.0
      DO 90 I=1,NRG
      PD(I)=(BET5(I)*AA5(I)+BET8(I)*AA8(I)+BET9(I)*AA9(I)+BET0(I)*AA0(I)
     X+BET1(I)*AA1(I)+BET2(I)*AA2(I))*FLXMAX(I)
      PDC=PDC+PD(I)*VOL(I)/CORVOL
90    CONTINUE
C     CALCULATE POWER IN EACH REGION , UNITS : WATTS
      DO 91 I=1,NRG
      PWR(I)=PD(I)*VOL(I)
91    CONTINUE
C     CALCULATE TOTAL CORE POWER , UNITS : WATTS
      PTOT=0.0
      DO 92 I=1,NRG
      PTOT=PTOT+PWR(I)
92    CONTINUE
C
C     CALCULATE INTEGRATED NUMBER DENSITIES IN EACH REGION
C     UNITS : CM**-5
      DO 93 I=1,NRG
      FLU=FLUENC(I)
      EINT5(I)=AN5(I)*(1.0-EXP(-AMU5(I)*FLU))/AMU5(I)
      EINT8(I)=AN8(I)*(1.0-EXP(-AMU8(I)*FLU))/AMU8(I)
      CONST1=AN9(I)+GAM8(I)*AN8(I)/(AMU8(I)-AMU9(I))
      CONST2=CONST1-AN9(I)
      EINT9(I)=CONST1*(1.0-EXP(-AMU9(I)*FLU))/AMU9(I)-CONST2*
     X(1.0-EXP(-AMU8(I)*FLU))/AMU8(I)
      EINT0(I)=(AAA(I)/AMU0(I))*(1.0-EXP(-AMU0(I)*FLU))+(BBB(I)/AMU9(I))
     X*(1.0-EXP(-AMU9(I)*FLU))+(CCC(I)/AMU8(I))*(1.0-EXP(-AMU8(I)*FLU))
      EINT1(I)=(DDD(I)/AMU1(I))*(1.0-EXP(-AMU1(I)*FLU))+(EEE(I)/AMU0(I))
     X*(1.0-EXP(-AMU0(I)*FLU))+(FFF(I)/AMU9(I))*(1.0-EXP(-AMU9(I)*FLU))
     X+(GGG(I)/AMU8(I))*(1.0-EXP(-AMU8(I)*FLU))
```

```
      EINT2(I)=(HHH(I)/AMU2(I))*(1.0-EXP(-AMU2(I)*FLU))+(QQQ(I)/AMU0(I))
     X*(1.0-EXP(-AMU0(I)*FLU))+(RRR(I)/AMU1(I))*(1.0-EXP(-AMU1(I)*FLU))
     X+(SSS(I)/AMU9(I))*(1.0-EXP(-AMU9(I)*FLU))+(TTT(I)/AMU8(I))*
     X(1.0-EXP(-AMU8(I)*FLU))
93    CONTINUE
C     CALCULATE THE ENERGY DENSITY IN EACH REGION , UNITS : KWH/L
      EDC=0.0
      DO 94 I=1,NRG
      ED(I)=(BET5(I)*EINT5(I)+BET8(I)*EINT8(I)+BET9(I)*EINT9(I)+
     XBET0(I)*EINT0(I)+BET1(I)*EINT1(I)+BET2(I)*EINT2(I))/3600.0
      EDC=EDC+ED(I)*VOL(I)/CORVOL
94    CONTINUE
C     CALCULATE TOTAL ENERGY DENSITY OF CORE
      ETOT=0.0
      DO 95 I=1,NRG
      ETOT=ETOT+ED(I)*VOL(I)
95    CONTINUE
      EDTOT=ETOT/CORVOL
C     CALCULATE KG HEAVY METAL/LITER IN EACH REGION
C     AMTHM IN METRIC TONS
      DO 96 I=1,NRG
      AMT(I)=(AMTHM(I)/VOL(I))*1.0E+06
96    CONTINUE
C     CALCULATE BURNUP IN EACH REGION , UNITS : MWD/MTHM
      DO 97 I=1,NRG
      BURNUP(I)=PD(I)*TIME/(24.0*AMT(I))
97    CONTINUE
C     CALCULATE TOTAL CORE BURNUP
      TOTHM=0.0
      DO 98  I=1,NRG
      TOTHM=TOTHM+AMTHM(I)
98    CONTINUE
      TBURN=0.0
      DO 99 I=1,NRG
      TBURN=TBURN+BURNUP(I)*AMTHM(I)/TOTHM
99    CONTINUE
C
C      CALCULATE THE EQILIBRIUM CONCENTRATION OF SAMARIUM 149 DUE TO
C      THE FISSIONING OF U235,U238,PU239,AND PU241
C      YSM5(K)=CUMULATIVE YIELD OF SM149 DUE TO THE FISSIONING OF U235
C
      DO 620 I=1,NRG
      TABS=0.0
      SSM5(I)=0.0
      SSM8(I)=0.0
      SSM9(I)=0.0
      SSM1(I)=0.0
      DO 622 K=1,G
      AA=FLXNRM(K,I)
      SSM5(I)=SSM5(I)+YSM5(K)*AA5(I)*FIS5(K,I)*AA
      SSM8(I)=SSM8(I)+YSM8(K)*AA8(I)*FIS8(K,I)*AA
      SSM9(I)=SSM9(I)+YSM9(K)*AA9(I)*FIS9(K,I)*AA
      SSM1(I)=SSM1(I)+YSM1(K)*AA1(I)*FIS1(K,I)*AA
      TABS=TABS+ABSSM(K,I)*AA
622   CONTINUE
```

```
      SM5(I)=SSM5(I)/TABS
      SM8(I)=SSM8(I)/TABS
      SM9(I)=SSM9(I)/TABS
      SM1(I)=SSM1(I)/TABS
620   CONTINUE
C
C      CALCULATE THE EQILIBRIUM CONCENTRATION OF XENON 135 DUE TO
C      THE FISSIONING OF U235,U238,PU239,AND PU241
C      YXE5(K)=CUMULATIVE YIELD OF XE135 DUE TO THE FISSIONING OF U235
C
      DX=2.10197E-5
      DO 623 I=1,NRG
      YABS=0.0
      XXE5(I)=0.0
      XXE8(I)=0.0
      XXE9(I)=0.0
      XXE1(I)=0.0
      DO 624 K=1,G
      AA=FLXNRM(K,I)
      XXE5(I)=XXE5(I)+YXE5(K)*AA5(I)*FIS5(K,I)*AA
      XXE8(I)=XXE8(I)+YXE8(K)*AA8(I)*FIS8(K,I)*AA
      XXE9(I)=XXE9(I)+YXE9(K)*AA9(I)*FIS9(K,I)*AA
      XXE1(I)=XXE1(I)+YXE1(K)*AA1(I)*FIS1(K,I)*AA
      YABS=YABS+ABSXE(K,I)*AA
624   CONTINUE
      CRABS=YABS+DX
      XE5(I)=XXE5(I)/CRABS
      XE8(I)=XXE8(I)/CRABS
      XE9(I)=XXE9(I)/CRABS
      XE1(I)=XXE1(I)/CRABS
623   CONTINUE
C     CALCULATION OF CONSTANTS FOR  FISSION PRODUCTION IN EACH REGION
C     UNITS : CM**2
      DO 100 I=1,NRG
      ETRS5(I)=0.0
      ETRS8(I)=0.0
      ETRS9(I)=0.0
      ETRS1(I)=0.0
      ETSS5(I)=0.0
      ETSS8(I)=0.0
      ETSS9(I)=0.0
      ETSS1(I)=0.0
      ETNS5(I)=0.0
      ETNS8(I)=0.0
      ETNS9(I)=0.0
      ETNS1(I)=0.0
      GAMRS5(I)=0.0
      GAMRS8(I)=0.0
      GAMRS9(I)=0.0
      GAMRS1(I)=0.0
      GAMSS5(I)=0.0
      GAMSS8(I)=0.0
      GAMSS9(I)=0.0
      GAMSS1(I)=0.0
      GAMNS5(I)=0.0
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```
      GAMNS8(I)=0.0
      GAMNS9(I)=0.0
      GAMNS1(I)=0.0
100   CONTINUE
      DO 101 I=1,NRG
      DO 102 K=1,G
      FR=FLXRAT(K,I)
      ETRS5(I)=ETRS5(I)+YRS5(K)*FIS5(K,I)*FR
      ETRS8(I)=ETRS8(I)+YRS8(K)*FIS8(K,I)*FR
      ETRS9(I)=ETRS9(I)+YRS9(K)*FIS9(K,I)*FR
      ETRS1(I)=ETRS1(I)+YRS1(K)*FIS1(K,I)*FR
      ETSS5(I)=ETSS5(I)+YSS5(K)*FIS5(K,I)*FR
      ETSS8(I)=ETSS8(I)+YSS8(K)*FIS8(K,I)*FR
      ETSS9(I)=ETSS9(I)+YSS9(K)*FIS9(K,I)*FR
      ETSS1(I)=ETSS1(I)+YSS1(K)*FIS1(K,I)*FR
      ETNS5(I)=ETNS5(I)+YNS5(K)*FIS5(K,I)*FR
      ETNS8(I)=ETNS8(I)+YNS8(K)*FIS8(K,I)*FR
      ETNS9(I)=ETNS9(I)+YNS9(K)*FIS9(K,I)*FR
      ETNS1(I)=ETNS1(I)+YNS1(K)*FIS1(K,I)*FR
102   CONTINUE
101   CONTINUE
      DO 104 I=1,NRG
      DO 105 K=1,G
      FR=FLXRAT(K,I)
      GAMRS5(I)=GAMRS5(I)+ABSRS5(K,I)*FR
      GAMRS8(I)=GAMRS8(I)+ABSRS8(K,I)*FR
      GAMRS9(I)=GAMRS9(I)+ABSRS9(K,I)*FR
      GAMRS1(I)=GAMRS1(I)+ABSRS1(K,I)*FR
      GAMSS5(I)=GAMSS5(I)+ABSSS5(K,I)*FR
      GAMSS8(I)=GAMSS8(I)+ABSSS8(K,I)*FR
      GAMSS9(I)=GAMSS9(I)+ABSSS9(K,I)*FR
      GAMSS1(I)=GAMSS1(I)+ABSSS1(K,I)*FR
      GAMNS5(I)=GAMNS5(I)+ABSNS5(K,I)*FR
      GAMNS8(I)=GAMNS8(I)+ABSNS8(K,I)*FR
      GAMNS9(I)=GAMNS9(I)+ABSNS9(K,I)*FR
      GAMNS1(I)=GAMNS1(I)+ABSNS1(K,I)*FR
105   CONTINUE
104   CONTINUE
      DO 106 I=1,NRG
      AA=GAMRS5(I)-AMU5(I)
      BB=GAMRS8(I)-AMU8(I)
      CC=GAMRS9(I)-AMU9(I)
      DD=GAMRS9(I)-AMU8(I)
      EE=GAMRS1(I)-AMU1(I)
      FF=GAMRS1(I)-AMU0(I)
      GG=GAMRS1(I)-AMU9(I)
      HH=GAMRS1(I)-AMU8(I)
      FL=FLUENC(I)
      CONST1=AN9(I)+GAM8(I)*AN8(I)/(AMU8(I)-AMU9(I))
      CONST2=AN9(I)-CONST1
      RSIN5(I)=(AN5(I)/AA)*(EXP(AA*FL)-1.0)
      RSIN8(I)=(AN8(I)/BB)*(EXP(BB*FL)-1.0)
      RSIN9(I)=(CONST1/CC)*(EXP(CC*FL)-1.0)+(CONST2/DD)*(EXP(DD*FL)-1.0)
      RSIN1(I)=(DDD(I)/EE)*(EXP(EE*FL)-1.0)+(EEE(I)/FF)*(EXP(FF*FL)-1.0)
     X+(FFF(I)/GG)*(EXP(GG*FL)-1.0)+(GGG(I)/HH)*(EXP(HH*FL)-1.0)
```

```
106   CONTINUE
      DO 107 I=1,NRG
      AA=GAMSS5(I)-AMU5(I)
      BB=GAMSS8(I)-AMU8(I)
      CC=GAMSS9(I)-AMU9(I)
      DD=GAMSS9(I)-AMU8(I)
      EE=GAMSS1(I)-AMU1(I)
      FF=GAMSS1(I)-AMU0(I)
      GG=GAMSS1(I)-AMU9(I)
      HH=GAMSS1(I)-AMU8(I)
      FL=FLUENC(I)
      CONST1=AN9(I)+GAM8(I)*AN8(I)/(AMU8(I)-AMU9(I))
      CONST2=AN9(I)-CONST1
      SSIN5(I)=(AN5(I)/AA)*(EXP(AA*FL)-1.0)
      SSIN8(I)=(AN8(I)/BB)*(EXP(BB*FL)-1.0)
      SSIN9(I)=(CONST1/CC)*(EXP(CC*FL)-1.0)+(CONST2/DD)*(EXP(DD*FL)-1.0)
      SSIN1(I)=(DDD(I)/EE)*(EXP(EE*FL)-1.0)+(EEE(I)/FF)*(EXP(FF*FL)-1.0)
     X+(FFF(I)/GG)*(EXP(GG*FL)-1.0)+(GGG(I)/HH)*(EXP(HH*FL)-1.0)
107   CONTINUE
      DO 108 I=1,NRG
      AA=GAMNS5(I)-AMU5(I)
      BB=GAMNS8(I)-AMU8(I)
      CC=GAMNS9(I)-AMU9(I)
      DD=GAMNS9(I)-AMU8(I)
      EE=GAMNS1(I)-AMU1(I)
      FF=GAMNS1(I)-AMU0(I)
      GG=GAMNS1(I)-AMU9(I)
      HH=GAMNS1(I)-AMU8(I)
      FL=FLUENC(I)
      CONST1=AN9(I)+GAM8(I)*AN8(I)/(AMU8(I)-AMU9(I))
      CONST2=AN9(I)-CONST1
      ANSIN5(I)=(AN5(I)/AA)*(EXP(AA*FL)-1.0)
      ANSIN8(I)=(AN8(I)/BB)*(EXP(BB*FL)-1.0)
      ANSIN9(I)=(CONST1/CC)*(EXP(CC*FL)-1.0)+(CONST2/DD)*(EXP(DD*FL)-1.0
     X)
      ANSIN1(I)=(DDD(I)/EE)*(EXP(EE*FL)-1.0)+(EEE(I)/FF)*(EXP(FF*FL)-1.0
     X)+(FFF(I)/GG)*(EXP(GG*FL)-1.0)+(GGG(I)/HH)*(EXP(HH*FL)-1.0)
108   CONTINUE
C
C     CALCULATE CONCENTRATIONS OF  FISSION PRODUCTS DUE TO THE
C     FISSIONING OF U235,U238,PU239,AND PU241 IN EACH REGION
C     UNITS : CM**-3
      DO 109 I=1,NRG
      FL=FLUENC(I)
      CORS5(I)=RS5(I)*EXP(-GAMRS5(I)*FL)+ETRS5(I)
     X*EXP(-GAMRS5(I)*FL)*RSIN5(I)
      CORS8(I)=RS8(I)*EXP(-GAMRS8(I)*FL)+ETRS8(I)
     X*EXP(-GAMRS8(I)*FL)*RSIN8(I)
      CORS9(I)=RS9(I)*EXP(-GAMRS9(I)*FL)+ETRS9(I)
     X*EXP(-GAMRS9(I)*FL)*RSIN9(I)
      CORS1(I)=RS1(I)*EXP(-GAMRS1(I)*FL)+ETRS1(I)
     X*EXP(-GAMRS1(I)*FL)*RSIN1(I)
      COSS5(I)=SS5(I)*EXP(-GAMSS5(I)*FL)+ETSS5(I)
     X*EXP(-GAMSS5(I)*FL)*SSIN5(I)
      COSS8(I)=SS8(I)*EXP(-GAMSS8(I)*FL)+ETSS8(I)
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     X*EXP(-GAMSS8(I)*FL)*SSIN8(I)
      COSS9(I)=SS9(I)*EXP(-GAMSS9(I)*FL)+ETSS9(I)
     X*EXP(-GAMSS9(I)*FL)*SSIN9(I)
      COSS1(I)=SS1(I)*EXP(-GAMSS1(I)*FL)+ETSS1(I)
     X*EXP(-GAMSS1(I)*FL)*SSIN1(I)
      CONS5(I)=ANS5(I)*EXP(-GAMNS5(I)*FL)+ETNS5(I)
     X*EXP(-GAMNS5(I)*FL)*ANSIN5(I)
      CONS8(I)=ANS8(I)*EXP(-GAMNS8(I)*FL)+ETNS8(I)
     X*EXP(-GAMNS8(I)*FL)*ANSIN8(I)
      CONS9(I)=ANS9(I)*EXP(-GAMNS9(I)*FL)+ETNS9(I)
     X*EXP(-GAMNS9(I)*FL)*ANSIN9(I)
      CONS1(I)=ANS1(I)*EXP(-GAMNS1(I)*FL)+ETNS1(I)
     X*EXP(-GAMNS1(I)*FL)*ANSIN1(I)
109   CONTINUE
C     RENAME THE VARIABLES FOR CONCENTRATONS TO THEIR
C     INITIAL CONDITION NAMES IN EACH REGION
      DO 110 I=1,NRG
      RS5(I)=CORS5(I)
      RS8(I)=CORS8(I)
      RS9(I)=CORS9(I)
      RS1(I)=CORS1(I)
      SS5(I)=COSS5(I)
      SS8(I)=COSS8(I)
      SS9(I)=COSS9(I)
      SS1(I)=COSS1(I)
      ANS5(I)=CONS5(I)
      ANS8(I)=CONS8(I)
      ANS9(I)=CONS9(I)
      ANS1(I)=CONS1(I)
      SM(I)=SM5(I)+SM8(I)+SM9(I)+SM1(I)
      XE(I)=XE5(I)+XE8(I)+XE9(I)+XE1(I)
      RS(I)=RS5(I)+RS8(I)+RS9(I)+RS1(I)
      SS(I)=SS5(I)+SS8(I)+SS9(I)+SS1(I)
      ANS(I)=ANS5(I)+ANS8(I)+ANS9(I)+ANS1(I)
      AN5(I)=AA5(I)
      AN8(I)=AA8(I)
      AN9(I)=AA9(I)
      AN1(I)=AA1(I)
      AN0(I)=AA0(I)
      AN2(I)=AA2(I)
110   CONTINUE
C
C     GO TO CURVE FIT SECTION
C
      GO TO 150
63    CONTINUE
      DO 878 I=1,NRG
      IF (FTW(I).LE.0.50) GO TO 64
878   CONTINUE
      INDAC=1
      NUKIE=2
      IF (TIME.EQ.0.0) NUKIE=1
      POOF=1.0
      INDIC=2
      TFTW=0.0
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```
      DO 123 I=1,NRG
      FTW1(I)=FTW(I)-DEC
      IF (FTW1(I).LT.0.50) FTW1(I)=0.50
      ATOT1(I)=(AFUEL/FTW1(I))+ACLAD
      AJAX=ATOT(I)/ATOT1(I)
      AN5(I)=AN5(I)*AJAX
      AN8(I)=AN8(I)*AJAX
      AN9(I)=AN9(I)*AJAX
      AN0(I)=AN0(I)*AJAX
      AN1(I)=AN1(I)*AJAX
      AN2(I)=AN2(I)*AJAX
      IF (TIME.EQ.0.0) GO TO 996
      RS(I)=RS(I)*AJAX
      SS(I)=SS(I)*AJAX
      ANS(I)=ANS(I)*AJAX
      XE(I)=XE(I)*AJAX
      SM(I)=SM(I)*AJAX
      RS5(I)=RS5(I)*AJAX
      RS8(I)=RS8(I)*AJAX
      RS9(I)=RS9(I)*AJAX
      RS1(I)=RS1(I)*AJAX
      SS5(I)=SS5(I)*AJAX
      SS8(I)=SS8(I)*AJAX
      SS9(I)=SS9(I)*AJAX
      SS1(I)=SS1(I)*AJAX
      ANS5(I)=ANS5(I)*AJAX
      ANS8(I)=ANS8(I)*AJAX
      ANS9(I)=ANS9(I)*AJAX
      ANS1(I)=ANS1(I)*AJAX
996   CONTINUE
      AAOX1(I)=AAOX1(I)*AJAX
      AAOX0(I)=AAOX0(I)/AJAX
      AAOX(I)=AAOX1(I)+AAOX0(I)
      AAH(I)=AAH(I)/AJAX
      AAZ(I)=AAZ(I)*AJAX
      ATOT(I)=ATOT1(I)
      FTW(I)=FTW1(I)
      TFTW=TFTW+(FTW(I)*VOL(I)/CORVOL)
123   CONTINUE
      WRITE (6,932)
      WRITE (6,1100)
1100  FORMAT(2X,'FTW HAS BEEN CHANGED TO INCREASE REACTIVITY',/)
      IF (NRGNS.EQ.6) WRITE (6,1034)
      IF (NRGNS.EQ.5) WRITE (6,1035)
      IF (NRGNS.EQ.4) WRITE (6,1036)
      IF (NRGNS.EQ.3) WRITE (6,1037)
      IF (NRGNS.EQ.2) WRITE (6,1038)
      IF (NRGNS.EQ.1) WRITE (6,1039)
      WRITE (6,1040)
      WRITE (6,1041) (AN5(I),I=1,NRGNS)
      WRITE (6,1042) (AN8(I),I=1,NRGNS)
      WRITE (6,1043) (AN9(I),I=1,NRGNS)
      WRITE (6,1044) (AN0(I),I=1,NRGNS)
      WRITE (6,1045) (AN1(I),I=1,NRGNS)
      WRITE (6,1046) (AN2(I),I=1,NRGNS)
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      WRITE (6,1047) (AAOX(I),I=1,NRGNS)
      WRITE (6,1048) (AAH(I),I=1,NRGNS)
      WRITE (6,1049) (AAZ(I),I=1,NRGNS)
      WRITE (6,1380) (RS(I),I=1,NRGNS)
      WRITE (6,1381) (SS(I),I=1,NRGNS)
      WRITE (6,1384) (ANS(I),I=1,NRGNS)
      WRITE (6,1382) (XE(I),I=1,NRGNS)
      WRITE (6,1383) (SM(I),I=1,NRGNS)
      WRITE (6,1065) (FTW(I),I=1,NRGNS)
      IF(TFTW.LT.0.49) GO TO 64
      GO TO 150
64    CONTINUE
      WRITE (6,1066) LMBDA
      WRITE (6,1067) TFTW
124   WRITE (6,1068)
      WRITE (6,1069) TBURN
      WRITE (6,1070) CONRAT
      WRITE (6,1071) TIME
      GO TO 126
133   WRITE (6,1081)
      WRITE (6,1082)NSSS
126   STOP
1000  FORMAT(4X,'********** INPUT DATA **********')
1001  FORMAT(//,1X,'THE CYLINDRICAL REACTOR HAS',1X,I2,1X,'REGIONS')
1002  FORMAT(1X,'THE LENGTH OF EACH TIMESTEP IS',1X,F7.2,1X,'HOURS')
1003  FORMAT(1X,'THE HEIGHT IS',1X,F7.1,1X,'CM')
1260  FORMAT (1X,'THE REGION VOLUMES ARE :',2X,6(F11.2,2X))
1004  FORMAT(1X,'THE CONVERGENCE CRITERION FOR THE EIGENVALUE IS',1X,E12
     1.5)
1005  FORMAT(1X,'THE TRANSVERSE BUCKLING IS ',E12.5,1X,'CM**2')
1006  FORMAT(1X,'THE REACTOR POWER IS TO BE SET AT ',E12.5,' WATTS')
1007  FORMAT(1X,'THE REACTOR USES A HEXAGONAL LATTICE')
1008  FORMAT(1X,'THE FUEL OUTER DIAMETER IS ',F7.4,' INCHES')
1009  FORMAT(1X,'THE CLADDING OUTER DIAMETER IS ',F7.4,' INCHES')
1010  FORMAT(//,37X,'ENRICHMENT %')
1011  FORMAT(15X,'U-235',6X,'U-238',5X,'PU-239',4X,'PU-240',3X,'PU-241
     1',3X,'PU-242',5X,'SPACING',/)
1012  FORMAT(1X,'REGION ',I1,2(5X,F6.3),5(4X,F6.3),6X,F6.4)
1016  FORMAT(//,3X,'********** END OF INPUT DATA **********')
1017  FORMAT(//,5X,'***** DATA AT END OF SUBSTP ',I2,' *****')
1018  FORMAT(//,5X,'***** END OF SUBSTP ',I2,' *****')
1019  FORMAT(/,5X,'TOTAL TIME =',F10.2,' HOURS')
1020  FORMAT(//,1X,'THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE
     1:')
1021  FORMAT(/,2X,'KEFF=',E12.5,2X,'AT TIME=',F10.2)
1022  FORMAT(2X,'FUEL TO WATER RATIO =',F6.4)
1052  FORMAT(2X,'GROUP 4 FLUX =',E15.8)
1023  FORMAT(2X,'GROUP 3 FLUX =',E15.8)
1024  FORMAT(2X,'GROUP 2 FLUX =',E15.8)
1025  FORMAT(2X,'GROUP 1 FLUX =',E15.8)
1026  FORMAT(2X,'TOTAL FLUX =',E15.8)
1027  FORMAT(2X,'ENERGY DENSITY =',E15.8)
1028  FORMAT(2X,'POWER DENSITY =',E15.8)
1029  FORMAT(2X,'TOTAL POWER =',E15.8)
1030  FORMAT(2X,'CONVERSION RATIO =',F7.4)
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1031  FORMAT(2X,'BURNUP THIS STEP =',E15.8)
1033  FORMAT(2X,'TIME =',F10.2)
1034  FORMAT(//,24X,'REGION 1',9X,'REGION 2',11X,'REGION 3',10X,
     1'REGION 4',10X,'REGION 5',10X,'REGION 6')
1035  FORMAT(//,24X,'REGION 1',9X,'REGION 2',11X,'REGION 3',11X,'REGION
     1 4',10X,'REGION 5')
1036  FORMAT(//,24X,'REGION 1',9X,'REGION 2',11X,'REGION 3',11X,'REGION
     1 4')
1037  FORMAT(//,24X,'REGION 1',9X,'REGION 2',11X,'REGION 3')
1038  FORMAT(//,24X,'REGION 1',9X,'REGION 2')
1039  FORMAT(//,24X,'REGION 1')
1040  FORMAT(1X,'NUMBER DENSITY')
1041  FORMAT(2X,'U-235',14X,E15.8,5(2X,E15.8))
1042  FORMAT(2X,'U-238',14X,E15.8,5(2X,E15.8))
1043  FORMAT(2X,'PU-239',13X,E15.8,5(2X,E15.8))
1044  FORMAT(2X,'PU-240',13X,E15.8,5(2X,E15.8))
1045  FORMAT(2X,'PU-241',13X,E15.8,5(2X,E15.8))
1046  FORMAT(2X,'PU-242',13X,E15.8,5(2X,E15.8))
1047  FORMAT(2X,'O-16',15X,E15.8,5(2X,E15.8))
1048  FORMAT(2X,'H&H2O',14X,E15.8,5(2X,E15.8))
1049  FORMAT(2X,'ZIRC2',14X,E15.8,5(2X,E15.8))
1380  FORMAT(2X,'RS FPS',13X,6(E15.8,2X))
1381  FORMAT(2X,'SS FPS',13X,6(E15.8,2X))
1382  FORMAT(2X,'XE-135',13X,6(E15.8,2X))
1383  FORMAT(2X,'SM-149',13X,6(E15.8,2X))
1384  FORMAT(2X,'NS FPS',13X,6(E15.8,2X))
1053  FORMAT(/,2X,'NEUTRON FLUX')
1054  FORMAT(2X,'GROUP 1',12X,6(E15.8,2X))
1055  FORMAT(2X,'GROUP 2',12X,6(E15.8,2X))
1056  FORMAT(2X,'GROUP 3',12X,6(E15.8,2X))
1051  FORMAT(2X,'GROUP 4',12X,6(E15.8,2X))
1050  FORMAT(2X,'FPS',16X,6(E15.8,2X))
1059  FORMAT(/,2X,'CONVERSION RATIO',4X,6(F7.4,11X))
1060  FORMAT(2X,'BURNUP',13X,6(E15.8,2X))
1061  FORMAT(2X,'POWER DENSITY',6X,6(E15.8,2X))
1062  FORMAT(2X,'POWER',14X,6(E15.8,2X))
1063  FORMAT(2X,'ENERGY DENSITY',5X,6(E15.8,2X))
1064  FORMAT(2X,'FLUENCE',12X,6(E15.8,2X))
1065  FORMAT(2X,'FTW RATIO',11X,6(F6.4,11X))
1066  FORMAT(//,1X,'REACTOR HAS BEEN SHUT DOWN BECAUSE 1. KEFF='
     1,E15.8)
1067  FORMAT(36X,'2. OVERALL FUEL TO WATER RATIO =',F6.4)
1068  FORMAT(//,1X,'AT SHUTDOWN TIME ,')
1069  FORMAT(/,3X,'TOTAL BURNUP =',E15.8)
1070  FORMAT(3X,'CONVERSION RATIO =',F6.4)
1071  FORMAT(3X,'RUNNING TIME =',F10.2,' HOURS')
1081  FORMAT(//,1X,'PROGRAM SHUT DOWN BECAUSE THE EIGENVALUE FAILED
     1 TO CONVERGE AFTER 200 ITERATIONS')
1082  FORMAT(/,1X,'PROGRAM WAS ON SUBSTP',1X,I3)
1083  FORMAT(1X,'REGION WIDTHS FROM THE CENTER OUT IN CM ARE:')
1084  FORMAT(1X,6(F10.5))
      END
      SUBROUTINE SYSTEM
C
C     THIS ROUTINE SETS UP THE COEFFICIENT MATRIX FOR THE FINITE
```

```
C      DIFFERENCE EQUATIONS
C
       REAL LMBDA
       INTEGER G,BCL,BCR,PP
       INTEGER SUM
       COMMON /BLOCK1/ SR(4,6),SA(4,6),SF(4,6),DC(4,6),SP(4,6),BUC(4,6),
      1H(60),A(240),D(240),C(240),NOPTS(6),P,NRGNS,G,N,BCL,BCR
       COMMON /BLOCK2/ SRB(4,60),SFB(4,60),SRBM(4,60),SFBM(4,60),PHI(4,60
      1),PH(4,60),B(240),S(240),CHI(4),LMBDA,FLUX(4,6)
       COMMON /OUTPUT/ OPTOUT,NSUM1
       DIMENSION ST(4,60), DB(4,60), STBM(4,60), STBP(4,60), SRBP(4,60),
      1SFBP(4,60), STB(4,60), DBM(4,60), SB(4,60)
       PP=P+0.5
C
C      FIRST COMPUTE NODAL COEFFICIENTS FROM BASIC DATA
C
       DO 3 I=1,G
       R=0.0
       SUM=0
       DO 3 J=1,NRGNS
       ST(I,J)=SA(I,J)+SR(I,J)+DC(I,J)*BUC(I,J)+SP(I,J)
       IF (J.GT.1) SUM=SUM+NOPTS(J-1)
       NOPT=NOPTS(J)
       DO 3 K=1,NOPT
       L=SUM+K
       STBP(I,L)=0.0
       SRBP(I,L)=0.0
       SFBP(I,L)=0.0
       IF (L.GT.1) R=R+H(L-1)
       GEOMP=((R+H(L)/2.0)**(PP+1)-R**(PP+1))/(P+1.0)
       IF (L.EQ.1) GO TO 1
       L=L-1
       GEOMM=((R-H(L)/2.0)**(PP+1)-R**(PP+1))/(P+1.0)
       L=L+1
       KK=J
       IF (J.GT.1.AND.K.EQ.1) KK=J-1
       DBM(I,L)=DC(I,KK)*(R-H(L-1)/2.0)**PP/H(L-1)
       SFBM(I,L)=-SF(I,KK)*GEOMM
       SRBM(I,L)=-SR(I,KK)*GEOMM
       STBM(I,L)=-ST(I,KK)*GEOMM
       KK=J
       STBP(I,L)=ST(I,KK)*GEOMP
       SRBP(I,L)=SR(I,KK)*GEOMP
       SFBP(I,L)=SF(I,KK)*GEOMP
       DB(I,L)=DC(I,J)*(R+H(L)/2.0)**PP/H(L)
       GO TO 2
1      STBP(I,L)=ST(I,J)*GEOMP
       SRBP(I,L)=SR(I,J)*GEOMP
       SFBP(I,L)=SF(I,J)*GEOMP
       DB(I,L)=DC(I,J)*(R+H(L)/2.0)**PP/H(L)
       DBM(I,L)=0.0
       STBM(I,L)=0.0
       SRBM(I,L)=0.0
       SFBM(I,L)=0.0
2      STB(I,L)=STBM(I,L)+STBP(I,L)
```

```
      SRB(I,L)=SRBM(I,L)+SRBP(I,L)
      SFB(I,L)=SFBM(I,L)+SFBP(I,L)
3     CONTINUE
      R=R+H(N-1)
      DO 4 I=1,G
      L=N
      J=NRGNS
      GEOMM=((R-H(L)/2.0)**(PP+1)-R**(PP+1))/(P+1.0)
      DB(I,L)=DC(I,J)*(R+H(L)/2.0)**PP/H(L)
      STBM(I,L)=-ST(I,J)*GEOMM
      SRBM(I,L)=-SR(I,J)*GEOMM
      SFBM(I,L)=-SF(I,J)*GEOMM
      STBP(I,L)=0.0
      SRBP(I,L)=0.0
      SFBP(I,L)=0.0
      STB(I,L)=STBM(I,L)
      SRB(I,L)=SRBM(I,L)
      SFB(I,L)=SFBM(I,L)
      STBM(I,1)=0.0
      SRBM(I,1)=0.0
      SFBM(I,1)=0.0
4     CONTINUE
C
C     COMPUTE GENERAL MATRIX ELEMENTS FOR ENTIRE MATRIX; LATER WE LL
C     REPLACE THOSE WHICH ARE DETERMINED BY BOUNDARY CONDITIONS
C
      N1=N-1
      SUM=0.0
      DO 5 I=1,G
      SUM=(I-1)*N
      DO 5 J=1,NRGNS
      IF (J.GT.1) SUM=SUM+NOPTS(J-1)
      NOPT=NOPTS(J)
      DO 5 K=1,NOPT
      L=SUM+K
      LL=L-(I-1)*N
      A(L)=-DBM(I,LL)
      D(L)=DB(I,LL)+DBM(I,LL)+STB(I,LL)
      C(L)=-DB(I,LL)
5     CONTINUE
C
C     SET UP MATRIX ELEMENTS WHICH DEPEND ON BOUNDARY CONDITIONS
C
      GO TO (6,8),BCL
6     NP=(G-1)*N+1
      DO 7 J=1,NP,N
      A(J)=0.0
      C(J)=0.0
7     D(J)=0.0
      GO TO 10
8     NP=(G-1)*N+1
      DO 9 J=1,NP,N
      I=1
      IF (J.GT.1) I=(J-1)/N+1
      D(J)=DC(I,1)/H(1)+H(1)*ST(I,1)/2.0/(P+1.0)
```

```
      A(J)=0.0
9     C(J)=-DC(I,1)/H(1)
10    CONTINUE
      GO TO (11,13),BCR
11    NP=G*N
      DO 12 J=N,NP,N
      A(J)=0.0
      C(J)=0.0
12    D(J)=1.0
      GO TO 15
13    NP=G*N
      DO 14 J=N,NP,N
      I=J/N
      C(J)=0.0
      D(J)=DB(I,N)+STBM(I,N)
      A(J)=-DB(I,N)
14    CONTINUE
15    CONTINUE
      RETURN
      END
      SUBROUTINE SOURCE
C
C     THIS ROUTINE COMPUTES THE G-GROUP SOURCE VECTOR FROM THE KNOWN
C     FLUX VECTOR. THE FLUX VECTOR IS ASSUMED TO BE AVAILABLE IN COMMON
C     AS PHI(K,J),WHERE K=GROUP NO. AND J=SPATIAL POINT NO.
C
      INTEGER G,BCL,BCR
      REAL NSIGFB
      REAL LMBDA
      COMMON /BLOCK1/ SR(4,6),SA(4,6),SF(4,6),DC(4,6),SP(4,6),BUC(4,6),
     1H(60),A(240),D(240),C(240),NOPTS(6),P,NRGNS,G,N,BCL,BCR
      COMMON /BLOCK2/ SRB(4,60),SFB(4,60),SRBM(4,60),SFBM(4,60),PHI(4,60
     1),PH(4,60),B(240),S(240),CHI(4),LMBDA,FLUX(4,6)
      COMMON /OUTPUT/ OPTOUT,NSUM1
      JS=G*N
      N1=N-1
      DO 2 I=1,G
      DO 2 J=1,N1
      KN=(I-1)*N+J
C
C     COMPUTE FISSION SOURCE
C
      SUM=0.0
      DO 1 K=1,G
1     SUM=SUM+  SFB (K,J)*PHI(K,J)
      CHIT=CHI(I)
      S(KN)=CHIT*SUM/LMBDA
      IF (I.EQ.1) GO TO 2
C
C     COMPUTE SLOWING - DOWN SOURCE
C
      S(KN)=S(KN)+SRB(I-1,J)*PH(I-1,J)
2     CONTINUE
C
C     PUT IN BOUNDARY TERMS
```

```
C
      GO TO (3,5),BCL
3     NP=(G-1)*N+1
      DO 4 J=1,NP,N
4     S(J)=0.0
      GO TO 8
5     NP=(G-1)*N+1
      I=0
      DO 7 J=1,NP,N
      SUM=0.0
      I=I+1
      DO 6 K=1,G
6     SUM=SUM+SF(K,1)*PHI(K,1)
      S(J)=CHI(I)/LMBDA*H(1)*SUM/4.0
      IF (I.EQ.1) GO TO 7
      S(J)=S(J)+H(1)*SR(I-1,1)*PH(I-1,1)/4.0
7     CONTINUE
C
C
8     GO TO (9,11),BCR
9     NP=G*N
      DO 10 J=N,NP,N
      S(J)=0.0
10    CONTINUE
      GO TO 14
11    NP=G*N
      I=0
      DO 13 J=N,NP,N
      I=I+1
      SUM=0.0
      DO 12 K=1,G
12    SUM=SUM+SFBM(K,N)*PHI(K,N)
      S(J)=CHI(I)*SUM/LMBDA
      IF (I.EQ.1) GO TO 13
      S(J)=S(J)+SRBM(I-1,N)*PH(I-1,N)
13    CONTINUE
14    RETURN
      END
      FUNCTION KK (J)
C
C       FUNCTION KK DETERMINES THE REGION NUMBER GIVEN TNE POINT NO.
C
      INTEGER G,BCL,BCR
      COMMON /BLOCK1/ SR(4,6),SA(4,6),SF(4,6),DC(4,6),SP(4,6),BUC(4,6),
     1H(60),A(240),D(240),C(240),NOPTS(6),P,NRGNS,G,N,BCL,BCR
      NOPT=0
      KN=0
1     KN=KN+1
      IF (KN.GT.NRGNS) GO TO 2
      NOPT=NOPTS(KN)+NOPT
      IF (J.GT.NOPT) GO TO 1
      KK=KN
      GO TO 3
2     KK=KN-1
3     CONTINUE
```

```
      RETURN
      END
      SUBROUTINE SOLVE
C
C     THIS SUBROUTINE ITERATES FOR THE GROUP FLUXES. EQUATIONS ARE
C     SOLVED BY GAUSS ELIMINATION USING THE TRID SUBROUTINE
C
      REAL NSIGFB,LMBDA
      INTEGER G,BCL,BCR
      COMMON /BLOCK1/ SR(4,6),SA(4,6),SF(4,6),DC(4,6),SP(4,6),BUC(4,6),
     1H(60),A(240),D(240),C(240),NOPTS(6),P,NRGNS,G,N,BCL,BCR
      COMMON /BLOCK2/ SRB(4,60),SFB(4,60),SRBM(4,60),SFBM(4,60),PHI(4,60
     1),PH(4,60),B(240),S(240),CHI(4),LMBDA,FLUX(4,6)
      COMMON /BLOCK3/ RES(4,10),THETA(10),EPS,EPS1,SIGB,JS,IT
      COMMON /OUTPUT/ OPTOUT,NSUM1
      COMMON /MAX/ SMAX,V(240),BAX,TIME
      DIMENSION NSIGFB(4,60),  DD(240)
C
      JS=G*N
      JIP=0
      DO 1 I=1,G
      DO 1 J=1,N
1     PH(I,J)=PHI(I,J)
      IT=0
      JS2=N-1
      JS1=2
C
C     PREPARE  CHEBYSHEV  ACCELERATION  PARAMETERS
C
      II=4
      DO 2 I=1,II
2     THETA(I)=0.0
      LL=0
3     IT=IT+1
      IF (IT.GT.200) GO TO 22
      LMBDA1=LMBDA
      IJ=II+1
      LL=LL+1
      IF (LL.GE.II+1) CALL CBYSHV (LL,II)
      IF (LL.EQ.IJ) LL=1
      IF (II.GE.3) GO TO 5
      JI=II+1
      DO 4 I=JI,3
4     THETA(I)=0.0
      II=3
5     CONTINUE
C
C     ACCELERATE
C
      DO 6 I=1,G
      DO 6 J=1,N
6     PHI(I,J)=PH(I,J)*(1.0+THETA(LL))-PHI(I,J)*THETA(LL)
C
C     COMPUTE EIGENVALUE
C
```

```
      LMBDA=0.0
      DO 7 I=1,G
      DO 7 J=1,N
7     LMBDA=LMBDA+SFB(I,J)*PHI(I,J)
C
C     SOLVE EQUATIONS
C
      I=0
8     I=I+1
      CALL SOURCE
      IA=(I-1)*N+1
      CALL TRID (IA,N,A,D,C,S,V)
      IB=IA+N-1
      DO 9 J=IA,IB
      K=J-IA+1
      PH(I,K)=V(J)
9     CONTINUE
      IF (I.LT.G) GO TO 8
C
C     CHECK FOR CONVERGENCE
C
      DO 10 I=1,G
      DO 10 J=1,N
      CRIT=ABS(PHI(I,J)-PH(I,J))
      IF (PHI(I,J).NE.0.0) CRIT=CRIT/PHI(I,J)
      IF (CRIT-EPS) 10,10,11
10    CONTINUE
      JIP=JIP+1
      IF (JIP.EQ.2) GO TO 16
C
C     UPDATE  CONVERGENCE  PARAMETERS
C
11    CONTINUE
      IF (BCL.GT.1) JS1=1
      IF (BCR.GT.1) JS2=N
      ZLBU=0.0
      ZLBL=1.0E01
      DO 13 J=JS1,JS2
      SUM1=0.0
      SUM2=0.0
      DO 12 I=1,G
      SUM1=SUM1+SFB(I,J)*PH(I,J)
12    SUM2=SUM2+SFB(I,J)*PHI(I,J)
      SUM2=SUM2/LMBDA
      IF (SUM1.EQ.0.0) GO TO 13
      IF (SUM2.EQ.0.0) GO TO 13
      BIG=SUM1/SUM2
      IF (BIG.GT.ZLBU) ZLBU=BIG
      IF (BIG.LT.ZLBL) ZLBL=BIG
13    CONTINUE
      DO 14 I=1,G
14    RES(I,LL)=0.0
      DO 15 I=1,G
      DO 15 J=1,N
15    RES(I,LL)=RES(I,LL)+ABS(PH(I,J)-PHI(I,J))
```

```
      EPS1=(ZLBU-ZLBL)/LMBDA
      IF (IT.LT.3) GO TO 3
      GO TO 3
C
C     ITERATION HAS CONVERGED
C
16    CONTINUE
      SMAX=0.0
      DO 19 J=1,N
      V(J)=0.0
      DO 18 I=1,G
18    V(J)=V(J)+PH(I,J)
      V(J)=V(J)/G
      IF (V(J).GT.SMAX) SMAX=V(J)
19    CONTINUE
      DO 21 J=1,N
      DO 20 I=1,G
20    PH(I,J)=PH(I,J)/SMAX
      V(J)=V(J)/SMAX
21    CONTINUE
      SAX=0.0
      RAX=0.0
      DO 40 J=1,NSUM1
      IF (V(J).GE.RAX) RAX=V(J)
40    SAX=SAX+V(J)
      TAX=SAX/NSUM1
      BAX=RAX/TAX
      GO TO 23
C
C     ITERATION FAILED TO CONVERGE
C
22    IT=IT-1
23    RETURN
C
C
C
      END
      SUBROUTINE CBYSHV (J,I)
      INTEGER G,BCL,BCR
      REAL LMBDA
      COMMON /BLOCK1/ SR(4,6),SA(4,6),SF(4,6),DC(4,6),SP(4,6),BUC(4,6),
     1H(60),A(240),D(240),C(240),NOPTS(6),P,NRGNS,G,N,BCL,BCR
      COMMON /BLOCK2/ SRB(4,60),SFB(4,60),SRBM(4,60),SFBM(4,60),PHI(4,60
     1),PH(4,60),B(240),S(240),CHI(4),LMBDA,FLUX(4,6)
      COMMON /BLOCK3/ RES(4,10),THETA(10),EPS,EPS1,SIGB,JS,IT
      COMMON /OUTPUT/ OPTOUT,NSUM1
      Z(L,M)=1.0+COS((2.0*L+1.0)*3.141593/2.0/M)
C     IF (OPTOUT.EQ.1.) WRITE (6,8)
C
C     COMPUTE SIGMA-BAR
C
      SIGB=0.0
      DO 1 I=1,G
1     SIGB=SIGB+RES(I,J-1)/RES(I,J-2)
      SIGB=SIGB/G
```

```
      ZIP=1.0
      IF (SIGB.GT.ZIP) GO TO 6
C
C     COMPUTE I - THE NUMBER OF ITERATIONS IN THE NEXT CYCLE
C
      I=-1
2     IF (I.GT.9) GO TO 3
      I=I+1
      RATIO=EPS1/TCB(I,-1.0+2.0/SIGB)
      IF (RATIO.GT.EPS) GO TO 2
3     CONTINUE
      IF (I.EQ.0) GO TO 6
C
C     COMPUTE AND PRINT THETAS
C
      DO 4 L=1,I
      K=L
      K=K-1
      THETA(K+1)=SIGB*Z(K,I)/(2.0-SIGB*Z(K,I))
4     CONTINUE
      RETURN
6     I=4
      DO 7 K=1,I
7     THETA(K)=0.0
      RETURN
      END
      FUNCTION TCB (N,X)
      DIMENSION TN(20)
      TN(1)=1
      IF (N.EQ.0) GO TO 2
      TN(2)=X
      IF (N.EQ.1) GO TO 2
      NNN=N+1
      DO 1 I=3,NNN
1     TN(I)=2.0*X*TN(I-1)-TN(I-2)
2     TCB=TN(N+1)
      RETURN
      END
      SUBROUTINE SUMMER
      REAL LMBDA
      INTEGER G,BCL,BCR,PP,PP1
      COMMON /BLOCK1/ SR(4,6),SA(4,6),SF(4,6),DC(4,6),SP(4,6),BUC(4,6),
     1H(60),A(240),D(240),C(240),NOPTS(6),P,NRGNS,G,N,BCL,BCR
      COMMON /BLOCK2/ SRB(4,60),SFB(4,60),SRBM(4,60),SFBM(4,60),PHI(4,60
     1),PH(4,60),B(240),S(240),CHI(4),LMBDA,FLUX(4,6)
      COMMON /BLOCK5/ DEL(6),POWER,PHIB,HT
      COMMON /MAX/ SMAX,V(240),BAX,TIME
      DIMENSION  SOUR(4,60)
      PP=P+0.5
      WRITE (6,32) LMBDA,TIME
      WRITE (6,37)
      WRITE (6,38) (J,V(J),J=1,N)
      WRITE(6,42) BAX
42    FORMAT(/,26X,'PEAK TO AVERAGE = ',F7.4)
32    FORMAT (//,30X,5HKEFF=,F10.5,5X,5HTIME=,F10.2)
```

```
37    FORMAT (//,25X,29HRELATIVE POINT GROUP AVERAGES,/)
38    FORMAT (26X,I2,3X,E15.7)
C
C     COMPUTE FISSION SOURCE AT EACH POINT
C
      DO 2 J=1,N
      SUM=0.0
      DO 1 I=1,G
1     SUM=SUM+SFB(I,J)*PHI(I,J)
2     S(J)=SUM
C
C     INTEGRATE SOURCE TO COMPUTE NORMALIZATION CONSTANT
C
      R1=-H(1)
      R2=0.0
      SUM=0.0
      PP1=PP+1
      N1=N-1
      DO 7 L=1,N1
      J=L
      IF (J.EQ.1) R1=R1+H(1)
      IF (J.GT.1) R1=R1+H(J-1)
      R2=R2+H(J)
      J=J+1
      GO TO (3,4,5), PP1
3     SUM=SUM+H(J-1)/2.0*(S(J-1)+S(J))
      GO TO 6
4     SUM=SUM+(R2*R2-R1*R1)*(2.*S(J)+S(J-1))/3.
      GO TO 6
5     SUM=SUM+(R2**3-R1**3)*(3.*S(J)+S(J-1))/4.
6     J=J-1
7     CONTINUE
      GO TO (10,8,9), PP1
8     SUM=SUM/(R2*R2)
      GO TO 11
9     SUM=SUM/(R2**3)
      GO TO 11
10    SUM=SUM/R2
11    CONTINUE
      RNORM=SUM*N
C
C     COMPUTE POINTWISE NORMALIZED SOURCE
C
      DO 12 I=1,N
12    S(I)=S(I)/RNORM
      DO 15 I=1,N
      DO 14 J=1,G
      SOUR(J,I)=PHI(J,I)*SFB(J,I)/RNORM
14    CONTINUE
15    CONTINUE
C
      LLL=0
16    LLL=LLL+1
C
C     COMPUTE AVERAGE SOURCE (LLL=1) OR FLUX (LLL=2)
```

```
C
      SMAX=0.0
      DO 18 J=1,N
      SUM=0.0
      DO 17 K=1,G
      IF (LLL.EQ.2) SUM=SUM+PHI(K,J)
      IF (LLL.EQ.1) SUM=SUM+PHI(K,J)*SFB(K,J)
17    CONTINUE
      SUM=SUM/G
      IF (SUM.GT.SMAX) SMAX=SUM
18    A(J)=S(J)
      DO 30 K=1,G
      ISUM1=1
      ISUM2=0
      DO 19 JJ=1,N
      IF (LLL.EQ.2) S(JJ)=PHI(K,JJ)
19    IF (LLL.EQ.1) S(JJ)=PHI(K,JJ)*SFB(K,JJ)
      DO 30 I=1,NRGNS
      IF (I.GT.1) ISUM1=ISUM1+NOPTS(I-1)
      ISUM2=ISUM1+NOPTS(I)-1
C
C     CALCULATE THE AVERAGE FOR THE REGION AND GROUP WE ARE IN
C
      SUM=0.0
      DO 24 L=ISUM1,ISUM2
      IF (L.EQ.1) R1=0.0
      IF (L.GT.1) R1=R1+H(L-1)
      IF (L.EQ.ISUM1) R3=R1
      R2=R1+H(L)
      SUM = SUM + (R2**PP1 - R1**PP1) * (PP1*S(L) + S(L+1))/ (PP1+1.0)
24    CONTINUE
      SUM = SUM/(R2**PP1 - R3**PP1)
29    CONTINUE
      FLUX(K,I)=SUM
30    CONTINUE
      IF (LLL.EQ.1) GO TO 16
C
      RETURN
      END
      SUBROUTINE SEARCH
      REAL LMBDA
      INTEGER G,BCL,BCR
      COMMON /BLOCK1/ SR(4,6),SA(4,6),SF(4,6),DC(4,6),SP(4,6),BUC(4,6),
     1H(60),A(240),D(240),C(240),NOPTS(6),P,NRGNS,G,N,BCL,BCR
      COMMON /BLOCK2/ SRB(4,60),SFB(4,60),SRBM(4,60),SFBM(4,60),PHI(4,60
     1),PH(4,60),B(240),S(240),CHI(4),LMBDA,FLUX(4,6)
      COMMON /BLOCK4/ DESEIG,EPS2,SPP
      DIMENSION DUM(4,6)
C
C                     POISON SEARCH
C
      DESEIG=1.0
      EPS2=1.0E-3
      DO 31 K=1,G
      DO 32 J=1,NRGNS
```

```
      SP(K,J)=5.0E-2
32    CONTINUE
31    CONTINUE
      DO 1 I=1,G
      DO 1 J=1,NRGNS
1     DUM(I,J)=SP(I,J)
      ITE=0
C
C     ESTABLISH FIRST TWO POINTS
C
      CALL SYSTEM
      DO 2 I=1,G
      DO 2 J=1,N
2     PHI(I,J)=1.0
      X1=1.0
      LMBDA=DESEIG
      CALL SOLVE
      E1=LMBDA-DESEIG
      ITE=ITE+1
      IF (ABS(E1)-EPS2) 9,9,3
3     DO 4 I=1,G
      DO 4 J=1,NRGNS
4     SP(I,J)=0.0
      X0=0.0
      CALL SYSTEM
      CALL SOLVE
      E0=LMBDA-DESEIG
C
C     ITERATE FOR DESEIG, THE DESIRED EIGENVALUE
C
      ITE=ITE+1
      X2=X0
      E11=E0
5     CONTINUE
      DO 6 I=1,G
      DO 6 J=1,NRGNS
6     SP(I,J)=DUM(I,J)
      X2=(E1*X0-E0*X1)/(E1-E0)
      DO 7 I=1,G
      DO 7 J=1,NRGNS
7     SP(I,J)=X2*SP(I,J)
      E0=E1
      ITE=ITE+1
      X0=X1
      X1=X2
      CALL SYSTEM
      CALL SOLVE
      E1=LMBDA-DESEIG
      E11=E1
C
C     CHECK FOR CONVERGENCE
C
      IF (ABS(E1)-EPS2) 9,9,8
8     IF (ITE.LT.25) GO TO 5
      WRITE (6,37)
```

```
37    FORMAT (2X,'POISON SEARCH FAILED')
9     CONTINUE
      SPP=SP(1,1)
      DO 25 J=1,NRGNS
      DO 26 I=1,G
      SP(I,J)=0.0
26    CONTINUE
25    CONTINUE
      RETURN
C
      END
C      SUBROUTINE FOR SOLVING A SYSTEM OF LINEAR SIMULTANEOUS
C      EQUATIONS HAVING A TRIDIAGONAL COEFFICIENT MATRIX.
C      THE EQUATIONS ARE NUMBERED IF THROUGH IF + N-1, AND THEIR
C      SUB-DIAGONAL, DIAGONAL, AND SUPER-DIAGONAL COEFFICIENTS
C      ARE STORED IN THE ARRAYS A,D, AND C.  THE COMPUTED SOLU-
C      TION VECTOR V(IF)...V(IF + N-1) IS STORED IN THE ARRAY V.
C
      SUBROUTINE TRID (IF,N,A,D,C,S,V)
      DIMENSION A(240), D(240), C(240), S(240), BETA(240), GAMMA(270), V
     1(240)
C
C                          COMPUTE INTERMEDIATE ARRAYS BETA AND GAMMA
C
      BETA(IF)=D(IF)
      GAMMA(IF)=S(IF)/BETA(IF)
      IFP1=IF+1
      L=IF+N-1
      DO 1 I=IFP1,L
      BETA(I)=D(I)-A(I)*C(I-1)/BETA(I-1)
1     GAMMA(I)=(S(I)-A(I)*GAMMA(I-1))/BETA(I)
C
C                          COMPUTE FINAL SOLUTION VECTOR V
C
      V(L)=GAMMA(L)
      LAST=L-IF
      DO 2 K=1,LAST
      I=L-K
2     V(I)=GAMMA(I)-C(I)*V(I+1)/BETA(I)
      RETURN
      END
C*************** DATA TABLES GO HERE *****************
1.3288E+00  1.3288E+00  1.3313E+00  7.3531E+00  7.3531E+00  7.3437E+00
1.2635E+00  1.2635E+00  1.2635E+00  3.4429E+00  3.4429E+00  3.4223E+00
2.1246E+00  2.1246E+00  2.1158E+00  1.1070E+01  1.1070E+01  1.1047E+01
1.6564E+00  1.6564E+00  1.6514E+00  4.0486E+00  4.0486E+00  4.0366E+00
3.6079E+01  3.6079E+01  3.4715E+01  4.8093E+01  4.8093E+01  4.6747E+01
2.4193E+01  2.4193E+01  2.3369E+01  5.8518E+01  5.8518E+01  5.6526E+01
3.6141E+02  3.6141E+02  3.3438E+02  3.7568E+02  3.7568E+02  3.4871E+02
3.0757E+02  3.0757E+02  2.8412E+02  7.4394E+02  7.4394E+02  6.8724E+02
1.3709E+00  1.3367E+00  1.3197E+00  7.5903E+00  7.3990E+00  7.2991E+00
1.3046E+00  1.2712E+00  1.2538E+00  3.5604E+00  3.4609E+00  3.4082E+00
2.1310E+00  2.1219E+00  2.1255E+00  1.1144E+01  1.1079E+01  1.1100E+01
1.6642E+00  1.6566E+00  1.6561E+00  4.0694E+00  4.0502E+00  4.0472E+00
3.6902E+01  3.6079E+01  4.8705E+01  4.8035E+01  4.8035E+01  4.6786E+01
```

```
2.4481E+01  2.3965E+01  2.3090E+01  5.9216E+01  5.7966E+01  5.5851E+01
3.8484E+02  3.4240E+02  3.1741E+02  3.9855E+02  3.5632E+02  3.3125E+02
3.2827E+02  2.9172E+02  2.7034E+02  7.9403E+02  7.0561E+02  6.5390E+02
1.3668E+00  1.3300E+00  1.3300E+00  7.5860E+00  7.3737E+00  7.3737E+00
1.3013E+00  1.2648E+00  1.2648E+00  3.5603E+00  3.4495E+00  3.4495E+00
2.1500E+00  2.1237E+00  2.1237E+00  1.1202E+01  1.1082E+01  1.1082E+01
1.6770E+00  1.6570E+00  1.6570E+00  4.1000E+00  4.0508E+00  4.0508E+00
3.6987E+01  3.6393E+01  3.6393E+01  4.8792E+01  4.8348E+01  4.8348E+01
2.4423E+01  2.4033E+01  2.4033E+01  5.9074E+01  5.8132E+01  5.8132E+01
4.0670E+02  3.6717E+02  3.6717E+02  4.2068E+02  3.8134E+02  3.8134E+02
3.4704E+02  3.1301E+02  3.1301E+02  8.3942E+02  7.5711E+02  7.5711E+02
4.3778E-01  4.3778E-01  4.2483E-01  7.4957E+00  7.4957E+00  7.4947E+00
3.7557E-01  3.7557E-01  3.5980E-01  1.0547E+00  1.0547E+00  1.0037E+00
2.5606E-01  2.5606E-01  2.5422E-01  1.1082E+01  1.1082E+01  1.1062E+01
3.6421E-04  3.6421E-04  3.6156E-04  8.8053E-04  8.8053E-04  8.7405E-04
2.2007E+00  2.2007E+00  2.0429E+00  1.3752E+01  1.3752E+01  1.3650E+01
7.1038E-05  7.1038E-05  6.4287E-05  1.6478E-04  1.6478E-04  1.4912E-04
1.5402E+00  1.5402E+00  1.4417E+00  1.0048E+01  1.0048E+01  1.0026E+01
0.0 0.0 0.0 0.0 0.0 0.0
4.5741E-01  4.4137E-01  4.2924E-01  7.7336E+00  7.5417E+00  7.4448E+00
3.9438E-01  3.7898E-01  3.6631E-01  1.1083E+00  1.0619E+00  1.0265E+00
2.5919E-01  2.5546E-01  2.5650E-01  1.1232E+01  1.1121E+01  1.1111E+01
3.9190E-04  3.8230E-04  3.5338E-04  9.4804E-04  9.2467E-04  8.5420E-04
2.4435E+00  2.1849E+00  2.0243E+00  1.3937E+01  1.3755E+01  1.3610E+01
7.1904E-05  8.0678E-05  8.4281E-05  1.6679E-04  1.8714E-04  1.9550E-04
1.6226E+00  1.4727E+00  1.3826E+00  9.7442E+00  9.7861E+00  9.6952E+00
0.0 0.0 0.0 0.0 0.0 0.0
4.6132E-01  4.3980E-01  4.3980E-01  7.7276E+00  7.5167E+00  7.5167E+00
3.9937E-01  3.7786E-01  3.7786E-01  1.1264E+00  1.0624E+00  1.0624E+00
2.5804E-01  2.5587E-01  2.5587E-01  1.1227E+01  1.1107E+01  1.1107E+01
3.8919E-04  3.7804E-04  3.7804E-04  9.4150E-04  9.1430E-04  9.1430E-04
2.5786E+00  2.2399E+00  2.2399E+00  1.4218E+01  1.3899E+01  1.3899E+01
6.6635E-05  7.4795E-05  7.4795E-05  1.5457E-04  1.7349E-04  1.7349E-04
1.7060E+00  1.5677E+00  1.5677E+00  9.9730E+00  1.0008E+01  1.0008E+01
0.0 0.0 0.0 0.0 0.0 0.0
1.8937E+00  1.8937E+00  1.8937E+00  7.4979E+00  7.4979E+00  7.4917E+00
1.8819E+00  1.8819E+00  1.8812E+00  6.0518E+00  6.0518E+00  6.0186E+00
1.9902E+00  1.9902E+00  1.9930E+00  1.0776E+01  1.0776E+01  1.0772E+01
1.6376E+00  1.6376E+00  1.6400E+00  4.7653E+00  4.7653E+00  4.7726E+00
4.3234E+01  4.3234E+01  4.2899E+01  5.5808E+01  5.5808E+01  5.5676E+01
2.5720E+01  2.5720E+01  2.5042E+01  7.3902E+01  7.3902E+01  7.1953E+01
1.1159E+03  1.1159E+03  1.1786E+03  1.1242E+03  1.1242E+03  1.1871E+03
7.2799E+02  7.2799E+02  7.5808E+02  2.0917E+03  2.0917E+03  2.1782E+03
1.9560E+00  1.9066E+00  1.8795E+00  7.7389E+00  7.5451E+00  7.4442E+00
1.9442E+00  1.8948E+00  1.8675E+00  6.2608E+00  6.0892E+00  5.9933E+00
2.0179E+00  2.0010E+00  1.9938E+00  1.0872E+01  1.0800E+01  1.0817E+01
1.6643E+00  1.6487E+00  1.6378E+00  4.8450E+00  4.7991E+00  4.7646E+00
4.3904E+01  4.3308E+01  4.0547E+01  5.6136E+01  5.5864E+01  5.3186E+01
2.5900E+01  2.5456E+01  2.3376E+01  7.4420E+01  7.3143E+01  6.7168E+01
9.4437E+02  1.0094E+03  1.0178E+03  9.5203E+02  1.0176E+03  1.0263E+03
6.3400E+02  6.6220E+02  6.6176E+02  1.8217E+03  1.9027E+03  1.9014E+03
1.9514E+00  1.8967E+00  1.8967E+00  7.7331E+00  7.5189E+00  7.5189E+00
1.9397E+00  1.8849E+00  1.8849E+00  6.2598E+00  6.0665E+00  6.0665E+00
2.0305E+00  1.9972E+00  1.9972E+00  1.0930E+01  1.0796E+01  1.0796E+01
1.6710E+00  1.6455E+00  1.6455E+00  4.8639E+00  4.7892E+00  4.7892E+00
```

4.3362E+01	4.2546E+01	4.2546E+01	5.5710E+01	5.5137E+01	5.5137E+01
2.5537E+01	2.4897E+01	2.4897E+01	7.3377E+01	7.1537E+01	7.1537E+01
9.5274E+02	9.9603E+02	9.9603E+02	9.6049E+02	1.0042E+03	1.0042E+03
6.4393E+02	6.6005E+02	6.6005E+02	1.8502E+03	1.8965E+03	1.8965E+03
1.6896E+00	1.6896E+00	1.6892E+00	7.3577E+00	7.3577E+00	7.3594E+00
1.6287E+00	1.6287E+00	1.6258E+00	5.2434E+00	5.2434E+00	5.2075E+00
6.5646E-01	6.5646E-01	6.5585E-01	1.1041E+01	1.1041E+01	1.1027E+01
2.6071E-01	2.6071E-01	2.6075E-01	7.6863E-01	7.6863E-01	7.6869E-01
7.5922E+02	7.5922E+02	6.8615E+02	8.3985E+02	8.3985E+02	7.6109E+02
3.1932E-01	3.1932E-01	3.0942E-01	9.1640E-01	9.1640E-01	8.8799E-01
1.9953E+02	1.9953E+02	1.9482E+02	2.0232E+02	2.0232E+02	1.9752E+02
3.9517E-02	3.9517E-02	3.8537E-02	1.1341E-01	1.1341E-01	1.1059E-01
1.7466E+00	1.7015E+00	1.6748E+00	7.5908E+00	7.4021E+00	7.3071E+00
1.6848E+00	1.6403E+00	1.6132E+00	5.4308E+00	5.2774E+00	5.1832E+00
6.7303E-01	6.6691E-01	6.5121E-01	1.1138E+01	1.1096E+01	1.1105E+01
2.7465E-01	2.6946E-01	2.5475E-01	8.1009E-01	7.9469E-01	7.5091E-01
4.3097E+02	3.5819E+02	2.7262E+02	4.8499E+02	4.0620E+02	3.1482E+02
2.5044E-01	2.3093E-01	2.3096E-01	7.1873E-01	6.6275E-01	6.6284E-01
2.0068E+02	1.9583E+02	1.9316E+02	2.0349E+02	1.9849E+02	1.9570E+02
3.9812E-02	3.8766E-02	3.8196E-02	1.1425E-01	1.1125E-01	1.0962E-01
1.7379E+00	1.6917E+00	1.6917E+00	7.5805E+00	7.3752E+00	7.3752E+00
1.6769E+00	1.6310E+00	1.6310E+00	5.4169E+00	5.2552E+00	5.2552E+00
6.7290E-01	6.6373E-01	6.6373E-01	1.1174E+01	1.1076E+01	1.1076E+01
2.7238E-01	2.6636E-01	2.6636E-01	8.0334E-01	7.8544E-01	7.8544E-01
3.3824E+02	2.4152E+02	2.4152E+02	3.8454E+02	2.8070E+02	2.8070E+02
2.2591E-01	2.2165E-01	2.2165E-01	6.4835E-01	6.3612E-01	6.3612E-01
2.0815E+02	2.0272E+02	2.0272E+02	2.1105E+02	2.0550E+02	2.0550E+02
4.1308E-02	4.0165E-02	4.0165E-02	1.1855E-01	1.1527E-01	1.1527E-01
1.7797E+00	1.7797E+00	1.7829E+00	7.7812E+00	7.7812E+00	7.8023E+00
1.6874E+00	1.6874E+00	1.6886E+00	5.5206E+00	5.5206E+00	5.4973E+00
2.4934E+00	2.4934E+00	2.4848E+00	1.2129E+01	1.2129E+01	1.2115E+01
2.1312E+00	2.1312E+00	2.1251E+00	6.3110E+00	6.3110E+00	6.2937E+00
6.0286E+01	6.0286E+01	5.8678E+01	7.2472E+01	7.2472E+01	7.0953E+01
4.8972E+01	4.8972E+01	4.7492E+01	1.4360E+02	1.4360E+02	1.3926E+02
9.9121E+02	9.9121E+02	9.7573E+02	1.0017E+03	1.0017E+03	9.8637E+02
7.3304E+02	7.3304E+02	7.1986E+02	2.1495E+03	2.1495E+03	2.1108E+03
1.8377E+00	1.7918E+00	1.7670E+00	8.0170E+00	7.8251E+00	7.7385E+00
1.7431E+00	1.6988E+00	1.6746E+00	5.7104E+00	5.5543E+00	5.4682E+00
2.5087E+00	2.4907E+00	2.5028E+00	1.2236E+01	1.2152E+01	1.2167E+01
2.1468E+00	2.1311E+00	2.1381E+00	6.3597E+00	6.3123E+00	6.3303E+00
6.4828E+01	5.9782E+01	5.7012E+01	7.6770E+01	7.1889E+01	6.9264E+01
5.2381E+01	4.8335E+01	1.6212E+01	1.5360E+02	1.4173E+02	1.3551E+02
9.5904E+02	9.1532E+02	8.6948E+02	9.6894E+02	9.2559E+02	8.7984E+02
7.1217E+02	6.7803E+02	6.4289E+02	2.0883E+03	1.9882E+03	1.8851E+03
1.8314E+00	1.7822E+00	1.7822E+00	8.0060E+00	7.8005E+00	7.8005E+00
1.7379E+00	1.6901E+00	1.6901E+00	5.7055E+00	5.5339E+00	5.5339E+00
2.5267E+00	2.4941E+00	2.4941E+00	1.2293E+01	1.2153E+01	1.2153E+01
2.1611E+00	2.1335E+00	2.1335E+00	6.4012E+00	6.3190E+00	6.3190E+00
6.3717E+01	6.0672E+01	6.0672E+01	7.5704E+01	7.2849E+01	7.2849E+01
5.1755E+01	4.9341E+01	4.9341E+01	1.5176E+02	1.4469E+02	1.4469E+02
9.9260E+02	9.5078E+02	9.5078E+02	1.0027E+03	9.6115E+02	9.6115E+02
7.3699E+02	7.0517E+02	7.0517E+02	2.1611E+03	2.0678E+03	2.0678E+03
1.5543E+00	1.5543E+00	1.5451E+00	7.3172E+00	7.3172E+00	7.3250E+00
1.5154E+00	1.5154E+00	1.5048E+00	4.7999E+00	4.7999E+00	4.7421E+00
4.1973E-01	4.1973E-01	4.1824E-01	1.1336E+01	1.1336E+01	1.1322E+01

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1.6770E-01  1.6670E-01  1.6738E-01  4.8449E-01  4.8449E-01  4.8354E-01
9.3420E+01  9.3420E+01  8.7036E+01  1.2479E+02  1.2479E+02  1.1940E+02
0.0 0.0 0.0 0.0 0.0 0.0
1.1034E+01  1.1034E+01  1.0432E+01  1.8896E+01  1.8896E+01  1.8348E+01
0.0 0.0 0.0 0.0 0.0 0.0
1.6088E+00  1.5629E+00  1.5385E+00  7.5472E+00  7.3618E+00  7.2705E+00
1.5693E+00  1.5239E+00  1.4992E+00  4.9774E+00  4.8237E+00  4.7403E+00
4.3097E-01  4.2555E-01  4.1559E-01  1.1440E+01  1.1370E+01  1.1362E+01
1.7786E-01  1.7412E-01  1.6347E-01  5.1407E-01  5.0321E-01  4.7219E-01
1.0553E+02  9.7141E+01  9.7910E+01  1.3735E+02  1.3079E+02  1.3155E+02
0.0 0.0 0.0 0.0 0.0 0.0
1.1494E+01  1.0597E+01  1.0053E+01  1.9019E+01  1.8268E+01  1.7702E+01
0.0 0.0 0.0 0.0 0.0 0.0
1.6093E+00  1.5605E+00  1.5605E+00  7.5381E+00  7.3376E+00  7.3376E+00
1.5702E+00  1.5218E+00  1.5218E+00  4.9935E+00  4.8262E+00  4.8262E+00
4.3082E-01  4.2226E-01  4.2226E-01  1.1486E+01  1.1343E+01  1.1343E+01
1.7638E-01  1.7184E-01  1.7184E-01  5.0975E-01  4.9658E-01  4.9658E-01
8.1541E+01  7.4683E+01  7.4683E+01  1.1069E+02  1.0614E+02  1.0614E+02
0.0 0.0 0.0 0.0 0.0 0.0
1.2046E+01  1.1211E+01  1.1211E+01  1.9711E+01  1.9011E+01  1.9011E+01
0.0 0.0 0.0 0.0 0.0 0.0
9.1378E-03  9.1378E-03  9.2033E-03  5.1456E+00  5.1456E+00  5.1566E+00
0.0 0.0 0.0 0.0 0.0 0.0
2.2664E-02  2.2664E-02  2.1807E-02  9.2329E+00  9.2329E+00  9.1246E+00
0.0 0.0 0.0 0.0 0.0 0.0
8.7996E-02  8.7996E-02  8.6898E-02  6.9588E+00  6.9588E+00  6.9359E+00
0.0 0.0 0.0 0.0 0.0 0.0
1.2572E-01  1.2572E-01  1.1825E-01  6.3271E+00  6.3271E+00  6.4346E+00
0.0 0.0 0.0 0.0 0.0 0.0
9.1467E-03  9.0847E-03  9.1301E-03  5.1450E+00  5.0995E+00  5.1447E+00
0.0 0.0 0.0 0.0 0.0 0.0
2.1140E-02  2.2106E-02  2.1231E-02  9.2343E+00  9.1711E+00  9.1320E+00
0.0 0.0 0.0 0.0 0.0 0.0
8.6442E-02  7.6571E-02  8.2146E-02  6.9278E+00  6.8649E+00  6.9448E+00
0.0 0.0 0.0 0.0 0.0 0.0
1.3619E-01  1.2356E-01  1.1737E-01  6.2740E+00  6.3473E+00  6.5133E+00
0.0 0.0 0.0 0.0 0.0 0.0
9.0604E-03  9.0631E-03  9.0631E-03  5.1341E+00  5.1236E+00  5.1236E+00
0.0 0.0 0.0 0.0 0.0 0.0
2.1498E-02  2.2072E-02  2.2072E-02  9.2043E+00  9.2162E+00  9.2162E+00
0.0 0.0 0.0 0.0 0.0 0.0
8.4807E-02  7.7276E-02  7.7276E-02  6.9420E+00  6.9083E+00  6.9083E+00
0.0 0.0 0.0 0.0 0.0 0.0
1.4156E-01  1.2715E-01  1.2715E-01  6.3107E+00  6.3084E+00  6.3084E+00
0.0 0.0 0.0 0.0 0.0 0.0
3.2000E-05  3.2000E-05  3.1590E-05  2.9715E+00  2.9715E+00  3.0184E+00
0.0 0.0 0.0 0.0 0.0 0.0
1.4910E-04  1.4910E-04  1.4656E-04  1.1195E+01  1.1195E+01  1.1063E+01
0.0 0.0 0.0 0.0 0.0 0.0
1.2548E-02  1.2548E-02  1.1763E-02  2.0730E+01  2.0730E+01  2.0801E+01
0.0 0.0 0.0 0.0 0.0 0.0
2.1373E-01  2.1373E-01  1.9702E-01  3.9716E+01  3.9716E+01  3.7903E+01
0.0 0.0 0.0 0.0 0.0 0.0
3.1757E-05  3.1855E-05  3.2057E-05  2.9169E+00  2.9570E+00  3.0085E+00
0.0 0.0 0.0 0.0 0.0 0.0
```

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1.4727E-04  1.4718E-04  1.4853E-04  1.1054E+01  1.1067E+01  1.1200E+01
0.0 0.0 0.0 0.0 0.0 0.0
1.3070E-02  1.2184E-02  1.1070E-02  2.0806E+01  2.0840E+01  2.0826E+01
0.0 0.0 0.0 0.0 0.0 0.0
2.3602E-01  2.1094E-01  1.9831E-01  4.2178E+01  3.9687E+01  3.8533E+01
0.0 0.0 0.0 0.0 0.0 0.0
3.1886E-05  3.2059E-05  3.2059E-05  2.9004E+00  2.9445E+00  2.9445E+00
0.0 0.0 0.0 0.0 0.0 0.0
1.4775E-04  1.4765E-04  1.4765E-04  1.1075E+01  1.1081E+01  1.1081E+01
0.0 0.0 0.0 0.0 0.0 0.0
1.3034E-02  1.1983E-02  1.1983E-02  2.0803E+01  2.0791E+01  2.0791E+01
0.0 0.0 0.0 0.0 0.0 0.0
2.4123E-01  2.1824E-01  2.1824E-01  4.2605E+01  4.0328E+01  4.0328E+01
0.0 0.0 0.0 0.0 0.0 0.0
1.0661E-02  1.0661E-02  8.9105E-03  2.3858E+00  2.3858E+00  2.4153E+00
0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 3.8904E+00  3.8904E+00  3.8928E+00
0.0 0.0 0.0 0.0 0.0 0.0
5.9452E-06  5.9452E-06  5.4779E-06  3.7265E+00  3.7265E+00  3.7270E+00
0.0 0.0 0.0 0.0 0.0 0.0
1.0551E-04  1.0551E-04  9.7041E-05  3.7510E+00  3.7510E+00  3.7388E+00
0.0 0.0 0.0 0.0 0.0 0.0
1.0524E-02  1.0501E-02  9.8578E-03  2.3711E+00  2.3579E+00  2.3918E+00
0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 3.9394E+00  3.9166E+00  3.8647E+00
0.0 0.0 0.0 0.0 0.0 0.0
6.1488E-06  5.6356E-06  5.0648E-06  3.7167E+00  3.7199E+00  3.7185E+00
0.0 0.0 0.0 0.0 0.0 0.0
1.1645E-04  1.0212E-04  9.4419E-05  3.7416E+00  3.7225E+00  3.6938E+00
0.0 0.0 0.0 0.0 0.0 0.0
1.1568E-02  1.0002E-02  1.0002E-02  2.3341E+00  2.3602E+00  2.3602E+00
0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 3.9347E+00  3.9001E+00  3.9001E+00
0.0 0.0 0.0 0.0 0.0 0.0
6.0622E-06  5.4675E-06  5.4675E-06  3.7168E+00  3.7220E+00  3.7220E+00
0.0 0.0 0.0 0.0 0.0 0.0
1.2059E-04  1.0771E-04  1.0771E-04  3.7593E+00  3.7502E+00  3.7502E+00
0.0 0.0 0.0 0.0 0.0 0.0
0.65089E-01 0.65089E-01 0.67771E-01 0.69037E-01 0.69037E-01 0.71860E-01
0.63215E-01 0.63215E-01 0.65765E-01 0.67895E-01 0.67895E-01 0.70566E-01
0.56375E+00 0.56375E+00 0.55780E+00 0.58377E+00 0.58377E+00 0.57731E+00
0.54854E+00 0.54854E+00 0.54245E+00 0.56369E+00 0.56369E+00 0.55734E+00
0.12489E+03 0.12489E+03 0.11633E+03 0.12777E+03 0.12777E+03 0.11842E+03
0.12339E+03 0.12339E+03 0.11452E+03 0.12932E+03 0.12932E+03 0.11849E+03
0.56297E+03 0.56297E+03 0.48876E+03 0.0 0.0 0.0
0.12654E+04 0.12654E+04 0.10968E+04 0.19584E+04 0.19584E+04 0.16975E+04
0.63978E-01 0.64991E-01 0.66202E-01 0.67875E-01 0.68941E-01 0.70208E-01
0.62182E-01 0.63143E-01 0.64265E-01 0.66857E-01 0.67860E-01 0.68976E-01
0.55701E+00 0.55703E+00 0.56607E+00 0.57838E+00 0.57746E+00 0.58480E+00
0.54336E+00 0.54254E+00 0.54958E+00 0.55847E+00 0.55752E+00 0.56464E+00
0.13672E+03 0.12103E+03 0.11081E+03 0.13832E+03 0.12295E+03 0.11185E+03
0.13385E+03 0.11910E+03 0.10864E+03 0.14149E+03 0.12468E+03 0.11403E+03
0.66787E+03 0.54291E+03 0.48021E+03 0.0 0.0 0.0
0.14960E+04 0.12184E+04 0.10733E+04 0.23121E+04 0.18844E+04 0.16581E+04
0.63057E-01 0.64403E-01 0.64403E-01 0.66900E-01 0.68315E-01 0.68315E-01
```

0.61284E-01 0.62563E-01 0.62563E-01 0.65875E-01 0.67216E-01 0.67216E-01
0.55910E+00 0.55900E+00 0.55900E+00 0.58026E+00 0.57925E+00 0.57925E+00
0.54513E+00 0.54423E+00 0.54423E+00 0.56027E+00 0.55926E+00 0.55926E+00
0.13493E+03 0.12325E+03 0.12325E+03 0.13555E+03 0.12400E+03 0.12400E+03
0.13126E+03 0.12045E+03 0.12045E+03 0.13861E+03 0.12811E+03 0.12811E+03
0.70361E+03 0.58497E+03 0.58497E+03 0.0 0.0 0.0
0.15728E+04 0.13119E+04 0.13119E+04 0.24294E+04 0.20285E+04 0.20285E+04
0.46315E-01 0.46315E-01 0.47994E-01 0.45881E-01 0.45881E-01 0.47755E-01
0.46105E-01 0.46105E-01 0.47814E-01 0.46834E-01 0.46834E-01 0.48570E-01
0.23352E+00 0.23352E+00 0.23086E+00 0.28702E+00 0.28702E+00 0.28371E+00
0.29182E+00 0.29182E+00 0.28845E+00 0.29275E+00 0.29275E+00 0.28938E+00
0.21452E+02 0.21452E+02 0.19845E+02 0.22232E+02 0.22232E+02 0.20467E+02
0.22664E+02 0.22664E+02 0.20793E+02 0.23008E+02 0.23008E+02 0.21073E+02
0.52681E+02 0.52681E+02 0.48397E+02 0.0 0.0 0.0
0.47281E+02 0.47281E+02 0.43450E+02 0.49204E+02 0.49204E+02 0.45216E+02
0.45723E-01 0.46349E-01 0.46965E-01 0.45285E-01 0.45909E-01 0.46531E-01
0.45497E-01 0.46132E-01 0.46769E-01 0.46227E-01 0.46871E-01 0.47505E-01
0.23149E+00 0.23098E+00 0.23367E+00 0.28442E+00 0.28389E+00 0.28732E+00
0.28919E+00 0.28864E+00 0.29212E+00 0.29012E+00 0.28957E+00 0.29305E+00
0.23571E+02 0.20951E+02 0.20068E+02 0.24552E+02 0.21703E+02 0.20734E+02
0.25092E+02 0.22091E+02 0.21058E+02 0.25504E+02 0.22409E+02 0.21329E+02
0.58470E+02 0.51264E+02 0.47450E+02 0.0 0.0 0.0
0.52459E+02 0.46015E+02 0.42606E+02 0.54595E+02 0.47886E+02 0.44336E+02
0.45036E-01 0.45883E-01 0.45883E-01 0.44606E-01 0.45451E-01 0.45451E-01
0.44806E-01 0.45668E-01 0.45668E-01 0.45516E-01 0.46391E-01 0.46391E-01
0.23216E+00 0.23173E+00 0.23173E+00 0.28530E+00 0.28479E+00 0.28479E+00
0.29008E+00 0.28956E+00 0.28956E+00 0.29101E+00 0.29048E+00 0.29048E+00
0.23251E+02 0.22147E+02 0.22147E+02 0.24206E+02 0.23017E+02 0.23017E+02
0.24734E+02 0.23474E+02 0.23474E+02 0.25133E+02 0.23820E+02 0.23820E+02
0.60410E+02 0.53720E+02 0.53720E+02 0.0 0.0 0.0
0.54195E+02 0.48212E+02 0.48212E+02 0.56402E+02 0.50173E+02 0.50173E+02
0.20375E-01 0.20375E-01 0.21341E-01 0.24269E-01 0.24269E-01 0.25189E-01
0.25841E-01 0.25841E-01 0.26748E-01 0.28397E-01 0.28397E-01 0.29352E-01
0.28337E+00 0.28337E+00 0.28030E+00 0.10511E+00 0.10511E+00 0.10516E+00
0.12015E+00 0.12015E+00 0.11984E+00 0.13133E+00 0.13133E+00 0.13105E+00
0.22023E+01 0.22023E+01 0.21566E+01 0.27873E+01 0.27873E+01 0.27155E+01
0.30087E+01 0.30087E+01 0.29397E+01 0.34503E+01 0.34503E+01 0.33557E+01
0.22291E+01 0.22291E+01 0.20499E+01 0.0 0.0 0.0
0.25650E+01 0.25650E+01 0.23608E+01 0.26533E+01 0.26533E+01 0.24426E+01
0.20226E-01 0.20429E-01 0.20728E-01 0.24088E-01 0.24328E-01 0.24645E-01
0.25645E-01 0.25897E-01 0.26206E-01 0.28181E-01 0.28457E-01 0.28801E-01
0.28074E+00 0.28032E+00 0.28395E+00 0.10425E+00 0.10409E+00 0.10637E+00
0.11911E+00 0.11893E+00 0.12127E+00 0.13017E+00 0.12998E+00 0.13263E+00
0.22837E+01 0.22476E+01 0.21919E+01 0.28886E+01 0.28395E+01 0.27610E+01
0.31184E+01 0.30539E+01 0.29934E+01 0.35667E+01 0.34921E+01 0.34263E+01
0.24733E+01 0.21696E+01 0.20104E+01 0.0 0.0 0.0
0.28428E+01 0.24975E+01 0.23162E+01 0.29401E+01 0.25836E+01 0.23967E+01
0.19961E-01 0.20242E-01 0.20242E-01 0.23777E-01 0.24109E-01 0.24109E-01
0.25320E-01 0.25671E-01 0.25671E-01 0.27825E-01 0.28210E-01 0.28210E-01
0.28159E+00 0.28115E+00 0.28115E+00 0.10453E+00 0.10437E+00 0.10437E+00
0.11944E+00 0.11928E+00 0.11928E+00 0.13054E+00 0.13037E+00 0.13037E+00
0.23221E+01 0.22527E+01 0.22527E+01 0.29461E+01 0.28555E+01 0.28555E+01
0.31806E+01 0.30887E+01 0.30887E+01 0.36503E+01 0.35467E+01 0.35467E+01
0.25551E+01 0.22731E+01 0.22731E+01 0.0 0.0 0.0
0.29359E+01 0.26152E+01 0.26152E+01 0.30363E+01 0.27052E+01 0.27052E+01

```
0.57734E-03 0.57734E-03 0.55987E-03 0.53119E-01 0.53119E-01 0.55490E-01
0.0 0.0 0.0 0.0 0.0 0.0
0.32381E-02 0.32381E-02 0.32022E-02 0.94622E+00 0.94622E+00 0.93569E+00
0.0 0.0 0.0 0.0 0.0 0.0
0.39815E+03 0.39815E+03 0.35932E+03 0.28456E+03 0.28456E+03 0.27477E+03
0.0 0.0 0.0 0.0 0.0 0.0
0.17754E+07 0.17754E+07 0.15785E+07 0.46639E+05 0.46639E+05 0.42972E+05
0.0 0.0 0.0 0.0 0.0 0.0
0.57851E-03 0.57188E-03 0.57174E-03 0.51840E-01 0.52765E-01 0.54213E-01
0.0 0.0 0.0 0.0 0.0 0.0
0.32163E-02 0.32060E-02 0.32382E-02 0.93355E+00 0.93445E+00 0.94953E+00
0.0 0.0 0.0 0.0 0.0 0.0
0.38426E+03 0.34994E+03 0.28989E+03 0.28977E+03 0.26647E+03 0.22207E+03
0.0 0.0 0.0 0.0 0.0 0.0
0.20118E+07 0.17016E+07 0.15261E+07 0.50721E+05 0.44606E+05 0.41102E+05
0.0 0.0 0.0 0.0 0.0 0.0
0.59011E-03 0.58169E-03 0.58169E-03 0.51273E-01 0.52469E-01 0.52469E-01
0.0 0.0 0.0 0.0 0.0 0.0
0.32234E-02 0.32137E-02 0.32137E-02 0.93724E+00 0.93756E+00 0.93756E+00
0.0 0.0 0.0 0.0 0.0 0.0
0.38957E+03 0.32151E+03 0.32151E+03 0.28498E+03 0.24553E+03 0.24553E+03
0.0 0.0 0.0 0.0 0.0 0.0
0.20815E+07 0.18170E+07 0.18170E+07 0.51710E+05 0.47175E+05 0.47175E+05
0.0 0.0 0.0 0.0 0.0 0.0
1.0929E+01  1.0929E+01  1.1444E+01  0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0
1.7667E+01  1.7667E+01  2.0944E+01  0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0
1.3096E+01  1.3096E+01  1.4202E+01  0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0
5.8533E+00  5.8533E+00  4.4265E+00  0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0
1.0635E+01  1.1381E+01  1.1544E+01  0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0
1.4295E+01  1.7643E+01  2.0943E+01  0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0
1.1433E+01  1.2908E+01  1.4048E+01  0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0
6.4642E+00  3.7196E+00  2.5717E+00  0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0
1.1042E+01  1.1193E+01  1.1193E+01  0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0
1.4118E+01  1.7684E+01  1.7684E+01  0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0
1.1560E+01  1.3170E+01  1.3170E+01  0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0
7.1722E+00  4.1438E+00  4.1438E+00  0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0
C*************** END OF DATA TABLES *****************
2 1 3 0 1.0E-4
107.480 44.520 40.0
2.775E9 0.7 365.0 700.0 0.1
0.75 0.25 0.0 0.0
0.020 0.980 0.0 0.0 0.0 0.0
0.021 0.979 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0
  0.079 0.079 0.0
0.324 0.379
```

APPENDIX B

CROSS SECTION DATA TABLES

U-235

TIME HOURS	GROUP	XSECT	FUEL TO WATER RATIO 0.50	0.90	1.30
0.0					
	1	SIGA		0.13288E 01	0.13313E 01
		SIGT		0.73531E 01	0.73437E 01
		SIGF		0.12635E 01	0.12635E 01
		NU-SIGF		0.34429E 01	0.34223E 01
	2	SIGA		0.21246E 01	0.21158E 01
		SIGT		0.11070E 02	0.11047E 02
		SIGF		0.16564E 01	0.16514E 01
		NU-SIGF		0.40486E 01	0.40366E 01
	3	SIGA		0.36079E 02	0.34715E 02
		SIGT		0.48093E 02	0.46747E 02
		SIGF		0.24193E 02	0.23369E 02
		NU-SIGF		0.58518E 02	0.56526E 02
	4	SIGA		0.36141E 03	0.33438E 03
		SIGT		0.37568E 03	0.34871E 03
		SIGF		0.30757E 03	0.28412E 03
		NU-SIGF		0.74394E 03	0.68724E 03
9800.0					
	1	SIGA	0.13709E 01	0.13367E 01	0.13197E 01
		SIGT	0.75903E 01	0.73990E 01	0.72991E 01
		SIGF	0.13046E 01	0.12712E 01	0.12538E 01
		NU-SIGF	0.35604E 01	0.34609E 01	0.34082E 01
	2	SIGA	0.21310E 01	0.21219E 01	0.21255E 01
		SIGT	0.11144E 02	0.11079E 02	0.11100E 02
		SIGF	0.16642E 01	0.16566E 01	0.16561E 01
		NU-SIGF	0.40694E 01	0.40502E 01	0.40472E 01
	3	SIGA	0.36902E 02	0.36079E 02	0.48705E 02
		SIGT	0.48035E 02	0.48035E 02	0.46786E 02
		SIGF	0.24481E 02	0.23965E 02	0.23090E 02
		NU-SIGF	0.59216E 02	0.57966E 02	0.55851E 02
	4	SIGA	0.38484E 03	0.34240E 03	0.31741E 03
		SIGT	0.39855E 03	0.35632E 03	0.33125E 03
		SIGF	0.32827E 03	0.29172E 03	0.27034E 03
		NU-SIGF	0.79403E 03	0.70561E 03	0.65390E 03
30800.0					
	1	SIGA	0.13668E 01	0.13300E 01	
		SIGT	0.75860E 01	0.73737E 01	
		SIGF	0.13013E 01	0.12648E 01	
		NU-SIGF	0.35603E 01	0.34495E 01	
	2	SIGA	0.21500E 01	0.21237E 01	
		SIGT	0.11202E 02	0.11082E 02	
		SIGF	0.16770E 01	0.16570E 01	
		NU-SIGF	0.41000E 01	0.40508E 01	
	3	SIGA	0.36987E 02	0.36393E 02	
		SIGT	0.48792E 02	0.48348E 02	
		SIGF	0.24423E 02	0.24033E 02	
		NU-SIGF	0.59074E 02	0.58132E 02	
	4	SIGA	0.40670E 03	0.36717E 03	
		SIGT	0.42068E 03	0.38134E 03	
		SIGF	0.34704E 03	0.31301E 03	
		NU-SIGF	0.83942E 03	0.75711E 03	

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TIME HOURS	GROUP	XSECT	FUEL TO WATER RATIO 0.50	0.90	1.30
0.0					
	1	SIGA		0.43778E 00	0.42483E 00
		SIGT		0.74957E 01	0.74947E 01
		SIGF		0.37557E 00	0.35980E 00
		NU-SIGF		0.10547E 01	0.10037E 01
	2	SIGA		0.25606E 00	0.25422E 00
		SIGT		0.11082E 02	0.11062E 02
		SIGF		0.36421E-03	0.36156E-03
		NU-SIGF		0.88053E-03	0.87405E-03
	3	SIGA		0.22007E 01	0.20429E 01
		SIGT		0.13752E 02	0.13650E 02
		SIGF		0.71038E-04	0.64287E-04
		NU-SIGF		0.16478E-03	0.14912E-03
	4	SIGA		0.15402E 01	0.14417E 01
		SIGT		0.10048E 02	0.10026E 02
		SIGF		0.00000E 00	0.00000E 00
		NU-SIGF		0.00000E 00	0.00000E 00
9800.0					
	1	SIGA	0.45741E 00	0.44137E 00	0.42924E 00
		SIGT	0.77336E 01	0.75417E 01	0.74448E 01
		SIGF	0.39438E 00	0.37898E 00	0.36631E 00
		NU-SIGF	0.11083E 01	0.10619E 01	0.10265E 01
	2	SIGA	0.25919E 00	0.25546E 00	0.25650E 00
		SIGT	0.11232E 02	0.11121E 02	0.11111E 02
		SIGF	0.39190E-03	0.38230E-03	0.35338E-03
		NU-SIGF	0.94804E-03	0.92467E-03	0.85420E-03
	3	SIGA	0.24435E 01	0.21849E 01	0.20243E 01
		SIGT	0.13937E 02	0.13755E 02	0.13610E 02
		SIGF	0.71904E-04	0.80678E-04	0.84281E-04
		NU-SIGF	0.16679E-03	0.18714E-03	0.19550E-03
	4	SIGA	0.16226E 01	0.14727E 01	0.13826E 01
		SIGT	0.97442E 01	0.97861E 01	0.96952E 01
		SIGF	0.00000E 00	0.00000E 00	0.00000E 00
		NU-SIGF	0.00000E 00	0.00000E 00	0.00000E 00
30800.0					
	1	SIGA	0.46132E 00	0.43980E 00	
		SIGT	0.77276E 01	0.75167E 01	
		SIGF	0.39937E 00	0.37786E 00	
		NU-SIGF	0.11264E 01	0.10624E 01	
	2	SIGA	0.25804E 00	0.25587E 00	
		SIGT	0.11227E 02	0.11107E 02	
		SIGF	0.38919E-03	0.37804E-03	
		NU-SIGF	0.94150E-03	0.91430E-03	
	3	SIGA	0.25786E 01	0.22399E 01	
		SIGT	0.14218E 02	0.13899E 02	
		SIGF	0.66635E-04	0.74795E-04	
		NU-SIGF	0.15457E-03	0.17349E-03	
	4	SIGA	0.17060E 01	0.15677E 01	
		SIGT	0.99730E 01	0.10008E 02	
		SIGF	0.00000E 00	0.00000E 00	
		NU-SIGF	0.00000E 00	0.00000E 00	

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TIME HOURS	GROUP	XSECT	FUEL TO WATER RATIO 0.50	0.90	1.30
0.0					
	1	SIGA		0.18937E 01	0.18937E 01
		SIGT		0.74979E 01	0.74917E 01
		SIGF		0.18819E 01	0.18812E 01
		NU-SIGF		0.60518E 01	0.60186E 01
	2	SIGA		0.19902E 01	0.19930E 01
		SIGT		0.10776E 02	0.10772E 02
		SIGF		0.16376E 01	0.16400E 01
		NU-SIGF		0.47653E 01	0.47726E 01
	3	SIGA		0.43234E 02	0.42899E 02
		SIGT		0.55808E 02	0.55676E 02
		SIGF		0.25720E 02	0.25042E 02
		NU-SIGF		0.73902E 02	0.71953E 02
	4	SIGA		0.11159E 04	0.11786E 04
		SIGT		0.11242E 04	0.11871E 04
		SIGF		0.72799E 03	0.75808E 03
		NU-SIGF		0.20917E 04	0.21782E 04
9800.0					
	1	SIGA	0.19560E 01	0.19066E 01	0.18795E 01
		SIGT	0.77389E 01	0.75451E 01	0.74442E 01
		SIGF	0.19442E 01	0.18948E 01	0.18675E 01
		NU-SIGF	0.62608E 01	0.60892E 01	0.59933E 01
	2	SIGA	0.20179E 01	0.20010E 01	0.19938E 01
		SIGT	0.10872E 02	0.10800E 02	0.10817E 02
		SIGF	0.16643E 01	0.16487E 01	0.16378E 01
		NU-SIGF	0.48450E 01	0.47991E 01	0.47646E 01
	3	SIGA	0.43904E 02	0.43308E 02	0.40547E 02
		SIGT	0.56136E 02	0.55864E 02	0.53186E 02
		SIGF	0.25900E 02	0.25456E 02	0.23376E 02
		NU-SIGF	0.74420E 02	0.73143E 02	0.67168E 02
	4	SIGA	0.94437E 03	0.10094E 04	0.10178E 04
		SIGT	0.95203E 03	0.10176E 04	0.10263E 04
		SIGF	0.63400E 03	0.66220E 03	0.66176E 03
		NU-SIGF	0.18217E 04	0.19027E 04	0.19014E 04
30800.0					
	1	SIGA	0.19514E 01	0.18967E 01	
		SIGT	0.77331E 01	0.75189E 01	
		SIGF	0.19397E 01	0.18849E 01	
		NU-SIGF	0.62598E 01	0.60665E 01	
	2	SIGA	0.20305E 01	0.19972E 01	
		SIGT	0.10930E 02	0.10796E 02	
		SIGF	0.16710E 01	0.16455E 01	
		NU-SIGF	0.48639E 01	0.47892E 01	
	3	SIGA	0.43362E 02	0.42546E 02	
		SIGT	0.55710E 02	0.55137E 02	
		SIGF	0.25537E 02	0.24897E 02	
		NU-SIGF	0.73377E 02	0.71537E 02	
	4	SIGA	0.95274E 03	0.99603E 03	
		SIGT	0.96049E 03	0.10042E 04	
		SIGF	0.64393E 03	0.66005E 03	
		NU-SIGF	0.18502E 04	0.18965E 04	

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TIME HOURS	GROUP	XSECT	FUEL TO WATER RATIO 0.50	0.90	1.30
0.0					
	1	SIGA		0.16896E 01	0.16892E 01
		SIGT		0.73577E 01	0.73594E 01
		SIGF		0.16287E 01	0.16258E 01
		NU-SIGF		0.52434E 01	0.52075E 01
	2	SIGA		0.65646E 00	0.65585E 00
		SIGT		0.11041E 02	0.11027E 02
		SIGF		0.26071E 00	0.26075E 00
		NU-SIGF		0.76863E 00	0.76869E 00
	3	SIGA		0.75922E 03	0.68615E 03
		SIGT		0.83985E 03	0.76109E 03
		SIGF		0.31932E 00	0.30942E 00
		NU-SIGF		0.91640E 00	0.88799E 00
	4	SIGA		0.19953E 03	0.19482E 03
		SIGT		0.20232E 03	0.19752E 03
		SIGF		0.39517E-01	0.38537E-01
		NU-SIGF		0.11341E 00	0.11059E 00
9800.0					
	1	SIGA	0.17466E 01	0.17015E 01	0.16748E 01
		SIGT	0.75908E 01	0.74021E 01	0.73071E 01
		SIGF	0.16848E 01	0.16403E 01	0.16132E 01
		NU-SIGF	0.54308E 01	0.52774E 01	0.51832E 01
	2	SIGA	0.67303E 00	0.66691E 00	0.65121E 00
		SIGT	0.11138E 02	0.11096E 02	0.11105E 02
		SIGF	0.27465E 00	0.26946E 00	0.25475E 00
		NU-SIGF	0.81009E 00	0.79469E 00	0.75091E 00
	3	SIGA	0.43097E 03	0.35819E 03	0.27262E 03
		SIGT	0.48499E 03	0.40620E 03	0.31482E 03
		SIGF	0.25044E 00	0.23093E 00	0.23096E 00
		NU-SIGF	0.71873E 00	0.66275E 00	0.66284E 00
	4	SIGA	0.20068E 03	0.19583E 03	0.19316E 03
		SIGT	0.20349E 03	0.19849E 03	0.19570E 03
		SIGF	0.39812E-01	0.38766E-01	0.38196E-01
		NU-SIGF	0.11425E 00	0.11125E 00	0.10962E 00
30800.0					
	1	SIGA	0.17379E 01	0.16917E 01	
		SIGT	0.75805E 01	0.73752E 01	
		SIGF	0.16769E 01	0.16310E 01	
		NU-SIGF	0.54169E 01	0.52552E 01	
	2	SIGA	0.67290E 00	0.66373E 00	
		SIGT	0.11174E 02	0.11076E 02	
		SIGF	0.27238E 00	0.26636E 00	
		NU-SIGF	0.80334E 00	0.78544E 00	
	3	SIGA	0.33824E 03	0.24152E 03	
		SIGT	0.38454E 03	0.28070E 03	
		SIGF	0.22591E 00	0.22165E 00	
		NU-SIGF	0.64835E 00	0.63612E 00	
	4	SIGA	0.20815E 03	0.20272E 03	
		SIGT	0.21105E 03	0.20550E 03	
		SIGF	0.41308E-01	0.40165E-01	
		NU-SIGF	0.11855E 00	0.11527E 00	

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TIME HOURS	GROUP	XSECT	FUEL TO WATER RATIO 0.50	0.90	1.30
0.0					
	1	SIGA		0.17797E 01	0.17829E 01
		SIGT		0.77812E 01	0.78023E 01
		SIGF		0.16874E 01	0.16886E 01
		NU-SIGF		0.55206E 01	0.54973E 01
	2	SIGA		0.24934E 01	0.24848E 01
		SIGT		0.12129E 02	0.12115E 02
		SIGF		0.21312E 01	0.21251E 01
		NU-SIGF		0.63110E 01	0.62937E 01
	3	SIGA		0.60286E 02	0.58678E 02
		SIGT		0.72472E 02	0.70953E 02
		SIGF		0.48972E 02	0.47492E 02
		NU-SIGF		0.14360E 03	0.13926E 03
	4	SIGA		0.99121E 03	0.97573E 03
		SIGT		0.10017E 04	0.98637E 03
		SIGF		0.73304E 03	0.71986E 03
		NU-SIGF		0.21495E 04	0.21108E 04
9800.0					
	1	SIGA	0.18377E 01	0.17918E 01	0.17670E 01
		SIGT	0.80170E 01	0.78251E 01	0.77385E 01
		SIGF	0.17431E 01	0.16988E 01	0.16746E 01
		NU-SIGF	0.57104E 01	0.55543E 01	0.54682E 01
	2	SIGA	0.25087E 01	0.24907E 01	0.25028E 01
		SIGT	0.12236E 02	0.12152E 02	0.12167E 02
		SIGF	0.21468E 01	0.21311E 01	0.21381E 01
		NU-SIGF	0.63597E 01	0.63123E 01	0.63303E 01
	3	SIGA	0.64828E 02	0.59782E 02	0.57012E 02
		SIGT	0.76770E 02	0.71889E 02	0.69264E 02
		SIGF	0.52381E 02	0.48335E 02	0.16212E 02
		NU-SIGF	0.15360E 03	0.14173E 03	0.13551E 03
	4	SIGA	0.95904E 03	0.91532E 03	0.86948E 03
		SIGT	0.96894E 03	0.92559E 03	0.87984E 03
		SIGF	0.71217E 03	0.67803E 03	0.64289E 03
		NU-SIGF	0.20883E 04	0.19882E 04	0.18851E 04
30800.0					
	1	SIGA	0.18314E 01	0.17822E 01	
		SIGT	0.80060E 01	0.78005E 01	
		SIGF	0.17379E 01	0.16901E 01	
		NU-SIGF	0.57055E 01	0.55339E 01	
	2	SIGA	0.25267E 01	0.24941E 01	
		SIGT	0.12293E 02	0.12153E 02	
		SIGF	0.21611E 01	0.21335E 01	
		NU-SIGF	0.64012E 01	0.63190E 01	
	3	SIGA	0.63717E 02	0.60672E 02	
		SIGT	0.75704E 02	0.72849E 02	
		SIGF	0.51755E 02	0.49341E 02	
		NU-SIGF	0.15176E 03	0.14469E 03	
	4	SIGA	0.99260E 03	0.95078E 03	
		SIGT	0.10027E 04	0.96115E 03	
		SIGF	0.73699E 03	0.70517E 03	
		NU-SIGF	0.21611E 04	0.20678E 04	

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TIME HOURS	GROUP	XSECT	FUEL TO WATER RATIO 0.50	0.90	1.30
0.0					
	1	SIGA		0.15543E 01	0.15451E 01
		SIGT		0.73172E 01	0.73250E 01
		SIGF		0.15154E 01	0.15048E 01
		NU-SIGF		0.47999E 01	0.47421E 01
	2	SIGA		0.41973E 00	0.41824E 00
		SIGT		0.11336E 02	0.11322E 02
		NU-SIGF		0.48449E 00	0.48354E 00
		SIGF		0.16670E 00	0.16738E 00
	3	SIGA		0.93420E 02	0.87036E 02
		SIGT		0.12479E 03	0.11940E 03
		SIGF		0.00000E 00	0.00000E 00
		NU-SIGF		0.00000E 00	0.00000E 00
	4	SIGA		0.11034E 02	0.10432E 02
		SIGT		0.18896E 02	0.18348E 02
		SIGF		0.00000E 00	0.00000E 00
		NU-SIGF		0.00000E 00	0.00000E 00
9800.0					
	1	SIGA	0.16088E 01	0.15629E 01	0.15385E 01
		SIGT	0.75472E 01	0.73618E 01	0.72705E 01
		SIGF	0.15693E 01	0.15239E 01	0.14992E 01
		NU-SIGF	0.49774E 01	0.48237E 01	0.47403E 01
	2	SIGA	0.43097E 00	0.42555E 00	0.41559E 00
		SIGT	0.11440E 02	0.11370E 02	0.11362E 02
		SIGF	0.17786E 00	0.17412E 00	0.16347E 00
		NU-SIGF	0.51407E 00	0.50321E 00	0.47219E 00
	3	SIGA	0.10553E 03	0.97141E 02	0.97910E 02
		SIGT	0.13735E 03	0.13079E 03	0.13155E 03
		SIGF	0.00000E 00	0.00000E 00	0.00000E 00
		NU-SIGF	0.00000E 00	0.00000E 00	0.00000E 00
	4	SIGA	0.11494E 02	0.10597E 02	0.10053E 02
		SIGT	0.19019E 02	0.18268E 02	0.17702E 02
		SIGF	0.00000E 00	0.00000E 00	0.00000E 00
		NU-SIGF	0.00000E 00	0.00000E 00	0.00000E 00
30800.0					
	1	SIGA	0.16093E 01	0.15605E 01	
		SIGT	0.75381E 01	0.73376E 01	
		SIGF	0.15702E 01	0.15218E 01	
		NU-SIGF	0.49935E 01	0.48262E 01	
	2	SIGA	0.43082E 00	0.42226E 00	
		SIGT	0.11486E 02	0.11343E 02	
		SIGF	0.17638E 00	0.17184E 00	
		NU-SIGF	0.50975E 00	0.49658E 00	
	3	SIGA	0.81541E 02	0.74683E 02	
		SIGT	0.11069E 03	0.10614E 03	
		SIGF	0.00000E 00	0.00000E 00	
		NU-SIGF	0.00000E 00	0.00000E 00	
	4	SIGA	0.12046E 02	0.11211E 02	
		SIGT	0.19711E 02	0.19011E 02	
		SIGF	0.00000E 00	0.00000E 00	
		NU-SIGF	0.00000E 00	0.00000E 00	

ZIRC2

TIME HOURS	GROUP	XSECT	FUEL TO WATER RATIO 0.50	0.90	1.30
0.0					
	1	SIGA		0.91378E-02	0.92033E-02
		SIGT		0.51456E 01	0.51566E 01
		SIGF		0.00000E 00	0.00000E 00
		NU-SIGF		0.00000E 00	0.00000E 00
	2	SIGA		0.22664E-01	0.21807E-01
		SIGT		0.92329E 01	0.91246E 01
		SIGF		0.00000E 00	0.00000E 00
		NU-SIGF		0.00000E 00	0.00000E 00
	3	SIGA		0.87996E-01	0.86898E-01
		SIGT		0.69588E 01	0.69359E 01
		SIGF		0.00000E 00	0.00000E 00
		NU-SIGF		0.00000E 00	0.00000E 00
	4	SIGA		0.12572E 00	0.11825E 00
		SIGT		0.63271E 01	0.64346E 01
		SIGF		0.00000E 00	0.00000E 00
		NU-SIGF		0.00000E 00	0.00000E 00
9800.0					
	1	SIGA	0.91467E-02	0.90847E-02	0.91301E-02
		SIGT	0.51450E 01	0.50995E 01	0.51447E 01
		SIGF	0.00000E 00	0.00000E 00	0.00000E 00
		NU-SIGF	0.00000E 00	0.00000E 00	0.00000E 00
	2	SIGA	0.21140E-01	0.22106E-01	0.21231E-01
		SIGT	0.92343E 01	0.91711E 01	0.91320E 01
		SIGF	0.00000E 00	0.00000E 00	0.00000E 00
		NU-SIGF	0.00000E 00	0.00000E 00	0.00000E 00
	3	SIGA	0.86442E-01	0.76571E-01	0.82146E-01
		SIGT	0.69278E 01	0.68649E 01	0.69448E 01
		SIGF	0.00000E 00	0.00000E 00	0.00000E 00
		NU-SIGF	0.00000E 00	0.00000E 00	0.00000E 00
	4	SIGA	0.13619E 00	0.12356E 00	0.11737E 00
		SIGT	0.62740E 01	0.63473E 01	0.65133E 01
		SIGF	0.00000E 00	0.00000E 00	0.00000E 00
		NU-SIGF	0.00000E 00	0.00000E 00	0.00000E 00
30800.0					
	1	SIGA	0.90604E-02	0.90631E-02	
		SIGT	0.51341E 01	0.51236E 01	
		SIGF	0.00000E 00	0.00000E 00	
		NU-SIGF	0.00000E 00	0.00000E 00	
	2	SIGA	0.21498E-01	0.22072E-01	
		SIGT	0.92043E 01	0.92162E 01	
		SIGF	0.00000E 00	0.00000E 00	
		NU-SIGF	0.00000E 00	0.00000E 00	
	3	SIGA	0.84807E-01	0.77276E-01	
		SIGT	0.69420E 01	0.69083E 01	
		SIGF	0.00000E 00	0.00000E 00	
		NU-SIGF	0.00000E 00	0.00000E 00	
	4	SIGA	0.14156E 00	0.12715E 00	
		SIGT	0.63107E 01	0.63084E 01	
		SIGF	0.00000E 00	0.00000E 00	
		NU-SIGF	0.00000E 00	0.00000E 00	

H&H2O

TIME HOURS	GROUP	XSECT	FUEL TO WATER RATIO 0.50	0.90	1.30
0.0					
	1	SIGA		0.32000E-04	0.31590E-04
		SIGT		0.29715E 01	0.30184E 01
		SIGF		0.00000E 00	0.00000E 00
		NU-SIGF		0.00000E 00	0.00000E 00
	2	SIGA		0.14910E-03	0.14656E-03
		SIGT		0.11195E 02	0.11063E 02
		SIGF		0.00000E 00	0.00000E 00
		NU-SIGF		0.00000E 00	0.00000E 00
	3	SIGA		0.12548E-01	0.11763E-01
		SIGT		0.20730E 02	0.20801E 02
		SIGF		0.00000E 00	0.00000E 00
		NU-SIGF		0.00000E 00	0.00000E 00
	4	SIGA		0.21373E 00	0.19702E 00
		SIGT		0.39716E 02	0.37903E 02
		SIGF		0.00000E 00	0.00000E 00
		NU-SIGF		0.00000E 00	0.00000E 00
9800.0					
	1	SIGA	0.31757E-04	0.31855E-04	0.32057E-04
		SIGT	0.29169E 01	0.29570E 01	0.30085E 01
		SIGF	0.00000E 00	0.00000E 00	0.00000E 00
		NU-SIGF	0.00000E 00	0.00000E 00	0.00000E 00
	2	SIGA	0.14727E-03	0.14718E-03	0.14853E-03
		SIGT	0.11054E 02	0.11067E 02	0.11200E 02
		SIGF	0.00000E 00	0.00000E 00	0.00000E 00
		NU-SIGF	0.00000E 00	0.00000E 00	0.00000E 00
	3	SIGA	0.13070E-01	0.12184E-01	0.11070E-01
		SIGT	0.20806E 02	0.20840E 02	0.20826E 02
		SIGF	0.00000E 00	0.00000E 00	0.00000E 00
		NU-SIGF	0.00000E 00	0.00000E 00	0.00000E 00
	4	SIGA	0.23602E 00	0.21094E 00	0.19831E 00
		SIGT	0.42178E 02	0.39687E 02	0.38533E 02
		SIGF	0.00000E 00	0.00000E 00	0.00000E 00
		NU-SIGF	0.00000E 00	0.00000E 00	0.00000E 00
30800.0					
	1	SIGA	0.31886E-04	0.32059E-04	
		SIGT	0.29004E 01	0.29445E 01	
		SIGF	0.00000E 00	0.00000E 00	
		NU-SIGF	0.00000E 00	0.00000E 00	
	2	SIGA	0.14775E-03	0.14765E-03	
		SIGT	0.11075E 02	0.11081E 02	
		SIGF	0.00000E 00	0.00000E 00	
		NU-SIGF	0.00000E 00	0.00000E 00	
	3	SIGA	0.13034E-01	0.11983E-01	
		SIGT	0.20803E 02	0.20791E 02	
		SIGF	0.00000E 00	0.00000E 00	
		NU-SIGF	0.00000E 00	0.00000E 00	
	4	SIGA	0.24123E 00	0.21824E 00	
		SIGT	0.42605E 02	0.40328E 02	
		SIGF	0.00000E 00	0.00000E 00	
		NU-SIGF	0.00000E 00	0.00000E 00	

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TIME HOURS	GROUP	XSECT	FUEL TO WATER RATIO 0.50	0.90	1.30
0.0					
	1	SIGA		0.10661E-01	0.89105E-02
		SIGT		0.23858E 01	0.24153E 01
		SIGF		0.00000E 00	0.00000E 00
		NU-SIGF		0.00000E 00	0.00000E 00
	2	SIGA		0.00000E 00	0.00000E 00
		SIGT		0.38904E 01	0.38928E 01
		SIGF		0.00000E 00	0.00000E 00
		NU-SIGF		0.00000E 00	0.00000E 00
	3	SIGA		0.59452E-05	0.54779E-05
		SIGT		0.37265E 01	0.37270E 01
		SIGF		0.00000E 00	0.00000E 00
		NU-SIGF		0.00000E 00	0.00000E 00
	4	SIGA		0.10551E-03	0.97041E-04
		SIGT		0.37510E 01	0.37388E 01
		SIGF		0.00000E 00	0.00000E 00
		NU-SIGF		0.00000E 00	0.00000E 00
9800.0					
	1	SIGA	0.10524E-01	0.10501E-01	0.98578E-02
		SIGT	0.23711E 01	0.23579E 01	0.23918E 01
		SIGF	0.00000E 00	0.00000E 00	0.00000E 00
		NU-SIGF	0.00000E 00	0.00000E 00	0.00000E 00
	2	SIGA	0.00000E 00	0.00000E 00	0.00000E 00
		SIGT	0.39394E 01	0.39166E 01	0.38647E 01
		SIGF	0.00000E 00	0.00000E 00	0.00000E 00
		NU-SIGF	0.00000E 00	0.00000E 00	0.00000E 00
	3	SIGA	0.61488E-05	0.56356E-05	0.50648E-05
		SIGT	0.37167E 01	0.37199E 01	0.37185E 01
		SIGF	0.00000E 00	0.00000E 00	0.00000E 00
		NU-SIGF	0.00000E 00	0.00000E 00	0.00000E 00
	4	SIGA	0.11645E-03	0.10212E-03	0.94419E-04
		SIGT	0.37416E 01	0.37225E 01	0.36938E 01
		SIGF	0.00000E 00	0.00000E 00	0.00000E 00
		NU-SIGF	0.00000E 00	0.00000E 00	0.00000E 00
30800.0					
	1	SIGA	0.11568E-01	0.10002E-01	
		SIGT	0.23341E 01	0.23602E 01	
		SIGF	0.00000E 00	0.00000E 00	
		NU-SIGF	0.00000E 00	0.00000E 00	
	2	SIGA	0.00000E 00	0.00000E 00	
		SIGT	0.39347E 01	0.39001E 01	
		SIGF	0.00000E 00	0.00000E 00	
		NU-SIGF	0.00000E 00	0.00000E 00	
	3	SIGA	0.60622E-05	0.54675E-05	
		SIGT	0.37168E 01	0.37220E 01	
		SIGF	0.00000E 00	0.00000E 00	
		NU-SIGF	0.00000E 00	0.00000E 00	
	4	SIGA	0.12059E-03	0.10771E-03	
		SIGT	0.37593E 01	0.37502E 01	
		SIGF	0.00000E 00	0.00000E 00	
		NU-SIGF	0.00000E 00	0.00000E 00	

FISSION PRODUCTS-RS

TIME HOURS	GROUP	XSECT	FUEL TO WATER RATIO 0.50	0.90	1.30
0.0					
	1	SIGA-25		0.65089E-01	0.67771E-01
		SIGA-28		0.69037E-01	0.71860E-01
		SIGA-49		0.63215E-01	0.65765E-01
		SIGA-41		0.67895E-01	0.70566E-01
	2	SIGA-25		0.56375E 00	0.55780E 00
		SIGA-28		0.58377E 00	0.57731E 00
		SIGA-49		0.54854E 00	0.54245E 00
		SIGA-41		0.56369E 00	0.55734E 00
	3	SIGA-25		0.12489E 03	0.11633E 03
		SIGA-28		0.12777E 03	0.11842E 03
		SIGA-49		0.12339E 03	0.11452E 03
		SIGA-41		0.12932E 03	0.11849E 03
	4	SIGA-25		0.56297E 03	0.48876E 03
		SIGA-28		0.00000E 00	0.00000E 00
		SIGA-49		0.12654E 04	0.10968E 04
		SIGA-41		0.19584E 04	0.16975E 04
9800.0					
	1	SIGA-25	0.63978E-01	0.64991E-01	0.66202E-01
		SIGA-28	0.67875E-01	0.68941E-01	0.70208E-01
		SIGA-49	0.62182E-01	0.63143E-01	0.64265E-01
		SIGA-41	0.66857E-01	0.67860E-01	0.68976E-01
	2	SIGA-25	0.55701E 00	0.55703E 00	0.56607E 00
		SIGA-28	0.57838E 00	0.57746E 00	0.58480E 00
		SIGA-49	0.54336E 00	0.54254E 00	0.54958E 00
		SIGA-41	0.55847E 00	0.55752E 00	0.56464E 00
	3	SIGA-25	0.13672E 03	0.12103E 03	0.11081E 03
		SIGA-28	0.13832E 03	0.12295E 03	0.11185E 03
		SIGA-49	0.13385E 03	0.11910E 03	0.10864E 03
		SIGA-41	0.14149E 03	0.12468E 03	0.11403E 03
	4	SIGA-25	0.66787E 03	0.54291E 03	0.48021E 03
		SIGA-28	0.00000E 00	0.00000E 00	0.00000E 00
		SIGA-49	0.14960E 04	0.12184E 04	0.10733E 04
		SIGA-41	0.23121E 04	0.18844E 04	0.16581E 04
30800.0					
	1	SIGA-25	0.63057E-01	0.64403E-01	
		SIGA-28	0.66900E-01	0.68315E-01	
		SIGA-49	0.61284E-01	0.62563E-01	
		SIGA-41	0.65875E-01	0.67216E-01	
	2	SIGA-25	0.55910E 00	0.55900E 00	
		SIGA-28	0.58026E 00	0.57925E 00	
		SIGA-49	0.54513E 00	0.54423E 00	
		SIGA-41	0.56027E 00	0.55926E 00	
	3	SIGA-25	0.13493E 03	0.12325E 03	
		SIGA-28	0.13555E 03	0.12400E 03	
		SIGA-49	0.13126E 03	0.12045E 03	
		SIGA-41	0.13861E 03	0.12811E 03	
	4	SIGA-25	0.70361E 03	0.58497E 03	
		SIGA-28	0.00000E 00	0.00000E 00	
		SIGA-49	0.15728E 04	0.13119E 04	
		SIGA-41	0.24294E 04	0.20285E 04	

FISSION PRODUCTS-SS

TIME HOURS	GROUP	XSECT	FUEL TO WATER RATIO 0.50	0.90	1.30
0.0					
	1	SIGA-25		0.46315E-01	0.47994E-01
		SIGA-28		0.45881E-01	0.47755E-01
		SIGA-49		0.46105E-01	0.47814E-01
		SIGA-41		0.46834E-01	0.48570E-01
	2	SIGA-25		0.23352E 00	0.23086E 00
		SIGA-28		0.28702E 00	0.28371E 00
		SIGA-49		0.29182E 00	0.28845E 00
		SIGA-41		0.29275E 00	0.28938E 00
	3	SIGA-25		0.21452E 02	0.19845E 02
		SIGA-28		0.22232E 02	0.20467E 02
		SIGA-49		0.22664E 02	0.20793E 02
		SIGA-41		0.23008E 02	0.21073E 02
	4	SIGA-25		0.52681E 02	0.48397E 02
		SIGA-28		0.00000E 00	0.00000E 00
		SIGA-49		0.47281E 02	0.43450E 02
		SIGA-41		0.49204E 02	0.45216E 02
9800.0					
	1	SIGA-25	0.45723E-01	0.46349E-01	0.46965E-01
		SIGA-28	0.45285E-01	0.45909E-01	0.46531E-01
		SIGA-49	0.45497E-01	0.46132E-01	0.46769E-01
		SIGA-41	0.46227E-01	0.46871E-01	0.47505E-01
	2	SIGA-25	0.23149E 00	0.23098E 00	0.23367E 00
		SIGA-28	0.28442E 00	0.28389E 00	0.28732E 00
		SIGA-49	0.28919E 00	0.28864E 00	0.29212E 00
		SIGA-41	0.29012E 00	0.28957E 00	0.29305E 00
	3	SIGA-25	0.23571E 02	0.20951E 02	0.20068E 02
		SIGA-28	0.24552E 02	0.21703E 02	0.20734E 02
		SIGA-49	0.25092E 02	0.22091E 02	0.21058E 02
		SIGA-41	0.25504E 02	0.22409E 02	0.21329E 02
	4	SIGA-25	0.58470E 02	0.51264E 02	0.47450E 02
		SIGA-28	0.00000E 00	0.00000E 00	0.00000E 00
		SIGA-49	0.52459E 02	0.46015E 02	0.42606E 02
		SIGA-41	0.54595E 02	0.47886E 02	0.44336E 02
30800.0					
	1	SIGA-25	0.45036E-01	0.45883E-01	
		SIGA-28	0.44606E-01	0.45451E-01	
		SIGA-49	0.44806E-01	0.45668E-01	
		SIGA-41	0.45516E-01	0.46391E-01	
	2	SIGA-25	0.23216E 00	0.23173E 00	
		SIGA-28	0.28530E 00	0.28479E 00	
		SIGA-49	0.29008E 00	0.28956E 00	
		SIGA-41	0.29101E 00	0.29048E 00	
	3	SIGA-25	0.23251E 02	0.22147E 02	
		SIGA-28	0.24206E 02	0.23017E 02	
		SIGA-49	0.24734E 02	0.23474E 02	
		SIGA-41	0.25133E 02	0.23820E 02	
	4	SIGA-25	0.60410E 02	0.53720E 02	
		SIGA-28	0.00000E 00	0.00000E 00	
		SIGA-49	0.54195E 02	0.48212E 02	
		SIGA-41	0.56402E 02	0.50173E 02	

FISSION PRODUCTS-NS

TIME HOURS	GROUP	XSECT	FUEL TO WATER RATIO 0.50	0.90	1.30
0.0					
	1	SIGA-25		0.20375E-01	0.21341E-01
		SIGA-28		0.24269E-01	0.25189E-01
		SIGA-49		0.25841E-01	0.26748E-01
		SIGA-41		0.28397E-01	0.29352E-01
	2	SIGA-25		0.28337E 00	0.28030E 00
		SIGA-28		0.10511E 00	0.10516E 00
		SIGA-49		0.12015E 00	0.11984E 00
		SIGA-41		0.13133E 00	0.13105E 00
	3	SIGA-25		0.22023E 01	0.21566E 01
		SIGA-28		0.27873E 01	0.27155E 01
		SIGA-49		0.30087E 01	0.29397E 01
		SIGA-41		0.34503E 01	0.33557E 01
	4	SIGA-25		0.22291E 01	0.20499E 01
		SIGA-28		0.00000E 00	0.00000E 00
		SIGA-49		0.25650E 01	0.23608E 01
		SIGA-41		0.26533E 01	0.24426E 01
9800.0					
	1	SIGA-25	0.20226E-01	0.20429E-01	0.20728E-01
		SIGA-28	0.24088E-01	0.24328E-01	0.24645E-01
		SIGA-49	0.25645E-01	0.25897E-01	0.26206E-01
		SIGA-41	0.28181E-01	0.28457E-01	0.28801E-01
	2	SIGA-25	0.28074E 00	0.28032E 00	0.28395E 00
		SIGA-28	0.10425E 00	0.10409E 00	0.10637E 00
		SIGA-49	0.11911E 00	0.11893E 00	0.12127E 00
		SIGA-41	0.13017E 00	0.12998E 00	0.13263E 00
	3	SIGA-25	0.22837E 01	0.22476E 01	0.21919E 01
		SIGA-28	0.28886E 01	0.28395E 01	0.27610E 01
		SIGA-49	0.31184E 01	0.30539E 01	0.29934E 01
		SIGA-41	0.35667E 01	0.34921E 01	0.34263E 01
	4	SIGA-25	0.24733E 01	0.21696E 01	0.20104E 01
		SIGA-28	0.00000E 00	0.00000E 00	0.00000E 00
		SIGA-49	0.28428E 01	0.24975E 01	0.23162E 01
		SIGA-41	0.29401E 01	0.25836E 01	0.23967E 01
30800.0					
	1	SIGA-25	0.19961E-01	0.20242E-01	
		SIGA-28	0.23777E-01	0.24109E-01	
		SIGA-49	0.25320E-01	0.25671E-01	
		SIGA-41	0.27825E-01	0.28210E-01	
	2	SIGA-25	0.28159E 00	0.28115E 00	
		SIGA-28	0.10453E 00	0.10437E 00	
		SIGA-49	0.11944E 00	0.11928E 00	
		SIGA-41	0.13054E 00	0.13037E 00	
	3	SIGA-25	0.23221E 01	0.22527E 01	
		SIGA-28	0.29461E 01	0.28555E 01	
		SIGA-49	0.31806E 01	0.30887E 01	
		SIGA-41	0.36503E 01	0.35467E 01	
	4	SIGA-25	0.25551E 01	0.22731E 01	
		SIGA-28	0.00000E 00	0.00000E 00	
		SIGA-49	0.29359E 01	0.26152E 01	
		SIGA-41	0.30363E 01	0.27052E 01	

XE-135 & SM-149

TIME HOURS	GROUP	XSECT	FUEL TO WATER RATIO 0.50	0.90	1.30
0.0					
	1	SIGA-XE		0.57734E-03	0.55987E-03
		SIGA-SM		0.53119E-01	0.55490E-01
	2	SIGA-XE		0.32381E-02	0.32022E-02
		SIGA-SM		0.94622E 00	0.93569E 00
	3	SIGA-XE		0.39815E 03	0.35932E 03
		SIGA-SM		0.28456E 03	0.27477E 03
	4	SIGA-XE		0.17754E 07	0.15785E 07
		SIGA-SM		0.46639E 05	0.42972E 05
9800.0					
	1	SIGA-XE	0.57851E-03	0.57188E-03	0.57174E-03
		SIGA-SM	0.51840E-01	0.52765E-01	0.54213E-01
	2	SIGA-XE	0.32163E-02	0.32060E-02	0.32382E-02
		SIGA-SM	0.93355E 00	0.93445E 00	0.94953E 00
	3	SIGA-XE	0.38426E 03	0.34994E 03	0.28989E 03
		SIGA-SM	0.28977E 03	0.26647E 03	0.22207E 03
	4	SIGA-XE	0.20118E 07	0.17016E 07	0.15261E 07
		SIGA-SM	0.50721E 05	0.44606E 05	0.41102E 05
30800.0					
	1	SIGA-XE	0.59011E-03	0.58169E-03	
		SIGA-SM	0.51273E-01	0.52469E-01	
	2	SIGA-XE	0.32234E-02	0.32137E-02	
		SIGA-SM	0.93724E 00	0.93756E 00	
	3	SIGA-XE	0.38957E 03	0.32151E 03	
		SIGA-SM	0.28498E 03	0.24553E 03	
	4	SIGA-XE	0.20815E 07	0.18170E 07	
		SIGA-SM	0.51710E 05	0.47175E 05	

NORMALIZED FLUX VALUES

TIME HOURS	GROUP		FUEL TO WATER RATIO 0.50	0.90	1.30
0.0					
	1	FLUX		0.10929E 02	0.11444E 02
	2	FLUX		0.17667E 02	0.20944E 02
	3	FLUX		0.13096E 02	0.14202E 02
	4	FLUX		0.58533E 01	0.44265E 01
9800.0					
	1	FLUX	0.10635E 02	0.11381E 02	0.11544E 02
	2	FLUX	0.14295E 02	0.17643E 02	0.20943E 02
	3	FLUX	0.11433E 02	0.12908E 02	0.14048E 02
	4	FLUX	0.64642E 01	0.37196E 01	0.25717E 01
30800.0					
	1	FLUX	0.11042E 02	0.11193E 02	
	2	FLUX	0.14118E 02	0.17684E 02	
	3	FLUX	0.11560E 02	0.13170E 02	
	4	FLUX	0.71722E 01	0.41438E 01	

APPENDIX C

FISSION PRODUCT ISOTOPES MAKING UP EACH LUMPED PRODUCT GROUP

Fission Product Group	Isotope	Z	A
Rapidly Saturating	RH	45	103
	Ag	47	109
	Cd	48	113
	In	49	115
	Xe	54	131
	Pm	61	147
	Sm	62	151
	Sm	62	152
	Eu	63	153
	Gd	64	155
	Gd	64	157
Slowly Saturating	Mo	42	95
	Tc	43	99
	Cs	55	133
	Nd	60	143
	Nd	60	145
Non-Saturating	Br	35	81
	Se	34	82
	Kr	36	83
	Kr	36	84
	Kr	36	85
	Rb	37	85
	Kr	36	86
	Rb	37	87
	Sr	38	88
	Y	39	89
	Sr	38	90
	Zr	40	91
	Zr	40	92
	Zr	40	93
	Zr	40	94
	Zr	40	96
	Mo	42	96
	Mo	42	97
	Mo	42	98
	Mo	42	100
	Ru	44	100
	Ru	44	101

Fission Product Group	Isotope	Z	A
Non-Saturating (Cont.)	Ru	44	102
	Ru	44	104
	Pd	44	104
	Pd	46	104
	Pd	46	105
	Pd	46	106
	Pd	46	107
	Pd	46	108
	Pd	46	110
	Cd	48	111
	Cd	48	112
	Cd	48	114
	Te	52	126
	I	53	127
	Te	52	128
	I	53	129
	Te	52	130
	Xe	54	132
	Xe	54	134
	Cs	55	135
	Xe	54	136
	Cs	55	137
	Ba	56	138
	Ce	58	140
	Pr	59	141
	Ce	58	142
	Nd	60	144
	Nd	60	146
	Sm	62	147
	Nd	60	148
	Sm	62	148
	Nd	60	150
	Sm	62	150
	Sm	62	154
	Gd	64	156
	Gd	64	158
	Tb	65	159

APPENDIX D

ANALYTIC SOLUTIONS OF THE FUEL DEPLETION EQUATIONS

$$M_5(\Theta) = M_5(0)\, e^{-\mu_5 \Theta}$$

$$M_8(\Theta) = M_8(0)\, e^{-\mu_8 \Theta}$$

$$M_9(\Theta) = \left\{ M_9(0) + \frac{\gamma_8 M_8(0)}{\mu_8 - \mu_9} \right\} e^{-\mu_9 \Theta} + \frac{\gamma_8 M_8(0)}{\mu_9 - \mu_8}\, e^{-\mu_8 \Theta}$$

$$M_0(\Theta) = A\, e^{-\mu_0 \Theta} + B\, e^{-\mu_9 \Theta} + C\, e^{-\mu_8 \Theta}$$

$$M_1(\Theta) = D\, e^{-\mu_1 \Theta} + E\, e^{-\mu_0 \Theta} + F\, e^{-\mu_9 \Theta} + G\, e^{-\mu_8 \Theta}$$

$$M_2(\Theta) = H\, e^{-\mu_2 \Theta} + Q\, e^{-\mu_0 \Theta} + R\, e^{-\mu_1 \Theta} + S\, e^{-\mu_9 \Theta} + T\, e^{-\mu_8 \Theta}$$

where

$$A = M_0(0) + \frac{\gamma_9 \gamma_8 M_8(0)}{(\mu_0 - \mu_9)(\mu_9 - \mu_8)} + \frac{\gamma_9 M_9(0)}{\mu_9 - \mu_0} + \frac{\gamma_9 \gamma_8 M_8(0)}{(\mu_8 - \mu_0)(\mu_9 - \mu_8)}$$

$$B = \frac{\gamma_9}{\mu_0 - \mu_9} \left[M_9(0) + \frac{\gamma_8 M_8(0)}{\mu_8 - \mu_9} \right]$$

$$C = \frac{\gamma_9 \gamma_8 M_8(0)}{(\mu_0 - \mu_8)(\mu_9 - \mu_8)}$$

$$D = M_1(0) + \frac{\mu_0}{\mu_0-\mu_1} A + \frac{\mu_0}{\mu_9-\mu_1} B + \frac{\mu_0}{\mu_8-\mu_1} C$$

$$E = \frac{\mu_0}{\mu_1-\mu_0} A$$

$$F = \frac{\mu_0}{\mu_1-\mu_9} B$$

$$G = \frac{\mu_0}{\mu_1-\mu_8} C$$

$$H = M_2(0) + \frac{\gamma_1}{\mu_1-\mu_2} D + \frac{\gamma_1}{\mu_0-\mu_2} E + \frac{\gamma_1}{\mu_9-\mu_2} F + \frac{\gamma_1}{\mu_8-\mu_2} G$$

$$Q = \frac{\gamma_1}{\mu_2-\mu_0} E$$

$$R = \frac{\gamma_1}{\mu_2-\mu_1} D$$

$$S = \frac{\gamma_1}{\mu_2-\mu_9} F$$

$$T = \frac{\gamma_1}{\mu_2-\mu_8} G$$

APPENDIX E

PROGRAM OUTPUT FOR EXAMPLE NO. 1

```
********** INPUT DATA **********

THE CYLINDRICAL REACTOR HAS  4 REGIONS
REGION WIDTHS FROM THE CENTER OUT IN CM ARE:
  88.76199  36.35201  27.89400  40.00000
THE REACTOR USES A HEXAGONAL LATTICE
THE FUEL OUTER DIAMETER IS  0.3240 INCHES
THE CLADDING OUTER DIAMETER IS  0.3790 INCHES
THE HEIGHT IS    365.0 CM
THE TRANSVERSE BUCKLING IS  0.74082E-04 CM**2
THE REACTOR POWER IS TO BE SET AT  0.27750E+10 WATTS
THE LENGTH OF EACH TIMESTEP IS  700.00 HOURS
THE CONVERGENCE CRITERION FOR THE EIGENVALUE IS  0.10000E-03
THE REGION VOLUMES ARE :   9034340.00   8915228.00   8895856.00  15870784.0
```

	ENRICHMENT %						
	U-235	U-238	PU-239	PU-240	PU-241	PU-242	SPACING
REGION 1	1.900	98.100	0.0	0.0	0.0	0.0	0.080
REGION 2	2.000	98.000	0.0	0.0	0.0	0.0	0.080
REGION 3	2.100	97.900	0.0	0.0	0.0	0.0	0.080
REGION 4	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.19946408E+21	0.20996462E+21	0.22046513E+21	0.0
U-238	0.10298647E+23	0.10288275E+23	0.10277881E+23	0.0
PU-239	0.0	0.0	0.0	0.0
PU-240	0.0	0.0	0.0	0.0
PU-241	0.0	0.0	0.0	0.0
PU-242	0.0	0.0	0.0	0.0
O-16	0.30318971E+23	0.30319219E+23	0.30319440E+23	0.24426610E+23
H&H2O	0.18645501E+23	0.18645501E+23	0.18645501E+23	0.48853220E+23
ZIRC2	0.70738129E+22	0.70738129E+22	0.70738129E+22	0.0
FTW RATIO	1.1839	1.1839	1.1839	0.0

```
********* END OF INPUT DATA **********

TIME=      0.0
```

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.50304E-02	0.11173E-01	0.57781E-01	0.16360E+01
REGION 2	0.50399E-02	0.11198E-01	0.58775E-01	0.16360E+01
REGION 3	0.50494E-02	0.11224E-01	0.59769E-01	0.16360E+01
REGION 4	0.26198E-03	0.0	0.63400E-02	0.31742E+01
GROUP 2				
REGION 1	0.32049E-02	0.81487E-03	0.41692E-01	0.91662E+00
REGION 2	0.32245E-02	0.85729E-03	0.42799E-01	0.91661E+00
REGION 3	0.32441E-02	0.89970E-03	0.43907E-01	0.91661E+00
REGION 4	0.72840E-05	0.0	0.39147E-02	0.12066E+01
GROUP 3				

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.50353E-02	0.11198E-01	0.61552E-01	0.16373E+01
REGION 2	0.50442E-02	0.11222E-01	0.62516E-01	0.16373E+01
REGION 3	0.50534E-02	0.11243E-01	0.62533E-01	0.16371E+01
REGION 4	0.26178E-03	0.0	0.67676E-02	0.31779E+01
GROUP 2				
REGION 1	0.32056E-02	0.81951E-03	0.44357E-01	0.91684E+00
REGION 2	0.32245E-02	0.85991E-03	0.45389E-01	0.91684E+00
REGION 3	0.32439E-02	0.90042E-03	0.45675E-01	0.91674E+00
REGION 4	0.72780E-05	0.0	0.42766E-02	0.12069E+01
GROUP 3				
REGION 1	0.29837E-01	0.11490E-01	0.34103E-01	0.75948E+00
REGION 2	0.30169E-01	0.12059E-01	0.35258E-01	0.75892E+00
REGION 3	0.30375E-01	0.12617E-01	0.35465E-01	0.75851E+00
REGION 4	0.61884E-03	0.0	0.50832E-02	0.77418E+00
GROUP 4				
REGION 1	0.10058E+00	0.15244E+00	0.0	0.56920E+00
REGION 2	0.10399E+00	0.15913E+00	0.0	0.56585E+00
REGION 3	0.10460E+00	0.16229E+00	0.0	0.56516E+00
REGION 4	0.10631E-01	0.0	0.0	0.43951E+00

***** DATA AT END OF SUBSTP 1 *****

TOTAL TIME = 700.00 HOURS

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.18986634E+21	0.20016008E+21	0.21372866E+21	0.0
U-238	0.10288014E+23	0.10277935E+23	0.10271189E+23	0.0
PU-239	0.90216952E+19	0.87772166E+19	0.58107342E+19	0.0
PU-240	0.21420356E+18	0.20230134E+18	0.88650324E+17	0.0
PU-241	0.17873661E+17	0.16061666E+17	0.49258121E+16	0.0
PU-242	0.17592186E+15	0.14073749E+15	0.52776558E+14	0.0
O-16	0.30318971E+23	0.30319219E+23	0.30319440E+23	0.24426610E+23
H&H2O	0.18645501E+23	0.18645501E+23	0.18645501E+23	0.48853220E+23
ZIRC2	0.70738129E+22	0.70738129E+22	0.70738129E+22	0.0
RS FPS	0.85638954E+18	0.86637579E+18	0.58299845E+18	0.0
SS FPS	0.24492600E+19	0.24862817E+19	0.16782132E+19	0.0
NS FPS	0.14267318E+20	0.14465986E+20	0.97239687E+19	0.0
XE-135	0.25877554E+16	0.26818114E+16	0.24383179E+16	0.0
SM-149	0.21611584E+17	0.22508171E+17	0.22966672E+17	0.0
REACTION RATES				
FISSION THEN ABSORPTION				
U-235	0.30010444E+13	0.30677968E+13	0.21260371E+13	0.0
U-235	0.37218628E+13	0.38049635E+13	0.26364304E+13	0.0
U-238	0.38192153E+12	0.37724337E+12	0.24466319E+12	0.0
U-238	0.42140413E+13	0.40977134E+13	0.26510486E+13	0.0
PU-239	0.32078338E+12	0.30251228E+12	0.13004210E+12	0.0
PU-239	0.49905356E+12	0.47061395E+12	0.20229974E+12	0.0
PU-240	0.53772928E+08	0.49955088E+08	0.14187571E+08	0.0
PU-240	0.19795206E+11	0.18156093E+11	0.51482624E+10	0.0
PU-241	0.66463565E+09	0.57902106E+09	0.11527098E+09	0.0
PU-241	0.88982502E+09	0.77516570E+09	0.15432555E+09	0.0
PU-242	0.32172078E+05	0.25395141E+05	0.61757187E+04	0.0

REGION 1	0.29355E-01	0.11392E-01	0.30695E-01	0.75988E+00
REGION 2	0.29702E-01	0.11991E-01	0.31943E-01	0.75927E+00
REGION 3	0.30049E-01	0.12591E-01	0.33191E-01	0.75866E+00
REGION 4	0.61316E-03	0.0	0.46680E-02	0.77421E+00

GROUP 4

REGION 1	0.88022E-01	0.14036E+00	0.0	0.58148E+00
REGION 2	0.91600E-01	0.14775E+00	0.0	0.57781E+00
REGION 3	0.95179E-01	0.15514E+00	0.0	0.57419E+00
REGION 4	0.10444E-01	0.0	0.0	0.44345E+00

KEFF= 1.02543 TIME= 0.0

RELATIVE POINT GROUP AVERAGES

1	0.9301940E+00
2	0.9306695E+00
3	0.9320966E+00
4	0.9344769E+00
5	0.9378082E+00
6	0.9420918E+00
7	0.9473299E+00
8	0.9535234E+00
9	0.9606772E+00
10	0.9687927E+00
11	0.9778571E+00
12	0.9877622E+00
13	0.9978668E+00
14	0.1000000E+01
15	0.9974324E+00
16	0.9900625E+00
17	0.9779723E+00
18	0.9613277E+00
19	0.9403268E+00
20	0.9151768E+00
21	0.8860782E+00
22	0.8531845E+00
23	0.8165453E+00
24	0.7849008E+00
25	0.7492787E+00
26	0.7098397E+00
27	0.6668370E+00
28	0.6205867E+00
29	0.5714672E+00
30	0.5199466E+00
31	0.4666619E+00
32	0.4125981E+00
33	0.3594763E+00
34	0.3090441E+00
35	0.2621380E+00
36	0.2190755E+00
37	0.1797704E+00
38	0.1439129E+00
39	0.1110759E+00
40	0.8077431E-01
41	0.5250027E-01
42	0.2574286E-01
43	0.0

PEAK TO AVERAGE = 1.1747

TIME= 700.00

PU-242	0.20645100E+07	0.16045540E+07	0.38927719E+06	0.0
O-16	0.29292167E+11	0.28959810E+11	0.18794709E+11	0.34043692E+10
H&H2O	0.18998696E+12	0.18415570E+12	0.11955313E+12	0.11196020E+12
ZIRC2	0.14665017E+12	0.14260601E+12	0.92329279E+11	0.0
FPS	0.27021876E+12	0.27050803E+12	0.15548940E+12	0.0
TOTAL	0.37044649E+13	0.37481800E+13	0.25008695E+13	0.0
TOTAL	0.90917883E+13	0.90184499E+13	0.58812457E+13	0.11536453E+12
NEUTRON FLUX				
GROUP 1	0.10156932E+15	0.10042622E+15	0.65175323E+14	0.12976870E+14
GROUP 2	0.17790228E+15	0.17365219E+15	0.11216522E+15	0.28031523E+14
GROUP 3	0.12342448E+15	0.11988713E+15	0.77545651E+14	0.21758858E+14
GROUP 4	0.43022755E+14	0.41686214E+14	0.27079786E+14	0.92461985E+13
CONVERSION RATIO	0.9124	0.8742	0.8495	
BURNUP	0.74667798E+03	0.75525977E+03	0.50324878E+03	
POWER DENSITY	0.12045274E+03	0.12183731E+03	0.81183151E+02	
POWER	0.10882109E+10	0.10862072E+10	0.72219341E+09	
ENERGY DENSITY	0.82303062E+05	0.83469625E+05	0.56067617E+05	
FLUENCE	0.44831364E+21	0.43760324E+21	0.28265634E+21	0.70639435E+20
FTW RATIO	1.1839	1.1839	1.1839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.10254E+01 AT TIME= 0.0
FUEL TO WATER RATIO =1.1839
GROUP 4 FLUX = 0.42762053E+14
GROUP 3 FLUX = 0.11991035E+15
GROUP 2 FLUX = 0.17127929E+15
GROUP 1 FLUX = 0.96801449E+14
TOTAL FLUX = 0.43075301E+15
TOTAL FISSION REACTION RATE= 0.99535144E+13
TOTAL ABSORPTION REACTION RATE= 0.24106829E+14
ENERGY DENSITY = 0.73996687E+05
POWER DENSITY = 0.10789963E+03
TOTAL POWER = 0.28966116E+10
CONVERSION RATIO = 0.8824
BURNUP THIS STEP = 0.66886182E+03
POISON MAC CROSS SECTION NEEDED IS 0.48223860E-03
TIME = 700.00

***** END OF SUBSTP 1 *****

KEFF= 1.00759 TIME= 700.00

RELATIVE POINT GROUP AVERAGES

1	0.1000000E+01
2	0.9999672E+00
3	0.9998667E+00
4	0.9996992E+00
5	0.9994587E+00
6	0.9991446E+00
7	0.9987515E+00
8	0.9982750E+00
9	0.9977136E+00
10	0.9970607E+00
11	0.9963095E+00
12	0.9954377E+00
13	0.9943395E+00
14	0.9924873E+00
15	0.9886702E+00

16	0.9804487E+00
17	0.9677631E+00
18	0.9507223E+00
19	0.9295040E+00
20	0.9043154E+00
21	0.8753715E+00
22	0.8428808E+00
23	0.8070189E+00
24	0.7678760E+00
25	0.7349069E+00
26	0.6987263E+00
27	0.6594863E+00
28	0.6174098E+00
29	0.5727696E+00
30	0.5258879E+00
31	0.4771658E+00
32	0.4271624E+00
33	0.3767828E+00
34	0.3277096E+00
35	0.2818750E+00
36	0.2388315E+00
37	0.1992109E+00
38	0.1630917E+00
39	0.1302523E+00
40	0.1003119E+00
41	0.7281131E-01
42	0.4725809E-01
43	0.2315214E-01
44	0.0

PEAK TO AVERAGE = 1.1755

TIME= 1400.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.50395E-02	0.11221E-01	0.63140E-01	0.16386E+01
REGION 2	0.50479E-02	0.11242E-01	0.63808E-01	0.16386E+01
REGION 3	0.50572E-02	0.11260E-01	0.62967E-01	0.16382E+01
REGION 4	0.26159E-03	0.0	0.72120E-02	0.31815E+01
GROUP 2				
REGION 1	0.32056E-02	0.82183E-03	0.45635E-01	0.91708E+00
REGION 2	0.32238E-02	0.86044E-03	0.46415E-01	0.91706E+00
REGION 3	0.32436E-02	0.90034E-03	0.46015E-01	0.91685E+00
REGION 4	0.72720E-05	0.0	0.46683E-02	0.12071E+01
GROUP 3				
REGION 1	0.30483E-01	0.11548E-01	0.35353E-01	0.75875E+00
REGION 2	0.30753E-01	0.12088E-01	0.36209E-01	0.75830E+00
REGION 3	0.30739E-01	0.12625E-01	0.35646E-01	0.75825E+00
REGION 4	0.62453E-03	0.0	0.55236E-02	0.77414E+00
GROUP 4				
REGION 1	0.10734E+00	0.16265E+00	0.0	0.56290E+00
REGION 2	0.10994E+00	0.16814E+00	0.0	0.56038E+00
REGION 3	0.10823E+00	0.16797E+00	0.0	0.56184E+00
REGION 4	0.10818E-01	0.0	0.0	0.43564E+00

***** DATA AT END OF SUBSTP 2 *****

TOTAL TIME = 1400.00 HOURS

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.18061922E+21	0.19129219E+21	0.20778937E+21	0.0
U-238	0.10277102E+23	0.10268013E+23	0.10265041E+23	0.0
PU-239	0.17093571E+20	0.16185884E+20	0.10733802E+20	0.0
PU-240	0.76199894E+18	0.68150809E+18	0.29880988E+18	0.0
PU-241	0.12193144E+18	0.10224579E+18	0.29115068E+17	0.0
PU-242	0.20934701E+16	0.16360733E+16	0.33425153E+15	0.0
O-16	0.30318971E+23	0.30319219E+23	0.30319440E+23	0.24426610E+23
H&H2O	0.18645501E+23	0.18645501E+23	0.18645501E+23	0.48853220E+23
ZIRC2	0.70738129E+22	0.70738129E+22	0.70738129E+22	0.0
RS FPS	0.17284213E+19	0.16875041E+19	0.11125618E+19	0.0
SS FPS	0.49717134E+19	0.48717777E+19	0.32109027E+19	0.0
NS FPS	0.29236225E+20	0.28581215E+20	0.18720672E+20	0.0
XE-135	0.27260549E+16	0.27600845E+16	0.24252717E+16	0.0
SM-149	0.22853031E+17	0.23620503E+17	0.23745873E+17	0.0
REACTION RATES				
FISSION THEN ABSORPTION				
U-235	0.28737630E+13	0.27621495E+13	0.18663803E+13	0.0
U-235	0.35851967E+13	0.34461859E+13	0.23280275E+13	0.0
U-238	0.39320932E+12	0.36228956E+12	0.22453545E+12	0.0
U-238	0.43230503E+13	0.39317982E+13	0.24366033E+13	0.0
PU-239	0.60687588E+12	0.52135893E+12	0.21520246E+12	0.0
PU-239	0.94384331E+12	0.81082096E+12	0.33467662E+12	0.0
PU-240	0.19650898E+09	0.16138981E+09	0.43842816E+08	0.0
PU-240	0.69658804E+11	0.56604934E+11	0.15382704E+11	0.0
PU-241	0.45205217E+10	0.34395715E+10	0.60942259E+09	0.0
PU-241	0.60811633E+10	0.46268867E+10	0.81981670E+09	0.0
PU-242	0.39435444E+06	0.28372506E+06	0.35919348E+05	0.0
PU-242	0.25497664E+08	0.18110272E+08	0.22925730E+07	0.0
O-16	0.30294614E+11	0.27935695E+11	0.17319199E+11	0.30392489E+10
H&H2O	0.19136427E+12	0.17361555E+12	0.10803846E+12	0.10699388E+12
ZIRC2	0.14983201E+12	0.13628775E+12	0.84509065E+11	0.0
FPS	0.33514062E+12	0.30515311E+12	0.15742042E+12	0.0
TOTAL	0.38785631E+13	0.36493968E+13	0.23067697E+13	0.0
TOTAL	0.96344841E+13	0.88930433E+13	0.54827952E+13	0.11003311E+12
NEUTRON FLUX				
GROUP 1	0.10456645E+15	0.96431327E+14	0.59782656E+14	0.11586687E+14
GROUP 2	0.18386653E+15	0.16776639E+15	0.10371507E+15	0.25054037E+14
GROUP 3	0.12740898E+15	0.11577715E+15	0.71724175E+14	0.19680043E+14
GROUP 4	0.43173263E+14	0.39157167E+14	0.24386489E+14	0.87377932E+13
CONVERSION RATIO	0.8819	0.8508	0.8363	
BURNUP	0.15701997E+04	0.14764727E+04	0.93079468E+03	
POWER DENSITY	0.12652003E+03	0.11896608E+03	0.75023865E+02	
POWER	0.11430249E+10	0.10606095E+10	0.66740147E+09	
ENERGY DENSITY	0.86852312E+05	0.81911750E+05	0.51959980E+05	
FLUENCE	0.46334356E+21	0.42277119E+21	0.26136197E+21	0.63136157E+20
FTW RATIO	1.1839	1.1839	1.1839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.10076E+01 AT TIME= 700.00
FUEL TO WATER RATIO =1.1839
GROUP 4 FLUX = 0.40779775E+14
GROUP 3 FLUX = 0.11672827E+15
GROUP 2 FLUX = 0.16677138E+15
GROUP 1 FLUX = 0.93874547E+14
TOTAL FLUX = 0.41815372E+15

```
TOTAL FISSION REACTION RATE= 0.98347296E+13
TOTAL ABSORPTION REACTION RATE= 0.24120335E+14
ENERGY DENSITY = 0.73649125E+05
POWER DENSITY = 0.10694691E+03
TOTAL POWER = 0.28710359E+10
CONVERSION RATIO = 0.8599
BURNUP THIS STEP = 0.13271475E+04
POISON MAC CROSS SECTION NEEDED IS  0.15853764E-03
TIME =    1400.00

   ***** END OF SUBSTP  2 *****

                        KEFF=    1.00717      TIME=    1400.00

                    RELATIVE POINT GROUP AVERAGES

                      1     0.1000000E+01
                      2     0.9996744E+00
                      3     0.9987000E+00
                      4     0.9970753E+00
                      5     0.9947973E+00
                      6     0.9918646E+00
                      7     0.9882759E+00
                      8     0.9840311E+00
                      9     0.9791295E+00
                     10     0.9735696E+00
                     11     0.9673487E+00
                     12     0.9604565E+00
                     13     0.9528084E+00
                     14     0.9439623E+00
                     15     0.9365823E+00
                     16     0.9252549E+00
                     17     0.9099442E+00
                     18     0.8907654E+00
                     19     0.8678886E+00
                     20     0.8415114E+00
                     21     0.8118387E+00
                     22     0.7790674E+00
                     23     0.7433689E+00
                     24     0.7048413E+00
                     25     0.6728188E+00
                     26     0.6381382E+00
                     27     0.6009365E+00
                     28     0.5614077E+00
                     29     0.5197873E+00
                     30     0.4763519E+00
                     31     0.4314473E+00
                     32     0.3855637E+00
                     33     0.3395209E+00
                     34     0.2949075E+00
                     35     0.2538228E+00
                     36     0.2148328E+00
                     37     0.1788390E+00
                     38     0.1460646E+00
                     39     0.1163680E+00
                     40     0.8941489E-01
                     41     0.6477600E-01
                     42     0.4198107E-01
                     43     0.2054806E-01
                     44     0.0

                    PEAK TO AVERAGE =  1.2328
```

TIME= 2100.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.50432E-02	0.11241E-01	0.64542E-01	0.16400E+01
REGION 2	0.50513E-02	0.11261E-01	0.64863E-01	0.16399E+01
REGION 3	0.50608E-02	0.11277E-01	0.63254E-01	0.16392E+01
REGION 4	0.26140E-03	0.0	0.76735E-02	0.31852E+01
GROUP 2				
REGION 1	0.32051E-02	0.82268E-03	0.46687E-01	0.91733E+00
REGION 2	0.32229E-02	0.85987E-03	0.47185E-01	0.91728E+00
REGION 3	0.32432E-02	0.89985E-03	0.46200E-01	0.91696E+00
REGION 4	0.72660E-05	0.0	0.50930E-02	0.12073E+01
GROUP 3				
REGION 1	0.31202E-01	0.11582E-01	0.36207E-01	0.75787E+00
REGION 2	0.31375E-01	0.12097E-01	0.36753E-01	0.75759E+00
REGION 3	0.31116E-01	0.12624E-01	0.35589E-01	0.75795E+00
REGION 4	0.63022E-03	0.0	0.59906E-02	0.77410E+00
GROUP 4				
REGION 1	0.11327E+00	0.17134E+00	0.0	0.55750E+00
REGION 2	0.11498E+00	0.17555E+00	0.0	0.55584E+00
REGION 3	0.11134E+00	0.17272E+00	0.0	0.55903E+00
REGION 4	0.11006E-01	0.0	0.0	0.43184E+00

***** DATA AT END OF SUBSTP 3 *****

TOTAL TIME = 2100.00 HOURS

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.17180429E+21	0.18315160E+21	0.20238640E+21	0.0
U-238	0.10266018E+23	0.10258362E+23	0.10259218E+23	0.0
PU-239	0.24283743E+20	0.22599819E+20	0.15073266E+20	0.0
PU-240	0.15248159E+19	0.13164343E+19	0.58241241E+18	0.0
PU-241	0.35789543E+18	0.28332216E+18	0.79270390E+17	0.0
PU-242	0.92358977E+16	0.66674385E+16	0.12138608E+16	0.0
O-16	0.30318971E+23	0.30319219E+23	0.30319440E+23	0.24426610E+23
H&H2O	0.18645501E+23	0.18645501E+23	0.18645501E+23	0.48853220E+23
ZIRC2	0.70738129E+22	0.70738129E+22	0.70738129E+22	0.0
RS FPS	0.25887825E+19	0.24627026E+19	0.16042424E+19	0.0
SS FPS	0.75252159E+19	0.71756064E+19	0.46477203E+19	0.0
NS FPS	0.44651677E+20	0.42414374E+20	0.27228376E+20	0.0
XE-135	0.28422988E+16	0.28273144E+16	0.24231765E+16	0.0
SM-149	0.23986069E+17	0.24623228E+17	0.24482306E+17	0.0
REACTION RATES				
FISSION THEN ABSORPTION				
U-235	0.27227241E+13	0.25226002E+13	0.16892486E+13	0.0
U-235	0.34178408E+13	0.31668274E+13	0.21199795E+13	0.0
U-238	0.40295766E+12	0.35493780E+12	0.21397773E+12	0.0
U-238	0.43926694E+13	0.38250050E+13	0.23081465E+13	0.0
PU-239	0.85162997E+12	0.68864351E+12	0.27854963E+12	0.0
PU-239	0.13240799E+13	0.10706487E+13	0.43305501E+12	0.0
PU-240	0.40133146E+09	0.30428621E+09	0.81126496E+08	0.0
PU-240	0.13624312E+12	0.10232503E+12	0.27314778E+11	0.0
PU-241	0.13084701E+11	0.90008863E+10	0.15266729E+10	0.0

PU-241	0.17692164E+11	0.12170072E+11	0.20642322E+10	0.0
PU-242	0.17822030E+07	0.11323900E+07	0.12423319E+06	0.0
PU-242	0.11557782E+09	0.72602688E+08	0.79721960E+07	0.0
O-16	0.31185830E+11	0.27488813E+11	0.16571154E+11	0.28272888E+10
H&H2O	0.19069639E+12	0.16568726E+12	0.10045502E+12	0.10597479E+12
ZIRC2	0.15156078E+12	0.13198426E+12	0.79671656E+11	0.0
FPS	0.39777835E+12	0.33838445E+12	0.16202858E+12	0.0
TOTAL	0.39907964E+13	0.35754858E+13	0.21833816E+13	0.0
TOTAL	0.10059860E+14	0.88405904E+13	0.52492899E+13	0.10880208E+12
NEUTRON FLUX				
GROUP 1	0.10715715E+15	0.94459669E+14	0.56941401E+14	0.10780181E+14
GROUP 2	0.18808754E+15	0.16423931E+15	0.98793828E+14	0.23191129E+14
GROUP 3	0.13019732E+15	0.11327656E+15	0.68306724E+14	0.18434151E+14
GROUP 4	0.42853758E+14	0.37223777E+14	0.22591008E+14	0.85590561E+13
CONVERSION RATIO	0.8668	0.8406	0.8303	
BURNUP	0.24326628E+04	0.21772002E+04	0.13244880E+04	
POWER DENSITY	0.13053485E+03	0.11683212E+03	0.71124496E+02	
POWER	0.11792960E+10	0.10415849E+10	0.63271322E+09	
ENERGY DENSITY	0.89913187E+05	0.80701625E+05	0.49346090E+05	
FLUENCE	0.47398050E+21	0.41388306E+21	0.24896043E+21	0.58441629E+20
FTW RATIO	1.1839	1.1839	1.1839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.10072E+01 AT TIME= 1400.00
FUEL TO WATER RATIO =1.1839
GROUP 4 FLUX = 0.39329536E+14
GROUP 3 FLUX = 0.11496721E+15
GROUP 2 FLUX = 0.16428845E+15
GROUP 1 FLUX = 0.92673331E+14
TOTAL FLUX = 0.41125815E+15
TOTAL FISSION REACTION RATE= 0.97496638E+13
TOTAL ABSORPTION REACTION RATE= 0.24258529E+14
ENERGY DENSITY = 0.73411187E+05
POWER DENSITY = 0.10629720E+03
TOTAL POWER = 0.28535941E+10
CONVERSION RATIO = 0.8492
BURNUP THIS STEP = 0.19804441E+04
POISON MAC CROSS SECTION NEEDED IS 0.15267612E-03
TIME = 2100.00

***** END OF SUBSTP 3 *****

KEFF= 1.00226 TIME= 2100.00

RELATIVE POINT GROUP AVERAGES

1	0.1000000E+01
2	0.9996015E+00
3	0.9984066E+00
4	0.9964148E+00
5	0.9936273E+00
6	0.9900428E+00
7	0.9856655E+00
8	0.9804977E+00
9	0.9745442E+00
10	0.9678093E+00
11	0.9602974E+00
12	0.9520127E+00
13	0.9429473E+00

14	0.9330294E+00
15	0.9218830E+00
16	0.9129767E+00
17	0.9003618E+00
18	0.8840205E+00
19	0.8640640E+00
20	0.8406614E+00
21	0.8140022E+00
22	0.7842796E+00
23	0.7516840E+00
24	0.7163774E+00
25	0.6784478E+00
26	0.6470580E+00
27	0.6131809E+00
28	0.5769452E+00
29	0.5385348E+00
30	0.4981720E+00
31	0.4561180E+00
32	0.4126992E+00
33	0.3683830E+00
34	0.3239679E+00
35	0.2810523E+00
36	0.2420549E+00
37	0.2046267E+00
38	0.1699723E+00
39	0.1384611E+00
40	0.1100153E+00
41	0.8432341E-01
42	0.6095842E-01
43	0.3944352E-01
44	0.1928673E-01
45	0.0

PEAK TO AVERAGE = 1.2510

TIME= 2800.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.50465E-02	0.11260E-01	0.65699E-01	0.16414E+01
REGION 2	0.50543E-02	0.11278E-01	0.65692E-01	0.16412E+01
REGION 3	0.50644E-02	0.11293E-01	0.63431E-01	0.16403E+01
REGION 4	0.26121E-03	0.0	0.81527E-02	0.31889E+01
GROUP 2				
REGION 1	0.32043E-02	0.82272E-03	0.47502E-01	0.91757E+00
REGION 2	0.32219E-02	0.85879E-03	0.47742E-01	0.91749E+00
REGION 3	0.32428E-02	0.89918E-03	0.46272E-01	0.91706E+00
REGION 4	0.72600E-05	0.0	0.55540E-02	0.12076E+01
GROUP 3				
REGION 1	0.31925E-01	0.11605E-01	0.36717E-01	0.75696E+00
REGION 2	0.31991E-01	0.12098E-01	0.36997E-01	0.75687E+00
REGION 3	0.31493E-01	0.12617E-01	0.35370E-01	0.75763E+00
REGION 4	0.63591E-03	0.0	0.64858E-02	0.77407E+00
GROUP 4				
REGION 1	0.11847E+00	0.17877E+00	0.0	0.55287E+00
REGION 2	0.11938E+00	0.18183E+00	0.0	0.55195E+00
REGION 3	0.11413E+00	0.17685E+00	0.0	0.55655E+00
REGION 4	0.11193E-01	0.0	0.0	0.42811E+00

***** DATA AT END OF SUBSTP 4 *****

TOTAL TIME = 2800.00 HOURS

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.16349288E+21	0.17557301E+21	0.19732128E+21	0.0
U-238	0.10254881E+23	0.10248851E+23	0.10253539E+23	0.0
PU-239	0.30668053E+20	0.28283749E+20	0.19040551E+20	0.0
PU-240	0.24101955E+19	0.20415017E+19	0.91807132E+18	0.0
PU-241	0.73575800E+18	0.56275644E+18	0.15803061E+18	0.0
PU-242	0.25719776E+17	0.17592186E+17	0.30786326E+16	0.0
O-16	0.30318971E+23	0.30319219E+23	0.30319440E+23	0.24426610E+23
H&H2O	0.18645501E+23	0.18645501E+23	0.18645501E+23	0.48853220E+23
ZIRC2	0.70738129E+22	0.70738129E+22	0.70738129E+22	0.0
RS FPS	0.34145608E+19	0.31951049E+19	0.20715855E+19	0.0
SS FPS	0.10066651E+20	0.94179009E+19	0.60307377E+19	0.0
NS FPS	0.60245936E+20	0.56076096E+20	0.35492429E+20	0.0
XE-135	0.29364713E+16	0.28889118E+16	0.24373615E+16	0.0
SM-149	0.25010359E+17	0.25532773E+17	0.25177768E+17	0.0
REACTION RATES				
FISSION THEN ABSORPTION				
U-235	0.25515241E+13	0.23350309E+13	0.15745187E+13	0.0
U-235	0.32237242E+13	0.29503772E+13	0.19886464E+13	0.0
U-238	0.40761511E+12	0.35174154E+12	0.20990263E+12	0.0
U-238	0.44140027E+13	0.37685853E+13	0.22508659E+13	0.0
PU-239	0.10501385E+13	0.82513605E+12	0.33358001E+12	0.0
PU-239	0.16322218E+13	0.12824703E+13	0.51844999E+12	0.0
PU-240	0.63951334E+09	0.46610406E+09	0.12497901E+09	0.0
PU-240	0.20777684E+12	0.15010575E+12	0.40296899E+11	0.0
PU-241	0.26214142E+11	0.17083859E+11	0.28796751E+10	0.0
PU-241	0.35639325E+11	0.23225958E+11	0.39149061E+10	0.0
PU-242	0.50199450E+07	0.29605300E+07	0.30891169E+06	0.0
PU-242	0.32709350E+09	0.19086782E+09	0.19930288E+08	0.0
O-16	0.31688528E+11	0.27359945E+11	0.16320328E+11	0.27187622E+10
H&H2O	0.18785311E+12	0.16004324E+12	0.96078004E+11	0.10847361E+12
ZIRC2	0.15161668E+12	0.12944343E+12	0.77316424E+11	0.0
FPS	0.45404520E+12	0.37190474E+12	0.17036372E+12	0.0
TOTAL	0.40361337E+13	0.35294586E+13	0.21210040E+13	0.0
TOTAL	0.10338891E+14	0.88637052E+13	0.51622697E+13	0.11119238E+12
NEUTRON FLUX				
GROUP 1	0.10839439E+15	0.93593025E+14	0.55826589E+14	0.10367514E+14
GROUP 2	0.19029353E+15	0.16287185E+15	0.96913857E+14	0.22166511E+14
GROUP 3	0.13160585E+15	0.11226011E+15	0.66967248E+14	0.17839432E+14
GROUP 4	0.42040063E+14	0.35807646E+14	0.21521829E+14	0.86643562E+13
CONVERSION RATIO	0.8614	0.8380	0.8288	
BURNUP	0.32916721E+04	0.28742305E+04	0.17190112E+04	
POWER DENSITY	0.13232521E+03	0.11556165E+03	0.69189850E+02	
POWER	0.11954708E+10	0.10302582E+10	0.61550285E+09	
ENERGY DENSITY	0.91385187E+05	0.79995187E+05	0.48057844E+05	
FLUENCE	0.47953963E+21	0.41043696E+21	0.24422291E+21	0.55859606E+20
FTW RATIO	1.1839	1.1839	1.1839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.10023E+01 AT TIME= 2100.00
FUEL TO WATER RATIO =1.1839
GROUP 4 FLUX = 0.38293358E+14
GROUP 3 FLUX = 0.11430819E+15

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GROUP 2 FLUX = 0.16334801E+15
GROUP 1 FLUX = 0.92188503E+14
TOTAL FLUX = 0.40813759E+15
TOTAL FISSION REACTION RATE= 0.96865962E+13
TOTAL ABSORPTION REACTION RATE= 0.24476029E+14
ENERGY DENSITY = 0.73245062E+05
POWER DENSITY = 0.10583670E+03
TOTAL POWER = 0.28412319E+10
CONVERSION RATIO = 0.8459
BURNUP THIS STEP = 0.26315410E+04
POISON MAC CROSS SECTION NEEDED IS  0.47929367E-04
TIME =   2800.00

   ***** END OF SUBSTP  4 *****


FTW HAS BEEN CHANGED TO INCREASE REACTIVITY
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	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.15792688E+21	0.16959576E+21	0.19060363E+21	0.0
U-238	0.99057575E+22	0.98999343E+22	0.99044649E+22	0.0
PU-239	0.29623975E+20	0.27320841E+20	0.18392329E+20	0.0
PU-240	0.23281422E+19	0.19719994E+19	0.88681626E+18	0.0
PU-241	0.71070968E+18	0.54359779E+18	0.15265056E+18	0.0
PU-242	0.24844165E+17	0.16993270E+17	0.29738227E+16	0.0
O-16	0.29932738E+23	0.29932977E+23	0.29933193E+23	0.24426610E+23
H&H2O	0.19302644E+23	0.19302644E+23	0.19302644E+23	0.48853220E+23
ZIRC2	0.68329875E+22	0.68329875E+22	0.68329875E+22	0.0
RS FPS	0.32983139E+19	0.30863291E+19	0.20010595E+19	0.0
SS FPS	0.97239401E+19	0.90972756E+19	0.58254259E+19	0.0
NS FPS	0.58194899E+20	0.54167027E+20	0.34284110E+20	0.0
XE-135	0.28365014E+16	0.27905610E+16	0.23543832E+16	0.0
SM-149	0.24158899E+17	0.24663528E+17	0.24320609E+17	0.0
FTW RATIO	1.0839	1.0839	1.0839	0.0

TIME= 2800.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.49232E-02	0.10993E-01	0.66141E-01	0.16776E+01
REGION 2	0.49308E-02	0.11011E-01	0.66137E-01	0.16774E+01
REGION 3	0.49406E-02	0.11026E-01	0.63817E-01	0.16764E+01
REGION 4	0.26121E-03	0.0	0.81527E-02	0.31889E+01
GROUP 2				
REGION 1	0.30997E-02	0.79518E-03	0.50042E-01	0.92965E+00
REGION 2	0.31166E-02	0.83005E-03	0.50309E-01	0.92956E+00
REGION 3	0.31369E-02	0.86910E-03	0.48763E-01	0.92913E+00
REGION 4	0.72600E-05	0.0	0.55540E-02	0.12076E+01
GROUP 3				
REGION 1	0.31209E-01	0.11314E-01	0.39560E-01	0.76261E+00
REGION 2	0.31257E-01	0.11794E-01	0.39890E-01	0.76253E+00
REGION 3	0.30736E-01	0.12299E-01	0.38225E-01	0.76331E+00
REGION 4	0.63591E-03	0.0	0.64858E-02	0.77407E+00
GROUP 4				

REGION 1	0.11596E+00	0.17442E+00	0.0	0.55061E+00
REGION 2	0.11693E+00	0.17757E+00	0.0	0.54965E+00
REGION 3	0.11205E+00	0.17318E+00	0.0	0.55387E+00
REGION 4	0.11193E-01	0.0	0.0	0.42811E+00

KEFF= 1.01820 TIME= 2800.00

RELATIVE POINT GROUP AVERAGES

1	0.1000000E+01
2	0.9996203E+00
3	0.9984826E+00
4	0.9965863E+00
5	0.9939327E+00
6	0.9905227E+00
7	0.9863541E+00
8	0.9814319E+00
9	0.9757614E+00
10	0.9693456E+00
11	0.9621890E+00
12	0.9542951E+00
13	0.9456552E+00
14	0.9361964E+00
15	0.9255400E+00
16	0.9169461E+00
17	0.9046900E+00
18	0.8887466E+00
19	0.8692247E+00
20	0.8462870E+00
21	0.8201180E+00
22	0.7909054E+00
23	0.7588322E+00
24	0.7240444E+00
25	0.6866032E+00
26	0.6554804E+00
27	0.6216910E+00
28	0.5853612E+00
29	0.5466812E+00
30	0.5058853E+00
31	0.4632514E+00
32	0.4191278E+00
33	0.3740151E+00
34	0.3287696E+00
35	0.2851183E+00
36	0.2450728E+00
37	0.2066360E+00
38	0.1711463E+00
39	0.1390126E+00
40	0.1101506E+00
41	0.8422107E-01
42	0.6076130E-01
43	0.3925652E-01
44	0.1917734E-01
45	0.0

PEAK TO AVERAGE = 1.2444

TIME= 3500.00

	SA	NUSF	SR	DC
GROUP 1				

REGION 1	0.49247E-02	0.11005E-01	0.66819E-01	0.16789E+01
REGION 2	0.49323E-02	0.11022E-01	0.66570E-01	0.16786E+01
REGION 3	0.49430E-02	0.11037E-01	0.63746E-01	0.16774E+01
REGION 4	0.26102E-03	0.0	0.86498E-02	0.31926E+01

GROUP 2

REGION 1	0.30975E-02	0.79257E-03	0.50498E-01	0.92993E+00
REGION 2	0.31143E-02	0.82680E-03	0.50569E-01	0.92980E+00
REGION 3	0.31355E-02	0.86717E-03	0.48654E-01	0.92927E+00
REGION 4	0.72540E-05	0.0	0.60553E-02	0.12078E+01

GROUP 3

REGION 1	0.31856E-01	0.11300E-01	0.39620E-01	0.76172E+00
REGION 2	0.31807E-01	0.11764E-01	0.39769E-01	0.76182E+00
REGION 3	0.31060E-01	0.12275E-01	0.37805E-01	0.76297E+00
REGION 4	0.64159E-03	0.0	0.70112E-02	0.77403E+00

GROUP 4

REGION 1	0.11974E+00	0.17968E+00	0.0	0.54741E+00
REGION 2	0.12019E+00	0.18210E+00	0.0	0.54690E+00
REGION 3	0.11426E+00	0.17634E+00	0.0	0.55201E+00
REGION 4	0.11380E-01	0.0	0.0	0.42443E+00

***** DATA AT END OF SUBSTP 5 *****

TOTAL TIME = 3500.00 HOURS

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.15021772E+21	0.16247788E+21	0.18573188E+21	0.0
U-238	0.98952866E+22	0.98909451E+22	0.98990561E+22	0.0
PU-239	0.34798945E+20	0.32052769E+20	0.21893106E+20	0.0
PU-240	0.32623412E+19	0.27483162E+19	0.12640909E+19	0.0
PU-241	0.11912901E+19	0.89973476E+18	0.25776071E+18	0.0
PU-242	0.53497838E+17	0.35694545E+17	0.62628182E+16	0.0
O-16	0.29932738E+23	0.29932977E+23	0.29933193E+23	0.24426610E+23
H&H2O	0.19302644E+23	0.19302644E+23	0.19302644E+23	0.48853220E+23
ZIRC2	0.68329875E+22	0.68329875E+22	0.68329875E+22	0.0
RS FPS	0.40625569E+19	0.37730225E+19	0.24531127E+19	0.0
SS FPS	0.12208955E+20	0.11299272E+20	0.71950414E+19	0.0
NS FPS	0.73626588E+20	0.67738836E+20	0.42507788E+20	0.0
XE-135	0.28272202E+16	0.27806488E+16	0.23571054E+16	0.0
SM-149	0.24083913E+17	0.24509665E+17	0.24083376E+17	0.0
REACTION RATES				
FISSION THEN ABSORPTION				
U-235	0.23790218E+13	0.22043951E+13	0.15222272E+13	0.0
U-235	0.29836454E+13	0.27647929E+13	0.19085142E+13	0.0
U-238	0.38538189E+12	0.33422560E+12	0.20115600E+12	0.0
U-238	0.41492247E+13	0.35614800E+13	0.21431300E+13	0.0
PU-239	0.11858000E+13	0.93547974E+12	0.38629743E+12	0.0
PU-239	0.18358626E+13	0.14482827E+13	0.59803271E+12	0.0
PU-240	0.83070874E+09	0.60521805E+09	0.16728427E+09	0.0
PU-240	0.26533600E+12	0.19165459E+12	0.52989243E+11	0.0
PU-241	0.42862698E+11	0.27729023E+11	0.48005980E+10	0.0
PU-241	0.57982890E+11	0.37510021E+11	0.64939418E+10	0.0
PU-242	0.10084433E+08	0.58301870E+07	0.61485037E+06	0.0
PU-242	0.65973274E+09	0.37750554E+09	0.39796080E+08	0.0
O-16	0.31532507E+11	0.27357819E+11	0.16452608E+11	0.26351731E+10
H&H2O	0.19907163E+12	0.17049911E+12	0.10304756E+12	0.11122573E+12
ZIRC2	0.14109206E+12	0.12108510E+12	0.72839856E+11	0.0

FPS	0.50140991E+12	0.40911844E+12	0.18563642E+12	0.0
TOTAL	0.39939054E+13	0.35024389E+13	0.21146464E+13	0.0
TOTAL	0.10165813E+14	0.87321551E+13	0.50871717E+13	0.11386087E+12
NEUTRON FLUX				
GROUP 1	0.10504675E+15	0.91144155E+14	0.54811131E+14	0.10050101E+14
GROUP 2	0.17729367E+15	0.15252680E+15	0.91427002E+14	0.20715667E+14
GROUP 3	0.12519593E+15	0.10735608E+15	0.64484874E+14	0.16983424E+14
GROUP 4	0.42683586E+14	0.36549048E+14	0.22113730E+14	0.88040391E+13
CONVERSION RATIO	0.8259	0.8042	0.7938	
BURNUP	0.42269375E+04	0.37001680E+04	0.22216250E+04	
POWER DENSITY	0.13116403E+03	0.11485075E+03	0.69059143E+02	
POWER	0.11849802E+10	0.10239206E+10	0.61434010E+09	
ENERGY DENSITY	0.90932875E+05	0.79743250E+05	0.48042855E+05	
FLUENCE	0.44677988E+21	0.38436731E+21	0.23039603E+21	0.52203475E+20
FTW RATIO	1.0839	1.0839	1.0839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.10182E+01 AT TIME= 2800.00
FUEL TO WATER RATIO =1.0839
GROUP 4 FLUX = 0.39034877E+14
GROUP 3 FLUX = 0.10919379E+15
GROUP 2 FLUX = 0.15286166E+15
GROUP 1 FLUX = 0.89724501E+14
TOTAL FLUX = 0.39081464E+15
TOTAL FISSION REACTION RATE= 0.96109907E+13
TOTAL ABSORPTION REACTION RATE= 0.24098978E+14
ENERGY DENSITY = 0.73004187E+05
POWER DENSITY = 0.10516653E+03
TOTAL POWER = 0.28232410E+10
CONVERSION RATIO = 0.8111
BURNUP THIS STEP = 0.33868435E+04
TIME = 3500.00

***** END OF SUBSTP 5 *****

KEFF= 1.00869 TIME= 3500.00

RELATIVE POINT GROUP AVERAGES

1	0.1000000E+01
2	0.9997052E+00
3	0.9988208E+00
4	0.9973482E+00
5	0.9952892E+00
6	0.9926397E+00
7	0.9894022E+00
8	0.9855781E+00
9	0.9811682E+00
10	0.9761761E+00
11	0.9706044E+00
12	0.9644558E+00
13	0.9577306E+00
14	0.9504157E+00
15	0.9424319E+00
16	0.9334170E+00
17	0.9254384E+00
18	0.9137672E+00
19	0.8983755E+00
20	0.8793721E+00

21	0.8569195E+00
22	0.8311991E+00
23	0.8023992E+00
24	0.7706947E+00
25	0.7362261E+00
26	0.6990330E+00
27	0.6679652E+00
28	0.6340279E+00
29	0.5973485E+00
30	0.5581256E+00
31	0.5166059E+00
32	0.4730816E+00
33	0.4279191E+00
34	0.3816425E+00
35	0.3351586E+00
36	0.2903354E+00
37	0.2497316E+00
38	0.2102634E+00
39	0.1737093E+00
40	0.1406678E+00
41	0.1111165E+00
42	0.8471429E-01
43	0.6096702E-01
44	0.3931581E-01
45	0.1918390E-01
46	0.0

PEAK TO AVERAGE = 1.2263

TIME= 4200.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.49261E-02	0.11016E-01	0.67314E-01	0.16802E+01
REGION 2	0.49338E-02	0.11033E-01	0.66878E-01	0.16799E+01
REGION 3	0.49454E-02	0.11049E-01	0.63634E-01	0.16784E+01
REGION 4	0.26083E-03	0.0	0.91655E-02	0.31963E+01
GROUP 2				
REGION 1	0.30955E-02	0.79015E-03	0.50792E-01	0.93020E+00
REGION 2	0.31122E-02	0.82376E-03	0.50713E-01	0.93005E+00
REGION 3	0.31341E-02	0.86530E-03	0.48495E-01	0.92940E+00
REGION 4	0.72481E-05	0.0	0.66014E-02	0.12081E+01
GROUP 3				
REGION 1	0.32443E-01	0.11291E-01	0.39510E-01	0.76094E+00
REGION 2	0.32316E-01	0.11739E-01	0.39525E-01	0.76117E+00
REGION 3	0.31377E-01	0.12252E-01	0.37322E-01	0.76264E+00
REGION 4	0.64728E-03	0.0	0.75686E-02	0.77400E+00
GROUP 4				
REGION 1	0.12324E+00	0.18428E+00	0.0	0.54449E+00
REGION 2	0.12329E+00	0.18613E+00	0.0	0.54433E+00
REGION 3	0.11642E+00	0.17927E+00	0.0	0.55020E+00
REGION 4	0.11567E-01	0.0	0.0	0.42082E+00

***** DATA AT END OF SUBSTP 6 *****

TOTAL TIME = 4200.00 HOURS

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.14302544E+21	0.15573273E+21	0.18100127E+21	0.0
U-238	0.98848562E+22	0.98819109E+22	0.98935797E+22	0.0
PU-239	0.39434275E+20	0.36392498E+20	0.25240248E+20	0.0
PU-240	0.42054912E+19	0.35507716E+19	0.16770906E+19	0.0
PU-241	0.17768108E+19	0.13405774E+19	0.39464551E+18	0.0
PU-242	0.96985722E+17	0.64246663E+17	0.11434921E+17	0.0
O-16	0.29932738E+23	0.29932977E+23	0.29933193E+23	0.24426610E+23
H&H2O	0.19302644E+23	0.19302644E+23	0.19302644E+23	0.48853220E+23
ZIRC2	0.68329875E+22	0.68329875E+22	0.68329875E+22	0.0
RS FPS	0.47698881E+19	0.44200378E+19	0.28937310E+19	0.0
SS FPS	0.14634082E+20	0.13466155E+20	0.85568734E+19	0.0
NS FPS	0.88924401E+20	0.81290571E+20	0.50746174E+20	0.0
XE-135	0.28800411E+16	0.28296479E+16	0.23920028E+16	0.0
SM-149	0.24808431E+17	0.25180599E+17	0.24646172E+17	0.0
REACTION RATES				
FISSION THEN ABSORPTION				
U-235	0.22103269E+13	0.20797687E+13	0.14714594E+13	0.0
U-235	0.27852244E+13	0.26208622E+13	0.18534650E+13	0.0
U-238	0.38596660E+12	0.33769043E+12	0.20499327E+12	0.0
U-238	0.41331060E+13	0.35790709E+13	0.21699441E+13	0.0
PU-239	0.13011559E+13	0.10374439E+13	0.43841238E+12	0.0
PU-239	0.20140010E+13	0.16057736E+13	0.67854991E+12	0.0
PU-240	0.10697866E+10	0.78795418E+09	0.22540448E+09	0.0
PU-240	0.32643488E+12	0.23836859E+12	0.68150333E+11	0.0
PU-241	0.61898203E+11	0.40351416E+11	0.72343593E+10	0.0
PU-241	0.84024492E+11	0.54774821E+11	0.98200003E+10	0.0
PU-242	0.18320544E+08	0.10607337E+08	0.11439310E+07	0.0
PU-242	0.12035441E+10	0.68969293E+09	0.74264080E+08	0.0
O-16	0.31658406E+11	0.27705913E+11	0.16799502E+11	0.26435261E+10
H&H2O	0.19430172E+12	0.16786535E+12	0.10224540E+12	0.11853955E+12
ZIRC2	0.13978160E+12	0.12100711E+12	0.73317482E+11	0.0
FPS	0.54516882E+12	0.44583341E+12	0.20064895E+12	0.0
TOTAL	0.39604338E+13	0.34960510E+13	0.21223231E+13	0.0
TOTAL	0.10254901E+14	0.88619478E+13	0.51730113E+13	0.12118308E+12
NEUTRON FLUX				
GROUP 1	0.10521826E+15	0.92086699E+14	0.55835279E+14	0.10082493E+14
GROUP 2	0.17786171E+15	0.15434936E+15	0.93174333E+14	0.20603864E+14
GROUP 3	0.12549643E+15	0.10854954E+15	0.65649213E+14	0.17120818E+14
GROUP 4	0.41500038E+14	0.35845495E+14	0.21861031E+14	0.92780123E+13
CONVERSION RATIO	0.8340	0.8126	0.7998	
BURNUP	0.50441680E+04	0.44434570E+04	0.26803816E+04	
POWER DENSITY	0.13028809E+03	0.11481985E+03	0.69390244E+02	
POWER	0.11770668E+10	0.10236449E+10	0.61728538E+09	
ENERGY DENSITY	0.90427250E+05	0.79788437E+05	0.48295695E+05	
FLUENCE	0.44821146E+21	0.38896014E+21	0.23479930E+21	0.51921736E+20
FTW RATIO	1.0839	1.0839	1.0839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.10087E+01 AT TIME= 3500.00
FUEL TO WATER RATIO =1.0839
GROUP 4 FLUX = 0.38599391E+14
GROUP 3 FLUX = 0.11015833E+15
GROUP 2 FLUX = 0.15417101E+15
GROUP 1 FLUX = 0.90453773E+14
TOTAL FLUX = 0.39338223E+15
TOTAL FISSION REACTION RATE= 0.95788078E+13
TOTAL ABSORPTION REACTION RATE= 0.24411034E+14
ENERGY DENSITY = 0.72932812E+05

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POWER DENSITY = 0.10497121E+03
TOTAL POWER = 0.28179971E+10
CONVERSION RATIO = 0.8188
BURNUP THIS STEP = 0.40603909E+04
TIME =    4200.00

   ***** END OF SUBSTP  6 *****

                          KEFF=   0.99821     TIME=   4200.00

                    RELATIVE POINT GROUP AVERAGES

                      1     0.1000000E+01
                      2     0.9997468E+00
                      3     0.9989834E+00
                      4     0.9977137E+00
                      5     0.9959354E+00
                      6     0.9936469E+00
                      7     0.9908482E+00
                      8     0.9875394E+00
                      9     0.9837219E+00
                     10     0.9793949E+00
                     11     0.9745601E+00
                     12     0.9692189E+00
                     13     0.9633699E+00
                     14     0.9569969E+00
                     15     0.9500190E+00
                     16     0.9420669E+00
                     17     0.9347427E+00
                     18     0.9236965E+00
                     19     0.9088988E+00
                     20     0.8904538E+00
                     21     0.8685251E+00
                     22     0.8432900E+00
                     23     0.8149337E+00
                     24     0.7836286E+00
                     25     0.7495042E+00
                     26     0.7125794E+00
                     27     0.6815701E+00
                     28     0.6474717E+00
                     29     0.6104128E+00
                     30     0.5706012E+00
                     31     0.5282968E+00
                     32     0.4838074E+00
                     33     0.4375179E+00
                     34     0.3899778E+00
                     35     0.3421463E+00
                     36     0.2960436E+00
                     37     0.2548203E+00
                     38     0.2142066E+00
                     39     0.1764761E+00
                     40     0.1424380E+00
                     41     0.1121355E+00
                     42     0.8522302E-01
                     43     0.6116928E-01
                     44     0.3936609E-01
                     45     0.1918406E-01
                     46     0.0

                    PEAK TO AVERAGE =  1.2150

TIME=    4900.00
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	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.49275E-02	0.11027E-01	0.67583E-01	0.16815E+01
REGION 2	0.49353E-02	0.11043E-01	0.67017E-01	0.16811E+01
REGION 3	0.49478E-02	0.11060E-01	0.63446E-01	0.16794E+01
REGION 4	0.26064E-03	0.0	0.97001E-02	0.32000E+01
GROUP 2				
REGION 1	0.30936E-02	0.78808E-03	0.50909E-01	0.93048E+00
REGION 2	0.31101E-02	0.82103E-03	0.50722E-01	0.93029E+00
REGION 3	0.31328E-02	0.86356E-03	0.48269E-01	0.92954E+00
REGION 4	0.72421E-05	0.0	0.71976E-02	0.12083E+01
GROUP 3				
REGION 1	0.32961E-01	0.11287E-01	0.39220E-01	0.76028E+00
REGION 2	0.32779E-01	0.11719E-01	0.39138E-01	0.76060E+00
REGION 3	0.31680E-01	0.12230E-01	0.36759E-01	0.76232E+00
REGION 4	0.65297E-03	0.0	0.81601E-02	0.77396E+00
GROUP 4				
REGION 1	0.12640E+00	0.18838E+00	0.0	0.54189E+00
REGION 2	0.12614E+00	0.18979E+00	0.0	0.54200E+00
REGION 3	0.11847E+00	0.18200E+00	0.0	0.54850E+00
REGION 4	0.11755E-01	0.0	0.0	0.41728E+00

***** DATA AT END OF SUBSTP 7 *****

TOTAL TIME = 4900.00 HOURS

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.13629611E+21	0.14932249E+21	0.17639428E+21	0.0
U-238	0.98744439E+22	0.98728091E+22	0.98880178E+22	0.0
PU-239	0.43640725E+20	0.40415391E+20	0.28462345E+20	0.0
PU-240	0.51415858E+19	0.43665367E+19	0.21201146E+19	0.0
PU-241	0.24443463E+19	0.18537766E+19	0.56207034E+18	0.0
PU-242	0.15715100E+18	0.10423370E+18	0.18981969E+17	0.0
O-16	0.29932738E+23	0.29932977E+23	0.29933193E+23	0.24426610E+23
H&H2O	0.19302644E+23	0.19302644E+23	0.19302644E+23	0.48853220E+23
ZIRC2	0.68329875E+22	0.68329875E+22	0.68329875E+22	0.0
RS FPS	0.54228980E+19	0.50287121E+19	0.33233168E+19	0.0
SS FPS	0.17000493E+20	0.15600291E+20	0.99134035E+19	0.0
NS FPS	0.10406056E+21	0.94807774E+20	0.59053433E+20	0.0
XE-135	0.29287524E+16	0.28768851E+16	0.24279660E+16	0.0
SM-149	0.25504834E+17	0.25835152E+17	0.25207532E+17	0.0
REACTION RATES				
FISSION THEN ABSORPTION				
U-235	0.20588926E+13	0.19672513E+13	0.14261735E+13	0.0
U-235	0.26073283E+13	0.24914281E+13	0.18052033E+13	0.0
U-238	0.38732766E+12	0.34204785E+12	0.20951781E+12	0.0
U-238	0.41264360E+13	0.36067418E+13	0.22040491E+13	0.0
PU-239	0.13963708E+13	0.11275715E+13	0.48785451E+12	0.0
PU-239	0.21609180E+13	0.17449018E+13	0.75490178E+12	0.0
PU-240	0.13093284E+10	0.97899443E+09	0.29027354E+09	0.0
PU-240	0.38079844E+12	0.28226814E+12	0.83573473E+11	0.0
PU-241	0.82560156E+11	0.54599074E+11	0.10164990E+11	0.0
PU-241	0.11248992E+12	0.74391618E+11	0.13849031E+11	0.0
PU-242	0.29809536E+08	0.17440288E+08	0.19407580E+07	0.0

PU-242	0.19669535E+10	0.11389819E+10	0.12639987E+09	0.0
O-16	0.31848436E+11	0.28128993E+11	0.17204228E+11	0.26599240E+10
H&H2O	0.18994056E+12	0.16561203E+12	0.10170302E+12	0.12667211E+12
ZIRC2	0.13878297E+12	0.12125235E+12	0.74024485E+11	0.0
FPS	0.58600679E+12	0.48183122E+12	0.21619435E+12	0.0
TOTAL	0.39264883E+13	0.34924638E+13	0.21340000E+13	0.0
TOTAL	0.10336512E+14	0.89976912E+13	0.52708256E+13	0.12933202E+12
NEUTRON FLUX				
GROUP 1	0.10560143E+15	0.93273318E+14	0.57046292E+14	0.10145166E+14
GROUP 2	0.17884598E+15	0.15663665E+15	0.95259824E+14	0.20525095E+14
GROUP 3	0.12608965E+15	0.11006666E+15	0.67048936E+14	0.17301218E+14
GROUP 4	0.40401566E+14	0.35218665E+14	0.21660174E+14	0.98040210E+13
CONVERSION RATIO	0.8438	0.8226	0.8072	
BURNUP	0.58499961E+04	0.51912969E+04	0.31496921E+04	
POWER DENSITY	0.12937109E+03	0.11486594E+03	0.69848129E+02	
POWER	0.11687823E+10	0.10240558E+10	0.62135885E+09	
ENERGY DENSITY	0.89866875E+05	0.79866625E+05	0.48630762E+05	
FLUENCE	0.45069182E+21	0.39472418E+21	0.24005476E+21	0.51723226E+20
FTW RATIO	1.0839	1.0839	1.0839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.99821E+00 AT TIME= 4200.00
FUEL TO WATER RATIO =1.0839
GROUP 4 FLUX = 0.38265961E+14
GROUP 3 FLUX = 0.11143229E+15
GROUP 2 FLUX = 0.15590639E+15
GROUP 1 FLUX = 0.91415141E+14
TOTAL FLUX = 0.39701953E+15
TOTAL FISSION REACTION RATE= 0.95529520E+13
TOTAL ABSORPTION REACTION RATE= 0.24734331E+14
ENERGY DENSITY = 0.72881250E+05
POWER DENSITY = 0.10482965E+03
TOTAL POWER = 0.28141970E+10
CONVERSION RATIO = 0.8282
BURNUP THIS STEP = 0.47350547E+04
TIME = 4900.00

***** END OF SUBSTP 7 *****

KEFF= 0.98769 TIME= 4900.00

RELATIVE POINT GROUP AVERAGES

1	0.1000000E+01
2	0.9997623E+00
3	0.9990485E+00
4	0.9978632E+00
5	0.9962010E+00
6	0.9940627E+00
7	0.9914466E+00
8	0.9883530E+00
9	0.9847823E+00
10	0.9807363E+00
11	0.9762119E+00
12	0.9712113E+00
13	0.9657315E+00
14	0.9597585E+00
15	0.9532090E+00
16	0.9457183E+00

17	0.9386944E+00
18	0.9279615E+00
19	0.9134887E+00
20	0.8953824E+00
21	0.8737979E+00
22	0.8489131E+00
23	0.8209097E+00
24	0.7899553E+00
25	0.7561699E+00
26	0.7195544E+00
27	0.6886858E+00
28	0.6545736E+00
29	0.6173464E+00
30	0.5772173E+00
31	0.5344551E+00
32	0.4893788E+00
33	0.4423836E+00
34	0.3940367E+00
35	0.3453357E+00
36	0.2984327E+00
37	0.2570573E+00
38	0.2157061E+00
39	0.1771742E+00
40	0.1424907E+00
41	0.1117672E+00
42	0.8465421E-01
43	0.6058497E-01
44	0.3890403E-01
45	0.1893274E-01
46	0.0

PEAK TO AVERAGE = 1.2097

TIME= 5600.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.49289E-02	0.11037E-01	0.67656E-01	0.16828E+01
REGION 2	0.49367E-02	0.11053E-01	0.66996E-01	0.16823E+01
REGION 3	0.49502E-02	0.11072E-01	0.63177E-01	0.16804E+01
REGION 4	0.26045E-03	0.0	0.10254E-01	0.32037E+01
GROUP 2				
REGION 1	0.30920E-02	0.78645E-03	0.50877E-01	0.93075E+00
REGION 2	0.31083E-02	0.81871E-03	0.50609E-01	0.93052E+00
REGION 3	0.31316E-02	0.86200E-03	0.47977E-01	0.92967E+00
REGION 4	0.72361E-05	0.0	0.78498E-02	0.12086E+01
GROUP 3				
REGION 1	0.33413E-01	0.11290E-01	0.38786E-01	0.75973E+00
REGION 2	0.33190E-01	0.11705E-01	0.38629E-01	0.76011E+00
REGION 3	0.31965E-01	0.12211E-01	0.36118E-01	0.76203E+00
REGION 4	0.65866E-03	0.0	0.87881E-02	0.77392E+00
GROUP 4				
REGION 1	0.12930E+00	0.19210E+00	0.0	0.53954E+00
REGION 2	0.12878E+00	0.19315E+00	0.0	0.53987E+00
REGION 3	0.12041E+00	0.18456E+00	0.0	0.54690E+00
REGION 4	0.11942E-01	0.0	0.0	0.41379E+00

***** DATA AT END OF SUBSTP 8 *****

TOTAL TIME = 5600.00 HOURS

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.12996213E+21	0.14322532E+21	0.17191893E+21	0.0
U-238	0.98639866E+22	0.98636308E+22	0.98823793E+22	0.0
PU-239	0.47520206E+20	0.44177814E+20	0.31568632E+20	0.0
PU-240	0.60665598E+19	0.51870769E+19	0.25870728E+19	0.0
PU-241	0.31745276E+19	0.24253115E+19	0.75820563E+18	0.0
PU-242	0.23526030E+18	0.15685193E+18	0.29378951E+17	0.0
O-16	0.29932738E+23	0.29932977E+23	0.29933193E+23	0.24426610E+23
H&H2O	0.19302644E+23	0.19302644E+23	0.19302644E+23	0.48853220E+23
ZIRC2	0.68329875E+22	0.68329875E+22	0.68329875E+22	0.0
RS FPS	0.60269565E+19	0.55997380E+19	0.37399734E+19	0.0
SS FPS	0.19318279E+20	0.17700444E+20	0.11259990E+20	0.0
NS FPS	0.11912297E+21	0.10826808E+21	0.67352740E+20	0.0
XE-135	0.29775408E+16	0.29220021E+16	0.24604748E+16	0.0
SM-149	0.26188052E+17	0.26483129E+17	0.25771062E+17	0.0
REACTION RATES				
FISSION THEN ABSORPTION				
U-235	0.19286123E+13	0.18619249E+13	0.13785429E+13	0.0
U-235	0.24551327E+13	0.23703868E+13	0.17538577E+13	0.0
U-238	0.39093410E+12	0.34676959E+12	0.21362239E+12	0.0
U-238	0.41430989E+13	0.36377975E+13	0.22336231E+13	0.0
PU-239	0.14815131E+13	0.12062839E+13	0.53235030E+12	0.0
PU-239	0.22922207E+13	0.18663342E+13	0.82357780E+12	0.0
PU-240	0.15554145E+10	0.11760182E+10	0.35996979E+09	0.0
PU-240	0.42992062E+12	0.32226207E+12	0.98431533E+11	0.0
PU-241	0.10444099E+12	0.69888770E+11	0.13485453E+11	0.0
PU-241	0.14287163E+12	0.95604703E+11	0.18445513E+11	0.0
PU-242	0.45070128E+08	0.26620432E+08	0.30625790E+07	0.0
PU-242	0.29867310E+10	0.17461545E+10	0.20013698E+09	0.0
O-16	0.32224322E+11	0.28584038E+11	0.17576018E+11	0.26677565E+10
H&H2O	0.18657568E+12	0.16340189E+12	0.10086613E+12	0.13486496E+12
ZIRC2	0.13855300E+12	0.12158874E+12	0.74560897E+11	0.0
FPS	0.62682504E+12	0.51628592E+12	0.23088575E+12	0.0
TOTAL	0.39070980E+13	0.34860685E+13	0.21383610E+13	0.0
TOTAL	0.10450406E+14	0.91239890E+13	0.53520200E+13	0.13753267E+12
NEUTRON FLUX				
GROUP 1	0.10659767E+15	0.94560131E+14	0.58142616E+14	0.10174790E+14
GROUP 2	0.18085992E+15	0.15909970E+15	0.97168669E+14	0.20348012E+14
GROUP 3	0.12740296E+15	0.11170406E+15	0.68325984E+14	0.17415171E+14
GROUP 4	0.39511199E+14	0.34595727E+14	0.21392662E+14	0.10322134E+14
CONVERSION RATIO	0.8549	0.8338	0.8159	
BURNUP	0.66694805E+04	0.59357617E+04	0.36129495E+04	
POWER DENSITY	0.12891383E+03	0.11480687E+03	0.70062790E+02	
POWER	0.11646513E+10	0.10235292E+10	0.62326835E+09	
ENERGY DENSITY	0.89601687E+05	0.79859750E+05	0.48793875E+05	
FLUENCE	0.45576682E+21	0.40093099E+21	0.24486504E+21	0.51276983E+20
FTW RATIO	1.0839	1.0839	1.0839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.98769E+00 AT TIME= 4900.00
FUEL TO WATER RATIO =1.0839
GROUP 4 FLUX = 0.37977107E+14
GROUP 3 FLUX = 0.11290857E+15
GROUP 2 FLUX = 0.15792992E+15
GROUP 1 FLUX = 0.92558558E+14

TOTAL FLUX = 0.40137382E+15
TOTAL FISSION REACTION RATE= 0.95315275E+13
TOTAL ABSORPTION REACTION RATE= 0.25063919E+14
ENERGY DENSITY = 0.72843812E+05
POWER DENSITY = 0.10472726E+03
TOTAL POWER = 0.28114488E+10
CONVERSION RATIO = 0.8387
BURNUP THIS STEP = 0.54111250E+04
TIME = 5600.00

***** END OF SUBSTP 8 *****

FTW HAS BEEN CHANGED TO INCREASE REACTIVITY

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.12485194E+21	0.13759361E+21	0.16515898E+21	0.0
U-238	0.94761276E+22	0.94757853E+22	0.94937952E+22	0.0
PU-239	0.45651670E+20	0.42440709E+20	0.30327328E+20	0.0
PU-240	0.58280186E+19	0.49831175E+19	0.24853471E+19	0.0
PU-241	0.30497022E+19	0.23299465E+19	0.72839251E+18	0.0
PU-242	0.22600970E+18	0.15068436E+18	0.28223751E+17	0.0
O-16	0.29530283E+23	0.29530513E+23	0.29530720E+23	0.24426610E+23
H&H2O	0.20092697E+23	0.20092697E+23	0.20092697E+23	0.48853220E+23
ZIRC2	0.65643072E+22	0.65643072E+22	0.65643072E+22	0.0
RS FPS	0.57899722E+19	0.53795520E+19	0.35929148E+19	0.0
SS FPS	0.18558666E+20	0.17004452E+20	0.10817239E+20	0.0
NS FPS	0.11443898E+21	0.10401091E+21	0.64704377E+20	0.0
XE-135	0.28604622E+16	0.28071071E+16	0.23637275E+16	0.0
SM-149	0.25158321E+17	0.25441793E+17	0.24757725E+17	0.0
FTW RATIO	0.9839	0.9839	0.9839	0.0

TIME= 5600.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.47811E-02	0.10705E-01	0.67498E-01	0.17235E+01
REGION 2	0.47886E-02	0.10720E-01	0.66811E-01	0.17230E+01
REGION 3	0.48017E-02	0.10738E-01	0.62881E-01	0.17211E+01
REGION 4	0.26045E-03	0.0	0.10254E-01	0.32037E+01
GROUP 2				
REGION 1	0.29726E-02	0.75607E-03	0.53307E-01	0.94403E+00
REGION 2	0.29883E-02	0.78706E-03	0.53023E-01	0.94381E+00
REGION 3	0.30107E-02	0.82863E-03	0.50227E-01	0.94297E+00
REGION 4	0.72361E-05	0.0	0.78498E-02	0.12086E+01
GROUP 3				
REGION 1	0.32449E-01	0.10963E-01	0.41492E-01	0.76522E+00
REGION 2	0.32193E-01	0.11364E-01	0.41354E-01	0.76562E+00
REGION 3	0.30908E-01	0.11849E-01	0.38760E-01	0.76760E+00
REGION 4	0.65866E-03	0.0	0.87881E-02	0.77392E+00
GROUP 4				
REGION 1	0.12562E+00	0.18587E+00	0.0	0.53737E+00
REGION 2	0.12520E+00	0.18706E+00	0.0	0.53761E+00

REGION 3	0.11735E+00	0.17926E+00	0.0	0.54414E+00
REGION 4	0.11942E-01	0.0	0.0	0.41379E+00

KEFF= 1.00051 TIME= 5600.00

RELATIVE POINT GROUP AVERAGES

1	0.1000000E+01
2	0.9998435E+00
3	0.9993727E+00
4	0.9985889E+00
5	0.9974899E+00
6	0.9960740E+00
7	0.9943396E+00
8	0.9922851E+00
9	0.9899096E+00
10	0.9872116E+00
11	0.9841912E+00
12	0.9808433E+00
13	0.9771672E+00
14	0.9731421E+00
15	0.9686775E+00
16	0.9633831E+00
17	0.9577010E+00
18	0.9482492E+00
19	0.9349852E+00
20	0.9180048E+00
21	0.8974612E+00
22	0.8735296E+00
23	0.8463862E+00
24	0.8161899E+00
25	0.7830426E+00
26	0.7469031E+00
27	0.7161235E+00
28	0.6817083E+00
29	0.6437856E+00
30	0.6025841E+00
31	0.5583977E+00
32	0.5115792E+00
33	0.4625702E+00
34	0.4120038E+00
35	0.3609958E+00
36	0.3119552E+00
37	0.2682179E+00
38	0.2244074E+00
39	0.1836823E+00
40	0.1471921E+00
41	0.1150533E+00
42	0.8686942E-01
43	0.6200663E-01
44	0.3973783E-01
45	0.1931461E-01
46	0.0

PEAK TO AVERAGE = 1.1875

TIME= 6300.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.47811E-02	0.10710E-01	0.67216E-01	0.17248E+01
REGION 2	0.47888E-02	0.10726E-01	0.66495E-01	0.17242E+01

REGION 3	0.48030E-02	0.10746E-01	0.62423E-01	0.17221E+01
REGION 4	0.26026E-03	0.0	0.10828E-01	0.32074E+01
GROUP 2				
REGION 1	0.29699E-02	0.75285E-03	0.53006E-01	0.94434E+00
REGION 2	0.29854E-02	0.78334E-03	0.52686E-01	0.94410E+00
REGION 3	0.30087E-02	0.82620E-03	0.49792E-01	0.94315E+00
REGION 4	0.72301E-05	0.0	0.85652E-02	0.12088E+01
GROUP 3				
REGION 1	0.32826E-01	0.10945E-01	0.40763E-01	0.76473E+00
REGION 2	0.32544E-01	0.11333E-01	0.40602E-01	0.76517E+00
REGION 3	0.31148E-01	0.11820E-01	0.37979E-01	0.76730E+00
REGION 4	0.66434E-03	0.0	0.94551E-02	0.77388E+00
GROUP 4				
REGION 1	0.12762E+00	0.18834E+00	0.0	0.53587E+00
REGION 2	0.12712E+00	0.18939E+00	0.0	0.53618E+00
REGION 3	0.11891E+00	0.18123E+00	0.0	0.54295E+00
REGION 4	0.12129E-01	0.0	0.0	0.41036E+00

***** DATA AT END OF SUBSTP 9 *****

TOTAL TIME = 6300.00 HOURS

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.11900484E+21	0.13183123E+21	0.16079712E+21	0.0
U-238	0.94662602E+22	0.94669627E+22	0.94882963E+22	0.0
PU-239	0.48780141E+20	0.45593053E+20	0.33118205E+20	0.0
PU-240	0.67406913E+19	0.58144066E+19	0.29790113E+19	0.0
PU-241	0.37774821E+19	0.29198807E+19	0.94519297E+18	0.0
PU-242	0.31771488E+18	0.21429042E+18	0.41587928E+17	0.0
O-16	0.29530283E+23	0.29530513E+23	0.29530720E+23	0.24426610E+23
H&H2O	0.20092697E+23	0.20092697E+23	0.20092697E+23	0.48853220E+23
ZIRC2	0.65643072E+22	0.65643072E+22	0.65643072E+22	0.0
RS FPS	0.63316367E+19	0.59077123E+19	0.39986302E+19	0.0
SS FPS	0.20809322E+20	0.19082033E+20	0.12175269E+20	0.0
NS FPS	0.12923389E+21	0.11744816E+21	0.73156261E+20	0.0
XE-135	0.28277361E+16	0.27901224E+16	0.23794395E+16	0.0
SM-149	0.24810257E+17	0.25075067E+17	0.24401848E+17	0.0
REACTION RATES				
FISSION THEN ABSORPTION				
U-235	0.18047576E+13	0.17831633E+13	0.13613977E+13	0.0
U-235	0.22677470E+13	0.22348038E+13	0.17052991E+13	0.0
U-238	0.37178370E+12	0.33585516E+12	0.21037593E+12	0.0
U-238	0.39090043E+13	0.34950286E+13	0.21790783E+13	0.0
PU-239	0.15298619E+13	0.12750758E+13	0.58040169E+12	0.0
PU-239	0.23585861E+13	0.19657350E+13	0.89471307E+12	0.0
PU-240	0.16800494E+10	0.13049933E+10	0.41693107E+09	0.0
PU-240	0.45513625E+12	0.35043213E+12	0.11158566E+12	0.0
PU-241	0.12806613E+12	0.88279286E+11	0.17895715E+11	0.0
PU-241	0.17254659E+12	0.11893834E+12	0.24111305E+11	0.0
PU-242	0.59578400E+08	0.36251552E+08	0.43917780E+07	0.0
PU-242	0.39225687E+10	0.23621504E+10	0.28467738E+09	0.0
O-16	0.32073470E+11	0.28970848E+11	0.18106774E+11	0.26762186E+10
H&H2O	0.20003180E+12	0.17836520E+12	0.11172302E+12	0.14208198E+12
ZIRC2	0.12889424E+12	0.11516628E+12	0.71688520E+11	0.0
FPS	0.65831299E+12	0.55280933E+12	0.25121194E+12	0.0
TOTAL	0.38362069E+13	0.34837124E+13	0.21704905E+13	0.0

TOTAL	0.10180252E+14	0.90426090E+13	0.53677979E+13	0.14475815E+12
NEUTRON FLUX				
GROUP 1	0.10457435E+15	0.94463024E+14	0.59038386E+14	0.10207793E+14
GROUP 2	0.16997249E+15	0.15224545E+15	0.94403331E+14	0.19550892E+14
GROUP 3	0.12240474E+15	0.10927345E+15	0.67825956E+14	0.17087887E+14
GROUP 4	0.40411733E+14	0.36026471E+14	0.22602601E+14	0.10768215E+14
CONVERSION RATIO	0.8326	0.8122	0.7926	
BURNUP	0.76838867E+04	0.69594062E+04	0.43004102E+04	
POWER DENSITY	0.12668816E+03	0.11483092E+03	0.71169113E+02	
POWER	0.11445437E+10	0.10237437E+10	0.63311002E+09	
ENERGY DENSITY	0.88241312E+05	0.80019625E+05	0.49613035E+05	
FLUENCE	0.42833061E+21	0.38365827E+21	0.23789639E+21	0.49268236E+20
FTW RATIO	0.9839	0.9839	0.9839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.10005E+01 AT TIME= 5600.00
FUEL TO WATER RATIO =0.9839
GROUP 4 FLUX = 0.39419982E+14
GROUP 3 FLUX = 0.11006011E+15
GROUP 2 FLUX = 0.15060211E+15
GROUP 1 FLUX = 0.92161727E+14
TOTAL FLUX = 0.39224353E+15
TOTAL FISSION REACTION RATE= 0.94904097E+13
TOTAL ABSORPTION REACTION RATE= 0.24735388E+14
ENERGY DENSITY = 0.72710500E+05
POWER DENSITY = 0.10435286E+03
TOTAL POWER = 0.28013975E+10
CONVERSION RATIO = 0.8163
BURNUP THIS STEP = 0.63197422E+04
TIME = 6300.00

***** END OF SUBSTP 9 *****

FTW HAS BEEN CHANGED TO INCREASE REACTIVITY

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.11353064E+21	0.12576703E+21	0.15340048E+21	0.0
U-238	0.90308116E+22	0.90314827E+22	0.90518344E+22	0.0
PU-239	0.46536258E+20	0.43495783E+20	0.31594774E+20	0.0
PU-240	0.64306213E+19	0.55469449E+19	0.28419770E+19	0.0
PU-241	0.36037186E+19	0.27855665E+19	0.90171437E+18	0.0
PU-242	0.30310003E+18	0.20443309E+18	0.39674894E+17	0.0
O-16	0.29118433E+23	0.29118649E+23	0.29118848E+23	0.24426610E+23
H&H2O	0.21061521E+23	0.21061521E+23	0.21061521E+23	0.48853220E+23
ZIRC2	0.62623499E+22	0.62623499E+22	0.62623499E+22	0.0
RS FPS	0.60403826E+19	0.56359592E+19	0.38146940E+19	0.0
SS FPS	0.19852096E+20	0.18204264E+20	0.11615210E+20	0.0
NS FPS	0.12328915E+21	0.11204557E+21	0.69791087E+20	0.0
XE-135	0.26976609E+16	0.26617775E+16	0.22699858E+16	0.0
SM-149	0.23668989E+17	0.23921619E+17	0.23279367E+17	0.0
FTW RATIO	0.8839	0.8839	0.8839	0.0

TIME= 6300.00

SA	NUSF	SR	DC

GROUP 1

REGION 1	0.46052E-02	0.10308E-01	0.66832E-01	0.17702E+01
REGION 2	0.46126E-02	0.10323E-01	0.66094E-01	0.17697E+01
REGION 3	0.46262E-02	0.10342E-01	0.61946E-01	0.17675E+01
REGION 4	0.26026E-03	0.0	0.10828E-01	0.32074E+01

GROUP 2

REGION 1	0.28355E-02	0.71881E-03	0.55266E-01	0.95868E+00
REGION 2	0.28503E-02	0.74790E-03	0.54934E-01	0.95844E+00
REGION 3	0.28725E-02	0.78875E-03	0.51890E-01	0.95750E+00
REGION 4	0.72301E-05	0.0	0.85652E-02	0.12088E+01

GROUP 3

REGION 1	0.31691E-01	0.10546E-01	0.43346E-01	0.76986E+00
REGION 2	0.31382E-01	0.10917E-01	0.43203E-01	0.77032E+00
REGION 3	0.29943E-01	0.11380E-01	0.40509E-01	0.77248E+00
REGION 4	0.66434E-03	0.0	0.94551E-02	0.77388E+00

GROUP 4

REGION 1	0.12317E+00	0.18089E+00	0.0	0.53273E+00
REGION 2	0.12277E+00	0.18206E+00	0.0	0.53296E+00
REGION 3	0.11511E+00	0.17472E+00	0.0	0.53918E+00
REGION 4	0.12129E-01	0.0	0.0	0.41036E+00

KEFF= 1.01117 TIME= 6300.00

RELATIVE POINT GROUP AVERAGES

1	0.1000000E+01
2	0.9999155E+00
3	0.9996621E+00
4	0.9992415E+00
5	0.9986503E+00
6	0.9978876E+00
7	0.9969470E+00
8	0.9958316E+00
9	0.9945341E+00
10	0.9930536E+00
11	0.9913867E+00
12	0.9895310E+00
13	0.9874783E+00
14	0.9852070E+00
15	0.9826186E+00
16	0.9792998E+00
17	0.9748375E+00
18	0.9665753E+00
19	0.9544569E+00
20	0.9385718E+00
21	0.9190681E+00
22	0.8961157E+00
23	0.8698825E+00
24	0.8405181E+00
25	0.8081024E+00
26	0.7725487E+00
27	0.7419497E+00
28	0.7073310E+00
29	0.6688180E+00
30	0.6266523E+00
31	0.5811523E+00
32	0.5327049E+00

33	0.4817982E+00
34	0.4291340E+00
35	0.3759516E+00
36	0.3249263E+00
37	0.2788152E+00
38	0.2325397E+00
39	0.1896381E+00
40	0.1513833E+00
41	0.1178926E+00
42	0.8871597E-01
43	0.6314701E-01
44	0.4038290E-01
45	0.1960225E-01
46	0.0

PEAK TO AVERAGE = 1.1676

TIME= 7000.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.46046E-02	0.10310E-01	0.66385E-01	0.17714E+01
REGION 2	0.46121E-02	0.10325E-01	0.65648E-01	0.17708E+01
REGION 3	0.46270E-02	0.10347E-01	0.61425E-01	0.17684E+01
REGION 4	0.26007E-03	0.0	0.11423E-01	0.32111E+01
GROUP 2				
REGION 1	0.28321E-02	0.71425E-03	0.54850E-01	0.95902E+00
REGION 2	0.28468E-02	0.74296E-03	0.54513E-01	0.95876E+00
REGION 3	0.28698E-02	0.78550E-03	0.51428E-01	0.95772E+00
REGION 4	0.72241E-05	0.0	0.93521E-02	0.12091E+01
GROUP 3				
REGION 1	0.32012E-01	0.10509E-01	0.42514E-01	0.76943E+00
REGION 2	0.31690E-01	0.10870E-01	0.42377E-01	0.76990E+00
REGION 3	0.30155E-01	0.11342E-01	0.39720E-01	0.77217E+00
REGION 4	0.67003E-03	0.0	0.10164E-01	0.77385E+00
GROUP 4				
REGION 1	0.12460E+00	0.18237E+00	0.0	0.53175E+00
REGION 2	0.12420E+00	0.18353E+00	0.0	0.53196E+00
REGION 3	0.11641E+00	0.17619E+00	0.0	0.53825E+00
REGION 4	0.12316E-01	0.0	0.0	0.40698E+00

***** DATA AT END OF SUBSTP 10 *****

TOTAL TIME = 7000.00 HOURS

NUMBER DENSITY	REGION 1	REGION 2	REGION 3	REGION 4
U-235	0.10810859E+21	0.12031053E+21	0.14914414E+21	0.0
U-238	0.90214622E+22	0.90229889E+22	0.90464616E+22	0.0
PU-239	0.49038395E+20	0.46112409E+20	0.34089857E+20	0.0
PU-240	0.73239701E+19	0.63806507E+19	0.33588871E+19	0.0
PU-241	0.43150818E+19	0.33829598E+19	0.11365608E+19	0.0
PU-242	0.40717115E+18	0.27883615E+18	0.55696861E+17	0.0
O-16	0.29118433E+23	0.29118649E+23	0.29118848E+23	0.24426610E+23
H&H2O	0.21061521E+23	0.21061521E+23	0.21061521E+23	0.48853220E+23
ZIRC2	0.62623499E+22	0.62623499E+22	0.62623499E+22	0.0

RS FPS	0.65196663E+19	0.61179818E+19	0.42070163E+19	0.0
SS FPS	0.22039543E+20	0.20258511E+20	0.12984380E+20	0.0
NS FPS	0.13784053E+21	0.12549738E+21	0.78353204E+20	0.0
XE-135	0.26640799E+16	0.26425841E+16	0.22850627E+16	0.0
SM-149	0.23257055E+17	0.23504410E+17	0.22901672E+17	0.0

REACTION RATES
FISSION THEN ABSORPTION

U-235	0.16960685E+13	0.17107192E+13	0.13459312E+13	0.0
U-235	0.20938375E+13	0.21120135E+13	0.16609517E+13	0.0
U-238	0.35459590E+12	0.32560172E+12	0.20718669E+12	0.0
U-238	0.37053467E+13	0.33670331E+13	0.21297386E+13	0.0
PU-239	0.15662559E+13	0.13345982E+13	0.62682373E+12	0.0
PU-239	0.24062313E+13	0.20502901E+13	0.96288683E+12	0.0
PU-240	0.17954898E+10	0.14317153E+10	0.47709491E+09	0.0
PU-240	0.47583455E+12	0.37603272E+12	0.12473998E+12	0.0
PU-241	0.15253891E+12	0.10837603E+12	0.23115076E+11	0.0
PU-241	0.20263810E+12	0.14396549E+12	0.30710002E+11	0.0
PU-242	0.75604144E+08	0.47473408E+08	0.60103970E+07	0.0
PU-242	0.49387520E+10	0.30687247E+10	0.38593357E+09	0.0
O-16	0.31986860E+11	0.29365367E+11	0.18637750E+11	0.27055700E+10
H&H2O	0.21850076E+12	0.19798911E+12	0.12573350E+12	0.15083333E+12
ZIRC2	0.12066089E+12	0.10955699E+12	0.69164466E+11	0.0
FPS	0.69024324E+12	0.59059595E+12	0.27321546E+12	0.0
TOTAL	0.37713294E+13	0.34807732E+13	0.22035363E+13	0.0
TOTAL	0.99502155E+13	0.89799073E+13	0.53961608E+13	0.15353885E+12

NEUTRON FLUX				
GROUP 1	0.10367506E+15	0.95183287E+14	0.60410795E+14	0.10320155E+14
GROUP 2	0.16156177E+15	0.14706669E+15	0.92498261E+14	0.18925136E+14
GROUP 3	0.11887223E+15	0.10784339E+15	0.67865030E+14	0.16898914E+14
GROUP 4	0.41813151E+14	0.37879766E+14	0.24092284E+14	0.11318001E+14
CONVERSION RATIO	0.8133	0.7933	0.7711	
BURNUP	0.88137695E+04	0.81124570E+04	0.50909336E+04	
POWER DENSITY	0.12463020E+03	0.11481174E+03	0.72291672E+02	
POWER	0.11259515E+10	0.10235727E+10	0.64309606E+09	
ENERGY DENSITY	0.86965937E+05	0.80130000E+05	0.50441953E+05	
FLUENCE	0.40713554E+21	0.37060797E+21	0.23309560E+21	0.47691326E+20
FTW RATIO	0.8839	0.8839	0.8839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.10112E+01 AT TIME= 6300.00
FUEL TO WATER RATIO =0.8839
GROUP 4 FLUX = 0.41325722E+14
GROUP 3 FLUX = 0.10829763E+15
GROUP 2 FLUX = 0.14505056E+15
GROUP 1 FLUX = 0.92619510E+14
TOTAL FLUX = 0.38729331E+15
TOTAL FISSION REACTION RATE= 0.94556389E+13
TOTAL ABSORPTION REACTION RATE= 0.24479804E+14
ENERGY DENSITY = 0.72592625E+05
POWER DENSITY = 0.10402591E+03
TOTAL POWER = 0.27926203E+10
CONVERSION RATIO = 0.7964
BURNUP THIS STEP = 0.73442812E+04
TIME = 7000.00

***** END OF SUBSTP 10 *****

KEFF= 0.99980 TIME= 7000.00

RELATIVE POINT GROUP AVERAGES

1	0.1000000E+01
2	0.9999401E+00
3	0.9997604E+00
4	0.9994634E+00
5	0.9990442E+00
6	0.9985002E+00
7	0.9978306E+00
8	0.9970345E+00
9	0.9961070E+00
10	0.9950465E+00
11	0.9938495E+00
12	0.9925119E+00
13	0.9910280E+00
14	0.9893743E+00
15	0.9874528E+00
16	0.9848509E+00
17	0.9808540E+00
18	0.9730723E+00
19	0.9614484E+00
20	0.9460697E+00
21	0.9270818E+00
22	0.9046484E+00
23	0.8789352E+00
24	0.8500835E+00
25	0.8181624E+00
26	0.7830608E+00
27	0.7526678E+00
28	0.7180340E+00
29	0.6792846E+00
30	0.6366693E+00
31	0.5905182E+00
32	0.5412337E+00
33	0.4893213E+00
34	0.4355100E+00
35	0.3811007E+00
36	0.3289609E+00
37	0.2824913E+00
38	0.2350898E+00
39	0.1910132E+00
40	0.1518219E+00
41	0.1177110E+00
42	0.8821338E-01
43	0.6256759E-01
44	0.3990452E-01
45	0.1933731E-01
46	0.0

PEAK TO AVERAGE = 1.1601

TIME= 7700.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.46041E-02	0.10312E-01	0.65863E-01	0.17726E+01
REGION 2	0.46117E-02	0.10328E-01	0.65138E-01	0.17719E+01
REGION 3	0.46279E-02	0.10353E-01	0.60868E-01	0.17693E+01
REGION 4	0.25988E-03	0.0	0.12038E-01	0.32149E+01
GROUP 2				
REGION 1	0.28290E-02	0.71053E-03	0.54379E-01	0.95935E+00

REGION 2	0.28435E-02	0.73876E-03	0.54043E-01	0.95907E+00
REGION 3	0.28674E-02	0.78258E-03	0.50933E-01	0.95794E+00
REGION 4	0.72181E-05	0.0	0.10220E-01	0.12093E+01

GROUP 3

REGION 1	0.32269E-01	0.10485E-01	0.41670E-01	0.76911E+00
REGION 2	0.31945E-01	0.10835E-01	0.41536E-01	0.76957E+00
REGION 3	0.30346E-01	0.11310E-01	0.38907E-01	0.77191E+00
REGION 4	0.67572E-03	0.0	0.10917E-01	0.77381E+00

GROUP 4

REGION 1	0.12610E+00	0.18383E+00	0.0	0.53070E+00
REGION 2	0.12569E+00	0.18498E+00	0.0	0.53092E+00
REGION 3	0.11774E+00	0.17762E+00	0.0	0.53730E+00
REGION 4	0.12503E-01	0.0	0.0	0.40366E+00

***** DATA AT END OF SUBSTP 11 *****

TOTAL TIME = 7700.00 HOURS

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.10299706E+21	0.11511155E+21	0.14499562E+21	0.0
U-238	0.90120226E+22	0.90143600E+22	0.90409672E+22	0.0
PU-239	0.51424827E+20	0.48621196E+20	0.36525811E+20	0.0
PU-240	0.81838014E+19	0.71978726E+19	0.38905515E+19	0.0
PU-241	0.50479370E+19	0.40117045E+19	0.13962390E+19	0.0
PU-242	0.52609432E+18	0.36579432E+18	0.75734361E+17	0.0
O-16	0.29118433E+23	0.29118649E+23	0.29118848E+23	0.24426610E+23
H&H2O	0.21061521E+23	0.21061521E+23	0.21061521E+23	0.48853220E+23
ZIRC2	0.62623499E+22	0.62623499E+22	0.62623499E+22	0.0
RS FPS	0.69531301E+19	0.65617172E+19	0.45851053E+19	0.0
SS FPS	0.24177663E+20	0.22281067E+20	0.14350188E+20	0.0
NS FPS	0.15223836E+21	0.13891861E+21	0.86976735E+20	0.0
XE-135	0.26887899E+16	0.26698231E+16	0.23127647E+16	0.0
SM-149	0.23657281E+17	0.23902605E+17	0.23288700E+17	0.0
REACTION RATES				
FISSION THEN ABSORPTION				
U-235	0.15971123E+13	0.16278587E+13	0.13100500E+13	0.0
U-235	0.19744518E+13	0.20125466E+13	0.16188399E+13	0.0
U-238	0.36005688E+12	0.33269219E+12	0.21325808E+12	0.0
U-238	0.37404488E+13	0.34203784E+13	0.21770808E+13	0.0
PU-239	0.16128064E+13	0.13903877E+13	0.66812897E+12	0.0
PU-239	0.24774600E+13	0.21357480E+13	0.10262014E+13	0.0
PU-240	0.20330465E+10	0.16468219E+10	0.56720819E+09	0.0
PU-240	0.50975762E+12	0.40921176E+12	0.14019173E+12	0.0
PU-241	0.17589443E+12	0.12746968E+12	0.28354011E+11	0.0
PU-241	0.23353537E+12	0.16923564E+12	0.37650260E+11	0.0
PU-242	0.99315312E+08	0.63709248E+08	0.84174820E+07	0.0
PU-242	0.64916808E+10	0.41208233E+10	0.54020147E+09	0.0
O-16	0.32449503E+11	0.29974508E+11	0.19157852E+11	0.27388086E+10
H&H2O	0.21597212E+12	0.19691504E+12	0.12589990E+12	0.16153864E+12
ZIRC2	0.12088587E+12	0.11044533E+12	0.70145016E+11	0.0
FPS	0.72600414E+12	0.62615500E+12	0.29166141E+12	0.0
TOTAL	0.37480007E+13	0.34801168E+13	0.22203639E+13	0.0
TOTAL	0.10037453E+14	0.91147249E+13	0.55073655E+13	0.16427739E+12
NEUTRON FLUX				
GROUP 1	0.10530114E+15	0.97274466E+14	0.62171279E+14	0.10445834E+14
GROUP 2	0.16420450E+15	0.15040301E+15	0.95137653E+14	0.18832408E+14
GROUP 3	0.12073232E+15	0.11020997E+15	0.69741444E+14	0.17119584E+14

GROUP 4	0.41176254E+14	0.37534676E+14	0.24040777E+14	0.11985364E+14
CONVERSION RATIO	0.8298	0.8095	0.7841	
BURNUP	0.96560703E+04	0.89406016E+04	0.56515508E+04	
POWER DENSITY	0.12398645E+03	0.11490755E+03	0.72907013E+02	
POWER	0.11201357E+10	0.10244268E+10	0.64857011E+09	
ENERGY DENSITY	0.86507125E+05	0.80188125E+05	0.50875793E+05	
FLUENCE	0.41379524E+21	0.37901534E+21	0.23974687E+21	0.47457666E+20
FTW RATIO	0.8839	0.8839	0.8839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.99980E+00 AT TIME= 7000.00
FUEL TO WATER RATIO =0.8839
GROUP 4 FLUX = 0.41374276E+14
GROUP 3 FLUX = 0.11046178E+15
GROUP 2 FLUX = 0.14786770E+15
GROUP 1 FLUX = 0.94518876E+14
TOTAL FLUX = 0.39422243E+15
TOTAL FISSION REACTION RATE= 0.94484814E+13
TOTAL ABSORPTION REACTION RATE= 0.24823787E+14
ENERGY DENSITY = 0.72601312E+05
POWER DENSITY = 0.10404498E+03
TOTAL POWER = 0.27931325E+10
CONVERSION RATIO = 0.8119
BURNUP THIS STEP = 0.80879570E+04
TIME = 7700.00

***** END OF SUBSTP 11 *****

FTW HAS BEEN CHANGED TO INCREASE REACTIVITY

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.97375107E+20	0.10882834E+21	0.13708123E+21	0.0
U-238	0.85201124E+22	0.85223237E+22	0.85474763E+22	0.0
PU-239	0.48617871E+20	0.45967274E+20	0.34532089E+20	0.0
PU-240	0.77370995E+19	0.68049863E+19	0.36781908E+19	0.0
PU-241	0.47724016E+19	0.37927313E+19	0.13200264E+19	0.0
PU-242	0.49737817E+18	0.34582795E+18	0.71600506E+17	0.0
O-16	0.28711839E+23	0.28712042E+23	0.28712231E+23	0.24426610E+23
H&H2O	0.22277501E+23	0.22277501E+23	0.22277501E+23	0.48853220E+23
ZIRC2	0.59205266E+22	0.59205266E+22	0.59205266E+22	0.0
RS FPS	0.65736029E+19	0.62035546E+19	0.43348334E+19	0.0
SS FPS	0.22857950E+20	0.21064884E+20	0.13566904E+20	0.0
NS FPS	0.14392864E+21	0.13133594E+21	0.82229220E+20	0.0
XE-135	0.25420261E+16	0.25240946E+16	0.21865257E+16	0.0
SM-149	0.22365982E+17	0.22597915E+17	0.22017518E+17	0.0
FTW RATIO	0.7839	0.7839	0.7839	0.0

TIME= 7700.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.43936E-02	0.98310E-02	0.67188E-01	0.18192E+01
REGION 2	0.44008E-02	0.98458E-02	0.66473E-01	0.18186E+01
REGION 3	0.44162E-02	0.98694E-02	0.62126E-01	0.18159E+01
REGION 4	0.25988E-03	0.0	0.12038E-01	0.32149E+01

GROUP 2

REGION 1	0.26804E-02	0.67266E-03	0.57622E-01	0.97416E+00
REGION 2	0.26942E-02	0.69936E-03	0.57301E-01	0.97388E+00
REGION 3	0.27167E-02	0.74076E-03	0.54064E-01	0.97277E+00
REGION 4	0.72181E-05	0.0	0.10220E-01	0.12093E+01

GROUP 3

REGION 1	0.31156E-01	0.99602E-02	0.45987E-01	0.77317E+00
REGION 2	0.30835E-01	0.10291E-01	0.45879E-01	0.77364E+00
REGION 3	0.29270E-01	0.10738E-01	0.43110E-01	0.77598E+00
REGION 4	0.67572E-03	0.0	0.10917E-01	0.77381E+00

GROUP 4

REGION 1	0.12076E+00	0.17481E+00	0.0	0.52526E+00
REGION 2	0.12048E+00	0.17611E+00	0.0	0.52538E+00
REGION 3	0.11321E+00	0.16978E+00	0.0	0.53107E+00
REGION 4	0.12503E-01	0.0	0.0	0.40366E+00

KEFF= 1.01428 TIME= 7700.00

RELATIVE POINT GROUP AVERAGES

1	0.1000000E+01
2	0.9999759E+00
3	0.9999076E+00
4	0.9997912E+00
5	0.9996278E+00
6	0.9994122E+00
7	0.9991426E+00
8	0.9988158E+00
9	0.9984307E+00
10	0.9979850E+00
11	0.9974742E+00
12	0.9968949E+00
13	0.9962395E+00
14	0.9954840E+00
15	0.9945257E+00
16	0.9929411E+00
17	0.9895939E+00
18	0.9824854E+00
19	0.9715496E+00
20	0.9568680E+00
21	0.9385808E+00
22	0.9168479E+00
23	0.8918284E+00
24	0.8636518E+00
25	0.8323683E+00
26	0.7978253E+00
27	0.7676675E+00
28	0.7329810E+00
29	0.6938860E+00
30	0.6506404E+00
31	0.6035933E+00
32	0.5531734E+00
33	0.4999234E+00
34	0.4446319E+00
35	0.3887124E+00
36	0.3352830E+00
37	0.2867920E+00
38	0.2375883E+00

39	0.1921204E+00
40	0.1519744E+00
41	0.1172974E+00
42	0.8754742E-01
43	0.6188470E-01
44	0.3936788E-01
45	0.1904681E-01
46	0.0

PEAK TO AVERAGE = 1.1497

TIME= 8400.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.43947E-02	0.98374E-02	0.66848E-01	0.18201E+01
REGION 2	0.44022E-02	0.98528E-02	0.66170E-01	0.18194E+01
REGION 3	0.44190E-02	0.98800E-02	0.61850E-01	0.18165E+01
REGION 4	0.25969E-03	0.0	0.12675E-01	0.32186E+01
GROUP 2				
REGION 1	0.26770E-02	0.66640E-03	0.57469E-01	0.97442E+00
REGION 2	0.26906E-02	0.69282E-03	0.57176E-01	0.97413E+00
REGION 3	0.27142E-02	0.73636E-03	0.53986E-01	0.97292E+00
REGION 4	0.72121E-05	0.0	0.11182E-01	0.12096E+01
GROUP 3				
REGION 1	0.31430E-01	0.98962E-02	0.45454E-01	0.77284E+00
REGION 2	0.31110E-01	0.10221E-01	0.45380E-01	0.77329E+00
REGION 3	0.29492E-01	0.10686E-01	0.42730E-01	0.77567E+00
REGION 4	0.68141E-03	0.0	0.11719E-01	0.77378E+00
GROUP 4				
REGION 1	0.12136E+00	0.17499E+00	0.0	0.52473E+00
REGION 2	0.12116E+00	0.17641E+00	0.0	0.52477E+00
REGION 3	0.11409E+00	0.17056E+00	0.0	0.53025E+00
REGION 4	0.12691E-01	0.0	0.0	0.40039E+00

***** DATA AT END OF SUBSTP 12 *****

TOTAL TIME = 8400.00 HOURS

NUMBER DENSITY	REGION 1	REGION 2	REGION 3	REGION 4
U-235	0.92526120E+20	0.10383255E+21	0.13299942E+21	0.0
U-238	0.85112944E+22	0.85141902E+22	0.85422566E+22	0.0
PU-239	0.50339301E+20	0.47861847E+20	0.36580963E+20	0.0
PU-240	0.86220348E+19	0.76516026E+19	0.42357234E+19	0.0
PU-241	0.54201173E+19	0.43684916E+19	0.15775265E+19	0.0
PU-242	0.63333629E+18	0.44763317E+18	0.96018151E+17	0.0
O-16	0.28711839E+23	0.28712042E+23	0.28712231E+23	0.24426610E+23
H&H2O	0.22277501E+23	0.22277501E+23	0.22277501E+23	0.48853220E+23
ZIRC2	0.59205266E+22	0.59205266E+22	0.59205266E+22	0.0
RS FPS	0.69425033E+19	0.65930785E+19	0.46911180E+19	0.0
SS FPS	0.24947567E+20	0.23061843E+20	0.14935466E+20	0.0
NS FPS	0.15816232E+21	0.14469605E+21	0.90930034E+20	0.0
XE-135	0.24674276E+16	0.24609290E+16	0.21666309E+16	0.0
SM-149	0.21431303E+17	0.21669029E+17	0.21192932E+17	0.0

REACTION RATES
FISSION THEN ABSORPTION

U-235	0.15233010E+13	0.15725935E+13	0.12963189E+13	0.0
U-235	0.18737256E+13	0.19344382E+13	0.15939131E+13	0.0
U-238	0.33376482E+12	0.31108111E+12	0.20126374E+12	0.0
U-238	0.35007853E+13	0.32293844E+13	0.20724801E+13	0.0
PU-239	0.16388540E+13	0.14332031E+13	0.70561884E+12	0.0
PU-239	0.25045269E+13	0.21902037E+13	0.10782173E+13	0.0
PU-240	0.20769057E+10	0.17122967E+10	0.60927360E+09	0.0
PU-240	0.50798035E+12	0.41506701E+12	0.14677036E+12	0.0
PU-241	0.19872422E+12	0.14733115E+12	0.34246558E+11	0.0
PU-241	0.26407056E+12	0.19577156E+12	0.45512380E+11	0.0
PU-242	0.11649770E+09	0.76624064E+08	0.10581731E+08	0.0
PU-242	0.76501688E+10	0.49798144E+10	0.68157850E+09	0.0
O-16	0.31108096E+11	0.28982837E+11	0.18690114E+11	0.26695521E+10
H&H2O	0.24520249E+12	0.22552281E+12	0.14521860E+12	0.16677929E+12
ZIRC2	0.11361334E+12	0.10470156E+12	0.67020599E+11	0.0
FPS	0.76110227E+12	0.66452619E+12	0.31434611E+12	0.0
TOTAL	0.36968354E+13	0.34659956E+13	0.22380670E+13	0.0
TOTAL	0.98097609E+13	0.89935755E+13	0.54828466E+13	0.16944883E+12
NEUTRON FLUX				
GROUP 1	0.10239088E+15	0.95401072E+14	0.61521128E+14	0.10179907E+14
GROUP 2	0.15444025E+15	0.14269145E+15	0.90980275E+14	0.17623241E+14
GROUP 3	0.11525147E+15	0.10613270E+15	0.67680313E+14	0.16365440E+14
GROUP 4	0.43869870E+14	0.40340799E+14	0.26014667E+14	0.12255155E+14
CONVERSION RATIO	0.7912	0.7711	0.7423	
BURNUP	0.11006457E+05	0.10288332E+05	0.65766836E+04	
POWER DENSITY	0.12233925E+03	0.11447296E+03	0.73475967E+02	
POWER	0.11052541E+10	0.10205524E+10	0.65363149E+09	
ENERGY DENSITY	0.85595125E+05	0.80088562E+05	0.51349434E+05	
FLUENCE	0.38918926E+21	0.35958231E+21	0.22927029E+21	0.44410559E+20
FTW RATIO	0.7839	0.7839	0.7839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.10143E+01 AT TIME= 7700.00
FUEL TO WATER RATIO =0.7839
GROUP 4 FLUX = 0.44026250E+14
GROUP 3 FLUX = 0.10613443E+15
GROUP 2 FLUX = 0.13992827E+15
GROUP 1 FLUX = 0.92544701E+14
TOTAL FLUX = 0.38263327E+15
TOTAL FISSION REACTION RATE= 0.94008980E+13
TOTAL ABSORPTION REACTION RATE= 0.24455611E+14
ENERGY DENSITY = 0.72418250E+05
POWER DENSITY = 0.10353487E+03
TOTAL POWER = 0.27794381E+10
CONVERSION RATIO = 0.7725
BURNUP THIS STEP = 0.92957734E+04
TIME = 8400.00

***** END OF SUBSTP 12 *****

KEFF= 1.00486 TIME= 8400.00

RELATIVE POINT GROUP AVERAGES

1	0.9967068E+00
2	0.9967293E+00
3	0.9967940E+00

4	0.9969019E+00
5	0.9970513E+00
6	0.9972386E+00
7	0.9974623E+00
8	0.9977179E+00
9	0.9980046E+00
10	0.9983189E+00
11	0.9986573E+00
12	0.9990174E+00
13	0.9993904E+00
14	0.9997522E+00
15	0.1000000E+01
16	0.9997081E+00
17	0.9971825E+00
18	0.9908949E+00
19	0.9807770E+00
20	0.9669066E+00
21	0.9494201E+00
22	0.9284737E+00
23	0.9042214E+00
24	0.8767853E+00
25	0.8462003E+00
26	0.8122835E+00
27	0.7824103E+00
28	0.7477084E+00
29	0.7082972E+00
30	0.6644449E+00
31	0.6165177E+00
32	0.5649649E+00
33	0.5103557E+00
34	0.4535171E+00
35	0.3959468E+00
36	0.3410099E+00
37	0.2917880E+00
38	0.2410635E+00
39	0.1940953E+00
40	0.1527769E+00
41	0.1173235E+00
42	0.8715641E-01
43	0.6136133E-01
44	0.3891525E-01
45	0.1879161E-01
46	0.0

PEAK TO AVERAGE = 1.1413

TIME= 9100.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.43960E-02	0.98442E-02	0.66474E-01	0.18210E+01
REGION 2	0.44036E-02	0.98600E-02	0.65843E-01	0.18203E+01
REGION 3	0.44219E-02	0.98905E-02	0.61565E-01	0.18171E+01
REGION 4	0.25950E-03	0.0	0.13335E-01	0.32224E+01
GROUP 2				
REGION 1	0.26738E-02	0.66083E-03	0.57293E-01	0.97468E+00
REGION 2	0.26873E-02	0.68686E-03	0.57032E-01	0.97437E+00
REGION 3	0.27117E-02	0.73216E-03	0.53893E-01	0.97306E+00
REGION 4	0.72061E-05	0.0	0.12251E-01	0.12098E+01
GROUP 3				

REGION 1	0.31642E-01	0.98419E-02	0.44949E-01	0.77262E+00
REGION 2	0.31334E-01	0.10159E-01	0.44908E-01	0.77304E+00
REGION 3	0.29691E-01	0.10636E-01	0.42356E-01	0.77541E+00
REGION 4	0.68709E-03	0.0	0.12572E-01	0.77374E+00

GROUP 4

REGION 1	0.12207E+00	0.17516E+00	0.0	0.52409E+00
REGION 2	0.12196E+00	0.17667E+00	0.0	0.52406E+00
REGION 3	0.11503E+00	0.17128E+00	0.0	0.52938E+00
REGION 4	0.12878E-01	0.0	0.0	0.39718E+00

***** DATA AT END OF SUBSTP 13 *****

TOTAL TIME = 9100.00 HOURS

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.87951730E+20	0.99053560E+20	0.12899486E+21	0.0
U-238	0.85024403E+22	0.85059396E+22	0.85369199E+22	0.0
PU-239	0.51979667E+20	0.49676041E+20	0.38575037E+20	0.0
PU-240	0.94725104E+19	0.84810412E+19	0.48074167E+19	0.0
PU-241	0.60649413E+19	0.49553846E+19	0.18535655E+19	0.0
PU-242	0.78169119E+18	0.56194720E+18	0.12508044E+18	0.0
O-16	0.28711839E+23	0.28712042E+23	0.28712231E+23	0.24426610E+23
H&H2O	0.22277501E+23	0.22277501E+23	0.22277501E+23	0.48853220E+23
ZIRC2	0.59205266E+22	0.59205266E+22	0.59205266E+22	0.0
RS FPS	0.72665162E+19	0.69438216E+19	0.50316775E+19	0.0
SS FPS	0.26982490E+20	0.25029124E+20	0.16306737E+20	0.0
NS FPS	0.17221070E+21	0.15806303E+21	0.99700038E+20	0.0
XE-135	0.24656664E+16	0.24653067E+16	0.21819304E+16	0.0
SM-149	0.21549930E+17	0.21795580E+17	0.21356665E+17	0.0
REACTION RATES				
FISSION THEN ABSORPTION				
U-235	0.14362933E+13	0.15031819E+13	0.12707347E+13	0.0
U-235	0.17679621E+13	0.18503759E+13	0.15634876E+13	0.0
U-238	0.33654211E+12	0.31688235E+12	0.20699342E+12	0.0
U-238	0.35142354E+13	0.32749356E+13	0.21194321E+13	0.0
PU-239	0.16658884E+13	0.14791947E+13	0.74643269E+12	0.0
PU-239	0.25443067E+13	0.22591245E+13	0.11398766E+13	0.0
PU-240	0.22943887E+10	0.19278641E+10	0.70866765E+09	0.0
PU-240	0.53036777E+12	0.44163813E+12	0.16118579E+12	0.0
PU-241	0.21989038E+12	0.16693966E+12	0.40544932E+11	0.0
PU-241	0.29208425E+12	0.22174106E+12	0.53862674E+11	0.0
PU-242	0.14506680E+09	0.98035392E+08	0.14176430E+08	0.0
PU-242	0.95352054E+10	0.63771197E+10	0.91275571E+09	0.0
O-16	0.31318544E+11	0.29475693E+11	0.19184562E+11	0.26971392E+10
H&H2O	0.24351893E+12	0.22624430E+12	0.14696094E+12	0.17795980E+12
ZIRC2	0.11332708E+12	0.10549835E+12	0.68081857E+11	0.0
FPS	0.79228509E+12	0.70105294E+12	0.33605675E+12	0.0
TOTAL	0.36610517E+13	0.34682228E+13	0.22654254E+13	0.0
TOTAL	0.98389375E+13	0.91164603E+13	0.56090364E+13	0.18065693E+12
NEUTRON FLUX				
GROUP 1	0.10319840E+15	0.97131373E+14	0.63219117E+14	0.10283274E+14
GROUP 2	0.15529189E+15	0.14493793E+15	0.93139604E+14	0.17399586E+14
GROUP 3	0.11597672E+15	0.10788302E+15	0.69327265E+14	0.16492522E+14
GROUP 4	0.43420509E+14	0.40332108E+14	0.26241948E+14	0.12931503E+14
CONVERSION RATIO	0.8048	0.7845	0.7518	
BURNUP	0.11833004E+05	0.11175738E+05	0.72230977E+04	
POWER DENSITY	0.12126631E+03	0.11465422E+03	0.74436050E+02	
POWER	0.10955610E+10	0.10221683E+10	0.66217216E+09	

ENERGY DENSITY	0.84833062E+05	0.80206500E+05	0.52027035E+05	
FLUENCE	0.39133550E+21	0.36524334E+21	0.23471180E+21	0.43846940E+20
FTW RATIO	0.7839	0.7839	0.7839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.10049E+01 AT TIME= 8400.00
FUEL TO WATER RATIO =0.7839
GROUP 4 FLUX = 0.44347316E+14
GROUP 3 FLUX = 0.10758066E+15
GROUP 2 FLUX = 0.14154424E+15
GROUP 1 FLUX = 0.94014854E+14
TOTAL FLUX = 0.38748685E+15
TOTAL FISSION REACTION RATE= 0.93946999E+13
TOTAL ABSORPTION REACTION RATE= 0.24745051E+14
ENERGY DENSITY = 0.72425500E+05
POWER DENSITY = 0.10355214E+03
TOTAL POWER = 0.27799014E+10
CONVERSION RATIO = 0.7849
BURNUP THIS STEP = 0.10082234E+05
TIME = 9100.00

***** END OF SUBSTP 13 *****

KEFF= 0.99557 TIME= 9100.00

RELATIVE POINT GROUP AVERAGES

1	0.9933824E+00
2	0.9934205E+00
3	0.9935328E+00
4	0.9937205E+00
5	0.9939816E+00
6	0.9943127E+00
7	0.9947122E+00
8	0.9951764E+00
9	0.9957030E+00
10	0.9962900E+00
11	0.9969333E+00
12	0.9976293E+00
13	0.9983720E+00
14	0.9991345E+00
15	0.9998176E+00
16	0.1000000E+01
17	0.9978074E+00
18	0.9919022E+00
19	0.9822171E+00
20	0.9688264E+00
21	0.9518632E+00
22	0.9314789E+00
23	0.9078212E+00
24	0.8810061E+00
25	0.8510535E+00
26	0.8177578E+00
27	0.7882406E+00
28	0.7536924E+00
29	0.7142310E+00
30	0.6701312E+00
31	0.6217698E+00
32	0.5696093E+00
33	0.5142345E+00
34	0.4564972E+00

35	0.3979601E+00
36	0.3422014E+00
37	0.2929159E+00
38	0.2412817E+00
39	0.1933785E+00
40	0.1514060E+00
41	0.1156440E+00
42	0.8547699E-01
43	0.5992002E-01
44	0.3787597E-01
45	0.1825194E-01
46	0.0

PEAK TO AVERAGE = 1.1399

TIME= 9800.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.43974E-02	0.98512E-02	0.66009E-01	0.18219E+01
REGION 2	0.44050E-02	0.98673E-02	0.65426E-01	0.18211E+01
REGION 3	0.44247E-02	0.99011E-02	0.61220E-01	0.18177E+01
REGION 4	0.25931E-03	0.0	0.14016E-01	0.32262E+01
GROUP 2				
REGION 1	0.26708E-02	0.65587E-03	0.57053E-01	0.97494E+00
REGION 2	0.26842E-02	0.68143E-03	0.56824E-01	0.97461E+00
REGION 3	0.27094E-02	0.72818E-03	0.53753E-01	0.97321E+00
REGION 4	0.72001E-05	0.0	0.13444E-01	0.12101E+01
GROUP 3				
REGION 1	0.31802E-01	0.97953E-02	0.44412E-01	0.77250E+00
REGION 2	0.31510E-01	0.10104E-01	0.44398E-01	0.77289E+00
REGION 3	0.29863E-01	0.10591E-01	0.41944E-01	0.77520E+00
REGION 4	0.69278E-03	0.0	0.13482E-01	0.77370E+00
GROUP 4				
REGION 1	0.12273E+00	0.17531E+00	0.0	0.52350E+00
REGION 2	0.12269E+00	0.17691E+00	0.0	0.52341E+00
REGION 3	0.11591E+00	0.17193E+00	0.0	0.52857E+00
REGION 4	0.13065E-01	0.0	0.0	0.39402E+00

***** DATA AT END OF SUBSTP 14 *****

TOTAL TIME = 9800.00 HOURS

NUMBER DENSITY	REGION 1	REGION 2	REGION 3	REGION 4
U-235	0.83617296E+20	0.94489232E+20	0.12508648E+21	0.0
U-238	0.84935142E+22	0.84975854E+22	0.85314840E+22	0.0
PU-239	0.53561733E+20	0.51421784E+20	0.40511532E+20	0.0
PU-240	0.10304073E+20	0.93004258E+19	0.53916708E+19	0.0
PU-241	0.66953045E+19	0.55404303E+19	0.21434144E+19	0.0
PU-242	0.94200879E+18	0.68755541E+18	0.15847041E+18	0.0
O-16	0.28711839E+23	0.28712042E+23	0.28712231E+23	0.24426610E+23
H&H2O	0.22277501E+23	0.22277501E+23	0.22277501E+23	0.48853220E+23
ZIRC2	0.59205266E+22	0.59205266E+22	0.59205266E+22	0.0
RS FPS	0.75522683E+19	0.72583435E+19	0.53553825E+19	0.0
SS FPS	0.28972712E+20	0.26964177E+20	0.17673563E+20	0.0

NS FPS	0.18618859E+21	0.17139326E+21	0.10854787E+21	0.0
XE-135	0.24665871E+16	0.24691359E+16	0.21935563E+16	0.0
SM-149	0.21673019E+17	0.21924902E+17	0.21518271E+17	0.0

REACTION RATES
FISSION THEN ABSORPTION

U-235	0.13600607E+13	0.14345705E+13	0.12392533E+13	0.0
U-235	0.16753644E+13	0.17672239E+13	0.15257924E+13	0.0
U-238	0.34089081E+12	0.32239491E+12	0.21183961E+12	0.0
U-238	0.35432536E+13	0.33168923E+13	0.21570792E+13	0.0
PU-239	0.16966620E+13	0.15201594E+13	0.78243214E+12	0.0
PU-239	0.25897436E+13	0.23202848E+13	0.11941100E+13	0.0
PU-240	0.25209774E+10	0.21448573E+10	0.81055846E+09	0.0
PU-240	0.54876655E+12	0.46271345E+12	0.17349267E+12	0.0
PU-241	0.24102994E+12	0.18615783E+12	0.47007572E+11	0.0
PU-241	0.32003765E+12	0.24717040E+12	0.62424461E+11	0.0
PU-242	0.17717781E+09	0.12209774E+09	0.18380992E+08	0.0
PU-242	0.11654926E+11	0.79492096E+10	0.11831631E+10	0.0
O-16	0.31674610E+11	0.29940503E+11	0.19595579E+11	0.27092805E+10
H&H2O	0.24283087E+12	0.22661182E+12	0.14798271E+12	0.18864544E+12
ZIRC2	0.11352683E+12	0.10615547E+12	0.68823745E+11	0.0
FPS	0.82478917E+12	0.73517420E+12	0.35605296E+12	0.0
TOTAL	0.36413395E+13	0.34655468E+13	0.22813595E+13	0.0
TOTAL	0.99016392E+13	0.92201109E+13	0.57065330E+13	0.19135470E+12

NEUTRON FLUX				
GROUP 1	0.10448810E+15	0.98772974E+14	0.64645549E+14	0.10327321E+14
GROUP 2	0.15683966E+15	0.14703336E+15	0.94889048E+14	0.17040007E+14
GROUP 3	0.11722028E+15	0.10952479E+15	0.70677663E+14	0.16510421E+14
GROUP 4	0.43147191E+14	0.40257047E+14	0.26337662E+14	0.13556345E+14
CONVERSION RATIO	0.8176	0.7971	0.7612	
BURNUP	0.12700430E+05	0.12050281E+05	0.78454961E+04	
POWER DENSITY	0.12071863E+03	0.11466885E+03	0.75019806E+02	
POWER	0.10906130E+10	0.10222989E+10	0.66736538E+09	
ENERGY DENSITY	0.84437562E+05	0.80210187E+05	0.52436652E+05	
FLUENCE	0.39523590E+21	0.37052381E+21	0.23912040E+21	0.42940802E+20
FTW RATIO	0.7839	0.7839	0.7839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.99557E+00 AT TIME= 9100.00
FUEL TO WATER RATIO =0.7839
GROUP 4 FLUX = 0.44631522E+14
GROUP 3 FLUX = 0.10900244E+15
GROUP 2 FLUX = 0.14312812E+15
GROUP 1 FLUX = 0.95492759E+14
TOTAL FLUX = 0.39225453E+15
TOTAL FISSION REACTION RATE= 0.93882459E+13
TOTAL ABSORPTION REACTION RATE= 0.25019611E+14
ENERGY DENSITY = 0.72429375E+05
POWER DENSITY = 0.10356613E+03
TOTAL POWER = 0.27802772E+10
CONVERSION RATIO = 0.7967
BURNUP THIS STEP = 0.10870141E+05
TIME = 9800.00

***** END OF SUBSTP 14 *****

KEFF= 0.98701 TIME= 9800.00

RELATIVE POINT GROUP AVERAGES

1	0.9951678E+00
2	0.9951980E+00
3	0.9952860E+00
4	0.9954346E+00
5	0.9956393E+00
6	0.9958974E+00
7	0.9962074E+00
8	0.9965675E+00
9	0.9969725E+00
10	0.9974215E+00
11	0.9979094E+00
12	0.9984327E+00
13	0.9989845E+00
14	0.9995388E+00
15	0.1000000E+01
16	0.9999525E+00
17	0.9976521E+00
18	0.9916973E+00
19	0.9820217E+00
20	0.9687003E+00
21	0.9518628E+00
22	0.9316567E+00
23	0.9082262E+00
24	0.8816806E+00
25	0.8520318E+00
26	0.8190585E+00
27	0.7897253E+00
28	0.7552413E+00
29	0.7157241E+00
30	0.6714523E+00
31	0.6228091E+00
32	0.5702637E+00
33	0.5144091E+00
34	0.4561121E+00
35	0.3969857E+00
36	0.3407997E+00
37	0.2918385E+00
38	0.2396355E+00
39	0.1911156E+00
40	0.1487868E+00
41	0.1129889E+00
42	0.8306563E-01
43	0.5796139E-01
44	0.3650862E-01
45	0.1755401E-01
46	0.0

PEAK TO AVERAGE = 1.1389

TIME= 10500.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.43939E-02	0.98467E-02	0.66961E-01	0.18228E+01
REGION 2	0.44016E-02	0.98631E-02	0.66388E-01	0.18220E+01
REGION 3	0.44226E-02	0.99001E-02	0.62079E-01	0.18183E+01
REGION 4	0.26173E-03	0.0	0.14013E-01	0.32286E+01
GROUP 2				
REGION 1	0.26682E-02	0.65117E-03	0.57816E-01	0.97526E+00
REGION 2	0.26813E-02	0.67626E-03	0.57596E-01	0.97493E+00
REGION 3	0.27072E-02	0.72425E-03	0.54475E-01	0.97342E+00

REGION 4	0.72009E-05	0.0	0.13514E-01	0.12100E+01
GROUP 3				
REGION 1	0.32162E-01	0.97549E-02	0.45022E-01	0.77195E+00
REGION 2	0.31864E-01	0.10056E-01	0.45026E-01	0.77234E+00
REGION 3	0.30135E-01	0.10550E-01	0.42589E-01	0.77475E+00
REGION 4	0.69306E-03	0.0	0.13536E-01	0.77365E+00
GROUP 4				
REGION 1	0.12402E+00	0.17657E+00	0.0	0.52237E+00
REGION 2	0.12404E+00	0.17822E+00	0.0	0.52223E+00
REGION 3	0.11732E+00	0.17350E+00	0.0	0.52728E+00
REGION 4	0.13069E-01	0.0	0.0	0.39397E+00

***** DATA AT END OF SUBSTP 15 *****

TOTAL TIME = 10500.00 HOURS

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.79493899E+20	0.90135008E+20	0.12129095E+21	0.0
U-238	0.84844755E+22	0.84891322E+22	0.85259806E+22	0.0
PU-239	0.55104479E+20	0.53110616E+20	0.42388794E+20	0.0
PU-240	0.11130629E+20	0.10116985E+20	0.59872190E+19	0.0
PU-241	0.73026748E+19	0.61129152E+19	0.24461583E+19	0.0
PU-242	0.11133743E+19	0.82370133E+18	0.19608251E+18	0.0
O-16	0.28711839E+23	0.28712042E+23	0.28712231E+23	0.24426610E+23
H&H2O	0.22277501E+23	0.22277501E+23	0.22277501E+23	0.48853220E+23
ZIRC2	0.59205266E+22	0.59205266E+22	0.59205266E+22	0.0
RS FPS	0.78046997E+19	0.75400868E+19	0.56612292E+19	0.0
SS FPS	0.30927045E+20	0.28865294E+20	0.19028870E+20	0.0
NS FPS	0.20011974E+21	0.18468506E+21	0.11738180E+21	0.0
XE-135	0.24700921E+16	0.24726551E+16	0.22017014E+16	0.0
SM-149	0.21800876E+17	0.22057556E+17	0.21679526E+17	0.0
REACTION RATES				
FISSION THEN ABSORPTION				
U-235	0.12965097E+13	0.13713749E+13	0.12060260E+13	0.0
U-235	0.15980466E+13	0.16903947E+13	0.14856885E+13	0.0
U-238	0.34636857E+12	0.32734236E+12	0.21548676E+12	0.0
U-238	0.35869960E+13	0.33559759E+13	0.21848098E+13	0.0
PU-239	0.17443838E+13	0.15681276E+13	0.81901539E+12	0.0
PU-239	0.26621929E+13	0.23931482E+13	0.12497390E+13	0.0
PU-240	0.27662620E+10	0.23683372E+10	0.91473971E+09	0.0
PU-240	0.59525713E+12	0.50512822E+12	0.19345913E+12	0.0
PU-241	0.26332011E+12	0.20560367E+12	0.53784764E+11	0.0
PU-241	0.34953966E+12	0.27291563E+12	0.71406387E+11	0.0
PU-242	0.21288446E+09	0.14858989E+09	0.23134400E+08	0.0
PU-242	0.13871985E+11	0.95843328E+10	0.14740396E+10	0.0
O-16	0.32208605E+11	0.30421524E+11	0.19940135E+11	0.27324004E+10
H&H2O	0.24298534E+12	0.22662198E+12	0.14822572E+12	0.19599596E+12
ZIRC2	0.11468820E+12	0.10717607E+12	0.69541298E+11	0.0
FPS	0.85952292E+12	0.76756117E+12	0.37420414E+12	0.0
TOTAL	0.36535596E+13	0.34749630E+13	0.22952490E+13	0.0
TOTAL	0.10055306E+14	0.93589246E+13	0.57984848E+13	0.19872835E+12
NEUTRON FLUX				
GROUP 1	0.10627480E+15	0.10038347E+15	0.65797708E+14	0.10312959E+14
GROUP 2	0.15906777E+15	0.14902708E+15	0.96208962E+14	0.16550655E+14
GROUP 3	0.11897182E+15	0.11109290E+15	0.71717498E+14	0.16418887E+14
GROUP 4	0.43036109E+14	0.40129725E+14	0.26302095E+14	0.14119296E+14

CONVERSION RATIO	0.8315	0.8106	0.7702	
BURNUP	0.13616664E+05	0.12912910E+05	0.84356250E+04	
POWER DENSITY	0.12065956E+03	0.11455893E+03	0.75229507E+02	
POWER	0.10900795E+10	0.10213189E+10	0.66923085E+09	
ENERGY DENSITY	0.84392500E+05	0.80129687E+05	0.52581832E+05	
FLUENCE	0.40085077E+21	0.37554814E+21	0.24244657E+21	0.41707643E+20
FTW RATIO	0.7839	0.7839	0.7839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.98701E+00 AT TIME= 9800.00
FUEL TO WATER RATIO =0.7839
GROUP 4 FLUX = 0.44872879E+14
GROUP 3 FLUX = 0.11040309E+15
GROUP 2 FLUX = 0.14468814E+15
GROUP 1 FLUX = 0.97002172E+14
TOTAL FLUX = 0.39696611E+15
TOTAL FISSION REACTION RATE= 0.94237717E+13
TOTAL ABSORPTION REACTION RATE= 0.25411426E+14
ENERGY DENSITY = 0.72435625E+05
POWER DENSITY = 0.10357924E+03
TOTAL POWER = 0.27806292E+10
CONVERSION RATIO = 0.8093
BURNUP THIS STEP = 0.11659715E+05
TIME = 10500.00

***** END OF SUBSTP 15 *****

FTW HAS BEEN CHANGED TO INCREASE REACTIVITY

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.74255474E+20	0.84195376E+20	0.11329822E+21	0.0
U-238	0.79253716E+22	0.79297221E+22	0.79641431E+22	0.0
PU-239	0.51473241E+20	0.49610774E+20	0.39595490E+20	0.0
PU-240	0.10397152E+20	0.94503046E+19	0.55926780E+19	0.0
PU-241	0.68214493E+19	0.57100915E+19	0.22849633E+19	0.0
PU-242	0.10400061E+19	0.76942181E+18	0.18316118E+18	0.0
O-16	0.28339608E+23	0.28339797E+23	0.28339977E+23	0.24426610E+23
H&H2O	0.23849082E+23	0.23849082E+23	0.23849082E+23	0.48853220E+23
ZIRC2	0.55303798E+22	0.55303798E+22	0.55303798E+22	0.0
RS FPS	0.72903921E+19	0.70432164E+19	0.52881704E+19	0.0
SS FPS	0.28889043E+20	0.26963139E+20	0.17774923E+20	0.0
NS FPS	0.18693242E+21	0.17251485E+21	0.10964668E+21	0.0
XE-135	0.23073201E+16	0.23097142E+16	0.20566156E+16	0.0
SM-149	0.20364261E+17	0.20604028E+17	0.20250908E+17	0.0
FTW RATIO	0.6839	0.6839	0.6839	0.0

TIME= 10500.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.41546E-02	0.92957E-02	0.68832E-01	0.18754E+01
REGION 2	0.41619E-02	0.93112E-02	0.68274E-01	0.18746E+01
REGION 3	0.41817E-02	0.93461E-02	0.63876E-01	0.18710E+01
REGION 4	0.26173E-03	0.0	0.14013E-01	0.32286E+01
GROUP 2				

REGION 1	0.24992E-02	0.60941E-03	0.62433E-01	0.98970E+00
REGION 2	0.25115E-02	0.63286E-03	0.62242E-01	0.98937E+00
REGION 3	0.25357E-02	0.67766E-03	0.58970E-01	0.98792E+00
REGION 4	0.72009E-05	0.0	0.13514E-01	0.12100E+01

GROUP 3

REGION 1	0.30892E-01	0.91718E-02	0.50679E-01	0.77363E+00
REGION 2	0.30593E-01	0.94520E-02	0.50727E-01	0.77403E+00
REGION 3	0.28895E-01	0.99095E-02	0.48151E-01	0.77646E+00
REGION 4	0.69306E-03	0.0	0.13536E-01	0.77365E+00

GROUP 4

REGION 1	0.11761E+00	0.16572E+00	0.0	0.51343E+00
REGION 2	0.11772E+00	0.16749E+00	0.0	0.51323E+00
REGION 3	0.11174E+00	0.16383E+00	0.0	0.51755E+00
REGION 4	0.13069E-01	0.0	0.0	0.39397E+00

KEFF= 1.01124 TIME= 10500.00

RELATIVE POINT GROUP AVERAGES

1	0.9642848E+00
2	0.9644724E+00
3	0.9650352E+00
4	0.9659741E+00
5	0.9672855E+00
6	0.9689666E+00
7	0.9710184E+00
8	0.9734390E+00
9	0.9762285E+00
10	0.9793860E+00
11	0.9829105E+00
12	0.9867975E+00
13	0.9910279E+00
14	0.9955049E+00
15	0.9997725E+00
16	0.1000000E+01
17	0.9965933E+00
18	0.9894628E+00
19	0.9786710E+00
20	0.9643373E+00
21	0.9466022E+00
22	0.9255959E+00
23	0.9014108E+00
24	0.8740256E+00
25	0.8431399E+00
26	0.8150273E+00
27	0.7812008E+00
28	0.7417617E+00
29	0.6970021E+00
30	0.6473371E+00
31	0.5932856E+00
32	0.5355080E+00
33	0.4749695E+00
34	0.4134386E+00
35	0.3549432E+00
36	0.3019659E+00
37	0.2472021E+00
38	0.1969063E+00
39	0.1532499E+00
40	0.1164003E+00

41	0.8560842E-01
42	0.5976278E-01
43	0.3765801E-01
44	0.1811139E-01
45	0.0

PEAK TO AVERAGE = 1.1420

TIME= 11200.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.41508E-02	0.92884E-02	0.69425E-01	0.18764E+01
REGION 2	0.41581E-02	0.93041E-02	0.68928E-01	0.18756E+01
REGION 3	0.41794E-02	0.93434E-02	0.64582E-01	0.18717E+01
REGION 4	0.26415E-03	0.0	0.14010E-01	0.32311E+01
GROUP 2				
REGION 1	0.24952E-02	0.60101E-03	0.62870E-01	0.99002E+00
REGION 2	0.25072E-02	0.62401E-03	0.62730E-01	0.98969E+00
REGION 3	0.25326E-02	0.67123E-03	0.59564E-01	0.98815E+00
REGION 4	0.72017E-05	0.0	0.13585E-01	0.12098E+01
GROUP 3				
REGION 1	0.31228E-01	0.90681E-02	0.50858E-01	0.77310E+00
REGION 2	0.30935E-01	0.93428E-02	0.50968E-01	0.77350E+00
REGION 3	0.29167E-01	0.98291E-02	0.48602E-01	0.77600E+00
REGION 4	0.69334E-03	0.0	0.13591E-01	0.77360E+00
GROUP 4				
REGION 1	0.11765E+00	0.16527E+00	0.0	0.51332E+00
REGION 2	0.11791E+00	0.16716E+00	0.0	0.51301E+00
REGION 3	0.11243E+00	0.16431E+00	0.0	0.51690E+00
REGION 4	0.13074E-01	0.0	0.0	0.39393E+00

***** DATA AT END OF SUBSTP 16 *****

TOTAL TIME = 11200.00 HOURS

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.70380830E+20	0.79969082E+20	0.10947438E+21	0.0
U-238	0.79173507E+22	0.79219894E+22	0.79589909E+22	0.0
PU-239	0.52182681E+20	0.50520589E+20	0.40979643E+20	0.0
PU-240	0.11220472E+20	0.10285096E+20	0.62155128E+19	0.0
PU-241	0.73126143E+19	0.62036205E+19	0.25757423E+19	0.0
PU-242	0.12255069E+19	0.92251664E+18	0.22018050E+18	0.0
O-16	0.28339608E+23	0.28339797E+23	0.28339977E+23	0.24426610E+23
H&H2O	0.23849082E+23	0.23849082E+23	0.23849082E+23	0.48853220E+23
ZIRC2	0.55303798E+22	0.55303798E+22	0.55303798E+22	0.0
RS FPS	0.74780579E+19	0.72689725E+19	0.55732177E+19	0.0
SS FPS	0.30772674E+20	0.28852716E+20	0.19161040E+20	0.0
NS FPS	0.20043344E+21	0.18578835E+21	0.11874611E+21	0.0
XE-135	0.21870658E+16	0.22081546E+16	0.20152553E+16	0.0
SM-149	0.18987256E+17	0.19231103E+17	0.19030888E+17	0.0
REACTION RATES				
FISSION THEN ABSORPTION				
U-235	0.12255494E+13	0.13381298E+13	0.12217284E+13	0.0

U-235	0.14992854E+13	0.16370798E+13	0.14940530E+13	0.0
U-238	0.30055891E+12	0.29260513E+12	0.19733860E+12	0.0
U-238	0.31848242E+13	0.30695301E+13	0.20447599E+13	0.0
PU-239	0.17262979E+13	0.16058061E+13	0.86944075E+12	0.0
PU-239	0.26175068E+13	0.24347704E+13	0.13181261E+13	0.0
PU-240	0.25639401E+10	0.22804700E+10	0.92104832E+09	0.0
PU-240	0.57620149E+12	0.50799025E+12	0.20317995E+12	0.0
PU-241	0.27898354E+12	0.22741510E+12	0.62982476E+11	0.0
PU-241	0.37092904E+12	0.30235545E+12	0.83747340E+11	0.0
PU-242	0.21587051E+09	0.15792954E+09	0.25249056E+08	0.0
PU-242	0.14055264E+11	0.10179432E+11	0.16057487E+10	0.0
O-16	0.29369016E+11	0.28573671E+11	0.19181052E+11	0.26928630E+10
H&H2O	0.28078480E+12	0.26976682E+12	0.18000616E+12	0.19192283E+12
ZIRC2	0.10364243E+12	0.99763552E+11	0.66194223E+11	0.0
FPS	0.86555034E+12	0.80087384E+12	0.40506674E+12	0.0
TOTAL	0.35341677E+13	0.34663920E+13	0.23524341E+13	0.0
TOTAL	0.95421465E+13	0.91608779E+13	0.58159163E+13	0.19461564E+12
NEUTRON FLUX				
GROUP 1	0.97819524E+14	0.95176492E+14	0.63892084E+14	0.10071173E+14
GROUP 2	0.14024184E+15	0.13534863E+15	0.89448147E+14	0.15684168E+14
GROUP 3	0.10726795E+15	0.10319308E+15	0.68151065E+14	0.15625412E+14
GROUP 4	0.46207892E+14	0.44386558E+14	0.29657890E+14	0.13845331E+14
CONVERSION RATIO	0.7705	0.7505	0.7078	
BURNUP	0.15066777E+05	0.14733953E+05	0.98848281E+04	
POWER DENSITY	0.11678256E+03	0.11434370E+03	0.77141052E+02	
POWER	0.10550533E+10	0.10194002E+10	0.68623565E+09	
ENERGY DENSITY	0.82007812E+05	0.80275000E+05	0.54049375E+05	
FLUENCE	0.35340928E+21	0.34107843E+21	0.22540931E+21	0.39524101E+20
FTW RATIO	0.6839	0.6839	0.6839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.10112E+01 AT TIME= 10500.00
FUEL TO WATER RATIO =0.6839
GROUP 4 FLUX = 0.48304021E+14
GROUP 3 FLUX = 0.10218997E+15
GROUP 2 FLUX = 0.13105745E+15
GROUP 1 FLUX = 0.91653075E+14
TOTAL FLUX = 0.37320420E+15
TOTAL FISSION REACTION RATE= 0.93529938E+13
TOTAL ABSORPTION REACTION RATE= 0.24713527E+14
ENERGY DENSITY = 0.72167625E+05
POWER DENSITY = 0.10283646E+03
TOTAL POWER = 0.27606892E+10
CONVERSION RATIO = 0.7477
BURNUP THIS STEP = 0.13232113E+05
TIME = 11200.00

***** END OF SUBSTP 16 *****

KEFF= 1.00481 TIME= 11200.00

RELATIVE POINT GROUP AVERAGES

1	0.9462311E+00
2	0.9465022E+00
3	0.9473136E+00
4	0.9486683E+00
5	0.9505644E+00
6	0.9529982E+00

7	0.9559714E+00
8	0.9594837E+00
9	0.9635351E+00
10	0.9681265E+00
11	0.9732563E+00
12	0.9789237E+00
13	0.9851131E+00
14	0.9917319E+00
15	0.9983313E+00
16	0.1000000E+01
17	0.9981194E+00
18	0.9925960E+00
19	0.9834839E+00
20	0.9708960E+00
21	0.9549625E+00
22	0.9358026E+00
23	0.9134935E+00
24	0.8879874E+00
25	0.8589351E+00
26	0.8319809E+00
27	0.7989011E+00
28	0.7597872E+00
29	0.7149389E+00
30	0.6647918E+00
31	0.6098909E+00
32	0.5509301E+00
33	0.4889197E+00
34	0.4257001E+00
35	0.3654558E+00
36	0.3108584E+00
37	0.2544109E+00
38	0.2025815E+00
39	0.1576132E+00
40	0.1196759E+00
41	0.8799219E-01
42	0.6141230E-01
43	0.3869060E-01
44	0.1860597E-01
45	0.0

PEAK TO AVERAGE = 1.1406

TIME= 11900.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.41471E-02	0.92812E-02	0.70078E-01	0.18774E+01
REGION 2	0.41543E-02	0.92970E-02	0.69643E-01	0.18766E+01
REGION 3	0.41768E-02	0.93395E-02	0.65292E-01	0.18725E+01
REGION 4	0.26657E-03	0.0	0.14007E-01	0.32336E+01
GROUP 2				
REGION 1	0.24913E-02	0.59315E-03	0.63352E-01	0.99034E+00
REGION 2	0.25031E-02	0.61555E-03	0.63264E-01	0.99001E+00
REGION 3	0.25290E-02	0.66373E-03	0.60125E-01	0.98839E+00
REGION 4	0.72025E-05	0.0	0.13655E-01	0.12097E+01
GROUP 3				
REGION 1	0.31531E-01	0.89737E-02	0.51127E-01	0.77264E+00
REGION 2	0.31252E-01	0.92415E-02	0.51291E-01	0.77301E+00
REGION 3	0.29425E-01	0.97257E-02	0.49023E-01	0.77558E+00
REGION 4	0.69361E-03	0.0	0.13646E-01	0.77355E+00

GROUP 4

REGION 1	0.11790E+00	0.16484E+00	0.0	0.51305E+00
REGION 2	0.11828E+00	0.16683E+00	0.0	0.51264E+00
REGION 3	0.11305E+00	0.16439E+00	0.0	0.51631E+00
REGION 4	0.13078E-01	0.0	0.0	0.39389E+00

***** DATA AT END OF SUBSTP 17 *****

TOTAL TIME = 11900.00 HOURS

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.66740461E+20	0.75920944E+20	0.10568513E+21	0.0
U-238	0.79094288E+22	0.79142207E+22	0.79537217E+22	0.0
PU-239	0.52788732E+20	0.51319239E+20	0.42279705E+20	0.0
PU-240	0.11973365E+20	0.11071062E+20	0.68423928E+19	0.0
PU-241	0.78261478E+19	0.67354851E+19	0.27394904E+19	0.0
PU-242	0.14183172E+19	0.10848046E+19	0.25926814E+18	0.0
O-16	0.28339608E+23	0.28339797E+23	0.28339977E+23	0.24426610E+23
H&H2O	0.23849082E+23	0.23849082E+23	0.23849082E+23	0.48853220E+23
ZIRC2	0.55303798E+22	0.55303798E+22	0.55303798E+22	0.0
RS FPS	0.76366668E+19	0.74671551E+19	0.58367641E+19	0.0
SS FPS	0.32594750E+20	0.30714250E+20	0.20560357E+20	0.0
NS FPS	0.21368943E+21	0.19908408E+21	0.12799505E+21	0.0
XE-135	0.21677524E+16	0.21970038E+16	0.20203145E+16	0.0
SM-149	0.18894566E+17	0.19144576E+17	0.18976055E+17	0.0
REACTION RATES				
FISSION THEN ABSORPTION				
U-235	0.11519090E+13	0.12816367E+13	0.12103157E+13	0.0
U-235	0.14089716E+13	0.15677144E+13	0.14798700E+13	0.0
U-238	0.29557948E+12	0.29286839E+12	0.20129815E+12	0.0
U-238	0.31442694E+13	0.30845006E+13	0.20913366E+13	0.0
PU-239	0.17285859E+13	0.16433891E+13	0.91922950E+12	0.0
PU-239	0.26202813E+13	0.24910947E+13	0.13932366E+13	0.0
PU-240	0.26934218E+10	0.24594834E+10	0.10346604E+10	0.0
PU-240	0.60286193E+12	0.54569665E+12	0.22708113E+12	0.0
PU-241	0.29575125E+12	0.24893751E+12	0.68694991E+11	0.0
PU-241	0.39322930E+12	0.33097567E+12	0.91344273E+11	0.0
PU-242	0.24594434E+09	0.18606648E+09	0.30344400E+08	0.0
PU-242	0.15938859E+11	0.11938198E+11	0.19184617E+10	0.0
O-16	0.28937396E+11	0.28653232E+11	0.19596354E+11	0.27886223E+10
H&H2O	0.27808740E+12	0.27193908E+12	0.18456668E+12	0.19731749E+12
ZIRC2	0.10238932E+12	0.10031399E+12	0.67717915E+11	0.0
FPS	0.88024089E+12	0.83289781E+12	0.43227677E+12	0.0
TOTAL	0.34747628E+13	0.34694758E+13	0.24005994E+13	0.0
TOTAL	0.94752033E+13	0.92657209E+13	0.59889408E+13	0.20010612E+12
NEUTRON FLUX				
GROUP 1	0.96277027E+14	0.95337553E+14	0.65205002E+14	0.10335366E+14
GROUP 2	0.13828919E+15	0.13584352E+15	0.91368685E+14	0.16046178E+14
GROUP 3	0.10585605E+15	0.10365120E+15	0.69639321E+14	0.16006730E+14
GROUP 4	0.45745831E+14	0.44726229E+14	0.30396306E+14	0.14232673E+14
CONVERSION RATIO	0.7798	0.7597	0.7138	
BURNUP	0.15769105E+05	0.15698973E+05	0.10733359E+05	
POWER DENSITY	0.11489920E+03	0.11453133E+03	0.78771759E+02	
POWER	0.10380383E+10	0.10210726E+10	0.70074214E+09	
ENERGY DENSITY	0.80663875E+05	0.80416250E+05	0.55156016E+05	
FLUENCE	0.34848854E+21	0.34232564E+21	0.23024908E+21	0.40436361E+20
FTW RATIO	0.6839	0.6839	0.6839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.10048E+01 AT TIME= 11200.00
FUEL TO WATER RATIO =0.6839
GROUP 4 FLUX = 0.48735011E+14
GROUP 3 FLUX = 0.10258558E+15
GROUP 2 FLUX = 0.13141513E+15
GROUP 1 FLUX = 0.91778737E+14
TOTAL FLUX = 0.37451444E+15
TOTAL FISSION REACTION RATE= 0.93448380E+13
TOTAL ABSORPTION REACTION RATE= 0.24929953E+14
ENERGY DENSITY = 0.72129000E+05
POWER DENSITY = 0.10280531E+03
TOTAL POWER = 0.27598531E+10
CONVERSION RATIO = 0.7559
BURNUP THIS STEP = 0.14069789E+05
TIME = 11900.00

***** END OF SUBSTP 17 *****

KEFF= 0.99774 TIME= 11900.00

RELATIVE POINT GROUP AVERAGES

1	0.9393753E+00
2	0.9396784E+00
3	0.9405864E+00
4	0.9420993E+00
5	0.9442160E+00
6	0.9469339E+00
7	0.9502553E+00
8	0.9541820E+00
9	0.9587110E+00
10	0.9638442E+00
11	0.9695815E+00
12	0.9759207E+00
13	0.9828452E+00
14	0.9902694E+00
15	0.9977539E+00
16	0.1000000E+01
17	0.9987708E+00
18	0.9939737E+00
19	0.9856605E+00
20	0.9739388E+00
21	0.9589326E+00
22	0.9407547E+00
23	0.9194723E+00
24	0.8950236E+00
25	0.8670294E+00
26	0.8407599E+00
27	0.8081354E+00
28	0.7692416E+00
29	0.7243816E+00
30	0.6740011E+00
31	0.6186597E+00
32	0.5590694E+00
33	0.4962628E+00
34	0.4321189E+00
35	0.3709137E+00
36	0.3154278E+00
37	0.2580628E+00
38	0.2054108E+00

39	0.1597528E+00
40	0.1212564E+00
41	0.8912575E-01
42	0.6218714E-01
43	0.3917108E-01
44	0.1883476E-01
45	0.0

PEAK TO AVERAGE = 1.1389

TIME= 12600.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.41437E-02	0.92749E-02	0.70719E-01	0.18784E+01
REGION 2	0.41504E-02	0.92894E-02	0.70298E-01	0.18776E+01
REGION 3	0.41743E-02	0.93360E-02	0.66011E-01	0.18733E+01
REGION 4	0.26900E-03	0.0	0.14004E-01	0.32360E+01
GROUP 2				
REGION 1	0.24878E-02	0.58607E-03	0.63838E-01	0.99065E+00
REGION 2	0.24990E-02	0.60700E-03	0.63741E-01	0.99034E+00
REGION 3	0.25256E-02	0.65691E-03	0.60708E-01	0.98862E+00
REGION 4	0.72033E-05	0.0	0.13726E-01	0.12096E+01
GROUP 3				
REGION 1	0.31825E-01	0.88936E-02	0.51411E-01	0.77220E+00
REGION 2	0.31542E-01	0.91365E-02	0.51568E-01	0.77258E+00
REGION 3	0.29685E-01	0.96387E-02	0.49469E-01	0.77515E+00
REGION 4	0.69389E-03	0.0	0.13700E-01	0.77350E+00
GROUP 4				
REGION 1	0.11819E+00	0.16453E+00	0.0	0.51275E+00
REGION 2	0.11855E+00	0.16635E+00	0.0	0.51236E+00
REGION 3	0.11372E+00	0.16461E+00	0.0	0.51568E+00
REGION 4	0.13082E-01	0.0	0.0	0.39384E+00

***** DATA AT END OF SUBSTP 18 *****

TOTAL TIME = 12600.00 HOURS

NUMBER DENSITY	REGION 1	REGION 2	REGION 3	REGION 4
U-235	0.63289930E+20	0.72050927E+20	0.10196878E+21	0.0
U-238	0.79015430E+22	0.79064249E+22	0.79483850E+22	0.0
PU-239	0.53309830E+20	0.52017121E+20	0.43486371E+20	0.0
PU-240	0.12669716E+20	0.11808315E+20	0.74672497E+19	0.0
PU-241	0.84035586E+19	0.72226127E+19	0.30328225E+19	0.0
PU-242	0.17391283E+19	0.12567330E+19	0.31662416E+18	0.0
O-16	0.28339608E+23	0.28339797E+23	0.28339977E+23	0.24426610E+23
H&H2O	0.23849082E+23	0.23849082E+23	0.23849082E+23	0.48853220E+23
ZIRC2	0.55303798E+22	0.55303798E+22	0.55303798E+22	0.0
RS FPS	0.77768886E+19	0.76438785E+19	0.60913648E+19	0.0
SS FPS	0.34360583E+20	0.32543627E+20	0.21960449E+20	0.0
NS FPS	0.22698227E+21	0.21230887E+21	0.13733739E+21	0.0
XE-135	0.21538238E+16	0.21836384E+16	0.20215155E+16	0.0
SM-149	0.18816750E+17	0.19043142E+17	0.18937920E+17	0.0

REACTION RATES

FISSION THEN ABSORPTION

U-235	0.10920265E+13	0.12252065E+13	0.11868695E+13	0.0
U-235	0.13355136E+13	0.14984518E+13	0.14509796E+13	0.0
U-238	0.29318133E+12	0.29264203E+12	0.20319437E+12	0.0
U-238	0.31310028E+13	0.30948071E+13	0.21182420E+13	0.0
PU-239	0.17427438E+13	0.16756412E+13	0.95961403E+12	0.0
PU-239	0.26410410E+13	0.25393124E+13	0.14540593E+13	0.0
PU-240	0.28298911E+10	0.26240827E+10	0.11404485E+10	0.0
PU-240	0.63083538E+12	0.57995028E+12	0.24917528E+12	0.0
PU-241	0.31727177E+12	0.26872191E+12	0.77245055E+11	0.0
PU-241	0.42184927E+12	0.35728608E+12	0.10271477E+12	0.0
PU-242	0.29943475E+09	0.21561230E+09	0.37430464E+08	0.0
PU-242	0.19314463E+11	0.13771784E+11	0.23542065E+10	0.0
O-16	0.28757074E+11	0.28685074E+11	0.19811942E+11	0.28510006E+10
H&H2O	0.27778266E+12	0.27371228E+12	0.18743578E+12	0.20042652E+12
ZIRC2	0.10202356E+12	0.10071487E+12	0.68609286E+11	0.0
FPS	0.90177982E+12	0.86279776E+12	0.45611300E+12	0.0
TOTAL	0.34483502E+13	0.34650498E+13	0.24280983E+13	0.0
TOTAL	0.94898959E+13	0.93494863E+13	0.61094924E+13	0.20327747E+12

NEUTRON FLUX

GROUP 1	0.95573055E+14	0.95339634E+14	0.65850959E+14	0.10472113E+14
GROUP 2	0.13754666E+15	0.13613659E+15	0.92421153E+14	0.16216173E+14
GROUP 3	0.10536347E+15	0.10395437E+15	0.70478065E+14	0.16199978E+14
GROUP 4	0.45677330E+14	0.44999882E+14	0.30855766E+14	0.14455083E+14

CONVERSION RATIO	0.7880	0.7689	0.7192	
BURNUP	0.16600535E+05	0.16632590E+05	0.11512414E+05	
POWER DENSITY	0.11410367E+03	0.11446658E+03	0.79727844E+02	
POWER	0.10308513E+10	0.10204956E+10	0.70924723E+09	
ENERGY DENSITY	0.78385812E+05	0.80459437E+05	0.55890664E+05	
FLUENCE	0.34661757E+21	0.34306395E+21	0.23290130E+21	0.40864748E+20
FTW RATIO	0.6839	0.6839	0.6839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.99774E+00 AT TIME= 11900.00
FUEL TO WATER RATIO =0.6839
GROUP 4 FLUX = 0.49086560E+14
GROUP 3 FLUX = 0.10291265E+15
GROUP 2 FLUX = 0.13171180E+15
GROUP 1 FLUX = 0.91837407E+14
TOTAL FLUX = 0.37554818E+15
TOTAL FISSION REACTION RATE= 0.93414983E+13
TOTAL ABSORPTION REACTION RATE= 0.25152134E+14
ENERGY DENSITY = 0.71620125E+05
POWER DENSITY = 0.10283293E+03
TOTAL POWER = 0.27605942E+10
CONVERSION RATIO = 0.7635
BURNUP THIS STEP = 0.14917297E+05
TIME = 12600.00

***** END OF SUBSTP 18 *****

KEFF= 0.99114 TIME= 12600.00

RELATIVE POINT GROUP AVERAGES

1	0.9444477E+00
2	0.9447258E+00
3	0.9455587E+00
4	0.9469489E+00

5	0.9488930E+00
6	0.9513898E+00
7	0.9544383E+00
8	0.9580400E+00
9	0.9621946E+00
10	0.9669035E+00
11	0.9721665E+00
12	0.9779822E+00
13	0.9843346E+00
14	0.9911440E+00
15	0.9979994E+00
16	0.1000000E+01
17	0.9987300E+00
18	0.9941003E+00
19	0.9861598E+00
20	0.9750089E+00
21	0.9607607E+00
22	0.9435170E+00
23	0.9233291E+00
24	0.9001122E+00
25	0.8734445E+00
26	0.8480881E+00
27	0.8161327E+00
28	0.7776522E+00
29	0.7329530E+00
30	0.6824902E+00
31	0.6268384E+00
32	0.5667273E+00
33	0.5032141E+00
34	0.4382163E+00
35	0.3761019E+00
36	0.3197733E+00
37	0.2615342E+00
38	0.2080977E+00
39	0.1617823E+00
40	0.1227539E+00
41	0.9019852E-01
42	0.6291950E-01
43	0.3962490E-01
44	0.1905075E-01
45	0.0

PEAK TO AVERAGE = 1.1335

TIME= 13300.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.41400E-02	0.92676E-02	0.71283E-01	0.18794E+01
REGION 2	0.41466E-02	0.92821E-02	0.70911E-01	0.18786E+01
REGION 3	0.41719E-02	0.93325E-02	0.66711E-01	0.18741E+01
REGION 4	0.27142E-03	0.0	0.14001E-01	0.32385E+01
GROUP 2				
REGION 1	0.24843E-02	0.57893E-03	0.64262E-01	0.99096E+00
REGION 2	0.24951E-02	0.59925E-03	0.64204E-01	0.99065E+00
REGION 3	0.25224E-02	0.65049E-03	0.61284E-01	0.98886E+00
REGION 4	0.72041E-05	0.0	0.13797E-01	0.12095E+01
GROUP 3				
REGION 1	0.32078E-01	0.88111E-02	0.51653E-01	0.77183E+00
REGION 2	0.31813E-01	0.90474E-02	0.51844E-01	0.77218E+00

REGION 3	0.29938E-01	0.95619E-02	0.49913E-01	0.77473E+00
REGION 4	0.69417E-03	0.0	0.13755E-01	0.77345E+00

GROUP 4

REGION 1	0.11838E+00	0.16410E+00	0.0	0.51252E+00
REGION 2	0.11881E+00	0.16600E+00	0.0	0.51208E+00
REGION 3	0.11439E+00	0.16488E+00	0.0	0.51506E+00
REGION 4	0.13086E-01	0.0	0.0	0.39380E+00

***** DATA AT END OF SUBSTP 19 *****

TOTAL TIME = 13300.00 HOURS

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.60003938E+20	0.68364625E+20	0.98337892E+20	0.0
U-238	0.78936527E+22	0.78986292E+22	0.79429987E+22	0.0
PU-239	0.53758536E+20	0.52622838E+20	0.44600889E+20	0.0
PU-240	0.13313854E+20	0.12496082E+20	0.80803901E+19	0.0
PU-241	0.89368129E+19	0.77907172E+19	0.34076240E+19	0.0
PU-242	0.19533484E+19	0.14516368E+19	0.37807367E+18	0.0
O-16	0.28339608E+23	0.28339797E+23	0.28339977E+23	0.24426610E+23
H&H2O	0.23849082E+23	0.23849082E+23	0.23849082E+23	0.48853220E+23
ZIRC2	0.55303798E+22	0.55303798E+22	0.55303798E+22	0.0
RS FPS	0.78909729E+19	0.77859299E+19	0.63247592E+19	0.0
SS FPS	0.36105868E+20	0.34337414E+20	0.23357638E+20	0.0
NS FPS	0.24005789E+21	0.22548283E+21	0.14675020E+21	0.0
XE-135	0.21410208E+16	0.21706679E+16	0.20216575E+16	0.0
SM-149	0.18729609E+17	0.18958565E+17	0.18909594E+17	0.0
REACTION RATES				
FISSION THEN ABSORPTION				
U-235	0.10399906E+13	0.11671102E+13	0.11594807E+13	0.0
U-235	0.12716763E+13	0.14271707E+13	0.14172805E+13	0.0
U-238	0.29231022E+12	0.29142109E+12	0.20448385E+12	0.0
U-238	0.31329805E+13	0.30947116E+13	0.21384575E+13	0.0
PU-239	0.17629132E+13	0.16995299E+13	0.99562147E+12	0.0
PU-239	0.26708971E+13	0.25748318E+13	0.15082182E+13	0.0
PU-240	0.29677514E+10	0.27683453E+10	0.12425669E+10	0.0
PU-240	0.65868136E+12	0.60945544E+12	0.27020499E+12	0.0
PU-241	0.33870506E+12	0.29081607E+12	0.87861756E+11	0.0
PU-241	0.45035409E+12	0.38666823E+12	0.11683365E+12	0.0
PU-242	0.33564877E+09	0.24826880E+09	0.45006304E+08	0.0
PU-242	0.21541315E+11	0.15786426E+11	0.28152492E+10	0.0
O-16	0.28726047E+11	0.28619325E+11	0.19969024E+11	0.29070019E+10
H&H2O	0.27881046E+12	0.27457572E+12	0.18971722E+12	0.20301283E+12
ZIRC2	0.10215227E+12	0.10077779E+12	0.69283742E+11	0.0
FPS	0.92578959E+12	0.88748261E+12	0.47810675E+12	0.0
TOTAL	0.34372216E+13	0.34518912E+13	0.24487332E+13	0.0
TOTAL	0.95416064E+13	0.94000770E+13	0.62108834E+13	0.20591981E+12
NEUTRON FLUX				
GROUP 1	0.95366326E+14	0.95017561E+14	0.66301309E+14	0.10583252E+14
GROUP 2	0.13747640E+15	0.13596429E+15	0.93178997E+14	0.16343185E+14
GROUP 3	0.10538028E+15	0.10390870E+15	0.71091473E+14	0.16349915E+14
GROUP 4	0.45827620E+14	0.45123799E+14	0.31218020E+14	0.14639722E+14
CONVERSION RATIO	0.7959	0.7770	0.7241	
BURNUP	0.17497488E+05	0.17523035E+05	0.12273945E+05	
POWER DENSITY	0.11380913E+03	0.11411276E+03	0.80460281E+02	
POWER	0.10281902E+10	0.10173412E+10	0.71576294E+09	
ENERGY DENSITY	0.79904250E+05	0.80097625E+05	0.56402383E+05	
FLUENCE	0.34644053E+21	0.34262992E+21	0.23481107E+21	0.41201779E+20

FTW RATIO	0.6839	0.6839	0.6839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.99114E+00 AT TIME= 12600.00
FUEL TO WATER RATIO =0.6839
GROUP 4 FLUX = 0.49407492E+14
GROUP 3 FLUX = 0.10319505E+15
GROUP 2 FLUX = 0.13195718E+15
GROUP 1 FLUX = 0.91875826E+14
TOTAL FLUX = 0.37643536E+15
TOTAL FISSION REACTION RATE= 0.93378461E+13
TOTAL ABSORPTION REACTION RATE= 0.25358460E+14
ENERGY DENSITY = 0.72180562E+05
POWER DENSITY = 0.10285901E+03
TOTAL POWER = 0.27612943E+10
CONVERSION RATIO = 0.7706
BURNUP THIS STEP = 0.15766641E+05
TIME = 13300.00

***** END OF SUBSTP 19 *****

FTW HAS BEEN CHANGED TO INCREASE REACTIVITY

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.55126945E+20	0.62808098E+20	0.90345217E+20	0.0
U-238	0.72520744E+22	0.72566456E+22	0.72974077E+22	0.0
PU-239	0.49389165E+20	0.48345773E+20	0.40975825E+20	0.0
PU-240	0.12231735E+20	0.11480429E+20	0.74236342E+19	0.0
PU-241	0.82104491E+19	0.71575051E+19	0.31306592E+19	0.0
PU-242	0.17945844E+19	0.13336504E+19	0.34734466E+18	0.0
O-16	0.28060362E+23	0.28060538E+23	0.28060700E+23	0.24426610E+23
H&H2O	0.25958964E+23	0.25958964E+23	0.25958964E+23	0.48853220E+23
ZIRC2	0.50808800E+22	0.50808800E+22	0.50808800E+22	0.0
RS FPS	0.72496123E+19	0.71531071E+19	0.58106969E+19	0.0
SS FPS	0.33171263E+20	0.31546537E+20	0.21459177E+20	0.0
NS FPS	0.22054653E+21	0.20715610E+21	0.13482268E+21	0.0
XE-135	0.19670035E+16	0.19942408E+16	0.18573417E+16	0.0
SM-149	0.17207310E+17	0.17417656E+17	0.17372666E+17	0.0
FTW RATIO	0.5839	0.5839	0.5839	0.0

TIME= 13300.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.38591E-02	0.86083E-02	0.71838E-01	0.19390E+01
REGION 2	0.38653E-02	0.86217E-02	0.71499E-01	0.19382E+01
REGION 3	0.38887E-02	0.86685E-02	0.67350E-01	0.19338E+01
REGION 4	0.27142E-03	0.0	0.14001E-01	0.32385E+01
GROUP 2				
REGION 1	0.22886E-02	0.53304E-03	0.68137E-01	0.10033E+01
REGION 2	0.22986E-02	0.55172E-03	0.68121E-01	0.10030E+01
REGION 3	0.23237E-02	0.59880E-03	0.65167E-01	0.10013E+01
REGION 4	0.72041E-05	0.0	0.13797E-01	0.12095E+01

GROUP 3

REGION 1	0.30350E-01	0.81513E-02	0.56355E-01	0.76939E+00
REGION 2	0.30090E-01	0.83673E-02	0.56596E-01	0.76975E+00
REGION 3	0.28278E-01	0.88346E-02	0.54649E-01	0.77225E+00
REGION 4	0.69417E-03	0.0	0.13755E-01	0.77345E+00

GROUP 4

REGION 1	0.11060E+00	0.15124E+00	0.0	0.49924E+00
REGION 2	0.11107E+00	0.15315E+00	0.0	0.49880E+00
REGION 3	0.10725E+00	0.15276E+00	0.0	0.50122E+00
REGION 4	0.13086E-01	0.0	0.0	0.39380E+00

KEFF= 1.00533 TIME= 13300.00

RELATIVE POINT GROUP AVERAGES

1	0.9306945E+00
2	0.9310367E+00
3	0.9320615E+00
4	0.9337708E+00
5	0.9361635E+00
6	0.9392372E+00
7	0.9429912E+00
8	0.9474270E+00
9	0.9525471E+00
10	0.9583521E+00
11	0.9648424E+00
12	0.9720185E+00
13	0.9798664E+00
14	0.9883043E+00
15	0.9969137E+00
16	0.1000000E+01
17	0.9999067E+00
18	0.9965358E+00
19	0.9899268E+00
20	0.9801718E+00
21	0.9673756E+00
22	0.9516301E+00
23	0.9329688E+00
24	0.9112753E+00
25	0.8860614E+00
26	0.8615960E+00
27	0.8301861E+00
28	0.7918835E+00
29	0.7469974E+00
30	0.6960016E+00
31	0.6395048E+00
32	0.5782880E+00
33	0.5134844E+00
34	0.4471212E+00
35	0.3836789E+00
36	0.3239234E+00
37	0.2640490E+00
38	0.2098048E+00
39	0.1630490E+00
40	0.1237355E+00
41	0.9095693E-01
42	0.6347823E-01
43	0.3999304E-01
44	0.1923298E-01
45	0.0

PEAK TO AVERAGE = 1.1323

TIME= 14000.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.38554E-02	0.85991E-02	0.72065E-01	0.19401E+01
REGION 2	0.38613E-02	0.86123E-02	0.71790E-01	0.19394E+01
REGION 3	0.38863E-02	0.86638E-02	0.67852E-01	0.19347E+01
REGION 4	0.27384E-03	0.0	0.13998E-01	0.32410E+01
GROUP 2				
REGION 1	0.22840E-02	0.52321E-03	0.68237E-01	0.10036E+01
REGION 2	0.22937E-02	0.54119E-03	0.68272E-01	0.10034E+01
REGION 3	0.23197E-02	0.59040E-03	0.65569E-01	0.10016E+01
REGION 4	0.72049E-05	0.0	0.13869E-01	0.12094E+01
GROUP 3				
REGION 1	0.30589E-01	0.80208E-02	0.56182E-01	0.76905E+00
REGION 2	0.30347E-01	0.82299E-02	0.56467E-01	0.76937E+00
REGION 3	0.28529E-01	0.87260E-02	0.54848E-01	0.77184E+00
REGION 4	0.69445E-03	0.0	0.13810E-01	0.77340E+00
GROUP 4				
REGION 1	0.10991E+00	0.14964E+00	0.0	0.49968E+00
REGION 2	0.11047E+00	0.15158E+00	0.0	0.49918E+00
REGION 3	0.10730E+00	0.15215E+00	0.0	0.50109E+00
REGION 4	0.13091E-01	0.0	0.0	0.39375E+00

***** DATA AT END OF SUBSTP 20 *****

TOTAL TIME = 14000.00 HOURS

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.51987197E+20	0.59235476E+20	0.86727577E+20	0.0
U-238	0.72448552E+22	0.72494173E+22	0.72923501E+22	0.0
PU-239	0.49317970E+20	0.48418041E+20	0.41687975E+20	0.0
PU-240	0.12872347E+20	0.12166704E+20	0.80458193E+19	0.0
PU-241	0.86195246E+19	0.76185622E+19	0.34850527E+19	0.0
PU-242	0.20262493E+19	0.15441014E+19	0.41833999E+18	0.0
O-16	0.28060362E+23	0.28060538E+23	0.28060700E+23	0.24426610E+23
H&H2O	0.25958964E+23	0.25958964E+23	0.25958964E+23	0.48853220E+23
ZIRC2	0.50808800E+22	0.50808800E+22	0.50808800E+22	0.0
RS FPS	0.73058930E+19	0.72416815E+19	0.60098767E+19	0.0
SS FPS	0.34871143E+20	0.33318281E+20	0.22868734E+20	0.0
NS FPS	0.23340364E+21	0.22026712E+21	0.14439049E+21	0.0
XE-135	0.18738459E+16	0.19065338E+16	0.18130010E+16	0.0
SM-149	0.16093754E+17	0.16303679E+17	0.16390802E+17	0.0
REACTION RATES				
FISSION THEN ABSORPTION				
U-235	0.99703738E+12	0.11344963E+13	0.11594010E+13	0.0
U-235	0.12117533E+13	0.13788680E+13	0.14087535E+13	0.0
U-238	0.26117643E+12	0.26393038E+12	0.18765565E+12	0.0
U-238	0.28665163E+13	0.28706267E+13	0.20088053E+13	0.0
PU-239	0.17467284E+13	0.17123141E+13	0.10295548E+13	0.0
PU-239	0.26293704E+13	0.25775393E+13	0.15496433E+13	0.0
PU-240	0.27593620E+10	0.26276805E+10	0.12219182E+10	0.0

PU-240	0.64102983E+12	0.60560926E+12	0.27797507E+12	0.0
PU-241	0.35768035E+12	0.31569589E+12	0.10080256E+12	0.0
PU-241	0.47617429E+12	0.42027031E+12	0.13420292E+12	0.0
PU-242	0.33560090E+09	0.25803152E+09	0.49295824E+08	0.0
PU-242	0.21523079E+11	0.16399606E+11	0.30806738E+10	0.0
O-16	0.27660714E+11	0.27933241E+11	0.19742843E+11	0.29099318E+10
H&H2O	0.33852785E+12	0.33801391E+12	0.23598780E+12	0.20218872E+12
ZIRC2	0.95109382E+11	0.95122162E+11	0.66188358E+11	0.0
FPS	0.94015442E+12	0.91783024E+12	0.50841236E+12	0.0
TOTAL	0.33657161E+13	0.34293206E+13	0.24786837E+13	0.0
TOTAL	0.92478175E+13	0.92482107E+13	0.62127876E+13	0.20509865E+12
NEUTRON FLUX				
GROUP 1	0.91845594E+14	0.92756731E+14	0.65564018E+14	0.10500632E+14
GROUP 2	0.12652871E+15	0.12686770E+15	0.88082095E+14	0.15718601E+14
GROUP 3	0.99385224E+14	0.99365494E+14	0.68843964E+14	0.15806329E+14
GROUP 4	0.50628890E+14	0.50544266E+14	0.35317550E+14	0.14600861E+14
CONVERSION RATIO	0.7513	0.7334	0.6784	
BURNUP	0.19662184E+05	0.19978859E+05	0.14252949E+05	
POWER DENSITY	0.11149089E+03	0.11342204E+03	0.81478882E+02	
POWER	0.10072466E+10	0.10111834E+10	0.72482432E+09	
ENERGY DENSITY	0.78543125E+05	0.79901437E+05	0.57249496E+05	
FLUENCE	0.31885232E+21	0.31970632E+21	0.22196687E+21	0.39831946E+20
FTW RATIO	0.5839	0.5839	0.5839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.10053E+01 AT TIME= 13300.00
FUEL TO WATER RATIO =0.5839
GROUP 4 FLUX = 0.54158883E+14
GROUP 3 FLUX = 0.98602634E+14
GROUP 2 FLUX = 0.12319377E+15
GROUP 1 FLUX = 0.89647007E+14
TOTAL FLUX = 0.36560211E+15
TOTAL FISSION REACTION RATE= 0.92737204E+13
TOTAL ABSORPTION REACTION RATE= 0.24913897E+14
ENERGY DENSITY = 0.71938062E+05
POWER DENSITY = 0.10218701E+03
TOTAL POWER = 0.27432543E+10
CONVERSION RATIO = 0.7257
BURNUP THIS STEP = 0.17965617E+05
TIME = 14000.00

***** END OF SUBSTP 20 *****

KEFF= 0.99706 TIME= 14000.00

RELATIVE POINT GROUP AVERAGES

1	0.9219436E+00
2	0.9223189E+00
3	0.9234442E+00
4	0.9253224E+00
5	0.9279528E+00
6	0.9313342E+00
7	0.9354694E+00
8	0.9403615E+00
9	0.9460142E+00
10	0.9524315E+00
11	0.9596185E+00
12	0.9675771E+00

13	0.9762980E+00
14	0.9857057E+00
15	0.9954008E+00
16	0.9992223E+00
17	0.1000000E+01
18	0.9976367E+00
19	0.9921674E+00
20	0.9836775E+00
21	0.9722645E+00
22	0.9580085E+00
23	0.9409298E+00
24	0.9208884E+00
25	0.8973507E+00
26	0.8739914E+00
27	0.8433474E+00
28	0.8054590E+00
29	0.7606384E+00
30	0.7093743E+00
31	0.6522962E+00
32	0.5902125E+00
33	0.5242931E+00
34	0.4566235E+00
35	0.3918041E+00
36	0.3306913E+00
37	0.2694691E+00
38	0.2140284E+00
39	0.1662678E+00
40	0.1261333E+00
41	0.9269071E-01
42	0.6467175E-01
43	0.4073733E-01
44	0.1958863E-01
45	0.0

PEAK TO AVERAGE = 1.1300

TIME= 14700.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.38517E-02	0.85903E-02	0.72359E-01	0.19413E+01
REGION 2	0.38574E-02	0.86032E-02	0.72143E-01	0.19406E+01
REGION 3	0.38839E-02	0.86589E-02	0.68399E-01	0.19357E+01
REGION 4	0.27626E-03	0.0	0.13995E-01	0.32435E+01
GROUP 2				
REGION 1	0.22797E-02	0.51405E-03	0.68401E-01	0.10040E+01
REGION 2	0.22890E-02	0.53122E-03	0.68478E-01	0.10037E+01
REGION 3	0.23158E-02	0.58208E-03	0.66001E-01	0.10018E+01
REGION 4	0.72057E-05	0.0	0.13940E-01	0.12093E+01
GROUP 3				
REGION 1	0.30800E-01	0.79009E-02	0.56114E-01	0.76876E+00
REGION 2	0.30578E-01	0.81018E-02	0.56434E-01	0.76904E+00
REGION 3	0.28771E-01	0.86198E-02	0.55094E-01	0.77145E+00
REGION 4	0.69472E-03	0.0	0.13865E-01	0.77335E+00
GROUP 4				
REGION 1	0.10943E+00	0.14817E+00	0.0	0.49997E+00
REGION 2	0.11006E+00	0.15012E+00	0.0	0.49942E+00
REGION 3	0.10745E+00	0.15152E+00	0.0	0.50090E+00

REGION 4 0.13095E-01 0.0 0.0 0.39371E+00

***** DATA AT END OF SUBSTP 21 *****

TOTAL TIME = 14700.00 HOURS

	REGION 1	REGION 2	REGION 3	REGION 4
NUMBER DENSITY				
U-235	0.49018392E+20	0.55824387E+20	0.83166303E+20	0.0
U-238	0.72376404E+22	0.72421215E+22	0.72871755E+22	0.0
PU-239	0.49244118E+20	0.48470132E+20	0.42345148E+20	0.0
PU-240	0.13447150E+20	0.12792500E+20	0.86558206E+19	0.0
PU-241	0.90330994E+19	0.80882758E+19	0.38606602E+19	0.0
PU-242	0.22660451E+19	0.17671791E+19	0.49858564E+18	0.0
O-16	0.28060362E+23	0.28060538E+23	0.28060700E+23	0.24426610E+23
H&H2O	0.25958964E+23	0.25958964E+23	0.25958964E+23	0.48853220E+23
ZIRC2	0.50808800E+22	0.50808800E+22	0.50808800E+22	0.0
RS FPS	0.73443517E+19	0.73087298E+19	0.61915050E+19	0.0
SS FPS	0.36521167E+20	0.35054946E+20	0.24284113E+20	0.0
NS FPS	0.24609164E+21	0.23334035E+21	0.15410384E+21	0.0
XE-135	0.18504818E+16	0.18858487E+16	0.18090461E+16	0.0
SM-149	0.15925618E+17	0.16134728E+17	0.16295802E+17	0.0
REACTION RATES				
FISSION THEN ABSORPTION				
U-235	0.94280647E+12	0.10829420E+13	0.11408811E+13	0.0
U-235	0.11456825E+13	0.13160226E+13	0.13860602E+13	0.0
U-238	0.25993891E+12	0.26523068E+12	0.19134428E+12	0.0
U-238	0.28641581E+13	0.28967342E+13	0.20547067E+13	0.0
PU-239	0.17470692E+13	0.17341958E+13	0.10718670E+13	0.0
PU-239	0.26292383E+13	0.26098386E+13	0.16129322E+13	0.0
PU-240	0.28712832E+10	0.27789281E+10	0.13408428E+10	0.0
PU-240	0.66488612E+12	0.63852760E+12	0.30384056E+12	0.0
PU-241	0.37567857E+12	0.33925903E+12	0.11451374E+12	0.0
PU-241	0.50014762E+12	0.45165039E+12	0.15246072E+12	0.0
PU-242	0.37386906E+09	0.29703706E+09	0.59937360E+08	0.0
PU-242	0.23861686E+11	0.18791723E+11	0.37247050E+10	0.0
O-16	0.27611148E+11	0.28154278E+11	0.20184625E+11	0.30071580E+10
H&H2O	0.33922430E+12	0.34208960E+12	0.24196029E+12	0.20763129E+12
ZIRC2	0.95082119E+11	0.96041239E+11	0.67714589E+11	0.0
FPS	0.95641954E+12	0.94631657E+12	0.53743216E+12	0.0
TOTAL	0.33287370E+13	0.34247016E+13	0.25200050E+13	0.0
TOTAL	0.92463075E+13	0.93441648E+13	0.63810128E+13	0.21063841E+12
NEUTRON FLUX				
GROUP 1	0.91472536E+14	0.93278016E+14	0.66879117E+14	0.10757019E+14
GROUP 2	0.12623899E+15	0.12783276E+15	0.89954785E+14	0.16057652E+14
GROUP 3	0.99234498E+14	0.10020402E+15	0.70342085E+14	0.16171135E+14
GROUP 4	0.50713011E+14	0.51133599E+14	0.36196525E+14	0.14991962E+14
CONVERSION RATIO	0.7640	0.7464	0.6873	
BURNUP	0.20455734E+05	0.20989852E+05	0.15239258E+05	
POWER DENSITY	0.11033092E+03	0.11334412E+03	0.82892303E+02	
POWER	0.99676698E+09	0.10104886E+10	0.73739776E+09	
ENERGY DENSITY	0.77696125E+05	0.79823687E+05	0.58243918E+05	
FLUENCE	0.31812217E+21	0.32213854E+21	0.22668605E+21	0.40751243E+20
FTW RATIO	0.5839	0.5839	0.5839	0.0

THE FOLLOWING ARE VALUES TAKEN OVER THE ENTIRE CORE :

KEFF= 0.99706E+00 AT TIME= 14000.00
FUEL TO WATER RATIO =0.5839
GROUP 4 FLUX = 0.54905402E+14

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GROUP 3 FLUX = 0.99542494E+14
GROUP 2 FLUX = 0.12423775E+15
GROUP 1 FLUX = 0.90281957E+14
TOTAL FLUX = 0.36896722E+15
TOTAL FISSION REACTION RATE= 0.92734436E+13
TOTAL ABSORPTION REACTION RATE= 0.25182115E+14
ENERGY DENSITY = 0.71956687E+05
POWER DENSITY = 0.10223912E+03
TOTAL POWER = 0.27446533E+10
CONVERSION RATIO = 0.7371
BURNUP THIS STEP = 0.18895043E+05
TIME =  14700.00

   ***** END OF SUBSTP 21 *****


FTW HAS BEEN CHANGED TO INCREASE REACTIVITY
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NUMBER DENSITY	REGION 1	REGION 2	REGION 3	REGION 4
U-235	0.44835568E+20	0.51060792E+20	0.76069580E+20	0.0
U-238	0.66200393E+22	0.66241375E+22	0.66653455E+22	0.0
PU-239	0.45042030E+20	0.44334086E+20	0.38731766E+20	0.0
PU-240	0.12299684E+20	0.11700895E+20	0.79172050E+19	0.0
PU-241	0.82622900E+19	0.73980904E+19	0.35312234E+19	0.0
PU-242	0.20726795E+19	0.16163821E+19	0.45604052E+18	0.0
O-16	0.27984368E+23	0.27984526E+23	0.27984675E+23	0.24426610E+23
H&H2O	0.28380735E+23	0.28380735E+23	0.28380735E+23	0.48853220E+23
ZIRC2	0.46473205E+22	0.46473205E+22	0.46473205E+22	0.0
RS FPS	0.67176466E+19	0.66850637E+19	0.56631732E+19	0.0
SS FPS	0.33404747E+20	0.32063641E+20	0.22211894E+20	0.0
NS FPS	0.22509225E+21	0.21342903E+21	0.14095391E+21	0.0
XE-135	0.16925771E+16	0.17249262E+16	0.16546772E+16	0.0
SM-149	0.14566656E+17	0.14757924E+17	0.14905255E+17	0.0
FTW RATIO	0.5000	0.5000	0.5000	0.0

TIME= 14700.00

	SA	NUSF	SR	DC
GROUP 1				
REGION 1	0.35753E-02	0.79308E-02	0.71535E-01	0.19943E+01
REGION 2	0.35806E-02	0.79426E-02	0.71350E-01	0.19936E+01
REGION 3	0.36050E-02	0.79941E-02	0.67751E-01	0.19889E+01
REGION 4	0.27626E-03	0.0	0.13995E-01	0.32435E+01
GROUP 2				
REGION 1	0.20901E-02	0.47110E-03	0.70625E-01	0.10097E+01
REGION 2	0.20986E-02	0.48683E-03	0.70741E-01	0.10095E+01
REGION 3	0.21231E-02	0.53336E-03	0.68325E-01	0.10078E+01
REGION 4	0.72057E-05	0.0	0.13940E-01	0.12093E+01
GROUP 3				
REGION 1	0.28898E-01	0.72698E-02	0.58923E-01	0.76080E+00
REGION 2	0.28684E-01	0.74529E-02	0.59281E-01	0.76108E+00
REGION 3	0.26960E-01	0.79225E-02	0.58002E-01	0.76337E+00
REGION 4	0.69472E-03	0.0	0.13865E-01	0.77335E+00
GROUP 4				

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   REGION 1     0.10188E+00     0.13582E+00     0.0             0.48326E+00
   REGION 2     0.10250E+00     0.13772E+00     0.0             0.48276E+00
   REGION 3     0.10029E+00     0.13946E+00     0.0             0.48390E+00
   REGION 4     0.13095E-01     0.0             0.0             0.39371E+00

REACTOR HAS BEEN SHUT DOWN BECAUSE 1. KEFF= 0.99907619E+00
                                   2. OVERALL FUEL TO WATER RATIO =0.5000

AT SHUTDOWN TIME ,

  TOTAL BURNUP = 0.18895043E+05
  CONVERSION RATIO =0.7538
  RUNNING TIME =  14700.00 HOURS
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RFD-1: A 1-D, 4-GROUP CODE TO CALCULATE BURNUP CYCLES USING MECHANICAL SPECTRAL SHIFT

by

Russell Lee Sherman

(ABSTRACT)

Increased conversion ratios and burnup can be achieved by mechanically changing the fuel-to-water volume ratio of a reactor over the core lifetime. As the fuel-to-water ratio decreases, the neutron spectrum softens, thereby increasing core reactivity. Proposed mechanical spectral shift reactors utilize this concept.

RFD-1, a 1-dimensional, 4-group code was developed to compute fuel burnup cycles for spectral shift reactors. The code calculates burnup for a triangular core lattice having a beginning fuel to water ratio as high as 1.30. Core shutdown occurs at a fuel to water ratio of 0.50. The microscopic cross sections were obtained through use of the VIM code and tabulated for use in RFD-1 as a function of fuel to water ratio and burnup time. The fission product group cross sections were developed using the VIM and TOAFEW codes. The flexibility of RFD-1 allows the user to study a wide variety of possible core configurations.

Results of RFD-1 show that increased conversion and burnup, using lower initial enrichments than that of standard Pressurized Water Reactors, result for mechanical spectral shift designs. The next step is to study specific spectral shift designs in greater detail.

The RFD-1 code could be improved primarily through refinements in its cross section data tables.