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NEUTRON AND PHOTON TRANSPORT:
PLANE, CYLINDER, SPHERE
(DIGITAL COMPUTER PROGRAM S)

B. H. Duane
REACTOR PHYSICS UNIT

REPRODUCIBLE COPY

July 31, 1957

GENERAL ELECTRIC-AIRCRAFT NUCLEAR PROPULSION DEPARTMENT-CINCINNATI 15, OHIO

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ABSTRACT OF REPORT NO. XDC 58-5-167

TITLE: Neutron and Photon Transport: Plane, Cylinder, Sphere
(Digital Computer Program S)

AUTHOR AND ORIGINATING UNIT: B. H. Duane, Reactor Physics Unit

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Digital computer Program S constructs neutron and photon transport theory solutions having plane, cylindrical, or spherical symmetry. Lattice detail in geometry, energy, and momentum-angles is flexible. Anisotropic scattering-transfer is neglected.

For aircraft nuclear propulsion applications, the initial version of the program (developed by B. G. Carlson as the Los Alamos SNG Neutron Code) has been generalized to include the effects of time-delayed neutron or photon production and to provide the flux adjoint.

The input consists of geometry, material concentrations, collision cross sections, scattering-transfer cross sections, fission multiplication cross sections, inverse period, Laplace-time-transform of fission production spectra, and Laplace-time-transform of fixed source distribution. The output includes reactivity, critical size, flux distribution, adjoint distribution, and power distribution.

This report provides the minimum information needed to make effective engineering use of the extended program. The emphasis is upon physics, input, and output. Further relevant digital mathematics and FLOCO coding information can be found in B. G. Carlson's Los Alamos documents, LA-1891, "Solution of the Transport Equation by S_n Approximations", T-1-139, "Flow Code Systems Manual", and T-1-140, "SNG Neutron Diffusion Code", copies of which are being distributed internally with this report.

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1. PHYSICS

1.1 Neutron Transport

Let $n(t, \underline{r}, \underline{p}) dV(\underline{r}, \underline{p})$ be the probable number of neutrons in position ($\underline{r}$) and momentum ($\underline{p}$) volume element $dV(\underline{r}, \underline{p})$ at time t . The neutron transport equation, balancing accumulation, leakage, collision removal, in-scattering, and fission multiplication has the form

$$\begin{aligned} & \partial n(t, \underline{r}, \underline{p}) / \partial t + \nabla \cdot \underline{\Omega} v n(t, \underline{r}, \underline{p}) + v n(t, \underline{r}, \underline{p}) \sum_A N_A(\underline{r}) \sigma_A(\underline{p}) \\ &= \sum_A N_A(\underline{r}) \int v' n(t, \underline{r}, \underline{p}') (2\pi)^{-1} \sigma_{AS}(\underline{p}' | \underline{p}, \underline{\Omega}' \cdot \underline{\Omega}) dV(\underline{p}') \\ &+ \sum_A N_A(\underline{r}) \sum_{j=0}^J \int_0^\infty \int_{-\infty}^t v' n(t', \underline{r}, \underline{p}') \nu_A(\underline{p}') \sigma_{Af}(\underline{p}') \beta_{Aj}(\underline{p}') \lambda_{Aj} e^{-\lambda_{Aj}(t-t')} \\ &\cdot (4\pi)^{-1} S_{Aj}(\underline{p}) dt' p'^2 dp', \end{aligned} \quad (1.1.1)$$

where v is the neutron velocity, $\underline{\Omega}$ is the unit vector $\underline{p}/p$, and N_A is the concentration (nuclei/volume) of nuclei of species A having collision cross section σ_A , scattering-transfer cross section σ_{AS} , fission cross section σ_{Af} , and delayed neutron production spectra

$$\nu_A(\underline{p}') \beta_{Aj}(\underline{p}') \lambda_{Aj} e^{-\lambda_{Aj}(t-t')} S_{Aj}(\underline{p}).$$

The quantity ν_A is neutron multiplication per fission, and β_{Aj} is the fraction of fission neutrons emitted with a mean delay time of $1/\lambda_{Aj}$ in a momentum spectrum S_{Aj} . Unique separation of the production spectrum into such components is provided by imposing the normalization

$$\sum_{j=0}^J \beta_{Aj} = 1, \quad \int_0^\infty S_{Aj}(\underline{p}) p^2 dp = 1.$$

For notational compactness, prompt neutrons are represented as having a mean delay time of $1/\lambda_{Ao}$, with $\lambda_{Ao} = \infty$. In the fission production term, the notation $n(t, \underline{r}, \underline{p}) = \int n(t, \underline{r}, \underline{p}) d\Omega$ is used for the integral of the neutron angular

distribution over all solid angle elements $d\Omega$. The scattering-transfer cross sections $\sigma_{As}(p' | p, \underline{\Omega}' \cdot \underline{\Omega})$ are defined by the statement that

$$N_A(\underline{r}) v' n(t, \underline{r}, \underline{p}') \cdot (2\pi)^{-1} \sigma_{As}(p' | p, \underline{\Omega}' \cdot \underline{\Omega}) dV(\underline{p}') dV(\underline{p})$$

represents the rate at which neutrons are transferred from $dV(\underline{p}')$ to $dV(\underline{p})$ by scattering from nuclear species A.

This equation has few significant validity limitations. The effects of molecular binding and thermal agitation of the nuclei, for example, are contained in the cross sections and do not influence the structure of the equation. The limitations of interest in reactor work are neglect of spin-polarization and crystalline structure, neglect of photo-neutron production, and neglect of time-variation of material concentration.

Postulating a normal mode¹ having an exponential time-dependence of the form

$$n(t, \underline{r}, \underline{p}) = n(\omega, \underline{r}, \underline{p}) e^{\omega t}, \quad (1.1.2)$$

defining reactivity k by replacement of v by v/k , defining a critical dimension scale factor ρ by replacement of $N_A(\underline{r})$ by $N_A(\underline{r}/\rho)$ and noting that the result is also representable as a replacement of ∇ by $\rho^{-1}\nabla$, and setting

$$\phi(\omega, \underline{r}, \underline{p}) = v n(\omega, \underline{r}, \underline{p}), \quad (1.1.3)$$

$$\Sigma(\omega, \underline{r}, \underline{p}) = \sum_A N_A(\underline{r}) \sigma_A(\underline{p}) + \omega/v, \quad (1.1.4)$$

$$\Sigma_s(\underline{r}, p' | p, \underline{\Omega}' \cdot \underline{\Omega}) = \sum_A N_A(\underline{r}) \sigma_{As}(p' | p, \underline{\Omega}' \cdot \underline{\Omega}), \quad (1.1.5)$$

$$v \Sigma_f(\omega, \underline{r}, p' | p) = \sum_A \sum_{j=0}^J N_A(\underline{r}) v_A(p') \sigma_{Af}(p') \beta_{Aj}(p') \lambda_{Aj} S_{Aj}(p) / (\omega + \lambda_{Aj}), \quad (1.1.6)$$

¹ Superposition of such normal modes yields the Laplace transform representation

$$n(\omega, \underline{r}, \underline{p}) = \int_0^\infty e^{-\omega t} n(t, \underline{r}, \underline{p}) dt,$$

$$n(t, \underline{r}, \underline{p}) = (1/2\pi i) \int_{-i\infty}^{i\infty} n(\omega, \underline{r}, \underline{p}) e^{\omega t} d\omega.$$

reduces equation (1.1.1) to the Program S canonical form

$$\begin{aligned}
 & \frac{1}{\rho} \nabla \cdot \underline{\Omega} \phi(\omega, \underline{r}, \underline{p}) + \phi(\omega, \underline{r}, \underline{p}) \Sigma(\omega, \underline{r}, \underline{p}) \\
 &= \int \phi(\omega, \underline{r}, \underline{p}') \cdot (2\pi)^{-1} \Sigma_s(\underline{r}, \underline{p}' | \underline{p}, \underline{\Omega}' \cdot \underline{\Omega}) dV(\underline{p}') \\
 &+ (1/k) \int_0^\infty \phi(\omega, \underline{r}, \underline{p}') \cdot (4\pi)^{-1} v \Sigma_f(\omega, \underline{r}, \underline{p}' | \underline{p}) p'^2 dp'. \quad (1.1.7)
 \end{aligned}$$

The generalized definitions of reactivity $k(\omega, \rho)$ and critical dimension factor $\rho(\omega, k)$ introduced here for flexibility imply that the physical reactivity is $k(\omega = 0, \rho = 1)$, that the physical critical dimension factor is $\rho(\omega = 0, k = 1)$, and that the physical inverse period is $\omega(k = 1, \rho = 1)$. The symbol ϕ represents flux, Σ is a collision-plus-accumulation probability per path length, Σ_s is a scattering-transfer probability per path length, and $v\Sigma_f$ is a prompt-plus-delayed fission-multiplication-transfer probability per path length.

The physical boundary conditions on the last equation, over any non-reentrant surface $\underline{r}_S$ enclosing the entire reactor, are that the flux vanish for all inward directions $\underline{\Omega}_{IN}$:

$$\phi(\omega, \underline{r}_S, \underline{p} \underline{\Omega}_{IN}) = 0. \quad (1.1.8)$$

1.2 Adjoint

Constructing the adjoint transport equation, by multiplying equation (1.1.7) by an adjoint element $\phi^*(\omega, \underline{r}, \underline{p}) dV(\underline{r}, \underline{p})$, integrating over all momentum-space and over the position-space within a non-reentrant surface enclosing the entire reactor, and performing a functional variation of $\phi(\omega, \underline{r}, \underline{p})$, yields

$$\begin{aligned}
 & - \frac{1}{\rho} \nabla \cdot \underline{\Omega} \phi^*(\omega, \underline{r}, \underline{p}) + \Sigma(\omega, \underline{r}, \underline{p}) \phi^*(\omega, \underline{r}, \underline{p}) \\
 &= \int (2\pi)^{-1} \Sigma_s(\underline{r}, \underline{p} | \underline{p}', \underline{\Omega} \cdot \underline{\Omega}') \phi^*(\omega, \underline{r}, \underline{p}') dV(\underline{p}') \\
 &+ (1/k) \int_0^\infty (4\pi)^{-1} v \Sigma_f(\omega, \underline{r}, \underline{p} | \underline{p}') \phi^*(\omega, \underline{r}, \underline{p}') p'^2 dp', \quad (1.2.1)
 \end{aligned}$$

together with the adjoint boundary conditions

$$\phi^*(\omega, \underline{r}_S, p \underline{\Omega}_{\text{out}}) = 0, \quad (1.2.2)$$

where $\underline{\Omega}_{\text{out}}$ represents an outward direction on the boundary surface $\underline{r}_S$.

Comparison of the adjoint equations (1.2.1, 1.2.2) with the flux equations (1.1.7, 1.1.8) shows that the adjoint equations, including boundary conditions, are obtainable from the flux equations by replacement of $(\underline{\Omega})$ by $(-\underline{\Omega})$ and by momentum-transposition of the transfer cross sections from

$$[\Sigma_s(\underline{r}, p' | p, \underline{\Omega}' \cdot \underline{\Omega}) \nu \Sigma_f(\omega, \underline{r}, p' | p)] \text{ to } [\Sigma_s(\underline{r}, p | p', \underline{\Omega} \cdot \underline{\Omega}') \nu \Sigma_f(\omega, \underline{r}, p | p')] .$$

Consequently the flux machine program can be generalized to construct the adjoint, simply by momentum-transposition of the transfer cross sections in the input and replacement of $(\underline{\Omega})$ by $(-\underline{\Omega})$ in the output.

Formulated explicitly, the flux function satisfying equations (1.1.7, 1.1.8) and the adjoint function satisfying equations (1.2.1, 1.2.2), both of which are dependent upon the parameters in those equations, are related by the functional identity

$$\begin{aligned} & \phi^*(\omega, \rho, k, \underline{r}_S, \Sigma, \Sigma_s(p' | p), \nu \Sigma_f(p' | p) | \underline{r}, p) \\ &= \phi(\omega, \rho, k, \underline{r}_S, \Sigma, \Sigma_s(p | p'), \nu \Sigma_f(p | p') | \underline{r}, -p). \end{aligned} \quad (1.2.3)$$

By glancing back at equations (1.1.1, 1.1.2), finally, it can be seen that the time-dependence of the adjoint normal mode is given by

$$\phi^*(t, \underline{r}, p) = \phi^*(\omega, \underline{r}, p) e^{-\omega t}. \quad (1.2.4)$$

1.3 Photon Transport

Let $n(t, \underline{r}, p) dV(\underline{r}, p)$ be the photon occupational probability in photon position $(\underline{r})$ and photon momentum (p) volume element $dV(\underline{r}, p)$ at time t , appropriately averaged over spin-polarization sub-states. Expressed in terms of energy flux $\phi = c^2 \rho n$, where c is the velocity of light, the photon transport equation, balancing accumulation, leakage, collision removal, scattering-transfer, and photon production, has the form

$$\begin{aligned}
& \partial \phi(t, \underline{r}, \underline{p}) / \partial t + \nabla \cdot \underline{\Omega} \phi(t, \underline{r}, \underline{p}) + \phi(t, \underline{r}, \underline{p}) \sum_A N_A(\underline{r}) \sigma_A(\underline{p}) \\
& = \sum_A \phi(t, \underline{r}, \underline{p}') N_A(\underline{r}) (2\pi)^{-1} (\underline{p}/\underline{p}') \sigma_{As}(\underline{p}' | \underline{p}, \underline{\Omega}' \cdot \underline{\Omega}) dV(\underline{p}') \\
& + \sum_A \int_0^\infty \int_{-\infty}^t \phi_0(t', \underline{r}, \underline{p}_0) N_A(\underline{r}) \sigma_{oA}(\underline{p}_0) E_A(\underline{p}_0) \\
& \cdot (4\pi)^{-1} S_A(t-t', \underline{p}_0, \underline{p}) dt' \underline{p}_0^2 d\underline{p}_0, \quad (1.3.1)
\end{aligned}$$

where $\underline{\Omega}$ is the unit vector $\underline{p}/p$ and where N_A is the concentration (nuclei/volume) of atoms of species A having photon collision and photon scattering-transfer cross sections σ_A and σ_{As} respectively. In the last term, which describes photon production by neutron-induced reactions (fission, non-fission neutron capture, and neutron inelastic scattering, all followed by chain decay of products), the factors $\phi_0(t', \underline{r}, \underline{p}_0) N_A(\underline{r}) \sigma_{oA}(\underline{p}_0) \underline{p}_0^2 d\underline{p}_0$ give the neutron-nucleus collision rate density (collisions/volume $\times$ time), with the subscript (o) labelling neutron parameters. The time-delayed photon energy production spectrum $E_A(\underline{p}_0) \cdot (4\pi)^{-1} S_A(t-t', \underline{p}_0, \underline{p})$ has been factored by imposing the normalization

$$\int_0^\infty \int_0^\infty S_A(t, \underline{p}_0, \underline{p}) dt \underline{p}^2 d\underline{p} = 1. \quad (1.3.2)$$

The quantity $E_A(\underline{p}_0)$ is the total photon energy release induced locally (within charged particle range) by the neutron-nucleus collision and is dependent upon the nuclear species A and the neutron momentum $\underline{p}_0$. The normalized photon energy emission spectrum $S_A(t-t', \underline{p}_0, \underline{p})$ depends at most upon the nuclear species A, the delay time $(t-t')$, the neutron momentum $\underline{p}_0$, and the photon momentum $\underline{p}$. Processes which begin and end locally with photons (such as positron-electron pair production followed by bremsstrahlung, scintillation, and annihilation) are contained in the photon scattering-transfer cross section σ_{As} .

Synthesis of available experimental and theoretical information into adequately comprehensive photon collision cross sections $\sigma_A(\underline{p})$, photon scattering transfer cross sections $\sigma_{As}(\underline{p}' | \underline{p}, \underline{\Omega}' \cdot \underline{\Omega})$, and photon production spectra

$E_A(p_0)S_A(t-t', p_0, p)$, to the extent required in high-performance reactor work, is a non-trivial but cleanly separable problem.

There appear to be few significant limitations upon the validity of this photon transport equation. The limitations of interest in reactor work are neglect of time-variation of material concentration, neglect of non-localized photon production due to streaming of charged particles through void passages, neglect of crystalline structure and spin polarization, and neglect of photon-induced fission.

The photon response to excitation by a neutron normal mode (equation 1.1.2, integrated on $vd\Omega$)

$$\phi_0(t, \underline{r}, p_0) = \phi_0(\omega, \underline{r}, p_0) e^{\omega t} \quad (1.3.3)$$

evidently has the same time-factor, with

$$\phi(t, \underline{r}, p) = \phi(\omega, \underline{r}, p) e^{\omega t}. \quad (1.3.4)$$

For proceeding on this postulate reduces equation (1.3.1) to

$$\begin{aligned} & \frac{\omega}{c} \phi(\omega, \underline{r}, p) + \nabla \cdot \underline{\Omega} \phi(\omega, \underline{r}, p) + \phi(\omega, \underline{r}, p) \sum_A N_A(\underline{r}) \sigma_A(p) \\ &= \sum_A N_A(\underline{r}) \int \phi(\omega, \underline{r}, p') \cdot (2\pi)^{-1} (p/p') \sigma_{As}(p' | p, \underline{\Omega} \cdot \underline{\Omega}) dV(p') \\ &+ \sum_A \int_0^\infty \phi_0(\omega, \underline{r}, p_0) N_A(\underline{r}) \sigma_{oA}(p_0) E_A(p_0) \cdot (4\pi)^{-1} S_A(\omega, p_0, p) p_0^2 dp_0, \end{aligned} \quad (1.3.5)$$

where

$$S_A(\omega, p_0, p) = \int_0^\infty e^{-\omega t} S_A(t, p_0, p) dt \quad (1.3.6)$$

is the Laplace time-delay transform of the neutron-photon production spectrum.

Setting

$$\Sigma(\omega, \underline{r}, p) = \sum_A N_A(\underline{r}) \sigma_A(p) + \omega/c, \quad (1.3.7)$$

$$\Sigma_s(\underline{r}, \underline{p}' | \underline{p}, \underline{\Omega}' \cdot \underline{\Omega}) = \sum_A N_A(\underline{r}) \sigma_{As}(\underline{p}' | \underline{p}, \underline{\Omega}' \cdot \underline{\Omega}), \quad (1.3.8)$$

$$Q(\omega, \underline{r}, \underline{p}) = \sum_A \int_0^\infty \phi_0(\omega, \underline{r}, p_0) N_A(\underline{r}) \sigma_{oA}(p_0) E_A(p_0) \cdot S_A(\omega, p_0, p) p_0^2 dp_0, \quad (1.3.9)$$

reduces equation (1.3.5) to the Program S canonical form

$$\begin{aligned} & \nabla \cdot \underline{\Omega} \phi(\omega, \underline{r}, \underline{p}) + \phi(\omega, \underline{r}, \underline{p}) \Sigma(\omega, \underline{r}, \underline{p}) \\ &= \int \phi(\omega, \underline{r}, \underline{p}') \cdot (2\pi)^{-1} (p/p') \Sigma_s(\underline{r}, \underline{p}' | \underline{p}, \underline{\Omega}' \cdot \underline{\Omega}) dV(\underline{p}') \\ &+ (4\pi)^{-1} Q(\omega, \underline{r}, \underline{p}), \end{aligned} \quad (1.3.10)$$

which differs in structure from the neutron equation (1.1.7) only by replacement of the fission source by the fixed photon source $Q(\omega, \underline{r}, \underline{p})$, and by modification of the photon transfer probability per path length Σ_s to an energy transfer probability per path length $(p/p') \Sigma_s$. As defined by equation (1.3.7), Σ is the photon collision-plus-accumulation probability per path length.

The physical boundary conditions on the last equation, over any non-reentrant surface $\underline{r}_S$ enclosing the entire reactor, are that the flux vanish for all inward directions $\underline{\Omega}_{IN}$:

$$\phi(\omega, \underline{r}_S, p \underline{\Omega}_{IN}) = 0. \quad (1.3.11)$$

2. MATHEMATICS

2.1 Method

The neutron and photon transport equation solved by the interim version of Program S has the canonical form

$$\begin{aligned}
& \frac{1}{\rho} \nabla \cdot \underline{\underline{\phi}}(\omega, \underline{r}, \underline{p}) + \phi(\omega, \underline{r}, \underline{p}) \Sigma(\omega, \underline{r}, \underline{p}) \\
& = \int_0^\infty \phi(\omega, \underline{r}, \underline{p}') \cdot (4\pi)^{-1} \Sigma_s(\underline{r}, \underline{p}' | \underline{p}) p'^2 d\underline{p}' \\
& + (1/k) \int_0^\infty \phi(\omega, \underline{r}, \underline{p}') \cdot (4\pi)^{-1} \nu \Sigma_f(\omega, \underline{r}, \underline{p}' | \underline{p}) p'^2 d\underline{p}' \\
& + (4\pi)^{-1} Q(\omega, \underline{r}, \underline{p}), \tag{2.1.1}
\end{aligned}$$

with the boundary conditions

$$\phi(\omega, \underline{r}_S, \underline{p} \Omega_{IN}) = 0. \tag{2.1.2}$$

With neglect of anisotropic scattering-transfer, and with appropriate interpretation of symbols, this canonical form includes the neutron equations (1.1.7, 1.1.8), the adjoint equations (1.2.3, 1.2.2), and the photon equations (1.3.10, 1.3.11), with sufficient additional flexibility to accommodate both a neutron fixed-source and a photon induced-source (photo-fission).

The numerical solution is constructed by an iterative last-free-flight loop. With the results of the previous loop designated by Roman primes, the loop begins with the approximation to equation (2.1.1),

$$\begin{aligned}
& \frac{1}{\rho^I} \nabla \cdot \underline{\underline{\phi}}^I(\omega, \underline{r}, \underline{p}) + \phi^I(\omega, \underline{r}, \underline{p}) \Sigma(\omega, \underline{r}, \underline{p}) \\
& = \int_0^\infty \phi^I(\omega, \underline{r}, \underline{p}') \cdot (4\pi)^{-1} \Sigma_s(\underline{r}, \underline{p}' | \underline{p}) p'^2 d\underline{p}' \\
& + \frac{1}{k^I} \int_0^\infty \phi^I(\omega, \underline{r}, \underline{p}') \cdot (4\pi)^{-1} \nu \Sigma_f(\omega, \underline{r}, \underline{p}' | \underline{p}) p'^2 d\underline{p}' \\
& + (4\pi)^{-1} Q(\omega, \underline{r}, \underline{p}), \tag{2.1.3}
\end{aligned}$$

$$\phi(\underline{r}_S, \underline{p} \Omega_{IN}) = 0. \tag{2.1.4}$$

The program integrates this differential equation in $\phi(\omega, \underline{r}, \underline{p})$ by a lattice line-integration scheme designed to produce rapid convergence by integrating always in the direction of particle travel. A glance at the structure of the left side of equation (2.1.3) shows that the result of this numerical lattice integration is expressible in the analytic form

$$\phi(\omega, \underline{r}, \underline{p}) = \int \frac{e^{-\int_{\underline{r}'}^{\underline{r}} \rho^I \Sigma(\omega, \underline{r}'', \underline{p}) \underline{\Omega} \cdot d\underline{r}''}}{4\pi |\underline{r}' - \underline{r}|^2} \delta(\underline{\Omega} | \underline{\Omega}_{\underline{r}-\underline{r}'}) \rho^I Q^I(\omega, \underline{r}', \underline{p}) dV(\underline{r}'), \quad (2.1.5)$$

where, for brevity, $(4\pi)^{-1} Q^I(\omega, \underline{r}, \underline{p})$ has been used to represent the composite source function consisting of the entire right side of equation (2.1.3). The angular delta function $\delta(\underline{\Omega} | \underline{\Omega}_{\underline{r}-\underline{r}'})$ has an angular integral of unity and vanishes except for $\underline{\Omega} \cdot \underline{\Omega}_{\underline{r}-\underline{r}'} = 1$, where $\underline{\Omega}_{\underline{r}-\underline{r}'}$ is the unit vector $(\underline{r}-\underline{r}')/|\underline{r}-\underline{r}'|$. The line integration in the exponent of the attenuation kernel follows the last free flight from $\underline{r}'$ to $\underline{r}$.

The loop estimate for reactivity k or critical dimension factor ρ is obtained by inserting the loop flux in the integral of equation (2.1.1) over $dV(\underline{r}, \underline{p})$, to obtain either

$$k = \frac{F'}{L/\rho + C - S - Q} = \frac{F}{S^I + F^I/k^I - S}, \text{ or} \quad (2.1.6)$$

$$\rho = \frac{L}{F/k - C + S + Q} = \frac{L}{F/k^I + L/\rho^I - S^I - F^I/k^I + S}, \quad (2.1.7)$$

where (L, C, S, F, Q) represent respectively the integrated (leakage, collision, scattering, fission production, fixed source) rates, as given by

$$\begin{aligned} L &= \int \underline{\Omega} \phi(\underline{r}, \underline{p}) \cdot d\underline{A}(\underline{r}) dV(\underline{p}), \\ C &= \int \phi(\underline{r}, \underline{p}) \Sigma(\underline{r}, \underline{p}) dV(\underline{r}) p^2 dp, \\ S &= \int \phi(\underline{r}, \underline{p}') \Sigma_s(\underline{r}, \underline{p}' | \underline{p}) p^2 dp p'^2 dp' dV(\underline{r}), \\ F &= \int \phi(\underline{r}, \underline{p}') v \Sigma_f(\underline{r}, \underline{p}' | \underline{p}) p^2 dp p'^2 dp' dV(\underline{r}), \\ Q &= \int Q(\underline{r}, \underline{p}) p^2 dp dV(\underline{r}). \end{aligned}$$

Successive traversals of this mathematical loop correspond physically to successive free flights. The loop is terminated when the magnitude of the refinement in reactivity k or in critical outer dimension r_g/ρ becomes and remains less than the error tolerance ϵ specified in the input, for three successive traversals of the loop.

2.2 Geometry

2.21 Slab

In slab geometry, with

$$\phi(\omega, \underline{r}, p) = \phi(\omega, z, p, \psi)/2\pi XY, \quad (2.21.1)$$

$$Q(\omega, \underline{r}, p) = Q(\omega, z, p)/XY, \quad (2.21.2)$$

where z is distance measured normal to the slab of transverse dimensions ($X = \infty = Y$) and ψ is the polar angle between the particle momentum and the z -axis, the Program S canonical form equations (2.1.1, 2.1.2) become

$$\begin{aligned} & \frac{1}{\rho} (\cos \psi) \frac{\partial}{\partial z} \phi(\omega, z, p, \psi) + \phi(\omega, z, p, \psi) \Sigma(\omega, z, p) \\ &= \int_0^\infty \phi(\omega, z, p') \cdot 2^{-1} \Sigma_s(z, p' | p) p'^2 dp' \\ &+ (1/k) \int_0^\infty \phi(\omega, z, p') \cdot 2^{-1} \Sigma_f(\omega, z, p' | p) p'^2 dp' \\ &+ 2^{-1} Q(\omega, z, p), \end{aligned} \quad (2.21.3)$$

$$\phi(\omega, z_g, p, \psi_{IN}) = 0. \quad (2.21.4)$$

2.22 Cylinder

In cylindrical geometry, with

$$\phi(\omega, \underline{r}, p) = \phi(\omega, r, p, \theta, \psi)/2\pi Z, \quad (2.22.1)$$

$$Q(\omega, \underline{r}, p) = Q(\omega, r, p)/2\pi Z, \quad (2.22.2)$$

where r is radial distance from the cylinder axis, θ is the polar angle between the particle momentum and the cylinder axis, ϕ is the azimuthal angle from the transverse radius vector $\underline{r}$ to the transverse projection of the neutron momentum, and $(Z = \infty)$ is the cylinder length, the Program S canonical form equations (2.1.1, 2.1.2) become

$$\begin{aligned} & \frac{1}{\rho} (\sin \theta) \left[(\cos \phi) \frac{\partial}{\partial r} - \left(\frac{\sin \phi}{r} \right) \frac{\partial}{\partial \phi} \right] \phi(\omega, r, p, \theta, \phi) \\ & + \phi(\omega, r, p, \theta, \phi) \Sigma(\omega, r, p) \\ & = \int_0^\infty \phi(\omega, r, p') \cdot (4\pi)^{-1} \Sigma_s(r, p' | p) p'^2 dp' \\ & + (1/k) \int_0^\infty \phi(\omega, r, p') \cdot (4\pi)^{-1} \Sigma_f(\omega, r, p' | p) p'^2 dp' \\ & + (4\pi)^{-1} Q(\omega, r, p), \end{aligned} \quad (2.22.3)$$

$$\phi(\omega, r_s, p, \theta, \phi_{IN}) = 0. \quad (2.22.4)$$

2.23 Sphere

In spherical geometry, with

$$\phi(\omega, \underline{r}, \underline{p}) = \phi(\omega, r, p, \phi) / 4\pi \cdot 2\pi, \quad (2.23.1)$$

$$Q(\omega, \underline{r}, p) = Q(\omega, r, p) / 4\pi, \quad (2.23.2)$$

where r is radial distance from the center of the sphere and ϕ is the polar angle between radius vector and the particle momentum, the Program S canonical form equations (2.1.1, 2.1.2) become

$$\begin{aligned}
& \frac{1}{\rho} \left[(\cos \psi) \frac{\partial}{\partial r} - \left(\frac{\sin \psi}{r} \right) \frac{\partial}{\partial \psi} \right] \phi(\omega, r, p, \psi) + \phi(\omega, r, p, \psi) \Sigma(\omega, r, p) \\
& = \int_0^\infty \phi(\omega, r, p') \cdot 2^{-1} \Sigma_g(r, p' | p) p'^2 dp' \\
& + (1/k) \int_0^\infty \phi(\omega, r, p') \cdot 2^{-1} \Sigma_f(\omega, r, p' | p) p'^2 dp' \\
& + 2^{-1} Q(\omega, r, p), \tag{2.23.3}
\end{aligned}$$

$$\phi(\omega, r_S, p, \psi_{IN}) = 0. \tag{2.23.4}$$

2.3 Digital Representation

A critical grasp of the digital representation is needed to provide digital input and to interpret digital output.

2.31 Energy

With $d_n p$ signifying a differential lying within the increment n , the energy digitalization is defined by

$$\phi_n(\underline{r}, \underline{\Omega}) = \int \phi(\underline{r}, \underline{p}) p^2 d_n p; \quad n = 1, \dots, N. \tag{2.31.1}$$

2.32 Polar angle: cylindrical geometry

For cylindrical geometry (equation 2.22.1), a polar-angle Gauss-Legendre digital representation is defined by the sequence²:

$$\ell = 1, \dots, L;$$

$$P_L(\cos \theta_\ell) = 0; \quad w_\ell = 2 / [\partial P_L(\cos \theta_\ell) / \partial \theta_\ell]^2;$$

$$f_\ell = f(\theta_\ell); \quad \phi_{n\ell}(r, \psi) = \phi_n(r, \theta_\ell, \psi);$$

$$\int_0^\pi f(\theta) \phi_n(r, \theta, \psi) \sin \theta d\theta \doteq \sum_{\ell=1}^L f_\ell \phi_{n\ell}(r, \psi) w_\ell. \tag{2.32.1}$$

² Kopal, Z., "Numerical Analysis" (Wiley, New York, 1955), Equation VII-G-13, and Appendix IV.

<u>L</u>	<u>$\pm \cos \theta_L$</u>	<u>$w_L = w_{L-L+1}$</u>
2	0.5773 5027	1
4	0.8611 3631 0.3399 8104	0.3478 5485 0.6521 4515
6	0.9324 6951 0.6612 0939 0.2386 1919	0.1713 2449 0.3607 6157 0.4679 1393
8	0.9602 8986 0.7966 6648 0.5255 3241 0.1834 3464	0.1012 2854 0.2223 8103 0.3137 0665 0.3626 8378
10	0.9739 0653 0.8650 6337 0.6794 0957 0.4333 9539 0.1488 7434	0.0666 7134 0.1494 5135 0.2190 8636 0.2692 6021 0.2955 2422

The polar angle flux element is given by $\phi_n(r, \theta, \psi) \sin \theta d\theta$, with integration over the range $0 \leq \theta \leq \pi$ performed by use of equation (2.32.1).

2.33 Relative angle

All functional dependence upon the relative angle ψ (equations 2.21.1, 2.22.1, 2.23.1) is digitalized as a continuous succession of M straight line segments in $\cos \psi$, as typified by

$$\phi_{n\ell m}(r) = \phi_{n\ell}(r, \psi_m); m = 0, \dots, M;$$

$$\begin{aligned} \phi_{n\ell}(r, \psi) &= \sum_{m=1}^M \left[\frac{\cos \psi - \cos \psi_m}{\cos \psi_{m-1} - \cos \psi_m} \phi_{n\ell, m-1}(r) + \frac{\cos \psi - \cos \psi_{m-1}}{\cos \psi_m - \cos \psi_{m-1}} \phi_{n\ell m}(r) \right] \\ &\quad \times \left[\begin{array}{l} 1, \cos \psi_{m-1} \leq \cos \psi \leq \cos \psi_m \\ 0, \text{ otherwise} \end{array} \right], \\ &= \sum_{m=0}^M \left[\left(\frac{\cos \psi - \cos \psi_{m+1}}{\cos \psi_m - \cos \psi_{m+1}} \right) \left(\begin{array}{l} 1, \cos \psi_m \leq \cos \psi \leq \cos \psi_{m+1} \\ 0, \text{ otherwise} \end{array} \right) \right. \\ &\quad \left. + \left(\frac{\cos \psi - \cos \psi_{m-1}}{\cos \psi_m - \cos \psi_{m-1}} \right) \left(\begin{array}{l} 1, \cos \psi_{m-1} \leq \cos \psi \leq \cos \psi_m \\ 0, \text{ otherwise} \end{array} \right) \right] \phi_{n\ell m}(r). \end{aligned} \tag{2.33.1}$$

The relative-angle flux element is given by $\phi_n(z, \psi) \sin \psi d\psi$ in slab geometry, by $2\phi_{n\ell}(r, \psi) d\psi$ in cylindrical geometry, and by $\phi_n(r, \psi) \sin \psi d\psi$ in spherical geometry, with the range of ψ taken as 0 to π in all three cases.

In the interim version of Program S, M is restricted to even integers to minimize risk of numerical instability; and the increments $\cos \psi_m - \cos \psi_{m-1}$ are all taken as equal, to simplify calculations.

2.34 Radius

Flux dependence upon position r (with r representing a generalized radius coordinate identifiable as z in slab coordinates, r in cylindrical coordinates, or r in spherical coordinates) is digitalized as a continuous succession of straight line segments in r , representable by analogy with equation (2.33.1), in the form

$$\begin{aligned} \phi_{in\ell m} &= \phi_{n\ell m}(r_i); i = 0, 1, \dots, I; \\ \phi_{n\ell m}(r) &= \sum_{i=0}^I \left[\left(\frac{r - r_{i-1}}{r_i - r_{i-1}} \right) \begin{pmatrix} 1, & r_{i-1} \leq r \leq r_i \\ 0, & \text{otherwise} \end{pmatrix} \right. \\ &\quad \left. + \left(\frac{r - r_{i+1}}{r_i - r_{i+1}} \right) \begin{pmatrix} 1, & r_i \leq r \leq r_{i+1} \\ 0, & \text{otherwise} \end{pmatrix} \right] \times \phi_{in\ell m}. \end{aligned} \quad (2.34.1)$$

The interim program requires that $r_0 = 0$ and limits the treatment of slab geometry to configurations symmetric about the plane $r_0 = 0$.

The array of digitalized coordinates (i, n, ℓ, m) can be kept in manifestly proper correspondence with the array of continuous coordinates (r, p, θ, ψ) by use of an order-identification, with the first letter referring to radius, the second to energy, the third to polar angle, and the fourth to relative angle, in both representations.

2.35 Nuclear data

Nuclear data needed as input to Program S include energy-increment-averaged collision cross sections $\bar{\sigma}_n$, scattering-transfer cross sections $\bar{\sigma}_{snn'}$, prompt or delayed fission-multiplication cross sections $\overline{\nu\sigma_f\beta}_{jn}$, and prompt or delayed production spectra $\bar{S}_{jn}$. Expressing these incrementally-averaged data in terms of the point data $(\sigma_n, \sigma_{sn}, \nu\sigma_{fn}, \beta_j, S_{jn})$ published in W. B. Henderson's "Cross Sections for Reactor Analysis" (GE-ANPD XDC 57-7-83,

May 31, 1957) leads to the following interim formulation. The notation is the same as that used by Henderson, with $[n = (0, 1, \dots, N); T = (3000, 2500, 2000, 1500, 1000, 500, 68)^{\circ}\text{F}]$ labelling a discrete lethargy scale beginning with an upper energy $E_0 = 10$ Mev and extending down into the thermal energy range.

2.351 Collision cross sections³

$$\sigma_n = \sigma_{an} + \sigma_{Sn}.$$

$$\bar{\sigma}_n = (\sigma_{n-1} + \sigma_n)/2, \quad n = (1, \dots, 17).$$

$$\bar{\sigma}_{18} = \left[\left(\frac{\mu_{T=68^{\circ}\text{F}} - \mu_{18}}{\mu_{17} - \mu_{18}} + 1 \right) \sigma_{17} + \left(\frac{\mu_{T=68^{\circ}\text{F}} - \mu_{17}}{\mu_{18} - \mu_{17}} \right) \sigma_{18} \right] / 2.$$

$$\bar{\sigma}_N = \sigma_T.$$

The special treatment of energy-increment-18 is needed to recover incrementally averaged experimental data from Henderson's level-18 manipulation. At room temperature, $N = 19$.

2.352 Fission multiplication cross sections

$$\bar{v}\sigma_{fn} = (v\sigma_{f,n-1} + v\sigma_{fn})/2, \quad n = (1, \dots, 17).$$

$$\bar{v}\sigma_{18} = \left[\left(\frac{\mu_{T=68^{\circ}\text{F}} - \mu_{18}}{\mu_{17} - \mu_{18}} + 1 \right) v\sigma_{f17} + \left(\frac{\mu_{T=68^{\circ}\text{F}} - \mu_{17}}{\mu_{18} - \mu_{17}} \right) v\sigma_{f18} \right] / 2.$$

$$\bar{v}\sigma_{fN} = v\sigma_{fT}.$$

3

$$\frac{1}{2} \left(\frac{\mu_{T=68^{\circ}\text{F}} - \mu_{18}}{\mu_{17} - \mu_{18}} + 1 \right) = 0.59268412$$

$$\frac{1}{2} \left(\frac{\mu_{T=68^{\circ}\text{F}} - \mu_{17}}{\mu_{18} - \mu_{17}} \right) = 0.40731588$$

2.353 Fission multiplication transform

$$\overline{v\sigma}_{fn}(\omega) = \left[1 - \sum_{j=1}^J \frac{\beta_j \omega}{\omega + \lambda_j} \right] \overline{v\sigma}_{fn}, \text{ where } \lambda_j = \omega_j.$$

2.354 Fission production spectra

$$\overline{S}_n = (S_{n-1} + S_n)(\mu_n - \mu_{n-1})/2, \quad \sum_{n=1}^N \overline{S}_n = 1.$$

$$\overline{S}_{jn} = (S_{j,n-1} + S_{jn})(\mu_n - \mu_{n-1})/2, \quad \sum_{n=1}^N \overline{S}_{jn} = 1.$$

2.355 Production spectrum transform

$$\overline{S}_n(\omega) = \left[\overline{S}_n - \sum_{j=1}^J \frac{\beta_j \overline{S}_{jn} \omega}{\omega + \lambda_j} \right] / \left[1 - \sum_{j=1}^J \frac{\beta_j \omega}{\omega + \lambda_j} \right].$$

2.356 Scattering-transfer cross sections

For elastic isotropic scattering in center-of-mass coordinates, with neglect of atomic binding and thermal agitation of nuclei, the angularly integrated scattering-transfer cross section for a nucleus having a mass A times that of a neutron is given by⁴

$$\sigma_{As}(p|p') = \frac{(A+1)^2}{2A} \frac{\sigma_{As}(p)}{p^2 p'} \left[\begin{array}{l} 1, \text{ } p \frac{A-1}{A+1} < p' < p \\ 0, \text{ otherwise} \end{array} \right]. \quad (2.356.1)$$

The momenta $p|p'$ are arranged in chronological order (p scatters to p').

Digitalizing this transfer cross section, by incrementally averaging over an epithermal entrance flux having a uniform distribution in lethargy μ and incrementally integrating over the corresponding exit adjoint (which has a uniform distribution in momentum-space) normalized to unity, yields

⁴ Marshak, R. E., "Theory of Slowing Down of Neutrons by Elastic Collision with Atomic Nuclei", Rev. Mod. Phys. 19, 185-238 (1947).

$$\bar{\sigma}_{Asnn'} = \int \frac{(A+1)^2}{2A} \frac{\sigma_{As}(p)}{p^2 p'} \left[\begin{array}{l} 1, p \frac{A-1}{A+1} < p' < p \\ 0, \text{otherwise} \end{array} \right] \frac{d_n \mu}{\Delta_n \mu} p'^2 d_{n,p'},$$

(2.356.2)

where $d\mu = -2(dp)/p$, $\Delta_n \mu = \mu_n - \mu_{n-1}$, and d_n signifies a differential lying within the increment n . The integration is elementary, but a bit tricky because of multiple constraints.

For thermal entrance flux, averaging over a Maxwellian entrance flux, and integrating over the Maxwellian exit adjoint (which has a uniform distribution in momentum-space) normalized to unity, replaces equation (2.356.2).

Performing the integration, with $\sigma_{As}(p) d_n \mu$ approximated by $\bar{\sigma}_{Asn} d_n \mu$, yields:

For $n > n'$, $\bar{\sigma}_{Asnn'} = 0$.

2.356.3

For epithermal $n = n'$, with $\xi_A = 1 - \frac{(A+1)^2}{2A} \ln \left(\frac{A+1}{A-1} \right)$,

$$\bar{\sigma}_{Asnn'} = \frac{\bar{\sigma}_{Asn}}{\Delta_n \mu} \left[\begin{array}{l} \Delta_n \mu - \xi_A, \Delta_n \mu \geq \ln \left(\frac{A+1}{A-1} \right)^2 \\ \frac{(A+1)^2}{4A} (e^{-\Delta_n \mu} - 1 + \Delta_n \mu), \Delta_n \mu \leq \ln \left(\frac{A+1}{A-1} \right)^2 \end{array} \right]$$

2.356.4

For thermal $N = N'$, $\bar{\sigma}_{AsNN'} = \bar{\sigma}_{AsT}$.

2.356.5

$$\bar{\sigma}_{Asnn'} = \frac{\bar{\sigma}_{Asn}}{\Delta_n \mu} \left[\begin{array}{l} - \left\{ \xi_A - (\mu_{n'-1} - \mu_{n-1}) + \frac{(A+1)^2}{4A} \left[e^{-(\mu_{n'-1} - \mu_{n-1})} + \mu_{n'-1} - \mu_{n-1} - 1 \right] \right\} \left[\begin{array}{l} 1, \mu_{n'-1} - \mu_{n-1} \leq \ln [(A+1)/(A-1)]^2 \\ 0, \text{otherwise} \end{array} \right] \\ - \left\{ \xi_A - (\mu_{n'} - \mu_n) + \frac{(A+1)^2}{4A} \left[e^{-(\mu_{n'} - \mu_n)} + \mu_{n'} - \mu_n - 1 \right] \right\} \left[\begin{array}{l} 1, \mu_{n'} - \mu_n \leq \ln [(A+1)/(A-1)]^2 \\ 0, \text{otherwise} \end{array} \right] \\ + \left\{ \xi_A - (\mu_{n'} - \mu_{n-1}) + \frac{(A+1)^2}{4A} \left[e^{-(\mu_{n'} - \mu_{n-1})} + \mu_{n'} - \mu_{n-1} - 1 \right] \right\} \left[\begin{array}{l} 1, \mu_{n'} - \mu_{n-1} \leq \ln [(A+1)/(A-1)]^2 \\ 0, \text{otherwise} \end{array} \right] \\ + \left\{ \xi_A - (\mu_{n'-1} - \mu_n) + \frac{(A+1)^2}{4A} \left[e^{-(\mu_{n'-1} - \mu_n)} + \mu_{n'-1} - \mu_n - 1 \right] \right\} \left[\begin{array}{l} 1, \mu_{n'-1} - \mu_n \leq \ln [(A+1)/(A-1)]^2 \\ 0, \text{otherwise} \end{array} \right] \end{array} \right]$$

2.356.6

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The incrementally averaged total scattering cross section $\bar{\sigma}_{sn}$ needed in the evaluation of these expressions is given by:

$$\bar{\sigma}_{sn} = (\sigma_{s,n-1} + \sigma_{sn})/2, \quad n = (1, \dots, 17).$$

$$\bar{\sigma}_{s18} = \left[\left(\frac{\mu_{T=68^\circ F} - \mu_{18}}{\mu_{17} - \mu_{18}} + 1 \right) \sigma_{17} + \left(\frac{\mu_{T=68^\circ F} - \mu_{17}}{\mu_{18} - \mu_{17}} \right) \sigma_{18} \right] / 2.$$

$$\bar{\sigma}_{sN} = \sigma_{sT}.$$

From the definitional identity

$$\sigma_s(p) = \int_0^\infty \sigma_s(p|p') p'^2 dp',$$

it follows that these digitalized transfer cross sections satisfy the identity

$$\bar{\sigma}_{Asn} = \sum_{n'=1}^{n'=N} \bar{\sigma}_{Asnn'}.$$

As reflected in the numerical compilation in section 3, these formulas simplify extensively for heavy elements, intermediate elements, and hydrogen. The calculational complexity is at its worst for deuterium.

2.36. Concentration

Material concentration $N_A(\underline{r})$, fixed-source concentration $Q(\omega, \underline{r}, p)$, and fission production concentration

$$P(\omega, \underline{r}) = \frac{\rho}{k} \int_0^\infty v(\omega) \Sigma_f(\underline{r}, p) \phi(\omega, \underline{r}, p) p^2 dp \quad (2.36.1)$$

are digitalized as piecewise uniform functions. With $r^\mu dr$ representing a generalized volume element, where $\mu = (0, 1, 2)$ for (slab, cylinder, sphere) geometry respectively, the digital representation used is:

$$N_{Ai} = \int_{r_{i-1}}^{r_i} N_A(r) r^\mu dr / \int_{r_{i-1}}^{r_i} r^\mu dr; \quad i = 1, \dots, I. \quad (2.36.2)$$

$$Q_n(\omega, r) = \rho \int Q(\omega, r, p) p^2 d_n p; \quad n = 1, \dots, N. \quad (2.36.3)$$

$$Q_{in}(\omega, r) = \int_{r_{i-1}}^{r_i} Q_n(\omega, r) r^\mu dr / \int_{r_{i-1}}^{r_i} r^\mu dr. \quad (2.36.4)$$

$$P_n(\omega, r) = \frac{\rho}{k} \int v(\omega) \Sigma_f(r, p) \phi(\omega, r, p) p^2 d_n p. \quad (2.36.5)$$

$$P_{in}(\omega) = \int_{r_{i-1}}^{r_i} P_n(\omega, r) r^\mu dr / \int_{r_{i-1}}^{r_i} r^\mu dr. \quad (2.36.6)$$

3. NUCLEAR DATA

3.1 Data Processing

The large number of elements and isotopes of interest in reactor development work, combined with the complex energy-dependence of nuclear reactions, implies that immediately foreseeable engineering demand for a compilation of nuclear data sufficiently comprehensive to exploit the capabilities of transport theory can be met only by electronic data processing methods.

The availability of the extensive GE-ANPD compilation of nuclear data, processed for use with diffusion theory and stored in the peripheral memory of the IBM-704, was exploited to provide the following preliminary compilation of nuclear data for use with transport theory. The FORTRAN Automatic Coding System⁵ was used to read the entire diffusion theory nuclear data file into the fast memory, extract from it the physical information upon which it is based, reprocess it for use with transport theory, and prepare the final compilation on Multilith paper for publication.

⁵ "Programmer's Reference Manual, The Fortran Automatic Coding System for the IBM 704 EDPM", International Business Machines Corp., New York.

The theory described in section 2.35 was used, with one refinement. To improve the treatment of hydrogen molecular binding, the nucleus/neutron mass ratio A appearing in equation (2.356.1) was replaced by an energy-dependent effective mass $A(p)$ equal to two-thirds the ratio of zeroth to first Legendre scattering moment.

To evaluate the reliability of the machine calculations, a partial compilation for ten elements (Al, N, O, Mg, Cu, Si, U238, U235, Cr, Be) was worked out on a desk calculator, with suppression of the energy-dependent effective mass refinement to simplify hand calculation. Of 671 non-zero cross sections checked by hand, first-significant-figure discrepancies occurred with 40 of the high energy scattering cross sections for Al and Be. About half of the remaining 631 cross sections checked with the machine calculation to three significant figures, and the other half showed exact agreement with the five-figure machine tabulation.

The third-significant-figure discrepancies seem attributable to the more refined effective mass treatment by the machine in resonance regions.

The first-significant-figure discrepancies for Al and Be led to deleting Al and Be from the compilation, pending further study. Further theory refinement, to include scattering anisotropic in center-of-mass coordinates, appears to be needed for these elements.

Four anomalous negative isotropic scatter-transfer moments appear on the second page of the tabulation for hydrogen, each having a magnitude of the order of 10^{-6} barns. These have been left untouched for the present, to provide objective information concerning the level of accumulated round-off error in the machine calculations.

It is informative to note that the scatter-transfer first Legendre moments are predominantly negative for heavy elements and predominantly positive for light elements, as required by energy-momentum conservation.

Further development work is needed to get into the compilation the effects of inelastic scattering, thermal agitation, and exothermic scatter-transfer.

3.2 Machine Tabulation

The machine prepares four pages of data for each element, but suppresses the print-out of pages containing nothing but zeros. A coded integer is printed at the right of each temperature to indicate the extent to which suppression of entire pages of zero data has occurred. The integer 0, which appears for most

elements, indicates that all non-zero data is tabulated on one page. The integer 10, which appears for fissionable material, indicates that a page of non-zero data on the fission production spectrum follows. The integer 100, which appears for light elements, indicates that two pages of non-zero data on scatter-transfer moments follow.

This zero-suppression feature condenses the tabulation to about one-fourth its total extent and yet conveys the positive information that all missing entries for each element have the definite value zero.

In anticipation of future needs, the tabulation includes somewhat more energy and angular harmonic detail than can be utilized immediately in the initial operating version of Program S.

The notation used in the tabulation is intended to be as self-evident as possible, within the limitations of the machine's Hollerith characters. Each entry is labelled both with a descriptive word and with a Hollerith representation for the Greek or Latin algebraic symbol commonly used to represent the quantity. The L-th Legendre moment for scatter-transfer from energy-band N1 to energy-band N2, for example, commonly symbolized as $\sigma_{SL}(N1, N2)$, is labelled by the machine as SGSL(N1, N2).

A more complete compilation of such nuclear data is being prepared as a separate document⁶.

⁶ Duane, B. H., "Cross Sections for Reactor Analysis, Volume 3, Neutron Transfer", to be published.

GE-ANPD REACTOR ANALYSIS

INPUT INTERPRETER

NUCLEAR DATA FORM 2

LEVEL N	ENERGY E (EV)	LETHARGY U=LN(10MEV/E)	1/VELOCITY 1/V (SEC/CM)	BAND N
0	+INFINITY	-INFINITY		
1	6.0653065E 06	5.0000000E-01	2.5973792E-10	1
2	3.6787944E 06	1.0000000E 00	3.3351009E-10	2
3	2.2313016E 06	1.5000000E 00	4.2823544E-10	3
4	1.3533528E 06	2.0000000E 00	5.4986518E-10	4
5	8.2084998E 05	2.5000000E 00	7.0604085E-10	5
6	4.9787068E 05	3.0000000E 00	9.0657440E-10	6
7	3.0197383E 05	3.5000000E 00	1.1640646E-09	7
8	1.8315639E 05	4.0000000E 00	1.4946885E-09	8
9	2.4787522E 04	6.0000000E 00	2.9026958E-09	9
10	3.3546263E 03	8.0000000E 00	7.8903449E-09	10
11	4.5399929E 02	1.0000000E 01	2.1448182E-08	11
12	6.1442124E 01	1.2000000E 01	5.8302204E-08	12
13	8.3152871E 00	1.4000000E 01	1.5848182E-07	13
14	1.8553914E 00	1.5500000E 01	3.7339754E-07	14
15	6.8256034E-01	1.6500000E 01	6.8863408E-07	15
16	2.5109992E-01	1.7500000E 01	1.1353657E-06	16
17	9.2374495E-02	1.8500000E 01	1.8719016E-06	17
18	3.2162206E-02	1.9555059E 01	3.1326930E-06	18
19	0	+INFINITY	4.0313012E-06	19

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
2.0200000E 00	1.0080000E 00	0.	2.9316000E 02 100

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
1.1500E 00	0.	2.4502E-01	2.2733E-01	3.5608E-01	2.8467E-01
1.7000E 00	0.	3.6220E-01	3.3605E-01	5.2638E-01	4.2081E-01
2.4250E 00	0.	5.1667E-01	4.7936E-01	7.5087E-01	6.0024E-01
3.3000E 00	0.	7.0310E-01	6.5231E-01	1.0218E 00	8.1679E-01
4.3001E 00	0.	9.1616E-01	8.4998E-01	1.3314E 00	1.0643E 00
5.5001E 00	0.	1.1718E 00	1.0872E 00	1.7030E 00	1.3613E 00
7.1501E 00	0.	1.5234E 00	1.4133E 00	2.2139E 00	1.7697E 00
9.0501E 00	0.	1.9282E 00	1.7889E 00	6.1580E 00	4.0353E 00
1.3950E 01	0.	7.9190E 00	6.3556E 00	5.2148E 00	2.8017E 00
1.8751E 01	0.	1.0644E 01	8.5442E 00	7.0092E 00	3.7695E 00
1.9802E 01	0.	1.1240E 01	9.0226E 00	7.4017E 00	3.9804E 00
2.0005E 01	0.	1.1353E 01	9.1120E 00	7.4765E 00	4.0168E 00
2.0162E 01	0.	1.1439E 01	9.1864E 00	6.7677E 00	3.8199E 00
2.0626E 01	0.	9.9312E 00	8.2897E 00	6.7442E 00	4.2722E 00
2.1050E 01	0.	7.7255E 00	6.7453E 00	8.3911E 00	5.6197E 00
2.2382E 01	0.	8.2095E 00	7.1085E 00	8.9168E 00	5.7728E 00
2.4686E 01	0.	9.0646E 00	7.7530E 00	1.0153E 01	6.1716E 00
2.9452E 01	0.	1.1294E 01	9.4150E 00	1.7931E 01	6.3662E 00
3.3793E 01	0.	3.3500E 01	1.7200E 01		

SCATTER
 L N1 N2
 SGSL(N1,N2)

H=(H2)/2

0 1 3	0 1 4	0 1 5	0 1 6	0 1 7	0 1 8
2.1597E-01	1.3100E-01	7.9453E-02	4.8190E-02	2.9229E-02	1.7728E-02
0 1 9	0 1 10	0 1 11	0 1 12	0 1 13	0 1 14
2.3630E-02	3.1979E-03	4.3307E-04	5.8401E-05	7.9513E-06	1.9193E-06
0 1 15	0 1 16	0 1 17	0 1 18	0 1 19	0 2 4
-1.0967E-06	0.	0.	0.	0.	3.1927E-01
0 2 5	0 2 6	0 2 7	0 2 8	0 2 9	0 2 10
1.9364E-01	1.1745E-01	7.1238E-02	4.3208E-02	5.7591E-02	7.7939E-03
0 2 11	0 2 12	0 2 13	0 2 14	0 2 15	0 2 16
1.0542E-03	1.4307E-04	1.9860E-05	1.6212E-06	8.1062E-07	0.
0 2 17	0 2 18	0 2 19	0 3 5	0 3 6	0 3 7
0.	0.	0.	4.5542E-01	2.7623E-01	1.6754E-01
0 3 8	0 3 9	0 3 10	0 3 11	0 3 12	0 3 13
1.0162E-01	1.3544E-01	1.8331E-02	2.4806E-03	3.3649E-04	4.3941E-05
0 3 14	0 3 15	0 3 16	0 3 17	0 3 18	0 3 19
6.3598E-06	1.1563E-06	-0.	0.	0.	0.
0 4 6	0 4 7	0 4 8	0 4 9	0 4 10	0 4 11
6.1975E-01	3.7590E-01	2.2799E-01	3.0389E-01	4.1127E-02	5.5649E-03
0 4 12	0 4 13	0 4 14	0 4 15	0 4 16	0 4 17
7.5374E-04	1.0307E-04	1.1015E-05	2.3603E-06	3.9339E-06	-2.3603E-06
0 4 18	0 4 19	0 5 7	0 5 8	0 5 9	0 5 10
0.	0.	8.0756E-01	4.8981E-01	6.5285E-01	8.8354E-02
0 5 11	0 5 12	0 5 13	0 5 14	0 5 15	0 5 16
1.1957E-02	1.6193E-03	2.1837E-04	2.6655E-05	5.1260E-06	1.0252E-06
0 5 17	0 5 18	0 5 19	0 6 8	0 6 9	0 6 10
5.1260E-06	-4.1008E-06	0.	1.0329E 00	1.3768E 00	1.8632E-01
0 6 11	0 6 12	0 6 13	0 6 14	0 6 15	0 6 16
2.5216E-02	3.4120E-03	4.5896E-04	5.9009E-05	1.0490E-05	3.9339E-06
0 6 17	0 6 18	0 6 19	0 7 9	0 7 10	0 7 11
1.3113E-06	-0.	0.	2.9509E 00	3.9935E-01	5.4048E-02
0 7 12	0 7 13	0 7 14	0 7 15	0 7 16	0 7 17
7.3148E-03	9.9213E-04	1.1762E-04	2.3866E-05	8.5235E-06	-0.
0 7 18	0 7 19	0 8 10	0 8 11	0 8 12	0 8 13
1.7047E-06	0.	8.3339E-01	1.1279E-01	1.5262E-02	2.0681E-03
0 8 14	0 8 15	0 8 16	0 8 17	0 8 18	0 8 19
2.5245E-04	4.3154E-05	1.5104E-05	6.4731E-06	1.0788E-05	-6.4731E-06
0 9 11	0 9 12	0 9 13	0 9 14	0 9 15	0 9 16
7.0575E-01	9.5514E-02	1.2925E-02	1.5723E-03	2.8603E-04	1.0477E-04
0 9 17	0 9 18	0 9 19	0 10 12	0 10 13	0 10 14
3.9080E-05	1.4135E-05	6.6519E-06	9.4859E-01	1.2838E-01	1.5608E-02
0 10 15	0 10 16	0 10 17	0 10 18	0 10 19	0 11 13
2.8348E-03	1.0433E-03	3.8333E-04	1.4529E-04	7.0408E-05	1.0017E 00
0 11 14	0 11 15	0 11 16	0 11 17	0 11 18	0 11 19
1.2180E-01	2.2112E-02	8.1343E-03	2.9935E-03	1.1365E-03	5.9835E-04
0 12 14	0 12 15	0 12 16	0 12 17	0 12 18	0 12 19
9.0909E-01	1.6505E-01	6.0720E-02	2.2337E-02	8.4710E-03	4.5264E-03
0 13 15	0 13 16	0 13 17	0 13 18	0 13 19	0 14 16
1.2287E 00	4.5202E-01	1.6629E-01	6.3082E-02	3.3655E-02	2.4811E 00
0 14 17	0 14 18	0 14 19	0 15 17	0 15 18	0 15 19
9.1273E-01	3.4624E-01	1.8458E-01	3.0869E 00	1.1710E 00	6.2543E-01
0 16 18	0 16 19	0 17 19			
3.3826E 00	1.7912E 00	5.3328E 00			

H=(H2)/2

HYDROGEN

SCATTER
L N1 N2
SGSL(N1,N2)

1 1 3	1 1 4	1 1 5	1 1 6	1 1 7	1 1 8
1.3455E-01	6.3613E-02	3.0094E-02	1.4251E-02	6.7592E-03	3.2142E-03
1 1 9	1 1 10	1 1 11	1 1 12	1 1 13	1 1 14
2.8093E-03	1.7841E-04	2.3148E-05	6.5875E-06	2.1958E-06	-3.0078E-06
1 1 15	1 1 16	1 1 17	1 1 18	1 1 19	1 2 4
4.8377E-06	0.	0.	0.	0.	1.9888E-01
1 2 5	1 2 6	1 2 7	1 2 8	1 2 9	1 2 10
9.4028E-02	4.4479E-02	2.1060E-02	9.9866E-03	8.6303E-03	4.9905E-04
1 2 11	1 2 12	1 2 13	1 2 14	1 2 15	1 2 16
5.0310E-05	1.2442E-05	3.7868E-06	1.0819E-06	1.8934E-06	0.
1 2 17	1 2 18	1 2 19	1 3 5	1 3 6	1 3 7
0.	0.	0.	2.8366E-01	1.3408E-01	6.3409E-02
1 3 8	1 3 9	1 3 10	1 3 11	1 3 12	1 3 13
3.0009E-02	2.5726E-02	1.3826E-03	1.0647E-04	1.8902E-05	5.7864E-06
1 3 14	1 3 15	1 3 16	1 3 17	1 3 18	1 3 19
1.9288E-06	7.7152E-07	1.9288E-06	0.	0.	0.
1 4 6	1 4 7	1 4 8	1 4 9	1 4 10	1 4 11
3.8596E-01	1.8242E-01	8.6251E-02	7.3658E-02	3.8140E-03	2.4459E-04
1 4 12	1 4 13	1 4 14	1 4 15	1 4 16	1 4 17
3.2018E-05	7.8732E-06	3.6741E-06	5.2488E-07	-3.4773E-06	6.1017E-06
1 4 18	1 4 19	1 5 7	1 5 8	1 5 9	1 5 10
0.	0.	5.0290E-01	2.3768E-01	2.0264E-01	1.0320E-02
1 5 11	1 5 12	1 5 13	1 5 14	1 5 15	1 5 16
5.9876E-04	6.1893E-05	1.3678E-05	4.1034E-06	1.3678E-06	1.3678E-06
1 5 17	1 5 18	1 5 19	1 6 8	1 6 9	1 6 10
-2.7784E-06	4.8301E-06	0.	6.4324E-01	5.4793E-01	2.7657E-02
1 6 11	1 6 12	1 6 13	1 6 14	1 6 15	1 6 16
1.5164E-03	1.2597E-04	2.6243E-05	5.2485E-06	3.4990E-06	8.7476E-07
1 6 17	1 6 18	1 6 19	1 7 9	1 7 10	1 7 11
8.7476E-07	2.6243E-06	0.	1.5068E 00	7.5713E-02	4.0239E-03
1 7 12	1 7 13	1 7 14	1 7 15	1 7 16	1 7 17
2.9341E-04	4.9471E-05	1.1373E-05	7.9608E-06	1.1373E-06	1.1373E-06
1 7 18	1 7 19	1 8 10	1 8 11	1 8 12	1 8 13
4.5490E-06	0.	2.0202E-01	1.0467E-02	6.7222E-04	8.8526E-05
1 8 14	1 8 15	1 8 16	1 8 17	1 8 18	1 8 19
2.1592E-05	5.7578E-06	2.8789E-06	4.3184E-06	-9.8063E-06	1.5564E-05
1 9 11	1 9 12	1 9 13	1 9 14	1 9 15	1 9 16
1.4063E-01	7.4219E-03	5.2417E-04	7.1276E-05	2.0523E-05	1.2203E-05
1 9 17	1 9 18	1 9 19	1 10 12	1 10 13	1 10 14
7.2109E-06	4.9921E-06	9.4296E-06	1.9081E-01	1.0656E-02	8.4750E-04
1 10 15	1 10 16	1 10 17	1 10 18	1 10 19	1 11 13
1.8465E-04	9.6239E-05	5.4461E-05	3.3572E-05	6.6398E-05	2.0141E-01
1 11 14	1 11 15	1 11 16	1 11 17	1 11 18	1 11 19
1.0415E-02	1.2530E-03	4.3486E-04	1.9065E-04	1.0438E-04	1.5441E-04
1 12 14	1 12 15	1 12 16	1 12 17	1 12 18	1 12 19
1.8963E-01	1.7772E-02	4.1810E-03	1.0636E-03	3.2486E-04	2.4374E-04
1 13 15	1 13 16	1 13 17	1 13 18	1 13 19	1 14 16
3.5453E-01	8.1644E-02	1.9756E-02	5.4919E-03	3.3161E-03	9.7168E-01
1 14 17	1 14 18	1 14 19	1 15 17	1 15 18	1 15 19
2.2798E-01	5.9162E-02	2.9218E-02	1.2450E 00	2.7841E-01	6.1575E-02
1 16 18	1 16 19	1 17 19			
1.1657E 00	5.2903E-02	5.7538E-01			

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
2.0400000E 00	1.0080000E 00	0.	2.9316000E 02 100

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
1.1500E 00	0.	2.4502E-01	2.2733E-01	3.5608E-01	2.8467E-01
1.7000E 00	0.	3.6220E-01	3.3605E-01	5.2638E-01	4.2081E-01
2.4250E 00	0.	5.1667E-01	4.7936E-01	7.5087E-01	6.0024E-01
3.3000E 00	0.	7.0310E-01	6.5231E-01	1.0218E 00	8.1679E-01
4.3001E 00	0.	9.1616E-01	8.4998E-01	1.3314E 00	1.0643E 00
5.5001E 00	0.	1.1718E 00	1.0872E 00	1.7030E 00	1.3613E 00
7.1501E 00	0.	1.5234E 00	1.4133E 00	2.2139E 00	1.7697E 00
9.0501E 00	0.	1.9282E 00	1.7889E 00	6.1580E 00	4.0353E 00
1.3950E 01	0.	7.9190E 00	6.3556E 00	5.2148E 00	2.8017E 00
1.8726E 01	0.	1.0630E 01	8.5311E 00	6.9998E 00	3.7608E 00
1.9777E 01	0.	1.1226E 01	9.0095E 00	7.3923E 00	3.9717E 00
2.0005E 01	0.	1.1353E 01	9.1120E 00	7.4765E 00	4.0168E 00
2.0012E 01	0.	1.1353E 01	9.1076E 00	6.7173E 00	3.7736E 00
2.0276E 01	0.	9.7623E 00	8.1324E 00	6.6295E 00	4.1699E 00
2.0600E 01	0.	7.5616E 00	6.5737E 00	8.2131E 00	5.4049E 00
2.3082E 01	0.	8.5041E 00	7.2444E 00	9.2368E 00	5.5803E 00
2.9986E 01	0.	1.1265E 01	9.2365E 00	1.2617E 01	6.2591E 00
3.9578E 01	0.	1.6865E 01	1.2185E 01	2.2486E 01	1.0600E 00
4.5533E 01	0.	4.5240E 01	1.3520E 01		

HYDROGEN

SCATTER
L N1 N2
SGSL(N1,N2)

H=(H2O-O)/2

0 1 3	0 1 4	0 1 5	0 1 6	0 1 7	0 1 8
2.1597E-01	1.3100E-01	7.9453E-02	4.8190E-02	2.9229E-02	1.7728E-02
0 1 9	0 1 10	0 1 11	0 1 12	0 1 13	0 1 14
2.3630E-02	3.1979E-03	4.3307E-04	5.8401E-05	7.9513E-06	1.9193E-06
0 1 15	0 1 16	0 1 17	0 1 18	0 1 19	0 2 4
-1.0967E-06	0.	0.	0.	0.	3.1927E-01
0 2 5	0 2 6	0 2 7	0 2 8	0 2 9	0 2 10
1.9364E-01	1.1745E-01	7.1238E-02	4.3208E-02	5.7591E-02	7.7939E-03
0 2 11	0 2 12	0 2 13	0 2 14	0 2 15	0 2 16
1.0542E-03	1.4307E-04	1.9860E-05	1.6212E-06	8.1062E-07	0.
0 2 17	0 2 18	0 2 19	0 3 5	0 3 6	0 3 7
0.	0.	0.	4.5542E-01	2.7623E-01	1.6754E-01
0 3 8	0 3 9	0 3 10	0 3 11	0 3 12	0 3 13
1.0162E-01	1.3544E-01	1.8331E-02	2.4806E-03	3.3649E-04	4.3941E-05
0 3 14	0 3 15	0 3 16	0 3 17	0 3 18	0 3 19
6.3598E-06	1.1563E-06	-0.	0.	0.	0.
0 4 6	0 4 7	0 4 8	0 4 9	0 4 10	0 4 11
6.1975E-01	3.7590E-01	2.2799E-01	3.0389E-01	4.1127E-02	5.5649E-03
0 4 12	0 4 13	0 4 14	0 4 15	0 4 16	0 4 17
7.5374E-04	1.0307E-04	1.1015E-05	2.3603E-06	3.9339E-06	-2.3603E-06
0 4 18	0 4 19	0 5 7	0 5 8	0 5 9	0 5 10
0.	0.	8.0756E-01	4.8981E-01	6.5285E-01	8.8354E-02
0 5 11	0 5 12	0 5 13	0 5 14	0 5 15	0 5 16
1.1957E-02	1.6193E-03	2.1837E-04	2.6655E-05	5.1260E-06	1.0252E-06
0 5 17	0 5 18	0 5 19	0 6 8	0 6 9	0 6 10
5.1260E-06	-4.1008E-06	0.	1.0329E 00	1.3768E 00	1.8632E-01
0 6 11	0 6 12	0 6 13	0 6 14	0 6 15	0 6 16
2.5216E-02	3.4120E-03	4.5896E-04	5.9009E-05	1.0490E-05	3.9339E-06
0 6 17	0 6 18	0 6 19	0 7 9	0 7 10	0 7 11
1.3113E-06	-0.	0.	2.9509E 00	3.9935E-01	5.4048E-02
0 7 12	0 7 13	0 7 14	0 7 15	0 7 16	0 7 17
7.3148E-03	9.9213E-04	1.1762E-04	2.3866E-05	8.5235E-06	-0.
0 7 18	0 7 19	0 8 10	0 8 11	0 8 12	0 8 13
1.7047E-06	0.	8.3339E-01	1.1279E-01	1.5262E-02	2.0681E-03
0 8 14	0 8 15	0 8 16	0 8 17	0 8 18	0 8 19
2.5245E-04	4.3154E-05	1.5104E-05	6.4731E-06	1.0788E-05	-6.4731E-06
0 9 11	0 9 12	0 9 13	0 9 14	0 9 15	0 9 16
7.0575E-01	9.5514E-02	1.2925E-02	1.5723E-03	2.8603E-04	1.0477E-04
0 9 17	0 9 18	0 9 19	0 10 12	0 10 13	0 10 14
3.9080E-05	1.4135E-05	6.6519E-06	9.4732E-01	1.2821E-01	1.5587E-02
0 10 15	0 10 16	0 10 17	0 10 18	0 10 19	0 11 13
2.8310E-03	1.0430E-03	3.8394E-04	1.4398E-04	7.5895E-05	1.0004E 00
0 11 14	0 11 15	0 11 16	0 11 17	0 11 18	0 11 19
1.2165E-01	2.2086E-02	8.1223E-03	2.9891E-03	1.1351E-03	6.0466E-04
0 12 14	0 12 15	0 12 16	0 12 17	0 12 18	0 12 19
9.0909E-01	1.6505E-01	6.0720E-02	2.2337E-02	8.4710E-03	4.5264E-03
0 13 15	0 13 16	0 13 17	0 13 18	0 13 19	0 14 16
1.2196E 00	4.4865E-01	1.6505E-01	6.2612E-02	3.3439E-02	2.4389E 00
0 14 17	0 14 18	0 14 19	0 15 17	0 15 18	0 15 19
8.9721E-01	3.4035E-01	1.8180E-01	3.0214E 00	1.1462E 00	6.0772E-01
0 16 18	0 16 19	0 17 19			
3.5040E 00	1.7551E 00	5.9684E 00			

SCATTER
L N1 N2
SGSL(N1,N2)

H=(H2O-O)/2

1 1 3	1 1 4	1 1 5	1 1 6	1 1 7	1 1 8
1.3455E-01	6.3613E-02	3.0094E-02	1.4251E-02	6.7592E-03	3.2142E-03
1 1 9	1 1 10	1 1 11	1 1 12	1 1 13	1 1 14
2.8093E-03	1.7841E-04	2.3148E-05	6.5875E-06	2.1958E-06	-3.0078E-06
1 1 15	1 1 16	1 1 17	1 1 18	1 1 19	1 2 4
4.8377E-06	0.	0.	0.	0.	1.9888E-01
1 2 5	1 2 6	1 2 7	1 2 8	1 2 9	1 2 10
9.4028E-02	4.4479E-02	2.1060E-02	9.9866E-03	8.6303E-03	4.9905E-04
1 2 11	1 2 12	1 2 13	1 2 14	1 2 15	1 2 16
5.0310E-05	1.2442E-05	3.7868E-06	1.0819E-06	1.8934E-06	0.
1 2 17	1 2 18	1 2 19	1 3 5	1 3 6	1 3 7
0.	0.	0.	2.8366E-01	1.3408E-01	6.3409E-02
1 3 8	1 3 9	1 3 10	1 3 11	1 3 12	1 3 13
3.0009E-02	2.5726E-02	1.3826E-03	1.0647E-04	1.8902E-05	5.7864E-06
1 3 14	1 3 15	1 3 16	1 3 17	1 3 18	1 3 19
1.9288E-06	7.7152E-07	1.9288E-06	0.	0.	0.
1 4 6	1 4 7	1 4 8	1 4 9	1 4 10	1 4 11
3.8596E-01	1.8242E-01	8.6251E-02	7.3658E-02	3.8140E-03	2.4459E-04
1 4 12	1 4 13	1 4 14	1 4 15	1 4 16	1 4 17
3.2018E-05	7.8732E-06	3.6741E-06	5.2488E-07	-3.4773E-06	6.1017E-06
1 4 18	1 4 19	1 5 7	1 5 8	1 5 9	1 5 10
0.	0.	5.0290E-01	2.3768E-01	2.0264E-01	1.0320E-02
1 5 11	1 5 12	1 5 13	1 5 14	1 5 15	1 5 16
5.9876E-04	6.1893E-05	1.3678E-05	4.1034E-06	1.3678E-06	1.3678E-06
1 5 17	1 5 18	1 5 19	1 6 8	1 6 9	1 6 10
-2.7784E-06	4.8301E-06	0.	6.4324E-01	5.4793E-01	2.7657E-02
1 6 11	1 6 12	1 6 13	1 6 14	1 6 15	1 6 16
1.5164E-03	1.2597E-04	2.6243E-05	5.2485E-06	3.4990E-06	8.7476E-07
1 6 17	1 6 18	1 6 19	1 7 7	1 7 10	1 7 11
8.7476E-07	2.6243E-06	0.	1.5068E 00	7.5713E-02	4.0239E-03
1 7 12	1 7 13	1 7 14	1 7 15	1 7 16	1 7 17
2.9341E-04	4.9471E-05	1.1373E-05	7.9608E-06	1.1373E-06	1.1373E-06
1 7 18	1 7 19	1 8 10	1 8 11	1 8 12	1 8 13
4.5490E-06	0.	2.0202E-01	1.0467E-02	6.7222E-04	8.8526E-05
1 8 14	1 8 15	1 8 16	1 8 17	1 8 18	1 8 19
2.1592E-05	5.7578E-06	2.8789E-06	4.3184E-06	-9.8063E-06	1.5564E-05
1 9 11	1 9 12	1 9 13	1 9 14	1 9 15	1 9 16
1.4063E-01	7.4219E-03	5.2417E-04	7.1276E-05	2.0523E-05	1.2203E-05
1 9 17	1 9 18	1 9 19	1 10 12	1 10 13	1 10 14
7.2109E-06	4.9921E-06	9.4296E-06	1.8879E-01	9.9721E-03	6.3883E-04
1 10 15	1 10 16	1 10 17	1 10 18	1 10 19	1 11 13
1.1168E-04	5.4352E-05	2.6059E-05	1.7125E-05	2.9038E-05	1.9939E-01
1 11 14	1 11 15	1 11 16	1 11 17	1 11 18	1 11 19
9.8435E-03	1.0533E-03	3.1374E-04	1.1873E-04	5.8187E-05	7.5485E-05
1 12 14	1 12 15	1 12 16	1 12 17	1 12 18	1 12 19
1.8963E-01	1.7772E-02	4.1810E-03	1.0636E-03	3.2486E-04	2.4374E-04
1 13 15	1 13 16	1 13 17	1 13 18	1 13 19	1 14 16
3.4378E-01	7.5875E-02	1.6424E-02	3.4255E-03	2.9656E-04	9.3044E-01
1 14 17	1 14 18	1 14 19	1 15 17	1 15 18	1 15 19
2.0761E-01	4.7377E-02	1.2249E-02	1.1326E 00	2.1161E-01	-2.2804E-02
1 16 18	1 16 19	1 17 19			
8.3172E-01	-3.5646E-01	-1.0455E 00			

WATER/2

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
2.0600000E 00	9.0100000E 00	0.	2.9316000E 02 100

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
1.4900E 00	0.	3.2392E-01	2.9232E-01	4.7075E-01	3.4023E-01
2.5250E 00	0.	5.5597E-01	4.9704E-01	8.0798E-01	5.6333E-01
3.2600E 00	0.	7.0629E-01	6.3919E-01	1.0264E 00	7.4980E-01
4.2400E 00	0.	9.1566E-01	8.3103E-01	1.3307E 00	9.8248E-01
6.3076E 00	0.	1.3912E 00	1.2423E 00	2.0219E 00	1.4032E 00
7.8426E 00	0.	1.7327E 00	1.5455E 00	2.5181E 00	1.7400E 00
9.0876E 00	0.	1.9791E 00	1.7835E 00	2.8762E 00	2.0677E 00
1.0925E 01	0.	2.3476E 00	2.1413E 00	7.4974E 00	4.1584E 00
1.5825E 01	0.	9.0119E 00	6.9658E 00	5.9346E 00	2.6183E 00
2.0601E 01	0.	1.1717E 01	9.1314E 00	7.7162E 00	3.5632E 00
2.1652E 01	0.	1.2311E 01	9.6149E 00	8.1073E 00	3.7879E 00
2.1880E 01	0.	1.2439E 01	9.7153E 00	8.1915E 00	3.8283E 00
2.1900E 01	0.	1.2447E 01	9.7170E 00	7.3644E 00	3.6801E 00
2.2176E 01	0.	1.0696E 01	8.7284E 00	7.2638E 00	4.2380E 00
2.2500E 01	0.	8.2842E 00	7.0994E 00	8.9979E 00	5.5782E 00
2.4982E 01	0.	9.2656E 00	7.7798E 00	1.0064E 01	5.7002E 00
3.1886E 01	0.	1.2095E 01	9.7839E 00	1.3547E 01	6.2475E 00
4.1559E 01	0.	1.7965E 01	1.2755E 01	2.3367E 01	5.9018E-01
4.7613E 01	0.	4.7320E 01	1.3610E 01		

SCATTER
 L N1 N2
 SGSL(N1,N2)

(H2O)/2

0 1 3	0 1 4	0 1 5	0 1 6	0 1 7	0 1 8
2.8552E-01	1.7318E-01	1.0504E-01	6.3708E-02	3.8641E-02	2.3224E-02
0 1 9	0 1 10	0 1 11	0 1 12	0 1 13	0 1 14
6.0231E-03	0.	0.	0.	0.	0.
0 1 15	0 1 16	0 1 17	0 1 18	0 1 19	0 2 4
0.	0.	0.	0.	0.	4.9007E-01
0 2 5	0 2 6	0 2 7	0 2 8	0 2 9	0 2 10
2.9724E-01	1.8029E-01	1.0935E-01	6.5927E-02	1.8175E-02	0.
0 2 11	0 2 12	0 2 13	0 2 14	0 2 15	0 2 16
0.	0.	0.	0.	0.	0.
0 2 17	0 2 18	0 2 19	0 3 5	0 3 6	0 3 7
0.	0.	0.	6.2256E-01	3.7760E-01	2.2903E-01
0 3 8	0 3 9	0 3 10	0 3 11	0 3 12	0 3 13
1.3891E-01	1.5917E-01	0.	0.	0.	0.
0 3 14	0 3 15	0 3 16	0 3 17	0 3 18	0 3 19
0.	0.	0.	0.	0.	0.
0 4 6	0 4 7	0 4 8	0 4 9	0 4 10	0 4 11
8.0711E-01	4.8954E-01	2.9692E-01	3.9384E-01	6.2382E-03	0.
0 4 12	0 4 13	0 4 14	0 4 15	0 4 16	0 4 17
0.	0.	0.	0.	0.	0.
0 4 18	0 4 19	0 5 7	0 5 8	0 5 9	0 5 10
0.	0.	1.2263E 00	7.4380E-01	9.2427E-01	0.
0 5 11	0 5 12	0 5 13	0 5 14	0 5 15	0 5 16
0.	0.	0.	0.	0.	0.
0 5 17	0 5 18	0 5 19	0 6 8	0 6 9	0 6 10
0.	0.	0.	1.5273E 00	2.0281E 00	3.6248E-02
0 6 11	0 6 12	0 6 13	0 6 14	0 6 15	0 6 16
0.	0.	0.	0.	0.	0.
0 6 17	0 6 18	0 6 19	0 7 9	0 7 10	0 7 11
0.	0.	0.	3.8337E 00	3.9843E-01	0.
0 7 12	0 7 13	0 7 14	0 7 15	0 7 16	0 7 17
0.	0.	0.	0.	0.	0.
0 7 18	0 7 19	0 8 10	0 8 11	0 8 12	0 8 13
0.	0.	1.0147E 00	6.5368E-02	0.	0.
0 8 14	0 8 15	0 8 16	0 8 17	0 8 18	0 8 19
0.	0.	0.	0.	0.	0.
0 9 11	0 9 12	0 9 13	0 9 14	0 9 15	0 9 16
8.0245E-01	7.6057E-02	0.	0.	0.	0.
0 9 17	0 9 18	0 9 19	0 10 12	0 10 13	0 10 14
0.	0.	0.	1.0443E 00	1.2165E-01	5.0956E-04
0 10 15	0 10 16	0 10 17	0 10 18	0 10 19	0 11 13
0.	0.	0.	0.	0.	1.0972E 00
0 11 14	0 11 15	0 11 16	0 11 17	0 11 18	0 11 19
1.2476E-01	9.4105E-03	0.	0.	0.	0.
0 12 14	0 12 15	0 12 16	0 12 17	0 12 18	0 12 19
9.9604E-01	1.8067E-01	5.8031E-02	9.5657E-03	0.	0.
0 13 15	0 13 16	0 13 17	0 13 18	0 13 19	0 14 16
1.3370E 00	4.9187E-01	1.8069E-01	5.8789E-02	7.7363E-03	2.6722E 00
0 14 17	0 14 18	0 14 19	0 15 17	0 15 18	0 15 19
9.8305E-01	3.7292E-01	1.6166E-01	3.3102E 00	1.2557E 00	6.0204E-01
0 16 18	0 16 19	0 17 19			
3.8177E 00	1.7527E 00	6.1077E 00			

WATER/2

SCATTER
L N1 N2
SGSL(N1,N2)

1 1 3	1 1 4	1 1 5	1 1 6	1 1 7	1 1 8
1.3073E-01	3.8398E-02	-5.0057E-05	-1.4188E-02	-1.7734E-02	-1.6751E-02
1 1 9	1 1 10	1 1 11	1 1 12	1 1 13	1 1 14
-5.4534E-03	0.	0.	0.	0.	0.
1 1 15	1 1 16	1 1 17	1 1 18	1 1 19	1 2 4
0.	0.	0.	0.	0.	1.9744E-01
1 2 5	1 2 6	1 2 7	1 2 8	1 2 9	1 2 10
3.9787E-02	-2.2853E-02	-4.3229E-02	-4.5276E-02	-1.6234E-02	0.
1 2 11	1 2 12	1 2 13	1 2 14	1 2 15	1 2 16
0.	0.	0.	0.	0.	0.
1 2 17	1 2 18	1 2 19	1 3 5	1 3 6	1 3 7
0.	0.	0.	2.9542E-01	9.3779E-02	8.6555E-03
1 3 8	1 3 9	1 3 10	1 3 11	1 3 12	1 3 13
-2.3670E-02	-8.5670E-02	0.	0.	0.	0.
1 3 14	1 3 15	1 3 16	1 3 17	1 3 18	1 3 19
0.	0.	0.	0.	0.	0.
1 4 6	1 4 7	1 4 8	1 4 9	1 4 10	1 4 11
3.9659E-01	1.3476E-01	2.2713E-02	-1.2176E-01	-5.8218E-03	0.
1 4 12	1 4 13	1 4 14	1 4 15	1 4 16	1 4 17
0.	0.	0.	0.	0.	0.
1 4 18	1 4 19	1 5 7	1 5 8	1 5 9	1 5 10
0.	0.	4.8561E-01	9.1376E-02	-3.2747E-01	0.
1 5 11	1 5 12	1 5 13	1 5 14	1 5 15	1 5 16
0.	0.	0.	0.	0.	0.
1 5 17	1 5 18	1 5 19	1 6 8	1 6 9	1 6 10
0.	0.	0.	5.9483E-01	-2.7954E-01	-3.3213E-02
1 6 11	1 6 12	1 6 13	1 6 14	1 6 15	1 6 16
0.	0.	0.	0.	0.	0.
1 6 17	1 6 18	1 6 19	1 7 9	1 7 10	1 7 11
0.	0.	0.	8.9519E-01	-2.4387E-01	0.
1 7 12	1 7 13	1 7 14	1 7 15	1 7 16	1 7 17
0.	0.	0.	0.	0.	0.
1 7 18	1 7 19	1 8 10	1 8 11	1 8 12	1 8 13
0.	0.	-1.9063E-01	-5.4022E-02	0.	0.
1 8 14	1 8 15	1 8 16	1 8 17	1 8 18	1 8 19
0.	0.	0.	0.	0.	0.
1 9 11	1 9 12	1 9 13	1 9 14	1 9 15	1 9 16
-1.0976E-01	-4.9322E-02	0.	0.	0.	0.
1 9 17	1 9 18	1 9 19	1 10 12	1 10 13	1 10 14
0.	0.	0.	-6.8258E-02	-6.8392E-02	-4.9026E-04
1 10 15	1 10 16	1 10 17	1 10 18	1 10 19	1 11 13
0.	0.	0.	0.	0.	-5.0811E-02
1 11 14	1 11 15	1 11 16	1 11 17	1 11 18	1 11 19
-6.4097E-02	-7.8921E-03	0.	0.	0.	0.
1 12 14	1 12 15	1 12 16	1 12 17	1 12 18	1 12 19
-1.8051E-02	-6.2243E-02	-3.5245E-02	-8.0166E-03	0.	0.
1 13 15	1 13 16	1 13 17	1 13 18	1 13 19	1 14 16
1.6881E-01	-4.9365E-02	-6.3529E-02	-3.6341E-02	-6.6112E-03	7.4363E-01
1 14 17	1 14 18	1 14 19	1 15 17	1 15 18	1 15 19
4.3407E-02	-6.8342E-02	-8.5090E-02	9.3211E-01	1.3105E-02	-2.2283E-01
1 16 18	1 16 19	1 17 19			
5.4899E-01	-6.2897E-01	-1.4813E 00			

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
3.1000000E 00	2.0147000E 00	0.	2.9316000E 02 100

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
1.1850E 00	0.	2.8391E-01	2.4162E-01	4.1259E-01	2.3410E-01
1.6450E 00	0.	3.9411E-01	3.3542E-01	5.7275E-01	3.2497E-01
2.1900E 00	0.	5.2469E-01	4.4655E-01	7.6251E-01	4.3263E-01
2.7000E 00	0.	6.4687E-01	5.5054E-01	9.4008E-01	5.3338E-01
3.1000E 00	0.	7.4271E-01	6.3210E-01	1.0794E 00	6.1240E-01
3.3150E 00	0.	7.9422E-01	6.7594E-01	1.1542E 00	6.5488E-01
3.3500E 00	0.	8.0260E-01	6.8307E-01	1.1664E 00	6.6179E-01
3.3500E 00	0.	8.0260E-01	6.8307E-01	2.5294E 00	4.5195E-01
3.3500E 00	0.	2.1384E 00	1.1895E 00	1.2071E 00	-6.7093E-02
3.3500E 00	0.	2.1384E 00	1.1895E 00	1.2071E 00	-6.7093E-02
3.3500E 00	0.	2.1384E 00	1.1895E 00	1.2071E 00	-6.7093E-02
3.3500E 00	0.	2.1384E 00	1.1895E 00	1.1460E 00	-2.2158E-02
3.3500E 00	0.	1.8160E 00	1.1534E 00	1.2220E 00	1.3502E-01
3.3501E 00	0.	1.3858E 00	1.0140E 00	1.5052E 00	3.5111E-01
3.5251E 00	0.	1.4582E 00	1.0669E 00	1.5838E 00	3.6945E-01
3.9752E 00	0.	1.6443E 00	1.2031E 00	1.8417E 00	3.9975E-01
4.5965E 00	0.	1.9757E 00	1.4222E 00	2.6205E 00	1.1105E-01
4.8994E 00	0.	4.8990E 00	1.6580E 00		

DEUTERIUM

SCATTER
L N1 N2
SGSL(N1,N2)

0 1 3	0 1 4	0 1 5	0 1 6	0 1 7	0 1 8
2.5025E-01	1.5178E-01	8.0093E-02	6.3767E-03	0.	0.
0 1 9	0 1 10	0 1 11	0 1 12	0 1 13	0 1 14
0.	0.	0.	0.	0.	0.
0 1 15	0 1 16	0 1 17	0 1 18	0 1 19	0 2 4
0.	0.	0.	0.	0.	3.4739E-01
0 2 5	0 2 6	0 2 7	0 2 8	0 2 9	0 2 10
2.1070E-01	1.1118E-01	8.8521E-03	0.	0.	0.
0 2 11	0 2 12	0 2 13	0 2 14	0 2 15	0 2 16
0.	0.	0.	0.	0.	0.
0 2 17	0 2 18	0 2 19	0 3 5	0 3 6	0 3 7
0.	0.	0.	4.6249E-01	2.8051E-01	1.4802E-01
0 3 8	0 3 9	0 3 10	0 3 11	0 3 12	0 3 13
1.1785E-02	0.	0.	0.	0.	0.
0 3 14	0 3 15	0 3 16	0 3 17	0 3 18	0 3 19
0.	0.	0.	0.	0.	0.
0 4 6	0 4 7	0 4 8	0 4 9	0 4 10	0 4 11
5.7019E-01	3.4584E-01	1.8249E-01	1.4529E-02	0.	0.
0 4 12	0 4 13	0 4 14	0 4 15	0 4 16	0 4 17
0.	0.	0.	0.	0.	0.
0 4 18	0 4 19	0 5 7	0 5 8	0 5 9	0 5 10
0.	0.	6.5466E-01	3.9707E-01	2.2621E-01	0.
0 5 11	0 5 12	0 5 13	0 5 14	0 5 15	0 5 16
0.	0.	0.	0.	0.	0.
0 5 17	0 5 18	0 5 19	0 6 8	0 6 9	0 6 10
0.	0.	0.	7.0006E-01	6.6651E-01	0.
0 6 11	0 6 12	0 6 13	0 6 14	0 6 15	0 6 16
0.	0.	0.	0.	0.	0.
0 6 17	0 6 18	0 6 19	0 7 9	0 7 10	0 7 11
0.	0.	0.	1.3810E 00	0.	0.
0 7 12	0 7 13	0 7 14	0 7 15	0 7 16	0 7 17
0.	0.	0.	0.	0.	0.
0 7 18	0 7 19	0 8 10	0 8 11	0 8 12	0 8 13
0.	0.	1.8027E-02	0.	0.	0.
0 8 14	0 8 15	0 8 16	0 8 17	0 8 18	0 8 19
0.	0.	0.	0.	0.	0.
0 9 11	0 9 12	0 9 13	0 9 14	0 9 15	0 9 16
4.5068E-03	0.	0.	0.	0.	0.
0 9 17	0 9 18	0 9 19	0 10 12	0 10 13	0 10 14
0.	0.	0.	4.5068E-03	0.	0.
0 10 15	0 10 16	0 10 17	0 10 18	0 10 19	0 11 13
0.	0.	0.	0.	0.	4.5068E-03
0 11 14	0 11 15	0 11 16	0 11 17	0 11 18	0 11 19
0.	0.	0.	0.	0.	0.
0 12 14	0 12 15	0 12 16	0 12 17	0 12 18	0 12 19
4.5068E-03	0.	0.	0.	0.	0.
0 13 15	0 13 16	0 13 17	0 13 18	0 13 19	0 14 16
6.5620E-02	0.	0.	0.	0.	3.0600E-01
0 14 17	0 14 18	0 14 19	0 15 17	0 15 18	0 15 19
6.0090E-03	0.	0.	4.4998E-01	9.0136E-03	0.
0 16 18	0 16 19	0 17 19			
4.7807E-01	4.9056E-03	4.8895E-01			

DEUTERIUM

SCATTER
L N1 N2
SGSL(N1,N2)

D=(D20-0)/2

1 1 3	1 1 4	1 1 5	1 1 6	1 1 7	1 1 8
3.0886E-02	-4.7475E-02	-5.7638E-02	-5.9413E-03	0.	0.
1 1 9	1 1 10	1 1 11	1 1 12	1 1 13	1 1 14
0.	0.	0.	0.	0.	0.
1 1 15	1 1 16	1 1 17	1 1 18	1 1 19	1 2 4
0.	0.	0.	0.	0.	4.2876E-02
1 2 5	1 2 6	1 2 7	1 2 8	1 2 9	1 2 10
-6.5904E-02	-8.0012E-02	-8.2475E-03	0.	0.	0.
1 2 11	1 2 12	1 2 13	1 2 14	1 2 15	1 2 16
0.	0.	0.	0.	0.	0.
1 2 17	1 2 18	1 2 19	1 3 5	1 3 6	1 3 7
0.	0.	0.	5.7081E-02	-8.7738E-02	-1.0652E-01
1 3 8	1 3 9	1 3 10	1 3 11	1 3 12	1 3 13
-1.0980E-02	0.	0.	0.	0.	0.
1 3 14	1 3 15	1 3 16	1 3 17	1 3 18	1 3 19
0.	0.	0.	0.	0.	0.
1 4 6	1 4 7	1 4 8	1 4 9	1 4 10	1 4 11
7.0374E-02	-1.0817E-01	-1.3133E-01	-1.3537E-02	0.	0.
1 4 12	1 4 13	1 4 14	1 4 15	1 4 16	1 4 17
0.	0.	0.	0.	0.	0.
1 4 18	1 4 19	1 5 7	1 5 8	1 5 9	1 5 10
0.	0.	8.0800E-02	-1.2420E-01	-1.6633E-01	0.
1 5 11	1 5 12	1 5 13	1 5 14	1 5 15	1 5 16
0.	0.	0.	0.	0.	0.
1 5 17	1 5 18	1 5 19	1 6 8	1 6 9	1 6 10
0.	0.	0.	8.6404E-02	-3.1067E-01	0.
1 6 11	1 6 12	1 6 13	1 6 14	1 6 15	1 6 16
0.	0.	0.	0.	0.	0.
1 6 17	1 6 18	1 6 19	1 7 9	1 7 10	1 7 11
0.	0.	0.	-2.2663E-01	0.	0.
1 7 12	1 7 13	1 7 14	1 7 15	1 7 16	1 7 17
0.	0.	0.	0.	0.	0.
1 7 18	1 7 19	1 8 10	1 8 11	1 8 12	1 8 13
0.	0.	-1.6796E-02	0.	0.	0.
1 8 14	1 8 15	1 8 16	1 8 17	1 8 18	1 8 19
0.	0.	0.	0.	0.	0.
1 9 11	1 9 12	1 9 13	1 9 14	1 9 15	1 9 16
-4.1990E-03	0.	0.	0.	0.	0.
1 9 17	1 9 18	1 9 19	1 10 12	1 10 13	1 10 14
0.	0.	0.	-4.1990E-03	0.	0.
1 10 15	1 10 16	1 10 17	1 10 18	1 10 19	1 11 13
0.	0.	0.	0.	0.	-4.1990E-03
1 11 14	1 11 15	1 11 16	1 11 17	1 11 18	1 11 19
0.	0.	0.	0.	0.	0.
1 12 14	1 12 15	1 12 16	1 12 17	1 12 18	1 12 19
-4.1990E-03	0.	0.	0.	0.	0.
1 13 15	1 13 16	1 13 17	1 13 18	1 13 19	1 14 16
-4.9134E-02	0.	0.	0.	0.	-1.6456E-01
1 14 17	1 14 18	1 14 19	1 15 17	1 15 18	1 15 19
-5.5987E-03	0.	0.	-2.3845E-01	-8.3980E-03	0.
1 16 18	1 16 19	1 17 19			
-2.5508E-01	-4.6639E-03	-2.7604E-01			

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
3.8000000E 00	1.0017000E 01	0.	2.9316000E 02 100

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
1.5250E 00	0.	3.9664E-01	3.2286E-01	5.7643E-01	2.6240E-01
2.4700E 00	0.	6.8300E-01	5.3709E-01	9.9258E-01	3.6890E-01
3.0250E 00	0.	8.0814E-01	6.4810E-01	1.1744E 00	4.9189E-01
3.6400E 00	0.	9.6340E-01	7.7667E-01	1.4001E 00	6.0418E-01
5.1050E 00	0.	1.4531E 00	1.1234E 00	2.1117E 00	7.0005E-01
5.6550E 00	0.	1.6341E 00	1.2519E 00	2.3749E 00	7.3699E-01
5.2900E 00	0.	1.4875E 00	1.1583E 00	2.1618E 00	7.5328E-01
5.2300E 00	0.	1.4625E 00	1.1426E 00	3.7675E 00	-5.7427E-02
5.2300E 00	0.	3.7876E 00	1.4305E 00	1.4424E 00	-2.3048E-01
5.2300E 00	0.	3.7876E 00	1.4305E 00	1.4424E 00	-2.3048E-01
5.2300E 00	0.	3.7876E 00	1.4305E 00	1.4424E 00	-2.3048E-01
5.2300E 00	0.	3.7876E 00	1.4305E 00	1.4424E 00	-2.3048E-01
5.2300E 00	0.	3.3068E 00	1.5073E 00	1.8032E 00	-2.1407E-01
5.2301E 00	0.	2.5251E 00	1.5211E 00	2.5250E 00	-1.8125E-01
5.4051E 00	0.	2.5896E 00	1.5768E 00	2.6123E 00	-1.6095E-01
5.8652E 00	0.	2.7691E 00	1.7203E 00	2.8942E 00	-1.5350E-01
6.5781E 00	0.	3.1920E 00	1.9595E 00	3.3856E 00	-3.4135E-01
6.9805E 00	0.	6.9800E 00	1.7450E 00		

(HEAVY WATER)/2

SCATTER
L N1 N2
SGSL(N1,N2)

(D20)/2

0 1 3	0 1 4	0 1 5	0 1 6	0 1 7	0 1 8
3.4962E-01	1.8633E-01	1.5978E-02	0.	0.	0.
0 1 9	0 1 10	0 1 11	0 1 12	0 1 13	0 1 14
0.	0.	0.	0.	0.	0.
0 1 15	0 1 16	0 1 17	0 1 18	0 1 19	0 2 4
0.	0.	0.	0.	0.	6.0146E-01
0 2 5	0 2 6	0 2 7	0 2 8	0 2 9	0 2 10
1.9297E-01	0.	0.	0.	0.	0.
0 2 11	0 2 12	0 2 13	0 2 14	0 2 15	0 2 16
0.	0.	0.	0.	0.	0.
0 2 17	0 2 18	0 2 19	0 3 5	0 3 6	0 3 7
0.	0.	0.	7.1234E-01	3.2260E-01	7.4885E-03
0 3 8	0 3 9	0 3 10	0 3 11	0 3 12	0 3 13
0.	0.	0.	0.	0.	0.
0 3 14	0 3 15	0 3 16	0 3 17	0 3 18	0 3 19
0.	0.	0.	0.	0.	0.
0 4 6	0 4 7	0 4 8	0 4 9	0 4 10	0 4 11
8.4920E-01	4.1055E-01	1.6760E-02	0.	0.	0.
0 4 12	0 4 13	0 4 14	0 4 15	0 4 16	0 4 17
0.	0.	0.	0.	0.	0.
0 4 18	0 4 19	0 5 7	0 5 8	0 5 9	0 5 10
0.	0.	1.2573E 00	2.8291E-01	0.	0.
0 5 11	0 5 12	0 5 13	0 5 14	0 5 15	0 5 16
0.	0.	0.	0.	0.	0.
0 5 17	0 5 18	0 5 19	0 6 8	0 6 9	0 6 10
0.	0.	0.	1.3895E 00	2.5646E-01	0.
0 6 11	0 6 12	0 6 13	0 6 14	0 6 15	0 6 16
0.	0.	0.	0.	0.	0.
0 6 17	0 6 18	0 6 19	0 7 9	0 7 10	0 7 11
0.	0.	0.	1.6407E 00	0.	0.
0 7 12	0 7 13	0 7 14	0 7 15	0 7 16	0 7 17
0.	0.	0.	0.	0.	0.
0 7 18	0 7 19	0 8 10	0 8 11	0 8 12	0 8 13
0.	0.	0.	0.	0.	0.
0 8 14	0 8 15	0 8 16	0 8 17	0 8 18	0 8 19
0.	0.	0.	0.	0.	0.
0 9 11	0 9 12	0 9 13	0 9 14	0 9 15	0 9 16
0.	0.	0.	0.	0.	0.
0 9 17	0 9 18	0 9 19	0 10 12	0 10 13	0 10 14
0.	0.	0.	0.	0.	0.
0 10 15	0 10 16	0 10 17	0 10 18	0 10 19	0 11 13
0.	0.	0.	0.	0.	0.
0 11 14	0 11 15	0 11 16	0 11 17	0 11 18	0 11 19
0.	0.	0.	0.	0.	0.
0 12 14	0 12 15	0 12 16	0 12 17	0 12 18	0 12 19
0.	0.	0.	0.	0.	0.
0 13 15	0 13 16	0 13 17	0 13 18	0 13 19	0 14 16
0.	0.	0.	0.	0.	1.1994E-01
0 14 17	0 14 18	0 14 19	0 15 17	0 15 18	0 15 19
0.	0.	0.	1.7991E-01	0.	0.
0 16 18	0 16 19	0 17 19			
2.0306E-01	0.	2.0171E-01			

(HEAVY WATER)/2

SCATTER
L N1 N2
SGSL(N1,N2)

1 1 3	1 1 4	1 1 5	1 1 6	1 1 7	1 1 8
-4.1257E-02	-1.1945E-01	-1.4555E-02	0.	0.	0.
1 1 9	1 1 10	1 1 11	1 1 12	1 1 13	1 1 14
0.	0.	0.	0.	0.	0.
1 1 15	1 1 16	1 1 17	1 1 18	1 1 19	1 2 4
0.	0.	0.	0.	0.	-1.7873E-01
1 2 5	1 2 6	1 2 7	1 2 8	1 2 9	1 2 10
-1.4726E-01	0.	0.	0.	0.	0.
1 2 11	1 2 12	1 2 13	1 2 14	1 2 15	1 2 16
0.	0.	0.	0.	0.	0.
1 2 17	1 2 18	1 2 19	1 3 5	1 3 6	1 3 7
0.	0.	0.	-1.3984E-01	-2.2799E-01	-7.1654E-03
1 3 8	1 3 9	1 3 10	1 3 11	1 3 12	1 3 13
0.	0.	0.	0.	0.	0.
1 3 14	1 3 15	1 3 16	1 3 17	1 3 18	1 3 19
0.	0.	0.	0.	0.	0.
1 4 6	1 4 7	1 4 8	1 4 9	1 4 10	1 4 11
-1.4351E-01	-2.8156E-01	-1.5773E-02	0.	0.	0.
1 4 12	1 4 13	1 4 14	1 4 15	1 4 16	1 4 17
0.	0.	0.	0.	0.	0.
1 4 18	1 4 19	1 5 7	1 5 8	1 5 9	1 5 10
0.	0.	-4.6723E-01	-2.2621E-01	0.	0.
1 5 11	1 5 12	1 5 13	1 5 14	1 5 15	1 5 16
0.	0.	0.	0.	0.	0.
1 5 17	1 5 18	1 5 19	1 6 8	1 6 9	1 6 10
0.	0.	0.	-5.6409E-01	-2.0983E-01	0.
1 6 11	1 6 12	1 6 13	1 6 14	1 6 15	1 6 16
0.	0.	0.	0.	0.	0.
1 6 17	1 6 18	1 6 19	1 7 9	1 7 10	1 7 11
0.	0.	0.	-7.1163E-01	0.	0.
1 7 12	1 7 13	1 7 14	1 7 15	1 7 16	1 7 17
0.	0.	0.	0.	0.	0.
1 7 18	1 7 19	1 8 10	1 8 11	1 8 12	1 8 13
0.	0.	0.	0.	0.	0.
1 8 14	1 8 15	1 8 16	1 8 17	1 8 18	1 8 19
0.	0.	0.	0.	0.	0.
1 9 11	1 9 12	1 9 13	1 9 14	1 9 15	1 9 16
0.	0.	0.	0.	0.	0.
1 9 17	1 9 18	1 9 19	1 10 12	1 10 13	1 10 14
0.	0.	0.	0.	0.	0.
1 10 15	1 10 16	1 10 17	1 10 18	1 10 19	1 11 13
0.	0.	0.	0.	0.	0.
1 11 14	1 11 15	1 11 16	1 11 17	1 11 18	1 11 19
0.	0.	0.	0.	0.	0.
1 12 14	1 12 15	1 12 16	1 12 17	1 12 18	1 12 19
0.	0.	0.	0.	0.	0.
1 13 15	1 13 16	1 13 17	1 13 18	1 13 19	1 14 16
0.	0.	0.	0.	0.	-9.3235E-02
1 14 17	1 14 18	1 14 19	1 15 17	1 15 18	1 15 19
0.	0.	0.	-1.3985E-01	0.	0.
1 16 18	1 16 19	1 17 19			
-1.5587E-01	0.	-1.5681E-01			

LITHIUM

L.I

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
3.4000000E 00	6.9400000E 00	0.	2.9316000E 02 100

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
1.8841E 00	0.	9.1192E-01	4.2811E-01	9.5291E-01	-2.3434E-01
2.2102E 00	0.	1.0935E 00	4.9589E-01	1.1002E 00	-2.8043E-01
2.0067E 00	0.	9.3925E-01	4.6233E-01	1.0335E 00	-2.3827E-01
1.7036E 00	0.	8.9575E-01	3.6338E-01	7.9859E-01	-2.1773E-01
1.5211E 00	0.	6.7969E-01	3.5415E-01	7.9518E-01	-1.6433E-01
1.2592E 00	0.	5.2381E-01	2.9578E-01	6.6594E-01	-1.0673E-01
1.6982E 00	0.	7.5015E-01	3.9487E-01	8.8718E-01	-1.7892E-01
2.1834E 00	0.	1.0358E 00	4.9470E-01	1.1242E 00	-2.8470E-01
1.7740E 00	0.	1.4873E 00	2.3730E-01	2.3767E-01	-6.2304E-02
1.3781E 00	0.	1.0509E 00	1.9371E-01	1.9411E-01	-4.8708E-02
1.4671E 00	0.	9.6151E-01	1.4329E-01	1.4349E-01	-3.8295E-02
2.0855E 00	0.	9.6280E-01	1.3703E-01	1.3720E-01	-3.7030E-02
3.7767E 00	0.	9.6280E-01	1.3703E-01	1.3720E-01	-3.7030E-02
6.7374E 00	0.	9.1706E-01	1.4937E-01	1.8294E-01	-4.9374E-02
1.1849E 01	0.	8.2560E-01	1.7406E-01	2.7440E-01	-7.4060E-02
1.8822E 01	0.	8.2560E-01	1.7406E-01	2.7440E-01	-7.4060E-02
3.0316E 01	0.	8.2560E-01	1.7406E-01	2.7440E-01	-7.4060E-02
4.9985E 01	0.	8.3356E-01	1.7412E-01	2.6644E-01	-7.1434E-02
6.4068E 01	0.	1.1000E 00	1.0659E-01		

LITHIUM

SCATTER
L N1 N2
SGSL(N1,N2)

LI

0 1 3	0 1 4	0 1 5	0 1 6	0 1 7	0 1 8
1.5172E-02	0.	0.	0.	0.	0.
0 1 9	0 1 10	0 1 11	0 1 12	0 1 13	0 1 14
0.	0.	0.	0.	0.	0.
0 1 15	0 1 16	0 1 17	0 1 18	0 1 19	0 2 4
0.	0.	0.	0.	0.	1.1296E-02
0 2 5	0 2 6	0 2 7	0 2 8	0 2 9	0 2 10
0.	0.	0.	0.	0.	0.
0 2 11	0 2 12	0 2 13	0 2 14	0 2 15	0 2 16
0.	0.	0.	0.	0.	0.
0 2 17	0 2 18	0 2 19	0 3 5	0 3 6	0 3 7
0.	0.	0.	2.7273E-02	0.	0.
0 3 8	0 3 9	0 3 10	0 3 11	0 3 12	0 3 13
0.	0.	0.	0.	0.	0.
0 3 14	0 3 15	0 3 16	0 3 17	0 3 18	0 3 19
0.	0.	0.	0.	0.	0.
0 4 6	0 4 7	0 4 8	0 4 9	0 4 10	0 4 11
6.5572E-04	0.	0.	0.	0.	0.
0 4 12	0 4 13	0 4 14	0 4 15	0 4 16	0 4 17
0.	0.	0.	0.	0.	0.
0 4 18	0 4 19	0 5 7	0 5 8	0 5 9	0 5 10
0.	0.	3.5130E-02	0.	0.	0.
0 5 11	0 5 12	0 5 13	0 5 14	0 5 15	0 5 16
0.	0.	0.	0.	0.	0.
0 5 17	0 5 18	0 5 19	0 6 8	0 6 9	0 6 10
0.	0.	0.	5.5243E-02	0.	0.
0 6 11	0 6 12	0 6 13	0 6 14	0 6 15	0 6 16
0.	0.	0.	0.	0.	0.
0 6 17	0 6 18	0 6 19	0 7 2	0 7 10	0 7 11
0.	0.	0.	4.2669E-02	0.	0.
0 7 12	0 7 13	0 7 14	0 7 15	0 7 16	0 7 17
0.	0.	0.	0.	0.	0.
0 7 18	0 7 19	0 8 10	0 8 11	0 8 12	0 8 13
0.	0.	0.	0.	0.	0.
0 8 14	0 8 15	0 8 16	0 8 17	0 8 18	0 8 19
0.	0.	0.	0.	0.	0.
0 9 11	0 9 12	0 9 13	0 9 14	0 9 15	0 9 16
0.	0.	0.	0.	0.	0.
0 9 17	0 9 18	0 9 19	0 10 12	0 10 13	0 10 14
0.	0.	0.	0.	0.	0.
0 10 15	0 10 16	0 10 17	0 10 18	0 10 19	0 11 13
0.	0.	0.	0.	0.	0.
0 11 14	0 11 15	0 11 16	0 11 17	0 11 18	0 11 19
0.	0.	0.	0.	0.	0.
0 12 14	0 12 15	0 12 16	0 12 17	0 12 18	0 12 19
0.	0.	0.	0.	0.	0.
0 13 15	0 13 16	0 13 17	0 13 18	0 13 19	0 14 16
0.	0.	0.	0.	0.	0.
0 14 17	0 14 18	0 14 19	0 15 17	0 15 18	0 15 19
0.	0.	0.	0.	0.	0.
0 16 18	0 16 19	0 17 19			
0.	0.	0.			

LITHIUM

SCATTER
L N1 N2
SGSL(N1,N2)

L1

1 1 3	1 1 4	1 1 5	1 1 6	1 1 7	1 1 8
-1.3776E-02	0.	0.	0.	0.	0.
1 1 9	1 1 10	1 1 11	1 1 12	1 1 13	1 1 14
0.	0.	0.	0.	0.	0.
1 1 15	1 1 16	1 1 17	1 1 18	1 1 19	1 2 4
0.	0.	0.	0.	0.	-1.0459E-02
1 2 5	1 2 6	1 2 7	1 2 8	1 2 9	1 2 10
0.	0.	0.	0.	0.	0.
1 2 11	1 2 12	1 2 13	1 2 14	1 2 15	1 2 16
0.	0.	0.	0.	0.	0.
1 2 17	1 2 18	1 2 19	1 3 5	1 3 6	1 3 7
0.	0.	0.	-2.4056E-02	0.	0.
1 3 8	1 3 9	1 3 10	1 3 11	1 3 12	1 3 13
0.	0.	0.	0.	0.	0.
1 3 14	1 3 15	1 3 16	1 3 17	1 3 18	1 3 19
0.	0.	0.	0.	0.	0.
1 4 6	1 4 7	1 4 8	1 4 9	1 4 10	1 4 11
-6.4345E-04	0.	0.	0.	0.	0.
1 4 12	1 4 13	1 4 14	1 4 15	1 4 16	1 4 17
0.	0.	0.	0.	0.	0.
1 4 18	1 4 19	1 5 7	1 5 8	1 5 9	1 5 10
0.	0.	-2.9819E-02	0.	0.	0.
1 5 11	1 5 12	1 5 13	1 5 14	1 5 15	1 5 16
0.	0.	0.	0.	0.	0.
1 5 17	1 5 18	1 5 19	1 6 8	1 6 9	1 6 10
0.	0.	0.	-4.4052E-02	0.	0.
1 6 11	1 6 12	1 6 13	1 6 14	1 6 15	1 6 16
0.	0.	0.	0.	0.	0.
1 6 17	1 6 18	1 6 19	1 7 9	1 7 10	1 7 11
0.	0.	0.	-3.5953E-02	0.	0.
1 7 12	1 7 13	1 7 14	1 7 15	1 7 16	1 7 17
0.	0.	0.	0.	0.	0.
1 7 18	1 7 19	1 8 10	1 8 11	1 8 12	1 8 13
0.	0.	0.	0.	0.	0.
1 8 14	1 8 15	1 8 16	1 8 17	1 8 18	1 8 19
0.	0.	0.	0.	0.	0.
1 9 11	1 9 12	1 9 13	1 9 14	1 9 15	1 9 16
0.	0.	0.	0.	0.	0.
1 9 17	1 9 18	1 9 19	1 10 12	1 10 13	1 10 14
0.	0.	0.	0.	0.	0.
1 10 15	1 10 16	1 10 17	1 10 18	1 10 19	1 11 13
0.	0.	0.	0.	0.	0.
1 11 14	1 11 15	1 11 16	1 11 17	1 11 18	1 11 19
0.	0.	0.	0.	0.	0.
1 12 14	1 12 15	1 12 16	1 12 17	1 12 18	1 12 19
0.	0.	0.	0.	0.	0.
1 13 15	1 13 16	1 13 17	1 13 18	1 13 19	1 14 16
0.	0.	0.	0.	0.	0.
1 14 17	1 14 18	1 14 19	1 15 17	1 15 18	1 15 19
0.	0.	0.	0.	0.	0.
1 16 18	1 16 19	1 17 19			
0.	0.	0.			

LITHIUM 6

L16

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
3.4200000E 00	6.0170299E 00	0.	2.9316000E 02 100

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
1.8850E 00	0.	7.9471E-01	4.3416E-01	9.7711E-01	-1.7725E-01
2.0500E 00	0.	8.4452E-01	4.6137E-01	1.0383E 00	-1.8836E-01
1.8700E 00	0.	7.3192E-01	3.9985E-01	8.9990E-01	-1.6324E-01
1.4050E 00	0.	5.0021E-01	2.7327E-01	6.1502E-01	-1.1156E-01
1.3450E 00	0.	4.6557E-01	2.5434E-01	5.7242E-01	-1.0384E-01
1.7900E 00	0.	6.0632E-01	3.3124E-01	7.4548E-01	-1.3523E-01
4.7950E 00	0.	1.3058E 00	7.1334E-01	1.6054E 00	-2.9123E-01
4.9650E 00	0.	1.1910E 00	6.5064E-01	1.5590E 00	-3.4319E-01
1.7400E 00	0.	5.0980E-01	9.0030E-02	9.0201E-02	-2.2950E-02
3.0000E 00	0.	1.6993E-01	3.0010E-02	3.0067E-02	-7.6501E-03
6.0500E 00	0.	5.0980E-01	9.0030E-02	9.0201E-02	-2.2950E-02
1.2850E 01	0.	1.9117E 00	3.3761E-01	3.3825E-01	-8.6064E-02
3.1750E 01	0.	4.0359E 00	7.1274E-01	7.1409E-01	-1.8169E-01
7.3000E 01	0.	4.7973E 00	9.7681E-01	1.2027E 00	-3.0601E-01
1.3200E 02	0.	4.1960E 00	1.1298E 00	1.8040E 00	-4.5901E-01
2.2800E 02	0.	4.1960E 00	1.1298E 00	1.8040E 00	-4.5901E-01
3.8550E 02	0.	4.1960E 00	1.1298E 00	1.8040E 00	-4.5901E-01
6.4785E 02	0.	4.2901E 00	1.1059E 00	1.7099E 00	-4.3506E-01
8.4325E 02	0.	6.0000E 00	6.7080E-01		

LITHIUM 6

SCATTER
L N1 N2
SGSL(N1,N2)

LI6

0 1 3	0 1 4	0 1 5	0 1 6	0 1 7	0 1 8
6.3175E-02	0.	0.	0.	0.	0.
0 1 9	0 1 10	0 1 11	0 1 12	0 1 13	0 1 14
0.	0.	0.	0.	0.	0.
0 1 15	0 1 16	0 1 17	0 1 18	0 1 19	0 2 4
0.	0.	0.	0.	0.	6.7135E-02
0 2 5	0 2 6	0 2 7	0 2 8	0 2 9	0 2 10
0.	0.	0.	0.	0.	0.
0 2 11	0 2 12	0 2 13	0 2 14	0 2 15	0 2 16
0.	0.	0.	0.	0.	0.
0 2 17	0 2 18	0 2 19	0 3 5	0 3 6	0 3 7
0.	0.	0.	5.8183E-02	0.	0.
0 3 8	0 3 9	0 3 10	0 3 11	0 3 12	0 3 13
0.	0.	0.	0.	0.	0.
0 3 14	0 3 15	0 3 16	0 3 17	0 3 18	0 3 19
0.	0.	0.	0.	0.	0.
0 4 6	0 4 7	0 4 8	0 4 9	0 4 10	0 4 11
3.9764E-02	0.	0.	0.	0.	0.
0 4 12	0 4 13	0 4 14	0 4 15	0 4 16	0 4 17
0.	0.	0.	0.	0.	0.
0 4 18	0 4 19	0 5 7	0 5 8	0 5 9	0 5 10
0.	0.	3.7010E-02	0.	0.	0.
0 5 11	0 5 12	0 5 13	0 5 14	0 5 15	0 5 16
0.	0.	0.	0.	0.	0.
0 5 17	0 5 18	0 5 19	0 6 8	0 6 9	0 6 10
0.	0.	0.	4.8199E-02	0.	0.
0 6 11	0 6 12	0 6 13	0 6 14	0 6 15	0 6 16
0.	0.	0.	0.	0.	0.
0 6 17	0 6 18	0 6 19	0 7 9	0 7 10	0 7 11
0.	0.	0.	1.0380E-01	0.	0.
0 7 12	0 7 13	0 7 14	0 7 15	0 7 16	0 7 17
0.	0.	0.	0.	0.	0.
0 7 18	0 7 19	0 8 10	0 8 11	0 8 12	0 8 13
0.	0.	0.	0.	0.	0.
0 8 14	0 8 15	0 8 16	0 8 17	0 8 18	0 8 19
0.	0.	0.	0.	0.	0.
0 9 11	0 9 12	0 9 13	0 9 14	0 9 15	0 9 16
0.	0.	0.	0.	0.	0.
0 9 17	0 9 18	0 9 19	0 10 12	0 10 13	0 10 14
0.	0.	0.	0.	0.	0.
0 10 15	0 10 16	0 10 17	0 10 18	0 10 19	0 11 13
0.	0.	0.	0.	0.	0.
0 11 14	0 11 15	0 11 16	0 11 17	0 11 18	0 11 19
0.	0.	0.	0.	0.	0.
0 12 14	0 12 15	0 12 16	0 12 17	0 12 18	0 12 19
0.	0.	0.	0.	0.	0.
0 13 15	0 13 16	0 13 17	0 13 18	0 13 19	0 14 16
0.	0.	0.	0.	0.	0.
0 14 17	0 14 18	0 14 19	0 15 17	0 15 18	0 15 19
0.	0.	0.	0.	0.	0.
0 16 18	0 16 19	0 17 19			
0.	0.	0.			

LITHIUM 6

SCATTER
L N1 N2
SGSL(N1,N2)

Li6

1 1 3	1 1 4	1 1 5	1 1 6	1 1 7	1 1 8
-5.1756E-02	0.	0.	0.	0.	0.
1 1 9	1 1 10	1 1 11	1 1 12	1 1 13	1 1 14
0.	0.	0.	0.	0.	0.
1 1 15	1 1 16	1 1 17	1 1 18	1 1 19	1 2 4
0.	0.	0.	0.	0.	-5.5000E-02
1 2 5	1 2 6	1 2 7	1 2 8	1 2 9	1 2 10
0.	0.	0.	0.	0.	0.
1 2 11	1 2 12	1 2 13	1 2 14	1 2 15	1 2 16
0.	0.	0.	0.	0.	0.
1 2 17	1 2 18	1 2 19	1 3 5	1 3 6	1 3 7
0.	0.	0.	-4.7666E-02	0.	0.
1 3 8	1 3 9	1 3 10	1 3 11	1 3 12	1 3 13
0.	0.	0.	0.	0.	0.
1 3 14	1 3 15	1 3 16	1 3 17	1 3 18	1 3 19
0.	0.	0.	0.	0.	0.
1 4 6	1 4 7	1 4 8	1 4 9	1 4 10	1 4 11
-3.2577E-02	0.	0.	0.	0.	0.
1 4 12	1 4 13	1 4 14	1 4 15	1 4 16	1 4 17
0.	0.	0.	0.	0.	0.
1 4 18	1 4 19	1 5 7	1 5 8	1 5 9	1 5 10
0.	0.	-3.0321E-02	0.	0.	0.
1 5 11	1 5 12	1 5 13	1 5 14	1 5 15	1 5 16
0.	0.	0.	0.	0.	0.
1 5 17	1 5 18	1 5 19	1 6 8	1 6 9	1 6 10
0.	0.	0.	-3.9487E-02	0.	0.
1 6 11	1 6 12	1 6 13	1 6 14	1 6 15	1 6 16
0.	0.	0.	0.	0.	0.
1 6 17	1 6 18	1 6 19	1 7 9	1 7 10	1 7 11
0.	0.	0.	-8.5038E-02	0.	0.
1 7 12	1 7 13	1 7 14	1 7 15	1 7 16	1 7 17
0.	0.	0.	0.	0.	0.
1 7 18	1 7 19	1 8 10	1 8 11	1 8 12	1 8 13
0.	0.	0.	0.	0.	0.
1 8 14	1 8 15	1 8 16	1 8 17	1 8 18	1 8 19
0.	0.	0.	0.	0.	0.
1 9 11	1 9 12	1 9 13	1 9 14	1 9 15	1 9 16
0.	0.	0.	0.	0.	0.
1 9 17	1 9 18	1 9 19	1 10 12	1 10 13	1 10 14
0.	0.	0.	0.	0.	0.
1 10 15	1 10 16	1 10 17	1 10 18	1 10 19	1 11 13
0.	0.	0.	0.	0.	0.
1 11 14	1 11 15	1 11 16	1 11 17	1 11 18	1 11 19
0.	0.	0.	0.	0.	0.
1 12 14	1 12 15	1 12 16	1 12 17	1 12 18	1 12 19
0.	0.	0.	0.	0.	0.
1 13 15	1 13 16	1 13 17	1 13 18	1 13 19	1 14 16
0.	0.	0.	0.	0.	0.
1 14 17	1 14 18	1 14 19	1 15 17	1 15 18	1 15 19
0.	0.	0.	0.	0.	0.
1 16 18	1 16 19	1 17 19			
0.	0.	0.			

BORON

B

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
8.0000000E 00	1.0820000E 01	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
4.0433E 00	0.	2.5981E 00	6.5585E-01	1.4019E 00	-4.0745E-01
4.0556E 00	0.	2.5981E 00	6.5585E-01	1.4019E 00	-4.0745E-01
4.0713E 00	0.	2.5981E 00	6.5585E-01	1.4019E 00	-4.0745E-01
4.0917E 00	0.	2.5981E 00	6.5585E-01	1.4019E 00	-4.0745E-01
4.1178E 00	0.	2.5981E 00	6.5585E-01	1.4019E 00	-4.0745E-01
4.1510E 00	0.	2.5981E 00	6.5585E-01	1.4019E 00	-4.0745E-01
4.1940E 00	0.	2.5981E 00	6.5585E-01	1.4019E 00	-4.0745E-01
4.2491E 00	0.	2.5981E 00	6.5585E-01	1.4019E 00	-4.0745E-01
4.5213E 00	0.	3.6495E 00	3.5026E-01	3.5046E-01	-1.0186E-01
5.4156E 00	0.	3.6495E 00	3.5026E-01	3.5046E-01	-1.0186E-01
7.8505E 00	0.	3.6495E 00	3.5026E-01	3.5046E-01	-1.0186E-01
1.4479E 01	0.	3.6495E 00	3.5026E-01	3.5046E-01	-1.0186E-01
3.2463E 01	0.	3.6495E 00	3.5026E-01	3.5046E-01	-1.0186E-01
6.3947E 01	0.	3.5327E 00	3.8422E-01	4.6729E-01	-1.3582E-01
1.1831E 02	0.	3.2991E 00	4.5212E-01	7.0093E-01	-2.0372E-01
1.9245E 02	0.	3.2991E 00	4.5212E-01	7.0093E-01	-2.0372E-01
3.1468E 02	0.	3.2991E 00	4.5212E-01	7.0093E-01	-2.0372E-01
5.2383E 02	0.	3.3356E 00	4.4149E-01	6.6435E-01	-1.9309E-01
6.7359E 02	0.	4.0000E 00	2.4840E-01		

BORON 10

B10

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
8.0200000E 00	1.0016120E 01	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
1.7302E 00	0.	9.3395E-01	2.6327E-01	5.6605E-01	-1.6247E-01
1.9953E 00	0.	1.0585E 00	2.9837E-01	6.4153E-01	-1.8413E-01
2.4285E 00	0.	1.2764E 00	3.5980E-01	7.7360E-01	-2.2204E-01
2.6622E 00	0.	1.3542E 00	3.8174E-01	8.2078E-01	-2.3558E-01
3.2256E 00	0.	1.6188E 00	4.5633E-01	9.8116E-01	-2.8161E-01
4.7770E 00	0.	2.4750E 00	6.9766E-01	1.5000E 00	-4.3054E-01
5.8556E 00	0.	3.0042E 00	8.4684E-01	1.8208E 00	-5.2260E-01
6.1983E 00	0.	3.0353E 00	8.5562E-01	1.8397E 00	-5.2802E-01
7.7689E 00	0.	4.5283E 00	4.7139E-01	4.7171E-01	-1.3539E-01
1.2569E 01	0.	4.5736E 00	4.7610E-01	4.7643E-01	-1.3674E-01
2.5201E 01	0.	4.3019E 00	4.4782E-01	4.4812E-01	-1.2862E-01
5.9909E 01	0.	3.8490E 00	4.0068E-01	4.0095E-01	-1.1508E-01
1.5518E 02	0.	3.6226E 00	3.7711E-01	3.7737E-01	-1.0831E-01
3.2239E 02	0.	3.4968E 00	4.1322E-01	5.0316E-01	-1.4441E-01
6.1111E 02	0.	3.2453E 00	4.8542E-01	7.5474E-01	-2.1662E-01
1.0049E 03	0.	3.2453E 00	4.8542E-01	7.5474E-01	-2.1662E-01
1.6541E 03	0.	3.2453E 00	4.8542E-01	7.5474E-01	-2.1662E-01
2.7649E 03	0.	3.2847E 00	4.7412E-01	7.1535E-01	-2.0532E-01
3.5604E 03	0.	4.0000E 00	2.6880E-01		

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
3.3000000E 00	1.2014000E 01	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
1.4250E 00	0.	9.7196E-01	2.1343E-01	4.5304E-01	-1.3363E-01
1.4750E 00	0.	1.0061E 00	2.2092E-01	4.6894E-01	-1.3832E-01
1.8500E 00	0.	1.2618E 00	2.7709E-01	5.8816E-01	-1.7349E-01
2.0250E 00	0.	1.3812E 00	3.0329E-01	6.4380E-01	-1.8989E-01
2.5250E 00	0.	1.7222E 00	3.7818E-01	8.0276E-01	-2.3678E-01
3.1350E 00	0.	2.1383E 00	4.6955E-01	9.9669E-01	-2.9399E-01
3.6250E 00	0.	2.4725E 00	5.4294E-01	1.1525E 00	-3.3994E-01
4.0150E 00	0.	2.7385E 00	6.0135E-01	1.2765E 00	-3.7651E-01
4.4500E 00	0.	4.0963E 00	3.5353E-01	3.5369E-01	-1.0433E-01
4.7000E 00	0.	4.3264E 00	3.7339E-01	3.7356E-01	-1.1019E-01
4.7000E 00	0.	4.3264E 00	3.7339E-01	3.7356E-01	-1.1019E-01
4.7000E 00	0.	4.3264E 00	3.7339E-01	3.7356E-01	-1.1019E-01
4.7001E 00	0.	4.3264E 00	3.7339E-01	3.7356E-01	-1.1019E-01
4.7503E 00	0.	4.2466E 00	4.1448E-01	5.0338E-01	-1.4848E-01
4.8005E 00	0.	4.0370E 00	4.9386E-01	7.6302E-01	-2.2506E-01
4.8008E 00	0.	4.0370E 00	4.9386E-01	7.6302E-01	-2.2506E-01
4.8013E 00	0.	4.0370E 00	4.9386E-01	7.6302E-01	-2.2506E-01
4.8429E 00	0.	4.1114E 00	4.8621E-01	7.2934E-01	-2.1513E-01
4.6798E 00	0.	4.6770E 00	2.6191E-01		

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
6.3000000E 00	1.4008000E 01	0.	2.9316000E 02

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGSQ(N,N)	SGS1(N,N)	SGSQ(N,N+1)	SGS1(N,N+1)
1.8651E 00	0.	1.3528E 00	2.4348E-01	5.1222E-01	-1.5396E-01
1.8501E 00	0.	1.3419E 00	2.4152E-01	5.0810E-01	-1.5272E-01
1.7252E 00	0.	1.2512E 00	2.2521E-01	4.7377E-01	-1.4241E-01
1.9252E 00	0.	1.3963E 00	2.5132E-01	5.2869E-01	-1.5892E-01
1.7753E 00	0.	1.2875E 00	2.3173E-01	4.8750E-01	-1.4653E-01
2.0004E 00	0.	1.4507E 00	2.6111E-01	5.4929E-01	-1.6511E-01
2.9255E 00	0.	2.1217E 00	3.8187E-01	8.0334E-01	-2.4147E-01
3.5756E 00	0.	2.5931E 00	4.6673E-01	9.8186E-01	-2.9513E-01
4.6513E 00	0.	4.3307E 00	3.1917E-01	3.1928E-01	-9.5969E-02
5.5785E 00	0.	5.1922E 00	3.8266E-01	3.8279E-01	-1.1506E-01
7.5296E 00	0.	7.0037E 00	5.1616E-01	5.1634E-01	-1.5520E-01
9.6261E 00	0.	8.9408E 00	6.5893E-01	6.5915E-01	-1.9813E-01
1.0026E 01	0.	9.2715E 00	6.8330E-01	6.8353E-01	-2.0545E-01
1.0144E 01	0.	9.0800E 00	7.5480E-01	9.1503E-01	-2.7504E-01
1.0330E 01	0.	8.6656E 00	8.9679E-01	1.3794E 00	-4.1463E-01
1.0534E 01	0.	8.6828E 00	8.9857E-01	1.3822E 00	-4.1545E-01
1.0924E 01	0.	8.7562E 00	9.0616E-01	1.3938E 00	-4.1896E-01
1.1791E 01	0.	9.1307E 00	9.1453E-01	1.3663E 00	-4.1067E-01
1.2601E 01	0.	1.0934E 01	5.2483E-01		

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
3.6000000E 00	1.6004000E 01	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
6.8000E-01	0.	5.1562E-01	7.8657E-02	1.6438E-01	-5.0097E-02
1.6500E 00	0.	1.2511E 00	1.9086E-01	3.9886E-01	-1.2156E-01
1.6700E 00	0.	1.2663E 00	1.9318E-01	4.0370E-01	-1.2304E-01
1.8800E 00	0.	1.4255E 00	2.1746E-01	4.5446E-01	-1.3850E-01
4.0150E 00	0.	3.0444E 00	4.6442E-01	9.7056E-01	-2.9579E-01
4.6850E 00	0.	3.5525E 00	5.4193E-01	1.1325E 00	-3.4516E-01
3.8750E 00	0.	2.9383E 00	4.4824E-01	9.3672E-01	-2.8549E-01
3.7500E 00	0.	2.8435E 00	4.3377E-01	9.0650E-01	-2.7627E-01
3.7500E 00	0.	3.5234E 00	2.2657E-01	2.2663E-01	-6.9067E-02
3.7500E 00	0.	3.5234E 00	2.2657E-01	2.2663E-01	-6.9067E-02
3.7500E 00	0.	3.5234E 00	2.2657E-01	2.2663E-01	-6.9067E-02
3.7500E 00	0.	3.4478E 00	2.4959E-01	3.0217E-01	-9.2090E-02
3.7500E 00	0.	3.2967E 00	2.9563E-01	4.5325E-01	-1.3813E-01
3.7500E 00	0.	3.2967E 00	2.9563E-01	4.5325E-01	-1.3813E-01
3.7751E 00	0.	3.3187E 00	2.9761E-01	4.5627E-01	-1.3906E-01
3.9631E 00	0.	3.5089E 00	3.0480E-01	4.5399E-01	-1.3836E-01
4.1626E 00	0.	4.1624E 00	1.7482E-01		

FLUORINE

F

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)	
6.0000000E 00	1.9000000E 01	0.	2.9316000E 02	0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
1.0750E 00	0.	8.5455E-01	1.0625E-01	2.2045E-01	-6.8195E-02
1.3000E 00	0.	1.0334E 00	1.2849E-01	2.6659E-01	-8.2469E-02
1.8000E 00	0.	1.4309E 00	1.7791E-01	3.6913E-01	-1.1419E-01
2.4250E 00	0.	1.9277E 00	2.3968E-01	4.9730E-01	-1.5384E-01
2.6500E 00	0.	2.1066E 00	2.6192E-01	5.4344E-01	-1.6811E-01
4.2000E 00	0.	3.3387E 00	4.1512E-01	8.6131E-01	-2.6644E-01
7.0750E 00	0.	5.6241E 00	6.9926E-01	1.4509E 00	-4.4881E-01
7.9000E 00	0.	6.2799E 00	7.8080E-01	1.6201E 00	-5.0114E-01
5.6250E 00	0.	5.3366E 00	2.8833E-01	2.8838E-01	-8.9206E-02
3.6500E 00	0.	3.4629E 00	1.8710E-01	1.8713E-01	-5.7885E-02
3.4501E 00	0.	3.2731E 00	1.7684E-01	1.7688E-01	-5.4715E-02
3.4001E 00	0.	3.2257E 00	1.7428E-01	1.7431E-01	-5.3921E-02
3.4004E 00	0.	3.2257E 00	1.7428E-01	1.7431E-01	-5.3921E-02
3.4008E 00	0.	3.1676E 00	1.9226E-01	2.3242E-01	-7.1895E-02
3.4015E 00	0.	3.0514E 00	2.2820E-01	3.4862E-01	-1.0784E-01
3.4525E 00	0.	3.0962E 00	2.3156E-01	3.5375E-01	-1.0943E-01
3.5041E 00	0.	3.1411E 00	2.3492E-01	3.5888E-01	-1.1102E-01
3.6983E 00	0.	3.3327E 00	2.4165E-01	3.5875E-01	-1.1098E-01
3.8339E 00	0.	3.8250E 00	1.3541E-01		

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
7.3000000E 00	2.2991000E 01	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
2.1750E 00	0.	1.8048E 00	1.7960E-01	3.7017E-01	-1.1609E-01
2.3250E 00	0.	1.9293E 00	1.9198E-01	3.9570E-01	-1.2409E-01
2.7000E 00	0.	2.2405E 00	2.2295E-01	4.5952E-01	-1.4411E-01
2.3001E 00	0.	1.9086E 00	1.8992E-01	3.9144E-01	-1.2276E-01
3.6501E 00	0.	3.0288E 00	3.0140E-01	6.2120E-01	-1.9482E-01
5.1001E 00	0.	4.2320E 00	4.2113E-01	8.6798E-01	-2.7221E-01
3.7501E 00	0.	3.1118E 00	3.0966E-01	6.3822E-01	-2.0016E-01
3.9502E 00	0.	3.2777E 00	3.2617E-01	6.7226E-01	-2.1083E-01
4.2003E 00	0.	4.0213E 00	1.7868E-01	1.7870E-01	-5.6044E-02
2.5251E 01	0.	2.4176E 01	1.0742E 00	1.0743E 00	-3.3691E-01
2.5003E 01	0.	2.3936E 01	1.0636E 00	1.0637E 00	-3.3358E-01
3.0570E 00	0.	2.9202E 00	1.2976E-01	1.2977E-01	-4.0697E-02
3.1440E 00	0.	2.9920E 00	1.3295E-01	1.3296E-01	-4.1696E-02
3.2151E 00	0.	2.9949E 00	1.4920E-01	1.8012E-01	-5.6485E-02
3.3215E 00	0.	2.9689E 00	1.8135E-01	2.7614E-01	-8.6597E-02
3.4410E 00	0.	3.0329E 00	1.8526E-01	2.8209E-01	-8.8462E-02
3.5428E 00	0.	3.0512E 00	1.8638E-01	2.8380E-01	-8.9001E-02
3.6736E 00	0.	3.0577E 00	1.8124E-01	2.6825E-01	-8.4124E-02
3.8229E 00	0.	3.3750E 00	9.8550E-02		

MAGNESIUM

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
5.1400000E 00	2.4320000E 01	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SGS0(N,N)	SCATTER SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
1.6250E 00	0.	1.3632E 00	1.2725E-01	2.6182E-01	-8.2399E-02
1.7500E 00	0.	1.4680E 00	1.3704E-01	2.8196E-01	-8.8736E-02
2.2750E 00	0.	1.9084E 00	1.7815E-01	3.6655E-01	-1.1536E-01
2.6750E 00	0.	2.2440E 00	2.0946E-01	4.3100E-01	-1.3563E-01
2.9750E 00	0.	2.4957E 00	2.3296E-01	4.7934E-01	-1.5085E-01
4.3000E 00	0.	3.6072E 00	3.3671E-01	6.9282E-01	-2.1802E-01
6.8250E 00	0.	5.7253E 00	5.3444E-01	1.0997E 00	-3.4607E-01
8.7250E 00	0.	7.3192E 00	6.8325E-01	1.4058E 00	-4.4244E-01
6.2500E 00	0.	5.9982E 00	2.5172E-01	2.5175E-01	-7.9224E-02
3.4001E 00	0.	3.2630E 00	1.3694E-01	1.3695E-01	-4.3098E-02
3.4003E 00	0.	3.2630E 00	1.3694E-01	1.3695E-01	-4.3098E-02
3.4009E 00	0.	3.2630E 00	1.3694E-01	1.3695E-01	-4.3098E-02
3.4024E 00	0.	3.2630E 00	1.3694E-01	1.3695E-01	-4.3098E-02
3.4050E 00	0.	3.2174E 00	1.5130E-01	1.8260E-01	-5.7464E-02
3.4095E 00	0.	3.1261E 00	1.8004E-01	2.7391E-01	-8.6196E-02
3.4157E 00	0.	3.1261E 00	1.8004E-01	2.7391E-01	-8.6196E-02
3.4259E 00	0.	3.1261E 00	1.8004E-01	2.7391E-01	-8.6196E-02
3.3212E 00	0.	3.0275E 00	1.6923E-01	2.5028E-01	-7.8760E-02
3.1951E 00	0.	3.1392E 00	8.6642E-02		

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
5.5000000E 00	2.8090000E 01	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
1.8600E 00	0.	1.5985E 00	1.2758E-01	2.6152E-01	-8.2945E-02
2.1650E 00	0.	1.8606E 00	1.4851E-01	3.0441E-01	-9.6551E-02
2.6450E 00	0.	2.2731E 00	1.8144E-01	3.7190E-01	-1.1796E-01
3.2900E 00	0.	2.8274E 00	2.2566E-01	4.6259E-01	-1.4670E-01
3.5000E 00	0.	3.0079E 00	2.4010E-01	4.9212E-01	-1.5610E-01
3.3050E 00	0.	2.8403E 00	2.2671E-01	4.6470E-01	-1.4739E-01
3.5250E 00	0.	3.0294E 00	2.4178E-01	4.9563E-01	-1.5718E-01
3.6200E 00	0.	3.1110E 00	2.4829E-01	5.0899E-01	-1.6141E-01
2.5251E 00	0.	2.4362E 00	8.8753E-02	8.8757E-02	-2.8153E-02
1.8252E 00	0.	1.7608E 00	6.4148E-02	6.4151E-02	-2.0348E-02
2.0257E 00	0.	1.9538E 00	7.1176E-02	7.1181E-02	-2.2576E-02
2.1018E 00	0.	2.0262E 00	7.3812E-02	7.3817E-02	-2.3412E-02
2.1949E 00	0.	2.1130E 00	7.6976E-02	7.6981E-02	-2.4416E-02
2.2403E 00	0.	2.1255E 00	8.6671E-02	1.0452E-01	-3.3151E-02
2.2447E 00	0.	2.0686E 00	1.0301E-01	1.5642E-01	-4.9606E-02
2.2474E 00	0.	2.0593E 00	1.0254E-01	1.5572E-01	-4.9384E-02
2.2485E 00	0.	2.0407E 00	1.0162E-01	1.5431E-01	-4.8941E-02
2.2451E 00	0.	2.0122E 00	9.7129E-02	1.4340E-01	-4.5482E-02
2.2353E 00	0.	2.1200E 00	5.0668E-02		

PHOSPHOROUS

P

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
6.2000000E 00	3.0975000E 01	0.	2.9316000E 02

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
2.2000E 00	0.	1.9197E 00	1.3709E-01	2.8032E-01	-8.9349E-02
2.5000E 00	0.	2.1815E 00	1.5578E-01	3.1855E-01	-1.0153E-01
2.9000E 00	0.	2.5305E 00	1.8070E-01	3.6952E-01	-1.1777E-01
3.0750E 00	0.	2.6832E 00	1.9161E-01	3.9182E-01	-1.2489E-01
2.8500E 00	0.	2.4869E 00	1.7759E-01	3.6315E-01	-1.1574E-01
2.8000E 00	0.	2.4432E 00	1.7448E-01	3.5677E-01	-1.1372E-01
2.9000E 00	0.	2.5305E 00	1.8070E-01	3.6952E-01	-1.1777E-01
2.9751E 00	0.	2.5959E 00	1.8537E-01	3.7907E-01	-1.2081E-01
3.2501E 00	0.	3.1465E 00	1.0352E-01	1.0353E-01	-3.2991E-02
3.4004E 00	0.	3.2917E 00	1.0830E-01	1.0831E-01	-3.4519E-02
3.4010E 00	0.	3.2917E 00	1.0830E-01	1.0831E-01	-3.4519E-02
3.4026E 00	0.	3.2917E 00	1.0830E-01	1.0831E-01	-3.4519E-02
3.4072E 00	0.	3.2917E 00	1.0830E-01	1.0831E-01	-3.4519E-02
3.4151E 00	0.	3.2556E 00	1.1981E-01	1.4441E-01	-4.6025E-02
3.4288E 00	0.	3.1834E 00	1.4282E-01	2.1661E-01	-6.9038E-02
3.4474E 00	0.	3.1834E 00	1.4282E-01	2.1661E-01	-6.9038E-02
3.5282E 00	0.	3.2302E 00	1.4492E-01	2.1980E-01	-7.0051E-02
3.8345E 00	0.	3.4800E 00	1.5165E-01	2.2365E-01	-7.1284E-02
3.9665E 00	0.	3.7980E 00	8.2417E-02		

SULFUR

5

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
6.1000000E 00	3.2066000E 01	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
2.1750E 00	0.	1.5560E 00	1.0718E-01	2.1903E-01	-6.9904E-02
2.7000E 00	0.	2.0162E 00	1.3887E-01	2.8381E-01	-9.0574E-02
2.9600E 00	0.	2.3668E 00	1.6304E-01	3.3317E-01	-1.0634E-01
2.6470E 00	0.	2.2573E 00	1.5551E-01	3.1774E-01	-1.0143E-01
2.1620E 00	0.	1.8847E 00	1.2983E-01	2.6530E-01	-8.4676E-02
2.6751E 00	0.	2.3449E 00	1.6152E-01	3.3008E-01	-1.0535E-01
2.4251E 00	0.	2.1258E 00	1.4644E-01	2.9923E-01	-9.5512E-02
3.2502E 00	0.	2.8490E 00	1.9625E-01	4.0103E-01	-1.2800E-01
3.0003E 00	0.	2.9075E 00	9.2537E-02	9.2546E-02	-2.9537E-02
1.0009E 00	0.	9.6915E-01	3.0846E-02	3.0849E-02	-9.8458E-03
1.0025E 00	0.	9.6915E-01	3.0846E-02	3.0849E-02	-9.8458E-03
1.0068E 00	0.	9.6915E-01	3.0846E-02	3.0849E-02	-9.8458E-03
1.0185E 00	0.	9.6915E-01	3.0846E-02	3.0849E-02	-9.8458E-03
1.0421E 00	0.	9.5887E-01	3.4128E-02	4.1132E-02	-1.3128E-02
1.0958E 00	0.	9.5707E-01	4.1506E-02	6.2931E-02	-2.0086E-02
1.1650E 00	0.	9.7583E-01	4.2320E-02	6.4165E-02	-2.0480E-02
1.2460E 00	0.	9.7583E-01	4.2320E-02	6.4165E-02	-2.0480E-02
1.4404E 00	0.	1.0252E 00	4.3191E-02	6.3675E-02	-2.0324E-02
1.4972E 00	0.	1.0626E 00	2.2315E-02		

POTASSIUM

K

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)	
7.4000000E 00	3.9110999E 01	0.	2.9316000E 02	0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
2.7801E 00	0.	2.4980E 00	1.3860E-01	2.8203E-01	-9.0784E-02
3.2051E 00	0.	2.8799E 00	1.5980E-01	3.2514E-01	-1.0467E-01
3.3502E 00	0.	3.0102E 00	1.6699E-01	3.3985E-01	-1.0937E-01
3.1402E 00	0.	2.8215E 00	1.5650E-01	3.1854E-01	-1.0249E-01
2.6653E 00	0.	2.3946E 00	1.3284E-01	2.7036E-01	-8.7001E-02
2.1904E 00	0.	1.9678E 00	1.0916E-01	2.2217E-01	-7.1494E-02
1.8905E 00	0.	1.6983E 00	9.4214E-02	1.9174E-01	-6.1706E-02
2.0507E 00	0.	1.8420E 00	1.0217E-01	2.0797E-01	-6.6908E-02
1.9014E 00	0.	1.8518E 00	4.8182E-02	4.8187E-02	-1.5502E-02
1.5137E 00	0.	1.4717E 00	3.8297E-02	3.8296E-02	-1.2325E-02
1.6050E 00	0.	1.5545E 00	4.0450E-02	4.0452E-02	-1.3016E-02
1.7873E 00	0.	1.7154E 00	4.4635E-02	4.4637E-02	-1.4363E-02
2.0193E 00	0.	1.8957E 00	4.9333E-02	4.9329E-02	-1.5879E-02
2.2014E 00	0.	1.9758E 00	5.7430E-02	6.9153E-02	-2.2256E-02
2.3483E 00	0.	1.9460E 00	6.8714E-02	1.0398E-01	-3.3454E-02
2.5667E 00	0.	1.9697E 00	6.9549E-02	1.0525E-01	-3.3859E-02
2.9607E 00	0.	2.0409E 00	7.2081E-02	1.0906E-01	-3.5101E-02
3.6175E 00	0.	2.1524E 00	7.3876E-02	1.0871E-01	-3.4985E-02
4.0087E 00	0.	2.2615E 00	3.8898E-02		

CALCIUM

CA

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
5.4000000E 00	4.0080000E 01	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
3.0000E 00	0.	2.7026E 00	1.4618E-01	2.9738E-01	-9.5783E-02
3.0000E 00	0.	2.7026E 00	1.4618E-01	2.9738E-01	-9.5783E-02
3.0000E 00	0.	2.7026E 00	1.4618E-01	2.9738E-01	-9.5783E-02
3.0001E 00	0.	2.7026E 00	1.4618E-01	2.9738E-01	-9.5783E-02
3.0001E 00	0.	2.7026E 00	1.4618E-01	2.9738E-01	-9.5783E-02
3.0001E 00	0.	2.7026E 00	1.4618E-01	2.9738E-01	-9.5783E-02
3.0001E 00	0.	2.7026E 00	1.4618E-01	2.9738E-01	-9.5783E-02
3.0001E 00	0.	2.7026E 00	1.4618E-01	2.9738E-01	-9.5783E-02
3.0003E 00	0.	2.9257E 00	7.4346E-02	7.4346E-02	-2.3946E-02
3.0008E 00	0.	2.9257E 00	7.4346E-02	7.4346E-02	-2.3946E-02
3.0022E 00	0.	2.9257E 00	7.4346E-02	7.4346E-02	-2.3946E-02
3.0060E 00	0.	2.9257E 00	7.4346E-02	7.4346E-02	-2.3946E-02
3.0162E 00	0.	2.9257E 00	7.4346E-02	7.4346E-02	-2.3946E-02
3.0341E 00	0.	2.9009E 00	8.2328E-02	9.9128E-02	-3.1928E-02
3.0651E 00	0.	2.8513E 00	9.8291E-02	1.4869E-01	-4.7891E-02
3.1073E 00	0.	2.8513E 00	9.8291E-02	1.4869E-01	-4.7891E-02
3.1769E 00	0.	2.8513E 00	9.8291E-02	1.4869E-01	-4.7891E-02
3.2961E 00	0.	2.8591E 00	9.5792E-02	1.4093E-01	-4.5392E-02
3.3814E 00	0.	3.0000E 00	5.0400E-02		

SCANDIUM

SC

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
5.6000000E 00	4.4959999E 01	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
2.8014E 00	0.	2.5517E 00	1.2227E-01	2.4826E-01	-8.0266E-02
2.8018E 00	0.	2.5517E 00	1.2227E-01	2.4826E-01	-8.0266E-02
2.8023E 00	0.	2.5517E 00	1.2227E-01	2.4826E-01	-8.0266E-02
2.8029E 00	0.	2.5517E 00	1.2227E-01	2.4826E-01	-8.0266E-02
2.8037E 00	0.	2.5517E 00	1.2227E-01	2.4826E-01	-8.0266E-02
2.8048E 00	0.	2.5517E 00	1.2227E-01	2.4826E-01	-8.0266E-02
2.8062E 00	0.	2.5517E 00	1.2227E-01	2.4826E-01	-8.0266E-02
2.8079E 00	0.	2.5517E 00	1.2227E-01	2.4826E-01	-8.0266E-02
3.2166E 00	0.	3.1291E 00	7.0927E-02	7.0932E-02	-2.2927E-02
1.1595E 01	0.	1.1294E 01	2.5600E-01	2.5602E-01	-8.2747E-02
1.1372E 01	0.	1.1001E 01	2.4937E-01	2.4937E-01	-8.0617E-02
1.0833E 01	0.	1.0267E 01	2.3275E-01	2.3275E-01	-7.5252E-02
2.1655E 01	0.	2.0290E 01	4.5997E-01	4.5995E-01	-1.4872E-01
2.5656E 01	0.	2.3048E 01	5.8313E-01	7.0193E-01	-2.2688E-01
2.7634E 01	0.	2.2936E 01	7.0402E-01	1.0640E 00	-3.4402E-01
2.9990E 01	0.	2.2936E 01	7.0402E-01	1.0640E 00	-3.4402E-01
3.4276E 01	0.	2.3318E 01	7.1563E-01	1.0817E 00	-3.4963E-01
4.1487E 01	0.	2.3914E 01	7.1357E-01	1.0489E 00	-3.3913E-01
4.7328E 01	0.	2.6049E 01	3.9074E-01		

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
4.3000000E 00	4.7900000E 01	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
6.0003E 00	0.	5.5030E 00	2.4505E-01	4.9702E-01	-1.6105E-01
6.8004E 00	0.	6.2367E 00	2.7774E-01	5.6329E-01	-1.8254E-01
7.4005E 00	0.	6.7870E 00	3.0216E-01	6.1299E-01	-1.9856E-01
7.2007E 00	0.	6.6036E 00	2.9407E-01	5.9642E-01	-1.9327E-01
6.9509E 00	0.	6.3743E 00	2.8380E-01	5.7571E-01	-1.8650E-01
5.7011E 00	0.	5.2278E 00	2.3277E-01	4.7217E-01	-1.5297E-01
4.5014E 00	0.	4.1272E 00	1.8372E-01	3.7276E-01	-1.2072E-01
6.1518E 00	0.	5.6406E 00	2.5114E-01	5.0944E-01	-1.6504E-01
2.1504E 01	0.	2.1055E 01	4.4525E-01	4.4525E-01	-1.4425E-01
2.1710E 01	0.	2.1251E 01	4.4937E-01	4.4939E-01	-1.4557E-01
5.2736E 00	0.	5.8219E 00	1.2312E-01	1.2312E-01	-3.9894E-02
4.3177E 00	0.	4.1522E 00	8.7803E-02	8.7806E-02	-2.8443E-02
4.3211E 00	0.	4.0249E 00	8.5123E-02	8.5114E-02	-2.7583E-02
4.5346E 00	0.	3.9771E 00	9.3856E-02	1.1293E-01	-3.6596E-02
4.9978E 00	0.	3.9781E 00	1.1377E-01	1.7188E-01	-5.5674E-02
5.5728E 00	0.	4.0021E 00	1.1446E-01	1.7292E-01	-5.6008E-02
6.5394E 00	0.	4.0596E 00	1.1612E-01	1.7541E-01	-5.6829E-02
8.4149E 00	0.	4.3802E 00	1.2181E-01	1.7898E-01	-5.7978E-02
9.9310E 00	0.	4.9640E 00	6.9496E-02		

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
4.2000000E 00	5.2010000E 01	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
1.4002E 00	0.	1.2930E 00	5.2813E-02	1.0698E-01	-3.4753E-02
1.4002E 00	0.	1.2930E 00	5.2813E-02	1.0698E-01	-3.4753E-02
1.4003E 00	0.	1.2930E 00	5.2813E-02	1.0698E-01	-3.4753E-02
1.4004E 00	0.	1.2930E 00	5.2813E-02	1.0698E-01	-3.4753E-02
1.4505E 00	0.	1.3392E 00	5.4682E-02	1.1080E-01	-3.5977E-02
1.5506E 00	0.	1.4316E 00	5.8463E-02	1.1844E-01	-3.8468E-02
1.6507E 00	0.	1.5239E 00	6.2239E-02	1.2608E-01	-4.0954E-02
1.8010E 00	0.	1.6625E 00	6.7887E-02	1.3754E-01	-4.4667E-02
2.7520E 00	0.	2.6975E 00	5.2541E-02	5.2533E-02	-1.7066E-02
7.6554E 00	0.	7.5039E 00	1.4616E-01	1.4614E-01	-4.7474E-02
8.0148E 00	0.	7.8472E 00	1.5283E-01	1.5282E-01	-4.9635E-02
4.2403E 00	0.	4.1198E 00	8.0229E-02	8.0232E-02	-2.6049E-02
4.1593E 00	0.	3.9726E 00	7.7372E-02	7.7366E-02	-2.5127E-02
4.2803E 00	0.	3.9468E 00	8.5747E-02	1.0316E-01	-3.3502E-02
4.4891E 00	0.	3.8953E 00	1.0250E-01	1.5473E-01	-5.0254E-02
4.8238E 00	0.	3.9434E 00	1.0380E-01	1.5664E-01	-5.0906E-02
5.3933E 00	0.	4.0395E 00	1.0628E-01	1.6046E-01	-5.2103E-02
6.2374E 00	0.	4.0872E 00	1.0458E-01	1.5356E-01	-4.9871E-02
6.8410E 00	0.	4.2690E 00	5.5070E-02		

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
4.4000000E 00	5.4940000E 01	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
3.3508E 00	0.	3.1077E 00	1.1963E-01	2.4226E-01	-7.8759E-02
3.7010E 00	0.	3.4324E 00	1.3221E-01	2.6757E-01	-8.7070E-02
3.7012E 00	0.	3.4324E 00	1.3221E-01	2.6757E-01	-8.7070E-02
3.5516E 00	0.	3.2933E 00	1.2680E-01	2.5672E-01	-8.3493E-02
3.3771E 00	0.	3.1309E 00	1.2059E-01	2.4407E-01	-7.9420E-02
3.2526E 00	0.	3.0150E 00	1.1613E-01	2.3503E-01	-7.6481E-02
3.5784E 00	0.	3.3165E 00	1.2767E-01	2.5853E-01	-8.4057E-02
3.9044E 00	0.	3.6180E 00	1.3929E-01	2.8203E-01	-9.1713E-02
7.2091E 00	0.	7.0698E 00	1.3019E-01	1.3017E-01	-4.2349E-02
1.0927E 02	0.	1.0727E 02	1.9751E 00	1.9751E 00	-6.4226E-01
1.3407E 02	0.	1.3158E 02	2.4228E 00	2.4226E 00	-7.8802E-01
3.1733E 01	0.	3.0980E 01	5.7051E-01	5.7039E-01	-1.8560E-01
3.1576E 00	0.	2.6119E 00	4.8090E-02	4.8090E-02	-1.5638E-02
3.2531E 00	0.	2.1518E 00	4.4181E-02	5.3151E-02	-1.7280E-02
4.1985E 00	0.	2.1205E 00	5.2717E-02	7.9547E-02	-2.5877E-02
5.6797E 00	0.	2.2988E 00	5.7142E-02	8.6236E-02	-2.8045E-02
8.1868E 00	0.	2.6554E 00	6.6023E-02	9.9615E-02	-3.2412E-02
1.1937E 01	0.	2.7506E 00	6.6516E-02	9.7609E-02	-3.1768E-02
1.4273E 01	0.	2.5630E 00	3.1269E-02		

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)	
4.0000000E 00	5.5850000E 01	0.	2.9316000E 02	0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SGS0(N,N)	SCATTER SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
2.6301E 00	0.	2.4429E 00	9.2471E-02	1.8711E-01	-6.0911E-02
2.9202E 00	0.	2.7123E 00	1.0269E-01	2.0774E-01	-6.7655E-02
3.1402E 00	0.	2.9166E 00	1.1048E-01	2.2339E-01	-7.2796E-02
2.9103E 00	0.	2.7030E 00	1.0232E-01	2.0703E-01	-6.7402E-02
2.4204E 00	0.	2.2478E 00	8.5121E-02	1.7217E-01	-5.6081E-02
2.9005E 00	0.	2.6937E 00	1.0199E-01	2.0632E-01	-6.7187E-02
3.6207E 00	0.	3.3625E 00	1.2736E-01	2.5754E-01	-8.3924E-02
3.6808E 00	0.	3.4182E 00	1.2941E-01	2.6181E-01	-8.5253E-02
4.2417E 00	0.	4.1646E 00	7.5444E-02	7.5413E-02	-2.4564E-02
5.4997E 00	0.	5.3973E 00	9.7769E-02	9.7735E-02	-3.1829E-02
8.0579E 00	0.	7.9019E 00	1.4316E-01	1.4309E-01	-4.6617E-02
1.0550E 01	0.	1.0328E 01	1.8712E-01	1.8702E-01	-6.0939E-02
1.1200E 01	0.	1.0907E 01	1.9756E-01	1.9751E-01	-6.4298E-02
1.1231E 01	0.	1.0768E 01	2.1759E-01	2.6158E-01	-8.5229E-02
1.1338E 01	0.	1.0565E 01	2.5835E-01	3.8969E-01	-1.2689E-01
1.1421E 01	0.	1.0406E 01	2.5446E-01	3.8382E-01	-1.2498E-01
1.1676E 01	0.	1.0257E 01	2.5085E-01	3.7831E-01	-1.2323E-01
1.2383E 01	0.	1.0282E 01	2.4453E-01	3.5876E-01	-1.1684E-01
1.2847E 01	0.	1.0603E 01	1.2724E-01		

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
4.1000000E 00	5.8690000E 01	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SGS0(N,N)	SCATTER SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
2.8003E 00	0.	2.6090E 00	9.4440E-02	1.9100E-01	-6.2240E-02
3.0003E 00	0.	2.7954E 00	1.0114E-01	2.0464E-01	-6.6642E-02
3.1004E 00	0.	2.8885E 00	1.0451E-01	2.1146E-01	-6.8859E-02
3.0506E 00	0.	2.8419E 00	1.0287E-01	2.0805E-01	-6.7795E-02
3.2007E 00	0.	2.9817E 00	1.0804E-01	2.1829E-01	-7.1242E-02
3.6009E 00	0.	3.3544E 00	1.2147E-01	2.4557E-01	-8.0073E-02
4.6012E 00	0.	4.2862E 00	1.5517E-01	3.1378E-01	-1.0227E-01
5.6515E 00	0.	5.2646E 00	1.9061E-01	3.8541E-01	-1.2563E-01
9.0032E 00	0.	8.8465E 00	1.5348E-01	1.5348E-01	-4.9984E-02
1.5059E 01	0.	1.4793E 01	2.5666E-01	2.5665E-01	-8.3585E-02
1.8623E 01	0.	1.8283E 01	3.1719E-01	3.1719E-01	-1.0329E-01
1.9364E 01	0.	1.8971E 01	3.2924E-01	3.2913E-01	-1.0729E-01
1.9673E 01	0.	1.9167E 01	3.3270E-01	3.3254E-01	-1.0845E-01
1.9765E 01	0.	1.8959E 01	3.6699E-01	4.4112E-01	-1.4389E-01
1.9646E 01	0.	1.8304E 01	4.2859E-01	6.4633E-01	-2.1066E-01
1.9848E 01	0.	1.8062E 01	4.2321E-01	6.3781E-01	-2.0816E-01
1.9293E 01	0.	1.6807E 01	3.9367E-01	5.9346E-01	-1.9357E-01
1.9471E 01	0.	1.5777E 01	3.5929E-01	5.2705E-01	-1.7180E-01
2.0899E 01	0.	1.6819E 01	1.9342E-01		

COPPER

CU

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
8.3599999E 00	6.3540000E 01	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
3.6902E 00	0.	3.4578E 00	1.1497E-01	2.3222E-01	-7.5855E-02
3.7603E 00	0.	3.5234E 00	1.1718E-01	2.3662E-01	-7.7326E-02
3.2603E 00	0.	3.0548E 00	1.0162E-01	2.0516E-01	-6.7060E-02
3.1354E 00	0.	2.9377E 00	9.7647E-02	1.9729E-01	-6.4416E-02
3.4856E 00	0.	3.2657E 00	1.0854E-01	2.1932E-01	-7.1603E-02
4.0357E 00	0.	3.7811E 00	1.2580E-01	2.5393E-01	-8.3031E-02
4.6509E 00	0.	4.3574E 00	1.4493E-01	2.9263E-01	-9.5641E-02
5.2562E 00	0.	4.9243E 00	1.6364E-01	3.3070E-01	-1.0794E-01
6.6675E 00	0.	6.5601E 00	1.0491E-01	1.0486E-01	-3.4263E-02
9.7069E 00	0.	9.5474E 00	1.5268E-01	1.5261E-01	-4.9862E-02
9.5688E 00	0.	9.3998E 00	1.5030E-01	1.5025E-01	-4.9067E-02
7.3262E 00	0.	7.1605E 00	1.1451E-01	1.1446E-01	-3.7393E-02
7.4141E 00	0.	7.1605E 00	1.1451E-01	1.1446E-01	-3.7393E-02
7.8330E 00	0.	7.3818E 00	1.3158E-01	1.5817E-01	-5.1653E-02
8.1887E 00	0.	7.3899E 00	1.5927E-01	2.4008E-01	-7.8395E-02
8.4960E 00	0.	7.3366E 00	1.5816E-01	2.3835E-01	-7.7864E-02
9.0284E 00	0.	7.2737E 00	1.5679E-01	2.3631E-01	-7.7186E-02
9.7922E 00	0.	7.0353E 00	1.4754E-01	2.1627E-01	-7.0672E-02
1.0259E 01	0.	6.9859E 00	7.4051E-02		

ZIRCONIUM

ZR

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
5.2000000E 00	9.1219999E 01	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
4.0750E 00	0.	3.8954E 00	8.9674E-02	1.7961E-01	-5.9519E-02
4.0000E 00	0.	3.8237E 00	8.8034E-02	1.7630E-01	-5.8434E-02
4.2000E 00	0.	4.0149E 00	9.2439E-02	1.8512E-01	-6.1359E-02
5.0500E 00	0.	4.8274E 00	1.1108E-01	2.2258E-01	-7.3709E-02
6.5000E 00	0.	6.2135E 00	1.4277E-01	2.8649E-01	-9.4673E-02
7.9500E 00	0.	7.5996E 00	1.7475E-01	3.5040E-01	-1.1592E-01
8.6000E 00	0.	8.2210E 00	1.8901E-01	3.7904E-01	-1.2537E-01
8.6501E 00	0.	8.2687E 00	1.9051E-01	3.8125E-01	-1.2650E-01
8.5001E 00	0.	8.4063E 00	9.3834E-02	9.3658E-02	-3.0934E-02
7.4003E 00	0.	7.3185E 00	8.1792E-02	8.1540E-02	-2.7032E-02
6.6009E 00	0.	6.5273E 00	7.2971E-02	7.2725E-02	-2.4131E-02
6.4025E 00	0.	6.3295E 00	7.0699E-02	7.0520E-02	-2.3339E-02
6.2018E 00	0.	6.1267E 00	6.8448E-02	6.8262E-02	-2.2605E-02
6.1993E 00	0.	6.0941E 00	7.5855E-02	9.0868E-02	-3.0086E-02
6.2023E 00	0.	6.0389E 00	9.0765E-02	1.3608E-01	-4.5070E-02
6.1999E 00	0.	6.0194E 00	9.0482E-02	1.3564E-01	-4.4935E-02
6.1991E 00	0.	5.9900E 00	9.0058E-02	1.3498E-01	-4.4733E-02
6.2095E 00	0.	5.9584E 00	8.7127E-02	1.2711E-01	-4.2094E-02
6.1849E 00	0.	6.0253E 00	4.4587E-02		

NIOBIUM

NB

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
5.3400000E 00	9.2909999E 01	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
2.3001E 00	0.	2.2013E 00	4.9126E-02	9.8651E-02	-3.2566E-02
3.0001E 00	0.	2.8713E 00	6.4030E-02	1.2867E-01	-4.2430E-02
3.9501E 00	0.	3.7806E 00	8.4334E-02	1.6942E-01	-5.5894E-02
5.2001E 00	0.	4.9770E 00	1.1095E-01	2.2304E-01	-7.3509E-02
6.7002E 00	0.	6.4126E 00	1.4332E-01	2.8738E-01	-9.5079E-02
8.0002E 00	0.	7.6569E 00	1.7073E-01	3.4313E-01	-1.1313E-01
8.7503E 00	0.	8.3747E 00	1.8712E-01	3.7531E-01	-1.2412E-01
9.0004E 00	0.	8.6140E 00	1.9209E-01	3.8602E-01	-1.2729E-01
8.4008E 00	0.	8.3099E 00	9.0251E-02	9.0073E-02	-2.9771E-02
7.3021E 00	0.	7.2217E 00	7.8423E-02	7.8278E-02	-2.5863E-02
6.7056E 00	0.	6.6282E 00	7.2042E-02	7.1845E-02	-2.3802E-02
6.6153E 00	0.	6.5292E 00	7.0958E-02	7.0773E-02	-2.3438E-02
6.5415E 00	0.	6.4303E 00	6.9783E-02	6.9699E-02	-2.2983E-02
6.4873E 00	0.	6.3085E 00	7.6301E-02	9.1503E-02	-3.0221E-02
6.5165E 00	0.	6.2138E 00	9.0832E-02	1.3618E-01	-4.5112E-02
6.5246E 00	0.	6.1160E 00	8.9198E-02	1.3404E-01	-4.4198E-02
6.5026E 00	0.	5.9203E 00	8.6450E-02	1.2975E-01	-4.2890E-02
6.4537E 00	0.	5.5806E 00	7.9318E-02	1.1579E-01	-3.8304E-02
6.4190E 00	0.	5.4434E 00	3.9192E-02		

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
5.3000000E 00	9.5949999E 01	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
1.7771E 00	0.	1.7010E 00	3.6911E-02	7.4033E-02	-2.4486E-02
2.9277E 00	0.	2.8030E 00	6.1035E-02	1.2200E-01	-4.0560E-02
4.0534E 00	0.	3.8811E 00	8.4393E-02	1.6892E-01	-5.6043E-02
5.2294E 00	0.	5.0071E 00	1.0900E-01	2.1793E-01	-7.2427E-02
6.3557E 00	0.	6.0851E 00	1.3211E-01	2.6485E-01	-8.7663E-02
7.4323E 00	0.	7.1153E 00	1.5486E-01	3.0970E-01	-1.0288E-01
8.5844E 00	0.	8.2173E 00	1.7829E-01	3.5765E-01	-1.1826E-01
9.0370E 00	0.	8.6486E 00	1.8814E-01	3.7643E-01	-1.2496E-01
8.3252E 00	0.	8.2135E 00	8.6771E-02	8.6547E-02	-2.8671E-02
7.5184E 00	0.	7.3726E 00	7.7709E-02	7.7389E-02	-2.5759E-02
9.8150E 00	0.	9.1884E 00	1.1180E-01	1.1160E-01	-3.6802E-02
1.7415E 01	0.	1.3301E 01	1.4916E-01	1.4890E-01	-4.9164E-02
1.7900E 01	0.	1.2701E 01	1.4912E-01	1.4884E-01	-4.9121E-02
9.8546E 00	0.	8.0362E 00	1.1564E-01	1.3881E-01	-4.5636E-02
6.4785E 00	0.	5.9808E 00	7.9453E-02	1.1922E-01	-3.9453E-02
6.6490E 00	0.	5.9058E 00	7.9458E-02	1.1921E-01	-3.9458E-02
7.0286E 00	0.	5.8808E 00	7.9580E-02	1.1921E-01	-3.9580E-02
7.5176E 00	0.	5.6834E 00	7.7320E-02	1.1296E-01	-3.7320E-02
7.4532E 00	0.	5.2360E 00	3.6652E-02		

CADMIUM

CD

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
8.3000000E 00	1.1241000E 02	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
4.2502E 00	0.	4.0979E 00	7.6363E-02	1.5210E-01	-5.0863E-02
4.0502E 00	0.	3.9051E 00	7.2865E-02	1.4494E-01	-4.8564E-02
4.7003E 00	0.	4.5318E 00	8.4201E-02	1.6820E-01	-5.6001E-02
5.8003E 00	0.	5.5924E 00	1.0427E-01	2.0757E-01	-6.9473E-02
6.6004E 00	0.	6.3638E 00	1.1818E-01	2.3619E-01	-7.8581E-02
7.1505E 00	0.	6.8941E 00	1.2815E-01	2.5588E-01	-8.5245E-02
7.4007E 00	0.	7.1352E 00	1.3307E-01	2.6483E-01	-8.8670E-02
7.3009E 00	0.	7.0388E 00	1.3099E-01	2.6125E-01	-8.7194E-02
7.0519E 00	0.	6.9869E 00	6.3303E-02	6.3074E-02	-2.1003E-02
6.7551E 00	0.	6.6896E 00	6.0617E-02	6.0390E-02	-2.0117E-02
6.6139E 00	0.	6.5410E 00	5.9245E-02	5.9048E-02	-1.9645E-02
6.6378E 00	0.	6.5410E 00	5.9245E-02	5.9048E-02	-1.9645E-02
5.6026E 00	0.	5.4508E 00	4.9486E-02	4.9208E-02	-1.6486E-02
5.4250E 00	0.	4.7921E 00	4.8396E-02	5.7856E-02	-1.9296E-02
2.2500E 01	0.	5.4016E 00	6.5972E-02	9.8416E-02	-3.2972E-02
9.4385E 02	0.	1.4093E 01	1.7170E-01	2.5677E-01	-8.5596E-02
2.7230E 03	0.	2.2588E 01	2.7477E-01	4.1154E-01	-1.3677E-01
3.1735E 03	0.	1.6279E 01	1.9270E-01	2.8085E-01	-9.3338E-02
3.0148E 03	0.	1.0304E 01	6.1824E-02		

INDIUM

IN

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
8.3199999E 00	1.1485000E 02	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
4.0208E 00	0.	3.8592E 00	7.0552E-02	1.4078E-01	-4.6952E-02
4.0267E 00	0.	3.8592E 00	7.0552E-02	1.4078E-01	-4.6952E-02
4.6350E 00	0.	4.4140E 00	8.0754E-02	1.6101E-01	-5.3761E-02
5.6850E 00	0.	5.3788E 00	9.8541E-02	1.9621E-01	-6.5649E-02
6.5500E 00	0.	6.1603E 00	1.1227E-01	2.2471E-01	-7.4598E-02
6.9950E 00	0.	6.5124E 00	1.1910E-01	2.3756E-01	-7.9271E-02
6.9950E 00	0.	6.4497E 00	1.1807E-01	2.3527E-01	-7.8633E-02
6.9600E 00	0.	6.3629E 00	1.1596E-01	2.3210E-01	-7.7052E-02
6.7400E 00	0.	6.1454E 00	5.4823E-02	5.4551E-02	-1.8243E-02
6.7650E 00	0.	4.8817E 00	4.3436E-02	4.3332E-02	-1.4378E-02
7.0000E 00	0.	2.9736E 00	2.6467E-02	2.6395E-02	-8.7668E-03
7.9000E 00	0.	1.9824E 00	1.7669E-02	1.7597E-02	-5.8690E-03
3.7900E 01	0.	1.9824E 00	1.7669E-02	1.7597E-02	-5.8690E-03
1.1126E 03	0.	1.9765E 00	1.9625E-02	2.3463E-02	-7.8254E-03
1.1491E 03	0.	2.0630E 01	2.4655E-01	3.6953E-01	-1.2265E-01
1.1900E 02	0.	2.1613E 01	2.5830E-01	3.8713E-01	-1.2850E-01
9.6000E 01	0.	3.9296E 00	4.7076E-02	7.0388E-02	-2.3476E-02
1.2333E 02	0.	3.9333E 00	4.5854E-02	6.6715E-02	-2.2254E-02
1.7585E 02	0.	3.7894E 00	2.2357E-02		

XENON 135

XE135

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
8.5999999E 00	1.3495000E 02	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
2.5006E 01	0.	2.4254E 01	3.7878E-01	7.4635E-01	-2.5378E-01
2.5007E 01	0.	2.4254E 01	3.7878E-01	7.4635E-01	-2.5378E-01
2.5009E 01	0.	2.4254E 01	3.7878E-01	7.4635E-01	-2.5378E-01
2.5012E 01	0.	2.4254E 01	3.7878E-01	7.4635E-01	-2.5378E-01
2.5015E 01	0.	2.4254E 01	3.7878E-01	7.4635E-01	-2.5378E-01
2.5020E 01	0.	2.4254E 01	3.7878E-01	7.4635E-01	-2.5378E-01
2.5025E 01	0.	2.4254E 01	3.7878E-01	7.4635E-01	-2.5378E-01
2.5032E 01	0.	2.4254E 01	3.7878E-01	7.4635E-01	-2.5378E-01
2.5068E 01	0.	2.4813E 01	1.8845E-01	1.8659E-01	-6.3446E-02
2.5184E 01	0.	2.4813E 01	1.8845E-01	1.8659E-01	-6.3446E-02
2.5500E 01	0.	2.4813E 01	1.8845E-01	1.8659E-01	-6.3446E-02
2.8860E 01	0.	2.7295E 01	2.0753E-01	2.0525E-01	-7.0026E-02
7.3695E 01	0.	6.9478E 01	5.2769E-01	5.2245E-01	-1.7769E-01
6.5770E 02	0.	4.3562E 02	3.6939E 00	4.3786E 00	-1.4939E 00
7.2500E 03	0.	2.8912E 03	2.9447E 01	4.3809E 01	-1.4772E 01
1.3300E 04	0.	5.0239E 03	5.1174E 01	7.6125E 01	-2.5674E 01
1.4166E 06	0.	2.4385E 05	2.5006E 03	3.6952E 03	-1.2628E 03
2.8583E 06	0.	4.0838E 05	4.0477E 03	5.8605E 03	-1.9765E 03
2.9768E 06	0.	3.5343E 05	1.7672E 03		

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
5.4200000E 00	1.3736000E 02	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
5.5001E 00	0.	5.3391E 00	8.1218E-02	1.6092E-01	-5.4268E-02
5.5001E 00	0.	5.3391E 00	8.1218E-02	1.6092E-01	-5.4268E-02
5.7501E 00	0.	5.5818E 00	8.4883E-02	1.6824E-01	-5.6708E-02
6.7501E 00	0.	6.5525E 00	9.9580E-02	1.9750E-01	-6.6505E-02
7.0002E 00	0.	6.7952E 00	1.0300E-01	2.0481E-01	-6.8701E-02
6.1002E 00	0.	5.9215E 00	9.0049E-02	1.7848E-01	-6.0159E-02
5.4503E 00	0.	5.2905E 00	8.0363E-02	1.5946E-01	-5.3658E-02
5.0504E 00	0.	4.9022E 00	7.4054E-02	1.4775E-01	-4.9309E-02
6.4508E 00	0.	6.4028E 00	4.7543E-02	4.7180E-02	-1.5938E-02
7.5022E 00	0.	7.4451E 00	5.5040E-02	5.4858E-02	-1.8290E-02
7.5060E 00	0.	7.4451E 00	5.5040E-02	5.4858E-02	-1.8290E-02
8.5162E 00	0.	8.4378E 00	6.2373E-02	6.2172E-02	-2.0723E-02
9.5441E 00	0.	9.4305E 00	6.9831E-02	6.9488E-02	-2.3281E-02
9.8429E 00	0.	9.6549E 00	7.9547E-02	9.5088E-02	-3.1772E-02
9.6771E 00	0.	9.3610E 00	9.3111E-02	1.3898E-01	-4.6561E-02
1.0042E 01	0.	9.6074E 00	9.5433E-02	1.4263E-01	-4.7658E-02
1.0631E 01	0.	1.0002E 01	9.9628E-02	1.4849E-01	-4.9893E-02
1.3183E 01	0.	1.2206E 01	1.1791E-01	1.7162E-01	-5.7259E-02
1.5959E 01	0.	1.4921E 01	7.3113E-02		

SAMARIUM

SM

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
8.2199999E 00	1.5043000E 02	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
1.0000E 01	0.	8.7581E 00	1.2219E-01	2.4193E-01	-8.1692E-02
1.0000E 01	0.	8.7581E 00	1.2219E-01	2.4193E-01	-8.1692E-02
1.0000E 01	0.	8.7581E 00	1.2219E-01	2.4193E-01	-8.1692E-02
1.0000E 01	0.	8.7581E 00	1.2219E-01	2.4193E-01	-8.1692E-02
1.0000E 01	0.	8.2715E 00	1.1583E-01	2.2849E-01	-7.7583E-02
1.0000E 01	0.	7.7849E 00	1.0909E-01	2.1505E-01	-7.3090E-02
1.0000E 01	0.	7.2984E 00	1.0128E-01	2.0160E-01	-6.7533E-02
1.0000E 01	0.	6.3253E 00	8.7950E-02	1.7472E-01	-5.8700E-02
1.2500E 01	0.	5.4630E 00	3.7261E-02	3.6962E-02	-1.2511E-02
1.7500E 01	0.	4.9664E 00	3.3750E-02	3.3600E-02	-1.1250E-02
3.0000E 01	0.	7.4496E 00	5.0633E-02	5.0400E-02	-1.6883E-02
7.0000E 01	0.	1.4899E 01	1.0127E-01	1.0080E-01	-3.3767E-02
5.5000E 02	0.	2.4832E 01	1.6878E-01	1.6800E-01	-5.6278E-02
5.2500E 02	0.	1.9821E 01	1.5000E-01	1.7920E-01	-6.0000E-02
1.5000E 02	0.	1.2332E 01	1.1253E-01	1.6800E-01	-5.6278E-02
3.7500E 02	0.	1.4798E 01	1.3503E-01	2.0160E-01	-6.7533E-02
5.7500E 03	0.	5.6727E 01	5.1763E-01	7.7281E-01	-2.5888E-01
8.7842E 03	0.	8.2641E 01	7.3746E-01	1.0664E 00	-3.6077E-01
7.8991E 03	0.	5.4070E 01	2.4332E-01		

EUROPIUM

EU

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
8.2399999E 00	1.5200000E 02	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
1.0000E 01	0.	8.7634E 00	1.1894E-01	2.3657E-01	-7.9336E-02
1.0000E 01	0.	8.7634E 00	1.1894E-01	2.3657E-01	-7.9336E-02
1.0000E 01	0.	8.7634E 00	1.1894E-01	2.3657E-01	-7.9336E-02
1.0000E 01	0.	8.7634E 00	1.1894E-01	2.3657E-01	-7.9336E-02
1.0000E 01	0.	8.2766E 00	1.1233E-01	2.2343E-01	-7.4928E-02
1.0000E 01	0.	7.7897E 00	1.0854E-01	2.1031E-01	-7.3339E-02
1.0000E 01	0.	7.3029E 00	9.9113E-02	1.9714E-01	-6.6113E-02
1.0000E 01	0.	6.3291E 00	8.5898E-02	1.7086E-01	-5.7298E-02
1.2500E 01	0.	5.4639E 00	3.6321E-02	3.6143E-02	-1.2121E-02
1.7500E 01	0.	4.9671E 00	3.3019E-02	3.2857E-02	-1.1019E-02
6.0000E 01	0.	9.9343E 00	6.6038E-02	6.5714E-02	-2.2038E-02
2.0000E 02	0.	1.7385E 01	1.1618E-01	1.1501E-01	-3.9177E-02
3.0000E 02	0.	1.9869E 01	1.3379E-01	1.3144E-01	-4.5794E-02
3.0000E 02	0.	1.4869E 01	1.1173E-01	1.3144E-01	-4.5730E-02
1.4075E 03	0.	1.2336E 01	1.1009E-01	1.6428E-01	-5.5094E-02
1.7650E 03	0.	1.4803E 01	1.3211E-01	1.9714E-01	-6.6113E-02
8.6250E 02	0.	1.2336E 01	1.1009E-01	1.6428E-01	-5.5094E-02
2.2981E 03	0.	9.4732E 00	8.2370E-02	1.1950E-01	-4.0162E-02
3.8176E 03	0.	1.0560E 01	4.6464E-02		

GADOLINIUM

GD

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
8.2040000E 00	1.5690000E 02	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
8.0424E 00	0.	7.7945E 00	1.0386E-01	2.0553E-01	-6.9455E-02
7.5544E 00	0.	7.3073E 00	9.7537E-02	1.9269E-01	-6.5287E-02
6.5697E 00	0.	6.3330E 00	8.4928E-02	1.6700E-01	-5.6978E-02
5.5896E 00	0.	5.3587E 00	7.0939E-02	1.4130E-01	-4.7289E-02
5.1150E 00	0.	4.8715E 00	6.4742E-02	1.2846E-01	-4.3242E-02
5.1480E 00	0.	4.8715E 00	6.4742E-02	1.2846E-01	-4.3242E-02
5.1900E 00	0.	4.8715E 00	6.4742E-02	1.2846E-01	-4.3242E-02
5.2440E 00	0.	4.8715E 00	6.4742E-02	1.2846E-01	-4.3242E-02
5.5110E 00	0.	4.9679E 00	3.2310E-02	3.2114E-02	-1.0810E-02
6.3860E 00	0.	4.9679E 00	3.2310E-02	3.2114E-02	-1.0810E-02
8.7650E 00	0.	4.9679E 00	3.2310E-02	3.2114E-02	-1.0810E-02
1.7752E 01	0.	7.4518E 00	4.8434E-02	4.8170E-02	-1.6184E-02
4.7500E 01	0.	1.4904E 01	9.6868E-02	9.6341E-02	-3.2368E-02
1.3750E 02	0.	3.7179E 01	2.7012E-01	3.2114E-01	-1.0887E-01
1.2750E 02	0.	3.2083E 01	2.8046E-01	4.1748E-01	-1.4071E-01
5.2500E 02	0.	2.4679E 01	2.1702E-01	3.2115E-01	-1.0952E-01
6.2500E 03	0.	7.8972E 01	6.8993E-01	1.0276E 00	-3.4593E-01
2.5619E 04	0.	1.3596E 02	1.1561E 00	1.6757E 00	-5.6424E-01
3.6097E 04	0.	1.5430E 02	6.6349E-01		

DYSPROSIUM

DY

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)	
8.2600000E 00	1.6251000E 02	0.	2.9316000E 02	0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SGS0(N,N)	SCATTER SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
1.0028E 01	0.	9.7550E 00	1.2622E-01	2.4503E-01	-8.5223E-02
1.0036E 01	0.	9.7550E 00	1.2622E-01	2.4503E-01	-8.5223E-02
1.0047E 01	0.	9.7550E 00	1.2622E-01	2.4503E-01	-8.5223E-02
1.0060E 01	0.	9.7550E 00	1.2622E-01	2.4503E-01	-8.5223E-02
1.0077E 01	0.	9.7550E 00	1.2622E-01	2.4503E-01	-8.5223E-02
1.0099E 01	0.	9.7550E 00	1.2622E-01	2.4503E-01	-8.5223E-02
1.0127E 01	0.	9.7550E 00	1.2622E-01	2.4503E-01	-8.5223E-02
1.0163E 01	0.	9.7550E 00	1.2622E-01	2.4503E-01	-8.5223E-02
1.0340E 01	0.	9.9387E 00	6.2306E-02	6.1258E-02	-2.1306E-02
1.0924E 01	0.	9.9387E 00	6.2306E-02	6.1258E-02	-2.1306E-02
1.2512E 01	0.	9.9387E 00	6.2306E-02	6.1258E-02	-2.1306E-02
1.9337E 01	0.	1.2423E 01	7.7889E-02	7.6573E-02	-2.6639E-02
1.0050E 02	0.	1.8884E 01	1.1863E-01	1.1639E-01	-4.0728E-02
5.0700E 02	0.	2.3804E 01	1.6741E-01	1.9603E-01	-6.9012E-02
4.8450E 02	0.	2.6175E 01	2.2141E-01	3.2467E-01	-1.1276E-01
2.2050E 02	0.	5.3338E 01	4.5280E-01	6.6160E-01	-2.3140E-01
4.2750E 02	0.	8.3959E 01	7.1393E-01	1.0414E 00	-3.6543E-01
7.7595E 02	0.	9.2981E 01	7.6493E-01	1.0924E 00	-3.7923E-01
1.0005E 03	0.	9.1500E 01	3.7515E-01		

HAFNIUM

HF

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
8.2800000E 00	1.7858000E 02	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
6.7410E 00	0.	6.5478E 00	7.8419E-02	1.5220E-01	-5.2959E-02
6.8276E 00	0.	6.6211E 00	7.8932E-02	1.5390E-01	-5.3187E-02
6.9174E 00	0.	6.6944E 00	8.0060E-02	1.5561E-01	-5.4030E-02
7.0368E 00	0.	6.7921E 00	8.1345E-02	1.5788E-01	-5.4935E-02
7.1114E 00	0.	6.8410E 00	8.1658E-02	1.5902E-01	-5.5057E-02
7.1929E 00	0.	6.8899E 00	8.1796E-02	1.6015E-01	-5.5006E-02
7.4836E 00	0.	7.1342E 00	8.4900E-02	1.6583E-01	-5.7160E-02
7.8357E 00	0.	7.4274E 00	8.8135E-02	1.7264E-01	-5.9255E-02
9.3432E 00	0.	8.7997E 00	5.0671E-02	5.0257E-02	-1.7041E-02
1.3339E 01	0.	1.1932E 01	6.9291E-02	6.8151E-02	-2.3691E-02
1.8493E 01	0.	1.4766E 01	8.5141E-02	8.4331E-02	-2.8711E-02
2.5764E 01	0.	1.5760E 01	9.0632E-02	9.0008E-02	-3.0402E-02
5.1250E 01	0.	2.0384E 01	1.1801E-01	1.1642E-01	-4.0110E-02
6.5700E 02	0.	3.8208E 01	2.4662E-01	2.9152E-01	-1.0032E-01
6.5000E 02	0.	3.1142E 01	2.4317E-01	3.5778E-01	-1.2347E-01
5.3000E 01	0.	9.3921E 00	7.3919E-02	1.0791E-01	-3.7819E-02
5.4750E 01	0.	7.9091E 00	6.1965E-02	9.0867E-02	-3.1565E-02
7.6367E 01	0.	7.9139E 00	6.0093E-02	8.6124E-02	-2.9693E-02
1.0255E 02	0.	7.9995E 00	3.0398E-02		

TUNGSTEN

W

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
8.5000000E 00	1.8392000E 02	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
5.0511E 00	0.	4.9383E 00	5.6411E-02	1.1170E-01	-3.7726E-02
5.8014E 00	0.	5.6717E 00	6.5250E-02	1.2830E-01	-4.3790E-02
6.6018E 00	0.	6.4540E 00	7.3427E-02	1.4599E-01	-4.9007E-02
6.9023E 00	0.	6.7474E 00	7.8423E-02	1.5263E-01	-5.2893E-02
6.9029E 00	0.	6.7474E 00	7.8423E-02	1.5263E-01	-5.2893E-02
7.1038E 00	0.	6.9429E 00	8.0093E-02	1.5705E-01	-5.3823E-02
7.5548E 00	0.	7.3830E 00	8.4787E-02	1.6700E-01	-5.6852E-02
8.1062E 00	0.	7.9208E 00	9.2266E-02	1.7918E-01	-6.2296E-02
9.2130E 00	0.	9.1491E 00	5.1472E-02	5.0877E-02	-1.7431E-02
1.2035E 01	0.	1.1934E 01	6.6719E-02	6.6357E-02	-2.2319E-02
1.5096E 01	0.	1.4917E 01	8.3880E-02	8.2951E-02	-2.8380E-02
1.8260E 01	0.	1.7900E 01	1.0075E-01	9.9542E-02	-3.4154E-02
3.3190E 01	0.	1.2928E 01	7.2426E-02	7.1888E-02	-2.4326E-02
2.7025E 01	0.	5.8565E 00	3.6611E-02	4.3502E-02	-1.4781E-02
8.3750E 00	0.	5.3403E 00	4.0204E-02	5.9723E-02	-2.0224E-02
9.9000E 00	0.	4.9447E 00	3.7691E-02	5.5303E-02	-1.9191E-02
1.3050E 01	0.	4.9447E 00	3.7691E-02	5.5303E-02	-1.9191E-02
1.8747E 01	0.	4.9476E 00	3.6698E-02	5.2417E-02	-1.8198E-02
2.0625E 01	0.	3.7730E 00	1.3960E-02		

GOLD

AU

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
8.3399999E 00	1.9700000E 02	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
5.2400E 00	0.	5.1041E 00	5.4889E-02	1.0594E-01	-3.7175E-02
6.5975E 00	0.	6.4217E 00	6.9038E-02	1.3329E-01	-4.6751E-02
7.1025E 00	0.	6.8969E 00	7.2673E-02	1.4314E-01	-4.8737E-02
6.1125E 00	0.	5.9025E 00	6.3796E-02	1.2251E-01	-4.3311E-02
5.3000E 00	0.	5.0698E 00	5.4280E-02	1.0523E-01	-3.6685E-02
5.6650E 00	0.	5.3637E 00	5.8299E-02	1.1133E-01	-3.9684E-02
6.8150E 00	0.	6.4168E 00	6.9942E-02	1.3319E-01	-4.7672E-02
7.8250E 00	0.	7.3230E 00	7.8951E-02	1.5200E-01	-5.3536E-02
9.5250E 00	0.	8.7055E 00	4.5627E-02	4.4483E-02	-1.5877E-02
1.1700E 01	0.	9.5263E 00	4.9627E-02	4.8674E-02	-1.7072E-02
1.3700E 01	0.	9.2527E 00	4.8140E-02	4.7276E-02	-1.6520E-02
1.5650E 01	0.	1.1591E 01	6.0798E-02	5.9226E-02	-2.1188E-02
6.1900E 01	0.	5.1736E 01	2.6753E-01	2.6433E-01	-9.0731E-02
7.4375E 02	0.	5.9593E 01	3.4870E-01	4.0669E-01	-1.4470E-01
7.0715E 02	0.	1.9450E 01	1.3705E-01	1.9978E-01	-7.0235E-02
3.4300E 01	0.	9.0570E 00	6.2600E-02	9.3019E-02	-3.1490E-02
4.6650E 01	0.	7.9187E 00	5.6353E-02	8.1340E-02	-2.9152E-02
6.9835E 01	0.	6.5292E 00	4.4428E-02	6.3528E-02	-2.2013E-02
9.3216E 01	0.	6.3744E 00	2.1673E-02		

MERCURY

HG

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
7.7000000E 00	2.0061000E 02	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
5.2776E 00	0.	5.1481E 00	5.4945E-02	1.0685E-01	-3.7078E-02
6.6090E 00	0.	6.4462E 00	6.8995E-02	1.3379E-01	-4.6623E-02
7.0472E 00	0.	6.8675E 00	7.4202E-02	1.4254E-01	-5.0368E-02
6.2779E 00	0.	6.1033E 00	6.5077E-02	1.2668E-01	-4.3895E-02
5.4915E 00	0.	5.3196E 00	5.7442E-02	1.1042E-01	-3.8979E-02
6.2688E 00	0.	6.0641E 00	6.5399E-02	1.2587E-01	-4.4353E-02
7.6013E 00	0.	7.3475E 00	7.8941E-02	1.5250E-01	-5.3441E-02
8.8200E 00	0.	8.5133E 00	9.1755E-02	1.7670E-01	-6.2208E-02
1.0487E 01	0.	1.0163E 01	5.2690E-02	5.1926E-02	-1.7959E-02
1.2604E 01	0.	1.1805E 01	6.1723E-02	6.0317E-02	-2.1382E-02
1.5560E 01	0.	1.3481E 01	7.0275E-02	6.8882E-02	-2.4205E-02
2.0220E 01	0.	1.4675E 01	7.6388E-02	7.4981E-02	-2.6238E-02
2.4500E 01	0.	1.6416E 01	8.5944E-02	8.3881E-02	-2.9844E-02
2.7000E 01	0.	1.8871E 01	1.1038E-01	1.2879E-01	-4.5780E-02
4.3000E 01	0.	1.9797E 01	1.3919E-01	2.0334E-01	-7.1188E-02
9.0250E 01	0.	1.9797E 01	1.3919E-01	2.0334E-01	-7.1188E-02
1.7025E 02	0.	1.9797E 01	1.3919E-01	2.0334E-01	-7.1188E-02
2.9213E 02	0.	1.9807E 01	1.3550E-01	1.9273E-01	-6.7504E-02
3.6330E 02	0.	2.0000E 01	6.8000E-02		

LEAD

PB

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
7.6000000E 00	2.0721000E 02	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
5.2250E 00	0.	5.1250E 00	5.2119E-02	1.0002E-01	-3.5399E-02
7.1500E 00	0.	7.0131E 00	7.3221E-02	1.3688E-01	-5.0341E-02
7.2250E 00	0.	7.0867E 00	7.3740E-02	1.3831E-01	-5.0620E-02
6.0000E 00	0.	5.8851E 00	6.0281E-02	1.1485E-01	-4.1081E-02
5.5250E 00	0.	5.4192E 00	5.5129E-02	1.0576E-01	-3.7449E-02
5.7750E 00	0.	5.6644E 00	5.8562E-02	1.1055E-01	-4.0082E-02
6.0250E 00	0.	5.9097E 00	6.2077E-02	1.1534E-01	-4.2796E-02
8.0751E 00	0.	7.9204E 00	8.1810E-02	1.5458E-01	-5.5970E-02
1.0400E 01	0.	1.0350E 01	5.0546E-02	4.9766E-02	-1.7266E-02
1.1100E 01	0.	1.1047E 01	5.5101E-02	5.3124E-02	-1.9581E-02
1.1401E 01	0.	1.1345E 01	5.6377E-02	5.4558E-02	-1.9897E-02
1.1402E 01	0.	1.1345E 01	5.6377E-02	5.4558E-02	-1.9897E-02
1.1406E 01	0.	1.1345E 01	5.6377E-02	5.4558E-02	-1.9897E-02
1.1413E 01	0.	1.1327E 01	6.3009E-02	7.2745E-02	-2.6529E-02
1.1401E 01	0.	1.1266E 01	7.6550E-02	1.0888E-01	-4.0150E-02
1.1317E 01	0.	1.1167E 01	7.4697E-02	1.0791E-01	-3.8617E-02
1.0970E 01	0.	1.0796E 01	7.1906E-02	1.0432E-01	-3.7026E-02
9.6580E 00	0.	9.4544E 00	6.1687E-02	8.6554E-02	-3.1156E-02
8.6951E 00	0.	8.5443E 00	2.7342E-02		

BISMUTH

BJ

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
7.5000000E 00	2.0900000E 02	0.	2.9316000E 02 0

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
5.6000E 00	0.	5.4928E 00	5.5563E-02	1.0719E-01	-3.7643E-02
7.3000E 00	0.	7.1603E 00	7.4414E-02	1.3975E-01	-5.1054E-02
7.2500E 00	0.	7.1112E 00	7.3837E-02	1.3879E-01	-5.0637E-02
5.3500E 00	0.	5.2476E 00	5.3985E-02	1.0241E-01	-3.6865E-02
4.5000E 00	0.	4.4139E 00	4.5605E-02	8.6143E-02	-3.1205E-02
5.4000E 00	0.	5.2966E 00	5.5789E-02	1.0338E-01	-3.8509E-02
6.7000E 00	0.	6.5717E 00	6.7209E-02	1.2825E-01	-4.5769E-02
7.6500E 00	0.	7.5036E 00	7.6811E-02	1.4644E-01	-5.2331E-02
9.4500E 00	0.	9.4048E 00	4.6120E-02	4.5222E-02	-1.5880E-02
1.1100E 01	0.	1.1047E 01	5.4780E-02	5.3122E-02	-1.9260E-02
1.0200E 01	0.	1.0151E 01	4.9621E-02	4.8810E-02	-1.6981E-02
9.1004E 00	0.	9.0564E 00	4.4988E-02	4.3551E-02	-1.5868E-02
9.2012E 00	0.	9.1560E 00	4.5274E-02	4.4028E-02	-1.5834E-02
9.2025E 00	0.	9.1413E 00	5.0552E-02	5.8704E-02	-2.1112E-02
9.0998E 00	0.	9.0080E 00	5.9913E-02	8.7047E-02	-3.0809E-02
8.8480E 00	0.	8.7554E 00	5.8772E-02	8.4611E-02	-3.0484E-02
8.5982E 00	0.	8.5028E 00	5.7600E-02	8.2174E-02	-3.0128E-02
8.7138E 00	0.	8.6130E 00	5.6583E-02	7.8853E-02	-2.8769E-02
8.8610E 00	0.	8.8326E 00	2.8264E-02		

THORIUM

TH

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
-1.3000000E 00	2.3205000E 02	2.3205000E 02	2.9316000E 02 10

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
8.0550E 00	8.9000E-01	7.5664E 00	6.8822E-02	1.3361E-01	-4.6492E-02
7.8500E 00	3.8000E-01	7.5664E 00	6.8822E-02	1.3361E-01	-4.6492E-02
7.3800E 00	3.3000E-01	7.1242E 00	6.6792E-02	1.2581E-01	-4.5766E-02
6.6150E 00	1.6500E-01	6.4363E 00	5.9119E-02	1.1366E-01	-4.0123E-02
6.6900E 00	2.5000E-02	6.5346E 00	6.1038E-02	1.1540E-01	-4.1753E-02
7.4500E 00	0.	7.2225E 00	6.5152E-02	1.2753E-01	-4.3837E-02
8.7250E 00	0.	8.4016E 00	7.6928E-02	1.4836E-01	-5.2133E-02
1.0245E 01	0.	9.8265E 00	9.2806E-02	1.7354E-01	-6.3806E-02
1.2575E 01	0.	1.2097E 01	5.4470E-02	5.2711E-02	-1.9235E-02
1.5035E 01	0.	1.4288E 01	6.3083E-02	6.2247E-02	-2.1468E-02
1.4900E 01	0.	1.4039E 01	6.2543E-02	6.1167E-02	-2.1653E-02
4.5750E 01	0.	1.2794E 01	5.7908E-02	5.5750E-02	-2.0643E-02
4.4700E 01	0.	1.1998E 01	5.3331E-02	5.2273E-02	-1.8385E-02
1.2200E 01	0.	1.1583E 01	5.8486E-02	6.7390E-02	-2.4701E-02
1.3200E 01	0.	1.1995E 01	7.2528E-02	1.0498E-01	-3.7437E-02
1.4300E 01	0.	1.2292E 01	7.3729E-02	1.0758E-01	-3.7769E-02
1.5350E 01	0.	1.2243E 01	7.5565E-02	1.0716E-01	-3.9750E-02
1.7426E 01	0.	1.2460E 01	7.2532E-02	1.0331E-01	-3.6099E-02
1.8583E 01	0.	1.2401E 01	3.5963E-02		

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
9.2234999E 03	2.3511750E 02	2.3511750E 02	2.9316000E 02 10

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SGS0(N,N)	SCATTER SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
4.7500E 00	4.1930E 00	3.1955E 00	2.7807E-02	5.4452E-02	-1.8707E-02
5.1500E 00	3.7294E 00	3.5397E 00	3.0860E-02	6.0316E-02	-2.0780E-02
5.4000E 00	3.5863E 00	3.6872E 00	3.2884E-02	6.2834E-02	-2.2384E-02
6.2500E 00	3.7751E 00	4.3754E 00	3.9254E-02	7.4564E-02	-2.6794E-02
7.7000E 00	4.0197E 00	5.6536E 00	5.0485E-02	9.6345E-02	-3.4385E-02
1.0100E 01	5.5062E 00	7.4188E 00	3.1443E-02	3.1204E-02	-1.0583E-02
1.3050E 01	9.0250E 00	8.4644E 00	3.5985E-02	3.5603E-02	-1.2185E-02
1.8650E 01	1.7856E 01	8.4644E 00	3.5985E-02	3.5603E-02	-1.2185E-02
4.8250E 01	5.9052E 01	8.4644E 00	3.5985E-02	3.5603E-02	-1.2185E-02
9.9000E 01	1.3025E 02	8.4644E 00	3.5985E-02	3.5603E-02	-1.2185E-02
8.6000E 01	1.1180E 02	8.4525E 00	4.0046E-02	4.7470E-02	-1.6246E-02
7.1500E 01	1.2180E 02	8.4288E 00	4.8170E-02	7.1206E-02	-2.4370E-02
1.5300E 02	2.9400E 02	8.4288E 00	4.8170E-02	7.1206E-02	-2.4370E-02
2.5750E 02	5.1170E 02	8.4288E 00	4.8170E-02	7.1206E-02	-2.4370E-02
4.6559E 02	9.5379E 02	8.6345E 00	4.7480E-02	6.9103E-02	-2.3110E-02
6.0890E 02	1.2370E 03	8.5000E 00	2.3800E-02		

URANIUM 235

U235

FISSION NEUTRON SPECTRUM

COMPOSITE BETA	BETA1	BETA2	BETA3	BETA4	BETA5	BETA6
1.0000E 00	2.300E-04	1.420E-03	1.260E-03	2.640E-03	8.000E-04	2.200E-04

LAMDA	LAMDA1	INVERSE MEAN DELAY LAMDA2	(/SEC) LAMDA3	LAMDA4	LAMDA5	LAMDA6
2.7716E-02	1.260E-02	3.110E-02	1.134E-01	3.060E-01	1.253E 00	3.381E 00

ENERGY SPECTRUM						
S(N)	S1(N)	S2(N)	S3(N)	S4(N)	S5(N)	S6(N)
2.1844E-02	0.	0.	0.	0.	0.	0.
1.1568E-01	0.	0.	0.	0.	0.	0.
2.1225E-01	0.	0.	10.000E-05	2.275E-03	2.000E-04	0.
2.2483E-01	0.	0.	1.865E-02	5.095E-02	2.452E-02	0.
1.8156E-01	4.705E-02	1.495E-01	1.084E-01	1.509E-01	1.155E-01	0.
1.1402E-01	1.197E-01	2.774E-01	1.856E-01	1.941E-01	1.882E-01	0.
6.3545E-02	2.224E-01	3.077E-01	1.961E-01	1.837E-01	1.950E-01	0.
3.2922E-02	2.419E-01	1.969E-01	1.605E-01	1.424E-01	1.563E-01	1.000E 00
3.3141E-02	3.688E-01	6.840E-02	2.793E-01	2.338E-01	2.707E-01	0.
1.8502E-04	0.	0.	4.430E-02	3.600E-02	4.270E-02	0.
2.5610E-05	0.	0.	6.100E-03	5.000E-03	5.900E-03	0.
3.5000E-06	0.	0.	8.000E-04	7.000E-04	8.000E-04	0.
4.7000E-07	0.	0.	10.000E-05	10.000E-05	10.000E-05	0.
0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
-1.0400000E 00	2.3812500E 02	2.3812500E 02	2.9316000E 02 10

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SCATTER			
		SGS0(N,N)	SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
7.0750E 00	9.5250E-01	6.5800E 00	4.2227E-02	5.9951E-02	-3.2227E-02
6.9700E 00	3.1250E-01	6.6602E 00	5.0127E-02	8.9827E-02	-3.5127E-02
7.6350E 00	0.	7.3803E 00	6.2695E-02	1.1970E-01	-4.2695E-02
8.9900E 00	0.	8.6754E 00	8.0957E-02	1.4962E-01	-5.5957E-02
1.0305E 01	0.	9.9305E 00	9.4834E-02	1.7950E-01	-6.4834E-02
1.2305E 01	0.	1.1933E 01	5.4235E-02	5.2359E-02	-1.9235E-02
1.3890E 01	0.	1.3140E 01	6.2568E-02	5.9837E-02	-2.2568E-02
1.5115E 01	0.	1.3140E 01	6.2568E-02	5.9837E-02	-2.2568E-02
2.4540E 01	0.	1.2048E 01	5.4106E-02	5.2360E-02	-1.9106E-02
1.5115E 02	0.	1.0105E 01	4.6018E-02	4.4875E-02	-1.6018E-02
1.3937E 02	0.	9.1652E 00	5.1221E-02	5.9816E-02	-2.1221E-02
9.5050E 00	0.	8.9953E 00	6.1084E-02	8.9714E-02	-3.1084E-02
9.5950E 00	0.	8.8302E 00	5.1697E-02	7.4802E-02	-2.6697E-02
9.7700E 00	0.	8.5751E 00	4.4902E-02	5.9887E-02	-2.4902E-02
1.0246E 01	0.	8.2929E 00	4.0400E-02	5.6741E-02	-2.0400E-02
1.0357E 01	0.	7.9182E 00	2.2200E-02		

PLUTONIUM 239

PU239

FORMULA F	MASS A (OXY16=16)	FUEL MASS AF (OXY16=16)	TEMPERATURE T (DEG K)
-1.2000000E 00	2.3912700E 02	2.3912700E 02	2.9316000E 02 10

CROSS SECTION (BARN)

COLLIDE SG(N)	MULTIPLY NUSGF(N)	SGS0(N,N)	SCATTER		
			SGS1(N,N)	SGS0(N,N+1)	SGS1(N,N+1)
7.0500E 00	5.7600E 00	4.1788E 00	3.6397E-02	7.1206E-02	-2.4497E-02
7.0500E 00	5.3300E 00	4.2771E 00	3.7658E-02	7.2884E-02	-2.5478E-02
8.0000E 00	4.9000E 00	5.5062E 00	4.9506E-02	9.3835E-02	-3.3825E-02
9.1000E 00	4.7550E 00	6.7352E 00	6.0612E-02	1.1478E-01	-4.1432E-02
9.7500E 00	4.6100E 00	7.3252E 00	6.3191E-02	1.2482E-01	-4.2331E-02
1.2475E 01	8.7850E 00	7.9665E 00	3.4109E-02	3.3510E-02	-1.1709E-02
1.6075E 01	1.6560E 01	7.9665E 00	3.4109E-02	3.3510E-02	-1.1709E-02
1.3750E 01	1.2960E 01	7.9665E 00	3.4109E-02	3.3510E-02	-1.1709E-02
3.5500E 01	4.3200E 01	7.9665E 00	3.4109E-02	3.3510E-02	-1.1709E-02
6.4000E 01	1.0222E 02	7.9665E 00	3.4109E-02	3.3510E-02	-1.1709E-02
6.7000E 01	1.2380E 02	7.9553E 00	3.8011E-02	4.4680E-02	-1.5611E-02
5.8750E 02	8.5390E 02	7.9330E 00	4.5817E-02	6.7020E-02	-2.3417E-02
1.2705E 03	2.0305E 03	7.9330E 00	4.5817E-02	6.7020E-02	-2.3417E-02
1.2263E 03	2.1960E 03	8.7263E 00	5.1674E-02	7.3730E-02	-2.7034E-02
7.9965E 02	1.6278E 03	9.5238E 00	5.3253E-02	7.6225E-02	-2.6373E-02
1.0107E 03	2.0743E 03	9.9957E 00	2.7988E-02		

4. INPUT AND OUTPUT: PROGRAM S

4.1 Input

An initial test case of particular interest in reactor engineering work is sketched in Figure 1. This study of a boron carbide control rod centered in a void annulus had among its objectives delineation of the limitations of the numerical analysis method in both voids and strong absorbers, development of a method for obtaining control-rod-cell albedos on a basis sufficiently flexible to span the range of interest in reactor design, and placement of cell homogenization on a firm logical foundation with inclusion of cell leakage effects. The input data following Figure 1 has been normalized to a void outer radius of unity, to provide dimensional invariance in interpretation of the output.

Each line of numerical data on the input form begins with a format indicator in column 1, having the interpretation:

- 9, alphanumeric floating decimal;
- 0, octal integer;
- I, binary-scaled alphanumeric fixed-point decimal.

This format indicator is followed in columns 2-72 by eight 8-character numbers separated by 1-character blanks. Columns 73-80 are not read by the machine and may be used for alphanumeric comment.

The alphanumeric floating decimal format minimizes card-reading time (and maximizes confusion entropy) by compressing 8 decimal digits, an algebraic sign, and a floating decimal point into 8 alphanumeric characters. The algebraic sign, the decimal point, and the digit following the decimal point are combined into one character, in accordance with the equivalence scheme:

+	=	+	.0	-	=	-	.0
A	=	+	.1	J	=	-	.1
B	=	+	.2	K	=	-	.2
C	=	+	.3	L	=	-	.3
D	=	+	.4	M	=	-	.4
E	=	+	.5	N	=	-	.5
F	=	+	.6	O	=	-	.6
G	=	+	.7	P	=	-	.7
H	=	+	.8	Q	=	-	.8
I	=	+	.9	R	=	-	.9

505 091

Figure 1
CONTROL ROD IN VOID ANNULUS

Physics, Input, Output:
Mathematics: LA-1891
Program: T-1-140, T-1-139

Remarks

[illegible]

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GE-ANP Reactor Analysis Program S
Neutron or Photon Transport
Slab, Cylinder, or Sphere

PROBABILITY/PATH (1/CM)

B₄C 2.519 G/cc

Physics, Input, Output:
Mathematics: IA-1891
Program: T-1-140, T-1-139

PAGE 2

Remarks

2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	
048120530		1	40100530		(55)																																		SG(B4C)	
900000000		1	D8303000		1	C1193000		1	00000000		1	00000000		1	00000000		1	00000000		1	00000000		1	00000000		1	00000000		1	00000000		1	00000000		1	B4C (3) 01				
			D8575000		1	C1286000		1	A6634000																														02	
			D9776000		1	C1988000		1	A6678000																														03	
			E0481000		1	C2316000		1	A7005000																														04	
			E2139000		1	C3252000		1	A7158000																														05	
			E4177000		1	C4393000		1	A7594000																														06	
			E5995000		1	C5310000		1	A8126000																														07	
			E7670000		1	C6040000		1	A8554000																														08	
			F1852000		1	E1310000		1	A8894000																														09	
DUPLICATE COL. 1-10		G2357000		1	E1941000		1	+4818400		DUPLICATE COL. 37-78																														10
			I9090000		1	E1941000		1	+4872900																														11	
			1G187000		1	E1941000		1	+4872900																														12	
			3F932000		1	E1941000		1	+4872900																														13	
			7A512000		1	E0440000		1	+4872900																														14	
			13A21000		1	D7299000		1	+6511800																														15	
			21B61000		1	D7299000		1	+9789400																														16	
			34F81000		1	D7299000		1	+9789400																														17	
			57F45000		1	D7905000		1	+9789400																														18	
			74+83000		1	E6751000		1	+9295400																														19	
048120531		1	40100531		(54)																																			SG(VOID)

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335 094

TR-ANP Reactor Analysis Program S
Neutron or Photon Transport
Slab, Cylinder, or Sphere

PROBABILITY/PATH (1CM)
FE 7.87 G/CC

Physics, Input, Output:
Mathematics: LA-1591
Program: T-1-140, T-1-139

PAGE 3

Remarks

2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80																														
048120532①40100530⑤⑤																																																		SG(FE)																			
900000000①B2329000①B0739000①00000000C①000000000①000000000①000000000①000000000①000000000①FE④01																																																																					
B4791000①B3026000①+1588500																																																		02																			
B6659000①B4761000①+1763600																																																		03																			
B4707000①B2947000①+1896500																																																		04																			
B0548000①A9083000①+1757600																																																		05																			
B4624000①B2868000①+1461700																																																		06																			
C0738000①B8546000①+1751600																																																		07																			
C1249000①B7019000①+2186400																																																		08																			
C6011000①C5356000①+2222700																																																		09																			
DUPLICATE COL. 1-10										D6691000①D5821000①+0640230										DUPLICATE COL. 37-78																				10																													
F8409000①F7084000①+0829730																																																												11									
H9566000①H7681000①+1214800																																																												12									
I5087000①I2600000①+1587700																																																												13									
I5346000①I1420000①+1676800																																																												14									
I6256000①H9695000①+2220700																																																												15									
I6964000①H8344000①+3308300																																																												16									
I9126000①H7075000①+3258500																																																												17									
I+512000①H7290000①+3211700																																																												18									
I+906000①I0015000①+3045700																																																												19									

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GE-ANP Reactor Analysis Program S. SENSORS
Neutron or Photon Transport
Slab, Cylinder, or Sphere

IN	7.31	G/CC
CU	8.94	G/CC
AH	19.3	G/CC

Physics, Input, Output:
Mathematics: LA-1891
Program: T-1-140, T-1-139

PAGE 5
Remarks

[illegible]

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[illegible]

555

GE-ANP Reactor Analysis Program S
Neutron or Photon Transport
Slab, Cylinder, or Sphere

CYLINDER 54 CONSTANTS

Physics, Input, Output:
Mathematics: LA-1891
Program: T-1-140, T-1-139

PAGE 6

Remarks

2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
048220515		(63)																																				ANG BASIS	
9J1870515		0J6787443		00000000		0A6787443		0A1870515																															
048220516																																							
9I1000000		0H5099140		0B5384240		0D9200400		0I4964120																															
048220517																																							
900000000		0I4964120		0D9200400		0B5384240		0H5099140																															
048220520																																							
900000000		00I496412		02B926367		02B926367		00I496412																															
048210521																																							
9I4043230		0E0837410																																					
048210522																																							
9F5214520		0C4785480																																					
048100503		(64)																																				FP(I)	
048100514		(64)																																				SC(I)	
048120523		048100523		(65)																																		PH(I,N)	

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101

For example, in alphanumeric floating decimal:

π	= 3A415927	$-\pi$	= 3J415927
$\pi/10$	= C1415927	$-\pi/10$	= L1415927
$\pi/100$	= +3141593	$-\pi/100$	= -3141593
$10^7 \pi$	= 31415927	$-10^6 \pi$	= 3141592P
$10^{-8} \pi$	= +0000003	$-10^{-8} \pi$	= -0000003

Octal integer format is used for storage allocation control and for labeling of materials in mixture specifications. The octal control data are to be taken directly from the sample input form insofar as applicable, omitted where inapplicable, and extended in the same pattern where necessary and where manifestly possible without octal number overlap. Table 1, at the end of section 4.1, delineates the admissible extensions more sharply. It should be noted that storage overlap considerations at present limit compositional complexity to 16 materials. Any of these 16 materials may be defined as a specified mixture of up to seven previously defined materials or previously defined mixtures. It is planned to extend the limitation of 16 materials to 24. Compositional complexity limitations which may occur can be surmounted to a useful extent by a preliminary mixing calculation available as an option in the nuclear data processing program described in section 3.1. Commonly occurring compounds and alloys are being included in the nuclear data compilation mentioned in section 3.2.

With one exception, input data entries requiring the binary-scaled fixed point decimal format are integers lying in a range where this scheme coincides with the decimal integer system, and it is safe to proceed simply by following the pattern shown on the sample input. The one exception, 2*MM (floating simulated as fixed), is given by the conversion table:

<u>Decimal</u>	<u>Binary-Scaled Alphanumeric Fixed-Point Decimal</u>
4	526 + 0000
8	530 + 0000
12	531 + 0000
16	534 + 0000

For example, in the test case shown, 2*MM = 8 is entered as 530 + 0000.

The geometry-dependent angular-basis blocks (SN constants 048220515-048220520 and 048210521-048210522), as calculated by Carlson, are tabulated in Table 2 for plane, spherical, and cylindrical geometry and for the S2, S4, and S8 level of angular distribution detail.

Table 1

INPUT DECK ASSEMBLY: PROGRAM S

FLOCO Definition	Physical Definition	Format	Note
040000000	Parameters (800-827) _g defining problem scope and digital lattice.		1,16
	800 Case number.	Floating	
	801 Convergence parameter error tolerance DH.	"	
	802 Estimated convergence parameter H.	"	
	803 Zero (802 at previous iteration).	"	2
	804 Zero (803 at previous iteration).	"	2
	805 Zero (804 at previous iteration).	"	2
	806 Zero (iteration count).	"	2
	807 Field: +1, flux; -1, adjoint; 0, both.	"	3
	810 Number of radial lattice increments II.	Fixed	2
	811 Number of radial lattice points II + 1.	"	
	812 Number of energy bands NN.	"	
	813 Number of mixtures.	"	
	814 Type of convergence parameter H. Homogeneous ($Q = 0$) eigenvalue: 0, Reactivity K; 1, Critical radius R(II); 2, Inverse period OMEGA.		4
	Inhomogeneous ($Q \neq 0$) inverse multiplication 1/M: 0, Scatter; 1, ; 2, .		4
	815 Geometry: 0, plane; 1, sphere; 2, cylinder.	"	
	816 Volume source Q(I,N): 0, none; 1, given.	"	
	817 Surface source Q(N): 0, none; 1, given.	"	

Table 1

INPUT DECK ASSEMBLY: PROGRAM S

FLOCO Definition	Physical Definition	Format	Note
	820 Number of relative-angle segments MM.	Fixed	5,2
	821 MM/2.	"	2
	822 MM+1.	"	
	823 2*MM. (Floating simulated as fixed.)	"	2
	824 Number of theory words (1200).	"	2
	825 Zero (set to 1 to mark convergence).	"	2
	826 Number of sensors SS.	"	
	827 Cell boundary lattice point IC.	"	
040400767	Flexible free storage allocation.		
048241401	Flexible theory storage allocation.		
048110501	Lattice radii R(I), I = 0, II.	Floating	16
048120526	Inverse mean inverse velocities V(N), N = 1, NN.	"	6
048120527	Composite prompt-plus-delayed fission production spectrum S(N), N = 1, NN.	"	7
040100565	Delay fractions BETA(J), J = 1, 0.	"	6,7
040100566	Inverse mean delays LAMDA(J), J = 1, 8.	"	6,7
048120567 40100567	Delayed fission production spectra (S(J,N), J = 1, 8), N = 1, NN.	"	6,7
048120530 40100530	Cross Sections	Floating	8,9
...	Multiply Collide Scatter		
048120537 40100537	(NUSGF(N), SG(N), (SGSO(N1,N), N1=N, N-5)),		
048120540 40100540	N=1, NN.		
...			
048120547 40100547			

Table 1

INPUT DECK ASSEMBLY: PROGRAM S

FLOCO Definition	Physical Definition	Format	Note
048130550 40100550	Mixture compositions: (MAT(J), J = 1, JJ(MIX) ≤ 7), MIX), zeros to fill card. (MAT(J), J = 1, JJ(MIX) ≤ 7), MIX), zeros to fill card. ...	Octal	8,10
048130560 40100560	Mixture proportions: (N(MAT(J)), J = 1, JJ(MIX)), zero, zeros to fill card. (N(MAT(J)), J = 1, JJ(MIX)), zero, zeros to fill card. ...	Floating	8,11
048100502	Reactor material composition: MAT(I), I = 1, II.	Octal	10
048100504	Reactor material concentrations: N(I), I = 1, II.	Floating	12
048120563	Surface source Q(N), N = 1, NN.	"	13
048120513 48100513	Volume source (Q(IN), I = 1, II), N = 1, NN.	"	13
048260570 48120570	Sensor activation cross sections (SG(N,S), N = 1, NN), S = 1, SS.	"	13
048260562	Sensor concentrations N(S), S = 1, SS.	"	13
048220515	Angular basis.	Floating	14
048220516			
048220517			
048220520			
048210521			
048210522			
048100503	Fission production/volume $\overline{FP}(I)$, I = 1, II.	"	15,16
048100514	Scattering/volume $\overline{SC}(I)$, I = 1, II.	"	16
048120523 48100523	Flux ($\overline{PHI}(I,N)$, I = 1, II), N = 1, NN.	"	16

Table 1

INPUT DECK ASSEMBLY: PROGRAM S

NOTES

1. Parameter block is to be recoded so as to eliminate forward reference in physical definitions.
2. Entry is to be stored in program or computed by program, rather than fed in as input, at next recoding.
3. Entry is to be shifted to fixed point card, at next recoding.
4. Operating in a useful form, but incomplete.
5. Number of cylindrical-geometry polar-angle lattice points LL is equal to number of relative-angle segments MM.
6. Control card may be omitted in steady-state system.
7. Control card may be omitted if system contains no fissile material.

Normalization:

$$\sum_N S(N) = 1 = \sum_N S(J,N).$$

8. Flexibility:

$$N(I) \sum_{MAT(I)} N(MAT)SG(MAT) = \text{PROBABILITY/PATH}.$$

Materials may be defined either directly, by entry of cross section storage allocation and data, or indirectly, by entry of storage allocation and specifications for mixing up to 7 previously defined materials or previously defined mixtures. Control cards not needed may be omitted.

9. For endothermic scatter, $N = 1$ labels high energy flux or low energy adjoint. For exothermic scatter, $N = 1$ labels low energy flux or high energy adjoint. If adjoint of stated problem is requested, machine transposes all transfer cross sections and inverts energy scale; user of program provides adjoint angle reversal by negative labelling of output current and leakage.
10. A material or mixture is entered as the last 3 octal integers of its FLOCO definition.

$$11. \text{ Machine computes } SG(MIX) = \sum_{J=1}^{JJ(MIX)} N(MAT(J))SG(MAT),$$

for each successive mixture, and places these cross sections in the storage allocation reserved by previous entry of a FLOCO definition for the mixture.

12. Void regions, with $N(I) = 0$, are admissible. Strong absorbers cause no trouble. The mirror-reflection boundary condition commonly used in infinite-lattice idealization is obtainable by enveloping a cell with a synthetic scattering film ten or so mean free paths thick ($SGSO(N,N) = 1 = SG(N)$, all other $SG = 0$). However, a more realistic cell-fine-structure analysis, with inclusion of leakage effects, is obtainable by working with a typical cell centered in an homogenized core.

Table 1

INPUT DECK ASSEMBLY: PROGRAM S

NOTES

13. Control card not relevant to the problem may be omitted.
14. Given in Table 2.
15. Initial estimate may be entered as 1 in fuel, 0 elsewhere.
16. Binary restart cards, containing P800-807, $R(I)$, $\overline{FP}(I)$, $\overline{SC}(I)$, $\overline{PHI}(I,N)$ from same problem, or from problem having the same (I,N) lattice, may be inserted after these control cards to provide initial guess. Control card followed by no data sets a block to zero initial values.

0	1	2	3	4	5	6	7	8
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890

Table 2

ANGULAR BASIS

PLANE AND SPHERE S2 CONSTANTS

048220515		SNG C 00
9J6666667	00000000 A6666667	SNG SNOO
048220516		SNG C 00
91+000000	C3333333 F6666667	SNG SN10
048220517		SNG C 00
900000000	F6666667 C3333333	SNG SN20
048220520		SNG C 00
900000000	1C333333 1C333333	SNG SN30
048210521		SNG C 00
048210522		SNG C 00

PLANE AND SPHERE S4 CONSTANTS

048220515		SNG C 00
9J0416667	J2500000 00000000 A2500000 A0416667	SNG SNOO
048220516		SNG C 00
91+000000	OF666667 OA666667 OC333333 OH333333	SNG SN10
048220517		SNG C 00
900000000	OH333333 OC333333 OA666667 OF666667	SNG SN20
048220520		SNG C 00
900000000	1F666667 3F666667 3F666667 1F666667	SNG SN30
048210521		SNG C 00
048210522		SNG C 00

PLANE AND SPHERE S6 CONSTANTS

048220515		SNG C 00
9-7407407	J11111111 -5555556 00000000 +5555556 A1111111 +7407407	SNG SNOO
048220516		SNG C 00
910000000	G7777778 D4444444 A1111111 B2222222 E5555556 H8888889	SNG SN10
048220517		SNG C 00
900000000	H8888889 E5555556 B2222222 A1111111 D4444444 G7777778	SNG SN20
048220520		SNG C 00
900000000	1G777778 4D444444 5G777778 5G777778 4D444444 1G777778	SNG SN30
048210521		SNG C 00
048210522		SNG C 00

0	1	2	3	4	5	6	7	8
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890

0 1 2 3 4 5 6 7 8
1234567890123456789012345678901234567890123456789012345678901234567890

PLANE AND SPHERE S8 CONSTANTS

048220515 SNG C 00
9-5729167 -9375000 -6250000 -3125000 00000000 +3125000 +6250000 +9375000 SNG SN00
9+5729167 SNG SN00
048220516 SNG C 00
910000000 H3333333 E8333333 C3333333 08333333 A6666667 D1666667 F6666667 SNG SN10
9I1666667 SNG SN10
048220517 SNG C 00
900000000 I1666667 F6666667 D1666667 A6666667 08333333 C3333333 E8333333 SNG SN20
9H3333333 SNG SN20
048220520 SNG C 00
900000000 1H3333333 4H3333333 6H3333333 7H3333333 7H3333333 6H3333333 4H3333333 SNG SN30
91H3333333 SNG SN30
048210521 SNG C 00
048210522 SNG C 00

CYLINDER S2 CONSTANTS

048220515 SNG C 00
9K0264238 00000000 B0264238 SNG SN00
048220516 SNG C 00
91+000000 D6267010 H1056950 SNG SN10
048220517 SNG C 00
900000000 H1056950 D6267010 SNG SN20
048220520 SNG C 00
900000000 H1056950 H1056950 SNG SN30
048210521 SNG C 00
9I1649660 SNG SN40
048210522 SNG C 00
91+000000 SNG SN50

CYLINDER S4 CONSTANTS

048220515 SNG C 00
9J1870515 J6787443 00000000 A6787443 A1870515 SNG SN00
048220516 SNG C 00
91+000000 H5099140 B5384240 D9200400 I4964120 SNG SN10
048220517 SNG C 00
900000000 I4964120 D9200400 B5384240 H5099140 SNG SN20
048220520 SNG C 00
900000000 OI496412 2B926367 2B926367 OI496412 SNG SN30
048210521 SNG C 00
9I4043230 E0837410 SNG SN40
048210522 SNG C 00
9F5214520 C4785480 SNG SN50

0 1 2 3 4 5 6 7 8
1234567890123456789012345678901234567890123456789012345678901234567890

0	1	2	3	4	5	6	7	8
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890

CYLINDER S6 CONSTANTS

048220515								SNG C 00
9-8144679	J4106998	-8144679	00000000	+8144679	A4106998	+8144679		SNG SN00
048220516								SNG C 00
91+000000	I3249790	F3777220	A7215600	C3958920	G6034180	I7736150		SNG SN10
048220517								SNG C 00
900000000	I7736150	G6034180	C3958920	A7215600	F3777220	I3249790		SNG SN20
048220520								SNG C 00
900000000	OI773615	2F702012	3F475626	3F475626	2F702012	OI773615		SNG SN30
048210521								SNG C 00
9I7111320	G5020140	C6124870						SNG SN40
048210522								SNG C 00
9D6791390	C6076160	A7132450						SNG SN50

CYLINDER S8 CONSTANTS

048220515								SNG C 00
9-6170093	J1400846	-8725829	-4722383	00000000	+4722383	+8725829	A1400846	SNG SN00
9+6170093								SNG SN00
048220516								SNG C 00
91+000000	I6177590	G8991530	D9779710	A2989420	B5778420	F0621740	H6235940	SNG SN10
9I8721480								SNG SN10
048220517								SNG C 00
900000000	I8721480	H6235940	F0621740	B5778420	A2989420	D9779710	G8991530	SNG SN20
9I6177590								SNG SN20
048220520								SNG C 00
900000000	OI872148	2H113500	4B074827	4I630640	4I630640	4B074827	2H113500	SNG SN30
9OI872148								SNG SN30
048210521								SNG C 00
9I8303190	H5077360	F0441920	B7900430					SNG SN40
048210522								SNG C 00
9C6268380	C1370670	B2238100	A0122850					SNG SN50

0	1	2	3	4	5	6	7	8
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890

4.2 Operation

For a normal run, the input data deck is sandwiched between the FLOCO assembly deck and the Program S deck and given to the machine operator with the instructions shown in Figure 2. After readying the printer, card punch, and card reader, the operator presses the "Clear Memory" button and then the "Load Cards" button. Program operation is completely automatic and requires no further operator manipulation.

The complete input data is printed out immediately. Sense light 4 flashes a binary iteration count. Every fourth iteration, the program prints one line of monitor information consisting of the iteration count, the last four eigenvalues listed in chronological order, integrated leakage rate, integrated scatter rate, and integrated fission production rate. Sense light 3 flashes on at convergence. After convergence, the program executes one more iteration, during which the final solution is generated and condensed into output information having maximum engineering usefulness. Automatic punching of three packets of binary cards begins near the end of the output-print. The first card packet contains information needed to restart the same problem: parameters 800-807, radii $R(I)$, incrementally averaged fission production density $\overline{FP}(I)$, incrementally-averaged scattering density $\overline{SC}(I)$, and incrementally-averaged flux density $\overline{\phi}(I,N)$. The second packet contains cell-homogenized cross sections $\nu\Sigma_f(N)$, $\Sigma(N)$, $\Sigma_{g0}(N - \Delta N, N)$. The third packet contains similar reactor-homogenized cross sections.

This punched-card output can be fed back into the program as input, on a selective basis, simply by replacing the corresponding decimal cards in the input deck with these binary cards.

If both flux and adjoint output have been specified, sense light 2 flashes on to indicate automatic entry into a similar cycle for the adjoint calculation. Accumulator and multiplier-quotient registers flash full at the final stop, with HTR 0 1000 displayed in the storage register.

Pressing the "Start" button then transfers control to the card loader to read in the next case. Successive cases involving a change in digital lattice structure must be redefined completely by feeding in the new input data deck followed by the Program S deck. Successive cases having identical digital lattice structure can be defined by feeding in data changes only, with each data block preceded by its octal control card, and with the change packet followed by the last three cards in the Program S deck ($\uparrow$ 0 TRA0420 and two blank cards).

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Figure 2

PRODUCTION

Name
 Ext. No. Copies.....
 Job Est. Time.....
 Charge Badge.....
 Production Lib.....
 Other FLOCO PRINT BOARD.....
 Load: Cards..... X Tape.....
 Sense Switches Tapes 4.....
 1..... 4..... 1..... 5.....
 2..... 5..... UP 2..... 6.....
 3..... 6..... UP 3..... 7.....
 Dec. Input: Card..... X Tape.....
 Dec. Output: Printer..... X Tape.....
 Punch..... X BINARY.....
 Crt. Used: Yes No.....
 Tapes to be:
 Saved 4..... Listed 4.....
 1..... 5..... 1..... 5.....
 2..... 6..... 2..... 6.....
 3..... 7..... 3..... 7.....
 Instructions: CLEAR MEMORY, LOAD CARDS.
 ACC FULL
 FINAL STOP: 77777 M-Q FULL.
 For forced termination and restart
 cards, depress SS-6.

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Depressing sense switch 6 at any time brings the calculation to a controlled termination at the end of the next iteration and provides then the full array of output whether or not the pre-specified convergence criterion has been met.

Sense switch 5 at present is used principally to select subroutines under development but not yet released for engineering use. Also, the complete four-dimensional flux distribution $\phi(I,N,L,M)$ is provided as additional output if sense switch 5 is down at the time of entry into the final iteration. Sense switches 1-2-3-4 are inactive, in conformance with ANP Production Operator Program (POP) requirements.

Any occurrence of uncontrolled accumulator overflow during an iteration automatically activates the monitor print at the end of the iteration. If departure from the usual pattern of a monitor print every fourth iteration appears in the output near convergence, the case should be restarted with a more stringent convergence criterion, to force continuance through the singular region.

Until adequate familiarization with program limitations is acquired, it is recommended that every run be monitored by the using engineer.

4.3 Limitations

Work is in progress on delineating numerical limitations of the analysis method. A tape-output option is being added, to reduce print-out time. A FORTRAN reformulation of the analysis method is being extended to include input-output processing, anisotropic and exothermic transfer, adjoint-weighted convergence acceleration, complex field material mode option, and photon energy deposition, with provisions for placing the entire program in an iterative loop to generate a reactor design. The feasibility of extending the analysis method to finite-cylinder geometry is being studied.

4.4 Improvements

Recent expansion of the program capabilities includes: calculation of lattice-point flux, adjoint, or both; calculation of lattice-point current, adjoint current, or both; fission-production normalization; entry of energy-dependent isotropic surface source; calculation of sensor-activation traverses for any number of sensor materials; and calculation of either a flux-weighted or adjoint-weighted spatial homogenization, both for the entire reactor and for a central cell extending out to any specified radius. The homogenization output provides: energy-dependent transfer cross sections for the homogenized cell,

suitable for direct re-entry into a Program S gross structure analysis; energy-dependent cell albedos; and energy-dependent flux diffusion coefficients for the homogenized cell, with inclusion of lumped-void leakage enhancement and other fine structure heterogeneity effects.

4.5 Output

Machine output for the study sketched in Figure 1 follows. In the tape-output extension being formulated, machine insertion of the indicated labelling is being provided.

The print-out begins with all the input data, listed in the order shown in Table 1. An index follows the parameters. This index is an octal print of the program memory allocation stored in core locations 400_8 - 777_8 . Core location 501_8 , for example, contains the block-base location (4615_8) for the radii $R(I)$ which follow the 501 control card in the input deck. The parameters 810 - 817 , and the material labels, also are printed as octal integers. The rest of the output is in 7-figure floating decimal. The second lattice radius, for example, which reads $3.488773-01$, means 3.488773×10^{-01} .

Following the input print, a one-line monitor print occurs every fourth iteration and lists the iteration count, the last four eigenvalues (H''' , H'' , H' , H), leakage L , scatter SC , and fission production FP . The first block of print-out after convergence lists radii $R(I)$, volume elements $DV(I-)/2$, fission production $FP(I-)$ and $FP(I+)$, and sensor activation traverses $A(I,S)$. Fission production and sensor activation are portrayed as point values which are to be connected by straight lines.

The next block of output repeats radii and volume elements, and then gives flux $\phi(I,N)$ and current $J(I,N)$. Flux and current dependence upon radii is portrayed as point values which are to be connected by straight lines. Flux and current dependence upon energy is portrayed as energy-band integrated values. Core-average fission production is normalized to unity, if no surface or volume source is present.

The third and fourth blocks of output provide respectively, a flux-weighted cell homogenization and a flux-weighted reactor-homogenization, for use with exploratory off-design work requiring less detailed analysis. The cell-homogenization is performed by direct spatial integration of each of the reaction-rate terms in the balance equation, with preservation of the detailed balance of leakage, collision, scatter-transfer, fission production, and fixed-source production.

The calculation of the cell-homogenized diffusion coefficient provides an interesting illustration. Requiring that cell-leakage be preserved leads uniquely to defining the energy-dependent diffusion coefficient $D(p)$ for an homogenized cell by the relation

$$\int \nabla \cdot \underline{J}(r,p) dV_{\text{cell}}(r) = - \int \nabla \cdot D(p) \nabla \phi(r,p) dV_{\text{cell}}(r),$$

where $\underline{J}(r,p)$ and $\phi(r,p)$, respectively, are Program S current and flux output. For a central cell having slab, cylindrical, or spherical symmetry (with arbitrarily complex heterogeneity which may include void gaps, annuli, or shells), performing the indicated integration by conversion to a surface integral yields

$$D(p) = [-J(r,p)/(\partial\phi(r,p)/\partial r)]_{r=r_C^-}, \quad (4.31)$$

where $D(p)$ is the leakage-preserving diffusion coefficient for the homogenized cell and $r = r_C^-$ represents an approach to the cell outer radius from the interior. It is to be noted that this argument has both necessary and sufficient character. There is no other diffusion coefficient which preserves cell leakage.

The print-out provides, finally, a complete array of analogous adjoint output. It is to be noted that the labelling of the adjoint energy scale is inverted and that a negative sign is attached to adjoint current and leakage labels.

At the end of the run, information which remains undisturbed in the fast memory includes flux, current, fission production, adjoint, adjoint current, adjoint fission production, and all input data. A perturbation theory subroutine is being formulated to pick up this information in the fast memory and put it to further use.

Also, an option is available which provides this information on a selective basis as punched-card output, in a form suitable for use as direct input to other machine analysis programs.

PROGRAM S
PARAMETERS

INPUT									
FLOCO	C.64000	BB	0.02250						
800-807	5.900000	00	1.000000-06	1.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00
810-817	C.000024	00	0.000025 00	0.000023 00	0.000000 00	0.000000 00	0.000002 00	0.000000 00	0.000001 00
820-827	C.000004	00	0.000002 00	0.000005 00	8.000000 00	0.002260 00	0.000000 00	0.000003 00	0.000020 00

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CORE			INDEX						
400-407	C.000000	00	0.002310 00	0.002353 00	0.002402 00	0.002431 00	0.002503 00	0.002521 00	0.002547 00
410-417	C.002641	00	0.002660 00	0.002740 00	0.003027 00	0.003114 00	0.003210 00	0.003247 00	0.003174 00
420-427	C.004366	00	0.003315 00	0.000000 00	0.000000 00	0.003370 00	0.003443 00	0.003620 00	0.003651 00
430-437	C.003517	00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00
440-447	0.000000	00	0.000000 00	0.000000 00	0.000000 00	0.004045 00	0.004107 00	0.000000 00	0.000000 00
450-457	0.004147	00	0.004272 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00
460-477	0.60000	STZ	0.000002						
500-507	0.000000	00	0.004615 00	0.005642 00	0.006064 00	0.005666 00	0.006753 00	0.006777 00	0.007023 00
510-517	0.007047	00	0.007073 00	0.007120 00	0.000000 00	0.006110 00	0.006015 00	0.006022 00	0.006027 00
520-527	0.006034	00	0.006036 00	0.006040 00	0.006133 00	0.007125 00	0.007321 00	0.000000 00	0.000000 00
530-537	0.004640	00	0.005113 00	0.005366 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00
540-557	0.60000	STZ	0.000002						
560-567	0.000000	00	0.000000 00	0.006010 00	0.005711 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00
570-577	0.005714	00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00
600-607	0.007344	00	0.010206 00	0.011052 00	0.011077 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00
610-617	0.011102	00	0.000000 00	0.000000 00	0.011545 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00
620-627	0.000000	00	0.000000 00	0.000000 00	0.011477 00	0.000000 00	0.011522 00	0.000000 00	0.000000 00
630-637	0.011224	00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.011570 00	0.011613 00	0.000000 00
640-677	0.60000	STZ	0.000004						
700-707	0.011636	00	0.012500 00	0.013344 00	0.013371 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00
710-757	0.60000	STZ	0.000005						
760-767	0.000000	00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.002310 00
770-777	0.001000	00	0.002017 00	0.001504 00	0.001330 00	0.002072 00	0.017400 00	0.000000 00	0.000000 00

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0.64000	BB	0.04615	501	LATTICE RADII R(I), I = 0, II					
0.000000	00	3.488773	-01	3.571272	-01	3.653771	-01	3.736270	-01
4.066266	-01	4.148765	-01	4.165265	-01	4.181765	-01	4.198265	-01
4.586646	-01	5.939985	-01	7.293323	-01	8.646661	-01	1.000000	00
								3.818769	-01
								3.901268	-01
								4.214765	-01
								4.231264	-01
								4.332770	-01

CROSS SECTIONS

BAND		MULTIPLY		COLLIDE		CROSS SECTIONS							
N		NUSGF(N)		SG(N)		SGSO(N,N)	SGSO(N-1,N)	SGSO(N-2,N)	SCATTER	SGSO(N-3,N)	SGSO(N-4,N)	SGSO(N-5,N)	
		0.64000	BB	0.04640	530 B4C								
1	0.000000	00		4.830300	-01	3.119300	-01	0.000000	00	0.000000	00	0.000000	00
2	0.000000	00		4.857500	-01	3.128600	-01	1.663400	-01	0.000000	00	0.000000	00
3	0.000000	00		4.977600	-01	3.198800	-01	1.667800	-01	0.000000	00	0.000000	00
4	0.000000	00		5.048100	-01	3.231600	-01	1.700500	-01	0.000000	00	0.000000	00
5	0.000000	00		5.213900	-01	3.325200	-01	1.715800	-01	0.000000	00	0.000000	00
6	0.000000	00		5.417700	-01	3.439300	-01	1.759400	-01	0.000000	00	0.000000	00
7	0.000000	00		5.599500	-01	3.531000	-01	1.812600	-01	0.000000	00	0.000000	00
8	0.000000	00		5.767000	-01	3.634000	-01	1.855400	-01	0.000000	00	0.000000	00
9	0.000000	00		6.185200	-01	5.131000	-01	1.889400	-01	0.000000	00	0.000000	00
10	0.000000	00		7.235700	-01	5.194100	-01	4.818400	-02	0.000000	00	0.000000	00
11	0.000000	00		9.909000	-01	5.194100	-01	4.872900	-02	0.000000	00	0.000000	00
12	0.000000	00		1.718700	00	5.194100	-01	4.872900	-02	0.000000	00	0.000000	00
13	0.000000	00		3.693200	00	5.194100	-01	4.872900	-02	0.000000	00	0.000000	00
14	0.000000	00		7.151200	00	5.044000	-01	4.872900	-02	0.000000	00	0.000000	00
15	0.000000	00		1.312100	C1	4.729900	-01	6.511800	-02	0.000000	00	0.000000	00
16	0.000000	00		2.126100	C1	4.729900	-01	9.789400	-02	0.000000	00	0.000000	00

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17	0.000000 00	3.468100 01	4.729900-01	5.789400-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
18	0.000000 00	5.764500 01	4.790500-01	5.789400-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
19	0.000000 00	7.408300 01	5.675100-01	5.295400-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00

0.64000 BB 0.05113 531 VOID

N	NUSGF(N)	SG(N)	SGSO(N,N)	SGSO(N-1,N)	SGSO(N-2,N)	SGSO(N-3,N)	SGSO(N-4,N)	SGSO(N-5,N)
1	0.000000 00	2.232900-01	2.073900-01	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00
2	0.000000 00	2.479100-01	2.302600-01	1.588500-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
3	0.000000 00	2.665900-01	2.476100-01	1.763600-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
4	0.000000 00	2.470700-01	2.294700-01	1.896500-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
5	0.000000 00	2.054800-01	1.908300-01	1.757600-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
6	0.000000 00	2.462400-01	2.286800-01	1.461700-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
7	0.000000 00	3.073800-01	2.854600-01	1.751600-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
8	0.000000 00	3.124900-01	2.901900-01	2.186400-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
9	0.000000 00	3.601100-01	3.535600-01	2.222700-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
10	0.000000 00	4.669100-01	4.582100-01	6.402300-03	0.000000 00	0.000000 00	0.000000 00	0.000000 00
11	0.000000 00	6.840900-01	6.708400-01	8.297300-03	0.000000 00	0.000000 00	0.000000 00	0.000000 00
12	0.000000 00	8.956600-01	8.768100-01	1.214800-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
13	0.000000 00	9.508700-01	9.260300-01	1.587700-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
14	0.000000 00	9.534600-01	9.142000-01	1.676800-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
15	0.000000 00	9.625600-01	8.969500-01	2.220700-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
16	0.000000 00	9.696400-01	8.834400-01	3.308300-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
17	0.000000 00	9.912600-01	8.707500-01	3.258500-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
18	0.000000 00	1.051200 00	8.729000-01	3.211700-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
19	0.000000 00	1.090600 00	9.001500-01	3.045700-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00

0.64000 BB 0.05642 502
 0.004640 00 0.004640 00
 0.004640 00 0.004640 00
 0.005113 00 0.005113 00

REACTOR MATERIALS MAT(I), I = 1, II

0.004640 00	0.004640 00	0.004640 00	0.004640 00	0.004640 00	0.004640 00
0.004640 00	0.004640 00	0.004640 00	0.004640 00	0.005113 00	0.005366 00

0.64000 BB 0.05666 504
 1.636180 00 1.636180 00
 1.636180 00 1.636180 00
 2.251100 00 2.251100 00

MATERIAL CONCENTRATIONS N(I), I = 1, II

(N*SG = PROBABILITY/PATH)

1.636180 00	1.636180 00	1.636180 00	1.636180 00	1.636180 00	1.636180 00
1.636180 00	1.636180 00	1.636180 00	1.636180 00	2.251100 00	2.228245 00

0.64000 BB 0.05711 563
 9.471104-01 3.739646 00
 7.517287 00 5.021930 00
 7.598351-01 5.980839-01

SURFACE SOURCE Q(N), N = 1, NN

6.346773 00	6.850132 00	6.002114 00	4.759334 00	3.624363 00	2.782745 00
4.517746 00	4.029646 00	3.284121 00	2.048087 00	1.229335 00	1.017542 00
2.176584 00					

0.64000 BB 0.05714 570

SENSOR ACTIVATION CROSS SECTIONS (SG(N,S), N = 1, NN), S = 1, SS

	IN	CU	AU
1	7.974500-04	1.023250-03	2.300800-03
2	2.070695-02	7.055695-02	1.533846-01
3	3.527846 00	4.575721 00	6.597839 00
4	1.795000-05	2.305000-05	2.955000-05
5	2.159500-04	5.864500-04	1.595200-03
6	1.287128-01	2.153601-01	2.774417-01
7	1.770700-03	2.508500-03	3.689000-03
8	4.574340-02	1.254254-01	2.597043-01
9	2.281266 00	3.732772 00	5.125737 00

0.64000 BB 0.06010 562

SENSOR CONCENTRATIONS N(S), S = 1, SS

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2.251100 00	2.251100 00	2.251100 00		
0.64000 BB	0.06015 515	ANGULAR BASIS		
-1.187051-01	-1.678744-01	0.000000 00	1.678744-01	1.187051-01
0.64000 BB	0.06022 516			
1.200000 00	8.509914-01	2.538424-01	4.920040-01	9.496412-01
0.64000 BB	0.06027 517			
0.000000 00	9.496412-01	4.920040-01	2.538424-01	8.509914-01
0.64000 BB	0.06034 520			
0.000000 00	9.496412-01	2.292636 00	2.292636 00	9.496412-01
0.64000 BB	0.06036 521			
9.404323-01	5.083741-01			
0.64000 BB	0.06040 522			
6.521452-01	3.478548-01			
0.64000 BB	0.06064 503	FISSION PRODUCTION/VOLUME FP(I), I = 1, II		
0.60000 STZ	0.00003			
0.64000 BB	0.06110 514	LABORATORY-ELASTIC SCATTER/VOLUME SC(I), I = 1, II		
0.60000 STZ	0.00003			
0.64000 BB	0.06133 523	FLUX/VOLUME (PHI(I,N), I = 1, II), N = 1, NN		
0.60000 STZ	0.00071			

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6.0000

1.0000

LAST FOUR EIGENVALUES ORDERED CHRONOLOGICALLY

OUTPUT	ITERATION	HPPP	HPP	HP	H	LEAKAGE L	SCATTER SC	FISS PROD FP
	4.000000 00	0.000000 00	0.000000 00	1.000000 00	9.861240-01	-7.744675-01	1.807252 00	0.000000 00
	8.000000 00	9.960193-01	9.988302-01	9.996499-01	9.998936-01	-7.523721-01	1.817430 00	0.000000 00
	1.200000 01	9.999673-01	9.999898-01	9.999968-01	9.999990-01	-7.522018-01	1.817515 00	0.000000 00
	1.600000 01	9.999997-01	9.999999-01	1.000000 00	1.000000 00	-7.522002-01	1.817516 00	0.000000 00
	R(I)	DV(I-)/2	FP(I-)	FP(I+)	A(I, IN)	A(I, CU)	A(I, AU)	
CONVERGE	0.000000 00	0.000000 00	0.000000 00	0.000000 00	3.687353 00	3.542635-02	5.352710 00	
	3.488773-01	3.042884-02	0.000000 00	0.000000 00	3.441089 01	8.968609-02	3.324893 01	
	3.571272-01	1.456118-03	0.000000 00	0.000000 00	3.883670 01	9.566074-02	3.733889 01	
	3.653771-01	1.490148-03	0.000000 00	0.000000 00	4.419132 01	1.031736-01	4.228310 01	
	3.736270-01	1.524179-03	0.000000 00	0.000000 00	5.084696 01	1.129365-01	4.842490 01	
	3.818769-01	1.558209-03	0.000000 00	0.000000 00	5.912233 01	1.260968-01	5.605082 01	
	3.901268-01	1.592240-03	0.000000 00	0.000000 00	6.963748 01	1.450948-01	6.572155 01	
	3.983767-01	1.626267-03	0.000000 00	0.000000 00	8.350345 01	1.761645-01	7.842433 01	
	4.066266-01	1.660301-03	0.000000 00	0.000000 00	1.046185 02	2.387591-01	9.772088 01	
	4.148765-01	1.694331-03	0.000000 00	0.000000 00	1.417184 02	4.196949-01	1.313829 02	
	4.165265-01	3.429487-04	0.000000 00	0.000000 00	1.525431 02	4.848881-01	1.411473 02	
	4.181765-01	3.443130-04	0.000000 00	0.000000 00	1.652513 02	5.726139-01	1.525433 02	
	4.198265-01	3.456711-04	0.000000 00	0.000000 00	1.803393 02	6.913081-01	1.659807 02	
	4.214765-01	3.470323-04	0.000000 00	0.000000 00	1.996852 02	9.054817-01	1.829557 02	
	4.231264-01	3.483936-04	0.000000 00	0.000000 00	2.289616 02	1.435998 00	2.079209 02	
	4.332770-01	2.173250-03	0.000000 00	0.000000 00	2.357111 02	1.481314 00	2.139996 02	
	4.586646-01	5.661061-03	0.000000 00	0.000000 00	2.666502 02	1.686836 00	2.417820 02	
	5.939985-01	3.561523-02	0.000000 00	0.000000 00	3.191009 02	2.030483 00	2.888773 02	
	7.293323-01	4.477286-02	0.000000 00	0.000000 00	3.336090 02	2.124131 00	3.019271 02	
	8.646661-01	5.393047-02	0.000000 00	0.000000 00	3.423264 02	2.180214 00	3.097698 02	
	1.000000 00	6.308810-02	0.000000 00	0.000000 00	3.483289 02	2.218769 00	3.151706 02	
	R(I)	DV(I-)/2	PHI(I,1)	PHI(I,2)	PHI(I,3)	PHI(I,4)	PHI(I,5)	PHI(I,6)
	0.000000 00	0.000000 00	7.798649-01	3.210920 00	5.750040 00	6.594723 00	6.009643 00	4.877459 00
	3.488773-01	3.042884-02	8.289417-01	3.366874 00	5.928756 00	6.675037 00	6.010685 00	4.842102 00
	3.571272-01	1.456118-03	8.312213-01	3.374115 00	5.937065 00	6.678808 00	6.010773 00	4.840454 00
	3.653771-01	1.490148-03	8.336944-01	3.381953 00	5.946025 00	6.682843 00	6.010849 00	4.838663 00
	3.736270-01	1.524179-03	8.363932-01	3.390485 00	5.955743 00	6.687187 00	6.010912 00	4.836707 00
	3.818769-01	1.558209-03	8.393565-01	3.399832 00	5.966347 00	6.691891 00	6.010959 00	4.834555 00
	3.901268-01	1.592240-03	8.426310-01	3.410135 00	5.977991 00	6.697016 00	6.010988 00	4.832173 00
	3.983767-01	1.626267-03	8.462725-01	3.421565 00	5.990861 00	6.702636 00	6.010993 00	4.829519 00
	4.066266-01	1.660301-03	8.503474-01	3.434324 00	6.005172 00	6.708836 00	6.010971 00	4.826543 00
	4.148765-01	1.694331-03	8.549346-01	3.448653 00	6.021184 00	6.715717 00	6.010912 00	4.823184 00
	4.165265-01	3.429487-04	8.559192-01	3.451725 00	6.024609 00	6.717182 00	6.010896 00	4.822461 00
	4.181765-01	3.443130-04	8.569287-01	3.454872 00	6.028116 00	6.718680 00	6.010877 00	4.821721 00
	4.198265-01	3.456711-04	8.579638-01	3.458098 00	6.031709 00	6.720212 00	6.010857 00	4.820961 00
	4.214765-01	3.470323-04	8.590254-01	3.461405 00	6.035388 00	6.721778 00	6.010835 00	4.820181 00
	4.231264-01	3.483936-04	8.601145-01	3.464796 00	6.039159 00	6.723381 00	6.010810 00	4.819380 00
	4.332770-01	2.173250-03	8.628481-01	3.473244 00	6.048504 00	6.727567 00	6.011028 00	4.817398 00
	4.586646-01	5.661061-03	8.725665-01	3.504779 00	6.084391 00	6.741591 00	6.009367 00	4.810664 00
	5.939985-01	3.561523-02	8.952271-01	3.576216 00	6.164138 00	6.774209 00	6.006720 00	4.795097 00
	7.293323-01	4.477286-02	9.061099-01	3.610506 00	6.202443 00	6.790041 00	6.005645 00	4.787604 00
	8.646661-01	5.393047-02	9.129242-01	3.631972 00	6.226430 00	6.799998 00	6.005023 00	4.782909 00
	1.000000 00	6.308810-02	9.177059-01	3.647034 00	6.243262 00	6.806999 00	6.004602 00	4.779613 00
	PHI(I,7)	PHI(I,8)	PHI(I,9)	PHI(I,10)	PHI(I,11)	PHI(I,12)	PHI(I,13)	PHI(I,14)
	3.757408 00	2.875755 00	7.233880 00	4.303430 00	2.793108 00	1.090049 00	5.296759-02	5.226289-03
	3.716634 00	2.847400 00	7.321416 00	4.531621 00	3.338594 00	2.036525 00	8.783568-01	2.397383-01
	3.714731 00	2.846088 00	7.325513 00	4.542021 00	3.363791 00	2.079383 00	9.270286-01	2.708928-01
	3.712676 00	2.844682 00	7.329955 00	4.553272 00	3.391203 00	2.127023 00	9.832341-01	3.076812-01
	3.710447 00	2.843168 00	7.334799 00	4.565517 00	3.421205 00	2.180243 00	1.048395 00	3.526845-01

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3.708012 00	2.841527 00	7.340117 00	4.578932 00	3.454275 00	2.240157 00	1.124747 00	4.073011-01
3.75335 00	2.839737 00	7.345996 00	4.593736 00	3.491018 00	2.308283 00	1.215753 00	4.753940-01
3.702372 00	2.837773 00	7.352540 00	4.610192 00	3.532194 00	2.386671 00	1.335266 00	5.635607-01
3.699071 00	2.835602 00	7.359874 00	4.628623 00	3.578750 00	2.478062 00	1.493443 00	6.902862-01
3.695371 00	2.833189 00	7.368150 00	4.649416 00	3.631867 00	2.586114 00	1.703071 00	8.913994-01
3.694578 00	2.832674 00	7.369929 00	4.653888 00	3.643368 00	2.610020 00	1.752724 00	9.437490-01
3.693766 00	2.832148 00	7.371754 00	4.658475 00	3.655198 00	2.634816 00	1.805630 00	1.001877 00
3.692934 00	2.831610 00	7.373626 00	4.663183 00	3.667372 00	2.660547 00	1.862078 00	1.066645 00
3.692082 00	2.831059 00	7.375548 00	4.668016 00	3.679904 00	2.687264 00	1.922386 00	1.139064 00
3.691207 00	2.830495 00	7.377521 00	4.672979 00	3.692808 00	2.715021 00	1.986904 00	1.220312 00
3.689068 00	2.829238 00	7.382293 00	4.683883 00	3.716140 00	2.750399 00	2.021068 00	1.254905 00
3.681137 00	2.823228 00	7.399276 00	4.731019 00	3.847360 00	2.989234 00	2.278544 00	1.419402 00
3.663932 00	2.810801 00	7.434946 00	4.819709 00	4.054735 00	3.374819 00	2.724411 00	1.698639 00
3.655646 00	2.804887 00	7.452168 00	4.862188 00	4.152733 00	3.516695 00	2.848368 00	1.776069 00
3.650451 00	2.811197 00	7.462974 00	4.888758 00	4.213686 00	3.603412 00	2.922928 00	1.822626 00
3.646804 00	2.798613 00	7.470565 00	4.907393 00	4.256328 00	3.663611 00	2.974293 00	1.854693 00
PHI(I,15)	PHI(I,16)	PHI(I,17)	PHI(I,18)	PHI(I,19)	J(I,1)	J(I,2)	J(I,3)
0.000000 00	0.000000 00	0.000000 00	9.557060-08	0.000000 00	5.711786-10	6.587817-10	4.569429-09
4.999923-02	1.150045-02	1.096413-03	2.201791-05	4.693457-06	-3.928238-02	-1.241013-01	-1.399066-01
6.241685-02	1.625267-02	1.903460-03	5.509941-05	1.511203-05	-4.026991-02	-1.271672-01	-1.432553-01
7.830835-02	2.313555-02	3.339403-03	1.400551-04	4.978763-05	-4.126156-02	-1.302422-01	-1.466069-01
9.875624-02	3.319470-02	5.902343-03	3.669622-04	1.645917-04	-2.25778-02	-1.333274-01	-1.499615-01
1.252372-01	4.802152-02	1.055454-02	9.703538-04	6.136038-04	-4.325908-02	-1.364239-01	-1.533194-01
1.597830-01	7.023572-02	1.914320-02	2.628707-03	2.340593-03	-4.426609-02	-1.395329-01	-1.566809-01
2.052153-01	1.040708-01	3.544707-02	7.215296-03	9.211497-03	-4.527950-02	-1.426561-01	-1.600462-01
2.787852-01	1.566814-01	6.775714-02	2.054821-02	3.692318-02	-4.630070-02	-1.457951-01	-1.634150-01
4.135268-01	2.594757-01	1.359101-01	6.747030-02	1.779842-01	-4.732916-02	-1.489522-01	-1.667903-01
4.561759-01	2.934837-01	1.562243-01	8.428275-02	2.355150-01	-4.753603-02	-1.495859-01	-1.674658-01
5.066343-01	3.337305-01	1.910117-01	1.057918-01	3.138779-01	-4.774328-02	-1.502205-01	-1.681415-01
5.668853-01	4.021204-01	2.377752-01	1.363307-01	4.217219-01	-4.795093-02	-1.508559-01	-1.688174-01
6.395018-01	4.861282-01	3.165532-01	1.983086-01	6.344077-01	-4.815899-02	-1.514922-01	-1.694935-01
7.278330-01	5.999406-01	4.453580-01	3.465837-01	1.251354 00	-4.836746-02	-1.521295-01	-1.701699-01
7.511760-01	6.200223-01	4.604996-01	3.582537-01	1.292929 00	-4.723434-02	-1.485655-01	-1.661833-01
8.503871-01	7.074836-01	5.229682-01	4.092458-01	1.483025 00	-4.503784-02	-1.429713-01	-1.599336-01
1.19195 00	8.422477-01	6.292225-01	4.945544-01	1.797925 00	-3.503966-02	-1.103974-01	-1.234951-01
1.065789 00	8.819347-01	6.582589-01	5.176406-01	1.882547 00	-2.853792-02	-8.991225-02	-1.005795-01
1.093794 00	9.051667-01	6.756757-01	5.314573-01	1.933111 00	-2.407128-02	-7.583958-02	-9.483730-02
1.113077 00	9.211589-01	6.876584-01	5.409530-01	1.967835 00	-2.081363-02	-6.557597-02	-7.335597-02
J(I,4)	J(I,5)	J(I,6)	J(I,7)	J(I,8)	J(I,9)	J(I,10)	J(I,11)
4.569429-09	0.000000 00	5.886992-09	3.602278-09	6.587817-10	8.522119-09	5.986992-09	6.587817-10
-6.057508-02	9.342014-04	2.739084-02	3.079061-02	2.123692-02	-6.465840-02	-1.574699-01	-3.510966-01
-6.189722-02	1.051109-03	2.808872-02	3.153287-02	2.172910-02	-6.628920-02	-1.614823-01	-3.611181-01
-6.321169-02	1.174663-03	2.879024-02	3.227611-02	2.222052-02	-6.792716-02	-1.655150-01	-3.712597-01
-6.451766-02	1.305456-03	2.949569-02	3.302041-02	2.271109-02	-6.957301-02	-1.695701-01	-3.815351-01
-6.581411-02	1.444239-03	3.020553-02	3.376585-02	2.320067-02	-7.122760-02	-1.736501-01	-3.919602-01
-6.709989-02	1.591899-03	3.092022-02	3.451253-02	2.368913-02	-7.289193-02	-1.777580-01	-4.025540-01
-6.837364-02	1.749427-03	3.164033-02	3.526055-02	2.417626-02	-7.456715-02	-1.818972-01	-4.133396-01
-6.963379-02	1.918056-03	3.236654-02	3.601003-02	2.466190-02	-7.625470-02	-1.860719-01	-4.243445-01
-7.087842-02	2.099180-03	3.309963-02	3.676114-02	2.514577-02	-7.795621-02	-1.902870-01	-4.356025-01
-7.212531-02	2.137020-03	3.324712-02	3.691156-02	2.524231-02	-7.829831-02	-1.911353-01	-4.379873-01
-7.337148-02	2.175424-03	3.339495-02	3.706208-02	2.533877-02	-7.864104-02	-1.919555-01	-4.401841-01
-7.461690-02	2.214430-03	3.354309-02	3.721266-02	2.543514-02	-7.898443-02	-1.928376-01	-4.424933-01
-7.586154-02	2.254062-03	3.369155-02	3.736332-02	2.553142-02	-7.932855-02	-1.936917-01	-4.449154-01
-7.710541-02	2.294297-03	3.384037-02	3.751406-02	2.562761-02	-7.967335-02	-1.945479-01	-4.471507-01
-7.841619-02	2.240537-03	3.304756-02	3.663519-02	2.502721-02	-7.780681-02	-1.899902-01	-4.366751-01
-6.670993-02	3.784115-03	3.140076-02	3.480238-02	2.460703-02	-7.270754-02	-1.791240-01	-4.131124-01
-5.151107-02	2.921944-03	2.424653-02	2.687316-02	1.900066-02	-5.614221-02	-1.383133-01	-3.199903-01
-4.195277-02	2.379724-03	1.974736-02	2.188661-02	1.547492-02	-4.572457-02	-1.126481-01	-2.597993-01

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-3.538651-02	2.007242-03	1.665657-02	1.846100-02	1.305284-02	-3.856799-02	-9.501693-02	-2.191367-01
-3.059754-02	1.735571-03	1.440234-02	1.596258-02	1.128634-02	-3.334846-02	-8.215794-02	-1.894801-01
J(I,12)	J(I,13)	J(I,14)	J(I,15)	J(I,16)	J(I,17)	J(I,18)	J(I,19)
1.646954-10	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00
-4.924630-01	-3.644528-01	-1.413925-01	-3.392575-02	-8.291732-03	-8.318130-04	-1.762559-05	-4.100721-06
-5.118382-01	-3.929212-01	-1.601624-01	-4.212706-02	-1.167183-02	-1.443837-03	-4.461976-05	-1.339624-05
-5.317480-01	-4.231383-01	-1.815390-01	-5.242008-02	-1.647480-02	-2.514014-03	-1.134485-04	-4.378475-05
-5.522699-01	-4.554322-01	-2.055038-01	-6.540081-02	-2.334832-02	-4.399421-03	-2.925884-04	-1.451500-04
-5.734953-01	-4.902020-01	-2.329051-01	-8.185424-02	-3.326201-02	-7.754714-03	-7.633755-04	-5.211686-04
-5.955345-01	-5.279603-01	-2.642969-01	-1.028241-01	-4.769900-02	-1.379900-02	-2.020677-03	-1.915553-03
-6.185243-01	-5.665123-01	-3.003969-01	-1.297103-01	-6.897419-02	-2.488202-02	-5.430429-03	-7.221068-03
-6.426371-01	-6.058013-01	-3.424455-01	-1.649081-01	-1.007703-01	-4.576691-02	-1.496618-02	-2.794719-02
-6.680932-01	-6.475830-01	-3.900538-01	-2.102458-01	-1.493969-01	-9.679177-02	-4.484939-02	-1.213023-01
-6.733642-01	-6.562425-01	-4.003657-01	-2.207190-01	-1.616247-01	-9.856435-02	-5.511174-02	-1.574894-01
-6.787020-01	-6.650035-01	-4.109596-01	-2.317519-01	-1.750825-01	-1.121584-01	-6.793825-02	-2.054239-01
-6.841094-01	-6.738656-01	-4.218408-01	-2.433736-01	-1.896060-01	-1.276675-01	-8.412029-02	-2.694036-01
-6.895892-01	-6.828282-01	-4.330147-01	-2.556145-01	-2.054293-01	-1.456004-01	-1.044698-01	-3.557279-01
-6.951445-01	-6.918905-01	-4.444860-01	-2.685048-01	-2.226706-01	-1.661929-01	-1.303098-01	-4.727394-01
-6.788591-01	-6.756813-01	-4.239297-01	-2.541550-01	-2.101138-01	-1.565314-01	-1.225806-01	-4.444782-01
-6.417321-01	-6.229473-01	-3.892707-01	-2.344434-01	-1.947459-01	-1.462238-01	-1.162996-01	-4.264262-01
-4.561089-01	-3.869857-01	-2.415327-01	-1.451744-01	-1.203372-01	-9.008923-02	-7.127143-02	-2.603187-01
-3.714740-01	-3.151772-01	-1.967143-01	-1.182361-01	-9.800762-02	-7.337241-02	-5.804641-02	-2.120143-01
-3.133325-01	-2.658470-01	-1.659254-01	-9.973032-02	-8.266789-02	-6.188847-02	-4.896124-02	-1.788307-01
-2.709280-01	-2.298689-01	-1.434701-01	-8.623344-02	-7.148013-02	-5.351287-02	-4.233513-02	-1.546289-01

FLUX-WEIGHTED CELL HOMOGENIZATION

VOLUME SOURCE Q(N), N = 1, NN

REACTION PROBABILITY/PATH

N	NUSGF(N)	SG(N)	SGSO(N,N)	SGSO(N-1,N)	SGSO(N-2,N)	SGSO(N-3,N)	SGSO(N-4,N)	SGSO(N-5,N)
	0.64000 88	0.11545 613						
	0.60000 STZ	0.00003						
	0.64000 88	0.11224						
1	0.000000 00	7.229946-01	4.828547-01	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00
2	0.000000 00	7.336117-01	4.901296-01	2.339839-01	0.000000 00	0.000000 00	0.000000 00	0.000000 00
3	0.000000 00	7.556582-01	5.043973-01	2.355424-01	0.000000 00	0.000000 00	0.000000 00	0.000000 00
4	0.000000 00	7.615761-01	5.048094-01	2.409729-01	0.000000 00	0.000000 00	0.000000 00	0.000000 00
5	0.000000 00	7.752937-01	5.087871-01	2.431327-01	0.000000 00	0.000000 00	0.000000 00	0.000000 00
6	0.000000 00	8.138924-01	5.339226-01	2.487402-01	0.000000 00	0.000000 00	0.000000 00	0.000000 00
7	0.000000 00	8.539806-01	5.602787-01	2.569652-01	0.000000 00	0.000000 00	0.000000 00	0.000000 00
8	0.000000 00	8.784874-01	5.715657-01	2.639248-01	0.000000 00	0.000000 00	0.000000 00	0.000000 00
9	0.000000 00	9.470062-01	7.988897-01	2.680055-01	0.000000 00	0.000000 00	0.000000 00	0.000000 00
10	0.000000 00	1.117005 00	8.326454-01	6.820120-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
11	0.000000 00	1.533737 00	8.901607-01	6.842695-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
12	0.000000 00	2.521075 00	9.750180-01	6.682074-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
13	0.000000 00	4.526248 00	1.076431 00	6.156978-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
14	0.000000 00	6.890837 00	1.146982 00	5.497022-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
15	0.000000 00	9.081332 00	1.210965 00	6.293105-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
16	0.000000 00	1.032742 01	1.274873 00	8.225480-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
17	0.000000 00	1.110146 01	1.320078 00	7.194504-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
18	0.000000 00	1.193774 01	1.365931 00	6.473447-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
19	0.000000 00	1.242241 01	1.434310 00	5.926713-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00
	PHI(N)	L(N)/PHI(N)	DIFF COEFF D(N)	ALBEDO A(N)				
1	8.239918-01	-9.605597-01	1.185431-01	8.115743-01				
2	3.350890 00	-7.441896-01	1.151023-01	8.491355-01				
3	5.909977 00	-4.720073-01	1.131446-01	9.001080-01				
4	6.666216 00	-1.745444-01	1.207665-01	9.611870-01				
5	6.010401 00	2.745338-03	1.446061-02	1.002522 00				
6	4.845619 00	2.825698-02	2.959485-02	1.026454 00				
7	3.720874 00	4.078483-02	2.784924-02	1.038545 00				
8	2.850534 00	3.764157-02	2.598796-02	1.035482 00				
9	7.312680 00	-1.734194-01	1.086905-01	9.614523-01				

10	4.508968 00	-6.929017-01	9.647734-02	8.592143-01
11	3.285427 00	-2.193164 00	7.992621-02	6.464278-01
12	1.957603 00	-5.717733 00	6.821456-02	3.992254-01
13	9.287232-01	-1.169930 01	6.142376-02	2.929968-01
14	4.109628-01	-1.652129 01	6.007818-02	2.915728-01
15	1.874231-01	-2.181773 01	5.999285-02	2.891743-01
16	1.307894-01	-2.597110 01	5.995701-02	2.866288-01
17	8.650981-02	-2.948137 01	5.942616-02	2.827029-01
18	5.279033-02	-3.230578 01	5.790239-02	2.752169-01
19	2.216916-01	-3.354976 01	5.694999-02	2.697798-01

FLUX-WEIGHTED REACTOR HOMOGENIZATION

0.64000 BB		0.11545 613		VOLUME SOURCE Q(N), N = 1, NN					
0.60000 STZ		0.00003		REACTION PROBABILITY/PATH					
N	NUSGF(N)	SG(N)	SGSO(N,N)	SGSO(N-1,N)	SGSO(N-2,N)	SGSO(N-3,N)	SGSO(N-4,N)	SGSO(N-5,N)	
	0.64000 BB	0.11224							
1	0.000000 00	1.411744-01	9.428390-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
2	0.000000 00	1.455745-01	9.725907-02	4.643069-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
3	0.000000 00	1.530867-01	1.021845-01	4.771790-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
4	0.000000 00	1.579349-01	1.046868-01	4.997272-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
5	0.000000 00	1.631986-01	1.070992-01	5.117923-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
6	0.000000 00	1.728287-01	1.133775-01	5.281958-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
7	0.000000 00	1.821359-01	1.194955-01	5.480521-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
8	0.000000 00	1.871370-01	1.217559-01	5.622176-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
9	0.000000 00	1.963131-01	1.656088-01	5.555719-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
10	0.000000 00	2.214958-01	1.651087-01	1.352390-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
11	0.000000 00	2.676866-01	1.553617-01	1.194271-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
12	0.000000 00	3.278174-01	1.267823-01	8.688753-03	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
13	0.000000 00	3.658273-01	8.700102-02	4.776287-03	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
14	0.000000 00	4.047637-01	6.737309-02	3.228918-03	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
15	0.000000 00	4.112443-01	5.483807-02	2.849806-03	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
16	0.000000 00	3.972540-01	4.903919-02	3.164002-03	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
17	0.000000 00	3.801603-01	4.520496-02	2.463696-03	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
18	0.000000 00	3.784316-01	4.330062-02	2.052111-03	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
19	0.000000 00	3.827470-01	4.419255-02	1.826079-03	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
	PHI(N)	L(N)/PHI(N)	DIFF COEFF D(N)	ALBEDO A(N)					
1	8.877534-01	-1.875623-01	5.890840-01	9.132163-01					
2	3.552478 00	-1.476736-01	5.892200-01	9.305742-01					
3	6.137113 00	-9.562279-02	5.897999-01	9.540806-01					
4	6.762465 00	-3.619692-02	5.915372-01	9.821801-01					
5	6.006806 00	5.778685-04	1.395219-01	1.001156 00					
6	4.800549 00	6.000291-03	1.478340-01	1.012126 00					
7	3.670185 00	8.698518-03	1.480774-01	1.017663 00					
8	2.815092 00	8.018455-03	1.477356-01	1.016262 00					
9	7.421137 00	-3.594971-02	5.945982-01	9.823021-01					
10	4.783629 00	-1.373985-01	5.966622-01	9.352030-01					
11	3.960104 00	-3.827780-01	6.013512-01	8.364891-01					
12	3.167152 00	-6.843448-01	6.090755-01	7.423087-01					
13	2.417346 00	-7.607315-01	6.056529-01	7.322459-01					
14	1.471849 00	-7.798087-01	6.054834-01	7.320362-01					
15	8.706896-01	-7.923232-01	6.052018-01	7.316827-01					
16	7.152978-01	-7.994448-01	6.049027-01	7.313078-01					
17	5.314587-01	-8.055246-01	6.043831-01	7.306458-01					
18	4.166946-01	-8.127799-01	6.033701-01	7.293251-01					
19	1.513679 00	-8.172348-01	6.026511-01	7.283748-01					

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OUTPUT	ITERATION	HPPP	HPP	HP	H	-L*	SC*	FP*
	4.000000 00	0.000000 00	0.000000 00	1.000000 00	1.000133 00	-6.807335-01	1.827431 00	0.000000 00
	8.000000 00	1.000060 00	1.000023 00	1.000008 00	1.000002 00	-6.809587-01	1.827258 00	0.000000 00
	1.200000 01	1.000001 00	1.000000 00	1.000000 00	1.000000 00	-6.809638-01	1.827255 00	0.000000 00
	1.300000 01	1.000000 00	1.000000 00	1.000000 00	1.000000 00	-6.809638-01	1.827255 00	0.000000 00
CONVERGE	R(I) 0.000000 00	DV(I-)/2 0.000000 00	FP*(I-) 0.000000 00	FP*(I+) 0.000000 00	A*(I, IN) 3.530949 00	A*(I, CU) 3.373326-02	A*(I, AU) 5.134209 00	
	3.488773-01	3.042884-02	0.000000 00	0.000000 00	3.368165 01	8.765205-02	3.254366 01	
	3.571272-01	1.456118-03	0.000000 00	0.000000 00	3.809591 01	9.364270-02	3.662332 01	
	3.653771-01	1.490148-03	0.000000 00	0.000000 00	4.348812 01	1.011976-01	4.160391 01	
	3.736270-01	1.524179-03	0.000000 00	0.000000 00	5.013869 01	1.109769-01	4.774175 01	
	3.818769-01	1.558209-03	0.000000 00	0.000000 00	5.841151 01	1.241539-01	5.536614 01	
	3.901268-01	1.592240-03	0.000000 00	0.000000 00	6.893298 01	1.432024-01	6.504191 01	
	3.983767-01	1.626267-03	0.000000 00	0.000000 00	8.277166 01	1.743507-01	7.771464 01	
	4.066266-01	1.660301-03	0.000000 00	0.000000 00	1.039301 02	2.370103-01	9.705296 01	
	4.148765-01	1.694331-03	0.000000 00	0.000000 00	1.410785 02	4.180403-01	1.307619 02	
	4.165265-01	3.429487-04	0.000000 00	0.000000 00	1.519176 02	4.832399-01	1.405403 02	
	4.181765-01	3.443130-04	0.000000 00	0.000000 00	1.646417 02	5.709955-01	1.519517 02	
	4.198265-01	3.456711-04	0.000000 00	0.000000 00	1.797485 02	6.898407-01	1.654069 02	
	4.214765-01	3.470323-04	0.000000 00	0.000000 00	1.991089 02	9.040364-01	1.823964 02	
	4.231264-01	3.483936-04	0.000000 00	0.000000 00	2.283999 02	1.434776 00	2.073762 02	
	4.332770-01	2.173250-03	0.000000 00	0.000000 00	2.353045 02	1.480308 00	2.136016 02	
	4.586646-01	5.661061-03	0.000000 00	0.000000 00	2.662964 02	1.686063 00	2.414301 02	
	5.939985-01	3.561523-02	0.000000 00	0.000000 00	3.189981 02	2.030187 00	2.887636 02	
	7.293323-01	4.477286-02	0.000000 00	0.000000 00	3.335364 02	2.123906 00	3.018452 02	
	8.646661-01	5.393047-02	0.000000 00	0.000000 00	3.422688 02	2.180029 00	3.097041 02	
	1.000000 00	6.308810-02	0.000000 00	0.000000 00	3.482804 02	2.218612 00	3.151151 02	
	R(I) 0.000000 00	DV(I-)/2 0.000000 00	PHI*(I,19) 0.000000 00	PHI*(I,18) 4.364233-09	PHI*(I,17) 0.000000 00	PHI*(I,16) 0.000000 00	PHI*(I,15) 0.000000 00	PHI*(I,14) 5.079149-03
	3.488773-01	3.042884-02	4.640685-06	1.988176-05	1.054506-03	1.124847-02	4.900651-02	2.347378-01
	3.571272-01	1.456118-03	1.503900-05	5.145385-05	1.848267-03	1.595777-02	6.135441-02	2.658082-01
	3.653771-01	1.490148-03	4.945626-05	1.346166-04	3.261916-03	2.278629-02	7.717481-02	3.030261-01
	3.736270-01	1.524179-03	1.638514-04	3.575022-04	5.798987-03	3.277062-02	9.755219-02	3.480117-01
	3.818769-01	1.558209-03	6.113493-04	9.579780-04	1.041210-02	4.753259-02	1.239667-01	4.026903-01
	3.901268-01	1.592240-03	2.334879-03	2.616968-03	1.894571-02	6.965977-02	1.584593-01	4.707634-01
	3.983767-01	1.626267-03	9.192662-03	7.209237-03	3.517756-02	1.034006-01	2.038592-01	5.585297-01
	4.066266-01	1.660301-03	3.688043-02	2.061258-02	6.739545-02	1.559114-01	2.772821-01	6.857939-01
	4.148765-01	1.694331-03	1.778295-01	6.779660-02	1.354325-01	2.574684-01	4.120577-01	8.873106-01
	4.165265-01	3.429487-04	2.353212-01	8.470503-02	1.556123-01	2.924475-01	4.547435-01	9.397648-01
	4.181765-01	3.443130-04	3.136332-01	1.063345-01	1.903740-01	3.375874-01	5.052428-01	9.980039-01
	4.198265-01	3.456711-04	4.214100-01	1.372654-01	2.370765-01	4.009234-01	5.655331-01	1.062888 00
	4.214765-01	3.470323-04	6.338380-01	1.997002-01	3.156682-01	4.848543-01	6.381766-01	1.135423 00
	4.231264-01	3.483936-04	1.250038 00	3.495397-01	4.442275-01	5.985338-01	7.265056-01	1.216784 00
	4.332770-01	2.173250-03	1.291492 00	3.615113-01	4.593674-01	6.187112-01	7.501897-01	1.252603 00
	4.586646-01	5.661061-03	1.481857 00	4.118960-01	5.220447-01	7.013551-01	8.494867-01	1.417299 00
	5.939985-01	3.561523-02	1.797599 00	4.752956-01	6.289638-01	8.429478-01	1.018960 00	1.698112 00
	7.293323-01	4.477286-02	1.882325 00	5.181445-01	6.580831-01	8.817308-01	1.065636 00	1.775710 00
	8.646661-01	5.393047-02	1.932937 00	5.318507-01	6.755385-01	9.050076-01	1.093674 00	1.822346 00
	1.000000 00	6.308810-02	1.967690 00	5.412808-01	6.875440-01	9.210262-01	1.112977 00	1.854460 00
	PHI*(I,13) 4.945146-02	PHI*(I,12) 1.010053 00	PHI*(I,11) 2.666224 00	PHI*(I,10) 4.090803 00	PHI*(I,9) 6.854024 00	PHI*(I,8) 3.511197 00	PHI*(I,7) 3.501623 00	PHI*(I,6) 4.449118 00
	8.575896-01	1.984421 00	3.256843 00	4.384628 00	7.060375 00	3.300976 00	3.532538 00	4.542416 00
	9.068009-01	2.028593 00	3.284166 00	4.398327 00	7.070008 00	3.291289 00	3.533937 00	4.546762 00
	9.635600-01	2.077672 00	3.313822 00	4.413094 00	7.080383 00	3.280715 00	3.535530 00	4.551469 00
	1.029317 00	2.132471 00	3.346203 00	4.429111 00	7.091624 00	3.269104 00	3.537352 00	4.556595 00

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1.106337 00	2.194121 00	3.381810 00	4.446597 00	7.103883 00	3.256275 00	3.539444 00	4.562212 00
1.199275 00	2.264166 00	3.421273 00	4.465821 00	7.117341 00	3.242006 00	3.541860 00	4.568414 00
1.322861 00	2.344675 00	3.465382 00	4.487113 00	7.132217 00	3.226026 00	3.544664 00	4.575298 00
1.482265 00	2.438412 00	3.515120 00	4.510869 00	7.148775 00	3.208012 00	3.547937 00	4.582992 00
1.693356 00	2.549052 00	3.571704 00	4.537567 00	7.167328 00	3.187571 00	3.551775 00	4.591645 00
1.743331 00	2.573505 00	3.583936 00	4.543295 00	7.171301 00	3.183163 00	3.552618 00	4.593501 00
1.796567 00	2.598857 00	3.596511 00	4.549168 00	7.175371 00	3.178636 00	3.553489 00	4.595404 00
1.853354 00	2.625154 00	3.609443 00	4.555191 00	7.179542 00	3.173987 00	3.554389 00	4.597355 00
1.914308 00	2.652447 00	3.622748 00	4.561368 00	7.183817 00	3.169210 00	3.555320 00	4.599355 00
1.978877 00	2.680789 00	3.636440 00	4.567707 00	7.188200 00	3.164300 00	3.556282 00	4.601408 00
2.013305 00	2.716876 00	3.661260 00	4.581563 00	7.198488 00	3.153224 00	3.558429 00	4.606435 00
2.275629 00	2.962023 00	3.801358 00	4.643181 00	7.239473 00	3.105906 00	3.566811 00	4.624344 00
2.723680 00	3.370882 00	4.022779 00	4.758686 00	7.323849 00	3.006571 00	3.584649 00	4.665352 00
2.847871 00	3.514010 00	4.127495 00	4.813993 00	7.364405 00	2.959353 00	3.593063 00	4.685059 00
2.922540 00	3.601323 00	4.192648 00	4.848582 00	7.389808 00	2.929913 00	3.598293 00	4.697401 00
2.973970 00	3.661870 00	4.238235 00	4.872840 00	7.407636 00	2.909294 00	3.601950 00	4.706063 00
PHI*(I,5)	PHI*(I,4)	PHI*(I,3)	PHI*(I,2)	PHI*(I,1)	-J*(I,19)	-J*(I,18)	-J*(I,17)
5.652683 00	6.578898 00	6.344876 00	4.165089 00	1.482750 00	0.000000 00	0.000000 00	0.000000 00
5.759102 00	6.661668 00	6.347754 00	4.040775 00	1.322598 00	-4.090867-06	-1.727808-05	-8.232467-04
5.764074 00	6.665533 00	6.347906 00	4.035012 00	1.315142 00	-1.336934-05	-4.389710-05	-1.430230-03
5.769440 00	6.669691 00	6.348045 00	4.028761 00	1.307093 00	-4.370279-05	-1.125033-04	-2.494306-03
5.775266 00	6.674191 00	6.348169 00	4.021943 00	1.298353 00	-1.448018-04	-2.914883-04	-4.373262-03
5.781631 00	6.679031 00	6.348274 00	4.014459 00	1.288806 00	-5.202253-04	-7.636020-04	-7.720935-03
5.788629 00	6.684460 00	6.348357 00	4.006193 00	1.278309 00	-1.912980-03	-2.025715-03	-1.375652-02
5.796373 00	6.690382 00	6.348411 00	3.997004 00	1.266698 00	-7.213549-03	-5.453755-03	-2.483122-02
5.804999 00	6.696953 00	6.348429 00	3.986726 00	1.253772 00	-2.792749-02	-1.503902-02	-4.571041-02
5.814665 00	6.704290 00	6.348402 00	3.975160 00	1.239297 00	-1.212400-01	-4.504922-02	-8.673662-02
5.816735 00	6.705858 00	6.348391 00	3.972678 00	1.236199 00	-1.574126-01	-5.534915-02	-9.849121-02
5.818855 00	6.707462 00	6.348377 00	3.970133 00	1.233027 00	-2.053288-01	-6.821926-02	-1.120756-01
5.821027 00	6.709105 00	6.348361 00	3.967524 00	1.229777 00	-2.692856-01	-8.446259-02	-1.275895-01
5.823253 00	6.710787 00	6.348342 00	3.964849 00	1.226447 00	-3.555715-01	-1.048736-01	-1.455160-01
5.825534 00	6.712510 00	6.348321 00	3.962104 00	1.223035 00	-4.725480-01	-1.307636-01	-1.661123-01
5.831291 00	6.716868 00	6.348370 00	3.955320 00	1.214397 00	-4.442683-01	-1.230550-01	-1.563672-01
5.850393 00	6.732415 00	6.347986 00	3.929688 00	1.183653 00	-4.270066-01	-1.149830-01	-1.466822-01
5.896305 00	6.768037 00	6.347434 00	3.871790 00	1.111903 00	-2.604804-01	-7.090427-02	-9.021724-02
5.918448 00	6.785217 00	6.347250 00	3.844041 00	1.077375 00	-2.121460-01	-5.774738-02	-7.347666-02
5.932336 00	6.795993 00	6.347156 00	3.826680 00	1.055738 00	-1.789418-01	-4.870901-02	-6.197641-02
5.942090 00	6.803560 00	6.347097 00	3.814502 00	1.040549 00	-1.547249-01	-4.211704-02	-5.358990-02
-J*(I,16)	-J*(I,15)	-J*(I,14)	-J*(I,13)	-J*(I,12)	-J*(I,11)	-J*(I,10)	-J*(I,9)
0.000000 00	0.000000 00	0.000000 00	0.000000 00	1.307052-09	6.587817-10	1.317563-09	1.317563-09
-8.248909-03	-3.384990-02	-1.413661-01	-3.665390-01	-5.061865-01	-3.777085-01	-2.057427-01	-1.510513-01
-1.161668-02	-4.205198-02	-1.601963-01	-3.952665-01	-5.260266-01	-3.882527-01	-2.108259-01	-1.546763-01
-1.640885-02	-5.235240-02	-1.814331-01	-4.257684-01	-5.464029-01	-3.989099-01	-2.159244-01	-1.583050-01
-2.327304-02	-6.534907-02	-2.054645-01	-4.583725-01	-5.673914-01	-4.096917-01	-2.210398-01	-1.619377-01
-3.317950-02	-8.192925-02	-2.329538-01	-4.934783-01	-5.890810-01	-4.206117-01	-2.261735-01	-1.655750-01
-4.761610-02	-1.028373-01	-2.644555-01	-5.213290-01	-6.115784-01	-4.316861-01	-2.313276-01	-1.692173-01
-6.889662-02	-1.297757-01	-3.006463-01	-5.689633-01	-6.350111-01	-4.429339-01	-2.365042-01	-1.728652-01
-1.007105-01	-1.649389-01	-3.427880-01	-6.085346-01	-6.595370-01	-4.543780-01	-2.417061-01	-1.765193-01
-1.493232-01	-2.103336-01	-3.905910-01	-6.595991-01	-6.853561-01	-4.660458-01	-2.469361-01	-1.801805-01
-1.515642-01	-2.208297-01	-4.009448-01	-6.593135-01	-6.906918-01	-4.684095-01	-2.479857-01	-1.809136-01
-1.750133-01	-2.318856-01	-4.115805-01	-6.631282-01	-6.960909-01	-4.707816-01	-2.490367-01	-1.816670-01
-1.895533-01	-2.435290-01	-4.225030-01	-6.770422-01	-7.015558-01	-4.731655-01	-2.500889-01	-1.823808-01
-2.053938-01	-2.557880-01	-4.337167-01	-6.860544-01	-7.070889-01	-4.755605-01	-2.511426-01	-1.831149-01
-2.226489-01	-2.686898-01	-4.452251-01	-6.951637-01	-7.126929-01	-4.779669-01	-2.521976-01	-1.838493-01
-2.499239-01	-2.840121-01	-4.235965-01	-6.786439-01	-6.959963-01	-4.667694-01	-2.462892-01	-1.795422-01
-1.53046-01	-2.348888-01	-3.903110-01	-6.243891-01	-6.585434-01	-4.417553-01	-2.331611-01	-1.705809-01
-1.204856-01	-1.452861-01	-2.417925-01	-3.873472-01	-4.581425-01	-3.411078-01	-1.800388-01	-1.317166-01
-9.812848-02	-1.183270-01	-1.969267-01	-3.154716-01	-3.731303-01	-2.778123-01	-1.466311-01	-1.072755-01

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-8.276984-02	-9.980704-02	-1.661046-01	-2.660954-01	-3.147295-01	-2.343304-01	-1.236810-01	-9.048523-02
-7.156828-02	-8.629978-02	-1.436250-01	-2.300837-01	-2.721360-01	-2.026176-01	-1.069428-01	-7.823954-02
-J*(I,8)	-J*(I,7)	-J*(I,6)	-J*(I,5)	-J*(I,4)	-J*(I,3)	-J*(I,2)	-J*(I,1)
6.587817-10	6.854144-09	1.317563-09	1.317563-09	1.317563-09	0.000000 00	6.854144-09	1.471748-09
1.648994-01	-2.726920-02	-7.190603-02	-8.182415-02	-6.380621-02	-8.857723-04	9.963266-02	1.262907-01
1.693883-01	-2.823081-02	-7.369618-02	-8.378478-02	-6.529252-02	-8.120649-04	1.021420-01	1.293241-01
1.739186-01	-2.921458-02	-7.549264-02	-8.574723-02	-6.677721-02	-7.316993-04	1.046622-01	1.323608-01
1.784946-01	-3.022330-02	-7.729592-02	-8.771166-02	-6.826011-02	-6.439859-04	1.071943-01	1.354010-01
1.831218-01	-3.126024-02	-7.910654-02	-8.967824-02	-6.974097-02	-5.480791-04	1.097395-01	1.384452-01
1.878962-01	-3.232925-02	-8.092516-02	-9.164716-02	-7.121953-02	-4.430632-04	1.122993-01	1.414937-01
1.925551-01	-3.343488-02	-8.275248-02	-9.361866-02	-7.269545-02	-3.277424-04	1.148756-01	1.445468-01
1.973772-01	-3.458260-02	-8.458939-02	-9.559301-02	-7.416840-02	-2.008503-04	1.174705-01	1.476052-01
2.022828-01	-3.577885-02	-8.643688-02	-9.757052-02	-7.563788-02	-6.076861-05	1.200863-01	1.506692-01
2.032748-01	-3.602444-02	-8.680775-02	-9.796642-02	-7.593131-02	-3.103322-05	1.206121-01	1.512828-01
2.042706-01	-3.627234-02	-8.717907-02	-9.836247-02	-7.622458-02	-6.632962-07	1.211390-01	1.518967-01
2.052705-01	-3.652262-02	-8.755089-02	-9.875866-02	-7.651767-02	3.031374-05	1.216669-01	1.525107-01
2.062746-01	-3.677534-02	-8.792321-02	-9.915500-02	-7.681060-02	6.194763-05	1.221957-01	1.531251-01
2.072829-01	-3.703059-02	-8.829604-02	-9.955149-02	-7.710334-02	9.425735-05	1.227257-01	1.537398-01
2.08268-01	-3.616306-02	-8.622749-02	-9.721925-02	-7.529702-02	9.202251-05	1.198505-01	1.501380-01
1.962093-01	-3.469319-02	-8.248018-02	-9.283394-02	-7.199257-02	4.744046-04	1.155472-01	1.442238-01
1.515058-01	-2.678886-02	-6.368831-02	-7.168309-02	-5.559014-02	3.662942-04	8.922152-02	1.113645-01
1.233926-01	-2.181796-02	-5.187043-02	-5.838172-02	-4.527493-02	2.983013-04	7.266570-02	9.069991-02
1.040797-01	-1.840312-02	-4.375191-02	-4.924407-02	-3.818870-02	2.516108-04	6.129236-02	7.650395-02
8.999425-02	-1.591258-02	-3.783083-02	-4.257969-02	-3.302050-02	2.175253-04	5.299743-02	6.615037-02

ADJOINT-WEIGHTED CELL HOMOGENIZATION

VOLUME SOURCE Q(N), N = NN, 1		REACTION PROBABILITY/PATH							
N	NUSGF*(N)	SG*(N)	SGSO*(N,N)	SGSO*(N,N+1)	SGSO*(N,N+2)	SGSO*(N,N+3)	SGSO*(N,N+4)	SGSO*(N,N+5)	
	0.64000 BB	0.11545 613							
	0.60000 STZ	0.00003							
	0.64000 BB	0.11224							
19	0.000000 00	1.242294 01	1.434359 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
18	0.000000 00	1.191440 01	1.365722 00	6.137208-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
17	0.000000 00	1.107582 01	1.320513 00	7.126148-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
16	0.000000 00	1.029519 01	1.275643 00	3.155105-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
15	0.000000 00	9.045200 00	1.212337 00	9.410809-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
14	0.000000 00	6.863280 00	1.148968 00	7.311363-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
13	0.000000 00	4.510755 00	1.078977 00	6.188522-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
12	0.000000 00	2.516147 00	9.773595-01	6.793201-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
11	0.000000 00	1.532680 00	8.907752-01	6.935768-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
10	0.000000 00	1.116129 00	8.324681-01	6.928497-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
9	0.000000 00	9.461350-01	7.983633-01	6.837999-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
8	0.000000 00	8.814224-01	5.722799-01	2.706597-01	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
7	0.000000 00	8.529141-01	5.600174-01	2.632550-01	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
6	0.000000 00	8.122140-01	5.332861-01	2.559009-01	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
5	0.000000 00	7.741149-01	5.082674-01	2.478839-01	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
4	0.000000 00	7.615465-01	5.047995-01	2.427445-01	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
3	0.000000 00	7.570381-01	5.048027-01	2.413291-01	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
2	0.000000 00	7.373250-01	4.913604-01	2.374143-01	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
1	0.000000 00	7.323942-01	4.865330-01	2.391131-01	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
	PHI*(N)	-L*(N)/PHI*(N)	DIFF COEFF D*(N)	ALBEDO A*(N)					
19	2.214761-01	-3.362810 01	5.694656-02	2.687839-01					
18	6.327437-02	-3.169574 01	5.793715-02	2.834406-01					
17	8.627103-02	-2.965565 01	5.941400-02	2.804483-01					
16	1.303627-01	-2.613086 01	5.999542-02	2.845757-01					
15	1.866374-01	-2.195120 01	6.005478-02	2.878187-01					
14	4.078609-01	-1.669142 01	6.016579-02	2.896724-01					
13	9.165726-01	-1.188182 01	6.042818-02	2.913542-01					
12	1.902687 00	-6.036868 00	6.819911-02	3.844108-01					
11	3.198261 00	-2.409143 00	8.005141-02	6.228238-01					

10	4.354043 00	-9.340246-01	9.606648-02	8.174686-01
9	7.038692 00	-4.227011-01	1.056641-01	9.099912-01
8	3.321298 00	2.576004-01	2.631800-02	1.289235 00
7	3.530501 00	-1.713968-01	1.050758-01	9.618357-01
6	4.532898 00	-3.173719-01	1.169191-01	9.311130-01
5	5.747991 00	-2.816991-01	1.233814-01	9.384804-01
4	6.652860 00	-1.887444-01	1.175614-01	9.581219-01
3	6.347123 00	3.259168-04	7.848996-03	1.000299 00
2	4.053349 00	1.243027-01	2.861147-02	1.124963 00
1	1.339319 00	4.695563-01	2.977456-02	1.644427 00

ADJOINT-WEIGHTED REACTOR HOMOGENIZATION

0.64000 BB		0.11545 613		VOLUME SOURCE Q(N), N = NN, 1					
0.60000 STZ		0.00003		REACTION PROBABILITY/PATH					
N	NUSGF*(N)	SG*(N)	SGSO*(N,N)	SGSO*(N,N+1)	SGSO*(N,N+2)	SGSO*(N,N+3)	SGSO*(N,N+4)	SGSO*(N,N+5)	
19	0.000000 00	3.824631-01	4.415937-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
18	0.000000 00	3.800172-01	4.356058-02	1.957500-03	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
17	0.000000 00	3.784054-01	4.511533-02	2.434647-03	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
16	0.000000 00	3.948949-01	4.893012-02	3.128070-03	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
15	0.000000 00	4.080488-01	5.469120-02	4.245422-03	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
14	0.000000 00	4.003886-01	6.702828-02	4.265287-03	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
13	0.000000 00	3.602690-01	8.617671-02	4.942703-03	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
12	0.000000 00	3.195482-01	1.241237-01	5.627301-03	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
11	0.000000 00	2.629911-01	1.528472-01	1.190101-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
10	0.000000 00	2.169805-01	1.618354-01	1.346930-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
9	0.000000 00	1.921307-01	1.621229-01	1.388586-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
8	0.000000 00	2.025643-01	1.315186-01	6.220174-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
7	0.000000 00	1.769976-01	1.162154-01	5.463096-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
6	0.000000 00	1.665259-01	1.093381-01	5.246663-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
5	0.000000 00	1.591857-01	1.045179-01	5.097381-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
4	0.000000 00	1.577705-01	1.045799-01	5.028968-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
3	0.000000 00	1.592570-01	1.061946-01	5.076806-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
2	0.000000 00	1.615918-01	1.076863-01	5.203163-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
1	0.000000 00	1.816696-01	1.206840-01	5.931177-02	0.000000 00	0.000000 00	0.000000 00	0.000000 00	
PHI*(N)	-L*(N)/PHI*(N)	DIFF COEFF D*(N)	ALBEDO A*(N)						
19	1.513395 00	-8.178957-01	6.025249-01	7.282118-01					
18	3.173373-01	-8.073477-01	6.044358-01	7.306728-01					
17	5.312198-01	-8.070318-01	6.040880-01	7.302759-01					
16	7.149853-01	-8.007806-01	6.046452-01	7.309874-01					
15	8.703529-01	-7.932395-01	6.050404-01	7.314832-01					
14	1.470796 00	-7.812095-01	6.052572-01	7.317564-01					
13	2.414235 00	-7.624233-01	6.054564-01	7.320041-01					
12	3.151792 00	-6.907462-01	6.082724-01	7.412013-01					
11	3.921163 00	-4.133826-01	6.015095-01	8.254602-01					
10	4.711693 00	-1.815786-01	5.966312-01	9.159044-01					
9	7.291864 00	-8.583764-02	5.939173-01	9.586259-01					
8	3.040321 00	5.920049-02	1.476695-01	1.131893 00					
7	3.579024 00	-3.556853-02	5.888282-01	9.324837-01					
6	4.651094 00	-6.506999-02	5.910806-01	9.583538-01					
5	5.880414 00	-5.792748-02	5.908237-01	9.717419-01					
4	6.755686 00	-3.910247-02	5.905454-01	9.807730-01					
3	6.347264 00	6.854145-05	1.239457-01	1.000137 00					
2	3.890845 00	2.724211-02	1.472462-01	1.057163 00					
1	1.135892 00	1.164729-01	1.473513-01	1.291331 00					

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4.6 Program S Listing

Development work in extending the capabilities of Program S is still sufficiently far from completion to make a complete program report neither desirable nor possible at this time. A formal record of the program as initially released for GE-ANPD use definitely is needed, however, to provide users of the program with a basis for detailed trouble-shooting of malfunctioning cases. A direct listing of the program seems to provide the best interim integration of these requirements. Table 3 is a complete listing. Any one in possession of Carlson's original SNG Neutron Diffusion Code can assemble this extended version in operating form by replacing the SNG formulae packet with a punched-card transcription of this listing. The FLOCO assembly packet remains unaltered.

TABLE 3
GE-ANPD PROGRAM S
FORMULATION 1

INTERNAL FLOCO DEFINITIONS

048100505		DR(I)/2
048100506		SR(I)/2
048100507		DR/SR
048100510		DH(I)
048100511		Q(I)
048110512		DV(I)/2
048220524	48110524	PH(INLM)
048120525		L(N)
048120600	48110600	PH(I,N)
048120601	48110601	J(I,N)
048110602		P(I-)
048110603		P(I+)
048260610	48110610	A(I,S)
048120630	40100630	SG(N,N)
048120623		PHI(N)
048120625		L(N)
048120613		Q(N)
048120635		D(N)
048120636		A(N)
048120700	48110700	PH*(I,N)
048120701	48110701	J*(I,N)
048110702		P*(I-)
048110703		P*(I+)

SUBROUTINE 401								CROSS SECTION MIXING
040000401	LXA1813	70001243	SXD4840	CLA1550	STA0216	CLA1560	STA0223SNG	MX00
0 STA0230	SXD1841	LXA1812	LXA2110	LXA4110	STZ0830	CLA4000	STA0220SNG	MX10
0 CLA1000	STA0225	STA0235	CLA4000	TZE0234	CLA2000	TZE0233	LRS0043SNG	MX20
0 FMP4000	FAD0830	STO0830	20014216	CLA0830	STO2000	20012214	20011213SNG	MX30
0 LXD1841	20011204	LXD4840	TRA4001					SNG MX40

SUBROUTINE 402								GEOMETRY
040000402	LXA2815	CAL0207	SUB0101	STA0210	STA0213	LXA1810	CLA1501SNG	GE00
0 FAD1000	SUB0111	STO1506	FSB1000	STO1505	70002225	FDH1506	STQ1507SNG	GE10
0 LDQ1505	FMP1506	30012225	LRS0043	FMP1506	STO1512	20011207	TRA4001SNG	GE20

IBROUTINE 403

MEAN FREE PATH

040000403	LXA1814	LXD2841	LDQ0100	70011207	CLA0802	FDH2526	STQ0830SNG	HI00
0 LXA1810	CLA1502	STA0213	CLA2000	SUB0107	STA0217	LDQ1504	FMP0000SNG	HI10
0 FAD0830	TPL0223	CLA0100	LRS0043	FMP1505	STO1510	20011211	TRA4001SNG	HI20

SUBROUTINE 404

FREE FLIGHT SOURCE

040000404	LXA1810	LXD2841	CLA1502	STA0205	CLA2000	STA0226	LDQ2527SNG	ST00
0 FMP1503	STO0830	CLA0816	TZE0222	CLA2513	STA0216	LDQ1000	FMP0802SNG	ST10
0 FAD0830	STO0830	STZ0831	CLA2523	LXA2106	STA0231	CLA2000	TZE0237SNG	ST20
0 LRS0043	FMP1000	FAD0831	STO0831	CAL0231	SUB0810	20012225	LDQ0831SNG	ST30
0 FMP1504	FAD0830	ADD0112	LRS0043	FMP1505	LDQ0120	TLQ0250	CLA0100SNG	ST40
0 STO1511	20011202	TRA4001					SNG	ST50

SUBROUTINE 405

BOUNDARY CONDITIONS

040000405	CLA0817	TZE0206	LXD1841	LDQ1563	TRA0207	LDQ0100	LXA1822	BC00 GE
0 CLA1524	SUB0101	STA0214	78211216	STQ0000	20011210	TRA4001		BC10 GE

SUBROUTINE 406

ANGULAR BASIS

040000406	LXA1815	30011206	CLA0121	LDQ0121	TRA0211	LXD1842	CLA1522SNG	SN00
0 LDQ1521	STO0836	STQ0837	FMP2516	STO0833	LDQ0837	FMP2517	STO0834SNG	SN10
0 LDQ0837	FMP2520	STO0835	LDQ0837	FMP0836	STO0837	TRA4001	SNG	SN20

SUBROUTINE 407

ANGULAR FLUX

040000407	CLS0101	38212204	CLA0101	STO0843	CLA2524	38212210	SUB0101SNG	AF00
0 STA0257	SUB0811	STA0235	ADD0843	STA0243	ADD0811	STA0264	LXA1101SNG	AF10
038212222	LXA1810	LDQ1507	FMP0835	STO0831	78202231	CLA1511	SUB0111SNG	AF20
0 TRA0246	CLA0834	FAD0831	FSB1510	LRS0043	FMP1000	STO0832	CLS0834SNG	AF30
0 FAD0831	FSB1510	LRS0043	FMP1000	FAD0832	FAD1511	STO0832	CLA0833SNG	AF40
0 FAD0831	FAD1510	STO0830	CLA0833	FSB0831	FSB1510	LRS0043	FMP1000SNG	AF50
0 FAD0832	FDH0830	TQP0264	LDQ0100	STQ1000	38212270	20011222	TRA0272SNG	AF60
010011271	78101222	TRA4001					SNG	AF70

SUBROUTINE 410

CENTER CONDITIONS

040000410	LXA1821	10011203	CLA1524	SUB0811	STA0207	STA0210	LDQ0000SNG	CC00
0 STQ0000	CAL0207	SUB0811	STA0207	CAL0210	ADD0811	20011206	TRA4001SNG	CC10

SUBROUTINE 411

TOTAL FLUX AND LEAKAGE

040000411	SXD4840	LXD4842	10014204	LXD2841	CLA2523	STA0232	STA0233SNG	TF00
0 LXA1810	STZ0830	LXA2822	CLA2524	STA0217	SUB0101	STA0220	CLA1000SNG	TF10
0 FAD1000	38202223	30012224	SUB0111	FAD0830	STO0830	20012213	FDH0823SNG	TF20
0 FMP0836	38214233	FAD1000	STO1000	20011211	LXA2822	STZ0830	CLA2524SNG	TF30
0 STA0241	LDQ1000	FMP2515	FAD0830	STO0830	20012237	LRS0043	FMP0837SNG	TF40
0 LXD2841	38214253	FAD2525	STO2525	LXD4840	LXA2815	30012260	TRA4003SNG	TF50
0 TRA4001							SNG	TF60

SUBROUTINE 412

FISSION PRODUCTION AND ELASTIC SCATTER

040000412	LXA1810	STZ0831	STZ0832	LDQ1503	FMP1512	FAD0831	STO0831SNG	FD00
0 LDQ1514	FMP1512	FAD0832	STO0832	20011204	LXA1810	CLA1502	STA0226SNG	FD10
0 LXA2812	STZ0830	STZ0833	CLA2523	STA0234	STA0240	CLA2000	SUB0106SNG	FD20
0 STA0237	SUB0102	STA0233	LDQ0000	FMP1000	FAD0830	STO0830	LDQ0000SNG	FD30
0 FMP1000	FAD0833	STO0833	20012223	LRS0043	FMP1504	STO1514	LDQ0830SNG	FD40
0 FMP1504	STO1503	20011216	LXA1810	STZ0830	STZ0833	LDQ1503	FMP1512SNG	FD50
0 FAD0830	STO0830	LDQ1514	FMP1512	FAD0833	STO0833	20011256	TRA4001SNG	FD60

SUBROUTINE 413

MISCELLANEOUS AVERAGES

040000413	CLA0816	TZE0222	LXA2812	STZ0837	CLA2513	STA0210	LXA1810SNG	AV00
0 LDQ1000	FMP1512	FAD0837	STO0837	20011210	20012205	LRS0043	FMP0802SNG	AV10
0 FAD0831	STO0831	LXA2814	70012240	LXA2812	STZ0835	CLA2523	STA0231SNG	AV20
0 LXA1810	CLA1000	FDH2526	FMP1512	FAD0835	STO0835	20011231	20012226SNG	AV30
0 LXA1812	CLA0100	FAD1525	20011242	LXA2815	70002253	LRS0043	FMP1501SNG	AV40
030012253	LRS0043	FMP1501	FDH0122	STQ0834	CLA0122	FSB0806	TPL4002SNG	AV50
0 CLA0832	FDH0833	STQ0836	FMP0831	STO0831	TRA4001		SNG	AV60

SUBROUTINE 414

PARAMETER CHANGE

040000414	CLA0804	STO0805	CLA0803	STO0804	CLA0802	STO0803	CLA0817SNG	CP00
0 TZE0213	LDQ0836	TRA0257	CLA0816	TZE0221	CLA0831	FSB0830	FDH0837SNG	CP10
0 TRA0257	LXA2814	30002234	CLA0830	FDH0831	STQ0802	LXA1810	CLA1503SNG	CP20
0 FDH0802	STQ1503	20011227	TRA0260	30012252	CLA0831	FSB0834	STO0836SNG	CP30
0 CLA0830	FSB0834	FDH0836	STQ0836	LXA1811	CLA1501	FDH0836	STQ1501SNG	CP40
020011245	TRA0257	LDQ0802	FMP0835	FAD0830	FSB0831	FDH0835	STQ0802SNG	CP50
0 TRA4001							SNG	CP60

SUBROUTINE 417

MONITOR PRINT

040000417	SXD4840	TSX4771	10011807	10011806	10011805	10011804	10011803	MP00 GE
010011835	10011834	50011831	LXD4840	TRA4001				MP10 GE

IBROUTINE 415

CONVERGENCE TEST

040000415	CLA0806	FAD0121	STO0806	MSE0144	PSE0144	MSE0143	TRA0211	EX00	GE
0 TRA4002	CLA0111	ALS0006	ADD0040	STP0040	TNO0221	SXD4150	TSX4417	EX10	GE
0 LXD4150	LXA1103	CLA1805	FSB1806	LDQ0801	LLS0000	TZE0235	TLQ0235	EX20	GE
020011222	CLA0101	STO0825	PSE0143	TRA4001	PSE0166	TRA4001	TRA0233	EX30	GE

SUBROUTINE 416

DUMP

040000416	SXD4841	CLA0807	TMI0205	TRA0206	TSX4222	TSX4774	10101810	DP00	GE
018111501	18101503	18101514	58122523	CLA0807	TMI0220	LXD4841	TRA4001	DP10	GE
0 TSX4222	TRA0216	SXD4140	LXA1812	LXA2101	SXD2226	70001245	CLA2523	DP20	GE
0 STA0236	STA0240	CLA1523	STA0237	STA0241	LXA4810	LDQ4000	CLA4000	DP30	GE
0 STO4000	STQ4000	20014236	10012244	20011225	LXD4140	TRA4001		DP40	GE

SUBROUTINE 421

INPUT PRINT

040000421	SXD4153	TSX4772	10301830	14001770	18111501	18121526	18121527	IP00	GE
010101565	10101566	58122567	35500020	CLA0213	ARS0022	STA0220	LXA4213	IP10	GE
0 CLA4000	TZE0227	STA0225	SXD4152	TSX4772	58122000	LXD4152	20014220	IP20	GE
0 TSX4772	18132550	18132560	18101502	18101504	18121563	18122513	18262570	IP30	GE
018261562	18221515	18221516	18221517	18221520	18211521	18211522	18101503	IP40	GE
018101514	58122523	LXD4153	TRA4001					IP50	GE

SUBROUTINE 424

LATTICE POINT FLUX AND CURRENT

040000424	SXD4840	LXD4842	10014204	LXD2841	CLA2600	STA0242	STA0243	FJ00	GE
0 CLA2601	STA0247	STA0250	LXA1811	STZ0860	STZ0861	LXA2822	CLA2524	FJ10	GE
0 STA0222	STA0230	CLA1000	38202225	30012226	SUB0111	FAD0860	STO0860	FJ20	GE
0 LDQ1000	FMP2515	FAD0861	STO0861	20012217	CLA0860	ADD0111	FDH0823	FJ30	GE
0 FMP0836	38214243	FAD1000	STO1000	LDQ0861	FMP0837	38214250	FAD1000	FJ40	GE
0 STO1000	20011214	LXD4840	TRA4001					FJ50	GE

SUBROUTINE 425

LATTICE POINT FISSION PRODUCTION

040000425	LXA1810	CLA1502	STA0213	LXA2812	STZ0860	STZ0861	CLA2600	FP00	GE
0 STA0224	SUB0101	STA0220	CLA2000	SUB0110	STA0217	STA0223	LDQ0000	FP10	GE
0 FMP1000	FAD0861	STO0861	LDQ0000	FMP1000	FAD0860	STO0860	20012207	FP20	GE
0 LDQ0860	FMP1504	STO1602	LDQ0861	FMP1504	10011236	STO1603	20021202	FP30	GE
0 CLA0816	ADD0817	ADD0814	TNZ0254	LXA1811	CLA1602	FDH0802	STQ1602	FP40	GE
0 CLA1603	FDH0802	STQ1603	20011245	TRA4001				FP50	GE

SUBROUTINE 430

FISSION PRODUCTION NORMALIZATION

040000430	CLA0816	ADD0817	TNZ4001	STZ0150	STZ0151	LXA1810	CLA1602	NF00	GE
010011211	FAD1603	20011213	TZE0223	LRS0043	FMP1512	FAD0150	STO0150	NF10	GE
0 CLA1512	FAD0151	STO0151	20011207	CLA0151	ADD0111	FDH0150	STQ0151	NF20	GE
0 LXA1106	LDQ1836	FMP0151	STO1836	20011231	LXA1811	38101245	LDQ1503	NF30	GE
0 FMP0151	STO1503	LDQ1514	FMP0151	STO1514	LDQ1602	FMP0151	STO1602	NF40	GE
0 LDQ1603	FMP0151	STO1603	LXA2812	38101263	CLA2523	STA0260	STA0262	NF50	GE
0 LDQ1000	FMP0151	STO1000	CLA2600	STA0266	STA0270	LDQ1000	FMP0151	NF60	GE
0 STO1000	CLA2601	STA0274	STA0276	LDQ1000	FMP0151	STO1000	20012254	NF70	GE
020011236	TRA4001							NF80	GE

SUBROUTINE 426

SENSOR ACTIVATION

040000426	CLA0826	TZE0231	SXD4140	LXA1826	CLA1610	STA0225	CLA1570	SA00	GE
0 STA0217	LXA2811	STZ0150	LXA4812	CLA4600	STA0216	LDQ2000	FMP4000	SA10	GE
0 FAD0150	STO0150	20014214	LDQ0150	FMP1562	STO2000	20012212	20011205	SA20	GE
0 LXD4140	TRA4001							SA30	GE

SUBROUTINE 427

HOMOGENIZATION

040000427	SXD4140	CLA0811	SUB0827	ALS0022	STD0216	STD0231	STD0251	H000	GE
0 STD0307	STZ0150	LXA2810	CLA2512	FAD0150	STO0150	70002220	20012213	H010	GE
0 LXA1812	CLA1523	STA0225	STZ1623	LXA2810	LDQ2000	FMP2512	FAD1623	H020	GE
0 STO1623	70002233	20012225	FDH0150	STQ1623	20011221	CLA0816	TZE0256	H030	GE
0 LXA1812	CLA1513	STA0245	STZ1613	LXA2810	LDQ2000	FMP2512	FAD1613	H040	GE
0 STO1613	70002253	20012245	FDH0150	STQ1613	20011241	LXA1812	CLA1523	H050	GE
0 STA0275	CLA1630	STA0304	STA0305	LXA2810	PXD2000	SUB0117	STD0303	H060	GE
0 CLA2502	STA0272	CLA1000	STA0276	LXA4110	LDQ2000	FMP4000	FDH1623	H070	GE
0 FMP2504	FDH0150	FMP2512	30002305	FAD4000	STO4000	20014275	70002311	H100	GE
020012270	CLA1601	STA0313	CLA2000	STO0151	LXA4815	70004324	LRS0043	H110	GE
0 FMP2501	30014324	LRS0043	FMP2501	SUB0111	FDH1623	STQ1625	CLA1625	H120	GE
0 FDH0150	STQ1625	CLA1600	STA0336	STA0340	STA0350	CLA2000	10012340	H130	GE
0 FSB2000	20012342	SUB0111	FDH2505	STQ1635	CLS0151	FDH1635	STQ1635	H140	GE
0 CLA2000	SUB0111	FSB0151	STO1636	FAD0151	FAD0151	FDH1636	STQ1636	H150	GE
020011257	TSX4772	18121613	58122630	TSX4771	18121623	18121625	18121635	H160	GE
058121636	TSX4774	58122630	LXD4140	TRA4001				H170	GE

SUBROUTINE 444

OUTPUT PRINT

040000444	SXD4867	TSX4417	CLA0826	TNZ0213	TSX4771	18111501	18111512	OP00	GE
018111602	58111603	TRA0221	TSX4771	18111501	18111512	18111602	18111603	OP10	GE
058262610	TSX4771	18111501	18111512	18122600	58122601	TSX4416	CLA0827	OP20	GE
0 TZE0232	TSX4427	CLA0827	STO0857	CLA0810	STO0827	TSX4427	CLA0857	OP30	GE
0 STO0827	LXD4867	TRA4001						OP40	GE

SUBROUTINE 445

FIELD STORAGE

040000445	LDQ0802	STQ0032	LXA1811	LDQ1602	STQ1702	LDQ1603	STQ1703	FS00	GE
^ LXA2812	CLA2600	STA0221	CLA2700	STA0222	CLA2601	STA0223	CLA2701	FS10	GE
STA0224	LDQ1000	STQ1000	LDQ1000	STQ1000	20012211	20011204	STZ0040	FS20	GE
U CLS0800	ST00800	LXA1104	STZ1807	20011233	CLS0121	ST00807	STZ0825	FS30	GE
0 TRA4001								FS40	GE

SUBROUTINE 450-451

ADJOINT

040000450	MSE0142	PSE0142	SXD4140	LXA1812	LDQ1527	STQ1636	STZ1527	A000	GE
020011205	35500020	CLA0211	ARS0022	STA0216	LXA1211	CLA1000	TZE0323	A010	GE
0 STA0232	STA0242	STA0262	STA0264	STA0272	STA0305	STA0310	LXA2110	A020	GE
0 STZ0150	LXA4812	CLA4000	STA0234	CLA2000	FAD0150	ST00150	20014232	A030	GE
0 TZE0254	LXA4812	CLA4000	STA0245	STA0252	CLA2000	FDH0150	STQ4527	A040	GE
0 LDQ4636	FMP0150	ST02000	20014242	SXD1141	LXA2105	LXA1812	60011300	A050	GE
0 SXD1142	LXA4812	CLA1000	STA0266	CLA4000	STA0267	LDQ2000	STQ2000	A060	GE
020014271	20011262	CLA4000	STA0274	STZ2000	20014272	LXD1142	20012257	A070	GE
0 LXA2110	LXA1812	LXA4101	SXD4304	70001321	CLA1000	STA0313	STA0315	A100	GE
0 CLA4000	STA0314	STA0316	LDQ2000	CLA2000	ST02000	STQ2000	10014320	A110	GE
020011303	20012301	LXD1141	20011216					A120	GE
040000451	LXA1812	LXA2101	SXD2204	70001273	LDQ1526	CLA2526	ST01526	A200	GE
0 STQ2526	LDQ1527	CLA2527	ST01527	STQ2527	CLA0817	TZE0223	LDQ1563	A210	GE
0 CLA2563	ST01563	STQ2563	CLA0816	TZE0241	CLA1513	STA0234	STA0236	A220	GE
0 CLA2513	STA0235	STA0237	LXA4810	LDQ4000	CLA4000	ST04000	STQ4000	A230	GE
020014234	CLA1523	STA0250	STA0252	CLA2523	STA0251	STA0253	LXA4810	A240	GE
0 LDQ4000	CLA4000	ST04000	STQ4000	20014250	LXA4826	70004271	CLA4570	A250	GE
0 STA0264	STA0265	STA0266	STA0267	LDQ1000	CLA2000	ST01000	STQ2000	A260	GE
020014257	10012272	20011203	LXD4140	TRA4001				A270	GE

SUBROUTINE 420

FLOW CODE

040000420	TSX4421	TSX4401	CLA0807	TMI0206	TRA0212	TSX4450	PSE0165	FC00	GE
0 TRA0212	TSX4421	TSX4402	LXA2812	SXD2841	TSX4403	TSX4404	TSX4405	FC10	GE
0 LXA2821	SXD2842	LXA2822	TSX4406	TSX4407	20012226	38212223	TSX4410	FC20	GE
0 TSX4406	TSX4407	20012230	MSE0143	TRA0243	PSE0143	TSX4424	PSE0165	FC30	GE
0 TRA0243	TSX4771	58222524	TSX4411	LXD2842	20012221	LXD2841	20012214	FC40	GE
0 TSX4412	TSX4413	TSX4414	TSX4415	TRA0212	TSX4425	TSX4430	TSX4426	FC50	GE
0 TSX4444	CLA0825	TZE0267	CLA0807	TNZ0267	TSX4445	TRA0206	LXA4101	FC60	GE
0 CLA0300	ST04000	PXD0000	MSE0003	PSE0006	ST00150	LDQ0150	TRA4000	FC70	GE
0 HTR0770								FC100GE	

* TRA0420

TRANSFER
BLANK
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- OPTIONS (PUNCH FIELD, PUNCH ADJOINT, PRINT THEORY)

@ TSX4774	18122600	18122601	18111602	58111603	HTR0770
@ TSX4774	18122700	18122701	18111702	58111703	HTR0770
@ TSX4773	58240401	HTR0770			

PUNCH F
PUNCH F*
PRINT S

U N C L A S S I F I E D

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Bernard H. Duane

U N C L A S S I F I E D

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