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PERC, A Two-dimensional
Perturbation Code Based on
Diffusion Theory

by

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May 1967

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TABLE OF CONTENTS

	<u>Page</u>
MATHEMATICAL FORMULATION	5
LIFETIME AND ALPHA CALCULATIONS	14
DISPLAY CALCULATIONS	15
MACHINE REQUIREMENTS	16
PROGRAM USAGE	16
CARD DECK PREPARATION	18
RESTRICTIONS	19
SCHEMATIC FLOW DIAGRAM	19
APPENDIX A: Derivation of $\delta(1/k)$ for the Case of Linear, Homogeneous Boundary Conditions	22
APPENDIX B: Sample Problem	25
REFERENCES	72

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MATHEMATICAL FORMULATION

PERC is a two-dimensional code based on diffusion theory and is primarily concerned with estimating the changes in k_{eff} due to changes in the reactor systems. The means for estimating these changes is first-order perturbations theory based on the steady-state, multigroup diffusion equations with zero boundary conditions on the external surface. This approach of perturbing the steady-state system is similar to that of Meghreblian and Holmes.¹ In addition, a prompt-neutron lifetime is performed.

The steady-state, multigroup diffusion equations in the absence of external sources can be written in the form

$$\left(\frac{1}{k} F - M\right) \phi = 0, \quad (1)$$

where F is the fission operator and M is the operator containing the Laplacian, absorption, and scattering terms. The boundary conditions on the external surfaces are assumed to be either $\phi = 0$ or $\partial\phi/\partial n = 0$.[†] The system is perturbed, and the perturbed system is assumed to be described by

$$\left(\frac{1}{k'} F' - M'\right) \phi' = 0. \quad (2)$$

Moreover, the perturbed flux still satisfies boundary conditions of the form $\phi' = 0$ or $\partial\phi'/\partial n = 0$.

Note that in this formulation we are perturbing the steady-state system and we seek the value k' for which the system remains in a steady state. Thus we are perturbing the eigenvalue problem defined by Eq. (1). If we set $M' = M + \delta M$, $F' = F + \delta F$, $\phi' = \phi + \delta\phi$, and $1/k' = 1/k + \delta(1/k)$, then Eq. (2) becomes

$$0 = \left(\frac{1}{k} F - M\right) \phi + \delta\left(\frac{1}{k}\right) F \phi + \left(\frac{1}{k} \delta F - \delta M\right) \phi + \left(\frac{1}{k} F - M\right) \delta\phi \\ + \text{higher-order terms.} \quad (3)$$

[†]Appendix A gives the derivation for the core of linear, homogeneous boundary conditions.

Forming the inner product of each term in this equation with the adjoint flux ϕ^* corresponding to the unperturbed system, we obtain, after neglecting higher-order terms,

$$0 = \delta\left(\frac{1}{k}\right) \langle F\phi, \phi^* \rangle + \left\langle \left(\frac{1}{k} \delta F - \delta M\right) \phi, \phi^* \right\rangle + \left\langle \left(\frac{1}{k} F - M\right) \delta\phi, \phi^* \right\rangle. \quad (4)$$

We have assumed that the perturbed flux lies in the domain of the unperturbed operator. If we apply Green's theorem to the last inner product, we obtain

$$\begin{aligned} \left\langle \left(\frac{1}{k} F - M\right) \delta\phi, \phi^* \right\rangle &= \left\langle \delta\phi, \left(\frac{1}{k} F - M\right)^* \phi^* \right\rangle \\ &+ \sum_{g=1}^G \int_{B(R)} D_g \left\{ \phi_g^* \frac{\partial}{\partial n} \delta\phi_g - \delta\phi_g \frac{\partial \phi_g^*}{\partial n} \right\} ds, \end{aligned} \quad (5)$$

where the index g refers to the energy groups and the integral extends over the external surface. Here $\left(\frac{1}{k} F - M\right)^*$ denotes the adjoint of the operator $\frac{1}{k} F - M$, and its domain coincides with that of the operator $\frac{1}{k} F - M$ since the boundary conditions are linear and homogeneous. Thus ϕ^* satisfies the same boundary conditions as ϕ ; moreover, since these conditions are restricted to be of the form $\phi = 0$ or $\partial\phi/\partial n = 0$, $\delta\phi$ satisfies the same boundary conditions. Thus both terms on the right-hand side of Eq. (5) vanish. If we had permitted a boundary condition of the form

$$\frac{D}{2} \frac{\partial \phi}{\partial n} + \frac{1}{4} \phi = 0,$$

then ϕ^* would still satisfy the same boundary conditions; however, ϕ' would satisfy

$$\frac{D'}{2} \frac{\partial \phi'}{\partial n} + \frac{1}{4} \phi' = 0,$$

where D' is a perturbed diffusion constant. Thus $\delta\phi$ would then satisfy

$$\frac{D'}{2} \frac{\partial}{\partial n} \delta\phi + \frac{1}{4} \delta\phi + \frac{\delta D}{2} \frac{\partial \phi}{\partial n} = 0.$$

In this case, the last term on the right-hand side would not be zero, and we would have

$$\left\langle \left(\frac{1}{k} F - M \right) \delta \phi, \phi^* \right\rangle = \sum_{g=1}^G \int_{B(R)} D_g \frac{\delta D_g}{2D_g D'_g} \phi'_g \phi_g^* ds. \quad (6)$$

However, as shown in Appendix A, this term occurs also in

$$\left\langle \left(\frac{1}{k} \delta F - \delta M \right) \phi, \phi^* \right\rangle,$$

but with opposite sign. Thus the formulation herein holds for linear, homogeneous boundary conditions.

Returning now to Eq. (3) we obtain

$$\delta \left(\frac{1}{k} \right) = \frac{\left\langle \left(\delta M - \frac{1}{k} \delta F \right) \phi, \phi^* \right\rangle}{\langle F \phi, \phi^* \rangle}. \quad (7)$$

This is the basic equation for measuring the change in k by means of perturbation theory. To evaluate the inner products that appear in Eq. (6), we must examine in some detail the structure of the multigroup diffusion equation. The homogeneous, multigroup equation can be written in the form

$$-\nabla \cdot [D_g(r) \nabla \phi_g(r)] + \Sigma_R^g(r) \phi_g(r) = \sum_{g' \neq g} \Sigma^{g' \rightarrow g}(r) \phi_{g'}(r) + \frac{1}{k} S_g(r), \quad (8)$$

where r denotes the spatial coordinate, g the energy-group index, and $\phi_g(r)$ the neutron flux. The fission-source density is given by

$$S_g(r) = \sum_{g'=1}^G \chi^{g' \rightarrow g}(r) (\nu \Sigma_f)_{g'}(r) \phi_{g'}(r). \quad (9)$$

Moreover, the removal term $\Sigma_R^g(r)$ includes the buckling contribution $D_g(r) B_g^2(r)$. All the cross sections that appear are macroscopic and thus are piecewise constant over regions of the reactor. Since perturbations of the cross sections are permitted at various levels of homogenization, we shall display the formulas used to construct the macroscopic cross sections. This is discussed completely by Sparck and Mueller.²

If we are given the isotope cross sections $\Sigma_{tr,i}^g$, $\Sigma_{c,i}^g$, $\Sigma_{f,i}^g$, $\Sigma_{el,i}^g$, $\Sigma_{in,i}^g$, and $\Sigma_{(n,2n),i}^g$, and the transfer matrices $T_{el}(g \rightarrow g')$, $T_{in}(g' \rightarrow g)$, and $T_{in}(g' \rightarrow g)$ for isotope i , then the removal cross section is defined by

$$\begin{aligned} \Sigma_{R,i}^g &= \Sigma_{c,i}^g + \Sigma_{f,i}^g \\ &+ \sum_{g'=1}^G \left\{ \Sigma_{el,i}^g T_{el}(g \rightarrow g') + \Sigma_{in,i}^g T_{in}(g \rightarrow g') + \frac{1}{2} \Sigma_{(n,2n),i}^g T_{(n,2n)}(g \rightarrow g') \right\}. \end{aligned} \quad (10)$$

The material cross sections for a material m are thus defined by

$$\chi_m^{g' \rightarrow g} = \frac{\sum_{i \in m} \chi_i^{g' \rightarrow g} \nu_i^g (\Sigma_f)_i^{g'} \rho_i}{\sum_{i \in m} \nu_i^{g'} (\Sigma_f)_i^{g'} \rho_i}, \quad (11)$$

$$(\nu \Sigma_f)_m^g = \sum_{i \in m} \nu_i^g \Sigma_{f,i}^g \rho_i, \quad (12)$$

and

$$\left(\Sigma_{type}^g \right)_m = \sum_{i \in m} \Sigma_{type,i}^g \rho_i \quad (13)$$

for type equal to R , f , and tr , and if D^g is given, $\Sigma_{tr,i}^g$ is formed by setting

$$\Sigma_{tr,i}^g = \frac{1}{3D_i^g} \quad (14)$$

and then forming $\left(\Sigma_{tr}^g \right)_m$ by means of Eq. (13).

The cross sections for a composition c made up of materials m are found in an analogous fashion. Thus, for example, $\chi_c^{g' \rightarrow g}$ is defined by

$$\chi_c^{g' \rightarrow g} = \frac{\sum_{m \in c} \chi_m^{g' \rightarrow g} (\nu \Sigma_f)_m^{g'} \rho_m}{\sum_{m \in c} (\nu \Sigma_f)_m^{g'} \rho_m} \quad (15)$$

The cross sections for each composition c are the macroscopic cross sections that appear in Eqs. (8) and (9).

We shall now begin to evaluate the inner products that appear in Eq. (7) when changes are made in any of the cross sections at any level of homogenization. Because of the linear structure of the equation, it will suffice to consider the effect of four basic changes separately. Suppose first that a change is made in the capture cross section of any isotope or any collection of isotopes; moreover, no other changes are made in any other cross sections. Then there will be no changes in the fission, scattering, or Laplacian terms of Eqs. (7) and (9). The change $\delta \Sigma_R^g(r)$ in the removal cross section at the composition level can be found by homogenizing the modified removal cross sections to obtain the modified macroscopic removal cross section, $\tilde{\Sigma}_R^g(r)$, then setting

$$\delta \Sigma_R^g(r) = \tilde{\Sigma}_R^g(r) - \Sigma_R^g(r) \quad (16)$$

for each group g and composition c . Hence, in this case, $\delta F = 0$ and $\langle \delta M \phi, \phi^* \rangle$ is approximated by

$$\langle \delta M \phi, \phi^* \rangle \approx \sum_r \sum_{g=1}^G \delta \Sigma_R^g(r) \phi_g(r) \phi_g^*(r) V_r, \quad (17)$$

where V_r denotes the volume of the cell centered at r . Note that Eq. (17) is the discrete approximation to the integral inner product associated with Eqs. (8) and (9). Note also that the changes are considered only at the macroscopic level; i.e., changes are made at any level, then the modified macroscopic cross sections are calculated, and finally the changes in the macroscopic cross section are computed, e.g., Eq. (16). This procedure eliminates an undue number of special cases in considering all possible changes of the various cross sections.

We shall consider next a change in any of the scattering cross sections. In this case, a change will be induced at the macroscopic level in the scattering cross sections and in the removal cross section. The contribution from the removal term has already been calculated. The contribution from the scattering change is found in the following way: A modified scattering source into each group is formed by using the modified cross sections. Thus,

$$\tilde{Q}_g(r) = \sum_{g' \neq g} \Sigma^{g'g}(r) \phi_{g'}(r). \quad (18)$$

The change in the scattering source is then defined by

$$\delta Q_g(r) = \tilde{Q}_g(r) - Q_g(r). \quad (19)$$

Again $\delta F = 0$, and there is no change in the Laplacian, so that

$$\langle \delta M \phi, \phi^* \rangle \cong \sum_r V_r \left\{ \sum_{g=1}^G [\delta \Sigma_R^g(r) \phi_g(r) - \delta Q_g(r)] \phi_g^*(r) \right\}. \quad (20)$$

The third case will be changes in any cross section that will induce changes in the fission-source density. Thus, for example, we might have modifications in any of the quantities $\chi_i^{g' \rightarrow g}$, ν_i^g , or $\Sigma_{f,i}^g$. As can be seen from Eq. (11), a change in $\Sigma_{f,i}^g$ will induce a change in the removal cross section. Again, corresponding to any change, the modified macroscopic quantities are constructed. Thus in this case the modified fission-source density is formed. This is given by

$$\tilde{S}_g(r) = \sum_{g'=1}^G \tilde{\chi}^{g'g}(r) (\nu \Sigma_f)_{g'}(r) \phi_{g'}(r). \quad (21)$$

The change in the fission-source density is then defined by

$$\delta S_g(r) = \tilde{S}_g(r) - S_g(r). \quad (22)$$

In this case, we obtain

$$\left\langle \left(\delta M - \frac{1}{k} \delta F \right) \phi, \phi^* \right\rangle \cong \sum_r V_r \left\{ \sum_{g=1}^G \left[\delta \Sigma_R^g(r) \phi_g(r) - \frac{1}{k} \delta S_g(r) \right] \phi_g^*(r) \right\}. \quad (23)$$

where the term $\delta \Sigma_R^g(r)$ is in this case induced by the presence of the fission cross section in the removal cross-section term.

We shall consider next perturbations of the diffusion constants. The problem is to estimate

$$\int_R \int \phi^* \left\{ \text{div}[(D + \delta D) \nabla \phi] - \text{div}[D \nabla \phi] \right\} dV, \quad (24)$$

where R is the domain of the reactor. Here and henceforth, we shall drop the group index. Now apply the identity

$$\psi \text{div}(K \nabla \phi) = \text{div}(\psi K \nabla \phi) - K \nabla \phi \cdot \nabla \psi. \quad (25)$$

Then the above integral takes the following form:

$$\int_R \int \left\{ \text{div}[\delta D \phi^* \nabla \phi] - \delta D \nabla \phi \cdot \nabla \phi^* \right\} dV. \quad (26)$$

If we apply Green's Theorem to the first term, we obtain

$$\int_{B(R)} \delta D \phi^* \frac{\partial \phi}{\partial n} ds - \int_R \int \delta D \nabla \phi \cdot \nabla \phi^* dV. \quad (27)$$

By assumption, $\phi^* \partial \phi / \partial n = 0$ at all points of the boundary. Thus we finally obtain

$$\begin{aligned} \langle \delta M \phi, \phi^* \rangle &= - \sum_{g=1}^G \int_R \int \phi_g^* \left\{ \text{div}[(D_g + \delta D_g) \nabla \phi_g] - \text{div}[D_g \nabla \phi_g] \right\} dV \\ &= \sum_{g=1}^G \int_R \int \delta D_g \nabla \phi_g \cdot \nabla \phi_g^* dV. \end{aligned} \quad (28)$$

It now remains to approximate the volume integrals in a manner consistent with the finite-difference approximation of the multigroup diffusion equation. For convenience of presentation, we shall consider the geometry to xy . The first step is the following approximation:

$$\int_R \int \delta D \nabla \phi^* \cdot \nabla \phi dV \cong \sum_{r \in R} \delta D(r) (\nabla \phi^*)_r \cdot (\nabla \phi)_r V_r, \quad (29)$$

where the summation extends over all the mesh cells and V_r denotes the volume of a mesh cell. It remains to approximate the gradients that are

	N O	
WO	O O	OE
	O S	

evaluated at the center of each mesh cell. Consider any mesh cell indexed by 0 and its four adjacent cells as in the figure on the left. Thus, for example, we wish to approximate the partial derivative with respect to x of ϕ at 0 in terms of the values of ϕ at 0, E, and W. We do this to first-order accuracy by neglecting variations of ϕ in the y direction, and by taking into account the continuity of the flux and current across

the boundary of the cell. If $(\hat{\phi}_x)_E^-$ denotes the partial derivative of ϕ evaluated at the boundary between the mesh cell and its neighbor to the east, with the $-$ sign indicating that it is evaluated on the left, then

$$(\hat{\phi}_x)_E^- \approx \frac{D_E}{\frac{1}{2}(\Delta x)_E D_0 + \frac{1}{2}(\Delta x)_0 D_E} (\phi_E - \phi_0), \quad (30)$$

where $(\Delta x)_E$ and $(\Delta x)_0$ are the widths of the cells centered at E and 0, respectively, and D_E and D_0 denote the diffusion lengths in each of these cells. Note that we have dropped the group index. The corresponding approximation to $(\hat{\phi}_x)_W^+$ is given by

$$(\hat{\phi}_x)_W^+ \approx \frac{D_W}{\frac{1}{2}(\Delta x)_W D_0 + \frac{1}{2}(\Delta x)_0 D_W} (\phi_0 - \phi_W). \quad (31)$$

The approximation for the partial derivative with respect to x , $(\phi_x)_0$, at the center of the mesh cell is then defined by

$$(\phi_x)_0 \approx \frac{1}{2} \left\{ (\hat{\phi}_x)_E^- + (\hat{\phi}_x)_W^+ \right\}. \quad (32)$$

If the mesh cell contains an exterior boundary, for example on the right side, then the homogeneous boundary condition $A(\partial\phi/\partial n) + B\phi = 0$ applies on this side. This will lead to the following first-order approximation for $(\hat{\phi}_x)_E^-$ in terms of ϕ_0 :

$$(\hat{\phi}_x)_E^- \approx \frac{-B}{A + \frac{1}{2}(\Delta x)_0 B} \phi_0. \quad (33)$$

Similar approximations are made at the remaining exterior boundaries. In a similar way, approximations are made to $(\phi_y)_0$, $(\phi_x^*)_0$, and $(\phi_y^*)_0$; these yield an approximation to the right-hand side of Eq. (29) and in turn complete

the approximations of the right-hand side of Eq. (28). It remains to approximate the inner product $\langle F\phi, \phi^* \rangle$; this is done by setting

$$\langle F\phi, \phi^* \rangle \cong \sum_{r \in R} \sum_{g=1}^G S_g(r) \phi_g^*(r) V_r, \quad (34)$$

where $S_g(r)$ is defined by

$$S_g(r) = \sum_{g'=1}^G \chi^{g'g}(r) (\nu\sigma_f)_{g'}(r) \phi_{g'}(r). \quad (35)$$

Finally, then, if we define $H = \langle F\phi, \phi^* \rangle$ and A_1 , A_2 , A_3 , and A_4 by the following formulas, we can approximate $\delta(1/k)$:

$$A_1 = \frac{-1}{H} \sum_{g=1}^G \left\{ \sum_{r \in R} \delta D(r) (\nabla \phi)_r \cdot (\nabla \phi^*)_r V_r \right\}, \quad (36)$$

$$A_2 = \frac{-1}{H} \sum_{g=1}^G \sum_{r \in R} \delta \Sigma_R^g(r) \phi_g(r) \phi_g^*(r) V_r, \quad (37)$$

and

$$A_3 = \frac{+1}{H} \sum_{g=1}^G \sum_{r \in R} \delta Q_g(r) \phi_g^*(r) V_r, \quad (38)$$

where $\delta Q_g(r)$ is defined by Eq. (19),

and

$$A_4 = \frac{+1}{kH} \sum_{g=1}^G \sum_{r \in R} \delta S_g(r) \phi_g^*(r) V_r, \quad (39)$$

where $\delta S_g(r)$ is defined by Eq. (22).

Thus if any cross section, isotope density, volume fraction, or any combination of these is modified, or if the assignment of compositions to regions is changed, then the change in $\delta(1/k)$ is estimated by

$$\delta \left(\frac{1}{k} \right) = -(A_1 + A_2 + A_3 + A_4). \quad (40)$$

Thus,

$$\frac{\delta k}{k} = k(A_1 + A_2 + A_3 + A_4), \quad (41)$$

and

$$\frac{\delta k}{k^2} = A_1 + A_2 + A_3 + A_4. \quad (42)$$

LIFETIME AND ALPHA CALCULATIONS

The following argument for an α calculation based on first-order perturbation theory is similar to that by Weinberg and Wigner.³ Let us assume that the reactor is described by the steady-state system,

$$\left(\frac{1}{k} F - M\right) \phi = 0, \quad (43)$$

and the adjoint flux ϕ^* is then defined by

$$\left(\frac{1}{k} F^* - M^*\right) \phi^* = 0. \quad (44)$$

The system is perturbed, and we assume its behavior can be described by

$$V^{-1} \frac{\partial \Phi}{\partial t} = \left(\frac{1}{k} F' - M'\right) \Phi, \quad (45)$$

where $\Phi = \Phi(r, t)$. Assume further that Φ has the form

$$\Phi(r, t) = \phi'(r) e^{\alpha t}. \quad (46)$$

Hence Eq. (44) takes the form

$$\left(\frac{1}{k} F' - M'\right) \phi' = \alpha V^{-1} \phi'. \quad (47)$$

Writing $F' = F + \delta F$, $M' = M + \delta M$, and $\phi' = \phi + \delta \phi$, and taking the inner product of both sides of Eq. (46) with the adjoint flux ϕ^* , we have, after neglecting higher-order terms and using Eq. (43), the following expression:

$$\alpha \langle V^{-1} \phi', \phi^* \rangle = \left\langle \left(\frac{1}{k} \delta F - \delta M\right) \phi, \phi^* \right\rangle. \quad (48)$$

If we assume that $\alpha \delta \phi$ is of second-order magnitude, we can replace ϕ' by ϕ in Eq. (47) obtaining

$$\alpha = \frac{\left\langle \left(\frac{1}{k} \delta F - \delta M\right) \phi, \phi^* \right\rangle}{\langle V^{-1} \phi, \phi^* \rangle}. \quad (49)$$

Now a steady-state perturbation calculation would yield, by Eq. (7), the following expression:

$$\left\langle \left(\frac{1}{k} \delta F - \delta M \right) \phi, \phi^* \right\rangle = - \langle F \phi, \phi^* \rangle \delta \left(\frac{1}{k} \right). \quad (50)$$

Thus we have

$$\alpha = \frac{\langle F \phi, \phi^* \rangle}{\langle V^{-1} \phi, \phi^* \rangle} \frac{\delta k}{k^2}. \quad (51)$$

This is the expression used to calculate α by means of perturbation theory.

The prompt-neutron lifetime, ℓ_P , in the context of perturbation theory is defined in the case when the reactor is initially critical by the following expression:³

$$\ell_P = \frac{1}{\alpha} \frac{\delta k}{k}. \quad (52)$$

If we view the static multiplication factor $1/k$ as a fictitious yield factor for which the system is critical, the above expression for ℓ_P might be used in the case of a noncritical system. However, Shaftman⁴ has pointed out that the correct expression for ℓ_P in the noncritical situation is

$$\hat{\ell}_P = \frac{1}{\alpha} \frac{\delta k}{k^2}. \quad (53)$$

DISPLAY CALCULATIONS

The following calculations are performed for printed-display purposes. The scattering contribution to the change in $1/k$ is rewritten as

$$\bar{A}_3 = \frac{1}{H} \sum_{g=1}^G \sum_{r \in R} \delta \bar{Q}_g(r) \phi_g(r) V_r,$$

where

$$\bar{Q}_g(r) = \sum_{g' \neq g} \Sigma^{g \rightarrow g'}(r) \phi_{g'}^*(r)$$

and

$$\delta \bar{Q}_g(r) = \tilde{\bar{Q}}_g(r) - \bar{Q}_g(r).$$

The scattering out-transfer contribution to the change in $1/k$ is given by

$$A_5 = \frac{1}{H} \sum_{g=1}^G \sum_{r \in R} \left\{ \sum_{g' \neq g} \delta \Sigma^{g \rightarrow g'}(r) \right\} \phi_g(r) \phi_g^*(r) V_r. \quad (54)$$

The difference in the scattering contribution and the scattering out-transfer contribution is

$$A_6 = \bar{A}_3 - A_5. \quad (55)$$

The absorption contribution $\left(\Sigma_a = \Sigma_c + \Sigma_f = \Sigma_R - \sum_{g' \neq g} \Sigma^{g \rightarrow g'} \right)$ is

$$A_7 = A_2 - A_5. \quad (56)$$

The quantities A_1 , A_2 , A_3 , A_4 , A_5 , A_6 , A_7 , and $\delta(1/k)$ are each printed by region and group, by region summed over groups, and by group summed over region, and summed over the entire reactor. (see Appendix B).

MACHINE REQUIREMENTS

A CDC-1604 or CDC-3600 Computer, one bank of 32K core, eight tape units, and the SCOPE operating system are required for the execution of CANDID2D and hence for PERC.

PROGRAM USAGE

PERC was written to be run in conjunction with ANL-CANDID,⁷ the Argonne Two-dimensional Diffusion Theory Program based on CANDID2D.⁸ In fact, PERC was written as an overlay of ANL-CANDID and consequently makes use of its input processing and calculational facilities. Thus, each PERC run requires a complete CANDID input card deck.

The following procedure must be followed in using PERC:

1. Real Calculation

A CANDID real calculation (straight k_{eff} or search) must be run to convergence, and the final flux tape saved in the manner described in Ref. 7.

2. Adjoint Calculation

A CANDID adjoint k_{eff} calculation must also be run and the flux tape saved. If the real and adjoint calculations are run separately, the result

will be two flux tapes. If the real calculation precedes the adjoint calculation, the real tape may be mounted during the adjoint run. Following convergence, the adjoint flux will be written as the second file of the real tape. If the real and adjoint calculations are run concurrently, one tape containing both the real and adjoint fluxes is prepared. In any case, following convergence of the adjoint problem, CANDID places original composition cross sections on the adjoint tape for anticipated use by PERC. Thus, at this point, the flux tape(s) will contain the following information:

- a. Converged real flux (1st file)
- b. Converged adjoint flux (2nd file)
- c. Original composition cross sections (3rd, 4th, ..., Nth files, depending on the reactor configuration).

3. Perturbation Calculation

As indicated above, the input preparation programs in CANDID are used to prepare perturbed data for PERC. This requires the duplication of those parts of the normal CANDID input deck⁶ that are not changed for the perturbation calculation. When a change is made, this also implies that the total change must be input. For example, if it is desired to change σ^f by $\delta\sigma^f$, $\bar{\sigma}^f = \sigma^f + \delta\sigma^f$ must be input to the program, which in turn forms $\delta\sigma^f = \bar{\sigma}^f - \sigma^f$.

The following types of perturbations may be made:

- a. Composition cross sections (i.e., volume-fraction changes)
(NOTE: New region and composition definitions and assignments may not be made. The original geometrical configuration must be maintained throughout all calculations. However, composition reassignment may be achieved by defining "dummy" compositions containing the same materials for the real and adjoint calculations. The materials can then be reassigned for the perturbation calculation.)

- b. Material cross sections (i.e., number densities) and material assignment to composition.

- c. Buckling by region and/or group.

- d. Isotope cross sections and isotope assignment to material.

Changes a-c are straightforward and can be made directly in the input deck. Changes in the isotope cross-section values require changing the cross-section data as generated by XLBIT.² To effect these changes requires the insertion of the type 7 cards into the input deck.⁶ The user is cautioned to be aware of the limitations in applying perturbation theory. It must be remembered that linear approximation is being made (i.e., perturbing a high-flux gradient region may yield erroneous results since terms of ϕ^2 and higher are neglected). Also, if small perturbations are being made, the real and adjoint calculations must be sufficiently accurate to guarantee meaningful perturbation results.

CARD DECK PREPARATION

1. SCOPE Control Cards

Reference 7 gives a complete description of the SCOPE control cards required for a CANDID run. The following control cards are required for mounting the real and adjoint flux tapes for a perturbation run:

a. Real, Adjoint, and Cross Sections on One Tape

This tape is mounted on LUN (logical unit number) 49 by using the control card

$$\begin{matrix} 7 \\ 9 \end{matrix} \text{EQUIP}, 49 = (\text{FLUXRA}, \text{VERSION } \#), \text{SV}$$

Special instructions must be given to the operator as to the real number of the tape. The name (FLUXRA) is chosen for unique identification.

b. Real, Adjoint, and Cross Sections on Two Tapes

The real tape is mounted on LUN 49 as above:

$$\begin{matrix} 7 \\ 9 \end{matrix} \text{EQUIP}, 49 = (\text{FLUXR}, \text{VERSION } \#), \text{SV}$$

The adjoint tape (including cross sections) is mounted on LUN 48 by using

$$\begin{matrix} 7 \\ 9 \end{matrix} \text{EQUIP}, 48 = (\text{FLUXA}, \text{VERSION } \#), \text{SV}$$

2. Input Card Deck

References 6-8 give complete descriptions of input data preparation for a CANDID run. Changes to the input deck for perturbation purposes should be made following these descriptions. (The addition of type 700000 cards is necessary if microscopic cross-section changes are made.) A complete CANDID input deck must be present for each perturbation run.

When the required changes for perturbation have been made in the CANDID problem deck, a nonzero punch in column 16 to the type 11 card (code-dependent input) signals a perturbation run. A nonblank punch in column 17 of the same card indicates that two flux tapes will be mounted. Otherwise, only one flux tape will be expected by the program. The final k_{eff} must appear in columns 46-57 of the type 500000 card.

3. Back-to-Back Runs

See Ref. 7.

RESTRICTIONS

1. PERC does not handle R- θ geometry.
2. The code uses dynamic storage allocation, as does CANDID. However, a certain maximum problem size can be run (approximately 1000 channel group-prints is a maximum). To decrease the probability of exceeding available storage, the chi-vector option (i.e., composition fission fractions independent of incident energy) should be used if applicable to the problem. A nonblank punch in column 15 of the 11 card selects this option. Otherwise, a chi matrix is assumed which increases by $GMAX*(GMAX-1)$ the amount of storage required to store the fission fractions for each composition.
3. The running time of a typical problem is from 1 to 4 min depending on its size.

SCHEMATIC FLOW DIAGRAM

CALL OUTPERT $[A_{r,g}^1 (r = 1, \dots, R, g = 1, \dots, G), \text{Title}]$

↓
Title = Removal contribution

CALL OUTPERT $[A_{r,g}^2 (r = 1, \dots, R, g = 1, \dots, G), \text{Title}]$

↓
Title = Scattering out contribution

CALL OUTPERT $[\bar{A}_{r,g}^3 (r = 1, \dots, R, g = 1, \dots, G), \text{Title}]$

↓
Title = Source contribution

CALL OUTPERT $[A_{r,g}^4 (r = 1, \dots, R, g = 1, \dots, G), \text{Title}]$

↓
Title = Scattering removal contribution.

CALL OUTPERT $[A_{r,g}^5 (r = 1, \dots, R, g = 1, \dots, G), \text{Title}]$

↓
Title = Scattering difference contribution.

CALL OUTPERT $[A_{r,g}^6 (r = 1, \dots, R, g = 1, \dots, G), \text{Title}]$

↓
Title = Capture + fission = absorption contribution

CALL OUTPERT $[A_{r,g}^7 (r = 1, \dots, R, g = 1, \dots, G), \text{Title}]$

↓
Title = Total $\delta(1/k)$

CALL OUTPERT $[\delta(1/k)_{r,g} (r = 1, \dots, R, g = 1, \dots, G), \text{Title}]$

↓
CALL TOTPERT { Computes each contribution by region summed over
groups and by groups summed over region.

↓
RETURN

APPENDIX A

Derivation of $\delta(1/k)$ for the Case of Linear,
Homogeneous Boundary Conditions

In this appendix we shall show how the derivation of the expression for $\delta(1/k)$ is modified when linear, homogeneous boundary conditions are present. Moreover, we shall show that the final formulation is the same as in the previous case. Thus it is valid to use this code when linear, homogeneous conditions are present.

Let us assume then that the unperturbed flux ϕ satisfies

$$\left(\frac{1}{k}F - M\right) \phi = 0 \quad (A-1)$$

with an exterior boundary condition of the form

$$D_g \frac{\partial \phi_g}{\partial n} + \Lambda_g \phi_g = 0, \quad (A-2)$$

where D_g is the diffusion constant and Λ_g is a fixed constant. Then as before, the adjoint flux ϕ^* satisfies

$$\left(\frac{1}{k}F - M\right)^* \phi^* = 0 \quad (A-3)$$

with

$$D_g \frac{\partial \phi_g^*}{\partial n} + \Lambda_g \phi_g^* = 0. \quad (A-4)$$

The system is then perturbed, and the perturbed flux ϕ' satisfies

$$\left(\frac{1}{k'}F' - M'\right) \phi' = 0 \quad (A-5)$$

with

$$D'_g \frac{\partial \phi'_g}{\partial n} + \Lambda'_g \phi'_g = 0. \quad (A-6)$$

From Eq. (A-6) we see that $\delta\phi = \phi' - \phi$ satisfies

$$D' \frac{\partial}{\partial n} \delta\phi + \Lambda \delta\phi + \delta D \frac{\partial \phi}{\partial n} = 0; \quad (A-7)$$

or to first-order accuracy,

$$D \frac{\partial}{\partial n} \delta \phi + \Lambda \delta \phi + \delta D \frac{\partial \phi}{\partial n} = 0. \quad (\text{A-8})$$

As before, we form the inner product of Eq. (A-5) with ϕ^* , and neglecting higher-order terms, we obtain

$$0 = \delta \left(\frac{1}{k} \right) \langle F \phi, \phi^* \rangle + \left\langle \left(\frac{1}{k} \delta F - \delta M \right) \phi, \phi^* \right\rangle + \left\langle \left(\frac{1}{k} F - M \right) \delta \phi, \phi^* \right\rangle. \quad (\text{A-9})$$

Now Green's theorem on the last inner product yields

$$\begin{aligned} \left\langle \left(\frac{1}{k} F - M \right) \delta \phi, \phi^* \right\rangle &= \left\langle \delta \phi \left(\frac{1}{k} F - M \right)^* \phi^* \right\rangle \\ &+ \sum_{g=1}^G \int_{B(R)} D_g \left\{ \phi_g^* \frac{\partial}{\partial n} \delta \phi_g - \delta \phi_g \frac{\partial}{\partial n} \phi_g^* \right\} ds. \end{aligned} \quad (\text{A-10})$$

From Eq. (A-8) we have

$$D \left\{ \phi^* \frac{\partial}{\partial n} \delta \phi - \delta \phi \frac{\partial}{\partial n} \phi^* \right\} = \frac{\Lambda \delta D}{D} \phi \phi^*. \quad (\text{A-11})$$

Thus $\delta(1/k)$ takes the form

$$\delta \left(\frac{1}{k} \right) = \frac{1}{\langle F \phi, \phi^* \rangle} \left\{ \left\langle \left(\delta M - \frac{1}{k} \delta F \right) \phi, \phi^* \right\rangle - \sum_{g=1}^G \int_{B(R)} \Lambda_g \frac{\delta D_g}{D_g} \phi_g \phi_g^* ds \right\}. \quad (\text{A-12})$$

Let us now consider the contribution to δM when $\delta D \neq 0$. Recall from Eq. (24) that we must estimate the following integral:

$$\begin{aligned} -\langle \delta M \phi, \phi^* \rangle &= \sum_{g=1}^G \iint \phi^* \left\{ \text{div}[(D + \delta D) \nabla \phi] - \text{div}[D \nabla \phi] \right\} dV \\ &= \sum_{g=1}^G \int_{B(R)} \delta D \phi^* \frac{\partial \phi}{\partial n} d\Omega - \iint \delta D \nabla \phi \cdot \nabla \phi^* dV. \end{aligned} \quad (\text{A-13})$$

Since $D \frac{\partial \phi}{\partial n} + \Lambda \phi = 0$, we have

$$\langle \delta M \phi, \phi^* \rangle = \sum_g \int_{B(R)} \Lambda \frac{\delta D}{D} \phi \phi^* ds + \iint \delta D \nabla \phi \cdot \nabla \phi^* dV. \quad (\text{A-14})$$

Inserting this expression into Eq. (A-12), we see that the line integral terms cancel, leaving us with the usual expression for $\delta(1/k)$.

APPENDIX B

Sample Problem

1. Description

The sample problem is a cylinder with U^{238} reflector and a sodium mixture in the core as indicated by the map- and material-assignment data in the sample output. Real and adjoint fluxes were obtained by running the problem with material 1 in the core. The perturbation was made by substituting material 2 for material 1 as indicated by the material assignment.

2. Sample Problem Input

PERC SAMPLE INPUT CARD DECK LISTING

```

+MOUNT,L29654
+MOUNT,LUN47
+MOUNT,L14301
+MOUNT,LUN44
+MOUNT,L24454
+MOUNT,LUN49
+MOUNT,L24147
+MOUNT,LUN48
+MOUNT,TOTS5
EQUIP,44=(DMENELEY/224EX,12),SV,RO
EQUIP,49=(HELM511,7),RO,SV
EQUIP,48=(HELM510,4),RO,SV
EQUIP,47=(CANDID2DAOV,16),RO,SV
LOADMAIN,47,20,100000,7
100000510.
PERC SAMPLE PROBLEM
11      XX      XXX
121      22      22      16      0      0
122      0
132      1.0      1.0
133      1.0
200000      0.0      76.5      X      0.0      76.2
2      10.0      76.5      0.0      76.2
2      20.0      46.5      0.0      45.72
2      30.0      14.27      0.0      10.16
2      40.0      14.27      17.78      27.94
2      50.0      14.27      35.56      45.72
2      614.27      24.91      0.0      10.16
2      714.27      24.91      17.78      27.94
2      814.27      24.91      35.56      45.72
2      924.91      35.37      0.0      10.16
2      1024.91      35.37      17.78      27.94
2      1124.91      35.37      35.56      45.72
2      1235.37      46.50      0.0      10.16
2      1335.37      46.50      17.78      27.94
2      1435.37      46.50      35.56      45.72
2      150.0      9.34      0.0      7.62
200016 0.0      46.50      27.94      35.56
210000      49.34      214.27      219.94      X
210000      224.91      435.37      446.50      X
210000      251.18      259.20      276.50      X
210000      2 7.62      2 10.16      2 17.78      Y
210000      4 27.94      4 35.56      4 45.72      Y
210000      2 50.8      2 58.42      2 76.20      Y
300000      X      X      X      X

```

```

4000000000000 224EX
400000      1R 1N901.0
400000      2R 2N911.0
400000      3R 3N921.0
400000      4R 4N931.0
400000      5      15.004223      16.000566      17.001214
400000      5      53.000081      U238C0.03993
410000      1      51.0
410000      2      21.0
420000      1      1
420000      2      2      3      4      5      6      7      8      9      10
420000      2      11      12      13      14      15      16
500000      X 1.0      .997967
600000X
700000R 1N90S
224EXR 1N90 0 0      1.00000+007      XX
224EXR 1N90 0 1      1.00000+000 3.07330+009
224EXR 1N90 0 2      1.50000+000 2.33940+009
224EXR 1N90 0 3      2.00000+000 1.82920+009
224EXR 1N90 0 4      2.50000+000 1.42700+009
224EXR 1N90 0 5      3.00000+000 1.11140+009
224EXR 1N90 0 6      3.50000+000 8.65640+008
224EXR 1N90 0 7      4.00000+000 6.74740+008
224EXR 1N90 0 8      4.50000+000 5.26240+008
224EXR 1N90 0 9      5.00000+000 4.10700+008
224EXR 1N90 0 10     5.50000+000 3.20320+008
224EXR 1N90 0 11     6.00000+000 2.49620+008
224EXR 1N90 0 12     6.50000+000 1.94300+008
224EXR 1N90 0 13     7.00000+000 1.51300+008
224EXR 1N90 0 14     7.75000+000 1.12340+008
224EXR 1N90 0 15     8.25000+000 8.11240+007
224EXR 1N90 0 16     8.50000+000 6.66950+007
224EXR 1N90 0 17     9.00000+000 5.58460+007
224EXR 1N90 0 18     9.25000+000 4.57810+007
224EXR 1N90 0 19     9.75000+000 3.85470+007
224EXR 1N90 0 20     1.05000+001 2.91440+007
224EXR 1N90 0 21     1.15000+001 1.90560+007
224EXR 1N90 0 22     1.27500+001 1.13980+007
224EXR 1N90 1 1      1.00422-001-1.84849-002 2.84964-002 1.00000+000
224EXR 1N90 1 2      1.20702-001-1.46459-002 2.38517-002 1.00000+000
224EXR 1N90 1 3      1.23408-001-1.08563-002 1.88457-002 1.00000+000
224EXR 1N90 1 4      1.36756-001-3.27953-003 7.97070-003 1.00000+000
224EXR 1N90 1 5      1.71073-001-2.27893-003 6.64216-003 1.00000+000
224EXR 1N90 1 6      1.93472-001-2.43699-003 6.94236-003 1.00000+000
224EXR 1N90 1 7      2.24714-001-2.38524-003 7.59541-003 1.00000+000
224EXR 1N90 1 8      2.59154-001-2.09748-003 8.45538-003 1.00000+000
224EXR 1N90 1 9      2.95039-001-1.68571-003 9.47834-003 1.00000+000
224EXR 1N90 1 10     3.14038-001-1.33795-003 1.08368-002 1.00000+000
224EXR 1N90 1 11     3.64360-001-1.15440-003 1.26094-002 1.00000+000
224EXR 1N90 1 12     3.28533-001-1.25060-003 1.48368-002 1.00000+000
224EXR 1N90 1 13     3.85172-001-1.33920-003 1.70567-002 1.00000+000
224EXR 1N90 1 14     5.28479-001-1.35210-003 2.05780-002 1.00000+000
224EXR 1N90 1 15     7.45957-001-4.68530-003 2.63314-002 1.00000+000
224EXR 1N90 1 16     4.80676-001-7.11760-003 3.11461-002 1.00000+000
224EXR 1N90 1 17     4.70750-001-9.06640-003 3.66220-002 1.00000+000
224EXR 1N90 1 18     4.37311-001-6.38290-003 4.40635-002 1.00000+000
224EXR 1N90 1 19     4.98125-001-1.10574-002 5.10541-002 1.00000+000
224EXR 1N90 1 20     4.90350-001-1.77845-002 6.44465-002 1.00000+000
224EXR 1N90 1 21     4.50304-001-2.18753-002 9.12045-002 1.00000+000
224EXR 1N90 1 22     4.60510-001-3.13457-002 1.28677-001 1.00000+000
224EXR 1N90 2 0 1      1.30350-001 2.10890-001 2.32230-001 1.79410-001 1.14870-001
224EXR 1N90 2 0 2      6.48400-002 3.40970-002 1.71250-002 8.39590-003 4.06970-003
224EXR 1N90 2 0 3      1.95320-003 9.33280-004 4.39520-004 2.66770-004 6.81470-005
224EXR 1N90 2 0 4      1.84590-005 2.23790-005 6.11890-006 7.15960-006 4.40620-006
224EXR 1N90 2 0 5      1.56410-006 3.92650-007
224EXR 1N90 5 1      1.00000+000      12
224EXR 1N90 5 2      1.00000+000      12

```


224EXR	1N90	6	19	10	4.33963-001	2.41644-002	0.00000+000	0.00000+000
224EXR	1N90	6	20	10	4.32161-001	1.15263-002	0.00000+000	
224EXR	1N90	6	21	10	3.76570-001	4.40416-003		
224EXR	1N90	6	22	10	3.63178-001			
700000R	2N919							
224EXR	2N91	0	0		1.00000+007		XX	
224EXR	2N91	0	1			1.00000+000	3.07330+009	
224EXR	2N91	0	2			1.50000+000	2.33940+009	
224EXR	2N91	0	3			2.00000+000	1.82920+009	
224EXR	2N91	0	4			2.50000+000	1.42700+009	
224EXR	2N91	0	5			3.00000+000	1.11140+009	
224EXR	2N91	0	6			3.50000+000	8.65640+008	
224EXR	2N91	0	7			4.00000+000	6.74740+008	
224EXR	2N91	0	8			4.50000+000	5.26240+008	
224EXR	2N91	0	9			5.00000+000	4.10700+008	
224EXR	2N91	0	10			5.50000+000	3.20320+008	
224EXR	2N91	0	11			6.00000+000	2.49620+008	
224EXR	2N91	0	12			6.50000+000	1.94300+008	
224EXR	2N91	0	13			7.00000+000	1.51300+008	
224EXR	2N91	0	14			7.75000+000	1.12340+008	
224EXR	2N91	0	15			8.25000+000	8.11240+007	
224EXR	2N91	0	16			8.50000+000	6.66950+007	
224EXR	2N91	0	17			9.00000+000	5.58460+007	
224EXR	2N91	0	18			9.25000+000	4.57810+007	
224EXR	2N91	0	19			9.75000+000	3.85470+007	
224EXR	2N91	0	20			1.05000+001	2.91440+007	
224EXR	2N91	0	21			1.15000+001	1.90560+007	
224EXR	2N91	0	22			1.27500+001	1.13980+007	
224EXR	2N91	1	1			9.00041-002	-1.85521-002	2.84964-002 1.00000+000
224EXR	2N91	1	2			1.07162-001	-1.46459-002	2.38517-002 1.00000+000
224EXR	2N91	1	3			1.10255-001	-1.08568-002	1.88457-002 1.00000+000
224EXR	2N91	1	4			1.14797-001	-3.28102-003	7.97070-003 1.00000+000
224EXR	2N91	1	5			1.36123-001	-2.28131-003	6.64216-003 1.00000+000
224EXR	2N91	1	6			1.67476-001	-2.44076-003	6.94236-003 1.00000+000
224EXR	2N91	1	7			1.95405-001	-2.39061-003	7.59541-003 1.00000+000
224EXR	2N91	1	8			2.32662-001	-2.10464-003	8.45538-003 1.00000+000
224EXR	2N91	1	9			2.66228-001	-1.69791-003	9.47834-003 1.00000+000
224EXR	2N91	1	10			2.75824-001	-1.36167-003	1.08368-002 1.00000+000
224EXR	2N91	1	11			3.27645-001	-1.17820-003	1.26094-002 1.00000+000
224EXR	2N91	1	12			2.94795-001	-1.26330-003	1.48368-002 1.00000+000
224EXR	2N91	1	13			3.45399-001	-1.34970-003	1.70567-002 1.00000+000
224EXR	2N91	1	14			4.54603-001	-1.36310-003	2.05780-002 1.00000+000
224EXR	2N91	1	15			4.08641-001	-5.57120-003	2.63314-002 1.00000+000
224EXR	2N91	1	16			4.07026-001	-7.31140-003	3.11461-002 1.00000+000
224EXR	2N91	1	17			4.38990-001	-9.12410-003	3.66220-002 1.00000+000
224EXR	2N91	1	18			4.13253-001	-6.40190-003	4.40635-002 1.00000+000
224EXR	2N91	1	19			4.74164-001	-1.10796-002	5.10541-002 1.00000+000
224EXR	2N91	1	20			4.66390-001	-1.78137-002	6.44465-002 1.00000+000
224EXR	2N91	1	21			4.26392-001	-2.19204-002	9.12045-002 1.00000+000
224EXR	2N91	1	22			4.36606-001	-3.14216-002	1.28677-001 1.00000+000
224EXR	2N91	2	0	1	1.30350-001	2.10890-001	2.32230-001	1.79410-001 1.14870-001
224EXR	2N91	2	0	2	6.48400-002	3.40970-002	1.71250-002	8.39590-003 4.06970-003
224EXR	2N91	2	0	3	1.95320-003	9.33280-004	4.39520-004	2.66770-004 6.81470-005
224EXR	2N91	2	0	4	1.84590-005	2.23790-005	6.11890-006	7.15960-006 4.40620-006
224EXR	2N91	2	0	5	1.56410-006	3.92650-007		
224EXR	2N91	5	1		1.00000+000	12		
224EXR	2N91	5	2		1.00000+000	12		
224EXR	2N91	5	3		1.00000+000	12		
224EXR	2N91	5	4		1.00000+000	12		
224EXR	2N91	5	5		1.00000+000	12		
224EXR	2N91	5	6		1.00000+000	12		
224EXR	2N91	5	7		1.00000+000	12		
224EXR	2N91	5	8		1.00000+000	12		
224EXR	2N91	5	9		1.00000+000	12		
224EXR	2N91	5	10		1.00000+000	12		
224EXR	2N91	5	11		1.00000+000	11		
224EXR	2N91	5	12		1.00000+000	10		
224EXR	2N91	5	13		1.00000+000	9		

224EXR	2N91	5	14		1.00000+000	8				
224EXR	2N91	5	15		1.00000+000	7				
224EXR	2N91	5	16		1.00000+000	6				
224EXR	2N91	5	17		1.00000+000	5				
224EXR	2N91	5	18		1.00000+000	4				
224EXR	2N91	5	19		1.00000+000	3				
224EXR	2N91	5	20		1.00000+000	2				
224EXR	2N91	5	21		1.00000+000	1				
224EXR	2N91	5	22		3.39350-001	0				
224EXR	2N91	6	1	10	2.56076-002	1.38759-002	1.11925-002	1.19603-002	8.62599-003	
224EXR	2N91	6	1	20	4.86002-003	2.30946-003	9.84371-004	3.99641-004	1.55391-004	
224EXR	2N91	6	1	30	5.90679-005	2.21811-005	7.36195-006			
224EXR	2N91	6	2	10	4.50722-002	2.33374-002	1.01911-002	8.35148-003	5.59496-003	
224EXR	2N91	6	2	20	3.01554-003	1.40846-003	6.02023-004	2.41590-004	9.22609-005	
224EXR	2N91	6	2	30	3.35727-005	1.25496-005	3.04694-006			
224EXR	2N91	6	3	10	5.65388-002	2.19721-002	1.15766-002	6.25512-003	3.23405-003	
224EXR	2N91	6	3	20	1.56270-003	6.80625-004	2.77346-004	1.07695-004	4.04062-005	
224EXR	2N91	6	3	30	1.49950-005	5.54968-006	0.00000+000			
224EXR	2N91	6	4	10	8.00484-002	1.86779-002	5.61378-003	3.66435-003	1.33321-003	
224EXR	2N91	6	4	20	4.83923-004	1.80550-004	6.82508-005	2.60494-005	9.29721-006	
224EXR	2N91	6	4	30	1.46711-006	0.00000+000	0.00000+000			
224EXR	2N91	6	5	10	1.09434-001	2.03531-002	6.47673-004	6.78540-004	3.80465-004	
224EXR	2N91	6	5	20	1.67498-004	6.48582-005	2.45251-005	9.06807-006	2.67337-006	
224EXR	2N91	6	5	30	0.00000+000	0.00000+000	0.00000+000			
224EXR	2N91	6	6	10	1.39211-001	2.31116-002	4.83341-004	1.16672-004	3.81846-005	
224EXR	2N91	6	6	20	9.29858-006	3.02968-006	1.07651-006	3.57922-007	0.00000+000	
224EXR	2N91	6	6	30	0.00000+000	0.00000+000	0.00000+000			
224EXR	2N91	6	7	10	1.63189-001	2.63496-002	4.00335-004	1.77083-004	6.22639-005	
224EXR	2N91	6	7	20	1.32144-005	5.46389-006	2.61541-006	0.00000+000	0.00000+000	
224EXR	2N91	6	7	30	0.00000+000	0.00000+000	0.00000+000			
224EXR	2N91	6	8	10	2.00280-001	2.55948-002	2.84500-004	8.70367-005	3.73560-005	
224EXR	2N91	6	8	20	1.67259-005	8.83159-006	1.39725-006	3.25704-007	1.98564-007	
224EXR	2N91	6	8	30	0.00000+000	0.00000+000	0.00000+000			
224EXR	2N91	6	9	10	2.29956-001	2.69239-002	1.30755-003	2.33198-004	1.63357-005	
224EXR	2N91	6	9	20	8.78788-006	1.22846-006	2.87293-007	2.83317-007	0.00000+000	
224EXR	2N91	6	9	30	0.00000+000	0.00000+000	0.00000+000			
224EXR	2N91	6	10	10	2.42111-001	2.30722-002	5.67222-004	3.75913-004	1.73358-004	
224EXR	2N91	6	10	20	3.11030-005	7.39659-006	7.37006-006	1.59665-006	1.50799-006	
224EXR	2N91	6	10	30	0.00000+000	0.00000+000	0.00000+000			
224EXR	2N91	6	11	10	2.87871-001	2.83313-002	1.13192-005	0.00000+000	0.00000+000	
224EXR	2N91	6	11	20	0.00000+000	0.00000+000	0.00000+000	0.00000+000	0.00000+000	
224EXR	2N91	6	11	30	0.00000+000	0.00000+000				
224EXR	2N91	6	12	10	2.56765-001	2.44310-002	1.73160-005	4.82066-006	1.53959-006	
224EXR	2N91	6	12	20	1.60386-006	2.92343-007	0.00000+000	0.00000+000	0.00000+000	
224EXR	2N91	6	12	30	0.00000+000					
224EXR	2N91	6	13	10	3.05043-001	2.46483-002	0.00000+000	0.00000+000	0.00000+000	
224EXR	2N91	6	13	20	0.00000+000	5.26944-007	0.00000+000	0.00000+000	0.00000+000	
224EXR	2N91	6	14	10	4.17350-001	1.80376-002	0.00000+000	0.00000+000	0.00000+000	
224EXR	2N91	6	14	20	0.00000+000	0.00000+000	0.00000+000	0.00000+000		
224EXR	2N91	6	15	10	3.64615-001	2.32654-002	0.00000+000	0.00000+000	0.00000+000	
224EXR	2N91	6	15	20	0.00000+000	0.00000+000	0.00000+000			
224EXR	2N91	6	16	10	3.30813-001	5.23778-002	0.00000+000	0.00000+000	0.00000+000	
224EXR	2N91	6	16	20	0.00000+000	0.00000+000				
224EXR	2N91	6	17	10	3.89830-001	2.16612-002	0.00000+000	0.00000+000	0.00000+000	
224EXR	2N91	6	17	20	0.00000+000					
224EXR	2N91	6	18	10	3.21564-001	5.40270-002	0.00000+000	0.00000+000	0.00000+000	
224EXR	2N91	6	19	10	4.13389-001	2.08005-002	0.00000+000	0.00000+000		
224EXR	2N91	6	20	10	4.10084-001	9.67246-003	0.00000+000			
224EXR	2N91	6	21	10	3.53400-001	3.70791-003				
224EXR	2N91	6	22	10	3.39350-001					
700000R	3N929									
224EXR	3N92	0	0		1.00000+007			XX		
224EXR	3N92	0	1			1.00000+000	3.07330+009			
224EXR	3N92	0	2			1.50000+000	2.33940+009			
224EXR	3N92	0	3			2.00000+000	1.82920+009			
224EXR	3N92	0	4			2.50000+000	1.42700+009			
224EXR	3N92	0	5			3.00000+000	1.11140+009			

224EXR 3N92 0 6	3.5000C+000	8.65640+008		
224EXR 3N92 0 7	4.0000C+000	6.74740+008		
224EXR 3N92 0 8	4.5000C+000	5.26240+008		
224EXR 3N92 0 9	5.0000C+000	4.10700+008		
224EXR 3N92 0 10	5.5000C+000	3.20320+008		
224EXR 3N92 0 11	6.0000C+000	2.49620+008		
224EXR 3N92 0 12	6.5000C+000	1.94300+008		
224EXR 3N92 0 13	7.0000C+000	1.51300+008		
224EXR 3N92 0 14	7.7500C+000	1.12340+008		
224EXR 3N92 0 15	8.2500C+000	8.11240+007		
224EXR 3N92 0 16	8.5000C+000	6.66950+007		
224EXR 3N92 0 17	9.0000C+000	5.58460+007		
224EXR 3N92 0 18	9.2500C+000	4.57810+007		
224EXR 3N92 0 19	9.7500C+000	3.85470+007		
224EXR 3N92 0 20	1.0500C+001	2.91440+007		
224EXR 3N92 0 21	1.1500C+001	1.90560+007		
224EXR 3N92 0 22	1.2750C+001	1.13980+007		
224EXR 3N92 1 1	1.00553-001-1.84841-002	2.84964-002	1.00000+000	
224EXR 3N92 1 2	1.20872-001-1.46459-002	2.38517-002	1.00000+000	
224EXR 3N92 1 3	1.23573-001-1.08562-002	1.88457-002	1.00000+000	
224EXR 3N92 1 4	1.37031-001-3.27951-003	7.97070-003	1.00000+000	
224EXR 3N92 1 5	1.7150C-001-2.27890-003	6.64216-003	1.00000+000	
224EXR 3N92 1 6	1.93798-001-2.43694-003	6.94236-003	1.00000+000	
224EXR 3N92 1 7	2.25077-001-2.38517-003	7.59541-003	1.00000+000	
224EXR 3N92 1 8	2.59487-001-2.09739-003	8.45538-003	1.00000+000	
224EXR 3N92 1 9	2.95400-001-1.68555-003	9.47834-003	1.00000+000	
224EXR 3N92 1 10	3.14491-001-1.33765-003	1.08368-002	1.00000+000	
224EXR 3N92 1 11	3.64815-001-1.15410-003	1.26094-002	1.00000+000	
224EXR 3N92 1 12	3.28958-001-1.25050-003	1.48368-002	1.00000+000	
224EXR 3N92 1 13	3.85675-001-1.33910-003	1.70567-002	1.00000+000	
224EXR 3N92 1 14	5.29380-001-1.35190-003	2.05780-002	1.00000+000	
224EXR 3N92 1 15	7.48990-001-4.67410-003	2.63314-002	1.00000+000	
224EXR 3N92 1 16	4.81527-001-7.11510-003	3.11461-002	1.00000+000	
224EXR 3N92 1 17	4.71147-001-9.06560-003	3.66220-002	1.00000+000	
224EXR 3N92 1 18	4.37615-001-6.38270-003	4.40635-002	1.00000+000	
224EXR 3N92 1 19	4.98428-001-1.10572-002	5.10541-002	1.00000+000	
224EXR 3N92 1 20	4.90653-001-1.77841-002	6.44465-002	1.00000+000	
224EXR 3N92 1 21	4.50606-001-2.18747-002	9.12045-002	1.00000+000	
224EXR 3N92 1 22	4.60812-001-3.13447-002	1.28677-001	1.00000+000	
224EXR 3N92 2 0 1	1.30350-001	2.10890-001	2.32230-001	1.79410-001
224EXR 3N92 2 0 2	6.48400-002	3.4097C-002	1.71250-002	8.39590-003
224EXR 3N92 2 0 3	1.95320-003	9.33280-004	4.39520-004	2.66770-004
224EXR 3N92 2 0 4	1.84590-005	2.23790-005	6.11890-006	7.15960-006
224EXR 3N92 2 0 5	1.56410-006	3.9265C-007		4.40620-006
224EXR 3N92 5 1	1.00000+000	12		
224EXR 3N92 5 2	1.00000+000	12		
224EXR 3N92 5 3	1.00000+000	12		
224EXR 3N92 5 4	1.00000+000	12		
224EXR 3N92 5 5	1.00000+000	12		
224EXR 3N92 5 6	1.00000+000	12		
224EXR 3N92 5 7	1.00000+000	12		
224EXR 3N92 5 8	1.00000+000	12		
224EXR 3N92 5 9	1.00000+000	12		
224EXR 3N92 5 10	1.00000+000	12		
224EXR 3N92 5 11	1.00000+000	11		
224EXR 3N92 5 12	1.00000+000	10		
224EXR 3N92 5 13	1.00000+000	9		
224EXR 3N92 5 14	1.00000+000	8		
224EXR 3N92 5 15	1.00000+000	7		
224EXR 3N92 5 16	1.00000+000	6		
224EXR 3N92 5 17	1.00000+000	5		
224EXR 3N92 5 18	1.00000+000	4		
224EXR 3N92 5 19	1.00000+000	3		
224EXR 3N92 5 20	1.00000+000	2		
224EXR 3N92 5 21	1.00000+000	1		
224EXR 3N92 5 22	3.63479-001	0		
224EXR 3N92 6 1 10	2.90382-002	1.60162-002	1.28762-002	1.34317-002
224EXR 3N92 6 1 20	5.33277-003	2.52204-003	1.07280-003	4.34668-004
				1.68872-004

224EXR	3N92	6	1	30	6.41663-005	2.40755-005	7.74667-006		
224EXR	3N92	6	2	10	5.18908-002	2.80150-002	1.08869-002	9.13093-003	6.02438-003
224EXR	3N92	6	2	20	3.20250-003	1.48433-003	6.31676-004	2.52284-004	9.61562-005
224EXR	3N92	6	2	30	3.50393-005	1.30968-005	3.04694-006		
224EXR	3N92	6	3	10	6.56182-002	2.62052-002	1.15766-002	6.25512-003	3.23405-003
224EXR	3N92	6	3	20	1.56526-003	6.82583-004	2.77805-004	1.07695-004	4.04062-005
224EXR	3N92	6	3	30	1.49950-005	5.54968-006	0.00000+000		
224EXR	3N92	6	4	10	9.47210-002	2.54814-002	6.37016-003	3.66435-003	1.33321-003
224EXR	3N92	6	4	20	4.83923-004	1.80550-004	6.82508-005	2.60494-005	9.29721-006
224EXR	3N92	6	4	30	1.46711-006	0.00000+000	0.00000+000		
224EXR	3N92	6	5	10	1.36536-001	2.72377-002	1.64892-003	9.72908-004	4.62567-004
224EXR	3N92	6	5	20	1.77134-004	6.48582-005	2.45251-005	9.06807-006	2.67337-006
224EXR	3N92	6	5	30	0.00000+000	0.00000+000	0.00000+000		
224EXR	3N92	6	6	10	1.60679-001	2.79325-002	4.83341-004	1.16672-004	5.27068-005
224EXR	3N92	6	6	20	1.89266-005	6.73911-006	2.48787-006	3.57922-007	0.00000+000
224EXR	3N92	6	6	30	0.00000+000	0.00000+000	0.00000+000		
224EXR	3N92	6	7	10	1.86935-001	3.22703-002	4.00335-004	1.77083-004	6.22639-005
224EXR	3N92	6	7	20	1.32144-005	5.46389-006	2.61541-006	0.00000+000	0.00000+000
224EXR	3N92	6	7	30	0.00000+000	0.00000+000	0.00000+000		
224EXR	3N92	6	8	10	2.23136-001	2.95560-002	2.84500-004	8.70367-005	3.73560-005
224EXR	3N92	6	8	20	1.67259-005	8.83159-006	1.39725-006	3.25704-007	1.98564-007
224EXR	3N92	6	8	30	0.00000+000	0.00000+000	0.00000+000		
224EXR	3N92	6	9	10	2.54099-001	3.19398-002	1.30755-003	2.33198-004	1.63357-005
224EXR	3N92	6	9	20	8.78788-006	1.22846-006	2.87293-007	2.83317-007	0.00000+000
224EXR	3N92	6	9	30	0.00000+000	0.00000+000	0.00000+000		
224EXR	3N92	6	10	10	2.74052-001	2.97736-002	5.67222-004	3.75913-004	1.73358-004
224EXR	3N92	6	10	20	3.11030-005	7.39659-006	7.37006-006	1.59665-006	1.50799-006
224EXR	3N92	6	10	30	0.00000+000	0.00000+000	0.00000+000		
224EXR	3N92	6	11	10	3.18978-001	3.43696-002	1.13192-005	0.00000+000	0.00000+000
224EXR	3N92	6	11	20	0.00000+000	0.00000+000	0.00000+000	0.00000+000	0.00000+000
224EXR	3N92	6	11	30	0.00000+000	0.00000+000			
224EXR	3N92	6	12	10	2.85775-001	2.95705-002	1.73160-005	4.82066-006	1.53959-006
224EXR	3N92	6	12	20	1.60386-006	2.92343-007	0.00000+000	0.00000+000	0.00000+000
224EXR	3N92	6	12	30	0.00000+000				
224EXR	3N92	6	13	10	3.38565-001	3.13915-002	0.00000+000	0.00000+000	0.00000+000
224EXR	3N92	6	13	20	0.00000+000	5.26944-007	0.00000+000	0.00000+000	0.00000+000
224EXR	3N92	6	14	10	4.83549-001	2.66049-002	0.00000+000	0.00000+000	0.00000+000
224EXR	3N92	6	14	20	0.00000+000	0.00000+000	0.00000+000	0.00000+000	
224EXR	3N92	6	15	10	6.14713-001	1.12620-001	0.00000+000	0.00000+000	0.00000+000
224EXR	3N92	6	15	20	0.00000+000	0.00000+000	0.00000+000		
224EXR	3N92	6	16	10	3.85627-001	7.18683-002	0.00000+000	0.00000+000	0.00000+000
224EXR	3N92	6	16	20	0.00000+000	0.00000+000			
224EXR	3N92	6	17	10	4.17538-001	2.60517-002	0.00000+000	0.00000+000	0.00000+000
224EXR	3N92	6	17	20	0.00000+000				
224EXR	3N92	6	18	10	3.37991-001	6.19431-002	0.00000+000	0.00000+000	0.00000+000
224EXR	3N92	6	19	10	4.34222-001	2.42083-002	0.00000+000	0.00000+000	
224EXR	3N92	6	20	10	4.32439-001	1.15509-002	0.00000+000		
224EXR	3N92	6	21	10	3.76861-001	4.41442-003			
224EXR	3N92	6	22	10	3.63479-001				
700000R	4N939								
224EXR	4N93	0	0		1.00000+007		xx		
224EXR	4N93	0	1			1.00000+000	3.07330+009		
224EXR	4N93	0	2			1.50000+000	2.33940+009		
224EXR	4N93	0	3			2.00000+000	1.82920+009		
224EXR	4N93	0	4			2.50000+000	1.42700+009		
224EXR	4N93	0	5			3.00000+000	1.11140+009		
224EXR	4N93	0	6			3.50000+000	8.65640+008		
224EXR	4N93	0	7			4.00000+000	6.74740+008		
224EXR	4N93	0	8			4.50000+000	5.26240+008		
224EXR	4N93	0	9			5.00000+000	4.10700+008		
224EXR	4N93	0	10			5.50000+000	3.20320+008		
224EXR	4N93	0	11			6.00000+000	2.49620+008		

224EXR	4N93	0	12			6.50000+000	1.94300+008		
224EXR	4N93	0	13			7.00000+000	1.51300+008		
224EXR	4N93	0	14			7.75000+000	1.12340+008		
224EXR	4N93	0	15			8.25000+000	8.11240+007		
224EXR	4N93	0	16			8.50000+000	6.66950+007		
224EXR	4N93	0	17			9.00000+000	5.58460+007		
224EXR	4N93	0	18			9.25000+000	4.57810+007		
224EXR	4N93	0	19			9.75000+000	3.85470+007		
224EXR	4N93	0	20			1.05000+001	2.91440+007		
224EXR	4N93	0	21			1.15000+001	1.90560+007		
224EXR	4N93	0	22			1.27500+001	1.13980+007		
224EXR	4N93	1	1			9.01358-002	-1.85512-002	2.84964-002	1.00000+000
224EXR	4N93	1	2			1.07334-001	-1.46459-002	2.38517-002	1.00000+000
224EXR	4N93	1	3			1.10422-001	-1.08568-002	1.88457-002	1.00000+000
224EXR	4N93	1	4			1.15077-001	-3.28101-003	7.97070-003	1.00000+000
224EXR	4N93	1	5			1.36582-001	-2.28128-003	6.64216-003	1.00000+000
224EXR	4N93	1	6			1.67808-001	-2.44071-003	6.94236-003	1.00000+000
224EXR	4N93	1	7			1.95784-001	-2.39055-003	7.59541-003	1.00000+000
224EXR	4N93	1	8			2.32999-001	-2.10455-003	8.45538-003	1.00000+000
224EXR	4N93	1	9			2.66596-001	-1.69776-003	9.47834-003	1.00000+000
224EXR	4N93	1	10			2.76369-001	-1.36137-003	1.08368-002	1.00000+000
224EXR	4N93	1	11			3.28120-001	-1.17790-003	1.26094-002	1.00000+000
224EXR	4N93	1	12			2.95223-001	-1.26310-003	1.48368-002	1.00000+000
224EXR	4N93	1	13			3.45903-001	-1.34960-003	1.70567-002	1.00000+000
224EXR	4N93	1	14			4.55582-001	-1.36300-003	2.05780-002	1.00000+000
224EXR	4N93	1	15			4.20661-001	-5.56000-003	2.63314-002	1.00000+000
224EXR	4N93	1	16			4.08038-001	-7.30890-003	3.11461-002	1.00000+000
224EXR	4N93	1	17			4.39396-001	-9.12340-003	3.66220-002	1.00000+000
224EXR	4N93	1	18			4.13557-001	-6.40160-003	4.40635-002	1.00000+000
224EXR	4N93	1	19			4.74467-001	-1.10793-002	5.10541-002	1.00000+000
224EXR	4N93	1	20			4.66693-001	-1.78134-002	6.44465-002	1.00000+000
224EXR	4N93	1	21			4.26694-001	-2.19198-002	9.12045-002	1.00000+000
224EXR	4N93	1	22			4.36908-001	-3.14207-002	1.28677-001	1.00000+000
224EXR	4N93	2	0	1	1.30350-001	2.10890-001	2.32230-001	1.79410-001	1.14870-001
224EXR	4N93	2	0	2	6.48400-002	3.40970-002	1.71250-002	8.39590-003	4.06970-003
224EXR	4N93	2	0	3	1.95320-003	9.33280-004	4.39520-004	2.66770-004	6.81470-005
224EXR	4N93	2	0	4	1.84590-005	2.23790-005	6.11890-006	7.15960-006	4.40620-006
224EXR	4N93	2	0	5	1.56410-006	3.92650-007			
224EXR	4N93	5	1		1.00000+000	12			
224EXR	4N93	5	2		1.00000+000	12			
224EXR	4N93	5	3		1.00000+000	12			
224EXR	4N93	5	4		1.00000+000	12			
224EXR	4N93	5	5		1.00000+000	12			
224EXR	4N93	5	6		1.00000+000	12			
224EXR	4N93	5	7		1.00000+000	12			
224EXR	4N93	5	8		1.00000+000	12			
224EXR	4N93	5	9		1.00000+000	12			
224EXR	4N93	5	10		1.00000+000	12			
224EXR	4N93	5	11		1.00000+000	11			
224EXR	4N93	5	12		1.00000+000	10			
224EXR	4N93	5	13		1.00000+000	9			
224EXR	4N93	5	14		1.00000+000	8			
224EXR	4N93	5	15		1.00000+000	7			
224EXR	4N93	5	16		1.00000+000	6			
224EXR	4N93	5	17		1.00000+000	5			
224EXR	4N93	5	18		1.00000+000	4			
224EXR	4N93	5	19		1.00000+000	3			
224EXR	4N93	5	20		1.00000+000	2			
224EXR	4N93	5	21		1.00000+000	1			
224EXR	4N93	5	22		3.39651-001	0			
224EXR	4N93	6	1	10	2.56505-002	1.39026-002	1.12135-002	1.19787-002	8.63754-003
224EXR	4N93	6	1	20	4.86593-003	2.31211-003	9.85475-004	4.00078-004	1.55559-004
224EXR	4N93	6	1	30	5.91316-005	2.22048-005	7.36675-006		
224EXR	4N93	6	2	10	4.51582-002	2.33958-002	1.01997-002	8.36121-003	5.60033-003
224EXR	4N93	6	2	20	3.01788-003	1.40941-003	6.02393-004	2.41724-004	9.23096-005
224EXR	4N93	6	2	30	3.35910-005	1.25564-005	3.04694-006		
224EXR	4N93	6	3	10	5.66528-002	2.20250-002	1.15766-002	6.25512-003	3.23405-003
224EXR	4N93	6	3	20	1.56273-003	6.80649-004	2.77352-004	1.07695-004	4.04062-005


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224EXR 4N93 6 3 30 1.49950-005 5.54968-006 0.00000+000
224EXR 4N93 6 4 10 8.02335-002 1.87634-002 5.62322-003 3.66435-003 1.33321-003
224EXR 4N93 6 4 20 4.83923-004 1.80550-004 6.82508-005 2.60494-005 9.29721-006
224EXR 4N93 6 4 30 1.46711-006 0.00000+000 0.00000+000
224EXR 4N93 6 5 10 1.09789-001 2.04398-002 6.60173-004 6.82215-004 3.81490-004
224EXR 4N93 6 5 20 1.67619-004 6.48582-005 2.45251-005 9.06807-006 2.67337-006
224EXR 4N93 6 5 30 0.00000+000 0.00000+000 0.00000+000
224EXR 4N93 6 6 10 1.39483-001 2.31713-002 4.83341-004 1.16672-004 3.83659-005
224EXR 4N93 6 6 20 9.41878-006 3.07599-006 1.09413-006 3.57922-007 0.00000+000
224EXR 4N93 6 6 30 0.00000+000 0.00000+000 0.00000+000
224EXR 4N93 6 7 10 1.63493-001 2.64253-002 4.00335-004 1.77083-004 6.22639-005
224EXR 4N93 6 7 20 1.32144-005 5.46389-006 2.61541-006 0.00000+000 0.00000+000
224EXR 4N93 6 7 30 0.00000+000 0.00000+000 0.00000+000
224EXR 4N93 6 8 10 2.00569-001 2.56430-002 2.84500-004 8.70367-005 3.73560-005
224EXR 4N93 6 8 20 1.67259-005 8.83159-006 1.39725-006 3.25704-007 1.98564-007
224EXR 4N93 6 8 30 0.00000+000 0.00000+000 0.00000+000
224EXR 4N93 6 9 10 2.30260-001 2.69871-002 1.30755-003 2.33198-004 1.63357-005
224EXR 4N93 6 9 20 8.78788-006 1.22846-006 2.87293-007 2.83317-007 0.00000+000
224EXR 4N93 6 9 30 0.00000+000 0.00000+000 0.00000+000
224EXR 4N93 6 10 10 2.42565-001 2.31625-002 5.67222-004 3.75913-004 1.73358-004
224EXR 4N93 6 10 20 3.11030-005 7.39659-006 7.37006-006 1.59665-006 1.50799-006
224EXR 4N93 6 10 30 0.00000+000 0.00000+000 0.00000+000
224EXR 4N93 6 11 10 2.88268-001 2.84084-002 1.13192-005 0.00000+000 0.00000+000
224EXR 4N93 6 11 20 0.00000+000 0.00000+000 0.00000+000 0.00000+000 0.00000+000
224EXR 4N93 6 11 30 0.00000+000 0.00000+000
224EXR 4N93 6 12 10 2.57130-001 2.44931-002 1.73160-005 4.82066-006 1.53959-006
224EXR 4N93 6 12 20 1.60386-006 2.92343-007 0.00000+000 0.00000+000 0.00000+000
224EXR 4N93 6 12 30 0.00000+000
224EXR 4N93 6 13 10 3.05463-001 2.47320-002 0.00000+000 0.00000+000 0.00000+000
224EXR 4N93 6 13 20 0.00000+000 5.26944-007 0.00000+000 0.00000+000 0.00000+000
224EXR 4N93 6 14 10 4.18218-001 1.81488-002 0.00000+000 0.00000+000 0.00000+000
224EXR 4N93 6 14 20 0.00000+000 0.00000+000 0.00000+000 0.00000+000
224EXR 4N93 6 15 10 3.74347-001 2.55421-002 0.00000+000 0.00000+000 0.00000+000
224EXR 4N93 6 15 20 0.00000+000 0.00000+000 0.00000+000
224EXR 4N93 6 16 10 3.32401-001 5.17994-002 0.00000+000 0.00000+000 0.00000+000
224EXR 4N93 6 16 20 0.00000+000 0.00000+000
224EXR 4N93 6 17 10 3.90184-001 2.17127-002 0.00000+000 0.00000+000 0.00000+000
224EXR 4N93 6 17 20 0.00000+000
224EXR 4N93 6 18 10 3.75895-001 0.00000+000 0.00000+000 0.00000+000 0.00000+000
224EXR 4N93 6 19 10 4.13654-001 2.08379-002 0.00000+000 0.00000+000
224EXR 4N93 6 20 10 4.10367-001 9.69279-003 0.00000+000
224EXR 4N93 6 21 10 3.53697-001 3.71206-003
224EXR 4N93 6 22 10 3.39651-001

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END OF PROBLEM.

3. Sample Problem Output

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO.

2

REACTOR GEOMETRY

GEOMETRY TYPE	LEFT BOUND	RIGHT BOUND	BOTTOM BOUND	TOP BOUND
RZ WITHOUT INVERSION	0.0000+000	7.6500+001	0.0000+000	7.6200+001

REGION BOUNDARIES

REGION NO.	LEFT BDRY.	RIGHT BDRY.	BOTTOM BDRY.	TOP BDRY.
1	0.0000+000	7.6500+001	0.0000+000	7.6200+001
2	0.0000+000	4.6500+001	0.0000+000	4.5720+001
3	0.0000+000	1.4270+001	0.0000+000	1.0160+001
4	0.0000+000	1.4270+001	1.7780+001	2.7940+001
5	0.0000+000	1.4270+001	3.5560+001	4.5720+001
6	1.4270+001	2.4910+001	0.0000+000	1.0160+001
7	1.4270+001	2.4910+001	1.7780+001	2.7940+001
8	1.4270+001	2.4910+001	3.5560+001	4.5720+001
9	2.4910+001	3.5370+001	0.0000+000	1.0160+001
10	2.4910+001	3.5370+001	1.7780+001	2.7940+001
11	2.4910+001	3.5370+001	3.5560+001	4.5720+001
12	3.5370+001	4.6500+001	0.0000+000	1.0160+001
13	3.5370+001	4.6500+001	1.7780+001	2.7940+001
14	3.5370+001	4.6500+001	3.5560+001	4.5720+001
15	0.0000+000	9.3400+000	0.0000+000	7.6200+000
16	0.0000+000	4.6500+001	2.7940+001	3.5560+001

PROB. NO. 5.10000+002 2DCANDID.

PERC SAMPLE PROBLEM

PAGE NO. 3

MESH DEFINITION

INCREMENT METHOD - X(R) DIRECTION

X(R)	INCREMENTS	X(R)	INCREMENTS	X(R)	INCREMENTS	X(R)	INCREMENT	X(R)
0.0000+000	4	9.3400+000	2	1.4270+001	2	1.9940+001	2	2.4910+001
2.4910+001	4	3.5370+001	4	4.6500+001	2	5.1180+001	2	5.9200+001
5.9200+001	2	7.6500+001						

IMAX = 24

X(R) PLUS DELTA X(R) FROM LEFT TO RIGHT OF REACTOR

MESH NO.	1	2	3	4	5	6	7	8	9	10
ABSCISSA	2.3350+000	4.6700+000	7.0050+000	9.3400+000	1.1805+001	1.4270+001	1.7105+001	1.9940+001	2.2425+001	2.4910+001
MESH NO.	11	12	13	14	15	16	17	18	19	20
ABSCISSA	2.7525+001	3.0140+001	3.2755+001	3.5370+001	3.8153+001	4.0935+001	4.3718+001	4.6500+001	4.8840+001	5.1180+001
MESH NO.	21	22	23	24						
ABSCISSA	5.5190+001	5.9200+001	6.7850+001	7.6500+001						

PROB, NO, 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 4

MESH DEFINITION

INCREMENT METHOD - Y(Z) DIRECTION

Y(Z)	INCREMENTS	Y(Z)	INCREMENTS	Y(Z)	INCREMENTS	Y(Z)	INCREMENTS	Y(Z)
0.0000+000	2	7.6200+000	2	1.0160+001	2	1.7780+001	4	2.7940+001
2.7940+001	4	3.5560+001	4	4.5720+001	2	5.0800+001	2	5.8420+001
5.8420+001	2	7.6200+001						

JMAX = 24

Y(Z) PLUS DELTA Y(Z) FROM BOTTOM TO TOP OF REACTOR

Y(Z) MESH NO.	1	2	3	4	5	6	7	8	9	10
ORDINATE	3.8100+000	7.6200+000	8.8900+000	1.0160+001	1.3970+001	1.7780+001	2.0320+001	2.2860+001	2.5400+001	2.7940+001
Y(Z) MESH NO.	11	12	13	14	15	16	17	18	19	20
ORDINATE	2.9845+001	3.1750+001	3.3659+001	3.5560+001	3.8100+001	4.0640+001	4.3180+001	4.5720+001	4.8260+001	5.0800+001
Y(Z) MESH NO.	21	22	23	24						
ORDINATE	5.4610+001	5.8420+001	6.7310+001	7.6200+001						

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM
REGION MAP

PAGE NO. 5

Z
MESH
POINTS

(REGION NUMBER BY MESH POINT)

Z
MESH
POINTS

R MESH POINTS																								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
24*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1* 24
23*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1* 23
22*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1* 22
21*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1* 21
20*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1* 20
19*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1* 19
18*	5	5	5	5	5	5*	8	8	8	8*	11	11	11	11*	14	14	14	14*	1	1	1	1	1	1* 18
17*	5	5	5	5	5	5*	8	8	8	8*	11	11	11	11*	14	14	14	14*	1	1	1	1	1	1* 17
16*	5	5	5	5	5	5*	8	8	8	8*	11	11	11	11*	14	14	14	14*	1	1	1	1	1	1* 16
15*	5	5	5	5	5	5*	8	8	8	8*	11	11	11	11*	14	14	14	14*	1	1	1	1	1	1* 15
14*	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16*	1	1	1	1	1	1* 14
13*	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16*	1	1	1	1	1	1* 13
12*	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16*	1	1	1	1	1	1* 12
11*	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16*	1	1	1	1	1	1* 11
10*	4	4	4	4	4	4*	7	7	7	7*	10	10	10	10*	13	13	13	13*	1	1	1	1	1	1* 10
9*	4	4	4	4	4	4*	7	7	7	7*	10	10	10	10*	13	13	13	13*	1	1	1	1	1	1* 9
8*	4	4	4	4	4	4*	7	7	7	7*	10	10	10	10*	13	13	13	13*	1	1	1	1	1	1* 8
7*	4	4	4	4	4	4*	7	7	7	7*	10	10	10	10*	13	13	13	13*	1	1	1	1	1	1* 7
6*	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2*	1	1	1	1	1	1* 6
5*	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2*	1	1	1	1	1	1* 5
4*	3	3	3	3	3	3*	6	6	6	6*	9	9	9	9*	12	12	12	12*	1	1	1	1	1	1* 4
3*	3	3	3	3	3	3*	6	6	6	6*	9	9	9	9*	12	12	12	12*	1	1	1	1	1	1* 3
2*	15	15	15	15*	3	3*	6	6	6	6*	9	9	9	9*	12	12	12	12*	1	1	1	1	1	1* 2
1*	15	15	15	15*	3	3*	6	6	6	6*	9	9	9	9*	12	12	12	12*	1	1	1	1	1	1* 1
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	

R MESH POINTS

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 7

MATERIAL ASSIGNMENT DATA

THE CROSS SECTION SET IS IDENTIFIED AS 224EX

MATERIAL MAKEUP

MATERIAL NUMBER	ISOTOPE ID	NUMBER DENSITY	ISOTOPE ID	NUMBER DENSITY	ISOTOPE ID	NUMBER DENSITY	ISOTOPE ID	NUMBER DENSITY
1	R 1N90	1.000000+000						
2	R 2N91	1.000000+000						
3	R 3N92	1.000000+000						
4	R 4N93	1.000000+000						
5	15	4.223000-003	16	5.660000-004	17	1.214000-003	53	8.100000-005
	U238C0	3.993000-002						

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 8

COMPOSITION MAKEUP

COMPOSITION NUMBER	MATERIAL NUMBER/ID	VOLUME FRACTION	MATERIAL NUMBER/ID	VOLUME FRACTION	MATERIAL NUMBER/ID	VOLUME FRACTION	MATERIAL NUMBER/ID	VOLUME FRACTION
1	5	1.000000+000						
2	2	1.000000+000						

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 9

COMPOSITION ASSIGNMENT BY REGION NUMBER

REGION NO.	1	2	3	4	5	6	7	8	9	10
COMPOSITION NO.	1	2	2	2	2	2	2	2	2	2
REGION NO.	11	12	13	14	15	16				
COMPOSITION NO.	2	2	2	2	2	2				

PROB. NO, 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 13

COMPOSITION NUMBER... 1

ENERGY GROUP	DIFFUSION COEFFICIENT	REMOVAL CROSS SECTION	FISSION CROSS SECTION	FISSION REACTION RATE
1	1.9166+000	1.3239-001	2.5240+002	7.9011-002
2	1.7594+000	1.3137-001	2.2980+002	6.3716-002
3	1.7131+000	1.1542-001	1.7089+002	4.4768-002
4	1.6971+000	5.3045-002	1.1865-003	2.9920-003
5	1.4407+000	2.6631-002	1.4902-004	3.6905-004
6	1.1620+000	2.5282-002	9.9938-005	2.4610-004
7	9.3833-001	2.7993-002	1.0998-004	2.6925-004
8	7.7612-001	3.1058-002	1.2286-004	2.9973-004
9	6.7605-001	3.3329-002	1.3801-004	3.3599-004
10	6.2871-001	2.5772-002	1.5798-004	3.8415-004
11	5.9213-001	2.5557-002	1.8396-004	4.4698-004
12	5.8689-001	2.8849-002	2.1655-004	5.2594-004
13	5.4382-001	3.4129-002	2.4903-004	6.0464-004
14	4.6318-001	3.5752-002	3.0049-004	7.2946-004
15	4.0847-001	3.2602-002	3.8455-004	9.3341-004
16	3.7453-001	4.1195-002	4.5488-004	1.1041-003
17	3.4272-001	3.2721-002	5.3488-004	1.2982-003
18	4.3036-001	5.1959-002	6.4356-004	1.5620-003
19	3.4996-001	4.4651-002	7.4566-004	1.8098-003
20	3.9755-001	3.5966-002	9.4130-004	2.2845-003
21	5.9524-001	5.8760-002	1.3321-003	3.2331-003
22	6.5495-001	7.5321-002	1.8794-003	4.5614-003

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 14

COMPOSITION NUMBER... 1

ENERGY
GROUP

FISSION SPECTRUM

1	1.3035-001
2	2.1089-001
3	2.3223-001
4	1.7941-001
5	1.1487-001
6	6.4840-002
7	3.4097-002
8	1.7125-002
9	8.3959-003
10	4.0697-003
11	1.9532-003
12	9.3328-004
13	4.3952-004
14	2.6677-004
15	6.8147-005
16	1.8459-005
17	2.2379-005
18	6.1189-006
19	7.1596-006
20	4.4062-006
21	1.5641-006
22	3.9265-007

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 15

COMPOSITION NUMBER... 1

ENERGY GROUP	GROUPS FROM WHICH NEUTRONS ARE SCATTERED.				
	(SUM DOWN TO OBTAIN TOTAL SCATTERING CROSS-SECTION PER ENERGY GROUP.)				
	1	2	3	4	5
1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	1.3219-002	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	2.4114-002	2.0848-002	0.0000+000	0.0000+000	0.0000+000
4	2.7382-002	2.7886-002	2.7702-002	0.0000+000	0.0000+000
5	2.0447-002	2.5763-002	2.7990-002	2.0597-002	0.0000+000
6	1.1675-002	1.6976-002	2.0655-002	1.2076-002	1.7652-002
7	5.6182-003	8.9444-003	1.0719-002	9.4041-003	2.2261-004
8	2.4323-003	4.1006-003	5.1702-003	3.0969-003	1.5744-003
9	9.8980-004	1.7260-003	2.2445-003	1.0022-003	1.0353-003
10	3.8697-004	6.8874-004	9.1323-004	3.4968-004	4.7315-004
11	1.4766-004	2.6562-004	3.5683-004	1.3050-004	1.8237-004
12	5.5549-005	1.0009-004	1.3594-004	4.9182-005	6.9070-005
13	1.9592-005	3.7478-005	5.1067-005	1.6718-005	2.5597-005
14	0.0000+000	8.7226-006	1.9028-005	3.1095-007	5.7148-006
15	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
16	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
17	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
18	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
19	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
20	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
21	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
22	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 16

COMPOSITION NUMBER... 1

ENERGY GROUP	GROUPS FROM WHICH NEUTRONS ARE SCATTERED.				
	(SUM DOWN TO OBTAIN TOTAL SCATTERING CROSS-SECTION PER ENERGY GROUP.)				
	6	7	8	9	10
1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
5	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
6	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
7	1.9798-002	0.0000+000	0.0000+000	0.0000+000	0.0000+000
8	7.0794-004	2.0969-002	0.0000+000	0.0000+000	0.0000+000
9	4.1359-006	8.3098-004	2.2555-002	0.0000+000	0.0000+000
10	1.3536-006	3.5868-004	4.5375-004	1.7559-002	0.0000+000
11	3.2962-007	8.2754-005	8.7748-005	4.5835-003	7.9645-003
12	1.0740-007	4.6843-007	7.4699-005	6.0495-004	2.1083-003
13	3.8161-008	1.9369-007	2.9726-005	5.7908-007	1.2959-003
14	1.2688-008	9.2713-008	1.4275-005	3.1152-007	5.8109-004
15	0.0000+000	0.0000+000	4.9531-008	4.3547-008	1.0356-004
16	0.0000+000	0.0000+000	1.1546-008	1.0184-008	2.4642-005
17	0.0000+000	0.0000+000	7.0388-009	1.0043-008	2.4566-005
18	0.0000+000	0.0000+000	0.0000+000	0.0000+000	5.7376-006
19	0.0000+000	0.0000+000	0.0000+000	0.0000+000	5.6632-006
20	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
21	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
22	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000

PROB, NO, 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 17

COMPOSITION NUMBER... 1

ENERGY GROUP	GROUPS FROM WHICH NEUTRONS ARE SCATTERED.				
	(SUM DOWN TO OBTAIN TOTAL SCATTERING CROSS-SECTION PER ENERGY GROUP.)				
	11	12	13	14	15
1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
5	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
6	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
7	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
8	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
9	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
10	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
11	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
12	8.9040-003	0.0000+000	0.0000+000	0.0000+000	0.0000+000
13	4.0125-007	8.3444-003	0.0000+000	0.0000+000	0.0000+000
14	0.0000+000	6.1383-007	9.3383-003	0.0000+000	0.0000+000
15	0.0000+000	1.7089-007	0.0000+000	6.4994-003	0.0000+000
16	0.0000+000	5.4576-008	0.0000+000	0.0000+000	9.3454-003
17	0.0000+000	5.6855-008	0.0000+000	0.0000+000	0.0000+000
18	0.0000+000	1.0363-008	0.0000+000	0.0000+000	0.0000+000
19	0.0000+000	0.0000+000	1.8679-008	0.0000+000	0.0000+000
20	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
21	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
22	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 18

COMPOSITION NUMBER... 1

ENERGY GROUP	GROUPS FROM WHICH NEUTRONS ARE SCATTERED.				
	(SUM DOWN TO OBTAIN TOTAL SCATTERING CROSS-SECTION PER ENERGY GROUP.)				
	16	17	18	19	20
1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
5	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
6	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
7	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
8	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
9	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
10	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
11	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
12	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
13	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
14	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
15	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
16	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
17	1.6973-002	0.0000+000	0.0000+000	0.0000+000	0.0000+000
18	0.0000+000	8.0096-003	0.0000+000	0.0000+000	0.0000+000
19	0.0000+000	0.0000+000	1.6866-002	0.0000+000	0.0000+000
20	0.0000+000	0.0000+000	0.0000+000	5.5092-003	0.0000+000
21	0.0000+000	0.0000+000	0.0000+000	0.0000+000	3.3752-003
22	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 19

COMPOSITION NUMBER... 1

ENERGY GROUP	GROUPS FROM WHICH NEUTRONS ARE SCATTERED.	
	(SUM DOWN TO OBTAIN TOTAL SCATTERING CROSS-SECTION PER ENERGY GROUP.)	
	21	22
1	0.0000+000	0.0000+000
2	0.0000+000	0.0000+000
3	0.0000+000	0.0000+000
4	0.0000+000	0.0000+000
5	0.0000+000	0.0000+000
6	0.0000+000	0.0000+000
7	0.0000+000	0.0000+000
8	0.0000+000	0.0000+000
9	0.0000+000	0.0000+000
10	0.0000+000	0.0000+000
11	0.0000+000	0.0000+000
12	0.0000+000	0.0000+000
13	0.0000+000	0.0000+000
14	0.0000+000	0.0000+000
15	0.0000+000	0.0000+000
16	0.0000+000	0.0000+000
17	0.0000+000	0.0000+000
18	0.0000+000	0.0000+000
19	0.0000+000	0.0000+000
20	0.0000+000	0.0000+000
21	0.0000+000	0.0000+000
22	2.1106-003	0.0000+000

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 20

COMPOSITION NUMBER... 2

ENERGY GROUP	DIFFUSION COEFFICIENT	REMOVAL CROSS SECTION	FISSION CROSS SECTION	FISSION REACTION RATE
1	3.7035+000	6.4396-002	2.8496-002	2.8496-002
2	3.1106+000	6.2090-002	2.3852-002	2.3852-002
3	3.0233+000	5.3716-002	1.8846-002	1.8846-002
4	2.9037+000	3.4748-002	7.9707-003	7.9707-003
5	2.4488+000	2.6689-002	6.6422-003	6.6422-003
6	1.9903+000	2.8269-002	6.9424-003	6.9424-003
7	1.7059+000	3.2215-002	7.5954-003	7.5954-003
8	1.4327+000	3.2382-002	8.4554-003	8.4554-003
9	1.2521+000	3.6272-002	9.4783-003	9.4783-003
10	1.2085+000	3.3713-002	1.0837-002	1.0837-002
11	1.0174+000	3.9774-002	1.2609-002	1.2609-002
12	1.1307+000	3.8030-002	1.4837-002	1.4837-002
13	9.6507-001	4.0356-002	1.7057-002	1.7057-002
14	7.3324-001	3.7253-002	2.0578-002	2.0578-002
15	8.1571-001	4.4026-002	2.6331-002	2.6331-002
16	8.1895-001	7.6212-002	3.1146-002	3.1146-002
17	7.5932-001	4.9159-002	3.6622-002	3.6622-002
18	8.0661-001	9.1689-002	4.4064-002	4.4064-002
19	7.0299-001	6.0775-002	5.1054-002	5.1054-002
20	7.1471-001	5.6305-002	6.4447-002	6.4447-002
21	7.8175-001	7.2592-002	9.1205-002	9.1205-002
22	7.6346-001	9.7255-002	1.2868-001	1.2868-001

PROB, NO, 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 21

COMPOSITION NUMBER... 2

ENERGY GROUP	FISSION SPECTRUM
1	1.3035-001
2	2.1089-001
3	2.3223-001
4	1.7941-001
5	1.1487-001
6	6.4840-002
7	3.4097-002
8	1.7125-002
9	8.3959-003
10	4.0697-003
11	1.9532-003
12	9.3328-004
13	4.3952-004
14	2.6677-004
15	6.8147-005
16	1.8459-005
17	2.2379-005
18	6.1189-006
19	7.1596-006
20	4.4062-006
21	1.5641-006
22	3.9265-007

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 22

COMPOSITION NUMBER... 2

ENERGY GROUP GROUPS FROM WHICH NEUTRONS ARE SCATTERED.
 (SUM DOWN TO OBTAIN TOTAL SCATTERING CROSS-SECTION PER ENERGY GROUP.)

	1	2	3	4	5
1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	1.3876-002	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	1.1193-002	2.3337-002	0.0000+000	0.0000+000	0.0000+000
4	1.1960-002	1.0191-002	2.1972-002	0.0000+000	0.0000+000
5	8.6260-003	8.3515-003	1.1577-002	1.8678-002	0.0000+000
6	4.8600-003	5.5950-003	6.2551-003	5.6138-003	2.0353-002
7	2.3095-003	3.0155-003	3.2341-003	3.6643-003	6.4767-004
8	9.8437-004	1.4085-003	1.5627-003	1.3332-003	6.7854-004
9	3.9964-004	6.0202-004	6.8063-004	4.8392-004	3.8047-004
10	1.5539-004	2.4159-004	2.7735-004	1.8055-004	1.6750-004
11	5.9068-005	9.2261-005	1.0769-004	6.8251-005	6.4858-005
12	2.2181-005	3.3573-005	4.0406-005	2.6049-005	2.4525-005
13	7.3620-006	1.2550-005	1.4995-005	9.2972-006	9.0681-006
14	0.0000+000	3.0469-006	5.5497-006	1.4671-006	2.6734-006
15	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
16	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
17	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
18	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
19	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
20	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
21	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
22	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000

PROB, NO, 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 23

COMPOSITION NUMBER... 2

ENERGY GROUP	GROUPS FROM WHICH NEUTRONS ARE SCATTERED.				
	(SUM DOWN TO OBTAIN TOTAL SCATTERING CROSS-SECTION PER ENERGY GROUP.)				
	6	7	8	9	10
1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
5	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
6	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
7	2.3112-002	0.0000+000	0.0000+000	0.0000+000	0.0000+000
8	4.8334-004	2.6350-002	0.0000+000	0.0000+000	0.0000+000
9	1.1667-004	4.0034-004	2.5595-002	0.0000+000	0.0000+000
10	3.8185-005	1.7708-004	2.8450-004	2.6924-002	0.0000+000
11	9.2986-006	6.2264-005	8.7037-005	1.3076-003	2.3072-002
12	3.0297-006	1.3214-005	3.7356-005	2.3320-004	5.6722-004
13	1.0765-006	5.4639-006	1.6726-005	1.6336-005	3.7591-004
14	3.5792-007	2.6154-006	8.8316-006	8.7879-006	1.7336-004
15	0.0000+000	0.0000+000	1.3973-006	1.2285-006	3.1103-005
16	0.0000+000	0.0000+000	3.2570-007	2.8729-007	7.3966-006
17	0.0000+000	0.0000+000	1.9856-007	2.8332-007	7.3701-006
18	0.0000+000	0.0000+000	0.0000+000	0.0000+000	1.5966-006
19	0.0000+000	0.0000+000	0.0000+000	0.0000+000	1.5080-006
20	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
21	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
22	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 24

COMPOSITION NUMBER... 2

ENERGY GROUP	GROUPS FROM WHICH NEUTRONS ARE SCATTERED. (SUM DOWN TO OBTAIN TOTAL SCATTERING CROSS-SECTION PER ENERGY GROUP.)				
	11	12	13	14	15
1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
5	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
6	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
7	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
8	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
9	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
10	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
11	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
12	2.8331-002	0.0000+000	0.0000+000	0.0000+000	0.0000+000
13	1.1319-005	2.4431-002	0.0000+000	0.0000+000	0.0000+000
14	0.0000+000	1.7316-005	2.4648-002	0.0000+000	0.0000+000
15	0.0000+000	4.8207-006	0.0000+000	1.8038-002	0.0000+000
16	0.0000+000	1.5396-006	0.0000+000	0.0000+000	2.3265-002
17	0.0000+000	1.6039-006	0.0000+000	0.0000+000	0.0000+000
18	0.0000+000	2.9234-007	0.0000+000	0.0000+000	0.0000+000
19	0.0000+000	0.0000+000	5.2694-007	0.0000+000	0.0000+000
20	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
21	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
22	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000

PROB, NO, 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 25

COMPOSITION NUMBER... 2

ENERGY GROUP	GROUPS FROM WHICH NEUTRONS ARE SCATTERED.				
	(SUM DOWN TO OBTAIN TOTAL SCATTERING CROSS-SECTION PER ENERGY GROUP.)				
	16	17	18	19	20
1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
5	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
6	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
7	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
8	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
9	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
10	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
11	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
12	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
13	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
14	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
15	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
16	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
17	5.2378-002	0.0000+000	0.0000+000	0.0000+000	0.0000+000
18	0.0000+000	2.1661-002	0.0000+000	0.0000+000	0.0000+000
19	0.0000+000	0.0000+000	5.4027-002	0.0000+000	0.0000+000
20	0.0000+000	0.0000+000	0.0000+000	2.0801-002	0.0000+000
21	0.0000+000	0.0000+000	0.0000+000	0.0000+000	9.6725-003
22	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 26

... COMPOSITION NUMBER... 2

ENERGY GROUP GROUPS FROM WHICH NEUTRONS ARE SCATTERED.
 (SUM DOWN TO OBTAIN TOTAL SCATTERING CROSS-SECTION PER ENERGY GROUP.)

	21	22
1	0.0000+000	0.0000+000
2	0.0000+000	0.0000+000
3	0.0000+000	0.0000+000
4	0.0000+000	0.0000+000
5	0.0000+000	0.0000+000
6	0.0000+000	0.0000+000
7	0.0000+000	0.0000+000
8	0.0000+000	0.0000+000
9	0.0000+000	0.0000+000
10	0.0000+000	0.0000+000
11	0.0000+000	0.0000+000
12	0.0000+000	0.0000+000
13	0.0000+000	0.0000+000
14	0.0000+000	0.0000+000
15	0.0000+000	0.0000+000
16	0.0000+000	0.0000+000
17	0.0000+000	0.0000+000
18	0.0000+000	0.0000+000
19	0.0000+000	0.0000+000
20	0.0000+000	0.0000+000
21	0.0000+000	0.0000+000
22	3.7079+003	0.0000+000

CANDID2D IS PREPARING X SECTIONS ONLY ON LUN 43

I# 1 G#1 J#1 FLUX= 8.4724311+001
 I# 2 G#1 J#1 FLUX= 8.4392659+001
 I# 3 G#1 J#1 FLUX= 8.3731840+001
 I# 4 G#1 J#1 FLUX= 8.2746776+001
 I# 5 G#1 J#1 FLUX= 8.1408631+001
 I# 6 G#1 J#1 FLUX= 7.9692468+001

I#	7	G#1	J#1	FLUX#	7.7496062-001
I#	8	G#1	J#1	FLUX#	7.4739514-001
I#	9	G#1	J#1	FLUX#	7.1802956-001
I#	10	G#1	J#1	FLUX#	6.8801802-001
I#	11	G#1	J#1	FLUX#	6.5489392-001
I#	12	G#1	J#1	FLUX#	6.1881628-001
I#	13	G#1	J#1	FLUX#	5.8110556-001
I#	14	G#1	J#1	FLUX#	5.4231067-001
I#	15	G#1	J#1	FLUX#	5.0181054-001
I#	16	G#1	J#1	FLUX#	4.6041140-001
I#	17	G#1	J#1	FLUX#	4.2043467-001
I#	18	G#1	J#1	FLUX#	3.8316506-001
I#	19	G#1	J#1	FLUX#	3.4264623-001
I#	20	G#1	J#1	FLUX#	2.9282048-001
I#	21	G#1	J#1	FLUX#	2.2846818-001
I#	22	G#1	J#1	FLUX#	1.6191529-001
I#	23	G#1	J#1	FLUX#	8.1003403-002
I#	24	G#1	J#1	FLUX#	2.1015654-002

CANDID2D HAS COPIED FLUX FROM LUN 49 ONTO LUN 42

I MAXIN= 24 J MAXIN= 24 I MAXOUT= 24 J MAXOUT= 24

CANDID2D IS PREPARING X SECTIONS ONLY ON LUN 55

PROB. NO.	5.10000+002	2DCANDID	PERC SAMPLE PROBLEM	PAGE NO.	27
DELTA K/K#	2.0325335-002				
H	2.5905608+003				
K EFF	9.9796700+001				
LIFETIME#	8.7734160-010	LIFETIME(S)#	8.7555796-010		

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 28

CANDID2D PERTURBATION CALCULATION, LEAKAGE CONTRIBUTION TO D(1/K)

GROUP	REGION 1	REGION 2	REGION 3	REGION 4	REGION 5	REGION 6	REGION 7	GROUP
1	0.00000+000	-1.09880-004	-2.23261-006	-9.10445-006	-1.84514-005	-1.63212-005	-2.34651-005	1
2	0.00000+000	-1.95450-004	-3.72427-006	-1.53109-005	-3.47543-005	-2.74011-005	-3.93961-005	2
3	0.00000+000	-2.90073-004	-5.52346-006	-2.28816-005	-5.15609-005	-4.09256-005	-5.87501-005	3
4	0.00000+000	-5.10135-004	-9.97169-006	-4.13147-005	-8.91122-005	-7.40383-005	-1.05909-004	4
5	0.00000+000	-6.57820-004	-1.40283-005	-5.74340-005	-1.06317-004	-1.03360-004	-1.47327-004	5
6	0.00000+000	-4.43164-004	-9.96215-006	-4.03896-005	-6.84433-005	-7.28936-005	-1.03696-004	6
7	0.00000+000	-3.31964-004	-7.54859-006	-3.05507-005	-5.06531-005	-5.51463-005	-7.84905-005	7
8	0.00000+000	-2.30780-004	-4.91678-006	-1.99443-005	-3.78310-005	-3.59192-005	-5.12877-005	8
9	0.00000+000	-1.44229-004	-3.03629-006	-1.23468-005	-2.37101-005	-2.21839-005	-3.17888-005	9
10	0.00000+000	-1.37830-004	-2.81313-006	-1.14424-005	-2.33016-005	-2.05159-005	-2.95045-005	10
11	0.00000+000	-7.36656-005	-1.36937-006	-5.57891-006	-1.35282-005	-9.97642-006	-1.44006-005	11
12	0.00000+000	-7.40048-005	-1.24899-006	-5.12213-006	-1.45929-005	-9.12049-006	-1.32298-005	12
13	0.00000+000	-4.71245-005	-6.92392-007	-2.85499-006	-1.01619-005	-5.06494-006	-7.37615-006	13
14	0.00000+000	-3.83137-005	-4.88524-007	-2.02060-006	-8.96979-006	-3.57974-006	-5.22127-006	14
15	0.00000+000	-1.81061-005	-2.41662-007	-9.97128-007	-4.12574-006	-1.76849-006	-2.57762-006	15
16	0.00000+000	-1.10820-005	-1.48004-007	-6.15529-007	-2.51798-006	-1.08925-006	-1.59049-006	16
17	0.00000+000	-6.30146-006	-8.74628-008	-3.68672-007	-1.38846-006	-6.50679-007	-9.51880-007	17
18	0.00000+000	-1.47069-006	-1.94230-008	-8.23366-008	-3.33549-007	-1.45244-007	-2.12512-007	18
19	0.00000+000	-1.14040-006	-1.48720-008	-6.35647-008	-2.60303-007	-1.12090-007	-1.63956-007	19
20	0.00000+000	-5.02526-007	-6.60167-009	-2.84257-008	-1.14196-007	-5.01402-008	-7.32528-008	20
21	0.00000+000	-1.01698-007	-1.17456-009	-5.08251-009	-2.49194-008	-8.97040-009	-1.30839-008	21
22	0.00000+000	-4.59060-009	-5.17172-011	-2.24199-010	-1.14323-009	-3.96142-010	-5.76711-010	22
GROUP	REGION 8	REGION 9	REGION 10	REGION 11	REGION 12	REGION 13	REGION 14	GROUP
1	-3.34071-005	-4.42528-005	-4.34110-005	-4.13446-005	-8.43088-005	-6.84436-005	-4.57006-005	1
2	-6.18794-005	-7.58690-005	-7.37672-005	-7.44775-005	-1.56913-004	-1.24991-004	-8.07549-005	2
3	-9.14099-005	-1.14383-004	-1.10386-004	-1.09171-004	-2.31555-004	-1.83509-004	-1.15517-004	3
4	-1.58223-004	-2.03714-004	-1.97860-004	-1.89087-004	-3.99448-004	-3.17008-004	-1.96634-004	4
5	-1.92579-004	-2.78604-004	-2.70013-004	-2.37272-004	-4.83813-004	-3.92402-004	-2.48498-004	5
6	-1.25811-004	-1.91972-004	-1.87414-004	-1.58339-004	-3.13728-004	-2.58672-004	-1.68250-004	6
7	-9.35406-005	-1.44538-004	-1.41514-004	-1.18620-004	-2.32738-004	-1.92924-004	-1.27109-004	7
8	-6.87356-005	-9.54077-005	-9.33937-005	-8.51325-005	-1.71812-004	-1.40033-004	-9.20621-005	8
9	-4.30948-005	-5.94761-005	-5.83066-005	-5.34982-005	-1.07856-004	-8.79742-005	-5.79704-005	9
10	-4.21709-005	-5.53756-005	-5.44447-005	-5.20217-005	-1.05694-004	-8.58586-005	-5.67646-005	10
11	-2.40815-005	-2.73744-005	-2.69058-005	-2.89233-005	-6.07386-005	-4.84468-005	-3.19046-005	11
12	-2.56138-005	-2.58024-005	-2.52502-005	-3.00515-005	-6.46229-005	-5.07537-005	-3.29460-005	12
13	-1.75501-005	-1.48007-005	-1.44014-005	-1.99820-005	-4.43744-005	-3.41994-005	-2.17370-005	13
14	-1.52966-005	-1.06278-005	-1.03079-005	-1.69541-005	-3.86465-005	-2.93353-005	-1.83853-005	14
15	-7.06918-006	-5.18664-006	-5.04751-006	-7.91502-006	-1.79237-005	-1.36813-005	-8.68895-006	15
16	-4.31089-006	-3.24846-006	-3.14673-006	-4.82037-006	-1.08924-005	-8.30768-006	-5.24271-006	16
17	-2.38294-006	-1.97514-006	-1.90151-006	-2.67975-006	-6.01003-006	-4.59742-006	-2.84710-006	17
18	-5.69551-007	-4.43088-007	-4.25484-007	-6.32808-007	-1.43607-006	-1.09163-006	-6.69158-007	18
19	-4.43439-007	-3.42791-007	-3.28157-007	-4.89496-007	-1.11724-006	-8.46709-007	-5.12447-007	19
20	-1.94302-007	-1.53367-007	-1.46314-007	-2.13747-007	-4.89369-007	-3.70248-007	-2.21397-007	20
21	-4.19107-008	-2.75054-008	-2.61341-008	-4.48009-008	-1.05202-007	-7.84559-008	-4.58251-008	21
22	-1.91687-009	-1.20673-009	-1.14525-009	-2.03223-009	-4.80687-009	-3.57080-009	-2.06761-009	22

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 29

CANDID2D PERTURBATION CALCULATION.			LEAKAGE CONTRIBUTION TO D(1/K)
GROUP	REGION 15	REGION 16	GROUP
1	=3.92518-007	=1.06631-004	1
2	=6.53951-007	=1.85578-004	2
3	=9.68159-007	=2.75020-004	3
4	=1.74628-006	=4.84727-004	4
5	=2.45968-006	=6.38668-004	5
6	=1.74884-006	=4.35800-004	6
7	=1.32553-006	=3.28120-004	7
8	=8.63780-007	=2.23938-004	8
9	=5.33673-007	=1.40538-004	9
10	=4.94914-007	=1.33568-004	10
11	=2.41129-007	=6.94260-005	11
12	=2.20014-007	=6.82573-005	12
13	=1.22012-007	=4.18638-005	13
14	=8.60658-008	=3.25297-005	14
15	=4.25784-008	=1.55661-005	15
16	=2.60509-008	=9.59046-006	16
17	=1.53589-008	=5.56955-006	17
18	=3.40611-009	=1.27632-006	18
19	=2.60223-009	=9.83392-007	19
20	=1.15228-009	=4.33187-007	20
21	=2.04603-010	=8.33025-008	21
22	=8.99737-012	=3.70390-009	22

PROB, NO, 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 30

CANDID2D PERTURBATION CALCULATION, REMOVAL CONTRIBUTION TO D(1/K)

GROUP	REGION 1	REGION 2	REGION 3	REGION 4	REGION 5	REGION 6	REGION 7	GROUP
1	0.00000+000	2.81876+003	5.22195+004	5.62242+004	2.12542+004	1.28085+003	9.11445+004	1
2	0.00000+000	4.96004+003	9.28643+004	9.97903+004	3.64814+004	2.27468+003	1.61537+003	2
3	0.00000+000	4.74978+003	8.97626+004	9.61660+004	3.44384+004	2.19395+003	1.55313+003	3
4	0.00000+000	1.10293+002	2.09011+003	2.23301+003	8.06689+004	5.09776+003	3.59815+003	4
5	0.00000+000	1.67825+002	3.14968+003	3.36549+003	1.26947+003	7.68134+003	5.42201+003	5
6	0.00000+000	1.21137+002	2.25611+003	2.41240+003	9.35491+004	5.50425+003	3.88787+003	6
7	0.00000+000	1.35124+002	2.50989+003	2.68604+003	1.04732+003	6.12711+003	4.33166+003	7
8	0.00000+000	8.77413+003	1.63034+003	1.74795+003	6.71607+004	3.98568+003	2.82325+003	8
9	0.00000+000	8.32993+003	1.54365+003	1.65859+003	6.35480+004	3.78019+003	2.68389+003	9
10	0.00000+000	9.01090+003	1.66297+003	1.79154+003	6.86003+004	4.08076+003	2.90549+003	10
11	0.00000+000	5.62366+003	1.03770+003	1.12048+003	4.22304+004	2.55095+003	1.82068+003	11
12	0.00000+000	3.90417+003	7.22036+004	7.81159+004	2.87479+004	1.77780+003	1.27154+003	12
13	0.00000+000	3.32753+003	6.18726+004	6.70397+004	2.37846+004	1.52528+003	1.09270+003	13
14	0.00000+000	3.02186+003	5.64636+004	6.12118+004	2.11014+004	1.39252+003	9.98172+004	14
15	0.00000+000	6.91253+003	1.28562+003	1.39405+003	4.90710+004	3.17102+003	2.27356+003	15
16	0.00000+000	1.74150+003	3.25188+004	3.52467+004	1.22326+004	8.01909+004	5.74723+004	16
17	0.00000+000	5.13915+004	9.65590+005	1.04518+004	3.56762+005	2.37904+004	1.70275+004	17
18	0.00000+000	2.30045+004	4.34288+005	4.69664+005	1.57774+005	1.06933+004	7.64657+005	18
19	0.00000+000	9.79667+005	1.85973+005	2.00788+005	6.65633+006	4.57365+005	3.26497+005	19
20	0.00000+000	2.30468+005	4.40346+006	4.74384+006	1.55090+006	1.08119+005	7.70078+006	20
21	0.00000+000	1.33541+006	2.57770+007	2.77097+007	8.73566+008	6.31883+007	4.49049+007	21
22	0.00000+000	6.21003+009	1.20421+009	1.29229+009	4.03306+010	2.94808+009	2.09131+009	22
GROUP	REGION 8	REGION 9	REGION 10	REGION 11	REGION 12	REGION 13	REGION 14	GROUP
1	3.43621+004	1.26279+003	8.97190+004	3.35745+004	8.58970+004	6.08572+004	2.22549+004	1
2	5.89115+004	2.22947+003	1.58098+003	5.72895+004	1.47110+003	1.04060+003	3.70040+004	2
3	5.55032+004	2.13454+003	1.50914+003	5.36350+004	1.38512+003	9.77194+004	3.41552+004	3
4	1.29733+003	4.93696+003	3.48050+003	1.24851+003	3.23593+003	2.27673+003	8.04273+004	4
5	2.04095+003	7.46872+003	5.26531+003	1.97091+003	5.09539+003	3.58444+003	1.31872+003	5
6	1.50418+003	5.37423+003	3.79085+003	1.45698+003	3.76182+003	2.64706+003	9.95467+004	6
7	1.68487+003	5.99394+003	4.23148+003	1.63415+003	4.21579+003	2.96856+003	1.11902+003	7
8	1.08206+003	3.90746+003	2.76373+003	1.05163+003	2.70727+003	1.90984+003	7.10284+004	8
9	1.02567+003	3.71682+003	2.63481+003	9.99662+004	2.56530+003	1.81366+003	6.72906+004	9
10	1.10959+003	4.02995+003	2.86464+003	1.08610+003	2.77513+003	1.96729+003	7.30267+004	10
11	6.84335+004	2.52712+003	1.80061+003	6.71952+004	1.71082+003	1.21561+003	4.45073+004	11
12	4.66680+004	1.76334+003	1.25898+003	4.58976+004	1.16592+003	8.30207+004	2.97810+004	12
13	3.86636+004	1.51385+003	1.08258+003	3.80665+004	9.65345+004	6.88539+004	2.39035+004	13
14	3.43198+004	1.38214+003	9.88970+004	3.38016+004	8.56918+004	6.11610+004	2.06857+004	14
15	7.98177+004	3.15195+003	2.25585+003	7.87083+004	1.99310+003	1.42280+003	4.90561+004	15
16	1.98952+004	7.94774+004	5.68612+004	1.95691+004	4.96319+004	3.54211+004	1.20486+004	16
17	5.79818+005	2.34448+004	1.67521+004	5.67360+005	1.44428+004	1.02961+004	3.44593+005	17
18	2.56270+005	1.09071+004	7.50123+005	2.50073+005	6.38040+005	4.54488+005	1.49759+005	18
19	1.07996+005	4.47260+005	3.18788+005	1.04912+005	2.68681+005	1.91094+005	6.21714+006	19
20	2.51225+006	1.05136+005	7.47728+006	2.42723+006	6.24559+006	4.43273+006	1.42188+006	20
21	1.41277+007	6.11209+007	4.33749+007	1.35811+007	3.51287+007	2.48800+007	7.71009+008	21
22	6.51364+010	2.84158+009	2.01304+009	6.24003+010	1.61964+009	1.14515+009	3.51409+010	22

PROB. NO, 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 31

CANDID2D PERTURBATION CALCULATION, REMOVAL CONTRIBUTION TO D(1/K)

GROUP	REGION 15	REGION 16	GROUP
1	2.67317-004	1.53386-003	1
2	4.75538-004	2.67975-003	2
3	4.59910-004	2.54305-003	3
4	1.07160-003	5.87351-003	4
5	1.61517-003	8.98481-003	5
6	1.15697-003	6.51764-003	6
7	1.28688-003	7.28617-003	7
8	8.35517-004	4.74258-003	8
9	7.90644-004	4.51819-003	9
10	8.51211-004	4.91356-003	10
11	5.30861-004	3.07788-003	11
12	3.69172-004	2.13954-003	12
13	3.16220-004	1.82453-003	13
14	2.88527-004	1.65697-003	14
15	6.56933-004	3.79784-003	15
16	1.66159-004	9.53311-004	16
17	4.93409-005	2.79360-004	17
18	2.21937-005	1.24605-004	18
19	9.50575-006	5.27586-005	19
20	2.25150-006	1.23261-005	20
21	1.31848-007	7.09527-007	21
22	6.16149-010	3.28525-009	22

~~CANDID2D PERTURBATION CALCULATION, SCAT OUT CONTRIBUTION TO D(1/K)~~

GROUP	REGION 1	REGION 2	REGION 3	REGION 4	REGION 5	REGION 6	REGION 7	GROUP
1	0.00000+000	-2.39672-003	-4.50865-004	-4.83704-004	-1.75061-004	-1.10309-003	-7.82027-004	1
2	0.00000+000	-4.42622-003	-8.35552-004	-8.96036-004	-3.20040-004	-2.04371-003	-1.44826-003	2
3	0.00000+000	-4.16010-003	-7.93639-004	-8.48586-004	-2.94930-004	-1.93714-003	-1.36854-003	3
4	0.00000+000	-1.10974-002	-2.11322-003	-2.25468-003	-8.04009-004	-5.14918-003	-3.62929-003	4
5	0.00000+000	-1.73156-002	-3.26557-003	-3.48414-003	-1.29963-003	-7.95538-003	-5.60662-003	5
6	0.00000+000	-1.23195-002	-2.30936-003	-2.46638-003	-9.37977-004	-5.62947-003	-3.97141-003	6
7	0.00000+000	-1.35983-002	-2.53705-003	-2.71444-003	-1.04049-003	-6.19274-003	-4.37711-003	7
8	0.00000+000	-8.82129-003	-1.64408-003	-1.76329-003	-6.67165-004	-4.02065-003	-2.84917-003	8
9	0.00000+000	-8.40031-003	-1.55841-003	-1.76554-003	-6.36019-004	-3.81841-003	-2.71295-003	9
10	0.00000+000	-9.16407-003	-1.69214-003	-1.82463-003	-6.92373-004	-4.15532-003	-2.96144-003	10
11	0.00000+000	-5.74210-003	-1.05827-003	-1.14362-003	-4.30784-004	-2.60313-003	-1.85952-003	11
12	0.00000+000	-4.06823-003	-7.51318-004	-8.13898-004	-2.98112-004	-1.85159-003	-1.32609-003	12
13	0.00000+000	-3.50618-003	-6.49458-004	-7.04361-004	-2.51945-004	-1.60197-003	-1.14873-003	13
14	0.00000+000	-3.29557-003	-6.12203-004	-6.63931-004	-2.34516-004	-1.51012-003	-1.08287-003	14
15	0.00000+000	-6.91759-003	-1.28473-003	-1.39312-003	-4.93986-004	-3.16890-003	-2.27209-003	15
16	0.00000+000	-1.73123-003	-3.22995-004	-3.50110-004	-1.21939-004	-7.96521-004	-5.70893-004	16
17	0.00000+000	-4.96384-004	-9.32835-005	-1.00985-004	-3.43662-005	-2.29846-004	-1.64527-004	17
18	0.00000+000	-2.40577-004	-4.53647-005	-4.90613-005	-1.65674-005	-1.11699-004	-7.98756-005	18
19	0.00000+000	-1.02131-004	-1.93651-005	-2.09082-005	-6.96965-006	-4.76244-005	-3.39981-005	19
20	0.00000+000	-2.19393-005	-4.19672-006	-4.52103-006	-1.46749-006	-1.03039-005	-7.33875-006	20
21	0.00000+000	-1.26992-006	-2.44741-007	-2.63084-007	-8.35939-008	-5.99914-007	-4.26317-007	21
22	0.00000+000	0.00000+000	0.00000+000	0.00000+000	0.00000+000	0.00000+000	0.00000+000	22
GROUP	REGION 8	REGION 9	REGION 10	REGION 11	REGION 12	REGION 13	REGION 14	GROUP
1	-2.82412-004	-1.07703-003	-7.62525-004	-2.73819-004	-7.05131-004	-4.98116-004	-1.75936-004	1
2	-5.16186-004	-1.99228-003	-1.40996-003	-4.99854-004	-1.28844-003	-9.09890-004	-3.17711-004	2
3	-4.74801-004	-1.87397-003	-1.32239-003	-4.56819-004	-1.18412-003	-8.34109-004	-2.84784-004	3
4	-1.29182-003	-4.97114-003	-3.49974-003	-1.23983-003	-3.22186-003	-2.26401-003	-7.91145-004	4
5	-2.08693-003	-7.70698-003	-5.42473-003	-2.00750-003	-5.21009-003	-3.65916-003	-1.32889-003	5
6	-1.50694-003	-5.47367-003	-3.85634-003	-1.45373-003	-3.76585-003	-2.64682-003	-9.75968-004	6
7	-1.67386-003	-6.04438-003	-4.26628-003	-1.62017-003	-4.18488-003	-2.94645-003	-1.09272-003	7
8	-1.07537-003	-3.93793-003	-2.78643-003	-1.04439-003	-2.68859-003	-1.89756-003	-6.95876-004	8
9	-1.02715-003	-3.75565-003	-2.66419-003	-1.00154-003	-2.56804-003	-1.81688-003	-6.68548-004	9
10	-1.12072-003	-4.10865-003	-2.92331-003	-1.09834-003	-2.80244-003	-1.98848-003	-7.32036-004	10
11	-6.98515-004	-2.58280-003	-1.84179-003	-6.86883-004	-1.74647-003	-1.24194-003	-4.54459-004	11
12	-4.84369-004	-1.84291-003	-1.31749-003	-4.77923-004	-1.21082-003	-8.63235-004	-3.08279-004	12
13	-4.09763-004	-1.59655-003	-1.14276-003	-4.04960-004	-1.02438-003	-7.31249-004	-2.55727-004	13
14	-3.81474-004	-1.50268-003	-1.07560-003	-3.76552-004	-9.53124-004	-6.80466-004	-2.35305-004	14
15	-8.03519-004	-3.14986-003	-2.25441-003	-7.92363-004	-2.00612-003	-1.43212-003	-4.97337-004	15
16	-1.98323-004	-7.89776-004	-5.65065-004	-1.95149-004	-4.94798-004	-3.53139-004	-1.20538-004	16
17	-5.58543-005	-2.26700-004	-1.62003-004	-5.46962-005	-1.39177-004	-9.92260-005	-3.31148-005	17
18	-2.69095-005	-1.09815-004	-7.84004-005	-2.62714-005	-6.70068-005	-4.77301-005	-1.58068-005	18
19	-1.13076-005	-4.65957-005	-3.32119-005	-1.09891-005	-2.81345-005	-2.00099-005	-6.54183-006	19
20	-2.37700-006	-1.00235-005	-7.12855-006	-2.29737-006	-5.91228-006	-4.19600-006	-1.33713-006	20
21	-1.35182-007	-5.80691-007	-4.12079-007	-1.30027-007	-3.36229-007	-2.38121-007	-7.43226-008	21
22	0.00000+000	0.00000+000	0.00000+000	0.00000+000	0.00000+000	0.00000+000	0.00000+000	22

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 33

CANDID2D PERTURBATION CALCULATION.

SCAT OUT CONTRIBUTION TO D(1/K)

GROUP	REGION 15	REGION 16	GROUP
1	=2.30951=004	=1.28891=003	1
2	=4.28026=004	=2.37564=003	2
3	=4.06768=004	=2.21186=003	3
4	=1.08374=003	=5.88636=003	4
5	=1.67504=003	=9.22575=003	5
6	=1.18443=003	=6.59331=003	6
7	=1.30072=003	=7.31152=003	7
8	=8.42409=004	=4.76218=003	8
9	=7.98049=004	=4.55795=003	9
10	=8.65963=004	=5.00417=003	10
11	=5.41305=004	=3.14835=003	11
12	=3.84080=004	=2.23868=003	12
13	=3.31909=004	=1.93252=003	13
14	=3.12834=004	=1.81318=003	14
15	=6.56479=004	=3.80060=003	15
16	=1.65040=004	=9.48224=004	16
17	=4.76678=005	=2.70121=004	17
18	=2.31833=005	=1.30409=004	18
19	=9.89834=006	=5.50388=005	19
20	=2.14585=006	=1.17401=005	20
21	=1.25187=007	=6.75427=007	21
22	=0.00000=000	=0.00000=000	22

~~CANDID2D PERTURBATION CALCULATION, SCAT REM CONTRIBUTION TO D(1/K)~~

[illegible][illegible]

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 35

CANDID2D PERTURBATION CALCULATION. SCAT REM CONTRIBUTION TO D(1/K)

GROUP	REGION 15	REGION 16	GROUP
1	=2,64761-004	=1,51919-003	1
2	=4,75538-004	=2,67975-003	2
3	=4,59855-004	=2,54275-003	3
4	=1,07138-003	=5,87234-003	4
5	=1,61469-003	=8,98220-003	5
6	=1,15606-003	=6,51252-003	6
7	=1,28570-003	=7,27948-003	7
8	=8,33991-004	=4,73392-003	8
9	=7,88702-004	=4,50709-003	9
10	=8,48172-004	=4,89602-003	10
11	=5,28751-004	=3,06565-003	11
12	=3,68250-004	=2,13420-003	12
13	=3,15722-004	=1,82166-003	13
14	=2,88153-004	=1,65482-003	14
15	=6,50419-004	=3,76018-003	15
16	=1,64499-004	=9,43783-004	16
17	=4,86929-005	=2,75691-004	17
18	=2,21399-005	=1,24303-004	18
19	=9,44343-006	=5,24127-005	19
20	=2,21659-006	=1,21350-005	20
21	=1,23827-007	=6,66362-007	21
22	0,00000+000	0,00000+000	22

CANDID2D PERTURBATION CALCULATION. SCAT DIF CONTRIBUTION TO D(1/K)

GROUP	REGION 1	REGION 2	REGION 3	REGION 4	REGION 5	REGION 6	REGION 7	GROUP
1	0.00000+000	3.95093-004	6.63383-005	7.31633-005	3.54496-005	1.65518-004	1.20705-004	1
2	0.00000+000	5.33819-004	9.30912-005	1.01867-004	4.47736-005	2.30977-004	1.67110-004	2
3	0.00000+000	5.89114-004	1.03879-004	1.12959-004	4.94128-005	2.56469-004	1.84405-004	3
4	0.00000+000	-7.03004-005	-2.35334-005	-2.21151-005	2.51864-006	-5.24439-005	-3.18551-005	4
5	0.00000+000	-5.37964-004	-1.16807-004	-1.19629-004	-3.05268-005	-2.76276-004	-1.86189-004	5
6	0.00000+000	-2.15274-004	-5.50241-005	-5.58728-005	-3.22131-006	-1.29552-004	-8.66036-005	6
7	0.00000+000	-9.82995-005	-2.94661-005	-3.08649-005	5.86509-006	-7.12524-005	-4.94210-005	7
8	0.00000+000	-6.31904-005	-1.67240-005	-1.85412-005	3.21497-006	-4.22473-005	-3.10743-005	8
9	0.00000+000	-9.08423-005	-1.85487-005	-2.10279-005	-2.10032-006	-4.75013-005	-3.56488-005	9
10	0.00000+000	-1.85338-004	-3.51074-005	-3.94826-005	-8.81882-006	-8.91325-005	-6.63187-005	10
11	0.00000+000	-1.40792-004	-2.46980-005	-2.76006-005	-1.01588-005	-6.23266-005	-4.60692-005	11
12	0.00000+000	-1.73801-004	-3.10844-005	-3.46893-005	-1.13509-005	-7.82306-005	-5.77289-005	12
13	0.00000+000	-1.83891-004	-3.17062-005	-3.50196-005	-1.44738-005	-7.90856-005	-5.77517-005	13
14	0.00000+000	-2.77633-004	-4.83002-005	-5.26078-005	-2.37756-005	-1.19409-004	-8.59921-005	14
15	0.00000+000	-7.36099-005	-1.18648-005	-1.28965-005	-8.14246-006	-2.93216-005	-2.10758-005	15
16	0.00000+000	-7.13750-006	-1.05745-006	-1.16617-006	-8.34682-007	-2.62705-006	-1.91424-006	16
17	0.00000+000	1.07820-005	2.00736-006	2.16040-006	8.41433-007	4.93376-006	3.51174-006	17
18	0.00000+000	-1.10902-005	-2.04122-006	-2.20874-006	-8.28258-007	-5.02545-006	-3.59533-006	18
19	0.00000+000	-4.80642-006	-8.89715-007	-9.61020-007	-3.56952-007	-2.18773-006	-1.56231-006	19
20	0.00000+000	7.50112-007	1.38462-007	1.49254-007	5.93621-008	3.40372-007	2.42622-007	20
21	0.00000+000	-1.57528-008	-2.65196-009	-2.84402-009	-1.55165-009	-6.47149-009	-4.58531-009	21
22	0.00000+000	0.00000+000	0.00000+000	0.00000+000	0.00000+000	0.00000+000	0.00000+000	22
GROUP	REGION 8	REGION 9	REGION 10	REGION 11	REGION 12	REGION 13	REGION 14	GROUP
1	5.79238-005	1.73684-004	1.26088-004	5.87161-005	1.45626-004	1.04638-004	4.44858-005	1
2	7.29286-005	2.37190-004	1.71021-004	7.30413-005	1.82667-004	1.30710-004	5.23282-005	2
3	8.01646-005	2.60312-004	1.86573-004	7.94670-005	2.00839-004	1.42968-004	5.67271-005	3
4	5.24469-006	-3.51610-005	-1.99395-005	8.42702-006	1.34207-005	1.22658-005	1.29674-005	4
5	-4.65722-005	-2.40432-004	-1.60945-004	-3.71723-005	-1.16184-004	-7.57588-005	-1.05574-005	5
6	-3.94204-006	-1.03669-004	-6.84804-005	2.10133-006	-6.98952-006	-1.84144-006	1.87156-005	6
7	9.46419-006	-5.59404-005	-3.86760-005	1.24851-005	2.70437-005	1.93865-005	2.52786-005	7
8	4.71012-006	-3.76162-005	-2.77526-005	5.32115-006	1.37337-005	8.79373-006	1.31101-005	8
9	-3.99661-006	-4.79692-005	-3.58583-005	-4.33881-006	-9.04312-006	-7.67150-006	2.71218-006	9
10	-1.50931-005	-9.30841-005	-6.89040-005	-1.61146-005	-3.72213-005	-2.82098-005	-4.37611-006	10
11	-1.69002-005	-6.57153-005	-4.83364-005	-1.76018-005	-4.24502-005	-3.11576-005	-1.11549-005	11
12	-1.88545-005	-8.39744-005	-6.16503-005	-2.00934-005	-4.78091-005	-3.51006-005	-1.12121-005	12
13	-2.37362-005	-8.50826-005	-6.18840-005	-2.48937-005	-6.05552-005	-4.37937-005	-1.70686-005	13
14	-3.87212-005	-1.22334-004	-8.79109-005	-3.89744-005	-9.73187-005	-6.96494-005	-2.87165-005	14
15	-1.32580-005	-2.91704-005	-2.09275-005	-1.30856-005	-3.27861-005	-2.34329-005	-1.16413-005	15
16	-1.35945-006	-2.94545-006	-2.13676-006	-1.41357-006	-3.44016-006	-2.46811-006	-1.25612-006	16
17	1.36602-006	4.66961-006	3.31844-006	1.29468-006	3.35822-006	2.38291-006	8.92777-007	17
18	-1.34466-006	-4.99844-006	-3.57003-006	-1.32469-006	-3.35750-006	-2.39153-006	-8.66410-007	18
19	-5.78817-007	-2.16293-006	-1.54214-006	-5.66666-007	-1.44254-006	-1.02578-006	-3.65447-007	19
20	9.62931-008	3.27056-007	2.32783-007	9.22240-008	2.36461-007	1.67991-007	6.27379-008	20
21	-2.49948-009	-6.66504-009	-4.71700-009	-2.47781-009	-6.31255-009	-4.45680-009	-1.91210-009	21
22	0.00000+000	0.00000+000	0.00000+000	0.00000+000	0.00000+000	0.00000+000	0.00000+000	22

PROB, NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 37

CANDID2D PERTURBATION CALCULATION.

SCAT DIF CONTRIBUTION TO D(1/K)

GROUP	REGION 15	REGION 16	GROUP
1	3.38106+005	2.30284+004	1
2	4.75121+005	3.04110+004	2
3	5.30873+005	3.30890+004	3
4	-1.23586+005	-1.40177+005	4
5	-6.03439+005	-2.43556+004	5
6	-2.83756+005	-8.07953+005	6
7	-1.50167+005	-3.20310+005	7
8	-8.41829+006	-2.82576+005	8
9	-9.34767+006	-5.08634+005	9
10	-1.77908+005	-1.08145+004	10
11	-1.25540+005	-8.27064+005	11
12	-1.58305+005	-1.04484+004	12
13	-1.61869+005	-1.10861+004	13
14	-2.46813+005	-1.58358+004	14
15	-6.05995+006	-4.04152+005	15
16	-5.41392+007	-4.44095+006	16
17	1.02507+006	5.57009+006	17
18	-1.04345+006	-6.10625+006	18
19	-4.54906+007	-2.62614+006	19
20	7.07449+008	3.94903+007	20
21	-1.35953+009	-9.06434+009	21
22	0.00000+000	0.00000+000	22

PROB. NO, 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 39

CANDID2D PERTURBATION CALCULATION. SQRC OUT CONTRIBUTION TO D(1/K)

GROUP	REGION 15	REGION 16	GROUP
1	0.00000+000	0.00000+000	1
2	0.00000+000	0.00000+000	2
3	0.00000+000	0.00000+000	3
4	0.00000+000	0.00000+000	4
5	0.00000+000	0.00000+000	5
6	0.00000+000	0.00000+000	6
7	0.00000+000	0.00000+000	7
8	0.00000+000	0.00000+000	8
9	0.00000+000	0.00000+000	9
10	0.00000+000	0.00000+000	10
11	0.00000+000	0.00000+000	11
12	0.00000+000	0.00000+000	12
13	0.00000+000	0.00000+000	13
14	0.00000+000	0.00000+000	14
15	0.00000+000	0.00000+000	15
16	0.00000+000	0.00000+000	16
17	0.00000+000	0.00000+000	17
18	0.00000+000	0.00000+000	18
19	0.00000+000	0.00000+000	19
20	0.00000+000	0.00000+000	20
21	0.00000+000	0.00000+000	21
22	0.00000+000	0.00000+000	22

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 40

CANDID2D PERTURBATION CALCULATION, CAP+FIS CONTRIBUTION TO D(1/K)

GROUP	REGION 1	REGION 2	REGION 3	REGION 4	REGION 5	REGION 6	REGION 7	GROUP
1	0.00000+000	5.61057-003	1.03940-003	1.11911-003	4.23053-004	2.54946-003	1.81418-003	1
2	0.00000+000	9.92009-003	1.85729-003	1.99581-003	7.29627-004	4.54937-003	3.23073-003	2
3	0.00000+000	9.49899-003	1.79514-003	1.92320-003	6.88727-004	4.38763-003	3.10608-003	3
4	0.00000+000	2.20564-002	4.17979-003	4.46557-003	1.61322-003	1.01945-002	7.19558-003	4
5	0.00000+000	3.35602-002	6.29845-003	6.73000-003	2.53857-003	1.53604-002	1.08425-002	5
6	0.00000+000	2.42179-002	4.51045-003	4.82291-003	1.87025-003	1.10042-002	7.77268-003	6
7	0.00000+000	2.70123-002	5.01747-003	5.36962-003	2.09367-003	1.22486-002	8.65935-003	7
8	0.00000+000	1.75322-002	3.25770-003	3.49270-003	1.34199-003	7.96408-003	5.64135-003	8
9	0.00000+000	1.66394-002	3.08351-003	3.31310-003	1.26940-003	7.55110-003	5.36119-003	9
10	0.00000+000	1.79896-002	3.32000-003	3.57668-003	1.36956-003	8.14694-003	5.80061-003	10
11	0.00000+000	1.12250-002	2.07127-003	2.23650-003	8.42930-004	5.09176-003	3.63413-003	11
12	0.00000+000	7.79860-003	1.44227-003	1.56037-003	5.74241-004	3.55116-003	2.53991-003	12
13	0.00000+000	6.64982-003	1.23648-003	1.33974-003	4.75317-004	3.04816-003	2.18367-003	13
14	0.00000+000	6.03980-003	1.12854-003	1.22344-003	4.21755-004	2.78323-003	1.99505-003	14
15	0.00000+000	1.37565-002	2.55849-003	2.77428-003	9.76554-004	6.31060-003	4.52458-003	15
16	0.00000+000	3.46559-003	6.47125-004	7.01411-004	2.43430-004	1.59580-003	1.14370-003	16
17	0.00000+000	1.02108-003	1.91850-004	2.07663-004	7.08838-005	4.72684-004	3.38313-004	17
18	0.00000+000	4.59531-004	8.67523-005	9.38190-005	3.15166-005	2.13607-004	1.52746-004	18
19	0.00000+000	1.95291-004	3.70727-005	4.00259-005	1.32690-005	9.11731-005	6.50854-005	19
20	0.00000+000	4.57362-005	8.73864-006	9.41412-006	3.07775-006	2.14561-005	1.52822-005	20
21	0.00000+000	2.58958-006	4.99859-007	5.37339-007	1.69399-007	1.22533-006	8.70781-007	21
22	0.00000+000	6.21003-009	1.20421-009	1.29229-009	4.03306-010	2.94808-009	2.09131-009	22
GROUP	REGION 8	REGION 9	REGION 10	REGION 11	REGION 12	REGION 13	REGION 14	GROUP
1	6.83957-004	2.51350-003	1.78580-003	6.68280-004	1.70973-003	1.21133-003	4.42971-004	1
2	1.17823-003	4.45895-003	3.16196-003	1.14579-003	2.94221-003	2.08120-003	7.40079-004	2
3	1.11000-003	4.26882-003	3.01810-003	1.07264-003	2.77008-003	1.95427-003	6.83062-004	3
4	2.59439-003	9.87293-003	6.96030-003	2.49677-003	6.47121-003	4.55301-003	1.60839-003	4
5	4.08131-003	1.49353-002	1.05291-002	3.94124-003	1.01893-002	7.16784-003	2.63705-003	5
6	3.00717-003	1.07442-002	7.57871-003	2.91282-003	7.52068-003	5.29204-003	1.99015-003	6
7	3.36819-003	1.19824-002	8.45909-003	3.26681-003	8.42772-003	5.93439-003	2.23702-003	7
8	2.16214-003	7.80778-003	5.52241-003	2.10134-003	5.40960-003	3.81620-003	1.41927-003	8
9	2.04883-003	7.42450-003	5.26314-003	1.99687-003	5.12430-003	3.62287-003	1.34416-003	9
10	2.21522-003	8.04551-003	5.71904-003	2.16832-003	5.54035-003	3.92756-003	1.45793-003	10
11	1.36595-003	5.04420-003	3.59406-003	1.34123-003	3.41485-003	2.42640-003	8.88377-004	11
12	9.32194-004	3.52228-003	2.51483-003	9.16806-004	2.32893-003	1.65834-003	5.94877-004	12
13	7.72663-004	3.02532-003	2.16345-003	7.60731-004	1.92917-003	1.37599-003	4.77693-004	13
14	6.85950-004	2.76249-003	1.97666-003	6.75594-004	1.71272-003	1.22243-003	4.13445-004	14
15	1.58844-003	6.27264-003	4.48934-003	1.56636-003	3.96644-003	2.83148-003	9.76257-004	15
16	3.95915-004	1.58160-003	1.13154-003	3.89426-004	9.87677-004	7.04882-004	2.39768-004	16
17	1.15202-004	4.65818-004	3.32842-004	1.12727-004	2.86960-004	2.04570-004	6.84661-005	17
18	5.11919-005	2.09888-004	1.49843-004	4.99540-005	1.27453-004	9.07873-005	2.99156-005	18
19	2.15284-005	8.91588-005	6.35486-005	2.09136-005	5.35600-005	3.80936-005	1.23935-005	19
20	4.98554-006	2.08641-005	1.48386-005	4.81683-006	1.23943-005	8.79671-006	2.82172-006	20
21	2.73960-007	1.18523-006	8.41111-007	2.63361-007	6.81203-007	4.82465-007	1.49511-007	21
22	6.51364-010	2.84158-009	2.01304-009	6.24003-010	1.61964-009	1.14515-009	3.51409-010	22

PROB, NO, 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 41

CANDID2D PERTURBATION CALCULATION. CAP+FIS CONTRIBUTION TO D(1/K)

GROUP	REGION 15	REGION 16	GROUP
1	5.32078+004	3.05305+003	1
2	9.51076+004	5.35950+003	2
3	9.19766+004	5.08580+003	3
4	2.14298+003	1.17459+002	4
5	3.22986+003	1.79670+002	5
6	2.31303+003	1.30302+002	6
7	2.57258+003	1.45657+002	7
8	1.66951+003	9.47650+003	8
9	1.57935+003	9.02528+003	9
10	1.69938+003	9.80959+003	10
11	1.05961+003	6.14352+003	11
12	7.37421+004	4.27373+003	12
13	6.31942+004	3.64619+003	13
14	5.76680+004	3.31179+003	14
15	1.30735+003	7.55802+003	15
16	3.30658+004	1.89709+003	16
17	9.80338+005	5.55051+004	17
18	4.43335+005	2.48908+004	18
19	1.89492+005	1.05171+004	19
20	4.46810+006	2.44611+005	20
21	2.55675+007	1.37589+006	21
22	6.16149+010	3.28525+009	22

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 42

CANDID2D PERTURBATION CALCULATION, TOTAL CONTRIBUTION TO D(1/K)

GROUP	REGION 1	REGION 2	REGION 3	REGION 4	REGION 5	REGION 6	REGION 7	GROUP
1	0.00000+000	3.12160-004	6.90978-005	6.94338-005	1.90300-005	1.61442-004	1.05953-004	1
2	0.00000+000	3.38369-004	8.93669-005	8.65564-005	1.00193-005	2.03576-004	1.27714-004	2
3	0.00000+000	2.99608-004	9.84630-005	9.01921-005	-2.10696-006	2.15883-004	1.25842-004	3
4	0.00000+000	-5.78235-004	-3.30881-005	-6.29842-005	-8.64326-005	-1.25465-004	-1.37046-004	4
5	0.00000+000	-1.19090-003	-1.29918-004	-1.76083-004	-1.36474-004	-3.77399-004	-3.31936-004	5
6	0.00000+000	-6.48910-004	-6.32117-005	-9.43649-005	-7.09288-005	-1.98116-004	-1.87242-004	6
7	0.00000+000	-4.17867-004	-3.47121-005	-5.89515-005	-4.38272-005	-1.20778-004	-1.23938-004	7
8	0.00000+000	-2.77936-004	-1.86615-005	-3.52912-005	-3.33888-005	-7.08829-005	-7.72327-005	8
9	0.00000+000	-2.14607-004	-1.77927-005	-2.93000-005	-2.42493-005	-6.03984-005	-6.08441-005	9
10	0.00000+000	-2.91000-004	-3.19840-005	-4.45295-005	-2.96715-005	-9.50807-005	-8.54511-005	10
11	0.00000+000	-1.92106-004	-2.19429-005	-2.87260-005	-2.20085-005	-6.21640-005	-5.32333-005	11
12	0.00000+000	-2.38058-004	-3.05306-005	-3.78610-005	-2.52261-005	-8.29123-005	-6.77839-005	12
13	0.00000+000	-2.25777-004	-3.14245-005	-3.68191-005	-2.42612-005	-8.17491-005	-6.34075-005	13
14	0.00000+000	-3.12024-004	-4.80558-005	-5.38338-005	-3.24715-005	-1.21181-004	-8.99177-005	14
15	0.00000+000	-2.31637-005	6.43138-007	-6.86513-008	-7.40178-006	3.57254-007	-1.10626-006	15
16	0.00000+000	-8.14348-007	2.04460-006	1.74099-006	-2.13009-006	4.29828-006	2.23926-006	16
17	0.00000+000	1.12300-005	3.18804-006	3.16440-006	-7.84763-008	7.40756-006	4.79614-006	17
18	0.00000+000	-1.20031-005	-1.95532-006	-2.17718-006	-1.12355-006	-4.91137-006	-3.62241-006	18
19	0.00000+000	-5.38453-006	-7.82659-007	-8.92944-007	-5.73615-007	-1.99996-006	-1.51221-006	19
20	0.00000+000	6.04968-007	2.00144-007	1.94390-007	-3.07838-008	4.57891-007	2.88782-007	20
21	0.00000+000	-3.62118-008	1.18549-008	8.93069-009	-2.11567-008	2.29987-008	9.64868-009	21
22	0.00000+000	1.61943-009	1.15249-009	1.06809-009	-7.39925-010	2.55194-009	1.51462-009	22
GROUP	REGION 8	REGION 9	REGION 10	REGION 11	REGION 12	REGION 13	REGION 14	GROUP
1	2.78016-005	1.41504-004	9.12542-005	2.05812-005	6.95293-005	4.20125-005	9.12723-007	1
2	1.10492-005	1.61321-004	9.72535-005	-1.43623-006	2.57536-005	5.71926-006	-2.84266-005	2
3	-1.11790-005	1.46185-004	7.63671-005	-2.96394-005	-3.05499-005	-4.04244-005	-5.87491-005	3
4	-1.52719-004	-2.39889-004	-2.17105-004	-1.80411-004	-3.85382-004	-3.04288-004	-1.83506-004	4
5	-2.38557-004	-5.16861-004	-4.29424-004	-2.73870-004	-5.98513-004	-4.67117-004	-2.58671-004	5
6	-1.28570-004	-2.91414-004	-2.52913-004	-1.55091-004	-3.17759-004	-2.58431-004	-1.48751-004	6
7	-8.25307-005	-1.94980-004	-1.76308-004	-1.04636-004	-2.01827-004	-1.70814-004	-1.00804-004	7
8	-6.20481-005	-1.25883-004	-1.16096-004	-7.78896-005	-1.53131-004	-1.27749-004	-7.76539-005	8
9	-4.45717-005	-9.83142-005	-8.76919-005	-5.53812-005	-1.10597-004	-9.11901-005	-5.36951-005	9
10	-5.33029-005	-1.34073-004	-1.13122-004	-6.42590-005	-1.33009-004	-1.07045-004	-5.85338-005	10
11	-3.82618-005	-8.30454-005	-6.80854-005	-4.38543-005	-9.63889-005	-7.47727-005	-4.12906-005	11
12	-4.33031-005	-1.05374-004	-8.37571-005	-4.89990-005	-1.09521-004	-8.37814-005	-4.34145-005	12
13	-4.06775-005	-9.74999-005	-7.45810-005	-4.42763-005	-1.03410-004	-7.69091-005	-3.84292-005	13
14	-5.35722-005	-1.31168-004	-9.69350-005	-5.54897-005	-1.34853-004	-9.81908-005	-4.68333-005	14
15	-1.24116-005	-3.09883-006	-3.60343-006	-1.31951-005	-3.09441-005	-2.30042-005	-1.54653-005	15
16	-3.68194-006	1.74935-006	3.99429-007	-4.27813-006	-9.37215-006	-7.23566-006	-5.29465-006	16
17	-2.55426-007	5.77356-006	3.61704-006	-6.39932-007	-7.58386-007	-8.62284-007	-1.50175-006	17
18	-1.85207-006	-5.18672-006	-3.81361-006	-1.89686-006	-4.63885-006	-3.37294-006	-1.49925-006	18
19	-9.51451-007	-2.21249-006	-1.66129-006	-9.87379-007	-2.38363-006	-1.74720-006	-8.37134-007	19
20	-5.90517-008	3.36722-007	2.02418-007	-8.38838-008	-1.56059-007	-1.33519-007	-1.36648-007	20
21	-3.58156-008	3.01240-009	-4.46400-009	-3.90166-008	-9.01439-008	-6.77769-008	-4.30468-008	21
22	-1.26551-009	1.63485-009	8.67792-010	-1.40822-009	-3.18723-009	-2.42565-009	-1.71622-009	22

PROB, NO, 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 43

CANDID2D PERTURBATION CALCULATION.			TOTAL	CONTRIBUTION TO D(1/K)
GROUP	REGION 15	REGION 16	GROUP	
1	3.59736-005	1.38317-004	1	
2	4.68582-005	1.18532-004	2	
3	5.21740-005	5.61733-005	3	
4	-1.38911-005	-4.97572-004	4	
5	-6.23332-005	-8.79607-004	5	
6	-2.92144-005	-5.11469-004	6	
7	-1.51616-005	-3.53467-004	7	
8	-7.75522-006	-2.43529-004	8	
9	-7.93896-006	-1.80301-004	9	
10	-1.52471-005	-2.24173-004	10	
11	-1.06852-005	-1.39899-004	11	
12	-1.51287-005	-1.67399-004	12	
13	-1.58110-005	-1.49852-004	13	
14	-2.43929-005	-1.88737-004	14	
15	4.12352-007	-1.83176-005	15	
16	1.09322-006	-4.50365-006	16	
17	1.65772-006	3.66947-006	17	
18	-9.93039-007	-7.08041-006	18	
19	-3.95186-007	-3.26363-006	19	
20	1.04506-007	1.52856-007	20	
21	6.45683-009	-4.92029-008	21	
22	6.07151-010	-4.18645-010	22	

PROB, NO, 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 44

CONTRIBUTIONS TO DEL(1/K) SUMMED BY GROUP

GROUP NO	LEAKAGE	REMOVAL	SCAT OUT	SCAT REM	SCAT DIF	SORC OUT	CAP+FIS	TOTAL
1	-6.47347-004	1.26386-002	-1.06863-002	-1.25178-002	1.83152-003	0.00000+000	2.51565-002	1.30500-003
2	-1.15092-003	2.21509-002	-1.97078-002	-2.21509-002	2.44315-003	0.00000+000	4.43019-002	1.29223-003
3	-1.70163-003	2.11424-002	-1.84525-002	-2.11399-002	2.68734-003	0.00000+000	4.22823-002	9.88236-004
4	-2.98093-003	4.90803-002	-4.92974-002	-4.90706-002	-2.26880-004	0.00000+000	5.81509-002	-3.19802-003
5	-3.83060-003	7.50150-002	-7.72520-002	-7.49931-002	-2.25891-003	0.00000+000	1.50008-001	-6.06766-003
6	-2.58028-003	5.43150-002	-5.50911-002	-5.42723-002	-8.18825-004	0.00000+000	1.08587-001	-3.35638-003
7	-1.93478-003	6.06352-002	-6.09011-002	-6.05796-002	-3.21445-004	0.00000+000	1.21215-001	-2.20060-003
8	-1.35206-003	3.93433-002	-3.94964-002	-3.92714-002	-2.24938-004	0.00000+000	7.86148-002	-1.50510-003
9	-8.46543-004	3.73694-002	-3.76596-002	-3.72776-002	-3.82046-004	0.00000+000	7.46470-002	-1.13678-003
10	-8.11801-004	4.04654-002	-4.11341-002	-4.03209-002	-8.13137-004	0.00000+000	8.07863-002	-1.48048-003
11	-4.36561-004	2.52400-002	-2.57799-002	-2.51397-002	-6.40222-004	0.00000+000	5.03797-002	-9.76464-004
12	-4.40837-004	1.74948-002	-1.82370-002	-1.74511-002	-7.85894-004	0.00000+000	3.49459-002	-1.18305-003
13	-2.82306-004	1.48699-002	-1.56925-002	-1.48465-002	-8.45989-004	0.00000+000	2.97163-002	-1.10488-003
14	-2.30763-004	1.34735-002	-1.47304-002	-1.34560-002	-1.27438-003	0.00000+000	2.69296-002	-1.48766-003
15	-1.08938-004	3.08818-002	-3.09232-002	-3.05755-002	-3.47688-004	0.00000+000	6.14573-002	-1.50368-004
16	-6.66290-005	7.76662-003	-7.72374-003	-7.68900-003	-3.47391-005	0.00000+000	1.54556-002	-2.37455-005
17	-3.77274-005	2.28608-003	-2.20795-003	-2.25606-003	4.81111-005	0.00000+000	4.54215-003	4.04076-005
18	-8.81127-006	1.02136-003	-1.06868-003	-1.01888-003	-4.97922-005	0.00000+000	2.04025-003	-5.61266-005
19	-6.82146-006	4.34040-004	-4.52724-004	-4.31194-004	-2.15295-005	0.00000+000	8.65234-004	-2.55053-005
20	-2.99822-006	1.01866-004	-9.69249-005	-1.00286-004	3.36135-006	0.00000+000	2.02152-004	1.94274-006
21	-6.08270-007	5.87917-006	-5.59484-006	-5.52151-006	-7.33219-008	0.00000+000	1.14007-005	-3.23933-007
22	-2.74419-008	2.72968-008	0.00000+000	0.00000+000	0.00000+000	0.00000+000	2.72968-008	-1.45038-010

PROB. NO. 5.10000+002 2DCANDID

PERC SAMPLE PROBLEM

PAGE NO. 45

CONTRIBUTIONS TO DEL(1/K) SUMMED BY REGION

REGION NO	LEAKAGE	REMOVAL	SCAT OUT	SCAT REM	SCAT DIF	SORC OUT	CAP+FIS	TOTAL
1	0.00000+000	0.00000+000	0.00000+000	0.00000+000	0.00000+000	0.00000+000	0.00000+000	0.00000+000
2	-3.32314-003	1.17479-001	-1.17823-001	-1.17218-001	-6.04428-004	0.00000+000	2.34697-001	-3.66677-003
3	-6.80758-005	2.19084-002	-2.20413-002	-2.18599-002	-1.81401-004	0.00000+000	4.37683-002	-2.01043-004
4	-2.78457-004	2.35241-002	-2.36562-002	-2.34718-002	-1.84387-004	0.00000+000	4.69959-002	-4.10591-004
5	-5.60154-004	8.80522-003	-8.75843-003	-8.78597-003	2.75452-005	0.00000+000	1.75912-002	-5.13357-004
6	-5.00272-004	5.36281-002	-5.39374-002	-5.35091-002	-4.28310-004	0.00000+000	1.07137-001	-8.09591-004
7	-7.15425-004	3.80512-002	-3.82532-002	-3.79663-002	-2.86831-004	0.00000+000	7.61175-002	-9.17400-004
8	-1.00841-003	1.42075-002	-1.41287-002	-1.41763-002	4.75390-005	0.00000+000	2.83837-002	-9.29690-004
9	-1.35557-003	5.25834-002	-5.28000-002	-5.24659-002	-3.34079-004	0.00000+000	1.05049-001	-1.57213-003
10	-1.31840-003	3.72566-002	-3.73942-002	-3.71729-002	-2.21285-004	0.00000+000	7.44294-002	-1.45601-003
11	-1.23167-003	1.38201-002	-1.37242-002	-1.37896-002	6.53639-005	0.00000+000	2.76097-002	-1.13577-003
12	-2.53423-003	3.55020-002	-3.52957-002	-3.54240-002	1.28318-004	0.00000+000	7.09260-002	-2.32800-003
13	-2.04353-003	2.50891-002	-2.49350-002	-2.50338-002	9.88079-005	0.00000+000	5.01230-002	-1.88941-003
14	-1.31246-003	9.14205-003	-8.99212-003	-9.12219-003	1.30064-004	0.00000+000	1.82642-002	-1.16254-003
15	-1.19479-005	1.12220-002	-1.12908-002	-1.11973-002	-9.34996-005	0.00000+000	2.24193-002	-8.06669-005
16	-3.19817-003	6.35130-002	-6.35672-002	-6.33707-002	-1.96424-004	0.00000+000	1.26884-001	-3.25238-003

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