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"LOLA SYSTEM: A CODE BLOK FOR NODAL PWR SIMULATION"

PART. II - MELON-3, CONCON AND CONAXI CODES.

por

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JUNTA DE ENERGIA NUCLEAR

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COMPUTER CODE ABSTRACT

LOLA SYSTEM

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This code has been included in the coordinated Research Programme (CRP) on "Codes Adaptable to Small and Medium Size Computers Available in developing countries for In-Core Fuel Management" of the International Atomic Energy Agency.

1. Program, Name and Title:

LOLA System, a code block for Nodal PWR simulation.

2. Problem solved:

The LOLA System is a part of the JEN-UPM code package for PWR fuel management, scope or design calculations. It is a code package for core burnup calculations using nodal theory based on a FLARE type code. The LOLA System includes four modules; the first one (MELON-3) generates the constants of the K_∞ and M^2 correlations to be input into SIMULA-3. It needs the K_∞ and M^2 fuel assembly values at different conditions of moderator temperature, Boron concentration, burnup, etc., which are provided by MARIA fuel assembly calculations.

The main module (SIMULA-3) is the core burnup calculations code in three dimensions and one group of energy, it normally uses a geometrical representation of one node per fuel assembly or per quarter of fuel assembly. It has included a thermal hydraulic feed-back on flow and voids and criticality searches on Boron concentration and control rods insertion.

The CONCON code makes the calculation of the albedoes, transport factors, K_∞ and M^2 correction factors to be input into SIMULA-3. The calculation is made in the XY transversal plane. The CONAXI code is similar to CONCON, but in the axial direction.

3. Method of solution:

MELON-3 makes a mean squares fit of K_∞ and M^2 values at different conditions in order to determine the constants of the feedback correlations.

SIMULA-3 uses a modified 1-group nodal theory, with a new transport kernel that provides the same node interface leakages than a fine mesh diffusion calculation.

CONCON and CONAXI determine the transport and correction factors, as well as the albedoes, to be input into SIMULA-3; by a method of leakages equivalence to the detailed diffusion calculation of CARMEN or VENTURE, these factors include also the heterogeneity effects inside the node.

4. Restrictions:

No. of X,Y,Z nodes ≤ 15x15x17
No. of material types ≤ 15
No. of fuel assembly types ≤ 15

5. Unusual features of the system:

SIMULA-3 uses as input data the interface units generated by the other modules, with the correlation constants, the transport factors, the albedoes and the K_∞ and M^2 correction factors.

6. Relationship to other programs:

MARIA System generates the K_∞ and M^2 values at different conditions to be input into MELON-3.

CARMEN System provides the detailed fine-mesh fluxes and the cross sections by zone to be input into CONCON and CONAXI codes.

7. Other programming, restrictions or operating information:

None.

8. Computer and language.

UNIVAC-1100 and CYBER-835.
FORTRAN - V.

9. Typical Running Time.

The module with a more relevant running time is the SIMULA-3, with about 90 cpu seconds per burnup step in the UNIVAC-1100/80 or in the CYBER-835.

10. Operating System.

UNIVAC-1100, EXEC 8; CYBER-835, NOS 2.1

11. Machine requirements

18K works for the code source and about 38Kwords for the data.

12. Availability.

Available through the OECD-NEA Data Bank, Saclay, France.

13. Status.

Production.

14. References:

1.- J.M. Aragonés, C. Ahnert, J. Gómez Santamaría and I. Rodríguez Olabarría, "LOLA System, a code block for nodal PWR simulation". 1ª parte JEN-568, 2ª parte JEN-571 (1984).

2.- J.M. Aragonés, C. Ahnert, "MARIA System, a code block for PWR fuel assembly calculations". JEN-543 (1983).

3.- C. Ahnert, J.M. Aragonés. "CARMEN System, a code block for neutronic PWR calculation by diffusion theory with space dependent feedback effects". JEN-515 (1982).

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1. INTRODUCTION.

The LOLA System is a part of the JEN-UPM code package, for PWR fuel management, scope or design calculations. It is also a code package for core burnup calculations using the nodal theory. The CARMEN [1] and MARIA [2] Systems complete the whole JEN-UPM package.

The MARIA System is the fuel assembly calculations block, and the CARMEN System is the core burnup calculations block by diffusion theory. The LOLA System is based on a FLARE type [3] nodal code, three dimensional and one energy group, this is the SIMULA-3 code. The SIMULA-3 code [7] may use the geometrical representation of one node per fuel assembly or one node per quarter of fuel assembly.

The LOLA System also includes the MELON-3, CONCON and CONAXI codes (Figure 1). MELON-3 makes the generation of the constants of the k_∞ and M^2 correlations to be input into SIMULA-3. It needs as input data the k_∞ and M^2 fuel assembly values at different conditions of moderator temperature, Boron concentration, burnup, etc.

The fuel assembly calculations for PWR are made by the MARIA System.

The CONCON code makes the calculation of the albedoes, transport factors, k_∞ and M^2 correction factors to be input into SIMULA-3. These parameters are obtained in an explicit way, by a method that preserves the same leakage values in the nodal calculation by SIMULA-3, than in the reference calculation by diffusion theory with CARMEN. The calculation is made in the XY transversal plane.

CONAXI is quite similar to CONCON, but in the axial direction. The four codes are connected by interface units, those connections jointly with the connections to MARIA and CARMEN Systems can be seen in figure 1.

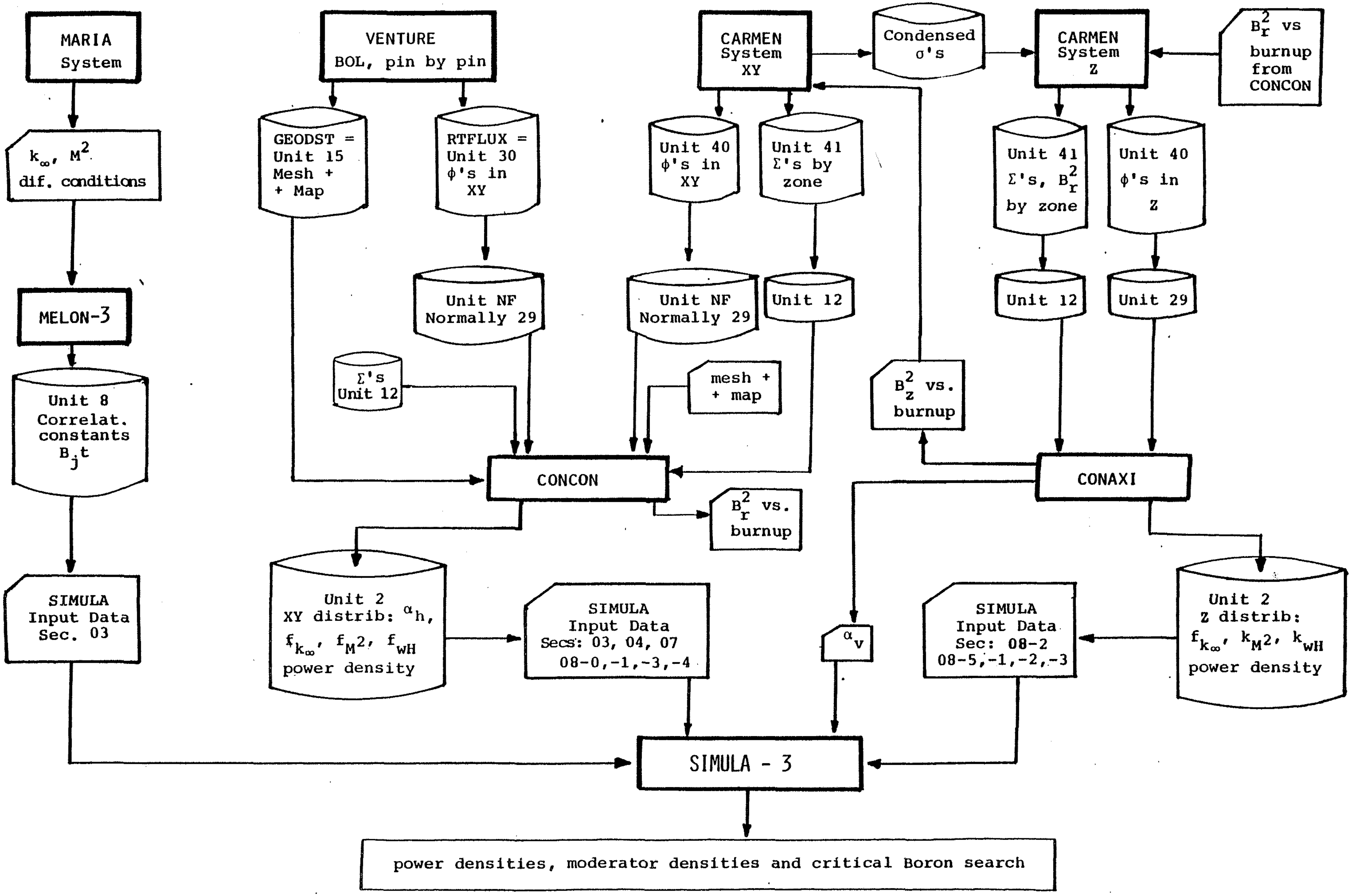

FIGURE 1 - LOLA SYSTEM

ADDENDUM - A Summary of the expressions used by SIMULA-3.

Before starting the description of MELON-3, CONCON and CONAXI Codes, we will include here a summary of the expressions used by the SIMULA-3 Code |6|, with the same identification numbers, which it is also the one used in the present report.

Nodal Source:

$$S_\ell = \frac{\frac{k_{\infty\ell}}{\lambda}\left[\sum_m^v S_m W^v_{m\ell} + \sum_m^h S_m W^h_{m\ell}\right]}{1 - \frac{k_{\infty\ell}}{\lambda}\left[1 - (2-\alpha^v_\ell) W^v_{\ell m} - (4-\alpha^h_\ell) W^h_{\ell m}\right]} \qquad (8)$$

where the superscripts refer to vertical and horizontal values.

Eigenvalue:

$$\lambda = \frac{\sum_\ell S_\ell - \sum_\ell S_\ell W_{\ell m} \; (n_\ell - \alpha_\ell)}{\sum_\ell \frac{S_\ell}{K_{\infty\ell}}} \qquad (10)$$

Equation (8) and (10) are solved iteratively starting from an initial guess for the source at each node and λ.

Transport Kernels:

$$(W_{ij})_h = \frac{2}{1 + \frac{f_i}{f_j} \frac{M_i^2}{M_j^2}} \; \frac{g^h \cdot M_i^2}{k_{\infty i} \cdot x^2}$$

$$(W_{ij})_v = \frac{2}{1 + f_{ij} \frac{M_i^2}{M_j^2}} \; \frac{g^v \cdot M_i^2}{k_{\infty i} \cdot z^2} \qquad (22)$$

f_i and f_j are the "transport factors" and are input data to the code.

The local k_∞ value is determined by the following expression:

$$k_\infty = H \left[1 + \left(\frac{\Delta k_\infty}{k_\infty}\right)_{Xe} + \left(\frac{\Delta k_\infty}{k_\infty}\right)_{Dop}\right] \cdot \left[1 + \left(\frac{\Delta k_\infty}{k_\infty}\right)_{E} + \left(\frac{\Delta k_\infty}{k_\infty}\right)_{P}\right] \cdot \left[1 + \left(\frac{\Delta k_\infty}{k_\infty}\right)_{B}\right] \qquad (33)$$

where $H = \left[k^+ + \{(0.5)(c_t) - 0.5\}\ (k^+ - k^-)\right]\ XK'_{ij}$

k^+, k^- = k_∞ versus moderator density, with control and without control. See equations (35).

c_t = the fraction of control. See input card type 1.

XK'_{ij} = partial fuel factor (See input cards 8) the CONCON and CONAXI codes may be used to calculated these factors.

The correlations used presently by SIMULA-3 are analized in the next parragraphs:

a) Migration area

$$M^2 \text{ (control)} = B_1(1+B_2U+B_3U^2)\ XM_{ij} \qquad (34)$$

$$M^2 \text{ (no control)} = B_4(1+B_5U+B_6U^2)\ XM_{ij}$$

U = relative moderator density.

B_1 to B_6 are input data.

XM_{ij} = M^2 correction factor (See input cards 8), they may be determined by CONCON and CONAXI codes.

M^2 for intermediate control rod positions are linearly interpolated between two values.

b) k_∞ versus moderator density.

$$k_\infty \text{ (control)} = B_7(1+B_8U + B_9U^2) = K^+ \qquad (35)$$

$$k_\infty \text{ (no control)} = B_{10}(1+B_{11}U + B_{12}U^2) = K^-$$

B_7 to B_{12} are input data.

For other rod positions, k_∞ is determined by linear interpolation of two values.

c) Doppler worth.

$$-\left(\frac{\Delta k_\infty}{k_\infty}\right)_{Dop} = f_D(P) \cdot g_D(U)$$

$$f_D(P) = B_{16}P\ (1 + B_{42}P) \qquad (36)$$

$$g_D(U) = 1 + B_{17}(1-U)\ .\ (1+B_{43}U)$$

P = relative power density.
U = relative moderator density.

B_{16}, B_{17}, B_{42} and B_{43} are input data.

d) Equilibrium Xenon worth.

$$-\left(\frac{\Delta k_\infty}{k_\infty}\right)_{Xe} = f_X(P) \cdot g_X(E)$$

$$f_X(P) = \frac{B_{14}P\ (1+B_{13})}{P+B_{13}} \qquad (37)$$

$$g_X(E) = 1+B_{15}E+B_{44}E^2+B_{45}E^3+B_{46}E^4 \qquad (38)$$

P = relative power density.

E = exposure, in 10^3 Mwd/T units

B_{13}, B_{14}, B_{15}, B_{44}, B_{45} and B_{46} are input data.

e) Boron worth.

$$-\left(\frac{\Delta k_\infty}{k_\infty}\right)_B = U \cdot f_B(B) \cdot g_B(E)$$

$$f_B(B) = B.(B_{29}+B_{30}B+B_{31}B^2)$$

$$g_B(E) = 1+B_{32}E+B_{33}E^2+B_{40}E^3+B_{41}E^4 \qquad (39)$$

B = boron concentration in ppm.

E = exposure, in 10^3 Mwd/T units.

B_{29} to B_{33}, B_{40} and B_{41} are input data.

f) Exposure worth.

$$-\left(\frac{\Delta k_\infty}{k_\infty}\right)_E = B_{18}+B_{20}E+B_{21}E^2+B_{22}E^3 +B_{23}E^4 \qquad (40)$$

E = exposure, in 10^3 Mwd/T units.

B_{18} and B_{20} to B_{23} are input data.

The exposure E, is computed as follows:

$$E_t = E_{t-1} + B_{28} \cdot \Delta E \cdot P \cdot Z_E \qquad (41)$$

where t = time step number

ΔE = exposure increment, 10^3 Mwd/T.

Z_E = normalization factor

B_{28} = is to account for non-uniform fuel loading.

The normalization factor, Z_E, is computed internally by the code to maintain the core average value at ΔE. B_{28} is used to account for non-uniform fuel loading.

g) Burnable poison.

$$-\left(\frac{\Delta k_\infty}{k_\infty}\right)_P = B_{18}\exp(-B_{19}E) \tag{42}$$

this can be used to include other burnup dependent effects.

2. MELON-3 CODE.

The MELON-3 code has been developed as an utility program to calculate the coefficients of the reactivity correlations in the SIMULA-3 code for PWR applications.

The object is to automatize this stage of the LOLA usage, it is located between the fuel assembly calculations by MARIA and the nodal core calculation by SIMULA.

The code uses the M^2 and k_∞ values at different conditions calculated by MARIA [2], and performs the fitting of the SIMULA-3 correlations, suplying the resulting coefficients written on an interface unit, in the format needed by the nodal code.

2.1. Methods and procedures.

MELON-3 uses also the expressions for the correlations included in the SIMULA-3 code, for PWR applications (See 1.1.2.1) of [6], and the procedure of fitting is to determine by "least squares" methods the coefficients of the correlations in order to get the expected changes in reactivity calculated by the MARIA executions.

Then for each correlation, the code performs:

a) Calculation of the M^2 and k_∞ values at the reference conditions of the other variables not included in the particular correlation; when the input values are at other conditions. The object is to get the isolated effect in reactivity due to changes in one variable.

b) Calculation of the reactivity changes.

c) Calculation of the coefficients of the correlations.

d) Writting of the resulting coefficients on an interface unit.

The procedure should keep the consistency of the wholeness, in order to consider any effect, just at one time. The method followed by MELON-3 in each particular correlation in described.

2.1.1. Migration Area.

The fit of the expression (34) is done using a set of M^2 values at different relative moderator densities. They are determined by fuel assembly calculations at "reference conditions" for the other variables.

2.1.2. k_∞ versus moderator density.

The fit of the expressions (35) is done using a set of k_∞ values at different relative moderator densities; for the other conditions there are five different possibilities (input data IC(19)). Normally it is used the option IC(19)=2, with the "reference conditions" BU, EU, PDU and PXU given in card 15.

MELON calculates the k_∞ values corresponding to the no Boron, no Exposure, no Xenon and no Doppler situation, in order to fit the present correlation. The correction of the input k_∞ values is made after the reactivity worthes of the Boron, Exposure, Xenon and Doppler have been determined, using the following expression:

$$K_U = \frac{k_\infty}{\left[1 + \left(\frac{\Delta k_\infty}{k_\infty}\right)_{Dop} + \left(\frac{\Delta k_\infty}{k_\infty}\right)_{Xe}\right]\left[1 + \left(\frac{\Delta k_\infty}{k_\infty}\right)_{B}\right]\left[1 + \left(\frac{\Delta k_\infty}{k_\infty}\right)_{E}\right]}$$

2.1.3. Doppler worth.

To fit the first expressions (36) of the Doppler worth, a set of k_∞ values at different power densities are needed, the other conditions are in the fuel assembly calculations keeped at their reference values.

With the obtained k_∞ values, the following expression is fitted by MELON:

$$-\left(\frac{\Delta k_\infty}{k_\infty}\right)_{Dop} = 1 - \frac{k_\infty(P)}{k_\infty(P=0.0)} = f_D(P) \cdot g_D(U=1.0) =$$

$$= B_{16}P(1+B_{42}P)$$

To fit the second expression (36) of the Doppler worth, a set of fuel assembly calculations at different moderator densities is needed, the k_∞ values are determined at HFP (hot full power) and HZP (hot zero power) conditions, to get the Doppler worth at different moderator densities.

With the obtained k_∞ values, the following expression is fitted by MELON:

$$-\left(\frac{\Delta k_\infty}{k_\infty}\right)_{Dop} = 1 - \frac{k_\infty(P=PDU)}{k_\infty(P=0.0)} = f_D\ (P=PDU) \cdot g_D(U) =$$

$$= B_{16}.PDU.(1+B_{42}.PDU).(1+B_{17}(1-U)(1+B_{43}U))$$

2.1.4. Equilibrium Xenon Worth

To fit the second expression (38) of the Xenon worth, a set of fuel assembly calculations at different exposures is needed, calculating the k_∞ values at equilibrium Xenon condition and without Xenon, in order to get the Xenon worth at different exposures.

With the given k_∞ values, the following expression if fitted by MELON:

$$g_X(E) = \left[1 - \frac{k_\infty(Xe=Xe^{eq})}{k_\infty(Xe=0.0)}\right] \Big/ f_X(P=PU) =$$

$$= \begin{cases} B_{15} + B_{44}E + B_{45}E^2;\ B_{46}=0 & (\text{if NXE} = 3 \text{ or } 2) \\ (1+B_{15}E + B_{44}E^2 + B_{45}E^3 + B_{46}E^4) & (\text{if NXE} \geq 4 \text{ or} \leq 1) \end{cases}$$

To fit the first expression (37) of the Xenon worth, a set of MARIA calculations at different power densities are needed, with the equilibrium Xenon concentration corresponding to each power level. As a changes on the power level produces also a change in the reactivity due to the Doppler effect; to get the isolated Xenon worth value, MELON deducts of the reactivity change, the part due to the Doppler worth, after it has been determined.

With the obtained k_∞ values, the following expression is fitted by MELON:

$$-\left(\frac{\Delta k_\infty}{k_\infty}\right)_{Xe} = 1 - \frac{k_\infty(P)}{k_\infty(P=0.0)} - \left(\frac{\Delta k_\infty}{k_\infty}\right)_{Dop} =$$

$$= f_X(P)\cdot g_X(E=0.0) = B_{14}\,\frac{P(1+B_{13})}{(P+B_{13})}$$

2.1.5. <u>Boron worth.</u>

To fit the first expression (39) of the Boron worth, a set of k_∞ values at different Boron concentrations are needed, those fuel assembly calculations are made with the equilibrium Xenon condition, in order to get the more realistic value of the Boron worth.

With the obtained k_∞ values the following expression is fitted by MELON:

$$-\left(\frac{\Delta k_\infty}{k_\infty}\right)_B = 1 - \frac{k_\infty(B)}{k_\infty(B=0.0)} = U.f_B(B).g_B(E=0.0) =$$

$$= B(B_{29} + B_{30}B + B_{31}B^2)$$

To fit the second expression (39) of the Boron worth a set of k_∞ values at different exposures are needed, those fuel assembly calculations are made with the corresponding core critical Boron concentration and without Boron, in order to get the Boron worth at different exposures.

With the obtained k_∞ values, the following expression is fitted by MELON:

$$g_B(E) = \left[1 - \frac{k_\infty(B)}{k_\infty(B=0.0)}\right] / f_B(B) =$$

$$= \begin{array}{ll} B_{32} + B_{33}E + B_{40}E^2;\ B_{41}=0. & \text{(if NBE = 3, 2)} \\ (1+B_{32}E + B_{33}E^2 + B_{40}E^3 + B_{41}E^4) & \text{(if NBE} \geq 4 \text{ or} \leq 1) \end{array}$$

2.1.6. Exposure Worth.

To fit the expression (40) of the exposure worth, a set of k_∞ values at different exposures are needed, using the core critical Boron concentration associated to each exposure.

For the other conditions there are three possibilities (input data IC(34)); normally it is used the option IC(34)=1, at reference conditions, using the k_∞ at BOL without Xenon, the other k_∞ values with Eq. Xenon.

If the k_∞ values include the Xenon, Doppler and Boron influences, MELON makes the deduction of the corresponding worthes before the fitting of the exposure worth. The Doppler and Xenon worthes are calculated for the relative power of PDXE given in card 15.

With the corrected k_∞ values, the following expression is fitted by MELON:

$$-\left(\frac{\Delta k_\infty}{k_\infty}\right) = 1 - \frac{k_\infty(E)}{k_\infty(E=0.0)} = B_{18} + B_{20}E + B_{21}E^2 + B_{22}E^3 + B_{23}E^4$$

This fit can be made in two intervals of exposures; when the fit is done in one interval, B_{18} is set equal to 0.0. In the second interval B_{18} is not zero in general. The number of coefficients can be reduced from 5 up to 2 through input variable IFIT = IC (35).

2.2. MELON-3 Input Data.

Column	Content	Description
Card 1	Title card. Format (20A4)	
1-80	TITLE(I),I=1,20	Alphanumeric identification of the case. If TITLE(1)='ENDA', a new fuel assembly follows. If TITLE(1)='LAST', exucution stops.
Card 2	Control Parameters. Format (36I2)	
1-2	IC(1)	Number of Boron Concentrations input on card 3 for the Boron worth calculation. If=0 the data of the previous case are used. Normally IC(1)=IC(2).
3-4	IC(2)=IB	Number of k_∞ values input on card 4 for the Boron worth calculation ($\leq$8).
5-6	IC(3)=IBE	Number of cards 5 for the Boron worth calculation versus Exposure ($\leq$16).
7-8	IC(4)=NBE	Number of coefficients in the fit of the exposure on the Boron worth ($\leq$4). If$\leq$ 1 it is set NBE=4.
11-12	IC(6)	Number of P values (relative power density) input on card 6 for the Doppler worth calculation. If=0 the data of the previous case are used. Normally IC(6)=IC(7).
13-14	IC(7)=ID	Number of k_∞ values input on card 7 for the Doppler worth calculation ($\leq$8).
15-16	IC(8)=IDU	Number of cards 8 for the Doppler worth calculation versus Moderator Density ($\leq$16).
21-22	IC(11)	Number of P values input on card 9 for the Xenon worth calculation. If=0 the data of the previous case, are used. Normally IC(11)=IC(12).

Column	Contents	Designation
23-24	IC(12)=IX	Number of k_∞ values input on card 10 for the Xenon worth calculation (≤8).
25-26	IC(13)=IXE	Number of cards 11 for the Xenon worth calculation versus Exposure (≤16).
27-28	IC(14)=NXE	Number of coefficients for the fit of the effect of the exposure on the Xenon worth (≤4). If ≤1 it is set NXE=4.
31-32	IC(16)	Number of Moderator temperatures and Densities input on card 12 and 13 for the k_∞ vs. Moderator Density calculation. If=0 the data of the previous case are used. Normally IC(16)=IC(17).
33-34	IC(17)=IXU	Number of k_∞ values input on card 14 for the k_∞ vs. Moderator Density calculation (≤16).
35-36	IC(18)=IUAVE	Index of the Moderator Density Value (One of those provided on card 13) considered as reference Moderator Density (U=1).
37-38	IC(19)	Option used for the kind of k_∞ values provided on card 14 for the k_∞ vs. Moderator Density calculation = 0, k_∞'s are no Boron, no Xenon, no Doppler (P=0.0), no Exposure. = 1, k_∞'s are with Boron, no Xenon, no Doppler (P=0.0), no Exposure. = 2, k_∞'s are with Boron, with Doppler (P=PDU), no Xenon, no Exposure. = 3, k_∞'s are with Boron, with Doppler (P=PDU) and Xenon, no Exposure. = 4, k_∞'s are with Boron, with Doppler (P=PDU) Xenon and Exposure. If this number is not 0, card 15 is required.
51-52	IC(26)	Number of Temperatures and Densities input on cards 16 and 17 for the Migration Area vs. Moderator Density calculation. Normally IC(26)=IC(27).
53-54	IC(27)=IMU	Number of Migration Area values input on card 18 for the Migration Area vs. Moderator Density calculation(≤16).

Column	Content	Description
61-62	IC(31)	Number of Boron concentrations input on card 19 for the Exposure worth calculation correspondent to each Exposure. If =0 the data of the previous case are used. Normally. IC(31)=IC(33).
63-64	IC(32)	Number of Exposure values input on card 20 for the Exposure worth calculation. If =0 the data of the previous case are used Normally, IC(32)=IC(33).
65-66	IC(33)=IE	Number of k_∞ values input on card 21 for the Exposure worth calculation (≤16).
67-68	IC(34)=IKIND	Kind of k_∞ values input on card 21. Options are: = 0, all k_∞'s are without Xenon and Doppler (P=0.0). = 1, the first k_∞ is with Doppler (P=PDXE) and no Xenon; the others are with Doppler and Xenon (P=PDXE). = 2, all k_∞'s are with Doppler and Xenon (P=PDXE).
69-70	IC(35)=IFIT	Kind of fit for the Exposure worth correlation. Options are: = 0, fit in one interval (from 0 to E max). = 1, fit in two intervals (from 0 to 5000 Mwd/T and from 1000 Mwd/T to E max). = 2, both fits. IFIT/10=NCE = Number of coefficients in the fit por the second interval (≤5). If ≤1 it is set NCE=5.
71-72	IC(36)	Option to write in unit 8 the coefficients B_n calculated by MELON: = 0, no used. = N, fuel assembly type number.

Boron Worth Cards.

If IC(2)=IB=0, cards 3, 4 and 5 are omitted.

Card 3. Boron concentrations (8E10.2). If IC(1)≠ 0.

1-10, 11-20, ...	B(I),I=1,IB	Boron concentrations for the next k_∞ values.

Card 4. k_∞ values (8E10.5)

1-10, 11-20, ...	BK(I),I=1,IB	k_∞ values corresponding to the previous Boron.

Cards 5. Boron worth versus Exposure (4E12.5)
As many cards as IBE=IC(3)

1-10	EBE(I)	Exposure values (Gwd/T) correspondent to the next k_∞ values.
11-20	BBE(I)	Boron concentration (ppm), for the previous Exposures.
21-30	BEK(I)	k_∞ values for the previous Exposures and Boron Concentrations.
31-40	SBEK(I)	k_∞ values for the previous Exposures and without Boron.

Doppler Worth Cards.

If IC(7)=ID=0, cards 6, 7 amd 8 are omitted.

Card 6. P values (8E10.2). If IC(6)$\neq$0.

1-10, 11-20,...	SPD(I),I=1,ID	Relative Power Density (P) values for the next k_∞ values.

Card 7. k_∞ values (8E10.5)

1-10, 11-20,...	SPDK(I),I=1,ID	k_∞ values corresponding to the previous P values.

Card 8. Doppler worth versus Moderator Density (3E10.5).
As many cards as IDU=IC(8).

1-10	UD(I)	Moderator Density values (U) for the next k_∞ values.
11-20	ZPK(I)	k_∞ values for the previous Moderator Densities, at 0 % Power.
21-30	FPK(I)	As ZPK(I), but at 100 % Power. (At PDU relative power density if PDU>0 on card 15).

Xenon Worth Cards

If IC(12)=IX=0, cards 9, 10 and 11 are omitted.

Card 9, P Values (8E10.2)

1-10, 11-20,...	XE(I),I=1,IX	Relative power density (P) values for the next k_∞ values.

Card 10. k_∞ values. (8E10.5)

1-10, 11-20,...	XEK(I),I=1,IX	k_∞ values corresponding to the previous P values. Now with equilibrium Xenon.

Cards 11. Xenon worth versus exposure (3E10.5)
As many cards as IXE=IC(13)

1-10	EX(I)	Exposure (Gwd/T) for the next k_∞ values.
11-20	CXK(I)	k_∞ values (with Xenon) corresponding to the previous Exposures (at PDXE relative power).
21-30	SXK(I)	k_∞ values (without Xenon) corresponding to the previous Exposures.

k_∞ versus Moderator Density Cards.

If IC(17)=IKU=0, cards 12, 13, 14 and 15 are omitted.

Card 12. Moderator Temperature values (8E10.2)

1-10, 11-20,...	T(I),I=1,IKU	Moderator Temperature values (in °C), correspondent to the next Moderator Densities values.

Card 13. Moderator Density values (8E10.5)

1-10, 11-20,...	U(I),I=1,IKU	Moderator Densitye values (in g/cc) correspondent to the next k_∞ values.

Card 14. k_∞ values (8E10.5)

1-10, 11-20,...	UK(I),I=1,IKU	k_∞ values for the previous Moderator Densities.

Card 15. Reference values (6E10.5). If IC(19)≠0.

1-10	BU	Boron concentration (ppm) used in the previous k_∞ values given in card 14.
11-20	EU	Exposure (Gwd/T) used in the previous k_∞ values given in card 14, as well as in cards 4 and 10.
21-30	UU	Relative moderator density used as reference in the k_∞ values given in cards 4, 7, 10 and 21.
31-40	PDU	Relative power density for Doppler effect used in the previous k_∞ values given in card 14.
41-50	PXU	Relative power density for Xenon (equilibrium) used in the previous k_∞ values given in card 14.
51-60	PDXE	Relative power density for Doppler and Xenon (equilibrium) used in the k_∞^- values given in cards 11 and 21.

Migration Area vs. Moderator Density Cards.

If IC(27)=IMU=0, cards 16, 17 and 18 are omitted.

Card 16. Moderator Temperature values (8E10.2)

1-10, 11-20,...	TM(I),I=1,IMU	Moderator Temperature values (in °C) correspondent to the next Moderator Densities values.

Card 17. Moderator Density values (8E10.5)

1-10, 11-20,...	UM(I),I=1,IMU	Moderator Density values (in g/cc), correspondent to the next Migration Area values.

Card 18. M^2 values (8E10.5)

1-10, 11-20,...	UMK(I),I=1,IMU	Migration Area values for the previous Moderator Densities.

Exposure Worth Cards.

If IC(3)=IE=0, cards, 19, 20 and 21 are omitted.

Card 19. Boron Concentration values (8E10.2)

1-10, 11-20,...	EB(I),I=1,IE	Boron concentration (ppm) corresponding to the next exposures values.

Card 20. Exposures values (8E10.5)

1-10, 11-20,...	E(I),I=1,IE	Exposure values (Gwd/T) corresponding to the next k_∞ values.

Card 21. k_∞ values (8E10.5)

1-10, 11-20,...	EK(I),I=1,IE	k_∞ values for the previous Exposure values.

2.3. MELON-3 Sample Problem.

In listing 2 are the input data of a typical MELON-3 execution.

The k_∞ and M^2 values at different conditions that appear in these input data, are determined by fuel assembly calculations using the MARIA System.

2.4. MELON-3 Output.

2.4.1. Printed Output.

The printed output is on listing 3., and it contains fundamentally the following information for each correlation or reactivity worth:

a) k_∞ input values

b) $\frac{\Delta k_\infty}{k_\infty}$ calculated, from the input k_∞.

c) $\frac{\Delta k_\infty}{k_\infty}$ calculated, by the correlation using the coefficients already determined by the code.

d) Resulting coefficients.

2.4.2. Tapes Output.

MELON-3 writes on the logical unit number 8, the resulting coefficients to be input to the SIMULA-3 code, and in the required format. Each MELON-3 execution generates the input data Section 03 for SIMULA-3 per each material type.

2.5. MELON-3 Program Characteristics.

2.5.1. I/O Unit requirements.

Unit 8. Constants of the correlations determined by the MELON-3 code. It is used as input data in the SIMULA-3 code for the 03 data Section (B_{jT} constants).

2.5.2. Restrictions on the Complexity of the Problem.

There are some limits in the dimensions of the k_∞ tables in the input data. These restrictions appear in the input data description.

2.5.3. Program Structure.

MELON-3 code has been programmed in FORTRAN - V. It is composed of a main program and 17 subroutines, and it contains about 1200 sentences.

Name of subroutine	Description
MELON-1	Main program. Calls input reading routine LEER and routines to calculate the different correlations BORON, DOPXEN, KINFMD, M2MODE nad EXPOSU.
LEER	Reads and checks input dat. Prints input data. Terminates job when finds a LAST card. Calls CABEZA and ERROR if required.
RECARD	Writes Title line.
CABEZA	Prints the information on the TITLE card on every page of the output with a page number.
ERROR	Prints the error type and stops the job.
BORON	Calculates the boron worth correlation and prints the results on page 1. Calls EXAFIT and/or ALSQ.
EXAFIT	Calculates the coefficients of a polynomial when the number of points is equal to the number of coefficients using a matrix method to solve the system of equations.
ALSQ	Fits a polynomial by a least squares method.

DOPLER	Calculates the Doppler worth correlation.
XENON	Calculates the Xenon worth correlation.
DOPWOR FUNCTION	Calculates the Doppler worth with the coefficients calculated by DOPLER as function of power density and moderator density.
XENWOR FUNCTION	Calculates the Xenon worth with the coefficients calculated by XENON as function of power density and exposure.
IDATZ	Writes on unit 8 the resulting coefficients in SIMULA format.
BORWOR FUNCTION	Calculates the boron worth with the coefficients calculated by BORON as function of boron concentration and moderator density.
KINFMD	Calculates the k_∞ vs. Moderator Density correlation for No Control and Full Control and prints results on pages 4 and 5. Calls BORWOR and EXPWOR when needed and EXAFIT or ALSQ.
M2MODE	Calculates the M^2 vs. Moderator Density correlation and prints results on page 6. Calls EXAFIT or ALSQ.
EXPOSU	Calculates the exposure worth correlation and prints results on pages 7 and 8. Calls BORWOR function and EXAFIT or ALSQ.
EXPWOR FUNCTION	Calculates the exposure worth with the coefficients calculated by EXPOSU as function of the given exposure.

2.5.4. Machine time requirements and core storage.

It requires a short running time, and about 15 k words of central memory.

3. CONCON Code.

3.1. Methods and procedures.

CONCON is a code that makes the calculation of the albedoes α_ℓ in the external boundaries of the active core, to be used by SIMULA in the expressions (8) and (10); and the determination of the transport factors f_i, f_j to be used by SIMULA-3 in the expression of the transport kernel type 4, equation (22), for the horizontal direction.

The goal of this code is to get the values of these parameters by equivalence of the leakages obtained by the nodal theory expressions to the leakages obtained by a previous detailed diffusion calculation (CARMEN or VENTURE [5]).

CONCON needs as input data the fine mesh fluxes distributions, the detailed geometry description and the macroscopic cross sections by zone from the detailed diffusion calculation.

The code calculates the one group average values of diffusion D_i^*, source S_i^* and leakage L_{ij}^* by node; using the fine-mesh finite difference formalism.

Inserting the transport kernel expression (22) into the equation

$$W_{ij}S_i - W_{ji}S_j = L_{ij}^*$$

where, L_{ij}^* is the total net leakage from node i to j, determined previously. The values of the transport factors are obtained explicitly by:

$$\frac{f_i}{f_j} = \frac{M_j^2}{M_i^2} \cdot \frac{D_i^* - L_{ij}^*\, X^2/2}{D_i^* + L_{ij}^*\, X^2/2}$$

where,

$$D_i^* = \frac{M_i^2}{k_{\infty_i}} \cdot S_i^*$$

The experience shows that the transport factors in the X and Y directions are nearly the same, then it is possible to use an average value for the horizontal direction. Also, we have found that their values change in a negligible way within the same fuel type, then it is possible to use an average value for the nodes of the same fuel type.

Physically these factors include the corrections due to the effects of node size and heterogeneities, as well as the spectral variations of the leakages between nodes.

Following the same procedure, the albedoes in the core periphery are determined explicitly from the fine-mesh diffusion leakages:

$$\alpha_i = 1 - \frac{L^*_{ij}}{S^*_i} \cdot \frac{k_{\infty i} X^2}{M_i^2} = 1 - \frac{L^*_{ij} X^2}{D^*_i}$$

The CONCON code also computes some correction factors to be applied to the k_∞ and M^2 by node, to take account the effect that these parameters are determined by fuel assembly calculations in a condition of zero current in the outer boundary, and with the approximation of fundamental mode buckling, circunstance that does not correspond to the actual situation of the nodes in the interior of the core.

CONCON calculates these corrections by comparison with the k_∞ and M^2 values per node, determined from the detailed diffusion results, by ratios of the source and diffusions to the absorptions, respectively.

These correction factors are used in SIMULA-3 code as "partial fuel factors" in the expression (33) for the k_∞ by node and in (34) for the M^2 by node.

CONCON correction factors	Input Data in SIMULA-3
Lateral albedoes (α_ℓ)	Cards type 7
Transport factors (f_{ij})	Cards type 8 4
Transport factors, average value by fuel type	Cards type 3 (B_{39})
k_∞ correction factors	Cards type 8 0
k_∞ correction factors, average value by fuel type	Cards type 3 (B_{51})
M^2 correction factors	Cards type 8 3
M^2 correction factors, average value by fuel type	Cards type 3 (B_{54})
Reference power distribution	Cards type 8 1

It has been found that, for checkerboard loading pattern, the consideration of an average value by node type is enough, and their values are affected by changes on the Boron concentrations and moderator density. For the nodes with control or burnable absorber rods the correction factors are more relevant.

By the use of the CARMEN SYSTEM to provide the fine-mesh fluxes needed by CONCON, the sensibility of the albedoes, transport and correction factors to the burnup may be obtained.

Our experience is that, when the core average burnup increases, the lateral albedoes decrease their absolute values in about 0.015 at end-of-life; and the axial albedoes increase their absolute values in about 0.035 at end-of-life. That means an small sensibility to the burnup. But they are sensibles to the changes in the water density. The transport factors, which are for the fuel assemblies without absorber pins about 0.97 and for the fuel assemblies with absorber pins about 1.03, when the core average burnup increase, their values go to a value of 1.0.

The correction factors to the k_∞ values per node, are in any case very close to the unity.

And the correction factors to the M^2 values per node are about 1.02 for the fuel assemblies without burnable absorbers, and about 0.94 for the fuel assemblies with burnable absorbers, their values have a tendency to the unity when the core average burnup increase.

3.2. CONCON input Data.

3.2.1. Input file

Column	Content	Description
Card 1	Control Parameters.	Format (10I5)
1-5	NP	= 1, with inter-assembly gap. = 0, without inter-assembly gap.
6-10	NI	n° of intervals by side of fuel assembly (total intervals in core ≤LP).
11-15	NE	n° of assemblies in the centerline of the whole core. (≤LE).
16-20	NG	n° of groups. (≤LG)
21-25	NM	n° of materials. (≤LM)
26-30	NF	Input file with fluxes distribution (normally 29) it is provided by VENTURE or CARMEN executions. With negative sign, it makes fluxes diagonals symmetry.
31-35	ND	= 0, 1 assembly by node in the SIMULA-3 code. (Whole core) = 1, 1/4 assembly by node. (Whole core) = 2, case of 4 quarters of fuel assembly in SIMULA-3.
36-40	NW	n° of fuel assembly types for transport kernel calculation. (≤LK)

Colum	Content	Description
41-45	NC	= 0, input fluxes distribution from VENTURE execution.
		> 0, input fluxes from CARMEN execution.
46-50	NKM	= 0, weighting with input k_∞ and M^2.
		≠ 0, weighting with calculated k_∞ and M^2 from homogeneized 2-group cross sections by node type.
		≥ 5, weighting with calculated k_∞ and M^2 from CARMEN zones.

Cards 2 Geometrical Data. Format 6(3X,E9.6)

Needed if NC>0

4-12 16-24 ⋮	H(I),I=1,MPI	Interval lenght; as many as intervals in the diffusion calculation.

Cards 3 Material by interval. Format (24I3)

Needed if NC>0

For J = 1, MPJ

1-3 4-6 ⋮	(M(I,J),I=1,MPI)	Material number by interval, starting new card for a new line.

Cards 4 K-infinite. Format (8E10.5)

Needed if NKM=0 and NW>0

1-8 9-16 ⋮	(XINFK(K),K=1,NW)	k_∞ value per fuel type.

Cards 5 M^2 . Format (8E10.5)

Needed if NKM=0 and NW>0

1-8 9-16 ⋮	(XMIGK(K),K=1,NW)	M^2 value per fuel type.

Cards 6 Fuel assembly type. Format (16I5)

Needed if NW>0

For I=1,NE

1-5 6-10 ⋮	MK(I,J),J=1,NE	N° of fuel assembly type by assembly. NE is the number of assemblies in the centerline for 1/4 core.

3.2.2. Format of zone cross sections on input unit 12 (TAPE 12)

Card 1 Cross Sections. Format (2I6, 3E12.6)

Needed if NC=0

1-6	K	Material number.
7-12	L	Energy group.
13-24	D(K,L)	Macroscopic diffusion constant.
25-36	A(K,L)	Macroscopic absorption cross Section.
37-48	F(K,L)	Macroscopic ν . fission cross Section.

Card 2 Cross Sections. Format (6E12.6)

Needed if NC=0

1-12 13-24 ⋮	R(K,L,I),I=1,NG	Macroscopic scattering cross Section from group L to each of the other groups.

As many sets of cards 1 and 2 as groups of energy, and for each material until the NM materials.
For NC>0, these cross sections are repeated for each burnup step.

3.3. Sample Problem.

In listing 4 is the input data for a sample problem of CONCON execution, for a 1/4 core calculation with quarter of assembly nodes.

3.4. Output

3.4.1. Printed Output.

In listing 5 is the printed output of the CONCON execution with the input data on listing 4.

3.4.2. Tape Output

CONCON performs a punched output on tape 2 of the k_∞ and M^2 correction factors, transport factors and albedoes to be input to the SIMULA-3 code. (See Section 07, 08-0, 08-1, 08-3 and 08-4 of SIMULA input data listing 1).

3.5. Program characteristics.

CONCON is an utility code with about 1000 fortran sentences.

3.5.1. I/O Unit requirements.

Unit NF. Input fluxes distribution, provided by VENTURE (RTFLUX unit) or CARMEN.

Unit 15. If NC=0. Mesh boundaries and material map from VENTURE. (GEODST unit).

Unit 12. Cross Sections by zone from CARMEN execution in CITATION format.

Unit 2. Results of CONCON execution to be input in SIMULA-3 data.

3.5.2. Restrictions on the complexity of the problem.

Some dimensional limitations are in the source by a PARAMETER sentence. The present values are:

LE = 17, LG = 2, LM = 65, LK = 20, LP = 145.

3.5.3. Program Structure.

It has only 4 subroutines.

3.5.4. Machine time requirements and core storage.

It takes only 5 seconds of CP time in the CYBER-835 for a single quarter core calculation.

Required central memory for the above values of the dimensioning parameters is 80 k-words on the CYBER-835.

4. CONAXI Code

4.1. Methods and procedures.

This utility code was programmed to make the same type of calculation that the CONCON code but in the axial direction.

It determines the albedoes α_ℓ in the external boundaries of the active core (top and bottom faces) to be used in (8) and (10) and the f_{ij} to be used by SIMULA-3 in the expression of the transport kernel type 4, equation (22) for the vertical direction.

The procedure followed by CONAXI is similar to the one used by CONCON, also it is able to make the one-dimensional diffusion calculation by itself using the macroscopic cross sections provided as input data, the alternative is to use the fine-mesh fluxes distributions provided by a CARMEN axial calculation, this is the recommended way when this calculation at different burnup steps is wanted.

CONAXI also computes the k_∞ and M^2 correction factors by node to be applied to their nodal values, as the CONCON code. These factors are used by SIMULA-3 code in the expressions (33) and (34) respectively.

CONAXI correction factors	Input Data in SIMULA-3
Axial albedos	Card type 2, variables AV_1, $AV_{k\ max}$
Transport factors (f_{ij})	Card type 08 5 3
k_∞ correction factors	Card type 08 5 1
M^2 correction factors	Card type 08 5 2
Power distribution	Card type 08 2

4.2. CONAXI Input Data.

Card 1 Format (24I3)

1-5 6-10 ⋮	INOD(I),I=1,10	Number of axial nodes to be used in the SIMULA-3 execution. As many input as different CONAXI cases wished.

Cards 2 Section 004. Geometric Mesh description, (Similar to the CITATION input data).

Card 2.1: 004

Card 2.2: (6(I3.E9.0))

Specify the number of mesh points and the region width for each vertical region going from left to right. For a two-dimensional problem also specify the number of mesh points and the region width for each horizontal region going from the top to bottom starting with a new card. For a three dimensional problem also specify the number of mesh points and the region width for each region going from front to back. In referring to the geometric mesh, rows of mesh points go from top to bottom, columns of mesh points go from left to right, and planes of mesh points go from front to back. Data must be ended for each traverse by a blank entry; if the last card of data is filled for any traverse, another card in required (blank).

Cards 3 Section 005: Zone Placement
(Similar to the CITATION input data)

Card 3.1: 005

Card 3.2:(24I3)

Specify the zone identification numbers (i.e., location of uniform composition) of each vertical region for the first horizontal row of regions going from left to right. Beginning with a new card, specify the zone numbers of each vertical region in the second horizontal row of regions. Continue these specifications going from top to bottom. For a one-dimensional problem the zone numbers are specified for only one horizontal region. For a three-dimensional problem, give the two-dimensional grid for each block of mesh-point planes going from front to back. The cross section set later to be associated with the zone numbered 1 will be used as a reference, so zone 1 might be located within a core rather than in a blanket or reflector. Also it will prove convenient to number consecutively zones which will contain the same material (will have the same nuclides and use the same microscopic cross section tape).

Cards 4. Section 008. Macroscopic Cross Sections.
(Similar to the CITATION input data).

No needed if Σ's and fluxes from CARMEN execution are read.

Card 4.1: 008

Card 4.2: The Number of Groups and Scattering Range (3I3)

KMAX(1-3) - The number of energy groups.
IX28(4-6) - The number of groups for downscatter.
IX29(7-9) - The number of groups for upscatter.

Card 4.3: Cross Sections (2I6,5E12.0)

M(1-6) - A zone number.
K(7-12) - A group number.
SIG1(13-24) - Diffusion coefficient.
SIG3(25-36) - Absorption cross section.
SIG4(37-48) - Production cross section ($\nu\Sigma_f$).
SIG5(49-60) - 1/v cross section for primary mode calculation.

Card 4.4: Scattering Cross Sections (6E12.0).

Specify the cross section for scatter from group K (above) to each of the other groups 1 to KMAX.

The code continues reading card 4.3 and cards 4.4 until a zero M is found (blank card).

Card 4.5: Fission Source Distribution Function (6E12.0).

Specify the fraction of fission neutrons that are born in groups 1 to KMAX.

Cards 5. Section 024: Buckling Specifications.

(Similar to the CITATION input data).

No needed if Σ's from CARMEN execution are read.

Card 5.1: 024

Card 5.2: Indicator. IND(I3,E9.0).

If IND = 1, specify a constant buckling in columns 4-12 (E9.0) on this card and no additional data is required.

If IND = 2, specify values of group dependent buckling starting with card 3 (6E12.0).

If IND = 3, specify two zone numbers on card 3 (2I3) followed by the group dependent buckling on cards 4 (6E12.0) which will apply to the set of consecutive zones specified on card 3. Continue with cards 3 and 4 for as many zones as required. A blank card (zero zone number) must be used to end this data.

Card 6. Format (A6,I6)

Needed if Σ's and fluxes from CARMEN execution are read.

1-3	= 777
7-12	= MAT, number of materials in the CARMEN execution.

4.3. Sample Problem.

In listing 6 are the input data for a CONAXI Sample problem.

4.4. Output.

4.4.1. Printed output.

In listing 7 is the printed output of a CONAXI execution with the input data on listing 6.

4.4.2. Tapes Output.

Unit 2. Reference axial power distribution, k_∞ and M^2 correction factors, transport factors and albedoes to be input to the SIMULA-3 code (See Sections 08-2 and 08-5-1, -2 and -3 of the SIMULA input data).

4.5. Program Characteristics.

CONAXI is an utility code with 500 fortran sentences.

4.5.1. I/O Unit requirements.

Unit 29. Fluxes from CARMEN Execution. Used if card 6 is input in the data.

Unit 12. B_r^2 and cross sections by zone from CARMEN execution.
Used if card 6 is input in the data.

4.5.2. Restrictions on the complexity of the problem.

Some dimensional limitations by a PARAMETER sentence on the main program. N° of axial zones, LZ⩽60. Number of axial fine-mesh points, LP⩽500.

4.5.3. Program Structure.

It has only 3 subroutines.

4.5.4. Machine time requirements and core storage.

It takes about 1' of CPU in the UNIVAC-1100 for a case with 15 burnup steps, and a few k-words of central memory.

5. REFERENCIAS.

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LISTING 2

MELON-3 - Input Data for a
sample problem.

LISTING 2 MELON-3 INPUT DATA FOR SAMPLE PROBLEM

```
MELON-3    INPUT DATA    FUEL TYPE 1
 4 4 0      4 4 0      4 4 0      3 3 2 2                     3 3                 1
0.0        500.0      883.0      1177.0
1.18396    1.11015    1.05998    1.02467
0.0        0.5        1.0        2.0
1.06222    1.05602    1.05023    1.04063
0.0        0.5        1.0        2.0
1.10457    1.07092    1.05991    1.04683
291.67     310.0      328.3
1.05458    1.0        0.93146
1.04712    1.05023    1.05324
1200.0                0.0
291.67     310.0      328.3
1.05458    1.0        0.93146
55.27257   59.1033    64.53939
MELON-3    INPUT DATA    FUEL TYPE 2
 0 4 0      0 4 0      0 4 0      0 3 2 2                     3 3                 2
1.27616    1.21496    1.17225    1.14164
1.18429    1.17749    1.17113    1.16059
1.22108    1.18512    1.17129    1.15545
1.17038    1.17113    1.1709
1200.0                0.0
291.67     310.0      328.3
1.05458    1.0        0.93146
54.71142   58.49939   63.87598
MELON-3    INPUT DATA    FUEL TYPE 3
 0 4 0      0 4 0      0 4 0      0 3 2 2                     3 3                 3
1.05585    1.00968    0.97722    0.95383
0.98784    0.98116    0.97584    0.9666
1.01532    0.98497    0.97375    0.95463
0.97755    0.97584    0.97287
1200.0                0.0
291.67     310.0      328.3
1.05458    1.0        0.93146
53.21902   56.71511   64.02138
LAST
```

LISTING 3

MELON-3 - Printed output for
a sample problem.

*** DOPPLER WORTH CALCULATION ***

$$\left(\frac{DK}{K}\right)_{DOPPLER} = \frac{K\text{-}INF(U,P,B,E0)}{K\text{-}INF(U,1,B,E0)} - 1$$

RELATIVE POWER DENSITY SP	K-INF(U,P,B,E0) (WIMS)	-(DK/K) DOPPLER (CALCULATED)	-(DK/K) DOPPLER (FITTED)
0.00	1.062220	0.000000	0.000000
.50	1.056020	.005837	.005893
1.00	1.050230	.011288	.011246
2.00	1.040630	.020325	.020332

COEFFICIENTS OF THE SIMULA EXPRESSION -(DK/K) = B16.P(1 + B42.P)

B16 = .123253E-01

B42 = -.875891E-01

*** XENON WORTH CALCULATION ***

$$\left(\frac{DK}{K}\right)_{XENON} = \left(\frac{K\text{-}INF(U,P,B,E0)}{K\text{-}INF(U,0,B,E0)} - 1\right) - \left(\frac{DK}{K}\right)_{DOPPLER}$$

RELATIVE POWER DENSITY P	K-INF(U,P,B,E0) (WITH XENON) (WIMS)	-(DK/K) XENON (CALCULATED)	-(DK/K) XENON (FITTED)
0.00	1.104570	0.000000	0.000000
.50	1.070920	.024572	.024662
1.00	1.059910	.029186	.029091
2.00	1.046830	.031941	.031960

COEFFICIENTS OF THE SIMULA EXPRESSION -(DK/K) = B14.P(1 + B13) / (P + B13)

B13 = .218872E+00

B14 = .290909E-01

*** K-INF VS. MODERATOR DENSITY CALCULATION ***

$$K\text{-}INF(U,0,0,0) = \frac{K\text{-}INF(U,P,B,E)}{(1+(DK/K)D+XE)(1+(DK/K)B)(1+(DK/K)E)}$$

MODERATOR TEMPERATURE (C)	MODERATOR DENSITY U	K-INF(U,P,B,E) (WIMS)	K-INF(U,0,0,0) (CALCULATED)	K-INF(U,0,0,0) (FITTED)
291.67	1.054580	1.047120	1.237545	1.237545
310.00	1.000000	1.050230	1.230486	1.230486
328.30	.931460	1.053240	1.220754	1.220754

COEFFICIENTS OF THE EXPRESSION K-INF = B7(1 + B8.U + B9.U**2)

B7 = .992825E+00

B8 = .342835E+00

B9 = -.103457E+00

*** MIGRATION AREA VS. MODERATOR DENSITY CALCULATION ***

MODERATOR TEMPERATURE (C)	MODERATOR DENSITY U	MIGRATION AREA (WIMS)	MIGRATION AREA (FITTED)
291.67	1.054580	55.272570	55.272570
310.00	1.000000	59.103300	59.103300
328.30	.931460	64.539390	64.539390

COEFFICIENTS OF THE SIMULA EXPRESSION M2 = B1(1 + B2.U + B3.U**2)

B1 = .207466E+03

B2 = -.107244E+01

B3 = .357318E+00

LISTING 3 MELON-3 PRINTED OUTPUT OF SAMPLE PROBLEM

*** BORON WORTH CALCULATION ***

$$\left(\frac{DK}{K}\right)_{BORON} = \frac{K\text{-}INF(U,P,B,EO)}{K\text{-}INF(U,P,0,EO)} - 1$$

BORON CONCENTRATION (PPM)	K-INF(U,P,B,EO) (WIMS)	-(DK/K) BORON (CALCULATED)	-(DK/K) BORON (FITTED)
0.0	1.183960	0.000000	0.000000
500.0	1.110150	.062342	.062342
883.0	1.059980	.104716	.104716
1177.0	1.024670	.134540	.134540

COEFFICIENTS OF THE SIMULA EXPRESSION   (DK/K) = -U.B(B29+B30.B+B31.B**2)

B29 = .133506E-03

B30 = -.186296E-07

B31 = .196998E-11

LISTING 4

CONCON - Input Data.

LISTING 4 CONCON INPUT DATA FOR SAMPLE PROBLEM

```
1   17   15    2   60  -29    1    8    0    1
1
7    1
8    5    1
7    1    5    1
1    5    1    5    8
3    1    5    4    2
8    6    2    2
2    2
```

LISTING 5

CONCON - Printed Output

LISTING 5 CONCON PRINTED OUTPUT OF SAMPLE PROBLEM

```
PROGRAM CONCON   J.M.ARAGONES AND C.AHNERT   SEPT 84

NP =   1 = 0/1 = NO/YES INTERASSEMBLY GAP
NI = 17 = FINE-MESH INTERVALS (CELLS) PER FULL ASSEMBLY
NE = 15 = FUEL ASSEMBLIES IN THE WHOLE CORE
NG =   2 = ENERGY GROUPS
NM = 60 = MATERIALS OR CROSS SECTION SETS
NF =-29 = INTERFACE FILE RTFLUX DE VENTURE
ND =   1 = 0/1 = WHOLE/QUARTERS OF FUEL ASSEMBLY NODES
NW =   8 = NODE TYPES FOR CORRECTION FACTORS
NC =   0 = 0/1 = VENTURE/CARMEN FLUXES, GEOMETRY AND XS
NKM=   1 = 0/1 = INPUT/CALCULATED K-INF AND M**2 (NODAL)

INTERFACE FILE RTFLUX      DUMMY1DUMMY2     1
     NDIM= 2       NGROUP= 2       NINTI= 143       NINTJ= 143       NINTK=    1
     ITER=  74       EFFK= 1.0088140       POWER= .1000000E+01

INTERFACE FILE 15  NAME = GEODST  USER = URINAL  INPUT  VERS 1
      6      60   20449        1      143      143        1      143      143        1        1        2        1        2        0
      0     110       6        1        1        0        1        0        0        0        0        0

MESH BOUNDARIES FROM INTERFACE FILE GEODST

.             .632378E+00 .189713E+01 .316189E+01 .442664E+01 .569140E+01 .695615E+01 .822091E+01 .948566E+01 .107504E+02
.108566E+02 .121214E+02 .133861E+02 .146509E+02 .159156E+02 .171804E+02 .184452E+02 .197099E+02 .209747E+02 .222394E+02
.235042E+02 .247689E+02 .260337E+02 .272984E+02 .285632E+02 .298279E+02 .310927E+02 .323575E+02 .324637E+02 .337284E+02
.349932E+02 .362579E+02 .375227E+02 .387874E+02 .400522E+02 .413169E+02 .425817E+02 .438465E+02 .451112E+02 .463760E+02
.476407E+02 .489055E+02 .501702E+02 .514350E+02 .526997E+02 .539645E+02 .540707E+02 .553355E+02 .566002E+02 .578650E+02
.591297E+02 .603945E+02 .616592E+02 .629240E+02 .641887E+02 .654535E+02 .667182E+02 .679830E+02 .692478E+02 .705125E+02
.717773E+02 .730420E+02 .743068E+02 .755715E+02 .756777E+02 .769425E+02 .782072E+02 .794720E+02 .807367E+02 .820015E+02
.832663E+02 .845310E+02 .857958E+02 .870605E+02 .883253E+02 .895900E+02 .908548E+02 .921195E+02 .933843E+02 .946490E+02
.959138E+02 .971786E+02 .972848E+02 .985495E+02 .998143E+02 .101079E+03 .102344E+03 .103609E+03 .104873E+03 .106138E+03
.107403E+03 .108668E+03 .109932E+03 .111197E+03 .112462E+03 .113727E+03 .114991E+03 .116256E+03 .117521E+03 .118786E+03
.118892E+03 .120157E+03 .121421E+03 .122686E+03 .123951E+03 .125216E+03 .126480E+03 .127745E+03 .129010E+03 .130275E+03
.131539E+03 .132804E+03 .134069E+03 .135334E+03 .136598E+03 .137863E+03 .139128E+03 .140393E+03 .140499E+03 .141764E+03
.143028E+03 .144293E+03 .145558E+03 .146823E+03 .148087E+03 .149352E+03 .150617E+03 .151882E+03 .153146E+03 .154411E+03
.155676E+03 .156941E+03 .158205E+03 .159470E+03 .160735E+03 .162000E+03 .162106E+03 .163371E+03 .164635E+03 .165900E+03
.167165E+03 .168430E+03 .169694E+03 .170959E+03

FINE-MESH CELLS WIDTHS
.632378E+00 .126476E+01 .126476E+01 .126476E+01 .126475E+01 .126476E+01 .126475E+01 .126475E+01 .126476E+01 .106206E+00
.126475E+01 .126476E+01 .126476E+01 .126476E+01 .126476E+01 .126476E+01 .126476E+01 .126475E+01 .126476E+01 .126476E+01
.126476E+01 .126475E+01 .126476E+01 .126476E+01 .126476E+01 .126475E+01 .126476E+01 .106206E+00 .126476E+01 .126476E+01
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.126475E+01 .126475E+01 .126475E+01 .106206E+00 .126475E+01 .126475E+01 .126475E+01 .126475E+01 .126475E+01 .126475E+01
.126476E+01 .126475E+01 .126475E+01 .126475E+01 .126475E+01 .126475E+01 .126475E+01 .126475E+01 .126475E+01 .126475E+01
.126476E+01 .106206E+00 .126475E+01 .126475E+01 .126475E+01 .126476E+01 .126475E+01 .126476E+01 .126475E+01 .126475E+01
.126476E+01 .126475E+01 .126476E+01 .126475E+01 .126476E+01 .126475E+01 .126475E+01 .126476E+01 .126475E+01 .106210E+00
.126475E+01 .126476E+01 .126475E+01 .126476E+01 .126475E+01 .126475E+01 .126476E+01 .126475E+01 .126476E+01 .126475E+01
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.126475E+01 .126475E+01 .126476E+01 .126475E+01 .126475E+01 .106210E+00 .126475E+01 .126476E+01 .126475E+01 .126475E+01
.126476E+01 .126475E+01 .126475E+01
```

FUEL ASSEMBLY WIDTHS

```
  1  10 1 10.803521    2  19 1 10.803519    3  28 1 10.803519    4  37 1 10.803519    5  46 1 10.803519    6  55 1 10.803518
  7  64 1 10.803515    8  73 1 10.803514    9  82 1 10.803515   10  91 1 10.803513   11 100 1 10.803515   12 109 1 10.803515
 13 118 1 10.803505   14 127 1 10.803505   15 136 1 10.803505   16 142 0  7.641625
```

MAP OF MATERIALS PER CELL

```
 4  3  2  1  2  2  1  2  5 35 51 45 44 45 45 44 45 47 50 47 45 44 45 45 44 45 51 35 60 57 56 57 57 56 57 58 59 58 57 56
57 57 56 57 60 35 51 45 44 45 45 44 45 47 50 47 45 44 45 45 44 45 51 35  5  2  1  2  2  1  2  3  4  3  2  1  2  2  1  2
 5 35 18 16 15 14 12 11 12 14 17 14 12 11 12 14 15 16 18 35 60 57 56 57 57 56 57 58 59 58 57 56 57 57 56 57 60 35 10  7
 6  7  7  6  7  8  9  8  7  6  7  7  6  7 10 52 53 53 54 54 54 54 54
54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54
55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55
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55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55
```

MAT	GROUP	DIF	ABS	NU-FIS	REM	K-INF	M**2	B2-MAT	FLUX RATIO
1	1	.149414E+01	.905000E-030.		.281339E-01				
1	2	.312872E+00	.272371E-010.		0.	0.00000000	51.453121	-.019435167	.751989
2	1	.136700E+01	.947935E-02	.591923E-02	.168183E-01				
2	2	.400338E+00	.797714E-01	.107553E+000.		1.08605079	55.440489	.001552129	4.780080
3	1	.137040E+01	.939774E-02	.590030E-02	.166397E-01				
3	2	.401522E+00	.794477E-01	.107100E+000.		1.08681086	56.114916	.001547019	4.811903
4	1	.150351E+01	.869227E-030.		.266410E-01				
4	2	.318086E+00	.265273E-010.		0.	0.00000000	54.652956	-.018297272	.777269
5	1	.137044E+01	.933630E-02	.589731E-02	.166289E-01				
5	2	.401565E+00	.794498E-01	.107103E+000.		1.08914012	56.277268	.001583945	4.816064
6	1	.148427E+01	.875993E-030.		.266846E-01				
6	2	.322350E+00	.266346E-010.		0.	0.00000000	53.854698	-.018568482	.773817
7	1	.135686E+01	.101348E-01	.737200E-02	.159137E-01				
7	2	.402113E+00	.995564E-01	.150044E+000.		1.20103298	55.010218	.003654466	6.348344
8	1	.136017E+01	.100427E-01	.733753E-02	.157305E-01				
8	2	.403807E+00	.989998E-01	.149183E+000.		1.20171423	55.722958	.003619948	6.386425
9	1	.149350E+01	.839208E-030.		.251406E-01				
9	2	.329796E+00	.257230E-010.		0.	0.00000000	57.487081	-.017395213	.794977
10	1	.136020E+01	.998013E-02	.733071E-02	.157200E-01				
10	2	.403885E+00	.989959E-01	.149176E+000.		1.20424027	55.886754	.003654538	6.391362
11	1	.375622E+00	.114804E-010.		.124907E-01				
11	2	.231157E+00	.349750E+000.		0.	0.00000000	15.669834	-.063816886	26.819918
12	1	.136610E+01	.984036E-02	.661928E-02	.160620E-01				
12	2	.414627E+00	.876632E-01	.126020E+000.		1.14477949	56.057313	.002582705	5.524463
13	1	.136800E+01	.982751E-02	.663198E-02	.162137E-01				
13	2	.412229E+00	.882809E-01	.126937E+000.		1.14771279	55.827940	.002645858	5.512096
14	1	.136710E+01	.986203E-02	.664634E-02	.163150E-01				
14	2	.410803E+00	.886928E-01	.127547E+000.		1.14798555	55.498649	.002666471	5.503404
15	1	.149743E+01	.865255E-030.		.262992E-01				
15	2	.329457E+00	.260593E-010.		0.	0.00000000	55.124742	-.018140674	.763626
16	1	.136703E+01	.987213E-02	.665209E-02	.163553E-01				
16	2	.410165E+00	.888605E-01	.127796E+000.		1.14825572	55.386726	.002676737	5.500253
17	1	.150015E+01	.862685E-030.		.261468E-01				
17	2	.330478E+00	.259093E-010.		0.	0.00000000	55.541665	-.018004502	.763352
18	1	.136818E+01	.978214E-02	.664337E-02	.163229E-01				
18	2	.410383E+00	.887640E-01	.127653E+000.		1.15148243	55.697888	.002719716	5.506398
19	1	.371545E+00	.112300E-010.		.121506E-01				
19	2	.225700E+00	.345950E+000.		0.	0.00000000	15.891223	-.062927818	27.303036
20	1	.136186E+01	.101560E-01	.732536E-02	.156271E-01				
20	2	.415467E+00	.970431E-01	.146157E+000.		1.19419442	55.873378	.003475616	6.302319
21	1	.136372E+01	.101424E-01	.733769E-02	.157725E-01				
21	2	.413063E+00	.977200E-01	.147206E+000.		1.19720607	55.657736	.003543192	6.288382
22	1	.136282E+01	.101791E-01	.735515E-02	.158739E-01				
22	2	.411539E+00	.982050E-01	.147955E+000.		1.19749541	55.321978	.003569927	6.279136

23	1	.149336E+01	.850644E-03	0.	.255721E-01				
23	2	.334795E+00	.257069E-01	0.	0.	0.00000000	56.518004	-.017693477	.773623
24	1	.136273E+01	.101899E-01	.736184E-02	.159139E-01				
24	2	.410879E+00	.983970E-01	.148252E+00	0.	1.19777246	55.208254	.003582299	6.275559
25	1	.149605E+01	.848024E-03	0.	.254171E-01				
25	2	.335948E+00	.255441E-01	0.	0.	0.00000000	56.959592	-.017556306	.772945
26	1	.136387E+01	.100978E-01	.734852E-02	.158805E-01				
26	2	.411152E+00	.982715E-01	.148059E+00	0.	1.20108245	55.526209	.003621397	6.281948
27	1	.377222E+00	.115160E-01	0.	.125239E-01				
27	2	.229648E+00	.348806E+00	0.	0.	0.00000000	15.691496	-.063728786	26.682538
28	1	.136907E+01	.986722E-02	.661850E-02	.160994E-01				
28	2	.415349E+00	.874087E-01	.125644E+00	0.	1.14390600	56.053665	.002567290	5.495555
29	1	.137097E+01	.985271E-02	.662970E-02	.162405E-01				
29	2	.413106E+00	.879874E-01	.126503E+00	0.	1.14672331	55.851402	.002627030	5.484611
30	1	.137044E+01	.987470E-02	.663926E-02	.163101E-01				
30	2	.412077E+00	.882860E-01	.126945E+00	0.	1.14698461	55.631321	.002642120	5.479724
31	1	.150277E+01	.864138E-03	0.	.262275E-01				
31	2	.331039E+00	.258907E-01	0.	0.	0.00000000	55.469678	-.018027868	.759613
32	1	.137019E+01	.988549E-02	.664390E-02	.163426E-01				
32	2	.411571E+00	.884310E-01	.127160E+00	0.	1.14709045	55.527528	.002648965	5.477803
33	1	.150383E+01	.863710E-03	0.	.261502E-01				
33	2	.331656E+00	.257966E-01	0.	0.	0.00000000	55.668720	-.017963409	.758654
34	1	.137090E+01	.980426E-02	.663779E-02	.163269E-01				
34	2	.411651E+00	.883808E-01	.127086E+00	0.	1.15022280	55.768294	.002693695	5.481123
35	1	.153490E+01	.760116E-03	0.	.287540E-01				
35	2	.310961E+00	.276921E-01	0.	0.	0.00000000	52.005605	-.019228697	.755118
36	1	.373113E+00	.112618E-01	0.	.121789E-01				
36	2	.224178E+00	.345061E+00	0.	0.	0.00000000	15.917313	-.062824674	27.176207
37	1	.136446E+01	.101823E-01	.732548E-02	.156582E-01				
37	2	.416112E+00	.967738E-01	.145742E+00	0.	1.19328344	55.866647	.003459729	6.272326
38	1	.136633E+01	.101669E-01	.733612E-02	.157930E-01				
38	2	.413876E+00	.974051E-01	.146719E+00	0.	1.19617421	55.678650	.003523329	6.259946
39	1	.136579E+01	.101902E-01	.734765E-02	.158624E-01				
39	2	.412785E+00	.977542E-01	.147259E+00	0.	1.19644581	55.455017	.003542435	6.254840
40	1	.149826E+01	.849231E-03	0.	.254888E-01				
40	2	.336408E+00	.255341E-01	0.	0.	0.00000000	56.886061	-.017578999	.769767
41	1	.136554E+01	.102017E-01	.735325E-02	.158948E-01				
41	2	.412252E+00	.979230E-01	.147519E+00	0.	1.19655609	55.349429	.003551185	6.252812
42	1	.149932E+01	.848790E-03	0.	.254108E-01				
42	2	.337084E+00	.254346E-01	0.	0.	0.00000000	57.095838	-.017514411	.768600
43	1	.136624E+01	.101190E-01	.734335E-02	.158785E-01				
43	2	.412365E+00	.978555E-01	.147416E+00	0.	1.19977316	55.594793	.003593379	6.256106
44	1	.379129E+00	.115437E-01	0.	.125458E-01				
44	2	.228030E+00	.347742E+00	0.	0.	0.00000000	15.738366	-.063538999	26.562865
45	1	.137246E+01	.989051E-02	.661619E-02	.161212E-01				
45	2	.416191E+00	.871156E-01	.125211E+00	0.	1.14294978	56.106575	.002547826	5.469578
46	1	.137442E+01	.987385E-02	.662610E-02	.162539E-01				
46	2	.414052E+00	.876684E-01	.126031E+00	0.	1.14571201	55.929083	.002605299	5.460057
47	1	.137414E+01	.988676E-02	.663201E-02	.162987E-01				
47	2	.413346E+00	.878753E-01	.126338E+00	0.	1.14593167	55.791498	.002615661	5.457878
48	1	.150827E+01	.863249E-03	0.	.261584E-01				
48	2	.332575E+00	.257264E-01	0.	0.	0.00000000	55.817110	-.017915654	.755706
49	1	.137404E+01	.989126E-02	.663389E-02	.163124E-01				
49	2	.413114E+00	.879438E-01	.126439E+00	0.	1.14597614	55.747298	.002618533	5.457555
50	1	.150846E+01	.863836E-03	0.	.261149E-01				
50	2	.332978E+00	.256654E-01	0.	0.	0.00000000	55.912949	-.017884945	.754747
51	1	.137434E+01	.981765E-02	.662989E-02	.163097E-01				
51	2	.413059E+00	.879442E-01	.126440E+00	0.	1.14901207	55.929016	.002664307	5.459630
52	1	.121074E+01	.280148E-02	0.	.139150E-01				
52	2	.321824E+00	.728870E-01	0.	0.	0.00000000	72.428277	-.013806762	4.918712

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53     1 .103012E+01 .469393E-020.           .910111E-03
53     2 .331135E+00 .122792E+000.          0.             0.00000000  183.816819 -.005440199  132.940611
54     1 .133095E+01 .129169E-020.           .390618E-01
54     2 .260313E+00 .324190E-010.          0.             0.00000000   32.982273 -.030319318     .627890
55     1 .100000E+01 .100000E+010.          0.
56     1 .277074E+00 .459024E-010.           .104322E-01
56     2 .204697E+00 .771224E+000.          0.             0.00000000    4.918370 -.203319401   69.938088
57     1 .142441E+01 .939017E-02 .577546E-02 .149047E-01
57     2 .421490E+00 .764756E-01 .102964E+000.             1.06274053   62.203809  .001008628    5.159511
58     1 .142356E+01 .948036E-02 .582294E-02 .155373E-01
58     2 .419673E+00 .768638E-01 .103506E+000.             1.06801407   60.501783  .001124166    4.977431
59     1 .156519E+01 .855548E-030.           .250489E-01
59     2 .333230E+00 .257103E-010.          0.             0.00000000   60.421609 -.016550370     .806233
60     1 .142309E+01 .943328E-02 .582987E-02 .156469E-01
60     2 .419060E+00 .770141E-01 .103715E+000.             1.07152615   60.355814  .001185075    4.953752

MAP OF NODE TYPES IN THE (SE) 1/4 CORE
            1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
     1      1  7  7  8  8  7  7  1  1  3  3  8  8  2  2
     2      7  1  1  5  5  1  1  5  5  1  1  6  6  2  2
     3      7  1  1  5  5  1  1  5  5  1  1  6  6  2  2
     4      8  5  5  1  1  5  5  1  1  5  5  2  2  0  0
     5      8  5  5  1  1  5  5  1  1  5  5  2  2  0  0
     6      7  1  1  5  5  1  1  5  5  4  4  2  2  0  0
     7      7  1  1  5  5  1  1  5  5  4  4  2  2  0  0
     8      1  5  5  1  1  5  5  8  8  2  2  0  0  0  0
     9      1  5  5  1  1  5  5  8  8  2  2  0  0  0  0
    10      3  1  1  5  5  4  4  2  2  0  0  0  0  0  0
    11      3  1  1  5  5  4  4  2  2  0  0  0  0  0  0
    12      8  6  6  2  2  2  2  0  0  0  0  0  0  0  0
    13      8  6  6  2  2  2  2  0  0  0  0  0  0  0  0
    14      2  2  2  0  0  0  0  0  0  0  0  0  0  0  0
    15      2  2  2  0  0  0  0  0  0  0  0  0  0  0  0

CORE AVERAGE FLUX FOR GROUP  1  .14511690E-05

CORE INTEGRATED REACTIONS AND AVERAGED CROSS SECTIONS FOR GROUP  1
     LEAK        DIFF         ABS          FIS          REM         FLUX          VOL
.126292E+02 .239465E+05 .165913E+03 .104683E+03 .299096E+03 .177468E+05 .183244E+05
.527392E-03 .134934E+01 .934891E-02 .589870E-02 .168535E-01 .968478E+00 .183244E+05

CORE AVERAGE FLUX FOR GROUP  2  .28479252E-06

CORE INTEGRATED REACTIONS AND AVERAGED CROSS SECTIONS FOR GROUP  2
     LEAK        DIFF         ABS          FIS          REM         FLUX          VOL
.572135E+01 .691626E+04 .151887E+04 .193068E+040.                  .174120E+05 .183244E+05
.827232E-03 .397213E+00 .872314E-01 .110882E+000.                  .950206E+00 .183244E+05

CORE INTEGRATED REACTIONS AND AVERAGED CROSS SECTIONS FOR GROUP
.199565E-04 .367201E-01 .673331E-03 .701755E-03 .434038E-03 .307124E-01 .183244E+05
.543475E-03 .119561E+01 .219238E-01 .228493E-01 .141324E-01 .167604E-05

  MAT GROUP    DIF          ABS          NU-FIS       REM          K-INF        M**2      B2-MAT       FLUX RATIO
   1     1 .138146E+01 .859954E-02 .534572E-02 .177872E-01
   1     2 .391730E+00 .740204E-01 .958923E-010.             1.07483015   56.161889  .001332401    4.190782
   2     1 .137076E+01 .918258E-02 .664541E-02 .168184E-01
   2     2 .394320E+00 .913824E-01 .133212E+000.             1.19598873   56.007953  .003499302    5.515527
   3     1 .133470E+01 .941091E-02 .601258E-02 .166759E-01
   3     2 .400991E+00 .922617E-01 .115811E+000.             1.03252030   54.025006  .000601949    5.547123
   4     1 .133023E+01 .968609E-02 .665014E-02 .162302E-01
   4     2 .401661E+00 .100783E+00 .134082E+000.             1.08878836   54.028000  .001643377    6.250258
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5	1	.132260E+01	.957357E-02	.600828E-02	.164820E-01				
5	2	.401769E+00	.951300E-01	.115903E+000.		1.00128233	53.435506	.000023998	5.772332
6	1	.131780E+01	.984425E-02	.664593E-02	.160359E-01				
6	2	.402277E+00	.103707E+00	.134261E+000.		1.05834855	53.452264	.001091601	6.494596
7	1	.131091E+01	.973375E-02	.600376E-02	.162823E-01				
7	2	.402369E+00	.983528E-01	.115959E+000.		.96897849	52.875590	-.000586689	6.025991
8	1	.133875E+01	.120649E-01	.528837E-02	.151617E-01				
8	2	.409986E+00	.102477E+00	.977089E-010.		.72794624	50.828068	-.005352432	6.614173

TYPE	NODES	K-INF	M**2	WH	F-KINF	F-M2	F-WH	F-WH(INT)	F-WH*M2	FINT*M2
1	164	1.069537	57.382175	.455142	.995075	1.021728	.990140	.978250	56.816396	56.134131
2	144	1.194313	56.338821	.404316	.998599	1.005908	1.000373	.937996	56.359847	52.845600
3	16	1.036509	53.135292	.445238	1.003863	.983531	1.013708	1.028590	53.863652	54.654416
4	32	1.090891	53.592607	.423314	1.001931	.991941	1.005703	.976694	53.898256	52.343592
5	160	1.005466	52.487027	.450795	1.004179	.982250	1.007917	1.028118	52.902580	53.962866
6	32	1.062558	52.569000	.428720	1.003978	.983476	1.011410	1.007294	53.168808	52.952429
7	32	.973834	51.747696	.462355	1.005011	.978669	1.015549	1.039510	52.552304	53.792251
8	48	.727754	50.868001	.585181	.999736	1.000786	.977149	1.107400	49.705624	56.331235
WHOLE CORE										
	628	1.042215	54.534996	.448254	1.000025	.999967	.999854	1.000000	54.527049	54.534996

AVERAGE ALBEDO (LEAKAGE PROB PER FACE) = .738609

ALBTOT PER NODE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.83773
2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.83151
3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.52301	1.56984
4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.68814	0.00000	0.00000
5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.80128	0.00000	0.00000
6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.81279	0.00000	0.00000
7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.65279	1.59362	0.00000	0.00000
8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.60868	0.00000	0.00000	0.00000	0.00000
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.61126	1.54849	0.00000	0.00000	0.00000	0.00000
10	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.61126	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.60868	1.54849	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.65279	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
13	0.00000	0.00000	0.00000	.68814	.80128	.81279	1.59362	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	0.00000	0.00000	.52301	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
15	.83773	.83151	1.56984	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

REF-S PER NODE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	.94207	.86375	.78746	.53689	.58804	.97880	1.18579	1.37472	1.40007	1.31723	1.07516	.56122	.43396	.66268	.43714
2	.86375	.95242	.96682	.91896	.99737	1.19869	1.32227	1.34437	1.34745	1.32629	1.17146	.98890	.75663	.67936	.41126
3	.78746	.96682	1.07127	1.11510	1.19682	1.31664	1.37884	1.35909	1.34161	1.32634	1.21561	1.09732	.80526	.58022	.30530
4	.53689	.91896	1.11510	1.26830	1.33614	1.32966	1.35180	1.39562	1.36308	1.25735	1.15137	1.24592	.86229	0.00000	0.00000
5	.58804	.99737	1.19682	1.33614	1.38164	1.34303	1.32483	1.33940	1.28757	1.15573	1.05957	1.17394	.77822	0.00000	0.00000
6	.97880	1.19869	1.31664	1.32966	1.34303	1.35934	1.29547	1.17793	1.08399	1.14352	1.05707	.99530	.63259	0.00000	0.00000
7	1.18579	1.32227	1.37884	1.35180	1.32483	1.29547	1.16308	.94923	.83869	.91971	.81705	.68272	.40381	0.00000	0.00000
8	1.37472	1.34437	1.35909	1.39562	1.33940	1.17793	.94923	.52751	.44628	.74142	.59539	0.00000	0.00000	0.00000	0.00000
9	1.40007	1.34745	1.34161	1.36308	1.28757	1.08399	.83869	.44628	.32452	.46723	.33110	0.00000	0.00000	0.00000	0.00000
10	1.31723	1.32629	1.32634	1.25735	1.15573	1.14352	.91971	.74142	.46723	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
11	1.07516	1.17146	1.21561	1.15137	1.05957	1.05707	.81705	.59539	.33110	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	.56122	.98890	1.09732	1.24592	1.17394	.99530	.68272	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
13	.43396	.75663	.80526	.86229	.77822	.63259	.40381	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	.66268	.67936	.58022	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
15	.43714	.41126	.30530	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

FWHAVE PER NODE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	.97358	1.03859	1.01426	1.11186	1.12328	1.03387	1.06196	.99566	.99833	1.03894	1.01613	1.12347	1.08903	.91234	.92135
2	1.03859	.96791	.95656	1.01105	1.01927	.96345	.97640	1.04335	1.04953	.99215	.97911	1.02364	.98035	.90448	.90985
3	1.01426	.95656	.95694	1.02643	1.03724	.97156	.97220	1.03521	1.04097	.98621	.97940	1.02252	.99286	.91929	.90485
4	1.11186	1.01105	1.02643	.97459	.97920	1.03255	1.03045	.97594	.97962	1.03813	1.02401	.96578	.95554	.62463	.29718
5	1.12328	1.01927	1.03724	.97920	.97892	1.03458	1.03182	.97583	.97695	1.01793	1.00340	.95912	.96077	.45213	.08087
6	1.03387	.96345	.97156	1.03255	1.03458	.97830	.97759	1.03133	1.01298	.98580	.98139	.94509	.95232	.32079	.05530
7	1.06196	.97640	.97220	1.03045	1.03182	.97759	.98023	1.02115	.99156	.96730	.96863	.93567	.94098	.16716	.02868
8	.99566	1.04335	1.03521	.97594	.97583	1.03133	1.02115	1.11415	1.09237	.93435	.93457	.43041	.26172	.07968	.00806
9	.99833	1.04953	1.04097	.97962	.97695	1.01298	.99156	1.09237	1.06105	.90449	.91605	.15951	.03093	0.00000	0.00000
10	1.03894	.99215	.98621	1.03813	1.01793	.98580	.96730	.93435	.90449	.33987	.20411	.06632	.00716	0.00000	0.00000
11	1.01613	.97911	.97940	1.02401	1.00340	.98139	.96863	.93457	.91605	.14870	.02752	0.00000	0.00000	0.00000	0.00000
12	1.12347	1.02364	1.02252	.96578	.95912	.94509	.93567	.45266	.24906	.07035	.00711	0.00000	0.00000	0.00000	0.00000
13	1.08903	.98035	.99286	.95554	.96077	.95232	.94098	.18225	.03435	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	.91234	.90448	.91929	.49696	.42713	.28339	.17637	.07348	.00813	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
15	.92135	.90985	.90485	.15283	.03200	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

XK-INF PER NODE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	.99983	1.00205	.99753	.99852	1.00363	.99621	1.00330	1.00004	1.00050	1.00307	.99627	1.00514	.98737	1.00347	.99856
2	1.00205	.99973	.99975	.99645	.99808	.99982	.99995	1.00156	1.00176	1.00039	.99910	1.00397	.99508	1.00238	.99863
3	.99753	.99975	1.00013	1.00247	1.00363	1.00019	1.00014	1.00187	1.00156	1.00015	.99860	1.00432	.99397	.99651	.99484
4	.99852	.99645	1.00247	1.00025	1.00020	1.00148	1.00195	1.00016	1.00018	1.00280	.99719	1.00336	.99705	0.00000	0.00000
5	1.00363	.99808	1.00363	1.00020	1.00016	1.00184	1.00142	1.00021	.99984	.99703	.99130	1.00354	.99868	0.00000	0.00000
6	.99621	.99982	1.00019	1.00148	1.00184	1.00014	1.00019	1.00385	.99822	1.00393	1.00131	1.00277	.99899	0.00000	0.00000
7	1.00330	.99995	1.00014	1.00195	1.00142	1.00019	1.00011	.99798	.99041	.99872	.99431	.99721	.99494	0.00000	0.00000
8	1.00004	1.00156	1.00187	1.00016	1.00021	1.00385	.99798	1.01286	1.00392	1.00312	.99699	0.00000	0.00000	0.00000	0.00000
9	1.00050	1.00176	1.00156	1.00018	.99984	.99822	.99041	1.00392	.97747	.99817	.99507	0.00000	0.00000	0.00000	0.00000
10	1.00307	1.00039	1.00015	1.00280	.99703	1.00393	.99872	1.00312	.99817	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
11	.99627	.99910	.99860	.99719	.99130	1.00131	.99431	.99699	.99507	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	1.00514	1.00397	1.00432	1.00336	1.00354	1.00277	.99721	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
13	.98737	.99508	.99397	.99705	.99868	.99899	.99494	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	1.00347	1.00238	.99651	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
15	.99856	.99863	.99484	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

XM-M*2 PER NODE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1.00137	.99535	1.00590	.99622	.99849	1.00503	.99528	1.00009	.99833	.99537	1.00564	1.00313	1.00226	.99139	1.00294
2	.99535	1.00095	1.00052	1.00500	1.00403	.99971	1.00042	.99466	.99448	.99889	1.00273	.99093	1.00803	.99568	1.00270
3	1.00590	1.00052	1.00032	.99429	.99377	.99935	.99980	.99458	.99470	.99976	1.00534	.99376	1.01190	1.01101	1.00944
4	.99622	1.00500	.99429	.99846	.99922	.99470	.99454	.99960	.99935	.99425	1.00825	.99153	1.00843	0.00000	0.00000
5	.99849	1.00403	.99377	.99922	.99962	.99459	.99472	.99910	1.00014	1.00931	1.02379	.99055	1.00163	0.00000	0.00000
6	1.00503	.99971	.99935	.99470	.99459	.99986	.99941	.99372	1.00906	.99658	1.00065	.99451	1.00143	0.00000	0.00000
7	.99528	1.00042	.99980	.99454	.99472	.99941	.99838	1.00370	1.02161	.99960	1.00435	1.00836	1.00917	0.00000	0.00000
8	1.00009	.99466	.99458	.99960	.99910	.99372	1.00370	1.00016	1.00228	.99298	1.00930	0.00000	0.00000	0.00000	0.00000
9	.99833	.99448	.99470	.99935	1.00014	1.00906	1.02161	1.00228	.99468	1.00400	1.00838	0.00000	0.00000	0.00000	0.00000
10	.99537	.99889	.99976	.99425	1.00931	.99658	.99960	.99298	1.00400	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
11	1.00564	1.00273	1.00534	1.00825	1.02379	1.00065	1.00435	1.00930	1.00838	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	1.00313	.99093	.99376	.99153	.99055	.99451	1.00836	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
13	1.00226	1.00803	1.01190	1.00843	1.00163	1.00143	1.00917	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	.99139	.99568	1.01101	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
15	1.00294	1.00270	1.00944	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

XF-M*2 PER NODE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	.99523	.99911	.97571	1.00403	1.01434	.99457	1.02160	1.01780	1.02052	1.01006	.98789	1.01451	.98341	.97265	.98226
2	.99911	.98943	.97783	.98340	.99140	.98487	.99811	1.01482	1.02083	1.01421	1.00088	1.01622	.97325	.96427	.96999
3	.97571	.97783	.97822	.99836	1.00888	.99316	.99382	1.00689	1.01250	1.00814	1.00118	1.01512	.98567	.98006	.96466
4	1.00403	.98340	.99836	.99626	1.00098	1.00431	1.00227	.99764	1.00140	1.00973	.99600	1.02962	1.01870	0.00000	0.00000
5	1.01434	.99140	1.00888	1.00098	1.00068	1.00629	1.00360	.99753	.99867	.99009	.97596	1.02252	1.02428	0.00000	0.00000
6	.99457	.98487	.99316	1.00431	1.00629	1.00005	.99933	1.00312	.98528	1.00933	1.00481	1.00757	1.01527	0.00000	0.00000
7	1.02160	.99811	.99382	1.00227	1.00360	.99933	1.00202	.99322	.96444	.99038	.99174	.99752	1.00318	0.00000	0.00000
8	1.01780	1.01482	1.00689	.99764	.99753	1.00312	.99322	1.00610	.98643	.99611	.99635	0.00000	0.00000	0.00000	0.00000
9	1.02052	1.02083	1.01250	1.00140	.99867	.98528	.96444	.98643	.95815	.96428	.97661	0.00000	0.00000	0.00000	0.00000
10	1.01006	1.01421	1.00814	1.00973	.99009	1.00933	.99038	.99611	.96428	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
11	.98789	1.00088	1.00118	.99600	.97596	1.00481	.99174	.99635	.97661	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	1.01451	1.01622	1.01512	1.02962	1.02252	1.00757	.99752	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
13	.98341	.97325	.98567	1.01870	1.02428	1.01527	1.00318	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	.97265	.96427	.98006	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
15	.98226	.96999	.96466	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

LISTING 6

CONAXI - Input Data

LISTING 6   CONAXI   INPUT DATA FOR SAMPLE PROBLEM

```
 17
  8000
  CALCULO AXIAL DEL NUCLEO * HZP * BOL * 17 NODOS AXIALES A 17 TEMPERAT
   INTERPOLACION CUADRATICA ENTRE 557 F, 310 C , 328 C (TRJQ.VXHZP1322)
001
     0         2  2        0            0        0  1     1
  1     1  1  1  1        1  1     1  1  1


003
  0  2        1               0     0


004
  7    9.867  3    4.247  8   10.886  8  21.5153  8  21.5153  8  21.5153
  8  21.5153  8  21.5153  8  21.5153  8  21.5153  8  21.5153  8  21.5153
  8  21.5153  8  21.5153  8  21.5153  8  21.5153  8  21.5153  8  21.5153
  8  21.5153  8  21.5153 19   25.0
005
 18 19 20  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 21
008
  2  1  0
     1     1  .134489+01  .922861-02  .594982-02
  .000000     .169284-01
     1     2  .386765+00  .879801-01  .110227+00
  .000000     .000000
     2     1  .134835+01  .921834-02  .594421-02
  .000000     .168219-01
     2     2  .388689+00  .877264-01  .110006+00
  .000000     .000000
     3     1  .135196+01  .920765-02  .593836-02
  .000000     .167118-01
     3     2  .390711+00  .874685-01  .109783+00
  .000000     .000000
```

4	1	.135573+01	.919656-02	.593229-02
.000000		.165983-01		
4	2	.392830+00	.872063-01	.109558+00
.000000		.000000		
5	1	.135966+01	.918505-02	.592600-02
.000000		.164811-01		
5	2	.395047+00	.869399-01	.109331+00
.000000		.000000		
6	1	.136374+01	.917313-02	.591948-02
.000000		.163605-01		
6	2	.397362+00	.866692-01	.109102+00
.000000		.000000		
7	1	.136798+01	.916080-02	.591273-02
.000000		.162363-01		
7	2	.399775+00	.863943-01	.108871+00
.000000		.000000		
8	1	.137237+01	.914805-02	.590577-02
.000000		.161085-01		
8	2	.402285+00	.861151-01	.108637+00
.000000		.000000		
9	1	.137692+01	.913489-02	.589857-02
.000000		.159772-01		
9	2	.404893+00	.858316-01	.108402+00
.000000		.000000		
10	1	.138162+01	.912132-02	.589115-02
.000000		.158424-01		
10	2	.407599+00	.855439-01	.108165+00
.000000		.000000		
11	1	.138649+01	.910733-02	.588350-02
.000000		.157040-01		
11	2	.410403+00	.852519-01	.107925+00
.000000		.000000		
12	1	.139150+01	.909294-02	.587563-02
.000000		.155620-01		
12	2	.413304+00	.849557-01	.107684+00
.000000		.000000		

13	1	.139668+01	.907813-02	.586754-02
.000000		.154166-01		
13	2	.416303+00	.846552-01	.107440+00
.000000		.000000		
14	1	.140200+01	.906291-02	.585922-02
.000000		.152676-01		
14	2	.419400+00	.843505-01	.107195+00
.000000		.000000		
15	1	.140749+01	.904727-02	.585067-02
.000000		.151150-01		
15	2	.422595+00	.840415-01	.106947+00
.000000		.000000		
16	1	.141313+01	.903122-02	.584190-02
.000000		.149589-01		
16	2	.425887+00	.837283-01	.106697+00
.000000		.000000		
17	1	.141892+01	.901476-02	.583290-02
.000000		.147993-01		
17	2	.429277+00	.834107-01	.106446+00
.000000		.000000		
18	1	.1385487+01	.1206319-02	.0000000
.0000000		.4601563-01		
18	2	.2564353+00	.3474068-01	.0000000
.0000000		.0000000		
19	1	.1165067+01	.3357353-02	.0000000
.0000000		.1782809-01		
19	2	.3033003+00	.8915832-01	.0000000
.0000000		.0000000		
20	1	.1335547+01	.1693670-02	.0000000
.0000000		.3962929-01		
20	2	.2670533+00	.4706987-01	.0000000
.0000000		.0000000		
21	1	.1349550+01	.1454159-02	.0000000
.0000000		.4299972-01		
21	2	.2627307+00	.4071018-01	.0000000
.0000000		.0000000		

```
  1.00000000   .00000000
012
  1  1               -1    NODO  1
  2  2               -1    NODO  2
  3  3               -1    NODO  3
  4  4               -1    NODO  4
  5  5               -1    NODO  5
  6  6               -1    NODO  6
  7  7               -1    NODO  7
  8  8               -1    NODO  8
  9  9               -1    NODO  9
 10 10               -1    NODO 10
 11 11               -1    NODO 11
 12 12               -1    NODO 12
 13 13               -1    NODO 13
 14 14               -1    NODO 14
 15 15               -1    NODO 15
 16 16               -1    NODO 16
 17 17               -1    NODO 17
 18 18               -1    NODO 18
 19 19               -1    NODO 19
 20 20               -1    NODO 20
 21 21               -1    NODO 21
000
024
  2
  .566980-03  .101944-02
999
```

LISTING 7

CONAXI - Printed Output

LISTING 7 CONAXI PRINTED OUTPUT OF SAMPLE PROBLEM

SUBROUTINE DIFAXI J.M. ARAGONES JUN 82

ITER	FLUXRELCHG	FISSRELCHG	SOURCE	K-EFF	EXTRAP				
1	11.1576828	-.7350314	2.6457029	2.6457029		.3799871	.2649686	0.0000000	0.0000000
2	-.7019829	-.1952228	.3732617	.9875395		1.0174155	.8047772	-.0106734	.0703751
3	-.1436898	-.1425778	1.0022608	.9897721		1.0149554	.8574222	.8736983	.5877559
4	-.1118588	-.1113001	1.0014926	.9912494		1.0133383	.8886999	.9052103	.6693273
5	-.0906850	-.0904159	1.0010691	.9923091		1.0121753	.9095841	.9249833	.7219449
6	-.0758438	-.0757247	1.0008103	.9931132		1.0112787	.9242753	.9376361	.7617910
7	-.0649554	-.0649167	1.0006397	.9937486		1.0105602	.9350833	.9468538	.7923555
8	-.0566646	-.0566704	1.0005208	.9942661		1.0099662	.9433296	.9537172	.8163004
9	-.0501591	-.0501898	1.0004341	.9946976		1.0094630	.9498102	.9589702	.8354554
10	-.0449275	-.0449722	1.0003687	.9950644		1.0090302	.9550278	.9632976	.8510699
11	-.0406340	-.0406862	1.0003180	.9953807		1.0086499	.9593138	.9665365	.8640101
12	-.0370497	-.0371056	1.0002777	.9956572		1.0083137	.9628944	.9694443	.8748892
13	-.0340139	-.0340712	1.0002451	.9959012		1.0080120	.9659288	.9717295	.8841505
14	-.0314105	-.0314678	1.0002183	.9961187		1.0077389	.9685322	.9736424	.8921213
15	-.0291539	-.0292102	1.0001960	.9963139		1.0074897	.9707898	.9752944	.8990476
16	-.0271793	-.0272342	1.0001771	.9964904		1.0072612	.9727658	.9767528	.9051172
17	-.0254371	-.0254903	1.0001610	.9966509		1.0070502	.9745097	.9779850	.9104762
18	-.0238887	-.0239399	1.0001472	.9967975		1.0068537	.9760601	.9789898	.9152394
19	-.0225034	-.0225526	1.0001351	.9969322		1.0066702	.9774474	.9798904	.9194985
20	-.0212567	-.0213039	1.0001246	.9970564		1.0064975	.9786961	.9806161	.9233274
21	-.0201287	-.0201740	1.0001153	.9971713		1.0063339	.9798260	.9811488	.9267862
22	-.0191032	-.0191465	1.0001070	.9972781		1.0061775	.9808535	.9814888	.9299244
23	-.0181667	-.0182082	1.0000997	.9973775		1.0060280	.9817918	.9818203	.9327830
SOURCE EXTRAPOL		-.4158007	1.0000000	.9973775	22.4201306	54.0065154	13.8771986		
24	-.4053558	.0177348	1.0021806	.9995524		1.0177348	.9941185	2.8885989	.3013042
25	.0146083	.0144866	.9999503	.9995027		1.0144866	.9945824	.8313297	.9157056
26	.0119530	.0118550	.9999585	.9994612		1.0118550	.9949858	.8302022	.9205271
27	.0097810	.0097011	.9999653	.9994265		1.0097011	.9953451	.8280092	.9236922
28	.0079884	.0079224	.9999710	.9993975		1.0079224	.9956655	.8245750	.9268156
SOURCE EXTRAPOL (		.0553727	1.0000000	.9993975	7.0447472	4.7004415	12.6641105		
29	.0522715	-.0033502	.9998063	.9992040		1.0020538	.9966498	.2137591	.7163502
30	-.0030986	-.0030939	1.0000093	.9992133		1.0019557	.9969061	.9542090	.9204037
31	-.0028997	-.0028975	1.0000086	.9992219		1.0018643	.9971025	.9551108	.9336228
32	-.0027466	-.0027462	1.0000080	.9992299		1.0017796	.9972538	.9563490	.9450335
33	-.0026278	-.0026288	1.0000076	.9992375		1.0017003	.9973712	.9571282	.9546237
34	-.0025349	-.0025368	1.0000072	.9992447		1.0016259	.9974632	.9578938	.9624911
35	-.0024612	-.0024640	1.0000070	.9992517		1.0015561	.9975360	.9586394	.9688038
36	-.0024020	-.0024052	1.0000067	.9992584		1.0014906	.9975948	.9593602	.9737650
37	-.0023534	-.0023570	1.0000065	.9992649		1.0014289	.9976430	.9600523	.9775854
38	-.0023125	-.0023164	1.0000064	.9992713		1.0013708	.9976836	.9607132	.9804649
39	-.0022773	-.0022813	1.0000063	.9992776		1.0013170	.9977187	.9620569	.9825827
40	-.0022461	-.0022502	1.0000061	.9992837		1.0012661	.9977498	.9626472	.9840933
41	-.0022176	-.0022217	1.0000060	.9992897		1.0012180	.9977783	.9631935	.9851263
42	-.0021909	-.0021950	1.0000059	.9992956		1.0011723	.9978050	.9637060	.9857877
43	-.0021653	-.0021694	1.0000058	.9993015		1.0011290	.9978306	.9641861	.9861634

SOURCE	EXTRAPOL	-.0854032	1.0000000	.9993015	39.2815235	26.9221146	71.2718363		
44	-.0862158	-.0010461	1.0002309	.9995322		1.0006897	.9989539	.5890033	.4755439
45	-.0010320	-.0010331	1.0000019	.9995341		1.0006497	.9989669	.9426792	.9865118
46	-.0010085	-.0010090	1.0000019	.9995360		1.0006145	.9989910	.9463890	.9756342
47	-.0009772	-.0009771	1.0000018	.9995378		1.0005828	.9990229	.9490695	.9674457
48	-.0009405	-.0009401	1.0000017	.9995395		1.0005548	.9990599	.9524116	.9611829
49	-.0009006	-.0008999	1.0000016	.9995410		1.0005294	.9991001	.9547192	.9563488
50	-.0008589	-.0008580	1.0000015	.9995425		1.0005070	.9991420	.9582148	.9526068
51	-.0008166	-.0008156	1.0000013	.9995438		1.0004864	.9991844	.9599840	.9497217
52	-.0007745	-.0007734	1.0000012	.9995450		1.0004684	.9992266	.9633707	.9475244
53	-.0007333	-.0007321	1.0000011	.9995461		1.0004520	.9992679	.9654093	.9458907
54	-.0006934	-.0006922	1.0000010	.9995471		1.0004370	.9993078	.9673583	.9447272
55	-.0006551	-.0006538	1.0000009	.9995480		1.0004239	.9993462	.9704062	.9439629
56	-.0006186	-.0006173	1.0000008	.9995487		1.0004120	.9993827	.9722029	.9435421
57	-.0005840	-.0005828	1.0000007	.9995494		1.0004011	.9994172	.9740785	.9434209
58	-.0005514	-.0005502	1.0000006	.9995500		1.0003914	.9994498	.9762249	.9435636
59	-.0005208	-.0005196	1.0000005	.9995505		1.0003828	.9994804	.9784103	.9439409
60	-.0004922	-.0004911	1.0000004	.9995509		1.0003751	.9995089	.9801767	.9445278
61	-.0004655	-.0004644	1.0000004	.9995513		1.0003682	.9995356	.9819439	.9453028
62	-.0004407	-.0004397	1.0000003	.9995516		1.0003620	.9995603	.9836890	.9462466
63	-.0004177	-.0004167	1.0000002	.9995518		1.0003566	.9995833	.9853807	.9473416
64	-.0003964	-.0003954	1.0000002	.9995520		1.0003519	.9996046	.9870059	.9485714
65	-.0003767	-.0003758	1.0000001	.9995521		1.0003477	.9996242	.9885425	.9499204
66	-.0003585	-.0003576	1.0000001	.9995522		1.0003441	.9996424	.9900317	.9513734
67	-.0003418	.0003411	1.0000000	.9995522		1.0003411	.9996591	.9916814	.9529156
68	.0003387	.0003386	1.0000000	.9995523		1.0003386	.9996745	.9928662	.9545325
69	.0003367	.0003366	1.0000000	.9995522		1.0003366	.9996886	.9943959	.9562098
70	.0003350	.0003350	1.0000000	.9995522		1.0003350	.9997016	.9956057	.9579334
71	.0003338	.0003338	.9999999	.9995521		1.0003338	.9997136	.9968151	.9596896
72	.0003330	.0003330	.9999999	.9995520		1.0003330	.9997245	.9980492	.9614651
73	.0003326	.0003327	.9999999	.9995519		1.0003327	.9997346	.9992184	.9632471
74	.0003322	.0003323	.9999999	.9995518		1.0003323	.9997438	.9993664	.9650234
75	.0003315	.0003316	.9999999	.9995516		1.0003316	.9997522	.9980513	.9667828
76	.0003304	.0003304	.9999998	.9995515		1.0003304	.9997600	.9968529	.9685147
77	.0003289	.0003289	.9999998	.9995513		1.0003289	.9997671	.9957645	.9702098
78	.0003270	.0003271	.9999998	.9995511		1.0003271	.9997736	.9947751	.9718594
79	.0003249	.0003250	.9999998	.9995509		1.0003250	.9997795	.9938750	.9734565
80	.0003226	.0003226	.9999998	.9995507		1.0003226	.9997850	.9930556	.9749947
81	.0003200	.0003200	.9999998	.9995505		1.0003200	.9997900	.9923092	.9764689
82	.0003172	.0003173	.9999998	.9995503		1.0003173	.9997946	.9916290	.9778752
83	.0003143	.0003143	.9999998	.9995501		1.0003143	.9997988	.9910091	.9792107
84	.0003112	.0003112	.9999998	.9995499		1.0003112	.9998027	.9904439	.9804734
85	.0003080	.0003080	.9999998	.9995497		1.0003080	.9998063	.9899287	.9816623
86	.0003046	.0003046	.9999998	.9995495		1.0003046	.9998096	.9894591	.9827772
87	.0003012	.0003012	.9999998	.9995493		1.0003012	.9998127	.9890311	.9838185
88	.0002977	.0002977	.9999998	.9995491		1.0002977	.9998155	.9886413	.9847876
89	.0002941	.0002941	.9999998	.9995489		1.0002941	.9998181	.9882864	.9856859
90	.0002905	.0002905	.9999998	.9995487		1.0002905	.9998205	.9879635	.9865157
91	.0002868	.0002868	.9999998	.9995485		1.0002868	.9998228	.9876700	.9872795
92	.0002832	.0002831	.9999998	.9995483		1.0002831	.9998249	.9874034	.9879799
93	.0002794	.0002794	.9999998	.9995481		1.0002794	.9998268	.9871616	.9886201
94	.0002757	.0002757	.9999998	.9995479		1.0002757	.9998287	.9869426	.9892030
95	.0002720	.0002720	.9999998	.9995477		1.0002720	.9998304	.9867445	.9897318
96	.0002683	.0002682	.9999998	.9995475		1.0002682	.9998320	.9865657	.9902098

SOURCE EXTRAPOL		.0201127	1.0000000	.9995475	75.0000000	73.4360925	101.1434191		
97	.0201067	-.0000852	.9999865	.9995341		1.0000669	.9999148	.2461413	.5023095
98	-.0000832	-.0000832	1.0000001	.9995342		1.0000641	.9999168	.9586041	.9768060
99	-.0000815	-.0000815	1.0000001	.9995344		1.0000615	.9999185	.9591360	.9790243
100	-.0000799	-.0000800	1.0000002	.9995345		1.0000591	.9999200	.9600957	.9811886
101	-.0000786	-.0000787	1.0000002	.9995347		1.0000567	.9999213	.9605966	.9833607
102	-.0000774	-.0000775	1.0000002	.9995349		1.0000545	.9999225	.9610598	.9857571
103	-.0000765	-.0000766	1.0000002	.9995350		1.0000524	.9999234	.9615040	.9877493
104	-.0000757	-.0000758	1.0000002	.9995352		1.0000504	.9999242	.9619298	.9896200
105	-.0000751	-.0000752	1.0000002	.9995354		1.0000485	.9999248	.9623375	.9918401
106	-.0000746	-.0000747	1.0000002	.9995356		1.0000467	.9999253	.9627279	.9936764
107	-.0000742	-.0000744	1.0000002	.9995358		1.0000450	.9999256	.9631014	.9954960
108	-.0000740	-.0000742	1.0000002	.9995360		1.0000433	.9999258	.9634585	.9973448
109	-.0000740	-.0000741	1.0000002	.9995362		1.0000418	.9999259	.9640378	.9990385
110	-.0000740	-.0000742	1.0000002	.9995364		1.0000403	.9999258	.9645909	1.0007026
111	-.0000740	-.0000742	1.0000002	.9995365		1.0000389	.9999258	.9648949	.9995965
112	-.0000738	-.0000740	1.0000002	.9995367		1.0000375	.9999260	.9651852	.9975550
113	-.0000735	-.0000737	1.0000002	.9995369		1.0000362	.9999263	.9654624	.9957306
114	-.0000731	-.0000733	1.0000002	.9995371		1.0000350	.9999267	.9657271	.9940944
115	-.0000726	-.0000727	1.0000002	.9995373		1.0000338	.9999273	.9659797	.9926223
116	-.0000719	-.0000721	1.0000002	.9995375		1.0000327	.9999279	.9662208	.9912942
117	-.0000712	-.0000714	1.0000002	.9995377		1.0000316	.9999286	.9666188	.9900929
118	-.0000705	-.0000706	1.0000002	.9995378		1.0000305	.9999294	.9671303	.9890041
119	-.0000696	-.0000698	1.0000002	.9995380		1.0000295	.9999302	.9673337	.9880152
120	-.0000687	-.0000689	1.0000002	.9995382		1.0000286	.9999311	.9675281	.9871157
121	-.0000678	-.0000679	1.0000002	.9995384		1.0000276	.9999321	.9677137	.9862963
122	-.0000668	-.0000669	1.0000002	.9995385		1.0000268	.9999331	.9678911	.9855488
123	-.0000658	-.0000659	1.0000002	.9995387		1.0000259	.9999341	.9680607	.9848664
SOURCE EXTRAPOL		-.0027359	1.0000000	.9995387	41.4873082	30.3093951	65.0781913		
124	-.0027535	-.0000218	1.0000069	.9995456		1.0000140	.9999782	.5218395	.3261554
125	-.0000200	-.0000199	1.0000000	.9995456		1.0000135	.9999801	.9687376	.9120665
126	-.0000182	-.0000182	1.0000000	.9995456		1.0000131	.9999818	.9705347	.9124619
127	-.0000167	-.0000166	1.0000000	.9995456		1.0000128	.9999834	.9726697	.9129392

POINT FLUX IN GROUP 1 FROM DIFAXI

.113985E-03	.165759E-03	.228946E-03	.307894E-03	.408040E-03	.536278E-03	.701436E-03	.935626E-03	.122572E-02	.156187E-02
.192483E-02	.236821E-02	.294975E-02	.370339E-02	.467308E-02	.591541E-02	.750285E-02	.952801E-02	.133514E-01	.178231E-01
.221129E-01	.263371E-01	.305267E-01	.346883E-01	.388217E-01	.429254E-01	.469939E-01	.510178E-01	.550020E-01	.589443E-01
.628420E-01	.666922E-01	.704926E-01	.742417E-01	.779368E-01	.815638E-01	.851298E-01	.886337E-01	.920735E-01	.954469E-01
.987521E-01	.101989E+00	.105158E+00	.108240E+00	.111244E+00	.114172E+00	.117021E+00	.119789E+00	.122476E+00	.125083E+00
.127612E+00	.130042E+00	.132384E+00	.134639E+00	.136805E+00	.138882E+00	.140871E+00	.142771E+00	.144592E+00	.146305E+00
.147924E+00	.149451E+00	.150886E+00	.152229E+00	.153479E+00	.154640E+00	.155722E+00	.156695E+00	.157573E+00	.158359E+00
.159053E+00	.159656E+00	.160169E+00	.160595E+00	.160946E+00	.161193E+00	.161348E+00	.161416E+00	.161396E+00	.161292E+00
.161102E+00	.160832E+00	.160496E+00	.160063E+00	.159546E+00	.158948E+00	.158272E+00	.157519E+00	.156690E+00	.155790E+00
.154835E+00	.153792E+00	.152676E+00	.151489E+00	.150235E+00	.148915E+00	.147529E+00	.146084E+00	.144594E+00	.143032E+00
.141406E+00	.139723E+00	.137984E+00	.136191E+00	.134345E+00	.132451E+00	.130526E+00	.128541E+00	.126506E+00	.124426E+00
.122302E+00	.120136E+00	.117929E+00	.115687E+00	.113424E+00	.111117E+00	.108771E+00	.106393E+00	.103982E+00	.101541E+00
.990715E-01	.965769E-01	.940722E-01	.915358E-01	.889731E-01	.863877E-01	.837811E-01	.811546E-01	.785095E-01	.758488E-01
.731860E-01	.705037E-01	.678050E-01	.650926E-01	.623681E-01	.596321E-01	.568858E-01	.541315E-01	.513807E-01	.486207E-01
.458519E-01	.430767E-01	.402958E-01	.375098E-01	.347196E-01	.319265E-01	.291397E-01	.263515E-01	.235595E-01	.207641E-01
.179626E-01	.151452E-01	.122799E-01	.926422E-02	.661811E-02	.520442E-02	.409264E-02	.321828E-02	.253061E-02	.198974E-02
.156429E-02	.122959E-02	.966219E-03	.758898E-03	.595601E-03	.466855E-03	.365192E-03	.284713E-03	.220751E-03	.169595E-03
.128277E-03	.944000E-04	.659994E-04							

POINT FLUX IN GROUP 2 FROM DIFAXI

.994171E-04	.197729E-03	.290567E-03	.380580E-03	.464030E-03	.527846E-03	.543613E-03	.463275E-03	.553149E-03	.825637E-03
.142866E-02	.199817E-02	.257286E-02	.318159E-02	.381708E-02	.442149E-02	.485186E-02	.481328E-02	.354031E-02	.369530E-02
.431508E-02	.506587E-02	.585125E-02	.664286E-02	.743149E-02	.821196E-02	.897312E-02	.973627E-02	.104951E-01	.112469E-01
.119902E-01	.127241E-01	.134468E-01	.141536E-01	.148283E-01	.155095E-01	.161850E-01	.168503E-01	.175038E-01	.181440E-01
.187688E-01	.193720E-01	.199319E-01	.205036E-01	.210692E-01	.216225E-01	.221613E-01	.226842E-01	.231885E-01	.236666E-01
.240917E-01	.245347E-01	.249718E-01	.253956E-01	.258034E-01	.261935E-01	.265631E-01	.269031E-01	.271829E-01	.274864E-01
.277851E-01	.280702E-01	.283387E-01	.285889E-01	.288175E-01	.290147E-01	.291466E-01	.293078E-01	.294657E-01	.296107E-01
.297394E-01	.298500E-01	.299392E-01	.299962E-01	.299854E-01	.300087E-01	.300308E-01	.300412E-01	.300364E-01	.300146E-01
.299723E-01	.298985E-01	.297570E-01	.296531E-01	.295501E-01	.294372E-01	.293108E-01	.291690E-01	.290083E-01	.288178E-01
.285619E-01	.283460E-01	.281331E-01	.279121E-01	.276798E-01	.274342E-01	.271719E-01	.268824E-01	.265316E-01	.262219E-01
.259170E-01	.256062E-01	.252863E-01	.249555E-01	.246106E-01	.242417E-01	.238175E-01	.234338E-01	.230562E-01	.226749E-01
.222867E-01	.218900E-01	.214819E-01	.210536E-01	.205774E-01	.201393E-01	.197083E-01	.192753E-01	.188376E-01	.183936E-01
.179409E-01	.174720E-01	.169636E-01	.164895E-01	.160227E-01	.155555E-01	.150852E-01	.146108E-01	.141303E-01	.136374E-01
.131143E-01	.126202E-01	.121330E-01	.116463E-01	.111581E-01	.106675E-01	.101731E-01	.967025E-02	.914669E-02	.864571E-02
.815038E-02	.765608E-02	.716136E-02	.666557E-02	.616784E-02	.566557E-02	.515248E-02	.465457E-02	.416163E-02	.367344E-02
.319735E-02	.275931E-02	.244302E-02	.251610E-02	.370160E-02	.387922E-02	.362965E-02	.320054E-02	.272376E-02	.226543E-02
.185504E-02	.150231E-02	.120685E-02	.963491E-03	.765270E-03	.604929E-03	.475654E-03	.371341E-03	.286627E-03	.216761E-03
.157372E-03	.104130E-03	.522587E-04							

PROGRAMA CONAXI ARAGONES-AHNERT SEPT 84

MAT	DIF(1)	ABS(1)	FIS(1)	REM(1)	DIF(2)	ABS(2)	FIS(2)	K-INF	M**2	B2-MAT	FLUX-RAT
1	1.34489000	.00922861	.00594982	.01692840	.38676500	.08798010	.11022700	1.0378736	54.359835	.69672E-03	5.21311
2	1.34835000	.00921834	.00594421	.01682190	.38868900	.08772640	.11000600	1.0379013	54.741086	.69237E-03	5.23101
3	1.35196000	.00920765	.00593836	.01671180	.39071100	.08746850	.10978300	1.0379259	55.140189	.68781E-03	5.25002
4	1.35573000	.00919656	.00593229	.01659830	.39283000	.08720630	.10955800	1.0379492	55.557509	.68306E-03	5.27010
5	1.35966000	.00918505	.00592600	.01648110	.39504700	.08693990	.10933100	1.0379679	55.994110	.67807E-03	5.29138
6	1.36374000	.00917313	.00591948	.01636050	.39736200	.08666920	.10910200	1.0379838	56.449456	.67288E-03	5.31381
7	1.36798000	.00916080	.00591273	.01623630	.39977500	.08639430	.10887100	1.0379936	56.924810	.66743E-03	5.33749
8	1.37237000	.00914805	.00590577	.01610850	.40228500	.08611510	.10863700	1.0379910	57.420301	.66163E-03	5.36246
9	1.37692000	.00913489	.00589857	.01597720	.40489300	.08583160	.10840200	1.0379890	57.936680	.65570E-03	5.38875
10	1.38162000	.00912132	.00589115	.01584240	.40759900	.08554390	.10816500	1.0379792	58.474094	.64950E-03	5.41639
11	1.38649000	.00910733	.00588350	.01570400	.41040300	.08525190	.10792500	1.0379531	59.034169	.64290E-03	5.44548
12	1.39150000	.00909294	.00587563	.01556200	.41330400	.08495570	.10768400	1.0379229	59.616319	.63612E-03	5.47607
13	1.39668000	.00907813	.00586754	.01541660	.41630300	.08465520	.10744000	1.0378762	60.222017	.62894E-03	5.50816
14	1.40200000	.00906291	.00585922	.01526760	.41940000	.08435050	.10719500	1.0378228	60.851198	.62156E-03	5.54188
15	1.40749000	.00904727	.00585067	.01511500	.42259500	.08404150	.10694700	1.0377478	61.505841	.61373E-03	5.57730
16	1.41313000	.00903122	.00584190	.01495890	.42588700	.08372830	.10669700	1.0376571	62.185676	.60556E-03	5.61446
17	1.41892000	.00901476	.00583290	.01479930	.42927700	.08341070	.10644600	1.0375577	62.891575	.59718E-03	5.65345
18	1.38548700	.00120632	0.00000000	.04601563	.25643530	.03474068	0.00000000	0.0000000	29.339894	-.34083E-01	.56504
19	1.16506700	.00335735	0.00000000	.01782809	.30330030	.08915832	0.00000000	0.0000000	54.993752	-.18184E-01	4.69165
20	1.33554700	.00169367	0.00000000	.03962929	.26705330	.04706987	0.00000000	0.0000000	32.319732	-.30941E-01	.97925
21	1.34955000	.00145416	0.00000000	.04299972	.26273070	.04071018	0.00000000	0.0000000	30.358431	-.32940E-01	.74549

NODP,NODU,NPP,NPU,H = 3 20 18 154 365.760100

17 NODOS AXIALES DE ALTURA = 21.515300

CORE K-EFF = .9995456 TOTAL SOURCE = .1000000E+01

NODO	G	DIF	DB2	ABS	FIS	REM	FLUX	LEAK	INT-FLUX	LEFT-FSD	RIGHT-FSD	INT-FSD
1	1	.8195554	.0004647	.0056238	.0036257	.0103159	.0283233	-.0025332	.0108185	.7450376	.9923500	0.0000000
1	2	.0465519	.0000475	.0105895	.0132672	0.0000000	.0055943	.0002113	.0042750	2.6834028	1.0061654	0.0000000
1	3	.8661073	.0005121	.0162133	.0168929	.0103159	.0339176	-.0023219	.0150935	.8527952	.9966600	0.0000000
2	1	1.7631887	.0009997	.0120545	.0077730	.0219974	.0607783	-.0020372	.0449623	.9902778	.9932551	1.0020925
2	2	.0969727	.0000989	.0218866	.0274450	0.0000000	.0115958	-.0001097	.0085935	.9959498	.9868625	1.0102571
2	3	1.8601614	.0010986	.0339411	.0352181	.0219974	.0723741	-.0021469	.0535558	.9903841	.9931115	1.0063369
3	1	2.6234514	.0014874	.0178673	.0115233	.0324289	.0901907	-.0018550	.0760918	.9913036	.9933159	1.0019686
3	2	.1441273	.0001469	.0322658	.0404973	0.0000000	.0171452	-.0000978	.0144918	.9973602	.9866658	.9894745
3	3	2.7675786	.0016344	.0501330	.0520205	.0324289	.1073359	-.0019528	.0905836	.9914218	.9931708	1.0017043
4	1	3.3660304	.0019085	.0228334	.0147288	.0412106	.1153978	-.0015951	.1035755	.9919395	.9935230	1.0013875
4	2	.1847023	.0001883	.0410030	.0515124	0.0000000	.0218535	-.0000816	.0196527	.9983423	.9865605	.9883041
4	3	3.5507326	.0020968	.0638364	.0662412	.0412106	.1372512	-.0016767	.1232282	.9920666	.9933737	1.0011130
5	1	3.9638724	.0022474	.0267776	.0172763	.0480480	.1355008	-.0012770	.1263493	.9924627	.9938026	1.0010684
5	2	.2172240	.0002214	.0478055	.0601177	0.0000000	.0255571	-.0000623	.0238797	.9992305	.9865511	.9873203
5	3	4.1810964	.0024689	.0745831	.0773940	.0480480	.1610579	-.0013393	.1502290	.9925985	.9936493	1.0007811
6	1	4.3993844	.0024944	.0295922	.0190961	.0527785	.1499384	-.0009216	.1436828	.9929421	.9941284	1.0008665
6	2	.2407548	.0002454	.0525114	.0661030	0.0000000	.0281606	-.0000412	.0270434	1.0000393	.9865568	.9865123
6	3	4.6401392	.0027398	.0821036	.0851991	.0527785	.1780990	-.0009628	.1707262	.9930854	.9939701	1.0005678
7	1	4.6643943	.0026446	.0312355	.0201606	.0553608	.1584777	-.0005492	.1551819	.9934069	.9944937	1.0007263
7	2	.2548727	.0002598	.0550798	.0694096	0.0000000	.0296319	-.0000196	.0290809	1.0008568	.9865993	.9857121
7	3	4.9192670	.0029044	.0863154	.0895703	.0553608	.1881096	-.0005688	.1842628	.9935579	.9943303	1.0004148
8	1	4.7594701	.0026985	.0317260	.0204816	.0558653	.1611907	-.0001791	.1607710	.9938802	.9949017	1.0006173
8	2	.2596456	.0002647	.0555810	.0701173	0.0000000	.0299985	.0000016	.0299908	1.0016842	.9866887	.9849405
8	3	5.0191157	.0029632	.0873071	.0905989	.0558653	.1911892	-.0001775	.1907618	.9940389	.9947333	1.0002931
9	1	4.6930397	.0026609	.0311350	.0201045	.0544561	.1584157	.0001717	.1606641	.9943532	.9953337	1.0005516
9	2	.2555741	.0002605	.0541781	.0684248	0.0000000	.0293379	.0000212	.0298275	1.0025078	.9867970	.9842205
9	3	4.9486138	.0029214	.0853131	.0885293	.0544561	.1877536	.0001929	.1904916	.9945194	.9951603	1.0002150
10	1	4.4795356	.0025398	.0295735	.0191005	.0513648	.1506944	.0004901	.1553115	.9948402	.9957981	1.0004960
10	2	.2434898	.0002482	.0511019	.0646152	0.0000000	.0277652	.0000387	.0286894	1.0033527	.9869274	.9834996
10	3	4.7230254	.0027880	.0806753	.0837157	.0513648	.1784595	.0005287	.1840010	.9950141	.9956197	1.0001469
11	1	4.1379994	.0023462	.0271810	.0175594	.0468688	.1387159	.0007664	.1453377	.9953526	.9963023	1.0004475
11	2	.2244692	.0002288	.0466284	.0590294	0.0000000	.0254214	.0000533	.0267064	1.0042389	.9870923	.9827616
11	3	4.3624685	.0025750	.0738093	.0765888	.0468688	.1641373	.0008197	.1720441	.9955346	.9961191	1.0000855
12	1	3.6901236	.0020922	.0241136	.0155816	.0412689	.1232566	.0009944	.1314868	.9958724	.9968224	1.0004317
12	2	.1997387	.0002036	.0410568	.0520408	0.0000000	.0224618	.0000650	.0240289	1.0051470	.9872995	.9820377
12	3	3.8898624	.0022958	.0651704	.0676224	.0412689	.1457185	.0010593	.1555157	.9960629	.9966353	1.0000565
13	1	3.1585424	.0017908	.0205299	.0132692	.0348641	.1051096	.0011728	.1145537	.9964147	.9973732	1.0004091
13	2	.1705664	.0001739	.0346847	.0440200	0.0000000	.0190430	.0000734	.0208146	1.0060658	.9875175	.9813468
13	3	3.3291088	.0019647	.0552145	.0572892	.0348641	.1241527	.0012463	.1353683	.9966136	.9971823	1.0000218

14	1	2.5649696	.0014543	.0165807	.0107195	.0279322	.0850329	.0013032	.0953222	.9969616	.9979345	1.0004129
14	2	.1381671	.0001409	.0277884	.0353143	0.0000000	.0153119	.0000790	.0172168	1.0070334	.9877688	.9806204
14	3	2.7031367	.0015951	.0443691	.0460338	.0279322	.1003448	.0013822	.1125390	.9971705	.9977413	1.0000118
15	1	1.9290183	.0010937	.0123996	.0080186	.0207157	.0637006	.0013908	.0745148	.9975320	.9985204	1.0004035
15	2	.1036322	.0001056	.0206093	.0262264	0.0000000	.0113978	.0000819	.0133749	1.0080535	.9881009	.9798774
15	3	2.0326505	.0011994	.0330090	.0342450	.0207157	.0750985	.0014727	.0878897	.9977529	.9983280	.9999884
16	1	1.2670137	.0007184	.0080974	.0052379	.0134122	.0416727	.0014425	.0527534	.9981159	.9990954	1.0004052
16	2	.0678746	.0000692	.0133440	.0170046	0.0000000	.0074074	.0000826	.0094075	1.0091447	.9887017	.9791469
16	3	1.3348883	.0007876	.0214414	.0222424	.0134122	.0490801	.0015251	.0621608	.9983541	.9989150	.9999739
17	1	.5894539	.0003342	.0037450	.0024231	.0061480	.0193083	.0014673	.0305302	.9968101	.7090571	1.0022926
17	2	.0329702	.0000336	.0064063	.0081755	0.0000000	.0035697	.0000816	.0054080	1.0380826	2.7844420	.9524308
17	3	.6224241	.0003678	.0101512	.0105986	.0061480	.0228781	.0015489	.0359382	1.0032503	.8400761	.9956787
18	1	52.8690434	.0299757	.3510658	.2266796	.6150361	38.4199663	.0018437	.0075169	0.0000000	0.0000000	0.0000000
18	2	2.8813335	.0029373	.6125204	.7733204	0.0000000	7.1270085	-.0002103	.0031749	0.0000000	0.0000000	0.0000000
18	3	55.7503769	.0329130	.9635862	1.0000000	.6150361	45.5469748	.0016334	.0106919	0.0000000	0.0000000	0.0000000

NODO	MAT	M-2	K-INF	XK-INF	XM-2	XF-DIF
1	1	53.4196942	1.0419190	1.0038977	.9827052	1.0257623
2	2	54.8056520	1.0376240	.9997328	1.0011795	1.0057793
3	3	55.2046844	1.0376495	.9997337	1.0011697	1.0053335
4	4	55.6224165	1.0376716	.9997325	1.0011683	1.0051543
5	5	56.0595814	1.0376885	.9997308	1.0011693	1.0050875
6	6	56.5156475	1.0377020	.9997285	1.0011726	1.0050875
7	7	56.9917786	1.0377091	.9997259	1.0011764	1.0051213
8	8	57.4880895	1.0377037	.9997232	1.0011806	1.0051985
9	9	58.0053271	1.0376988	.9997204	1.0011849	1.0052875
10	10	58.5436194	1.0376860	.9997176	1.0011890	1.0053889
11	11	59.1045705	1.0376571	.9997148	1.0011926	1.0055246
12	12	59.6875523	1.0376242	.9997122	1.0011949	1.0056524
13	13	60.2940626	1.0375749	.9997097	1.0011963	1.0058118
14	14	60.9238694	1.0375197	.9997080	1.0011943	1.0059581
15	15	61.5787366	1.0374447	.9997080	1.0011852	1.0061027
16	16	62.2575663	1.0373591	.9997128	1.0011561	.9803184
17	17	61.3151644	1.0440716	1.0062781	.9749345	0.0000000

ALBEDOS INFERIOR = 1.2410043 SUPERIOR = 1.2147958

```
DATOS SECCION 08 5 PARA SIMULA-3 EN UNIDAD 2
REF-S-AX 08 2 0  .28718  .59871  .88435 1.12610 1.31570 1.44838 1.52269 1.54018
REF-S-AX 08 2 0 1.50500 1.42317 1.30201 1.14958  .97392  .78257  .58216  .37812
REF-S-AX 08 2 0  .18018
XK-AXIAL 08 5 1 1.00390  .99973  .99973  .99973  .99973  .99973  .99973  .99972
XK-AXIAL 08 5 1  .99972  .99972  .99971  .99971  .99971  .99971  .99971  .99971
XK-AXIAL 08 5 1 1.00628
XM-AXIAL 08 5 2  .98271 1.00118 1.00117 1.00117 1.00117 1.00117 1.00118 1.00118
XM-AXIAL 08 5 2 1.00118 1.00119 1.00119 1.00119 1.00120 1.00119 1.00119 1.00116
XM-AXIAL 08 5 2  .97493
XF-AXIAL 08 5 3 1.02576 1.00578 1.00533 1.00515 1.00509 1.00509 1.00512 1.00520
XF-AXIAL 08 5 3 1.00529 1.00539 1.00552 1.00565 1.00581 1.00596 1.00610  .98032
XF-AXIAL 08 5 3 0.00000
```

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