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GENERATION OF A WIMS-D/4 MULTIGROUP CONSTANTS LIBRARY BASED ON THE JENDL-3.2 NUCLEAR DATA AND ITS VALIDATION THROUGH SOME BENCHMARK EXPERIMENTS ANALYSIS

November 1996

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Generation of a WIMS-D/4 Multigroup Constants Library based on the JENDL-3.2 Nuclear Data and its Validation through Some Benchmark Experiments Analysis

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A new 69 group library of multigroup constants for the lattice code WIMS-D/4 has been generated with an improved resonance treatment, processing nuclear data from JENDL-3.2 by NJOY91.108. A parallel ENDF/B-VI based library has also been constructed for intercomparison of results. Benchmark calculations for a number of thermal reactor critical assemblies of both uranium and plutonium fuels have been performed with the code WIMS-D/4.1 with its three different libraries: the original WIMS library (NEA-0329/10) and the new ENDF/B-VI and JENDL-3.2 based libraries. The results calculated with both ENDF and JENDL based libraries show similar tendency and are found in better agreement with the experimental values. Benchmark parameters are further calculated with the comprehensive lattice code SRAC95. The results from SRAC95 and WIMS-D/4.1 (both with JENDL-3.2 based libraries) agrees well to each other as well as to the other previously published values.

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Keywords: WIMS-D/4, Multigroup Constants, NJOY91.108, JENDL-3.2, ENDF/B-VI, WIMS-Library (NEA-0329/10), Nuclear Data, Averaging Spectrum, Potential Cross Section, Goldstein-Cohen Parameter, Resonance Integrals, Resonance Interference, Thermal Reactor, Benchmark Experiments, Integral Parameters, Data Verification, Code Verification, Validation, SRAC95

ＪＥＮＤＬ-3.２のＷＩＭＳ-Ｄ／４多群定数ライブラリー作成及びベンチマーク実験解析

日本原子力研究所東海研究所原子炉工学部
Mafizur RAHMAN*・高野　秀機

（1996年10月４日受理）

ＪＥＮＤＬ-3.２核データを用いて、核計算コードＷＩＭＳ-Ｄ／４の多群定数ライブラリーを作成した。このライブラリー作成においては、ＮＪＯＹ91.108プロセスコードを用いて、共鳴領域の取り扱いを改良して行った。また、ＥＮＤＦ／Ｂ-Ⅵ核データについても同様の計算を行い多群ライブラリーを作成した。これらの多群定数ライブラリーを用いてウラン及びプルトニウム燃料熱中性子炉のベンチマーク計算を実施した。ベンチマーク計算の結果は、ＪＥＮＤＬ-3.２とＥＮＤＦ／Ｂ-Ⅵともによく似た傾向を示し実験値とも概略よい一致を示した。さらに、格子計算コードＳＲＡＣ95の結果ともよく似た傾向を示した。

＊ バングラデッシュ原子力研究所

Contents

1. Introduction

The WIMS package [1] originating from the Winfrith Laboratory is widely used for reactor calculations of a wide variety of thermal reactors. It consists of a lattice transport code and the associated data library. The lattice code exists in a version, of which WIMS-D/4 is available on non-commercial terms and LWR-WIMS and WIMS-E are distributed to the users through the ANSWERS service [2] on commercial terms. They all use basically the same multigroup data library [3] although the commercial versions allow some format extensions and their library is reported to include some further data adjustments [4] which improve the performance of WIMS.

The libraries supplied with different versions of the WIMS code are based on old and obsolete basic evaluated data originating in the early sixties. Relatively good performance of the library was achieved through a series of empirical adjustments to the multigroup data and particularly to the resonance integrals so as to force better agreement with integral benchmark experiments through comparisons of the calculated integral parameters with a wide range of benchmark experiments. Instead, several deficiencies [6,7] of the non-commercially available WIMS library, distributed by the NEA Data Bank were observed by the users. Also some important nuclides such as Am-241for typical power and research reactor calculations are not included in library.

With the objective to improve the performance of WIMS for lattice calculations by updating its library based on one of the recently released evaluated data files such as BROND-2, CENDL-2, ENDF/B-VI, JEF-2 and JENDL-3.2, the Nuclear Data Section of IAEA has initiated a program named 'WIMS Library Update Project (WLUP)' through international cooperation in 1991 [5]. The work completed so far under this project includes: (i) optimization of WIMS inputs to model some selected benchmark experiments as accurately as possible [6], (ii) intercomparison of data entered into the WIMS library using different processing systems [7] and (iii) upgrading of the WIMSR module of the NJOY data processing system so that it could be used reliably to prepare group constants for the WIMS library [8]. A parametric study of the effect of different NJOY input options on integral results calculated by WIMS has also been performed and consistent set of NJOY input instructions in processing some important materials from evaluated data files have been established [9].

With these developments in hand, we tried in the present work to construct a new WIMS-D/4 library based on JENDL-3.2, the Japanese evaluated nuclear data library. The new library is verified for its applicability to Mixed Oxide (MOX) cores of varying plutonium contents which is as well, valid for burnup calculation of uranium fueled cores.

2. Data processing details

The evaluated data files we processed are:

i) ENDF/B-VI : ^{1}H, ^{16}O, ^{27}Al, ^{235}U (ENDF/B-VI.Rev.3), ^{238}U (revision-2) and
ii) JENDL-3.2 (revision-2): 24 nuclides.

A list of nuclides in the library with details of data tabulation is given in Appendix-A.

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2.1 Data processing system

The NJOY system [10] has recently become the standard tool for processing basic nuclear data into multigroup libraries for various applications. The principal advantage of NJOY is its most general purpose applicability and comprehensive capability to process data in the recent ENDF-6 format. Version NJOY91.108 is used in our work with the following corrections / changes to the IAEA updates of the WIMSR module of NJOY [11] :

i) Modifications required for calculating library group constants with 16-resonance-groups (thermal cutoff at 2.1 eV), in contrast to the usual library with 13-resonance-groups (thermal cutoff at 4 eV), in routines RESINT, RESOUT and WIMOUT
ii) Modifications required to calculate the resonance contributions to elastic scattering and to include corresponding resonance integrals into the WIMS library for selected isotopes (e.g., ^{238}U, ^{240}Pu and ^{242}Pu), in routines RESINT, RESOUT and WIMOUT
iii) A format change in writing P-1 scattering matrices to meet the requirements of 'WRITER' - a program to write WIMS binary library, in routine WIMOUT
iv) A variable 'SIGOL' is replaced with 'SGOL' , used in converting cross sections to resonance integrals, in routine WIMOUT
v) A variable 'NZ' is replaced with 'LZ' in a statement that defines the inverse flux variable 'CFLUX' for reference or fully shielded sigma zero, in routine XSECS

2.2 General remarks on data processing

For WIMS-D library generation the following modules of NJOY are invoked in sequence: MODER-RECONR-BROADR-UNRESR-THERMR-GROUPR-WIMSR in FACOM M-780 computer. One important finding is that in RECONR, the default value '7' for the option 'number of significant digits' reconstructs the resonance integrals incorrectly; we used 6, instead.

The selection of some important data processing input parameters defines the range of applicability of a multigroup data library. The demands of the WIMS-D library in particular are rather high, since it has to cover the requirements for a large variety of lattices, differing in the type of moderator, fuel/moderator volume ratio, lattice pitch, operating conditions etc. The library format restrictions on multigroup constants representation are limited to only a few data types, where relatively weak (but non-negligible) lattice type dependence is expected. Example of such cases are the shape of the weighting function in generating the multigroup constants and the assumptions related to the detailed slowing-down treatment in generating the resonance integrals. In this work, the input option selection has been made on basic principles, having in mind a typical light water reactor (LWR). However, the applied principles and the assumptions are valid for other reactor types, too.

2.2.1 Averaging spectrum

For averaging the group constants we used the mid-life PWR flux spectrum, one of the in-built input options of the GROUPR module (IWT = 5; EPRI-CELL LWR) of NJOY. Special treatment was applied in the resonance range and is given for each nuclide separately, where applicable.

2.2.2 Fission spectrum

In the WIMS-D/4 library a single fission spectrum is specified for all fissile nuclides. This does not seem to have an strong effect on the multiplication factors of well thermalized systems, but the reaction rates were found to differ considerably with changes in fission spectrum [12]. In our analysis, for uranium cores ^{235}U fission spectrum from ENDF/B-V and for plutonium cores ^{239}Pu fission spectrum from JENDL-3.2 are used.

2.2.3 Potential cross section

The sensitivity of the integral parameters on the choice of potential cross section is not very high, provided the resonance integrals are derived from the cross sections consistently. We used a constant value (taken from the comment section of the evaluated data file) for resonance materials and corresponding self-shielded scattering cross sections (by setting SIGP=0 on WIMSR input) for non-resonant isotopes.

2.2.4 Slowing down power

The slowing down power is defined as the product of the average lethargy decrement per collision ξ and the scattering cross section σ_s, normalized by the group lethergy widths τ. It is defined by using the self-shielded scattering cross section.

2.2.5 Goldstein-Cohen parameter

The Goldstein-Cohen value λ_g should be consistent with the resonance integral. The λ_g values for ^1H, ^{16}O, ^{235}U and ^{238}U are taken from EPRI-CELL code validation report[13]. This code uses resonance treatment similar to WIMS. The reported values were condensed to the WIMS group structure. For other materials, a constant value is used, taken from the present WIMS-D library.

2.2.6 Transport cross section

The transport cross section $\sigma_{tr}(g)$ in the thermal range is defined in the usual way,

$$\sigma_{tr}(g) = \sigma_a(g) + \sigma_{s0}(g) - \sum_h \sigma_{s1}(g \dashrightarrow h) \tag{1}$$

where $\sigma_a(g)$ is the absorption cross section, $\sigma_{s0}(g)$ the scattering cross section and $\sigma_{s1}(g - h)$ is the first moment of the scattering cross section for transfer from group g to h. Above thermal energies an alternative definition is applied:

$$\sigma_{tr}(g) = \sigma_a(g) + \sigma_{s0}(g) - \sum_h \sigma_{s1}(h \dashrightarrow g) \frac{J_{(h)}}{J_{(g)}} \tag{2}$$

where $J_{(g)}$ is the neutron current spectrum. The B_1 flux approximation for large systems as calculated by NJOY was applied to define $J_{(g)}$.

2.2.7 Absorption cross section

In the WIMS definition of the absorption cross section σ_a , the values are reduced by the value of the (n,2n) cross section. The neutron balance and the total cross section are preserved by taking extra neutrons into account in the transfer matrix.

2.2.8 Scattering cross section

It contains a corrections to the self-scattering term such that the sum of the absorption cross section and all the elements of the scattering matrix for a particular group add up to the transport cross section in that group (and not the total cross section). The exceptions are the moderators with explicitly given P_1 scattering matrices (i.e., hydrogen, deuterium, oxygen and carbon).

2.2.9 Resonance integrals

In the WIMS library the resonance integrals for absorption and neutron yield per fission (product of the average number of neutrons emitted per fission and the fission cross section) are tabulated as function of the background cross section σ_b. The relation between more commonly applied Bonderenko background cross section σ_0 and the WIMS σ_b is given by

$$\sigma_b = \sigma_0 + \lambda\sigma_p \tag{3}$$

where λ is the Goldstein-Cohen parameter and σ_p is the potential scattering cross section of the absorber.

The self-shielded cross section for some reaction x as calculated by NJOY can be converted to the resonance integral I_x through the relation

$$I_x = \frac{\sigma_x\,\sigma_b}{\sigma_b + \sigma_a} \tag{4}$$

where subscript 'a' stands for absorption. The above definition is not exact and ignores the resonance scattering, but it is exactly the inverse of the relation used in WIMS to calculate the self-shielded cross sections from the resonance integrals:

$$\sigma_x = \frac{I_x}{1 - \dfrac{I_a(\sigma_b)}{\sigma_b}} \tag{5}$$

2.2.10 Self-shielding due to elastic resonances

In the WIMS library, self-shielding of the absorption and the fission reaction in resonance materials can be taken into account explicitly by tabulating the resonance integrals. However, self-shielding of the scattering resonances can not be treated in the same way. As an alternative, we considered the intermediate resonance approximation in which the resonance integrals are defined

$$I_x = \int_g \frac{1}{\phi(E)dE} \int_g \sigma_x(E)\phi(E)dE \left\{ \frac{\sigma_0 + \lambda\,\sigma_p}{\sigma_0 + \lambda\,\sigma_p + \lambda\,\sigma_{er}(E) + \sigma_a(E)} \right\} dE \quad (6)$$

where $\phi(E)$ is the smooth neutron spectra (i.e., without perturbation due to resonances, normally by 1/E shape) and σ_{er} is the resonance contribution to elastic scattering. Using this definition, the relation between the self-shielded cross sections and the resonance integrals is:

$$\sigma_x(\sigma_b) = \frac{I_x(\sigma_b)}{1 - \frac{I_a(\sigma_b)}{\sigma_b} - \frac{\lambda\, I_{er}(\sigma_b)}{\sigma_b}} \quad (7)$$

Definitions given by equations (5) and (7) are equivalent if the resonance contribution to elastic scattering is negligible. But for nuclides with prominent elastic resonances (e.g., ^{238}U, ^{240}Pu and ^{242}Pu), equation (7) will be more appropriate to use (in WIMS) and in that case, its inverse relation

$$I_x = \frac{\sigma_x\ \sigma_b}{\sigma_a + \sigma_b + \lambda\,\sigma_{er}} \quad (8)$$

must be used (in WIMSR) in converting the self-shielded cross sections to the corresponding integrals.

2.2.11 Resonance interference treatment in NJOY

In practice, a fuel rod rarely contains only one resonance isotope. As an example, let us consider a mixture of a few percent of ^{239}Pu with ^{238}U as the major component. There will a strong dip in the flux associated with the 6.7 eV ^{238}U resonance that will affect the flux in the region of the 7.8 eV ^{239}Pu resonance (interference effect), and there will also be a dip in the flux corresponding to 7.8 eV resonance (self-shielding effect). This additional complication in the flux shape would be expected to change the group constants for ^{239}Pu since both features lie in the same group for typical group structures. However, the effect of ^{239}Pu on the ^{238}U group constants should be minimal. This argument suggests that the flux calculation be used for ^{238}U as a single resonance material. The resulting flux could then be used to estimate the flux to be used in averaging the ^{239}Pu cross section as follows:

$$\phi_{239}(E,\sigma_0) = \frac{\phi_{238}(E,50)}{\sigma_0 + \frac{\phi_{239}(E)}{1 + \{\phi_{238}(E)/50\}}} \quad (9)$$

where the ^{238}U flux is the characterisric of a background of 50 barns/atom, witch ie representative of many thermal reactor systems. This formula assumes that the effect of ^{239}Pu on the scattering source for the mixture is small, but it retains the absorption effects. The self-shielding of ^{239}Pu is treated in the narrow resonance approximation only. The GOUPR flux calculator includes an option to write out a file containing the calculated flux and cross section needed for this formula(e.g., for ^{238}U) and another option to skip the flux calculation and use the formula above to obtain the weighting flux(e.g., for ^{239}Pu).

2.3 Specific material processing details

Specific material processing details are furnished as NJOY inputs in Appendix -B.

3. Benchmark Experiments

The validation of the present work is performed by analyzing the following seventeen thermal reactor benchmark experiments:

- TRX-1, TRX-2 (1.3% enriched metal fueled, H_2O moderated critical lattices), BAPL-1, BAPL-2, BAPL-3 (1.3% enriched UO_2 fueled, H_2O moderated critical lattices) recommended by Cross Section Evaluation Working Group [14]
- Tank Type Critical Assembly (TCA) lattices [15] :
  i) 1.50U, 1.83U, 2.48U and 3.00U (2.6 w% enriched UO_2 fueled, H_2O moderated) and
  ii) 2.42PU, 2.98PU, 4.24PU and 5.55PU (3.0 w% enriched Pu-UO_2 (MOX) fueled, H_2O moderated)
- NEACRP HCLWR lattices[16] :
  (i) V6E8 (V_m/V_f =.6, Pu fis.=8%), (ii) V1E7 (V_m/V_f =1.1, Pu fis.=7%),
- OECD/NEA lattices for Plutonium Recycling in PWRs[17] :
  (i) Benchmark A - poor-isotopic-quality plutonium : V_m/V_f = 1.9284, Pu content= 12.5 w/o (6.0 w/o fissile), isotopic vector (^{238}Pu: ^{239}Pu:^{240}Pu:^{241}Pu:^{242}Pu = 4:36:28:12:20),
  (ii) Benchmark B - better plutonium vector: V_m/V_f =1.9284, Pu content= 4.0 w/o(2.8 w/o fissile), isotopic vector (^{238}Pu: ^{239}Pu:^{240}Pu:^{241}Pu:^{242}Pu =1.8:59:23:12.2:4.0).

4. Benchmark calculations

Benchmark calculations for the above mentioned lattices are done with the lattice codes WIMS-D/4.1[18] and SRAC95 [19] of which the input specifications are given in Appendix-C. The integral parameters calculated are:

k_{inf} ----infinite multiplication factor
k_{eff} ----effective multiplication factor
ρ^{28} ----the ratio of epithermal to thermal capture reaction rates in ^{238}U,
δ^{25} ---- the ratio of epithermal to thermal fission reaction rates in ^{235}U,
δ^{28} ----the ratio of total fission reaction rates in ^{238}U and ^{235}U,
C^* ----the ratio of capture reaction rates in ^{238}U to fission reaction rates in ^{235}U.

The ratios refer to reaction rates correspond to a thermal cutoff energy of 0.625 eV.

4.1 Calculation with WIMS-D/4.1

Following modifications are introduced into the code WIMS-D/4.1

- To calculate with the 16-resonance-groups library, the dimension of all variables related to the number of resonance groups are changed from 13 to 16 in routines: CHN12, CHN13, CHN21, DASQUE, DATAG, DATAR, REACT, RESALT and RESINT
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- To take into account of self-shielding due to elastic resonances in ^{238}U, ^{240}Pu and ^{242}Pu in routine RESALT and RESINT

- To skip WIMS treatment of resonance interference of ^{238}U on ^{239}Pu, ^{240}Pu and ^{242}Pu in routine RESALT

Calculations are done for equivalent cylindrical lattices with:

i) the original library (NEA0329/10),
ii) ENDF/B-VI based new 13-resonance-groups library (thermal cutoff at 4 eV),
iii) JENDL-3.2 based new 13-resonance-groups library (thermal cutoff at 4 eV),
iv) JENDL-3.2 based new 16-resonance-groups library (thermal cutoff at 2.1 eV),
v) JENDL-3.2 based new 16-resonance-groups library (thermal cutoff at 2.1 eV) with elastic resonance integrals for ^{238}U, ^{240}Pu and ^{242}Pu,
vi) JENDL-3.2 based new 16-resonance-groups library (thermal cutoff at 2.1 eV) with NJOY treatment of resonance interference of ^{238}U on ^{239}Pu, ^{240}Pu and ^{242}Pu.

The TRX and BAPL lattices were modeled with optimized inputs which were suggested in the final report of the WIMS Library Update Project Stage-I by Ravnik et. al. [20]. The inputs were the result of a detailed parametric study of the WIMS input options and were optimized for accuracy.

4.2 Calculation with SRAC95

Calculations are done in real lattice geometries, using the PEACO routine (ultra-fine group calculation by the collision probability method) and with JENDL-3.2 based library.

5. Results and discussions

5.1 Data verification

WIMS results for the TRX and BAPL lattices with the original WIMS library (NEA0329/10) and the new ENDF/B-VI and JENDL-3.2 based libraries are presented in Table 1. The C/E value for the five lattices from the three different libraries are plotted in Figs. 1- 5. All the calculated parameters for the five lattices using the two new libraries show similar tendency with negligible differences in some points. Almost all lie within the uncertainty limit of the measurements. These limits are slightly exceeded in ρ^{28} of TRX-1 and δ^{28} of BAPL-2, 3. The parameters lie outside twice-the-uncertainity interval are k_{eff} of TRX-2 , BAPL-1, BAPL-2,3 (JENDL only) and ρ^{28} of BAPL-2.

Comparing the results from the original WIMS library and the new library with the measurements we observe that the parameters are predicted equally well. The major improvement in the new library is in predicting ρ^{28} and C^* which may have favorable consequences for burnup calculations due to the increased conversion ratio, particularly for low enriched systems. The predicted k_{eff} is apparently worse with the new library, whereas, the difference from the measurements and the spread of the results with the original WIMS library are considerably larger. No adjustments are made to the multigroup data set of the new library.

- To skip WIMS treatment of resonance interference of ^{238}U on ^{239}Pu, ^{240}Pu and ^{242}Pu in routine RESALT

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v) JENDL-3.2 based new 16-resonance-groups library (thermal cutoff at 2.1 eV) with elastic resonance integrals for ^{238}U, ^{240}Pu and ^{242}Pu,
vi) JENDL-3.2 based new 16-resonance-groups library (thermal cutoff at 2.1 eV) with NJOY treatment of resonance interference of ^{238}U on ^{239}Pu, ^{240}Pu and ^{242}Pu.

The TRX and BAPL lattices were modeled with optimized inputs which were suggested in the final report of the WIMS Library Update Project Stage-I by Ravnik et. al. [20]. The inputs were the result of a detailed parametric study of the WIMS input options and were optimized for accuracy.

4.2 Calculation with SRAC95

Calculations are done in real lattice geometries, using the PEACO routine (ultra-fine group calculation by the collision probability method) and with JENDL-3.2 based library.

5. Results and discussions

5.1 Data verification

WIMS results for the TRX and BAPL lattices with the original WIMS library (NEA0329/10) and the new ENDF/B-VI and JENDL-3.2 based libraries are presented in Table 1. The C/E value for the five lattices from the three different libraries are plotted in Figs. 1- 5. All the calculated parameters for the five lattices using the two new libraries show similar tendency with negligible differences in some points. Almost all lie within the uncertainty limit of the measurements. These limits are slightly exceeded in ρ^{28} of TRX-1 and δ^{28} of BAPL-2, 3. The parameters lie outside twice-the-uncertainity interval are k_{eff} of TRX-2 , BAPL-1, BAPL-2,3 (JENDL only) and ρ^{28} of BAPL-2.

Comparing the results from the original WIMS library and the new library with the measurements we observe that the parameters are predicted equally well. The major improvement in the new library is in predicting ρ^{28} and C^* which may have favorable consequences for burnup calculations due to the increased conversion ratio, particularly for low enriched systems. The predicted k_{eff} is apparently worse with the new library, whereas, the difference from the measurements and the spread of the results with the original WIMS library are considerably larger. No adjustments are made to the multigroup data set of the new library.

5.2 Code verification

Integral parameters for TRX and BAPL lattices calculated by SRAC95 and WIMS-D/4.1 (both with JENDL-3.2 based library) are given in Table 2 and their C/E values are plotted in Figs. 6-10. They agree well to each other excepting an overestimation in ρ^{28} of TRX-1 and TRX-2 by WIMS-D/4.1 and for BAPL-2 by SRAC95.

For TCA UO_2 lattices, k_{inf} and k_{eff} are calculated by MVP[21], SRAC95 and WIMS-D/4.1 (thrice: with original NEA 0329/10, and ENDF-B/VI and JENDL based libraries) and they are presented in Table 3. For TCA PuO_2-UO_2 (MOX) lattices, k_{inf} and k_{eff} as calculated by MVP, SRAC95 and WIMS-D/4.1 are given in Table 4. The k_{inf} and k_{eff} values are plotted as function of cell pitch in Figs. 11 and 12 for TCA UO_2 lattices and in Figs. 13 and 14 for TCA PuO_2-UO_2 lattices. They all agree reasonably to each other.

For the benchmark of NEA high conversion LWR and Plutonium Recycling, only k_{inf} is calculated and presented in Table 5. They all are underestimated by WIMS-D/4.1 (using usual 13- resonance-groups new library) compared to those from SRAC95 with a maximum of 4% for the poor-Pu-vector lattice with high content of ^{242}Pu . These underestimation, as we thought, is due to the unshielded absorption resonance of ^{242}Pu at 2.67 eV. We reprocessed all the materials in the new library with 16 resonance groups, taking the thermal cutoff at 2.1 eV (group number 30 of WIMS group-structure) instead of the usual one at 4.eV (group number 27). As we can see in the Table 5 and in Fig. 15, WIMS-D/4.1 results are improved to some extent with this 16-resonance-groups library. We then recalculated the parameters for TRX, BAPL, TCA UO_2 and TCA PuO_2-UO_2 lattices with WIMS-D/4.1 using the 16-resonance-groups library which are given along with percent differences from 13-resonance-groups calculations, in Tables 6, 7 and 8 respectively. The differences are positive for k_{inf}, k_{eff} and negative for other parameters. They are negligible and caused mainly due to the lesser thermal upscattering in 16-resonance-group library.

The parameters of all the seventeen lattices are further calculated with WIMS-D/4.1 (with 16-resonance-groups library), taking into account of the self-shielding due to elastic resonances of ^{238}U, ^{240}Pu and ^{242}Pu and the effects are presented as the percent differences relative to no elastic shielding, in Tables 9 and 10. These are negligible except for δ^{25} (TRX, BAPL), and for k_{inf} of two NEA HCLWR lattices in which resonance absorption become dominant due to intermediate neutron spectrum.

Moreover, we calculated the parameters for MOX lattices of TCA and NEA to see the effects of resonance interference (of ^{238}U on ^{239}Pu, ^{240}Pu and ^{242}Pu) treatment in NJOY, relative to WIMS-D/4.1 interference treatment. The results as shown in Table 11. The effects are always positive for ^{239}Pu and negative for ^{240}Pu and ^{242}Pu, with a very strong net positive contribution for NEA lattices with higher plutonium concentration. More detail study should be done for this mutual interference effect.

Finally, the parameters for the MOX lattices of NEA from WIMS-D.4.1 (including all the effects as stated above, excepting NJOY interference treatment) and SRAC95 along with some other results from previous calculations are furnished in Tables 12 and 13.

6. Conclusion

The JENDL-3.2 based 69-group WIMS-D library was prepared using NJOY91.108 data processing system. A number of thermal reactor benchmark lattices have been analyzed. The results show no significant differences with those from a similarly processed ENDF/B-VI based library. Almost all the parameters lie within or not too far from the uncertainty interval of the measurements which would further be improved by energy mesh refinement in the fast energy range. Compared to the results obtained using an original WIMS library (NEA 0329/10) it can be concluded that a significant improvement in predicting global lattice parameters has been achieved, even though the new multigroup constants library is generated from first principles.

Benchmark results for the TRX, BAPL and TCA lattices as calculated by WIMS-D/4.1 and SRAC95 (both with JENDL-3.2 based data) agree reasonably well. But for lattices with higher plutonium concentrations (NEA high conversion LWR and Plutonium Recycling lattices), WIMS-D/4.1 systematically underestimates the k_{inf} compared to SRAC95 and some other previous calculations. This underestimation, as we thought, is due to the unshielded absorption resonance of ^{242}Pu at 2.67 eV, which is found to be true, improving the results to a considerable extent by introducing a 16-resonance-groups (Thermal cutoff at 2.1 eV) WIMS library. Whereas, this 16-resonance-groups library do have no noticeable negative effect (due to lesser thermal upscattering) for the TRX, BAPL and TCA lattices. So, we recommend a 16-resonance-groups WIMS-D/4 library compared to the usual 13-resonance-groups (thermal cutoff at 4 eV) ones. A further improvement of the WIMS calculated parameters for different lattices is achieved by taking into account of the self-shielding due to elastic resonances in ^{238}U, ^{240}Pu and ^{242}Pu. Futhermore, it was shown that more detail study should be done for the mutual interference effect in higher Pu-content cores.

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Benchmark results for the TRX, BAPL and TCA lattices as calculated by WIMS-D/4.1 and SRAC95 (both with JENDL-3.2 based data) agree reasonably well. But for lattices with higher plutonium concentrations (NEA high conversion LWR and Plutonium Recycling lattices), WIMS-D/4.1 systematically underestimates the k_{inf} compared to SRAC95 and some other previous calculations. This underestimation, as we thought, is due to the unshielded absorption resonance of ^{242}Pu at 2.67 eV, which is found to be true, improving the results to a considerable extent by introducing a 16-resonance-groups (Thermal cutoff at 2.1 eV) WIMS library. Whereas, this 16-resonance-groups library do have no noticeable negative effect (due to lesser thermal upscattering) for the TRX, BAPL and TCA lattices. So, we recommend a 16-resonance-groups WIMS-D/4 library compared to the usual 13-resonance-groups (thermal cutoff at 4 eV) ones. A further improvement of the WIMS calculated parameters for different lattices is achieved by taking into account of the self-shielding due to elastic resonances in ^{238}U, ^{240}Pu and ^{242}Pu. Futhermore, it was shown that more detail study should be done for the mutual interference effect in higher Pu-content cores.

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Table 1
Integral parameters for TRX and BAPL latices calculated by WIMS-D/4.1

Lattices	Results from	k_{inf}	k_{eff}	ρ^{28}	δ^{25}	δ^{28}	C^*
TRX-1	EXPT.	-----	1.00000 (0.3)	1.320 (1.6)	0.0987 (1.0)	0.0946 (4.3)	0.797 (1.0)
	NEA 0329 /10	1.1825 (C/E)	1.0021 (.2)	1.2784 (-3.2) 0.9685	0.0990 (.3) 1.0034	0.0965 (2) 1.0201	0.7797 (-2.2) 0.9783
	ENDF-VI	1.1767 (C/E)	0.9928 (-.72)	1.362 (3.2) 1.0318	0.0982 (-.51) 0.9949	0.0970 (2.5) 1.0254	0.8022 (.65) 1.0065
	JENDL-3.2	1.1771 (C/E)	0.9948 (-.52)	1.3612 (3.1) 1.0312	0.0982 (-.51) 0.9949	0.0959 (1.4) 1.0137	0.8016 (.58) 1.0058
TRX-2	EXPT.	-----	1.00000 (.10)	0.837 (1.9)	0.0614 (1.3)	0.0693 (5.1)	0.647 (0.93)
	NEA 0329 /10	1.1633 (C/E)	0.9961 (-.39)	0.8071 (-3.6) 0.9643	0.0611 (-.49) 0.9951	0.0695 (.3) 1.0029	0.6357 (-1.7) 0.98253
	ENDF-VI	1.1624 (C/E)	0.9940 (-.6)	0.8532 (1.9) 1.0194	0.0604 (-1.6) 0.9837	0.0688 (-.7) 0.9928	0.6466 (-.06) 0.9994
	JENDL-3.2	1.1635 (C/E)	0.9958 (-.4)	0.8530 (1.9) 1.0191	0.0604 (-1.6) 0.9837	0.0684 (-1.3) 0.9870	0.6465 (-.08) 0.9992
BAPL-1	EXPT.	-----	1.00000 (.10)	1.39 (.72)	0.0840 (2.4)	0.0780 (5.1)	0.00000
	NEA 0329 /10	1.1414 (C/E)	1.0027 (.27)	1.3584 (-2.3) 0.9773	0.0843 (.36) 1.0036	0.0755 (-3.2) 0.9680	0.8002
	ENDF-VI	1.1444 (C/E)	1.0024 (.24)	1.3824 (-.55) 0.9945	0.0827 (-1.5) 0.9845	0.0744 (-4.6) 0.9538	0.8029
	JENDL-3.2	1.1461 (C/E)	1.0047 (.5)	1.3833 (-.48) 0.9952	0.0826 (-1.7) 0.9833	0.0741 (-5) 0.9500	0.8032
BAPL-2	EXPT.	-----	1.00000 (.10)	1.120(.89)	0.0680(1.5)	0.0700(5.7)	0.00000
	NEA 0329 /10	1.1441 (C/E)	1.0003 (.03)	1.1335 (1) 1.0121	0.0689 (1.3) 1.0132	0.0652 (-6.9) 0.9314	0.7318
	ENDF-VI	1.1478 (C/E)	1.0014 (.1)	1.1513 (2.8) 1.0280	0.0675 (-.7) 0.9926	0.0640 (-8.6) 0.9143	0.7328
	JENDL-3.2	1.1498 (C/E)	1.0036 (.4)	1.1519 (2.8) 1.0285	0.0675 (-.7) 0.9926	0.0639 (-8.7) 0.9129	0.7329
BAPL-3	EXPT.	-----	1.00000(.10)	0.906(1.1)	0.0520(1.9)	0.0570(5.3)	0.00000
	NEA 0329 /10	1.1289 (C/E)	0.9980 (-.2)	0.8935 (-1.4) 0.9862	0.0530 (1.9) 1.0192	0.0538(-5.6) 0.9439	0.6568
	ENDF-VI	1.1333 (C/E)	1.0008 (.08)	0.9057 (-.03) 0.9997	0.0519 (-.2) 0.9981	0.0525 (-7.9) 0.9211	0.6552
	JENDL-3.2	1.1354 (C/E)	1.0030 (.3)	0.9061 (.01) 1.0001	0.0519 (-.2) 0.9981	0.0525(-7.9) 0.9211	0.6563

Note : Measurements and their % uncertainity (in parenthesis) are given in row-1. Other values in parenthesis are the % differences from measurements.

Table 2
Integral parameters for TRX and BAPL latices calculated by SRAC95 and WIMS-D/4.1

Lattices	Results from	k_{inf}	k_{eff}	ρ^{28}	δ^{25}	δ^{28}	C^*
TRX-1	EXPT.	-----	1.00000(0.3)	1.320(1.6)	0.0987(1.0)	0.0946(4.3)	0.797(1.0)
	SRAC95 (JENDL-3.2)	1.1808 (C/E)	0.999 (-.1)	1.3362 (1.2) 1.0123	0.0975 (-1.2) 0.9878	0.0958 (1.3) 1.0127	0.7951(-.23) 0.9976
	WIMS-D/4.1 (JENDL-3.2)	1.1771 (C/E)	0.9948 (-.52)	1.3612 (3.1) 1.0312	0.0982 (-.51) 0.9949	0.0959 (1.4) 1.0137	0.8016 (.58) 1.0058
TRX-2	EXPT.	-----	1.00000(.10)	0.837(1.9)	0.0614(1.3)	0.0693(5.1)	0.647(0.93)
	SRAC95 (JENDL-3.2)	1.1681 (C/E)	1.0010 (.1)	0.8340 (-.36) 0.9964	0.0598(-2.6) 0.9739	0.0686(-1) 0.9899	0.6411(-.9) 0.9909
	WIMS-D /4.1 (JENDL-3.2)	1.1635 (C/E)	0.9958 (-.4)	0.8530 (1.9) 1.0191	0.0604 (-1.6) 0.9837	0.0684 (-1.3) 0.9870	0.6465 (-.08) 0.9992
BAPL-1	EXPT.	-----	1.00000(.10)	1.39(.72)	0.0840(2.4)	0.0780(5.1)	0.0000
	SRAC95 (JENDL-3.2)	1.1425 (C/E)	1.0019 (.2)	1.3973 (.5) 1.0053	0.0825 (-1.8) 0.9821	0.0741 (-5) 0.9500	0.08979
	WIMS-D/4.1 (JENDL-3.2)	1.1461 (C/E)	1.0047 (.5)	1.3833 (-.48) 0.9952	0.0826 (-1.7) 0.9833	0.0741 (-5) 0.9500	0.8032
BAPL-2	EXPT.	-----	1.00000 (.10)	1.120 (0.89)	0.0680 (1.5)	0.0700 (5.7)	0.0000
	SRAC95 (JENDL-3.2)	1.1472 (C/E)	1.0022 (.22)	1.1604 (3.6) 1.0361	0.0673 (-1) 0.9897	0.0639 (-8.7) 0.9129	0.73754
	WIMS-D/4.1 (JENDL-3.2)	1.1498 (C/E)	1.0036 (.4)	1.1519 (2.8) 1.0285	0.0675 (-.7) 0.9926	0.0639 (-8.7) 0.9129	0.7329
BAPL-3	EXPT.	-----	1.00000(.10)	0.906(1.1)	0.0520(1.9)	0.0570(5.3)	0.0000
	SRAC95 (JENDL-3.2)	1.13411 (C/E)	1.0029 (.3)	0.9090 (.33) 1.0033	0.0517 (-.58) 0.9942	0.0526 (-7.7) 0.9228	0.6588
	WIMS-D/4.1 (JENDL-3.2)	1.1354 (C/E)	1.0030 (.3)	0.9061 (.01) 1.0001	0.0519 (-.2) 0.9981	0.0525(-7.9) 0.9211	0.6563

Note : Measurements and their % uncertainity (in parenthesis) are given in row-1. Other values in parenthesis are the % differences from measurements.

Table 3
Multiplication factors for TCA UO_2 lattices (MVP, SRAC95 and WIMS-D/4.1)

Lattice name	Code name	k_{inf}	k_{eff}
1.50U	MVP	--------	1.0026 (±0.00052)
	SRAC95	1.3595	1.0060
	WIMS (NEA0329/10)	1.3543	1.0055
	WIMS (ENDF/B-VI)	1.3582	1.0012
	WIMS (JENDL-3.2)	1.3604	1.0042

Table 3 (Continued)

1.83U	MVP	--------	1.0031 (±0.00057)
	SRAC95	1.3712	1.0075
	WIMS (NEA0329/10)	1.3650	1.0052
	WIMS (ENDF/B-VI)	1.3698	1.0027
	WIMS (JENDL-3.2)	1.3721	1.0055
2.48U	MVP	--------	1.0038 (±0.00055)
	SRAC95	1.3681	1.0046
	WIMS (NEA0329/10)	1.3612	0.9998
	WIMS (ENDF/B-VI)	1.3668	1.0001
	WIMS (JENDL-3.2)	1.3693	1.0026
3.00U	MVP	--------	1.0021 (±0.00052)
	SRAC95	1.3518	1.0061
	WIMS (NEA0329/10)	1.3454	1.0056
	WIMS (ENDF/B-VI)	1.3512	1.0025
	WIMS (JENDL-3.2)	1.3538	1.0048

Table 4
Multiplication factors for TCA PuO_2-UO_2 (MOX) lattices (MVP, SRAC95 and WIMS-D/4.1)

Lattices	Code name	k_{inf}	k_{eff}
2.42PU	MVP	---------	0.9961 (±0.0007)
	SRAC95	1.3443	0.9907
	WIMS-D/4.1	1.3365	0.9881
2.98PU	MVP	---------	0.9994 (±0.00059)
	SRAC95	1.3393	0.9944
	WIMS-D/4.1	1.3337	0.9928
4.24PU	MVP	---------	0.9995 (±0.00054)
	SRAC95	1.3001	0.9978
	WIMS-D/4.1	1.2971	0.9974
5.55PU	MVP	---------	1.0001(±0.00074)
	SRAC95	1.2421	0.9996
	WIMS-D/4.1	1.2410	1.0006

Table 5
Multiplication factors for NEA HCLWR and Plutonium Recycling lattices (SRAC95 and WIMS-D/4.1)

Lattices	Code name		k_{inf}
NEA-V6E8	SRAC95		1.0982
	WIMS-D /4.1	13 res grps	1.0833
		16 res grps	1.0997
NEA-V1E7	SRAC95		1.1277
	WIMS-D /4.1	13 res grps	1.1054
		16 res grps	1.1275
NEA-A (poor Pu- vctor)	SRAC95		1.1333
	WIMS-D /4.1	13 res grps	1.0915
		16 res grps	1.1290
NEA-B (better Pu-vector)	SRAC95		1.1911
	WIMS-D /4.1	13 res grps	1.1747
		16 res grps	1.1813

Table 6

Integral parameters for TRX and BAPL latices from WIMS-D/4.1 with 16 resonance groups

(The values in parenthesis are the % differences from 13 resonance group calculation)

Lattices	Results from	k_{inf}	k_{eff}	ρ^{28}	δ^{25}	δ^{28}	C^*
TRX-1	EXPT.	----	1.00000	1.320	0.0987	0.0946	0.797
	WIMS-D/4.1 (JENDL-3.2)	1.1775 (0.03)	0.9952 (0.04)	1.3580 (-0.235)	0.09752 (-0.69)	0.09579 (-0.115)	0.8008 (-0.175)
TRX-2	EXPT.	----	1.00000	0.837	0.0614	0.0693	0.647
	WIMS-D/4.1 (JENDL-3.2)	1.1637 (0.017)	0.9961 (0.03)	0.8514 (-0.19)	0.0600 (-0.66)	0.0684 (0.0)	0.646 (-0.077)
BAPL-1	EXPT.	----	1.00000	1.39	0.0840	0.0780	0.0000
	WIMS-D/4.1 (JENDL-3.2)	1.1465 (0.035)	1.0050 (0.03)	1.3809 (-0.17)	0.0822 (-0.48)	0.0741 (0.0)	0.8025 (-0.087)
BAPL-2	EXPT.	----	1.00000	1.120	0.0680	0.0700	0.0000
	WIMS-D/4.1 (JENDL-3.2)	1.1501 (0.026)	1.0040 (0.04)	1.1500 (-0.165)	0.0671 (-0.59)	0.0639 (0.0)	0.7324 (-0.068)
BAPL-3	EXPT.	----	1.00000	0.906	0.0520	0.0570	0.0000
	WIMS-D/4.1 (JENDL-3.2)	1.1357 (0.026)	1.0033 (0.03)	0.9046 (-0.166)	0.0516 (-0.578)	0.0525 (0.0)	0.6559 (-0.107)

Table 7

Multiplication factors for TCA UO_2 lattices from WIMS-D/4.1 with 16 resonance groups

(The values in parenthesis are the % differences from 13 resonance group calculation)

Lattice name	Code name	k_{inf}	k_{eff}
1.50U	WIMS-D/4.1	1.3608 (0.029)	1.0046 (0.04)
1.83U	WIMS-D/4.1	1.3725 (0.029)	1.0058 (0.03)
2.48U	WIMS-D/4.1	1.3696 (0.022)	1.0028 (0.02)
3.00U	WIMS-D/4.1	1.3540 (0.015)	1.0050 (0.02)

Table 8

Multiplication factors for TCA PuO_2-UO_2 lattices from WIMS-D/4.1 with 16 resonance groups

(The values in parenthesis are the % differences from 13 resonance group calculation)

Lattice name	Code name	k_{inf}	k_{eff}
2.42PU	WIMS-D/4.1	1.3382 (0.05)	0.9886 (0.05)
2.98PU	WIMS-D/4.1	1.3351 (0.04	0.9932 (0.04)
4.24PU	WIMS-D/4.1	1.2980 (0.02)	0.9976 (0.02)
5.55PU	WIMS-D/4.1	1.2417 (0.02)	1.0007 (0.01)

Table 9

Influence of self-shielding due to U-238 elastic resonances on TRX and BAPL lattices

(The values in the table are % differences relative to no elastic resonance shielding)

Lattice name	Results from	k_{inf}	k_{eff}	ρ^{28}	δ^{25}	δ^{28}	C^*
TRX-1	WIMS-D/4.1 (JENDL-3.2 : 16 res. grps.)	0.035	0.039	0.007	1.241	-0.03	-0.112
TRX-2	"	0.021	0.059	-0.012	1.133	0.015	-0.062
BAPL-1	"	0.026	0.029	-0.029	0.925	0.027	-0.087
BAPL-2	"	0.02	0.022	-.0.009	0.88	0.016	-0.055
BAPL-3	"	0.015	0.017	0.0	0.853	0.019	-0.045

Table 10

Influence of self-shielding due to elastic resonances on TCA and NEACRP lattices

(The values in the table are % differences relative to no elastic resonance shielding)

Lattice name	Total Pu content : number densities ($10^{24}/cm^3$)	Results from	U-238		Pu-240		Pu-242	
			k_{inf}	k_{eff}	k_{inf}	k_{eff}	k_{inf}	k_{eff}
TCA 1.50U	0.0	WIMS-D/4.1 (JENDL-3.2 : 16 res. grps.)	0.024	0.033	------	------	-------	------
TCA 1.83U	0.0	"	0.019	0.027	------	------	-------	------
TCA 2.48U	0.0	"	0.014	0.02	-------	-------	--------	-------
TCA 3.00U	0.0	"	0.012	0.017	-------	-------	--------	-------
TCA 2.42Pu	4.0364x0^{-4}	"	-0.004	-0.0003	0.007	0.010	-0.003	-0.003
TCA 2.98Pu	"	"	-0.003	-0.0004	0.007	0.006	-0.003	-0.002
TCA 4.24Pu	"	"	-0.001	0.0003	0.005	0.005	-0.002	-0.001
TCA 5.55Pu	"	"	-0.001	0.0002	0.004	0.004	-0.001	-0.001
NEA V6E8	$2.7375x10^{-3}$	"	0.4	--------	-0.01	--------	0.123	-------
NEA V1E7	$2.3941x10^{-3}$	"	0.2	--------	0.02	--------	0.03	-------
NEA-A	$2.2927x10^{-2}$	"	0.08	-------	0.02	-------	0.09	-------
NEA-B	$2.155x10^{-2}$	"	0.04	-------	0.06	-------	0.03	-------

Table 11
Influence of NJOY treatment of resonance interference on TCA and NEACRP lattices
(The values in the table are % differences relative to WIMS interference treatment)

Lattices Name	Total Pu content : number densities ($10^{24}/cm^3$)	Results from	Pu-239		Pu-240		Pu-242	
			k_{inf}	k_{eff}	k_{inf}	k_{ff}	k_{inf}	k_{eff}
TCA 2.42Pu	$4.0364x0^{-4}$	WIMS-D/4.1 (JENDL-3.2 : 16 res. grps.)	0.012	0.024	-0.012	-0.011	-0.005	-0.004
TCA 2.98Pu	$4.0364x0^{-4}$	"	0.012	0.021	-0.009	-0.008	-0.004	-0.003
TCA 4.24Pu	$4.0364x0^{-4}$	"	0.013	0.02	-0.006	-0.006	-0.003	-0.002
TCA 5.55Pu	$4.0364x0^{-4}$	"	0.016	0.02	-0.004	-0.004	-0.002	-0.002
NEA V6E8	$2.7375x10^{-3}$	"	1.55	--------	-0.48	--------	-0.186	-------
NEA V1E7	$2.3941x10^{-3}$	"	0.9	--------	-0.31	--------	-0.187	-------
NEA-A	$2.2927x10^{-2}$	"	0.533	-------	-0.24		-0.252	------
NEA-B	$2.155x10^{-2}$	"	0.208	-------	-0.054		-0.057	------

Table 12
Infinite multiplication factor for NEA HCLWR Lattices
(WIMS-D/4.1, SRAC95 and Others [16])

Lattice	WIMS-D /4.1	SRAC95	WIMS-E	HELIOS.HX	WIMS-ATR	BOXER	DANDE	CASMO
V6E8	1.105	1.098	1.096	1.105	1.107	1.093	1.091	1.103
V1E7	1.130	1.128	1.119	1.122	1.130	1.116	1.120	1.120

Table 13
Infinite multiplication factor for NEA Plutonium Recycling Lattices
(WIMS-D/4.1, SRAC95 and Others [17])

Lattice	WIMS-D /4.1	SRAC95	ANL	BNFL	CEA	ECN	EDF	HIT
Benchmark-A	1.1310	1.1333	1.1324	1.1043	1.1334	1.1313	1.1217	1.1396
Benchmark-B	1.1822	1.1911	1.1785	1.1805	1.1896	1.1838	1.1744	1.1926

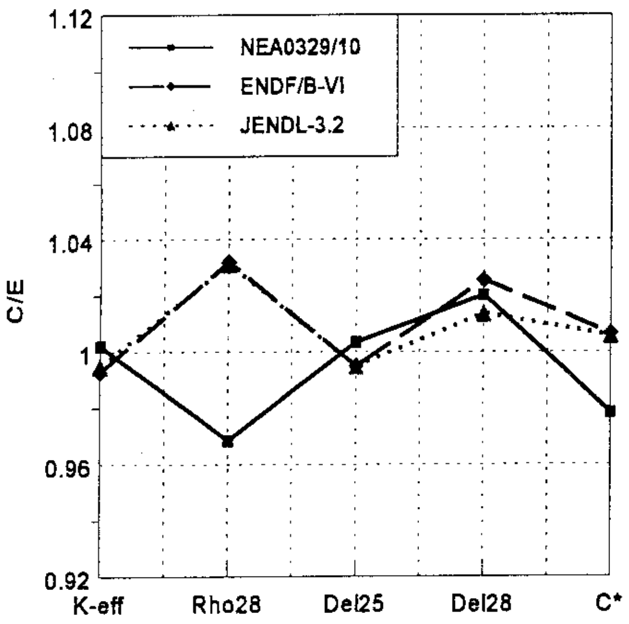


Fig. 1: C / E value of lattice parameters of TRX-1 from WIMS-D/4.1 with three different data libraries

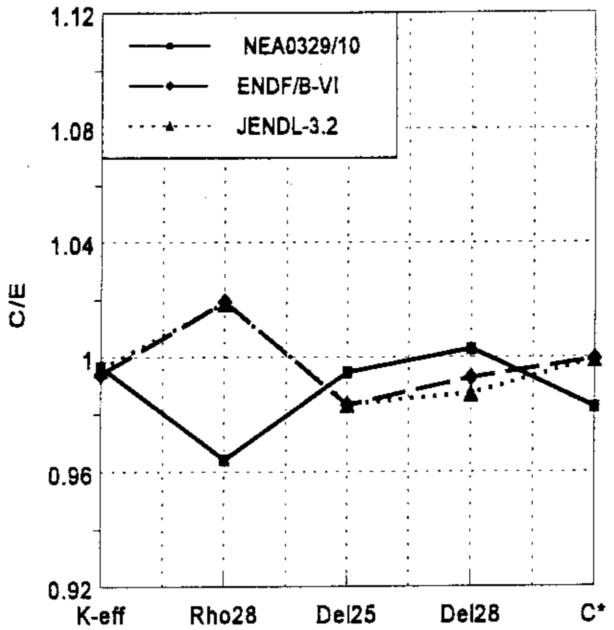


Fig. 2: C / E value of lattice parameters of TRX-2 from WIMS-D/4.1 with three different data libraries

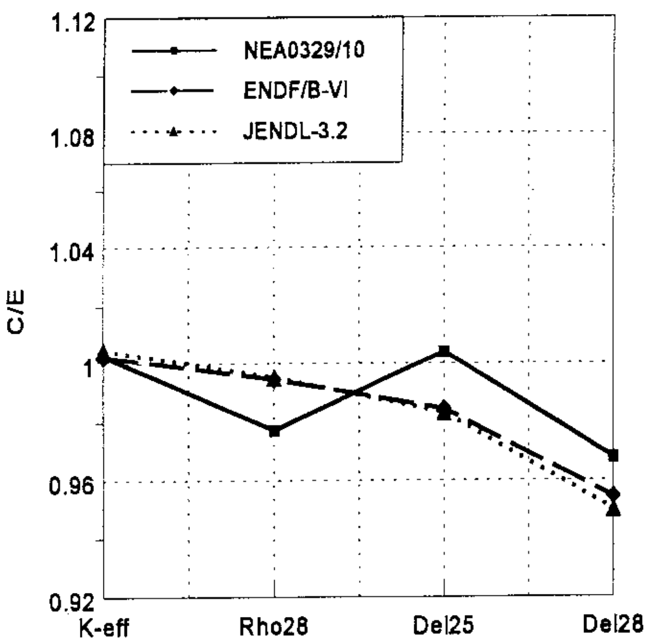


Fig. 3: C / E value of lattice parameters of BAPL-1 from WIMS-D/4.1 with three different data libraries

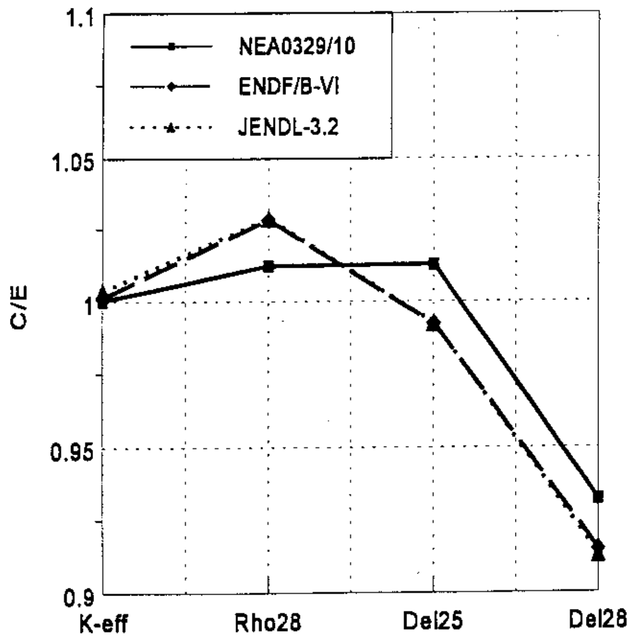


Fig. 4: C / E value of lattice parameters of BAPL-2 from WIMS-D/4.1 with three different data libraries

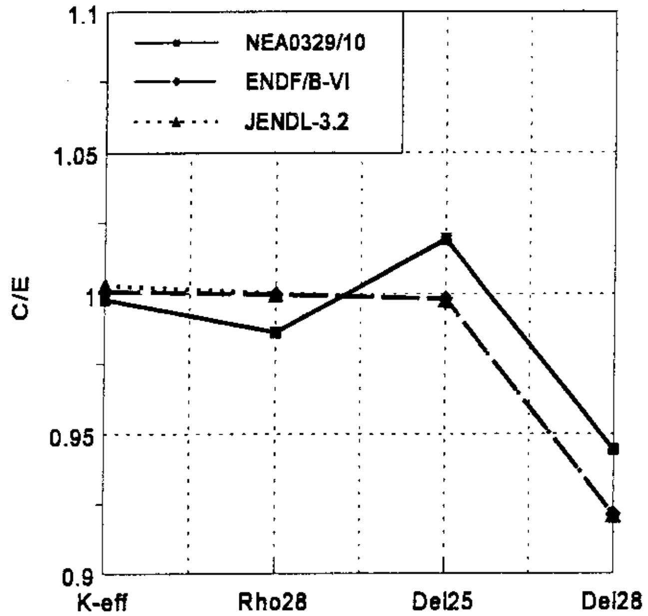


Fig. 5: C / E value of lattice parameters of BAPL-3 from WIMS-D/4.1 with three different data libraries

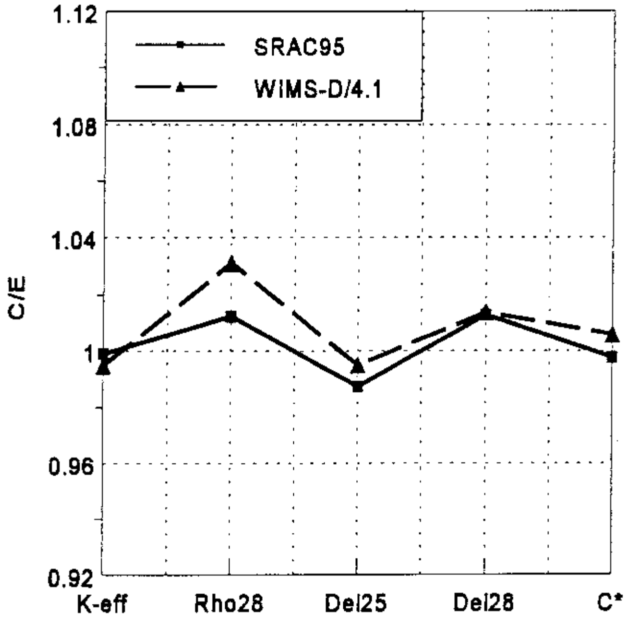


Fig. 6: C / E value of lattice parameters of TRX-1 from SRAC95 and WIMS-D/4.1

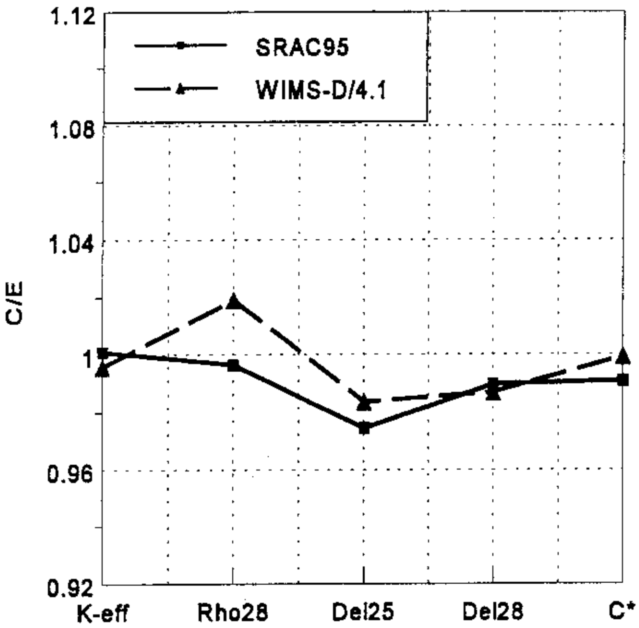


Fig. 7: C / E value of lattice parameters of TRX-2 from SRAC95 and WIMS-D/4.1

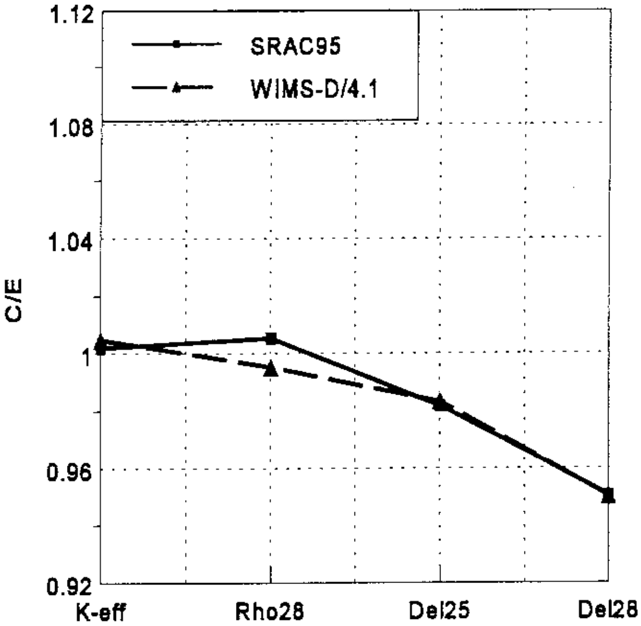


Fig. 8: C / E value of lattice parameters of BAPL-1 from SRAC95 and WIMS-D/4.1

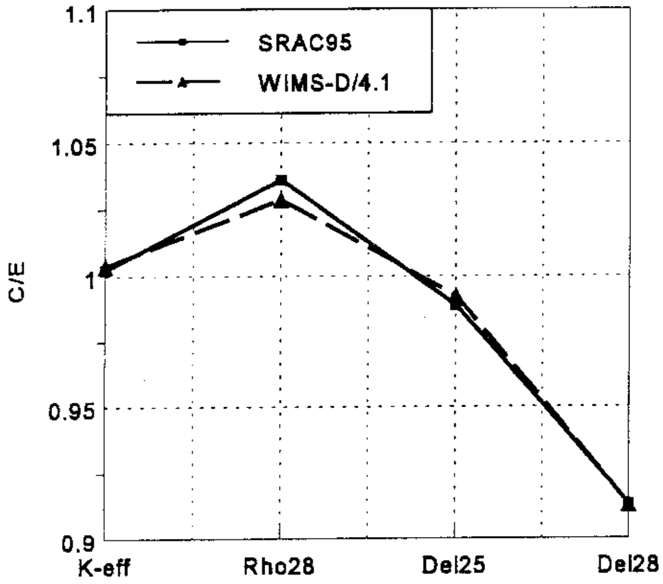


Fig. 9: C / E value of lattice parameters of BAPL-2 from SRAC95 and WIMS-D/4.1

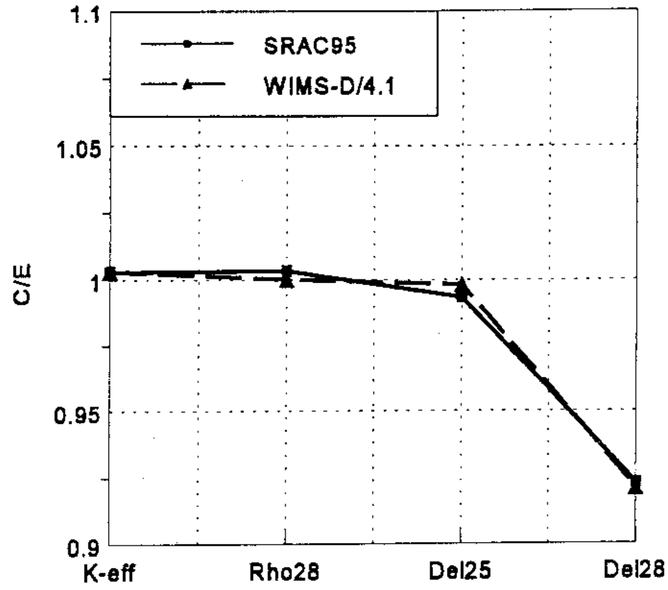
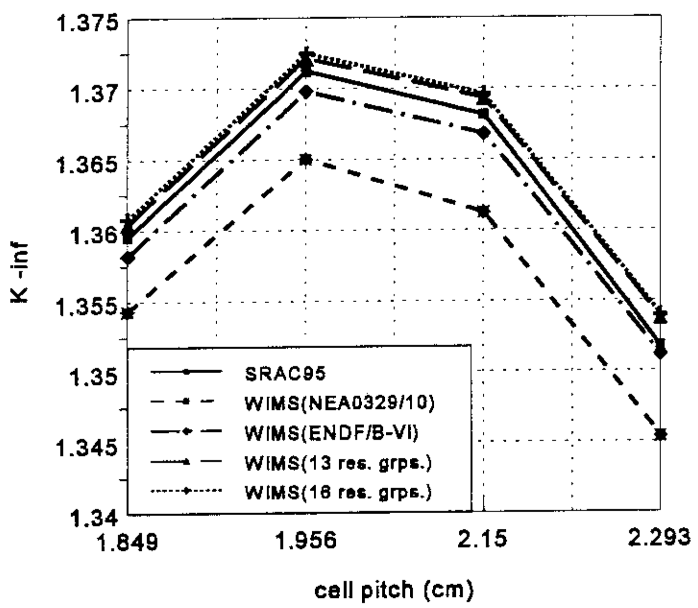


Fig. 10: C / E value of lattice parameters of BAPL-3 from SRAC95 and WIMS-D/4.1



Fif. 11: k_{inf} as function of cell pitch of TCA UO_2 lattice from SRAC95 and WIMS-D/4.1(with four data libraries)

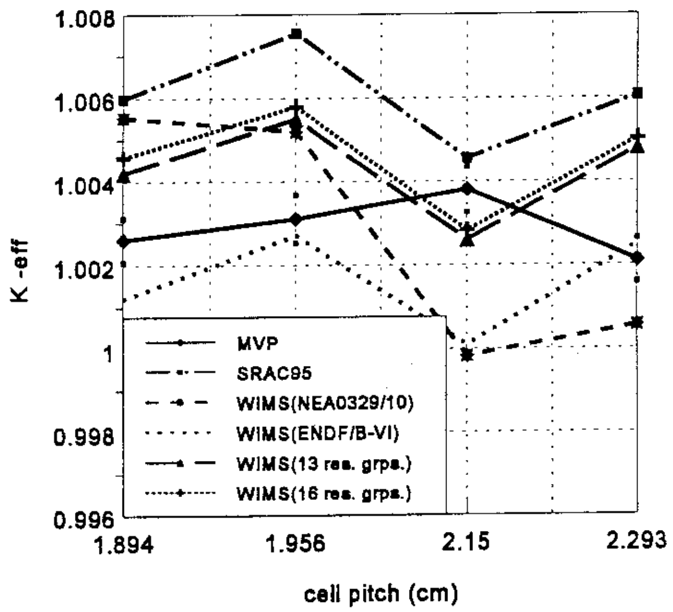


Fig. 12: k_{eff} as function of cell pitch of TCA UO_2 lattice from SRAC95 and WIMS-D/4.1(with four data libraries)

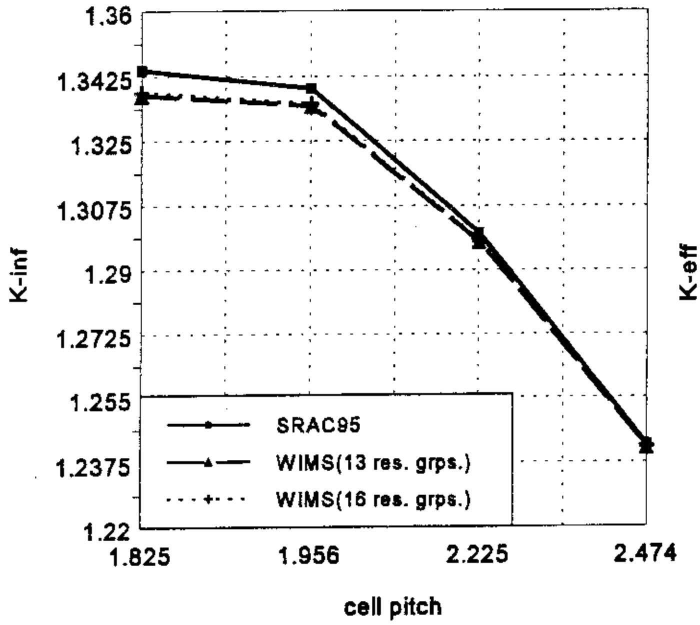


Fig. 13: k_{inf} as function of cell pitch of TCA PuO_2-UO_2 (MOX) lattice from SRAC95 and WIMS-D/4.1

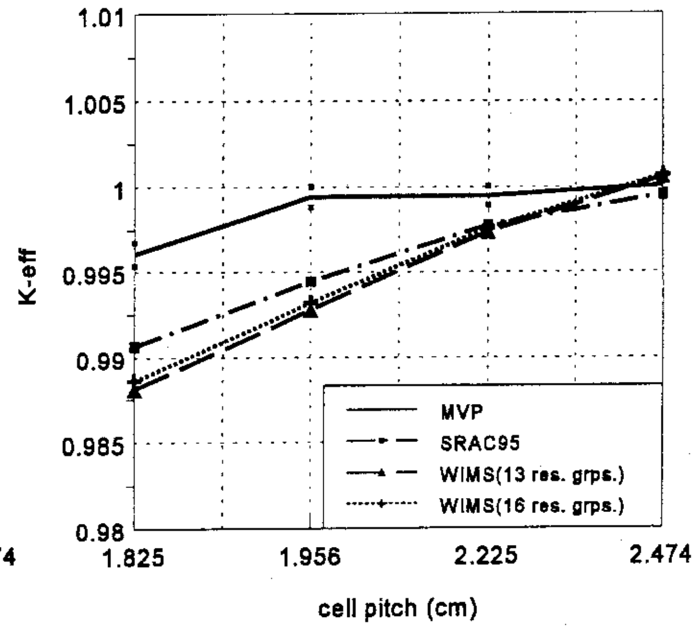


Fig. 14: k_{eff} as function of cell pitch of TCA PuO_2-UO_2 (MOX) lattice from SRAC95 and WIMS-D/4.1

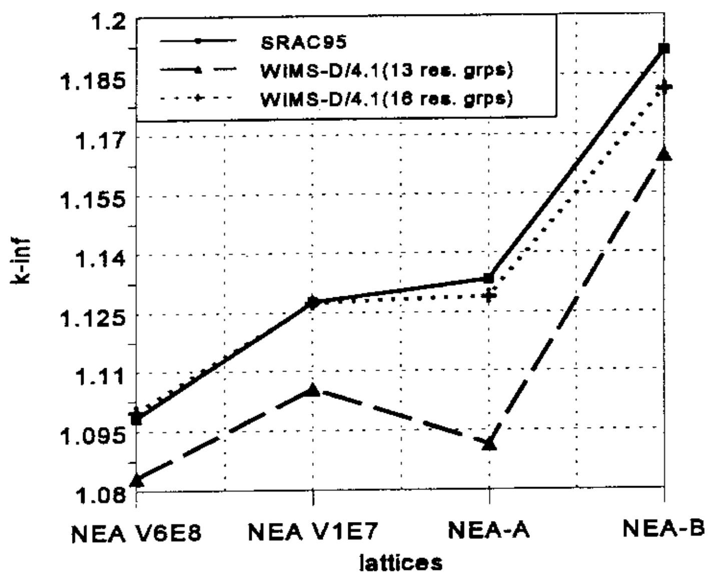


Fig. 15: k_{inf} of four NEA lattices from SRAC95 and WIMS-D/4.1

Appendix- A
List of nuclides in the library with details of data tabulation

Material	WIMS ID	Self-Shielding Model , Refference Sigma Zero	Resonance Tabulation, Sigma Zero Grid	Thermal Scattering Law, Temperatures
^{1}H	125	Narrow Resonance Approx. (NRA), Infinity	No resonance tabulation	H-1 in H_2O, (293, 400, 500, 600)
^{1}H in ZrH	126	"	"	H-1 in ZRH, (293, 400, 600, 1200)
^{2}D	128	"	"	D-2 in D_2O, (93, 400, 500, 600)
^{10}B	525	"	"	Free gas, (293, 500, 700, 1600)
^{11}B	528	"	"	Free gas, (293, 600)
^{12}C	625	"	"	Graphite, (293, 500, 700,1000,1600)
^{16}O	825	"	"	Free gas, (293, 600, 900, 1500)
^{27}Al	1325	"	"	Free gas, (293)
Cr (nat.)	2400	NJOY Flux Calculator upto 3E5eV & NRA above, Infinity	"	Free gas, (293, 600)
^{55}Mn	2525	NJOY Flux Calculator upto 1E5eV & NRA above, Infinity	"	Free gas, (293, 600)
Fe (nat.)	2600	NJOY Flux Calculator upto 3.5E5eV & NRA above, Infinity	"	Free gas, (293, 600)
Ni (nat.)	2800	NJOY Flux Calculator upto 5.53E5eV & NRA above, Infinity	"	Free gas, (300, 600)
Zr (nat.)	4000	NJOY Flux Calculator upto 3.016E4eV & NRA above, Infinity	"	Free gas, (293, 600)
Zr in ZrH	4001	NJOY Flux Calculator upto 3.016E4eV & NRA above, Infinity	"	Free gas, (293, 400, 600, 1200)
^{234}U	9225	NJOY Flux Calculator upto 1.5E3eV & NRA above, 1E6	Abs . Integral only, (5E1,1E2,1E3,1E4,1E5, 1E6,1.5E6, 2E6,8E6, 1E10)	Free gas, (293, 600, 1500)

Appendix- A (continued)

^{235}U	9228	NJOY Flux Calculator upto 5E2eV & NRA above, 8E2	Abs. & Fiss. Integral, (5E2,8E2,1.2E3,1.8E3, 2.8E3,4.5E3,8E3,1E4, 3E4,1E10)	Free gas, (293, 600, 900, 1500)
^{236}U	9231	NJOY Flux Calculator upto 1.53E3eV & NRA above, 1E6	Abs. Integral only, (5E1,1E2,1E3,1E4,1E5, 1E6,1.5E6, 2E6,8E6, 1E10)	Free gas, (293, 600, 1500)
^{238}U	9237	NJOY Flux Calculator upto 1E4eV & NRA above, 28	Abs. & Elst. Integral, (1.2E1,2.8E1,5.E1,1E2, 1.4E2,2.6E2,1E3,1E4, 1E5,1E10)	Free gas, (293, 600, 900, 1500)
^{238}Pu -	9434	NJOY Flux Calculator upto 5E2eV & NRA above, 1E5	No resonance tabulation	Free gas, (293, 600, 1500)
^{239}Pu	9437	NJOY Flux Calculator upto 2.5E3eV & NRA above, 1E3	Abs. & Fiss. Integral, (1E1,5E1,1E2,1E3,2E3,1E 4,1E5,1E6,1.5E6, 1E10)	Free gas, (293, 600, 900, 1500)
^{240}Pu	9440	NJOY Flux Calculator upto 4E3eV & NRA above, 1E4	Abs. & Elst. Integral, (5E1,1E2,1E3,1E4,1E5, 1E6,1.5E6, 2E6,8E6, 1E10)	Free gas (293, 600, 900, 1500)
^{241}Pu	9443	NJOY Flux Calculator upto 3E2eV & NRA above, 2E3	Abs. & Fiss. Integral, (1E1,5E1,1E2,1E3,2E3,1E 4,1E5,1E6,1.5E6, 1E10)	Free gas, (293, 600, 900, 1500)
^{242}Pu	9446	NJOY Flux Calculator upto 1.15E3eV & NRA above, 1E5	Abs. & Elst. Integral, (5E1,1E2,1E3,1E4,1E5, 1E6,1.5E6, 2E6,8E6, 1E10)	Free gas, (293, 600, 900, 1500)
^{241}Am	9543	NJOY Flux Calculator upto 1.5E2eV & NRA above, 1E6	Abs . Integral only, (5E1,1E2,1E3,1E4,1E5, 1E6,1.5E6, 2E6,8E6, 1E10)	Free gas, (293, 600, 1500)

APPENDIX -B: NJOY INPUT INSTRUCTIONS

B-1: HYDROGEN BOUND H_2O

```
0 /
6 /
*MODER*
20 -21
*MODER*
30 -31 / CONVERT SCATTERING LAW DATA TO BINARY UNIT-31
*RECONR*
-21 -22
*PENDF TAPE FOR H-1(H2O) FROM JENDL-3.2(F6) TAPE 301*/
125 2/
.002 .0 6 .002 1.E-10
*1-H-1(H2O) FROM JENDL-3.2(F6) TAPE T301*/
*PROCESSED BY THE NJOY91-V108 */
.0/
*BROADR*
-22 -23
125 4 0 0 0./
.002 1.E06 .002 1.E-10/
293. 400. 500. 600.
0/
*UNRESR*
-21 -23 -24
125 4 1 1
293. 400. 500. 600.
1.E10
-0/
THERMR* / ADD THERMAL SCATTERING DATA TO UNIT-26
-31 -24 -26
1 125 8 4 4 0 2 222 1
293. 400. 500. 600.
0.005 2.1
*GROUPR*
-21 -26 0 -25
125 9 0 5 1 4 1 1
*1-H-1(H2O) FROM JENDL-3.2(F6)*/
293. 400. 500. 600.
1.E10
3 / 293K
3 222 /
3 252 /
6 /
6 222 /
0 /
3 / 400K
3 222 /
3 252 /
6 /
6 222 /
0 /
3 / 500K
3 222 /
3 252 /
6 /
6 222 /
0 /
3 / 600K
3 222 /
3 252 /
6 /
6 222 /
0 /
0 /
*WIMSR*
-25 27
2 4
1 0 0 1
125
1
0 0 1.E10 0 0. 222 0 0 1 0 0 /
1.00 1.00 1.00 1.00 1.00 1.00 .990 .987 .987 .963 .966 1. .941
.941 .941 .941
*STOP*
```

B-2: HYDROGEN BOUND IN ZRH

```
0 /
6 /
*MODER*
20 -21
*MODER*
30 -31 / CONVERT SCATTERING LAW DATA TO BINARY UNIT-31
*RECONR*
-21 -22
*PENDF TAPE FOR H-1(ZRH) FROM JENDL-3.2(F6) TAPE 301*/
125 2/
.002 .0 6 .002 1.E-10
*1-H-1(ZRH) FROM JENDL-3.2(F6) TAPE T301*/
*PROCESSED BY THE NJOY91-V108 */
0/
*BROADR*
-22 -23
125 4 0 0 0./
.002 1.E06 .002 1.E-10/
293. 400. 600. 1200.
0/
*UNRESR*
-21 -23 -24
125 4 1 1
293. 400. 600. 1200.
1.E10
0/
*THERMR* / ADD THERMAL SCATTERING DATA TO UNIT-26
-31 -24 -26
7 125 8 4 4 12 1 225 1
293. 400. 600. 1200.
0.005 2.1
*GROUPR*
-21 -26 0 -25
125 9 0 5 1 4 1 1
*1-H-1(ZRH) FROM JENDL-3.2(F6)*/
```

```
293. 400. 600. 1200.
1.E10
3 /  293K
3 225 /
3 226 /
3 252 /
6 /
6 225 /
6 226 /
0 /
3 /  400K
3 225 /
3 226 /
3 252 /
6 /
6 225 /
6 226 /
0 /
3 /  600K
3 225 /
3 226 /
3 252 /
6 /
6 225 /
6 226 /
0 /
3 / 1200K
3 225 /
3 226 /
3 252 /
6 /
6 225 /
6 226 /
0 /
0 /
*WIMSR*
-25 27
2 4
1 0 0 1
125
1
0 0 1.E10 0 0. 225 226  1 1 0 0 / NO P1 SCATT.
1.00 1.00 1.00 1.00 1.00 1.00 .990 .987 .987 .963 .966  1.0 .941
.941 .941 .941
*STOP*
```

B-3 : DEUTERIUM BOUND IN D_2O

```
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6 /
*MODER*
20 -21
*MODER*
30 -31 / CONVERT SCATTERING LAW DATA TO BINARY UNIT-31
*RECONR*
-21 -22
*PENDF TAPE FOR2-D-1(D2O) FROM JENDL-3.2(F6) TAPE 301*/
128 2/
.002 .0 6 .002 1.E-10
*2-D-1(D2O) FROM JENDL-3.2(F6) TAPE T301*/
*PROCESSED BY THE NJOY91-V108 */
0/
*BROADR*
-22 -23
128 4 0 0 0./
.002 1.E06 .002 1.E-10/
293. 400. 500. 600.
0/
*UNRESR*
-21 -23 -24
128 4 1 1
293. 400. 500. 600.
1.E10
0/
*THERMR* / ADD THERMAL SCATTERING DATA TO UNIT-26
-31 -24 -26
11 128 8 4 4 0 2 228 1
293. 400. 500. 600.
0.005 2.1
*GROUPR*
-21 -26 0 -25
128 9 0 5 1 4 1 1
*2-D-1(D2O) FROM JENDL-3.2(F6)*/
293. 400. 500. 600.
1.E10
3 /  293K
3 228 /
3 252 /
6 /
6 228 /
0 /
3 /  400K
3 228 /
3 252 /
6 /
6 228 /
0 /
3 /  500K
3 228 /
3 252 /
6 /
6 228 /
0 /
3 /  600K
3 228 /
3 252 /
6 /
6 228 /
0 /
0 /
*WIMSR*
-25 27
2 4
1 0 0 1
128
```

```
1
0 0 1.E10 0 0. 228 0 0 1 0 0 /
1.00 1.00 1.00 1.00 1.00 1.00 .990 .987 .987 .963 .966 1. .941
.941 .941 .941
*STOP*
```

B-4 : BORON -10

```
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6 /
*MODER*
20 -21
*RECONR*
-21 -22
*PENDF TAPE FOR B-10 FROM JENDL-3.2(F6) TAPE 301*/
525 2/
.002 .0 6 .002 1.E-10
*5-B-10 FROM JENDL-3.2(F6) TAPE T301 */
*PROCESSED BY THE NJOY91-V108 */
0/
*BROADR*
-22 -23
525 4 0 0 0./
.002 1.E06 .002 1.E-10/
293. 500. 700. 1600.
0/
*UNRESR*
-21 -23 -24
525 4 2 1
293. 500. 700. 1600.
1.E10 1.E04
0/
*THERMR*
0 -24 -26
0 525 12 4 1 0 1 221 1
293. 500. 700. 1600.
0.005 2.1
*GROUPR*
-21 -26 0 -25
525 9 0 5 1 4 2 1
*5-B-10 FROM JENDL-3.2(F6)*/
293. 500. 700. 1600.
1.E10 1.E04
3 /     293K
3 221 /
3 252 /
6 /
6 221 /
0 /
3 /     500K
3 221 /
3 252 /
6 /
6 221 /
0 /
3 /     700K
3 221 /
3 252 /
6 /
6 221 /
0 /
3 /     1600K
3 221 /
3 252 /
6 /
6 221 /
0 /
0 /
*WIMSR*
-25 27
2 4
1 0 0 1
525
5
0 0 1.E09 0 0.0 221 0 1 1 0 0 /
0.97 0.97 0.97 0.97 0.97 0.97 0.97 0.97 0.97 0.97 0.97 0.97 0.97
0.97 0.97 0.97
*STOP*
```

B-5: BORON-11

```
0 /
6 /
*MODER*
20 -21
*RECONR*
-21 -22
*PENDF TAPE FOR B-11 FROM JENDL-3.2(F6) TAPE 301*/
528 2/
.002 .0 6 .002 1.E-10
*5-B-11 FROM JENDL-3.2(F6) TAPE T301 */
*PROCESSED BY THE NJOY91-V108 */
0/
*BROADR*
-22 -23
528 2 0 0 0./
.002 1.E06 .002 1.E-10/
293. 600.
0/
*UNRESR*
-21 -23 -24
528 2 2 1
293. 600.
1.E10 1.E04
0/
*THERMR*
0 -24 -26
0 528 12 2 1 0 1 221 1
293. 600.
0.005 2.1
*GROUPR*
-21 -26 0 -25
528 9 0 5 1 2 2 1
*5-B-11 FROM JENDL-3.2(F6)*/
```

```
293. 600.
1.E10 1.E04
3 /      293K
3 221 /
3 252 /
6 /
6 221 /
0 /
3 /      600K
3 221 /
3 252 /
6 /
6 221 /
0 /
0 /
*WIMSR*
-25 27
 2 4
 1 0 0 1
 528
 5
 0 0 1.E09  0  0.0   221 0 1  1 0 0 /
 0.97 0.97 0.97 0.97 0.97 0.97 0.97 0.97 0.97 0.97 0.97 0.97 0.97
 0.97 0.97 0.97
*STOP*
```

B-6: CARBON-12 (GRAFHITE SCATTERING LAW)

```
0 /
6 /
*MODER*
20 -21
*MODER*
30 -31 / CONVERT SCATTERING LAW DATA TO BINARY UNIT-31
*RECONR*
-21 -22
*PENDF TAPE FOR C-12 FROM JENDL-3.2(F6) TAPE 301*/
625 2/
.002 .0  6  .002  1.E-10
*6-C-12 FROM JENDL-3.2(F6) TAPE T301 */
*PROCESSED BY THE NJOY91-V108 */
0/
*BROADR*
-22 -23
625 5 0 0 0./
.002 1.E06 .002 1.E-10/
293. 500. 700. 1000. 1600.
0/
*UNRESR*
-21 -23 -24
625 5  2  1
293. 500. 700. 1000. 1600.
1.E10 1.E04
0/
*THERMR*
-31 -24 -26
31  625  12 5 4 1  1 229 1
293. 500. 700. 1000. 1600.
0.005  2.1
*GROUPR*
-21 -26 0 -25
625 9 0 5 1 5 2 1
*6-C-12 FROM JENDL-3.2(F6)*/
293. 500. 700. 1000. 1600.
1.E10 1.E04
3 /      293K
3 229 /
3 230 /
3 252 /
6 /
6 229 /
6 230 /
0 /
3 /      500K
3 229 /
3 230 /
3 252 /
6 /
6 229 /
6 230 /
0 /
3 /      700K
3 229 /
3 230 /
3 252 /
6 /
6 229 /
6 230 /
0 /
3 /      1000K
3 229 /
3 230 /
3 252 /
6 /
6 229 /
6 230 /
0 /
3 /      1600K
3 229 /
3 230 /
3 252 /
6 /
6 229 /
6 230 /
0 /
0 /
*WIMSR*
-25 27
 2 4
 1 0 0 1
 625
 6
 0 0 1.E09  0  0.0   229 230 0 1 0 0 /
 0.94 0.94 0.94 0.94 0.94 0.94 0.94 0.94 0.94 0.94 0.94 0.94 0.94
 0.94 0.94 0.94
*STOP*
```

B-7: OXYGEN-16

```
0 /
6 /
*MODER*
20 -21
*RECONR*
-21 -22
*PENDF TAPE FOR O-16 FROM JENDL-3.2(F6) TAPE 301*/
825 2/
.002 .0 6 .002 1.E-10
*8-O-16 FROM JENDL-3.2(F6) TAPE T301 */
*PROCESSED BY THE NJOY91-V108 */
0/
*BROADR*
-22 -23
825 4 0 0 0./
.002 1.E06 .002 1.E-10/
293. 600. 900. 1500.
0/
*UNRESR*
-21 -23 -24
825 4 5 1
293. 600. 900. 1500.
1.E10 1.E04 1.E03 40. 28.
0/
*THERMR*
0 -24 -26
0 825 12 4 1 0 1 221 1
293. 600. 900. 1500.
0.005 2.1
*GROUPR*
-21 -26 0 -25
825 9 0 5 1 4 5 1
*8-O-16 FROM JENDL-3.2(F6)*/
293. 600. 900. 1500.
1.E10 1.E04 1.E03 40. 28.
3 /     293K
3 221 /
3 252 /
6 /
6 221 /
0 /
3 /     600K
3 221 /
3 252 /
6 /
6 221 /
0 /
3 /     900K
3 221 /
3 252 /
6 /
6 221 /
0 /
3 /     1500K
3 221 /
3 252 /
6 /
6 221 /
0 /
0 /
*WIMSR*
-25 27
2 4
1 0 0 1
825
8
0 0 1.E09 0 0.0 221 0 0 1 0 0 /
1.00 1.00 1.00 1.00 1.00 .992 .972 .911 .909 .712 .734 .984 .643
.643 .643 .643
*STOP*
```

B-8: ALUMINIUM-27

```
0 /
6 /
*MODER*
20 -21
*RECONR*
-21 -22
*PENDF TAPE FOR AL-27 FROM JENDL-3.2(F6) TAPE 301*/
1325 2/
.002 0. 6 .002 1.E-10
*13-AL-27 FROM JENDL-3.2(F6) TAPE T301*/
*PROCESSED BY THE NJOY91-V108 */
0/
*BROADR*
-22 -23
1325 1 0 0 0/
.002 1.E06 .002 1.E-10/
293./
0/
*UNRESR*
-21 -23 -24
1325 1 2 1
293.0/
1.E10 5.E02
0/
*THERMR*
0 -24 -26
0 1325 12 1 1 0 1 221 1
293.0
0.005 2.1
*GROUPR*
-21 -26 0 -25
1325 9 0 5 1 1 2 1
*13-AL-27 FROM JENDL-3.2(F6)*/
293.
1.E10 5.E02
3 / 293K
3 221 /
3 252 /
6 /
6 221 /
```

```
0/
0/
*WIMSR*
-25 27
2 4
1 0 0 1
1325
13
1 0 1.E10 0 0.0  221 0 1 1 0 0 /
.85 .85 .85 .85 .85 .85 .85 .85 .85 .85 .85 .85 .85
.85 .85 .85
*STOP*
```

B-9: CHROMIUM (NATURAL)

```
0 /
6 /
*MODER*
20 -21
*RECONR*
-21 -22
*PENDF TAPE FOR CR(NAT.) FROM JENDL-3.2(F6) TAPE 306*/
2400 2/
.002 0. 6 .002 1.E-10/
*CR(NAT.) FROM JENDL-3.2(F6) TAPE T306*/
*PROCESSED BY THE NJOY91-V108 */
0/
*BROADR*
-22 -23
2400 2 0 0 0./
.003 1.E06 .06 1.E-07/
293. 600.
0/
*UNRESR*
-21 -23 -24
2400 2 2 1
293. 600.
1.E10 1.E4
0/
*THERMR* /
0 -23 -26
0 2400 12 2 1 0 1 221 1
293. 600.
0.005 2.1
*GROUPR*
-21 -26 0 -25
2400 9 0 -5 1 2 2 1
*CR(NAT.)FROM JENDL-3.2(F6)*/
293. 600.
1.E10 1.E4
3.E05 3.38   30000 / CHECK SPECTRUM AVOVE UPPER END OF RR RANGE
3 / 293K
3 221 /
3 252 /
6 /
6 221 /
0 /
3 / 600K
3 221 /
3 252 /
6 /
6 221 /
0 /
0 /
*WIMSR*
-25 27
2 4
1 0 0 1
2400
24
0 0 1.E10 0 0.0  221 0 1 1 0 0 /
0.68 0.68 0.68 0.68 0.68 0.68 0.68 0.68 0.68 0.68 0.68 0.68 0.68
0.68 0.68 0.68 /
*STOP*
```

B-10: MANGANESE-55

```
0 /
6 /
*MODER*
20 -21
*RECONR*
-21 -22
*PENDF TAPE FOR MN-55 FROM JENDL-3.2(F6) TAPE 306*/
2525 2/
.002 0. 6 .002 1.E-10/
*MN-55 FROM JENDL-3.2(F6) TAPE T306*/
*PROCESSED BY THE NJOY91-V108 */
0/
*BROADR*
-22 -23
2525 2 0 0 0./
.003 1.E06 .06 1.E-07/
293. 600.
0/
*UNRESR*
-21 -23 -24
2525 2 2 1
293. 600.
1.E10 1.E4
0/
*THERMR* /
0 -23 -26
0 2525 12 2 1 0 1 221 1
293. 600.
0.005 2.1
*GROUPR*
-21 -26 0 -25
2525 9 0 -5 1 2 2 1
*MN-55 FROM JENDL-3.2(F6)*/
293. 600.
1.E10 1.E4
1.E05 2.167  30000 / CHECK SPECTRUM AVOVE UPPER END OF RR RANGE
3 / 293K
```

```
3 221 /
3 252 /
6 /
6 221 /
0 /
3 /  600K
3 221 /
3 252 /
6 /
6 221 /
0 /
0 /
*WIMSR*
-25 27
 2 4
 1 0 0 1
 2525
 25
 0 0 1.E10  0  0.0   221 0 1 1 0 0 /
 0.  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.
*STOP*
```

B-11: IRON (NATURAL)

```
0  /
6  /
*MODER*
20 -21
*RECONR*
-21 -22
*PENDF TAPE FOR FE(NAT.) FROM JENDL-3.2(F6) TAPE 306*/
2600 2/
.002  0.  6  .002  1.E-10/
*FE(NAT.) FROM JENDL-3.2(F6) TAPE T306*/
*PROCESSED BY THE NJOY91-V108  */
0/
*BROADR*
-22 -23
2600 2 0 0  0./
.003 1.E06 .06  1.E-07/
293.  600.
0/
*UNRESR*
-21 -23 -24
2600 2 2 1
293.  600.
1.E10 1.E4
0/
*THERMR* /
0 -23 -26
0  2600 12  2 1 0 1 221 1
293.  600.
0.005  2.1
*GROUPR*
-21 -26 0 -25
2600 9 0 -5 1 2 2 1
*FE(NAT.)FROM JENDL-3.2(F6)*/
293.  600.
1.E10 1.E4
3.5E05  11.36   30000  / CHECK SPECTRUM AVOVE UPPER END OF RR RANGE
3 /  293K
3 221 /
3 252 /
6 /
6 221 /
0 /
3 /  600K
3 221 /
3 252 /
6 /
6 221 /
0 /
0 /
*WIMSR*
-25 27
 2 4
 1 0 0 1
 2600
 26
 0 0 1.E10  0  0.0   221 0 1 1 0 0 /
 0.5  0.5  0.5  0.5  0.5  0.5  0.5  0.5  0.5  0.5  0.5  0.5  0.5
 0.5  0.5  0.5 /
*STOP*
```

B-12: NICKEL (NATURAL)

```
0  /
5  /
*MODER*
20 -21
*RECONR*
-21 -22
*PENDF TAPE FOR NI(NAT.) FROM JENDL-3.2(F6) TAPE 304*/
2800 2/
.002  0.  6  .04   1.E-07/
*NI(NAT.) FROM JENDL-3.2(F6) TAPE T304*/
*PROCESSED BY THE NJOY91-V108  */
0/
*BROADR*
-22 -23
2800 2 0  0 300./
.003 1.E06 .06  1.E-07/
300.  600.
0/
*UNRESR*
-21 -23 -24
2800 2 2 1
300.  600.
1.E10 1.E4
0/
*THERMR* /
0 -23 -26
0  2800 12  2 1 0 1 221 1
300.  600.
0.005  2.1
*GROUPR*
```

```
-21 -26 0 -25
2800 9 0 -5 1 2 2 1
*NI(NAT.)FROM JENDL-3.2(F6)*/
300. 600.
1.E10 1.E4
5.53E05 17.859 30000 / CHECK SPECTRUM AVOVE UPPER END OF RR RANGE
3 / 300K
3 221 /
3 252 /
6 /
6 221 /
0 /
3 / 600K
3 221 /
3 252 /
6 /
6 221 /
0 /
0 /
*WIMSR*
-25 27
2 4
1 0 0 1
2800
28
0 0 1.E10 0 0.0 221 0 1 1 0 0 /
0.63 0.63 0.63 0.63 0.63 0.63 0.63 0.63 0.63 0.63 0.63 0.63 0.63
0.63 0.63 0.63 /
*STOP*
```

B-13: ZIRCONIUM (NATURAL)

```
0 /
6 /
*MODER*
20 -21
*RECONR*
-21 -22
*PENDF TAPE FOR ZR(NAT.) FROM JENDL-3.2(F6) TAPE 306*/
4000 2/
.002 293. 6 .002 1.E-10/
*ZR(NAT.) FROM JENDL-3.2(F6) TAPE T306*/
*PROCESSED BY THE NJOY91-V108 */
0/
*BROADR*
-22 -23
4000 2 0 0 293./
.003 1.E06 .06 1.E-07/
293. 600.
0/
*THERMR* /
0 -23 -26
0 4000 12 2 1 0 1 221 1
293. 600.
0.005 2.1
*GROUPR*
-21 -26 0 -25
4000 9 0 -5 1 2 2 1
*ZR(NAT.)FROM JENDL-3.2(F6)*/
293. 600.
1.E10 1.E4
3.016E04 6.4084 30000 / CHECK SPECTRUM AVOVE UPPER END OF RR RANGE
3 / 293K
3 221 /
3 252 /
6 /
6 221 /
0 /
3 / 600K
3 221 /
3 252 /
6 /
6 221 /
0 /
0 /
*WIMSR*
-25 27
2 4
1 0 0 1
4000
40
0 0 1.E10 0 0.0 221 0 1 1 0 0 /
0.22 0.22 0.22 0.22 0.22 0.22 0.22 0.22 0.22 0.22 0.22 .22 .22
0.22 0.22 0.22
*STOP*
```

B-14: ZIRCONIUM IN ZRH

```
0 /
6 /
*MODER*
20 -21
*MODER*
30 -31 / CONVERT SCATTERING LAW DATA TO BINARY UNIT-31
*RECONR*
-21 -22
*PENDF TAPE FOR ZR(ZRH) FROM JENDL-3.2(F6) TAPE 306*/
4000 2/
.002 .0 6 .04 1.E-10/
*ZR(ZRH) FROM JENDL-3.2(F6) TAPE T306*/
*PROCESSED BY THE NJOY91-V108 */
0/
*BROADR*
-22 -23
4000 4 0 0 0./
.003 1.E06 .06 1.E-10/
293. 400. 600. 1200.
0/
*THERMR* /
-31 -23 -26
58 4000 12 4 4 13 1 235 1
293. 400. 600. 1200.
0.005 2.1
*GROUPR*
-21 -26 0 -25
4000 9 0 -5 1 4 3 1
*ZR(ZRH) FROM JENDL-3.2(F6)*/
```

```
293. 400. 600. 1200.
1.E10 1.E3 5.E2
3.016E04 6.4084 9000 / CHECK SPECTRUM AVOVE UPPER END OF RR RANGE
3 / 293K
3 235 /
3 236 /
3 252 /
6 /
6 235 /
0 /
3 / 400K
3 235 /
3 236 /
3 252 /
6 /
6 235 /
0 /
3 / 600K
3 235 /
3 236 /
3 252 /
6 /
6 235 /
0 /
3 / 1200K
3 235 /
3 236 /
3 252 /
6 /
6 235 /
0 /
0 /
*WIMSR*
-25 27
 2 4
 1 0 0 1
 4000
 40
 0 0 1.E09 0 0.0 235 236 1 1 0 0 /
 0.22 0.22 0.22 0.22 0.22 0.22 0.22 0.22 0.22 0.22 0.22 0.22 0.22
 0.22 0.22 0.22
*STOP*
```

B-15: URANIUM-234

```
0 /
6 /
*MODER*
20 -21
*RECONR*
-21 -22
*PENDF TAPE FOR U-234 FROM JENDL-3.2(F6) TAPE 313*/
9225 2/
.002 0. 6 .04 1.E-07/
*92-U-234 FROM JENDL-3.2(F6) TAPE T313*/
*PROCESSED BY THE NJOY91-V108 */
0/
*BROADR*
-22 -23
9225 3 0 1 0 /
.003 1.E06 .06 1.E-07/
293. 600. 1500.
0/
*UNRESR*
-21 -23 -24
9225 3 10 1
293. 600. 1500.
1.E10 8.E06 2.E06 1.5E06 1.E06 1.E05 1.E04 1.E03 1.E02 5.E01
0/
*THERMR*
0 -24 -26 /ADD THERMAL SCATTERING DATA TO UNIT-26
0 9225 12 3 1 0 1 221 1
293. 600. 1500..
0.005 2.1
*GROUPR*
-21 -26 0 -25
9225 9 0 -5 1 3 10 1
*92-U-234 FROM JENDL-3.2(F6)*/
293. 600. 1500.
1.E10 8.E06 2.E06 1.5E06 1.E06 1.E05 1.E04 1.E03 1.E02 5.E01
1.5E03 19.41 30000/
3 /        293.K
3 221 /
3 252 /
3 452 /
5 18 /
6 /
6 18 /
6 221 /
0/
3 /        600.K
3 221 /
3 252 /
3 452 /
5 18/
6 /
6 18/
6 221 /
0 /
3 /        1500.K
3 221 /
3 252 /
3 452 /
5 18/
6 /
6 18/
6 221 /
0 /
0 /
*WIMSR*
-25 27
 2 4
 1 0 0 1
 9225
 92
```

```
0 0 1.E06 1 19.41 221 0 1 1 0 0 /
0.1965 0.1965 0.1965 0.1965 0.1965 0.1965 0.1965 0.1965 0.1965 0.1965
0.1965 0.1965 0.1965 0.1965 0.1965 0.1965 /
*STOP*
```

B-16: URANIUM-235

```
0 /
6 /
*MODER*
20 -21
*RECONR*
-21 -22
*PENDF TAPE FOR U-235 FROM JENDL-3.2(F6) TAPE 313*/
9228 2/
.002 0. 6 .04 1.E-07 /
*92-U-235 FROM JENDL-3.2(F6) TAPE T313*/
*PROCESSED BY THE NJOY91-V108 */
0/
*BROADR*
-22 -23
9228 4 0 1 0./
.002 1.E06 .04 1.E-07/
293. 600. 900. 1500./
0/
*UNRESR*
-21 -23 -24
9228 4 10 1
293. 600. 900. 1500./
1.E10 3.E04 1.E04 8.E03 4.5E03 2.8E03 1.8E03 1.2E03 8.E02 5.E02
0/
*THERMR*
0 -24 -26
0 9228 12 4 1 0 1 221 1
293. 600. 900. 1500.
0.005 2.1
*GROUPR*
-21 -26 0 -25
9228 9 0 -5 1 4 10 1
*92-U-235 FROM JENDL-3.2(F6)*/
293. 600. 900. 1500.
1.E10 3.E04 1.E04 8.E03 4.5E03 2.8E03 1.8E03 1.2E03 8.E02 5.E02
5.E02 11.5 30000/
3 /      293K
3 221 /
3 252 /
3 452 /
3 455 /
5 455 /
5 18 /
6 /
6 221 /
0 /
3 /      600K
3 221 /
3 252 /
3 452 /
3 455 /
5 455 /
5 18 /
6 /
6 221 /
0 /
3 /      900K
3 221 /
3 252 /
3 452 /
3 455 /
5 455 /
5 18 /
6 /
6 221 /
0 /
3 /      1500K
3 221 /
3 252 /
3 452 /
3 455 /
5 455 /
5 18 /
6 /
6 221 /
0 /
0 /
*WIMSR*
-25 27
2 4
1 0 0 1
9228
92
0 0 8.E02 1 11.5 221 0 1 0 0 0 /
0.990 0.980 0.971 0.962 0.953 0.933 0.577 0.320 0.320 0.075 0.191
0.800 0.414 0.414 0.414 0.414/
*STOP*
```

B-17: URANIUM-236

```
0 /
6 /
*MODER*
20 -21
*RECONR*
-21 -22
*PENDF TAPE FOR U-236 FROM JENDL-3.2(F6) TAPE 313*/
9231 2/
.002 0. 6 .04 1.E-07/
*92-U-236 FROM JENDL-3.2(F6) TAPE T313*/
*PROCESSED BY THE NJOY91-V108 */
0/
*BROADR*
-22 -23
9231 3 0 1 0 /
.003 1.E06 .06 1.E-07/
293. 600. 1500.
```

```
0/
*UNRESR*
-21 -23 -24
9231 3 10 1
293. 600. 1500.
1.E10 8.E06 2.E06 1.5E06 1.E06 1.E05 1.E04 1.E03 1.E02 5.E01
0/
*THERMR*
0 -24 -26 /ADD THERMAL SCATTERING DATA TO UNIT-26
0 9231 12 3 1 0 1 221 1
293. 600. 1500.
0.005 2.1
*GROUPR*
-21 -26 0 -25
9231 9 0 -5 1 3 10 1
*92-U-236 FROM JENDL-3.2(F6)*/
293. 600. 1500.
1.E10 8.E06 2.E06 1.5E06 1.E06 1.E05 1.E04 1.E03 1.E02 5.E01
1.5E03 8.337 30000/
3 /        293.K
3 221 /
3 252 /
3 452 /
5 18 /
6 /
6 18 /
6 221 /
0/
3 /        600.K
3 221 /
3 252 /
3 452 /
5 18/
6 /
6 18/
6 221 /
0 /
3 /        1500.K
3 221 /
3 252 /
3 452 /
5 18/
6 /
6 18/
6 221 /
0 /
0 /
*WIMSR*
-25 27
 2 4
 1 0 0 1
 9231
 92
 0 0 1.E06 1  8.337  221 0 1 1 0 0 /
 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2
 0.2 0.2 0.2 /
*STOP*
```

B-18: URANIUM-238

```
0 /
6 /
*MODER*
20 -21
*RECONR*
-21 -22
*PENDF TAPE FOR U-238 FROM JENDL-3.2(F6) TAPE 313*/
9237 2/
.002 0. 6 .05 1.E-07/
*92-U-238 FROM JENDL-3.2(F6) TAPE T313*/
*PROCESSED BY THE NJOY91-V108 */
0/
*BROADR*
-22 -23
9237 4 0 1 0 /
.003 1.E06 .06 1.E-07/
293. 600. 900. 1500.
0/
*UNRESR*
-21 -23 -24
9237 4 10 1
293. 600. 900. 1500.
1.E10 1.E5 1.E04 1.E3 2.6E2 1.4E2 1.E2 50. 28. 12.
0/
*THERMR*
0 -24 -26 /ADD THERMAL SCATTERING DATA TO UNIT-26
0 9237 12 4 1 0 1 221 1
293. 600. 900. 1500.
0.005 2.1
*GROUPR*
-21 -26 0 -25
9237 9 0 -5 1 4 10 1
*92-U-238 FROM JENDL-3.2(F6)*/
293. 600. 900. 1500.
1.E10 1.E5 1.E04 1.E3 2.6E2 1.4E2 1.E2 50. 28. 12.
1.E04 10.599 20000 -28 7 .7768 7.496 .35 1.72368E-07 .08395 /
3 /        293.K
3 221 /
3 252 /
3 452 /
3 455 /
5 455 /
5 18 /
6 /
6 18 /
6 221 /
0/
3 /        600.K
3 221 /
3 252 /
3 452 /
3 455 /
5 18/
5 455 /
6 /
```

```
6 18/
6 221 /
0 /
3 /        900.K
3 221 /
3 252 /
3 452 /
3 455 /
5 18/
5 455 /
6 /
6 18/
6 221 /
0 /
3 /        1500.K
3 221 /
3 252 /
3 452 /
3 455 /
5 18/
5 455 /
6 /
6 18/
6 221 /
0 /
0 /
*WIMSR*
-25 27
 2 4
 1 0 0 1
 9237
 92
 0 0 28. 1 10.599  221 0 1 1 0 0 /
 0.990 0.980 0.971 0.962 0.953 0.933 0.577 0.320 0.320 0.075 0.191
 0.800 0.414 0.414 0.414 0.414 /
*STOP*
```

B-19: PLUTONIUM-238

```
0  /
6  /
*MODER*
20 -21
*RECONR*
-21 -22
*PENDF TAPE FOR PU-238 FROM JENDL-3.2(F6)TAPE 314*/
9434 2/
.002 0. 6 .04 1.E-07/
*94-PU-238 FROM JENDL-3.2(F6) TAPE T314*/
*PROCESSED BY THE NJOY91-V108  */
0/
*BROADR*
-22 -23
9434 3 0 0 0 /
.003 1.E06 .06  1.E-07/
293. 600. 1500.
0/
*UNRESR*
-21 -23 -24
9434 3 10 1
293. 600. 1500.
1.E10 8.E06 2.E06 1.5E06 1.E06 1.E05 1.E04 1.E03 1.E02 5.E01
0/
*THERMR*
0 -24 -26
0 9434 12  3 1 0 1 221 1
293. 600. 1500.
0.005  2.1
*GROUPR*
-21 -26 0 -25
9434 9 0 -5 1 3 10 1
*94-PU-238 FROM JENDL-3.2(F6)*/
293. 600. 1500.
1.E10 8.E06 2.E06 1.5E06 1.E06 1.E05 1.E04 1.E03 1.E02 5.E01
5.E02 28.53  30000/
3 /  293K
3 221 /
3 252 /
3 452 /
5  18 /
6 /
6 221 /
0 /
3 /  600K
3 221 /
3 252 /
3 452 /
6 /
6 221 /
0 /
3 /  1500K
3 221 /
3 252 /
3 452 /
6 /
6 221 /
0 /
0 /
*WIMSR*
-25 27
 2 4
 1 0 0 1
 9434
 94
 0 0 1.E05  0 28.53  221 0 1 1 0 0 /
 0.2  0.2  0.2  0.2  0.2  0.2  0.2  0.2  0.2  0.2  0.2  0.2  0.2
 0.2  0.2  0.2 /
*STOP*
```

B-20: PLUTONIUM-239

```
0  /
6  /
*MODER*
```

```
20 -21
*RECONR*
-21 -22
*PENDF TAPE FOR PU-239 FROM JENDL-3.2(F6)TAPE 314*/
9437 2/
.002 0. 6 .04 1.E-07/
*94-PU-239 FROM JENDL-3.2(F6) TAPE T314*/
*PROCESSED BY THE NJOY91-V108 */
0/
*BROADR*
-22 -23
9437 4 0 0 0/
.003 1.E06 .06 1.E-07/
293. 600. 900. 1500.
0/
*UNRESR*
-21 -23 -24
9437 4 10 1/
293. 600. 900. 1500.
1.E10 1.5E06 1.E06 1.E05 1.E04 2.E03 1.E03 1.E02 5.E01 1.E01
0/
*THERMR*
0 -24 -26
0 9437 12 4 1 0 1 221 1
293. 600. 900. 1500.
0.005 2.1
*GROUPR*
-21 -26 0 -25
9437 9 0 -5 1 4 10 1
*94-PU-239 FROM JENDL-3.2(F6)*/
293. 600. 900. 1500.
1.E10 1.5E06 1.E06 1.E05 1.E04 2.E03 1.E03 1.E02 5.E01 1.E01
2.5E03 7.97 30000/
3 /        293K
3 221 /
3 252 /
3 452 /
3 455 /
5 455 /
5 18 /
6 /
6 221 /
0 /
3 /        600K
3 221 /
3 252 /
3 452 /
3 455 /
6 /
6 221 /
0 /
3 /        900K
3 221 /
3 252 /
3 452 /
3 455 /
6 /
6 221 /
0 /
3 /        1500K
3 221 /
3 252 /
3 452 /
3 455 /
6 /
6 221 /
0 /
0 /
*WIMSR*
-25 27
2 4
1 0 0 1
9437
94
0 0 1.E03 1 7.97 221 0 1 0 0 0 /
0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2
0.2 0.2 0.2
*STOP*
```

B-21: PLUTONIUM-240

```
0 /
6 /
*MODER*
20 -21
*RECONR*
-21 -22
*PENDF TAPE FOR PU-240 FROM JENDL-3.2(F6)TAPE 314*/
9440 2/
.002 0. 6 .04 1.E-07 /
*94-PU-240 FROM JENDL-3.2(F6) TAPE T314*/
*PROCESSED BY THE NJOY91-V108 */
0/
*BROADR*
-22 -23
9440 4 0 0 0 /
.003 1.E06 .06 1.E-07/
293. 600. 900. 1500.
0/
*UNRESR*
-21 -23 -24
9440 4 10 1
293. 600. 900. 1500.
1.E10 8.E06 2.E06 1.5E06 1.E06 1.E05 1.E04 1.E03 1.E02 5.E01
0/
*THERMR*
0 -24 -26
0 9440 12 4 1 0 1 221 1
293. 600. 900. 1500.
0.005 2.1
*GROUPR*
-21 -26 0 -25
9440 9 0 0 1 4 10 1
*94-PU-240 FROM JENDL-3.2(F6)*/
293. 600. 900. 1500.
```

```
1.E10 8.E06 2.E06 1.5E06 1.E06 1.E05 1.E04 1.E03 1.E02 5.E01
4.E03 1.644 30000/ -28
3 / 293K
3 221 /
3 252 /
3 452 /
3 455 /
5 455 /
5 18 /
6 /
6 221 /
0 /
3 / 600K
3 221 /
3 252 /
3 452 /
3 455 /
6 /
6 221 /
0 /
3 / 900K
3 221 /
3 252 /
3 452 /
3 455 /
6 /
6 221 /
0 /
3 / 1500K
3 221 /
3 252 /
3 452 /
3 455 /
6 /
6 221 /
0 /
0 /
*WIMSR*
-25 27
2 4
1 0 0 1
9440
94
0 0 1.E04 1 1.644 221 0 1 1 0 0 /
0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2
0.2 0.2 0.2
*STOP*
```

B-22: PLUTONIUM-241

```
0 /
6 /
*MODER*
20 -21
*RECONR*
-21 -22
*PENDF TAPE FOR PU-241 FROM JENDL-3.2(F6)TAPE 314*/
9443 2/
.002 0. 6 .04 1.E-07/
*94-PU-241 FROM JENDL-3.2(F6) TAPE T314*/
*PROCESSED BY THE NJOY91-V108 */
0/
*BROADR*
-22 -23
9443 4 0 0 0/
.003 1.E06 .06 1.E-07/
293. 600. 900. 1500.
0/
*UNRESR*
-21 -23 -24
9443 4 10 1/
293. 600. 900. 1500.
1.E10 1.5E06 1.E06 1.E05 1.E04 2.E03 1.E03 1.E02 5.E01 1.E01
0/
*THERMR*
0 -24 -26
0 9443 12 4 1 0 1 221 1
293. 600. 900. 1500.
0.005 2.1
*GROUPR*
-21 -26 0 -25
9443 9 0 -5 1 4 10 1
*94-PU-241 FROM JENDL-3.2(F6)*/
293. 600. 900. 1500.
1.E10 1.5E06 1.E06 1.E05 1.E04 2.E03 1.E03 1.E02 5.E01 1.E01
3.E02 11.35 30000/
3 / 293K
3 221 /
3 252 /
3 452 /
3 455 /
5 455 /
5 18 /
6 /
6 221 /
0 /
3 / 600K
3 221 /
3 252 /
3 452 /
3 455 /
6 /
6 221 /
0 /
3 / 900K
3 221 /
3 252 /
3 452 /
3 455 /
6 /
6 221 /
0 /
3 / 1500K
3 221 /
3 252 /
```

```
3 452 /
3 455 /
6 /
6 221 /
0 /
0 /
*WIMSR*
-25 27
2 4
1 0 0 1
9443
94
0 0 2.E03  1  11.35  221 0 1 0 0 0 /
0.2  0.2  0.2  0.2  0.2  0.2  0.2  0.2  0.2  0.2  0.2  0.2  0.2
0.2  0.2  0.2
*STOP*
```

B-23: PLUTONIUM-242

```
0  /
6  /
*MODER*
20 -21
*RECONR*
-21 -22
*PENDF TAPE FOR PU-242 FROM JENDL-3.2(F6)TAPE 314*/
9446 2/
.002 0. 6 .04  1.E-07/
*94-PU-242 FROM JENDL-3.2(F6) TAPE T314*/
*PROCESSED BY THE NJOY91-V108  */
0/
*BROADR*
-22 -23
9446 4 0 0 0 /
.003 1.E06  .06   1.E-07/
293. 600. 900. 1500.
0/
*UNRESR*
-21 -23 -24
9446 4 10 1
293. 600. 900. 1500.
1.E10  8.E06  2.E06  1.5E06  1.E06  1.E05  1.E04  1.E03  1.E02  5.E01
0/
*THERMR*
0 -24 -26
0 9446 12  4 1 0 1 221 1
293. 600. 900. 1500.
0.005 2.1
*GROUPR*
-21 -26 0 -25
9446 9 0 0  1 4 10 1
*94-PU-242 FROM JENDL-3.2(F6)*/
293. 600. 900. 1500.
1.E10  8.E06  2.E06  1.5E06  1.E06  1.E05  1.E04  1.E03  1.E02  5.E01
1.15E3   8.32 30000   / -28
3 /  293K
3 221 /
3 252 /
3 452 /
5  18 /
6 /
6 221 /
0 /
3 /  600K
3 221 /
3 252 /
3 452 /
6 /
6 221 /
0 /
3 /  900K
3 221 /
3 252 /
3 452 /
6 /
6 221 /
0 /
3 /  1500K
3 221 /
3 252 /
3 452 /
6 /
6 221 /
0 /
0 /
*WIMSR*
-25 27
2 4
1 0 0 1
9446
94
0 0  1.E05  1  8.32  221 0 1 1 0 0 /
.19  .19  .19  .19  .19  .19  .19  .19  .19  .19  .19  .19  .19
.19.  19.  19
*STOP*
```

B-24: AMERICIUM-241

```
0  /
6  /
*MODER*
20 -21
*RECONR*
-21 -22
*PENDF TAPE FOR AM-241 FROM JENDL-3.2(F6) TAPE 313*/
9543 2/
.002  0. 6 .04  1.E-07/
*PENDF TAPE FOR AM-241 FROM JENDL-3.2(F6) TAPE T313*/
*PROCESSED BY THE NJOY91-V108  */
0/
*BROADR*
-22 -23
9543 3 0 0 0 /
.003   1.E06  .06  1.E-07/
```

```
293. 600. 1500.
0/
*UNRESR*
-21 -23 -24
9543 3 10 1
293. 600. 1500.
1.E10 8.E06 2.E06 1.5E06 1.E06 1.E05 1.E04 1.E03 1.E02 5.E01
0/
*THERMR*
0 -24 -26 /ADD THERMAL SCATTERING DATA TO UNIT-26
0 9543 12 3 1 0 1 221 1
293. 600. 1500.
0.005 2.1
*GROUPR*
-21 -26 0 -25
9543 9 0 -5 1 3 10 1
*95-AM-241 FROM JENDL-3.2(F6)*/
293. 600. 1500.
1.E10 8.E06 2.E06 1.5E06 1.E06 1.E05 1.E04 1.E03 1.E02 5.E01
1.5E02 11.13 30000/
3 /        293.K
3 221 /
3 252 /
3 452 /
5 18 /
6 /
6 18 /
6 221 /
0/
3 /        600.K
3 221 /
3 252 /
3 452 /
6 /
6 18/
6 221 /
0 /
3 /        1500.K
3 221 /
3 252 /
3 452 /
6 /
6 18/
6 221 /
0 /
0 /
*WIMSR*
-25 27
2 4
1 0 0 1
9543
95
0 0 1.E06 1 11.13 221 0 1 1 0 0 /
0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2
*STOP*
```

APPENDIX -C: INPUT SPECIFICATIONS OF WIMS-D/4.1 AND SRAC95 FOR THE DIFFERENT BENCHMARK LATTICE

C-1: WIMS INPUT FOR TRX-1

```
***************************************************************
* TRX-1   SEQUENCE 1   S12   REGULAR 1 6
*              STAND. INPUT NMETERIAL 3
***************************************************************
CELL    6
SEQUENCE  1
NGROUP  69  2
NMESH   10
NREGION  4  0  4
NMATERIAL 3
NREACT   2
PREOUT
INITIATE
ANNULUS  1 0.4915  1
ANNULUS  2 0.5042  0
ANNULUS  3 0.5753  2
ANNULUS  4 0.94822 3
FEWGROUP  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 $
     19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 $
     37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 $
     55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
MESH    4  1  1  4
MATERIAL  1 -1  293.0 1 9228.1 0.0006253 9237.1 0.047205
MATERIAL  2 -1  293.0 2  1325 0.06025
MATERIAL  3 -1  293.0 3   125 0.06676     825 0.03338
REGULAR  1  6
S      12
BEGINC
THERMAL  24
BEEONE   1
DNB      1 0.    0. 0.    0.
DNB      2 0.    0. 0.    0.
DNB      3 0.06676 0. 0.03338 0.
BUCKLINGS 0.005174  0.000526
DIFFUSION 1  3  1
LEAKAGE  5
REACTION (9228 293.0)(9237,293.0)
PARTITION 45  69
BEGINC
```

C-2: WIMS INPUT FOR TRX-2

```
***************************************************************
* TRX-2   SEQUENCE 1   S12   REGULAR 1 6
*              STAND. INPUT NMETERIAL 3
***************************************************************
CELL    6
SEQUENCE  1
NGROUP  69  2
NMESH   14
NREGION  4  0  4
```

```
NMATERIAL 3
NREACT  2
PREOUT
INITIATE
ANNULUS  1 0.4915  1
ANNULUS  2 0.5042  0
ANNULUS  3 0.5753  2
ANNULUS  4 1.1414  3
FEWGROUP  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 $
      19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 $
      37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 $
      55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
MESH    4  1  1  8
MATERIAL  1 -1  293.0 1 9228.1 0.0006253 9237.1 0.047205
MATERIAL  2 -1  293.0 2  1325 0.06025
MATERIAL  3 -1  293.0 3   125 0.06676      825 0.03338
REGULAR  1  6
S      12
BEGINC
THERMAL  24
BEEONE   1
DNB     1 0.     0. 0.     0.
DNB     2 0.     0. 0.     0.
DNB     3 0.06676 0. 0.03338 0.
BUCKLINGS 0.004943  0.000526
DIFFUSION 1  3  1
LEAKAGE  5
REACTION (9228,293.0) (9237,293.0)
PARTITION 45  69
BEGINC
```

C-3: WIMS INPUT FOR BAPL-1

```
****************************************************************
* BAPL-UO2-1    SEQUENCE 1 S 12   REGULAR 1 6
*                      STAND. INPUT  MMETERIAL 3
****************************************************************
CELL    6
SEQUENCE  1
NGROUP  69  2
NMESH    10
NREGION  4  0  4
NMATERIAL 3
NREACT   2
PREOUT
INITIATE
ANNULUS  1 0.4864  1
ANNULUS  2 0.5042  0
ANNULUS  3 0.5753  2
ANNULUS  4 0.8179  3
FEWGROUP  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 $
      19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 $
      37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 $
      55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
MESH    4  1  1  4
MATERIAL  1 -1  293.0 1 9228.1 0.0003112 9237.1 0.023127 825 0.046946
MATERIAL  2 -1  293.0 2    1325 0.06025
MATERIAL  3 -1  293.0 3    125 0.06676      825 0.03338
REGULAR  1  6
S      12
BEGINC
THERMAL  24
BEEONE   1
DNB     1 0.     0. 0.     0.
DNB     2 0.     0. 0.     0.
DNB     3 0.06676 0. 0.03338 0.
BUCKLINGS 0.002734  0.000525
DIFFUSION 1  3  1
LEAKAGE  5
REACTION (9228,293.0) (9237,293.0)
PARTITION 45  69
BEGINC
```

C-4: WIMS INPUT FOR BAPL-2

```
****************************************************************
* BAPL-UO2-2    SEQUENCE 1 S 12   REGULAR 1 6
* 09.05.96           STAND. INPUT  MMETERIAL 3
****************************************************************
CELL    6
SEQUENCE  1
NGROUP  69  2
NMESH    10
NREGION  4  0  4
NMATERIAL 3
NREACT   2
PREOUT
INITIATE
ANNULUS  1 0.4864  1
ANNULUS  2 0.5042  0
ANNULUS  3 0.5753  2
ANNULUS  4 0.86752 3
FEWGROUP  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 $
      19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 $
      37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 $
      55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
MESH    4  1  1  4
MATERIAL  1 -1  293.0 1 9228.1 0.0003112 9237.1 0.023127 825 0.046946
MATERIAL  2 -1  293.0 2    1325 0.06025
MATERIAL  3 -1  293.0 3    125 0.06676      825 0.03338
REGULAR  1  6
S      12
BEGINC
THERMAL  24
BEEONE   1
DNB     1 0.     0. 0.     0.
DNB     2 0.     0. 0.     0.
DNB     3 0.06676 0. 0.03338 0.
BUCKLINGS 0.003018  0.000529
DIFFUSION 1  3  1
LEAKAGE  5
REACTION (9228,293.0) (9237,293.0)
PARTITION 45  69
BEGINC
```

C-5: WIMS INPUT FOR BAPL-3

```
****************************************************************
* BAPL-UO2-3 SEQUENCE 1 S 12  REGULAR 1 6
* 03.04.96         STAND. INPUT  MMETERIAL 3
****************************************************************
CELL   6
SEQUENCE  1
NGROUP  69  2
NMESH   10
NREGION  4  0  4
NMATERIAL 3
NREACT   2
PREOUT
INITIATE
ANNULUS   1 0.4864  1
ANNULUS   2 0.5042  0
ANNULUS   3 0.5753  2
ANNULUS   4 0.94806 3
FEWGROUP  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 $
      19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 $
      37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 $
      55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
MESH    4  1  1  4
MATERIAL  1 -1  293.0 1 9228.1 0.0003112 9237.1 0.023127 825 0.046946
MATERIAL  2 -1  293.0 2   1325 0.06025
MATERIAL  3 -1  293.0 3    125 0.06676     825 0.03338
REGULAR  1  6
S    12
BEGINC
THERMAL  24
BEEONE   1
DNB     1 0.    0. 0.    0.
DNB     2 0.    0. 0.    0.
DNB     3 0.06676 0. 0.03338 0.
BUCKLINGS 0.002892  0.000530
DIFFUSION 1  3  1
LEAKAGE  5
REACTION (9228,293.0) (9237,293.0)
PARTITION 45  69
BEGINC
```

C-6: WIMS INPUT FOR TCA 150U

```
****************************************************************
* TCA150U        SEQUENCE 1   S12   REGULAR 1 6
* 10.06.96       STAND. INPUT  MMETERIAL 3
****************************************************************
CELL    6
SEQUENCE  1
NGROUP  69  2
NMESH   20
NREGION  4  0  4
NMATERIAL 3
PREOUT
INITIATE
ANNULUS   1 0.625    1
ANNULUS   2 0.6325   0
ANNULUS   3 0.7085   2
ANNULUS   4 1.04321313
FEWGROUP  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 $
      19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 $
      37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 $
      55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
MESH    8  1  3  8
MATERIAL  1 -1  300.0 1  9228.1 6.086E-04 $
      9237.1 2.255E-02  825 4.725E-02
MATERIAL  2 -1  300.0 2   1325  5.587E-02
MATERIAL  3 -1  300.0 3    125 6.676E-02  825 3.338E-02
REGULAR  1
S     12
BEGINC
THERMAL  24
BEEONE   1
DNB     1 0.    0. 0.    0.
DNB     2 0.    0. 0.    0.
DNB     3 0.06676 0. 0.03338 0.
BUCKLINGS 0.0079139   0.000786096
DIFFUSION 1  3  1
LEAKAGE  5
BEGINC
```

C-7: WIMS INPUT FOR TCA 183U

```
****************************************************************
* TCA183U        SEQUENCE 1   S12   REGULAR 1 6
* 10.06.96       STAND. INPUT  MMETERIAL 3
****************************************************************
CELL    6
SEQUENCE  1
NGROUP  69  2
NMESH   20
NREGION  4  0  4
NMATERIAL 3
PREOUT
INITIATE
ANNULUS   1 0.625    1
ANNULUS   2 0.6325   0
ANNULUS   3 0.7085   2
ANNULUS   4 1.103583  3
FEWGROUP  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 $
      19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 $
      37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 $
      55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
MESH    8  1  3  8
MATERIAL  1 -1  300.0 1  9228.1 6.086E-04 $
      9237.1 2.255E-02  825 4.725E-02
MATERIAL  2 -1  300.0 2   1325  5.587E-02
MATERIAL  3 -1  300.0 3    125 6.676E-02  825 3.338E-02
REGULAR  1
S     12
BEGINC
THERMAL  24
```

```
BEEONE  1
DNB     1 0.    0. 0.    0.
DNB     2 0.    0. 0.    0.
DNB     3 0.06676 0. 0.03338 0.
BUCKLINGS 0.00885495  0.00047504
DIFFUSION 1  3  1
LEAKAGE  5
BEGINC
```

C-8: WIMS INPUT FOR TCA 248U

```
****************************************************************
* TCA248U  SEQUENCE 1   S12   REGULAR 1 6
* 10.06.96           STAND. INPUT  MMETERIAL 3
****************************************************************
CELL    6
SEQUENCE  1
NGROUP  69  2
NMESH   20
NREGION  4  0  4
NMATERIAL 3
PREOUT
INITIATE
ANNULUS  1 0.625    1
ANNULUS  2 0.6325   0
ANNULUS  3 0.7085   2
ANNULUS  4 1.2130386 3
FEWGROUP 1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 $
      19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 $
      37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 $
      55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
MESH     8  1  3  8
MATERIAL  1 -1  300.0 1  9228.1 6.086E-04 $
      9237.1 2.255E-02  825 4.725E-02
MATERIAL  2 -1  300.0 2   1325  5.587E-02
MATERIAL  3 -1  300.0 3    125 6.676E-02  825 3.338E-02
REGULAR   1
S       12
BEGINC
THERMAL  24
BEEONE   1
DNB     1 0.    0. 0.    0.
DNB     2 0.    0. 0.    0.
DNB     3 0.06676 0. 0.03338 0.
BUCKLINGS 0.00867071  0.00121928
DIFFUSION 1  3  1
LEAKAGE  5
BEGINC
```

C-9: WIMS INPUT FOR TCA 300U

```
****************************************************************

* TCA300U  SEQUENCE 1   S12   REGULAR 1 6
* 10.06.96           STAND. INPUT  MMETERIAL 3
****************************************************************
CELL    6
SEQUENCE  1
NGROUP  69  2
NMESH   20
NREGION  4  0  4
NMATERIAL 3
PREOUT
INITIATE
ANNULUS  1 0.625    1
ANNULUS  2 0.6325   0
ANNULUS  3 0.7085   2
ANNULUS  4 1.2937197 3
FEWGROUP 1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 $
      19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 $
      37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 $
      55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
MESH     8  1  3  8
MATERIAL  1 -1  300.0 1  9228.1 6.086E-04 $
  -   9237.1 2.255E-02  825 4.725E-02
MATERIAL  2 -1  300.0 2   1325  5.587E-02
MATERIAL  3 -1  300.0 3    125 6.676E-02  825 3.338E-02
REGULAR   1
S       12
BEGINC
THERMAL  24
BEEONE   1
DNB     1 0.    0. 0.    0.
DNB     2 0.    0. 0.    0.
DNB     3 0.06676 0. 0.03338 0.
BUCKLINGS 0.00872856  0.000951431
DIFFUSION 1  3  1
LEAKAGE  5
BEGINC
```

C-10: WIMS INPUT FOR TCA 242PU

```
****************************************************************
* TCA242   SEQUENCE 1   S12   REGULAR 1
* 30.05.96           STAND. INPUT  MMETERIAL 3
****************************************************************
CELL    6
SEQUENCE  1
NGROUP  69  2
NMESH   20
NREGION  4  0  4
NMATERIAL 3
PREOUT
INITIATE
ANNULUS  1 0.5325   1
ANNULUS  2 0.5415   0
ANNULUS  3 0.6115   2
ANNULUS  4 1.0296723 3
FEWGROUP 1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 $
      19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 $
      37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 $
      55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
MESH     8  1  3  8
```

```
MATERIAL 1 -1 300.0 1 9225.1 7.436E-07 9228.1 9.393E-05 $
      9237.1 1.295E-02 9434.1 2.0E-06 9437.1 2.749E-04 $
      9440.1 8.843E-05 9443.1 2.819E-05 9446.1 8.124E-06 $
      9543.1 1.059E-06 825 2.784E-02
MATERIAL 2 -1 300.0 2 4000 3.84E-02
MATERIAL 3 -1 300.0 3 125 6.676E-02 825 3.338E-02
REGULAR 1
S 12
BEGINC
THERMAL 24
BEEONE 1
DNB 1 0. 0. 0. 0.
DNB 2 0. 0. 0. 0.
DNB 3 0.06676 0. 0.03338 0.
BUCKLINGS 0.00660895 0.00147104
DIFFUSION 1 3 1
LEAKAGE 5
BEGINC
```

C-11: WIMS INPUT FOR TCA 298PU

```
***************************************************************
* TCA2.98PU SEQUENCE 1 S12 REGULAR 1 6
* 07.05.96        STAND. INPUT MMETERIAL 3
***************************************************************
CELL 6
SEQUENCE 1
NGROUP 69 2
NMESH 20
NREGION 4 0 4
NMATERIAL 3
PREOUT
INITIATE
ANNULUS 1 0.5325 1
ANNULUS 2 0.5415 0
ANNULUS 3 0.6115 2
ANNULUS 4 1.103583 3
FEWGROUP 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 $
      19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 $
      37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 $
      55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
MESH 8 1 3 8
MATERIAL 1 -1 300.0 1 9225.1 7.436E-07 9228.1 9.393E-05 $
      9237.1 1.295E-02 9434.1 2.0E-06 9437.1 2.749E-04 $
      9440.1 8.843E-05 9443.1 2.819E-05 9446.1 8.124E-06 $
      9543.1 1.059E-06 825 2.784E-02
MATERIAL 2 -1 300.0 2 4000 3.84E-02
MATERIAL 3 -1 300.0 3 125 6.676E-02 825 3.338E-02
REGULAR 1
S 12
BEGINC
THERMAL 24
BEEONE 1
DNB 1 0. 0. 0. 0.
DNB 2 0. 0. 0. 0.
DNB 3 0.06676 0. 0.03338 0.
BUCKLINGS 0.00670258 0.00157741
DIFFUSION 1 3 1
LEAKAGE 5
BEGINC
```

C-12: WIMS INPUT FOR TCA 424PU

```
***************************************************************
* TCA4.24PU SEQUENCE 1 S12 REGULAR 1 6
* 07.05.96        STAND. INPUT MMETERIAL 3
***************************************************************
CELL 6
SEQUENCE 1
NGROUP 69 2
NMESH 20
NREGION 4 0 4
NMATERIAL 3
PREOUT
INITIATE
ANNULUS 1 0.5325 1
ANNULUS 2 0.5415 0
ANNULUS 3 0.6115 2
ANNULUS 4 1.2553539 3
FEWGROUP 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 $
      19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 $
      37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 $
      55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
MESH 8 1 3 8
MATERIAL 1 -1 300.0 1 9225.1 7.436E-07 9228.1 9.393E-05 $
      9237.1 1.295E-02 9434.1 2.0E-06 9437.1 2.749E-04 $
      9440.1 8.843E-05 9443.1 2.819E-05 9446.1 8.124E-06 $
      9543.1 1.059E-06 825 2.784E-02
MATERIAL 2 -1 300.0 2 4000 3.84E-02
MATERIAL 3 -1 300.0 3 125 6.676E-02 825 3.338E-02
REGULAR 1
S 12
BEGINC
THERMAL 24
BEEONE 1
DNB 1 0. 0. 0. 0.
DNB 2 0. 0. 0. 0.
DNB 3 0.06676 0. 0.03338 0.
BUCKLINGS 0.00612493 0.00166506
DIFFUSION 1 3 1
LEAKAGE 5
BEGINC
```

C-13: WIMS INPUT FOR TCA 555PU

```
***************************************************************
* TCA5.55PU SEQUENCE 1 S12 REGULAR 1 6
* 07.05.96        STAND. INPUT MMETERIAL 3
***************************************************************
CELL 6
SEQUENCE 1
NGROUP 69 2
NMESH 20
```

```
NREGION 4 0 4
NMATERIAL 3
PREOUT
INITIATE
ANNULUS 1 0.5325 1
ANNULUS 2 0.5415 0
ANNULUS 3 0.6115 2
ANNULUS 4 1.3958406 3
FEWGROUP 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 $
     19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 $
     37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 $
     55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
MESH 8 1 3 8
MATERIAL 1 -1 300.0 1 9225.1 7.436E-07 9228.1 9.393E-05 $
     9237.1 1.295E-02 9434.1 2.0E-06 9437.1 2.749E-04 $
     9440.1 8.843E-05 9443.1 2.819E-05 9446.1 8.124E-06 $
     9543.1 1.059E-06 825 2.784E-02
MATERIAL 2 -1 300.0 2 4000 3.84E-02
MATERIAL 3 -1 300.0 3 125 6.676E-02 825 3.338E-02
REGULAR 1
S 12
BEGINC
THERMAL 24
BEEONE 1
DNB 1 0. 0. 0. 0.
DNB 2 0. 0. 0. 0.
DNB 3 0.06676 0. 0.03338 0.
BUCKLINGS 0.00486039 0.0016496
DIFFUSION 1 3 1
LEAKAGE 5
BEGINC
```

C-14: WIMS INPUT FOR NEA V6E8

```
***************************************************************
* NEAV6E8 SEQUENCE 1 S12 REGULAR 1 6
* 30.05.96 STAND. INPUT MMETERIAL 3
***************************************************************
CELL 6
SEQUENCE 1
NGROUP 69
NMESH 20
NREGION 3 0 3
NMATERIAL 3
PREOUT
INITIATE
ANNULUS 1 0.41 1
ANNULUS 2 0.475 2
ANNULUS 3 0.5713996 3
FEWGROUP 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 $
     19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 $
     37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 $
     55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
MESH 8 4 8
MATERIAL 1 -1 900.0 1 9228.1 6.094E-05 $
   9237.1 2.025E-02 9437.1 1.563E-03 $
   9440.1 6.872E-04 9443.1 2.765E-04 $
   9446.1 2.108E-04 825 4.610E-02
MATERIAL 2 -1 600.0 2 2400 1.570E-02 2525 1.486E-03 $
          2600 4.831E-02 2800 7.648E-03
MATERIAL 3 -1 600.0 3 125 4.744E-02 825 2.372E-02
REGULAR 1 6
S 12
BEGINC
BEGINC
```

C-15: WIMS INPUT FOR NEA V1E7

```
***************************************************************
* NEAV1E7 SEQUENCE 1 S12 REGULAR 1 6
* 30.05.96 STAND. INPUT MMETERIAL 3
***************************************************************
CELL 6
SEQUENCE 1
NGROUP 69 2
NMESH 20
NREGION 3 0 3
NMATERIAL 3
PREOUT
INITIATE
ANNULUS 1 0.41 1
ANNULUS 2 0.475 2
ANNULUS 3 0.6407572 3
FEWGROUP 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 $
     19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 $
     37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 $
     55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
MESH 8 4 8
MATERIAL 1 -1 900.0 1 9228.1 6.194E-05 $
     9237.1 2.058E-02 9437.1 1.367E-03 $
     9440.1 6.009E-04 9443.1 2.418E-04 9446.1 1.844E-04 $
     825 4.608E-02
MATERIAL 2 -1 600.0 2 4000 3.702E-02
MATERIAL 3 -1 600.0 3 125 4.744E-02 825 2.372E-02
REGULAR 1 6
S 12
BEGINC
BEGINC
```

C-16: WIMS INPUT FOR NEA-A

```
***************************************************************
* NEAA SEQUENCE 1 S12 REGULAR 1 6
* 30.05.96 STAND. INPUT MMETERIAL 3
***************************************************************
CELL 6
SEQUENCE 1
NGROUP 69
NMESH 20
NREGION 3 0 3
NMATERIAL 3
PREOUT
INITIATE
```

```
ANNULUS  1 0.4095   1
ANNULUS  2 0.4750   2
ANNULUS  3 0.74096  3
FEWGROUP 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 $
      19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 $
      37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 $
      55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
MESH   8 4 8
MATERIAL 1 -1 933.0 1 9228.1 1.4456E-04 $
   9237.1 1.9939E-02 9434  1.1467E-04 9437.1 1.0285E-03 $
   9440.1 7.9657E-04 9443.1 3.3997E-04 $
   9446.1 5.6388E-04 825  4.5854E-02
MATERIAL 2 -1 579.3 2 4000  4.3248E-02
MATERIAL 3 -1 579.3 3  125  4.7716E-02 825 2.3858E-02 $
               525  3.6346E-06 528 1.6226E-05
REGULAR  1 6
S     12
BEGINC
BEGINC
```

C-17: WIMS INPUT FOR NEA-B

```
*****************************************************************
* NEAB    SEQUENCE 1  S12  REGULAR 1 6
* 30.05.96        STAND. INPUT  MMETERIAL 3
*****************************************************************
CELL   6
SEQUENCE 1
NGROUP  69
NMESH   20
NREGION  3 0 3
NMATERIAL 3
PREOUT
INITIATE
ANNULUS  1 0.4095   1
ANNULUS  2 0.4750   2
ANNULUS  3 0.74096  3
FEWGROUP 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 $
      19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 $
      37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 $
      55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
MESH    8 4 8
MATERIAL 1 -1 933.0 1 9225.1 2.4626E-07 9228.1 5.1515E-05 $
   9237.1 2.0295E-02 9434  2.1800E-05 9437.1 7.1155E-04 $
   9440.1 2.7623E-04 9443.1 1.4591E-04 $
   9446.1 4.7643E-05 825  4.3100E-02
MATERIAL 2 -1 579.3 2 4000  4.3248E-02
MATERIAL 3 -1 579.3 3  125  4.7716E-02 825  2.3858E-03 $
               525  3.6346E-06 528  1.6226E-05
REGULAR  1 6
S      12
BEGINC
BEGINC
```

C-18: SRAC95 INPUT FOR TRX-1

```
TRX10000                                      00951000
TRX-1 BENCHMARK PROBLEM : HEXAGONAL CYLINDER : USING PEACO        00952000
 11112  143-20  00002  01120                     00953002
 0.0057000  / BUCKLING                            00954000
J2031.PFASTB6.DATA     OLD FILE                     00955000
J2031.PTHMLB6.DATA     OLD FILE                     00956000
J2031.PMCRSB6.DATA     OLD FILE                     00957000
J2031.FASTU.DATA     SCR CORE                       00958000
J2031.THERMALU.DATA     SCR CORE                    00959000
J2031.UMCROSS.DATA     SCR CORE                     00959100
J2031.MACROWRK.DATA     NEW CORE                    00959200
J2031.MACRO.DATA     NEW CORE                       00959300
J2031.FLUX.DATA     NEW CORE                        00959400
J2031.MICREF.DATA     SCR CORE                      00959500
61 46 0 0 /                          00959600
61(1)    /                           00959700
46(1)    /                           00959800
                                     00959900
 6 6 6 3 1  1 6 0 0 0  5 0 10 29 0  0 60 0 /          00960000
 0 100 50 5 5 5 1 0.00001 0.0001  0.001 1.00  100.0 0.1       00960100
 1 1 1 2 3 3 / T-R                     00960200
 1   1 1 / R-X                         00960300
 1   2 3 / R-M                         00960400
 0.0  0.284 0.40 0.4915  0.5753  0.75  0.9030  / RX          00960500
&31 3  1   / PLOT FOR PIJ                    00960600
 3 / NMAT                              00960700
FUELXM1X  0 2  293.0  0.9830  0.0  /1           00960800
XU050001  2 1  6.2530E-04                   00960900
XU080001  2 1  4.7205E-02                   00961000
CLADXM2X  0 1  293.0  0.1676  0.0  /2           00961100
XAL70001  2 1  5.17276E-02                  00961200
COOLXM3X  0 2  293.0  2.000  0.0  /3            00961300
XH01H001  0 1  6.6760E-02                   00961400
XO060001  0 1  3.3380E-02                   00961500
0 0  1 0 / IOPT(1:3),MREC -------- << REACTION RATE >> ------------+  00961600
 1 1 2  1 1 1 70(1.0) 0.7047902  36(0.0) / MPOSI,L235,L238,IX,IY,IX,FGS 00961700
 0   / PLOT FOR PEACO                         00961800
```

C-19: SRAC95 INPUT FOR TRX-2

```
TRX2
TRX-2 BENCHMARK PROBLEM .
 11112  143-20  00002  01100
 0.005469
J9347.PFASTJ32.DATA     OLD FILE                    01110000
J9347.PTHMLJ32.DATA     OLD FILE                    01120000
J9347.PMCRSJ32.DATA     OLD FILE                    01130000
J9062.FASTU.DATA     SCR CORE                       01140000
J9062.THERMALU.DATA     SCR CORE                    01150000
J9062.UMCROSS.DATA     SCR CORE                     01160000
J9062.MACROWRK.DATA     SCR CORE                    01170000
J9062.MACRO.DATA     SCR CORE                       01180000
J9062.FLUX.DATA     SCR CORE                        01190000
J9062.MICREF.DATA     SCR CORE                      01200000
61 46 0  0 /
```

```
61(1)     /
46(1)     /

6 7 7 3 1  1 7 0 0 0  5 0 10 3 0 0  0 6 0 0
0 100 50 5 5 5 0  0.00001  0.0001  0.001 1.0 100.0 0.1
1 1 1 2 3 3 3 / T-R
1   1 1   / R-X
1   2 3   / R-M
0.0  0.284 0.40 0.4915  0.5753  0.80  0.96  1.0870 / RX
3
METAXM1X  0 2  293.0  0.9830  0.0  /1
XU050001  2 1  6.2530E-04
XU080001  2 1  4.7205E-02
CLADXM3X  0 1  293.0  0.1676  0.0  /3
XAL70001  2 0  5.17276E-02
MOD1XM4X  0 2  293.0  2.000  0.0  /4
XH01H001  0 0  6.6760E-02
XO060001  0 0  3.3380E-02
0 0  1 0 / IOPT(1:3),MREC ---------- << REACTION RATE >> ------------+
1 1 2  1 1 1 70(1.0) 0.7047902  36(0.0) / MPOSI,L235,L238,IX,IY,IX,FGS
0/ PEACO
```

C-20: SRAC95 INPUT FOR BAPL-1

```
BAP1                                          00000010
BAPL-1 BENCHMARK PROBLEM . THERMAL CUT IS 2.3824 EV :          00000020
1 1 1 1 2  1 4 3 -2 0  0 0 0 0 2  2 1 1 0 0           00000030
0.003259                                      00000040
J9347.PFASTJ32.DATA     OLD FILE                         01110000
J9347.PTHMLJ32.DATA     OLD FILE                         01120000
J9347.PMCRSJ32.DATA     OLD FILE                         01130000
J9062.FASTU.DATA        SCR CORE                         01140000
J9062.THERMALU.DATA     SCR CORE                           01150000
J9062.UMCROSS.DATA      SCR CORE                          01160000
J9062.MACROWRK.DATA     SCR CORE                            01170000
J9062.MACRO.DATA        SCR CORE                         01180000
J9062.FLUX.DATA         SCR CORE                         01190000
J9062.MICREF.DATA       SCR CORE                         01200000
61 46 0  0/
61(1)     /
46(1)     /
                                            00000230
6 6 6 4 1  1 6 0 0 0  5 0 10 2 9 0  0 6 0 0           00000240
0 100 50 5 5 5 0  0.00001 0.0001  0.001 1.0 100.0 0.1        00000250
1 1 1 2 3 4 / T-R
1   1 1 1 / R-X
1   2 3 3 / R-M
0.0  0.284 0.40 0.4864  0.5753  0.70  0.7789 / RX         00000280
 3 / NMAT                                   00000430
UO21X11X  0 3  293.0  0.9728  0.0  /1            00000440
XU050001  2 1  3.1120E-04                       00000450
XU080001  2 1  2.3127E-02                       00000460
XO060001  0 0  4.6946E-02                       00000460
CLD1X12X  0 1  293.0  0.1778  0.0  /3            00000510
XAL70001  0 0  4.89943E-02                      00000520
MOD1X13X  0 2  293.0  2.000  0.0  /4             00000530
XH01H001  0 0  6.6760E-02                       00000540
```

```
XO060001  0 0  3.3380E-02                          00000550
0 0  1 0 / IOPT(1:3),MREC --------- << REACTION RATE >> ----------+  00001070
1 1 2  1 1 1 70(1.0) 0.7047902  36(0.0) / MPOSI,L235,L238,IX,IY,IX,FGS
0/ PEACO                                          00000690
```

C-21: SRAC95 INPUT FOR BAPL-2

```
BAP2                                          00000010
BAPL-2 BENCHMARK PROBLEM . THERMAL CUT IS 2.3824 EV :          00000020
1 1 1 1 2  1 4 3 -2 0  0 0 0 0 2  2 1 1 0 0           00000030
0.003547                                      00000040
J9347.PFASTJ32.DATA     OLD FILE                         01110000
J9347.PTHMLJ32.DATA     OLD FILE                         01120000
J9347.PMCRSJ32.DATA     OLD FILE                         01130000
J9062.FASTU.DATA        SCR CORE                         01140000
J9062.THERMALU.DATA     SCR CORE                           01150000
J9062.UMCROSS.DATA      SCR CORE                          01160000
J9062.MACROWRK.DATA     SCR CORE                            01170000
J9062.MACRO.DATA        SCR CORE                         01180000
J9062.FLUX.DATA         SCR CORE                         01190000
J9062.MICREF.DATA       SCR CORE                         01200000
61 46 0  0/
61(1)     /
46(1)     /
                                            00000230
6 6 6 4 1  1 6 0 0 0  5 0 10 2 9 0  0 6 0 0           00000240
0 100 50 5 5 5 0  0.00001 0.0001  0.001 1.0 100.0 0.1        00000250
1 1 1 2 3 4 / T-R
1   1 1 1 / R-X
1   2 3 3 / R-M
0.0  0.284 0.40 0.4864  0.5753  0.75  0.82615 / RX        00000280
 3 / NMAT                                   00000430
UO22X21X  0 3  293.0  0.9728  0.0  /1            00000440
XU050001  2 1  3.1120E-04                       00000450
XU080001  2 1  2.3127E-02                       00000460
XO060001  0 0  4.6946E-02                       00000460
CLD2X22X  0 1  293.0  0.1778  0.0  /3            00000510
XAL70001  0 0  4.89943E-02                      00000520
MOD2X23X  0 2  293.0  2.000  0.0  /4             00000530
XH01H001  0 0  6.6760E-02                       00000540
XO060001  0 0  3.3380E-02                       00000550
0 0  1 0 / IOPT(1:3),MREC --------- << REACTION RATE >> ----------+  00001070
1 1 2  1 1 1 70(1.0) 0.7047902  36(0.0) / MPOSI,L235,L238,IX,IY,IX,FGS
0/ PEACO                                          00000690
```

C-22: SRAC95 INPUT FOR BAPL-3

```
BAP3                                          00000010
BAPL-3 BENCHMARK PROBLEM . THERMAL CUT IS 2.3824 EV :          00000020
1 1 1 1 2  1 4 3 -2 0  0 0 0 0 2  2 1 1 0 0           00000030
0.003422                                      00000040
J9347.PFASTJ32.DATA     OLD FILE                         01110000
J9347.PTHMLJ32.DATA     OLD FILE                         01120000
J9347.PMCRSJ32.DATA     OLD FILE                         01130000
J9062.FASTU.DATA        SCR CORE                         01140000
J9062.THERMALU.DATA     SCR CORE                           01150000
```

```
J9062.UMCROSS.DATA     SCR CORE                 01160000
J9062.MACROWRK.DATA    SCR CORE                 01170000
J9062.MACRO.DATA       SCR CORE                 01180000
J9062.FLUX.DATA        SCR CORE                 01190000
J9062.MICREF.DATA      SCR CORE                 01200000
61 46 0 0/
61(1)    /
46(1)    /
                                      00000230
6 6 6 4 1  1 6 0 0 0  5 0 10 29 0  0 60 0            00000240
0 100 50 5 5 5 0  0.00001 0.0001  0.001 1.0 100.0 0.1      00000250
1 1 1 2 3 4 / T-R
1   1 1 1 / R-X
1   2 3 3 / R-M
0.0  0.284 0.40 0.4864  0.5753  0.77  0.90285 / RX         00000280
 3 / NMAT                                 00000430
UO23X31X  0 3  293.0  0.9728  0.0 /1                 00000440
XU050001  2 1  3.1120E-04                        00000450
XU080001  2 1  2.3127E-02                        00000460
XO060001  0 0  4.6946E-02                        00000460
CLD3X32X  0 1  293.0  0.1778  0.0  /3               00000510
XAL70001  0 0  4.89943E-02                       00000520
MOD3X33X  0 2  293.0  2.000  0.0  /4               00000530
XH01H001  0 0  6.6760E-02                        00000540
XO060001  0 0  3.3380E-02                        00000550
0 0  1 0 / IOPT(1:3),MREC ——— << REACTION RATE >> ————+  00001070
 1 1 2  1 1 1 70(1.0) 0.7047902  36(0.0) / MPOSI,L235,L238,IX,IY,IX,FGS
0/ PEACO                                 00000690
```

C-23: SRAC95 INPUT FOR TCA 150U

```
T15U
TCA 1.50U  BENCHMARK PROBLEM : PICTH 1.849 CM : 24X24 : B2 = 0.008700  00013600
 1 1 1 1 2  1 4 3 -2 0  0 0 0 0 2  2 1 0 0 0           00009900
 8.70000E-3                                00013800
J9347.PFASTJ32.DATA    OLD FILE                01110000
J9347.PTHMLJ32.DATA    OLD FILE                01120000
J9347.PMCRSJ32.DATA    OLD FILE                01130000
J9062.FASTU.DATA       SCR CORE                01140000
J9062.THERMALU.DATA    SCR CORE                01150000
J9062.UMCROSS.DATA     SCR CORE                01160000
J9062.MACROWRK.DATA    SCR CORE                01170000
J9062.MACRO.DATA       SCR CORE                01180000
J9062.FLUX.DATA        SCR CORE                01190000
J9062.MICREF.DATA      SCR CORE                01200000
61 46 0 0/                                 00010900
61(1)    /                                 00011000
46(1)    /                                 00011100
                                        00011200
 4 8 8 8 1  1 8 0 0 0  5 0 6 23 0  0 45 0            00011300
0 100 50 5 5 5 0  0.00001  0.0001  0.001 1.0 100.0 0.1     00011400
   8(1)  / R-X                              00011500
1 1 1 2 3 3 3 3 / R-M                          00011600
0.0  0.360844 0.510310  0.625000 0.708500              00011700
   0.805319 0.891687  0.970398 0.924500  / RX
3 / NMAT                                   00013810
PIN2XP2X  0 3  300.0  1.2500  0.0 /1                 00013900
XU050001  2 0  6.08600E-04                       00014000
XU080001  2 0  2.25500E-02                       00014100
XO060001  0 0  4.72500E-02                       00014200
CLD2XC2X  0 1  300.0  0.1670  0.0 /2                00014300
XAL70001  2 0  5.58700E-02                       00014400
MOD2XM2X  0 2  300.0  2.000  0.0 /3                00014500
XH01H001  0 0  6.6760E-02                        00014600
XO060001  0 0  3.3380E-02                        00014700
0/ PEACO                                   00015300
```

C-24: SRAC95 INPUT FOR TCA 183U

```
T18U                                       00009700
TCA 1.83U  BENCHMARK PROBLEM : PICTH 1.956 CM : 22X22 : B2 = 0.009330  00013600
 1 1 1 1 2  1 4 3 -2 0  0 0 0 0 2  2 1 0 0 0           00009900
 9.33000E-3                                00013800
J9347.PFASTJ32.DATA    OLD FILE                01110000
J9347.PTHMLJ32.DATA    OLD FILE                01120000
J9347.PMCRSJ32.DATA    OLD FILE                01130000
J9062.FASTU.DATA       SCR CORE                01140000
J9062.THERMALU.DATA    SCR CORE                01150000
J9062.UMCROSS.DATA     SCR CORE                01160000
J9062.MACROWRK.DATA    SCR CORE                01170000
J9062.MACRO.DATA       SCR CORE                01180000
J9062.FLUX.DATA        SCR CORE                01190000
J9062.MICREF.DATA      SCR CORE                01200000
61 46 0 0/                                 00010900
61(1)    /                                 00011000
46(1)    /                                 00011100
                                        00011200
 4 9 9 9 1  1 9 0 0 0  5 0 6 23 0  0 45 0            00011300
0 100 50 5 5 5 0  0.00001  0.0001  0.001 1.0 100.0 0.1     00011400
   9(1)  / R-X                              00011500
1 1 1 2 3 3 3 3 3 / R-M                        00011600
0.0 0.360844 0.510310 0.6250  0.7085                00011700
   0.803209 0.887872 0.965137 1.036659  0.97800 / RX
3 / NMAT                                   00013810
PIN2XP2X  0 3  300.0  1.2500  0.0 /1                 00013900
XU050001  2 0  6.08600E-04                       00014000
XU080001  2 0  2.25500E-02                       00014100
XO060001  0 0  4.72500E-02                       00014200
CLD2XC2X  0 1  300.0  0.1670  0.0 /2                00014300
XAL70001  2 0  5.58700E-02                       00014400
MOD2XM2X  0 2  300.0  2.000  0.0 /3                00014500
XH01H001  0 0  6.6760E-02                        00014600
XO060001  0 0  3.3380E-02                        00014700
0/ PEACO                                   00015300
```

C-25: SRAC95 INPUT FOR TCA 248U

```
T24U                                       00009700
TCA 2.48U  BENCHMARK PROBLEM : PICTH 2.150 CM : 20X20 : B2 = 0.009890  00013600
 1 1 1 1 2  1 4 3 -2 0  0 0 0 0 2  2 1 0 0 0           00009900
9.89000E-3                                 00013800
J9347.PFASTJ32.DATA    OLD FILE                01110000
J9347.PTHMLJ32.DATA    OLD FILE                01120000
```

```
J9347.PMCRSJ32.DATA    OLD FILE                01130000
J9062.FASTU.DATA       SCR CORE                01140000
J9062.THERMALU.DATA    SCR CORE                  01150000
J9062.UMCROSS.DATA     SCR CORE                 01160000
J9062.MACROWRK.DATA    SCR CORE                   01170000
J9062.MACRO.DATA       SCR CORE                01180000
J9062.FLUX.DATA        SCR CORE               01190000
J9062.MICREF.DATA      SCR CORE                01200000
61 46 0 0/                            00010900
61(1)    /                           00011000
46(1)    /                           00011100
                                    00011200
4 11 11 11 1  1 11 0 0 0  5 0 6 23 0  0 45 0        00011300
0 100 50 5 5 5 0  0.00001  0.0001  0.001 1.0 100.0 0.1     00011400
  11(1)  / R-X                          00011500
1 1 1 2 7(3)  / R-M                        00011600
0.0  0.360844 0.510310 0.6250  0.70850              00011700
0.800288 0.882580 0.957829 1.027582 1.090289 1.154513 1.07500 / RX  00011700
3 / NMAT                               00013810
PIN2XP2X  0 3  300.0  1.2500  0.0 /1          00013900
XU050001  2 0  6.08600E-04                00014000
XU080001  2 0  2.25500E-02                00014100
XO060001  0 0  4.72500E-02                00014200
CLD2XC2X  0 1  300.0  0.1670  0.0 /2          00014300
XAL70001  2 0  5.58700E-02                00014400
MOD2XM2X  0 2  300.0  2.000  0.0 /3           00014500
XH01H001  0 0  6.6760E-02                 00014600
XO060001  0 0  3.3380E-02                 00014700
0/ PEACO                              00015300
```

C-26: SRAC95 INPUT FOR TCA 300U

```
T30U
TCA 3.00U  BENCHMARK PROBLEM : PICTH 2.293 CM : 19X19 : B2 = 0.009680  00013600
1 1 1 1 2  1 4 3 -2 0  0 0 0 0 2  2 1 0 0 0        00009900
9.68000E-3                            00013800
J9347.PFASTJ32.DATA    OLD FILE                01110000
J9347.PTHMLJ32.DATA    OLD FILE                 01120000
J9347.PMCRSJ32.DATA    OLD FILE                 01130000
J9062.FASTU.DATA       SCR CORE                01140000
J9062.THERMALU.DATA    SCR CORE                  01150000
J9062.UMCROSS.DATA     SCR CORE                 01160000
J9062.MACROWRK.DATA    SCR CORE                   01170000
J9062.MACRO.DATA       SCR CORE                01180000
J9062.FLUX.DATA        SCR CORE               01190000
J9062.MICREF.DATA      SCR CORE                01200000
61 46 0 0/                            00010900
61(1)    /                           00011000
46(1)    /                           00011100
                                    00011200
4 15 15 11 1  1 15 0 0 0  5 0 6 23 0  0 45 0        00011710
0 100 50 5 5 5 0  0.00001  0.0001  0.001 1.0 100.0 0.1     00011720
1 2 3 4 5 5 5 6 6 7 7 8 9 10 11
  11(1)  / R-X                          00011730
1 1 1 2 3 3 3 3 3 3 3 / R-M                    00011740
0.0  0.360844 0.510310 0.6250  0.70850              00011750
0.737 0.765 0.818 0.868 0.914730 0.959 1.002053 1.082353 1.157094
1.227292 1.14650
3 / NMAT                               00013810
PIN2XP2X  0 3  300.0  1.2500  0.0 /1          00013900
XU050001  2 0  6.08600E-04                00014000
XU080001  2 0  2.25500E-02                00014100
XO060001  0 0  4.72500E-02                00014200
CLD2XC2X  0 1  300.0  0.1670  0.0 /2          00014300
XAL70001  2 0  5.58700E-02                00014400
MOD2XM2X  0 2  300.0  2.000  0.0 /3           00014500
XH01H001  0 0  6.6760E-02                 00014600
XO060001  0 0  3.3380E-02                 00014700
0/ PEACO                              00015300
```

C-27: SRAC95 INPUT FOR TCA 242PU

```
T242
TCA 2.42PU BENCHMARK PROBLEM . USING CRITICAL BUCKLING = 0.00808
1 1 1 1 2  1 4 3 -2 0  0 0 0 0 2  0 1 0 0 0
0.0080800
J9347.PFASTJ32.DATA    OLD FILE                01110000
J9347.PTHMLJ32.DATA    OLD FILE                 01120000
J9347.PMCRSJ32.DATA    OLD FILE                 01130000
J9062.FASTU.DATA       SCR CORE                01140000
J9062.THERMALU.DATA    SCR CORE                  01150000
J9062.UMCROSS.DATA     SCR CORE                 01160000
J9062.MACROWRK.DATA    SCR CORE                   01170000
J9062.MACRO.DATA       SCR CORE                01180000
J9062.FLUX.DATA        SCR CORE               01190000
J9062.MICREF.DATA      SCR CORE                01200000
61 46 0 0/
61(1)    /
46(1)    /

4 7 7 7 1  1 7 0 0 0  5 0 6 23 0  0 45 0
0 100 50 5 5 5 0  0.00001  0.0001  0.001 1.0 100.0 0.1
  7(1)  / R-X
1 1 1 2 3 3 3 / R-M
0.0  0.3074 0.4348  0.5325  0.6115  0.77632 0.91182  0.91250/ RX
3
PIN2XP2X  0 10  300.0  1.0650  0.0 /1
XU040001  2 0  7.43600E-07
XU050001  2 0  9.39300E-05
XU080001  2 0  1.29500E-02
XPU80001  2 0  2.00000E-06
XPU90001  2 0  2.74900E-04
XPU00001  2 0  8.84300E-05
XPU10001  2 0  2.81900E-05
XPU20001  2 0  8.12400E-06
XAM10001  2 0  1.05900E-06
XO060001  0 0  2.78400E-02
CLD2XC2X  0 1  300.0  0.1580  0.0 /3
XZRN0001  2 0  3.84000E-02
MOD2XM2X  0 2  300.0  2.000  0.0 /4
XH01H001  0 0  6.6760E-02
XO060001  0 0  3.3380E-02
0/ PEACO
```

C-28: SRAC95 INPUT FOR TCA 298PU

```
T298
TCA 2.98PU BENCHMARK PROBLEM . USING CRITICAL BUCKLING = 0.00828
 1 1 1 1 2  1 4 3 -2 0  0 0 0 0 2  0 1 0 0 0
 0.0082800
J9347.PFASTJ32.DATA     OLD FILE                 01110000
J9347.PTHMLJ32.DATA     OLD FILE                 01120000
J9347.PMCRSJ32.DATA     OLD FILE                 01130000
J9062.FASTU.DATA        SCR CORE                 01140000
J9062.THERMALU.DATA     SCR CORE                 01150000
J9062.UMCROSS.DATA      SCR CORE                 01160000
J9062.MACROWRK.DATA     SCR CORE                 01170000
J9062.MACRO.DATA        SCR CORE                 01180000
J9062.FLUX.DATA         SCR CORE                 01190000
J9062.MICREF.DATA       SCR CORE                 01200000
61 46 0 0/
61(1)   /
46(1)   /

 4 8 8 8 1  1 8 0 0 0  5 0 6 2 3 0  0 4 5 0
 0 100 50 5 5 5 0 0.00001 0.0001 0.001 1.0 100.0 0.1
  8(1)   / R-X
 1 1 1 2 3 3 3 3 / R-M
 0.0 0.3074 0.4348 0.5325 0.6115 0.76479 0.89212 1.0034 0.9780 / RX
 3
PIN2XP2X  0 10  300.0  1.0650 0.0 /1
XU040001  2 0  7.43600E-07
XU050001  2 0  9.39300E-05
XU080001  2 0  1.29500E-02
XPU80001  2 0  2.00000E-06
XPU90001  2 0  2.74900E-04
XPU00001  2 0  8.84300E-05
XPU10001  2 0  2.81900E-05
XPU20001  2 0  8.12400E-06
XAM10001  2 0  1.05900E-06
XO060001  0 0  2.78400E-02
CLD2XC2X  0 1  300.0  0.1580 0.0 /3
XZRN0001  2 0  3.84000E-02
MOD2XM2X  0 2  300.0  2.000  0.0 /4
XH01H001  0 0  6.6760E-02
XO060001  0 0  3.3380E-02
0/ PEACO
```

C-29: SRAC95 INPUT FOR TCA 424PU

```
T424
TCA 4.24PU BENCHMARK PROBLEM . USING CRITICAL BUCKLING = 0.00779
 1 1 1 1 2  1 4 3 -2 0  0 0 0 0 2  0 1 0 0 0
 0.0077900
J9347.PFASTJ32.DATA     OLD FILE                 01110000
J9347.PTHMLJ32.DATA     OLD FILE                 01120000
J9347.PMCRSJ32.DATA     OLD FILE                 01130000
J9062.FASTU.DATA        SCR CORE                 01140000
J9062.THERMALU.DATA     SCR CORE                 01150000
J9062.UMCROSS.DATA      SCR CORE                 01160000
J9062.MACROWRK.DATA     SCR CORE                 01170000
J9062.MACRO.DATA        SCR CORE                 01180000
J9062.FLUX.DATA         SCR CORE                 01190000
J9062.MICREF.DATA       SCR CORE                 01200000
61 46 0 0/
61(1)   /
46(1)   /

 4 9 9 9 1  1 9 0 0 0  5 0 6 2 3 0  0 4 5 0
 0 100 50 5 5 5 0 0.00001 0.0001 0.001 1.0 100.0 0.1
  9(1)  / R-X
 1 1 1 2 3 3 3 3 3 / R-M
 0.0 0.3074 0.4348 0.5325 0.6115 0.78378 0.9245 1.0465 1.1556 1.1125/RX
 3
PIN2XP2X  0 10  300.0  1.0650 0.0 /1
XU040001  2 0  7.43600E-07
XU050001  2 0  9.39300E-05
XU080001  2 0  1.29500E-02
XPU80001  2 0  2.00000E-06
XPU90001  2 0  2.74900E-04
XPU00001  2 0  8.84300E-05
XPU10001  2 0  2.81900E-05
XPU20001  2 0  8.12400E-06
XAM10001  2 0  1.05900E-06
XO060001  0 0  2.78400E-02
CLD2XC2X  0 1  300.0  0.1580 0.0 /3
XZRN0001  2 0  3.84000E-02
MOD2XM2X  0 2  300.0  2.000  0.0 /4
XH01H001  0 0  6.6760E-02
XO060001  0 0  3.3380E-02
0/ PEACO
```

C-30: SRAC95 INPUT FOR TCA 555PU

```
T555
TCA 5.55PU BENCHMARK PROBLEM . USING CRITICAL BUCKLING = 0.00651
 1 1 1 1 2  1 4 3 -2 0  0 0 0 0 2  0 1 0 0 0
 0.0065100
J9347.PFASTJ32.DATA     OLD FILE                 01110000
J9347.PTHMLJ32.DATA     OLD FILE                 01120000
J9347.PMCRSJ32.DATA     OLD FILE                 01130000
J9062.FASTU.DATA        SCR CORE                 01140000
J9062.THERMALU.DATA     SCR CORE                 01150000
J9062.UMCROSS.DATA      SCR CORE                 01160000
J9062.MACROWRK.DATA     SCR CORE                 01170000
J9062.MACRO.DATA        SCR CORE                 01180000
J9062.FLUX.DATA         SCR CORE                 01190000
J9062.MICREF.DATA       SCR CORE                 01200000
61 46 0 0/
61(1)   /
46(1)   /

 4 11 11 11 1  1 11 0 0 0  5 0 6 2 3 0  0 4 5 0
 0 100 50 5 5 5 0 0.00001 0.0001 0.001 1.0 100.0 0.1
  11(1)  / R-X
 1 1 1 2 3 3 3 3 3 3 3 / R-M
 0.0 0.3074 0.4348 0.5325 0.6115 0.77385 0.9076 1.0240 1.1285
   1.2241 1.3200 1.2370 / RX
```

```
3
PIN2XP2X  0 10  300.0  1.0650  0.0 /1
XU040001  2 0  7.43600E-07
XU050001  2 0  9.39300E-05
XU080001  2 0  1.29500E-02
XPU80001  2 0  2.00000E-06
XPU90001  2 0  2.74900E-04
XPU00001  2 0  8.84300E-05
XPU10001  2 0  2.81900E-05
XPU20001  2 0  8.12400E-06
XAM10001  2 0  1.05900E-06
XO060001  0 0  2.78400E-02
CLD2XC2X  0 1  300.0  0.1580  0.0  /3
XZRN0001  2 0  3.84000E-02
MOD2XM2X  0 2  300.0  2.000  0.0  /4
XH01H001  0 0  6.6760E-02
XO060001  0 0  3.3380E-02
0/ PEACO
```

C-31: SRAC95 INPUT FOR NEA V6E8

```
V6E8
CELL (BURNUP) CALCULATION BY PIJ WITH COOLING OPTION :  65 FP CHAIN
1 1 1 1 2  1 4 3 -2 1  0 0 0 0 2  0 1 0 0 0 / SRAC CONTROL
1.00E-15  / GEOMETRICAL BUCKLING
J9347.PFASTJ32.DATA     OLD  FILE
J9347.PTHMLJ32.DATA     OLD  FILE
J9347.PMCRSJ32.DATA     OLD  FILE
J4244.FASTU.DATA        SCR  CORE
J4244.THERMALU.DATA     SCR  CORE
J4244.UMCROSS.DATA      SCR  CORE
J4244.MACROWRK.DATA     SCR  CORE
J4244.MACRO.DATA        NEW  CORE
J4244.FLUX.DATA         SCR  CORE
J4244.MICREF.DATA       SCR  CORE
61 46  1 1 /  107 GROUP => 2 GROUP
61(1)    /
46(1)    /
61       /
46       /

 6 5 5 3 1   1 5 0 0 0   5 0 6 1 5 0   0 3 0 0  / PATH             00012300
 0 20 50 5 5 5 -1  0.0001 0.00001 0.001 1.0 10. 0.5 /                00012400
 1 1 1 2 3 / T-R                                      00012500
 3(1)  / R-X                                          00012600
 1 2 3  / M-R                                         00012700
0.0 0.236714 0.334764 0.41 0.475 0.544150 / D : 0.95 VM/VP : 0.6        00000100
 3 / NMAT                                             00000200
FUELX01X  0 7 900.0 0.82 0.0 / MAT 1 ; FUEL ROD UO2/PUO2              00000300
XU050009  2 0 6.0940E-05   /1   ----------                 00000100
XU080009  2 0 2.0250E-02   /2   ENRICHMENT 8.0%                  00000200
XPU90009  2 0 1.5630E-03   /3   ----------                 00000300
XPU00009  2 0 6.8720E-04   /4                            00000400
XPU10009  2 0 2.7650E-04   /5                            00000500
XPU20009  2 0 2.1080E-04   /6                            00000600
XO060009  0 0 4.6100E-02   /7                            00000800
MAT2X0BX  0 4 600. 0.13      0.0    / MAT  2 : CLADDING          00013000
XFEN0008  2 0 4.8310E-02   / 1                          00013300
XCRN0008  2 0 1.5700E-02   / 2                          00013400
XNIN0008  2 0 7.6480E-03   / 3                          00013400
XMN50008  2 0 1.4860E-03   / 4                          00013400
MAT3XLWX  0 2 600. 1.0      0.0     / MAT  3 : LIGHT WATER        00013500
XH01H008  0 0 4.7440E-02   / 1 VVVVVVVVVVVV                    00013600
XO060008  0 0 2.3720E-02   / 2 VVVVVVVVVVVV                    00013700
0  /  PEACO                                  0001440
```

C-32: SRAC95 INPUT FOR NEA V1E7

```
V1E7
CELL (BURNUP) CALCULATION BY PIJ WITH COOLING OPTION :  65 FP CHAIN
1 1 1 1 2  1 4 3 -2 1  0 0 0 0 2  0 1 0 0 0 / SRAC CONTROL
1.00E-15   / GEOMETRICAL BUCKLING
J9347.PFASTJ32.DATA     OLD  FILE
J9347.PTHMLJ32.DATA     OLD  FILE
J9347.PMCRSJ32.DATA     OLD  FILE
J4244.FASTU.DATA        SCR  CORE
J4244.THERMALU.DATA     SCR  CORE
J4244.UMCROSS.DATA      SCR  CORE
J4244.MACROWRK.DATA     SCR  CORE
J4244.MACRO.DATA        NEW  CORE
J4244.FLUX.DATA         SCR  CORE
J4244.MICREF.DATA       SCR  CORE
61 46  1 1 /  107 GROUP => 2 GROUP
61(1)    /
46(1)    /
61       /
46       /

 6 5 5 3 1   1 5 0 0 0   5 0 6 3 0 0   0 6 0 0  / PATH
 0 100 100 5 5 5 -1  0.0001 0.00001 0.001 1.0 10. 0.5  /
 1 1 1 2 3 / T-R
 3(1)  / R-X
 1 2 3  / M-R
0.0 0.236714 0.334764 0.41 0.475 0.610200 / D : 0.95 VM/VP : 1.1
 3 / NMAT
FUELX01X  0 7 900.0 0.82 0.0 / MAT 1 ; FUEL ROD UO2/PUO2
XU050009  2 0 6.1940E-05   /1   ----------
XU080009  2 0 2.0580E-02   /2   ENRICHMENT 7.0%
XPU90009  2 0 1.3670E-03   /3   ----------
XPU00009  2 0 6.0090E-04   /4
XPU10009  2 0 2.4180E-04   /5
XPU20009  2 0 1.8440E-04   /6
XO060009  0 0 4.6080E-02   /7
MAT2X0BX  0 1 600. 0.13      0.0    / MAT  2 : CLADDING
XZRN0008  2 0 3.7020E-02   / 1
MAT3XLWX  0 2 600. 1.0       0.0    / MAT  3 : LIGHT WATER
XH01H008  0 0 4.7440E-02   / 1 VOID 0%
XO060008  0 0 2.3720E-02   / 2
0  / PEACO
```

C-33: SRAC95 INPUT FOR NEA-A

```
NEAA
NEAA - BENCHMARK PROBLEM
1 1 1 1 2  1 4 3 -2 1  0 0 0 0 2  0 1 0 0 0 / SRAC CONTROL
1.00E-30  / GEOMETRICAL BUCKLING
J9347.PFASTJ32.DATA    OLD FILE
J9347.PTHMLJ32.DATA    OLD FILE
J9347.PMCRSJ32.DATA    OLD FILE
J4244.FASTU.DATA       SCR CORE
J4244.THERMALU.DATA    SCR CORE
J4244.UMCROSS.DATA     SCR CORE
J4244.MACROWRK.DATA    SCR CORE
J4244.MACRO.DATA       NEW CORE
J4244.FLUX.DATA        SCR CORE
J4244.MICREF.DATA      SCR CORE
61 46  1 1 /  107 GROUP => 2 GROUP
61(1)   /
46(1)   /
61      /
46      /

4 7 7 3 1  1 7 0 0 0  5 0 6 2 3 0  0 4 5 0  / PATH            00012300
0 50 50 5 5 5 -1  0.0001 0.00001 0.001 1.0 10. 0.5 /          00012400
1 1 1 2 3 3 3/T-R                                       00012500
3(1)  / R-X                                             00012600
1 2 3  / M-R                                            00012700
0.0 0.2364 0.3344 0.4095  0.475  0.5774 0.6642  0.656650 /        00000100
 3 / NMAT                                               00000200
FUELX01X  0 8 933.0 0.819  0.0 / MAT 1 : FUEL                    00000300
XU050009  2 0 1.4456E-04   /1                               00000100
XU080009  2 0 1.9939E-02   /2                               00000200
XPU80009  2 0 1.1467E-04   /3                               00000300
XPU90009  2 0 1.0285E-03   /4                               00000300
XPU00009  2 0 7.9657E-04   /5                               00000400
XPU10009  2 0 3.3997E-04   /6                               00000500
XPU20009  2 0 5.6388E-04   /7                               00000600
XO060009  2 0 4.5854E-02   /8                               00000600
MAT2X0BX  0 1 579.3  0.131  0.0    / MAT  2 : CLADDING          00013000
XZRN0008  2 0 4.3248E-02   / 1                              00013400
MAT3XLWX  0 4 579.3 1.0    0.0    / MAT  3 : LIGHT WATER        00013500
XH01H008  0 0 4.7716E-02   / 1 VVVVVVVVVVV                     00013600
XO060008  0 0 2.3858E-02   / 2 VVVVVVVVVVV                     00013700
XB000008  0 0 3.6346E-06   / 2 VVVVVVVVVVV                     00013700
XB010008  0 0 1.6226E-05   / 2 VVVVVVVVVVV                     00013700
0  /  PEACO                                             00014400
```

C-34 : SRAC95 INPUT FOR NEA-B

```
NEAB
NEAB - BENCHMARK PROBLEM
1 1 1 1 2  1 4 3 -2 1  0 0 0 0 2  0 1 0 0 0 / SRAC CONTROL
1.00E-30  / GEOMETRICAL BUCKLING
J9347.PFASTJ32.DATA    OLD FILE
J9347.PTHMLJ32.DATA    OLD FILE
J9347.PMCRSJ32.DATA    OLD FILE
J4244.FASTU.DATA       SCR CORE
J4244.THERMALU.DATA    SCR CORE
J4244.UMCROSS.DATA     SCR CORE
J4244.MACROWRK.DATA    SCR CORE
J4244.MACRO.DATA       NEW CORE
J4244.FLUX.DATA        SCR CORE
J4244.MICREF.DATA      SCR CORE
61 46  1 1 /  107 GROUP => 2 GROUP
61(1)   /
46(1)   /
61      /
46      /

4 7 7 3 1  1 7 0 0 0  5 0 6 2 3 0  0 4 5 0  / PATH            00012300
0 50 50 5 5 5 -1  0.0001 0.00001 0.001 1.0 10. 0.5 /          00012400
1 1 1 2 3 3 3 / T-R                                     00012500
3(1)  / R-X                                             00012600
1 2 3  / M-R                                            00012700
0.0 0.2364 0.3344 0.4095  0.475 0.5774 0.6642 0.656650 /          00000100
 3 / NMAT                                               00000200
FUELX01X  0 9 933.0 0.819  0.0 / MAT 1 ; FUEL ROD UO2/PUO2       00000300
XU040009  2 0 2.4626E-07   /1                               00000100
XU050009  2 0 5.1515E-05   /2                               00000100
XU080009  2 0 2.0295E-02   /3                               00000200
XPU80009  2 0 2.1800E-05   /4                               00000300
XPU90009  2 0 7.1155E-04   /5                               00000300
XPU00009  2 0 2.7623E-04   /6                               00000400
XPU10009  2 0 1.4591E-04   /7                               00000500
XPU20009  2 0 4.7643E-05   /8                               00000600
XO060009  2 0 4.3100E-02   /9                               00000600
MAT2X0BX  0 1 579.3  0.131  0.0    / MAT  2 : CLADDING          00013000
XZRN0008  2 0 4.3248E-02   / 1                              00013400
MAT3XLWX  0 4 579.3  1.0   0.0    / MAT  3 : MODERATOR          00013500
XH01H008  0 0 4.7716E-02   / 1 VVVVVVVVVVV                     00013600
XO060008  0 0 2.3858E-03   / 2 VVVVVVVVVVV                     00013700
XB000008  0 0 3.6346E-06   / 2 VVVVVVVVVVV                     00013700
XB010008  0 0 1.6226E-05   / 2 VVVVVVVVVVV                     00013700
0  /  PEACO                                             00014400
```