JAERI-Research
96-010

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March 1996

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編集兼発行　日本原子力研究所

印　　刷　㈱原子力資料サービス

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(Received January 31, 1996)

The applicability of JENDL-3.2 to fast reactor calculations is better than that of JENDL-3.1 and the improved characteristics are mainly as follows:

(1) For Pu fueled cores, the effective multiplication factors overestimated by JENDL-3.1 were considerably improved by JENDL-3.2, because the fission spectrum of ^{239}Pu and inelastic scattering cross sections of ^{238}U and Fe in the JENDL-3.2 file were revised.

(2) For a large U fueled core ZPR-6-6A, the effective multiplication factor calculated by JENDL-3.2 is in good agreement with the experimental value. This is due to a 14% decrease in the capture resonance integral of ^{235}U in JENDL-3.2 than that in JENDL-3.1.

(3) The ratios of ^{238}U fission to ^{235}U fission obtained by using JENDL-3.2 are smaller by about 4% on the average than those by JENDL-3.1 due to the softer fission spectrum of JENDL-3.2 file than the Madland-Nix one of JENDL-3.1.

(4) It is found that the effect of the difference in the ^{238}U inelastic scattering cross sections between JENDL-3.2 and ENDF/B-VI is 1.4% on averaged value for effective multiplication factor. This is due to considerable different evaluation for discrete and continuum inelastic scattering data.

Keywords: Benchmark Test, Sensitivity Analysis, Group Constant Set, Nuclear Data File, JENDL-3.2, Fast Reactor, Integral Quantity,Effective Multiplication Factor, Central Reaction Rate Ratio, Fission Spectrum, ENDF/B-VI, Inelastic Scattering Cross Section, ^{238}U, Capture Cross Section, ^{235}U.

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高速炉ベンチマーク計算に基づいたJENDL-3.2の感度解析

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（1996年1月31日受理）

JENDL-3.2は，JENDL-3.1より高速炉核特性計算への適用性がよく，それらの主な特徴は以下のようである。

(1) JENDL-3.2における^{239}Puの核分裂スペクトル，^{238}U及びFeの非弾性散乱断面積の再評価により，Pu炉心の実効増倍係数が改善されている。

(2) JENDL-3.2による大型ウラン炉心ZPR-6-6Aの実効増倍係数は実験値との一致がよい。これは，JENDL-3.2の^{235}U捕獲共鳴積分値が，JENDL-3.1より14%小さく評価されているためである。

(3) JENDL-3.2がMadland-Nixより柔らかい核分裂スペクトルを採用したことにより，中心反応率比^{238}U(n,f)／^{235}U(n,f)は4％小さくなり，結果は改善される。

(4) ENDF/B-VIとJENDL-3.2の^{238}U非弾性散乱断面積の相違は，実効増倍係数に平均して1.4%の大きな影響を及ぼした。これは，両者で分離レベルと連続レベルの評価に極めて大きな相違があるためである。

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1. Introduction

Some problems of the JENDL-3.1 data file were revealed through various benchmark tests[1]. As its updated file, the JENDL-3.2P data was prepared in January 1994. The JENDL-3.2P file is the preliminary version of the JENDL-3 Revision 2, JENDL-3.2 file. The benchmark tests of JENDL-3.2P for thermal and fast reactors have been already reported in the international conference of Nuclear Data for Science and Technology, Gatlinburg, May, 1994[2]. After modifying the inelastic scattering cross sections of ^{238}U and fission spectrum of ^{233}U in the JENDL-3.2P file, the JENDL-3.2 data file[3] was released in June 1994. The JENDL-3.2 file as the final version requires further verification and validation. In this paper, the benchmark calculations of JENDL-3.2 for 21 fast reactor benchmark assemblies are shown and compared with those by the JENDL-3.2P and JENDL-3.1 files .The results of the benchmark calculations are discussed as related to the major characteristics of JENDL-3.2. In order to analyze the discrepancies among the results calculated with JENDL-3.2 , JENDL-3.1 and ENDF / B-VI , the effects of important nuclide cross sections or fission spectrum of the JENDL-3.1 and ENDF / B-VI files on the integral quantities are studied by performing a sensitivity analysis based on benchmark calculations .

2. Fast reactor benchmark assemblies

The fast reactor benchmark assemblies consist of 18 critical assemblies selected by Hardie et al.[4], the MOZART cores (MZA and MZB) and the JOYO mock-up core FCA-5-2 . Table 1 gives main characteristics of 21 fast critical assemblies . Asshown in Table 1, these assemblies have very wide varieties from 12 to 4000 liters in core size, from almost no fertile to 8.6 concentration ratio of fertile to fissile in the core and 14-plutonium, 6-uranium and 1-plutonium plus uranium cores .

The ZPPR-2, ZPR-6-7 and ZPR-6-6A are large critical assemblies, and ZPPR-2 and ZPR-6-7 are similar in composition to a large LMFBR . The ZPR-6-7 and ZPR-6-6A are designed to be as identical as possible, but ZPR-6-6A has ^{235}U core .

1. Introduction

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3 . Benchmark calculations

For the benchmark calculations, the group constant sets (JFS-3 type) with 70-group structure have been generated from different nuclear data files by using a processing code system TIMS-PGG [5] . The group constant set JFS-3-J31 , for example , was generated from the JENDL-3.1 file. All the benchmark calculations for different group constant sets are performed by the JAERI benchmark code system based on one-dimensional diffusion model (BENCH-1D) . The procedure of benchmark calculations in this study is shown as follows :

(1) The called.BENCHN1D data pool library file is created by using a utility code PDSEDIT , and it includes group averaged data processed from the original nuclear data files: JENDL-3.2, JENDL-3.2P, JENDL-3.1, JENDL-2 and ENDF/B-VI.

(2) The group constant sets are produced from the created BENCHN1D data library by using a code PDSMAKE . The group constant sets generated are called JFS-3-J32 , JFS-3-J32P , JFS-3-J31 , JFS-3-J32NJ31 and JFS-3-J32NB6 .

The JFS-3-J32NJ31 sets , which are mixed libraries of JENDL-3.2 and JENDL-3.1, consist of 11 sets which are expressed as U235J31 ,U238J31 , Pu239J31 , Pu240J31 , Pu241J31 , FeJ31 , NiJ31 , NaJ31 , XU238J31 , XU235J31and XP239J31 . The U235J31 set , for example , is generated based on JENDL-3.2 and only the cross sections of ^{235}U are from JENDL-3.1 ; the XU235J31 set is also generated based on JENDL-3.2 and the fission spectrum of ^{235}U is from JENDL-3.1 . The JFS-3-J32NB6 sets , mixed libraries of JENDL-3.2 and ENDF/B-VI, include 8 sets which are U235B6 , U238B6 , Pu239B6 , Pu240B6 , Pu241B6 , XU235B6 , XU238B6 , XPu239B6. In the JFS-3-J32NB6 sets , B6 means the ENDF / B-VI data file .

(3) Integral quantities (effective multiplication factor and central reaction rate ratio) for the 21 fast reactor benchmark assemblies are calculated by a homogeneous one-dimensional diffusion code EXPANDA .

(4) Benchmark calculations for the different group constant sets are summarized by using a code BENCH .

The integral quantities obtained with the different group constant sets are compared in the ratio of calculation to experimental value (C / E-value) for the 21 benchmark assemblies . The effective multiplication factors calculated with the homogeneous 1-D diffusion code are corrected by using the correction factors of 1 to 2D , diffusion to transport , heterogeneity[6] . Table 2 shows the correction values of the effective multiplication factors calculated for the 21 one-dimensional fast reactor benchmark cores . The nuclides and nuclear data files used for main group constant sets are shown in Table 3 .

4 . Results and discussions

Table 4 gives the C / E - values for the effective multiplication factors which are obtained with the JFS-3-J32 , JFS-3-J32P and JFS-3-J31 sets , and Fig . 1 shows them as a function of core volume for the 21 benchmark assemblies . Tables 5 - 9 give the C / E- values for the central reaction rate ratios and these results are shown as a function of core volume in Figs . 2 - 6 .

4.1 Comparison of Benchmark Calculations for the JENDL-3.2 and JENDL-3.1 sets

4.1.1 Effective multiplication factor

(1) Plutonium cores

It is shown from Table 4 that all the results obtained with the JFS-3-J32 set are smaller than those with the JFS-3-J31 set for 15 benchmark cores and the averaged value for the JFS-3-J32 set is 0.998, while 1.004 for JFS-3-J31. It is also observed from Table 4 that the benchmark results calculated with the JFS-3-J31 set have a tendency to overestimate the experimental value and this tendency are considerably improved by using the JFS-3-J32 set .

(4) Benchmark calculations for the different group constant sets are summarized by using a code BENCH.

The integral quantities obtained with the different group constant sets are compared in the ratio of calculation to experimental value (C/E-value) for the 21 benchmark assemblies. The effective multiplication factors calculated with the homogeneous 1-D diffusion code are corrected by using the correction factors of 1 to 2D, diffusion to transport, heterogeneity [6]. Table 2 shows the correction values of the effective multiplication factors calculated for the 21 one-dimensional fast reactor benchmark cores. The nuclides and nuclear data files used for main group constant sets are shown in Table 3.

4. Results and discussions

Table 4 gives the C/E-values for the effective multiplication factors which are obtained with the JFS-3-J32, JFS-3-J32P and JFS-3-J31 sets, and Fig. 1 shows them as a function of core volume for the 21 benchmark assemblies. Tables 5 - 9 give the C/E-values for the central reaction rate ratios and these results are shown as a function of core volume in Figs. 2 - 6.

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Table 10.1 gives the comparison for effective multiplication factors between the JFS-3-J32 and JFS-3-J32NJ31 sets. All the results obtained with the JFS-3-J32 are smaller than those with the U238J31, FeJ31 and Xp239 J31 sets for 15 cores and on the contrary, all the results obtained with the JFS-3-J32 set are slightly larger than those with the U235J31 set.

The averaged value obtained with the JFS-3-J32 set is decreased by 0.14% in comparison with those by the Xp239J31 set due to softer ^{239}Pu fission spectrum in the JENDL-3.2 file than Madland-Nix one in JENDL-3.1. Figures. 7.1-9.2 show the comparison of group-wised fission spectra for ^{239}Pu, ^{235}U and ^{238}U between the JFS-3-J32 and JFS-3-J31 sets.

The averaged result calculated with the JFS-3-J32 set is decreased by 0.15 % in comparing that of the U238J31 set because inelastic scattering cross sections of ^{238}U in the JENDL-3.2 file are smaller than those in the JENDL-3.1 file in high energy range of about 1-8 MeV. Figures 10.1 and 10.2 show the comparison of inelastic scattering group cross section of ^{238}U between the JFS-3-J32 and JFS-3-J31 sets. The results obtained with JFS-3-J32 are decreased by 0.12 % on an average in comparing that of the FeJ31 set because the total inelastic scattering cross section of Fe in JENDL-3.2 is larger than that in JENDL-3.1. In the comparison of results for the JFS-3-J32 and FeJ31 sets, the soft neutron spectrum formed by larger total inelastic scattering plays important role in decreasing effective multiplication factors obtained by JFS-3-J32 and the effect depends on core size. Figures 11.1 and 11.2 show the comparison for the inelastic scattering group cross section of Fe from the JENDL-3.2 and JENDL-3.1 files.

The result obtained with the FeJ31 set is obviously larger than that with U238J31 set for the ZPR-3-54 assembly, but on the contrary for the ZPR-3-53 assembly. This is because the ZPR-3-54 has a pure iron reflector and the ZPR-3-53 has a U reflector , though the core compositions for these two assemblies are identical. The results calculated with the U238J31, FeJ31 and Xp239J31 sets are in very good agreement with the experimenta value on an average, but those are overestimated for large Pu fueled assemblies ZPR-6-7 and ZPPR-2.

In general, for plutonium fueled cores, the fission spectrum of ^{239}Pu and inelastic scattering cross sections of Fe and ^{238}U in the JENDL-3.2 file play important role in improving the overestimate by the JENDL-3.1 file.

(2) Uranium cores

It is shown from Table 4 that the averaged value obtained with JFS-3-J32 for 6 benchmark assemblies is in very good agreement with that by JFS-3-J31, but the differences of the calculated results between the JFS-3-J32 and JFS-3-J31 sets are very large for some assemblies. The results calculated by using the JFS-3-J32 set are larger than those by JFS-3-J31 set for assemblies ZPR-6-6A, ZEBRA-2 and VERA-1B but inversely for ZPR-3-6F, ZPR-3-12 and ZPR-3-11 cores. For large core ZPR-6-6A with soft neutron spectrum, the effective multiplication factor is well predicted with using the JFS-3-J32 set by improving the underestimate by the JFS-3-J31 set.

Table 10.2 shows the comparison for effective multiplication factors between the JFS-3-J32 and JFS-3-J32NJ31 sets for uranium fueled benchmark assemblies. All the result obtained with the JFS-3-J32 set are smaller than those with the U238J31 and XU235J31 sets for 6 U benchmark cores and the reasons are similar to Pu fueled cores. All the results calculated with the JFS-3-J32 set for 6 U fueled cores are larger than those with the U235J31 set and the difference in two group constant sets depends strongly on the concentration of ^{235}U. This is because capture resonance integral cross section of ^{235}U in the JENDL-3.2 file is about 14% smaller than that in the JENDL-3.1 file and the small capture resonance cross section of ^{235}U leads the small neutron absorption in the core and causes large effective multiplication factor. Figures 12.1 and 12.2 show the comparison for capture group cross section constant of ^{235}U between the JFS-3-J32 and JFS-3-J31 sets. It is also observed from the comparison of the results for the JFS-3-J32 and U235J31 sets that the effect of ^{235}U capture resonance cross sections in the JENDL-3.2 file on effective multiplication factor is from 0.05 % to 1 % for 6 U benchmark assemblies and depends directly on core size and concentration of ^{235}U. For ZPR-6-6A, the effect of ^{235}U capture resonance cross section in JENDL-3.2 plays a predominant role in improving the underestimate by JENDL-3.1 because effective multiplication factor calculated with the JFS-3-J32 set is 1 % larger than that with the U235J31 set . For small cores , in general , the effective multiplication factors are decreased in comparison with those by the JFS-3-J31 set because the effects of the ^{238}U inelastic scattering cross sections and ^{235}U fission spectrum are predominant , particularly due to high ratio of fertile to fissile for ZPR-3-11 . But for small core VERA-1B , the calculated result by using JFS-3-J32 set increased in comparing that of the JFS-3-J31 set due to its enriched uranium core (90 % EU) . It is also noticed from Table 10.2 that the results obtained with the XU235J31 set become better for assemblies ZPR-3-11 and ZPR-3-12 .

4.1.2 Central reaction rate ratios

(1) Ratio of ^{238}U fission to ^{235}U fission (Tables 5, 11.1 and 11.2)

All the results obtained with the JFS-3-J32 set are smaller than those of JFS-3-J31 set for 21 benchmark assemblies and averaged values are decreased by about 4.4 % for both Pu and U fueled cores as shown in Table 5 . This is due to softer fission spectrum of the JENDL-3.2 file than Madland-Nix one of JENDL-3.1, because the ^{238}U fission is a threshold reaction and it is very sensitive to high energy spectrum above 1 MeV . It should be noticed that the average by using JFS-3-J32 set is still overestimated by 7 % for Pu fueled cores , though it is satisfactory for U fueled cores . The core design target accuracy for this ratio value is not so serious and the rigorous measurement is also difficult.

(2) Ratio of ^{239}Pu fission to ^{235}U fission (Tables 6, 12,1 and 12.2)

It is shown from Table 6 that all the results by using the JFS-3-J32 set are slightly smaller than those with JFS-3-J31 for 21 benchmark cores . But , in general , the averaged value and its standard deviation are all satisfactory for this two group constant sets . The reason may be due to adopting simultaneous evaluation for main fission nuclide in two group constant sets .

(3) Ratio of ^{240}Pu fission to ^{235}U fission (Tables 7, 13.1 and 13.2)

It is observed from Table 7 that the overestimates with the JFS-3-J31 set are slightly improved by using the JFS-3-J32 set, however, the averaged value with the JFS-3-J32 set still overestimated by 10 % and 7 % for Pu and U fueled core respectively. Especially, the standard deviation shows large value of about 13 %for both Pu and U fueled cores.

(4) Ratio of ^{238}U capture to ^{235}U fission (Tables 8, 14.1 and 14.2)

The differences of calculated results between the JFS-3-J32 and JFS-3-J31 sets are very small for 21 cores as shown in Table 8. For Pu fueled cores, the averaged value (C/E) is increased from 0.98 to 1.00 and standard deviation is decreased from 10 % to 5% when assembly VERA-11A was omitted from the statistical average. For U fueled cores, the averaged value is 0.96 and the standard deviation is 8 %.

(5) Ratio of ^{238}U capture to ^{239}Pu fission (Tables 9, 15.1 and 15.)

All the results obtained with the JFS-3-J32 set are slightly larger than those by the JFS-3-J31 set except for ZPR-3-11 assembly as shown in Table 9 because the fission spectra of JENDL-3.2 are softer than those of JENDL-3.1. As for assembly ZPR-3-11, the effect of ^{238}U inelastic scattering may be important due to high concentration ratio of fertile to fissile. For Pu fueled cores, the averaged values for the JFS-3-J32 and JFS-3-J31 sets are all satisfactory and for U fueled cores including FCA-5-2, the results have a tendency to underestimate the experimental value.

4.2 Comparison of benchmark calculations for the JENDL-3.2 and JENDL-3.2P sets

4.2.1 Effective multiplication factor

The averaged value obtained with JFS-3-J32 for 21 benchmark assemblies is 0.998 , and it is better than 0.997 of JFS-3-J32P . The standard deviations of effective multiplication factors for two group constant sets are nearly equal for both Pu and U fueled cores . It is observed from Table 4 that all the results calculated with JFS-3-J32 are slightly larger than those of JFS-3-J32P , except for VERA-1B , ZPR-3-6F and ZPR-3-54 assemblies . Figs . 13.1 and 13.2 show the comparison of the inelastic scattering group cross section of ^{238}U . It is seen that the inelastic scattering cross section of ^{238}U in JENDL-3.2 are smaller than those of JENDL-3.2P in energy range about 200Kev - 2Mev. In the comparison for effective multiplication factor between the JENDL-3.2 and JENDL-3.2P files , the small inelastic scattering cross sections of ^{238}U in JENDL-3.2 lead hard neutron spectrum and cause large effective multiplication factor , for the most of benchmark cores but for some small cores , hard neutron spectrum lead larger neutron leakage from the core and cause small effective multiplication factor. As for assembly ZPR-3-54 , the result calculated with JFS-3-J32 is smaller than that with JFS-3-J32P because it has an iron reflector and the hard neutron spectrum leads large neutron leakage from the core due to very low elastic scattering cross section of iron in about 23 keV as shown in Fig . 14 .

4.2.2 Central reaction rate ratio

It is shown from Tables 5 , 8 and 9 that for the ratio of ^{238}U fission to ^{235}U fission , all the results obtained with the JFS-3-J32 set are larger than those with JFS-3-J32P for 21 benchmark cores and for ratio of ^{238}U capture to ^{235}U fission and ^{239}Pu fission , all the results are smaller than those by JFS-3-J32P. The differences for central reaction rate ratios mentioned above between two group constant sets are due to harder neutron spectrum formed by the low inelastic scattering of ^{238}U in JENDL-3.2 than that of JENDL-3.2P , and they depend directly on the concentration ratio of fertile to fissile .

4.3 Comparison of benchmark calculations for the JENDL-3.2 and ENDF/B-VI sets

Tables 16.1-21.2 show the results for effective multiplication factors and central reaction rate ratios obtained by using the JFS-3-J32 and JFS-3-J32NB6 sets. The effects of main fission nuclide cross sections in the ENDF/B-VI file on integral quantities are obtained by benchmark calculations using the JFS-3-J32NB6 sets.

4.3.1 Effective multiplication factor

The differences between the effective multiplication factors calculated with JFS-3-J32 and JFS-3-J32NB6 are very similar to them between the JFS-3-J32 and U238B6 sets as shown in Tables 16.1 and 16.2. The results calculated with the JFS-3-J32 set are in good agreement with experimental value on an average for both Pu and U fueled cores as mentioned in Section 4.1. On the other hand the averaged value by the U238B6 set is overestimated by about 1.4 % for both Pu and U fueled cores. All the results with the U238B6 set are larger than those with the JFS-3-J32 set, except for assembly ZPR-3-54 surrounded with iron reflector .The effect of iron reflector on effective multiplication factor for assembly ZPR-3-54 was already described in Section 4.1. The difference of results for the U238B6 and JFS-3-J32 sets depend considerably on the concentration ratio of fertile to fissile and shows week dependece on core size, for example it is 3.2 % and 2.6 % for assembly ZEBRA-3 and ZPR-3-11 respectively. It is not clear to have so large difference when using cross sections of ^{238}U in the ENDF/B-VI file. The reason may be different inelastic scattering cross section for ^{238}U between the JENDL-3.2 and ENDF/B-VI files. Table 22 shows the effective multiplication factors obtained respectively by U238J2, U238J31, U238J32P, U238B6 and JFS-3-J32 and Fig. 15 shows ^{238}U inelastic scattering group cross section from JENDL-2, JENDL-3.1, JENDL-3.2P, JENDL-3.2 and ENDF/B-VI files. It is found from Table 22 and Fig. 15 that the differences of effective multiplication factors from the JENDL-type file are small, though the difference of ^{238}U inelastic scattering cross sections is very large, for example, for JENDL-2 and JENDL-3.2. But the difference is very large value of about 1.3 %, thought the the difference of ^{238}U inelastic scattering cross sections is not very obvious for the JENDL-3.2 and ENDF/B-VI files. The reason may be very different inelastic scattering matrices of ^{238}U between the JENDL-type and ENDF/B-VI files.

For U fueled cores, the results calculated with the JFS-3-J32 set are slightly smaller than those of XU235B6 set because ^{235}U fission spectrum of the JENDL-3.2 is softer than that of the ENDF / B-VI file as shown in Figs. 16.1 and 16.2.

4.3.2 Central reaction rate ratio

It is observed from Tables 17.1 - 21.2 that the effects of ^{238}U cross sections in the ENDF / B-VI file on central reaction rate ratios are obvious (above 1 % on an average). It may be due to different inelastic scattering matrices of ^{238}U between the ENDF / B-VI and JENDL-3.2 files.

As for U fueled cores, the averaged value for the ratio of ^{238}U fission to ^{235}U fission by using JFS-3-J32 set is 1.2 % smaller than that by the XU235B6 set because ^{235}U fission spectrum of JENDL-3.2 is softer than that of the ENDF / B-VI file.

4.3.3 Comparison of ^{238}U Inelastic Scattering Cross Sections Between JENDL-3 and ENDF/B-VI

Figures 17 and 18 show the total and partial inelastic scattering cross sections of ^{238}U in the JENDL-3.2 and ENDF/B-VI data files. The total cross sections of ENDF/B-VI is larger than that of JENDL-3.2 in the neighboring of 5 MeV. This affects neutron leakage for small cores and very hard neutron spectrum cores. The partial cross sections consist of a continuum and a lot of discrete levels. The evaluated data from the first to fourth levels are in very good agreement with each other. However, it is observed that the evaluation for high energy level and continuum level is considerably different. As a result, energy distributions between JENDL-3.2 and ENDF/B-VI will be large different.

5. Conclusion

(1) The applicability of the JENDL-3.2 file to fast reactor calculations is better than that of the JENDL-3.1 file and the improved characteristics are mainly as follows :

For U fueled cores, the results calculated with the JFS-3-J32 set are slightly smaller than those of XU235B6 set because ^{235}U fission spectrum of the JENDL-3.2 is softer than that of the ENDF / B-VI file as shown in Figs. 16.1 and 16.2.

4.3.2 Central reaction rate ratio

It is observed from Tables 17.1 - 21.2 that the effects of ^{238}U cross sections in the ENDF / B-VI file on central reaction rate ratios are obvious (above 1 % on an average). It may be due to different inelastic scattering matrices of ^{238}U between the ENDF / B-VI and JENDL-3.2 files.

As for U fueled cores, the averaged value for the ratio of ^{238}U fission to ^{235}U fission by using JFS-3-J32 set is 1.2 % smaller than that by the XU235B6 set because ^{235}U fission spectrum of JENDL-3.2 is softer than that of the ENDF / B-VI file.

4.3.3 Comparison of ^{238}U Inelastic Scattering Cross Sections Between JENDL-3 and ENDF/B-VI

Figures 17 and 18 show the total and partial inelastic scattering cross sections of ^{238}U in the JENDL-3.2 and ENDF/B-VI data files. The total cross sections of ENDF/B-VI is larger than that of JENDL-3.2 in the neighboring of 5 MeV. This affects neutron leakage for small cores and very hard neutron spectrum cores. The partial cross sections consist of a continuum and a lot of discrete levels. The evaluated data from the first to fourth levels are in very good agreement with each other. However, it is observed that the evaluation for high energy level and continuum level is considerably different. As a result, energy distributions between JENDL-3.2 and ENDF/B-VI will be large different.

5. Conclusion

(1) The applicability of the JENDL-3.2 file to fast reactor calculations is better than that of the JENDL-3.1 file and the improved characteristics are mainly as follows :

A. For Pu fueled cores, the effective multiplication factors overestimated by JENDL -3.1 were considerably improved by JENDL-3.2 because the fission spectrum of ^{239}Pu and inelastic scattering cross sections of ^{238}U and Fe in the JENDL-3.2 file were revised.

B. For U fueled cores, the averaged value obtained by JENDL-3.1 for the ratio of ^{238}U fission to ^{235}U is overestimated by about 4 %, but that by JENDL-3.2 shows satisfactory value due to softer fission spectrum of JENDL-3.2 than Madland-Nix one of JENDL-3.1.

C. For a large U fueled core ZPR-6-6A, the effective multiplication factor calculated by using the JFS-3-J32 set is in good agreement with the experimental value, and the underestimate of effective multiplication factor by the JFS-3-J31 set was improved. This is due to the lower capture resonance cross sections of ^{235}U in JENDL-3.2 than those in JENDL-3.1. Hence, the effective multiplication factor will be much adequately predicted by increasing slightly the capture resonance cross sections of ^{235}U in the JENDL-3.2 file.

(2) The averaged value for effective multiplication factor calculated by JENDL-3.2 is by about 0.1% better than that by using JENDL-3.2P for both Pu and U fueled cores due to decreasing the inelastic scattering cross section of ^{238}U in JENDL-3.2.

(3) The ratios of ^{238}U fission to ^{235}U fission obtained by using JFS-3-J32 are by about 4 % smaller on an average than those by JFS-3-J31 for both Pu and U fueled cores due to softer fission spectrum of JENDL-3.2 file than Madland-Nix one of JENDL-3.1. The averaged value by JFS-3-J32 is still overestimated by 7 % for Pu fueled cores though it is satisfactory for U fueled cores.

(4) For the ratio of ^{240}Pu fission to ^{235}U fission, the averaged value by JENDL-3.2 is still overestimated by above 7 % and the standard deviation shows large value of about 13 % for both Pu and U fueled cores.

(5) The discrepancies in ^{238}U cross sections between JENDL - type and ENDF / B-VI files have considerable effect on effective multiplication factor and central reaction rate ratios . The difference of the averaged value for effective multiplication factor is large value of 1.4 % between the JFS-3-J32 and U238B6 sets . The main reason , maybe , is very different inelastic scattering matrices of ^{238}U between the JENDL-3.2 and ENDF / B-VI files.

(6) It is observed that the prediction accuracy of a group constant set to integral data depends on various reactor types such as large core with soft neutron spectrum and small core with hard neutron spectrum . It is necessary to analyze and select some reliable critical experiments by using the JENDL-3.2 data file .

Acknowledgement

The authors wish to express their thanks to Mr. H. Akie for his helpful discussion and assistance with computation .

(5) The discrepancies in ^{238}U cross sections between JENDL - type and ENDF / B-VI files have considerable effect on effective multiplication factor and central reaction rate ratios. The difference of the averaged value for effective multiplication factor is large value of 1.4 % between the JFS-3-J32 and U238B6 sets. The main reason, maybe, is very different inelastic scattering matrices of ^{238}U between the JENDL-3.2 and ENDF / B-VI files.

(6) It is observed that the prediction accuracy of a group constant set to integral data depends on various reactor types such as large core with soft neutron spectrum and small core with hard neutron spectrum. It is necessary to analyze and select some reliable critical experiments by using the JENDL-3.2 data file.

Acknowledgement

The authors wish to express their thanks to Mr. H. Akie for his helpful discussion and assistance with computation.

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Table 1 Characteristics of Benchmark Assemblies

Assembly	Fissile Fuel	Core Volume (liter)	Fertile to Fissile Ratio	Comments
VERA-11A	Pu	12	0.05	Pu+C , no U in the core
ZEBRA-3	Pu	60	8.6	hard spectrum,80% above 100kev
SNEAK-7A	Pu	110	3.0	
FCA-5-2	Pu+U	200	2.3	Pu/EU=1/3
ZPR-3-54	Pu	220	1.6	Fe reflector
ZPR-3-53	Pu	220	1.6	U reflector
SNEAK-7B	Pu	310	7.0	
ZPR-3-50	Pu	340	4.5	additional C for ZPR-3-48
ZPR-3-48	Pu	410	4.5	soften spectrum due to added C
ZPR-3-49	Pu	450	4.5	remove Na for ZPR-3-48
MZA	Pu	570	3.9	
ZPR-3-56B	Pu	610	4.6	Ni reflector
MZB	Pu	1800	5.8	
ZPPR-2	Pu	2400	6.5	equal volume 2-zone core L/D=0.5
ZPR-6-7	Pu	3100	6.5	L/D=0.9
VERA-1B	U	30	0.08	90% EU+C
ZPR-3-6F	U	50	1.1	
ZPR-3-12	U	100	3.8	U+C
ZPR-3-11	U	140	7.5	
ZEBRA-2	U	430	6.2	U+C
ZPR-6-6A	U	4000	5.0	L/D=0.8

Table 2 Correction Factors of Effective Multiplication Factors with Homogeneous 1-D Diffusion Model

NO	Assembly	1 to 2-D	Diffusion to Transport(Sn)	Heterogeneity
1	VERA-11A	0.0035	0.0472	0.0[a]
2	VERA-1B	0.0038	0.0237	0.0[a]
3	ZPR-3-6F	-0.0028	0.0192	0.0[a]
4	ZEBRA-3	-0.0006	0.0126	0.0[a]
5	ZPR-3-12	-0.0009	0.0099	0.0[a]
6	SNEAK-7A	0.0061	0.0120	-0.0045[b]
7	ZPR-3-11	0.0001	0.0060	0.0[a]
8	ZPR-3-54	-0.0164	0.0144	0.0230
9	ZPR-3-53	-0.0150	0.0087	0.0230
10	SNEAK-7B	0.0042	0.0047	-0.0021[b]
11	ZPR-3-50	-0.0133	0.0056	0.0220
12	ZPR-3-48	-0.0009	0.0064	0.0183
13	ZEBRA-2	-0.0007	0.0033	0.0[a]
14	ZPR-3-49	-0.0139	0.0068	0.0158
15	ZPR-3-56B	-0.0166	0.0065	0.0102
16	ZPR-6-7	-0.0020	0.0016	0.0166
17	ZPR-6-6A	-0.0013	0.0013	0.0073
18	ZPPR-2	0.0003	0.0024	0.0175
19	MZA	-0.0196	0.0075	0.0140
20	MZB	-0.0186	0.0036	0.0123
21	FCA-5-2	-0.0150	0.0098	0.0024

a The atomic densities and/or sizes were adjusted to account for heterogeneities.
b Includes corrections for cylindricalization , actual control rod position , and heterogeneity.

Table 3 Nuclides and Nuclear Data File Used in Group Constant Sets

NO	Nuclide	Nuclear Data File			
		JFS-3-J32	JFS-3-J32P	JFS-3-J31	JFS-3-B6
1	Be*	JENDL-3.2	JENDL-3.2	JENDL-3.2	JENDL-3.2
2	B-10*	JENDL-3.2	JENDL-3.2	JENDL-3.2	JENDL-3.2
3	B-11*	JENDL-3.2	JENDL-3.2	JENDL-3.2	JENDL-3.2
4	C	JENDL-3.2	JENDL-3.2	JENDL-3.1	JENDL-3.2
5	O	JENDL-3.2	JENDL-3.2	JENDL-3.1	JENDL-3.2
6	Na	JENDL-3.2	JENDL-3.2	JENDL-3.1	JENDL-3.2
7	Al	JENDL-3.2	JENDL-3.2	JENDL-3.1	JENDL-3.2
8	Si	JENDL-3.2	JENDL-3.2	JENDL-3.1	JENDL-3.2
9	Cr	JENDL-3.2	JENDL-3.2	JENDL-3.1	JENDL-3.2
10	Mn	JENDL-3.2	JENDL-3.2	JENDL-3.1	JENDL-3.2
11	Fe	JENDL-3.2	JENDL-3.2	JENDL-3.1	JENDL-3.2
12	Ni	JENDL-3.2	JENDL-3.2	JENDL-3.1	JENDL-3.2
13	Cu	JENDL-3.2	JENDL-3.2	JENDL-3.1	JENDL-3.2
14	Mo	JENDL-3.2	JENDL-3.2	JENDL-3.1	JENDL-3.2
15	U-234	JENDL-3.2	JENDL-3.2	JENDL-3.1	JENDL-3.2
16	U-235	JENDL-3.2	JENDL-3.2	JENDL-3.1	ENDF-B6
17	U-238	JENDL-3.2	JENDL-3.2P	JENDL-3.1	ENDF-B6
18	Pu-240	JENDL-3.2	JENDL-3.2	JENDL-3.1	ENDF-B6
19	Pu-241	JENDL-3.2	JENDL-3.2	JENDL-3.1	ENDF-B6
20	Pu-239	JENDL-3.2	JENDL-3.2	JENDL-3.1	ENDF-B6

*) These nuclides are the same evaluated data in JENDL-3.1 and -3.2.

Table 4 Comparison of Effective Multiplication Factors (C/E values)

N0	Assembly (Pu-fuel)	Exp.	JFS-3-J32	JFS-3-J32P	JFS-3-J31
1	VERA-11A	1.00000	0.98246	0.98244	0.98817
4	ZEBRA-3	1.00000	0.98384	0.98128	0.99130
6	SNEAK-7A	1.00000	1.00074	0.99994	1.00602
8	ZPR-3-54	1.00000	1.00831	1.00851	1.00950
9	ZPR-3-53	1.00000	0.99933	0.99902	1.00183
10	SNEAK-7B	1.00000	0.99847	0.99646	1.00447
11	ZPR-3-50	1.00000	0.99932	0.99836	1.00440
12	ZPR-3-48	1.00000	1.00237	1.00117	1.00852
14	ZPR-3-49	1.00000	1.00354	1.00215	1.00942
15	ZPR-3-56B	1.00000	1.01098	1.01018	1.01658
16	ZPR-6-7	1.00000	1.00084	0.99935	1.00826
18	ZPPR-2	1.00000	1.00546	1.00435	1.01242
19	MZA	1.01080	0.99645	0.99558	1.00264
20	MZB	1.00400	0.99751	0.99617	1.00468
21	FCA-5-2	1.00000	0.98546	0.98497	0.98678
Average			0.99834	0.99733	1.00367
Stnd. Dev.			0.00816	0.00828	0.00835
	(U-fuel)				
2	VERA-1B	1.00000	0.99433	0.99452	0.99142
3	ZPR-3-6F	1.00000	1.00358	1.00380	1.00650
5	ZPR-3-12	1.00000	0.99854	0.99815	1.00058
7	ZPR-3-11	1.00000	0.99780	0.99576	1.00316
13	ZEBRA-2	1.00000	0.98567	0.98464	0.98294
17	ZPR-6-6A	1.00000	1.00206	1.00149	0.99554
Average			0.99700	0.99639	0.99669
Stnd. Dev.			0.00588	0.00614	0.00787
* * * * *					
All Assemblies					
Average			0.99795	0.99706	1.00167
Stnd. Dev.			0.00761	0.00774	0.00880

Table 5 Comparison of Central Reaction Rate Raio--^{238}U fission／^{235}U fission (C/E values)

NO	Assembly (Pu-fuel)	Exp.	JFS-3-J32	JFS-3-J32P	JFS-3-J31
1	VERA-11A	0.10200	0.89100	0.88972	0.90864
4	ZEBRA-3	0.04610	0.99526	0.97811	1.03404
6	SNEAK-7A	0.04480	0.99302	0.98572	1.03050
8	ZPR-3-54	0.02540	1.23033	1.22577	1.26780
9	ZPR-3-53	0.02540	1.23405	1.23015	1.27126
10	SNEAK-7B	0.03300	1.02861	1.01680	1.07571
11	ZPR-3-50	0.02510	1.20350	1.19379	1.24779
12	ZPR-3-48	0.03260	1.07158	1.06184	1.12021
14	ZPR-3-49	0.03450	1.10488	1.09396	1.15539
15	ZPR-3-56B	0.03080	0.99518	0.98672	1.04998
16	ZPR-6-7	0.02200	1.02470	1.01642	1.08303
18	ZPPR-2	0.02010	1.12517	1.11555	1.18947
19	MZA	0.03366	1.02199	1.01410	1.07220
20	MZB	0.02256	1.04505	1.03607	1.10128
21	FCA-5-2	0.03960	1.11635	1.10902	1.17141
Average			1.07204	1.06358	1.11858
Stnd. Dev.			0.09403	0.09445	0.09685
	(U-fuel)				
2	VERA-1B	0.08600	0.92393	0.92345	0.95412
3	ZPR-3-6F	0.07800	0.98315	0.97666	1.01862
5	ZPR-3-12	0.04700	1.04278	1.03040	1.08529
7	ZPR-3-11	0.03800	1.02671	1.00869	1.07430
13	ZEBRA-2	0.03200	1.03001	1.01767	1.07843
17	ZPR-6-6A	0.02410	0.97407	0.96645	1.03815
Average			0.99677	0.98722	1.04148
Stnd. Dev.			0.04108	0.03620	0.04569
*****					
All Assemblies					
Average			1.05054	1.04176	1.09655
Stnd. Dev.			0.08919	0.08909	0.09224

Table 6 Comparison of Central Reaction Rate Raio--^{239}U fission／^{235}U fission (C/E values)

NO	Assembly (Pu-fuel)	Exp.	JFS-3-J32	JFS-3-J32P	JFS-3-J31
1	VERA-11 A	1.18000	0.98740	0.98656	0.99043
4	ZEBRA-3	1.19000	0.97793	0.97501	0.97797
6	SNEAK-7A	1.01600	0.97571	0.97398	0.98227
8	ZPR-3-54	0.92800	0.96006	0.95930	0.96009
9	ZPR-3-53	0.92800	0.95991	0.95922	0.95999
10	SNEAK-7B	1.01200	0.99305	0.99071	0.99795
11	ZPR-3-50	0.90300	1.00551	1.00378	1.01009
12	ZPR-3-48	0.97600	0.99969	0.99772	1.00811
14	ZPR-3-49	0.98600	1.01431	1.01208	1.02218
15	ZPR-3-56B	1.02800	0.95089	0.94929	0.95981
16	ZPR-6-7	0.94250	0.98270	0.98126	0.99209
18	ZPPR-2	0.93700	0.98938	0.98785	0.99891
19	MZA	1.01338	0.98651	0.98491	0.99540
20	MZB	0.94877	0.98928	0.98771	0.99853
21	FCA-5-2	1.10400	0.96934	0.96788	0.97765
Average			0.98278	0.98115	0.98876
Stnd. Dev.			0.01700	0.01674	0.01836
	(U-fuel)				
2	VERA-1B	1.20000	0.95527	0.95487	0.96226
3	ZPR-3-6F	1.22000	1.01201	1.01044	1.01671
5	ZPR-3-12	1.12000	0.98845	0.98596	0.99442
7	ZPR-3-11	1.19000	0.97284	0.96990	0.97445
13	ZEBRA-2	0.98700	1.00637	1.00386	1.01562
17	ZPR-6-6A				
Average			0.98699	0.98501	0.99269
Stnd. Dev.			0.02103	0.02069	0.02174
*****					
All Assemblies					
Average			0.98383	0.98211	0.98974
Stnd. Dev.			0.01818	0.01789	0.01934

Table 7 Comparison of Central Reaction Rate Raio--^{240}Pu fission／^{235}U fission (C/E values)

N0	Assembly (Pu-fuel)	Exp.	JFS-3-J32	JFS-3-J32P	JFS-3-J31
1	VERA-11A	0.47500	1.10215	1.09967	1.11003
4	ZEBRA-3	0.37300	0.98673	0.96780	1.00059
6	SNEAK-7A				
8	ZPR-3-54	0.17400	1.23284	1.22732	1.24922
9	ZPR-3-53	0.17400	1.23413	1.22909	1.25052
10	SNEAK-7B				
11	ZPR-3-50	0.15900	1.36369	1.35008	1.39012
12	ZPR-3-48	0.24300	1.06478	1.05329	1.09099
14	ZPR-3-49				
15	ZPR-3-56B	0.28200	0.84869	0.84046	0.87305
16	ZPR-6-7				
18	ZPPR-2	0.17000	1.11955	1.10867	1.15208
19	MZA	0.25993	1.01389	1.00484	1.03976
20	MZB	0.19194	1.03466	1.02443	1.06299
21	FCA-5-2				
Average			1.10011	1.09056	1.12193
Stnd. Dev.			0.13945	0.14014	0.13913
	(U-fuel)				
2	VERA-1B	0.39900	1.21208	1.21076	1.23682
3	ZPR-3-6F	0.53000	0.98595	0.97819	1.00525
5	ZPR-3-12				
7	ZPR-3-11	0.34000	1.00878	0.98818	1.02925
13	ZEBRA-2	0.23700	1.06491	1.04910	1.09896
17	ZPR-6-6A				
Average			1.06793	1.05656	1.09257
Stnd. Dev.			0.08805	0.09307	0.09012
*****					
All Assemblies					
Average			1.09092	1.08085	1.11354
Stnd. Dev.			0.12774	0.12938	0.12776

Table 8 Comparison of Central Reaction Rate Raio--^{238}U capture／^{235}U fission (C/E values)

N0	Assembly (Pu-fuel)	Exp.	JFS-3-J32	JFS-3-J32P	JFS-3-J31
1	VERA-11A	0.15800	0.73894	0.74019	0.73453
4	ZEBRA-3				
6	SNEAK-7A	0.13760	0.96585	0.96755	0.96519
8	ZPR-3-54				
9	ZPR-3-53				
10	SNEAK-7B	0.13100	1.00611	1.00844	1.01017
11	ZPR-3-50				
12	ZPR-3-48	0.13800	0.96297	0.96471	0.96140
14	ZPR-3-49				
15	ZPR-3-56B				
16	ZPR-6-7	0.13200	1.06808	1.06938	1.06808
18	ZPPR-2				
19	MZA	0.13143	1.01937	1.02104	1.01763
20	MZB	0.13510	1.03550	1.03691	1.03577
21	FCA-5-2	0.14000	0.90613	0.90778	0.90203
Average			0.96287	0.96450	0.96185
Stnd. Dev.			0.09668	0.09677	0.09840
	(U-fuel)				
2	VERA-1B	0.13500	0.91371	0.91448	0.90140
3	ZPR-3-6F	0.10400	0.94307	0.94542	0.93522
5	ZPR-3-12	0.12300	0.96334	0.96635	0.96416
7	ZPR-3-11	0.11200	0.96234	0.96563	0.97319
13	ZEBRA-2	0.13600	0.96675	0.96901	0.97118
17	ZPR-6-6A	0.13780	1.02126	1.02260	1.02241
Average			0.96175	0.96391	0.96126
Stnd. Dev.			0.03221	0.03231	0.03708
*****					
All Assemblies					
Average			0.96239	0.96425	0.96160
Stnd. Dev.			0.07607	0.07615	0.07824

Table 9 Comparison of Central Reaction Rate Ratio--^{238}U capture／^{239}U fission (C/E values)

N0	Assembly (Pu-fuel)	Exp.	JFS-3-J32	JFS-3-J32P	JFS-3-J31
1	VERA-11A				
4	ZEBRA-3				
6	SNEAK-7A	0.13500	0.99307	0.99658	0.98576
8	ZPR-3-54				
9	ZPR-3-53				
10	SNEAK-7B	0.12900	1.01666	1.02143	1.01575
11	ZPR-3-50				
12	ZPR-3-48	0.14100	0.96596	0.96961	0.95633
14	ZPR-3-49				
15	ZPR-3-56B				
16	ZPR-6-7	0.14000	1.08730	1.09022	1.07700
18	ZPPR-2				
19	MZA	0.12970	1.03331	1.03667	1.02233
20	MZB	0.14240	1.04671	1.04980	1.03728
21	FCA-5-2	0.12680	0.93487	0.93800	0.92273
Average			1.01113	1.01461	1.00245
Stnd. Dev.			0.04747	0.04737	0.04796
	(U-fuel)				
2	VERA-1B	0.12200	0.88202	0.88313	0.86381
3	ZPR-3-6F	0.08500	0.93457	0.93836	0.92251
5	ZPR-3-12	0.11000	0.97301	0.97852	0.96799
7	ZPR-3-11	0.09400	0.99044	0.99684	0.99996
13	ZEBRA-2	0.13800	0.95918	0.96381	0.95480
17	ZPR-6-6A				
Average			0.94784	0.95213	0.94181
Stnd. Dev.			0.03764	0.03945	0.04625
* * * * *					
All Assemblies					
Average			0.98476	0.98858	0.97719
Stnd. Dev.			0.05365	0.05391	0.05592

Table 10.1 Comparison of Effective Multiplication Factors (C/E values)

N0	Assembly (Pu-fuel)	Exp.	JFS-3-J32	U235J31	U238J31	Pu239 J31	Pu240 J31	Pu241 J31	FeJ31	NiJ31	NaJ31	Xu238 J31	Xp239 J31	Xu235 J31
1	VERA-11A	1.00000	0.98246	0.98242	0.98453	0.98251	0.98245	0.98246	0.98264	0.98244	0.98246	0.98384	0.98361	0.98246
4	ZEBRA-3	1.00000	0.98384	0.98384	0.98585	0.98374	0.98358	0.98384	0.98431	0.98386	0.98385	0.98456	0.98676	0.98401
6	SNEAK-7A	1.00000	1.00074	1.00055	1.00273	1.00110	1.00073	1.00075	1.00135	1.00075	1.00074	1.00149	1.00229	1.00078
8	ZPR-3-54	1.00000	1.00831	1.00824	1.00843	1.00758	1.00829	1.00831	1.00947	1.00828	1.00831	1.00831	1.00885	1.00832
9	ZPR-3-53	1.00000	0.99933	0.99924	1.00043	0.99912	0.99932	0.99933	0.99954	0.99932	0.99933	0.99993	1.00024	0.99933
10	SNEAK-7B	1.00000	0.99847	0.99791	1.00057	0.99858	0.99845	0.99848	0.99974	0.99855	0.99846	0.99887	1.00042	0.99877
11	ZPR-3-50	1.00000	0.99932	0.99918	1.00104	0.99965	0.99929	0.99932	1.00006	0.99934	0.99932	0.99974	1.00111	0.99934
12	ZPR-3-48	1.00000	1.00237	1.00228	1.00393	1.00325	1.00237	1.00237	1.00360	1.00242	1.00236	1.00286	1.00414	1.00239
14	ZPR-3-49	1.00000	1.00354	1.00347	1.00492	1.00368	1.00354	1.00355	1.00506	1.00360	1.00354	1.00408	1.00544	1.00356
15	ZPR-3-56B	1.00000	1.01098	1.01089	1.01212	1.01176	1.01096	1.01098	1.01261	1.01177	1.01091	1.01098	1.01205	1.01100
16	ZPR-6-7	1.00000	1.00084	1.00070	1.00177	1.00229	1.00081	1.00086	1.00339	1.00094	1.00114	1.00102	1.00226	1.00086
18	ZPPR-2	1.00000	1.00546	1.00533	1.00696	1.00672	1.00541	1.00548	1.00765	1.00554	1.00557	1.00553	1.00674	1.00547
19	MZA	1.01080	0.99645	0.99618	0.99807	0.99739	0.99642	0.99648	0.99841	0.99656	0.99643	0.99664	0.99761	0.99649
20	MZB	1.00400	0.99751	0.99710	0.99892	0.99877	0.99748	0.99754	0.99984	0.99767	0.99774	0.99764	0.99881	0.99758
21	FCA-5-2	1.00000	0.98546	0.98295	0.98656	0.98562	0.98545	0.98546	0.98591	0.98545	0.98529	0.98626	0.98601	0.98616
Average			0.99834	0.99802	0.99979	0.99879	0.99832	0.99835	0.99957	0.99843	0.99836	0.99878	0.99976	0.99843
Stnd. Dev.			0.00816	0.00842	0.00793	0.00832	0.00816	0.00816	0.00861	0.00825	0.00818	0.00789	0.00806	0.00808

Table 10.2 Comparison of Effective Multiplication Factors (C/E values)

NO	Assembly (U-fuel)	Exp.	JFS-3-J32	U235J31	U238J31	Pu239 J31	Pu240 J31	Pu241 J31	FeJ31	NiJ31	NaJ31	Xu238 J31	Xp239 J31	Xu235 J31
2	VERA-1B	1.00000	0.99433	0.98920	0.99555	0.99433	0.99433	0.99433	0.99414	0.99422	0.99433	0.99546	0.99433	0.99444
3	ZPR-3-6F	1.00000	1.00358	1.00302	1.00446	1.00358	1.00385	1.00385	1.00370	1.00358	1.00358	1.00448	1.00358	1.00494
5	ZPR-3-12	1.00000	0.99854	0.99555	1.00072	0.99854	0.99854	0.99854	0.99884	0.99855	0.99855	0.99906	0.99854	1.00062
7	ZPR-3-11	1.00000	0.99780	0.99736	0.99994	0.99780	0.99780	0.99780	0.99824	0.99782	0.99780	0.99810	0.99780	1.00075
13	ZEBRA-2	1.00000	0.98567	0.97767	0.98790	0.98567	0.98567	0.98567	0.98597	0.98567	0.98567	0.98606	0.98567	0.98797
17	ZPR-6-6A	1.00000	1.00206	0.99150	1.00339	1.00206	1.00206	1.00206	1.00289	1.00211	1.00211	1.00221	1.00206	1.00347
Average			0.99700	0.99237	0.99866	0.99700	0.99760	0.99700	0.99730	0.99699	0.99701	0.99756	0.99700	0.99870
Stnd.Dev.			0.00588	0.00791	0.00559	0.00588	0.00588	0.00588	0.00597	0.00589	0.00589	0.00590	0.00588	0.00581
********														
All Assemblies														
Average			0.99795	0.99640	0.99947	0.99828	0.99794	0.99796	0.99892	0.99802	0.99799	0.99843	0.99897	0.99851
Stnd.Dev.			0.00761	0.00866	0.00735	0.00775	0.00760	0.00761	0.00801	0.00768	0.00762	0.00739	0.00760	0.00750

Table 11.1 Comparison of Central Reaction Rate Raio--^{238}U fission/^{235}U fission (C/E values)

N0	Assembly (Pu- fuel)	Exp.	JFS-3-J32	U235J31	U238J31	Pu239 J31	Pu240 J31	Pu241 J31	FeJ31	NiJ31	NaJ31	Xu238 J31	Xp239 J31	Xu235 J31
1	VERA-11A	0.10200	0.89100	0.89230	0.89276	0.89109	0.89103	0.89101	0.89521	0.89121	0.89110	0.89153	0.90216	0.89100
4	ZEBRA-3	0.04611	0.99526	0.99589	1.01867	0.99522	0.99524	0.99526	0.99761	0.99534	0.99526	0.99471	1.00846	0.99630
6	SNEAK-7A	0.04480	0.99302	0.99547	1.00145	0.99408	0.99302	0.99303	1.00243	0.99344	0.99304	0.99273	1.00853	0.99344
8	ZPR-3-54	0.02540	1.23033	1.22735	1.23734	1.23147	1.23032	1.23033	1.24222	1.23079	1.23033	1.23033	1.25251	1.23042
9	ZPR-3-53	0.02540	1.23405	1.23103	1.23747	1.23473	1.23404	1.23405	1.24745	1.23451	1.23405	1.23371	1.25590	1.23414
10	SNEAK-7B	0.03300	1.02861	1.03185	1.04206	1.02919	1.02859	1.02861	1.03957	1.02901	1.02862	1.02826	1.04276	1.03106
11	ZPR-3-50	0.02510	1.20350	1.20388	1.21275	1.20500	1.20351	1.20351	1.21513	1.20381	1.20350	1.20312	1.22387	1.20372
12	ZPR-3-48	0.03260	1.07158	1.07359	1.08078	1.07324	1.07155	1.07159	1.08675	1.07204	1.07343	1.07119	1.08779	1.07177
14	ZPR-3-49	0.03450	1.10488	1.10372	1.11627	1.10600	1.10488	1.10489	1.12119	1.10541	1.10488	1.10447	1.12129	1.10507
15	ZPR-3-56B	0.03080	0.99518	0.99796	1.00209	0.99694	0.99518	0.99518	1.01777	0.99492	0.99787	0.99518	1.01038	0.99537
16	ZPR-6-7	0.02200	1.02470	1.02740	1.03178	1.02660	1.02467	1.02473	1.04936	1.02526	1.02772	1.02452	1.04017	1.02496
18	ZPPR-2	0.02010	1.12517	1.12819	1.13243	1.12744	1.12519	1.12520	1.15215	1.12582	1.12879	1.12509	1.14233	1.12547
19	MZA	0.03366	1.02199	1.02474	1.02797	1.02337	1.02195	1.02204	1.04258	1.02278	1.02468	1.02185	1.03677	1.02251
20	MZB	0.02256	1.04505	1.04817	1.05206	1.04695	1.04504	1.04510	1.06783	1.04582	1.04817	1.04492	1.06028	1.04594
21	FCA-5-2	0.03960	1.11635	1.12109	1.12358	1.11673	1.11636	1.11635	1.13329	1.11698	1.11839	1.11589	1.12311	1.12836
Average			1.07204	1.07380	1.08047	1.07320	1.07204	1.07206	1.08737	1.07248	1.07331	1.07183	1.08775	1.07330
Stnd. Dev.			0.09403	0.09290	0.09326	0.09417	0.09403	0.09403	0.09540	0.09411	0.09384	0.09193	0.09659	0.09430

Table 11.2 Comparison of Central Reaction Rate Ratio--^{238}U fission／^{235}U fission (C/E values)

NO	assembly (U-fuel)	Exp.	JFS-3-J32	U235J31	U238J31	Pu239 J31	Pu240 J31	Pu241 J31	FeJ31	NiJ31	NaJ31	Xu238 J31	Xp239 J31	Xu235 J31
2	VERA-1B	0.08600	0.92393	0.92878	0.92482	0.92393	0.92393	0.92393	0.92921	0.92436	0.92393	0.92426	0.92393	0.94229
3	ZPR-3-6F	0.07800	0.98315	0.98250	0.99150	0.98315	0.98315	0.98315	0.98867	0.98435	0.98315	0.98319	0.98315	1.00009
5	ZPR-3-12	0.04700	1.04278	1.04624	1.05672	1.04278	1.04278	1.04278	1.04732	1.04291	1.04278	1.04250	1.04278	1.06234
7	ZPR-3-11	0.03800	1.02671	1.02688	1.05148	1.02671	1.02671	1.02671	1.02951	1.02683	1.02671	1.02645	1.02671	1.04510
13	ZEBRA-2	0.03200	1.03001	1.04034	1.04328	1.03001	1.03001	1.03001	1.03390	1.03012	1.03002	1.02968	1.03001	1.04999
17	ZPR-6-6A	0.02400	0.97407	0.98574	0.98024	0.97407	0.97404	0.97404	0.99652	0.97450	0.97672	0.97395	0.97407	0.99238
Average			0.99677	1.00175	1.00801	0.99677	0.99677	0.99677	1.00419	0.99701	0.99722	0.99667	0.99677	1.01536
Stnd.Dev.			0.04108	0.04093	0.04738	0.04180	0.04108	0.04108	0.03938	0.04095	0.04085	0.04086	0.04108	0.04162
********														
All Assemblies														
Average			1.05054	1.05321	1.05976	1.05136	1.05053	1.05053	1.06360	1.05091	1.05157	1.05035	1.06176	1.05675
Stnd.Dev.			0.08919	0.08898	0.08903	0.08949	0.08919	0.08919	0.09141	0.08926	0.08915	0.08909	0.09400	0.08679

Table 12.1 Comparison of Central Reaction Rate Raio--^{239}Pu fission／^{235}U fission (C/E values)

NO	Assembly (Pu-fuel)	Exp.	JFS-3-J32	U235J31	U238J31	Pu239 J31	Pu240 J31	Pu241 J31	FeJ31	NiJ31	NaJ31	Xu238 J31	Xp239 J31	Xu235 J31
1	VERA-11A	1.18000	0.98740	0.98883	0.98810	0.98758	0.98744	0.98741	0.98831	0.98749	0.98740	0.98730	0.98664	0.98740
4	ZEBRA-3	1.19000	0.97793	0.97860	0.97769	0.97775	0.97794	0.97793	0.97833	0.97796	0.97793	0.97768	0.97745	0.97792
6	SNEAK-7A	1.01600	0.97571	0.97796	0.97723	0.97723	0.97574	0.97572	0.97690	0.97586	0.97572	0.97563	0.97557	0.97574
8	ZPR-3-54	0.92800	0.96006	0.95766	0.96082	0.96032	0.96007	0.96007	0.96079	0.96018	0.96006	0.96006	0.96043	0.96007
9	ZPR-3-53	0.92800	0.95991	0.95747	0.96066	0.96010	0.95992	0.95991	0.96091	0.96003	0.95991	0.95986	0.96022	0.95992
10	SNEAK-7B	1.01200	0.99305	0.99581	0.99274	0.99385	0.99307	0.99305	0.99443	0.99318	0.99305	0.99299	0.99286	0.99311
11	ZPR-3-50	0.90300	1.00551	1.00567	1.00698	1.00715	1.00522	1.00552	1.00648	1.00560	1.00551	1.00546	1.00563	1.00552
12	ZPR-3-48	0.97600	0.99969	1.00182	1.00071	1.00235	0.99970	0.99969	1.00159	0.99984	1.00009	0.99962	0.99946	0.99969
14	ZPR-3-49	0.98600	1.01431	1.01686	1.01579	1.01577	1.01433	1.01432	1.01639	1.01449	1.01431	1.01424	1.01401	1.01432
15	ZPR-3-56B	1.02800	0.95089	0.95347	0.95065	0.95357	0.95092	0.95089	0.95379	0.95093	0.95143	0.95089	0.95075	0.95090
16	ZPR-6-7	0.94250	0.98270	0.98517	0.98223	0.98636	0.98271	0.98271	0.98542	0.98286	0.98323	0.98267	0.98258	0.98270
18	ZPPR-2	0.93700	0.98938	0.99191	0.98879	0.99309	0.98940	0.98939	0.99214	0.98955	0.98996	0.98936	0.98928	0.98938
19	MZA	1.01338	0.98651	0.98898	0.98656	0.98307	0.98656	0.98653	0.98933	0.98679	0.98709	0.98649	0.98628	0.98652
20	MZB	0.94877	0.98928	0.99189	0.98870	0.99291	0.98931	0.98930	0.99189	0.98952	0.98985	0.98926	0.98916	0.98931
21	FCA-5-2	1.10400	0.96934	0.97234	0.97006	0.97045	0.96936	0.96935	0.97151	0.96954	0.96977	0.96926	0.96921	0.96966
Average			0.98278	0.98429	0.98318	0.98450	0.98280	0.98279	0.98455	0.98292	0.98302	0.98273	0.98264	0.98281
Stnd. Dev.			0.01700	0.01772	0.01719	0.01733	0.01700	0.01700	0.01707	0.01702	0.01697	0.01699	0.01690	0.01698

Table 12.2 Comparison of Central Reaction Rate Raio--^{239}Pu fission/^{235}U fission (C/E values)

NO	Assembly (U-fuel)	Exp.	JFS-3-J32	U235J31	U238J31	Pu239 J31	Pu240 J31	Pu241 J31	FeJ31	NiJ31	NaJ31	Xu238 J31	Xp239 J31	Xu235 J31
2	VERA-1B	1.20000	0.95527	0.95868	0.95592	0.95607	0.95527	0.95527	0.95597	0.95545	0.95527	0.95524	0.95527	0.95656
3	ZPR-3-6F	1.22000	1.01201	1.01290	1.01388	1.01203	1.01201	1.01201	1.01292	1.01210	1.01201	1.01197	1.01201	1.01236
5	ZPR-3-12	1.12000	0.98845	0.99129	0.98997	0.98885	0.98845	0.98845	0.98901	0.98850	0.98845	0.98840	0.98845	0.98892
7	ZPR-3-11	1.19000	0.97284	0.97386	0.97277	0.97286	0.97284	0.97284	0.97323	0.97287	0.97284	0.97282	0.97284	0.97282
13	ZEBRA-2	0.98700	1.00637	1.01126	1.00775	1.00818	1.00637	1.00637	1.00676	1.00641	1.00638	1.00632	1.00637	1.00700
17	ZPR-6-6A													
Average			0.98699	0.98960	0.98806	0.98760	0.98699	0.98699	0.98758	0.98707	0.98699	0.98695	0.98699	0.98753
Stnd.Dev.			0.02103	0.02107	0.02156	0.02113	0.02103	0.02103	0.02106	0.02099	0.02103	0.02102	0.02103	0.02085
********														
All Assemblies														
Average			0.98383	0.98562	0.98440	0.98528	0.98358	0.98358	0.98530	0.98396	0.98401	0.98378	0.98372	0.98399
Stnd.Dev.			0.01818	0.01875	0.01850	0.01841	0.01818	0.01818	0.01819	0.01818	0.01815	0.01817	0.01812	0.01814

Table 13.1 Comparison of Central Reaction Rate Ratio--^{240}Pu fission／^{235}U fission
(C/E values)

N0	Assembly (Pu-fuel)	Exp.	JFS-3-J32	U235J31	U238J31	Pu239 J31	Pu240 J31	Pu241 J31	FeJ31	NiJ31	NaJ31	Xu238 J31	Xp239 J31	Xu235 J31
1	VERA-11A	0.47500	1.10215	1.10375	1.10495	1.10225	1.10223	1.10216	1.10446	1.10241	1.10215	1.10215	1.10350	1.10215
4	ZEBRA-3	0.37300	0.98673	0.98738	1.00021	0.98670	0.98675	0.98273	0.98759	0.98684	0.98674	0.98638	0.98717	0.98699
6	SNEAK-7A													
8	ZPR-3-54	0.17400	1.23284	1.22986	1.23782	1.23372	1.23289	1.23285	1.23749	1.23342	1.23284	1.23284	1.24003	1.23289
9	ZPR-3-53	0.17400	1.23413	1.23110	1.23880	1.23465	1.23418	1.23414	1.24012	1.23472	1.23413	1.23384	1.24100	1.23418
10	SNEAK-7B													
11	ZPR-3-50	0.15900	1.36369	1.36411	1.37557	1.36516	1.36375	1.36370	1.36893	1.36414	1.36369	1.36336	1.36971	1.36381
12	ZPR-3-48	0.24300	1.06478	1.06713	1.07430	1.06626	1.06482	1.06479	1.07063	1.06535	1.06676	1.06449	1.06781	1.06486
14	ZPR-3-49													
15	ZPR-3-56B	0.28200	0.84869	0.85105	0.85460	0.84999	0.84874	0.84869	0.85632	0.84870	0.85105	0.84869	0.85122	0.84875
16	ZPR-6-7													
18	ZPPR-2	0.17000	1.11955	1.12254	1.12662	1.12147	1.11962	1.11958	1.12965	1.12031	1.12316	1.11949	1.12287	1.11967
19	MZA	0.25993	1.01389	1.01659	1.02021	1.01514	1.01398	1.01393	1.02186	1.01484	1.01671	1.01379	1.01651	1.01410
20	MZB	0.19194	1.03466	1.03771	1.04142	1.03628	1.03473	1.03470	1.04291	1.03561	1.03784	1.03457	1.03746	1.03501
21	FCA-5-2													
Average			1.10011	1.10112	1.10745	1.10116	1.10017	1.10013	1.10600	1.10063	1.10151	1.09996	1.10373	1.10024
Stnd. Dev.			0.13945	0.13816	0.13965	0.13947	0.13945	0.13945	0.13915	0.13953	0.13871	0.13941	0.14113	0.13942

Table 13.2 Comparison of Central Reaction Rate Ratio--^{240}Pu fission/^{235}U fission (C/E values)

N0	Assembly (U-fuel)	Exp.	JFS-3-J32	U235J31	U238J31	Pu239 J31	Pu240 J31	Pu241 J31	FeJ31	NiJ31	NaJ31	Xu238 J31	Xp239 J31	Xu235 J31
2	VERA-1B	0.39900	1.21208	1.21926	1.21401	1.21208	1.21209	1.21208	1.21473	1.21277	1.21208	1.21214	1.21208	1.22407
3	ZPR-3-6F	0.53000	0.98595	0.98633	0.99412	0.98595	0.98595	0.98595	0.98778	0.98623	0.98595	0.98585	0.98595	0.99170
5	ZPR-3-12													
7	ZPR-3-11	0.34000	1.00878	1.00943	1.02269	1.00878	1.00877	1.00878	1.00957	1.00891	1.00878	1.00862	1.00878	1.01306
13	ZEBRA-2	0.23700	1.06491	1.07531	1.07801	1.06491	1.06491	1.06491	1.06621	1.06505	1.06493	1.06466	1.06491	1.07325
17	ZPR-6-6A													
Average			1.06793	1.07258	1.07721	1.06793	1.06793	1.06793	1.06957	1.06824	1.06793	1.06782	1.06793	1.07552
Stnd.Dev.			0.08805	0.09076	0.08455	0.08805	0.08805	0.08805	0.08856	0.08824	0.08805	0.08812	0.08805	0.09083
********														
All Assemblies														
Average			1.09092	1.09297	1.09881	1.09167	1.09096	1.09093	1.09559	1.09138	1.09192	1.09078	1.09350	1.09318
Stnd.Dev.			0.12774	0.12710	0.12712	0.12781	0.12774	0.12774	0.12784	0.12785	0.12723	0.12772	0.12924	0.12793

Table 14.1 Comparison of Central Reaction Rate Ratio--^{238}U capture／^{235}U fission (C/E values)

N0	Assembly (Pu-fuel)	Exp.	JFS-3-J32	U235J31	U238J31	Pu239 J31	Pu240 J31	Pu241 J31	FeJ31	NiJ31	NaJ31	Xu238 J31	Xp239 J31	Xu235 J31
1	VERA-11A	0.15800	0.73894	0.73998	0.73660	0.73884	0.73888	0.73893	0.73718	0.73881	0.73894	0.73909	0.73908	0.73894
4	ZEBRA-3													
6	SNEAK-7A	0.13760	0.96585	0.96799	0.96500	0.96586	0.96582	0.96585	0.96482	0.96570	0.96585	0.96593	0.96534	0.96582
8	ZPR-3-54													
9	ZPR-3-53													
10	SNEAK-7B	0.13100	1.00661	1.00869	1.00885	1.00625	1.00608	1.00611	1.00539	1.00596	1.00610	1.00617	1.00584	1.00599
11	ZPR-3-50													
12	ZPR-3-48	0.13800	0.96297	0.96500	0.96159	0.96305	0.96296	0.96297	0.96197	0.96282	0.96262	0.96303	0.96267	0.96296
14	ZPR-3-49													
15	ZPR-3-56B													
16	ZPR-6-7	0.13200	1.06808	1.07075	1.06705	1.06820	1.06806	1.06808	1.06763	1.06792	1.06762	1.06811	1.06787	1.06807
18	ZPPR-2													
19	MZA	0.13143	1.01937	1.02181	1.01895	1.01933	1.01930	1.01936	1.01730	1.01904	1.01874	1.01940	1.01918	1.01935
20	MZB	0.13510	1.03550	1.03816	1.03482	1.03560	1.03547	1.03550	1.03495	1.03527	1.03502	1.03552	1.03531	1.03547
21	FCA-5-2	0.14000	0.90613	0.90721	0.90548	0.90610	0.90610	0.90612	0.90386	0.90586	0.90561	0.90624	0.90607	0.90556
Average			0.96287	0.96495	0.96229	0.96290	0.96283	0.96286	0.96164	0.96267	0.96256	0.96294	0.96267	0.96277
Stnd. Dev.			0.09668	0.09724	0.09733	0.09674	0.09669	0.09668	0.09765	0.09666	0.09657	0.09664	0.09657	0.09671

Table 14.2 Comparison of Central Reaction Rate Ratio--^{238}U capture／^{235}U fission (C/E values)

NO	Assembly (U-fuel)	Exp.	JFS-3-J32	U235J31	U238J31	Pu239 J31	Pu240 J31	Pu241 J31	FeJ31	NiJ31	NaJ31	Xu238 J31	Xp239 J31	Xu235 J31
2	VERA-1B	0.13500	0.91371	0.90878	0.91110	0.91371	0.91371	0.91371	0.91189	0.91336	0.91371	0.91377	0.91371	0.91118
3	ZPR-3-6F	0.10400	0.94307	0.94201	0.94164	0.94307	0.94307	0.94307	0.94087	0.94292	0.94307	0.94315	0.94307	0.94123
5	ZPR-3-12	0.12300	0.96334	0.96445	0.96515	0.96334	0.96334	0.96334	0.96261	0.96327	0.96334	0.96341	0.96334	0.96217
7	ZPR-3-11	0.11200	0.96234	0.96240	0.97442	0.96234	0.96234	0.96234	0.96166	0.96228	0.96234	0.96237	0.96234	0.96168
13	ZEBRA-2	0.13600	0.96675	0.97084	0.96832	0.96675	0.96675	0.96675	0.96658	0.96672	0.96675	0.96680	0.96675	0.96576
17	ZPR-6-6A	0.13780	1.02126	1.02493	1.02106	1.02126	1.02126	1.02126	1.02050	1.02109	1.02079	1.02128	1.02126	1.02056
Average			0.96175	0.96224	0.96361	0.96175	0.96175	0.96175	0.96069	0.96161	0.96167	0.96180	0.96175	0.96043
Stnd.Dev.			0.03221	0.03482	0.03337	0.03221	0.03221	0.03221	0.03264	0.03226	0.03207	0.03220	0.03221	0.03277
********														
All Assemblies														
Average			0.96239	0.96379	0.96286	0.96241	0.96237	0.96238	0.96123	0.96222	0.96218	0.96245	0.96227	0.96177
Stnd.Dev.			0.07607	0.07698	0.07675	0.07611	0.07607	0.07607	0.07641	0.07606	0.07596	0.07604	0.07599	0.07620

Table 15.1 Comparison of Central Reaction Rate Ratio--^{238}U capture／^{235}Pu fission (C/E values)

N0	Assembly (Pu- fuel)	Exp.	JFS-3-J32	U235J31	U238J31	Pu239 J31	Pu240 J31	Pu241 J31	FeJ31	NiJ31	NaJ31	Xu238 J31	Xp239 J31	Xu235 J31
1	VERA-11A													
4	ZEBRA-3													
6	SNEAK-7A	0.13500	0.99307	0.99298	0.99065	0.99153	0.99301	0.99306	0.99080	0.99276	0.99306	0.99323	0.99269	0.99302
8	ZPR-3-54													
9	ZPR-3-53													
10	SNEAK-7B	0.12900	1.01666	1.01645	1.01975	1.01598	1.01662	1.01665	1.01452	1.01638	1.01665	1.01678	1.01658	1.01648
11	ZPR-3-50													
12	ZPR-3-48	0.14100	0.96596	0.96594	0.96358	0.96348	0.96593	0.96596	0.96312	0.96566	0.96522	0.96609	0.96588	0.96595
14	ZPR-3-49													
15	ZPR-3-56B													
16	ZPR-6-7	0.14000	1.08730	1.08729	1.08677	1.08338	1.08726	1.08729	1.08384	1.08695	1.08624	1.08736	1.08721	1.08728
18	ZPPR-2													
19	MZA	0.12970	1.03331	1.03320	1.03283	1.03059	1.03318	1.03327	1.02827	1.03268	1.03206	1.03335	1.03336	1.03327
20	MZB	0.14270	1.04671	1.04664	1.04665	1.04299	1.04665	1.04669	1.04341	1.04622	1.04563	1.04675	1.04665	1.04665
21	FCA-5-2	0.12680	0.93487	0.93311	0.93352	0.93377	0.93483	0.93486	0.93045	0.93440	0.93392	0.93507	0.93493	0.93398
Average			1.01113	1.01080	1.01054	1.00882	1.01167	1.01111	1.00777	1.01072	1.01040	1.01123	1.01104	1.01095
Stnd. Dev.			0.04747	0.04786	0.04815	0.04666	0.04746	0.04746	0.04748	0.04745	0.04735	0.04742	0.04746	0.04766

Table 15.2 Comparison of Central Reaction Rate Ratio--^{238}U capture／^{235}Pu fission (C/E values)

NO	Assembly (U-fuel)	Exp.	JFS-3-J32	U235J31	U238J31	Pu239 J31	Pu240 J31	Pu241 J31	FeJ31	NiJ31	NaJ31	Xu238 J31	Xp239 J31	Xu235 J31
2	VERA-1B	0.12200	0.88202	0.87414	0.87889	0.88128	0.88202	0.88202	0.87961	0.88150	0.88202	0.88210	0.88202	0.87838
3	ZPR-3-6F	0.08500	0.93457	0.93270	0.93143	0.93456	0.93457	0.93457	0.93156	0.93434	0.93457	0.93469	0.93457	0.93243
5	ZPR-3-12	0.11000	0.97301	0.97135	0.97335	0.97262	0.97301	0.97301	0.97173	0.97290	0.97301	0.97313	0.97301	0.97137
7	ZPR-3-11	0.09400	0.99044	0.98948	1.00295	0.99042	0.99044	0.99044	0.98935	0.99035	0.99044	0.99051	0.99044	0.98979
13	ZEBRA-2	0.13800	0.95918	0.95858	0.95941	0.95746	0.95918	0.95918	0.95863	0.95911	0.95917	0.95927	0.95918	0.95759
17	ZPR-6-6A													
Average			0.94784	0.94525	0.94921	0.94727	0.94784	0.94784	0.94618	0.94764	0.94784	0.94794	0.94784	0.94591
Stnd.Dev.			0.03764	0.04007	0.04204	0.03775	0.03764	0.03764	0.03825	0.03780	0.03764	0.03764	0.03764	0.03860
********														
All Assemblies														
Average			0.98476	0.98349	0.98498	0.98317	0.98472	0.98475	0.98211	0.98444	0.98433	0.98486	0.98471	0.98385
Stnd.Dev.			0.05365	0.05522	0.05480	0.05277	0.05363	0.05364	0.05336	0.05363	0.05338	0.05363	0.05362	0.05454

Table 16.1 Comparison of Effective Multiplication Factors
(C/E values)

NO	Assembly (Pu-fuel)	Exp.	JFS-3-J32	U235B6	U238B6	Pu239B6	Pu240B6	Pu241B6	XU235B6	XU238B6	XPu239B6
1	VERA-11A	1.00000	0.98246	0.98262	0.99979	0.98345	0.98270	0.98241	0.98246	0.98346	0.98298
4	ZEBRA-3	1.00000	0.98384	0.98388	1.01533	0.98725	0.98418	0.98381	0.98398	0.98436	0.98462
6	SNEAK-7A	1.00000	1.00074	1.00120	1.01539	1.00014	1.00173	1.00070	1.00077	1.00128	1.00121
8	ZPR-3-54	1.00000	1.00831	1.00759	1.00707	1.00812	1.00984	1.00837	1.00831	1.00831	1.00864
9	ZPR-3-53	1.00000	0.99933	0.99918	1.00842	0.99887	1.00067	0.99937	0.99933	0.99976	0.99971
10	SNEAK-7B	1.00000	0.99847	0.99903	1.01782	0.99776	0.99920	0.99841	0.99870	0.99876	0.99894
11	ZPR-3-50	1.00000	0.99932	0.99970	1.01093	0.99825	1.00035	0.99932	0.99933	0.99962	0.99986
12	ZPR-3-48	1.00000	1.00237	1.00331	1.01804	1.00216	1.00310	1.00234	1.00238	1.00272	1.00285
14	ZPR-3-49	1.00000	1.00354	1.00392	1.02082	1.00319	1.00424	1.00352	1.00356	1.00393	1.00405
15	ZPR-3-56B	1.00000	1.01098	1.01177	1.01826	1.01142	1.01276	1.01098	1.01100	1.01098	1.01120
16	ZPR-6-7	1.00000	1.00084	1.00236	1.01392	1.00041	1.00251	1.00079	1.00086	1.00097	1.00110
18	ZPPR-2	1.00000	1.00546	1.00674	1.01608	1.00552	1.00705	1.00538	1.00547	1.00551	1.00570
19	MZA	1.00000	0.99645	0.99753	1.00612	0.99715	0.99920	0.99635	0.99648	0.99659	0.99670
20	MZB	1.00000	0.99751	0.99896	1.00882	0.99754	1.00009	0.99744	0.99756	0.99760	0.99774
21	FCA-5-2	1.00000	0.98546	0.98701	0.99827	0.98617	0.98584	0.98545	0.98596	0.98604	0.98566
Average			0.99834	0.99899	1.01167	0.99849	0.99956	0.99831	0.99841	0.99866	0.99873
Stnd. Dev.			0.00816	0.00816	0.00658	0.00757	0.00855	0.00817	0.00810	0.00796	0.00810

Table 16.2 Comparison of Effective Multiplication Factors
(C/E values)

NO	Assembly (U-fuel)	Exp.	JFS-3-J32	U235B6	U238B6	Pu239B6	Pu240B6	Pu241B6	XU235B6	XU238B6	XPu239B6
2	VERA-1B	1.00000	0.99433	0.99516	1.00711	0.99433	0.99433	0.99433	0.99435	0.99511	0.99433
3	ZPR-3-6F	1.00000	1.00358	1.00419	1.01799	1.00358	1.00358	1.00358	1.00455	1.00423	1.00358
5	ZPR-3-12	1.00000	0.99854	1.00131	1.01162	0.99854	0.99854	0.99854	1.00010	0.99892	0.99854
7	ZPR-3-11	1.00000	0.99780	0.99971	1.02346	0.99780	0.99780	0.99780	1.00015	0.99802	0.99780
13	ZEBRA-2	1.00000	0.98567	0.98872	0.99711	0.98567	0.98567	0.98567	0.98741	0.98596	0.98567
17	ZPR-6-6A	1.00000	1.00206	1.00509	1.00869	1.00206	1.00206	1.00206	1.00307	1.00217	1.00206
Average			0.99700	0.99903	1.01100	0.99700	0.99700	0.99700	0.99827	0.99740	0.99700
Stnd. Dev.			0.00588	0.00563	0.00835	0.00588	0.00588	0.00588	0.00581	0.00589	0.00588
*******											
All Assemblies											
Average			0.99795	0.99900	1.01148	0.99807	0.99883	0.99793	0.99837	0.99830	0.99823
Stnd. Dev.			0.00761	0.00753	0.00714	0.00716	0.00796	0.00761	0.00752	0.00745	0.00758

Table 17.1 Comparison of Central Reaction Rate Ratio--^{238}U fission／^{235}U fission (C/E values)

NO	Assembly (Pu-fuel)	Exp.	JFS-3-J32	U235B6	U238B6	Pu239B6	Pu240B6	Pu241B6	XU235B6	XU238B6	XPu239B6
1	VERA-11A	0.10200	0.89100	0.89250	0.87373	0.88480	0.89062	0.89085	0.89100	0.89138	0.89358
4	ZEBRA-3	0.04610	0.99526	0.99590	1.04798	0.99294	0.99516	0.99519	0.99598	0.99486	0.99882
6	SNEAK-7A	0.04480	0.99302	0.98876	1.00892	0.98680	0.99187	0.99277	0.99330	0.99281	0.99776
8	ZPR-3-54	0.02540	1.23033	1.21996	1.24013	1.22430	1.22824	1.23013	1.23039	1.23033	1.23750
9	ZPR-3-53	0.02540	1.23405	1.22313	1.23216	1.22828	1.23212	1.23387	1.23411	1.23381	1.24116
10	SNEAK-7B	0.03300	1.02861	1.02331	1.06387	1.02364	1.02793	1.02842	1.03024	1.02836	1.03305
11	ZPR-3-50	0.02510	1.20350	1.19454	1.22909	1.19784	1.20201	1.20327	1.20365	1.20323	1.21009
12	ZPR-3-48	0.03260	1.07158	1.06717	1.09757	1.06678	1.07075	1.07138	1.07171	1.07130	1.07647
14	ZPR-3-49	0.03450	1.10488	1.10010	1.13476	1.09879	1.10408	1.10466	1.10501	1.10458	1.10975
15	ZPR-3-56B	0.03080	0.99518	0.99144	1.02210	0.99042	0.99358	0.99518	0.99531	0.99518	0.99984
16	ZPR-6-7	0.02200	1.02470	1.01896	1.04713	1.02091	1.02294	1.02435	1.02487	1.02458	1.02966
18	ZPPR-2	0.02010	1.12517	1.11917	1.15289	1.12049	1.12335	1.12474	1.12537	1.12511	1.13064
19	MZA	0.03366	1.02199	1.01880	1.04385	1.01769	1.01947	1.02099	1.02233	1.02189	1.02639
20	MZB	0.02256	1.04505	1.04008	1.07116	1.04120	1.04243	1.04432	1.04564	1.04496	1.04988
21	FCA-5-2	0.03960	1.11635	1.11200	1.12757	1.11364	1.11610	1.11621	1.12432	1.11602	1.11837
Average			1.07204	1.06705	1.09286	1.06723	1.07071	1.07175	1.07288	1.07189	1.07686
Stnd. Dev.			0.09403	0.09110	0.09456	0.09381	0.09377	0.09405	0.09420	0.09396	0.09506

Table 17.2 Comparison of Central Reaction Rate Raio--^{238}U fission／^{235}U fission
(C/E values)

NO	Assembly (U-fuel)	Exp.	JFS-3-J32	U235B6	U238B6	Pu239B6	Pu240B6	Pu241B6	XU235B6	XU238B6	XPu239B6
2	VERA-1B	0.08600	0.92393	0.92001	0.90674	0.92393	0.92393	0.92393	0.93578	0.92418	0.92393
3	ZPR-3-6F	0.07800	0.98315	0.97684	0.99023	0.98315	0.98315	0.98315	0.99455	0.98318	0.98315
5	ZPR-3-12	0.04700	1.04278	1.03607	1.07490	1.04278	1.04278	1.04278	1.05587	1.04258	1.04278
7	ZPR-3-11	0.03800	1.02671	1.02023	1.07582	1.02671	1.02671	1.02671	1.03927	1.02652	1.02671
13	ZEBRA-2	0.03200	1.03001	1.02527	1.06429	1.03001	1.03001	1.03001	1.04332	1.02977	1.03001
17	ZPR-6-6A	0.02410	0.97407	0.97039	0.99170	0.97407	0.97407	0.97407	0.98609	0.97398	0.97407
Average			0.99677	0.99147	1.01728	0.99677	0.99677	0.99677	1.00915	0.99670	0.99677
Stnd. Dev.			0.04108	0.04026	0.06132	0.04108	0.04108	0.04108	0.04160	0.04092	0.04108
*******											
All Assemblies											
Average			1.05054	1.04545	1.07126	1.04710	1.04958	1.05033	1.05467	1.05041	1.05398
Stnd. Dev.			0.08919	0.08693	0.09288	0.08821	0.08876	0.08915	0.08753	0.08910	0.09080

Table 18.1 Comparison of Central Reaction Rate Ratio--^{239}Pu fission／^{235}U fission (C/E values)

N0	Assembly (Pu-fuel)	Exp.	JFS-3-J32	U235B6	U238B6	Pu239B6	Pu240B6	Pu241B6	XU235B6	XU238B6	XPu239B6
1	VERA-11A	1.18000	0.98740	0.98924	0.99045	0.98108	0.98731	0.98734	0.98740	0.98731	0.98618
4	ZEBRA-3	1.19000	0.97793	0.97876	0.99842	0.97960	0.97795	0.97789	0.97795	0.97788	0.97719
6	SNEAK-7A	1.01600	0.97571	0.97200	0.98811	0.97022	0.97538	0.97564	0.97573	0.97566	0.97510
8	ZPR-3-54	0.92800	0.96006	0.95131	0.96477	0.95748	0.95977	0.96003	0.96007	0.96006	0.95980
9	ZPR-3-53	0.92800	0.95991	0.95107	0.96309	0.95740	0.95964	0.95988	0.95992	0.95988	0.95964
10	SNEAK-7B	1.01200	0.99305	0.98822	1.00917	0.98769	0.99289	0.99299	0.99312	0.99301	0.99255
11	ZPR-3-50	0.90300	1.00551	0.99836	1.01725	1.00177	1.00526	1.00547	1.00552	1.00547	1.00513
12	ZPR-3-48	0.97600	0.99969	0.99668	1.01422	0.99629	0.99947	0.99962	0.99969	0.99964	0.99906
14	ZPR-3-49	0.98600	1.01431	1.01037	1.02985	1.00943	1.01410	1.01424	1.01432	1.01426	1.01361
15	ZPR-3-56B	1.02800	0.95089	0.94829	0.96370	0.94792	0.95051	0.95089	0.95090	0.95089	0.95037
16	ZPR-6-7	0.94250	0.98270	0.97902	0.99447	0.98027	0.98233	0.98259	0.98270	0.98268	0.98228
18	ZPPR-2	0.93700	0.98938	0.98575	1.00169	0.98683	0.98902	0.98925	0.98938	0.98937	0.98896
19	MZA	1.01338	0.98651	0.98474	0.99883	0.98398	0.98587	0.98617	0.98653	0.98649	0.98589
20	MZB	0.94877	0.98928	0.98634	1.00185	0.98696	0.98873	0.98907	0.98931	0.98927	0.98885
21	FCA-5-2	1.10400	0.96934	0.96773	0.97858	0.96660	0.96930	0.96929	0.96971	0.96928	0.96906
Average			0.98278	0.97919	0.99430	0.97957	0.98250	0.98269	0.98282	0.98274	0.98224
Stnd. Dev.			0.01700	0.01762	0.01939	0.01653	0.01700	0.01697	0.01698	0.01699	0.01692

Table 18.2 Comparison of Central Reaction Rate Ratio--^{239}Pu fission／^{235}U fission (C/E values)

NO	Assembly (U-fuel)	Exp.	JFS-3-J32	U235B6	U238B6	Pu239B6	Pu240B6	Pu241B6	XU235B6	XU238B6	XPu239B6
2	VERA-1B	1.20000	0.95527	0.95528	0.95631	0.95133	0.95527	0.95527	0.95633	0.95524	0.95527
3	ZPR-3-6F	1.22000	1.01201	1.01363	1.02203	1.01229	1.01201	1.01201	1.01259	1.01198	1.01201
5	ZPR-3-12	1.12000	0.98845	0.98629	1.00522	0.98645	0.98845	0.98845	0.98904	0.98842	0.98845
7	ZPR-3-11	1.19000	0.97284	0.97223	0.99079	0.97575	0.97284	0.97284	0.97314	0.97282	0.97284
13	ZEBRA-2	0.98700	1.00637	1.00184	1.02340	1.00290	1.00637	1.00637	1.00700	1.00634	1.00637
17	ZPR-6-6A										
Average			0.98699	0.98585	0.99955	0.98575	0.98699	0.98699	0.98762	0.98696	0.98699
Stnd. Dev.			0.02103	0.02072	0.02471	0.02137	0.02103	0.02103	0.02093	0.02102	0.02103
*******											
All Assemblies											
Average			0.98383	0.98086	0.99561	0.98111	0.98362	0.98376	0.98402	0.98379	0.98343
Stnd. Dev.			0.01818	0.01867	0.02097	0.01806	0.01820	0.01817	0.01817	0.01817	0.01815

Table 19.1 Comparison of Central Reaction Rate Ratio--^{240}Pu fission／^{235}U fission (C/E values)

NO	Assembly (Pu-fuel)	Exp.	JFS-3-J32	U235B6	U238B6	Pu239B6	Pu240B6	Pu241B6	XU235B6	XU238B6	XPu239B6
1	VERA-11A	0.47500	1.10215	1.10400	1.10407	1.09840	1.10506	1.10198	1.10215	1.10211	1.09996
4	ZEBRA-3	0.37300	0.98673	0.98731	1.07786	0.98694	0.99798	0.98663	0.98696	0.98648	0.98481
6	SNEAK-7A										
8	ZPR-3-54	0.17400	1.23284	1.22217	1.25898	1.22892	1.23695	1.23267	1.23287	1.23284	1.23376
9	ZPR-3-53	0.17400	1.23413	1.22304	1.25096	1.23043	1.23834	1.23398	1.23416	1.23293	1.23499
10	SNEAK-7B										
11	ZPR-3-50	0.15900	1.36369	1.35328	1.42422	1.35968	1.37046	1.36347	1.36377	1.36345	1.36404
12	ZPR-3-48	0.24300	1.06478	1.06022	1.11637	1.06217	1.07229	1.06460	1.06484	1.06457	1.06414
14	ZPR-3-49										
15	ZPR-3-56B	0.28200	0.84869	0.84529	0.88855	0.84634	0.85512	0.84869	0.84874	0.84869	0.84828
16	ZPR-6-7										
18	ZPPR-2	0.17000	1.11955	1.11321	1.16804	1.11681	1.12886	1.11916	1.11964	1.11951	1.11926
19	MZA	0.25993	1.01389	1.01059	1.05550	1.01159	1.02085	1.01299	1.01404	1.01381	1.01318
20	MZB	0.19194	1.03466	1.02944	1.08009	1.03251	1.04280	1.03401	1.03490	1.03460	1.03431
21	FCA-5-2										
Average			1.10011	1.09485	1.14246	1.09738	1.10687	1.09982	1.10021	1.10000	1.09967
Stnd. Dev.			0.13945	0.13648	0.13698	0.13864	0.13860	0.13947	0.13943	0.13942	0.13999

Table 19.2 Comparison of Central Reaction Rate Ratio--^{240}Pu fission／^{235}U fission (C/E values)

NO	Assembly (U-fuel)	Exp.	JFS-3-J32	U235B6	U238B6	Pu239B6	Pu240B6	Pu241B6	XU235B6	XU238B6	XPu239B6
2	VERA-1B	0.39900	1.21208	1.20250	1.20892	1.21208	1.21622	1.21208	1.21991	1.21211	1.21208
3	ZPR-3-6F	0.53000	0.98595	0.97645	1.01965	0.98595	0.99254	0.98595	0.99028	0.98587	0.98595
5	ZPR-3-12										
7	ZPR-3-11	0.34000	1.00878	1.00048	1.09563	1.00878	1.02194	1.00878	1.01233	1.00867	1.00878
13	ZEBRA-2	0.23700	1.06491	1.05790	1.13481	1.06491	1.07319	1.06491	1.07058	1.06473	1.06491
17	ZPR-6-6A										
Average			1.06793	1.05933	1.11475	1.06793	1.07597	1.06793	1.07327	1.06784	1.06793
Stnd. Dev.			0.08805	0.08779	0.06834	0.08805	0.08596	0.08805	0.08960	0.08810	0.08805
*******											
All Assemblies											
Average			1.09092	1.08470	1.13455	1.08896	1.09804	1.09071	1.09251	1.09081	1.09060
Stnd. Dev.			0.12774	0.12556	0.12204	0.12697	0.12660	0.12774	0.12778	0.12772	0.12813

Table 20.1 Comparison of Central Reaction Rate Ratio--^{238}U capture／^{235}U fission (C/E values)

N0	Assembly (Pu-fuel)	Exp.	JFS-3-J32	U235B6	U238B6	Pu239B6	Pu240B6	Pu241B6	XU235B6	XU238B6	XPu239B6
1	VERA-11A	0.159800	0.73894	0.74019	0.72824	0.74268	0.73920	0.73905	0.73894	0.73907	0.74031
4	ZEBRA-3										
6	SNEAK-7A	0.13760	0.96585	0.96070	0.94877	0.96740	0.96577	0.96593	0.96583	0.96591	0.96623
8	ZPR-3-54										
9	ZPR-3-53										
10	SNEAK-7B	0.13100	1.00661	1.00066	0.97820	1.00749	1.00605	1.00617	1.00599	1.00616	1.00645
11	ZPR-3-50										
12	ZPR-3-48	0.13800	0.96297	0.95762	0.94452	0.96420	0.96286	0.96302	0.96296	0.96302	0.96335
14	ZPR-3-49										
15	ZPR-3-56B										
16	ZPR-6-7	0.13200	1.06808	1.06026	1.05396	1.06921	1.06789	1.06816	1.06808	1.06810	1.06835
18	ZPPR-2										
19	MZA	0.13143	1.01937	1.01491	0.99892	1.02094	1.01938	1.01974	1.01934	1.01939	1.01989
20	MZB	0.13500	1.03550	1.02877	1.01994	1.03663	1.03531	1.03566	1.03547	1.03551	1.03579
21	FCA-5-2	0.14000	0.90613	0.90406	0.88501	0.90710	0.90614	0.90620	0.90550	0.90621	0.90639
Average			0.96287	0.95840	0.94469	0.96446	0.96282	0.96299	0.96276	0.96292	0.96335
Stnd. Dev.			0.09668	0.09413	0.09493	0.09599	0.09656	0.09670	0.09671	0.09665	0.09639

Table 20.2 Comparison of Central Reaction Rate Ratio--^{238}U capture/^{235}U fission (C/E values)

NO	Assembly (U-fuel)	Exp.	JFS-3-J32	U235B6	U238B6	Pu239B6	Pu240B6	Pu241B6	XU235B6	XU238B6	XPu239B6
2	VERA-1B	0.13500	0.91371	0.91196	0.90692	0.91371	0.91371	0.91371	0.91151	0.91377	0.91371
3	ZPR-3-6F	0.10400	0.94307	0.94950	0.90369	0.94307	0.94307	0.94307	0.94125	0.94313	0.94307
5	ZPR-3-12	0.12300	0.96334	0.96334	0.92453	0.96334	0.96334	0.96334	0.96209	0.96339	0.96334
7	ZPR-3-11	1.11200	0.96234	0.96487	0.90272	0.96234	0.96234	0.96234	0.96143	0.96236	0.96234
13	ZEBRA-2	0.13600	0.96675	0.96184	0.94282	0.96675	0.96675	0.96675	0.96585	0.96679	0.96675
17	ZPR-6-6A	0.13780	1.02126	1.01550	1.00616	1.02126	1.02125	1.02126	1.02058	1.02127	1.02126
Average			0.96175	0.96117	0.93114	0.96175	0.96175	0.96175	0.96045	0.96178	0.96175
Stnd. Dev.			0.03221	0.03036	0.03641	0.03221	0.03221	0.03221	0.03269	0.03220	0.03221
*******											
All Assemblies											
Average			0.96239	0.95959	0.93888	0.96329	0.96236	0.96246	0.96177	0.96243	0.96266
Stnd. Dev.			0.07607	0.07389	0.07591	0.07557	0.07598	0.07608	0.07619	0.07604	0.07586

Table 21.1 Comparison of Central Reaction Rate Ratio--^{238}Uu capture／^{239}Pu fission (C/E values)

NO	Assembly (Pu-fuel)	Exp.	JFS-3-J32	U235B6	U238B6	Pu239B6	Pu240B6	Pu241B6	XU235B6	XU238B6	XPu239B6
1	VERA-11A										
4	ZEBRA-3										
6	SNEAK-7A	0.13500	0.99307	0.99155	0.96327	1.00030	0.99330	0.99322	0.99302	0.99319	0.99409
8	ZPR-3-54										
9	ZPR-3-53										
10	SNEAK-7B	0.12900	1.01666	1.01610	0.97266	1.02357	1.01677	1.01678	1.01646	1.01675	1.01751
11	ZPR-3-50										
12	ZPR-3-48	0.14100	0.96596	0.96349	0.93388	0.97048	0.96606	0.96607	0.96595	0.96605	0.96695
14	ZPR-3-49										
15	ZPR-3-56B										
16	ZPR-6-7	0.14000	1.08730	1.08339	1.06023	1.09114	1.08751	1.08749	1.08729	1.08734	1.08804
18	ZPPR-2										
19	MZA	0.12970	1.03331	1.03063	1.00009	1.03756	1.03399	1.03404	1.03326	1.03334	1.03448
20	MZB	0.14240	1.04671	1.04301	1.01805	1.05032	1.04711	1.04711	1.04665	1.04674	1.04746
21	FCA-5-2	0.12680	0.93487	0.93429	0.90447	0.93853	0.93492	0.93499	0.93387	0.93502	0.93541
Average			1.01113	1.00892	0.97895	1.01599	1.01138	1.01139	1.01093	1.01120	1.01199
Stnd. Dev.			0.04747	0.04655	0.04847	0.04731	0.04757	0.04755	0.04769	0.04743	0.04749

Table 21.2 Comparison of Central Reaction Rate Ratio--^{238}Uu capture／^{239}Pu fission (C/E values)

NO	Assembly (U-fuel)	Exp.	JFS-3-J32	U235B6	U238B6	Pu239B6	Pu240B6	Pu241B6	XU235B6	XU238B6	XPu239B6
2	VERA-1B	0.12200	0.88202	0.88031	0.87451	0.88567	0.88202	0.88202	0.87891	0.88209	0.88202
3	ZPR-3-6F	0.08500	0.93457	0.93945	0.88677	0.93431	0.93457	0.93457	0.93224	0.93466	0.93457
5	ZPR-3-12	0.11000	0.97301	0.97514	0.91823	0.97499	0.97301	0.97301	0.97117	0.97310	0.97301
7	ZPR-3-11	0.09400	0.99044	0.99368	0.91225	0.98749	0.99044	0.99044	0.98920	0.99049	0.99044
13	ZEBRA-2	0.13800	0.95918	0.95862	0.91986	0.96249	0.95918	0.95918	0.95769	0.95925	0.95918
17	ZPR-6-6A										
Average			0.94784	0.94944	0.90232	0.94899	0.94784	0.94784	0.94584	0.94792	0.94784
Stnd. Dev.			0.03764	0.03894	0.01830	0.03624	0.03764	0.03764	0.03828	0.03764	0.03764
*******											
All Assemblies											
Average			0.98476	0.98414	0.94702	0.98807	0.98491	0.98491	0.98381	0.98483	0.98526
Stnd. Dev.			0.05365	0.05249	0.054200.	0.05426	0.05377	0.05377	0.05447	0.05363	0.05391

Table 22 Comparison of Effective Multiplication Factors (C/E values)

N0	Assembly (Pu-fuel)	Exp.	JFS-3-J32	U238J32P	U238J31	U238J2	U238B6
1	VERA-11A	1.00000	0.98246	0.98244	0.98453	0.98035	0.99979
4	ZEBRA-3	1.00000	0.98384	0.98128	0.98585	0.98461	1.01533
6	SNEAK-7A	1.00000	1.00074	0.99994	1.00273	1.00042	1.01539
8	ZPR-3-54	1.00000	1.00831	1.00851	1.00843	1.00848	1.00707
9	ZPR-3-53	1.00000	0.99933	0.99902	1.00043	0.99893	1.00842
10	SNEAK-7B	1.00000	0.99847	0.99646	1.00057	0.99851	1.01782
11	ZPR-3-50	1.00000	0.99932	0.99836	1.00104	1.00007	1.01093
12	ZPR-3-48	1.00000	1.00237	1.00117	1.00393	1.00286	1.01804
14	ZPR-3-49	1.00000	1.00354	1.00215	1.00492	1.00359	1.02082
15	ZPR-3-56B	1.00000	1.01098	1.01018	1.01212	1.01086	1.01826
16	ZPR-6-7	1.00000	1.00084	0.99935	1.00177	1.00035	1.01392
18	ZPPR-2	1.00000	1.00546	1.00435	1.00696	1.00539	1.01608
19	MZA	1.01080	0.99645	0.99558	0.99807	0.99657	1.00612
20	MZB	1.00400	0.99751	0.99617	0.99892	0.99734	1.00882
21	FCA-5-2	1.00000	0.98546	0.98497	0.98656	0.98539	0.99827
Average			0.99834	0.99733	0.99979	0.99825	1.01167
Stnd. Dev.			0.00816	0.00828	0.00793	0.00838	0.00658
	(U-fuel)						
2	VERA-1B	1.00000	0.99433	0.99492	0.99555	0.99338	1.00711
3	ZPR-3-6F	1.00000	1.00358	1.00380	1.00446	1.00360	1.01799
5	ZPR-3-12	1.00000	0.99854	0.99815	1.00072	1.00079	1.01162
7	ZPR-3-11	1.00000	0.99780	0.99576	0.99994	1.00030	1.02346
13	ZEBRA-2	1.00000	0.98567	0.98464	0.98790	0.98830	0.99711
17	ZPR-6-6A	1.00000	1.00206	1.00149	1.00339	1.00213	1.00869
Average			0.99700	0.99639	0.99866	0.99808	1.01100
Stnd. Dev.			0.00588	0.00614	0.00559	0.00543	0.00835
* * * * *							
All Assemblies							
Average			0.99795	0.99706	0.99947	0.99820	1.01148
Stnd. Dev.			0.00761	0.00774	0.00735	0.00765	0.00714

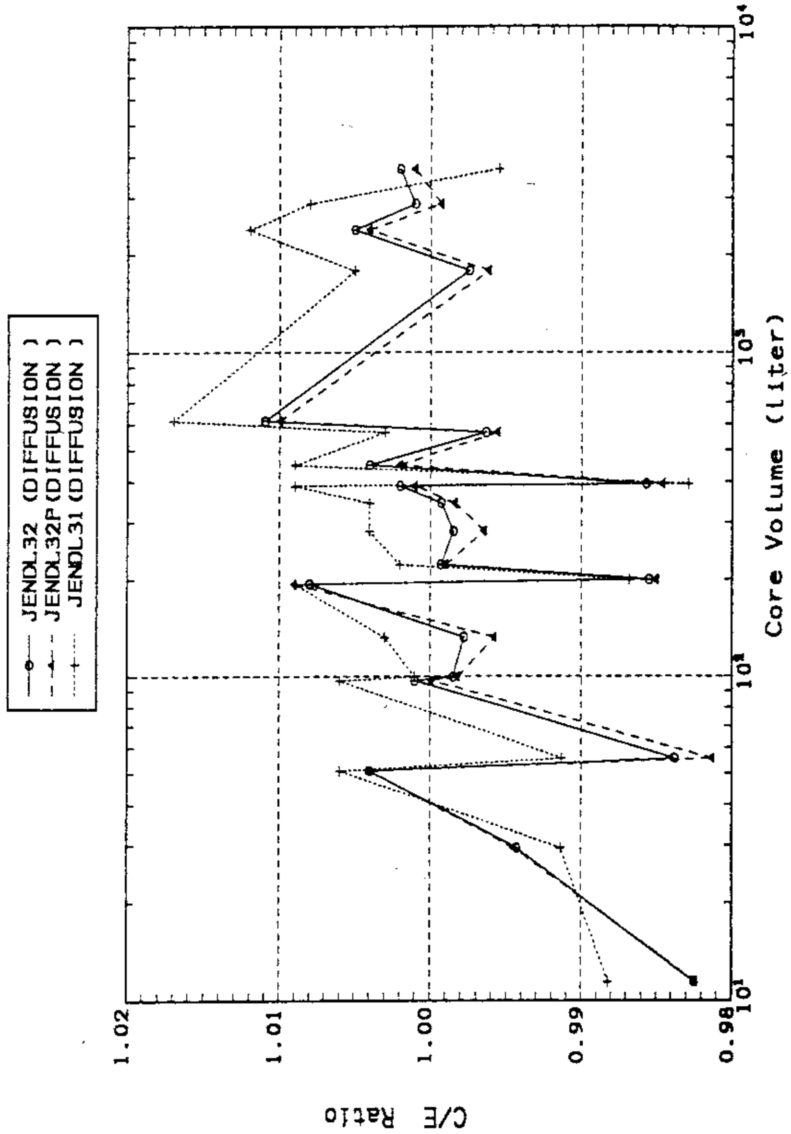

Fig. 1　κ-effective

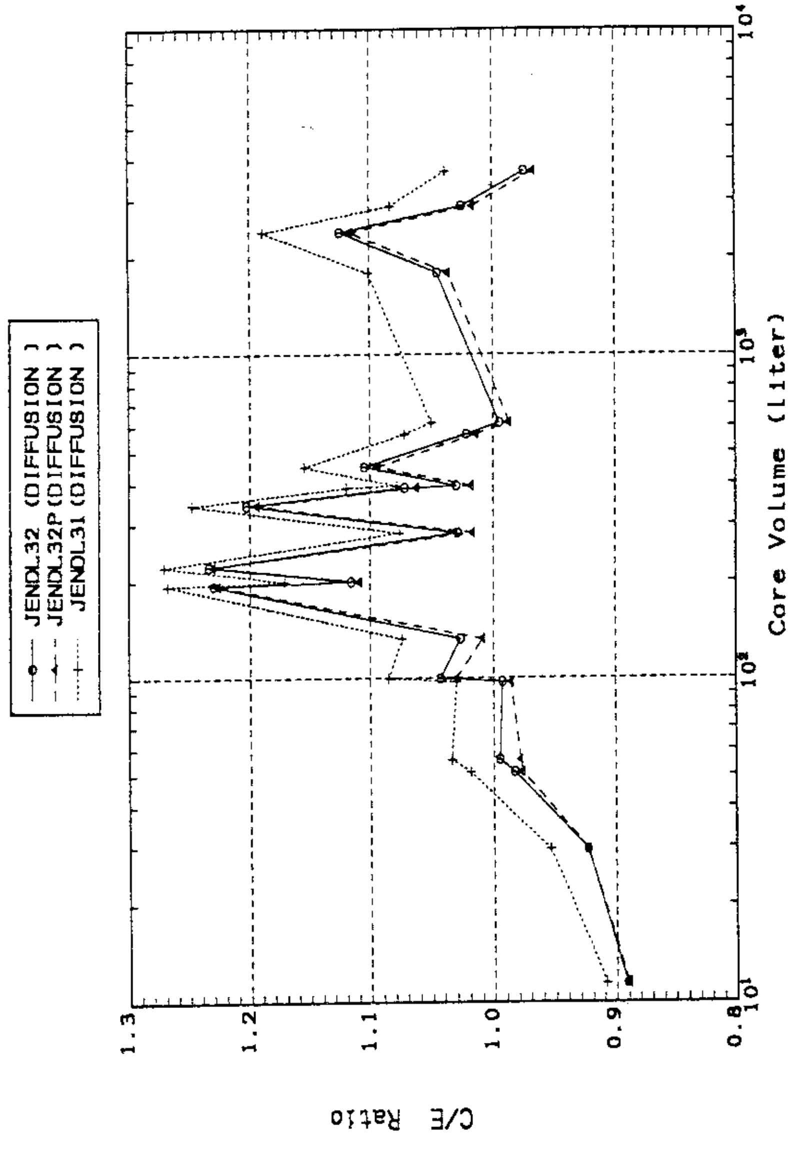

Fig. 2 C/E Ratio of $\langle \sigma_f^{238} / \sigma_f^{235} \rangle$

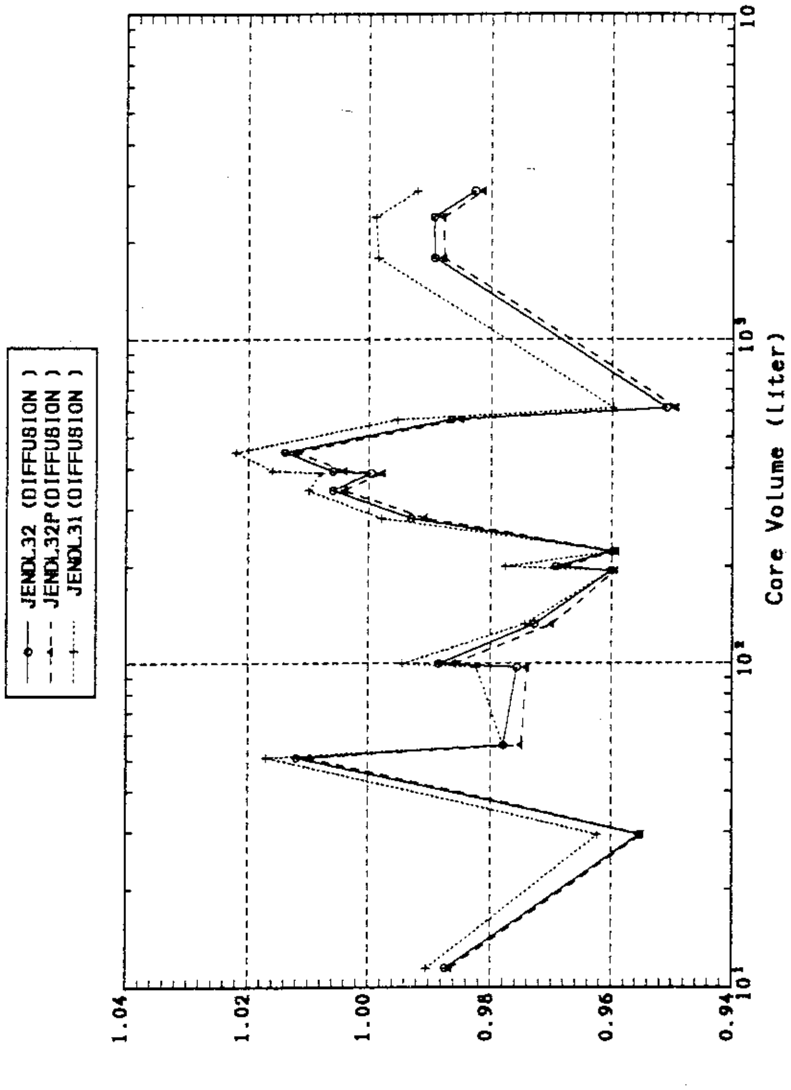

Fig. 3 C/E Ratio of $\langle \sigma_f^{239} / \sigma_f^{235} \rangle$

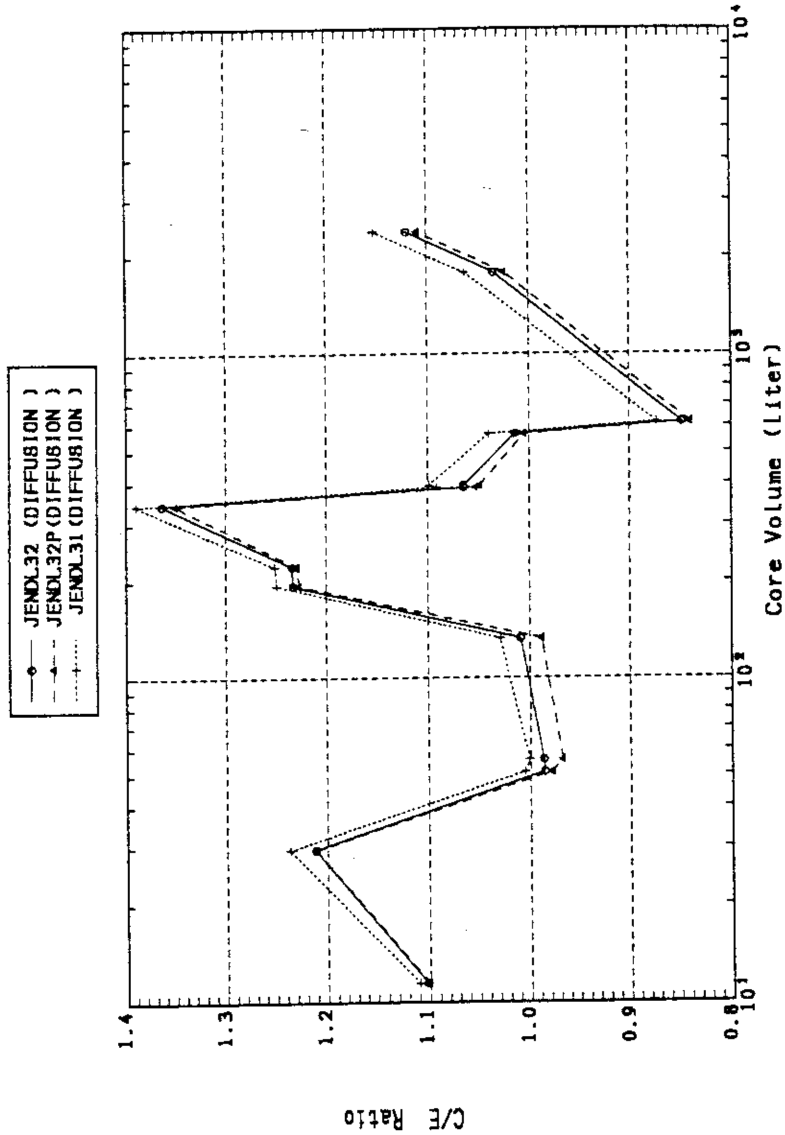

Fig. 4　C/E Ratio of $\langle \sigma_f^{240} / \sigma_f^{235} \rangle$

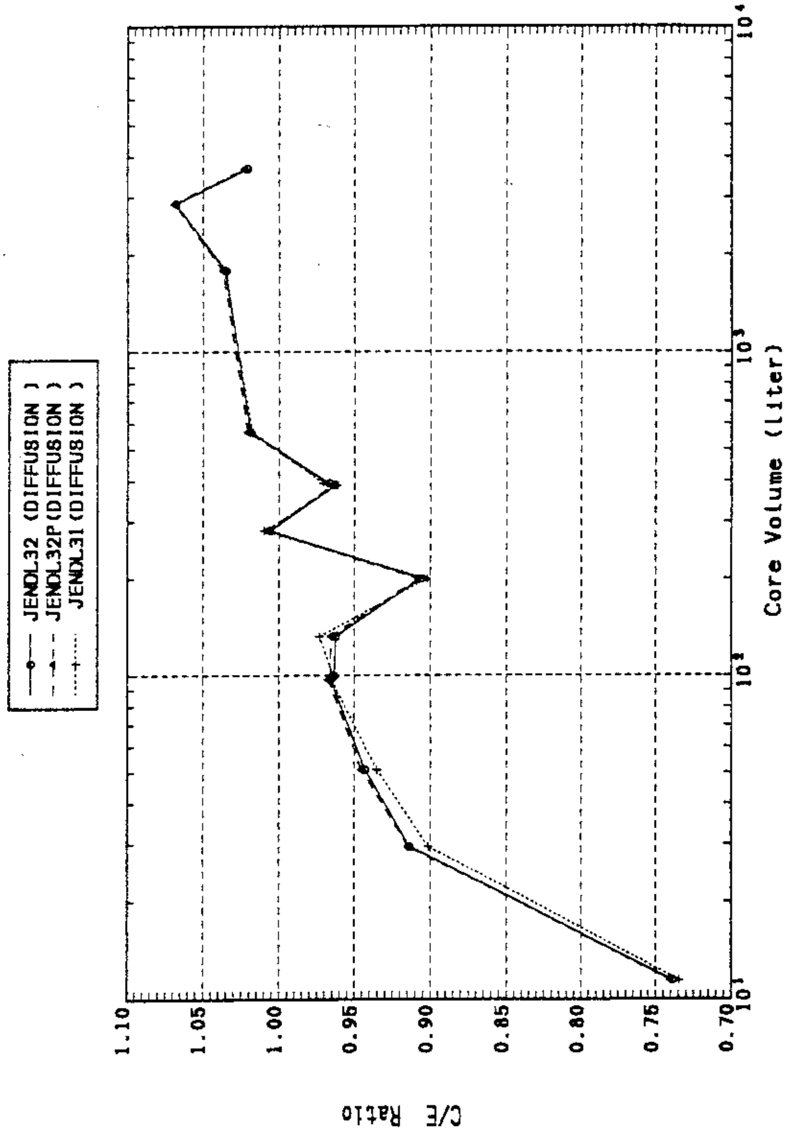

Fig. 5 C/E Ratio of $\langle \sigma_c^{238} / \sigma_f^{235} \rangle$

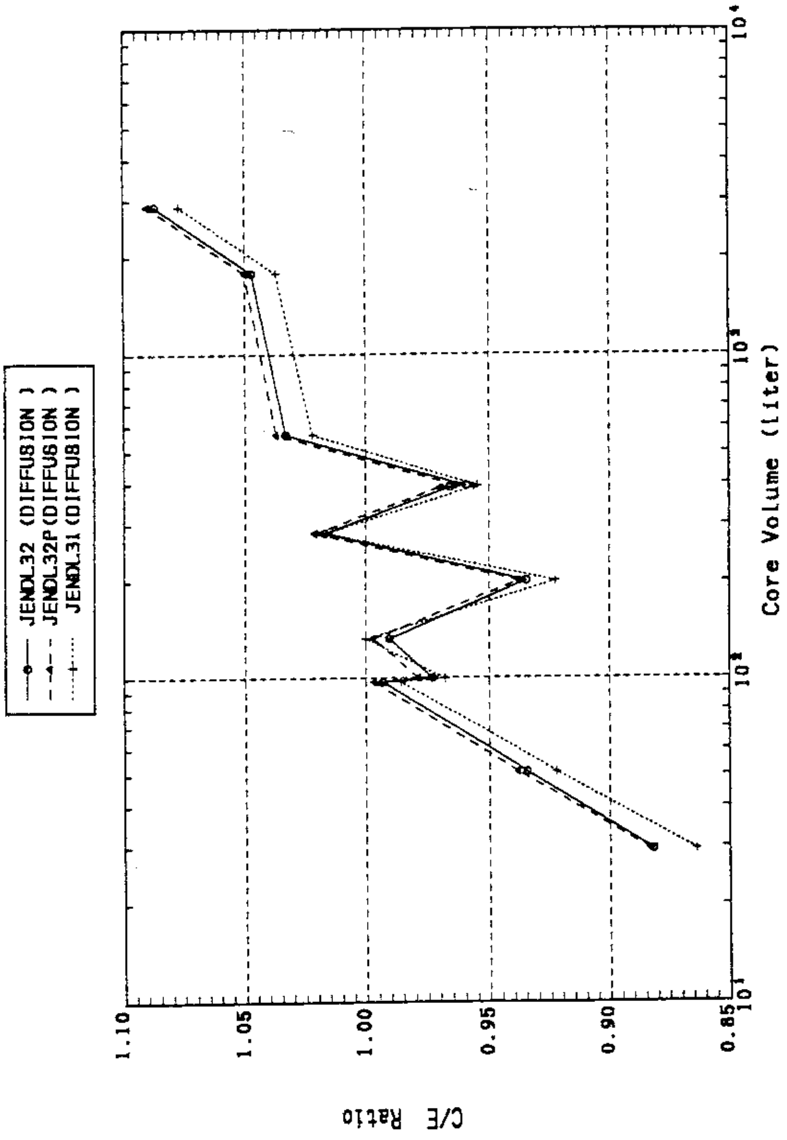

Fig. 6 C/E Ratio of $\langle \sigma_c^{238} / \sigma_f^{239} \rangle$

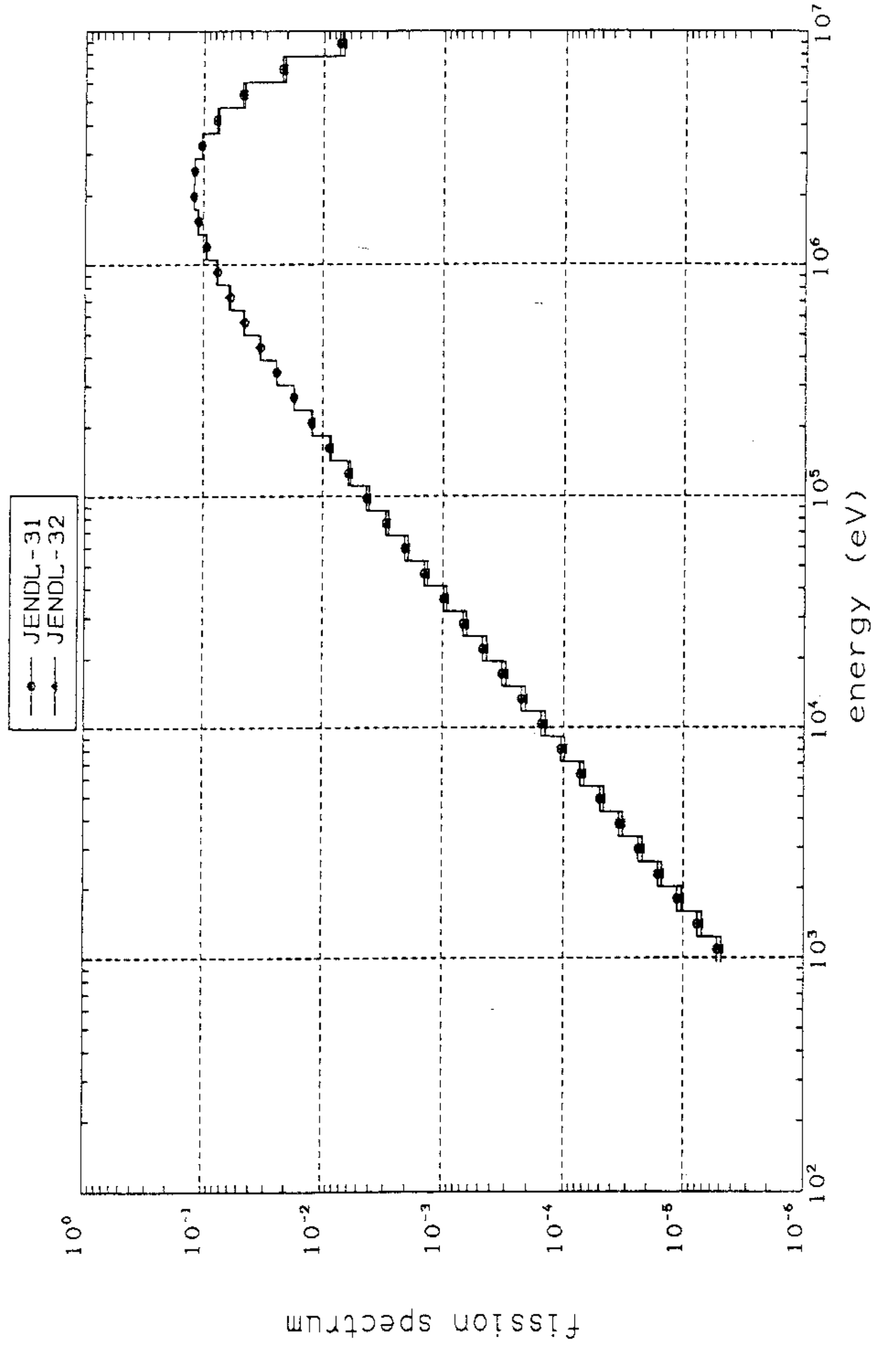

Fig. 7.1 Comparison of ^{239}Pu Fission Spectrum Group Constant

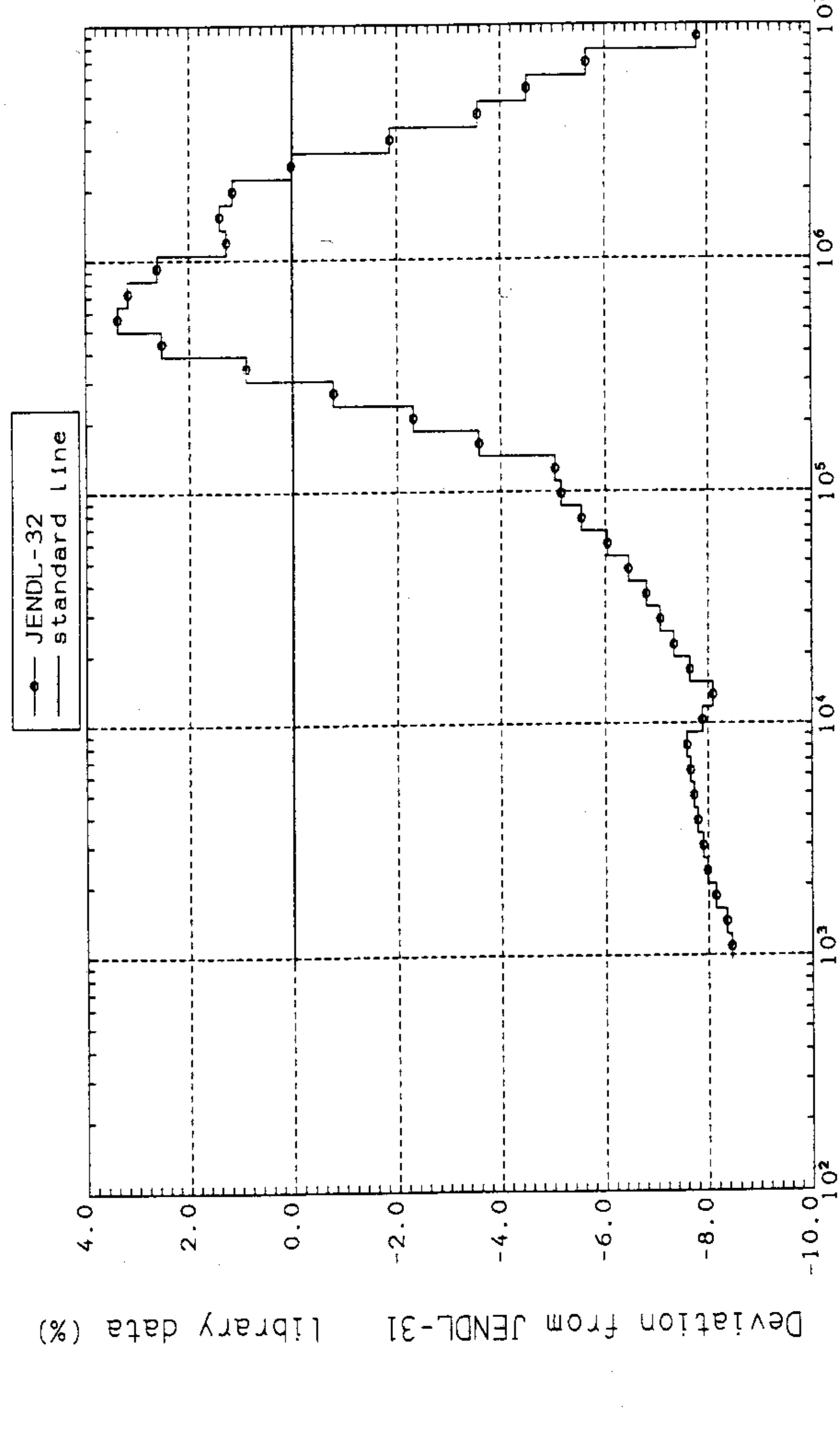

Fig. 7.2 Comparison of ^{239}Pu Fission Spectrum Group Constant

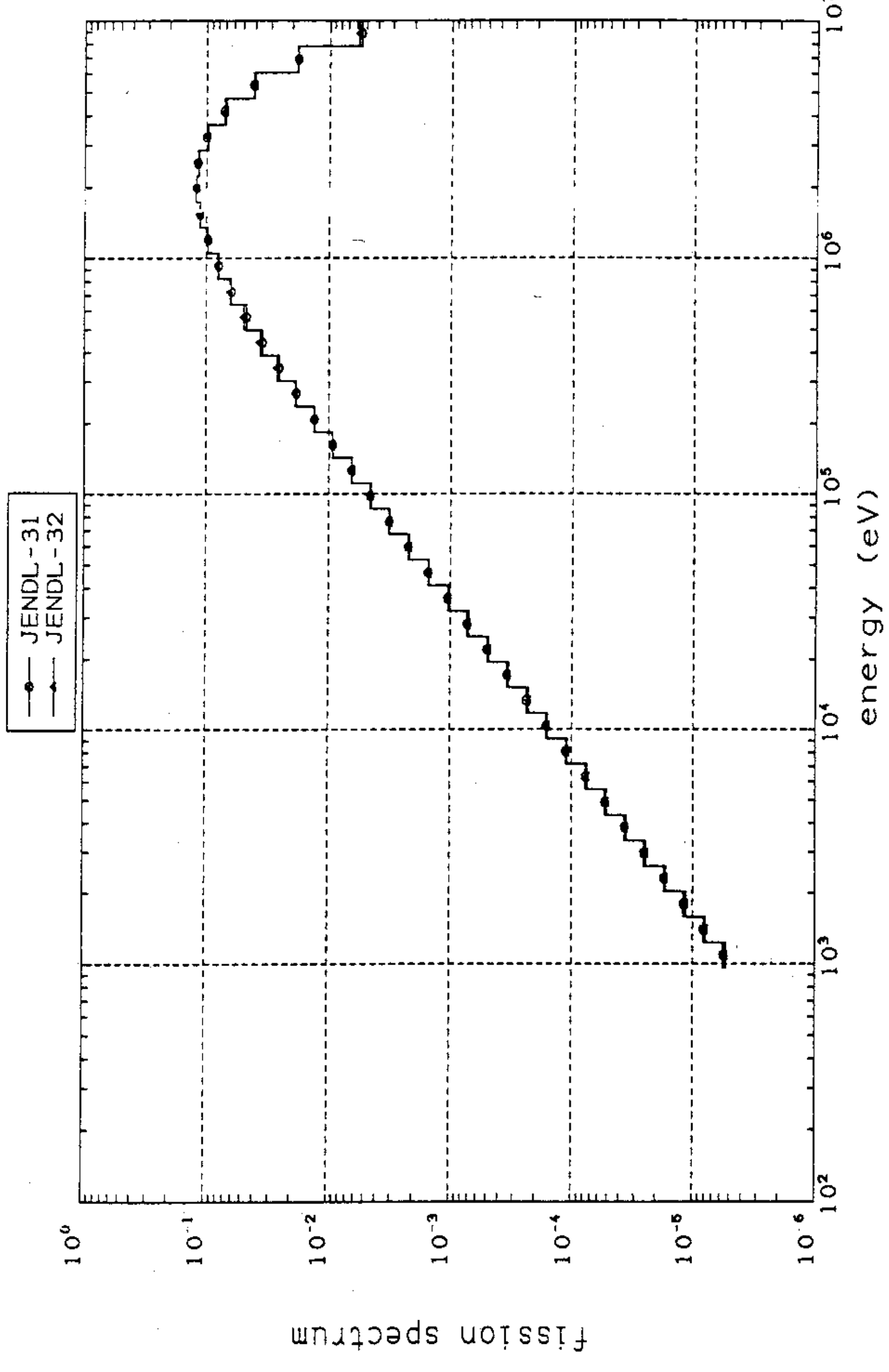

Fig. 8.1 Comparison of ^{235}U Fission Spectrum Group Constant

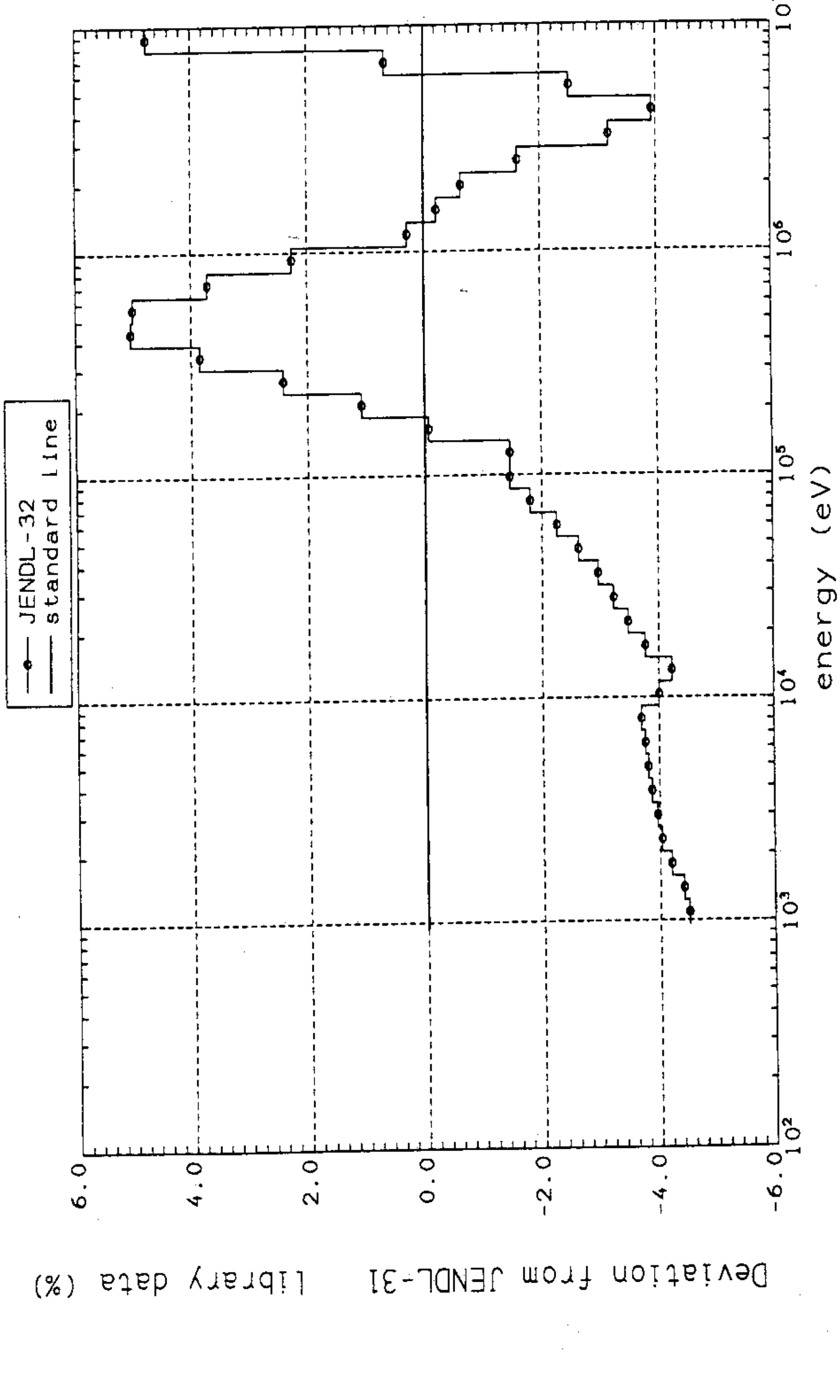

Fig. 8.2 Comparison of ^{235}U Fission Spectrum Group Constant

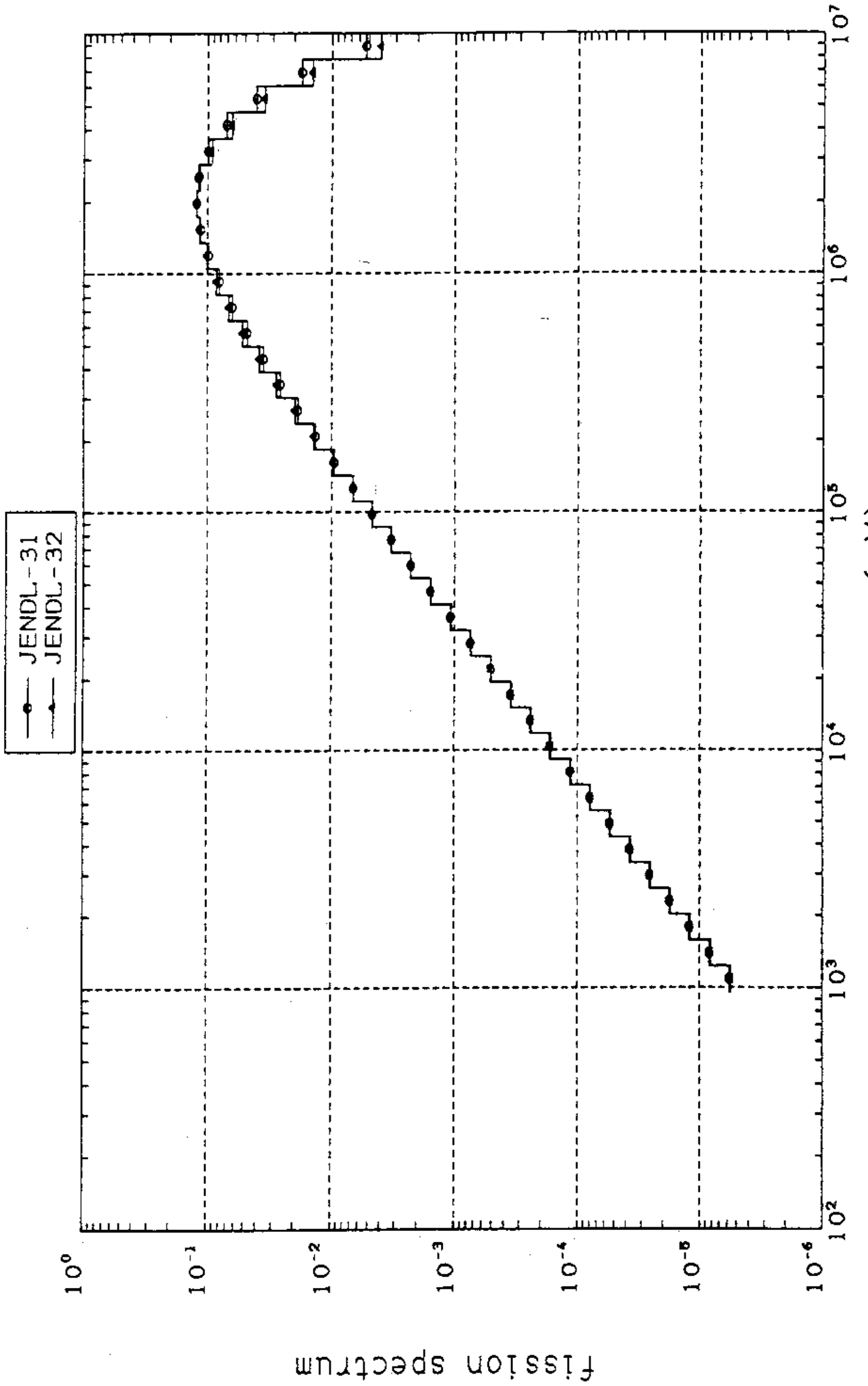

Fig. 9.1 Comparison of ^{238}U Fission Spectrum Group Constant

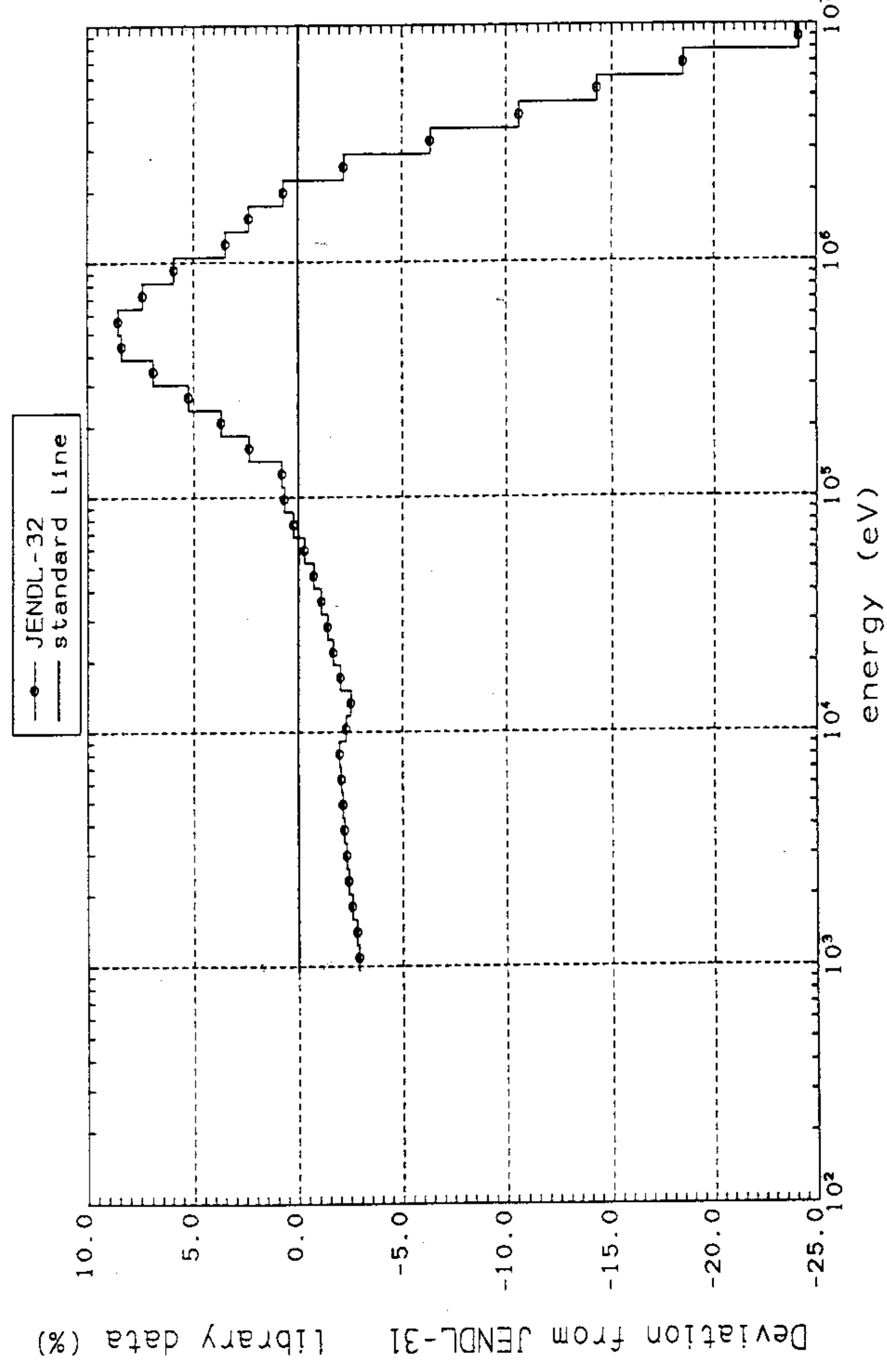

Fig. 9.2 Comparison of ^{238}U Fission Spectrum Group Constant

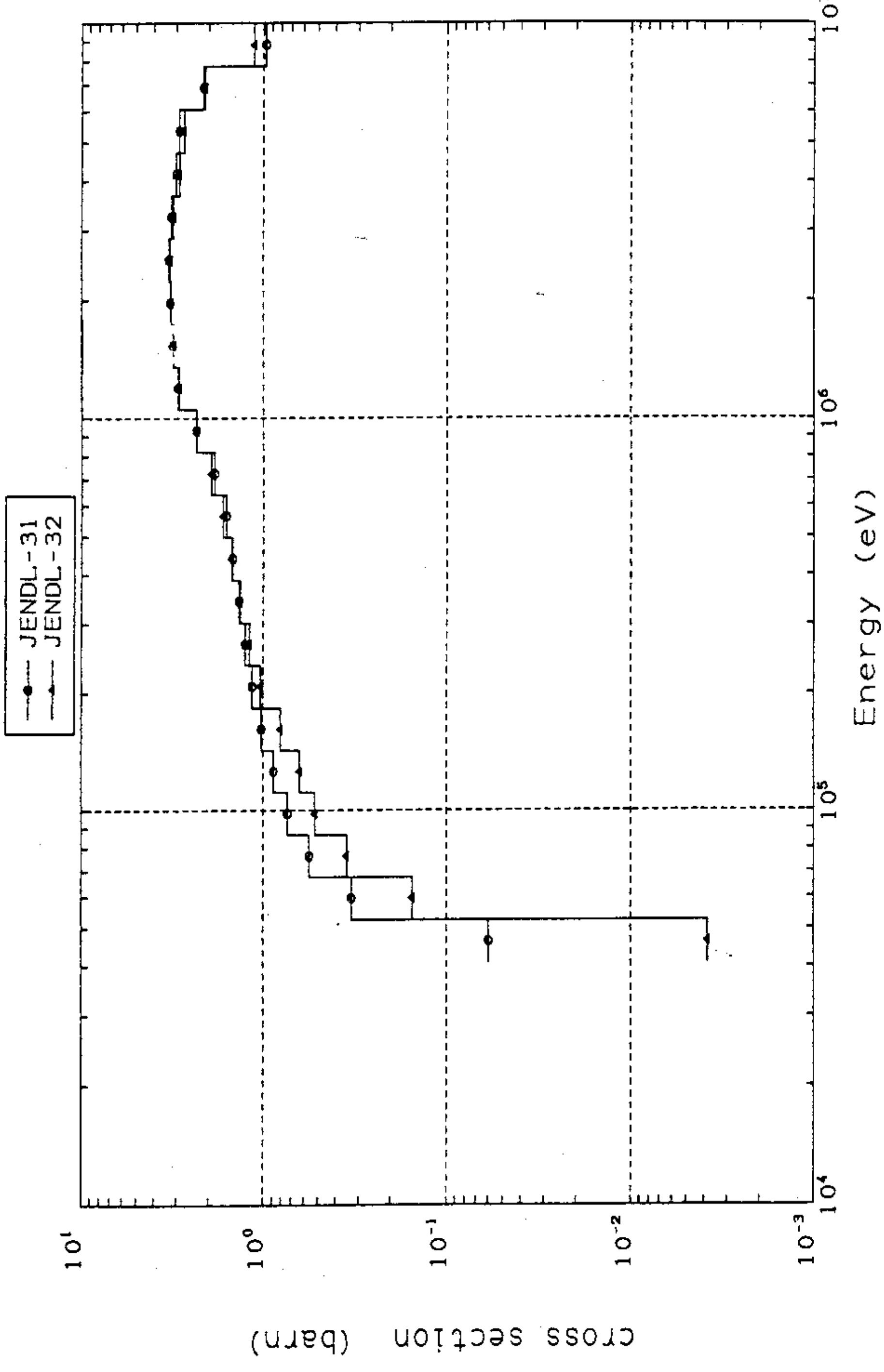

Fig. 10.1 Comparison of ^{238}U Inelastic Group Constant

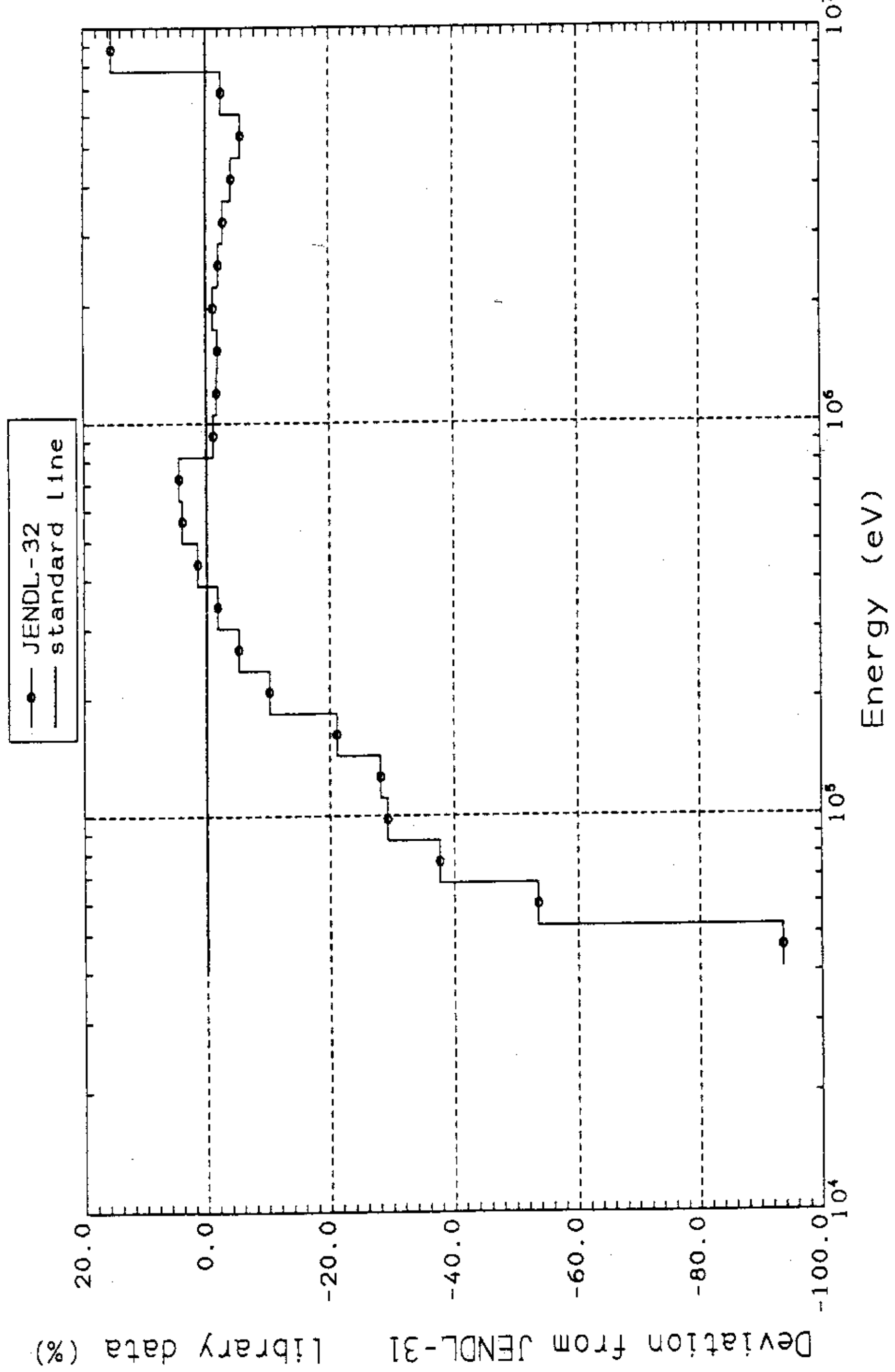

Fig. 10.2 Comparison of ^{238}U Inelastic Group Constant

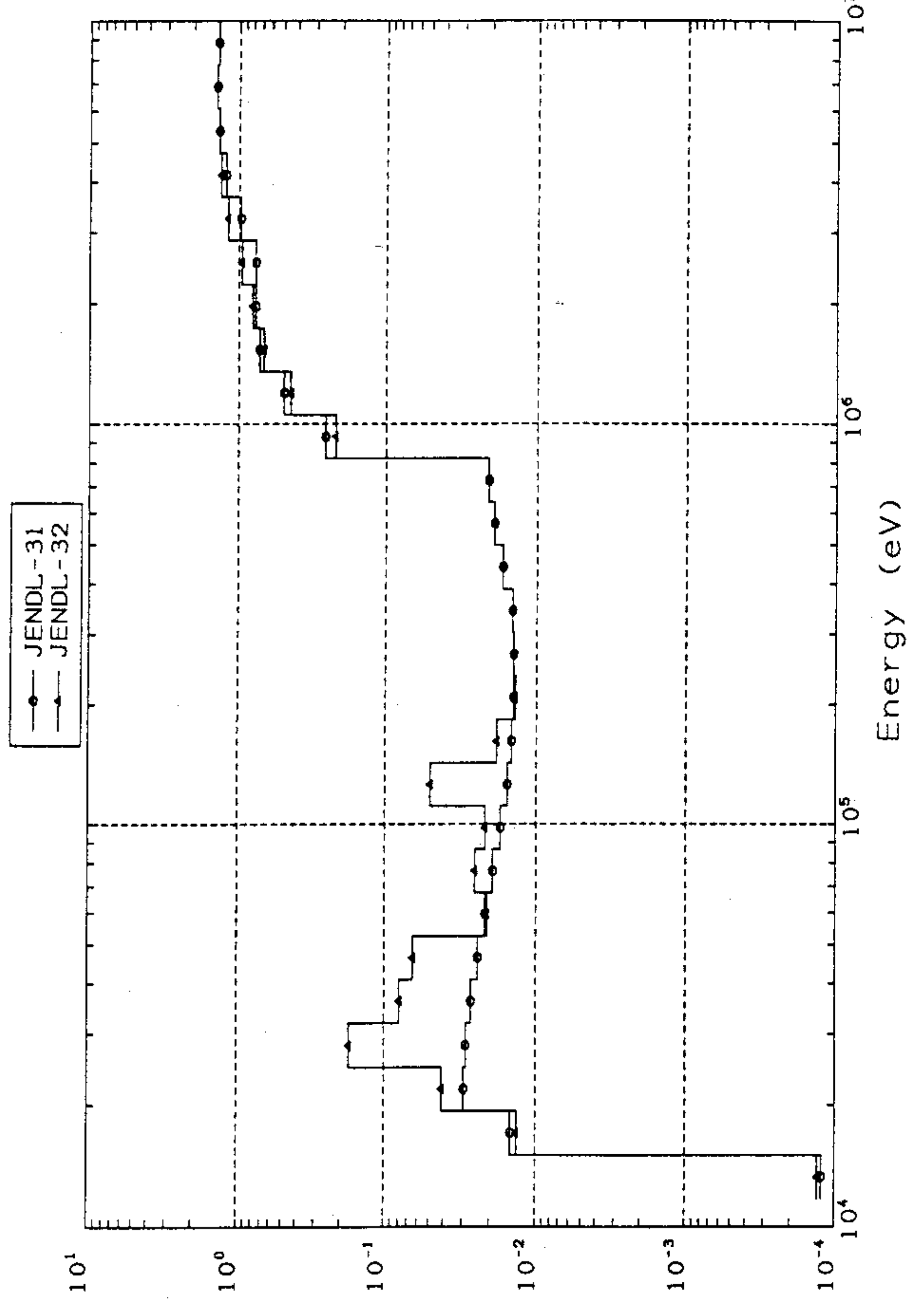

Fig. 11.1　Comparison of Fe-nat.　Inelastic Group Constant

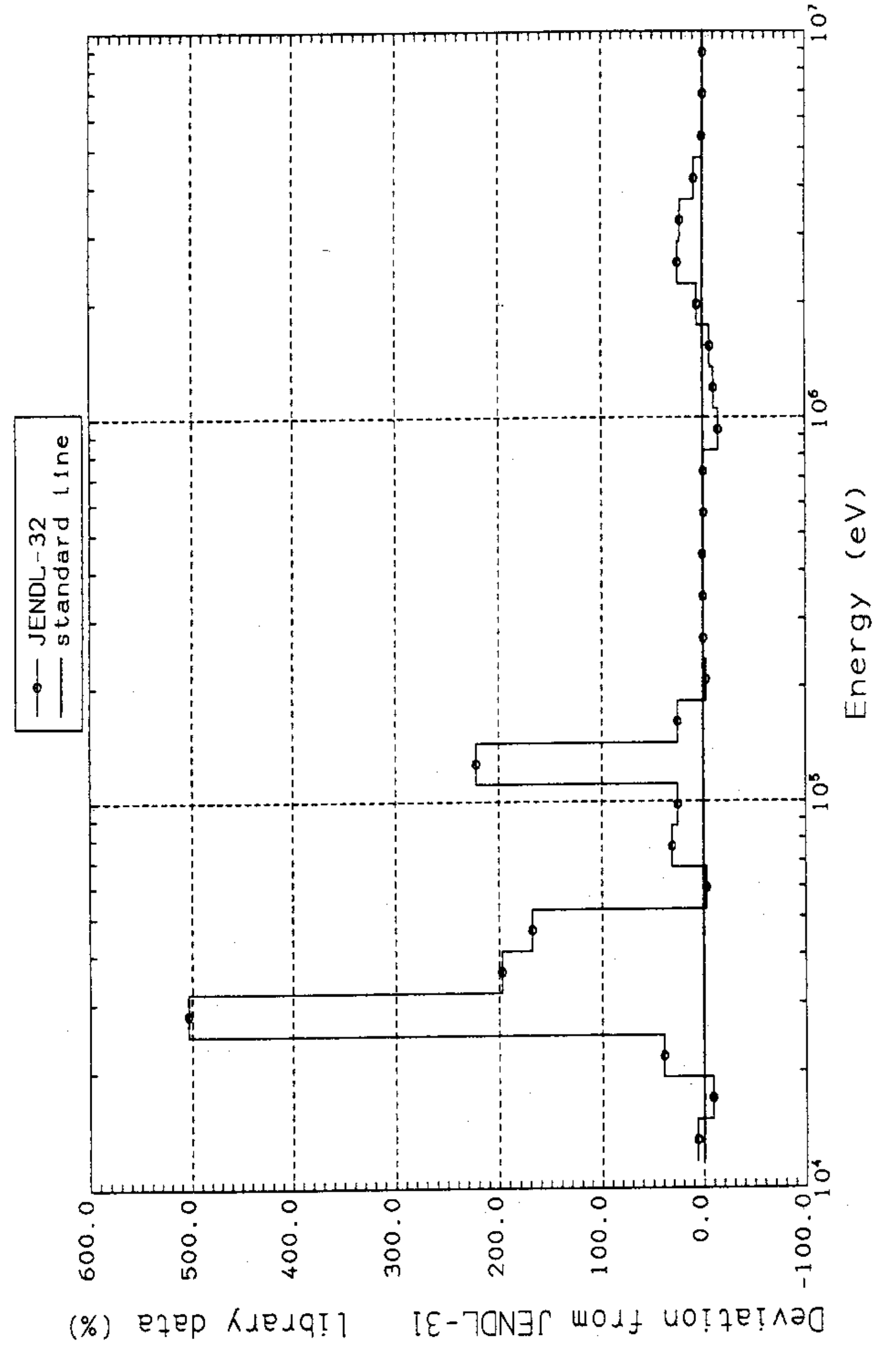

Fig. 11.2 Comparison of Fe-nat. Inelastic Group Constant

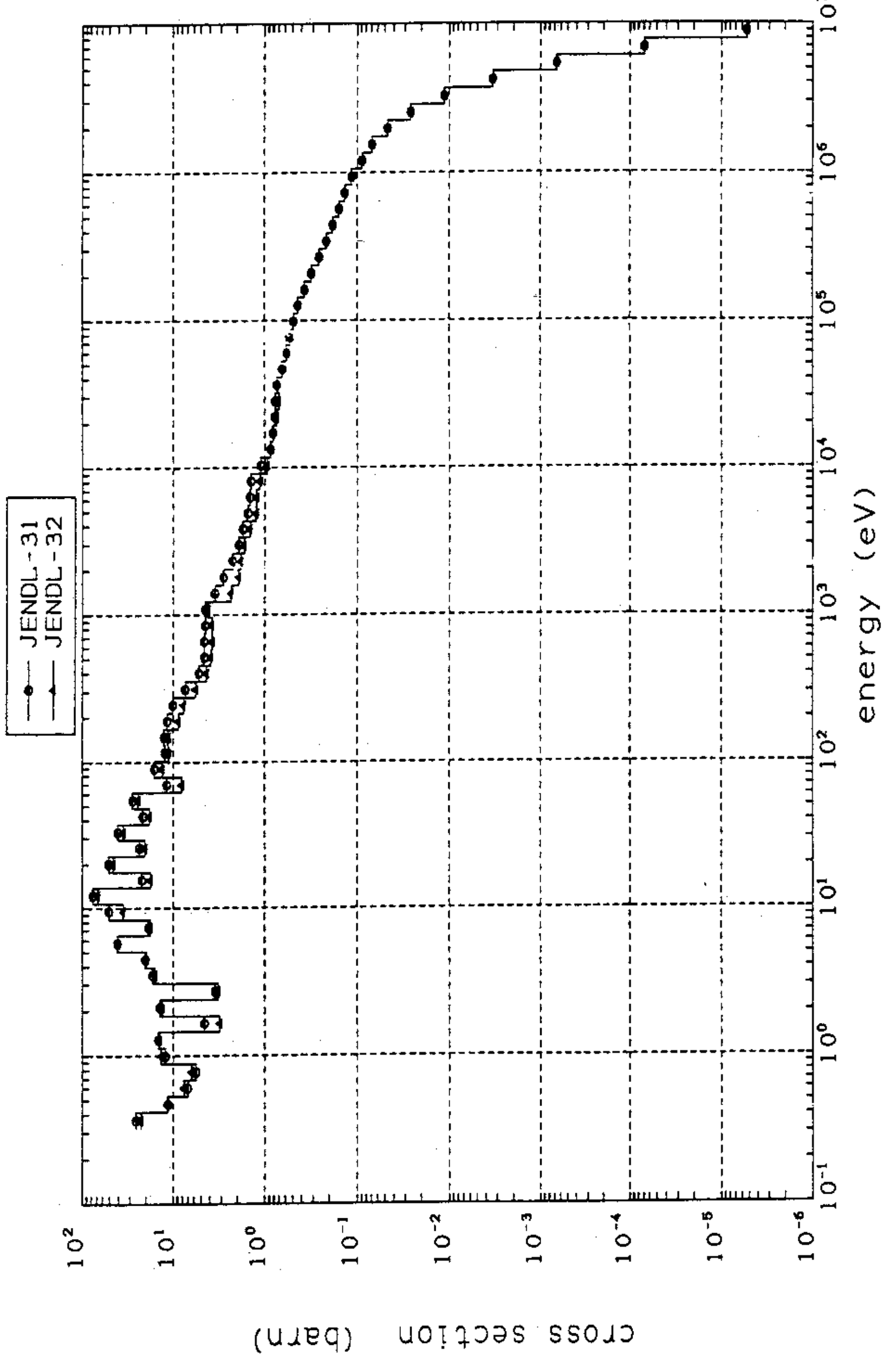

Fig. 12.1 Comparison of ^{235}U Capture Group Constant

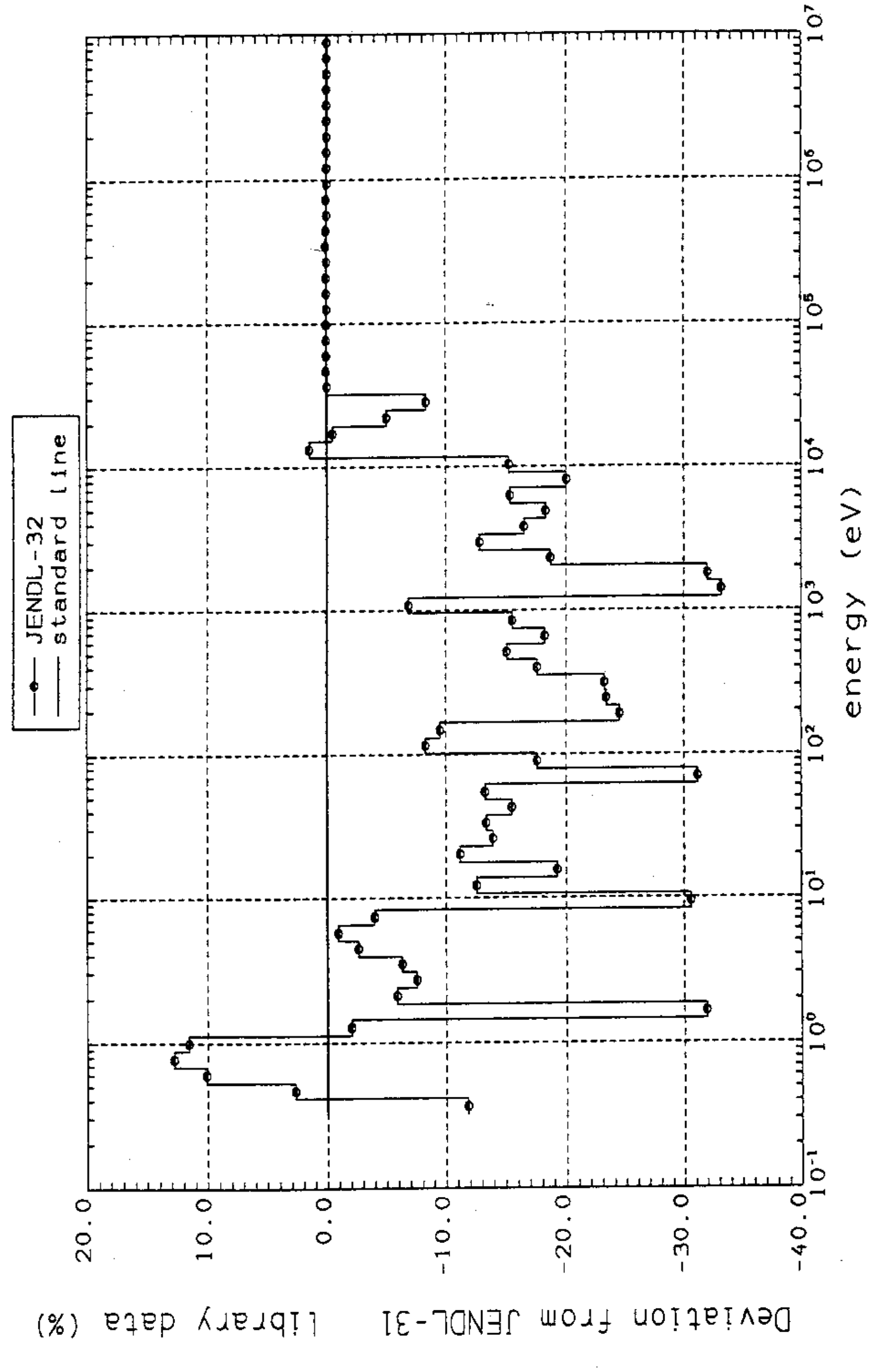

Fig. 12.2 Comparison of ^{235}U Capture Group Constant

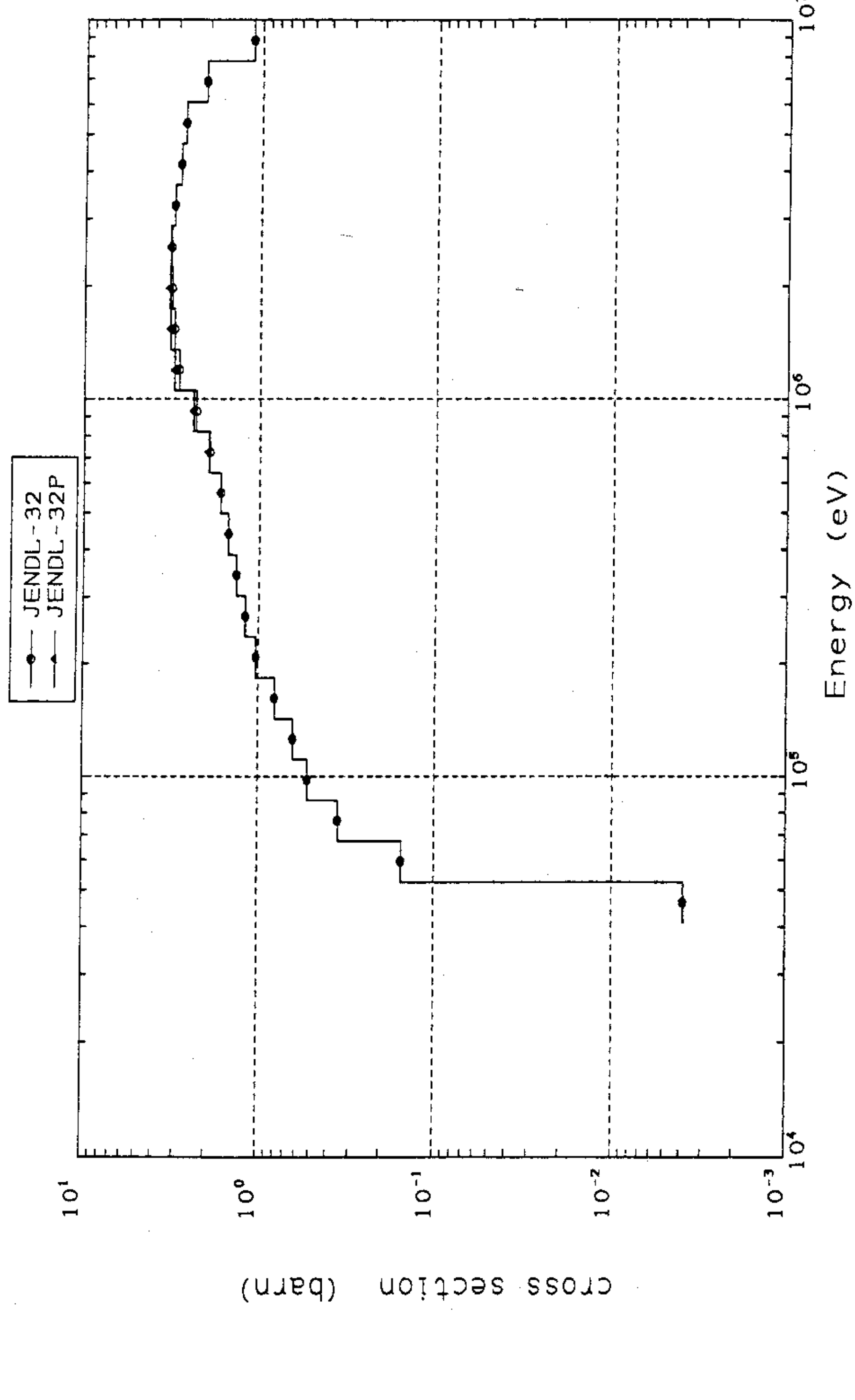

Fig. 13.1　Comparison of ^{238}U Inelastic Group Constant

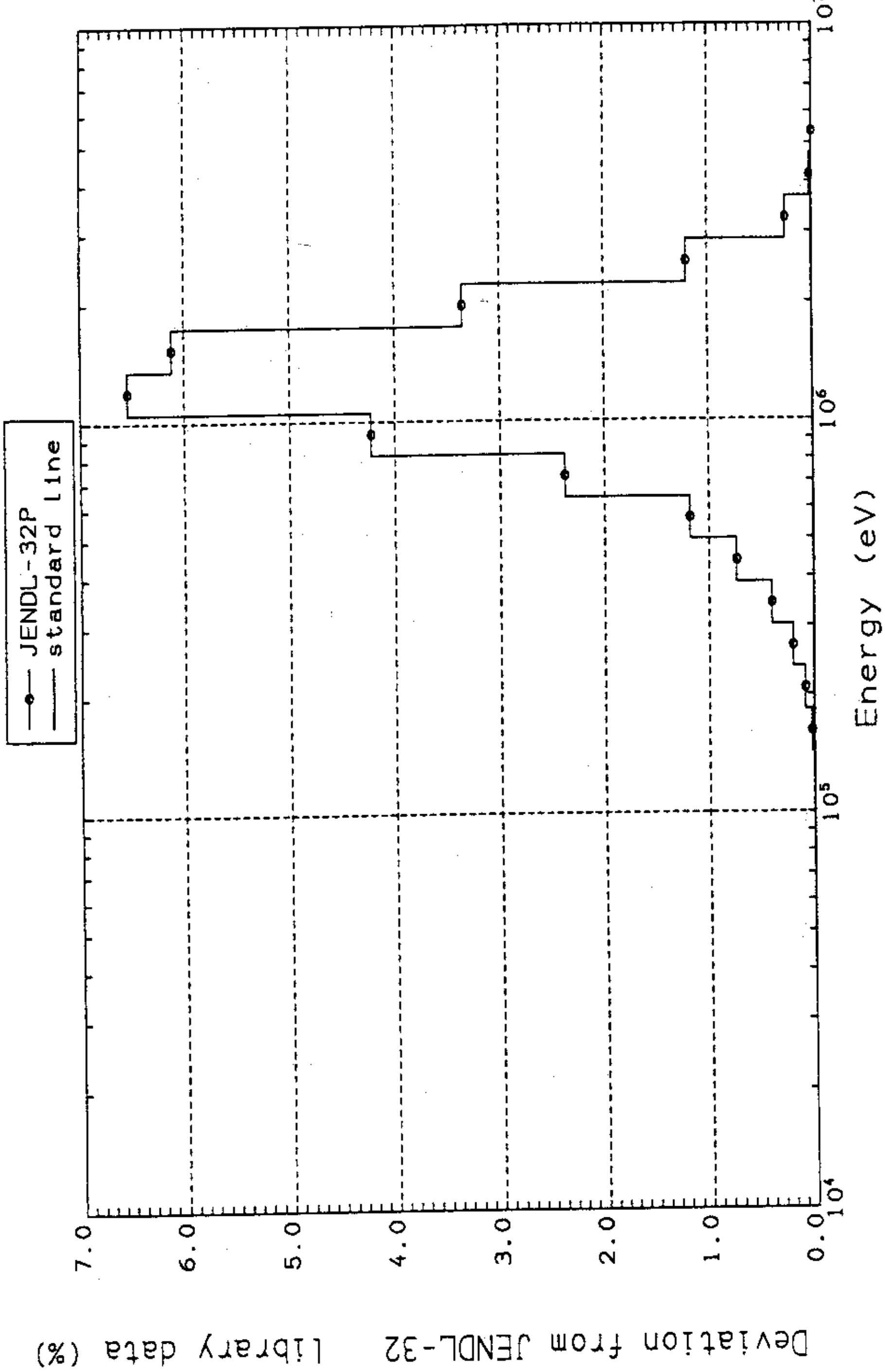

Fig. 13.2 Comparison of ^{238}U Inelastic Group Constant

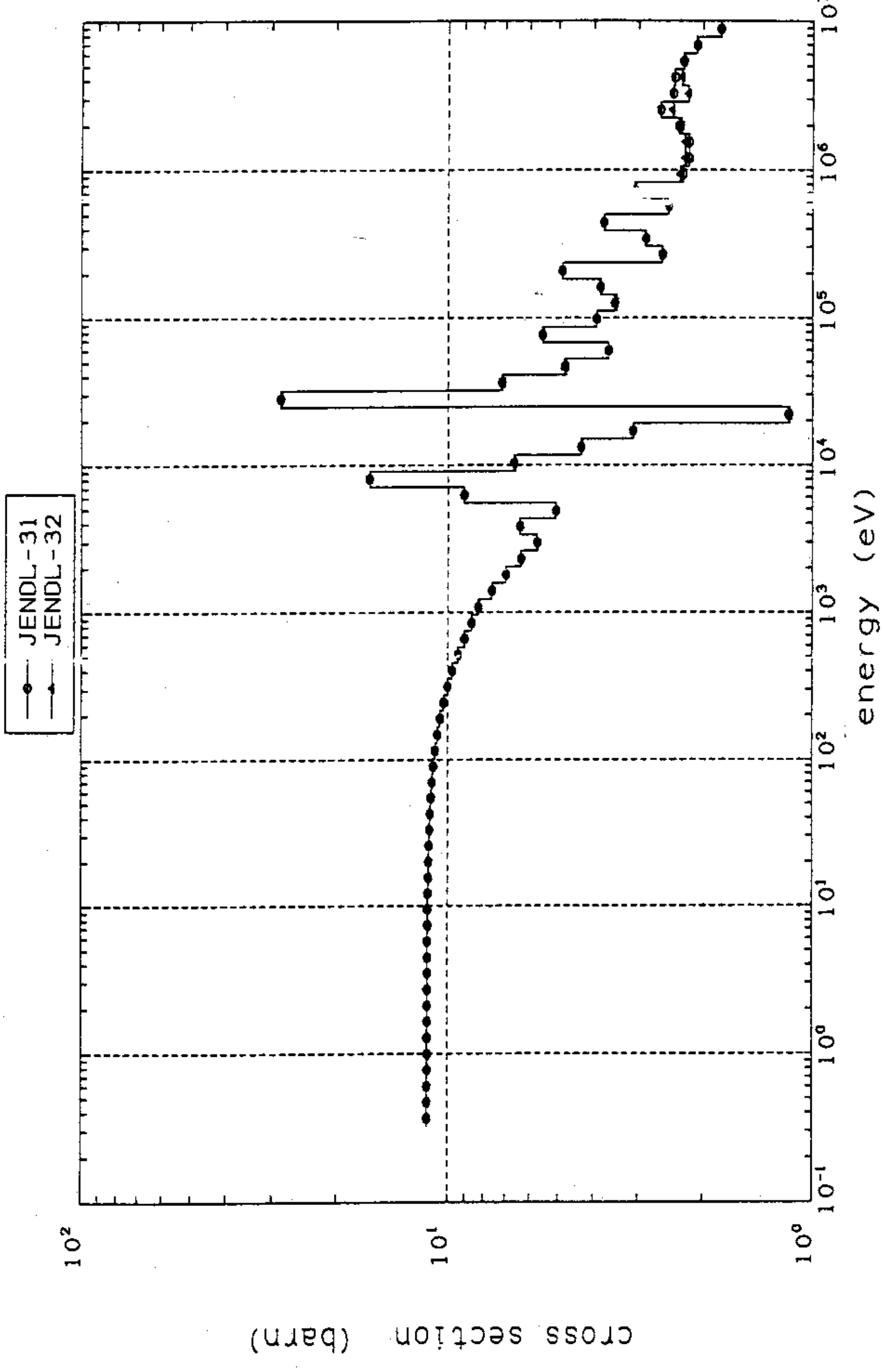

Fig. 14 Comparison of Fe-nat. Elastic Group Constant

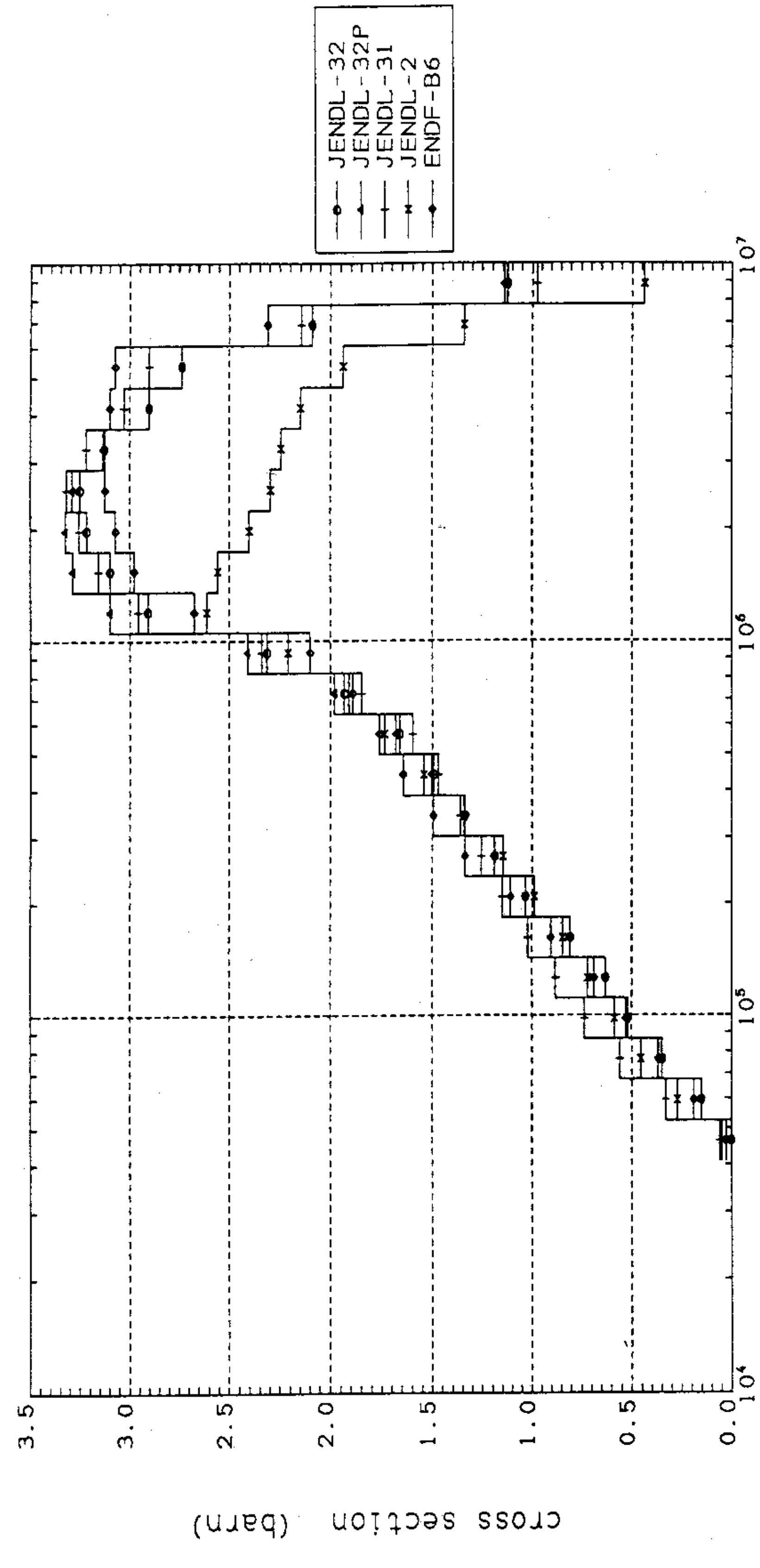

Fig. 15 Comparison of ^{238}U Inelastic Group Constant

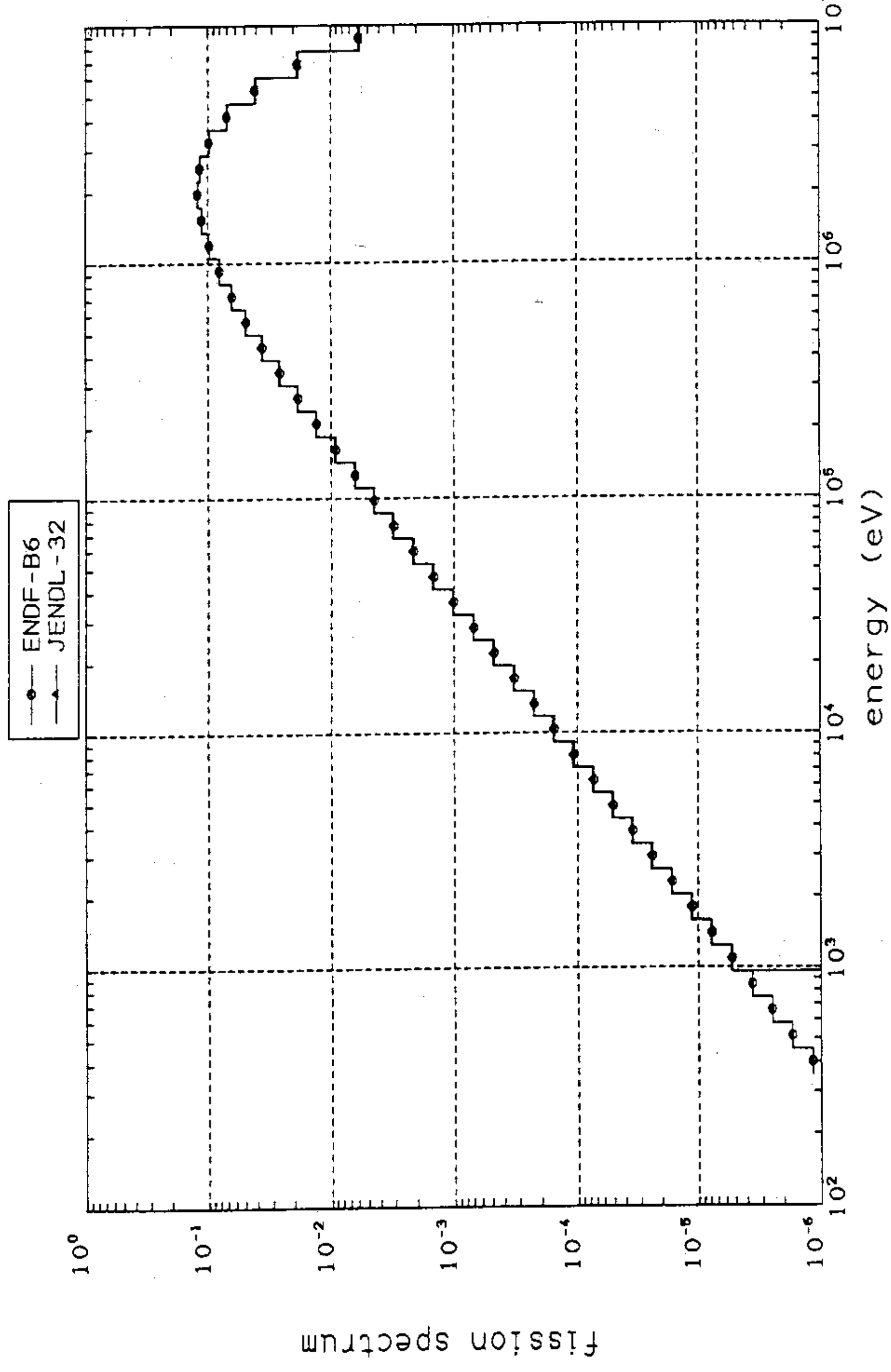

Fig. 16.1 Comparison of ^{235}U Fission Spectrum Group Constant

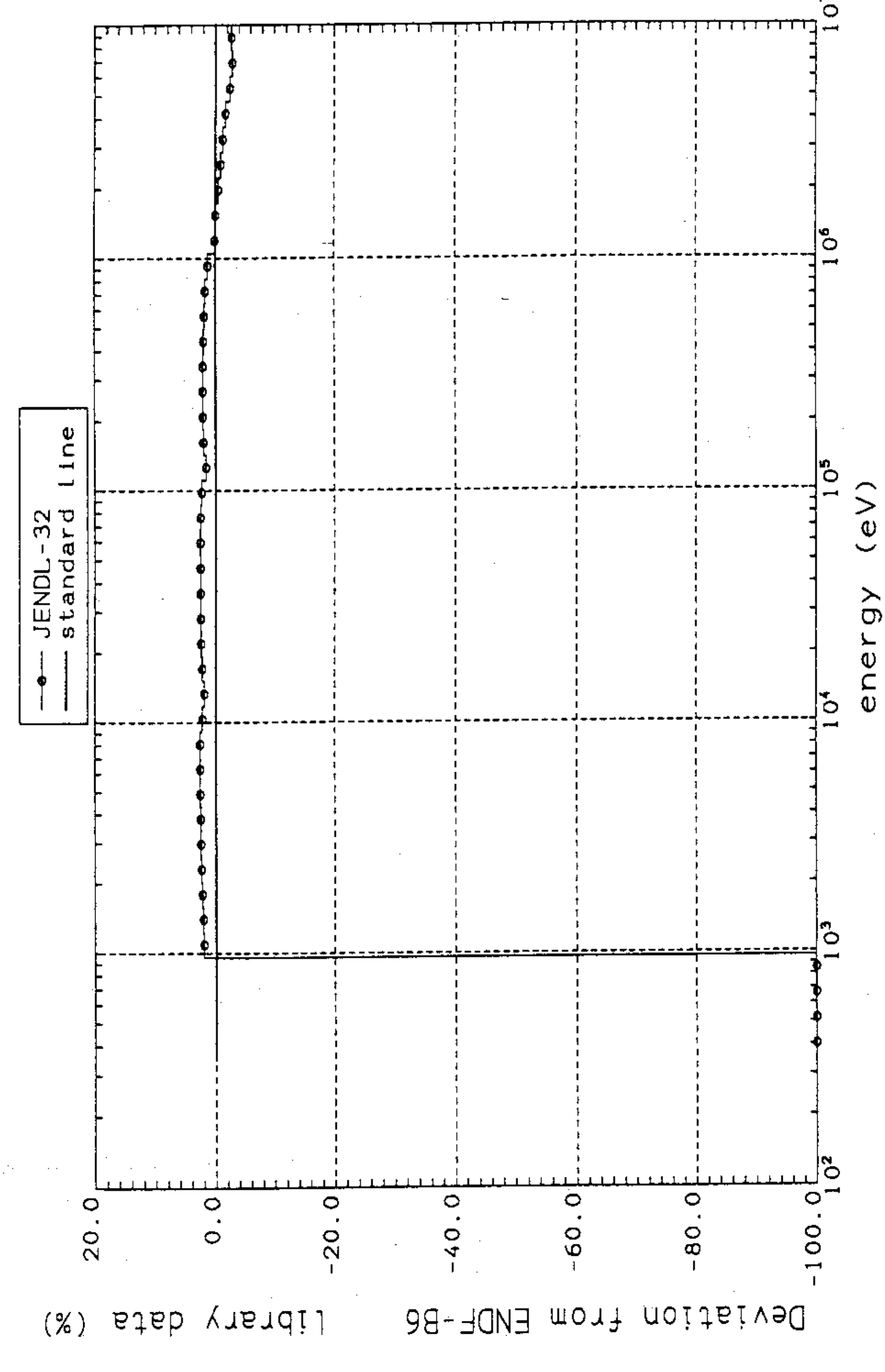

Fig. 16.2 Comparison of ^{235}U Fission Spectrum Group Constant

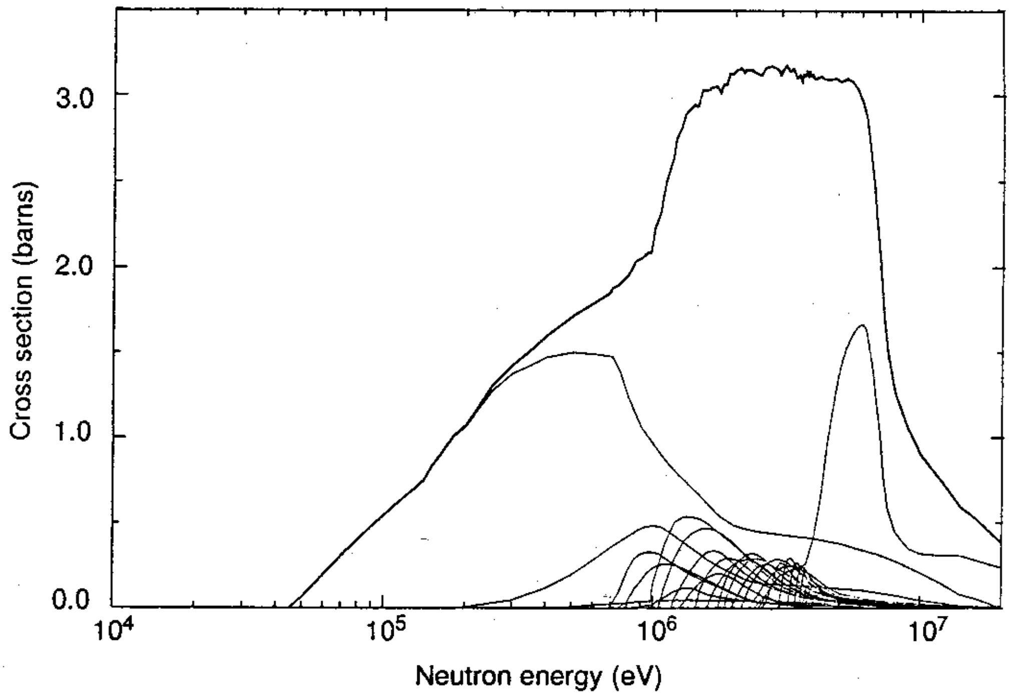

Fig. 17 Total inelastic scattering cross section of ^{238}U and its partial cross sections of continuum and discrete levels in ENDF/B-VI library

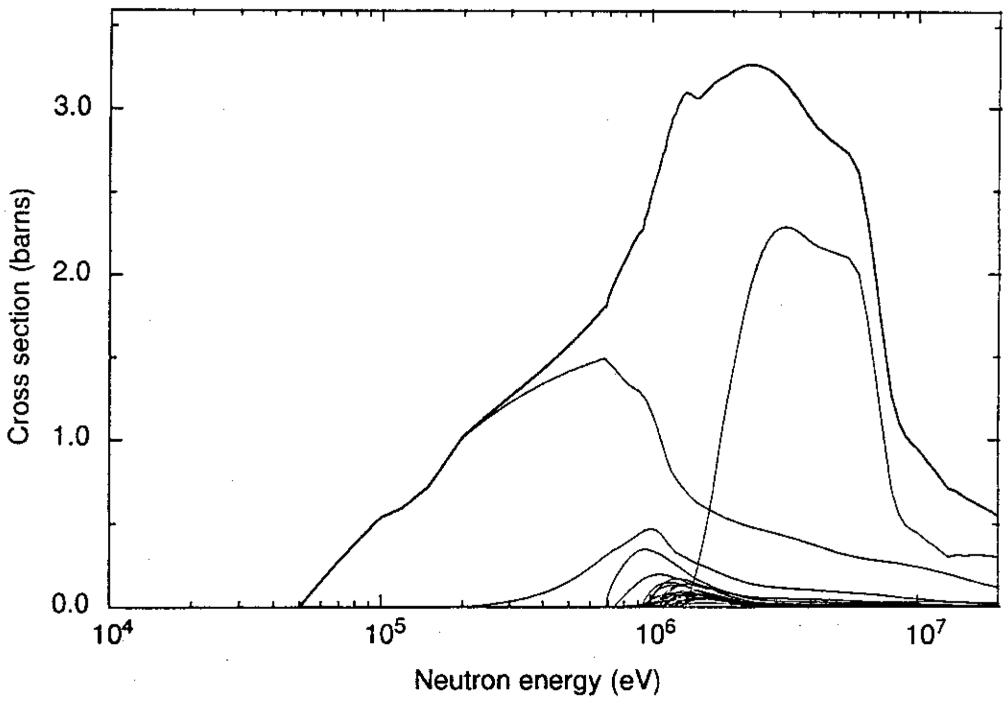

Fig. 18 Total inelastic scattering cross section of ^{238}U and its partial cross sections of continuum and discrete levels in JENDL-3 library