

International Atomic Energy Agency

INDC(NDS)-131

Distr.: G

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**INDC**

**INTERNATIONAL NUCLEAR DATA COMMITTEE**

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Fourth Meeting of the Coordinated Research Project  
on the Intercomparison of Evaluations of  
Actinide Neutron Nuclear Data

Vienna, 12 - 13 October 1981

SUMMARY REPORT

H.D. Lemmel  
Nuclear Data Section  
International Atomic Energy Agency

May 1982

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**IAEA NUCLEAR DATA SECTION, WAGRAMERSTRASSE 5, A-1400 VIENNA**



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Abstract

The fourth Research Coordination Meeting of the participants in the IAEA Coordinated Research Programme on the Intercomparison of Evaluations of Actinide Neutron Nuclear Data was convened by the IAEA Nuclear Data Section on 12-13 October 1981 in Vienna.

The meeting participants presented reports on the status of their work, on completed evaluations, on intercomparisons of evaluations, and on specific topics on related nuclear theory and required data accuracies. The IAEA Nuclear Data Library for Actinides (INDL/A) is envisaged to be completed by the end of 1982.

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Fourth Meeting of the Coordinated Research Project  
on the Intercomparison of Evaluations of  
Actinide Neutron Nuclear Data

Vienna, 12 - 13 October 1981

Vienna International Center, Tower A, Room A23-46

Opening 9:00 hrs

Agenda

- A. 1. Opening, Election of Chairman, Adoption of Agenda
2. Brief progress-reports by participants:  
- activities completed and being done  
- special problems encountered  
- plans for the next year
3. Definition of topics to be discussed either  
in plenary or in subgroups
- B. Topical discussions.
1. Results and conclusions from intercomparisons of available  
evaluations
2. Discrepancies in the Am-241 fission cross-section data in  
the 100 keV region
3. Np-237 cross-sections:  
- fission cross section to be considered as standard  
- problems with (n,2n) data
4. Pu-238 total and capture cross-sections
5. Fast neutron scattering on actinide nuclei  
(OECD/NEANDC Specialists' Meeting on same topic,  
23-25 Nov. 1981)
6. Problems of intercomparisons in the resonance region
7. (n,2n) data [Bychkov]
8. Thermal Am cross-sections [Goel]
9. Requirements for the checking of files [Usachev]
10. Review of graphical intercomparisons [Mattes]

C. Work towards termination of the CRP in 1982

1. What can be achieved and what can be done in the remaining period?
2. Completion of partial evaluations
3. Testing and intercomparisons of evaluations
4. Conclusions; date of 1982 Meeting

D. New CRP for data testing to start in 1983

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K. Okamoto  
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List of papers distributed at the meeting  
(The sequence of numbering is incidental)

1. M. Caner, S. Yiftah: Curium-248 Neutron data evaluation, progress report
2. G. Maino et al.: CNEN-Bologna Activity in the period May 1980-May 1981
3. K. Okamoto: Information on nuclear data activities in the People's Republic of China. INDC/P(81)-13
4. INR Karlsruhe: Progress Report
5. H. Derrien et al.: Evaluation of Np-237... INDC(FR)-42
6. H. Derrien: Evaluation of Pu-238... To be published as INDC(FR)-...
7. J. Salvy: Progress report of recent works on actinide nuclear data at Bruyères-le-Châtel. NEANDC(E)-211.  
(A preliminary version had been distributed earlier.)
8. Japanese Progress Report on Evaluation of Actinide Neutron Nuclear Data
9. M.K. Mehta: Status Report No. 4
10. M.K. Mehta: Graphs of Th-232 data
11. L.N. Usachev et al.: Required accuracies of transactinide nuclear data for fast reactors fuel cycle
12. J.E. Lynn et al.: UK Progress Report, June 1980-Sept. 1981
13. H. Condé: Status Report, Actinide Data Work in Sweden
14. G. de Saussure, R.Q. Wright: Comparison of the ENDF/B-V and SOKRATOR Evaluations of U-235, Pu-239, Pu-240 and Pu-241 at low neutron energies
15. V. Pronyaev, D.E. Cullen: Comparison of Strength Functions and Average Level Spacing for U and Pu Isotopes
16. D.E. Cullen, O. Schwerer: Comparison of Uranium and Plutonium Group Averaged Cross-Sections and Staircase Plots
17. B. Goel: Averages of KEDAK Cross-Sections for Different Neutron Fields
18. B. Goel: Comparison of One-Group Constants for the NEACRP-LMFBR Benchmark: Am-241 to Cm-244

19. JAERI Nuclear Data Center: Staff
20. T. Nakagawa, S. Igarasi: Evaluation of Neutron Nuclear Data for Cm-243
21. S.B. Garg, A. Sinha: Evaluation of Neutron Cross-Sections for U-232 and U-234
22. S.B. Garg, A. Sinha: Evaluation of Neutron Cross-Sections for Th-233
23. A. Sinha, V.K. Shukla, S.B. Garg: Evaluation of Neutron Cross Sections for Pa-231 and Pa-233
24. R.P. Anand et al.: Evaluation of the (n,2n) and (n,3n) Cross-Sections of Th-232, Th-233, and Pa-233
25. H.M. Jain, M.K. Mehta: Evaluation of the (n,gamma) Cross-Section of Th-232
26. G. Maino et al.: Evaluation of Cm-243 Neutron Cross-Section from  $10^{-5}$  eV to 15 MeV. Report RIT/FIS(81)-1
27. G. Maino et al.: Evaluation of Cm-245 Neutron Cross-Sections from  $10^{-5}$  eV to 15 MeV. Report RIT/FIS(81)-2
28. M. Mattes: Graphical Intercomparisons



Summary on the  
Fourth Meeting of the Coordinated Research Project (CRP)  
on the Intercomparison of Evaluations of  
Actinide Neutron Nuclear Data

The Fourth Research Coordination Meeting of this Project took place in Vienna, 12-13 October 1981. For the Third Meeting that took place in Vienna, 12-13 June 1981, see the Summary Report INDC(NDS)-119.

During the past year groups at Dresden (German Democratic Republic) and Leningrad (USSR) joined the CRP which includes now 13 members.

The evaluations performed by the participants are contained in the data library INDL/A of which the content at the time of the meeting is documented in Rev.4 of IAEA-NDS-12 (see Appendix<sup>\*</sup>). As compared to the version of August 1980, the following evaluations have been added during the past year:

File 1: complete evaluation in ENDF/B format

3371	93-Np-237	Cadarache	INDC(FR)-42
9521	95-Am-242	JAERI	JAERI-M-8903
9522	95-Am-242-m	JAERI	JAERI-M-8903

File 3: complete evaluation in KEDAK format

2	96-Cm-246	Soreq	IA-1358
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File 4: partial evaluations in ENDF/B format

9646	96-Cm-246	Bologna	CNEN-RI/FI/(80)7
9647	96-Cm-247	Bologna	Not documented
9648	96-Cm-248	Bologna	CNEN-RI/FI/(80)10

The participants presented progress-reports on their work, reports and intercomparisons of evaluations completed, as well as papers on specific topics. See the list of papers on page 8. These papers are not appended to this summary report but are available from the IAEA Nuclear Data Section upon request.

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<sup>\*</sup>) Note by editor: Appended is Rev.6 of IAEA-NDS-12 as of May 1982. This includes additional evaluations on Pu isotopes from Minsk and on Cm isotopes from Bologna and JAERI.

S. Yiftah presented a progress report (paper 1) on the evaluation of Cm-248 in the thermal and fast energy range, including graphical comparison with ENDF/B-5. He expects new experimental data from Oak Ridge which are, however, not yet available.

Data are still produced in KEDAK format. The meeting recommended that they should possibly be issued also in ENDF/B format.

B. Goel (paper 4) reported on evaluations being finalized on Am-241, 242, 243 in KEDAK format. There are still some unresolved discrepancies when comparing with integral measurements, in particular in the cases of Am-241 and 242, where new integral measurements are needed. The data for Am-243 seem to be in good agreement.

Comparisons of averaged data were presented in papers 17 and 18, and this work is planned to be continued.

The meeting recommended to convert the KEDAK data into ENDF/B format. This presents particular problems in the secondary neutron energy distributions.

M. Mattes reported on her work of checking data, converting UK format data to ENDF/B format, and performing graphical intercomparisons by plotting point data and 620-group data (paper 28). A special session (agenda item 10) was devoted to the review of the graphical intercomparisons.

The different temperatures used in ENDF/B-5 (zero temperature) and UKNDL (higher temperature) are noticeable in the plots.

The data converted from UKNDL into ENDF/B format so far consider cross-sections only and not differential data.

It was recommended that Mrs. Mattes prepare a written summary of the work.

A. Ventura gave a progress-report (paper 2) on the CNEN-Bologna activities, mainly on curium isotopes. Evaluations for the isotopes Cm-243 and 245 are being completed for the full energy range. The others (Cm-242, 246-248) for which the resonance region had been evaluated, are also planned to be extended to the full energy range. (Note by editor: Cm-242 and 246 completed in April 1982)

The format used is ENDF/B-4 with Reich-Moore parameters which would have to be converted to Adler-Adler parameters for ENDF/B-5.

H. Condé reported on the Swedish activities (paper 13) on a comprehensive compilation of experimental and evaluated actinide data. The intercomparison of evaluations is done in cooperation with CNEN Bologna.

The Swedish group offers to monitor the updateness of evaluations, with respect to new experimental data.

K. Okamoto (paper 3) reported on nuclear data evaluation activities in the People's Republic of China, where a Chinese Evaluated Nuclear Data Library (CENDL) has been started. In the field of actinides

some evaluations on specific reactions have been reported, e.g. U-236 (n, $\gamma$ ) from 1 keV to 15 MeV and Am-243 (n,f).

H. Derrien reported on the completed evaluation on Np-237 (paper 5) and on an evaluation in progress on Pu-238 (paper 6). For Pu-238 there are still some problems to solve as, for example, the statistical model produces too large cross-sections.

The evaluation on Am-241 was completed and is now brought into ENDF/B format.

J. Salvy (paper 7) presented a voluminous progress-report [NEANDC(E)-211] on actinide nuclear data measurements and evaluations being done in Bruyères-le-Châtel.

The discussion in the meeting concentrated on the energy dependence of nu-bar.

M.K. Mehta presented a status report (papers 9 and 10) and several evaluation reports (papers 21 to 25) on the Th-U cycle, where work is in progress on Th-232, 233, 234, U-232, 233, 234, Pa-231, 233. For Th-232 data are ready but must still be coded in ENDF/B format and checked for internal consistency. In the low energy region the evaluation by Vasiliu will be used; in the higher energy range the Indian evaluation includes some more recent experimental data that were not yet available for the Romanian evaluation.

K. Harada presented a review on the activities of the JAERI Nuclear Data Center (paper 19) and a report on the evaluation of Cm-243 which was finished and is available on magnetic tape.

R. Arlt reported on the Dresden-Leningrad cooperation on precision measurements of the U-235 fission cross-section in the MeV range, using high-purity U-235 foils and the time-correlated associated particle method. As U-235 is a standard, these measurements will have an impact also on other actinides. Measurements were made, among others, also on Np-237 which is in discussion to be recognized as a standard.

L.N. Usachev gave a summary of the work by V.A. Konshin who had completed evaluations on Pu-239, 240, 241, 242. These were presently reviewed by V.G. Pronyaev at the IAEA Nuclear Data Section and a final version is expected to be included in INDL/A in early 1982.

The Nuclear Data Center at Obninsk works on the evaluation of (n,2n) and (n,3n) reactions for actinides. (See further below, report by V. Bychkov.)

Furthermore, L.N. Usachev presented a report (paper 11) on the required accuracies of transactinide nuclear data for the fast fuel cycle. The most important accuracy requirements are the capture cross-sections of Np-237 (10%), Pu-242 (5%), Am-243 (6%), and the (n,2n) cross sections of N-237 (25%) and U-238 (15%). The required accuracies are given in parentheses; in most cases the data presently available have an accuracy of 50% only. Also important is the Am-241 capture cross-section (required 10%, achieved 15%) and the branching ratio of spontaneous fission of Cm-242.

B.H. Patrick reported on UK activities (paper 12), based on 0.2 manyears only. The evaluation of Am-243 was finished, the documentation is in progress. Resonance parameters were chosen from the most comprehensive measurement, with bound levels to fit the thermal data. There are no accurate measurements of the fission cross-section in the thermal region, and a fission width was chosen to give a small cross-section consistent with the measured upper limit. Above the resonance region (250 eV), the elastic scattering cross-section was taken to be the same as for Am-241.

Agreement of the UK evaluation is better with the Japanese one than with ENDF/B-5. However, below 30 keV the UK and Japanese evaluations are somewhat discrepant.

Upon question by Usachev about accuracies, Patrick pointed to the Am-241 report AERE-R-8528 which has typical tables of uncertainties. Data were tested in a ZEBRA spectrum, and discrepancies existing between different experimental sets of differential data could be decided.

H. Derrien presented a summary on the Specialists' Meeting on U and Pu Resonance Parameter Data for Nuclear Reactor Safety, that had taken place at the IAEA in Vienna from 28 Sept. to 2 Oct. 1981.

In particular, the following papers were mentioned:

G. de Saussure, R.Q. Wright (paper 14): Comparison of the ENDF/B-5 and SOKRATOK evaluations by V.A. Konshin of U-235, Pu-239, 240, 241 at low energies.

V. Pronyaev, D.E. Cullen (paper 15): Comparison of Strength Functions and Average Level Spacing for U and Pu Isotopes.

D.E. Cullen, O. Schwerer (paper 16): Comparison of U and Pu Group averaged cross-sections and staircase plots..

V. Bychkov presented an evaluation of (n,2n) and (n,3n) reactions on 20 fissile isotopes. Experimental data exist practically for Th-232 and U-238 only. For other isotopes only theoretical estimates are possible. The results are similar to those of M.K. Mehta.

B. Goel presented comparisons of spectrum averaged actinide cross-sections (papers 17 and 18). It was concluded that each participant should compute for his evaluations such spectrum averages for a number of defined spectra.

H. Derrien reviewed the Np-237 problem as contained in the NEANDC discrepancy file [NEANDC-124, INDC(UK)-33].

The reaction Np-237(n,2n) produces two isomers of Np-236 with half-lives of 22 hrs and  $1.15 \cdot 10^5$  y which decay to Pu-236 and U-236. The Np-237 isomers have a small energy difference. The uncertainty of the branching ratios produces a serious uncertainty on the formation of Pu-236 (decaying to U-232) which is important for reactors. The branching ratio, which is well known at 14 MeV only, may be strongly energy dependent, but this energy dependence is not known. Measurements to be made in the difficult energy region from 7 to 13 MeV, would require a large-size sample of Np-237.



V. Pronyaev mentioned that M. Uhl and B. Strohmaier in Vienna are using their code STAPRE for fitting the (n,2n) and (n,f) reactions on Np-237. This may bring some conclusions about the energy dependence of the branching ratio.

Note by editor: Available is only a preliminary result which is not fully satisfactory.

R. Arlt raised the question whether Np-237 will be adopted as a standard. His measurement at 8.4 MeV matches exactly Derrien's evaluation. U-238 and Np-237 are in competition of being a standard. U-238 is easier available but Np-237 has the lower threshold.

It was concluded that Arlt's experiment and Derrien's evaluation make it possible to consider Np-237 as a standard.

H. Derrien drew attention to the discrepancies existing for Pu-238 and suggested that this be considered for the INDC discrepancy list. His evaluation brings out large changes as compared to ENDF/B-5 which is still the same as ENDF/B-3. Experimental data (not much else than a set of bomb-shot data) are insufficient.

M. Mattes presented graphical comparisons (paper 28). Some conclusions are:

For Cm isotopes there are significant changes as compared to ENDF/B, because more resonances are known now. The Italian and Japanese evaluations are in good agreement; but this is not surprising as both use the same set of experimental data. The Bologna evaluations using single-level parameters, yield sometimes negative scattering cross-sections. Multilevel parameters as used in the Japanese evaluations appear to be preferable.

For Pu-242 the resonance parameters go up to higher energies in the Bologna evaluation as compared to Bruyères-le-Châtel. ENDF/B-5 shows additional resonances at ca 15 eV and 150 eV.

It would be recommendable that the evaluations by Bologna and Bruyères-le-Châtel be combined.

For Am-243 620-group data were compared. The Bologna evaluation gives no negative resonance, the Japanese evaluation gives one negative resonance. This yields some differences in the thermal range. Some discrepancies exist in the (small!) fission cross-section. Otherwise the Italian and Japanese evaluations are in good agreement.

For Am-241 the UK evaluation was compared with the Bologna evaluation, where the latter and the ENDF/B-5 data had to be Doppler broadened to match the temperature of 297°K assumed in the UK file. In the Bologna evaluation, resonances extend to higher energies as compared to the UK evaluation, where resonances go up to 50 eV only.

## Conclusions

### 1. Integral data

It was recommended, that for each evaluation the following data should be computed and documented, in order to facilitate intercomparisons:

- the 2200 m/s cross-sections and fission neutron yields
- the same data averaged for a thermal Maxwellian of  $T=300^{\circ}\text{K}$
- the resonance integrals with an energy limit of 0.50 eV (the upper limit should be irrelevant)
- the cross-sections integrated over the NEACRP fast reactor spectrum, a Maxwellian spectrum with  $KT = 1.42 \text{ MeV}$  (av. energy = 2.13 MeV), corresponding to Cf-252 spontaneous fission and a U-235 fission spectrum.

[Action to B. Goel to provide numerical values to be used for all evaluations].

Note by editor: The IAEA Nuclear Data Section has available upon request the following spectra:

<u>Spectrum name</u>	<u>av. energy</u>	<u>groups</u>	<u>range given</u>
NEACRP (Karlsruhe)	432 keV	208	0.014 eV - 10.5MeV
YAYOI (Argonne)	1.39 MeV	100	$10^{-4}\text{eV}$ - 20MeV
U-235 thermal fission spectrum from ENDF/B-5	2.03 MeV	620	$10^{-4}\text{eV}$ - 18MeV
same from NBS	1.98 MeV	620	$10^{-4}\text{eV}$ - 18MeV

### 2. Graphical intercomparisons

The graphical intercomparisons presented by Mrs. Mattes were found very valuable. She was asked, as manpower permits, to continue the work.

The graphs presented are being copied by NDS whereby, however, the two-colour curves cannot be distinguished. Mrs. Mattes will produce, upon individual request, two-colour plots.

The possibility of producing different dotted lines in addition to the continuous lines, making black-and-white reproduction possible, should be investigated.

Evaluators are invited to comment on the differences encountered.

Graphical intercomparisons should be restricted to the cross-sections. Graphical intercomparison of angular and secondary energy distributions was considered less important.

### 3. Format Conversion of UKNDL and KEDAK data

At the beginning of the CRP it had been determined that evaluations would be accepted in ENDF/B, KEDAK or UKNDL formats.

In the meantime, ENDF/B has been recognized as international format for evaluated data. Evaluations produced in KEDAK or UKNDL format therefore run the risk of being ignored by data users.

It is therefore strongly recommended that KEDAK and UKNDL formatted data be converted to ENDF/B format, either by the authors or by others. (M. Mattes already converted part of UKNDL-1009B to ENDF/B format.) Difficulties are encountered with secondary energy spectra data. Action mainly to Karlsruhe and Stuttgart. IAEA/NDS and NEA Data Bank should be kept informed.

B. Patrick points out that he has all resonance parameters from his evaluations on file, which may be more suitable for producing an ENDF/B format file than the UKNDL point data.

For the purpose of intercomparison of evaluations in different formats, attention is drawn to the code "4 ACES" by Panini and Vaccari, obtainable from CNEN Bologna, producing group data from different library formats.

In the case that UKNDL and KEDAK data cannot be converted to ENDF/B point data, they may be useful (and easier to obtain) in the form of ENDF/B 620-group data.

### 4. ENDF/B problems

After ENDF/B has been recognized as the international format for evaluated neutron data, it seems inevitable that some ENDF/B rules, formats, laws etc. will have to be reviewed.

All participants are requested to submit comments about details of the ENDF/B format.

For data converted from UKNDL to ENDF/B format, there will be more than 5000 points per reaction, so that the ENDF/B limit will be exceeded.

Similarly, using the code RECENT with 0.1% accuracy gives 250000 points for U-238.

The conversion from ENDF/B-4 to ENDF/B-5 format can be done by IAEA/NDS.

Those who use for the fissile materials the Reich-Moore formalism, are recommended to use the code POLLI by De Saussure for conversion to Adler-Adler formalism. It seems possible, however, that Reich-Moore parameters as permitted in ENDF/B-4 only, may become permitted also in ENDF/B-5. Action to Fröhner and Goel to keep the participants informed about any developments. Action on IAEA/NDS to obtain the code POLLI.

It was pointed out that the code CHECKER5 is not yet perfect. Participants should report, which improvements should be made.

#### 5. Completeness of evaluations

It was found essential that all evaluations be "complete". This means in particular:

- the full energy range up to 20 MeV should be covered;
- secondary energy spectra and angular distributions should be included;
- decay data should be included.

It should be found out, however, for which actinides "complete" evaluations are actually used in burnup and benchmark calculations in order to define the data needs.

"Incomplete" evaluations could be "completed" by supplementation with data from other available evaluations. For example, decay data could be taken over from ENDF/B-5 (action on Lemmel).

#### 6. Finalizing of INDL/A by the end of 1982

1. See the subsequent list for evaluations to be completed.
2. Partial evaluations should be completed as specified in Conclusion 5.
3. Consistent fission-neutron yield data normalized to the INDC standard value of Cf-252 can be left for future consideration. This data can easily be updated and no action is needed at present.
4. UKNDL and KEDAK data should possibly be converted to ENDF/B format as specified in Conclusion 3. Problems are encountered with angular and secondary-energy distribution data.
5. Evaluators should check as far as possible the formal correctness of the files. Checks will be done also at IAEA/NDS.
6. For convenience of data users, evaluations should be available in several options:
  - ENDF/B-4 and ENDF/B-5 format;
  - resonance parameters and point data produced by RECENT;
  - 620-group data (perhaps also other group sets as required).

These conversions should be done by the CRP participants and/or IAEA/NDS.

7. Graphical plotting is essential not only for intercomparison but in particular for checking.
8. Uncertainties should be well-documented by the evaluators, typically in the form of tables as given in the UK report AERE-R-8528.
9. Nuclides or data-types (e.g. decay-data, fission yields) not covered by CRP participants shall be taken over from other sources in order to obtain a complete data library as required by data users.
10. For a summary documentation of INDL/A, NDS shall prepare a draft.

7. Evaluations to be completed by the end of 1982

	CRP eval. completed	CRP eval. partial	CRP eval. planned	other eval. for comparison
<u>90Th</u>				
228	JENDL-2			
230	JENDL-2			
231				ENDL-78
232	Vasiliu 81	Ganesan/Mehta		JENDL-2/ENDF/B-4
233	JENDL-2		Mehta *)	ENDL-78
234	JENDL-2		Mehta *)	
<u>91Pa</u>				
231	JENDL-2			
232			Mehta *)	
233	Vasiliu 81		Mehta *)	ENDF/B-5/JENDL-2
234	JENDL-2		Mehta *)	
<u>92U</u>				
232	JENDL-2		Mehta *)	
233	Vasiliu?/JENDL-2		Mehta *)	ENDF/B-4
234			Mehta *)	ENDL-78
235	Konshin 81			ENDF/B-5/JENDL-2
236	JENDL-2			ENDL-78
28	JENDL-2			ENDF/B-4
239				ENDL-78

\*) only partial evaluation planned

	CRP eval. completed	CRP eval. partial	CRP eval. planned	other eval. for comparison
<u>93Np</u>				
237	Derrien 80			ENDF/B-5/JENDL-2
239	Konshin 80			
<u>94Pu</u>				
236	JENDL-2			
238	Derrien 81			ENDF/B-5/JENDL-2
239	Konshin 80			ENDF/B-4/JENDL-2
240	Konshin 81			ENDF/B-4/JENDL-2
241	Konshin 80	Bol.		ENDL-78/JENDL-2
242	Konshin 80/ B oogna/Salvy		Yiftah*82	ENDF/B-5
<u>95Am</u>				
241	Patrick 80*/Derrien 81/KFK*	Bol.		ENDF/B-5
242g	JENDL-2			ENDF/B-5
242m	JENDL-2/KFK*		Patrick*82	ENDF/B-5
243	JENDL-2/Patrick 81*/KFK*	Bol.		ENDF/B-5
<u>96Cm</u>				
242	JENDL-2/Bol.82			
243	JENDL-2/Bol.81			
244	JENDL-2/Yiftah 80*			
245	JENDL-2/Bol.81			ENDF/B-5
246	Yiftah 81*/Bol.82			
247	Bol. 82			
248	Bol. 82		Yiftah*82	

\* format conversion required

8. Next phase

The participants recommend to the IAEA to start, after finalizing the present CRP, a new CRP on "Validation and testing of the IAEA Actinides File". This will include the following topics:

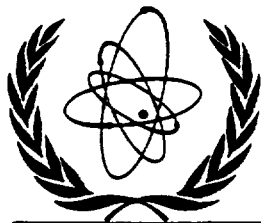
1. Mutual reviews of evaluations by other evaluators;
2. to resolve the discrepancies encountered;
3. testing of data by integral experiments and benchmarks;
4. to stimulate new measurements where required;
5. to improve and update the evaluations as required and to finalize the IAEA Actinides File (INDL/A).

9. Next Meeting

The next and final meeting of the CRP is scheduled to take place in Geel on 2-3 September 1982, preceding the Antwerp Conference on Nuclear Data for Science and Technology, 6-10 September.







INTERNATIONAL ATOMIC ENERGY AGENCY

Rev. 6

# NUCLEAR DATA SERVICES

DOCUMENTATION SERIES OF THE IAEA NUCLEAR DATA SECTION

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## INDL/A

IAEA Nuclear Data Library for  
Evaluated Neutron Reaction Data of Actinides

### Contents and Documentation

This Library contains evaluations performed by participants of the IAEA Coordinated Research Project on the Intercomparison of Evaluations of Actinide Neutron Nuclear Data. The data are available on magnetic tape, free of charge, from the IAEA Nuclear Data Section.

H.D. Lemmel, editor

May 1982



The tape contains five files:

A. Complete evaluations

File 1: ENDF/B format

3371		93-Np-237	Cadarache	INDC(FR)-42
4381		94-Pu-238	Cadarache	INDC(FR)- to be published
5161		94-Pu-242	Bruyères-le-Châtel	CEA-N-2084
9421	Rev.2	94-Pu-239	Minsk	INDC(CCP)-166
9431	Rev.1	94-Pu-240	Minsk	unpublished
9440	Rev.0	94-Pu-241	Minsk	INDC(CCP)-142
9450	Rev.2	94-Pu-242	Minsk	INDC(CCP)-150
9521		95-Am-242	JAERI	JAERI-M-8903
9522		95-Am-242-m	JAERI	JAERI-M-8903
9543		95-Am-243	JAERI	IAEA-NDS-12/1 *)
9642		96-Cm-242	JAERI	IAEA-NDS-12/2 *)
9643		96-Cm-243	JAERI	IAEA-NDS-12/5 *)
9644		96-Cm-244	JAERI	IAEA-NDS-12/1 *)
9645		96-Cm-245	JAERI	IAEA-NDS-12/3 *)
9662		96-Cm-242	Bologna	INDC(ITY)-7
9663		96-Cm-243	Bologna	CNEN-RT/FI(81)23
9665		96-Cm-245	Bologna	CNEN-RT/FI(81)24
9666		96-Cm-246	Bologna	INDC(ITY)-8
9990	Rev.81	90-Th-232	Romania	INDC(RUM)-10
9993	Rev.81	91-Pa-233	Romania	INDC(ROM)-12

File 2: UKNDL format

1009	B	95-Am-241	Harwell	AERE-R-8528
1010		95-Am-243	Harwell	progress report 1981

File 3: KEDAK format

1		96-Cm-244	Soreq	IA-1353
2		96-Cm-246	Soreq	IA-1358

B. Partial evaluations

File 4: ENDF/B-4 format, resolved resonance region

9441		94-Pu-241	Bologna	IAEA-NDS-12/4 *)
9442		94-Pu-242	Bologna	CNEN-RT/FI-(79)1
9541		95-Am-241	Bologna	CNEN-RT/FI-(79)6
9543		95-Am-243	Bologna	Not documented
9646		96-Cm-246	Bologna	CNEN-RT/FI-(80)7
9647		96-Cm-247	Bologna	Not documented
9648		96-Cm-248	Bologna	CNEN-RT/FI-(80)10

File 5: ENDF/B-5 format, fission cross-section converted from UKNDL format

9509		95-Am-241	Harwell, Stuttgart conversion From UKNDL-1009-B	AERE-R-8528
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\*) Available as microfiche from IAEA-NDS upon request  
INDC reports available from IAEA-NDS upon request

File 1: Complete evaluations in ENDF/B format

Documentation of format: BNL-NCS-50496, October 1975

Note: Not all of the evaluations follow the ENDF/B rules strictly. For example, resonance parameters and cross-section data are sometimes both included. Caution is therefore required before applying ENDF/B computer programs.

Accession number 3371

93-Np-237

1830 records, date of release 81/3

Authors: H. Derrien, J.P. Doat, E. Fort, D. Lafond  
Cadarache, France, 1981

Complete documentation: Report INDC(FR)-42 (dated Sept. 1980)

Title: Evaluation of Np-237 Neutron Cross-Sections in the Energy Range from  $10^{-5}$ eV to 14 MeV.

Compare 1979 Knoxville Conference on Nuclear Cross-Sections for Technology, page 872

Accession-number 4381

94-Pu-238

announced August 1981

Author: H. Derrien  
Cadarache, France, 1981

Complete documentation: Report INDC(FR)-.. to be published,  
(see working paper 6 at 1981 CRP Meeting)

Title: Evaluation of Pu-238 Neutron Cross-Sections in the Energy Range  $10^{-5}$ eV to 3 MeV.

Accession-number 5161

94-Pu-242

1165 records, date of release 79/3

Authors: J. Jary, Ch. Lagrange, C. Philis, J. Salvy  
Bruyères-le-Châtel, France 1979

Complete documentation: Report CEA-N-2084 (June 1979)

Title: Compte Rendu de Travaux sur l'Evaluation de Données Nucléaires Relatives aux Actinides (Pu-240, Pu-242, Th-232)

Accession-number 9421

94-Pu-239

2222 records, evaluated Sept. 1980, Rev.2 Dec. 1981

Authors: G.V. Antsipov, L.A. Bakhanovich, V.F. Zharkov, V.A. Zenevich  
A.B. Klepatskii, V.A. Konshin, V.M. Maslov, G.B. Morogovskii,  
Ju.V. Porodzinskii, E.Sh. Sukhovitskii  
Inst. Teplo-i Massoobmena (ITM) imeni A.V. Lykova, Minsk, USSR

Title: Nuclear Data Evaluation for Pu-239 in the Energy Region  
from 0 to 15 MeV

Reports: ITM preprints nr. 12 to 16, Minsk 1981  
English translation see INDC(CCP)-166, IAEA, June 1981

This evaluation supersedes the 1974 evaluation by same authors known as  
SOKRATOR-2021 and INDL/V-9420.

Accession-number 9431

94-Pu-240

1768 records, received Nov. 1981, Rev. I Dec. 1981

Authors: E.S. Sukhovitskii, G.V. Antsipov, V.A. Konshin, A.B. Klepatskii,  
V.A. Zenevich, J.V. Porodzinskii  
Inst. Teplo-i Massoobmena (ITM) imeni A.V. Lykova, Minsk, USSR

Title: Nuclear Data Evaluation for Pu-240 in the Energy Region  
from 0 to 15 MeV

Unpublished

This evaluation supersedes the 1978 evaluation by same authors known as  
SOKRATOR-2023 and INDL/V-9430.

Accession-number 9440

94-Pu-241

2507 records, released 79/5 as INDL/A-2024, revised Nov. 1981 under new  
accession-number INDL/A-9440 Rev.0.

Authors: V.A. Konshin, G.V. Antsipov, E.Sh. Sukhovitskii, L.A. Bakhanov,  
A.B. Klepatskii, G.B. Morogovskii, Ju.V. Porodzinskii  
Minsk, USSR, 1979. Revised in 1981

Complete documentation: Report INDC(CCP)-142, translation by IAEA  
January 1980

Title: Evaluation of Nuclear Data for Pu-241 in Neutron Energy Range from  
0.001 eV to 15 MeV

Accession-number 9450

94-Pu-242

1554 records, released 79/5 as INDL/A-2025, revised Dec. 1981 under new accession number INDL/A-9450 Rev.2

Authors: G.V. Antsipov, L.A. Bakhanovic, A.B. Klepatskii, V.A. Konshin, V.M. Maslov, G.B. Morogovskii, Ju.V. Porodzinskii, E.S. Shukovitskii, V.A. Zenevich  
Minsk, USSR, 1979. Revised in 1981

Complete documentation: Report INDC(CCP)-150, translation by IAEA  
July 1980. (A.K. Krasin, editor)

Title: Evaluation of Nuclear Data for Pu-242 in the Neutron Energy Region from  $10^{-5}$  eV to 15 MeV.

Accession-number 9521

95-Am-242

1427 records, received 81/3

Authors: T. Nakagawa et al.  
Nuclear Data Center, JAERI, Tokai, Japan, 1980

Evaluation of Neutron Data of Am-242 and Am-242m

Report JAERI-M-8903 (June 1980)

Accession-number 9522

95-Am-242-m

1424 records, received 81/3

Authors: T. Nakagawa et al.  
Nuclear Data Center, JAERI, Tokai, Japan, 1980

Evaluation of Neutron Data of Am-242 and Am-242m

Report JAERI-M-8903 (June 1980)

Accession-number 9543

95-Am-243

2635 records, date of release 78/10

Authors: T. Fuketa, S. Igarasi, T. Asami, Y. Kikuchi, T. Nakagawa  
Nuclear Data Center, JAERI, Tokai, Japan, 1979

Evaluation of Neutron Data on Am-243 and Cm-244

Report IAEA-NDS-12/1 (Feb. 1979)  
Original report JAERI-M-7174 (1977), in Japanese

Accession-number 9642

96-Cm-242

737 records, received 79/11

Authors: S. Igarasi et al.

Nuclear Data Center, JAERI, Tokai, Japan, 1980

Report IAEA-NDS-12/2 (June 1979)

Original report JAERI-M-8342 (1979), in Japanese

Accession-number 9643

96-Cm-243

3928 records, received 81/10

Authors: T. Nakagawa, S. Igarasi

Nuclear Data Center, JAERI, Tokai, Japan, 1981

Report IAEA-NDS-12/5 (July 1981)

Title: Energy Range  $10^{-5}$ eV to 20 MeV

Accession-number 9644

96-Cm-244

2544 records, date of release 78/10

JAERI 1979

Report IAEA-NDS-12/1 (Feb. 1979)

This is a revision of the earlier evaluation published as JAERI-M-7574,  
June 1977

Original report JAERI-M-7175 (1977), in Japanese

Accession-number 9645

96-Cm-245

2625 records, received 79/11

Authors: S. Igarasi, T. Nakagawa

Nuclear Data Center, JAERI, Tokai, Japan, 1978

Report IAEA-NDS-12/3 (June 1978)

Original report JAERI-M-7733 (1978), in Japanese

Accession-number 9662

96-Cm-242

831 records, received 82/4

Authors: G. Maino, E. Menapace, M. Motta, M. Vaccari  
CNEN, Bologna, Italy

Title: Evaluation of Cm-242 Neutron Cross-Sections from  $10^{-5}$  eV  
to 15 MeV

Complete documentation: INDC(ITY)-7 (1982) = TIB/FICS(82)2

The evaluation of the resonance region was contained in report  
CNEN-RT/FI/(79)2 (Feb. 1979) and INDL/A File 4 acc-nr. 9642, which is  
superseded.

Accession-number 9663

96-Cm-243

(acc-nr. changed from originally 9643 to 9663)

1021 records, received 82/4

Authors: G. Maino, T. Martinelli, E. Menapace, M. Motta, M. Vaccari,  
A. Ventura

Complete documentation: CNEN-RT/FI(81)23, October 1981

Title: Evaluation of Cm-243 Neutron Cross-Sections from  $10^{-5}$ eV to 15 MeV

Accession-number 9665

96-Cm-245

(acc-nr. changed from originally 9643 to 9665)

1197 records, received 82/4

Authors: G. Maino, T. Martinelli, E. Menapace, M. Motta, M. Vaccari

Complete documentation: CNEN-RT/FI(81)24, October 1981

Title: Evaluation of Cm-245 Neutron Cross-Sections from  $10^{-5}$ eV to 15MeV

Accession-number 9666

96-Cm-246

(acc-nr. changed from originally 9646 to 9666)

720 records, received 82/4

Authors: G. Maino, E. Menapace, M. Vaccari, A. Ventura

Complete documentation: INDC(ITY)-8, 1982 = TIB/FICS(82)3

Title: Evaluation of Cm-246 neutron cross-sections  
from  $10^{-5}$ eV to 15 MeV



Accession-number 9990

90-Th-232

1761 records, date of release 79/2, revised 80/4

Authors: G. Vasiliu, S. Mateescu, D. Gheorghe, M. Ciodaru,  
E. Badescu, N. Dragan, O. Bujoreanu, C. Craciun,  
L. Pintiliescu, M. Zaharcu, D. Popescu, T. Statnicov  
V. Avrigeanu  
Institute of Nuclear Power Reactors, Pitesti, Romania, 1980

Complete documentation: INDC(RUM)-10, May 1980. A Summary of the  
evaluation is included on tape.

Preliminary! Being revised in 1981

Accession-number 9993

91-Pa-233

990 records, date of release 80/5

Authors: G. Vasiliu, S. Mateescu, S. Rapeanu, V. Avrigeanu  
M. Ciodaru, N. Dragan, T. Statnicov, O. Bujoreanu  
Institute of Nuclear Power Reactors, Pitesti, Romania, 1980

Complete documentation: Report INDC(ROM)-12, July 1980

Title: Nuclear Data Evaluation for Pa-233

Preliminary! Being revised in 1981

File 2: Complete evaluations in UKNDL format

Documentation of format: AWRE/0-70/63, 1963

Note: In the case of a 4-digit accession-number its first digit is dropped in the record identification field of each record.

Accession-number 1009 B

95-Am-241

4205 records, date of release 79/3, revised 1980

Authors: J.E. Lynn, B.H. Patrick, M.G. Sowerby, E.M. Bowey  
Nuclear Physics Division, AERE, Harwell, U.K.

Complete documentation: AERE-R-8528

Note: Version A contained some small errors in resolved resonance parameters above 50 eV. The corrections were included in a revised report to be published in "Progress in Nuclear Energy".

The fission cross-section was converted by M. Mattes, IKE Stuttgart, to ENDF/B-5 format. See File 5.

Accession-number 1010

95-Am-243

7980 records, date of release 81/9

Authors: J.E. Lynn, B.H. Patrick, M.G. Sowerby, E.M. Bowey  
Nuclear Physics Division, AERE, Harwell, UK

Summary of documentation: Progress Report, September 1981

Energy range:  $10^{-5}$ eV - 15 MeV

File 3: Complete evaluations in KEDAK format

Documentation of format: KFK-880, 1968

Accession-number 1

96-Cm-244

2166 records, date of release 79/3. The file is dated 9/11h is the date of conversion from internal KEDAK to standard KEDAK,d at NDS 80/1.

Authors: M. Caner, S. Yiftah  
Soreq Nuclear Research Centre, Israel

Title: Curium-244 Neutron Data Evaluation

Report IA-1353, March 1979

Accession-number 2

96-Cm-246

2240 records, date of release 80/6. The file is dated 16/1h is the date of conversion from internal KEDAK to standax at Karlsruhe. Date of receipt at NDS 81/3.

Authors: M. Caner, Y. Bartal, S. Yiftah  
Israel Atomic Energy Commission

Title: Curium-246 Neutron Data Evaluation

Report IA-1358, June 1980

File 4: Partial evaluations (resolved resonance region) in ENDF/B format

Documentation of format: BNL-NCS-50496, October 1975

Note: The number of records is for all nuclides somewhat larger than originally announced due to the "1451" section added by NDS.

Accession-number 9441

94-Pu-241

149 records, released 79/5

Authors: E. Menapace, M. Motta, A. Ventura  
Centro di Calcolo del CNEN, Bologna, Italy

Title: Evaluation of Pu-241 Cross-Sections in the Resonance Region

Report IAEA-NDS-12/4 (Feb. 1979)

Accession-number 9442

94-Pu-242

89 records, released 79/5

Authors: E. Menapace, M. Motta, A. Ventura  
Centro di Calcolo del CNEN, Bologna, Italy

Title: Pu-242 Evaluation in Resolved Resonance Region

Report CNEN-RT/FI-(79)1 (Jan. 1979)

See also: Meeting on Nuclear Data of Higher Pu and Am Isotopes,  
Brookhaven, November 1978

Accession-number 9541

95-Am-241

248 records, released 79/5

Authors: G. Maino, E. Menapace, M. Motta, A. Ventura

Title: Am-241 Neutron Cross-Sections in the Resonance Region

Report CNEN-RT/FI-(79)6 (Feb. 1979)

Accession-number 9543

95-Am-243

234 records, preliminary data released 79/5

Authors: E. Menapace  
Centro di Calcolo del CNEN, Bologna, Italy

Not documented

Accession-number 9642 (superseded)

96-Cm-242

38 records, released 79/5

Authors: E. Menapace, M. Motta, A. Ventura, A. Montaguti  
Centro di Calcolo del CNEN, Bologna, Italy

Title: Evaluation of Cm-242 in the Resonance Region

Report CNEN-RT/FI-(79)2 (Feb. 1979)

Superseded by and included in INDL/A file 1 acc.nr. 9662

Accession-number 9646 (superseded)

96-Cm-246

39 records, released 81/5

Authors: T. Martinelli, E. Menapace, M. Motta, M. Vaccari, A. Ventura  
Centro di Calcolo del CNEN, Bologna, Italy

Title: Evaluation of Cm-246 Neutron Cross-Sections in the Resonance  
Region

Report CNEN-RT/FI-(80)7 (March 1980)

Superseded by and included in INDL/A file 1 acc.nr. 9666

Accession-number 9647

96-Cm-247

65 records, released 81/5

Authors: T. Martinelli, E. Menapace, M. Motta, M. Vaccari  
Centro di Calcolo del CNEN, Bologna, Italy

Title: Evaluation of Cm-247 Neutron Cross-Sections in the Resonance  
Region

Proceedings of the Second Technical Meeting on the Nuclear Transmutation  
of Actinides, Ispra, 21-24 April 1980, p. 171-190

Accession-number 9648

96-Cm-248

54 records, released 81/5

Authors: T. Martinelli, E. Menapace, M. Motta, M. Vaccari, A. Ventura

Title: Evaluation of Cm-248 Neutron Cross-Sections in the Resonance  
Region

Report CNEN-RT/FI-(80)10, April 1980

File 5: Data converted from UKNDL format into ENDF/B format

Accession-number 9509

95-Am-241

685 records, December 1981

Conversion by: M. Mattes, Stuttgart

Containing: 95-Am-241(n,f) taken from File 2, Acc-Nr. 1009B,  
by J.E. Lynn et al. Data are given pointwise in log-log  
interpolation.

Cross-reference: The same data linearized and in 620 group structure, see  
data library IRDF-82, acc-nr. 1009

History of INDL/A

Status as of June 1981 is documented in IAEA-NDS-12 Rev. 4.

Contents:

File 1: 2024, 2025, 3371, 5161, 9521, 9522, 9543, 9642, 9644,  
9645, 9990, 9993

File 2: 1009 B

File 3: 1, 2

File 4: 9441, 9442, 9541, 9543, 9642, 9646, 9647, 9648

Changes until April 1982

File 1: 2024 replaced by 9440 Rev.0  
2025 replaced by 9450 Rev.2

Added: 4381, 9421, 9431, 9440, 9450, 9643,  
9662, 9663, 9665, 9666

File 2: Added: 1010

File 4: Deleted: 9642

File 5: Added: 1009 B

Status as of May 1982 is documented in IAEA-NDS-12 Rev. 6 (May 1982)

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