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INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

Co-ordination of the International Network of Nuclear Structure and Decay Data Evaluation

Summary Report of an IAEA Advisory Group Meeting

hosted by the CEC Central Bureau for Nuclear Measurements
in Geel, Belgium, 9-13 November 1992

Edited by H.D. Lemmel

December 1993

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

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Abstract

The IAEA Nuclear Data Section convened the tenth meeting of the international nuclear structure and decay data evaluators network in Geel, Belgium, 9-13 November 1992, hosted by the CEC Central Bureau for Nuclear Measurements. The meeting was attended by 25 scientists from 12 member states and three international organizations, concerned with the compilation, evaluation, and dissemination of nuclear structure and decay data. The present document contains a summary report of the meeting, the conclusions and recommendations, and the activity reports of the participants.

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FOREWORD

The international nuclear structure and decay data (NSDD) network, consisting of evaluation groups and data service centres, aims at a complete and continuous nuclear structure data evaluation of all isobaric nuclear mass-chains on a six-year cycle, the continuous publication of these evaluations and their dissemination to the scientific community. The evaluated mass-chain data resulting from this concerted international effort are published in the journals Nuclear Physics A and Nuclear Data Sheets; they comprise the currently recommended "best values" of all nuclear structure and decay data. The resulting data files which include comprehensive gamma-ray spectra, nuclear half-lives and other data types, are needed in practically all applications of nuclear technology. The recommended values are made available to users in various media such as on-line computer serices, PC diskettes with gamma-ray catalogues, wall-charts of nuclides, handbooks, nuclear wallet cards, and others.

The international NSDD network has evolved from the pioneering work in the late fourties and early fifties by physicists from the California Institute of Technology (Pasadena), the Rijksuniversiteit at Utrecht (Netherlands) and the Nuclear Data Group (Washington and Oak Ridge). The United States effort is presently co-ordinated by the US National Nuclear Data Center at the Brookhaven National Laboratory, whereas the international co-operation is supported by the IAEA Nuclear Data Section.

Periodic meetings of this network have the objectives to maintain the coordination of all centres and groups participating in the compilation, evaluation and dissemination of NSDD, to maintain and improve the standards and rules governing NSDD evaluation, and to review the development and common use of the computerized systems and databases maintained specifically for this activity.

List of NSDD meetings

place	date	report
1. Vienna, Austria	29.4. - 3.5.1974	INDC(NDS)-60
2. Vienna, Austria	3. - 7.5.1976	INDC(NDS)-79
3. Oak Ridge, USA	14. - 18.11.1977	INDC(NDS)-92
4. Vienna, Austria	21. - 25.4.1980	INDC(NDS)-115
5. Zeist, Netherlands	11. - 14.5.1982	INDC(NDS)-133
6. Karlsruhe, Germany	3. - 6.4.1984	INDC(NDS)-157
7. Grenoble, France	2. - 5.6.1986	INDC(NDS)-182
8. Ghent, Belgium	16. - 20.5.1988	INDC(NDS)-206
9. Kuwait, Kuwait	10. - 14.3.1990	INDC(NDS)-250
10. Geel, CEC, Belgium	9. - 13.11.1992	INDC(NDS)-296

LIST OF ABBREVIATIONS

CAJaD	Centre for Data on the Structure of the Atomic Nucleus and Nuclear Reactions of the USSR State Committee on the Utilization of Atomic Energy, located at the Kurchatov Institute in Moscow.
CBNM	CEC Central Bureau for Nuclear Measurements, located at Geel, Belgium. Now: Institute of Reference Materials and Measurements.
CD-ROM	Compact disk with read-only memory.
CEC	Commission of the European Communities.
CNDC	Chinese Nuclear Data Center, located at the Institute of Atomic Energy (IAE), Beijing.
CPND	Charged Particle Nuclear Data.
DBMS	Database Management System.
EBCDIC	Extended binary-coded decimal interchange code.
ENSDF	Computer-based Evaluated Nuclear Structure Data File.
Evaluation	• Mass-chain evaluation: to obtain best data for the structure and decay of all nucides with the same mass. • Horizontal evaluation: to obtain best values of a certain decay parameter for many nuclides irrespective of their mass.
EXFOR	Computer-based system for the compilation and international exchange of experimental nuclear reaction data.
FIZ	Fachinformationszentrum Energie, Physik, Mathematik GmbH, Eggenstein-Leopoldshafen, Germany.
IAEA/NDS	Nuclear Data Section of the International Atomic Energy Agency.
ICRM	International Committee for Radionuclide Metrology.
INDC	International Nuclear Data Committee.
INIS	International Nuclear Information System, operated by the IAEA.
IRMM	CEC Institute of Reference Materials and Measurements.
JAERI	Japan Atomic Energy Research Institute.
KACHAPAG	Karlsruhe Charged Particle Group.
KISR	Kuwait Institute for Scientific Research.
LIYaF	Leningrad Institut Yadernoy Fiziki: Data Centre of the Leningrad Nuclear Physics Institute of the USSR Academy of Sciences.
NDP	Nuclear Data Project located at the Oak Ridge National Laboratory.
NDS	Nuclear Data Sheets, a journal devoted to ENSDF data.
NDS	IAEA Nuclear Data Section.
NNDC	National Nuclear Data Center, located at the Brookhaven National Laboratory, USA.
NSDD	Nuclear Structure and Decay Data.
NSR	Nuclear Structure References, a bibliographic file related to ENSDF.
USNDN	U.S. Nuclear Data Network.

INTRODUCTION

The tenth meeting of the members of the Network of Nuclear Structure Decay Data Evaluators was hosted by the CEC Central Bureau of Nuclear Measurements (CBNM) in Geel, Belgium. The participants enjoyed a most generous hospitality and very good meeting conditions. The meeting was attended by 25 scientists representing 16 groups in 12 countries, and 3 international organizations. The list of participants is given in Annex 1.

The meeting was opened by Prof. Müller, Director of CBNM, by H.D. Lemmel on behalf of the IAEA, and by W. Bambynek as the local organizer. Receptions were given by the CBNM and, privately, by W. Bambynek.

Mr. R. Meyer and Mr. P. Endt served as chairmen for the technical and the scientific parts of the agenda, respectively.

Originally, the 1992 meeting had been planned to be held in Tashkent, USSR. Though this was, in the end, not possible, the efforts of Dr. F.E. Chukreev to host the meeting, were appreciated. When a change of the meeting place turned out to be necessary, the meeting was organized at Geel by Drs. A.J. Deruytter and W. Bambynek at rather short notice. Special thanks were given to W. Bambynek who, at the time of the meeting, was a retiree after many years of active participation in the NSDD Network. J. Blachot has retired some time ago but he continues to participate in the network. Another retiree is Dr. A. Hashizume; in his place Dr. H. Iimura from JAERI, Japan was welcomed. A most cordial welcome was expressed to Dr. Ameenah Farhan from Kuwait, who has hosted the previous meeting 10-14 March 1990 in Kuwait City.

The IAEA made it possible to upgrade the meeting from a Consultants' Meeting to an Advisory Group Meeting, whereby a better representation of the Chinese and Russian evaluation groups could be financed. Dr. Y. Tendow, RIKEN Sapporo, Japan, was not able to attend but expressed in a letter that he wishes to continue to participate. Another letter was received from Dr. H. Behrens, Fachinformationszentrum Karlsruhe, Germany. He continues to have insufficient support for an active participation in the NSDD evaluation, but he would be pleased to continue to act as a distribution centre. P.M. Endt, also an active retiree, expressed regrets from C. v. der Leun who was unable to attend the meeting but who will continue to be an active member of the network.

The Evaluated Nuclear Structure and Decay Data File (ENSDF) together with its bibliographic file Nuclear Structure References (NSR) is the internationally recognized database for nuclear level schemes, half-lives, decay gamma ray spectra, etc., of all the known nuclear isotopes (more than 2500). In addition to the main regular ENSDF publications in the journals Nuclear Data Sheets and Nuclear Physics A, there are various other publications based on ENSDF. In particular, a new edition of the well-known handbook "Table of Isotopes" by the Lawrence Berkeley Laboratory, USA, which serves a large user community (10 000 copies are being printed), is in preparation.

The input to the ENSDF and NSR databases is contributed by presently 18 nuclear data evaluation groups in 11 countries. A list of these groups is given in Annex 2, together

with the work distribution as of 1992. The databases are made available to the nuclear data users by the data centers listed in Annex 3.

Guidance to the evaluation work is given primarily by Drs. M. Bhat and J. Tuli of the National Nuclear Data Center (NNDC) at BNL, USA, and by M. Martin of the Nuclear Data Project (NDP) at ORNL, USA.

Despite the large user community, which illustrates the importance of this database, there is significant lack of support in several countries. Two groups in UK and India have discontinued their co-operation. Another group in Germany has announced its temporary discontinuation due to lack of funding. Data evaluations from these groups are presently still contained in the ENSDF database.

The amount of new measurements of nuclear structure and decay data in a large number of institutes is such, that the level scheme of each nuclide should be re-evaluated every 5 to 6 years. This goal has not been reached. Evaluations for about one tenth of the nuclides are more than eight years old, indicating that some part of the database is known to be outdated due to lack of support.

Consequently, some time of the meeting had to be devoted to the question of priorities of data evaluation and to the work re-distribution among the available groups and their co-workers. It will be an important task for the IAEA Nuclear Data Section to find additional nuclear data groups that could join the network of nuclear data evaluators.

MINUTES

The agenda of the meeting is given in Annex 4. The resulting actions and conclusions are listed on pages 11-15. A list of PC programs presented at the meeting is given in Annex 5. Lists of the scientific presentations given by the participants and status reports, are contained in Annexes 6 and 7 respectively.

The discussions included the exchange of views of participants on many technical details, of which the major items are summarized in the following.

M. Bhat and **J. Tuli** reported the status of mass-chain evaluations. To judge on the up-to-dateness of ENSDF by the age of evaluations alone is no longer quite meaningful, because for some mass-chains there is little new material, whereas other mass-chains require more frequent updating when new experimental data become available. It would be advisable to create a subgroup to define priorities. Some mass-chains get updated perhaps too often whereas others should be updated more frequently. There should be an indicator in the ENSDF system to indicate such cases where the mass-chain evaluation is old but still up-to-date due to the absence of new experimental data. **J. Tuli** was asked to draft a written proposal, which can be found in the List of Actions (pages 11-15).

The work of the reviewers was acknowledged, though their work gets little acknowledgment in the Nuclear Data Sheets. It was suggested to mention the reviewer, either in the author's acknowledgments or in a line underneath of the title: Reviewed by .....

R. Meyer suggested to have the review activities more centralized. But M. Bhat reported on his good experiences with evaluators as reviewers. For the evaluators the review activity is educating when they study other people's work.

The difficult manpower situation of the network was discussed.

H. Lemmel reported on his efforts to find additional groups to join the network. His contacts with German authorities remained in vain due to lack of funds, though H. Behrens, Karlsruhe, continues to have strong interest to join again as an active mass chain evaluator. Interest was expressed from Hungary, both Debrecen and Budapest, and H. Lemmel will continue to try to establish contacts.

In Sweden the manpower for mass-chain evaluations is down to zero, but there is interest in high-spin "horizontal evaluation".

Zhou Chunmei offered to take over additional mass-chains.

Ming Ming King, Republic of China, does not have a permanent mass assignment but receives ad hoc assignments from Brookhaven. As the Republic of China continues not to be a member state of the IAEA, Dr. King could not formally participate in the network.

P. Ekström reported that he obtains reduced funding so that he has to discontinue mass-chain evaluations. He will continue with horizontal evaluations and on-line services to customers.

I. Kondurov announced the new name of his center (Data Centre of the Petersburg Nuclear Physics Institute, Gatchina). He will continue with mass-chain evaluations (presently 131). There is no funding for other groups such as that in Kharkov or Gridnev's activity.

W. Bambynek reported that the new emphasis of CBNM is towards metrology and that, after his retirement, his work will discontinue. **T. Altzitzoglu** should be contacted for any future NSDD work at CBNM.

M. Bhat reported that NNDC lost one evaluator so that their workload will be reduced in future.

A. Farhan has resumed the work with mass 74 though under restricted working conditions due to the loss of the entire university library and limited budget and manpower resources. She invites scientists to come to Kuwait for one year or more to do teaching plus mass-chain evaluations.

NSR is compiled primarily at NNDC with external contributions only from Petersburg/Russia and RIKEN/Japan. It was suggested that China should regularly contribute to NSR, since **Zhuang Youxiang** learned NSR indexing during his stay in Brookhaven.

It was suggested to have the official ENSDF documentation, i.e.

- the ENSDF Manual by J. Tuli, and

- the Guidelines for evaluators by M. Martin,

available on floppy diskettes. A computer copy of the Manual has been produced by R. Firestone during his work for CD-ROM. This should be updated by J. Tuli and distributed on a floppy diskette. The Guidelines are available in Wordperfect and could be distributed on diskettes.

J. Blachot acknowledged that Brookhaven did a very good job in providing all network members with codes usable on all computers.

J. Tuli presented the list of available ENSDF analysis codes. These can be retrieved from the NNDC on-line system by FTP, not by e-mail.

F. Chukreev appreciated the fast response of Brookhaven. He had communicated to **J. Tuli** some mistakes he had found in the Nuclear Data Sheets. The mistakes were corrected and all ENSDF users, through the usual distribution, had the corrected data within a very short period.

H. Lemmel reported that the IAEA has been asked through formal channels to produce an "International Chart of Nuclides", based on the argument, that the different existing handbooks and wall-charts of nuclides do not show the same numbers. What kind of data this international chart is supposed to contain, has not been defined.

To some extent, ENSDF is supposed to be the database for an International Chart of Nuclides. However, it is known, that the system cannot be updated fast enough. Actually, for the nuclides that were included in the file of "X-and Gamma-Ray Standards for Detector Calibration", different half-life values than those contained in ENSDF were recommended. Also ICRM has issued new precise half-life values for important nuclides. In ENSDF these values cannot be updated before the relevant mass-chain has been re-evaluated.

Consequently it seems that an additional database as "International Chart of Nuclides" would be needed. This may start with the half-lives of ground-states and isomers as taken from ENSDF, but would include revised values as soon as such revised values have been approved by an international authority.

In the case of detector calibration standards, the IAEA group of experts was certainly such an authority to issue new internationally recommended values of half-lives, and of x- and gamma-rays, that were investigated for this specific project. But this group was not a continuing group.

IAEA/NDS has scheduled for 1993 or 1994 a Consultants' Meeting to investigate the needs and feasibility of a database for an International Chart of Nuclides, in close contact with ICRM and the ENSDF network.

F. Chukreev recalled that horizontal and mass-chains evaluations are both essential and that the interaction of both types of evaluators is essential. ENSDF may require additional mechanisms to include "horizontal" data not yet adopted by the responsible evaluator. It must be avoided that databases for different applications contain different numbers.

Several participants stressed the need for horizontal half-life evaluations, and all groups were invited to submit comments on the conflict between horizontal half-life evaluations and those contained in ENSDF. The problem is also submitted to the Formats and Procedures Subcommittee. It should be discussed at the next meeting.

M. Martin reported that the NIST Radioactivity Group under Robin **Hutchinson** updates their recommended values continuously as soon as new measurements become available. The main discrepancies between ICRM and ENSDF are with the emission probabilities, though the differences are small due to the overall increased accuracy of the available data. Emission probabilities of ICRM have not been checked for consistency with the overall nuclear structure which is better treated by ENSDF evaluators though with delays of several years.

A new compilation of horizontal evaluations would be desirable.

New developments on high-spin data and superdeformed bands were discussed, which were previously not adequately covered in ENSDF and NSR. **M. Martin** reported on a database of experimental data existing in Oak Ridge. About 1 man-year would be needed to convert this into ENSDF format, without data evaluation, though some degree of evaluation would be desirable. High-spin databases, partly existing also elsewhere, are quite

voluminous and may involve thousands of gamma-lines. It was agreed that such data should be included in ENSDF and that rules and guidelines should be updated accordingly.

In the absence of **R.G. Helmer** his note on "Use of total absorption γ-ray data" was presented by **J.K. Tuli**. Helmer's prescription of including the data in ENSDF was discussed. Evaluators cautioned about adopting the "pseudo" levels as they might be combination of levels. However, Iβ to well defined levels would be very useful.

F.E. Chukreev stressed the necessity that evaluators should draw attention to assumptions made in the evaluation, although this is mentioned in M. Martin's guidelines. He presented two cases of unsolved problems

- the Pu-239 alpha decay;

- the Ba-133 decay; in this case the IAEA group on X and gamma-ray standards for detector calibration had been mislead by ENSDF data. In an article in Yadernye Konstanty Chukreev obtains significantly lower intensities than the X/gamma Standards Group due to different assumptions on penetration factors. An action was given to Lemmel to distribute Chukreev's Ba-133 paper and to contact the X/gamma Standards Group.

Note after the meeting: An English translation of this paper is being published as report INDC(CCP)-361.

M. Martin continues to act as the chairman of the Formats and Procedures Subcommittee. He calls for communication of questions. Participation of non-US network members in this group is difficult but could be arranged if their travel plans would be known.

The ENSDF publication in the journals Nuclear Physics and Nuclear Data Sheets continues despite of reduced funding. N.D.S. has 700 paid subscriptions plus free copies, which means a slight increase. The production codes have been improved; larger character size and Postscript output have increased the readability. The improved code is available in the on-line system and can be used by everybody who has a Postscript printer. A PC version is not yet available.

R. Firestone reports on the progress of the new issue of the Table of Isotopes. The large masses of data exceed the limitations given by a handy volume.

R. Meyer draws attention to the forthcoming changes in information technology. This starts a long discussion on the merits and disadvantages of

- print media,
- on-line services, and
- compact disks,

each of them absorbing significant amounts of programming manpower.

P. Ekström offers on-line NSR and his updated radioactivity database derived from ENSDF, of which updates are received on floppies from Brookhaven. This is an important service to Swedish scientists (over 200 logins in 1992) and some neighbouring countries.

M. Bhat reports that scientists in Germany use the on-line services of the Karlsruhe FIZ information centre. However, as they are charged for this service many of them continue to log in at NNDC.

M. Lederer presented his report, "How to Revitalize the Nuclear Data Compilation and Evaluation Program" (paper A7) - Major points were summarized in a set of viewgraphs (paper A5).

There was an extensive discussion on future needs and developments, from the users' viewpoint and from the evaluators' viewpoint. In many cases proposals that appeared desirable were not practical under the given limitations of funds and manpower. **M. Lederer** pointed out that a centralized and continuous evaluation would be desirable but not possible. The existing network is not efficient but practical. The network is the best way to make use of the available expertise in many institutes, which would not exist to the same extent in a centralized effort.

W. Bambynek pointed out that decay data users are not happy with N.D.S. because it contains too much structure information. The user community of decay data users which is larger than the nuclear structure community, should receive more attention. To some extent the decay data users are well served with special PC files and handbooks derived from ENSDF.

C. Stone presented his work for an ENSDF system based on DBMS, starting from a Chart of Nuclides and then going deeper and deeper. The present Mackintosh system is planned to be supplemented by versions for IBM and work stations. At first the adopted levels and gamma lines will be included. The output will be tabular or graphical, on screen or on printer.

J. Blachot presented the PC version of a Chart of Nuclides by a student of D. Weaver, Birmingham. Regrettably, this is planned as a one-off job only.

I. Kondurov presented a software package for neutron-activation analysis using ENSDF data, data from the Table of Isotopes, cross-sections from Brookhaven and others.

M. Lederer presented a diskette "Nuclear Science Utilities".

R. Meyer expressed the need for a database oriented system ENSDF-2. Participants stressed that this is not trivial as it has to be designed such that no information of the present more flexible ENSDF would be lost or misinterpreted. R. Meyer intends to look out for the manpower required for the development of ENSDF-2 which has to be done as an effort parallel to ENSDF.

Participants pointed out that special presentations for specific user groups remain to be essential and should have high priority. There are various user groups (such as P. Ekström's decay data file, or also commercial companies like Canberra) who continue to need subsets from ENSDF for specific applications.

M. Bhat and J. Tuli explained in detail the NNDC on-line system which enables users at any time to obtain up-to-date information. ENSDF consists of the archival file with published evaluations which is on-line accessible by everyone and of which updates are distributed to various centers in regular intervals several times per year. Updates are made simultaneously with the publication in N.D.S. In addition, there is the working ENSDF file containing new evaluations during their review period before publication; this part of ENSDF is on-line accessible to the network only.

H. Lemmel reported that the on-line system from NNDC is being installed also at IAEA/NDS. At the IAEA the INIS database is made available on-line and on CD-ROM. In this case a CD-ROM is reasonable because by far the largest part of the INIS database (i.e. from the beginning until about 2 years before presence) remains unchanged. In contrast to INIS, all nuclear data files are updated so frequently that their distribution on CD-ROM would not be a good service to those customers who have the facilities of on-line access to one of the data centers. Even in the IAEA/NDS service area which includes mostly developing countries, computer networks for on-line access to the IAEA databases are being developed rapidly. If the manpower is too limited for programming support of on-line and CD, preference should be given to the on-line service, and this is how IAEA/NDS has decided.

M. Lederer and **R. Meyer** stated that on-line and CD-ROM are complementary and both are needed. **R. Firestone** will release the first CD-ROM with ENSDF, ENDF and the Table of Isotopes, and with Postscript graphics capability. Users will work under Windows but need not have Postscript. **R. Firestone** drafted a statement on the Development of ENSDF which can be found on p. 15.

The **next meeting** is suggested to be in the US in spring 1994 hosted by Berkeley and co-sponsored by Oak Ridge and Brookhaven. Craig Stone and R. Firestone are suggested as organizers.

LIST OF ACTIONS agreed at the Meeting

drafted by P. Ekström

A) Standing actions

1	Network	Inform the US/NNDC of errors in ENSDF, NSR, NDS publications and distributed codes. The US/NNDC is requested to acknowledge these communications and inform the network on the disposition of the suggested corrections.
2	Network	Inform the centre responsible of any evaluation errors.
3	Network	Send to US/NNDC comments and suggestions on all ENSDF-related manuals as well as symbols, abbreviations and conventions used in the NDS publications.
4	Network	Send to M. Martin comments and suggestions on the "Guidelines for Evaluators".
5	Network	Inform US/NNDC of any new computer codes written, so that they can distribute them to interested members of the netwok.
6	Network	NSDD evaluators are encouraged to seek comments from their colleagues and/or experts in the pertinent mass region during the evaluation and publication process.
7	Network	Identify to US/NNDC prospective referees within and outside their groups.
8	Network	The centre/project heads should keep US/NNDC informed of changes of personnel in their respective groups.
9	Network	The centre/project heads are responsible for the dissemination of memos and communications regarding the evaluation within their respective groups. (Network communications are distributed only to the contact person of a centre/project.)
10	IAEA/NDS	Advertise ENSDF/NSR and how to access these files to the NDS service area; in particular to include ENSDF/NSR presentation in their training courses.
11	Network	Notify the NNDC of any horizontal evaluation of importance.

B) Actions arising from this meeting

1	R. Firestone	Transfer the ENSDF coding manual in RTF format to J. Tuli for distribution and on-line access.
2	M. Martin	Transfer the Evaluation Guidelines to J. Tuli in an appropriate format for distribution and on-line access.
3	IAEA/NDS	In collaboration with US/NNDC, prepare a pamphlet advertising the NSDD network. Also publicise NSDD network in the Nuclear Data Section Newsletter.
4	M. Martin	Collect all existing and revised rules for spin/parity assignments in time for discussion at the next meeting and circulate it to the network.
5	IAEA/NNDC	Make available statistics of access to the NNDC/IAEA databases.
6	IAEA/NDS	Translate the paper by F. Chukreev in Jadernye Konstanty about the Ba-133 decay. Note after the meeting: See report INDC(CCP)-361.
7	F. Chukreev	Communicate the official name of his institute to the NNDC.
8	NNDC	Make the new N.D.S. production code available to the network (PC and/or VAX version).
9	F&P comm.	Prepare a paper outlining the principles for assigning mass-chain evaluation priorities. Have the paper distributed and collect possible comments from the network in time for the next NSDD meeting.
10	F&P comm.	Establish a procedure to get adopted properties included in decay data sets.
11	F&P comm.	Initiate an effort to enhance the database structure of ENSDF (see statement Development of ENSDF by R. Firestone) and, in parallel, develop a computer code to facilitate data entry into ENSDF.
12	NNDC	Ask C. van der Leun to promote ENSDF and NSR services in EPS.
13	J. Tuli	Try to improve the user-friendliness of the NNDC addresses database. In particular look into the possibility of using wild cards in searches.
14	Network	Comment on the conflict between ENSDF and new horizontal evaluations (mainly half-lives and emission probabilities).

15	NNDC	Include half-life values from the ICRM evaluation into ENSDF as soon as feasible in the following way: Communicate proposed changes to the responsible evaluator. The evaluator may within a month communicate his/her objections. In the absence of objections, the new value will be included in ENSDF with the appropriate comments. If necessary, half-life dependent quantities will be recalculated.

Decisions and statements agreed at the meeting

1 The F&P subcommittee should be renamed The Formats and Procedures Subcommittee of the NSDD Network (F&P of the NSDD).

2 Dr. A. Farhan is appointed as a representative of the non-US members in the above mentioned committee.

3 The resumption of the evaluation of neutron resonance data should be encouraged.

4 All conference proceedings should be classified as secondary sources for coding into the NSR.

5 The proposal that the N.D.S. Recent References publication rate should be limited to one issue per year containing all references added during the previous year is supported.

6 The rate of new experimental data continues to be such that the evaluators' manpower should remain at least at the present level.

7 The efforts to obtain a current data file for high-spin data should be supported (see statement on High-spin Data Files).

8 All three means of dissemination of ENSDF, namely publication of Nuclear Data Sheets, on-line systems and CD-ROM (electronic publication) should be maintained and/or developed not at the expense of each other but in parallel. Sufficient funds should be provided for all these activities.

9 The next NSDD meeting should be held in Asilomar, California in the spring of 1994. Local organisers on behalf of the US NDN are R. Firestone and C. Stone.

10 Reassignment of A-chains according to need (Proposal drafted by J.K. Tuli)

A-chains to be evaluated during a year should be prioritized as follows:

(i). A group (e.g. F&P subcommittee) decides on a list of A-chains, about 50 to 100 in numbers, each year.
(ii) This list is circulated amongst the evaluation centers and the coordinator suggests the A-chains that should be done by various centers during the next year.
(iii) Centers inform the coordinator of their agreement to the acceptance of the responsibility or to modify it.
(iv) Centers inform the coordinator of the approximate date of completion of their respective evaluations.
(v) Remaining A-chains of the center's responsibility are evaluated in continuous or full mode on the time available basis.

How to prioritize A-chains?

a. List of references by A, Z since last literature cut off date.
b. Order A, Z by no. of references.
c. Scan recent conferences and journals to determine the areas of activity.

11 High-spin Data Files (drafted by R. Firestone, M. Martin, B. Singh and P. Ekström)

Recent developments in high-spin physics have created demand for more current up-to-date data inclusion of high-spin data into ENSDF. The third generation of large gamma-ray detector arrays is coming on line: the Eurogam facility is already functional and Gammasphere will be operational by the end of 1992. These facilities will provide a large amount of new gamma-ray data.

Efforts have already begun at Berkeley, McMaster and Oak Ridge to evaluate and compile high-spin data for inclusion in ENSDF.

The NSDD network strongly supports these efforts, and encourages other data centres to join in this collaboration. The High-spin Data Base would be of great benefit for the high-spin Nuclear Physics community to co-ordinate their efforts and it would visualise ENSDF and NSDD evaluation work.

12 Development of ENSDF (drafted by R. Firestone)

Electronic publication of ENSDF is a rapidly developing mechanism for ENSDF distribution. In order to expedite this development, a modernization of the ENSDF file structure is very desirable. This would include the estabishment of indices defining the relationships between levels and transitions, standardization of text representation, reorganization of the database structure, and isolation of numerical from non-numerical quantities. Existing ENSDF data would be conserved in this process and the impact on evaluators would be minimal. Changes to ENSDF involving the content of the file would be subject to approval by the F & P subcommittee.

The new ENSDF file would be prepared by evaluators. Software would be provided for file generation. A word processing environment would be supported where evaluators would not be required to know format. Internal error checking, calculation utilities, and level scheme drawings would be supported. Development would be aimed at IBM-PC computers with possible expansion to other platforms.

The NSDD evaluators recognize the importance of this effort and endorse the modernization of ENSDF for electronic publication. The efforts of the US DOE to find resources to support these developments are strongly encouraged.

IAEA Advisory Group Meeting on the
Network of Nuclear Structure and Decay Data Evaluators
Geel, Belgium, 9 - 13 November 1992

hosted by the CEC Central Bureau for Nuclear Measurements

LIST OF PARTICIPANTS

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EVALUATION RESPONSIBILITY

Center	Mass Chains
a. US/NNDC	45-50,57,58,65-73,94-97,99,136-148, 150,152,165,199
b. US/NDP	81-85,200-205,207-209,213-236, (excepting 215,219,223,227), 237-243(odd),244-266
c. US/LBL	89-93,167-194,206,210-212,215,219, 223,227
d. US/INEL	87,153-163
e. US/TUNL	3-20
f. Russia/MOS	1,2,164,166,238-244(even)
g. Russia/StP	86,88,130-135
h. Holland	21-44
i. PRC	51-56,195-198
j. France	101,104,107-109,111,113-117
k. Japan	118-129
l. Sweden	59-63
m. Kuwait	74-80
n. Belgium	102,103,105,106,110,112
o. Canada	64,98,100,149,151

Annex 3

NSDD DISTRIBUTION CENTERS

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IAEA Advisory Group Meeting of the
Participants in the International Network of
NUCLEAR STRUCTURE AND DECAY DATA EVALUATORS

Geel, Belgium, 9-13 November 1992

hosted by the
CEC Central Bureau of Nuclear Measurements

AGENDA

(The meeting starts at 9:30 hrs on Monday, 9 November 1992)

Technical part of the agenda

A. Introductory Items

1. Opening statements
2. Election of chairman
3. Adoption of the agenda
4. Announcements
5. Review of actions from last meeting,
   see report INDC(NDS)-250, Annex 5

B. NSDD Network

1. Status of members, mass chain evaluation assignments
2. Short reports from non-US network members
3. Report from the US NSDD Network
4. Call for additional network evaluators for the review of A-chains

C. Evaluation of Nuclear Structure and Decay Data

1. Current mass-chain evaluation status
2. Rules, guidelines, formats

D. Publication of Nuclear Structure and Decay Data

1. NSDD publication in Nuclear Physics ($A < 45$)
2. Nuclear Data Sheets publications ($A > 44$)
3. Future publications, CD-ROM
4. Table of Isotopes
5. Wall Charts
6. Horizontal compilations and evaluations
7. Who does the reviews?

E. Electronic access to ENSDF and related databases

1. On-line access to nuclear data at the NNDC, NEA Data Bank and IAEA: Status and enhancements

2. Electronic capabilities

F. The Nuclear Structure Reference (NSR) file

Status, contents, format, publication

G. The Evaluated Nuclear Structure Data File (ENSDF) system

1. Status, contents, format, changes?
2. ENSDF physics computer codes
3. ENSDF output computer codes

H. NSDD publicity and distribution

1. Distribution of the ENSDF data tapes
2. Data centre services
3. ENSDF for specific user groups
4. Publicity of ENSDF

I. Next Meeting

J. Summary of Conclusions and Recommendations

Scientific Lectures

See separate list

Schedule

Monday to Friday forenoon: Technical part of the Agenda.
Monday and Tuesday afternoon: Scientific Lectures.
Wednesday afternoon: Visit of the lab.
Thursday afternoon: Excursion.

Schedule

IAEA Advisory Group Meeting of the Participants in the NSDD Network

Time	Monday, 9 Nov. 92	Tuesday, 10 Nov. 92	Wednesday, 11 Nov. 92	Thursday, 12 Nov. 92	Friday, 13 Nov. 92
08:00 08:30		Pick up at hotels	Pick up at Clubhouse Pick up at Bosrand	Pick up at hotels	Pick up at hotels
09:00	Pick up at hotels	Technical part	Technical part	Technical part	Technical part
09:30	Opening				
10:00 10:30	Technical part				
11:00	**Coffee break**				
11:30 12:00 12:30	Technical part	Technical part	Technical part	Technical part	Technical part
13:00 13:30	**Lunch**				
14:00 14:30	Scientific lectures	Scientific lectures	Visit of laboratories	Excursion to Antwerpen	
15:00	**Coffee break**				
15:30 16:00 16:30	Scientific lectures	Scientific lectures			
17:00	Departure to hotels	Departure to hotels	Departure to hotels		
18:30 19:00 21:00 22:30			Pick up at hotels Official dinner Departure to hotels	Dinner in Antwerpen Departure to hotels	

Annex 5

List of computer programs presented at the meeting

NUC, J. Blachot
Display of basic decay properties from the JEF-2 file (nuclear chart/table/spectrum).
Probably no further development.

Miscellaneous utility programs, M. Lederer
ALPHA - calculates hindrance factors
BETA - calculates log ft, B+/K/L.. ratios
CLEB - calculates Clebsch-Gordan coefficients
ICC - calculates internal conversion coefficients
AVG - calculates weighted and unweighted averages
Probably no further development.

GANAAS, H.D. Lemmel
Neutron activation analysis
Further development continues.

NAADF, I. Kondurov
Analysis on neutron activation data
The program will be further developed.

BOMJ, F. Chukreev
Program to place unplaced gammas in a level scheme
No futher development.

MacNuclide, C. Stone
Designed to be a database management system for nuclear data. Visualises nuclear properties. Complex Boolean Searches. First version for Macintosh will be distributed in three months. A version containing most ENSDF data and running on other platforms (PC and UNIX workstations) should be finished within a year and be distributed on CD-ROM.

Presentations

A... = paper number, paper was distributed
\- = no copy was distributed at the meeting

- J.K. Tuli: Presentation on Nuclear Data Sheets
- M. Martin: High Spin databases

A1 B. Singh: Evaluation of superdeformed bands in the A = 190 region (viewgraphs distributed)

A2 R.B. Firestone, B. Singh: Nuclear Data for the High-Spin Community

A3 R.G. Helmer: Use of Total Absorption Gamma-Ray Data in Evaluations of Decay Schemes (presented by J. Tuli)

A4 F.E. Chukreev: On some unused capabilities in ENSDF

- G. Audi: The Evaluation of Nuclear Masses

A5 C.M. Lederer: Report on the NSDD Programme (viewgraphs)

A6 R.B. Firestone: 8th Edition of the Table of Isotopes Progress Report

A7 C.M. Lederer: How to Revitalize the Nuclear Data Compilation and Evaluation Program

A8 C.A. Stone: Software Package MacNuclide (folder distributed) (with PC demonstration on Mackintosh)

- J. Blachot: Summary on the Electronic Chart of Nuclides by D. Weaver et al. (with PC demonstration, transparancy)
- I. Kondurov: Software package for Neutron Activation Analysis
- H.D. Lemmel: Brief mentioning of GANAAS, IAEA software package for Neutron Activation Analysis (diskette and manual available on request)

A9 C.M. Lederer: Nuclear Science Utilities (diskette with manual distributed)

- J.K. Tuli: Statistics on ENSDF (transparancies)
- J.K. Tuli: NNDC Online Data Service (transparancies)

Annex 7

List of Status Reports

1. M.R. Bhat: Nuclear Structure Networks
2. A. Farhan: Status Report, Kuwait Nuclear Data Project
3. J. Blachot: Status Report on French Activities in NSDD
4. Zhou Chunmei, Huo Junde: Status on NSDD Evaluation for A-Chains in China

4a. Huo Junde: Status on NSDD Measurement and Evaluation for Mass Chains in Jilin University

5. F.E. Chukreev, E.N. Shurshikov: The Evaluation of NSDD in CAJAD
6. I.A. Kondurov, Yu.V. Sergeenkov: Status Report on NSDD Activities of PNPI Data Centre
7. B. Singh: Nuclear Data Project at McMaster University, Status Report
8. H. Iimura: Status Report of Japanese Activities in NSDD
9. P.M. Endt: Status Report Utrecht
10. P. Ekström, J. Lyttkens-Lindén: NSDD Evaluation in Sweden
11. D. De Frenne: Status Report Belgian Group
12. W. Bambynek: Statement on CBNM's Activity in Evaluation and Compilation of Decay Data during 1990 and 1992
13. H.D. Lemmel: NDS activity in the field of NSDD
14. M.R. Bhat: US Contribution to the Evaluation of Nuclear Structure Data and Related Activities

NUCLEAR STRUCTURE NETWORKS

US Nuclear Data Network(USNDN)(1976)
BNL,INEL,LBL,NIST,ORNL & TUNL

Nuclear Structure & Decay Data(NSDD) Network(1976)
USNDN,Holland,Kuwait,France,Belgium,Japan, Russia,Canada,Sweden,China & Taiwan

Former members:
UK(1976-1985;10 A-chains)
Germany(1976-1989;23 A-chains)

NSDD NETWORK(1992)

Group	No. of Evaluators
BNL	1.75@
INEL	0.7
LBL	2.5
ORNL	2.0
TUNL	0.6
HOLLAND	
KUWAIT	0.5
FRANCE	0.6
BELGIUM	0.5
JAPAN	1.5
CAJaD	2.0
LIYaF#	1.5
CANADA	0.5
SWEDEN	0.0
CHINA*	0.5
TAIWAN	0.3
Total	15.5

@An increase is under negotiation
#Leningrad,Tashkent,Kharkov
*Beijing,Shanghai,Jilin U

AVERAGE AGE(YRS) OF A-CHAINS BASED ON LITERATURE CUT-OFF DATE

October 16, 1992

Group	ENSDF	ENSDF + NEW#	Maximum Age*
BNL	4.9	2.9	6.5
INEL	4.7	3.6	5.4
LBL	4.3	3.2	6.7
NDP	4.6	4.4	8.2
TUNL	4.2	—	5.4
HOLLAND	2.4	—	2.4
KUWAIT	4.6	4.6	8.4
FRANCE	4.5	2.0	5.8
BELGIUM	2.3	2.3	4.4
JAPAN	9.8	5.2	13.0
CAJaD	5.0	4.4	5.9
LIYaF	7.7	7.7	7.8
CANADA	5.2	3.2	7.5
SWEDEN	6.5	3.0	3.2
CHINA	5.0	2.4	4.8

#A-chains submitted for NDS publication
*A-chain not being evaluated

NUMBER OF OUTDATED A-CHAINS BASED ON LITERATURE CUT-OFF DATE

October 16, 1992

Group	Total	No. Outdated*
BNL	39	3
INEL	12	2
LBL	41	7
NDP	60	14
TUNL	18	4
HOLLAND	24	0
KUWAIT	7	2
FRANCE	10	1
BELGIUM	7	0
JAPAN	12	4
CAJaD	10	1
LIYaF	6	2
CANADA	5	1
SWEDEN	5	0
CHINA	10	0

*A-chains older than 5 yrs & not being evaluated or submitted for publication

RE-ASSIGNMENT of A-CHAINS SINCE MARCH 1990

A	Group
81-85	NDP
87	INEL
89-93	LBL
94-97,99	BNL
163	INEL
199	BNL
206,210-212	LBL
215,219,223	
227	

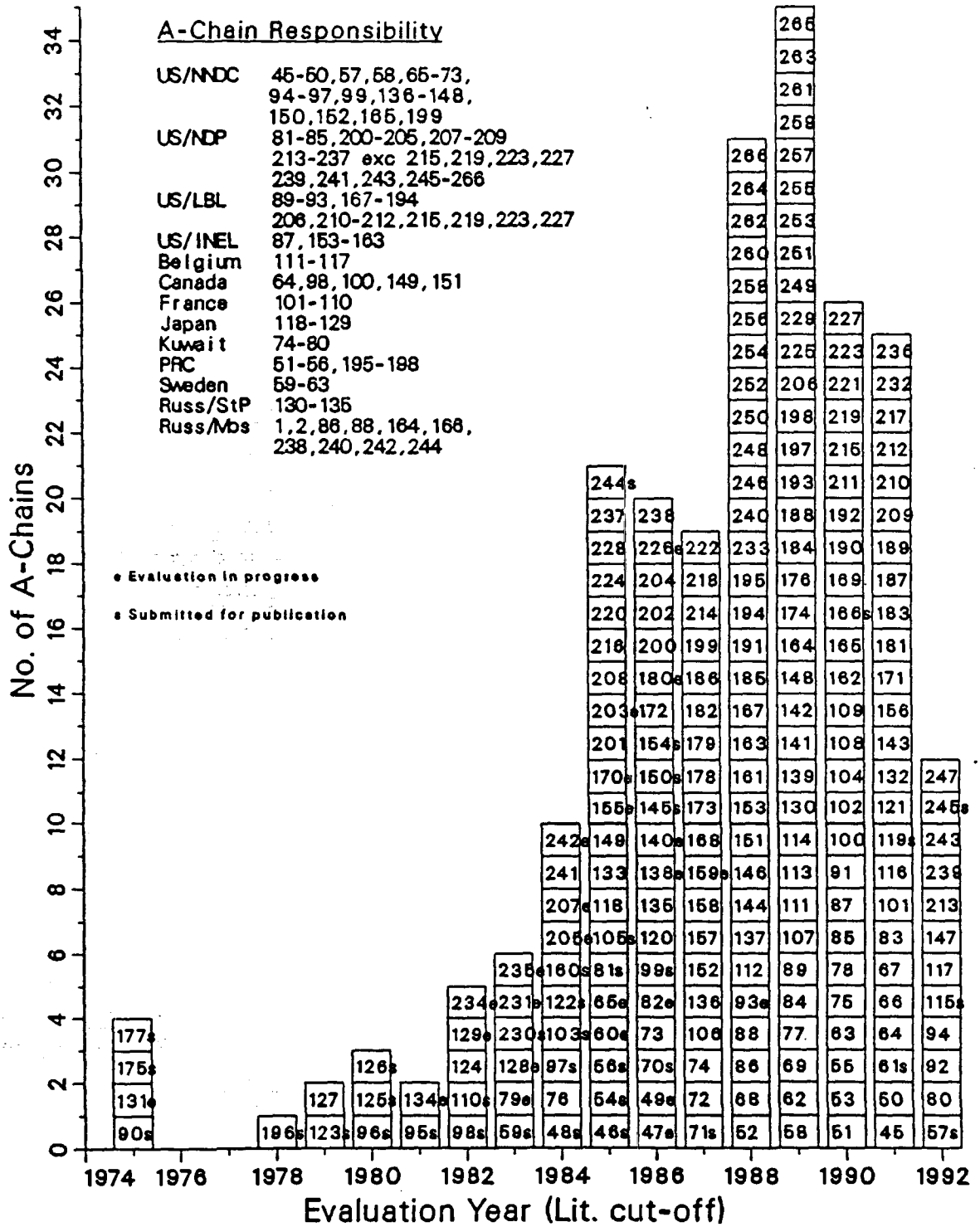
Mass-chain Assignments
(November 25, 1991)

A-range	No. of mass-chains	Evaluation Group
1-2	2	CAJaD/Russia
3-20	18	TUNL/USA
21-44	24	Univ. of Utrecht/Netherlands
45-50	6	NNDC/USA
51-56	6	CNDC/PRC
57,58	2	NNDC/USA
59-63	5	Lund Univ./Sweden
64	1	McMaster Univ./Canada
65-73	9	NNDC/USA
74-80	7	KISR/Kuwait
81-85	5	NDP/USA
86,88	2	CAJaD/Russia
87	1	INEL/USA
89-93	5	LBL/USA
94-97,99	5	NNDC/USA
98,100	2	McMaster Univ./Canada
101-110	10	Grenoble/France
111-117	7	Univ. of Gent/Belgium
118-129	12	JAERI/Japan
130-135	6	LIYaF/Russia
136-148	13	NNDC/USA
149,151	2	McMaster Univ./Canada
150,152	2	NNDC/USA
153-163	11	INEL/USA
164,166	2	CAJaD/Russia
165	1	NNDC/USA
167-194	28	LBL/USA
195-198	4	CNDC/PRC
199	1	NNDC/USA
200-205	6	NDP/USA
206	1	LBL/USA
207-209	3	NDP/USA
210-212	3	LBL/USA
213,214	2	NDP/USA
215	1	LBL/USA
216-218	3	NDP/USA
219	1	LBL/USA
220-222	3	NDP/USA
223	1	LBL/USA
224-226	3	NDP/USA
227	1	LBL/USA
228-237	10	NDP/USA
238-244(even)	4	CAJaD/Russia
239-243(odd)	3	NDP/USA
245-266	22	NDP/USA

A-Chain Status in ENSDF (A>44)

Center - ALL

30-OCT-92



Status of A=5-44 in ENSDF

October 1992

Group	A-range	Status
NNDC	5-12	Coded & merged into ENSDF
NDP	13-26	A=13-20 to be done
Grenoble	27-32	A=27-32,21,22 coded & merged into ENSDF
LBL	33-44	Coded & merged into ENSDF; A=23-26 being coded

FUTURE PROSPECTS & PROBLEMS

Problems:

1. Scarcity of new evaluators/groups to do evaluations. Information on prospective new evaluators would be helpful.

2. Quality control of evaluations to maintain integrity of ENSDF is essential given the diverse backgrounds & expertise of network evaluators. Processing, checking & adequate reviews cannot be de-emphasized or eliminated.

FUTURE PROSPECTS & PROBLEMS

Prospects:

1. Give priority to evaluations in the mass-regions of current research interest & where there are many new data.

2. Supplement A-chain evaluations with other "horizontal" evaluations.

3. Develop databases to provide current information for basic research

4. Provide modules tailored for specialized applications

IAEA Meeting on the Coordination of the International Network of Nuclear Structure and Decay Data Evaluators
Geel, Belgium, 9 - 13 November 1992

Status Report

Kuwait Nuclear Data Project
Kuwait Institute for Scientific Research
Ameenah Farhan

Introduction

This report reviews the evaluation of the nuclear structure decay data, and related activities of the Kuwaiti Group for the period (March 1990 - November 1992)

Financial Support

*The project is funded jointly by the **Kuwait Institute for Scientific Research (KISR)** and the **Kuwait Foundation for the Advancement of Sciences (KFAS)**. Funding was approved for the period (August 1990 - July 1993), but because of the Iraqi invasion and the situation in Kuwait after liberation, we were not able to continue working on this project. Recently, the project was reactivated and funding was approved for the period (September 1992 - December 1995).*

Manpower

Dr. Ameenah Farhan (Physics Dept. Kuwait University), is working as a part-time researcher and project leader for the project. Dr. shaheen Rab was working as a full-time researched for the project before the invasion.

Mass Chain Evaluation

The mass chain A = 75 was published in the August 1990 issue of NDS.

The mass chain A = 78 was submitted for review in July 1990. During the Iraqi invasion and after liberation Dr. Shaheen Rab was in Dhaka, and she was able to contact Brookhaven center for post-review and manuscript correction. A = 78 was published in June 1991.

Dr. Ameenah Farhan was working on mass chain A = 80 which, was almost finished and scheduled to be submitted by the end of August 1990. The prepared file was lost during the brutal Iraqi invasion and we were not able to finish this mass chain.

The Kuwaiti Nuclear Data Group lost all their computer files and references during the invasion. KISR computer main frame and library were looted. The group is using Kuwait university VAX computer and all the updated computer codes necessary for mass chain evaluation has been installed. References published before 1992 has been ordered.

Work on A = 74 has been started, and we hope to be able to finish the evaluation by summer 1993.

STATUS REPORT ON FRENCH ACTIVITIES IN NUCLEAR STRUCTURE AND DECAY DATA

Jean BLACHOT
CEA Grenoble

1. A-CHAIN PUBLICATION.

Since 1978, The CEA/ FRANCE has been member of the Network. The list of the publications are given below.

Nuclear Data Sheets	32, 287	(1981)	A=116
	35, 375	(1982)	A=114
	41, 111	(1984)	A=109
	41, 325	(1984)	A=104
	45, 701	(1985)	A=101
	50, 63	(1987)	A=117
	52, 565	(1987)	A=115
	59, 333	(1990)	A=116
	59, 729	(1990)	A=113
	60, 139	(1990)	A=114
	60, 889	(1990)	A=111
	62, 709	(1991)	A=107
	62, 803	(1991)	A=108
	63, 305	(1991)	A=101
	64, 1	(1991)	A=104
	64, 913	(1991)	A=109
	66, 451	(1992)	A=117
	67, 1	(1992)	A=115

A=103 sent the 920519

2. CONTINUOUS UPDATE

A=116 have been sent at the beginning of 1992
Most of the masses are updated but we are waiting about a clear position of the network before to send them

3. COMPUTER.

All the computer programs from NNDC are running on PC and on Sun.
Gamut and Spinoza run only on Sun.

4. CODING OF NUCLEAR PHYSICS EVALUATION.

The 1990 evaluation of P. Endt have been translated in ENSDF for masses : 21, 22, 27, 28, 29, 30, 31, 32
We have also contributed to the transfer of the references in NSR.

4.DEVELOPMENT OF THE JEF LIBRARY.

We have participated to the development of the JEF2 file. It is a decay data file for applied users , mainly from Nuclear reactors

1. J Blachot , C. Nordborg, BNL92, Brookhaven oct. 1992

Status on Nuclear Structure and Decay Data Evaluation for A-chain in China

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China has been one of the members of International Nuclear Structure and Decay Data Network since 1986. It has primary responsibility for evaluating and updating NSDD for A=51-56 and 195-198, and temporary for evaluating NSDD for A=61, 170, and 172.

Finacial Support and Person

The project is partly funded by the Department of Science and Technology, China National Nuclear Corparation. But finacial support is very limited. The basic evaluators are two part-time (0.6 full-time) physicists.

NSDD Evaluation

The status of NSDD evaluation at present is as follows:

A = 55	NDS, Vol. 44, 463 (1985)
A = 51	NDS, Vol. 48, 111 (1986)
A = 54	NDS, Vol. 50, 255 (1987)
A = 170	NDS, Vol. 50, 351 (1987)
A = 56	NDS, Vol. 51, 1 (1987)
A = 172	NDS, Vol. 51, 577 (1987)
A = 195	NDS, Vol. 57, 1 (1989)
A = 52	NDS, Vol. 58, 677 (1989)
A = 198	NDS, Vol. 60, 527 (1990)
A = 53	NDS, VOl. 61, 47 (1990)
A = 197	NDS, Vol. 62, 433 (1991)
A = 61	received for publication
A = 196	in review

update:

A = 51	NDS, Vol. 63, 229 (1991)
A = 55	NDS, VOl. 64, 723 (1991)
A = 56	received for publication
A = 54	in review

We wish also to maintain the same region in A=51-56, and 195-198 in the future.

Status on Nuclear Structure and Decay Data Measurement and Evaluation for Mass Chains in Jilin University

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1. Decay Data Measurement

   ^{192}Ir: Z. Phys., A329, 307 (1988)
   ^{124}Sb: Z. Phys., A331, 329 (1988)
   ^{131}Ba: Z. Phys., A336, 317 (1990)
   ^{156}Eu: Fourth Asia Pacific Physics Conference Seoul, Korea, 1990
   ^{182}Ta: Z. Phys., A342, 141 (1992)
   ^{162}Eu: Z. Phys., A (to be published)

2. High-Spin Measurement

   ^{176}Ta: Z. Phys., A339, 417 (1991)

3. NSDD Evaluation

   A=61*: Nuclear Data Sheets, 48, 111 (1986)
   A=52 : Nuclear Data Sheets, 58, 677 (1989)
   A=53 : Nuclear Data Sheets, 61, 47 (1990)
   A=55*: Nuclear Data Sheets, 44, 463 (1985)
   A=56*: Nuclear Data Sheets, 50, 255 (1987)
   Uptade:
   A=55 : Nuclear Data Sheets, 64, 723 (1991)
   A=66 : to be published
   A=54 : in review

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* Conperated with China Institute of Atomic Energy, Beijing.

The evaluation of nuclear structure and decay data in CAJAD.

F. E. Chukreev, E. N. Shurshikov.

Over a period of 1990-1992 years the CAJAD in the sphere of its responsibility had finished the evaluation for following mass chains :

A=244 (December 1990)
A=4 (December 1990)
A=166 (November 1990)
A=164 (December 1991)

As previously announced, the CAJAD continued its investigations to provide better coverage of all available experimental information for the evaluation of nuclear structure characteristic. Our investigation of Ba-133 decay have been published by "Yadernye Konstanty" [1].

To help the evaluators we developed the code "BOMJ". This code find a places in level system for possible attachment quanta. We are using this code constantly. Therefore this code had been sent to NEA Data Bank. We have some codes for data analysis on ambiguity of interpretation, but we have not detail documentation for its. Main rules have been published [2],[3]. We can not promise to prepare all needed documents quickly, but we are ready to teach everybody which could visit CAJAD or invite somebody from CAJAD.

We have some hardnesses as our country entirely. After last Meeting in Kuwait we lost one evaluators and one mathematic. Our libraries have not some journals and we are forced to write the letters for the authors and ask the reprints.

References.

1. F.E. Chukreev, "Selection of radioactive sources for calibrating gamma-ray spectrometers", Voprosy atomoj nauki i tekhn., Ser. "Yadernye Konstanty", N2, 1992.

2. F.E. Chukreev, "The operation research as an instrument for analysis and planning of nuclear spectroscopic experiment", INDC(CCP) -309/N, IAEA, December 1989.

3. F.E. Chukreev, "Compilation of a system of restrictions to analyze radioactive decay schemes", Voprosy atomnoj nauki i tekhn. , Ser. "Yadernye Konstanty ", N2, 34 (1990).

STATUS REPORT ON NSDD ACTIVITIES OF PNPI DATA CENTRE

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1. A-chain evaluation for ENSDF

In the range of our responsibility A=132 was published in 1992. A=134 evaluation is in progress and will be finished this year.

A=131 was forwarded to the Kharkov group (Urkaine) in 1991 to perform cooperative evaluation. This work was delayed because of very small financial support, however, the group hope to get it in 1993. After finishin A=131 we shall closed our cycle and situation will be simpler, because we need only to update the files. After getting experience, when evaluating A=131, the Kharkov group is ready to evaluate new A-chains.

2. Keyword references for the NSR file

During last two years keyword references were prepared scanning JINR, Dubna preprints and communications and Proceedings of the Conference on the Nuclear Structure and Nuclear Spectroscopy. Rare Soviet periodical editions were also used in preparation of keyword references. This work was performed in cooperation with a group from St.Petersburg University. We can enlarge a number of editions to be referenced.

3. Application of data files in NAA and Electronic Wall Chart

The work on using *a priori* infromation in neutron activation analysis (NAA) was continued. In progress is PC-program that can extract from data files the necessary

information on radioactive decay schemes of nuclei and cancalculate the intensities of the gamma quanta from decay of the nuclei obtained in the neutron irradiation of a given chemical element, with the neutron flux and activation cross-section being taken into account.

The basis of all the calculations is the data presented in the new NAADF file, which contains a set of data from the original ENSDF file on the decay schemes of all nuclei produced in the (n,γ) reaction, either directly or as a result of subsequent decay of the products of this reaction. For each chemical element the NAADF file contains the half-lives of these nuclei, the gamma quantum yields in decay and a matrix of the coefficients of the system of differential equations describing the build-up of radioactive nuclei in the (n,γ) reaction (with burn-up and their subsequent decay chains being taken into account). In calculation of the coefficients, use was made of the modern data on the isotopic abundance and the neutron cross-sections.

On the basis of the NAADF file a computer program can be used to calculate the intensities of all gamma quanta produced after the irradiation of nuclei in a given neutron flux, with irradiation and cooling time being taken into account. The results of these calculations are used to compile a realistic table intended for identification of the gamma lines in activation analysis spectra.

The essential part of this program is the image of the Periodical Table and the image of a fragment of the Wall Chart of Isotopes on the screen of PC monitor. The pictures can be used for presenting the main information on the elements and/or isotopes and also as a menu for choosing an isotope of interest and displaying relevant data.This software module can be used as a base for designing the Electronic Wall Chart.

4. Using horisontal compilations

The compilations on magnetic moments and life-times were used by A.Shlyakhter (Harvard University, USA) in his investigation of distribution of uncertainties of these data. He showed that an exponential probability distribution is generaly a more realistic model for the probability density function than is the normal distribution.

ENSDF gamma-enegries and masses from compilation of Wapstra were used by S.Sukhoruchkin (PNPI) for searching non-statistical effects in energy and mass distribution.

Nuclear Data Project at McMaster University, Hamilton, Canada Status report (November 1992) Presented by B. Singh

Since the 1990 meeting of this group, the following mass chains have been published:

1. **A=100**, Nuclear Data Sheets 60, 1-137 (1990).
2. **A=64** (update), Nuclear Data Sheets 62, 603-707 (1991).
3. **A=98** (update), Nuclear Data Sheets (in press) (1992).

This completes one cycle of evaluation of mass chains assigned to the McMaster group (A=64, 98, 100, 149, 151).

Work is currently in progress on **A=149** which was last published by the McMaster group in 1985. It is expected that this mass chain will be submitted by spring 1993. The **A=151** which was published by the McMaster group in 1988 will be the next one to be evaluated.

In collaboration with the Isotopes Project at Berkeley, the following mass chains were published during 1990-92:

1. **A=188**, Nuclear Data Sheets 59, 133-262 (1990).
2. **A=190**, Nuclear Data Sheets 61, 243-363 (1990).
3. **A=80** (update), Nuclear Data Sheets 66, 623-703 (1992).

Work is currently in progress on **A=79** which was last published by the Kuwait group in 1982. This will be submitted by December, 1992. The plan is to work on the evaluation of **A=76** in 1993, last published in 1984 by the Kuwait group.

In an attempt to make the ENSDF more current for the high-spin data, a collaborative effort with the Berkeley group has been undertaken to evaluate and update reaction and adopted datasets with **A=189-198** for existing data (up to early 1992) on superdeformed (SD) bands in the **A=190** region. Of course, procedures and guidelines for including these updates into ENSDF remain to be worked out, some of which could possibly be discussed at this meeting. Known SD band data for the **A=190** region have already been entered in the ENSDF format and we plan to complete the updating of the datasets for such bands for **A=150** and **A=130** region by spring 1993. The following report was presented at the International High-spin meeting in Ottawa, 1992:

R.B. Firestone and B. Singh, Nuclear Data for the High-Spin Community, Proc. Int. Conf. Nucl. Struc. at High Angular Momentum (Ottawa, 1992), volume 2, 214-219 (1992).

The following research papers were published on work done in collaboration with groups from the University of Toronto and the Lawrence Berkeley Laboratory:

1. **B. Singh**, H.W. Taylor, E. Browne, H.L. Hall, E.B. Norman, R.M. Larimer, A.O. Macchiavelli, K.T. Lesko and B. Sur; Study of gamma radiation from ^{100}Pd decay, Z., Fur Physik 341, 249-253 (1992).
2. **B. Singh** and H.W. Taylor, ^{194}Au Half-life and emission probabilities, Appl. Radiation Isot. 43, 647-649 (1992).
3. **B. Singh** and H.W. Taylor, Measuring shelf afterlife, Nature 356, 293.
4. H.W. Taylor and **B. Singh**, Radioactivity in fine papers, Jour. Environ. Radioactivity (in press) (1992).

The research funding supplied by the Natural Sciences and Engineering Research Council (NSERC) of Canada supports about 0.5 FTE to the evaluation effort. The present grant was renewed last April for a period of three years.

Status report of Japanese Activities in Nuclear Structure and Decay Data

1. Personnel

Dr. Y. Kikuchi, General Manager of JAERI/Nuclear Data Center, is representing Japanese group of the international network for nuclear structure data evaluation since October 1989.

2. Mass-chain evaluation

The Japanese group will maintain the permanently assigned mass range of 118-129. The evaluation of A=177, which was temporally assigned to the Japanese group, has been transferred to the LBL group in USA in 1991.

A-Chain Evaluation Status

A	Cutoff Date of the latest NDS	Status	Evaluator
118		submitted	Kitao
119		to be published	Kitao, Kanbe, Ogawa
120	Mar. 28, 1986	will be submitted by June, 1993	Kitao, Tamura
121		NDS **64**, 323(1991)	Tamura, Iimura, Miyano, Ohya
122		submitted	Tamura
123		submitted	Ohya, Tamura
124	May 31, 1982	will be submitted by January, 1993	Iimura, Tamura
125		submitted	Katakura, Oshima
126		submitted	Miyano
127	Oct. 1, 1979	will be submitted by February, 1993	Kitao
128	Feb. 28, 1983	will be submitted by February, 1993	Kanbe
129	Mar. 31, 1982	will be submitted by December, 1992	Tendow

3. Computer

Evaluation work is carried out with analysis programs developed by the US groups. Those programs are operational on FACOM-M780 computers, IBM compatible machine, of JAERI Tokai and Riken, and also on NEC-PC9800 personnel computers.

4. Other related activities on nuclear structure and decay data

a. Bibliographic data compilation
   Computerized compilation of Japanese references (secondary sources) is being carried out by JAERI and RIKEN nuclear data groups continuously.

b. Revision of the Chart of Nuclides
   The 5th edition is in press and will be available soon. The chart is characterized by inclusion of estimated values for unmeasured beta-decay partial half-lives of the nuclides far from the beta-stable line. Those values are based on the gross-theory of beta-decay.

c. Horizontal compilation
   Tables of strong gamma-rays emitted from radioactive nuclides and of gamma-rays unplaced in decay schemes were published as JAERI-M 92-051 and 91-037, respectively. Those are useful to make spectroscopic analysis of metal irradiated with high energy charged particles and to estimate radiation energy from radioactive nuclides.

STATUS REPORT UTRECHT

- A new compilation for the A = 21-44 region, last covered in 1978 (edition VI), has appeared on December 31, 1990, in Nucl. Phys. A521, 1 (1990) (edition VII). A list of Errata and Addenda has appeared in Nucl. Phys A529. A large fraction of the data has been transcribed into ENSDF, for A = 21, 22 and 27-32 by Jean Blachot, and for A = 33-44 by Virginia Shirley; at present she is working on A = 23-26.

- A new version of my compilation on γ-ray strenghts in the A = 5-44 region will be submitted next week to ADNDT. Because the number of transitions with known strengths has almost doubled, recommended upper limits (RUL) could be determined with much more confidence.

- In the late 70's measurements have been performed in Utrecht of the γ-ray spectrum resulting from the ^{66}Ga(ε) ^{66}Zn decay ($T_{\frac{1}{2}}$ = 9.5 h), with excellent energy resolution, statistics, and Compton suppression. This work has provided γ-ray energies of 21 lines with errors below 10 ppm, of which several in the hitherto uncovered E_γ = 3.5-4.8 MeV region. Publication is now in progress.

Pieter M. Endt

IAEA meeting on the Co-ordination of the International Network of Nuclear Structure and Decay Data Evaluators, Geel, Belgium, 9-13 November 1992

Status report: Sweden

Nuclear Structure and Decay Data Evaluation in Sweden

Peter Ekström and Jacquette Lyttkens-Lindén

Financial support and personnel

Attempts to obtain a long-term solution for the funding of the project have failed. We have, however, obtained a partial funding of 80 000 SEK per year. This sum will only cover the cost of maintaining and updating the NSR and decay γ-ray databases.

Mass-chain evaluation

The A=90 evaluation has been reviewed, corrected and sent back to NNDC for publication. Because of several circumstances the evaluation of this mass-chain has taken an embarrassingly long time (it has long been a sore thumb in the NDS evaluation statistics). It is now, however, finished with a literature cut-off date of 10 August 1992.

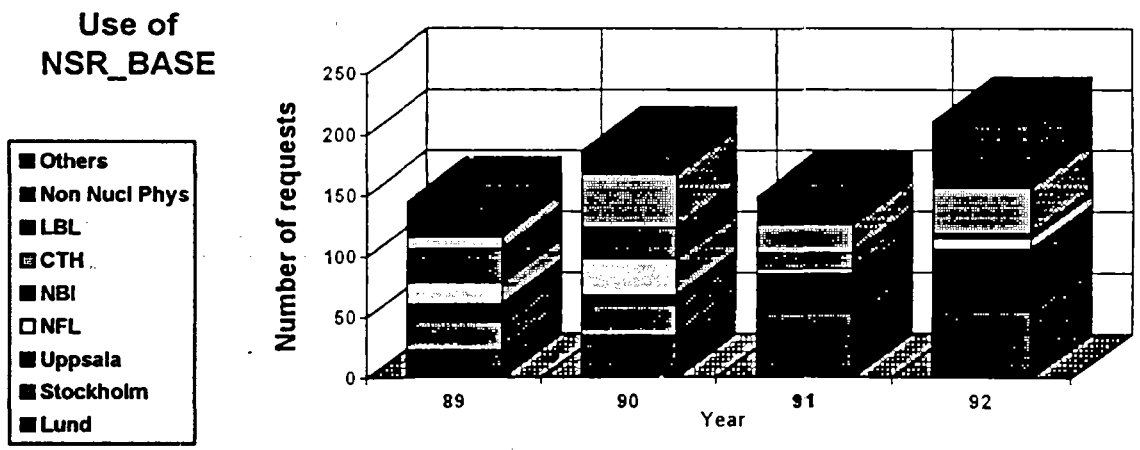
Data base for radioactivity γ rays

Since the last meeting in Kuwait, an update of the radioactivity γ-ray data base has been made (from ENSDF 2/27/90). Fourtysix copies of the partial data base for PC and ten copies of the complete data base for VAX/VMS have been distributed.

The Nuclear Structure Reference on-line data base

The local installation of the NSR data base is continuously updated with the updates from the NNDC. Since our facility for reading reel tapes was recently abandoned, the NNDC has very obligingly developed a procedure for distributing the updates on floppy disks. The possible extra work for the NNDC is hopefully offset by cheaper distribution media and more convenient update procedure at Lund.

The base contains at present 45103 references (primary references from 1975 and secondary references from 1989). The usage of the data base from different laboratories is shown in the figure.



STATUS REPORT BELGIAN GROUP

D. De Frenne, E. Jacobs

We continued our effort in Ghent in the mass region A = 101-117, where we have the responsibility of the mass chains A = 102, 103, 105, 106, 110 and 112.

Since the last meeting in Kuwait we finished A = 102 and 110 and sent recently the A = 105 evaluation to Brookhaven. J. Blachot took over the evaluation of A = 103 because we wanted that all the masses for which we were responsible were updated before the end of 1992.

We are also strongly involved in experimental nuclear spectroscopy research in our laboratory in Ghent. We have built a new resonant scattering facility with polarized photons. This was done in collaboration with the group of Prof. Kneissel of Stuttgart and Dr. C. Wesselborg of Giessen which have great expertise in that domain. As electron source we use a 15 MeV electron linac with a duty cycle of 2 %, a maximum mean current of 1 mA and a repetition frequency of 5000 Hz. The enriched target material of the order of several grams is furnished by the group of Dr. L. Govor and Dr. Demidov of the Kurchatov Institute of Moscow. We have in mind two different kinds of nuclei which we want to investigate. In collaboration with the group of Giessen and Stuttgart we would like to investigate the scissor mode excitations in deformed nuclei while in collaboration with the Russian group we are interested in highly exciled $1^{(+,-)}$ states in spherical nuclei.

Statement on CBNM's Activity in Evaluation and Compilation of Decay Data during 1990 and 1992

W. Bambynek

Evaluation of X- and Gamma-Ray Emission Probabilities

The IAEA Coordinated Research Project on X- and Gamma-Ray Standards for Detector Efficiency Calibration has been terminated. The results are published in IAEA-TECDOC-619 (1991). CBNM supplied the X-ray emission probabilities.

Evaluation of L-Capture Probabilities

The L-elecron capture probabilities P_{L1}, P_{L2}, P_{L3} of ^{152}Eu, ^{153}Gd ^{169}Yb and ^{175}Hf have been evaluated on request.

Measurement of Alpha-Particle Emission Probabilities of Actinides

Measurements of the alpha-particle emission probabilities of ^{237}Np, ^{236}Pu, ^{239}Pu and ^{234}Am have been measured and the results published.

NDS activities in the field of NSDD

The main event during the past year was the installation of a VAX computer in the IAEA Computer Center, which is primarily reserved for nuclear data. Consequently, our computer configuration is now similar to that of the data centers in Brookhaven and at NEA. By courtesy of NNDC, the entire on-line nuclear data system developed in Brookhaven has been implemented at the IAEA. This includes ENSDF and NSR, as well as CINDA, EXFOR, NUDAT and the main evaluated data files BROND-2, CENDL-2, ENDF/B-6 and JENDL-3. JEF-2 is expected to be implemented soon.

The on-line data system at the IAEA has been called

NDIS = Nuclear Data Information System.

It is the fourth IAEA on-line system after

INIS	=	International Nuclear Information System:
AGRIS	=	INIS-similar biblographic system for food and agriculture; and
PRIS	=	Power Reactor Information System.

The existence of NDIS will now be widely advertised, and this will include advertisement of ENSDF and NSR.

We tried hard, but without success, to find additional groups who could join the mass chain evaluators' network. We contacted scientists and offices in several countries. Heinz Behrens in Karlsruhe, FIZ, would still like to co-operate, but he sees no chance to find adequate support. He wanted to attend the meeting at Geel but could not, for health reasons.

The only new nuclear data group that we found, is in Debrecen, Hungary. They would be most competent for NSDD evaluation, but again, they could not find sufficient support with at least some degree of continuity. However, they have joined the network of compilation and evaluation of charged-particle reaction data.

NDS has issued the following NSDD relevant publications:

IAEA-TECDOC-619: X-ray and gamma-ray standards for detector calibration. With a PC diskette.

INDC(NDS)-248: M. Lammer, O. Schwerer: Handbook of nuclear data for safeguards.

INDC(CCP)-338: V.P. Chechev, F.E. Chukreev: Handbook of radiation and decay characteristics of long-lived radionuclides.

The **situation of the Nuclear Data Centers** can be summarized as follows.

The boom of nuclear data production that occurred in the 1970's and early 1980's is definitely over. Data needs and data production continue at a reduced level, but they do continue. Needs for data measurement and evaluation have been defined at various scientific meetings and by the INDC.

Consequently, the established nuclear data files continue to need regular updating and presentation in significantly more user-friendly formats and media. The nuclear data centers continue to have important functions as a service to the scientific community.

In the past years, the staff at the nuclear data centers has been reduced. However, the reduction of staff was significantly more than could be justified by the reduced amount of data production. The consequences are regrettable. The Brookhaven Center is no longer in the position to provide complete data compilation. The US part of CINDA and EXFOR are no longer complete, and the continuation of ENSDF and NSR is in danger. The international centers at NEA and IAEA suffer primarily from lack of continuity. Once the continuous compilation work gets interrupted, and once the know-how of updating the file maintenance computer codes gets interrupted, it is very tedious and manpower-wasting to continue. It is hoped that the Russian data centers can continue despite of the economic difficulties. It would be most regrettable if the experience gained by the production of the BROND Library could not be utilized internationally. The Russian charged-particle and photonuclear data centers play an important role also for the NEA countries, because the NEA Data Bank, regrettably, did not have a mandate for these data categories.

During the past year the IAEA has obtained a VAX computer, and NDS has taken over the data management systems operated on the VAX computers at Brookhaven and at the NEA Data Bank. Ideally, we are now in the satisfactory situation, that all centers use the same software. Consequently, all centers will benefit from a code improvement programmed at one of the centers. In practice, however, we are now in the ridiculous situation, that needed code improvements cannot be implemented at all, because none of the centers has sufficient manpower to do it.

The network of the nuclear data centers is in a difficult situation and needs support. Support is not only needed for the data centers themselves, but also for related activities in the member states, where important data activities have been discontinued in the past years.

In the UK and in Germany the mass-chain evaluation activities contributing to the ENSDF database have been discontinued. Consequently, the Nuclear Data Sheets are not sufficiently up-to-date.

In Karlsruhe, the work on the famous Chart of Nuclides has been discontinued. The Chart is still now a bestseller, but a large fraction of its data contents is superseded.

In West Europe a center for compilation and evaluation of charged-particle reaction data is badly lacking. A reliable database for proton beam monitoring and production of radioisotopes for medical applications does not exist.

These are only some examples, where nuclear data activities need continuing support.

The **IAEA Nuclear Data Programme** for 1993/94 was reviewed by the INDC at its 18th Meeting, 15-19 October 1990. This review is still valid until the next INDC Meeting in 1993.

The programme, which serves the co-ordination of applied nuclear physics and nuclear data research, can be summarized as follows.

A. Data Centre in the narrower sense (long-term activities):

A.1 Co-ordination of data centre networks for
- Nuclear Reaction Data;
- Nuclear Structure and Decay Data;
- Atomic Data for Fusion;
- Fission-Product Yield Data;
- Intermediate Energy Nuclear Data (to be started):

and some more.

A.2 Data centre services to countries outside OECD and former USSR, including
- data compilation, mainly in CINDA and EXFOR;
- maintenance and documentation of about 100 general and specialized data libraries;
- provision of retrievals and data centre services, including advice, training, technical support, etc.

B. Specific nuclear data topics (fixed-term activities):

B.1 Meetings to assess data needs for specific applications.

B.2 Creation of handbooks and databases for specific applications, with emphasis on international recommended data, such as
- data for reactor neutron dosimetry
- x and gamma-ray standards for detector calibration
- standards for nuclear data measurements (in co-operation with former NEANDC)

and others.

B.3 Research contracts, training courses, etc.

The recommendations of the INDC can be summarized as follows:

- to strengthen the international data centre activities in view of the decline and partial discontinuation of national data centre activities, and to ensure that the basic files (CINDA, EXFOR, ENDF, ENSDF) are kept complete, up-to-date and in high quality;

- to stimulate the continuation of existing and the creation of new data center activities in member states;

- to maintain standard reference data files and to work towards unique international databases;

- to provide training and services to developing countries;

- to strengthen the computing capacity of NDS;

- to work towards international data libraries for fusion applications, including radiation damage, material activation, and atomic and molecular surface interaction;

- to promote databases that may be needed for incineration of radioactive waste and for reactor decommissioning;

- to work towards an international library of activation cross-sections and decay data for energies up to 100 MeV;

- to continue to give high priority to the nuclear data needs of reactors, including not only advanced reactors but all types, and to investigate the adequacy of the available databases;

- and not to deal with other data types such as material property data or environmental radon data.

U.S.Contribution to the Evaluation of Nuclear Structure Data and Related Activities

M. R. Bhat

October 16, 1992

Introduction

This report reviews the evaluation of nuclear structure, decay data and related activities of the U.S.Nuclear Data Network (USNDN) for the period March 1990 - October 1992. Members of the USNDN are: BNL–National Nuclear Data Center (NNDC), INEL–Nuclear Physics Branch, LBL–Isotopes Project, ORNL– Nuclear Data Project, Triangle Universities Nuclear Laboratory (TUNL), and the NIST– Photon and Charged Particle Data Center.

1 BNL–National Nuclear Data Center (NNDC)

1.1 International Network Coordination

1.1.1 Recruitment of New Evaluators

M. M. King of the National Tsing Hua University, Taiwan continues her participation in the network; A=62 and 63 were published in 1990 and 1991 respectively and A=60 is being evaluated. Funding for this work has been extended up to July 1996 in the current funding cycle. In May 1990, A=82 was temporarily assigned to V. M. Belenkij (Tashkent) and A. V. Kuznichenko (Kharkov) who are collaborating with the group at Gatchina on the evaluation of A=131. In March 1992, K. A. Gridnev of the Dept. of Nuclear Spectroscopy, University of St. Petersburg wrote to the NNDC reiterating his interest in doing mass-chain evaluations. He was requested to collaborate with the group at Gatchina to become familiar with the work while trying to clarify his organizational and other problems. H. Lemmel of the IAEA has been exploring a possible participation of F. Tarkanyi of Debrecen, Hungary in the NSDD network; nothing definite has materialized as yet.

1.1.2 Mass-chain Assignments

At the NSDD meeting in Kuwait, A=86, 88 were assigned to CAJaD (Russia) and A=98, 100 were assigned to McMaster University (Canada). The remaining 16 mass-chains in the A=81–100 range were divided amongst NNDC, INEL, LBL and NDP in proportion to the number of evaluators at each of these groups. At the USNDN meeting in October 1991, A=199 was assigned to NNDC, A=163 to INEL, and A=206, 210, 211, 212, 215, 219, 223, and 227 were assigned to the LBL group.

1.1.3 Mass-chain Evaluations Older than 5 years

In May 1991, members of the NSDD network were requested to give high priority to the re-evaluation of mass-chains with a literature cut-off date older than 5 years in view of the publication of the 8^{th} Edition of the *Table of Isotopes* scheduled to be sent to the publisher by December 1992. Since the contents of this book would be based on the ENSDF, the A-chain evaluations in it and the activities of the NSDD network would achieve a high professional profile in this publication. It is gratifying to note that some members responded positively to this request and have sent in new evaluations. It is hoped that the network productivity in the future would be high enough to keep the literature cut-off age of A-chains in the ENSDF less than 5 years to satisfy user expectations on the currency of ENSDF.

1.2 Nuclear Structure References (NSR)

1.2.1 The NSR File Status

As of October 16, 1992, the NSR file contained 125,392 entries. The number of primary entries is steady at about 2600/year. Primary reference coverage continues to be complete. In spite of manpower problems, secondary entries have stabilized at approximately 1000/year. The publication of the four-monthly issues of Recent References in the *Nuclear Data Sheets* continues on schedule.

1.2.2 Improvements and Corrections to the NSR File

In order to serve the interests of the NSR user community more comprehensively, all secondary source entries continue to be complete with Reference, Title and Authors. The author indexing in the NSR data is done in such a way that references with variants in spelling of an author's name will be retrieved when the standard spelling of the name is entered in a retrieval. At the same time, the entries were corrected for misspelled author names, often misspelled in the publications themselves. A string search of all the entries in the NSR was done to identify references dealing with superdeformation, they were then retrieved and modified to include indexing of

superdeformation/superdeformed. Similar changes were made to references dealing with hyperdeformation and supersymmetry making these references retrievable on these keyword dependent selectors.

All corrections brought to the attention of the NSR file manager by evaluators and others are checked and the file is promptly updated with the corrections and the user who suggested the corrections is notified by letter in all cases including those where the corrections were deemed not necessary or feasible.

1.2.3 The NSR Coding Manual and the Coding of Russian, Japanese, and Chinese Journals

The NSR coding manual is being updated as required for the compilation effort at the NNDC. Data centers already involved in preparing NSR entries are on the distribution list. Many files containing Russian conference proceedings and JINR reports were received by e-mail from the compilers at Gatchina (Russia); they were checked and merged with the NSR file. A tape containing entries from Laboratory Reports was received from the RIKEN data center in Japan. These entries have been checked and will be merged with the NSR file soon. Reports from major French and other European Laboratories continue to be coded at the NNDC. There has been no participation from China in the NSR coding effort. Chinese journals continue to be coded at the NNDC.

The NNDC continues to receive author keyword abstracts at a reduced rate of of about 15-20% of the NSR entries for *Physical Review* C. These are prepared for entry after major modifications by the NSR compiler. A letter was written to Prof. S. Austin, Editor of *Physical Review* C, requesting the reinstatement of key word abstracts in the journal; this was an action item for the NNDC approved at the Kuwait meeting of the NSDD network. His reply stated that there was no sufficient justification to re-open discussion of this question at the present time and that he intended to maintain the present general arrangement as recommended by the Executive Committee of the Division of Nuclear Physics of the American Physical Society in 1983. Galleys of keyword abstracts received from *Nuclear Physics* are corrected and returned on a regular basis.

1.2.4 NSR Services

Monthly and triannual distributions of the NSR file entries are being sent to the various data centers and evaluators according to schedule. A-chain related updates as well as the handling of evaluator key-numbers and references has proceeded smoothly. In the period March '90 to October '92 retrieval requests from the NSR file on varied topics were received and processed by the NNDC. The number of this type of requests has decreased due to the increased access to the NSR online.

A-Chain Status in ENSDF (A>44)

Center - ALL

16-OCT-92

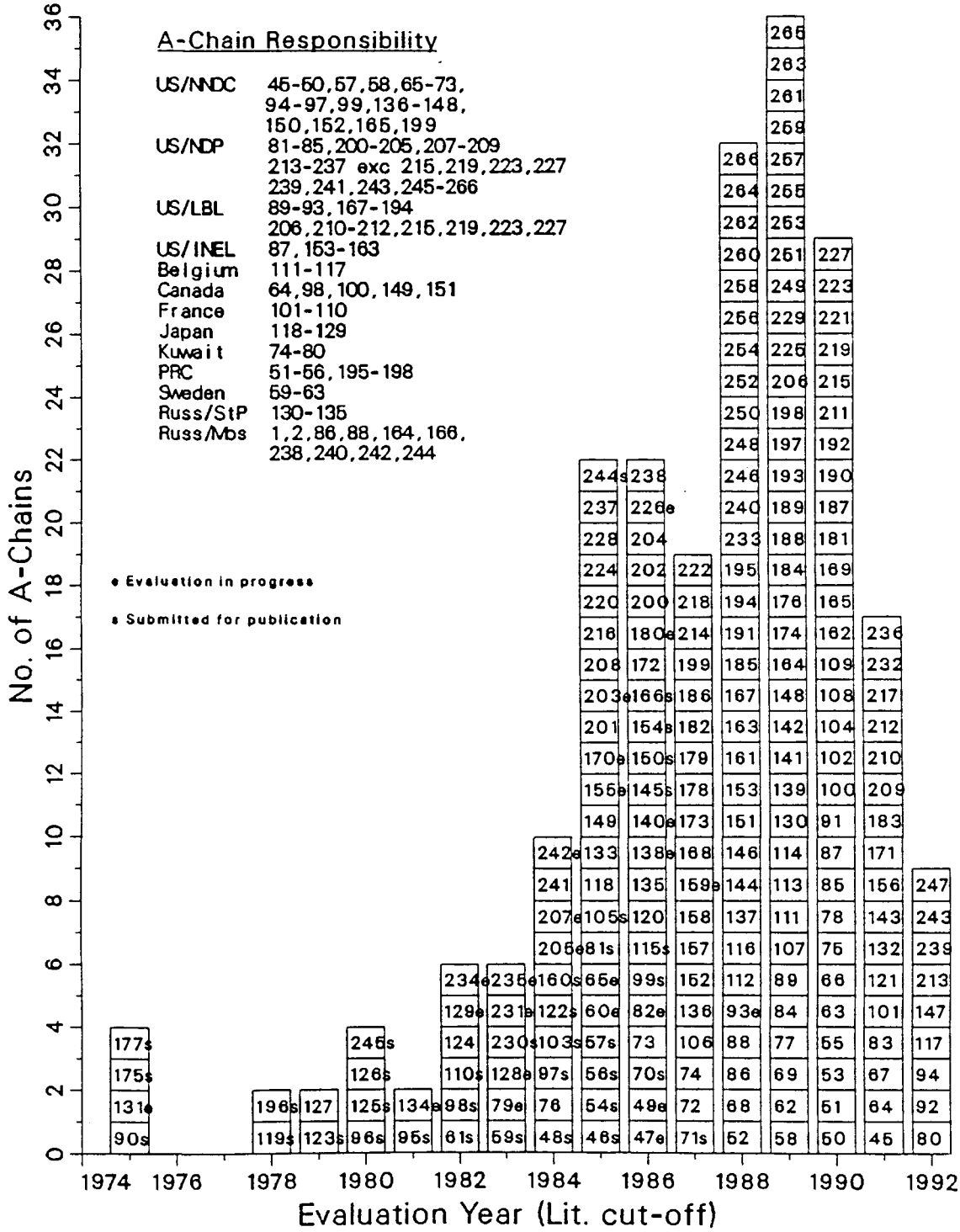


Fig. 1

Table 1
On-line Access Statistics 1986-1992

Year	Runs	Retrievals	NSR	ENSDF	NUDAT	CINDA	CSISRS	ENDF	MIRD	PLOT	PHYSCO	X-RAY
1986	648	1621	814	142	536	129	--	--	--	--	--	--
1987	1275	4263	2521	863	815	60	--	4	--	--	--	--
1988	2264	8748	5022	1303	1492	285	459	187	--	--	--	--
1989	3374	8406	3253	850	1841	522	1649	150	121	11	9	0
1990	5436	12067	5613	1256	2204	187	1623	1019	53	39	65	8
1991	10142	22183	11517	2807	4021	371	1384	1525	40	69	172	277
1992*	11524	22543	9261	2828	5199	307	1330	2316	116	176	78	932

*As of October 19, 1992

1.3 The Evaluated Nuclear Structure Data File (ENSDF)

1.3.1 The ENSDF Status

The ENSDF is being continuously updated on the basis of new evaluations published in the NDS and those done in the "continuous mode". The current status of mass-chains for A>44 in the ENSDF is shown in Fig. 1. This figure also shows those A-chains that are being evaluated and/or have been submitted for publication.

The ENSDF is distributed twice a year; generally in February and in August. Usually, only those A-chains that have been modified since the last distribution are included.

Since the evaluations of mass-chains A<45 are not automatically entered into the ENSDF, a procedure was established at the NSDD meeting in 1980 for the conversion of the evaluated data for A=5-44 into the ENSDF format. This procedure has been reviewed recently and updated. The division of responsibility for this conversion as agreed at Grenoble in 1986 and the status of these A-chains is as follows:

Center	A-Range	Status
NNDC	A=5-12	Coded & merged into ENSDF
NDP	A=13-26	A=13-20 to be done
Grenoble	A=27-32	A=27-32,21,22 coded & merged into ENSDF
LBL	A=33-44	Coded & merged into ENSDF; A=23-26 being coded

1.4 The NNDC Online System

1.4.1 Usage

The number of retrievals per year performed from the NNDC online data service has nearly tripled since 1989-the last year reported to the network. See Table 1 for the current statistics. Retrievals from the NSR file continue to account for the largest fraction of the retrievals, running from 40 to 50%; the second most popular database is the NUDAT file now reaching 25% of the total retrievals.

The service has approximately 500 active users; about 80% are from the United States and the rest are from Canada, Western Europe, Japan, Brazil, Israel and Australia. Non-US users account for about 12% of the retrievals performed. The world-wide growth in networking, INTERNET in particular, has made this service available all over the world. Most users, US and foreign reach the NNDC computer via INTERNET.

1.4.2 Improvements

Since the last international network meeting, we have continued to improve the online service. All database retrieval programs now have a video user interface for access with ANSI-compliant video terminals as well as a sequential input-output interface for non-ANSI terminals. Menus for option selection have been standardized across all programs. The video version menus now contain a line giving a brief description of the menu item currently selected. Also in video mode, all data output is placed in a scrolling window which can be paged forward or backward or returned to the first or last windows.

In August 1991, an improved user control mechanism was instituted. As before, users must establish access authorization. However, this may be accomplished by the user directly when the GUEST account is used. On logout the required information is entered by the user through an interactive dialog. Within each account, individual users can be separately identified without having to establish an account. The service maintains a record of the profiles of individual users who are identified by their names. These profiles provide the capability of setting defaults such as terminal type, graphics capability for each user and allows us to prepare more refined user statistics.

Several new features were added to the ENSDF database access module. Users can call up a reference from the NSR file by entering a keynumber which has been seen an ENSDF data set. The ability to retrieve data sets based on information in the data set ID has been added to the prior feature of retrieval by NUCID. It is also possible to retrieve by NUCID, data sets from mass-chains which have been sent for review and not yet published in the *Nuclear Data Sheets*. This improves the currency of the ENSDF data available online.

The user input interface to the NUDAT database has been re-designed and simplified to eliminate the need to specify parameter selection values using DATATRIEVE (and the associated query language) conventions. Now parameter specification interfaces have been standardized across all programs. In video mode, "HELP" information appears at the bottom of the screen and changes based on the input field selected.

Several other new features have been added to the online service menus. ENSDF utility and physics code packages are accessible via the CODES module. Online service documentation is available in PostScript format via DOCUMENTATION module. Currently, detailed user documentation is available for access and general features, NSR, ENSDF and NUDAT. The PROBLEM option has been added so that the user can send comments or describe difficulties to the online service manager.

The nuclear structure databases were installed at the NEA Data Bank(NEADB) in 1988. They have been receiving data and software updates on a regular basis since that time. The NEADB offers online service to scientists in their member countries. In February 1992, the entire NNDC online system, software and databases, was installed in the new MicroVAX at the IAEA Nuclear Data Section. The system is also being

Table 2

Nuclear Data Sheets Processing Statistics fro 1985-92

Elapsed Time (months)

Year	No. of A-chains Published	NNDC	Evaluator	Review	Editor-in-Chief	Publisher	Total Elapsed Time
1985	22	4.4	2.7	2.2	0.4	2.2	11.8
1986	22	5.2	3.6	2.8	1.0	2.2	14.7
1987	27	4.6	3.3	3.4	0.5	2.1	13.9
1988	19	3.8	3.7	3.6	0.8	2.5	14.4
1989	21	4.5	3.7	4.4	0.6	2.2	15.5
1990	29	5.2	4.5	4.9	0.7	1.7	17.0
1991	29	4.0	3.8	5.3	0.5	1.6	15.2
1992*	20	3.1	5.4	4.1	0.5	1.4	14.4
Nominal		4.0	3.0	2.5	0.5	2.0	12.0

*As of August 1992 issue.

considered for installation at Gatchina.

1.5 The *Nuclear Data Sheets* (NDS) Publication

1.5.1 Status of the NDS Production Pipeline

As of October 16, 1992, there are 33 A-chains in the production pipeline. Information on the status of the NDS production pipeline is sent to the members of the NSDD every month. The different stages of processing of an A-chain are shown along with dates when a particular stage was begun or is expected to begin. If the evaluators find that the NNDC has not received the material mailed by them, or vice versa, they are requested to contact us immediately to trace it and/or send duplicates to avoid delays in processing. Efforts are also made to smooth out the processing load in spite of the evaluations arriving at the NNDC in groups with dormant periods in between. The processing codes are made more efficient continually by including many automatic features and updated to include new format changes. Work is almost complete on a new computer code to implement the new format for the NDS approved at the last NSDD meeting in 1990. The new format intermixes drawings and tables and presents data by residual nucleus only. A sample output of the new code for A=54 was distributed to the NSDD network in July, 1992.

1.5.2 NDS Processing Statistics for 1985-1992

The processing statistics for A-chains published in the NDS for 1985-1992 are shown in Table 2. In addition to the average elapsed time spent in the various steps of processing, nominal times are shown. These are the time intervals we would like to achieve for an efficient and smoothly operating system with the present number of personnel. The NNDC continually reviews A-chain processing to make it as efficient as possible and deliver reviewed evaluations of good quality quickly. Excessive time taken by some evaluators in returning their A-chains to the NNDC and the time spent in review continue to be problems. These can be reduced only with the active cooperation of the persons involved. Evaluators can help by submitting clean evaluations conforming to the evaluator guidelines, corrected for format and physics errors and by responding promptly and completely to the questions or comments by the reviewer or editors.

1.5.3 Size of the A-chains in the NDS

In June '86 at the Grenoble NSDD meeting a new set of guidelines were adopted for the publication format for the NDS. It eliminated redundant presentation of data without sacrificing any essential information. The page length statistics for the past five years are as follows:

Year	No. of A-chains Published	Pages/A-chain
1987	27	76
1988	18+1(u)	92
1989	21	101
1990	18+11(u)	82
1991	12+17(u)	83
1992*	9+17(u)	77
(u)=published in update format *As of October '92 issue		

The number of A-chains published in the "update" format continues to grow and the average page length of the mass-chains has remained essentially constant in 1990 and 1991. In 1992, 26 A-chains have been published or sent to the publisher and their average length is 77 pages. It is felt that an average length of 70-80 pages/A-chain is adequate to stay current with network productivity and avoid any surges in subscription costs determined from a current ceiling of 2500 pages/year.

1.6 Mass-chain Evaluations and Related Activities

The NNDC submitted for publication A=45, 67, 143, 145, 150, 165 and 211 in 1990, and A=46, 48, 57, 94, 96 and 212 in 1991. In addition, two mass-chains A=50 and 66 which were about a year old were re-evaluated in a continuous evaluation mode in 1991. In 1992, the NNDC has submitted A=70, 71, 95, 97 and 99 for publication and A=47, 49, 65, 138 and 140 are being evaluated. Apart from the evaluation of mass-chains, the NNDC physicists' effort has been directed towards improving the NDS production and processing codes, ENSDF code development and in reviewing several mass-chains.

1.7 Nuclear Structure Related Publications

Nuclear Wallet Cards published and distributed in July 1990, continue to be in great demand. In addition to the new data published since the last edition, the new Wallet Cards contain data on hypernuclei, information on how to access the NNDC online databases and updated Appendices.

1.8 ENSDF Related Codes

A β release version of the code ÆGIS (Automated Evaluation Graphical Interface System) was developed for the VAX and IBM-PC and distributed to several evaluators for testing. While limited in functionality, it has proved useful in constructing and checking the adopted levels, gammas data set.

Table 3: Status of ENSDF Physics Processing Codes (October 1, 1992)

Code	Function	Version No.	IBM PC[a]	Documentation
ADDGAM	Adds γ's to adopted data set.	1(2)	Yes	No
DELTA	Analyzes angular correlation data.	1[b]	Yes	LUNFD/(NFFR-3048) 1-27
FMTCHK	ENSDF format checking.	7(124)	Yes	No
GABS	Calculates absolute ΔI_γ's.	V[b]		Yes
GAMUT	Creates adopted levels, gammas from source data sets.	[b,c]	No	LBL-26024
GTOL	Determines level energies from a least-squares fit to E_γ's & feedings.	5(12)	Yes[d]	BNL-NCS-23375/R LUNFD/(NFFR-3049) 1-27
HSICC	Interpolates internal conversion coefficients.	11(9)	Yes	Nucl. Data A4, 1 Nuclear Data Tables A9, 119 BNL-NCS-23375/R
LOGFT	Calculates log ft.	7(9)	Yes	Nucl. Data Tables A10, 206
PANDORA	Physics check of ENSDF data sets. Aids with adopted gammas & XREF.	5(4)	Yes	Yes
PREND	Constructs level schemes from ENSDF data sets.	2.4[c]	No	Yes
RADLST	Calculates atomic & nuclear radiations. Checks energy balance.	5.4g	Yes[d]	BNL-NCS-52142
RULER	Calculates reduced transition probabilities.	1.14	Yes	Yes
SPINOZA	Physics check of an ENSDF data set.	1(2)	No	Yes
TREND	Tabular display of ENSDF data.	6.12	Yes	No

[a]IBM PC version numbers may be lower than those of VAX or ANSI versions.
[b]Program as received from the author.
[c]Program contains VAX extensions of ANSI-standard FORTRAN 77.
[d]With limitations due to memory capacity.

The code RADLST is being updated to:

1. fit within the conventional memory limitations of the IBM-PC,
2. provide a finer grid for the continuum spectra,
3. provide additional details required by the Medical Internal Radiation Dose (MIRD) Committee.
4. implement the latest ENSDF formats,
5. conform to the latest recommendations of the Formats and Procedures Subcommittee pertaining to the calculation of radiation intensities and their uncertainties, and
6. remove the arbitrary limits on number of radiations considered.

The program has been successfully used on MacIntosh, Sun, and Cray computers in addition to the VAX.

A new version of GTOL which has approximately half the executable size of the current version is under testing. This version will allow the same capabilities under MS-DOS as other systems.

The other ENSDF codes continue to be maintained by the NNDC; their current status is given in Table 3. The ENSDF distribution directory on the NNDC VAX cluster has been reorganized to make it easier to obtain the programs *via* electronic networks. The subprogram libraries F77STR, NSDCNV, and NSDMTH have been concatanated into NSDFLIB. "READ ME" files have been added for all the program packages and, where available, informal documentation has also been added to the distribution. The ENSDF programs are also now available through the NNDC online system.

1.9 User Services

The NNDC provides the following services to the NSDD network evaluators and others on routine basis: (i) monthly NSR updates to all evaluation centers for A-chains assigned to them, (ii) complete NSR retrieval at the start of an A-chain evaluation for those who cannot access NSR online, (iii) copies of references to evaluators (with help from the NDP for older references), (iv) ENSDF updates are sent twice a year, (v) NSR updates are sent once in four months, (vi) special retrievals from the NSR and ENSDF, (vii) ENSDF physics codes are maintained and corrections and updates are sent on request,

1.10 Publicity for NSR, ENSDF & Related Databases

The following is a list of items done to publicize the NSR, ENSDF and related databases:

- Every issue of the NDS contains a brief description of these databases and how to access them online.
- The 1990 edition of the Nuclear Wallet Cards with an initial printing of 10,000 copies, has a 4-page yellow colored centerfold giving information on the online data bases, how to access them and a sample login.
- The NNDC online system was installed at the NEA Data Bank and the Nuclear Data Section of the IAEA to provide access to users in their service areas.
- Demonstration booths for online access were provided at professional meetings such as the American Physical Society's Nuclear Physics Division, Society of Nuclear Medicine, and special topical conferences on Capture Gamma-ray Spectroscopy and Industrial Radiation and Radioisotope Measurement Applications.
- Talk on the ENSDF was given at the users' meeting of commercial companies like the Canberra Nuclear Data Systems. This served as a forum to tell users what data resources are available and to find out what their needs are.
- Short communications on the databases have appeared in the newsletters or or journals of professional societies.
- The NNDC sends Nuclear Wallet Cards for distribution as part of the registration package at topical conferences.

2 Mass-chain Evaluations and Related Activities at INEL

2.1 Mass-chain Evaluations

Within the International Nuclear Structure and Decay Data Evaluation Network, INEL has permanent evaluation responsibility for the twelve mass-chains A=87 and A=153-163. This includes two masses, 87 and 163, that have been transferred from other groups within the last two years. The current status of these evaluations is summarized as follows:

A-chain	Publication	Comments
87	NDS **62**, 327 (1991)	Done by FIZ,Karlsruhe
153(u)	NDS **60**, 419 (1990)	
154	NDS **52**, 1 (1987)	New evaluation submitted
155	NDS **50**, 563 (1987)	Being evaluated
156(u)	NDS **65**, 65 (1992)	
157	NDS **55**, 71 (1988)	
158	NDS **56**, 199 (1989)	
159	NDS **53**, 507 (1988)	Being evaluated
160	NDS **46**, 187 (1985)	New evaluation submitted
161	NDS **59**, 1 (1990)	
162	NDS **64**, 79 (1991)	
163	NDS **56**, 313 (1989)	Done by NNDC
(u)=published in update form		

As is evident from this table, our evaluation effort is satisfactory in terms of currency, with only one A-chain over five years old. Previously, at the request of the ORNL Nuclear Data Project, we undertook the evaluation of the A=206 mass-chain as a temporary assignment. Our evaluation was published in NDS **61**, 93 (1990). The future responsibility for this mass-chain has been transferred to the LBL group.

Two individuals, funded at a total level of approximately 0.7 full-time equivalents, are involved in this effort.

2.2 Related Activities

2.2.1 Use of total absorption γ-ray spectrometer results

In response to a request from the Nuclear Data Network, we prepared a document describing the β-feeding information that can be deduced from analysis of spectra obtained from a total absorption γ-ray spectrometer at the INEL. The possible uses of this information in the evaluation of decay schemes for ENSDF were discussed.

2.2.2 The Evaluated Nuclear Data File/B (ENDF/B)

The Nuclear Physics Group at INEL has the primary responsibility for the preparation of the evaluated experimental nuclear decay data for inclusion in the Evaluated Nuclear Data File/B (ENDF/B), the accepted base of nuclear data for the U. S. program in reactor research and technology. For several years, a major effort was in progress at the INEL to prepare such information for Version VI of ENDF/B. This version has now been released.

The nuclides included in Version VI are grouped into three general categories. These, together with the number of such nuclides for which the INEL-generated eval-

uations, are: the Activation File (158 nuclides); the Actinide File (108 nuclides); and the Fission-Product File (510 nuclides). In order to avoid the proliferation of files of evaluated data, drawn from the same base of experimental information, whose contents differ trivially from each other, ENSDF has been used as the starting point for this evaluation. However, ENDF/B contains important data categories not included in ENSDF, and, where deemed appropriate, data other than those in ENSDF have been used.

With the inclusion of model-based estimates for the average β- and γ-ray decay energies for a number of important, but poorly or incompletely studied, fission-product nuclides, the data in the Version-VI fission-product file have been able to provide a good description of the measured decay heat for a number of fissioning nuclear systems.

However, this particular choice of values is not unique; and a number of questions regarding the decay-heat related portion of this file remain. A brief presentation of this situation was given in the following invited paper: "The File of Evaluated Decay data in ENDF/B", C. W. Reich and T. R. England (LANL), presented at the 1991 Spring Meeting of the American Nuclear Society, Orlando, Florida, June 2-6, 1991 (Trans. Am. Nucl. Soc. **63**, 163 (1991)).

2.2.3 IAEA Coordinated Research Program on Decay Data

We participated in the IAEA Coordinated Research Program(CRP) on decay data for nuclides used in the calibration of γ-ray detectors, both by measuring quantities of special interest and by evaluating assigned decay schemes. The results of this work were published in September 1991 as IAEA-TECDOC-619 (September 1991) which is titled "X-ray and gamma-ray standards for detector calibration".

2.2.4 IAEA Coordinated Research Program on Transactinium Data

As a planned follow-on to the work of the IAEA Coordinated Research Program (CRP) on the measurement and evaluation of transactinium isotope nuclear data (TND), a meeting of the former participants (or their replacements) was held at IAEA headquarters in Vienna in November 1989. At this meeting, the status of the relevant TND was reviewed. In light of the number of important new measurements that had appeared since the conclusion of the work of this CRP, it was decided to produce an update to the report (entitled "Decay Data of the Transactinium Nuclides", IAEA Technical Reports Series, No. 261, issued in 1986) produced by that group. Accordingly, a number of new evaluations were undertaken. This work has now been completed; and it is anticipated that a document updating the 1986 report will be issued in due course.

3 LBL-Isotopes Project

3.1 Nuclear Data Evaluation

The LBL Isotopes Project has permanent responsibility for evaluating 41 mass-chains with $89 \leq A \leq 93, 167 \leq A \leq 194, 206, 210, 211, 212, 215, 219, 223$, and 227; temporary responsibility for 8 mass chains with $A = 59, 76, 79, 80, 81$, and 83; and is responsible for converting $A = 23 - 26$ and $A = 33 - 44$ to ENSDF format. $A = 181, 187$, and 189 are evaluated in continuous update mode and a summary of the current publication status of LBL mass chains is given in the Table 4.

The Isotopes Project contributed approximately 2.5 full-time equivalent (FTE) effort into mass-chain evaluation during 1990-1992. This includes off-site personnel Dr. C.M. Baglin who evaluates for LBL from her residence in Morgan Hill, Ca., and Dr. B. Singh who evaluates for LBL in Canada. Between 1990-1992 the Isotopes Project published 21 mass chains and 4 additional mass chains are presently in the publication pipeline.

3.2 8^{th} Edition of the *Table of Isotopes*

The design of the 8^{th} edition of the *Table of Isotopes* and the development of production software have been completed. This edition will contain mass-chain decay scheme diagrams, tables of adopted level, γ-ray information, combined decay scheme drawings similar to those presented in the 7^{th} edition, and rotational band drawings. The data are from ENSDF with additional updating to include newly discovered isotopes and additional super-deformed rotational band data. New atomic mass data from Audi and Wapstra have been provided and will be used to replace the previous Q-values in the file. log ft values and α-hindrance factors will be updated accordingly. Two sample pages of the mass-chain A=237 are shown Figs. 2 and 3. Production of the 8^{th} edition is in progress, and first drafts for about 50 mass chains have been prepared. The projected completion date for the 8^{th} edition of the *Table of Isotopes* is mid-1993.

3.3 Electronic Access to ENSDF

The increasing size and complexity of the ENSDF file have led to requests for a new, user friendly, versatile data search and retrieval system. Among the projects we are developing to address those needs is an Electronic *Table of Isotopes* to provide access to ENSDF data on desk-top computers, and a computer program CHARTIST for generating nuclear charts from ENSDF. A demonstration CD-ROM was prepared containing ENSDF, ENDF, and associated software to test this method of distribution for large databases. We plan to release a CD-ROM for general use containing ENSDF, ENDF, the *Table of Isotopes*, Nuclear Structure References, associated manuals, and

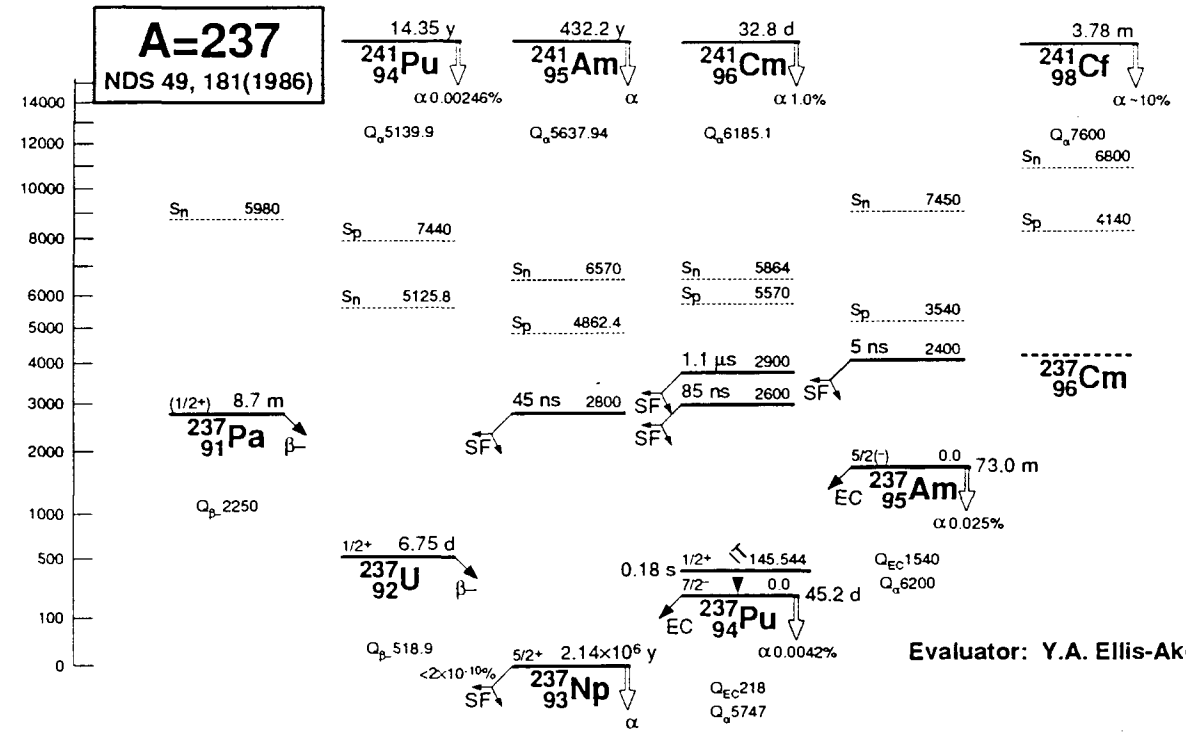
Table 4: Status of LBL Mass-Chain Assignments

Mass Chain	Publ. Year	Status
23-26[a]	1990	Nucl. Phys. A521, 1 (1990)
33-44[a]	1990	Nucl. Phys. A521, 1 (1990)
59[c]	1983	Submitted 1991 (LBL)
76[c]	1985	Published (Kuwait)
79[b,c]	1982	Published (Kuwait)
80[c]	1992	Published (LBL)
81[c]	1985	Submitted 1991 (LBL)
83[c]	1992	Published (LBL)
89	1989	Published (Germany)
90	1975	Submitted 1991 (Sweden)
91	1990	Published (Germany)
92	1992	Published (LBL)
93[b]	1988	Published (Germany)
167	1989	Published (LBL)
168	1988	Published (LBL)
169	1991	Published (LBL)
170	1987	Published (China)
171	1992	Published (LBL)
172	1987	Published (China)
173	1988	Published (LBL)
174	1991	Published (LBL)
175	1976	In press (LBL)
176	1990	Published (LBL)
177	1975	Submitted 1992 (LBL)
178	1988	Published (LBL)
179	1988	Published (LBL)
180[b]	1987	Published (LBL)
181	1991	Published (LBL)
182	1988	Published (LBL)
183	1992	Published (LBL)
184	1989	Published (LBL)
185	1989	Published (LBL)
186	1988	Published (LBL)
187	1991	Published (LBL)
188	1990	Published (LBL)
189	1990	Published (LBL)
190	1990	Published (LBL)
191	1989	Published (LBL)
192	1991	Published (LBL)
193	1990	Published (LBL)
194	1989	Published (LBL)
206	1990	Published (INEL)
210	1992	Published (LBL)
211	1991	Published (BNL)
212	1992	Published (BNL)
215	1992	Published (LBL)
219	1992	Published (LBL)
223	1992	Published (LBL)
227	1992	Published (LBL)

[a] $A = 23 - 26$ are currently being converted into ENSDF format and $A = 33 - 44$ have been submitted for inclusion into ENSDF by LBL.

[b] Presently being evaluated.

[c] Temporary assignment.



Evaluator: Y.A. Ellis-Akovali

$^{237}_{91}Pa$

Δ: 47640 *100*

Populating Reactions and Decay Modes

^{238}U(t,α) E=15 MeV (77Th04)

Levels:

0, (1/2⁺), 8.7 *2* m, %β⁻=100	**393** *6*, (5/2⁺)
35 *2*, (3/2⁺)	**491** *4*
90 *3*, (3/2⁻)	**554** *8*
105 *5*, (9/2⁺)	**577** *8*
147 *6*, (7/2⁻)	**624** *4*
158 *6*, (13/2⁺)	**686** *8*
202 *6*	**714** *8*
258 *4*	**741** *8*
319 *4*	**972** *8*
364 *4*, (3/2⁺)	**1025** *6*
	1112 *4*

γ(^{237}U) from ^{237}Pa (8.7 m) β⁻ decay *<for Iγ% multiply by 0.343>*

45.05, ***179.12*** (t_γ 0.51), ***310.12*** (t_γ 5.17), ***498.72*** (t_γ 7.19), ***529.42*** (t_γ 43.644), ***540.72*** (t_γ 27.327), ***543.65*** (t_γ 0.73), ***554.92*** (t_γ 4.55), ***701.05*** (t_γ 0.42), ***722.62*** (t_γ 2.44), ***734.02*** (t_γ 1.94), ***847.15*** (t_γ 1.55), ***853.72*** (t_γ 100), ***865.02*** (t_γ 45.646), ***1333.25*** (t_γ 0.50 25), ***1344.85*** (t_γ 0.30 15), ***1395.95*** (t_γ 0.50 25), ***1407.55*** (t_γ 0.30 15).

$^{237}_{92}U$

Δ: 45387 *2*

Populating Reactions and Decay Modes

A ^{237}Pa β⁻ decay (74Ka05)

B ^{241}Pu α decay (65Ba26, 68Ba25, 68Ah01, 76BaZZ, 76GuZN)

C ^{236}U(n,γ) res:primary γs (79Vo05)

D ^{236}U(n,γ) res:secondary γs (79Vo05)

E ^{236}U(d,p) E=11.96 MeV (65Br22)

F ^{238}U(d,t) (70Bo31, 72Er03)

G ^{238}U(^{3}He,α) E=30 MeV (70Vo03)

Levels and γ-ray branchings:

0.0, 1/2⁺, 6.75 *1* d, *[ABCDEF]*, %β⁻=100

11.392, 3/2⁺, *[ABCDEFG]* γ_0***11.392*** (t_γ 100)

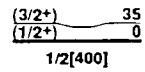
56.304, 5/2⁺, *[ABCDF]* γ_{11}***44.86*** *10* (t_γ 33 4) γ_0***56.32*** *10* (t_γ 100 7)

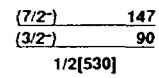
82.866, 7/2⁺, *[BDEFG]* γ_{56}***26.6*** γ_{11}***71.62*** (t_γ 100)

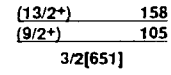
159.962, 5/2⁺, 3.1 *1* ns, *[BCDF]* γ_{83}***77.10*** *10* (t_γ 11.4 4) γ_{56}***103.6805*** (t_γ 54.8 7) γ_{11}***148.567*** *10* (t_γ 100 2) γ_0***159.95520*** (t_γ 3.53 8)

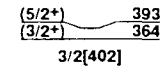
163.*2*, 9/2⁺, *[EFG]*

204.199, 7/2⁺, *[BDF]* γ_{160}***44.20*** *10* (t_γ 100 4) M1+E2 γ_{83}***121.22*** (t_γ 16.5 *18*)









$^{237}_{91}Pa$ Rotational Bands

205 *4*, 11/2⁺, *[FG]*

260.95 *14*, 9/2⁺, *[BEFG]* γ_{204}***56.76*** *10* (t_γ 100)

274.0 *10*, (7/2)⁻, 155 *6* ns, *[B]* γ_{160}***114.0*** *10* (t_γ 100) E1

316 *5*, (9/2⁻), *[B]*

327 *3*, 11/2⁺, *[BG]*

367 *3*, (11/2⁻), *[BFG]*

426.15 *6*, (7/2⁺), *[D]* γ_{160}***266.176*** (t_γ 100)

432 *10*, *[G]*

482 *1*, (9/2⁺), *[EF]*

506 *2*, (15/2⁻), *[FG]*

530 *4*, *[F]*

540.625, 1/2⁻, *[ACDF]* γ_{11}***529.265*** (t_γ 100 7) γ_0***540.615*** (t_γ 62 5)

551 *2*, (11/2⁺), *[EG]*

554.986, 3/2⁻, *[ACD]* γ_{56}***498.625*** (t_γ 100 8) γ_{11}***543.686*** (t_γ 12.5 *11*) γ_0***555.029*** (t_γ 95 9)

578.01 *6*, (5/2⁻), *[DF]* γ_{83}***495.096*** (t_γ 80 7) γ_{56}***521.53*** *11* (t_γ 6.8 *14*) γ_{11}***566.656*** (t_γ 100 8)

632 *3*, (13/2⁺), *[G]*

657 *3*, *[E]*

664.27 *20*, 3/2⁺, *[CDF]* γ_{160}***504.32*** *10* (t_γ 24 4) γ_{83}***581.9020*** (t_γ 28 6) γ_{11}***652.876*** (t_γ 100 8) γ_0***664.216*** (t_γ<170)

666.45 *10*, (5/2⁺), *[CD]* γ_{56}***610.29*** *11* (t_γ 28 5) γ_{11}***654.8020*** (t_γ 16 5) γ_0***666.419*** (t_γ 100 *12*)

677.59 *10*, 3/2⁺,5/2⁺, *[CD]* γ_{426}***251.2020*** (t_γ 14 6) γ_{204}***473.427*** (t_γ 81 9) γ_{160}***517.5010*** (t_γ 53 9) γ_{83}***594.6020*** (t_γ 58 *14*) γ_{56}***621.377*** (t_γ 100 *12*)

688 *2*, *[G]*

697.656, (5/2⁺), *[CDeF]* γ_{160}***537.619*** (t_γ 27 4) γ_{83}***614.8610*** (t_γ 32 5) γ_{56}***641.346*** (t_γ 84 8) γ_{11}***686.298*** (t_γ 100 *10*)

698 *2*, *[e]*

718 *6*, *[G]*

720.45 *10*, 3/2⁻, *[CD]* γ_{56}***664.21*** (t_γ<592) γ_{11}***709.06*** *12* (t_γ 100 *17*) γ_0***720.44*** *12* (t_γ 68 *11*)

Fig. 2

$^{237}_{92}U$ (Continued)

734.34 *10*, (1/2⁻), *[ACD]* γ_{555}*179.53* (t_γ29) γ_{11}*722.886* (t_γ100 9) γ_0*734.427* (t_γ68 7)

758.16 *6*, (3/2⁻), *[CD]* γ_{56}*701.876* (t_γ100 9) γ_{11}*746.8020* (t_γ14 4) γ_0*758.156* (t_γ68 6)

798 *2*, (9/2⁺), *[FG]*

832.45 *14*, (5/2⁺), *[CD]* γ_{160}*672.516* (t_γ100 9) γ_{11}*820.43* (t_γ33 9)

846.94 *15*, (1/2⁺), *[CDe]* γ_{160}*687.53* (t_γ11 5) γ_0*846.899* (t_γ100 8)

848 *1*, (11/2⁺), *[eG]*

865.0 *2*, 1/2⁻, *[ACDeFG]* γ_{555}*310.22* (t_γ5.1 7) γ_{11}*853.62* (t_γ100 9) γ_0*865.12* (t_γ46 5)

866 *3*, *[e]*

872.15 *14*, (3/2⁺), *[CD]* γ_{555}*317.14* (t_γ<12) γ_{541}*331.23* (t_γ6 4) γ_{205}*667.53* (t_γ17 7) γ_{160}*712.1020* (t_γ15 4) γ_{56}*815.959* (t_γ100)

893.43 *20*, (5/2⁺), *[CDE]* γ_{56}*837.14* *14* (t_γ100 18) γ_{11}*882.0020* (t_γ87 15)

903.4 *5*, (3/2⁻), *[A]* γ_{56}*847.15* (t_γ100)

905.7 *2*, (1/2⁺), *[CD]* γ_{56}*849.45* *13* (t_γ49 8) γ_{11}*894.14* *10* (t_γ100 *10*) γ_0*906.01* *12* (t_γ87 *12*)

909.4 *3*, (1/2⁻,3/2⁻), *[CDF]* γ_0*909.34*

911 *4*, (5/2⁻), *[G]*

920.6 *2*, (3/2⁺), *[CD]* γ_{56}*864.00* *20* (t_γ100 18) γ_{11}*909.34* *11* (t_γ<107)

946 *2*, (9/2⁺), *[FG]*

947.85 *20*, (5/2⁺), *[CD]* γ_{664}*283.40* γ_{426}*521.53* γ_{83}*865.1* γ_{11}*936.40* *20* (t_γ90 17) γ_0*947.97* *14* (t_γ100 *20*)

952 *2*, *[E]*

971 *2*, *[G]*

981.26 *10*, (3/2⁺), *[CDe]* γ_{698}*283.40* *20* (t_γ10 4) γ_{664}*317.14* *12* (t_γ25 5) γ_{578}*403.167* (t_γ38 4) γ_{555}*426.338* (t_γ51 7) γ_{541}*440.696* (t_γ100 9)

984 *4*, *[F]*

987 *3*, *[E]*

1013 *4*, *[F]*

1033 *2*, *[C]*

1040 *1*, (11/2⁺), *[G]*

1050.0 *10*, (1/2⁺,3/2⁺), *[CE]*

1068 *2*, (1/2⁺,3/2⁺), *[C]*

1078 *1*, (1/2⁺,3/2⁺,5/2⁺), *[C]*

1085.0 *10*, (1/2⁺,3/2⁺), *[CE]*

1094.7 *10*, (5/2⁺), *[C]*

1108.8 *3*, (1/2⁻,3/2⁻), *[C]*

1110 *2*, *[Ef]*

1112 *3*, *[f]*

1122.8 *3*, (1/2⁻,3/2⁻), *[C]*

1126 *2*, *[E]*

1128.0 *10*, (5/2⁺), *[C]*

1140 *3*, (13/2⁺), *[G]*

1155 *3*, *[F]*

1162 *2*, *[E]*

1175.3 *3*, (1/2⁻,3/2⁻), *[C]*

1183.0 *3*, (1/2⁺,3/2⁺), *[C]*

1189 *3*, *[fG]*

1192 *2*, *[Ef]*

1201 *1*, (1/2⁻,3/2⁻), *[C]*

1208 *4*, *[F]*

1215 *2*, *[C]*

1229 *1*, (1/2⁺,3/2⁺), *[C]*

1235 *3*, *[E]*

1247 *3*, *[F]*

1259 *2*, (15/2⁻), *[G]*

1268 *2*, (1/2⁺,3/2⁺,5/2⁺), *[C]*

1287 *1*, (1/2⁺,3/2⁺), *[C]*

1299 *3*, *[g]*

1301 *2*, *[Cg]*

1344.7 *5*, (1/2⁻), *[AC]* γ_{11}*1333.25* (t_γ100 *50*) γ_0*1344.85* (t_γ60 *30*)

1372 *3*, *[E]*

1375 *3*, *[F]*

1380.4 *10*, (1/2⁺,3/2⁺), *[C]*

1407.4 *5*, (1/2⁺), *[AC]* γ_{11}*1395.95* (t_γ100 *50*) γ_0*1407.55* (t_γ60 *30*)

1424.0 *10*, (1/2⁻,3/2⁻), *[C]*

1441 *2*, *[C]*	**1733** *2*, *[C]*	**2039** *2*, *[C]*
1485 *2*, *[C]*	**1738** *2*, *[C]*	**2057** *2*, *[C]*
1488 *2*, *[C]*	**1741** *4*, *[F]*	**2061** *2*, *[C]*
1493 *2*, *[C]*	**1755** *2*, *[C]*	**2063** *2*, *[C]*
1508 *2*, *[C]*	**1757** *2*, *[C]*	**2069** *2*, *[C]*
1527 *2*, *[C]*	**1760** *2*, *[C]*	**2076** *2*, *[C]*
1531 *2*, *[G]*	**1798** *2*, *[C]*	**2079** *2*, *[C]*
1550 *2*, *[C]*	**1803** *2*, *[C]*	**2092** *2*, *[C]*
1561 *3*, *[g]*	**1823** *2*, *[C]*	**2101** *2*, *[C]*
1563 *2*, *[Cg]*	**1838** *2*, *[C]*	**2108** *2*, *[C]*
1567 *2*, *[C]*	**1849** *2*, *[G]*	**2133** *2*, *[C]*
1579 *2*, *[C]*	**1864** *2*, *[C]*	**2136** *2*, *[C]*
1583 *3*, *[F]*	**1873** *2*, *[C]*	**2139** *2*, *[C]*
1588 *2*, *[C]*	**1883** *2*, *[C]*	**2148** *2*, *[C]*
1605 *3*, *[G]*	**1888** *2*, *[G]*	**2154** *2*, *[C]*
1612 *3*, *[F]*	**1889** *2*, *[C]*	**2171** *2*, *[C]*
1622 *2*, *[C]*	**1896** *2*, *[C]*	**2176** *2*, *[C]*
1634 *2*, *[C]*	**1900** *2*, *[C]*	**2211** *2*, *[C]*
1647 *2*, *[C]*	**1915** *2*, *[C]*	**2221** *2*, *[C]*
1651 *2*, *[C]*	**1929** *2*, *[C]*	**2226** *2*, *[C]*
1659 *2*, *[C]*	**1940** *2*, *[C]*	**2237** *2*, *[C]*
1667 *2*, *[C]*	**1955** *2*, *[C]*	**2244** *2*, *[C]*
1694 *2*, *[C]*	**1961** *2*, *[C]*	**2255** *2*, *[C]*
1696 *2*, *[C]*	**1962** *2*, *[C]*	**2263** *2*, *[C]*
1698 *2*, *[C]*	**1968** *2*, *[C]*	**2274** *2*, *[C]*
1712 *2*, *[C]*	**1977** *2*, *[C]*	**2282** *2*, *[C]*
1717 *4*, *[F]*	**1990** *2*, *[C]*	**2297** *2*, *[C]*
1719 *2*, *[C]*	**1999** *2*, *[C]*	**2308** *2*, *[C]*
1727 *2*, *[C]*	**2004** *2*, *[C]*	

$\gamma(^{237}Np)$ from ^{237}U (6.75 d) β^- decay *<for Iγ% multiply by 1.0>*

2.3, ***13.812*** (t_γ0.099 4) M1+E2: δ=0.0321 *10*, ***26.348*** *10* (t_γ2.43 6) E1, ***33.195*** *11* (t_γ0.130 5) M1+E2: δ=0.13 *3*, ***38.543*** ($t_{\gamma+e}$0.4) (M1+E2), ***42.735***, ***43.423*** *20* (t_γ0.0240 *20*) M1+E2: δ=0.41 *2*, ***51.013*** (t_γ0.340 *10*) E1, ***59.5363*** (t_γ34.5 7) E1, ***64.832*** (t_γ1.28 2) E1, ***69.763*** (t_γ0.00095 *19*) (E1), ***75.82***, ***102.982*** (t_γ0.0064 *9*) E1, ***114.095***, ***164.612*** (t_γ1.852 *18*) E2, ***208.000*** *10* (t_γ21.14 *23*) M1+E2: δ=+0.156 *5*, ***221.804*** (t_γ0.0212 7) E2, ***234.404*** (t_γ0.0205 7) M2, ***267.544*** (t_γ0.710 *20*) E1+M2: δ=0.490 *15*, ***292.71*** (t_γ0.0025 7), ***309.1*** (t_γ0.00027), ***332.364*** (t_γ1.195 *20*) E2, ***335.384*** (t_γ0.095 2) M1+E2: δ=0.46 *17*, ***337.72*** (t_γ0.0089 5) (E2), ***340.45*** (t_γ0.00165 *33*), ***368.594*** (t_γ0.040 2) M1(+E2): δ<0.31, ***370.944*** (t_γ0.107 2) M1+E2: δ=0.43 $^{+7}_{-21}$.

$^{237}_{93}Np$

Δ: 44868 *2*

Populating Reactions and Decay Modes

A ^{237}U β⁻ decay (66Ya05, 76GuZN, 85He02, 85Wi04)

B ^{237}Pu EC decay (58Ho02, 79El05, 83Ah02)

C ^{241}Am α decay (52As04, 54As05, 55Go57, 57Ro20, 62Le11, 64Ba26, 65Mi06, 66Le13, 68Ba25, 68Ka09, 69Br12, 69HoZY, 71Cl03, 71Gr17, 74HeYW, 75IoZZ, 76BaZZ, 76GuZN, 76Sk01, 78Ge06, 78Ge17, 79Go12, 81Ba68, 84Va27)

D ^{236}U(^{3}He,d), ^{236}U(α,t) (70El02)

E ^{237}Np(d,d') E=16 MeV (76Th01)

F Coulomb excitation (58Ne03, 80Si16, 83Ku05)

Levels and γ-ray branchings:

0.0, 5/2⁺, 2.14×10⁶ *1* y, *[ABCEF]*, %α=100, %SF≤2×10⁻¹⁰, μ=+2.5 *3*, Q=+4.1 *7*

33.192 *2*, 7/2⁺, 54 *24* ps, *[ABCDEF]*
γ_0***33.195*** *11* (t_γ100) M1+E2: δ=0.13 *3*

59.537 *1*, 5/2⁻, 67 *2* ns, *[ABC]*, μ=+1.34 *12*, Q=+4.1 *7* γ_{33}***26.345*** *1* (t_γ6.71 *14*) E1
γ_0***59.537*** *1* (t_γ100) E1

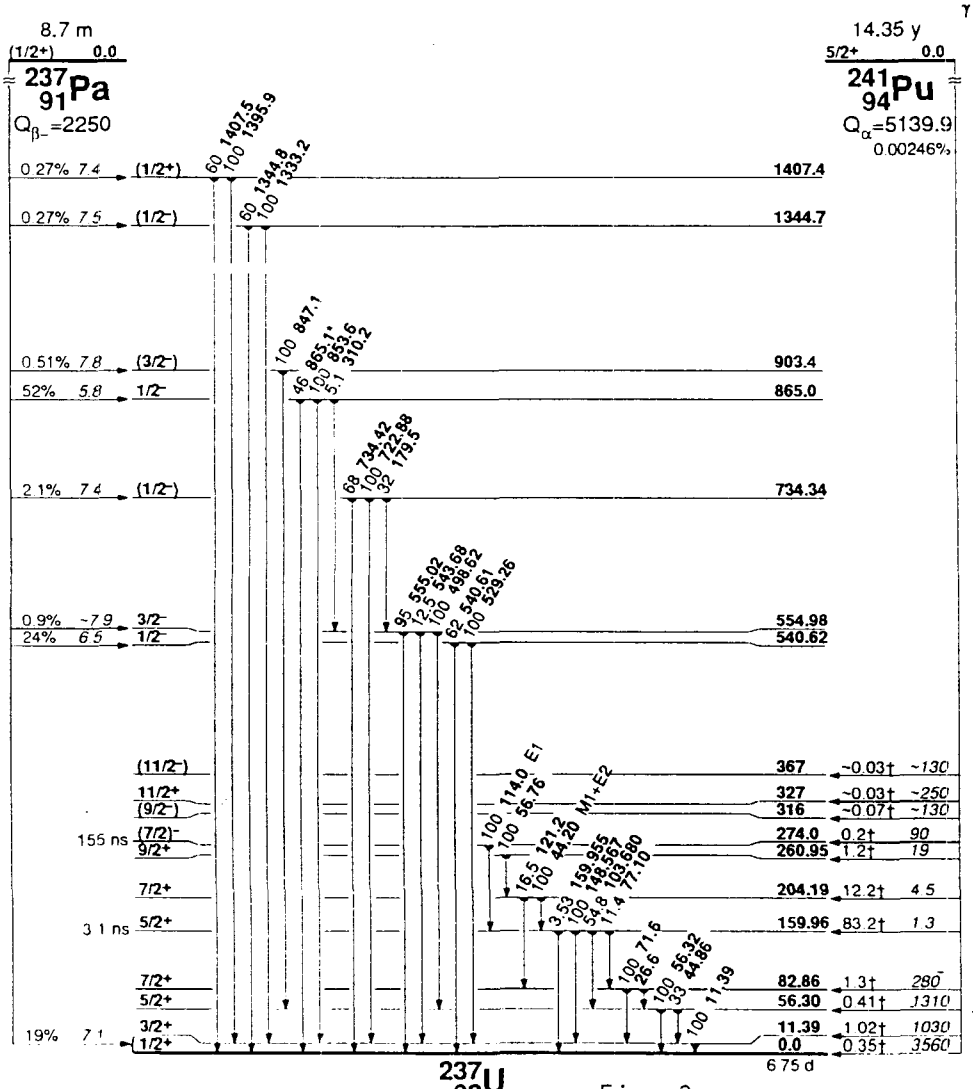


Fig. 3

software for viewing, searching and retrieving data from those files in 1993. In 1992 the U.S. Department of Energy issued a budget directive requesting that "more effective electronic data dissemination techniques be developed at LBL." In order to meet this goal, we have been collaborating with Dr. C.A. Stone, San Jose State University, to modernize the design of the ENSDF file, provide a database management system for ENSDF, and develop a format-free evaluation editor for entering data into the file.

4 ORNL–Nuclear Data Project

4.1 Mass-chain Evaluations

The mass-chains 209, 213, 217, 221, 225, 232, 236, 239, 243, 245, and 247 have been published.

The mass-chains 205, 207, 230, and 235 have been submitted for publication.

The mass-chains 203, 231, and 234 are being worked on.

4.2 Mass-chain Editing

The NDP staff provided reviews of the mass-chains 48, 57, 67, 70, 85, 87, 90, 92, 96, 98, 101, 107, 117, 119, 141, 142, 145, 147, 150, 156, 160, 164, 169, 171, 175, 183, 192, 206 and 210.

5 Triangle Universities Nuclear Laboratory (TUNL)

At the 1990 NSDD meeting, permanent responsibility for the evaluation of A=3-20 was assigned to the TUNL evaluation group. During the past two years, as described below, TUNL worked with Prof. F. Ajzenberg-Selove of the University of Pennsylvania to complete the transfer to TUNL of the A=5-20 evaluation responsibility.

5.1 A=4

The evaluation of A=4 carried out in collaboration with G. M. Hale of Los Alamos National Laboratory was in progress during most of the period covered by this report. A preliminary version was prepared and mailed in May 1991 soliciting comments. During the summer of 1991 revisions based on the response to the preprint were made, and the completed manuscript was submitted *Nuclear Physics* A, in the fall of 1991. The paper "Energy Levels of Light Nuclei A=4" by D. R. Tilley, H. R. Weller, and G. M. Hale was published in *Nuclear Physics* A474, 1 (1992).

5.2 A=5–20

The transfer to TUNL of the project for the evaluation of nuclear data in the mass range A=5–20 carried out for many years by Prof. Fay Ajzenberg-Selove at the University of Pennsylvania was completed in 1990. Since December 1990, TUNL has carried out literature coverage for A=3–20 on a continuing basis, compiling bibliographical listing for relevant experimental and theoretical work utilizing several resources including monthly updates to the NSR file from the NNDC, Current Contents on diskette with abstracts and Physics Abstracts. Aside from these continuing activities, most of the effort during 1992 has been devoted to preparation of the evaluation of A=16, 17. A preliminary version of A=16 was issued in July 1992, and copies were mailed out to solicit corrections and suggestions. The form and style of the TUNL evaluation is very similar to the earlier Ajzenberg-Selove evaluations except that discussions of theoretical work are included. TUNL plans on entering the evaluated data into the ENSDF maintained by the NNDC. Work is proceeding on A=17 with objective of completing A=16, 17 in late 1992 or early 1993. Following the completion of A=16, 17, TUNL will begin the evaluation of A=18–20 and continue the cycle.

6 Photon and Charged-Particle Data Center

The Photon and Charged-Particle Data Center at the National Institute of Standards and Technology (NIST) collects experimental data on photon and charged particle interactions, evaluates the data critically and carries out transport calculations to check the evaluated data. The data pertain to cross sections for the interaction of photons, electrons and positrons, and protons at energies above approximately 1 kev. A number of recently developed data bases are available from the NIST Office of Standard Reference Data, including PC code packages for rapid determination of x-ray and γ-ray attenuation coefficients and interaction cross sections, electron and positron stopping powers and ranges, and electron-bremsstrahlung differential spectra in any material.