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INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

Coordination of the International Network of Nuclear Structure and Decay Data Evaluators

Summary Report of an IAEA Advisory Group Meeting

hosted by the Lawrence Berkeley Laboratory, University of California,
on behalf of the U.S. Government,
16-20 May 1994

Edited by C.L. Dunford and H.D. Lemmel

August 1994

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

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Abstract

The IAEA Nuclear Data Section convened the eleventh meeting of the international nuclear structure and decay data evaluators network in Berkeley, California, 16-20 May 1994, hosted by the Lawrence Berkeley Laboratory, University of California, on behalf of the U.S. Government. The meeting was attended by 43 scientists from 13 member states and two 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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August 1994

LIST OF ABBREVIATIONS

CAJaD	Centre for Data on the Structure of the Atomic Nucleus and Nuclear Reactions, Kurchatov Institute, Moscow, Russia.
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, Institute of Atomic Energy (IAE), Beijing.
CPND	Charged-particle nuclear reaction data.
DBMS	Database Management System.
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 one or a few selected nuclear parameters 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, International Atomic Energy Agency.
ICRM	International Committee for Radionuclide Metrology.
INDC	International Nuclear Data Committee.
INEL	Idaho Nuclear Engineering Laboratory, USA.
INIS	International Nuclear Information System, operated by the IAEA.
IP	Isotopes Project at LBL.
IRMM	CEC Institute of Reference Materials and Measurements, Geel, Belgium.
JAERI	Japan Atomic Energy Research Institute.
KACHAPAG	Karlsruhe Charged Particle Group.
KISR	Kuwait Institute for Scientific Research.
LBL	Lawrence Berkeley Laboratory, University of California, USA.
LIYaF	Leningrad Institut Yadernoy Fiziki: Data Centre of the St. Petersburg Nuclear Physics Institute of the Russian Academy of Sciences.
NDP	Nuclear Data Project, 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, Brookhaven National Laboratory, USA.
NSDD	Nuclear Structure and Decay Data.
NSR	Nuclear Structure References, a bibliographic file related to ENSDF.
ORNL	Oak Ridge National Laboratory, USA.
PC	Personal Computer.
USDOE	U.S. Department of Energy.
USNDN	U.S. Nuclear Data Network.
TUNL	Traingle Universities Nuclear Laboratory, USA.

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FOREWORD

The international network of nuclear structure and decay data (NSDD) evaluators, consisting of evaluation groups and data service centres, aims at a complete and periodic nuclear structure data evaluation of all isobaric nuclear mass-chains, 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 and explain the way in which they were obtained from the published data. The resulting data files 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 services, PC diskettes and compact disks, 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 Berkeley Radiation Laboratory and the Pasadena Institute of Technology (California) the Rijksuniversiteit at Utrecht (Netherlands) and the Nuclear Data Group (Washington and Oak Ridge). The United States effort is presently coordinated by the Executive Committee of the U.S. Nuclear Data Network. The ENSDF master database is maintained by the US National Nuclear Data Center at the Brookhaven National Laboratory. 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
11.	Berkeley, USA	16. - 20.5.1994	INDC(NDS)-307

The most recent meetings of the U.S. Nuclear Data Network

Asilomar	19. Oct. 1993	BNL-NCS-60566
Williamsburg, VA	around 26-29 Oct. 1994	

INTRODUCTION

The eleventh meeting of the members of the Network of Nuclear Structure and Decay Data Evaluators was hosted by the Lawrence Berkeley Laboratory, University of California, on behalf of the U.S. Government. The meeting was attended by 43 scientists from 13 countries and two international organizations. The list of participants is given in Annex 1.

The meeting was opened by J. Symons, Director of the LBL Nuclear Science Division. He emphasized the importance of this internationally coordinated evaluation activity and the need to serve new users. After the welcome by C. Dunford on behalf of the Agency, C. van der Leun from the Netherlands was selected to be the General Chairman of the meeting and I. Kondurov from Russia was selected to chair the scientific sessions.

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 with excitation energies, spins, parities, isospins, lifetimes, decay properties, of all the known nuclear isotopes (more than 2500).

The input to the ENSDF and NSR databases is contributed by presently 16 nuclear data evaluation groups in 10 countries. A list of these groups is given in Annex 2, together with the work distribution as of 1992/1994. The databases are made available to the nuclear data users by the data centers listed in Annex 3.

Coordination meetings of the NSDD Network are held every two years under IAEA auspices to review the results of the previous two years' activities and to plan the work for the next two years. The present meeting was one of the most important meetings of the network since its founding meeting 20 years ago. The goals and objectives of the US component of the cooperation are now changing significantly. New users and new information dissemination techniques are being emphasized. As a result of intensive discussions among all of the participants, new activities were proposed with resources identified for a more efficient implementation of the essential task of maintaining an up-to-date, quality ENSDF database of fundamental nuclear structure and radioactive decay data.

MINUTES

The first day's agenda was adopted. At the end of the first day, in the light of the day's discussions, the remaining agenda items were reviewed and revisions adopted. The final Agenda is given in Annex 4.

After the actions from the previous meeting (see report INDC(NDS)-296) were reviewed, short status reports from the evaluation centres were presented. They are reproduced in Annex 5.

D. De Frenne from Belgium reported that Belgium continues with responsibility for its assigned mass chains. Since the last network meeting, evaluations for A=105 and 106 have been completed and A=112 has been started. They continue to investigate high energy dipole and quadrupole transitions using nuclear resonance fluorescence techniques.

B. Singh from Canada reported that one mass chain evaluation has been published since the last meeting, 2 more are in review and 2 are now being evaluated. An effort to compile high-spin data for superdeformed bands and fission isomers has been completed. The work will be updated annually. As a test case, these data have been included in a revised evaluation for the A=124 mass chain.

The Chinese evaluation activity is located in two centres, one at the CNDC in Beijing and one at Jilin University in Changchun. Since the last meeting, they have published two A-chain evaluations and submitted an additional three.

J. Blachot presented for France. They continue to have responsibility for 11 mass chains. Three mass chains have been published in the past two years. All mass chains are maintained in a continuously updated mode. Data from Utrecht have been entered into the ENSDF format. The group also participates in a collaboration to provide a file for input to nuclear reaction model calculations.

H. Iimura stated that four mass chain evaluations have been published since the last meeting, four are currently being reviewed and two more will be submitted in 1994. Secondary references from Japan are compiled for the NSR bibliographic data base. The 5th edition of the Japanese Chart of Nuclides was issued in 1992. A revised edition is planned for 1996.

A. Farhan reported for Kuwait. The centre was destroyed during the Gulf War and has only recently been reestablished at the 0.3 man-year level. Two evaluations will be submitted this year.

The activity of the Dutch centre at Utrecht was described by **C. van der Leun**. The work is carried on by **Pieter Endt** and himself, both retired. Not very much new information is available in their mass region since their last evaluations were published in Nuclear Physics. Publication of new evaluations for selected mass chains (instead of the whole A=21-44 range) might be considered in the future.

I. Kondurov discussed the Russian Centre at Kurchatov Institute on behalf of F.E. Chukreev who could not attend because of visa problems. Only one evaluation for A=244 has been completed because of a decrease in Russian government support and loss of staff. One new evaluator has been hired. **I. Kondurov** also presented the report from the Petersburg Nuclear Physics Institute. They have responsibility for six mass chains. A=133 will be published this year, A=135 is in progress and A=133 has been transferred to ORNL. Their centre continues to scan and encode Russian secondary literature for the NSR file. He mentioned interest in reviving the neutron resonance parameter evaluations formerly done by **S. Mughabghab** at BNL if funding can be supplied.

P. Ekström reported that the Swedish effort does not include mass chain evaluations but continues to concentrate on a PC based NSR file.

Representatives from several new cooperating evaluation centres also attended. **G. Molnár** from the Institute of Isotopes, Budapest, described his group's interest in capture gamma-ray studies for nuclear structure physics, nuclear astrophysics and analitical chemistry. Work is carried out at the recently refurbished and upgraded research reactor of the Budapest Neutron Centre. Work is also done at the Institute for Nuclear Research, Debrecen, at the van de Graaff and a new cyclotron. The 9th International Symposium on Capture Gamma-Ray Spectroscopy and Related Topics will be organized at Budapest in October 1996.

J.M. Los Arcos of CIEMAT is involved in metrology evaluations.

T.D. MacMahon from Imperial College, UK is interested in the methods for evaluating discrepant data.

A.L. Nichols from AEA Harwell, UK, chairs the UK Chemical Nuclear Data Committee (renamed UK Nuclear Science Foum) which has now assumed responsibility for coordinating nuclear reaction data activity in the UK. This group is driven by industry needs. They are involved in the evaluation of decay data for fission product nuclides, activation products, actinides, and fission product yields. Decay data for Pa-234g and Pa-234m have recently been evaluated as well as data for the U-232 decay chain.

The major data centres also presented reports. **M. Konieczny** from the NEA Data Bank described a PC based programme for displaying JEF reaction and decay data in ENDF format. This work was sponsored by the NEA. In addition, the Data Bank provides on-line access to the nuclear structure and decay data files, NSR, ENSDF and NUDAT.

C.L. Dunford presented the IAEA NDS status report.

Finally, **M.R. Bhat** presented the report for the National Nuclear Data Center and for the US evaluators network. The US network consists of five evaluation centres at BNL, INEL, LBL, ORNL and TUNL. This network supplies about 60% of the mass-chain evaluations. These groups are also involved in nuclear structure research, metrology evaluations, computer software development and publications.

J.K. Tuli gave a survey on the status of mass-chain evaluations (see Annex 6.1). There are only 11 mass-chain evaluations left that are older than 10 years, and all of them are in the process of re-evaluation and publication.

T.W. Burrows, reviewed the status of ENSDF analysis and checking codes (see Annex 6.2). Almost all codes and modules have been updated and documented during the past 2 years, and 3 codes have been added. The major enhancements are summarized in Annex 6.2.

The review of the nuclear structure and decay data portion of the US nuclear data programme was presented by **J. Dairiki** from LBL (see Annex 7). The review was conducted by the Executive Committee of the US Nuclear Data Network. This committee has been given the responsibility of coordinating the US activities. The report is a collection of statements by task forces charged to look into different aspects of the programme. The major emphasis of the document was placed on new ways of carrying out the mandate for the US programme. The proposal cited the emphasis of the DOE Nuclear Physics Division, the programme's US funding source on frontiers of nuclear physics. These areas include high spin states, heavy-ion reactions and astrophysics.

Presentations were given by each of the tasks force leaders, followed by a general discussion.

A.L. Nichols discussed applied user needs for consistent "quality assured" data and their desire to avoid using data files that include gaps on the data declared to be "unknown". The plan to perform metrology evaluations and produce adopted decay data sets in ENSDF was strongly supported by him.

J.K. Tuli emphasized the importance of prioritizing mass chain evaluation activities. New evaluations should be performed on the basis of the importance of the mass chain to users and the availability of new data.

The afternoon scientific session was devoted to high-spin physics. **J. Cizewski** discussed the urgent need for compilation and evaluation of the results of high-spin physics experiments. An experimental data file (combining several already existing files) should be created to provide rapid access of researchers to new data. This file should be in ENSDF format.

B. Singh noted the difficulty in accessing secondary literature where most new results appear before final publication.

F. Stephens, LBL, presented a lecture on the new Gammasphere detector and high spin physics. This new multiple coincidence detector allows very weak transitions to be seen for the first time. Tremendous amounts of new data are being generated by this facility and from the European EUROGAM detector. After the lecture, a tour of the Gammasphere facility was given.

On Tuesday morning, the meeting accepted **C.L. Dunford**'s proposal to develop a programme with committed resources for the next two years. In particular the plan should

make certain that a current and quality ENSDF database be maintained. The issues to be discussed might be

(a) Continuation of the mass chain evaluations,
(b) Integration of "horizontal evaluations" into ENSDF,
(c) Coordination of the diverse activities,
(d) Modernizing the data bases,
(e) Improved user access to the data produced.

The chairman, **C. van der Leun**, organized four working groups to discuss assigned issues and prepare draft conclusions, recommendations and plan of action. The groups with their chairmen and secretary were decided as follows:

- Coordination/Communication and Marketing: **C.W. Reich, G. Molnár**
- Optimization of Nuclear Data Evaluations: **A.L. Nichols, J. Cizewski**
- Data Base Development and Tools: **P. Ekström, T. Burrows**
- Dissemination of Information: **M.J. Martin, G. Audi**

The groups were to carry on parallel discussions for the following two days with one progress report to the entire meeting before a draft document was presented for final consideration.

A brief general discussion followed. **G. Molnár** mentioned the possibility of getting additional resources from Eastern European countries. This could be accomplished within current Western European programmes for cooperation in science with these countries. The meeting expressed the opinion that the two year cycle between network meetings was too long. A Consultant's Meeting of limited scope and attendance at no cost to the IAEA, to review progress and discuss problems, was proposed for the odd year.

On Tuesday afternoon, **M. Barnett**, the head of the LBL Particle Data Group, gave a presentation on their activities. This group publishes documentation concerning recommended properties of fundamental particles. A collaboration with the CERN Particle Data Group exists. The group scans the literature and assigns two staff members or collaborators to review independently each article determined to be relevant. Their particle property data base is updated on the basis of reviews of published data only. The database is published every two years.

On Tuesday evening and during coffee breaks several network developed PC codes were demonstrated, including

B. Potet, J. Duflo, G. Audi: NUCLEUS, a driver program for nuclear data visualization

B. Potet, G. Audi, O. Bersillon, J. Blachot: NUBASE for NUCLEUS, a program module for NUBASE database on PC

M. Konieczny, B. Potet, J. Rockey: A PC program for displaying data from the Joint Evaluated File (JEF) library

C. Stone: MacNuclide
J. James: Nuclear CD-ROM
Frank Chu: VuENSDF
R. Firestone: The Electronic Table of Isotopes
P. Ekström and E. Browne: Papyrus NSR.

On Thursday afternoon, another scientific session was held. This session heard presentations on decay data evaluation, nuclear astrophysics, radioactive-beam physics, nuclear masses and evaluating discrepant data.

Network publications were discussed briefly. The Nuclear Data Sheets will continue to be published. The hard copy form will continue as long as the publisher, Academic Press, sees a market. Electronic publication development will continue. The Table of Isotopes publication is nearly ready for publication. The book will be published by **John Wiley**. It will cost 145 US dollars for the 2 volume edition. A CD-ROM version will be included with the publication. The future of the publication and the method for updating the CD-ROM version has not been determined. A LATEX version of the Nuclear Physics publication for $A<21$ will be available as each mass chain is published. The brochure describing the network's activities and products was discussed as proposed at the last meeting and to be prepared by the Nuclear Data Section. The meeting was disappointed that the publication of this brochure was not approved by the IAEA Publication Committee. The IAEA was urged to publish an updated and professionally-designed brochure as soon as possible.

The full text of the meeting's **conclusions and recommendations** follows on page 11. The related **actions** are listed on page 19. The main points are:

(a) Priority must be given to the currency and quality of the ENSDF file;

(b) An organization of non-US network members was needed to provide improved communication with the US Nuclear Data network;

(c) A small meeting (to be held in between the IAEA Advisory Group Meetings) is needed to monitor network activities;

(d) A limited number of "horizontal" evaluations were endorsed to be integrated into ENSDF;

(e) A high-spin evaluation activity will be started;

(f) A radioactive decay evaluation activity will be started;

(g) New mass chain evaluations will be done on the basis of network assigned priorities;

(h) Improvements in the contents of the NSR files were planned;

(i) An ENSDF data entry and checking programme will be designed;

(j) Development of local and remote access to the network's data bases will continue in parallel;

(k) The Nuclear Data Sheets publication will continue;

(l) Promotional articles will be prepared, also for popular scientific journals;

(m) The Agency's meeting on a "Nuclear Wall Chart" database has broad interest and participation needs to be expanded.

The **next network meeting** will be held in Vienna in 1996 unless a proposal from a network member for another location is received within one year. Expression of interest has been received tentatively from Budapest, Hungary, (adjacent to the Capture Gamma-Ray Symposium in October 1996) and Orsay, France.

Conclusions and Recommendations

IAEA Advisory Group Meeting
on the Coordination of the

Nuclear Structure and Decay Data Evaluators' Network

The conclusions and recommendations were written by the following subgroups:

Coordination/Communication and Marketing Subgroup
C.W. Reich (Chair), G. Molnár (Secretary)

Optimisation of Nuclear Data Evaluations
A.L. Nichols (Chair), J.A. Cizewski (Secretary)

Database Development and Tools
L.P. Ekström (Chair), T.W Burrows (Secretary)

Dissemination of Information
M.J. Martin (Chair), G. Audi (Secretary)

Coordination/Communication

(1) Network coordination should be strengthened in order that all members of the network are kept informed of network activities and actions, identified action items are followed up and implemented, and new initiatives are developed, put forward, and acted upon in a timely manner.

a) Within the network, the establishment of a European executive committee, parallel to the existing U.S. Executive Committee was recommended to coordinate the activities of the non-U.S. network members. The participation of the non-European, non-US network members in the European committee will be coordinated through the IAEA. Because it is important that these two groups work together and communicate regularly, it was further recommended that the chairmen of the two groups establish a regular communication mechanism.

b) It is recommended that the two executive committees be charged with (i) developing a regular form of communication between all network members (e.g., electronic mailing), and (ii) a strategy for recruiting new evaluators.

c) It is recommended that IAEA sponsor an additional network meeting with limited scope and number of participants to focus on urgent issues in the "off" years (between the biennial meetings).

(2) The network needs to establish better contact with its user community. This community consists of both basic physics researchers and those working in fields where nuclear data are needed. The proposal for a high-spin evaluator is a good step in this direction. Because the community of applied users of nuclear data is much more diverse, their data requirements and the exact form of the interface need further study. Assignment of some evaluators to focus on the coordination of decay-data evaluation will begin this process.

Nuclear Data Evaluation

(3) The Nuclear Structure and Decay Data Evaluators' (NSDD) Network has proved to be a reasonably successful vehicle for the mass-chain evaluations. However, recent years have seen significant declines in the available expertise and a decrease in the funding originally envisaged as necessary for such an exercise. Furthermore, reductions in experimental work in specific mass regions do not warrant a systematic and comprehensive approach to the evaluation of all of the mass chains as in the past.

(4) In total, approximately 15 man-years of effort (FTE-full time equivalent) per annum are available for nuclear structure evaluations. This effort needs to be more carefully directed according to a set of agreed priorities.

(5) It is recommended that 20% of the available effort be directed now towards new areas of evaluation.

a) A level of 1 FTE should be devoted to the evaluation of the decay data for ~250 nuclides (primarily as standards, activation products, and medical nuclides) to be coupled to ENSDF. This exercise requires a coordinator to assist initially in defining an agreed list of radionuclides that will be evaluated to a pre-defined cut-off date.

b) A level of 2 FTEs from the current international effort plus a coordinator should be identified to compile and evaluate the data from heavy-ion induced gamma-ray spectroscopy. The evaluated high-spin state data file should be generated and incorporated into the ENSDF data files.

(6) Care needs to be taken by the NSDD Network to avoid delays in the remaining area of the program, namely the on-going mass chain evaluation. This effort will continue to require the balance of the network evaluators (11 or 12 FTEs). These A-chain evaluations will be selected in the future on the basis of

a) Prioritization, e.g., importance in basic physics research and applied fields.
b) Publication of significant quality (and quantities) of new data.

They should not be simply evaluated in an "automatic" mode. Therefore a small group (see item 10 below) will be assigned the task of prioritizing and coordinating the mass chain evaluations.

(7) The international evaluation effort should keep abreast of other areas where "horizontal" evaluations may be appropriate for possible incorporation into the ENSDF data files (see 5a above).

(8) The new decay data evaluation activity should be implemented as follows:

a) A Radioactive Decay Data subgroup should be established to determine which radionuclides and decay parameters should be evaluated, to prioritise and monitor these evaluations, and to integrate these evaluations into ENSDF.

b) The participating evaluators must justify and agree upon a list of ~250 radionuclides with a coordinator selected by the decay data subgroup (8g below) before beginning the work. They should meet to discuss the proposed radionuclide list during the IAEA Consultants Meeting in Vienna, October, 1994.

c) The evaluators will keep abreast of relevant data developments at all times.

d) Revised data will be initially released every 2 years to the user community. The new evaluations will be continuously integrated into the ENSDF file.

e) A rigorous mechanism must be agreed with the coordinator to "document" discrepancies within the evaluations and between published measurements, and to communicate these discrepancies to measurers, evaluators and users.

f) ENSDF data files represent an important starting point for this work in conjunction with original publications.

g) The Decay Data Subgroup will be: E. Browne (Lawrence Berkeley Laboratory), R.G. Helmer (Idaho National Engineering Laboratory), A.L. Nichols (Harwell, UK), and J.K. Tuli (Brookhaven National Laboratory).

(9) The new high-spin data file activity should be implemented as follows.

a) A job definition should be formulated by the US NDN for the coordinator of this work package. The role will include:

Prioritization of nuclides to be evaluated;
Review evaluations;
Integration of files into ENSDF.

This job should be filled as soon as possible, preferably by October 1994.

b) A small High-Spin Subgroup should be set up to assist the coordinator in determining evaluation priorities and establishing the high-spin data file. In addition to the coordinator, the subgroup will initially consist of

B. Singh (McMaster University, Canada)
A representative from the Gammasphere users community
A representative from the Eurogam users community

When the coordinator position is filled the composition of this subgroup will be re-examined.

c) Measurers of such data must send their data files to the coordinator for compilation and subsequent evaluation.

(10) The ongoing A-chain evaluation activity should be reorganised as follows.

a) Each head of the evaluation centres will be responsible for providing a list of priorities for A>44 mass-chain evaluations on an annual basis. A subgroup of the International Nuclear Structure and Decay Data Network is established to use this input to define priorities and assign these mass-chains to the available evaluation effort. This subgroup will be:

G. Audi (Orsay, France)
M. J. Martin (Oak Ridge National Laboratory)
B. Singh (McMaster University, Canada)
J. K. Tuli (Brookhaven National Laboratory)

b) Mass chain evaluation assignments will be reviewed and summarised every 2 years during the biennial meeting of the IAEA Advisory Group Meeting.

c) The A-chain Priority Subgroup should:

(i) Assign priorities;

(ii) Approach responsible evaluator (responsible for specific priority mass chain) to seek their agreement to undertake the necesssary evaluation(s).

(iii) If unable to get evaluators' concurrence on the required timescale, transfer evaluation to another evaluator.

(11) Data evaluation requirements should be reviewed every 2 years at the IAEA Advisory Group Meeting.

Database development and tools

(12) The data files NSR and ENSDF will increasingly be used for database applications. This will put additional demands on the homogeneity, scope, currentness, accuracy and completeness of these files.

(13) Actions should be taken to provide links between the NSR and experimental data files (e.g. EXFOR, HSDF) and with electronically published journals.

(14) To aid the evaluator and the ENSDF physics coordinator, a data entry/data checking program should be developed. NSR and ENSDF should be scanned with enhanced data-checking programs, and errors/inconsistencies should be corrected.

(15) To facilitate automatic conversion into other database formats, using the existing formats and the extended character set, the interpretation of information in ENSDF should as far as possible be unambiguous.

(16) Inclusion of experimental data files into ENSDF and the fact that only selected parts of mass-chains will be used in some applications, puts new demands on the identification, classification and documentation of the data source in the data sets.

(17) Eventually, ENSDF will have to be converted into a relational database. Work should be initiated to show how this can be achieved, taking into account all relationships implied by accepted physics knowledge A subgroup consisting of G. Audi (Orsay), R. Firestone (Lawrence Berkeley Laboratory), C. Stone (San Jose) and J. Tuli (Brookhaven National Laboratory) will be responsible for this planning.

(18) In order to support the development of the databases, the network will need a system for information and discussions. It is proposed that e-mail/fax groups are set up for the different subjects.

Dissemination

(19) The Nuclear Structure and Decay Data (NSDD) Network should disseminate through the data distribution centers, the following recommended data.

a) ENSDF and derived databases, outputs and subsets useful to the user community

b) NSR useful to a broad research community

c) Databases of masses, isotopic abundances, high-spin data, radioactivity, nuclear moments and photo atomic data

d) Analysis and extraction programs related to the above databases

(20) The network also supports the dissemination of other specialised nuclear data such as ENSDF updates, NUBASE and nuclear "Wall Charts". Evaluated nuclear reaction data, although not within the scope of this network, are of value to the entire nuclear data community.

(21) These data will continue to be distributed as printed publications, on-line access and computer-readable media such as CD-ROMs.

(22) The Nuclear Data Sheets journal publication should be continued because

a) Evaluators from several countries (e.g. Japan, Belgium, Kuwait, China, and Canada) may loose their support if they are not associated with refereed hard copy publications (NDS). At least 4 FTE outside US are affected

b) In many countries there is no easy access to on-line and/or to CD-ROM

c) Almost no money would be saved if stopped

d) Before hard copy is suppressed, we need to be sure that the archival aspects are guaranteed.

(23) The on-line access to the NSDD network products is important and development should continue.

a) The full-screen mode of the on-line service is quite user-friendly, but not the line-by-line mode. The user should be encouraged to go to full screen mode. A simplified manual of a very few pages should be produced with directions added on how to get full screen mode on most of the available terminals.

b) Database updates should be transmitted to NEA and IAEA at least on a monthly basis, and should move to a "drop-through" mode (in which the user connecting to one of these centres would transparently log in directly to NNDC).

c) The distribution data centres (IAEA, NEA, NNDC), should coordinate development activities, for example, to increase speed of data access, which is highly desirable.

(24) Local access to NSDD network products is also extremely valuable. Development of applications and data distribution packages should continue for the following products in priority order.

a) Table of Isotopes in page image
b) Nuclear Data Sheets in page image
c) ENSDF file
d) NSR (at least for key references used in ENSDF)
e) Analysis and Extraction Programs to derive outputs, cuts and subsets of ENSDF (executables on PC, Mac, UNIX Workstation, VAX Workstation, etc.)
f) NUDAT
g) RADLIST
h) Gammas sorted by energy
i) Complete NSR

An estimate of space requirement for each item should be made to determine how much will fit in a CD-ROM.

Marketing

(25) The purpose of the marketing activity should be to promote the use of NSR, ENSDF and their products.

(26) The network must do a better job of identifying suitable markets and advertising products. Because of its origin in the basic nuclear-physics community, this community is, at least to some extent, aware of two of the products of the network, namely the Nuclear Data Sheets and the Table of Isotopes. Efforts to increase awareness in this community should continue; and the addition of a "high-spin coordinator" within the Network should help in this process.

(27) However, more needs to be done with regard to the users of nuclear data who are working in other disciplines. Some possible ways to achieve this are:

a) Publish concise overview articles and news items describing the Network activities and products in appropriate journals. C. Stone has volunteered to lead such an effort. C. van der Leun has expressed a willingness to explore the possibilities in media such as Nuclear Physics News and Europhysics News in Europe.

b) Request that the IAEA Nuclear Data Section prepare suitable promotional material regarding the Network and its products, and distribute them to the broadest feasible audience within the channels available to them.

c) Request that the Network members identify as many laboratories and individuals using nuclear data as possible as a first step in informing them about the nuclear data available in ENSDF and its various derivatives.

d) Establish contacts and promote interaction with nuclear instrument manufacturers and their user groups. R.G. Helmer, for example, has been asked to make a presentation during a user's group meeting set up by one such manufacturer in the U.S. Between 100 and 150 people are expected to attend.

e) Exhibit and demonstrate Network products at meetings of various professional and technical societies.

f) Stimulate inclusion of acknowledgements to Network input in, or contributions to, scientific publications. Suggested examples of acknowledgements should be prepared by the Network.

Action Items

Coordination/Communication

1.	Van der Leun	Set up a European executive committee to coordinate the activities of the non-U.S. evaluators.
2.	Chairs Executive Committee	Establish appropriate means of communication between the U.S.and European executive committees.
3.	European Executive Committee	Attempt to include data evaluation activities in the NuPECC long-range plan.
4.	IAEA NDS	Arrange for network meetings of limited scope in the alternate years.
5.	Executive Committee	Develop strategy for recruiting new evaluators.
6.	Burrows	Implement an e-mail system for news and discussions on different network related subjects.

Horizontal Evaluations

7.	Browne, Helmer,	Establish list of radionuclides for which the decay data will
be	Nichols, Tuli	evaluated, prioritize and monitor the evaluations, and incorporate evaluated data into ENSDF.
8.	Browne, Helmer	Organize an effort (at an estimated level of 1 FTE) to evaluate the decay data for about 250 nuclides.
9.	Browne, Helmer	Discuss proposed list of radionuclides for which the decay data are to be evaluated at IAEA Consultants Meeting in Vienna in October 1994.
10.	Browne, Helmer	Release updates of decay data for the selected radionuclides every two years, beginning in 1996.
11.	Browne, Helmer	Establish a mechanism to document discrepancies within the decay data evaluations and between published measurements, and communicate these discrepancies.
12.	Singh	Organize effort to a level of about 2 FTEs to evaluate the data from heavy-ion induced gamma-ray spectroscopy experiments.

13.	U.S. Executive Committee	Define and fill a new position for a high-spin coordinator by October 1994.
14.	U.S. Executive Committee	Establish a small group to assist the coordinator in assigning priorities, and assure that the data are inserted into ENSDF.
15.	Network	Keep abreast of and solicit activities in other areas where horizontal evaluations may be appropriate in the future for incorporation into ENSDF.

A-Chain Evaluations
(for subgroup members see item (10) of the Conclusions and Recommendations)

16.	Evaluation Center Heads	Inform the A-chain-priority subgroup concerning the current evaluation needs for A>44. This information should be updated annually.
17.	A-chain priority subgroup	Analyze the known evaluation needs and determine the evaluation priorities for the next period (by July 1).
18.	Network	Consult the A-chain priority list and the subgroup before beginning new evaluations.
19.	Network	Review data evaluation needs at the IAEA Advisory Group Meeting of the Network.
20.	Evaluators	Respond to reviewers comments without delay.

Database development and tools: NSR

21.	NNDC	Continue development of procedures to do "basic" entry of articles from main nuclear physics journals automatically. Expand contributions from other centers.
22.	NNDC	Add new selectors which are appropriate for the new categories of references that will be entered. If no more specific keywords are available, use PACS number (decoded).
23.	U.S. Executive Committee	Secure the continuity of scanning and entry of references into the NSR.

24. NNDC	Implement the proposal to add a data index line to NSR to facilitate retrieval of experimental data (e.g., EXFOR, HSDF).
25. NNDC/IP	Look into both the benefits and any problems of duplication of efforts with the activities of both the Particle Data Group and the TUNL group.

Database development and tools: ENSDF
(for subgroup members see item (17) of the Conclusions and Recommendations)

26. Burrows, Chu	Define specifications for the input/checking program.
27. Network	Give the file editor/physics coordinator authority to make corrections to the file.
28. Burrows	Enhance FMTCHK to signal missing FL= information or missing final levels.
29. NNDC	Correct obvious errors in ENSDF, e.g., o Missing FL= information o Missing final levels o Parent records o Inconsistent multipolarities/Spin parities
30. NNDC	Propose and implement format to include information about the evaluator/spokesperson/status in all data sets.
31. NNDC	Propose and implement classification/identifier to ID field so that data sets with the same DSID can be uniquely identified.
32. Network	Begin planning for the implementation of ENSDF into a relational-database.
33. NNDC/IP	Start converting comment records into the alternate character set and store the comments in this way in ENSDF.

Dissemination

34. Network	Disseminate a file of nuclear moments.
35. Network	Continue the production of a journal "publication" for the mass chain evaluations.
36. NNDC	Continue to improve the on-line system, adding a simplified manual and directions on how to get full-screen mode.

37. NNDC, IAEA, NEA	Update the NEA and IAEA databases more frequently and, in the future, move to a "drop-through" mode, whereby users connecting to either NEA or IAEA would transparently log in directly to NNDC.
38. NNDC, IAEA, NEA	Coordinate computer/distribution development activities in the three distribution centers.
39. Network	Develop distribution of data on CD-ROMs, giving first priority to the *Table of Isotopes*, *Nuclear Data Sheets*, ENSDF, NSR, and analysis and extraction programs.

Marketing

40. Stone	Prepare articles for publication regarding network activities and its products. Network approval should be sought prior to any publication.
41. Van der Leun	Explore the possibilities of inclusion of articles and news items regarding the Network in European media.
42. Network	Provide comments on current draft brochure to IAEA (by August 31, 1994).
43. IAEA/NDS	Prepare and distribute promotional material regarding the Network and its products in 1994. In particular there should be a brochure, professionally produced if possible.
44. Network	Identify as many laboratories, individuals and companies using nuclear data as possible.
45. Network	Demonstrate network products to appropriate audiences.
46. Network	Stimulate inclusion of acknowledgments to the Network in scientific and technical publications.
47. Stone, James	Contact members of the health physics community in the U.S. concerning the data needs of that community.
48. Stone	Carry out a study of how nuclear data can impact on nuclear science and health physics education.

ANNEXES

Annex 1

IAEA Advisory Group Meeting on the
Coordination of the
Nuclear Structure and Decay Data Evaluators' Network
16-20 May 1994
in San Francisco/Berkeley, California, USA

hosted by the Lawrence Berkeley Laboratory, University of California
on behalf of the U.S. Government

Scientific Secretaries: C.L. Dunford, H.D. Lemmel

LIST OF PARTICIPANTS

BELGIUM
Denis de Frenne
Laboratorium voor Kernfysika
Proeftuinstraat 86
B-9000 Gent
Tel. +32-91-646-532
Fax +32-91-646-699
BITNET: INWFF@BGERUG51

CANADA
Balraj Singh
Tandem Accelerator Laboratory
McMaster University
Hamilton, Ontario L8S 4K1
Tel. 416-525-9140ext. 3631
Fax 416-335-8540
Telex 061-8347
BITNET: BALRAJ@MCMASTER

CHINA
Huo Junde
Department of Physics
Jilin University
Changchun 130023
Tel. 86-431-822-331
ext. 3131 or 2502
Fax 86-431-823-907
Telex 83040 juc cn

Zhou Chunmei
Chinese Nuclear Data Centre
Institute of Atomic Energy
P.O. Box 275 (41)
102413 Beijing
Tel. 86-1-935-7830
Fax 86-1-935-7008
Telex 222373 iae cn

FRANCE
Jean Blachot
C.E.N. de Grenoble
SPSMS/LIH - 85 X - 38041
F-38041 Grenoble Cédex
Tel. (76) 88-39-26
Fax 76885109
Telex 320323 ene f

G. Audi
CSNSM, IN2P3-CNRS
Laboratoire René Bernas
Bâtiment 108
91405 Orsay Campus
Tel. +33-1-6941-5223
Fax +33-1-69415268
BITNET: AUDI@FRCPN11.IN2P3.FR

HUNGARY
Gábor Molnár
Department of Nuclear Physics
Institute of Isotopes
Hungarian Academy of Sciences
H-1525 Budapest, P.O.B. 77
Tel. +36-1-275-4347
Fax +36-1-275-4349

JAPAN
Hideki Iimura
Nuclear Chemistry Laboratory
Department of Chemistry
Japan Atomic Energy Research Institute (JAERI)
2-4 Shirakata-shirane
Tokai-mura, Naka-gun
Ibaraki-ken 319-11
Tel. +81 292-82-5525
Fax +81 292-82-6097
Telex 3632340
BITNET: J4231@JPNJAERI

KUWAIT
Ameenah R. Farhan
Nuclear Data Project
Kuwait Institute for Scientific Research
P.O. Box 24885
13109 Safat
Tel. 965-484-9553
Fax 965-484-6891,438-7436
Telex 22299 kisr kt

NETHERLANDS
C. Van der Leun
Robert J. Van de Graaff Laboratorium
Princetonlaan 4
3508 TA Utrecht
Tel. +31-30-531492
Fax +31-30-518689
Telex 40048 fylut nl

RUSSIA
I.A. Kondurov
Data Centre
Petersburg Nuclear Physics Institute
Gatchina, St. Petersburg 188350
Tel. +7-81271-30569
Fax +7-81271-37196
INTERNET: KOND@LNPI.SPB.SU

Yu.V. Sergeenkov
Data Centre
Petersburg Nuclear Physics Institute
Gatchina, St. Petersburg 188350
Tel. +7-81271-30569
Fax +7-81271-37196
INTERNET: KOND@LNPI.SPB.SU

SPAIN
J.M. Los Arcos
Metrología de Radiaciones
Centro de Investigaciones Energéticas,
Medioambientales y Tecnológicas
(CIEMAT)
Avenida Complutense, 22
E-28040 Madrid
Tel. 346-6000
Fax 346-6005

SWEDEN
Peter Ekström
Department of Physics
Lund University
Sölvegatan 14
223 62 Lund
Tel. +46-46-107-647
Fax +46-46-104-709
BITNET: GARBOPE@SELDC52

UNITED KINGDOM
T.D. MacMahon
Centre for Analytical Research
in the Environment
Imperial College at Silwood Park
Buckhurst Road
Ascot, Berkshire SL5 7TE
Tel. +44-344-294290
Fax +44-344-24931

A.L. Nichols
AEA Technology Environmental
and Process Engineering
404 Harwell, Didcot
Oxfordshire OX11 0RA
Tel. 0235-434-113
Fax 0235-436-285

U.S.A.
M.R. Bhat
National Nuclear Data Center
Bldg. 197D, P.O. Box 5000
Brookhaven National Laboratory
Upton, N.Y. 11973-5000
Tel. 516-282-2814
Fax 516-282-2806
Telex 6852516 bnl doe us
BITNET: NNDCMB@BNL

E. Browne
Nuclear Sciences Division
1 Cyclotron Road
Lawrence Berkeley Laboratory
Berkeley, CA 94720

T.W. Burrows
National Nuclear Data Center
Bldg. 197D, P.O. Box 5000
Brookhaven National Laboratory
Upton, N.Y. 11973-5000
Tel. 516-282-2902
Fax 516-282-2806
Telex 6852516 bnl doe us
BITNET: NNDCTB@BNL

Jolie A. Cizewski
Rutgers State University
Department of Physics & Astronomy
P.O. Box 849
Piscataway, NJ 08854

Janis Dairiki
Bldg. 70A, Room 3307
Lawrence Berkeley Laboratory
1 Cyclotron Road
Berkeley, CA 94720
Tel. 510-486-5673
Fax 510-486-5757
BITNET: DAIRIKI@CSA5.LBL.GOV

Richard B. Firestone
Nuclear Sciences Division
1 Cyclotron Road
Lawrence Berkeley Laboratory
Berkeley, CA 94720
Tel. 510-486-7646
Fax 510-486-5757

M.J. Martin
Nuclear Data Project
Bldg. 6000, MS-371
Oak Ridge National Laboratory
P.O. Box X
Oak Ridge, TN 37831
Tel. 615-574-4691
Fax 615-574-1268

R.A. Meyer
ER-23 GTN
Division of Nuclear Physics
U.S. Department of Energy
Washington D.C. 20585
Tel. 301-903-3833
Fax 301-903-3613

C.W. Reich
MS2219
Idaho National Engineering Lab.
EG & G Idaho Inc.
P.O. Box 1625
Idaho Falls, ID 83415
Tel. 208-526-4159
Fax 208-526-9822

Craig A. Stone
Department of Chemistry
San José State University
San José, CA 95192-0101
Tel. 408-924-4940
Fax 408-924-4945

D.R. Tilley
Triangle University Nuclear Laboratory
Duke University
Durham, NC 27706

J.K. Tuli
National Nuclear Data Center
Bldg. 197D, P.O. Box 5000
Brookhaven National Laboratory
Upton, N.Y. 11973-5000
Tel. 516-282-5080
Fax 516-282-2806
BITNET: NNDCJT@BNL

I.A.E.A.
C.L. Dunford
IAEA Nuclear Data Section
Wagramerstr. 5, P.O. Box 100
A-1400 Vienna, Austria
Tel. +43-1-2360-1709
Fax +43-1-234564
BITNET: RNDS@IAEA1
INTERNET:DUNFORD@IAEAND.IAEA.OR.AT

OECD/Nuclear Energy Agency
M. Konieczny
Le Seine Saint-Germain
12, boulevard des Iles
F-92130 Issy-les-Moulineaux, France
Tel. +33 (1) 4524-1085
Fax +33 (1) 45241110
BITNET: KONIECZN@FRNEAB51
INTERNET: KONIECZN@NEA.FR

Part-time participants from U.S.A.:

BNL:	S. Ramavataram
LBL:	C. Baglin F. Chu J. Zipkin
LLNL:	J. Becker
ORNL:	A. Artna-Cohen S. Rab M. Schmorak
TUNL:	R. Chasteler C.M. Cheves
UC Berkeley:	J. James C.M. Lederer J. Vujic

DATA EVALUATION CENTERS

status of 1992/1994

a. National Nuclear Data Center
Brookhaven National Laboratory
Upton, NY 11973, U.S.A.
Contact: M.R. Bhat

b. Nuclear Data Project
Oak Ridge National Laboratory
Oak Ridge, TN 37831, U.S.A.
Contact: M.J. Martin

c. Isotopes Project
Lawrence Berkeley Laboratory
Berkeley, CA 94720, U.S.A.
Contact: J.M. Dairiki

d. Idaho National Engineering Laboratory
E.G. & G. Idaho, Inc.
P.O. Box 1625
Idaho Falls, ID 83415, U.S.A.
Contact: R.G. Helmer

e. Triangle University Nuclear Laboratory
Duke University
Durham, NC 27706, U.S.A.
Contact: H.R. Weller/D.R. Tilley

f. Center for Nuclear Structure and Reaction Data
I.V. Kurchatov Institute of Atomic Energy
46 Ulitsa Kurchatov
123 182 Moscow, Russia
Contact: F.E. Chukreev

g. Nuclear Data Center
St. Petersburg Nuclear Physics Institute
Academy of Sciences of Russia
Gatchina, Leningrad Region
188 350, Russia
Contact: I.A. Kondurov

h. Fysisch Laboratorium
Princetonplein 5, Postbus 80.000
3508 TA Utrecht, The Netherlands
Contact: C. Van der Leun

i. Chinese Nuclear Data Center
Institute of Atomic Energy
P.O. Box 275 (41), Beijing, China
Contact: Zhang Jingshang, Zhou Chunmei

ii. Nuclear Physics Laboratory
Jilin University
Changchun 130023, China
Contact: Huo Junde

j. Centre d'Etudes Nucléaires
DRF-SPH
Cedex No. 85
F-38041 Grenoble Cedex, France
Contact: J. Blachot

k. Nuclear Data Center
Tokai Research Establishment, JAERI
Tokai-Mura, Naka-gun
Ibaraki-Ken 319-11, Japan
Contact: Y. Kikuchi

l. Institute of Physics
University of Lund
Sölvegatan 14
S-223 62 Lund, Sweden
Contact: P. Ekström

m. Nuclear Data Project
Kuwait Institute for Scientific Research
P.O. Box 24885
Kuwait, Kuwait
Contact: A. Farhan

n. Laboratorium voor Kernfysica
Proeftuinstraat 86
B-9000 Gent, Belgium
Contact: D. De Frenne

o. Tandem Accelerator Laboratory
McMaster University
Hamilton, Ontario L8S 4K1, Canada
Contact: J.A. Kuehner

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	82,84,85,200-205,207-209, 213-236 (except 215,219,223,227), 237-243(odd),244-266
c. US/LBL	81,83,89-93,167-194,206,210-212, 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

NSDD DISTRIBUTION CENTERS

National Nuclear Data Center
Brookhaven National Laboratory
Upton, NY 11973, U.S.A.
Contact: J.K. Tuli

OECD Nuclear Energy Agency
Le Seine St. Germain
12, blvd. des Iles
F-92130 Issy-les-Moulineaux, France
Contact: N. Tubbs

Center for Nuclear Structure and Reaction Data
I.V. Kurchatov Institute of Atomic Energy
46 Ulitsa Kurchatova
123182 Moscow, Russia
Contact: F.E. Chukreev

IAEA Nuclear Data Section
Wagramerstr. 5, P.O. Box 100
A-1400 Vienna, Austria
Contact: C.L. Dunford

Fachinformationszentrum Energie, Physik,
Mathematik GmbH
Kernforschungszentrum
D-76344 Eggestein-Leopoldshafen, Germany
Contact: H. Behrens

Annex 4

IAEA Advisory Group Meeting on the
Coordination of the Nuclear Structure and Decay Data Evaluators' Network

San Francisco/Berkeley, California, USA
16-20 May 1994

hosted by the Lawrence Berkeley Laboratory, University of California
on behalf of the U.S. Government

AGENDA

The objectives of the meeting are to coordinate all centres and groups that participate in the compilation, evaluation and dissemination of Nuclear Structure and Decay Data (NSDD), to review the development and common use of the computerized ENSDF database maintained specifically for this activity, and to provide for the publication of evaluated NSDD in "Nuclear Data Sheets" and other print and electronic media.

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

B. NSDD Network reports
   1. Short status reports by the participants
   2. Brief discussion of the reports

C. Proposals of the U.S. Nuclear Data Network (USNDN)
   1. Reports from the USNDN,
      its Executive Committee and Task Forces
   2. General comments on the USNDN proposals

D. What should be achieved at this Meeting?
   1. Review of the agenda: What to discuss under which item?
   2. Formation of subgroups as appropriate, and definition of their tasks

E. Detailed discussion of the USNDN proposals
   1. What would be the role of the network evaluators?
   2. Mass-chain evaluations and horizontal evaluations
   3. Coordination and priorities
   4. Database development/definition
   5. Code development
   6. Tools for evaluators
   7. Publication of evaluations
   8. Output for users

F. Workplan for the next 2 years: who will do what?
   1. Database maintenance
   2. Contributions by evaluators' network
   3. Guidance of evaluators
   4. Data transmission to the data service centers

Working Groups

   1. Coordination/Communication and Marketing
   2. Optimization of Nuclear Data Evaluations
   3. Data Base Development and Tools
   4. Dissemination of Information

G. Publication and data dissemination
   1. Current publications
      - Nuclear Data Sheets
      - Nuclear Physics ($A \leq 44$)
      - Handbooks
      - Other
   2. On-line
   3. PC
      - near-term releases MacNuclide, TOI, NSR, VuENSDF
   4. CD-ROM
   5. Future directions

H. Miscellaneous topics
   1. Which mass table is now to be used?
   2. Proposed IAEA information brochure
   3. Publicity
   4. Next meeting:
      - programme of the meeting
      - date and place of the meeting
   5. Miscellaneous

I. Conclusions

Scientific part of the agenda

I. High-Spin Scientific Afternoon
1. Summary of the High-Spin Evaluation Task Force
2. Gammasphere: Physics and facility
3. Discussion of high-spin evaluation

Gammasphere tour

II. Michael Barnett, Particle Data Group

III. Software demonstrations

IV. Physics
1. E. Browne: Summary of the U.S. Decay Data Sub-Task Force
2. E.B. Norman: Nuclear astrophysics
3. J.M. Nitschke: Radioactive beam physics
4. G. Audi: Nuclear masses
5. T.D. MacMahon: Evaluating Discrepant Data

Social events

Monday	18:00 - 21:30	Welcoming Dinner and Beerfest at the Firestone's
Wednesday	12:00 - 18:00	Wine country expedition
Thursday	18:30 - 21:30	Banquet at California Culinary Academy

SCHEDULE

	Monday	Tuesday	Wednesday	Thursday	Friday
09:00 - 10:30	agenda A	agenda D	8:30 - 10:00 Working Groups	Final Working Group Discussions	agenda G and H
10:30 - 10:50			10:00 - 11:30		
10:50 - 12:15	agenda B	agenda E	Preliminary Working Group Reports	Final Working Group Reports	agenda I conclusions
12:15 - 13:30			12:15		12:30 Adjourn
13:30 - 15:00	agenda C I. High Spin	II. Barnett agenda E	**Excursion**	agenda F Drafting conclusions/actions	
15:00 - 15:20					
15:20 - 17:30	I. cont'd 16:15 - 17:00 **Gammasphere tour**	agenda E (cont'd) III. Software demos	18:30	IV. Physics	

Status Reports

5.1 D. De Frenne, E. Jacobs: Status report Belgian group

5.2 B. Singh: Status report of the Nuclear Data Project at McMaster University

5.3 Chinese contributions:

a) Zhou Chunmei, Huo Junde: Nuclear structure and decay data evaluation for A-chain in China
b) Huo Junde, Liu Yunzuo: Progress on nuclear data at Nuclear Physics Laboratory of Jilin University

5.4 J. Blachot, G. Marguier: French contribution to NSDD

5.5 H. Iimura: Status report of Japanese activities in nuclear structure and decay data

5.6 A. Farhan: Status report, Kuwait Nuclear Data Project, Kuwait Institute for Scientific Research

5.7 Russian contributions:

a) F.E. Chukreev: Nuclear structure and decay data evaluation in CAJaD
b) I.A. Kondurov, Yu.V. Sergeenkov: Status report on NSDD activities of PNPI data centre

5.8 P. Ekström: Nuclear structure and decay data evaluation in Sweden

5.9 UK contributions:

a) A.L. Nichols: UK nuclear data evaluations, progress report
b) T.D. MacMahon: Status report Imperial College

5.10 C. van der Leun: Status report Utrecht

5.11 C.L. Dunford, H.D. Lemmel: IAEA Nuclear Data Section, progress report

5.12 M.R. Bhat: U.S. contribution to the evaluation of nuclear structure data and related activities

a) R.G. Helmer, C.W. Reich: INEL mass-chain evaluation project
b) C. Baglin, E. Browne, F. Chu, J.M. Dairiki, R.B. Firestone, B. Singh, V.S. Shirley, J. Zipkin: Isotopes Project status report
c) M.R. Bhat: National Nuclear Data Center activity report
d) M.J. Martin: ORNL Nuclear Data Project
e) D.R. Tilley, H.R. Weller, C.M. Cheves, R.M. Chasteler: TUNL A=3-20 data project report

5.1 STATUS REPORT BELGIAN GROUP

D. De Frenne, E. Jacobs

Although the situation with respect to low energy physics in Belgium is not the best we will still keep our reponsability for the masses A=102; 103; 105; 106; 110 en 112 for the next years.
Since last meeting in Geel in 1992, we published an update for A=105 and send to Brookhaven A=106. For this year we will start the evaluation of mass chain A=112.
Apart from evaluating mass chains we are still involved in a number of other activities in different domaines.
First of all we are continuing our efforts in the study of high energy dipole and quadrupole transitions in spherical and deformed nuclei using nuclear resonance fluorescence techniques at our 15 MeV linear accelerator in Gent. We just finished a study of ^{116}Sn where we found some 70 dipole transitions which all but one turned out to be E1's. The work on ^{124}Sn is almost finished. This work is also part of an internal network where other labs as KVI Groningen, Münster, Bari and Milano are participating.
We have also performed electro- and photofission studies of ^{236}U and ^{232}Th and measured angular distributions of the fissionfragments. We found evidence for the existence of a fission isomer in the second well for both nuclei and could determine the fission barrier parameters for both nuclei.
From next year on we will be involved, for a period of 5 years, in a common project together with the agriculture and organic chemistry divisions of the university of Gent. The aim of the project is to study the preservation of food and the sterilization of biomaterials by irradiation with electrons and gammas. We will also remain active in bone cancer therapy.
From ESA we got a budget of 1.3 M$ for the next 5 years, to develop a biological dosimeter based on the damage on the human bone marrow cells caused by HZE particles in spacecrafts. This research will be performed in collaboration with a number of radiobiologists of the university of Ghent. The launching of the BION satellite with our experimental setup by a Russian missile is foreseen for the end of 1996.

Status report of the Nuclear Data Project at McMaster University (Nov. 1992 - May 1994) (B. Singh)

Mass Chains:

The McMaster group has responsibility for the evaluation of 5 mass chains with about 0.5 FTE financial support. Since the 1992 IAEA meeting of this group, the following mass chains have been published or submitted for publication:

A=98 (update), Nuclear Data Sheets **67**, 693-807 (1992).
A=149 (update), Nuclear Data Sheets (submitted Feb. 94; at review stage).

Work is currently in progress on **A=151** which was last published by the McMaster group in 1988. It is expected that this mass chain will be completed and submitted by spring 1995. The mass chains **A=100** and **A=64** were published in 1990 and 1991, respectively. The average age of the mass chains (not being evaluated) assigned to McMaster is about 2.5 years and none is older than 4 years.

In association with the Isotopes Project at Berkeley, the following mass chains have been published or submitted since the 1992 meeting:

A=79 (update), Nuclear Data Sheets **70**, 437-529 (1993)
A=76 (update), Nuclear Data Sheets (submitted Dec. 1993; at review stage).

Work is currently in progress on **A=172** which was last published by the Chinese group in 1987. This mass chain is expected to be submitted by October 1994.

Superdeformed bands:

In an attempt to make the ENSDF more current for the recent high-spin data dealing particularly with the subject of superdeformation, a collaborative effort with the Berkeley group has been undertaken to evaluate and update data on superdeformed bands in nuclei. For each nuclide, where superdeformation has been reported, two datasets were updated, the reaction dataset (such as (HI,xnγ)) and the adopted dataset. The first version of this work was completed in April, 93 and a booklet was prepared which contained tables and figures for all the superdeformed bands known at the time. This booklet was sent to several researchers at laboratories engaged in high-spin work, for their comments. In August, 93 these data were included in the ENSDF to make these available for on-line retrieval purposes. A second revision and updating was completed about a month ago to include all the literature on this subject up to April 7, 1994. This revision also included the updating of fission isomer data, a subject which is closely related to superdeformation in nuclei. The most recent version of the monograph will include all such data, presented in the form of tables and figures. A complete reference list is provided in three parts for superdeformation-experimental, superdeformation-theory, and fission isomers, respectively. Computer files, in the ENSDF format (39 for SD bands, 6 for fission isomers, and three for reference keynumbers) are available on two floppy disks. The future plan is to update these data about once every year.

continued...

Mass-Chain Priority Status:

Reference lists were scanned for about 25 mass chains, published prior to 1987, to determine if some of the mass chains need to be given a priority for their evaluation. The results were conveyed to BNL, LBL, and ORNL data centers and they have probably used this information in some way. This search also suggested, as expected, that a large percentage of papers published in experimental nuclear structure deal with high-spin gamma-ray studies. On a trial basis **A=124** mass chain (published in 1982) was chosen to determine the amount of time it would take to update all the high-spin data available for this mass chain. There was very little high-spin data available at the time of the 1982 NDS. Subsequently, many papers in high-spin studies in **A=124** have been published. It took about 10 work days to evaluate and update all the high-spin data for **A=124** in the reaction datasets. This gives some idea as to the total amount of time it may take to bring all the published high-spin data for all nuclides to current level.

Review of Mass Chains:

Two mass chains were reviewed at McMaster during 1992-94, one in 1993 and another in 1994.

Other Research Activities:

Following research papers were published on work done in collaboration with a researcher from the University of Toronto:

H.W. Taylor and **B. Singh**, Radioactivity in Fine Papers, Jour. Environ. Radioactivity **21**, 177-187 (1993).

B. Singh and H.W. Taylor, Half-lives of Microsecond Isomers in ^{151}Eu and ^{181}W, Appl. Rad. Isot. **45**, 374-376 (1994).

A proposal for in-beam gamma-ray studies of level structure of the odd-odd nucleus **^{168}Tm** was initiated by **B. Singh** and presented in Dec. 93 at a PAC committee meeting of P.S.I. Cyclotron facility, Switzerland. This project is a collaboration of 10 researchers from four institutions: University of Fribourg (Drissi S., Garrett P.E., Jolie J, Kern J., Lehman H and Warr N.); McMaster University (Burke D.G. and **Singh B.**); Banaras Hindu University (Sood P.C.) and University of Toronto (Taylor H.W.). The proposal was accepted by the PAC committee and 76 shifts of experiment time were allotted. The first experiments are scheduled for July 1994.

Funding:

The Natural Sciences and Engineering Research Council (NSERC) of Canada supports about 0.5 FTE of the evaluation effort at McMaster. The present grant continues up to March, 95 and we intend to apply to NSERC for renewal in Fall 1994. The work on mass chains A=79, 76, and 172 is financed by about 0.5 FTE support from the Isotopes Project in Berkeley.

Nuclear Structure and Decay Data Evaluation for A-Chain in China

Zhou Chunmei
Chinese Nuclear Data Center
Institute of Atomic Energy
P.O.Box 275 (41), Beijing 102413

Huo Junde
Department of Physics
Jilin University, Changchun 130023

The chinese group has permanent responsibility for evaluating and updating NSDD for A=51-56, and 195-198. The status is follows:

Updated-A	Status	Evaluator
51	NDS, 63,229(1991)	Zhou Chunmei, CNDC
52	submitted	Huo Junde, Jilin U
53	NDS, 61,47(1990)	Huo Junde, Jilin U
54	NDS, 68,887(1993)	Huo Junde, Jilin U
55	NDS, 64,723(1991)	Huo Junde, Jilin U
56	NDS, 67,523(1992)	Huo Junde, Jilin U
*61	NDS, 67,271(1992)	Zhou Chunmei, CNDC
195	NDS, 71,367(1994)	Zhou Chunmei, CNDC
196	submitted	Wang Gongqing, Shanghai
197	NDS, 62,433(1991)	Zhou Chunmei, CNDC
198	submitted	Zhou Chunmei, CNDC

*, temporally assigned to China.

5.3

Progress on Nuclear Data at Nuclear Physics Laboratory of Jilin University in 1998

Huo Junde Liu Yunzuo
(Department of Physics, Jilin University, China)

1. Nuclear Data Evaluation

1.1 A=64 Mass Chain

The nuclei involved in the evaluation of nuclear structure and decay data for A=64 mass chain are ^{64}K, ^{64}Ca, ^{64}Sc, ^{64}Ti, ^{64}V, ^{64}Cr, ^{64}Mn, ^{64}Fe, ^{64}Co, ^{64}Ni, ^{64}Cu. The 1987 evaluation of nuclear data sheets for A=64 (published in Nuclear Data Sheets, Vol. 50, 255 (1987)) has been revised by using experimental data from nuclear reaction and decay studies.

Nuclear data sheets for updating of A=64 has been published in Nuclear Data Sheets, Vol. 68, 887 (1993).

2.2 A=52 Mass Chain

The 1989 evaluation of nuclear data sheets for A=52 (published in Nuclear Data Sheets, Vol. 58, 677(1989)) has been updated using experimental nuclear structure and decay data. Many of the data sets presented in the last evaluation are re-evaluated.

The evaluated result has been sent to NNDC, U.S.A., and will be published in Nuclear Data Sheets.

2. Nuclear Decay Data Meassurement

2.1 On some new levels in ^{183m}W

In a recent study[1], five new γ-rays and two new levels were claimed to have been observed in the decay of ^{183}Ta. The energies and relative intensities of these γ-rays are: 49.48 keV(4.49), 136.65 keV(0.12), 146.72 keV(0.04), 169.34 keV(0.20) and 1294.57 keV(0.08), where the intensities are given in parentheses and normalized to the 1121.33 keV γ-ray (I_γ(rel)=100). The level at 1624.07 keV is depopulated by two γ-rays: 1294.57 and 136.65 keV. The level at 1656.64 keV is depopulated by two γ-rays: 146.72 and 169.34 keV. Figure 2 of [1] was given to show the coincidence relation 1294.57 keV-100.10 keV. Figure 3 of [1] was intended to show the coincidence relations 136.65 keV-1001.67 keV and 169.34 keV-1001.67 keV. The 146.72 keV γ-ray was also claimed to be seen to be in weak coincidene with the 100.10 and 229.33 keV γ-rays, but they were not indicated in the coincidence spectra of [1].

Our study shows that the intensities of the γ-rays (if they exist) depopulating the new levels are too weak to be observed in the coincidence spectra of [1] and that the claimed observation of the coincidence relations in [1] is in contradiction with the γ-ray intensities and level schemme of [1]. The evidences and arguments were presented in [2].

2.2 Study on the level structure of ^{164}Gd through the decay of ^{164}Eu

The nucleus ^{164}Eu lies at the edge of the region of strongly deformed nuclei and its decay has been studied for several times. [3] and [4] are the latest studies of the decay of ^{164}Eu and large amount of discrepances exist between these two studies. [2] reported 172 γ-rays in 1968 and only 82 of them were confirmed by [4] in 1980.

Trying to clarify the discrepances, the singles and coincidence spectra of γ-rays emitted in the decay of ^{164}Eu were reinvestigated in our laboratory. Data analysis are in progress.

References:
[1] J.K. Jabber and N.M. Steward, J. Phys. G: Nucl. Phys. 16, 271, 1990.
[2] Liu Yunzuo, Sun Huibin and Huo Junde, J. Phys. G: Nucl. Part. Phys. 19, 213, 1993.
[3] R.A. Meyer, Phys. Rev., Vol. 170, 1089, 1968.
[4] A.K. Sharma et al., J. Phys. Soc. Japan, Vol. 48, 1407, 1980.

5.4

French Contribution to NSDD

Berkeley 1994

J. Blachot, G. Marguier

A. EVALUATION

France has permanent responsibility for the evaluation of 11 mass chains : 101, 104, 107, 108, 109, 111, 113, 114, 115, 116, 117 and for converting data with A=21,22, 27-32 from P. Endt 's evaluation to ENSDF format.

A=103 from Belgium has been published in 1993
NDS 68,311

Continuous evaluation.

In January 1993 and 1994 , most of the masses under our responsibility have been updated in a continuous evaluation mode and are now in ENSDF with a cutoff date of January 94

116,114 have been sent to publication in 1994.

B. The NUBASE data base

To be displayed by NUCLEUS [1] , the Nubase data base has been established with the collaboration of G. Audi and O. Bersillon

1. G. Audi, J. Duflo , B. Potet ,To be published and presentation to this meeting
2. Nubase , see communication to this meeting.

Status Report of Japanese Activities in Nuclear Structure and Decay Data

1. Personnel

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

2. Mass-chain evaluation

The Japanese group will maintain the permanently assigned mass range of 118-129.

A-Chain Evaluation Status

A	Cutoff Date of the latest NDS	Status	Evaluator
118		author post-review	Kitao
119		NDS 67, 327(1992)	Kitao, Kanbe, Ogawa
120	March 28, 1986	will be submitted by June, 1994	Kitao
121		NDS 64, 323(1991)	Tamura, Iimura, Miyano, Ohya
122		NDS 71, 461(1994)	Tamura
123		NDS 70, 531(1993)	Ohya, Tamura
124	May 31, 1982	will be submitted by August, 1994	Iimura, Tamura
125		NDS 70, 217(1993)	Katakura, Oshima, Kitao, Iimura
126		NDS 69, 429(1993)	Miyano
127		submitted	Kitao
128		submitted	Kanbe
129		author post-review	Tendow

3. Computer

Evaluation work is carried out with analysis programs developed by the US groups. Those programs are operational on our IBM compatible main-frame and personal 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 was published in 1992 and is available. 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. The 6th edition is in preparation and will be published in 1996.

c. Gamma-rays table from ENSDF

List of three strong gamma-rays emitted from each radioactive nuclides was published as JAERI-M Report 94-059. This is a quick index to identify nuclides from energy of peaks on the gamma-ray spectrum.

5. Experimental research

Experimental work has been performed in collaboration with groups from Nagoya University and Hiroshima University, using the mass-separator connected on-line to JAERI 20 UR tandem accelerator. The following are our recent papers.

a. T. Morikawa, M. Oshima, T. Sekine, Y. Hatsukawa, S. Ichikawa, H. Iimura, A. Osa, M. Shibata and A. Taniguchi; Lifetime measurement of the first 2^+ state in ^{122,124,126}Ba, Phys. Rev. C46, R6(1992).

b. H. Iimura, Y. Nakahara, S. Ichikawa, M. Kubota and T. Horiguchi; Nuclear moments of ^{143}Pr by laser spectroscopy, to be published in Phys. Rev. C

c. H. Iimura, S. Ichikawa N. Shinohara, M. Magara, M. Oshima, M. Asai, A. Osa and H. Yamamoto; Level scheme of ^{127}La fed by the ^{127}Ce decay, JAERI-M Report 93-174, 84(1993).

IAEA Meeting on the Coordination of the International Network of Nuclear Structure and Decay Data Evaluators
Berkeley, USA, 16 - 20 May 1994

Status Report
Kuwait nuclear Data Project

Kuwait Institute for Scientific Research
Ameenah Farhan

This report covers the evaluation and related research activities of the Kuwaiti Group for the period (November 1992 - May 1994)

Financial Support :

The project is still funded by Kuwait Institute for Scientific Research (KISR) and the Kuwait Foundation for the Advancement of Sciences (KFAS) , funding was approved for the period (Jan. 1993 - Dec. 1995)

Man Power:

Ameenah Farhan (Physics Dept. Kuwait University) is still working as a part-time researcher for the project (0.3 MP)

Mass Chain Evaluation

* Mass Chain A=74 is almost finished and will be submitted by the end of May
* Mass chain A=77, Ameenah Farhan will start working on this mass chain which is scheduled to be submitted by the end of 1994.

Status report
"Nuclear Structure and Decay Data Evaluation in CAJAD"

F.E.Chukreev

My report on this subject I must begin by the words : " Our successes are not very good".

After Geel Meeting the evaluation for 244 mass chain have been finished only. Decreasing our successes was created by two circumstances:

1. Financial support of this activity by Russian government is not sufficient. Our attempts to find additional support from international funds are unsuccessful.

2. Shurshikov's leave evaluation work have forced CAJAD to find new evaluators. After some examines we included Dr V.E. Makarenko for evaluation job.

CAJAD has some promises for additional financial support but all promises are not fulfilled.

Therefore CAJAD could not continue the analysis of new experimental data for alpha-decay Pu-239 to check the possibility another interpretations than ENSDF one.

We conserve our point of view that some important sets of experimental data could be explained by different interpretations. Some examples of these interpretations I have presented for Geel Meetings. Our appeal to extend ENSDF have not heared. Additional examples are needed probably. I would like to repeat that if ENSDF will combine data collection and collection of unresolved problems then ENSDF importance will increase. Scientists community will have additional stimulus for experimental investigations.

Some words regarding to ENSDF data dissemination. I do not know an user, which have need for all ENSDF data simultaneously. The majority would like have separate parts ENSDF for everyday application on PC. But users totality has need for all ENSDF.

We thank NEA Data Bank for possibility to test NUC code for our users. The possibility of NUC code are enough for a majority of our users. This code is not complex but it contains very much data for different applications. I must remark that data base of this code has the mistakes and this data base must be clear from this mistakes and must be completed by conversion and beta electrons.

After Geel Meeting our "BOMJ" code to help the evaluators to place unplaced gamma-transitions between known levels have been submitted for NEA Data Bank and these code have been included as IAEA-1246.

STATUS REPORT ON NSDD ACTIVITIES OF PNPI DATA CENTRE

I.A.Kondurov, Yu.V.Sergeenkov

Data Centre of the Petersburg Nuclear Physics Institute
Gatchina 188350 Russia

1. Mass-chain evaluation for ENSDF

Mass-chain evaluation status is as follows:

chain	last publication	status
A = 130	NDS 58 765 (1989)	
A = 131	NDS 17 573 (1976)	to be published in 1994 (in collaboration with BNL)
A = 132	NDS 65 277 (1992)	
A = 133	NDS 49 893 (1986)	transferred to ORNL in 1993
A = 134	NDS 34 475 (1981)	to be published in 1994
A = 135	NDS 52 205 (1987)	evaluation to be finished in 1994

2. Keyword references for the NSR file

During last two years we continued the preparation of the keyword references of JINR (Dubna) preprints and communications and Proceedings of the Conference on the Nuclear Structure and Nuclear Spectroscopy. Because of lack of financial support we have now no possibility to continue our collaboration with the Petersburg University group and to prepare keyword references of rare Russian periodical editions.

3. Application of data files in Neutron Activation Analysis

The work on using a priori information in neutron activation analysis (NAA) was continued. Finished is the IBM PC-program that can extract from data files the necessary information on radioactive decay schemes of nuclei and can calculate the intensities of the gamma-quanta 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,g) 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,g) 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.

IAEA meeting on the co-ordination of the international network of nuclear structure and decay data evaluators, Berkeley, California, 16-20 May 1994

Status report: Sweden

Nuclear Structure and Decay Data Evaluation in Sweden

Peter Ekström, Department of Physics, Lund University,
Sölvegatan 14, S223 62 Lund, Sweden

Financial support and personnel

During the last two years, the funding for the project has been SEK 80000 (about $10000) per year. This is sufficient for updating and maintaining the on-line reference system and for some database development in collaboration with the Isotopes Project at Berkeley.

Mass-chain evaluation

Since the last meeting in 1992, the evaluation of A=90 has been published.

The NSR on-line

The local installation of the NSR database is continuously updated with updates from the NNDC. The last update was successfully performed by transferring the update file with FTP via Internet.

The database at present contains 49290 references (primary references from 1975 and secondary references from 1989). Although no marketing of the service has been done the last few years, the number of logins per year is still increasing (1990:278, 1991:200, 1992:385, 1993:440). This can only be interpreted as a confirmation that the users still find it a useful service.

Papyrus NSR

Papyrus NSR is a system for searching the literature database NSR on a PC. The system is based on a commercial bibliographic program, Papyrus. It contains more than 130000 references from 1910 to the present. Papyrus NSR allows indexed searches on keywords, authors, year of publication, journal, title, type of reference and keynumber, and un-indexed searches on the keyword abstract.

During the summer of 1993, Peter Ekström visited the Isotopes Project at Berkeley with funding from the US Department of Energy. During this visit the main part of the work to transfer the NSR to Papyrus was performed in collaboration with Edgardo Browne. Since December 1993, a test version of the system has been available on the Lund University local area network. The CD-ROM version will be released in May 1994.

UK NUCLEAR DATA EVALUATIONS, PROGRESS REPORT: MAY 1994

A L NICHOLS
353 Harwell
Didcot, Oxfordshire
OX11 0RA
United Kingdom

SUMMARY

The basic nuclear data for commercial application in the UK are monitored and peer-reviewed by the UK Chemical Nuclear Data Committee (UKCNDC). Work undertaken under the auspices of the UKCNDC includes the measurement and evaluation of radionuclide half-lives, other decay parameters (e.g. transition energies and transition probabilities) and fission yields; the evaluation studies for 1993/94 are described in this document. Efforts are also being made to extend the technical responsibilities of the committee towards neutron cross sections, and provide a forum for the communication and debate of relevant international developments (e.g. NEA-Nuclear Science Committee and IAEA Nuclear Data Section).

1 INTRODUCTION

The United Kingdom Chemical Nuclear Data Committee (UKCNDC) has for over 20 years identified specific data needs for the UK nuclear industry. The data that fall within the auspices of the UKCNDC are normally determined by standard chemical techniques in conjunction with mass spectrometry, alpha-particle spectrometry and gamma-ray spectroscopy (e.g. fission yields and decay data). All such measurement and evaluation programmes are co-ordinated to meet data requests identified by members of the committee. An additional important aim is to produce and maintain recommended libraries of relevant nuclear data. These data files have to be assembled in a suitable form for a wide range of applications, including reactor design, fuel handling, reprocessing, waste management, shielding and transport. Such libraries need to be regularly updated so that the best data can be used with confidence.

The role of the UKNDC has been reviewed during 1993 and the scope of the committee has been broadened to include the evolution and maintenance of UK links with the NEA-Nuclear Science Committee and the IAEA Nuclear Data Section. Technical expertise has also been expanded to include reviews and recommendations of neutron cross-section data.

Work described below focusses on the UKCNDC evaluation efforts during 1993/94 for nuclear power applications within the UK.

2 DATA LIBRARIES: EVALUATIONS

2.1 Data library developments

The status of the UK Data Libraries is summarised in Table 1. Significant progress has been made in the evaluation of specific decay data (activiation products and a limited number of fission products) and fission yields. These studies have also been undertaken to assist in the development of the Joint Evaluated Files (JEF).

Table 1: *UKCNDC Data Libraries - Status Table, December 1993.*

Data	Present status	File development
Fission product decay data	UKFPDD-2 evaluations (ENDF/B-V format) were submitted for JEF-1.1 and partially included. Some of these evaluations have been carried through to JEF-2.2.	
Activation product decay data	UKPADD-2 evaluations (ENDF/B-VI format) have been submitted to the NEA Data Bank, and will be incorporated into the future JEF-3.	Over 90 additional nuclides are being evaluated by A L Nichols (AEA), as described in Section 2.1(a) (development of UKPADD-3).
Heavy element and actinide decay data	UKHEDD-2 evaluations (ENDF/B-VI format) have been submitted and absorbed into JEF-2.2.	Decay data for Pa-234g and Pa-234m have been evaluated for incorporation into UKHEDD-2.
Fission yields	UKFY-2 has been submitted and accepted into JEF-2.2. A minor update to make the yields consistent with the JEF-2.2 decay data was completed in July 1993.	A new evaluation (UKFY-3) is being undertaken by R W Mills (see Section 2.4).

(a) **Activation and fission product decay data - evaluations under way**
(A.L. Nichols (Harwell)).
An assessment by Yamamuro and Iijima has resulted in the identification of approximately 90 radionuclides from specific (n,x) reactions that will be generated in the core region (1). Evaluations are being made to improve the UK decay-data files for these radionuclides, and so contribute to the evolution of the JEF library.

Work has begun to collect and evaluate the defined data, and establish the recommended values in a data library (ENDF-6 format). The measured decay data are being extracted from the literature sources, and evaluations have begun to create and improve a number of the data files. The work is being undertaken for specific activation/fission product nuclides:

^{53}Mn, ^{60}Fe, ^{60m}Co, ^{66}Ni, ^{67}Cu, ^{81}Kr, ^{81m}Kr, ^{83m}Kr, ^{85}Kr, ^{85m}Kr, ^{83}Rb, ^{84}Rb, ^{84m}Rb, ^{86}Rb, ^{86m}Rb, ^{83}Sr, ^{83m}Sr, ^{90}Sr, ^{91}Y, ^{91m}Y, ^{88}Zr, ^{91}Nb, ^{91m}Nb, ^{92}Nb, ^{92m}Nb, ^{105}Rh, ^{105m}Rh, ^{103}Pd, ^{107}Pd, ^{107m}Pd, ^{105}Ag, ^{105m}Ag, ^{106}Ag, ^{106m}Ag, ^{111}Ag, ^{111m}Ag, ^{115}Cd, ^{115m}Cd, ^{115m}In, ^{119}Sb, ^{120}Sb, ^{120m}Sb, ^{133}Xe, ^{133m}Xe, ^{129}Cs, ^{131}Cs, ^{132}Cs, ^{131}Ba, ^{131m}Ba, ^{140}Nd, ^{147}Nd, ^{143}Pm, ^{144}Pm, ^{146}Pm, ^{147}Pm, ^{148}Pm, ^{148m}Pm, ^{149}Pm, ^{151}Pm, ^{151}Sm, ^{153}Sm, ^{149}Eu, ^{150}Eu, ^{150m}Eu, ^{156}Eu, ^{150}Gd, ^{151}Gd, ^{153}Gd, ^{175}Yb, ^{171}Lu, ^{171m}Lu, ^{172}Lu, ^{172m}Lu, ^{173}Lu, ^{174}Lu, ^{174m}Lu, ^{177}Lu, ^{177m}Lu, ^{173}Hf, ^{177m}Hf, ^{177n}Hf, ^{177}Ta, ^{183}Ta, ^{178}W, ^{201}Tl, ^{202}Tl, ^{202}Pb, ^{202m}Pb, ^{203}Pb, ^{203m}Pb, ^{203n}Pb and ^{205}Pb.

The decay data for over half of these radionuclides have been evaluated (April 1994), and some of the data have been assembled in preparation to produce the data files in ENDF-6 format.

(b) **Activation product decay data - completed files** (A.L. Nichols (Harwell)). The decay data of various radionuclides have been evaluated on the basis of a series of well-defined specifications and the requirements of the UK nuclear power, fuel reprocessing and waste management programmes (2). These radionuclides are mainly activation products and standards that are commonly used in gamma-ray spectroscopy. Computer-based files have been generated in ENDF-6 format, including lists of the references used to produce the proposed decay scheme and comments that identify any inadequacies.

The new activation product decay data library (UKPADD-2) contains comprehensive data for 236 nuclides. This library contains recommended data for the following parameters:

(i) half-life,

(ii) total decay energies (Q-values),

(iii) branching fractions,

(iv) alpha-particle energies and emission probabilities,

(v) beta-particle energies, emission probabilities and transition types,

(vi) gamma-ray energies, emission probabilities and internal-conversion coefficients,

(vii) spontaneous fission data including prompt and gamma-ray spectra.

The spin and parity of the decaying nuclide have been defined, and uncertainties are assigned to all evaluated data. Other data in UKPADD-2 (mean energies, discrete electrons and mean x-rays) were derived from the above data using the processing code COGEND (3,4). The component contributions to the average energies (beta, electromagnetic and heavy particle) are derived from the evaluated input data by COGEND, which has data libraries of fluorescence yields, Auger-electron energies, mean x-ray energies and electron-wave-function ratios from which capture ratios can be calculated. All data include associated uncertainties.

The library has been generated in ENDF-6 format (5). There is a general information section for each nuclide which contains:

(i) name of the evaluator and date of the evaluation (month and year),

(ii) list of references used to construct the recommended data set,

(iii) detailed comments associated with the evaluation,

(iv) consistency check of the evaluation data.

The recommended decay data are contained within the main data section. Every effort has been made to produce consistent and comprehensive data sets. All of the energy data are in eV, and the absolute emission probabilities are expressed as fractions of the decay (calculated from the spectral normalisation factor and relative emission probabilities).

The various decay parameters of the majority of radionuclides in UKPADD-2 have been reasonably well defined in the published literature, and were evaluated with good precision and confidence to produce consistent decay schemes.

(c) **Heavy element and actinide decay data** (A.L. Nichols (Harwell)).
Several recent measurements of the absolute emission probability of the 1001 keV gamma ray of Pa-234m have resulted in doubts concerning the recommended decay data for this radionuclide. A value of 0.00590 ± 0.00010 has been adopted in previous evaluations on the basis of a single datum generated by Bjornholm and Nielsen (1963). However, more recent gamma-ray studies by Moss (1986), Scott and Marlow (1990), Siemon et al (1992), and Lin and Harbottle (1992) are in good agreement to give a newly recommended value of 0.00835 ± 0.00011 (6). Some of these recent measurements also include new gamma-ray data for Pa-234g decay. Thus, comprehensive re-evaluations have been undertaken of the decay schemes for both radionuclides, and the resulting data will be included in the UK Heavy Element and Actinide Decay Data library, UKHEDD-2 (7). The new value for the 1001 keV gamma-ray emission of Pa-234m should provide a consistent basis for the measurement and reporting of this radionuclide in environmental monitoring programmes.

2.2 Evaluation of nuclear decay scheme data (G.A. Sutton, A. Taylor and P. Smedley (MAFF Directorate of Fisheries Research)).
Investigations are being made into the uranium/radium (4n + 2) series, particular interest being directed towards radium-226, and lead-214 and bismuth-214 daughters. The disparity between the analytical results from these radionuclides has raised doubts regarding the validity of the gamma-ray emission probability data quoted in the literature. Work continues to investigate this problem.

2.3 Interrogation and extraction of JEF 2 decay data
(J. Rockey, J. Blackband and D.R. Weaver (University of Birmingham), B. Potet and M. Konieczny (NEA Data Bank)).
Further work on a PC-based computer program has been sponsored by the NEA Data Bank and conducted through a Summer Vacation Studentship at the University of Birmingham. These studies in 1993 were carried out in collaboration with another student based at the Data Bank in Paris. Tasks undertaken at Birmingham included the insertion into the main program of the fission yield module reported last year. In addition, the program was extended to include information on beta spectra, based on the analysis codes of Tobias (8). The work at the NEA Data Bank included a radical restructuring of the previous code (known as NUC.EXE) and the provision of a significant number of new features. The new code is known as NUCLEUS, and it is expected to be available from the Data Bank shortly.

2.4 **Fission product yield evaluations** (M.F. James (Consultant to BNF plc), R.W. Mills (BNF plc) and D. R. Weaver (University of Birmingham)).
The UK fission-product yield evaluation programme has continued with work focused on the development of a new evaluated library (UKFY3) as an update to UKFY2 (the latter is described in AEA reports AEA-TRS-1015, 1018 and 1019). Work has been completed in the following areas: expanding the experimental database (both with new data and with other types of data to aid in a greater understanding of the fission-product production process), adapting the analysis procedure to use more of the data by iteration of the relative and ratio of ratio data, and improving the technique of generating complete yield sets using mass yields rather than chain yields.

Efforts are also continuing to examine different models that can be used to explain the fission-product yield production process; these models will be used to assist in the generation of the UKFY3 file.

The UK group remains involved in the IAEA Coordinated Research Programme on the Compilation and Evaluation of Fission Yield Nuclear Data and the JEF (Joint European File) evaluation programme of the NEA.

References

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2. A L Nichols, "Activation Product Decay Data: UKPADD-2 Data Files", AEA Technology Report AEA-RS-5449, March 1993.
3. A Tobias, "COGEND: A Code to Generate Nuclear Decay Scheme Data in ENDF/B Format", CEGB Report RD/B/N4147, 1977.
4. A Tobias, "Extensions to COGEND for ENDF/B-V Output of Spontaneous Fission Decay Data", CEGB Report RD/B/N4309, 1978.
5. P F Rose and C L Dunford (editors), "ENDF-102 Data Formats and Procedures for the Evaluated Nuclear Data File ENDF-6", National Nuclear Data Centre, Brookhaven National Laboratory Report BNCL-NCS-44945, 1990; revised October 1991.
6. A L Nichols and J Toole, "Evaluation of Pa-234m and Pa-234g Decay Schemes: Relative Gamma-ray Emission Probabilities and Normalisation Factors", AEA Technology Report AEA-InTec-1671, December 1993.
7. A L Nichols, "Heavy Element and Actinide Decay Data: UKHEDD-2 Data Files" AEA Technology Report AEA-RS-5219, December 1991.
8. A Tobias, Nuclear Electric, Berkeley Technology Centre, Berkeley, Gloucestershire, GL13 9PB, England.

IAEA Advisory Group Meeting on the Coordination of the Nuclear Structure and Decay Data Evaluators' Network

Lawrence Berkeley Laboratory, 16-20 May 1994

Participant's Status Report - Desmond MacMahon,
Imperial College, London, U. K.

FACILITIES:
- 100 kW research and teaching reactor;
- 4π ß-γ coincidence equipment for absolute disintegration rate measurements;
- high resolution Ge gamma ray spectrometers;

ACTIVITIES:
- decay scheme measurements and evaluations;
- recent measurements include ^{101}Mo, ^{101}Tc, ^{154}Eu, ^{198}Au, ^{237,239}Np;
- evaluation of discrepant sets of data, application of developed techniques to half-life data of ^{90}Sr, ^{137}Cs, ^{154} Eu (not discrepant) and ^{252}Cf.

CONTACT: Desmond MacMahon
Centre for Analytical Research in the Environment,
Imperial College of Science, Technology & Medicine,
Silwood Park,
Ascot
Berkshire SL5 7TE, England

Telephone: 44-344-294290
Fax: 44-344-24931
Email: t.macmahon@ic.ac.uk

5.10 Status report Utrecht

a. Energy levels of A = 21-44 nuclei

The seventh edition of this review article has been published in Nucl. Phys. **A521** (1990) 1; lists of Errata and Addenda in Nucl. Phys. **A529** (1991) 763 and **A564** (1993) 609.

Preparations for the next edition are in continuous progress. The influx of new data, however, has slowed down considerably.

b. Gamma-ray transition strengths

An update of the review article on gamma-ray transition strengths in A = 5-44 nuclei has been published in ADNDT **55** (1993) 171.

c. Gamma-ray energy calibration standards

A task group of the IUPAP commission on Atomic Masses and Fundamental Constants, consisting of P.H.M. Van Assche, R.C. Helmer and C. van der Leun, published in 1979 (see ADNDT **24** (1979) 39) a consistent set of IUPAP- recommended gamma-ray energies for calibration purposes.

An update of this set is in preparation. It takes into account the most recent adjustments in the fundamental constants and changes in the deduced gamma-ray wavelengths.

d. The ^{66}Ga($\beta^+ + \epsilon$)^{66}Zn decay

In order to extend the range of precision gamma-ray energies for calibration purposes (see above), the ^{66}Ga gamma-ray spectrum has been investigated in Utrecht. The analysis provides the energies of 26 strong lines with a precision of better than 10 ppm. Of particular importance are the five lines in the range E_γ = 3.76 - 4.81 MeV, a hitherto uncovered high-energy region.

Cor van der Leun

IAEA Nuclear Data Section

PROGRESS REPORT

May 1994

I. Staff

In 1992, Josef Schmidt retired as head of the Nuclear Data Section after more than twenty years in that position. The position was unfilled for more than one year until Charles Dunford arrived in July 1993. Douglas Muir, the Section's Deputy Head has returned to Los Alamos National Laboratory. After a vacancy of about one year, Pavel Oblozinsky from the Slovak Academy of Sciences, Bratislava, Slovakia was hired to fill that position. During this period, first Valentin Konshin and then Hans Lemmel served as acting Section Head. At the beginning of 1994, Wang Dahai from PR China retired. He had been handling many of the Technical Cooperation projects assigned to NDS. His post will not be filled.

During the next two year period, S. Ganesan will be leaving the Section at the end of his five year appointment and Nikolai Kocherov will be retiring. Neither position will be filled due to the Section's budget being reduced by about 15% in the 1995-1996 period. Sometime in 1995, it is planned to shift one post from the Atomic and Molecular Unit into nuclear data to complete the implementation of the budget reduction. As a result of these reductions, the Section's nuclear data processing activity will be terminated and the nuclear data assessment activity reduced.

Budgeting and planning have been complicated by the failure of IAEA Member States to pay their assessment on time. As a result, each year 10-12% of the Section's program has been deferred. When the deferred money is released at unforseen times, deferred activities have to be carried out on short notice. Sometimes priorities may have changed then. At the present time NDS is spending deferred program money from 1992 and 1993.

II. Nuclear Data Activities

Most of the nuclear data activities are related to nuclear reaction data, including the compilation and exchange of experimental data in EXFOR format, of evaluated data in ENDF format, and of bibliographic information in CINDA. During the past years priority had been given to the provision of evaluated data libraries for fusion applications. Among others this includes the preparation of JONACS (joint neutron activation cross-sections), a comprehensive data library for 11 000 neutron activation reactions with 636 target nuclides in the incident neutron energy range up to 20 MeV; this includes a decay data sublibrary which was mostly derived from ENSDF.

Within the ENSDF/NSR network, the IAEA Nuclear Data Section serves only as a data distribution center, apart from its co-ordinative function.

III. VAX Computer and On-line Data Service

Significant progress has been made on the migration of the NDS computing activity to its VAX computer. Deferred equipment money from 1992 was used to purchase computer terminal for all the staff members. This includes 5 X-window terminals for the most intensive computer users. The disk storage has been increased by 2 gigabytes to 7 gigabytes and the fast memory doubled to 64 megabytes, the maximum allowed on the MicroVax 4000 system. A 4mm audio-digital data tape unit was added for backup purposes and large scale data transmission to users with compatible units. Two HP-LaserJet Printers with augmented paper trays have been installed to handle the increased output from the VAX. The present computer configuration is attached.

We have also installed additional software. With the installation of the MULTINET TCP/IP software we are now able to access the INTERNET directly and not through a DEC UNIX gateway. File difficulties were resolved and user access to the on-line service simplified. We have also purchased DISKKEEPER software to manage our disk usage and FLINT for Fortran source code checking.

Our current priority is to discontinue user of the IAEA IBM mainframe for our center's work by the end of 1994. The use of NNDC database software has helped us immensely. Our major remaining tasks are primarily to migrate administrative programs.

The on-line data service is identical to the NNDC system. Very close cooperation between NNDC and NDS is maintained so that problems are solved expeditiously and new features introduced when possible while continuing to use identical software. In the past nine months, the NDS service has added access to number of computer codes for processing ENDF and ENSDF formatted data files. Significant improvements in the video version of the user interface have also been made. Multiple file transmission within a single SEND command using a new multiple-selection menu is now possible. The NSR data base program allows a wildcard search of retrievable parameter values which significantly enhances the power of the program. Complete data libraries can be downloaded from the service. Currently available are the IRDF files and the 1993 Audi-Wapstra mass evaluations.

The NDS on-line data service is now beginning to show steadily increasing usage. The direct link to INTERNET, advertising of the service and the growing access to electronic computer networks within our service area account for the growth. In 1993, 590 retrievals were performed by NDS on-line service customers; already in the first four months of 1994, 866 retrievals have been made.

As shown on the attached table we have now 127 users on 113 active accounts, from 31 countries. The main users (with more than 6 users) are not only from the neighbourhood (Austria, Czechia, Poland, Hungary) but also from remote countries like Australia, Brazil, Israel, South Korea.

IV. Conventional data center services

The majority of the data center services continue to be done by mail, i.e. by dispatching magnetic tapes, diskettes and related printed materials. In 1993 about 300 data requests received from about 60 countries resulted in the dispatch of 367 diskettes, 119 magnetic tapes and 6 cartridges, plus numerous printed materials.

The IAEA Nuclear Data Newsletter is published once a year advertising the availabilty of new or updated data libraries and printed materials such as neutron data related meeting proceedings, INDC reports, data processing codes, and others.

Available nuclear data libraries are documented in IAEA-NDS-documents. These are not reports in the normal sense. They are sent out only together with data libraries; no data library is sent out without an IAEA-NDS-document containing at least brief information on contents, format and origin of the data library.

Special issues are:

IAEA-NDS-0:	index to the IAEA-NDS-documents
IAEA-NDS-7:	index to the available nuclear data libraries
IAEA-NDS-150:	User's Manual of the NNDC/NDS Online Nuclear Data Service

V. Meetings

The detailed meeting and consultant schedule for 1994 is attached.

In 1995 the NDS will organize the following meetings:

1) International Nuclear Data Committee Meeting
2) NRDC Technical Consultants Meeting
3) FENDL-2 Development Advisory Group Meeting
4) 2nd Photon Production Research Coordination Meeting
5) 3nd Long-Lived Activation Cross Sections Research Coordination Meeting
6) Reactor Decommissioning Data Advisory Group Meeting
7) Charged-Particle Nuclear Data Research Coordination Meeting

In 1996 the NDS will organize the following meetings:

1) Nuclear Reaction Data Centres Advisory Group Meeting
2) Nuclear Structure and Decay Data Advisory Group Meeting
3) 2nd Nuclear Model Parameters Research Coordination Meeting
4) FENDL-2 Processing Advisory Group Meeting
5) Final Fission Product Yield Research Coordination Meeting
6) INDC Nuclear Standards Data File Consultants' Meeting
7) First Charged Particle Fusion Reaction Research Coordination Meeting
8) Workshop on Nuclear Data for Applications in Nuclear Technology

VI. Publications

INDC reports continue to be published and distributed. They are either NDS produced or submitted by member states or national and international institutes. They may contain nuclear data information of the following categories:

- progress reports by countries or institutes;
- original scientific work of interest;
- minutes and proceedings of meetings;
- work by participants of co-ordinated research projects;
- translations of Russian (and other) originals.

While most of the reports are related to nuclear reaction data, the following two reports are of interest to the NSDD network:

INDC(CCP)-361. F.E. Chukreev, Selection of radiation sources for calibration of gamma-ray spectrometer. - It contains primerily an evaluation of Ba-133 decay data. - Translation of a paper from 1992.

INDC(CCP)-363. V.E. Makarenko, F.E. Chukreev, Identification of high-spin states in U-235. - Translation of a paper from 1988.

IAEA Nuclear Data Section

PROGRESS REPORT

May 1994

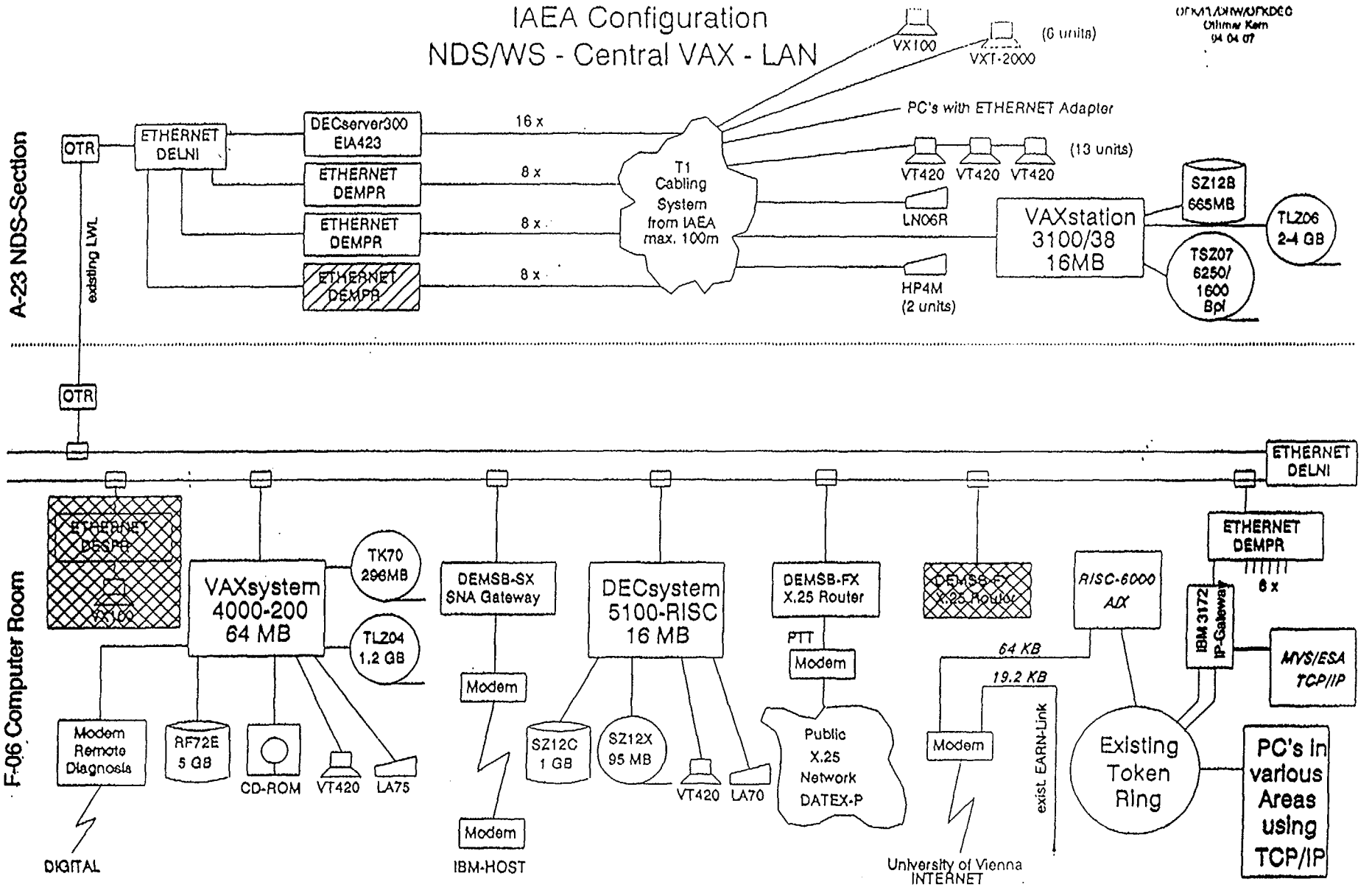
ATTACHMENTS

III. VAX Computer and On-line Data Service

- IAEA configuration
- On-line service users by country

V. Meetings

- NDS Meetings 1994


IAEA Configuration
NDS/WS - Central VAX - LAN
A-23 NDS-Section
F-06 Computer Room
OTR
existing LWL
ETHERNET DELNI
DECserver300 EIA423
ETHERNET DEMPR
16 x
8 x
T1 Cabling System from IAEA max. 100m
VX100
VXT-2000
(6 units)
PC's with ETHERNET Adapter
VT420
(13 units)
LN06R
HP4M (2 units)
VAXstation 3100/38 16MB
SZ12B 665MB
TLZ06 2-4 GB
TSZ07 6250/ 1600 Bpi
VAXsystem 4000-200 64 MB
TK70 296MB
TLZ04 1.2 GB
DEMSB-SX SNA Gateway
DECsystem 5100-RISC 16 MB
DEMSB-FX X.25 Router
PTT
Modem
Public X.25 Network DATEX-P
RISC-6000 AIX
64 KB
19.2 KB
exist. EARN-Link
IBM 3172 IP-Gateway
MVS/ESA TCP/IP
Modem Remote Diagnosis
RF72E 5 GB
CD-ROM
VT420
LA75
SZ12C 1 GB
SZ12X 95 MB
LA70
Existing Token Ring
PC's in various Areas using TCP/IP
DIGITAL
IBM-HOST
University of Vienna
INTERNET

ONLINE SERVICE USERS BY COUNTRY

Country	Active Accounts	Users ("Names")
Argentina	0	1
Australia	13	15
Austria	12	16
Brazil	8	9
Canada	2	2
Chile	1	1
Croatia	2	2
Czech Republic	10	10
France	4	5
Germany	3	3
Hungary	6	8
India	0	1
Israel	6	6
Italy	3	3
Latvia	1	1
Mexico	1	1
Netherlands	1	1
New Zealand	1	1
Poland	9	9
Romania	3	4
Russia	3	4
Slovakia	2	2
South Africa	2	2
South Korea	6	6
Spain	1	1
Switzerland	2	2
Taiwan	1	1
Thailand	1	1
United Kingdom	2	2
U.S.A.	5	5
Venezuela	2	2

31	countries
113	active accounts
127	users

NDS MEETINGS 1994

Month/ Duration	Responsible Officer	Type/Title of Meeting	Location
April			
18 - 21	Pashchenko	**SPM** "Charged-Particle and Photonuclear Data Evaluations for FENDL"	Smolenice, Slovakia
11/4 - 6/5	Ganesan	Workshop on Nuclear Data Processing and Reactor Physics Calculations for Applications in Nuclear Technology	Trieste, Italy
25 - 27	Lemmel/Schwerer	**AGM** "13th Nuclear Reaction Data Centres"	Paris, France
May			
4 - 6	Obložinský	NEANSC Working Party on Evaluation Cooperation	Oak Ridge, USA
9 - 13	Ganesan	Workshop on Nuclear Data Processing and Reactor Physics Calculations for Applications in Nuclear Technology	Bologna, Italy

Month/ Duration	Responsible Officer	Type/Title of Meeting	Location
May (contd.)			
9 - 13	Dunford	International Conference on Nuclear Data for Science and Technology	Gatlinburg, USA
16 - 20	Dunford	Coordination of the Nuclear Structure and Decay Data Evaluators Network	Berkeley, CA USA
September			
5 - 6	Janev	**TC** "8th Meeting of the IFRC A+M Subcommittee"	Vienna
7 - 9	Janev	**AGM** "Atomic, Molecular and Particle-Surface Interaction Data for Divertor Physics Design Studies"	Vienna
7 - 9	Pashchenko	**SPM** "Comparison of Activation Cross Section Measurements and Experimental Techniques"	St. Petersburg, Russia
12 - 16	Ganesan	**AGM** "Improved Evaluations and Integral Data Testing for FENDL"	Garching, Germany
19 - 23	Obložinský	**RCM** "Development of Reference Input Parameter Library for Nuclear Model Calculations of Nuclear Data"	Ravenna, Italy

Month/ Duration	Responsible Officer	Type/Title of Meeting	Location
September (cont'd)			
26 - 30	Langley	**RCM** "Thermomechanical Properties of Plasma Facing Materials"	Vienna
October			
4 - 7	Pashchenko	**RCM** "Establishment of an International Reference Data Library of Nuclear Activation Cross Sections" (1st RCM)	Debrecen, Hungary
10 - 12	Janev	**RCM** "Radiative Cooling Rates of Fusion Plasma Impurities"	Vienna
17 - 20	Lammer	**RCM** "Compilation and Evaluation of Fission Yield Nuclear Data"	Vienna
24 - 28	Lemmel	Development of an International Chart of the Nuclides	Vienna
November			
1 - 4	Pashchenko	**RCM** "Improvement of Neutron-Induced He Production Cross Sections" (2nd RCM)	Beijing, China

Month/ Duration	Responsible Officer	Type/Title of Meeting	Location
7 - 11	Kocherov	**CM** "Nuclear Data for Fission Reactor Decommissioning"	Vienna
14 - 17	Obložinský	**RCM** "Measurement, Calculation and Evaluation of Photon Production Data"	Bologna, Italy

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

April 22, 1994

INEL Mass-Chain Evaluation Project
Activity Report for May 1994
to
International Network of Nuclear Structure
and Decay Data Evaluation

R. G. Helmer and C. W. Reich

I. Mass-Chain Evaluations

We have responsibility for 12 mass chains (87 and 153-163) and are proceeding with the evaluations. Three evaluations, A=155, 157 and 159, have recently been completed and are in the review or post-review stage of processing. The status of all of the evaluations is given in the National Nuclear Data Center report.

II. Nuclear Data Network Activities

In response to decisions made at the last meeting of the U.S. Nuclear Data Network, held October, 1993, we have participated in the sub-task force on decay-data evaluations and the publications group. We assisted in the preparation of a sub-task force report.

At the Symposium on Applications of Nuclear Chemistry held at the meeting of the American Chemical Society, March, 1994, a presentation was given on the present status of files of decay data. The talk described the current need for high quality evaluations and for communication among applied users of decay data to determine the problems that exist. We have been invited to give a similar presentation at the Canberra User's Group meeting in June and this will provide another opportunity to solicit user input.

III. International Activities

Contact has been maintained with International Committee of Radionuclide Metrology (ICRM) and its Working Groups on Non-Neutron Nuclear Data (3ND) and Gamma-Ray Spectrometry. The 3ND Working Group has been discussing techniques for the averaging of discrepant data.

IV. INEL Measurement Activities

The methodology to obtain relative I_β distributions, as a function of the level energy, from the analysis of the spectra from the total absorption γ-ray spectrometer (TAGS) at the INEL has been completely upgraded. The analysis now includes the influence of the β particles, bremsstrahlung from the β-decay branches and the random summing. This system is also used to measure the intensity of the ground-state β^- branch, thereby, giving the complete I_β distribution. Three papers have been prepared which report the results from both the singles and coincidence measurements for ^{89}Rb,

^{138m,g}Cs, ^{139}Cs, ^{140}Cs, ^{141}Cs, and ^{141}Ba. In the cases of ^{138m}Cs, ^{141}Cs, and ^{141}Ba, these results show at what level energies the existing decay schemes are incomplete. TAGS measurements have been made for over 40 radionuclides.

An extensive series of γ-ray energy measurements on ^{233}U sources, directed toward the measurement of the level energy of the first excited state in ^{229}Th, has now been completed. The result of these measurements is that the energy of this level is 3.5 ± 1.0 electron Volts. Although this a factor of ~20 smaller than the lowest first excited-state energy previously known, its greatest interest lies in the fact that it is comparable to the level spacings characteristic of atomic systems. This makes ^{229}Th a good candidate for studying processes in which the nucleus is directly excited via external atomic electron interactions, which has important implications for many areas of atomic, molecular, and condensed matter physics.

V. Related Publications

"Measurement of β^- end-point energies using a Ge detector with Monte Carlo generated response functions," R. C. Greenwood and M. H. Putnam, Nucl. Instr. and Meth. A337, 106 (1993).

"An excited state of ^{229}Th at 3.5 eV," R. G. Helmer and C. W. Reich, Phys. Rev. C 49, (April 1994).

"Radionuclide Decay Data-Evaluation and Dissemination," R. G. Helmer, invited talk in Symposium on Applications of Nuclear Chemistry at American Chemical Society meeting, San Diego, March, 1994.

"Methodology for the measurement of β^--decay intensity distributions from the analysis of total absorption γ-ray spectra," R. G. Helmer, M. H. Putnam, R. C. Greenwood, and H. Willmes, submitted to Nucl. Instr. and Meth.

"Beta-decay intensity distributions of the fission-products ^{139}Cs, ^{140}Cs, and ^{141}Ba measured with a total absorption γ-ray spectrometer," R. G. Helmer, R. C. Greenwood, M. H. Putnam, and K. D. Watts, to be presented at Symposium on Radiation Measurements and Applications, Ann Arbor, May 1994 and published in Nucl. Instr. and Meth.

"Beta-decay intensity distributions of fission-product isotopes measured using a total absorption gamma-ray spectrometer," R. C. Greenwood, R. G. Helmer, M. H. Putnam and K. D. Watts, to be presented at Intern. Conf. on Nucl. Data for Science and Technology, Gatlinburg, May 1994.

Isotopes Project Status Report

C. Baglin, E. Brown, F. Chu, J.M. Dairiki, R.B. Firestone, B. Singh, V.S. Shirley, and J. Zipkin
Lawrence Berkeley Laboratory

April 15, 1994

Introduction

The Isotopes Project has continued its active data evaluation effort, both in mass-chain evaluations and in the horizontal evaluation of superdeformed band data, while producing the 8th edition of the *Table of Isotopes*. Our program of data evaluation by off-site consultants and employees has been extremely successful. The Isotopes Project has played a seminal role in the development of new electronic dissemination and publication methods for nuclear data. In addition, the group has increased its leadership role in the U.S. Nuclear Data Network. J. Dairiki is presently serving as the Chairman of the USNDN Executive Committee and the Isotopes Project is well represented on the task forces established by the Executive Committee.

A. Evaluation

1. Mass-Chain Evaluation (V.S. Shirley, C.M. Baglin, B. Singh, E. Browne, R.B. Firestone).

The Isotopes Project has permanent responsibility for evaluating 43 mass chains with A=81, 83, 89-93, 167-194, 206, 210-212, 215, 219, 223, and 227, and for converting data with A=23-26, and 33-44 from P. Endt's evaluations to ENSDF format. The project has accepted temporary responsibility for evaluating the following mass chains: A=76, 79, and 80 (from the Nuclear Data Project at Kuwait); and A=59 (from the Swedish Group at Lund).

The following summarizes the Isotopes Project 1993 mass-chain evaluation activity:

Number of mass-chain evaluations *submitted* to BNL between 1-1-93 and 12-31-93.	6 (A=76,168, 173, 178, 179, 185)
Number of mass-chain evaluations *published* between 1-1-93 and 12-31-93:	6 (A=59, 79, 81, 93, 175, 177)
Number of mass-chain evaluations *reviewed* between 1-1-93 and 10-15-93:	2

The Isotopes Project has dedicated about 2.0 full-time employees (FTE) to mass-chain evaluation in 1993.

2. Evaluation Methodology and Computer Codes (C.M. Baglin and E. Browne).

A new IBM/PC version, by C.M. Baglin, of the computer program GABS (for normalizing decay schemes), is available as of August 1993. This version accepts "publication records" (PN) and produces correct results.

3. Horizontal Evaluation: Superdeformed Bands (B. Singh and R.B. Firestone)

Among the most exciting developments in nuclear physics has been the recent discovery of superdeformation in high-spin physics. The evolution of large detector arrays has led to a burst of new data on this subject. Because very little of that data was in the ENSDF file, and the demand for high-spin information is high, we initiated a horizontal evaluation of superdeformed band data. This evaluation is now up-to-date and includes 91 superdeformed bands from 39 nuclides.

With publication tools developed to produce the *Table of Isotopes* we have produced the first draft of the *Table of Superdeformed Nuclear Bands*. This book contains adopted level data for each nucleus with superdeformed bands, the moment of inertia and induced moments for each band, and band level scheme drawings. Additional related data for actinide shape (fission) isomers have been included. The first draft has been distributed widely for comment, and we plan a general distribution in 1994.

We are continuing to update the superdeformed database and gratefully acknowledge the helpful advice of the LBL and McMaster high-spin groups, suggestions from Gammasphere users, and prepublication data provided by various researchers. We have also begun to update additional high-spin data for ENSDF and the *Table of Isotopes*.

B. 8th Edition of the *Table of Isotopes* (R.B. Firestone, V.S. Shirley, F. Chu, and J. Zipkin)

The first draft of the 8th edition has been completed. Q-value data and proton/neutron separation energies have been updated with values provided by Audi and Wapstra from their 1993 evaluation. Thermal cross-section information from BNL-325, updated natural abundances, nuclear moments from Raghavan, and references have also been added. We have also included the superdeformed band data recently updated in ENSDF by Balraj Singh and added information about recently discovered isotopes that are not yet in ENSDF. Mass chains through A=183 have been edited for consistency of presentation and scientific content. The second draft is expected to be completed by this summer. We have sent mass chains A=1-90 to evaluators for their comments. The process of final layout for the 8th edition has been automated to allow interactive merging of tables and figures, on screen, with a VAX-4000 workstation. The book is projected to contain 3000 pages in two volumes and is expected to be completed by early 1995.

In addition to the printed book we have prepared a beta-test computerized version on CD-ROM. This form of the book does not have the size constraints of the printed book and can thus contain far more information. The CD-ROM version includes the entire NSR reference file, the *Table of Superdeformed Nuclear Bands*, an *Energy-Ordered Table of Decay Gamma Rays*, Chart of the *Table of Isotopes*, the ENSDF file with manual, and VuENSDF to view the ENSDF data. Adobe Acrobat software is available to view the *Table of Isotopes* with zoom capabilities, interactive bookmarks for quick access to subject matter, and hypertext links between related information. The Acrobat software is supported on Microsoft Windows, Macintosh, and UNIX operating systems. Most printers are supported for preparing hard copy from the CD-ROM. A demonstration system containing about 14,000 pages is now available. Annual updates of the *Table of Isotopes* and related material on CD-ROM are planned. Publication of the *Table of Isotopes* on the internet is also being explored.

C. VuENSDF (F. Chu and R.B. Firestone)

We have begun to develop the interactive version of the *Table of Isotopes* which we proposed at the 1990 and 1991 USNDN meetings, and the 1992 IAEA/NSDD Evaluators' meeting at Geel. The goal is to provide interactive access to nuclear data in an object-oriented environment on desktop computers. The VuENSDF program currently supports nuclear band, decay and general level scheme drawings from all ENSDF datasets. The program currently runs on Macintosh

computers, and a Windows version is under development. The level schemes can be scaled and scrolled in both vertical (energy) and horizontal (labels and γ-rays) directions. Transitions can be shown from groups of levels or one can display transitions de-exciting selected levels to the ground state. Coincidence criteria can be utilized to select transitions for display. Nearly all data on ENSDF level, gamma, beta, alpha, and parent records are presented on the drawings. Complimentary tabular data presentations are also being developed to provide more complete information including comments. File navigation tools are provided to rapidly select ENSDF data for display. Multiple windows can be created and saved for comparison.

VuENSDF can display any data file which uses the ENSDF format. This makes it a useful tool for both evaluators preparing datasets and researchers analyzing experimental information. Future plans include printer support, selection of data by property, nuclear application software, and linkage of ENSDF to other data files including Nuclear Structure References (NSR), atomic masses, moments, and atomic data. A graphical "Chart of the Nuclides" interface to the data will be used to simplify isotope selection. We are developing an extended version of the ENSDF file, ENSDF/2, for electronic publication. It will contain explicit linkage between related data, inverted indices, updated information, and standardized presentation. VuENSDF is available for beta testing and the first general distribution is targeted for late 1994.

D. Nuclear Structure References (NSR) on Desktop Computers (P. Ekstrom, E. Browne, and L. Mumaw).

The Lund-Berkeley Collaboration has implemented the NSR file (produced by S. Ramavataram, Brookhaven National Laboratory) on IBM/PC and Macintosh computers, as a complement to the existing on-line system. Retrieval of information can be done using the PAPYRUS bibliographic database management system, produced by Research Software Design, Inc., and Niles & Associates, Inc. The entire database is up to date as of December 1993 and will be distributed on compact disks (CD-ROM). It is expected to be released by summer 1994. This system will be useful in particular for those who do not have on-line computer network access to NSR. Lorin Mumaw, an undergraduate student from the Chemistry Department, San Jose State University, participated in the project during the summer of 1993, working on implementation of NSR on the Macintosh.

E. *Table of Isotopes* Databases (R.B. Firestone)

Three databases, based on the *Table of Isotopes*, have been established. They are the Evaluated High-Spin Data File (EHSDF), Evaluated Decay Data File (EDDF), and the Evaluated Nuclear Chart Data File (ENCDF). These databases will be maintained in ENSDF and ENSDF/2 formats. Our goal is to maintain these databases as nearly up-to-date as possible. The data will be published in the yearly electronic updates of the *Table of Isotopes*, and they can be displayed with VuENSDF.

F. Research Publications

1. *Half-lives of Microsecond Isomers in ^{151}Eu and ^{181}W*, B. Singh and H.W. Taylor, Appl. Radiat. Isotopes **45**, 374 (1994).

2. *Radioactivity in Paper*, H.W. Taylor and B. Singh, J. Environ. Radioactivity **21**, 177 (1993).

3. *Electron-Capture Decay of ^{231}U*, E. Browne, I. Ahmad, K.E. Gregorich, S.A. Kreek, D.M. Lee, and D.C. Hoffman, Nuclear Instruments and Methods for Physics Research **339**, 209 (1994).

National Nuclear Data Center Activity Report

M. R. Bhat

April 15, 1994

This report reviews the evaluation of nuclear structure, decay data and related activities of the National Nuclear Data Center (NNDC) for the period November 1992 to April 1994.

1 Nuclear Structure References (NSR)

The number of primary entries is about 2600/year. Primary reference coverage continues to be complete; secondary entries have stabilized at approximately 1000/year. The publication of four-monthly issues of Recent References in the *Nuclear Data Sheets* was discontinued in August 1992. A cumulative issue for the period September 1992 to December 1993 was published recently.

Several errors in the NSR file and dictionaries were noted by Peter Ekstrom and Eddie Browne in the development of NSR Papyrus; these have been corrected. 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 is notified by letter as to the results. In response to suggestions from the user community, starting in 1993, articles which may not have nuclear structure information but deal with relevant physics are being entered into the NSR file. Such entries can be retrieved by author name or string search of title. This implies complete coverage of journals like *Physical Review C* or *Nuclear Physics A*.

The American Physical Society has plans to provide the NNDC with sample electronic publication files of *Physical Review Letters* and *Physical Review C*. A program is being developed which will translate the reference, title, and authors in these files to NSR field entries; later work will develop aids in scanning the abstract and article in these files for the keywords.

Files containing Russian conference proceedings and JINR reports from Gatchina (Russia) and entries from Laboratory reports from RIKEN (Japan) were received and merged into the NSR. The NNDC continues to receive author keyword abstracts at a reduced rate of about 15-20% of the NSR entries for *Physical Review C*.

2 The Evaluated Nuclear Structure Data File (ENSDF)

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=1-266 is shown in a separate report accompanying this contribution. 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. A subset of the evaluated data for A=5-44 published in *Nuclear Physics* has been entered into the ENSDF with contributions from CEA, Grenoble, LBL, NDP and the NNDC. Superdeformed band information for 37 nuclides as coded by B. Singh (McMaster U.) has been added to the ENSDF and is available to users of the online system.

3 The NNDC Online System

Usage of the NNDC online data service continues to grow almost exponentially with a 66% increase in retrievals in 1993 over 1992. Retrievals from the NSR file continue to dominate with about 35% of all retrievals in 1993; NUDAT is the second most popular database with 22% of the total. Retrievals from the ENSDF and ENDF nearly doubled between 1992 and 1993 and CSISRS retrievals almost tripled. The total retrievals in 1992 and in 1993 were 29927 and 48444 respectively.

Enhancements have continued to make the online system more user friendly. In particular, NSR now has wild-card search capabilities for all selection criteria and the ability to preview the results immediately.

The 1993 Atomic Mass evaluation by Audi, Wapstra, et. al. has been added to the system via the MASSES module. The IRDF90 library and D. E. Cullen's ENDF codes from the Nuclear Data section, IAEA, will be added soon.

Access to the service is now available also via the World Wide Web and work has begun on a client/server system. A new module to calculate reaction and decay Q values and reaction threshold energies based on the 1993 Atomic Mass evaluation is being written.

4 The *Nuclear Data Sheets* (NDS) Publication

As of April 15, 1994, there are 31 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.

In June 1986 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	10+20(u)	79
1993	7+25(u)	85
(u)=published in update format		

5 Mass-chain Evaluations and Related Activities

The NNDC submitted for publication A=65, 70, 71, 95, 97, 99 and 138 in 1992, and A=47, 131 (jointly with St. Petersburg), 136, 140 and 199 in 1993 respectively. A=45, 50 and 66 in 1992 and A=45, 48 and 50 in 1993 were re-evaluated in a continuous evaluation mode. Apart from the evaluation of mass-chains, the NNDC physicists' effort has been directed towards improving the NDS production and processing codes, the NNDC online system, ENSDF code development (see separate report for status of codes), and in reviewing several mass-chains.

6 Nuclear Structure Related Publications

The next edition of the Nuclear Wallet Cards expected to be published in 1995 will be based on the 1993 Audi, Wapstra mass evaluation and other available new data.

7 User Services

The NNDC provides the following services to the NSDD network evaluators and others on a 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. The current status of ENSDF Physics processing codes is described in a separate report accompanying this contribution.

8 Publicity for NSR, ENSDF & Related Databases

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

- Information on the NNDC products and services is now available on the World Wide Web.
- The NNDC prepared a draft of a brochure advertising the NSDD network in collaboration with the Nuclear Data Section of the IAEA.
- 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. The system is being considered for installation at Gatchina and Obninsk, Russia.
- Demonstration booths for online access were provided at professional meetings such as the American Physical Society's Nuclear Physics Division at Asilomar.
- An invited paper " Decay Data for Nuclear Medicine: Applications, Sources, and Programs " was presented at the March, 1994 meeting of the American Chemical Society in San Diego to publicize the data bases available at the NNDC.
- The NNDC sends Nuclear Wallet Cards for distribution as part of the registration package at topical conferences such as: 1994 Symposium on Radiation Measurements and Applications (8th in a Series) to be held at the University of Michigan, May 16-19, 1994.

ORNL–Nuclear Data Project

1 Mass-chain Evaluations

The mass-chains 203, 205, 207, 230, 231, 234, 235, and 245 have been published.

The mass-chains 201, 204, and 241 have been submitted for publication.

The mass-chains 133, 202, 208, and 237 are being worked on.

2 Mass-chain Editing

The NDP staff provided reviews of the mass-chains 47, 59, 79, 81, 97, 99, 103, 105, 106, 116, 122, 123, 126, 128, 129, 140, 154, 155, 159, 168, 178, 179, 180, 185, 196, 201, and 230.

As part of the revised review procedure, the Editor-in-Chief sees each mass-chain reviewed by other evaluators prior to the mass-chain being returned to the author(s). Comments are added to those of the reviewer, if needed, based just on a reading of the manuscript. This procedure gives the author(s) all the suggested changes at the same state, and has resulted in significantly fewer changes being required at the Galley stage. The Editor-in-Chief continues to be responsible to resolving problems arising from differences of opinion between the author(s) and the reviewer.

3 Low-Mass Data

Adopted level, gamma, and decay data for A = 13–20 were entered into ENSDF. The A = 16, 17 data are those of the TUNL center, published in 1993.

TUNL A = 3 - 20 DATA PROJECT REPORT
to
NUCLEAR STRUCTURE AND DECAY DATA EVALUATORS' NETWORK

D.R. Tilley[1], H.R. Weller[2], C.M. Cheves[2] and R.M. Chasteler[2]

Triangle Universities Nuclear Laboratory, Durham, NC 27708-0308

[1]*Department of Physics, North Carolina State University, Raleigh, North Carolina, 27695-8202*
[2]*Department of Physics, Duke University, Durham, North Carolina 27708-0305*

I. TUNL is responsible for data evaluations in the mass range A = 3 - 20. The current status of these evaluations is summarized below:

Nuclear Mass	Publication/Status	Comments
A = 3	Nucl. Phys. A474, 1 (1987)	TUNL
A = 4	Nucl. Phys. A541, 1 (1992)	TUNL/LANL
A = 5 - 10	Nucl. Phys. A490, 1 (1988)	U. Penn. (FAS)
A = 11 - 12	Nucl. Phys. A506, 1 (1990)	U. Penn. (FAS)
A = 13 - 15	Nucl. Phys. A523, 1 (1991)	U. Penn. (FAS)
A = 16 - 17	Nucl. Phys. A564, 1 (1993)	TUNL
A = 18 - 20	Nucl. Phys. A475, 1 (1987) A = 18 Prelim. version mailed A = 19 Prelim. version near completion	U. Penn. (FAS) TUNL, 1/94 TUNL, 4/94

II. Related Activities

During the period since the 1992 meeting of the IAEA Advisory Group of the NSDD Evaluator's Network, TUNL has continued its coverage of the literature, compiling a bibliographical listing for relevant experimental and theoretical work, utilizing the resources of the Triangle Area Libraries as well as Monthly Updates from NNDC, Current Contents on Diskette with Abstracts, and Physics Abstracts.

Preliminary versions of the A = 16 and A = 17 reviews were distributed in preprint form in June 1992 and December 1992 respectively and after making revisions based on responses to the preprints, TUNL submitted the manuscript in ESP-LaTeX format to Nuclear Physics. The review was published as "Energy Levels of Light Nuclei A = 16 - 17," Nuclear Physics A564 (1993) 1. During this period TUNL also worked on computer techniques for making revisions to the large hand-drawn level

diagrams for A = 5 - 20 supplied by Professor Fay Ajzenberg-Selove. Methods were developed for scanning the drawings and editing them using currently available graphics applications for the Macintosh. Drawings edited in this way were used for the A = 16 - 17 manuscript.

Work on a new version of A = 18 - 20 began in late 1993 and a preliminary version of A = 18 was mailed in January 1994. A preliminary version of A = 19 is near completion.

In addition to work on the update to A = 18 - 20, a high priority was assigned to the entry of A = 5 - 20 data into ENSDF, and TUNL worked closely with Dr. Murray Martin of the Nuclear Data Project at ORNL. Dr. Martin had earlier carried out level and decay data entry for A = 16 - 17 and was very helpful to TUNL personnel as they worked to learn the procedures.

In September 1993 the project gained the services of Dr. Robert Chasteler whose responsibilities as a DOE-sponsored post doctoral research associate is divided equally between the nuclear data project and the radiative capture research program at TUNL. Dr. Chasteler is expected to play a major role in developing new techniques for the TUNL project and in performing compiled and evaluated data entry into ENSDF files. At the present time he is entering level, decay, and reaction data for A = 18, 19, 20 into ENSDF format for eventual inclusion into the ENSDF files at NNDC. His efforts enabled TUNL to include some of the ENSDF generated gamma-ray decay diagrams along with the mailing of the A = 18 preliminary version in order to obtain opinions about their values from the preprint recipients.

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Annex 6

Working papers

6.1 J.K. Tuli: Status of mass-chains A = 1 to 266

6.2 T.W. Burrows: Status of ENSDF analysis and checking codes

Status of Mass Chains
A=1 to 266

National Nuclear Data Center

15-APR-1994

The information in this listing is based on the latest data that the NNDC has received. If there are any errors or omissions, please contact J.K. Tuli with your corrections.

The date given in the Submission Date column is when the NNDC received an evaluation for processing and publication in *Nuclear Data Sheets* or when a manuscript was submitted to *Nuclear Physics*.

"Cont. eval." in the Submission Date column indicates receipt of an evaluation in the continous or yearly update mode. The literature cutoff date in column 4 is the date for this evaluation and not the published version.

The average ages are based on the literature cutoff date given in column 4.

Center	A	Reference	Cutoff Date	Age (Yrs)	Revision Date	Submission Date
Belgium	111	NDS 60, 889 (1990)	1-Jan-1994	0.28		Cont. eval.
	112	NDS 57, 443 (1989)	1-Jun-1988	5.87		
	113	NDS 59, 729 (1990)	1-Jan-1994	0.28		Cont. eval.
	114	NDS 60, 139 (1990)	1-Dec-1992	1.37	30-Mar-1994	Cont. eval.
	115	NDS 67, 1 (1992)	1-Jan-1994	0.28		Cont. eval.
	116	NDS 59, 333 (1990)	1-Dec-1991	2.37	30-Mar-1994	Cont. eval.
	117	NDS 66, 451 (1992)	1-Jan-1994	0.28		Cont. eval.
		Average age of all A-chains		1.54		
		Average age of A-chains not under revision		1.41		
Canada	64	NDS 62, 603 (1991)	31-Mar-1991	3.04		
	98	NDS 67, 693 (1992)	21-Dec-1992	1.31		
	100	NDS 60, 1 (1990)	25-Apr-1990	3.97		
	149	NDS 46, 1 (1985)	1-May-1985	8.96	1-Sep-1992	28-Feb-1994
	151	NDS 55, 185 (1988)	1-Jul-1988	5.79	30-Mar-1994	
		Average age of all A-chains		4.61		
		Average age of A-chains not under revision		2.78		
France	101	NDS 63, 305 (1991)	1-Jan-1994	0.28		Cont. eval.
	102	NDS 63, 373 (1991)	1-Jul-1990	3.79		
	103	NDS 68, 311 (1993)	1-Jun-1992	1.87		
	104	NDS 64, 1 (1991)	1-Jan-1994	0.28		Cont. eval.
	105	NDS 68, 935 (1993)	1-May-1992	1.95		
	106	NDS 53, 73 (1988)	1-Jan-1987	7.29	22-Jan-1993	7-Jul-1993
	107	NDS 62, 709 (1991)	1-Jan-1994	0.28		Cont. eval.
	108	NDS 62, 803 (1991)	1-Jan-1994	0.28		Cont. eval.
	109	NDS 64, 913 (1991)	1-Jan-1994	0.28		Cont. eval.
	110	NDS 67, 809 (1992)	1-Nov-1991	2.45		
		Average age of all A-chains		1.88		
		Average age of A-chains not under revision		1.28		
Holland	21	NP A521, 1 (1990)	1-Jun-1990	3.87		
	22	NP A521, 1 (1990)	1-Jun-1990	3.87		
	23	NP A521, 1 (1990)	1-Jun-1990	3.87		
	24	NP A521, 1 (1990)	1-Jun-1990	3.87		
	25	NP A521, 1 (1990)	1-Jun-1990	3.87		
	26	NP A521, 1 (1990)	1-Jun-1990	3.87		
	27	NP A521, 1 (1990)	1-Jun-1990	3.87		
	28	NP A521, 1 (1990)	1-Jun-1990	3.87		
	29	NP A521, 1 (1990)	1-Jun-1990	3.87		
	30	NP A521, 1 (1990)	1-Jun-1990	3.87		
	31	NP A521, 1 (1990)	1-Jun-1990	3.87		
	32	NP A521, 1 (1990)	1-Jun-1990	3.87		
	33	NP A521, 1 (1990)	1-Jun-1990	3.87		
	34	NP A521, 1 (1990)	1-Jun-1990	3.87		
	35	NP A521, 1 (1990)	1-Jun-1990	3.87		
	36	NP A521, 1 (1990)	1-Jun-1990	3.87		
	37	NP A521, 1 (1990)	1-Jun-1990	3.87		
	38	NP A521, 1 (1990)	1-Jun-1990	3.87		
	39	NP A521, 1 (1990)	1-Jun-1990	3.87		
	40	NP A521, 1 (1990)	1-Jun-1990	3.87		
	41	NP A521, 1 (1990)	1-Jun-1990	3.87		
	42	NP A521, 1 (1990)	1-Jun-1990	3.87		
	43	NP A521, 1 (1990)	1-Jun-1990	3.87		

Center	A	Reference	Cutoff Date	Age (Yrs)	Revision Date	Submission Date
Holland	44	NP A521, 1 (1990)	1-Jun-1990	3.87		
		Average age of all A-chains		3.87		
		Average age of A-chains not under revision		3.87		
INEL/USA	87	NDS 62, 327 (1991)	1-Dec-1990	3.37		
	153	NDS 60, 419 (1990)	1-Sep-1988	5.62		
	154	NDS 69, 507 (1993)	1-Mar-1993	1.12		
	155	NDS 50, 563 (1987)	1-Aug-1985	8.70	1-Oct-1992	6-May-1993
	156	NDS 65, 65 (1992)	1-May-1991	2.96		
	157	NDS 55, 71 (1988)	1-Jun-1987	6.87	1-Sep-1993	14-Feb-1994
	158	NDS 56, 199 (1989)	1-Aug-1987	6.70	30-Mar-1994	
	159	NDS 53, 507 (1988)	1-May-1987	6.96	1-Oct-1992	30-Apr-1993
	160	NDS 68, 405 (1993)	1-Oct-1992	1.54		
	161	NDS 59, 1 (1990)	1-Jul-1988	5.79		
	162	NDS 64, 79 (1991)	15-Apr-1990	4.00		
	163	NDS 56, 313 (1989)	30-Oct-1988	5.46		
		Average age of all A-chains		4.92		
		Average age of A-chains not under revision		3.73		
Japan	118	NDS 51, 329 (1987)	31-May-1985	8.87	28-Oct-1992	4-Jan-1993
	119	NDS 67, 327 (1992)	1-May-1991	2.96		
	120	NDS 52, 641 (1987)	26-Mar-1986	8.05		
	121	NDS 64, 323 (1991)	1-Aug-1991	2.70	30-Mar-1994	
	122	NDS 49, 315 (1986)	31-Dec-1984	9.29	28-Jan-1992	27-Aug-1992
	123	NDS 70, 437 (1993)	1-Jan-1993	1.28		
	124	NDS 41, 413 (1984)	1-Jun-1982	11.87	3-Jan-1994	
	125	NDS 70, 217 (1993)	1-Mar-1992	2.12		
	126	NDS 69, 429 (1993)	1-Apr-1992	2.04		
	127	NDS 35, 181 (1982)	1-Oct-1979	14.54	30-Oct-1978	6-May-1993
	128	NDS 38, 191 (1983)	28-Feb-1983	11.13	15-Mar-1991	19-Apr-1993
	129	NDS 39, 551 (1983)	1-Apr-1982	12.04	15-Mar-1991	4-Mar-1993
		Average age of all A-chains		7.24		
		Average age of A-chains not under revision		3.29		
Kuwait	74	NDS 51, 225 (1987)	1-Feb-1987	7.20	2-Aug-1993	
	75	NDS 60, 735 (1990)	31-Mar-1990	4.04		
	76	NDS 42, 233 (1984)	1-Jun-1984	9.87	26-Jan-1993	27-Dec-1993
	77	NDS 57, 223 (1989)	1-Apr-1989	5.04	30-Mar-1994	
	78	NDS 63, 1 (1991)	1-Dec-1990	3.37		
	79	NDS 70, 437 (1993)	10-Dec-1993	0.35		
	80	NDS 66, 623 (1992)	22-Jun-1992	1.82		
		Average age of all A-chains		4.53		
		Average age of A-chains not under revision		2.39		
LBL/USA	81	NDS 69, 267 (1993)	1-May-1993	0.96		
	83	NDS 66, 281 (1992)	1-Nov-1991	2.46		
	89	NDS 58, 351 (1989)	27-Apr-1989	4.97		
	90	NDS 67, 579 (1992)	10-Aug-1992	1.68		
	91	NDS 60, 835 (1990)	30-Jun-1990	3.79		
	92	NDS 66, 347 (1992)	1-Feb-1994	0.20		Cont. eval.
	93	NDS 70, 1 (1993)	1-Aug-1993	0.70		
	167	NDS 58, 871 (1989)	1-Sep-1988	5.62	30-Mar-1994	
	168	NDS 71, 261 (1994)	1-Jul-1993	0.79		
	169	NDS 64, 505 (1991)	1-Mar-1990	4.12		
	170	NDS 50, 351 (1987)	1-Nov-1985	8.45	1-Jun-1992	
	171	NDS 66, 69 (1992)	30-Jun-1991	2.79		
	172	NDS 51, 577 (1987)	2-Feb-1986	8.20	30-Mar-1994	

Center	A	Reference	Cutoff Date	Age (Yrs)	Revision Date	Submission Date
LBL/USA	173	NDS 54, 589 (1988)	30-Sep-1987	6.54	1-Sep-1993	6-Dec-1993
	174	NDS 62, 1 (1991)	1-Nov-1989	4.45		
	175	NDS 69, 903 (1993)	1-May-1993	0.96		
	176	NDS 60, 227 (1990)	30-May-1989	4.88		
	177	NDS 68, 747 (1993)	1-Jul-1992	1.79		
	178	NDS 54, 199 (1988)	1-Mar-1987	7.12	9-Feb-1987	27-Aug-1993
	179	NDS 55, 483 (1988)	1-Sep-1987	6.62	1-Sep-1993	1-Oct-1993
	180	NDS 71, 81 (1994)	1-Nov-1992	1.45		
	181	NDS 62, 101 (1991)	22-Dec-1992	1.31		Cont. eval.
	182	NDS 54, 307 (1988)	30-Apr-1987	6.96		
	183	NDS 65, 589 (1992)	22-Dec-1992	1.31		Cont. eval.
	184	NDS 58, 243 (1989)	1-Jun-1989	4.87		
	185	NDS 58, 441 (1989)	1-Sep-1988	5.62	1-Sep-1993	15-Nov-1993
	186	NDS 55, 583 (1988)	1-Aug-1987	6.70		
	187	NDS 62, 159 (1991)	1-Dec-1991	2.37		Cont. eval.
	188	NDS 59, 133 (1990)	15-Dec-1989	4.33		
	189	NDS 59, 869 (1990)	31-Oct-1991	2.46		Cont. eval.
	190	NDS 61, 243 (1990)	10-Oct-1990	3.51		
	191	NDS 56, 709 (1989)	1-Feb-1988	6.20	30-Mar-1994	
	192	NDS 64, 205 (1991)	1-Dec-1990	3.37		
	193	NDS 61, 519 (1990)	1-Aug-1989	4.70		
	194	NDS 56, 75 (1989)	1-Oct-1988	5.54		
	206	NDS 61, 93 (1990)	1-Jun-1989	4.87		
	210	NDS 65, 209 (1992)	1-Apr-1991	3.04		
	211	NDS 63, 79 (1991)	1-Apr-1990	4.04		
	212	NDS 66, 171 (1992)	29-Mar-1991	3.05		
	215	NDS 65, 669 (1992)	30-Aug-1990	3.62		
	219	NDS 65, 669 (1992)	31-Aug-1990	3.62		
	223	NDS 65, 669 (1992)	31-Aug-1990	3.62		
	227	NDS 65, 669 (1992)	31-Aug-1990	3.62		
	Average age of all A-chains			3.89		
	Average age of A-chains not under revision			3.23		
MOS/Russia	1	Unpublished	1-Jan-1988	6.29		
	2	Unpublished	1-Jan-1988	6.29		
	86	NDS 54, 527 (1988)	15-Apr-1988	6.00		
	88	NDS 54, 1 (1988)	15-Feb-1988	6.16		
	164	NDS 65, 365 (1992)	1-Aug-1989	4.70		
	166	NDS 67, 45 (1992)	1-Oct-1990	3.54		
	238	NDS 53, 601 (1988)	1-Dec-1986	7.37	30-Mar-1994	
	240	NDS 59, 947 (1990)	1-Oct-1993	0.54		Cont. eval.
	242	NDS 45, 509 (1985)	1-Jun-1984	9.87	1-Oct-1990	1-Jun-1993
	244	NDS 49, 785 (1986)	1-May-1985	8.96	21-Feb-1990	1-Jun-1993
	Average age of all A-chains			5.97		
	Average age of A-chains not under revision			4.79		
NDP/USA	82	NDS 50, 1 (1987)	1-Sep-1986	7.62	13-Mar-1991	
	84	NDS 56, 551 (1989)	1-Jan-1989	5.28		
	85	NDS 62, 271 (1991)	1-Nov-1990	3.45		
	200	NDS 51, 689 (1987)	1-Dec-1986	7.37		
	201	NDS 71, 421 (1994)	1-Mar-1994	0.12		
	202	NDS 50, 669 (1987)	1-Jul-1986	7.79	30-Mar-1994	
	203	NDS 70, 173 (1993)	1-Aug-1993	0.70		
	204	NDS 50, 719 (1987)	1-Jan-1986	8.28	1-Sep-1993	11-Mar-1994
	205	NDS 69, 679 (1993)	1-Jun-1993	0.87		

Center	A	Reference	Cutoff Date	Age (Yrs)	Revision Date	Submission Date
NDP/USA	207	NDS 70, 315 (1993)	1-Oct-1993	0.54		
	208	NDS 47, 797 (1986)	1-Dec-1985	8.37	30-Mar-1994	
	209	NDS 63, 723 (1991)	30-Jun-1991	2.79		
	213	NDS 66, 237 (1992)	1-Feb-1992	2.20		
	214	NDS 55, 665 (1988)	1-Sep-1987	6.62		
	216	NDS 49, 83 (1986)	1-Dec-1985	8.37		
	217	NDS 63, 439 (1991)	12-Feb-1991	3.17		
	218	NDS 52, 789 (1987)	1-Mar-1987	7.12		
	220	NDS 49, 102 (1986)	1-Dec-1985	8.37		
	221	NDS 61, 623 (1990)	1-Jul-1990	3.79		
	222	NDS 51, 765 (1987)	1-Feb-1987	7.20		
	224	NDS 49, 117 (1986)	1-Dec-1985	8.37		
	225	NDS 60, 617 (1990)	1-Jun-1989	4.87		
	226	NDS 50, 229 (1987)	1-Apr-1986	8.04	15-Apr-1992	
	228	NDS 49, 136 (1986)	1-Dec-1985	8.37		
	229	NDS 58, 555 (1989)	1-Feb-1989	5.20		
	230	NDS 69, 155 (1993)	31-Jan-1993	1.20		
	231	NDS 70, 387 (1993)	1-Aug-1993	0.70		
	232	NDS 63, 139 (1991)	1-Mar-1991	3.12		
	233	NDS 59, 263 (1990)	1-Dec-1988	5.37		
	234	NDS 71, 181 (1994)	1-Aug-1993	0.70		
	235	NDS 69, 375 (1993)	1-Jun-1993	0.87		
	236	NDS 63, 183 (1991)	1-Mar-1991	3.12		
	237	NDS 49, 181 (1986)	1-Jun-1985	8.87	30-Mar-1994	
	239	NDS 66, 839 (1992)	1-Jan-1992	2.29		
	241	NDS 44, 407 (1985)	1-Aug-1984	9.70	1-Sep-1993	1-Mar-1994
	243	NDS 66, 897 (1992)	7-Oct-1993	0.52		Cont. eval.
	245	NDS 67, 153 (1992)	13-Oct-1993	0.50		Cont. eval.
	246	NDS 57, 515 (1989)	1-Dec-1988	5.37		
	247	NDS 66, 505 (1992)	13-Oct-1993	0.50		Cont. eval.
	248	NDS 57, 543 (1989)	1-Dec-1988	5.37		
	249	NDS 59, 507 (1990)	30-Apr-1989	4.96		
	250	NDS 57, 558 (1989)	1-Dec-1988	5.37		
	251	NDS 59, 545 (1990)	30-Apr-1989	4.96		
	252	NDS 57, 579 (1989)	1-Dec-1988	5.37		
	253	NDS 59, 575 (1990)	30-Apr-1989	4.96		
	254	NDS 57, 590 (1989)	1-Dec-1988	5.37		
	255	NDS 59, 591 (1990)	30-Apr-1989	4.96		
	256	NDS 57, 601 (1989)	1-Dec-1988	5.37		
	257	NDS 59, 605 (1990)	30-Apr-1989	4.96		
	258	NDS 57, 610 (1989)	1-Dec-1988	5.37		
	259	NDS 59, 614 (1990)	30-Apr-1989	4.96		
	260	NDS 57, 616 (1989)	1-Dec-1988	5.37		
	261	NDS 59, 620 (1990)	30-Apr-1989	4.96		
	262	NDS 57, 621 (1989)	1-Dec-1988	5.37		
	263	NDS 59, 624 (1990)	30-Apr-1989	4.96		
	264	NDS 57, 624 (1989)	1-Dec-1988	5.37		
	265	NDS 59, 626 (1990)	30-Apr-1989	4.96		
	266	NDS 57, 624 (1989)	1-Dec-1988	5.37		
	Average age of all A-chains			4.76		
	Average age of A-chains not under revision			4.26		
NNDC/USA	45	NDS 65, 1 (1992)	8-Nov-1993	0.44		Cont. eval.
	46	NDS 68, 271 (1993)	1-Oct-1991	2.54		

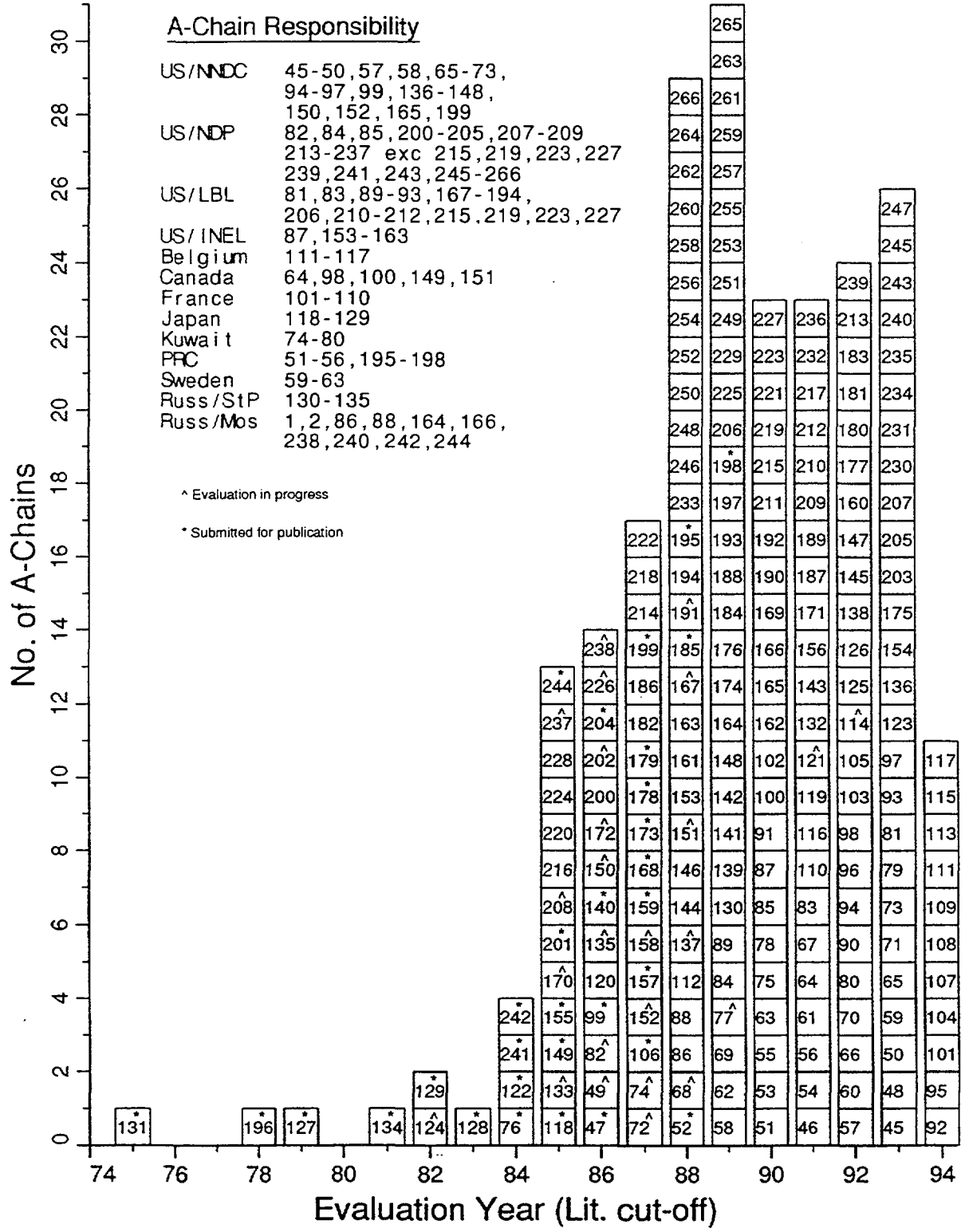
Center	A	Reference	Cutoff Date	Age (Yrs)	Revision Date	Submission Date
NNDC/USA	47	NDS 48, 1 (1986)	14-Feb-1986	8.17	25-Aug-1992	7-Dec-1993
	48	NDS 68, 1 (1993)	10-Nov-1993	0.43		Cont. eval.
	49	NDS 48, 569 (1986)	28-Mar-1986	8.05	25-Aug-1992	
	50	NDS 61, 1 (1990)	8-Nov-1993	0.44		Cont. eval.
	57	NDS 67, 195 (1992)	1-Jul-1992	1.79		
	58	NDS 61, 189 (1990)	1-Feb-1989	5.20		
	65	NDS 69, 209 (1993)	1-Jun-1993	0.87		
	66	NDS 61, 461 (1990)	24-Nov-1992	1.39		Cont. eval.
	67	NDS 64, 875 (1991)	3-Oct-1991	2.54		
	68	NDS 55, 1 (1988)	27-Apr-1988	5.97	22-Mar-1993	
	69	NDS 58, 1 (1989)	18-Jan-1989	5.24		
	70	NDS 68, 117 (1993)	1-Dec-1992	1.37		
	71	NDS 68, 579 (1993)	3-Feb-1993	1.20		
	72	NDS 56, 1 (1989)	1-Nov-1987	6.46	30-Mar-1994	
	73	NDS 69, 857 (1993)	9-Mar-1993	1.10		
	94	NDS 66, 1 (1992)	1-Feb-1992	2.20		
	95	NDS 68, 635 (1993)	5-Apr-1994	0.03		Cont. eval.
	96	NDS 68, 165 (1993)	1-Oct-1992	1.54		
	97	NDS 70, 85 (1993)	1-Jul-1993	0.79		
	99	NDS 48, 663 (1986)	15-Feb-1986	8.16	1-Jun-1992	14-Aug-1992
	136	NDS 71, 1 (1994)	13-Jan-1993	1.25		
	137	NDS 59, 767 (1990)	1-Nov-1988	5.45	13-Oct-1993	
	138	NDS 69, 69 (1993)	17-Jun-1992	1.83		
	139	NDS 57, 337 (1989)	17-Apr-1989	4.99		
	140	NDS 51, 395 (1987)	1-Mar-1986	8.12	1-Jun-1992	29-Jan-1993
	141	NDS 63, 573 (1991)	31-Aug-1989	4.62		
	142	NDS 63, 647 (1991)	31-Jul-1989	4.71		
	143	NDS 64, 429 (1991)	1-Jan-1991	3.29		
	144	NDS 56, 607 (1989)	1-Nov-1988	5.45		
	145	NDS 68, 997 (1993)	1-Oct-1992	1.54		
	146	NDS 60, 953 (1990)	31-Oct-1988	5.45		
	147	NDS 66, 705 (1992)	1-Apr-1992	2.04		
	148	NDS 59, 393 (1990)	31-Jul-1989	4.71		
	150	NDS 48, 345 (1986)	1-Jan-1986	8.28		
	152	NDS 58, 93 (1989)	1-Nov-1987	6.45	30-Mar-1994	
	165	NDS 65, 439 (1992)	1-Nov-1990	3.45		
	199	NDS 53, 331 (1988)	1-Apr-1987	7.04	15-Jan-1993	9-Nov-1993
	Average age of all A-chains			3.71		
	Average age of A-chains not under revision			2.69		
PRC	51	NDS 63, 229 (1991)	1-Dec-1990	3.37		
	52	NDS 58, 677 (1989)	1-Nov-1988	5.45	28-Feb-1986	13-Oct-1993
	53	NDS 61, 47 (1990)	1-Jan-1990	4.29		
	54	NDS 68, 887 (1993)	1-Mar-1991	3.13		
	55	NDS 64, 723 (1991)	1-Sep-1990	3.62		
	56	NDS 67, 523 (1992)	1-Dec-1991	2.37		
	195	NDS 71, 367 (1994)	1-Feb-1994	0.20		
	196	NDS 28, 485 (1979)	1-Sep-1978	15.62	7-Mar-1986	17-Sep-1992
	197	NDS 62, 433 (1991)	1-Dec-1989	4.37		
	198	NDS 60, 527 (1990)	1-Mar-1989	5.12	11-Feb-1988	1-Feb-1994
	Average age of all A-chains			4.75		
	Average age of A-chains not under revision			3.05		
StP/Russia	130	NDS 58, 765 (1989)	1-Aug-1989	4.70		
	131	NDS 17, 573 (1976)	1-Dec-1975	18.37	15-Sep-1987	20-Sep-1993

Center	A	Reference	Cutoff Date	Age (Yrs)	Revision Date	Submission Date
StP/Russia	132	NDS 65, 277 (1992)	1-Sep-1991	2.62		
	133	NDS 49, 639 (1986)	1-Jan-1985	9.28	30-Mar-1994	
	134	NDS 34, 475 (1981)	1-Dec-1981	12.37	1-Jul-1991	13-May-1993
	135	NDS 52, 205 (1987)	1-Jul-1986	7.79	17-Nov-1993	
	Average age of all A-chains			9.19		
	Average age of A-chains not under revision			3.66		
Sweden	59	NDS 69, 733 (1993)	1-Aug-1993	0.71		
	60	NDS 69, 1 (1993)	1-May-1992	1.96		
	61	NDS 67, 271 (1992)	1-Oct-1991	2.54		
	62	NDS 60, 337 (1990)	19-Jul-1989	4.74		
	63	NDS 64, 815 (1991)	1-May-1990	3.96		
	Average age of all A-chains			2.78		
	Average age of A-chains not under revision			2.78		
TUNL/USA	3	NP A474, 1 (1987)	1-Jun-1987	6.87		
	4	NP A541, 1 (1992)	1-Jun-1991	2.87		
	5	NP A490, 1 (1988)	1-Jun-1988	5.87		
	6	NP A490, 1 (1988)	1-Jun-1988	5.87		
	7	NP A490, 1 (1988)	1-Jun-1988	5.87		
	8	NP A490, 1 (1988)	1-Jun-1988	5.87		
	9	NP A490, 1 (1988)	1-Jun-1988	5.87		
	10	NP A490, 1 (1988)	1-Jun-1988	5.87		
	11	NP A506, 1 (1990)	1-Jun-1989	4.87		
	12	NP A506, 1 (1990)	1-Jun-1989	4.87		
	13	NP A523, 1 (1991)	23-Jul-1990	3.73		
	14	NP A523, 1 (1991)	23-Jul-1990	3.73		
	15	NP A523, 1 (1991)	23-Jul-1990	3.73		
	16	NP A565, 1 (1993)	28-Jul-1993	0.72		
	17	NP A565, 1 (1993)	28-Jul-1993	0.72		
	18	NP A475, 1 (1987)	1-Jun-1987	6.87	1-Dec-1993	
	19	NP A475, 1 (1987)	1-Jun-1987	6.87	1-Dec-1993	
	20	NP A475, 1 (1987)	1-Jun-1987	6.87	1-Dec-1993	
	Average age of all A-chains			4.89		
	Average age of A-chains not under revision			4.49		
	Average age of all A-chains			4.43		
	Average age of A-chains not under revision			3.48		

A-Chain Status in ENSDF (A>44)

Center - ALL

15-APR-94



Status of ENSDF Analysis and Checking Codes

Thomas W. Burrows
National Nuclear Data Center
Brookhaven National Laboratory
Upton, NY 11973-5000 USA

April 14, 1994

1 Introduction

The National Nuclear Data Center (NNDC) is responsible for the maintenance, quality assurance, and distribution of the computer codes used in the preparation of data for inclusion into the Evaluated Nuclear Structure Data File (ENSDF). The NNDC maintains and distributes 12 programs and a library of subprograms; in addition, it distributes four programs contributed by other groups within the network (Isotopes Project, Lawrence Berkeley Laboratory (IP), and University of Lund).

All programs are checked to see that they work "as advertised" before distribution. Programs maintained by the NNDC are corrected based on feedback from the users; problems noted in other programs are forwarded to the responsible authors. Enhancements to the NNDC-maintained programs are made based on suggestions from the users, decisions of the Formats and Procedures subcommittee, and the experiences of the NNDC staff in processing mass-chain evaluations. Major program changes are checked by extracting a relevant subset of data from ENSDF and using this as input to the new version.

Problems or suggested improvements should either be reported to the current author of the code or to:

Thomas W. Burrows
National Nuclear Data Center
Building 197D
Brookhaven National Laboratory
P.O. Box 5000
Upton, NY 11973-5000
Phone: 516-282-5084 FAX: 516-282-2806
BITNET: "NNDCTB@BNL"
HEPNET: BNL::NNDCTB
INTERNET: "NNDCTB@BNL.GOV"

2 Progress Since October 1992

The current status of the ENSDF analysis and checking codes is summarized in Table 1.

2.1 Enhancements

Major enhancements have been made to the programs FMTCHK and GTOL and HISCC and LOGFT were also enhanced. These enhancements are outlined in Appendix A.

2.2 Codes Added to the Distribution

Three codes have been added to the distribution since October 1992. These are:

ALPHAD calculates α-hindrance factors and R_0's. The program was provided by the Nuclear Data Project (NDP). Work is underway at the NNDC to incorporate a later version of the program (AHF) developed R.C. Ward for the NDP and to provide realistic estimates of the uncertainties.

ENSDAT creates high-quality PostScript files of tables and drawings from ENSDF-formatted files in a form similar to the Nuclear Data Sheets. This program was developed by R.R. Kinsey (NNDC) and executable versions of it are available for MS-DOS, VAX VMS, and AXP Open-VMS.

GABSPC was received from C. Baglin (IP) and is the MS-DOS version of the program GABS. Later work by C. Baglin and E. Browne (IP) and T.W. Burrows (NNDC) produced a common source code for MS-DOS, VAX, and ANSI-standard FORTRAN.

A more general purpose code, PC-NUDAT, which may be of use to the network is being developed by R.R. Kinsey (NNDC). PC-NUDAT is an MS-DOS clone of the NNDC Online Data Service program NUDAT and should be available for β testing by the end of April 1994.

2.3 Distribution

As noted in the last progress report the ability to download the ANSI-standard and VAX versions of ENSDF analysis and checking codes was added to the NNDC On-Line Data Service along with the ability to obtain these codes *via* an anonymous account.[1] In 1993 there were 873 retrievals of these codes and the ENDF utility codes from the service.

In April 1993 a set of three $3\frac{1}{2}$-inch high-density floppy diskettes was distributed containing MS-DOS sources and executables of all the codes except for GAMUT, RADLIST, SPINOZA, and PREND, supporting documentation and "READ ME" files, sample input and output, and simple installation batch files. As programs are modified, this distribution is kept current and updates are sent to the 18 users or groups who have requested the MS-DOS versions. See Appendix B.3 for details on how to obtain this distribution.

[1] See Appendices B.1 and B.2 for details on accessing this distribution

Table 1: Status of ENSDF Analysis and Checking Codes (March 28, 1994)

Code	Function	Version[a] No./Date	MS-DOS	Documentation
ADDGAM	Adds γ's to adopted data set.	1(3) 930414	Yes	No (See "Read Me" file)
ALPHAD	Calculates α HF's, R_0's, and theoretical $T_{\frac{1}{2}}^{\alpha}$'s	1.2 930421	Yes	No (See "Read Me" file)
DELTA	Analyzes angular correlation data.	1.01 930415	Yes	LUNFD/(NFFR-3048) 1-27
ENSDAT	Produces tables and drawings	3.70 931110	Yes	No (See "Read Me" file)
FMTCHK	ENSDF format checking.	8.2 931119	Yes	No (See "Read Me" file)
GABS	Calculates absolute ΔI_γ's.	VIIa 930827	Yes	Yes
GAMUT	Creates adopted levels, gammas from source data sets.	[b,c] 8809	No	LBL-26024
GTOL	Determines level energies from a least-squares fit to E_γ's & feedings.	6.2 931126	Yes	BNL-NCS-23375/R LUNFD/(NFFR-3049) 1-27
HSICC	Interpolates internal conversion coefficients.	11(11) 931123	Yes	Nucl. Data A4, 1 Nuclear Data Tables A9, 119 BNL-NCS-23375/R
LOGFT	Calculates log ft.	7(14) 930903	Yes	Nucl. Data Tables A10, 206
NSDFLIB	Support subprograms for many codes	4(12) 930401	Yes	Yes
PANDORA	Physics check of ENSDF data sets. Aids with adopted gammas & XREF.	6.1 931115	Yes	Yes
PREND	Constructs level schemes from ENSDF data sets.	2.5a[c] 931128	No	Yes
RADLST	Calculates atomic & nuclear radiations. Checks energy balance.	5.5 881005	No	BNL-NCS-52142
RULER	Calculates reduced transition probabilities.	1.18 931129	Yes	Yes
SPINOZA	Physics check of an ENSDF data set.	1(4)[b,c] 930809	No	Yes
TREND	Tabular display of ENSDF data.	6.14 931129	Yes	No (See "Read Me" file)

[a]Please check with the NNDC as to more recent versions.

[b]Program as received from the author.

[c]Program contains VAX extensions of ANSI-standard FORTRAN 77.

Appendices

A Program Enhancements

A.1 Major Enhancements

FMTCHK

1. Spurious messages eliminated.
2. Summary of number of messages displayed on terminal.
3. Check order of level energies.
4. Check for valid data set identification on X records.
5. More syntax checking on N and PN records and cross checking between N and PN record and GAMMA, BETA, and EC record fields.
6. More checking on the identification record.
7. Added documentation on the warning and error messages to the "Read me" file READFMTC.ME.
8. Finished implementation of update (U) comment.
9. Check for unrealistically exponents.
10. Cross check optional data in parentheses in DSID of IDENTIFCATION record and PARENT record.
11. Consistency check between multiple placement flags in column 77 of GAMMA record and RI and TI.

GTOL

1. Compact symmetric matrix inversion reduces memory requirements.
2. First level encountered is always assumed to be fixed.
3. Non-numeric level energies of the form "num+X", *etc.* are properly handled.
4. Non-numeric level energies of the form "SP+num" are ignored.
5. Production normalization (PN) record implemented.
6. Non-numeric uncertainties on feeding radiations retained for output.
7. "FL=" updated when new file created.
8. Size of report reduced.
9. Implemented Asilomar Formats and Procedures subcommittee recommendations to allow specifications of DEG, DRI, and DTI when not given.

A.2 Substantive Changes

HSICC

1. Publication comment coding added in version 11(6) replaced with coding to put CC on "S G" record.
2. Improved logic on handling uncertainties.

3. Improved logic on number of significant digits to retain in output.
4. Implemented Formats and Procedures subcommittee recommendation to multiply L=3,4 coefficients by 0.975 ± 0.010 and 0.975 ± 0.005, respectively.

LOGFT

1. More terminal output warning of possible problems.
2. Faster integration routines added.
3. Production normalization record implemented.
4. More checking on input data.

A detailed intercomparison of results from the programs LOGFT and BETAF (C.M. Lederer. University of California) was made between December 1992 and February 1993. This resulted in the improvement of both codes.

B Program Distribution

B.1 NNDC Online Data Service

VAX and ANSI-standard source codes, relevant documentation, data, and sample input and output may be obtained directly from the NNDC ALPHA computer through the NNDC Online Data Service. The programs may also be obtained in other media on request (see page 1 for the address); however, there may be a delay in satisfying such requests.

After logging on to the NNDC Online Data Service, select the FILES/CODES option. Within the CODES menu, select either ENSDF_UTILITY[2] or ENSDF_ANALYSIS[3] and then select either ANSI-77 for source code conforming to ANSI FORTRAN 77 or VAX/VMS for source code which may contain VAX/VMS FORTRAN 77 extensions.[4] After selecting the desired programs or documentation, the user will be queried as to the method of file transmission. The selected programs along with relevant documentation, data files, and subprogram libraries will be then transmitted *via* the selected method.

Note that if the user selects DOCUMENTATION, the file DISTRM.MEM will be transmitted. This file contains a table listing the latest version numbers and dates of the programs. It also contains brief descriptions of each code, machine dependencies and availability, data required, and subprogram library dependencies.

B.2 Anonymous Account

The ENSDF codes, documentation, and data may also be obtained by logging into an anonymous account[5] using FTP. A sample dialog would be:

[2] General documentation, NSDFLIB, ADDGAM, FMTCHK, PREND, and TREND

[3] General documentation, NSDFLIB, DELTA, GABS, GAMUT, GTOL, HSICC, LOGFT, PANDORA, RADLST, RULER, and SPINOZA

[4] Please use the Data Service HELP feature to obtain more details.

[5] Directory restrictions apply.

```
ftp bnlnd2.dne.bnl.gov
Name: bnlndc
Password:
ftp>get [scr.ensdf_pgm]readme.1st
ftp>bye
```

This will connect the user to the NNDC anonymous account, log into the anonymous account, retrieve the file README.1ST,[6] and disconnect. Figure 1 outlines the current organization of the directory. General information, data, and FORTRAN sources are contained in ENSDF_PGM and all relevant files for each program are contained in a subdirectory with the program name.

The file DISTRM.MEM in ENSDF_PGM contains a table listing the latest version numbers and dates of the programs. It also contains brief descriptions of each code, machine dependencies and availability, data required, and subprogram library dependencies. Each subdirectory contains a "Read Me" file (*e.g.*, READADDG.ME in ADDGAM) which provides additional details about the program.

Extensions for the FORTRAN source codes follow the following conventions:

ANS ANSI-standard FORTRAN 77 code with machine-dependent coding included.[7]

FOR ANSI-standard FORTRAN 77 code with no machine-dependent coding included.

VAX FORTRAN 77 code with VAX/VMS extensions and, possibly, machine-dependent coding.[7]

Other machine-dependent source codes (*e.g.*, for IBM PC's and clones) may be constructed by downloading the ANSI version of the code and the program SETMDC found in the ENSDF_PGM directory.

B.3 MS-DOS Distribution

A distribution of MS-DOS versions has been prepared. It includes all of the ENSDF analysis and checking codes[8] except for GAMUT, PREND, RADLST, and SPINOZA. In addition to the FORTRAN source code, sample input and output, and documentation, this distribution also contains the executable code and object libraries, installation batch files, and installation notes. The standard distribution consists of four $3\frac{1}{2}$-inch high-density diskettes.[9]

The distribution may be requested by either leaving a note on the NNDC Online Data Service or by contacting the address given on page 1.

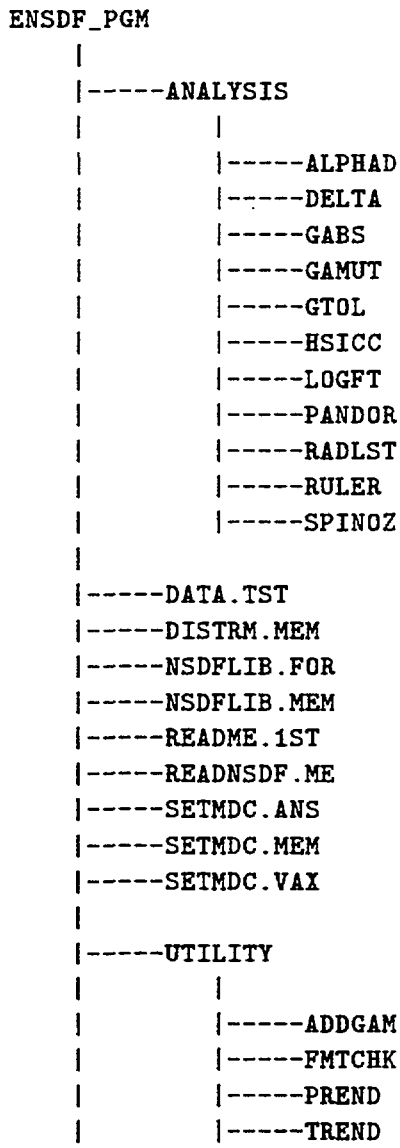
[6] Contains the current information on the organization and content of the ENSDF analysis and checking codes directory ENSDF_PGM

[7] Machine-dependent coding is in the form of special comments recognized by the program SETMDC.

[8] All MS-DOS versions are current with VAX/VMS and ANSI versions as of March 28, 1994.

[9] Other media can be specified but there may be a delay in satisfying the request.

Figure 1: NNDC ENSDF Program Directory Tree



Proposal and task force reports from the USNDN Executive Committee

7.1 J.M. Dairiki: Circular letter, and USNDN task forces

7.2 Nuclear structure data information in the year 2000: Outline

7.3 M.R. Bhat, T.W. Burrows, S. Ramavataram: NSR task force report

7.4 J.M. Dairiki, C.W. Reich, C.A. Stone: Preliminary report of the task force on user outreach

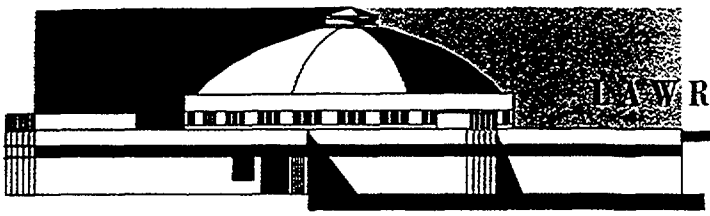
7.5 J.A. Cizewski, Y.A. Akovali, P. Ekström. R. Tilley, J.K. Tuli: Draft report of the task force on nuclear structure evaluations

7.6 J.A. Cizewski, P. Ekström, J.D. Garrett, B. Singh, J.K. Tuli: Draft report of sub-taskforce on high-spin evaluations

7.7 Y.A. Akovali, E. Browne, R.G. Helmer, J.K. Tuli: Draft report of the sub-taskforce on nuclear decay data

7.8 P. Ekström, R.B. Firestone, R. Kinsey, C.A. Stone: Program development - the online system and CD-ROM distributions for nuclear data

7.9 M.J. Martin, R.G. Helmer, J.K. Tuli: Report of the task force on publications



LAWRENCE BERKELEY LABORATORY

Nuclear Science Division • Mailstop 70A-3307
One Cyclotron Road • Berkeley, California 94720
Telephone: 510-486-5146 • Fax: 510-486-4808

April 15, 1994

Dear Colleague,

One outcome of the last U.S. Nuclear Data Network (USNDN) meeting, held at Asilomar in October 1993, was the establishment of a new leadership team -- the Executive Committee --made up of members representing both U.S. and foreign data centers and the research community. Current members of the Executive Committee are Fay Azjenberg-Selove (Univ. Penn.), Mulki Bhat (BNL), Jolie Cizewski(Rutgers), Janis Dairiki (LBL, chairman), and Peter Ekström (Univ. Lund). As one of its first actions, the Executive Committee established several task forces (see enclosed listing) to address key issues relating to Network activities and changing priorities.

In addition to coordination of the on-going activities, the Executive Committee is proceeding, through actions and recommendations of the task forces and continuing interaction with both evaluators and the scientific community, to develop a long-range plan for the evaluation and dissemination of nuclear data. Some of the questions being considered are: (1) What are the long term objectives of the network; (2) What activities should the network be carrying out; (3) How should the network be organized and coordinated in order to achieve the objectives and the desired activities; (4) What form of interface is needed between the network and its users, and between the U.S. and its international partners? A copy of the framework for the plan is enclosed. We would appreciate your comments and suggestions at the upcoming IAEA Advisory Group meeting. The plan itself will be completed in draft form during the summer and will incorporate recommendations from the task force reports and from the May meeting.

Also enclosed with this letter are copies of preliminary reports from four of the major task forces. This material is being distributed prior to the May meeting so that all participants can come to the meeting prepared to discuss the task force recommendations and also contribute their own ideas and suggestions.

We look forward to seeing you in May and expect to have a stimulating and productive meeting.

Sincerely,

Janis Dairiki
Chairman, USNDN Executive Committee

Enc:

USNDN Task Forces

Evaluation Task Force: This is a standing task force to address all issues concerning data evaluation, including the subject of horizontal evaluations and various proposals already on the table.

Members: J.A. Cizewski (chairman), Y.A. Akovali, L.P. Ekström, R. Tilley, and J.T. Tuli.

This task force formed two sub-task forces to address the specific issues of high-spin data and decay data, respectively.

Members (high-spin): J.A. Cizewski (chairman), L.P. Ekström, J.D. Garrett, and B. Singh
Members (decay data): Y.A. Akovali (chairman), E. Browne, R.G. Helmer and J.K. Tuli

Electronic Development Task Force -- to provide coordination of all code development activities, to recommend priorities, and, in the longer term, to address adapting ENSDF to modern database techniques.

Members: L.P. Ekström (chairman), R.B Firestone, R. Kinsey and C.A. Stone

Outreach Task Force -- to explore better interactions with current users and to broaden the user community.

Members: J.M. Dairiki (chairman), C. Reich and C.A. Stone

NSR Task Force -- to look into enhancing NSR by the addition of other references; cooperation with publishers and journals; provide for the continuity of the scanning effort.

Members: M.R. Bhat (chairman), S. Ramavataram and T.W. Burrows

Publications Task Force -- to coordinate network publications and to assure that proper credit is given to the network and to evaluators. (Formed 2/94)

Members: M.J. Martin (chairman), R.G. Helmer and J.K.Tuli

International Participation Task Force -- to encourage increased international participation.

Members: L.P. Ekström and R.A. Meyer

File Integrity Task Force

Members: M.J. Martin

Nuclear Structure Data Information in the Year 2000: Outline

Introduction

The U.S. Nuclear Data Network (NDN) has been very successful in providing users in the private and government sectors with evaluated nuclear data that were critical to the developments in basic research and nuclear technology over the past several decades. Easily accessible, accurate, current nuclear data are becoming increasingly important in today's highly technical, multidisciplinary and competitive world, with uses in basic and applied research and development.

The USNDN has initiated an examination of the future needs of users of evaluated nuclear structure data and how these data can best be disseminated. It is especially important to undertake such a study at this time when so many changes have taken place. Resources are much more limited in the decade of the 90's, more users require more different types of data and there is a need to more effectively use new technology in both the evaluation and dissemination of data. This long-range plan will present the results of the study. It represents a continuing process by the network data centers to work together to enhance their collective productivity and accuracy, to develop new methods to disseminate the evaluated data, and to continue to examine how these efforts can best be focused to meet the needs of their users.

Long-range objectives

- **The prime objectives of the USNDN are (1) to serve the data needs of the frontier areas of nuclear physics and (2) to serve the data needs of the broader scientific community.** Frontier areas currently include high-spin physics, radioactive beam physics, nuclear astrophysics, and the research programs to be conducted at the two major nuclear physics facilities now under construction, CEBAF and RHIC.

Guiding Principles

- To provide quality up-to-date reference and evaluated data in the most useful and convenient forms.
- To effectively use new technologies in the evaluation and dissemination of data.
- To interact closely with the user community and set priorities in consensus with users.
- To increase the involvement of non-U.S. participants.
- To coordinate all network activities in a manner that promotes collaborative and productive interactions among participants, and maximizes the cost effectiveness.

Approach

- Describe activities now being carried out by the network, including specific activities and FTE involved in each.
- Identify and prioritize activities to be carried out in the year 2000 in order to accomplish the long-range objectives; specify FTE required.
- Identify changes and resources that are necessary to accomplish the long-range priorities.
- Specify near-term actions.

Reports and recommendations from the task forces, and discussions and recommended actions at the May international meeting are expected to form the central part of this plan.

Important Network Activities

- Network coordination/leadership
- Nuclear Structure References
- Data Evaluation
- Electronic development
  Publications
  Evaluator tools
  Database/file development
  File quality/maintenance
- User interactions/input
- Data Dissemination/Products

Nuclear Structure References (NSR) Task Force Report

M. R. Bhat, T. W. Burrows and S. Ramavataram

(April 6, 1994)

Errors in the NSR:

Peter Ekström and Ed Browne encountered several problems in the NSR while creating the data base for NSR Papyrus. These problems were discussed via e-mail and during a visit by Ekstrom to the NNDC in January 1994. Some of these errors were noted in the older entries done prior to 1980; if these references are used and cited in mass-chain evaluations they are brought up to the current standards. If additional resources become available, as many as possible of these older entries will be corrected. Other problems noted are: duplicate entries, dictionary errors, reference errors and errors in the transliteration of authors' names. These problems have been corrected and data entry and NSR update procedures have been modified to make sure that these do not occur in the future.

Electronic Scanning of Literature:

At present, almost all of the articles that appear in Phys. Rev. C, and those on nuclear physics in Phys. Rev. A, B, and D are scanned and coded into the NSR. The very few articles in Phys. Rev. C which are purely theory papers without applications to specific nuclides are not coded at present; however, they will be included in the NSR beginning now without selectors and could be retrieved by author or a string search on the title or abstract. A string search capability for NSR retrievals will be added in the near future.

It may be possible to scan computer files containing Phys. Rev. C or Nuclear Physics A article titles, authors and abstracts. A string search will be done on the abstract to give a zero-th order keyword abstract which can then be edited by the scanner to include additional information based on a careful reading of the whole article. This additional step is needed because most of the abstracts do not list all the information contained in the body of the paper.

The publishers of both these journals have responded positively to this proposal and we have had some discussions with them as to how to blend it with their own near future plans for electronic publication of these journals. There are plans to use the Standard Generalized Markup Language (SGML) as the standard language for electronic publications. The editors of Phys. Rev. C have promised to make available SGML files of some articles for us to look into this procedure.

Recommendations:

1. A second scanner should be hired and trained to scan the literature and code references into the NSR. It is expected that this addition would enable a more complete coverage of secondary references than is possible now.

2. The automatic scanning of computer files of articles accepted for publication in Phys. Rev. C and Nuclear Physics should be implemented after the necessary code developments are done.

Preliminary Report of the Task Force on User Outreach

J.M. Dairiki, Lawrence Berkeley Laboratory, Chairman
C.M. Reich, Idaho National Engineering Laboratory
C.A. Stone, San Jose State University

This task force was established to explore ways of improving network interactions with current users and to identify new users. The group has just begun its work; some of the early thoughts and ideas are summarized briefly in this preliminary report. We look forward to fruitful discussions regarding user outreach with our international colleagues at the May meeting.

As our work proceeds, it is important to keep in mind that, since we are funded by the DOE Division of Nuclear Physics, our primary users are nuclear physicists in the experimental programs supported by the same Division of DOE. However, satisfying the needs of these users will often provide data needed for other purposes as well.

Interactions with users

Initial suggestions of ways to improve the interactions with current users and identify new users are summarized below. Some of the work in this area overlaps with the efforts of the evaluation task forces who, by the nature of their charges, are working closely with the appropriate user communities.

1. One suggestion is to hold the annual network meetings in conjunction with other professional meetings, such as those of the American Physical Society (APS), American Chemical Society (ACS), and American Nuclear Society (ANS). This worked very well at Asilomar in fall 1993 and we recommend that the 1994 meeting again be held with the DNP fall meeting in Williamsburg.

2. Network members must have a greater presence at professional meetings and conferences attended by our users. This can be accomplished with both invited and contributed talks, and demonstrations.

   In this regard, the Executive Committee organized a campaign to nominate a speaker for an invited talk at the Spring 1994 APS Washington meeting. It was nearly successful; the campaign will be repeated for the fall 1994 DNP meeting.

   We were able to work with Bill McHarris (MSU) to organize a session on Nuclear Data for Applications within his Symposium on Applications of Nuclear Chemistry at the San Diego ACS meeting March 13-17, 1994. Speakers (and titles) were Craig Stone (MacNuclide Nuclear Data Environment), Tom Burrows (Decay Data for Nuclear Medicine: Applications, Sources, and Programs), Dick Helmer (Radionuclide Decay Data -- Evaluation and Dissemination), Roger White (Oncology Isotope and Dosage Data), and Rick Firestone (Table of Isotopes Data for Nuclear Chemistry Applications). Janis Dairiki chaired the session and led off with a short introduction/overview of the U.S. Nuclear Data Network. Frank Chu (LBL) and Peter Ekström (Univ. Lund) demonstrated new programs/products -- Papyrus NSR, Table of Isotopes on CD-ROM, and VuENSDF. The audience was not too large (~25) but was interested and enthusiastic.

3. When the draft of the long-range plan is completed (after the international meeting), it should be circulated to the research community for comments.

4. The network should explore the idea of establishing a users advisory group to both improve interactions with users, and provide input and advice to the network.

5. Members of the Executive Committee recently suggested that we each have conversations with our colleagues in various research areas to determine their data needs and how well they are being met. This action has just begun. The task force recommends that all network members participate in this effort, in particular, reaching out to colleagues in forefront research areas where we have not traditionally compiled and evaluated data -- CEBAF and RHIC, for example. This is an area where we could profit greatly by help from our international colleagues.

Marketing

1. The USNDN has not done a very good job of letting users know what is available. As a start, we recommend that the network prepare an attractive brochure for distribution to users and publishers, containing information on network services and products. This is particularly important now that we are on the brink of releasing several new electronic developments. Other advertising options should also be explored. For example, the IAEA has proposed an informational brochure; this will be discussed at the upcoming international meeting. The Papyrus NSR CD-ROM, which is expected to be released later this month, contains some "advertising" for other network products.

2. We also need to ensure that the network and evaluators get proper credit for their work when it is referenced.

3. Demonstrations of new programs and capabilities are very effective. For example, a demonstration of MacNuclide at the Bernkastel-Kues Conference on Nuclei Far from Stability attracted a long line of interested users. Demonstrations of new programs in our own institutions should not be overlooked either. A recent talk/demonstration at the weekly LBL Nuclear Science Division staff meeting led to many requests for copies of beta-test versions of VuENSDF and the Table of Isotopes CD-ROM. VuENSDF has recently been made available to users at the Gammasphere facility and to researchers in Sweden. This activity should be encouraged and increased.

4. We need to initiate discussions with publishers regarding both publication and distribution of data in hard copy and electronic forms and to identify new user markets. We should also work with them to make better use of electronic data (e.g., references) already existing in databases. As a first step in this direction, members of the Executive Committee held a very productive meeting with representatives of Academic Press when they met in San Diego at the ACS meeting.

5. We must establish mechanisms to track the quality and usefulness of our products so we can measure our successes and our failures, and learn from them. Similarly, we must know who is using our data and products and how they use them and how successful they are. We need to have a formal feedback process.

DRAFT REPORT OF THE TASK FORCE ON NUCLEAR STRUCTURE EVALUATIONS

J. A. Cizewski, Rutgers University, Chair
Y. A. Akovali, Oak Ridge National Laboratory
P. Ekstrom, University of Lund
R. Tilley, North Carolina State University
J. K. Tuli, Brookhaven National Laboratory

The Task Force on Nuclear Structure Evaluations was charged to assess the present and future needs and directions for the evaluation of nuclear structure data. It was recognized quickly that two areas were in need of immediate attention, those of the gamma-ray data from heavy-ion induced reactions and the decay data needs of the applied physics community. The special needs in these areas were previously recognized in reports by M. Martin and J. Garrett from Oak Ridge (on high-spin data) and R. Helmer (INEL), E. Browne (LBL), and M. Schmorak (ORNL) (for decay data). The present draft report has relied heavily on these earlier proposals, and we thank those authors for their detailed assessments and recommendations. They made the work of the present sub-task groups much easier.

There are currently about 12 FTE evaluators world-wide, with about 8 FTE effort centered in the U.S. It is critical that the evaluator resources be maintained at this level, although it is likely that the focus of the evaluations of these individuals will evolve as a function of time.

Most of this report details the background and recommendations of the two sub-task forces. Here we only summarize those recommendations.

High-spin evaluations. There is a critical need to evaluate and compile the gamma-ray data from heavy-ion reactions.

1. We recommend 1.5-2.0 FTEs be identified no later than the end of 1994 (or FY 1994 for US resources). These individuals would focus on the evaluation of high-spin data from primary sources, and when feasible, secondary sources. The evaluator resources would be taken from those currently in the International Network. Between 1.0 - 1.5 FTE effort would come from the US, with the remainder from resources outside of the US.

2. We recommend the establishment of a high-spin coordinator in the US. During the trial period this position would be a post-doctoral, with at least 1/2 of the support to come from the USNDN. This would add an additional 0.5 FTE evaluator to the US efforts. This position would be available at the beginning of FY 95 and it is recommended that the coordination be centered at Oak Ridge National Laboratory.

Nuclear Decay Data. The applied nuclear science communities and the highly specialized metrologists need easy access to the decay data of about 250 nuclides.

1. We recommend that 1.0 FTEs for a 2-year period be devoted to the development of the decay data file to meet the needs of the applied scientists. These resources would be taken from those currently in the US Network. At the end of this period, about 0.5 FTE per year will be needed to maintain this file.

A-chains vs. Horizontal Evaluations. The sub-task forces were organized to assess the needs for two kinds of horizontal evaluations. A question to be addressed in future discussions is how much of the International evaluation effort should be directed towards "horizontal" evaluations in contrast to the traditional organization of responsibilities as A-chains. This question will not only include A>44, but should also include the evaluation of the data on the lighter nuclei. This task force on nuclear structure evaluations welcomes input from the International Network as well as the users of the evaluated data as we further address all of these issues.

Currency and Quality Control. It is critical that the ENSDF be as free of errors as possible and that the evaluations are based on as much of the measured data as possible. In the process of their work, the sub-task force on decay data determined these recommendations:

1. We recommend that the scanning effort for the Nuclear Structure References (NSR) be augmented to a full-time effort to allow for more complete scanning of secondary sources. Efforts should be initiated to identify a second scanner to meet future needs.

2. The US Network will no longer be able to provide the resources necessary to run checking codes for evaluations or to generate pre-review copy. Therefore, we recommend that all evaluators be required to use the available checking codes and, whenever possible, that evaluations be scrutinized by internal review before submission. Failure to comply with these checking requirements will have to result in immediate return of the manuscript.

DRAFT REPORT OF SUB-TASK FORCE ON HIGH-SPIN EVALUATIONS

J. A. Cizewski, Rutgers University, Chair
P. Ekstrom, University of Lund
J. D. Garrett, Oak Ridge National Laboratory
B. Singh, McMaster University (Canada)
J. K. Tuli, Brookhaven National Laboratory

Introduction: Need for a centralized high-spin data file

Of increasing importance for the nuclear structure research community is the creation of a data file for experimental data in the frontier areas of nuclear structure physics. This report focuses on the management of data from the studies of high-spin states.

Nearly all nuclear physics groups active in high-spin research maintain a computerized data file of the level schemes deduced from their own experiments. Furthermore, several of those groups have also made an effort to produce data files for specific mass regions that address the needs of their own research program. While some of these files may have had a common origin in the Niels Bohr Institute data file, each laboratory produced a separate data file which then evolved on its own. Attempts to standardize the diverging data files have not been successful, due mainly to the lack of a single person devoted to this task. Furthermore, the recent explosion of data on high-spin states, associated with the advent of sizable arrays of Compton-suppressed germanium detectors, has made it nearly impossible for any of the individual groups to maintain a comprehensive file for even a limited number of nuclides in the deformed region. The recent start of the scientific programs associated with EUROGAM, GASP and early implementation of GAMMASPHERE herald yet another dramatic increase in the amount of high-spin data.

In order to keep abreast of such developments it is essential that a high-spin data file be in place as soon as possible. By incorporating into one file the data presently available only in fragmented sources (segments of data files, lab and conference reports, etc.,) and maintaining this file, a single-source base of continuously updated data can be made available to the research community.

To maximize the usefulness of a high-spin data file for theoretical studies, it is also critical that evaluated data be available. The high-spin coordinator proposed in this report, and specific individuals associated with both the US and international nuclear data networks, should work together to evaluate the available high-spin data, as well as to establish procedures for the timely evaluation of all of these data. Because the research programs are an international effort, and there has been a long tradition of international cooperation in the evaluation of nuclear structure data, it is likely that new international collaborations will be involved in the compilation, maintenance, and evaluation of the high-spin data files.

The proposed high-spin data file would be a product of the International Nuclear Data Network. As such it will benefit from the innovations currently being developed by this Network to enhance the evaluation and dissemination of nuclear structure data.

Framework and features of the proposed high-spin data file

The existing Evaluated Nuclear Structure Data File (ENSDF) is the logical computer-based system to use for high-spin spectroscopic information. The on-line access requests for data from this file are growing at a rapid rate, indicating increased awareness and use of the file. We are proposing two files: the High Spin Data File (HSDF) which would be a compilation of high-spin data, and the Evaluated High Spin Data File (EHSDF). The purpose of HSDF is to compile and maintain a complete and current computerized listing of high-spin data and to provide these data in a convenient format for use in a variety of tasks. It would primarily be of interest to active practitioners in the field who need as complete and up-to-date source of high-spin γ-ray spectroscopy data as is possible. This file would provide the basis for the EHSDF, which would be the most reliable source of evaluated high-spin data. Both files would be available electronically for such tasks as comparison with nuclear models, calculation of secondary quantities of scientific interest (e.g., moments of inertia of "identical bands", level spacing distributions, and residual interactions), simulations of the continuum of nuclear states, and literature searches to determine if particular systems had been studied. However, the HSDF would be available with the clear caveat that these data have not been evaluated, but rather deduced quantities, such as spin-parity assignments, are those proposed by the original authors and should not be considered adopted quantities. Upon entry in the EHSDF the evaluated data files would be available for incorporation into ENSDF, and where appropriate adopted quantities based on both high-spin and other spectroscopic probes would be derived.

The HSDF would contain high-spin nuclear structure information provided directly by the researchers. The data under consideration would be divided into two categories: primary-source data and secondary-source data. The first category includes data that have been peer reviewed and published. The second category includes data which have not been reviewed from sources such as laboratory reports, conferences, and theses. While it is to be expected that this file would include the published data that are not already in ENSDF, it is the collection of the secondary-source material that will be of special value. In this field it is seldom that all analyzed data are published in refereed journals, so that conference proceedings, laboratory reports, and theses are the main sources for high-spin data. At best it can be years before the detailed results from a measurement are published. It is critical that this secondary source material be compiled, and eventually

incorporated in the evaluated data base. In the case of published papers, HSDF could also act as a repository for backup data that were not included in the publication.

The data for the HSDF would be provided by the authors and reformatted, where necessary, by the HSDF coordinator for entry into the file. The standardized file format will allow the research community efficient access to, and extraction of, the data. At the same time, the format in which the data can be provided will not be so rigid as to inhibit the researchers' participation in the system. The minimum requirements for inclusion in the file would be that the data consist of gamma-ray energies and excitation energies assigned to a specific nuclide. As much additional data (such as gamma-ray intensities, gamma-ray character, spins and parities, lifetimes, static moments, intrinsic configurations) as a researcher wishes to provide can easily be included in the file.

The mass-chain evaluators would also have access to these data. Working with the high-spin coordinator or an evaluator concentrating on high-spin evaluations, the "traditional" evaluators would be able to incorporate the high-spin data into the individual mass-chain evaluations as these mass chains are updated. The single-source ENSDF-compatible nature of both the HSDF and EHSDF data bases would save evaluators considerable time in preparing their mass chains, and conversely, would allow the extensive set of analysis, checking, and output programs designed for ENSDF to be available for users of HSDF and EHSDF. The data-base management aspects of both HSDF and EHSDF will be coordinated with the International Network to ensure compatibility with ENSDF, and to maximize the usefulness of these files to present and future users.

Role of the high-spin data file coordinator

The role of the coordinator would be to establish and manage the high-spin data files. During the initial phase the coordinator would spend nearly full-time developing the system, and would work closely with the International Network and the existing high-spin data files. Thereafter, the coordinator's time would be spent managing these files and coordinating the evaluation of the high spin data to be included in EHSDF. The coordinator would interact with the data producers to ensure that the file will satisfy their needs, and to assist them in transferring their data to HSDF. The coordinator would also assist nuclear structure researchers in accessing and obtaining information from the HSDF. The data transfer process would likely require some reformatting, and management of the file would involve development of some data format checking codes and of auxiliary data manipulating programs as needed. The coordinator would work closely with the efforts in the Network that are developing new software for evaluation and dissemination of nuclear structure data and would exploit the Network's expertise in these areas.

To carry out effectively the coordinator role, the candidate would need to be an experienced nuclear structure researcher who has familiarity with modern computational techniques and with the existing data files, and who has good contacts with the major groups producing the data. The coordinator will have high visibility within the research community. Once the feasibility of the project is demonstrated, and the files are established, it will be essential for the maximum effective use of the files that the coordinator position be a permanent one so that long-range continuity can be provided in the liaison between the files and the researchers. A permanent coordinator position will eliminate the need for periodic retraining, and will provide the degree of confidence in the system needed to maximize the researchers' use of the system. Maintenance of the files as current up-to-date research tools with continually expanding and diverse input/output requirements is expected to absorb a major fraction of the coordinator's time. The coordinator would also be expected to help with the evaluation of the high-spin data and to coordinate the efforts within the Network to ensure that all of the high-spin data are being evaluated in a timely manner. Since the coordinator would be partly supported by the research program, it is expected that the coordinator would be actively involved in research, for example by using the files for systematic nuclear structure studies. This aspect of the coordinator's role will allow the coordinator to keep abreast of new developments in the field as they arise, and to help ensure that the output capabilities of the file keep pace with the needs of the researchers.

The specifications of the coordinator position will necessitate extensive travel, especially in the first year, in order to establish and maintain close contact with the researchers and the data-base personnel. In particular, it will be very important that the coordinator attend the major high-spin conferences, as well as meetings of the US and International Data Networks.

Siting of the U.S. coordinator

It is essential that the high-spin coordinator be sited at a facility with an active experimental group in gamma-ray spectroscopy, which also has strong ties with the evaluators in the USNDN. Two facilities in the US have this tradition: at the Oak Ridge and Lawrence Berkeley Laboratories. The present report recommends that the high-spin coordinator be sited at Oak Ridge.

In the first two, trial years of this project, the coordinator will be a post-doctoral. If this trial is successful, the position will evolve into a permanent one. Because the work of the high-spin coordination will have a major impact on research in gamma-ray spectroscopy, we recommend that partial funding for the coordination be provided by either one of the heavy-ion laboratories or the Gammasphere project. Since the coordinator will also interact extensively with the national effort in nuclear data evaluation, at least 50% of the support should come from the resources available for the USNDN.

ORNL has a pre-eminent data evaluation group, the Nuclear Data Project, and a leading experimental program in high-spin physics. These meet the two most important criteria for siting the high-spin coordinator. In addition, the recently established Nuclear Structure Theory Research Group, coordinated jointly by ORNL and the University of Tennessee, will provide complementary theory expertise. Indeed, this group, with its sizable guest program, promises to provide the most significant nuclear structure theory effort in the US. Finally, a Radioactive-Beam Facility is being constructed at ORNL, which will provide new data from nuclides never before produced. It is likely that the anticipated explosion in nuclear structure information for nuclei far from the line of beta stability will be another area of research which will require a coordinator, with roles to be modeled after those of the high-spin coordinator. Taken together, the infrastructure at ORNL would provide a stimulating environment within which the high-spin coordinator could function most effectively.

Some of these capabilities are available at LBL. However, the history of high-spin data files is much more extensive at ORNL than at LBL. At present, the most complete operational high-spin data file in existence is the ORNL/UTK data file. This file has evolved from the original Copenhagen Data File and was modified by adding a keyword input format to make it compatible with the Cologne High-Spin Data File being used in several German and Scandinavian Laboratories. Extensive effort has been taken to make this data file as complete as possible for all deformed nuclei. It is estimated that the existing ORNL-UT High-Spin Data file represents a total effort of about eight man years. Much of the recent data-entry effort has utilized student participants in the ORNL Science and Engineering Research Semester and University of Tennessee Science Alliance.

Evaluation of published high-spin data

There currently exists a lot of high-spin data which are not in ENSDF at this time. Within the next 6 months a significant part of the evaluation effort should be redirected to focus on the evaluation of high-spin data. This should be done with existing resources in the evaluation network. It is estimated that with the dedicated involvement of 1.5-2.0 FTEs currently in the International Network, complete updating could be achieved in two years. This effort would complement the responsibility of the high-spin coordinator. Also, it would update the ENSDF file and maintain an updated file during the period in which an individual would be identified and trained as the high-spin coordinator. The goal would be that by the end of the trial period for the high-spin coordinator, all of the published data would have been incorporated into HSDF and an initial data base for the EHSDF would exist. The coordinator could then focus on incorporating the most current results and those only available in secondary sources. He or she would also have

experienced high-spin evaluators who would continue to play a major role in the evaluation of the HSDF data.

The high-spin coordinator would work with the Network to assess the number of FTEs necessary to maintain the HSDF and EHSDF, and incorporate the evaluated data into ENSDF. It is likely that at least 1 FTE currently fully assigned to the USNDN would be needed to work with the coordinator; additional evaluator resources could be identified in the international community. The evaluators associated with the Isotopes Project have had extensive recent experience in the horizontal evaluation of high-spin data (including superdeformed bands). Therefore, it is recommended that within 6 months 1.0 - 1.5 FTEs (at least partially based at LBL) be fully assigned to focus on high-spin evaluations. The A-chains currently assigned to these individuals would be redistributed within the International Network, at least on a temporary basis.

International Cooperation

The explosion of high-spin gamma-ray data is not limited to the US, but also comes from the new arrays of detectors in Europe, which include Eurogam, GASP, NordBall and the proposed Euroball. The Coordinator of the USNDN, the program manager, and the high-spin coordinator should work with the international community to identify the counterpart of a high-spin coordinator in Europe. They could use the paradigm of the US coordinator, who would be partly supported by the research effort, and partly supported by the existing evaluation network. Or the foreign coordinator could be fully supported by the research efforts, with strong support from an existing European data center. While it is likely that the US high-spin coordinator would play the major role in coordinating the input of high-spin data into the HSDF, EHSDF, and eventually ENSDF, he/she would work closely with the European coordinator to develop uniform formats and policies which ensure the integrity of the file.

DRAFT REPORT OF THE SUB-TASK FORCE ON NUCLEAR DECAY DATA

Y. A. Akovali, Oak Ridge National Laboratory, Chair
E. Browne, Lawrence Berkeley Laboratory
R. G. Helmer, Idaho National Engineering Laboratory
J. K. Tuli, Brookhaven National Laboratory

In this report we assess the needs for evaluations of data from radioactive decay by the various groups who work in different fields of nuclear science and we explore the general direction and scope of such evaluations.

We have identified the following groups, for which we present their data needs and our recommendations: (A) Applied Scientists, (B) Metrologists, and (C) Nuclear Structure Scientists. Their specific needs are summarized in Table 1.

A. Applied Scientists

This group includes industrial and research scientists working in fields such as environmental monitoring, health physics, nuclear medicine, nuclear power industry, tracer techniques, and radioactive waste management. Their primary data needs are best values for gamma-ray energies (Eg), absolute intensities (%g), and isotopes' half-life (T1/2). Secondary needs include level energies and their particle feeding abundances, placement of gamma rays in decay schemes, as well as subshell and total conversion coefficients. Recently X ray intensities have become a new tool for determining plutonium concentration in environmental samples, so X-ray data for actinides are needed too.

Although most of the data that applied scientists need are generally available in ENSDF and not more than five years old, some users need a single cut-off date for all relevant mass-chain evaluations. They also often need retrievals specifically tailored to their use.

R.G. Helmer, E. Browne, and M.R. Schmorak in their 1992 report discuss in detail how to improve this situation. In Table 2 we list the 214 isotopes (taken from the report of Helmer and collaborators) that are significant in applied work. This number may be extended to 250 by including additional isotopes for medical and other applications. Other independent groups of data evaluation, such as the Physikalish-Technische Bundesanstalt (PTB) in Germany, the Laboratoire Primaire des Rayonnements Ionisants (LPRI) in France, and AEA in the United Kingdom, also provide evaluated data on radioactive decay to applied users. Although these data may be available to evaluators of ENSDF, a formal consultation with members of these independent groups should help to provide a more reliable and widely accepted set of recommended values.

Recommendations:

1. We recommend support for the proposal of Helmer and collaborators for creating a computer file with data from the radioactive decay of about 250 isotopes used in applied work. This new file (independent of ENSDF) should contain a collection of well-evaluated decay schemes selected for their importance in various applications, such as gamma-ray spectrometry. The data should be of high quality and well documented. In the U.S. one FTE evaluator for a period of two years would be responsible for establishing this file. After the initial period 0.5 FTE would be dedicated to maintaining this file. This evaluation would not replace the corresponding data sets in ENSDF, although it may constitute an invaluable resource to evaluators of mass chains as they get updated.

2. We recommend formal consultations between the evaluators of the above file of radioactive decay data, the evaluators at AEA, LPRI, and PTB, and the evaluator of the corresponding mass chain in ENSDF.

3. We recommend that potential applied users be informed about the production and contents of this new file. Possible financial support from the community of applied users should be explored.

B. Metrologists

These are highly specialized nuclear scientists involved in precise measurements of nuclear properties such as half-lives, photon energies and emission probabilities, and particle intensities. They also participate in the evaluation of such quantities. Groups at the National Institute of Science and Technology (NIST) in the United States, the Physikalisch-Technische Bundesanstalt in Germany, the Laboratoire Primaire des Rayonnements in France, the National Physical Laboratory in the United Kingdom, and the Central Bureau for Nuclear Measurements (CBNM) in Belgium are involved in this type of work. Their measurements are of high quality. However, they often either do not publish their results or they publish them in internal reports of limited distribution.

Recommendation:

The excellent work of these groups should be utilized uniformly by all evaluators of the International Data Network. We recommend that the evaluator for the applied files be the contact person between this group and the ENSDF evaluators, and that these measurements be available to the central repository for ENSDF for distribution.

C. Nuclear Structure Scientists

Nuclear structure scientists are constantly seeking reliable and current nuclear data for their research work in a variety of nuclear fields. Results from our survey show that ENSDF has met well their data needs on radioactive decay and no additional quantities need to be included in ENSDF.

Recommendations:

1. No change to the current form of data sets for radioactive nuclei in ENSDF.

D. Recommendations for improving currency and the cycle period

During the course of our discussions we raised ideas that also affect nuclear data evaluations other than radioactive decay.

1. Due to a very large number of publications, the secondary reference sources (having lower priority) are being delayed in scanning. Also, newer journals and those that specialize in review articles are not scanned routinely. Some of the very important and crucial data quite often are published only in reports. We strongly recommend that the current part-time effort of bibliography scanning for the Nuclear Structure References (NSR) be increased to at least its original level of one full time employee (FTE). It is anticipated that the current scanner will retire from full-time work within the next several years. An additional scanner should be identified as soon as the resources are available. The new scanner will be required to exploit electronic methods to maximize the efficient input of primary references, and should be able to have sufficient time to augment the scope of Nuclear Structure References by including references from publications not being regularly scanned at present.

2. It has been noted by the Panel on Basic Nuclear Data Compilations, some reviewers, and the Editor-in-Chief that many mass chain evaluations contain an unreasonably large number of mistakes which cause unnecessary delays in processing and reviewing A-chain evaluations. Because of limited resources, the US Network will no longer be able to run checking codes for evaluations or to generate pre-review copy. Therefore, all evaluators will be required to run the checking codes available throughout the Network before submitting an evaluation. Evaluations submitted with a large number of errors will have to be returned to the evaluator. In addition we recommend that at all centers with more than one evaluator every A-chain be internally reviewed before external review. This recommendation was agreed upon in 1991 by the US Network. The evaluators should no longer rely on the reviewer and/or the Editor-in-Chief to catch errors which could easily have been corrected before submission of the evaluation.

3. The International Network should continue to explore methods to improve the quality and scope of the evaluations submitted by evaluators.

Several Categories of Decay Data and Areas of their Application

Category	Uses					
	Nuclide identification	Quantitative nuclide assay	Bio-medical	Nuclear physics	Reactor technology	Astro-physics
Half-life	X	X	X	X	X	X
Q-value				X	X	X
Decay modes (branching fractions)				X	X	X
γ-ray energy	X	X	X	X	X	
γ-ray emission probability		X	X		X	
Relative γ-ray intensities	X		X	X		
β-ray energy			X	X	X	X
β-ray intensity			X	X	X	X
α-particle energy	X	X	X	X	X	
α-particle emission probability		X	X	X	X	
Delayed neutron energy spectra				X	X	
X-ray emission probability		X	X		X	
Electron energy			X		X	
Electron emission probability			X		X	
Level energy				X		X
Level spin-parity				X		X

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Table 1

Nuclide	Half-life	Nuclide	Half-life	Nuclide	Half-life
^{127}Te	9.3 h	^{141}Ce	32 d	^{188}Re	16 h
^{127}Te	109 d	^{142}Ba	10 m	^{191}Os	15 d
^{127}Xe	36 d	^{142}La	1.5 h	^{192}Ir	73 d
^{128}I	24 m	^{142}Pr	19 h	^{194}Ir	19 h
^{129}Te	1.1 h	^{143}Ce	1.3 d	^{197}Pt	18 h
^{129}Te	33 d	^{144}Ce	284 d	^{197}Hg	2.6 d
^{129}I	15 My	^{144}Pr	7.2 m	^{198}Au	2.6 d
^{130}I	12 h	^{144}Pr	17 m	^{199}Pt	30 m
^{131}Te	1.2 d	^{145}Pr	5.9 h	^{199}Au	3.1 d
^{131}Te	25 m	^{147}Nd	10 d	^{203}Hg	46 d
^{131}I	8.0 d	^{147}Pm	2.6 y	^{208}Tl	3.0 m
^{131}Xe	11 d	^{149}Nd	1.7 h	^{210}Pb	22 y
^{131}Ba	11 d	^{152}Eu	9.3 h	^{212}Pb	10 h
^{132}Te	3.2 d	^{152}Eu	13 y	^{212}Bi	1.0 h
^{132}I	2.2 h	^{153}Sm	1.9 d	^{214}Pb	26 m
^{133}I	20 h	^{153}Gd	241 d	^{214}Bi	19 m
^{133}Xe	2.1 d	^{154}Eu	8.8 y	^{226}Ra	1.6 ky
^{133}Xe	5.2 d	^{155}Sm	22 m	^{228}Ac	6.1 h
^{133}Ba	10 y	^{155}Eu	4.9 y	^{228}Th	1.9 y
^{134}I	52 m	^{156}Eu	15 d	^{229}Th	7.3 ky
^{134}Cs	2.0 y	^{160}Tb	72 d	^{232}Th	14 Gy
^{135}I	6.5 h	^{165}Dy	2.3 h	^{232}U	68 y
^{135}Xe	9.1 h	^{166}Ho	1.2 ky	^{233}Pa	27 d
^{135}Xe	15 m	^{169}Yb	32 d	^{234}Th	24 d
^{136}Cs	13 d	^{170}Tm	128 d	^{234}Pa	1.1 m
^{137}Xe	3.8 m	^{171}Er	7.5 h	^{234}U	245 ky
^{137}Cs	30 y	^{175}Yb	4.1 d	^{235}U	703 My
^{138}Xe	14 m	^{175}Hf	70 d	^{238}Pu	87 y
^{138}Cs	32 m	^{177}Lu	6.7 d	^{239}Np	2.3 d
^{139}Xe	39 s	^{177}Lu	160 d	^{239}Pu	24 ky
^{139}Cs	9.2 m	^{180}Hf	5.5 h	^{240}Pu	6.5 ky
^{139}Ba	1.4 h	^{180}Ta	8.1 h	^{241}Pu	14 y
^{139}Ce	137 d	^{181}Hf	42 d	^{241}Am	432 y
^{140}Ba	12 d	^{182}Ta	115 d	^{243}Am	7.3 ky
^{140}La	1.6 d	^{183}Ta	5.1 d	^{244}Cm	18 y
^{141}Ba	18 m	^{185}Os	93 d		
^{141}La	3.9 h	^{187}W	23 h		

Table 2

Nuclide	Half-life	Nuclide	Half-life	Nuclide	Half-life
^{7}Be	53 d	^{70}Ga	21 m	^{95}Nb	3.6 d
^{19}O	26 s	^{71}Zn	3.9 h	^{95}Nb	34 d
^{20}F	11 s	^{72}Ga	14 h	^{97}Zr	16 h
^{22}Na	2.6 y	^{75}Ge	1.3 h	^{97}Nb	1.2 h
^{24}Na	14 h	^{75}Se	119 d	^{98}Nb	51 m
^{26}Al	720 ky	^{76}As	1.0 d	^{99}Mo	2.7 d
^{27}Mg	9.4 m	^{77}Ge	11 h	^{99}Tc	6.0 h
^{28}Al	2.2 m	^{80}Br	17 m	^{101}Mo	14 m
^{31}Si	2.6 h	^{82}Br	1.4 d	^{101}Tc	14 m
^{37}S	5.0 m	^{83}Br	2.3 h	^{103}Ru	39 d
^{38}Cl	37 m	^{84}Br	31 m	^{103}Rh	56 m
^{40}K	1.2 Gy	^{85}Kr	4.4 h	^{103}Pd	16 d
^{41}Ar	1.8 h	^{85}Kr	10 y	^{105}Ru	4.4 h
^{42}K	12 h	^{85}Sr	64 d	^{105}Rh	1.4 d
^{46}Sc	83 d	^{86}Rb	18 d	^{105}Rh	45 3
^{47}Ca	4.5 d	^{87}Kr	1.2 h	^{106}Rh	29 s
^{47}Sc	3.3 d	^{88}Kr	2.8 h	^{108}Ag	127 y
^{48}Sc	1.8 d	^{88}Rb	17 m	^{109}Pd	13 h
^{49}Ca	8.7 m	^{88}Y	106 d	^{109}Cd	1.2 y
^{51}Ti	5.7 m	^{89}Kr	3.1 m	^{110}Ag	249 d
^{51}Cr	27 d	^{89}Rb	15 m	^{113}Sn	115 d
^{52}V	3.7 m	^{90}Kr	32 s	^{115}Cd	2.2 d
^{54}Mn	312 d	^{90}Y	3.1 y	^{115}Cd	44 d
^{55}Fe	2.7 y	^{91}Sr	9.5 h	^{115}In	4.4 h
^{56}Mn	2.5 h	^{91}Y	49 m	^{116}In	54 m
^{56}Co	77 d	^{91}Y	58 d	^{117}Sn	13 d
^{57}Co	271 d	^{92}Sr	2.7 h	^{122}Sb	2.7 d
^{58}Co	70 d	^{92}Y	3.5 h	^{123}Sn	129 d
^{59}Fe	44 d	^{92}Nb	10 d	^{123}Te	119 d
^{60}Co	5.2 y	^{93}Y	10 h	^{124}Sb	60 d
^{64}Cu	12 h	^{93}Nb	13 y	^{125}Sn	9.6 d
^{65}Ni	2.5 h	^{94}Y	18 m	^{125}Sb	2.7 y
^{65}Zn	244 d	^{94}Nb	20 ky	^{125}Te	58 d
^{66}Cu	5.1 m	^{95}Y	10 m	^{126}Sb	12 d
^{69}Zn	13 h	^{95}Zr	64 d	^{127}Sb	3.8 d

Program Development - the On-Line System and CD-ROM Distributions for Nuclear Data

Task force on code development under the US NDN Executive Committee:

L Peter Ekström, Lund University, Sweden
Richard B Firestone, Isotopes Project, LBL
Robert Kinsey, National Nuclear Data Center, BNL
Craig A Stone, San José State University

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1. Structure and purpose of this document

This document describes how we believe nuclear data could and should be disseminated in the future. That is, however, only one side of the problem. Equally important is what the **users of nuclear data** want and need. For this we require input - suggestions, constructive criticism, abuse and maybe praise. The purpose of the document is (i) to give the Executive Committee some background for its decisions and (ii) to inform the evaluation network on the developments, so they can give their input. In order to get views also from users of nuclear data, the preliminary releases of nuclear data products will contain questionnaires. It is also suggested that the network forms a Nuclear Data User's group, partly for license rights (Adobe Acrobat Reader), but also to facilitate two-way communications on the products of the network.

The main part of the document contains the results of the deliberations of the Task Force. The Appendix contains separate statements by each member of the task force, and a draft of a suggested brochure to advertise the electronic activities.

2. Introduction and summary

The recent developments of computer codes and new means of dissemination are absolutely crucial for the effort of renewing nuclear data evaluation, and this renewal is in turn crucial to the whole future of the US NDN and the international network.

The evaluation process must result in applications/databases that are **easy to use**, that can be run on personal computers and **contain current data that are in demand by applied and basic research users.** The programs should allow **systematic searches** and easy **exporting of data** for use in more specialized applications. The efforts should be carefully planned, and duplication of work should be avoided. The development should as far as possible make use of commercial/outside developments (e.g. Papyrus, Acrobat, Internet services).

The primary product of the nuclear data evaluation today - the **Nuclear Data Sheets** - has a very small circulation and is almost exclusively used by nuclear physicists. The development of new means of distribution - **high-capacity computer networks** and **CD-ROMs** - creates new possibilities, but also some problems in recognition of the evaluators who produce the data files. The distribution system is, however, not the important part (that may change as technology evolves), but the creation of **highly interactive and easy-to-use database systems which contain current data.**

It is a most urgent task to adapt the databases ENSDF and NSR for efficient use with computer-based retrieval applications. These applications, primarily written for Macintosh and Windows, must be simple to use and menu-driven.

Highest priority should be given to the presently far advanced systems, the **TOI CD-ROM** (general nuclear and decay data), **VuENSDF** (flexible display of decay- and level schemes with ENSDF input), **MacNuclide** (nuclear data with a nuclide-chart interface) and **Papyrus NSR** (a PC-based system for literature searches with the NSR). The extensively used **on-line system** should be enhanced, especially with respect to user-friendliness. Also, studies should be performed to find out to what extent new developments in network software (e.g. Gopher and WWW) and hardware (data superhighways) can be utilized for enhancing the on-line system and for data/application distribution.

The databases are the basis for the dissemination effort. The continuous work on updating the databases ENDSF and NSR should be secured. Particular attention should be paid to the continued evaluation and inclusion into ENSDF of mass numbers 21-44, and to the continued effort regarding the scanning of journals for the NSR.

Parallel deliberations by other task forces, e.g. the high-spin task force, decay data task force and the ENSDF integrity task force, also have a direct and important influence on the success of the dissemination effort. It is anticipated that most of the code development will be done at the centers featured in the Appendix, but bilateral collaborations, modeled on the Lund-LBL collaboration, should be encouraged.

3. Program development

Detailed descriptions of on-going and proposed program development at NNDC (BNL), IP (LBL) and San José State University are given in the Appendix. Highest priority should be given to program development for **Macintosh (system 7.1+)** and **Windows (3.1+)**. Some programs may also be developed for UNIX systems and for VMS. Programs should be menu-driven and when porting between platforms is of interest, C++ is the preferred language. Great care should be taken to document the programs. Limitations of the programs should be clearly stated.

The functionality of the ENSDF codes (FMTCHK, RADLST, GTOL, HSICC, LOGFT, PANDORA), should in the long run, as far as possible, be included as modules in other programs, e.g., VuENSDF and MacNuclide.

The programs and databases should (with the exception of some commercial products) be made freely available (or with a nominal charge) on CD-ROM and via network transfer.

3.1. The on-line system

User statistics shows that many researchers find the on-line system useful. This is clearly a reason for devoting resources to enhancing the system further. There is no conflict between an on-line system and a PC/Macintosh-based system - they complement each other. Experience from other systems shows that the release of a database on CD-ROM does not decrease but rather increase the use of the corresponding on-line system [1].

Improvements should be made mainly in the user interface. The majority of the searches in the on-line system are very simple searches, e.g., for the NSR, searching for references with information on a particular nuclide. Special attention should be paid to these simple searches, so they can be performed intuitively and in as few steps as possible.

The possibility of using new developments in Internet client/server systems should be investigated. With the development of faster computer communications the possibility of updating local data bases will increase and the division between on-line and local systems may even disappear. File access via Wide Area Networks with TCP/IP will soon be available [2]. Provided the networks have a high enough capacity and are sufficiently reliable, applications developed for use on standalone PS's can then be used for remote access to a database.

3.2. The Nuclear Structure References file

The NSR file is central to nuclear structure research since publications are the foundation of scientific research. The NSR is currently disseminated in several ways:

- NDS Recent References publication
- On-line data base
- TOI CD-ROM
- Papyrus NSR

It is very important that **the continuous scanning of journals and reports** is guarantied. The entry process could possibly be made more efficient by using computer files of the contents of at least some of the major journals. This would yield two benefits: **all** articles in these journals

would be entered, and it would not be necessary to type in the title and authors by hand. There are already some developments in this direction.

A first release of Papyrus NSR for PC will be issued on CD-ROM in April 1994. This will contain the NSR in four parts, the whole NSR and an easy-to-use shell with a help function, see section A4.1. Papyrus NSR will be updated and distributed on CD-ROM every six to twelve months. For more current information, the on-line system or network updates can be used. When a Macintosh version of Papyrus becomes available, the NSR should be made available also for Macintosh.

3.3. The TOI CD-ROM

The printed version of the TOI has for a long time proven to be very useful, and the CD-ROM version will enhance its usefulness considerably. The CD-ROM is cheap to produce, easy to update and distribute and it provides new possibilities by creating links between data.

With the release of Adobe Acrobat, the CD-ROM version of the Table of Isotopes can be released in April-May 1994. This beta-release would have the dual purpose of being a "pre-print" version of the TOI and a test version of the CD-ROM issue. With the Adobe Acrobat Viewer (which will be distributed with the TOI CD-ROM) it is possible to view and print the pages of the TOI, and also to use links created between tables and decay schemes, to references etc. Adobe Acrobat is presently available for Macintosh, Windows and UNIX. The different platforms use the same input file.

In addition to the tables and decay schemes, the TOI CD-ROM will contain all NSR references with keyword abstracts (the keynumbers in the book will have pointers to the appropriate reference), a decay book with a γ-ray-ordered table, the Table of Superdeformed Bands, ENSDF and ENSDF/2 (for VuENSDF, see below), file manuals and nuclear charts. For a more detailed description of the TOI CD-ROM, see section A2.2. The TOI CD-ROM will be distributed with the book, and it should be updated once a year.

3.4. VuENSDF

While the TOI CD-ROM gives a static (predetermined) display of decay schemes and tables, VuENSDF (Vu is a rationalized spelling of View) gives dynamic (user-chosen) displays of decay schemes. For details on VuENSDF and plans for further development, see section A2.3.

The program should keep the present flat **ENSDF/2 format** (see section A2.4) since this makes it much easier to add new data sets (a database format would require importing new data sets with all the problems that may follow). Also, the ENSDF format is a well-defined standard format which contains all quantities of interest.

A simple, flexible table-output format should be created for export to user applications. Another important extension is an easy-to-use **ENSDF editor** which would enter data in the appropriate field and also perform completeness and consistency checks.

The further development of the program should be decided with **specific users in mind.** Taking into account the present possibilities of VuENSDF, and the current scientific interest in high-spin nuclear physics (anticipating the availability of up-to-date high-spin data in the near future), the needs of the following two user groups should be fulfilled as soon as possible:

Experimentalists:	Aiding identification of rays (γ-ray search), obtaining an up-to-date status of any nuclide
Theoreticians:	Selecting band structures, plotting band parameters (alignments etc.), systematic studies of nuclear properties

VuENSDF should be ported to Windows as soon as possible.

3.5. MacNuclide

This program has a very good potential to become a tool for systematic studies of nuclear properties using the nuclear chart (color-coded), ladder diagrams and plots of different nuclear properties. The nuclear chart also serves as an intuitive interface to choose nuclides. The program should be finished and released (possibly through a publisher) as soon as possible.

The very promising **teaching aspects of MacNuclide** (see section A3.2) **should be further developed.** The program could, even with the data available at present, become a very useful teaching tool for basic nuclear physics courses.

3.6. ENSDF data base development

As long as ENSDF data are published in the NDS there will be a need for programming support of the publication process. Also, the programs operating on ENSDF (e.g. RADLST, LOGFT, GTOL, HSICC, FMTCHK, PANDORA) need to be maintained and enhanced. In the long run, the functionality of these programs should be included in one menu-driven program for data entry and data retrieval. This would considerably simplify the use of the facilities, and it would make changes in data format much easier.

For efficient retrievals and to ensure the integrity of the database, the structure of ENSDF must be modified. As the first step, the IP has created ENSDF/2 (section A2.4), in which some quantities within a data set are indexed. With this format, data sets can still be easily exchanged, since there is no indexing outside the data set (with the exception of labels of parent states in decay data sets).

As the next step, the ENSDF dictionary must be abandoned, and instead a character set covering subscripts, superscripts, Greek letters etc., will have to be implemented. In the longer perspective, the whole of ENSDF will have to be transformed into a modern database format to permit fast retrieval. This is the most important task remaining for the Codes Group.

The ENSDF-ENSDF/2 formats will continue to be used as data-exchange formats. With the development of a data-entry program, the issue of formats should disappear, since formats would not be visible to the evaluators or the users. A format-conversion program should be written to facilitate conversions between the different existing formats, see section A4.2.

3.7. Resources required

It is not easy to estimate the FTE requirements and the needs for funds. Obviously, these requirements depend on the level of ambition and the speed with which new developments are to be implemented.

IP, LBL:
2 FTE code/database/CD-ROM development
Funds to cover hardware/software (computer equipment, program licenses, CD-ROM production). Funds for collaboration with other data centers on specific projects and summer student's projects.

NNDC, BNL
2 FTE for code development and for development of the on-line system.

SJSU:
Development of MacNuclide (postdoc, student's projects etc.): 0.85 FTE including overheads equivalent to a national lab.

References

[1] G. Petersson, Optical Data Storage (in Swedish), Studentlitteratur, 1993

[2] Byte, January 1994 p 227

Appendices. On-going and proposed program/database developments

A1. Databases and the on-line system

R. Kinsey

A1.1. On-line System

On-going

- Continue to enhance and improve the system and codes that allow users easy and quick access to the bibliographic and numeric databases maintained at the NNDC
- Improvements will be made in the user interface while at the same time moving towards the developing standards of graphical user interfaces
- Development of a program to calculate decay and reaction Q-values and reaction threshold energies based on 1993 Atomic Mass Evaluation. The program will be modularized and an ISAM data base has been developed for later porting to other platforms

Proposed

- The development of server and a platform independent client is crucial if the system is to take advantage of the display abilities of workstations and PC's and at the same time make the current speed limitations of the networks less important. The point and click aspect of interaction also becomes available in the client/server mode

A1.2. NSR database

On going

- Maintain the high quality of the updates to the NSR database
- Improve and upgrade the contents of the database
- Provide users easy access to the references of interest to them
- Provide nuclear structure evaluators with the most up-to-date literature searches in their areas of interest

A1.3. ENSDF database

On going

- Insure the quality of the database by checking evaluations for format compliance and physics consistency
- Use the review process so that the interpretations of the data and the presentation to the user of the data are reasonably consistent

- Provide the evaluators with codes usable on different computer platforms to help them in checking and processing their evaluations
- Insure that the codes are current with respect to the latest formats or interpretations of the formats
- In addition to the format and physics checking codes above, the drawing and tables code ENSDAT, which gives the evaluator the information about how the data will be presented to the user, will be maintained and provided

Proposed

- An editor should be developed to help the evaluator to more easily enter the available data and make evaluation decisions
- Modularize LOGFT, HSICC, and RULER for later integration into other systems
- Update RADLIST

A1.4. ENSDF publication

It seems reasonable that it will be very difficult to maintain the currency and quality of the ENSDF database without a citable, refereed publication. This is most likely especially true for non-US evaluators but even for US evaluators who are also under pressure to produce a publications list. Great progress has been made over the years to reduce the costs of this publication to the sponsoring agency. At the present time, the additional cost of producing the final layout and photo ready copy for the publication add very little to the cost of producing and reviewing an evaluation.

On going

- Continue the publication of the Nuclear Data Sheets with the minimal manpower and costs currently allocated to the project
- Use the coding required for supporting ENSDAT and preparing the manuscript and review copies of an evaluation to continue maintenance of the publication code

A1.5. CINDA, CSISRS, and ENDF databases

On going

- These databases need to be maintained as a resource for the future and to support the reaction community
- Processing codes need to be maintained but any proposed new features will be in the On-line systems area

Proposed

- Add the capability to plot data and evaluated curves to the On-line system

A1.6. Other code development

PC-NUDAT

A PC version of the popular On-line code NUDAT is being developed. At the present time it runs under DOS. It is proposed to complete this code and transport it to the Windows and Mac operating systems. As with the on-line version, it provides the user with adopted levels, gammas,

radiations, thermal properties, and resonance integrals. It is intended primarily for applied users of nuclear structure data.

A2. Database development and CD-ROM publication

R.B. Firestone

A2.1. Summary of LBL Nuclear Data Dissemination Products

Eight editions of the Table of Isotopes

Seven editions of this book were published between 1940 and 1978, and the 8th edition is scheduled to go to the publisher in 1994. The new edition is about 3000 pages (2 volumes) and will be published by John Wiley & Sons, Inc. The 8th edition provides full coverage of Adopted Levels, Gammas data and decay data from the Evaluated Nuclear Structure Data File (ENSDF). We do not expect to publish full printed versions of the Table of Isotopes in the near future due to the rapidly increasing quantity of information.

Ninth edition of the Table of Isotopes

Future editions of the Table of Isotopes will be published on electronic media. The 9th edition is being developed as a PDF (portable document format) document for distribution on CD-ROM. This edition will utilize Adobe Acrobat software to display the book on PC and Macintosh computers complete with electronic bookmarks and hypertext links. A beta test version of this edition will be available soon. John Wiley & Sons, Inc. are very interested in publishing annual updates beginning in 1995 and providing coupons for an introductory copy to purchasers of the 8th edition. The publisher will assist us in reaching a broader community and assuring that the CD-ROM version is available in libraries. Serializing the publication of this book will also provide evaluators with a citable reference to their work.

VuENSDF

The VuENSDF program provides interactive access to nuclear data on desktop computers. This program provides tools for data selection and presentation. A new ENSDF/2 format database is being developed for VuENSDF. ENSDF/2 supports data indexing and will be more generally useful than ENSDF. A beta test version of VuENSDF is now available.

Future versions will support extensive database searching capabilities and interactive application software. In addition, software for updating the ENSDF/2 database will be provided. This software would allow users to generate or modify ENSDF/2 interactively without knowledge of database formats.

Other Databases

Databases for high-spin (EHSDF), decay (EDDF), and nuclear chart properties (ENCDF) are being developed as byproducts of the Table of Isotopes development. These databases have been updated beyond the cut-off dates in the ENSDF file. In addition, we have databases of atomic abundances, thermal neutron cross-sections, and nuclear moments which have been extracted from the literature for the Table of Isotopes. The nuclear mass tables of Audi and Wapstra are also available as databases at LBL.

Other Printed Publications

The Table of Superdeformed Nuclear Bands has been generated from the EHSDF file and will be published as a report. The Energy-ordered Table of Decay γ-rays was generated from the EDDF

file and will be published as a report and as an Appendix to the 8th edition of the Table of Isotopes. Several nuclear charts have been generated in recent years, and a new chart, based on the ENCDF, is under development at this time.

Other CD-ROM Publications

In addition to the Table of Isotopes, we will include electronic versions of the other printed publications described above. We will also include a 14,000 page book of Nuclear Structure Reference abstracts. The CD-ROM will provide Acrobat Reader software, a beta test copy of VuENSDF, the ENSDF/2 and ENSDF databases, and associated manuals and literature.

An initial test release of this CD-ROM will be made available, without charge, to anyone interested in joining a USNDN users group which we hope to form. This will allow us to take advantage of a free distribution offer from Adobe to existing organized groups. It will also provide an excellent means for the USNDN to interact with the users of nuclear data and provide them with better service.

A2.2. ENSDF CD-ROM Publications

CD-ROM technology provides a low-cost solution to publishing and distributing nuclear data. Each CD-ROM can contain about 100,000 pages of text or nearly 700MB of data. The disks are very durable, simplifying distribution, and they are produced by an inexpensive injection molding process. CD-ROM drives are now available for as little as $200, and computer manufacturers are now installing them as standard equipment on many machines. Finally, unlike floppy disks, the data on the CD-ROM can normally be read by both Macintosh and PC computers requiring the production of only a single version.

A beta version of the ENSDF CD-ROM is about to be released. It will be made available, at no charge, to anyone interested in testing this product. A brief description of the contents of the beta test ENSDF CD-ROM follows.

Adobe ACROBAT Software: ACROBAT software represents a major enhancement to the postscript language. With this software virtually any computer generated document can be can be converted to PDF (portable document format) and viewed on both PC and Macintosh computers. The PDF format supports page selection and magnification, interactive bookmarks, hypertext links between pages, and printing. A copy of the ACROBAT reader is included with each CD-ROM. This software can be distributed without charge to members of a pre-existing organization so it may be advantageous to form a USNDN users group for this purpose.

Table of Isotopes: A complete (4500 page) draft of the 8th Edition of the Table of Isotopes will be included on the ENSDF CD-ROM. It will contain bookmark indices to all skeleton decay scheme, table, radioactive decay scheme, and rotational band drawings. In addition hypertext links will facilitate movement between tables and figures by mouse clicks on the isotope designations.

Nuclear Structure References: A 14,000 page book of nuclear structure reference abstracts from 1910-1993 is included. This book provides bookmark indices to the standard NSR reference keynumbers which are referenced in the Table of Isotopes.

Table of Superdeformed Nuclear Bands: This monograph is being prepared as a report and will be included on the CD-ROM.

Energy-ordered γ-ray Table: Abbreviated versions of this book will be included as appendices to the Table of Isotopes and as a published report. A complete version containing 82,500 γ-rays, based on the Table of Isotopes, is included with bookmarks to enter the table at 100 keV intervals.

ENSDF and ENSDF/2 Files: The standard ENSDF file and a new version ENSDF/2 which has been modified for the VuENSDF program are included on the CD-ROM. In addition, the ENSDF Manual by J.K. Tuli is provided.

VuENSDF: The VuENSDF (formerly ETOI) code is available on the CD-ROM. It display decay scheme drawings and tables for the entire ENSDF file or user-created ENSDF format files.

A2.3. VuENSDF for Desktop Publication of Nuclear Data

In 1993 we began the development of VuENSDF (formerly called the Electronic Table of Isotopes or ETOI) to provide desktop access to nuclear data on personal computers. The aim of this project has been to partially replace the publication of Nuclear Data Sheets with the more flexible capabilities of an electronic desktop publication system.

In the first phase of this project, we will support access to the entire ENSDF file on both Macintosh and PC computers. The VuENSDF program provides menus for the interactive selection of mass chains, individual datasets, or nuclear band structures.

Selection of ENSDF data by A or Z through an interactive Chart of the Nuclides interface is also under development. Author and publication information can be interactively displayed. Multiple windows are supported so that several screens of figures can be created at one time for comparison.

Decay scheme figures can be scaled and scrolled under user control. Transitions can be displayed from groups of levels, feeding or deexciting individual levels, or by setting coincidence requirements on specific γ-ray energies. Color is used to differentiate between levels populated by in-band and out-of-band transitions in decay drawings and to highlight the interactive selection of data. Tabular listings of levels or γ-rays can be generated. The drawings and tables can be printed when hard copy is required. An advanced version of the ENSDF database, ENSDF/2, is being developed for use with VuENSDF.

A beta-test version of VuENSDF program is now available for the Macintosh. The most recent test version will soon be available at the LBL 88" cyclotron near the Gammasphere experimental area. We will distribute test versions of VuENSDF to all interested users. Their feedback will help guide future development.

The current version of the ENSDF/2 database is about 60 MB and will be made available by electronic file transfer. It will also be distributed as part of a beta-test CD-ROM in early 1994.

The second phase in the development of VuENSDF will include implementation of database management software to support the search and display of ENSDF by nuclear property as well as dataset. This program will include the Phase II version of ENSDF/2, described elsewhere. In addition, VuENSDF will have an interactive data editor to support both the evaluators and users who want to modify or update the database. This will remove the need for detailed knowledge of file formats allowing more people to participate in evaluation or use evaluation tools.

Users and evaluators will be able to modify the database by editing tables or figures. The program will perform necessary format and physics checking to insure the integrity of the database. In addition, this version of VuENSDF will support a variety of application software to calculate conversion coefficients, reduced transition probabilities, Nilsson diagrams, gross theory, and other useful quantities. The second phase of VuENSDF development is expected to be completed by the end of 1995, although features will continue to be added beyond then.

A2.4. Reviewing Policies for Electronic Publications

The policies for reviewing the Table of Isotopes publications have been established and are discussed below. The question of reviewing ENSDF/2 data files for electronic publication must also be considered.

Current ENSDF reviewing policies involve both scientific considerations and Nuclear Data Sheet concerns. The second phase of VuENSDF development will incorporate evaluator tools for the production of ENSDF/2 data files. These tools will stringently enforce format and physics standards and allow evaluators to generate user-ready evaluations. The organization of ENSDF/2 will support evaluation by either horizontal properties or mass chain.

In either case, the additions, deletions, and changes to the original file would be flagged for subsequent review. Reviewers would generally be expected to utilize VuENSDF to perform their reviews and prepare their comments on special reviewer comment records. After review, the file editor would incorporate the new information into the master database. This review process would be expected to proceed rapidly through Internet file transfers. For minor corrections or additions the editors, at there discretion, would modify the file directly.

Procedures for reviewing the printed and CD-ROM versions of the Table of Isotopes have been developed and tested. The input data are generally from ENSDF and other sources which have previously been reviewed. The Table of Isotopes editors perform a secondary review of the data to correct errors or omissions and to update information from standard sources such as up-to-date mass and nuclear moment tables. In addition, limited updating is performed to add newly discovered isotopes and to augment high-spin data.

This updating is reviewed by an evaluator in addition to the editor. The editors also enforce a standard style of presentation for the data. Mass chains prepared for the Table of Isotopes publications are sent to the original evaluators for further review. Final editorial decisions are made by the Table of Isotopes editors.

A2.5. ENSDF/2 Format For Electronic Publication

The ENSDF/2 format for the Evaluated Nuclear Structure Data File (ENSDF) is being developed at the Lawrence Berkeley Laboratory to support the development of electronic publication of nuclear data on desktop computers. This effort has been divided into two phases.

In the first phase, the ENSDF file will be enhanced to include statistical information on each dataset, explicit level, transition, and cross-reference indexing, updating of mass related data, and standardization of comment formats. This phase is designed to be an ENSDF upgrade and will not change the content of the pre-existing ENSDF file. Phase I will be completed at LBL without the requirement of evaluator assistance.

The second phase of development will be the incorporation of ENSDF/2 into a data base management system which will be provided with the ENSDF desktop publication system. An evaluator shell will be provided to support interactive entry of nuclear data on the desktop. Phase II will contain internal format checking procedures and standard ENSDF calculation utilities, obviating the need for pre-existing software.

The Phase I format will become the standard transmission format for ENSDF/2. It is anticipated that conventional ENSDF format data will continue to be prepared by some evaluators, although this format will not be recommended. We will provide software to convert between ENSDF and ENSDF/2 (Phases I and II).

Phase I

Software for ENSDF/2 development has been derived, in part, from codes developed to produce the 8th edition of the Table of Isotopes. A preliminary version of ENSDF/2 is used by the beta version of the VuENSDF program.

Statistical Information: Interactive generation of tables and figures is facilitated by the inclusion of "I" records, following the DSID record, that indicate the quantities of level and transitions in each dataset, which fields are utilized, and other information that can improve the generation of output.

Indexing: In order to accurately support the genetic information implied by a level scheme it is necessary that the initial and final levels associated with all transitions are explicitly included in the file. We have developed a two-character index which is used to uniquely name each level in a dataset. Redundant fields 4-5 on each level record have been utilized to store this index. For γ-ray records the initial level index is inferred from the previous level record, but the final level must be calculated from available data. We do this by comparing possible final levels on the basis of energy difference, multipolarity versus J, +X information, and band assignment. These criteria are weighted and the final level is selected by software. Possible problems with final level selection are documented for off-line checking. The final level index is stored in fields 4-5 of the γ-ray record.

Rotational band information is also indexed. Each band comment record is assigned a single-character index which is stored in column 3 of the comment record and column 3 of the associated level records. On γ-ray records the band assignment of the initial level is stored in column 2 and that of the final level in column 3.

For all records uncertainty information is moved from column 80 to column 1, and for levels isomeric information is moved from column 78 to column 2. This accommodates a significant decrease in the size of the ENSDF/2 file.

Beta and alpha-decay records have well defined final levels and their initial levels are referred to the parent record. This is not completely satisfactory because parent records are not always consistent with the associated adopted levels. This problem is solved by matching the parent record to the associated adopted level (see cross-referencing below) and storing the associated level index in columns 78-79 of the parent record and columns 4-5 of the beta or alpha record.

For delayed particle data the situation is more complex because parent, level, and final level indices are all required. For delayed-particle records the final level index will be stored in columns 2-3. For beta, alpha, and delayed-particle records information in column 80 will be moved to column 1.

Cross-references: Cross-indexing of levels in datasets to Adopted levels is indicated, in ENSDF, by XREF records specifying the dataset, but not the specific level within that dataset, which is matched. In order to make the cross-referencing explicit, the matching adopted level ID from columns 4-5 is stored in columns 78-79 of the corresponding dataset records. This matching is performed on the basis of the existing XREF record information, and a weighted comparison of energies, J values, half-lives, and γ-ray deexcitation patterns. When XREF records have not been entered into the file, they can be created automatically.

Mass Data: Masses in ENSDF generally correspond to values from the Wapstra and Audi mass tables at the time of the evaluation. These values are supplemented in ENSDF/2 with the newest available values (currently Nuclear Physics A564, 1 (1993)). The masses are included on a "2 Q" record following the original Q record in the adopted levels dataset.

In addition, the previously unused parent record fields 56-64 are used to store the newest Q-values. Recalculated logft values or hindrance factors are stored in the unused fields 56-64 on A, E, or B records.

Comment Records: Comments in ENSDF are generally interpreted from a context sensitive dictionary. An alternative ASCII character set is also defined for ENSDF which allows a more exact description of the output text.

For ENSDF/2 comments will be converted to the ASCII character set. This will change the content of character records, but not their presentation at output. An exact translation of ENSDF will require some proofreading because of the imprecise nature of the ENSDF dictionary.

ENSDF Cleanup: In ENSDF/2 the records will be reorganized in a more regular and predicable manner. This will include grouping records of a common type so that primary records are followed by secondary records and then by comments. Level records, and gamma records following each level, will be organized by energy in ascending order. Flagged comments will be given unique flag characters and included only on "FLAG=" records. Column 77 flags will also be moved to "FLAG=" records. Comment and reference information included on secondary data records will be removed to comment records. DSID information on X records will be exactly matched to actual dataset names.

Phase II

The second phase of ENSDF/2 development will divide the Phase I file into separate databases of levels, transitions, and comments. These databases will be interconnected by common indices and it will be possible to reconstruct the Phase I format database, or even original ENSDF, from these databases. Development of Phase II will be coupled to the selection of database management software to support data retrieval and display. This will allow us to access and evaluate nuclear data by property as well as by isotopic dataset. Several modifications of ENSDF/2 are anticipated in Phase II that will make the file more versatile.

Document Comments: Comments will be treated as editable documents which can be prepared in a conventional word-processor environment. Standard comments will be available for use by the evaluator, however it will be possible to create more complex comments with mathematical expressions, imbedded drawings, and a full range of available fonts and characters. This will allow the display of spectra and figures directly taken from published papers.

Reference Links: Reference keynumbers in ENSDF will be hypertext linked to the Nuclear Structure Reference file (NSR). This will require distribution of the NSR file with ENSDF/2 for these links to become effective. These hypertext links provide direct indexing of the references from the comments so that they can be retrieved and displayed with the comment information.

Numerical Data: At this time ENSDF is essentially a text file. However, it is often desirable to search the file quantitatively. We will add numerical fields to ENSDF to provide searchable values of energies and intensities. In addition, the spins and multipolarities will be numerically searchable.

Data Entry: Phase II ENSDF/2 will have database modification capabilities which allow the user or evaluator to interactively enter or change data. These will be driven primarily by full screen table editors that will allow users to edit standard level and transition tables. Input format checking will assure the integrity of the file and help the user correctly perform level-transition indexing and cross-referencing.

Application software for calculating conversion coefficients, logft values, alpha hindrance factors, least-squares level energy calculations, decay scheme balancing and normalization, and many other utilities will be provided.

Standardization: The ENSDF/2 file will adopt standard data presentation formats which will be selected in concert with the editors and evaluators of the file. These formats will be enforced by

data checking algorithms. The purpose of this standardization will be to provide users with a more standard presentation of information than was possible in the past.

A2.6. Special Purpose Databases: EHSDF, EDDF and ENCDF

Although ENSDF is an excellent general purpose nuclear data file, it is not uniformly up-to-date or completely suitable for applied use. Horizontal evaluation has been proposed to counter these deficiencies.

The interconnection of information in ENSDF has made it difficult to up-date the file directly without compromising the self-consistency of the file. We are therefore developing topical databases from ENSDF and other sources for the Table of Isotopes. These databases can be updated independently from ENSDF and used as the starting point for ENSDF mass-chain evaluations. They are designed to be rapidly updated and readily maintained.

Evaluated High-Spin Data File EHSDF

This file was proposed at the Chalk River High-Spin Conference. Band information contained in this file has been extracted from ENSDF and is being updated for the 8th edition of the Table of Isotopes.

The evaluated superdeformed data provided by Balraj Singh has been included. The file has been provided to high-spin researchers interested in C4 symmetry breaking in nuclear bands. It is also the source file for the Table of Superdeformed Nuclear Bands.

Evaluated Decay Data File EDDF

The EDDF file has been extracted from the 8th Edition of the Table of Isotopes. It is derived from ENSDF with limited updating and has been edited for internal consistency. This file was initially developed to prepare the Energy-ordered Decay γ-ray Tables and is maintained as both an energy-ordered file of 82,500 transitions and as a parent-ordered decay γ-ray file. Complimentary α- and delayed-particle tables are also planned. We expect to update codes developed from the Table of Radioactive Isotopes so that x-rays and continuous radiation can be added.

Evaluated Nuclear Chart Data File ENCDF

This file is also derived from the 8th edition of the Table of Isotopes and forms the basis for the TOI Chart of Nuclides which will appear with the 8th edition and on the CD-ROM versions. Half-lives, decay branchings, abundances, thermal cross-sections, genetic feedings, and masses for about 2500 isotopes and their isomers are included in this file.

A3. MacNuclide

A3.1. The MacNuclide Project: Current Efforts and Future Directions

C.A. Stone

Introduction

MacNuclide is a highly-interactive program for nuclear data that serves both as a visualization tool and a data base management system. Properties are displayed in visual forms that are common to nuclear physics: the chart of nuclides, systematics plots, and level schemes. Tabular displays of information are also available. Graphics are easily transferred to other programs. A physicist may create a custom nuclide chart and transfer the image to a graphics program, eventually printing it as a color figure or slide. Any property in the data base, and any calculated property, can be output to binary or text files, making the information available to other programs on local or remote computers. Likewise, custom information can be generated outside of MacNuclide and treated as a part of the standard data base. MacNuclide is a multifaceted program that provides a unique tool for nuclear physics.

Visualization of properties through the nuclide chart is a powerful feature of MacNuclide. Results of data base searches are displayed as a group of nuclides colored in the chart. Thirty two such groups can be created and assigned unique colors. The standard decay modes chart, for example, is constructed by searching for alpha emitters and storing results in a group that is painted green. Stable nuclides can be stored as a group that is painted black.

Continuing the searches through the other decay modes produces the familiar chart. Answers to complex questions are formed by combining results from several searches. One example could be to find those nuclides that decay by electron capture, that are not even-even nuclides, and whose half life is between 5 and 6 hours or 2 to 3 hours. Boolean operators instruct the program how to combine new results with previous ones. Standard groups of nuclides have been added to increase the flexibility of searches. These include even-even, odd-A, and the other related groups. Others include stable nuclides, fission products, and custom groups defined by the user. Features are available to automatically construct a chart showing trends in some defined or calculable property. Charts showing Q-values for a reaction, half lives, spins, fission yields, and any other property are easily generated. It is a powerful method of viewing and manipulating nuclear properties.

Detailed properties are displayed by entering a nuclide name or clicking the mouse at the appropriate spot in the chart. A window appears showing a skeleton level scheme and a tabular listing of standard properties, calculated properties, and custom properties input through disk files. The level scheme is interactive. Decay arrows display menus of functions on nuclear decay when selected. Daughter decay chains are created through one command, and another changes the current nuclide to the decay daughter. Neutron and proton labels provide methods of moving through the nuclide chart.

Systematics plots can be created for any group of nuclides. These nuclides may belong to a specific group such as fission products, or they may be the result of a complex series of searches. A window appears showing a level scheme for each of the nuclides. Standard systematics features include ordering nuclides in a variety of ways, hiding nuclides, coloring levels on the basis of

some property or even hiding certain levels. The current version of MacNuclide displays isomeric states, calculated levels such as separation energies and reaction Q-values, and levels input from external files, such as from a modeling code. Level data from ENSDF has been down-loaded onto the Macintosh and will be installed in MacNuclide when the systematics editor is complete.

Current Efforts

Four projects are underway on the MacNuclide project. A primary effort is to complete the systematics editor. Development efforts have used isomeric states and calculated levels, allowing the project to focus on defining the user interface. Adopted levels and levels from other data sets will be installed as the editor nears completion. Most of the (ASCII) level data has been down-loaded onto local computers. Preliminary tests have demonstrated it is feasible to convert the data into a binary format and access the data through MacNuclide. Searching functions are under development that allow users to search by data set, level property or some other feature. These functions will be used alongside other data base search functions.

Neutron cross sections, and x-ray and γ-ray data bases are being installed in MacNuclide. A team of six energetic undergraduate students are down-loading the information, performing the feasibility studies, and designing components of the user interface. Each set of properties is installed with functionality needed to search, display and otherwise manipulate the information. Input and output features are also available for these nuclear properties.

A novel and recent feature of MacNuclide is a formula editor. It is often more efficient to type in a simple command than execute a series of mouse movements. The formula editor allows for this key-board entry. Nearly all commands are now available through the formula editor, including chart and level scheme display, daughter decay chains, and data base searches. An example is the command "half-life 1.0 min to 12.2 hours." Scripting features have also been defined. The program can save a series of commands as a single function for later recall. A series of commands can also be loaded through a text file and executed. This is a method of creating tutorials on nuclear data or creating an electronic poster of research. Special text annotation, multimedia functions, and other features will be included to support this feature.

Intermediate-Term Efforts

Features in MacNuclide are extensive enough that they are grouped together into a suite of libraries. Examples are chart visualization, systematics, and properties libraries. Effort over the intermediate term focuses on developing the γ-ray library, the reaction library, and extending the visualization library. Searches on γ-ray properties is a simple example of a feature in the γ-ray library. Other features will be included to generate custom spectral libraries for γ-ray spectroscopy programs, allowing physicists to tailor their analyses to experimental conditions. Interference searching and identification is another important part of this library. A feature under consideration is to display γ-ray spectra from an experiment that are overlaid with γ-ray lines from a set of nuclides. The γ-ray library has the potential providing users with tools for experimental design and analysis.

Components of a reaction library exist within the current version of MacNuclide. Effort in the intermediate term will extend these features. Some of the planned features include calculations on possible/probable parents and daughters, cross section codes, and reaction rate calculations that include ion source and other yields.

The visualization library will be extended to increase the flexibility of the chart display. Displays are currently created using Boolean values to determine if a nuclide is to be painted. Floating point displays will provide the ability of creating data arrays, transforming them and

having results immediately available as a color chart. Three-dimensional imaging of the chart display and color Postscript output are desirable features that have been frequently requested by users. They are planned during this phase of the project. An intriguing and feasible feature is to generate multimedia displays of results. Time-dependent results can be shown by creating and storing images in JPEG format. Movies can then be played back to show some process, they can be stored to disk, or they can even exported to a word processing document. Several commercial word processors support JPEG format.

A final goal in the intermediate term is to convert the existing source code to Microsoft Windows format. Many in the nuclear physics community have IBM compatible computers and they would benefit by this development. Most of the existing software can be readily ported to the second platform. An important core of the code, the memory management and the user interface, will require significant but not unreasonable effort to perform this conversion. Companies exist whose business is to convert code between the IBM and Macintosh platforms. The most efficient use of resources may be to concentrate development on one platform and contract with such companies to migrate the code to alternate platforms.

A3.2. MacNuclide and Nuclear Physics Education

MacNuclide has been used in the classroom now for over four years. Extensive testing has taken place at San Jose State University as well as at several other universities. Some have used MacNuclide in general chemistry and physics courses to present topics of nuclear physics. Others have incorporated MacNuclide into undergraduate and graduate courses in nuclear chemistry, nuclear physics, and health physics. Within these courses, MacNuclide has served to provide class demonstrations, tutorials on specific topics, and as a environment within which to solve challenging homework problems. This extensive use of MacNuclide has demonstrated the need for educational software for undergraduate and graduate nuclear physics education.

Three phases are envisioned for the educational materials. A series of tutorials will be developed in the first phase. Some will include built-in tutorials on topics of general interest to the community. Examples are tutorials on half lives, radioactive decay, stability, fission, natural radioactivity, and nuclear models. Concepts within the tutorials can be explored in a variety of ways. Nucleon pairing, for example, may draw its illustrations from nuclide charts showing Q-values, from systematics of 2+ energies, and from plots of ground state spins. Instructors can use commands available through the formula editor to create custom tutorials. Many of the planned tutorials will form a set of electronic laboratories within which students can explore broader concepts. Some examples include statistics in radiation detection and measurement, reaction dynamics, nuclear models, and radioactive decay. Electronic experiments will be included in these laboratories, experiments through which students can explore parameters, perform the (electronic) measurement and review results. Such experiments draw from data that is synthesized or from real experiments. In a final phase of the project, all of the tutorials and laboratories are brought together as a multimedia encyclopedia of nuclear physics.

A4. Papyrus NSR and ENSDF format conversion

L.P. Ekström

A4.1. Papyrus NSR

The first version of the Nuclear Structure References system for PC is to be released on CD-ROM in April 1994. The system is based on a commercial bibliographic program, Papyrus. The database contains more than 130000 references from 1910. Papyrus NSR allows indexed searches on keywords, authors, year of publication, journal, title, type of reference and keynumber, and unindexed searches on the keyword abstract. Papyrus NSR contains an extensive Windows Help function which describes commands, the structure of the database and contains useful tables, e.g. list of subject keywords, elements, etc.

The system will be updated once every 6 months to a year, but more frequent updates (e.g., every tree months) will be available for FTP transfer. Papyrus NSR will be updated with moderate effort. An enhanced version of Papyrus for Macintosh is expected to be released in 1994, and the porting of the database will require some work. Later, an enhanced Windows version is expected to be released.

Papyrus NSR is dependent of the securing of the continuous scanning of nuclear structure references. Since the system allows searching on titles, also entries without keywords and keyword abstract are useful. Hence the automatic entry into the NSR of all references in the core nuclear physics journals would be of great value.

A4.2. Format conversion program

There is a lot of high-spin level-scheme and decay data already coded in different formats. Examples are the ORNL-TU high spin database, the Danish NUCI database and the format used by D Radford for his experiment-analysis program. There is thus a need for a conversion program between these formats and the ENSDF-ENSDF/2 formats. The conversion program would be useful for getting ENSDF data into these different databases in order to run a database management system on a more complete set of data. The program would also be used for conversions the opposite way, e.g. as a help for evaluators to convert large sets of data into ENSDF format. Work is already underway within the Lund-LBL collaboration in writing such a program.

A5. Electronic Nuclear Data Services from the U.S. Nuclear Data Network

An international network of evaluators coordinated by the IAEA are involved in providing the user's community with up-to-date and reliable nuclear data. This effort results in two data files, the NSR (Nuclear Structure References) containing literature references and ENSDF (Evaluated Nuclear Structure Data File) containing the physical nuclear structure and decay data. In addition to the data files, the network provides software to use them. The nuclear data are disseminated in a variety of ways, both in the form of books and journal articles and as electronic publications.

A5.1. Papyrus NSR

Papyrus NSR is a system for searching the literature database NSR on a PC. The system is based on a commercial bibliographic program, Papyrus. It contains more than 130000 references from 1910 to the present. Papyrus NSR allows indexed searches on keywords, authors, year of publication, journal, title, type of reference and keynumber, and un-indexed searches on the keyword abstract.

The Nuclear Structure References system Papyrus NSR on CD-ROM can be ordered via email: EBrowne@LBL.Gov. It can also be obtained by FTP transfer from Garbo.Lucas.LU.Se (User: NSR, no password). Read README.TXT in the \NSR directory for instructions. This FTP service will in the future also contain updates. For queries on the FTP service contact Peter.Ekstrom@Nuclear.LU.Se.

A5.2. NNDC on-line service

The National Nuclear Data Center, Brookhaven National Laboratory, maintains bibliographic and numeric databases for low- and medium-energy nuclear physics including NSR and ENSDF. These databases are regularly updated and may be accessed via ESNET, Internet, or World Wide Web. The addresses are:

ESNET: BNLND2 (44436 or 43.404)

Internet: BNLND2.DNE.BNL.Gov (130.199.112.132)

WWW: http://necs01.dne.bnl.gov/html/ndc.html

At the login prompt, enter NNDC. New users may enter authorization code GUEST. This will give them limited access to the system and, on logout, allow them to sign up for the service. For more information, contact the NNDC (Internet mail: NNDC@BNL.Gov).

A5.3. Table of Isotopes on CD-ROM

Table of Isotopes, CD-ROM version (in preparation), will contain the next edition of the Table of Isotopes, produced by the Isotopes Project, Lawrence Berkeley Laboratory.

In addition to the tables and decay schemes the TOI CD-ROM will contain all NSR references with keyword abstracts, a decay book with an energy-ordered γ-ray table, the Table of Superdeformed Bands, ENSDF, file manuals and nuclear charts. For more information contact Richard B. Firestone (email: RBF@LBL.Gov).

A5.4. VuENSDF

VuENSDF is a program for interactive access of the Evaluated Nuclear Structure Data File (ENSDF). The TOI CD-ROM gives a static (predetermined) display of decay schemes and tables, whereas VuENSDF gives dynamic (user chosen) displays and plots of decay schemes.

Decay scheme figures can be scaled and scrolled under user control. Transitions can be displayed from groups of levels, feeding or deexciting individual levels, or by setting coincidence requirements on specific γ-ray energies. Color is used to differentiate between levels populated by in-band and out-of-band transitions in decay drawings and to highlight the interactive selection of data. Tabular listings of levels or γ-rays can be generated. The drawings and tables can be printed when hard copy is required. An advanced version of the ENSDF database, ENSDF/2, is being developed for use with VuENSDF.

A Macintosh version of the program will be released shortly. To order, contact Frank Chu via email: SYFChu@LBL.GOV.

A5.5. MacNuclide

MacNuclide is a powerful nuclear data tool for nuclear physics. MacNuclide imports your custom nuclear properties from binary or text files, treating the information as a part of its standard data base. Export nuclear properties to other programs on local or remote computers. Properties are displayed in visual forms that are common to nuclear physics: the chart of nuclides, nuclear systematics, and level schemes. Visualization of properties through the nuclide chart is a powerful feature of MacNuclide. The chart shows trends of any property across all nuclides. Results of data base searches are displayed as a group of colored nuclides. Answer complex questions by combining results of several searches using simple Boolean functions. A powerful systematics editor displays trends of nuclear structure across any defined collection of nuclides. Double click the mouse on a particular nuclide to produce and interactive level scheme. MacNuclide is a visualization tool and a data base management system that enhances your nuclear physics environment.

For further information contact Craig Stone via electronic mail at Stone.C@Applelink.Apple.Com

REPORT OF THE TASK FORCE ON PUBLICATIONS

M. J. Martin, ORNL Chair
R. G. Helmer, INEL
J. K. Tuli, BNL

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The original charter for the publications task force was to coordinate network publications and to assure that proper credit is given to the network and to the evaluators. In addition, this task force has been assigned the role of defining the contents of current publications and their alternatives.

A. In the role of a standing committee, the following broad tasks can be defined.

1. To review proposals submitted by network evaluators for publications based on ENSDF. The main purpose of this review will be to avoid duplication of effort, and to ensure that adequate credit is given to the network and/or to individual evaluators. The committee could also advise the author(s) of the feasibility and need for the proposed publication, and perhaps provide guidance on its contents and presentation.

2. To recommend suitable evaluator(s)/center(s) in cases where the network sees a need for a a particular horizontal evaluation. In such cases it will be important to minimize any possible adverse impact on the main work of the network.

B. In the role as a task force on network products and publications, the following questions need to be addressed.

1. Which of the current publications and products need to be kept and/or revised, and what should be the frequency of distribution?

2. If a product or service is to be eliminated should it be replaced by an alternative product or service?

3. What should be the format, contents, and frequency of distribution of new products?

At the present time, the following products/publications (ongoing or planned) are based directly on the evaluation in ENSDF.

1. *Nuclear Data Sheets* - Published monthly with 11 issues devoted to mass-chain evaluations and 1 issue giving yearly updates to the NSR file.

2. NNDC,NEA,IAEA on-line data bases

3. *Table of Radioactive Isotopes* (last publication in 1986)

4. *Table of Isotopes*, 8th edition (expected publication in 6/95)

5. Nuclear Wallet Cards (last publication in 1990, next publication in 1995).

6. MacNuclide (incorporation of ENSDF data still in planning stage).

7. Selected retrievals, eg. Catalog of Gamma Rays from Radionuclides, Medlst/Radlst output in NCRP report #58 (second edition published in 1985)

The proposed phaseout of the *Nuclear Data Sheets* over the next few years and its replacement by CR-ROM invites a careful consideration of the contents of this new distribution medium. Plans are also well underway for distribution of the NSR file on CD-ROM.

A. NSR CD-ROM

The entire NSR file, containing references from 1901 to the present, can be placed on a single CD-ROM and accessed via an interactive software program, eg. PAPYRUS. Retrieval requests for a specified period of years (months?) by subject, property, reaction or decay type, author, A or Z (etc.?) should be allowed for, with a reasonable set of output options built in for producing the resulting reference list(s). The frequency of distribution needs to be decided upon, and whether the distribution is of the complete file each time, or of an initial complete file with subsequent updates. If each CD-ROM issue is complete, some mechanism for flagging new entries will be needed.

B. ENSDF CD-ROM

ENSDF can be stored in several different forms.

1. In the form presently termed ENSDF, the file is a collection of data sets. A retrieval program would then retrieve the data sets by type, i.e. adopted properties, decay, reaction, as a function of A or Z (including ranges). Once a data set or a collection of sets is retrieved, one should have at least the following four output options:

   a) Storing it as a computer file in ENSDF format.

   b) Formatting the data as a tabular listing and/or drawings similar to what appears in the *Nuclear Data Sheets*. This could be done using ENSDAT.

   c) Formatting the data to the *Table of Isotopes* format (see 3. below).

   d) Formatting the data using RADLST, the $E\gamma$, $I\gamma$, etc., output most used by the applied research community.

2. The file is presently stored in an alternate property-oriented form called NUDAT. Data from this file can be retrieved by specified properties, such as excitation energies, $J\pi$, $T\frac{1}{2}$, $E\gamma$, γ-ray character. These retrievals can be by A and/or Z. Ranges and multiple passes should be allowed for. The above can presently be done with the NNDC on-line system, but further retrieval criteria should be built in, such as band assignments. The output should be formattable to suit the user's needs. Provision should be included for graphical display of the data.

3. The file could be stored in the *Table of Isotopes* format. This would enable users to obtain outputs for the retrievals mentioned above in the TOI format.

4. Craig Stone's MacNuclide would be an additional desirable program to include.

The above division of file formats is based on what is presently available. If ENSDF were to be converted to a "true" data base format, then a single file format would suffice.

Additional files to consider for inclusion on a CD-ROM are the following:

1. The super-deformed bands

2. Some of the appendices from the TOI

3. The mass adjustment (presently included in NUDAT)

4. Static moments