# MINUTES OF THE FIFTH ANNUAL MEETING OF THE PANEL ON REFERENCE NUCLEAR DATA

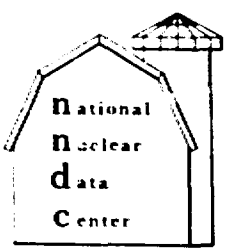
BROOKHAVEN NATIONAL LABORATORY
OCTOBER 23-24, 1980

Edited by
T.W. Burrows, J.J. Coyne, and
D.S. Brenner

April 1981

INFORMATION ANALYSIS CENTER REPORT

NATIONAL NUCLEAR DATA CENTER
BROOKHAVEN NATIONAL LABORATORY
UPTON, NEW YORK 11973



**BNL-NCS-51364**
UC 34d
(Physics -- Particles and Fields -- TIC 4500)

# MINUTES OF THE FIFTH ANNUAL MEETING OF THE PANEL ON REFERENCE NUCLEAR DATA*

BROOKHAVEN NATIONAL LABORATORY
October 23-24, 1980

Edited by:

**T.W. BURROWS**
NATIONAL NUCLEAR DATA CENTER
BROOKHAVEN NATIONAL LABORATORY
UPTON, NY 11973

**J.J. COYNE**
CENTER FOR RADIATION RESEARCH
NATIONAL BUREAU OF STANDARDS
WASHINGTON, DC 20234

AND

**D.S. BRENNER**
PHYSICS DEPARTMENT
BROOKHAVEN NATIONAL LABORATORY
UPTON, NY 11973



*Subject to Panel approval at the Sixth Annual Meeting, Fall 1981.

National
Nuclear
Data
Center

**BROOKHAVEN NATIONAL LABORATORY**
**ASSOCIATED UNIVERSITIES, INC.**
UNDER CONTRACT NO. DE-AC02-76CH00016 WITH THE
**UNITED STATES DEPARTMENT OF ENERGY**

## DISCLAIMER



**Printed in the United States of America**
**Available from**
**National Technical Information Service**
**U.S. Department of Commerce**
**5285 Port Royal Road**
**Springfield, VA 22161**

**NTIS price codes:**
**Printed Copy: A04; Microfiche Copy: A01**

TABLE OF CONTENTS


1.0 WELCOME . . . . . 1

2.0 APPROVAL OF AGENDA AND MINUTES OF THE FOURTH MEETING . . . . . 1
2.1 Agenda . . . . . 1
2.2 Minutes Of The Fourth Meeting . . . . . 1

3.0 ELECTIONS . . . . . 1

4.0 REACTOR PHYSICS DATA NEEDS . . . . . 2
4.1 Neutron . . . . . 2
4.1.1 Clarification Of NJOY Covariance Processing Module . . . 2
4.1.2 General Description Of NJOY . . . . . 2
4.1.3 Other . . . . . 3
4.2 Charged Particle . . . . . 3
4.3 Photonuclear . . . . . 3

5.0 FUSION DATA NEEDS . . . . . 4
5.1 Charged Particle . . . . . 4
5.1.1 Charged Particle Nuclear Data "Barn" Books . . . . . 4
5.1.2 CSEWG CPND Subcommittee . . . . . 5
5.2 Neutron . . . . . 5

6.0 BIOMEDICAL DATA NEEDS . . . . . 6
6.1 Radiopharmaceutical Council Survey . . . . . 6
6.2 Outline Of Biomedical Wall Chart . . . . . 6
6.2.1 Relevant Developments At The National Nuclear Data Center 10
6.3 Applicability Of MEDLIS Retrieval To MIRD . . . . . 11
6.4 Survey Of Availability Of Data Satisfying Medical Needs . . . . 12
6.5 Charged-Particle Data Needs And Private Libraries Which May Satisfy Such Needs . . . . . 12
6.6 Other . . . . . 14

7.0 STATUS OF INTERNATIONAL AND NATIONAL COOPERATION . . . . . 14

8.0 STATUS AND AVAILABILITY OF DATA FILES . . . . . 15

9.0 STATUS OF TRANSFER OF RESPONSIBILITIES FROM NDP TO NNDC . . . . . 15

10.0 STATUS OF PUBLICATIONS . . . . . 16
10.1 "Radioactivity" Handbook . . . . . 16

10.2 Other Publications . . . . . 17

11.0 ON-LINE DATA BASE SYSTEMS . . . . . 17

12.0 MISCELLANEOUS ACTION ITEMS FROM THE FOURTH MEETING . . . . . 17

13.0 SUMMARY OF RECOMMENDATIONS AND ACTIONS . . . . . 17

14.0 ADJOURNMENT . . . . . 18

15.0 ACKNOWLEDGEMENTS . . . . . 18

TABLES

Table 1. ACRONYMS . . . . . 19
Table 2. DOCUMENTATION ON PREVIOUS PANEL MEETINGS . . . . . 19

APPENDICES

A. PANEL ON REFERENCE NUCLEAR DATA . . . . . 29
B. ATTENDEES AND OBSERVERS TO THE FIFTH MEETING . . . . . 33
C. AGENDA . . . . . 35
D. DRAFT OUTLINE OF A BIOLOGICAL WALL CHART . . . . . 37
E. SAMPLE OF NNDC RETRIEVAL DEVELOPMENTS . . . . . 39
F. STATUS OF "RADIOACTIVITY" HANDBOOK AND SUMMARY OF SURVEY RESULTS . 43
G. SUMMARY OF RECENT PUBLICATIONS . . . . . 53

G.1 CENTER FOR EXPERIMENTAL PHOTONUCLEAR DATA, MOSCOW STATE UNIVERSITY 53

G.2 CROSS SECTION EVALUATION WORKING GROUP . . . . . 53

G.3 IAEA-SPONSORED NUCLEAR STRUCTURE AND DECAY DATA NETWORK . . . . . 53

G.4 FACHINFORMATIONSZENTRUM, KARLSRUHE . . . . . 54

G.5 GESELLSCHAFT FUER SCHWERONFORSCHUNG, DARMSTADT . . . . . 54

G.6 ISOTOPES PROJECT, LAWRENCE BERKELEY LABORATORY . . . . . 54

G.7 KERNFORSCHUNGSZENTRUM KARLSRUHE, INSTITUTE FUER RADIOCHEMIE . . . 54

G.8 NATIONAL NUCLEAR DATA CENTER, BROOKHAVEN NATIONAL LABORATORY . . . 55
G.8.1 ENDF Documentation . . . . . 55
G.8.2 "Recent References" And Nuclear Data Sheets . . . . . 55
G.8.3 Other Publications . . . . . 55

G.9 NUCLEAR DATA CENTER, OBNINSK, USSR . . . . . 56

G.10 NUCLEAR DATA SECTION, INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA 56

G.11 NUCLEAR ENERGY AGENCY - DATA BANK, SACLAY . . . . . 56

G.12 NUCLEAR DATA PROJECT, OAK RIDGE NATIONAL LABORATORY . . . . . 57

G.13 NUCLEAR PHYSICS BRANCH, IDAHO FALLS NATIONAL ENGINEERING LABORATORY 57

G.14 NUCLEAR REACTION DATA NETWORK . . . . . 57

G.15 RADIATION SHIELDING INFORMATION CENTER, OAK RIDGE NATIONAL LABORATORY 57

G.16 RIJKSUNIVERSITEIT UTRECHT, UTRECHT, NETHERLANDS . . . . . 58

G.17 UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA, PA . . . . . 58

G.18 US NUCLEAR DATA NETWORK . . . . . 58

INDEX . . . . . 21

The minutes follow the order of discussion in general. In some cases, the discussions have been rearranged to provide a more logical grouping.

To aid the reader a table of acronyms and their definitions have been included, as well as a table listing the documentation of previous meetings.

## 1.0 WELCOME

The attendees and observers to the Fifth Annual Meeting of the Panel on Reference Nuclear Data were welcomed by S. Pearlstein, Director of the National Nuclear Data Center, Brookhaven National Laboratory. The Panel membership is given in Appendix A and the attendees and observers are listed in Appendix B.

## 2.0 APPROVAL OF AGENDA AND MINUTES OF THE FOURTH MEETING

### 2.1 Agenda

*The agenda was approved as modified (Appendix C).*

### 2.2 Minutes Of The Fourth Meeting

Two corrections were made to the minutes before approval. These corrections were both to page 2. In the ninth line from the bottom, "Zr-95" should read "Zr-93". In the fifth line from the bottom, "of lesser importance" should read "more important".

## 3.0 ELECTIONS

J.J. Coyne succeeded L. Stewart as Chairman. D. Brenner was unanimously elected as Vice-Chairman. T.W. Burrows remained as secretary. L. Stewart was gratefully thanked for her long service on the Panel and for serving as Chairman for two years.

## 4.0 REACTOR PHYSICS DATA NEEDS

### 4.1 Neutron

4.1.1 Clarification Of NJOY Covariance Processing Module - D. Muir noted that he and others have been working on the correction of errors in the NJOY processing system for two years and the program now appears to be working correctly. In the Los Alamos report, LA-8733-MS, there is an example of covariance processing. The package is now in a final version and is available from Los Alamos National Laboratory.

4.1.2 General Description Of NJOY - In response to a question by J.J. Coyne, D. Muir gave a brief description of NJOY. NJOY is a large computer "program" intended to prepare neutron and photon transport libraries from the Evaluated Nuclear Data File (ENDF). This program is not the only one which processes ENDF data. Codes at Argonne and Oak Ridge are similar, but do slightly different tasks depending on the problems to be solved. NJOY processes all data types required for transport and heat deposition. The heat-deposition data produced are identical to the biological dose except for a conversion factor. The output transport data are either in a deterministic form (multigroup suitible for ANISIN) or for a random walk input (Monte-Carlo). The Monte Carlo file is generated first and this is processed to produce the multigroups.

J.J. Coyne noted that there are groups, e.g. Munich, who are producing 50 MeV neutron beams for cancer therapy and processing codes such as NJOY would be very useful for calculations of tissue material and collimator effects. According to Coyne, many of these neutron therapy groups are modifying their beams to approach the characteristics of gamma therapy devices. This is primarily because they are familiar with gamma therapy; however, they are not taking advantage of the neutrons.

There is a user's manual for NJOY available and this may be obtained from D. Muir or R. MacFarlane. ENDF tapes are available through NNDC.

Since there had been some discussion at the last meeting of difficulties at Brookhaven in getting NJOY to work correctly on their computers, an action was placed on D. Muir to see that Brookhaven had the latest version of NJOY.

In response to questions by J.J. Coyne and L. Stewart on the size of NJOY and on the availability of libraries which already existed, D. Muir noted that the code is very large. There are 10 modules, consisting of approximately 3000 card images each. Not all of these modules are needed for any one application. Although the package is exportable, it would probably be better and faster to use an already existing library. The package has many very nice features, but could easily take someone 6 months to get operational. There are already multigroup data sets generated for most of the construction materials to about 20 MeV incident neutron energy; a few exist to 50 or 60 MeV. One data set for therapy was done by W.B. Wilson at Los Alamos for his Texas A and M thesis. It is documented in LA-7159-T. A similar set assembled at ORNL is described in Nuclear Science and Engineering, vol. 69, 378-388. There is, of course, a

problem if the basic data base does not exist. A third suggestion by D. Muir was that interested people work with people within the ENDF system to produce the relevant data sets.

J.J. Coyne noted that an article he coauthored on kerma factors involved a great deal of work and that the data was available from NJOY. In comparisons between the two sets of calculations, he found very good agreement. Also there were at least three people in Germany who had started to reduplicate these efforts before finding his work.

4.1.3 Other - J.J. Coyne noted that the Europeans working on neutron therapy devices are still using ENDF/B-IV for the tissue materials and would like to use ENDF/B-V. S. Pearlstein and L. Stewart noted that hydrogen and carbon are standards and, therefore, available. D. Muir noted that nitrogen and oxygen did not change from version IV. While these are the four most important, J.J. Coyne also mentioned that there is also some interest in trace elements and collimator materials.

L. Stewart asked if the (n,gamma) and (n,alpha) in nickel had been pinned down yet. P. Hemmig answered that nickel is not used at present; however, the whole question of gas production is of concern for damage studies. He has not heard of any criticisms of ENDF in this regard. L. Stewart stated the the ENDF Gas Production Files should be released in January. These files will also include gas production going through short-lived states. P. Hemmig noted that a complete set is required.

4.2 Charged Particle

L. Stewart noted the need for (alpha,n) thick target yields for subcritical assemblies and the $^{18}O$(alpha,n) cross sections for reactions in water. The recent workshop (INDC(NDS)-114) on neutron sources which included (alpha,n) sources was mentioned by T.W. Burrows.

In response to a question, P. Hemmig thought that there were many charged-particle needs which were not submitted for inclusion in the request list.

4.3 Photonuclear

L. Stewart noted that there are a large amount of experimental photonuclear data and many requests for evaluated data, particularly for the (gamma,f), (gamma,n), and (gamma,2n). However, ENDF does not contain photonuclear data and does not have the formats for these data. S. Pearlstein noted that the Berman photonuclear library is contained in the Cross Section Information Storage and Retrieval System (CSISRS) and that the BNL-325 package could be used to process these.

As an example of the need for photofission data, D. Muir described a problem in data testing. The neutron population is often measured by means of $^{238}U$ fission. When the neutron spectrum is soft, most of the events triggered in the detector are due to photofission.

According to J.J. Coyne, there is also a need for photonuclear data in neutron cancer therapy. Since most measurements are of dose, neutrons and gammas will both contribute to the measurement; however, gammas are less effective biologically by a factor of 3.

L. Stewart mentioned the joint effort of Los Alamos and Berkeley to compile data for photon-induced neutron multiplicities. J.J. Coyne noted that such reactions tend to soften the neutron spectrum.

D. Muir noted that while photoproduction and transport are currently handled in ENDF, there are no (gamma,xn). E. Kamykowski asked if there is any effort to fill the gap in ENDF on photonuclear data. V. McLane answered that the NNDC has not received a readable version of the new Berman library yet. She also mentioned that the Moscow Photonuclear Data Center was transmitting a tape of experimental data. When these are received and entered into CSISRS, the BNL-325 package could be used. L. Stewart wondered about the availibity of photon-induced neutron multiplicities and possible evaluation plans. She also noted that there would have to be new formats in ENDF to handle these data.

D. Muir noted that many of the photonuclear data measured are for safeguards and wondered if we should talk to these people. R. Heath mentioned that the appropriate society was Nuclear Materials Management Organization; however, most of the data requests come through the safeguards offices at Brookhaven and Los Alamos.

## 5.0 FUSION DATA NEEDS

### 5.1 Charged Particle

5.1.1 Charged Particle Nuclear Data "Barn" Books - Copies of G.H. Miley's preprint for the recent Evaluation Methods and Procedures workshop were distributed[1]. This preprint reviewed the status of nuclear data requirements for current and future fusion devices.

M.R. Bhat reviewed the plans of the National Nuclear Data Center for a charged-particle "Barn" book aimed at the fusion and biomedical communities. This book of curves was reviewed last year and the plans are essentially un-

---

1. G.H. Miley. "Charged-Particle Cross Section Data for Fusion Plasma Applications" in the Conference on Nuclear Data Evaluation Methods and Procedures (Sept. 22-26, 1980. Brookhaven National Laboratory). To be published.

changed (See Appendices J and K of the Fourth Panel Minutes[2] for details).

In the general discussion which followed, M.R. Bhat and T.W. Burrows discussed the problems in compiling the required data. L. Stewart and H. Makowitz noted that the energy range requirements differ for various applications.

5.1.2 CSEWG CPND Subcommittee - L. Stewart briefly reviewed the May organizational meeting of the CSEWG Charged Particle Nuclear Data Subcommittee. The meeting attempted to define areas of charged-particle nuclear data needs and discussed possible formats which would allow ENDF to be used as an interim exchange format for evaluated charged particle data. Among other data needs discussed were the use of various neutron sources as standards. In many cases the angular distribution and cross section of the source are assumed to provide the normalization of the neutron-induced reaction. At the May meeting, G.M. Hale presented three possible formalisms to handle the elastic scattering of charged-particles which go to infinity at 0 degrees due to Coulomb scattering. A preliminary discussion of these and other possible format changes has been circulated and these proposals will be discussed at Los Alamos during the week of October 27, 1980. A major impetus in obtaining a common interim format is the (alpha,n) evaluations by F. Mann.

J.J. Coyne stressed simplicity in formats since there will always be other people who will want to use the data. L. Stewart noted that ENDF is sufficiently flexible to handle both simple and complex representations.

5.2 Neutron

S. Pearlstein began the discussion by summarizing portions of a draft report by the IAEA Interregional Cooperation Program. Recognizing the wide availability of 14-MeV neutron generators in the developing countries, the report recognizes the valuable assistance that could be obtained from these sources in measuring needed 14-MeV cross sections for fusion applications. In reply to a question from D. Muir, S. Pearlstein replied that this draft report had been discussed at the recent INDC meeting.

H. Makowitz noted two corrections to the Minutes of the Fourth Meeting. These have been summarized on page 1. For the transmutation of the fission products the (n,2n) cross sections are more important than the (n,p). L. Stewart noted that above threshold the (n,n'p) reaction rapidly takes over. She also noted that cross sections for the four important fission products ($^{90}Sr$,

---

2. T.W. Burrows, L. Stewart, and J.J. Coyne. Minutes of the Fourth Annual Meeting of the Panel on Reference Nuclear Data. BNL-NCS-51250 (1980).

$^{137}Cs$, $^{85}Kr$, and $^{93}Zr$) mentioned by H. Makowitz in the last meeting are still missing from ENDF. H. Makowitz noted that most of the data for fission product cross sections are found outside of ENDF. In the cases of $^{90}Sr$ and $^{137}Cs$, there are data, but there is confusion in the data. For the others, there is very little data. L. Stewart noted that most of the theoretical cross sections are produced using the code THRESH.

H. Makowitz will contact people working with alternate materials for a list of the materials being considered and the required activation data. He also noted that there seems to be a disagreement between those groups designing on the basis of stainless steel and those designing on the basis of other materials. R. Ng mentioned that General Atomic has been funded for low-activation work. An action was placed on H. Makowitz to include the main-line (e.g. stainless steel) activation needs in his survey. R. Ng mentioned the interim report by Oak Ridge on the ETF design. A discussion on this report and of the differences between the main-line and low-activation groups between R. Ng and H. Makowitz followed.

## 6.0 BIOMEDICAL DATA NEEDS

### 6.1 Radiopharmaceutical Council Survey

F.P. Castronovo has prepared a new survey for the Council and it is to be included in the October newsletter of the Radiopharmaceutical Council.

### 6.2 Outline Of Biomedical Wall Chart

A preliminary draft outline of a biomedical wall chart by F.P. Castronovo was distributed (see Appendix D). A general discussion of the proposal and the availability of both the nuclear and non-nuclear data followed. This discussion was hampered to some extent, since the author of the outline, F.P. Castronovo,* was not present. N. Morcos felt that the chart, as outlined, would have to be changed every six months due to changes in the chemical forms used for delivery. S. Pearlstein suggested the possibilty of merging nuclear and medical data bases to produce such a chart. According to N. Morcos, the medical data base is not stable. S. Pearlstein felt that such an instability was a strong argument for computerizing the data base for rapid turnaround. However, N. Morcos felt that there was no computerized data base in this area of medicine. J.J. Coyne noted that there are a large number of unsophisticated users of radioisotopes and suggested that the aim of the biomedical wall chart might be these users.

---

*F.P. Castronovo provided a response to the discussions to T.W. Burrows on December 9, 1980. These responses are included as notes following the relevant discussion.

Response from F.P. Castronovo

The purpose of the Biomedical Wall Chart is to provide readily available information of commonly used radiopharmaceuticals and biological agents in a "general" format. The chemical forms used in the clinic are not changing every six months. In fact, a review of the *Nuclear Medicine Physicians' Desk Reference* for the years between 1971 and 1979 shows little change in the list of commonly performed imaging procedures. It is not the purpose of this wall chart to list all experimental agents, since they have not proven to be "well established". Also, it would take more than 6 months to complete the FDA protocols necessary to establish a new radiopharmaceutical in the clinic.

The proposed Biomedical Wall Chart would contain selected nuclear datum which would be important to biomedical users. It should not compete with the charts of nuclides which serve a vast community of medical and physical users.

While the experimental medical (radiopharmaceutical) data base is not stable, the commonly used agents are stable. A computerization of the data base would "keep tabs" on agents recently released for human use after all FDA requirements are met. As soon as this occurs, the agent could be added to the Biomedical Wall Chart. There certainly is a need for a computerized data base. Perhaps the Biomedical Wall Chart could act as a catalyst for a biomedical data base.

The Biomedical Wall Chart would serve primarily the academic area. Students in Nuclear Medicine, Nuclear Cardiology, radiopharmacy, radiopharmacology, nuclear nursing, etc. would benefit from such a chart. Even established professionals in these areas would refer to this chart from time to time just as they refer to the Radiological Health Handbook and the Chart of the Nuclides.

J.K. Tuli also suggested a list of quantities which, if recommended by the Panel or some authoratative group, could be included with the nuclear data on a chart. These quantities included:

(1) List of useful isotopes
(2) Chemical forms used
(3) Critical organs for the radionuclide
(4) Biological half-life
(5) Radiation dose in the critical organ
(6) Whole body radiation dose
(7) Usual theraputic or diagnostic dose levels
(8) Maximum permissible dose concentrations in the body, air, water, etc.

Response from F... Castronovo: All items, except (8), are potential candidates for a Biomedical Wall Chart. The eighth item is Health Physics.

K. Lathrop stressed that the maximum permissible dose should be left to the decision of the physician.

Response from F.P. Castronovo

There are FDA recommendations for maximum permissible dose for volunteers in radiation studies. The institutional Radiation Safety Committee (Radioactive Drug Research Committee) reviews all human applications pertaining to radionuclides, with special emphasis on the radiation dose received by patients.

K. Lathrop noted that one of the functions of the Medical Internal Radiation Dose Committee (MIRD) is to combine biological data with nuclear data. While the committee has published a great deal on nuclear data and models, there are only nine reports dealing with biological doses or retention. It is very difficult to get the appropriate data. Three of the problems are:

(1) Only biokinetic data on humans are used by the committee,
(2) Gathering of such data is not interesting work, and
(3) Facilities for gathering the data are limited.

MIRD has published a summary of their publications relating to biological dose.

Response from F.P. Castronovo: Such biokinetic data would be difficult to present in chart form.

In regard to computerizing the medical data, S. Pearlstein asked if there was one main journal containing these data. N. Morcos cited the Journal of Nuclear Medicine, but noted that the data are not necessarily universal and the bulk of it is changing with time. He also noted that putting such data in a computerized data base might infringe on the medical doctor's perogative. R.L. Heath pointed out that MIRD is the only group dealing with both nuclear and biomedical data that is recognized by the medical profession. K. Lathrop liked the idea of computerizing the data, but at present there are not enough data. There could be enough data in the future. The biological data that are needed are biokinetic (i.e. time-activity) curves for each organ.

S. Whetstone noted that it seemed to him that nuclear data did not enter until after the work was done. N. Morcos cited the example of thyroid treatment with iodine. There are too many variables in the human body to allow a simple representation on a chart.

Response from F.P. Castronovo

It would not be the purpose of the chart to list all the biomedical variables pertaining to radioiodine. Information such as the half-life, uses, radiation dose, primary photon energy, and usual dose ranges would be included. Perhaps the average whole body dose and some production information would also be included. However, no pharmacodynamic information would be supplied since this is not the pur-

pose of the Biomedical Wall Chart.

D. Brenner feared that a biomedical wall chart codified in a simple way complex data.

Response from F.P. Castronovo: The purpose of the chart is not to be a final informational organ for the biomedical community. The complex data will, of course, be left to the investigational journals where it belongs.

S. Whetstone noted that in the nuclear wall charts there is a relationship between all the squares of the chart, while for the biomedical chart this relationship does not appear to exist.

Response from F.P. Castronovo

The Chart of the Nuclides simply relates protons to neutrons. The Biomedical Wall Chart has no simple common denominator to evolve from. Even so, the creation of "biotopes", "biomers", "biotones", and "biobars" is a distinct possibility. For example, $^{99m}$Tc(Na[illegible]) and $^{99m}$Tc(Diphosphonate) would be "biomers" of each other. A clear relationship exists between a specific chemical form and a target organ to be imaged, and this is what the Biomedical Wall Chart will emphasize.

J.J. Coyne attempted to summarize the discussion by emphasizing two points:

(1) Why have a wall chart if the squares are not related?
(2) There are serious problems in the availibility and changability of the biomedical data.

Response from F.P. Castronovo

The squares are related in the biomedical sense and, therefore, should not be graded in comparison to the Chart of the Nuclides. There are distinct relationships which may not be as easy to combine as neutrons and protons, but nevertheless they are related in a biomedical sense.

As noted above, the information pertaining to commonly used radiopharmaceuticals has not changed drastically since 1971. Each Biomedical Wall Chart would be dated just as a book is dated. There are no serious problems relative to finding well established data and the changability of the biomedical data actually does not pertain to the chart as outlined. Such pharmacodynamics (kinetic) data is well represented by the MIRD committee and journal articles.

In addition, a radiopharmaceutical out of favor in the United States may not be treated as such elsewhere. For example, $^{113m}$In

still finds much use in countries like China, Mexico, etc. The information proposed for the Biomedical Wall Chart is for all to review.

6.2.1 Relevant Developments At The National Nuclear Data Center - J.K. Tuli distributed three examples of work underway at the NNDC to combine subsets of data from the files resident at the Center. These examples are in Appendix E and include:

(1) Teletype dialogue for on-line retrievals,
(2) Hardcopy (both tabular and graphical) retrievals, and
(3) Microfiche.

Data were combined from the following files:

(1) Evaluated Nuclear Data File Version V (ENDF/B-V)
(2) Evaluated Nuclear Structure Data File (ENSDF)
(3) Wapstra-Bose Mass Tables
(4) BNL-325, Third Edition

L. Stewart suggested the addition of the reference citations and the energy of the metastable state to the examples given.

Since some of the discussion related this effort to the current wall charts, R.L. Heath emphasized that the wall chart effort included an evaluation or selection effort rather than just a retrieval. It was pointed out by J.K. Tuli and others that the retrievals in the examples were of evaluated data.

D. Brenner asked about the goal of such an effort. S. Pearlstein noted that in the area of nuclear structure and decay data, ENSDF was continually changing and there is a need for a cheap way of disseminating these changes. The effort of combining these various data files is still developing and the NNDC would like feedback. In particular, the following questions were asked:

(1) Are on-line retrievals useful?
(2) Are fiche useful and on what time scale?
(3) Should the nuclear and atomic radiations be included?

D. Brenner felt that there would usually be specific needs for the types of data included in the examples and, therefore, a call-in or retrieval would be better than distributing fiche. N. Morcos questioned the cost effectiveness of answering each request or providing fiche on all the nuclides on a periodic basis. One chart might be more useful. S. Pearlstein thought that the fiche would probably be sent to subscribers.

R. Heath and S. Whetstone pointed out that ENDF is the accredited file for reactor physics. However, S. Whetstone thought that significant changes should be monitored. In the area of reactor physics, S. Pearlstein thought that the present developments should be regarded as supplementary to ENDF.

S. Whetstone thought that for these types of retrievals the link must be through the researcher. N. Morcos pointed out that the physician never sees the nuclear data.

N. Morcos thought that these developments were very useful and E. Kamykowski felt that faster dissemination was very important, so on-line access would be useful. D. Brenner noted that the example was a fairly simple case with few transitions. He wanted to know how many lines would be present in a radionuclide with a complex spectra. J.K. Tuli said that the number of lines were variable, depending upon an intensity cutoff. In the example shown, the cutoff was 0.1%.

K. Lathrop cited the importance of the Wall Chart as a quick reference, but the Wall Chart lacks internal conversion and this is very important. D. Brenner felt there would be a limited need for such services in the community he represents. N. Morcos felt that these services would be very useful to medical departments which are linked with physics departments at various universities.

6.3 Applicability Of MEDLIS Retrieval To MIRD

The discussion continued with K. Lathrop's presentation on the applicability of MEDLIS* to MIRD. The committee had specifically requested $^{99m}Tc$ shown in the example since it is important. They plan to update the MIRD publications dealing with decay data in a loose-leaf format. There are approximately 100 to 200 nuclides in the current publications and they would like to see thirty additional ones added.

While they have had problems in updating these publications due to the lack of evaluated data in the appropriate format, T. Dillman is working on a report for NCRP or ICRU. Since the data are in their format, the committee may use these data to update the publications. They are also considering obtaining the data from the ENSDF file residing at the NNDC. J.K. Tuli provided MIRD with several forms of output. The major complaint was that these outputs contained too much data. K. Lathrop will send samples of the Dillman format to the NNDC for analysis.

R.L. Heath asked about the relationship between NCRP, ICRP, and MIRD. K. Lathrop replied that MIRD is within the Society of Nuclear Medicine and is charged with various publication responsibilities. There are no official links to NCRP or ICRP.

---

*MEDLIS is a program created at the Nuclear Data Project, Oak Ridge National Laboratory. It processes decay data sets in the ENSDF format to provide tables of radiations, ordered by radiation and energy. The original version also produced a computer file of these data in a psuedo-ENDF format. NNDC modified this program to produce the computer file in legal ENDF/B-V format.

In reply to a question from J.J. Coyne, K. Lathrop thought that MIRD did not have enough biological data to be put into an on-line computer base. With the exception of the published MIRD data, most of the biological data have been collected using animals. The Bureau of Radiological Health has given contracts to collect the appropriate biokinetic data.

6.4 Survey Of Availability Of Data Satisfying Medical Needs

T.W. Burrows distributed a survey of data satisfying the needs expressed in Table 2 of the Third Minutes[3]. He stressed that due to the breadth of the survey it is relatively shallow. The Panel was asked to provide comments on the handout. Due to the size of the handout and its preliminary and incomplete nature, it has not been included as an appendix.

6.5 Charged-Particle Data Needs And Private Libraries Which May Satisfy Such Needs

Since J. MacDonald was unable to attend, this agenda item will be carried over to the next meeting.

K. Lathrop cited the need for charged-particle nuclear data, particularly for medical cyclotrons. The Bibliography of Integral Charged Particle Nuclear Data[4] is useful, but requires the user to work in the library. The bibliography on accelerator-produced radioisotopes[5] was of limited usefulness. People at medical cyclotrons need books of curves, such as those produced by Barbier[6]. L. Stewart mentioned Howerton's compilation of reaction thresholds[7] as a useful

---

3. T.W. Burrows, L. Stewart, and J.J. Coyne. Minutes of the Third Annual Meeting of the Panel on Reference Nuclear Data. BNL-NCS-51023 (1979).

4. T.W. Burrows and P. Dempsey. The Bibliography of Integral Charged-Particle Nuclear Data, Fourth Edition. BNL-NCS-50640, 4th Edition (1980).

5. D.R. Christman and K.I. Karlstrom. Accelerator Produced Nuclides for Use in Biology and Medicine. A Bibliography, 1939 - 1973. BNL-50448 (1975).
Accelerator Produced Nuclides for Use in Biology and Medicine. A Bibliography, January 1974 - June 1976. BNL-50448-Vol. II (1978).

6. M. Barbier. Induced Radioactivity (North-Holland, NY, 1969).

tool.

J.K. Tuli asked if there was a need for curves for all the possible radionuclides or only a few. K. Lathrop felt that many were needed. J.K. Tuli felt from the discussions and various surveys that there was a definite need for a horizontal compilation of charged-particle excitation functions; however, if the needs could be narrowed down, such an effort would be more feasible. He asked if the Data Centers could be informed of those radioisotopes of primary use.

D. Muir and S. Pearlstein cited the works by Muenzel, et al., in the Landholt-Bornstein series[8] as being useful. T.W. Burrows referred to the earlier discussion on charged-particle "Barn" books and to the tabular publication by Muenzel, et al.[9], of the integral charged-particle data contained in the international exchange format (EXFOR). He also noted that the Source List[10] contained several useful references relevant to the discussion.

S. Whetstone asked if there is any list of medical cyclotrons. K. Lathrop cited a table in a recent symposium and said that she would supply the table.

---

7. R.J. Howerton. Thresholds of Nuclear Reactions Induced by Neutrons, Photons, Protons, Deuterons, Tritons, and Alpha Particles. UCRL-50400, Vol. 9 (1970).

8. K.A. Keller, et al. Q-Values and Excitation Functions of Nuclear Reactions. Q-Values. Landholt-Bornstein, Group I, Vol. 5, Part A (Springer-Verlag, NY, 1973).
Q-values and Excitation Functions of Nuclear Reactions. Excitation Functions for Charged-Particle Induced Reactions. Landholt-Bornstein, Group I, Vol. 5, Part B (Springer-Verlag, NY, 1973).
Q-Values and Excitation Functions of Nuclear Reactions. Estimates of Unknown Excitation Functions and Thick Target Yields for p, d, He-3, and Alpha Reactions. Landholt-Bornstein, Group I, Vol. 5, Part C (Springer-Verlag, NY, 1974).

9. H. Muenzel, H. Klewe-Nebenius, J. Lange, G. Pfennig, and K. Hemberle. Karslruhe Charged Particle Reaction Data Compilation. Physik Daten 15 (Fachsinformationszentrum, Karlsruhe, Fed. Rep. of Germany, 1979).

10. T.W. Burrows and N.E. Holden. A Source List of Nuclear Data Bibliographies, Compilations, and Evaluations, Second Edition. BNL-NCS-50702, Second Edition (1978).

6.6 Other

J.J. Coyne felt that there was noone coordinating neutron work for energies above 20 MeV and that there is a need for such coordination. The National Cancer Institute is pushing neutron therapy; however, the major emphasis is on hardware. Four machines funded by the institute are in development, ranging from final planning in Los Angeles to machine installation at the M.V. Anderson Hospital, Houston. Germany is also heavily involved in neutron cancer therapy and the facility in Amsterdam, The Netherlands, has treated 500 patients. This case load will increase when they receive their new machine. Most of the sources rely on 50 MeV proton or deuteron beams on beryllium. There seems to be sufficient charged-particle induced data for these; however, data are needed for the neutron reactions and these needs will grow.

As an example of a possible problem, he briefly described some work he and J. MacDonald are involved in. The experiment involves a "tissue-equivalent" proportional counter to measure the ionization effects of (n,charged particle) reactions. The calculations, based on ENDF, agree with the experiments at 14 MeV, but disagree for the alpha-production at 20 MeV. This might indicate a possible problem in either the $^{12}C(n,n'3alpha)$ or $^{16}O(n,n'4alpha)$ evaluations at 20 MeV. This could be important since the 20-MeV ENDF data are often used to tie higher energy calculations to. There was a general discussion of possible causes for this discrepancy, but no general conclusion. Several current or planned experiments were cited which may shed light on the problem. L. Stewart also suggested that if the neutron energy distribution were measured at 20 MeV this would tend to tie down the alpha distributions.

7.0 STATUS OF INTERNATIONAL AND NATIONAL COOPERATION

Instead of presenting a formal discussion on national and international cooperation, S. Pearlstein asked for questions. Since both D. Muir and H. Makowitz were new members of the Panel, D. Muir asked what types of input are needed from the community they represent. S. Pearlstein thought that they should work back from the applications to the community's need to provide additional guidance to the data centers. S. Pearlstein cited the brief descriptions of data files and examples of linking these files as a case where centers could use guidance.

S. Whetstone asked about the relationship between the Panel and CSEWG. S. Pearlstein thought that CSEWG was more involved in the design and development of specific national objectives whereas the Panel covered more general needs. There was also a discussion of the changes in membership of the E-10 Committee of ASTM. R. Heath stated that the committee will submit its needs through the Division of Controlled Nuclear Fusion, American Nuclear Society.

## 8.0 STATUS AND AVAILABILITY OF DATA FILES

C.L. Dunford briefly described the files resident at the NNDC, services available (see Appendix M of the Fourth Panel Minutes[2] for a description), and recent publications derived from them (see Appendix G for the publications). The major changes from last year are in the nuclear structure and decay data files. These changes came about, in main, with the transfer of responsibilities between the Nuclear Data Project and the National Nuclear Data Center and will be discussed below.

S. Whetstone asked what is done when possible errors are found in ENDF. He cited as a specific example the recent communication from Macklin on errors found in the (n,gamma) data taken at ORELA. S. Pearlstein noted that ENDF, by design, is very conservative to changes. There is also the MOD concept in ENDF and the responsible evaluators were informed of this problem. Several people also noted that this communication would have differing impacts on the associated evaluations. L. Stewart suggested the use of the NNDC newsletter to warn the user community of possible errors in ENDF.

## 9.0 STATUS OF TRANSFER OF RESPONSIBILITIES FROM NDP TO NNDC

J.K. Tuli briefly described the status of the transfer of responsibilities from the Nuclear Data Project to the National Nuclear Data Center. This transfer involves the maintenance, updating, scanning effort, services, and publication of Nuclear Structure References and the maintenance, updating, services and publication of the Evaluated Nuclear Structure Data File.

The transfer of responsibility for the Nuclear Structure References file was completed on October 1, 1980. All necessary tools are in hand and the scanner from Oak Ridge transferred to the Center on September 15, 1980. The NNDC will provide photoready copy to Academic Press for the 1980 Recent References Cumulative to be published in the Nuclear Data Sheets and thereafter, assume responsibility for providing copy for Recent References.

The development of tools for the transfer of ENSDF is progressing well. The plotting package from Nuclear Data Project has been modified for the Center's use and development of the table producing program is well in hand. There should be no problems in meeting the July 1, 1981, deadline for transfer.

With the transfer of responsibilities the Center has increased its services. This increase includes providing references and other assistance to the evaluators in the IAEA-sponsored Nuclear Structure and Decay Data Network.

J.K. Tuli stressed that the Nuclear Data Project will remain active in the evaluation of mass chains.

## 10.0 STATUS OF PUBLICATIONS

### 10.1 "Radioactivity" Handbook

Copies of the status report on the "Radioactivity" Handbook and a summary of the survey results prepared by J. Dairiki were distributed. See Appendix F for these. She would like to receive comments on these. Prior to the general discussion, several observations made in the survey summary were pointed out by T.W. Burrows. These were:

(1) There was a clear mandate for decay schemes to be included.
(2) There was a clear interest in a compilation of isotope production.
(3) While there was a strong interest in data completeness, the opinions seemed to be about equally split between the following three publication options:
    (a) One volume
    (b) Two volumes divided into tabular data and decay schemes
    (c) Two volumes with a convenient A-chain division

The summary also suggested that, since the Reus work on energy-ordered gammas would appear in the Atomic Data and Nuclear Data Tables, the energy-ordered gamma table suggested for the Handbook could be dropped, saving 100 pages. Several people felt that this table was important and should be included. R.L. Heath thought that, since the Handbook was designed to be a subset of data contained in ENSDF, such a table should not be included.

J.K. Tuli suggested that the survey results were somewhat biased by the familiarity of the respondents with the Table of Isotopes. He also pointed out the concern for size. While 1500 pages were not too cumbersome, future editions should not be allowed to grow.

S. Whetstone asked if this Handbook is appropriate to the applied user, since the Gove Panel has stated that such a Handbook is of no use to the basic scientist. The general consensus appeared to be that it was. There was also some discussion on how to define the difference between the basic and applied groups. From the survey it also appeared that there was substantial interest in the "basic" community for the Handbook.

There was a general discussion of the economics of publication and the fear that the Handbook might be too expensive. S. Pearlstein cited the example of the Table of Isotopes where the royalties normally paid to the authors were used to reduce the price of the Table. The other major consideration in the cost is the size of the press run. Since there was a high positive response on using the Handbook, it was felt that this would tend to reduce the price.

## 10.2 Other Publications

Since most of the data centers were not represented at the meeting, a discussion of recent publications and publication plans would have been incomplete. Therefore, it was decided that T.W. Burrows would collect the information and include it as Appendix G.

## 11.0 ON-LINE DATA BASE SYSTEMS

Since there had been no response to a memo from T.W. Burrows asking for suggestions on this topic, the topic was continued to the next meeting. The general consensus was that such a discussion would be very useful both to the Panel members and to the data centers.

## 12.0 MISCELLANEOUS ACTION ITEMS FROM THE FOURTH MEETING

Only the items concerning the distribution of the wall charts had not been included in the agenda. N.E. Holden contacted General Electric to get their distribution list. They send approximately 300 to 500 copies to each of the national laboratories. The rest of the distribution is by request and they do not retain a list of these requests. D. Muir suggested that the NNDC should not be conservative in their estimate of the distribution for the U.S. and Canada. A rough estimate could be made by finding out the number of copies produced and the number already distributed.

## 13.0 SUMMARY OF RECOMMENDATIONS AND ACTIONS

S. Whetstone was still somewhat worried about the usefulness of nuclear data centers to the biomedical community. L. Stewart suggested that the Panel recommend that the data residing at the NNDC be made available to MIRD for updating their publications.

J.J. Coyne summarized the function of the Panel by noting that its main function should be to recommend the usages of the data available at the nuclear data centers.

S. Pearlstein suggested that the societies should find members who would undertake the responsiblity of summarizing nuclear data interests and requirements from abstracts, papers, and presentations made at society meetings.

R. Heath discussed the couplings of the Panel with the data centers and with their societies. It appears that the first part of the coupling, between the data centers and the Panel, is working well; however, the coupling between the representatives and the societies needs improvement. It is very important for the representatives to report back to their societies. In some cases this appears to be working quite well; in other cases, there seems to be little

communication.

### Action Items

D. Muir — See that Brookhaven has the latest version of NJOY.

H. Makowitz — Provide a list of activation data required for fusion design.

K. Lathrop — Supply a table of medical cyclotrons in use.

J. MacDonald — To continue to monitor the biomedical charged-particle data needs and to check on the existence and availability of private libraries containing such data.

T.W. Burrows — Collect a list of recent publications and include this as Appendix G.

NNDC — To organize a presentation for the sixth Panel meeting on on-line data base systems and their accessibility.

### Recommendations

The NNDC should provide MIRD with the necessary nuclear data to update the MIRD publications.

## 14.0 ADJOURNMENT

The meeting was adjourned with the suggestion that the next meeting be held in about one year and a strong effort be made to hold the meeting earlier to avoid the large number of competing meetings held in October and November.

## 15.0 ACKNOWLEDGEMENTS

The Panel on Reference Nuclear Data, consisting of professional user groups of nuclear data, was initiated by S. Pearlstein in 1975.

The Panel gratefully thanks L. Stewart for her long service on the Panel and for serving as chairman for two years.

Table 1. ACRONYMS

| Acronym | Definition |
|---|---|
| CPND | Charged-Particle-Induced Nuclear Data |
| CINDA | Computerized Index to Neutron Data |
| CSEWG | Cross Section Evaluation Working Group |
| CSISRS | Cross Section Information Storage and Retrieval System |
| ENDF | Evaluated Nuclear Data File |
| ENSDF | Evaluated Nuclear Structure Data File |
| ETF | Experimental Test Facility |
| EXFOR | International Exchange Format |
| FMIT | Fusion Materials Irradiation Facility |
| IAEA | International Atomic Energy Agency |
| ICRP | International Council on Radiation Protection |
| MIRD | Medical Internal Radiation Dose Committee |
| NCRP | National Council on Radiation Protection |
| NDP | Nuclear Data Project, Oak Ridge National Laboratory |
| NNDC | National Nuclear Data Center, Brookhaven National Laboratory |
| NSR | Nuclear Structure References |
| RSIC | Radiation Shielding Information Center, Oak Ridge National Laboratory |

Table 2. DOCUMENTATION ON PREVIOUS PANEL MEETINGS

All meetings of the Panel on Reference Nuclear Data have been held at Brookhaven National Laboratory.

| Date | Documentation |
|---|---|
| October 19,1976 | Panel on Reference Nuclear Data and Surveys of Reference Data Requirements. T.W. Burrows and S. Pearlstein. Brookhaven National Laboratory Report BNL-NCS-50717 (1977). |
| October 25,1977 | Panel on Reference Nuclear Data. J.E. Cline and T.W. Burrows. Unpublished. |
| October 5,1978 | Minutes of the Third Annual Meeting of the Panel on Reference Nuclear Data. T.W. Burrows, L. Stewart, and J.J. Coyne. Brookhaven National Laboratory Report BNL-NCS-51023 (1979). |
| November 1-2,1979 | Minutes of the Fourth Annual Meeting of the Panel on Reference Nuclear Data. T.W. Burrows, L. Stewart, and J.J. Coyne. Brookhaven National Laboratory Report BNL-NCS-51250 (1980). |

$^{12}C(n,n'3alpha)$ . . . . . 14
$^{16}O(n,n'4alpha)$ . . . . . 14
$^{18}O(alpha,n)$ Cross Sections . . . . . 3
$^{93}Zr$ . . . . . 1
$^{95}Zr$ . . . . . 1
$^{99}Tc$ . . . . . 40
$^{99m}Tc$ . . . . . 11, 40
$^{99m}Tc$(Diphosphonate) . . . . . 9
$^{99m}Tc(NaTcO_4)$ . . . . . 9
$^{113m}In$ . . . . . 9
$^{238}U$ Fission . . . . . 4

(gamma,2n) . . . . . 3
(gamma,f) . . . . . 3
(gamma,n) . . . . . 3
(gamma,xn) . . . . . 4

Accelerator-Produced Nuclides . . . . . 12
Accelerator-Produced Radioisotopes . . . 12
ACKNOWLEDGEMENTS . . . . . 18
ACRONYMS . . . . . 19
Action Items . . . . . 18
Activation Cross Sections . . . . . 6
ADJOURNMENT . . . . . 18
AGENDA . . . . . 35
Agenda . . . . . 1
Alternate Materials . . . . . 6
American Association of Physics in Medicine 29
American Chemical Society
  Division of Nuclear Chemistry and Technology 29
American Nuclear Society
  Division of Controlled Nuclear Fusion 14, 30
  Division of Isotopes and Radiation . . 30
  Division of Radiation Protection and Shielding 30
  Division of Reactor Physics . . . . . 31
ANISIN . . . . . 2
Applicability of MEDLIS Retrieval to MIRD 11
APPROVAL OF AGENDA AND MINUTES OF THE FOURTH MEETING 1
Argonne National Laboratory . . . . . 2
ASTM, E-10 Committee . . . . . 14, 31
Atomic and Molecular Data . . . . . 56
Atomic Data and Nuclear Data Tables . . 16, 54, 57 to 58
ATTENDEES AND OBSERVERS TO THE FIFTH MEETING 33

Bibliography of Integral Charged Particle Nuclear Data
  Archival Edition . . . . . 55
  Supplement 1 . . . . . 55
Biobars . . . . . 9
Biokinetic Data . . . . . 8, 12
Biological Dose . . . . . 2, 4, 8

Biological Effectiveness
  Gammas . . . . . 4
  Neutrons . . . . . 4
Biological Half-Life . . . . . 7
Biological Retention . . . . . 8
BIOMEDICAL DATA NEEDS . . . . . 6
Biomedical Wall Chart . . . . . 5, 38
Biomers . . . . . 9
Biotones . . . . . 9
Biotopes . . . . . 9
BNL-325
  Fourth Edition . . . . . 55 to 56
  Package . . . . . 3 to 4
  Third Edition . . . . . 10
Brookhaven National Laboratory
  National Nuclear Data Center . . . . . 1, 4, 10, 15, 19, 53, 55 to 58

Cancer Therapy
  Gammas . . . . . 2
  Neutrons . . . . . 2 to 4, 14
  Neutrons - 50 MeV . . . . . 2
Center for Experimental Photonuclear Data 4, 53, 57
Charged Particle Nuclear Data "Barn" Books 4, 13
Charged-Particle Elastic Scattering Formalisms 5
Charged-Particle-Induced Excitation Functions 13
Charged-Particle-Induced Nuclear Data . 19, 54
  (alpha,n) Evaluations . . . . . 5
Charged-Particle-Induced Nuclear Data Needs 5
  Biomedical . . . . . 12
  Fusion . . . . . 4
  Reactor Physics . . . . . 3
CINDA . . . . . 19, 56
Collimator Effects . . . . . 2
Collimator Materials . . . . . 3
Community Input To Panel . . . . . 14
Compilation of Compilations . . . . . 13, 54, 56
Computerized Index to Neutron Data . . . 19, 56
Coulomb Scattering . . . . . 5
CPND . . . . . 5, 19
Cross Section Evaluation Working Group (CSEWG) 19, 53
  Charged Particle Nuclear Data Subcommittee 5
Cross Section Information Storage and Retrieval System (CSISRS) 3, 19
CSEWG . . . . . 5, 14, 19, 57
CSISRS . . . . . 3 to 4, 19

Data Files
  Combinations of . . . . . 10
Data Library Collection (DLC) . . . . . 57
Data Testing . . . . . 3
Decay Data
  $^{99}$Tc . . . . . 11, 40
  $^{99m}$Tc . . . . . 40

Actinides . . . . . 55
Decay Schemes . . . . . 16
Energy-Ordered Gammas . . . . . 16, 54
Fission Products . . . . . 55
Spectra . . . . . 57
Uranium Half-Lifes . . . . . 56
Developments at the NNDC Relevant to Biomedical Needs 10
DLC . . . . . 57
DOCUMENTATION ON PREVIOUS PANEL MEETINGS 19
DRAFT OUTLINE OF BIOLOGICAL WALL CHART . 37

ELECTIONS . . . . . 1
ENDF . . . . . 2 to 6, 10 to 11, 14 to 15, 19, 53, 57
as an interim format for evaluated CPND 5
Availability . . . . . 2 to 3
Documentation . . . . . 55
Formats and Procedures . . . . . 55
Gas Production Files . . . . . 3
Possible Errors . . . . . 15
ENDF/B-V
Actinide Decay Data . . . . . 55
Fission Product Decay Data . . . . . 55
Summary Documentation . . . . . 55
Energy-Ordered Gammas . . . . . 16, 54
ENSDF . . . . . 10 to 11, 15 to 16, 19
ETF . . . . . 6, 19
ETF Design . . . . . 6
Evaluated Nuclear Data File (ENDF) . . . 2, 10, 19
Evaluated Nuclear Structure Data File (ENSDF) 10, 15, 19
EXFOR . . . . . 13, 19, 53
Experimental Test Facility . . . . . 19

Fachinformationszentrum . . . . . 53 to 54
FDA Protocols . . . . . 7
Fission Detectors . . . . . 3
FMIT . . . . . 19
FUSION DATA NEEDS . . . . . 4
Fusion Materials Irradiation Facility . 19

Gamma-Ray Energy Calibration Standards . 57 to 58
Gas Production . . . . . 3
General Atomic . . . . . 6
General Electric . . . . . 17
Gesellschaft fuer Schweronforschung . . 54

Health Physics Society . . . . . 31
Heat Deposition . . . . . 2

IAEA . . . . . 19
ICRP . . . . . 11, 19

ICRU . . . . . 11
Idaho National Engineering Laboratory
  Nuclear Physics Branch . . . . . 53, 57 to 58
IEEE, Nuclear Science and Plasma Society 31
Induced Radioactivity . . . . . 12
International Atomic Energy Agency . . . 19
  -Sponsored Nuclear Structure and Decay Data Network 15, 53, 57
  Interregional Cooperation Program . . 5
  Nuclear Data Section . . . . . 55 to 57
International Council on Radiation Protection 19
International Exchange Format (EXFOR) . 13, 19
Ionization Effects
  (n,charged particle) Reactions . . . . 14
Isotope Production . . . . . 16
Isotopes Project . . . . . 53 to 54, 58

Journal of Nuclear Medicine . . . . . 8

Karlsruhe Charged Particle Reaction Data Compilation 13, 54
Kerma Factors . . . . . 3, 56
Kernforschungszentrum, Karlsruhe . . . . 54, 57

Lawrence Berkeley Laboratory
  Isotopes Project . . . . . 53 to 54, 58
Los Alamos National Laboratory . . . . . 2
Low-Activation Devices . . . . . 6

Mass Chain Evaluations . . . . . 15
  A = 5 to 20 . . . . . 58
  A = 11 to 12 . . . . . 58
  A = 13 to 15 . . . . . 58
  A = 16 . . . . . 58
  A = 21 to 44 . . . . . 58
  A > 45 . . . . . 57
Mass Tables . . . . . 10
Maximum Permissible Dose - FDA Recommendations 8
Medical Cyclotrons . . . . . 12 to 14
Medical Data Base . . . . . 6
  Radiopharmaceutical . . . . . 7
MEDLIS . . . . . 11
Minutes of the Fourth Annual Meeting . . 1, 5
  Corrections . . . . . 1
MIRD . . . . . 8, 11 to 12, 17 to 19, 32
MIRD Publications . . . . . 11
MISCELLANEOUS ACTION ITEMS FROM THE FOURTH MEETING 17
Monte Carlo Libraries . . . . . 2
Multigroup Libraries . . . . . 2, 57

National Bureau of Standards
  Photonuclear Data Center . . . . . 53, 58
National Cancer Institute . . . . . 14
National Council on Radiation Protection 19

National Nuclear Data Center (NNDC) . . 1, 4, 10, 15, 19, 53, 55 to 58
NCRP . . . . . 11, 19
NDP . . . . . 19
Neutron Cross Sections
  $^{12}C(n,n'3alpha)$ . . . . . 14
  $^{16}O(n,n'4alpha)$ . . . . . 14
  $^{85}Kr$ . . . . . 6
  $^{90}Sr$ . . . . . 5
  $^{93}Zr$ . . . . . 6
  $^{137}Cs$ . . . . . 6
  (n,2n) Reactions . . . . . 5
  (n,alpha) in Nickel . . . . . 3
  (n,charged particle) . . . . . 14
  (n,gamma) . . . . . 15
  (n,gamma) in Nickel . . . . . 3
  (n,n'p) . . . . . 5
  (n,p) . . . . . 5
  10 to 50 MeV . . . . . 55
  14 MeV . . . . . 5
  Alpha Production . . . . . 14
  Carbon . . . . . 3
  ENDF/B . . . . . 55
  Fission Products . . . . . 5 to 6
  Hydrogen . . . . . 3
  Nitrogen . . . . . 3
  Oxygen . . . . . 3
Neutron Data Needs
  Biomedical . . . . . 3, 14
  Fusion . . . . . 5
  Reactor Physics . . . . . 2
Neutron Generators
  14-MeV . . . . . 5
Neutron Population . . . . . 4
Neutron Reactions
  Normalization of . . . . . 5
Neutron Source Reactions . . . . . 3, 14
  (alpha,n) . . . . . 3
  as Standards . . . . . 5
Neutron Transport Libraries . . . . . 2
NJOY . . . . . 2 to 3, 18
  Covariance Processing Module . . . . . 2
  General Description . . . . . 2
  Size and Complexity . . . . . 2
  User's Manual . . . . . 2
NNDC . . . . . 11, 15, 19, 53
NSR . . . . . 19
Nuclear Data Center . . . . . 56 to 57
Nuclear Data for Fusion Reactor Technology 56
Nuclear Data Project (NDP) . . . . . 11, 15, 19, 53 to 54, 56 to 58
Nuclear Data Section . . . . . 56 to 57
Nuclear Data Sheets . . . . . 15, 54 to 57
Nuclear Data Sheets . . . . . 57

Nuclear Energy Agency - Data Bank . . . 56 to 57
Nuclear Materials Management Organization 4
Nuclear Physics . . . . . 58
Nuclear Reaction Data Network . . . . . 57
Nuclear Safeguards . . . . . 4
Nuclear Structure and Decay Data . . . . 15, 56
Nuclear Structure References (NSR) . . . 15, 19
Nuklidkarte . . . . . 54

Oak Ridge National Laboratory . . . . . 2, 6
  Nuclear Data Project . . . . . 11, 15, 19, 53 to 54, 56 to 58
  ORELA . . . . . 15
  Radiation Shielding Information Center 19, 57
ON-LINE DATA BASE SYSTEMS . . . . . 17
On-Line Retrievals . . . . . 10
Other Publications . . . . . 16

Panel Membership . . . . . 29
Photofission . . . . . 3
Photon Transport . . . . . 4
  Libraries . . . . . 2
Photon-Induced Neutron Multiplicities . 4
Photoneutrons . . . . . 3 to 4
Photonuclear Data . . . . . 3 to 4, 53
  Berman Library . . . . . 3 to 4
Photonuclear Data Center, NBS . . . . . 53 , 58
Photonuclear Data Needs
  Biomedical . . . . . 4
  Reactor Physics . . . . . 3
Photoproduction . . . . . 4
Physik Daten . . . . . 54
Preprocessed Libraries
  Availability . . . . . 2
  Construction Materials . . . . . 2
  Neutron Therapy . . . . . 2
Preprocessors . . . . . 2

Q-Values . . . . . 13

Radiation Research Society . . . . . 32
Radiation Shielding Information Center . 57
Radiation Transport Applications . . . . 57
Radioactive Decay Spectra . . . . . 57
Radioactive Drug Research Committee
  Radiation Safety Committee . . . . . 8
Radioactivity Handbook . . . . . 16, 43, 54
Radiochemicals . . . . . 6
Radiopharmaceutical Council Survey . . . 6
Reaction Thresholds . . . . . 12 to 13
Reactor Physics . . . . . 10
REACTOR PHYSICS DATA NEEDS . . . . . 2
Recent References . . . . . 15, 55, 57

Recommendations . . . . . 18
Relationship between the Panel and CSEWG 14
Resonance Parameters
  Z = 1 - 60 . . . . . 55
  Z > 60 . . . . . 56
Response Functions . . . . . 57
Rijksuniversiteit, Utrecht . . . . . 53, 57
RSIC . . . . . 19

SAMPLE OF NNDC RETRIEVAL DEVELOPMENTS . 39
Society of Nuclear Medicine . . . . . 32
  Medical Internal Radiation Dose Committee 8, 19, 32
  The Radiopharmaceutical Council . . . 32
Standard Reference Nuclear Data . . . . 55
STATUS AND AVAILABILITY OF DATA FILES . 14
STATUS OF "RADIOACTIVITY" HANDBOOK AND SUMMARY OF SURVEY RESULTS 43
STATUS OF INTERNATIONAL AND NATIONAL COOPERATION 14
STATUS OF PUBLICATIONS . . . . . 15
STATUS OF TRANSFER OF RESPONSIBILITIES FROM NDP TO NNDC 15
Subcritical Assemblies . . . . . 3
SUMMARY OF RECENT PUBLICATIONS . . . . . 53
SUMMARY OF RECOMMENDATIONS AND ACTIONS . 17
Survey of Availability of Data Satisfying Medical Needs 12

Table of Isotopes . . . . . 16
Texas A and M . . . . . 2
Thick Target Yields . . . . . 13
  (alpha,n) . . . . . 3
THRESH . . . . . 6
Tissue Materials . . . . . 2 to 3
Tissue-Equivalent Proportional Counter . 14
Trace Elements . . . . . 3
Transmutation . . . . . 5
Transport Data . . . . . 2

University of Pennsylvania . . . . . 53, 58
Uranium Half-Lifes . . . . . 56
US Nuclear Data Network . . . . . 58

Wall Charts . . . . . 17, 54
WELCOME . . . . . 1

## APPENDIX A

## PANEL ON REFERENCE NUCLEAR DATA

Membership - November 14, 1980

American Association of Physics in Medicine:

Dr. Joseph C. MacDonald
Memorial Sloan-Kettering Cancer Center
Biophysics Laboratory
1275 York Avenue
New York, New York 10021

American Chemical Society:

Division of Nuclear Chemistry and Technology

Dr. Daeg S. Brenner*
Bldg. 510
Physics Department
Brookhaven National Laboratory
Upton, New York 11953
(Vice-Chairman, Panel on Reference Nuclear Data)

Dr. Nabil Morcos
Bldg. 830
Department of Nuclear Energy
Brookhaven National Laboratory
Upton, New York 11953

---

*Permanent address:
Chemistry Department
Clark University
Worcester, Massachusetts 01610

American Nuclear Society:

Division of Controlled Nuclear Fusion

Dr. Henry Makowitz
Bldg. 129
Department of Nuclear Energy
Brookhaven National Laboratory
Upton, New York 11953

Dr. Douglas Muir
T-2 Nuclear Data
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

Division of Isotopes and Radiation

Dr. Michael D. D'Agostino
Grumman Aerospace Corporation
Research Department, Plant 26
Bethpage, New York 11714
(ex-officio)

Dr. Edward Kamykowski
Grumman Aerospace Corporation
Research Department, Plant 26
Bethpage, New York 11714

Dr. Jack Trombka
NASA - Goddard Space Flight Center
Laboratory for Theoretical Studies
Greenbelt, Maryland 20910

Division of Radiation Protection and Shielding

Dr. R. Roussin
Oak Ridge National Laboratory
Post Office Box X
Oak Ridge, Tennessee 37830

Dr. Leona Stewart*
Oak Ridge National Laboratory
Post Office Box X
Oak Ridge, Tennessee 37830

Division of Reactor Physics

Prof. Donald R. Harris
Department of Nuclear Engineering
Rensselaer Polytechnic Institute
Troy, New York 12181

ASTM, E-10 Committee

Dr. William Morgan
Battelle Northwest Laboratories
Post Office Box 999
Richland, Washington 99352

Dr. W.N. Bishop
Babcock and Wilcox Company
Post Office Box 1260
Lynchburg, Virginia 24505

Health Physics Society:

Dr. Thomas J. Bauer
University of Florida
4735 N.W. 28th Terrace
Gainesville, Florida 32605

Institute of Electrical and Electronic Engineers:

Nuclear Science and Plasma Society

Dr. James E. Cline
Science Applications, Inc.
#3 Choke Cherry Road
Rockville, Maryland 20850

---

*Permanent address:
Los Alamos National Laboratory
Post Office Box 1663
M.S. 243
Los Alamos , New Mexico 87545

Dr. George H. Miley
University of Illinois
214 Nuclear Engineering Laboratory
Urbana, Illinois 61801

Radiation Research Society:

Dr. Randall S. Caswell
Center for Radiation Research
National Bureau of Standards
Washington, D.C. 20234

Dr. Joseph Coyne
Center for Radiation Research
National Bureau of Standards
Washington, D.C. 20234
(Chairman, Panel on Reference Nuclear Data)

Society of Nuclear Medicine:

Dr. Robert H. Rohrer
Department of Physics
Emory University
Atlanta, Georgia 30322

Medical Internal Radiation Dose Committee

Dr. Katherine A. Lathrop
Franklin McLean Memorial
University of Chicago
950 East 59th Street
Post Office Box 420
Chicago, Illinois 60637

The Radiopharmaceutical Council

Dr. Frank P. Castronovo
The Massachusetts General Hospital
Radiology Department
Boston, Massachusetts 02114

## APPENDIX B

## ATTENDEES AND OBSERVERS TO THE FIFTH MEETING

| NAME | INSTITUTE* | SOCIETY REPRESENTATION* |
|---|---|---|
| Bhat, M.R. | National Nuclear Data Center, BNL | |
| Brenner, D.S. | BNL/Clark University | Div. of Nuclear Chemistry and Technology, ACS |
| Burrows, T.W. | National Nuclear Data Center, BNL | |
| Coyne, J.J. | National Bureau of Standards | Radiation Research Society |
| Dunford, C.L. | National Nuclear Data Center, BNL | |
| Heath, R. | INEL | |
| Hemming, P. | DOE/RRT | |
| Holden, N.E. | National Nuclear Data Center, BNL | |
| Kamykowski, E. | Grumman Aerospace | Div. of Isotopes and Radiation, ANS |
| Lathrop, K. | University of Chicago | Society of Nuclear Medicine |
| MacLane, V. | National Nuclear Data Center, BNL | |
| Makowitz, H. | BNL | Division of Controlled Fusion, ANS |
| Morcos, N. | BNL | Div. of Nuclear Chemistry and Technology, ACS |
| Muir, D. | LANL | Division of Controlled Fusion, ANS |

---

*INSTITUTES: BNL = Brookhaven National Laboratory
DOE/OBES= Department of Energy, Office of Basic Energy Science
DOE/OFE = Department of Energy, Office of Fusion Energy
DOE/RRT = Department of Energy, Office of Reactor Research and Technology
INEL = Idaho National Engineering Laboratory
LANL = Los Alamos National Laboratory
ORNL = Oak Ridge National Laboratory

SOCIETIES: ACS = American Chemical Society
ANS = American Nuclear Society

| | | |
|---|---|---|
| Ng, R. | DOE/OFE | |
| Pearlstein, S. | National Nuclear Data Center, BNL | |
| Stewart, L. | LANL/ORNL | Div sion of Radiation Protection and Shielding, ANS |
| Tuli, J.K. | National Nuclear Data Center, BNL | |
| Whetstone, S. | DOE/OBES | |

APPENDIX C

AGENDA

Fifth Annual Meeting
Panel on Reference Nuclear Data

Brookhaven National Laboratory

1:00 p.m., October 23
to
12:00 p.m., October 24, 1980

THURSDAY, OCTOBER 23

| | | |
|---|---|---|
| I. | Welcome | S. Pearlstein (1:00-1:10) |
| II. | Approval of Agenda and of Minutes to Fourth Meeting | L. Stewart (1:10-1:20) |
| III. | Election of Officers | L. Stewart (1:20-1:50) |
| IV. | Reactor Physics Data Needs | All (1:50-2:50) |
| A. | Neutron | |
| 1. | Clarification of MOY Covariance Processing Module | D. Muir |
| B. | Charged-Particle | |
| C. | Photonuclear | |
| COFFEE BREAK | | (2:50-3:00) |
| V. | Fusion Data Needs | (3:00-3:45) |
| A. | Charged-Particle | |
| 1. | Charged Particle "Barn" Books | G.T. Miley[a], M. Bhat |

---

[a] Handout - Author will not be attending

| | | |
|---|---|---|
| | 2. Cross Section Evaluation Working Group Charged Particle Nuclear Data Subcommittee | L. Stewart |
| B. | Neutron | All |
| VI. | Biomedical Data Needs | (3:45-5:00) |
| A. | Radiopharmaceutical Council Survey | F.P. Castranovo+ |
| B. | Outline of Biomedical Wall Chart<br>B. Relevant Developments at the National Nuclear Data Center | F.P. Castranovo#<br>J.K. Tuli |
| C. | Survey of Availability of Data Satisfying Medical Needs | T.W. Burrows |
| D. | Charged Particle Data Needs and Private Libraries Which May Satisfy Such Needs | J. MacDonald# |
| E. | Applicability of MEDLIS Retrievals to Medical Internal Radiation Dose Committee | K. Lathrop |
| F. | Other | All |

FRIDAY, OCTOBER 24

| | | |
|---|---|---|
| VII. | Status of International and National Cooperation | S. Pearlstein (9:00-9:15) |
| VIII. | Status and Availability of Data Files | C.L. Dunford (9:15-9:30) |
| IX. | Status of Transfer of Responsibilities from the Nuclear Data Project to the National Nuclear Data Center | J.K. Tuli (9:30-9:45) |
| X. | Status of Publications | (9:45-10:45) |
| A. | "Radioactivity Handbook" | J.M. Dairiki# |
| B. | Other | All |
| COFFEE BREAK | | (10:45-11:00) |
| XI. | On-Line Data Base Systems | All (11:00-11:15) |
| XII. | Miscellaneous Action Items from the Fourth Meeting | All (11:15-11:30) |
| XIII. | Summary of Recommendations and Actions | J.J. Coyne (11:30-11:45) |
| XIV. | Adjournment | J.J. Coyne (11:45-12:00) |

---

+ Presented by T.W. Burrows

#Presented by J.J. Coyne

## APPENDIX D

## DRAFT OUTLINE OF A BIOLOGICAL WALL CHART

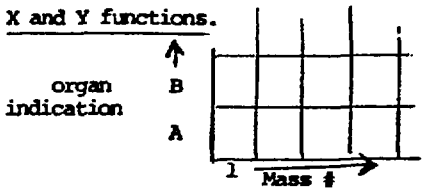
F.P. Castronovo
6 October 1980

BIOMEDICAL WALL CHART

DRAFT #1

List of inclusions:

(1) X and Y functions.

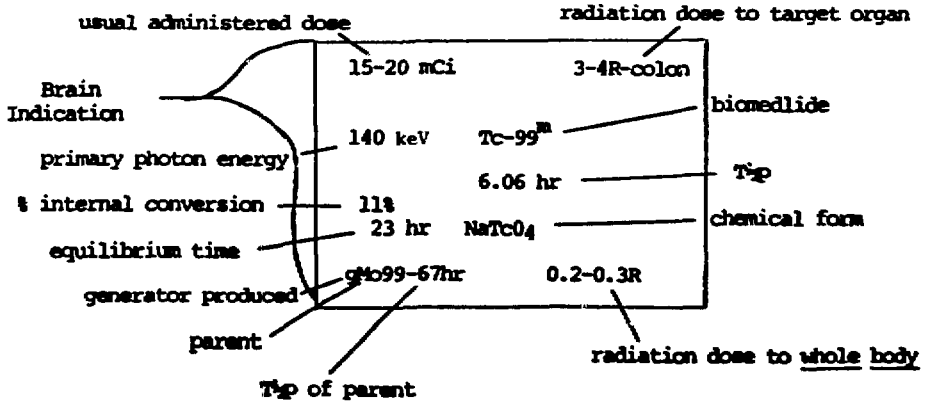



(2) Organ indications - (y axis) organs listed in alphabetical order, such as:

Abscess
Bone
Bone Marrow
Brain
Cardiovascular
Kidney
Liver
Lung
Pancreas
Spleen
Thyroid
Tumor, etc.

(3) Mass # (x axis)

(4) Individual biomedicalnuclide or "biomedlide" (example)




(5) Color codes may be used to clarify mCi dose, target organ, etc.

## APPENDIX E

## SAMPLE OF NNDC RETRIEVAL DEVELOPMENTS

# Tc 99

7712

(1/2)−

6.02 h 3

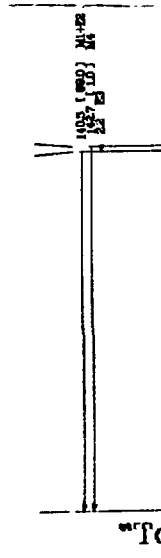
$\gamma$ =5.380±0.075
100 IT(0.14)$\gamma$ .140

9/2+

$2.13 \times 10^5$ a

$\sigma_\gamma$=19±2
$I_\gamma$ =340±20
$\gamma$ =6.120±0.061
100 $\beta^-$(0.29)$\beta^-$.293

98.90625




99TC IT DECAY (6.02 H 3) I(MIN)=0.0010%
FEEDING OF 6.02-H 99TC IN 99MO DECAY=87.52

| RADIATION TYPE | ENERGY (KEV) | | INTENSITY (%) | | (G-RAD/ UCI-H) |
|---|---|---|---|---|---|
| CE-M- 1 | 1.630 | 5 | 86.84 | 16 | 0.0030 |
| CE-NOP- 1 | 2.106 | 5 | 12.18 | 20 | 0.0005 |
| AUGER-L | 2.16999 | | 10.4 | 7 | 0.0005 |
| AUGER-K | 15.5 | | 2.1 | 4 | 0.0007 |
| CE-K- 2 | 119.422 | 15 | 8.8 | 4 | 0.022N |
| CE-K- 3 | 121.63 | 3 | 0.69 | 4 | 0.0016 |
| CE-L- 2 | 137.424 | 15 | 1.06 | 4 | 0.0031 |
| CE-L- 3 | 139.63 | 3 | 0.215 | 14 | 0.0006 |
| CE-M- 2 | 139.922 | 15 | 0.198 | 10 | 0.0006 |
| CE-NOP- 2 | 140.398 | 16 | 0.0376 | 20 | 0.0001 |
| CE-MNO- 3 | 142.13 | 3 | 0.050 | 4 | 0.0002 |
| X-RAY L | 2.42 | | 0.49 | 17 | 0 |
| X-RAY KA2 | 18.2508 | 8 | 2.12 | 13 | 0.0008 |
| X-RAY KA1 | 18.3671 | 8 | 4.06 | 24 | 0.0016 |
| X-RAY KB | 20.6 | | 1.22 | 8 | 0.0005 |
| G 2 | 140.466 | 15 | 88.97 | 24 | 0.266 |
| G 3 | 142.675 | 25 | 0.0241 | 14 | 0 |

```
 INPUT DEV:[...EXFPROJ.PROG]. D...DDL

OUTPUT DEV:FILENAME.EXFPROJ;PROG3? TTY:

TYPE ITEL(0-2=G;T;G!T); IDEV(0-4=V;C;FR;FI;VUNL)
2

TYPE      IZ;IA;IOPT;IDTL;MAG

43 99

DATA FOR  43-TC- 99  METASTABLE STATE
SPIN AND PARITY = (1/2)-
HALF-LIFE = 6.02 H 3
U-235 FISSION YIELD (%) =   5.33 +-   0.06
DECAY MODES   BR (%)  Q (MEV)  RADIATIONS (MEV) DECREASING INTENSITY
    INT TRANS  100    0.1430  GAMMA       0.1405
ENTRY DATE = 780329

DATA FOR  43-TC- 99
ATOMIC MASS =   98.90625
SPIN AND PARITY = 9/2+
HALF-LIFE = 2.13E5 Y 5
THERMAL CROSS SECTIONS
    CAPTURE     (B)     = 19         (+-)  2
RESONANCE INTEGRALS
    CAPTURE     (B)     = 340        (+-)  20
U-235 FISSION YIELD (%) =   6.12 +-   0.06
DECAY MODES   BR (%)  Q (MEV)  RADIATIONS (MEV) DECREASING INTENSITY
    BETA- DK  100    0.2930  BETA -      0.2935
ENTRY DATE = 771212
TYPE      IZ;IA;IOPT;IDTL;MAG

-1

[EPL238.VER]


END OF DISSPLA 8.2 --     4559 VECTORS GENERATED IN   1 PLOT FRAMES.
-ISSCO-  4186 SORRENTO VALLEY BLVD.,SAN DIEGO CALIF. 92121

DISSPLA IS A CONFIDENTIAL PROPRIETARY PRODUCT OF ISSCO AND ITS USE
   IS SUBJECT TO A NONDISSEMINATION AND NONDISCLOSURE AGREEMENT.

STOP

END OF EXECUTION
CPU TIME:  12.49 ELAPSED TIME:  2:14.59
EXIT

.PRINT EPL238.VER/FORMS:V
[LPT01:EPL238=/Seq:910/Limit:109: 1 File]
```

## APPENDIX F

STATUS OF "RADIOACTIVITY" HANDBOOK AND SUMMARY OF SURVEY RESULTS

## Status Report: Radioactivity Handbook

Work has begun on the development of the computer codes necessary to produce the Radioactivity Handbook from ENSDF. We foresee three major blocks of programming:

1) To establish all parent-daughter links and check all data sets for completeness and consistency.

2) To modify ENSDF data in order to provide "best values" for $\gamma$-ray properties, independent of the decay parent, in cases where ENSDF does not.

3) To provide final output formats for both tabular data and decay schemes.

After each major step, the decisions (and the bases for them) will be clearly displayed so that the evaluator may approve (or edit) them before they are adopted. Thus, the production is automated but provides for human guidance and intervention.

The first program is nearly complete. Its output will be an edited version of ENSDF free of data holes and inconsistent data. Work has begun on the algorithms for adopting both $\gamma$-ray energies and intensities -- the heart of the second major program. Simultaneously we are adopting our existing level-scheme graphics program to handle data in ENSDF formats. The remaining code, the tabular data output program, will require subroutines for calculating atomic properties and conversion-electron intensities. The physics necessary for these calculations is being studied; work on the code will not begin until next year.

Janis Dairiki
Isotopes Project
Lawrence Berkeley Laboratory
October 16, 1980

# Results of the Radioactivity Handbook Survey

Janis Dairiki
Isotopes Project
Lawrence Berkeley Laboratory
Berkeley, California

A Radioactivity Handbook for applied users is one of the planned publications of the U.S. Nuclear Data Network. On behalf of the NDN, the Isotopes Project at LBL will produce the Handbook with specifications agreeable to members of the international network of nuclear structure and decay data centers. The purpose of the Handbook is to provide a compilation of recommended decay data, based on the Evaluated Nuclear Structure Data File (ENSDF), that is detailed enough for use in sophisticated applications, but that is organized clearly so as to be readily usable in routine applications.

Samples illustrating the proposed contents and format of the Radioactivity Handbook have been distributed, along with a survey requesting specific comments and feedback, to members of several professional societies. Approximately 5000 surveys were distributed; 806 completed surveys have been returned from:

| | | |
|---|---|---|
| American Physical Society (APS): | | |
| Division of Nuclear Physics | 303 | (38%) |
| American Chemical Society (ACS): | | |
| Division of Nuclear Chemistry and Technology | 120 | (15%) |
| Recipients of the National Nuclear Data Center (NNDC) Newsletter | 116 | (14%) |
| American Nuclear Society (ANS): | | |
| Radiation and Protection Shielding Division (RPSD) | 127 | (16%) |
| Isotopes and Radiation Division (IRD) | 92 | (11%) |
| International Committee for Radionuclide Metrology (ICRM) | 20 | (2.5%) |
| ASTM/E-10 Committee | 9 | (1.1%) |
| American Association of Physicists in Medicine (AAPM) | 3 | (0.4%) |
| Health Physics Society (HPS) | 1 | (0.1%) |
| Others | 15 | (1.9%) |

There is some cross-linking of membership that is not included in the above numbers. Many scientists belong to more than one professional society; in particular, most of the recipients of the NNDC newsletter are also members of at least one other society.

Figure 1 shows the actual survey, as well as the responses (in % of total replies) to each question. Question I provides some general data on the respondent's type of work and his/her need for nuclear data. Question II defines the specific data that he/she uses. Question III is an attempt to determine if there is a consensus about the optimum size of such a handbook. The responses of each society to these survey questions are given in Table I.

A very broad range of occupations and applications of data was evidenced in the replies. A strong cross-linkage between different applications and professions was also evident. As another way of viewing the responses, we have attempted a rough quantitative breakdown of the results into the following fields of application:

| | | | |
|---|---|---|---|
| Basic: | basic nuclear physics research, nuclear theory, teaching | 345 | (43%) |
| Chem: | activation analysis, isotope production, tracer studies, chemical applications | 158 | (20%) |
| React: | reactor design, reactor safety, fuel rod and shielding design, radioactive waste problems, nuclear engineering | 131 | (16%) |
| Med: | medical diagnostics, radiotherapy, radiopharmaceutical production | 59 | ( 7%) |
| HP: | health physics, radiation dosimetry, radiation protection | 37 | ( 5%) |
| Envir: | environmental studies and monitoring | 35 | ( 4%) |
| Other: | weapons design, safeguards programs, geoscience applications, astrophysics, atmospheric physics, cosmology | 41 | ( 5%) |

Table II summarizes the responses of each group to most of the questions on the survey.

Final conclusions have not yet been drawn from these results. However, there are some interesting observations. There is a clear

mandate to include decay schemes in the Handbook. There were a few comments expressing great satisfaction that absolute photon intensities will be given. Clearly (question II. d) only basic researchers consider spins and parities to be important. However, the inclusion of these quantities on the level schemes will require no additional space and will be useful to a large body of researchers. On the other hand, let us consider isotope production methods which were considered important by slightly more than half of those surveyed. The medical professions, in particular, were very enthusiastic in their response. What they want, however, is a complete entry with reactions, production cross sections, yields, and original references. There is a need for collecting all this data in one place in a usable fashion since no such compilation currently exists. Certainly none of this data is contained in ENSDF. It would, therefore, require major compilation effort and is probably outside the scope of the Handbook production schedule. Perhaps isotope production would be an appropriate subject for an independent horizontal compilation.

Other types of data requested include charged particle cross sections (9 responses), fission yields (15), shielding factors (6), nuclear moments (13), neutron energies (14), spontaneous fission properties (9), dosimetry data (7), level half-lives (6), adopted levels and their properties (6), and conversion coefficients (6). Three to five requests were obtained for each of the following: detailed x-ray data including fluorescence yields, photon absorption coefficients, particle binding energies, resonance integrals, the total energy associated with each decay mode, γ-ray multipolarities and mixing ratios, and range-energy curves and tables.

There are two ways to view the results of question III concerning the Handbook size. On the one hand, there is a three-way split between 1) including all the data in one volume, 2) dividing it into 2 volumes on the basis of tabular data and decay schemes, and 3) producing two volumes with a convenient A-chain division. On the other hand, the results can be interpreted as a greater than 2 to 1 preference for a two-volume publication. Some of those scientists who favored publication in one volume also suggested the publication of an additional compact handbook for field use. Another suggestion (6 responses) was to reduce the size by omitting the energy-ordered γ-ray table. Since Atomic Data and Nuclear Data Tables plan to publish the energy-ordered γ-ray catalog of U. Reus and co-workers in 1981, omission of such a table in the Handbook seems justified and would reduce the final size by at least 100 pages. There were a few comments to the effect that 1500 pages were not considered too cumbersome but future editions of the Handbook should not be allowed to grow in size. Half of those who wanted a very compact book (option 3) would achieve it by eliminating decay schemes. The other half would include complete radiation data on the decay schemes and eliminate the gamma and electron listings.

As a final comment, the answers to question IV would indicate that we have a ready audience.

Figure 1. Radioactivity Handbook Survey

Please take a few minutes to let us know your reaction to the contents and format proposed for the Radioactivity Handbook.

I. a) NAME: Total responses 806 (Optional)

OCCUPATION: Foreign responses 95 (12%)

Professional society from which you received this Handbook survey: _____

b) Do you use or encounter radioisotopes, nuclear reactors, or charged-particle accelerators, or deal with nuclear properties in your work?

| | |
|---|---|
| 81% radioisotopes | 50% reactors |
| 54% accelerators | 73% nuclear properties |

c) For what purpose? (Type of application, e.g.: tracers in chemical studies, medical diagnostics, reactor design, etc.)

II. The following data categories are proposed for inclusion in the Handbook. Please indicate the types of data important to you.

95% a) half-lives of radioactive substances

84% b) natural isotopic abundances

66% c) nuclear masses

46% d) nuclear spins and parities

69% e) neutron and fission cross sections

93% f) nuclear decay modes and genetic (parent-daughter) relationships

55% g) isotope production methods

98% h) energies and intensities of radiations:

| | |
|---|---|
| 97% gamma rays | 53% conversion electrons |
| 74% x-rays | 46% "delayed" p,n,α, and fission data |
| 75% α particles | 33% average $e^-$ energy ($\beta^-$+ce+Auger) |
| 38% Auger electrons | 34% average e+ energy ($\beta$+ + pair) |
| 38% protons | 41% average photon energy ($\gamma$+x-ray) |
| 82% β- and β+ particles | |
| ____ other radiations (specify) | |

85% i) decay scheme for each parent isotope

____5) other types of data (specify)

III. The Handbook, as defined in the attached material, will be ~1500 pages and will include all the above data categories under one cover. There is some concern about the resulting size of such a complete volume. The question then arises as to possible trade-offs between the size of the Handbook and the scope of the data included - portability vs completeness. It can be seen in the Handbook descriptive material that two types of data account for ~2/3 of the bulk - photon and electron listings (500 pages) and decay schemes (500 pages). Any compromise aimed at significantly reducing the size of the Handbook must involve some manipulation and/or sacrifice of at least one of these data categories. Please indicate your feelings about any compromise by checking one of the following three statements.

26% 1) Completeness of the data in a single volume is the most important consideration.

69% 2) Completeness of the data is more important but there should be some compromise with portability. The Handbook should contain all the above data catagories but it should be published as two (or more) smaller volumes. Possible ways to do this are suggested below. Please indicate your preference.

31% a) All tabular data could be contained in one volume (~1000 pages) and decay schemes in a second volume.

34% b) Mass-chain data could be divided into two or more volumes. For example, all data for masses A=1-130 could be published in one volume and all data for A>130 in a second volume.

0.6% c) other (specify)

2.7% 3) Portability is a more important factor than completeness of the data. What data are you willing to give up in order to obtain a more compact book?

1.1% 4) Either 1) or 2)

1% 5) No preference

IV. What is the likelihood that you will use the Handbook defined in the attached material?

75% definitely  4% possibly  ___ definitely not
19% probably  0.7% not likely  0.9% no response

Return to: J.M. Dairiki
Isotopes Project
Bldg. 70A-2255B
Lawrence Berkeley Laboratory
Berkeley, CA 94720

TABLE I

| SURVEY QUESTION | | SOCIETY | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | APS | ACS | NNDC | ANS-RPSD | ANS-IRD | ASTM | HPS + AAPM | OTHERS | TOTAL |
| I. | a) total responses | 303 | 120 | 116 | 127 | 92 | 9 | 4 | 35 | 806 |
| | foreign responses | 30 | 6 | 24 | 3 | 5 | | | 27 | 95 |
| | | Responses (in %) | | | | | | | | |
| | b) radioisotopes | 80 | 93 | 72 | 71 | 92 | 100 | 100 | 94 | 81 |
| | accelerators | 73 | 51 | 62 | 31 | 29 | --- | 75 | 40 | 54 |
| | reactors | 30 | 63 | 58 | 76 | 57 | 89 | --- | 43 | 50 |
| | nuclear properties | 82 | 67 | 75 | 65 | 59 | 56 | 75 | 83 | 73 |
| II. | a) half-lives | 92 | 98 | 97 | 95 | 97 | 100 | 100 | 100 | 95 |
| | b) abundances | 82 | 83 | 95 | 80 | 82 | 100 | 75 | 80 | 84 |
| | c) masses | 75 | 65 | 78 | 49 | 57 | 78 | 50 | 51 | 66 |
| | d) spins/parities | 71 | 38 | 56 | 10 | 12 | --- | 25 | 51 | 46 |
| | e) neutron cross sections | 58 | 75 | 83 | 73 | 75 | 100 | 75 | 60 | 69 |
| | f) decay modes | 93 | 93 | 97 | 93 | 86 | 100 | 100 | 94 | 93 |
| | g) production methods | 47 | 59 | 47 | 66 | 70 | 67 | 100 | 63 | 55 |
| | h) radiations | 97 | 98 | 98 | 99 | 97 | 100 | 100 | 97 | 98 |
| | gamma rays | 96 | 98 | 96 | 99 | 96 | 100 | 100 | 97 | 97 |
| | x-rays | 70 | 80 | 70 | 76 | 76 | 100 | 100 | 83 | 74 |
| | $\alpha$ particles | 77 | 78 | 76 | 73 | 65 | 100 | 50 | 83 | 75 |
| | Auger electrons | 35 | 38 | 41 | 35 | 42 | 56 | 75 | 46 | 38 |
| | protons | 45 | 33 | 40 | 35 | 33 | 22 | 25 | 31 | 38 |
| | $\beta^{\pm}$ particles | 78 | 87 | 76 | 84 | 86 | 100 | 100 | 83 | 82 |
| | conversion electrons | 57 | 60 | 49 | 44 | 45 | 56 | 50 | 66 | 53 |
| | delayed particles | 44 | 48 | 52 | 50 | 43 | 33 | 25 | 43 | 46 |
| | ave $e^-$ energy | 31 | 39 | 37 | 44 | 50 | 67 | 75 | 29 | 38 |
| | ave $e^+$ energy | 29 | 35 | 35 | 42 | 43 | 56 | 50 | 23 | 34 |
| | ave photon energy | 34 | 33 | 41 | 54 | 60 | 44 | 75 | 29 | 41 |

TABLE 1, Continued

| SURVEY QUESTION | SOCIETY | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | APS | ACS | NNDC | ANS-RPSD | ANS-IRD | ASTM | IRPS + AAPM | OTHERS | TOTAL |
| i) decay schemes | 87 | 85 | 87 | 76 | 85 | 78 | 75 | 91 | 85 |
| III. 1) one volume | 24 | 32 | 28 | 28 | 25 | -- | 25 | 23 | 26 |
| 2) two volumes | 72 | 65 | 68 | 64 | 68 | 100 | 75 | 69 | 69 |
| a) division by data category | 29 | 40 | 21 | 30 | 39 | 33 | 25 | 20 | 31 |
| b) division by A chain | 38 | 23 | 42 | 28 | 27 | 56 | -- | 49 | 34 |
| IV. Usage | | | | | | | | | |
| definitely | 79 | 78 | 80 | 61 | 67 | 100 | 75 | 83 | 75 |
| probably | 16 | 17 | 17 | 32 | 24 | | 25 | 14 | 19 |
| possibly | 3 | 3 | 2 | 6 | 7 | | | | 4 |

TABLE II

| SURVEY QUESTION | | | FIELD OF APPLICATION | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Basic | Chem | React | Med | HP | Envir | Other | Total |
| I. | a) | total responses | 345 | 158 | 131 | 59 | 37 | 35 | 41 | 806 |
| | | foreign responses | 60 | 17 | 11 | 1 | 4 | 2 | | 95 |
| | | | Responses (in %) for each profession | | | | | | | |
| | b) | radioisotopes | 79 | 96 | 57 | 93 | 84 | 94 | 88 | 81 |
| | | accelerators | 79 | 35 | 19 | 75 | 41 | 20 | 46 | 54 |
| | | reactors | 36 | 59 | 88 | 41 | 51 | 49 | 37 | 50 |
| | | nuclear properties | 87 | 60 | 66 | 54 | 59 | 66 | 76 | 73 |
| II. | a) | half-lives | 93 | 97 | 98 | 97 | 86 | 100 | 95 | 95 |
| | b) | abundances | 83 | 89 | 79 | 80 | 81 | 91 | 88 | 84 |
| | c) | masses | 83 | 59 | 59 | 58 | 38 | 29 | 51 | 66 |
| | d) | spins/parities | 84 | 19 | 15 | 15 | 8 | 9 | 29 | 46 |
| | e) | neutron cross sections | 61 | 74 | 83 | 61 | 70 | 63 | 85 | 69 |
| | f) | decay modes | 92 | 91 | 94 | 97 | 92 | 94 | 93 | 93 |
| | g) | production methods | 49 | 61 | 56 | 86 | 68 | 51 | 39 | 55 |
| | h) | radiations | 97 | 98 | 98 | 98 | 100 | 97 | 95 | 98 |
| | | gamma rays | 96 | 97 | 98 | 97 | 100 | 97 | 93 | 97 |
| | | x-rays | 71 | 82 | 66 | 92 | 84 | 71 | 66 | 74 |
| | | $\alpha$ particles | 81 | 70 | 71 | 69 | 89 | 83 | 54 | 75 |
| | | Auger electrons | 41 | 30 | 28 | 66 | 62 | 31 | 17 | 38 |
| | | protons | 49 | 23 | 33 | 46 | 46 | 20 | 27 | 38 |
| | | $\beta^{\pm}$ particles | 80 | 82 | 79 | 93 | 95 | 86 | 66 | 82 |
| | | conversion electrons | 64 | 45 | 40 | 66 | 62 | 34 | 29 | 53 |
| | | delayed particles | 50 | 37 | 62 | 34 | 41 | 23 | 51 | 46 |
| | | ave $e^-$ energy | 30 | 38 | 43 | 61 | 65 | 37 | 27 | 38 |
| | | ave $e^+$ energy | 28 | 30 | 39 | 61 | 65 | 31 | 27 | 34 |
| | | ave photon energy | 30 | 35 | 56 | 64 | 76 | 40 | 46 | 41 |
| | i) | decay schemes | 87 | 84 | 79 | 92 | 84 | 74 | 83 | 85 |
| III. | 1) one volume | | 26 | 25 | 21 | 36 | 35 | 31 | 19 | 26 |
| | 2) two volumes | | 70 | 70 | 73 | 59 | 62 | 57 | 71 | 69 |
| | | a) division by data category | 25 | 37 | 34 | 32 | 27 | 37 | 37 | 31 |
| | | b) division by A chain | 41 | 30 | 35 | 22 | 30 | 14 | 24 | 34 |
| IV. Usage | | | | | | | | | | |
| | definitely | | 79 | 77 | 67 | 81 | 70 | 60 | 76 | 75 |
| | probably | | 18 | 15 | 27 | 10 | 24 | 34 | 24 | 19 |
| | possibly | | 2 | 5 | 6 | 7 | | 6 | | 4 |

APPENDIX G

SUMMARY OF RECENT PUBLICATIONS*

This summary contains relevant publications which have been distributed since the last Panel meeting (November, 1979) or which are planned for publication prior to the next Panel meeting (Fall, 1981). There are also brief discussions of continuing projects of the various nuclear data networks and some discussion of data files which have not been mentioned in the text of the minutes.

G.1 CENTER FOR EXPERIMENTAL PHOTONUCLEAR DATA, MOSCOW STATE UNIVERSITY

In addition to compiling photonuclear data in the EXFOR format, the center produces a bibliographic series, Photonuclear Data.

G.2 CROSS SECTION EVALUATION WORKING GROUP

By January, 1981, all of Version V of the Evaluated Nuclear Data File (ENDF) will be released. Most of the groups have issued summary documentation on their evaluations. An index of these documents is available from the National Nuclear Data Center. In addition, please refer to the NNDC for a list of general summary documentation for ENDF.

G.3 IAEA-SPONSORED NUCLEAR STRUCTURE AND DECAY DATA NETWORK

Please refer to Fachinformationszentrum, Karlsruhe; Nuclear Physics Branch, Idaho Falls National Engineering Laboratory; Isotopes Project, Lawrence Berkeley Laboratory; National Nuclear Data Center, Brookhaven National Laboratory; Nuclear Data Project, Oak Ridge National Laboratory; Photonuclear Data Center; National Bureau of Standards; Rijkuniversiteit, Utrecht; and University of Pennsylvania.

---

* As of January 29, 1981

## G.4 FACHINFORMATIONSZENTRUM, KARLSRUHE

The Center continues to sponsor a series of bibliographies, compilations, and evaluations entitled Physik Daten. The Atomic Energy Documentation Service, Inc., 7 Woodland Ave., Larchmont, NY, distributes this series in the United States. Included in this series is a compilation of bibliographies, compilations, and evaluations covering the field of physics.

The Center also contributes to the Nuclear Data Sheets produced by the Nuclear Data Project and published by Academic Press.

## G.5 GESELLSCHAFT FUER SCHWERONFORSCHUNG, DARMSTADT

The energy-ordered gamma-ray compilation by U. Reus, W. Westmeier (University of Marburg), and I. Warnecke should appear in the Atomic Data and Nuclear Data Tables in 1981.

## G.6 ISOTOPES PROJECT, LAWRENCE BERKELEY LABORATORY

The Isotopes Project has continued work on the "Radioactivity" Handbook. Please refer to Appendix F for a status report.

The Project also contributes to the Nuclear Data Sheets produced by the Nuclear Data Project and published by Academic Press.

## G.7 KERNFORSCHUNGSZENTRUM KARLSRUHE, INSTITUTE FUER RADIOCHEMIE

The manuscript of the fifth edition of the Nuklidkarte should be ready by Spring, 1981.

Two additional volumes of the Karlsruhe Charged-Particle Reaction Data Compilation are in prepartion by the Karlsruhe Charged Particle Data Group. These will be published by the Fachinformationszentrum in Physik Daten. The Group is continuing work on a planned publication to present these data in a graphical format.

## G.8 NATIONAL NUCLEAR DATA CENTER, BROOKHAVEN NATIONAL LABORATORY

### G.8.1 ENDF Documentation

| | |
|---|---|
| ENDF 102. Data Formats and Procedures for the Evaluated Nuclear Data File, ENDF | BNL-NCS-50496 (ENDF-102) 2nd Edition (ENDF/B-V) October, 1979 |
| ENDF-200. ENDF/B Cross Sections | BNL-NCS- (ENDF-200) 3rd Edition (ENDF/B-V) May, 1981 |
| ENDF-201. ENDF/B Summary Documentation | BNL-NCS-17541 (ENDF-201) 3rd Edition (ENDF/B-V) July, 1979 |
| ENDF-300. Standard Reference and Other Important Nuclear Data | BNL-NCS-51123 (ENDF-300) December, 1979 |
| ENDF/B-V Actinide Decay Data | October, 1981 |
| ENDF/B-V Fission Product Decay Data | September, 1981 |

### G.8.2 "Recent References" And Nuclear Data Sheets

On October 1, 1980, the Center assumed responsibility for the maintenance and production of "Recent References". The first issue to be produced by the NNDC will be the yearly cumulative in December, 1980. The Center will assume responsibility for the Nuclear Data Sheets in July, 1981.

### G.8.3 Other Publications

| | |
|---|---|
| The Bibliography of Integral Charged Particle Nuclear Data, Archival Edition | BNL-NCS-50640, Fourth Edition March, 1980 |
| The Bibliography of Integral Charged Particle Nuclear Data, Supplement 1 | BNL-NCS-50640, Fourth Edition, Supplement 1 March, 1981 |
| Symposium on Neutron Cross Sections from 10 to 50 MeV | BNL-NCS-51245 July, 1980 |
| Resonance Parameters Z= 1 - 60 | BNL-325, Vol. 1, Part 1 Fourth Edition July, 1981 |

| | |
|---|---|
| Resonance Parameters Z > 60 | BNL-325, Vol. 1, Part 2<br>Fourth Edition<br>December, 1981 |
| The Uranium Half-Lives - A Critical Review | BNL-NCS-51320<br>in press |

The Center also participates in the compilation, evaluation, and exchange of nuclear reaction and structure data. It also contributes to the Computerized Index to Neutron Data published by the Nuclear Data Section, IAEA, Vienna and to the Nuclear Data Sheets produced by the Nuclear Data Project and published by Academic Press.

G.9 NUCLEAR DATA CENTER, OBNINSK, USSR

The Center participates in the compilation and exchange of nuclear reaction data and contributes to the Computerized Index to Neutron Data published by the Nuclear Data Section, IAEA, Vienna.

G.10 NUCLEAR DATA SECTION, INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA

The Data Section publishes CINDA on behalf of the National Nuclear Data Center, USA, Nuclear Data Center, USSR, Nuclear Energy Agency - Data Bank, and itself. An archival edition was pulished in 1976. A 1976-1979 cumulative was published in 1980 and a 1976-1980 cumulative should be published in June, 1981.#

The Section also participates in the compilation and exchange of nuclear reaction data.

Several other publications are also issued by the Section. These include a "compilation of compilations" on nuclear structure, decay data and a bibliographic series on atomic and molecular data, and Nuclear Data For Fusion Reactor Technolgy (IAEA-TECDOC-223, December, 1979).

G.11 NUCLEAR ENERGY AGENCY - DATA BANK, SACLAY

The Data Bank participates in the compilation and exchange of nuclear reaction data and contributes to the Computerized Index to Neutron Data published by the Nuclear Data Section, IAEA, Vienna.

---

#A limited number of these publications are available from the National Nuclear Data Center.

## G.12 NUCLEAR DATA PROJECT, OAK RIDGE NATIONAL LABORATORY

The Data Project continued to publish mass chain evaluations in the Nuclear Data Sheets on behalf of the IAEA-Sponsored Nuclear Structure and Decay Data Network.

Until October, 1980, the Project also had the responsibility for preparing the three issues of Recent References which appear in the Nuclear Data Sheets each year.

## G.13 NUCLEAR PHYSICS BRANCH, IDAHO FALLS NATIONAL ENGINEERING LABORATORY

Personnel in this group contribute to the Nuclear Data Sheets produced by the Nuclear Data Project and published by Academic Press. The Branch, through its involvement in CCEWG, has the prime responsibility within the United States for the preparation of evaluated sets of decay data for inclusion in ENDF.

R.G. Helmer participated in an evaluation which resulted in the publication of "Recommended Standards for Gamma-Ray Energy Calibration (1979)" in Atomic Data and Nuclear Data Tables 24, 39 (1979).

## G.14 NUCLEAR REACTION DATA NETWORK

Please refer to Center for Atomic and Nuclear Data, USSR, Center for Experimental Photonuclear Data, Moscow State University, Kernforschungzentrum Karlsruhe (Karlsruhe Charged Particle Data Group), National Nuclear Data Center, USA, Nuclear Data Center, USSR, Nuclear Energy Agency - Data Bank, Saclay, and the Nuclear Data Section, IAEA, Vienna.

## G.15 RADIATION SHIELDING INFORMATION CENTER, OAK RIDGE NATIONAL LABORATORY

The center generates, collects, analyzes, packages, and distributes data libraries useful for radiation transport applications. The Data Library Collection (DLC) includes multigroup neutron and gamma-ray cross sections, radioactive decay spectra, kerma factors and response functions and other nuclear data for various applications.

Abstracts of the Data Libraries are published in ORNL-RSIC-30. A monthly newsletter is the means of timely communication with the user community.

G.16 RIJKSUNIVERSITEIT UTRECHT, UTRECHT, NETHERLANDS

The last evaluation by P.M. Endt and C. van der Leun of the A = 21 to A = 44 was published in Nuclear Physics in 1978. C. van der Leun also participated in an evaluation effort which resulted in the publication of "Recommended Standards for Gamma-Ray Energy Calibrations (1979)" in Atomic Data and Nuclear Data Tables 24, 39 (1979).

G.17 UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA, PA

F. Ajzenberg-Selove continues her evaluation efforts on the A = 5 to 20 nuclei. In 1980 new evaluations for A = 11 and 12 were published in Nuclear Physics. The new evaluations for A = 13 to 15 has been accepted for publication in Nuclear Physics in 1981. The evaluation for A = 16 is in progress.

G.18 US NUCLEAR DATA NETWORK

Please refer to the Nuclear Physics Branch, Idaho National Engineering Laboratory; Isotopes Project, Lawrence Berkeley Laboratory; Nuclear Data Project, Oak Ridge National Laboratory; National Nuclear Data Center, Brookhaven National Laboratory; Photonuclear Data Center, National Bureau of Standards; and the University of Pennsylvania.

U.S. GOVERNMENT PRINTING OFFICE: 614-090-#59