NUCLEAR ENERGY AGENCY NUCLEAR DATA COMMITTEE

SUMMARY RECORD OF THE
TWENTY-SEVENTH MEETING
(TECHNICAL SESSIONS)
LOS ALAMOS, NEW MEXICO, USA
SEPTEMBER 26-30, 1988

Compiled by
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TWENTY-SEVENTH MEETING OF THE NEANDC
LOS ALAMOS, NEW MEXICO, USA - 26-30 SEPT. 1988

TECHNICAL SESSIONS

A. Relations with Other Committees

1. Report from NEANDC Observer at the 30th Meeting of the NEACRP

The 30th NEACRP meeting was held at the Technical Research Centre, Helsinki, Finland, from September 14 to 18, 1987. The NEANDC observer at the meeting was H. Condé, who gave the following report:

Report from the NEANDC

The work of the NEANDC was reported by the NEANDC observer, in particular, the status of the task force activities and the High Priority Request list, the facility resources and manpower problem, and the publication of new volumes of the monographs. The proposals from the 26th NEANDC meeting on new task forces and an overlapping meeting of the NEANDC and NEACRP, with some joint sessions, were also reported and discussed.

High Priority Request List

The NEACRP agreed to the procedure adopted by the NEANDC, which states that items should only be deleted from the request list after the results of evaluation are available and with the agreement of the NEACRP. In general, it was noted that progress is slow due to the specific manpower situation and the fact that emphasis in the neutron data measurements has shifted gradually towards data for fusion applications.

NEANDC Task Forces

The NEACRP members had a very positive attitude to the NEANDC task force activities and were anxious to get the response from the $^{56}$Fe and $^{238}$U task forces.

The proposal from the 26th NEANDC meeting to set up a task force to solve the outstanding problems in decay heat calculations, which was addressed and specified at the Studsvik Meeting on Decay Heat Predictions, was discussed and endorsed by the NEACRP. Additional data issues were discussed but no further topics for NEANDC task forces were proposed.

Delayed Neutron Data

Recent analysis of several integral $\beta_{\text{eff}}$ measurements, performed at ANL and SNEAK in fast critical facilities, indicate that somewhat high delayed neutron data for both $^{238}$U and $^{239}$Pu are needed to get calculation/experiment agreement in $^{238}$U/$^{239}$Pu and $^{238}$U/$^{235}$U systems. Further integral validation of recent delayed neutron data was recommended for the next NEACRP meeting to shed light on the discrepancy between integral and microscopic estimates in $\beta_{\text{eff}}$. The NEA secretariat was asked to acquire from Rudstam et al. a set of delayed neutron data for these calculations.

Joint Meeting of NEANDC/NEACRP

The proposal from the NEANDC to the NEACRP for a joint meeting in the fall of 1988 was discussed. The NEANDC proposal stressed the problems associated with the possible loss of key expertise in the fields of nuclear data and reactor physics, and suggested more interactions between the committees in, for example, defining future data task force activities.
The NEACRP members also expressed concern with the loss of key expertise but could not identify any productive response to this issue. It was felt, however, that adequate communication between the two committees already exists. In addition, the NEACRP had a previous, informal commitment to hold the 1988 NEACRP meeting in Japan. Based on these considerations, the NEACRP decided that a joint meeting in 1988 was not justified.

**Topics for the 1988 NEACRP Meeting**

The NEACRP decided on topics to be discussed at its next meeting in Japan, October, 1988. Several of these items involve data problems and thus are potential subjects for joint NEANDC/NEACRP undertakings:

1. Validation of Fission Product Data.
2. Integral Validation of Recent Delayed Neutron Data,
3. Advanced FBR Core Design Studies,
4. Physics Aspects of Transuranium Burning by Reactors and Accelerators,
5. Gamma-Energy Deposition (Critical Experiments, Power Reactors, Gamma-Production Data, etc.),
6. Monitoring of Actinides—Physics Aspects,
7. Calculation and Measurements of Void Coefficients.

**Election of Committee Officers**

The NEACRP elected new officers for the upcoming mandate time period, as follows:

- **Chairman:** K. Shirakata, Japan
- **Vice-Chairman:** P. Wydler, Switzerland
- **Secretary:** F. McDonnell, Canada.

Following Condé’s report, Salvatores pointed out that a proposal will be made at the next NEACRP meeting for a joint international measurement of β_{eff} that should serve as a benchmark for validating new evaluation files. Condé mentioned that faulty Pn values are apparently also part of the problem.

A question was raised as to whether the NEACRP fully understood that our proposal was not really for a joint NEANDC/NEACRP meeting but rather was for a scheduling of our two meetings at the same general location with some overlap in time so that we could have one or two joint sessions during the meetings.

The Chairman inquired as to the last date that the High Priority Data Request List had been updated by the NEACRP and whether there are plans for a new update. J. Rowlands replied that the last update was in 1983 but that in fact the request list is some 10 years old with a few revisions. Rowlands added that he has made a partial update of the request list which he will distribute at the present meeting. The Chairman also inquired as to whether the NEACRP addresses the question of fusion data requests. It was pointed out that while the High Priority Data Request List does include some fusion data requests, they have come through other channels.

S. Igarasi agreed to serve as the NEANDC observer at the upcoming NEACRP meeting in Japan (Action 2). Chairman Smith agreed to write a letter to the Chairman of the NEACRP, Dr. Shirakata, informing him that S. Igarasi will serve as the NEANDC observer at the upcoming NEACRP meeting in Japan (Action 3).

**2. Other NEA Committees**

There were brief comments on NEA Safety and Waste Management Committees but the discussion was deferred to the NEA Data Bank report.
3. National and Regional Committees

i. Japan

S. Igarashi reported on activities of the Japanese Nuclear Data Committee (JNDC). The JNDC was convened twice since the last NEANDC. In addition the Steering Committee met some ten times to discuss future activities of the INDC, to examine the JENDL-3 activity, to advise the JAERI/NDC and, in particular, to discuss preparations for the Mito Conference.

The second version of the JNDC Fission Product Decay Data Library is almost complete. Calculated results using this library show good agreement with the experimental data from ORNL and Tokyo University. Mass-chain evaluations for $A=119$ and 121 are almost complete, and the $A=117$ evaluation will be completed this month.

A seminar on nuclear data was held on November 12 and 13, 1987, at the Tokai Research Establishment of JAERI. The main theme of the seminar was JENDL-3. A total of some 36 papers were presented, including several interesting review papers. The proceedings were published as JAERI-M 88-065.

ii. U.S. Nuclear Data Committee

S. Whetstone reported that the U.S. Nuclear Data Committee has its annual meeting last April. He noted that his activities within DOE have moved from Basic Energy Sciences to the Nuclear Physics sector of the DOE organization and budget. A review of the U.S. nuclear data program is planned but the review committee has not yet been appointed.

4. International Committees - INDC

J. Schmidt reported on activities of the International Nuclear Data Committee. The most recent meeting was held in Beijing, China, on October 19-23, 1987. The INDC meetings remain on the schedule of one meeting approximately every 18 months, with the next meeting scheduled for June 26-30, 1989, in Vienna.

A detailed, written summary of the Beijing INDC meeting was distributed by Dr. Schmidt, so he limited his discussion to highlights of the meeting, as follows. He reported support by the INDC of the remaining nuclear data activities in the fission reactor area, as well as the growing areas of geophysics, safeguards, medicine, and fusion. Concern was expressed by the INDC on the growing number of meetings in the nuclear data area that the IAEA sponsors. Following a formal proposal from the Scientific Advisory Committee of the Agency last December, the number of meetings was reduced by six. Dr. Schmidt mentioned that the Agency is sponsoring a new project referred to as the International Thermonuclear Experimental Reactor (IETR) project. Short term needs for the project include atomic and nuclear data. An attempt is being made to compile a library of selected evaluated nuclear data, which will be called the Fusion Evaluated Nuclear Data Library (FENDL), and concern was expressed by the INDC that the Nuclear Data Section (NDS) might not have the manpower needed to carry out this project.

Considerable discussion occurred at the Beijing INDC meeting regarding the transfer of nuclear data and applied nuclear technology to developing countries. The INDC recommended that more fellowships be made available for visits to developed laboratories, particularly for the purpose of nuclear data evaluation. Dr. Schmidt commented that some 6 or 7 fellowships are provided now. Regarding coordinated research programs and research coordination meetings, the committee recommended better coordination with NEANDC-sponsored meeting as well as better use of joint meetings.
On the subject of conferences and symposia, there are altogether four meetings scheduled this year and next celebrating the 50th year of nuclear fission. The INDC recommended that the IAEA cooperate in the organization and execution of the International Symposium on the Physics and Chemistry of Fission (Gaussig, 14-18 November 1988). At that time insufficient information was available regarding the conference at the National Institute of Standards and Technology at Gaithersburg, Maryland, the conference in Leningrad, USSR, and the conference at the Hahn-Meitner Institute in Berlin to decide upon IAEA cooperation. Since that time, however, it was decided that the three latter conferences all satisfy the criteria for IAEA cooperation and expect that status to be granted to all. The INDC recommended that the next U.S. nuclear data technology meeting be held in 1990, so as to maintain the biennial cycle of conferences (U. S. in 1990, Kiev in 1992, and Europe in 1994).

Regarding the WRENDA 1987-88 request list, the decision was made to limit the list to fission, fusion, and safeguards data requests in order to avoid making the list too extensive. As a result the requests for medical data, actinides decay data, and fission yields are kept separate in the newly released version of WRENDA.

The existing three-year term of the INDC will be completed at the end of 1988, so nominations have been invited from member states for the INDC term covering the next three-year period, 1989-1991. Serious consideration is presently being given by the IAEA as to how the agency's programs should be reviewed in the future. It is felt that because of the growth of the agency in many areas, it is too large a task to ask the present Scientific Advisory Committee to oversee everything. There are, however, a number of other special committees, such as the INDC, that might be asked to take an expanded role. The outcome of these considerations is not known at present, but the INDC is expected to continue with at least its present responsibilities for review of the nuclear data program.

Some discussion followed Schmidt's report concerning the considerations/review of the IAEA and of the location and date of the next nuclear data conference. Regarding the latter, Whetstone pointed out that ORNL has volunteered to host the next conference in Knoxville, Tennessee, provided the conference can be held in 1991 rather than 1990. H. Vonach commented that he felt 1990 was too soon to have the conference and that 1991 was a better time scale. Further discussion was deferred to the Meetings Subcommittee (see Sect. II.1.6 and Appendix 10).

B. Reports of Data Centers

1. NEA Data Bank

The verbal report from the NEA Data Bank was given by N. Tubbs. The complete report is included as Appendix 1. In his report, Tubbs emphasized CINDA and the question of funding, particularly if an archival issue is to be published. It was pointed out that the use of on-line services are not as common with the NEADB as with the NNDC at Brookhaven. The activities of the data center in the areas of decay heat, charged-particle, and medium energy nuclear data were discussed, as well as new efforts in the compilation of chemical-thermodynamic data. In the case of nuclear structure and decay data, the NEADB obtains a file from the NNDC and distributes it. Charged-particle and medium-energy data are accepted but are not part of the official compilation. The chemical-thermodynamic data is compiled in an EXFOR type data base. There is also an evaluation effort that is structured in a manner similar to JEF and is functioning smoothly.

In the discussion following the verbal report, S. Whetstone inquired about the entry in the written report (App. 1, item 18), which states that the data bank has had difficulty acquiring the latest versions of nuclear model codes. Tubbs replied that this has been a problem in the past but that a number of the needed codes were obtained from participants at the March, 1988, IAEA workshop in Trieste. Whetstone pointed out that this matter was discussed at the last USNDC meeting and that steps have been taken to facilitate the distribution of codes.
2. IAEA Nuclear Data Section

The complete report from the IAEA Nuclear Data Section is included as Appendix 2. J. Schmidt gave a brief verbal report at the meeting summarizing some of the activities. The experimental data compilation, EXFOR, now has some 60,000 data sets with 12.5 million records. The NDS continues to convene meetings of the data centers and to provide continuity in the use and interpretation of the experimental data compilation rules, especially as concerns new data types. Regarding CINDA, supplements are now only published once a year rather than the previous twice yearly rate. Earlier the four centers, with agreement by the NEANDC and INDC, had planned to publish a final archival edition in 1990. This plan has been abandoned due to the excessive expense of implementing it, particularly in view of the fact the NNDC will have to limit its support of CINDA books publications after 1990. That is, the last publications of conventional CINDA books will occur in 1989 and 1990. The difficulty of providing CINDA access to developing countries who do not have on-line access to Vienna was discussed, and Schmidt mentioned the possibility of providing CINDA updates or supplements on floppy disks or diskettes in lieu of the archival issue. An extended discussion occurred regarding the termination of the CINDA book publications. Concern was expressed by a number of members regarding this situation, but it was generally accepted that individuals with network access to one of the data centers could still obtain new CINDA information. The main impact will be felt by scientists who do not have such access. An action was placed on the next NEANDC Chairman (Action 12) to insure that the long-range question of data compilation and publication (for example, CINDA) is on the agenda for the next NEANDC meeting.

It was noted that the lectures from the recent Workshop on Applied Nuclear Theory and Nuclear Model Calculations for Nuclear Technology Applications, held in February and March of 1988 at the International Centre for Theoretical Physics in Trieste, will be published by World Scientific Publishing Co. of Singapore.

Regarding structure and decay data, CRP’s were held on gamma-ray standards for detector calibration and on transactinide decay data. The NDS continues to coordinate the nuclear structure and decay data network, and the operation continues to run smoothly. Due to the enormous effort required, the compilation of charged-particle data remains a limited activity. Recently, Japanese and Chinese data groups have begun to make significant contributions in the charged-particle data area. The Russian group at Kurchatov Institute of Atomic Energy in Moscow continues to make a significant contribution to charged-particle data compilation. The NDS is attempting to coordinate the compilation and evaluation activities of charged-particle induced radioisotope production data at the Russian, Chinese, and Japanese centers.

In the medium-energy data area, the NDS has initiated a new CRP on neutron data for radiotherapy. Agreement has been reached on measurements and evaluations to be done on tissue material to 100 MeV. Schmidt mentioned that medium energy programs are underway at Los Alamos, Brookhaven, and in the Soviet Union.

3. U.S. National Nuclear Data Center

The complete report on activities of the NNDC at Brookhaven National Laboratory is attached as Appendix 3. A verbal report was given by C. Dunford.

Dunford reminded the committee that the new issue of the book of curves is now available, "Neutron Cross Section Curves," Volume 2 of Neutron Cross Sections, published by Academic Press. New features of the book include more use of grids on the graphs and a more careful presentation of isomer-production cross sections. Regarding the nuclear structure activity, the five-year cycle that was requested has not been met, and this situation is largely accepted by the U. S. community. Dunford commented that the NNDC is encouraging more use of their on-line data retrieval service. The NNDC has been very active over the past few years in developing this service. The last major file that needed to be implemented was the EXFOR data base, which has
been completed. Additionally, the center is now working actively to make graphical displays available through the on-line system.

Regarding charged-particle data, the NNDC had a visitor from China who worked on compilation for 15 months. Otherwise, there has been little activity. The NNDC is attempting to arrange for a Japanese visitor who would work on charged-particle and medium-energy data compilation.

4. JAERI Nuclear Data Center

A written report describing activities at the JAERI Nuclear Data Center was provided by S. Igarasi and is included as Appendix 4. Dr. Igarasi also gave a brief verbal report. All items discussed are included in the written version, with the main subject during the 1987 fiscal year being the benchmark testing of the JENDL-3 data file. The tests cover fast and thermal reactors, fusion neutronics, and shielding calculations. Because the tests have revealed some problems, particularly for fast reactors, the testing and evaluation activities are continuing.

C. Model Codes

The Chairman commented on problems with nuclear model codes. He cited differences in charged-particle production cross section calculations in a recent code comparison activity sponsored by the NEADB, and pointed out that documentation is lacking for some of the major model codes in common use. He mentioned that there is only one optical model fitting code in the world that includes calculations of compound nucleus and nuclear temperature contributions in a fit. He commented that the major code used in coupled-channel calculations, ECIS, is undocumented. Finally, he recommended that the situation with model codes might be a good topic for a task force study.

In the discussion that followed, Dunford pointed out that it is almost impossible to fully document a major code before it is outdated by an improved version. Young commented, and was supported by Perey, that probably the best way to learn to use a major code is to spend some time with an expert in its use doing specific calculations. Michaudon suggested that one approach that could be taken would be to establish by peer review which of the existing codes used for a particular purpose is the best and to then devote the necessary manpower needed to document that code. Furthermore, he commented that documentation can be divided into three steps: (1) a simple user description that describes how to use a code; (2) a general description of how the code works; and (3) a detailed description of the theory and methods used in the code. Items (1) and (2) are very important for the use of a code and do not require a great deal of effort to produce. The Chairman recommended that the matter be further considered under the agenda item on task forces.

D. Reports of National Evaluation Efforts

1. Japanese Evaluated Nuclear Data Library (JENDL)

The status of the JENDL-3 data library was discussed earlier in the meeting by S. Igarasi and is given under Section II.B.4 and in Appendix 4.

2. Evaluated Nuclear Data File (ENDF/B)

C. Dunford reported on the status of work in the U. S. on Version VI of ENDF/B. Dunford stated that processing of preliminary files of ENDF/B-VI data has begun and a meeting is scheduled in December at Oak Ridge National Laboratory for checking and testing the data received to date. A second review session is scheduled for the main meeting of the Cross Section Evaluation Working Group (CSEWG) in March at Brookhaven. At that meeting the major actinide evaluations will be presented, and Phase 2 (integral) data testing activities will be initiated. If all goes according to schedule, the release of initial files of ENDF/B-VI data should begin in the fall of 1989. Because of the requirements for integral data testing, the major actinide evaluations will be
the last materials to be released. Dunford pointed out that a review of fusion-related evaluations will be given in a paper by Dunford, Larson, and Young at the American Nuclear Society Topical Meeting on Fusion in October at Salt Lake City, Utah.

In response to a question by Vonach, Dunford stated that future work in the ENDF/B system will be directed at improving those data files not included in the first release of Version VI, and they will be issued as mods or supplementary releases of ENDF/B-VI.

3. Joint Evaluated File (JEF)

M. Salvatores summarized the situation regarding work on the European JEF data base. Essentially, the evaluation work for JEF-2 is progressing satisfactorily on the schedule foreseen. In particular, part of the data base will be ready by the end of 1988 in order for benchmark calculations to begin. Release of the JEF-2 data file is planned for the middle of 1989. A paper describing the benchmarking of the earlier JEF-1 file was distributed. The same benchmarks will be used to test the JEF-2 evaluations.

In response to a question from Whetstone, Salvatores stated that JEF-2 will not satisfy all the European data needs. When JEF-2 was planned, it was realized that it would not be practical to complete evaluations for all materials on a reasonable time scale, so additional work is contemplated past JEF-2. Following a question by Schmidt regarding the relation between JEF and the EFF file, Salvatores responded that EFF is directed at fusion interests but there is a great deal of commonality and overlapping between the two files. That is, in many cases the same evaluations appear in both files.

4. INDC Evaluation Activities

J. Schmidt reported on evaluation activities at the IAEA. He stated that, at the instigation of the Fusion Council of the IETR project, the first meeting concerning development of the Fusion Evaluated Nuclear Data Library (FENDL) was held in Vienna in November, 1987. The major conclusion of the meeting was to put the FENDL library together using evaluations from five major projects: ENDF/B-IV, ENDF/B-VI, EFF, JENDL-1, and ENDL. It was decided to pursue benchmark testing of the library, as documented in the report INDC(NDS)-201 (January, 1988). An important aspect of the meeting was to decide which evaluations will be taken from each of the files, when they will be due, and who will be responsible for their review. All evaluations will be in ENDF/B-VI format. In addition to being a file of general purpose data for fusion applications, FENDL will include the REAC activation data library, the IAEA dosimetry reaction data file which will be updated by Vonach's institute, an evaluated charged-particle data library, and a photon interaction data file. At this point only an informal agreement exists between the IAEA and IETR. The present schedule calls for the first review of the FENDL in May, 1989. Compilation and comparison of the various data files has begun in Vienna.

5. International Cooperation

This was a second preliminary discussion prior to the first meeting of the Evaluation Subcommittee that was formed in the Executive Session under Item I.G above. During this discussion the representatives of the three major evaluation groups gave opening statements as to the attitudes, expectations, and goals for achievements through the international evaluation cooperation effort.

i. JEF

M. Salvatores gave a brief presentation as representative of the JEF community. He began by summarizing the actions that led to the present meeting, mentioning the initiative taken at the previous NEANDC meeting, the resulting letters to the three evaluation groups from the Chairman, and the responses and proposals from the various groups. As concerns JEF, the matter was discussed at several scientific coordination meetings and a very positive view emerged. The result
was a preliminary proposal that began the discussions in detail, which were then continued at the Mito Conference.

The perspective from the JEF point of view is the following. The year 1989 is viewed as a turning point. Although some activities will still be underway such as continued testing, by the end of 1989 most of the work in setting up the JEF-2 data file will be complete. As with the other evaluation groups, difficulties and technical problems have been encountered in developing the file that, primarily due to the manpower limitation, have not been completely resolved. As a result, there will still be a need for improvements after the file is issued in 1989. Because of manpower limitations, an international, cooperative approach to addressing these and similar problems encountered elsewhere appears attractive. The best way to achieve this cooperation would be to expand upon existing, lab-to-lab collaborations, which have been very successful, and to make them more global. It was felt that this could be best achieved by utilizing the existing framework involved with the NEANDC, NEACRP, and NEADB, and to only consider expansion of this framework on a longer time scale. A short term objective would then be to begin the cooperation within the boundary conditions that presently exist for the evaluation groups and to attempt to improve what has been achieved thus far. Longer term objectives can be broader and will naturally evolve as time goes on. To begin this process, it is suggested that a Task Force be set up in the NEANDC/NEACRP/NEADB framework to decide how this international cooperation should work. It is thought that within one year from now, we should have a realistic plan in place so that global collaborations can be initiated.

ii. ENDF/B

C. Dunford addressed the international evaluation cooperation question from the ENDF/B perspective. He commented that he felt it essential to establish a cooperative approach to evaluation problems over the next year because of the inability of our separate programs to solve all the problems. Especially, it is important to establish a mechanism that will demonstrate we can improve upon what we have been able to do in the past. The important things that we need to address are (1) what are our goals for this activity; (2) what is the framework we need to accomplish them, and (3) how to implement this framework.

In response to an inquiry by Michaudon, Dunford elaborated as to what might be achieved through evaluation cooperation. Dunford felt that an overall goal was simply to improve our capabilities for doing evaluation work by broadening the expertise base. A logical outcome of such cooperation should be that differences between evaluations in the various systems should diminish, and in fact some evaluations will become essentially identical. For the foreseeable future, it is likely that the individual systems will continue to exist, but they will tend to converge in technical content.

iii. JENDL

S. Igarasi presented the views from the JENDL community regarding international cooperation with evaluations. Although international cooperation is widely regarded as potentially useful, the problem is how to plan and implement such plans by common consent among three separate groups. The situations with each evaluation group are different. While JEF is a common, voluntary file of the NEA countries, both JENDL and ENDF/B are national files developed with their countries support. As regards JENDL, its plans are aimed at future needs for nuclear data, and it is especially favorable to participate in a cooperative plan. On the other hand, we would like to avoid developing an international common file that is too closely tied to fast or thermal fission reactors, because the result will probably be similar to existing files and will reduce our other activities in data evaluation.

A reasonable and practical cooperation is to exchange information and data even in the preliminary stages of evaluations. The JAERI/NDC can play a liaison role on the Japanese side for cooperation between scientists and can promote the exchange of information and data. The JAERI fellowship and foreign researcher program can also be utilized as far as possible for this
cooperation. Because nuclear data needs are shifting away from thermal and fast reactors, the objectives of our cooperation must be future data needs, including fusion neutronics applications. Additionally, it would be desirable to promote cooperation on topics that will attract the interest of young scientists and students.

E. Meetings - Initial Discussion

An initial discussion was held prior to the meeting of the Meetings Subcommittee, primarily to discuss conferences and meetings held since the last NEANDC meeting.

H. Condé reported on the NEANDC/NEACRP Specialists' Meeting on Data for Decay Heat Calculations held in Studsvik. The proceedings from that meeting have been issued. One of the main outcomes of the meeting was a proposal to form a task force on decay heat. Additionally, a proposal was made to both the NEANDC and NEACRP for an intercomparison of decay heat inventory calculations, and this proposal has already been approved by both committees. The benchmark calculational exercise is being coordinated by the NEADB. In conjunction with the decay heat meeting, there was a second meeting at Studsvik arranged by the IAEA on the subject of fission yields. The main outcome of the second meeting was a proposal to form a CRF on fission yields. The task force proposal is discussed further under Agenda item G below on Task Forces.

H. Vonach reported on the NEANDC Specialists' Meeting on Preequilibrium Theory, which was held in February, 1988, at Semmering. Basically the meeting provided an overview of the status of experiments and theory in the area of preequilibrium theory for incident light particles in the energy range 10-100 MeV. Some 45 scientists attended the meeting, with approximately 10 coming from non-NEA countries. The proceedings from the conference have been issued. One of the main problems identified at the meeting is the poor state of preequilibrium calculations for emission charged particles in light particle reactions. The Chairman commented that the meeting was very informative and thanked Vonach on behalf of the Committee for a very well-planned meeting.

S. Igarasi summarized the International Conference on Nuclear Data for Science and Technology, held in Mito, Japan, from May 30 to June 3, 1988. A total of 289 scientists from 30 countries and 3 international organizations participated in the conference. The total number of papers presented was 262, including 33 invited papers. Approximately 86 papers described neutron experimental results, and some 100 presentations gave non-neutron experimental data. The proceedings from the conference are expected to be issued around the beginning of November, 1988. All the NEANDC members who were able to attend the conference agreed that it was very well organized and executed, and was a most valuable contribution to the nuclear data field. The Chairman expressed the appreciation of the Committee to Dr. Igarasi for his effort in arranging the conference.

Other meetings discussed included the ANS Reactor Physics meeting held last week at Jackson Hole, Wyoming, and the NEACRP Specialist Meeting on Cross Section Adjustment from Integral Experiments, also at Jackson Hole. J. Schmidt summarized relevant IAEA-organized meetings since the last NEANDC meeting. Four conferences on the 50th anniversary of fission were briefly discussed, and the general complementarity of the meetings was noted. The Chairman pointed out that a conference commemorating the 50th anniversary of the successful operation of the first fission reactor will be held in 1992 in Chicago, under the auspices of the University of Chicago and the American Nuclear Society.

F. Manpower

K. Böckhoff discussed the status of the Manpower Report. Minor modifications have been made since the last NEANDC meeting, mainly involving separation of the various international components. The final version of the report is NEANDC A230 / NEACRP A860, dated June 1988, and was distributed to the NEANDC prior to the meeting. The report was accepted by the
NEANDC, and the appreciation of the Committee for a very fine effort was expressed to Dr. Böckhoff.

Following Böckhoff's report, discussion centered on the question of the best manner for the Committee to follow up on the manpower study. It was generally agreed that the manner in which the dwindling manpower in the nuclear data area can be best utilized is through closer international cooperation. An ad hoc subcommittee on Interlaboratory Working Groups, to be chaired by K. Böckhoff, was formed to discuss this issue further and to report back recommendations to the full Committee.

G. Task Forces

1. Task Force on $^{56}\text{Fe}$ 1.15-keV Resonance

F. Perey reported on the status of the $^{56}\text{Fe}$ Task Force. As indicated at the Rome NEANDC meeting, the general consensus of the task force members is that the basic source of the $\Gamma_\\gamma$ discrepancy is the use of an incorrect response function in analyzing capture measurements. The problem is thought to be caused by the creation of electrons in the environment of the detector and from the source. The possibility of performing improved calculations of these effects was investigated. Improved calculations of response functions and new measurements have been made, with the result that the extent of the discrepancies is now considerably narrowed. It is not possible, however, to make a general statement covering all such experiments for all nuclides, as the effect is gamma-ray-spectrum dependent.

The task force has agreed that a final report can now be written. It is not planned to include all the details of the work but to give a fairly concise overview of the work with emphasis on the task force conclusions. Perey accepted an action (Action 13) to prepare a final report for the $^{56}\text{Fe}$ task force by January 1, 1989. Recommended values for the 1.15-keV resonance will be included in the report, together with any conclusions regarding the nature of the problem that are agreed to by the participating laboratories. With completion of the final report, the $^{56}\text{Fe}$ Task Force will be terminated. The NEA Data Bank reaffirmed their agreement to an action (Action 14) to publish the $^{56}\text{Fe}$ task force report as a wide-distribution NEANDC(U)/NEACRP(L) report.

2. Task Force on $^{238}\text{U}$

M. Sowerby presented both oral and written reports on the status of the $^{238}\text{U}$ Task Force, with more details being given in the paper (IA04) at the Mito Conference by Sowerby and Corvi entitled "Matters Related to the NEANDC Task Forces on $^{238}\text{U}$ and $^{56}\text{Fe}$ Resonances." A summary of the status of the task force is as follows:

i. The discrepancy in neutron widths has been shown to be due to the experimental resolution functions being wider and more complex than experimenters assumed;

ii. A new analysis taking into account the lessons learned by the task force is in progress and will give parameters up to 10 keV. This work is described in the paper "$^{238}\text{U}$ Resolved Resonance Parameters" by M. C. Moxon, M. G. Sowerby, Y. Nakajima and C. Nordborg, presented at the Jackson Hole Reactor Physics Conference, Sept. 18-22, 1988. The work of the task force will not be considered complete until the new parameters are available, at which time work will start on the task force report;

iii. The new resonance analysis makes use of the high resolution capture measurements of R. L. Macklin et al., ORNL/TM-10666 (1988). However, there appears to be problems with the normalization and background of these data, which are currently being investigated. Unfortunately it will not be possible to take account in the analysis of the recent high-resolution transmission measurements of Harvey et al. (Mito Conference, Paper CA04) due to time limitations;
iv. The problem of the $^{238}\text{U}$ capture cross section appears to be partially resolved. Improved evaluations by Poenitz (part of the ENDF/B-VI standards evaluation) and Fröhner ("The Unresolved Resonance Range of $^{238}\text{U}$," Jackson Hole 1988 Reactor Physics Conference) have produced data sets that are consistent with integral measurements in fast reactors. However, the spread between the differential measurements is still large, and there remains a need for better differential capture measurements that emphasize new approaches and minimize corrections. The resonance analysis of the Macklin et al. data leads to average capture cross sections that are higher than the evaluation of Poenitz between 4 and 10 keV. When the final resolved resonance analysis is completed, it will be possible to better assess the accuracy of the Poenitz evaluation;

v. It is planned to complete the resolved resonance analysis by the end of 1988 in order to meet the deadlines of the JEF-2 project.

In the discussion that followed, it was pointed out that a separate analysis is being performed by Roger Macklin at Oak Ridge, which will provide a check of the task force results. Sowerby accepted an action (Action 15) to prepare a final report for the $^{238}\text{U}$ Task Force before the next NEANDC meeting. The NEA Data Bank reaffirmed their agreement to an action (Action 16) to publish the $^{238}\text{U}$ task force report as a wide-distribution NEANDC(U)/NEACRP(L) report.

To summarize, the time scale for completion of the task force work is to complete the resonance analysis by the end of 1988, to incorporate the results in the JEF-2 evaluation by April, 1989, and to complete the task force's final report by the next NEANDC meeting.

3. Possible New Task Forces

An extended discussion was held on the possibility of setting up a new task force on decay heat, as recommended by the Studsvik NEANDC/NEACRP Specialists' Meeting on Data for Decay Heat Predictions (see agenda item II.E above). In the recommendation from Studsvik, it was recognized that the discrepancy in $^{239}\text{Pu}$ decay heat is only part of a larger problem involving discrepancies between integral measurements for $^{235}\text{U}$, $^{239}\text{Pu}$, and other fissioning systems, as well as discrepancies between integral measurements and summation calculations of decay heat. The Specialists' Meeting recommended that a task force consider all these problems and try to:

i. Resolve differences between various input data;
ii. Resolve differences between various integral measurements;
iii. Resolve differences between calculations and experiments, or, if this does not seem possible with present knowledge;
iv. To suggest further experimental and theoretical work leading to the resolution of the differences;
v. Consider not only total decay heat but also the separate beta and gamma-ray components and their spectra;
vi. Include sensitivity studies in addressing the problems.

During the discussion it was noted that such a task force would complement the IAEA CRP on Fission Yields that resulted from the Studsvik (IAEA) meeting, as well as the NEANDC/NEACRP benchmark intercomparison of decay heat calculations. It was generally concluded that the NEACRP should have a strong interest in the decay heat question. Much of the discussion centered on the question of whether the decay heat problem is too broad to be effectively addressed by a task force, that is, whether or not the various questions might be better addressed in the framework of a working group. It was mentioned that Duchemin of Saclay is thought to have reported a method for identifying specific nuclides that are important in the decay heat problem.

The final conclusion of the Committee was that the proposal from the Studsvik meeting is too broad for a task force effort as it now stands and must be narrowed and made more specific. To this end, several actions resulted. E. Fort accepted an action (Action 18) to investigate with
Duchemin the question of which specific nuclides have deficiencies in decay data that are causing problems in calculations of decay heat from fissionable nuclides and to communicate the results of his discussions to A. Smith. S. Igarasi was asked (Action 19) to bring the question of the decay heat task force to the attention of the NEACRP at the October, 1988, meeting in Japan. Igarasi agreed to ask the NEACRP's assistance in defining the character of the task force, that is, exactly what should be the aim and goal of the task force, and exactly what questions should be investigated. A. Smith agreed to inform J. LeSage about the possible decay heat task force and to discuss with him the need to narrow the goals and scope of the task force into manageable proportions (Action 20). J. Rowlands was asked to organize a discussion of the possible decay heat task force in conjunction with the November, 1988 JEF meeting and attempt to identify specific questions and issues that might be addressed (Action 21). As part of this action, P. Young agreed to ask T. England if he or some other U. S. representative can attend the JEF meeting.

H. National Laboratory Reports

Because of time limitations, it was not possible to review the various national activities in the nuclear data area. Instead, members were referred to the national progress reports that have been published. Additionally, Chairman Smith invited members to provide the Scientific Secretary with summaries of activities at their laboratories if they wished to have entries in the minutes, and these are included below.

1. Belgium

K. Böckhoff provided a summary of activities at CBNM for the period May 1987 - September 1988.

Data for Fission Reactors

The $^{235}$U eta experiment planned at ILL had to be postponed to October 1988 due to difficulties with the transport of the $^{235}$U samples.

Low-energy fission cross section measurements have been carried out at GELINA between 2 meV and 10 eV for $^{233,235}$U and $^{239,241}$Pu. Except for $^{241}$Pu, the results are published in the proceedings from the Mito Conference. Also published there are the results of the low-energy capture experiment on $^{238}$U.

The extensive simultaneous studies of the fission fragment yields of $^{235}$U(n,f) as functions of M, TKE, θ, and Eα have been terminated and are accepted for publication in Nucl. Phys. (also published in the Mito Conference proceedings). The multi-exit-channel fission model of Brosa et al. has been applied to the distributions measured at thermal energies and results published in Z. Natf. 42a, 1987. Also accepted for publication in Nucl. Phys. are the M, TKE, θ results and neutron energy distribution measurements of $^{252}$Cf(sp.f.). Additionally, the $^{241}$Am(n,f) data obtained between 1 eV and 10 MeV have been published in Nucl. Sci. Eng. 99, 1988.

Investigations on the response functions and efficiencies of C$_6$D$_6$ detectors (important for the solution of the $^{56}$Fe task force problem) have been published in Nucl. Instr. Meth. A 265, 1988, and at the Mito Conference. High-resolution transmission and capture measurements on $^{58,60,61}$Ni are being continued.

A paper on resonance data of $^{52}$Cr+n has been accepted by Nucl. Phys. and a paper on non-statistical effects observed for that reaction was published at the Mito Conference. The $^{93}$Nb(n,n') cross section was determined in collaboration with IRK-Vienna.

Data for Fusion Reactors

The $^7$Li double differential neutron emission cross section measurements have been published in Nucl. Instr. Meth. A 256, 1988, (method) and Nucl. Sci. Eng. 97, 1987 (data).
Similar measurements have been started on $^9$Be and will be continued, probably in 1989. The $^9$Be(n,t) cross section data measured in collaboration with KFA Jülich have been published in *Nucl. Sci. Eng.* 98, 1988. Within that collaboration, the (n,x) cross sections of different Mo isotopes also have been determined by activation measurements. The $^{52}$Cr(n,2n) cross section has been measured in collaboration with IRK-Vienna.

**Underlying Physics**

The data on neutron resonances in $^{28}$Si+n have been further analysed with respect to M1 and E2 transition strengths. Discontinuities in the level spacing of $^{28}$Si+n and $^{32}$S+n have been analyzed and interpreted in terms of doorway structure. The resonances of even lead isotopes have been studied in relation to the occurrence of intruder states.

2. France (Bruyères-le-Châtel)

J. Fréhaut reported that in the field of nuclear data measurements, neutron production cross sections for the reactions (d+$^6$Li) and (d+$^7$Li) have been obtained in the incident energy range between 0.25 and 3 MeV. The existence of a resonance around 1 MeV has been confirmed for $^7$Li. The (p,n) and (d,2n) cross sections for $^{151}$Eu and $^{153}$Eu have been accurately measured in the energy range from threshold up to 12 MeV in cooperation with LLNL. Significant differences have been observed between the two nuclei, which can be interpreted as effects of nuclear deformation.

In the evaluation and theoretical field, the experimental data for $^6$, $^7$Li+d have been interpreted in the framework of a sequential emission model. The fast-neutron-induced fission total gamma-ray energy spectra from previous measurements using a large Gd-loaded liquid scintillator have been analyzed, and original information on the neutron-gamma competition in fission has been obtained. Our fission neutron multiplicity data have been re-analyzed, and the behavior of their variance has been interpreted in the framework of a neutron-gamma competition in the de-excitation of the fragments.

3. France (Cadarache, Saclay, Bordeaux)

A summary was provided by E. Fort covering work at Cadarache, Saclay, and Bordeaux.

The activities for neutron data evaluation and validation are concentrated in the Department for Physics Research (D.R.P.) at Cadarache. The main activity was devoted to $^{239}$Pu evaluation, with the aim to have a complete file available by the end of January 1989. A new set of resonance parameters (E ≤ 1100 eV) has been obtained by H. Derrien in cooperation with ORNL. It is considered as substantially improved with respect to previous publications ((ORNL/TM10098). Partial correlation matrices are given for some energy ranges. A publication has been made at the Mito Conference. For the unresolved range (1 - 30 keV), the work is nearly complete. In the continuum region (30 keV - 20 MeV) (E. Fort), a third version of the evaluation is now available. Integral informations (SUPER PHENIX start-up experiments: critical mass, control rod worth) have been integrated into the evaluation. A publication has been made in *Nucl. Sci. Eng.* 99, 4 (Aug., 1988) concerning $\sigma_p(E)$, which has been recalculated afterwards by making use of the most recent resonance parameters.

The gamma energy (average number of quanta $N_\gamma$, average energy per quantum $\bar{\epsilon}_\gamma$, spectra) released in prompt fission has been evaluated (E. Fort) in a framework of a cooperation with J. Fréhaut (BRC) using a new phenomenological model which establishes an energy dependence for $N_\gamma$ and $\bar{\epsilon}_\gamma$.

The cross section covariance matrices have been established (E. Fort) in cooperation with the NEADB (Saclay) and Dr. Kanda (Kyushu University) by merging experimental and nuclear model information.
For $^{241}$Pu an improved resonance parameter set has been issued (H. Derrien in cooperation with ORNL). The $v_p(E)$ curve has been evaluated (E. Fort) up to 10 eV. The data have been tested against thermal and epithermal integral data by Tellier (Saclay). The $v_p(E)$ curve for $^{235}$U has been calculated using the same formalism without satisfactory results. The work is frozen until the release of a complete analysis of the measurements by Knitter et al. (Mito Conference) indicating a specific origin for the observed fluctuations.

Concerning the basic data validation activity, it should be mentioned that an analysis of the shape of the cross section in the thermal and subthermal ranges has been related with the LWR temperature coefficient (Santamarina - publication at the IAEA Consultant's Meeting, Vienna, 1987). In the department of heat transfer studies (DEMT) at Saclay, there is also a continuing work on cross-section validation for the LWR formulae (H. Tellier). The nuclear constants obtained in the epithermal range from integral parameters of experiments like ICARE, ERAME (S) have proved to be consistent with the thermal values obtained from burned fuel analyses.

In the effort to understand the discrepancies between integral data and summation calculations for cooling times between $10^2$ and $10^3$ sec. for what concerns the gamma component to the residual heating, a method has been developed (Buchemin) to identify the nuclei responsible for these discrepancies. The most important nuclei are: $^{93}$Sr, $^{85}$Y, $^{104}$Tc and above all, $^{102}$Tc. There is an active contribution to the JEF-2 decay file (Buchemin in cooperation with Blachot). For the short-lived nuclei, improved values for the average beta and gamma energies have been obtained by filling the gap between the highest energy known level and the Qβ value with levels belonging to statistical distributions.

In the department of ionizing ray applications (DAMRI) at Saclay, an activity of decay data measurement and evaluation is also developed on specifically targeted applications (medicine, ...). Tables and libraries are released on request.

At the request of fast breeder reactor designers, the Laboratory of Nuclear Physics (OUASTI - Barreau) at Bordeaux Gradignan (Bordeaux University) has measured the yields for $^3$H and $^4$He production in ternary fission for $^{239}$Pu, $^{235}$U, and $^{238}$U in the energy range from thermal to 2 MeV. An extension of the measurement is planned up to 6 MeV.

4. Germany

S. Qaim reported that the experimental nuclear data activities at Julich are continuing in three directions: (1) fundamental studies on trinucleon emission reactions, (2) cross-section data for fusion technology, and (3) data measurements for biomedical applications. Of special interest are investigations of isomeric cross-section ratios as a function of energy, and excitation functions of charged-particle-induced reactions on gas targets. Work on cross section systematics and model calculations is also progressing.

5. Italy

In his summary, C. Coceva reported that a new experimental facility has been set up at the Legnaro National Laboratory near Padova, for the production of tagged neutrons in the energy range from 2 to 32 MeV. The system consists of a gaseous tritium or deuterium target, with identification of the $^3$He or $^4$He associated particle by time-of-flight. The target can be applied either to the 7-MeV Van de Graaff or to the XTU tandem (see Proceedings of Mito Conference).

Spins and ground-state or first-excited-state partial radiative widths of $^{25}$Mg and $^{57}$Fe resonances were obtained at the Bologna threshold photo-neutron facility. Results were presented at the $γ$-ray conference in Leuven. Additionally, a program was written to calculate the characteristics of neutron sources based on low-energy electron accelerators with a deuterium target. Results of the calculations and experimental measurements were reported at the Mito Conference.
At the "Nuclear Data" group in Bologna, calculations have been performed of gamma-ray yields and spectra from neutron capture, and of level densities from a preequilibrium model. Evaluations have been carried out of neutron data of Cr, Fe, and Al for the fusion file. Gamma-ray production data have been evaluated for $^{54,56,57,58}$Fe from 0.1 to 15 MeV. The activity on implementation and development of nuclear data processing codes has continued.

6. Japan

A summary describing nuclear data activities in Japan was provided by S. Igarasi.

Precise measurements of the $^{27}$Al($n,p$)$^{27}$Mg reaction cross sections were made at neutron energy 5.0 MeV and in the range 14.6 to 19.9 MeV by a group at Electrotechnical Laboratory (ETL). They used the Cockcroft type accelerator to obtain the neutrons of 14.6 to 19.9 MeV, and the VdG accelerator for 5.0 MeV neutrons. Aluminum foils of 99.99% purity were used. The $\gamma$-counting method with a pure Ge detector and the $4\pi\beta$-$\gamma$ counting technique were utilized to measure the $^{27}$Mg activity. The resulting data seem to be in agreement with measurement of Ryves but deviate from ENDF/B-V.

Angular distributions of neutron elastic scattering and inelastic scattering to the $2^+$ ($E_x = 1.23$ MeV) and $3^-$ ($E_x = 2.32$ MeV) states of $^{118}$Sn were measured at $E_n = 14.9$ and 18.0 MeV using the JAERI tandem fast neutron TOF spectrometer. Strong forward peaks were observed in the angular distribution of the inelastic scattering cross sections. Final results will be published in *J. Nucl. Sci. Tech.* 25, 511(1988).

Gamma-ray production cross sections of Al, Si, Fe, Pb, and Bi have been measured at $E_n = 7.8$ MeV using the JAERI tandem accelerator and NaI(Tl) detectors. An accurate correction for gamma-rays emitted due to Compton scattering in the sample was made in addition to neutron multiple scattering and gamma-ray self-shielding corrections.

The JAERI Linac was used to obtain resonance parameters of $^{28}$Si. Transmission measurements were made in the neutron energy range between 30 keV and 500 keV with a 56-m flight path and a $^6$Li glass scintillator. The obtained resonance parameters are given in the progress report NEANDC(J)-130/U.

A $^6$Li converter was installed in a large thermal neutron irradiation facility of the Kyoto University Reactor (KUR) to obtain a 14-MeV neutron flux of $2.5 \times 10^5$ n/cm$^2$/sec. Using the 14-MeV neutrons, activation cross sections for 23 reactions were measured relative to the $^{27}$Al($n,$u)$^{24}$Si reaction cross section.

The KUR group measured the thermal neutron cross section and the (n,2n) reaction cross section for $^{231}$Pa using gamma-ray and alpha-ray spectrometric methods following irradiation with purely thermalized neutrons and fission-type neutrons, respectively. They also obtained resonance parameters of $^{232}$Th. Neutron transmission spectra were measured using the linac TOF method and a $^6$Li glass scintillator placed at the 22-m station. The neutron and capture widths for 21 s-wave resonances were obtained.

The number of prompt neutrons ($\nu_p$) as a function of individual fragment mass was measured for the thermal neutron-induced fission of $^{233}$U and $^{235}$U using the super mirror neutron guide tube facility of the KUR. They measured the velocities and energies of two fission fragments simultaneously to obtain fragment masses for pre- and post-neutron emission. $\nu_p$ was deduced from the difference of two fragment masses.

Using proton beams of 19 MeV from the tandem VdG accelerator in Kyushu University, the energy spectra of deuterons from the (p,d) reactions of Mo-92, 94, 96, 98, and 100 has been measured to study shell effect around N=50. Also measured was the (p,p'), (p,d), and (p,$^3$He) reactions of $^6$Li using 14-MeV polarized protons from the tandem accelerator. They compared the results with several nuclear model calculations.
Helium production cross sections of major elements in stainless steel have been measured in Kyushu University by using the helium accumulation method. Samples were irradiated by 14.8-MeV neutrons at OKTAVIAN and FNS. The cross sections were measured relative to the helium production cross section of Al. Analyses are now in progress.

Formation cross sections of short-lived nuclei has been measured in Nagoya University. Measurements of the $^{92}$Mo($n,2n)$, $^{92}$Mo($n,\alpha$), $^{63}$Cu($n,2n$), $^{65}$Cu($n,\alpha$), $^{90}$Zr($n,2n$) and $^{55}$Mn($n,\alpha$) reactions were made by using OKTAVIAN. The cross sections were obtained by the activation method. The gamma rays from the induced short-lived nuclei were measured by a Ge detector. Some results are shown in the Progress Report.

The $^{235}$U($n,f$) cross sections were measured at five neutron energy points from 13.5 to 14.9 MeV in Tohoku University. A newly developed detector was used. The overall uncertainties of the measurement were 2.5 - 2.8%.

Fission cross section ratios of $^{239}$Pu and $^{242}$Pu relative to $^{235}$U were also measured in the energy range from 0.6 to 7.0 MeV using the 4.5 MV Dynamitron accelerator of Tohoku University. A fast-timing, back-to-back fission chamber was used. The overall uncertainty was about 2%. The results for the $^{239}$Pu/$^{235}$U ratio are slightly higher than those of other experiments.

The energy-angle double-differential neutron scattering cross sections for Be, C and O have been measured at 14.1 and 18.0 MeV neutron energies in Tohoku University. The angle-dependent neutron emission spectra for Al, Fe, Ni, Cu, and Zr have been measured at 14.1 and 18.0 MeV. At 14.1 MeV, the measurements were also made for Ti, V, Cr and Mn. Some results were analyzed by using nuclear models.

Measurements of capture gamma-ray spectra of Fe and Ni have been made in the keV neutron energy region by using the 3.2 MV Pelletron accelerator in Tokyo Institute of Technology. The measurements were performed using a TOF method. The capture gamma-rays were detected by an anti-Compton NaI(T1) detector. The observed spectra exhibit strong transitions from capture states to low-lying states.

7. Netherlands

Fission-product nuclear data

As a contribution to the JEF-2 data file (Joint Evaluated Data File) and in cooperation with the NEA Data Bank, some work has been performed to update the fission-product cross-section file. In 1987/1988 the activities were directed towards updating the resolved-resonance ranges of the evaluations. In many cases new resolved-resonance parameters were inserted and corresponding adjustments were made in the data files. The thermal cross sections were checked and, if necessary, adjusted to the most recent experimental values. In a number of cases the maximum energy $E_H$ of the resolved-resonance range was extended. In order to estimate the effect of missed resonances on the $(n,\gamma)$ cross-section just below $E_H$, a code was written based upon a statistical estimate of the number of missed resonances. In a number of cases the calculated corrections need to be inserted as a smooth background cross-section. Furthermore, a code was developed to assign spins to those resonances for which no measured spin values were available. This code was applied to all evaluations. The resulting data file is in accordance with ENDF-VI rules. The multilevel Breit-Wigner formula is applied to all evaluations.

Further work with respect to the updating of inelastic scattering cross-sections of fission-product nuclide evaluations is in progress.
Use of JEF-1 data in the AMPX/SCALE code system

For reactor physics calculations of thermal research reactors the Oak Ridge code systems AMPX-2 and SCALE-3, supplemented with various other codes (e.g. CITATION, ANISIN, TWOTRAN), have been installed at the CDC-CYBER (NOS-VE) system, after translation to FORTRAN-77. The nuclear data libraries are based upon the JEF-1 data file in the same 218-group structure as the ENDF/B-V library included in the SCALE-3 package. As a starting point a JEF-1 based library made at ENEA-Bologna will be used. The processing into AMPX working format is performed by means of the AMPX-2 and NJOY code systems. In the previous case the code MILER developed at Bologna is used for the interfacing. So far this route is only possible for non-resonant cross-sections. More work is necessary to enable the processing of nuclear data stored in the ENDF-V format. In cooperation with IRI-Delft, where the same system has been installed on an IBM-computer, benchmark calculations are performed.

European Fusion File

The European Fusion File (EFF) is designed for neutron and photon transport calculations in fusion reactor technology. The project is part of the European Fusion Technology Program of the European community, to which several laboratories contribute. The file management and maintenance is performed at ECN-Petten.

Since the distribution of EFF-1 in early 1986, some benchmarking of the data file has been performed and various 175-group transport libraries (VITAMIN-J structure) have been distributed among European users. The EFF-1 lead (Pb) file has been released to the IAEA and to the NEA Data Bank for the purpose of benchmark testing.

The EFF-1 file already means a large improvement as compared to the until recently adopted data files based upon ENDF/B-IV. However, further updating is necessary, particularly with respect to the double-differential neutron emission cross-sections in the continuum and consistent differential photon-production cross-sections. Also more work is demanded to create reliable covariance files. The contents of EFF-2 will be the same as that of EFF-1, with some extensions. The EFF-2 file will be supplementary to the JEF-2 file, with emphasis on evaluations for Li, Be, Al, Si, Fe, Cr, Ni, and Pb. The format will be ENDF/B-VI with some restrictions on the use of the rather extensive possibilities. The work is in good progress.

Activation file for fusion reactor

Recently an extensive report on the work made to update the REAC-2 activation file for fusion reactor technology has been issued. It describes the work performed at ECN-Petten under contract with JRC-Ispira. The revisions for this so-called REAC-ECN-3 library were made by means of renormalizations of the cross-sections to experimental data at 14.5 MeV or to data from 14.5-MeV systematics. Uncertainty estimates were given for the systematics. Furthermore, a number of reactions has been added. The file essentially contains cross sections for almost all stable and unstable nuclides with half lives exceeding one day. If a reaction can produce isomers, the cross sections for producing the ground and isomeric states are given separately. New systematics were developed for the isomer ratios. Further work is in progress to update the library, in particular with respect to (n,γ) and (n, n'γ) reactions.

Preequilibrium nuclear reaction theory

An extensive review has been written to summarize the status of recent developments of the exciton model in its master equation formulation. Progress has been made in the modeling and the calculation of angular distributions, γ-ray emission, particle-hole state densities, preformation factors for complex particle emission and two-fermion models. The most interesting development, however, is the integration of precompound and compound models by including angular-momentum conservation. At present this unified model is successful in predicting angle-integrated quantities. It is essentially equivalent to the quantal multi-step compound models, but it has some
computational advantages. The possibilities for further integration of precompound and compound models on a quantum-mechanical basis have also been considered.

8. Sweden

H. Condt provided an update to the Swedish Nuclear Data Progress Report for 1986 [NEANDC(OR)-161/U], primarily regarding experimental facilities.

The Gustaf Weiner 100-MeV cyclotron at the Svedberg Laboratory was first used for experiments in November, 1987. The monoenergetic intermediate energy neutron beam facility has been tested. Three different magnetic spectrometers have been built: one for (n, charged particle) in particular, (n,p) reaction studies; one pair spectrometer for (p,γ) measurements; and, one high-resolution spectrometer for charged-particle reaction studies. A multiparameter detection system has been built for heavy-ion reaction studies. Furthermore, methods and equipment for proton radiation cancer therapy and radionuclide production have been developed.

The first partial injection to the CELSIUS storage ring of a proton beam was made in June, 1988. Runs with uncooled beams are scheduled in December, 1988, and the electron cooling equipment will be installed in March, 1989. Funds have been allocated to equip the cyclotron with an external ECR heavy ion source in 1989 and a polarized ion source in 1990. A subnanosecond pulsing system is also being built.

Average beta energies have been determined in 121 fission products with half-lives between a fraction of second and a couple of hours with the re-designed ion source system of the OSIRIS facility. If one adds the contribution from the well known long-lived nuclides, the experimentally determined data now cover above 90% of the beta heat emitted in nuclear fuel at short cooling times (≤ 100 sec.). A corresponding study of the gamma part of the decay heat is underway. A compilation has recently been made of delayed-neutron branching ratios (Pn values) by E. Lunel for the JEF library.

An integral determination of the beta and gamma heat in thermal-neutron-induced fission of 235U and 239Pu and of the gamma heat in fast fission of 238U have been made. The beta particles were counted with Si(Li) detectors, the gamma rays with a NaI crystal, and the number of fissions were estimated from fission chamber or gamma-ray counting. Results agree with Dickens' experimental data but disagree with summation calculations, in particular for the gamma decay heat of 239Pu.

9. United States

A. Smith gave an oral outline of nuclear data activities at U.S. laboratories, and P. Young provided a short written summary. The summary was based upon the most recent issue of "Reports to the DOE Nuclear Data Committee," BNL-NCS-40911 (May 1988), which contains contributions from some 19 U. S. laboratories.

The largest experimental nuclear data programs are at Argonne National Laboratory, Los Alamos National Laboratory, the National Institute of Standards and Technology, and Oak Ridge National Laboratory, but significant contributions also come from several of the other laboratories. The bulk of the evaluation work for ENDF/B-VI is being carried out at the above four national laboratories, plus Lawrence Livermore National Laboratory, Idaho National Engineering Laboratory, Hanford Engineering Development Laboratory, and Brookhaven National Laboratory.

**Argonne National Laboratory**

Measurements of neutron total, elastic, and inelastic cross sections continue, generally over the range E_n = 1-12 MeV for σ_t and 4-10 MeV for σ_scatt, with some double differential emission data being obtained. Such experiments have been performed with Be, V, Co, 58Ni, Zr, and In targets. Neutron activation measurements have been made of (n,α) cross sections for Co and
$^{54}\text{Fe}$, and integral tests in a Be(d,n) field have been carried out for these nuclei. In the area of integral experiments, efforts have been made to better characterize the Be(d,n) field, and sphere transmission measurements have been made for Be and Nb targets. Additionally, integral tests of $^{238}\text{U}$ neutron-induced fission cross sections have been made in a Be(d,n) field.

In the theoretical area, studies continue of the optical model and dispersion relations, aimed at development of general potentials that characterize bound as well as scattering states. Investigations of covariance matrix properties are in progress, especially the effect of long-range correlations on covariance matrices and the requirement for positive definiteness. Evaluations of neutron-induced reactions are in progress or completed for Nb, Y, V, Co, Zr, Bi, In, $^{58}\text{Ni}$, and $^{238}\text{U}$, many of which will be included in the first issue of ENDF/B-VI.

Los Alamos National Laboratory

Measurements of interactions among hydrogen isotopes over the energy range 10-120 keV are now complete. Results for the $^3\text{H}(d,\alpha)n$ cross section are published [Phys. Rev. C 35, 1999 (1985)], analysis of the $^2\text{H}(d,p)^3\text{H}$ and $^2\text{H}(d,n)^3\text{He}$ data are finished, and analysis of the $^7\text{Be}(t,2n)^4\text{He}$ data are in progress. From WNR, measurements are complete for the $^7\text{Be}(n,p)^7\text{Li}$ cross section from 25 meV to 13.5 keV (to be published in Phys. Rev.); neutron-induced fission cross-section ratios for $E_n = 1-400$ MeV have been obtained for $^{232}\text{Th}$, $^{235,238}\text{U}$, $^{237}\text{Np}$, and $^{239}\text{Pu}$; gamma-ray production data for $^{12}\text{C}$, $^{11}\text{B}$, $^{14}\text{N}$, and $^{15}\text{N}$ have been taken at 5 angles between 40$^\circ$ and 145$^\circ$ for $E_n = 2-25$ MeV and $E_n = 1-200$ MeV; $^{40}\text{Ca}(n,\gamma)$ data have been obtained at 4 angles for $E_n = 2$ to 50 MeV; and proton-induced gamma-ray production cross sections have been measured for C, Al, Fe, and U targets.

New R-matrix analyses have been completed for the $A=5$ and $A=8$ systems. Initial results have been obtained for a global medium-energy nucleon-nucleus phenomenological optical model potential using a relativistic Schrödinger formulation and covering the ranges $50 \leq E_{n,p} \leq 400$ MeV and $27 \leq A \leq 208$. Modeling in the GNASH reaction theory code has been improved to permit calculations at higher energies, and transport libraries to 100 MeV in ENDF/B format have been developed for neutron reactions on $^{16}\text{O}$, $^{27}\text{Al}$, $^{28}\text{Si}$, $^{40}\text{Ca}$, and $^{56}\text{Fe}$, and for proton reactions on $^{12}\text{C}$ and $^{27}\text{Al}$. An evaluation of fission-product yields as well as cross section evaluations of neutron reactions with $^{6,7}\text{Li}$, $^{10,11}\text{B}$, $^{151,153}\text{Eu}$, $^{165}\text{Ho}$, $^{197}\text{Au}$, $^{235}\text{U}$ and $^{239}\text{Pu}$ are complete or in progress for ENDF/B-VI.

National Institute of Standards and Technology

New experimental data for the $^{235}\text{U}(n,f)$ cross section from thermal to 1 keV and for the $^3\text{He}(n,p)^7\text{Li}$ cross section from $E_n = 1$ eV to 750 keV were obtained with the linac accelerator. A collaborative experiment to measure the $^{235}\text{U}(n,f)$ cross section standard in the MeV region was performed with Los Alamos personnel at WNR.

In collaboration with personnel from Idaho Nuclear Engineering Laboratory, Los Alamos, and Oak Ridge, the simultaneous neutron cross section standards analysis for ENDF/B-VI was completed. A new photon interaction cross section data base has been developed covering the photon energy range from 100 eV to 10 GeV. A simultaneous evaluation of kerma and cross section data for $n+C$ is in progress.

Oak Ridge National Laboratory

Experimental results from ORELA include new neutron transmission measurements for $^{86}\text{Kr}$, $^{32}\text{S}$, $^{235,238}\text{U}$ and $^{239}\text{Pu}$, generally covering the keV range or higher in neutron energy. New neutron radiative capture measurements have been made in the keV energy region for...
Neutron-induced gamma-ray production measurements were completed for $^{10,11}$B and $^{53}$Cr for neutron energies between -0.1 and 10 MeV. Additionally, fission-product yields for fast-neutron fission of $^{233,244,246,248}$Cm were experimentally determined.

Theoretical efforts include a new analysis of the n+$^{208}$Pb mean field from -20 to 165 MeV using a dispersion relation constraint. An improved preequilibrium model was implemented in TNG, and statistical/preequilibrium analyses were carried out for neutron-induced reactions on $^{52,53}$Cr, $^{58,60}$Ni, and $^{184}$W. R-matrix analyses with the multilevel Reich-Moore code SAMMY are in progress for $^{235}$U and $^{239}$Pu. In support of the ENDF/B-VI effort, evaluations have been completed or are in progress for $^{50,52,53,54}$Cr, $^{54,56,57,58}$Fe, $^{58,60,61,62,64}$Ni, $^{63,65}$Cu, Pb, and $^{240}$Pu.

Other U.S. Laboratories

At Lawrence Livermore National Laboratory, a method for combining R-matrix and shell model calculations is being developed and applied to light systems (for example, n+$^{14}$N calculations), and investigations of fundamental properties of the optical model continue. Measurements of $\sigma_{\text{inel}}$ for actinide vibrational levels continue at Lowell University, and delayed neutron spectra have been obtained for neutron-induced fission of $^{235,238}$U and $^{239}$Pu. At Ohio University, (p,n) emission spectra have been measured for $\text{E}_n = 6$-8 MeV for $^{59}$Co and isotopes of Fe and Ni; (n,xp) emission spectra have been obtained at $\approx 10$ MeV for Ni isotopes; and neutron scattering data have been taken between 8-24 MeV for even Zr isotopes. At Triangle Universities National Laboratory, neutron scattering and polarization measurements continue ($^6$Li and $^{208}$Pb), as well as investigations of fundamental properties of the optical model and dispersion relations.

I. Subcommittee Reports

1. Evaluation Cooperation

J. Rowlands reported on the meeting of the ad hoc Evaluation Cooperation Subcommittee. In summary, the subcommittee recommended the formation of a joint NEANDC/NEACRP Task Force to consider ways of improving cooperation between the ENDF/B, JEF, and JENDL evaluation groups. Discussion of Rowlands' report centered on how the NEANDC will monitor the activities of the Task Force, and on what the reporting requirements will be. In the end it was decided that the NEANDC/NEACRP members who participate in the Task Force activities will provide the necessary linkage with the parent committees, and the Task Force will formally report to both the NEANDC and NEACRP in one year's time. The subcommittee's report was accepted after minor modification and is included as Appendix 5.

Discussion then turned to the question of the actions that the NEANDC needed to take in order to establish the Task Force. Chairman Smith agreed to contact and inform the Chairman of the NEACRP, Dr. Shirakata, concerning the proposal of the NEANDC to form a joint NEANDC/NEACRP Task Force on International Cooperation with Data Evaluation (Action 9). If the formation of such a task force is approved by the NEACRP and by the JENDL, JEF, and ENDF/B evaluation groups, then Chairman Smith, in conjunction with Chairman Shirakata and in consultation with the heads of the three evaluation groups, will appoint a chairman for the task force (Action 10).

The actual makeup and membership of the task force was next considered. After some discussion it was agreed that we envisioned the task force as being comprised of approximately 9 members: 2 representatives from each of the three major evaluation groups, 1 representative from each of the parent committees, and a chairman. The Committee agreed that we would recommend to the NEACRP that J. Rowlands be chairman of the task force and that H. Vonach be the
NEANDC representative to the task force. Both Rowlands and Vonach were agreeable to these nominations.

Chairman Smith agreed to write a letter to Johnny Rosén asking him to publicize and highlight the International Evaluation Task Force to the NEA (Action 11).

2. Interlaboratory Working Groups

A plenary session of the Interlaboratory Working Groups Subcommittee was held by its chairman, K. Böckhoff. A preliminary proposal for interlaboratory working groups was offered and discussed by Dr. Böckhoff. The main purpose for such working groups is to partially compensate for dwindling manpower by promoting better international cooperation among laboratories. Such working groups would operate at a level beyond NEANDC task forces, that is, they would provide a mechanism to pursue the solution of problems identified by task forces in a more detailed manner. The importance of having well-defined aims for such working groups, to avoid making the process too bureaucratic, and to not eliminate competitive approaches to solving problems were all emphasized. More efficient use of electronic mail was discussed, and the Subcommittee concluded that efforts should be made to facilitate its use at laboratories where it is now difficult. It was agreed that an important function of the NEANDC in setting up such working groups would be to eliminate obstacles to international cooperation.

Some six specific subjects were identified for possible working groups, and two of these were selected for immediate consideration:

i. Capture cross-section data (resonance parameters) of Fe, Cr, and Ni;
ii. Activation cross-section data for fusion reactors.

The complete Subcommittee report and actions are included as Appendix 6.

3. Data of Special Interest

M. Sowerby chaired the meeting of the Data of Special Interest Subcommittee, which was held in a plenary session with the full NEANDC. Much of the meeting was devoted to reviewing the INDC/NEANDC Discrepancy and Data of Special Interest File, prior to submitting it to the INDC for their review and eventual publication by the IAEA Nuclear Data Section. In the discussion that followed, the usefulness of monitoring data discrepancies and having a Subcommittee to keep such a list was reaffirmed; however, in view of our dwindling manpower, the need for a formal report documenting the discrepancy list was questioned. The Subcommittee agreed that, after the present file is published, the matter of any new publication will be reviewed before any formal commitment is made.

The full minutes of the Subcommittee meeting are included in Appendix 7 with a list of the Subcommittee actions.

4. Standards

H. Condé chaired the meeting of the Standards Committee, which was held in a plenary session of the NEANDC. Most of the meeting was spent in reviewing status reports for the INDC/NEANDC Standards File. It was noted that updated status reports have still not been received from all assigned reviewers. Additionally, not all standard files are complete but they should be available soon when the various national evaluations are finished. Condé agreed to produce a first preliminary layout of the file at the next NEANDC meeting. He noted that he had received a positive response from Atomic Data and Nuclear Data Tables regarding publication of the INDC/NEANDC Standards File.

Minutes from the Subcommittee meeting are included in Appendix 8 together with actions on the Subcommittee members.
5. Technical Activities

The Subcommittee on Technical Activities also met in a plenary session of the NEANDC and was chaired by K. Böckhoff. The meeting concentrated on reviewing the High Priority List of Nuclear Data Requirements for nuclear data measurements relevant to fission reactors. Subcommittee actions resulted in the modified request list being communicated to the NEACRP at their forthcoming meeting in Japan. Additionally, the Chairman accepted an action (Action 6) to keep the NEACRP Chairman informed about progress made in measurement programs related to the High Priority List of Nuclear Data Requirements.

A somewhat less detailed review was carried out of the measurement requests relevant to fusion energy. The subcommittee chairman suggested that a more detailed review will be carried out at the next NEANDC meeting.

Minutes from the subcommittee meeting appear in Appendix 9 along with the Subcommittee actions.

6. Meetings

The report from the Subcommittee on Meetings was given by S. Whetstone. During the report some minor corrections were made; the final minutes are included in Appendix 10.

The Subcommittee presented to the full NEANDC a suggestion that a specialists' meeting on "Standard Neutron Cross Sections in the Energy Region above 20 MeV" be considered for NEANDC organization. In the discussion that followed, Condé pointed out that a number of laboratories are pursuing neutron work at energies above 20 MeV, and several possible standard reactions have been suggested, including $^1H(n,n)$ scattering and the $^{238}U(n,f)$ cross section. Because of other meetings already scheduled or proposed for NEANDC sponsorship, it was decided that the earliest time for the proposed standards meeting would be in calendar year 1991, and that a final decision on whether to hold such a meeting would be decided at the next NEANDC meeting. H. Condé agreed to prepare a proposal for a "Specialists' Meeting on Standard Neutron Cross Sections in the Energy Region between 20 MeV and 1 GeV," to be presented at the next NEANDC meeting (Action 22) and to include a recommended date, site, and organizing committee. P. Young agreed to investigate the interest at Los Alamos in the proposed specialists meeting on standard neutron cross sections (Action 23).

During the discussion, attention was again directed to the excellent meetings that were arranged at Semmering and at Mito. The Chairman formally expressed the appreciation of the NEANDC to Prof. Vonach and Dr. Igarasi for arranging these fine technical conferences.

7. Sources

S. Cierjacks reported on the meeting of the Sources Subcommittee. Prior to the meeting, a draft subcommittee report on "Neutron Sources for Nuclear Data Measurements" was distributed. At the subcommittee meeting, a number of comments and suggestions were made which Cierjacks will consider for incorporation into the report. Additionally, he is obtaining comments on the draft from several individuals outside the Committee. The report is expected to be complete by the end of 1988 and will be issued as an NEANDC document.

During the Subcommittee report, Dr. Cierjacks inquired of the full Committee regarding the advisability of including as an NEANDC contribution the part of the above report that deals with white neutron sources in the upcoming special Nuclear Science and Engineering article on neutron sources. After some discussion, the Committee recommended that Dr. Cierjacks author the article himself and simply mention the NEANDC work, with appropriate acknowledgments to individuals
for the contributions he has received. Full endorsement of the Committee will be reserved for the NEANDC report from the Subcommittee.

8. Monographs

A. Michaudon reported on the meeting of the Monographs Subcommittee. Major progress was reported in arranging for a new publisher for the monographs. In particular, informal agreement has been reached between the OECD and ANS whereby the monographs will be published by the ANS with a subsidy from the OECD that will permit the books to be sold for $25 per copy. This agreement is expected to be formalized shortly. Progress was also reviewed by the Subcommittee on three future books: Data Uncertainties (Ed: D. L. Smith), Optical Model (Ed: J. Rapaport), and Charged Particle Emission (Ed: S. Qaim). Full details of the Subcommittee report are given in Appendix 11.

In the discussion that followed a question was raised concerning the possibility that Pergamon Press might object to the new publishing arrangement, particularly if the new books are very similar in appearance to the previous ones published by Pergamon. It was felt that this possibility was very unlikely because the previous contract with Pergamon only called for the publication of three books, which has now been accomplished. Additionally, Pergamon has been given ample opportunity to bid on publishing the NEANDC monographs but has indicated no interest. Finally, the Committee was confident that the ANS legal staff will carefully consider all questions of this nature.

J. Topical Conference

A topical conference on Measurement and Interpretation of Nuclear Data from White Neutron Sources was organized and chaired by P. Lisowski of Los Alamos. The conference was held Sept. 27 in the auditorium of the Physics Building, and the program is given in Appendix 12. The meeting was followed on Sept. 28 by a tour led by Dr. Lisowski of the Los Alamos WNR (Weapons Neutron Research) facility white neutron source, as well as the LAMPF and LANSCE facilities.
APPENDIX 1

NEA NUCLEAR DATA COMMITTEE

Progress Report from NEA Data Bank

September 1988

I. INTRODUCTION

1. The Data Bank's programme of work and finances have continued under intensive discussion in the Steering Committee for Nuclear Energy. A detailed examination of the overall work programme, and the relative importance to be given to the 'traditional' services on nuclear data and computer programs, as compared to the 'priority' activities in nuclear safety and waste management, was made by the 'Wise Men' group in July 1987. Its recommendations, set out in the report NE(87)14, were further examined by a Working Group of the Steering Committee in order to produce financial proposals which could be accepted by the Steering Committee for application in 1989 and beyond. In consequence, savings will be made in the budgets for both the NEA main Secretariat and the new work at the Data Bank in the 'priority areas'. The nuclear data and computer program services should not be directly affected by these measures.

2. The 'Wise Men' group placed first priority on the completion and validation of JEF-2, and stressed that continued effort beyond 1988 would probably be necessary. The minimum level acceptable for computer program and nuclear data services was considered to be eight scientific staff for 1988. A further review, based on progress in 1987-88, would set the appropriate Manning levels for different activities in 1989 and beyond.

II. SCIENTIFIC SERVICES

Computer Program Services

3. During 1987 a total of 75 programs were added to the master files, out of a total of 194 programs received from institutions in the Data Bank's member countries, through the exchange agreement with U.S. centres, and from establishments in non-OECD countries registered through IAEA. A total of 1692 user requests were recorded, of which 1365 were satisfied. Outstanding requests for programs which were available at the Data Bank but had not yet been tested at the end of the year stood at 226, corresponding to a backlog of 77 programs to be tested and master-filed. This should be compared to the figure of 42 programs awaiting test and master-filing in January 1987. 101 programs had been requested from their authors, but had not been received for testing.

4. The distribution of customer requests by subject category, and the distribution by subject in the full program collection, is shown in two pie charts (Figs. 1 and 2). High interest was shown by requesters in the associated categories 'Safety, Accidents', and 'Heat and Fluid Flow'. New structural analysis codes had been acquired in 1986, and were much requested in 1987. Similarly, new versions of some well-known mathematics and statistics packages have produced a high volume of repeat requests from customers who already have the previous version.
5. In 1988, up to the present, about 1,000 packages have been sent out, with 211 of them to countries served on behalf of IAEA. Because program testing has been planned so as to satisfy the greatest number of requesters, the number of requests outstanding for programs available at the Data Bank but not yet tested has fallen to 180. Unfortunately this corresponds to 97 programs awaiting test. It will be seen that programs are being sent out at approximately the same rate of 1987, for a slightly lesser number of requests, and an increase in the backlog of testing work.

6. The master-files contain 1347 program packages in all, though it is intended to reduce this to its earlier figure of 1000, by placing the obsolete codes in separate archive storage. Some older codes are unique, covering developments which are not often used but represent an important effort in research, and should be preserved. It will be seen from the pie chart that the largest single field is reactor safety, followed by heat and fluid flow, and mathematical and statistical packages.

7. Almost 30 percent of the codes received in 1987 were related to evaluated data processing: the change to ENDF/B-6 format affects all evaluations, and JEF in particular. In the same context, a number of new nuclear model codes were acquired, which together with waste management, safety and mathematical subroutines made up a further 40 percent, in approximately equal proportions.

8. While waiting for a general improvement in the networking facilities for transmitting larger files between our VAX and other types of computer, service of customer requests by network is continued at a relatively low level. An experiment in submitting a program with its data files from the Data Bank to the University of Stuttgart CRAY-2 machine was functionally successful, but had a turnaround time of 24 hours due to penalties imposed by EARN on the transmission of large files. Such delays would be a serious disadvantage in testing programs on distant computers via network, and it may be some time before we can routinely work in this way.

**Nuclear Data Services**

**Experimental data compilation and CINDA**

9. The number of EXFOR entries to be compiled had slightly decreased for the year 1987. This was thought to be due to the fact that a major nuclear data conference was to be held in Mito City, Japan, in May 1988, and scientists were waiting to present their work at that time. A similar trend has been noticed in the past. A total of 76 EXFOR entries, of which 47 were new compilations, were transmitted to the other data centers. These figures are comparable with what was received from the other data centers. Following the Mito conference, the preprints show that there should be a surge in the volume of data to be compiled, when the data requested actually reach the Data Bank. This is unlikely to change the overall downward trend in new nuclear data measurements.

10. The workload on CINDA was comparable with the previous years. A total of 6800 records was loaded on to the data base in 1987. The total number of records in the whole CINDA is now about 220,000. The number of entries is expected to increase in 1988 due to the above-mentioned large nuclear data conference. It was decided at the last meeting of the Data Centers to issue only one CINDA complement volume per year and, if economically possible, to
issue a revised archival volume of the whole CINDA in three volumes, in 1990. Funding difficulties in the U.S. have, however, cast doubt on this: at least in the U.S., CINDA may soon be restricted to on-line service only.

Customer service

11. A total of 152 requests by mail, telephone and telex were answered in 1987. The number of data records sent out was more that 19 million. About 83 percent of the requests originated from France, United Kingdom, F.R. of Germany and Japan; many of them were for experimental data. For 1988 up to the present, just under 120 requests have been answered.

12. The number of requests mentioned above was slightly less than in previous years, but this is most probably due to the fact that the NEA Data Bank started in June 1987 a network service for the nuclear data bases. This means that specially authorised users (collaborators in JEF and other projects) who have access to a computer linked to a public packet switching network can consult the nuclear data bases such as EXFOR, CINDA and Evaluated data directly. A total of 438 accesses to the nuclear data bases were registered during 1987. As of September 1988, there are 27 authorized users for nuclear data on-line services.

13. The figures for data retrieval are much lower via network, about 125,000 records only in total for the 438 searches, since these requesters are chiefly interested in scanning the data interactively, and receiving only those data they intend to use directly as input to their own work (227 files dispatched via network). With the compression of manpower for the traditional services, we expect that network access by our most frequent users will save a significant amount of time for the scientist responsible for answering data requests.

The Joint Evaluated File (JEF)

14. A presentation by M. Salvatores and C. Nordborg last week at Jackson Hole gives a full overview of progress in benchmarking JEF-1 and in the assembly of JEF-2, incorporating new and revised evaluations to take account of the benchmark results. It is hoped to complete assembly of JEF-2 by mid-1989.

15. The work at the NEA Data Bank in 1987 and 1988 was to a large extent concerned with supporting the different evaluation efforts. Staff members of the Data Bank have been involved, for example, in the continued updating of the resonance information of the JEF fission product file, and in the analysis of the experimental data used in the study of the U-238 resonance region, and in the calculation and estimation of the covariance information to be included in the new Pu-239 evaluation. Work was also done on the JEF-1 Decay Data File, and a special publication comparing parameters such as half-lives, Q-values and average decay energies between JEF-1 and other evaluated libraries were prepared for the NEANDC Specialists' Meeting on Decay Heat Predictions, held in Studsvik, Sweden, in September 1987.

Validation of Nuclear Model codes

16. The "blind benchmark", where participants were asked to calculate reaction cross sections including pre-equilibrium effects for neutrons on W-184 at energies up to 26 MeV, was completed in early 1988 and presented at the Semmering meeting. Seven contributions had been received, demonstrating that the models could reasonably describe the neutron energy spectrum except for the highest energy part where additional contributions representing direct
excitation of collective levels were found to be necessary. Angular distributions could currently only be described adequately by phenomenological and semi-phenomenological models.

17. A first draft of the results for the statistical model exercise was sent out to participants early in 1988.

18. The Data Bank has had some difficulty in acquiring the latest versions of nuclear model codes, or some new ones, and overall the Data Bank collection of model codes needs improving and updating. However, during 1988 a number of new versions, and PC versions, were obtained following the March 1988 IAEA Workshop at ICTP Trieste.

III. ACTIVITIES IN THE AREAS OF NUCLEAR SAFETY AND WASTE MANAGEMENT

Thermochemical Data Base (TDB)

19. During 1987, work on the scientific foundations of the project was completed. The first years have been characterised by extensive discussions about the data selection procedure, the extrapolation to the infinite dilution or zero ionic strength, the standards and conventions for the TDB publications and the assignment of uncertainties for a comparatively small number of important species, where proper statistical methods cannot always be applied due to scarcity of data. Moreover, available data from different sources may appear inconsistent, even if both experimental methods used seem to be appropriate. An example is the formation of the complex \( \text{UO}_2\text{F}^+ \). Finally, a consistent procedure has been adopted that can be used in all the following reviews. The resulting guidelines were published in early 1988. These series of guidelines form an important basis for the review procedures of all the key elements.

20. A new NEA Expert Group on Geochemical Modelling and Data was formed in 1987, and met for the first time in March 1988. The group will co-ordinate the contributions of Member countries to the TDB project, and advise on the administrative and budgetary arrangements needed. The Group will monitor the overall progress of TDB and ISIRS, assign priorities for the review of new elements, and guide the choice of new reviewers and the tasks to be carried out by the Data Bank.

21. The specialist team on Uranium gathered in December 1987 for the second time to discuss the current draft report and to set deadlines for the review procedures of the following six months. The full draft in its final edition format is being made ready for the review and quality assurance. The specialist teams on Americium and Technetium thermodynamics have become active in 1987. Both teams met at the NEA Data Bank in autumn 1987 and discussed in detail the review procedures and timetables. Progress in the reviews was somewhat hindered in 1987 due to discussions about the selection procedures and the assignment of uncertainties. However, a common and consistent procedure in this respect is of crucial importance for the review groups. The specialist teams on Neptunium and Plutonium started their review officially in spring 1988 and were able to make commitments for 1989 on the basis of the guidelines prepared with the other groups.

22. The specialist team on Iodine became active in 1987. The review is still in the starting phase.
23. A tutorial workshop on the speciation code MINEQL-EIR was organised in March 1987. The course was given by the two original authors of this code. A similar tutorial workshop on EQ3/6 is planned for spring 1989. Data Bank staff were active in presenting the TDB project to different groups likely to be interested in its output. Contacts have been taken with the EEC's "Chemval" project to ensure co-ordination between the two. They are working on very different time-scales, and information is shared between them.

24. In 1987 and 1988, fifteen requests for compiled data were answered. About 300,000 records were sent out.

Probabilistic Systems Assessment Codes (PSCA)

25. The Data Bank acts as code librarian to the PSCA User Group, and in 1987 took on the co-ordination of the first level of intercomparison of these codes (PSACOIN level O). Five new PSA codes were contributed to the Data Bank, and were tested on one of the large external computers regularly used for this purpose.

26. The intercomparison exercise involved twelve different groups, submitting 21 solutions in all (two of these were withdrawn before the end of the exercise). Four iterations were required to eliminate a number of misunderstandings, and some programming errors. After the final run, comparisons showed rather good consistency between the nineteen solutions for a series giving the mean close at six different times. Results for the sensitivity of these solutions were less consistent. Considerable work was also needed to establish the clearest possible presentation of the results, and a report of the study was issued in November 1987.

27. Replies have been received from participants in the Level E (exact solution) exercise, and the analysis and a first draft of the report are now under discussion. It is hoped to make good progress with the Sensitivity exercise by the end of 1988 (solutions are expected by November 1988).

The Incident Reporting System (IRS)

28. The main development work on the IRS Data Base System took place in 1987. The definitions of the Dictionary of Codes and the content of the file were settled in early 1987 and a new structure was implemented. Loading software was developed to convert from the original (JRC Ispra) data base and a sophisticated retrieval program was designed and implemented. The retrieval system has been incorporated into the Network Service customer interface for use by IRS co-ordinators in Member countries.

29. A data entry program was developed to allow new incident reports, as well as corrections, to be entered by clerical staff. During 1987, some 250 older reports were recorded as part of the 'backfitting' program, with a further 550 to be recorded in 1988. Coding work in 1987 was done by consultants from NEA Secretariat, and in 1988 the Data Bank has contributed also.

30. The Data Bank now has a microcomputer version of the IRS data base, for use on IBM PCs with dBaseIII. The aim is to offer the choice of an on-line service to national IRS co-ordinators, and regular distribution of IRS data on diskettes.

31. A related data base on reactor scrams has been implemented. This database is updated once a year from information sent by Member countries and simple tables of scram statistics are produced from the data base for the PWG-1 annual meetings.
Figure 1. Program Dispatches by Subject Categories

Total number is 1385

- Static Design Study: 5.9%
- Exper. Data Process.: 3.2%
- Pre & Postprocessors: 9.5%
- Multigroup X-section: 2.3%
- Lattice & Cell Prob.: 3.4%
- Cross Sections Calc.: 3.7%
- Mathematical Subr.: 19.7%
- Nuclear Fusion: 1.0%
- Structural Analysis: 8.8%
- Heat and Fluid Flow: 10.4%
- Reactor Systems: 2.6%
- Waste & Environment: 7.6%
- Safety, Accidents: 10.4%
- Reactor Kinetics: 2.0%
- Fuel Management: 3.8%
- Radiation Shielding: 7.7%
1. Data Assessment and Research Coordination

1.1. Scientific Meetings

- Analysis of the REAL-84 Intercomparison Exercise, held on 26-28 May 1987 in Jackson Hole, USA, (INDC(NDS)-198).

- Evaluation of Fission Yield Data, held on 11-15 September 1987 in Studsvik, Sweden, (INDC(NDS)-208), to be published.

- Preparatory Meeting on Influence of Target and Sample Properties on Nuclear Data Measurements, held on 21-24 September 1987 in Geel, Belgium, (INDC(NDS)-200).

- Nuclear Theory on Fast Neutron Nuclear Data Evaluation, held on 12-16 October 1987 in Beijing, People's Republic of China, proceedings to be published as IAEA-TECDOC.

- Fusion Evaluated Nuclear Data Library (FENDL), held on 16-18 November 1987 in Vienna, Austria, (INDC(NDS)-201).


- Main Meeting on Influence of Target and Sample Properties on Nuclear Data Measurements, held on 5-9 September 1988 in Darmstadt, FRG.

1.2. Research Coordination

The following nuclear data Coordinated Research Programmes (CRP) are currently active:


- CRP on the Measurement and Analysis of Double-Differential Neutron Emission Spectra in (p,n) and (a,n) Reactions. Last meeting: 8-10 February 1988, Vienna, Austria, (INDC(NDS)-205). Next Meeting: 1989, Bologna, close to MEANDC Level Density Meeting.


The following CRPs are planned for the future:


- CRP on the Measurement and Calculation of Activation Cross Sections for the Generation of Long-Lived Radionuclides. First meeting scheduled for Spring 1989, close to the NEAMDC Activation Cross Section Meeting at Argonne.

2. Data Centre Activities

2.1. Data Centre Coordination

- Nuclear Reaction Data
  The 9th IAEA meeting of the "Nuclear Reaction Data Centres" was hosted by the US NNDC at the Brookhaven National Laboratory on 27-30 October 1987. The minutes of that meeting are published in IAEA report INDC(NDS)-204 (April 1988).

- Nuclear Structure Data
  The 8th meeting of the International Nuclear Structure and Decay Data (NSDD) Network was held in Ghent, Belgium, on 16-20 May 1988. The minutes of that meeting will be published in IAEA Report INDC(NDS)-206.

2.2. Data Files and Systems

- CINDA. CINDA compilation and publication of the CINDA books has continued as a routine operation. However, the publication of the CINDA books in the traditional way is likely to be discontinued.

In the USA, many CINDA users have now direct access to the CINDA master file through telephone lines; as a result the NNDC will discontinue the financial support of the CINDA books publication. Also in the NEA service area direct access to NEADB is ongoing or planned.

As of 1988, the half-year Supplement issue, previously published in December, will be discontinued.

Originally it was planned to publish a final "archival issue" of the entire CINDA file in 1990 in an issue of four or five volumes. It seems that this will not be possible for financial reasons. Therefore, the last issues of CINDA are expected to be published in 1989 and in 1990 in the conventional mode.
For the future, the question is how to provide CINDA services to those countries and institutes that do not have on-line access to one of the CINDA master files. The entire CINDA file having a contents of close to 250 000 records with a volume of ca. 40 MB is too large for personal computers. NDS considers to produce a CINDA update version for personal computers so that selective CINDA retrievals and/or annual CINDA Supplements could be made available on 1.2 MB diskettes of which, however, several hundred copies would have to be distributed regularly.

- **EXFOR.** The EXFOR compilation and data exchange has continued as a routine operation. The EXFOR database has now reached a size of 60 000 data sets ("subentries") with 4.5 million records (equivalent to 0.36 Gigabytes).

It has proven to be essential that representatives of the data centers continue to meet once a year in order to provide continuity in the correct and common understanding of compilation rules. In addition, there are always new data types or unusual representations of data that require discussion and agreement of new coding rules. At present, special emphasis is given to neutron induced fission-product yield data and to the data coding in cases when short-living isomers occur in charged-particle nuclear reaction data. Experienced compilers are required for the correct and uniform coding of the newly defined data.

- **Evaluated Data**

  **Standards.** The ENDF/B-VI Standards File was issued in 1987 by the MNDC. In addition to this, NDS issued the new evaluation by W. Mannhart, PTB Braunschweig, of the Cf-252 spontaneous fission neutron spectrum. It is available on magnetic tape which is documented in IAEA-ND-98.

  **BROND.** The USSR evaluated nuclear data library BROND was issued in 1988. The contents of the magnetic tape "BROND-ND-1" is documented in IAEA-ND-90 Rev. 1. A more detailed summary description of the evaluations is given in INDC(CCP)-283 which is an IAEA translation of a book in Russian. The format of BROND is ENDF/B-V, except for two materials which are basically coded in ENDF/B-V format, but contain in addition energy-angular distributions in ENDF/B-VI format.

2.3. **Code Development**

Copies of all codes mentioned below have been sent to NEA Data Bank.

- **Data processing codes converted for PC.** The ENDF/B pre-processing codes, a modular set of codes each of which reads and writes data in the ENDF/B format, has been implemented for use on IBM PC-AT personal computers. This set of codes has been sent to about 30 users, and based on feedback from some of these users it is currently being updated. These codes are also designed to run on several different mainframe configurations.
The following codes have been implemented for PC use and are also currently being updated following user feedback.

PLOTTAB: A general independent plotting code which plots any combination of continuous curves and/or discrete points.

LINTAB: Constructs linearly interpolable tables of cross-sections.

HEATER: Calculates spectrum averaged reaction rates from LINTAB output.

- Nuclear Model Codes

The following four nuclear model codes have been converted to be used on IBM PC-AT personal computers for the ICTP Workshop on Applied Nuclear Physics and Nuclear Model Codes held in Trieste in February 1988: SCAT2 (Bruyère-le-Chatel), STAPRE (IRK, Vienna), ALICE (LLNL, Livermore) and EMPIRE (Warsaw, Poland).

- Code Comparison Exercise

Round 1: Using codes to calculate flat weighted 0 degree $K_{\text{unshielded}}$ cross sections using the SAND-II 620 group structure. Of the 13 codes participating in this exercise, 7 have been improved to the point where they can reproduce the benchmark results from the entire ENDF/B library. Results are published in report INDC(NDS)-170 and in Nucl.Sci.Eng. 99, 172, 1988.


3. Data Centre Services

3.1. Request Statistics

In 1987 NDS received 894 requests. Statistics for each of the considered categories for that year are as follows:

- Experimental data: 19 requests
- Evaluated data: 72 requests
- Bibliographic data: 14 requests
- Publications/reports: 653 requests
- Data processing codes: 136 requests

In response to these requests, the following information has been sent out during 1987:

- Experimental data: $2.638 \times 10^6$ records
- Evaluated data: $3.759 \times 10^6$ records
- Bibliographic data: 46 data sets
- Publications/reports: 1 701
- Data processing codes: 421
3.2. Publications

- The IAEA Nuclear Data Newsletter continues to be published once or twice a year whenever important new data files or documents were received that must be announced to customers. Its distribution exceeds 3000 in the NDS service area. To OECD countries and USSR it is distributed upon request only (ca. 350 copies) in order not to interfere with the services of the other centres. Attached to the Newsletter is a return postcard by which data, reports or other information can be requested.

- Fission Products Newsletter. The publication frequency of this report has been changed from annual to biennial. Last edition: INDC(NDS)-191, January 1988.


- WRENDA 87/88. WRENDA 87/88 (INDC(SEC)-95) is the ninth edition of the World Request List for Nuclear Data. The requests in this edition come from 18 different countries and one international organization.

In this edition, there are some changes to the request file since the production of the previous edition. To summarize the changes, 60 requests listed in the previous edition were modified, 661 withdrawn, 72 satisfied and 266 new requests were added. The total number of requests is 937 of which 326 are Priority 1, 475 are Priority 2 and 136 are Priority 3 requests. There are no Priority 4 requests.

The number of current requests related to fission reactor technology is 605, while the number of requests related to nuclear fusion is 253, that related to nuclear materials safeguards is 56 and to other applications is 23.

4. Technology Transfer

4.1. IAEA Technical Cooperation Interregional Training Course on Neutron Physics and Nuclear Data Measurements with Accelerators and Research Reactors

This training course was jointly organized by the IAEA and the USSR State Committee on the Utilization of Atomic Energy. It was convened during the period 18 May - 9 June 1987 in Riga, Latvian USSR, at the P. Stucka Latvian University and in Leningrad at the V.G. Khlopin Radium Institute. The course also included visits to the Kurchatov Institute of Atomic Energy in Moscow and the Institute of Nuclear Physics in Tashkent.
The objectives of this training course were to enable the participants to upgrade and update their knowledge of fast neutron physics and to become acquainted with recent developments in the field of fast neutron measurements and their technological applications of immediate benefit to their home countries.

4.2. Workshop on Applied Nuclear Theory and Nuclear Model Calculations for Nuclear Technology Applications

The Workshop on Applied Nuclear Theory and Nuclear Model Calculations for Nuclear Technology Applications, organized jointly by the IAEA Nuclear Data Section and the International Centre for Theoretical Physics (ICTP) Trieste, was held at the ICTP, Trieste, Italy, from 15 February to 18 March 1988.

This Workshop was held in continuation of the series of Winter Colleges on Advances in Nuclear Theory and Nuclear Data for Reactor Applications organized biennially since 1978, and was planned as a follow-up of the one held in 1984 on Nuclear Model Computer Codes and complementary to the one held in 1986 on Applications in Nuclear Data and Reactor Physics. It was designed to familiarize participants with recent developments in the analysis of neutron resonances and in fast neutron nuclear reactions and models and associated modern computer codes which are widely used in the analysis and computation of nuclear data needed for nuclear technology applications. The Workshop also provided an opportunity to participants to discuss their local operating experiences and problems encountered in the use of nuclear reaction model computer codes.

The lectures will be published by World Scientific Publishing Co., Singapore.

5. Forthcoming IAEA/WDS Meetings 1988/89
(subject to revisions!)

AG = Advisory Group Meeting
CM = Consultants Meeting
RCM = Research Coordination Meeting
SPM = Specialists Meeting
TC = Technical Committee Meeting

1988

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APPENDIX 3
National Nuclear Data Center
Report to 27th NEANDC Meeting

1. Cross Section Evaluation Working Group (CSEWG)

CSEWG completed its 22nd year of activity with its annual meeting on May 10-12, 1988. Emphasis in the past few years has been on completion of a simultaneous, self-consistent fit to the "neutron standard" cross sections. The fit has included both the 2200 meter per second data for the important fissile nuclides, the six standard cross sections and cross sections for several reactions closely linked to the standard cross sections via ratio measurements such as $^{239}$Pu(n,f) and $^{238}$U(n,γ). With the standards effort now completed, the main emphasis of the CSEWG effort will be the completion and testing of new evaluations for ENDF/B-VI.

Several evaluations have been received and processed by BNL for review. We expect to receive the remaining evaluations within the next 6 months. A major meeting will be held in early December to review all new evaluations for materials with $Z<90$. The heavy materials ($Z>90$) will be reviewed in February-March 1989. Data testing and release should occur 6 months later.

Major new formats for the resolved resonance region were adopted. The Reich-Moore format was restored to its ENDF-5 format and approved for use for any nuclide where inelastic competition is negligible. A new hybrid $R$-matrix format was also approved. More than two resonance regions (i.e., multiple resolved resonance regions) have been adopted for handling the new U-235 evaluation. The covariance formats (files >30) have been approved with major changes occurring in file 32 (resonance parameters) and new formats adopted for files 34, 35 and 40.

2. Nuclear Data Sheets

The NNDC has been producing the Nuclear Data Sheets at the rate of about an issue a month. Of these, nine issues a year are devoted to nuclear structure evaluation and the remaining three to the publication of Recent References.

The Center evaluated $A=68, 71, 139, 144, 148, 152$ and $163$ and submitted them for publication; $A=69, 146, and 147$ are being evaluated.

The U.S. is part of an international network of evaluators contributing recommended values of nuclear structure information to the Evaluated Nuclear Structure Data File (ENSDF). Publication of the Nuclear Data Sheets proceeds directly from this computerized file. In addition to the U.S., evaluations have been received or are anticipated from the Federal Republic of Germany, U.S.S.R., France, Japan, Belgium, Kuwait, Sweden, the People's Republic of China and Canada. India has joined the network and has started evaluation of mass-chains.

A new concise format for the published A-chains in the Nuclear Data Sheets has been approved by the international network and adopted. This format reduces the size of the publication without omitting essential information and improves its readability.
3. **Online Services**

For approximately 3 years, the NNDC has offered online access to several of its nuclear data bases. This service is available on the NNDC's VAX-11/780 computer via HEPNET (PHYSNET) MFENET, MILNET or over telephone lines. In the past year, access to CSISRS (EXFOR) and ENDF has been added to existing access to NSR, CINDA ENSDF and the numerical nuclear data base, NUDAT. We have recently provided NEWS, file transfer and electronic mail facilities. During the past year, the service has been used by more than 30 researchers. Approximately 4500 retrievals have been done in that period with about 260 hours of connect time used. More than one-half of the accesses have been to the NSR data base. Last spring, the NNDC produced online systems and data bases for NSR, ENSDF, and NUDAT which have been installed on the Nuclear Energy Agency Data Bank VAX computer and are available to researchers in their service area. Presently we are experimenting with including graphical display capabilities in our online services. Presently modules to plot either in Tektronx or Postscript mode are available from the CSISRS, ENSDF and ENDF data bases.

4. **Neutron Reaction Data**

Considerable effort has been devoted to production of the next edition of the neutron data atlas (formerly BNL-325). A thorough review of the existing neutron cross section data base for both completeness and accuracy was done. As a result of the review, the quality of both CINDA and CSISRS have been significantly improved. The publication is now available from Academic Press.

5. **Charged Particle Reaction Data**

Before the Nuclear Data Project at ORNL was reorganized in the late 1970's, it included a small charged particle reaction data compilation activity. This activity was transferred to the NNDC along with the responsibility for publishing the NUCLEAR DATA SHEETS. For several years after the transfer, as part of an international charged particle data compilation effort, we were able to continue to produce a bibliography of charged particle cross sections and thick target yields. Funding cuts forced us to discontinue that activity, but we were able to continue the publication of the bibliography with a reduced effort by deriving the publication from the NSR data base. The NNDC holds meetings of the Medium Energy Nuclear Data Working Group, which includes among its activities a benchmark comparison of high energy nuclear model codes. A comparison of preequilibrium and intranuclear cascade calculations was reported in BNL- NCS-52155 (May 1988). As part of a DOE-JAERI cooperation agreement, a Japanese scientist will be a resident at the NNDC for one year to help prepare data libraries for medium energy applications.

Several new compilations of high energy charged particle data have been added to the experimental data file, CSISRS, with the help of a visiting scientist from the People's Republic of China.

High energy neutron and proton induced libraries for Fe-56 have been prepared in the ENDF-6 formats.
APPENDIX 4
Activities of JAERI Nuclear Data Center
and
Japanese Nuclear Data Committee
—— April 1987 to August 1988 ——

September 1988

1. The JAERI Nuclear Data Center (JAERI/NDC) has continued to work in cooperation with the Working Group of the Japanese Nuclear Data Committee (JNDC). The main subject in 1987 fiscal year was the benchmark tests of JENDL-3. They have made the tests for fast reactor, thermal reactor, fusion neutronics and shielding calculations. Results of the tests revealed some problems of the JENDL-3 data; especially for the fast reactors. Hence, the nuclear data evaluation and the tests are still going on.

The JAERI/NDC has started evaluation of the \((\alpha,n)\) reaction cross sections of Li, B, C and O, and calculation of the activation cross sections for some nuclides. These were included in the proposals for the post-JENDL-3 activities.

The JAERI/NDC has served users with the experimental and evaluated nuclear data. In this period, there was 137 requests for the evaluated neutron data libraries, 16 requests for the experimental data and 11 requests for the ENSDF. The JAERI/NDC received a half million records of the experimental data from the NEA/DB and Osaka Univ., 235 thousand records of the evaluated neutron data from the NEA/DB and 2 million records of the ENSDF from BNL/NNDC.
Under the Scientists Exchange Program of the STA, Dr. S. Wiboolsake, Chiang Mai University, Thailand, joined the JAERI/NDC from September 1 to November 30, 1987. She studied the systematics on the optical potential of $^{12}$C using analyzing power and cross section data from 8 to 15 MeV neutron energy.
APPENDIX 5
REPORT OF THE NEANDC SUBCOMMITTEE ON EVALUATION COOPERATION

The subcommittee met on the evening of Monday, 26 September 1988.


Background

Following the discussion on evaluation cooperation at the previous NEANDC meeting, the chairman, A. B. Smith, had written to the chairmen of the ENDF/B, JENDL, and JEF Projects (C. Dunford, S. Igarasi, and M. Salvatores) to enquire about the possibility of organizing a closer cooperation between the projects. These chairmen had replied positively to this proposal, having discussed the proposal with the members of the management groups of the projects. An informal discussion had been held at the time of the Mito Conference and it had been proposed that the subject be discussed by the NEANDC. Consequently, this subcommittee meeting was convened to consider how a closer collaboration might be arranged.

Proposal

The subcommittee proposed that a joint NEANDC-NEACRP Task Force should be set up to consider ways of improving cooperation between the three projects and asked if the NEANDC and NEACRP would be willing to support this proposal. The chairmen of the three projects would also need to get the agreement of their respective management groups. It was requested that the NEA should provide the secretarial support.

The Task Force would formally report to the NEANDC and NEACRP in one year's time.

Membership of the Proposed Task Force

It was proposed that the chairmen of the projects (C. Dunford, S. Igarasi, and M. Salvatores or people nominated by them), together with a representative of EFF, should be members, along with one colleague from each project (to be nominated by the chairmen of the projects) and one or more representative of both the NEANDC and NEACRP. It was suggested that it could be valuable to include a reactor physicist, a nuclear theory specialist, and a nuclear data measurer to provide a broad advisory role to the Task Force.

Objectives

The ultimate objective would be the convergence of the files. In the shorter term, the objective would be to help the existing projects in NEA Member Countries (including the EFF Project) to improve their files. This could be done, for example, by discussing ways of exchanging evaluations (and all associated information about the evaluations), information about evaluation plans and work in progress, by identifying evaluation requirements and considering ways of sharing the work involved in carrying out the evaluations and associated benchmark testing. The projects would continue to be responsible for their own files.

Exchange

The data files of the participants would be made freely available to the other participating projects. The distribution policies of the other projects would be respected. Any work done as a consequence of the collaboration would be made available as each project sees fit, according to its own distribution policies.

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Any project cooperating with non NEA member countries in its work would have the same freedom of exchange of the information with these partners.

Methods of Work

The members of the Task Force would make proposals on ways of improving the exchange of information and cooperation both between projects and between individual evaluators.

For example, the meetings of a project could be open to representatives of the other projects, and specialist meetings could be arranged to discuss evaluation in particular areas, such as fission-product data, yields, decay data, cross-section data, delayed neutron data, and evaluation methodology. Such meetings would be focused on the needs of the projects.

Particular questions which could be discussed and collaborative activities undertaken include:

A. The fields for potential cooperation: evaluation, standards, evaluation review processes, formats, processing, benchmark testing, specification of benchmarks.

B. Limitations in existing evaluations, evaluation requirements, intercomparison of evaluations, and the identification of inconsistencies, incomplete evaluations (gamma-production data, covariances).

C. Formulation of plans to meet outstanding requirements and resolve discrepancies and ways of collaborating to meet requirements. Identify priorities.

D. Exchange of scientists between laboratories could help to further the collaboration and the Task Force could consider ways of fostering such exchanges.

In the first instance, members of the Task Force would set down written proposals and distribute them to members. A meeting should be held in about 6 months time (tentative date: Paris, May 1989, possibly in conjunction with the FENDL meeting). A detailed plan of work should be formulated within 12 months so that work could begin in cooperation after the release of JEF-2, JENDL-3, and ENDF/B-VI.

Actions to be taken by the NEANDC

1. Consider the proposal and decide whether to support it.

2. Nominate one or more potential members.

3. Consider whether they wish to propose a chairman for the Task Force (for further consideration by the NEACRP and Task Force members).

4. Submit the proposal to NEACRP for further comments, approval, and nomination of members to the Task Force (M. Salvatores is willing to make the presentation).

Following this, and approval by project management committees, the Task Force would begin operation.

John Rowlands
September 26, 1988
APPENDIX 6

REPORT OF THE SUBCOMMITTEE ON INTERLABORATORY WORKING GROUPS


The subcommittee met on 27th and 28th of September in the morning to discuss the suggestion of Karl Böckhoff for the establishment of an Interlaboratory Working Group, as outlined in the annex.

The basic idea is to enhance collaboration between the different neutron data measurers in the OECD area as a means to counteract the present--and still rising--manpower problems. The existing and successful operating task forces deliver a suitable model for such a collaboration. The main task should, however, be strictly reserved for specific, well defined actions of highest priority, while the domain of the proposed working groups may be also field oriented. The final aim is to solve the data problems identified in the NEANDC/NEACRP priority list with a greater efficiency, mainly by improved communication and mutually agreed upon collaboration. Interdisciplinary work could be very useful.

It was stated that such an initiative is fully in line with the mandate of NEANDC.

The committee agreed to the principle of improved collaboration, which already exists in many other research fields and has developed also in special cases in the neutron data field, not necessarily related to high priority subjects.

There was a consensus that a coordination of the efforts should be flexible in character and that the collaboration should only develop on a mutually agreed basis.

The role of the chairman of the working group is mainly to facilitate communication between the members of the working group and to report to the NEANDC either directly or through a member.

The role of the NEANDC is to identify suitable fields and/or subjects of work and make first suggestions for possible members including the chairman of the respective working groups, without prejudicing the final composition.

Members of the NEANDC suggested the following subjects for consideration:

1.) Capture cross-section data (resonance parameters) of Fe, Cr, and Ni.
2.) Activation cross-section data for fusion reactors.
3.) Data related to the neutron multiplication in Be.
4.) Neutron cross-section data in the thermal energy range.
5.) Inelastic neutron cross-section data of fission products in the mass range near $A = 105$.
6.) Fission cross-section ratios in the MeV range.
The Committee decided to first launch two of such Working Groups to obtain some experience with the approach of stimulated collaboration and agreed to start with the subjects 1.) and 2.). As possible chairman (coordinators), the following were identified:

For Subject 1.): Members of the $^{56}$Fe task force (Chairman - F. G. Perey).

For Subject 2.): D. Smith (Chairman, ANL).

Further Working Groups and their composition may be suggested to the NEANDC Chairman if desired. He will inform the members and request their approval by letter. The respective potential chairmen (or coordinators) of the suggested Working Groups will be informed by him on the endorsement of the request by NEANDC.

The NEA Data Bank will provide technical assistance and Mr. Tubbs will investigate whether travel subsidies could be supplied by NEA considering the fact that the mandate of NEANDC fully covers this initiative.

K. H. Böckhoff  
September 28, 1988

Subcommittee Actions

1. Smith  
   Inform Donald Smith about the NEANDC-endorsed suggestion to set up "Interlaboratory Working Groups" and ask him whether he would agree to initiate such a group which aims at solving the most important data problems in the area of activation cross sections for fusion reactors.

2. Perey  
   Initiate an "Interlaboratory Working Group" which continues the work of the $^{56}$Fe Task Force and extends it to the other resonance parameters of the Fe isotopes, and those of the Ni and Cr isotopes.

3. Tubbs  
   Assure that the NEA Data Bank will provide technical assistance to the "Interlaboratory Working Groups" and investigate whether travel subsidies can be supplied by NEA.

4. All Members  
   Suggest further subjects for "Interlaboratory Working Groups" and possible initiators.
ANNEX

27th Meeting of NEANDC

Proposal for the establishment of

**Interlaboratory Working Groups**

The need for a stronger international collaboration in the field of nuclear data for energy applications is widely recognized and emphasized also by the closing speakers of the recent Mito Conference. One of the major reasons for this need is to be seen in the scarce and further shrinking human resources which serve that field, as confronted with the data problems still existing or expected to arise.

While OECD-wide the separated evaluation activities (delivering the end product of the neutron/nuclear data work) eventually will grow together aiming at a common file it would be difficult to perceive why an intensified collaboration across laboratory borders should not be also possible for the front end of the Nuclear Data System.

The very successful NEANDC experiment of the $^{60}$Fe and $^{233}$U task forces has demonstrated that such a collaboration can work. These groups had to respond to urgent and special problems. Beyond the level of such task forces there are still many data problems waiting for a solution which can be more effectively achieved in a true interlaboratory collaboration between the geographically scattered experts. The modern telecommunication systems are very helpful and even a condition for such a cooperation. Obviously such an enterprise can work only on a voluntary and mutual agreement base.

It is suggested that NEANDC defines a number of suitable subjects and proposes candidates for working group members including a chairman (coordinator). Subjects could be rather general like data for structural materials, fission products, fusion or more specific like the heritage of the $^{60}$Fe task force. The resp. chairmen should change in a suitable cycle, depending on the subject of the working group. The groups can organise meetings and exchange of members between the labs should be encouraged. The chairmen should regularly report to the NEANDC.

Bialy

23. Sept. 84
APPENDIX 7

Report of the Sub-committee on Data of Special Interest

The Sub-committee met on the mornings of the 28th and 29th September 1988 and the following people attended.

K. H. Böckhoff  F. G. J. Perey
S. W. Cierjacks  S. M. Qaim
C. Coceva  J. L. Rowlands
H. Conde  J. J. Schmidt
E. Fort  A. B. Smith
J. Frehaut  M. G. Sowerby (Chairman)
S. Igarasi  H. Vonach
J. E. Lynn  S. L. Whetstone
A. Michaudon  P. G. Young
C. Nordborg

(i) The Sub-committee reviewed the Sub-committee actions listed in Appendix 11 of the Summary Record of the 26th Meeting as follows:

(1) Sowerby said that he had discussed the publication of a report on the data considered by the Sub-committee with the Chairman of the INDC Discrepancy Sub-committee (Patrick). As a result the matter was discussed at the INDC meeting in Beijing in October 1987 where it was agreed that a new version of the INDC/NEANDC Discrepancy and Data of Special Interest File should be published and the responsibility for the new version was accepted by INDC. A proposed schedule was established and entries to the File were requested. For those items on the INDC Discrepancy List the entries were requested from the responsible INDC reviewer; where the items are only considered by the NEANDC the entries were requested from the NEANDC reviewers. It had been hoped that all the entries would be available by this meeting and that a first draft of the report would be available for review by the Sub-committee. Unfortunately this had not happened but the available entries would be reviewed later in the Sub-committee meeting.

(2) Perey said that he had decided not to calibrate the CRNL capture detectors at the tagged photon facility at the University of Illinois after returning from the Rome Meeting as further consideration had convinced him that it was not the best thing to do.

(3), (4), (5), (6) The entries to the File under these actions had not been received in time to fulfil action (7).

(ii) The available entries for the proposed INDC/NEANDC Discrepancy and Data of Special Interest File, which are listed in Table 1, were considered by the Sub-committee. There was some discussion of the editing required before publication and it was agreed that in view of the available effort the minimum of effort should be expended on this.

The following comments were made on the topics covered by the available entries.

47
Fe, Cr and Ni on?

In view of the problems associated with total energy detectors which use the pulse height weighting technique, Perey reported that new capture measurements are to be made at Oak Ridge on all isotopes of Fe, Ni and Cr. The measurements will be made with an improved detector system after full checks to ensure that its response functions are properly understood. Böckhoff said that transmission and capture measurements on Ni isotopes were in progress at Geel.

Rh-103(n,n')Rh-103m

Vonach said that he has arranged with Liskien to do a measurement at Geel. In view of the limited use of this reaction as a dosimeter it was decided that this cross-section should be dropped from the list.

Pu-239 resonance parameters

The fission cross-section data of Weston and Todd (NSE 88 (1984) 567) used in the analysis differs from the cross-section evaluated with the ENDF/B-VI standards particularly above the resolved energy range. The measurements have therefore been repeated for both U-235 and Pu-239 using a longer flight path. Derrien may return to Oak Ridge to do further resonance analysis. In the draft entry to the file on U-235, Pu-239 and Pu-241 resonance parameters it is noted that parameter evaluations of these nuclides in the USSR and Eastern Europe are not well documented. Schmidt (Action 1) will try to obtain any improved documentation that is available. It was noted that papers on U-235, U-238, Pu-239 and Pu-241 resonance parameters were presented at the 1988 International Reactor Physics Conference, September 19-22, Jackson Hole, U.S.A.

Delayed neutrons from fission

Condé said that the Studsvik Group had supplied a new list of Pu-values to the Data Bank. As no up to date entry to the File was available, Condé agreed to obtain one from Professor Rudstam (Action 2). It was not clear to the Sub-committee if there were problems in performance predictions for reactors associated with delayed neutron data (e.g. $\beta_{eff}$). As integral validation of delayed neutron data is to be discussed by the NEACRP at their meeting in October, Igarasi agreed to inform the Committee if there were any remaining problems (Action 3).

Np-237(n,2n) (Deleted from NEANDC list)

Fort reported that the PROFIL experiments in PHENIX support the JEF-1 evaluation. The C/E ratios for the Pu-236 production and the branching ratio for the production of Np-236g and Np-236m are 1.2 and 0.91 respectively.

(iii) The Sub-committee then discussed the items that are in the NEANDC File of Data of Special Interest and for which there were no recent entries.
Li-7(n,n't)α

Young said that he had presented a paper at the Mito Conference (Paper DD 25). There were now no discrepancies except at 14 MeV though the body of new information disagrees with the data of Swinhoe et al. A Working Group of the NZANDC (Young, D. L. Smith, Qaim and Igarasi) has considered the problem and considers the present data are as good as present techniques permit. Only if there were a technique breakthrough should new measurements be performed. Qaim agreed to provide a new entry to the File (Action 4) and then the topic should be deleted from the List.

Fe, Ni and Cr scattering

Smith said that the situation had not changed since he had written the previous entry to the File which should be used in the publication. The adoption of a global potential for calculation of cross-sections in this mass region is highly suspect as the measured data are very much isotope dependent.

Nb-93(n,n')Nb-93m

Vonach said that the measured cross-sections were in good agreement and did not support the peak in the cross-section at -2.8 MeV given in the evaluation of Strohmaier et al. A new evaluation is to be performed in Vienna and it is thought that the cross-section is known to ±5% from -1 to 6 MeV. It was also noted that the recommended half-life of Nb-93m has changed. It was recently given as 15.8±0.4 y (Nucl. Data Sheets 54, 99 (1988)) which is to be compared to a value of 13.6±0.3 y given in the Table of Radioactive isotopes. Vonach agreed to write an entry to the File (Action 5).

U-238 capture cross-section

It was noted that the errors in the evaluation associated with ENDF-B/VI Standards are currently being investigated and it is hoped to have matters settled by the next CSEWG meeting.

U-238(n,n') cross-section

Smith said that he hopes to have a new evaluation complete by February 1989 and then he could provide a new entry to the File.

Pu-239(n,f) cross-section

Cierjacks reported that he was investigating the energy scale of the Kari et al measurements. Fort reported that the SUPERPHENIX start-up experiments gave information on the cross-section and agreed to provide information on this to the Committee (Action 6). Rowlands wondered if the ratio of the Pu-239 fission to U-238 capture cross-section was being changed in recent evaluations in a manner consistent with integral evidence. After discussion it was agreed that the ratio changes were satisfactory.

U-235 alpha in resonances

As Oak Ridge were to perform measurements, Perey agreed to obtain an entry to the File on this topic (Action 7).
B-10 total cross-section at 800 keV

It was agreed that this item should be dropped from the List and be considered by the Standards Sub-committee.

Li-6 He production

As there was no new information it was agreed that the existing entry to the File should be used in the publication.

(iv) The status of Be-9(n,2n) data was discussed. The multiplication of neutrons in Be is being widely studied particularly in Japan and there appear to be inconsistencies between integral and differential data. There seems to be little coordination between the various groups concerned and Igarasi agreed to review the present position and report to the Committee (Action 8).

Smith reported that there was a new measurement at Rockwell International of the half-life of tritium by Oliver et al (NEANDC-US)226/U, page 165, 1988). The value of 12.38±0.03 y is consistent with the NBS recommendation of 12.43±0.05 y but is higher than recommended in current evaluations (e.g. Handbook of Radioactive Isotopes 12.33±0.06 y).

(v) There was some discussion on the value of the proposed publication of the INDC/NEANDC Discrepancy and Data of Special Interest File. The Sub-committee decided that, though it has limited use at this time of shrinking worldwide effort, the publication should be completed. The need for future publications would then be assessed and at the present time there should be no commitment to future publications. Sowerby agreed to pass these views to the Chairman of the INDC Sub-committee on Discrepancies (Action 9).

The Sub-committee considered how it should operate at future NEANDC meetings and it recommended that only a few items of current interest should be considered in detail. Discussions would be aided if for each topic a member of the Sub-committee was able to provide an in depth review at the meeting.

M. G. Sowerby

Nuclear Physics and Instrumentation Division, Building 418.15, Harwell Laboratory, UK

October, 1988
Actions from Sub-committee on Data of Special Interest

(1) Schmidt  Attempt to get improved documentation on the resonance analyses of U-235 and Pu-239 performed in the USSR and Eastern Europe.

(2) Condé  Obtain status report on delayed neutrons from Prof. Rudstam by the 1st January 1989.

(3) Igarasi  Following the NEACRP meeting in Japan in October 1988 inform the Committee if there still exists a problem in $\beta_{\text{eff}}$ which implies uncertainties in delayed neutron data.

(4) Qaim  Provide a status report on the Li-7(n,n'α)T cross-section by the 1st January 1989.

(5) Vonach  Provide a status report on the Nb-93(n,n')nb-93m cross-section by the 1st January 1989.

(6) Fort  Provide the Committee with information on the Pu-239 fission cross-section arising from the analysis of the SUPER PHENIX start up experiments.


(8) Igarasi  Review the work on the neutron multiplication in Be and circulate a summary to the Committee.

(9) Sowerby  Write to the Chairman of the INDC Discrepancy informing him of the conclusions of the NEANDC on the publication of the joint INDC/NEANDC Discrepancy and Data of Special Interest File.
### Table 1

Status of entries to proposed publication of INDC/NEANDC "Discrepancy File"

<table>
<thead>
<tr>
<th>Topic</th>
<th>Considered by</th>
<th>Comment</th>
</tr>
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<tbody>
<tr>
<td>Li-7((n,nt)\alpha)</td>
<td>yes</td>
<td>yes</td>
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<tr>
<td>Li-6 tritium production</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Fe, Cr, Ni capture</td>
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<td>yes</td>
</tr>
<tr>
<td>Fe, Cr, Ni scattering</td>
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<td>yes</td>
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<tr>
<td>Nb-93((n,n'))Nb-93m</td>
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<td>yes</td>
</tr>
<tr>
<td>U-235 resolved resonance parameters</td>
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<td>yes</td>
</tr>
<tr>
<td>Pu-239 resolved resonance parameters</td>
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<td>yes</td>
</tr>
<tr>
<td>Np-237((n,2n))</td>
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</tr>
<tr>
<td>Np-237(\nu)</td>
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<tr>
<td>U-238 capture</td>
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<td>yes</td>
</tr>
<tr>
<td>U-238((n,n'))</td>
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<td>yes</td>
</tr>
<tr>
<td>Pu-239((n,f) &gt;1) keV</td>
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</tr>
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<td>Pu-241 resolved resonance parameters</td>
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</tr>
<tr>
<td>Pu-239 decay heat</td>
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<td>yes</td>
</tr>
<tr>
<td>Rh-103((n,n'))Rh-103m</td>
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<td>Delayed neutrons from fission</td>
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<td>U-235 alpha in resonances</td>
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<td>B-10 total cross-section at 800 keV</td>
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<tr>
<td>B-10 He production</td>
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<td>Li-6 He production at 14 MeV</td>
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<td>Sr-90 and Cs-137 half-lives</td>
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</tr>
<tr>
<td>Cf-252 half-life</td>
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</tbody>
</table>
APPENDIX 8

NEANDC STANDARDS SUBCOMMITTEE REPORT
TO THE 27TH NEANDC MEETING
LANL, USA, SEPT. 26-30, 1988

1. Attendance

The Standards Subcommittee matters were discussed in a plenary session on Sept. 29, 1988.

2. Actions from the 26th Meeting

The Standards Subcommittee actions listed in Appendix 11 of the Summary Record of the 26th Meeting were reviewed, as follows:

1) done, (see 3. ENDF/B-VI evaluations)

2) done, the document, IAEA-NDS-98 (Rev 1) by H. Lemmel with the 252 Cf evaluation by Mannhart was distributed at the meeting.

3) done, (see 4. "INDC/NEANDC standard data file")

4) continuing action (Action 1)

5) continuing action (Action 2)

6) done, (see 6. "Future meetings")

7) done, (see 4. "INDC/NEANDC standard data file")

8) done
3. **ENDF/B-VI evaluation**

P. Young reported about the status of the ENDF/B-VI evaluations. The standard cross section evaluation was completed and released to the community at large for comments in August, 1987. At the May 1988 CSEWG meeting, the Standards Subcommittee recommended and received approval for the cross section data in the standards evaluation. The covariance data is not yet finalized, primarily due to questions concerning the smallness of the uncertainties that resulted from the simultaneous analysis. It is hoped that this issue will be resolved and a recommendation made at the May, 1989 CSEWG meeting. It is also hoped that draft documentation will be available by the next CSEWG meeting.

4. **INDC/NEANDC Standard Data File**

H. Condé presented a compilation of status reports to the Standards File. The following comments were made concerning the specific items:

**H(n,n)H and 6Li(n,t)4He**

New entries are being prepared by G. Hale LANL due by late 88.

**10B(n,α)7Li**

A report had been prepared by E Wattecamps, CBMN. Concern was expressed with weaknesses in the data base and with deviating results from gas-counting and differential measurements. A small expert meeting was proposed to discuss the data base (see 6. "Future meetings")

**C(n,n)C**

A.B. Smith referred to the entry of the 1985 edition of the file. No significant work has been done recently.
Entry by F. Corvi, BCMN. The reviewer should be asked to include comments on detector efficiency problems due to the relative low gamma-ray multiplicity in Au(n,γ). Böckhoff expressed the wish of Corvi to withdraw from being a reviewer. Smith will ask Poenitz if he is willing to take on this responsibility (Action 10).

$^{235}$U(n,γ)

Entry by M. Sowerby, Harwell. A.B. Smith remarked that the ENDF/B-VI evaluation claim an accuracy of 0.5% at 1 MeV which is on the lower side compared to errors in fission foil assay. Furthermore, no correlation has been introduced between measurements made using the same techniques.

$^{235}$U fiss. fragment anisotropy

New entry by H. Knitter, BCMN due to mid 1989.

$^{238}$U(n,γ)

Condé was asked to enquire about status report from Prof. Kanda (Action 3). Smith reported that the ANL measurement by Meadows showed no structure in the energy range round 2.5 MeV. Smith was asked to send Meadow’s report to Prof. Kanda (Action 4).

$^{27}$Al(n,α), $^{93}$Nb(n,2n)$^{92}$Nb and $^{59}$Co(n,2n)$^{58}$Co

New evaluations are done on the $^{27}$Al(n,α) and the $^{93}$Nb(n,2n)$^{92}$Nb at IRK, Vienna. Vonach will send the evaluations for review to P. Young, LANL (Actions 5 and 6). Status reports on $^{27}$Al (n,α), $^{93}$Nb(n,2n) and $^{59}$Co(n,2n) will be prepared by mid 1989 (Action 7).

Neutron Energy Standards

New entry by C. Coceva. Perey was asked to send the results from the $^{238}$U transmission measurement at ORELA to Coceva (Action 8).
Actinide Half-Lives and Gamma-ray Standards

New entries by Lorenz, IAEA/Bambynek, CBMN and by Legrand, Saclay/Lorenz, IAEA.

Thermal Parameters

New entry by H. Lemmel, IAEA.

Low energy cross section dependence

New entry by C. Wagemans, CBMN. There are still uncertainties in the shape of the energy dependence for the $^{235}\text{U}$ $\eta$-value below 1 meV. Measurements are in progress at ILL, Grenoble.

$^{252}\text{Cf}$ fission spectrum

Two new entries by W. Poenitz, ANL and H. Lemmel, IAEA. Furthermore, P. Young reported the status of the $^{252}\text{Cf}$ fission neutron spectrum for ENDF/B-VI. Madland will use the refined version of the Los Alamos model and the experimental results of Poenitz-Tamura and Mannhârts evaluation and formulate recommendations to CSEWG Standards Subcommittee. Final decision will hopefully be taken at the next CSEWG meeting.

$^{225}\text{Cf}$ nu-bar

Entry from July 1985 by Boldeman, AAEC. When the report shall be updated, a comparison should be made of the Axton and the ENDF/B-VI nu-bar values.

Neutron-Flux Comparison

New entry by Grenier, Bruyères-le-Châtel. The results of the inter-comparisons are not yet final. An update should be made before publishing the report.

In the final comments on the INDC/NEANDC Standards File it was noted that the editing of the file will be a major task. Condé agreed to
continue the compilation of the reports and to produce a first preliminary lay-out of the file to the next NEANDC meeting. The editor (Dr. A. Li-Scholz) of Atomic Data and Nuclear Data Tables had positively responded on a question from Condé about publishing the INDC/NEANDC Standards File. Further contact will be taken when the lay-out of the file exists.

5. **International reference fission foil(s)**

A.B. Smith expressed a concern about the control of the standard reference fission-foil situation. It was reported that intercomparisons of fission foils originating from NBS (NIST), ANL, KRI, HAR, CBMN, LANL had taken place at ANL by Poenitz and more recently at KRI by Voronin et al. Furthermore, IAEA/NDS will act as a post-box for fission-foil exchange and CBMN will produce, store and assay the foils as a result of a recommendation from INDC. Smith agreed to send letters to NIST, CBMN and IAEA/NDS informing about the concern of NEANDC of the future availability of highly accurate $^{235}\text{U}$ standard fission-foils for cross section measurements (Action 11).

6. **Future meetings**

Condé reported about a discussion on future meetings in the field of nuclear standard reference data held at Mito, May 31, 1988. Four different subjects for future meetings were raised and deferred to the Subcommittee on Meetings for further discussions.

The subjects were:

1) ENOF/B-VI evaluation procedure

2) $^{10}\text{B}(n,\alpha)$ data base

3) Energy dependence in the thermal range of fissile parameters

4) Standard cross sections in the energy region above 20 MeV.
## LIST OF ACTIONS

**Subcommittee on Standards**  
LANL, 29 Sept., 1988

<table>
<thead>
<tr>
<th>Action Number</th>
<th>Name</th>
<th>Action Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Vonach</td>
<td>Distribute information on double-differential cross-section measurements and evaluation on Pb</td>
<td></td>
</tr>
<tr>
<td>2. Schmidt</td>
<td>Bring to the attention of the IAEA/CRP on Gamma-Ray Standards for Detector Calibrations the proposal for using the deuteron photo-disintegration cross section as a standard</td>
<td></td>
</tr>
<tr>
<td>3. Condé</td>
<td>Enquire about status report on $^{238}$U(n,f) from Prof. Kanda</td>
<td></td>
</tr>
<tr>
<td>4. Smith</td>
<td>Send report on the ANL measurement by Meadows on $^{238}$U(n,f) to Prof. Kanda</td>
<td></td>
</tr>
<tr>
<td>5. Vonach</td>
<td>Send the &quot;Vienna&quot; evaluation on $^{27}$Al(n,α) and $^{93}$Nb(n,2n) to P. Young</td>
<td></td>
</tr>
<tr>
<td>6. Young</td>
<td>Review the &quot;Vienna&quot; evaluations on $^{27}$Al(n,α) and $^{93}$Nb(n,2n) and inform S.C. members</td>
<td></td>
</tr>
<tr>
<td>7. Vonach</td>
<td>Prepare status reports for $^{27}$Al(n,α), $^{93}$Nb(n,2n) and $^{59}$Co(n,2n) by the middle of 1989</td>
<td></td>
</tr>
<tr>
<td>8. Perey</td>
<td>Send result of $^{239}$U transmission measurement by J. Harvey to Coceva when analyzed</td>
<td></td>
</tr>
<tr>
<td>9. Condé</td>
<td>Ask Boldeman to include information on the correlation between fission fragment direction and multiplicity in the review of $^{252}$Cf nu-bar</td>
<td></td>
</tr>
<tr>
<td>10. Smith</td>
<td>Ask Poenitz if he is willing to review the $^{197}$Au(n,γ) cross section in place of Corvi.</td>
<td></td>
</tr>
<tr>
<td>11. Smith</td>
<td>Send letters to NIST, CBMN and IAEA/NDS informing about the concern of NEANDC of the future availability of highly accurate U235 standard fission foils for cross section measurements.</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX 9

Report of the Subcommittee on Technical Activities


The subject "Interlaboratory Working Groups" which was on the agenda of this Subcommittee was handed over to an ad-hoc Subcommittee (see relevant report).

High Priority Request List

Co-chaired by J. Rowlands, the Subcommittee reviewed the progress regarding high priority requests for fission reactors (NEACRP-A-568 / NEANDC-A-180) compiled by Böckhoff. A report on this review written by Rowlands and sent to the NEACRP is annexed.

Neutron Sources

The Subcommittee discussed briefly the Summary Report of the NEANDC Working Group on Intense Neutron Sources drafted by Cierjacks. Members were invited to send further comments to him enabling him to publish the paper as a NEANDC-U-Report before the next Meeting.

Neutron Detectors

The Subcommittee believed that this subject is and will be sufficiently covered by the Laboratory Progress Reports which are permanently on the agenda of NEANDC.

Actions

1. Rowlands:
   Send to Igarasi a summary of the NEANDC review of the High Priority Request List for Fission Reactors.

2. Igarasi:
   Inform NEACRP on the results of this review at its forthcoming meeting in Japan and ask the advice of the NEACRP regarding the suggested modifications of the List.

3. Subcommittee members:
   Send as soon as possible after the meeting comments on the Summary Report on Intense Neutron Sources to Cierjacks.

4. Cierjacks:
   Distribute the finalized Summary Report on Intense Neutron Sources as a NEANDC-U document.
Report to the NEACRP on the High Priority Measurement Requirements for the Fission Reactor Program

The NEANDC Technical Activities Subcommittee reviewed the progress towards meeting the High Priority Measurement Requirements for Fission Reactor Applications. In the opinion of the subcommittee several of the requirements have now been met (or will be met by evaluations now in progress) and they recommended that the NEACRP should propose that members should arrange for these requests to be reviewed by the national committees requesting them. In particular, it is anticipated that a number of requests will be met by the evaluations now in progress for ENDF/B-VI, JEF-2 and JENDL-3.

Some interim revisions to the list had been made prior to the meeting. These were mainly revisions to the status remarks in the Standards, Dosimetry and Fission Product sections. The interim revisions also include some new fission product requests proposed by H Gruppelaar (The Netherlands). These are for capture in Ru-102 and Ru-104 (0.4 to 3 KeV) and inelastic scattering in even-even isotopes to check the theory.

Some items have been reduced in priority or deleted in the latest Japanese and UK request lists. These include the requests for Pd-109 capture, Pu-240 fission, Am-241 branching ratio and Am-243 capture. In addition the Fe-57 (n,n') request (USA) has been withdrawn.

A Requests considered by the NEANDC to have been met

Standards

Cf-252 $\nu_a$  
(Axton evaluation)

Cf-252 $\chi$  
(eg Mannhart evaluation)

B Requests which should be reviewed when evaluations now in progress are completed (together with the associated uncertainty estimates)

It is expected that the following requests will have been met, at least over part of the energy range.

Standards

B-10 (n,a)  
(ENDF/B-VI) (part of range)

U-235 (n,f)  
(ENDF/B-VI) (part or whole of range)

Dosimetry

All the requirements are considered to have been met, or nearly met, although specific evaluations which meet the requirements have not been identified by the NEANDC.
**Primary Actinides**

i) **Shapes of cross sections at thermal energies**

- **U-235 (n,f)**  
  (Geel and ILL measurements could meet requirements to 0.1 eV)

- **U-238 (n,γ)**  
  (Geel measurements could meet requirements to 1 eV)

ii) **Resonance parameters, fission and capture cross sections**

- **U-235**  
  (ENDF/B-VI does not meet the 1% accuracy requirement)

- **U-238**  
  (JEF-2/ENDF/B-IV evaluation should meet the 3% requirement)

- **Pu-239**  
  (JEF-2/ENDF/B-VI evaluation does not meet the 1% requirement below 1 KeV. The 2% and 3% requirement for (n,f) might be met and the 5% requirement for (n,γ) taking into account French irradiation experiments (PROFIL))

- **Pu-240**  
  Evaluations in progress could meet the requirements for 1% in the 1 eV resonance and 3% to 100 eV.

- **Pu-241**  
  JEF-2/ENDF/B-VI evaluation might meet the requirement for 3% (in the resonance range)

iii) **Inelastic Scattering**

- **U-238 and Pu-239**  
  (ENDF/B-VI might meet the requirements)

iv) **Total cross-sections**

- **Pu-239 and Pu-240**  
  (ENDF/B-IV might meet the requirements)

**Secondary Actinides**

**Am-241 capture**  
The JEF evaluation has been compared with the results of fast reactor irradiation experiments (PROFIL) and the evaluation is considered to meet the requirement.
C Other Comments

Structural Materials

Capture cross-sections - a new NEANDC Task Force will consider the status of these.

Inelastic scattering - work at ANL should meet these requirements.

Primary Actinides

Shapes of cross sections at thermal energies

U-235 eta (measurements have been made at Geel and Harwell - measurements are planned at ILL and, for alpha, at ORNL)

Fission Spectra

There is a proposal for an IAEA CRP to assess the accuracy of fission spectra. Recent measurements at ANL could meet the Pu-239 requirement above about 200 KeV.

John Rowlands

AEE Winfrith

October, 1988
APPENDIX 10
REPORT OF THE SUBCOMMITTEE ON MEETINGS

The meeting took place on Thursday, 29 September 1988. The following were in attendance:

K. Böckhoff
H. Condé
J. Fréhaut
A. Michaudon
F. Perey
J. Rowlands
N. Tubbs
S. Whetstone, Chairman

C. Coceva
E. Fort
S. Igarasi
C. Nordborg
S. Qairn
J. Schmidt
H. Vonach
P. Young

AGENDA

The agenda for the subcommittee meeting was as follows:

1. Overview of Report at Last Meeting - Actions
2. Next International Conference on Nuclear Data
3. Future Specialists' Meetings
4. Past International Conference (Mito) and Specialists' Meeting (Semmering)
5. Information regarding other meetings

SUBCOMMITTEE MEETING

1. Overview of Previous Subcommittee Report

The chairman quickly reviewed the main topics mentioned in last year's report and recommended that the topics 2. and 3. be discussed first to permit several members to attend the subcommittee meeting on Monographs.

2. Next International Nuclear Data Conference

The Chairman summarized the discussions that took place at the meeting of the DoE Nuclear Data Committee in April 1988. In view of the chronology: Antwerp (1982), Santa Fe (1985), Mito (1988), the obvious question was: should the next conference (probably in 1991) be held in the U.S. or in Europe? At the same meeting, Bob Peelle (ORNL, presented a proposal that the conference be held at Oak Ridge Nat. Lab. in 1991. The committee members voted (narrowly) in favor of offering the next conference to a European host in 1991, supporting the ORNL offer as a very suitable back-up, or as the U.S. candidate for the next following conference.

S. Qaim made a strong presentation that he be given the opportunity to investigate the possibility of holding the conference in Jülich in 1991. There was unanimous agreement within the subcommittee that Qaim be granted a month or so to obtain a commitment from his laboratory, with the ORNL proposal to be accepted if this commitment could not be secured within a reasonable period (by 1 December 1988). Action 1 on Qaim to inform the Chairman by the above date of his laboratory's decision.
3. **Future Specialists' Meetings**

a. **Level Densities** - It was approved by NEANDC at the last meeting that G. Reffo (with the concurrence of Coceva and the assistance of Young) organize a meeting to be held in the late spring or early fall 1989, in Bologna. Coceva reports that it has not been possible to obtain commitments from Reffo or the ENEA to proceed with this meeting. Two appropriate alternate locations have been identified: Vienna (Vonach) and Geel (Böckhoff/Rohr). The subcommittee (including Böckhoff) agrees that Vonach's preliminary proposal should be investigated next. It was also agreed that the time of the meeting should be coordinated with the IAEA Research Coordination Meeting planned for the Fall on "Measurements and Analysis of Double-Differential Neutron Emission Spectra in (p,n) and (α,n) Reactions."

b. **Activation Cross Sections** - At its last meeting, NEANDC approved a proposal from Smith that a Specialists' Meeting on "Neutron Activation Cross Sections for Fission and Fusion Energy Applications" be held at Argonne National Lab. in the Spring of 1989 and to be chaired by D. L. Smith. It is now proposed that the meeting be held in late September 1989 and that it be coordinated with the planned IAEA Consultants' Meeting on "Activation Cross Sections for the Generation of Long-Lived Radionuclides." Action 5 on Smith to inform Schmidt as to the dates as soon as possible. Smith will provide NEANDC members with a list of proposed program committee members.

c. **Neutron-Induced Charged-Particle Emission** - NEANDC previously had agreed to reconsider at its next meeting a proposal from Qaim to hold such a meeting in Jülich in 1990 or later. Qaim agreed that, particularly if Jülich is selected as the site for the next International Conference, this proposal be considered for a later time.

d. **Capture Reactions** - This topic was considered at the last NEANDC meeting, but no proposals were received. Because no proposals were received at the present subcommittee meeting, it is suggested that the topic be dropped for the time being.

Condé reported on an ad hoc meeting convened at Mito at which four candidates for the NEANDC Specialist Meetings were proposed:

a. Allan Carlson (NIST) proposed that a meeting be organized to discuss "Evaluation Procedures for the ENDF-6 Standards." The subcommittee suggests that this proposal be retained for possible consideration by the NEANDC Working Group on Evaluation.

b. Carlson also suggested that a small group be assembled to discuss problems in the $^{10}\text{B}$ (n,α) data base. The subcommittee suggests that the CBNM, NIST, and Jülich pursue this as a small interlaboratory working group project. Action 6 on Böckhoff.

c. A meeting on the "Thermal Values for the Actinides" was suggested. The subcommittee suggests that this be considered as a possible interlaboratory working group. Action 7 on Rowlands.

d. Suggested also was a Specialists' Meeting on "Standard Neutron Cross Sections in the Energy Region above 20 MeV." The subcommittee agreed to present this suggestion to the full committee, since it would appear appropriate for a Specialists' Meeting if the committee agrees that the topic area falls within its scope of interest.
4. **Mito Conference and Semmering Specialists' Meeting**

The Chairman mentioned favorable comments he received on both meetings, particularly those included in the large number of trip reports filed with the DoE.

5. **Other Meetings**

Four conferences celebrating the discovery of fission were noted:


c. April 26-28, 1989, Gaithersburg, MD, "Fifty Years with Nuclear Fission" - ANS/NST(NBS). Schmidt reported that IAEA will authorize cooperation. Tubbs suggested that OECD/NEA be approached for "co-sponsorship" - no funds. Action 8 on Whetstone.


**SUBCOMMITTEE ACTIONS**

1. **Qaim**
   
   Inform the Chairman by 1 December, 1988 of the KFA's interest in hosting the next International Conference on Nuclear Data.

2. **Coceva and Whetstone**
   
   Ascertain the willingness of Reffo and his institution to make a commitment by 1 December 1988 to hold the Specialist Meeting on "Level Densities" in Bologna in 1989 and report to the Chairman.

3. **Vonach and Schmidt**
   
   Investigate the feasibility of holding the above Specialist Meeting (Action 2) in Vienna, coordinated with the IAEA/RCM on "Measurements and Analysis of Double-Differential Neutron Emission Spectra in (p,n) and (α,n) Reactions" and report to the Chairman.

4. **Chairman**
   
   Upon completion of the above Actions 2 and 3, authorize the proper actions to initiate plans for the Specialist Meeting.

5. **Smith**
   
   Inform Schmidt of the dates of the Specialist Meeting on "Activation Cross Sections" and distribute to the Committee Members a list of the proposed program committee.

6. **Böckhoff**
   
   Set up a small interlaboratory working group including CBNM, NIST, and KFA to deal with problems in the $^{10}\text{B}(n,\alpha)$ data base.

7. **Rowlands**
   
   Set up a small interlaboratory working group to investigate the status of "Thermal Values for the Actinides."

8. **Whetstone**
   
   Pursue the suggestion of the Committee that the OECD/NEA cosponsor the International Conference - Fifty Years with Nuclear Fission that will be held in April, 1989 at Gaithersburg, Maryland.
APPENDIX 11

REPORT OF THE SUBCOMMITTEE ON MONOGRAPHS

1. Previous Meeting Actions

All actions coming from the last Subcommittee meeting have been completed.

2. Publisher

This was a critical issue at the last meeting. Since then, progress has been made with the ANS and between the ANS and OECD.

A meeting took place in Paris at the OECD Headquarters between Mr. Strohl (NEA Deputy Director), J. Rosén, and A. Michaudon to discuss the monograph project and also nuclear data in the OECD countries. At the end of the meeting, Mr. Strohl declared that he was very sympathetic to our project and that he would try to find a way to finance it.

This meeting was followed by a letter written by Mrs. Russell (OECD) to the ANS indicating that the OECD agreed to the third option proposed by the ANS. In this option, the OECD gives $9800 dollars to the ANS for each book and ANS publishes the book at a cost of $25 per copy. This agreement should be shortly formalized in Paris. We are also informed that a sum of $9800 is budgeted for the first book in 1989. Such a sum will also be proposed for the NEA budgets for 1990 and 1991.

It is understood that the books will have 200 pages each at most including everything (bibliographic references, indexes, etc.). Therefore, the road seems now clear for the publication of the next three books, subject to the formal approval between the OECD and the ANS.

3. Future Books

Progress made in the preparation of the forthcoming three books was reviewed by the Subcommittee.

a. Data Uncertainties (Editor: D. L. Smith)

A progress report was made by the Editor and distributed to the Subcommittee. The table of contents was approved by the Subcommittee, but it was also recommended that Chapter 13 should be more important than the other chapters in order to include several examples of applications of the covariance method to nuclear data. A first draft is expected to be given to the General Editors by March, 1989, and the final version could be ready for publication by July, 1989. Those dates will be proposed to the Editor.

b. Optical Model (Editor: J. Rapaport)

The table of contents was distributed to the Subcommittee and approved. Nevertheless, the Subcommittee was concerned about the possibility of condensing the material already gathered in 200 pages total. Also, it was felt that a substantial fraction of the book should address the use of the optical model with a presentation of codes and examples of calculations. A first draft is expected by November, 1989, and completion by March, 1990.
c. Charged Particle Emission (Editor: S. Qaim)

The outline was already distributed and approved at the last NEANDC meeting. A first draft is expected by March, 1990, and completion by December, 1990.

Although other books could be envisaged, the Subcommittee felt that it was premature to launch other books at the present time. It will be early enough to do it at the next NEANDC meeting.

Participants:

- K. Böckhoff
- S. Cierjacks
- R. Haight
- S. Qaim
- A. Michaudon
- C. Nordborg
- A. B. Smith

Subcommittee Actions:

1. Smith Monitor the progress made in the ANS/OECD agreement on the ANS side.

2. Michaudon Monitor the progress made in the ANS/OECD agreement on the OECD side.

3. Michaudon, Smith Negotiate with ANS the contracts with the General Editors, the Editors, and the Authors.

4. Michaudon Write to J. Rapaport to communicate to him the remarks of the Subcommittee about the book on the Optical Model.

5. Michaudon Write to D. L. Smith to communicate to him the remarks of the Subcommittee about the book on Data Uncertainties.
APPENDIX 12

Measurement and Interpretation of Nuclear Physics Data from White Neutron Sources.

Tuesday September 27, 1988
Physics Auditorium (TA-3, SM 215)

12:45 - 13:30 M. Sowerby (Harwell), Nuclear Physics Measurements at the Harwell Linac.

13:30-14:00 S. Qaim (Jullich), Nuclear Reaction Cross Section Measurements Using d + Be Source.

14:00-14:45 F. Perey (ORNL), Recent Experimental Activities at OREAL.

14:45-15:15 Break

15:15-15:45 C. Bowman (LANL), A Description of the LANSCE Neutron Source and Recent Results of Fundamental Symmetry Studies.

15:45 -1600 P. Koehler (LANL), Neutron Cross Sections of Unstable Nuclei.

16:00-16:30 S. Wender (LANL), A Description of the WNR Fast Neutron Source and Results of Recent Neutron Induced Gamma Ray Experiments.

16:30-16:45 P. Lisowski (LANL), Fission Cross Section Studies at WNR.

16:45-17:00 R. Haight (LANL), Two Facilities for \( (n,\text{charged-particle}) \) Studies with Fast Neutrons at WNR.