Report of the NEACRP/NEANDC Task Force

on

Evaluation Cooperation

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1   Members of the Task Force

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2   Background

At its meeting in September 1988, the NEANDC proposed that a joint NEACRP/NEANDC Task Force should be established to explore ways of improving collaboration on evaluation of nuclear data between the evaluation projects of NEA Member Countries (ENDF, JEF/EFF and JENDL). This followed the recommendation of the NEANDC Subcommittee on Evaluation Cooperation whose members included the chairmen of ENDF, JEF/EFF and JENDL projects. (Informal discussions had also been held at the time of the Mito Conference in May 1988). The NEACRP endorsed the proposed objectives at its October 1988 meeting and the management committees of the evaluation projects also supported the proposal. The Task Force held its first meeting at OECD Headquarters on 5 May 1989 and met subsequently at Brookhaven National Laboratory on 5 and 6 October 1989.

3   Discussion

Most projects are currently completing new files of evaluations and the current status of each evaluation project is given in ANNEX 1. Plans for evaluation activities after release of the new files are now being considered and so improved collaboration between the projects is timely.

With the limited effort currently available for carrying out evaluations, each project has been able to make new evaluations only for highest priority items. By exchanging files

and technical information, each project could benefit from the work already completed by the other projects. In the future, by sharing the work involved, the evaluated data can be improved, extended and tested for a wider range of applications, to the benefit of the user community.

Sharing information on benchmark testing is also considered to be an important aim of the collaboration. The development of evaluation methodology, processing techniques and formats would also be topics for cooperation.

4 Recommendations

The Task Force recommends the formation of a NEACRP/NEANDC Working Group on Evaluation Cooperation. The proposed Charter and Organization are given in ANNEX 2. Proposed collaborative activities are given in ANNEX 3. It is recommended that the Working Group, under the chairmanship of C. Dunford (ENDF), should begin its work immediately following approval by the special NEACRP/NEANDC meeting on Monday 9 October 1989. The first meeting of the Working Group would be held in Cadarache, France, 30 April to 1 May 1990 in conjunction with the ANS Topical Meeting on Reactor Physics (PHYSOR'90), which will be held in Marseille. Objectives of this meeting are to review the current status of the separate projects, to review the status of the exchange particularly with regard to the release of the evaluated data files, and to review the activities of the first cooperative subgroups and the guidelines for their work.

Status Report on the Evaluation Projects

1 ENDF

The next CSEWG Meeting will be held on 13-16 November 1989. Invitations will be sent to the other projects to send observers. The meeting will include a covariance data file review. The evaluation work for ENDF/B-VI is now complete but processing and benchmark testing are behind schedule. The present proposal is to release the evaluations not requiring testing, probably in January 1990. The next regular meeting will be held in the Spring of 1990. The Spring meeting will concentrate on benchmark testing results. It might be necessary to adopt a reduced programme of benchmark testing.

The graphical intercomparisons prepared for the FENDL meeting have been very helpful in showing the need for some improvements prior to release.

The present thinking is that improvements to ENDF/B-VI will be issued as modifications (Mod 1, Mod 2 etc).

2 JENDL

There had been a 2-year program of benchmark testing of the JENDL-3 preliminary file which resulted in some reevaluation of data. The General Purpose File evaluations are now complete apart from the comments sections (File 1). Some materials in the Fission Product File remain to be completed. The General Purpose File will be released before the end of the year but can be made available outside Japan on request prior to general release. Group Cross Sections are now being generated in standard structures. The fission product decay data file (version 2) is complete.

Following completion of JENDL-3, the JNDC committee structure was reorganized. Two directions are being followed, one being the work on data for special purposes (such as photon interaction data) and the other, the development of a new evaluation system, for example an expert system embodying codes and data together with evaluation procedures. Documents detailing the materials in the files and the new committee structure were distributed to the Task Force meeting.

3 JEF

Most of the JEF-2 evaluations have been received at the NEA Data Bank and the aim is to have all the evaluations ready for release for benchmark testing by the end of 1989. The evaluations could be made available to the other projects for preliminary testing also at this time. A 1 to $1\frac{1}{2}$ year programme of benchmark testing is then foreseen (in the case of JEF-1, benchmark testing resulted in the issue of version 1.1 after about 9 months and it is expected that a similar revised version of JEF-2 might be issued).

Particular areas where more work is needed are:

1. Gamma production data

2. Kerma related data

3. Covariance data

4. Activation data

It is important that an organization should remain to maintain the file and the capability of resolving outstanding problems and meeting new requirements in the future. A more complete status summary is given in the report NEACRP-A-993 : "Status of the JEF-2 Library".

4 EFF

EFF-1 had been directed to the requirements for tritium breeding (^{7}Li, Pb, Be, Al, Si). The ^{7}Li evaluation was completed very recently at Birmingham and Be will follow. There is a cooperation effort with Los Alamos Natational Laboratory on light isotope data, especially double differential data.

The EFF-2 programme is more directed to shielding for NET/ITER, i.e., data for steel (Fe, Cr, and Ni) with double differential scattering data, gamma production data and covariances being important. JEF-2 data are being used in the resonance region below $\sim$ 1 MeV. ^{58}Ni and ^{60}Ni are complete and IRK Vienna has done work on ^{56}Fe and ^{52}Cr. Further work on Fe, Cr and Ni isotopes, including an effort on covariances, is in progress. The aim is to complete the evaluations early in 1990 for the EFF-2.0 starter file. Al and Si are being evaluated at ENEA Bologna. There is also a requirement for data for O, Cu, Mn, W, Mg, S, Ca, Co, Sn, Ta, Ba and In. There is a major programme of work on the production of a European Activation File (EAF). The programmes for EFF-2 and EAF-2 are defined up to the end of 1991. EFF evaluations can be released to OECD countries. High-priority areas for cooperation are:

1. Covariance data for structural materials

2. Gamma production data

3. Consistent kerma calculations

4. Double-differential particle emission cross sections

5. Processing of DDX, kerma, and modification of the MCNP code to accept file 6 format

6. Activation data for fusion reactor application

A more complete status report is given in the report to the FENDL Meeting in May 1989.

ANNEX 2

NEACRP/NEANDC

Working Group on Evaluation Cooperation
Working Arrangements

6 October 1989

1 Introduction

The evaluation cooperation activities described within this document will occur among the
different evaluation projects within the Member Countries of the OECD Nuclear Energy
Agency. Those projects currently are ENDF (United States), JEF/EFF (Western Europe)
and JENDL (Japan). It is noted that the JEF and EFF projects are closely related. The
EFF project is funded partly by the European Community Fusion Technology Programme,
whereas the JEF project is a joint project of the NEA Data Bank member countries.

2 Objectives

The Working Group is established to promote the exchange of information concerning
nuclear data evaluations, validation, and related topics, and to provide a framework for
cooperative activities between the members of the different projects. This will include the
possible exchange of scientists to promote the cooperation. The long-term aim is to im-
prove the quality and completeness of the evaluated data files available to the cooperating
parties.

3 Methods of Work

A Working Group on Evaluation Cooperation is established under the joint sponsorship
of the NEACRP and the NEANDC. The Working Group will meet at least annually and
a report on the progress of the cooperation will be made to the sponsoring committees at
that time.
The Working Group will consist of up to four representatives of each of the three coop-
erating parties, nominated by the projects, and up to two representatives from each of
the sponsoring committees. The chairmanship of the Working Group will be selected by
consensus agreement of the members for a two year term.
The technical activities will be carried out by subgroups established by the Working Group.
The function of the Working Group will be to supervise this cooperation. This will be
accomplished by identifying problems to solve, deciding priorities and organizing the effort
to share the work within the cooperating projects.

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4 Subgroups

The technical work of the cooperation will be performed by subgroups established by the Working Group to complete particular tasks. These subgroups will consist of members nominated by the Working Group who have special expertise in the subject area and are willing to participate. Subgroup members must come from the participating projects. However, observers from nonparticipating projects may be permitted if it will further the work of the subgroup.

The subgroups will be responsible for their own working methods and for the selection of their coordinator. A member of the Working Group will be assigned to follow the progress of each subgroup. Each subgroup will be responsible for providing an annual progress report for the Working Group and for a final report. Each subgroup will be dissolved when its task is completed.

5 Secretariat

The Secretariat of the Working Group will be the NEA. The secretary of the Working Group, a staff member of the NEA, will be responsible for maintaining the official records of the Working Group and organizing meetings of the group in consultation with the chairman. In particular, the Secretariat will maintain a list of the cooperative activities in progress, which will include the names of the scientists involved and, on completion of the activity, a summary of the results prepared by each subgroup.

6 Availability of information

Data files and related technical documents generated by a cooperating project will be freely available to the other projects and the communities they represent. However, each project must respect the dissemination policy of the originating project.

The results of all cooperative activities will be available to all participating projects to disseminate as they see fit. Distribution of information within the cooperation will be to the chairmen of the projects, the Secretariat and selected other interested people. Distribution of information about the cooperation to parties outside the cooperation will be made via the Secretariat.

ANNEX 3

List of Proposed Tasks

It was considered that it would be mutually beneficial to cooperate on a number of studies with the initial emphasis being on the intercomparison of existing evaluations and analyzing the differences. The topics which have been selected for initial study are given below together with the names of the Working Group members who will initiate the studies and monitor progress on behalf of the Working Group.

Additional tasks may be sponsored by the Working Group. In order for the Working Group to consider sponsoring another task, a brief description of the task should be submitted to the chairman of one of the cooperating projects, ENDF, JEF, EFF or JENDL. The submission may include a proposed list of participants. However, the project chairmen will solicit interest from their projects if no such list is provided.

1 High Priority Tasks

1.1 Intercomparison of the files for ^{52}Cr, ^{56}Fe and ^{58}Ni

D. Larson

Graphical intercomparisons of data have been found to be very helpful in identifying deficiencies in files. It is proposed to carry out intercomparisons initially for the most important structural materials (for which there are new evaluations in each file) and to investigate the reasons for any significant differences. Overlay comparisons will be done initially for cross sections (in File 3), followed by comparisons of the energy-angle correlated outgoing particle distributions (in File 6), and broad-group resonance region data (in File 2). Benefits expected from these comparisons include information useful for improving structural material evaluations in individual libraries, for assessing differences associated with present-day evaluation techniques, and for development of techniques for making File 6 overlays.

1.2 Generation of covariance files for ^{56}Fe and ^{nat}Fe

H. Gruppelaar

Covariance data are required to assess uncertainties in design parameters (e.g. in the design of shields for the superconducting magnets of fusion reactors) and to refine the use of nuclear data in reactor applications. It is not always clear how much detail is required in the covariance files for different applications, the requirements being related to the sensitivity calculations. Collaboration in the general area of covariance files is beneficial to all parties. Initially, it is proposed to concentrate on covariance data for ^{56}Fe and natural Fe in view of their importance in reactors, particularly for fusion reactor shielding applications. The JEF-2/EFF-2 and ENDF/B-VI covariance data (files 32 and 33) should be intercompared and the methodology used to produce these data should be discussed. Possible improvements should be indicated. A study is also recommended of the methods used to evaluate and store covariance information for double-differential and photon production cross sections.

1.3 Actinide data in the thermal energy range

M. Sowerby

Thermal nuclear constants for the primary actinides have been extensively studied. The most recent evaluation was performed by E. J. Axton and values based on this work (e.g. ENDF/B-VI standards) are widely used. H. Tellier (see for example Proc. of 1988 Int. Conf. on Reactor Physics held in Jackson Hole, Vol 1, p.303) has studied the data taking into account thermal reactor benchmarks and obtains significantly different values for some of these constants, the data for ^{239}Pu being particularly discrepant. The origin of these differences needs to be identified and perhaps the evaluations reassessed.

The above differences could be associated with the shapes of the cross sections in the thermal energy region for which different values have been adopted in different evaluations. The analysis of lattice temperature coefficient measurements has suggested that η for ^{235}U should be energy dependent below 0.0253 eV to account in part for the discrepancies. One recent measurement supports this contention but another does not. These measurements are claimed to be accurate ($\sim \pm 0.5\%$) but are difficult to perform and analyze, the corrections to the measured data being complex and difficult to evaluate. A cooperative project which takes into account both integral and differential data would be very valuable.

1.4 ^{238}U capture and inelastic scattering cross sections

Y. Kikuchi

The capture and inelastic scattering cross sections of ^{238}U are of primary importance for fast reactors. The recent evaluations of the capture cross section give lower values than previous ones between 50 and 300 keV and the values are lower than the mean values of existing experimental data. These choices for evaluated data from the lower values of experimental data might be partly influenced by the results from integral tests. It should be checked whether these low values are justified or are in fact compensating for deficiencies in other nuclear data such as the ^{238}U inelastic scattering cross section. Comparison of the detailed evaluation processes and the sensitivity analysis may be helpful in answering these questions. As to the inelastic scattering, the experimental data are scarce. The evaluated data mainly depend on the calculations and different evaluations are discrepant with each other. The origins of these discrepancies should be understood. Comparison of reactor spectra calculated with the different evaluated data files are also helpful. It should be noted that the effect of inelastic scattering on the reactor spectrum is competitive with the fission spectra (χ) of major fissile nuclides. So the χ-values should be reviewed together with the inelastic scattering data.

1.5 ^{239}Pu 1–100 keV fission cross section

M. Salvatores

The evaluation of the ^{239}Pu fission cross-section is of particular importance for fast reactors (K_{eff}, sodium void reactivity coefficient, control rod worths). The simultaneous evaluation performed by W. Poenitz et.al. as part of the ENDF/B-VI standards evaluation provides a very accurate set of values. However there remain discrepancies. The resolved resonance parameter evaluation by H. Derrien et.al. is based on high resolution fission cross-section measurements by L. Weston et.al., which give average values at the top of the resolved region (1 keV) significantly lower than the values by W. Poenitz. The cross section evaluations above 1 keV should therefore be reviewed.

1.6 Delayed neutron data benchmarking

R. McKnight

Current calculation-to-experiment (C/E) discrepancies (up to 10%) on integral measurements of β_{eff} result in undesirable conservatism in design and operation of reactor control systems. Delayed neutron data uncertainties, which are significant in β_{eff} calculations, may be summarized as follows:

absolute yields	$\pm$ 4 to 5 %
group parameters	$\pm$ 3 to 15 %
delayed spectra	$\pm$ 10 to 20 %

A collaborative effort to improve these data is recommended. The resultant data could also be tested with the new integral measurements on β_{eff} which are being proposed at NEACRP as international experimental benchmarks and which are expected to provide high quality experimental information relative to ^{238}Pu, ^{235}U and ^{238}U.

2 Other Important Tasks

1. Decay heat data improvement

2. Covariance files for ^{238}Pu

3. Inelastic scattering for fission products

4. ^{9}Be covariance files

5. Capture for structural materials

6. Uncertainties in standard cross sections

7. Photon production files

8. Integral data testing for higher actinides

9. Benchmark specifications and calculations