Status of the JEFF-3 File Project

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Background and organisation

The Joint Evaluated File (JEF) Project was initiated in the early eighties by member countries of the OECD Nuclear Energy Agency Data Bank. The aim of this Project was to produce the best possible evaluated nuclear data files to meet the needs of fission reactor technology applications.

The first library, JEF-1, was released in the mid-eighties. A second library, JEF-2, was produced in 1990 and subsequently updated. The latest update, JEF-2.2, released in 1992, has been widely distributed and validated.

A new library, called JEFF-3, is currently under preparation. Its first release is scheduled for early 2002. This JEFF-3 library represents a major effort jointly undertaken by physicists who previously worked separately on the JEF File, the European Fusion File (EFF Project) and the associated European Activation File (EAF), sponsored by the European Community Fusion Technology Programme.

As described in the JEFF Project mandate, the Scientific Co-ordination Group (SCG) has responsibility for the overall management of the Project. SCG members are nominated by the Nuclear Science Committee Executive Group.

There are currently five Working Groups within the JEFF Project, performing technical work on :
- Evaluation, Processing and Benchmarking,
- Radioactive Decay and Fission Yield data,
- Fission Product Cross Sections,
- Intermediate Energy data,
- Fusion data (EFF group).

Evaluated files are produced in standard ENDF-6 format.
NJOY Users' group meetings are periodically held in conjunction with JEFF meetings.

Experimental data are provided by the Institute for Reference Materials and Measurements (IRMM) Geel and other laboratories.

The Secretariat of the Project is the NEA Data Bank. As part of this task, the NEA Data Bank provides general information and maintains a list of actions relative to the JEFF Project. The NEA Data Bank also provides support for assembling, QA testing, maintaining, and distributing the libraries and the associated documentation, as well as for collecting user feedback and requests.

Status of the JEFF-3 library

Over the past eight years or so, the latest versions of the JEF and EFF files have been extensively tested for a wide range of applications: thermal reactors, fast reactors, criticality and shielding calculations. Considerable evidence has been accumulated from this extensive benchmarking, demonstrating that the overall quality of the files is reasonably good. However, it was also found that improvements were required for the following materials: U-

235 (epithermal capture), plutonium isotopes, minor actinides, Th-232, sodium, lead, structural, fission yields and fission products, radioactive decay data, Li-7 and Be-9, neutron absorbers such as Hf and Er, etc. In addition, entire subsets of data were lacking in JEF-2.2: photon-production data for many nuclides, covariance information for most nuclides, and data for neutron energies ranging from 20 to 200 MeV (intermediate energies).

It was therefore decided to produce a new library, JEFF-3, with the double objective of correcting the known deficiencies of JEF-2.2 and of being more complete so as to meet the users' needs.

General Purpose File

In 1997-1998, following an extensive review of candidate evaluations, a first selection was made and a preliminary version of the JEFF-3 General Purpose file, JEFF-3T, was assembled by the NEA Data Bank. As a selection rule, it was decided to give preference to the available JEF or EFF data whenever no other data could be proven to be of better quality.

This JEFF-3T starter file subsequently underwent thorough testing by the NEA Data Bank. The tests were done according to recently-developed QA procedures which included running the BNL checking codes on every evaluated data set. As part of the tests, the file was processed with NJOY 97.107, 97.108 and 99.05. These tests helped identify and correct a few inconsistencies which had not been detected by the QA checks.

Prior to any official release, it was decided to perform a limited validation of the JEFF-3T file by recalculating a subset of the JEF-2.2 benchmarks. This limited benchmarking started in early 2000 and results were reported at the last JEFF meeting held at the NEA Data Bank on December 4-6, 2000. Additional results are expected to be presented at the next JEFF meeting, especially on PWR uranium lattices for which JEFF-3T appears to yield a slight systematic underestimation of reactivity.

Since JEFF-3T was produced, new or recently revised evaluations have been tested and included in the file, in place of the initial data. For example, the latest EFF evaluations of Be-9, Ni-58, Ni-60 and Fe-56 in JEFF-3T have been included. Other data are being revised, for instance capture cross sections of Cs-133, Rh-103, Sm-149 and Eu-155 for thermal system applications. Thus, the file will be progressively improved until it is deemed ready for release.

Special Purpose Files

The initial JEFF-3 Activation File will be made from EAF-2001, the latest version of the comprehensive activation file EAF produced by the EFF Project. Some format issues still need to be resolved, however.

A JEFF-3 Decay Data starter file has been assembled from the UKPADD-6 and UKHEDD-2.2 evaluations, with complements taken from NUBASE and ENSDF data converted into ENDF-6 format. Energy balance checks were systematically applied in this process, which lead to the elimination of some data. The NEA Data Bank subsequently applied its extended QA procedures to this JEFF-3T Decay Data starter file. Some corrections were made. The file was then sent to a limited group of specialists for further checking and improvements. Indeed, additional work is needed, notably on mean beta decay energies, before the file can be considered ready for validation. Also, an updated Fission Yield starter file consistent with this JEFF-3 Decay Data starter file still has to be produced from the UKFY3 evaluations.

The production of the JEFF-3T Intermediate Energy special purpose files with the TALYS nuclear reaction model code will start as soon as this new code becomes fully operational later this year.

The target date for the official release of the first version of the JEFF-3 library is 2002. Current efforts aim at assuring that this library will be of high quality, internally consistent and as free of errors as possible. Following this initial release, the various parts of the file will be completed and improved in subsequent versions. As with past JEF and EFF libraries, improvements of the JEFF-3.0 library will be guided by users' needs and feedback, as well as by the results of the benchmarking studies.

The next JEFF meeting will take place in Aix-en-Provence on May 15-18, 2001, in conjunction with an NJOY workshop.

JANIS Software and documentation

An upgraded version of the JEF-PC software, called JANIS, has been developed by the NEA Data Bank for graphic display of the JEFF (and other ENDF-6-formatted) files. This programme inherits the features of JEF-PC while incorporating a number of improvements such as the capability to display resonance parameters, energy and angular distributions, etc. JANIS was written in JAVA for maximum portability. A first version is available from the NEA Data Bank for testing purposes (see http://www.nea.fr/html/dbdata/janis/). JANIS is distributed free of charge.

Apart from the JEFF files themselves, an extensive documentation in the form of on-line electronic files (*pdf* format) is also available to the Project participants from the NEA Data Bank web server.

In addition, several JEFF Reports have been issued recently:
- JEFF Report 15 on GODIVA (uranium metal) and JEZEBEL (plutonium metal) fast critical calculations;
- JEFF Report 16 on uranium and plutonium LWR pin cell calculations;
- JEFF Report 17 on the JEF-2.2 library. This comprehensive report includes a description of the data, a summary of the validation studies, a list of known errors and deficiencies, and recommendations for JEFF-3;
- JEFF Report 18 on methods for analysing and evaluating neutron-induced reaction data in the resolved and unresolved resonance range. This is a reference document which includes the underlying physics, mathematical and statistical background.