PROCESSING AND TESTING ENDF/B-VI
WITH NJOY AND TRANSX

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ABSTRACT

The NJOY Nuclear Data Processing System has been used to process the Evaluated Nuclear Data File ENDF/B-VI, including all changes through Release 2, into multigroup cross section libraries that can be used with many different neutron/photon transport codes and into ACE format for use with the MCNP continuous-energy Monte Carlo code. The ENDF-6 format contains a number of new features of interest to reactor physics, including new resonance treatments (especially Reich-Moore), energy-angle distributions for outgoing neturons, photons, and charged particles, and an extended treatment of the thermal scattering laws. Evaluators have taken advantage of these new formats to produce new evaluations for many materials important to reactor physics. Some examples include ^{235}U, ^{238}U, and ^{239}Pu with resonance ranges extended to higher energies to minimize problems with the unresolved range and with energy-angle correlated distributions for neutron scattering, and the isotopes of Fe, Ni, and Cr with new Reich-Moore resonance evaluations and energy-angle distributions for emitted neutrons and charged particles. These features improve calculations of transport through thick structures and give much better KERMA values.

Over the last several years, the NJOY code has been gradually upgraded to handle the new features of the ENDF-6 format. This effort has been aided by users at other laboratories in the US and around the world who have helped us to find and remove problems. In late 1993, the version NJOY 91.91 was used to process many of the materials of ENDF/B-VI.2 into several multigroup libraries in MATXS format. MATXS10 is a 30x12 (that is, 30 neutron groups and 12 photon groups) library that is compact and useful for high-energy problems where resonance effects are not important. MATXS11 is an 80x24 library with extensive selfshielding tables. It is useful for fast-reactor and fusion studies. MATXS12 is a 69x24 thermal reactor library with selfshielding and upscatter. MATXS13 is a 187x24 multipurpose library for fusion, fast-reactor, and thermal-reactor problems. MATXS14 is a 175x42 library for fusion neutronics studies.

We have also prepared partial ENDF/B-V libraries using matching specifications for use in comparisons and for establishing bias factors against previous results; they are MATXS5, MATXS6, MATXS7, and MATXS8. There is no ENDF/B-V version of the 175x42 library. The materials included in each library vary with the application (MATXS12 is the largest, with 250 materials, because of the detailed fission-product cross sections provided). It was also necessary to extend the methods in NJOY used to prepare libraries for the Monte-Carlo code MCNP, to modify the ACE format used for these libraries, and to develop new sampling techniques inside MCNP to handle the energy-angle distributions. This work is now complete, and MCNP can now run with ENDF/B-VI libraries.

An important part of the release of each new version of the ENDF/B libraries has been testing. This includes testing for proper use of the formats, testing the physical consistency of the data in the files, and testing against selected benchmarks. As part of the consistency testing, we have performed a detail energy-balance study of ENDF/B-VI. Although there are still problems (including negative KERMA factors), it is overall a great improvement over ENDF/B-V, especially for the important structural materials Fe, Ni, Cr, and Cu. We have also analyzed many CSEWG benchmarks, including the Los Alamos fast criticals (JEZEBEL, GODIVA, FLATOP, BIGTEN, etc.), the Argonne ZPR assemblies (6/7, 6/6a), some of the aqueous thermal criticals (ORNL1, ORNL2, ORNL10, L7, L8, L9), and some of the thermal lattices (TRX1, TRX2, BAPL1, BAPL2, BAPL3) using cross sections produced by TRANSX with the ONEDANT and TWODANT transport codes. These results don't always tell whether the underlying evaluated data has been improved, but they do give you a good idea of how the new libraries will perform for reactor physics calculations.

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