

# Status of ORNL Cross-Section Processing and Library Generation Capabilities

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Oak Ridge National Laboratory (ORNL) has an ongoing effort to develop and maintain state-of-the-art radiation transport capabilities. This effort is leading to improvements in radiation transport and nuclear data generation capabilities. With the release of SCALE 5.0 in June 2004, vastly improved modeling tools are available to nuclear analysts for performing a wide variety of radiation transport analyses. Additionally, a new version of the AMPX cross-section processing system has been developed at ORNL to generate continuous-energy and multigroup (MG) cross-section libraries from Evaluated Nuclear Data Files (ENDF/B). Work has been performed at ORNL to develop MG and continuous-energy ENDF/B-VI libraries for the next update of the SCALE code system, which is scheduled to be released in the summer of 2005.

AMPX can be used to generate a variety of MG and/or continuous-energy [pointwise (PW)] cross-section libraries. In addition, AMPX can be used to process cross-section covariance data from ENDF/B-formatted evaluations and generate covariance data files to be used with adjoint-based sensitivity/uncertainty (S/U) analysis sequences (i.e., TSUNAMI) in the SCALE 5 system. The TSUNAMI sequences can perform either 1-dimensional (1-D) discrete ordinates or 3-dimensional (3-D) Monte Carlo S/U calculations. At ORNL, the TSUNAMI software is being used to perform validation studies, design experiments, investigate the performance of existing cross-section data evaluations for specific applications, and make recommendations for new cross-section measurements, etc.

One of the advancements with SCALE 5.0 is the improved resolved-resonance self-shielding treatment with the CENTRM/PMC sequence. CENTRM provides a PW solution to the 1-D discrete ordinates form of the Boltzmann transport equation in order to provide problem-dependent PW flux spectra that can be used in PMC to generate self-shielded MG cross sections in the resolved-resonance region. To support the resonance self-shielding capabilities in SCALE, MG and PW ENDF/B-VI.7 cross-section libraries have been generated using the AMPX cross-section processing system, and the libraries have been tested by calculating 273 benchmark cases with the MG and PW ENDF/B-VI libraries. Of the total number of cases, 243 cases are critical benchmarks that include (1) low-enriched, (2) intermediate-enriched, and (3) highly enriched uranium systems, in addition to (4) mixed-oxide, (5) plutonium, and (6)  $^{233}\text{U}$  systems. In addition to the critical benchmark experiments, 30 cases are calculational benchmarks from the Organisation for Economic Co-operation and Development/Nuclear Energy Agency (OECD/NEA) Criticality Working Group Benchmark 20 problem.

Historically, the SCALE system has provided MG versions of the Monte Carlo transport codes KENO V.a and KENO VI for performing criticality safety calculations. Continuous-energy versions of KENO V.a and KENO VI (i.e., Point KENO V.a and Point KENO VI) have been developed and are being tested at ORNL for release with a future version of SCALE 5. In order to support the current Point KENO development effort, AMPX has been used to generate a test cross-section library consisting of 50 ENDF/B-VI.7 nuclides that include all the U and Pu isotopes in addition to thermal moderator data for H in  $\text{H}_2\text{O}$  and H in  $\text{CH}_2$ . Work is currently in progress to develop a complete Point KENO ENDF/B-VI cross-section library that will be distributed with Point KENO V.a and Point KENO VI. Testing with various critical and calculational benchmarks problems has been performed and compared with MCNP4C calculated results. Additional details concerning the AMPX MG and PW cross-section library generation and testing with SCALE 5 will be provided at the GEN-IV Nuclear Data workshop.