# Generation of multi-group cross sections and covariance data based on JENDL-4.0 for the

# SCALE code system

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**Abstract:** A multi-group cross section library and corresponding covariance data file were prepared for the SCALE code system. The new library was applied for the analysis of the SCALE sample problems and showed satisfactory results.

Keywords: SCALE, JENDL-4.0, AMPX, COVERX, nuclear cross sections, multi-group, resonance treatment

**1. Introduction** The SCALE code system [1] is widely used in the field of reactor physics. A drawback of SCALE is that it is generally not possible to create new cross section libraries. In the present paper we discuss the generation of multigroup cross sections (238 groups) and covariance data (44 groups) based on JENDL-4.0 for SCALE.

**2. SCALE cross sections** Recent versions of SCALE use many different types of cross section data: traditional multi-group data in the AMPX format, continuous energy (CE) cross sections for the CENTRM and the CEKENO modules, 3-group depletion cross sections for ORIGEN-S, and covariance data in the COVERX format. AMPX libraries are made with the AMPX2000 system which is not available to the public. In this work we used the NSLINK code [2] and NJOYCOVX [3] to create multi-group cross sections and corresponding covariance data. The format of



Figure 1: production of an AMPX library

**3. Testing** The performance of the new library was tested with the SCALE sample problems. Some important points: (1) most of the SCALE sample problems use only few isotopes (U, H, C, F); (2) the newest multi-group cross section library in SCALE does not contain resonance parameters for NITAWL so the comparison is made with the somewhat older SCALE library based on ENDF/B-V library; (3) there are no sample problems to test the covariance data. The input files are edited to use the ENDF/B-V library and NITAWL, and a second input file is generated for the JENDL-4.0 library. It was decided to use only the multiplication factor as a performance estimator. A total of 162 cases are calculated and the histogram of the error (ENDF/B-V vs. JENDL-4.0) is shown in Fig. 2. Cases with depletion (TRITON sequence) showed inexplicable errors; this problem needs to be addressed in the future.

the CE libraries is unknown and thus these libraries cannot be made. The necessary calculation steps are shown in Fig. 1. Two files with group-wise data are required: the "g0" file contains basic cross sections at infinite dilution and one temperature. The "gt" file contains cross sections at various dilutions, various temperatures, and with temperature-corrected scattering cross sections. The "gt" file is optional, e.g. if an isotope does not have resonances and is not relevant for scattering reactions only the "g0" file is sufficient. The entire processing is automated in a Python script for optimal quality control.



Figure 2: Histogram of error between new and existing AMPX library

**3.** Conclusion A multi-group cross section library based on JENDL-4.0 for the SCALE code system (AMPX format) was successfully produced and will be used in our future research activities. The new library is not applicable to depletion calculations.

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#### References

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