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Plans for Future SCALE Development Beyond Version 6.0

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INTRODUCTION

The SCALE (Standardized Computer Analyses for Licensing Evaluation) code system [1] provides a comprehensive and integrated package of codes and nuclear data for a wide range of applications in criticality safety, reactor physics, shielding, isotopic transmutation, and sensitivity/uncertainty (S/U) analysis. Since the release of version SCALE 5.1 in 2006, several important new codes have been developed, and various improvements made to existing ones[2,3]. Many of these new features will be available in SCALE 6.0, which has a projected release date of Fall 2008. In addition to near-term improvements, a master plan for longer term SCALE enhancement activities recently has been developed to provide an integrated framework for future methods development. Some of the major components of the SCALE advanced methods development plan are (1) improvements in nuclear data libraries, (2) significant software enhancements for functional modules (executables), and (3) redesign of the fundamental SCALE computational architecture. This paper will discuss future directions for SCALE development after release of SCALE 6.0.

NUCLEAR DATA LIBRARIES

Like the current version 5.1, SCALE 6.0 will include pointwise (PW) and multigroup (MG) nuclear data libraries based on ENDF/B-V and VI data. In addition, limited testing of recently released ENDF/B-VII has been performed in-house to demonstrate that the new data can be successfully processed; therefore, PW and MG libraries can be generated relatively quickly when funding becomes available. In conjunction with this activity, the development team is considering a generic universal group structure of >500 groups for the ENDF-VII MG library, which would be applicable for both fast and thermal reactor physics, as well as shielding analysis. To utilize the supergroup library efficiently for deterministic transport calculations, an automated, problem-specific group collapsing procedure will be implemented into the SCALE computation sequences.

NEW CODES AND CAPABILITIES

The SCALE methods development plan identifies several high-priority areas for future methods development of functional modules, including both incremental improvements in existing software and development of new codes or capabilities. Table I lists some of the new methods being developed or planned for various applications. These will be discussed in detail during the presentation.

TABLE I. Sample of Methods Development for Advanced Functional Modules in SCALE

Application	Task
Criticality Safety	1. Parallel computation for KENO
Radiation Source Terms	1. Replace computation methods in ORIGEN 2. Rewrite ORIGEN for dynamic memory, object-oriented code
Reactor Physics	1. Three-dimensional (3-D) version of NEWT unstructured mesh transport code 2. Low-order method for rapid, approximate self-shielding
Shielding	1. Continuous-energy version of Monaco Monte Carlo code 2. New 3-D deterministic transport code

"SCALE-UP" ACTIVITIES

While improvements continue to be made to individual functional modules, the SCALE computational architecture itself has remained basically the same since its inception 30 years ago. The system consists of a driver routine, a set of executable functional modules, and various calculational sequences. The driver routine executes individual functional modules (e.g., CENTRM, KENO, NEWT, ORIGEN, etc.) in some order specified by user input; or alternatively it may execute a calculational sequence (e.g., CSAS, SAS1, TRITON, TSUNAMI, etc.), which consists of a predefined series of calculations by a set of functional modules. This procedure provides a framework whereby independent codes can be linked to provide a more comprehensive capability than possible with the individual programs—allowing flexibility to address a wide variety of applications. However, the current system was designed originally for mainframe computers with a single CPU and with significantly less memory than today's PCs. It has been recognized that the present SCALE computation system could be restructured to take advantage of modern hardware and software capabilities, while retaining many of the modular features of the present system. Preliminary work is being done to define specifications and capabilities for a more advanced computation architecture, which has been designated as "SCALE-UP" (***S***tandardized ***C***omputational ***A***nalysis ***L***ibrary ***E***nsemble of ***U***nified ***P***rograms). The following are some of the desired characteristics of the SCALE-UP system:

- more shared routines and functions, including a universal geometry processor (UGP) for all functional modules;
- reduced use of data exchange via external interface files in computation sequences (more storage in RAM);
- high-level parallelization for simultaneous execution of multiple functional modules;
- high-level subdomain decomposition of 3-D geometry, with capability to use different (or same) computation methods in each unit; and
- generalized coupling of different computational methods via boundary source transformations.

SUMMARY

A comprehensive plan has been designed for future SCALE methods development activities in all applications areas. The list of tasks is continuously revised and expanded as current development activities are completed, and new priorities are identified. Planned methods development activities after the release of SCALE 6.0 currently include improvements in existing functional modules, development of several new codes and data libraries, as well as a redesign of the basic SCALE computational architecture to provide coarse level parallelization and generalized coupling between different computation methods, and more efficient exchange of data between computational modules.

REFERENCES

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