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<u>Abstract</u>
Topics of interest:
neutron-gamma codes

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Current Status of the Oak Ridge Monte Carlo Shielding Codes

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Abstract. The Multigroup Oak Ridge Stochastic Experiment code, MORSE[1], is a three-dimensional (3-D) multipurpose neutron and gamma-ray transport code that has been in use for nearly 30 years and has undergone several evolutions during that time. Oak Ridge National Laboratory (ORNL) has two versions that are distributed by the Radiation Safety Information Computational Center (RSICC): MORSE-CGA and MORSE-SGC. MORSE-SGC is part of the SCALE[2] computer code system, both as a stand-alone program and as part of two of the shielding analysis sequences, SAS3 and SAS4.

Both SGC and CGA use the Multiple Array System (MARS) geometry package. The primary difference in the two versions is the cross-section structure. MORSE-SGC has a supergrouping capability which allows a problem to run with only part of the cross-section groups in core rather than the entire energy range. Because of the amount of memory available in today's computers, this feature is not nearly as important now as it was when the code was originally developed. The other major difference in the two versions is that SGC has built-in routines for the source selection and estimation routines whereas the user can supply his own routines and override the provided versions in CGA.

SAS4 was developed to solve spent fuel shipping and storage cask problems and, as a result, has an automated geometry modeling procedure. When developing the SAS4 shielding analysis sequence, one of the objectives was to automate the selection of biasing parameters for MORSE and the preparation of cross-section data. As a result of this, SAS4 runs cross-section resonance processing modules BONAMI and NITAWL and an adjoint case using the one-dimensional code XSDRNPM prior to executing the MORSE module. The adjoint XSDRNPM results are used to generate biasing parameters for MORSE. Another feature of SAS4 is that the PICTURE program which generates 2-D color plots or printer plots can be run from within SAS4. A number of changes were required for MORSE-SGC in order to implement a new SAS4 option for surface detectors and subdetectors.

The SAS3 shielding analysis sequence runs the cross-section modules and MORSE. At present there is no automated selection of biasing parameters. SAS3

can, however, solve many problems that the specialized SAS4 can't handle. Examples of such problems are streaming through ventilation ducts and cask penetrations, dose rate analysis from a large array of casks, and applications to more generalized shielding problems such as criticality alarm systems. Currently SAS3 or MORSE-SGC can treat any of these applications, however, the user must generate and input very detailed biasing parameters.

Because unbiased Monte Carlo methods are not practical for real reactor and away-from-reactor applications which are typically large and geometrically complex and which also involve significant attenuation, the development of a three-dimensional Monte Carlo shielding analysis sequence with automatic variance reduction is highly desirable. As indicated above, the SAS4 sequence uses the one-dimensional code XSDRNPM to produce biasing parameters for MORSE; however, for general purpose three-dimensional shielding calculations, use of three-dimensional adjoint functions is necessary. For this reason, ORNL expects to develop a code sequence that uses the SN adjoint output from the three-dimensional discrete ordinates transport code TORT to produce variance reduction parameters for use in MORSE. Development of this capability will require significant changes to MORSE and to the shielding sequence in which it is implemented. This sequence may be an update to the SAS3 sequence discussed above or it may be an additional shielding sequence. Sources of funding are being investigated with several proposals in process. Additional biasing options for SAS3 and SAS4 are also possible with future development projects under consideration.

Work currently in progress on the SCALE code system includes the development of SCALE5. Although version 4.4a, the current release of SCALE, is FORTRAN-90 compatible, it requires using several of the extensions to the language. Version 5 will be pure FORTRAN-90 and, as such, will not require use of extensions.

One current project under development is a SCALE shielding analysis graphical user interface (GUI) for Windows 95/98/NT/2000. The GUI will provide an easy-to-use system to assist the occasional and inexperienced SCALE users in the setup and execution of SAS4/MORSE. The material information cross-section portion is nearly identical to that for the CSAS criticality sequence which is already complete; the primary development effort will be in the geometry input specifications.

All of the codes discussed here run on multiple computer platforms, including DEC-Alpha, IBM RISC 6000 series, Sun and HP workstations and on personal computers. Those in the SCALE system are under configuration control and have been validated and verified. A set of shielding benchmarks has been documented in Ref. 3 and is available on the SCALE website (http://www.cped.ornl.gov/scale).

References

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