SCALE Criticality Safety and Radiation Shielding Course

Criticality Safety: KENO-VI

KENO-VI is a 3-D generalized geometry Monte Carlo code that can perform continuous energy (CE) or multigroup (MG) calculations using the latest ENDF/B-VII data in SCALE 6. It uses the SCALE Generalized Geometry Package (SGGP), which is the same geometry package used by the MAVRIC radiation shielding sequence in SCALE. SGGP includes almost 20 geometric shapes and provides the following modeling features: intersecting geometry regions; hexagonal, rectangular, and dodecahedral arrays; rotation and truncation of bodies; and the use of an array boundary that intersects the array. KENO-VI includes 2-D color plotting capability and HTML output and is compatible with the SCALE Windows interfaces GeeWiz and KENO3D. GeeWiz provides a menu-driven interface to set up and run SCALE models. KENO3D is an interactive 3-D visualization tool for viewing SCALE geometry models.

KENO-VI can be used with MAVRIC (see below) to perform an integrated criticality accident alarm system (CAAS) analysis.

Radiation Shielding: MAVRIC

The MAVRIC (Monaco with Automated Variance Reduction using Importance Calculations) sequence provides 3-D automated variance reduction for deep-penetration problems. The basic functional module is Monaco – a fixed-source, 3-D, general geometry, multi-group, Monte Carlo code. MAVRIC uses the SCALE Standard Composition Library and the SCALE Generalized Geometry Package (SGGP), which is the same geometry used by the KENO-VI criticality safety code. The MAVRIC sequence is based on the CADIS (Consistent Adjoint Driven Importance Sampling) methodology. For a given tally in a Monte Carlo calculation that the users wants to optimize, the CADIS method uses the result of an adjoint calculation from a 3-D deterministic code to create both an importance map for weight windows and a biased source distribution. MAVRIC is completely automated — from a single user input, it creates the cross sections (forward and adjoint), computes the adjoint fluxes, creates the importance map and biased source, and then executes the Monaco Monte Carlo calculation. An extension to the CADIS method using both forward and adjoint discrete ordinates calculations (FW-CADIS) is included in MAVRIC so that multiple point tallies or mesh tallies over large areas can be optimized (calculated with roughly the same relative uncertainty). In this course, participants will run several MAVRIC exercise problems that demonstrate: a standard Monte Carlo calculation without variance reduction; a simple shielding problem using CADIS to optimize a single tally; and a mesh tally calculation of dose rates over a large volume, with nearly uniform relative uncertainty. The last exercise problem will use the new CAAS modeling capability in SCALE – where a fission distribution calculated by KENO-VI is used as a source in a MAVRIC shielding calculation.