ENHANCEMENTS TO THE BURNUP CREDIT CRITICALITY SAFETY ANALYSIS SEQUENCE IN SCALE

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Abstract - SCALE (Standardized Computer Analyses for Licensing Evaluations) is a system of computer codes and automated calculational sequences developed at Oak Ridge National Laboratory for criticality safety, shielding, and reactor analyses. The SCALE sequence to perform automated burnup credit criticality calculations for spent nuclear fuel systems is STARBUCS (Standardized Analysis of Reactivity for Burnup Credit using SCALE). STARBUCS uses the capabilities of the SCALE driver to automate depletion and Monte Carlo criticality calculations using the ORIGEN isotope generation and depletion code and either the CSAS5 (KENO V.a) or CSAS6 (KENO-VI) criticality safety sequence, respectively. The STARBUCS input options allow analysts or reviewers to investigate the impact on criticality safety of various assumptions related to burnup credit calculation methodology for spent fuel in transport or storage casks. Options are provided to model the axial and horizontal variations of the burnup within a spent fuel assembly, to select the actinide and fission product nuclides for spent fuel composition calculations, and to adjust the predicted inventories to account for isotopic composition bias and bias uncertainty. The following STARBUCS enhancements are available with the SCALE 6 release: the capability of performing burnup loading curve search, the ability to use either multi-group or continuous energy Monte Carlo criticality calculations, reduced number of iterations required to achieve eigenvalue convergence, reduced output options, and the option of saving the input files created for the criticality calculations for use in subsequent calculations such as cross-section sensitivity and uncertainty analyses with SCALE/TSUNAMI. For burnup loading curve analyses, STARBUCS performs iterative burnup credit criticality calculations using an initial fuel enrichment search to determine combinations of fuel enrichment and burnup that yield a user-specified critical limit within convergence tolerance criteria. The paper presents a review of the STARBUCS features available in SCALE 6, STARBUCS applications that illustrate the impact of various modeling assumptions on burnup loading curves, and a comparison between STARBUCS calculations using SCALE multi-group and continuous energy cross-section libraries in terms of computer time and k_{eff} results for various spent fuel configurations.

[*] Managed by UT-Battelle, LLC, for the U.S. Department of Energy under contract No. DE-AC05-00OR22725.