

RAPID Tool

Alireza Haghghat (haghghat@vt.edu)

Nuclear Science and Engineering Lab (<http://nsel.ncr.vt.edu>), Virginia Tech, Arlington, VA

Prof. Alireza Haghghat, Dr. William Walters (postdoctoral fellow), and Nathan Roskoff (PhD student) from the Nuclear Science and Engineering Lab (NSEL) at Virginia Tech have developed^{1,2,3} an accurate and fast software tool RAPID (Real-time Analysis for spent fuel Pool and cask In-situ Detection) for monitoring of spent fuel pool and cask criticality safety and safeguards. RAPID is multi-stage response function particle transport code⁴ capable of quickly and accurately calculating pool eigenvalue, subcritical multiplication, 3-D pin-wise fission densities, and detector responses. These detector responses can be used in conjunction with inspection measurements for identification of partial fuel defects and ultimately estimate isotopic composition of the spent fuel.

RAPID is based on the fission matrix method^{5,6} for calculation of the pool or cask subcritical multiplication source. RAPID is written in FORTRAN 95 and is capable of being run on any operating system. RAPID includes automated post-processing using the open-source R environment⁷. Figs. 1a-3c provide samples of some of the automated post processing capabilities.

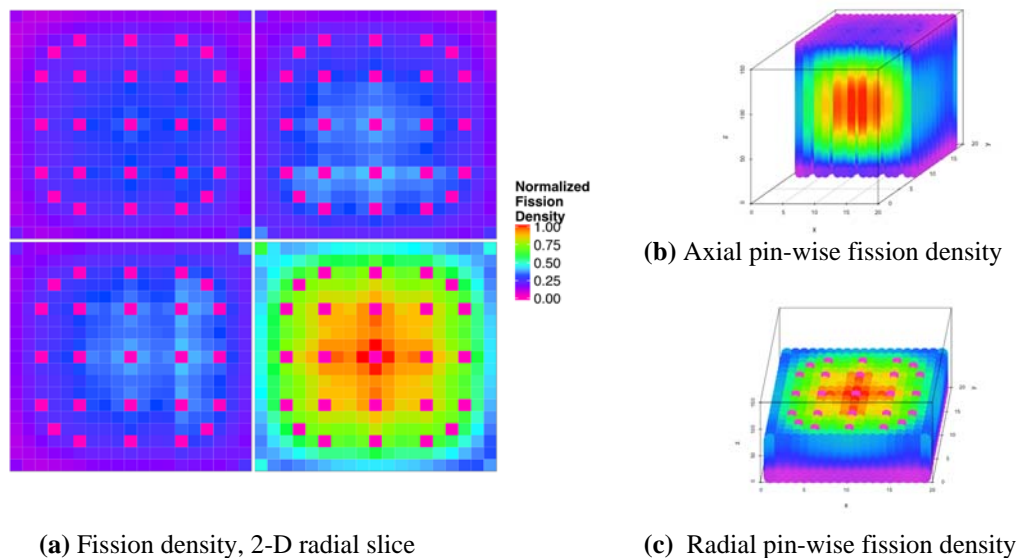


Fig. 1 – Sample RAPID post-processing capabilities

RAPID uses the SCALE package to determine isotopic densities as a function of burnup and cooling time. RAPID has been successfully benchmarked against the straightforward MCNP Monte Carlo predictions. Fig. 2a shows a pool containing an 9x9 array of assemblies. Corresponding RAPID and MCNP fission density predictions shown in Fig. 2b are in good agreement, while the MCNP results contain noticeable uncertainty.



Fig. 2a – Pool of 9x9 assemblies

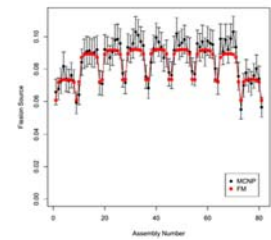


Fig. 2b – Assembly-wise fission density distribution

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