Convergence issues in Best-estimate Monte Carlo Depletion Calculations

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Source convergence issues in Monte Carlo criticality simulation were previously seen as a difficult research problem, fortunately having a marginal impact on real world criticality licensing, which focuses mainly on k-effective estimation. Applied in depletion calculations, Monte Carlo source convergence is now a key point for the reliability and usability of this type of application. As a first approach, the VESTA depletion interface is used to simulate isotopes composition histories on a parametric ill-conditioned benchmark of infinite lattice of PWR fuel pins modeled with MORET5 Monte Carlo code. Besides initial random seeds, several simulation parameters (neutrons population size, number of batches, time sampling and geometrical binning) are compared in term of simulation cost versus time compositions discrepancy. The probability density of resulting compositions obtained on such “crude” Monte Carlo propagation of simulation noise due to Boltzmann equation Monte Carlo solving process tends to arise numerical instability which lead to false neutronic oscillations similar to (physically true) Xenon effect. The density function observed are investigated to suggest some explanations based on Monte Carlo neutron simulation characteristics and convergence issues.