Used Fuel Criticality Validation

Validation Using Measured Critical Data from Power Reactors

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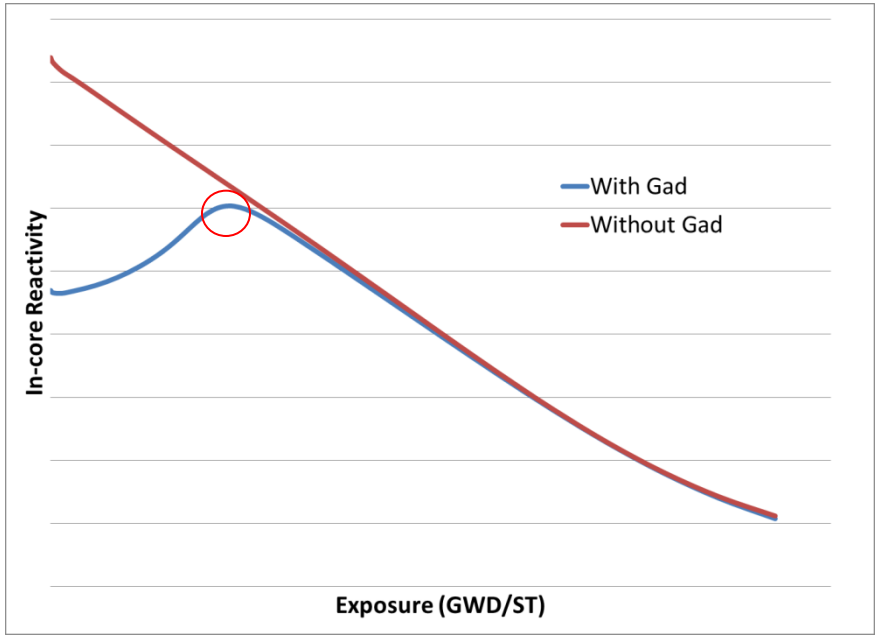
Introduction

- Typically BWR spent fuel pool criticality analyses assume the fuel is at peak reactivity with gad modeled
- Need to validate the isotopics and cross sections for used fuel isotopes which are credited in the analysis



Cold Core Critical Data Available

- Before a BWR reactor restarts after a fuel reload, cold critical control rod configuration measurements are taken
- Compare critical conditions from power plant startups with predicted eigenvalues in lattice physics/core simulator code package to calculate a bias and uncertainty
- Every plant has its own data

Applicability of Cold Core Critical Data

1. Moderator temperature and density is about the same as the rack
2. Control rods which are being removed during the startup are similar in their neutronic effect (Boron) to the neutron absorbers in rack
3. The fuel is the same
4. Average core burnup is similar to the peak reactivity burnup used in the criticality analysis

Applicability of Cold Core Critical Data

- The cold critical measurements either involve a small local subset of control rods and their adjacent bundles or typical control rod withdrawal sequences with banked rod movements to significantly extracted positions at several distinct and spatially separate locations in the core.
- Therefore, the results are sensitive to the fidelity of the lattice physics code in assessing the local isotopic compositions and reactivities
- Thus, this data is capable of providing benchmark experiments for spent fuel pool conditions

Methods for Using Bias/Uncertainty

Method A (The cold core critical bias and uncertainty covers only the isotopic content bias/uncertainty)

- Criticality Code Validation bias includes:
  - Fresh fuel criticality benchmark bias
  - Cold critical bias
- Criticality Code Validation uncertainty includes:
  - Fresh fuel criticality benchmark uncertainty
  - Cold critical uncertainty
  - Actinide and fission product cross section uncertainty (one approach is outlined in NUREG/CR-7109)

Methods for using Bias/Uncertainty

Method B (The cold core critical bias and unc. covers both the isotopic content and worth bias/unc.)

- Criticality Code Validation bias includes:
  - Fresh fuel criticality benchmark bias
  - Cold critical bias
  - Benchmarking of Monte Carlo code to lattice physics code bias
- Criticality Code Validation uncertainty includes:
  - Fresh fuel criticality benchmark uncertainty
  - Cold critical uncertainty