RIC 2006
Session T1BC
Fuels - *Cladding Behavior for Regulatory Applications*

"Technical Concerns and Data Needs to Establish NRC Regulatory Guidance on the Transportation of Spent Fuel with High Burn-up and Advanced Cladding"

Dr. Robert E. Einziger
Sr. Materials Engineer
NRC Spent Fuel Program Office
U. S. Nuclear Regulatory Commission
March 7, 2006

Regulations

- No direct requirements in 10 CFR 71 on the retrievability of the fuel
- 71.55 (d)(2) – geometric form of the content can not be substantially altered during normal transport
- Other requirements on the fuel are derived only if the applicant's cask design requires specific behavior of the fuel to meet criticality, containment, confinement, and thermal regulations

Criticality

- Criticality should not occur during a regulatory transport accident, assuming moderator floods the cask
- Many paths to solve the issue
  - Fuel configuration stays within the basis used to analyze acceptable K_{eff}
  - Burnup credit
  - Moderator exclusion (stabilizer addition, container and seals stay intact)
  - Over poisoning the cask

High Burnup Fuel Configuration Stays Within the Basis Used to Analyze Acceptable K_{eff}

- How much and what type of fuel relocation is acceptable?
- Does high burnup fuel coming out of the pool have acceptable properties to meet cladding fracture requirements- appears so
- Do property changes occur during storage that increase fracture probability
  - hydride reorientation
  - reduction in ductility
- Similar behavior by other cladding alloys?
- Is canning of individual assemblies necessary?

Research in Progress

- ANL test program
  - High burnup Zircaloy 4
  - Hydride reorientation critical stress
  - Ductility, & axial strength as a function of reorientation
  - Fracture propensity as function of impact
- Possible testing of Zirlo, M5 depending on availability and funding
- Vendor, utility programs?

Current Situation

- There is no NRC position preventing the loading and transport of high burnup fuel
- Until the identified issues are solved, transportation may require casks that are less efficient or economical then desired