

10 CFR Parts 71 & 72 Criticality Safety of Spent Fuel

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Presentation Outline



- Long term storage
- Comparison of Parts 71 and 72 criticality safety requirements
- Differences in guidance and implementation
- Potential efficiency gained by consistent analysis

Long Term Storage



- COMDEK-09-01 – revisiting the paradigm for spent fuel storage and transportation regulatory programs
 - Storage and transportation beyond 120 yrs
 - Standards, regulations, guidance, review process, inspection, enforcement
- Extended Storage and Transportation of SNF (COMSECY-10-0007)
 - Research to support technical basis for extended storage followed by transportation
- DOE Gap Analysis to support extended storage of SNF
 - Identified criticality safety as an issue that cuts across all areas of waste management

Requirements – Part 72



- §72.124 – Spent fuel under all conditions (normal, off-normal, accident) must be subcritical; double contingency
 - Demonstration of continued efficacy of neutron absorbers
 - Criticality monitoring
- §72.236(c) – spent fuel storage cask must maintain subcriticality under credible conditions
- §72.236(m) – consideration of removal, transportation, and ultimate disposition of spent fuel

Requirements – Part 71



- §71.55(b) – Subcritical with: 1) most reactive credible configuration of contents, 2) water moderation to the most reactive credible extent, 3) full reflection
- §71.55(d) – subcritical under normal conditions
- §71.55(e) – subcritical under accident conditions
- §71.59 – criticality evaluation of package arrays; determination of criticality safety index (CSI)

Guidance



- SRPs:
 - NUREGs 1536 and 1567 for ISFSIs and Dry Cask Storage Systems
 - NUREGs 1609 and 1617 for Transportation packages for radioactive material and spent nuclear fuel
- NUREG/CR-6361- benchmark guide for LWR fuel in storage and transportation
- NUREG/CR-5661- transportation criticality safety analyses
- ISG-8 – burnup credit for PWR fuel
- ANS 8 series criticality safety standards

Implementation



- Part 71 – Issuance of Certificate of Compliance with attached:
 - Licensing drawings
 - Operating procedures
 - Maintenance program
- Part 72 – Issuance of Certificate of Compliance with attached Technical Specifications
 - Rulemaking

Implementation – Part 71



- Demonstration of subcriticality “as-loaded” with full water moderation (§71.55(b))
- Demonstration of subcriticality with damaged package and contents, with full water moderation (unless ISG-19 invoked to demonstrate no water in-leakage under accident conditions) (§71.55(e))
- Rely on fixed neutron absorbers and “full” burnup credit in order to demonstrate subcriticality of high-capacity PWR packages when water moderation considered.
- High burnup fuel – unknown mechanical properties

Implementation – Part 72



- Demonstration of subcriticality with cask under loading conditions, moderated to the most reactive extent with borated SFP water
- Cask considered to be dry under storage conditions
- Fresh fuel assumption – no burnup credit
- Soluble boron concentration in SFP (typically ~2000 ppm) sometimes raised as high as 2600 ppm during loading

Consistent Criticality Analysis



- Part 71 criticality analysis – cask as-loaded with fresh water – performed as part of Part 72 analysis
- Opposite of how current approvals are typically sought (i.e., storage approval followed by transportation certificate), but has many advantages:
 - One detailed criticality review replaces two
 - §72.236(m) satisfied
 - No need to credit soluble boron level during loading
 - Stakeholders satisfied that stored fuel is transportable with respect to criticality
 - Criticality analysis largely applicable over long term storage period

Questions?

