Burnup Credit for Casks – Industry Perspective

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Overview

- Introduction
- Need for Cask BUC
- General Criticality Analysis Differences
- Spent Fuel Casks vs. Spent Fuel Pools
- Spent Fuel Casks vs. Reactor Core
- Summary

Why Are We Here?

- Most issues cited as being "issues" associated with spent fuel BUC in casks appear to be no different, or minimally different, than those same characteristics for spent fuel BUC in spent fuel pools
- We want to engage NRC in a factual, pragmatic dialogue to determine what the real issues are and develop solution paths to obtain full BUC for casks

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Introduction

- Burnup credit (BUC) used in spent fuel pools
  - 10 CFR 50.68(b)(4) provides criteria for criticality control with and without boron credit
- Current transport cask certificates issued on basis of fresh fuel criticality analyses
  - Recommendations for Actinide-only BUC provided in ISG-8 R2
- Differences cited as basis for different treatment
  - SFP vs. casks
  - Core vs. casks

Current Status
SFP – Cask Comparison

Item	Pt 50 – SFP	Pt 71 – Cask
Moderation	Actual, nominal	Assumed, optimum
Isotopes credited	Act + FP	Major Act only
Depletion Benchmarking	Implicit, by using core design tools	Explicit, potentially on an isotope-by-isotope basis
Fuel Covered	95%+	20%

Need for Cask BUC

- BUC effects on in-pool cask loading operations
  - Subcriticality requirement differences
    - Pt 50 (w/ BUC): k_{eff}<0.95 w/ boron, <1.0 w/o boron
    - Pt 72 (w/o BUC): k_{eff}<0.95
  - Fixed neutron absorber credit differences
    - Pt 50: full credit
    - Pt 72: 75%-90% credit
  - Result: significant pool boron impacts – example (in a cask)
    - Pt 50: 0 ppm (k_{eff}<1.0), ~400 ppm (k_{eff}<0.95)
    - Pt 72: ~2600 ppm (k_{eff}<0.95)
  - Both are considered adequate to protect public health and safety

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Need for Cask BUC

- BUC for Transportation
  - Transportation of high capacity PWR casks / canisters
    - Current fresh fuel assumption: only able to ship fuel with very low enrichments
    - Actinide only: covers about 20% of current fuel
  - Option is to unload / repackage hundreds of canisters / casks - not ALARA, more fuel handling, more cask shipments

General Criticality Analysis Differences*

Casks (Part 71/72)	Spent Fuel Pools (Part 50)
Generic analyses	Plant-specific analyses
No site-specific in-core depletion data available	In-core depletion data available
Analyses must bound all plants and fuel designs	Analyses specific to that plant & assoc fuel designs
Multiple environments – storage, transport, pools	Single environment – spent fuel pools
Short-term storage in moderated environment	Long-term storage in moderated environment
Intermittent monitoring	Continuous monitoring
Stored and transported in open environment	Maintained in closed, confined, and controlled environment
Mobile and passive systems	Stationary and active system
Partial burnup credit available (actinides)	Full burnup credit permitted
75 to 90% credit for fixed neutron absorbers	Full credit for fixed neutron absorbers with surveillance program
Soluble boron credit needed to maintain subcriticality	No soluble boron credit permitted to maintain subcriticality

* Summarized from NEI/NRC Public Meeting on RIS 2005-05, November 10, 2005

Spent Fuel Casks vs. Spent Fuel Pools

- Analyses must bound all plants and fuel types
  - Generic analysis vs. plant specific analysis
    - Even on plant-specific basis, analysis is not for each assembly – bounding / conservative assumptions are used
    - Similar approach, for each fuel type, can certainly be used for casks
  - In-core depletion data availability
    - Data is available, but may be difficult to apply to generic applications for all fuel
    - Recommend to use a sampling of available data for each fuel type, across burnup range, to provide reasonable assurance that depletion used for generic applications is conservative

Spent Fuel Casks vs. Spent Fuel Pools

- Multiple environments vs. single environment
  - It is unclear how this affects the burnup credit criticality analyses – we are looking at optimum moderation, actual geometry of racks/baskets, etc.
- Time in moderated environment
  - Again, the most reactive configuration will be the optimum moderation case. The amount of time in a moderated environment in and of itself does not affect the analyses
- Intermittent vs. continuous monitoring
  - It is not clear how monitoring frequency mitigates or prevents criticality, or how it would affect a BUC analysis

Spent Fuel Casks vs. Spent Fuel Pools

- Open vs. closed environment
  - Transportation package is very robust
    - Required to prevent criticality under accident conditions at optimum moderation
    - Required to preclude moderator intrusion
    - Probability of accidental criticality has been assessed to be on the order of 10^{-14}, i.e., not credible
  - SFP
    - Required to prevent criticality under any accident conditions at full moderator density
  - How does the environment affect BUC criticality analyses?

Spent Fuel Casks vs. Spent Fuel Pools

- Mobile/passive vs. stationary/active system
  - It would seem that these are counter-balancing; i.e., that passive is better than active, but stationary is better than mobile

Spent Fuel Casks vs. Spent Fuel Pools

- Fixed neutron absorber credit
  - Same neutron absorber materials
  - Degradation mechanisms in pool resulted in monitoring requirements
  - Since the borated material in casks is usually dry, there are minimal degradation mechanisms
  - No basis for partial credit in casks

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Spent Fuel Casks vs. Spent Fuel Pools

- Soluble boron credit
  - PWR SFPs can rely on BUC & soluble boron credit
    - Soluble boron credit pools must demonstrate $k_{eff} < 1.0$ without boron
  - Current PWR casks do need soluble boron credit for loading
    - Lower ppm would be required with burnup credit
    - Consistent with Part 50 ppm requirements

Spent Fuel Casks vs. Reactor Core

- The same spent fuel is stored in spent fuel pools and loaded in spent fuel casks
- Therefore, citing that reactor core environment is too different from cask environment as a basis to say we can't have full BUC in casks (while allowing it in SFPs) is not consistent
- If reactor data is OK to support BUC in racks, it is hard to see a basis why this is not equally acceptable for BUC in casks

Summary

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