

High Burnup Licensing for Storage and Transportation

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Industry Comments Overview

- New requirements are being stipulated in the RIS
- Approach is based on laboratory experiments that are not representative of spent fuel assemblies
 - Ring compression testing of defueled cladding does not account for benefit of fuel-clad bond or presence of the fuel pellet.
 - Insufficient stresses in storage and transportation to cause significant fuel reconfiguration.
- Clarification needed that this is only applicable for license renewal (not initial license period)
- Licensing approach needs to be risk-informed
- RIS needs to rely on ISG-24 as the principle basis for storage and transportation of high burnup fuel.
- Backfit discussion needs to be modified

Regulatory Requirements

- Storage - 10CFR72.122(h):
 - “The spent fuel cladding must be protected during storage against degradation that leads to *gross* ruptures or the fuel must be otherwise confined such that degradation of the fuel during storage will not pose *operational safety problems* with respect to it’s removal from storage”

How are Regulatory Requirements Met?

- Storage:
 - Inert environment (i.e., helium)
 - Limited/no residual water via established drying process
 - Basket/canister design prevent significant fuel movement
 - Limitation of the peak clad temp below 400°C (realistically much lower)
 - Natural events fail to cause significant stresses on the fuel
 - Confinement boundary prevents water ingress

Regulatory Requirements

- Transportation - 10CFR71.55(d)(2):
 - “The geometric form of the package contents would not be *substantially* altered under normal conditions of transport described in 10CFR71.71”

How are Regulatory Requirements Met?

- Transportation:
 - Inert environment (i.e., helium)
 - Limited/no residual water via established drying process
 - Containment boundary and canister independently prevent water ingress (moderator exclusion)
 - Limitation of the peak clad temp below 400°C (realistically much lower)
 - Impact limiters reduce stresses on package and contents during hypothetical accident conditions to prevent substantial alteration

Risk-Informed Perspective

- Risk-informed perspectives and risk analysis continually show low risks
 - EPRI and NRC Dry Storage PRAs conducted in 2007
 - Annual cancer risk between $1.8\text{E-}12$ and $3.2\text{E-}14$ *

High Burnup Fuel is Likely NOT Brittle

- EPRI Results
 - Best estimate: No or little re-orientation should be expected during dry storage
 - Consequence: no unexpected behavior during storage and transportation

- Fuel and cask/canister internals issue: “significant” fuel geometric rearrangement?
UNLIKELY EVEN FOR ACCIDENT CONDITIONS

Radionuclide release (if any) due to loss of confinement is a slow, low health consequence process

* Compares to $2\text{E-}6$ LCF/yr. public & $1\text{E-}5$ LCF/yr. worker thresholds of negligible risk from NRC’s framework for “Risk-Informed Decision-making for Nuclear Material and Waste Applications”, Revision 1, February 2008

Link to Retrievability

- Retrievability
 - Framework for retrievability should focus on the dry storage system to perform the safety function, with cladding as defense in depth
 - Technologies exist today to handle fuel with gross ruptures or structural defects without impact on worker or public safety.
 - A revised performance-based and risk-informed definition for “canister-based” retrievability needs to be established.

Backfit Discussion

- Proposed Rulemaking (PRM) 72-7 requests extending backfit protection to CoC holders:
 - Allows resources to “be focused on regulatory activities that will yield the most substantial safety benefits”
 - Adheres to principles of fundamental fairness that underlie the application of the backfitting rule
 - Consistent with NRC’s Principles of Good Regulation, “...regulation should be perceived to be reliable and not unjustifiably in a state of transition.”
- Remove language about backfit “protection”

Summary

- Newer studies are showing that high burnup fuel is not significantly different (high burnup fuel may actually be better – as seen in operation through lower fuel leaker rate)
- Previous experimental tests were not representative of actual spent fuel
- Need to adhere to the actual words contained in the Code of Federal Regulations – no extra-regulatory requirements
- Current cask designs and loading operations already provide reasonable assurance that fuel assemblies will be protected against significant degradation.