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Strategy for Revising 50.46(b) ECCS Acceptance Criteria

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Rulemaking Objectives

Following Commission directive, develop a performance-based rule which:

- Establish appropriate safety margins for high-burnup fuel based on recent research results.
- Replace prescriptive criteria with performance-based regulatory requirements.
- Enable use of advanced cladding materials without exemptions.

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Rulemaking Plan

- Revise and expand 50.46(b) ECCS acceptance criteria.
  - Capture results of High Burnup LOCA Research Program which identified new embrittlement mechanisms (beyond basis of 1973 rule).
  - Not an alternative to existing criteria.
  - Not an optional rule.
- No immediate safety concerns.
  - Adequate safety margin for post-quench ductility.
  - No impact on radiological consequences.

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Applicability of Rule

Current Regulation:

- Paragraph (a)(1)(i) limits applicability to "zircaloy or ZIRLO".

Research Finding:

- Empirical database includes wide range of zirconium alloys (e.g., Zry-2, Zry-4, E110, ZIRLO, M5).
- Testing requirements and test procedures valid for all zirconium alloys.

Strategy for Revising Regulation:

- Replace "zircaloy or ZIRLO" with less specific terminology (e.g., approved zirconium-alloy).
- Applicability to new alloys will need to be demonstrated by testing.

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Peak Cladding Temperature

Current Regulation:

- Paragraph (b)(1) limits PCT to 2200°F to preserve cladding ductility.

Research Finding:

- Post quench ductility (PQD) decreases dramatically in samples oxidized beyond 2200°F.
- Confirms current regulatory criterion.

Strategy for Revising Regulation:

- No change.

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Local Oxidation Limit

Current Regulation:

- Paragraph (b)(2) limits local oxidation to 17% ECR to preserve cladding ductility.

Research Finding:

- New cladding embrittlement mechanism identified.
  - PQD sensitive to pre-transient cladding hydrogen concentration.
- A constant 17% ECR limit does not always ensure PQD.

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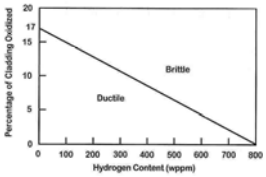
Local Oxidation (cont.)

Strategy for Revising Regulation:

Alternative Regulations:

1. Generic PQD criteria specified within rule.



2. Optional test program for defining alloy-specific or temperature-specific PQD criteria.

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ID Oxygen Diffusion

Current Regulation:

- None.

Research Finding:

- Oxygen from fuel bonding layer (on cladding ID) diffuses into the base metal and exacerbates cladding embrittlement.

Strategy for Revising Regulation:

- New requirement within rule.

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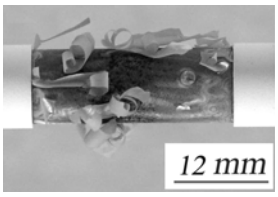
Breakaway Oxidation

Current Regulation:

- None.



Research Finding:

- New cladding embrittlement mechanism identified.
- Timing of transformation sensitive to manufacturing process.

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Breakaway Oxidation (cont)

Strategy for Revising Regulation:

- New performance requirement within rule.
  - Required testing to establish measured break-away time.
- Required periodic testing.

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Optional Test Program

- Regulations within 50.46(b)(2) specify general requirements for optional testing:
  - Criterion for the ductility test would be 2% strain using ring-compression tests.
  - Criterion for the breakaway oxidation test would be 200 wppm hydrogen uptake.
- Acceptable experimental protocols for establishing cladding ductility criteria and breakaway oxidation limits would be described within a Regulatory Guide.

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Rulemaking Process

Milestones:

1.	NUREG/CR-6967 & RIL-0801	Completed 6/2008
2.	FRN Soliciting Public Comment	Completed 8/2008
3.	Public Workshop #1	Completed 9/2008
4.	Assessment of Technical Basis	Completed 12/2008
5.	ACRS	Completed 12/2008
6.	Additional research testing (PQD and breakaway)	Planned 4/2009
7.	Comprehensive test procedures	Planned 4/2009
8.	Conceptual rule (structure and language)	Planned 4/2009
9.	Advance Notice of Proposed Rulemaking (ANPR)	Planned 8/2009
10.	Public comment period	
11.	Workshop #2	
12.	Backfit determination per 10 CFR 50.109	
13.	Proposed rule	Estimated 8/2010
14.	ACRS	
15.	Public comment period	
16.	Final rule	Estimated 8/2011

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