



**An Industry Technical Position  
On LOCA Rulemaking**

**21<sup>st</sup> Regulatory Information  
Conference  
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**Presentation Overview**

- Safety significance
- Industry position on hydrogen pre-charging as a surrogate for irradiation
- Outstanding issues
- Industry position on issues and test plans
- Summary

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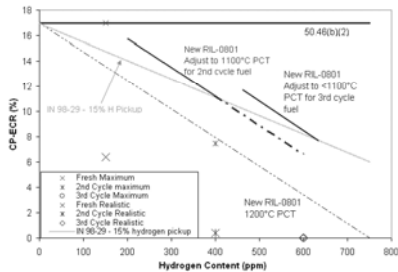
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**Safety Significance**

- Evaluations indicate no significant safety concerns with respect to current design basis and therefore no need to rush rulemaking without resolution to important issues



- IN-98-29 with 15% hydrogen pickup is more conservative
  - High burnup fuel can not reach high temperatures after 2<sup>nd</sup> cycle
- Most plants have PCT < 1100°C using BE evaluations
  - NUREG concluded "...beta layer does not appear to embrittle due to the low oxygen solubility (~0.4 wt.%) in the beta phase at 1100°C..."

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## Breakaway Oxidation Issue

- NRC is considering including a requirement for periodic testing into revised LOCA rule
  - Time to onset of breakaway oxidation to be based on 200 ppm hydrogen pickup
- Issues
  - Requirement precipitate by short breakaway time observed in the Russian E110 alloy
    - E110 is fabricated via an electrolytic process, fundamentally different from the Kroll process used by Western source material suppliers
    - Western alloys are not susceptible to short breakaway oxidation
  - Realistic LOCA temperature profiles are not isothermal
  - Visual precursors prior to breakaway can be used to determine breakaway times, no need for 200 ppm hydrogen criteria
    - Better suited for manufacturing environments
  - Realizes some form of breakaway testing will be required, but should not be addressed in the rule

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## Breakaway Oxidation Industry Position and Test Plans

- Industry proposes existing QA and qualification procedures are adequate to preclude the effect
  - Offered an extensive qualification program to establish baseline parameters to preclude breakaway oxidation
  - Re-qualification for any process changes that could affect breakaway oxidation
- Isolate cause of breakaway oxidation in E110
  - Planning tests to try and determine if the early breakaway phenomenon is due to impurities in the stock material
  - If successful institute procedures to control identified elements
  - Conduct breakaway oxidation tests early in the process to reduce risk and burden
- Collect data in support of a visual standard for breakaway oxidation test

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## Summary

- Evaluations indicate no significant safety concerns with respect to current design basis, industry will need time to complete planned tests
- Industry is in the process or planning to conduct further testing to address some of the key issues
  - LOCA oxidation tests to complement ANL work
  - ID oxidation tests to evaluate the impact of ID oxygen uptake on PQD
  - Chemical analyses and oxidation tests to attempt to isolate the cause of short breakaway oxidation time observed in E110
- Pre-hydriding appears to be a good surrogate for irradiation; allowing for implementation of new materials in a fast and cost effective manner
- New rule should be performance based and allow the industry flexibility in demonstrating compliance

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