Public Meeting on Draft Regulatory Guides for 50.46c – ORNL

Implementation of Periodic Breakaway Oxidation Testing

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Andrew Atwood

Westinghouse

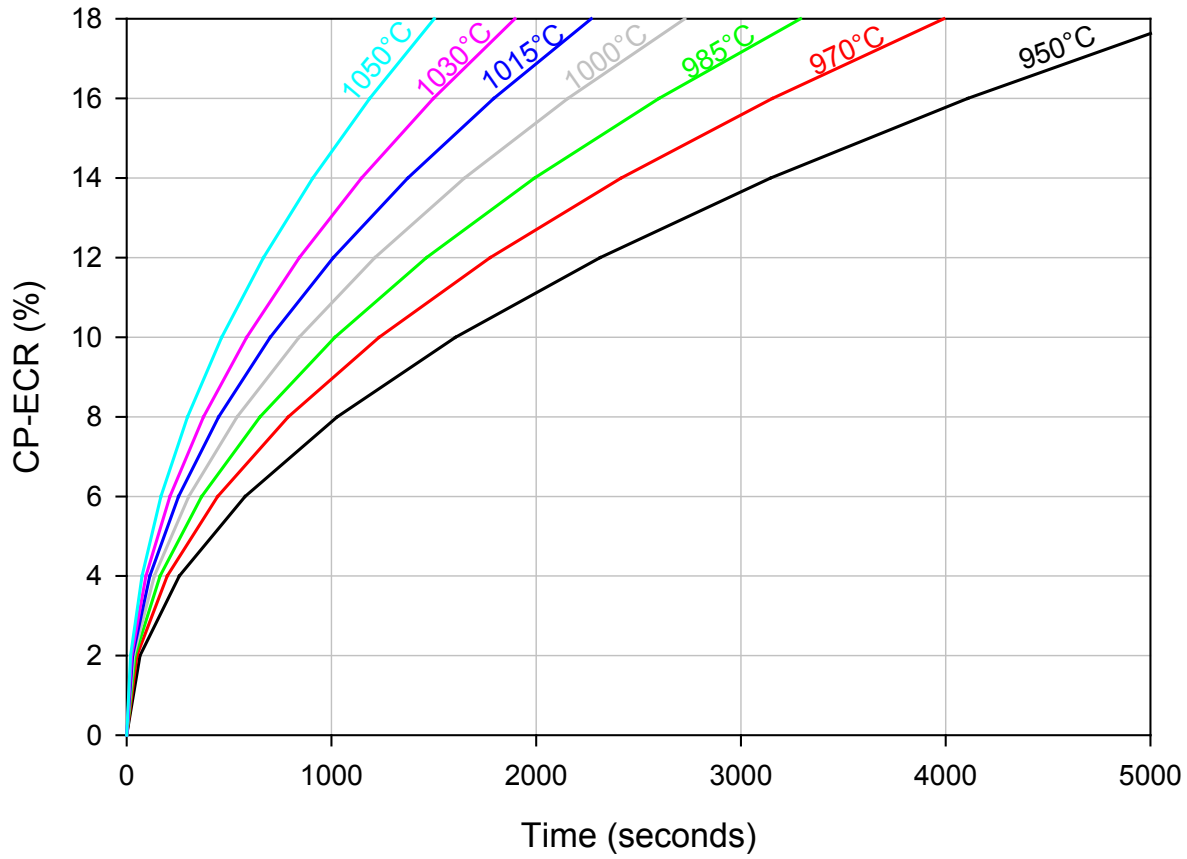
Outline

- Background
- Fuel cladding manufacturing
- Proposed testing relative to the draft regulation guides
- Test protocol

Breakaway Oxidation Alloy Specific Criterion

- In accordance with the draft regulation guide
  - The maximum period of time that fuel cladding may experience long-term oxidation in a Post-LOCA scenario will be determined (analytical limit).
  - Based on testing of cladding representative of those loaded into fuel assemblies, the temperature at which the minimum time to breakaway is observed will be determined (critical temperature).
  - At this critical temperature, the minimum time to breakaway oxidation will be determined (minimum time).

Time at Critical Temperature Limited by ECR limits



Fuel Cladding Manufacture

- Zirconium alloy components are melted into ingots.
- Fuel cladding is produced in lots which are produced from a single ingot. Multiple lots are fabricated from an ingot.
- For fuel assembly manufacture, fuel cladding tubes from multiple ingots are used for a reload region.

Current Requirements and Proposed Testing

- Draft regulatory guidelines require testing 5 repeats from each reload.
- Guidelines should be revised to reflect manufacturing process.
- Fuel cladding would then be certified to exhibit breakaway oxidation time exceeding the analytical limit time as part of the existing quality assurance program.

Propose to test on an ingot basis rather than a reload basis

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Current Requirements and Proposed Testing

- Draft regulatory guidelines require testing samples representative of fuel rods in an assembly relative to cleaning and scratches. The guidelines provide a provision for testing non-scratched samples if the breakaway times fall within the testing scatter.
- Scratches are expected to have a small effect on time to breakaway oxidation, but it may be greater than test scatter. If so, guidelines should allow for:
  - Determination and application of an allowance for the impact of scratches on time to breakaway oxidation, to be applied to production tests performed on unscratched tubing.

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Proposed Breakaway Oxidation Testing

- Proposed testing will consist of exposing non-scratched samples to steam at the critical temperature for greater than the analytical time.
- The results of the testing will be determined on an accept/reject basis.
  - Samples maintaining a black appearance = accept
  - Samples showing indications of breakaway oxidation will be further evaluated by hydrogen analysis of the indication location. Indication locations with < 200ppm hydrogen = accept.

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