

# Public Meeting on Draft Regulatory Guides for 50.46c – ORNL

## Implementation of Periodic Breakaway Oxidation Testing

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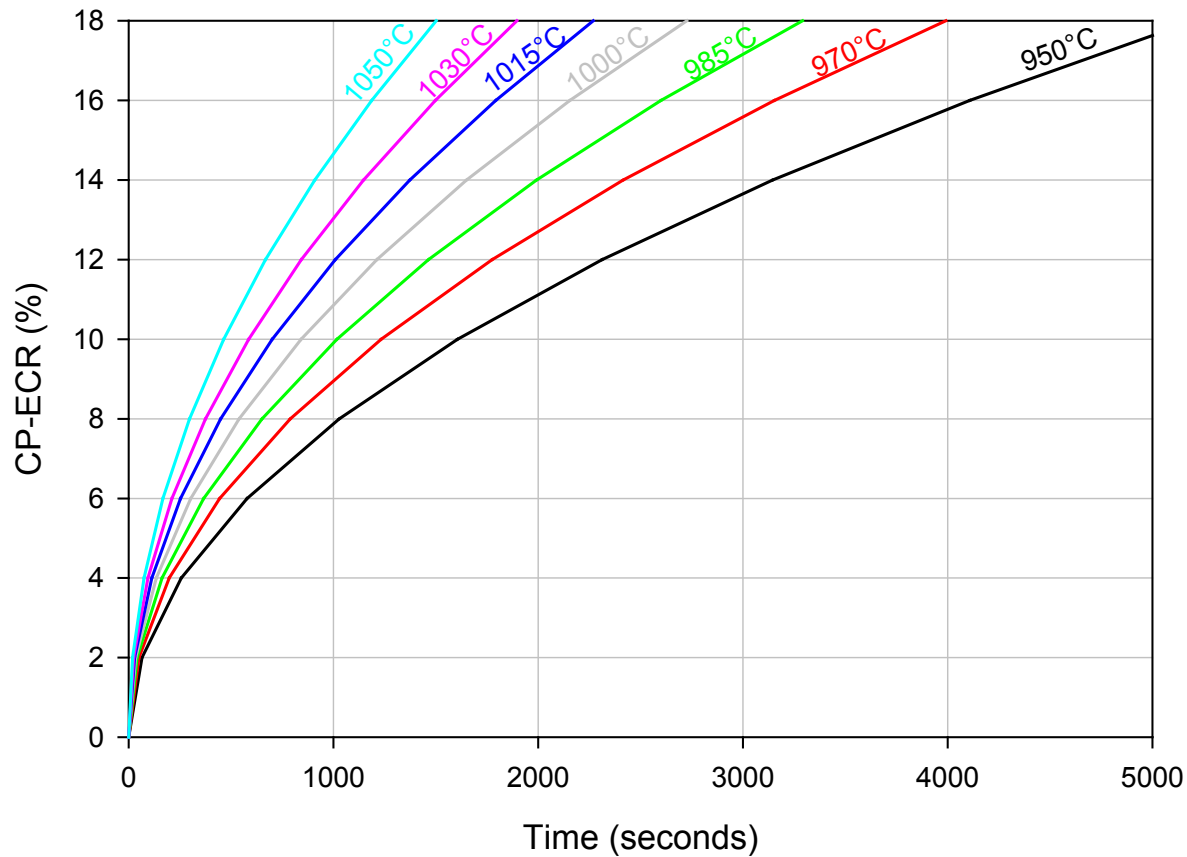
# Outline

- 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**

# 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.

# 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.