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EVALUATION OF ZIRCALOY FUEL CLAD OXIDATION AT MILLSTONE 3 PWR

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Project Manager:

Objectives: Analyze plant data on Zircaloy-4 clad oxide thickness taken from Millstone 3 in comparison with data from North Anna 1.

Comments:

COOLANT LITHIUM EFFECTS ON ZIRCALOY-4 CLAD OXIDE THICKNESS:

- Summary of laboratory tests
 - No voidage, no B, 3.5 ppm Li --> 2% to 5% increase of 2.2 ppm Li
 - No voidage, >50 ppm B, 3.5 ppm Li --> negligible increase
 - High voidage, any B, any Li --> large increase
- Plants do not operate with high voidage: effect may be slight
- Need to check actual plant data, especially for thick oxides
- Hence EPRI/Westinghouse program at Millstone 3 and comparison plant, North Anna 1.
EPRI contracted Nuclear Electric to analyse results.

SUMMARY OF OXIDE THICKNESS RESULTS:

- Millstone (Elev) 13% or 14%* higher than N Anna (Co-ord)
- Millstone One Cycle exposures (few rods only): D, E Assemblies (Elev) 29% or 42%* lower than A assemblies (Co-ord)
- Millstone Two Cycle exposures: D Assemblies (Elev) 33% or 36%* lower than B, C assemblies (Co-ord and Elev)
- All above results significant at >99% confidence level
- Hence inconsistent results on Li effect
- Inconsistency probably due to batch-to-batch differences in standard Zr-4 clad

* One value from slope of fit to measured vs predicted, the other from mean measured/predicted ratios

Remarks/Potential for dose limitation:

- Inconsistent apparent effect of Elevated Li Chemistry:
 - Millstone/N Anna, higher oxidation
 - Millstone/Millstone, lower oxidation
- Likely reason for inconsistency is batch-to-batch variation in cladding:
 - Composition
 - Annealing

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- Cannot conclude from this study that Elevated Li enhanced Millstone oxide thicknesses
- Future work: measure oxide thicknesses after Millstone cycle 4 exposed to Co-ordinated pH(308) 6.9 chemistry

References: Swan, T. and Polley, M.V., "Zircaloy Fuel Clad Oxidation at Millstone 3 PWR," *Radiation Field Control Seminar*, Electric Power Research Institute, Seattle, Washington, 1993.

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