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U.S.A. R-343

RELATIONSHIP OF RADIATION-INDUCED SEGREGATION PHENOMENA TO IRRADIATION-ASSISTED STRESS CORROSION CRACKING (IASCC)

Keywords: COMPONENT RELIABILITY; IASCC; STAINLESS STEEL; ELECTRON MICROSCOPY; NICKEL ALLOY

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Objectives: The aim of this study was to enhance the understanding of IASCC in austenitic stainless steels and nickel base alloys by examining microstructural changes and grain boundary segregation as a function of irradiation at LWR temperatures.

Comments: The following alloys were studied:

1) Type 304 stainless steel
2) Type 316 stainless steel
3) high-purity Type 304 stainless steel
4) commercial purity alloy X-750

The techniques used for the microstructural examination and the grain segregation studies were scanning transmission electron microscopy (STEM) and auger electron spectroscopy (AES). Each of the four alloys were examined after being irradiated, and nonirradiated specimens served as controls.

Remarks/Potential for dose limitation: The investigations demonstrated that exposure to high neutron fluences at LWR temperatures produces microstructural and grain boundary changes in austenitic stainless steels and nickel base alloys. The STEM studies revealed black spot damage in the Type 316 stainless steel specimens at both high and low fluences. Such damage is responsible for the large increase in yield stress observed in steels irradiated at low temperatures. The AES analysis revealed evidence of chromium depletion at the grain boundaries of the high-purity and commercial-purity Type 304 stainless steel specimens as well as the alloy X-750 specimen. Nickel enrichment occurred in both the high-purity Type 304 and alloy X-750 samples. Some evidence of phosphorus and sulfur segregation was visible in the grain boundaries of the commercial-purity specimens.

References: "Relationship of Radiation-Induced Segregation Phenomena to Irradiation-Assisted Stress Corrosion Cracking (IASCC)," EPRI TR-101987, Final Report, February 1993.

Duration: from: 19 to: 1993

Funding: N/A

Status: Completed

Last Update: June 4, 1993