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THE INTEGRITY OF INCONEL ALLOYS IN HIGH TEMPERATURE WATER CHEMISTRY

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Project Manager:

Objectives: To investigate the electrochemical behavior of nickel-based alloys using potentiodynamic technique in sulfate and/or chloride environments at 316°C.

Comments: A low chromium alloy was designed to simulate the grain boundary composition of sensitized Inconel 600. High pressure and temperature electrochemical technique was applied to evaluate the effect of sulfate and chloride ions on the corrosion behavior of nickel-based alloys. Anodic polarization scans were performed with a Solartron 1286 Electrochemical Interface that communicated with an HP computer at a scan rate of 1 mV/s. The platinum counter electrode and Ag/AgCl reference electrode were maintained in de-aerated electrolytes. It was found that the trend of high temperature electrochemical polarization curves is a little different for nickel-based alloys in neutral, acidic, and alkaline solutions. Chloride ions tend to corrode metals catalytically, especially in highly acidic media, and sulfate ions are less damaging in the corrosion process, providing sulfate salts can be formed on active sites.

Remarks/Potential for dose limitation: High temperature water chemistry is a critical issue in determining the life assessment of heat exchanger tubes made of nickel-based alloys. There are two major contaminants, sulfate and chloride anions, that may be present in PWRs and affect the material performance. In creviced regions, the level of impurity concentration may be elevated by as much as four orders of magnitude. At high concentrations of sulfate and chloride ions, nickel-based alloys quite possibly suffer from a detrimental corrosion problem

References: Yang, I.-J., "The Integrity of Inconel Alloys in High Temperature Water Chemistry," *Water Chemistry of Nuclear Reactor Systems 6*, Vol. 1, pp. 177-180, British Nuclear Energy Society, London, 1992.

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