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DEVELOPMENT AND USE OF AN IN-PILE LOOP FOR BWR CHEMISTRY STUDIES

Keywords: CONTAMINATION PREVENTION; COMPONENT RELIABILITY; WATER CHEMISTRY; NITROGEN-16; ELECTROCHEMICAL POTENTIALS

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Objectives: Measure and evaluate changes in radiolysis product generation as well as electrochemical corrosion potential (ECP) levels and nitrogen-16 (N-16) behavior as a function of BWR core coolant inlet water chemistry.

Comments: An in-pile loop has been successfully constructed and operated to simulate BWR coolant chemistry conditions. Results from a series of runs demonstrated the effects of a wide variety of organic and inorganic chemical additions on radiolysis product generation, N-16 behavior, and ECP. These results were consistent with similar measurements in the reactor coolant of full-scale BWRs, providing data useful in building more reliable predictive models to explain actual plant experience.

Water radiolysis products, such as oxygen and hydrogen peroxide, and their effect on ECP play an important role in the stress corrosion cracking of reactor plant materials and the behavior of important species such as N-16. The purpose of this study was to obtain quantitative cause and effect data important to the evaluation of BWR chemistry conditions, both inside and outside current guideline values.

Remarks/Potential for dose limitation: The observed effects of changing from normal water chemistry to HWC included reduced O_2 and H_2O_2 concentrations, more negative ECPs, and increased N-16 carry-over in the steam phase. Organic additives and hydrogen had similar effects, increasing N-16 steam phase activity by a factor of approximately five while lowering ECP to levels that protect against stress corrosion cracking (below -230 mV). However, measured concentrations of O_2, H_2, and H_2O_2 were higher by a factor of two or more than those calculated using the MIT radiolysis code. This result is of potential significance for peroxide generation where BWR plant data are lacking. Molybdate was identified as a promising additive, capable of significantly lowering ECP without increasing N-16 carry-over. Improvements were identified for future runs to measure H_2O_2 and determine ECP more accurately.

References: "Development and Use of an In-Pile Loop for BWR Chemistry Studies," *EPRI TR-102248 Final Report*, Electric Power Research Institute, Palo Alto, CA, September 1993.

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