ADVANCES IN BWR WATER CHEMISTRY

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ABSTRACT

This paper reviews recent advances in Boiling Water Reactor (BWR) water chemistry control with examples of plant experiences at U.S. designed BWRs. Water chemistry advances provide some of the most effective methods for mitigating materials degradation, reducing fuel performance concerns and lowering radiation fields. Mitigation of stress corrosion cracking (SCC) of materials remains a high priority and improved techniques that have been demonstrated in BWRs will be reviewed, specifically hydrogen injection combined with noble metal chemical addition (NMCA) and the newer on-line noble metal application process (OLNC). Hydrogen injection performance, an important part of SCC mitigation, will also be reviewed for the BWR fleet, highlighting system improvements that have enabled earlier injection of hydrogen including the potential for hydrogen injection during plant startup.

Water chemistry has been significantly improved by the application of prefiltration and optimized use of ion exchange resins in the CP (condensate polishing) and reactor water cleanup (RWCU) systems. EPRI has monitored and supported water treatment improvements to meet water chemistry goals as outlined in the EPRI BWR Water Chemistry Guidelines, particularly those for SCC mitigation of reactor internals and piping, minimization of fuel risk due to corrosion and crud deposits and chemistry control for radiation field reduction. In recent years, a significant reduction has occurred in feedwater corrosion product input, particularly iron. A large percentage of plants are now reporting <0.1 ppb feedwater iron. The impacts to plant operation and chemistry of lower feedwater iron will be explored.

Depleted zinc addition is widely practiced across the fleet and the enhanced focus on radiation reduction continues to emphasize the importance of controlling radiation source term. In addition, shutdown chemistry control is necessary to avoid excessive release of activated corrosion products from fuel surfaces to the coolant and to out-of-core surfaces that can delay cleanup and affect refueling operations. The increasing complexity of chemistry alternatives, coupled with the goals to increase output and reduce costs, continues to necessitate strategic planning to evaluate and optimize plant chemistry changes at power plants.