A Re-evaluation of the Boric Acid Thermodynamics for PWR Systems

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The MULTEQ computer model was developed by EPRI to calculate the composition, pH, and electro-chemical (redox) potential of aqueous solutions at elevated temperature and pressure. The model uses an extensive database of thermodynamic equilibrium constants, which determine the concentrations of aqueous species and the identities of precipitates formed in a given system. The thermodynamics for aqueous boric acid species defined in the current EPRI MULTEQ database [1] are largely based on the potentiometric measurements at 50-200°C carried out at Oak Ridge National laboratory (ORNL) in the early 1970s [2]. Recently, the data have been extended down to 10°C and up to 350°C as part of an EPRI-funded experimental study [3,4,5]. These data are used to derive revised entries in the MULTEQ model for calculations in PWR primary coolant. This includes the adoption of a new model for the activity coefficient of the neutral boric acid species in solution.

This communication will review the application conditions relevant to PWR primary system chemistry, the existing borate models and high-temperature database, and present revised entries based on a critical evaluation of the data with a focus on bulk coolant conditions.

References

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