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A Study on Soluble Boron Control During Load-Follow Operation Using Sliding Mode Observer in APR1400

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During daily load-follow operation, the xenon concentration in the reactor changes over time due to reactor power variation. To compensate for this change, the soluble boron concentration in the core is adjusted through dilution or boration. However, since xenon is not directly measurable in the reactor, the sliding mode observer is utilized to estimate the xenon concentration prior to the daily load-follow operation. This estimation provides the operator with valuable information to determine the appropriate boron concentration adjustment scenario. The robustness of the sliding mode observer relies on accurate estimation of the observer gains used in the model, ensuring the sliding surface is reached within a finite time.
Mode-K+ was employed to perform the load-follow operation in the APR1400 reactor. Soluble boron scenarios were chosen with linear variation over time, and no dilution or boration occurred before the completion of power ramp-down and ramp-up to prevent any reactivity divergence in the core. The results indicate good agreement between the observed xenon concentration and the actual xenon concentration variation in the core, calculated using time-dependent xenon concentration simulation. This analysis was conducted using a two-step procedure: cross-section evaluation using the SERPENT continuous energy Monte Carlo code, and whole core calculations performed using an in-house diffusion code called KANT.

Speaker Bio

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