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Title:
MODELLING OF INGRESS AND DIFFUSION OF HYDROGEN ISOTOPES IN CANDU FUEL CHANNEL ASSEMBLY

Abstract:

Hydrogen isotopes are present in CANDU® reactor pressure tubes as initial protium from manufacturing and through ingress during operation. Ingress is more prominent at the rolled joint connection at each end of the pressure tube such that concentration gradients cause inboard diffusion of the hydrogen.

Ingress and diffusion modelling is applied to demonstrate that hydrogen equivalent concentration, $[H_{eq}]$, remains within safe limits to ensure pressure tube integrity over the reactor operating interval. Previous modelling applied ingress as a source due to corrosion with heavy water at the pressure tube inner surface plus an empirically determined source at the rolled joint. The empirical ingress source may be unsuitable for evaluation of potential fuel channel design changes made to mitigate ingress.

In this work, the rolled joint ingress model is extended to explicitly include the end fitting and pressure tube assembly. The flow of hydrogen into the pressure tube at the rolled joint is determined by diffusion in both components and the interface condition where they are connected by the rolled joint. Results are presented to demonstrate how a more comprehensive depiction of the ingress and diffusion processes can be modelled.

Keywords:
CANDU Fuel Channels, Hydrogen Ingress

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