Damage modeling in the swelling evaluation of the WWERs pressure vessel internals

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Abstract

Long-term operation (LTO) of WWER-type nuclear power plants (NPPs) beyond their originally planned lifetime is critical in providing reliable low emissions power. In the aspects of pressure vessel internals (PVI) the main limiting factor is Irradiation induced swelling of the Core Baffle, which affects related PVI elements (pins, Core Barrel).
The reactor core baffle experiences heavy loadings of neutron and gamma irradiation, thus, the degradation of reactor internal material along with geometric distortion, called swelling, is quite severe. The computational model includes determination of the void swelling of an elementary volume of the Core Baffle material depending on the neutron fluence in dpa and temperature (based on heat rate assessment and compared to other swelling models, influence of the stress is accounted. Also, this degradation includes changes in the material microstructure and microchemistry and can lead to irradiation assisted stress corrosion cracking (IASCC).
The present study focuses on the damage modeling of PVI during the operational time. Due to the complex visco-plastic mechanism of Baffle deformation an attempt is made to use different damage mechanisms to estimate the lifetime of the components.

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