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Reactor pressure vessel steel smart behavior as cause of instability in kinetics of radiation embrittlement

Evgenii Krasikov
National Research Centre “Kurchatov Institute”, Russia

Influence of neutron irradiation on reactor pressure vessel (RPV) steel degradation are examined with reference to the possible reasons of the substantial experimental data scatter and furthermore-nonstandard (non-monotonous) and oscillatory embrittlement behavior. We suppose that the main factor affecting steel anomalous embrittlement is fast neutron intensity (dose rate or flux), flux effect manifestation depends on state-of-the-art fluence level. At low fluencies radiation degradation has to exceed normative value, then approaches to normative meaning and finally became sub normative. Data on radiation damage change including through the ex-service RPVs taking into account chemical factor, fast neutron fluence and neutron flux were obtained and analyzed. In our opinion, controversy in the estimation on neutron flux on radiation degradation impact may be explained by presence of the wavelike component in the embrittlement kinetics. Therefore flux effect manifestation depends on fluence level. At low fluencies radiation degradation has to exceed normative value, then approaches to normative meaning and finally became sub normative. As, hypothesis we suppose that at some stages of irradiation damaged metal have to be partially restored by irradiation i.e. neutron bombardment. Nascent during irradiation nanostructure undergo occurring once or periodically evolution in a direction both degradation and recovery of the initial properties. According to our hypothesis at some stage(s) of metal nanostructure degradation neutron bombardment became recovering factor. So, material smart behavior is a cause of instability in kinetics of radiation embrittlement of the reactor pressure vessel steel. As a result oscillation arise that in tern lead to enhanced data scatter.

ekrasikov@mail.ru