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Nanostructure evolution as cause of non-monotonic embrittlement kinetics of the RPV steel

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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-monotonic) and oscillatory embrittlement behavior. In our glance this phenomenon may be explained by nanostructure evolution of steel during irradiation that result in presence of the wavelike recovering component in the embrittlement kinetics. 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. 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. Owing to nanostructere evolution at low fluencies radiation degradation has to exceed normative value, then approaches to normative meaning and finally became sub normative. Paradoxically, as a result of dose rate effect manifestation peripheral RPV's zones in some range of fluencies have to be damaged to a large extent than situated closely to core. 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.

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