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DIFFERENT APPROACHES TO ESTIMATION OF REACTOR PRESSURE VESSEL MATERIAL EMBRITTLEMENT

The surveillance test data for the nuclear power plant which is under operation in Ukraine have been used to estimate WWER-1000 reactor pressure vessel (RPV) material embrittlement. The beltline materials (base and weld metal) were characterized using Charpy impact and fracture toughness test methods. The fracture toughness test data were analyzed according to the standard ASTM 1921-05. The pre-cracked Charpy specimens were tested to estimate a shift of reference temperature T_0 due to neutron irradiation. The maximum shift of reference temperature T_0 is 84 °C. A radiation embrittlement rate A_F for the RPV material was estimated using fracture toughness test data. In addition the A_F factor based on the Charpy curve shift (ΔT_F) has been evaluated. A comparison of the A_F values estimated according to different approaches has shown there is a good agreement between the radiation shift of Charpy impact and fracture toughness curves for weld metal with high nickel content (1,88 % wt). Therefore Charpy impact test data can be successfully applied to estimate the fracture toughness curve shift and therefore embrittlement rate. Furthermore it was revealed that radiation embrittlement rate for weld metal is higher than predicted by a design relationship. The enhanced embrittlement is most probably related to simultaneously high nickel and high manganese content in weld metal.

*Keywords***:** WWER-1000 reactor pressure vessel, surveillance specimens, neutron fluence, radiation embrittlement, fracture toughness.