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# Characterizing the Fracture Toughness Properties of Aluminum I-Rod Removed from National Research Universal Reactor

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**Abstract :** Extensive weld repair was carried out in 2009 after a leak was detected in the aluminum 5052 vessel of the National Research Universal (NRU) reactor. This was the second vessel installed since 1974. In support of the NRU vessel leak repair and fitness for service assessments, an estimate of property changes due to irradiation exposure is required to extend the service of the reactor until 2018. In order to fully evaluate the property changes in the vessel wall, an Iodine-125 rod (I rod) made from the same material and irradiated in the NRU reactor from 1974 1991, was retrieved and sectioned for microstructure characterization and mechanical testing. The different sections of the I rod were exposed to various levels of thermal neutron fluences from 0 to a maximum of 11.9 x 1022 n/cm2. The end of life thermal neutron fluence of the NRU vessel is estimated to be 2.2 x 1022 n/cm2 at 35 years of service. Tensile test and fracture toughness test was performed on the I-rod material at various axial locations. The changes in tensile properties were attributed primarily to the creation of finely dispersed Mg-Si precipitates that harden the material and reduced the ductility. Despite having a reduction in fracture toughness, the NRU vessel is still operation at the current fluence levels.

**Keywords :** aluminum alloy, fitness-for-service assessment , fracutre toughness, nuclear reactor, precipitate strengthening, radiation damage, tensile strength
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