EngInit - Blueprint for an engineering model for time-to-failure of thin-walled, irradiated components of 316 SS under nominal PWR-relevant SCC conditions

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Some nuclear reactor internal components are susceptible to cracking, e.g. irradiated 316 stainless steel baffle-to-former bolts. This is not an immediate safety issue; it is rather an economic issue due to inspection and replacement costs. The failures have been attributed to IASCC and international programs have shed light on the phenomena; e.g. EPRI-CIR.

The nuclear community is interested in (1) the time-to-failure as a function of stress level and dpa and (2) whether or not there is a critical stress level below which no failure occurs.

A damage-based model, EngInit, to predict time-to-failure of thin-walled, irradiated components has been developed. EngInit assumes that time-to-failure is inversely proportional to accumulated damage, that accumulated damage can be calculated from a damage rate and that the damage rate is power-law dependent on stress. The three parameters in the EngInit model are fluence-dependent and can also be made temperature- & environment-dependent.

Time-to-failure equations have been derived for a constant stress, two consecutive stress levels, a constant stress rate and an in-pile constant or relaxing stress.

Approximate parameters for the EngInit model have been obtained by comparison with literature and in-house post-irradiation time-to-failure data from hot-cell, autoclave, O-ring tests on nuclear power plant material.