Cracking of Irradiated CF-3 Cast Austenitic Stainless Steel with 24% Ferrite

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Cast austenitic stainless steels (CASS) are vulnerable to thermal aging and irradiation embrittlement due to their austenite-ferrite duplex microstructure. Exposed to neutron irradiation and high-temperature coolant under service conditions, the microstructure of CASS alloys undergoes significant changes, leading to deteriorated cracking properties and fracture resistance. To assess the impact of thermal aging and irradiation embrittlement on CASS materials, CF-3 static cast specimens with 24% ferrite were tested in low-corrosion-potential environments under as-received (i.e. unaged) and thermally aged conditions. The thermal aging was conducted at 400°C for 10,000 hr. Both unaged and aged specimens were irradiated to 0.08 dpa prior to the tests. Compared with unirradiated control specimens, no elevated crack susceptibility was observed at 0.08 dpa in the test environments. Neutron irradiation, however, had a dominant effect on the reduction of fracture toughness. Irradiation-induced degradation seemed to develop differently in the unaged and aged specimens, and the loss of fracture toughness was more significant in the unaged specimens.