Immersion Corrosion Testing of Iron-Chromium-Aluminium Tubes under Simulated Light Water Nuclear Reactors Normal Operation Conditions

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The US Department of Energy is funding research to improve the operation safety of existing Generation III light water reactors nuclear power plants. General Electric, Oak Ridge National Laboratory and Nippon Fuel Development are proposing to replace the current zirconium-based cladding using iron-chromium-aluminum alloys (FeCrAl). It is important to characterize the behavior of the FeCrAl materials, since they were never used before in nuclear applications. The characterization includes the behavior of the FeCrAl cladding in the entire fuel cycle, from power generation to used fuel disposition. The current work is related to the corrosion resistance of FeCrAl in pure water at temperatures of 288°C to 330°C under hydrogen and oxygen conditions. The specimens tested were tube segments of the fuel cladding geometry and microstructure and with a wall thickness of less than 0.5 mm. Mass change measurements of the tubes were conducted every three months for a total period of one year and compared with the mass changes of Zircaloy-2 tube segments. Four types of specimens were tested including tubes of APMT, C26M and two geometries of NFD ODS FeCrAl. The tested FeCrAl offered a good resistance to corrosion under reactor normal operation conditions by the development of a thin and protective chromium oxide on the surface. The FeCrAl specimens had a slight mass loss under the hydrogen tested conditions.