American Nuclear Society
South Carolina State University Chapter

James Allen Anderson Seminar Series

Chloride-induced Stress Corrosion Crack Growth under Dry Salt Conditions – Application to Evaluate Growth Rates in Multipurpose Canisters

Many dry cask storage systems for spent nuclear fuel consist of a dry shielded canister (DSC) design that includes a welded construction (and weld-sealed) austenitic stainless steel multipurpose canister that is placed within a concrete overpack and stored on an outside pad. The present regulatory basis for dry cask storage is 60 years (20-year initial and up to 40-year re-license). Aging of the materials and structures of Dry Cask Storage Systems (DCSS) are considered in the demonstration that the safety functions are maintained throughout the license period. The sealed stainless steel canister provides a confinement function in a DCSS. Stress corrosion cracking (SCC) may occur when chloride-bearing salts and/or dust deliquesce on the external surface of the spent nuclear fuel (SNF) canister at weld residual stress regions. An SCC growth rate test was developed using instrumented bolt-load compact tension specimens (ASTM E1681) with experimental apparatus that allows an initially dried salt to deliquesce and infuse naturally to the crack front under temperature and humidity parameters relevant to the canister storage environmental conditions. The shakedown tests were conducted over a range of relative humidity controlled by the guidance in ASTM E104 at 50 °C with salt assemblages of (1) mixture of artificial dust and deliquescent salts (2) a mixture of artificial dust and ASTM simulated sea salt. After five months exposure the specimens were examined for evidence of CISCC and observations are reported for both salt/dust mixtures. The test specimen and apparatus designs will be modified to enhance the interaction between the deliquescing salt and the crack front for more accurate characterization of the crack growth rate as a function of stress intensity factor, which is an essential input to the determination of in-service inspection frequency of SNF canisters.

Dr. Andrew Duncan is a Fellow Engineering in the Division of Material Science and Technology at the Savannah River National Laboratory. He received his bachelor degree in Metallurgical Engineering at University of Washington at Seattle, Master and PhD degrees in Materials Science and Engineering at University of Florida. His research focuses on Nuclear Materials Process Technology, Structural Integrity, Hydrogen Economy– Infrastructure Materials, National Defense, Radioactive Materials Management, Storage and Wasteform Characterization.

This seminar series is named after Dr. James Allen Anderson, who contributed significantly in the establishment of the first undergraduate Nuclear Engineering Program in a Historically Black College/University (HBCU).

Dr. Andrew Duncan

Materials Science and Technology Division

Savannah River National Laboratory

ECSC Rm 102, Wednesday, April 19th, 12 pm-1:00 pm, Free Pizza and Drink