From: Lombard, Mark
Sent: Wednesday, June 03, 2015 2:30 PM
To: Marvin Lewis (marvlewis@juno.com)
Cc: CHAIRMAN Resource; ACRSEOM Resource; Marcano, Damaris; Csontos, Aladar; Hsia, Anthony
Subject: Analysis of radiation release from a crack in a spent nuclear fuel dry storage canister

Mr. Lewis,

I'm writing with regards to a question you raised in an email dated April 8, 2015, to the Chairman of the Advisory Committee on Reactor Safeguards (ACRS). You requested information on the Nuclear Regulatory Commission (NRC) analyses of the dispersal of radioactive material through a microscopic or other through-wall crack in a spent nuclear fuel dry storage canister. The NRC has not conducted an analysis of that specific scenario. Nevertheless, I'd like to explain the NRC's basis for finding reasonable assurance that spent fuel can be stored safely with consideration of the potential for canister cracking.

The NRC has evaluated the radiological impact of spent fuel canister breaches, although the studies are only partially applicable (albeit conservatively so) to a potential cracking condition. In 1988, the NRC analyzed a postulated accident involving the removal of the lid of a storage cask in which all the fuel rods have been damaged (NUREG-1140). The analysis considered the release of krypton and iodine gases and found that the resultant doses were below the Environmental Protection Agency's protective action guidelines for taking protective action after an accident. In 2007 (NUREG-1864) and 2014 (NUREG-2125), the NRC calculated the radiological risks of spent fuel storage and transportation, respectively. Those analyses considered the post-accident release of gases and particulates from breached storage canisters that contain damaged fuel assemblies. In those studies, a large portion of radionuclides within the canister was considered to be able to pass through the breach, as the sizes of canister breaches following an impact accident were either calculated to be relatively large (NUREG-2125) or simply assumed to be so (NUREG-1864). Those studies concluded that the risks of storage and transportation are low.

For the microscopic cracking condition in your question, any radioactive material released from the fuel assemblies into the canister interior must traverse a tortuous path to escape to the outside environment. It is reasonable to expect that radiation release from such cracks would be less than that calculated in NUREG-1864 and NUREG-2125; however, the NRC has not specifically evaluated that breach configuration.

The NRC is addressing potential storage canister cracking in the renewal period of licensed operation by requiring periodic inspections of certain canisters to provide for the early detection of cracks well before they can grow through a canister wall, with associated mitigation if necessary to maintain the system's important to safety functions. As you are aware from your attendance by phone at our public meetings on the subject, the NRC has developed an example aging management program (AMP) for canister stress corrosion cracking in Draft NUREG-1927, Revision 1. In that AMP, canisters that are considered most susceptible to cracking are subject to periodic inspections. Inspection intervals are based on a conservative estimate of the growth rate of cracks through the canister wall. If inspections find degradation that is potentially indicative of cracking, inspection sample sizes must be increased, the flaws must be evaluated for the acceptability of continued service, and, if necessary, the canisters must be repaired or replaced. This inspection approach was part of the basis for the recent NRC approval of the Calvert Cliffs Independent Spent Fuel Storage Installation renewal application and is the approach that we anticipate will be in the final version of NUREG-1927, Revision 1.

In addition, in all phases of dry spent fuel storage (initial and renewed license periods), federal regulations 10 CFR Parts 50.47 and 72.32 require sites to have an emergency plan that includes the capability to detect and mitigate accidents and promptly notify offsite response organizations if an accident occurs. The NRC endorsed Nuclear Energy Institute's guidance document number 99-01, which provides guidance for defining site-specific emergency action levels for a postulated accident of a damaged loaded cask.

Thank you for your interest in this matter, and please let us know if you have further questions.

Sincerely,

Mark D. Lombard, Director
Division of Spent Fuel Management
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission

References:

U.S. NRC, "A Regulatory Analysis on Emergency Preparedness for Fuel Cycle and Other Radioactive Material Licensees," NUREG-1140, Washington, DC, January 1998, ADAMS Accession No. ML062020791.

U.S. NRC, "A Pilot Probabilistic Risk Assessment of a Dry Cask Storage System at a Nuclear Power Plant," NUREG-1864, Washington, DC, March 2007, ADAMS Accession No. ML071340012.

U.S. NRC, "Spent Fuel Transportation Risk Assessment," NUREG-2125, Washington, DC, January 2014, ADAMS Accession No. ML14031A323.

U.S. NRC, "Standard Review Plan for Renewal of Specific Licenses and Certificates of Compliance for Dry Storage of Spent Nuclear Fuel," Draft NUREG-1927, Revision 1, for Internal Coordination with ACRS, ADAMS Accession No. ML15068A303.

U.S. NRC, "Safety Evaluation Report for License Renewal, Calvert Cliffs Nuclear Power Plant Independence Spent Fuel Storage Installation," October 2014, ML14274A038.

NEI 99-01, Revision 6, "Development of Emergency Action Levels for Non-Passive Reactors," Nuclear Energy Institute, November 2012, ML12326A805.