Research Needs for Long Term Storage of Used Nuclear Fuel

With the increased need for longer term dry storage of increasingly higher burnup used light water reactor nuclear fuel, comes the need to enhance the technical basis for such storage. In fiscal year 2010, the DOE started planning for the study of those technical issues requiring further research and development, focusing on the degradation processes that occur during normal and off-normal dry storage conditions. In fiscal year 2011, the focus is being expanded to include design basis accident conditions and transportation after long term storage.

The planning started with a literature search for those features, events, and processes (FEPs) that could impact the five safety functions of the structures, systems, and components (SSCs) important to safety (ITS), namely: 1) thermal performance, 2) radiation protection, 3) confinement, 4) sub-criticality, and 5) retrievability. Review articles, presentations and standards were consulted (for example [1-3], and a consolidated list was created for each SSC of a generic dry cask storage system. In addition, the FEPs lists for the Yucca Mountain Project [4] and prepared for U.S. Department of Energy Advanced Modeling and Simulation Campaign [5] were scanned for applicable items. The result was discussion and a table of degradation mechanisms that may be impacted by longer storage times, higher burnup, or other data needs for each SSC. The SSCs included: 1) fuel, 2) cladding, 3) fuel assembly hardware, 4) fuel baskets, 5) neutron poisons, 6) neutron shields, 7) container, 8) overpack or storage module, 9) pad, and 10) monitoring systems. This paper presents the degradation mechanism tables for the container and concrete overpack.

1. American Society for Testing and Materials (ASTM). 2007. "Standard Guide for the Evaluation of Materials Used in Extended Service of Interim Spent Nuclear Fuel Dry Storage Systems". C1562-03. American Society for Testing and Materials.
2. Electric Power Research Institute (EPRI). 2002. *Technical Bases for Extended Dry Storage of Spent Nuclear Fuel*, EPRI, Palo Alto, CA: 2002. TR-1003416.
3. EPRI. 1998. *Data Needs for Long-Term Dry Storage of LWR Fuel*, EPRI, Palo Alto, CA: 1998. TR-108757.
4. U.S. Department of Energy (DOE). 2008. *Yucca Mountain Repository SAR.* DOE/RW-0573. Table 2.2-5.
5. Freeze, G.; Arguello, J.G.; Howard, R.; McNeish, J., Schultz, P.A., and Wang, Y. 2010. *Challenge Problem and Milestones for: Nuclear Energy Advanced Modeling and Simulation (NEAMS) Waste Integrated Performance and Safety Codes (IPSC).* Prepared for U.S. Department of Energy Advanced Modeling and Simulation Campaign.