APPLICATION OF NEUTRON-ABSORBING STRUCTURAL-AMORPHOUS METAL (SAM) COATINGS FOR SPENT NUCLEAR FUEL (SNF) CONTAINER: USE OF NOVEL COATING MATERIALS TO ENHANCE CRITICALITY SAFETY CONTROLS

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Prevention of nuclear criticality in spent fuel storage and transportation, as well as in geologic repository when the spent fuels are contained in disposal canisters and disposed of, is an important licensing requirement. To prevent nuclear criticality in spent fuel storage, transportation, and/or disposal, neutron-absorbing materials (or neutron poisons, such as borated stainless steel, BORAL™, METAMIC™, Ni-Gd™, and others) would have to be applied, usually as structural support baskets holding the spent fuel assemblies inside storage, transportation or disposal containers. When the container internals stay dry and the storage configurations stay intact, the potential for nuclear criticality is very small. However, if water is introduced, e.g., in an accident when a transport cask is dropped into a water body, or in a long-term scenario when the disposal container is breached and water enters the container. The potential for nuclear criticality can't be ruled out, especially in the case of the disposal container where boron in the borated stainless steel basket is preferentially leached out before the other fissionable materials.

The applications of boron-containing High-Performance Corrosion-Resistant Material – Structural Amorphous Metal (HPCRM-SAM) as the neutron-absorbing coatings to the metallic support structure can enhance criticality safety for spent nuclear fuel in storage pool racks; in baskets inside the dry storage containers, inside the transportation cask, and eventually inside the disposal container for repository disposal. The corrosion-resistance of the HPCRM-SAM coatings, when applied on the surface of the borated stainless steel basket can enhance the basket's corrosion resistance and help prevent the preferential leaching of the boron from the borated stainless steel. The use of these advanced boron-containing, iron-based, corrosion-resistant materials to prevent nuclear criticality in long-term spent fuel storage and disposal would be extremely beneficial the nuclear waste management programs.

Such materials could also be used to coat the entire outer surface of containers for the transportation and long-term storage of high-level radioactive waste (HLW) spent nuclear fuel (SNF), or to protect welds and heat affected zones, thereby preventing exposure to environments that might cause stress corrosion cracking. In the future, it may be possible to substitute such high-performance iron-based materials for more-expensive nickel-based alloys, thereby enabling cost savings in various industrial applications.