Summary

A Depleted Uranium Dioxide–Steel Cermet Spent-Nuclear-Fuel Super Cask

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Safeguards and security of spent nuclear fuel (SNF) is of increased international concern. Recent technical developments may enable construction of a multipurpose super cask with enhanced security features. The multipurpose cask is loaded with SNF at the reactor and then used for SNF storage, transport, and disposal. The SNF is handled only once—when the cask is loaded—minimizing handling of SNF and allowing the cask to be welded shut after loading. The cask weight (70 to 100 tons) and sealing system act as major physical barriers to thief or diversion.

The viability of a multipurpose cask depends upon meeting the multiple functional requirements for storage, transport, and disposal. This is accomplished by using casks constructed of cermets. The cermet cask contains various ceramics embedded in a continuous steel matrix. The thick cermet cask walls have clean layers of steel that are bonded to the cermet so that the inside and outside cask surfaces are clean steel. The cermet contains several ceramics. The depleted uranium dioxide (DUO_2) ceramic is added to maximize shielding efficiency. This enhanced shielding maximizes cask capacity (number of fuel assemblies per cask) and improves the economics. Hard ceramics (including DUO_2) in the cermet are used to improve resistance against military weapons, cutting tools, and other devices. The hard ceramics break up projectiles and de-focus explosive charges, which spreads out the forces and allows the ductile metal to absorb the energy of the assault without failure of the cask. Cermets are a traditional material used in high-performance tank armor, drill bits, machine tools, and vehicle brake shoes. The cask is a fraction of the size of a main battle tank but has a greater weight and thicker walls.

A new cermet fabrication method (patents applied for) creates the potential to produce a large thick-walled variable-composition cermet cask with low fabrication costs. The composition of the cermet can be varied from the inside to the outside of the cask so to maximize cask performance and the process produces a monolithic cask without cermet welding or joining operations. The combination of the new cermet cask fabrication technology and cask design approach creates the potential for an SNF super cask. The rationale behind the cask, its design, and the fabrication technologies are described.