**Integration Group for the Safety Case (IGSC) Symposium 2024***MOVING TOWARDS THE CONSTRUCTION OF A SAFE DGR – GETTING REAL*

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| **Abstract Title: Potential Packaging Options for Advanced Reactor Spent Nuclear Fuel** | |
| **Abstract (300-500 words):**  Due to increased interest in advanced reactor deployment and the new fuel cycles they may invoke, the U.S. Department of Energy (DOE) is assessing the long‑term management and final disposition of advanced-reactor spent nuclear fuel (SNF). Advanced reactors are generally categorized as using one of four different fuel forms: (1) oxide fuel, (2) tristructural isotropic (TRISO) fuel, (3) metallic fuel, or (4) fuel salt. Based on the preliminary characteristics of the discharged fuel, general packaging requirement assumptions can be made. However, packaging requirements change depending on the required function (i.e., storage, transportation, or disposal). This presentation provides an overview of packaging considerations for advanced reactors, highlighting the potential of a triple-purpose canister capable of fulfilling storage, transportation, and disposal functions within an integrated waste management system  Oxide fuel is the most prevalent fuel type in the existing U.S. fleet of light-water reactors. While small modular reactors planning to use oxide fuels have incorporated varying changes to fuel design (geometry, enrichment, cladding), packaging-related challenges remain similar. In the United States, most oxide fuel is loaded—or is planning to be loaded—into large-diameter (~2 m) canisters that meet all storage and transportation requirements as part of a designated system. However, direct disposal feasibility studies for large diameter canisters suggest thermal and criticality constraints in some geologic settings. Packaging the fuel into smaller-diameter triple-purpose canisters could enhance waste management integration.  TRISO fuel is utilized—in both pebble and prismatic form—in high-temperature gas-cooled reactors as well as salt-cooled reactors. TRISO fuel incorporates the moderator as part of its expected waste form, thereby increasing the volume of SNF generated per unit of energy. But despite this greater volume, managing the thermal, dose, and criticality constraints of TRISO SNF is relatively straightforward. In fact, some reactor vendors have proposed small-diameter canister designs that may simultaneously meet disposal, storage, and transportation constraints as part of a larger system without the need to repackage.  Metallic fuel is utilized in molten-metal-cooled fast reactors. Metallic SNF pose handling and packaging differences based on the sodium content. Non-sodium-bonded SNF could undergo direct disposal, whereas conditioning will likely be required before disposing of any sodium-bonded SNF. Such conditioning could facilitate packaging control, ensuring compliance with triple-purpose canister standards. In large-diameter canisters, direct disposition of non-sodium-bonded SNF may still be limited by thermal and criticality constraints.  The unique characteristics and associated uncertainties of discharged fuel salt increase the number of potential packaging and disposition strategies compared to other fuel forms. Direct disposition of the irradiated fuel salt, without conditioning, could lead to a comparatively high volume of SNF (irradiated fuel salt) generated per unit of energy, because the fuel salt functions as the coolant in addition to serving as the fuel. For some geologic settings, conditioning fuel salt into alternative waste forms may be necessary prior to disposal. | |