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# DOE Standard Canister Loading Methodology Poster

Elijah James Boland, Gordon M Petersen

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# DOE Standard Canister Loading Methodology

**Eli Boland, Missouri S&T, Gordon Petersen, Used Fuel Management**

## Introduction

- INL has over 250 different types of spent nuclear fuel (SNF) stored onsite. Some examples are shown in Figure 3.
- To manage the wide variety of SNF types, researchers designed the DOE Standard Canister (Figure 2).
- When offsite storage or disposal is available, the DOE Standard Canisters could be transported utilizing transportation overpacks. At the geological repository, the DOE Standard canisters can utilize extra space in the proposed Co-Disposal Waste Package between vitrified high-level waste canisters (i.e. co-disposal). Figure 1 shows a potential DOE SNF lifecycle.

## Prerequisite Actions Before Loading

- The material interactions of interest that may compromise canister integrity are corrosion, gas pressurization, metal embrittlement, and radiation damage. These interactions must be analyzed to ensure they do not exceed the values in Table 1 [2].
- Next, one must determine whether neutron absorbers* are required to control criticality, design the fuel basket to prevent excess fuel movement, mitigate criticality concerns, and protect against misloading for each fuel type. One must also ensure no materials are loaded that are deemed unacceptable for future storage, transportation, and disposal efforts.
- Then, the DOE Standard Canister is marked and labeled consistent with applicable requirements.
- Finally, the DOE Standard Canister is checked for pits, cracks, excess water, and deformities to ensure it performs as designed and that no damage occurred during setup.

*The specific neutron absorber will likely already be selected

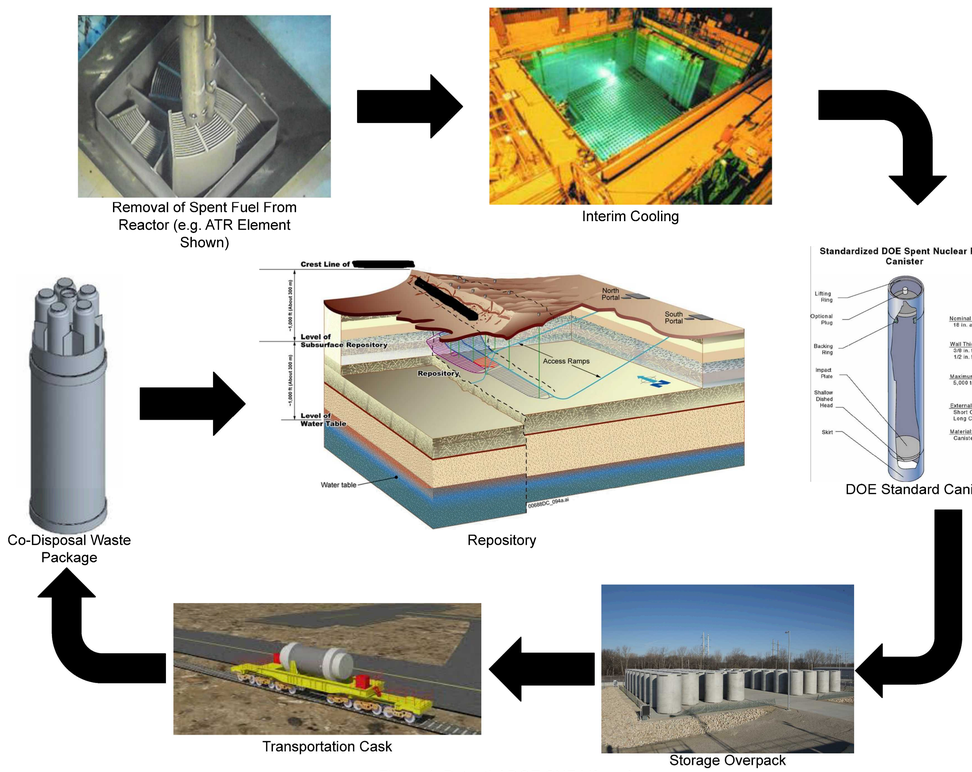


Figure 1: Potential DOE SNF Lifecycle

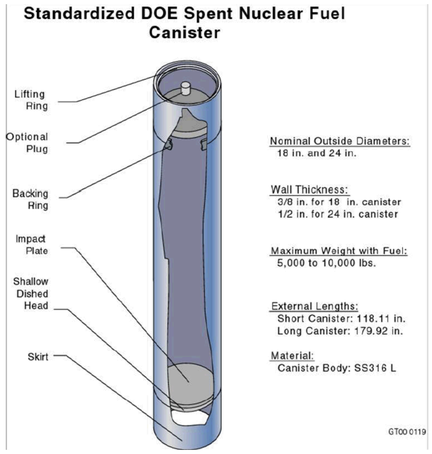


Figure 2: DOE Standard Canister

Table 1: Canister Limits

| | |
|---|---|
| Temperature | TBD |
| Pressure | TBD |
| Corrosion (storage) | 1.27 mm/100 years [4] |
| Lifetime | 100 years [4] |
| Radiation Damage | $10^{18}$ neutrons/cm$^2$ [2] |

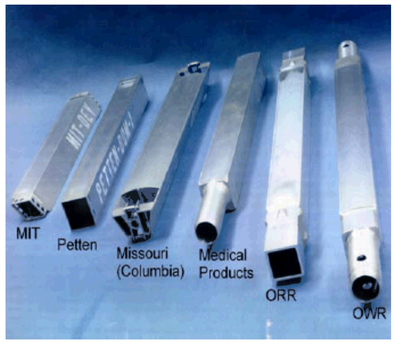


Figure 3: Research Reactor Fuel Assemblies

## Loading DOE Standard Canister

- The DOE Standard Canister may be loaded in accordance with 10 CFR Part 830.
- Next, the fuel may need to be dried.
  - This drying process may vary between DOE SNFs due to different geometries, conditions, and compositions of DOE SNFs.

## DOE Standard Canister Closure

- Next, The canister should be backfilled and will require a leak test.
  - "The standardized canister is helium leak-tested in accordance with *ASME (BPVC)*, Section V, Article 10, Appendix IV" [1].
- The canister is then welded to meet *ASME Boiler and Pressure Vessel Code (BPVC)*, Section III, Division 3, Subsections WA and WB requirements [1].

## Summary & Future Work

- The DOE Standard Canister will allow INL to place the SNF in a road-ready configuration in preparation for transportation offsite and eventual disposal.
- Fuel-specific procedures must be developed for drying and loading.

## References

1. "Yucca Mountain Repository SAR," Department of Energy (DOE), USA.
2. A. K. Wertsching, T. J. Hill, N. Mackay, S. M. Birk, "Material Interactions on Canister Integrity During Storage and Transport," Idaho National Laboratory (INL), Idaho Falls, ID, USA.
3. "ISF Facility Safety Analysis Report," Foster Wheeler Environmental Corporation (FWENC).
4. "Preliminary Design Specification for Department of Energy Standardized Spent Nuclear Fuel Canister," Department of Energy (DOE), USA.

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