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ANS Winter Meeting & Expo

SAND2019-14114C

2019

NUCLEAR TECHNOLOGY
FOR THE U.S. AND THE WORLD

Comparative Cost Analysis for Disposal of DPCs vs. Repackaging

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This is a technical presentation that does not take into account contractual limitations or obligations under the Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste (Standard Contract) (10 CFR Part 961). For example, under the provisions of the Standard Contract, spent nuclear fuel in multi-assembly canisters is not an acceptable waste form, absent a mutually agreed to contract amendment.

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Approved for Unclassified, Unlimited Release (SAND2019-*****).

Outline

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Background

- There are currently more than 2,800 DPCs containing SNF across the United States.
- DPCs have been designed, licensed, and loaded without comprehensive disposal criteria.
 - 10 CFR 72.236(m) requires that *“To the extent practicable in the design of spent fuel storage casks, consideration should be given to compatibility with removal of the stored spent fuel from a reactor site, transportation, and ultimate disposition by the Department of Energy”*
- Repackaging of SNF loaded in DPCs into specialized disposal canisters would be financially and operationally costly with radiological, operational safety, and management risks.

Purpose and Scope of Comparative Cost Analysis

- There are two disposition approaches that would not involve repackaging DPCs:
 - A disposal licensing strategy that addresses the risk (probability and consequence) from postclosure criticality events
 - Modification of existing loaded DPCs and changing the loading or design of future DPCs to decrease the probability of a criticality event in a repository below levels of concern.
- Compares direct disposal of SNF in DPCs vs. repackaging
 - Investigation of the cost to modify existing loaded DPCs and the cost to modify the loading or design of future DPCs
 - Evaluation of the cost for repackaging SNF into disposal canisters

Repository development and design is not evaluated and is considered a common non-discriminating cost

Cost Analysis Parameters

- Cost of specialized disposal canisters
- Cost of repackaging DPCs
- Cost of disposal of DPC hulls and baskets as LLW
- Cost of disposal overpacks
- Cost of treatment of existing DPCs
- Cost of modifications to future DPCs

Cost Analysis Bases and Assumptions (1 of 3)

- Specialized disposal canisters are assumed to be similar in capacity and cost to the Yucca Mountain TAD canisters
- Disposal overpacks are assumed to be similar in cost to the Yucca Mountain waste package
- DPC repackaging operations are assumed to be similar from a cost perspective to loading DPCs.
- Treatment of existing DPCs entails the use of injectable fillers (cementitious material, molten metal, or glass)

Cost Analysis Bases and Assumptions (2 of 3)

- Modifications to future DPCs entail
 - Use of DCRAAs for PWR DPCs and modified control blades for BWR DPCs,
 - Use of use of powder metallurgy borated stainless steel in lieu of (or in addition to) the aluminum-based neutron absorbers, or
 - Establishment of criticality-oriented loading schema (congruent with existing thermal and shielding zone loading requirements)
- Some cost elements are taken from the Total System Life Cycle Cost (TSLCC) for Yucca to allow for a comparative analysis.
 - These costs are escalated to 2019 based on an assumed fixed annual inflation rate of 2%.
- This cost analysis is time-independent and does not consider length of storage or repository availability.

Cost Analysis Bases and Assumptions (3 of 3)

- The entire SNF inventory is assumed to be loaded in DPCs, except for the SNF in the relatively small number of existing bare fuel casks
- The cost of loading DPCs at utility sites is assumed to be a sunk cost and is not reflected in this comparative cost analysis.
- The disposal drift length and associated engineered features (e.g., drip shields for the unsaturated hard rock disposal concept) are non-discriminating for DPC disposal.
- Transportation cost considerations are not reflected in the comparative cost analysis

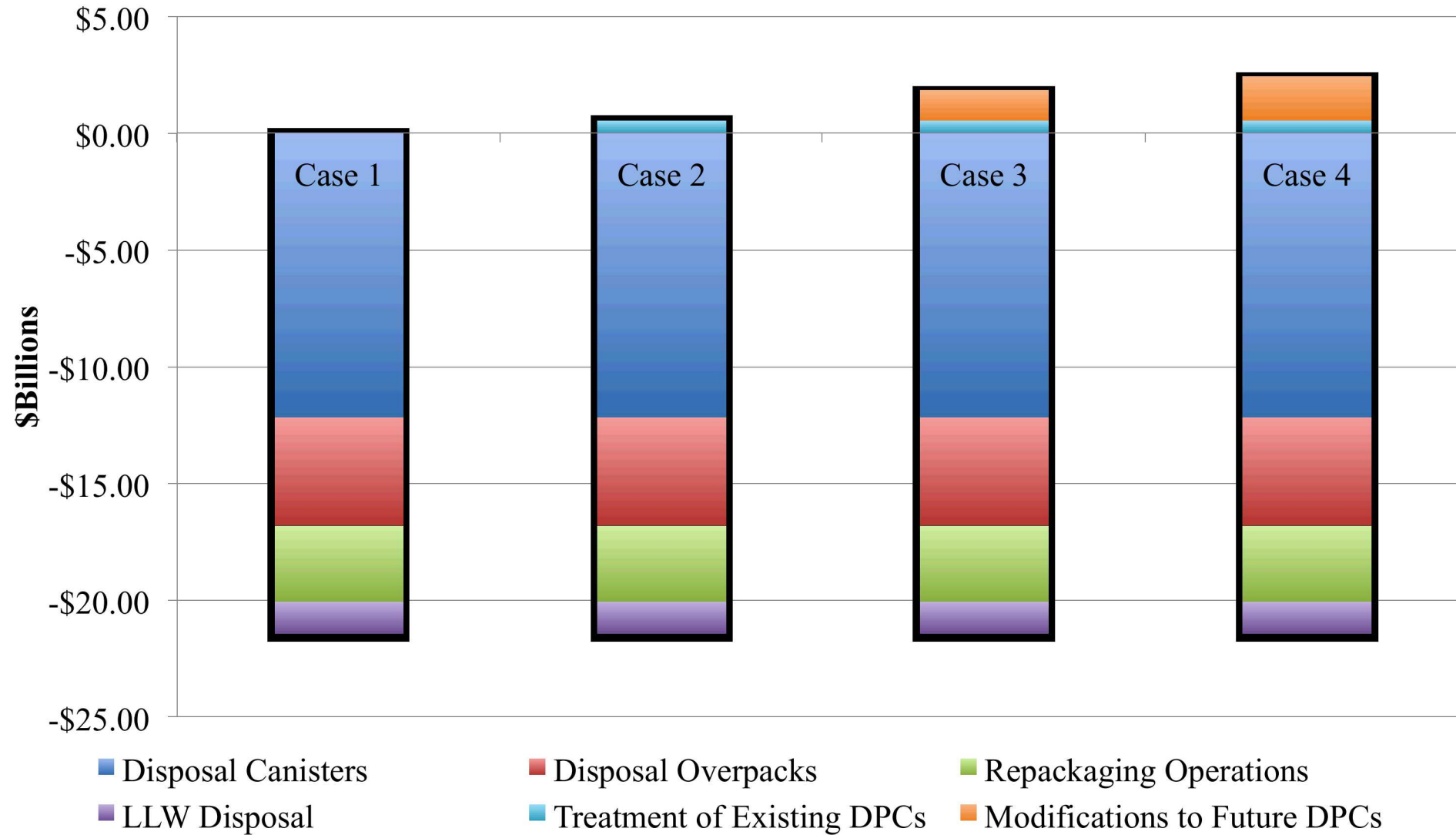
Analyzed Cases

- Case 1 (dispose of all DPCs with no treatment or modification)
 - This case would likely be associated with a consequence-based consideration of postclosure criticality or disposal in a salt geology.
- Case 2 (fillers for existing DPCs + modified loading for future DPCs)
 - Treating existing DPCs with fillers and using criticality-oriented zone loading for DPCs loaded in the future.
- Case 3 (fillers for existing DPCs + BSS for future DPCs)
 - Treating existing DPCs with fillers and design modifications for future DPCs to incorporate borated stainless steel plates.
- Case 4 (fillers for existing DPCs + DCRAs for Future DPCs)
 - Treating existing DPCs with fillers, and design modifications for future DPCs to incorporate DCRAs for PWR SNF and modified rods or control blades for BWR SNF.

Results (1 of 2)

Cost Element	Case 1	Case 2	Case 3	Case 4
Specialized Canisters	-\$12.2	-\$12.2	-\$12.2	-\$12.2
Disposal Overpacks	-\$4.64	-\$4.64	-\$4.64	-\$4.64
Repackaging Operations	-\$3.26	-\$3.26	-\$3.26	-\$3.26
LLW Disposal	-\$1.37	-\$1.37	-\$1.37	-\$1.37
Treatment of Existing DPCs	\$0.00	\$0.54	\$0.54	\$0.54
Modifications to Future DPCs	\$0.00 ^a	\$0.00 ^a	\$1.31	\$1.91
Total Cost Avoidance	-\$21.4	-\$20.9	-\$19.6	-\$19.0
^a The cost of modified loading is assumed to be minimal				

Results (2 of 2)



Conclusions

- The cost avoidance associated with direct disposal of SNF in DPCs is approximately \$20 billion regardless of the scenario.
- The significant contributors to cost avoidance are
 - Elimination of disposal canister procurement accounts for \$12.2 billion.
 - Reduction in the number of disposal overpacks accounts for \$4.64 billion.
 - Elimination of repackaging operations accounts for \$3.26 billion.
 - Elimination of disposal of DPC hulls and baskets as LLW accounts for \$1.37 billion.
- The primary contributors to additional costs associated with direct disposal of DPCs are:
 - Treatment of existing DPCs (i.e., fillers) accounts for \$0.54 billion.
 - Design modifications for future DPCs account for \$1.31 billion if using BSS plates or \$1.91 billion if using DCRA and modified control blades.

Future Considerations (1 of 2)

- Disposal Timing
 - Because DPCs generate more decay heat than smaller canisters, additional thermal aging may be needed prior to disposal. The cost of longer aging and delayed repository emplacement could reduce the avoided cost estimate.
- Transportation
 - DPCs generally have greater capacity than specialized disposal canisters. Depending on where the standardized canisters are loaded (e.g., utility sites, centralized storage facility, repository facility), transportation considerations could increase the avoided cost estimate.

Future Considerations (2 of 2)

- **Alternative Disposal Concepts**

- The estimated avoided cost could be impacted if direct disposal of DPCs changes emplacement drift design, emplacement method, or overpack design.

- **Licensing Considerations**

- Licensing a geologic repository for disposal of DPCs could require more effort than licensing for repackaging in purpose-designed disposal canisters. The costs of these activities could reduce the estimated avoided cost.