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EFFECT OF CANISTER SIZE ON COSTS OF DISPOSAL OF SRP HIGH-LEVEL WASTES

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DISCLAIMER

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ABSTRACT

The current plan for managing the high-level nuclear wastes at the Savannah River Plant (SRP) calls for processing them into solid forms contained in stainless steel canisters for eventual disposal in a federal geologic repository. A new SRP facility called the Defense Waste Processing Facility (DWPF) is being designed for the onsite waste processing operations. Preliminary evaluations indicate that costs of the overall disposal operation will depend significantly on the size of the canisters, which determines the number of waste forms to be processed. The objective of this study was to evaluate the effects of canister size on costs of DWPF process operations, including canister procurement, waste solidification, and interim storage, on offsite transport, and on repository costs of disposal, including provision of suitable waste packages.

* The information contained in this article was developed during the course of work under Contract No. DE-AC09-76SR00001 with the U.S. Department of Energy.

Canister sizes evaluated ranged from 12-in. to 32-in. diameters and from 10-ft to 14-ft lengths; the current reference design is a 24-in.-diameter, 10-ft-length canister. The corresponding numbers of waste forms to be processed over a nominal 20-year DWPF campaign ranged from 41,200 for the smallest canister to 4700 for the largest, compared to about 10,000 for the reference canister.

This evaluation incorporated recent modifications in the DWPF waste processing plan and utilized current studies of defense waste transportation and packaging. The DWPF is scheduled to be constructed to process SRP wastes in two stages, with Stage 1 devoted to solidification of insoluble sludge components and Stage 2 devoted to separation of radionuclides from soluble salt components of the waste for solidification in Stage 1 facilities. The nominal product of the DWPF operation will be about 500 canisters of reference design per year, each containing 3260 lb of solidification waste with a heat output of about 200 to 400 watts per canister, depending on the age of the waste. Pending shipment to a federal repository, the DWPF canisters will be stored onsite in a below-grade, concrete-shielded and air-cooled vault to be constructed in modular units each with capacity for two years of DWPF output. The canisters will ultimately be shipped to a federal repository, located conceptually for purposes of this study in the Northwest U.S. Possible shipping cask designs have recently been specified in General Atomics studies,[1] and waste

transport logistics have been discussed in a Battelle Pacific Northwest Laboratory report.[2]

At the repository site, the canisters would be assembled into "1000-year" waste packages, as called for by the Nuclear Regulatory Commission in 10CFR60. Conceptual designs for these packages have been developed in a study by the Westinghouse Advanced Energy Systems Division.[3] The packages would be emplaced in the repository using procedures also developed conceptually in the Westinghouse study.

Analysis of the incremental effects of canister size on costs of the several DWPF processing and offsite transport operations, summarized in Table 1, indicated that these costs for a nominal 20-year DWPF campaign ranged from an increase of $370 million for 12-in.-diameter, 10-ft-length canisters to a decrease of $66 million for 30-in.-diameter and 14-ft length canisters, compared to the approximately $2400 million cost of processing the reference 24-in.-diameter, 10-ft-length canisters. The relatively minor dependence of DWPF processing costs on canister size results from the large fixed charges incurred by DWPF construction and operation. Offsite transport costs are also nearly independent of canister size for rail shipment utilizing multi-canister casks, but do show some variability with canister size for truck shipments of single canister casks.

Repository costs in contrast were calculated to vary significantly with size and related number of canisters because of relatively high unit costs assumed for the waste packages. The Westinghouse study developed two general package concepts for defense waste disposal in a salt repository: (1) a borehole emplacement package, and (2) a self-shielded package for laydown emplacement. Unit costs of both packages typically ranged from $45,000 to $75,000, including package manufacture, assembly, and repository emplacement, resulting in repository costs of $700 to $750 million for disposal of a nominal 20-year DWPF waste canister output. These high repository costs are a consequence of the assumption that the high-integrity package, specified by NRC for high-heat commercial radioactive wastes, will also be required for low-heat defense wastes.

Differential effects of canister diameter on total costs of SRP waste disposal, including repository costs, are shown in Figure 1 for comparison with the effects on DWPF and transport costs. A substantial reduction ($200 to 350 million) in total SRP waste disposal costs, due principally to reduced repository costs, was calculated for use of 30- to 32-in.-diameter canisters of 10-ft length in place of the reference 24-in.-diameter canisters. Such a cost reduction would be contingent on the ability of the DWPF to handle larger canisters without major capital cost penalties and on development of capability for economically drilling

sufficiently large boreholes for borehole emplacement packages in a repository, or alternatively, on development of capability to handle the large self-shielded packages for laydown emplacement.

References

1. High Level Waste Transportation System Development Program. Final Report for Fiscal Year 1980. General Atomic Company, GA-A-16124 (UC-71) (January 1981).

2. W. B. Andrews, B. M. Cole, R. L. Engel, and J. M. Oyler. Defense Waste Transportation Cost and Logistics Studies. Pacific Northwest Laboratory, PNL-3721 (TCC-0191, UC-71) (February 1981).

3. Engineered Waste Package Conceptual Design. Defense High Level Waste (Form 1), Disposal in Salt. Westinghouse Advanced Energy Systems Division, AESD-TME-3086 (March 1981).

TABLE 1

Incremental Effects of Canister Size on DWPF Processing and Transport Costs of SRP High-Level Wastes

Canister Dimensions		Difference from Reference Canister Cost				
Diam., in.	Length, ft	Canister Procurement, M$*	Waste Processing, M$	Interim Storage, M$**	Offsite Transport, M$	Total Costs, M$
12	10	+241	-	+124	+ 5	+370
18	10	+ 63	-	+ 35	- 1	+ 97
24	10	Ref.	-	Ref.	Ref.	Ref.
30	10	- 34	-	- 19	+ 7	- 46
12	14	+163	+10	+ 90	+ 1	+264
18	14	+ 29	+10	+ 13	-16	+ 36
24	14	- 21	+10	- 18	-17	- 46
30	14	- 46	+10	- 35	+ 5	- 66

* Assumes 20-year DWPF operation.

** Assumes 12-year interim storage of waste canisters.

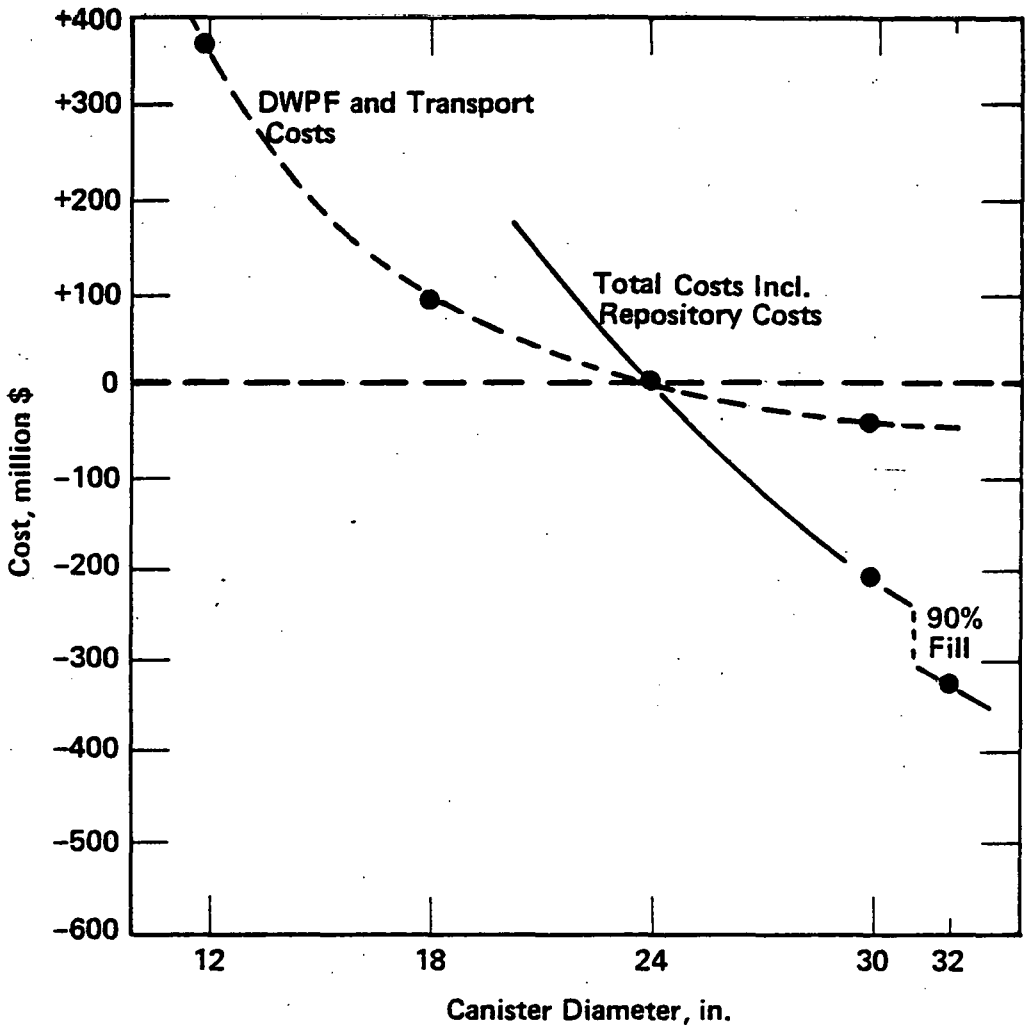

FIGURE 1. Differential Effects of Canister Diameter on Costs of SRP High-Level Waste Disposal