LOGISTICS ANALYSIS IN SUPPORT OF DOE FEE ADEQUACY REPORT

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ABSTRACT

In compliance with the Nuclear Waste Policy Act of 1982, the United States Department of Energy is required to determine annually the adequacy of the 1-mil per kilowatt-hour fee assessment of nuclear power plants. To support this determination, a series of analyses were performed to detail the anticipated costs that will be incurred to provide transportation equipment and services. The results of these analyses are documented in this presentation.

INTRODUCTION

The Nuclear Waste Policy Act of 1982 (Public Law 97-485) established a Nuclear Waste Fund to pay for the management and permanent disposal of commercial spent nuclear fuel and high-level radioactive waste in geologic repositories. The revenues for this fund come from a fee on electricity generated by nuclear power plants. The fee established in the Act is 1 mil per kilowatt-hour. The Act also established the Office of Civilian Radioactive Waste Management (OCRWM) within the Department of Energy (DOE) to administer the program for the management of commercial spent fuel and high-level waste. In managing this program, the DOE is required by the Act to determine annually whether the fee generates sufficient revenue to cover all costs. To support this determination, a series of analyses were performed to detail the anticipated cost that will be incurred to provide adequate transportation services within the waste management system.

The WASTES logistics model, developed at Pacific Northwest Laboratories under the sponsorship of the Monitored Retrievable Storage and Transportation Research and Development programs of the OCRWM, was used to perform these analyses. This model is discussed in a paper entitled, "WASTES: A Waste Management Logistics/Economics Model," also presented at Waste Management 1985.

The analyses estimate the cost for providing the transportation services between individual reactor sites and a repository. The "base case" scenarios investigate a two repository waste management system that is described in the draft DOE mission plan. Sites located in each of the various geologic media are combined to provide a range of transportation costs that may be incurred.

The results of the analyses are given as total transport cost (capital, maintenance, and shipping), description of fleet requirements (number and types of casks required), total transportation mileages, and required number of shipments. In addition, information is provided on the amounts of storage that will be required at individual sites and characteristics of the spent fuel that will be received at the various facilities throughout the waste management system.

The following section describes in detail the results obtained for the reference cases.

Reference Cases

The results for the reference cases are shown in Tables I and II. The reference cases analyze a two repository waste management system in which the first repository begins operation in 1998 with a receipt rate of 400 MTU (metric tons uranium) per year. The receipt rate for this repository is ramped slowly (400, 400, 400, 900, 1800, 3000) to a maximum receipt rate of 3000 MTU per year in 2003. This receipt rate is then maintained until the repository reaches a maximum capacity of 70,000 MTU. The second repository begins operation in 2006 with an initial receipt rate of 1800 MTU per year. This receipt rate is maintained for five years and is then increased to a maximum receipt rate of 3000 MTU per year. The maximum receipt rate is maintained until the repository reaches its maximum capacity of 70,000 MTU. (In cases analyzed for this exercise, the second repository only fills to a maximum capacity of approximately 54,585 MTU. This amount plus the 70,000 MTU stored in the first repository represents the total amount of fuel generated in DOE's Energy Information Administration (EIA) mid-case through the year 2020.)

For these analyses the spent fuel that is shipped to the repositories is selected from the total inventory of spent fuel discharge utilizing the following priorities:

1. Maintenance of Full Core Reserve (FCR) margin at individual reactors.
2. Decommissioning reactors (2-year following decommissioning).
3. Oldest fuel in system.

Both repositories maintain a minimum age of acceptance of 5 years on all spent fuel being shipped to the repository.

A series of eight different geologic media combinations are investigated in the reference cases. These combinations were defined by WESTON, the lead DOE contractor supporting the Total System Life Cycle Cost studies for the Department. Defined last fiscal year, the repository pairs were chosen to bracket the combinations for a two-repository storage system. It should be noted that since this analysis was performed, the DOE has identified that the Deaf Smith, Texas,

TABLE I

Reference Cases

Reference Name	Facility Name	Maximum Inventory	No. of Shipments Truck	No. of Shipments Rail	Million Cask Miles Truck	Million Cask Miles Rail	Shipping Costs Truck	Shipping Costs Rail	Shipping Costs Lease
REFBSC OTP	Davis Repos	70,002	38,951	19,085	59.2	28.0	367.6	801.3	
	Granite Repos	54,505	18,809	16,479	9.6	8.5	72.1	375.5	
	TOTALS	124,586	57,760	35,564	68.8	36.5	439.7	1,176.8	1,289.2
	GRAND TOTALS		93,324		105.3			2,905.7	
REFTG OTP	Yucca Mt Repos	69,999	39,801	18,939	70.8	34.7	437.2	890.9	
	Granite Repos	54,587	17,959	16,661	9.1	8.6	68.9	379.2	
	TOTALS	124,586	57,760	35,600	79.9	43.3	506.1	1,270.1	1,317.8
	GRAND TOTALS		93,360		123.3			3,094.0	
REFBG OTP	Hanford Repos	70,003	40,193	18,951	74.5	40.7	460.3	988.8	
	Granite Repos	54,583	17,567	16,636	9.0	8.9	67.5	387.7	
	TOTALS	124,586	57,760	35,587	83.5	49.6	527.7	1,376.5	1,396.5
	GRAND TOTALS		93,347		133.1			3,300.8	
REFBSBS OTP	Davis Repos	70,006	41,504	18,756	70.4	32.6	433.9	863.5	
	Deaf Smith Repos	54,580	16,256	16,816	21.7	22.5	135.4	665.4	
	TOTALS	124,586	57,760	35,572	92.1	55.1	569.3	1,528.9	1,535.0
	GRAND TOTALS		93,332		147.2			3,633.3	
REFTBS OTP	Yucca Mt Repos	70,000	57,363	16,415	116.2	31.4	711.4	791.3	
	Davis Repos	54,586	397	19,204	0.6	37.8	3.8	947.9	
	TOTALS	124,586	57,760	35,619	116.8	69.1	715.1	1,739.1	1,690.7
	GRAND TOTALS		93,379		185.9			4,145.0	
REFBBS OTP	Hanford Repos	70,002	43,378	18,324	84.6	44.1	521.0	1,029.6	
	Davis Repos	54,585	14,382	17,272	25.2	28.6	154.8	769.3	
	TOTALS	124,586	57,760	35,596	109.8	72.7	675.8	1,798.9	1,737.6
	GRAND TOTALS		93,356		182.5			4,212.3	
REFBT OTP	Hanford Repos	70,006	38,894	18,993	78.7	47.6	483.9	1,094.9	
	Yucca Mt Repos	54,580	18,864	16,599	34.8	31.9	214.7	793.0	
	TOTALS	124,586	57,758	35,592	113.5	79.6	698.6	1,887.8	1,765.4
	GRAND TOTALS		93,350		193.0			4,351.8	

TABLE Ia

Reference Cases

Reference Name	Facility Name	Start Year	Min Avg Age Year	Min Avg Age Age	Maximum Dry Year	Maximum Dry MTU	Cask Descr Truck/Rail	Casks Reqd Truck	Casks Reqd Rail
REFBSG OTP	Davis Repos	1998	2025	5.9	2001	7349	1-2/7-18	109	243
	Granite Repos	2006	2025	5.9					
REFTG OTP	Yucca Mt Repos	1998	2025	5.9	2001	7349	1-2/7-18	120	241
	Granite Repos	2006	2025	5.9					
REFBG OTP	Hanford Repos	1998	2025	5.9	2001	7349	1-2/7-18	114	259
	Granite Repos	2006	2025	5.9					
REFDSBS OTP	Davis Repos	1998	2025	5.9	2001	7349	1-2/7-18	131	293
	Deaf Smith Repos	2006	2025	5.9					
REFTBS OTP	Yucca Mt Repos	1998	2025	5.9	2001	7349	1-2/7-18	167	318
	Davis Repos	2006	2025	5.9					
REFBBS OTP	Hanford Repos	1998	2025	5.9	2001	7349	1-2/7-18	161	333
	Davis Repos	2006	2025	5.9					
REFBT OTP	Hanford Repos	1998	2025	5.9	2001	7349	1-2/7-18	168	335
	Yucca Mt Repos	2006	2025	5.9					

TABLE II

Generic Cask Cases

Reference Name	Facility Name	Maximum Inventory	No. of Shipments Truck	No. of Shipments Rail	Million Cask Miles Truck	Million Cask Miles Rail	Shipping Costs Truck	Shipping Costs Rail	Shipping Costs Lease
TREFBBS OTP	Hanford Repos	69,999	20,858	11,216	40.5	27.0	248.7	602.3	
	Davis Repos	54,587	6,643	10,862	11.8	18.0	72.5	453.8	
	TOTALS	124,587	27,501	22,078	52.3	45.0	321.2	1,056.1	1,032.0
	GRAND TOTALS		49,579		97.3			2,409.3	
TREFTG OTP	Yucca Mt Repos	70,006	19,198	11,676	34.2	21.3	210.6	521.8	
	Granite Repos	54,581	8,309	10,323	4.2	5.3	31.7	223.4	
	TOTALS	124,587	27,507	21,999	38.4	26.6	242.3	745.2	777.3
	GRAND TOTALS		49,506		65.0			1,764.9	
TREFBT OTP	Hanford Repos	70,001	18,622	11,612	37.7	29.2	231.0	639.7	
	Yucca Mt Repos	54,586	8,873	10,420	16.2	20.0	100.0	468.3	
	TOTALS	124,587	27,495	22,032	53.9	49.1	331.1	1,108.0	1,047.6
	GRAND TOTALS		49,527		103.0			2,486.6	
TREFDSG OTP	Davis Repos	70,007	18,706	11,778	28.5	17.2	176.5	470.1	
	Granite Repos	54,580	8,797	10,227	4.5	5.3	33.6	221.0	
	TOTALS	124,587	17,503	22,005	33.0	22.4	210.1	691.2	764.4
	GRAND TOTALS		49,508		55.4			1,665.7	

TABLE IIa

Generic Cask Cases

Reference Name	Facility Name	Start Year	Min Avg Age Year	Min Avg Age Age	Maximum Dry Year	Maximum Dry MTU	Cask Descr Truck/Rail	Casks Reqd Truck	Casks Reqd Rail
TREFBBS OTP	Hanford Repos	1998	2025	5.9	2001	7379	2-5/12-32	77	209
	Davis Repos	2006	2025	5.9					
TREFTC OTP	Yucca Mt Repos	1998	2025	5.9	2001	7379	2-5/12-32	56	151
	Granite Repos	2006	2025	5.9					
TREFBT OTP	Hanford Repos	1998	2025	5.9	2001	7379	2-5/12-32	80	211
	Yucca Mt Repos	2006	2025	5.9					
TREFBSG OTP	Davis Repos	1998	2025	6.0	2001	7379	2-5/12-32	52	154
	Granite Repos	2006	2025	5.9					

Yucca Mountain, Nevada, and Hanford, Washington sites are the preferred sites for the location of the first geologic repository. For the purposes of this analysis, the first repository is assumed to be located in one of the following four locations: Richton domed salt, Davis bedded salt, Yucca Mountain tuff, or Hanford basalt. The second repository is assumed to be located at one of the following three locations: a hypothetical granite site, Davis bedded salt, or Deaf Smith bedded salt. The WASTES code is utilized to optimize the total system transportation for each selected pair of repository sites. Capacities of the existing generation casks assumed were 1 Pressurized Water Reactor (PWR) or 2 Boiling Water Reactor (BWR) assemblies for truck and 7 PWR and 18 BWR assemblies for rail. Higher capacity generic design casks were assumed to contain 2 PWR or 5 BWR assemblies for truck or 12 PWR/32 BWR assemblies for rail.

CONCLUSIONS

The results for these cases show that, utilizing present day cask designs, approximately 58,000 truck shipments and 36,000 rail shipments will be required to ship the total amount of fuel (~124,600 MTU) generated by the year 2020. These numbers are reduced to approximately 27,500 truck shipments and 22,000 rail shipments if the larger capacity generic design transport casks are utilized.

The largest cost to transport the generated spent fuel occurs in the case where the first repository is located at Hanford and the second repository is located at Davis. The total cost to transport the spent fuel for this case is approximately 4.2 billion dollars utilizing present day cask designs and approximately 2.4 billion dollars utilizing generic cask designs. The smallest cost repository pair occurs when the first repository is located at Richton and the second repository is located in granite. The total transport cost to this repository combination is approximately 2.4 billion dollars utilizing present day cask designs and 1.4 billion dollars utilizing generic design casks. The large cost savings for transporting spent fuel to the Richton/granite repository pairing is due to this pairing being located closer to the Eastern sector of the United States (approximate centroid of all reactors). This trend is observed not only in transport cost, but also in total cask miles and total cask requirements. All of these quantities increase the farther west the repository pairing is located. The differences occurring between the use of present day cask designs and generic cask designs is relatively constant between all of the cases. The differences in the factors mentioned above (transport cost, cask miles, and cask requirements) is approximately a factor of 2.1 between present day and generic truck casks and 1.7 between the two rail casks.