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Civilian Radioactive Waste Management System
Management & Operating Contractor

Operational Waste Stream Assumption for TSLCC Estimates

TDR-CRW-MD-000001 REV 00

September 2000

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ACRONYMS AND ABBREVIATIONS

ACRONYMS

AP	Absorber Plates
BWR	Boiling Water Reactor
CALVIN	CRWMS Analysis and Logistics Visually Interactive
CR	Control Rods
CRWMS	Civilian Radioactive Waste Management System
CSNF	Commercial Spent Nuclear Fuel
DOE	U.S. Department of Energy
DPC	Dual-Purpose Canister
DSNF	DOE Spent Nuclear Fuel
HH	High Heat
HIC	High Integrity Container
HLW	High-Level Waste
INEEL	Idaho National Engineering and Environmental Laboratory
IPWF	Immobilized Plutonium Waste Form
ISF	Interim Storage Facility
LWT	Legal Weight Truck
M&O	Management and Operating Contractor
MCO	Multi-Canister Overpack
MGR	Monitored Geologic Repository
MOX	Mixed Oxide
MTHM	Metric Tons of Heavy Metal
MTU	Metric Tons of Uranium
OFF	Oldest Fuel First
PWR	Pressurized Water Reactor
QA	Quality Assurance
RSC	Regional Servicing Contractor

ACRONYMS AND ABBREVIATIONS (Continued))

SNF	Spent Nuclear Fuel
SR	Site Recommendation
SRS	Savannah River Site
TSLCC	Total System Life Cycle Cost
UCF	Uncanistered Fuel
VA	Viability Assessment
WAST	Waste Acceptance, Storage and Transportation
WP	Waste Package
WVDP	West Valley Demonstration Project
YFF	Youngest Fuel First
YFF10	Youngest Fuel First Older Than 10 Years

ABBREVIATIONS

hrs	Hours
Kinf	K - infinity
lbs	Pounds
Pu	Plutonium
yrs	Years

1. INTRODUCTION

1.1 PURPOSE

This document provides the background and basis for the operational waste stream used in the 2000 Total System Life Cycle Cost (TSLCC) estimate for the Civilian Radioactive Waste Management System (CRWMS). This document has been developed in accordance with its Development Plan (CRWMS M&O 2000a), and AP-3.11Q, *Technical Reports.*

1.2 SCOPE

The system simulation model, CALVIN (CRWMS Analysis and Logistics Visually Interactive) Version 3.0 (CRWMS M&O 2000b), calculates the logistics (loading, transporting, storing, and emplacing of casks containing waste) that define the waste stream. The CALVIN Version 3.0 model is appropriate for this application, and is used within the range of its validation (CRWMS M&O 2000c). In order to determine the operational waste stream, several pieces of input data are required.

- Inventory (quantity and location) and characteristics (e.g., burnup, metric tons of heavy metal [MTHM]) of the waste
- Waste package characteristics (capacity and limitations)
- Transportation cask characteristics (e.g., capacity, weight, maximum thermal load)
- Dry Storage cask characteristics (e.g., capacity, maximum thermal load).

All of this data is stored in a Microsoft Access 97™ database that is used as direct input into CALVIN. The database that includes the scenario used for this report is contained in reference CRWMS M&O 2000d, which has been submitted to the Records Processing Center in accordance with AP-17.1Q, *Record Source Responsibilities for Inclusionary Records*. The waste input data is described in more detail in Section 2.

In addition to the above source data, operational assumptions and data are required including:

- System facilities and locations (e.g., Interim Storage Facility (ISF), Monitored Geologic Repository [MGR])
- Assignment of preferred transportation and storage casks to individual facilities
- Assumptions on allocation – whose fuel gets selected (reactor priority)
- Assumptions on fuel selection – which fuel gets selected (fuel priority)
- Acceptance and emplacement rates.

The detailed assumptions used in the analysis are described in Section 3.

The summary results of the CALVIN calculations are presented in Section 4. These include:

- Transportation cask logistics (annual arrivals at the MGR)
- Transportation cask fleet
- Disposal containers emplaced at the MGR.

Reports describing the detailed input assumptions for the CALVIN scenarios that produced the waste stream results are included in Appendix A.

In some cases, different assumptions are used for the waste stream input to the MGR and the Waste Acceptance, Storage and Transportation (WAST) portions of the TSLCC estimate. This was due to the timing of the two cost estimates. The input to the MGR estimate was required sooner than the WAST estimate in order to meet the overall schedule for the TSLCC. As a result, the MGR estimate waste stream was based on preliminary assumptions that were subsequently modified after final review. As shown in Section 4, the modified assumptions resulted in only minor changes to the waste stream.

Several differences exist between the waste stream reported in this document and the previous waste stream report, issued to support the Viability Assessment (VA) and the 1998 TSLCC (*Basis for the VA and TSLCC Cost Estimate Operational Waste Stream* [CRMWS M&O 1998a]). These include revised commercial and government-managed waste inventories, annual acceptance rates, transportation cask fleet, and waste package characteristics. A more detailed comparison is provided in Appendix B.

1.3 QUALITY ASSURANCE

In accordance with the development plan (CRWMS M&O 2000a), this document has been classified as "non-QA." The CALVIN Version 3.0 computer model used to generate the waste stream is also "non-QA"; however, CALVIN Version 3.0 was developed and validated (CRWMS M&O 2000c) in accordance with AP-SI.1Q, *Software Management.*

2. REQUIRED INPUT DATA

2.1 WASTE INVENTORY AND CHARACTERISTICS

The waste information is provided by several sources. For commercial spent nuclear fuel (CSNF), including mixed-oxide (MOX) fuel, the waste inventory is taken from the *1999 Design Basis Waste Input Report for Commercial Spent Nuclear Fuel* (CRWMS M&O 1999a, Section 2.3).

The operational waste stream assumption for defense and commercial high-level waste (HLW) and U.S. Department of Energy (DOE) spent nuclear fuel (DSNF) canister shipments is consistent with the initial CRWMS receipt rates documented in requirement 3.2.1B of the *Civilian Radioactive Waste Management System Requirements Document* (DOE 2000, p10). This requirement provides annual rates for the government-managed nuclear material arrivals between 2010 and 2041 and, in particular, it provides the rates for the first 5 years of naval SNF and immobilized plutonium waste form (IPWF) (see Table 1 below).

Table 1. Government-Managed Nuclear Material Receipt Rates

Year	Received Annually at Repository (Canisters/year)	
	Naval SNF	**IPWF**
2010	1 DPC[a]	60 Canisters
2011	1 DPC	60 Canisters
2012	3 DPC	60 Canisters
2013	6 DPC	60 Canisters
2014	8 DPC	60 Canisters

[a]DPC = Dual-Purpose Canister

The operational waste stream assumptions for HLW and DSNF canister quantities are consistent with the Site Recommendation (SR) design basis (CRWMS 2000e, p. 4) (see Table 2 below). It is assumed that all HLW canisters except West Valley contain 0.5 MTHM equivalent (DOE 1999a, Appendix A, Section A.2.3.1); West Valley HLW canisters are assumed to contain 2.13 MTHM equivalent (Picha 1997).

Table 2. Incoming Canister Summary - DOE Spent Nuclear Fuel and High-Level Waste

Canister Type	18X10' DSNF	18X15' DSNF	HLW Short (Incl. 635 IPWF)	HLW Long	MCO[a]	Naval Short	Naval Long	Total
Full Inventory Case	1,570	1,874	7,647	14,500	397	200	100	26,288

[a]MCO = Multi-Canister Overpack

The quantities of DSNF at a particular location are based on information from the United States DOE Office of Environmental Management report, *DOE Spent Nuclear Fuel Information in Support of TSPA-SR*, (DOE 1999b). The file named "11RW_Input399A.xls," from this reference, contains site-specific quantities for DSNF. The file consists of a spreadsheet named "Package" with the columns named as shown in Table 3. Only data from the columns for "18X10," "18X15," "HIC," and "MCO" were used. The spreadsheet is separated in areas for each of the DOE sites: Hanford Site, Idaho National Engineering and Environmental Laboratory (INEEL), and Savannah River Site (SRS). The rows of the spreadsheet provide a total of the columns by site. These quantities, when totaled, do not precisely match the quantities in Table 2. Therefore, the quantities were adjusted slightly to maintain consistency with the total quantities used as input for the SR design. Table 3 below provides the source information and the adjusted site-specific canister quantities. The DSNF canisters are estimated to contain approximately 2,500 MTHM (DOE 1999a, Appendix A, Table A-17).

Table 3. Site-Specific DOE Spent Nuclear Fuel Canister Quantities

Package Counts	**18X10'**	**18X15'**	**HIC[a]**	**MCO**	**Total**
Hanford Site	0.00	634.94	26.00	396.65	1,057.60
INEEL	338.97	1,048.75	124.42	0.00	1,512.14
SRS	1,226.54	7.05	25.93	0.00	1259.52
Total	1,565.51	1,690.74	176.34	396.65	3,829.25
Adjusted Canister Quantities	**18X10**	**18X15 & HIC**		**MCO**	**Total**
Hanford Site	0	661		397	1,058
INEEL	342	1,179		0	1,521
SRS	1,228	34		0	1,262
Adjusted Total	**1,570**	**1,874**		**397**	**3,841**

[a]HIC = High Integrity Container

The quantity of HLW canisters at a particular location is based on Appendix A of the *Draft - Environmental Impact Statement - for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE 1999a, pages A-36 and A-37). This information is shown below in Table 4. The quantity of HLW canisters at SRS is provided as canisters containing the IPWF and canisters not containing IPWF. At SRS, the IPWF is placed into 635 canisters (DOE 1999a, pages A-52 and A-53). The waste form displaces a portion of the HLW volume and increases the quantity of HLW canisters at SRS by 77, from 5978 to a total of 6055. Of the 6055 HLW canisters at SRS, 5420 do not contain IPWF.

Table 4. Site-Specific High-Level Waste Canister Quantities

Site	**Hanford**	**INEEL**	**SRS**	**SRS-IPWF**	**West Valley Demonstration Project (WVDP)**
Canisters	14,500	1,292	5,420	635	300

It is assumed that there is one repository, and operations will proceed with a cost-effective packaging of DSNF and HLW such that all DSNF canisters can be co-disposed with HLW.

The receipt rates in the years 2015 to 2040 assumes that a relatively uniform rate of DSNF and HLW arrivals would accompany the CSNF arrival. This arrival rate of DSNF and HLW allows the MGR to maintain the desired line load, heat output per length of drift, at the time of emplacement.

The reference design for SR contains only a limited amount of temporary storage of DSNF and HLW at the MGR. Thus, the HLW and DSNF receipt rate is assumed to equal the emplacement rates.

Assumptions regarding the transportation cask and disposal container capacities are also used in developing the HLW and DSNF waste stream. Most DSNF canisters are co-disposed in a disposal container with five HLW canisters. To the extent possible, short DSNF canisters are co-disposed with short HLW canisters, and long DSNF canisters with long HLW canisters. Five HLW canisters are shipped per cask, and nine DSNF canisters are shipped per cask. The naval SNF disposal container and transportation cask contain a single naval SNF canister. Four MCOs are shipped per cask and two MCOs are co-disposed with two HLW canisters per disposal container. The IPWF disposal container contains five IPWF canisters without a DSNF canister. Five IPWF canisters are transported per cask.

Finally, it is assumed that all DSNF will be shipped from the State of Idaho by 12/31/2034 (Frei 1997, Attachment 2).

The above assumptions and the desire to minimize the cask fleet size are used to develop the HLW and DOE operational waste stream.

2.2 TRANSPORTATION CASK INFORMATION

The types and characteristics of transportation casks are provided in Table 5. The capacity is the number of assemblies or canisters that can be shipped in a cask. The heat limit is the maximum watts per assembly that a cask can handle. Cask life is the length of time a cask can be used before it needs to be refurbished (new basket, re-certified, etc.). Utilization is the number of days a cask is available for use each year, after routine maintenance and decontamination is performed. The load/unload times are the length of time, in days, at each facility that is required to load/unload a transportation cask containing SNF assemblies. This consists of all operations, including sealing/opening the cask, moving the assemblies, cooling time, draining, etc.

The casks listed in Table 5 are the same as those used in the cask fleet analysis (CRWMS M&O 1999b, Table 2) for the 1999 TSLCC Update and the 1999 Design Basis Waste Input Report (CRWMS M&O 1999a, Table A-1), except for the HLW, DSNF, and MOX SNF transportation casks. For the 2000 TSLCC, a single cask design is assumed for all HLW and DSNF, except naval SNF. The loaded weight of this cask when transporting HLW is assumed to be same as the long HLW cask used in the cask fleet unit cost analysis (CRWMS M&O 1999d, Attachment II, Table II-2) for the 1999 TSLCC Update. The loaded weight of the cask when transporting DSNF is assumed to be 150 tons, with the payload weight approximately equal to that of the HLW configuration. Weights for the naval SNF casks are assumed to be the same as the DSNF cask (although the weights are not used in cost calculations, since it is assumed that OCRWM will not transport naval SNF). For MOX SNF, it is now assumed that a standard pressurized water reactor (PWR) transportation cask will be used with a capacity of 21 or 24 assemblies, depending on the reactor site cask weight limit. In the WAST assumptions document for the 1998 TSLCC (CRWMS M&O 1998b, Section 4), it was assumed that MOX SNF radiation and heat emissions would be higher than regular SNF, requiring transportation casks to be de-rated from either 21 or 24 assemblies to 9 assemblies. The WAST cost input (CRWMS M&O 1999b, Table 2) to the 1999 TSLCC Update did not change this assumption. However, an evaluation of MOX SNF heat and radiation characteristics for waste packages (CRWMS M&O 1998c, Sections 4.2 and 5.2) concluded that MOX SNF radiation and heat characteristics are bounded by those of regular SNF for the age-range of interest for transportation (10 to 20 years).

Loading and unloading times shown in Table 5 are calculated from cask data contained in the CALVIN Version 3.0 database (CRWMS M&O 2000d, Cask_2000 table), using the formulas given in reference CRMWS M&O 2000b, Appendix A, Table A-14.

Table 5. Transportation Cask Characteristics

Cask_Name	Type	Cap.	Assem. Heat Limit (Watts)	Loaded Weight (lbs)	Empty Weight (lbs)	Load Time at Reactor (hrs)[a]	Unload Time at MGR (hrs)[b]	Cask Life (yrs)	Utilization (days/yr)
Legal Weight Truck Casks									
B-T-9/9-SP	BWR[c]	9	235	53666	47321	24.8	19.9	25	300
B-T-9/7-SP	BWR	7	303	53666	47321	24.8	19.9	25	300
B-T-9/5-SP	BWR	5	406	53666	47321	24.8	19.9	25	300
B-T-9/4-SP	BWR	4	530	53666	47321	24.8	19.9	25	300
B-T-9/2-SP	BWR	2	730	53666	47321	24.8	19.9	25	300
P-T-4/4-SP	PWR[d]	4	617	53661	47901	24.8	19.9	25	300
P-T-4/3-SP	PWR	3	740	53661	47901	24.8	19.9	25	300
P-T-4/2-SP	PWR	2	1234	53661	47901	24.8	19.9	25	300
B-T-2-SP	BWR	2	1100	51200	49826	24.8	19.9	25	300
P-T-1-SP	PWR	1	2500	51200	49730	24.8	19.9	25	300
Uncanistered Fuel Rail									
P-R-ST17-SP	PWR	17	1000	250000	221440	37.7	20.6	25	270
B-R-68-SP	BWR	68	238	250000	202400	37.7	20.6	25	270
P-R-24-SP	PWR	24	706	250000	209680	37.7	20.6	25	270
B-R-44-SP	BWR	44	466	200000	169200	37.7	20.6	25	270
P-R-21-SP	PWR	21	1000	200000	164720	37.7	20.6	25	270
B-R-32-SP	BWR	32	466	150000	127600	37.7	20.6	25	270
P-R-12-SP	PWR	12	1000	150000	129840	37.7	20.6	25	270

Table 5. Transportation Cask Characteristics (Continued)

Cask_Name	Type	Cap.	Assem. Heat Limit (Watts)	Loaded Weight (lbs)	Empty Weight (lbs)	Load Time at Reactor (hrs)[a]	Unload Time at MGR (hrs)[b]	Cask Life (yrs)	Utilization (days/yr)
B-R-32-SP-HH	BWR	32	2400	200000	177600	37.7	20.6	25	270
P-R-12-SP-HH	PWR	12	6000	200000	179840	37.7	20.6	25	270
B-R-17-SP-HH	BWR	17	2400	150000	138100	37.7	20.6	25	270
P-R-7-SP-HH	PWR	7	6000	150000	138240	37.7	20.6	25	270
P-R-ST7-SP-HH	PWR	7	6000	150000	138240	37.7	20.6	25	270
B-R-WV44-SP	BWR	44	N/A	200000	179540	37.7	20.6	25	270
P-R-WV20-SP	PWR	20	N/A	200000	173960	37.7	20.6	25	270
HLW and DSNF Rail									
H-R-5-SP-L&S	HLW	5	N/A	306297	265512	15.5	14.3	40	255
D-R-4-SP-MCO	DSNF	4	N/A	300000	265500	37.7	20.6	25	270
D-R-9-SP	DSNF	9	N/A	300000	265500	37.7	20.6	25	270
D-R-1-SP-NAVY S	DSNF	1	N/A	300000	265500	37.7	20.6	25	270
D-R-1-SP-NAVY L	DSNF	1	N/A	300000	265500	37.7	20.6	25	270
DPC Transportation Overpacks									
B-R-68-OV	BWR	68	238	244000	201200	54.2 (P) 21.7 (D)[e]	21.2	25	270
P-R-24-OV	PWR	24	706	238800	199000	54.2 (P) 21.7 (D)	21.2	25	270
B-R-44-OV	BWR	44	466	211563	181323	54.2 (P) 21.7 (D)	21.2	25	270
P-R-21-OV	PWR	21	1000	210210	179338	54.2 (P) 21.7 (D)	21.2	25	270
P-R-YR36-OV	PWR	36	347	238800	199000	54.2 (P) 21.7 (D)	21.2	25	270
B-R-BP64-OV	BWR	64	378	215000	173800	54.2 (P) 21.7 (D)	21.2	25	270
B-R-HI68-OV	BWR	68	238	238700	189100	54.2 (P) 21.7 (D)	21.2	25	270
P-R-HI24-OV	PWR	24	706	238800	190800	54.2 (P) 21.7 (D)	21.2	25	270
B-R-NAC56-OV	BWR	56	300	247745	208769	54.2 (P) 21.7 (D)	21.2	25	270
P-R-NAC26-OV	PWR	26	800	252930	217914	54.2 (P) 21.7 (D)	21.2	25	270
P-R-MP24-OV	PWR	24	764	263816	223923	54.2 (P) 21.7 (D)	21.2	25	270
P-R-VSC24-OV	PWR	24	1000	259660	225340	54.2 (P) 21.7 (D)	21.2	25	270

Table 5. Transportation Cask Characteristics (Continued)

Cask_Name	Type	Cap.	Assem. Heat Limit (Watts)	Loaded Weight (lbs)	Empty Weight (lbs)	Load Time at Reactor (hrs)[a]	Unload Time at MGR (hrs)[b]	Cask Life (yrs)	Utilization (days/yr)
B-R-WES44-OV	BWR	44	466	211536	181323	54.2 (P) 21.7 (D)	21.2	25	270
P-R-WES21-OV	PWR	21	1000	210210	179338	54.2 (P) 21.7 (D)	21.2	25	270
P-R-ST17-OV	PWR	17	1000	250000	221440	54.2 (P) 21.7 (D)	21.2	25	270

[a]Plus 30 minutes per assembly
[b]Plus 45 minutes per assembly
[c]BWR = boiling water reactor
[d]PWR = pressurized water reactor
[e]P = loading time from pool; D = loading time from dry storage

2.3 WASTE PACKAGES

The design characteristics of the MGR waste packages are displayed in Table 6. These design characteristics are taken from references CRWMS M&O 2000e and YMP 1998, Appendix C, Section 3.3. The waste package for incoming commercial fuel is chosen based on K-infinity (a measure of criticality) calculated from the characteristics of the fuel (age, burnup, and enrichment) on an individual assembly basis. The waste package for DSNF is chosen based on whether or not it is co-disposable and its other characteristics. Co-disposable waste is placed in the same waste package with another waste type. Co-disposable DSNF and HLW are emplaced until the quantities of one or the other are exhausted. The remaining waste and the DSNF that cannot be co-disposed are then emplaced in separate waste packages.

Table 6. Waste Package Characteristics

Cask_Name	Type	Capacity[b]	Maximum K inf
Commercial SNF Waste Packages			
B-E-44-SP-Plates	BWR	44	0.98
B-E-24-SP-Plates	BWR	24	N/A
P-E-21-SP-Big Rock	BWR	21	N/A
P-E-21-SP-Plates	PWR	21	0.98
P-E-21-SP-Rods	PWR	21	N/A
P-E-12-SP-Long	PWR	12	N/A
HLW and DSNF Waste Packages			
P-E-21-SP-MOX-Plates	PWR	21	0.98
P-E-21-SP-MOX-Rods	PWR	21	N/A
H-E-5-SP-PU	HLW	5	N/A

Table 6. Waste Package Characteristics (Continued)

Cask_Name	Type	Capacity[b]	Maximum K inf
H-E-5-SP-Long	HLW	5	N/A
D-E-1-CO-LL	Co-Disp[a]	1DSNF(L)/ 5 HLW(L)	N/A
D-E-1-CO-SS	Co-Disp[a]	1DSNF(S)/ 5 HLW(S)	N/A
D-E-1-CO-LS	Co-Disp[a]	1DSNF(S)/ 5 HLW(L)	N/A
D-E-2-CO-LMCO	Co-Disp[a]	2 MCO/2 HLW	N/A
D-E-1-SP-NAVY S	DSNF	1	N/A
D-E-1-SP-NAVY L	DSNF	1	N/A

[a]Co- Disposal Waste Package (DSNF + HLW)
[b]L = long; S = short; DSNF = DSNF

2.4 DRY STORAGE CASKS

Dry storage occurs at reactor sites that have limited pool capacity. When the pool is filled almost to capacity (traditionally the size of the reactor core is allowed as margin – known as Full Core Reserve), fuel is transferred from the pool to dry storage. When dry storage is required, dry storage casks are assigned based on year and on the capability of the reactor site (crane capacity, dimensional constraints, etc). All Purchasers with the capability to handle rail transportation casks are assumed to use large dual-purpose canisters (DPC) designed for storage and transportation only for onsite dry storage, if required. The capacities of these DPC storage systems are shown in Table 5 (under the DPC transportation overpack). The exceptions to this are Purchasers who have already committed to uncanistered fuel (UCF) cask storage for the lifetime of the reactor. Nothing in the design would preclude Purchasers from using multi-purpose canisters (storage, transportation and disposal); however, for the 2000 TSLCC such usage is not assumed. The oldest fuel is selected for dry storage, except for historical dry storage (which reports the actual assemblies that have been placed into dry storage). Five years after the last discharge, all fuel remaining at rail sites is unloaded into dry storage in DPCs. Fuel loaded prior to 1998 at rail sites in UCF casks is repacked into DPCs at this time. Fuel in dry storage is removed in the order it was placed into dry storage (first in is first out).

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3. OPERATIONAL ASSUMPTIONS AND DATA

3.1 UTILITY AND DOE WASTE FACILITIES AND LOCATIONS

The 2000 TSLCC cost estimates are based on disposal of wastes from 76 commercial utility SNF sites, 4 DOE sites, and West Valley. The locations of these sites are contained within the public domain.

The CRWMS includes a single MGR, assumed to be located at Yucca Mountain, Nevada. The TSLCC scenarios do not contain an ISF.

3.2 FACILITY TRANSPORTATION AND STORAGE CASKS

Table 7 displays the transportation and storage cask modal assignments on a pool basis for commercial SNF, HLW, and DSNF. Tables 8 and 9 display the transportation and storage modal definitions. These tables are based on the data used in the WAST input to 1999 TSLCC Update (CRWMS M&O 1999b, Tables 1 through 3). Casks are selected in order of priority, from lowest number (0) to highest. Fuel that does not meet the design limits of the primary cask (e.g., thermal limit) is loaded in a higher priority number cask with less stringent limits.

For the 2000 TSLCC, a slightly different set of transportation and storage modals was used than in the 1999 TSLCC Update. Since MOX fuel is assumed to be transported in casks that have identical characteristics as casks used for other SNF, the modals for reactor pools that use MOX fuel were changed to eliminate the use of separate MOX transportation casks. These pools are identified in Table 7. In addition, the transportation and storage modals associated with MOX fuel are not included in Tables 8 and 9. The modals in Tables 7 and 8 for Hanford, West Valley, INEEL, and SRS (Pools 124 through 143) have also been modified to reflect the revised HLW and DSNF transportation casks shown in Table 5.

Table 7. Transportation and Storage Modals by Pool

Pool #	Pool ID	Pool Name	Transportation Modal Type	Storage Modal Type
2	401	ARKANSAS NUCLEAR 1	P-100-R	P-Arc Nuc
3	402	ARKANSAS NUCLEAR 2	P-100-R	P-Arc Nuc
4	7006	BATTELLE, OH	P-LWT	P-LWT
5	1601	BEAVER VALLEY 1	P-125-R	P-125
6	1602	BEAVER VALLEY 2	P-125-R	P-125
7	4801	BELLEFONTE 1	P-125-R	P-125
8	4802	BELLEFONTE 2	P-125-R	P-125
9	1201	BIG ROCK 1	B-R-BP64	B-Big Rock
10	1001	BRAIDWOOD 1	P-125-R	P-125
11	4803	BROWNS FERRY1	B-100-R	B-100
12	4805	BROWNS FERRY3	B-100-R	B-100

Table 7. Transportation and Storage Modals by Pool (Continued)

Pool #	Pool ID	Pool Name	Transportation Modal Type	Storage Modal Type
13	791	BRUNSWICK 1 – PWR	P-75-R	P-75
14	792	BRUNSWICK 2 – PWR	P-75-R	P-75
15	701	BRUNSWICK 1	B-75-R	B-75
16	1003	BYRON 1	P-125-R	P-125
17	5101	CALLAWAY 1	P-125-R	P-125
18	501	CALVERT CLF 1	P-100-R	P-NUHOMS-24
19	1501	CATAWBA 1[a]	P-125-R	P-125
20	1502	CATAWBA 2[a]	P-125-R	P-125
21	2301	CLINTON 1	B-100-R	B-100
22	4901	COMANCHE PEAK 1	P-125-R	P-125
23	5801	COOK 1	P-100-R	P-100
24	3001	COOPER STATION	B-75-R	B-75
25	1701	CRYSTAL RIVER 3	P-LWT	P-LWT
26	5001	DAVIS-BESSE 1	P-125-R	P-D. Besse
27	3501	DIABLO CANYON 1	P-100-R	P-100
28	3502	DIABLO CANYON 2	P-100-R	P-100
29	1005	DRESDEN 1	B-R-HI68	B-HI-Star-D
30	1006	DRESDEN 2	B-75-R	B-75
31	1007	DRESDEN 3	B-75-R	B-75
32	2401	DUANE ARNOLD	B-75-R	B-75
33	1402	ENRICO FERMI 2	B-100-R	B-100
34	101	FARLEY 1	P-125-R	P-125
35	102	FARLEY 2	P-125-R	P-125
36	3901	FITZPATRICK	B-125-R	B-NAC56-D
37	3401	FORT CALHOUN	P-75-R	P-75
38	4401	GINNA	P-LWT	P-LWT
39	2901	GRAND GULF 1	B-125-R	B-125
40	5701	HADDAM NECK	P-R-NAC26	P-NAC26-D
41	7017	HANFORD WA BWR	B-LWT	B-LWT
42	7007	HANFORD WA PWR	P-LWT	P-LWT
43	703	HARRIS 1	P-75-R	P-75
44	793	HARRIS – BWR	B-75-R	B-75

Table 7. Transportation and Storage Modals by Pool (Continued)

Pool #	Pool ID	Pool Name	Transportation Modal Type	Storage Modal Type
45	795	HARRIS- ROBIN	P-75-R	P-75
46	2001	HATCH 1	B-125-R	B-HI-Star-D
47	4201	HOPE CREEK	B-125-R	B-125
48	3503	HUMBOLDT BAY	B-LWT	B-LWT
49	1101	INDIAN POINT 1	P-LWT	P-LWT
50	1102	INDIAN POINT 2	P-LWT	P-LWT
51	3902	INDIAN POINT 3	P-LWT	P-LWT
52	7012	INEEL EG&G B	B-LWT	B-LWT
53	7002	INEEL EG&G P	P-125-R	P-125
54	5501	KEWAUNEE	P-100-R	P-100
55	1301	LACROSSE	B-LWT	B-LWT
56	1008	LASALLE 1	B-125-R	B-125
57	3701	LIMERICK 1	B-100-R	B-100
58	2801	MAINE YANKEE	P-R-NAC26	P-NAC26-D
59	1504	MCGUIRE 1[a]	P-100-R	P-100
60	1505	MCGUIRE 2[a]	P-100-R	P-100
61	3201	MILLSTONE 1	B-75-R	B-75
62	3202	MILLSTONE 2	P-75-R	P-75
63	3203	MILLSTONE 3	P-100-R	P-100
64	3301	MONTICELLO	B-LWT	B-LWT
65	6601	MORRIS BWR	B-125-R	B-125
66	6602	MORRIS PWR	P-125-R	P-125
67	3101	NINE MILE POINT1	B-100-R	B-100
68	3102	NINE MILE POINT2	B-100-R	B-100
69	5201	NORTH ANNA 1[a]	P-125-R	P-TN32
70	1506	OCONEE 1	P-100-R	P-NUHOMS-24
71	1508	OCONEE 3	P-100-R	P-NUHOMS-24
72	1903	OYSTER CREEK 1	B-100-R	B-Oys. Creek
73	1204	PALISADES	P-WES21	P-Palisades
74	301	PALO VERDE 1	P-125-R	P-NAC26-D
75	302	PALO VERDE 2	P-125-R	P-NAC26-D
76	303	PALO VERDE 3	P-125-R	P-NAC26-D
77	3704	PEACHBOTTOM 2	B-100-R	B-100
78	3705	PEACHBOTTOM 3	B-100-R	B-100
79	901	PERRY 1	B-125-R	B-125

Table 7. Transportation and Storage Modals by Pool (Continued)

Pool #	Pool ID	Pool Name	Transportation Modal Type	Storage Modal Type
80	601	PILGRIM 1	B-LWT	B-LWT
81	5401	POINT BEACH 1	P-125-R	P-Pt. Beach
82	3302	PRAIRIE ISLAND 1	P-100-R	P-Pr. Island
83	1010	QUAD CITIES 1	B-75-R	B-75
84	4501	RANCHO SECO 1	P-R-MP24	P-MP24-D
85	705	ROBINSON 2	P-75-R	P-NUHOMS-7
86	2101	RIVER BEND 1	B-125-R	B-125
87	4202	SALEM 1	P-100-R	P-100
88	4203	SALEM 2	P-100-R	P-100
89	4792	SAN ONOFRE 1 IN 2	P-125-R	P-125
90	4701	SAN ONOFRE 1	P-125-R	P-125
91	4702	SAN ONOFRE 2	P-125-R	P-125
92	7001	SAVANNAH RIVER	P-125-R	P-125
93	5901	SEABROOK 1	P-125-R	P-125
94	4808	SEQUOYAH 1	P-125-R	P-125
95	2601	SHOREHAM	B-125-R	B-125
96	2201	SOUTH TEXAS 1	P-R-ST17	P-S. Texas
97	2202	SOUTH TEXAS 2	P-R-ST17	P-S. Texas
98	1801	ST LUCIE 1	P-LWT	P-LWT
99	1802	ST LUCIE 2	P-100-R	P-100
100	4601	SUMMER 1	P-125-R	P-125
101	5203	SURRY 1	P-125-R	P-Surry
102	3601	SUSQUEHANNA 1	B-125-R	B-NUHOMS-68
103	3801	TROJAN	P-R-VSC24	P-VSC24-D
104	1803	TURKEY POINT 3	P-100-R	P-100
106	2003	VOGTLE 1	P-75-R	P-75
107	6001	VERMONT YANKEE 1	B-75-R	B-75
108	5302	WASHINGTON NUCLEAR 2	B-125-R	B-HI-Star-D
109	2701	WATERFORD 3	P-125-R	P-125
110	4810	WATTS BAR 1	P-125-R	P-125
111	6401	WEST VALLEY B	B-R-WV44	B-125
112	6402	WEST VALLEY P	P-R-WV20	P-125
113	2501	WOLF CREEK 1	P-125-R	P-125
114	5601	YANKEE-ROWE 1	P-R-YR36	P-Yank Rowe
115	1012	ZION 1	P-100-R	P-100

Table 7. Transportation and Storage Modals by Pool (Continued)

Pool #	Pool ID	Pool Name	Transportation Modal Type	Storage Modal Type
116	1901	THREE MILE ISLAND 1	P-100-R	P-100
117	702	BRUNSWICK 2	B-75-R	B-75
118	1016	DRESDEN 1 IN 2	B-R-HI68	B-HI-Star-D
119	1017	DRESDEN 1 IN 3	B-R-HI68	B-HI-Star-D
120	1804	TURKEY POINT 4	P-100-R	P-100
121	4703	SAN ONOFRE 3	P-125-R	P-125
122	4793	SAN ONOFRE 1 IN 3	P-125-R	P-125
123	7007	HANFORD-HLW	HLW-Long	N/A
124	7012	INEEL-HLW	HLW-Long	N/A
125	7001	SRS-HLW	HLW-Long	N/A
126	6401	WVDP-HLW	HLW-Long	N/A
135	7007	HANFORD-DSNF-15'	DSNF-9	N/A
136	7007	HANFORD-DSNF-MCO	DSNF-MCO	N/A
137	7012	INEEL-NAVY-10'	NAVY-S	N/A
138	7012	INEEL-NAVY-15'	NAVY-L	N/A
139	7012	INEEL-DSNF-10'	DSNF-9	N/A
140	7012	INEEL-DSNF-15'	DSNF-9	N/A
141	7001	SRS-DSNF-10'	DSNF-9	N/A
142	7001	SRS-Pu-HLW	HLW-Long	N/A
143	7001	SRS-DSNF-15'	DSNF-9	N/A

[a]Pools that used “MOX” modals in reference CRWMS M&O 1999b Table 1

Table 8. 2000 TSLCC Transportation Modal Type Definitions

Modal Type	Cask Designator	Start Year	End Year	Priority[a]
B-LWT	B-T-9/9-SP	2010	2099	0
B-LWT	B-T-9/7-SP	2010	2099	1
B-LWT	B-T-9/5-SP	2010	2099	2
B-LWT	B-T-9/4-SP	2010	2099	3
B-LWT	B-T-9/2-SP	2010	2099	4
B-LWT	B-T-2-SP	2010	2099	5
P-LWT	P-T-4/4-SP	2010	2099	0
P-LWT	P-T-4/3-SP	2010	2099	1
P-LWT	P-T-4/2-SP	2010	2099	2
P-LWT	P-T-1-SP	2010	2099	3
B-75-R	B-R-32-SP	2010	2099	0

Table 8. 2000 TSLCC Transportation Modal Type Definitions (Continued)

Modal Type	Cask Designator	Start Year	End Year	Priority[a]
B-75-R	B-R-17-SP-HH	2010	2099	1
P-75-R	P-R-12-SP	2010	2099	0
P-75-R	P-R-7-SP-HH	2010	2099	1
B-100-R	B-R-44-SP	2010	2099	0
B-100-R	B-R-32-SP-HH	2010	2099	1
P-100-R	P-R-21-SP	2010	2099	0
P-100-R	P-R-12-SP-HH	2010	2099	1
B-125-R	B-R-68-SP	2010	2099	0
B-125-R	B-R-32-SP-HH	2010	2099	1
P-125-R	P-R-24-SP	2010	2099	0
P-125-R	P-R-12-SP-HH	2010	2099	1
P-R-YR36	P-C-YR36-ST	2010	2099	0
B-R-BP64	B-C-BP64-ST	2010	2099	0
P-R-ST17	P-R-ST17-SP	2010	2099	0
P-R-ST17	P-R-ST7-SP-HH	2010	2099	1
P-WES21	P-R-21-SP	2010	2099	0
P-WES21	P-R-12-SP-HH	2010	2099	1
B-R-HI68	B-C-HI68-ST	2010	2099	0
P-R-NAC26	P-C-NAC26-ST	2010	2099	0
P-R-MP24	P-C-MP24-ST	2010	2099	0
P-R-VSC24	P-C-VSC24-ST	2010	2099	0
B-R-WV44	B-R-WV44-SP	2010	2099	0
P-R-WV20	P-R-WV20-SP	2010	2099	0
HLW-Long	H-R-5-SP-L&S	2010	2099	0
HLW-PU	H-R-5-SP-PU	2010	2099	0
DSNF-MCO	D-R-4-SP-MCO	2010[b]	2099	0
DSNF-9	D-R-9-SP	2010[b]	2099	0
NAVY-L	D-R-1-SP-NAVY L	2010[b]	2099	0
NAVY-S	D-R-1-SP-NAVY S	2010[b]	2099	0

[a]Casks are used in order of priority, from lowest number to highest. Higher numbered casks have less stringent heat limits

[b]In CRWMS M&O 1998b Table 2, these dates are 1998; they were revised to be consistent with the 2010 start date used for the other modals.

Table 9. 2000 TSLCC Storage Cask Modal Type Definitions

Modal Type	Cask Designator	Start Year	End Year	Priority
B-LWT	B-C-68-ST	1968	2099	0
P-LWT	P-C-24-ST	1968	2099	0
B-75	B-C-68-ST	1968	2099	0
P-75	P-C-24-ST	1968	2099	0
B-100	B-C-68-ST	1968	2099	0
P-100	P-C-24-ST	1968	2099	0
B-125	B-C-68-ST	1968	2099	0
P-125	P-C-24-ST	1968	2099	0
P-Yank Rowe	P-C-YR36-ST	1968	2099	0
B-Big Rock	B-C-BP64-ST	1968	2099	0
P-S. Texas	P-C-ST17-ST	1968	2099	0
B-Oys. Creek	B-S-NUH68-SP	1968	2000	0
B-Oys. Creek	B-C-68-ST	2001	2099	0
P-Arc Nuc	P-S-VSC24-SP	1968	2000	0
P-Arc Nuc	P-C-24-ST	2001	2099	0
P-D. Besse	P-S-NUH24-SP	1968	2000	0
P-D. Besse	P-C-24-ST	2001	2099	0
P-Palisades	P-S-VSC24-SP	1968	2000	0
P-Palisades	P-C-WES21-ST	2001	2099	0
P-Pr. Island	P-S-TN40-SP	1968	2000	0
P-Pr. Island	P-C-24-ST	2001	2099	0
P-Surry	P-S-V/21-SP	1968	2000	0
P-Surry	P-S-TN32-SP	2001	2099	0
B-P. Bottom	B-S-TN68-SP	1968	2000	0
B-P. Bottom	B-C-68-ST	2001	2099	0
P-Pt. Beach	P-S-VSC24-SP	1968	2000	0
P-Pt. Beach	P-S-TN32-SP	2001	2099	0
P-MP24-D	P-C-MP24-ST	1968	2099	0
P-NAC26-D	P-C-NAC26-ST	1968	2099	0
B-NAC56-D	B-C-NAC56-ST	1968	2099	0
P-NUHOMS-7	P-S-NUH7-SP	1968	2099	0
P-NUHOMS-24	P-S-NUH24-SP	1968	2099	0
P-TN32	P-S-TN32-SP	1968	2099	0
B-HI-Star-D	B-C-HI68-ST	1968	2099	0
B-NUHOMS-68	B-S-NUH68-SP	1968	2099	0
P-VSC24-D	P-C-VSC24-ST	1968	2099	0

3.3 ACCEPTANCE RATES

The acceptance rates for CSNF are shown in Table 10. These are taken from reference CRWMS M&O 1999a, Table 2, and are consistent with the acceptance requirements shown in the *Civilian Radioactive Waste Management System Requirements Document* (DOE 2000, Table 1). Note that the rates are shown in terms of calendar year, and represent the actual amount of waste accepted in that year.

Table 10. Acceptance Rates for Commercial Spent Nuclear Fuel

Calendar Year	Acceptance Rate (MTHM/year)
2010	400
2011	600
2012	1,200
2013	2,000
2014	3,000
2015 – 2039	3,000
2040	1,600
Total	**83,800**

Tables 11 and 12 show the HLW and DSNF annual acceptance rates, respectively, used in the 2000 TSLCC. These rates were developed using the assumptions discussed in Section 2.1.

Table 11. High-Level Waste Annual Acceptance Rates

Year	Acceptance Rate (MTHM Equivalent/year)						Total (Canisters/ year)
	Hanford	INEEL	SRS	SRS-Pu[a]	West Valley	Total	
2010	0.0	5.0	17.5	30.0	0.0	52.5	105
2011	52.5	5.0	60.0	30.0	0.0	147.5	295
2012	77.5	5.0	102.5	30.0	0.0	215.0	430
2013	107.5	5.0	117.5	30.0	0.0	260.0	520
2014	135.0	5.0	135.0	30.0	0.0	305.0	610
2015	225.0	35.0	105.0	30.0	0.0	395.0	790
2016	225.0	35.0	105.0	30.0	0.0	395.0	790
2017	247.5	35.0	105.0	30.0	0.0	417.5	835
2018	247.5	35.0	105.0	30.0	0.0	417.5	835
2019	270.0	35.0	105.0	30.0	0.0	440.0	880
2020	270.0	31.0	109.0	17.5	0.0	427.5	855

Table 11. High-Level Waste Annual Acceptance Rates (Continued)

Year	Acceptance Rate (MTHM Equivalent/year)						Total (Canisters/ year)
	Hanford	INEEL	SRS	SRS-Pu[a]	West Valley	Total	
2021	270.0	30.0	110.0	0.0	0.0	410.0	820
2022	270.0	30.0	110.0	0.0	0.0	410.0	820
2023	270.0	30.0	110.0	0.0	0.0	410.0	820
2024	270.0	30.0	110.0	0.0	0.0	410.0	820
2025	270.0	30.0	92.5	0.0	74.7	467.2	820
2026	270.0	30.0	75.0	0.0	149.3	524.3	820
2027	270.0	30.0	75.0	0.0	149.3	524.3	820
2028	270.0	30.0	75.0	0.0	149.3	524.3	820
2029	265.0	30.0	82.5	0.0	117.3	494.8	810
2030	245.0	30.0	110.0	0.0	0.0	385.0	770
2031	245.0	30.0	110.0	0.0	0.0	385.0	770
2032	185.0	30.0	110.0	0.0	0.0	325.0	650
2033	150.0	30.0	110.0	0.0	0.0	290.0	580
2034	150.0	25.0	115.0	0.0	0.0	290.0	582
2035	295.0	0.0	117.5	0.0	0.0	412.5	825
2036	295.0	0.0	77.5	0.0	0.0	372.5	745
2037	360.0	0.0	53.5	0.0	0.0	413.5	825
2038	375.0	0.0	0.0	0.0	0.0	375.0	750
2039	352.5	0.0	0.0	0.0	0.0	352.5	705
2040	315.0	0.0	0.0	0.0	0.0	315.0	630
Total	**7,250.0**	**646.0**	**2,710.0**	**317.5**	**639.9**	**11,563.4**	**22,147**

[a]Pu = Plutonium

Table 12. DOE Spent Nuclear Fuel Acceptance Rates

Year	Acceptance Rate (Canisters/year)								
	Hanford		INEEL				Savannah River		Total
	Long	MCO	Naval-Short	Naval-Long	Short	Long	Short	Long	
2010	0	0	1	0	0	0	9	0	10
2011	0	0	1	0	9	0	18	0	28
2012	0	0	2	1	9	9	36	0	57
2013	0	0	4	2	9	18	45	0	78
2014	0	0	5	3	9	27	54	0	98
2015	9	0	8	4	9	54	54	0	138

Table 12. DOE Spent Nuclear Fuel Acceptance Rates (Continued)

Year	Acceptance Rate (Canisters/year)								
	Hanford		INEEL				Savannah River		Total
	Long	MCO	Naval-Short	Naval-Long	Short	Long	Short	Long	
2016	9	0	9	5	9	54	54	0	140
2017	9	0	10	5	9	63	54	0	150
2018	9	0	10	5	9	63	54	0	150
2019	18	0	10	5	18	63	45	0	159
2020	18	0	10	5	18	63	45	0	159
2021	18	0	10	5	18	63	45	0	159
2022	18	0	10	5	18	63	45	0	159
2023	18	0	10	5	18	63	45	0	159
2024	18	0	10	5	18	63	45	0	159
2025	18	0	10	5	18	63	45	0	159
2026	18	0	10	5	18	63	45	0	159
2027	27	0	10	5	18	54	45	0	159
2028	18	0	10	5	18	63	45	0	159
2029	18	0	10	5	18	63	45	0	159
2030	27	0	10	5	18	54	45	0	159
2031	27	0	10	5	18	54	45	0	159
2032	9	20	10	5	18	54	45	0	161
2033	0	40	10	5	18	45	45	0	163
2034	45	40	0	0	0	0	63	0	148
2035	36	40	0	0	0	0	54	9	139
2036	36	40	0	0	0	0	36	9	121
2037	63	40	0	0	0	0	22	9	134
2038	65	60	0	0	0	0	0	7	132
2039	63	60	0	0	0	0	0	0	123
2040	47	57	0	0	0	0	0	0	104
Total	**661**	**397**	**200**	**100**	**342**	**1,179**	**1,228**	**34**	**4,141**

3.4 FUEL ALLOCATION AND SELECTION

The term "fuel allocation" refers to the decision of selecting both reactor site and quantity (MTHM) of waste to be accepted in a given year. The allocation is based on the oldest discharged fuel in the system. This oldest fuel first (OFF) methodology closely approximates the Annual Priority Ranking (DOE 1995, Appendix A).

The term “fuel selection” refers to which individual assemblies are selected for shipment at the facility that has earned an allocation. For the 2000 TSLCC, the fuel selection model is based on the age of the discharged fuel. The selection criteria used is Youngest Fuel First greater than or equal to 10 years old (YFF10). Utilities have the right to select any fuel currently within their facilities, subject to the terms of the Standard Contract for Disposal (10 CFR 961, Article V). The YFF10 assumption provides a compromise between selecting the hottest fuel (possibly a utility preferred criteria) and cask limitations for transportation. Fuel that exceeds the heat limit of the primary cask is deferred until it cools, unless no other fuel is available at the site. In the latter case, a more robust cask (i.e., higher heat limit) is used if possible. Also, dry storage fuel is deferred until there is no other acceptable fuel on site. No fuel less than 5 years old is assumed to be accepted.

3.5 MISCELLANEOUS ASSUMPTIONS

The following additional assumptions are used in the calculation of the operational waste stream:

- Utilities are assumed to have the ability to perform cask loading operations 5 days a week, 12 hours a day. The MGR is assumed to be able to receive and process transportation casks and waste packages 5 days a week, 18 hours a day.
- Both rail and legal weight trucks provide transportation of waste. Rail shipments are via general freight, with one cask per train.
- A rail branch line connecting the main line with Yucca Mountain is assumed, beginning at the start of waste acceptance and transportation.
- Transportation of CSNF, HLW, and DSNF (except naval) is provided by four Regional Service Contractors (RSCs), each operating in one of four independent regions of the continental U.S. (i.e., no sharing of resources between regions).
- Waste packages will be emplaced at the MGR with an areal mass loading of 60 MTHM/acre, and a drift spacing of 81 meters (CRWMS M&O 2000f, Section 2.4).

The first four assumptions are identical with assumptions made in the 1998 waste stream report (CRWMS M&O 1998a). As shown in Appendix B, the last two assumptions differ from those in the 1998 TSLCC and the 1999 TSLCC update. The change in the number of RSCs has the effect of slightly increasing the number of HLW transportation casks required, while the change in MGR areal mass loading and drift spacing reduces the total length of drifting required for emplacement.

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4. OPERATIONAL WASTE STREAM

Tables 13 through 17 provide the results of analyses performed by CAVLIN Version 3.0 using the input data assumptions described in Sections 2 and 3. The detailed inputs for the CALVIN scenario is listed in Appendix A. The database containing the CALVIN scenario and other input data is contained in reference CRWMS M&O 2000d. Table 13 was copied from the data in the CALVIN "Shipments – Ann Tot" report, and shows the transportation cask logistics. Table 14 shows the transportation cask fleet; this table was created by summing the last row (total) of the CALVIN "Cask Fleet" report over the four regions and the cask types. Note that no DSNF transportation casks are included in the cask fleet. This is because the CRWMS is not responsible for procuring transportation casks for DSNF (including naval). Tables 15 and 16 were copied from the data in the CALVIN "WPs Quantities – Casks" report, and show the MGR waste package emplacement results. Table 17 is copied from the CALVIN "Defense Share" report, and displays the waste package piece count (the number and percentage of waste packages of each share type), as well as the drift length required for emplacement.

Table 13. Transportation Cask Logistics for the 2000 TSLCC

FY	CSNF			HLW	DSNF	Total
	Truck	UCF Rail	DPC Rail	Rail	Rail	
2010	1	22	8	21	2	54
2011	41	66	14	59	4	184
2012	67	100	14	86	9	276
2013	123	199	25	104	14	465
2014	146	272	42	122	18	600
2015	147	321	44	158	26	696
2016	78	294	32	158	28	590
2017	119	295	34	167	30	645
2018	73	278	34	167	30	582
2019	61	257	59	176	31	584
2020	21	246	70	171	31	539
2021	40	244	79	164	31	558
2022	21	279	66	164	31	561
2023	26	267	71	164	31	559
2024	1	223	107	164	31	526
2025	26	262	79	164	31	562
2026	23	245	90	164	31	553
2027	24	273	93	164	31	585
2028	1	234	117	164	31	547
2029	0	222	132	162	31	547

Table 13. Transportation Cask Logistics for the 2000 TSLCC (Continued)

FY	CSNF			HLW	DSNF	Total
	Truck	UCF Rail	DPC Rail	Rail	Rail	
2030	0	179	157	154	31	521
2031	0	173	160	154	31	518
2032	0	148	194	130	34	506
2033	0	108	216	116	37	477
2034	0	101	227	117	22	467
2035	0	77	231	165	21	494
2036	0	72	235	149	19	475
2037	0	58	251	165	21	495
2038	0	60	243	150	23	476
2039	0	34	261	141	22	458
2040	0	36	198	126	21	381
Total	**1,039**	**5,645**	**3,583**	**4,430**	**784**	**15,481**

Table 14. Transportation Cask Fleet

Cask Type	Number
Commercial Truck	
BWR	5
PWR	7
Commercial Rail	
Large	35
Medium	22
Small	16
High Heat	19
South Texas	3
Yankee Rowe	1
Big Rock Point	1
West Valley – BWR	1
West Valley – PWR	1
Government-Managed Rail	
HLW	17

Table 15. Commercial Waste Packages Emplaced in the Monitored Geologic Repository

Fiscal Year	44 BWR AP[a]	24 BWR AP[a]	21 PWR Big Rock	21 PWR AP[a]	21 PWR CR[b]	12 PWR AP Long	Total
2010	20	0	2	2	7	0	31
2011	41	7	4	20	8	0	80
2012	54	3	0	63	2	0	122
2013	104	0	3	103	13	0	223
2014	145	5	0	143	10	0	303
2015	147	15	3	195	5	0	365
2016	124	17	3	163	1	0	308
2017	138	8	0	204	4	0	354
2018	127	6	0	182	3	0	318
2019	121	6	3	192	3	9	334
2020	111	9	0	186	6	13	325
2021	120	0	3	206	6	12	347
2022	133	1	0	217	2	4	357
2023	117	0	0	232	2	10	361
2024	127	0	3	229	0	0	359
2025	136	0	0	212	11	3	362
2026	129	0	0	200	2	29	360
2027	132	1	0	219	1	11	364
2028	135	1	0	202	1	12	351
2029	135	0	0	190	1	11	337
2030	140	0	0	220	0	0	360
2031	142	0	0	217	0	0	359
2032	136	1	0	220	0	0	357
2033	146	0	0	120	8	47	321
2034	141	4	0	215	1	0	361
2035	151	1	0	168	4	10	334
2036	109	1	0	216	1	21	348
2037	114	0	0	218	2	12	346
2038	133	0	0	221	1	6	361
2039	139	0	0	222	0	0	361
2040	84	7	0	170	0	82	343
2041	1	1	1	102	1	1	107
Total	**3,732**	**94**	**25**	**5,669**	**106**	**293**	**9,919**

[a]AP = Absorber Plate
[b]CR = Control Rods

Table 16. High-Level Waste and DOE Spent Nuclear Fuel Waste Packages Emplaced in the Monitored Geologic Repository

Fiscal Year	5 IPWF	5 HLW Long Only	5 HLW Long/1 DSNF Long	5 HLW Short/1 DSNF Short	5 HLW Long/1 DSNF Short	2 MCO/2 HLW Long	Naval Long	Naval Short	Total
2010	12	0	0	9	0	0	1	0	22
2011	12	20	0	26	1	0	1	0	60
2012	12	20	9	43	2	0	2	1	89
2013	12	20	18	49	5	0	4	2	110
2014	12	20	27	56	7	0	5	3	130
2015	12	20	63	56	7	0	8	4	170
2016	12	20	63	56	7	0	9	5	172
2017	12	20	72	56	7	0	10	5	182
2018	12	20	72	56	7	0	10	5	182
2019	12	20	81	56	7	0	10	5	191
2020	7	20	81	56	7	0	10	5	186
2021	0	20	81	56	7	0	10	5	179
2022	0	20	81	56	7	0	10	5	179
2023	0	20	81	56	7	0	10	5	179
2024	0	20	81	56	7	0	10	5	179
2025	0	20	81	56	7	0	10	5	179
2026	0	20	81	56	7	0	10	5	179
2027	0	20	81	56	7	0	10	5	179
2028	0	20	81	56	7	0	10	5	179
2029	0	18	81	56	7	0	10	5	177
2030	0	10	81	56	7	0	10	5	169
2031	0	10	81	56	7	0	10	5	169
2032	0	0	63	56	7	10	10	5	151
2033	0	0	45	56	7	20	10	5	143
2034	0	0	45	56	7	20	0	0	128
2035	0	58	45	47	7	20	0	0	177
2036	0	60	45	31	5	20	0	0	161
2037	0	63	72	21	1	20	0	0	177
2038	0	68	70	0	0	30	0	0	168
2039	0	66	63	0	0	30	0	0	159

Table 16. High-Level Waste and DOE Spent Nuclear Fuel Waste Packages Emplaced in the Monitored Geologic Repository (Continued)

Fiscal Year	5 IPWF	5 HLW Long Only	5 HLW Long/1 DSNF Long	5 HLW Short/1 DSNF Short	5 HLW Long/1 DSNF Short	2 MCO/2 HLW Long	Naval Long	Naval Short	Total
2040	0	66	49	0	0	29	0	0	144
2041	0	0	0	0	0	0	0	0	0
Total	**127**	**779**	**1,874**	**1,402**	**168**	**199**	**200**	**100**	**4,849**

Table 17. Waste Package Piece Count and Drift Length

Share	CSNF	HLW	DSNF	West Valley[a]	Naval SNF
Piece Count	9,911	3,825	673	56	300
Piece Count (%)	67.1	25.9	4.6	0.4	2.0
Drift Length (meters)	70,026.5	17,913.3	3,129.5	212.8	1,690.0
Drift Length (%)	75.3	19.3	3.4	0.2	1.8

[a]HLW and SNF

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APPENDIX A
CALVIN INPUT ASSUMPTIONS

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CALVIN INPUT ASSUMPTIONS

Table A-1 lists the input assumptions for the CALVIN Version 3.0 scenario (number 478) that produced the results shown in Section 4. The CALVIN database that includes this scenario is contained in reference CRWMS M&O 2000d. The information in Table A-1 was taken from the CALVIN "Scenario Options" report. Input assumptions that are not relevant to the waste stream results (e.g., cost assumptions, ISF assumptions) are not shown. Note that the CSNF acceptance rate values in the table do not match the values in Table 10. This is because CALVIN models CSNF annual acceptance rates as remaining fixed for a 12-month period (e.g., an acceptance rate of 400 MTU/year beginning in June, 2010, is assumed to remain constant until June, 2011). In order to force the code to use the acceptance rates in Table 8 (i.e., 400 MTU is accepted in calendar year 2010, 600 MTU in calendar year 2011, etc.), the CALVIN CSNF input acceptance rates had to be manually adjusted. The following formula was used to adjust the CALVIN acceptance rates:

$$A(I) = C(I-1) \times 5/12 + C(I) \times 7/12$$

Where: $A(I)$ = Acceptance rate in calendar year I
$C(I)$ = CALVIN input acceptance rate in year I

Table A-1. CALVIN Input Assumptions for 2000 TSLCC Waste Stream

Category	Parameter	Value
General Options		
	Calendar or Fiscal Year	Fiscal Year
	180C Model	Revised DOE Model
	RSC/WAST Calculation	No
Reactor Options		
	Shifts/Day	2
	Days/Week	5
	Hours/Shift	6
	Holidays	10
ISF Options		
	No ISF	
MGR Options		
	Calculate Number of Cells	No
	Bare Cells	3
	Canistered Cells	2
	Shifts/Day	3

Table A-1. CALVIN Input Assumptions for 2000 TSLCC Waste Stream (Continued)

Category	Parameter	Value
	Days/Week	5
	Hours/Shift	6
	Holidays	11
	Latitude	36.859
	Longitude	116.474
	Co-Dispose	Yes
	Limit Rounding	Yes
	Fuel Blending	Yes
	PWR Basket Size	4
	BWR Basket Size	8
	WP[a] Upper Heat Limit (Watts)	11800
	PWR WP Lower Heat Limit (Watts)	9000
	Cask Unloads Before Blending	9999
	PWR Cold Assemblies Set Aside	3,500
	MTU[b] Over Emplacement Limit (%)	3.3333
Transportation Options		
	From Reactor	
	Dedicated Train	General Rail
	Unit Train Size	1
	Return Train Size	1
	Fleet Purchase Size	1
	HLW/DSNF	
	Dedicated Train	General Rail
	Unit Train Size	1
	Return Train Size	1
	MGR Rail Spur	Yes
	Year Avail	2010
	Regions	4
Utility Options		
	Pool Selection	OFF[c] only
	Years Early/Max. Reactor Life	N/A
	Unload Shutdown	Yes
	Unload Shutdown Years	5
	Earliest Unload Year	2000
	Min. Years (Unload – final pickup)	0

Table A-1. CALVIN Input Assumptions for 2000 TSLCC Waste Stream (Continued)

Category	Parameter	Value
Fuel Options		
	Fuel Selection	YFF10
	Strict YFF[d]	N/A
	Age to Switch to dry	5
	Defer Dry-By Failed Cask	Yes
	Number of failed casks	2
	Minimum Fuel Age	5
	Ignore Cask Limits	No
	CSNF Acceptance Rates	
	Begin Month-Acceptance	6
Year	Acceptance Rates (MTU)	To MGR (MTU)
2010	685.7	685.7
2011	538.8	538.8
2012	1672.3	1672.3
2013	2234.1	2234.1
2014	3547.1	3547.1
2015	2609.2	2609.2
2016	3279.1	3279.1
2017	2800.6	2800.6
2018	3142.4	3142.4
2019	2898.3	2898.3
2020	3072.7	3072.7
2021	2948.1	2948.1
2022	3037.1	3037.1
2023	2973.5	2973.5
2024	3018.9	3018.9
2025	2986.5	2986.5
2026	3009.6	3009.6
2027	2993.1	2993.1
2028	3004.9	3004.9
2029	2996.5	2996.5
2030	3002.5	3002.5
2031	2998.2	2998.2
2032	3001.3	3001.3
2033	2999.1	2999.1

Table A-1. CALVIN Input Assumptions for 2000 TSLCC Waste Stream (Continued)

Category	**Parameter**	**Value**
2034	3000.7	3000.7
2035	2999.5	2999.5
2036	3000.3	3000.3
2037	2999.8	2999.8
2038	3000.2	3000.2
2039	2999.9	2999.9
2040	3000.1	3000.1
2041	3000	3000
HLW Acceptance Rates		
	Begin Month-Acceptance	1
Year	Acceptance Rate (MTHM)	To MGR (MTHM)
2010	52.5	52.5
2011	147.5	147.5
2012	215	215
2013	260	260
2014	305	305
2015	395	395
2016	395	395
2017	417.5	417.5
2018	417.5	417.5
2019	440	440
2020	427.5	427.5
2021	410	410
2022	410	410
2023	410	410
2024	410	410
2025	467.2	467.2
2026	524.3	524.3
2027	524.3	524.3
2028	524.3	524.3
2029	494.8	494.8
2030	385	385
2031	385	385
2032	325	325
2033	290	290

Table A-1. CALVIN Input Assumptions for 2000 TSLCC Waste Stream (Continued)

Category	Parameter	Value
2034	290	290
2035	412.5	412.5
2036	372.5	372.5
2037	413.5	413.5
2038	375	375
2039	352.5	352.5
2040	315	315
2041	0	0
DSNF Acceptance Rates		
Year	Acceptance Rate (Canisters)	To MGR (Canisters)
2010	10	10
2011	28	28
2012	57	57
2013	78	78
2014	98	98
2015	138	138
2016	140	140
2017	150	150
2018	150	150
2019	159	159
2020	159	159
2021	159	159
2022	159	159
2023	159	159
2024	159	159
2025	159	159
2026	159	159
2027	159	159
2028	159	159
2029	159	159
2030	159	159
2031	159	159
2032	161	161
2033	163	163
2034	148	148

Table A-1. CALVIN Input Assumptions for 2000 TSLCC Waste Stream (Continued)

Category	Parameter	Value
2035	139	139
2036	121	121
2037	134	134
2038	132	132
2039	123	123
2040	104	104
2041	0	0

[a]WP = Waste Package
[b]MTU = Metric Tons of Uranium
[c]OFF = Oldest Fuel First
[d]YFF = Youngest Fuel First

APPENDIX B

COMPARISON WITH 1998 AND 1999 TSLCC WASTE STREAMS

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COMPARISON WITH 1998 AND 1999 TSLCC WASTE STREAMS

Table B-1 shows a comparison of the key assumptions and results of this report versus the waste stream for the 1998 TSLCC (CRWMS M&O 1998a) and the 1999 TSLCC Update (CRWMS M&O 1999c). Except where otherwise noted, the values for the 1998 TSLCC and the 1999 TSLCC Update in the table are from Appendix B of CRWMS M&O 1999c. Except where otherwise noted, the 2000 TSLCC assumptions are for the WAST life cycle cost estimate.

Table B-1. Comparison of 1998, 1999, and 2000 TSLCC Waste Streams

Assumption	1998 TSLCC	1999 TSLCC Update	2000 TSLCC
Waste Stream			
SNF Discharge Projection	1995 RW-859 Data	1995 RW-859 Data	1995 RW-859 Data with extended burnups
MGR Receipt Rates	See Tables 3, 4, and 5 of DOE 1998a	See Tables 11, 12, and 13 of CRWMS M&O 1999c	See Tables 10, 11, and 12 of this report
Waste Acceptance			
Amount Accepted	86,300 MTHM CSNF 19,657 defense HLW canisters: 5,390 SRS 1,190 INEEL 12,442 Hanford 635 Pu HLW SRS 276 West Valley HLW canisters 71 Argonne National Laboratory (ANL) canisters 2,570 MTHM DSNF: 3,857 canisters, including 300 naval	86,300 MTHM CSNF 19,657 defense HLW canisters: 5,390 SRS 1,190 INEEL 12,442 Hanford 635 Pu HLW SRS 276 West Valley HLW canisters 71 Argonne National Laboratory (ANL) canisters 2,570 MTHM DSNF: 3,857 canisters, including 300 naval	83,800 MTHM CSNF 21,847 defense HLW canisters: 5,420 SRS 1,292 INEEL 14,500 Hanford 635 Pu HLW SRS 300 West Valley HLW canisters 2,500 MTHM DSNF: 4,141 canisters, including 300 naval
Start Waste Pickup	4/2010	4/2010	6/2010
Last DSNF Pickup	2035[a]	2035[b]	2040
Transportation Modal Split	11 reactor pool facilities and 2 DOE storage sites ship by commercial LWT 89 pool facilities ship by rail	8 reactor pool facilities and 2 DOE storage sites ship by commercial LWT 92 pool facilities ship by rail	8 reactor pool facilities and 2 DOE storage sites ship by commercial LWT 92 pool facilities ship by rail

Table B-1. Comparison of 1998, 1999, and 2000 TSLCC Waste Streams (Continued)

Assumption	1998 TSLCC	1999 TSLCC Update	2000 TSLCC
National Transportation			
Transportation Cask Capacities	Commercial Rail: UCF: 26 PWR/61 BWR 12 PWR/24 BWR DPCs: 24/61, 21/44, 12/24 PWR/BWR HH: 7/17 PWR/BWR MOX: 9 PWR LWT: 1-4 PWR/2-9 BWR, Various specialty casks HLW: 5 canisters-short (SRS, INEEL, West Valley) 5 canisters-long (Hanford) DSNF: 1 – 6 canisters	Commercial Rail: UCF: 24 PWR/68 BWR 12 PWR/32 BWR DPCs: 24/68, 26/56,21/44 PWR/BWR HH: 12/32, 7/17 PWR/BWR MOX: 9 PWR LWT: 1-4 PWR/2-9 BWR, Various specialty casks HLW: 5 canisters-short (SRS, INEEL, West Valley) 5 canisters-long (Hanford) DSNF: 1 – 6 canisters	Commercial Rail: UCF: 24 PWR/68 BWR 12 PWR/32 BWR DPCs: 24/68, 26/56, 21/44 PWR/BWR HH: 12/32, 7/17 PWR/BWR MOX: 24, 21 PWR LWT: 1-4 PWR/2-9 BWR Various specialty casks HLW: 5 canisters (all HLW) DSNF: 9 canisters, 4 MCOs, 1 naval canister
Waste Package Capacities	12 PWR/24 BWR 21 PWR/44 BWR 5 HLW including IPWF 5 HLW co-disposed with 1 DSNF DSNF: Various	12 PWR S. Texas only/ 24 BWR 21 PWR/44 BWR (no assembly heat limit) 5 HLW including IPWF 5 HLW co-disposed with 1 DSNF DSNF: Various	12 PWR S. Texas only/ 24 BWR-AP 21 PWR/44 BWR-AP 21 PWR-CR 21 PWR – Big Rock Pt. 5 HLW including IPWF 5 HLW co-disposed with 1 DSNF (SS, LL, LS) 2 HLW co-disposed with 2 MCOs 1 naval-short 1 naval-long AP = absorber plates CR = control rods SS = short-short LL = long-long LS = long-short
Number of Shipments	Rail UCF 5,616 Rail DPC 5,425 Truck 3,037 HLW 4,003 DSNF 1,252 Total: 19,333	Rail UCF 4,804 Rail DPC 4,012 Truck 1,022 HLW 4,003 DSNF 1,252 Total: 15,093	Rail UCF 5,645 Rail DPC 3,583 Truck 1,039 HLW 4,430 DSNF 784 Total: 15,481

Table B-1. Comparison of 1998, 1999, and 2000 TSLCC Waste Streams (Continued)

Assumption	1998 TSLCC	1999 TSLCC Update	2000 TSLCC
Cask Fleet[c]	Commercial LWT: 14 Large Rail: 22 Medium Rail: 21 Small Rail: 52 High Heat Rail: 4 South Texas Rail: 4 Yankee Rowe Rail: 1 Big Rock Pt. Rail: 1 Defense HLW Short: 12 HLW Long: 14	Commercial LWT: 13 Large Rail: 39 Medium Rail: 22 Small Rail: 15 High Heat Rail: 7 South Texas Rail: 3 Yankee Rowe Rail: 1 Big Rock Pt. Rail: 1 West Valley PWR: 1 West Valley BWR: 1 Defense HLW Short: 8 HLW Long: 14	Commercial LWT: 12 Large Rail: 35 Medium Rail: 22 Small Rail: 16 High Heat Rail: 19 South Texas Rail: 3 Yankee Rowe Rail: 1 Big Rock Pt. Rail: 1 West Valley PWR: 1 West Valley BWR: 1 Defense HLW: 17
Number of Waste Packages	Large: 5,723 PWR/ 3,734 BWR (incl. 73 MOX) Small: 854 PWR/144 BWR HLW: 2,652 incl. IPWF 1,349 co-disp. with DSNF DSNF: 1,250 Total: 15,706	Large: 6,038 PWR/ 3,752 BWR (incl. 73 MOX) Small: 303 PWR/110 BWR HLW: 2,652 incl. IPWF 1,349 co-disp. with DSNF DSNF: 1,250 Total: 15,454	Large: 5,800 PWR/ 3,732 BWR Small: 293 PWR/94 BWR HLW: 907 incl. IPWF 3,643 co-disp. with DSNF DSNF: 300 Total: 14,769
Number of RSCs	4 Commercial, 1 Defense[d]	4 Commercial, 1 Defense[e]	4
MGR Emplacement Parameters	Areal Loading: 85 MT/acre[f] Drift Separation: 28 meters[g]	Areal Loading: 85 MT/acre[h] Drift Separation: 81 meters[i]	Areal Loading: 60 MT/acre[j] Drift Separation: 81 meters[j]

[a]Reference: DOE 1998a Table 4.
[b]Reference: CRWMS M&O 1999c Table 12.
[c]1998 results from DOE 1998a, Table 6; 1999 results from CRWMS M&O 1999c, Table 14.
[d]Reference: CRWMS M&O 1998d, Section 3.2.2.4.
[e]Reference: CRWMS M&O 1999b Section 2.
[f]Reference: DOE 1998a, Section 1.6.
[g]Reference: DOE 1998b, Section 4.2.1.2
[h]Reference: CRWMS M&O 1999c, Sections 3.2.2 – this parameter is not identified as changed from the VA design.
[i]Reference: CRWMS M&O 1999c Section 3.1.2
[j]Reference: CRWMS M&O 2000f, Section 2.4.

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