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TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE RISK ASSESSMENT, SENIOR SCIENTIST/ENGINEER

ORIGINATOR ALEX NAZARALI DATE 4-3-96

REVISION NO. _____

OBJECTIVE CALCULATE TOTAL CANCER INCIDENCE AND CANCER FATALITIES FOR POST-REMEDIATION ALTERNATIVES

METHODOLOGY SEE ATTACHMENT.

ASSUMPTIONS SEE ATTACHMENT.

(Continue on another sheet if necessary)

A. H. Nazarali 4-3-96
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APR 1996
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CALCULATION & RESULTS
ATTACHED

JACOBS\FORMS\CALCVR.SHT

SUMMARY TABLE FOR TOTAL RISK CALCULATION

All the alternative post-remediation total cancer incidence and cancer fatality for 10,000 years from present time

Alternatives	Residential Farmer		Industrial Worker		Recreational user	
	Cancer Incidence[1]	Cancer Fatality[2]	Cancer Incidence[1]	Cancer Fatality[2]	Cancer Incidence[1]	Cancer Fatality[2]
No Action	757	631	276	230	46	39
Long-Term Management	677	565	276	230	50	41
In Situ Fill and Cap	400	333	277	231	29	24
In Situ Vitrification	0	0	0	0	0	0
Ex Situ intermediate Separation	12	10	6	5	0	0
Ex Situ No Separation	12	10	6	5	0	0
Ex Situ Extensive Separation	12	10	6	5	0	0
Ex Situ In Situ Combination	72	60	30	25	1	0
Phased Implementation	12	10	6	5	0	0
Population Density (# of Indv./ km^2)	4.97		2.81		17.75	
Population per Generation (# of Indv)	3900		2200		1950	
Total population in 10,000 yr (# of Indv)	557,143		733,333		650,000	
Area of Land Use (km^2)	785		785		104	

1 Dose to risk conversion factor for cancer incidence used is 6.0E-04 (ICRP 1991).

2 Dose to risk conversion factor for cancer fatality used is 5.0E-04 (ICRP 1991).

Total Post-Remediation Cancer Incidences and Fatality Calculation Methodology and Results Using the Risk Contour Area.

For each alternative (total of 8) and receptor group (total of 4), five risk contours (three isopleth each), corresponded to 300, 500, 2,500, 5,000, and 10,000 years from present time have been calculated and presented in Appendix D, Figures D.5.1.1 through D.5.9.17.

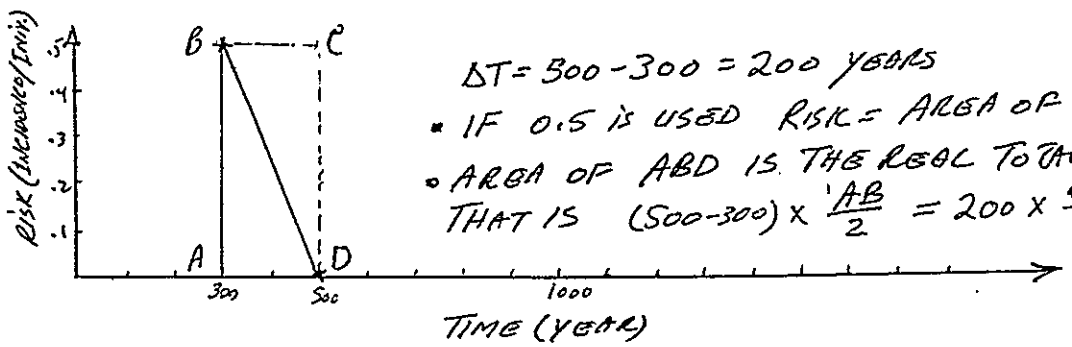
The total risk (cancer incidences) for each isopleth is calculated by multiplying the risk associated with each isopleth by the number of individuals within that isopleth. Then the total risk for the contour, which contains several isopleth, is the sum of the isopleth total risk. The risk in this calculation refers to the incremental lifetime cancer incidence. The cancer incidences are converted to the cancer fatality using the International Commission on Radiation Protection (ICRP) Publication 60 dose to risk conversion factors.

The risk contour presented in Appendix D and Volume One of the TWRS-EIS contains only three isopleths. In this calculation 18 isopleths are used for better estimation of the total risk. These isopleth are produced using the SURFER computer software. The area and corresponding risk print out are tabulated and presented in the attachment.

The data and calculated results for each alternative and receptor are presented in one table. Each table is identified by the alternative's abbreviation (e.g., NA-No Action, ISFC-In Situ Fill and Cap) followed by the receptor type such as residential farmer, industrial worker, and recreational shoreline user. All the tables have the same format and computation method.

The first column of each table presents the risk magnitude, which is the chance of developing cancer. The first risk of 0.5 indicates that 1 out of 2 within the isopleth with this risk has a chance of developing cancer, or an individual has a 50% chance of developing cancer. The next four columns, each containing three subcolumns, have the same format and represent the four time periods of interest, labeled as T1, T2, T3, and T4. The first column within each time period shows the area of each isopleth corresponded to the risk magnitude in square kilometers (km^2). The second column shows the total number of individuals within that area for the duration of that isopleth. The third column present the product of risk magnitude (first column) and the total number of individuals (second column) that is the total cancer incidence per the isopleth.

The area of isopleth with risk of 0.5 at time period T1 is 1.0 km^2 and zero at the time period of T2. This show the risk at the year 200 is 0.5 and at the year 500 is zero. Using the risk of 0.5 for the entire duration of 200 years will over estimate the total risk. For better estimating of the total risk the half value (average) of 0.5 is used for the duration of 200 years. The following graph presents the mathematical logic for this rational.



$\Delta T = 500 - 300 = 200$ YEARS

- IF 0.5 IS USED RISK = AREA OF ABCD
- AREA OF ABD IS THE REAL TOTAL DOSE

THAT IS $(500-300) \times \frac{AB}{2} = 200 \times \frac{0.5}{2} = 200 \times 0.25$

The following demonstrates the calculation for the NA residential farmer for a risk magnitude of 0.5, 0.3, and 0.2 for the time period of T1.

First Column:
Risk of 0.5 has isopleth with area of 1 km^2
Risk of 0.3 has isopleth with area of 3 km^2
Risk of 0.2 has isopleth with area of 50 km^2
.....
.....

Second Column:
The total number of individuals = (Area) x (population density) x (number of generations)

The population density, total population per generation, and number of generations are estimated and assumed based on the current data and anticipated changes. The generation refer to the time duration of a receptor involved in the activity, the industrial worker's generation is assumed 30 years, which means an industrial worker individual would be exposed to the contaminated media for entire duration of his/her occupancy. The same time duration of 30 years is assumed for the recreational shoreline user. This information regarding each receptors is presented in the summary table. For the residential farmer, the population density of 4.97 farming individuals per km^2 is assumed with farming of 70 years per generation. Therefore, for risk of 0.5:

Total number of farming individuals = 1.0 (km^2) x 4.97 (# of Individual per generation per km^2) x (200/70) (years per years per generation) = 14.2 individual0 farmers

Total risk for the 0.5 risk isopleth is
= 14.2 (individuals) x 0.5 (cancer incidence per individual)
= 7.10 cancer incidence for risk of 0.5 over 200 years
= 3..55 cancer incidences for average risk of 2.5 ([0.5 +0.0]/2) over 200 years

For risk of 0.3 the total cancer incidence
= 0.30 (risk/individual) x 3 (km^2) x 4.97 (individuals/km^2 -generation) x 200/70 (generations)
= 12.78 cancer Incidences for maximum risk of 0.3
= 6.39 cancer Incidences for average risk of 0.15 ([0.3+0.0]/2)

For risk of 0.2 the total cancer incidence
= 0.2 (risk/individual) x 50 (km^2) x 4.97 (individuals/km^2 -generation) x 200/70 (# of generation)
= 142 cancer Incidences for maximum risk of 0.2
= 71.00 cancer Incidences for average risk of 0.1 ([0.2+0.0]/2)

The same is applied to all the calculations.

The cancer incidences are converted to cancer fatalities using the ICRP Publication 60, Table 3. This table presents fatal cancer of 5.0E-04 per rem for exposed population of whole population

and non-fatal cancer of 1.0E-04 per rem. Using the above data, there would be 0.8 fatalities per each incidence (4.0E-04/5.0E-04). Therefore, the cancer incidences of 3.55, 6.39, and 71.00 would be corresponded to 2.84, 5.11, and 56.80 cancer fatalities.

The summary of the calculations is shown in the summary table.

Table D.14.1 All the alternative post-remediation total cancer incidence and cancer fatality for 10,000 years from present time

Alternatives	Residential Farmer		Industrial Worker		Recreational user	
	Cancer Incidence[1]	Cancer Fatality[1]	Cancer Incidence[1]	Cancer Fatality[2]	Cancer Incidence[1]	Cancer Fatality[2]
No Action	757	631	276	230	46	39
Long-Term Management	677	565	276	230	50	41
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In Situ Vitrification	0	0	0	0	0	0
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Ex Situ No Separation	12	10	6	5	0	0
Ex Situ Extensive Separation	12	10	6	5	0	0
Ex Situ In Situ Combination	72	60	30	25	1	0
Phased Implementation	12	10	6	5	0	0
Population Density (# of Indv./ km^2)	4.97		2.81		17.75	
Population per Generation (# of Indv)	3900		2200		1950	
Total population in 10,000 yr (# of Indv)	557,143		733,333		650,000	
Area of Land Use (km^2)	785		785		104	

1 Dose to risk conversion factor for cancer incidence used is 6.0E-04 (ICRP-60)
2 Dose to risk conversion factor for cancer fatality used is 5.0E-04 (ICRP-60)

Table D. **All the alternative post-remediation total cancer incidence and cancer fatality for 10,000 years from present time**

Alternatives	Residential Farmer		Industrial Worker		Recreational user	
	Cancer Incidence	Cancer Fatality	Cancer Incidence	Cancer Fatality	Cancer Incidence	Cancer Fatality
No Action	757	631	276	230	46	39
Long-Term Management	677	565	276	230	50	41
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Ex Situ Extensive Separation	12	10	6	5	0	0
Ex Situ In Situ Combination	72	60	30	25	1	0
Phased Implementation	12	10	6	5	0	0
Population Density (# of Indv./ km^2)	4.97		2.81		17.75	
Population per Generation (# of Indv)	3900		2200		1950	
Area of Land Use (km^2)	785		785		104	

Dose to risk conversion factor for cancer incidence is 6.0E-04
Dose to risk conversion factor for cancer fatality is 5.0E-04

NA	km2	# of Indv.	Risk	km2	# of Indv.	Risk	km2	# of Indv.	Risk	km2	# of Indv.	Risk
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50
0.5	1	14.20	3.55	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
0.3	3	42.60	6.39	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
0.2	50	710.00	71.00	10	1420.00	142.00	0	0.00	0.00	0	0.00	0.00
0.1	22	312.40	15.62	4	568.00	28.40	0	0.00	0.00	0	0.00	0.00
0.09	23	326.60	14.70	3	426.00	19.17	0	0.00	0.00	0	0.00	0.00
0.08	17	241.40	9.66	5	710.00	28.40	0	0.00	0.00	0	0.00	0.00
0.07	21	298.20	10.44	3	426.00	14.91	0	0.00	0.00	0	0.00	0.00
0.06	25	355.00	10.65	6	852.00	25.56	0	0.00	0.00	0	0.00	0.00
0.05	21	298.20	7.46	8	1136.00	28.40	0	0.00	0.00	0	0.00	0.00
0.04	52	738.40	14.77	12	1704.00	34.08	0	0.00	0.00	0	0.00	0.00
0.03	46	653.20	9.80	18	2556.00	38.34	0	0.00	0.00	0	0.00	0.00
0.02	35	497.00	4.97	58	8236.00	82.36	0	0.00	0.00	0	0.00	0.00
0.01	35	497.00	2.49	72	10224.00	51.12	0	0.00	0.00	0	0.00	0.00
0.005	63	894.60	2.24	183	25986.00	64.97	0	0.00	0.00	0	0.00	0.00
0.001	70	994.00	0.50	190	26980.00	13.49	1	177.50	0.09	0	0.00	0.00
0.0001	77	1093.40	0.05	82	11644.00	0.58	18	3195.00	0.16	0	0.00	0.00
0.00001	90	1278.00	0.01	37	5254.00	0.03	217	38517.50	0.19	77	27335.00	0.14
0.000001	33	468.60	0.00	30	4260.00	0.00	118	20945.00	0.01	305	108275.00	0.05
0	101	1434.20	0.00	64	9088.00	0.00	431	76502.50	0.00	403	143065.00	0.00
	785		184.27	785		571.81	785		0.45	785		0.19
Total												
756.72												
630.60												

LTM	km2	# of Indv.	Risk	km2	# of Indv.	Risk	km2	# of Indv.	Risk	km2	# of Indv.	Risk
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
0.3	1	14.20	2.13	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
0.2	4	56.80	5.68	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
0.1	0	0.00	0.00	9	1278.00	63.90	0	0.00	0.00	0	0.00	0.00
0.09	5	71.00	3.20	6	852.00	38.34	0	0.00	0.00	0	0.00	0.00
0.08	16	227.20	9.09	7	994.00	39.76	0	0.00	0.00	0	0.00	0.00
0.07	27	383.40	13.42	8	1136.00	39.76	0	0.00	0.00	0	0.00	0.00
0.06	38	539.60	16.19	12	1704.00	51.12	0	0.00	0.00	0	0.00	0.00
0.05	42	596.40	14.91	10	1420.00	35.50	0	0.00	0.00	0	0.00	0.00
0.04	74	1050.80	21.02	20	2840.00	56.80	0	0.00	0.00	0	0.00	0.00
0.03	44	624.80	9.37	25	3550.00	53.25	0	0.00	0.00	0	0.00	0.00
0.02	80	1136.00	11.36	46	6532.00	65.32	0	0.00	0.00	0	0.00	0.00
0.01	32	454.40	2.27	62	8804.00	44.02	0	0.00	0.00	0	0.00	0.00
0.005	102	1448.40	3.62	175	24850.00	62.13	0	0.00	0.00	0	0.00	0.00
0.001	81	1150.20	0.58	190	26980.00	13.49	1	177.50	0.09	0	0.00	0.00
0.0001	127	1803.40	0.09	83	11786.00	0.59	11	1952.50	0.10	0	0.00	0.00
0.00001	26	369.20	0.00	39	5538.00	0.03	188	33370.00	0.17	77	27335.00	0.14
0.000001	25	355.00	0.00	33	4686.00	0.00	154	27335.00	0.01	305	108275.00	0.05
0	61	866.20		60	8520.00	0.00	431	76502.50	0.00	403	143065.00	0.00
	785		112.92	785		564.00	785		0.37	785		0.19
Total												
677.48												
564.57												

ISFC	km2	# of Indv.	Risk	km2	# of Indv.	Risk	km2	# of Indv.	Risk	km2	# of Indv.	Risk					
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	2	710.00	7.10					
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	95	33725.00	168.63					
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	231	82005.00	205.01	14				
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	93	33015.00	16.51	311				
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	115	40825.00	2.04	169				
0.00001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	144	51120.00	0.26	143				
0.000001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	24	8520.00	0.00	45				
0	785	11147.00		785	111470.00	0.00	.785	139337.50	0.00	81	28755.00	0.00					
	785		0.00	785		0.00	785		0.00	785		399.55					
Total																	
399.55																	

ISV	km2	# of Indv.	Risk	km2	# of Indv.	Risk	km2	# of Indv.	Risk	km2	# of Indv.	Risk		T5			
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	1				
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	1				
0.00001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	31	11005.00	0.06	127				
0.000001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	356	126380.00	0.06	300				
0	785	11147.00		785	111470.00	0.00	785	139337.50	0.00	398	141290.00	0.00	356				
	785		0.00	785		0.00	785		0.00	785		0.12	785				
Total																	
0.12																	

ESIS	km2	# of Indv.	Risk	km2	# of Indv.	Risk	km2	# of Indv.	Risk	km2	# of Indv.	Risk		T5			
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	30	10650.00	5.33					
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	361	128155.00	6.41	242				
0.00001	0	0.00	0.00	0	0.00	0.00	122	21655.00	0.11	119	42245.00	0.21	68				
0.000001	0	0.00	0.00	0	0.00	0.00	233	41357.50	0.02	153	54315.00	0.03	33				
0	785	11147.00		785	111470.00	0.00	430	76325.00	0.00	122	43310.00	0.00	442				
	785		0.00	785		0.00	785		0.13	785		11.97	785				
Total																	
12.10																	

ESNS	km2	# of Indv.	Risk	km2	# of Indv.	Risk	km2	# of Indv.	Risk	km2	# of Indv.	Risk		T5			
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	30	10650.00	5.33					
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	357	126735.00	6.34					
0.00001	0	0.00	0.00	0	0.00	0.00	122	21655.00	0.11	122	43310.00	0.22					
0.000001	0	0.00	0.00	0	0.00	0.00	233	41357.50	0.02	153	54315.00	0.03					
0	785	11147.00		785	111470.00	0.00	430	76325.00	0.00	123	43665.00	0.00					
	785		0.00	785		0.00	785		0.13	785		11.91					
Total																	
12.03																	

ESES	km2	# of Indv.	Risk	km2	# of Indv.	Risk	km2	# of Indv.	Risk	km2	# of Indv.	Risk		T5			
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	30	10650.00	5.33					
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	357	126735.00	6.34					
0.00001	0	0.00	0.00	0	0.00	0.00	122	21655.00	0.11	122	43310.00	0.22					
0.000001	0	0.00	0.00	0	0.00	0.00	233	41357.50	0.02	153	54315.00	0.03	227				
0	785	11147.00		785	111470.00	0.00	430	76325.00	0.00	123	43665.00	0.00	558				
	785		0.00	785		0.00	785		0.13	785		11.91	785				
Total																	
12.03																	

ESISC	km2	# of Indv.	Risk	km2	# of Indv.	Risk	km2	# of Indv.	Risk	km2	# of Indv.	Risk		T5			
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	12	4260.00	10.65					
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	329	116795.00	58.40	11				
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	117	41535.00	2.08	361				
0.00001	0	0.00	0.00	0	0.00	0.00	43	7632.50	0.04	191	67805.00	0.34	125				
0.000001	0	0.00	0.00	0	0.00	0.00	277	49167.50	0.02	34	12070.00	0.01	83				
0	785	11147.00		785	111470.00	0.00	465	82537.50	0.00	102	36210.00	0.00	205				
	785		0.00	785		0.00	785		0.06	785		71.47	785				
Total																	
71.53																	

PI	km2	# of Indv.	Risk	km2	# of Indv.	Risk	km2	# of Indv.	Risk	km2	# of Indv.	Risk		T5			
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	30	10650.00	5.33					
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	361	128155.00	6.41	242				
0.00001	0	0.00	0.00	0	0.00	0.00	122	21655.00	0.11	119	42245.00	0.21	68				
0.000001	0	0.00	0.00	0	0.00	0.00	233	41357.50	0.02	153	54315.00	0.03	33				
0	785	11147.00		785	111470.00	0.00	430	76325.00	0.00	122	43310.00	0.00	442				
	785		0.00	785		0.00	785		0.13	785		11.97	785				
Total																	
12.10																	

NA	km2	total indv.	risk	km2	total indv.	risk	km2	total indv.	risk	km2	total indv.	risk					
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50		T5			
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.2	1	18.73	1.87	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.09	1	18.73	0.84	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.07	2	37.47	1.31	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.06	1	18.73	0.56	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.05	1	18.73	0.47	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.04	22	412.13	8.24	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.03	67	1255.13	18.83	17	3184.67	47.77	0	0.00	0.00	0	0.00	0.00					
0.02	81	1517.40	15.17	22	4121.33	41.21	0	0.00	0.00	0	0.00	0.00					
0.01	102	1910.80	9.55	32	5994.67	29.97	0	0.00	0.00	0	0.00	0.00					
0.005	78	1461.20	3.65	158	29598.67	74.00	0	0.00	0.00	0	0.00	0.00					
0.001	84	1573.60	0.79	207	38778.00	19.39	0	0.00	0.00	0	0.00	0.00					
0.0001	66	1236.40	0.06	187	35031.33	1.75	8	1873.33	0.09	0	0.00	0.00					
0.00001	106	1985.73	0.01	48	8992.00	0.04	155	36295.83	0.18	28	13113.33	0.07					
0.000001	53	992.87	0.00	31	5807.33	0.00	149	34890.83	0.02	286	133943.33	0.07	2				
0	120	2248.00	0.00	83	15548.67	0.00	473	110760.83	0.00	471	220585.00	0.00	783				
	785		61.37	785		214.14	785		0.29	785		0.13	785				
Total																	
275.93																	
229.95																	

LTM	km2	total indv.	risk	km2	total indv.	risk	km2	total indv.	risk	km2	total indv.	risk					
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50		T5			
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.2	1	18.73	1.87	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.08	1	18.73	0.75	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.06	2	37.47	1.12	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.05	1	18.73	0.47	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.04	18	337.20	6.74	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.03	57	1067.80	16.02	17	3184.67	47.77	0	0.00	0.00	0	0.00	0.00					
0.02	91	1704.73	17.05	22	4121.33	41.21	0	0.00	0.00	0	0.00	0.00					
0.01	102	1910.80	9.55	37	6931.33	34.66	0	0.00	0.00	0	0.00	0.00					
0.005	100	1873.33	4.68	153	28662.00	71.66	0	0.00	0.00	0	0.00	0.00					
0.001	105	1967.00	0.98	207	38778.00	19.39	0	0.00	0.00	0	0.00	0.00					
0.0001	79	1479.93	0.07	188	35218.67	1.76	7	1639.17	0.08	0	0.00	0.00					
0.00001	120	2248.00	0.01	48	8992.00	0.04	128	29973.33	0.15	26	12176.67	0.06					
0.000001	24	449.60	0.00	30	5620.00	0.00	156	36530.00	0.02	286	133943.33	0.07					
0	84	1573.60		83	15548.67	0.00	494	115678.33	0.00	473	221521.67	0.00	2				
	785		59.33	785		216.49	785		0.25	785		0.13					
Total																	
276.20																	
230.17																	

ISFC	km2	total indv.	risk	km2	total indv.	risk	km2	total indv.	risk	km2	total indv.	risk					
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	203	95071.67	237.68					
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	157	73528.33	36.76	43				
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	108	50580.00	2.53	407				
0.00001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	182	85236.67	0.43	71				
0.000001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	40	18733.33	0.01	144				
0	785	14705.67		785	147056.67	0.00	785	183820.83	0.00	95	44491.67	0.00	120				
	785		0.00	785		0.00	785		0.00	785		277.41	785				
Total																	
277.41																	
231.17																	

ISV	km2	total indv.	risk	km2	total indv.	risk	km2	total indv.	risk	km2	total indv.	risk					
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	1				
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.00001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.000001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	16	7493.33	0.00	22				
0	785	14705.67		785	147056.67	0.00	785	183820.83	0.00	769	360148.33	0.00	762				
	785		0.00	785		0.00	785		0.00	785		0.00	785				
Total																	
0.00																	
0.00																	

ESIS	km2	total indv.	risk	km2	total indv.	risk	km2	total indv.	risk	km2	total indv.	risk					
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	247	115678.33	5.78					
0.00001	0	0.00	0.00	0	0.00	0.00	5	1170.83	0.01	212	99286.67	0.50	1				
0.000001	0	0.00	0.00	0	0.00	0.00	255	59712.50	0.03	129	60415.00	0.03	283				
0	785	14705.67		785	147056.67	0.00	525	122937.50	0.00	197	92261.67	0.00	501				
	785		0.00	785		0.00	785		0.04	785		6.31	785				
Total																	
6.35																	
5.29																	

ESNS	km2	total indv.	risk	km2	total indv.	risk	km2	total indv.	risk	km2	total indv.	risk					
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	240	112400.00	5.62					
0.00001	0	0.00	0.00	0	0.00	0.00	5	1170.83	0.01	219	102565.00	0.51					
0.000001	0	0.00	0.00	0	0.00	0.00	255	59712.50	0.03	129	60415.00	0.03	0				
0	785	14705.67		785	147056.67	0.00	525	122937.50	0.00	197	92261.67	0.00	785				
	785		0.00	785		0.00	785		0.04	785		6.16	785				
Total																	
6.20																	
5.17																	

ESES	km2	total indv.	risk	km2	total indv.	risk	km2	total indv.	risk	km2	total indv.	risk					
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	240	112400.00	5.62					
0.00001	0	0.00	0.00	0	0.00	0.00	5	1170.83	0.01	219	102565.00	0.51					
0.000001	0	0.00	0.00	0	0.00	0.00	255	59712.50	0.03	129	60415.00	0.03	0				
0	785	14705.67		785	147056.67	0.00	525	122937.50	0.00	197	92261.67	0.00	785				
	785		0.00	785		0.00	785		0.04	785		6.16	785				
Total																	
6.20																	
5.17																	

ESISC	km2	total indv.	risk	km2	total indv.	risk	km2	total indv.	risk	km2	total indv.	risk					
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00					
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	1	468.33	1.17					
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	91	42618.33	21.31					
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	301	140968.33	7.05	105				
0.00001	0	0.00	0.00	0	0.00	0.00	3	702.50	0.00	133	62288.33	0.31	344				
0.000001	0	0.00	0.00	0	0.00	0.00	192	44960.00	0.02	139	65098.33	0.03	78				
0	785	14705.67		785	147056.67	0.00	590	138158.33	0.00	120	56200.00	0.00	258				
	785		0.00	785		0.00	785		0.03	785		29.87	785				
Total																	
29.90																	
24.92																	

PI	km2	total indv.	risk	km2	total indv.	risk	km2	total indv.	risk	km2	total indv.	risk					
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	247	115678.33	5.78	0				
0.00001	0	0.00	0.00	0	0.00	0.00	5	1170.83	0.01	212	99286.67	0.50	1				
0.000001	0	0.00	0.00	0	0.00	0.00	255	59712.50	0.03	129	60415.00	0.03	283				
0	785	14705.67		785	147056.67	0.00	525	122937.50	0.00	197	92261.67	0.00	501				
	785		0.00	785		0.00	785		0.04	785		6.31	785				
Total																	
6.35																	
5.29																	

NA Recreational shoreline

NA	km2	# of INDV.	Risk	km2	# of INDV.	Risk	km2	# of INDV.	Risk	km2	# of INDV.	Risk	km2	# of IN	Risk		
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.005	8	1000.00	2.50	10	12500.00	31.25	0	0.00	0.00	0	0.00	0.00	0				
0.001	13	1625.00	0.81	17	21250.00	10.63	0	0.00	0.00	0	0.00	0.00	0				
0.0001	5	625.00	0.03	14	17500.00	0.88	0	0.00	0.00	0	0.00	0.00	0				
0.00001	8	1000.00	0.01	26	32500.00	0.16	0	0.00	0.00	0	0.00	0.00	0				
0.000001	11	1375.00	0.00	3	3750.00	0.00	6	9375.00	0.00	1	3125.00	0.00	0				
0	59	7375.00	0.00	34	42500.00	0.00	98	153125.00	0.00	103	321875.00	0.00	104				
	104		3.35	104		42.91	104		0.00	104		0.00	104				
Total																	
46.27																	
38.56																	

LTM	km2	# of INDV.	Risk	km2	# of INDV.	Risk	km2	# of INDV.	Risk	km2	# of INDV.	Risk					
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.005	7	875.00	2.19	11	13750.00	34.38	0	0.00	0.00	0	0.00	0.00	0				
0.001	21	2625.00	1.31	17	21250.00	10.63	0	0.00	0.00	0	0.00	0.00	0				
0.0001	10	1250.00	0.06	13	16250.00	0.81	0	0.00	0.00	0	0.00	0.00	0				
0.00001	20	2500.00	0.01	26	32500.00	0.16	0	0.00	0.00	0	0.00	0.00	0				
0.000001	12	1500.00	0.00	3	3750.00	0.00	0	0.00	0.00	1	3125.00	0.00	0				
0	34	4250.00	0.00	34	42500.00	0.00	104	162500.00	0.00	103	321875.00	0.00	104				
	104		3.58	104		45.98	104		0.00	104		0.00	104				
Total																	
49.55																	
41.30																	

ISFC Recreational Shoreline

ISFC	km2	# of INDV.	Risk	km2	# of INDV.	Risk	km2	# of INDV.	Risk	km2	# of INDV.	Risk					
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	17	53125.00	26.56	0				
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	14	43750.00	2.19	0				
0.00001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	8	25000.00	0.13	32				
0.000001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	26	81250.00	0.04	11				
0	104	13000.00	0.00	104	130000.00	0.00	104	162500.00	0.00	39	121875.00	0.00	61				
	104		0.00	104		0.00	104		0.00	104		28.92	104				
Total																	
28.92																	
24.10																	

ISV	km2	# of INDV.	Risk	km2	# of INDV.	Risk	km2	# of INDV.	Risk	km2	# of INDV.	Risk					
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.00001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.000001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0	104	13000.00	0.00	104	130000.00	0.00	104	162500.00	0.00	104	325000.00	0.00	104				
	104		0.00	104		0.00	104		0.00	104		0.00	104				
Total																	
0.00																	
0.00																	

ESIS	km2	# of INDV.	Risk	km2	# of INDV.	Risk	km2	# of INDV.	Risk	km2	# of INDV.	Risk					
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.00001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	21	65625.00	0.33	0				
0.000001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	15	46875.00	0.02	8				
0	104	13000.00	0.00	104	130000.00	0.00	104	162500.00	0.00	68	212500.00	0.00	96				
	104		0.00	104		0.00	104		0.00	104		0.35	104				
Total																	
0.35																	
0.29																	

ESNS Recreational Shoreline

ESNS	km2	# of INDV.	Risk	km2	# of INDV.	Risk	km2	# of INDV.	Risk	km2	# of INDV.	Risk					
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.00001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	21	65625.00	0.33	0				
0.000001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	15	46875.00	0.02	0				
0	104	13000.00	0.00	104	130000.00	0.00	104	162500.00	0.00	68	212500.00	0.00	104				
	104		0.00	104		0.00	104		0.00	104		0.35	104				
Total																	
0.35																	
0.29																	

ESES	km2	# of INDV.	Risk	km2	# of INDV.	Risk	km2	# of INDV.	Risk	km2	# of INDV.	Risk					
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.00001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	21	65625.00	0.33	0				
0.000001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	15	46875.00	0.02	8				
0	104	13000.00	0.00	104	130000.00	0.00	104	162500.00	0.00	68	212500.00	0.00	96				
	104		0.00	104		0.00	104		0.00	104		0.35	104				
Total																	
0.35																	
0.29																	

ESISC	km2	# of INDV.	Risk	km2	# of INDV.	Risk	km2	# of INDV.	Risk	km2	# of INDV.	Risk					
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.00001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	33	103125.00	0.52	5				
0.000001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	11	34375.00	0.02	27				
0	104	13000.00	0.00	104	130000.00	0.00	104	162500.00	0.00	60	187500.00	0.00	72				
	104		0.00	104		0.00	104		0.00	104		0.53	104				
Total																	
0.53																	
0.44																	

IP	km2	# of INDV.	Risk	km2	# of INDV.	Risk	km2	# of INDV.	Risk	km2	# of INDV.	Risk					
	200	T1	0.50	2000	T2	0.50	2500	T3	0.50	5000	T4	0.50					
0.5	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.3	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.2	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.1	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.09	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.08	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.07	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.06	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.05	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.04	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.03	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.01	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.005	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.0001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0				
0.00001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	21	65625.00	0.33	0				
0.000001	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	15	46875.00	0.02	8				
0	104	13000.00	0.00	104	130000.00	0.00	104	162500.00	0.00	68	212500.00	0.00	96				
	104		0.00	104		0.00	104		0.00	104		0.35	104				
Total																	
0.00																	
0.00																	

S_R_1.CMP (RESIDENTIAL FARMER)

Time Period	Alternative	Risk = 1 Area (km2)	Risk > .9 Area (km2)	Risk > .8 Area (km2)	Risk > .7 Area (km2)	Risk > .6 Area (km2)	Risk > .5 Area (km2)	Risk > .4 Area (km2)	Risk > .3 Area (km2)	Risk > .2 Area (km2)
T1	No Action Alternative	0	0	0	0	0	0	1	0	3
	Long-Term Management Alternative	0	0	0	0	0	0	0	0	1
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0
T2	No Action Alternative	0	0	0	0	0	0	0	0	0
	Long-Term Management Alternative	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0
T3	No Action Alternative	0	0	0	0	0	0	0	0	0
	Long-Term Management Alternative	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0
T4	No Action Alternative	0	0	0	0	0	0	0	0	0
	Long-Term Management Alternative	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0

Time Period	Alternative	Risk = 1 Area (km2)	Risk > .9 Area (km2)	Risk > .8 Area (km2)	Risk > .7 Area (km2)	Risk > .6 Area (km2)	Risk > .5 Area (km2)	Risk > .4 Area (km2)	Risk > .3 Area (km2)	Risk > .2 Area (km2)
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0
T5	No Action Alternative	0	0	0	0	0	0	0	0	0
	Long-Term Management Alternative	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0

Time Period	Alternative	Risk > .1 Area (km2)	Risk > .09 Area (km2)	Risk > .08 Area (km2)	Risk > .07 Area (km2)	Risk > .06 Area (km2)	Risk > .05 Area (km2)	Risk > .04 Area (km2)	Risk > .03 Area (km2)	Risk > .02 Area (km2)
T1	No Action Alternative	50	22	23	17	21	25	21	52	46
	Long-Term Management Alternative	4	0	5	16	27	38	42	74	44
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0
T2	No Action Alternative	10	4	3	5	3	6	8	12	18
	Long-Term Management Alternative	0	9	6	7	8	12	10	20	25
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0
T3	No Action Alternative	0	0	0	0	0	0	0	0	0
	Long-Term Management Alternative	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0
T4	No Action Alternative	0	0	0	0	0	0	0	0	0
	Long-Term Management Alternative	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0

Time Period	Alternative	Risk > .1 Area (km2)	Risk > .09 Area (km2)	Risk > .08 Area (km2)	Risk > .07 Area (km2)	Risk > .06 Area (km2)	Risk > .05 Area (km2)	Risk > .04 Area (km2)	Risk > .03 Area (km2)	Risk > .02 Area (km2)
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0
T5	No Action Alternative	0	0	0	0	0	0	0	0	0
	Long-Term Management Alternative	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0

Time Period	Alternative	Risk > .01 Area (km2)	Risk > .005 Area (km2)	Risk > .001 Area (km2)	Risk > .0001 Area (km2)	Risk > .00001 Area (km2)	Risk > .000001 Area (km2)	Risk > .0000001 Area (km2)	Total Affected Area (km2)	Percent of Site
T1	No Action Alternative	35	35	63	70	77	90	33	684	0.471724
	Long-Term Management Alternative	80	32	102	81	127	26	25	724	0.49931
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0
T2	No Action Alternative	58	72	183	190	82	37	30	721	0.497241
	Long-Term Management Alternative	46	62	175	190	83	39	33	725	0.5
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0
T3	No Action Alternative	0	0	0	1	18	217	118	354	0.244138
	Long-Term Management Alternative	0	0	0	1	11	188	154	354	0.244138
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	122	233	355	0.244828
	Ex Situ No Separations Alternative	0	0	0	0	0	122	233	355	0.244828
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	122	233	355	0.244828
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	43	277	320	0.22069
	Phased Implementation Alternative	0	0	0	0	0	122	233	355	0.244828
T4	No Action Alternative	0	0	0	0	0	77	305	382	0.263448
	Long-Term Management Alternative	0	0	0	0	0	77	305	382	0.263448
	In Situ Fill and Cap Alternative	2	95	231	93	115	144	24	704	0.485517
	In Situ Vitrification Alternative	0	0	0	0	0	31	356	387	0.266897

Time Period	Alternative	Risk > .01 Area (km2)	Risk > .005 Area (km2)	Risk > .001 Area (km2)	Risk > .0001 Area (km2)	Risk > .00001 Area (km2)	Risk > .000001 Area (km2)	Risk > .0000001 Area (km2)	Total Affected Area (km2)	Percent of Site
	Ex Situ Intermediate Separations Alternative	0	0	0	30	361	119	153	663	0.457241
	Ex Situ No Separations Alternative	0	0	0	30	357	122	153	662	0.456552
	Ex Situ Extensive Separations Alternative	0	0	0	30	357	122	153	662	0.456552
	Ex Situ/In Situ Combination Alternative	0	0	12	329	117	191	34	683	0.471034
	Phased Implementation Alternative	0	0	0	30	361	119	153	663	0.457241
T5	No Action Alternative	0	0	0	0	0	0	5	5	0.003448
	Long-Term Management Alternative	0	0	0	0	0	0	5	5	0.003448
	In Situ Fill and Cap Alternative	0	0	14	311	169	143	45	682	0.470345
	In Situ Vitrification Alternative	0	0	0	1	1	127	300	429	0.295862
	Ex Situ Intermediate Separations Alternative	0	0	0	0	242	68	33	343	0.236552
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	227	227	0.156552
	Ex Situ/In Situ Combination Alternative	0	0	0	11	361	125	83	580	0.4
	Phased Implementation Alternative	0	0	0	0	242	68	33	343	0.236552

S_R_2.CMP (INDSTRIAL WORKER)

Time Period	Alternative	Risk = 1 Area (km2)	Risk > .9 Area (km2)	Risk > .8 Area (km2)	Risk > .7 Area (km2)	Risk > .6 Area (km2)	Risk > .5 Area (km2)	Risk > .4 Area (km2)	Risk > .3 Area (km2)	Risk > .2 Area (km2)	Risk > .1 Area (km2)
T1	No Action Alternative	0	0	0	0	0	0	0	0	0	1
	Long-Term Management Alternative	0	0	0	0	0	0	0	0	0	1
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0	0
T2	No Action Alternative	0	0	0	0	0	0	0	0	0	0
	Long-Term Management Alternative	0	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0	0
T3	No Action Alternative	0	0	0	0	0	0	0	0	0	0
	Long-Term Management Alternative	0	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0	0
T4	No Action Alternative	0	0	0	0	0	0	0	0	0	0
	Long-Term Management Alternative	0	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0	0

Time Period	Alternative	Risk = 1 Area (km2)	Risk > .9 Area (km2)	Risk > .8 Area (km2)	Risk > .7 Area (km2)	Risk > .6 Area (km2)	Risk > .5 Area (km2)	Risk > .4 Area (km2)	Risk > .3 Area (km2)	Risk > .2 Area (km2)	Risk > .1 Area (km2)
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0	0
T5	No Action Alternative	0	0	0	0	0	0	0	0	0	0
	Long-Term Management Alternative	0	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0	0

Time Period	Alternative	Risk > .09 Area (km2)	Risk > .08 Area (km2)	Risk > .07 Area (km2)	Risk > .06 Area (km2)	Risk > .05 Area (km2)	Risk > .04 Area (km2)	Risk > .03 Area (km2)	Risk > .02 Area (km2)	Risk > .01 Area (km2)	Risk > .005 Area (km2)
T1	No Action Alternative	0	1	0	2	1	1	22	67	81	102
	Long-Term Management Alternative	0	0	1	0	2	1	18	57	91	102
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0	0
T2	No Action Alternative	0	0	0	0	0	0	0	17	22	32
	Long-Term Management Alternative	0	0	0	0	0	0	0	17	22	37
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0	0
T3	No Action Alternative	0	0	0	0	0	0	0	0	0	0
	Long-Term Management Alternative	0	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0	0
T4	No Action Alternative	0	0	0	0	0	0	0	0	0	0
	Long-Term Management Alternative	0	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0	0

Time Period	Alternative	Risk > .09 Area (km2)	Risk > .08 Area (km2)	Risk > .07 Area (km2)	Risk > .06 Area (km2)	Risk > .05 Area (km2)	Risk > .04 Area (km2)	Risk > .03 Area (km2)	Risk > .02 Area (km2)	Risk > .01 Area (km2)	Risk > .005 Area (km2)
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0	0
T5	No Action Alternative	0	0	0	0	0	0	0	0	0	0
	Long-Term Management Alternative	0	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0	0	0	0

Time Period	Alternative	Risk > .001 Area (km2)	Risk > .0001 Area (km2)	Risk > .00001 Area (km2)	Risk > .000001 Area (km2)	Risk > .0000001 Area (km2)	Total Affected Area (km2)	Percent of Site
T1	No Action Alternative	78	84	66	106	53	665	0.458621
	Long-Term Management Alternative	100	105	79	120	24	701	0.483448
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0
T2	No Action Alternative	158	207	187	48	31	702	0.484138
	Long-Term Management Alternative	153	207	188	48	30	702	0.484138
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	0	0	0	0
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	0	0	0	0	0
	Phased Implementation Alternative	0	0	0	0	0	0	0
T3	No Action Alternative	0	0	8	155	149	312	0.215172
	Long-Term Management Alternative	0	0	7	128	156	291	0.20069
	In Situ Fill and Cap Alternative	0	0	0	0	0	0	0
	In Situ Vitrification Alternative	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations Alternative	0	0	0	5	255	260	0.17931
	Ex Situ No Separations Alternative	0	0	0	5	255	260	0.17931
	Ex Situ Extensive Separations Alternative	0	0	0	5	255	260	0.17931
	Ex Situ/In Situ Combination Alternative	0	0	0	3	192	195	0.134483
	Phased Implementation Alternative	0	0	0	5	255	260	0.17931
T4	No Action Alternative	0	0	0	28	286	314	0.216552
	Long-Term Management Alternative	0	0	0	28	286	314	0.216552
	In Situ Fill and Cap Alternative	203	157	108	182	40	690	0.475862
	In Situ Vitrification Alternative	0	0	0	0	16	16	0.011034

Time Period	Alternative	Risk > .001 Area (km2)	Risk > .0001 Area (km2)	Risk > .00001 Area (km2)	Risk > .000001 Area (km2)	Risk > .0000001 Area (km2)	Total Affected Area (km2)	Percent of Site
	Ex Situ Intermediate Separations Alternative	0	0	247	212	129	588	0.405517
	Ex Situ No Separations Alternative	0	0	240	219	129	588	0.405517
	Ex Situ Extensive Separations Alternative	0	0	240	219	129	588	0.405517
	Ex Situ/In Situ Combination Alternative	1	91	301	133	139	665	0.458621
	Phased Implementation Alternative	0	0	247	212	129	588	0.405517
T5	No Action Alternative	0	0	0	0	2	2	0.001379
	Long-Term Management Alternative	0	0	0	0	2	2	0.001379
	In Situ Fill and Cap Alternative	0	43	407	71	144	665	0.458621
	In Situ Vitrification Alternative	0	1	0	0	22	23	0.015862
	Ex Situ Intermediate Separations Alternative	0	0	0	1	283	284	0.195862
	Ex Situ No Separations Alternative	0	0	0	0	0	0	0
	Ex Situ Extensive Separations Alternative	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination Alternative	0	0	105	344	78	527	0.363448
	Phased Implementation Alternative	0	0	0	1	283	284	0.195862

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To Alex	From Mitch
Co.	Co.
Dept.	Phone #
Fax #	Fax #

S_R_4.CMP (RECREATIONAL SHORELINE USERS)

Period	Alternative	= 1 Area (km2)	Risk > .9 Area (km2)	Risk > .8 Area (km2)	Risk > .7 Area (km2)	Risk > .6 Area (km2)	Risk > .5 Area (km2)	Risk > .4 Area (km2)	Risk > .3 Area (km2)	Risk > .2 Area (km2)	Risk > .1 Area (km2)
T1	No Action	0	0	0	0	0	0	0	0	0	0
	Long-Term Management	0	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification	0	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination	0	0	0	0	0	0	0	0	0	0
	Phased Implementation	0	0	0	0	0	0	0	0	0	0
T2	No Action	0	0	0	0	0	0	0	0	0	0
	Long-Term Management	0	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification	0	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination	0	0	0	0	0	0	0	0	0	0
	Phased Implementation	0	0	0	0	0	0	0	0	0	0
T3	No Action	0	0	0	0	0	0	0	0	0	0
	Long-Term Management	0	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification	0	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination	0	0	0	0	0	0	0	0	0	0
	Phased Implementation	0	0	0	0	0	0	0	0	0	0
T4	No Action	0	0	0	0	0	0	0	0	0	0
	Long-Term Management	0	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification	0	0	0	0	0	0	0	0	0	0

S_R_4.CMP

Time Period	Alternative	Risk = 1 Area (km2)	Risk > .9 Area (km2)	Risk > .8 Area (km2)	Risk > .7 Area (km2)	Risk > .6 Area (km2)	Risk > .5 Area (km2)	Risk > .4 Area (km2)	Risk > .3 Area (km2)	Risk > .2 Area (km2)	Risk > .1 Area (km2)
	Ex Situ Intermediate Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination	0	0	0	0	0	0	0	0	0	0
	Phased Implementation	0	0	0	0	0	0	0	0	0	0
T5	No Action	0	0	0	0	0	0	0	0	0	0
	Long-Term Management	0	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification	0	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination	0	0	0	0	0	0	0	0	0	0
	Phased Implementation	0	0	0	0	0	0	0	0	0	0

S_R_4.CMP

Time Period	Alternative	Risk > .09 Area (km2)	Risk > .08 Area (km2)	Risk > .07 Area (km2)	Risk > .06 Area (km2)	Risk > .05 Area (km2)	Risk > .04 Area (km2)	Risk > .03 Area (km2)	Risk > .02 Area (km2)	Risk > .01 Area (km2)	Risk > .005 Area (km2)
T1	No Action	0	0	0	0	0	0	0	0	0	0
	Long-Term Management	0	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification	0	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination	0	0	0	0	0	0	0	0	0	0
	Phased Implementation	0	0	0	0	0	0	0	0	0	0
T2	No Action	0	0	0	0	0	0	0	0	0	0
	Long-Term Management	0	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification	0	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination	0	0	0	0	0	0	0	0	0	0
	Phased Implementation	0	0	0	0	0	0	0	0	0	0
T3	No Action	0	0	0	0	0	0	0	0	0	0
	Long-Term Management	0	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification	0	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination	0	0	0	0	0	0	0	0	0	0
	Phased Implementation	0	0	0	0	0	0	0	0	0	0
T4	No Action	0	0	0	0	0	0	0	0	0	0
	Long-Term Management	0	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification	0	0	0	0	0	0	0	0	0	0

S_R_4.CMP

Time Period	Alternative	Risk > .09 Area (km2)	Risk > .08 Area (km2)	Risk > .07 Area (km2)	Risk > .06 Area (km2)	Risk > .05 Area (km2)	Risk > .04 Area (km2)	Risk > .03 Area (km2)	Risk > .02 Area (km2)	Risk > .01 Area (km2)	Risk > .005 Area (km2)
	Ex Situ Intermediate Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination	0	0	0	0	0	0	0	0	0	0
	Phased Implementation	0	0	0	0	0	0	0	0	0	0
T5	No Action	0	0	0	0	0	0	0	0	0	0
	Long-Term Management	0	0	0	0	0	0	0	0	0	0
	In Situ Fill and Cap	0	0	0	0	0	0	0	0	0	0
	In Situ Vitrification	0	0	0	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ No Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ Extensive Separations	0	0	0	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination	0	0	0	0	0	0	0	0	0	0
	Phased Implementation	0	0	0	0	0	0	0	0	0	0

S_R_4.CMP

Time Period	Alternative	Risk> .001 Area (km2)	Risk> .0001 Area (km2)	Risk> .00001 Area (km2)	Risk> .000001 Area (km2)	Risk> .0000001 Area (km2)	Total Affected Area (km2)	Percent of Site
T1	No Action	8	13	5	8	11	45	0.031034
	Long-Term Management	7	21	10	20	12	70	0.048276
	In Situ Fill and Cap	0	0	0	0	0	0	0
	In Situ Vitrification	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations	0	0	0	0	0	0	0
	Ex Situ No Separations	0	0	0	0	0	0	0
	Ex Situ Extensive Separations	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination	0	0	0	0	0	0	0
	Phased Implementation	0	0	0	0	0	0	0
T2	No Action	10	17	14	26	3	70	0.048276
	Long-Term Management	11	17	13	26	3	70	0.048276
	In Situ Fill and Cap	0	0	0	0	0	0	0
	In Situ Vitrification	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations	0	0	0	0	0	0	0
	Ex Situ No Separations	0	0	0	0	0	0	0
	Ex Situ Extensive Separations	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination	0	0	0	0	0	0	0
	Phased Implementation	0	0	0	0	0	0	0
T3	No Action	0	0	0	0	6	6	0.004138
	Long-Term Management	0	0	0	0	0	0	0
	In Situ Fill and Cap	0	0	0	0	0	0	0
	In Situ Vitrification	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations	0	0	0	0	0	0	0
	Ex Situ No Separations	0	0	0	0	0	0	0
	Ex Situ Extensive Separations	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination	0	0	0	0	0	0	0
	Phased Implementation	0	0	0	0	0	0	0
T4	No Action	0	0	0	0	1	1	0.00069
	Long-Term Management	0	0	0	0	1	1	0.00069
	In Situ Fill and Cap	0	17	14	8	26	65	0.044828
	In Situ Vitrification	0	0	0	0	0	0	0

S_R_4.CMP

Time Period	Alternative	Risk> .001 Area (km2)	Risk> .0001 Area (km2)	Risk> .00001 Area (km2)	Risk> .000001 Area (km2)	Risk> .0000001 Area (km2)	Total Affected Area (km2)	Percent of Site
	Ex Situ Intermediate Separations	0	0	0	21	15	36	0.024828
	Ex Situ No Separations	0	0	0	21	15	36	0.024828
	Ex Situ Extensive Separations	0	0	0	21	15	36	0.024828
	Ex Situ/In Situ Combination	0	0	0	33	11	44	0.030345
	Phased Implementation	0	0	0	21	15	36	0.024828
T5	No Action	0	0	0	0	0	0	0
	Long-Term Management	0	0	0	0	0	0	0
	In Situ Fill and Cap	0	0	0	32	11	43	0.029655
	In Situ Vitrification	0	0	0	0	0	0	0
	Ex Situ Intermediate Separations	0	0	0	0	8	8	0.005517
	Ex Situ No Separations	0	0	0	0	0	0	0
	Ex Situ Extensive Separations	0	0	0	0	0	0	0
	Ex Situ/In Situ Combination	0	0	0	5	27	32	0.022069
	Phased Implementation	0	0	0	0	8	8	0.005517

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE Engineering / Revised Land Use Numbers To Support DEIS Rev C

ORIGINATOR Colin Henderson DATE 2/21/96

REVISION NO. 0

OBJECTIVE Calculate Land Use Numbers for all alternatives using Assumptions for Waste loading & blending defined for DEIS Rev C.

METHODOLOGY Use spreadsheet to organize data & summarize into Data specific to Section 5 tables.

ASSUMPTIONS Numbers reported to 2 significant figures. Assumptions for shrub steppe area and facility specific Land Use Requirements are shown on the attached backup data. This calc is supported by other CALCS for resizing of the LAW Vaults and HLW interim Storage.

(Continue on another sheet if necessary)

J.C. Henderson 2/21/96
SIGNATURE/DATE

David J. Murray 3/15/96
CHECKED/DATE

CALCULATION & RESULTS
ATTACHED

JACOBS\FORMS\CALCVR.SHT

	Table 5.7.1				Table 5.7.1				
	Temporary Land Commitments				Permanent Land Commitments				
	Remediation		Total		Remediation		Total		
	ha	(ac)	ha	(ac)	ha	(ac)	ha	(ac)	
No Action	0	0	0	0	0	0	17	(42)	
Long Term Management	50	(120)	50	(120)	8	(20)	25	(62)	
In Situ Fill and Cap	26	(64)	97	(240)	17	(42)	25	(62)	
In Situ Vitrification	110	(270)	180	(440)	17	(42)	25	(62)	
Ex Situ Intermediate Separations	120	(300)	250	(620)	37	(91)	49	(120)	
Ex Situ No Separations	150	(370)	250	(620)	19	(47)	27	(67)	
Ex Situ Extensive Separations	110	(270)	240	(590)	34	(84)	46	(110)	
Ex Situ/In Situ Combination	110	(270)	200	(490)	31	(77)	41	(100)	
Phased Implementation (Phase1)	33	(82)	33	(82)	0	0	0	0	
Phased Imp. Total Alternative	**150**	**(370)**	**280**	**(690)**	**40**	**(99)**	**52**	**(130)**	
Capsules No Action	0	0	0	0	0.6	(1.5)	0.6	(1.5)	
Capsules On-Site Disposal	4	(10)	4	(10)	1.8	(4.4)	1.8	(4.4)	
Capsules Overpack and Ship	2	(5)	2	(5)	0	0	0	0	
Capsules Vitrify with Tank Waste	1	(2)	1	(2)	0	0	0	0	
All Capsule Alternatives									

	Table 5.14.1				Table 5.14.1				Table 5.14.1		Table 5.14.1	
	200 Area Temp		200 Area Perm.		Borrow Sites		200 Area		Borrow Site		LAW Vault Area	
	Remediation		Total		temporary		Shrub-Steppe		Shrub-Steppe			
	ha	(ac)	ha	(ac)	ha	(ac)	ha	(ac)	ha	(ac)	ha	(ac)
No Action	0	0	17	(42)	0	0	0	0	0	0	N/A	
Long Term Management	50	(120)	25	(62)	0	0	10	(25)	0	0	N/A	
In Situ Fill and Cap	21	(52)	25	(62)	76	(190)	0	0	65	(160)	N/A	
In Situ Vitrification	110	(270)	25	(62)	71	(180)	23	(57)	60	(150)	N/A	
Ex Situ Intermediate Separations	120	(300)	49	(120)	130	(320)	59	(150)	110	(270)	17	(42)
Ex Situ No Separations	170	(420)	27	(67)	84	(210)	96	(240)	71	(180)	N/A	
Ex Situ Extensive Separations	110	(270)	46	(110)	120	(300)	57	(140)	110	(270)	14	(35)
Ex Situ/In Situ Combination	110	(270)	41	(100)	95	(230)	57	(140)	80	(200)	9	(22)
Phased Implementation (Phase1)	32	(79)	0	0	1	(2)	20	(49)	1	(2)	N/A	
Phased Imp. Total Alternative	150	(370)	52	(130)	130	(320)	79	(200)	110	(270)	17	(42)
Capsules No Action	0.6	(1.5)	0.6	(1.5)			0	0	0	0		
Capsules On-Site Disposal	1.8	(4.4)	1.8	(4.4)			1.5	(3.7)	0	0		
Capsules Overpack and Ship	0	0	0	0			0	0	0	0		
Capsules Vitrify with Tank Waste	0	0	0	0			0	0	0	0		
All Capsule Alternatives												

	Table 5.19.2			
	Continued Access Restrictions			
	Remediation		Total	
	ha	(ac)	ha	(ac)
No Action	0	0	17	(42)
Long Term Management	8	(20)	25	(62)
In Situ Fill and Cap	17	(42)	25	(62)
In Situ Vitrification	17	(42)	25	(62)
Ex Situ Intermediate Separations	37	(91)	49	(120)
Ex Situ No Separations	19	(47)	27	(67)
Ex Situ Extensive Separations	34	(84)	46	(110)
Ex Situ/In Situ Combination	31	(77)	41	(101)
Phased Implementation (Phase1)	0	0	0	0
Phased Imp. Total Alternative	40	(99)	52	(130)
Capsules No Action			0.6	[1.5]
Capsules On-Site Disposal			1.8	[4.4]
Capsules Overpack and Ship			none	
Capsules Vitrify with Tank Waste			none	
All Capsule Alternatives				

	Table 5.4.1 Shrub-Steppe Habitat				Table 5.4.1 Shrub-Steppe Habitat				Table 5.4.1 Shrub-Steppe Habitat			
	200 Areas Remediation				Borrow Sites				Total			
	Temporary		Total		Remediation		Total		Remediation		Total	
	ha	(ac)	ha	(ac)	ha	(ac)	ha	(ac)	ha	(ac)	ha	(ac)
No Action	0	0	0	0	0	0	0	0	0	0	0	0
Long Term Management	10	(25)	10	(25)	0	0	0	0	10	(25)	10	(25)
In Situ Fill and Cap	0	0	0	0	23	(57)	65	(160)	23	(57)	65	(160)
In Situ Vitrification	23	(57)	23	(57)	18	(44)	60	(150)	41	(100)	83	(210)
Ex Situ Intermediate Separations	59	(150)	59	(150)	24	(59)	110	(270)	83	(210)	170	(420)
Ex Situ No Separations	96	(240)	96	(240)	7	(17)	71	(180)	100	(250)	170	(420)
Ex Situ Extensive Separations	57	(140)	57	(140)	15	(37)	110	(270)	72	(180)	170	(420)
Ex Situ/In Situ Combination	57	(140)	57	(140)	17	(42)	80	(200)	74	(180)	140	(350)
Phased Implementation (Phase1)	20	(49)	20	(49)	1	(2)	1	(2)	21	(52)	21	(52)
Phased Imp. Total Alternative	79	(200)	79	(200)	21	(52)	110	(270)	**100**	**(250)**	**190**	**(470)**
Capsules No Action												
Capsules On-Site Disposal												
Capsules Overpack and Ship												
Capsules Vitrify with Tank Waste												
All Capsule Alternatives	<2	<5	0	0	0	0	0	0	<2	<5	<2	<5

	Table 5.1.1				Table 5.1.1				
	Soil Disturbance Remediation				Soil Distsurbance Total Proj.				
	Temporary		Permanent		Temporary		Permanent		
	ha	(ac)	ha	(ac)	ha	(ac)	ha	(ac)	
No Action	0	0	0	0	0	0	17	(42)	
Long Term Management	50	(120)	8	(20)	50	(120)	25	(62)	
In Situ Fill and Cap	26	(64)	17	(42)	97	(240)	25	(62)	
In Situ Vitrification	110	(270)	17	(42)	180	(440)	25	(62)	
Ex Situ Intermediate Separations	120	(300)	37	(91)	250	(620)	49	(120)	
Ex Situ No Separations	150	(370)	19	(47)	250	(620)	27	(67)	
Ex Situ Extensive Separations	110	(270)	34	(84)	240	(590)	46	(110)	
Ex Situ/In Situ Combination	110	(270)	31	(77)	200	(490)	41	(100)	
Phased Implementation (Phase1)	33	(82)	0	0	33	(82)	0	0	
Phased Imp. Total Alternative	150	(370)	40	(99)	280	(690)	52	(130)	
Capsules No Action	0	0	0.6	(1.5)	0	0	0.6	(1.5)	
Capsules On-Site Disposal	4	(10)	1.8	(4.4)	4	(10)	1.8	(4.4)	
Capsules Overpack and Ship	2	(5)	0	0	2	(5)	0	0	
Capsules Vitrify with Tank Waste	1	(3)	0	0	1	(2)	0	0	
All Capsule Alternatives									

Alternative	Location	Remediation Temporary Disturbance hectares	Remediation Temporary Disturbance % Shrub-Steppe	Remediation Shrub-Steppe Impacts hectares	Remediation Permanent Disturbance hectares	Remediation Permenant Dist. % Shrub-Steppe	Remediation Shrub-Steppe Permanent Impact hectares
No Action							
	Tank Farms	0					
Long Term Management							
	Tank Farms						
	New Tank Farms	50	20%	10	8	0.2	0
	Total	50		0	8		0
In Situ Fill and Cap							
	Tank Farms(operations)	1	0%	0	17	0	
	Pit 30 (operations)	25	90%	23			
	Tank Farms (barrier const.)						
	Pit 30 (barrier)						
	McGee						
	Vernita						
	Total	26		23	17		
In Situ Vitrification							
	Tank Farms (operations)	21	0%	0	17	0	
	Power Lines	70	33%	23			
	Pit 30 (operations)	20	90%	18			
	Tank Farms (barrier const.)						
	Pit 30 (barrier)						
	McGee (barrier)						
	Vernita (barrier)						
	Total	111		41	17		
Ex Situ Intermediate Separations							
	Retrieval Annexes	3	0%	0	0.4	0	
	Pit 30 (retrieval annexes)	1	90%	1			
	Vit Plant	88	67%	59	7	0	
	LAW Vaults				13	0	
	Pit 30 (treatment facilities)	25	90%	23			

Alternative	Location	Remediation Temporary Disturbance hectares	Remediation Temporary Disturbance % Shrub-Steppe	Remediation Shrub-Steppe Impacts hectares	Remediation Permanent Disturbance hectares	Remediation Permenant Dist. % Shrub-Steppe	Remediation Shrub-Steppe Permanent Impact hectares
	Tank Farms				17		
	Pit 30 (post rem)						
	McGee	0					
	Vernita	0					
	Total	117		83	37		
Ex Situ No Separations							
	Retrieval Annexes	3	0%	0	0.4	0	
	Pit30 (ret annexes)	1	90%	1		0	
	Vit Plant	143	67%	96	2		
	LAW Vaults	0					
	Pit 30 (treatment facilities)	7	90%	6			
	Tank Farms				17	0	
	Pit 30 (post rem)						
	McGee						
	Vernita						
	Total	154		103	19		
Ex Situ Extensive Separations							

Alternative	Location	Remediation Temporary Disturbance hectares	Remediation Temporary Disturbance % Shrub-Steppe	Remediation Shrub-Steppe Impacts hectares	Remediation Permanent Disturbance hectares	Remediation Permenant Dist. % Shrub-Steppe	Remediation Shrub-Steppe Permanent Impact hectares
	Retrieval Annexes	3	0%	0	0.4		
	Pit30 (ret annexes)	1	90%	1			
	Vit Plant	85	67%	57	7		
	LAW Vaults				10		
	Pit 30 (treatment facilities)	16	90%	14			
	Tank Farms	0			17		
	Pit 30 (post rem)	0					
	McGee						
	Vernita						
	Total	105		72	34		
Ex Situ/In Situ Combination							
	Retrieval Annexes	2	0%	0	0.2		
	Pit30 (ret annexes)	1	90%	1			
	Vit Plant	85	67%	57	7		
	LAW Vaults				7		
	Pit 30 (treatment facilities)	18	90%	16			
	Tank Farms	0			17		
	Pit 30 (post rem)	0					
	McGee						
	Vernita						
	Total	106		74	31		
Phased Implementation (Phase1)							
	Retrieval Annexes	0					
	Vit Plant	32		20			
	Pit 30	1		1			
	Tank Farms	0					
	Total	33		21	0		
Phased Imp. Total Alternative							
	Retrieval Annexes	3			0.4		

Land Use/Habitat Numbers

Alternative	Location	Remediation	Remediation	Remediation	Remediation	Remediation	Remediation
		Temporary	Temporary	Shrub-Steppe	Permanent	Permenant	Shrub-Steppe
		Disturbance	Disturbance	Impacts	Disturbance	Dist. %	Permanent Impact
		hectares	% Shrub-Steppe	hectares	hectares	Shrub-Steppe	hectares
	Pit30 (ret annexes)	1	90%	0.9			
	Vit Plant	88	67%	58.96	7		
	LAW Vaults				13		
	Pit 30 (treatment facilities)	22	90%	19.8			
	Tank Farms				17		
	Pit 30 (post rem)						
	McGee						
	Vernita						
	Phase 1 Vit Plant				3		
	Total	147		79.66	40		
Capsules No Action							

Land Use/Habitat Numbers

Alternative	Location	Remediation Temporary Disturbance hectares	Remediation Temporary Disturbance % Shrub-Steppe	Remediation Shrub-Steppe Impacts hectares	Remediation Permanent Disturbance hectares	Remediation Permenant Dist. % Shrub-Steppe	Remediation Shrub-Steppe Permanent Impact hectares
	WESF	0			0.6	0	
Capsules On-Site Disposal							
	Dry-Well Facility	4		1.5	1.8		1
Capsules Overpack and Ship							
	Vit Site	2	0%				
Capsules Vitrify with Tank Waste							
	Vit Site	1	0%				
All Capsule Alternatives							

Post Remediation (Closure)					
Temporary	Temporary	Temporary	Permanent	Permanent	Permanent
Disturbance	Dist. %	Shrub-Steppe	Disturbance	Dist %	SS Dist.
hectares	Shrub-Steppe	hectares	hectares	shrub-steppe	hectares
			17		
			17		
			17		0
				0	
20	0	0	8		
14	0.9	13		0.9	
16	0.75	12			
21	0.8	17			
71		42	8		0
				0	
20	0	0	8	0	0
14	0.9	13		0.9	
16	0.75	12		0.75	
21	0.8	17		0.8	
71		42	8		0
			4	0	

Post Remediation (Closure)					
Temporary	Temporary	Temporary	Permanent	Permanent	Permanent
Disturbance	Dist. %	Shrub-Steppe	Disturbance	Dist %	SS Dist.
hectares	Shrub-Steppe	hectares	hectares	shrub-steppe	hectares
24	0	0	8	0	
50	0.9	45			
25	0.75	19			
31	0.8	25			
130		89	12		0
20	0	0	8	0	
39	0.9	35			
16	0.75	12			
21	0.8	17			
96		64	8		0

Post Remediation (Closure)					
Temporary	Temporary	Temporary	Permanent	Permanent	Permanent
Disturbance	Dist. %	Shrub-Steppe	Disturbance	Dist %	SS Dist.
hectares	Shrub-Steppe	hectares	hectares	shrub-steppe	hectares
			4	0	
24	0	0	8	0	
51	0.9	46			
25	0.75	19			
31	0.8	25			
131		90	12		0
			2	0	
22	0	0	8	0	
29	0.9	26			
21	0.75	16			
26	0.8	21			
98		63	10		0

Post Remediation (Closure)					
Temporary	Temporary	Temporary	Permanent	Permanent	Permanent
Disturbance	Dist. %	Shrub-Steppe	Disturbance	Dist %	SS Dist.
hectares	Shrub-Steppe	hectares	hectares	shrub-steppe	hectares
			4		
24	0	0	8		
50	0.9	45			
25	0.75	19			
31	0.8	25			
130		89	12		0

Post Remediation (Closure)					
Temporary	Temporary	Temporary	Permanent	Permanent	Permanent
Disturbance	Dist. %	Shrub-Steppe	Disturbance	Dist %	SS Dist.
hectares	Shrub-Steppe	hectares	hectares	shrub-steppe	hectares

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE Engineering \ Revised Schedules.
In Support of Modifications made to DEIS Rev C.

ORIGINATOR Colin Henderson DATE 1/21/96

REVISION NO. 0

OBJECTIVE Calculate Revised Schedules based on basis changes made for DEIS Rev C.

METHODOLOGY 1) Calculate Revised Op Duration Required to produce the required Volume of HLW or LAW.
2) Adjust schedule for other functions to support 1.

ASSUMPTIONS Waste Volumes & Operating Durations taken from Waste Loading and blending modifications Calc. Operating Efficiency taken at 60% (Up to 70% for Phase 2 of Phased Imp).

(Continue on another sheet if necessary)

J.C. Henderson 2/21/96
SIGNATURE/DATE

David J. Murray 3/15/96
CHECKED/DATE

CALCULATION & RESULTS
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NO ACTION SCHEDULE				
	REV O DATA PACKAGE SCHEDULE			DEIS CHAPTER 3 SCHEDULE
Continued Operations				
Construction	N/A			
Operations	N/A			
D&D	N/A			
Monitoring & Maintenance	1995-2095		(100 years)	1997-2097
LONG-TERM MANAGEMENT SCHEDULE				
	REV O DATA PACKAGE SCHEDULE			DEIS CHAPTER 3 SCHEDULE
Continued Operations				
Construction				
Waste Retrieval	2032-2039	2082-2089	(7 years each)	2033-2037 2083-2087
New Tanks	2033-2037	2083-2087	(4 years each)	2033-2037 2083-2087
Operations	2037-2042	2087-2092	(5 years each)	2037-2042 2087-2092
D&D	2042-2047	2092-2097	(5 years each)	2042-2047 2092-2097 42-49,92-99 for WR&T
Monitoring & Maintenance	1995-2095		(100 years)	1997-2097
IN SITU FILL AND CAP SCHEDULE				
	REV O DATA PACKAGE SCHEDULE			PDEIS CHAPTER 3 SCHEDULE
Continued Operations	1995-2009	(14 years)		
Research and Development	N/A			N/A
Construction	2003-2005	(2 years)		2003-2005
Operation	2000-2009	(9 years)		2000-2009
D&D	2009-2012	(3 years)		2009-2012
Monitoring and Maintenance	2009-2029	(20 years)		2009-2029
Closure	2012-2029	(17 years)		2012-2029
Post Closure Monitoring	2029-2129	(100 years)		2029-2129
IN SITU VITRIFICATION SCHEDULE				
	REV O DATA PACKAGE SCHEDULE			DEIS CHAPTER 3 SCHEDULE
Continued Operations	1995-2013	(18 years)		
Research and Development	1995-2002	(7 years)		1997-2002
Construction	1998-2016	(18 years)		1998-2016
Operation	2000-2013	(13 years)		2005-2016
DST evaporation	2000-2005	(5 years)		2000-2005
ISV strart up	2005-2008	(3 years)		2005-2008
ISV operation	2008-2013	(5 years)		2008-2013
D&D	2013-2016	(3 years)		2013-2016
Monitoring and Maintenance	2013-2033	(20 years)		2016-2033

Closure	2016-2033 (17 years)	2016-2033
Post Closure Monitoring	2033-2133 (100 years)	2033-2133
EX SITU INTERMEDIATE SEPARATIONS SCHEDULE		
	REV O DATA PACKAGE SCHEDULE	DEIS CHAPTER 3 SCHEDULE
Continued Operations		1997
Research and Development	1995-2018 (23 years)	~~1995~~-2018
Construction		
Waste Retrieval and Transfer	1998-2017 (19 years)	1998-2017
Waste Treatment	1997-2007 (10 years)	1997-2007
Operation		
Waste Retrieval	2001-2023 (22 years)	2001-2024
Treatment	2004-2023 (19 years)	2004-2024
Pretreatment	2004-2019 (15 years)	
LLW Vitrification	2005-2019 (14 years)	2004-2024
HLW Vitrification	2009-2023 (14 years)	2011-2024
LLW Disposal	2005-2019 (14 years)	
HLW Transportation and Disposal	2019-2029 (10 years)	2019-2029
D&D		
Waste Retrieval facilities	2012-2025 (13 years)	2013-2026
Treatment Facilities	2019-2028 (9 years)	2024-2033
Monitoring and Maintenance		
HLW	2023-2029 (6 years)	2024-2029
LLW Disposal	2023-2034 (11 years)	
Closure	2010-2034 (24 years)	2010-2034
Post Closure Monitoring	2034-2134 (100 years)	2034-2134
EX SITU NO SEPARATIONS (VITRIFICATION AND CALCINATION)		
	REV O DATA PACKAGE SCHEDULE	PDEIS CHAPTER 3 SCHEDULE
Continued Operations	1995-2018 (23 years)	1997
Research and Development	1995-2005 (10 years)	~~1995~~-2005
Construction		
Waste Retrieval and Transfer	1998-2017 (19 years)	1998-2017
Waste Treatment	1997-2002 (5 years)	1997-2002
Operation		
Waste Retrieval	2001-2018 (17 years)	2001-2019
HLW Vitrification	2004-2018 (14 years)	2004-2019
HLW Transportation and Disposal	2017-2027 (10 years)	2017-2037
D&D		
Waste Retrieval facilities	2012-2020 (8 years)	2013-2021
Treatment Facilities	2018-2023 (5 years)	2019-2024

Monitoring and Maintenance			
HLW	2004-2027	(23 years)	2019-2037
Closure	2010-2024	(14 years)	2010-2024
Post Closure Monitoring	2024-2124	(100 years)	2024-2124
EX SITU EXTENSIVE SEPARATIONS SCHEDULE			
	REV O DATA PACKAGE SCHEDULE		DEIS CHAPTER 3 SCHEDULE
Continued Operations	1995-2024	(29 years)	1997
Research and Development	1995-2018	(23 years)	~~1995~~-2018
Construction			
Waste Retrieval and Transfer	1998-2017	(19 years)	1998-2017
Waste Treatment	1997-2006	(9 years)	1997-2006
Operation			
Waste Retrieval	2001-2024	(23 years)	2001-2024
Treatment	2003-2024	(21 years)	2004-2024
Pretreatment	2003-2018	(15 years)	
LLW Vitrification	2005-2024	(19 years)	
HLW Vitrification	2005-2019	(14 years)	
LLW Disposal	2005-2024	(19 years)	
HLW Transportation and Disposal	2020-2029	(9 years)	2020-2029
D&D			
Waste Retrieval facilities	2012-2025	(13 years)	2012-2025
Treatment Facilities	2019-2024	(5 years)	2024-2029
Monitoring and Maintenance			
HLW	2019-2029	(10 years)	2024-2029
LLW Disposal	2023-2030	(7 years)	
Closure	2010-2030	(20 years)	2010-2030
Post Closure Monitoring	2030-2130	(100 years)	2030-2130
IN SITU/EX SITU COMBINATION SCHEDULE			
-	REV O DATA PACKAGE SCHEDULE		DEIS CHAPTER 3 SCHEDULE
Continued Operations	1995-2023	(28 years)	1997
Research and Development	1995-2018	(23 years)	~~1995~~-2018
Construction			
Waste Retrieval and Transfer	1998-2017	(19 years)	1998-2017
Waste Treatment	1997-2007	(10 years)	1997-2007
Fill & Cap	2003-2005	(2 years)	2003-2005
Operation			
Waste Retrieval	2001-2023	(22 years)	2001-2024
Treatment	2004-2023	(19 years)	2004-2024
Pretreatment	2004-2019	(15 years)	
LLW Vitrification	2005-2019	(14 years)	
HLW Vitrification	2009-2023	(14 years)	

	LLW Disposal			2005-2019	(14 years)							
	HLW Transportation and Disposal			2019-2029	(10 years)			2019-2029				
	Fill and Cap Operations			2000-2009	(9 years)			2005-2018				
D&D								2019-2028				
	Waste Retrieval facilities			2012-2025	(13 years)			2012-2026				
	Treatment Facilities			2019-2028	(9 years)			2024-2033				
	Fill and Cap Equipment			2009-2012	(3 years)			2018-2021				
Monitoring and Maintenance												
	HLW			2023-2029	(6 years)			2024-2029				
	LLW Disposal			2023-2034	(11 years)							
	In Situ Tanks			2009-2029	(20 years)			2018-2034				
Closure				2010-2034	(24 years)			2010-2034				
Post Closure Monitoring				2034-2134	(100 years)			2034-2134				
								Phase 1		Phase 2		
	PHASED IMPLEMENTATION SCHEDULE											
				REV O DATA PACKAGE SCHEDULE				DEIS CHAPTER 3 SCHEDULE				
Continued Operations												
Research and Development				1995-1998	(3 years)							
Construction				1997-2002	(5 years)							
	Phase 1							1997-2002				
	Retrieval									2004-2020		
	Phase 2									2005-2012		
Operation				2002-2012	(10 years)							
	Phase 1							2002-2012				
	LAW Treatment Plants			2002-2012	(10 years)							
	HLW Treatment Plant			2002-2008	(6 years)							
	Phase 2											
	Waste Retrieval									2007-2028		
	Treatment									2011-2028		
D&D				2012-1014	(2 years)					2015-2031		
Monitoring and Maintenance												
Closure–				2012-2014	(2 years)					2016-2040		
Post Closure M&M										2040-2140		
	CAPSULES NO ACTION			REV O DATA PACKAGE SCHEDULE				DEIS CHAPTER 3 SCHEDULE				
Continued Operation								1997-2007				
Research and Development												
Construction												
Operation												
D&D												
Monitoring and Maintenance												
	CAPSULES ONSITE DISPOSAL											

					REV O DATA PACKAGE SCHEDULE				DEIS CHAPTER 3 SCHEDULE				
Continued Operation					1995-2028				1997-2028				
Research and Development													
Construction					2002-2009	(7 years)			2002-2009				
Operation					2010-2029	(19 years)			2010-2029				
D&D													
Monitoring and Maintenance									2029-2129				
	CAPSULES OVERPACK AND SHIP												
					REV O DATA PACKAGE SCHEDULE				DEIS CHAPTER 3 SCHEDULE				
Continued Operation					1995-2028				1997-2028				
Research and Development													
Construction					2002-2009				2002-2009				
Operation					2010-2028				2010-2028				
HLW Transportation and Disposal					2035-2040				2028-2029				
D&D													
Monitoring and Maintenance									2010-2029				
	CAPSULES VITRIFY WITH TANK WASTES												
					REV O DATA PACKAGE SCHEDULE				DEIS CHAPTER 3 SCHEDULE				
Continued Operation									1997-2023				
Research and Development													
Construction									2002-2007				
Operation									2005-2023				
D&D									2024-2029				
Monitoring and Maintenance									2023-2029				

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE ENGINEERING / ADDITIONAL COST OF CHARACTERIZATION ASSOCIATED WITH INSITU ALTERNATIVES

ORIGINATOR COLIN HENDERSON DATE 3/20/96

REVISION NO. 0

OBJECTIVE ESTIMATE (ROM) THE ADDITIONAL COSTS REQUIRED FOR CHARACTERIZATION UNDER THE INSITU ALTERNATIVES.

METHODOLOGY NOTED.

ASSUMPTIONS NOTED.

(Continue on another sheet if necessary)

J.C. Henderson
SIGNATURE/DATE

3-25-96
CHECKED/DATE

CALCULATION & RESULTS
ATTACHED

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Additional Cost of Characterization Associated with the In Situ Alternatives

Per conversation with John Guberski (WHC) and David Forehand (WHC) the current cost of characterization is approximately 4-4.5 million dollars per tank. Of this cost approximately 50% is cost associated with laboratory analysis and 50% is cost associated with taking the samples, maintaining the equipment, personnel...

Additional WHC contacts regarding available information for additional sampling requirements included John Garfield and Vern Hall. No specific information regarding additional costs was obtained. There was a consensus that additional characterization would be required for wastes that would be disposed of in place. The additional characterization would include both an increased number of samples and additional laboratory analyses.

Reviewed the Systems Engineering Study for the Closure of Single Shell Tanks WHC-EP-0405, the Tank Waste Technical Options Report WHC-EP-0616, and the Waste Characterization Plan for the Hanford Site Single Shell Tanks WHC-EP-0210 Revision 1,2, and 3. None of these documents provided specific information regarding the additional characterization requirements for in situ alternatives.

Relevant to the SSTs there is an average of 2 risers per tank that can be used for sampling.

Assumptions:
1. The characterization program would involve approximately two times the number of core samples and would require additional rises to be installed to facilitate sampling.
2. Assume that the additional number of core samples and additional risers would be approximately two times the current cost per tank of taking samples.
3. Assume that the laboratory cost would increase by a factor of 2.24 to account for RCRA analysis requirements.

The current cost of 4.5 million per tank is broken down at 50% for lab analysis and 50% for other activities associated with sampling.

The new characterization cost per tank would then be:

4.5 x 0.5 x 2 +4.5 x 0.5 x 2.25=9.6 million per tank
this is an increase of 5.1 million per tank

5.1million/tank x 177 tanks = 903 million dollars (1995)

Thus adding 903 million to the current operations cost for the In Situ Fill and Cap and In Situ Vitrification alternatives would provide for additional characterization. The Ex Situ/In Situ Combination alternative would be 60% or 542 million dollars.

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE Eng/ Phase 1 Implementation Phase 2 facility Sizing.

ORIGINATOR Colin Henderson DATE 2/22/96

REVISION NO. 0

OBJECTIVE Calculate the size of the Phase 2 Processing facilities required to process the remainder of the tank wastes following Phase 1.

METHODOLOGY Noted.

ASSUMPTIONS Assume that the volume of HLW & LAW vitrified product is the same as the Intermediate separations alternative

(Continue on another sheet if necessary)

SIGNATURE/DATE 2/21/96

CHECKED/DATE 3/6/96

CALCULATION & RESULTS
ATTACHED

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JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT Phased Implementation SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

TPA LIMITS:

Complete HLW VIT 12/31/2028

Complete LAW VIT 12/31/2024

Phase 1 LAW Processing begins 2002 Ends 2012

HLW Processing begins 2002 Ends 2008

Phase 2

LAW 2011-2024

HLW = 2011-2028

ASSUMPTIONS:

1) The phased implementation alt. waste loading is the same as the INT. Separations. Therefore the mass of HLW and LAW produced would be the SAME over the total Phased Implementation alt.

2) Phase 1 consists of 2 plants making 20 mt/day LAW & 1 plant making 1 mt/day HLW

3) The operating Efficiency during Phase 1 is 60%

4) The OPERATING Efficiency during Phase 2 would be 70%

5) The Phase 1 HLW Plant would not operate during Phase 2.

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

From the Intermediate Separations Alt.

* Mass of LAW = 8.07E+05 mt
* Mass of HLW = 54400 mt

Phase 1 Waste Processed

LAW = 2x20 mt/day x 365 day/yr x 0.6 (OE) x 10 yr
= 87,600 mt

HLW = 1x1 mt/day x 365 day/yr x 0.6 (OE) x 6 yr
= 1,314 mt.

Therefore during Phase 2 must process a total of

LAW = 8.07E5 - 87,600 = 719,400 mt

HLW = 54400 - 1314 mt = 53,086 mt.

LAW Demo Plants operate for 10 yrs during Phase 2

LAW = 40 mt/day x 10 yrs x 365 x 0.70 (OE)
= 102,200 mt.

Phase 2 High Capacity must then process.

LAW = 719400 - 102,200 = 617,200 mt
HLW = 53,086 mt

* Mass of HLW & LAW Produced under Intermediate Separations are taken from Waste loading and Blending Modifications Calculation Dated 2/21/96. See Attached Pages. LAW stream 437 HLW stream 344 as modified from the TPA Data Package for waste loading & blending

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

Plant Size is then:

$$L_{sw} = \frac{617200}{13\,yrs \times 365 \times .70\ (OE)} = 185\ mt/day$$

$$HLW = \frac{530840\ mt}{17\,yrs \times 365\,day/yr \times .70} = 12.2 \sim 12\ mt/day$$

FORM 91-005-1 (4/81)

Assumptions:										
1. HLW glass waste oxide loading basis to be 20 wt% waste oxides (excluding Na2O and SiO2)										
2. Using the WHC engineering data package material balance calculate the waste oxide loading										
and adjust mass of the glass produced to achieve a 20 wt % waste oxide loading										
3. LAW glass sodium oxide loading basis is to be 15 wt%										
	Input Stream			LAW			HLW			HLW fraction
	STREAM 1			407	437		314	344		
	solids	liquids		FRIT	GLASS		FRIT	GLASS		
Volume kilo-liters										
Specific Gravity										
Cs and Ba, (MCi)	5.28E+00	6.28E+01			4.93E-01			6.74E+01		0.990011751
Sr and Y, (MCi)	1.05E+02	2.10E+00			1.90E+00			1.05E+02		0.980392157
Tc, (MCi)	5.89E-03	2.61E-02			2.59E-02			5.91E-03		0.184745233
Am, (MCi)	9.51E-02	8.61E-03			8.60E-03			9.52E-02		0.917944268
Np, (MCi)	9.29E-05	1.03E-05			1.03E-05			9.29E-05		0.900193798
Pu-239, (MCi)	2.47E-02	1.67E-03			1.67E-03			2.47E-02		0.936670459
Pu-240, (MCi)	6.28E-03	4.14E-04			4.14E-04			6.28E-03		0.93815357
Pu-241,(MCi)	7.34E-02	1.49E-03			1.48E-03			7.34E-02		0.980104153
Total TRU, (MCi)	2.00E-01	1.22E-02			1.22E-02			2.00E-01		0.942507069
Total MCi	1.11E+02	6.49E+01			2.43E+00			1.73E+02		0.98351336
Total Mass Flow (MT)	1.94E+04	7.10E+05		2.81E+05	3.87E+05		1.36E+04	2.51E+04		
Total Cr, (MT)	1.32E+02	5.15E+01			1.44E+02			3.96E+01		
Total Na, (MT)	1.24E+03	6.51E+04			7.18E+04			2.33E+03		
Total Si, (MT)	5.24E+02	5.65E+00		1.07E+05	1.07E+05		5.29E+03	5.83E+03		
Total P, (MT)	7.80E+02	8.42E+02			1.35E+03			2.72E+02		
Total NO2-, (MT)	7.38E+01	9.54E+03								
Total NO3-, (MT)	1.03E+03	1.06E+05								
AG+	1.38E+00	3.28E-01								
AG2O					3.52E-01			1.48E+00		
AL+3	2.37E+03									
AL2O3				1.32E+04	1.94E+04			1.73E+03		
AL(OH)4-		4.83E+03								
AM+3	2.77E-02	2.51E-03								
AM2O3					2.76E-03			3.05E-02		
AS+5	4.98E-01	7.70E-01								
AS2O5					1.18E+00			7.66E-01		
B+3	9.94E-01	5.19E-01								
B2O3					1.67E+00		1.75E+03	1.76E+03		
BA+2	3.09E+00	7.91E-01								
BAO					8.81E-01			3.45E+00		
BE+2	7.61E-03	8.19E-02								
BEO					2.27E-01			2.16E-02		
BI+3	1.96E+02	6.76E+01								
BI2O3					7.52E+01			2.19E+02		
C14	4.53E-04	7.43E-04								
CA+2	1.33E+02	1.67E+01								
CANCRINITE	2.70E+03									
CAO				3.87E+04	3.87E+04			1.89E+02		
CD+2	7.93E+00	2.09E+00								
CDO					2.38E+00			9.06E+00		
CE+3	2.35E+02	2.37E+00								
CE2O3					2.79E+00			2.76E+02		
CL-	3.49E+00	3.11E+02								
CL2										
CO										
CO2										
CO3-2	2.25E+02	3.37E+03								
CR+3	1.32E+02									
CR2O3					2.11E+02			5.79E+01		
CR(OH)4-		1.19E+02								
CS+	9.25E-02	8.19E-01								
CS2O					6.83E-03			9.58E-01		
CU+2	7.46E-01	1.77E-01								
CUO					2.21E-01			9.34E-01		

CUSO4										
F-	5.97E+01	1.12E+03								
F2										
FE+3	7.63E+02	1.44E+01								
FE2O3					2.06E+01			1.21E+03		
H2										
H20		5.07E+05								
H2S										
HG										
HG+2	9.00E-03	9.49E-01								
I-	2.02E+01	5.46E+02								
I2										
K+	2.10E+01	2.19E-01								
K2O					2.65E-01			2.53E+01		
KEROSENE										
LA+3	2.10E+01	2.19E-01								
LA2O3					2.58E-01			2.46E+01		
LI+	2.46E-02	5.77E-03								
LI2O					1.24E-02		5.00E+02	5.03E+02		
MG+2	1.10E+01	9.65E-01								
MGO					1.60E+00			1.88E+01		
MNO2	2.09E+02	2.17E+01			2.16E+01			2.09E+02		
MO+6	8.01E-01	4.87E+00								
MOO3					7.29E+00			1.22E+00		
N2										
NA+	7.77E+02	6.51E+04								
NA2O					9.68E+04			3.14E+03		
NH3										
NI+3	6.57E+00	4.07E+00								
NI2FECN6	5.00E+02									
NI2O3					5.72E+00			9.27E+00		
NIO					1.50E-02			2.27E+02		
NO										
NO2										
NO2-	7.38E+01	9.54E+03								
NO3-	1.03E+03	1.06E+05								
NP+4	1.32E-01	1.46E-02								
NPO2					1.66E-02			1.50E-01		
O2										
OH-	5.00E+03	6.44E+03								
PB+4	3.28E+00	1.96E+00								
PBO2					2.26E+00			3.79E+00		
PO4-3	2.39E+03	2.58E+03								
P2O5					3.09E+03			6.22E+02		
P2O5:24W	5.21E-01									
PU+4	4.27E-01	2.88E-02								
PUO2					3.26E-02			4.84E-01		
S										
SI+4	7.90E+01	5.65E+00								
SIO2				2.29E+05	2.29E+05		1.13E+04	1.25E+04		
SO2										
SO4-2	3.97E+01	2.01E+03								
SR+2	3.64E+01	3.75E-01								
SRO					4.00E-01			4.29E+01		
TCO2										
TCO4-	5.68E-01	2.52E+00								
TC2O7					2.39E+00			5.45E-01		
TOC	1.16E+02	1.42E+03								
UO2+2	1.58E+03	8.52E+01								
UO3					9.02E+01			1.67E+03		
V+5	1.88E-01	6.20E-02								
V2O5					1.11E-01			3.35E-01		
W+6		7.47E-01								
WO2					2.91E-05			4.41E-01		
WO3					9.40E-01			2.06E-03		
ZN+2	9.45E-01	3.59E+00								
ZNO					4.46E+00			1.19E+00		

ZR+4	2.77E+02	4.48E-01								
ZRO2					6.49E-01			6.90E+02		
ZRO2:2H2	4.09E+02	2.15E+01								
WHC Data Package Basis:										
Mass LAW waste oxides					106544.7302					
LAW waste loading (waste oxide)					28%					
LAW waste loading (sodium oxide)					25%					
Mass HLW waste oxides								7.26E+03		
HLW waste loading (waste oxides)										
HLW WOL (- Na2O, - SiO2)								29%		
HLW WOL (all tank waste)								46%		
HLW							Mass of HLW			
20 wt. % waste oxide loading										
Blending factor				1	1.25	1.5	2	3.5		
Mass of glass required to achieve 20% wo loading, MT				36293.1358	45366.41975	54439.7037	72586.2716	127025.9753		
additional frit required (equals increased glass) MT				1.12E+04	2.03E+04	2.93E+04	4.75E+04	1.02E+05		
total frit required, MT *				2.48E+04	3.39E+04	4.29E+04	6.11E+04	1.16E+05		
WOL (- Na2O, - SiO2)				20%	16%	13%	10%	6%		
WOL (with all tank wastes)				32%	25%	21%	16%	9%		
glass density (MT/m^3)	2.63									
cullet packing fraction	0.7	(LAW only)								
Waste volume (m^3)				1.38E+04	1.72E+04	2.07E+04	2.76E+04	4.83E+04		
Canister Volume (m^3)	0.62									
Number of Canisters (1x)				2.23E+04	2.78E+04	3.34E+04	4.45E+04	7.79E+04		
Nu. of Canisters /HMPC	4									
Number of HMPCs				5.56E+03	6.96E+03	8.35E+03	1.11E+04	1.95E+04		
Number of trips @ 10 HMPCs /trip				556	696	835	1113	1948		
Glass formulation:										
(ref Ext. Sep Data Pkg.)	acceptable range			1	1.25	1.5	2	3.5		
SiO2	42 to 57 wt %			60.07%	64.68%	67.75%	71.59%	76.52%		
B2O3	5 to 20 wt %			8.82%	9.63%	10.17%	10.84%	11.71%		
Na2O	5 to 20 wt %			8.65%	6.92%	5.77%	4.33%	2.47%		
Li2O	1 to 7 wt %			2.52%	2.75%	2.91%	3.10%	3.35%		
Fe2O3	2 to 15 wt %			3.33%	0.00%	0.00%	0.00%	0.00%		
CaO	< or= 10 wt %			0.52%	0.42%	0.35%	0.26%	0.15%		
MgO	< or = 8 wt %			0.05%	0.04%	0.03%	0.03%	0.01%		
Al2O3	< or = 15 wt %			4.77%	3.81%	3.18%	2.38%	1.36%		
ZrO2	< or = 13 wt %			1.90%	1.52%	1.27%	0.95%	0.54%		
Cr2O3	< or = 0.5 wt %			0.16%	0.13%	0.11%	0.08%	0.05%		
P2O5	< or = 3 wt %			1.71%	1.37%	1.14%	0.86%	0.49%		
SO3	< or = 0.5 wt %									
HLW Facility Sizing										
Schedule	14 yrs									
Capacity MT/day	20									
Overall efficiency, %				36%	44%	53%	71%	124%		
Required capacity MT/day (assuming 14 yrs ops, 60% OE)				11.84	14.80	17.76	23.67	41.43		
Required operating duration yrs (assuming 20 MT/day, 60% OE)					10.36	12.43	16.57	29.00		
15 wt % waste oxide loading										
Mass of glass required to achieve 15% wo loading MT				4.84E+04	6.05E+04	7.26E+04	9.68E+04	1.69E+05		
Volume (m^3)				1.84E+04	2.30E+04	2.76E+04	3.68E+04	6.44E+04		
Number of Canisters (1x)				2.97E+04	3.71E+04	4.45E+04	5.94E+04	1.04E+05		
40 wt % waste oxide loading										
Mass of glass required to achieve 40% wo loading MT				1.81E+04	2.27E+04	2.72E+04	3.63E+04	6.35E+04		
Volume (m^3)				6.90E+03	8.62E+03	1.03E+04	1.38E+04	2.41E+04		

Number of Canisters (1x)				1.11E+04	1.39E+04	1.67E+04	2.23E+04	3.90E+04		
LAW										
15 wt. % sodium oxide loading										
Blending factor				1	1.25	1.5	2	3.5		
Mass of glass required to achieve 15% wo loading, MT				6.45E+05	8.07E+05	9.68E+05	1.29E+06	2.26E+06		
additional frit required (equals increased glass) MT				3.64E+05	5.26E+05	6.87E+05	1.01E+06	1.98E+06		
total frit required, MT				6.45E+05	8.07E+05	9.68E+05	1.29E+06	2.26E+06		
glass density (MT/m^3)	2.63									
cullet packing fraction	0.7									
Waste volume (m^3)				3.51E+05	4.38E+05	5.26E+05	7.01E+05	1.23E+06		
Number of 5300 m^3 vaults				66	83	99	132	231		
LAW facility sizing										
Schedule, years	14									
Capacity MT/day	200									
Overall efficiency, %				63%	79%	95%	126%	221%		
Required capacity MT/day (assuming 14 yrs ops, 60% OE)				210.48	263.10	315.72	420.96	736.68		
Required operating duration yrs (assuming 200 MT/day, 60% OE)				14.73	18.42	22.10	29.47	51.57		
10 wt. % sodium oxide loading										
Blending factor				1	1.25		2	3.5		
Mass of glass required to achieve 10				968000	1210000		1936000	3388000		
Waste volume, m^3				525801.195	657251.4938		1051602.39	1840304.183		
Number of 5,300 m^3 vaults				99	124		198	347		
25 wt. % sodium oxide loading										
Blending factor				1	1.25		2	3.5		
Mass of glass required to achive 25 wt % Na2O				387200	484000		774400	1355200		
Waste Volume				210320.478	262900.5975		420640.956	736121.673		
Number of 5,300 m^3 vaults				40	50		79	139		

Mass LAW

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE Engineering \ Waste Loading and Blending Modifications to support DEIS Rev C MODIFICATIONS

ORIGINATOR Colin Henderson DATE 2/21/96

REVISION NO. 0

OBJECTIVE Use WHC Rev 0 Data Package flowsheet data to recalculate the HLW & LAW Volumes using Revised Waste Loading, Blending factors, and a Common 0.62m³ Canister

METHODOLOGY Use WHC Data Pkg Material Balance data to Recalculate the HLW & LAW Volumes.

Data Packages WHC-SD-WM-EV-103, -100, -104 ALL Rev 0.

ASSUMPTIONS Noted.

(Continue on another sheet if necessary)

C. Henderson 2/21/96
SIGNATURE/DATE

David J. Murray 3/5/96
CHECKED/DATE

CALCULATION & RESULTS
ATTACHED

JACOBS\FORMS\CALCVR.SHT

1. HLW glass for any of the ex situ alternatives involving separations is calculated at 20 wt % waste oxides. The waste oxides exclude silica and sodium.
2. The HLW for the No Separations case is calculated at 20 wt % sodium oxide.
Note: EA glass limits are 17% Na_2O and 4.3% Li_2O and each Li_2O is equivalent to 2 Na_2O so the EA glass is equivalent to 25% Na_2O without any Li_2O. The privatization RFP states that the HLW glass will be 25 wt % waste oxides not counting the Na_2O or SiO_2.
3. The LAW glass composition is calculated at 15 wt % Na_2O.
4. The canister size for all HLW is set at 0.62 m^3 (1X canister)
5. The material balances contained in the WHC data packages were used to calculate the waste oxides for the HLW and LAW streams.
6. Sensitivity analysis will be done for the Intermediate Separations alternative at 15 wt %, and 40 wt % waste oxide loading.
7. The material balance for the Intermediate Separations case was used for the Phased Implementation alternative and was modified to account for additional radionuclide separations.
8. For purposes of interim onsite storage and transportation to the repository 4 of the 1x cans are assumed to be placed into an HMPC or similar packaging and would be repackaged at the repository.

Ex Situ alternative comparison

	Waste Loading weight %	Blending Factor	Canister Count (HLW) or, Number of LAW Vaults	Canister Size Vault Size (m^3)	Overall Processing Plant Efficiency	Duration of Operations (years)	Trips to Repository 10 rail cars/train 4 can/HMPC
No Separations							
WHC Data Pkg.	30%	1	21400	10	36%	14	
Proposed DEIS	20%	1.5	587426	0.62	60%	15	14686
Intermediate Separations							
HLW							
WHC Data Pkg.	45%	1	6800	1.26	25%	14	170
Proposed DEIS	20%	1.5	33386	0.62	60%	12	835
LAW							
WHC Data Pkg	25%	1	40	5300	36%	14	
Proposed DEIS	15%	1.25	83	5300	60%	19	
Extensive Separations							
HLW							
WHC Data Pkg.	34%	1	502	0.62	26%	14	13
Proposed DEIS	20%	1.5	1571	0.62	50%	14	39
LAW							
WHC Data Pkg.	25%	1	40	5300	36%	19	
Proposed DEIS	15%	1.25	83	5300	60%	19	
Ex Situ/In Situ Combination							
HLW							
12/95 DEIS	45%	1	3400	1.26	25%	14	85
Proposed DEIS	20%	1.5	16694	0.62	60%	12	418
LAW							
12/95 DEIS	25%	1	20	5300	36%	14	
Proposed DEIS	15%	1.25	42	5300	60%	19	
Phased Implementation							
HLW							
12/95 DEIS	0.45	1	6800	1.26	60% to 70%	Ph1=10, Ph2=14	170
Proposed DEIS	0.2	1.5	33386	0.62	60% to 85%	Ph1=6, Ph2=17	835
LAW							
12/95 DEIS	0.25	1	40	5300	60% to 70%	Ph1=10, Ph2=11	
Proposed DEIS	0.15	1.25	83	5300	60% to 85%	Ph=10, Ph2=13	

Assumptions:							
1. HLW glass waste oxide loading basis to be 20 wt% sodium oxides							
2. Using the WHC engineering data package material balance calculate the waste oxide loading							
and adjust mass of the glass produced to achieve a 20 wt % sodium oxide loading							
	Input		Frit	Output			
	Stream1		stream407	stream437			
	liquids	solids					
Volume kilo-liters	5.85E+05						
Specific Gravity	1.21E+00						
Cs and Ba, (MCi)	6.28E+01	5.28E+00		6.79E+01			
Sr and Y, (MCi)	2.10E+00	1.05E+02		1.07E+02			
Tc, (MCi)	2.61E-02	5.89E-03		3.18E-02			
Am, (MCi)	8.61E-03	9.51E-02		1.04E-01			
Np, (MCi)	1.03E-05	9.29E-05		1.03E-04			
Pu-239, (MCi)	1.67E-03	2.47E-02		2.64E-02			
Pu-240, (MCi)	4.14E-04	6.28E-03		6.70E-03			
Pu-241,(MCi)	1.49E-03	7.34E-02		7.48E-02			
Total TRU, (MCi)	1.22E-02	2.00E-01		2.12E-01			
Total MCi	6.49E+01	1.11E+02		1.76E+02			
Total Mass Flow (MT)	7.10E+05	1.94E+04	2.50E+05	3.57E+05			
Total Cr, (MT)	5.15E+01	1.32E+02		1.84E+02			
Total Na, (MT)	6.51E+04	1.24E+03		6.63E+04			
Total Si, (MT)	5.65E+00	5.24E+02	9.56E+04	9.61E+04			
Total P, (MT)	8.42E+02	7.80E+02		1.62E+03			
Total NO2-, (MT)	9.54E+03	7.38E+01					
Total NO3-, (MT)	1.06E+05	1.03E+03					
AG+	3.28E-01	1.38E+00					
AG2O				1.83E+00			
AL+3		2.37E+03					
AL2O3			1.00E+04	1.79E+04			
AL(OH)4-	4.83E+03						
AM+3	2.51E-03	2.77E-02					
AM2O3				3.32E-02			
AS+5	7.70E-01	4.98E-01					
AS2O5				1.95E+00			
B+3	5.19E-01	9.94E-01					
B2O3				4.87E+00			
BA+2	7.91E-01	3.09E+00					
BAO				4.33E+00			
BE+2	8.19E-02	7.61E-03					
BEO				2.48E-01			
BI+3	6.76E+01	1.96E+02					
BI2O3				2.94E+02			
C14	7.43E-04	4.53E-04					
CA+2	1.67E+01	1.33E+02					

CANCRINITE		2.70E+03					
CAO			3.55E+04	3.58E+04			
CD+2	2.09E+00	7.93E+00					
CDO				1.14E+01			
CE+3	2.37E+00	2.35E+02					
CE2O3				2.78E+02			
CL-	3.11E+02	3.49E+00					
CL2							
CO							
CO2							
CO3-2	3.37E+03	2.25E+02					
CR+3		1.32E+02					
CR2O3				2.68E+02			
CR(OH)4-	1.19E+02						
CS+	8.19E-01	9.25E-02					
CS2O				9.65E-01			
CU+2	1.77E-01	7.46E-01					
CUO				1.16E+00			
CUSO4							
F-	1.12E+03	5.97E+01					
F2							
FE+3	1.44E+01	7.63E+02					
FE2O3				1.23E+03			
H2							
H2O	5.07E+05						
H2S							
HG							
HG+2	9.49E-01	9.00E-03					
I-	5.46E+02	2.02E+01					
I2							
K+	2.19E-01	2.10E+01					
K2O				2.56E+01			
KEROSENE							
LA+3	2.19E-01	2.10E+01					
LA2O3				2.49E+01			
LI+	5.77E-03	2.46E-02					
LI2O				6.53E-02			
MG+2	9.65E-01	1.10E+01					
MGO				1.98E+01			
MNO2	2.17E+01	2.09E+02		2.31E+02			
MO+6	4.87E+00	8.01E-01					
MOO3				8.51E+00			
N2							
NA+	6.51E+04	7.77E+02					
NA2O				8.94E+04			
NH3							
NI+3	4.07E+00	6.57E+00					
NI2FECN6		5.00E+02					
NI2O3				1.50E+01			

NIO				2.27E+02			
NO							
NO2							
NO2-	9.54E+03	7.38E+01					
NO3-	1.06E+05	1.03E+03					
NP+4	1.46E-02	1.32E-01					
NPO2				1.66E-01			
O2							
OH-	6.44E+03	5.00E+03					
PB+4	1.96E+00	3.28E+00					
PBO2				6.05E+00			
PO4-3	2.58E+03	2.39E+03					
P2O5				3.71E+03			
P2O5:24W		5.21E-01					
PU+4	2.88E-02	4.27E-01					
PUO2				5.16E-01			
S							
SI+4	5.65E+00	7.90E+01					
SIO2			2.04E+05	2.06E+05			
SO2							
SO4-2	2.01E+03	3.97E+01					
SR+2	3.75E-01	3.64E+01					
SRO				4.33E+01			
TCO2							
TCO4-	2.52E+00	5.68E-01					
TC2O7				2.94E+00			
TOC	1.42E+03	1.16E+02					
UO2+2	8.52E+01	1.58E+03					
UO3				1.76E+03			
V+5	6.20E-02	1.88E-01					
V2O5				4.46E-01			
W+6	7.47E-01						
WO2				4.41E-01			
WO3				9.42E-01			
ZN+2	3.59E+00	9.45E-01					
ZNO				5.65E+00			
ZR+4	4.48E-01	2.77E+02					
ZRO2				7.07E+02			
ZRO2:2H2	2.15E+01	4.09E+02					
WHC data package basis:							
mass waste oxides				1.08E+05			
waste loading (wt%)				30%			
sodium oxide loading				25%			
20 wt. % sodium oxide loading							
Blending factor			1	1.25	1.5	2	3.5
Mass of glass required to achieve 20% sodium loading, M			4.47E+05	5.59E+05	6.71E+05	8.94E+05	1564500
additional frit required (equals increased glass) MT			9.00E+04	2.02E+05	3.14E+05	5.37E+05	1.21E+06

total frit required, MT			3.40E+05	4.52E+05	5.64E+05	7.87E+05	1.46E+06
Waste Loading (Na20 wt. %)			20%	16%	13%	10%	6%
Waste Loading (waste oxides)			24%	19%	16%	12%	7%
glass density (MT/m^3)	2.63						
cullet packing fraction	0.7						
Waste volume (m^3)			2.43E+05	3.04E+05	3.64E+05	4.86E+05	8.50E+05
Canister Volume (m^3)	0.62						
Number of Canisters (1x)			3.92E+05	4.90E+05	5.87E+05	7.83E+05	1.37E+06
Number of Canisters per HMPC		4					
Number of HMPCs			9.79E+04	1.22E+05	1.47E+05	1.96E+05	3.43E+05
Number of trips @ 10 HMPCs /trip			9.79E+03	1.22E+04	1.47E+04	1.96E+04	3.43E+04
Glass formulation:							
(ref Ext. Sep Data Pkg.	acceptable range	Calculated value					
SiO2	42 to 57 wt %		62.51%	66.33%	68.88%	72.06%	76.15%
B2O3	5 to 20 wt %		0.00%	0.00%	0.00%	0.00%	0.00%
Na20	5 to 20 wt %		20.00%	16.00%	13.33%	10.00%	5.71%
Li2O	1 to 7 wt %		0.00%	0.00%	0.00%	0.00%	0.00%
Fe2O3	2 to 15 wt %		0.28%	0.22%	0.18%	0.14%	0.08%
CaO	< or= 10 wt %		10.87%	11.53%	11.98%	12.53%	13.25%
MgO	< or = 8 wt %		0.00%	0.00%	0.00%	0.00%	0.00%
Al2O3	< or = 15 wt %		4.81%	4.65%	4.54%	4.40%	4.23%
ZrO2	< or = 13 wt %		0.16%	0.13%	0.11%	0.08%	0.05%
Cr2O3	< or = 0.5 wt %		0.06%	0.05%	0.04%	0.03%	0.02%
P2O5	< or = 3 wt %		0.83%	0.66%	0.55%	0.41%	0.24%
SO3	< or = 0.5 wt %						
Facility Sizing							
Schedule	14 yrs						
Capacity MT/day	200						
Overall efficiency, %			44%	55%	66%	87%	153%
Required capacity MT/day (assuming 14 yrs ops, 60% OE)				182	219	292	510
Required operating duration yrs (assuming 200 MT/day, 60% OE)				13	15.31	20	36
15 wt % sodium oxide loading							
Mass of glass required to achieve 15% wo loading MT			5.96E+05			Na2O loadin	15%
Volume (m^3) as cullet			3.24E+05				
Number of Canisters (1x)			5.22E+05				
40 wt % sodium oxide loading							
Mass of glass required to achieve 40% wo loading MT			2.24E+05			Na2O loadin	40%
Volume (m^3) as cullet			1.21E+05				
Number of Canisters (1x)			1.96E+05				

Assumptions:										
1. HLW glass waste oxide loading basis to be 20 wt% waste oxides (excluding Na2O and SiO2)										
2. Using the WHC engineering data package material balance calculate the waste oxide loading										
and adjust mass of the glass produced to achieve a 20 wt % waste oxide loading										
3. LAW glass sodium oxide loading basis is to be 15 wt%										
	Input Stream			LAW			HLW			HLW fraction
	STREAM 1			407	437		314	344		
	solids	liquids		FRIT	GLASS		FRIT	GLASS		
Volume kilo-liters										
Specific Gravity										
Cs and Ba, (MCi)	5.28E+00	6.28E+01			4.93E-01			6.74E+01		0.990011751
Sr and Y, (MCi)	1.05E+02	2.10E+00			1.90E+00			1.05E+02		0.980392157
Tc, (MCi)	5.89E-03	2.61E-02			2.59E-02			5.91E-03		0.184745233
Am, (MCi)	9.51E-02	8.61E-03			8.60E-03			9.52E-02		0.917944268
Np, (MCi)	9.29E-05	1.03E-05			1.03E-05			9.29E-05		0.900193798
Pu-239, (MCi)	2.47E-02	1.67E-03			1.67E-03			2.47E-02		0.936670459
Pu-240, (MCi)	6.28E-03	4.14E-04			4.14E-04			6.28E-03		0.93815357
Pu-241,(MCi)	7.34E-02	1.49E-03			1.48E-03			7.34E-02		0.980104153
Total TRU, (MCi)	2.00E-01	1.22E-02			1.22E-02			2.00E-01		0.942507069
Total MCi	1.11E+02	6.49E+01			2.43E+00			1.73E+02		0.98351336
Total Mass Flow (MT)	1.94E+04	7.10E+05		2.81E+05	3.87E+05		1.36E+04	2.51E+04		
Total Cr, (MT)	1.32E+02	5.15E+01			1.44E+02			3.96E+01		
Total Na, (MT)	1.24E+03	6.51E+04			7.18E+04			2.33E+03		
Total Si, (MT)	5.24E+02	5.65E+00		1.07E+05	1.07E+05		5.29E+03	5.83E+03		
Total P, (MT)	7.80E+02	8.42E+02			1.35E+03			2.72E+02		
Total NO2-, (MT)	7.38E+01	9.54E+03								
Total NO3-, (MT)	1.03E+03	1.06E+05								
AG+	1.38E+00	3.28E-01								
AG2O					3.52E-01			1.48E+00		
AL+3	2.37E+03									
AL2O3				1.32E+04	1.94E+04			1.73E+03		
AL(OH)4-		4.83E+03								
AM+3	2.77E-02	2.51E-03								
AM2O3					2.76E-03			3.05E-02		
AS+5	4.98E-01	7.70E-01								
AS2O5					1.18E+00			7.66E-01		
B+3	9.94E-01	5.19E-01								
B2O3					1.67E+00		1.75E+03	1.76E+03		
BA+2	3.09E+00	7.91E-01								
BAO					8.81E-01			3.45E+00		
BE+2	7.61E-03	8.19E-02								
BEO					2.27E-01			2.16E-02		
BI+3	1.96E+02	6.76E+01								
BI2O3					7.52E+01			2.19E+02		
C14	4.53E-04	7.43E-04								
CA+2	1.33E+02	1.67E+01								
CANCRINITE	2.70E+03									
CAO				3.87E+04	3.87E+04			1.89E+02		
CD+2	7.93E+00	2.09E+00								
CDO					2.38E+00			9.06E+00		
CE+3	2.35E+02	2.37E+00								
CE2O3					2.79E+00			2.76E+02		
CL-	3.49E+00	3.11E+02								
CL2										
CO										
CO2										
CO3-2	2.25E+02	3.37E+03								
CR+3	1.32E+02									
CR2O3					2.11E+02			5.79E+01		
CR(OH)4-		1.19E+02								
CS+	9.25E-02	8.19E-01								
CS2O					6.83E-03			9.58E-01		
CU+2	7.46E-01	1.77E-01								
CUO					2.21E-01			9.34E-01		

CUSO4										
F-	5.97E+01	1.12E+03								
F2										
FE+3	7.63E+02	1.44E+01								
FE2O3					2.06E+01			1.21E+03		
H2										
H20		5.07E+05								
H2S										
HG										
HG+2	9.00E-03	9.49E-01								
I-	2.02E+01	5.46E+02								
I2										
K+	2.10E+01	2.19E-01								
K2O					2.65E-01			2.53E+01		
KEROSENE										
LA+3	2.10E+01	2.19E-01								
LA2O3					2.58E-01			2.46E+01		
LI+	2.46E-02	5.77E-03								
LI2O					1.24E-02		5.00E+02	5.03E+02		
MG+2	1.10E+01	9.65E-01								
MGO					1.60E+00			1.88E+01		
MNO2	2.09E+02	2.17E+01			2.16E+01			2.09E+02		
MO+6	8.01E-01	4.87E+00								
MOO3					7.29E+00			1.22E+00		
N2										
NA+	7.77E+02	6.51E+04								
NA2O					9.68E+04			3.14E+03		
NH3										
NI+3	6.57E+00	4.07E+00								
NI2FECN6	5.00E+02									
NI2O3					5.72E+00			9.27E+00		
NIO					1.50E-02			2.27E+02		
NO										
NO2										
NO2-	7.38E+01	9.54E+03								
NO3-	1.03E+03	1.06E+05								
NP+4	1.32E-01	1.46E-02								
NPO2					1.66E-02			1.50E-01		
O2										
OH-	5.00E+03	6.44E+03								
PB+4	3.28E+00	1.96E+00								
PBO2					2.26E+00			3.79E+00		
PO4-3	2.39E+03	2.58E+03								
P2O5					3.09E+03			6.22E+02		
P2O5:24W	5.21E-01									
PU+4	4.27E-01	2.88E-02								
PUO2					3.26E-02			4.84E-01		
S										
SI+4	7.90E+01	5.65E+00								
SIO2				2.29E+05	2.29E+05		1.13E+04	1.25E+04		
SO2										
SO4-2	3.97E+01	2.01E+03								
SR+2	3.64E+01	3.75E-01								
SRO					4.00E-01			4.29E+01		
TCO2										
TCO4-	5.68E-01	2.52E+00								
TC2O7					2.39E+00			5.45E-01		
TOC	1.16E+02	1.42E+03								
UO2+2	1.58E+03	8.52E+01								
UO3					9.02E+01			1.67E+03		
V+5	1.88E-01	6.20E-02								
V2O5					1.11E-01			3.35E-01		
W+6		7.47E-01								
WO2					2.91E-05			4.41E-01		
WO3					9.40E-01			2.06E-03		
ZN+2	9.45E-01	3.59E+00								
ZNO					4.46E+00			1.19E+00		

ZR+4	2.77E+02	4.48E-01								
ZRO2					6.49E-01			6.90E+02		
ZRO2:2H2	4.09E+02	2.15E+01								
WHC Data Package Basis:										
Mass LAW waste oxides					106544.7302					
LAW waste loading (waste oxide)					28%					
LAW waste loading (sodium oxide)					25%					
Mass HLW waste oxides								7.26E+03		
HLW waste loading (waste oxides)										
HLW WOL (- Na2O, - SiO2)								29%		
HLW WOL (all tank waste)								46%		
HLW										
20 wt. % waste oxide loading										
Blending factor				1	1.25	1.5	2	3.5		
Mass of glass required to achieve 20% wo loading, MT				36293.1358	45366.41975	54439.7037	72586.2716	127025.9753		
additional frit required (equals increased glass) MT				1.12E+04	2.03E+04	2.93E+04	4.75E+04	1.02E+05		
total frit required, MT				2.48E+04	3.39E+04	4.29E+04	6.11E+04	1.16E+05		
WOL (- Na2O, - SiO2)				20%	16%	13%	10%	6%		
WOL (with all tank wastes)				32%	25%	21%	16%	9%		
glass density (MT/m^3)	2.63									
cullet packing fraction	0.7	(LAW only)								
Waste volume (m^3)				1.38E+04	1.72E+04	2.07E+04	2.76E+04	4.83E+04		
Canister Volume (m^3)	0.62									
Number of Canisters (1x)				2.23E+04	2.78E+04	3.34E+04	4.45E+04	7.79E+04		
Nu. of Canisters /HMPC	4									
Number of HMPCs				5.56E+03	6.96E+03	8.35E+03	1.11E+04	1.95E+04		
Number of trips @ 10 HMPCs /trip				556	696	835	1113	1948		
Glass formulation:										
(ref Ext. Sep Data Pkg.)	acceptable range			1	1.25	1.5	2	3.5		
SiO2	42 to 57 wt %			60.07%	64.68%	67.75%	71.59%	76.52%		
B2O3	5 to 20 wt %			8.82%	9.63%	10.17%	10.84%	11.71%		
Na20	5 to 20 wt %			8.65%	6.92%	5.77%	4.33%	2.47%		
Li2O	1 to 7 wt %			2.52%	2.75%	2.91%	3.10%	3.35%		
Fe2O3	2 to 15 wt %			3.33%	0.00%	0.00%	0.00%	0.00%		
CaO	< or= 10 wt %			0.52%	0.42%	0.35%	0.26%	0.15%		
MgO	< or = 8 wt %			0.05%	0.04%	0.03%	0.03%	0.01%		
Al2O3	< or = 15 wt %			4.77%	3.81%	3.18%	2.38%	1.36%		
ZrO2	< or = 13 wt %			1.90%	1.52%	1.27%	0.95%	0.54%		
Cr2O3	< or = 0.5 wt %			0.16%	0.13%	0.11%	0.08%	0.05%		
P2O5	< or = 3 wt %			1.71%	1.37%	1.14%	0.86%	0.49%		
SO3	< or = 0.5 wt %									
HLW Facility Sizing										
Schedule	14 yrs									
Capacity MT/day	20									
Overall efficiency, %				36%	44%	53%	71%	124%		
Required capacity MT/day (assuming 14 yrs ops, 60% OE)				11.84	14.80	17.76	23.67	41.43		
Required operating duration yrs (assuming 20 MT/day, 60% OE)					10.36	12.43	16.57	29.00		
15 wt % waste oxide loading										
Mass of glass required to achieve 15% wo loading MT				4.84E+04	6.05E+04	7.26E+04	9.68E+04	1.69E+05		
Volume (m^3)				1.84E+04	2.30E+04	2.76E+04	3.68E+04	6.44E+04		
Number of Canisters (1x)				2.97E+04	3.71E+04	4.45E+04	5.94E+04	1.04E+05		
40 wt % waste oxide loading										
Mass of glass required to achieve 40% wo loading MT				1.81E+04	2.27E+04	2.72E+04	3.63E+04	6.35E+04		
Volume (m^3)				6.90E+03	8.62E+03	1.03E+04	1.38E+04	2.41E+04		

Number of Canisters (1x)				1.11E+04	1.39E+04	1.67E+04	2.23E+04	3.90E+04		
LAW										
15 wt. % sodium oxide loading										
Blending factor				1	1.25	1.5	2	3.5		
Mass of glass required to achieve 15% wo loading, MT				6.45E+05	8.07E+05	9.68E+05	1.29E+06	2.26E+06		
additional frit required (equals increased glass) MT				3.64E+05	5.26E+05	6.87E+05	1.01E+06	1.98E+06		
total frit required, MT				6.45E+05	8.07E+05	9.68E+05	1.29E+06	2.26E+06		
glass density (MT/m^3)	2.63									
cullet packing fraction	0.7									
Waste volume (m^3)				3.51E+05	4.38E+05	5.26E+05	7.01E+05	1.23E+06		
Number of 5300 m^3 vaults				66	83	99	132	231		
LAW facility sizing										
Schedule, years	14									
Capacity MT/day	200									
Overall efficiency, %				63%	79%	95%	126%	221%		
Required capacity MT/day (assuming 14 yrs ops, 60% OE)				210.48	263.10	315.72	420.96	736.68		
Required operating duration yrs (assuming 200 MT/day, 60% OE)				14.73	18.42	22.10	29.47	51.57		
10 wt. % sodium oxide loading										
Blending factor				1	1.25		2	3.5		
Mass of glass required to achieve 10				968000	1210000		1936000	3388000		
Waste volume, m^3				525801.195	657251.4938		1051602.39	1840304.183		
Number of 5,300 m^3 vaults				99	124		198	347		
25 wt. % sodium oxide loading										
Blending factor				1	1.25		2	3.5		
Mass of glass required to achive 25 wt % Na2O				387200	484000		774400	1355200		
Waste Volume				210320.478	262900.5975		420640.956	736121.673		
Number of 5,300 m^3 vaults				40	50		79	139		

Assumptions:								
1. HLW glass waste oxide loading basis to be 20 wt% waste oxides (excluding Na2O and SiO2)								
2. Using the WHC engineering data package material balance calculate the waste oxide loading								
and adjust mass of the glass produced to achieve a 20 wt % waste oxide loading								
not counting the SiO2 or the Na2O								
	Input Stream			LAW			HLW	
	STREAM 1			407	437		1314	1344
	solids	liquids		FRIT	GLASS		FRIT	GLASS
Volume kilo-liters		5.84E+05						
Specific Gravity		1.21E+00						
Cs and Ba, (MCi)	7.60E+00	6.72E+01			6.86E-02			7.46E+01
Sr and Y, (MCi)	1.37E+02	1.41E+00			1.40E-02			1.37E+02
Tc, (MCi)	5.89E-03	2.61E-02			1.53E-04			3.17E-02
Am, (MCi)								
Np, (MCi)								
Pu-239, (MCi)								
Pu-240, (MCi)								
Pu-241,(MCi)								
Total TRU, (MCi)	1.92E-01	1.52E-02			1.20E-03			2.06E-01
Total MCi	1.45E+02	6.87E+01			8.39E-02			2.12E+02
Total Mass Flow (MT)	2.37E+04	7.06E+05		2.65E+05	3.86E+05		8.73E+02	1.32E+03
Total Cr, (MT)								
Total Na, (MT)								
Total Si, (MT)								
Total P, (MT)								
Total NO2-, (MT)								
Total NO3-, (MT)								
AG+	1.38E+00	3.28E-01						
AG2O					4.07E-01			1.43E+00
AL+3	2.37E+03							
AL2O3				1.16E+04	1.93E+04			1.94E+02
AL(OH)4-		4.83E+03						
AM+3	2.77E-02	2.51E-03						
AM2O3					3.41E-05			3.32E-02
APM-								3.44E-03
AS+5	4.98E-01	7.70E-01						
AS2O5					4.33E-01			1.51E+00
B+3	9.94E-01	5.19E-01						
B2O3					4.82E+00		1.22E+02	1.22E+02
BA+2	3.09E+00	7.91E-01						
BAO					8.76E-01			3.46E+00
BE+2	7.61E-03	8.19E-02						
BEO					5.53E-02			1.93E-01
BI+3	1.96E+02	6.76E+01						
BI2O3					2.90E+02			3.45E+00
C14	4.53E-04	7.43E-04						

CA+2	1.33E+02	1.67E+01						
CANCRINITE	2.70E+03							
CAO				3.84E+04	3.86E+04			2.34E+00
CD+2	7.93E+00	2.09E+00						
CDO					1.13E+01			1.26E-01
CE+3	2.35E+02	2.37E+00						
CE2O3					2.75E+02			3.40E+00
CL-	3.49E+00	3.11E+02						
CL2								
CO								
CO2								
CO3-2	2.25E+02	3.37E+03						
CR+3	1.32E+02							
CR2O3					2.67E+02			1.38E+00
CR(OH)4-		1.19E+02						
CS+	9.25E-02	8.19E-01						
CS2O					8.85E-04			9.64E-01
CU+2	7.46E-01	1.77E-01						
CUO					2.57E-01			8.99E-01
CUSO4								
F-	5.97E+01	1.12E+03						
F2								
FE+3	7.63E+02	1.44E+01						
FE2O3					3.74E+03			4.24E+01
H2								
H2O		5.07E+05			2.11E-04			1.10E+00
H2S								
HG								
HG+2	9.00E-03	9.49E-01						
HGO					2.07E+00			
I-	2.02E+01	5.46E+02						
I2								
K+	2.10E+01	2.19E-01						
K2O					2.55E+01			2.34E-02
KEROSENE								
LA+3	2.10E+01	2.19E-01						
LA2O3					2.46E+01			3.04E-01
LI+	2.46E-02	5.77E-03						
LI2O					6.53E-02		1.32E+01	1.32E+01
MG+2	1.10E+01	9.65E-01						
MGO					1.96E+01			2.20E-01
MNO2	2.09E+02	2.17E+01			2.31E+02			1.08E-01
MO+6	8.01E-01	4.87E+00						
MOO3					1.03E+01			9.24E-02
N2								
NA+	3.21E+03	6.26E+04						
NA2O					9.65E+04		2.40E+01	6.59E+01
NH3								
NI+3	6.57E+00	4.07E+00						

NI2FECN6	5.00E+02							
NI2O3					2.62E+02			2.82E+00
NIO					1.06E-03			1.20E+00
NO								
NO2								
NO2-	7.38E+01	9.54E+03						
NO3-	1.03E+03	1.06E+05						
NP+4	1.32E-01	1.46E-02						
NPO2					6.52E-03			1.66E-01
O2								
OH-	6.80E+03	4.64E+03						
PB+4	3.28E+00	1.96E+00						
PBO2					1.35E+00			4.71E+00
PO4-3	2.39E+03	2.58E+03						
P2O5					3.68E+03			3.96E+01
P2O5:24W	5.21E-01							
PU+4	4.27E-01	2.88E-02						
PUO2					5.42E-03			5.11E-01
S								
SI+4	7.90E+01	5.65E+00						
SIO2				2.15E+05	2.16E+05		7.13E+02	7.52E+02
SO2								
SO3					6.22E+03			1.92E-03
SO4-2	3.97E+01	2.01E+03						
SR+2	3.64E+01	3.75E-01						
SRO					4.41E-03			4.33E+01
TCO2								
TCO4-	5.68E-01	2.52E+00						
TC2O7					1.41E-02			2.92E+00
TIO2					3.16E-02			3.51E-04
TOC	1.16E+02	1.42E+03						
UO2+2	1.58E+03	8.52E+01						
UO3								2.77E+00
U3O8					1.08E+00			1.15E-02
V+5	1.88E-01	6.20E-02						
V2O5					9.92E-02			3.47E-01
W+6		7.47E-01						
WO2					1.09E-06			2.26E-04
WO3					2.10E-01			7.33E-01
ZN+2	9.45E-01	3.59E+00						
ZNO					3.17E+01			4.31E-01
ZR+4	2.77E+02	4.48E-01						
ZRO2					6.99E+02			8.55E+00
ZRO2:2H2	4.09E+02	2.15E+01						

Mass LAW waste oxides					121198.787			
LAW waste loading (waste oxides)					31%			
LAW waste loading (sodium oxide)					25%			
Mass HLW waste oxides								3.42E+02
HLW waste loading(-Na,-Si)								26%
HLW WOL (all tank waste)								34%
HLW								
20 wt. % waste oxide loading								
Blending factor				1	1.25	1.5	2	3.5
Mass of glass required to achieve 20% wo loading, MT				1707.54219	2134.42773	2561.313278	3415.08437	5976.397648
additional frit required (equals increased glass) MT				3.88E+02	8.14E+02	1.24E+03	2.10E+03	4.66E+03
total frit required, MT				1.26E+03	1.69E+03	2.11E+03	2.97E+03	5.53E+03
WOL (-Na,- Si)				20%	16%	13%	10%	6%
WOL (all tank waste)				26%	21%	17%	13%	7%
glass density (MT/m^3)	2.63							
cullet packing fraction	0.7	(LAW only)						
Waste volume (m^3)				6.49E+02	8.12E+02	9.74E+02	1.30E+03	2.27E+03
Canister Volume (m^3)	0.62							
Number of Canisters (1x)				1.05E+03	1.31E+03	1.57E+03	2.09E+03	3.67E+03
Nu. of Canisters /HMPC	4							
Number of HMPCs				2.62E+02	3.27E+02	3.93E+02	5.24E+02	9.16E+02
Number of trips @ 10 HMPCs /trip				26	33	39	52	92
Glass formulation:								
(ref Ext. Sep Data Pkg.)	acceptable range			1	1.25	1.5	2	3.5
SiO2	42 to 57 wt %			62.58%	66.39%	68.94%	72.12%	76.21%
B2O3	5 to 20 wt %			10.32%	11.06%	11.55%	12.16%	12.95%
Na20	5 to 20 wt %			4.48%	4.14%	3.91%	3.62%	3.25%
Li2O	1 to 7 wt %			1.11%	1.19%	1.24%	1.31%	1.39%
Fe2O3	2 to 15 wt %			2.48%	0.00%	0.00%	0.00%	0.00%
CaO	< or= 10 wt %			0.14%	0.11%	0.09%	0.07%	0.04%
MgO	< or = 8 wt %			0.01%	0.01%	0.01%	0.01%	0.00%
Al2O3	< or = 15 wt %			11.36%	9.09%	7.57%	5.68%	3.25%
ZrO2	< or = 13 wt %			0.50%	0.40%	0.33%	0.25%	0.14%
Cr2O3	< or = 0.5 wt %			0.08%	0.06%	0.05%	0.04%	0.02%
P2O5	< or = 3 wt %			2.32%	1.86%	1.55%	1.16%	0.66%
SO3	< or = 0.5 wt %			0.00%	0.00%	0.00%	0.00%	0.00%
HLW Facility Sizing								
Schedule	14 yrs							
Capacity MT/day	1							
Overall efficiency, %				33%	42%	50%	67%	117%
Required capacity MT/day (assuming 14 yrs ops, 60% OE)				0.56	0.70	0.84	1.11	1.95

Required operating duration yrs (assuming 1 MT/day, 60% OE)					9.75	11.70	15.59	27.29
15 wt % waste oxide loading								
Mass of glass required to achieve 15% wo loading MT				2.28E+03	2.85E+03	3.42E+03	4.55E+03	7.97E+03
Volume (m^3)				8.66E+02	1.08E+03	1.30E+03	1.73E+03	3.03E+03
Number of Canisters (1x)				1.40E+03	1.75E+03	2.09E+03	2.79E+03	4.89E+03
40 wt % waste oxide loading								
Mass of glass required to achieve 40% wo loading MT				8.54E+02	1.07E+03	1.28E+03	1.71E+03	2.99E+03
Volume (m^3)				3.25E+02	4.06E+02	4.87E+02	6.49E+02	1.14E+03
Number of Canisters (1x)				5.24E+02	6.54E+02	7.85E+02	1.05E+03	1.83E+03

LAW								
15 wt. % sodium oxide loading								
Blending factor				1	1.25	1.5	2	3.5
Mass of glass required to achieve 15% wo loading, MT				6.43E+05	8.04E+05	9.65E+05	1.29E+06	2.25E+06
additional frit required (equals increased glass) MT				2.57E+05	4.18E+05	5.79E+05	9.01E+05	1.87E+06
total frit required, MT				5.22E+05	6.83E+05	8.44E+05	1.17E+06	2.13E+06
glass density (MT/m^3)	2.63							
cullet packing fraction	0.7							
Waste volume (m^3)				3.49E+05	4.37E+05	5.24E+05	6.99E+05	1.22E+06
Number of 5300 m^3 vaults				66	83	99	132	231
LAW facility sizing								
Schedule, years	19							
Capacity MT/day	200							
Overall efficiency, %				46%	58%	70%	93%	162%
Required capacity MT/day (assuming 19 yrs ops, 60% OE)				154.61	193.26	231.92	309.22	541.14
Required operating duration yrs (assuming 200 MT/day, 60%				14.69	18.36	22.03	29.38	51.41
10 wt. % sodium oxide loading								
Blending factor				1	1.25	1.5	2	3.5
Mass of glass required to achieve 10				9.65E+05	1.21E+06	1.45E+06	1.93E+06	3.38E+06
Waste volume, m^3				5.24E+05	6.55E+05	7.86E+05	1.05E+06	1.83E+06
Number of 5,300 m^3 vaults				99	124	148	198	346
25 wt. % sodium oxide loading								
Blending factor				1	1.25	1.5	2	3.5
Mass of glass required to achive 25 wt % Na2O				3.86E+05	4.83E+05	5.79E+05	7.72E+05	1.35E+06
Waste Volume				2.10E+05	2.62E+05	3.15E+05	4.19E+05	7.34E+05
Number of 5,300 m^3 vaults				40	49	59	79	138

Assumptions:										
1. Phased Implementation Separations and Treatment is similar to Intermediate Separations										
except the separations for Sr, Tc, and TRU elements are taken from Extensive Separations										
2. HLW glass waste oxide loading basis to be 20 wt% waste oxides										
not counting the Na2O or SiO2 in the waste feed streatm										
3. Using the WHC engineering data package material balance calculate the waste oxide loading										
and adjust mass of the glass produced to achieve a 20 wt % waste oxide loading										
4. LAW glass sodium oxide loading basis is to be 15 wt%										
	Input Stream			LAW			HLW			
	STREAM 1			407	437		314	344		
	solids	liquids		FRIT	GLASS		FRIT	GLASS		HLW
Volume kilo-liters										fraction
Specific Gravity										
Cs and Ba, (MCi)	5.28E+00	6.28E+01			6.81E-01			6.74E+01		0.99
Sr and Y, (MCi)	1.05E+02	2.10E+00			1.07E+00			1.06E+02		0.99
Tc, (MCi)	5.89E-03	2.61E-02			3.20E-04			3.17E-02		0.99
Am, (MCi)	9.51E-02	8.61E-03			1.04E-03			1.03E-01		0.99
Np, (MCi)	9.29E-05	1.03E-05			1.03E-06			1.02E-04		0.99
Pu-239, (MCi)	2.47E-02	1.67E-03			2.64E-04			2.61E-02		0.99
Pu-240, (MCi)	6.28E-03	4.14E-04			6.69E-05			6.63E-03		0.99
Pu-241,(MCi)	7.34E-02	1.49E-03			7.49E-04			7.41E-02		0.99
Total TRU, (MCi)	2.00E-01	1.22E-02			2.12E-03			2.10E-01		0.99
Total MCi	1.11E+02	6.49E+01			1.76E+00			1.74E+02		0.99
Total Mass Flow (MT)	1.94E+04	7.10E+05		2.81E+05	3.87E+05		1.36E+04	2.51E+04		
Total Cr, (MT)	1.32E+02	5.15E+01			1.44E+02			3.96E+01		
Total Na, (MT)	1.24E+03	6.51E+04			7.18E+04			2.33E+03		
Total Si, (MT)	5.24E+02	5.65E+00		1.07E+05	1.07E+05		5.29E+03	5.83E+03		
Total P, (MT)	7.80E+02	8.42E+02			1.35E+03			2.72E+02		
Total NO2-, (MT)	7.38E+01	9.54E+03								
Total NO3-, (MT)	1.03E+03	1.06E+05								
AG+	1.38E+00	3.28E-01								
AG2O					3.52E-01			1.48E+00		
AL+3	2.37E+03									
AL2O3				1.32E+04	1.94E+04			1.73E+03		
AL(OH)4-		4.83E+03								
AM+3	2.77E-02	2.51E-03								
AM2O3					2.76E-03			3.05E-02		
AS+5	4.98E-01	7.70E-01								
AS2O5					1.18E+00			7.66E-01		
B+3	9.94E-01	5.19E-01								
B2O3					1.67E+00		1.75E+03	1.76E+03		
BA+2	3.09E+00	7.91E-01								
BAO					8.81E-01			3.45E+00		
BE+2	7.61E-03	8.19E-02								
BEO					2.27E-01			2.16E-02		
BI+3	1.96E+02	6.76E+01								
BI2O3					7.52E+01			2.19E+02		
CI4	4.53E-04	7.43E-04								
CA+2	1.33E+02	1.67E+01								
CANCRINITE	2.70E+03									
CAO				3.87E+04	3.87E+04			1.89E+02		
CD+2	7.93E+00	2.09E+00								
CDO					2.38E+00			9.06E+00		
CE+3	2.35E+02	2.37E+00								
CE2O3					2.79E+00			2.76E+02		
CL-	3.49E+00	3.11E+02								
CL2										
CO										
CO2										
CO3-2	2.25E+02	3.37E+03								
CR+3	1.32E+02									
CR2O3					2.11E+02			5.79E+01		
CR(OH)4-		1.19E+02								
CS+	9.25E-02	8.19E-01								

CS2O					6.83E-03			9.58E-01		
CU+2	7.46E-01	1.77E-01								
CUO					2.21E-01			9.34E-01		
CUSO4										
F-	5.97E+01	1.12E+03								
F2										
FE+3	7.63E+02	1.44E+01								
FE2O3					2.06E+01			1.21E+03		
H2										
H2O		5.07E+05								
H2S										
HG										
HG+2	9.00E-03	9.49E-01								
I-	2.02E+01	5.46E+02								
I2										
K+	2.10E+01	2.19E-01								
K2O					2.65E-01			2.53E+01		
KEROSENE										
LA+3	2.10E+01	2.19E-01								
LA2O3					2.58E-01			2.46E+01		
LI+	2.46E-02	5.77E-03								
LI2O					1.24E-02		5.00E+02	5.03E+02		
MG+2	1.10E+01	9.65E-01								
MGO					1.60E+00			1.88E+01		
MNO2	2.09E+02	2.17E+01			2.16E+01			2.09E+02		
MO+6	8.01E-01	4.87E+00								
MOO3					7.29E+00			1.22E+00		
N2										
NA+	7.77E+02	6.51E+04								
NA2O					9.68E+04			3.14E+03		
NH3										
NI+3	6.57E+00	4.07E+00								
NI2FECN6	5.00E+02									
NI2O3					5.72E+00			9.27E+00		
NIO					1.50E-02			2.27E+02		
NO										
NO2										
NO2-	7.38E+01	9.54E+03								
NO3-	1.03E+03	1.06E+05								
NP+4	1.32E-01	1.46E-02								
NPO2					1.66E-02			1.50E-01		
O2										
OH-	5.00E+03	6.44E+03								
PB+4	3.28E+00	1.96E+00								
PBO2					2.26E+00			3.79E+00		
PO4-3	2.39E+03	2.58E+03								
P2O5					3.09E+03			6.22E+02		
P2O5:24W	5.21E-01									
PU+4	4.27E-01	2.88E-02								
PUO2					3.26E-02			4.84E-01		
S										
SI+4	7.90E+01	5.65E+00								
SIO2				2.29E+05	2.29E+05		1.13E+04	1.25E+04		
SO2										
SO4-2	3.97E+01	2.01E+03								
SR+2	3.64E+01	3.75E-01								
SRO					4.00E-01			4.29E+01		
TCO2										
TCO4-	5.68E-01	2.52E+00								
TC2O7					2.94E-02			2.91E+00		
TOC	1.16E+02	1.42E+03								
UO2+2	1.58E+03	8.52E+01								
UO3					9.02E+01			1.67E+03		
V+5	1.88E-01	6.20E-02								
V2O5					1.11E-01			3.35E-01		
W+6		7.47E-01								
WO2					2.91E-05			4.41E-01		

WO3					9.40E-01			2.06E-03		
ZN+2	9.45E-01	3.59E+00								
ZNO					4.46E+00			1.19E+00		
ZR+4	2.77E+02	4.48E-01								
ZRO2					6.49E-01			6.90E+02		
ZRO2:2H2	4.09E+02	2.15E+01								
WHC Data Package Basis:										
Mass LAW waste oxides					106542.3696					
LAW waste loading (waste oxide)					28%					
LAW waste loading (sodium oxide)					25%					
Mass HLW waste oxides								7.26E+03		
HLW waste loading (waste oxides)								29%		
HLW										
20 wt. % waste oxide loading										
Blending factor				1	1.25	1.5	2	3.5		
Mass of glass required to achieve 20% wo loading, MT				36304.93905	45381.17381	54457.40858	72609.8781	127067.2867		
additional frit required (equals increased glass) MT				1.12E+04	2.03E+04	2.94E+04	4.75E+04	1.02E+05		
total frit required, MT				2.48E+04	3.39E+04	4.30E+04	6.11E+04	1.16E+05		
glass density (MT/m^3)	2.63									
cullet packing fraction	0.7	(LAW only)								
Waste volume (m^3)				1.38E+04	1.73E+04	2.07E+04	2.76E+04	4.83E+04		
Canister Volume (m^3)	0.62									
Number of Canisters (1x)				2.23E+04	2.78E+04	3.34E+04	4.45E+04	7.79E+04		
Nu. of Canisters /HMPC	4									
Number of HMPCs				5.57E+03	6.96E+03	8.35E+03	1.11E+04	1.95E+04		
Number of trips @ 10 HMPCs /trip				557	696	835	1113	1948		
Glass formulation:										
(ref Ext. Sep Data Pkg.)	acceptable range			1	1.25	1.5	2	3.5		
SiO2	42 to 57 wt %			60.08%	64.68%	67.75%	71.59%	76.52%		
B2O3	5 to 20 wt %			8.82%	9.63%	10.17%	10.84%	11.71%		
Na20	5 to 20 wt %			8.65%	6.92%	5.77%	4.32%	2.47%		
Li2O	1 to 7 wt %			2.52%	2.75%	2.91%	3.10%	3.35%		
Fe2O3	2 to 15 wt %			3.33%	0.00%	0.00%	0.00%	0.00%		
CaO	< or= 10 wt %			0.52%	0.42%	0.35%	0.26%	0.15%		
MgO	< or = 8 wt %			0.05%	0.04%	0.03%	0.03%	0.01%		
Al2O3	< or = 15 wt %			4.77%	3.81%	3.18%	2.38%	1.36%		
ZrO2	< or = 13 wt %			1.90%	1.52%	1.27%	0.95%	0.54%		
Cr2O3	< or = 0.5 wt %			0.16%	0.13%	0.11%	0.08%	0.05%		
P2O5	< or = 3 wt %			1.71%	1.37%	1.14%	0.86%	0.49%		
SO3	< or = 0.5 wt %									
HLW Facility Sizing										
Schedule	14 yrs									
Capacity MT/day	20									
Overall efficiency, %				36%	44%	53%	71%	124%		
Required capacity MT/day (assuming 14 yrs ops, 60% OE)				11.84	14.80	17.76	23.68	41.44		
Required operating duration yrs (assuming 20 MT/day, 60% OE)					10.36	12.43	16.58	29.01		
15 wt % waste oxide loading										
Mass of glass required to achieve 15% wo loading MT				4.84E+04	6.05E+04	7.26E+04	9.68E+04	1.69E+05		
Volume (m^3)				1.84E+04	2.30E+04	2.76E+04	3.68E+04	6.44E+04		
Number of Canisters (1x)				2.97E+04	3.71E+04	4.45E+04	5.94E+04	1.04E+05		
40 wt % waste oxide loading										
Mass of glass required to achieve 40% wo loading MT				1.82E+04	2.27E+04	2.72E+04	3.63E+04	6.35E+04		
Volume (m^3) as cullet				6.90E+03	8.63E+03	1.04E+04	1.38E+04	2.42E+04		
Number of Canisters (1x)				1.11E+04	1.39E+04	1.67E+04	2.23E+04	3.90E+04		

LAW										
15 wt. % sodium oxide loading										
Blending factor				1	1.25	1.5	2	3.5		
Mass of glass required to achieve 15% wo loading, MT				6.45E+05	8.07E+05	9.68E+05	1.29E+06	2.26E+06		
additional frit required (equals increased glass) MT				3.64E+05	5.26E+05	6.87E+05	1.01E+06	1.98E+06		
total frit required, MT				6.45E+05	8.07E+05	9.68E+05	1.29E+06	2.26E+06		
glass density (MT/m^3)	2.63									
cullet packing fraction	0.7									
Waste volume (m^3)				3.51E+05	4.38E+05	5.26E+05	7.01E+05	1.23E+06		
Number of 5300 m^3 vaults				66	83	99	132	231		
LAW facility sizing										
Schedule, years	14									
Capacity MT/day	200									
Overall efficiency, %				63%	79%	95%	126%	221%		
Required capacity MT/day (assuming 14 yrs ops, 60% OE)				210.48	263.10	315.72	420.96	736.68		
Required operating duration yrs (assuming 200 MT/day, 60% OE)				14.73	18.42	22.10	29.47	51.57		
10 wt. % sodium oxide loading										
Blending factor				1			2	3.5		
Mass of glass required to achieve 10				968000			1936000	3388000		
Waste volume, m^3				525801.195			1051602.39	1840304.183		
Number of 5,300 m^3 vaults				99			198	347		
25 wt. % sodium oxide loading										
Blending factor				1			2	3.5		
Mass of glass required to achive 25 wt % Na2O				387200			774400	1355200		
Waste Volume				210320.478			420640.956	736121.673		
Number of 5,300 m^3 vaults				40			79	139		

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE ENGR / COST - CAPSULE ALTERNATIVES

ORIGINATOR D. Stein DATE ~~2/6/96~~ 3/18/96

REVISION NO. ~~A~~ B

OBJECTIVE IDENTIFY THE COST FOR THE CAPSULE ALTERNATIVES DISCUSSED IN THE TWRS EIS - MODIFY PER PROPOSED DRAFT EIS (SMALL CANISTER)

METHODOLOGY SAME AS REV 0 BUT ALSO USE NEW REPOSITORY COST ESTIMATES PER PROPOSED DRAFT EIS CONDITIONS

ASSUMPTIONS

Rev B - Revised repository fee per latest direction — $360,000 per canister (1995 $)

(Continue on another sheet if necessary)

SIGNATURE

CHK: C. Henderson 3/25/96

CALCULATION & RESULTS ATTACHED

JACOBS\FORMS\CALCVR.SET

JACOBS ENGINEERING GROUP INC.

DATE ~~2/6/96~~ 3/18/96 SUBJECT Rev B ~~Rev A~~ SHEET NO. 1-2

BY D Stein CHKD. JOB NO.

CAPSULE OVERPACK + SHIP ALTERNATIVE

Cost Estimate

Modification per proposed Draft EIS
use of 61 x 305 cm canister
as a standard

previously 68 x 457 cm canister
was estimated for this alternative

Since max loading of 5 capsules
per canister, the 61 x 305 cm
canister will still be able to easily
hold the 5 capsules. Therefore
the same # of HMPCs (100)
and # of canisters (400) as before

The new costs will however have to
be estimated based on new repository
fees estimated per DEIS

new inter. sep. for DEIS has 33,386
canisters and costs $6,500 million
in repository fees

Variation from this inter. sep. case has
44,500 canisters and costs $7,800 million

Therefore Δ 11,114 canisters cost Δ $1,300 million
or $0.117 million each

repository fee = $0.117 million/canister × 400 canisters

repository fee = $46.8 million

3/18/96 revision per $360,000 canister repository fee (1995 $)

repository fee = $0.36 million/canister × 400 canisters = $144 million

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE 2/6/96 SUBJECT Rev B ~~Rev A~~ SHEET NO. 2-2

BY D Stern CHKD. JOB NO.

operating cost, which includes cost of canisters, HMPCs and casks will be same as previous because same numbers are used and costs should be similar.

VITRIFY WITH TANK WASTE ALTERNATIVE

Cost Estimate

250 canisters @ 1.6 m^3/canister for a total Δ volume of 400 m^3 was previously estimated for Cs/Sr Capsules from Ext Sep table 9-14

We now have 0.62 m^3/canister or

$$\frac{1.6\ m^3}{0.62\ m^3} \times 250 = 645 \text{ canisters}$$

~~repository fee = \$0.117 million/canister × 645 canisters~~

~~repository fee = \$75.4 million~~

3/18/96 revision per canister \$360,000 repository fee (1995 \$)

repository fee = \$0.36 million/can × 645 can = \$232 million

		Δ #	Δ cost
Δ op. cost	\$10,000/canister	(645 − 250)	3.9 million
	\$25,000/HMPC	(161 − 63)	2.5 million
	\$60,000/cask	(161 − 63)	5.8 million
			\$12.2 million

base cost = \$34 million

Δ cost = \$12 million

new op. cost = \$46 million

FORM 91-005-1 (4/81)

TWRS ALTERNATIVE COST SUMMARY

Cost Component			Capsules No Action	Capsules Onsite Disposal	Capsules Overpack and Ship	Vitrify with Tank Waste
Current Operations			$112	$377	$377	$315
Transfer System Upgrades(in current ops)						
Research and Development						
	Wast Retrieval and Transfer					
	Treatment				$14	$5
	Total R&D		$0	$0	$14	$5
Capital						
	Waste Retrieval and Transfer					
	Treatment			$83	$32	$36
	Closure			$5		
	Total Capital Costs		$0	$88	$32	$36
Operating						
	Waste Retrieval and Transfer					
	Treatment			$226	$34	$46 ~~$34~~
	Total Operating Costs		$0	$226	$34	$46 ~~$34~~
Monitoring and Maintenance						$1
D&D				$6	$6	$6
Repository Fee				$0	144 ~~$47~~ ~~$15~~	237 ~~$75~~ ~~$9~~
Total Cost (1995)			$112	$697	607 ~~$540~~ ~~$170~~	641 ~~$484~~ ~~$106~~
Total Cost summary in billions of dollars			$0.11	$0.70	~~$0.51~~ ~~$0.48~~	~~$0.48~~ ~~$0.11~~

The Overpack and Ship disposal fee is based on sending other wastes to the repository under the Intermediate Separations alternative. If no wastes other than capsules are sent to the repository the disposal fee would be approx. $3,385 million 1995 dollars.

~~Rev A~~

Rev B

3/18/96

Stein, David

From: Stein, David
To: Henderson, Colin
Subject: Capsule Alternatives Cost Revision(Repository Fee Change)
Date: Monday, March 18, 1996 1:54PM

Incorporating the revised Repository Fee method ($360,000 per canister) results in the following for the Capsule Alternatives:

	CAPSULE ALTERNATIVES	
	OVERPACK AND SHIP (millions)	VITRIFY WITH TANK WASTE (millions)
Current Operations	$377	$315
R&D	$14	$5
Capital	$32	$36
Operating	$34	$46
M&M	—	$1
D&D	$6	$6
Repository Fee	$144	$232
Total	$607	$641

RECEIVED
MAR 19 1996

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE Engineering - Group One Radioisotope Concentrations in Columbia River

ORIGINATOR D. Murray DATE 3/24/96

REVISION NO. _____

OBJECTIVE Determine concentrations of C-14, I-129, Tc-99 & U-238 in Columbia River for Long Term Management alternative

METHODOLOGY Ratio concentrations in river to be proportional to inventories in tanks

ASSUMPTIONS 1. Dissolution follows congruent dissolution model. 2. Nitrate conc = 0.08 g/L 3. All group one (K_d=0) contaminants will reach the river when nitrate reaches the river 4. Background concentrations aren't considered

(Continue on another sheet if necessary)

David D. Murray 3/24/96
SIGNATURE/DATE

[illegible] 3/28/96
CHECKED/DATE

CALCULATION & RESULTS
ATTACHED

JACOBS\FORMS\CALCVR.SHT

JACOBS ENGINEERING GROUP INC.

DATE 3/24/96 SUBJECT Groupe One Radioisotope Concentrations in Columbia River SHEET NO. 1/1

BY MJM CHKD. JOB NO. 01K47101

Concentrations of Group One Radioisotopes in the Columbia River at Median River Flow.

(1) Amounts in mt:

$NO_3^- = 1.07E+05$ mt - Appendix A

C-14 = 0.004
I-129 = 0.24
Tc-99 = 1.64
U-238 = 1423

} See calculations for selective retrieval

(2) So for NO_3^- $1.07 \times 10^5 \cdot f = 0.08$ g/L *
where f is a conversion factor from mt to g/L.

$$f = \frac{8 \times 10^{-2}}{1.07 \times 10^5} = 7.5 \times 10^{-7}$$

(3) Corresponding concentrations of radioisotopes

C-14 = 3×10^{-9} g/L

I-129 = 2×10^{-7} g/L

Tc-99 = 1×10^{-6} g/L

U-238 = 1×10^{-3} g/L

* 0.08 g/L is the ultimate nitrate concentration in the river at median flow rate

FORM 91-005-1 (4/81)

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE ENGR/COST - TANK WASTE ALTERNATIVES - COST UNCERTAINTY

ORIGINATOR D. Stein DATE 2/8/96

REVISION NO. Ø 1 C.H. 3/25/96

OBJECTIVE DETERMINE RANGE ESTIMATE FOR ALTERNATIVES

METHODOLOGY USE DECISION SCIENCE CORP (DSC) RANGE ESTIMATING PROGRAM for PERSONAL COMPUTERS (REP/PC)

ASSUMPTIONS RANGES FOR CRITICAL COST ITEMS ASSUMED, PROBABILTY OF COST EQUAL TO OR LESS ASSUMED PER ATTACHED BASES.

OUTPUT FILES INCLUDED

(Continue on another sheet if necessary)

SEE Attached Revision Description

SIGNATURE D J Stein

CHECKED: C.H. 2/21/96.

CALCULATION & RESULTS ATTACHED

JACOBS\FORMS\CALCVR.SET

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

CALCULATION: COST UNCERTAINTY

Rev 1 changes:

- Revised Cost Uncertainty to reflect the latest operations cost. (Revised due to canister/waste loading)
- Revised Ex Situ Cases to for repository fee @ $360,000/canister (1995 dollars) also included cost uncertainty calculations for ex situ alternatives
- Included Additional characterization cost in the In Situ filled Cap, In Situ Vitrification, and Ex Situ/In Situ Combination alternative. (903 million in the In Situ F&Cap and ISV Alt., 542 million in the Combo Alt.)

FORM 91-005-1 (4/81)

RECEIVED
MAR 21 1996

Stein, David

From: Stein, David
To: Henderson, Colin
Subject: Hanford TWEIS Alternatives Cost Update
Date: Wednesday, March 20, 1996 1:35PM

Following are Hanford TWEIS Alternatives cost updates with corrections for Treatment Operating Costs. These corrections were noted in the engineering calculations dated 2/20/96, but were never transferred to the final cost tables until now. The operating costs corrections are also presented here for your comparison.

TABLE 1

	PREVIOUS OPERATING COSTS (MILLIONS)	CORRECTED OPERATING COSTS(MILLIONS)
Intermediate Separations	$5,577	$5,509
No Separations(Vitrification)	$23,273	$22,742
No Separations(Calcination)	$8,182	$7,548
ExSitu/InSitu Combination	$2,672	$2,638

TABLE 2

ALTERNATIVE	TOTAL COST(WITH REPOSITORY FEE@$360,000 PER CANISTER) TARGET VALUE (MILLIONS)	95% CONFIDENCE RANGE (MILLIONS)
Intermediate Separations	$37,818	$30,399 ---- $40,552
No Separations(Vitrification)	$252,669	$69,475 ---- $252,669
No Separations(Calcination)	$85,815	$38,789 ---- $86,141
ExSitu/InSitu Combination	$25,526	$22,990 ---- $27,913

TABLE 3

ALTERNATIVE	COST EXCLUDING REPOSITORY FEE TARGET VALUE (MILLIONS)	95% CONFIDENCE RANGE (MILLIONS)
Intermediate Separations	$25,798	$23,775 ---- $29,741
No Separations(Vitrification)	$41,209	$25,560 ---- $43,559
No Separations(Calcination)	$26,015	$22,157 ---- $28,708
ExSitu/InSitu Combination	$19,516	$17,956 ---- $22,407

These changes should bring the alternatives up to date. Let me know if I can do anything else.

Stein, David

From: Stein, David
To: Henderson, Colin
Subject: TWEIS Cost Uncertainty Update
Date: Monday, March 18, 1996 10:04AM

Following are Hanford TWEIS Alternatives Cost Uncertainty updates which include an increase for tank characterization costs ($903 million for InSitu Fill & Cap and InSitu Vitrification and 60% of $903 or $542 million for InSitu/ExSitu Combo):

ALTERNATIVE	TARGET VALUE (millions)	95% CONFIDENCE RANGE (millions)
InSitu Fill & Cap	$7,884	$6,972 — $8,815
InSitu Vitrification	$16,578	$16,185 — $23,840
InSitu/ExSitu Combo with Repository Fee @ $360,000 per canister($6,010 million)	$25,560	$22,996 — $27,947
InSitu/ExSitu Combo without Repository Fee	$19,550	$17,968 — $22,441
InSitu/ExSitu Combo with Repository Fee @ $5,000 million(Feb 96)	$24,550	$22,466 — $27,151

After reviewing the cost components of the Repository Fee in the TRW Report, I can confirm that there was no double counting when compared to the Westinghouse Data Packages. The Repository Fee included a cost for an outer barrier for the HLW package in which it is placed before insertion into the vault. This outer barrier is either in addition to the MPC or replaces the MPC, I cannot determine which.

RECEIVED
MAR 19 1996

RECEIVED
MAR 14 1996

Stein, David

From: Stein, David
To: Henderson, Colin
Subject: Hanford TWEIS Alternatives Cost Uncertainty
Date: Wednesday, March 13, 1996 12:51PM

Following are Hanford TWEIS Alternatives Cost Uncertainty Tables with and without Repository Fee (fee has been calculated using $360,000 per canister per latest directive):

TABLE 1

ALTERNATIVE	TOTAL ALTERNATIVE COST(WITH REPOSITORY FEE) TARGET VALUE (millions)	95% CONFIDENCE RANGE (millions)
Intermediate Separations	$37,886	$30,465 — $40,598
No Separations (Vitrification)	$253,200	$69,971 — $253,200
No Separations (Calcination)	$86,449	$39,406 — $86,548
Extensive Separations	$28,544	$27,477 — $36,471
ExSitu/InSitu Combination	$25,018	$22,691 — $27,197
Phased Implementation	$38,728	$31,843 — $41,756
Junior Combo	$19,461	$18,512 — $22,053

Note: For most alternatives, repository fee is so high that it dominates the cost uncertainty. I would recommend that the repository fee be considered as a separate item with no range included and just a note as to how it was calculated; e.g. $360,000 charge per canister.

TABLE 2

ALTERNATIVE	ALTERNATIVE REMEDIATION COST(EXCLUDES REP FEE) TARGET VALUE (millions)	95% CONFIDENCE RANGE (million)
Intermediate Separations	$25,866	$23,818 — $29,808
No Separations (Vitrification)	$41,740	$25,628 — $44,074
No Separations (Calcination)	$26,649	$22,276 — $29,269
Extensive Separations	$27,979	$26,580 — $35,476
ExSitu/InSitu Combination	$19,008	$17,742 — $21,774
Phased Implementation	$26,708	$25,000 — $31,109
Junior Combo	$16,331	$15,089 — $18,633

I will send copies of the model output by Fed Ex this afternoon. Give me a call if you have any questions.

Henderson, Colin

From: Stein, David
To: Henderson, Colin
Subject: Hanford TWEIS Alternatives Cost Update
Date: Wednesday, March 20, 1996 1:35PM

Following are Hanford TWEIS Alternatives cost updates with corrections for Treatment Operating Costs. These corrections were noted in the engineering calculations dated 2/20/96, but were never transferred to the final cost tables until now. The operating costs corrections are also presented here for your comparison.

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These changes should bring the alternatives up to date. Let me know if I can do anything else.

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To: Henderson, Colin
Subject: TWEIS Cost Uncertainty Update
Date: Monday, March 18, 1996 10:04AM

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Henderson, Colin

From: Stein, David
To: Henderson, Colin
Subject: Capsule Alternatives Cost Revision(Repository Fee Change)
Date: Monday, March 18, 1996 1:54PM

Incorporating the revised Repository Fee method ($360,000 per canister) results in the following for the Capsule Alternatives:

	CAPSULE ALTERNATIVES	
	OVERPACK AND SHIP (millions)	VITRIFY WITH TANK WASTE (millions)
Current Operations	$377	$315
R&D	$14	$5
Capital	$32	$36
Operating	$34	$46
M&M	-----	$1
D&D	$6	$6
Repository Fee	$144	$232
Total	$607	$641

JACOBS ENGINEERING GROUP INC.

DATE 2/8/96 SUBJECT SHEET NO. 1-2

BY D. Stern CHKD. JOB NO.

Cost Uncertainty

Cost uncertainty for the various tank waste treatment alternatives has been evaluated using Decision Science Corporation (DSC) Range Estimating Program for personal computers (REP/PC). Typically, Range Estimating applies to one time decisions such as capital investments, engineering cost estimates, and competitive bids. The Range Estimating Program has enjoyed a long and successful record of use since its introduction by DSC in the early 1970s. It has been applied to thousands of diverse problems

JACOBS ENGINEERING GROUP INC.

DATE 2/8/96 SUBJECT SHEET NO. 2-2

BY D Stein CHKD. JOB NO.

by thousands of users. A small sampling of industries using REP/PC includes government, defense, engineering construction, and research.

Range Estimating is user friendly and its input heuristics allow the user to specify a simple range rather than require selection of a probability density function. Range Estimating's output heuristics clearly identify, quantify, and rank the risks and opportunities in the decision making problem.

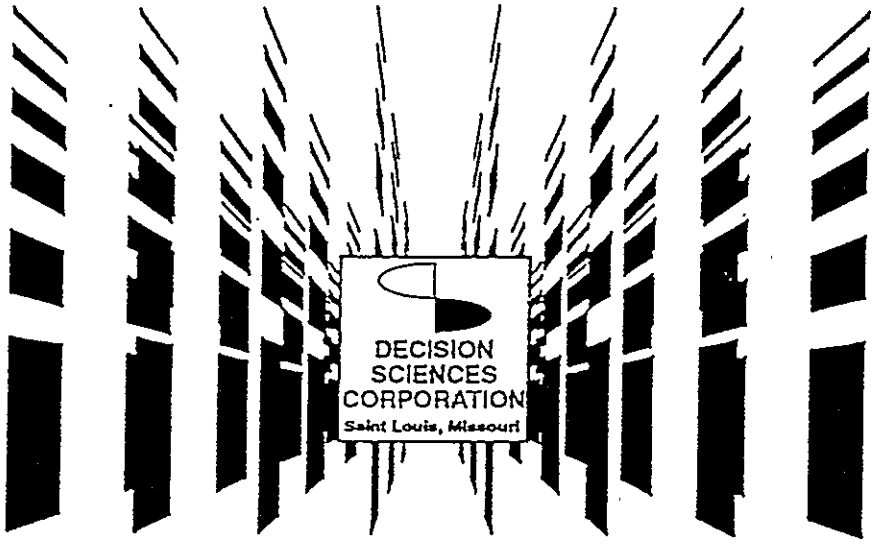
FORM 91-005-1 (4/81)

REP/PC™

Range Estimating Program for personal computers

User's Guide

Version 4.0
(July 1993)



Providing crystal-clear perspectives
for sound management decisions

Technical Support

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First Edition
July 1993

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JACOBS ENGINEERING GROUP INC.

DATE 2/5/96 SUBJECT HANFORD TWRS PROPOSED DEIS SHEET NO. 1-4

BY D. Stein CHKD. JOB NO.

BASIS FOR PROB/RANGE ELEMENTS

NUM	ELEMENT
1	CURRENT OPERATIONS (ALL ALTERNATIVES)
	PROB 50%
	RANGE −20%, +20%
COMMENT:	CONTINUATION OF CURRENT OPERATIONS BASED ON HISTORICAL COSTS. BASIC AMBIVALENCE SHOWN IN PROBABILITY AND RANGE.
2	R+D (WASTE RET. + TRANSFER)
3	R+D (TREATMENT)
6	CAPITAL (CLOSURE)
9	M+M
COMMENT:	NON-CRITICAL FOR ALL ALTERNATIVES

NOTE: THE BASES ESTIMATED HEREIN WERE DISCUSSED AND AGREED UPON IN 2/4/96 MEETING OF → Stein, C Henderson, D Murray (all from JEG). Reviewed and confirmed by L. Selby (JEG cost engr/estimator) on 2/8/96.

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE 2/5/94 SUBJECT SHEET NO. 2-4

BY D. Chen CHKD. JOB NO.

NUM	ELEMENT
4	CAPITAL (WASTE RET. + TRANSFER) (ALL ALTERNATIVES)
	PROB 50%
	RANGE −20%, +70%
7	OPERATING (WASTE RET. + TRANSFER) (ALL ALTERNATIVES)
	PROB 50%
	RANGE −20%, +70%

COMMENT: BASIC AMBIVALENCE RE PROBABILITIES. PESSIMISTIC VIEW OF HIGH RANGE DUE TO DIFFICULTY WITH METHODS TO RETRIEVE AND TRANSFER FOR CERTAIN TANKS AND HIGHER CAPITAL REQUIREMENTS AND LONGER OPERATIONAL PERIOD.

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

SHEET NO. 3-4

JOB NO.

SUBJECT

DATE 2/5/96

BY D Stein CHKD.

NUM	ELEMENT	ALTERNATIVE: LONG TERM MANAGE	NO SEP VITR.	NO SEP CALC.	INTER SEP + IN SITU / EX SITU COMBO	PHASED IMPL.	EXT. SEP.	In Situ Vitr.
5	CAPITAL (TREATMENT)							
	PROB	50%	50%	50%	40%	40%	30%	15%
	RANGE	-20%, +20%	-20%, +50%	-20%, +50%	-20%, +100%	-20%, +100%	-20%, +150%	-10%, +300%

Comments: STARTING WITH AMBIVALENCE, PROB. DECREASES WITH COMPLEXITY OF PROCESSES + UNKNOWNS. RANGE ON LOW SIDE STANDARD AT 20% DUE TO 40% CONTINGENCY ALREADY INCLUDED IN CAPITAL. ONLY -10% FOR IN SITU VITR. DUE TO PESSIMISM ON PROCESS. RANGE ON HIGH SIDE INCREASES DUE TO COMPLEXITY OF PROCESSES AND UNKNOWNS.

NUM	ELEMENT	LONG TERM MANAGE	NO SEP VITR.	NO SEP CALC.	INTER SEP + IN SITU / EX SITU COMBO	PHASED IMPL.	EXT. SEP.	In Situ Vitr.
8	OPERATING (TREATMENT)							
	PROB	NON-CRITICAL	75%	75%	65%	65%	55%	15%
	RANGE		-80%, +0%	-60%, +0%	-25%, +0%	-25%, +0%	-15%, +0%	-10%, +200%

Comments: PROB. DECREASES WITH LOWER QUANTITIES OF HLW GLASS GENERATED BY ALTERNATIVE DUE TO LARGE COST EFFECT OF # OF CANISTERS WHICH IS NEAR MAXIMUM FOR BASIS USED HEREIN. IN SITU COSTS VIEWED PESSIMISTICALLY. UPPER RANGE OF +0% DUE TO HIGHEST COSTS USED IN BASIS HEREIN (LOWEST WASTE OXIDE LOADING, SMALLEST CANISTER, HIGH STAFFING). LOWER RANGE BASED ON OP. COSTS FOR NOV 1995 SCENARIO (MORE LIKELY). IN SITU VITR. VIEWED PESSIMISTICALLY DUE TO LONGER OPERATION AND ADDITIONAL GLASS RAW MATERIALS.

SHEET NO. 4-4

JOB NO.

NUM	ELEMENT	ALTERNATIVE: NO. SEP VITR	NO. SEP CALC.	INTER. SEP.	IN SITU/ EX SITU	PHASED IMPL.	EXT SEP.
10	REPOSITORY FEE						
	PROB.	100%	100%	100%	100%	100%	0%
	RANGE	-80%, +0%	-60%, +0%	-40%, +0%	-38%, +0%	-40%, +0%	-0%, +0%

Comments: WITH THE LOW WASTE OXIDE LOADING USED AS A BASIS HERE, AND THE SMALLEST CANISTER SIZE USED AS A BASIS HERE, IT IS BELIEVED THAT THE REPOSITORY FEES ARE AT THE MAXIMUM PROBABLE. THE EXCEPTION IS EXT. SEP. WHERE REPOSITORY COSTS ARE ESSENTIALLY CONSTANT DUE TO SMALL VOLUME OF HLW WASTE FOR ANY SCENARIO. THE LOW RANGE HAS BEEN SET AT REPOSITORY FEE FOR NOV 1995 REPORT USING LARGER CANISTERS AND HIGHER WASTE OXIDE LOADING.

JE JACOBS ENGINEERING GROUP INC.

DATE 2/5/96 SUBJECT

BY DSkin CHKD.

EXPENSE ELEMENTS		
Pessimism	Absolute	0%
	Extreme	5%, 10%, 15%
	Moderate	20%, 25%, 30%
	Slight	35%, 40%, 45%
Ambivalence		50%
Optimism	Slight	55%, 60%, 65%
	Moderate	70%, 75%, 80%
	Extreme	85%, 90%, 95%
	Absolute	100%

PROFIT ELEMENTS		
Pessimism	Absolute	100%
	Extreme	85%, 90%, 95%
	Moderate	70%, 75%, 80%
	Slight	55%, 60%, 65%
Ambivalence		50%
Optimism	Slight	35%, 40%, 45%
	Moderate	20%, 25%, 30%
	Extreme	5%, 10%, 15%
	Absolute	0%

The Range

A range of possible values is specified for each critical element in the plan. The range is determined by specifying the lowest and highest values the critical element can assume. These lowest and highest values are set so far apart that there is greater than a 98% probability that the actual value of the critical element will materialize within the resulting range. Specifically, the "lowest" value is set so low that there is less than 1 chance in 100 that the actual value will be any lower; similarly, the "highest" value is set so high that there is less than a 1% probability that the actual value will be any higher. Thinking of it another way, the odds are about 99 to 1 against the actual value being lower than the lowest value. Also, the odds are about 99 to 1 against the actual value being higher than the highest value. Qualitatively speaking, the lowest and highest values are set far enough out such that they capture the "rather improbable" but not the "slightly absurd." Quite obviously, if there is substan-

tial uncertainty about the actual value of the critical element, its range will be quite broad. Conversely, a lesser degree of uncertainty will be reflected as a narrower range for the critical element.

NOTE: The lowest and highest values are completely independent of the probability factor. It is quite possible that a given critical element could have a fairly small difference between its target and lowest value and yet have a high probability of its actual value materializing in that narrow part of the range. Examples of this often occur in expense elements where it is not unusual to have a very small chance of the actual exceeding the target but, if it does, the amount by which it can exceed it is very large. Such a range is said to be "highly skewed."

Some people have difficulty with the idea of supplying a range; some even claim that the range is nothing more than a lot of guesswork. But that's precisely why the range is valuable in decision-making; it involves a lot of educated guessing by qualified people. On the other hand, the single-point value involves only a little guessing -- so little, in fact, that it can lead to serious errors in decision-making. There is nothing wrong with guessing. Nobel prizes have been awarded for shrewd guessing! Put another way: with the range, the decision-maker will be approximately correct; with the traditional single-point value, exactly wrong!

February 8, 1996

To: Mark Nelson/David Stein

From: Larry Selby

Subject: Review of REP-PC Risk Analyses

I have reviewed the input of the ten remediation scenarios and generally find them within reasonable ranges. I changed the input of one of the more complicated senarios, generally widening the spread between low and high, (usually by increasing the high end). The results were reasonably close (within about 5 %) which pretty much verifies the suitability of the variables as entered in the program. Certainly the target estimate numbers are not within an accuracy of 5% of total cost at the Order of Magnitude level of the estimates. At this point, very little is to be gained by changing the model and re-running the program.

I would recommend that at some appropriate future time a group of 4 to 6 individuals, most familiar with each of the processes meet, and re-evaluate the entries used in developing the model and then re-run the program. One of these individuals should be one of the estimating team who is familiar the the details of how the estimate (target amount) was developed. Additionally, the smaller items should be dropped, as they tend to distort the results, although they would not affect the actual total cost. I would also warn to resist the temptation to group the small items and treat them as a single item to make the arithmetic appear correct. This also distorts the results. Having used this program a number of times over the past few years I have found that we are frequently too optimistic in entering the highest cost. This number should be the cost that the group is 99% certain cannot or will not be exceeded by even the worst of circumstances. I would also recommend that at the Order of Magnitude estimate level, the contingency applied by the estimator should be considered as a real cost and not considered in arriving at the highest possible cost. More often than not that contingency is required in progressing to estimates prepared from detailed design documents.

REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 02-06-96

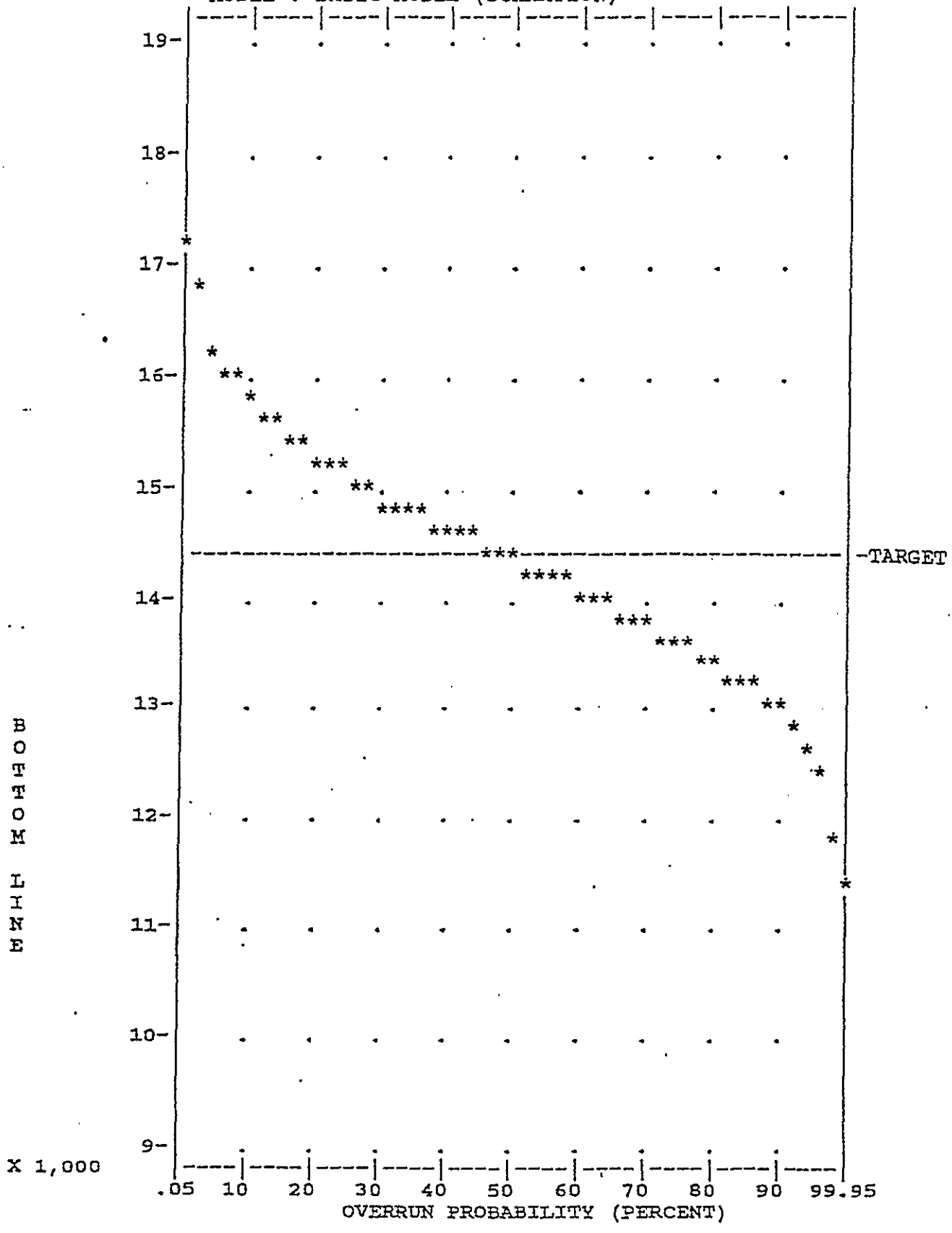
DATA : ~~ExSitu Exten.~~ No Action Case 01
MODEL : BASIC MODEL (SUMMATION)

NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		14300	50	11440	17160
2	R&D Waste Ret. & Transfer		0		0	0
3	R&D Treatment		0		0	0
4	Capital Waste Ret. & Transfer		0		0	0
5	Capital Treament		0		0	0
6	Capital Closure		0		0	0
7	Operations Waste Ret. & Transfer		0		0	0
8	Operations Treatment		0		0	0
9	M & M		0		0	0
10	Repository Fee		0		0	0
	TOTAL EXPENSE (INPUT TO REP/PC)		14300		11440 (THEORETICALS)	17160

+ PROBABILITY THAT ACTUAL VALUE WILL BE EQUAL TO OR LESS THAN TARGET

output file for
Range Estimate
Tank Waste Alternatives

REP/PC (Ver 4.0) - MGMT REPORT 2 GRAPHICAL OVERRUN PROFILE : 02-06-96
DATA : ExSitu Exten. Case 01
MODEL : BASIC MODEL (SUMMATION)



REP/PC (Ver-4.0) - MGMT REPORT 3 GRAPHICAL PRIORITY PROFILE : 02-06-96

DATA : ExSitu Exten. Case 01
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
14300	51 PCT	0 = .0 PCT

NUM	ELEMENT	UNIT	CORRECT	PROTECT
1	Current Operations NET EFFECT OF FROZEN ELEMENTS		----------|	++++++++++++

REP/PC (Ver-4.0) - MGMT REPORT 4 CONTINGENCY PROFILE : 02-06-96

DATA : ExSitu Exten. Case 01
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	2860	20.0	PCT
99.95	"	2849	19.9	"
95	"	1783	12.5	"
90	"	1430	10.0	"
85	"	1176	8.2	"
80	"	954	6.7	"
75	"	797	5.6	"
70	"	578	4.0	"
65	"	450	3.2	"
60	"	311	2.2	"
55	"	177	1.2	"
50	"	15	.1	"
45	"	-123	-.9	"
40	"	-263	-1.8	"
35	"	-382	-2.7	"
30	"	-576	-4.0	"
25	"	-716	-5.0	"
20	"	-896	-6.3	"
15	"	-1167	-8.2	"
10	"	-1377	-9.6	"
5	"	-1745	-12.2	"
0.05	"	-2839	-19.8	"
0	"	-2860	-20.0	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 02-06-96

DATA : ExSitu Exten. Long-Term Mgmt. Case 02
MODEL : BASIC MODEL (SUMMATION)

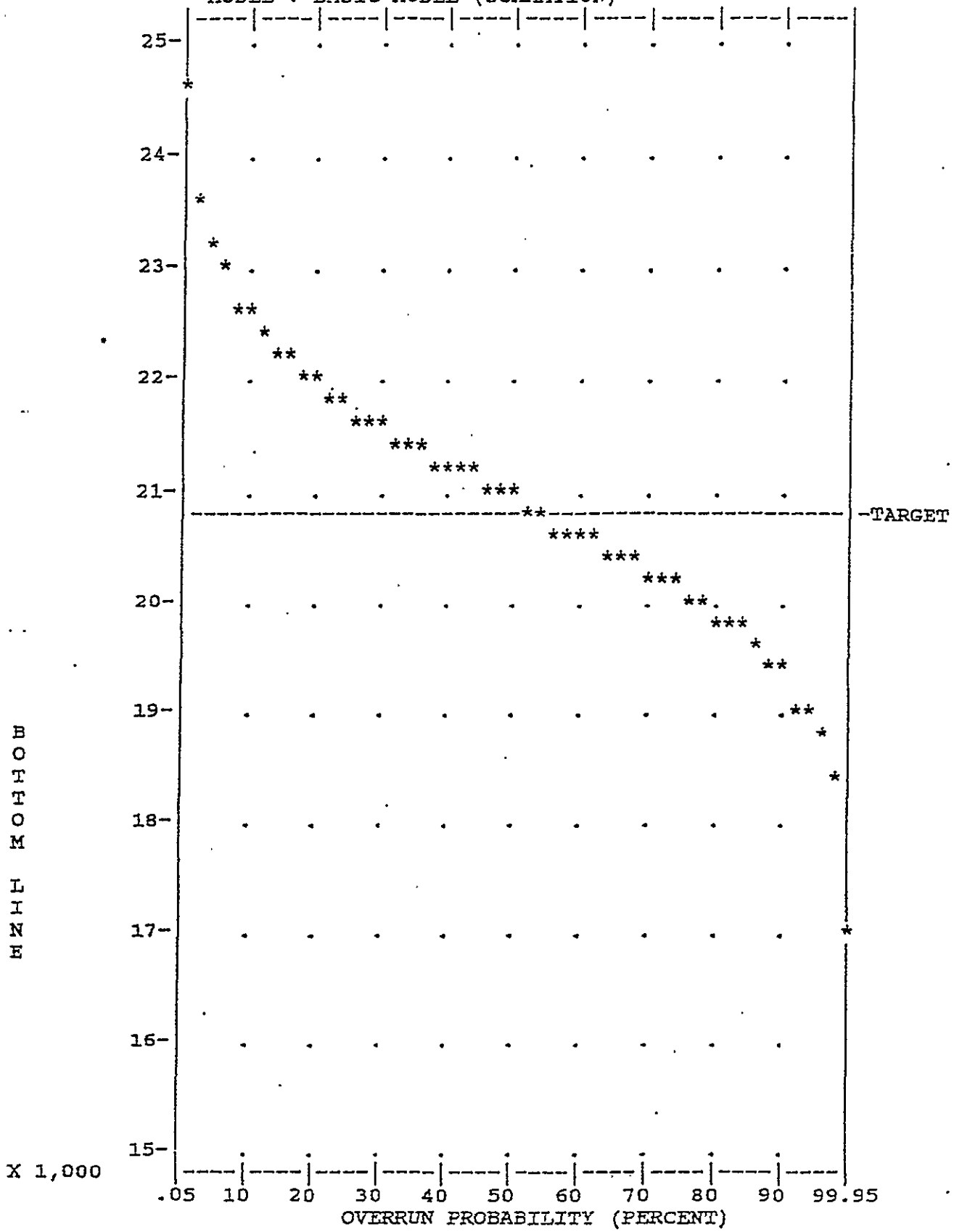
NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		14300	50	11440	17160
2	R&D Waste Ret. & Transfer		100.00		100.00	100.00
3	R&D Treatment		0		0	0
4	Capital Waste Ret. & Transfer		1930	50	1544	3281
5	Capital Treament		4000	50	3200	4800
6	Capital Closure		0		0	0
7	Operations Waste Ret. & Transfer		440		440	440
8	Operations Treatment		0		0	0
9	M & M		0		0	0
10	Repository Fee		0		0	0
	TOTAL EXPENSE (INPUT TO REP/PC)		20770		16724 (THEORETICALS)	25781

+ PROBABILITY THAT ACTUAL VALUE WILL BE EQUAL TO OR LESS THAN TARGET

REP/PC (Ver 4.0) - MGMT REPORT 2 GRAPHICAL OVERRUN PROFILE : 02-06-96

DATA : ExSitu Exten.. Case 02

MODEL : BASIC MODEL (SUMMATION)



REP/PC (Ver 4.0) - MGMT REPORT 3 GRAPHICAL PRIORITY PROFILE : 02-06-96

DATA : ExSitu Exten. Case 02
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
20770	54 PCT	0 = .0 PCT

NUM	ELEMENT	UNIT	CORRECT	PROTECT
1	Current Operations		----------	++++++++++++
4	Capital Waste Ret. & Transfer		-------	++
5	Capital Treament		----	++++
	NET EFFECT OF FROZEN ELEMENTS			

REP/PC (Ver 4.0) - MGMT REPORT 4 CONTINGENCY PROFILE : 02-06-96

DATA : ExSitu Exten. Case 02
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	5011	24.1	PCT
99.95	"	3750	18.1	"
95	"	2327	11.2	"
90	"	1771	8.5	"
85	"	1413	6.8	"
80	"	1159	5.6	"
75	"	958	4.6	"
70	"	741	3.6	"
65	"	597	2.9	"
60	"	442	2.1	"
55	"	301	1.5	"
50	"	141	.7	"
45	"	-30	-.1	"
40	"	-201	-1.0	"
35	"	-360	-1.7	"
30	"	-512	-2.5	"
25	"	-697	-3.4	"
20	"	-886	-4.3	"
15	"	-1109	-5.3	"
10	"	-1464	-7.0	"
5	"	-1894	-9.1	"
0.05	"	-3857	-18.6	"
0	"	-4046	-19.5	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 03-18-96

DATA : InSitu Fill & Cap Case 03
MODEL : BASIC MODEL (SUMMATION)

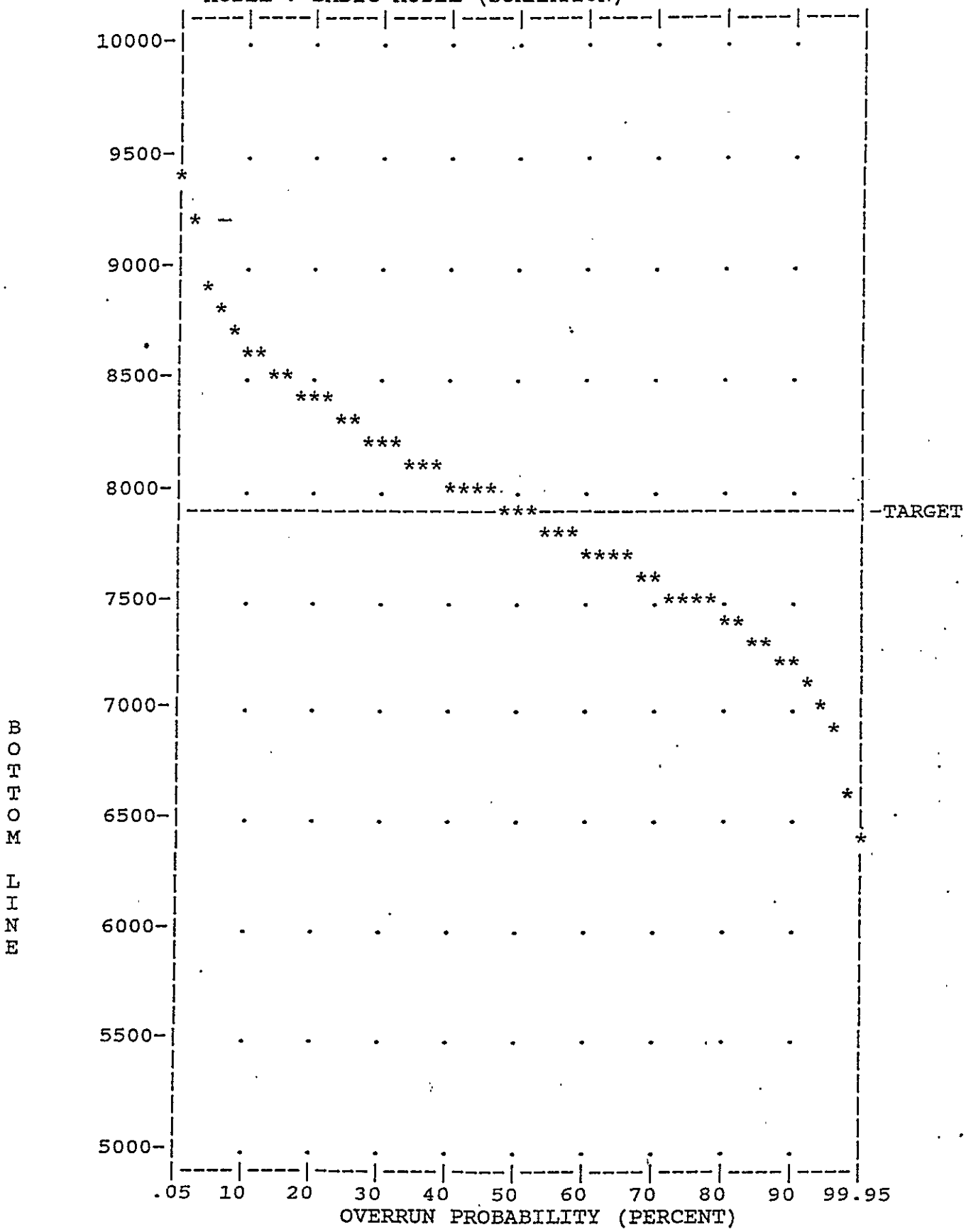
NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		7469	50	5975	8963
2	R&D Waste Ret. & Transfer		0		0	0
3	R&D Treatment		0		0	0
4	Capital Waste Ret. & Transfer		0		0	0
5	Capital Treament		25.00		25.00	25.00
6	Capital Closure		116.00		116.00	116.00
7	Operations Waste Ret. & Transfer		0		0	0
8	Operations Treatment		274		274	274
9	M & M		0		0	0
10	Repository Fee		0		0	0
	TOTAL EXPENSE (INPUT TO REP/PC)		7884		6390	9378
					(THEORETICALS)	

+ PROBABILITY THAT ACTUAL VALUE WILL BE EQUAL TO OR LESS THAN TARGET

REP/PC (Ver 4.0) - MGMT REPORT 2 GRAPHICAL OVERRUN PROFILE : 03-18-96

DATA : InSitu Fill & Cap Case 03

MODEL : BASIC MODEL (SUMMATION)



REP/PC (Ver 4.0) - MGMT REPORT 3 GRAPHICAL PRIORITY PROFILE : 03-18-96

DATA : InSitu Fill & Cap Case 03
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
7884	51 PCT	0 = .0 PCT

NUM	ELEMENT	UNIT	CORRECT	PROTECT
1	Current Operations NET EFFECT OF FROZEN ELEMENTS		----------|	++++++++++++

REP/PC (Ver 4.0) - MGMT REPORT 4 CONTINGENCY PROFILE : 03-18-96

DATA : InSitu Fill & Cap Case 03
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	1494	19.0	PCT
99.95	"	1488	18.9	"
95	"	931	11.8	"
90	"	747	9.5	"
85	"	614	7.8	"
80	"	498	6.3	"
75	"	416	5.3	"
70	"	302	3.8	"
65	"	235	3.0	"
60	"	163	2.1	"
55	"	92	1.2	"
50	"	8	.1	"
45	"	-64	-.8	"
40	"	-138	-1.7	"
35	"	-200	-2.5	"
30	"	-301	-3.8	"
25	"	-374	-4.7	"
20	"	-468	-5.9	"
15	"	-610	-7.7	"
10	"	-719	-9.1	"
5	"	-912	-11.6	"
0.05	"	-1483	-18.8	"
0	"	-1494	-18.9	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 03-18-96

DATA : InSitu Vitrification Case 04
MODEL : BASIC MODEL (SUMMATION)

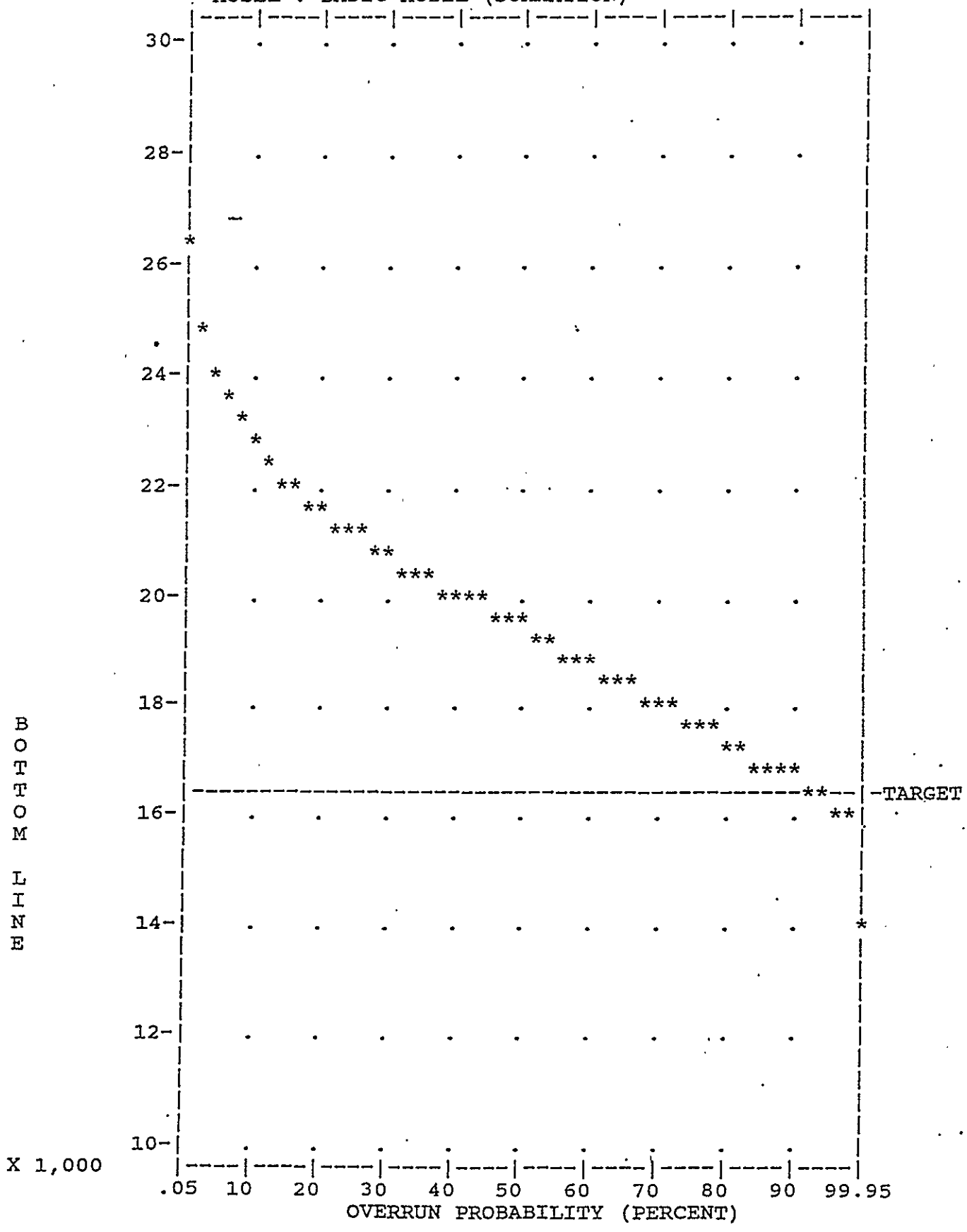
NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		8752	50	7002	10502
2	R&D Waste Ret. & Transfer		0		0	0
3	R&D Treatment		70.00		70.00	70.00
4	Capital Waste Ret. & Transfer		0		0	0
5	Capital Treament		4900	15	4410	9600
6	Capital Closure		116.00		116.00	116.00
7	Operations Waste Ret. & Transfer		0		0	0
8	Operations Treatment		2740	15	2466	8220
9	M & M		0		0	0
10	Repository Fee		0		0	0
	TOTAL EXPENSE (INPUT TO REP/PC)		16578		14064 (THEORETICALS)	28508

+ PROBABILITY THAT ACTUAL VALUE WILL BE EQUAL TO OR LESS THAN TARGET

REP/PC (Ver 4.0) - MGMT REPORT 2 GRAPHICAL OVERRUN PROFILE : 03-18-96

DATA : InSitu Vitrification Case 04

MODEL : BASIC MODEL (SUMMATION)



REP/PC (Ver 4.0) - MGMT REPORT 3 GRAPHICAL PRIORITY PROFILE : 03-18-96

DATA : InSitu Vitrification Case 04
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
16578	90 PCT	0 = .0 PCT

NUM	ELEMENT	UNIT	CORRECT	PROTECT
8	Operations Treatment		----------|	
5	Capital Treament		----------|	
1	Current Operations		--|++	
	NET EFFECT OF FROZEN ELEMENTS		|	

REP/PC (Ver 4.0) - MGMT REPORT 4 CONTINGENCY PROFILE : 03-18-96

DATA : InSitu Vitrification Case 04
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	11930	72.0	PCT
99.95	"	9748	58.8	"
95	"	7262	43.8	"
90	"	6052	36.5	"
85	"	5434	32.8	"
80	"	4922	29.7	"
75	"	4538	27.4	"
70	"	4138	25.0	"
65	"	3768	22.7	"
60	"	3494	21.1	"
55	"	3220	19.4	"
50	"	2848	17.2	"
45	"	2500	15.1	"
40	"	2153	13.0	"
35	"	1766	10.7	"
30	"	1359	8.2	"
25	"	1104	6.7	"
20	"	718	4.3	"
15	"	321	1.9	"
10	"	29	.2	"
5	"	-393	-2.4	"
0.05	"	-2400	-14.5	"
0	"	-2514	-15.2	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

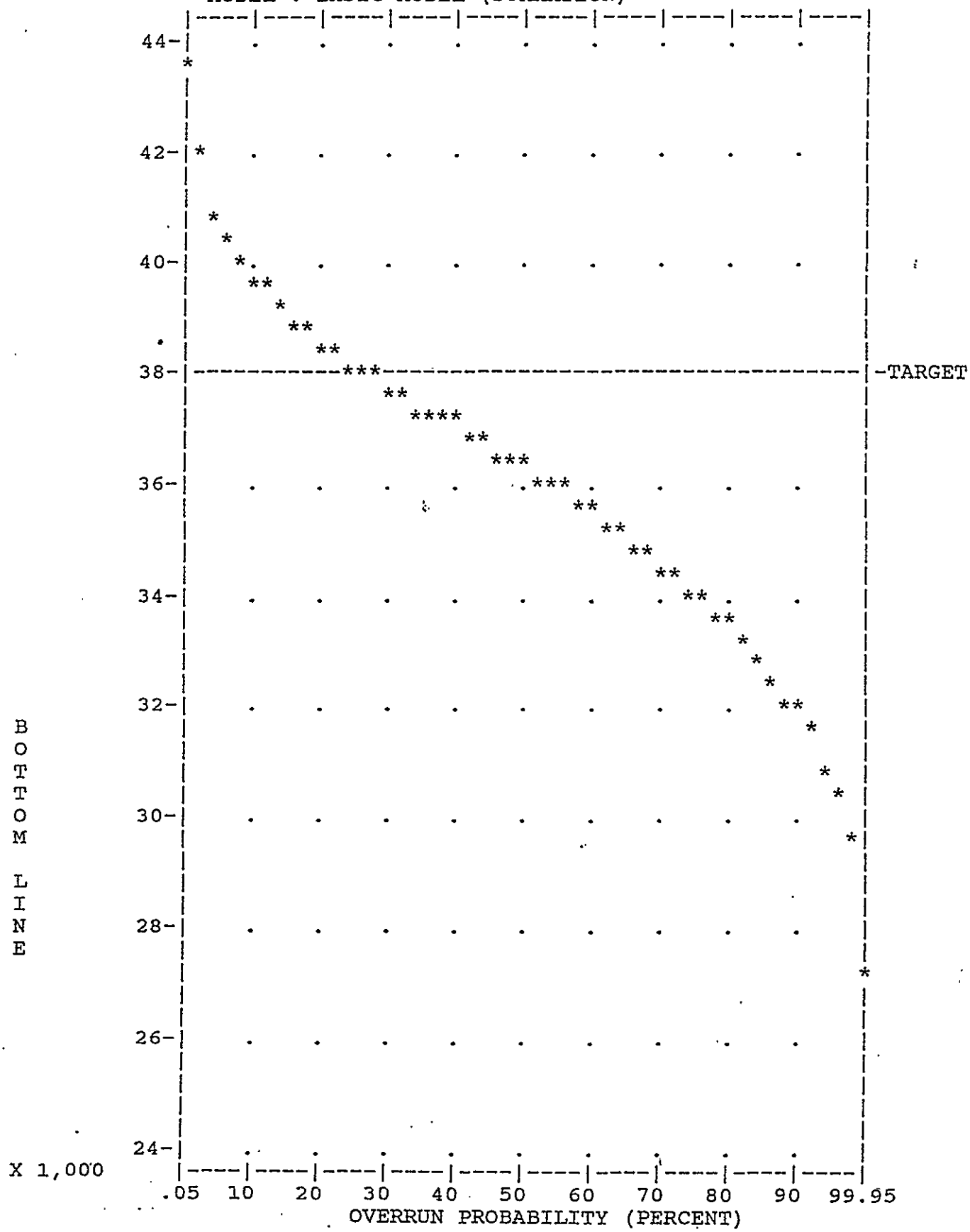
REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 03-20-96

DATA : Inter Sep Case 05
MODEL : BASIC MODEL (SUMMATION)

NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		8600	50	6880	10320
2	R&D Waste Ret. & Transfer		190.00		190.00	190.00
3	R&D Treatment		630		630	630
4	Capital Waste Ret. & Transfer		2280	50	824	3876
5	Capital Treatment		3600	40	2880	7200
6	Capital Closure		169.00		169.00	169.00
7	Operations Waste Ret. & Transfer		4820	50	3856	8194
8	Operations Treatment		5509	65	4183	5510
9	M & M		0		0	0
10	Repository Fee		12020	95	3900	12030
	TOTAL EXPENSE (INPUT TO REP/PC)		37818		23512 (THEORETICALS)	48119

+ PROBABILITY THAT ACTUAL VALUE WILL BE EQUAL TO OR LESS THAN TARGET

REP/PC (Ver 4.0) - MGMT REPORT 2 GRAPHICAL OVERRUN PROFILE : 03-20-96
DATA : Inter Sep Case 05
MODEL : BASIC MODEL (SUMMATION)



REP/PC (Ver 4.0) - MGMT REPORT 3 GRAPHICAL PRIORITY PROFILE : 03-20-96

DATA : Inter Sep Case 05
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
37818	29 PCT	0 = .0 PCT

NUM	ELEMENT	UNIT	CORRECT	PROTECT
10	Repository Fee			|+++++++++++++
5	Capital Treatment		----|	+
7	Operations Waste Ret. & Transfer		---|	+
4	Capital Waste Ret. & Transfer		-|	+
1	Current Operations		-|	+
8	Operations Treatment		|	+
	NET EFFECT OF FROZEN ELEMENTS		|	

REP/PC (Ver 4.0) - MGMT REPORT 4 CONTINGENCY PROFILE : 03-20-96

DATA : Inter Sep Case 05
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	10301	27.2	PCT
99.95	"	5713	15.1	"
95	"	2734	7.2	"
90	"	1887	5.0	"
85	"	1256	3.3	"
80	"	678	1.8	"
75	"	191	.5	"
70	"	-125	-.3	"
65	"	-490	-1.3	"
60	"	-804	-2.1	"
55	"	-1135	-3.0	"
50	"	-1576	-4.2	"
45	"	-1889	-5.0	"
40	"	-2362	-6.2	"
35	"	-2778	-7.3	"
30	"	-3219	-8.5	"
25	"	-3857	-10.2	"
20	"	-4403	-11.6	"
15	"	-5223	-13.8	"
10	"	-6014	-15.9	"
5	"	-7419	-19.6	"
0.05	"	-10733	-28.4	"
0	"	-14306	-37.8	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

FILENAME=C:\CASE05NF.OUT 03/20/96

10:35:58

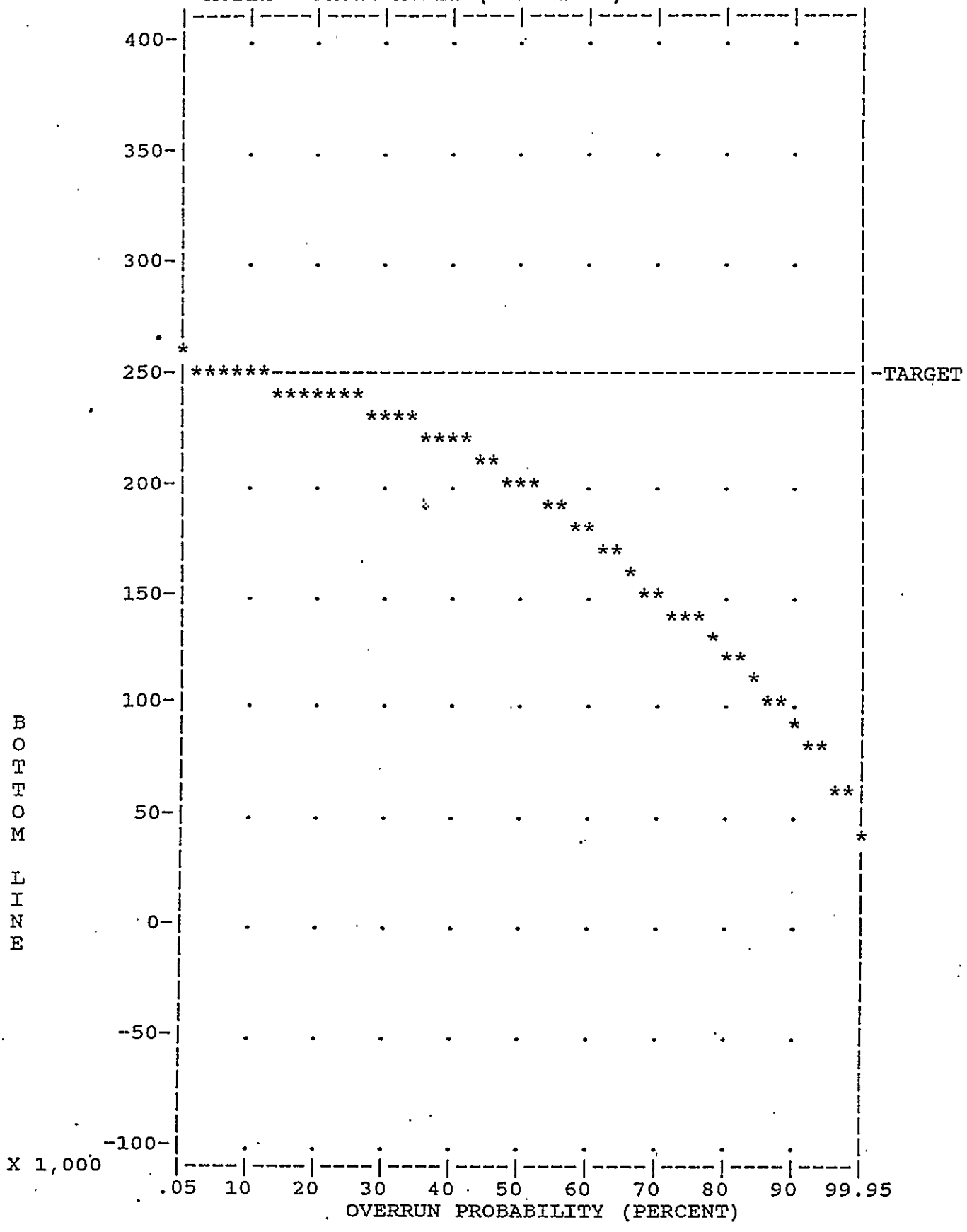
REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 03-20-96

DATA : No Sep Vitr Case 06
MODEL : BASIC MODEL (SUMMATION)

NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		8325	50	6660	9990
2	R&D Waste Ret. & Transfer		190.00		190.00	190.00
3	R&D Treatment		280		280	280
4	Capital Waste Ret. & Transfer		2280	50	1824	3876
5	Capital Treatment		2610	50	2088	3915
6	Capital Closure		152.00		152.00	152.00
7	Operations Waste Ret. & Transfer		4630	50	3704	7871
8	Operations Treatment		22742	75	4654	22743
9	M & M		0		0	0
10	Repository Fee		211460	95	12900	211461
	PREVIOUS ELEMENT HAS UNUSUAL DATA HOWEVER REP/PC USED THOSE VALUES					
	TOTAL EXPENSE (INPUT TO REP/PC)		252669		32452	260478
					(THEORETICALS)	

+ PROBABILITY THAT ACTUAL VALUE WILL BE EQUAL TO OR LESS THAN TARGET

REP/PC (Ver 4.0) - MGMT REPORT 2 GRAPHICAL OVERRUN PROFILE : 03-20-96
DATA : No Sep Vitr Case 06
MODEL : BASIC MODEL (SUMMATION)



REP/PC (Ver 4.0) - MGMT REPORT 3 GRAPHICAL PRIORITY PROFILE : 03-20-96

DATA : No Sep Vitr Case 06
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
252669	3 PCT	0 = .0 PCT

NUM	ELEMENT	UNIT	CORRECT	PROTECT
10	Repository Fee			|++++++++++++
8	Operations Treatment			|+
7	Operations Waste Ret. & Transfer			|
1	Current Operations			|
4	Capital Waste Ret. & Transfer			|
5	Capital Treatment			|
	NET EFFECT OF FROZEN ELEMENTS			|

REP/PC (Ver 4.0) - MGMT REPORT 4 CONTINGENCY PROFILE : 03-20-96

DATA : No Sep Vitr Case 06
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE
100	PCT	7809	3.1 PCT
99.95	"	3990	1.6 "
95	"	-1501	-.6 "
90	"	-4789	-1.9 "
85	"	-8473	-3.3 "
80	"	-12164	-4.8 "
75	"	-16547	-6.5 "
70	"	-21637	-8.6 "
65	"	-28309	-11.2 "
60	"	-33361	-13.2 "
55	"	-42447	-16.8 "
50	"	-52209	-20.7 "
45	"	-63127	-25.0 "
40	"	-74327	-29.4 "
35	"	-88544	-35.0 "
30	"	-102986	-40.8 "
25	"	-114820	-45.4 "
20	"	-129425	-51.2 "
15	"	-149380	-59.1 "
10	"	-163222	-64.6 "
5	"	-183194	-72.5 "
0.05	"	-212325	-84.0 "
0	"	-220217	-87.2 "

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 03-20-96

DATA : No Sep Calc Case 07
MODEL : BASIC MODEL (SUMMATION)

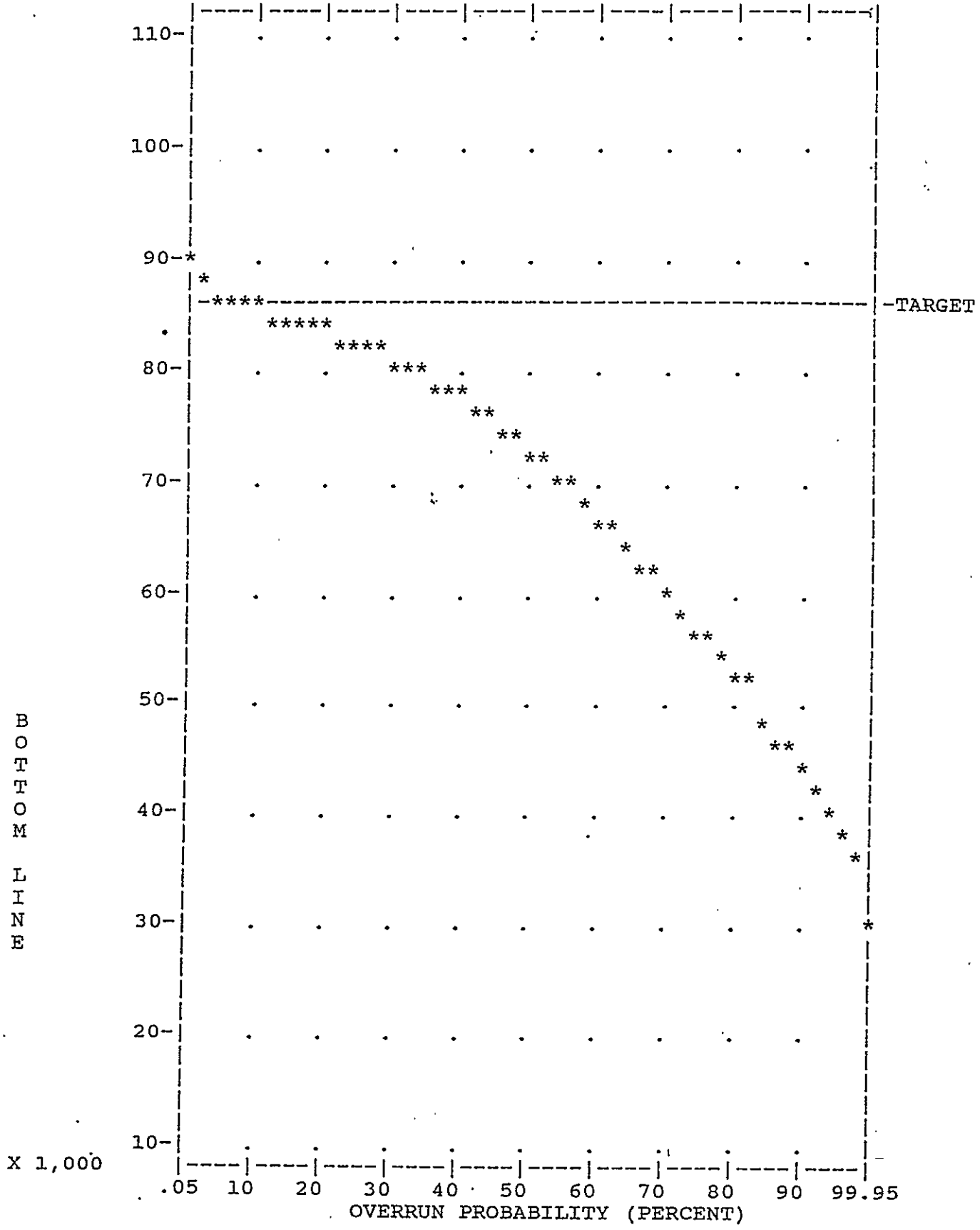
NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		8325	50	6660	9990
2	R&D Waste Ret. & Transfer		190.00		190.00	190.00
3	R&D Treatment		280		280	280
4	Capital Waste Ret. & Transfer		2280	50	1824	3876
5	Capital Treatment		2610	50	2088	3915
6	Capital Closure		152.00		152.00	152.00
7	Operations Waste Ret. & Transfer		4630	50	3704	7871
8	Operations Treatment		7548	75	3273	7549
9	M & M		0		0	0
10	Repository Fee		59800	95	7800	59801
	TOTAL EXPENSE (INPUT TO REP/PC)		85815		25971 (THEORETICALS)	93624

+ PROBABILITY THAT ACTUAL VALUE WILL BE EQUAL TO OR LESS THAN TARGET

REP/PC (Ver 4.0) - MGMT REPORT 2 GRAPHICAL OVERRUN PROFILE : 03-20-96

DATA : No Sep Calc Case 07

MODEL : BASIC MODEL (SUMMATION)



REP/PC (Ver 4.0) - MGMT REPORT 3 GRAPHICAL PRIORITY PROFILE : 03-20-96

DATA : No Sep Calc Case 07
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
85815	6 PCT	0 = .0 PCT

NUM	ELEMENT	UNIT	CORRECT	PROTECT
10	Repository Fee			++++++++++++
8	Operations Treatment			+
7	Operations Waste Ret. & Transfer			
1	Current Operations			
4	Capital Waste Ret. & Transfer			
5	Capital Treatment			
	NET EFFECT OF FROZEN ELEMENTS			

REP/PC (Ver 4.0) - MGMT REPORT 4 CONTINGENCY PROFILE : 03-20-96

DATA : No Sep Calc Case 07
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	7809	9.1	PCT
99.95	"	4249	5.0	"
95	"	326	.4	"
90	"	-756	-.9	"
85	"	-1644	-1.9	"
80	"	-2508	-2.9	"
75	"	-3447	-4.0	"
70	"	-5048	-5.9	"
65	"	-6593	-7.7	"
60	"	-8327	-9.7	"
55	"	-10467	-12.2	"
50	"	-13198	-15.4	"
45	"	-16026	-18.7	"
40	"	-18841	-22.0	"
35	"	-22543	-26.3	"
30	"	-26095	-30.4	"
25	"	-29353	-34.2	"
20	"	-33295	-38.8	"
15	"	-38344	-44.7	"
10	"	-42251	-49.2	"
5	"	-47026	-54.8	"
0.05	"	-55313	-64.5	"
0	"	-59844	-69.7	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 03-13-96

DATA : Ext Sep Case 08
MODEL : BASIC MODEL (SUMMATION)

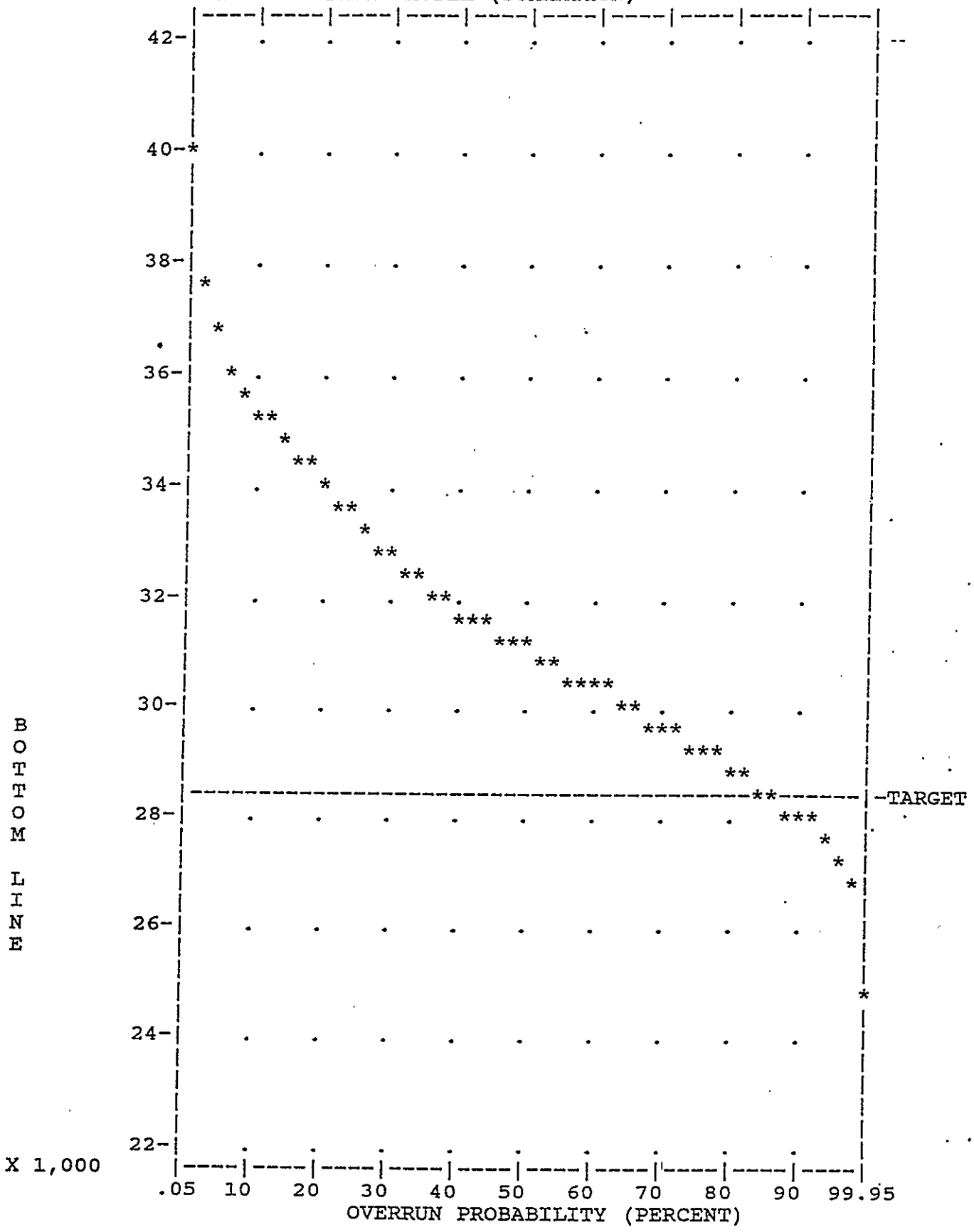
NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		8600	50	6880	10320
2	R&D Waste Ret. & Transfer		190.00		190.00	190.00
3	R&D Treatment		1300		1300	1300
4	Capital Waste Ret. & Transfer		2280	50	1824	3876
5	Capital Treatment		5202	30	4162	13005
6	Capital Closure		170.00		170.00	170.00
7	Operations Waste Ret. & Transfer		4820	50	3856	8194
8	Operations Treatment		5417	55	4604	5418
9	M & M		0		0	0
10	Repository Fee		565	40	564	3400
	TOTAL EXPENSE (INPUT TO REP/PC)		28544		23550 (THEORETICALS)	45873

+ PROBABILITY THAT ACTUAL VALUE WILL BE EQUAL TO OR LESS THAN TARGET

REP/PC (Ver 4.0) - MGMT REPORT 2 GRAPHICAL OVERRUN PROFILE : 03-13-96

DATA : Ext Sep Case 08

MODEL : BASIC MODEL (SUMMATION)



REP/PC (Ver 4.0) - MGMT REPORT 3 GRAPHICAL PRIORITY PROFILE : 03-13-96

DATA : Ext Sep Case 08
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
28544	84 PCT	0 = .0 PCT

NUM	ELEMENT	UNIT	CORRECT	PROTECT
5	Capital Treatment		----------|+	
7	Operations Waste Ret. & Transfer		----|+	
10	Repository Fee		----|	
1	Current Operations		--|++	
4	Capital Waste Ret. & Transfer		--|+	
8	Operations Treatment		|+	
	NET EFFECT OF FROZEN ELEMENTS		|	

REP/PC (Ver 4.0) - MGMT REPORT 4 CONTINGENCY PROFILE : 03-13-96

DATA : Ext Sep Case 08
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	17329	60.7	PCT
99.95	"	11338	39.7	"
95	"	7927	27.8	"
90	"	6814	23.9	"
85	"	6107	21.4	"
80	"	5523	19.4	"
75	"	4877	17.1	"
70	"	4178	14.6	"
65	"	3680	12.9	"
60	"	3235	11.3	"
55	"	2834	9.9	"
50	"	2499	8.8	"
45	"	2127	7.5	"
40	"	1804	6.3	"
35	"	1445	5.1	"
30	"	1052	3.7	"
25	"	706	2.5	"
20	"	366	1.3	"
15	"	-106	-.4	"
10	"	-555	-1.9	"
5	"	-1067	-3.7	"
0.05	"	-3712	-13.0	"
0	"	-4994	-17.5	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 03-20-96

DATA : ExSitu/InSitu Combo Case 09
MODEL : BASIC MODEL (SUMMATION)

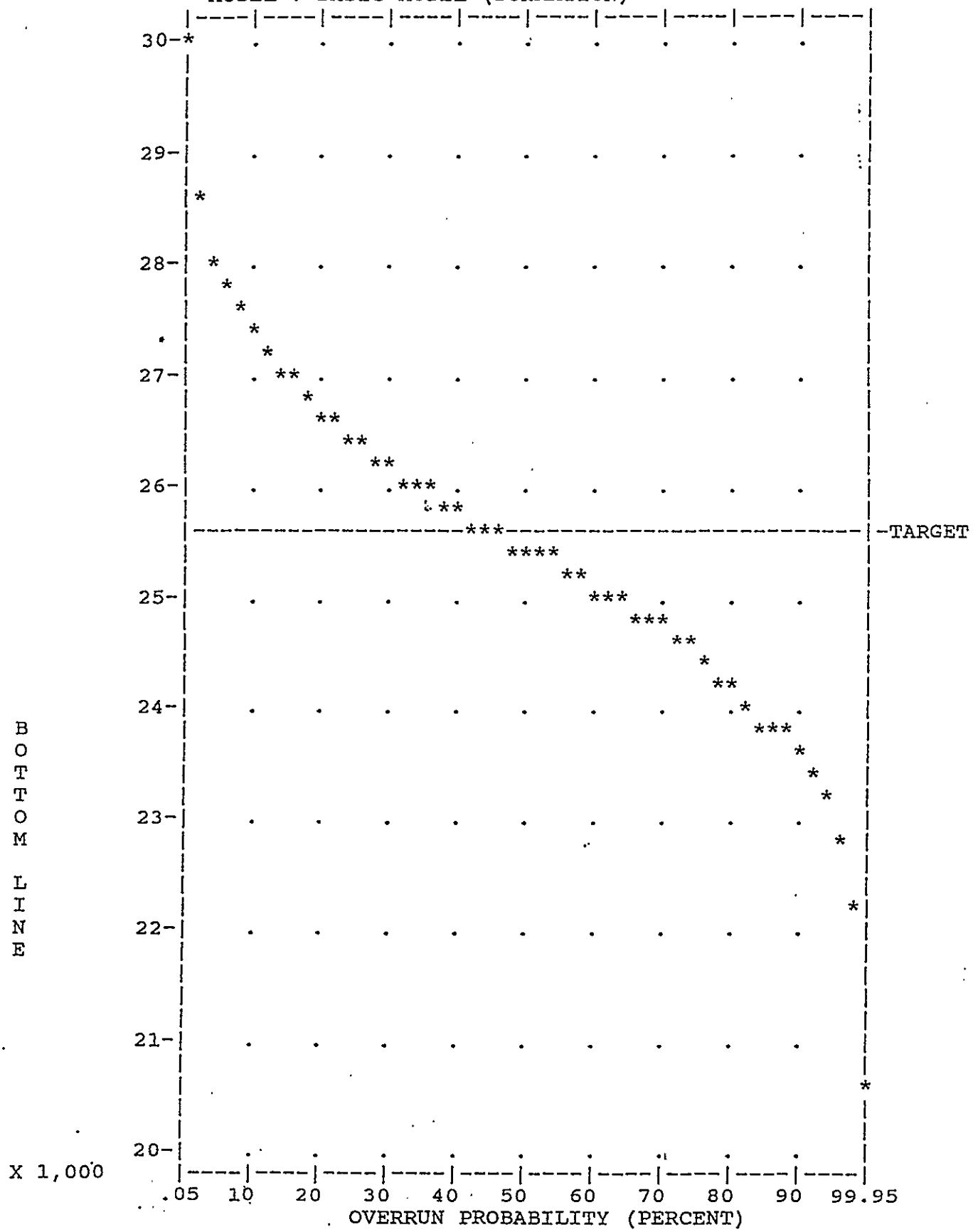
NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		9142	50	7114	10970
2	R&D Waste Ret. & Transfer		186.00		186.00	186.00
3	R&D Treatment		670		670	670
4	Capital Waste Ret. & Transfer		1388	50	1110	2360
5	Capital Treatment		2189	40	1751	4378
6	Capital Closure		137.00		137.00	137.00
7	Operations Waste Ret. & Transfer		3166	50	2533	5382
8	Operations Treatment		2638	65	2004	2639
9	M & M		0		0	0
10	Repository Fee		6010	95	3750	6011
	TOTAL EXPENSE (INPUT TO REP/PC)		25526		19255 (THEORETICALS)	32733

+ PROBABILITY THAT ACTUAL VALUE WILL BE EQUAL TO OR LESS THAN TARGET

REP/PC (Ver 4.0) - MGMT REPORT 2 GRAPHICAL OVERRUN PROFILE : 03-20-96

DATA : ExSitu/InSitu Combo Case 09

MODEL : BASIC MODEL (SUMMATION)



REP/PC (Ver 4.0) - MGMT REPORT 3 GRAPHICAL PRIORITY PROFILE : 03-20-96

DATA : ExSitu/InSitu Combo Case 09
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
25526	47 PCT	0 = .0 PCT

NUM	ELEMENT	UNIT	CORRECT	PROTECT
10	Repository Fee			++++++++++++
1	Current Operations		------	++++++
5	Capital Treatment		--------	+
7	Operations Waste Ret. & Transfer		-------	++
4	Capital Waste Ret. & Transfer		---	+
8	Operations Treatment			+++
	NET EFFECT OF FROZEN ELEMENTS			

REP/PC (Ver 4.0) - MGMT REPORT 4 CONTINGENCY PROFILE : 03-20-96

DATA : ExSitu/InSitu Combo Case 09
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	7207	28.2	PCT
99.95	"	4454	17.5	"
95	"	2387	9.4	"
90	"	1865	7.3	"
85	"	1475	5.8	"
80	"	1164	4.6	"
75	"	864	3.4	"
70	"	643	2.5	"
65	"	429	1.7	"
60	"	231	.9	"
55	"	58	.2	"
50	"	-96	-.4	"
45	"	-252	-1.0	"
40	"	-444	-1.7	"
35	"	-649	-2.5	"
30	"	-823	-3.2	"
25	"	-1056	-4.1	"
20	"	-1420	-5.6	"
15	"	-1666	-6.5	"
10	"	-1921	-7.5	"
5	"	-2536	-9.9	"
0.05	"	-4837	-18.9	"
0	"	-6271	-24.6	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

FILENAME=C:\CASE09NF.OUT 03/20/96

10:45:32

REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 03-12-96

DATA : Phased Impl Case 10
MODEL : BASIC MODEL (SUMMATION)

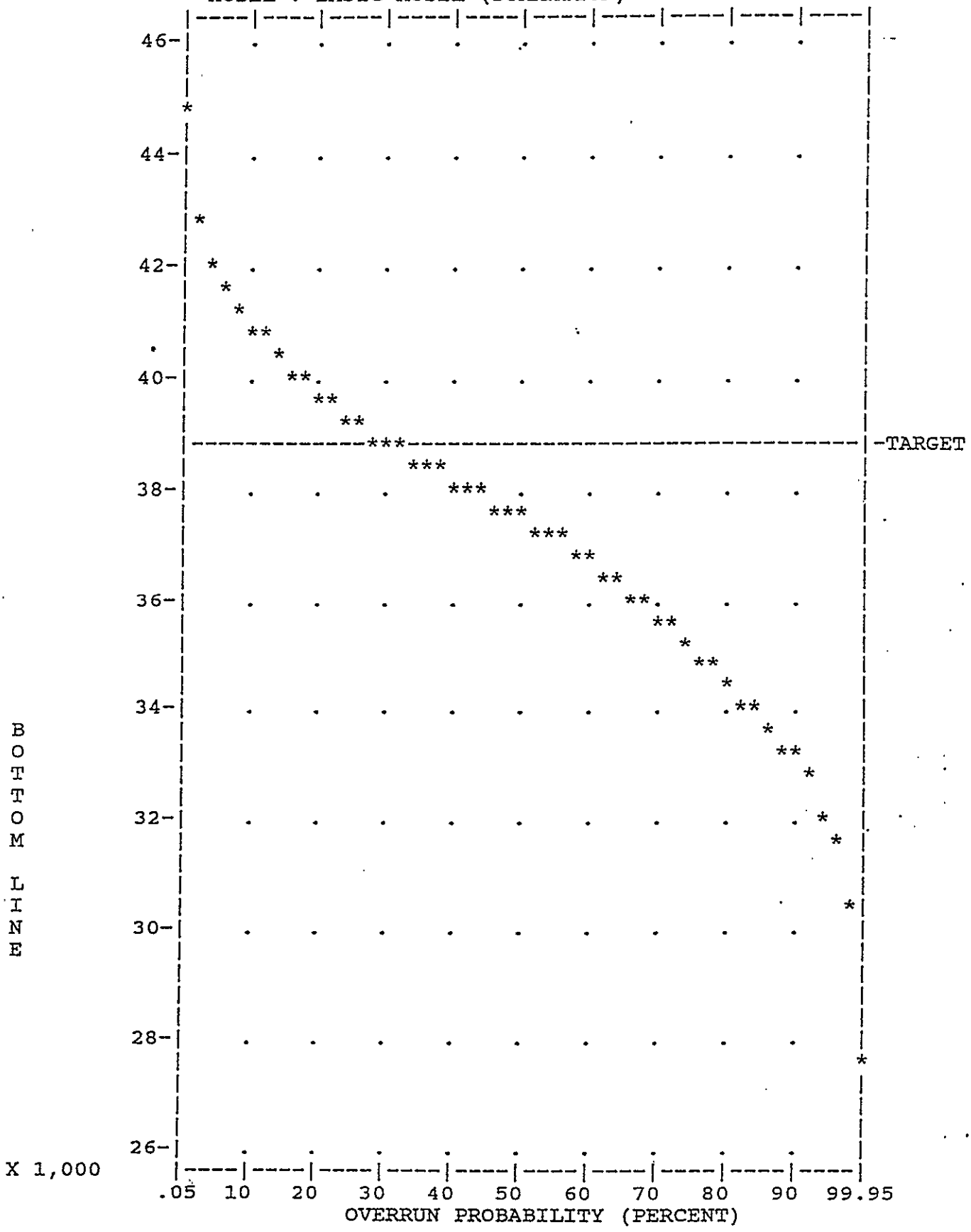
NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		8600	50	6880	10320
2	R&D Waste Ret. & Transfer		190.00		190.00	190.00
3	R&D Treatment		0		0	0
4	Capital Waste Ret. & Transfer		2280	50	1824	3876
5	Capital Treatment		4483	40	3586	8966
6	Capital Closure		211.00		211.00	211.00
7	Operations Waste Ret. & Transfer		3990	50	3192	6783
8	Operations Treatment		6954	50	5215	6955
9	M&M		0		0	0
10	Repository Fee		12020	95	3900	12021
	TOTAL EXPENSE (INPUT TO REP/PC)		38728		24998 (THEORETICALS)	49322

+ PROBABILITY THAT ACTUAL VALUE WILL BE EQUAL TO OR LESS THAN TARGET

REP/PC (Ver 4.0) - MGMT REPORT 2 GRAPHICAL OVERRUN PROFILE : 03-12-96

DATA : Phased Impl Case 10

MODEL : BASIC MODEL (SUMMATION)



REP/PC (Ver 4.0) - MGMT REPORT 3 GRAPHICAL PRIORITY PROFILE : 03-12-96

DATA : Phased Impl Case 10
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
38728	31 PCT	0 = .0 PCT

NUM	ELEMENT	UNIT	CORRECT	PROTECT
10	Repository Fee			|+++++++++++++
5	Capital Treatment		-----|	+
7	Operations Waste Ret. & Transfer		--|	+
1	Current Operations		-|	+
4	Capital Waste Ret. & Transfer		-|	
8	Operations Treatment		|	+
	NET EFFECT OF FROZEN ELEMENTS		|	

REP/PC (Ver 4.0) - MGMT REPORT 4 CONTINGENCY PROFILE : 03-12-96

DATA : Phased Impl Case 10
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	10594	27.4	PCT
99.95	"	6055	15.6	"
95	"	3028	7.8	"
90	"	2224	5.7	"
85	"	1507	3.9	"
80	"	992	2.6	"
75	"	461	1.2	"
70	"	45	.1	"
65	"	-244	-.6	"
60	"	-563	-1.4	"
55	"	-874	-2.3	"
50	"	-1238	-3.2	"
45	"	-1672	-4.3	"
40	"	-2126	-5.5	"
35	"	-2580	-6.7	"
30	"	-3006	-7.8	"
25	"	-3665	-9.5	"
20	"	-4292	-11.1	"
15	"	-4912	-12.7	"
10	"	-5717	-14.8	"
5	"	-6885	-17.8	"
0.05	"	-11080	-28.6	"
0	"	-13730	-35.4	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

FILENAME=C:\JUNCOMBO.OUT

03/12/96

13:00:44

JACOBS ENGINEERING GROUP INC.

DATE 2/12/96 SUBJECT SHEET NO.

BY D. Stein CHKD. JOB NO.

Phased Implementation (latest version)

Target Value $32,958

95% Confidence Range $30,226 – $36,542

FORM 87-005-1 (4/87)

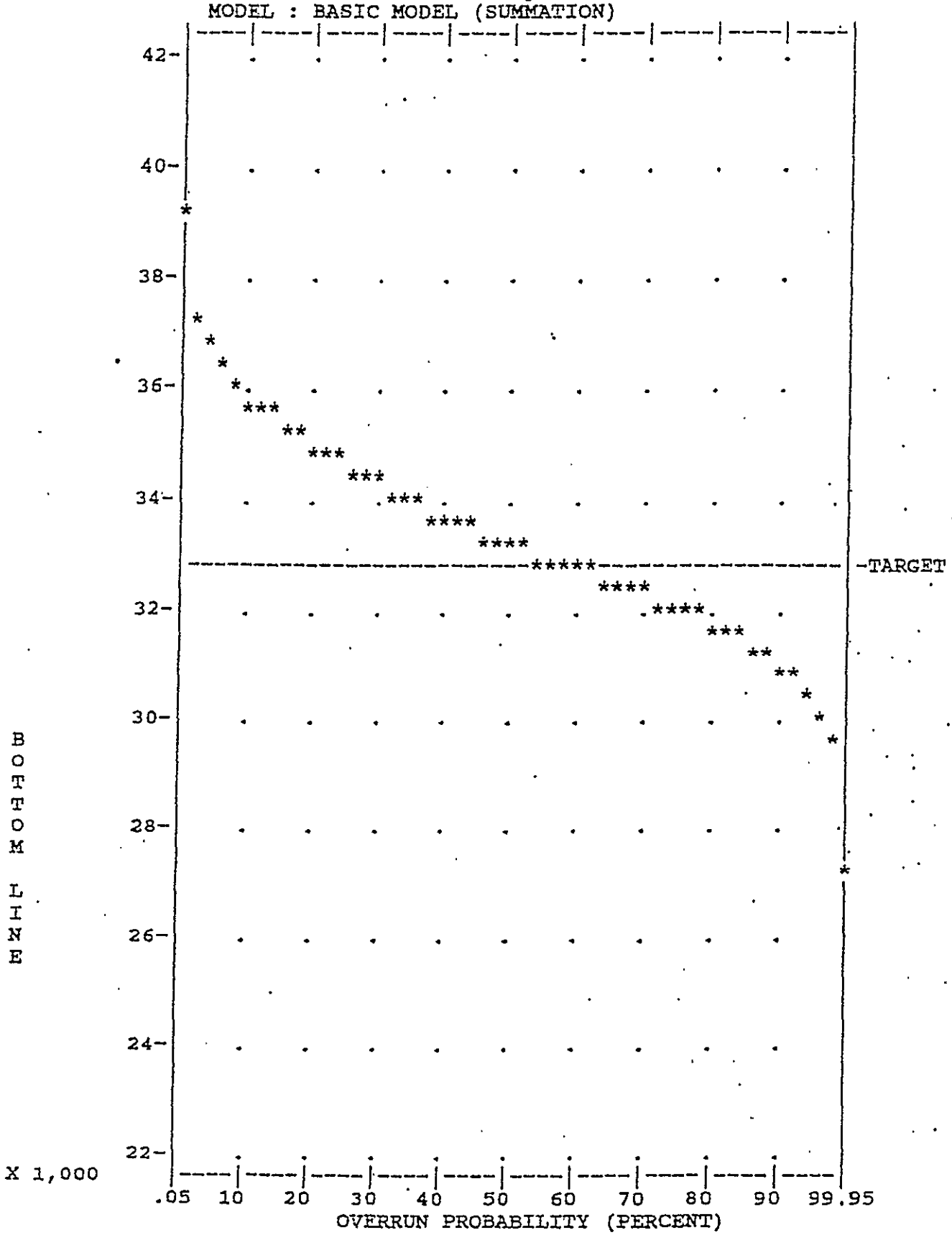
REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 02-12-96

DATA : ExSitu Exten. Sepa.r. Case 10
MODEL : BASIC MODEL (SUMMATION)

NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		8600	50	6880	10320
2	R&D Waste Ret. & Transfer		190.00		190.00	190.00
3	R&D Treatment		0		0	0
4	Capital Waste Ret. & Transfer		2280	50	1824	3876
5	Capital Treament		4305	40	4244	8610
6	Capital Closure		211.00		211.00	211.00
7	Operations Waste Ret. & Transfer		3990	50	3192	6783
8	Operations Treatment		6877	50	5158	6878
9	M & M		0		0	0
10	Repository Fee		6500	95	3900	6501
	TOTAL EXPENSE (INPUT TO REP/PC)		32953		25599 (THEORETICALS)	43369

+ PROBABILITY THAT ACTUAL VALUE WILL BE EQUAL TO OR LESS THAN TARGET

REP/PC (Ver 4.0) - MGMT REPORT 2 GRAPHICAL OVERRUN PROFILE : 02-12-96
DATA : ExSitu Exten. Sepa.r. Case 10
MODEL : BASIC MODEL (SUMMATION)



REP/PC (Ver 4.0) - MGMT REPORT 3 GRAPHICAL PRIORITY PROFILE : 02-12-96

DATA : ExSitu Exten. Sepa.r. Case 10
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
32953	55 PCT	0 = .0 PCT

NUM	ELEMENT	UNIT	CORRECT	PROTECT
5	Capital Treament		----------	
10	Repository Fee			++++++++++++
7	Operations Waste Ret. & Transfer		--------	++
1	Current Operations		----	++++
4	Capital Waste Ret. & Transfer		----	+
8	Operations Treatment			++++
	NET EFFECT OF FROZEN ELEMENTS			

REP/PC (Ver 4.0) - MGMT REPORT 4 CONTINGENCY PROFILE : 02-12-96

DATA : ExSitu Exten. Sepa.r. Case 10
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	10416	31.6	PCT
99.95	"	6159	18.7	"
95	"	3589	10.9	"
90	"	2782	8.4	"
85	"	2385	7.2	"
80	"	1960	6.0	"
75	"	1599	4.9	"
70	"	1282	3.9	"
65	"	935	2.8	"
60	"	709	2.2	"
55	"	422	1.3	"
50	"	223	.7	"
45	"	2	.0	"
40	"	-257	-.8	"
35	"	-452	-1.4	"
30	"	-682	-2.1	"
25	"	-936	-2.8	"
20	"	-1178	-3.6	"
15	"	-1518	-4.6	"
10	"	-1968	-6.0	"
5	"	-2727	-8.3	"
0.05	"	-5765	-17.5	"
0	"	-7354	-22.3	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

OUTPUT
FOR CASES
EXCLUDING
REPOSITORY
FEE

REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 03-20-96

DATA : Inter Sep w/o Rep Fee Case 05
MODEL : BASIC MODEL (SUMMATION)

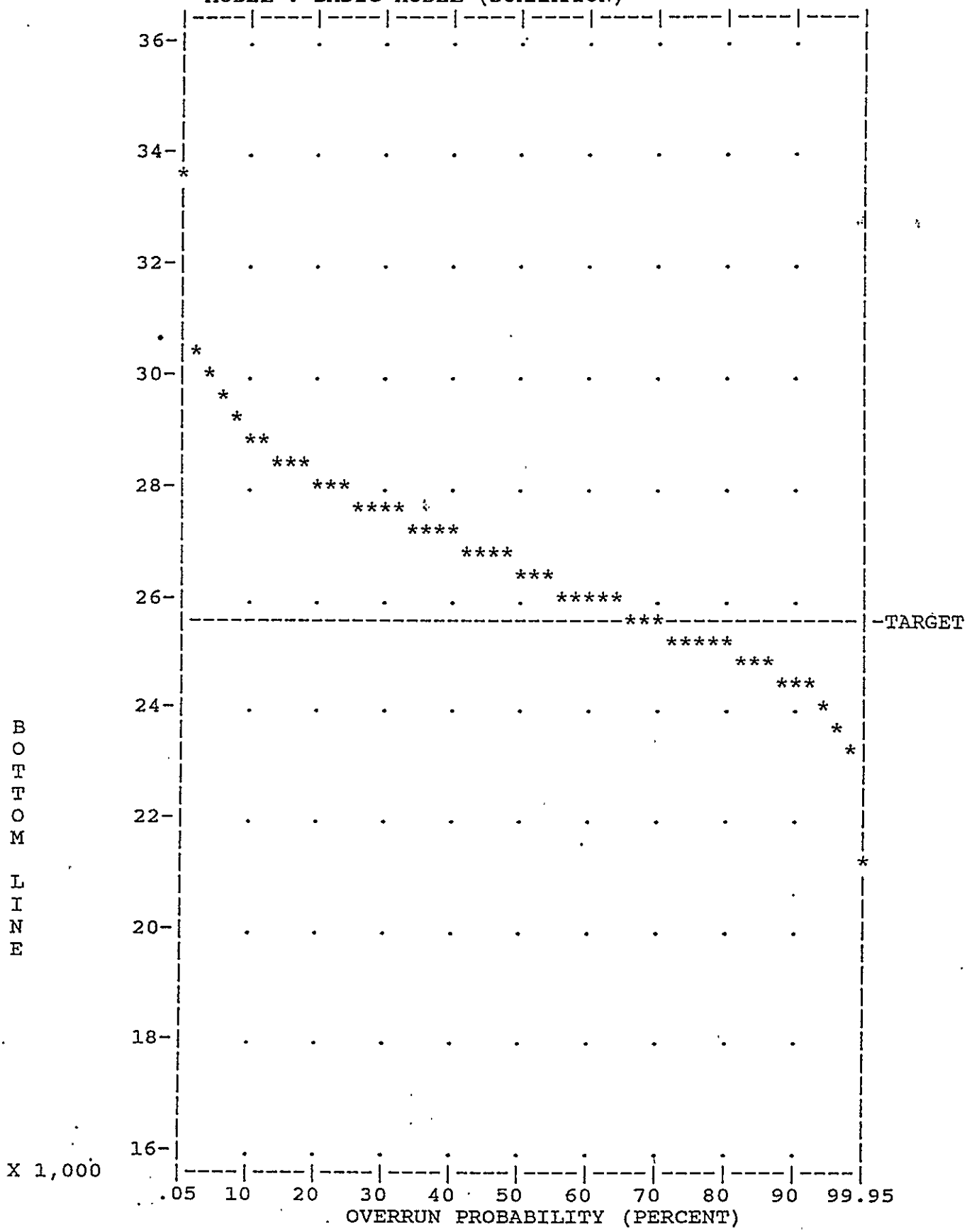
NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		8600	50	6880	10320
2	R&D Waste Ret. & Transfer		190.00		190.00	190.00
3	R&D Treatment		630		630	630
4	Capital Waste Ret. & Transfer		2280	50	824	3876
5	Capital Treatment		3600	40	2880	7200
6	Capital Closure		169.00		169.00	169.00
7	Operations Waste Ret. & Transfer		4820	50	3856	8194
8	Operations Treatment		5509	65	4183	5510
9	M & M		0		0	0
	TOTAL EXPENSE (INPUT TO REP/PC)		25798		19612 (THEORETICALS)	36089

+ PROBABILITY THAT ACTUAL VALUE WILL BE EQUAL TO OR LESS THAN TARGET

REP/PC (Ver 4.0) - MGMT REPORT 2 GRAPHICAL OVERRUN PROFILE : 03-20-96

DATA : Inter Sep w/o Rep Fee Case 05

MODEL : BASIC MODEL (SUMMATION)



REP/PC (Ver 4.0) - MGMT REPORT 3 GRAPHICAL PRIORITY PROFILE : 03-20-96

DATA : Inter Sep w/o Rep Fee Case 05
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
25798	64 PCT	0 = .0 PCT

NUM	ELEMENT	UNIT	CORRECT	PROTECT
5	Capital Treatment		----------|++	
7	Operations Waste Ret. & Transfer		----------|+++	
4	Capital Waste Ret. & Transfer		-----|++++	
1	Current Operations		-----|+++++	
8	Operations Treatment		|+++++	
	NET EFFECT OF FROZEN ELEMENTS		|	

REP/PC (Ver 4.0) - MGMT REPORT 4 CONTINGENCY PROFILE : 03-20-96

DATA : Inter Sep w/o Rep Fee Case 05
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	10291	39.9	PCT
99.95	"	7963	30.9	"
95	"	3943	15.3	"
90	"	3111	12.1	"
85	"	2633	10.2	"
80	"	2307	8.9	"
75	"	1991	7.7	"
70	"	1739	6.7	"
65	"	1466	5.7	"
60	"	1218	4.7	"
55	"	973	3.8	"
50	"	690	2.7	"
45	"	431	1.7	"
40	"	239	.9	"
35	"	-23	-.1	"
30	"	-313	-1.2	"
25	"	-574	-2.2	"
20	"	-779	-3.0	"
15	"	-1115	-4.3	"
10	"	-1391	-5.4	"
5	"	-2023	-7.8	"
0.05	"	-4609	-17.9	"
0	"	-6186	-24.0	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

FILENAME=C:\CASE06.OUT 03/20/96

10:37:51

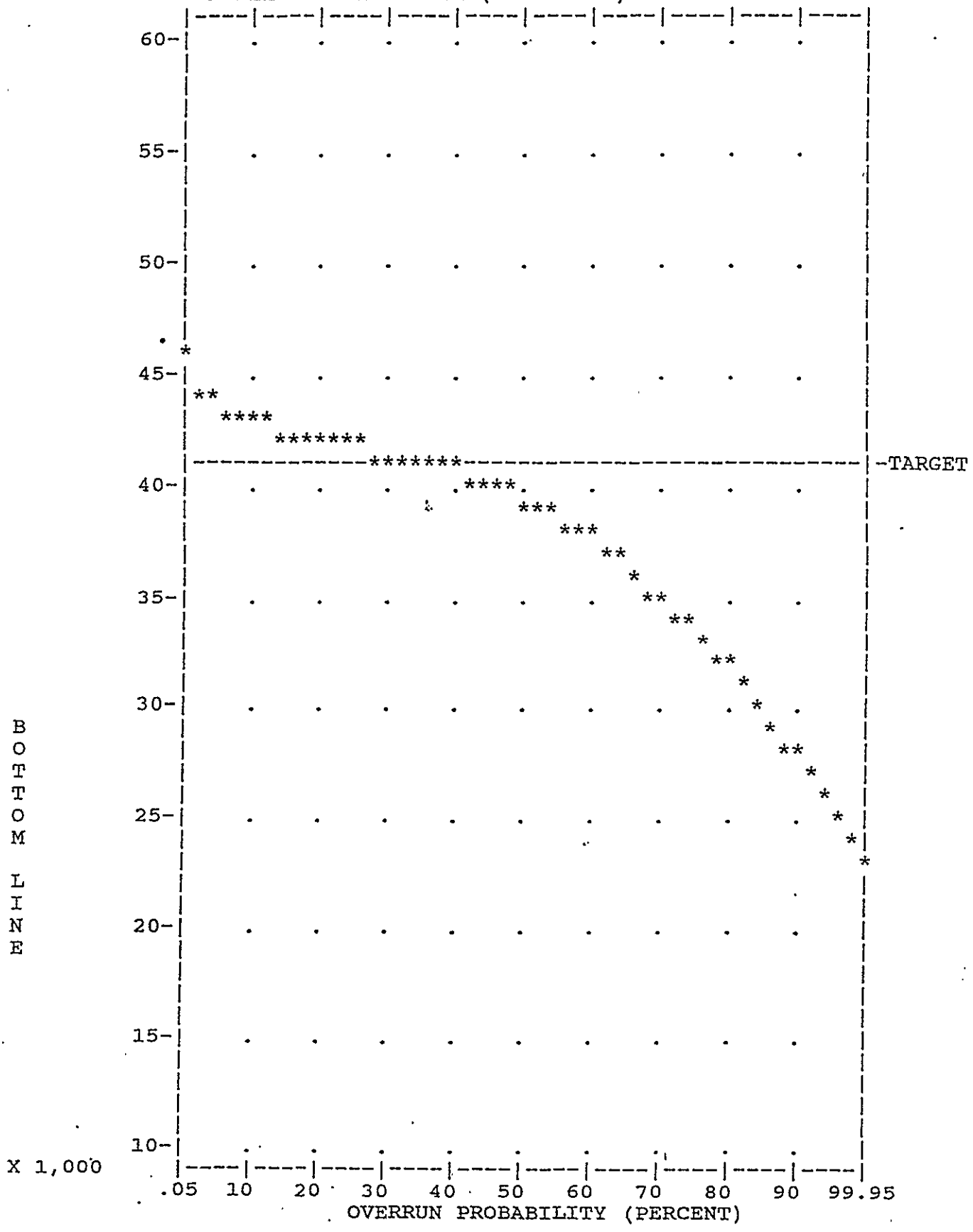
REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 03-20-96

DATA : No Sep Vitr w/o Rep Fee Case 06
MODEL : BASIC MODEL (SUMMATION)

NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		8325	50	6660	9990
2	R&D Waste Ret. & Transfer		190.00		190.00	190.00
3	R&D Treatment		280		280	280
4	Capital Waste Ret. & Transfer		2280	50	1824	3876
5	Capital Treatment		2610	50	2088	3915
6	Capital Closure		152.00		152.00	152.00
7	Operations Waste Ret. & Transfer		4630	50	3704	7871
8	Operations Treatment		22742	75	4654	22743
9	M & M		0		0	0
	TOTAL EXPENSE (INPUT TO REP/PC)		41209		19552 (THEORETICALS)	49017

+ PROBABILITY THAT ACTUAL VALUE WILL BE EQUAL TO OR LESS THAN TARGET

REP/PC (Ver 4.0) - MGMT REPORT 2 GRAPHICAL OVERRUN PROFILE : 03-20-96
DATA : No Sep Vitr w/o Rep Fee Case 06
MODEL : BASIC MODEL (SUMMATION)



REP/PC (Ver 4.0) - MGMT REPORT 3 GRAPHICAL PRIORITY PROFILE : 03-20-96

DATA : No Sep Vitr w/o Rep Fee Case 06
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
41209	30 PCT	0 = .0 PCT

NUM	ELEMENT	UNIT	CORRECT	PROTECT
8	Operations Treatment			|++++++++++++
7	Operations Waste Ret. & Transfer		--	|
1	Current Operations		-	|+
4	Capital Waste Ret. & Transfer		-	|
5	Capital Treatment		-	|
	NET EFFECT OF FROZEN ELEMENTS			|

REP/PC (Ver 4.0) - MGMT REPORT 4 CONTINGENCY PROFILE : 03-20-96

DATA : No Sep Vitr w/o Rep Fee Case 06
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	7808	19.0	PCT
99.95	"	5239	12.7	"
95	"	2350	5.7	"
90	"	1717	4.2	"
85	"	1181	2.9	"
80	"	758	1.8	"
75	"	434	1.1	"
70	"	11	.0	"
65	"	-328	-.8	"
60	"	-661	-1.6	"
55	"	-1173	-2.8	"
50	"	-1723	-4.2	"
45	"	-2528	-6.1	"
40	"	-3554	-8.6	"
35	"	-4767	-11.6	"
30	"	-6349	-15.4	"
25	"	-7709	-18.7	"
20	"	-9489	-23.0	"
15	"	-11441	-27.8	"
10	"	-13652	-33.1	"
5	"	-15649	-38.0	"
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(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

FILENAME=C:\CASE07.OUT

03/20/96

10:41:13

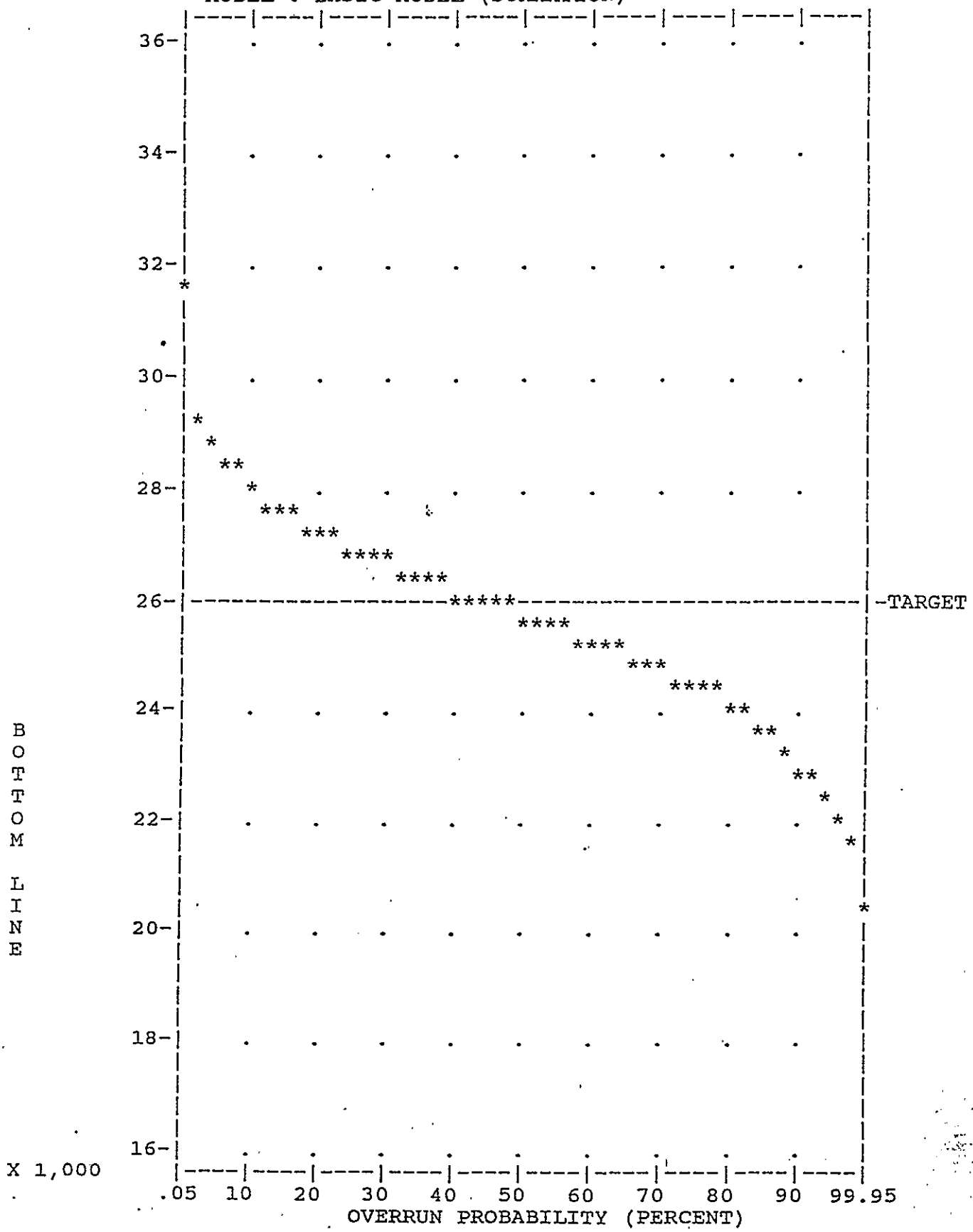
REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 03-20-96

DATA : No Sep Calc w/o Rep Fee Case 07
MODEL : BASIC MODEL (SUMMATION)

NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		8325	50	6660	9990
2	R&D Waste Ret. & Transfer		190.00		190.00	190.00
3	R&D Treatment		280		280	280
4	Capital Waste Ret. & Transfer		2280	50	1824	3876
5	Capital Treatment		2610	50	2088	3915
6	Capital Closure		152.00		152.00	152.00
7	Operations Waste Ret. & Transfer		4630	50	3704	7871
8	Operations Treatment		7548	75	3273	7549
9	M & M		0		0	0
	TOTAL EXPENSE (INPUT TO REP/PC)		26015		18171 (THEORETICALS)	33823

+ PROBABILITY THAT ACTUAL VALUE WILL BE EQUAL TO OR LESS THAN TARGET

REP/PC (Ver 4.0) - MGMT REPORT 2 GRAPHICAL OVERRUN PROFILE : 03-20-96
DATA : No Sep Calc w/o Rep Fee Case 07
MODEL : BASIC MODEL (SUMMATION)



REP/PC (Ver 4.0) - MGMT REPORT 3 GRAPHICAL PRIORITY PROFILE : 03-20-96

DATA : No Sep Calc w/o Rep Fee Case 07
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
26015	43 PCT	0 = .0 PCT

NUM	ELEMENT	UNIT	CORRECT	PROTECT
8	Operations Treatment			|+++++++++++++
7	Operations Waste Ret. & Transfer		-------|	++
1	Current Operations		---|	+++
4	Capital Waste Ret. & Transfer		---|	+
5	Capital Treatment		---|	+
	NET EFFECT OF FROZEN ELEMENTS		|	

REP/PC (Ver 4.0) - MGMT REPORT 4 CONTINGENCY PROFILE : 03-20-96

DATA : No Sep Calc w/o Rep Fee Case 07
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	7808	30.0	PCT
99.95	"	5486	21.1	"
95	"	2693	10.4	"
90	"	1989	7.7	"
85	"	1557	6.0	"
80	"	1194	4.6	"
75	"	905	3.5	"
70	"	630	2.4	"
65	"	425	1.6	"
60	"	155	.6	"
55	"	-69	-.3	"
50	"	-288	-1.1	"
45	"	-511	-2.0	"
40	"	-711	-2.7	"
35	"	-1004	-3.9	"
30	"	-1349	-5.2	"
25	"	-1607	-6.2	"
20	"	-1940	-7.5	"
15	"	-2366	-9.1	"
10	"	-3105	-11.9	"
5	"	-3858	-14.8	"
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(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

FILENAME=C:\CASE09.OUT 03/20/96

11:20:13

REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 03-12-96

DATA : Ext Sep w/o Rep Fee Case 08
MODEL : BASIC MODEL (SUMMATION)

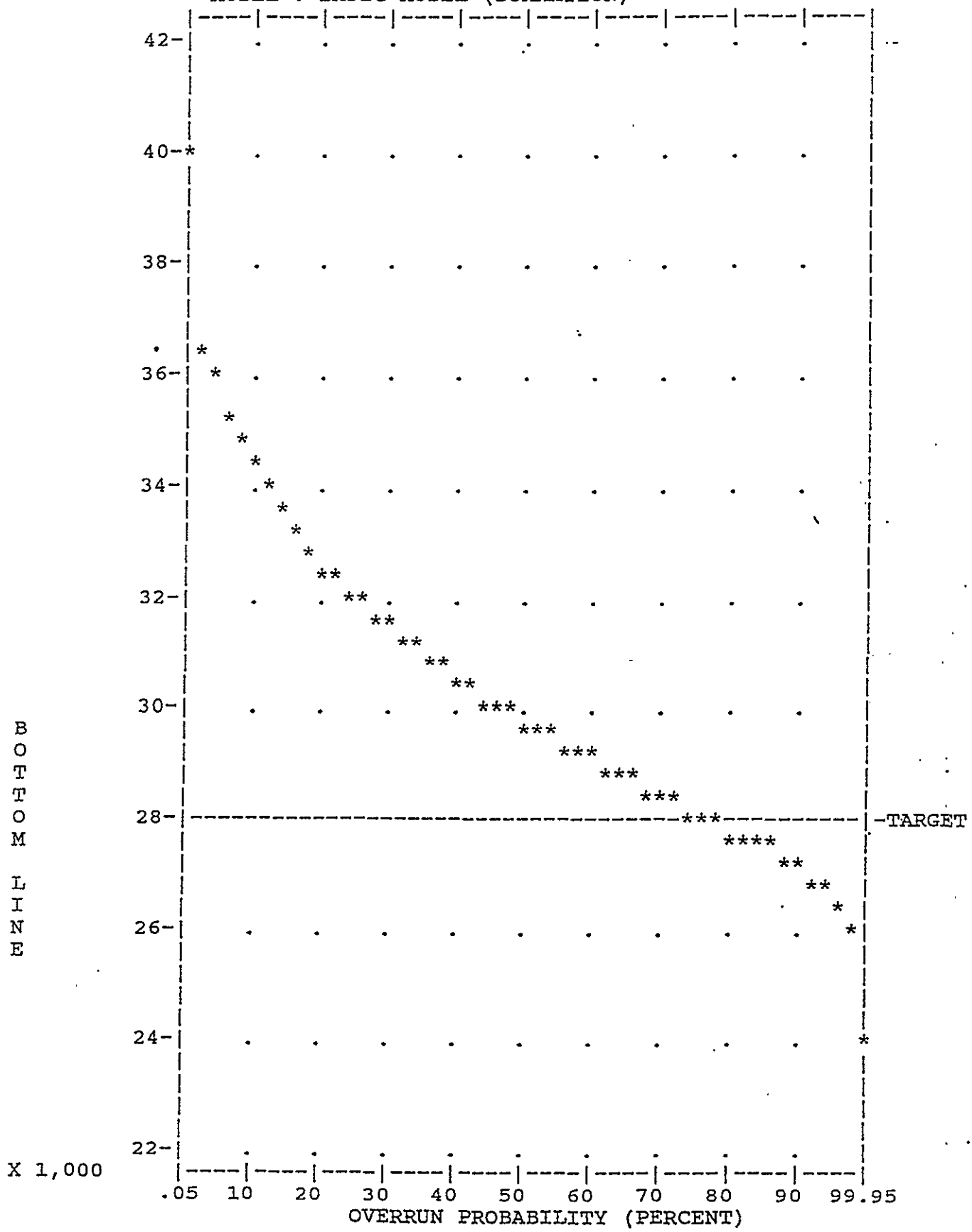
NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		8600	50	6880	10320
2	R&D Waste Ret. & Transfer		190.00		190.00	190.00
3	R&D Treatment		1300		1300	1300
4	Capital Waste Ret. & Transfer		2280	50	1824	3876
5	Capital Treament		5202	30	4162	13005
6	Capital Closure		170.00		170.00	170.00
7	Operations Waste Ret. & Transfer		4820	50	3856	8194
8	Operations Treatment		5417	55	4604	5418
9	M & M		0		0	0
	TOTAL EXPENSE (INPUT TO REP/PC)		27979		22986 (THEORETICALS)	42473

+ PROBABILITY THAT ACTUAL VALUE WILL BE EQUAL TO OR LESS THAN TARGET

REP/PC (Ver 4.0) - MGMT REPORT 2 GRAPHICAL OVERRUN PROFILE : 03-12-96

DATA : Ext Sep w/o Rep Fee Case 08

MODEL : BASIC MODEL (SUMMATION)



REP/PC (Ver 4.0) - MGMT REPORT 3 GRAPHICAL PRIORITY PROFILE : 03-12-96

DATA : Ext Sep w/o Rep Fee Case 08
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
27979	77 PCT	0 = .0 PCT

NUM	ELEMENT	UNIT	CORRECT	PROTECT
5	Capital Treament		----------|+	
7	Operations Waste Ret. & Transfer		----|+	
1	Current Operations		--|++	
4	Capital Waste Ret. & Transfer		--|+	
8	Operations Treatment		|+	
	NET EFFECT OF FROZEN ELEMENTS		|	

REP/PC (Ver 4.0) - MGMT REPORT 4 CONTINGENCY PROFILE : 03-12-96

DATA : Ext Sep w/o Rep Fee Case 08
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	14494	51.8	PCT
99.95	"	12109	43.3	"
95	"	7497	26.8	"
90	"	6282	22.5	"
85	"	5365	19.2	"
80	"	4615	16.5	"
75	"	3930	14.1	"
70	"	3464	12.4	"
65	"	3018	10.8	"
60	"	2545	9.1	"
55	"	2144	7.7	"
50	"	1739	6.2	"
45	"	1391	5.0	"
40	"	1061	3.8	"
35	"	755	2.7	"
30	"	477	1.7	"
25	"	146	.5	"
20	"	-185	-.7	"
15	"	-497	-1.8	"
10	"	-814	-2.9	"
5	"	-1399	-5.0	"
0.05	"	-3851	-13.8	"
0	"	-4993	-17.8	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

FILENAME=C:\CASE09NF.OUT 03/12/96

13:41:05

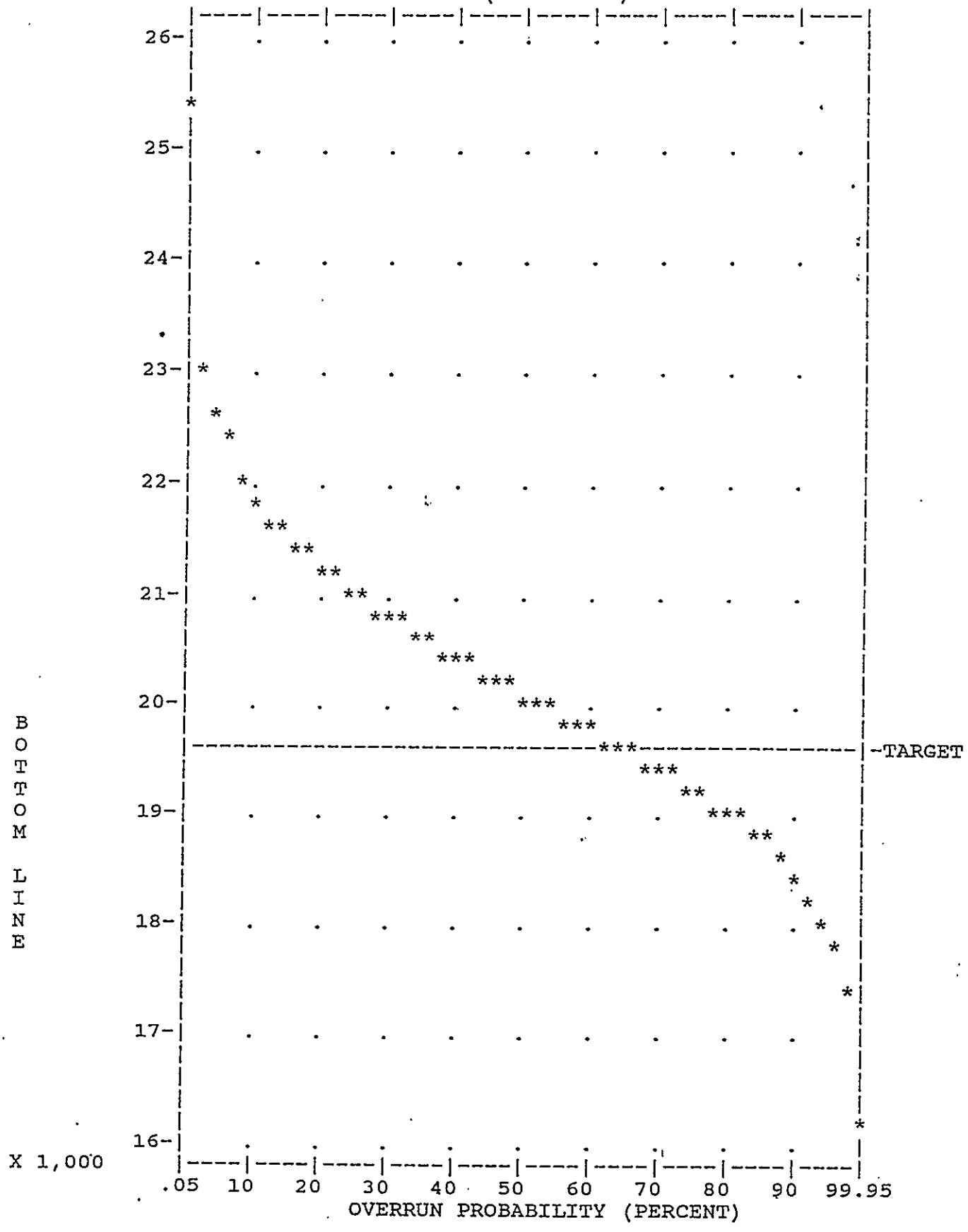
REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 03-20-96

DATA : ExSitu/InSituCombo w/o RF Case09
MODEL : BASIC MODEL (SUMMATION)

NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		9142	50	7114	10970
2	R&D Waste Ret. & Transfer		186.00		186.00	186.00
3	R&D Treatment		670		670	670
4	Capital Waste Ret. & Transfer		1388	50	1110	2360
5	Capital Treatment		2189	40	1751	4378
6	Capital Closure		137.00		137.00	137.00
7	Operations Waste Ret. & Transfer		3166	50	2533	5382
8	Operations Treatment		2638	65	2004	2639
9	M & M		0		0	0
	TOTAL EXPENSE (INPUT TO REP/PC)		19516		15505 (THEORETICALS)	26722

+ PROBABILITY THAT ACTUAL VALUE WILL BE EQUAL TO OR LESS THAN TARGET

REP/PC (Ver 4.0) - MGMT REPORT 2 GRAPHICAL OVERRUN PROFILE : 03-20-96
DATA : ExSitu/InSituCombo w/o RF Case09
MODEL : BASIC MODEL (SUMMATION)



REP/PC (Ver 4.0) - MGMT REPORT 4 CONTINGENCY PROFILE : 03-20-96

DATA : ExSitu/InSituCombo w/o RF Case09
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	7206	36.9	PCT
99.95	"	5794	29.7	"
95	"	2891	14.8	"
90	"	2316	11.9	"
85	"	2023	10.4	"
80	"	1750	9.0	"
75	"	1491	7.6	"
70	"	1253	6.4	"
65	"	1085	5.6	"
60	"	907	4.7	"
55	"	718	3.7	"
50	"	542	2.8	"
45	"	367	1.9	"
40	"	211	1.1	"
35	"	38	.2	"
30	"	-137	-.7	"
25	"	-323	-1.7	"
20	"	-488	-2.5	"
15	"	-726	-3.7	"
10	"	-1025	-5.2	"
5	"	-1560	-8.0	"
0.05	"	-3250	-16.6	"
0	"	-4011	-20.5	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

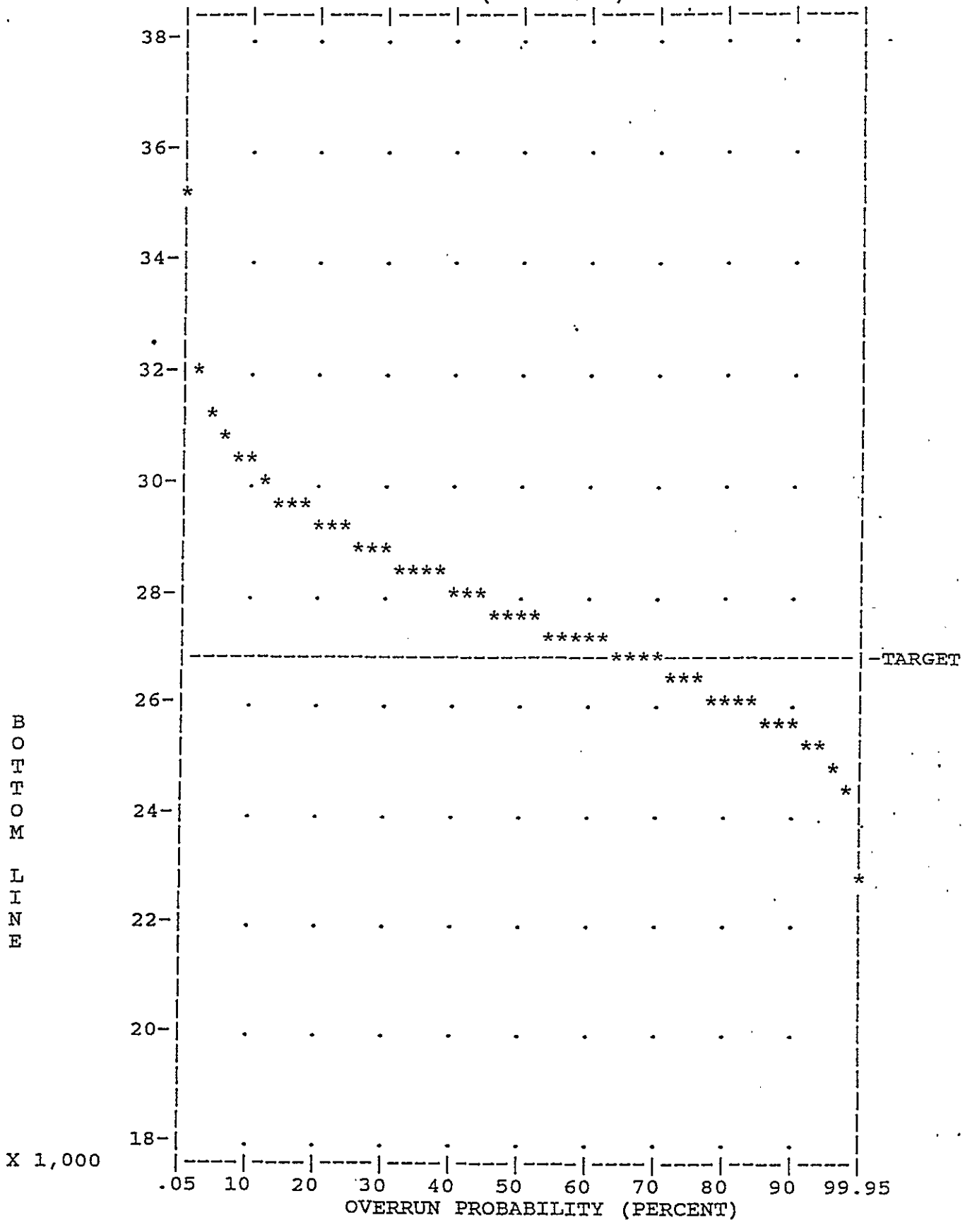
REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 03-12-96

DATA : Phased Impl w/o Rep Fee Case10
MODEL : BASIC MODEL (SUMMATION)

NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		8600	50	6880	10320
2	R&D Waste Ret. & Transfer		190.00		190.00	190.00
3	R&D Treatment		0		0	0
4	Capital Waste Ret. & Transfer		2280	50	1824	3876
5	Capital Treatment		4483	40	3586	8966
6	Capital Closure		211.00		211.00	211.00
7	Operations Waste Ret. & Transfer		3990	50	3192	6783
8	Operations Treatment		6954	50	5215	6955
9	M&M		0		0	0
	TOTAL EXPENSE (INPUT TO REP/PC)		26708		21098 (THEORETICALS)	37301

+ PROBABILITY THAT ACTUAL VALUE WILL BE EQUAL TO OR LESS THAN TARGET

REP/PC (Ver 4.0) - MGMT REPORT 2 GRAPHICAL OVERRUN PROFILE : 03-12-96
DATA : Phased Impl w/o Rep Fee Case10
MODEL : BASIC MODEL (SUMMATION)



REP/PC (Ver 4.0) - MGMT REPORT 3 GRAPHICAL PRIORITY PROFILE : 03-12-96

DATA : Phased Impl w/o Rep Fee Case10
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
26708	69 PCT	0 = .0 PCT

NUM	ELEMENT	UNIT	CORRECT	PROTECT
5	Capital Treatment		----------|++	
7	Operations Waste Ret. & Transfer		-------|++	
1	Current Operations		----|++++	
4	Capital Waste Ret. & Transfer		----|+	
8	Operations Treatment		|++++	
	NET EFFECT OF FROZEN ELEMENTS		|	

REP/PC (Ver 4.0) - MGMT REPORT 4 CONTINGENCY PROFILE : 03-12-96

DATA : Phased Impl w/o Rep Fee Case10
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	10593	39.7	PCT
99.95	"	8381	31.4	"
95	"	4401	16.5	"
90	"	3515	13.2	"
85	"	3043	11.4	"
80	"	2637	9.9	"
75	"	2279	8.5	"
70	"	1945	7.3	"
65	"	1676	6.3	"
60	"	1401	5.3	"
55	"	1088	4.1	"
50	"	847	3.2	"
45	"	629	2.4	"
40	"	413	1.6	"
35	"	187	.7	"
30	"	-40	-.1	"
25	"	-379	-1.4	"
20	"	-610	-2.3	"
15	"	-850	-3.2	"
10	"	-1246	-4.7	"
5	"	-1708	-6.4	"
0.05	"	-4019	-15.0	"
0	"	-5610	-21.0	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE Safety: Nonradiological /Nontoxicological Occupational Accidents Including transportation - includes closure

ORIGINATOR Michael Harker DATE 02/12/96

REVISION NO. 0

OBJECTIVE Show injuries and fatalities from construction operation, and transportation accidents. Replaces Old Calcs. for the TWRS EIS Rev. C.

METHODOLOGY See attachments

ASSUMPTIONS See attachments

Occupational injury and fatality rates - taken from the Occupational Injuries Summary Report, January - Dec. 1993 DOE/EH/01570-H5. Truck and Rail Transport incidence rates - taken from Non-Radiological Impacts of Transporting Radioactive Material. SAND81-1703 1982. Employee Transportation incidence rates - taken from 1993 Washington State Highway Accident Report. Round trip distance from Tri-Cities=1.40E+02 km; from Portland/Seattle = 8.00E+02 km. Carpool factor of 1.35/car from SIS EIS DOE/EIS-0212 1994.

(Continue on another sheet if necessary)

3-18-96
SIGNATURE/DATE

C. Henderson 3-19-96
CHECKED/DATE

CALCULATION & RESULTS
ATTACHED

JACOBS\FORMS\NONTOX.RAD\CALCVR.SHT

	EX SITU INTERMEDIATE SEPARATIONS ALTERNATIVE							
RETRIEVAL								
Waste Transport						total		
Onsite Truck						1.25E+04		
							Total	1.25E+04
Construction								
Offsite Truck			trips/yr	km/trip	yr	total		
	concrete		4.80E+02	1.40E+02	2.00E+01	1.34E+06		
	raw material		4.50E+01	8.00E+02	2.00E+01	7.20E+05		
	equipment		2.50E+01	1.00E+04	2.00E+01	5.00E+06		
	miscellaneous		5.20E+03	1.40E+02	2.00E+01	1.46E+07		
	steel W-314		5.30E+01	8.00E+02		4.24E+04		
	cement W-314		1.00E+02	1.40E+02		1.40E+04	Total	2.17E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	raw material		1.00E+01	8.00E+02	2.00E+01	1.60E+05	Total	1.60E+05
Onsite Truck								
	borrow W-314		1.38E+03	1.00E+01		1.38E+04	Total	1.38E+04
VITRIFICATION								
Construction								
Onsite Truck			trips	km/trip		total		
	borrow		1.69E+05	1.00E+01		1.69E+06		
							Total	1.69E+06
Offsite Truck			trips	km/trip		total		
	concrete		5.45E+04	1.40E+02		7.63E+06		
	steel		1.51E+04	8.00E+02		1.21E+07		
			trips/yr	km/trip	yr			
	miscellaneous		7.54E+03	1.40E+02	1.00E+01	1.06E+07		
							Total	3.03E+07
Processing								
Offsite Truck			trips/yr	km/trip	yr	total		
	glassformer/chem		2.30E+03	8.00E+02	1.90E+01	3.50E+07		
	miscellaneous		6.70E+03	1.40E+02	1.90E+01	1.78E+07		
							Total	5.28E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	glassformer/chem		2.74E+02	8.00E+02	1.90E+01	4.16E+06		
							Total	4.16E+06
VITRIFIED HLW TRANSPORT								
Offsite Rail			trips	km/trip		total		
	Yucca Mountain		8.35E+02	4.28E+03		3.57E+06		
							Total	3.57E+06
CLOSURE								
Onsite Truck			cu yd	trip/cu yd	km/trip	total		
	fill		9.86E+05	1.00E-01	1.00E+01	9.86E+05		
	silt		8.53E+05	1.00E-01	3.00E+01	2.56E+06		
	riprap		1.22E+06	1.00E-01	3.20E+01	3.90E+06		
	ag/sand		1.00E+06	1.00E-01	1.00E+01	1.00E+06		
							Total	8.45E+06
GROUT FILL IMUST								
Onsite Truck	sand/gravel		2.20E+03	1.00E+01		2.20E+04	Total	2.20E+04
Offsite Truck	cement		4.63E+02	1.40E+02		6.48E+04	Total	6.48E+04
Onsite Truck (km)		1.02E+07						
Onsite Rail (km)		0.00E+00						
Offsite Truck (km)		1.05E+08						
Offsite Rail (km)		7.90E+06						
EMPLOYEE VEHICLE								
Retrieval		person-yr	trip/yr	km/trip	car pool	total		
	Const.	1.06E+04	2.60E+02	1.40E+02	7.41E-01	2.86E+08		
	Ops/D&D	3.74E+04	2.60E+02	1.40E+02	7.41E-01	1.01E+09		
Vitrification								
	Const.	1.98E+04	2.60E+02	1.40E+02	7.41E-01	5.34E+08		
	Ops/D&D	1.73E+04	2.60E+02	1.40E+02	7.41E-01	4.67E+08		
Closure		4.90E+02	2.60E+02	1.40E+02	7.41E-01	1.32E+07		
							Total	2.31E+09

Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	1.05E+08	5.00E-02			5.24E+06		
	Rail	7.90E+06	5.00E-02			3.95E+05		
Suburban								
	Truck	1.05E+08	5.00E-02		1.02E+07	1.54E+07		
	Rail	7.90E+06	5.00E-02			3.95E+05		
Rural								
	Truck	1.05E+08	9.00E-01			9.43E+07		
	Rail	7.90E+06	9.00E-01			7.11E+06		
Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			5.24E+06	3.95E+05	1.54E+07	3.95E+05	9.43E+07	7.11E+06
urban truck fat/km		7.50E-09	3.93E-02					
urban truck inj/km		3.70E-07	1.94E+00					
urban rail fat/km		1.70E-08		6.71E-03				
urban rail inj/km		3.30E-08		1.30E-02				
sub truck fat.km		1.30E-08			2.01E-01			
sub truck inj/km		3.80E-07			5.86E+00			
sub rail fat/km		1.70E-08				6.71E-03		
sub rail inj/km		3.30E-08				1.30E-02		
rural truck fat/km		5.30E-08					5.00E+00	
rural truck inj/km		8.00E-07					7.55E+01	
rural rail fat/km		1.70E-08						1.21E-01
rural rail inj/km		3.30E-08						2.35E-01
	TOTAL FATALITIES		5.37E+00					
	TOTAL INJURIES		8.35E+01					
Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	2.31E+09	8.98E-09	2.07E+01				
	injuries	2.31E+09	7.14E-07	1.65E+03				
Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		5.37E+00	2.07E+01	2.61E+01			
	INJURIES		8.35E+01	1.65E+03	1.73E+03			
CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	3.09E+04	=	3011.775			
	LWC =	2.45E-02	3.09E+04	=	756.805			
	Fatality =	3.20E-05	3.09E+04	=	0.98848			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	5.47E+04	=	1203.4			
	LWC =	1.10E-02	5.47E+04	=	601.7			
	Fatality =	3.20E-05	5.47E+04	=	1.7504			
TOTALS								
	INJUR	5.95E+03						
	FATAL	2.88E+01						

			EX SITU NO SEPARATIONS ALTERNATIVE					
				VITRIFICATION				
RETRIEVAL								
Waste Transport						total		
Onsite Truck						1.25E+04	Total	1.25E+04
Construction								
Offsite Truck			trips/yr	km/trip	yr	total		
	concrete		4.80E+02	1.40E+02	2.00E+01	1.34E+06		
	raw material		4.50E+01	8.00E+02	2.00E+01	7.20E+05		
	equipment		2.50E+01	1.00E+04	2.00E+01	5.00E+06		
	miscellaneous		5.20E+03	1.40E+02	2.00E+01	1.46E+07		
	steel W-314		5.30E+01	8.00E+02		4.24E+04		
	cement/misc W-314		1.53E+02	1.40E+02		2.14E+04	Total	2.17E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	raw material		1.00E+01	8.00E+02	2.00E+01	1.60E+05	Total	1.60E+05
Onsite Truck								
	borrow W-314		1.38E+03	1.00E+01		1.38E+04	Total	1.38E+04
VITRIFICATION								
Construction								
Onsite Truck			trips	km/trip		total		
	borrow		1.18E+05	1.00E+01		1.18E+06	Total	1.18E+06
Offsite Truck			trips	km/trip		total		
	Tri Cities		4.38E+04	1.40E+02		6.13E+06		
	Portland/Seattle		4.34E+04	8.00E+02		3.47E+07		
			trips/yr	km/trip	yr			
	miscellaneous		5.20E+03	1.40E+02	5.50E+00	4.00E+06	Total	4.49E+07
Processing								
Offsite Truck			trips/yr	km/trip	yr	total		
	Portand/Seattle		4.17E+02	8.00E+02	1.50E+01	5.00E+06		
	miscellaneous		6.85E+03	1.40E+02	1.50E+01	1.44E+07	Total	1.94E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	Portland/Seattle		1.03E+02	8.00E+02	1.50E+01	1.24E+06	Total	1.24E+06
VITRIFIED HLW TRANSPORT								
Offsite Rail			trips	km/trip		total		
	Yucca Mountain		1.47E+04	4.28E+03		6.29E+07	Total	6.29E+07
CLOSURE								
Onsite Truck			cu yd	trip/cu yd	km/trip	total		
	fill		9.86E+05	1.00E-01	1.00E+01	9.86E+05		
	silt		4.93E+05	1.00E-01	3.00E+01	1.48E+06		
	riprap		8.35E+05	1.00E-01	3.20E+01	2.67E+06		
	ag/sand		5.43E+05	1.00E-01	1.00E+01	5.43E+05	Total	5.68E+06
GROUT FILL IMUST								
Onsite Truck sand/gravel			2.20E+03	1.00E+01		2.20E+04	Total	2.20E+04
Offsite Truick cement			4.63E+02	1.40E+02		6.48E+04	Total	6.48E+04
Onsite Truck (km)		6.91E+06						
Onsite Rail (km)		0.00E+00						
Offsite Truck (km)		8.60E+07						
Offsite Rail (km)		6.43E+07						
EMPLOYEE VEHICLE								
Retrieval		person-yr	trip/yr	km/trip	car pool	total		
	Const.	1.06E+04	2.60E+02	1.40E+02	7.41E-01	2.86E+08		
	Ops	3.15E+04	2.60E+02	1.40E+02	7.41E-01	8.50E+08		
Vitrification								
	Const.	1.48E+04	2.60E+02	1.40E+02	7.41E-01	3.99E+08		
	Ops	9.78E+03	2.60E+02	1.40E+02	7.41E-01	2.64E+08		
Closure		4.62E+02	2.60E+02	1.40E+02	7.41E-01	1.25E+07		
W-314		1.63E+02	2.60E+02	1.40E+02	7.41E-01	4.40E+06	Total	1.82E+09
	total	6.73E+04						

Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	8.60E+07	5.00E-02			4.30E+06		
	Rail	6.43E+07	5.00E-02			3.22E+06		
Suburban								
	Truck	8.60E+07	5.00E-02		6.91E+06	1.12E+07		
	Rail	6.43E+07	5.00E-02			3.22E+06		
Rural								
	Truck	8.60E+07	9.00E-01			7.74E+07		
	Rail	6.43E+07	9.00E-01			5.79E+07		
Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			4.30E+06	3.22E+06	1.12E+07	3.22E+06	7.74E+07	5.79E+07
urban truck fat/km		7.50E-09	3.22E-02					
urban truck inj/km		3.70E-07	1.59E+00					
urban rail fat/km		1.70E-08		5.47E-02				
urban rail inj/km		3.30E-08		1.06E-01				
sub truck fat.km		1.30E-08			1.46E-01			
sub truck inj/km		3.80E-07			4.26E+00			
sub rail fat/km		1.70E-08				5.47E-02		
sub rail inj/km		3.30E-08				1.06E-01		
rural truck fat/km		5.30E-08					4.10E+00	
rural truck inj/km		8.00E-07					6.19E+01	
rural rail fat/km		1.70E-08						9.84E-01
rural rail inj/km		3.30E-08						1.91E+00
	TOTAL FATALITIES		5.37E+00					
	TOTAL INJURIES		6.99E+01					
Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	1.82E+09	8.98E-09	1.63E+01				
	injuries	1.82E+09	7.14E-07	1.30E+03				
Cumulative fatalities/injuries from traffic impacts								
		-	transport	employee	TOTAL			
	FATALITIES		5.37E+00	1.63E+01	2.17E+01			
	INJURIES		6.99E+01	1.30E+03	1.37E+03			
CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	2.60E+04	=	2.54E+03			
	LWC =	2.45E-02	2.60E+04	=	6.38E+02			
	Fatality =	3.20E-05	2.60E+04	=	8.33E-01			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	4.13E+04	=	9.08E+02			
	LWC =	1.10E-02	4.13E+04	=	4.54E+02			
	Fatality =	3.20E-05	4.13E+04	=	1.32E+00			
TOTALS								
	INJUR	4.81E+03						
	FATAL	2.38E+01						

		EX SITU EXTENSIVE SEPARATIONS ALTERNATIVE						
RETRIEVAL								
Waste Transport						total		
Onsite Truck						1.25E+04	Total	1.25E+04
Construction								
Offsite Truck			trips/yr	km/trip	yr	total		
	concrete		4.80E+02	1.40E+02	2.00E+01	1.34E+06		
	raw material		4.50E+01	8.00E+02	2.00E+01	7.20E+05		
	equipment		2.50E+01	1.00E+04	2.00E+01	5.00E+06		
	miscellaneous		5.20E+03	1.40E+02	2.00E+01	1.46E+07		
	steel W-314		5.30E+01	8.00E+02		4.24E+04		
	cement/misc W-314		1.53E+02	1.40E+02		2.14E+04	Total	2.17E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	raw material		1.00E+01	8.00E+02	2.00E+01	1.60E+05	Total	1.60E+05
Onsite Truck								
	borrow		1.38E+03	1.00E+01		1.38E+04	Total	1.38E+04
VITRIFICATION								
Construction								
Onsite Truck			trips	km/trip		total		
	borrow		2.12E+05	1.00E+01		2.12E+06	Total	2.12E+06
Offsite Truck			trips	km/trip		total		
	Tri-Cities		1.07E+05	1.40E+02		1.50E+07		
	Portland/Seattle		2.62E+04	8.00E+02		2.10E+07		
			trips/yr	km/trip	yr			
	miscellaneous		5.20E+03	1.40E+02	9.00E+00	6.55E+06	Total	4.25E+07
Processing								
Offsite Truck			trips/yr	km/trip	yr	total		
	glassformer/chem		2.17E+03	8.00E+02	1.90E+01	3.30E+07		
	miscellaneous		5.20E+03	1.40E+02	1.90E+01	1.38E+07	Total	4.68E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	glassformer/chem		6.77E+02	8.00E+02	1.90E+01	1.03E+07	Total	1.03E+07
VITRIFIED HLW TRANSPORT								
Offsite Rail			trips	km/trip		total		
	Yucca Mountain		4.00E+01	4.28E+03		1.71E+05	Total	1.71E+05
CLOSURE								
Onsite Truck			cu yd	trip/cu yd	km/trip	total		
	fill		9.86E+05	1.00E-01	1.00E+01	9.86E+05		
	silt		8.53E+05	1.00E-01	3.00E+01	2.56E+06		
	riprap		1.22E+06	1.00E-01	3.20E+01	3.90E+06		
	ag/sand		1.00E+06	1.00E-01	1.00E+01	1.00E+06	Total	8.45E+06
GROUT FILL IMUST								
Onsite Truck sand/gravel			2.20E+03	1.00E+01		2.20E+04	Total	2.20E+04
Offsite Truck cement			4.63E+02	1.40E+02		6.48E+04	Total	6.48E+04
Onsite Truck (km)		1.06E+07						
Onsite Rail (km)		0						
Offsite Truck (km)		1.11E+08						
Offsite Rail (km)		1.06E+07						
EMPLOYEE VEHICLE								
Retrieval		person-yr	trip/yr	km/trip	car pool	total		
	Const.	1.06E+04	2.60E+02	1.40E+02	7.41E-01	2.86E+08		
	Ops/D&D	3.74E+04	2.60E+02	1.40E+02	7.41E-01	1.01E+09		
Vitrification								
	Const.	2.58E+04	2.60E+02	1.40E+02	7.41E-01	6.96E+08		
	Ops/D&D	6.95E+03	2.60E+02	1.40E+02	7.41E-01	1.87E+08		
Closure		4.90E+02	2.60E+02	1.40E+02	7.41E-01	1.32E+07		
	total	8.12E+04					Total	2.19E+09

Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	1.11E+08	5.00E-02			5.55E+06		
	Rail	1.06E+07	5.00E-02			5.31E+05		
Suburban								
	Truck	1.11E+08	5.00E-02		1.06E+07	1.62E+07		
	Rail	1.06E+07	5.00E-02			5.31E+05		
Rural								
	Truck	1.11E+08	9.00E-01			1.00E+08		
	Rail	1.06E+07	9.00E-01			9.56E+06		
Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			5.55E+06	5.31E+05	1.62E+07	5.31E+05	1.00E+08	9.56E+06
urban truck fat/km		7.50E-09	4.16E-02					
urban truck inj/km		3.70E-07	2.05E+00					
urban rail fat/km		1.70E-08		9.03E-03				
urban rail inj/km		3.30E-08		1.75E-02				
sub truck fat.km		1.30E-08			2.10E-01			
sub truck inj/km		3.80E-07			6.14E+00			
sub rail fat/km		1.70E-08				9.03E-03		
sub rail inj/km		3.30E-08				1.75E-02		
rural truck fat/km		5.30E-08					5.30E+00	
rural truck inj/km		8.00E-07					8.00E+01	
rural rail fat/km		1.70E-08						1.63E-01
rural rail inj/km		3.30E-08						3.15E-01
	TOTAL FATALITIES		5.73E+00					
	TOTAL INJURIES		8.85E+01					
Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	2.19E+09	8.98E-09	1.97E+01				
	injuries	2.19E+09	7.14E-07	1.56E+03				
Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		5.73E+00	1.97E+01	2.54E+01			
	INJURIES		8.85E+01	1.56E+03	1.65E+03			
CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	3.69E+04	=	3596.775			
	LWC =	2.45E-02	3.69E+04	=	903.805			
	Fatality =	3.20E-05	3.69E+04	=	1.18048			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	4.44E+04	=	975.7			
	LWC =	1.10E-02	4.44E+04	=	487.85			
	Fatality =	3.20E-05	4.44E+04	=	1.4192			
TOTALS								
	INJUR	6.23E+03						
	FATAL	2.80E+01						

	IN SITU VITRIFICATION ALTERNATIVE							
RETRIEVAL								
Waste Transport								
Onsite Truck						0.00E+00		
							Total	0.00E+00
Construction - (W-314)								
Offsite Truck			trips	km/trip		total		
	steel		5.30E+01	8.00E+02		4.24E+04		
	cement		1.00E+02	1.40E+02		1.40E+04		
	miscellaneous		5.30E+01	1.40E+02		7.42E+03		
							Total	6.38E+04
Onsite Truck			trips	km/trip		total		
	borrow		1.38E+03	1.00E+01		1.38E+04		
							Total	1.38E+04
VITRIFICATION								
Construction								
Onsite Truck			trips	km/trip		total		
	borrow		2.12E+05	1.00E+01		2.12E+06		
							Total	2.12E+06
Offsite Truck			trips/yr	km/trip	yr	total		
	miscellaneous		5.20E+03	1.40E+02	1.90E+01	1.38E+07		
							Total	1.38E+07
Offsite Rail			cars	trip/cars	km/trip	total		
	steel		2.60E+03	5.00E-02	8.00E+02	1.04E+05		
	cement		1.70E+03	5.00E-02	8.00E+02	6.80E+04		
							Total	1.72E+05
Processing								
Offsite Truck			trips/yr	km/trip	yr	total		
	miscellaneous		5.20E+03	1.40E+02	1.20E+01	8.74E+06		
							Total	8.74E+06
Offsite Rail			trips/yr	km/trip	yr	total		
	chem.		4.00E+00	8.00E+02	1.20E+01	3.84E+04		
							Total	3.84E+04
Grout Fill IMUSTs (outside tank farm areas)								
Onsite Truck			trips	km/trip		total		
	sand/gravel		7.70E+02	1.00E+01		7.70E+03	Total	7.70E+03
Offsite Truck			trips	km/trip		total		
	cement		1.60E+02	1.40E+02		2.24E+04	Total	2.24E+04
CLOSURE								
Onsite Truck			cu yd	trip/cu yd	km/trip	total		
	fill		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
	silt		4.93E+05	1.00E-01	3.00E+01	1.48E+06		
	riprap		8.34E+05	1.00E-01	3.20E+01	2.67E+06		
	ag/sand		5.43E+05	1.00E-01	1.00E+01	5.43E+05		
							Total	4.69E+06
Onsite Truck (km)		6.83E+06						
Onsite Rail (km)		0						
Offsite Truck (km)		2.27E+07						
Offsite Rail (km)		2.10E+05						
EMPLOYEE VEHICLE								
Routine		person-yr	trip/yr	km/trip	car pool	total		
	W-314	1.63E+02	2.60E+02	1.40E+02	7.41E-01	4.40E+06		
	Ops	1.83E+04	2.60E+02	1.40E+02	7.41E-01	4.94E+08		
Vitrification								
	Const.	2.20E+04	2.60E+02	1.40E+02	7.41E-01	5.93E+08		
	Ops/D&D	8.05E+03	2.60E+02	1.40E+02	7.41E-01	2.17E+08		
Closure		3.19E+02	2.60E+02	1.40E+02	7.41E-01	8.60E+06		
							Total	1.32E+09

Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	2.27E+07	5.00E-02			1.13E+06		
	Rail	2.10E+05	5.00E-02			1.05E+04		
Suburban								
	Truck	2.27E+07	5.00E-02		6.83E+06	7.97E+06		
	Rail	2.10E+05	5.00E-02			1.05E+04		
Rural								
	Truck	2.27E+07	9.00E-01			2.04E+07		
	Rail	2.10E+05	9.00E-01			1.89E+05		
Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			1.13E+06	1.05E+04	7.97E+06	1.05E+04	2.04E+07	1.89E+05
urban truck fat/km		7.50E-09	8.50E-03					
urban truck inj/km		3.70E-07	4.19E-01					
urban rail fat/km		1.70E-08		1.79E-04				
urban rail inj/km		3.30E-08		3.47E-04				
sub truck fat.km		1.30E-08			1.04E-01			
sub truck inj/km		3.80E-07			3.03E+00			
sub rail fat/km		1.70E-08				1.79E-04		
sub rail inj/km		3.30E-08				3.47E-04		
rural truck fat/km		5.30E-08					1.08E+00	
rural truck inj/km		8.00E-07					1.63E+01	
rural rail fat/km		1.70E-08						3.22E-03
rural rail inj/km		3.30E-08						6.25E-03
	TOTAL FATALITIES		1.20E+00					
	TOTAL INJURIES		1.98E+01					
Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	1.32E+09	8.98E-09	1.18E+01				
	injuries	1.32E+09	7.14E-07	9.40E+02				
Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		1.20E+00	1.18E+01	1.30E+01			
	INJURIES		1.98E+01	9.40E+02	9.60E+02			
CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	2.25E+04	=	2191.995			
	LWC =	2.45E-02	2.25E+04	=	550.809			
	Fatality =	3.20E-05	2.25E+04	=	0.719424			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	2.64E+04	=	579.7			
	LWC =	1.10E-02	2.64E+04	=	289.85			
	Fatality =	3.20E-05	2.64E+04	=	0.8432			
TOTALS								
	INJUR	3.73E+03						
	FATAL	1.46E+01						

			NO ACTION ALTERNATIVE					
RETRIEVAL								
Waste Transport								
Onsite Truck						0.00E+00		
							Total	0.00E+00
Construction								
Offsite Truck			trips/yr	km/trip	yr	total		
	concrete		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
	raw material		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
	equipment		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
	miscellaneous		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
							Total	0.00E+00
Offsite Rail			trips/yr	km/trip	yr	total		
	raw material		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
							Total	0.00E+00
ROUTINE								
Construction								
Onsite Truck			trips	km/trip		total		
	borrow		0.00E+00	0.00E+00		0.00E+00		
							Total	0.00E+00
Offsite Truck			trips/yr	km/trip	yr	total		
	miscellaneous		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
			trips	km/trip				
	Tri-Cities		0.00E+00	0.00E+00		0.00E+00		
	Portland/Seattle		0.00E+00	0.00E+00		0.00E+00		
							Total	0.00E+00
	Onsite Truck (km)		0.00E+00					
	Onsite Rail (km)		0.00E+00					
	Offsite Truck (km)		0.00E+00					
	Offsite Rail (km)		0.00E+00					
EMPLOYEE VEHICLE								
Routine		person-yr	trip/yr	km/trip	car pool	total		
	Const.	0.00E+00				0.00E+00		
	Ops	1.04E+05	2.60E+02	1.40E+02	7.41E-01	2.81E+09		
							Total	2.81E+09
Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	0.00E+00	5.00E-02			0.00E+00		
	Rail	0.00E+00	5.00E-02			0.00E+00		
Suburban								
	Truck	0.00E+00	5.00E-02		0.00E+00	0.00E+00		
	Rail	0.00E+00	5.00E-02			0.00E+00		
Rural								
	Truck	0.00E+00	9.00E-01			0.00E+00		
	Rail	0.00E+00	9.00E-01			0.00E+00		

Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
urban truck fat/km		7.50E-09	0.00E+00					
urban truck inj/km		3.70E-07	0.00E+00					
urban rail fat/km		1.70E-08		0.00E+00				
urban rail inj/km		3.30E-08		0.00E+00				
sub truck fat.km		1.30E-08			0.00E+00			
sub truck inj/km		3.80E-07			0.00E+00			
sub rail fat/km		1.70E-08				0.00E+00		
sub rail inj/km		3.30E-08				0.00E+00		
rural truck fat/km		5.30E-08					0.00E+00	
rural truck inj/km		8.00E-07					0.00E+00	
rural rail fat/km		1.70E-08						0.00E+00
rural rail inj/km		3.30E-08						0.00E+00
	TOTAL FATALITIES		0.00E+00					
	TOTAL INJURIES		0.00E+00					

Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	2.81E+09	8.98E-09	2.52E+01				
	injuries	2.81E+09	7.14E-07	2.00E+03				

Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		0.00E+00	2.52E+01	2.52E+01			
	INJURIES		0.00E+00	2.00E+03	2.00E+03			
CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	0.00E+00	=	0			
	LWC =	2.45E-02	0.00E+00	=	0			
	Fatality =	3.20E-05	0.00E+00	=	0			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	1.04E+05	=	2288			
	LWC =	1.10E-02	1.04E+05	=	1144			
	Fatality =	3.20E-05	1.04E+05	=	3.328			
TOTALS								
	INJUR	4.29E+03						
	FATAL	2.85E+01						

REP/PC (Ver 4.0) - MGMT REPORT 3 GRAPHICAL PRIORITY PROFILE : 03-20-96

DATA : ExSitu/InSituCombo w/o RF Case09
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
19516	66 PCT	0 = .0 PCT

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NUM ELEMENT                                UNIT     CORRECT        PROTECT

  1 Current Operations                                 ---------|++++++++++
  5 Capital Treatment                             -------------|++
  7 Operations Waste Ret. & Transfer                -----------|+++
  4 Capital Waste Ret. & Transfer                         -----|+
  8 Operations Treatment                                       |++++
    NET EFFECT OF FROZEN ELEMENTS                              |
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		ONSITE DRY STORAGE ALTERNATIVE							
ROUTINE									
Construction									
Onsite Truck			trips	km/trip		total			
	borrow		1.00E+02	1.00E+01		1.00E+03			
							Total	1.00E+03	
Offsite Truck			trips	km/trip		total			
	encasement pipe		1.40E+01	8.00E+02		1.12E+04			
	WESF modification		2.00E+02	1.40E+02		2.80E+04			
							Total	3.92E+04	
Capsule Transport									
Onsite Truck			trips	km/trip		total			
	to dry storage		1.84E+02	3.20E+01		5.89E+03			
							Total	5.89E+03	
		Onsite Truck (km)		6.89E+03					
		Onsite Rail (km)		0.00E+00					
		Offsite Truck (km)		3.92E+04					
		Offsite Rail (km)		0.00E+00					
EMPLOYEE VEHICLE									
Routine		person-yr	trip/yr	km/trip	car pool	total			
	Const.	2.10E+02	2.60E+02	1.40E+02	7.41E-01	5.66E+06			
	Packaging	1.94E+02	2.60E+02	1.40E+02	7.41E-01	5.23E+06			
	Storage	8.90E+02	2.60E+02	1.40E+02	7.41E-01	2.40E+07			
							Total	3.49E+07	
Distance traveled in population zones									
Urban		Offsite km	zone fraction		Onsite	TOTALS			
	Truck	3.92E+04	5.00E-02			1.96E+03			
	Rail	0.00E+00	5.00E-02			0.00E+00			
Suburban									
	Truck	3.92E+04	5.00E-02		6.89E+03	8.85E+03			
	Rail	0.00E+00	5.00E-02			0.00E+00			
Rural									
	Truck	3.92E+04	9.00E-01			3.53E+04			
	Rail	0.00E+00	9.00E-01			0.00E+00			
Fatalities/Injuries resulting from Truck and Rail transportation accidents									
			urban km		suburban km		rural km		

			truck	rail	truck	rail	truck	rail
			1.96E+03	0.00E+00	8.85E+03	0.00E+00	3.53E+04	0.00E+00
urban truck fat/km		7.50E-09	1.47E-05					
urban truck inj/km		3.70E-07	7.25E-04					
urban rail fat/km		1.70E-08		0.00E+00				
urban rail inj/km		3.30E-08		0.00E+00				
sub truck fat.km		1.30E-08			1.15E-04			
sub truck inj/km		3.80E-07			3.36E-03			
sub rail fat/km		1.70E-08				0.00E+00		
sub rail inj/km		3.30E-08				0.00E+00		
rural truck fat/km		5.30E-08					1.87E-03	
rural truck inj/km		8.00E-07					2.82E-02	
rural rail fat/km		1.70E-08						0.00E+00
rural rail inj/km		3.30E-08						0.00E+00
	TOTAL FATALITIES		2.00E-03					
	TOTAL INJURIES		3.23E-02					
Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	3.49E+07	8.98E-09	3.13E-01				
	injuries	3.49E+07	7.14E-07	2.49E+01				
Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		2.00E-03	3.13E-01	3.15E-01			
	INJURIES		3.23E-02	2.49E+01	2.50E+01			
CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	2.10E+02	=	20.475			
	LWC =	2.45E-02	2.10E+02	=	5.145			
	Fatality =	3.20E-05	2.10E+02	=	0.00672			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	1.08E+03	=	23.848			
	LWC =	1.10E-02	1.08E+03	=	11.924			
	Fatality =	3.20E-05	1.08E+03	=	0.034688			
TOTALS								
	INJUR	6.93E+01						
	FATAL	3.57E-01						

		OVERPACK AND SHIP ALTERNATIVE							
ROUTINE									
Construction									
Onsite Truck			trips	km/trip		total			
	borrow		0.00E+00	0.00E+00		0.00E+00			
							Total	0.00E+00	
Offsite Truck			trips	km/trip		total			
	encasement pipe		0.00E+00	0.00E+00		0.00E+00			
	WESF modification		2.00E+02	1.40E+02		2.80E+04			
							Total	2.80E+04	
Capsule Transport									
Offsite Rail			trips	km/trip		total			
	Yucca		5.00E+00	2.93E+03		1.47E+04			
							Total	1.47E+04	
		Onsite Truck (km)		0.00E+00					
		Onsite Rail (km)		0.00E+00					
		Offsite Truck (km)		2.80E+04					
		Offsite Rail (km)		1.47E+04					
EMPLOYEE VEHICLE									
Routine		person-yr	trip/yr	km/trip	car pool	total			
	Const.	1.00E+02	2.60E+02	1.40E+02	7.41E-01	2.70E+06			
	Packaging	5.10E+01	2.60E+02	1.40E+02	7.41E-01	1.38E+06			
	Storage	9.00E+01	2.60E+02	1.40E+02	7.41E-01	2.43E+06			
							Total	6.50E+06	
Distance traveled in population zones									
Urban		Offsite km	zone fraction		Onsite	TOTALS			
	Truck	2.80E+04	5.00E-02			1.40E+03			
	Rail	1.47E+04	5.00E-02			7.33E+02			
Suburban									
	Truck	2.80E+04	5.00E-02		0.00E+00	1.40E+03			
	Rail	1.47E+04	5.00E-02			7.33E+02			
Rural									
	Truck	2.80E+04	9.00E-01			2.52E+04			
	Rail	1.47E+04	9.00E-01			1.32E+04			
Fatalities/Injuries resulting from Truck and Rail transportation accidents									
			urban km		suburban km		rural km		
			truck	rail	truck	rail	truck	rail	

			1.40E+03	7.33E+02	1.40E+03	7.33E+02	2.52E+04	1.32E+04	
urban truck fat/km		7.50E-09	1.05E-05						
urban truck inj/km		3.70E-07	5.18E-04						
urban rail fat/km		1.70E-08		1.25E-05					
urban rail inj/km		3.30E-08		2.42E-05					
sub truck fat.km		1.30E-08			1.82E-05				
sub truck inj/km		3.80E-07			5.32E-04				
sub rail fat/km		1.70E-08				1.25E-05			
sub rail inj/km		3.30E-08				2.42E-05			
rural truck fat/km		5.30E-08					1.34E-03		
rural truck inj/km		8.00E-07					2.02E-02		
rural rail fat/km		1.70E-08						2.24E-04	
rural rail inj/km		3.30E-08						4.35E-04	
	TOTAL FATALITIES		1.61E-03						
	TOTAL INJURIES		2.17E-02						
Fatalities/Injuries resulting from Employee vehicle accidents									
		km	rate/km	TOTAL					
	fatalities	6.50E+06	8.98E-09	5.84E-02					
	injuries	6.50E+06	7.14E-07	4.64E+00					
Cumulative fatalities/injuries from traffic impacts									
			transport	employee	TOTAL				
	FATALITIES		1.61E-03	5.84E-02	6.00E-02				
	INJURIES		2.17E-02	4.64E+00	4.66E+00				
CONSTRUCTION ACCIDENTS									
		rate	person-yr						
	TRC =	9.75E-02	1.00E+02	=	9.75				
	LWC =	2.45E-02	1.00E+02	=	2.45				
	Fatality =	3.20E-05	1.00E+02	=	0.0032				
OPERATION ACCIDENTS									
		rate	person-yr						
	TRC =	2.20E-02	1.41E+02	=	3.102				
	LWC =	1.10E-02	1.41E+02	=	1.551				
	Fatality =	3.20E-05	1.41E+02	=	0.004512				
TOTALS									
	INJUR	1.75E+01							
	FATAL	6.77E-02							

		VITRIFY WITH TANK WASTE ALTERNATIVE							
ROUTINE									
Construction									
Onsite Truck			trips	km/trip		total			
	borrow		0.00E+00	0.00E+00		0.00E+00			
							Total	0.00E+00	
Offsite Truck			trips	km/trip		total			
	encasement pipe		0.00E+00	0.00E+00		0.00E+00			
	WESF modification		2.00E+02	1.40E+02		2.80E+04			
							Total	2.80E+04	
Capsule Transport									
Onsite Truck			trips	km/trip		total			
	to vitrification plant		1.84E+02	3.20E+01		5.89E+03			
							Total	5.89E+03	
		Onsite Truck (km)		5.89E+03					
		Onsite Rail (km)		0.00E+00					
		Offsite Truck (km)		2.80E+04					
		Offsite Rail (km)		0.00E+00					
EMPLOYEE VEHICLE									
Routine		person-yr	trip/yr	km/trip	car pool	total			
	Const.	1.00E+02	2.60E+02	1.40E+02	7.41E-01	2.70E+06			
	Packaging	5.10E+01	2.60E+02	1.40E+02	7.41E-01	1.38E+06			
	Storage	9.00E+01	2.60E+02	1.40E+02	7.41E-01	2.43E+06			
							Total	6.50E+06	
Distance traveled in population zones									
Urban		Offsite km	zone fraction		Onsite	TOTALS			
	Truck	2.80E+04	5.00E-02			1.40E+03			
	Rail	0.00E+00	5.00E-02			0.00E+00			
Suburban									
	Truck	2.80E+04	5.00E-02		0.00E+00	1.40E+03			
	Rail	0.00E+00	5.00E-02			0.00E+00			
Rural									
	Truck	2.80E+04	9.00E-01			2.52E+04			
	Rail	0.00E+00	9.00E-01			0.00E+00			
Fatalities/Injuries resulting from Truck and Rail transportation accidents									
			urban km		suburban km		rural km		
			truck	rail	truck	rail	truck	rail	

			1.40E+03	0.00E+00	1.40E+03	0.00E+00	2.52E+04	0.00E+00	
urban truck fat/km		7.50E-09	1.05E-05						
urban truck inj/km		3.70E-07	5.18E-04						
urban rail fat/km		1.70E-08		0.00E+00					
urban rail inj/km		3.30E-08		0.00E+00					
sub truck fat.km		1.30E-08			1.82E-05				
sub truck inj/km		3.80E-07			5.32E-04				
sub rail fat/km		1.70E-08				0.00E+00			
sub rail inj/km		3.30E-08				0.00E+00			
rural truck fat/km		5.30E-08					1.34E-03		
rural truck inj/km		8.00E-07					2.02E-02		
rural rail fat/km		1.70E-08						0.00E+00	
rural rail inj/km		3.30E-08						0.00E+00	
	TOTAL FATALITIES		1.36E-03						
	TOTAL INJURIES		2.12E-02						
Fatalities/Injuries resulting from Employee vehicle accidents									
		km	rate/km	TOTAL					
	fatalities	6.50E+06	8.98E-09	5.84E-02					
	injuries	6.50E+06	7.14E-07	4.64E+00					
Cumulative fatalities/injuries from traffic impacts									
			transport	employee	TOTAL				
	FATALITIES		1.36E-03	5.84E-02	5.97E-02				
	INJURIES		2.12E-02	4.64E+00	4.66E+00				
CONSTRUCTION ACCIDENTS									
		rate	person-yr						
	TRC =	9.75E-02	1.00E+02	=	9.75				
	LWC =	2.45E-02	1.00E+02	=	2.45				
	Fatality =	3.20E-05	1.00E+02	=	0.0032				
OPERATION ACCIDENTS									
		rate	person-yr						
	TRC =	2.20E-02	1.41E+02	=	3.102				
	LWC =	1.10E-02	1.41E+02	=	1.551				
	Fatality =	3.20E-05	1.41E+02	=	0.004512				
TOTALS									
	INJUR	1.75E+01							
	FATAL	6.74E-02							

			IN SITU FILL AND CAP					
Construction - (W-314)								
Offsite Truck			trips	km/trip		total		
	steel		5.30E+01	8.00E+02		4.24E+04		
	cement		1.00E+02	1.40E+02		1.40E+04		
	miscellaneous		5.30E+01	1.40E+02		7.42E+03		
							Total	6.38E+04
Onsite Truck			trips	km/trip	yr	total		
	borrow		1.38E+03	1.00E+01		1.38E+04		
							Total	1.38E+04
Grout Fill IMUSTs								
Construction								
Onsite Truck			trips	km/trip		total		
	sand/gravel		2.20E+03	1.00E+01		2.20E+04		
							Total	2.20E+04
Offsite Truck			trips	km/trip		total		
	cement		4.63E+02	1.40E+02		6.48E+04		
	Portland/Seattle		0.00E+00	0.00E+00		0.00E+00		
			trips/yr	km/trip	yr			
	miscellaneous		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
							Total	6.48E+04
Processing								
Offsite Truck			trips/yr	km/trip	yr	total		
	glassformer/chem		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
	miscellaneous		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
							Total	0.00E+00
Offsite Rail			trips/yr	km/trip	yr	total		
	glassformer/chem		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
							Total	0.00E+00
VITRIFIED HLW TRANSPORT								
Offsite Rail			trips	km/trip		total		
	Yucca Mountain		0.00E+00	0.00E+00		0.00E+00		
							Total	0.00E+00
CLOSURE								
Onsite Truck			cu yd	trip/cu yd	km/trip	total		
	fill		9.03E+05	1.00E-01	1.00E+01	9.03E+05		
	silt		4.93E+05	1.00E-01	3.00E+01	1.48E+06		
	riprap		8.34E+05	1.00E-01	3.20E+01	2.67E+06		
	ag/sand		5.43E+05	1.00E-01	1.00E+01	5.43E+05		
							Total	5.59E+06
Onsite Truck (km)		5.63E+06						
Onsite Rail (km)		0						
Offsite Truck (km)		1.29E+05						
Offsite Rail (km)		0.00E+00						
EMPLOYEE VEHICLE								
Routine		person-yr	trip/yr	km/trip	car pool	total		
	W-314	1.63E+02	2.60E+02	1.40E+02	7.41E-01	4.40E+06		
	Ops/D&D	2.39E+04	2.60E+02	1.40E+02	7.41E-01	6.45E+08		
Fill Tanks with Gravel								
	Const.	9.50E+01	2.60E+02	1.40E+02	7.41E-01	2.56E+06		
	Ops/D&D	1.51E+03	2.60E+02	1.40E+02	7.41E-01	4.07E+07		
Closure		4.67E+02	2.60E+02	1.40E+02	7.41E-01	1.26E+07		
	total	2.61E+04					Total	7.05E+08
Distance traveled in population zones								

Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	1.29E+05	5.00E-02			6.43E+03		
	Rail	0.00E+00	5.00E-02			0.00E+00		
Suburban								
	Truck	1.29E+05	5.00E-02		5.63E+06	5.64E+06		
	Rail	0.00E+00	5.00E-02			0.00E+00		
Rural								
	Truck	1.29E+05	9.00E-01			1.16E+05		
	Rail	0.00E+00	9.00E-01			0.00E+00		

Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			6.43E+03	0.00E+00	5.64E+06	0.00E+00	1.16E+05	0.00E+00
urban truck fat/km		7.50E-09	4.82E-05					
urban truck inj/km		3.70E-07	2.38E-03					
urban rail fat/km		1.70E-08		0.00E+00				
urban rail inj/km		3.30E-08		0.00E+00				
sub truck fat.km		1.30E-08			7.33E-02			
sub truck inj/km		3.80E-07			2.14E+00			
sub rail fat/km		1.70E-08				0.00E+00		
sub rail inj/km		3.30E-08				0.00E+00		
rural truck fat/km		5.30E-08					6.14E-03	
rural truck inj/km		8.00E-07					9.26E-02	
rural rail fat/km		1.70E-08						0.00E+00
rural rail inj/km		3.30E-08						0.00E+00
	TOTAL FATALITIES		7.95E-02					
	TOTAL INJURIES		2.24E+00					

Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	7.05E+08	8.98E-09	6.33E+00				
	injuries	7.05E+08	7.14E-07	5.03E+02				

Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		7.95E-02	6.33E+00	6.41E+00			
	INJURIES		2.24E+00	5.03E+02	5.06E+02			

CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	7.25E+02	=	70.6875			
	LWC =	2.45E-02	7.25E+02	=	17.7625			
	Fatality =	3.20E-05	7.25E+02	=	0.0232			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	2.54E+04	=	559.02			
	LWC =	1.10E-02	2.54E+04	=	279.51			
	Fatality =	3.20E-05	2.54E+04	=	0.81312			
TOTALS								
	INJUR	1.14E+03						
	FATAL	7.25E+00						

			EX SITU COMBINATION					
RETRIEVAL								
Waste Transport						total		
Onsite Truck						0.00E+00		
Construction								
Offsite Truck			trips/yr	km/trip	yr	total		
	concrete		2.40E+02	1.40E+02	2.00E+01	6.72E+05		
	raw material		2.25E+01	8.00E+02	2.00E+01	3.60E+05		
	equipment		1.25E+01	1.00E+04	2.00E+01	2.50E+06		
	miscellaneous		2.60E+03	1.40E+02	2.00E+01	7.28E+06		
	steel W-314		5.30E+01	8.00E+02		4.24E+04		
	cement/misc W-314		1.53E+02	1.40E+02		2.14E+04	Total	1.09E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	raw material		5.00E+00	8.00E+02	2.00E+01	8.00E+04	Total	8.00E+04
Onsite Truck								
	borrow W-314		1.38E+03	1.00E+01		1.38E+04	Total	1.38E+04
VITRIFICATION								
Construction								
Onsite Truck			trips	km/trip		total		
	borrow		8.40E+04	1.00E+01		8.40E+05	Total	8.40E+05
Offsite Truck			trips	km/trip		total		
	concrete		2.30E+04	1.40E+02		3.22E+06		
	steel		9.10E+03	8.00E+02		7.28E+06		
			trips/yr	km/trip	yr			
	miscellaneous		3.15E+03	1.40E+02	1.00E+01	4.41E+06	Total	1.49E+07
Processing								
Offsite Truck			trips/yr	km/trip	yr	total		
	glassformer/chem		1.30E+03	8.00E+02	1.90E+01	1.98E+07		
	miscellaneous		2.60E+03	1.40E+02	1.90E+01	6.92E+06	Total	2.67E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	glassformer/chem		1.37E+02	8.00E+02	1.90E+01	2.08E+06	Total	2.08E+06
VITRIFIED HLW TRANSPORT								
Offsite Rail			trips	km/trip		total		
	Yucca Mountain		4.18E+02	4.28E+03		1.79E+06	Total	1.79E+06
CLOSURE								
Onsite Truck			cu yd	trip/cu yd	km/trip	total		
	fill		9.36E+05	1.00E-01	1.00E+01	9.36E+05		
	silt		6.67E+05	1.00E-01	3.00E+01	2.00E+06		
	riprap		1.04E+06	1.00E-01	3.20E+01	3.33E+06		
	ag/sand		7.78E+05	1.00E-01	1.00E+01	7.78E+05	Total	7.04E+06
GROUT FILL IMUST								
Onsite Truck sand/gravel			2.20E+03	1.00E+01		2.20E+04	Total	2.20E+04
Offsite Truck cement			4.63E+02	1.40E+02		6.48E+04	Total	6.48E+04
Onsite Truck (km)		7.92E+06						
Onsite Rail (km)		0.00E+00						
Offsite Truck (km)		5.25E+07						
Offsite Rail (km)		3.95E+06						
EMPLOYEE VEHICLE								
Retrieval		person-yr	trip/yr	km/trip	car pool	total		
	Const.	6.36E+03	2.60E+02	1.40E+02	7.41E-01	1.72E+08		
	Ops/D&D	2.24E+04	2.60E+02	1.40E+02	7.41E-01	6.04E+08		
Vitrification								
	Const.	1.19E+04	2.60E+02	1.40E+02	7.41E-01	3.21E+08		
	Ops/D&D	1.04E+04	2.60E+02	1.40E+02	7.41E-01	2.81E+08		
Fill tank								
	Const.	5.70E+01	2.60E+02	1.40E+02	7.41E-01	1.54E+06		
	Ops/D&D	9.06E+02	2.60E+02	1.40E+02	7.41E-01	2.44E+07		
Closure		5.74E+02	2.60E+02	1.40E+02	7.41E-01	1.55E+07		
W-314		1.63E+02	2.60E+02	1.40E+02	7.41E-01	4.40E+06	Total	1.42E+09

Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	5.25E+07	5.00E-02			2.63E+06		
	Rail	3.95E+06	5.00E-02			1.98E+05		
Suburban								
	Truck	5.25E+07	5.00E-02		7.92E+06	1.05E+07		
	Rail	3.95E+06	5.00E-02			1.98E+05		
Rural								
	Truck	5.25E+07	9.00E-01			4.73E+07		
	Rail	3.95E+06	9.00E-01			3.56E+06		
Fatalities/injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			2.63E+06	1.98E+05	1.05E+07	1.98E+05	4.73E+07	3.56E+06
urban truck fat/km		7.50E-09	1.97E-02					
urban truck inj/km		3.70E-07	9.72E-01					
urban rail fat/km		1.70E-08		3.36E-03				
urban rail inj/km		3.30E-08		6.52E-03				
sub truck fat.km		1.30E-08			1.37E-01			
sub truck inj/km		3.80E-07			4.01E+00			
sub rail fat/km		1.70E-08				3.36E-03		
sub rail inj/km		3.30E-08				6.52E-03		
rural truck fat/km		5.30E-08					2.51E+00	
rural truck inj/km		8.00E-07					3.78E+01	
rural rail fat/km		1.70E-08						6.05E-02
rural rail inj/km		3.30E-08						1.17E-01
	TOTAL FATALITIES		2.73E+00					
	TOTAL INJURIES		4.29E+01					
Fatalities/injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	1.42E+09	8.98E-09	1.28E+01				
	injuries	1.42E+09	7.14E-07	1.02E+03				
Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		2.73E+00	1.28E+01	1.55E+01			
	INJURIES		4.29E+01	1.02E+03	1.06E+03			
CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	1.91E+04	=	1.86E+03			
	LWC =	2.45E-02	1.91E+04	=	4.67E+02			
	Fatality =	3.20E-05	1.91E+04	=	6.10E-01			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	3.37E+04	=	7.42E+02			
	LWC =	1.10E-02	3.37E+04	=	3.71E+02			
	Fatality =	3.20E-05	3.37E+04	=	1.08E+00			
TOTALS								
	INJUR	3.66E+03						
	FATAL	1.72E+01						

			LONG-TERM MANAGEMENT ALTERNATIVE					
RETRIEVAL								
Waste Transport								
Onsite Truck						0.00E+00		
							Total	0.00E+00
Construction								
Offsite Truck			trips/yr	km/trip	yr	total		
	concrete		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
	raw material		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
	equipment		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
	miscellaneous		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
							Total	0.00E+00
Offsite Rail			trips/yr	km/trip	yr	total		
	raw material		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
							Total	0.00E+00
ROUTINE								
Construction								
Onsite Truck			trips	km/trip		total		
	borrow		3.24E+04	1.00E+01		3.24E+05		
							Total	3.24E+05
Offsite Truck			trips/yr	km/trip	yr	total		
	miscellaneous		5.20E+03	1.40E+02	1.90E+01	1.38E+07		
			trips	km/trip				
	Tri-Cities		2.01E+04	1.40E+02		2.81E+06		
	Portland/Seattle		7.75E+03	8.00E+02		6.20E+06		
							Total	2.28E+07
	Onsite Truck (km)		3.24E+05					
	Onsite Rail (km)		0.00E+00					
	Offsite Truck (km)		2.28E+07					
	Offsite Rail (km)		0.00E+00					
EMPLOYEE VEHICLE								
Routine		person-yr	trip/yr	km/trip	car pool	total		
	Const.	3.75E+03	2.60E+02	1.40E+02	7.41E-01	1.01E+08		
	Ops	1.04E+05	2.60E+02	1.40E+02	7.41E-01	2.81E+09		
							Total	2.91E+09
Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	2.28E+07	5.00E-02			1.14E+06		
	Rail	0.00E+00	5.00E-02			0.00E+00		
Suburban								
	Truck	2.28E+07	5.00E-02		3.24E+05	1.47E+06		
	Rail	0.00E+00	5.00E-02			0.00E+00		
Rural								
	Truck	2.28E+07	9.00E-01			2.06E+07		
	Rail	0.00E+00	9.00E-01			0.00E+00		

Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			1.14E+06	0.00E+00	1.47E+06	0.00E+00	2.06E+07	0.00E+00
urban truck fat/km		7.50E-09	8.57E-03					
urban truck inj/km		3.70E-07	4.23E-01					
urban rail fat/km		1.70E-08		0.00E+00				
urban rail inj/km		3.30E-08		0.00E+00				
sub truck fat.km		1.30E-08			1.91E-02			
sub truck inj/km		3.80E-07			5.57E-01			
sub rail fat/km		1.70E-08				0.00E+00		
sub rail inj/km		3.30E-08				0.00E+00		
rural truck fat/km		5.30E-08					1.09E+00	
rural truck inj/km		8.00E-07					1.64E+01	
rural rail fat/km		1.70E-08						0.00E+00
rural rail inj/km		3.30E-08						0.00E+00
	TOTAL FATALITIES		1.12E+00					
	TOTAL INJURIES		1.74E+01					
Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	2.91E+09	8.98E-09	2.61E+01				
	injuries	2.91E+09	7.14E-07	2.08E+03				
Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		1.12E+00	2.61E+01	2.72E+01			
	INJURIES		1.74E+01	2.08E+03	2.09E+03			
CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	3.75E+03	=	365.625			
	LWC =	2.45E-02	3.75E+03	=	91.875			
	Fatality =	3.20E-05	3.75E+03	=	0.12			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	1.04E+05	=	2288			
	LWC =	1.10E-02	1.04E+05	=	1144			
	Fatality =	3.20E-05	1.04E+05	=	3.328			
TOTALS								
	INJUR	4.75E+03						
	FATAL	3.07E+01						

	TOTAL ALTERNATIVE PHASED IMPLEMENTATION 1 AND 2							
RETRIEVAL								
Waste Transport						total		
Onsite Truck						1.25E+04	Total	1.25E+04
Construction								
Offsite Truck			trips/yr	km/trip	yr	total		
	concrete		4.80E+02	1.40E+02	2.00E+01	1.34E+06		
	raw material		4.50E+01	8.00E+02	2.00E+01	7.20E+05		
	equipment		2.50E+01	1.00E+04	2.00E+01	5.00E+06		
	miscellaneous		5.20E+03	1.40E+02	2.00E+01	1.46E+07		
	borrow (W-314)		1.38E+03	1.00E+01		1.38E+04	Total	2.16E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	raw material		1.00E+01	8.00E+02	2.00E+01	1.60E+05		
	steel (W-314)		5.30E+01	8.00E+02		4.24E+04		
	cement (W-314)		1.00E+02	1.40E+02		1.40E+04	Total	2.16E+05
VITRIFICATION								
Construction								
Onsite Truck			trips	km/trip		total		
	borrow		1.44E+05	1.00E+01		1.44E+06	Total	1.44E+06
Offsite Truck			trips	km/trip		total		
	concrete		2.61E+04	1.40E+02		3.65E+06		
	steel		9.70E+03	8.00E+02		7.76E+06		
	miscellaneous		3.11E+04	1.40E+02		4.35E+06	Total	1.58E+07
Processing								
Offsite Truck			trips	km/trip		total		
	glassformer/chem		1.65E+04	8.00E+02		1.32E+07		
	miscellaneous		1.03E+05	1.40E+02		1.44E+07		
	process material		3.00E+04	1.40E+02		4.20E+06	Total	3.18E+07
Offsite Rail			trips	km/trip		total		
	glassformer/chem		3.00E+03	8.00E+02		2.40E+06	Total	2.40E+06
VITRIFIED HLW TRANSPORT								
Offsite Rail			trips	km/trip		total		
	Yucca Mountain		8.35E+02	4.28E+03		3.57E+06	Total	3.57E+06
CLOSURE								
Onsite Truck			cu yd	trip/cu yd	km/trip	total		
	fill		9.86E+05	1.00E-01	1.00E+01	9.86E+05		
	silt		8.53E+05	1.00E-01	3.00E+01	2.56E+06		
	riprap		1.22E+06	1.00E-01	3.20E+01	3.90E+06		
	ag/sand		1.00E+06	1.00E-01	1.00E+01	1.00E+06		
	grout fill sand IMUST		2.20E+03	1.00E+01		2.20E+04	Total	8.47E+06
Offsite Truck			trips	km/trip		total		
	groutfill cement IMUS		4.63E+02	1.40E+02		6.48E+04	Total	6.48E+04
Onsite Truck (km)		9.92E+06						
Onsite Rail (km)		0.00E+00						
Offsite Truck (km)		6.93E+07						
Offsite Rail (km)		6.19E+06						
EMPLOYEE VEHICLE								
Phase 1		person-yr	trip/yr	km/trip	car pool	total		
	Const.	1.16E+04	2.60E+02	1.40E+02	7.41E-01	3.13E+08		
	Ops/D&D	6.77E+03	2.60E+02	1.40E+02	7.41E-01	1.83E+08		
Phase 2								
	Const.	1.98E+04	2.60E+02	1.40E+02	7.41E-01	5.34E+08		
	Ops/D&D	4.91E+04	2.60E+02	1.40E+02	7.41E-01	1.32E+09		
							Total	2.35E+09

Distance traveled in population zones									
Urban		Offsite km	zone fraction		Onsite	TOTALS			
	Truck	6.93E+07	5.00E-02			3.46E+06			
	Rail	6.19E+06	5.00E-02			3.10E+05			
Suburban									
	Truck	6.93E+07	5.00E-02		9.92E+06	1.34E+07			
	Rail	6.19E+06	5.00E-02			3.10E+05			
Rural									
	Truck	6.93E+07	9.00E-01			6.24E+07			
	Rail	6.19E+06	9.00E-01			5.57E+06			
Fatalities/Injuries resulting from Truck and Rail transportation accidents									
			urban km		suburban km		rural km		
			truck	rail	truck	rail	truck	rail	
			3.46E+06	3.10E+05	1.34E+07	3.10E+05	6.24E+07	5.57E+06	
urban truck fat/km		7.50E-09	2.60E-02						
urban truck inj/km		3.70E-07	1.28E+00						
urban rail fat/km		1.70E-08		5.26E-03					
urban rail inj/km		3.30E-08		1.02E-02					
sub truck fat.km		1.30E-08			1.74E-01				
sub truck inj/km		3.80E-07			5.09E+00				
sub rail fat/km		1.70E-08				5.26E-03			
sub rail inj/km		3.30E-08				1.02E-02			
rural truck fat/km		5.30E-08					3.31E+00		
rural truck inj/km		8.00E-07					4.99E+01		
rural rail fat/km		1.70E-08						9.47E-02	
rural rail inj/km		3.30E-08						1.84E-01	
	TOTAL FATALITIES		3.61E+00						
	TOTAL INJURIES		5.65E+01						
Fatalities/Injuries resulting from Employee vehicle accidents									
		km	rate/km	TOTAL					
	fatalities	2.35E+09	8.98E-09	2.11E+01					
	injuries	2.35E+09	7.14E-07	1.68E+03					
Cumulative fatalities/injuries from traffic impacts									
			transport	employee	TOTAL				
	FATALITIES		3.61E+00	2.11E+01	2.47E+01				
	INJURIES		5.65E+01	1.68E+03	1.74E+03				
CONSTRUCTION ACCIDENTS									
		rate	person-yr						
	TRC =	9.75E-02	3.14E+04	=	3061.5				
	LWC =	2.45E-02	3.14E+04	=	769.3				
	Fatality =	3.20E-05	3.14E+04	=	1.0048				
OPERATION ACCIDENTS									
		rate	person-yr						
	TRC =	2.20E-02	5.59E+04	=	1229.14				
	LWC =	1.10E-02	5.59E+04	=	614.57				
	Fatality =	3.20E-05	5.59E+04	=	1.78784				
TOTALS									
	INJUR	6.03E+03							
	FATAL	2.75E+01							

	PHASE 1 IMPLEMENTATION SUB-ALTERNATIVE							
RETRIEVAL								
WASTE TRANSFER SYSTEM UPGRADE (W-314)								
Onsite Truck			trips	km/trip		total		
	borrow		1.38E+03	1.00E+00		1.38E+03	Total	1.38E+03
Offsite Truck								
	steel		5.30E+01	8.00E+02		4.24E+04		
	cement		1.00E+02	1.40E+02		1.40E+04	Total	5.64E+04
VITRIFICATION								
Construction								
Onsite Truck			trips	km/trip		total		
	borrow		1.96E+03	1.00E+01		1.96E+04	Total	1.96E+04
Offsite Truck			trips	km/trip		total		
	concrete		1.20E+03	1.40E+02		1.68E+05		
	steel		7.32E+03	8.00E+02		5.86E+06		
	miscellaneous		3.18E+03	1.40E+02		4.45E+05	Total	6.47E+06
Processing								
Offsite Truck			trips	km/trip		total		
	glassformer/chem		3.50E+03	8.00E+02		2.80E+06		
	glassformer/chem		3.57E+03	1.40E+02		5.00E+05		
	miscellaneous		5.20E+04	1.40E+02		7.28E+06	Total	1.06E+07
Offsite Rail			trips	km/trip		total		
	glassformer/chem		2.18E+02	8.00E+02		1.74E+05	Total	1.74E+05
VITRIFIED HLW TRANSPORT								
SITE RESTORATION								
Onsite Truck			trips	km/trip		total		
	contaminated waste		1.50E+03	1.61E+01		2.42E+04		
	noncont. waste		6.23E+04	1.61E+01		1.00E+06	Total	1.03E+06
GROUT FILL IMUST								
Onsite Truck (km)		1.05E+06						
Onsite Rail (km)		0.00E+00						
Offsite Truck (km)		1.71E+07						
Offsite Rail (km)		1.74E+05						
EMPLOYEE VEHICLE								
		person-yr	trip/yr	km/trip	car pool	total		
	Const.	1.07E+04	2.60E+02	1.40E+02	7.41E-01	2.89E+08		
	Ops/D&D	6.93E+03	2.60E+02	1.40E+02	7.41E-01	1.87E+08	Total	4.76E+08

Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	1.71E+07	5.00E-02			8.55E+05		
	Rail	1.74E+05	5.00E-02			8.72E+03		
Suburban								
	Truck	1.71E+07	5.00E-02		1.05E+06	1.90E+06		
	Rail	1.74E+05	5.00E-02			8.72E+03		
Rural								
	Truck	1.71E+07	9.00E-01			1.54E+07		
	Rail	1.74E+05	9.00E-01			1.57E+05		
Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			8.55E+05	8.72E+03	1.90E+06	8.72E+03	1.54E+07	1.57E+05
urban truck fat/km		7.50E-09	6.41E-03					
urban truck inj/km		3.70E-07	3.16E-01					
urban rail fat/km		1.70E-08		1.48E-04				
urban rail inj/km		3.30E-08		2.88E-04				
sub truck fat.km		1.30E-08			2.47E-02			
sub truck inj/km		3.80E-07			7.23E-01			
sub rail fat/km		1.70E-08				1.48E-04		
sub rail inj/km		3.30E-08				2.88E-04		
rural truck fat/km		5.30E-08					8.16E-01	
rural truck inj/km		8.00E-07					1.23E+01	
rural rail fat/km		1.70E-08						2.67E-03
rural rail inj/km		3.30E-08						5.18E-03
	TOTAL FATALITIES		8.50E-01					
	TOTAL INJURIES		1.34E+01					
Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	4.76E+08	8.98E-09	4.27E+00				
	injuries	4.76E+08	7.14E-07	3.40E+02				
Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		8.50E-01	4.27E+00	5.12E+00			
	INJURIES		1.34E+01	3.40E+02	3.53E+02			
CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	1.07E+04	=	1043.25			
	LWC =	2.45E-02	1.07E+04	=	262.15			
	Fatality =	3.20E-05	1.07E+04	=	0.3424			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	6.93E+03	=	152.46			
	LWC =	1.10E-02	6.93E+03	=	76.23			
	Fatality =	3.20E-05	6.93E+03	=	0.22176			
TOTALS								
	INJUR	1.55E+03						
	FATAL	5.68E+00						

		EX SITU NO SEPARATIONS ALTERNATIVE					
			CALCINATION				
RETRIEVAL							
Waste Transport					total		
Onsite Truck					1.25E+04	Total	1.25E+04
Construction							
Offsite Truck		trips/yr	km/trip	yr	total		
concrete		4.80E+02	1.40E+02	2.00E+01	1.34E+06		
raw material		4.50E+01	8.00E+02	2.00E+01	7.20E+05		
equipment		2.50E+01	1.00E+04	2.00E+01	5.00E+06		
miscellaneous		5.20E+03	1.40E+02	2.00E+01	1.46E+07		
steel W-314		5.30E+01	8.00E+02		4.24E+04		
cement/misc W-314		1.53E+02	1.40E+02		2.14E+04	Total	2.17E+07
Offsite Rail		trips/yr	km/trip	yr	total		
raw material		1.00E+01	8.00E+02	2.00E+01	1.60E+05	Total	1.60E+05
Onsite Truck							
borrow W-314		1.38E+03	1.00E+01		1.38E+04	Total	1.38E+04
CALCINATION							
Construction							
Onsite Truck		trips	km/trip		total		
borrow		3.30E+04	1.00E+01		3.30E+05	Total	3.30E+05
Offsite Truck		trips	km/trip		total		
Try Cities		3.40E+04	1.40E+02		4.76E+06		
Portland/Seattle		1.07E+04	8.00E+02		8.56E+06		
		trips/yr	km/trip	yr			
miscellaneous		5.20E+03	1.40E+02	5.50E+00	4.00E+06	Total	1.73E+07
Processing							
Offsite Truck		trips/yr	km/trip	yr	total		
Portand/Seattle		8.87E+02	8.00E+02	1.50E+01	1.06E+07		
miscellaneous		5.20E+03	1.40E+02	1.50E+01	1.09E+07	Total	2.16E+07
Offsite Rail		trips/yr	km/trip	yr	total		
Portland/Seattle		1.03E+02	8.00E+02	1.50E+01	1.24E+06	Total	1.24E+06
CALCINED HLW TRANSPORT							
Offsite Rail		trips	km/trip		total		
Yucca Mountain		4.15E+03	4.28E+03		1.78E+07	Total	1.78E+07
CLOSURE							
Onsite Truck		cu yd	trip/cu yd	km/trip	total		
fill		9.86E+05	1.00E-01	1.00E+01	9.86E+05		
silt		4.93E+05	1.00E-01	3.00E+01	1.48E+06		
riprap		8.35E+05	1.00E-01	3.20E+01	2.67E+06		
ag/sand		5.43E+05	1.00E-01	1.00E+01	5.43E+05	Total	5.68E+06
GROUT FILL IMUST							
Onsite Truck sand/gravel		2.20E+03	1.00E+01		2.20E+04	Total	2.20E+04
Offsite Truick cement		4.63E+02	1.40E+02		6.48E+04	Total	6.48E+04
Onsite Truck (km)	6.06E+06						
Onsite Rail (km)	0.00E+00						
Offsite Truck (km)	6.06E+07						
Offsite Rail (km)	1.92E+07						
EMPLOYEE VEHICLE							
Retrieval	person-yr	trip/yr	km/trip	car pool	total		
Const.	1.06E+04	2.60E+02	1.40E+02	7.41E-01	2.86E+08		
Ops	3.15E+04	2.60E+02	1.40E+02	7.41E-01	8.50E+08		
Vitrification							
Const.	1.48E+04	2.60E+02	1.40E+02	7.41E-01	3.99E+08		
Ops	9.78E+03	2.60E+02	1.40E+02	7.41E-01	2.64E+08		
Closure	4.62E+02	2.60E+02	1.40E+02	7.41E-01	1.25E+07		
W-314	1.63E+02	2.60E+02	1.40E+02	7.41E-01	4.40E+06	Total	1.82E+09
total	6.73E+04						

Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	6.06E+07	5.00E-02			3.03E+06		
	Rail	1.92E+07	5.00E-02			9.58E+05		
Suburban								
	Truck	6.06E+07	5.00E-02		6.06E+06	9.09E+06		
	Rail	1.92E+07	5.00E-02			9.58E+05		
Rural								
	Truck	6.06E+07	9.00E-01			5.46E+07		
	Rail	1.92E+07	9.00E-01			1.72E+07		
Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			3.03E+06	9.58E+05	9.09E+06	9.58E+05	5.46E+07	1.72E+07
urban truck fat/km		7.50E-09	2.27E-02					
urban truck inj/km		3.70E-07	1.12E+00					
urban rail fat/km		1.70E-08		1.63E-02				
urban rail inj/km		3.30E-08		3.16E-02				
sub truck fat.km		1.30E-08			1.18E-01			
sub truck inj/km		3.80E-07			3.45E+00			
sub rail fat/km		1.70E-08				1.63E-02		
sub rail inj/km		3.30E-08				3.16E-02		
rural truck fat/km		5.30E-08					2.89E+00	
rural truck inj/km		8.00E-07					4.37E+01	
rural rail fat/km		1.70E-08						2.93E-01
rural rail inj/km		3.30E-08						5.69E-01
	TOTAL FATALITIES		3.36E+00					
	TOTAL INJURIES		4.89E+01					
Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	1.82E+09	8.98E-09	1.63E+01				
	injuries	1.82E+09	7.14E-07	1.30E+03				
Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		3.36E+00	1.63E+01	1.97E+01			
	INJURIES		4.89E+01	1.30E+03	1.35E+03			
CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	2.60E+04	=	2.54E+03			
	LWC =	2.45E-02	2.60E+04	=	6.38E+02			
	Fatality =	3.20E-05	2.60E+04	=	8.33E-01			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	4.13E+04	=	9.08E+02			
	LWC =	1.10E-02	4.13E+04	=	4.54E+02			
	Fatality =	3.20E-05	4.13E+04	=	1.32E+00			
TOTALS								
	INJUR	4.79E+03						
	FATAL	2.18E+01						

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE Safety: Nonradiological /Nontoxicological Occupational Accidents Including transportation for No Closure

ORIGINATOR Michael Harker DATE 02/12/96

REVISION NO. 0

OBJECTIVE Show injuries and fatalities from construction operation, and transportation accidents. Replaces Old Calcs. for the TWRS EIS Rev. C.

METHODOLOGY See attachments

ASSUMPTIONS See attachments

Occupational injury and fatality rates were taken from the Occupational Injuries Summary Report, January - Dec. 1993 DOE/EH/01570-H5. Truck and Rail Transport incidence rates are from Non-Radiological Impacts of transporting radioactive material. SAND81-1703, 1982. Employee Transportation incidence rates are from 1993 Washington State Highway Accident Report. Round Trip distance from Tri-Cities=1.40E+02 km from Portland/Seattle=8.00E+02 km. Carpool factor of 1.35/car from SIS EIS DOE/EIS-0212 1994.

(Continue on another sheet if necessary)

3-18-96
SIGNATURE/DATE

C Henderson 3·19·96
CHECKED/DATE

CALCULATION & RESULTS
ATTACHED

JACOBS\FORMS\NONRAD.TOX\CALCVR.SHT

	EX SITU INTERMEDIATE SEPARATIONS ALTERNATIVE - REMEDIATION CALCS							
RETRIEVAL								
Waste Transport						total		
Onsite Truck						1.25E+04		
							Total	1.25E+04
Construction								
Offsite Truck			trips/yr	km/trip	yr	total		
	concrete		4.80E+02	1.40E+02	2.00E+01	1.34E+06		
	raw material		4.50E+01	8.00E+02	2.00E+01	7.20E+05		
	equipment		2.50E+01	1.00E+04	2.00E+01	5.00E+06		
	miscellaneous		5.20E+03	1.40E+02	2.00E+01	1.46E+07		
	steel W-314		5.30E+01	8.00E+02		4.24E+04		
	cement W-314		1.00E+02	1.40E+02		1.40E+04	Total	2.17E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	raw material		1.00E+01	8.00E+02	2.00E+01	1.60E+05	Total	1.60E+05
Onsite Truck								
	borrow W-314		1.38E+03	1.00E+01		1.38E+04	Total	1.38E+04
VITRIFICATION								
Construction								
Onsite Truck			trips	km/trip		total		
	borrow		1.69E+05	1.00E+01		1.69E+06		
							Total	1.69E+06
Offsite Truck			trips	km/trip		total		
	concrete		5.45E+04	1.40E+02		7.63E+06		
	steel		1.51E+04	8.00E+02		1.21E+07		
			trips/yr	km/trip	yr			
	miscellaneous		7.54E+03	1.40E+02	1.00E+01	1.06E+07		
							Total	3.03E+07
Processing								
Offsite Truck			trips/yr	km/trip	yr	total		
	glassformer/chem		2.30E+03	8.00E+02	1.90E+01	3.50E+07		
	miscellaneous		6.70E+03	1.40E+02	1.90E+01	1.78E+07		
							Total	5.28E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	glassformer/chem		2.74E+02	8.00E+02	1.90E+01	4.16E+06		
							Total	4.16E+06
VITRIFIED HLW TRANSPORT								
Offsite Rail			trips	km/trip		total		
	Yucca Mountain		8.35E+02	4.28E+03		3.57E+06		
							Total	3.57E+06
CLOSURE								
Onsite Truck			cu yd	trip/cu yd	km/trip	total		
	fill		0.00E+00	1.00E-01	1.00E+01	0.00E+00		
	silt		0.00E+00	1.00E-01	3.00E+01	0.00E+00		
	riprap		0.00E+00	1.00E-01	3.20E+01	0.00E+00		
	ag/sand		0.00E+00	1.00E-01	1.00E+01	0.00E+00		
							Total	0.00E+00
GROUT FILL IMUST								
Onsite Truck	sand/gravel		2.20E+03	1.00E+01		2.20E+04	Total	2.20E+04
Offsite Truck	cement		4.63E+02	1.40E+02		6.48E+04	Total	6.48E+04
Onsite Truck (km)		1.74E+06						
Onsite Rail (km)		0.00E+00						
Offsite Truck (km)		1.05E+08						
Offsite Rail (km)		7.90E+06						
EMPLOYEE VEHICLE								
Retrieval		person-yr	trip/yr	km/trip	car pool	total		
	Const.	1.06E+04	2.60E+02	1.40E+02	7.41E-01	2.86E+08		
	Ops/D&D	3.74E+04	2.60E+02	1.40E+02	7.41E-01	1.01E+09		
Vitrification								
	Const.	1.98E+04	2.60E+02	1.40E+02	7.41E-01	5.34E+08		
	Ops/D&D	1.73E+04	2.60E+02	1.40E+02	7.41E-01	4.67E+08		
Closure		0.00E+00	2.60E+02	1.40E+02	7.41E-01	0.00E+00		
							Total	2.30E+09

Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	1.05E+08	5.00E-02			5.24E+06		
	Rail	7.90E+06	5.00E-02			3.95E+05		
Suburban								
	Truck	1.05E+08	5.00E-02		1.74E+06	6.98E+06		
	Rail	7.90E+06	5.00E-02			3.95E+05		
Rural								
	Truck	1.05E+08	9.00E-01			9.43E+07		
	Rail	7.90E+06	9.00E-01			7.11E+06		
Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			5.24E+06	3.95E+05	6.98E+06	3.95E+05	9.43E+07	7.11E+06
urban truck fat/km		7.50E-09	3.93E-02					
urban truck inj/km		3.70E-07	1.94E+00					
urban rail fat/km		1.70E-08		6.71E-03				
urban rail inj/km		3.30E-08		1.30E-02				
sub truck fat.km		1.30E-08			9.07E-02			
sub truck inj/km		3.80E-07			2.65E+00			
sub rail fat/km		1.70E-08				6.71E-03		
sub rail inj/km		3.30E-08				1.30E-02		
rural truck fat/km		5.30E-08					5.00E+00	
rural truck inj/km		8.00E-07					7.55E+01	
rural rail fat/km		1.70E-08						1.21E-01
rural rail inj/km		3.30E-08						2.35E-01
	TOTAL FATALITIES		5.26E+00					
	TOTAL INJURIES		8.03E+01					
Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	2.30E+09	8.98E-09	2.06E+01				
	injuries	2.30E+09	7.14E-07	1.64E+03				
Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		5.26E+00	2.06E+01	2.59E+01			
	INJURIES		8.03E+01	1.64E+03	1.72E+03			
CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	3.04E+04	=	2.96E+03			
	LWC =	2.45E-02	3.04E+04	=	7.45E+02			
	Fatality =	3.20E-05	3.04E+04	=	9.73E-01			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	5.47E+04	=	1.20E+03			
	LWC =	1.10E-02	5.47E+04	=	6.02E+02			
	Fatality =	3.20E-05	5.47E+04	=	1.75E+00			
TOTALS								
	INJUR	5.89E+03						
	FATAL	2.86E+01						

			EX SITU NO SEPARATIONS ALTERNATIVE					
				VITRIFICATION - REMEDIATION CALCS				
RETRIEVAL								
Waste Transport						total		
Onsite Truck						1.25E+04	Total	1.25E+04
Construction								
Offsite Truck			trips/yr	km/trip	yr	total		
	concrete		4.80E+02	1.40E+02	2.00E+01	1.34E+06		
	raw material		4.50E+01	8.00E+02	2.00E+01	7.20E+05		
	equipment		2.50E+01	1.00E+04	2.00E+01	5.00E+06		
	miscellaneous		5.20E+03	1.40E+02	2.00E+01	1.46E+07		
	steel W-314		5.30E+01	8.00E+02		4.24E+04		
	cement/misc W-314		1.53E+02	1.40E+02		2.14E+04	Total	2.17E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	raw material		1.00E+01	8.00E+02	2.00E+01	1.60E+05	Total	1.60E+05
Onsite Truck								
	borrow W-314		1.38E+03	1.00E+01		1.38E+04	Total	1.38E+04
VITRIFICATION								
Construction								
Onsite Truck			trips	km/trip		total		
	borrow		1.18E+05	1.00E+01		1.18E+06	Total	1.18E+06
Offsite Truck			trips	km/trip		total		
	Try Cities		4.38E+04	1.40E+02		6.13E+06		
	Portland/Seattle		4.34E+04	8.00E+02		3.47E+07		
			trips/yr	km/trip	yr			
	miscellaneous		5.20E+03	1.40E+02	5.50E+00	4.00E+06	Total	4.49E+07
Processing								
Offsite Truck			trips/yr	km/trip	yr	total		
	Portland/Seattle		4.17E+02	8.00E+02	1.50E+01	5.00E+06		
	miscellaneous		6.85E+03	1.40E+02	1.50E+01	1.44E+07	Total	1.94E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	Portland/Seattle		1.03E+02	8.00E+02	1.50E+01	1.24E+06	Total	1.24E+06
VITRIFIED HLW TRANSPORT								
Offsite Rail			trips	km/trip		total		
	Yucca Mountain		1.47E+04	4.28E+03		6.29E+07	Total	6.29E+07
CLOSURE								
Onsite Truck			cu yd	trip/cu yd	km/trip	total		
	fill		0.00E+00	1.00E-01	1.00E+01	0.00E+00		
	silt		0.00E+00	1.00E-01	3.00E+01	0.00E+00		
	riprap		0.00E+00	1.00E-01	3.20E+01	0.00E+00		
	ag/sand		0.00E+00	1.00E-01	1.00E+01	0.00E+00	Total	0.00E+00
GROUT FILL IMUST								
Onsite Truck sand/gravel			2.20E+03	1.00E+01		2.20E+04	Total	2.20E+04
Offsite Truick cement			4.63E+02	1.40E+02		6.48E+04	Total	6.48E+04
Onsite Truck (km)		1.23E+06						
Onsite Rail (km)		0.00E+00						
Offsite Truck (km)		8.60E+07						
Offsite Rail (km)		6.43E+07						
EMPLOYEE VEHICLE								
Retrieval		person-yr	trip/yr	km/trip	car pool	total		
	Const.	1.06E+04	2.60E+02	1.40E+02	7.41E-01	2.86E+08		
	Ops	3.15E+04	2.60E+02	1.40E+02	7.41E-01	8.50E+08		
Vitrification								
	Const.	1.48E+04	2.60E+02	1.40E+02	7.41E-01	3.99E+08		
	Ops	9.78E+03	2.60E+02	1.40E+02	7.41E-01	2.64E+08		
Closure		0.00E+00	2.60E+02	1.40E+02	7.41E-01	0.00E+00		
	total	6.67E+04					Total	1.80E+09

Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	8.60E+07	5.00E-02			4.30E+06		
	Rail	6.43E+07	5.00E-02			3.22E+06		
Suburban								
	Truck	8.60E+07	5.00E-02		1.23E+06	5.53E+06		
	Rail	6.43E+07	5.00E-02			3.22E+06		
Rural								
	Truck	8.60E+07	9.00E-01			7.74E+07		
	Rail	6.43E+07	9.00E-01			5.79E+07		
Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			4.30E+06	3.22E+06	5.53E+06	3.22E+06	7.74E+07	5.79E+07
urban truck fat/km		7.50E-09	3.22E-02					
urban truck inj/km		3.70E-07	1.59E+00					
urban rail fat/km		1.70E-08		5.47E-02				
urban rail inj/km		3.30E-08		1.06E-01				
sub truck fat.km		1.30E-08			7.19E-02			
sub truck inj/km		3.80E-07			2.10E+00			
sub rail fat/km		1.70E-08				5.47E-02		
sub rail inj/km		3.30E-08				1.06E-01		
rural truck fat/km		5.30E-08					4.10E+00	
rural truck inj/km		8.00E-07					6.19E+01	
rural rail fat/km		1.70E-08						9.84E-01
rural rail inj/km		3.30E-08						1.91E+00
	TOTAL FATALITIES		5.30E+00					
	TOTAL INJURIES		6.77E+01					
Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	1.80E+09	8.98E-09	1.62E+01				
	injuries	1.80E+09	7.14E-07	1.28E+03				
Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		5.30E+00	1.62E+01	2.15E+01			
	INJURIES		6.77E+01	1.28E+03	1.35E+03			
CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	2.54E+04	=	2.48E+03			
	LWC =	2.45E-02	2.54E+04	=	6.22E+02			
	Fatality =	3.20E-05	2.54E+04	=	8.13E-01			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	4.13E+04	=	9.08E+02			
	LWC =	1.10E-02	4.13E+04	=	4.54E+02			
	Fatality =	3.20E-05	4.13E+04	=	1.32E+00			
TOTALS								
	INJUR	4.74E+03						
	FATAL	2.36E+01						

		EX SITU EXTENSIVE SEPARATIONS ALTERNATIVE - REMEDIATION CALCS						
RETRIEVAL								
Waste Transport						total		
Onsite Truck						1.25E+04	Total	1.25E+04
Construction								
Offsite Truck			trips/yr	km/trip	yr	total		
	concrete		4.80E+02	1.40E+02	2.00E+01	1.34E+06		
	raw material		4.50E+01	8.00E+02	2.00E+01	7.20E+05		
	equipment		2.50E+01	1.00E+04	2.00E+01	5.00E+06		
	miscellaneous		5.20E+03	1.40E+02	2.00E+01	1.46E+07		
	steel W-314		5.30E+01	8.00E+02		4.24E+04		
	cement/misc W-314		1.53E+02	1.40E+02		2.14E+04	Total	2.17E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	raw material		1.00E+01	8.00E+02	2.00E+01	1.60E+05	Total	1.60E+05
Onsite Truck								
	borrow		1.38E+03	1.00E+01		1.38E+04	Total	1.38E+04
VITRIFICATION								
Construction								
Onsite Truck			trips	km/trip		total		
	borrow		2.12E+05	1.00E+01		2.12E+06	Total	2.12E+06
Offsite Truck			trips	km/trip		total		
	Tri-Cities		1.07E+05	1.40E+02		1.50E+07		
	Portland/Seattle		2.62E+04	8.00E+02		2.10E+07		
			trips/yr	km/trip	yr			
	miscellaneous		5.20E+03	1.40E+02	9.00E+00	6.55E+06	Total	4.25E+07
Processing								
Offsite Truck			trips/yr	km/trip	yr	total		
	glassformer/chem		2.17E+03	8.00E+02	1.90E+01	3.30E+07		
	miscellaneous		5.20E+03	1.40E+02	1.90E+01	1.38E+07	Total	4.68E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	glassformer/chem		6.77E+02	8.00E+02	1.90E+01	1.03E+07	Total	1.03E+07
VITRIFIED HLW TRANSPORT								
Offsite Rail			trips	km/trip		total		
	Yucca Mountain		4.00E+01	4.28E+03		1.71E+05	Total	1.71E+05
CLOSURE								
Onsite Truck			cu yd	trip/cu yd	km/trip	total		
	fill		0.00E+00	1.00E-01	1.00E+01	0.00E+00		
	silt		0.00E+00	1.00E-01	3.00E+01	0.00E+00		
	riprap		0.00E+00	1.00E-01	3.20E+01	0.00E+00		
	ag/sand		0.00E+00	1.00E-01	1.00E+01	0.00E+00	Total	0.00E+00
GROUT FILL IMUST								
Onsite Truck sand/gravel			2.20E+03	1.00E+01		2.20E+04	Total	2.20E+04
Offsite Truck cement			4.63E+02	1.40E+02		6.48E+04	Total	6.48E+04
Onsite Truck (km)		2.17E+06						
Onsite Rail (km)		0.00E+00						
Offsite Truck (km)		1.11E+08						
Offsite Rail (km)		1.06E+07						
EMPLOYEE VEHICLE								
Retrieval		person-yr	trip/yr	km/trip	car pool	total		
	Const.	1.05E+04	2.60E+02	1.40E+02	7.41E-01	2.86E+08		
	Ops/D&D	3.74E+04	2.60E+02	1.40E+02	7.41E-01	1.01E+09		
Vitrification								
	Const.	2.58E+04	2.60E+02	1.40E+02	7.41E-01	6.96E+08		
	Ops/D&D	6.95E+03	2.60E+02	1.40E+02	7.41E-01	1.87E+08		
Closure		0.00E+00	2.60E+02	1.40E+02	7.41E-01	0.00E+00		
	total	8.08E+04					Total	2.18E+09

Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	1.11E+08	5.00E-02			5.55E+06		
	Rail	1.06E+07	5.00E-02			5.31E+05		
Suburban								
	Truck	1.11E+08	5.00E-02		2.17E+06	7.72E+06		
	Rail	1.06E+07	5.00E-02			5.31E+05		
Rural								
	Truck	1.11E+08	9.00E-01			1.00E+08		
	Rail	1.06E+07	9.00E-01			9.56E+06		
Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			5.55E+06	5.31E+05	7.72E+06	5.31E+05	1.00E+08	9.56E+06
urban truck fat/km		7.50E-09	4.16E-02					
urban truck inj/km		3.70E-07	2.05E+00					
urban rail fat/km		1.70E-08		9.03E-03				
urban rail inj/km		3.30E-08		1.75E-02				
sub truck fat.km		1.30E-08			1.00E-01			
sub truck inj/km		3.80E-07			2.93E+00			
sub rail fat/km		1.70E-08				9.03E-03		
sub rail inj/km		3.30E-08				1.75E-02		
rural truck fat/km		5.30E-08					5.30E+00	
rural truck inj/km		8.00E-07					8.00E+01	
rural rail fat/km		1.70E-08						1.63E-01
rural rail inj/km		3.30E-08						3.15E-01
	TOTAL FATALITIES		5.62E+00					
	TOTAL INJURIES		8.53E+01					
Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	2.18E+09	8.98E-09	1.96E+01				
	injuries	2.18E+09	7.14E-07	1.56E+03				
Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		5.62E+00	1.96E+01	2.52E+01			
	INJURIES		8.53E+01	1.56E+03	1.64E+03			
CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	3.64E+04	=	3.55E+03			
	LWC =	2.45E-02	3.64E+04	=	8.92E+02			
	Fatality =	3.20E-05	3.64E+04	=	1.16E+00			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	4.44E+04	=	9.76E+02			
	LWC =	1.10E-02	4.44E+04	=	4.88E+02			
	Fatality =	3.20E-05	4.44E+04	=	1.42E+00			
TOTALS								
	INJUR	6.17E+03						
	FATAL	2.78E+01						

	IN SITU VITRIFICATION ALTERNATIVE - REMEDIATION CALCS							
RETRIEVAL								
Waste Transport								
Onsite Truck						0.00E+00		
							Total	0.00E+00
Construction - (W-314)								
Offsite Truck			trips	km/trip		total		
	steel		5.30E+01	8.00E+02		4.24E+04		
	cement		1.00E+02	1.40E+02		1.40E+04		
	miscellaneous		5.30E+01	1.40E+02		7.42E+03		
							Total	6.38E+04
Onsite Truck			trips	km/trip		total		
	borrow		1.38E+03	1.00E+01		1.38E+04		
							Total	1.38E+04
VITRIFICATION								
Construction								
Onsite Truck			trips	km/trip		total		
	borrow		2.12E+05	1.00E+01		2.12E+06		
							Total	2.12E+06
Offsite Truck			trips/yr	km/trip	yr	total		
	miscellaneous		5.20E+03	1.40E+02	1.90E+01	1.38E+07		
							Total	1.38E+07
Offsite Rail			cars	trip/cars	km/trip	total		
	steel		2.60E+03	5.00E-02	8.00E+02	1.04E+05		
	cement		1.70E+03	5.00E-02	8.00E+02	6.80E+04		
							Total	1.72E+05
Processing								
Offsite Truck			trips/yr	km/trip	yr	total		
	miscellaneous		5.20E+03	1.40E+02	1.20E+01	8.74E+06		
							Total	8.74E+06
Offsite Rail			trips/yr	km/trip	yr	total		
	chem.		4.00E+00	8.00E+02	1.20E+01	3.84E+04		
							Total	3.84E+04
Grout Fill IMUSTs (outside tank farm areas)								
Onsite Truck			trips	km/trip		total		
	sand/gravel		7.70E+02	1.00E+01		7.70E+03	Total	7.70E+03
Offsite Truck			trips	km/trip		total		
	cement		1.60E+02	1.40E+02		2.24E+04	Total	2.24E+04
CLOSURE								
Onsite Truck			cu yd	trip/cu yd	km/trip	total		
	fill		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
	silt		0.00E+00	1.00E-01	3.00E+01	0.00E+00		
	riprap		0.00E+00	1.00E-01	3.20E+01	0.00E+00		
	ag/sand		0.00E+00	1.00E-01	1.00E+01	0.00E+00		
							Total	0.00E+00
Onsite Truck (km)		2.14E+06						
Onsite Rail (km)		0.00E+00						
Offsite Truck (km)		2.27E+07						
Offsite Rail (km)		2.10E+05						
EMPLOYEE VEHICLE								
Routine		person-yr	trip/yr	km/trip	car pool	total		
	W-314	1.63E+02	2.60E+02	1.40E+02	7.41E-01	4.40E+06		
	Ops	1.83E+04	2.60E+02	1.40E+02	7.41E-01	4.94E+08		
Vitrification								
	Const.	2.20E+04	2.60E+02	1.40E+02	7.41E-01	5.93E+08		
	Ops/D&D	8.05E+03	2.60E+02	1.40E+02	7.41E-01	2.17E+08		
Closure		0.00E+00	2.60E+02	1.40E+02	7.41E-01	0.00E+00		
							Total	1.31E+09

Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	2.27E+07	5.00E-02			1.13E+06		
	Rail	2.10E+05	5.00E-02			1.05E+04		
Suburban								
	Truck	2.27E+07	5.00E-02		2.14E+06	3.27E+06		
	Rail	2.10E+05	5.00E-02			1.05E+04		
Rural								
	Truck	2.27E+07	9.00E-01			2.04E+07		
	Rail	2.10E+05	9.00E-01			1.89E+05		
Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			1.13E+06	1.05E+04	3.27E+06	1.05E+04	2.04E+07	1.89E+05
urban truck fat/km		7.50E-09	8.50E-03					
urban truck inj/km		3.70E-07	4.19E-01					
urban rail fat/km		1.70E-08		1.79E-04				
urban rail inj/km		3.30E-08		3.47E-04				
sub truck fat.km		1.30E-08			4.26E-02			
sub truck inj/km		3.80E-07			1.24E+00			
sub rail fat/km		1.70E-08				1.79E-04		
sub rail inj/km		3.30E-08				3.47E-04		
rural truck fat/km		5.30E-08					1.08E+00	
rural truck inj/km		8.00E-07					1.63E+01	
rural rail fat/km		1.70E-08						3.22E-03
rural rail inj/km		3.30E-08						6.25E-03
	TOTAL FATALITIES		1.14E+00					
	TOTAL INJURIES		1.80E+01					
Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	1.31E+09	8.98E-09	1.18E+01				
	injuries	1.31E+09	7.14E-07	9.34E+02				
Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		1.14E+00	1.18E+01	1.29E+01			
	INJURIES		1.80E+01	9.34E+02	9.52E+02			
CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	2.22E+04	=	2.16E+03			
	LWC =	2.45E-02	2.22E+04	=	5.43E+02			
	Fatality =	3.20E-05	2.22E+04	=	7.09E-01			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	2.64E+04	=	5.80E+02			
	LWC =	1.10E-02	2.64E+04	=	2.90E+02			
	Fatality =	3.20E-05	2.64E+04	=	8.43E-01			
TOTALS								
	INJUR	3.69E+03						
	FATAL	1.44E+01						

			NO ACTION ALTERNATIVE - REMEDIATION CALCS					
RETRIEVAL								
Waste Transport								
Onsite Truck						0.00E+00		
							Total	0.00E+00
Construction								
Offsite Truck			trips/yr	km/trip	yr	total		
	concrete		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
	raw material		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
	equipment		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
	miscellaneous		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
							Total	0.00E+00
Offsite Rail			trips/yr	km/trip	yr	total		
	raw material		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
							Total	0.00E+00
ROUTINE								
Construction								
Onsite Truck			trips	km/trip		total		
	borrow		0.00E+00	0.00E+00		0.00E+00		
							Total	0.00E+00
Offsite Truck			trips/yr	km/trip	yr	total		
	miscellaneous		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
			trips	km/trip				
	Tri-Cities		0.00E+00	0.00E+00		0.00E+00		
	Portland/Seattle		0.00E+00	0.00E+00		0.00E+00		
							Total	0.00E+00
	Onsite Truck (km)		0.00E+00					
	Onsite Rail (km)		0.00E+00					
	Offsite Truck (km)		0.00E+00					
	Offsite Rail (km)		0.00E+00					
EMPLOYEE VEHICLE								
Routine		person-yr	trip/yr	km/trip	car pool	total		
	Const.	0.00E+00				0.00E+00		
	Ops	1.04E+05	2.60E+02	1.40E+02	7.41E-01	2.81E+09		
							Total	2.81E+09
Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	0.00E+00	5.00E-02			0.00E+00		
	Rail	0.00E+00	5.00E-02			0.00E+00		
Suburban								
	Truck	0.00E+00	5.00E-02		0.00E+00	0.00E+00		
	Rail	0.00E+00	5.00E-02			0.00E+00		
Rural								
	Truck	0.00E+00	9.00E-01			0.00E+00		
	Rail	0.00E+00	9.00E-01			0.00E+00		

Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
urban truck fat/km		7.50E-09	0.00E+00					
urban truck inj/km		3.70E-07	0.00E+00					
urban rail fat/km		1.70E-08		0.00E+00				
urban rail inj/km		3.30E-08		0.00E+00				
sub truck fat.km		1.30E-08			0.00E+00			
sub truck inj/km		3.80E-07			0.00E+00			
sub rail fat/km		1.70E-08				0.00E+00		
sub rail inj/km		3.30E-08				0.00E+00		
rural truck fat/km		5.30E-08					0.00E+00	
rural truck inj/km		8.00E-07					0.00E+00	
rural rail fat/km		1.70E-08						0.00E+00
rural rail inj/km		3.30E-08						0.00E+00
	TOTAL FATALITIES		0.00E+00					
	TOTAL INJURIES		0.00E+00					

Fatalities/Injuries resulting from Employee vehicle accidents				
		km	rate/km	TOTAL
	fatalities	2.81E+09	8.98E-09	2.52E+01
	injuries	2.81E+09	7.14E-07	2.00E+03

Cumulative fatalities/injuries from traffic impacts					
			transport	employee	TOTAL
	FATALITIES		0.00E+00	2.52E+01	2.52E+01
	INJURIES		0.00E+00	2.00E+03	2.00E+03
CONSTRUCTION ACCIDENTS					
		rate	person-yr		
	TRC =	9.75E-02	0.00E+00	=	0.00E+00
	LWC =	2.45E-02	0.00E+00	=	0.00E+00
	Fatality =	3.20E-05	0.00E+00	=	0.00E+00
OPERATION ACCIDENTS					
		rate	person-yr		
	TRC =	2.20E-02	1.04E+05	=	2.29E+03
	LWC =	1.10E-02	1.04E+05	=	1.14E+03
	Fatality =	3.20E-05	1.04E+05	=	3.33E+00
TOTALS					
	INJUR	4.29E+03			
	FATAL	2.85E+01			

		ONSITE DRY STORAGE ALTERNATIVE - REMEDIATION CALCS						
ROUTINE								
Construction								
Onsite Truck			trips	km/trip		total		
	borrow		1.00E+02	1.00E+01		1.00E+03		
							Total	1.00E+03
Offsite Truck			trips	km/trip		total		
	encasement pipe		1.40E+01	8.00E+02		1.12E+04		
	WESF modification		2.00E+02	1.40E+02		2.80E+04		
							Total	3.92E+04
Capsule Transport								
Onsite Truck			trips	km/trip		total		
	to dry storage		1.84E+02	3.20E+01		5.89E+03		
							Total	5.89E+03
		Onsite Truck (km)		6.89E+03				
		Onsite Rail (km)		0.00E+00				
		Offsite Truck (km)		3.92E+04				
		Offsite Rail (km)		0.00E+00				
EMPLOYEE VEHICLE								
Routine		person-yr	trip/yr	km/trip	car pool	total		
	Const.	2.10E+02	2.60E+02	1.40E+02	7.41E-01	5.66E+06		
	Packaging	1.94E+02	2.60E+02	1.40E+02	7.41E-01	5.23E+06		
	Storage	8.90E+02	2.60E+02	1.40E+02	7.41E-01	2.40E+07		
							Total	3.49E+07
Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	3.92E+04	5.00E-02			1.96E+03		
	Rail	0.00E+00	5.00E-02			0.00E+00		
Suburban								
	Truck	3.92E+04	5.00E-02		6.89E+03	8.85E+03		
	Rail	0.00E+00	5.00E-02			0.00E+00		
Rural								
	Truck	3.92E+04	9.00E-01			3.53E+04		
	Rail	0.00E+00	9.00E-01			0.00E+00		
Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	

			truck	rail	truck	rail	truck	rail	
			1.96E+03	0.00E+00	8.85E+03	0.00E+00	3.53E+04	0.00E+00	
urban truck fat/km		7.50E-09	1.47E-05						
urban truck inj/km		3.70E-07	7.25E-04						
urban rail fat/km		1.70E-08		0.00E+00					
urban rail inj/km		3.30E-08		0.00E+00					
sub truck fat.km		1.30E-08			1.15E-04				
sub truck inj/km		3.80E-07			3.36E-03				
sub rail fat/km		1.70E-08				0.00E+00			
sub rail inj/km		3.30E-08				0.00E+00			
rural truck fat/km		5.30E-08					1.87E-03		
rural truck inj/km		8.00E-07					2.82E-02		
rural rail fat/km		1.70E-08						0.00E+00	
rural rail inj/km		3.30E-08						0.00E+00	
	TOTAL FATALITIES		2.00E-03						
	TOTAL INJURIES		3.23E-02						
Fatalities/Injuries resulting from Employee vehicle accidents									
		km	rate/km	TOTAL					
	fatalities	3.49E+07	8.98E-09	3.13E-01					
	injuries	3.49E+07	7.14E-07	2.49E+01					
Cumulative fatalities/injuries from traffic impacts									
			transport	employee	TOTAL				
	FATALITIES		2.00E-03	3.13E-01	3.15E-01				
	INJURIES		3.23E-02	2.49E+01	2.50E+01				
CONSTRUCTION ACCIDENTS									
		rate	person-yr						
	TRC =	9.75E-02	2.10E+02	=	2.05E+01				
	LWC =	2.45E-02	2.10E+02	=	5.15E+00				
	Fatality =	3.20E-05	2.10E+02	=	6.72E-03				
OPERATION ACCIDENTS									
		rate	person-yr						
	TRC =	2.20E-02	1.08E+03	=	2.38E+01				
	LWC =	1.10E-02	1.08E+03	=	1.19E+01				
	Fatality =	3.20E-05	1.08E+03	=	3.47E-02				
TOTALS									
	INJUR	6.93E+01							
	FATAL	3.57E-01							

		OVERPACK AND SHIP ALTERNATIVE - REMEDIATION CALCS							
ROUTINE									
Construction									
Onsite Truck			trips	km/trip		total			
	borrow		0.00E+00	0.00E+00		0.00E+00			
							Total	0.00E+00	
Offsite Truck			trips	km/trip		total			
	encasement pipe		0.00E+00	0.00E+00		0.00E+00			
	WESF modification		2.00E+02	1.40E+02		2.80E+04			
							Total	2.80E+04	
Capsule Transport									
Offsite Rail			trips	km/trip		total			
	Yucca		5.00E+00	2.93E+03		1.47E+04			
							Total	1.47E+04	
		Onsite Truck (km)		0.00E+00					
		Onsite Rail (km)		0.00E+00					
		Offsite Truck (km)		2.80E+04					
		Offsite Rail (km)		1.47E+04					
EMPLOYEE VEHICLE									
Routine		person-yr	trip/yr	km/trip	car pool	total			
	Const.	1.00E+02	2.60E+02	1.40E+02	7.41E-01	2.70E+06			
	Packaging	5.10E+01	2.60E+02	1.40E+02	7.41E-01	1.38E+06			
	Storage	9.00E+01	2.60E+02	1.40E+02	7.41E-01	2.43E+06			
							Total	6.50E+06	
Distance traveled in population zones									
Urban		Offsite km	zone fraction		Onsite	TOTALS			
	Truck	2.80E+04	5.00E-02			1.40E+03			
	Rail	1.47E+04	5.00E-02			7.33E+02			
Suburban									
	Truck	2.80E+04	5.00E-02		0.00E+00	1.40E+03			
	Rail	1.47E+04	5.00E-02			7.33E+02			
Rural									
	Truck	2.80E+04	9.00E-01			2.52E+04			
	Rail	1.47E+04	9.00E-01			1.32E+04			
Fatalities/Injuries resulting from Truck and Rail transportation accidents									
			urban km		suburban km		rural km		
			truck	rail	truck	rail	truck	rail	

			1.40E+03	7.33E+02	1.40E+03	7.33E+02	2.52E+04	1.32E+04	
urban truck fat/km		7.50E-09	1.05E-05						
urban truck inj/km		3.70E-07	5.18E-04						
urban rail fat/km		1.70E-08		1.25E-05					
urban rail inj/km		3.30E-08		2.42E-05					
sub truck fat.km		1.30E-08			1.82E-05				
sub truck inj/km		3.80E-07			5.32E-04				
sub rail fat/km		1.70E-08				1.25E-05			
sub rail inj/km		3.30E-08				2.42E-05			
rural truck fat/km		5.30E-08					1.34E-03		
rural truck inj/km		8.00E-07					2.02E-02		
rural rail fat/km		1.70E-08						2.24E-04	
rural rail inj/km		3.30E-08						4.35E-04	
	TOTAL FATALITIES		1.61E-03						
	TOTAL INJURIES		2.17E-02						
Fatalities/Injuries resulting from Employee vehicle accidents									
		km	rate/km	TOTAL					
	fatalities	6.50E+06	8.98E-09	5.84E-02					
	injuries	6.50E+06	7.14E-07	4.64E+00					
Cumulative fatalities/injuries from traffic impacts									
			transport	employee	TOTAL				
	FATALITIES		1.61E-03	5.84E-02	6.00E-02				
	INJURIES		2.17E-02	4.64E+00	4.66E+00				
CONSTRUCTION ACCIDENTS									
		rate	person-yr						
	TRC =	9.75E-02	1.00E+02	=	9.75				
	LWC =	2.45E-02	1.00E+02	=	2.45				
	Fatality =	3.20E-05	1.00E+02	=	0.0032				
OPERATION ACCIDENTS									
		rate	person-yr						
	TRC =	2.20E-02	1.41E+02	=	3.102				
	LWC =	1.10E-02	1.41E+02	=	1.551				
	Fatality =	3.20E-05	1.41E+02	=	0.004512				
TOTALS									
	INJUR	1.75E+01							
	FATAL	6.77E-02							

		VITRIFY WITH TANK WASTE ALTERNATIVE - REMEDIATION CALCS							
ROUTINE									
Construction									
Onsite Truck			trips	km/trip		total			
	borrow		0.00E+00	0.00E+00		0.00E+00			
							Total	0.00E+00	
Offsite Truck			trips	km/trip		total			
	encasement pipe		0.00E+00	0.00E+00		0.00E+00			
	WESF modification		2.00E+02	1.40E+02		2.80E+04			
							Total	2.80E+04	
Capsule Transport									
Onsite Truck			trips	km/trip		total			
	to vitrification plant		1.84E+02	3.20E+01		5.89E+03			
							Total	5.89E+03	
		Onsite Truck (km)		5.89E+03					
		Onsite Rail (km)		0.00E+00					
		Offsite Truck (km)		2.80E+04					
		Offsite Rail (km)		0.00E+00					
EMPLOYEE VEHICLE									
Routine		person-yr	trip/yr	km/trip	car pool	total			
	Const.	1.00E+02	2.60E+02	1.40E+02	7.41E-01	2.70E+06			
	Packaging	5.10E+01	2.60E+02	1.40E+02	7.41E-01	1.38E+06			
	Storage	9.00E+01	2.60E+02	1.40E+02	7.41E-01	2.43E+06			
							Total	6.50E+06	
Distance traveled in population zones									
Urban		Offsite km	zone fraction		Onsite	TOTALS			
	Truck	2.80E+04	5.00E-02			1.40E+03			
	Rail	0.00E+00	5.00E-02			0.00E+00			
Suburban									
	Truck	2.80E+04	5.00E-02		0.00E+00	1.40E+03			
	Rail	0.00E+00	5.00E-02			0.00E+00			
Rural									
	Truck	2.80E+04	9.00E-01			2.52E+04			
	Rail	0.00E+00	9.00E-01			0.00E+00			
Fatalities/Injuries resulting from Truck and Rail transportation accidents									
			urban km		suburban km		rural km		
			truck	rail	truck	rail	truck	rail	

			1.40E+03	0.00E+00	1.40E+03	0.00E+00	2.52E+04	0.00E+00	
urban truck fat/km		7.50E-09	1.05E-05						
urban truck inj/km		3.70E-07	5.18E-04						
urban rail fat/km		1.70E-08		0.00E+00					
urban rail inj/km		3.30E-08		0.00E+00					
sub truck fat.km		1.30E-08			1.82E-05				
sub truck inj/km		3.80E-07			5.32E-04				
sub rail fat/km		1.70E-08				0.00E+00			
sub rail inj/km		3.30E-08				0.00E+00			
rural truck fat/km		5.30E-08					1.34E-03		
rural truck inj/km		8.00E-07					2.02E-02		
rural rail fat/km		1.70E-08						0.00E+00	
rural rail inj/km		3.30E-08						0.00E+00	
	TOTAL FATALITIES		1.36E-03						
	TOTAL INJURIES		2.12E-02						
Fatalities/Injuries resulting from Employee vehicle accidents									
		km	rate/km	TOTAL					
	fatalities	6.50E+06	8.98E-09	5.84E-02					
	injuries	6.50E+06	7.14E-07	4.64E+00					
Cumulative fatalities/injuries from traffic impacts									
			transport	employee	TOTAL				
	FATALITIES		1.36E-03	5.84E-02	5.97E-02				
	INJURIES		2.12E-02	4.64E+00	4.66E+00				
CONSTRUCTION ACCIDENTS									
		rate	person-yr						
	TRC =	9.75E-02	1.00E+02	=	9.75E+00				
	LWC =	2.45E-02	1.00E+02	=	2.45E+00				
	Fatality =	3.20E-05	1.00E+02	=	3.20E-03				
OPERATION ACCIDENTS									
		rate	person-yr						
	TRC =	2.20E-02	1.41E+02	=	3.10E+00				
	LWC =	1.10E-02	1.41E+02	=	1.55E+00				
	Fatality =	3.20E-05	1.41E+02	=	4.51E-03				
TOTALS									
	INJUR	1.75E+01							
	FATAL	6.74E-02							

			IN SITU FILL AND CAP - REMEDIATION CALCS					
Construction - (W-314)								
Offsite Truck			trips	km/trip		total		
	steel		5.30E+01	8.00E+02		4.24E+04		
	cement		1.00E+02	1.40E+02		1.40E+04		
	miscellaneous		5.30E+01	1.40E+02		7.42E+03		
							Total	6.38E+04
Onsite Truck			trips	km/trip	yr	total		
	borrow		1.38E+03	1.00E+01		1.38E+04		
							Total	1.38E+04
Grout Fill IMUSTs								
Construction								
Onsite Truck			trips	km/trip		total		
	sand/gravel		2.20E+03	1.00E+01		2.20E+04		
							Total	2.20E+04
Offsite Truck			trips	km/trip		total		
	cement		4.63E+02	1.40E+02		6.48E+04		
	Portland/Seattle		0.00E+00	0.00E+00		0.00E+00		
			trips/yr	km/trip	yr			
	miscellaneous		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
							Total	6.48E+04
Processing								
Offsite Truck			trips/yr	km/trip	yr	total		
	glassformer/chem		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
	miscellaneous		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
							Total	0.00E+00
Offsite Rail			trips/yr	km/trip	yr	total		
	glassformer/chem		0.00E+00	0.00E+00	0.00E+00	0.00E+00		
							Total	0.00E+00
VITRIFIED HLW TRANSPORT								
Offsite Rail			trips	km/trip		total		
	Yucca Mountain		0.00E+00	0.00E+00		0.00E+00		
							Total	0.00E+00
CLOSURE								
Onsite Truck			cu yd	trip/cu yd	km/trip	total		
	fill		0.00E+00	1.00E-01	1.00E+01	0.00E+00		
	silt		0.00E+00	1.00E-01	3.00E+01	0.00E+00		
	riprap		0.00E+00	1.00E-01	3.20E+01	0.00E+00		
	ag/sand		0.00E+00	1.00E-01	1.00E+01	0.00E+00		
							Total	0.00E+00
Onsite Truck (km)		3.58E+04						
Onsite Rail (km)		0.00E+00						
Offsite Truck (km)		1.29E+05						
Offsite Rail (km)		0.00E+00						
EMPLOYEE VEHICLE								
Routine		person-yr	trip/yr	km/trip	car pool	total		
	W-314	1.63E+02	2.60E+02	1.40E+02	7.41E-01	4.40E+06		
	Ops/D&D	2.39E+04	2.60E+02	1.40E+02	7.41E-01	6.45E+08		
Fill Tanks with Gravel								
	Const.	9.50E+01	2.60E+02	1.40E+02	7.41E-01	2.56E+06		
	Ops/D&D	1.51E+03	2.60E+02	1.40E+02	7.41E-01	4.07E+07		
Closure		0.00E+00	2.60E+02	1.40E+02	7.41E-01	0.00E+00		
	total	2.57E+04					Total	6.92E+08
Distance traveled in population zones								

Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	1.29E+05	5.00E-02			6.43E+03		
	Rail	0.00E+00	5.00E-02			0.00E+00		
Suburban								
	Truck	1.29E+05	5.00E-02		3.58E+04	4.22E+04		
	Rail	0.00E+00	5.00E-02			0.00E+00		
Rural								
	Truck	1.29E+05	9.00E-01			1.16E+05		
	Rail	0.00E+00	9.00E-01			0.00E+00		

Fatalities/Injuries resulting from Truck and Rail transportation accidents

			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			6.43E+03	0.00E+00	4.22E+04	0.00E+00	1.16E+05	0.00E+00
urban truck fat/km		7.50E-09	4.82E-05					
urban truck inj/km		3.70E-07	2.38E-03					
urban rail fat/km		1.70E-08		0.00E+00				
urban rail inj/km		3.30E-08		0.00E+00				
sub truck fat.km		1.30E-08			5.49E-04			
sub truck inj/km		3.80E-07			1.60E-02			
sub rail fat/km		1.70E-08				0.00E+00		
sub rail inj/km		3.30E-08				0.00E+00		
rural truck fat/km		5.30E-08					6.14E-03	
rural truck inj/km		8.00E-07					9.26E-02	
rural rail fat/km		1.70E-08						0.00E+00
rural rail inj/km		3.30E-08						0.00E+00
	TOTAL FATALITIES		6.73E-03					
	TOTAL INJURIES		1.11E-01					

Fatalities/Injuries resulting from Employee vehicle accidents

		km	rate/km	TOTAL
	fatalities	6.92E+08	8.98E-09	6.22E+00
	injuries	6.92E+08	7.14E-07	4.94E+02

Cumulative fatalities/injuries from traffic impacts

		transport	employee	TOTAL
	FATALITIES	6.73E-03	6.22E+00	6.22E+00
	INJURIES	1.11E-01	4.94E+02	4.94E+02

CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	2.58E+02	=	2.52E+01			
	LWC =	2.45E-02	2.58E+02	=	6.32E+00			
	Fatality =	3.20E-05	2.58E+02	=	8.26E-03			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	2.54E+04	=	5.59E+02			
	LWC =	1.10E-02	2.54E+04	=	2.80E+02			
	Fatality =	3.20E-05	2.54E+04	=	8.13E-01			
TOTALS								
	INJUR	1.08E+03						
	FATAL	7.05E+00						

			EX SITU COMBINATION - REMEDIATION CALCS					
RETRIEVAL								
Waste Transport						total		
Onsite Truck						0.00E+00		
Construction								
Offsite Truck			trips/yr	km/trip	yr	total		
	concrete		2.40E+02	1.40E+02	2.00E+01	6.72E+05		
	raw material		2.25E+01	8.00E+02	2.00E+01	3.60E+05		
	equipment		1.25E+01	1.00E+04	2.00E+01	2.50E+06		
	miscellaneous		2.60E+03	1.40E+02	2.00E+01	7.28E+06		
	steel W-314		5.30E+01	8.00E+02		4.24E+04		
	cement/misc W-314		1.53E+02	1.40E+02		2.14E+04	Total	1.09E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	raw material		5.00E+00	8.00E+02	2.00E+01	8.00E+04	Total	8.00E+04
Onsite Truck								
	borrow W-314		1.38E+03	1.00E+01		1.38E+04	Total	1.38E+04
VITRIFICATION								
Construction								
Onsite Truck			trips	km/trip		total		
	borrow		8.40E+04	1.00E+01		8.40E+05	Total	8.40E+05
Offsite Truck			trips	km/trip		total		
	concrete		2.30E+04	1.40E+02		3.22E+06		
	steel		9.10E+03	8.00E+02		7.28E+06		
			trips/yr	km/trip	yr			
	miscellaneous		3.15E+03	1.40E+02	1.00E+01	4.41E+06	Total	1.49E+07
Processing								
Offsite Truck			trips/yr	km/trip	yr	total		
	glassformer/chem		1.30E+03	8.00E+02	1.90E+01	1.98E+07		
	miscellaneous		2.60E+03	1.40E+02	1.90E+01	6.92E+06	Total	2.67E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	glassformer/chem		1.37E+02	8.00E+02	1.90E+01	2.08E+06	Total	2.08E+06
VITRIFIED HLW TRANSPORT								
Offsite Rail			trips	km/trip		total		
	Yucca Mountain		4.18E+02	4.28E+03		1.79E+06	Total	1.79E+06
CLOSURE								
Onsite Truck			cu yd	trip/cu yd	km/trip	total		
	fill		0.00E+00	1.00E-01	1.00E+01	0.00E+00		
	silt		0.00E+00	1.00E-01	3.00E+01	0.00E+00		
	riprap		0.00E+00	1.00E-01	3.20E+01	0.00E+00		
	ag/sand		0.00E+00	1.00E-01	1.00E+01	0.00E+00	Total	0.00E+00
GROUT FILL IMUST								
Onsite Truck sand/gravel			2.20E+03	1.00E+01		2.20E+04	Total	2.20E+04
Offsite Truck cement			4.63E+02	1.40E+02		6.48E+04	Total	6.48E+04
Onsite Truck (km)		8.76E+05						
Onsite Rail (km)		0.00E+00						
Offsite Truck (km)		5.25E+07						
Offsite Rail (km)		3.95E+06						
EMPLOYEE VEHICLE								
Retrieval		person-yr	trip/yr	km/trip	car pool	total		
	Const.	6.36E+03	2.60E+02	1.40E+02	7.41E-01	1.72E+08		
	Ops/D&D	2.24E+04	2.60E+02	1.40E+02	7.41E-01	6.04E+08		
Vitrification								
	Const.	1.19E+04	2.60E+02	1.40E+02	7.41E-01	3.21E+08		
	Ops/D&D	1.04E+04	2.60E+02	1.40E+02	7.41E-01	2.81E+08		
Fill tank								
	Const.	5.70E+01	2.60E+02	1.40E+02	7.41E-01	1.54E+06		
	Ops/D&D	1.80E+03	2.60E+02	1.40E+02	7.41E-01	4.86E+07		
Closure		0.00E+00	2.60E+02	1.40E+02	7.41E-01	0.00E+00		
							Total	1.43E+09

Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	5.25E+07	5.00E-02			2.63E+06		
	Rail	3.95E+06	5.00E-02			1.98E+05		
Suburban								
	Truck	5.25E+07	5.00E-02		8.76E+05	3.50E+06		
	Rail	3.95E+06	5.00E-02			1.98E+05		
Rural								
	Truck	5.25E+07	9.00E-01			4.73E+07		
	Rail	3.95E+06	9.00E-01			3.56E+06		
Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			2.63E+06	1.98E+05	3.50E+06	1.98E+05	4.73E+07	3.56E+06
urban truck fat/km		7.50E-09	1.97E-02					
urban truck inj/km		3.70E-07	9.72E-01					
urban rail fat/km		1.70E-08		3.36E-03				
urban rail inj/km		3.30E-08		6.52E-03				
sub truck fat.km		1.30E-08			4.55E-02			
sub truck inj/km		3.80E-07			1.33E+00			
sub rail fat/km		1.70E-08				3.36E-03		
sub rail inj/km		3.30E-08				6.52E-03		
rural truck fat/km		5.30E-08					2.51E+00	
rural truck inj/km		8.00E-07					3.78E+01	
rural rail fat/km		1.70E-08						6.05E-02
rural rail inj/km		3.30E-08						1.17E-01
	TOTAL FATALITIES		2.64E+00					
	TOTAL INJURIES		4.03E+01					
Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	1.43E+09	8.98E-09	1.28E+01				
	injuries	1.43E+09	7.14E-07	1.02E+03				
Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		2.64E+00	1.28E+01	1.55E+01			
	INJURIES		4.03E+01	1.02E+03	1.06E+03			
CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	1.83E+04	=	1.79E+03			
	LWC =	2.45E-02	1.83E+04	=	4.49E+02			
	Fatality =	3.20E-05	1.83E+04	=	5.86E-01			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	3.46E+04	=	7.61E+02			
	LWC =	1.10E-02	3.46E+04	=	3.81E+02			
	Fatality =	3.20E-05	3.46E+04	=	1.11E+00			
TOTALS								
	INJUR	3.61E+03						
	FATAL	1.71E+01						

			LONG-TERM MANAGEMENT ALTERNATIVE - REMEDIATION CALCS						
RETRIEVAL									
Waste Transport									
Onsite Truck						0.00E+00			
							Total	0.00E+00	
Construction									
Offsite Truck			trips/yr	km/trip	yr	total			
	concrete		0.00E+00	0.00E+00	0.00E+00	0.00E+00			
	raw material		0.00E+00	0.00E+00	0.00E+00	0.00E+00			
	equipment		0.00E+00	0.00E+00	0.00E+00	0.00E+00			
	miscellaneous		0.00E+00	0.00E+00	0.00E+00	0.00E+00			
							Total	0.00E+00	
Offsite Rail			trips/yr	km/trip	yr	total			
	raw material		0.00E+00	0.00E+00	0.00E+00	0.00E+00			
							Total	0.00E+00	
ROUTINE									
Construction									
Onsite Truck			trips	km/trip		total			
	borrow		3.24E+04	1.00E+01		3.24E+05			
							Total	3.24E+05	
Offsite Truck			trips/yr	km/trip	yr	total			
	miscellaneous		5.20E+03	1.40E+02	1.90E+01	1.38E+07			
			trips	km/trip					
	Tri-Cities		2.01E+04	1.40E+02		2.81E+06			
	Portland/Seattle		7.75E+03	8.00E+02		6.20E+06			
							Total	2.28E+07	
	Onsite Truck (km)		3.24E+05						
	Onsite Rail (km)		0.00E+00						
	Offsite Truck (km)		2.28E+07						
	Offsite Rail (km)		0.00E+00						
EMPLOYEE VEHICLE									
Routine		person-yr	trip/yr	km/trip	car pool	total			
	Const.	3.75E+03	2.60E+02	1.40E+02	7.41E-01	1.01E+08			
	Ops	1.04E+05	2.60E+02	1.40E+02	7.41E-01	2.81E+09			
							Total	2.91E+09	
Distance traveled in population zones									
Urban		Offsite km	zone fraction		Onsite	TOTALS			
	Truck	2.28E+07	5.00E-02			1.14E+06			
	Rail	0.00E+00	5.00E-02			0.00E+00			
Suburban									
	Truck	2.28E+07	5.00E-02		3.24E+05	1.47E+06			
	Rail	0.00E+00	5.00E-02			0.00E+00			
Rural									
	Truck	2.28E+07	9.00E-01			2.06E+07			
	Rail	0.00E+00	9.00E-01			0.00E+00			

Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			1.14E+06	0.00E+00	1.47E+06	0.00E+00	2.06E+07	0.00E+00
urban truck fat/km		7.50E-09	8.57E-03					
urban truck inj/km		3.70E-07	4.23E-01					
urban rail fat/km		1.70E-08		0.00E+00				
urban rail inj/km		3.30E-08		0.00E+00				
sub truck fat.km		1.30E-08			1.91E-02			
sub truck inj/km		3.80E-07			5.57E-01			
sub rail fat/km		1.70E-08				0.00E+00		
sub rail inj/km		3.30E-08				0.00E+00		
rural truck fat/km		5.30E-08					1.09E+00	
rural truck inj/km		8.00E-07					1.64E+01	
rural rail fat/km		1.70E-08						0.00E+00
rural rail inj/km		3.30E-08						0.00E+00
	TOTAL FATALITIES		1.12E+00					
	TOTAL INJURIES		1.74E+01					
Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	2.91E+09	8.98E-09	2.61E+01				
	injuries	2.91E+09	7.14E-07	2.08E+03				
Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		1.12E+00	2.61E+01	2.72E+01			
	INJURIES		1.74E+01	2.08E+03	2.09E+03			
CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	3.75E+03	=	3.66E+02			
	LWC =	2.45E-02	3.75E+03	=	9.19E+01			
	Fatality =	3.20E-05	3.75E+03	=	1.20E-01			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	1.04E+05	=	2.29E+03			
	LWC =	1.10E-02	1.04E+05	=	1.14E+03			
	Fatality =	3.20E-05	1.04E+05	=	3.33E+00			
TOTALS								
	INJUR	4.75E+03						
	FATAL	3.07E+01						

	TOTAL ALTERNATIVE PHASED IMPLEMENTATION 1 AND 2 - REMEDIATION CALCS							
RETRIEVAL								
Waste Transport						total		
Onsite Truck						1.25E+04	Total	1.25E+04
Construction								
Offsite Truck			trips/yr	km/trip	yr	total		
	concrete		4.80E+02	1.40E+02	2.00E+01	1.34E+06		
	raw material		4.50E+01	8.00E+02	2.00E+01	7.20E+05		
	equipment		2.50E+01	1.00E+04	2.00E+01	5.00E+06		
	miscellaneous		5.20E+03	1.40E+02	2.00E+01	1.46E+07		
	borrow (W-314)		1.38E+03	1.00E+01		1.38E+04	Total	2.16E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	raw material		1.00E+01	8.00E+02	2.00E+01	1.60E+05		
	steel (W-314)		5.30E+01	8.00E+02		4.24E+04		
	cement (W-314)		1.00E+02	1.40E+02		1.40E+04	Total	2.16E+05
VITRIFICATION								
Construction								
Onsite Truck			trips	km/trip		total		
	borrow		1.44E+05	1.00E+01		1.44E+06	Total	1.44E+06
Offsite Truck			trips	km/trip		total		
	concrete		2.61E+04	1.40E+02		3.65E+06		
	steel		9.70E+03	8.00E+02		7.76E+06		
	miscellaneous		3.11E+04	1.40E+02		4.35E+06	Total	1.58E+07
Processing								
Offsite Truck			trips	km/trip		total		
	glassformer/chem		1.65E+04	8.00E+02		1.32E+07		
	miscellaneous		1.03E+05	1.40E+02		1.44E+07		
	process material		3.00E+04	1.40E+02		4.20E+06	Total	3.18E+07
Offsite Rail			trips	km/trip		total		
	glassformer/chem		3.00E+03	8.00E+02		2.40E+06	Total	2.40E+06
VITRIFIED HLW TRANSPORT								
Offsite Rail			trips	km/trip		total		
	Yucca Mountain		8.35E+02	4.28E+03		3.57E+06	Total	3.57E+06
CLOSURE								
Onsite Truck			cu yd	trip/cu yd	km/trip	total		
	fill		0.00E+00	1.00E-01	1.00E+01	0.00E+00		
	silt		0.00E+00	1.00E-01	3.00E+01	0.00E+00		
	riprap		0.00E+00	1.00E-01	3.20E+01	0.00E+00		
	ag/sand		0.00E+00	1.00E-01	1.00E+01	0.00E+00		
	grout fill sand IMUST		0.00E+00	1.00E+01		0.00E+00	Total	0.00E+00
Offsite Truck			trips	km/trip		total		
	groutfill cement IMUS		4.63E+02	1.40E+02		6.48E+04	Total	6.48E+04
Onsite Truck (km)		1.45E+06						
Onsite Rail (km)		0.00E+00						
Offsite Truck (km)		6.93E+07						
Offsite Rail (km)		6.19E+06						
EMPLOYEE VEHICLE								
Phase 1		person-yr	trip/yr	km/trip	car pool	total		
	Const.	1.16E+04	2.60E+02	1.40E+02	7.41E-01	3.13E+08		
	Ops/D&D	6.77E+03	2.60E+02	1.40E+02	7.41E-01	1.83E+08		
Phase 2								
	Const.	1.98E+04	2.60E+02	1.40E+02	7.41E-01	5.34E+08		
	Ops/D&D	4.91E+04	2.60E+02	1.40E+02	7.41E-01	1.32E+09		
							Total	2.35E+09

Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	6.93E+07	5.00E-02			3.46E+06		
	Rail	6.19E+06	5.00E-02			3.10E+05		
Suburban								
	Truck	6.93E+07	5.00E-02		1.45E+06	4.92E+06		
	Rail	6.19E+06	5.00E-02			3.10E+05		
Rural								
	Truck	6.93E+07	9.00E-01			6.24E+07		
	Rail	6.19E+06	9.00E-01			5.57E+06		
Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			3.46E+06	3.10E+05	4.92E+06	3.10E+05	6.24E+07	5.57E+06
urban truck fat/km		7.50E-09	2.60E-02					
urban truck inj/km		3.70E-07	1.28E+00					
urban rail fat/km		1.70E-08		5.26E-03				
urban rail inj/km		3.30E-08		1.02E-02				
sub truck fat.km		1.30E-08			6.39E-02			
sub truck inj/km		3.80E-07			1.87E+00			
sub rail fat/km		1.70E-08				5.26E-03		
sub rail inj/km		3.30E-08				1.02E-02		
rural truck fat/km		5.30E-08					3.31E+00	
rural truck inj/km		8.00E-07					4.99E+01	
rural rail fat/km		1.70E-08						9.47E-02
rural rail inj/km		3.30E-08						1.84E-01
	TOTAL FATALITIES		3.50E+00					
	TOTAL INJURIES		5.32E+01					
Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	2.35E+09	8.98E-09	2.11E+01				
	injuries	2.35E+09	7.14E-07	1.68E+03				
Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		3.50E+00	2.11E+01	2.46E+01			
	INJURIES		5.32E+01	1.68E+03	1.73E+03			
CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	3.14E+04	=	3.06E+03			
	LWC =	2.45E-02	3.14E+04	=	7.69E+02			
	Fatality =	3.20E-05	3.14E+04	=	1.00E+00			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	5.59E+04	=	1.23E+03			
	LWC =	1.10E-02	5.59E+04	=	6.15E+02			
	Fatality =	3.20E-05	5.59E+04	=	1.79E+00			
TOTALS								
	INJUR	6.02E+03						
	FATAL	2.74E+01						

	PHASE 1 IMPLEMENTATION SUB-ALTERNATIVE - REMEDIATION CALCS							
RETRIEVAL								
WASTE TRANSFER SYSTEM UPGRADE (W-314)								
Onsite Truck			trips	km/trip		total		
	borrow		1.38E+03	1.00E+00		1.38E+03	Total	1.38E+03
Offsite Truck								
	steel		5.30E+01	8.00E+02		4.24E+04		
	cement		1.00E+02	1.40E+02		1.40E+04	Total	5.64E+04
VITRIFICATION								
Construction								
Onsite Truck			trips	km/trip		total		
	borrow		1.96E+03	1.00E+01		1.96E+04	Total	1.96E+04
Offsite Truck			trips	km/trip		total		
	concrete		1.20E+03	1.40E+02		1.68E+05		
	steel		7.32E+03	8.00E+02		5.86E+06		
	miscellaneous		3.18E+03	1.40E+02		4.45E+05	Total	6.47E+06
Processing								
Offsite Truck			trips	km/trip		total		
	glassformer/chem		3.50E+03	8.00E+02		2.80E+06		
	glassformer/chem		3.57E+03	1.40E+02		5.00E+05		
	miscellaneous		5.20E+04	1.40E+02		7.28E+06	Total	1.06E+07
Offsite Rail			trips	km/trip		total		
	glassformer/chem		2.18E+02	8.00E+02		1.74E+05	Total	1.74E+05
VITRIFIED HLW TRANSPORT								
SITE RESTORATION								
Onsite Truck			trips	km/trip		total		
	contaminated waste		1.50E+03	1.61E+01		2.42E+04		
	noncont. waste		6.23E+04	1.61E+01		1.00E+06	Total	1.03E+06
GROUT FILL IMUST								
Onsite Truck (km)		1.05E+06						
Onsite Rail (km)		0.00E+00						
Offsite Truck (km)		1.71E+07						
Offsite Rail (km)		1.74E+05						
EMPLOYEE VEHICLE								
		person-yr	trip/yr	km/trip	car pool	total		
	Const.	1.07E+04	2.60E+02	1.40E+02	7.41E-01	2.89E+08		
	Ops/D&D	6.93E+03	2.60E+02	1.40E+02	7.41E-01	1.87E+08	Total	4.76E+08

Distance traveled in population zones									
Urban		Offsite km	zone fraction		Onsite	TOTALS			
	Truck	1.71E+07	5.00E-02			8.55E+05			
	Rail	1.74E+05	5.00E-02			8.72E+03			
Suburban									
	Truck	1.71E+07	5.00E-02		1.05E+06	1.90E+06			
	Rail	1.74E+05	5.00E-02			8.72E+03			
Rural									
	Truck	1.71E+07	9.00E-01			1.54E+07			
	Rail	1.74E+05	9.00E-01			1.57E+05			
Fatalities/Injuries resulting from Truck and Rail transportation accidents									
			urban km		suburban km		rural km		
			truck	rail	truck	rail	truck	rail	
			8.55E+05	8.72E+03	1.90E+06	8.72E+03	1.54E+07	1.57E+05	
urban truck fat/km		7.50E-09	6.41E-03						
urban truck inj/km		3.70E-07	3.16E-01						
urban rail fat/km		1.70E-08		1.48E-04					
urban rail inj/km		3.30E-08		2.88E-04					
sub truck fat.km		1.30E-08			2.47E-02				
sub truck inj/km		3.80E-07			7.23E-01				
sub rail fat/km		1.70E-08				1.48E-04			
sub rail inj/km		3.30E-08				2.88E-04			
rural truck fat/km		5.30E-08					8.16E-01		
rural truck inj/km		8.00E-07					1.23E+01		
rural rail fat/km		1.70E-08						2.67E-03	
rural rail inj/km		3.30E-08						5.18E-03	
	TOTAL FATALITIES		8.50E-01						
	TOTAL INJURIES		1.34E+01						
Fatalities/Injuries resulting from Employee vehicle accidents									
		km	rate/km	TOTAL					
	fatalities	4.76E+08	8.98E-09	4.27E+00					
	injuries	4.76E+08	7.14E-07	3.40E+02					
Cumulative fatalities/injuries from traffic impacts									
			transport	employee	TOTAL				
	FATALITIES		8.50E-01	4.27E+00	5.12E+00				
	INJURIES		1.34E+01	3.40E+02	3.53E+02				
CONSTRUCTION ACCIDENTS									
		rate	person-yr						
	TRC =	9.75E-02	1.07E+04	=	1.04E+03				
	LWC =	2.45E-02	1.07E+04	=	2.62E+02				
	Fatality =	3.20E-05	1.07E+04	=	3.42E-01				
OPERATION ACCIDENTS									
		rate	person-yr						
	TRC =	2.20E-02	6.93E+03	=	1.52E+02				
	LWC =	1.10E-02	6.93E+03	=	7.62E+01				
	Fatality =	3.20E-05	6.93E+03	=	2.22E-01				
TOTALS									
	INJUR	1.55E+03							
	FATAL	5.68E+00							

			EX SITU NO SEPARATIONS ALTERNATIVE					
				CALCINATION - REMEDIATION CALCS				
RETRIEVAL								
Waste Transport						total		
Onsite Truck						1.25E+04	Total	1.25E+04
Construction								
Offsite Truck			trips/yr	km/trip	yr	total		
	concrete		4.80E+02	1.40E+02	2.00E+01	1.34E+06		
	raw material		4.50E+01	8.00E+02	2.00E+01	7.20E+05		
	equipment		2.50E+01	1.00E+04	2.00E+01	5.00E+05		
	miscellaneous		5.20E+03	1.40E+02	2.00E+01	1.46E+07		
	steel W-314		5.30E+01	8.00E+02		4.24E+04		
	cement/misc W-314		1.53E+02	1.40E+02		2.14E+04	Total	2.17E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	raw material		1.00E+01	8.00E+02	2.00E+01	1.60E+05	Total	1.60E+05
Onsite Truck								
	borrow W-314		1.38E+03	1.00E+01		1.38E+04	Total	1.38E+04
CALCINATION								
Construction								
Onsite Truck			trips	km/trip		total		
	borrow		3.30E+04	1.00E+01		3.30E+05	Total	3.30E+05
Offsite Truck			trips	km/trip		total		
	Try Cities		3.40E+04	1.40E+02		4.76E+06		
	Portland/Seattle		1.07E+04	8.00E+02		8.56E+05		
			trips/yr	km/trip	yr			
	miscellaneous		5.20E+03	1.40E+02	5.50E+00	4.00E+06	Total	1.73E+07
Processing								
Offsite Truck			trips/yr	km/trip	yr	total		
	Portand/Seattle		8.87E+02	8.00E+02	1.50E+01	1.06E+07		
	miscellaneous		5.20E+03	1.40E+02	1.50E+01	1.09E+07	Total	2.16E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	Portland/Seattle		1.03E+02	8.00E+02	1.50E+01	1.24E+06	Total	1.24E+06
CALCINED HLW TRANSPORT								
Offsite Rail			trips	km/trip		total		
	Yucca Mountain		4.15E+03	4.28E+03		1.78E+07	Total	1.78E+07
CLOSURE								
Onsite Truck			cu yd	trip/cu yd	km/trip	total		
	fill		0.00E+00	1.00E-01	1.00E+01	0.00E+00		
	silt		0.00E+00	1.00E-01	3.00E+01	0.00E+00		
	riprap		0.00E+00	1.00E-01	3.20E+01	0.00E+00		
	ag/sand		0.00E+00	1.00E-01	1.00E+01	0.00E+00	Total	0.00E+00
GROUT FILL IMUST								
Onsite Truck sand/gravel			2.20E+03	1.00E+01		2.20E+04	Total	2.20E+04
Offsite Truick cement			4.63E+02	1.40E+02		6.48E+04	Total	6.48E+04
Onsite Truck (km)		3.78E+05						
Onsite Rail (km)		0.00E+00						
Offsite Truck (km)		6.06E+07						
Offsite Rail (km)		1.92E+07						
EMPLOYEE VEHICLE								
Retrieval		person-yr	trip/yr	km/trip	car pool	total		
	Const.	1.06E+04	2.60E+02	1.40E+02	7.41E-01	2.86E+08		
	Ops	3.15E+04	2.60E+02	1.40E+02	7.41E-01	8.50E+08		
Vitrification								
	Const.	1.48E+04	2.60E+02	1.40E+02	7.41E-01	3.99E+08		
	Ops	9.78E+03	2.60E+02	1.40E+02	7.41E-01	2.64E+08		
Closure		0.00E+00	2.60E+02	1.40E+02	7.41E-01	0.00E+00		
	total	6.67E+04					Total	1.80E+09

Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	6.06E+07	5.00E-02			3.03E+06		
	Rail	1.92E+07	5.00E-02			9.58E+05		
Suburban								
	Truck	6.06E+07	5.00E-02		3.78E+05	3.41E+06		
	Rail	1.92E+07	5.00E-02			9.58E+05		
Rural								
	Truck	6.06E+07	9.00E-01			5.46E+07		
	Rail	1.92E+07	9.00E-01			1.72E+07		
Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			3.03E+06	9.58E+05	3.41E+06	9.58E+05	5.46E+07	1.72E+07
urban truck fat/km		7.50E-09	2.27E-02					
urban truck inj/km		3.70E-07	1.12E+00					
urban rail fat/km		1.70E-08		1.63E-02				
urban rail inj/km		3.30E-08		3.16E-02				
sub truck fat.km		1.30E-08			4.43E-02			
sub truck inj/km		3.80E-07			1.30E+00			
sub rail fat/km		1.70E-08				1.63E-02		
sub rail inj/km		3.30E-08				3.16E-02		
rural truck fat/km		5.30E-08					2.89E+00	
rural truck inj/km		8.00E-07					4.37E+01	
rural rail fat/km		1.70E-08						2.93E-01
rural rail inj/km		3.30E-08						5.69E-01
	TOTAL FATALITIES		3.29E+00					
	TOTAL INJURIES		4.67E+01					
Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	1.80E+09	8.98E-09	1.62E+01				
	injuries	1.80E+09	7.14E-07	1.28E+03				
Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		3.29E+00	1.62E+01	1.94E+01			
	INJURIES		4.67E+01	1.28E+03	1.33E+03			
CONSTRUCTION ACCIDENTS								
		rate	person-yr					
	TRC =	9.75E-02	2.54E+04	=	2.48E+03			
	LWC =	2.45E-02	2.54E+04	=	6.22E+02			
	Fatality =	3.20E-05	2.54E+04	=	8.13E-01			
OPERATION ACCIDENTS								
		rate	person-yr					
	TRC =	2.20E-02	4.13E+04	=	9.08E+02			
	LWC =	1.10E-02	4.13E+04	=	4.54E+02			
	Fatality =	3.20E-05	4.13E+04	=	1.32E+00			
TOTALS								
	INJUR	4.72E+03						
	FATAL	2.16E+01						

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE WATER RESOURCES

ORIGINATOR STEVE CARBALLIERA DATE 3/19/96

REVISION NO.

OBJECTIVE PROVIDE MAXIMUM GROUNDWATER CONCENTRATIONS IN PCi/L

METHODOLOGY FOR EACH RADIOISOTOPE CONVERT mg/L TO PCi/L BY MULTIPLYING BY ITS SPECIFIC ACTIVITY

ASSUMPTIONS

(Continue on another sheet if necessary)

2/16/96
SIGNATURE/DATE

Stephen W. Billitt 20-MAR-96
CHECKED/DATE

CALCULATION & RESULTS
ATTACHED

JACOBS\FORMS\CALCVR.SHT

PROJECTS/common/HANFORD/
Sheet1 APPFNEW.XLS

Table F.3.1.1. Maximum Concentrations Calculated for the No Action Alternative										
Constituent	300 years	300 years	500 years	500 years	2,500	2,500	5,000	5,000	10,000	10,000
	(mg/L)	(pCi/L)	(mg/L)	(pCi/L)	years	years	years	years	years	years
					(mg/L)	(pCi/L)	(mg/L)	(pCi/L)	(mg/L)	(pCi/L)
Kd										
Group 1										
(Kd = 0.0										
mL/g)										
C-14	1.55E-05	6.90E+04	4.57E-06	2.03E+04	2.13E-09	9.48E+00	3.18E-11	1.42E-01	0	0.00E+00
I-129	2.50E-03	4.40E+02	3.21E-04	5.65E+01	6.51E-07	1.15E-01	1.31E-08	2.31E-03	1.10E-12	1.94E-07
Np-237	2.92E-03	2.06E+03	6.45E-04	4.54E+02	4.18E-07	2.94E-01	8.42E-09	5.93E-03	7.00E-13	4.93E-07
Np-238	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00
Rh-106	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00
Rn-219	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00
Rn-222	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00
Ru-106	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00
Sb-126m	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00
Se-79	4.64E-04	3.23E+04	3.45E-04	2.40E+04	9.18E-08	6.39E+00	1.80E-09	1.25E-01	1.00E-13	6.96E-06
Tc-99	1.87E-02	3.16E+05	7.45E-03	1.26E+05	8.02E-06	1.36E+02	1.58E-07	2.67E+00	1.34E-11	2.26E-04
U-233	3.91E-08	3.77E-01	2.61E-08	2.52E-01	4.70E-12	4.53E-05	1.00E-13	9.64E-07	0	0.00E+00
U-234	1.93E-06	1.20E+01	2.84E-07	1.77E+00	1.91E-10	1.19E-03	3.80E-12	2.37E-05	0	0.00E+00
U-235	8.03E-01	1.73E+03	9.30E-02	2.01E+02	3.55E-05	7.67E-02	7.15E-07	1.54E-03	6.15E-11	1.33E-07
U-236	8.48E-07	5.48E-02	1.21E-07	7.82E-03	1.69E-10	1.09E-05	3.40E-12	2.20E-07	0	0.00E+00
U-238	1.23E+02	4.13E+04	1.42E+01	4.77E+03	5.04E-03	1.69E+00	1.02E-04	3.43E-02	0	0.00E+00
Ag+	1.23E-02		7.77E-03		9.07E-07		1.76E-08		1.50E-12	
As+5	8.92E-03		5.54E-03		3.15E-06		6.12E-08		5.20E-12	
B+3	1.09E-02		6.50E-03		6.68E-06		1.30E-07		1.11E-11	
Be+2	6.14E-04		4.09E-04		0		0		0	
Cl-	5.52E+00		1.23E+00		1.31E-03		2.56E-05		2.19E-09	
CO3-2	1.69E+02		1.94E+01		4.22E-03		8.51E-05		7.31E-09	
Cr+3	2.72E+00		3.80E-01		8.38E-07		1.69E-08		1.50E-12	
CrO4-2	6.60E-01		9.20E-02		1.48E-03		2.91E-05		2.49E-09	
F-	3.44E+01		4.67E+00		9.31E-04		1.87E-05		1.60E-09	
Fe(CN)6-4	1.90E+00		1.45E+00		3.58E-05		7.21E-07		6.20E-11	
Hg+	5.00E-02		6.04E-03		6.29E-06		1.27E-07		1.09E-11	
K+	3.40E+00		2.52E+00		5.87E-04		1.14E-05		9.74E-10	
Li+	2.12E-04		1.33E-04		8.76E-08		1.70E-09		1.00E-13	
Mo+6	3.72E-02		2.43E-02		1.33E-05		2.59E-07		2.21E-11	
Na+	3.63E+03		4.46E+02		5.86E-01		1.18E-02		1.01E-06	
NO2-	4.25E+02		4.96E+01		2.48E-02		4.98E-04		4.27E-08	
NO3-	6.62E+03		8.22E+02		1.21E+00		2.43E-02		2.09E-06	
OH-	1.27E+02		1.79E+01		6.02E-02		1.21E-03		1.04E-07	
SiO3-2	1.35E+02		1.57E+01		6.39E-03		1.29E-04		1.11E-08	
SO4-2	1.53E+02		1.77E+01		7.15E-03		1.44E-04		1.23E-08	
UO2+2	2.10E-01		1.42E-01		7.00E-13		0		0	
V+5	1.51E-03		1.12E-03		2.14E-07		4.16E-09		4.00E-13	
W+4	8.01E-01		9.67E-02		1.01E-04		2.03-06		1.74E-10	
Kd										
Group 2										
(Kd = 1.0										
mL/g)										
Bi-210	---		---		0	0.00E+00	0	0.00E+00	0	0.00E+00
Ni-63	---		---		5.81E-06	3.42E+05	1.73E-06	1.02E+05	5.58E-08	3.28E+03
Pa-231	---		---		8.20E-09	3.87E-01	5.67E-10	2.68E-02	3.79E-11	1.79E-03
Pa-233	---		---		1.73E-11	3.58E+02	0	0.00E+00	1.00E-13	2.07E+00
Pa-234m	---		---		0	0.00E+00	0	0.00E+00	0	0.00E+00
Po-211	---		---		0	0.00E+00	0	0.00E+00	0	0.00E+00
Bi+3	---		---		6.86E+00		4.70E-01		3.40E-02	
Ca+2	---		---		2.04E-01		6.48E-02		1.88E-03	
Cd+2	---		---		3.72E-02		3.81E-03		2.14E-04	
Cu+2	---		---		2.21E-03		3.88E-04		1.55E-05	
Fe+3	---		---		7.14E+00		5.11E-01		3.77E-02	
Mg+2	---		---		2.63E-02		5.36E-03		2.04E-04	
Ni+2	---		---		2.13E-01		8.37E-02		2.31E-03	

Table F.3.2.1. Maximum Contaminant Concentration Calculated for the Long Term Management Alternative										
Constituent	300 years		500 years		2,500		5,000		10,000	
	(mg/L)		(mg/L)		years		years		years	
					(mg/L)		(mg/L)		(mg/L)	
Kd										
Group 1										
(Kd = 0.0										
mL/g)										
C-14	3.15E-06	1.40E+04	3.96E-06	1.76E+04	2.13E-09	9.48E+00	3.18E-11	1.42E-01	0	0.00E+00
I-129	4.09E-04	7.20E+01	3.21E-04	5.65E+01	6.51E-07	1.15E-01	1.31E-08	2.31E-03	1.10E-12	1.94E-07
Np-237	2.92E-03	2.06E+03	6.45E-04	4.54E+02	4.19E-07	2.95E-01	8.46E-09	5.96E-03	7.00E-13	4.93E-07
Np-238	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00
Rh-106	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00
Rn-219	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00
Rn-222	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00
Ru-106	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00
Sb-126m	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00
Se-79	2.12E-04	1.48E+04	3.45E-04	2.40E+04	9.18E-08	6.39E+00	1.80E-09	1.25E-01	1.00E-13	6.96E-06
Tc-99	5.40E-03	9.13E+04	6.48E-03	1.10E+05	8.44E-06	1.43E+02	1.71E-07	2.89E+00	1.45E-11	2.45E-04
U-233	1.53E-08	1.47E-01	2.89E-08	2.79E-01	4.70E-12	4.53E-05	1.00E-13	9.64E-07	0	0.00E+00
U-234	3.82E-05	2.38E+02	3.20E-05	2.00E+02	1.91E-10	1.19E-03	3.80E-12	2.37E-05	0	0.00E+00
U-235	1.20E-01	2.59E+02	9.30E-02	2.01E+02	5.28E-06	1.14E-02	1.06E-07	2.29E-04	6.33E-11	1.37E-07
U-236	1.36E-07	8.79E-03	1.27E-07	8.20E-03	2.52E-11	1.63E-06	5.00E-13	3.23E-08	0	0.00E+00
U-237	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00
U-238	1.83E+01	6.15E+03	1.42E+01	4.77E+03	7.50E-04	2.52E-01	1.51E-05	5.07E-03	9.00E-09	3.02E-06
Ag+	8.52E-03		9.19E-03		1.02E-06		2.11E-08		1.80E-12	
As+5	6.19E-03		6.37E-03		3.54E-06		7.32E-08		6.30E-12	
B+3	7.73E-03		6.84E-03		7.52E-06		1.55E-07		1.34E-11	
Be+2	4.39E-04		4.84E-04		0		0		0	
Cl-	1.41E+00		1.27E+00		1.46E-03		3.01E-05		2.59E-09	
CO3-2	2.50E+01		1.94E+01		4.22E-03		8.51E-05		7.31E-09	
Cr+3	5.87E-01		4.45E-01		8.39E-07		1.69E-08		1.50E-12	
CrO4-2	1.10E-01		9.20E-02		1.60E-03		3.27E-05		2.82E-09	
F-	5.10E+00		4.04E+00		9.49E-04		1.92E-07		1.65E-09	
Fe(CN)6-4	8.73E-01		1.49E+00		5.32E-06		1.07E-07		6.39E-11	
Hg+	3.06E-04		3.30E-04		0		0		0	
K+	2.38E+00		2.69E+00		6.60E-04		1.36E-05		1.18E-09	
Li+	1.47E-04		1.50E-04		9.86E-08		2.04E-09		2.00E-13	
Mo+6	2.69E-02		2.81E-02		1.50E-05		3.10E-07		2.67E-11	
Na+	5.70E+02		4.44E+02		5.90E-01		1.19E-02		1.03E-06	
NO2-	6.38E+01		4.94E+01		2.53E-02		5.12E-04		4.41E-08	
NO3-	1.05E+03		8.21E+02		1.21E+00		2.44E-02		2.10E-06	
OH-	2.26E+01		1.79E+01		6.02E-02		1.21E-03		1.04E-07	
SiO3-2	2.02E+01		1.56E+01		6.40E-03		1.29E-04		1.11E-08	
SO4-2	2.28E+01		1.77E+01		7.23E-03		1.46E-04		1.26E-08	
UO2+2	1.26E-01		1.49E-01		3.80E-12		0		0	
V+5	1.06E-03		1.20E-03		2.41E-07		4.98E-09		4.00E-13	
W+4	3.92E-03		4.22E-03		2.00E-13		0		0	
Kd										
Group 2										
(Kd = 1.0										
mL/g)										
Bi-210	---		---		0	0.00E+00	0	0.00E+00	0	0.00E+00
Ni-63	---		---		2.00E-13	1.18E-02	0	0.00E+00	0	0.00E+00
Pa-231	---		---		8.20E-09	3.87E-01	5.67E-10	2.68E-02	3.79E-11	1.79E-03
Pa-233	---		---		0	0.00E+00	0	0.00E+00	0	0.00E+00
Pa-234m	---		---		0	0.00E+00	0	0.00E+00	0	0.00E+00
Po-211	---		---		0	0.00E+00	0	0.00E+00	0	0.00E+00
Bi+3	---		---		6.86E+00		4.70E-01		3.40E-02	
Ca+2	---		---		2.04E-01		6.48E-02		1.88E-03	
Cd+2	---		---		3.72E-02		3.81E-03		2.14E-04	
Cu+2	---		---		6.00E-06		1.24E-07		1.07E-11	
Fe+3	---		---		7.14E+00		5.11E-01		3.77E-02	
Mg+2	---		---		2.63E-02		5.36E-03		2.04E-04	
Ni+2	---		---		2.13E-01		8.37E-02		2.31E-03	

Table.3.3.1. Maximum Concentrations Calculated for the In Situ Fill and Cap Alternative						
	2500	2500	5,000	5,000	10,000	10,000
	years	years	years	years	years	years
	(mg/L)	(pCi/L)	(mg/L)	(pCi/L)	(mg/L)	(pCi/L)
C-14	1.40E-12	6.23E-03	2.99E-07	1.33E+03	1.93E-08	8.59E+01
I-129	9.82E-11	1.73E-05	4.74E-05	8.34E+00	1.46E-05	2.57E+00
Rn-219	0	0.00E+00	0	0.00E+00	0	0.00E+00
Rn-222	0	0.00E+00	0	0.00E+00	0	0.00E+00
Ru-106	0	0.00E+00	1.00E-13	3.34E-01	0	0.00E+00
Sb-126m	0	0.00E+00	0	0.00E+00	0	0.00E+00
Se-79	1.35E-11	9.40E-04	6.51E-06	4.53E+02	1.91E-06	1.33E+02
Tc-99	2.72E-09	4.60E-02	8.70E-04	1.47E+04	1.03E-04	1.74E+03
U-233	0	0.00E+00	5.84E-10	5.63E-03	1.03E-10	9.93E-04
U-234	1.00E-13	6.24E-07	3.70E-08	2.31E-01	4.41E-09	2.75E-02
U-235	2.02E-08	4.36E-05	1.57E-02	3.39E+01	1.61E-03	3.48E+00
U-236	1.00E-13	6.46E-09	1.62E-08	1.05E-03	3.81E-09	2.46E-04
U-237	0	0.00E+00	0	0.00E+00	0	0.00E+00
U-238	3.00E-06	1.01E-03	2.40E+00	8.06E+02	2.44E-01	8.20E+01
Ag+	5.40E-10		5.53E-04		1.68E-07	
As+5	6.70E-11		3.00E-04		5.79E-07	
B+3	1.72E-10		4.12E-04		1.23E-06	
Be+2	5.76E-11		3.61E-05		7.80E-09	
Cl	1.41E-07		1.09E-01		9.95E-03	
CO3-2	1.47E-06		3.31E+00		3.19E-01	
Cr+3	2.20E-11		8.83E-05		1.86E-05	
CrO4-2	7.22E-10		6.19E-02		1.21E-02	
F-	5.96E-06		6.75E-01		6.44E-02	
Fe(CN)6-4	1.16E-06		1.93E-01		1.14E-03	
Hg+	2.40E-12		1.61E-05		6.68E-09	
K+	9.74E-07		3.47E-01		1.08E-04	
Li+	0		6.63E-06		1.61E-08	
Mo+6	2.06E-09		1.73E-03		2.45E-06	
Na+	4.43E-05		7.00E+01		1.24E+01	
NO2-	3.66E-06		8.31E+00		8.64E-01	
NO3-	3.17E-05		1.27E+02		2.68E+01	
Np-237	2.02E-10	1.42E-04	6.87E-05	4.84E+01	9.19E-06	6.47E+00
Np-238	0	0.00E+00	0	0.00E+00	0	0.00E+00
OH-	1.94E-05		2.34E+00		1.35E+00	
Rh-106	0		0		0	
SO4-2	2.43E-06		2.98E+00		3.04E-01	
SO4-2	2.43E-06		2.98E+00		3.04E-01	
UO2+2	6.95E-08		2.27E-02		3.46E-07	
V+5	4.28E-10		1.54E-04		3.94E-08	
W+4	0		2.00E-04		8.67E-08	

Table F.3.4.1 Maximum Concentrations in Groundwater Calculated for the In Situ Vitrification Alt						
			5,000	5,000	10,000	10,000
Constituents			years	years	years	years
			(mg/L)	(pCi/L)	(mg/L)	(pCi/L)
Tc2O7			1.72E-06	2.91E+01	2.21E-06	3.73E+01
U-233			1.40E-12	1.35E-05	1.80E-12	1.74E-05
U-234			3.92E-11	2.45E-04	4.99E-11	3.11E-04
U-235			1.25E-05	2.70E-02	1.61E-05	3.48E-02
U-236			4.51E-11	2.91E-06	5.82E-11	3.76E-06
U-238			1.84E-03	6.18E-01	2.37E-03	7.96E-01
Ag2O			1.90E-06		2.45E-06	
As2O5			1.42E-06		1.83E-06	
B2O3			4.86E-06		6.27E-06	
BeO			1.01E-07		1.31E-07	
Cr2O3			7.11E-05		9.18E-05	
Li2O			3.38E-08		4.36E-08	
Na2O			7.39E-02		9.54E-02	
MoO3			6.31E-06		8.14E-06	
NpO2			1.63E-07		2.10E-07	
V2O5			2.78E-07		3.59E-07	
WO2			5.63E-07		7.26E-07	
WO3			1.12E-06		1.45E-06	

Table F.3.5.1. Maximum Concentrations Calculated for the Ex Situ Intermediate Seperations Alte						
	2,500	2,500	5,000	5,000	10,000	10,000
Constituent	years	years	years	years	years	years
	(mg/L)	(pCi/L)	(mg/L)	(pCi/L)	(mg/L)	(pCi/L)
C-14	3.42E-10	1.52E+00	6.80E-09	3.03E+01	2.00E-13	8.90E-04
I-129	5.32E-08	9.36E-03	2.01E-06	3.54E-01	1.21E-10	2.13E-05
Rn-219	0	0.00E+00	0	0.00E+00	0	0.00E+00
Rn-222	0	0.00E+00	0	0.00E+00	0	0.00E+00
Ru-106	0	0.00E+00	0	0.00E+00	0	0.00E+00
Sb-126	0	0.00E+00	0	0.00E+00	0	0.00E+00
Se-79	7.49E-09	5.21E-01	2.75E-07	1.91E+01	1.71E-11	1.19E-03
Tc-99	3.78E-07	6.39E+00	1.50E-05	2.54E+02	1.55E-09	2.62E-02
U-233	7.00E-13	6.75E-06	2.32E-11	2.24E-04	0	0.00E+00
U-234	2.45E-11	1.53E-04	1.42E-09	8.86E-03	0	0.00E+00
U-235	7.44E-06	1.61E-02	0.00058249	1.26E+00	7.16E-09	1.55E-05
U-236	4.57E-11	2.95E-06	6.63E-10	4.28E-05		0.00E+00
U-237	0	0.00E+00	0	0.00E+00	0	0.00E+00
U-238	1.11E-03	3.73E-01	8.90E-02	2.99E+01	1.02E-06	3.43E-04
Ag+	3.24E-10		1.94E-05		1.72E-10	
As+5	4.02E-11		1.39E-05		5.95E-10	
B+3	1.03E-10		1.82E-05		1.26E-09	
Be+2	3.46E-11		9.15E-07		0	
Cl-	1.71E-05		0.00405731		2.50E-07	
CrO4-2	2.57E-06		3.16E-03		2.87E-07	
F-	1.80E-03		2.47E-02		1.86E-07	
Fe(CN)6-4	4.47E-04		4.27E-03		7.22E-09	
Hg+	1.50E-12		7.64E-07		0	
Li+	0		3.29E-07		1.66E-11	
Na+	1.61E-03		2.78E+00		1.18E-04	
NO2-	2.10E-03		3.10E-01		4.96E-06	
NO3-	2.18E-02		5.13E+00		2.43E-04	
SO4-2	0.00907481		0.110655		1.44E-06	
UO2+2	4.23E-08		8.93E-05		0	
V+5	2.57E-10		1.23E-06		4.05E-11	
W+6	0		9.90E-06		0	
Np-237	7.19E-08	5.06E-02	2.22E-06	1.56E+00	8.42E-11	5.93E-05
Np-238	0	0.00E+00	0	0.00E+00	0	0.00E+00
Rh-106	0	0.00E+00	0	0.00E+00	0	0.00E+00
CO3-2	6.66E-04		1.21E-01		8.51E-07	
Cr+3	1.52E-08		3.56E-06		1.69E-10	
K+	5.83E-07		2.68E-03		1.11E-07	
Mo+6	1.24E-09		5.51E-05		2.52E-09	
OH-	6.53E-03		1.14E-01		1.22E-05	
SO4-2	9.07E-04		1.11E-01		1.44E-06	

Table F.3.5.2 Maximum Concentrations Calculated for the LAW Vaults - Intermediate Seperatio						
			5,000	5,000	10,000	10,000
Constituent			years	years	years	years
			(mg/L)	(pCi/L)	(mg/L)	(pCi/L)
Tc-99			4.56E-06	7.71E+01	1.23E-05	2.08E+02
U-233			2.00E-13	1.93E-06	6.00E-13	5.78E-06
U-234			6.60E-12	4.12E-05	1.76E-11	1.10E-04
U-235			2.06E-06	4.45E-03	5.56E-06	1.20E-02
U-236			7.60E-12	4.91E-07	2.05E-11	1.32E-06
U-238			3.09E-04	1.04E-01	8.35E-04	2.81E-01
Ag2O			1.19E-06		3.23E-06	
As2O5			2.80E-06		7.57E-06	
B2O3			5.46E-06		1.48E-05	
BeO			2.98E-07		8.06E-07	
Cr2O3			3.52E-06		9.51E-06	
Li-2O			2.11E-08		5.71E-08	
MoO3			1.77E-05		4.79E-05	
Na2O			2.66E-01		7.19E-01	
NpO2			5.33E-08		1.44E-07	
V2O5			2.27E-07		6.13E-07	
WO2			1.22E-10		3.29E-10	
WO3			3.66E-06		9.89E-06	

Table F.3.8.1 Maximum Concentration Calculated in Groundwater for the Ex Situ/In Situ Combin						
Constituent	2,500	2,500	5,000	5,000	10,000	10,000
	years	years	years	years	years	years
	(mg/L)	(pCi/L)	(mg/L)	(pCi/L)	(mg/L)	(pCi/L)
C-14	2.3E-10	1.02E+00	6.71E-10	2.99E+00	0.00E+00	0.00E+00
I-129	3.91E-08	6.88E-03	0.000000118	2.08E-02	1.08E-11	1.90E-06
Np-237	5.23E-08	3.68E-02	9.63E-08	6.78E-02	6.20E-12	4.36E-06
Np-238	0	0.00E+00	0	0.00E+00	0	0.00E+00
Rh-106	0	0.00E+00	0	0.00E+00	0	0.00E+00
Rn-219	0	0.00E+00	0	0.00E+00	0	0.00E+00
Rn-222	0	0.00E+00	0	0.00E+00	0	0.00E+00
Ru-106	0	0.00E+00	0	0.00E+00	0	0.00E+00
Sb-126m	0	0.00E+00	0	0.00E+00	0	0.00E+00
Se-79	5.49E-09	3.82E-01	1.59E-08	1.11E+00	1.40E-12	9.74E-05
Tc-99	2.78E-07	4.70E+00	0.000000815	1.38E+01	7.55E-11	1.28E-03
U-233	4E-13	3.86E-06	1.6E-12	1.54E-05	0.00E+00	0.00E+00
U-234	1.01E-11	6.30E-05	9.16E-11	5.72E-04	0.00E+00	0.00E+00
U-235	3.36E-06	7.26E-03	2.59E-05	5.59E-02	5.02E-10	1.08E-06
U-236	1.71E-11	1.10E-06	1.74E-10	1.12E-05	0.00E+00	0.00E+00
U-237	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-238	4.99E-04	1.68E-01	3.95E-03	1.33E+00	7.20E-08	2.42E-05
Cl-	6.63E-06		1.20E-04		1.99E-09	
CO3 -2	3.70E-04		4.22E-03		6.97E-08	
Cr+3	7.72E-09		1.35E-07		8.50E-12	
CrO4 -2	7.90E-07		5.23E-05		4.91E-09	
F-	7.15E-04		7.25E-03		1.05E-08	
Fe(CN)6	1.75E-04		1.33E-04		3.52E-10	
Hg+	2.94E-07		2.91E-06		1.05E-10	
Na+	7.30E-03		1.02E-01		5.42E-06	
NO2 -	1.33E-03		1.23E-02		2.76E-07	
NO3 -	1.11E-02		1.95E-01		1.23E-05	
OH -	2.39E-03		2.43E-02		5.45E-07	
SiO3 -2	2.95E-04		3.42E-03		2.27E-08	
SO4 -2	4.05E-04		3.94E-03		1.01E-07	
W+4	4.72E-06		4.67E-05		1.68E-09	

Table F.3.8.2 Maximum Concentration Calculated in Groundwater for the Ex Situ/In Situ Combin						
	2,500 years	2,500 years	5,000 years	5,000 years	10,000 years	10,000 years
Constituent	(mg/L)	(pCi/L)	(mg/L)	(pCi/L)	(mg/L)	(pCi/L)
C-14	1E-13	4.45E-04	5.89E-08	2.62E+02	1.45E-09	6.45E+00
I-129	9.5E-12	1.67E-06	2.16E-05	3.80E+00	1.07E-06	1.88E-01
Np-237	1.48E-11	1.04E-05	2.47E-05	1.74E+01	1.26E-06	8.87E-01
Np-238	0	0.00E+00	0	0.00E+00	0	0.00E+00
Rh-106	0	0.00E+00	0	0.00E+00	0	0.00E+00
Rn-219	0	0.00E+00	0	0.00E+00	0	0.00E+00
Rn-222	0	0.00E+00	0	0.00E+00	0	0.00E+00
Ru-106	0	0.00E+00	0	0.00E+00	0	0.00E+00
Sb-126m	0	0.00E+00	0	0.00E+00	0	0.00E+00
Se-79	1.3E-12	9.05E-05	0.00000298	2.07E+02	1.38E-07	9.60E+00
Tc-99	1.21E-10	2.04E-03	1.64E-04	2.77E+03	7.49E-06	1.27E+02
U-233	0	0.00E+00	4.96E-10	4.78E-03	4.06E-11	3.91E-04
U-234	0	0.00E+00	1.33E-08	8.30E-02	1.32E-09	8.24E-03
U-235	1.04E-09	2.25E-06	2.03E-03	4.38E+00	1.47E-04	3.18E-01
U-236	0	0.00E+00	2.18E-09	1.41E-04	6.99E-10	4.52E-05
U-237	0	0.00E+00	0	0.00E+00	0	0.00E+00
U-238	1.49E-07	5.01E-05	3.07E-01	1.03E+02	1.99E-02	6.69E+00
Ag+	1.1E-10		2.80E-03	0.00E+00	3.59E-08	0.00E+00
As+5	4.11E-11		4.92E-04		1.25E-07	
B+3	1.05E-10		1.91E-03		4.07E-08	
Be+2	3.45E-11		9.49E-06		1.00E-13	
Cl-	5.19E-08		8.49E-02		5.69E-04	
CO3 -2	1.51E-06		1.94E+00		6.18E-03	
Cr+3	9.4E-12		5.44E-05		6.38E-06	
CrO4 -2	1.84E-08		2.60E-02		4.82E-03	
F-	5.63E-07		2.99E-01		3.68E-03	
Fe(CN)6	1.86E-07		5.64E-02		2.93E-04	
Hg+	3.52E-10		1.03E-03		8.35E-06	
K+	3.19E-07		3.20E-02		5.09E-06	
Li+	0		1.37E-05		3.48E-09	
Mo+6	8.81E-10		3.33E-04		2.62E-08	
Na+	9.14E-06		4.38E+01		4.54E+00	
NO2 -	1.71E-06		3.15E+00		1.02E-01	
NO3 -	1.35E-05		7.83E+01		9.19E+00	
OH -	1.42E-06		2.84E+00		5.38E-01	
SiO3 -2	9.51E-08		1.45E+00		9.01E-02	
SO4 -2	4.31E-07		1.92E+00		1.65E-02	
UO2 +2	4.17E-08		8.61E-03		4.56E-11	
V+5	2.63E-10		3.35E-05		8.50E-09	
W+4	5.65E-09		1.74E-02		1.34E-04	

Table F.3.8.3 Maximum Concentration Calculated in Groundwater f				
Constituent	5,000 years	5,000 years	10.000 years	10.000 years
	(mg/L)	(pCi/L)	(mg/L)	(pCi/L)
Tc-99	2.34E-06	3.95E+01	6.30E-06	1.06E+02
U-233	1.00E-13	9.64E-07	3.00E-13	2.89E-06
U-234	3.40E-12	2.12E-05	9.00E-12	5.62E-05
U-235	1.05E-06	2.27E-03	9.00E-12	1.94E-08
U-236	3.90E-12	2.52E-07	1.05E-11	6.78E-07
U-238	1.58E-04	5.31E-02	4.28E-04	1.44E-01
Ag+	6.12E-07		1.65E-06	
As+5	1.43E-06		3.88E-06	
B+	2.80E-06		7.56E-06	
Be+2	1.53E-07		4.13E-07	
Cr+3	1.80E-06		4.87E-06	
K+	4.11E-07		1.11E-06	
Li+	1.08E-08		2.92E-08	
Mo+6	9.08E-06		2.46E-05	
Na+	1.36E-01		3.68E-01	
NpO2	2.73E-08		7.39E-08	
SiO3 -2	1.20E-01		5.40E-01	
V+	1.16E-07		3.14E-07	
WO3	1.87E-06		5.07E-06	
WO2	6.23E-11		1.69E-10	

Table F.3.9.1 Maximum Concentrations Calculated for the Phased Implementation Total Alternati						
Constituent	2,500 years	2,500 years	5,000 years	5,000 years	10,000 years	10,000 years
	(mg/L)	(pCi/L)	(mg/L)	(pCi/L)	(mg/L)	(pCi/L)
C-14	3.42E-10	1.52E+00	6.80E-09	3.03E+01	2.00E-13	8.90E-04
I-129	5.32E-08	9.36E-03	2.01E-06	3.54E-01	1.21E-10	2.13E-05
Rn-219	0	0.00E+00	0	0.00E+00	0	0.00E+00
Rn-222	0	0.00E+00	0	0.00E+00	0	0.00E+00
Ru-106	0	0.00E+00	0	0.00E+00	0	0.00E+00
Sb-126	0	0.00E+00	0	0.00E+00	0	0.00E+00
Se-79	7.49E-09	5.21E-01	2.75E-07	1.91E+01	1.71E-11	1.19E-03
Tc-99	3.78E-07	6.39E+00	1.50E-05	2.54E+02	1.55E-09	2.62E-02
U-233	7.00E-13	6.75E-06	2.32E-11	2.24E-04	0	0.00E+00
U-234	2.45E-11	1.53E-04	1.42E-09	8.86E-03	0	0.00E+00
U-235	7.44E-06	1.61E-02	5.82E-04	1.26E+00	7.16E-09	1.55E-05
U-236	4.57E-11	2.95E-06	6.63E-10	4.28E-05	0	0.00E+00
U-237	0	0.00E+00	0	0.00E+00	0	0.00E+00
U-238	1.11E-03	3.73E-01	8.90E-01	2.99E+02	1.02E-06	3.43E-04
Ag+	3.24E-10		1.94E-05		1.72E-10	
As+5	4.02E-11		1.39E-05		5.95E-10	
B+3	1.03E-10		1.82E-05		1.26E-09	
Be+2	3.46E-11		9.15E-07		0	
Cl-	1.71E-05		4.06E-03		2.50E-07	
CrO4-2	2.57E-06		3.16E-03		2.87E-07	
F-	1.80E-03		2.47E-02		1.86E-07	
Fe(CN)6-	4.47E-04		4.27E-03		7.22E-09	
Hg+	1.50E-12		7.64E-07		0	
Li+	0		3.29E-07		1.66E-11	
Na+	1.62E-02		2.78E+00		1.18E-04	
NO2	2.11E-03		3.09E-01		4.96E-06	
NO3	2.19E-02		5.13E+00		2.44E-04	
SO4-2	9.07E-04		1.11E-01		1.44E-06	
UO2+2	4.23E-08		8.93E-05		0	
V+5	2.57E-10		1.23E-06		4.05E-11	
W+6	0		9.90E-06		0	
	0		0		0	
Np-237	7.19E-08	5.06E-02	2.22E-06	1.56E+00	8.42E-11	5.93E-05
Np-238	0	0.00E+00	0	0.00E+00	0	0.00E+00
Rh-106	0	0.00E+00	0	0.00E+00	0	0.00E+00
CO3-2	6.66E-04		1.21E-01		8.51E-07	
Cr+3	1.52E-08		3.56E-06		1.69E-10	
K+	5.85E-07		2.68E-03		1.11E-07	
Mo+6	1.24E-09		5.51E-05		2.52E-09	
OH-	6.53E-03		1.14E-01		1.22E-05	
SO4-2	9.07E-04		1.11E-01		1.44E-06	

Table F.3.9.2 Maximum Concentration Calculated for the LAW Vaults - Phased Im					
Constituent	5,000 years	5,000 years	10,000 years	10,000 years	
	(mg/L)	(pCi/L)	(mg/L)	(pCi/L)	
Tc-99	4.56E-06	7.71E+01	1.23E-05	2.08E+02	
U-233	2.00E-13	1.93E-06	6.00E-13	5.78E-06	
U-234	6.60E-12	4.12E-05	1.76E-11	1.10E-04	
U-235	2.06E-06	4.45E-03	5.56E-06	1.20E-02	
U-236	7.60E-12	4.91E-07	2.05E-11	1.32E-06	
U-238	3.09E-04	1.04E-01	8.35E-04	2.81E-01	
Ag2O	1.19E-06		3.23E-06		
As2O5	2.80E-06		7.57E-06		
B2O3	5.46E-06		1.48E-05		
BeO	2.98E-07		8.06E-07		
Cr2O3	3.52E-06		9.51E-06		
Li-2O	2.11E-08		5.71E-08		
MoO3	1.77E-05		4.79E-05		
Na2O	2.66E-01		7.19E-01		
NpO2	5.33E-08		1.44E-07		
V2O5	2.27E-07		6.13E-07		
WO2	1.22E-10		3.29E-10		
WO3	3.66E-06		9.89E-06		

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE ENGR/COST Proposed Draft EIS Alternatives

ORIGINATOR D. Stein DATE 2/20/96

REVISION NO. ~~0~~ 1* C.H. 3/25/96

OBJECTIVE Re-estimate Alternative Costs based on Proposed Draft EIS basis changes (DEIS Rev C)

METHODOLOGY factor from previous cost estimates

ASSUMPTIONS Op. cost & repository fees only will be affected by changes proposed, other changes are minor & are neglected herein due to time constraints.

(Continue on another sheet if necessary)

* see ATTACHED Revision description

D. L. Stein
SIGNATURE

CHECKED: C. Henderson 3/25/96.

CALCULATION & RESULTS ATTACHED

93 ~~99~~ pages total excluding cover sheet.

JACOBS\FORMS\CALCVR.SHT

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

CALCULATION: Engr/Cost - Proposed Draft EIS Alternatives.

3/25/96 Revision:

1) Removed Phased Implementation alternative estimate with attached Calc. dated 2/27/96 for Phased Implementation.

2) Removed Cost Estimate for Modified Combo alternative.

FORM 91-005-1 (4/81)

RECEIVED
MAR 21 1996

Stein, David

From: Stein, David
To: Henderson, Colin
Subject: Hanford TWEIS Alternatives Cost Update
Date: Wednesday, March 20, 1996 1:35PM

Following are Hanford TWEIS Alternatives cost updates with corrections for Treatment Operating Costs. These corrections were noted in the engineering calculations dated 2/20/96, but were never transferred to the final cost tables until now. The operating costs corrections are also presented here for your comparison.

TABLE 1

	PREVIOUS OPERATING COSTS (MILLIONS)	CORRECTED OPERATING COSTS(MILLIONS)
Intermediate Separations	$5,577	$5,509
No Separations(Vitrification)	$23,273	$22,742
No Separations(Calcination)	$8,182	$7,548
ExSitu/InSitu Combination	$2,672	$2,638

TABLE 2

ALTERNATIVE	TOTAL COST(WITH REPOSITORY FEE@$360,000 PER CANISTER) TARGET VALUE (MILLIONS)	95% CONFIDENCE RANGE (MILLIONS)
Intermediate Separations	$37,818	$30,399 ----- $40,552
No Separations(Vitrification)	$252,669	$69,475 ----- $252,669
No Separations(Calcination)	$85,815	$38,789 ----- $86,141
ExSitu/InSitu Combination	$25,526	$22,990 ----- $27,913

TABLE 3

ALTERNATIVE	COST EXCLUDING REPOSITORY FEE TARGET VALUE (MILLIONS)	95% CONFIDENCE RANGE (MILLIONS)
Intermediate Separations	$25,798	$23,775 ----- $29,741
No Separations(Vitrification)	$41,209	$25,560 ----- $43,559
No Separations(Calcination)	$26,015	$22,157 ----- $28,708
ExSitu/InSitu Combination	$19,516	$17,956 ----- $22,407

These changes should bring the alternatives up to date. Let me know if I can do anything else.

Stein, David

From: Stein, David
To: Henderson, Colin
Subject: TWEIS Cost Uncertainty Update
Date: Monday, March 18, 1996 10:04AM

Following are Hanford TWEIS Alternatives Cost Uncertainty updates which include an increase for tank characterization costs ($903 million for InSitu Fill & Cap and InSitu Vitrification and 60% of $903 or $542 million for InSitu/ExSitu Combo):

ALTERNATIVE	TARGET VALUE (millions)	95% CONFIDENCE RANGE (millions)
InSitu Fill & Cap	$7,884	$6,972 — $8,815
InSitu Vitrification	$16,578	$16,185 — $23,840
InSitu/ExSitu Combo with Repository Fee @ $360,000 per canister($6,010 million)	$25,560	$22,996 — $27,947
InSitu/ExSitu Combo without Repository Fee	$19,550	$17,968 — $22,441
InSitu/ExSitu Combo with Repository Fee @ $5,000 million(Feb 96)	$24,550	$22,466 — $27,151

After reviewing the cost components of the Repository Fee in the TRW Report, I can confirm that there was no double counting when compared to the Westinghouse Data Packages. The Repository Fee included a cost for an outer barrier for the HLW package in which it is placed before insertion into the vault. This outer barrier is either in addition to the MPC or replaces the MPC, I cannot determine which.

RECEIVED
MAR 19 1996

RECEIVED
MAR 14 1996

Stein, David

From: Stein, David
To: Henderson, Colin
Subject: Hanford TWEIS Alternatives Cost Uncertainty
Date: Wednesday, March 13, 1996 12:51PM

Following are Hanford TWEIS Alternatives Cost Uncertainty Tables with and without Repository Fee (fee has been calculated using $360,000 per canister per latest directive):

TABLE 1

ALTERNATIVE	TOTAL ALTERNATIVE COST(WITH REPOSITORY FEE) TARGET VALUE (millions)	95% CONFIDENCE RANGE (millions)
Intermediate Separations	$37,886	$30,465 — $40,598
No Separations (Vitrification)	$253,200	$69,971 — $253,200
No Separations (Calcination)	$86,449	$39,406 — $86,548
Extensive Separations	$28,544	$27,477 — $36,471
ExSitu/InSitu Combination	$25,018	$22,691 — $27,197
Phased Implementation	$38,728	$31,843 — $41,756
Junior Combo	$19,461	$18,512 — $22,053

Note: For most alternatives, repository fee is so high that it dominates the cost uncertainty. I would recommend that the repository fee be considered as a separate item with no range included and just a note as to how it was calculated; e.g. $360,000 charge per canister.

TABLE 2

ALTERNATIVE	ALTERNATIVE REMEDIATION COST(EXCLUDES REP FEE) TARGET VALUE (millions)	95% CONFIDENCE RANGE (million)
Intermediate Separations	$25,866	$23,818 — $29,808
No Separations (Vitrification)	$41,740	$25,628 — $44,074
No Separations (Calcination)	$26,649	$22,276 — $29,269
Extensive Separations	$27,979	$26,580 — $35,476
ExSitu/InSitu Combination	$19,008	$17,742 — $21,774
Phased Implementation	$26,708	$25,000 — $31,109
Junior Combo	$16,331	$15,089 — $18,633

I will send copies of the model output by Fed Ex this afternoon. Give me a call if you have any questions.

Henderson, Colin

From: Stein, David
To: Henderson, Colin
Subject: Hanford TWEIS Alternatives Cost Update
Date: Wednesday, March 20, 1996 1:35PM

Following are Hanford TWEIS Alternatives cost updates with corrections for Treatment Operating Costs. These corrections were noted in the engineering calculations dated 2/20/96, but were never transferred to the final cost tables until now. The operating costs corrections are also presented here for your comparison.

TABLE 1

	PREVIOUS OPERATING COSTS (MILLIONS)	CORRECTED OPERATING COSTS(MILLIONS)
Intermediate Separations	$5,577	$5,509
No Separations(Vitrification)	$23,273	$22,742
No Separations(Calcination)	$8,182	$7,548
ExSitu/InSitu Combination	$2,672	$2,638

TABLE 2

ALTERNATIVE	TOTAL COST(WITH REPOSITORY FEE@$360,000 PER CANISTER) TARGET VALUE (MILLIONS)	95% CONFIDENCE RANGE (MILLIONS)
Intermediate Separations	$37,818	$30,399 ----- $40,552
No Separations(Vitrification)	$252,669	$69,475 ----- $252,669
No Separations(Calcination)	$85,815	$38,789 ----- $86,141
ExSitu/InSitu Combination	$25,526	$22,990 ----- $27,913

TABLE 3

ALTERNATIVE	COST EXCLUDING REPOSITORY FEE TARGET VALUE (MILLIONS)	95% CONFIDENCE RANGE (MILLIONS)
Intermediate Separations	$25,798	$23,775 ----- $29,741
No Separations(Vitrification)	$41,209	$25,560 ----- $43,559
No Separations(Calcination)	$26,015	$22,157 ----- $28,708
ExSitu/InSitu Combination	$19,516	$17,956 ----- $22,407

These changes should bring the alternatives up to date. Let me know if I can do anything else.

Henderson, Colin

From: Stein, David
To: Henderson, Colin
Subject: TWEIS Cost Uncertainty Update
Date: Monday, March 18, 1996 10:04AM

Following are Hanford TWEIS Alternatives Cost Uncertainty updates which include an increase for tank characterization costs ($903 million for InSitu Fill & Cap and InSitu Vitrification and 60% of $903 or $542 million for InSitu/ExSitu Combo):

ALTERNATIVE	TARGET VALUE (millions)	95% CONFIDENCE RANGE (millions)
InSitu Fill & Cap	$7,884	$6,972 --- $8,815
InSitu Vitrification	$16,578	$16,185 --- $23,840
InSitu/ExSitu Combo with Repository Fee @ $360,000 per canister($6,010 million)	$25,560	$22,996 --- $27,947
InSitu/ExSitu Combo without Repository Fee	$19,550	$17,968 --- $22,441
InSitu/ExSitu Combo with Repository Fee @ $5,000 million(Feb 96)	$24,550	$22,466 --- $27,151

After reviewing the cost components of the Repository Fee in the TRW Report, I can confirm that there was no double counting when compared to the Westinghouse Data Packages. The Repository Fee included a cost for an outer barrier for the HLW package in which it is placed before insertion into the vault. This outer barrier is either in addition to the MPC or replaces the MPC, I cannot determine which.

Henderson, Colin

From: Stein, David
To: Henderson, Colin
Subject: Capsule Alternatives Cost Revision(Repository Fee Change)
Date: Monday, March 18, 1996 1:54PM

Incorporating the revised Repository Fee method ($360,000 per canister) results in the following for the Capsule Alternatives:

	CAPSULE ALTERNATIVES	
	OVERPACK AND SHIP (millions)	VITRIFY WITH TANK WASTE (millions)
Current Operations	$377	$315
R&D	$14	$5
Capital	$32	$36
Operating	$34	$46
M&M	-----	$1
D&D	$6	$6
Repository Fee	$144	$232
Total	$607	$641

JACOBS ENGINEERING GROUP INC.

DATE 2/13/96 SUBJECT SHEET NO. 1 - 70

BY DLS CHKD. JOB NO.

Intermediate Separations Proposed DEIS

previous HLW glass — 45% waste oxide loading, 1.0 blend factor

from mass balance info

1.36E+04 MT glass formers
2.51E+04 MT glass product

proposed HLW glass — 20% waste oxide loading, 1.5 blend factor

from mass balance info

4.29E+04 MT glass formers
5.44E+04 MT glass product

ratio glass formers | ratio glass product

$\frac{4.29E+04}{1.36E+04} = 3.15$ | $\frac{5.44E+04}{2.51E+04} = 2.17$

previous LAW glass — 25% sodium oxide loading, 1.0 blend factor

from mass balance info

2.81E+05 MT glass formers
3.87E+05 MT glass product

proposed LAW glass — 15% sodium oxide loading, 1.25 blend factor

from mass balance info

7.01E+05 MT glass formers
8.07E+05 MT glass product

ratio glass formers | ratio glass product

$\frac{7.01E+05}{2.81E+05} = 2.49$ | $\frac{8.07E+05}{3.87E+05} = 2.09$

JACOBS ENGINEERING GROUP INC.

DATE 2/13/96 SUBJECT SHEET NO. 2 - 10

BY DZS CHKD. JOB NO.

Δ cost for glass formers

HLW (see attached TPA Tables)

Category	# previous	ratio used	$ Δ
SiO_2	452,000	3.15	972,000
B_2O_3	1,750,000	3.15	3,762,000
Li_2O	2,500,000	3.15	5,375,000
electricity	110,700,000	2.17	129,519,000

12 yrs operation @ 60% overall rate — total HLW Δ $139,628,000

LAW

SiO_2	9,140,000	2.49	13,648,000
Al_2O_3	6,600,000	2.49	9,834,000
CaO	2,322,000	2.49	3,460,000
other electricity	59,390,000 × 1/2 (estimate)	2.09	86,820,000
Kerosene	8,670,000	2.09	9,450,000
Sulfur	46,990,000	2.09	51,219,000
DCPD	504,000	2.09	549,000
CPD	504,000	2.09	549,000

19 yrs operation @ 60% overall rate — total LAW Δ $175,529,000

Δ Other Op. Costs

	#	$ previous	HLW ratio	LAW ratio	$ Δ
vaults	(45)	225,000,000	—	$\frac{83}{40} = 2.08$	243,000,000
canisters	(6820)	68,200,000	$\frac{33,586}{6820} = 4.91$	—	266,662,000 *
containers	(1705)	42,625,000	4.91	—	166,663,000
casks	(1705)	102,300,000	4.91	—	399,993,000
pads	(1)	26,000,000	4.91	—	101,660,000

total Δ other op. costs $1,177,978,000

* previously calculated in error @ $334,793,000

FORM 01-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE 2/13/94 SUBJECT SHEET NO. 3-10

BY DLS CHKD. JOB NO.

Δ labor costs

total labor per TPA → $1,700,000,000

save 2yrs on HLW operations 12 vs 14

spend 5yrs on LAW operations 19 vs 14

per table 9-2 in TPA report

HLW vit. requires 1.1E+07 staff-hrs

LAW vit. requires 1.1E+07 staff-hrs

total staff hrs (everything) → 3.1E+07

$1,700,000,000 / 3.1E+07 hrs → $55/hr

2.2E+07 total

new HLW hrs = (1.1E+07) × 12/14 = 0.94E+07

new LAW hrs = (1.1E+07) × 19/14 = 1.49E+07

2.43E+07 new

vs 2.2E+07 previous

Δ labor cost = (2.43E+07) − (2.2E+07) × $55/hr

Δ labor cost = $115,500,000

other Δ op. costs for water, steam other chemicals, etc have been ignored in calculations due to their negligible effect on Δ.

Δ summary on op. costs

Δ HLW	$139,628,000
Δ LAW	175,529,000
Δ other	1,177,978,000
Δ labor	115,500,000
Δ total	$1,608,635,000
previous op. cost	$3,900,000,000
new op. cost	$5,508,635,000

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE 2/13/96 SUBJECT SHEET NO. 4-10

BY DLS CHKD. JOB NO.

Intermediate Separations
Low Bounding Case

HLW @ 15%, 1.5 blend factor
LAW @ 10%, 1.25 blend factor

Low Bounding Case HLW glass – 15% waste oxide, 1.5 blend

mass of glass product – 7.26 E+04 mT
volume product – 2.76 E+04 m^3
canisters – 44,500
above/below from mass balance info

Low Bounding case HLW glass

6.11E+04 mT glass formers (7.26 – 2.51 + 1.36 = 6.11)
7.26E+04 mT glass product

total now, total prev., formers prev.

ratio glass formers

$\frac{6.11\ E+04}{1.36\ E+04} = 4.49$

ratio glass product

$\frac{7.26\ E+04}{2.51\ E+04} = 2.89$

Low Bounding Case LAW glass – 10% sodium oxide loading, 1.25 blend

mass of glass product – 1.21 E+06 mT
volume product – 6.57 E+05 m^3
vaults – 124
above/below from mass balance info

Low bounding case LAW glass

1.10E+06 mT glass formers (12.1 – 3.87 + 2.81 = 11.04)
1.21E+06 mT glass product

total now, total prev., formers prev.

ratio glass formers

$\frac{11.0}{2.81} = 3.91$

ratio glass product

$\frac{12.1}{3.87} = 3.13$

JACOBS ENGINEERING GROUP INC.

DATE 2/13/96 SUBJECT SHEET NO. 5-10

BY DLS CHKD. JOB NO.

Δ cost for glass formers

HLW

category	$ (thousands) previous	ratio used	$ (thousands) Δ
SiO_2	452	4.49	1,577
B_2O_3	1,750	4.49	6,107
Li_2O	2,500	4.49	8,725
electricity	110,700	2.89	209,223
17 yrs operation		total HLW Δ	$225,632

LAW

SiO_2	9,160	3.91	26,655
Al_2O_3	6,600	3.91	19,206
CaO	2,322	3.91	6,757
other electricity	159,300 × ½	3.13	169,655*
Kerosene	8,670	3.13	18,467
Sulfur	46,990	3.13	100,089
DCPD	504	3.13	1,074
CPD	504	3.13	1,074
		total LAW Δ	$342,977
26 yrs operation		* previously calculated in error @ $90,005	

Δ Other Op. Cost

	$ (thousands) previous	HLW ratio	LAW ratio	$ (thousands) Δ
vaults	225,000	—	$\frac{124}{40} = 3.10$	472,500
canisters	68,200	$\frac{44500}{6800} = 6.54$	—	377,830
containers	42,625	6.54	—	236,140
casks	102,300	6.54	—	566,740
pads	26,000	6.54	—	144,040
		total Δ other op cost		$1,797,250

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE 2/13/96 SUBJECT SHEET NO. 6-TO

BY DLS CHKD. JOB NO.

Δ labor costs

new HLW hrs = (1.1E+07) × 17/14 = 1.34E+07

new LAW hrs = (1.1E+07) × 26/14 = 2.04E+07

3.38E+07 vs 2.2E+7 before

Δ labor costs = (3.38E+07) − (2.2E+07) × $55/hr

Δ labor costs = $649,000,000

Δ summary on op. costs

Δ HLW	$225,632,000
Δ LAW	342,977,000
Δ other	1,797,250,000
Δ labor	649,000,000
Δ total	$3,014,859,000
previous op. cost	3,900,000,000
new op. cost	$6,914,859,000

repository fee for 44,500 canisters = ~~$1.6~~ billion

$16.02 billion

JACOBS ENGINEERING GROUP INC.

DATE 2/13/96 SUBJECT SHEET NO. 7-10

BY DLS CHKD. JOB NO.

Intermediate Separations
High Bounding Case

HLW @ 40%, 1.5 blend
LAW @ 25%, 1.25 blend

High Bounding Case HLW glass – 40%, 1.5 blend

mass of glass product – 2.72E+04 MT
volume product – 1.03E+04 m^3
canisters – 16,700

High Bounding Case HLW glass

1.57E+04 MT glass formers (2.72 − 2.51 + 1.36 = 1.57)
2.72E+04 MT glass product

total pres, total pre, formers pres

ratio glass formers: $\frac{1.57}{1.36} = 1.15$

ratio glass product: $\frac{2.72}{2.51} = 1.08$

High Bounding Case LAW glass – 25%, 1.25 blend

mass of glass product – 4.84E+05 MT
volume product – 2.63E+05 m^3
vaults – 50

High Bounding Case LAW glass

3.78E+05 MT glass formers (4.84 − 3.87 + 2.81 = 3.78)
4.84E+05 MT glass product

ratio glass formers: $\frac{3.78}{2.81} = 1.35$

ratio glass product: $\frac{4.84}{3.87} = 1.25$

JACOBS ENGINEERING GROUP INC.

DATE 2/13/96 SUBJECT SHEET NO. 8-10

BY DLS CHKD. JOB NO.

Δ cost for glass formers

HLW category	$ (Thousand) previous	ratio used	$ (Thousands) Δ
SiO_2	452	1.15	68
B_2O_3	1,750	1.15	262
Li_2O	2,500	1.15	375
electricity	110,700	1.08	8856

7 yrs operation — Total HLW Δ $9,561

LAW

SiO_2	9160	1.35	3206
Al_2O_3	6,600	1.35	2310
CaO	2,322	1.35	813
other electricity	159,300 x 1/2	1.25	19913
Kerosene	8,670	1.25	2168
Sulfur	46,990	1.25	11748
DCPD	504	1.25	126
CPD	504	1.25	126

11 yrs operation — total LAW Δ $40,410

Δ other Op. Costs

	$ previous (thou)	HLW ratio	LAW ratio	$ (Thousands) Δ
Vaults	225,000	—	$\frac{50}{40}=1.25$	56,250
Canisters	68,200	$\frac{167,200}{68,200}=2.45$	—	99,572
Containers	42,625	2.45	—	62,232
Casks	102,300	2.45	—	149,358
parts	26,000	2.45	—	37,960

total Δ other $405,372

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE 2/13/96 SUBJECT SHEET NO. 9-10

BY DLS CHKD. JOB NO.

Δ labor cost

new HLW hrs = $(1.1E+07) \times \frac{1}{14} = 0.55E+7$

new LAW hrs = $(1.1E+07) \times \frac{1}{14} = 0.86E+7$

1.41 E+7 vs 2.2 E+7

Δ labor cost = (1.41 E+7) − (2.2 E+7) × $55/hr

Δ labor costs = − $434,500,000

• Δ Summary on op. costs

Δ HLW	$ 9,561,000
Δ LAW	40,410,000
Δ other	405,372,000
Δ labor	−434,500,000
Δ total	$ 20,843,000
previous op. cost	$ 3,900,000,010
new op. cost	$ 3,920,843,010

repository fee for 16,700 canisters = ~~$6~~ billion

16,700 X 360,000 CAN = 6.012 billion

FORM 97-005-1 (4/81)

10-

SHEET NO. 10-10

JOB NO.

JACOBS ENGINEERING GROUP INC.

DATE 2/13/96 SUBJECT

BY DLS CHKD.

millim

Intermediate Sep. Sensitivity Summary

	Low Bound (15% HLW, 1.5 blend; 10% LAW, 1.25 blend)	Proposed Draft ET3 (20% HLW, 15% LAW)	High Bound (40% HLW, 25% LAW)
# Canisters	44,500	33,386	16,700
# Vaults	24	83	50
Δ HLW op cost	225.6	139.6	9.6
Δ LAW op. cost	343.0	175.5	40.4
Δ labor op. cost	649.0	115.5	434.5
Δ other op. cost (vaults, cans, etc)	1,797.3	1,178.0	405.4
total Δ	3,014.9	1,608.6	20.9
Op. cost base	3,900	3,900	3,900
total treatment op. costs	$6,915	$5,509	$3,921
repository fees	16,020 ~~7,800~~	12020 ~~6,500~~	$602 ~~5,000~~
Op. yrs. HLW	17	12	7
LAW	26	19	11

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE 2/6/96 SUBJECT SHEET NO. 1-1

BY D Stein CHKD. JOB NO. 01K47101

Ex Situ Inter Sep. Sensitivity Summary

		Proposed DEIS	
HLW glass loading	15%	20%	40%
LAW glass loading	10%	15%	25%
# canisters	44,500	33,386	16,700
# vaults	124	83	50
HLW op. yrs	17	12	7
LAW op. yrs	26	19	11
Cost Comparison			
Current Op.	$8,600	$8,600	$8,600
R+D	$820	$820	$820
Capital	$6,049	$6,049	$6,049
Operating	$~~11,655~~ 11,735	$~~10,397~~ 10,329	$8,741
M+M	$1	$1	$1
Repository Fee	$~~16,020~~ ~~7,800~~	$~~12,020~~ ~~6,500~~	$~~6,012~~ ~~3,000~~
	~~43,225~~	~~37,819~~	$~~36,223~~
Total Cost (1995)	$~~34,925~~	$~~32,367~~	$~~29,211~~
% variation from DEIS case	+7.9%	0%	−9.8%

WR+T Trent 4820 6835 *

WR+T Trent 4820 5577 **

WR+T Trent 4820 3921

2/13/96 check (see calcs.)

2/13/96 check (see calcs.)

* should be corrected to 6915 per

** should be corrected to 5509 per

FORM 91-005-1 (4/81)

Assumptions:

1. HLW glass waste oxide loading basis to be 20 wt% waste oxides (excluding Na2O and SiO2)
2. Using the WHC engineering data package material balance calculate the waste oxide loading and adjust mass of the glass produced to achieve a 20 wt % waste oxide loading
3. LAW glass sodium oxide loading basis is to be 15 wt%

	Input Stream		LAW		HLW		HLW fraction
	STREAM 1		407	437	314	344	
	solids	liquids	FRIT	GLASS	FRIT	GLASS	
Volume kilo-liters							
Specific Gravity							
Cs and Ba, (MCi)	5.28E+00	6.28E+01		4.93E-01		6.74E+01	0.990011751
Sr and Y, (MCi)	1.05E+02	2.10E+00		1.90E+00		1.05E+02	0.980392157
Tc, (MCi)	5.89E-03	2.61E-02		2.59E-02		5.91E-03	0.184745233
Am, (MCi)	9.51E-02	8.61E-03		8.60E-03		9.52E-02	0.917944268
Np, (MCi)	9.29E-05	1.03E-05		1.03E-05		9.29E-05	0.900193798
Pu-239, (MCi)	2.47E-02	1.67E-03		1.67E-03		2.47E-02	0.936670459
Pu-240, (MCi)	6.28E-03	4.14E-04		4.14E-04		6.28E-03	0.93815357
Pu-241,(MCi)	7.34E-02	1.49E-03		1.48E-03		7.34E-02	0.980104153
Total TRU, (MCi)	2.00E-01	1.22E-02		1.22E-02		2.00E-01	0.942507069
Total MCi	1.11E+02	6.49E+01		2.43E+00		1.73E+02	0.98351336
Total Mass Flow (MT)	1.94E+04	7.10E+05	2.81E+05	3.87E+05	1.36E+04	2.51E+04	
Total Cr, (MT)	1.32E+02	5.15E+01		1.44E+02		3.96E+01	
Total Na, (MT)	1.24E+03	6.51E+04		7.18E+04		2.33E+03	
Total Si, (MT)	5.24E+02	5.65E+00	1.07E+05	1.07E+05	5.29E+03	5.83E+03	
Total P, (MT)	7.80E+02	8.42E+02		1.35E+03		2.72E+02	
Total NO2-, (MT)	7.38E+01	9.54E+03					
Total NO3-, (MT)	1.03E+03	1.06E+05					
AG+	1.38E+00	3.28E-01					
AG2O				3.52E-01		1.48E+00	
AL+3	2.37E+03						
AL2O3			1.32E+04	1.94E+04		1.73E+03	
AL(OH)4-		4.83E+03					
AM+3	2.77E-02	2.51E-03					
AM2O3				2.76E-03		3.05E-02	
AS+5	4.98E-01	7.70E-01					
AS2O5				1.18E+00		7.66E-01	
B+3	9.94E-01	5.19E-01					
B2O3				1.67E+00	1.75E+03	1.76E+03	
BA+2	3.09E+00	7.91E-01					
BAO				8.81E-01		3.45E+00	
BE+2	7.61E-03	8.19E-02					
BEO				2.27E-01		2.16E-02	
BI+3	1.96E+02	6.76E+01					
BI2O3				7.52E+01		2.19E+02	
C14	4.53E-04	7.43E-04					
CA+2	1.33E+02	1.67E+01					
CANCRINITE	2.70E+03						
CAO			3.87E+04	3.87E+04		1.89E+02	
CD+2	7.93E+00	2.09E+00					
CDO				2.38E+00		9.06E+00	
CE+3	2.35E+02	2.37E+00					
CE2O3				2.79E+00		2.76E+02	
CL-	3.49E+00	3.11E+02					
CL2							
CO							
CO2							
CO3-2	2.25E+02	3.37E+03					
CR+3	1.32E+02						
CR2O3				2.11E+02		5.79E+01	
CR(OH)4-		1.19E+02					
CS+	9.25E-02	8.19E-01					
CS2O				6.83E-03		9.58E-01	
CU+2	7.46E-01	1.77E-01					
CUO				2.21E-01		9.34E-01	

CUSO4									
F-	5.97E+01	1.12E+03							
F2									
FE+3	7.63E+02	1.44E+01							
FE2O3					2.06E+01			1.21E+03	
H2									
H2O		5.07E+05							
H2S									
HG									
HG+2	9.00E-03	9.49E-01							
I-	2.02E+01	5.46E+02							
I2									
K+	2.10E+01	2.19E-01							
K2O					2.65E-01			2.53E+01	
KEROSENE									
LA+3	2.10E+01	2.19E-01							
LA2O3					2.58E-01			2.46E+01	
LI+	2.46E-02	5.77E-03							
LI2O					1.24E-02		5.00E+02	5.03E+02	
MG+2	1.10E+01	9.65E-01							
MGO					1.60E+00			1.88E+01	
MNO2	2.09E+02	2.17E+01			2.16E+01			2.09E+02	
MO+6	8.01E-01	4.87E+00							
MOO3					7.29E+00			1.22E+00	
N2									
NA+	7.77E+02	6.51E+04							
NA2O					9.68E+04			3.14E+03	
NH3									
NI+3	6.57E+00	4.07E+00							
NI2FECN6	5.00E+02								
NI2O3					5.72E+00			9.27E+00	
NIO					1.50E-02			2.27E+02	
NO									
NO2									
NO2-	7.38E+01	9.54E+03							
NO3-	1.03E+03	1.06E+05							
NP+4	1.32E-01	1.46E-02							
NPO2					1.66E-02			1.50E-01	
O2									
OH-	5.00E+03	6.44E+03							
PB+4	3.28E+00	1.96E+00							
PBO2					2.26E+00			3.79E+00	
PO4-3	2.39E+03	2.58E+03							
P2O5					3.09E+03			6.22E+02	
P2O5:24W	5.21E-01								
PU+4	4.27E-01	2.88E-02							
PUO2					3.26E-02			4.84E-01	
S									
SI+4	7.90E+01	5.65E+00							
SIO2				2.29E+05	2.29E+05		1.13E+04	1.25E+04	
SO2									
SO4-2	3.97E+01	2.01E+03							
SR+2	3.64E+01	3.75E-01							
SRO					4.00E-01			4.29E+01	
TCO2									
TCO4-	5.68E-01	2.52E+00							
TC2O7					2.39E+00			5.45E-01	
TOC	1.16E+02	1.42E+03							
UO2+2	1.58E+03	8.52E+01							
UO3					9.02E+01			1.67E+03	
V+5	1.88E-01	6.20E-02							
V2O5					1.11E-01			3.35E-01	
W+6		7.47E-01							
WO2					2.91E-05			4.41E-01	
WO3					9.40E-01			2.06E-03	
ZN+2	9.45E-01	3.59E+00							
ZNO					4.46E+00			1.19E+00	

ZR+4	2.77E+02	4.48E-01							
ZRO2					6.49E-01			6.90E+02	
ZRO2:2H2	4.09E+02	2.15E+01							
WHC Data Package Basis:									
Mass LAW waste oxides					106544.7302				
LAW waste loading (waste oxide)					28%				
LAW waste loading (sodium oxide)					25%				
Mass HLW waste oxides								7.26E+03	
HLW waste loading (waste oxides)								29%	
HLW									
20 wt. % waste oxide loading									
Blending factor				1	1.25	1.5	2	3.5	
Mass of glass required to achieve 25% wo loading, MT				36293.1358	45366.41975	54439.7037	72586.2716	127025.9753	
additional frit required (equals increased glass) MT				1.12E+04	2.03E+04	2.93E+04	4.75E+04	1.02E+05	
total frit required, MT				2.48E+04	3.39E+04	4.29E+04	6.11E+04	1.16E+05	
glass density (MT/m^3)	2.63								
cullet packing fraction	0.7	(LAW only)							
Waste volume (m^3)				1.38E+04	1.72E+04	2.07E+04	2.76E+04	4.83E+04	
Canister Volume (m^3)	0.62								
Number of Canisters (1x)				2.23E+04	2.78E+04	3.34E+04	4.45E+04	7.79E+04	
No. of Canisters /HMPC	4								
Number of HMPCs				5.56E+03	6.96E+03	8.35E+03	1.11E+04	1.95E+04	
Number of trips @ 10 HMPCs /trip				556	696	835	1113	1948	
Glass formulation:									
(ref Ext. Sep Data Pkg.)	acceptable range			1	1.25	1.5	2	3.5	
SiO2	42 to 57 wt %			60.07%	64.68%	67.75%	71.59%	76.52%	
B2O3	5 to 20 wt %			8.82%	9.63%	10.17%	10.84%	11.71%	
Na2O	5 to 20 wt %			8.65%	6.92%	5.77%	4.33%	2.47%	
Li2O	1 to 7 wt %			2.52%	2.75%	2.91%	3.10%	3.35%	
Fe2O3	2 to 15 wt %			3.33%	0.00%	0.00%	0.00%	0.00%	
CaO	< or = 10 wt %			0.52%	0.42%	0.35%	0.26%	0.15%	
MgO	< or = 8 wt %			0.05%	0.04%	0.03%	0.03%	0.01%	
Al2O3	< or = 15 wt %			4.77%	3.81%	3.18%	2.38%	1.36%	
ZrO2	< or = 13 wt %			1.90%	1.52%	1.27%	0.95%	0.54%	
Cr2O3	< or = 0.5 wt %			0.16%	0.13%	0.11%	0.08%	0.05%	
P2O5	< or = 3 wt %			1.71%	1.37%	1.14%	0.86%	0.49%	
SO3	< or = 0.5 wt %								
HLW Facility Sizing									
Schedule	14 yrs								
Capacity MT/day	20								
Overall efficiency, %				36%	44%	53%	71%	124%	
Required capacity MT/day (assuming 14 yrs ops, 60% OE)				11.84	14.80	17.76	23.67	41.43	
Required operating duration yrs (assuming 20 MT/day, 60% OE)					10.36	12.43	16.57	29.00	
~~15 wt % waste~~ oxide loading									
Mass of glass required to achieve 15% wo loading MT				4.84E+04	6.05E+04	7.26E+04	9.68E+04	1.69E+05	
Volume (m^3)				1.84E+04	2.30E+04	2.76E+04	3.68E+04	6.44E+04	
Number of Canisters (1x)				2.97E+04	3.71E+04	4.45E+04	5.94E+04	1.04E+05	
40 wt. % waste oxide loading									
Mass of glass required to achieve 40% wo loading MT				1.81E+04	2.27E+04	2.72E+04	3.63E+04	6.35E+04	
Volume (m^3)				6.90E+03	8.62E+03	1.03E+04	1.38E+04	2.41E+04	
Number of Canisters (1x)				1.11E+04	1.39E+04	1.67E+04	2.23E+04	3.90E+04	
LAW									

15 wt. % sodium oxide loading								
Blending factor			1	1.25	1.5	2	3.5	
Mass of glass required to achieve 15% wo loading, MT			6.45E+05	8.07E+05	9.68E+05	1.29E+06	2.26E+06	
additional frit required (equals increased glass) MT			3.64E+05	5.26E+05	6.87E+05	1.01E+06	1.98E+06	
total frit required, MT			6.45E+05	8.07E+05	9.68E+05	1.29E+06	2.26E+06	
glass density (MT/m^3)	2.63							
cullet packing fraction	0.7							
Waste volume (m^3)			3.51E+05	4.38E+05	5.26E+05	7.01E+05	1.23E+06	
Number of 5300 m^3 vaults			66	83	99	132	231	
LAW facility sizing								
Schedule, years	14							
Capacity MT/day.	200							
Overall efficiency, %			63%	79%	95%	126%	221%	
Required capacity MT/day (assuming 14 yrs ops, 60% OE)			210.48	263.10	315.72	420.96	736.68	
Required operating duration yrs (assuming 200 MT/day, 60% OE)			14.73	18.42	22.10	29.47	51.57	
10 wt. % sodium oxide loading								
Blending factor			1	[illegible]		2	3.5	
Mass of glass required to achieve 10 wt % Na2O			968000	1,210,000		1936000	3388000	
Waste volume, m^3			525801.195	657251.49		1051602.39	1840304.183	
Number of 5,300 m^3 vaults			99	124		198	347	
25 wt. % sodium oxide loading								
Blending factor			1	[illegible]		2	3.5	
Mass of glass required to achive 25 wt % Na2O			387200	484000		774400	1355200	
Waste Volume			210320.478	262900.59		420640.956	736121.673	
Number of 5,300 m^3 vaults			40	50		79	139	

15 wt. % sodium oxide loading								
Blending factor			1	1.25	1.5	2	3.5	
Mass of glass required to achieve 15% wo loading, MT			6.45E+05	8.07E+05	9.68E+05	1.29E+06	2.26E+06	
additional frit required (equals increased glass) MT			3.64E+05	5.26E+05	6.87E+05	1.01E+06	1.98E+06	
total frit required, MT			6.45E+05	8.07E+05	9.68E+05	1.29E+06	2.26E+06	
glass density (MT/m^3)	2.63							
cullet packing fraction	0.7							
Waste volume (m^3)			3.51E+05	4.38E+05	5.26E+05	7.01E+05	1.23E+06	
Number of 5300 m^3 vaults			66	83	99	132	231	
LAW facility sizing								
Schedule, years	14							
Capacity MT/day	200							
Overall efficiency, %			63%	79%	95%	126%	221%	
Required capacity MT/day (assuming 14 yrs ops, 60% OE)			210.48	263.10	315.72	420.96	736.68	
Required operating duration yrs (assuming 200 MT/day, 60% OE)			14.73	18.42	22.10	29.47	51.57	
10 wt. % sodium oxide loading								
Blending factor			1	1.25		2	3.5	
Mass of glass required to achieve 10			968000	1210000		1936000	3388000	
Waste volume, m^3			525801.195	657251.4938		1051602.39	1840304.183	
Number of 5,300 m^3 vaults			99	124		198	347	
25 wt. % sodium oxide loading								
Blending factor			1	1.25		2	3.5	
Mass of glass required to achive 25 wt % Na2O			387200	484000		774400	1355200	
Waste Volume			210320.478	262900.5975		420640.956	736121.673	
Number of 5,300 m^3 vaults			40	50		79	139	

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F.13 Backup for Table 9-19

Resource Requirements

Table F-37 gives the consumable resource requirements for the Tri-Party Agreement alternative data package. Where possible the information for resource usage was taken from the material balances in Appendix A. Exceptions are ion exchange media, decon chemicals, glycolic acid, raw and sanitary water, and electricity. How these values were obtained is defined in the Table 9-4 footnotes or backup. The raw material prices were taken from the "Chemical Marketing Reporter" or from the Facility Configuration Study.

Table F-38 gives the miscellaneous resource requirements for the Tri-Party Agreement alternative data package. All of the costs for the items were taken from the Facility Configuration Study except for solid waste. This value is based upon engineering judgement. The total cost for the LLW vaults in Table F-38 is a total cost which includes staffing for construction as well as consumable resources.

Table F-37. Operating Cost for Consumables.

Material	Unit	Unit Cost	Pretreatment/LLW Amount	Pretreatment/LLW Cost	HLW Amount	HLW Cost	Total Amount	Total Cost
Frit	Megagram	$3,860	52	$200,720		$0	52	$200,720
Flocculent	Megagram	$100	85	$8,500		$0	85	$8,500
Ion Exchange	Cubic Meter	$11,000	224	$2,464,000		$0	224	$2,464,000
NaNO2	Megagram	$210	54	$11,340		$0	54	$11,340
Sulfur	Megagram	$370	127,000	$46,990,000		$0	127,000	$46,990,000
DCPD*	Megagram	$150	3,360	$504,000		$0	3,360	$504,000
CPD**	Megagram	$150	3,360	$504,000		$0	3,360	$504,000
NaOH	Megagram	$250	26,200	$6,550,000		$0	26,200	$6,550,000
HNO3	Megagram	$160	4,190	$670,400		$0	4,190	$670,400
NH3	Megagram	$350	8,480	$2,968,000	277	$96,950	8,757	$3,064,950
Decon Chemicals	Megagram	$401	2,114	$847,714	3,171	$1,271,571	5,285	$2,119,285
Kerosene	Megagram	$150	57,800	$8,670,000		$0	57,800	$8,670,000
SiO2	Megagram	$40	229,000	$9,160,000	11,300	$452,000	240,300	$9,612,000
Al2O3	Megagram	$500	13,200	$6,600,000		$0	13,200	$6,600,000
CaO	Megagram	$60	38,700	$2,322,000		$0	38,700	$2,322,000

Table F-37. Operating Cost for Consumables.

		Unit	Pretreatment/LLW		HLW		Total	
Material	Unit	Cost	Amount	Cost	Amount	Cost	Amount	Cost
B2O3	Megagram	$1,000		$0	1,750	$1,750,000	1,750	$1,750,000
Li2O	Megagram	$5,000		$0	500	$2,500,000	500	$2,500,000
Glycolic Acid	Megagram	$1,740		$0	3,500	$6,090,000	3,500	$6,090,000
Sanitary Water	Cubic Meter	$0.03	797,000	$23,910	303,000	$9,090	1,100,000	$33,000
Raw Water	Cubic Meter	$0.03	9,878,900	$296,367	1,121,100	$33,633	11,000,000	$330,000
Steam	Megagram	$5		$0		$0		$0
Electricity	Megawatt-Hours	$30	5,310,000	$159,300,000	3,690,000	$110,700,000	9,000,000	$270,000,000
Subtotal				$248,090,951		$122,903,244		$370,994,195

Notes:

*Dicyclopentadiene
**Cyclopentadiene

HLW = high-level waste
LLW = low-level waste

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Table F-38. Other Operating Costs.

		Unit	Pretreatment/HLW		HLW		Total	
Material	Unit	Cost	Amount	Cost	Amount	Cost	Amount	Cost
Solid Waste	Cubic Meter	$1,000	1,000	$1,000,000	1,000	$1,000,000	2,000	$2,000,000
Equipment	Per Year	14 year	$18,000,000	$252,000,000	$5,000,000	$70,000,000		$322,000,000
Vaults	Per	$5,000,000	45	$225,000,000			45	$225,000,000
Canisters	Per	$10,000			6,820	$68,200,000	6,820	$68,200,000
Containers	Per	$25,000			1,705	$42,625,000	1705	$42,625,000
Casks	Per	$60,000			1,705	$102,300,000	1705	$102,300,000
Pads	Per	$26,000,000			1	$26,000,000	1	$26,000,000
Subtotal				$478,000,000		$310,125,000		$788,125,000
Total From Table F-37				$248,090,951		$122,903,244		$370,994,195
Grand Total				$726,090,951		$433,028,244		$1,159,119,195
Grand Total Minus Equipment				$474,090,951		$363,028,244		$837,119,195

Note:

HLW = high-level waste
LLW = low-level waste

Consumables

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JACOBS ENGINEERING GROUP INC.

DATE 2/19/96 SUBJECT SHEET NO. 1-2

BY DLS CHKD. JOB NO.

EZ Site No Separation Vitrification proposed DEIS

previous HLW glass - 30% sodium oxide loading, 1.0 blend factor

from mass balance info
2.50E+05 MT glass formers
3.57E+05 MT glass product

proposed HLW glass - 20% sodium oxide loading 1.5 blend factor

from mass balance info
5.64E+05 MT glass formers
6.71E+05 MT glass product

ratio glass formers: $\frac{5.64E+05}{2.50E+05} = 2.26$

ratio glass product: $\frac{6.71E+05}{3.57E+05} = 1.88$

Δ cost for glass formers

category	previous $ (Thou)	ratio	$ Δ (Thous)
SiO_2	8,160	2.26	$10,282
Al_2O_3	5,000	2.26	6,300
CaO	2,130	2.26	2,684
Kerosene	7,815	1.88	6,877
electricity	140,700	1.88	123,816
			$149,959

~same operation period, so Δ labor = 0

JACOBS ENGINEERING GROUP INC.

DATE 2/19/96 SUBJECT SHEET NO. 2-2

BY DJS CHKD. JOB NO.

other op. cost Δ

587,426 canisters, 0.62 m^3 each
vs. 21,400 canisters, 10 m^3 each previous
Repository Fee: 360,000 x 587,426 = 211.5 Billion

Add

			Δ $ (thous)
canisters	$10,000/each x 587,426	=	5,874,260
containers	$25,000/each x 587,426/4	=	3,671,413
casks	$60,000/each x 587,426/4	=	8,811,390
pads	26,000,000 each x 587,426/6820 (per 6820 canisters)	=	2,239,454

Subtract

canisters	$20,000/each x 21,400	=	428,000
containers			
casks	$65,000/each x 21,400	=	1,391,000
pads	$26,000,000/each x 21,400/6,820 x 7.5	=	612,000 *

pads not listed in Ate Sp. data pkg but assume one 10 m^3 canister occupies ~7.5 times area of 0.62 m^3 canister

Δ other op. cost $18,165

Δ op. cost summary (no Sp. vitrification)

	Δ $
Δ glass former/electricity/fuel etc.	$149,959,000
Δ other costs	18,165,000,000
total Δ op. cost	$18,315,000,000
previous op. cost	4,427,000,000
new op. cost	$22,742,000,000

* previously calculated in error @ $81,580,000

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Backup to Table 6-20. Operating Costs.

Material	Unit	Unit Cost	Vitrification	
			Material	Cost
Decon Chemicals	Megagram	$401	2,114	$848,040
Solid Waste	Cubic Meter	$1,000	1,000	$1,000,000
Kerosene	Megagram	$150	52,100	$7,815,000
Ammonia	Megagram	$350	8,570	$2,999,500
Process Water	Cubic Meter	$0.03	972,907	$29,187
SiO_2	Megagram	$40	204,000	$8,160,000
Al_2O_3	Megagram	$500	10,000	$5,000,000
CaO	Megagram	$60	35,500	$2,130,000
B_2O_3	Megagram	$1,000		$0
Li_2O	Megagram	$5,000		$0
				$27,981,727
				$1,998,695
Sanitary Water	Cubic Meter	$0.03	949,390	$28,482
Raw Water	Cubic Meter	$0.03	3,605,940	$108,178
Steam	Megagram	$5		$0
Electricity	Megawatt Hours	$30	4,690,000	$140,700,000
				$140,836,660
				$10,059,761

Table 6-17. Process Module: Overall Cost (1995 Dollars).

Process Module	No Separations
Pumping/sluicing	*
Hydraulic retrieval	*
Sludge wash	0
Cesium removal	0
Other radionuclide removal	0
Low-level waste vitrification	0
Low-level waste disposal	0
High-level waste vitrification	$7.30E9
High-level waste disposal fee	$1.29E10
Emptied single-shell tank closure	*
Emptied double-shell tank closure	*
Total	$2.02E10

Notes:

*Outside the scope of this document.

For additional backup information, see Appendix B.

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Table 6-18. Overall Cost Component (1995 Dollars).

Cost Component	No Separations
Capital	$2.61E9[1]
Operating	$1.63E10[2]
Monitoring and maintenance	$5.01E7[3]
Decontamination and decommissioning	$9.77E8[4]
Research and development	$2.80E8[5]
Total	$2.02E10[6]

Notes:

[1]Total capital cost includes 40 percent contingency. Contingency is excluded from operating monitoring and maintenance, decontamination and decommissioning, research and development cost, and high-level waste disposal.

[2]Total operating cost is calculated at annual operating cost (see Table 6-20). Operating costs include startup and actual hot operations.

[3]Total monitoring and maintenance cost is calculated in footnote 1 of Table 6-20. Monitoring and maintenance is for the HLW canisters stored onsite.

[4]Total decontamination and decommissioning cost is calculated as the sum of 30 percent of the capital cost plus three years of annual operating labor cost (Boomer et al.). Decontamination and decommissioning is defined as the extombment of the radioactively contaminated facilities located in the 200 East Area.

[5]Based on the research and development costs associated with the low-level waste Vitrification Facility (Boomer et al. 1994). Although high-level waste research and development costs are lower ($250,000,000), it is assumed that unknowns associated with no separations and the large equipment size will require additional testing.

[6]Costs associated with routine tank farm operations, estimated at $4,070 million (1995 dollars) are not included in these totals. In addition, costs associated with TWRS program management, characterization, tank farm upgrades, SST saltwell pumping, and tank farm safety issues resolution are not included.

For additional backup information, see Appendix B.

Boomer, K. D. and J. M. Colby, T. W. Crawford, J. S. Garfield, J. D. Galbraith, C. E. Golberg, C. E. Leach, D. E. Mitchell, F. D. Nankani, B. J. Slaathaug, L. M. Swanson, T. L. Waldo and C. M. Winkler, 1994, *Tank Waste Remediation System Facility Configuration Study*, WHC-SD-WM-ES-295, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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Table 6-19. Capital Cost Component (1995 Dollars).

Capital Cost Component	No Separations
Labor	$1.07E9[1]
Materials and supplies	$4.61E8[1]
Equipment	$8.18E8[1]
Local purchases	$2.61E8[2]
Total	$2.61E9

Notes:

[1]See cost estimate in Appendix D.

[2]Assumed to be 18 percent of total materials and supplies and equipment purchases, based on Westinghouse Hanford Company 1994 procurement.

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Table 6-20. Operating Cost Component (1995 Dollars).

Operating Cost Component	No Separations
Labor	$1.18E9[1]
Materials and supplies	$1.40E8[2]
High-level waste casks/canisters	$1.82E9[3]
Equipment	$2.10E8[4]
High-level waste disposal fee	$1.29E10[5]
Total	$1.63E10

Notes:

[1]From Table 6-3 Operational Personnel

(227E)($130,000/yr)(14 yr operations + 2 year startup + 1.5 yr decontamination and decommissioning)

(53 NE)($60,000/yr)(14 yr operations + 2 year startup + 1.5 yr decontamination and decommissioning)

(338 BU)($90,000/yr)(14 yr operations + 2 year startup + 1.5 yr D&D)

Total = $1.13E9

From Table 6-14 Monitoring and Maintenance Personnel

(1 E)($130,000/yr)(60 yr)

(1 NE)($60,000/yr)(60 yr)

(8 BU)($90,000/yr)(60 yr)

Total = $5.46E7

Grand Total = $1.18E9

[2]Includes cold chemicals and utilities at $10 million/year for 14 years (18% assumed to be purchased locally).

[3]Based on total cost requirement of 21,400 SS unshielded canisters and 21,400 concrete interim shielding casks. Canister/cask cost is from facility configuration study which assumes $65k for each cask and $20k for each canister.

[4]Based on replacement of melter at $15 million/year for 14 years (18% assumed to be purchased locally).

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Table 6-20. Operating Cost Component (1995 Dollars).

Notes (Continued):

[f]Table D-8 (TRW 1995) estimates the repository fee for the No Separations Alternative (Case 7-5SC) would be $8,800 million higher than the estimated repository fee for Case 1C, using the TRW Total System Life Cycle Cost model developed for the Office of Civilian Radioactive Waste Management. Per informal communications with Mr. Don Nitti of TRW on May 31, 1995, Hanford's repository fee for case 1C is estimated as follows:

Two repository case total life cycle cost	=	$48.294 billion
Defense program share	=	15.7%
Hanford's share based on ratio of number of Hanford waste packages (2,465) to total defense program waste packages (4,588), from Table 2-4 (TRW 1995)	=	53.7%

Hanford's share of Case 1C:
($48.294 billion x 0.157 x 0.537) = $4.072 billion

TRW, 1995, *Assessment of Pre-Closure System Cost and Health and Safety Impacts of Hanford High-Level Waste Vitrification Options on the Civilian Radioactive Waste Management System, A00000000-01717-5707-00003*, Rev. 0, TRW Environmental Safety Systems, Inc., Vienna, Virginia.

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Table 6-21. Overall Schedule (Calendar Year Start/Completion Date).

Activity	No Separations
Construction	06/1997[1] - 12/2002
Operation	12/2004 - 12/2018[1]
Decontamination and decommissioning	01/2019 - 12/2023[2]
Monitoring and maintenance	1/2005 - 12/2027[3]
Research and development	1995 - 2005[4]

Notes:

[1]Assumes high-level waste no separations will start operating in place of the pretreatment facility.

[2]Assumes 5 years per facility for decontamination and decommissioning after 14 years of operation.

[3]Assumes that the high level-waste casks stored on the Hanford Site will required monitoring until they are transported to the deep geologic repository. Monitoring and maintenance of the HLW product is assumed to begin one month after start of operations and would continue until completion of shipping to the geologic repository. Shipment of HLW canisters to the repository is assumed to occur over the period 2017 through 2027 (TRW 1995, Table D-6).

[4]Based on the draft multi-year program plan and will continue for one year after the start of operation of the high-level waste facility.

Boomer, K. D. and J. M. Colby, T. W. Crawford, J. S. Garfield, J. D. Galbraith, C. E. Golberg, C. E. Leach, D. E. Mitchell, F. D. Nankani, B. J. Slaathaug, L. M. Swanson, T. L. Waldo and C. M. Winkler, 1994, *Tank Waste Remediation System Facility Configuration Study*, WHC-SD-WM-ES-295, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

DOE, 1990, *Radioactive Waste Management*, DOE Order 5820.2A, U.S. Department of Energy, Washington, D.C.

TRW, 1995, *Assessment of Pre-Closure System Cost and Health and Safety Impacts of Hanford High-Level Waste Vitrification Options on the Civilian Radioactive Waste Management System, A00000000-01717-5707-00003*, Rev. 0, TRW Environmental Safety Systems, Inc., Vienna, Virginia.

No Separations

Assumptions:							
1. HLW glass waste oxide loading basis to be 20 wt% sodium oxides							
2. Using the WHC engineering data package material balance calculate the waste oxide loading							
and adjust mass of the glass produced to achieve a 20 wt % sodium oxide loading							
	Input		Frit	Output			
	Stream1		stream407	stream437			
	liquids	solids					
Volume kilo-liters	5.85E+05						
Specific Gravity	1.21E+00						
Cs and Ba, (MCi)	6.28E+01	5.28E+00		6.79E+01			
Sr and Y, (MCi)	2.10E+00	1.05E+02		1.07E+02			
Tc, (MCi)	2.61E-02	5.89E-03		3.18E-02			
Am, (MCi)	8.61E-03	9.51E-02		1.04E-01			
Np, (MCi)	1.03E-05	9.29E-05		1.03E-04			
Pu-239, (MCi)	1.67E-03	2.47E-02		2.64E-02			
Pu-240, (MCi)	4.14E-04	6.28E-03		6.70E-03			
Pu-241,(MCi)	1.49E-03	7.34E-02		7.48E-02			
Total TRU, (MCi)	1.22E-02	2.00E-01		2.12E-01			
Total MCi	6.49E+01	1.11E+02		1.76E+02			
Total Mass Flow (MT)	7.10E+05	1.94E+04	2.50E+05	3.57E+05			
Total Cr, (MT)	5.15E+01	1.32E+02		1.84E+02			
Total Na, (MT)	6.51E+04	1.24E+03		6.63E+04			
Total Si, (MT)	5.65E+00	5.24E+02	9.56E+04	9.61E+04			
Total P, (MT)	8.42E+02	7.80E+02		1.62E+03			
Total NO2-, (MT)	9.54E+03	7.38E+01					
Total NO3-, (MT)	1.06E+05	1.03E+03					
AG+	3.28E-01	1.38E+00					
AG2O				1.83E+00			
AL+3		2.37E+03					
AL2O3			1.00E+04	1.79E+04			
AL(OH)4-	4.83E+03						
AM+3	2.51E-03	2.77E-02					
AM2O3				3.32E-02			
AS+5	7.70E-01	4.98E-01					
AS2O5				1.95E+00			
B+3	5.19E-01	9.94E-01					
B2O3				4.87E+00			
BA+2	7.91E-01	3.09E+00					
BAO				4.33E+00			
BE+2	8.19E-02	7.61E-03					
BEO				2.48E-01			
BI+3	6.76E+01	1.96E+02					
BI2O3				2.94E+02			
C14	7.43E-04	4.53E-04					
CA+2	1.67E+01	1.33E+02					

CANCRINITE		2.70E+03					
CAO			3.55E+04	3.58E+04			
CD+2	2.09E+00	7.93E+00					
CDO				1.14E+01			
CE+3	2.37E+00	2.35E+02					
CE2O3				2.78E+02			
CL-	3.11E+02	3.49E+00					
CL2							
CO							
CO2							
CO3-2	3.37E+03	2.25E+02					
CR+3		1.32E+02					
CR2O3				2.68E+02			
CR(OH)4-	1.19E+02						
CS+	8.19E-01	9.25E-02					
CS2O				9.65E-01			
CU+2	1.77E-01	7.46E-01					
CUO				1.16E+00			
CUSO4							
F-	1.12E+03	5.97E+01					
F2							
FE+3	1.44E+01	7.63E+02					
FE2O3				1.23E+03			
H2							
H2O	5.07E+05						
H2S							
HG							
HG+2	9.49E-01	9.00E-03					
I-	5.46E+02	2.02E+01					
I2							
K+	2.19E-01	2.10E+01					
K2O				2.56E+01			
KEROSENE							
LA+3	2.19E-01	2.10E+01					
LA2O3				2.49E+01			
LI+	5.77E-03	2.46E-02					
LI2O				6.53E-02			
MG+2	9.65E-01	1.10E+01					
MGO				1.98E+01			
MNO2	2.17E+01	2.09E+02		2.31E+02			
MO+6	4.87E+00	8.01E-01					
MOO3				8.51E+00			
N2							
NA+	6.51E+04	7.77E+02					
NA2O				8.94E+04			
NH3							
NI+3	4.07E+00	6.57E+00					
NI2FECN6		5.00E+02					
NI2O3				1.50E+01			

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NIO				2.27E+02			
NO							
NO2							
NO2-	9.54E+03	7.38E+01					
NO3-	1.06E+05	1.03E+03					
NP+4	1.46E-02	1.32E-01					
NPO2				1.66E-01			
O2							
OH-	6.44E+03	5.00E+03					
PB+4	1.96E+00	3.28E+00					
PBO2				6.05E+00			
PO4-3	2.58E+03	2.39E+03					
P2O5				3.71E+03			
P2O5:24W		5.21E-01					
PU+4	2.88E-02	4.27E-01					
PUO2				5.16E-01			
S							
SI+4	5.65E+00	7.90E+01					
SIO2			2.04E+05	2.06E+05			
SO2							
SO4-2	2.01E+03	3.97E+01					
SR+2	3.75E-01	3.64E+01					
SRO				4.33E+01			
TCO2							
TCO4-	2.52E+00	5.68E-01					
TC2O7				2.94E+00			
TOC	1.42E+03	1.16E+02					
UO2+2	8.52E+01	1.58E+03					
UO3				1.76E+03			
V+5	6.20E-02	1.88E-01					
V2O5				4.46E-01			
W+6	7.47E-01						
WO2				4.41E-01			
WO3				9.42E-01			
ZN+2	3.59E+00	9.45E-01					
ZNO				5.65E+00			
ZR+4	4.48E-01	2.77E+02					
ZRO2				7.07E+02			
ZRO2:2H2	2.15E+01	4.09E+02					
WHC data package basis:							
mass waste oxides				1.08E+05	1.164E5		
waste loading (wt%)				30%			
sodium oxide loading				25%			
20 wt. % sodium oxide loading							
Blending factor			1	1.25	1.5	2	3.5
Mass of glass required to achieve 20% sodium loading, M			4.47E+05	5.59E+05	6.71E+05	8.94E+05	1564500
additional frit required (equals increased glass) MT			9.00E+04	2.02E+05	3.14E+05	5.37E+05	1.21E+06

total frit required, MT			3.40E+05	4.52E+05	5.64E+05	7.87E+05	1.46E+06
glass density (MT/m^3)	2.63						
cullet packing fraction	0.7						
Waste volume (m^3)			2.43E+05	3.04E+05	3.64E+05	4.86E+05	8.50E+05
Canister Volume (m^3)	0.62						
Number of Canisters (1x)			3.92E+05	4.90E+05	5.87E+05	7.83E+05	1.37E+06
Number of Canisters per HMPC		4					
Number of HMPCs			9.79E+04	1.22E+05	1.47E+05	1.96E+05	3.43E+05
Number of trips @ 10 HMPCs /trip			9.79E+03	1.22E+04	1.47E+04	1.96E+04	3.43E+04
Glass formulation:							
(ref Ext. Sep Data Pkg.	acceptable range	Calculated value					
SiO2	42 to 57 wt %		62.51%	66.33%	68.88%	72.06%	76.15%
B2O3	5 to 20 wt %		0.00%	0.00%	0.00%	0.00%	0.00%
Na20	5 to 20 wt %		20.00%	16.00%	13.33%	10.00%	5.71%
Li2O	1 to 7 wt %		0.00%	0.00%	0.00%	0.00%	0.00%
Fe2O3	2 to 15 wt %		0.28%	0.22%	0.18%	0.14%	0.08%
CaO	< or= 10 wt %		10.87%	11.53%	11.98%	12.53%	13.25%
MgO	< or = 8 wt %		0.00%	0.00%	0.00%	0.00%	0.00%
Al2O3	< or = 15 wt %		4.81%	4.65%	4.54%	4.40%	4.23%
ZrO2	< or = 13 wt %		0.16%	0.13%	0.11%	0.08%	0.05%
Cr2O3	< or = 0.5 wt %		0.06%	0.05%	0.04%	0.03%	0.02%
P2O5	< or = 3 wt %		0.83%	0.66%	0.55%	0.41%	0.24%
SO3	< or = 0.5 wt %						
Facility Sizing							
Schedule	14 yrs						
Capacity MT/day	200						
Overall efficiency, %			44%	55%	66%	87%	153%
Required capacity MT/day (assuming 14 yrs ops, 60% OE)				182	219	292	510
Required operating duration yrs (assuming 200 MT/day, 60% OE)				13	15	20	36
15 wt % sodium oxide loading							
Mass of glass required to achieve 15% wo loading MT			5.96E+05			Na2O loadin	15%
Volume (m^3) as cullet			3.24E+05				
Number of Canisters (1x)			5.22E+05				
40 wt % sodium oxide loading							
Mass of glass required to achieve 40% wo loading MT			2.24E+05			Na2O loadin	40%
Volume (m^3) as cullet			1.21E+05				
Number of Canisters (1x)			1.96E+05				

JACOBS ENGINEERING GROUP INC.

DATE 2/19/96 SUBJECT SHEET NO. 1-1

BY DLS CHKD. JOB NO.

Ex Situ No Separations Calcination Proposed DELS

The only change for calcination is in operating costs for canisters, casks, pads, etc due to change in canister size from $10 m^3$ to $0.62 m^3$ each.

$10,300$ canisters (previous) $\times \frac{10 m^3}{0.62 m^3} = 166,129$ canisters (new)

Add

					Δ $
canisters	$10,000/each	× 166,129	=		$1,661,290,000
containers	$25,000/each	× 166,129/4	=		1,038,306,000
casks	$60,000/each	× 166,129/4	=		2,491,935,000
pads	$25,000,000/each	× nil	=		0 *

subtract

canisters	$20,000/each	× 10,300	=	206,000,000
containers				
casks	$65,000/each	× 10,300	=	669,500,000

(assume pad areas are about the same for each case for this estimate)

$4,315,000,000

previous op cost 3,233,000,000

$7,548,000,000

Repository Fee = $360,000 × 166129 = $59.8 billion

* previously calculated in error @ $633,336,000

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE Engineering / Number of Canisters, Trips, and Curie Concentrations in the HLW for RadTran input. Perform for all Ex Situ alternatives.

ORIGINATOR Colin Henderson DATE 1/27/96

REVISION NO. 0

OBJECTIVE Using New baseline Assumptions for waste loading and Canister size and Blending factor Calculate the Number of Canisters, trips and Isotopic Concentration in the HLW product

METHODOLOGY Use IDHC Rev 0 data packages to determine Curies/m³ in the Old Case waste and Ratio By the change in Volume to determine Conc for new base Case. Combination alt. calculated based on % recovered on an isotope by isotope basis.

ASSUMPTIONS Noted.

(Continue on another sheet if necessary)

SIGNATURE

CALCULATION & RESULTS ATTACHED

JACOBS FORMS CALCV2.SET

Assumptions

1. HLW glass for any of the ex situ alternatives involving separations is calculated at 20 wt % waste oxides. The waste oxides exclude silica and sodium.
2. The HLW for the No Separations case is calculated at 20 wt % sodium oxide.
Note: EA glass limits are 17% Na_2O and 4.3% Li_2O and each Li_2O is equivalent to 2 Na_2O so the EA glass is equivalent to 25% Na_2O without any Li_2O. The privatization RFP states that the HLW glass will be 25 wt % waste oxides not counting the Na_2O or SiO_2.
3. The LAW glass composition is calculated at 15 wt % Na_2O.
4. The canister size for all HLW is set at 0.62 m^3 (1X canister)
5. The material balances contained in the WHC data packages were used to calculate the waste oxides for the HLW and LAW streams.
6. Sensitivity analysis will be done for the Intermediate Separations alternative at 15 wt %, and 40 wt % waste oxide loading.
7. The material balance for the Intermediate Separations case was used for the Phased Implementation alternative and was modified to account for additional radionuclide separations.
8. For purposes of interim onsite storage and transportation to the repository 4 of the 1x cans are assumed to be placed into an HMPC or similar packaging and would be repackaged at the repository.

RG 2/10.

No Separations WHC data package values					
			Vitrification		
Radionuclide Inventory			No Separations		
			HLW Glass (WHC data pkg)		
			Total Curies		
Am-241			1.04E+05		
Am-243			3.32E+01		
Cm-244			1.18E+02		
Cs-137			3.49E+07		
Ni-63			2.69E+05		
Np-237			6.97E+01		
Pu-238			1.08E+03		
Pu-239			2.64E+04		
Pu-240			6.70E+03		
Pu-241			7.49E+04		
Ru-106			3.79E-02		
Sm-151			6.30E+05		
Sn-126			6.27E+02		
Sr-90			4.36E+07		
Tc-99			3.21E+04		
U-233			1.21E-02		
U-234			2.12E-01		
U-235			2.06E+01		
U-238			4.81E+02		
Zr-93			3.94E+03		
Total (m3)			1.36E+05		
Note: Curies from decay daughter products not included					

No Separations Alternative New Base Case (1/26/96)					
	20 wt% sodium oxide loading, 1.5 blending factor				
			Vitrification		Calcination
			Radionuclide		Radionuclide
			Concentration		Concentration
			Curies /m^3		Curies /m^3
Am-241			2.86E-01		1.55E+00
Am-243		3.32E1 ÷ 30HE5 =	9.12E-05	OK	4.94E-04
Cm-244			3.24E-04		1.76E-03
Cs-137			9.58E+01		5.19E+02
Ni-63			7.39E-01		4.00E+00
Np-237			1.91E-04		1.04E-03
Pu-238			2.97E-03		1.61E-02
Pu-239			7.25E-02		3.93E-01
Pu-240			1.84E-02		9.97E-02
Pu-241			2.06E-01		1.11E+00
Ru-106			1.04E-07		5.64E-07
Sm-151			1.73E+00		9.38E+00
Sn-126			1.72E-03		9.33E-03
Sr-90			1.20E+02		6.49E+02
Tc-99			8.81E-02		4.78E-01
U-233			3.32E-08		1.80E-07
U-234			5.82E-07		3.15E-06
U-235			5.66E-05		3.07E-04
U-238			1.32E-03		7.16E-03
Zr-93			1.08E-02		5.86E-02
Total (m3)			3.64E+05		6.72E+04
Number of 0.62 m^3 canisters			5.87E+05		108388
Number of 0.62 m^3 canisters per HMPC			4		4
Number of trips to the repository			14686 14679		2710
Based on 10 HMPCs per train					
Note: Curies from decay daughter products not included					

10,300 canisters X 10 m3 each (old) / 0.62 m3 each (new)

= 166,129 canisters

Intermediate Separations WHC data package values		
Radionuclide Inventory	Low-Level Waste Glass Ci/m3	High-Level Waste Glass Ci/m3
Am-241	3.90E-02	1.00E+01
Am-243	1.30E-05	3.20E-03
C-14		
Cm-244	4.70E-06	5.90E-03
Cs-135	4.80E-06	1.50E-02
Cs-137	1.20E+00	3.70E+03
I-129		
Ni-63	2.60E-02	2.80E+01
Np-237	3.20E-05	6.60E-03
Pu-238	3.10E-04	1.10E-01
Pu-239	7.60E-03	2.60E+00
Pu-240	1.90E-03	6.70E-01
Pu-241	6.70E-03	7.80E+00
Ra-226		
Ru-106	8.50E-09	3.80E-06
Sm-151	3.10E-02	6.60E+01
Sn-126	7.20E-04	5.00E-02
Sr-90	4.30E+00	5.60E+03
Tc-99	1.20E-01	6.30E-01
Th-230	2.30E-12	4.10E-09
U-233	2.80E-09	1.20E-06
U-234	4.90E-08	2.10E-05
U-235	4.80E-06	2.10E-03
U-238	1.10E-04	4.80E-02
Zr-93	1.60E-05	4.10E-01
Total (m3)3	2.20E+05	9.40E+03
Note: Curies from decay daughter products not included		

Intermediate Separations New Base Case (1/26/96)			
20 wt% waste oxide loading, 1.5 blending factor			
		Sensitivity @	Sensitivity@
	Base Case	15 wt% loading	40 wt% loading
Radionuclide Inventory	HLW	HLW	HLW
	glass	glass	glass
	Ci/m^3	Ci/m^3	Ci/m^3
Am-241	4.54E+00	3.41E+00	9.08E+00
Am-243	1.45E-03	1.09E-03	2.91E-03
C-14	0.00E+00	0.00E+00	0.00E+00
Cm-244	2.68E-03	2.01E-03	5.36E-03
Cs-135	6.81E-03	5.11E-03	1.36E-02
Cs-137	1.68E+03	1.26E+03	3.36E+03
I-129	0.00E+00	0.00E+00	0.00E+00
Ni-63	1.27E+01	9.54E+00	2.54E+01
Np-237	3.00E-03	2.25E-03	5.99E-03
Pu-238	5.00E-02	3.75E-02	9.99E-02
Pu-239	1.18E+00	8.86E-01	2.36E+00
Pu-240	3.04E-01	2.28E-01	6.09E-01
Pu-241	3.54E+00	2.66E+00	7.08E+00
Ra-226	0.00E+00	0.00E+00	0.00E+00
Ru-106	1.73E-06	1.29E-06	3.45E-06
Sm-151	3.00E+01	2.25E+01	5.99E+01
Sn-126	2.27E-02	1.70E-02	4.54E-02
Sr-90	2.54E+03	1.91E+03	5.09E+03
Tc-99	2.86E-01	2.15E-01	5.72E-01
Th-230	1.86E-09	1.40E-09	3.72E-09
U-233	5.45E-07	4.09E-07	1.09E-06
U-234	9.54E-06	7.15E-06	1.91E-05
U-235	9.54E-04	7.15E-04	1.91E-03
U-238	2.18E-02	1.63E-02	4.36E-02
Zr-93	1.86E-01	1.40E-01	3.72E-01
Total (m3)3	2.07E+04	2.76E+04	1.03E+04
Number of 0.62 m^3 canisters	3.34E+04	4.45E+04	1.67E+04
Number of 0.62 m^3 can/HMPC	4	4	4
Number of HMPCs	8347	11129	4173
Number of trips to the repository at 10 HMPCs per trip	835	1113	418
Note: Curies from decay daughter products not included			

Extensive Separations Data Package values		
Note: data package values modified by ECN to Rev 0 data package		
Radionuclide Inventory	HLW Glass	LLW Glass
	Base Case (A-1)	Base Case (A-1A)
	Ci/m3	Ci/m3
Am-241	2.09E+02	7.34E-04
Am-243	6.69E-02	2.35E-07
C-14	0.00E+00	0.00E+00
Cm-244	2.30E-01	4.56E-06
Cs-135	2.91E-01	9.16E-07
Cs-137	7.02E+04	2.21E-01
I-129	0.00E+00	0.00E+00
Ni-63	8.47E+00	1.83E+00
Np-237	1.40E-01	1.87E-05
Pu-238	2.15E+00	7.80E-05
Pu-239	5.25E+01	1.90E-03
Pu-240	1.33E+01	4.84E-04
Pu-241	1.49E+02	5.41E-03
Ra-226	5.40E-10	7.20E-16
Ru-106	7.58E-05	1.01E-10
Sm-151		1.68E-03
Sn-126	1.25	1.67E-06
Sr-90	1.07E+05	3.72E-02
Tc-99	6.43E+01	1.06E-03
Th-230	7.80E-08	1.04E-13
U-233	3.68E-08	5.19E-11
U-234	6.76E-07	9.10E-10
U-235	6.57E-05	8.84E-08
U-238	1.53E-03	2.06E-06
Zr-93	9.59E-02	2.68E-02
total m3	496	1.47E+05
		solid
Note: Curies from decay daughter products not included		

Extensive Separations alternative New Base Case (1/26/96)

20 wt% waste oxide loading, 1.5 blending factor

Extensive Separations Data Package values

Radionuclide Inventory	HLW Glass Base Case (A-1) Ci/m3
Am-241	1.06E+02
Am-243	3.41E-02
C-14	0.00E+00
Cm-244	1.17E-01
Cs-135	1.48E-01
Cs-137	3.58E+04
I-129	0.00E+00
Ni-63	4.31E+00
Np-237	7.13E-02
Pu-238	1.09E+00
Pu-239	2.67E+01
Pu-240	6.77E+00
Pu-241	7.59E+01
Ra-226	2.75E-10
Ru-106	3.86E-05
Sm-151	0.00E+00
Sn-126	6.37E-01
Sr-90	5.45E+04
Tc-99	3.27E+01
Th-230	3.97E-08
U-233	1.87E-08
U-234	3.44E-07
U-235	3.35E-05
U-238	7.79E-04
Zr-93	4.88E-02
total m3	9.74E+02

Number of 0.62 m^3 canisters	1571
Number of 0.62 m^3 can/HMPC	4
Number of HMPCs	393
Number of trips to the repository @ 10 HMPCs/trip	40

Note: Curies from decay daughter products not included

Phased Implementation alternative New Base Case (1/26/96)	
20 wt % waste oxide loading, 1.5 blending factor	
	Base Case
Radionuclide Inventory	HLW
	glass
	Ci/m^3
Am-241	5.01E+00
Am-243	1.60E-03
C-14	0.00E+00
Cm-244	2.68E-03
Cs-135	6.81E-03
Cs-137	1.68E+03
I-129	0.00E+00
Ni-63	1.27E+01
Np-237	3.00E-03
Pu-238	5.15E-02
Pu-239	1.26E+00
Pu-240	3.19E-01
Pu-241	3.57E+00
Ra-226	0.00E+00
Ru-106	1.73E-06
Sm-151	3.00E+01
Sn-126	2.27E-02
Sr-90	2.56E+03
Tc-99	1.54E+00
Th-230	1.86E-09
U-233	5.45E-07
U-234	9.54E-06
U-235	9.54E-04
U-238	2.18E-02
Zr-93	1.86E-01
Total (m3)	2.07E+04
Number of 0.62 m^3 canisters	33386.30179
Number of 0.62 m^3 canisters	33387
Number of 0.62 m^3 can/HMPC	4
Number of HMPCs	8347
Number of trips to the repository @ 40 HMPC/trip	835
Note: Curies from decay daughter products not included	

Ex Situ / In Situ Combination Alternative New Base Case (1/26/96)

20 wt% waste oxide loading, 1.5 blending factor

Radionuclide Inventory	HLW glass Ci/m^3	Sel Ret. Recovery fraction
Am-241	6.97E+00	7.67E-01
Am-243	2.67E-03	9.20E-01
C-14	0.00E+00	9.00E-01
Cm-244	5.04E-03	9.40E-01
Cs-135	1.16E-02	8.50E-01
Cs-137	2.96E+03	8.80E-01
I-129	0.00E+00	9.00E-01
Ni-63	2.03E+01	8.00E-01
Np-237	5.58E-03	9.32E-01
Pu-238	3.97E-02	3.97E-01
Pu-239	1.48E+00	6.27E-01
Pu-240	3.69E-01	6.07E-01
Pu-241	4.01E+00	5.65E-01
Ra-226	0.00E+00	8.30E-01
Ru-106	1.28E-06	3.70E-01
Sm-151	4.32E+01	7.20E-01
Sn-126	3.32E-02	7.30E-01
Sr-90	3.56E+03	7.00E-01
Tc-99	5.15E-01	9.00E-01
Th-230	3.05E-09	8.20E-01
U-233	8.72E-07	8.00E-01
U-234	1.54E-05	8.10E-01
U-235	1.74E-03	9.10E-01
U-238	3.92E-02	9.00E-01
Zr-93	2.49E-01	6.70E-01
Total (m3)	1.03E+04	

Number of 0.62 m^3 canisters	16694	16613
Number of 0.62 m^3 can/HMPC	4	
Number of HMPCs	4174	4154
Number of trips to the repository (4 to HMPC packing)	418	416

Note the combination alt. retrieval fraction is calculated from the % of SST and DST inventory recovered as follows: recovery fraction = (curies recovered from SSTs ÷ Curies from DSTs) divided by (total curies in the SSTs ÷ total curies in DSTs)

The combination alternative volume of HLW glass is 1/2 of the Intermediate Separations

Note: Curies from decay daughter products not included

JACOBS ENGINEERING GROUP INC.

DATE 2/19/96 SUBJECT SHEET NO. 1-3

BY [illegible] CHKD. JOB NO.

Extensive Separations

Proposed DEIS

previous HLW glass - 34% waste oxide loading, 1.0 blend factor

from mass balance info

8.73E+02 MT glass formers

1.32 E+03 MT glass product

proposed HLW glass - 20% waste oxide loading, 1.5 blend factor

from mass balance info

2.11 E+03 MT glass formers

#Canisters = 1570 2.56 E+03 MT glass product

ratio glass formers ratio glass product

$\frac{2.11E+03}{8.73E+02} = 2.42$ $\frac{2.56E+03}{1.32E+03} = 1.94$

previous LAW glass - 25% sodium oxide loading, 1.0 blend factor

from mass balance info

2.65 E+05 MT glass formers

3.86 E+05 MT glass product

proposed LAW glass - 15% sodium oxide loading, 1.25 blend factor

from mass balance info

6.83 E+05 MT glass formers

8.04 E+05 MT glass product

ratio glass formers ratio glass product

$\frac{6.83 E+05}{2.65 E+05} = 2.58$ $\frac{8.04 E+05}{3.86 E+05} = 2.08$

JACOBS ENGINEERING GROUP INC.

DATE 2/19/96 SUBJECT SHEET NO. 2 - 3

BY DLS CHKD. JOB NO.

Since no breakdown of glass formers between HLW & LAW is provided in Ext. Sep. Data Pkg. and since HLW glass formers cost is small compared to LAW glass formers, ratio all glass formers costs from LAW ratio only.

· Δ cost for glass formers

category	previous $ (see attached Ext. Sep. tables) (thousands)	ratio	Δ $ (thou)
B_2O_3	57,500	2.58	$90,850
LiO_2	10,500	2.58	16,590
SiO_2	11,480	2.58	18,138
MgO	2,050	2.58	3,239
CaO	246	2.58	388
Kerosene	10,525	2.08	11,367
Sulfur	62,927	2.08	67,961
DCPD	672	2.08	725
CPD	672	2.08	725
Electricity	498,000	1.8 (same electricity ratio new as prev. used for inter. sep)	398,400
			$608,383

~ same duration of operation as before

Therefore Δ labor = 0

JACOBS ENGINEERING GROUP INC.

DATE 2/19/96 SUBJECT SHEET NO. 3-3

BY DZS CHKD. JOB NO.

△ Other Op. Costs

	$ previous	ratio	$ △ (Thous)
Vaults	190,000	83/38 = 2.18	$224,200
Canisters	4,480	1577/448 = 3.51	11,245
overpacks	6,720	3.51	16,867
			$252,312

△ summary on op. costs

LAW/HLW combined op. costs	$608,383,000
other costs	252,312,000
△ total	$860,695,000
previous op. cost	4,556,000,000
new op. cost	$5,416,695,000

Repository Fee = 1570 CSUX 360K = $565 million

Extensive Separations

Assumptions:								
1. HLW glass waste oxide loading basis to be 20 wt% waste oxides (excluding Na2O and SiO2)								
2. Using the WHC engineering data package material balance calculate the waste oxide loading								
and adjust mass of the glass produced to achieve a 20 wt % waste oxide loading								
not counting the SiO2 or the Na2O								
	Input Stream			LAW			HLW	
	STREAM 1			407	437		1314	1344
	solids	liquids		FRIT	GLASS		FRIT	GLASS
Volume kilo-liters		5.84E+05						
Specific Gravity		1.21E+00						
Cs and Ba, (MCi)	7.60E+00	6.72E+01			6.86E-02			7.46E+01
Sr and Y, (MCi)	1.37E+02	1.41E+00			1.40E-02			1.37E+02
Tc, (MCi)	5.89E-03	2.61E-02			1.53E-04			3.17E-02
Am, (MCi)								
Np, (MCi)								
Pu-239, (MCi)								
Pu-240, (MCi)								
Pu-241,(MCi)								
Total TRU, (MCi)	1.92E-01	1.52E-02			1.20E-03			2.06E-01
Total MCi	1.45E+02	6.87E+01			8.39E-02			2.12E+02
Total Mass Flow (MT)	2.37E+04	7.06E+05		2.65E+05	3.86E+05		8.73E+02	1.32E+03
Total Cr, (MT)								
Total Na, (MT)								
Total Si, (MT)								
Total P, (MT)								
Total NO2-, (MT)								
Total NO3-, (MT)								
AG+	1.38E+00	3.28E-01						
AG2O					4.07E-01			1.43E+00
AL+3	2.37E+03							
AL2O3				1.16E+04	1.93E+04			1.94E+02
AL(OH)4-		4.83E+03						
AM+3	2.77E-02	2.51E-03						
AM2O3					3.41E-05			3.32E-02
APM-								3.44E-03
AS+5	4.98E-01	7.70E-01						
AS2O5					4.33E-01			1.51E+00
B+3	9.94E-01	5.19E-01						
B2O3					4.82E+00		1.22E+02	1.22E+02
BA+2	3.09E+00	7.91E-01						
BAO					8.76E-01			3.46E+00
BE+2	7.61E-03	8.19E-02						
BEO					5.53E-02			1.93E-01
BI+3	1.96E+02	6.76E+01						
BI2O3					2.90E+02			3.45E+00
C14	4.53E-04	7.43E-04						

CA+2	1.33E+02	1.67E+01						
CANCRINITE	2.70E+03							
CAO				3.84E+04	3.86E+04			2.34E+00
CD+2	7.93E+00	2.09E+00						
CDO					1.13E+01			1.26E-01
CE+3	2.35E+02	2.37E+00						
CE2O3					2.75E+02			3.40E+00
CL-	3.49E+00	3.11E+02						
CL2								
CO								
CO2								
CO3-2	2.25E+02	3.37E+03						
CR+3	1.32E+02							
CR2O3					2.67E+02			1.38E+00
CR(OH)4-		1.19E+02						
CS+	9.25E-02	8.19E-01						
CS2O					8.85E-04			9.64E-01
CU+2	7.46E-01	1.77E-01						
CUO					2.57E-01			8.99E-01
CUSO4								
F-	5.97E+01	1.12E+03						
F2								
FE+3	7.63E+02	1.44E+01						
FE2O3					3.74E+03			4.24E+01
H2								
H2O		5.07E+05			2.11E-04			1.10E+00
H2S								
HG								
HG+2	9.00E-03	9.49E-01						
HGO					2.07E+00			
I-	2.02E+01	5.46E+02						
I2								
K+	2.10E+01	2.19E-01						
K2O					2.55E+01			2.34E-02
KEROSENE								
LA+3	2.10E+01	2.19E-01						
LA2O3					2.46E+01			3.04E-01
LI+	2.46E-02	5.77E-03						
LI2O					6.53E-02		1.32E+01	1.32E+01
MG+2	1.10E+01	9.65E-01						
MGO					1.96E+01			2.20E-01
MNO2	2.09E+02	2.17E+01			2.31E+02			1.08E-01
MO+6	8.01E-01	4.87E+00						
MOO3					1.03E+01			9.24E-02
N2								
NA+	3.21E+03	6.26E+04						
NA2O					9.65E+04		2.40E+01	6.59E+01
NH3								
NI+3	6.57E+00	4.07E+00						

NI2FECN6	5.00E+02							
NI2O3					2.62E+02			2.82E+00
NIO					1.06E-03			1.20E+00
NO								
NO2								
NO2-	7.38E+01	9.54E+03						
NO3-	1.03E+03	1.06E+05						
NP+4	1.32E-01	1.46E-02						
NPO2					6.52E-03			1.66E-01
O2								
OH-	6.80E+03	4.64E+03						
PB+4	3.28E+00	1.96E+00						
PBO2					1.35E+00			4.71E+00
PO4-3	2.39E+03	2.58E+03						
P2O5					3.68E+03			3.96E+01
P2O5:24W	5.21E-01							
PU+4	4.27E-01	2.88E-02						
PUO2					5.42E-03			5.11E-01
S								
SI+4	7.90E+01	5.65E+00						
SIO2				2.15E+05	2.16E+05		7.13E+02	7.52E+02
SO2								
SO3					6.22E+03			1.92E-03
SO4-2	3.97E+01	2.01E+03						
SR+2	3.64E+01	3.75E-01						
SRO					4.41E-03			4.33E+01
TCO2								
TCO4-	5.68E-01	2.52E+00						
TC2O7					1.41E-02			2.92E+00
TIO2					3.16E-02			3.51E-04
TOC	1.16E+02	1.42E+03						
UO2+2	1.58E+03	8.52E+01						
UO3								2.77E+00
U3O8					1.08E+00			1.15E-02
V+5	1.88E-01	6.20E-02						
V2O5					9.92E-02			3.47E-01
W+6		7.47E-01						
WO2					1.09E-06			2.26E-04
WO3					2.10E-01			7.33E-01
ZN+2	9.45E-01	3.59E+00						
ZNO					3.17E+01			4.31E-01
ZR+4	2.77E+02	4.48E-01						
ZRO2					6.99E+02			8.55E+00
ZRO2:2H2	4.09E+02	2.15E+01						

Mass LAW waste oxides				121198.787			
LAW waste loading (waste oxides)				31%			
LAW waste loading (sodium oxide)				25%			
Mass HLW waste oxides							3.42E+02
HLW waste loading							26%
HLW							
20 wt. % waste oxide loading							
Blending factor			1	1.25	1.5	2	3.5
Mass of glass required to achieve 20% wo loading, MT			1707.54219	2134.42773	2561.313278	3415.08437	5976.397648
additional frit required (equals increased glass) MT			3.88E+02	8.14E+02	1.24E+03	2.10E+03	4.66E+03
total frit required, MT			1.26E+03	1.69E+03	2.11E+03	2.97E+03	5.53E+03
glass density (MT/m^3)	2.63						
cullet packing fraction	0.7	(LAW only)					
Waste volume (m^3)			6.49E+02	8.12E+02	9.74E+02	1.30E+03	2.27E+03
Canister Volume (m^3)	0.62						
Number of Canisters (1x)			1.05E+03	1.31E+03	1.57E+03	2.09E+03	3.67E+03
Nu. of Canisters /HMPC	4						
Number of HMPCs			2.62E+02	3.27E+02	3.93E+02	5.24E+02	9.16E+02
Number of trips @ 10 HMPCs /trip			26	33	39	52	92
Glass formulation:							
(ref Ext. Sep Data Pkg.)	acceptable range		1	1.25	1.5	2	3.5
SiO2	42 to 57 wt %		62.58%	66.39%	68.94%	72.12%	76.21%
B2O3	5 to 20 wt %		10.32%	11.06%	11.55%	12.16%	12.95%
Na20	5 to 20 wt %		4.48%	4.14%	3.91%	3.62%	3.25%
Li2O	1 to 7 wt %		1.11%	1.19%	1.24%	1.31%	1.39%
Fe2O3	2 to 15 wt %		2.48%	0.00%	0.00%	0.00%	0.00%
CaO	< or= 10 wt %		0.14%	0.11%	0.09%	0.07%	0.04%
MgO	< or = 8 wt %		0.01%	0.01%	0.01%	0.01%	0.00%
Al2O3	< or = 15 wt %		11.36%	9.09%	7.57%	5.68%	3.25%
ZrO2	< or = 13 wt %		0.50%	0.40%	0.33%	0.25%	0.14%
Cr2O3	< or = 0.5 wt %		0.08%	0.06%	0.05%	0.04%	0.02%
P2O5	< or = 3 wt %		2.32%	1.86%	1.55%	1.16%	0.66%
SO3	< or = 0.5 wt %		0.00%	0.00%	0.00%	0.00%	0.00%
HLW Facility Sizing							
Schedule	14 yrs						
Capacity MT/day	1						
Overall efficiency, %			33%	42%	50%	67%	117%
Required capacity MT/day (assuming 14 yrs ops, 60% OE)			0.56	0.70	0.84	1.11	1.95
Required operating duration yrs (assuming 1 MT/day, 60% OE)				9.75	11.70	15.59	27.29

15 wt % waste oxide loading							
Mass of glass required to achieve 15% wo loading MT			2.28E+03	2.85E+03	3.42E+03	4.55E+03	7.97E+03
Volume (m^3)			8.66E+02	1.08E+03	1.30E+03	1.73E+03	3.03E+03
Number of Canisters (1x)			1.40E+03	1.75E+03	2.09E+03	2.79E+03	4.89E+03
40 wt % waste oxide loading							
Mass of glass required to achieve 40% wo loading MT			8.54E+02	1.07E+03	1.28E+03	1.71E+03	2.99E+03
Volume (m^3)			3.25E+02	4.06E+02	4.87E+02	6.49E+02	1.14E+03
Number of Canisters (1x)			5.24E+02	6.54E+02	7.85E+02	1.05E+03	1.83E+03

LAW							
15 wt. % sodium oxide loading							
Blending factor			1	1.25	1.5	2	3.5
Mass of glass required to achieve 15% wo loading, MT			6.43E+05	8.04E+05	9.65E+05	1.29E+06	2.25E+06
additional frit required (equals increased glass) MT			2.57E+05	4.18E+05	5.79E+05	9.01E+05	1.87E+06
total frit required, MT			5.22E+05	6.83E+05	8.44E+05	1.17E+06	2.13E+06
glass density (MT/m^3)	2.63						
cullet packing fraction	0.7						
Waste volume (m^3)			3.49E+05	4.37E+05	5.24E+05	6.99E+05	1.22E+06
Number of 5300 m^3 vaults			66	82	99	132	231
LAW facility sizing							
Schedule, years	19						
Capacity MT/day	200						
Overall efficiency, %			46%	58%	70%	93%	162%
Required capacity MT/day (assuming 19 yrs ops, 60% OE)			154.61	193.26	231.92	309.22	541.14
Required operating duration yrs (assuming 200 MT/day, 60%			14.69	18.36	22.03	29.38	51.41
10 wt. % sodium oxide loading							
Blending factor			1	1.25	1.5	2	3.5
Mass of glass required to achieve 10			9.65E+05	1.21E+06	1.45E+06	1.93E+06	3.38E+06
Waste volume, m^3			5.24E+05	6.55E+05	7.86E+05	1.05E+06	1.83E+06
Number of 5,300 m^3 vaults			99	124	148	198	346
25 wt. % sodium oxide loading							
Blending factor			1	1.25	1.5	2	3.5
Mass of glass required to achive 25 wt % Na2O			3.86E+05	4.83E+05	5.79E+05	7.72E+05	1.35E+06
Waste Volume			2.10E+05	2.62E+05	3.15E+05	4.19E+05	7.34E+05
Number of 5,300 m^3 vaults			40	49	59	79	138

Extensive 54-
Separations

Table F-8. Backup to Table 9-16. Process Modules: Overall Cost.

	Construction	Operating Labor	Operating Equipment	Materials and Supplies			LLW Vaults	HLW Canisters	R&D	Repository Fee	Total
				Start-up[1]	D&D[2]	Operation					
Radionuclide removal	$2,778	$1,159	$126	$92	$728	$569			$282		$5,733
Central facilities	$638										$638
LLW vitrification	$749	$308	$224	$24	$193	$151			$268		$1917
LLW disposal		$14	$14	$1	$9	$7	$190		$14		$248
HLW vitrification	$672	$320	$28	$25	$201	$157			$282		$1,685
HLW transportation		$3		$0	$2	$1					$6
HLW disposal								$11		$491	$502
Total	$4,837	$1,803	$392	$143	$1,132	$885	$190	$11	$846	$491	$10,730

Note:

D&D = decontamination and decommissioning
HLW = high-level waste
LLW = low-level waste
R&D = Research and Development

[1]Start-up and operation materials and supplies are allocated based on operation labor.

[2]Decontamination and decommissioning materials and supplies are allocated based on construction cost.

Table F-9. Backup to Table 9-18. Capital Costs (1995 Dollars).

Components	Extensive Pretreatment Facility	Centralized Facilities	LLW Vitrification Facility[1]	HLW Vitrification Facility[2]	Total All Facilities
Labor	1,210,606,000	318,524,000	2,678,586,000	272,903,000	2,778,350,000
Materials and supplies	479,276,000	202,194,000	98,837,000	147,518,000	748,665,000
Equipment	1,088,477,000	117,735,000	381,972,000	251,358,000	671,779,000
Total	2,778,359,000	638,453,000	748,665,0000	671,779,000	4,837,256,000

Notes:

HLW = high-level waste
LLW = low-level waste

[1]Low-level waste vitrification (low source), Option 2A.

[2]High-level waste vitrification facility is combined with extensive pretreatment.

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Table F-10a. Backup to Table 9-19. Operating Cost Component (Millions of 1995 Dollars) Extensive Pretreatment, Annual Consumables for Extensive Pretreatment with High-level Vitrification Detached Low-Level Waste Vitrification--Option 2A. (2 sheets).

Utility/Chemical description	Unit Cost ($/each)	Quantity Units	Cost
Glass Former			
B^2O^3	$1,000	57,500	$57,500,000
Fe^2O^3	$500	14	$7,000
LiO^2	$5,000	2,100	$10,500,00
SiO^2	$40	287,000	$11,480,000
MgO	$500	4,100	$2,050,000
CaO	$60	4,100	$246,000
Nitric acid 50 percent (Mg)	$160	465,000	$74,400,000
NaOH, 505 (Mg)	$250	150,000	$37,500,000
Flocculant (Mg)	$1,100	150	$165,000
Glycolic acid, 50 percent (Mg)	$1,740	7,700	$13,398,000
Oxalic acid (Mg)	$860	11,900	$10,234,000
Ammonia (Mg)	$350	9,240	$3,234,000
Ion exchange media (m^3)	$10,600	4,910	$52,046,000
FeSA (Mg)	$660	4,720	$3,115,200
Aluminum nitrate (Mg)	$460	112	$51,520
CMPO (Mg)	$6,530	5	$32,650
TBP (Mg)	$6,530	755	$4,930,150
NPH (Mg)	$440	703	$309,320
Sodium Carbonate (Mg)	$170	180	$30,600
Crown ether (Mg)	$6,530	284	$1,854,520
Formic acid, 96 percent (Mg)	$1,210	1,470	$1,778,700
HF (Mg)	$500	740	$370,000
Sodium oxalate (Mg)	$500	20,900	$10,450,000
Sodium bicarbonate (Mg)	$500	12,500	$6,250,000
Zinc nitrate (Mg)	$500	47	$23,500
Na^3 DTPA (Mg)	$500	196	$98,000
APM (Mg)	$500	10	$5,000
Hydroxylamine nitrate (Mg)	$500	95	$47,500
DCPD (Mg)	$150	4,480	$672,000
CPD (Mg)	$150	4,480	$672,000

Table F-10a. Backup to Table 9-19. Operating Cost Component (Millions of 1995 Dollars) Extensive Pretreatment, Annual Consumables for Extensive Pretreatment with High-level Vitrification Detached Low-Level Waste Vitrification--Option 2A. (2 sheets).

Utility/Chemical description	Unit Cost ($/each)	Quantity Units	Cost
Decontamination chemicals (Mg)	$401	14,000	$5,614,000
Sulfur (Mg)	$370	170,100	$62,937,000
Grout powders (Mg)	$100	0	$0
Kerosene (Mg)	$150	70,170	$10,525,500
Raw water (m^3)	$0.03	30,000,000	$900,000
Sanitary water (m^3)	$0.03	1,100,000	$33,000
Electricity (MWh)	$30	16,600,000	$498,000,000
Subtotal			$881,460,160
Solid waste (m^3)	$1,000	4,000	$4,000,000
Equipment (per year x 14 years)	$28,000,000	14	$392,000,000
Vaults	$5,000,000	38	$190,000,000
Canisters	$10,000	448	$4,480,000
Containers	$25,000	0	$0
Overpacks	$60,000	112	$6,720,000
Subtotal			$597,200,00
Total			$1,478,660,160
Total minus equipment			$1,086,660,160
Start-up costs (materials)			$143,000,000
Decontamination and decommmissioning (material)			$1,132,000,000
Total			$2,753,660,160
Total minus equipment			$2,361,660,160

Notes:

HLW = high-level waste
LLW = low-level waste
m^3 = cubic meters
Mg = megagrams

Annual equipment purchase estimated by K. D. Boomer.

Pretreatment	=	$ 9 million per year (size increase)
HLW vitrification	=	$ 2 million per year (melter)
LLW vitrification	=	$ 16 million per year (melter)
Sub-total	=	$ 27 mm per year
Miscellaneous	=	$ 1 million per year
Total	=	$28 million per year

Table F-10B. Backup to Table 9-19. Operating Cost Component (Millions of 1995 Dollars).

Staffing Category	Years	Staff Per Year	Total Staff Years	Total Staff Hours
Extensive separations	15	620	9,300	1.7E+07
LLW vitrification	15	160	2,400	4.3E+06
HLW vitrification	15	160	2,400	4.3E+06
Indirect staffing	19	29	551	1.0E+06
Pretreatment start-up	1.5	626	939	1.7E+06
LLW vitrification start-up	1.5	157	236	4.3E+05
HLW start-up	1.5	157	236	4.3E+05
Pretreatment decontamination and decommissioning	2	626	1,252	2.3E+06
LLW vitrification decontamination and decommissioning	2	157	314	5.7E+05
HLW decontamination and decommissioning	2	157	314	5.7E+05
HLW monitoring and maintenance	12	10	120	2.2E+05
HLW transportation	–	30	30	5.4E+04
Total				3.3E+07

Notes:

HLW = high-level waste
LLW = low-level waste

All staff hours are based on a staff-year of 1,812 hours.

EXTENSIVE SEPARATIONS PRETREATMENT ALTERNATIVE ENGINEERING DATA PACKAGE FOR THE TANK WASTE REMEDIATION SYSTEM ENVIRONMENTAL IMPACT STATEMENT

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ABSTRACT

In accordance with the National Environmental Policy Act of 1969, an environmental impact statement is required for disposal of the radioactive waste stored in 177 underground storage tanks at the Hanford Site.

This document is the engineering data package for the Extensive Separations Pretreatment alternative. It includes waste treatment operations that would take place between waste retrieval and transfer and closure of single-shell tanks and double-shell tanks. The purpose of this alternative would be to process the tank wastes and to reduce the amount of high-level waste to less than 625 cubic meters (equivalent to 1,000 glass canisters measuring 0.61 meters [m] diameter by 3.05 m long at 0.62 cubic meters each) and to reduce the curie

Table 9-16. Process Module: Overall Cost (Millions of 1995 Dollars).

Process Module	Extensive Separation Alternative
Radionuclide removal	$6,098
Low-level waste vitrification	1,917
Low-level waste disposal	248
High-level waste vitrification	1,685
High-level waste transportation[1]	7
High-level waste disposal	3,404
Centralized facilities	638
Total	$13,997

Note:

[1]Cost for high-level waste transportation and disposal are based upon 1000 canisters in 250 multi-purpose canisters.

[2]These cost results apply to the integrated combination of HLW Option 1 and LLW Option A (Option 1A). This combination of cesium and strontium capsule overpacking and LLW glass is the same combination of options as that assumed in the Tri-Party Agreement preferred alternative.

For additional information, see Appendix F, and also Jansen, G., 1995, *Backup Information for Data Tables in Extensive Separations Alternative Engineering Data Package*, WHC-SD-WM-DP-129, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Table 9-17. Overall Cost Component (Millions of 1995 Dollars). (2 sheets)

Cost Component	Extensive Separation Alternative
Capital	$5,202[1]
Operating	4,556[2]
Research and development	846[3]
Repository fee	3,393[4]
Total	$13,997

Notes:

[1]Total capital cost includes 40 percent contingency. Contingency is excluded from other costs. Also see Table 9-18 for additional explanation.

[2]Includes start-up, decontamination and decommissioning, and monitoring and maintenance costs for process facilities. Does not include costs associated with routine tank farm operations (estimated at $4,340 million in 1995 dollars). Also does not include costs associated with TWRS program management characterization, tank farm upgrades, single-shell tank saltwell pumping, and tank farm safety.

[3]Based on *Tank Waste Remediation System Integrated Technology Plan* WHC 1994), June 10, 1994 draft. The Research and Development costs depicted above are estimates based upon the pro ratio of capital costs with the Tri-Party Agreement Alternative.

[4]Table D-8, TRW 1995, estimates the repository fee for the Extensive Separations Alternative (Case 3-5SC) would be $679 million lower than the estimated repository fee for Case 1C, using the TRW Total-System Life Cycle Cost (TSLCC) model developed for the Office of Civilian Radioactive Waste Management. Per informal communications with Mr. don Nitti of TRW on 5/31/95 and 7/13/95, Hanford's repository fee for Case 1C is estimated as follows:

Two repository case total life cycle cost	=	$48.294 billion
Defense program share	=	15.7%
Hanford's share based on ratio of number of Hanford waste packages (2,465) to total defense program waste packages (4,588), from Table 2-4 of TRW 1995	=	53.7%
Hanford's share of Case 1C: ($48.294 billion x 0.157 x 0.537)	=	$4.072 billion

per p.9-33, this case requires 1000 canisters or 250 MPC (4 canisters per MPC) or 250 waste packages

but those canisters, per TRW report are 68 x 457 cm ∫ 1.26 m³

4.072 - .679 = $3.393 billion

Table 9-17. Overall Cost Component (Millions of 1995 Dollars). (2 sheets)

Notes: Continued

TRW, 1995, *Assessment of Pre-Closure System Cost and Health and Safety Impacts of Hanford High-Level Waste Vitrification Options on the Civilian Radioactive Waste Management System A00000000-01717-5707-00003*, Rev. 0, TRW Environmental Safety Systems, Inc., Vienna, Virginia.

WHC, 1994, *Tank Waste Remediation System Multi-Year Program Plan*, WHC-SP-1101, Westinghouse Hanford Company, Richland, Washington.

For additional information, see Appendix F, and also Jansen, G., 1995, *Backup Information for Data Tables in Extensive Separations Alternative Engineering Data Package*, WHC-SD-WM-DP-129, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Table 9-18. Capital Cost Component (Millions of 1995 Dollars)[2].

Capital Cost Component	Extensive Separation Alternative
Labor	$2,225
Materials and supplies	998
Equipment	1,682
Local purchases[1]	297
Total	$5,202

Notes:

[1]Local purchases - 15 percent of materials and supplies are assumed to be local purchases.

[2]Costs in this table reflect Option 1A as described in Section 2.0. This includes construction of the detached LLW vitrification facility and vaults. However, it does not include filling of the vaults with LLW glass/SPC. These costs are included in Table 9-19. Section 9.1 and Table 9-26 provide additional capital costs for Option 2A for the Cs/Sr cut-up cell. Section 9.2 and Table 9-27 provide the adjustments necessary to reflect capital costs for Option 2B, as described in Section 2.0. Costs of filling the grout tubes in Option 2B is covered in Table 9-19. Costs in this table also include a rough order of magnitude estimate of 365 million dollars for caustic recycling and thermal denitration. These process steps were not included in the original flowsheet upon which the detailed cost estimate for the balance of the facility was based (see Section 4.8.1).

For additional information, see Appendix F, and also Jansen, G., 1995, *Backup Information for Data Tables in Extensive Separations Alternative Engineering Data Package*, WHC-SD-WM-DP-129, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Table 9-19. Operating Cost Component (Millions of 1995 Dollars)[1].

Operating Cost Component	Extensive Separation Alternative
Labor	$1,803
Materials and supplies[2]	$2,007
Equipment[2]	$333
Local purchases[2]	$413
Total	$4,556

Notes:

[1]Includes filling of low-level waste vaults for vitrified LLW (Option 1A) as well as start-up, decontamination and decommissioning, and monitoring and maintenance costs. For grouted LLW (Option 2B), operating costs would be higher (see Section 9.2 and Tables 9-27 and 9-28).

[2]Local purchases are based on 15 percent of materials and supplies and equipment.

For additional information, see Appendix F, and also Jansen, G., 1995, *Backup Information for Data Tables in Extensive Separations Alternative Engineering Data Package*, WHC-SD-WM-DP-129, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Table 9-20. Overall Schedule[5].

Activity	Extensive Separation Alternative
Construction	12/97 - 12/2006[1]
Operation	1/2004 - 9/2019[2]
Decontamination and decommissioning	10/2019 - 10/2024[3]
Monitoring and maintenance	3/2019 - 9/2029[4]
Research and development	1995 - 2018

Notes:

[1]See the *Tank Waste Remediation System Facility Configuration Study* (Boomer et al. 1994), pages 63 and 114.

[2]See Boomer et al. 1994, pages 33, 63, and 114.

[3]Five years of decontamination and decommissioning assumed after completion of all processing and vitrification.

[4]Based upon 1,000 canisters, 250 multi-purpose canisters; shipments to repository beginning in 2020 and ending in 2029 per canister pickup schedule in Table D-6, Case 3-5 SC, TRW 1995. (See Table 9-7 for related information.)

[5]The assumed construction schedule and the 14 year facility operations schedule are highly optimistic for the extensive separations alternative. There is considerably higher technical risk for extensive separations than for the other TWRS-EIS alternatives evaluated. Consequently, there is higher schedule risk associated with this alternative than with the other alternatives.

Boomer, K. D., J. M. Colby, T. W. Crawford, J. S. Garfield, C. E. Golberg, C. E. Leach, D. E. Mitchell, F. D. Nankani, E. J. Slaathaug, L. M. Swanson, T. L. Waldo, and C. M. Winkler, 1994, *Tank Waste Remediation System Facility Configuration Study*, WHC-SD-WM-ES-295, Westinghouse Hanford Company, Richland, Washington. See Appendix F also.

TRW, 1995, *Assessment of Pre-Closure System Cost and Health and Safety Impacts of Hanford High-Level Waste Vitrification Options on the Civilian Radioactive Waste Management System A00000000-01717-5707-00003*, Rev. 0, TRW Environmental Safety Systems, Inc., Vienna, Virginia..

For additional information, see Appendix F, and also Jansen, G., 1995, *Backup Information for Data Tables in Extensive Separations Alternative Engineering Data Package*, WHC-SD-WM-DP-129, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Table F-8. Backup to Table 9-16. Process Modules: Overall Cost.

[illegible]	[illegible] Construction	[illegible] Operating Labor	[illegible] Operating Maintenance	Materials and Supplies			[illegible]	[illegible]	[illegible] R&D	[illegible] Repository	[illegible] Total
				Start-up[1]	D&D[2]	Operation[1]					
Radionuclide removal	$2,778	$1,159	$126	$92	$728	$569			$282		$5,733
Central facilities	$638										$638
LLW vitrification	$749	$308	$224	$24	$193	$151			$268		$1917
LLW disposal		$14	$14	$1	$9	$7	$190		$14		$248
HLW vitrification	$672	$320	$28	$25	$201	$157			$282		$1,685
HLW transportation		$3		$0	$2	$1					$6
HLW disposal								$11		$491	$502
Total	$4,837	$1,803	$392	$143	$1,132	$885	$190	$11	$846	$491	$10,730

Note:

D&D = decontamination and decommissioning
HLW = high-level waste
LLW = low-level waste
R&D = Research and Development

[1]Start-up and operation materials and supplies are allocated based on operation labor.

[2]Decontamination and decommissioning materials and supplies are allocated based on construction cost.

Table F-9. Backup to Table 9-18. Capital Costs (1995 Dollars).

Cost Components	Extensive Pretreatment Facility	Centralized Facility	LLW Vitrification Facility	HLW Vitrification Facility	Total All Facilities
Labor	1,210,606,000	318,524,000	2,678,586,000	272,903,000	2,778,350,000
Materials and supplies	479,276,000	202,194,000	98,837,000	147,518,000	748,665,000
Equipment	1,088,477,000	117,735,000	381,972,000	251,358,000	671,779,000
Total	2,778,359,000	638,453,000	748,665,0000	671,779,000	4,837,256,000

Notes:

HLW = high-level waste
LLW = low-level waste

[1]Low-level waste vitrification (low source), Option 2A.

[2]High-level waste vitrification facility is combined with extensive pretreatment.

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Table F-10a. Backup to Table 9-19. Operating Cost Component (Millions of 1995 Dollars; Extensive Pretreatment, Annual Consumables for Extensive Pretreatment with High-level Vitrification Detached Low-Level Waste Vitrification—Option 2A. (2 sheets).

Utility/Chemical description	Unit Cost ($/each)	Quantity Units	Cost
Glass Former			
B^2O^3	$1,000	57,500	$57,500,000
Fe^2O^3	$500	14	$7,000
LiO^2	$5,000	2,100	$10,500,00
SiO^2	$40	287,000	$11,480,000
MgO	$500	4,100	$2,050,000
CaO	$60	4,100	$246,000
Nitric acid 50 percent (Mg)	$160	465,000	$74,400,000
NaOH, 505 (Mg)	$250	150,000	$37,500,000
Flocculant (Mg)	$1,100	150	$165,000
Glycolic acid, 50 percent (Mg)	$1,740	7,700	$13,398,000
Oxalic acid (Mg)	$860	11,900	$10,234,000
Ammonia (Mg)	$350	9,240	$3,234,000
Ion exchange media (m^3)	$10,600	4,910	$52,046,000
FeSA (Mg)	$660	4,720	$3,115,200
Aluminum nitrate (Mg)	$460	112	$51,520
CMPO (Mg)	$6,530	5	$32,650
TBP (Mg)	$6,530	755	$4,930,150
NPH (Mg)	$440	703	$309,320
Sodium Carbonate (Mg)	$170	180	$30,600
Crown ether (Mg)	$6,530	284	$1,854,520
Formic acid, 96 percent (Mg)	$1,210	1,470	$1,778,700
HF (Mg)	$500	740	$370,000
Sodium oxalate (Mg)	$500	20,900	$10,450,000
Sodium bicarbonate (Mg)	$500	12,500	$6,250,000
Zinc nitrate (Mg)	$500	47	$23,500
Na^3 DTPA (Mg)	$500	196	$98,000
APM (Mg)	$500	10	$5,000
Hydroxylamine nitrate (Mg)	$500	95	$47,500
DCPD (Mg)	$150	4,480	$672,000
CPD (Mg)	$150	4,480	$672,000

Table F-10a. Backup to Table 9-19. Operating Cost Component (Millions of 1995 Dollars) Extensive Pretreatment, Annual Consumables for Extensive Pretreatment with High-level Vitrification Detached Low-Level Waste Vitrification—Option 2A. (2 sheets).

Utility/Chemical description	Unit Cost ($/each)	Quantity Units	Cost
Decontamination chemicals (Mg)	$401	14,000	$5,614,000
Sulfur (Mg)	$370	170,100	$62,937,000
Grout powders (Mg)	$100	0	$0
Kerosene (Mg)	$150	70,170	$10,525,500
Raw water (m^3)	$0.03	30,000,000	$900,000
Sanitary water (m^3)	$0.03	1,100,000	$33,000
Electricity (MWh)	$30	16,600,000	$498,000,000
Subtotal			$881,460,160
Solid waste (m^3)	$1,000	4,000	$4,000,000
Equipment (per year x 14 years)	$28,000,000	14	$392,000,000
Vaults	$5,000,000	38	$190,000,000
Canisters	$10,000	448	$4,480,000
Containers	$25,000	0	$0
Overpacks	$60,000	112	$6,720,000
Subtotal			$597,200,00
Total			$1,478,660,160
Total minus equipment			$1,086,660,160
Start-up costs (materials)			$143,000,000
Decontamination and decommmissioning (material)			$1,132,000,000
Total			$2,753,660,160
Total minus equipment			$2,361,660,160

Notes:

HLW = high-level waste
LLW = low-level waste
m^3 = cubic meters
Mg = megagrams

Annual equipment purchase estimated by K. D. Boomer.

Pretreatment	=	$ 9 million per year (size increase)
HLW vitrification	=	$ 2 million per year (melter)
LLW vitrification	=	$ 16 million per year (melter)
Sub-total	=	$ 27 mm per year
Miscellaneous	=	$ 1 million per year
Total	=	$28 million per year

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Table F-10B. Backup to Table 9-19. Operating Cost Component (Millions of 1995 Dollars).

Staffing Category	Years	Staff Per Year	Total Staff Years	Total Staff Hours
Extensive separations	15	620	9,300	1.7E+07
LLW vitrification	15	160	2,400	4.3E+06
HLW vitrification	15	160	2,400	4.3E+06
Indirect staffing	19	29	551	1.0E+06
Pretreatment start-up	1.5	626	939	1.7E+06
LLW vitrification start-up	1.5	157	236	4.3E+05
HLW start-up	1.5	157	236	4.3E+05
Pretreatment decontamination and decommissioning	2	626	1,252	2.3E+06
LLW vitrification decontamination and decommissioning	2	157	314	5.7E+05
HLW decontamination and decommissioning	2	157	314	5.7E+05
HLW monitoring and maintenance	12	10	120	2.2E+05
HLW transportation	–	30	30	5.4E+04
Total				3.3E+07

Notes:

HLW = high-level waste
LLW = low-level waste

All staff hours are based on a staff-year of 1,812 hours.

Table F-10C. Backup to Table 9-19. Operating Cost Component (Millions of 1995 Dollars).

Operation Mode	Exempt	Nonexempt	Bargaining Unit	Total	Cost Per Year
Pretreatment	202	40	378	620	$63
LLW vitrification	52	10	98	160	$16
HLW vitrification	52	10	98	160	$16
Total	306	60	574	940	$95

Notes:

HLW = high-level waste
LLW = low-level waste

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Table F-10D. Backup to Table 9-19. Operating Cost Component (Millions of 1995 Dollars).

Staffing Category	Total cost
Extensive separations	$940
LLW vitrification	$243
HLW vitrification	$243
Indirect staffing[1]	$33
Pretreatment start-up[2]	$94
LLW vitrification start-up[2]	$24
HLW start-up[2]	$24
Pretreatment decontamination and decommissioning[3]	$125
LLW vitrification decontamination and decommissioning[3]	$32
HLW decontamination and decommissioning	$32
HLW monitoring and maintenance[3, 4]	$8
HLW transportation[5]	$3
Total	$1,803

Notes:

[1]For indirect staffing, it was assumed that all workers would be nonexempt.

[2]The total start-up cost for each facility is arbitrarily set to the annual staffing requirements. These start-up requirements have been set to 1 1/2 years of the annual. This leaves 1 1/2 years of staff cost ($95 million + $24 million + $24 million = $143 million) for start-up materials and supplies.

($63 million x 1.5 yrs = $95 million) ($16 million x 1.5 yrs = $24 million) ($16 million x 1.5 yrs = $24 million).

[3]Decontamination and decommissioning for each facility is arbitrarily set equal to three years of staff cost plus thirty percent of the total capital cost minus the contingency. The staffing requirements have been set to two years of the annual. This leaves one year of staff cost ($63 million + $16 million + $16 million = $95 million) plus thirty percent of the capital for material and supplies.

The total capital is equal to the capital plus a forty percent contingency; therefore, the capital value to be used for the decontamination and decommissioning cost for materials and supplies is equal to:
Capital $4,837 million per 140 percent = $3,455 million

The cost based upon the capital would be as follows: capital decontamination and decommissioning = $3,455 million x 30 percent = $1,037 million. Thus, the total decontamination and decommissioning cost for materials and supplies is set to $1,132 million.

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Table F-10D. Backup to Table 9-19. Operating Cost Component (Millions of 1995 Dollars).

Notes (continued):

[f]For monitoring and maintenance, the following was assumed: exempt would be 10 percent, bargaining unit 10 percent, and nonexempt 80 percent.

[g]For HLW transportation, the following was assumed: exempt would be 36 percent, bargaining unit 36 percent, and nonexempt 28 percent.

All exempt and bargaining unit employees are assumed to be radiation workers. All nonexempt employees are nonradiation workers.

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Table F-11. Backup to Table 9-20. Overall Schedule.

Construction			
Option	Start	Finish	Facility Configuration Study
Pretreatment + HLW vitrification Standalone LLW vitrification Overall	July 2001 December 1997 December 1997	December 2006 July 2005 December 2006	page 114 page 63
Operation			
Pretreatment HLW vitrification LLW vitrification Overall	January 2004 March 2005 September 2005 January 2004	January 2018 March 2019 September 2019 September 2019	pages 114, 33 pages 114, 33 pages 63, 33
Decontamination and decommissioning for all facilities is assumed to start after the completion of process duration, that is, 5 years.			
	October 2019	October 2024	
Monitoring and maintenance is for HLW canisters. Monitoring and maintenance is assumed to start with the completion of HLW vitrification. Monitoring and maintenance is assumed to finish when the last multi-purpose canisters is shipped to the repository. Shipments to the repository start in 2035[1]. Based on discussions with K. D. Boomer, 1,000 canisters are assumed, 250 multi-purpose canisters. 10 multi-purpose canisters would be transported per week (Slaathaug 1995, Table 9-7, footnote 5). Duration of shipments = 250 multi-purpose canisters/10 = 25 weeks.			
	March 2019	September 2035	[1]page 151
Research and Development			
	1995	2018	

Notes:

HLW = high-level waste
LLW = low-level waste

JACOBS ENGINEERING GROUP INC.

DATE 2/19/96 SUBJECT SHEET NO. 1-1

BY DLS CHKD. JOB NO.

In Situ / Ex Situ Combination

Proposed DEIS

50% of Intermediate Separations Case is processed Ex Situ in this alternative, therefore ½ the canisters, containers, casks, vaults, etc and ½ the extra operating costs.

Intermediate Separations total op. cost Δ = $1,608,635,000
× ½
$804,318,000

previous exsitu/insitu base op. cost $1,834,000,000

New Treatment Op. Costs $2,638,318,000

Repository fees calculated for ½ the Inter. Sep. Case or $\frac{33386}{2}$ = 16,693 canisters per graph yields

$5.0 billion

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	Onsite Disposal Volume (m^3)	Offsite Disposal Volume (m^3)
Inter. Sep	438,000	20,700
No Sep. Vit.	0	364,000
No Sep. Calc.	0	96,000
Ext. Sep	437,000	974
Ex Site/In Site Combo.	324,600	10,350
Phased Imple	438,000	20,700

105,600 m^3 In Site
219,000 m^3 Ex Site ($\frac{1}{2}$ Inter Sep)
324,600 m^3 total

above per C. Henderson
new mass balance table
for proposed DEIS

Repository Fee = 360K/CON X 16,700 = $6.012 billion

Ex Situ alternative comparison

	Waste Loading weight %	Blending Factor	Canister Count (HLW) or, Number of LAW Vaults	Canister Size Vault Size (m^3)	Overall Processing Plant Efficiency	Duration of Operations (years)	Trips to Repository 10 rail cars/train 2 can/HMPC	Trips to Repository 10 rail cars/train 4 can/HMPC
No Separations (soda-lime)								
WHC Data Pkg.	30%	1	21400	9.32 actual (6.52 [illegible]) 10	36%	14	2140	
Proposed DEIS	20%	1.5	587426	0.62	60%	15	29371	14686
Intermediate Separations								
HLW								
WHC Data Pkg.	45%	1	(1705 4 pkg) 6800	1.26	25%	14	340	170
Proposed DEIS	20%	1.5	33386	0.62	60%	12	1669	835
LAW								
WHC Data Pkg	25%	1	40	5300	36%	14		
Proposed DEIS	15%	1.25	83	5300	60%	19		
Extensive Separations								
HLW (borosilicate)								
WHC Data Pkg.	34%	1	448 502	0.62	26%	14	25	13
Proposed DEIS	20%	1.5	1571	0.62	50%	14	79	39
LAW (borosilicate)								
WHC Data Pkg.	25%	1	38 40	5300	36%	19		
Proposed DEIS	15%	1.25	83	5300	60%	19		

calc. 10,300 @ 10 m³ Phased 26

166,129 @ 0.62m³

phased impl ~ same as inter. sep. or 33,386 canisters

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TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE ENGINEERING - COST ESTIMATE - PROPOSED DRAFT EIS (Rev C) PHASED IMPLEMENTATION

ORIGINATOR D. STEIN DATE 2/27/96

REVISION NO. 2

OBJECTIVE ESTIMATE COSTS FOR PHASED IMPLEMENTATION BASED ON PROPOSED DRAFT EIS BASIS

METHODOLOGY COMPARE PLANT SIZES TO TPA + EXT. SEP. AND FACTOR AND USE ENGR. JUDGEMENT

ASSUMPTIONS "Six-Tenths" factor rule for estimating plant costs is applicable

(Continue on another sheet if necessary)

SIGNATURE

CALCULATION & RESULTS ATTACHED

JACOBSFORMS\CALCVR.SHT

Cost Estimate for Phase 1 (Phased Implementation)

Assumptions:

R+D Costs

Assumed to be "zero" as a separate line item as phase 1 is itself an R+D program.

Repository Fee

Assumed to be "zero" as HLW will be stored on-site in canisters for future disposal by others. Fee not included here.

Capital Cost

To be estimated from TPA report where applicable using the "six tenths factor" rule.

$$\text{Cost of plant A} = \text{Cost of plant B}\left(\frac{\text{Capacity A}}{\text{Capacity B}}\right)^{0.6}$$

Operating Cost

To be estimated from TPA report by factoring and using staffing estimate comparisons

Closure Cost

To be factored from TPA based on capital cost ratio.

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DATE 12/7/95 SUBJECT SHEET NO. 2-15

BY DLS CHKD. JOB NO.

Information and data available

Both Extensive Retrieval (Ex Situ) which is based on The TPA report and Extensive Separations utilize 200 MT/D pretreatment and LLW vitrification plants TPA utilizes a 20 MT/D HLW vitrification plant and Ex. Sep. a 1 MT/D HLW vit. plant.

The pretreatment plants are significantly different in radionuclide separations with phased in plementation assumed to be somewhere in between them.

Capital Costs

Since emissions, staffing resources, etc. have already been estimated based on TPA info factoring capital costs will, where possible, also be based on TPA plants.

Table 9-16 backup (Table E-36), which is attached, will be used as it contains cost for TPA in various categories.

* The 200 T/D plants (LLW vit., centralized facilities & pretreatment) are assumed to be two identical 100 T/D trains. Then the cost of each 100 T/D train is assumed to be 1/2 the cost of the total 200 T/D plant. The cost of the 100 T/D plant

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BY DLS CHKD. JOB NO.

will be used to estimate the cost of the 20 TPD plant using the six tenths factor rule.

* The pretreatment plant will be assumed to be roughly 1/3 between Intermediate Sep. (TRA) and Ext. Sep. (closed to Inter. Sep) and will cost 1/3 between the two.

20 MT/D LLW vitrification plant

$C_{200} = \$1300$ million with $C_{100} = \frac{1}{2} C_{200}$

Then, $C_{100} = \$650$ million

Then, $C_{20} = \frac{C_{100}}{\left(\frac{100}{20}\right)^{0.6}} = \frac{650}{(5)^{0.6}} = \frac{650}{2.62}$

$C_{20} = \$248$ million

20 MT/D Centralized Facilities plant

$C_{200} = 520$ million with $C_{100} = \frac{1}{2} C_{200}$

Then, $C_{100} = \$260$ million

Then, $C_{20} = \frac{C_{100}}{\left(\frac{100}{20}\right)^{0.6}} = \frac{260}{2.62}$

$C_{20} = \$99$ million

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1 MT/D HLW vitrification plant

C_{20} = \$1400 million

$$C_1 = \frac{1400}{\left(\frac{20}{1}\right)^{0.6}} = \frac{1400}{6.03}$$

C_1 = \$232 million

20 MT/D Pretreatment plant

Assume separations to be 1/3 of the way between intermediate sep. & extensive sep.

Info available from Table B10 Cost Summary shows Ext. Ret (Ex Situ) capital at \$5880 million and Ext. Sep capital at \$7482 million. If capital for different sized HLW vit. plants is deducted then the difference should be a measure of difference in pretreat costs

5880 − 1400 = \$4480 million
total — HLW vit 20 T/D — Ext Ret (Ex Situ) or Inter Sep

vs.

7482 − 232 = \$7250 million
total — HLW vit 1 T/D estimated — Ext. Sep

Then, 7250 − 4480 = 2770 million more for Ext. Sep pretreat than the 380 million for Inter. Sep. pretreat. If we assume each alternative to have the same Cesium portion, then Ext. Sep. total pretreat is estimated to cost 2770 + 380 = 3150

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AT 1/3 between Inter. Sep + EXT. Sep, phase 1 pretreat 200 T/D plant is estimated to cost:

$$C_{200} = \left(2770 \times \frac{1}{3}\right) + 380 = \$1303 \text{ million}$$

Then $C_{100} = \frac{1}{2} C_{200} = \$652$ million

Then, $C_{20} = \frac{C_{100}}{\left(\frac{100}{20}\right)^{0.6}} = \frac{652}{2.62}$

$C_{20} = \$249$ million

Capital Cost Summary (phase 1)

	LLW/pretreat	LLW/pretreat + HLW	total
LLW vit	248	248	496
pretreat	249	249	498
central	99	99	198
HLW vit	—	232	232
	596	828	1424

Total capital for phase 1 is $1424 million

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JACOBS ENGINEERING GROUP INC

DATE 12/7 SUBJECT SHEET NO. [illegible]

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Operating Costs

Based on Table F-36 (attached)
Op Costs components based on ratio of various categories to capital equip, start-up, and D&D were estimated.

Operations costs factored at 10% for pretreatment & LLW vitri based on 10% capacity 20 MT/D vs. 200 MT/D.

Operations costs factored at 5% for HLW vitri based on 5% capacity 1 MT/D vs 20 MT/D.

LLW containers & costs estimated as follows: 32 m^3 container
3.17 m x 3.17 m x 3.17 m
area (3.17)² x 6 sides x 0.01 m thick ⇒ 0.6 m^3 steel
x 7.5 sp.gr ⇒ 4.5 MT/each
x 469 containers x $2500/each
$1.2 million
say $2 million

HLW canisters here x 5% estimate total for dried HLW from pretreat & HLW vitr. for both plants
$239 million x .05 = $12 million
divide up $4 million for each pretreat plant & $4 million HLW vitr. plant

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Estimate total labor separate based on staffing numbers

Staff years for Operation

	years	staff per yr	staff yrs
(for both plants) Pretreat/LLW	4	536	2144
(for both plants plus HLW plant) Pretreat/LLW/HLW	6	578	3468
D&D	2	961	1922
			7534 staff yrs

for TPA Dual Op. $723 million for 7080 staff yrs or $102,000/staff yr

Therefore

7534 staff yrs x $102,000/staff yr =

$768 million operating labor

Closure Cost

Capital phase I / Capital ext. retrieval x closure cost ext. ret = 1424 / 5880 x 170

= $41 million

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE 12/7 SUBJECT SHEET NO. 86 8-15

BY DGS CHKD. JOB NO.

Operating Cost (not including labor)

Capital		equip	startup	D+D	oper	LLW con.	HLW con	total
249	pretreat	37	15	62	37	—	4	155
99	central	—	—	—	—	—	—	—
248	LLW vit	37	15	62	37	2	—	153
232	HLW vit.	35	14	58	6	—	4	117

pretreat 155 x 2 plants = 310
central — x 2 plants = —
LLW vit 153 x 2 plants = 306
HLW vit 117 x 1 plant = 117
$733 million

Total operating cost = 733 + 768
portable labor
above

Total op. cost = $1501 million

FORM 81-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE 2/26/96 SUBJECT

BY DLS CHKD.

SHEET NO. 9-15

JOB NO.

Continued op. cost of demo plants in phase 2

- operate pretreat/LAW/central for additional 10 yrs (same as phase 1)
- do not operate HLW in phase 2 (too small)

operating cost (not including labor)

	equip	startup	D+D	ops	total
pretreat	37	—	—	37	74
central	—	—	—	—	—
LAW vit.	37	—	—	37	74
HLW vit	—	—	—	—	—

pretreat 74 x 2 plants = 148
central — x 2 plants = —
LAW vit. 74 x 2 plants = 148
HLW vit. — = —

$296 million

labor	years	staff/yr	staff yrs
(for both plants) pretreat/LAW	10	536	5360

5360 staff yrs x $102,000/staff yr = $547 million

op. cost of demo plants in phase 2

296 + 547 = $843 million

FORM 61-005-1 (4/61)

JACOBS ENGINEERING GROUP INC.

DATE 2/26/96 SUBJECT SHEET NO. 10-15

BY DLL CHKD. JOB NO.

Phase 1 Summary

capital cost	$ 1425	million
operating cost	$ 1500	million
closure costs	$ 41	million
continued operation in phase 2	$ 543	million

JACOBS ENGINEERING GROUP INC.

DATE 2/26/96 SUBJECT SHEET NO. 11-15

BY GLS CHKD. 12 MT/D HLW, 185 MT/D LAW JOB NO.

Capital Cost for Phase 2 Large Plants

(1) Consistent with phase 1 demo plants estimate, assume separations in pretreatment are 1/3 between inter. sep + ext. sep.

or 1/3 x $2770 million (difference between inter sep + ext. sep) = $923 million more than inter. sep. pretreatment cost of $380 million for a total of $1303 million

(2) Central facilities would be approximately the same as inter. sep. at $520 million even though it needs to support only 185 MT/D LAW and 12 MT/D HLW.

(3) LAW vitrification would be approximately the same as inter. sep. at $1300 million

(4) HLW vitrification would be approximately 1/2 that of HLW 25 MT/D or $\frac{1400}{2}$ = $700 million

(5) The result would be a total capital cost of 1303 + 520 + 1300 + 700 = $3823 million
(pretreat) (central) (LAW) (HLW)

(6) Assuming a 20% reduction in capital cost as a result of information gathered and optimization from phase 1 demo plants (this is approximately the same as assuming a 20% contingency here vs. 40% previously), yields $3823 million x (100 - 20)% = $3058 million

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE 2/26/96 SUBJECT SHEET NO. 90 12-15

BY DMS CHKD. JOB NO.

Operating Cost for Phase 2 Large Plants
(less operating labor)

Capital	plant	equip	startup	D+D	oper.	LAW vault	HLW can.	total
1042	pretreat	156	58	288	153	—	—	655
416	central	—	—	—	—	—	—	—
1046	LAW vit	413	54	265	141	225	—	828
560	HLW vit.	28	31	154	50	—	239	502
3058								$1985 million

above per similar Table F-36 for inter Sep. (attached)

Operating Labor for Phase 2 Large Plants

assume op. labor force is about the same as for the demo plants which comprize 2 separate facilities (this should be conservative):

		years	staff years
pretreat/LAW/HLW dual operation	578 staff/yr	13	7514
HLW only (72% of dual per inter sep case)	417 staff/yr	4	1668
D+D (same as demo plants)	961 staff/yr	2	1922
			11,104 staff yrs

This is approx. 70% of staff yrs estimated for inter sep case. This appears to be reasonable, again taking into account lower production rates here, shorter op. years, and efficiency due to info obtained in demo plants.

11,104 staff yrs × $102,000/staff yr = $1133 million
(as per IPA)

FORM 91-005-T (4/81)

JE JACOBS ENGINEERING GROUP INC.

DATE 2/26/94 SUBJECT SHEET NO. 13-15

BY DLS CHKD. JOB NO.

total op. cost base = $1985 + 1133 = $3118 million

Δ op. cost per inter. sep for 45% waste oxide loading, 1.5 blend factor for HLW and 15% Na_2O loading, 1.25 blend factor for LAW, small canisters (61 x 310 cm) (excluding labor Δ) This Δ takes into account all extra op. costs for the total alternative which would process same waste and product same products as inter. sep.

$1493 million*

total phase 2 large plants op. cost $4611 million

* Δ HLW $140 million
Δ LAW 175 million
Δ other op. cost (vaults, canisters etc) 1,178 million
$1493 million

assume closure cost = $170 million (same as inter sep)

Phase 2 Summary

Capital cost $3058 million

Operating cost $4611 million

Closure cost $170 million

From previous phased impl. (no change)

WR+T capital $2280 million

WR+T operating $3990 million

FORM 91-006-1 (4/87)

JACOBS ENGINEERING GROUP INC.

DATE 2/26/96 SUBJECT

BY DLS CHKD.

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SHEET NO. 14-15

JOB NO.

Phased Implementation Summary

	Phase 1	Phase 2	Total Phased
Current Op.	4900	3700	8600
Total R+D	0	190	190
Capital			
WR+T	—	2280	2280
Treat.	1425	3058	4483
Closure	41	170	211
Total Capital	1466	5508	6974
Operating			
WR+T	—	3990	3990
Treat.	1500	4611	6111
Demo plants in phase 2	—	843	843
Total Operating	1500	9444	10 944
		12020	$12020
Repository Fee	—	~~6500~~	~~6500~~
			$38,728
Total	7866 million	25 342 million	~~$33 208~~ million

FORM 91-005-1 (4/87)

F.11 Backup for Table 9-16

Capital Cost

Operating Cost

Table F-36. Total Cost by Unit Operation.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sludge wash	$43	$129	$6	$2	$12	$6			$9		$207
Cesium removal	$380	$276	$57	$21	$105	$56			$83		$975
Centralized facilities	$520										$520
LLW vitrification	$1,300	$624	$179	$68	$332	$176			$264		$2,934
LLW disposal		$16	$9	$4	$17	$9	$225		$14		$294
HLW vitrification	$1,400	$639	$70	$78	$384	$126			$260		$2,957
HLW transportation		$31									$24
HLW disposal								$239		$5,619	$5,858
Total	$3,643	$1,716	$322	$173	$886	$373	$225	$239	$630	$5,619	$13,826

Notes:

Table values are in millions of 1995 dollars.

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