This document was too large to scan as a whole document; therefore, it is required break into smaller sections.

EDMC NUMBER: 0047100

DOCUMENT NUMBER: NA

SECTION 8 OF

TWRS EIS
CALCULATION COVER SHEET

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

ORIGINATOR D. Stein DATE 2/8/96

REVISION NO. 0

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)

D L Stein
SIGNATURE

CHECKED: CH 2/21/96

CALCULATION & RESULTS ATTACHED

JACOBS\FORMS\CALCVR.SHT

JACOBS ENGINEERING GROUP INC.

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

BY D Stein 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. Stern 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.

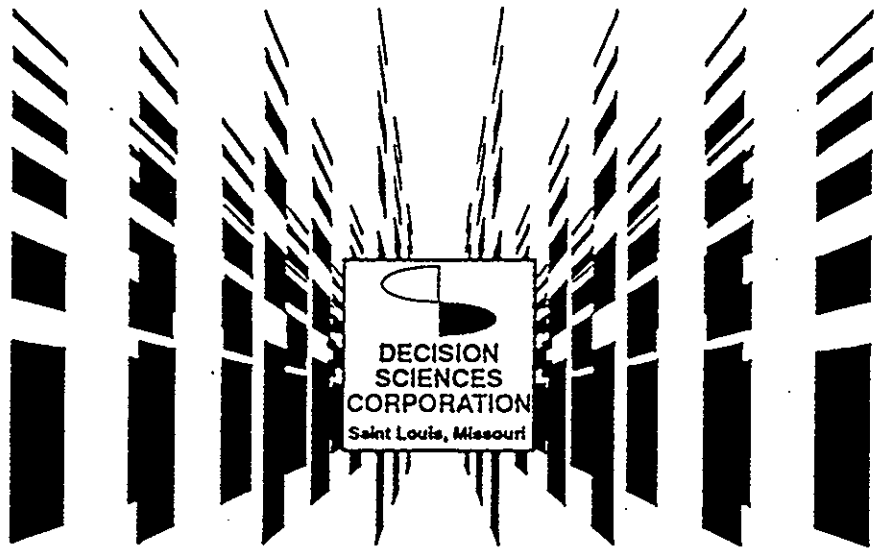
FORM 91-005-1 (4/81)

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

Telephone: 314/739-2662 Facsimile: 314/536-1001

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 D. 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)

SHEET NO. 3-4

JOB NO.

JACOBS ENGINEERING GROUP INC.

DATE 2/5/92 SUBJECT

BY D Stein CHKD.

Num	ELEMENT	ALTERNATIVE: LONG TERM MANAGE	NO SEP VITR.	NO SEP CALC.	INTER SEP + IN SITU / EXSITU 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 / EXSITU 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.

JACOBS ENGINEERING GROUP INC.

DATE 2/5/94 SUBJECT

BY DSkin CHKD.

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%	-25%, +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 NOW 1995 REPORT USING LARGER CANISTERS AND HIGHER WASTE OXIDE LOADING.

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

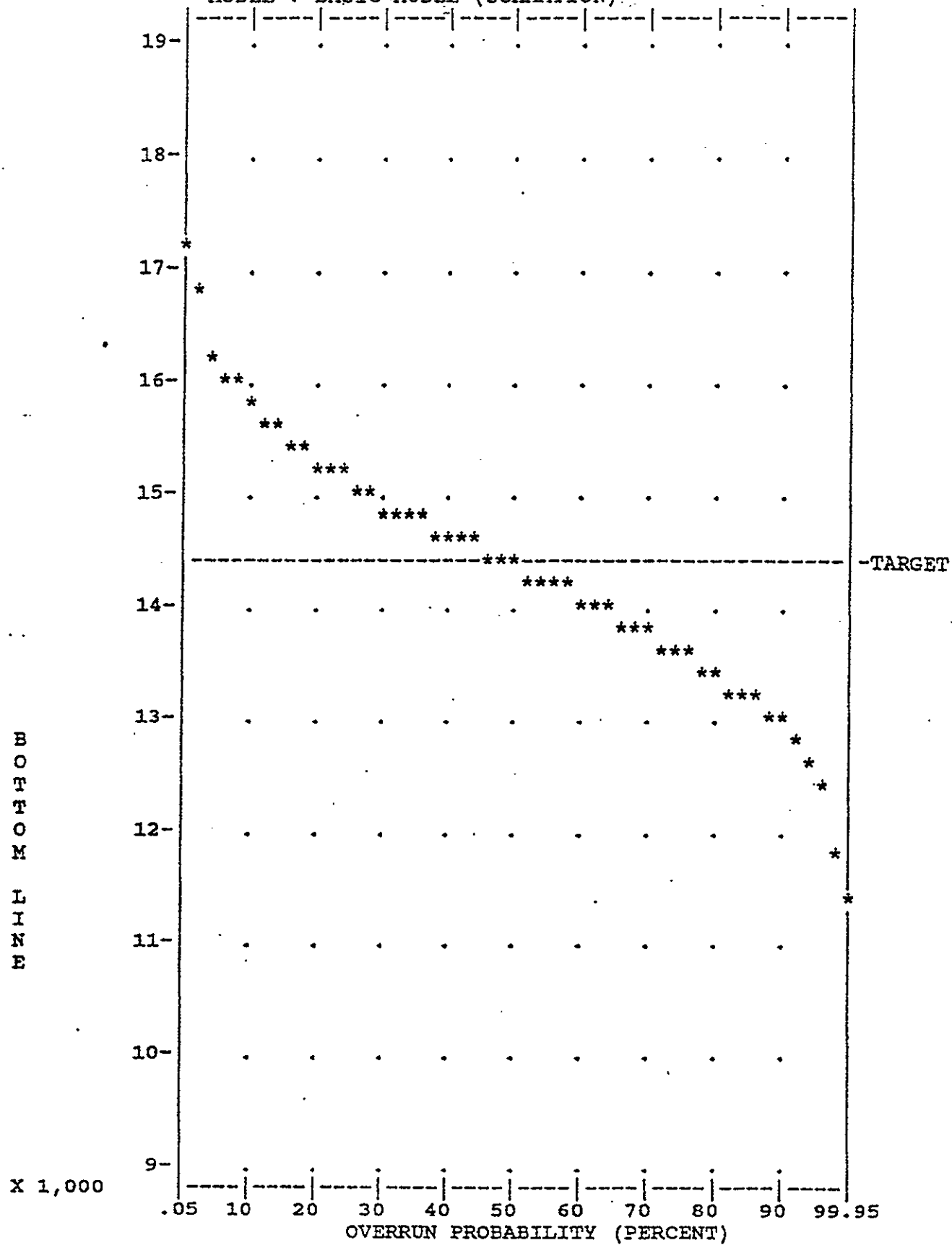
DATA : ExSitu Exten. Case 01
MODEL : BASIC MODEL (SUMMATION)

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. Case 02
MODEL : BASIC MODEL (SUMMATION)

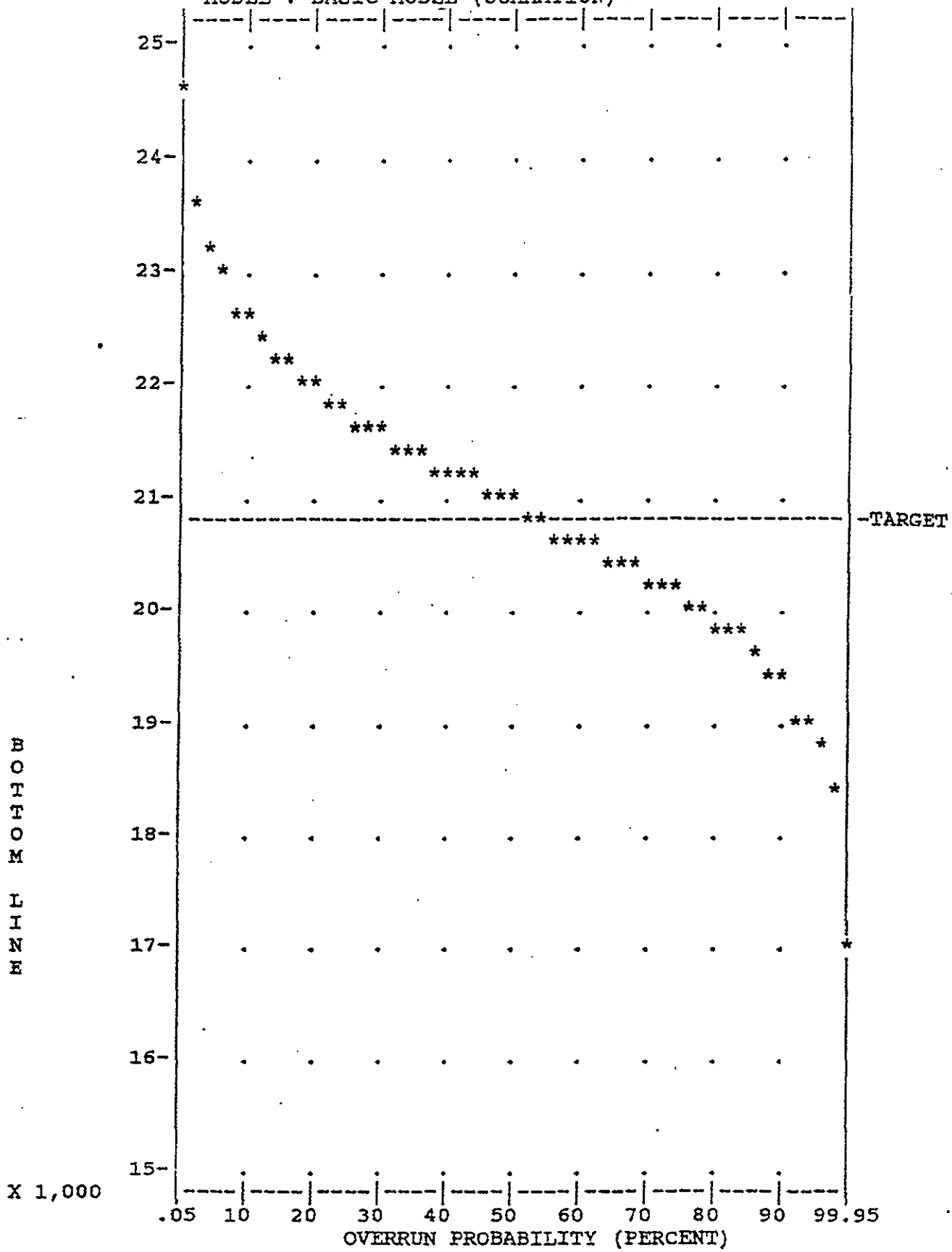
NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		14300	50	11440	17160
2	R&D Waste Ret. & Transfer		100.00		100.00	100.00
3	R&D Treatment		0		0	0
4	Capital Waste Ret. & Transfer		1930	50	1544	3281
5	Capital Treament		4000	50	3200	4800
6	Capital Closure		0		0	0
7	Operations Waste Ret. & Transfer		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 : 02-06-96

DATA : ExSitu Exten. Case 03
MODEL : BASIC MODEL (SUMMATION)

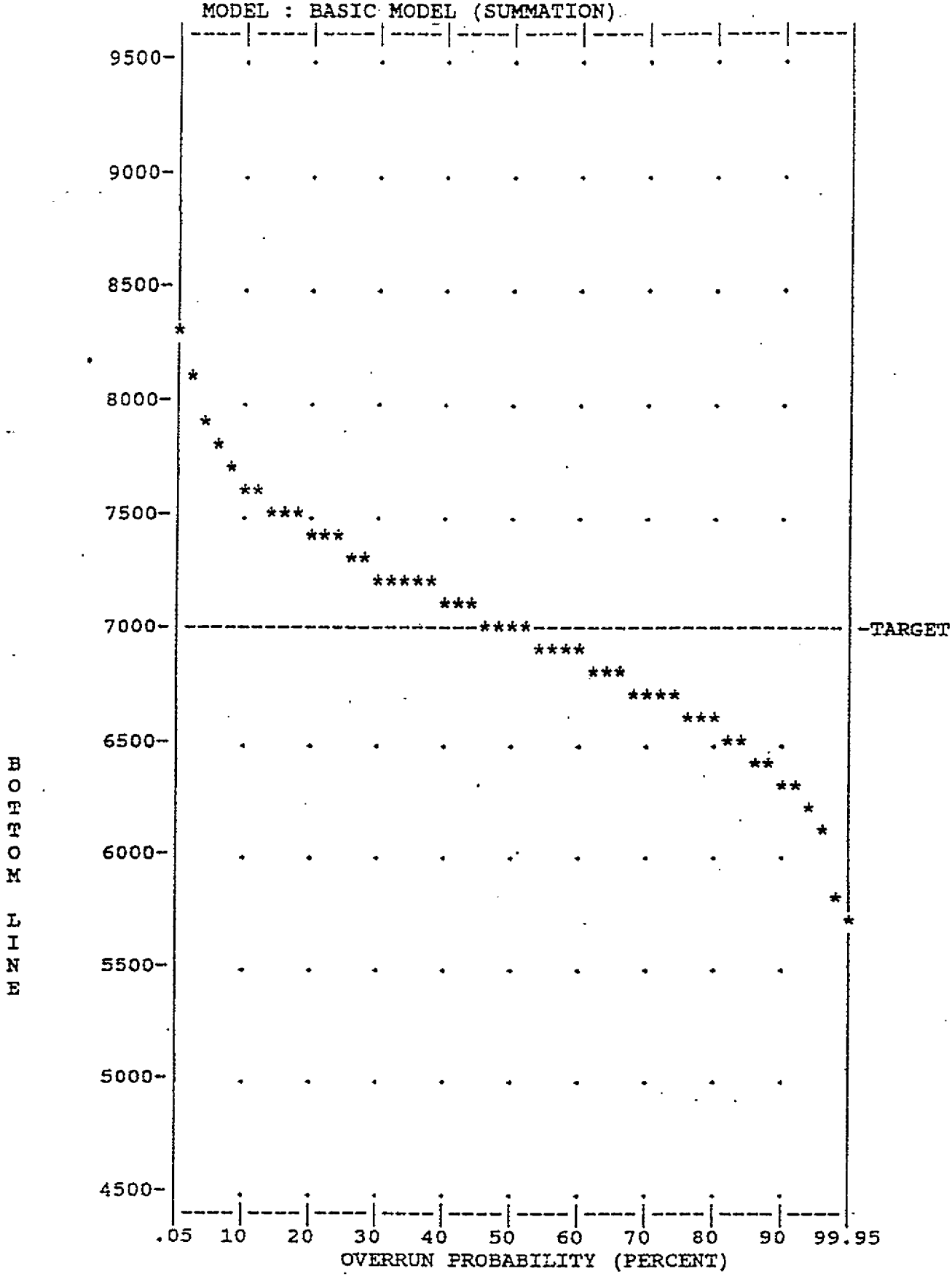
NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		6566	50	5253	7879
2	R&D Waste Ret. & Transfer		0		0	0
3	R&D Treatment		0		0	0
4	Capital Waste Ret. & Transfer		0		0	0
5	Capital Treament		25.00		25.00	25.00
6	Capital Closure		116.00		116.00	116.00
7	Operations Waste Ret. & Transfer		0		0	0
8	Operations Treatment		274		274	274
9	M & M		0		0	0
10	Repository Fee		0		0	0
	TOTAL EXPENSE (INPUT TO REP/PC)		6981		5668	8294
					(THEORETICALS)	

+ 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 03

MODEL : BASIC MODEL (SUMMATION)



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

DATA : ExSitu Exten. Case 03
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
6981	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 03
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	1313	18.8	PCT
99.95	"	1308	18.7	"
95	"	818	11.7	"
90	"	657	9.4	"
85	"	540	7.7	"
80	"	438	6.3	"
75	"	366	5.2	"
70	"	265	3.8	"
65	"	206	3.0	"
60	"	143	2.1	"
55	"	81	1.2	"
50	"	7	.1	"
45	"	-57	-.8	"
40	"	-121	-1.7	"
35	"	-175	-2.5	"
30	"	-265	-3.8	"
25	"	-329	-4.7	"
20	"	-411	-5.9	"
15	"	-536	-7.7	"
10	"	-632	-9.0	"
5	"	-801	-11.5	"
0.05	"	-1303	-18.7	"
0	"	-1313	-18.8	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

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

DATA : ExSitu Exten. Case 04
MODEL : BASIC MODEL (SUMMATION)

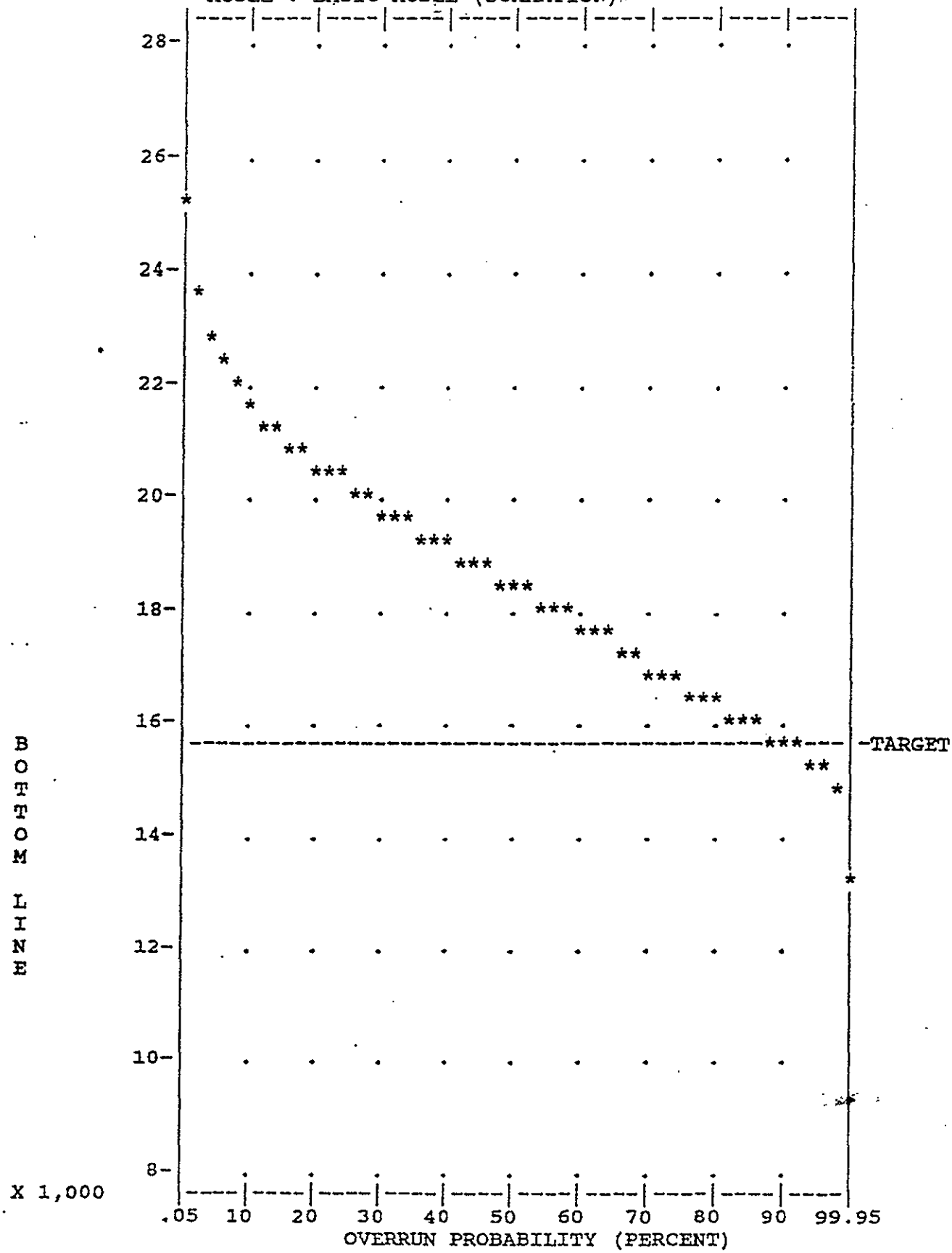
NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		7749	50	6199	9299
2	R&D Waste Ret. & Transfer		0		0	0
3	R&D Treatment		70.00		70.00	70.00
4	Capital Waste Ret. & Transfer		0		0	0
5	Capital Treament		4900	15	4410	9600
6	Capital Closure		116.00		116.00	116.00
7	Operations Waste Ret. & Transfer		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)		15575		13261 (THEORETICALS)	27305

+ 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 04

MODEL : BASIC MODEL (SUMMATION)



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

DATA : ExSitu Exten. Case 04
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
15575	91 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 : 02-06-96

DATA : ExSitu Exten. Case 04
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	11730	75.3	PCT
99.95	"	9656	62.0	"
95	"	7137	45.8	"
90	"	6031	38.7	"
85	"	5390	34.6	"
80	"	4923	31.6	"
75	"	4556	29.3	"
70	"	4123	26.5	"
65	"	3777	24.3	"
60	"	3485	22.4	"
55	"	3186	20.5	"
50	"	2832	18.2	"
45	"	2499	16.0	"
40	"	2174	14.0	"
35	"	1773	11.4	"
30	"	1404	9.0	"
25	"	1082	7.0	"
20	"	750	4.8	"
15	"	348	2.2	"
10	"	71	.5	"
5	"	-306	-2.0	"
0.05	"	-2201	-14.1	"
0	"	-2314	-14.9	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

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

DATA : ExSitu Exten. Case 05
MODEL : BASIC MODEL (SUMMATION)

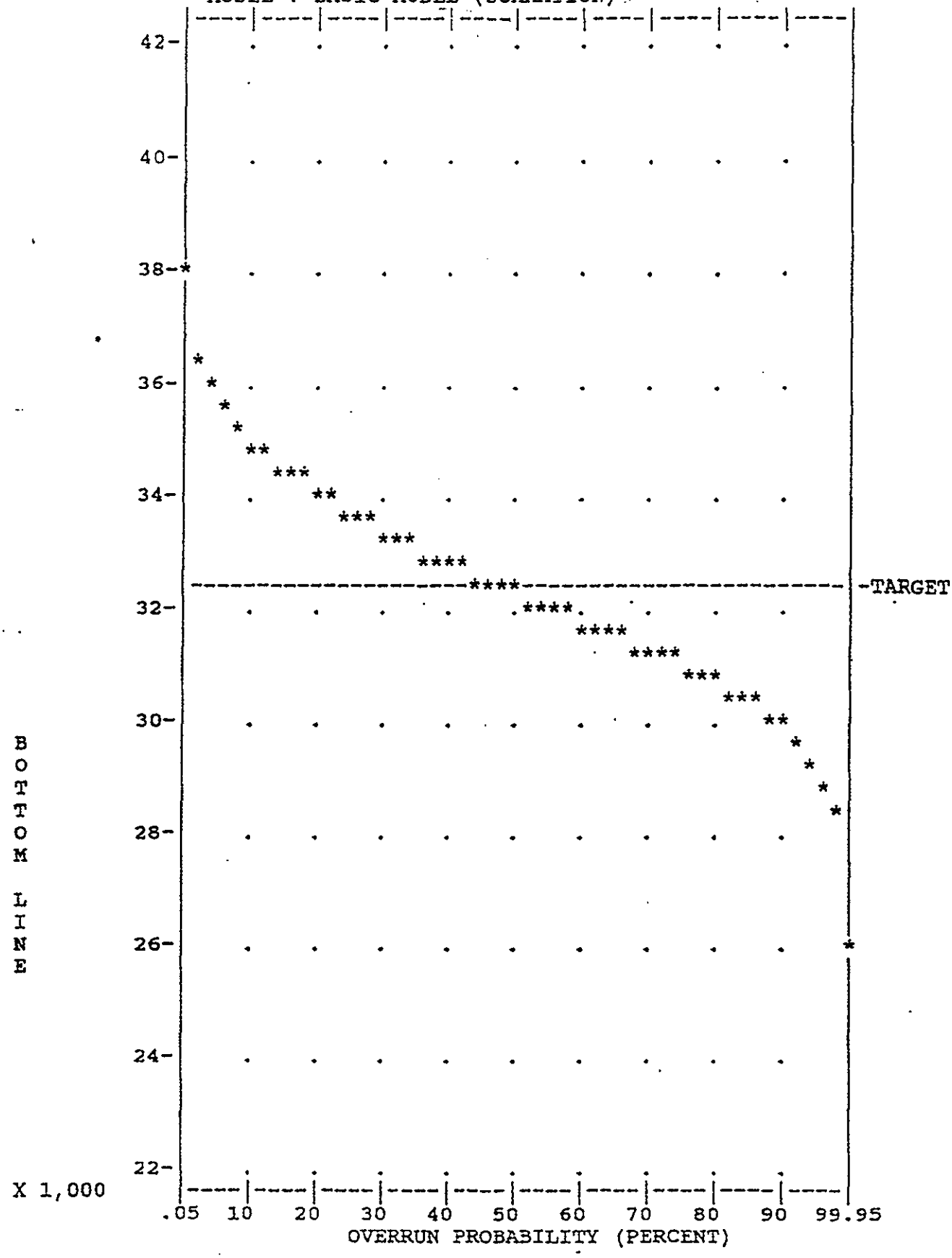
NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		8600	50	6880	10320
2	R&D Waste Ret. & Transfer		190.00		190.00	190.00
3	R&D Treatment		630		630	630
4	Capital Waste Ret. & Transfer		2280	50	824	3876
5	Capital Treament		3600	40	2880	7200
6	Capital Closure		169.00		169.00	169.00
7	Operations Waste Ret. & Transfer		4820	50	3856	8194
8	Operations Treatment		5577	65	4183	5578
9	M & M		0		0	0
10	Repository Fee		6500	95	3900	6501
	TOTAL EXPENSE (INPUT TO REP/PC)		32366		23512 (THEORETICALS)	42658

+ 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 05

MODEL : BASIC MODEL (SUMMATION)



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

DATA : ExSitu Exten. Case 05
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
32366	47 PCT	0 = .0 PCT

NUM	ELEMENT	UNIT	CORRECT	PROTECT
5	Capital Treament		----------	++
10	Repository Fee			+++++++++++++
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 : 02-06-96

DATA : ExSitu Exten. Case 05
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	10292	31.8	PCT
99.95	"	5824	18.0	"
95	"	3257	10.1	"
90	"	2553	7.9	"
85	"	2094	6.5	"
80	"	1707	5.3	"
75	"	1342	4.2	"
70	"	941	2.9	"
65	"	633	2.0	"
60	"	356	1.1	"
55	"	114	.4	"
50	"	-101	-.3	"
45	"	-335	-1.0	"
40	"	-607	-1.9	"
35	"	-822	-2.5	"
30	"	-1046	-3.2	"
25	"	-1363	-4.2	"
20	"	-1622	-5.0	"
15	"	-1970	-6.1	"
10	"	-2496	-7.7	"
5	"	-3171	-9.8	"
0.05	"	-6481	-20.0	"
0	"	-8854	-27.4	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

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

DATA : ExSitu Exten. Case 06
MODEL : BASIC MODEL (SUMMATION)

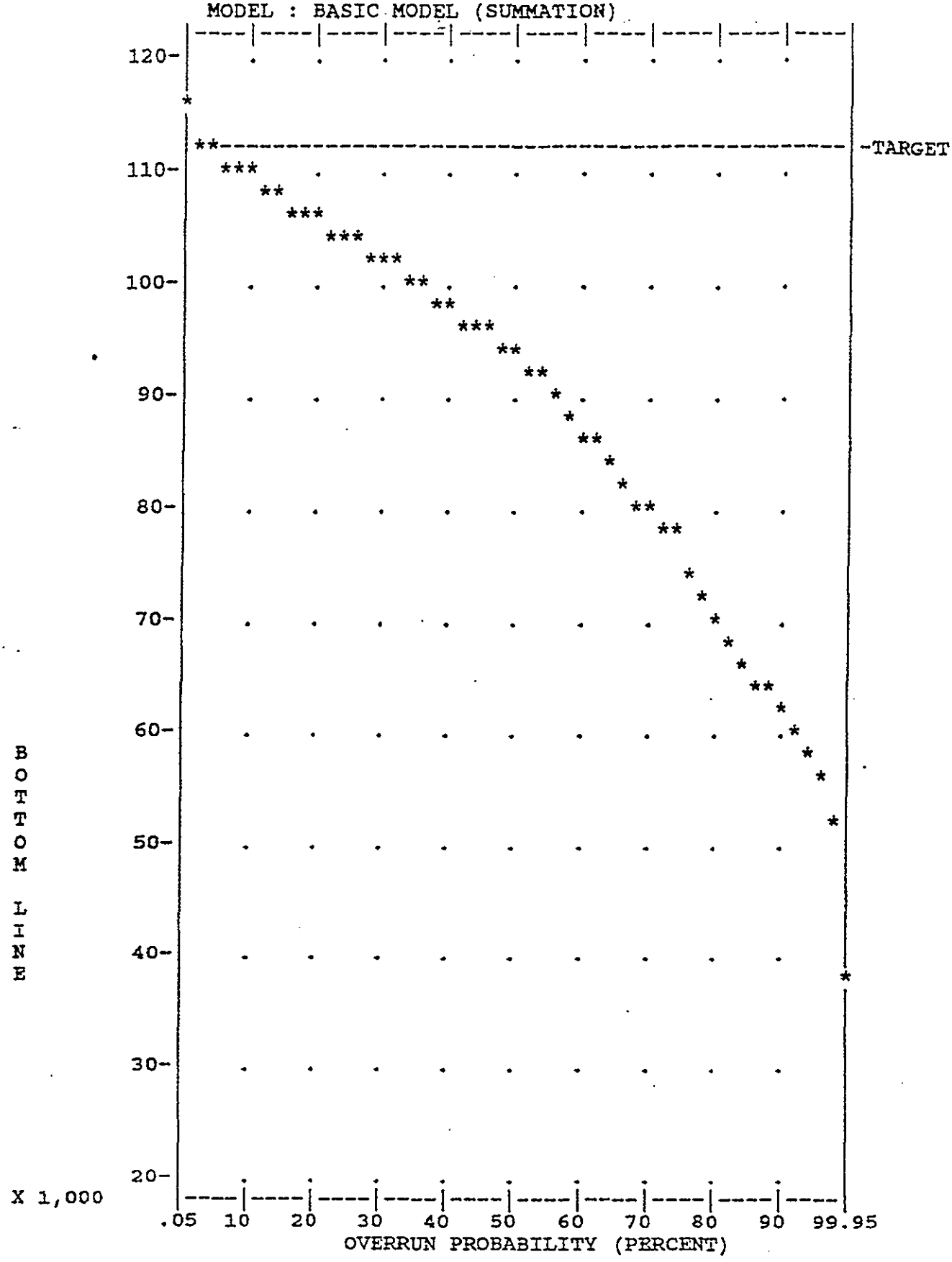
NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		8325	50	6660	9990
2	R&D Waste Ret. & Transfer		190.00		190.00	190.00
3	R&D Treatment		280		280	280
4	Capital Waste Ret. & Transfer		2280	50	1824	3876
5	Capital Treament		2610	50	2088	3915
6	Capital Closure		152.00		152.00	152.00
7	Operations Waste Ret. & Transfer		4630	50	3704	7871
8	Operations Treatment		23273	75	4654	23274
9	M & M		0		0	0
10	Repository Fee		69500	95	12900	69501
	TOTAL EXPENSE (INPUT TO REP/PC)		111240		32452 (THEORETICALS)	119049

+ 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 06

MODEL : BASIC MODEL (SUMMATION)



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

DATA : ExSitu Exten. Case 06
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
111240	4 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 Treament			
	NET EFFECT OF FROZEN ELEMENTS			

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

DATA : ExSitu Exten. Case 06
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	7809	7.0	PCT
99.95	"	4241	3.8	"
95	"	-443	-.4	"
90	"	-2133	-1.9	"
85	"	-3809	-3.4	"
80	"	-5983	-5.4	"
75	"	-7390	-6.6	"
70	"	-9245	-8.3	"
65	"	-11539	-10.4	"
60	"	-13489	-12.1	"
55	"	-15771	-14.2	"
50	"	-17923	-16.1	"
45	"	-20529	-18.4	"
40	"	-24826	-22.3	"
35	"	-27942	-25.1	"
30	"	-31478	-28.3	"
25	"	-35387	-31.8	"
20	"	-41332	-37.2	"
15	"	-46128	-41.5	"
10	"	-50031	-45.0	"
5	"	-55069	-49.5	"
0.05	"	-73391	-66.0	"
0	"	-78788	-70.8	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

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

DATA : ExSitu Exten. Case 07
MODEL : BASIC MODEL (SUMMATION)

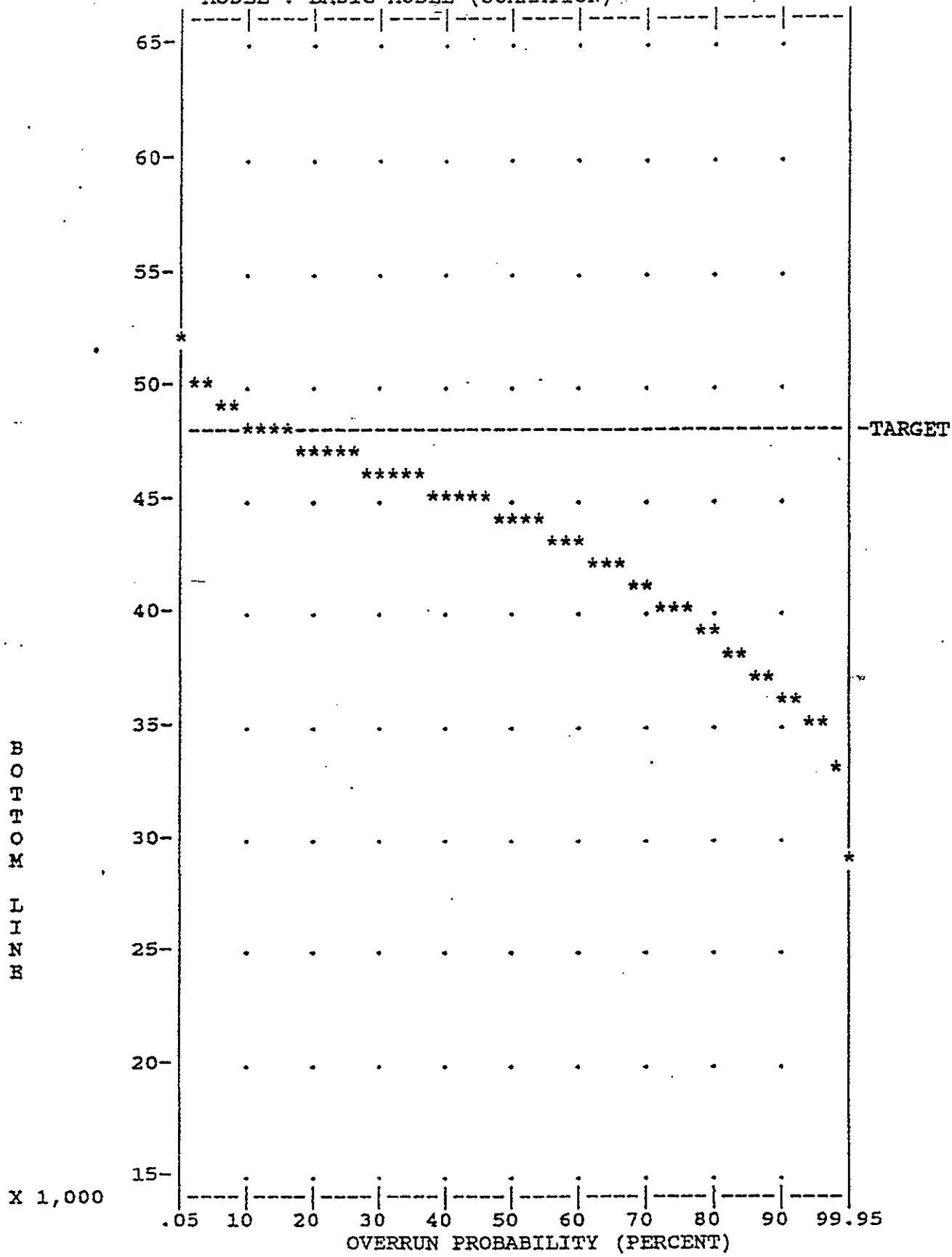
NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		8325	50	6660	9990
2	R&D Waste Ret. & Transfer		190.00		190.00	190.00
3	R&D Treatment		280		280	280
4	Capital Waste Ret. & Transfer		2280	50	1824	3876
5	Capital Treament		2610	50	2088	3915
6	Capital Closure		152.00		152.00	152.00
7	Operations Waste Ret. & Transfer		4630	50	3704	7871
8	Operations Treatment		8182	75	3273	8183
9	M & M		0		0	0
10	Repository Fee		21500	95	7800	21501
	TOTAL EXPENSE (INPUT TO REP/PC)		48149		25971 (THEORETICALS)	55958

+ 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 07

MODEL : BASIC MODEL (SUMMATION)



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

DATA : ExSitu Exten. Case 07
MOD MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
48149	12 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 Treament		-	
	NET EFFECT OF FROZEN ELEMENTS			

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

DATA : ExSitu Exten. Case 07
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	7809	16.2	PCT
99.95	"	4317	9.0	"
95	"	1269	2.6	"
90	"	230	.5	"
85	"	-466	-1.0	"
80	"	-995	-2.1	"
75	"	-1560	-3.2	"
70	"	-2001	-4.2	"
65	"	-2439	-5.1	"
60	"	-2935	-6.1	"
55	"	-3457	-7.2	"
50	"	-3988	-8.3	"
45	"	-4640	-9.6	"
40	"	-5415	-11.2	"
35	"	-6266	-13.0	"
30	"	-7342	-15.2	"
25	"	-8180	-17.0	"
20	"	-9503	-19.7	"
15	"	-10564	-21.9	"
10	"	-11768	-24.4	"
5	"	-13012	-27.0	"
0.05	"	-19153	-39.8	"
0	"	-22178	-46.1	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

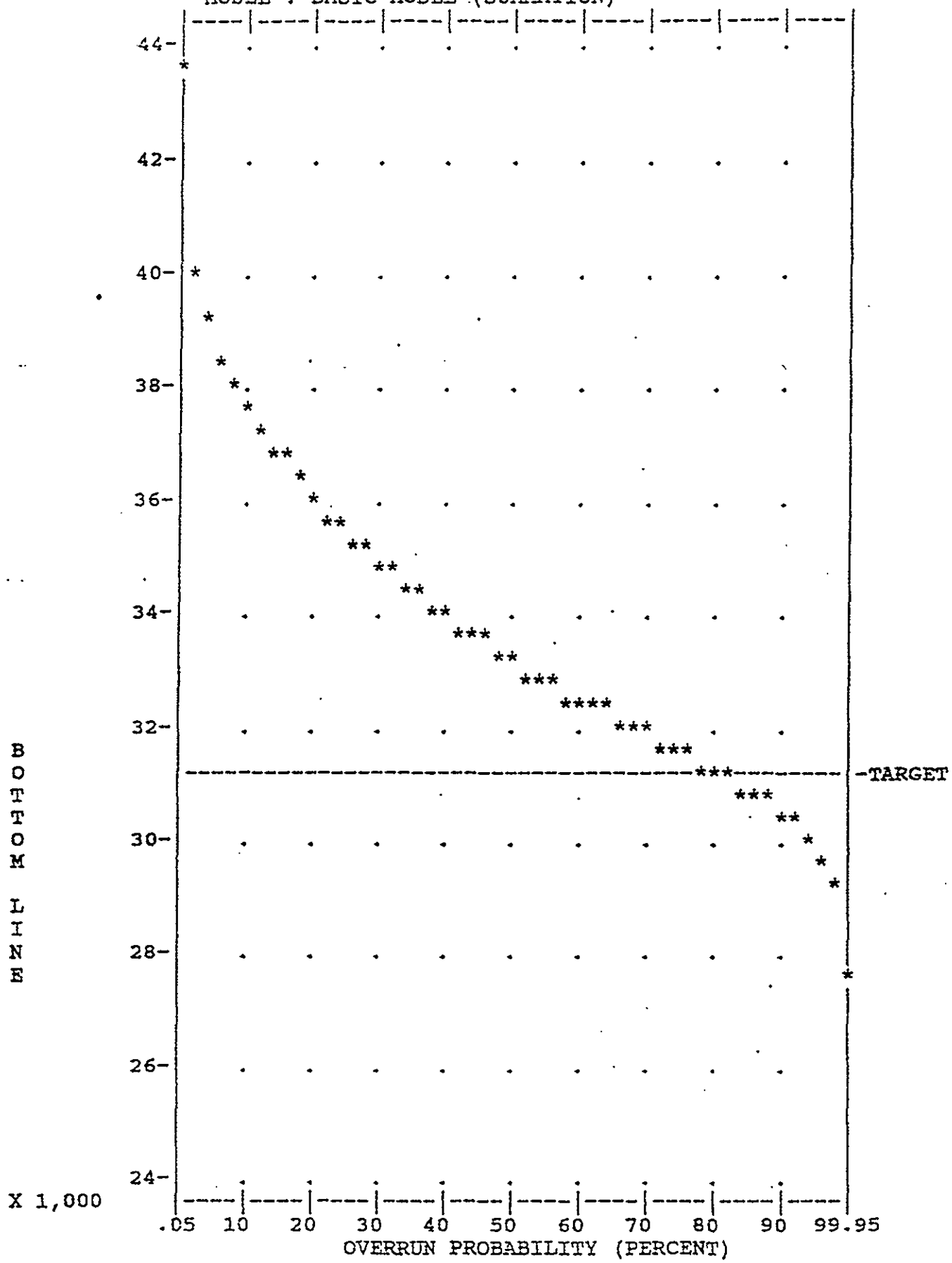
REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 02-06-96

DATA : ExSitu Exten. 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
10	Repository Fee		3400		3400	3400
	TOTAL EXPENSE (INPUT TO REP/PC)		31379		26386 (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 : 02-06-96
DATA : ExSitu Exten. Case 08
MODEL : BASIC MODEL (SUMMATION)



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

DATA : ExSitu Exten. Case 08
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
31379	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 : 02-06-95

DATA : ExSitu Exten. Case 08
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	14494	46.2	PCT
99.95	"	12109	38.6	"
95	"	7497	23.9	"
90	"	6282	20.0	"
85	"	5365	17.1	"
80	"	4615	14.7	"
75	"	3930	12.5	"
70	"	3464	11.0	"
65	"	3018	9.6	"
60	"	2545	8.1	"
55	"	2144	6.8	"
50	"	1739	5.5	"
45	"	1391	4.4	"
40	"	1061	3.4	"
35	"	755	2.4	"
30	"	477	1.5	"
25	"	146	.5	"
20	"	-185	-.6	"
15	"	-497	-1.6	"
10	"	-814	-2.6	"
5	"	-1399	-4.5	"
0.05	"	-3851	-12.3	"
0	"	-4993	-15.9	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

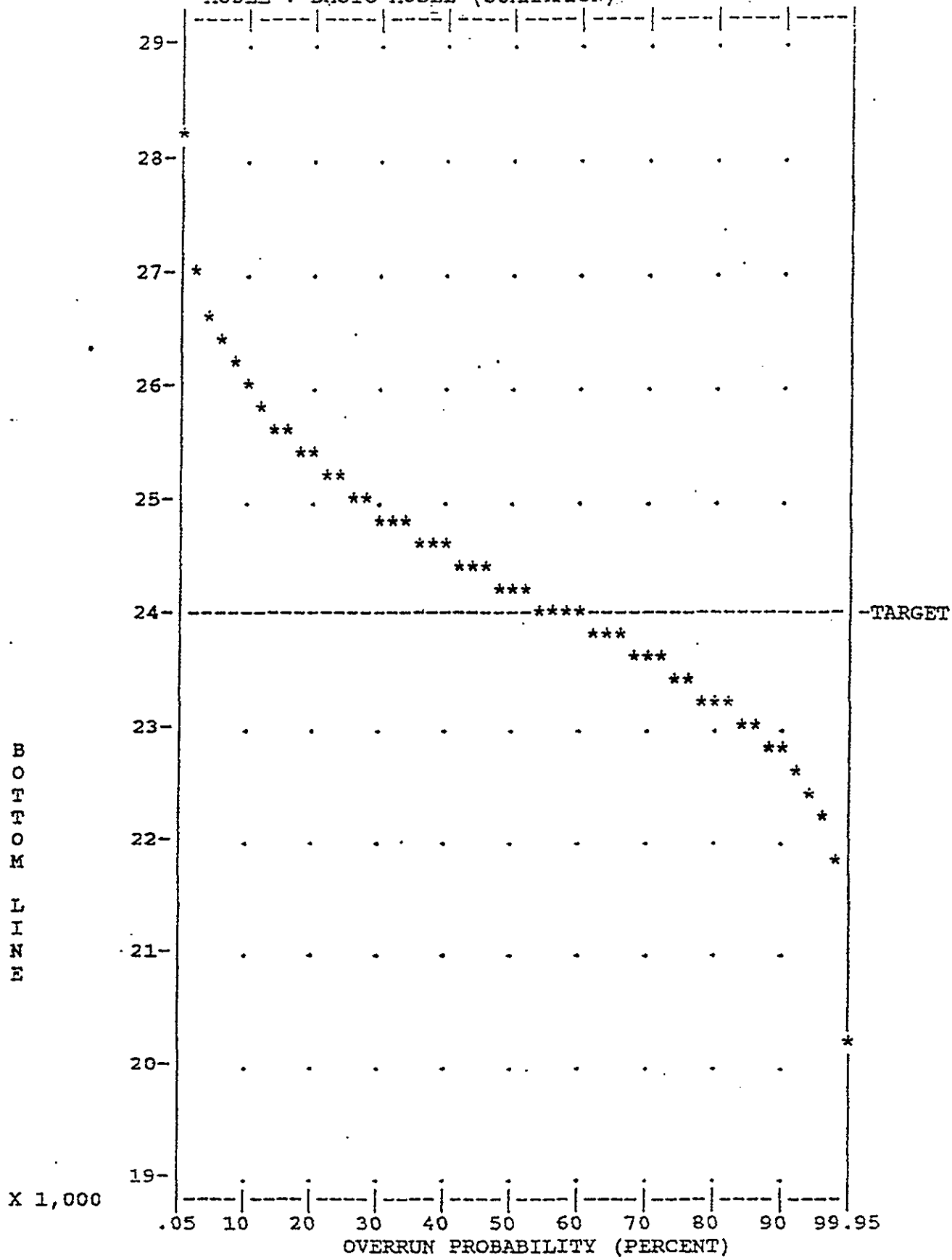
REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 02-06-96

DATA : ExSitu Exten. Sepa.r. Case 09
MODEL : BASIC MODEL (SUMMATION)

NUM	ELEMENT	UNIT	TARGET	PROB+	LOW	HIGH
1	Current Operations		8600	50	6880	10320
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 Treament		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		2672	65	2004	2673
9	M & M		0		0	0
10	Repository Fee		5000	95	3750	5001
	TOTAL EXPENSE (INPUT TO REP/PC)		24008		19021 (THEORETICALS)	31107

+ 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. Sepa.r. Case 09
MODEL : BASIC MODEL (SUMMATION)



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

DATA : ExSitu Exten. Sepa.r. Case 09
MODEL : BASIC MODEL (SUMMATION)

TOTAL EXPENSE	PROB OF OVERRUN	NET EFFECT OF FROZEN ELEMENTS
24008	57 PCT	0 = .0 PCT

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

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

DATA : ExSitu Exten. Sepa.r. Case 09
MODEL : BASIC MODEL (SUMMATION)

TO BE THIS CONFIDENT OF NOT HAVING COST OVERRUN		ADD THIS CONTINGENCY ABSOLUTE	RELATIVE	
100	PCT	7099	29.6	PCT
99.95	"	4167	17.4	"
95	"	2480	10.3	"
90	"	1908	8.0	"
85	"	1582	6.6	"
80	"	1335	5.6	"
75	"	1100	4.6	"
70	"	879	3.7	"
65	"	687	2.9	"
60	"	522	2.2	"
55	"	346	1	
50	"	176	.7	"
45	"	43	.2	"
40	"	-91	-.4	"
35	"	-249	-1.0	"
30	"	-429	-1.8	"
25	"	-613	-2.5	"
20	"	-807	-3.4	"
15	"	-1025	-4.3	"
10	"	-1268	-5.3	"
5	"	-1755	-7.3	"
0.05	"	-3831	-16.0	"
0	"	-4987	-20.8	"

(ABOVE RESULTS DERIVED FROM 1000 SIMULATIONS)

JACOBS ENGINEERING GROUP INC.

DATE 2/12/96 SUBJECT SHEET NO.

BY D. Stein CHKD. JOB NO.

Phased Implementation (latest version)

Target Value $32,953

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

FORM 01-006-1 (4/87)

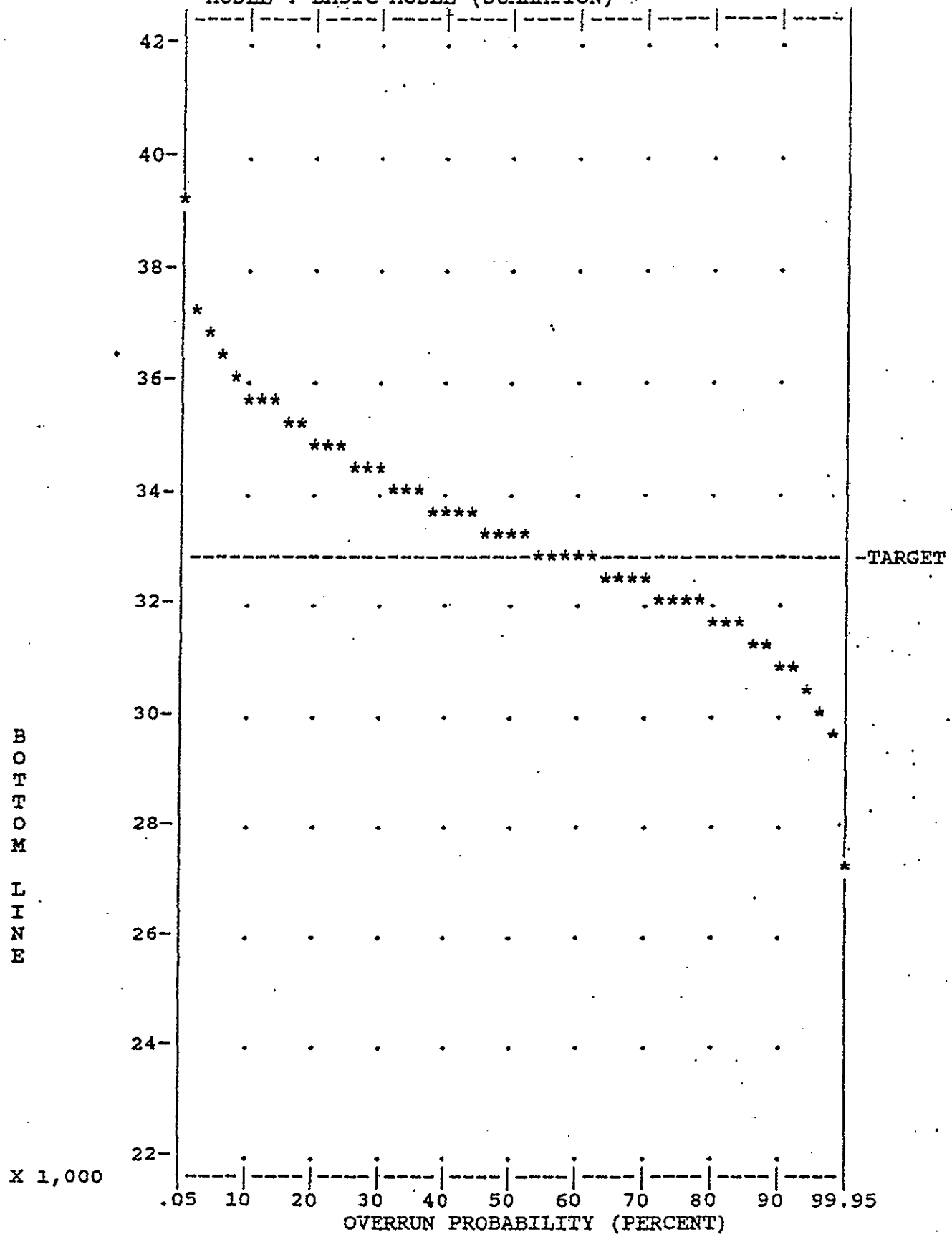
REP/PC (Ver 4.0) - MGMT REPORT 1 RANGE ESTIMATE : 02-12-96

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)

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE Safety: LCFs from radiological Accidents

ORIGINATOR Michael Harker DATE 02/12/95

REVISION NO. _____

OBJECTIVE Show LCFs from Radiological accidents.

METHODOLOGY See attachments

ASSUMPTIONS See attachments

(Continue on another sheet if necessary)

3/15/96
SIGNATURE/DATE

3/15/96
CHECKED/DATE

CALCULATION & RESULTS
ATTACHED

JACOBS\FORMS\CALCLCF.212

			NO ACTION ALTERNATIVE				
	Mispositioned Jumper (spray release 207 psi)						
1.10E-02	per year x	1.00E+01	years =	1.10E-01	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	1.40E+03	8.00E-04	1.12E+00	1.10E-01	1.23E-01		
MEI-W	1.40E+02	8.00E-04	1.12E-01	1.10E-01	1.23E-02		
N	2.50E+03	4.00E-04	1.00E+00	1.10E-01	1.10E-01		2.67E-01
MEI-N	6.70E+01	8.00E-04	5.36E-02	1.10E-01	5.90E-03		
P	6.20E+02	5.00E-04	3.10E-01	1.10E-01	3.41E-02		
MEI-P	2.90E-01	5.00E-04	1.45E-04	1.10E-01	1.60E-05		
		total LCF	2.43E+00				
	Hydrogen burn in waste tank						
9.00E-07	per year x	1.00E+02	years x	2.50E+01	tanks =	2.25E-03	probability
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	2.18E+05	n/a	n/a	2.25E-03	2.25E-03		
MEI-W	2.18E+04	n/a	n/a	2.25E-03	2.25E-03		
N	2.45E+04	4.00E-04	9.80E+00	2.25E-03	2.21E-02		
MEI-N	1.74E+03	n/a	n/a	2.25E-03	2.25E-03		
P	3.70E+03	5.00E-04	1.85E+00	2.25E-03	4.16E-03		
MEI-P	4.23E+00	5.00E-04	2.12E-03	2.25E-03	4.76E-06		
		total LCF	2.17E+01				

	LONG TERM MANAGEMENT ALTERNATIVE						
	Mispositioned Jumper (spray release 207 psi)						
1.10E-02	per year x	2.00E+01	years =	2.20E-01	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	1.40E+03	8.00E-04	1.12E+00	2.20E-01	2.46E-01		
MEI-W	1.40E+02	8.00E-04	1.12E-01	2.20E-01	2.46E-02		
N	2.50E+03	4.00E-04	1.00E+00	2.20E-01	2.20E-01		5.35E-01
MEI-N	6.70E+01	8.00E-04	5.36E-02	2.20E-01	1.18E-02		
P	6.20E+02	5.00E-04	3.10E-01	2.20E-01	6.82E-02		
MEI-P	2.90E-01	5.00E-04	1.45E-04	2.20E-01	3.19E-05		
		total LCF	2.43E+00				
	Hydrogen burn in waste tank						
9.00E-07	per year x	1.00E+02	years x	2.50E+01	tanks =	2.25E-03	probability
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	2.18E+05	n/a	n/a	2.25E-03	2.25E-03		
MEI-W	2.18E+04	n/a	n/a	2.25E-03	2.25E-03		
N	2.45E+04	4.00E-04	9.80E+00	2.25E-03	2.21E-02		
MEI-N	1.74E+03	n/a	n/a	2.25E-03	2.25E-03		
P	3.70E+03	5.00E-04	1.85E+00	2.25E-03	4.16E-03		
MEI-P	4.23E+00	5.00E-04	2.12E-03	2.25E-03	4.76E-06		
		total lcf	2.17E+01				

	INSITU FILL AND CAP ALTERNATIVE						
	Mispositioned Jumper (spray release 207 psi)						
1.10E-02	per year x	1.50E+01	years =	1.65E-01	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	1.40E+03	8.00E-04	1.12E+00	1.65E-01	1.85E-01		
MEI-W	1.40E+02	8.00E-04	1.12E-01	1.65E-01	1.85E-02		
N	2.50E+03	4.00E-04	1.00E+00	1.65E-01	1.65E-01		4.01E-01
MEI-N	6.70E+01	8.00E-04	5.36E-02	1.65E-01	8.84E-03		
P	6.20E+02	5.00E-04	3.10E-01	1.65E-01	5.12E-02		
MEI-P	2.90E-01	5.00E-04	1.45E-04	1.65E-01	2.39E-05		
		total lcf	2.43E+00				
	Tank Dome Collapse Due To Hydrogen Deflagration						
				1.00E-04	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	6.20E+04	n/a	n/a	1.00E-04	1.00E-04		
MEI-W	6.20E+03	n/a	n/a	1.00E-04	1.00E-04		
N	2.30E+04	4.00E-04	9.20E+00	1.00E-04	9.20E-04		
MEI-N	1.50E+03	n/a	n/a	1.00E-04	1.00E-04		
P	3.70E+03	5.00E-04	1.85E+00	1.00E-04	1.85E-04		
MEI-P	3.90E+00	5.00E-04	1.95E-03	1.00E-04	1.95E-07		
		total lcf	2.11E+01				
	Hydrogen burn in waste tank						
9.00E-07	per year x	1.90E+01	years x	2.50E+01	tanks =	4.28E-04	probability
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	2.18E+05	n/a	n/a	4.28E-04	4.28E-04		
MEI-W	2.18E+04	n/a	n/a	4.28E-04	4.28E-04		
N	2.45E+04	4.00E-04	9.80E+00	4.28E-04	4.19E-03		
MEI-N	1.74E+03	n/a	n/a	4.28E-04	4.28E-04		
P	3.70E+03	5.00E-04	1.85E+00	4.28E-04	7.91E-04		
MEI-P	4.23E+00	5.00E-04	2.12E-03	4.28E-04	9.04E-07		
		total lcf	2.17E+01				

	IN SITU VITRIFICATION ALTERNATIVE						
	Mispositioned Jumper (spray release 207 psi)						
1.10E-02	per year x	1.50E+01	years =	1.65E-01	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	1.40E+03	8.00E-04	1.12E+00	1.65E-01	1.85E-01		
MEI-W	1.40E+02	8.00E-04	1.12E-01	1.65E-01	1.85E-02		
N	2.50E+03	4.00E-04	1.00E+00	1.65E-01	1.65E-01		4.01E-01
MEI-N	6.70E+01	8.00E-04	5.36E-02	1.65E-01	8.84E-03		
P	6.20E+02	5.00E-04	3.10E-01	1.65E-01	5.12E-02		
MEI-P	2.90E-01	5.00E-04	1.45E-04	1.65E-01	2.39E-05		
		total lcf	2.43E+00				
		Off-Gas Duct Rupture					
7.00E-04	per year x	9.00E+00	years =	6.30E-03	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	2.50E+04	n/a	n/a	6.30E-03	6.30E-03		
MEI-W	2.50E+03	n/a	n/a	6.30E-03	6.30E-03		2.68E-01
N	4.50E+04	8.00E-04	3.60E+01	6.30E-03	2.27E-01		
MEI-N	1.20E+03	n/a	n/a	6.30E-03	6.30E-03		
P	1.10E+04	5.00E-04	5.50E+00	6.30E-03	3.47E-02		
MEI-P	5.20E+00	5.00E-04	2.60E-03	6.30E-03	1.64E-05		
		total LCF	5.15E+01				
	Hydrogen burn in waste tank						
9.00E-07	per year x	1.90E+01	years x	2.50E+01	tanks =	4.28E-04	
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	2.18E+05	n/a	n/a	4.28E-04	4.28E-04		
MEI-W	2.18E+04	n/a	n/a	4.28E-04	4.28E-04		
N	2.45E+04	4.00E-04	9.80E+00	4.28E-04	4.19E-03		
MEI-N	1.74E+03	n/a	n/a	4.28E-04	4.28E-04		
P	3.70E+03	5.00E-04	1.85E+00	4.28E-04	7.91E-04		
MEI-P	4.23E+00	5.00E-04	2.12E-03	4.28E-04	9.04E-07		
		total lcf	2.17E+01				

EX SITU INTERMEDIATE SEPARATIONS ALTERNATIVE							
	Mispositioned Jumper (spray release 207 psi)						
1.10E-02	per year x	2.30E+01	years =	2.53E-01	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	1.40E+03	8.00E-04	1.12E+00	2.53E-01	2.83E-01		
MEI-W	1.40E+02	8.00E-04	1.12E-01	2.53E-01	2.83E-02		6.15E-01
N	2.50E+03	4.00E-04	1.00E+00	2.53E-01	2.53E-01		
MEI-N	6.70E+01	8.00E-04	5.36E-02	2.53E-01	1.36E-02		
P	6.20E+02	5.00E-04	3.10E-01	2.53E-01	7.84E-02		
MEI-P	2.90E-01	5.00E-04	1.45E-04	2.53E-01	3.67E-05		
		total lcf	2.43E+00				
	Loss of Filtration (HEPA filter blowout)						
8.80E-06	per year x	2.30E+01	years x	2.50E+01	tanks =	5.06E-03	probability
	dose •	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	3.70E+04	n/a	n/a	5.06E-03	5.06E-03		
MEI-W	3.70E+03	n/a	n/a	5.06E-03	5.06E-03		
N	1.04E+03	4.00E-04	4.16E-01	5.06E-03	2.10E-03		
MEI-N	2.42E+01	8.00E-04	1.94E-02	5.06E-03	9.80E-05		
P	1.56E+02	5.00E-04	7.80E-02	5.06E-03	3.95E-04		
MEI-P	1.04E-01	5.00E-04	5.20E-05	5.06E-03	2.63E-07		
		total lcf	1.05E+01				
	Seismic Induced Line Break in Vault						
6.00E-05	per year x	2.00E+01	years =	1.20E-03	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	3.40E+01	4.00E-04	1.36E-02	1.20E-03	1.63E-05		
MEI-W	3.40E+00	4.00E-04	1.36E-03	1.20E-03	1.63E-06		
N	7.10E+00	4.00E-04	2.84E-03	1.20E-03	3.41E-06		
MEI-N	2.90E-01	4.00E-04	1.16E-04	1.20E-03	1.39E-07		
P	2.70E+00	5.00E-04	1.35E-03	1.20E-03	1.62E-06		
MEI-P	4.50E-04	5.00E-04	2.25E-07	1.20E-03	2.70E-10		
		total lcf	1.78E-02				
		Breached Canister					
6.00E-01	per year x	2.00E+01	years =	1.20E+01	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	1.45E-04	4.00E-04	5.80E-08	1.00E+00	5.80E-08		
MEI-W	1.45E-05	4.00E-04	5.80E-09	1.00E+00	5.80E-09		
N	5.80E-08	4.00E-04	2.32E-11	1.00E+00	2.32E-11		
MEI-N	4.00E-09	4.00E-04	1.60E-12	1.00E+00	1.60E-12		
P	1.50E-08	5.00E-04	7.50E-12	1.00E+00	7.50E-12		
MEI-P	2.40E-12	5.00E-04	1.20E-15	1.00E+00	1.20E-15		
		total lcf	5.80E-08				
	Hydrogen burn in waste tank						
9.00E-07	per year x	2.30E+01	years =	2.07E-05	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	2.18E+05	n/a	n/a	2.07E-05	2.07E-05		
MEI-W	2.18E+04	n/a	n/a	2.07E-05	2.07E-05		
N	2.45E+04	4.00E-04	9.80E+00	2.07E-05	2.03E-04		
MEI-N	1.74E+03	n/a	n/a	2.07E-05	2.07E-05		
P	3.70E+03	5.00E-04	1.85E+00	2.07E-05	3.83E-05		
MEI-P	4.23E+00	5.00E-04	2.12E-03	2.07E-05	4.38E-08		
		total lcf	2.17E+01				

EX SITU NO SEPARATIONS ALTERNATIVE							
	Mispositioned Jumper (spray release 207 psi)						
1.10E-02	per year x	1.80E+01	years =	1.98E-01	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	1.40E+03	8.00E-04	1.12E+00	1.98E-01	2.22E-01		
MEI-W	1.40E+02	8.00E-04	1.12E-01	1.98E-01	2.22E-02		
N	2.50E+03	4.00E-04	1.00E+00	1.98E-01	1.98E-01		4.81E-01
MEI-N	6.70E+01	8.00E-04	5.36E-02	1.98E-01	1.06E-02		
P	6.20E+02	5.00E-04	3.10E-01	1.98E-01	6.14E-02		
MEI-P	2.90E-01	5.00E-04	1.45E-04	1.98E-01	2.87E-05		
		total lcf	2.43E+00				
	Loss of Filtration (HEPA filter blowout)						
8.80E-06	per year x	1.80E+01	years =	1.58E-04	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	3.70E+04	n/a	n/a	1.58E-04	1.58E-04		
MEI-W	3.70E+03	n/a	n/a	1.58E-04	1.58E-04		
N	1.04E+03	4.00E-04	4.16E-01	1.58E-04	6.59E-05		
MEI-N	2.42E+01	8.00E-04	1.94E-02	1.58E-04	3.07E-06		
P	1.56E+02	5.00E-04	7.80E-02	1.58E-04	1.24E-05		
MEI-P	1.04E-01	5.00E-04	5.20E-05	1.58E-04	8.24E-09		
		total lcf	1.05E+01				
		Breached Canister					
6.00E-01	per year x	1.50E+01	years =	9.00E+00	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	1.45E-04	4.00E-04	5.80E-08	1.00E+00	5.80E-08		
MEI-W	1.45E-05	4.00E-04	5.80E-09	1.00E+00	5.80E-09		
N	5.80E-08	4.00E-04	2.32E-11	1.00E+00	2.32E-11		
MEI-N	4.00E-09	4.00E-04	1.60E-12	1.00E+00	1.60E-12		
P	1.50E-08	5.00E-04	7.50E-12	1.00E+00	7.50E-12		
MEI-P	2.40E-12	5.00E-04	1.20E-15	1.00E+00	1.20E-15		
		total lcf	5.80E-08				
	Hydrogen burn in waste tank						
9.00E-07	per year x	1.80E+01	years x	2.50E+01	tanks =	4.05E-04	probability
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	2.18E+05	n/a	n/a	4.05E-04	4.05E-04		
MEI-W	2.18E+04	n/a	n/a	4.05E-04	4.05E-04		
N	2.45E+04	4.00E-04	9.80E+00	4.05E-04	3.97E-03		
MEI-N	1.74E+03	n/a	n/a	4.05E-04	4.05E-04		
P	3.70E+03	5.00E-04	1.85E+00	4.05E-04	7.49E-04		
MEI-P	4.23E+00	5.00E-04	2.12E-03	4.05E-04	8.57E-07		
		total lcf	2.17E+01				

EX SITU EXTENSIVE SEPARATIONS ALTERNATIVE							
	Mispositioned Jumper (spray release 207 psi)						
1.10E-02	per year x	2.30E+01	years =	2.53E-01	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	1.40E+03	8.00E-04	1.12E+00	2.53E-01	2.83E-01		
MEI-W	1.40E+02	8.00E-04	1.12E-01	2.53E-01	2.83E-02		
N	2.50E+03	4.00E-04	1.00E+00	2.53E-01	2.53E-01		6.15E-01
MEI-N	6.70E+01	8.00E-04	5.36E-02	2.53E-01	1.36E-02		
P	6.20E+02	5.00E-04	3.10E-01	2.53E-01	7.84E-02		
MEI-P	2.90E-01	5.00E-04	1.45E-04	2.53E-01	3.67E-05		
		total lcf	2.43E+00				
	Loss of Filtration (HEPA filter blowout)						
8.80E-06	per year x	2.30E+01	years =	2.02E-04	probability		
	dose •	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	3.70E+04	n/a	n/a	2.02E-04	2.02E-04		
MEI-W	3.70E+03	n/a	n/a	2.02E-04	2.02E-04		
N	1.04E+03	4.00E-04	4.16E-01	2.02E-04	8.42E-05		
MEI-N	2.42E+01	8.00E-04	1.94E-02	2.02E-04	3.92E-06		
P	1.56E+02	5.00E-04	7.80E-02	2.02E-04	1.58E-05		
MEI-P	1.04E-01	5.00E-04	5.20E-05	2.02E-04	1.05E-08		
		total lcf	1.05E+01				
	Seismic Induced Line Break in Vault						
6.00E-05	per year x	2.00E+01	years =	1.20E-03	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	3.40E+01	4.00E-04	1.36E-02	1.20E-03	1.63E-05		
MEI-W	3.40E+00	4.00E-04	1.36E-03	1.20E-03	1.63E-06		
N	7.10E+00	4.00E-04	2.84E-03	1.20E-03	3.41E-06		
MEI-N	2.90E-01	4.00E-04	1.16E-04	1.20E-03	1.39E-07		
P	2.70E+00	5.00E-04	1.35E-03	1.20E-03	1.62E-06		
MEI-P	4.50E-04	5.00E-04	2.25E-07	1.20E-03	2.70E-10		
		total lcf	1.78E-02				
		Breached Canister					
6.00E-01	per year x	2.00E+01	years =	1.20E+01	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	1.45E-04	4.00E-04	5.80E-08	1.00E+00	5.80E-08		
MEI-W	1.45E-05	4.00E-04	5.80E-09	1.00E+00	5.80E-09		
N	5.80E-08	4.00E-04	2.32E-11	1.00E+00	2.32E-11		
MEI-N	4.00E-09	4.00E-04	1.60E-12	1.00E+00	1.60E-12		
P	1.50E-08	5.00E-04	7.50E-12	1.00E+00	7.50E-12		
MEI-P	2.40E-12	5.00E-04	1.20E-15	1.00E+00	1.20E-15		
		total lcf	5.80E-08				
	Hydrogen burn in waste tank						
9.00E-07	per year x	2.30E+01	years x	2.50E+01	tanks =	5.18E-04	probability
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	2.18E+05	n/a	n/a	5.18E-04	5.18E-04		
MEI-W	2.18E+04	n/a	n/a	5.18E-04	5.18E-04		
N	2.45E+04	4.00E-04	9.80E+00	5.18E-04	5.07E-03		
MEI-N	1.74E+03	n/a	n/a	5.18E-04	5.18E-04		
P	3.70E+03	5.00E-04	1.85E+00	5.18E-04	9.57E-04		
MEI-P	4.23E+00	5.00E-04	2.12E-03	5.18E-04	1.09E-06		
		total lcf	2.17E+01				

EX SITU/ IN SITU COMBINATION							
	Mispositioned Jumper (spray release 207 psi)						
1.10E-02	per year x	2.30E+01	years =	2.53E-01	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	1.40E+03	8.00E-04	1.12E+00	2.53E-01	2.83E-01		
MEI-W	1.40E+02	8.00E-04	1.12E-01	2.53E-01	2.83E-02		6.15E-01
N	2.50E+03	4.00E-04	1.00E+00	2.53E-01	2.53E-01		
MEI-N	6.70E+01	8.00E-04	5.36E-02	2.53E-01	1.36E-02		
P	6.20E+02	5.00E-04	3.10E-01	2.53E-01	7.84E-02		
MEI-P	2.90E-01	5.00E-04	1.45E-04	2.53E-01	3.67E-05		
		total lcf	2.43E+00				
	Loss of Filtration (HEPA filter blowout)						
8.80E-06	per year x	2.30E+01	years =	2.02E-04	probability		
	dose •	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	3.70E+04	n/a	n/a	2.02E-04	2.02E-04		
MEI-W	3.70E+03	n/a	n/a	2.02E-04	2.02E-04		
N	1.04E+03	4.00E-04	4.16E-01	2.02E-04	8.42E-05		
MEI-N	2.42E+01	8.00E-04	1.94E-02	2.02E-04	3.92E-06		
P	1.56E+02	5.00E-04	7.80E-02	2.02E-04	1.58E-05		
MEI-P	1.04E-01	5.00E-04	5.20E-05	2.02E-04	1.05E-08		
		total lcf	1.05E+01				
	Seismic Induced Line Break in Vault						
6.00E-05	per year x	2.00E+01	years =	1.20E-03	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	3.40E+01	4.00E-04	1.36E-02	1.20E-03	1.63E-05		
MEI-W	3.40E+00	4.00E-04	1.36E-03	1.20E-03	1.63E-06		
N	7.10E+00	4.00E-04	2.84E-03	1.20E-03	3.41E-06		
MEI-N	2.90E-01	4.00E-04	1.16E-04	1.20E-03	1.39E-07		
P	2.70E+00	5.00E-04	1.35E-03	1.20E-03	1.62E-06		
MEI-P	4.50E-04	5.00E-04	2.25E-07	1.20E-03	2.70E-10		
		total lcf	1.78E-02				
		Breached Canister					
6.00E-01	per year x	2.00E+01	years =	1.20E+01	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	1.45E-04	4.00E-04	5.80E-08	1.00E+00	5.80E-08		
MEI-W	1.45E-05	4.00E-04	5.80E-09	1.00E+00	5.80E-09		
N	5.80E-08	4.00E-04	2.32E-11	1.00E+00	2.32E-11		
MEI-N	4.00E-09	4.00E-04	1.60E-12	1.00E+00	1.60E-12		
P	1.50E-08	5.00E-04	7.50E-12	1.00E+00	7.50E-12		
MEI-P	2.40E-12	5.00E-04	1.20E-15	1.00E+00	1.20E-15		
		total lcf	5.80E-08				
	Hydrogen burn in waste tank						
9.00E-07	per year x	2.30E+01	years x	2.50E+01	tanks =	5.18E-04	probability
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	2.18E+05	n/a	n/a	5.18E-04	5.18E-04		
MEI-W	2.18E+04	n/a	n/a	5.18E-04	5.18E-04		
N	2.45E+04	4.00E-04	9.80E+00	5.18E-04	5.07E-03		
MEI-N	1.74E+03	n/a	n/a	5.18E-04	5.18E-04		
P	3.70E+03	5.00E-04	1.85E+00	5.18E-04	9.57E-04		
MEI-P	4.23E+00	5.00E-04	2.12E-03	5.18E-04	1.09E-06		
		total lcf	2.17E+01				

PHASED IMPLEMENTATION ALTERNATIVE - PHASE 1							
	Mispositioned Jumper (spray release 207 psi)						
1.10E-02	per year x	1.00E+01	years =	1.10E-01	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	1.40E+03	8.00E-04	1.12E+00	1.10E-01	1.23E-01		
MEI-W	1.40E+02	8.00E-04	1.12E-01	1.10E-01	1.23E-02		
N	2.50E+03	4.00E-04	1.00E+00	1.10E-01	1.10E-01		2.67E-01
MEI-N	6.70E+01	8.00E-04	5.36E-02	1.10E-01	5.90E-03		
P	6.20E+02	5.00E-04	3.10E-01	1.10E-01	3.41E-02		
MEI-P	2.90E-01	5.00E-04	1.45E-04	1.10E-01	1.60E-05		
		total lcf	2.43E+00				
	Seismic Induced Line Break in Vault						
6.00E-05	per year x	1.00E+01	years =	6.00E-04	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	3.40E+01	4.00E-04	1.36E-02	6.00E-04	8.16E-06		
MEI-W	3.40E+00	4.00E-04	1.36E-03	6.00E-04	8.16E-07		
N	7.10E+00	4.00E-04	2.84E-03	6.00E-04	1.70E-06		
MEI-N	2.90E-01	4.00E-04	1.16E-04	6.00E-04	6.96E-08		
P	2.70E+00	5.00E-04	1.35E-03	6.00E-04	8.10E-07		
MEI-P	4.50E-04	5.00E-04	2.25E-07	6.00E-04	1.35E-10		
		total lcf	1.78E-02				
		Breached Canister					
1.00E-02	per year x	1.00E+01	years =	1.00E-01	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	0.00E+00	4.00E-04	0.00E+00	1.00E-01	0.00E+00		
MEI-W	0.00E+00	4.00E-04	0.00E+00	1.00E-01	0.00E+00		
N	2.30E-04	4.00E-04	9.20E-08	1.00E-01	9.20E-09		
MEI-N	2.70E-05	4.00E-04	1.08E-08	1.00E-01	1.08E-09		
P	5.80E-05	5.00E-04	2.90E-08	1.00E-01	2.90E-09		
MEI-P	1.80E-08	5.00E-04	9.00E-12	1.00E-01	9.00E-13		
		total lcf	1.21E-07				
	Hydrogen burn in waste tank						
9.00E-07	per year x	1.00E+01	years x	2.50E+01	tanks =	2.25E-04	probability
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	2.18E+05	n/a	n/a	2.25E-04	2.25E-04		
MEI-W	2.18E+04	n/a	n/a	2.25E-04	2.25E-04		
N	2.45E+04	4.00E-04	9.80E+00	2.25E-04	2.21E-03		
MEI-N	1.74E+03	n/a	n/a	2.25E-04	2.25E-04		
P	3.70E+03	5.00E-04	1.85E+00	2.25E-04	4.16E-04		
MEI-P	4.23E+00	5.00E-04	2.12E-03	2.25E-04	4.76E-07		
		total lcf	2.17E+01				

PHASED IMPLEMENTATION ALTERNATIVE - TOTAL ALTERNA							
	Mispositioned Jumper (spray release 207 psi)						
1.10E-02	per year x	2.20E+01	years =	2.42E-01	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	1.40E+03	8.00E-04	1.12E+00	2.42E-01	2.71E-01		
MEI-W	1.40E+02	8.00E-04	1.12E-01	2.42E-01	2.71E-02		5.88E-01
N	2.50E+03	4.00E-04	1.00E+00	2.42E-01	2.42E-01		
MEI-N	6.70E+01	8.00E-04	5.36E-02	2.42E-01	1.30E-02		
P	6.20E+02	5.00E-04	3.10E-01	2.42E-01	7.50E-02		
MEI-P	2.90E-01	5.00E-04	1.45E-04	2.42E-01	3.51E-05		
		total lcf	2.43E+00				
	Loss of Filtration (HEPA filter blowout)						
8.80E-06	per year x	2.20E+01	years =	1.94E-04	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	3.70E+04	n/a	n/a	1.94E-04	1.94E-04		
MEI-W	3.70E+03	n/a	n/a	1.94E-04	1.94E-04		
N	1.04E+03	4.00E-04	4.16E-01	1.94E-04	8.05E-05		
MEI-N	2.42E+01	8.00E-04	1.94E-02	1.94E-04	3.75E-06		
P	1.56E+02	5.00E-04	7.80E-02	1.94E-04	1.51E-05		
MEI-P	1.04E-01	5.00E-04	5.20E-05	1.94E-04	1.01E-08		
		total lcf	1.05E+01				
	Seismic Induced Line Break in Vault						
6.00E-05	per year x	2.60E+01	years =	1.56E-03	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	3.40E+01	4.00E-04	1.36E-02	1.56E-03	2.12E-05		
MEI-W	3.40E+00	4.00E-04	1.36E-03	1.56E-03	2.12E-06		
N	7.10E+00	4.00E-04	2.84E-03	1.56E-03	4.43E-06		
MEI-N	2.90E-01	4.00E-04	1.16E-04	1.56E-03	1.81E-07		
P	2.70E+00	5.00E-04	1.35E-03	1.56E-03	2.11E-06		
MEI-P	4.50E-04	5.00E-04	2.25E-07	1.56E-03	3.51E-10		
		total lcf	1.78E-02				
		Breached Canister					
6.00E-01	per year x	2.60E+01	years =	1.56E+01	probability		
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	1.45E-04	4.00E-04	5.80E-08	1.00E+00	5.80E-08		
MEI-W	1.45E-05	4.00E-04	5.80E-09	1.00E+00	5.80E-09		
N	5.80E-08	4.00E-04	2.32E-11	1.00E+00	2.32E-11		
MEI-N	4.00E-09	4.00E-04	1.60E-12	1.00E+00	1.60E-12		
P	1.50E-08	5.00E-04	7.50E-12	1.00E+00	7.50E-12		
MEI-P	2.40E-12	5.00E-04	1.20E-15	1.00E+00	1.20E-15		
		total lcf	5.80E-08				
	Hydrogen burn in waste tank						
9.00E-07	per year x	2.20E+01	years x	2.50E+01	tanks =	4.95E-04	probability
	dose	LCF/rem	LCF	probability	LCF risk		
receptor	personrem				point esti		
W	2.18E+05	n/a	n/a	4.95E-04	4.95E-04		
MEI-W	2.18E+04	n/a	n/a	4.95E-04	4.95E-04		
N	2.45E+04	4.00E-04	9.80E+00	4.95E-04	4.85E-03		
MEI-N	1.74E+03	n/a	n/a	4.95E-04	4.95E-04		
P	3.70E+03	5.00E-04	1.85E+00	4.95E-04	9.16E-04		
MEI-P	4.23E+00	5.00E-04	2.12E-03	4.95E-04	1.05E-06		
		total lcf	2.17E+01				

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1.7.2

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE Safety: Transportation Accident Calculations

ORIGINATOR Michael R. Harker DATE 12/1/95

REVISION NO. 0

OBJECTIVE Provide number of fatalities and injuries resulting from employee vehicle accidents and transport (truck & rail) accidents.

METHODOLOGY Determine distance traveled in population zone and multiply distance by appropriate injury & fatality incidence rates.

ASSUMPTIONS

1- each person works 260 days a year. 2) round trip distance traveled to work from Tri Cities was 140 Km. 3) 1.35 passengers per vehicle. 4) Vitrified glass shipped to Yucca Mt. 2.938+03 Km round trip by rail.

(Continue on another sheet if necessary)

SIGNATURE

CALCULATION & RESULTS ATTACHED

JACOBS\FORMS\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		5.20E+04	1.00E+01		5.20E+05		
							Total	5.20E+05
Offsite Truck			trips	km/trip		total		
	concrete		2.90E+04	1.40E+02		4.06E+06		
	steel		9.50E+03	8.00E+02		7.60E+06		
			trips/yr	km/trip	yr			
	miscellaneous		5.20E+03	1.40E+02	1.00E+01	7.28E+06		
							Total	1.89E+07
Processing								
Offsite Truck			trips/yr	km/trip	yr	total		
	glassformer/chem		2.30E+01	8.00E+02	1.95E+01	3.59E+05		
	miscellaneous		5.20E+03	1.40E+02	1.95E+01	1.42E+07		
							Total	1.46E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	glassformer/chem		2.60E+02	8.00E+02	1.95E+01	4.06E+06		
							Total	4.06E+06
VITRIFIED HLW TRANSPORT								
Offsite Rail			trips	km/trip		total		
	Yucca Mountain		1.70E+02	2.93E+03		4.98E+05		
							Total	4.98E+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		6.93E+05	1.00E-01	3.00E+01	2.08E+06		
	riprap		1.05E+06	1.00E-01	3.20E+01	3.36E+06		
	ag/sand		7.93E+05	1.00E-01	1.00E+01	7.93E+05		
							Total	7.22E+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)		7.79E+06						
Onsite Rail (km)		0.00E+00						
Offsite Truck (km)		5.52E+07						
Offsite Rail (km)		4.71E+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	5.52E+07	5.00E-02			2.76E+06		
	Rail	4.71E+06	5.00E-02			2.36E+05		
Suburban								
	Truck	5.52E+07	5.00E-02		7.79E+06	1.05E+07		
	Rail	4.71E+06	5.00E-02			2.36E+05		
Rural								
	Truck	5.52E+07	9.00E-01			4.97E+07		
	Rail	4.71E+06	9.00E-01			4.24E+06		
Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			2.76E+06	2.36E+05	1.05E+07	2.36E+05	4.97E+07	4.24E+06
urban truck fat/km		7.50E-09	2.07E-02					

urban truck inj/km		3.70E-07	1.02E+00					
urban rail fat/km		1.70E-08		4.01E-03	-			
urban rail inj/km		3.30E-08		7.78E-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				4.01E-03		
sub rail inj/km		3.30E-08				7.78E-03		
rural truck fat/km		5.30E-08					2.63E+00	
rural truck inj/km		8.00E-07					3.98E+01	
rural rail fat/km		1.70E-08						7.21E-02
rural rail inj/km		3.30E-08						1.40E-01
	TOTAL FATALITIES		2.87E+00					
	TOTAL INJURIES		4.50E+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		2.87E+00	2.07E+01	2.36E+01			
	INJURIES		4.50E+01	1.65E+03	1.69E+03			

		EX SITU NO 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 W-314	1.38E+03	1.00E+01		1.38E+04	Total	1.38E+04
VITRIFICATION							
Construction							
Onsite Truck		trips	km/trip		total		
	borrow	2.02E+04	1.00E+01		2.02E+05	Total	2.02E+05
Offsite Truck		trips	km/trip		total		
	Try Cities	1.30E+04	1.40E+02		1.82E+06		
	Portland/Seattle	5.00E+03	8.00E+02		4.00E+06		
		trips/yr	km/trip	yr			
	miscellaneous	5.20E+03	1.40E+02	5.50E+00	4.00E+06	Total	9.82E+06
Processing							
Offsite Truck		trips/yr	km/trip	yr	total		
	Portand/Seattle	5.00E+01	8.00E+02	1.40E+01	5.60E+05		
	miscellaneous	5.20E+03	1.40E+02	1.40E+01	1.02E+07	Total	1.08E+07
Offsite Rail		trips/yr	km/trip	yr	total		
	Portland/Seattle	1.03E+02	8.00E+02	1.40E+01	1.15E+06	Total	1.15E+06
VITRIFIED HLW TRANSPORT							
Offsite Rail		trips	km/trip		total		
	Yucca Mountain	2.14E+03	2.93E+03		6.27E+06	Total	6.27E+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		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)		5.93E+06						
Onsite Rail (km)		0.00E+00						
Offsite Truck (km)		4.23E+07						
Offsite Rail (km)		7.58E+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	3.50E+03	2.60E+02	1.40E+02	7.41E-01	9.44E+07		
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		
	total	3.91E+04					Total	1.06E+09

Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	4.23E+07	5.00E-02			2.12E+06		
	Rail	7.58E+06	5.00E-02			3.79E+05		
Suburban								
	Truck	4.23E+07	5.00E-02		5.93E+06	8.05E+06		
	Rail	7.58E+06	5.00E-02			3.79E+05		
Rural								
	Truck	4.23E+07	9.00E-01			3.81E+07		
	Rail	7.58E+06	9.00E-01			6.83E+06		

Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			2.12E+06	3.79E+05	8.05E+06	3.79E+05	3.81E+07	6.83E+06
urban truck fat/km		7.50E-09	1.59E-02					
urban truck inj/km		3.70E-07	7.83E-01					
urban rail fat/km		1.70E-08		6.45E-03				
urban rail inj/km		3.30E-08		1.25E-02				

sub truck fat.km		1.30E-08			1.05E-01			
sub truck inj/km		3.80E-07			3.06E+00			
sub rail fat/km		1.70E-08				6.45E-03		
sub rail inj/km		3.30E-08				1.25E-02		
rural truck fat/km		5.30E-08					2.02E+00	
rural truck inj/km		8.00E-07					3.05E+01	
rural rail fat/km		1.70E-08						1.16E-01
rural rail inj/km		3.30E-08						2.25E-01
	TOTAL FATALITIES		2.27E+00					
	TOTAL INJURIES		3.46E+01					
Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	1.06E+09	8.98E-09	9.48E+00				
	injuries	1.06E+09	7.14E-07	7.54E+02				
Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		2.27E+00	9.48E+00	1.17E+01			
	INJURIES		3.46E+01	7.54E+02	7.88E+02			

		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		6.10E+04	1.00E+01		6.10E+05	Total	6.10E+05
Offsite Truck			trips	km/trip		total		
	Tri-Cities		2.70E+04	1.40E+02		3.78E+06		
	Portland/Seattle		1.10E+04	8.00E+02		8.80E+06		
			trips/yr	km/trip	yr			
	miscellaneous		5.20E+03	1.40E+02	9.00E+00	6.55E+06	Total	1.91E+07
Processing								
Offsite Truck			trips/yr	km/trip	yr	total		
	glassformer/chem		5.13E+02	8.00E+02	1.60E+01	6.57E+06		
	miscellaneous		5.20E+03	1.40E+02	1.60E+01	1.16E+07	Total	1.82E+07
Offsite Rail			trips/yr	km/trip	yr	total		
	glassformer/chem		6.37E+02	8.00E+02	1.60E+01	8.15E+06	Total	8.15E+06
VITRIFIED HLW TRANSPORT								
Offsite Rail			trips	km/trip		total		
	Yucca Mountain		1.00E+01	2.93E+03		2.93E+04	Total	2.93E+04
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		6.93E+05	1.00E-01	3.00E+01	2.08E+06		
	riprap		1.05E+06	1.00E-01	3.20E+01	3.36E+06		
	ag/sand		7.93E+05	1.00E-01	1.00E+01	7.93E+05	Total	7.22E+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)		7.88E+06						
Onsite Rail (km)		0						
Offsite Truck (km)		5.91E+07						
Offsite Rail (km)		8.34E+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.	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	5.91E+07	5.00E-02			2.95E+06		
	Rail	8.34E+06	5.00E-02			4.17E+05		
Suburban								
	Truck	5.91E+07	5.00E-02		7.88E+06	1.08E+07		
	Rail	8.34E+06	5.00E-02			4.17E+05		
Rural								
	Truck	5.91E+07	9.00E-01			5.32E+07		
	Rail	8.34E+06	9.00E-01			7.51E+06		
Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			2.95E+06	4.17E+05	1.08E+07	4.17E+05	5.32E+07	7.51E+06
urban truck fat/km		7.50E-09	2.22E-02					
urban truck inj/km		3.70E-07	1.09E+00					

urban rail fat/km		1.70E-08		7.09E-03				
urban rail inj/km		3.30E-08		1.38E-02				
sub truck fat.km		1.30E-08			1.41E-01			
sub truck inj/km		3.80E-07			4.12E+00			
sub rail fat/km		1.70E-08				7.09E-03		
sub rail inj/km		3.30E-08				1.38E-02		
rural truck fat/km		5.30E-08					2.82E+00	
rural truck inj/km		8.00E-07					4.26E+01	
rural rail fat/km		1.70E-08						1.28E-01
rural rail inj/km		3.30E-08						2.48E-01
	TOTAL FATALITIES		3.12E+00					
	TOTAL INJURIES		4.80E+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		3.12E+00	1.97E+01	2.28E+01			
	INJURIES		4.80E+01	1.56E+03	1.61E+03			

	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		1.83E+04	2.60E+02	1.40E+02	7.41E-01	4.94E+08		
	Ops	1.63E+02	2.60E+02	1.40E+02	7.41E-01	4.40E+06		
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			

			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			

		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			

		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			

		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

			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			

		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	2.60E+04	1.00E+01		2.60E+05	Total	2.60E+05
Offsite Truck		trips	km/trip		total		
	concrete	1.45E+04	1.40E+02		2.03E+06		
	steel	4.75E+03	8.00E+02		3.80E+06		
		trips/yr	km/trip	yr			
	miscellaneous	2.60E+03	1.40E+02	1.00E+01	3.64E+06	Total	9.47E+06
Processing							
Offsite Truck		trips/yr	km/trip	yr	total		
	glassformer/chem	1.15E+01	8.00E+02	1.95E+01	1.79E+05		
	miscellaneous	2.60E+03	1.40E+02	1.95E+01	7.10E+06	Total	7.28E+06
Offsite Rail		trips/yr	km/trip	yr	total		
	glassformer/chem	1.30E+02	8.00E+02	1.95E+01	2.03E+06	Total	2.03E+06
VITRIFIED HLW TRANSPORT							
Offsite Rail		trips	km/trip		total		
	Yucca Mountain	8.50E+01	2.93E+03		2.49E+05	Total	2.49E+05
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		5.76E+05	1.00E-01	3.00E+01	1.73E+06		
	riprap		9.21E+05	1.00E-01	3.20E+01	2.95E+06		
	ag/sand		6.43E+05	1.00E-01	1.00E+01	6.43E+05	Total	6.25E+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)		6.55E+06						
Onsite Rail (km)		0.00E+00						
Offsite Truck (km)		2.77E+07						
Offsite Rail (km)		2.36E+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		5.74E+02	2.60E+02	1.40E+02	7.41E-01	1.55E+07		
							Total	1.44E+09
Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	2.77E+07	5.00E-02			1.38E+06		
	Rail	2.36E+06	5.00E-02			1.18E+05		
Suburban								
	Truck	2.77E+07	5.00E-02		6.55E+06	7.93E+06		
	Rail	2.36E+06	5.00E-02			1.18E+05		
Rural								
	Truck	2.77E+07	9.00E-01			2.49E+07		
	Rail	2.36E+06	9.00E-01			2.12E+06		
Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			1.38E+06	1.18E+05	7.93E+06	1.18E+05	2.49E+07	2.12E+06
urban truck fat/km		7.50E-09	1.04E-02					

urban truck inj/km		3.70E-07	5.12E-01					
urban rail fat/km		1.70E-08		2.00E-03				
urban rail inj/km		3.30E-08		3.89E-03				
sub truck fat.km		1.30E-08			1.03E-01			
sub truck inj/km		3.80E-07			3.02E+00			
sub rail fat/km		1.70E-08				2.00E-03		
sub rail inj/km		3.30E-08				3.89E-03		
rural truck fat/km		5.30E-08					1.32E+00	
rural truck inj/km		8.00E-07					1.99E+01	
rural rail fat/km		1.70E-08						3.61E-02
rural rail inj/km		3.30E-08						7.00E-02
	TOTAL FATALITIES		1.47E+00					
	TOTAL INJURIES		2.35E+01					
Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	1.44E+09	8.98E-09	1.30E+01				
	injuries	1.44E+09	7.14E-07	1.03E+03				
Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		1.47E+00	1.30E+01	1.44E+01			
	INJURIES		2.35E+01	1.03E+03	1.05E+03			

			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			

	TOTAL 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		
	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		2.80E+04	1.00E+01		2.80E+05	Total	2.80E+05
Offsite Truck			trips	km/trip		total		
	concrete		1.57E+04	1.40E+02		2.20E+06		
	steel		1.21E+03	8.00E+02		9.68E+05		
	miscellaneous		2.92E+04	1.40E+02		4.09E+06	Total	7.25E+06
Processing								
Offsite Truck			trips	km/trip		total		
	glassformer/chem		3.72E+03	8.00E+02		2.98E+06		
	miscellaneous		1.03E+05	1.40E+02		1.44E+07		
	process material		3.57E+03	1.40E+02		5.00E+05	Total	1.79E+07
Offsite Rail			trips	km/trip		total		
	glassformer/chem		2.75E+03	8.00E+02		2.20E+06	Total	2.20E+06
VITRIFIED HLW TRANSPORT								
Offsite Rail			trips	km/trip		total		
	Yucca Mountain		1.70E+02	2.93E+03		4.98E+05	Total	4.98E+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		6.93E+05	1.00E-01	3.00E+01	2.08E+06		
	riprap		1.05E+06	1.00E-01	3.20E+01	3.36E+06		
	ag/sand		7.93E+05	1.00E-01	1.00E+01	7.93E+05		
	grout fill sand IMUST		2.20E+03	1.00E+01		2.20E+04	Total	7.24E+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)		7.53E+06						
Onsite Rail (km)		0.00E+00						
Offsite Truck (km)		4.69E+07						
Offsite Rail (km)		2.91E+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	4.33E+04	2.60E+02	1.40E+02	7.41E-01	1.17E+09		
							Total	2.20E+09
Distance traveled in population zones								
Urban		Offsite km	zone fraction		Onsite	TOTALS		
	Truck	4.69E+07	5.00E-02			2.34E+06		
	Rail	2.91E+06	5.00E-02			1.46E+05		
Suburban								
	Truck	4.69E+07	5.00E-02		7.53E+06	9.88E+06		
	Rail	2.91E+06	5.00E-02			1.46E+05		
Rural								
	Truck	4.69E+07	9.00E-01			4.22E+07		
	Rail	2.91E+06	9.00E-01			2.62E+06		
Fatalities/Injuries resulting from Truck and Rail transportation accidents								
			urban km		suburban km		rural km	
			truck	rail	truck	rail	truck	rail
			2.34E+06	1.46E+05	9.88E+06	1.46E+05	4.22E+07	2.62E+06
urban truck fat/km		7.50E-09	1.76E-02					

urban truck inj/km		3.70E-07	8.67E-01					
urban rail fat/km		1.70E-08		2.48E-03				
urban rail inj/km		3.30E-08		4.81E-03				
sub truck fat.km		1.30E-08			1.28E-01			
sub truck inj/km		3.80E-07			3.75E+00			
sub rail fat/km		1.70E-08				2.48E-03		
sub rail inj/km		3.30E-08				4.81E-03		
rural truck fat/km		5.30E-08					2.23E+00	
rural truck inj/km		8.00E-07					3.37E+01	
rural rail fat/km		1.70E-08						4.46E-02
rural rail inj/km		3.30E-08						8.66E-02
	TOTAL FATALITIES		2.43E+00					
	TOTAL INJURIES		3.84E+01					
Fatalities/Injuries resulting from Employee vehicle accidents								
		km	rate/km	TOTAL				
	fatalities	2.20E+09	8.98E-09	1.97E+01				
	injuries	2.20E+09	7.14E-07	1.57E+03				
Cumulative fatalities/injuries from traffic impacts								
			transport	employee	TOTAL			
	FATALITIES		2.43E+00	1.97E+01	2.22E+01			
	INJURIES		3.84E+01	1.57E+03	1.61E+03			

	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			

A.R
1.7.2

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE Natural Resources. Transportation (Vehicular Traffic Impacts)

ORIGINATOR A. Bachrach DATE 11/10/95

REVISION NO. 3

OBJECTIVE Estimate Impact of Vehicular Traffic Associated with TWRS alternatives on Baseline Traffic Conditions in Alternatives' Peak Year. Roadways are Stevens Rd at 1100 Area and Route 4 West of Wye Barricade.

METHODOLOGY 1) Estimate Future Baseline Traffic Volumes. 2) Estimate Peak Year Traffic Volume for each TWRS alternative and Sum 1)+2). Use Sum to evaluate level of traffic congestion

ASSUMPTIONS (attached)

(Continue on another sheet if necessary)

Carmi Bachrach
SIGNATURE

CALCULATION & RESULTS ATTACHED

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JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT TRAFFIC IMPACTS SHEET NO. 1

BY _____ CHKD. _____ JOB NO. _____

ASSUMPTIONS

1) Future Baseline Traffic Volume (Average Daily Traffic or ADT) and Future Baseline AM Peak Hour volume will follow historical patterns. Ratio of Total Site Employment to ADT on Stevens Rd. at 1100 Area is 1.725 (Benton Franklin Regional Commission 1993). Ratio of Total Site Employment to ADT on Route 4 West of Wye Barricade is .50 (WHC 1994) Above values used for all alternatives.

2) Use of alternate routes to 200 Areas (versus. Stevens Road and Route 4) based on Benton Franklin Regional Commission SR 240 Corridor Study of 1993). 11% of Site employees commute from Benton City/Yakima (West) and would use SR 24 and Route 11A. 6% of Site employees commute from West Richland and would use Route 10. 700 Vehicles would use State Route 240/240 Access Road. Above values used for all alternatives.

3) TWRS Peak Year employment obtained from Jacobs 1995 and are same values used in Economic Impact analysis

4) All TWRS Construction employment would work M-F day shift and would all be in peak hour.

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 2

BY _____ CHKD. _____ JOB NO. _____

5) TWRS Operations phase employment would include some workers not working M-F, day shift because of 7 day operating work schedule. 50% of non-exempt workers only assumed to work M-F day shift. All

6) exempt employees would work M-F day shift.

7) Per WHC Site planning factor, TWRS employees would have 1.35 person/vehicle to account for carpools and vanpools. (1/1.35 = .74 Factor). Value used for all TWRS alternatives.

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 3

BY _____ CHKD. _____ JOB NO. _____

Peak Year Employment (M-F Day Shift)

Alternative	Total # of Employees	M-F day	Year
No Action	760 (Routine Ops. only)	760	2001
Long-Term Mgmt.	760 (Routine Ops. only)	760	2001
[No analysis of impacts in 2030's during retaining. Analysis of Traffic Impacts 40 years in future of no value]			
In Situ Fill + Cap	<150	(No analysis)	
In Situ Vitrification	2600	2600	2004
Ex Situ Intermediate Separations	4100	4000	2001
Ex Situ No Separations	4400	4100	2000
Ex Situ Extensive Separations	7000	6700	2003
Ex Situ/In Situ Combination	2500	2400	2001
Phased Implementation (Phase 1)	3300	3300	1999
Capsules (all alts.)	<100	(No Analysis)	

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 4

BY _____ CHKD. _____ JOB NO. _____

Stevens Road Future Baseline Volumes

$\frac{\text{1992 ADT}}{\text{1992 Peak Hour}} = \frac{28,231}{3,362}$ Site Employment (1992) = 16,364

Employment: ADT = 1.725

Peak Hour: ADT = .119 (11.9%)

	Site Employment	ADT	Peak Hour
1999	14,758	25,460	3030 (3000)
2000	14,580	25,150	2990 (3000)
2001	14,366	24,780	2949 (2900)
2002	13,976	24,110	2870 (2900)
2003	13,527	23,330	2780 (2800)
2004	13,120	22,630	2690 (2700)

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 5

BY _____ CHKD. _____ JOB NO. _____

Route 4 Future Baseline

ADT 1994 (July) = 9201 Site Employment - 18,436 = (50%)

AM Peak Hour ~~2389~~ 1994 (July) 2389 Employment: ADT = 50%

ADT/Peak Hour Ratio = 26%

		Site Employ.		Route 4 ADT		Route 4 Peak Hour
1999	=	14,758 X	.5 =	7380	X.26	1920 (1900)
2000	=	14,580 X	"	7290	X "	1890 (1900)
2001	=	14,366 X	"	7180	X "	1860 (1900)
2002	=	13,976 X	"	6990	X "	1820 (1800)
2003	=	13,527 X	"	6760	X "	1760 (1800)
2004	=	12,795 X	"	6400	X "	1660 (1700)

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 6

BY _____ CHKD. _____ JOB NO. _____

No Action + Long Term Management (2001 – all employment is Routine Task Perth Operations)

Stevens Road at 1100 Area

Baseline ADT = 24,780

Baseline Am Peak = 2900

TWRS Employment = 760 X .741 (Occupancy Factor) = 560

- 280 Vehicles (50%) use SR 240/240 Access Road
- 62 Vehicles (11%) use Route 11A (West – Benton City)
- 34 Vehicles (6%) use Route 10 (West Richland)

– 376 (380) use alternates

– AM Peak Hour Volume = 2900 (Baseline) + 180 (TWRS) = (3100)

Route 4 West of Wye Barricade

Baseline ADT = 7380

Baseline Am Peak = 1920

TWRS Volum = 180 (– 50% using alternate: Rt 2/11A) = 90

Am Peak Hour Volume = 1920 + 90 = 2010 (2000)

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 7

BY _____ CHKD. _____ JOB NO. _____

In Situ Vitrification (Peak Year = 2004)

Stevens Rd. at 1100 Area

Baseline ADT = 22,630

Baseline AM Peak = 2700

TWRS Employees = 2600 X .74 (Occupancy Factor) = 1920

- 700 vehicles using SR 240/240 Access
- 210 vehicles (11%) using Route 11A (Benton City)
- 120 vehicles (6%) using Route 10 (West Richland)

-1030 vehicles using alternates

AM Peak Hour Volume = 2700 (Baseline) + 900 (TWRS) = 3600

Route 4 ~~patt~~ Wye Barricade

Baseline ADT = 6,400

Baseline AM Peak = 1660

TWRS Volume = 900 - 500 vehicles using Rt 2/11A = ~~500~~ 400

AM Peak Hour Volume = 1,660 (Baseline) + ~~900~~ (TWRS) = 2060 (2100)

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 8

BY _____ CHKD. _____ JOB NO. _____

Ex Situ Intermediate Separations (Peak Year = 2001)

Stevens Road at 1100 Area

Baseline ADT = 24,780

Baseline AM Peak = 2900

TWRS Employees = 4000 X .74 (Occupancy Factor) = 2960

- 700 Vehicles using SR 240/240 Access Road
- 330 vehicles using Route 11A
- 180 vehicles using Route 10
- 1210 using alternates

AM Peak Hour Volume = 2900 (Baseline) + 1750 (TWRS) = 4650 (4700)

Route 4 West of Wye Barricade

Baseline ADT = 7180

Baseline AM Peak = 1860

TWRS Volume = 1750 - 500 using Rt 2/11A alternate = 1250

AM Peak Hour Volume = 1860 (Baseline) + 1250 (TWRS) = 3110 (3100)

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 9

BY _____ CHKD. _____ JOB NO. _____

Ex Situ No Separations (Peak Year = 2000)

Stevens Road

Baseline ADT = 25,150

Baseline AM Peak = 3000

TWRS Employment = 4100 X .74 (Occupancy Factor) = 3030

- 700 Vehicles using SR 240/240 Access Road
- 330 vehicles using Route 11A
- 180 vehicles using Route 10

1210 using alternates

AM Peak Hour = 3000 (Baseline) + 1800 (TWRS) = 4,800

Route 4

Baseline ADT = 7290

Baseline AM Peak = 1890

TWRS Volume = 1800 − 500 vehicles using Route 2/11A) = 1300

AM Peak Hour Volume = 1890 (~~+ 1300~~ Baseline) + 1300 (TWRS) = 3200

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 10

BY _____ CHKD. _____ JOB NO. _____

Ex Situ Extensive Separations (Peak Year = 2003)

Stevens Road

Baseline ADT = 23,330

Baseline AM Peak = 2800

TWRS Employment = 6700 X .74 (Occupancy Factor) = 4960

- 700 Vehicles using SR 240/240 Access Rd.
- 550 Vehicles using Rt. 11A
- 300 Vehicles using Rt. 10

1550 vehicles using alternate

AM Peak Hour Volume = 2800 (Baseline) + 3400 (TWRS) = 6200

Route 4

Baseline ADT = 6760

AM Peak Hour = 1760

TWRS Volume = 3400 - 500 using Rt. 2/11A alternate

AM Peak Hour Volume = 1760 (Baseline) + 2900 (TWRS) = 4700

FORM 11-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 11

BY _____ CHKD. _____ JOB NO. _____

Ex Site / In Site Combination (Peak Year = 2001)

Stevens Road

Baseline ADT = 24,780

Baseline AM Peak = 2900

TWRS Employment = 2400 X .74 (Occupancy Factor) = 1780

-700 vehicles using SR/240/240 Access
-200 vehicles using Route 11A
-110 vehicles using Route 10
1010 vehicles using alternates

AM Peak Hour Volume = 2900 (Baseline) + 770 (TWRS) = 3670 (3700)

Route 4

Baseline ADT = 7180

Baseline AM Peak = 1860

TWRS Volume = 770 - 400 using Rt. 2/11A alternate = 370

AM Peak Hour Volume = 1860 (Baseline) + 370 (TWRS) = 2230 (2200)

FORM 91-005-1 (4/81)

Phased Implementation (Phase 1) Peak Year = ~~2000~~ 1999

Stevens Rd

Baseline ADT = 25,460

Baseline AM Peak = 3000

TWRS Employment = 3300 X .74 (Occupancy Factor) = 2440

- 700 vehicles using SR 240/240 Access Rd.
- 270 vehicles using Route 11A
- 150 vehicles using Route 10

-1120 vehicles using alternates

AM Peak Hour Volume = 3000 (Baseline) + 1300 (TWRS) = 4300

Route 4

Baseline ADT = 7380

Baseline AM Peak = 1920

TWRS Volume = 1300 - 500 using Rt. 2/11A alternate = 800

AM Peak Hour Volume = 1920 + 800 = 2720 (2700)

1.7.2

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE Engineering / Ex Situ Intermediate Separations Data Package.

ORIGINATOR Colin Henderson DATE 11/6/95

REVISION NO. 0

OBJECTIVE Identify the Cost for the Ex Situ Intermediate Separations alternative

METHODOLOGY Use the Waste Retrieval & Transfer, TPA, and Closure data packages to identify applicable Costs.

ASSUMPTIONS Current Ops Cost developed from TPA Rev B data package & Tank Farms Operations data used for M&O Component. Subsurface barriers and Cross-Site XFer line are not included (eg, taken out of) in the Retrieval Cost. W-314 Upgrades to the Existing Waste Transfer System are Included in Current Operations.

(Continue on another sheet if necessary)

Colin Henderson
SIGNATURE

CALCULATION & RESULTS ATTACHED

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JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

Summary:

Continued Operations (TPA Data PKG Rev B Table 9-17) $8,600

R&D.

Retrieval - 190 (WR&T Table 5-14

Treatment - 630 (TPA Data PKG Rev 0 Table 9-17)

$820 $820

CAPITAL

Retrieval - $2,280 (WR&T Table C 5-14)

Treatment - $3,600 (TPA Table 9-17)

Closure $169 (Closure Table 5-9 modified)

$6,049 $6,049

Operating:

Retrieval $4820 (WR&T Table 5-14)

Treatment 3,900 (TPA Table 9-17)

M&M

Total Ops 8,721 $8,721

Repository Fee 3960 (TPA Table 9-17) $3960

TOTAL $28,150

FORM 91-005-1 (4/81)

JUL 21 1995

ENGINEERING DATA TRANSMITTAL

Page 1 of 2

1. EDT № 6125

2. To: (Receiving Organization) TWRS Compliance Plans	3. From: (Originating Organization) Plant System Engineering	4. Related EDT No.: 605651
5. Proj./Prog./Dept./Div.: Tank Waste Remediation System	6. Cog. Engr.: E. A. Fredenburg	7. Purchase Order No.: n/a
8. Originator Remarks: This engineering data package provides supporting data for preparation of the TWRS Environmental Impact Statement. Data in this document complements data provided in separate documentation for the No Separations Alternative, the Extensive Separations Alternative, the Tri-Party Agreement Alternative, and the No Disposal Action Alternative. Environmental, Safety, and QA approvals required by WHC-CM-3-5 Section 12.7 were obtained on Rev. 3 of this document (EDT 605651). The only significant changes in this revision, relative to Rev. 3, involved changes to data tables addressing schedules for construction and operation of waste retrieval systems, for consistency with the other engineering data packages cited above.		9. Equip./Component No.: n/a
		10. System/Bldg./Facility: n/a
11. Receiver Remarks:		12. Major Assm. Dwg. No.: n/a
		13. Permit/Permit Application No.: n/a
		14. Required Response Date: n/a

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-EV-097		0	Waste Retrieval and Transfer Engineering Data Package for the Tank Waste Remediation System Environmental Impact Statement	E/S/Q	2	1	1

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
2	1	Cog.Eng. E. A. Fredenburg	[signature]	7-13-95							
2	1	Cog. Mgr. G. L. Dunford	[signature]	7/18/95							
		QA (approved by J. Weber, on EDT 605651)									
		Safety (approved by J. M. Garcia, on EDT 605651)									
		Env. (approved by R. H. Engelmann, on EDT 605651)									

18. E. A. Fredenburg [signature] 7-13-95 Signature of EDT Originator / Date	19. L. E. Bomemen Authorized Representative for Receiving Organization / Date	20. G. L. Dunford [signature] 7/18/95 Cognizant Manager / Date	21. DOE APPROVAL (if required) Ctrl. No. [ ] Approved [ ] Approved w/comments [ ] Disapproved w/comments [x] Not Required per Waiver WA-557

BD-7400-172-1

EDT-61216

ENGINEERING DATA TRANSMITTAL

1. EDT 605654

2. To: (Receiving Organization) TWRS Compliance Plans	3. From: (Originating Organization) Technical Integration	4. Related EDT No.: 605650
5. Proj./Prog./Dept./Div.: Tank Waste Remediation System	6. Cog. Engr.: E. A. Fredenburg	7. Purchase Order No.: n/a
8. Originator Remarks: This engineering data package provides supporting data for preparation of the TWRS Environmental Impact Statement. Data in this document complements data provided in separate documentation for the In-Situ Disposal Alternative, the No Separations Alternative, the Extensive Separations Alternative, the TPA Preferred Alternative, and the No Disposal Action Alternative. This document includes changes necessitated by a WHC internal review. WHC internal review comments and dispositions are contained in Review Comment Records which will be maintained in separate project files. This EDT transmits the engineering data package for waste retrieval and transfer to TWRS Compliance Plans as Rev. 3, for DOE-RL approval, per WHC-CM-3-5, Section 12.7.		9. Equip./Component No.: n/a
		10. System/Bldg./Facility: n/a
11. Receiver Remarks:		12. Major Assm. Dwg. No.: n/a
		13. Permit/Permit Application No.: n/a
		14. Required Response Date: n/a

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-EV-097		3	Waste Retrieval and Transfer Engineering Data Package for the Tank Waste Remediation System Environmental Impact Statement	E/S/Q D	1/1/1 4	1	

16. KEY

Approval Designator (F)	Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval	4. Review	1. Approved	4. Reviewed no/comment
	2. Release	5. Post-Review	2. Approved w/comment	5. Reviewed w/comment
	3. Information	6. Dist. (Receipt Acknow. Required)	3. Disapproved w/comment	6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
1	1	Cog.Eng.	E A Fredenburg	1/26/95	S4-53	G. A. Meyer		1/26/95	S4-53	1	
1	1	Cog. Mgr.	E A Fredenburg / G L Dunford	1/26/95							
1	1	QA	[illegible]	1/26/95	S1-57						
1	1	Safety	A. M. Tavera	1/26/95	R3-04						
1	1	Env.	[illegible]	1-26-95	H6-26						

18. E A Fredenburg E. A. Fredenburg Signature of EDT Originator — Date 1/26/95	19. R E Bowman L. E. Bowman Authorized Representative for Receiving Organization — Date 1/26/95	20. G. L. Dunford Cognizant Manager — Date	21. DOE APPROVAL (if required) Ctrl. No. [ ] Approved [ ] Approved w/comments [ ] Disapproved w/comments

Table 5-13. Comparison of Alternatives by Process Module for Retrieval and Transfer: (Millions of 1995 Dollars)[1].

Process Module	No Disposal Action	In Situ Disposal	Extensive Pretreatment	No Separations	TPA Preferred Alternative
SST retrieval	$0	$0	$2,508	$2,508	$2,508
SST confinement	$0	$0	$1,492	$1,492	$1,492
SST waste transfers	$0	$0	$1,956	$1,956	$1,956
SST subsurface barriers	$0	$0	$768	$768	$768
DST retrieval	$2,198	$0	$1,306	$1,213	$1,306
DST waste transfers	$272	$0	$458	$344	$458
MUST retrieval	$0	$0	$74	$74	$74
MUST waste transfers	$0	$0	$93	$93	$93
Total	$2,470	$0	$8,657	$8,466	$8,657

Note:

DST = double-shell tank
MUST = miscellaneous underground storage tanks
SST = single-shell tank
TPA = Tri-Party Agreement

[1]For basis of estimate, see Appendix A, Backup to Table 5-13, Overall Retrieval Costs for no action alternative.

Table 5-14. Comparison of Alternatives by Overall Cost Component for Retrieval and Transfer (Millions of 1995 Dollars).

Cost Component	No Disposal Action	In Situ Disposal	Extensive Pretreatment	No Separations	TPA Preferred Alternative
Capital[1]	$1,930	$0	$3,270	$3,270	2,280 ~~$3,270~~
Operating[2]	$440	$0	$5,180	$4,990	4,820 ~~$5,180~~
Research and Development[3]	$100	$0	$210	$210	190 ~~$210~~
Total	$2,470	$0	$8,660	$8,470	7,890 ~~$8,660~~

Notes:

TPA = Tri-Party Agreement

[1]For basis of capital cost estimate, see Table 5-15.

[2]For basis of operating cost estimate, see Table 5-16.

[3]Research and development cost is estimated as 5 percent of capital cost.

Modified per table 5-13 backup pg A-65 to remove Subsurface Barriers.
Capital Costs Reduced by 600 to remove X Site

Table 5-15. Comparison of Alternatives by Capital Cost Component for Retrieval and Transfer (Millions of 1995 Dollars)[1].

Capital Cost Component[2]	No Disposal Action	In Situ Disposal	Extensive Pretreatment	No Separations	TPA Preferred Alternative
Labor	$1,260	$0	$2,120	$2,120	$2,120
Materials/supplies	$190	$0	$330	$330	$330
Equipment	$380	$0	$660	$660	$660
Local purchases	$100	$0	$160	$160	$160
Total	$1,930	$0	$3,270	$3,270	$3,270

Notes:

TPA = Tri-Party Agreement

[1]For capital cost estimate, see Appendix A, Backup to Table 5-6, A-Construction Staff Hours.

[2]Capital costs are assumed to be broken down as follows: labor, 65 percent; materials and supplies, 10 percent; equipment, 20 percent; and local purchases, 5 percent.

Table 5-16. Comparison of Alternatives by Operating Cost Component for Retrieval and Transfer (Millions of 1995 Dollars)[1].

Operating Cost Component	No Disposal Action	In Situ Disposal	Extensive Pretreatment	No Separations	TPA Preferred Alternative
Labor	$396	$0	$4,596	$4,427	$4,596
Materials/Supplies	$17	$0	$194	$186	$194
Equipment	$25	$0	$290	$280	$290
Local Purchases	$8	$0	$97	$93	$97
Total	$446	$0	$5,177	$4,986	$5,177

Note:

TPA = Tri-Party Agreement

[1]For basis of estimate, see Appendix A, Backup to Table 5-16, A-Operating Costs for Tri-Party Agreement and Extensive Separation Alternatives.

Table 5-17. Comparison of Alternatives by Overall Schedule for Retrieval and Transfer (Calendar Year Start/Completion Date)[1]. (2 sheets)

Activity	No Disposal Action[2]	In Situ Disposal	Extensive Pretreatment	No Separations	TPA Preferred Alternative
Construction	2032[3]/2039 and 2082/2089	n/a	1998[3]/2017[4]	1998[3]/2017[4]	1998[3]/2017[4]
Operation	2035[5]/2042 and 2085/2092	n/a	2001[5]/2023[6]	2001[5]/2018[6]	2001[5]/2023[6]
Monitoring and maintenance	n/a	n/a	n/a	n/a	n/a
Decontamination and decommissioning	2044/2051 and 2094/2101	n/a	2012[7]/2025[8]	2012[7]/2020[8]	2012[7]/2025[8]
Research and development	ongoing/2003[9]	n/a	ongoing/2003[9]	ongoing/2003[9]	ongoing/2003[9]

Notes:

TPA = Tri-Party Agreement

[1]These start/complete dates do not consider the start/complete dates for the cross-site transfer line Project W-058 (part of the transfer system for retrieved single-shell tank (SST) wastes). This project is covered under the *Draft Environmental Impact Statement, Safe Interim Storage of Hanford Waste Tanks*, (DOE-RL 1994). Start/complete dates for the remainder of the waste transfer system for SST wastes is assumed bounded by the start/complete dates for SST retrieval systems. Start/complete dates for transfer systems for MUST wastes are assumed bounded by the start/complete dates for miscellaneous underground storage tank (MUST) retrieval systems.

[2]Two durations are shown: one for the first phase of retrieval to new storage tanks and one for the second phase that follows the first by 50 years. For the no action alternative, no SST wastes are retrieved; therefore DST's are not used for staging of SST waste. For this condition, the *Tank Waste Technical Options Report* (Boomer et al. 1993) estimate of DST retrieval duration (7 years) is used. Construction is assumed to have a 7-year duration, starting 3 years earlier than operations based on WHC-SD-W211-CDR-002, Appendix D (WHC 1994). Decontamination and decommissioning is assumed of comparable duration to construction (7 years) and to start 2 years following completion of retrieval operations. Start and finish dates for retrieval oprations are from Table 5-2 (Meng 1995).

Table 5-17. Comparison of Alternatives by Overall Schedule for Retrieval and Transfer (Calendar Year Start/Completion Date)[1]. (2 sheets)

Notes: (Continued)

[1]Excluding SST C-106 (Project W-320) and DSTs SY-101 and SY-103 (Project W-211) which are covered under separate National Environmental Policy Act documentation, the first double-shell tank (DST) to start construction is AW-101 (Package I of Project W-211) per WHC-SD-W211-CDR-002, Appendix D (WHC 1994). Construction of the first SST retrieval system does not start before 2000 per Tri-Party Agreement milestone M-45-04 (Ecology et al. 1990).

[2]Completed construction of SST retrieval systems is assumed to be one year prior to completion of retrieval from SSTs, September 30, 2018 per Tri-Party Agreement milestone M-45-05 (Ecology et al. 1990). DST retrieval system construction and installation is assumed to precede SST retrieval, since DSTs are used as staging tanks for SST wastes.

[3]Excluding SST C-106, DST SY-101, and SY-103, AW-101 will be the first DST to operate in 2001, per WHC-SD-W211-CDR-002, Appendix D (WHC 1994).

[4]For the Tri-Party Agreement preferred alternative, DST retrieval is assumed to continue until completion of vitification operations. The extensive separation alternative is assumed to have the same schedule. For the no separations alternative, vitrification operations are scheduled to be completed in 2018. DST retrieval operations will be conducted to support this schedule and will therefore also be conducted concurrent with, and completed at the time of, or shortly after completion of SST retrieval operations.

[5]Decontamination and decommissioning of retrieval systems is assumed to start with initiation of tank farm closure activities per Tri-Party Agreement milestone M-45-06-T3 (Ecology et al. 1990).

[6]Decontamination and decommissioning of retrieval systems is assumed to be completed two years after completion of retrieval operations.

[7]Tri-Party Agreement milestone M-45-03-T1 (Ecology et al. 1990).

Table 5-17. Comparison of Alternatives by Overall Schedule for Retrieval and Transfer (Calendar Year Start/Completion Date)[1]. (2 sheets)

Boomer, K. D., et al., 1993, *Tank Waste Technical Options Report*, WHC-EP-0616, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

DOE-RL, 1994, *Draft Environmental Impact Statement, Safe Interim Storage of Hanford Tank Wastes, Hanford Site, Richland, Washington*, DOE/EIS-0212, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA and DOE, 1994, *Hanford Federal Facility Agreement and Consent Order*, 2 vols, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency and U.S. Department of Energy, Olympia, Washington.

Meng, C. D., 1995, *No Disposal Action Engineering Data Package for the Tank Waste Remediation System Environmental Impact Statement*, WHC-SD-WM-EV-099, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC, 1994, *Conceptual Design Report, Initial Tank Retrieval Systems*, Project W-211, WHC-SD-W211-CDR-002, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Backup to Table 5-13. Overall Retrieval Costs for Tri-Party Agreement and Extensive Separations Alternatives (2 sheets).

Tanks	Cap Cost Millions	Operating Staff Hours	Op. Cost Millions	M&M Cost Millions	R&D Cost Millions	Total Cost Millions
SSTs						
Retrieval						
Arm-based	$283	13,514,932	$1,069	$0	$57	$1,408
Sluicing	$579	6,224,163	$492	$0	$29	$1,100
Confinement						
Arm-based	$587	11,080,075	$876	$0	$29	$1,492
Sluicing	$0	0	$0	$0	$0	$0
Barriers	$390	4,540,061	$359	$0	$20	$768
Transfer						
Pipeline	$408	19,329,408	$1,528	$0	$20	$1,956
Container	$0	0	$0	$0	$0	$0
SST Total =	$2,247	54,688,639	$4,324	$0	$155	$6,725
DSTs						
Retrieval						
Mixer pumps	$916	3,172,608	$251	$0	$46	$1,213
Sluicing	$48	541,987	$43	$0	$2	$93
Transfer						
Pipeline	$0	5,798,822	$458	$0	$0	$458
DST Total =	$964	9,513,418	$752	$0	$48	$1,764
MUSTs						
Retrieval						
Sluicing	$39	421,546	$33	$0	$2	$74

Backup to Table 5-13. Overall Retrieval Costs for Tri-Party Agreement and Extensive Separations Alternatives (2 sheets).

Transfer Container	$23	870,998	$69	$0	$1	$93
MUST Total =	$62	1,292,544	$102	$0	$3	$167
Retrieval =	$3,273	65,494,600	$5,177	$0	$207	$8,657

Notes:

DST = double-shell tank
MUST = miscellaneous underground storage tank
SST = single-shell tank

As indicated in Section 5.0, the values in these tables are imported from spreadsheet calculations. The number of significant figures shown does not imply level of accuracy or degree of confidence in the estimated values.

See Notes to Backup Table 5-6 Construction Staff Hours for capital cost basis.

See Table 5-1 and Table 5-16 for operating cost staff hours and basis.

D&D cost basis is included in operating cost, and is based on entombment in place, per the Hanford Mission Plan, DOE/RL-93-102.

Operating cost includes startup cost.

Retrieval R&D cost is assumed to be 5 percent of retrieval capital cost, except R&D cost for arm-based SST retrieval includes additional $43 million for SST retrieval test facility.

Boomer, K. D., et al., 1993, *Tank Waste Technical Options Report*, WHC-EP-0616, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Backup to Table 5-13. Overall Retrieval Costs for No Separations Alternative (2 sheets).

Tanks	Cap. Cost Millions	Operating Staff-hours	Op. Cost Millions	M&M Cost Millions	R&D Cost Millions	Total Cost Millions
SSTs						
Retrieval						
Arm-based	$283	13,514,932	$1,068	$0	$57	$1,408
Sluicing	$579	6,224,163	$492	$0	$29	$1,100
Confinement						
Arm-based	$587	11,080,075	$875	$0	$29	$1,492
Sluicing	$0	0	$0	$0	$0	$0
Barriers	$390	4,540,061	$359	$0	$20	$768
Transfer						
Pipeline	$408	19,329,408	$1,527	$0	$20	$1,955
Container	$0	0	$0	$0	$0	$0
SST Total =	$2,247	54,688,639	$4,320	$0	$112	$6,723
DSTs						
Retrieval						
Mixer pumps	$916	2,379,456	$188	$0	$46	$1,150
Sluicing	$48	406,490	$32	$0	$2	$83
Transfer						
Pipeline	$0	4,349,117	$344	$0	$0	$344
DST Total =	$964	7,135,063	$564	$0	$48	$1,576
MUSTs						
Retrieval						
Sluicing	$39	421,546	$33	$0	$2	$74

Backup to Table 5-13. Overall Retrieval Costs for No Separations Alternative (2 sheets).

Tanks	Cap Cost Millions	Operating Staff hours	Op. Cost Millions	M&M Cost Millions	R&D Cost Millions	Total Cost Millions
Transfer Container	$23	870,998	$69	$0	$1	$93
MUST Total =	$62	1,292,544	$102	$0	$3	$167
Retrieval =	$3,273	63,116,246	$4,986	$0	$207	$8,466

Notes:

DST = double-shell tank
MUST = miscellaneous underground storage tank
SST = single-shell tank

As indicated in Section 5.0, the values in these tables are imported from spreadsheet calculations. The number of significant figures shown does not imply level of accuracy or degree of confidence in the estimated values.

See Notes to Backup Table 5-6 Construction Staff hours for capital cost basis.

See Table 5-1 and Table 5-16 for operating cost staff hours and basis.

D&D cost is included in operating cost, and is based on entombment in place, per the Hanford Mission Plan, DOE/RL-93-102.

Operating cost includes startup costs.

Retrieval R&D cost is assumed to be 5 percent of retrieval capital cost, except R&D cost for arm-based SST retrieval also includes additional $43 million for SST retrieval test facility.

Boomer, K. D., et al., 1993, *Tank Waste Technical Options Report*, WHC-EP-0616, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Backup to Table 5-13. Overall Retrieval Costs for No Disposal Action Alternative (2 sheets).

Tanks	Capital Cost Millions	Operating Staff Hours	Operating Cost Millions	M&M Cost Millions	R&D Cost Millions	Total Cost Millions
SSTs						
Retrieval						
Arm-based	$0	0	$0	$0	$0	$0
Sluicing	$0	0	$0	$0	$0	$0
Confinement						
Arm-based	$0	0	$0	$0	$0	$0
Sluicing	$0	0	$0	$0	$0	$0
Barriers	$0	0	$0	$0	$0	$0
Transfer						
Pipeline	$0	0	$0	$0	$0	$0
Container	$0	0	$0	$0	$0	$0
SST Total =	$0	0	$0	$0	$0	$0
DSTs						
Retrieval						
Mixer pumps	$1,832	1,850,688	$149	$0	$92	$2,072
Sluicing	$96	316,159	$25	$0	$5	$126
Transfer						
Pipeline	$0	3,382,646	$272	$0	$0	$272
DST Total =	$1,928	5,549,493	$446	$0	$96	$2,470
MUSTs						
Retrieval						
Sluicing	$0	0	$0	$0	$0	$0

Backup to Table 5-13. Overall Retrieval Costs for No Disposal Action Alternative (2 sheets).

Tanks	Capital Cost Millions	Operating Staff Hours	Operating Cost Millions	M&M Cost Millions	R&D Cost Millions	Total Cost Millions
Transfer Container	$0	0	$0	$0	$0	$0
MUST Total =	$0	0	$0	$0	$0	$0
Retrieval =	$1,928	5,549,493	$446	$0	$96	$2,470

Notes:

DST = double-shell tank
MUST = miscellaneous underground storage tank
SST = single-shell tank

As indicated in Section 5.0, the values in these tables are imported from spreadsheet calculations. The number of significant figures shown does not imply level of accuracy or degree of confidence in the estimated values.

See Notes to Backup Table 5-6 Construction Staff hours for capital cost basis.

See Table 5-1 and Table 5-16 for operating cost staff hours and basis.

D&D cost is included in operating cost.

Operating cost includes startup costs.

Retrieval R&D cost is assumed to be 5 percent of retrieval capital cost.

Boomer, K. D., et al., 1993, *Tank Waste Technical Options Report*, WHC-EP-0616, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Backup to Table 5-16. Operating Costs for Tri-Party Agreement and Extensive Separations Alternatives (3 sheets).

mh/FTE = 1836	Weighting Factor %	FTE/yr Total	FTE/yr EX	FTE/yr NB	FTE/yr DU	Weighted	Life Cycle Factor	Lifetime Staff Hours	EX mhs	NB mhs	DU mhs
SSTs											
Retrieval											
Arm-based	33.56%	1371	242	61	1068	460.06711	16	13,514,932	2,385,568	601,321	10,528,043
Sluicing	73.83%	287	120	29	138	211.87919	16	6,224,163	2,602,438	628,922	2,992,803
Confinement											
Arm-based	33.56%	1124	232	91	801	377.18121	16	11,080,075	2,286,991	897,052	7,896,032
Sluicing	73.83%	0	0	0	0	0	16	0	0	0	0
Barriers	100.00%	112.4	23.2	9.1	80.1	112.4	22	4,540,061	937,094	367,567	3,235,399
Transfer											
Pipeline	100.00%	658	245	82	331	658	16	19,329,408	7,197,120	2,408,832	9,723,456
Container	0.00%	593	221	79	293	0	16	0	0	0	0
SST sub-total =								54,688,639	15,409,210	4,903,695	34,375,734
DSTs											
Retrieval											
Mixer pumps	100.00%	72	28	9	35	72	24	3,172,608	1,233,792	396,576	1,542,240
Sluicing	21.43%	57.4	24	5.8	27.6	12.3	24	541,987	226,615	54,765	260,607
Transfer											
Pipeline	100.00%	131.6	49	16.4	66.2	131.6	24	5,798,822	2,159,136	722,650	2,917,036
DST sub-total =								9,513,418	3,619,543	1,173,991	4,719,884
MUSTs											
Retrieval											
Sluicing	100.00%	14.35	6	1.45	6.9	14.35	16	421,546	176,256	42,595	202,694
Transfer											
Container	100.00%	29.65	11.05	3.95	14.65	29.65	16	870,998	324,605	116,035	430,358

Backup to Table 5-16. Operating Costs for Tri-Party Agreement and Extensive Separations Alternatives (3 sheets).

mh/FTE = 1836	Weighting Factor	FTE/yr Total	FTE/yr EX	FTE/yr NB	FTE/yr DU	Weighted	Life Cycle Factor	Lifetime Staff Hours	EX mhs	NB mhs	DU mhs
MUST sub-total =								1,292,544	500,861	158,630	633,053
TOTAL =								65,494,600	19,529,614	6,236,316	39,728,671

Notes:

DST = double-shell tank
MUST = miscellaneous underground storage tank
SST = single-shell tank

As indicated in Section 5.0, the values in these tables are imported from spreadsheet calculations. The number of significant figures shown does not imply level of accuracy or degree of confidence in the estimated values.

SST retrieval annual staff hours are based on WHC-EP-0616 (Boomer et al. 1993), Tables F4-5 and F4-16, with Maintenance DU reduced 1/4 to account for 1/3 longer SST retrieval (16 yrs vs 12 yrs), per Tri-Party Agreement schedule.

SST confinement annual staff hours are based on WHC-EP-0616, Table F7-13 (maximum of alternatives).

Backup to Table 5-16. Operating Costs for Tri-Party Agreement and Extensive Separations Alternatives (3 sheets).

Notes: (Continued)

SST subsurface barriers are based on assumed 10 percent of confinement annual staff hours, for cryogenic or air circulation barriers requiring operational support.

SST waste transfer annual staff hours are based on WHC-EP-0616, Table F8-5.

Subsurface barrier operations assumed required 6 years longer that SST retrieval operations, based on Tri-Party Agreement M-45 milestones.

Mixer pump DST retrieval annual staff hours are based on WHC-EP-0616, Table F5-4.

Assumes 6 DSTs will require sluicing following mixer pump operations to meet closure criteria.

Sluicing DST retrieval annual staff hours are assumed 20 percent (~28/149) of SST sluicing staff hours.

DST waste transfer annual staff hours are assumed 20 percent (~28/149) of SST waste transfer staff hours.

MUST retrieval staff hours are assumed 5 percent of SST retrieval staff hours (~10 x MUST vol./SST vol.)

MUST waste transfer staff hours are assumed 5 percent of SST transfer staff hours (~10 x MUST vol./SST vol.) for container transport (assumes pipelines not available).

Assumes no increase in WHC-EP-0616 staff estimates, for staging/blending in DSTs.

Staff hours/full time equivalent = 1836

Boomer, K. D., et al., 1993, *Tank Waste Technical Options Report*, WHC-EP-0616, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Backup to Table 5-16. Operating Costs for No Separations Alternative (3 sheets).

mh/FTE in 1836	Weighting Factor	FTE/yr Total	FTE/yr BX	FTE/yr NB	FTE/yr HU	Weighted	Life Cycle Factor	Lifetime Staff Hours	BX mh4	NB mh4	HU mh4
SSTs											
Retrieval											
Arm-based	33.56%	1371	242	61	1068	460.067114	16	13,514,932	2,385,568	601,321	10,528,043
Sluicing	73.83%	287	120	29	138	211.879195	16	6,224,163	2,602,438	628,922	2,992,803
Confinement											
Arm-based	33.56%	1124	232	91	801	377.181208	16	11,080,075	2,286,991	897,052	7,896,032
Sluicing	73.83%	0	0	0	0	0	16	0	0	0	0
Barriers	100.00%	112.4	23.2	9.1	80.1	112.4	22	4,540,061	937,094	367,567	3,235,399
Transfer											
Pipeline	100.00%	658	245	82	331	658	16	19,329,408	7,197,120	2,408,832	9,723,456
Container	0.00%	593	221	79	293	0	16	0	0	0	0
SST sub-total =								54,688,639	15,409,210	4,903,695	34,375,734
DSTs											
Retrieval											
Mixer pumps	100.00%	72	28	9	35	72	18	2,379,456	925,344	297,432	1,156,680
Sluicing	21.43%	57.4	24	5.8	27.6	12.3	18	406,490	169,961	41,074	195,455
Transfer											
Pipeline	100.00%	131.6	49	16.4	66.2	131.6	18	4,349,117	1,619,352	541,987	2,187,778
DST sub-total =								7,135,063	2,714,657	880,493	3,539,913
MUSTs											
Retrieval											
Sluicing	100.00%	14.35	6	1.45	6.9	14.35	16	421,546	176,256	42,595	202,694
Transfer											
Container	100.00%	29.65	11.05	3.95	14.65	29.65	16	870,998	324,605	116,035	430,358
MUST sub-total =								1,292,544	500,861	158,630	633,053

Backup to Table 5-16. Operating Costs for No Separations Alternative (3 sheets).

mh/FTE = 1836	Weighting Factor	FTE/yr Total	FTE/yr BX	FTE/yr NB	FTE/yr DU	Weighted	Life Cycle Factor	Lifetime Staff Hours	BX mhs	NB mhs	DU mhs
TOTAL =								63,116,246	18,624,728	5,942,818	38,548,699

Notes:

DST = double-shell tank
MUST = miscellaneous underground storage tank
SST = single-shell tank

As indicated in Section 5.0, the values in these tables are imported from spreadsheet calculations. The number of significant figures shown does not imply level of accuracy or degree of confidence in the estimated values.

SST retrieval annual staff hours are based on WHC-EP-0616 (Boomer et al. 1993), Tables F4-5 and F4-16, with Maintenance BU reduced 1/4 to account for 1/3 longer SST retrieval (16 yrs vs 12 yrs), per Tri-Party Agreement schedule.

SST confinement annual staff hours are based on WHC-EP-0616, Table F7-13 (maximum of alternatives).

Backup to Table 5-16. Operating Costs for No Separations Alternative (3 sheets).

Notes: (Continued)

SST subsurface barriers are based on assumed 10 percent of confinement annual staff hours, for cryogenic or air circulation barriers requiring operational support.

SST waste transfer annual staff hours are based on WHC-EP-0616, Table F8-5.

Subsurface barrier operations are assumed required 6 years longer that SST retrieval operations, based on Tri-Party Agreement M-45 milestones.

Mixer pump DST retrieval annual staff hours are based on WHC-EP-0616, Table F5-4.

Assumes 6 DSTs will require sluicing following mixer pump operations to meet closure criteria.

Sluicing DST retrieval annual staff hours assumed 20 percent (~28/149) of SST sluicing staff hours.

DST waste transfer annual staff hours assumed 20 percent (~28/149) of SST waste transfer staff hours.

MUST retrieval staff hours assumed 5 percent of SST retrieval staff hours (~10 x MUST vol./SST vol.)

MUST waste transfer staff hours assumed 5 percent of SST transfer staff hours (~10 x MUST vol./SST vol.) for container transport (assumes pipelines not available).

Assume no increase in WHC-EP-0616 staff estimates, for staging/blending in DSTs.

Staff hours/full time equivalent = 1836

Boomer, K. D., et al., 1993, *Tank Waste Technical Options Report*, WHC-EP-0616, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Backup to Table 5-16. Operating Costs for No Disposal Action Alternative (2 sheets).

mh/FTE = 1836	Weighting Factor	FTE/yr Total	FTE/yr EX	FTE/yr NP	FTE/yr BU	Weighted	Life Cycle Factor	Lifetime Staff hours	EX mhs	NP mhs	BU mhs
SSTs											
Retrieval											
Arm-based	33.56%	1371	242	61	1068	460.067114	0	0	0	0	0
Sluicing	73.83%	287	120	29	138	211.879195	0	0	0	0	0
Confinement											
Arm-based	33.56%	1124	232	91	801	377.181208	0	0	0	0	0
Sluicing	73.83%	0	0	0	0	0	0	0	0	0	0
Barriers	100.00%	112.4	23.2	9.1	80.1	112.4	0	0	0	0	0
Transfer											
Pipeline	100.00%	658	245	82	331	658	0	0	0	0	0
Container	0.00%	593	221	79	293	0	0	0	0	0	0
SST sub-total =								0	0	0	0
DSTs											
Retrieval											
Mixer pumps	100.00%	72	28	9	35	72	14	1,850,688	719,712	231,336	899,640
Sluicing	21.43%	57.4	24	5.8	27.6	12.3	14	316,159	132,192	31,946	152,021
Transfer											
Pipeline	100.00%	131.6	49	16.4	66.2	131.6	14	3,382,646	1,259,496	421,546	1,701,605
DST sub-total =								5,549,494	2,111,400	684,828	2,753,266
MUSTs											
Retrieval											
Sluicing	100.00%	14.35	6	1.45	6.9	14.35	0	0	0	0	0
Transfer											
Container	100.00%	29.65	11.05	3.95	14.65	29.65	0	0	0	0	0
MUST sub-total =								0	0	0	0
TOTAL =								5,549,494	2,111,400	684,828	2,753,266

Backup to Table 5-16. Operating Costs for No Disposal Action Alternative (2 sheets).

Notes:

DST = double-shell tank
MUST = miscellaneous underground storage tank
SST = single-shell tank

As indicated in Section 5.0, the values in these tables are imported from spreadsheet calculations. The number of significant figures shown does not imply level of accuracy or degree of confidence in the estimated values.

Mixer pump DST retrieval annual staff hours are based on WHC-EP-0616 (Boomer et al. 1993), Table F5-4.

Assumes 6 DSTs will require sluicing following mixer pump operations to meet closure criteria.

Sluicing DST retrieval annual staff hours are assumed 20 percent (~28/149) of SST sluicing staff hours.

DST waste transfer annual staff hours are assumed 20 percent (~28/149) of SST waste transfer staff hours.

Boomer, K. D., et al., 1993, *Tank Waste Technical Options Report*, WHC-EP-0616, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Backup to Table 5-16. Operating Costs Breakdown for Tri-Party Agreement and Extensive Separations Alternatives (2 sheets).

Description	CB	$/hr	hrs	CE percent	OH	Total	GA/CSP	Total with GA/CSP
WHC Labor:								
EX	#01	$39.52	19,529,614	n/a	22.50%	$945,467,673	24.50%	$1,177,107,253
NE	#00	$15.47	6,236,316	n/a	22.50%	$118,182,865	24.50%	$147,137,667
BU	#06	$28.59	39,728,670	n/a	22.50%	$1,391,407,277	24.50%	$1,732,302,060
Materials	#1	n/a	n/a	9.35%	n/a	n/a	incl.	$285,762,099
Purch. Svcs.	#2	n/a	n/a	16.95%	n/a	n/a	incl.	$518,109,214
Other Cont.	#3	n/a	n/a	23.56%	n/a	n/a	incl.	$719,971,086
Site Svcs	#4	n/a	n/a	9.36%	n/a	n/a	incl.	$286,046,675
Internal Chrg.	#5	n/a	n/a	7.80%	n/a	n/a	incl.	$238,463,136
IRM/BCSR	#6	n/a	n/a	2.37%	n/a	n/a	incl.	$72,493,457
IN Program:	FY94	% of	Actual	% of		Total =		$5,177,392,148
CE	BAC ($M)	#0 + #7	ACWP ($M)	#0 + #7				
#0 + #7	145.7507	100.00%	128.8883	100.00%		BREAKDOWN OF OPERATING COSTS FOR RETRIEVAL		
#1	9.4223	6.46%	12.05	9.35%		Category	Rate	Total
#2	23.9895	16.46%	21.8476	16.95%		Labor	88.78%	$4,596,540,098
#3	25.1576	17.26%	30.3597	23.56%		Mat'l/Supplies	3.74%	$193,617,517
#4	11.5042	7.89%	12.062	9.36%		Equipment	5.61%	$290,426,275
#5	13.0222	8.93%	10.0555	7.80%		Local Purchases	1.87%	$96,808,758
#6	1.5236	1.05%	3.0569	2.37%			Total =	$5,177,392,648

Backup to Table 5-16. Operating Costs Breakdown for Tri-Party Agreement and Extensive Separations Alternatives (2 sheets).

Notes:

As indicated in Section 5.0, the values in these tables are imported from spreadsheet calculations. The number of significant figures shown does not imply level of accuracy or degree of confidence in the estimated values.

WHC Labor staff hours are from Backup to Table 5-1 Operating Staff hours.

WHC labor rates and overhead rates are from FDS for TWRS for fiscal year 1995.

In calculation of operating costs, percentages given for material, purchased services, other contractors, site services, internal charges, and IRM are a percentage of WHC labor plus overhead, based on the IN program 1994 fiscal-year-to-date actual spending through July.

In calculation of breakdown of operating costs, cost element 1, materials, is estimated to be distributed 40 percent to materials/supplies, and 60 percent to equipment.

In calculation of breakdown of operating costs, local purchases is estimated to be 20 percent of cost element 2, purchased services.

Backup to Table 5-16. Operating Costs Breakdown for No Separations Alternative (2 sheets).

Description	CB	$/hr	hrs	CE %	OH	Total	GA/CSP	Total with GA/CSP
WHC Labor:								
EX	#01	$39.52	18,624,728	n/a	22.50%	$901,660,332	24.50%	$1,122,567,113
NE	#00	$15.47	5,942,818	n/a	22.50%	$112,620,858	24.50%	$140,212,968
BU	#06	$28.59	38,548,699	n/a	22.50%	$1,350,081,448	24.50%	$1,680,851,403
Materials	#1	n/a	n/a	9.35%	n/a	n/a	incl.	$275,205,425
Purch. Svcs.	#2	n/a	n/a	16.95%	n/a	n/a	incl.	$498,969,132
Other Cont.	#3	n/a	n/a	23.56%	n/a	n/a	incl.	$693,373,788
Site Svcs	#4	n/a	n/a	9.36%	n/a	n/a	incl.	$275,479,489
Internal Chrg.	#5	n/a	n/a	7.80%	n/a	n/a	incl.	$229,653,789
IRM/BCSR	#6	n/a	n/a	2.37%	n/a	n/a	incl.	$69,815,391

IN Program:	FY94	% of	(thru Aug)	% of		Total =		$4,986,128,498
CE	BAC ($M)	#0 + #7	FYTD ($M)	#0 + #7				
#0 + #7	145.7507	100.00%	128.8883	100.00%		BREAKDOWN OF OPERATING COSTS FOR RETRIEVAL		
#1	9.4223	6.46%	12.05	9.35%		Category	Rate	Total
#2	23.9895	16.46%	21.8476	16.95%		Labor	88.78%	$4,426,733,905
#3	25.1576	17.26%	30.3597	23.56%		Mat'l/Supplies	3.74%	$186,464,864
#4	11.5042	7.89%	12.062	9.36%		Equipment	5.61%	$279,697,296
#5	13.0222	8.93%	10.0555	7.80%		Local Purchases	1.87%	$93,232,432
#6	1.5236	1.05%	3.0569	2.37%			Total =	$4,986,128,498

Backup to Table 5-16. Operating Costs Breakdown for No Separations Alternative (2 sheets).

Notes:

As indicated in Section 5.0, the values in these tables are imported from spreadsheet calculations. The number of significant figures shown does not imply level of accuracy or degree of confidence in the estimated values.

WHC Labor staff hours are from Backup to Table 5-1 Operating Staff hours (= 2x DST operating staff hours).

WHC labor rates and overhead rates are from FDS, for TWRS, for fiscal year 1995

In calculation of operating costs, percentages given for material, purchased services, other contractors, site services, internal charges, and IRM are a percentage of WHC Labor plus Overhead, based on the 1N program 1994 fiscal-year-to-date actual spending through July.

In calculation of breakdown of operating costs, cost element 1, materials, is estimated to be distributed 40 percent to materials/supplies, and 60 percent to equipment.

In calculation of breakdown of operating costs, local purchases is estimated to be 20 percent of cost element 2, purchased services.

Backup to Table 5-16. Operating Costs Breakdown for No Disposal Action Alternative (2 sheets).

Description	CE	$/hr	hrs	CE %	OH	Total	GA/CSP	Total with GA/CSP
WHC Labor:								
EX	#01	$39.52	2,111,400	n/a	22.50%	$102,217,097	24.50%	$127,260,286
NE	#00	$15.47	684,828	n/a	22.50%	$12,978,004	24.50%	$16,157,615
BU	#06	$28.59	2,753,266	n/a	22.50%	$96,426,947	24.50%	$120,051,549
Materials	#1	n/a	n/a	9.35%	n/a	n/a	incl.	$24,632,235
Purch. Svcs.	#2	n/a	n/a	16.95%	n/a	n/a	incl.	$44,660,184
Other Cont.	#3	n/a	n/a	23.56%	n/a	n/a	incl.	$62,060,353
Site Svcs	#4	n/a	n/a	9.36%	n/a	n/a	incl.	$24,656,765
Internal Chrg.	#5	n/a	n/a	7.80%	n/a	n/a	incl.	$20,555,140
IRM/BCSR	#6	n/a	n/a	2.37%	n/a	n/a	incl.	$6,248,820

IN Program:	FY94	% of	(thru Aug)	% of		Total =		$446,282,946
CE	BAC ($M)	#0 + #7	FYTD ($M)	#0 + #7				
#0 + #7	145.7507	100.00%	128,8883	100.00%		BREAKDOWN OF OPERATING COSTS FOR RETRIEVAL		
#1	9.4223	6.46%	12.05	9.35%		Category	Rate	Total
#2	23.9895	16.46%	21.8476	16.95%		Labor	88.78%	$396,214,387
#3	25.1576	17.26%	30.3597	23.56%		Mat'l/Supplies	3.74%	$16,689,520
#4	11.5042	7.89%	12.062	9.36%		Equipment	5.61%	$25,034,279
#5	13.0222	8.93%	10.0555	7.80%		Local Purchases	1.87%	$8,344,760
#6	1.5236	1.05%	3.0569	2.37%			Total =	$446,282,946

Backup to Table 5-16. Operating Costs Breakdown for No Disposal Action Alternative (2 sheets).

Notes:

As indicated in Section 5.0, the values in these tables are imported from spreadsheet calculations. The number of significant figures shown does not imply level of accuracy or degree of confidence in the estimated values.

WHC Labor staff hours are from Backup to Table 5-1 Operating Staff hours (= 2x DST operating staff hours).

WHC labor rates and overhead rates are from FDS, for TWRS, for fiscal year 1995

In calculation of operating costs, percentages given for material, purchased services, other contractors, site services, internal charges, and IRM are a percentage of WHC Labor plus Overhead, based on the 1N program 1994 fiscal-year-to-date actual spending through July.

In calculation of breakdown of operating costs, cost element 1, materials, is estimated to be distributed 40 percent to materials/supplies, and 60 percent to equipment.

In calculation of breakdown of operating costs, local purchases is estimated to be 20 percent of cost element 2, purchased services.

Table 9-17. Overall Cost Component. (Millions of 1995 Dollars)

Cost Component	Tri-Party Agreement Preferred Alternative
Capital	3,600[1]
Operating	3,900[2]
Research and development	630[3]
Repository fee	1,750
Other related costs	8,600[4]
Total	$18,500

Notes:

[1]Total capital cost includes 40% contingency. Contingency is excluded from other costs.

[2]Includes start-up, decontamination and decommissioning, and monitoring and maintenance costs.

[3]Pg. 130 of Boomer 1994, which was based on a draft of the *Tank Waste Remediation System Multi-Year Program Plan* (MYPP) (WHC 1994).

[4]Other related costs are costs defined in the MYPP that should be included in the total costs, but are not directly related to operations. These costs are:

Program management	$1,180
Operations and maintenance	4,290
Tank farm safety	440
Tank farm upgrades	1,720
Characterization	933
Total	$8,563

(SIS 4342)

Round to $8,600 million. These costs are taken as total unescalated costs from the MYPP.

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.

WHC, 1994, *Tank Waste Remediation System Multi-Year Program Plan*, WHC-SP-1101, Westinghouse Hanford Company, Richland, Washington.

WHC-SD-WM-EV-104 Rev. 0
UC-630

Tri-Party Agreement Alternative Engineering Data Package for the Tank Waste Remediation System Environmental Impact Statement

E. J. Slaathaug

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Westinghouse Hanford Company P.O Box 1970 Richland, Washington

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U.S. Department of Energy under Contract DE-AC06-87RL10930

Approved for Public Release

Table 9-16. Process Module: Overall Cost.
(Millions of 1995 Dollars)

Process Module	Tri-Party Agreement Preferred Alternative
Sludge wash	210
Cesium removal	980
Centralized facilities	520
Low-level waste vitrification	2,900
Low-level waste disposal	290
High-level waste vitrification	3,000
High-level waste transportation	31
High-level waste disposal	5,900
Total	$13,800

Table 9-17. Overall Cost Component. (Millions of 1995 Dollars)

Cost Component	Tri-Party Agreement Preferred Alternative
Capital	3,600[1]
Operating	3,900[2]
Research and development	630[3]
Repository fee	3,960[4]
Total	$12,100

Notes:

[1]Total capital cost includes 40% contingency. Contingency is excluded from other costs.

[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 [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]Pg. 130 of Boomer 1994, which was based on a draft of the *Tank Waste Remediation System Multi-Year Program Plan* (MYPP) (WHC 1994).

[4]Table D-8, TRW 1995, estimates the repository fee for the TPA Alternative (Case 2-5SC) would be $112 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

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.

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*, A00000000-01717-5705-00003, Rev. 0, TRW Environmental Safety Systems, Inc., Vienna, Virginia.

Table 9-18. Capital Cost Component.
(Millions of 1994 Dollars)[1]

Capital Cost Component	Tri-Party Agreement Preferred Alternative
Labor	1,600
Materials/supplies[2]	610
Equipment[2]	1,100
Local purchases[2]	300
Total	$3,600

Notes:

[1]Excludes construction of low-level waste vaults.

[2]Local purchases set to 15% of material/supplies and equipment.

Table 9-19. Operating Cost Component. (Millions of 1995 Dollars)[1]

Operating cost component	Tri-Party Agreement Preferred Alternative
Labor	1,700
Materials/supplies	1,600
Equipment	270
Local purchases	330[2]
Total	$3,900

Notes:

[1]Includes construction of low-level waste vaults as well as start-up cost, decontamination and decommissioning cost, and monitoring and maintenance cost.

[2]Based on 15% of materials/supplies and equipment.

Table 9-20. Overall Schedule.
(Calendar Year Start/Completion Date)

Activity	Tri-Party Agreement Preferred Alternative
Construction	12/1997 - 11/2007[1, 2]
Operation	06/2004 - 12/2023[3]
Decontamination and decommissioning	06/2019 - 12/2028[4]
Monitoring and maintenance	12/2023 - 12/2029[5]
High-level waste disposal	12/2019 - 12/2029
Research and development	1995 - 2018[6]

Notes:

[1]Boomer, 1994, Figure 4.3-5, pp. 76. Does not include low-level waste (LLW) vaults.

[2]Boomer, 1994, Figure 4.4-5, pp. 92

[3]Boomer, 1994, Table 3.4-1, pp. 33. Finishes ahead of Tri-Party Agreement milestone.

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

[5]Monitoring and maintenance is for the high-level waste casks stored onsite until transportation to the repository.

[6]Based on the *Tank Waste Remediation System Multi-Year Program Plan* and is consistent with the LLW operation.

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.

WHC, 1994, *Tank Waste Remediation System Multi-Year Program Plan*, WHC-SP-1101, Westinghouse Hanford Company, Richland, Washington.

Table 9-21. Unit Process: Sequence of Construction.
(Calendar Year Start\Completion Date)

Unit process	Tri-Party Agreement Preferred Alternative
Sludge wash	12/1997 - 12/2003[4]
Cesium removal	12/1997 - 12/2003[4]
Other radionuclide removal	n/a
Low-level waste vitrification	12/1997-12/2003[1]
Low-level waste disposal	12/2003-12/2019[2]
High-level waste vitrification	06/2002-12/2007[3]
High-level waste transportation/disposal	n/a

Notes:

[1]Boomer, 1994, Figure 4.4-5, pp. 92.

[2]Construction of the low-level waste (LLW) vaults will commence when LLW Vitrification construction is complete which is approximately 1.5 years prior to LLW operations. Vault construction will continue as required through LLW operations.

[3]Tri-Party Agreement Milestone M-51-03-T04.

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.

Ecology, EPA and DOE, 1994, Hanford Federal Facility Agreement and Consent Order, 2 vols, as amended, Washington State Department of Ecology, Olympia, Washington, and U.S. Environmental Protection Agency and U.S. Department of Energy, Washington, D.C.

F.11 Backup for Table 9-16

Table F-36. Total Cost by Unit Operation.

	Construction	Labor	Equipment	Materials and Supplies			Low-Level Vaults	HLW Canisters	Research and Development	Repository Fee	Totals
				Start-up	D and D	Operations					
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.

The backup for Table 9-8 and Table 9-9 in this appendix contains capital cost for Pretreatment/LLW combined. To separate sludge wash and cesium removal from LLW vitrification, other cost estimates were employed. Cost estimates were found for a detached pretreatment facility and a detached LLW facility (these are contained in Table 9-8 and Table 9-9 backup). The total capital cost for each were taken and added together. This total was then divided into each staff hour value separately. The calculation was as follows:

Detached Separations	-	Total Capital Cost	=	$304,145,913
Detached LLW	-	Total Capital Cost	=	$966,251,470
		Total	=	$1,270,397,383

% separations = $304,145,913/$1,270,397,383 = 0.239 => Value used is 25 %

Therefore % LLW = 75%

This value was used to divide all costs that lumped Pretreatment/LLW together. Engineering judgement set the sludge wash capital cost equal to 10% of the total for separations (see above).

Engineering judgement set the cesium removal capital cost equal to 90% of the total for separations (see above).

Construction includes labor and materials. Total value was taken from Table 9-18.

Labor is operating labor only. It includes direct and indirect staffing. Total value was taken from Table 9-19.

Equipment cost is assumed cost for replacement equipment during operations. Total value was taken from Table 9-19 (including local purchases).

Material and supply cost covers start-up, operations, and decontamination and decommissioning. Total value was taken from Table 9-19 (including local purchases).

Values for the cost of the LLW Vaults and the HLW Canisters were taken from the backup for Table 9-4.

Totals for research and development costs were taken from Table 9-17.

F.12 Backup for Table 9-18

Capital costs are calculated using the design cost estimates (see Appendix C). The cost estimate is categorized as follows:

- Estimated labor, material, and equipment for both the M&O contractor and subcontracts
- Overhead and profit
- Construction and project management
- Engineering
- Contingency.

A. Calculation: Labor, Material, and Equipment for M&O Contractor and Subcontracts.

Costs for Total Project:

M&O Contractor		Labor	Material	Equipment
Pretreatment/LLW	=	$188,943,943	$105,550,250	$311,926,395
20T/D HLW Facility	=	$186,434,799	$116,905,668	$169,901,640
Centralized Facility	=	$59,634,131	$54,152,639	$38,934,126

From Cost Estimate (see Appendix C). Labor and material values came from MT 3. Equipment values taken from MT 2.

Subcontracts				
Pretreatment/LLW	=	$3,779,600	$5,669,400	$0
20T/D HLW Facility	=	$0	$0	$0
Centralized Facility	=	$13,426,200	$20,139,300	$0

Totals from Cost Estimate (see Appendix C. from MT 3. Estimating judgement set the labor and material values to 40% and 60% of the total, respectively.

B. Calculation: Overhead and Profit

% of M&O contractor labor for Overhead and Profit = 53%
% of M&O contractor material for Overhead and Profit = 5%
% of M&O contractor equipment for Overhead and Profit = 5%
% of Subcontract labor for Overhead and Profit = 10%
% of Subcontract material for Overhead and Profit = 10%

Based on cost estimating judgement.

M&O Contractor		Labor	Material	Equipment
Pretreatment/LLW	=	$100,140,290	$5,277,513	$15,596,320
20T/D HLW Facility	=	$98,810,443	$5,845,283	$8,495,082
Centralized Facility	=	$31,606,089	$2,707,632	$1,946,706
Subcontracts				
Pretreatment/LLW	=	$566,940	$377,960	$0
20T/D HLW Facility	=	$0	$0	$0
Centralized Facility	=	$2,013,930	$1,342,620	$0

C. Calculation: Construction and Project Management

Construction Management is set to 10% of the summation of the capital cost and the overhead and profit.

Based on cost estimating judgement.

M&O Contractor		Labor	Material	Equipment
Pretreatment/LLW	=	$28,908,423	$11,082,776	$32,752,271
20T/D HLW Facility	=	$28,524,524	$12,275,095	$17,839,672
Centralized Facility	=	$9,124,022	$5,686,027	$4,088,083
Subcontracts				
Pretreatment/LLW	=	$623,634	$415,756	$0
20T/D HLW Facility	=	$0	$0	$0
Centralized Facility	=	$2,215,323	$1,476,882	$0

Project Management is set to 10% of the summation of the capital cost, the overhead and profit, and the construction management plus 40% of 10% of the summation of the capital cost and the overhead and profit.

Based on cost estimating judgement.

M&O Contractor		Labor	Material	Equipment
Pretreatment/LLW	=	$43,362,635	$16,624,164	$49,128,407
20T/D HLW Facility	=	$42,786,786	$18,412,643	$26,759,508
Centralized Facility	=	$13,686,033	$8,529,041	$6,132,125
Subcontracts				
Pretreatment/LLW	=	$935,451	$623,634	$0
20T/D HLW Facility	=	$0	$0	$0
Centralized Facility	=	$3,322,985	$2,215,323	$0

D. Calculation: Engineering

Engineering is set to 40% of the summation of the capital cost and the overhead and profit.

Based on cost estimating judgement.

M&O Contractor		Labor	Material	Equipment
Pretreatment/LLW	=	$115,633,693	$44,331,105	$131,009,086
20T/D HLW Facility	=	$114,098,097	$49,100,381	$71,358,689
Centralized Facility	=	$36,496,088	$22,744,108	$16,352,333
Subcontracts				
Pretreatment/LLW	=	$2,494,536	$1,663,024	$0
20T/D HLW Facility	=	$0	$0	$0
Centralized Facility	=	$8,861,292	$5,907,528	$0

E. Calculation: Contingency

Contingency is set to 40% of the summation of the capital cost, overhead and profit, construction and project management, and engineering.

Based on cost estimating judgement.

M&O Contractor		Labor	Material	Equipment
Pretreatment/LLW	=	$190,795,594	$73,146,323	$216,164,992
20T/D HLW Facility	=	$188,261,860	$81,015,628	$117,741,837
Centralized Facility	=	$60,218,545	$37,527,779	$26,981,349
Subcontracts				
Pretreatment/LLW	=	$4,115,984	$2,743,990	$0
20T/D HLW Facility	=	$0	$0	$0
Centralized Facility	=	$14,621,132	$9,747,421	$0

F. Calculation: Overall Totals

M&O Contractor		Labor	Material	Equipment
Pretreatment/LLW	=	$667,784,578	$256,012,131	$756,577,471
20T/D HLW Facility	=	$658,916,510	$283,554,698	$412,096,428
Centralized Facility	=	$210,764,909	$131,347,226	$94,434,723
Subcontracts				
Pretreatment/LLW	=	$14,405,945	$9,603,964	$0
20T/D HLW Facility	=	$0	$0	$0
Centralized Facility	=	$51,173,961	$34,115,974	$0
Overall Total				
Pretreatment/LLW	=	$682,190,523	$265,616,095	$756,577,471
20T/D HLW Facility	=	$658,916,510	$283,554,698	$412,096,428
Centralized Facility	=	$261,938,870	$165,463,200	$94,434,723
		$1,603,045,904	$714,633,993	$1,263,108,622

Totals may not match totals from Table 9-17, but will be within 1%. Errors are caused by over generalization of cost estimating parameters.

To calculate for local purchases:

Local Purchases = 15% x (Equipment + Material/Supplies)

Local Purchases = $296,661,392

Which leaves:

Equipment = 85% x (Equipment)

Equipment = $607,438,894

and

Material/Supplies = 85% x (Material/Supplies)

Material/Supplies = $1,073,642,329

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.

		Unit	Pretreatment/ILLW		HLW		Total	
Material	Unit	Cost	Amount	Cost	Amount	Cost	Amount	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.

Supplies	Unit	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

Table F-38. Other Operating Costs.

		Unit	Pretreatment/LLW		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

Staffing

The staffing requirements for the Tri-Party Agreement alternative data package are given in Table F-39. This table is identical to the table used to calculate the operating personnel requirements by unit process (Table 9-3). The staffing requirements include the staffing for start-up operations, decontamination and decommissioning, and monitoring and maintenance. Staffing for the construction of the LLW vaults is included in the cost per vault in Table F-38.

Table F-39. Staffyears for Operation.

Staffing Category	Years	Staff Per Year	Total Staff-Years
Dual Operation	10	708	7080
Pretreatment/LLW Only	5	618	3090
HLW Only	4	509	2036
Indirect Staffing	19	29	551
Pretreatment/LLW Start-up	1.5	618	927
HLW Start-up	1.5	509	763.5
Pretreatment/LLW Decontamination and Decommissioning	2	618	1236
HLW Decontamination and Decommissioning	2	509	1018
HLW Monitoring and Maintenance	6	10	60
HLW Transportation	--	--	280

Notes:

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

The staffing breakdown for each operational mode is given in Table F-40. The staffing values in this table are identical to the ones used for the calculation of the operating personnel requirements (Table 9-3). The total cost per year was calculated by assuming that the average annual salaries are $130,000 for exempt, $60,000 for nonexempt, and $90,000 for bargaining unit employees (Boomer 1994).

Table F-40. Cost per Year by Process.

Operational Mode	Exempt	Nonexempt	Bargaining Unit	Cost Per Year (In Millions)
Pretreatment/low-level waste only	227	53	338	$63
Dual operation	253	53	402	$72
High-level waste only	200	51	258	$52

Table F-41 gives the total calculated cost for operating labor using the totals from Tables F-39 and F-40 with the following exceptions. For indirect staffing, it was assumed that all workers would be nonexempt employees. For monitoring and maintenance, it was assumed that one worker would be exempt, one would be bargaining unit, and the remaining eight would be nonexempt. 100 of the total workers for HLW transportation are assumed to be exempt, 100 bargaining units, and the remaining 80 nonexempt.

Table F-41. Staffing Operating Cost.

Staffing Category	Total Cost (In Millions)
Dual operation	$723
Pretreatment/low-level waste only	$316
HLW only	$209
Indirect Staffing	$33
Pretreatment/low-level waste start-up	$95
High-level waste start-up	$78
Pretreatment/low-level waste decontamination and decommissioning	$126
High-level waste decontamination and decommissioning	$105
High-level waste monitoring and maintenance	$4
High-level waste transportation	$27
Total	$1,716

Start-Up Costs

The total start-up cost for each facility is arbitrarily set to three times the annual staffing requirements for each facility. The staffing requirements for start-up of each facility has been set to one and a half years of the annual. This leaves one and a half years of staff cost ($95 million + $78 million = $173 million) for materials and supplies for start-up.

Decontamination and Decommissioning

The decontamination and decommissioning (D&D) cost 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 for each facility has been set to two years of the annual. This leaves one year of staff cost ($63 million + $52 million = $115 million) plus thirty percent of the capital for material and supplies.

The total capital is equal to the capital plus a forty percent contingency factor. Therefore the capital value to be used for the decontamination and decommissioning cost for materials and supplies is equal to:

Capital = $3,600 million / 140% = $2,571 million

The total capital cost is taken from Table 9-18.

The cost based upon the capital is:

Capital D&D = $2,571 million * 30% = $771 million

Thus the total D&D cost for materials and supplies is set to $886 million.

Summations

Labor is set equal to the total value calculated in Table F-41:

Labor = $1,716 million

The total cost for materials and supplies is:

Operating	=	$837 million (Table F-38)
Start-up	=	$173 million
Decontamination and Decommissioning	=	$886 million
Total	=	$1,896 million

Equipment purchase is set equal to the total value calculated in Table F-41:

Equipment = $322 million

However local purchases are set equal to 15 percent of the total equipment and materials and supplies cost. Therefore the values entered on Table 9-19 are:

Materials and supplies	=	$1,612 million
Equipment	=	$274 million
Local purchases	=	$332 million

Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Statement

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Date Published
July 1995

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Westinghouse Hanford Company P.O Box 1970 Richland, Washington

Management and Operations Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

Approved for Public Release

JUL 19 1995

ENGINEERING DATA TRANSMITTAL

1. EDT № 512

2. To: (Receiving Organization) TWRS Compliance Plans	3. From: (Originating Organization) Geotechnical Development Projects	4. Related EDT No.: n/a
5. Proj./Prog./Dept./Div.: Tank Waste Remediation System	6. Cog. Engr.: P. L. Kline	7. Purchase Order No.: n/a
8. Originator Remarks: This engineering data package provides supporting data for preparation of the TWRS Environmental Impact Statement. Data in this document complements data provided in separate documentation for the No Separations Alternative, the Extensive Separations Alternative, the Tri-Party Agreement Alternative, and the In Situ Disposal Alternative. Environmental, Safety, and QA approvals required by WHC-CM-3-5 Section 12.7 were obtained on Rev. 3 of this document. The only significant changes in this revision, relative to Rev. 3, involved changes to data tables addressing construction staffing requirements and costs.		9. Equip./Component No.: n/a
		10. System/Bldg./Facility: n/a
11. Receiver Remarks:		12. Major Assm. Dwg. No.: n/a
		13. Permit/Permit Application No.: n/a
		14. Required Response Date: n/a

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-EV-107		0	Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Statement	E/S/Q	2	1	1

16. KEY

Approval Designator (F)	Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval	4. Review	1. Approved	4. Reviewed no/comment
	2. Release	5. Post-Review	2. Approved w/comment	5. Reviewed w/comment
	3. Information	6. Dist. (Receipt Acknow. Required)	3. Disapproved w/comment	6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
2	1	Cog.Eng., P. L. Kline									
2	1	Cog. Mgr. J. G. Field		7/19/95							
		QA (approved by J. Weber, on EDT dated 3/6/95 attached)									
		Safety (approved by J. M. Garcia, on EDT dated 3/6/95 attached)									
		Env. (approved by R. K. Engelmann, on EDT attached)									

18.	19.	20.	21. DOE APPROVAL (if required)
P. L. Kline 7/19/95 Signature of EDT Originator Date	L. E. Bomeman 7/19/95 Authorized Representative for Receiving Organization Date	J. G. Field 7/19/95 Cognizant Manager Date	Ctrl. No. [ ] Approved [ ] Approved w/comments [ ] Disapproved w/comments [x] Not Required per Waiver WA-557

2. To: (Receiving Organization)	3. From: (Originating Organization)	4. Related EDT No.:
TWRS Compliance Plans	TWRS Compliance Plans	n/a
5. Proj./Prog./Dept./Div.:	6. Cog. Engr.:	7. Purchase Order No.:
Tank Waste Remediation System	P.L. Scanlon	n/a

8. Originator Remarks:

This engineering data package provides supporting data for preparation of the TWRS Environmental Impact Statement (EIS). Data in this document complements data provided in separate documentation for the In-Situ Disposal Alternative, the No Separations Alternative, the Extensive Separations Alternative, and the TPA Preferred Alternative. Data in this document are based on (a) landfill closure of the DST and SST tank farms, including in situ stabilization of underground waste storage tanks and ancillary tank farm equipment, (b) no cleanup or stabilization of contaminated soil, and (c) placement of an engineered surface barrier over tank farms and low-level waste disposal vaults. This EDT transmits the Closure Engineering Data Package to TWRS Compliance Plans as Rev. B, for DOE-RL approval, per WHC-CM-3-5, section 12.7.

9. Equip./Component No.: n/a

10. System/Bldg./Facility: n/a

11. Receiver Remarks: n/a

12. Major Assm. Dwg. No.: n/a

13. Permit/Permit Applicati: n/a

14. Required Response Date: n/a

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-EV-107		B	Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Statement	E/S/Q	1	1	1

16. KEY

Approval Designator (F)	Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information	4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment	4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
1	1	Cog.Eng. P.L. Scanlon		2/28/95	R2-06						

1	1	Cog.Mgr.	L.E. Borneman 2/28/95	32-06		
1	/	QA	J. Weber	51-57		
1	/	Safety	J.M. Gandld	83-09		
1	1	Env.	R.H. Engelkemeir	86-26		
1	/	Disp.Pro.	J.O. Honeyman	57-81		
			()			

18.	19.	20.	21. DOE APPROVAL (if required)
P.J. Sezelon 2/28/95 Signature of EDT Originator Date	L.E. Borneman 2/28/95 Authorized Representative for Receiving Organization Date	L.E. Borneman 2/28/95 Cognizant Manager Date	Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments

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Table 5-8. Comparison of Alternatives by Process Module: Capital Cost (Millions of 1995 Dollars).[1,2,3,4]

Process Modules	In Situ Disposal	Extensive Pretreatment Option A: Grout/gravel	Extensive Pretreatment Option B: Grout/gravel	No Separations: Grout/gravel	Tri-Party Agreement Preferred Alternative: Grout/gravel
Barrier construction[5]	$86	$113	$237	$86	$111
Emptied SST closure[6]	n/a	$26.6/$14.6	$26.6/$14.6	$26.6/$14.6	$26.6/$14.6
Emptied DST closure[7]	n/a	$4.4/$2.6	$4.4/$2.6	$4.4/$2.6	$4.4/$2.6
Total	$86	$144/$130	$268/$254	$117/$103	$142/$128

Notes:

SST = single-shell tank
DST = double-shell tank

[1]The cost of gravel was estimated from Appendix A, Cost Barrier Materials and was figured at $22 per cubic meter ($m^3$) for 756,000 m^3 of material, or $16,600,000. There are 16 55,000-gallon tanks that would be stabilized with the same grout mixture used for stabilizing the ancillary equipment. These tanks have a total void volume of 5,324 m^3. The cost of this grout was estimated at $0.14 per kilogram (kg) for Type I/II cement, $0.04/kg for fly ash, and $18.50/$m^3$ for sand from Pit 30. For 106,500 kg of cement, the cost would be $14,900; 958,000 kg of fly ash would cost $38,300; and 5,160,000 kg of sand (3,225 m^3 of sand) would cost $59,700. The total cost of this grout is $112,900. The cost of the water was not calculated. The cost of the air entrainment additive was unknown but assumed to be negligible.

[2]The cost of concrete was estimated at $0.14/kg for Type I/II cement, $0.04/kg for fly ash, and $18.50/$m^3$ for sand from Pit 30. For 15,000,000 kg of cement, the cost would be $2,100,000; 137,000,000 kg of fly ash would cost $5,480,000; 1,260,000,000 kg of sand (1,300,000 m^3 of sand) would cost $23,200,000. The total cost of this grout is $30,780,000. The cost of the water was not calculated. The cost of the air entrainment additive was unknown but assumed to be negligible.

[3]The cost of solidifying the ancillary equipment is based on the same grout formula as in notes 1 and 2. There is 13,700 m^3 of void space in the ancillary equipment for the SSTs and the DSTs. The SST ancillary equipment void space is 10,500 m^3, and the DST ancillary equipment void space is 3,200 m^3. For SST ancillary equipment, 210,000 kg of cement would cost $29,400; 1,890,000 kg of fly ash would cost $75,600; 17,400,000 kg of sand (10,900 m^3 of sand) would cost $201,500. The total cost of stabilizing the ancillary SST equipment would be $306,500. For DST ancillary equipment, 64,000 kg of cement would cost $8,960; 576,000 kg of fly ash would cost $23,000; 5,312,000 kg of sand (3,320 m^3 of sand) would cost $61,400. The total cost of stabilizing the ancillary DST equipment is $93,360. The cost of water was not calculated. The cost of the air entrainment additive was unknown but assumed to be negligible.

The costs for monitoring and maintenance are reflected in Table 5-10 and were not included in these costs.

Table 5-8. Comparison of Alternatives by Process Module: Capital Cost (Millions of 1995 Dollars).[1,2,3,4]

Notes: (Continued)

[5]Barrier construction includes the cost of the barrier over SSTs, DSTs, and the low-level waste vaults (where applicable).

[6]Emptied SST closure includes filling the SSTs with grout or gravel (in that order) and stabilizing the ancillary equipment with grout. The cost of the gravel slinger was unknown but was estimated at $100,000. It is assumed that the construction equipment and light-duty trucks are already available onsite and need not be purchased.

[7]Emptied DST closure includes filling the DSTs with grout or gravel (in that order) and stabilizing the ancillary equipment with grout. The cost of the gravel slinger was unknown but was estimated at $100,000. The cost of the grout plant and dry mix plant are unknown but were estimated at $250,000. It is assumed that construction equipment and light-duty trucks are already available onsite and need not be purchased.

For additional backup information, see Appendix A, Figures A2, A3, and A4; and Tables A5-A9 and A11.

Table 5-9. Comparison of Alternatives by Capital Cost Component (Millions of 1995 Dollars).

Capital Cost Component	No Site Disposal	Extensive Pretreatment Option A Grout/gravel	Extensive Pretreatment Option B Grout/gravel	No Separations Grout/gravel	Tri-Party Agreement Preferred Alternative Grout/gravel
Labor[1]	$30.6	$54.1/$57.1	$105/$107.3	$43.9/$46.9	$53.6/$56.6
Materials/supplies[2]	$28.5	$42.9/$37.4	$81.1/$75.6	$34.1/$28.6	$42.5/$37.0
Equipment[3]	n/a	$0.25/$0.35	$0.25/$0.35	$0.25/$0.35	$0.25/$0.35
Local purchases[4]	$57.5	$43.5/$35.1	$130/$121	$82.9/$74.5	~~$42.5/$34.1~~
Total	~~$127~~ $116	$141/$130	$316/$304	$161/$150	~~$139/$128~~

See Modified Table PS5-17a

Notes:

n/a = not applicable

[1]Average wage for an exempt employee at TWRS is $57.11/hour, for a non-exempt employee is $22.35/hour, and for a bargaining unit employee is $41.31/hour (based on overhead, the common support pool and general and administrative rates found in Soft Reporting on November 11, 1994 for organization code 70000). Labor costs were calculated taking the staff hours from Tables 5-2A through 5-2D and multiplying by the average wage. Ancillary equipment stabilization and barrier construction labor costs were included in both grout and gravel stabilization. It was assumed that all design, engineering, and supervisory personnel were exempt, and that all radiation and nonradiation workers were bargaining unit employees.

[2]Materials and supplies include the tank and ancillary equipment stabilization materials and the materials used in barrier construction over the tanks and over the LLW Vaults (in the Extensive Pretreatment and TPA Preferred Alternatives). They include only materials that cannot be bought locally (asphalt, asphalt coating and geotextile fabric for the barrier; fly ash for the grout mix). All other materials for stabilization and barrier construction are listed in local purchases. These numbers were calculated from Appendix A, Barrier Cost by Component. Asphalt would cost $27,800,000 for tank barriers, $45,300,000 for extensive pretreatment grout, $8,500,000 for extensive pretreatment glass, and $8,100,000 for the Tri-Party Agreement glass. Geotextiles would cost $717,000 for tank barriers, $1,700,000 for extensive pretreatment grout, $284,000 for extensive pretreatment glass, and $268,000 for Tri-Party Alternative glass. Fly ash would cost $5,600,000 for the grout stabilization option (both for tanks and ancillary equipment); it would cost $137,000 for the gravel stabilization option (for the 55,000-gallon tanks and for ancillary equipment). The cost of the grout option is listed first, and the cost of the gravel option is listed second.

Table 5-9. Comparison of Alternatives by Capital Cost Component (Millions of 1995 Dollars).

Notes (continued)

[h]Equipment is the cost of the dry mix plant and the concrete batch plant for the grout stabilization option, and the cost of the concrete batch plant, the dry mix plant, and the gravel slinger for the gravel stabilization option. The dry mix plant and the concrete batch plant are assumed to cost $250,000, and the gravel slinger is assumed to cost $100,000. All other heavy construction equipment and light-duty vehicles are assumed to be already onsite and do not have to be purchased.

[i]Local purchases include the Type I/II cement, the sand, and the gravel used in tank and ancillary equipment stabilization, and all barrier materials (with the exceptions of asphalt, asphalt coating, and the geotextile fabric—these costs are reflected in materials/supplies). Local purchases of material for tank barriers include $57,500,000 for barrier material; for grout stabilization, the cost is $25,400,000, and for gravel stabilization, the cost is $17,000,000. The cost of the grout stabilization is listed first; gravel stabilization is second.

For more backup information, see Appendix A, Figures A2, A3, and A4; and Tables A3-A9 and A11.

Table 5-9 Comparison of Alternatives by Capital Cost Component ($ millions, 1995)

Capital Cost Component	In Situ Disposal	Extensive Pretreatment Option A Grout/Gravel	Extensive Pretreatment Option B Grout/Gravel	No Separations Grout/Gravel	Tri-Party Agreement Preferred Alternative Grout/Gravel
Labor	$29.5	$52.1/$58.1	$97.9/$104	$42.7/$43.7	$51.6/$57.6
Materials & Supplies	$28.5	$42.9/$37.4	$81.1/$75.6	$34.1/$28.6	$42.5/$37.0
Equipment	n/a	$0.25/$0.35	$0.25/$0.35	$0.25/$0.35	$0.25/$0.35
Local Purchases	$57.5	(3) ~~$130/$121~~	$130/$121	(1) $82.9/$74.5	(2) ~~$42.5/$34.1~~ 123.3/
TOTAL	$115.5	~~$139/$131~~ 178.1/170.5	$309/$301	$160/$152	~~$137/$129~~ 177.2/169.4

(122.3/113.9)

Replacement Table.

Notes

(1) Minimum Cost for Ex-Situ Alt

(2) Costs cant go down for TPA. It appears that 40.4 was subtracted instead of added. So add 40.4 to ~~TPA~~ No Sepns local purchases, making them 123.3/114.9 for TPA

(3) Same must be done for Ext Spns, Option A. Δ = 39.4 in this case.

Table 5-10. Comparison of Alternatives by Monitoring and Maintenance Cost Component (Millions of 1995 Dollars).[1,2]

Monitoring and Maintenance Cost Component	In Situ Disposal	Extensive Pretreatment Option A	Extensive Pretreatment Option B	No Separations	Tri-Party Agreement Preferred Alternative
Labor[3]	0.39	0.40	0.40	0.39	0.40
Materials/supplies[4]	0.011	0.012	0.016	0.011	0.012
Equipment[3,5]	0.030	0.030	0.030	0.030	0.030
Local purchases[4]					
Total	0.43	0.44	0.45	0.43	0.44

Notes:

[1]See Appendix A for details on the calculations.

[2]Monitoring and maintenance applies to all phases of the closure package (tank stabilization, ancillary equipment stabilization, and barrier construction).

[3]The labor rates are based on an average wage of $130,000 per year for supervisors, and $60,000 per year for laborers and a clerk/secretary.

[4]All materials and supplies are local purchases.

[5]Equipment costs are based on one tractor with attachments and three pickup trucks, to be replaced once every five years.

For additional backup information, see Appendix A, Figures A2, A3, and A4; and Tables A3 and A9.

Table 5-11. Comparison of Alternatives by Overall Schedule (Calendar Year Start/Completion Date).[1]

Activity	On Site Disposal	Extensive Pretreatment Option A	Extensive Pretreatment Option B	No Separations	Tri-Party Agreement Preferred Alternative
Construction[2]	2013,2016/ 2030, 2033	2010/2060	2010/2030	2010/2024	2010/2034
Monitoring and maintenance[3]	2015/2133	2012/2160	2012/2130	2012/2124	2012/2134
Research and development[4]					

Notes:

[1]Based on WHC-EP-0616, *Tank Waste Technical Options Report*, (Boomer et al. 1993).

[2]The construction schedule is taken from Table 5-12 and assumes construction includes stabilization activities and barrier construction.

[3]Monitoring and maintenance scheduling assumes 100 years of operational control after the last barrier has been built.

[4]Because the stabilization methods and the barrier have been performed in engineering-scale demonstrations, the amount of research and development necessary would be negligible.

For additional backup information, see Appendix A, Figures A2, A3, and A4; and Tables A1-A9.

Boomer, K. D., A. L. Boldt, J. D. Galbraith, J. S. Garfield, C. E. Golberg, B. A. Higley, L. J. Johnson, M. J. Kupfer, R. M. Marusich, R. J. Parazin, A. N. Praga, G. W. Reddick, J. A. Reddick, E. J. Slaathaug, L. M. Swanson, T. L. Waldo, C. E. Worcester, 1993, *Tank Waste Technical Options Report*, Rev. 0, WHC-EP-0616, Westinghouse Hanford Company, Richland, Washington.

Table 5-12. Comparison of Alternatives by Unit Process: Sequence of Construction (Calendar Year: Start/Completion Date).[1]

Unit Process	In Situ Disposal: Chemical Vitrification	Extensive Pretreatment Option A[3]	Extensive Pretreatment Option B[3]	No Separations	Tri-Party Agreement Preferred Alternative
Barrier construction	2013,2016/ 2030,2033	2024/2060	2024/2030	n/a	2028/2034
Emptied SST closure[4]	n/a	2010/2024	2010/2024	2010/2024	2010/2024
Emptied DST closure[5]	n/a	2019/2023	2019/2023	2018/2022	2023/2027

Notes:

n/a = not applicable
SST = single-shell tank
DST = double-shell tank

[1]Based on WHC-EP-0616, *Tank Waste Technical Options Report*, (Boomer et al. 1993).

[2]The start/completion dates for barrier construction for the in-situ disposal alternative is based on WHC-SD-WM-EV-101 (McConville 1995). In situ chemical stabilization decontamination and decommissioning ends in 2013, and barrier construction over the tanks begins immediately after that task; it ends in 2030. In situ vitrification decontamination and decommissioning ends in 2016, and barrier construction over the tanks begins immediately after that task. It ends in 2033. 2016-2033

[3]The start and completion dates for barrier construction for the extensive pretreatment alternatives and the Tri-Party Agreement preferred alternative are based upon the assumption that no barrier construction over the low-level waste vaults can begin until decontamination and decommissioning activities for the facilities end.

[4]The start and completion dates for emptied SST closure are based on the Tank Farm Retrieval Sequence schedule found in WHC-SD-WM-ER-193. This schedule is reproduced in Appendix A. These figures reflect work occurring sequentially (that is, no parallel operations were used). Tank stabilization and ancillary equipment stabilization begin as soon as Tank Farm retrieval operations end; barrier construction begins as soon as tanks and ancillary equipment are stabilized.

[5]The start and completion dates for emptied DST closure are based upon the assumption that no tank or ancillary equipment stabilization can begin until treatment operations end, and no barrier construction can begin until tanks and ancillary equipment have been stabilized for each tank cluster. This assumption was used because no schedule was generated for the retrieval sequence of the DSTs. These figures reflect work occurring sequentially (that is, no parallel operations were used).

For additional backup information, see Appendix A, Tables A1-A9 and A-11.

Table 5-12.: Comparison of Alternatives by Unit Process: Sequence of Construction (Calendar Year: Start/Completion Date).

Boomer, K. D., A. L. Boldt, J. D. Galbraith, J. S. Garfield, C. E. Golberg, B. A. Higley, L. J. Johnson, M. J. Kupfer, R. M. Marusich, R. J. Parzen, A. N. Praga, G. W. Reddick, J. A. Reddick, E. J. Slaathaug, L. M. Swanson, T. L. Waldo, C. E. Worcester, 1993, *Tank Waste Technical Options Report*, Rev. 0, WHC-EP-0616, Westinghouse Hanford Company, Richland, Washington.

McConville, C.M., 1995, *Tank Waste Remediation System Environmental Impact Statement for In Situ Treatment and Disposal of Radioactive Waste in Hanford Site Underground Storage Tanks*, WHC-SD-WM-EV-101, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Table A11. Barrier Cost by Component (1994 Dollars)
(Backup for Table 5-1, 5-2D, 5-8 and 5-9).

BACKUP FOR BARRIER COST BY COMPONENT
(IN 1994 DOLLARS)

MATERIAL	111-A	111-AX	111-B	111-BX	111-BY	111-C	111-S	111-SX	111-T	111-TX	111-TY	111-U
Dsl Design	128,328	98,238	217,128	209,901	212,377	252,230	214,150	256,908	217,128	320,621	179,580	212,785
Eng/Impact	256,652	196,475	434,256	419,809	424,754	504,660	428,812	513,815	434,256	641,242	359,160	424,571
SRDI Fact	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759
ENG SUBTOTAL	444,737	354,472	802,043	689,472	696,890	817,049	703,127	830,482	802,043	1,021,622	448,498	706,615
Site Work	76,577	58,706	172,756	138,293	140,162	177,304	142,070	174,752	172,756	241,596	77,322	167,975
Base Course	43,833	33,757	83,514	71,072	71,697	85,173	72,587	86,743	83,514	107,758	44,274	81,610
Asphalt	1,096,642	844,176	2,088,454	1,777,317	1,797,943	2,129,936	1,815,190	2,169,204	2,088,454	2,694,759	1,107,162	2,045,832
Drain Gravel	81,837	71,460	170,607	146,155	147,601	174,096	148,167	177,408	170,607	218,831	92,060	167,430
Basin	1,202,706	945,832	2,147,732	1,858,531	1,874,404	2,168,433	1,884,407	2,234,904	2,147,732	2,710,535	1,213,411	2,108,115
Gravel Filter	48,891	34,861	109,292	89,737	90,875	111,865	92,061	113,354	109,292	147,461	49,475	100,613
Sand Filter	32,381	22,969	73,108	59,898	60,735	74,859	61,466	75,812	73,108	98,895	32,772	61,296
Geotextile	25,329	17,863	57,166	46,853	47,503	58,558	48,078	59,301	57,166	77,357	25,635	45,770
Lower SA	140,791	87,030	337,469	272,967	276,872	340,007	280,559	349,531	337,469	463,456	142,614	324,034
Upper SA	173,202	122,872	405,196	330,282	334,881	415,123	339,145	420,026	405,196	551,488	177,362	384,934
Road	8,378	7,883	13,600	12,463	12,556	13,758	12,616	14,207	13,600	15,796	9,440	13,444
CON SUBTOTAL	2,843,369	2,257,371	5,659,114	4,803,570	4,859,948	5,773,150	4,907,349	5,873,242	5,659,114	7,327,914	2,872,173	5,541,655
TOTAL	3,288,326	2,612,043	6,461,157	5,493,042	5,556,838	6,590,199	5,610,476	6,705,724	6,461,157	8,349,536	3,420,672	6,378,470

MATERIAL	DSI AN	DSI AP	DSI AW	DSI AY	DSI AZ	DSI SY	EXPRE OPT B	EXPRE OPT A	TPA GLASS	TOTALS
Dsl Design	180,130	168,913	114,841	86,730	88,730	100,770	5,858,899	1,038,855	883,131	11,157,583
Eng/Impact	360,660	337,825	269,683	133,460	133,460	201,540	11,713,798	2,077,708	1,966,867	22,315,184
SRDI Fact	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759	1,254,839
ENG SUBTOTAL	601,049	566,497	484,283	259,949	259,949	362,069	17,630,456	3,176,323	3,010,060	34,727,666
Site Work	115,947	101,290	60,757	40,402	40,402	60,224	14,400,406	1,265,455	1,144,522	18,869,696
Base Course	61,259	57,465	46,036	23,178	23,178	34,607	1,810,910	340,763	323,395	5,366,724
Asphalt	1,531,415	1,437,029	1,151,226	579,620	579,620	865,423	45,265,770	8,521,531	8,087,166	69,693,695
Drain Gravel	126,527	118,274	96,224	50,124	50,124	73,174	3,528,642	675,589	641,877	7,140,040
Basin	1,821,323	1,540,969	1,257,165	677,616	677,616	987,401	50,662,065	7,635,875	7,473,761	95,246,595
Gravel Filter	75,065	67,854	52,009	20,116	20,116	30,064	3,145,201	537,900	507,163	5,365,528
Sand Filter	49,874	45,167	34,475	13,090	13,090	23,783	2,136,698	383,657	342,727	3,759,962
Geotextile	39,090	35,330	26,967	10,239	10,239	16,603	1,671,353	284,437	266,060	2,841,104
Lower SA	225,328	200,592	150,681	50,800	50,800	100,731	10,776,043	1,783,667	1,677,545	18,389,664
Upper SA	274,365	248,548	186,919	67,667	67,667	127,293	12,268,394	2,065,062	1,944,652	21,320,393
Road	11,341	11,341	9,574	6,340	6,340	6,007	72,454	29,599	29,064	332,824
CON SUBTOTAL	4,131,552	3,868,957	3,097,133	1,539,194	1,539,194	2,315,310	133,555,045	23,703,635	22,440,040	254,765,649
TOTAL	4,732,601	4,435,454	3,556,416	1,799,143	1,799,143	2,677,379	151,185,501	26,879,958	25,450,100	289,493,315

NOTE. (1) The above design and construction costs are 1993 dollars escalated by a 2.9% inflation factor, and include a 15% contingency.

(2) The costs for EPT Option A, EPT Option B, and TPA Glass do not include the costs for barriers over the tank farms; they are strictly the costs of the barriers over the LLW Vaults.

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE Engineering / Ex Situ Intermediate Separations Data Package.

ORIGINATOR Colin Henderson DATE 11/6/95

REVISION NO. 0

OBJECTIVE Identify the Cost for the Ex Situ Intermediate Separations alternative

METHODOLOGY Use the Waste Retrieval & Transfer, TPA, and Closure data packages to identify applicable Costs.

ASSUMPTIONS Current Ops Cost developed from TPA Rev B data package & Task Farms Operations data used for M&O Component. Subsurface barriers and Cross-Site X-Fer line are not included (eg, taken out of) in the Retrieval Cost. W-314 Upgrades to the Existing Waste Transfer System are included in Current Operations.

(Continue on another sheet if necessary)

Colin Henderson
SIGNATURE

CALCULATION & RESULTS ATTACHED

JACOBS\FORMS\CALCVR.SHT

6.18.2

1a3

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

Summary:

Continued Operations (TPA Data PKG Rev B Table 9-17) $8,600

R&D.

Retrieval - 190 (WR&T Table 5-14

Treatment - 630 (TPA Data PKG Rev 0 Table 9-17)

$820 $820

CAPITAL

Retrieval - $2,280 (WR&T Table 5-14)

Treatment - $3,600 (TPA Table 9-17)

Closure $169 (Closure Table 5-9 modified)

$6,049 $6,049

Operating:

Retrieval $4820 (WR&T Table 5-14)

Treatment 3,900 (TPA Table 9-17)

M&M 1

Total OPS 8,721 $8,721

Repository Fee 3960 (TPA Table 9-17) $3,960

TOTAL $28,150

FORM 91-005-1 (4/81)

JUL 21 1995

ENGINEERING DATA TRANSMITTAL

1. EDT № 6125

2. To: (Receiving Organization) TWRS Compliance Plans	3. From: (Originating Organization) Plant System Engineering	4. Related EDT No.: 605651
5. Proj./Prog./Dept./Div.: Tank Waste Remediation System	6. Cog. Engr.: E. A. Fredenburg	7. Purchase Order No.: n/a
8. Originator Remarks: This engineering data package provides supporting data for preparation of the TWRS Environmental Impact Statement. Data in this document complements data provided in separate documentation for the No Separations Alternative, the Extensive Separations Alternative, the Tri-Party Agreement Alternative, and the No Disposal Action Alternative. Environmental, Safety, and QA approvals required by WHC-CM-3-5 Section 12.7 were obtained on Rev. 3 of this document (EDT 605651). The only significant changes in this revision, relative to Rev. 3, involved changes to data tables addressing schedules for construction and operation of waste retrieval systems, for consistency with the other engineering data packages cited above.		9. Equip./Component No.: n/a
		10. System/Bldg./Facility: n/a
11. Receiver Remarks:		12. Major Assm. Dwg. No.: n/a
		13. Permit/Permit Application No.: n/a
		14. Required Response Date: n/a

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-EV-097		0	Waste Retrieval and Transfer Engineering Data Package for the Tank Waste Remediation System Environmental Impact Statement	E/S/Q	2	1	1

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name (K) Signature (L) Date (M) MSIN	(J) Name (K) Signature (L) Date (M) MSIN	(G) Reason	(H) Disp.
2	1	Cog.Eng. E. A. Fredenburg E A Fredenburg 7-13-95			
2	1	Cog. Mgr. G. L. Dunford 7/18/95			
		QA (approved by J. Weber, on EDT 605651)			
		Safety (approved by J. M. Garcia, on EDT 605651)			
		Env. (approved by R. H. Engelmann, on EDT 605651)			

18.	19.	20.	21. DOE APPROVAL (if required)
E. A. Fredenburg E A Fredenburg 7-13-95 Signature of EDT Originator Date	L. E. Bomemen Authorized Representative for Receiving Organization Date	G L Dunford 7/18/95 Cognizant Manager Date	Ctrl. No. [ ] Approved [ ] Approved w/comments [ ] Disapproved w/comments [x] Not Required per Waiver WA-557

EDT-6124

ENGINEERING DATA TRANSMITTAL

1. ED[illegible]

2. To: (Receiving Organization) TWRS Compliance Plans	3. From: (Originating Organization) Technical Integration	4. Related EDT No.: 605650
5. Proj./Prog./Dept./Div.: Tank Waste Remediation System	6. Cog. Engr.: E. A. Fredenburg	7. Purchase Order No.: n/a

8. Originator Remarks:

This engineering data package provides supporting data for preparation of the TWRS Environmental Impact Statement. Data in this document complements data provided in separate documentation for the In-Situ Disposal Alternative, the No Separations Alternative, the Extensive Separations Alternative, the TPA Preferred Alternative, and the No Disposal Action Alternative. This document includes changes necessitated by a WHC internal review. WHC internal review comments and dispositions are contained in Review Comment Records which will be maintained in separate project files. This EDT transmits the engineering data package for waste retrieval and transfer to TWRS Compliance Plans as Rev. B, for DOE-RL approval, per WHC-CM-3-5, Section 12.7.

9. Equip./Component No.: n/a

10. System/Bldg./Facility: n/a

11. Receiver Remarks:

12. Major Assm. Dwg. No.: n/a

13. Permit/Permit Application No.: n/a

14. Required Response Date: n/a

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-EV-097		B	Waste Retrieval and Transfer Engineering Data Package for the Tank Waste Remediation System Environmental Impact Statement	E/S/Q D	1/1/1 4	1	

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D or N/A (see WHC-CM-3-5, Sec. 12.7)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
1	1	Cog. Eng.	E A Fredenburg	1/26/95	S4-53	G. A. Meyer	[illegible]	1/26/95	[illegible]	1	
1	1	Cog. Mgr.	E A Fredenburg	G L Dunford 1/26/95							
1	1	QA	[illegible]	1/26/95	S1-57						
1	1	Safety	[illegible] M Jones	1/26/95	R3-09						
1	1	Env.	[illegible]	1-26-95	H6-26						

18. E A Fredenburg E. A. Fredenburg Signature of EDT Originator — Date 1/26/95	19. L E Borneman L. E. Borneman Authorized Representative for Receiving Organization — Date 1/26/95	20. G. L. Dunford Cognizant Manager — Date	21. DOE APPROVAL (if required) Ctrl. No. [ ] Approved [ ] Approved w/comments [ ] Disapproved w/comments

Table 5-13. Comparison of Alternatives by Process Module for Retrieval and Transfer: (Millions of 1995 Dollars)[1].

Process Module	No Disposal Action	In Situ Disposal	Extensive Pretreatment	No Separations	TPA Preferred Alternative
SST retrieval	$0	$0	$2,508	$2,508	$2,508
SST confinement	$0	$0	$1,492	$1,492	$1,492
SST waste transfers	$0	$0	$1,956	$1,956	$1,956
SST subsurface barriers	$0	$0	$768	$768	$768
DST retrieval	$2,198	$0	$1,306	$1,213	$1,306
DST waste transfers	$272	$0	$458	$344	$458
MUST retrieval	$0	$0	$74	$74	$74
MUST waste transfers	$0	$0	$93	$93	$93
Total	$2,470	$0	$8,657	$8,466	$8,657

Note:

DST = double-shell tank
MUST = miscellaneous underground storage tanks
SST = single-shell tank
TPA = Tri-Party Agreement

[1]For basis of estimate, see Appendix A, Backup to Table 5-13, Overall Retrieval Costs for no action alternative.

Table 5-14. Comparison of Alternatives by Overall Cost Component for Retrieval and Transfer (Millions of 1995 Dollars).

Cost Component	No Disposal Action	In Situ Disposal	Extensive Pretreatment	No Separations	TPA Preferred Alternative
Capital[1]	$1,930	$0	$3,270	$3,270	2,280 ~~$3,270~~
Operating[2]	$440	$0	$5,180	$4,990	4,820 ~~$5,180~~
Research and Development[3]	$100	$0	$210	$210	190 ~~$210~~
Total	$2,470	$0	$8,660	$8,470	7,890 ~~$8,660~~

Notes:

TPA = Tri-Party Agreement

[1]For basis of capital cost estimate, see Table 5-15.

[2]For basis of operating cost estimate, see Table 5-16.

[3]Research and development cost is estimated as 5 percent of capital cost.

Modified per table 5-13 backup pg A-65 to remove Subsurface Barriers. Capital Costs Reduced by 600 to remove X Site

Table 5-15. Comparison of Alternatives by Capital Cost Component for Retrieval and Transfer (Millions of 1995 Dollars)[1].

Capital Cost Component[2]	No Disposal Action	In Situ Disposal	Extensive Pretreatment	No Separations	TPA Preferred Alternative
Labor	$1,260	$0	$2,120	$2,120	$2,120
Materials/supplies	$190	$0	$330	$330	$330
Equipment	$380	$0	$660	$660	$660
Local purchases	$100	$0	$160	$160	$160
Total	$1,930	$0	$3,270	$3,270	$3,270

Notes:

TPA = Tri-Party Agreement

[1]For capital cost estimate, see Appendix A, Backup to Table 5-6, A-Construction Staff Hours.

[2]Capital costs are assumed to be broken down as follows: labor, 65 percent; materials and supplies, 10 percent; equipment, 20 percent; and local purchases, 5 percent.

Table 5-16. Comparison of Alternatives by Operating Cost Component for Retrieval and Transfer (Millions of 1995 Dollars)[1].

Operating Cost Component	No Disposal Action	In Situ Disposal	Extensive Pretreatment	No Separations	TPA Preferred Alternative
Labor	$396	$0	$4,596	$4,427	$4,596
Materials/Supplies	$17	$0	$194	$186	$194
Equipment	$25	$0	$290	$280	$290
Local Purchases	$8	$0	$97	$93	$97
Total	$446	$0	$5,177	$4,986	$5,177

Note:

TPA = Tri-Party Agreement

[1]For basis of estimate, see Appendix A, Backup to Table 5-16, A-Operating Costs for Tri-Party Agreement and Extensive Separation Alternatives.

Table 5-17. Comparison of Alternatives by Overall Schedule for Retrieval and Transfer (Calendar Year Start/Completion Date)[1]. (2 sheets)

Activity	No Disposal Action[2]	In Situ Disposal	Extensive Pretreatment	No Separations	TPA Preferred Alternative
Construction	2032[3]/2039 and 2082/2089	n/a	1998[3]/2017[4]	1998[3]/2017[4]	1998[3]/2017[4]
Operation	2035[5]/2042 and 2085/2092	n/a	2001[5]/2023[6]	2001[5]/2018[6]	2001[5]/2023[6]
Monitoring and maintenance	n/a	n/a	n/a	n/a	n/a
Decontamination and decommissioning	2044/2051 and 2094/2101	n/a	2012[7]/2025[8]	2012[7]/2020[8]	2012[7]/2025[8]
Research and development	ongoing/2003[9]	n/a	ongoing/2003[9]	ongoing/2003[9]	ongoing/2003[9]

Notes:

TPA = Tri-Party Agreement

[1]These start/complete dates do not consider the start/complete dates for the cross-site transfer line Project W-058 [part of the transfer system for retrieved single-shell tank (SST) wastes]. This project is covered under the *Draft Environmental Impact Statement, Safe Interim Storage of Hanford Waste Tanks*, (DOE-RL 1994). Start/complete dates for the remainder of the waste transfer system for SST wastes is assumed bounded by the start/complete dates for SST retrieval systems. Start/complete dates for transfer systems for MUST wastes are assumed bounded by the start/complete dates for miscellaneous underground storage tank (MUST) retrieval systems.

[2]Two durations are shown: one for the first phase of retrieval to new storage tanks and one for the second phase that follows the first by 50 years. For the no action alternative, no SST wastes are retrieved; therefore DSTs are not used for staging of SST waste. For this condition, the *Tank Waste Technical Options Report* (Boomer et al. 1993) estimate of DST retrieval duration (7 years) is used. Construction is assumed to have a 7-year duration, starting 3 years earlier than operations based on WHC-SD-W211-CDR-002, Appendix D (WHC 1994). Decontamination and decommissioning is assumed of comparable duration to construction (7 years) and to start 2 years following completion of retrieval operations. Start and finish dates for retrieval oprations are from Table 5-2 (Meng 1995).

Table 5-17. Comparison of Alternatives by Overall Schedule for Retrieval and Transfer (Calendar Year Start/Completion Date)[1]. (2 sheets)

Notes: (Continued)

[1]Excluding SST C-106 (Project W-320) and DSTs SY-101 and SY-103 (Project W-211) which are covered under separate National Environmental Policy Act documentation, the first double-shell tank (DST) to start construction is AW-101 (Package 1 of Project W-211) per WHC-SD-W211-CDR-002, Appendix D (WHC 1994). Construction of the first SST retrieval system does not start before 2000 per Tri-Party Agreement milestone M-45-04 (Ecology et al. 1990).

[2]Completed construction of SST retrieval systems is assumed to be one year prior to completion of retrieval from SSTs, September 30, 2018 per Tri-Party Agreement milestone M-45-05 (Ecology et al. 1990). DST retrieval system construction and installation is assumed to precede SST retrieval, since DSTs are used as staging tanks for SST wastes.

[3]Excluding SST C-106, DST SY-101, and SY-103, AW-101 will be the first DST to operate in 2001, per WHC-SD-W211-CDR-002, Appendix D (WHC 1994).

[4]For the Tri-Party Agreement preferred alternative, DST retrieval is assumed to continue until completion of vitification operations. The extensive separation alternative is assumed to have the same schedule. For the no separations alternative, vitrification operations are scheduled to be completed in 2018. DST retrieval operations will be conducted to support this schedule and will therefore also be conducted concurrent with, and completed at the time of, or shortly after completion of SST retrieval operations.

[5]Decontamination and decommissioning of retrieval systems is assumed to start with initiation of tank farm closure activities per Tri-Party Agreement milestone M-45-06-T3 (Ecology et al. 1990).

[6]Decontamination and decommissioning of retrieval systems is assumed to be completed two years after completion of retrieval operations.

[7]Tri-Party Agreement milestone M-45-03-T1 (Ecology et al. 1990).

Table 5-17. Comparison of Alternatives by Overall Schedule for Retrieval and Transfer (Calendar Year Start/Completion Date)[1]. (2 sheets)

Boomer, K. D., et al., 1993, *Tank Waste Technical Options Report*, WHC-EP-0616, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

DOE-RL, 1994, *Draft Environmental Impact Statement, Safe Interim Storage of Hanford Tank Wastes, Hanford Site, Richland, Washington*, DOE/EIS-0212, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA and DOE, 1994, *Hanford Federal Facility Agreement and Consent Order*, 2 vols, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency and U.S. Department of Energy, Olympia, Washington.

Meng, C. D., 1995, *No Disposal Action Engineering Data Package for the Tank Waste Remediation System Environmental Impact Statement*, WHC-SD-WM-EV-099, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC, 1994, *Conceptual Design Report, Initial Tank Retrieval Systems*, Project W-211, WHC-SD-W211-CDR-002, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Backup to Table 5-13. Overall Retrieval Costs for Tri-Party Agreement and Extensive Separations Alternatives (2 sheets).

Tanks	Cap. Cost Millions	Operating Staff Hours	Op. Cost Millions	M&M Cost Millions	R&D Cost Millions	Total Cost Millions
SSTs						
Retrieval						
Arm-based	$283	13,514,932	$1,069	$0	$57	$1,408
Sluicing	$579	6,224,163	$492	$0	$29	$1,100
Confinement						
Arm-based	$587	11,080,075	$876	$0	$29	$1,492
Sluicing	$0	0	$0	$0	$0	$0
Barriers	$390	4,540,061	$359	$0	$20	$768
Transfer						
Pipeline	$408	19,329,408	$1,528	$0	$20	$1,956
Container	$0	0	$0	$0	$0	$0
SST Total =	$2,247	54,688,639	$4,324	$0	$155	$6,725
DSTs						
Retrieval						
Mixer pumps	$916	3,172,608	$251	$0	$46	$1,213
Sluicing	$48	541,987	$43	$0	$2	$93
Transfer						
Pipeline	$0	5,798,822	$458	$0	$0	$458
DST Total =	$964	9,513,418	$752	$0	$48	$1,764
MUSTs						
Retrieval						
Sluicing	$39	421,546	$33	$0	$2	$74

Backup to Table 5-13. Overall Retrieval Costs for Tri-Party Agreement and Extensive Separations Alternatives (2 sheets).

Transfer Container	$23	870,998	$69	$0	$1	$93
MUST Total =	$62	1,292,544	$102	$0	$3	$167
Retrieval =	$3,273	65,494,600	$5,177	$0	$207	$8,657

Notes:

DST = double-shell tank
MUST = miscellaneous underground storage tank
SST = single-shell tank

As indicated in Section 5.0, the values in these tables are imported from spreadsheet calculations. The number of significant figures shown does not imply level of accuracy or degree of confidence in the estimated values.

See Notes to Backup Table 5-6 Construction Staff Hours for capital cost basis.

See Table 5-1 and Table 5-16 for operating cost staff hours and basis.

D&D cost basis is included in operating cost, and is based on entombment in place, per the Hanford Mission Plan, DOE/RL-93-102.

Operating cost includes startup cost.

Retrieval R&D cost is assumed to be 5 percent of retrieval capital cost, except R&D cost for arm-based SST retrieval includes additional $43 million for SST retrieval test facility.

Boomer, K. D., et al., 1993, *Tank Waste Technical Options Report*, WHC-EP-0616, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Backup to Table 5-13. Overall Retrieval Costs for No Separations Alternative (2 sheets).

Tanks	Cap Cost Millions	Operating Staff hours	Op. Cost Millions	M&M Cost Millions	R&D Cost Millions	Total Cost Millions
SSTs						
Retrieval						
Arm-based	$283	13,514,932	$1,068	$0	$57	$1,408
Sluicing	$579	6,224,163	$492	$0	$29	$1,100
Confinement						
Arm-based	$587	11,080,075	$875	$0	$29	$1,492
Sluicing	$0	0	$0	$0	$0	$0
Barriers	$390	4,540,061	$359	$0	$20	$768
Transfer						
Pipeline	$408	19,329,408	$1,527	$0	$20	$1,955
Container	$0	0	$0	$0	$0	$0
SST Total =	$2,247	54,688,639	$4,320	$0	$112	$6,723
DSTs						
Retrieval						
Mixer pumps	$916	2,379,456	$188	$0	$46	$1,150
Sluicing	$48	406,490	$32	$0	$2	$83
Transfer						
Pipeline	$0	4,349,117	$344	$0	$0	$344
DST Total =	$964	7,135,063	$564	$0	$48	$1,576
MUSTs						
Retrieval						
Sluicing	$39	421,546	$33	$0	$2	$74

Backup to Table 5-13. Overall Retrieval Costs for No Separations Alternative (2 sheets).

Tanks	Cap Cost Millions	Operating Staff hours	Op. Cost Millions	M&M Cost Millions	R&D Cost Millions	Total Cost Millions
Transfer Container	$23	870,998	$69	$0	$1	$93
MUST Total =	$62	1,292,544	$102	$0	$3	$167
Retrieval =	$3,273	63,116,246	$4,986	$0	$207	$8,466

Notes:

DST = double-shell tank
MUST = miscellaneous underground storage tank
SST = single-shell tank

As indicated in Section 5.0, the values in these tables are imported from spreadsheet calculations. The number of significant figures shown does not imply level of accuracy or degree of confidence in the estimated values.

See Notes to Backup Table 5-6 Construction Staff hours for capital cost basis.

See Table 5-1 and Table 5-16 for operating cost staff hours and basis.

D&D cost is included in operating cost, and is based on entombment in place, per the Hanford Mission Plan, DOE/RL-93-102.

Operating cost includes startup costs.

Retrieval R&D cost is assumed to be 5 percent of retrieval capital cost, except R&D cost for arm-based SST retrieval also includes additional $43 million for SST retrieval test facility.

Boomer, K. D., et al., 1993, *Tank Waste Technical Options Report*, WHC-EP-0616, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Backup to Table 5-13. Overall Retrieval Costs for No Disposal Action Alternative (2 sheets).

Tanks	Capital Cost Millions	Operating Staff Hours	Operating Cost Millions	M&M Cost Millions	R&D Cost Millions	Total Cost Millions
SSTs						
Retrieval						
Arm-based	$0	0	$0	$0	$0	$0
Sluicing	$0	0	$0	$0	$0	$0
Confinement						
Arm-based	$0	0	$0	$0	$0	$0
Sluicing	$0	0	$0	$0	$0	$0
Barriers	$0	0	$0	$0	$0	$0
Transfer						
Pipeline	$0	0	$0	$0	$0	$0
Container	$0	0	$0	$0	$0	$0
SST Total =	$0	0	$0	$0	$0	$0
DSTs						
Retrieval						
Mixer pumps	$1,832	1,850,688	$149	$0	$92	$2,072
Sluicing	$96	316,159	$25	$0	$5	$126
Transfer						
Pipeline	$0	3,382,646	$272	$0	$0	$272
DST Total =	$1,928	5,549,493	$446	$0	$96	$2,470
MUSTs						
Retrieval						
Sluicing	$0	0	$0	$0	$0	$0

Backup to Table 5-13. Overall Retrieval Costs for No Disposal Action Alternative (2 sheets).

Tanks	Capital Cost Millions	Operating Staff Hours	Operating Cost Millions	M&M Cost Millions	R&D Cost Millions	Total Cost Millions
Transfer Container	$0	0	$0	$0	$0	$0
MUST Total =	$0	0	$0	$0	$0	$0
Retrieval =	$1,928	5,549,493	$446	$0	$96	$2,470

Notes:

DST = double-shell tank
MUST = miscellaneous underground storage tank
SST = single-shell tank

As indicated in Section 5.0, the values in these tables are imported from spreadsheet calculations. The number of significant figures shown does not imply level of accuracy or degree of confidence in the estimated values.

See Notes to Backup Table 5-6 Construction Staff hours for capital cost basis.

See Table 5-1 and Table 5-16 for operating cost staff hours and basis.

D&D cost is included in operating cost.

Operating cost includes startup costs.

Retrieval R&D cost is assumed to be 5 percent of retrieval capital cost.

Boomer, K. D., et al., 1993, *Tank Waste Technical Options Report*, WHC-EP-0616, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Backup to Table 5-16. Operating Costs for Tri-Party Agreement and Extensive Separations Alternatives (3 sheets).

mh/FTE = 1836	Weighting Factor	FTE/yr Total	FTE/yr EX	FTE/yr NE	FTE/yr DU	Weighted	Life Cycle Factor	Lifetime Staff Hours	EX mhs	NE mhs	DU mhs
SSTs											
Retrieval											
Arm-based	33.56%	1371	242	61	1068	460.06711	16	13,514,932	2,385,568	601,321	10,528,043
Sluicing	73.83%	287	120	29	138	211.87919	16	6,224,163	2,602,438	628,922	2,992,803
Confinement											
Arm-based	33.56%	1124	232	91	801	377.18121	16	11,080,075	2,286,991	897,052	7,896,032
Sluicing	73.83%	0	0	0	0	0	16	0	0	0	0
Barriers	100.00%	112.4	23.2	9.1	80.1	112.4	22	4,540,061	937,094	367,567	3,235,399
Transfer											
Pipeline	100.00%	658	245	82	331	658	16	19,329,408	7,197,120	2,408,832	9,723,456
Container	0.00%	593	221	79	293	0	16	0	0	0	0
SST sub-total =								54,688,639	15,409,210	4,903,695	34,375,734
DSTs											
Retrieval											
Mixer pumps	100.00%	72	28	9	35	72	24	3,172,608	1,233,792	396,576	1,542,240
Sluicing	21.43%	57.4	24	5.8	27.6	12.3	24	541,987	226,615	54,765	260,607
Transfer											
Pipeline	100.00%	131.6	49	16.4	66.2	131.6	24	5,798,822	2,159,136	722,650	2,917,036
DST sub-total =								9,513,418	3,619,543	1,173,991	4,719,884
MUSTs											
Retrieval											
Sluicing	100.00%	14.35	6	1.45	6.9	14.35	16	421,546	176,256	42,595	202,694
Transfer											
Container	100.00%	29.65	11.05	3.95	14.65	29.65	16	870,998	324,605	116,035	430,358

Backup to Table 5-16. Operating Costs for Tri-Party Agreement and Extensive Separations Alternatives (3 sheets).

mh/FTE = 1836	Weighting Factor	FTE/yr Total	FTE/yr EX	FTE/yr NB	FTE/yr BU	Weighted	Life Cycle Factor	Lifetime Staff Hours	EX mhs	NB mhs	BU mhs
MUST sub-total =								1,292,544	500,861	158,630	633,053
TOTAL =								65,494,600	19,529,614	6,236,316	39,728,671

Notes:

DST = double-shell tank
MUST = miscellaneous underground storage tank
SST = single-shell tank

As indicated in Section 5.0, the values in these tables are imported from spreadsheet calculations. The number of significant figures shown does not imply level of accuracy or degree of confidence in the estimated values.

SST retrieval annual staff hours are based on WHC-EP-0616 (Boomer et al. 1993), Tables F4-5 and F4-16, with Maintenance BU reduced 1/4 to account for 1/3 longer SST retrieval (16 yrs vs 12 yrs), per Tri-Party Agreement schedule.

SST confinement annual staff hours are based on WHC-EP-0616, Table F7-13 (maximum of alternatives).

Backup to Table 5-16. Operating Costs for Tri-Party Agreement and Extensive Separations Alternatives (3 sheets).

Notes: (Continued)

SST subsurface barriers are based on assumed 10 percent of confinement annual staff hours, for cryogenic or air circulation barriers requiring operational support.

SST waste transfer annual staff hours are based on WHC-EP-0616, Table F8-5.

Subsurface barrier operations assumed required 6 years longer that SST retrieval operations, based on Tri-Party Agreement M-45 milestones.

Mixer pump DST retrieval annual staff hours are based on WHC-EP-0616, Table F5-4.

Assumes 6 DSTs will require sluicing following mixer pump operations to meet closure criteria.

Sluicing DST retrieval annual staff hours are assumed 20 percent (~28/149) of SST sluicing staff hours.

DST waste transfer annual staff hours are assumed 20 percent (~28/149) of SST waste transfer staff hours.

MUST retrieval staff hours are assumed 5 percent of SST retrieval staff hours (~10 x MUST vol./SST vol.)

MUST waste transfer staff hours are assumed 5 percent of SST transfer staff hours (~10 x MUST vol./SST vol.) for container transport (assumes pipelines not available).

Assumes no increase in WHC-EP-0616 staff estimates, for staging/blending in DSTs.

Staff hours/full time equivalent = 1836

Boomer, K. D., et al., 1993, *Tank Waste Technical Options Report*, WHC-EP-0616, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Backup to Table 5-16. Operating Costs for No Separations Alternative (3 sheets).

mh/FTE = 1836	Weighting Factor	FTE/yr Total	FTE/yr EX	FTE/yr NE	FTE/yr BU	Weighted	Life Cycle Factor	Lifetime Staff-Hours	EX mhs	NE mhs	BU mhs
SSTs											
Retrieval											
Arm-based	33.56%	1371	242	61	1068	460.067114	16	13,514,932	2,385,568	601,321	10,528,043
Sluicing	73.83%	287	120	29	138	211.879195	16	6,224,163	2,602,438	628,922	2,992,803
Confinement											
Arm-based	33.56%	1124	232	91	801	377.181208	16	11,080,075	2,286,991	897,052	7,896,032
Sluicing	73.83%	0	0	0	0	0	16	0	0	0	0
Barriers	100.00%	112.4	23.2	9.1	80.1	112.4	22	4,540,061	937,094	367,567	3,235,399
Transfer											
Pipeline	100.00%	658	245	82	331	658	16	19,329,408	7,197,120	2,408,832	9,723,456
Container	0.00%	593	221	79	293	0	16	0	0	0	0
SST sub-total =								54,688,639	15,409,210	4,903,695	34,375,734
DSTs											
Retrieval											
Mixer pumps	100.00%	72	28	9	35	72	18	2,379,456	925,344	297,432	1,156,680
Sluicing	21.43%	57.4	24	5.8	27.6	12.3	18	406,490	169,961	41,074	195,455
Transfer											
Pipeline	100.00%	131.6	49	16.4	66.2	131.6	18	4,349,117	1,619,352	541,987	2,187,778
DST sub-total =								7,135,063	2,714,657	880,493	3,539,913
MUSTs											
Retrieval											
Sluicing	100.00%	14.35	6	1.45	6.9	14.35	16	421,546	176,256	42,595	202,694
Transfer											
Container	100.00%	29.65	11.05	3.95	14.65	29.65	16	870,998	324,605	116,035	430,358
MUST sub-total =								1,292,544	500,861	158,630	633,053

Backup to Table 5-16. Operating Costs for No Separations Alternative (3 sheets).

mh/FTE = 1836	Weighting Factor	FTE/yr Total	FTE/yr EX	FTE/yr NR	FTE/yr DU	Weighted	Life Cycle Factor	Lifetime Staff Hours	EX mhs	NR mhs	DU mhs
TOTAL =								63,116,246	18,624,728	5,942,818	38,548,699

Notes:

DST = double-shell tank
MUST = miscellaneous underground storage tank
SST = single-shell tank

As indicated in Section 5.0, the values in these tables are imported from spreadsheet calculations. The number of significant figures shown does not imply level of accuracy or degree of confidence in the estimated values.

SST retrieval annual staff hours are based on WHC-EP-0616 (Boomer et al. 1993), Tables F4-5 and F4-16, with Maintenance DU reduced 1/4 to account for 1/3 longer SST retrieval (16 yrs vs 12 yrs), per Tri-Party Agreement schedule.

SST confinement annual staff hours are based on WHC-EP-0616, Table F7-13 (maximum of alternatives).

Backup to Table 5-16. Operating Costs for No Separations Alternative (3 sheets).

Notes: (Continued)

SST subsurface barriers are based on assumed 10 percent of confinement annual staff hours, for cryogenic or air circulation barriers requiring operational support.

SST waste transfer annual staff hours are based on WHC-EP-0616, Table F8-5.

Subsurface barrier operations are assumed required 6 years longer that SST retrieval operations, based on Tri-Party Agreement M-45 milestones.

Mixer pump DST retrieval annual staff hours are based on WHC-EP-0616, Table F5-4.

Assumes 6 DSTs will require sluicing following mixer pump operations to meet closure criteria.

Sluicing DST retrieval annual staff hours assumed 20 percent (~28/149) of SST sluicing staff hours.

DST waste transfer annual staff hours assumed 20 percent (~28/149) of SST waste transfer staff hours.

MUST retrieval staff hours assumed 5 percent of SST retrieval staff hours (~10 x MUST vol./SST vol.)

MUST waste transfer staff hours assumed 5 percent of SST transfer staff hours (~10 x MUST vol./SST vol.) for container transport (assumes pipelines not available).

Assume no increase in WHC-EP-0616 staff estimates, for staging/blending in DSTs.

Staff hours/full time equivalent = 1836

Boomer, K. D., et al., 1993, *Tank Waste Technical Options Report*, WHC-EP-0616, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Backup to Table 5-16. Operating Costs for No Disposal Action Alternative (2 sheets).

mh/FTE = 1836	Weighting Factor	FTE/yr Total	FTE/yr BX	FTE/yr NB	FTE/yr BU	Weighted	Life Cycle Factor	Lifetime Staff hours	BX mhs	NB mhs	BU mhs
SSTs											
Retrieval											
Arm-based	33.56%	1371	242	61	1068	460.067114	0	0	0	0	0
Sluicing	73.83%	287	120	29	138	211.879195	0	0	0	0	0
Confinement											
Arm-based	33.56%	1124	232	91	801	377.181208	0	0	0	0	0
Sluicing	73.83%	0	0	0	0	0	0	0	0	0	0
Barriers	100.00%	112.4	23.2	9.1	80.1	112.4	0	0	0	0	0
Transfer											
Pipeline	100.00%	658	245	82	331	658	0	0	0	0	0
Container	0.00%	593	221	79	293	0	0	0	0	0	0
SST sub-total =								0	0	0	0
DSTs											
Retrieval											
Mixer pumps	100.00%	72	28	9	35	72	14	1,850,688	719,712	231,336	899,640
Sluicing	21.43%	57.4	24	5.8	27.6	12.3	14	316,159	132,192	31,946	152,021
Transfer											
Pipeline	100.00%	131.6	49	16.4	66.2	131.6	14	3,382,646	1,259,496	421,546	1,701,605
DST sub-total =								5,549,494	2,111,400	684,828	2,753,266
MUSTs											
Retrieval											
Sluicing	100.00%	14.35	6	1.45	6.9	14.35	0	0	0	0	0
Transfer											
Container	100.00%	29.65	11.05	3.95	14.65	29.65	0	0	0	0	0
MUST sub-total =								0	0	0	0
TOTAL =								5,549,494	2,111,400	684,828	2,753,266

Backup to Table 5-16. Operating Costs for No Disposal Action Alternative (2 sheets).

Notes:

DST = double-shell tank
MUST = miscellaneous underground storage tank
SST = single-shell tank

As indicated in Section 5.0, the values in these tables are imported from spreadsheet calculations. The number of significant figures shown does not imply level of accuracy or degree of confidence in the estimated values.

Mixer pump DST retrieval annual staff hours are based on WHC-EP-0616 (Boomer et al. 1993), Table F5-4.

Assumes 6 DSTs will require sluicing following mixer pump operations to meet closure criteria.

Sluicing DST retrieval annual staff hours are assumed 20 percent (~28/149) of SST sluicing staff hours.

DST waste transfer annual staff hours are assumed 20 percent (~28/149) of SST waste transfer staff hours.

Boomer, K. D., et al., 1993, *Tank Waste Technical Options Report*, WHC-EP-0616, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Backup to Table 5-16. Operating Costs Breakdown for Tri-Party Agreement and Extensive Separations Alternatives (2 sheets).

Description	CE	$/hr	hrs	CE percent	OH	Total	GA/CSP	Total with GA/CSP
WHC Labor:								
EX	#01	$39.52	19,529,614	n/a	22.50%	$945,467,673	24.50%	$1,177,107,253
NE	#00	$15.47	6,236,316	n/a	22.50%	$118,182,865	24.50%	$147,137,667
BU	#06	$28.59	39,728,670	n/a	22.50%	$1,391,407,277	24.50%	$1,732,302,060
Materials	#1	n/a	n/a	9.35%	n/a	n/a	incl.	$285,762,099
Purch. Svcs.	#2	n/a	n/a	16.95%	n/a	n/a	incl.	$518,109,214
Other Cont.	#3	n/a	n/a	23.56%	n/a	n/a	incl.	$719,971,086
Site Svcs	#4	n/a	n/a	9.36%	n/a	n/a	incl.	$286,046,675
Internal Chrg.	#5	n/a	n/a	7.80%	n/a	n/a	incl.	$238,463,136
IRM/BCSR	#6	n/a	n/a	2.37%	n/a	n/a	incl.	$72,493,457
IN Program:	FY94	% of	Actual	% of		Total =		$5,177,392,148
CE	BAC ($M)	#0 + #7	ACWP ($M)	#0 + #7				
#0 + #7	145.7507	100.00%	128.8883	100.00%		BREAKDOWN OF OPERATING COSTS FOR RETRIEVAL		
#1	9.4223	6.46%	12.05	9.35%		Category	Rate	Total
#2	23.9895	16.46%	21.8476	16.95%		Labor	88.78%	$4,596,540,098
#3	25.1576	17.26%	30.3597	23.56%		Mat'l/Supplies	3.74%	$193,617,517
#4	11.5042	7.89%	12.062	9.36%		Equipment	5.61%	$290,426,275
#5	13.0222	8.93%	10.0555	7.80%		Local Purchases	1.87%	$96,808,758
#6	1.5236	1.05%	3.0569	2.37%			Total =	$5,177,392,648

Backup to Table 5-16. Operating Costs Breakdown for Tri-Party Agreement and Extensive Separations Alternatives (2 sheets).

Notes:

As indicated in Section 5.0, the values in these tables are imported from spreadsheet calculations. The number of significant figures shown does not imply level of accuracy or degree of confidence in the estimated values.

WHC Labor staff hours are from Backup to Table 5-1 Operating Staff hours.

WHC labor rates and overhead rates are from FDS for TWRS for fiscal year 1995.

In calculation of operating costs, percentages given for material, purchased services, other contractors, site services, internal charges, and IRM are a percentage of WHC labor plus overhead, based on the 1N program 1994 fiscal-year-to-date actual spending through July.

In calculation of breakdown of operating costs, cost element 1, materials, is estimated to be distributed 40 percent to materials/supplies, and 60 percent to equipment.

In calculation of breakdown of operating costs, local purchases is estimated to be 20 percent of cost element 2, purchased services.

Backup to Table 5-16. Operating Costs Breakdown for No Separations Alternative (2 sheets).

Description	CE	$/hr	hrs	CE %	OH	Total	GA/CSP	Total with GA/CSP
WHC Labor:								
EX	#01	$39.52	18,624,728	n/a	22.50%	$901,660,332	24.50%	$1,122,567,113
NE	#00	$15.47	5,942,818	n/a	22.50%	$112,620,858	24.50%	$140,212,968
BU	#06	$28.59	38,548,699	n/a	22.50%	$1,350,081,448	24.50%	$1,680,851,403
Materials	#1	n/a	n/a	9.35%	n/a	n/a	incl.	$275,205,425
Purch. Svcs.	#2	n/a	n/a	16.95%	n/a	n/a	incl.	$498,969,132
Other Cont.	#3	n/a	n/a	23.56%	n/a	n/a	incl.	$693,373,788
Site Svcs	#4	n/a	n/a	9.36%	n/a	n/a	incl.	$275,479,489
Internal Chrg.	#5	n/a	n/a	7.80%	n/a	n/a	incl.	$229,653,789
IRM/BCSR	#6	n/a	n/a	2.37%	n/a	n/a	incl.	$69,815,391

IN Program:	FY94	% of	(thru Aug)	% of
CE	BAC ($M)	#0 + #7	FYTD ($M)	#0 + #7
#0 + #7	145.7507	100.00%	128.8883	100.00%
#1	9.4223	6.46%	12.05	9.35%
#2	23.9895	16.46%	21.8476	16.95%
#3	25.1576	17.26%	30.3597	23.56%
#4	11.5042	7.89%	12.062	9.36%
#5	13.0222	8.93%	10.0555	7.80%
#6	1.5236	1.05%	3.0569	2.37%

Total =		$4,986,128,498
BREAKDOWN OF OPERATING COSTS FOR RETRIEVAL		
Category	Rate	Total
Labor	88.78%	$4,426,733,905
Mat'l/Supplies	3.74%	$186,464,864
Equipment	5.61%	$279,697,296
Local Purchases	1.87%	$93,232,432
	Total =	$4,986,128,498

Backup to Table 5-16. Operating Costs Breakdown for No Separations Alternative (2 sheets).

Notes:

As indicated in Section 5.0, the values in these tables are imported from spreadsheet calculations. The number of significant figures shown does not imply level of accuracy or degree of confidence in the estimated values.

WHC Labor staff hours are from Backup to Table 5-1 Operating Staff hours (= 2x DST operating staff hours).

WHC labor rates and overhead rates are from FDS, for TWRS, for fiscal year 1995

In calculation of operating costs, percentages given for material, purchased services, other contractors, site services, internal charges, and IRM are a percentage of WHC Labor plus Overhead, based on the IN program 1994 fiscal-year-to-date actual spending through July.

In calculation of breakdown of operating costs, cost element 1, materials, is estimated to be distributed 40 percent to materials/supplies, and 60 percent to equipment.

In calculation of breakdown of operating costs, local purchases is estimated to be 20 percent of cost element 2, purchased services.

Backup to Table 5-16. Operating Costs Breakdown for No Disposal Action Alternative (2 sheets).

Description	CE	$/hr	hrs	CE %	OH	Total	GA/CSP	Total with GA/CSP
WHC Labor:								
EX	#01	$39.52	2,111,400	n/a	22.50%	$102,217,097	24.50%	$127,260,286
NE	#00	$15.47	684,828	n/a	22.50%	$12,978,004	24.50%	$16,157,615
BU	#06	$28.59	2,753,266	n/a	22.50%	$96,426,947	24.50%	$120,051,549
Materials	#1	n/a	n/a	9.35%	n/a	n/a	incl.	$24,632,235
Purch. Svcs.	#2	n/a	n/a	16.95%	n/a	n/a	incl.	$44,660,184
Other Cont.	#3	n/a	n/a	23.56%	n/a	n/a	incl.	$62,060,353
Site Svcs	#4	n/a	n/a	9.36%	n/a	n/a	incl.	$24,656,765
Internal Chrg.	#5	n/a	n/a	7.80%	n/a	n/a	incl.	$20,555,140
IRM/BCSR	#6	n/a	n/a	2.37%	n/a	n/a	incl.	$6,248,820

IN Program:	FY94	% of	(thru Aug)	% of		Total =		$446,282,946
CE	BAC ($M)	#0 + #7	FYTD ($M)	#0 + #7				
#0 + #7	145.7507	100.00%	128,8883	100.00%		BREAKDOWN OF OPERATING COSTS FOR RETRIEVAL		
#1	9.4223	6.46%	12.05	9.35%		Category	Rate	Total
#2	23.9895	16.46%	21.8476	16.95%		Labor	88.78%	$396,214,387
#3	25.1576	17.26%	30.3597	23.56%		Mat'l/Supplies	3.74%	$16,689,520
#4	11.5042	7.89%	12.062	9.36%		Equipment	5.61%	$25,034,279
#5	13.0222	8.93%	10.0555	7.80%		Local Purchases	1.87%	$8,344,760
#6	1.5236	1.05%	3.0569	2.37%			Total =	$446,282,946

Backup to Table 5-16. Operating Costs Breakdown for No Disposal Action Alternative (2 sheets).

Notes:

As indicated in Section 5.0, the values in these tables are imported from spreadsheet calculations. The number of significant figures shown does not imply level of accuracy or degree of confidence in the estimated values.

WHC Labor staff hours are from Backup to Table 5-1 Operating Staff hours (= 2x DST operating staff hours).

WHC labor rates and overhead rates are from FDS, for TWRS, for fiscal year 1995

In calculation of operating costs, percentages given for material, purchased services, other contractors, site services, internal charges, and IRM are a percentage of WHC Labor plus Overhead, based on the IN program 1994 fiscal-year-to-date actual spending through July.

In calculation of breakdown of operating costs, cost element 1, materials, is estimated to be distributed 40 percent to materials/supplies, and 60 percent to equipment.

In calculation of breakdown of operating costs, local purchases is estimated to be 20 percent of cost element 2, purchased services.

Table 9-17. Overall Cost Component. (Millions of 1995 Dollars)

Cost Component	Tri-Party Agreement Preferred Alternative
Capital	3,600[1]
Operating	3,900[2]
Research and development	630[3]
Repository fee	1,750
Other related costs	8,600[4]
Total	$18,500

Notes:

[1]Total capital cost includes 40% contingency. Contingency is excluded from other costs.

[2]Includes start-up, decontamination and decommissioning, and monitoring and maintenance costs.

[3]Pg. 130 of Boomer 1994, which was based on a draft of the *Tank Waste Remediation System Multi-Year Program Plan* (MYPP) (WHC 1994).

[4]Other related costs are costs defined in the MYPP that should be included in the total costs, but are not directly related to operations. These costs are:

Program management	$1,180
Operations and maintenance	4,290
Tank farm safety	440
Tank farm upgrades	1,720
Characterization	933
Total	$8,563

(SIB 4342)

Round to $8,600 million. These costs are taken as total unescalated costs from the MYPP.

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.

WHC, 1994, *Tank Waste Remediation System Multi-Year Program Plan*, WHC-SP-1101, Westinghouse Hanford Company, Richland, Washington.

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UC-630

Tri-Party Agreement Alternative Engineering Data Package for the Tank Waste Remediation System Environmental Impact Statement

E. J. Slaathaug

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Westinghouse Hanford Company P.O Box 1970 Richland, Washington

Management and Operations Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

Approved for Public Release

Table 9-16. Process Module: Overall Cost.
(Millions of 1995 Dollars)

Process Module	Tri-Party Agreement Preferred Alternative
Sludge wash	210
Cesium removal	980
Centralized facilities	520
Low-level waste vitrification	2,900
Low-level waste disposal	290
High-level waste vitrification	3,000
High-level waste transportation	31
High-level waste disposal	5,900
Total	$13,800

Table 9-17. Overall Cost Component. (Millions of 1995 Dollars)

Cost Component	Tri-Party Agreement Preferred Alternative
Capital	3,600[1]
Operating	3,900[2]
Research and development	630[3]
Repository fee	3,960[4]
Total	$12,100

Notes:

[1]Total capital cost includes 40% contingency. Contingency is excluded from other costs.

[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 [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]Pg. 130 of Boomer 1994, which was based on a draft of the *Tank Waste Remediation System Multi-Year Program Plan* (MYPP) (WHC 1994).

[4]Table D-8, TRW 1995, estimates the repository fee for the TPA Alternative (Case 2-5SC) would be $112 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

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.

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*, A00000000-01717-5705-00003, Rev. 0, TRW Environmental Safety Systems, Inc., Vienna, Virginia.

Table 9-18. Capital Cost Component.
(Millions of 1994 Dollars)[1]

Capital Cost Component	Tri-Party Agreement Preferred Alternative
Labor	1,600
Materials/supplies[2]	610
Equipment[2]	1,100
Local purchases[2]	300
Total	$3,600

Notes:

[1]Excludes construction of low-level waste vaults.

[2]Local purchases set to 15% of material/supplies and equipment.

Table 9-19. Operating Cost Component. (Millions of 1995 Dollars)[1]

Operating cost component	Tri-Party Agreement Preferred Alternative
Labor	1,700
Materials/supplies	1,600
Equipment	270
Local purchases	330[2]
Total	$3,900

Notes:

[1]Includes construction of low-level waste vaults as well as start-up cost, decontamination and decommissioning cost, and monitoring and maintenance cost.

[2]Based on 15% of materials/supplies and equipment.

Table 9-20. Overall Schedule.
(Calendar Year Start/Completion Date)

Activity	Tri-Party Agreement Preferred Alternative
Construction	12/1997 - 11/2007[1, 2]
Operation	06/2004 - 12/2023[3]
Decontamination and decommissioning	06/2019 - 12/2028[4]
Monitoring and maintenance	12/2023 - 12/2029[5]
High-level waste disposal	12/2019 - 12/2029
Research and development	1995 - 2018[6]

Notes:

[1]Boomer, 1994, Figure 4.3-5, pp. 76. Does not include low-level waste (LLW) vaults.

[2]Boomer, 1994, Figure 4.4-5, pp. 92

[3]Boomer, 1994, Table 3.4-1, pp. 33. Finishes ahead of Tri-Party Agreement milestone.

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

[5]Monitoring and maintenance is for the high-level waste casks stored onsite until transportation to the repository.

[6]Based on the *Tank Waste Remediation System Multi-Year Program Plan* and is consistent with the LLW operation.

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.

WHC, 1994, *Tank Waste Remediation System Multi-Year Program Plan*, WHC-SP-1101, Westinghouse Hanford Company, Richland, Washington.

Table 9-21. Unit Process: Sequence of Construction.
(Calendar Year Start\Completion Date)

Unit process	Tri-Party Agreement Preferred Alternative
Sludge wash	12/1997 - 12/2003[4]
Cesium removal	12/1997 - 12/2003[4]
Other radionuclide removal	n/a
Low-level waste vitrification	12/1997-12/2003[1]
Low-level waste disposal	12/2003-12/2019[2]
High-level waste vitrification	06/2002-12/2007[3]
High-level waste transportation/disposal	n/a

Notes:

[1]Boomer, 1994, Figure 4.4-5, pp. 92.

[2]Construction of the low-level waste (LLW) vaults will commence when LLW Vitrification construction is complete which is approximately 1.5 years prior to LLW operations. Vault construction will continue as required through LLW operations.

[3]Tri-Party Agreement Milestone M-51-03-T04.

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.

Ecology, EPA and DOE, 1994, Hanford Federal Facility Agreement and Consent Order, 2 vols, as amended, Washington State Department of Ecology, Olympia, Washington, and U.S. Environmental Protection Agency and U.S. Department of Energy, Washington, D.C.

F.11 Backup for Table 9-16

Table F-36. Total Cost by Unit Operation.

	Construction	Labor	Equipment	Materials and Supplies			Low-Level Vaults	HLW Canisters	Research and Development	Repository Fee	Totals
				Start-up	D and D	Operations					
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.

The backup for Table 9-8 and Table 9-9 in this appendix contains capital cost for Pretreatment/LLW combined. To separate sludge wash and cesium removal from LLW vitrification, other cost estimates were employed. Cost estimates were found for a detached pretreatment facility and a detached LLW facility (these are contained in Table 9-8 and Table 9-9 backup). The total capital cost for each were taken and added together. This total was then divided into each staff hour value separately. The calculation was as follows:

Detached Separations	-	Total Capital Cost	=	$304,145,913
Detached LLW	-	Total Capital Cost	=	$966,251,470
		Total	=	$1,270,397,383

% separations = $304,145,913/$1,270,397,383 = 0.239 => Value used is 25 %

Therefore % LLW = 75%

This value was used to divide all costs that lumped Pretreatment/LLW together. Engineering judgement set the sludge wash capital cost equal to 10% of the total for separations (see above).

Engineering judgement set the cesium removal capital cost equal to 90% of the total for separations (see above).

Construction includes labor and materials. Total value was taken from Table 9-18.

Labor is operating labor only. It includes direct and indirect staffing. Total value was taken from Table 9-19.

Equipment cost is assumed cost for replacement equipment during operations. Total value was taken from Table 9-19 (including local purchases).

Material and supply cost covers start-up, operations, and decontamination and decommissioning. Total value was taken from Table 9-19 (including local purchases).

Values for the cost of the LLW Vaults and the HLW Canisters were taken from the backup for Table 9-4.

Totals for research and development costs were taken from Table 9-17.

F.12 Backup for Table 9-18

Capital costs are calculated using the design cost estimates (see Appendix C). The cost estimate is categorized as follows:

- Estimated labor, material, and equipment for both the M&O contractor and subcontracts
- Overhead and profit
- Construction and project management
- Engineering
- Contingency.

A. Calculation: Labor, Material, and Equipment for M&O Contractor and Subcontracts.

Costs for Total Project:

M&O Contractor		Labor	Material	Equipment
Pretreatment/LLW	=	$188,943,943	$105,550,250	$311,926,395
20T/D HLW Facility	=	$186,434,799	$116,905,668	$169,901,640
Centralized Facility	=	$59,634,131	$54,152,639	$38,934,126

From Cost Estimate (see Appendix C). Labor and material values came from MT 3. Equipment values taken from MT 2.

Subcontracts				
Pretreatment/LLW	=	$3,779,600	$5,669,400	$0
20T/D HLW Facility	=	$0	$0	$0
Centralized Facility	=	$13,426,200	$20,139,300	$0

Totals from Cost Estimate (see Appendix C. from MT 3. Estimating judgement set the labor and material values to 40% and 60% of the total, respectively.

B. Calculation: Overhead and Profit

% of M&O contractor labor for Overhead and Profit = 53%
% of M&O contractor material for Overhead and Profit = 5%
% of M&O contractor equipment for Overhead and Profit = 5%
% of Subcontract labor for Overhead and Profit = 10%
% of Subcontract material for Overhead and Profit = 10%

Based on cost estimating judgement.

M&O Contractor		Labor	Material	Equipment
Pretreatment/LLW	=	$100,140,290	$5,277,513	$15,596,320
20T/D HLW Facility	=	$98,810,443	$5,845,283	$8,495,082
Centralized Facility	=	$31,606,089	$2,707,632	$1,946,706
Subcontracts				
Pretreatment/LLW	=	$566,940	$377,960	$0
20T/D HLW Facility	=	$0	$0	$0
Centralized Facility	=	$2,013,930	$1,342,620	$0

C. Calculation: Construction and Project Management

Construction Management is set to 10% of the summation of the capital cost and the overhead and profit.

Based on cost estimating judgement.

M&O Contractor		Labor	Material	Equipment
Pretreatment/LLW	=	$28,908,423	$11,082,776	$32,752,271
20T/D HLW Facility	=	$28,524,524	$12,275,095	$17,839,672
Centralized Facility	=	$9,124,022	$5,686,027	$4,088,083
Subcontracts				
Pretreatment/LLW	=	$623,634	$415,756	$0
20T/D HLW Facility	=	$0	$0	$0
Centralized Facility	=	$2,215,323	$1,476,882	$0

Project Management is set to 10% of the summation of the capital cost, the overhead and profit, and the construction management plus 40% of 10% of the summation of the capital cost and the overhead and profit.

Based on cost estimating judgement.

M&O Contractor		Labor	Material	Equipment
Pretreatment/LLW	=	$43,362,635	$16,624,164	$49,128,407
20T/D HLW Facility	=	$42,786,786	$18,412,643	$26,759,508
Centralized Facility	=	$13,686,033	$8,529,041	$6,132,125
Subcontracts				
Pretreatment/LLW	=	$935,451	$623,634	$0
20T/D HLW Facility	=	$0	$0	$0
Centralized Facility	=	$3,322,985	$2,215,323	$0

D. Calculation: Engineering

Engineering is set to 40% of the summation of the capital cost and the overhead and profit.

Based on cost estimating judgement.

M&O Contractor		Labor	Material	Equipment
Pretreatment/LLW	=	$115,633,693	$44,331,105	$131,009,086
20T/D HLW Facility	=	$114,098,097	$49,100,381	$71,358,689
Centralized Facility	=	$36,496,088	$22,744,108	$16,352,333
Subcontracts				
Pretreatment/LLW	=	$2,494,536	$1,663,024	$0
20T/D HLW Facility	=	$0	$0	$0
Centralized Facility	=	$8,861,292	$5,907,528	$0

E. Calculation: Contingency

Contingency is set to 40% of the summation of the capital cost, overhead and profit, construction and project management, and engineering.

Based on cost estimating judgement.

M&O Contractor		Labor	Material	Equipment
Pretreatment/LLW	=	$190,795,594	$73,146,323	$216,164,992
20T/D HLW Facility	=	$188,261,860	$81,015,628	$117,741,837
Centralized Facility	=	$60,218,545	$37,527,779	$26,981,349
Subcontracts				
Pretreatment/LLW	=	$4,115,984	$2,743,990	$0
20T/D HLW Facility	=	$0	$0	$0
Centralized Facility	=	$14,621,132	$9,747,421	$0

F. Calculation: Overall Totals

M&O Contractor		Labor	Material	Equipment
Pretreatment/LLW	=	$667,784,578	$256,012,131	$756,577,471
20T/D HLW Facility	=	$658,916,510	$283,554,698	$412,096,428
Centralized Facility	=	$210,764,909	$131,347,226	$94,434,723
Subcontracts				
Pretreatment/LLW	=	$14,405,945	$9,603,964	$0
20T/D HLW Facility	=	$0	$0	$0
Centralized Facility	=	$51,173,961	$34,115,974	$0
Overall Total				
Pretreatment/LLW	=	$682,190,523	$265,616,095	$756,577,471
20T/D HLW Facility	=	$658,916,510	$283,554,698	$412,096,428
Centralized Facility	=	$261,938,870	$165,463,200	$94,434,723
		$1,603,045,904	$714,633,993	$1,263,108,622

Totals may not match totals from Table 9-17, but will be within 1%. Errors are caused by over generalization of cost estimating parameters.

To calculate for local purchases:

Local Purchases = 15% x (Equipment + Material/Supplies)

Local Purchases = $296,661,392

Which leaves:

Equipment = 85% x (Equipment)

Equipment = $607,438,894

and

Material/Supplies = 85% x (Material/Supplies)

Material/Supplies = $1,073,642,329

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.

		Unit	Pretreatment/LLW		HLW		Total	
Material	Unit	Cost	Amount	Cost	Amount	Cost	Amount	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

Table F-38. Other Operating Costs.

		Unit	Pretreatment/LLW		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

Staffing

The staffing requirements for the Tri-Party Agreement alternative data package are given in Table F-39. This table is identical to the table used to calculate the operating personnel requirements by unit process (Table 9-3). The staffing requirements include the staffing for start-up operations, decontamination and decommissioning, and monitoring and maintenance. Staffing for the construction of the LLW vaults is included in the cost per vault in Table F-38.

Table F-39. Staffyears for Operation.

Staffing Category	Years	Staff Per Year	Total Staff-Years
Dual Operation	10	708	7080
Pretreatment/LLW Only	5	618	3090
HLW Only	4	509	2036
Indirect Staffing	19	29	551
Pretreatment/LLW Start-up	1.5	618	927
HLW Start-up	1.5	509	763.5
Pretreatment/LLW Decontamination and Decommissioning	2	618	1236
HLW Decontamination and Decommissioning	2	509	1018
HLW Monitoring and Maintenance	6	10	60
HLW Transportation	- -	- -	280

Notes:

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

The staffing breakdown for each operational mode is given in Table F-40. The staffing values in this table are identical to the ones used for the calculation of the operating personnel requirements (Table 9-3). The total cost per year was calculated by assuming that the average annual salaries are $130,000 for exempt, $60,000 for nonexempt, and $90,000 for bargaining unit employees (Boomer 1994).

Table F-40. Cost per Year by Process.

Operational Mode	Exempt	Nonexempt	Bargaining Unit	Cost Per Year (In Millions)
Pretreatment/low-level waste only	227	53	338	$63
Dual operation	253	53	402	$72
High-level waste only	200	51	258	$52

Table F-41 gives the total calculated cost for operating labor using the totals from Tables F-39 and F-40 with the following exceptions. For indirect staffing, it was assumed that all workers would be nonexempt employees. For monitoring and maintenance, it was assumed that one worker would be exempt, one would be bargaining unit, and the remaining eight would be nonexempt. 100 of the total workers for HLW transportation are assumed to be exempt, 100 bargaining units, and the remaining 80 nonexempt.

Table F-41. Staffing Operating Cost.

Staffing Category	Total Cost (In Millions)
Dual operation	$723
Pretreatment/low-level waste only	$316
HLW only	$209
Indirect Staffing	$33
Pretreatment/low-level waste start-up	$95
High-level waste start-up	$78
Pretreatment/low-level waste decontamination and decommissioning	$126
High-level waste decontamination and decommissioning	$105
High-level waste monitoring and maintenance	$4
High-level waste transportation	$27
Total	$1,716

Start-Up Costs

The total start-up cost for each facility is arbitrarily set to three times the annual staffing requirements for each facility. The staffing requirements for start-up of each facility has been set to one and a half years of the annual. This leaves one and a half years of staff cost ($95 million + $78 million = $173 million) for materials and supplies for start-up.

Decontamination and Decommissioning

The decontamination and decommissioning (D&D) cost 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 for each facility has been set to two years of the annual. This leaves one year of staff cost ($63 million + $52 million = $115 million) plus thirty percent of the capital for material and supplies.

The total capital is equal to the capital plus a forty percent contingency factor. Therefore the capital value to be used for the decontamination and decommissioning cost for materials and supplies is equal to:

Capital = $3,600 million / 140% = $2,571 million

The total capital cost is taken from Table 9-18.

The cost based upon the capital is:

Capital D&D = $2,571 million * 30% = $771 million

Thus the total D&D cost for materials and supplies is set to $886 million.

Summations

Labor is set equal to the total value calculated in Table F-41:

Labor = $1,716 million

The total cost for materials and supplies is:

Operating	=	$837 million (Table F-38)
Start-up	=	$173 million
Decontamination and Decommissioning	=	$886 million
Total	=	$1,896 million

Equipment purchase is set equal to the total value calculated in Table F-41:

Equipment = $322 million

However local purchases are set equal to 15 percent of the total equipment and materials and supplies cost. Therefore the values entered on Table 9-19 are:

Materials and supplies	=	$1,612 million
Equipment	=	$274 million
Local purchases	=	$332 million

WHC-SD-WM-EV-107, Rev
UC-2[illegible]

Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Statement

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Date Published
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Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
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Management and Operations Contractor for the
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Approved for Public Release

JUL 19 1995

ENGINEERING DATA TRANSMITTAL

1. EDT № 612

2. To: (Receiving Organization) TWRS Compliance Plans	3. From: (Originating Organization) Geotechnical Development Projects	4. Related EDT No.: n/a
5. Proj./Prog./Dept./Div.: Tank Waste Remediation System	6. Cog. Engr.: P. L. Kline	7. Purchase Order No.: n/a
8. Originator Remarks: This engineering data package provides supporting data for preparation of the TWRS Environmental Impact Statement. Data in this document complements data provided in separate documentation for the No Separations Alternative, the Extensive Separations Alternative, the Tri-Party Agreement Alternative, and the In Situ Disposal Alternative. Environmental, Safety, and QA approvals required by WHC-CM-3-5 Section 12.7 were obtained on Rev. 3 of this document. The only significant changes in this revision, relative to Rev. 3, involved changes to data tables addressing construction staffing requirements and costs.		9. Equip./Component No.: n/a
		10. System/Bldg./Facility: n/a
11. Receiver Remarks:		12. Major Assm. Dwg. No.: n/a
		13. Permit/Permit Application No.: n/a
		14. Required Response Date: n/a

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-EV-107		0	Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Statement	E/S/Q	2	1	1

16. KEY

Approval Designator (F)	Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information	4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment	4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
2	1	Cog.Eng. P. L. Kline									
2	1	Cog. Mgr. J. G. Field									
		QA (approved by J. Weber, on EDT dated 3/6/95 attached)									
		Safety (approved by J. M. Garcia, on EDT dated 3/6/95 attached)									
		Env. (approved by R. H. Engelmann, on EDT attached)									

18. P. L. Kline Signature of EDT Originator — Date 7/19/95	19. L. E. Bomeman Authorized Representative for Receiving Organization — Date 7/19/95	20. J. G. Field Cognizant Manager — Date	21. DOE APPROVAL (if required) Ctrl. No. [ ] Approved [ ] Approved w/comments [ ] Disapproved w/comments [x] Not Required per Waiver WA-557

2. To: (Receiving Organization)	3. From: (Originating Organization)	4. Related EDT No.:
TWRS Compliance Plans	TWRS Compliance Plans	n/a
5. Proj./Prog./Dept./Div.: Tank Waste Remediation System	6. Cog. Engr.: P.L. Scanlon	7. Purchase Order No.: n/a

8. Originator Remarks:

This engineering data package provides supporting data for preparation of the TWRS Environmental Impact Statement (EIS). Data in this document complements data provided in separate documentation for the In-Situ Disposal Alternative, the No Separations Alternative, the Extensive Separations Alternative, and the TPA Preferred Alternative. Data in this document are based on (a) landfill closure of the DST and SST tank farms, including in situ stabilization of underground waste storage tanks and ancillary tank farm equipment, (b) no cleanup or stabilization of contaminated soil, and (c) placement of an engineered surface barrier over tank farms and low-level waste disposal vaults. This EDT transmits the Closure Engineering Data Package to TWRS Compliance Plans as Rev. B, for DOE-RL approval, per WHC-CM-3-5, section 12.7.

9. Equip./Component No.: n/a

10. System/Bldg./Facility: n/a

11. Receiver Remarks: n/a

12. Major Assm. Dwg. No.: n/a

13. Permit/Permit Applicati: n/a

14. Required Response Date: n/a

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-EV-107		B	Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Statement	E/S/Q	1	1	1

15. KEY

Approval Designator (F)	Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information	4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment	4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
1	1	Cog.Eng. P.L. Scanlon		2/28/95	R2-06						

1	1	Cog.Mgr.	L.E. Bomeman	2/28/95	B2-06		
1	/	QA	J. Weber		S1-57		
1	/	Safety	J.M. Garold		B3-09		
1	1	Env.	R.H. Engelbert		N6-26		
1	/	Disp.Pro.	J.G. Honeyman		S7-31		

18.	19.	20.	21. DOE APPROVAL (if required)
P.L. Sexton 2/28/95 Signature of EDT Originator Date	L.E. Bomeman 2/28/95 Authorized Representative for Receiving Organization Date	L.E. Bomeman 2/28/95 Cognizant Manager Date	Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments

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Table 5-8. Comparison of Alternatives by Process Module: Capital Cost (Millions of 1995 Dollars).[1,2,3,4]

Process Module	In Situ Disposal	Extensive Pretreatment Option A: Grout/gravel	Extensive Pretreatment Option B: Grout/gravel	No Separations: Grout/gravel	Tri-Party Agreement Preferred Alternative: Grout/gravel
Barrier construction[5]	$86	$113	$237	$86	$111
Emptied SST closure[6]	n/a	$26.6/$14.6	$26.6/$14.6	$26.6/$14.6	$26.6/$14.6
Emptied DST closure[7]	n/a	$4.4/$2.6	$4.4/$2.6	$4.4/$2.6	$4.4/$2.6
Total	$86	$144/$130	$268/$254	$117/$103	$142/$128

Notes:

SST = single-shell tank
DST = double-shell tank

[1]The cost of gravel was estimated from Appendix A, Cost Barrier Materials and was figured at $22 per cubic meter ($m^3$) for 756,000 m^3 of material, or $16,600,000. There are 16 55,000-gallon tanks that would be stabilized with the same grout mixture used for stabilizing the ancillary equipment. These tanks have a total void volume of 5,324 m^3. The cost of this grout was estimated at $0.14 per kilogram (kg) for Type I/II cement, $0.04/kg for fly ash, and $18.50/$m^3$ for sand from Pit 30. For 106,500 kg of cement, the cost would be $14,900; 958,000 kg of fly ash would cost $38,300; and 5,160,000 kg of sand (3,225 m^3 of sand) would cost $59,700. The total cost of this grout is $112,900. The cost of the water was not calculated. The cost of the air entrainment additive was unknown but assumed to be negligible.

[2]The cost of concrete was estimated at $0.14/kg for Type I/II cement, $0.04/kg for fly ash, and $18.50/$m^3$ for sand from Pit 30. For 15,000,000 kg of cement, the cost would be $2,100,000; 137,000,000 kg of fly ash would cost $5,480,000; 1,260,000,000 kg of sand (1,300,000 m^3 of sand) would cost $23,200,000. The total cost of this grout is $30,780,000. The cost of the water was not calculated. The cost of the air entrainment additive was unknown but assumed to be negligible.

[3]The cost of solidifying the ancillary equipment is based on the same grout formula as in notes 1 and 2. There is 13,700 m^3 of void space in the ancillary equipment for the SSTs and the DSTs. The SST ancillary equipment void space is 10,500 m^3, and the DST ancillary equipment void space is 3,200 m^3. For SST ancillary equipment, 210,000 kg of cement would cost $29,400; 1,890,000 kg of fly ash would cost $75,600; 17,400,000 kg of sand (10,900 m^3 of sand) would cost $201,500. The total cost of stabilizing the ancillary SST equipment would be $306,500. For DST ancillary equipment, 64,000 kg of cement would cost $8,960; 576,000 kg of fly ash would cost $23,000; 5,312,000 kg of sand (3,320 m^3 of sand) would cost $61,400. The total cost of stabilizing the ancillary DST equipment is $93,360. The cost of water was not calculated. The cost of the air entrainment additive was unknown but assumed to be negligible.

[4]The costs for monitoring and maintenance are reflected in Table 5-10 and were not included in these costs.

Table 5-8. Comparison of Alternatives by Process Module: Capital Cost (Millions of 1995 Dollars).[1,2,3,4]

Notes: (Continued)

[3]Barrier construction includes the cost of the barrier over SSTs, DSTs, and the low-level waste vaults (where applicable).

[4]Emptied SST closure includes filling the SSTs with grout or gravel (in that order) and stabilizing the ancillary equipment with grout. The cost of the gravel slinger was unknown but was estimated at $100,000. It is assumed that the construction equipment and light-duty trucks are already available onsite and need not be purchased.

[4]Emptied DST closure includes filling the DSTs with grout or gravel (in that order) and stabilizing the ancillary equipment with grout. The cost of the gravel slinger was unknown but was estimated at $100,000. The cost of the grout plant and dry mix plant are unknown but were estimated at $250,000. It is assumed that construction equipment and light-duty trucks are already available onsite and need not be purchased.

For additional backup information, see Appendix A, Figures A2, A3, and A4; and Tables A3-A9 and A11.

Table 5-9. Comparison of Alternatives by Capital Cost Component (Millions of 1995 Dollars).

Capital Cost Component	In Situ Disposal	Extensive Pretreatment Option A Grout/gravel	Extensive Pretreatment Option B Grout/gravel	No Separations Grout/gravel	Tri-Party Agreement Preferred Alternative Grout/gravel
Labor[1]	$30.6	$54.1/$57.1	$105/$107.3	$43.9/$46.9	$53.6/$56.6
Materials/supplies[2]	$28.5	$42.9/$37.4	$81.1/$75.6	$34.1/$28.6	$42.5/$37.0
Equipment[3]	n/a	$0.25/$0.35	$0.25/$0.35	$0.25/$0.35	$0.25/$0.35
Local purchases[4]	$57.5	$43.5/$35.1	$130/$121	$82.9/$74.5	$42.5/$34.1
Total	~~$117~~ $116	$141/$130	$316/$304	$161/$150	$139/$128

See Modified Table P5-17a.

Notes:

n/a = not applicable

[1]Average wage for an exempt employee at TWRS is $57.11/hour, for a non-exempt employee is $22.35/hour, and for a bargaining unit employee is $41.31/hour (based on overhead, the common support pool and general and administrative rates found in Soft Reporting on November 11, 1994 for organization code 70000). Labor costs were calculated taking the staff hours from Tables 5-2A through 5-2D and multiplying by the average wage. Ancillary equipment stabilization and barrier construction labor costs were included in both grout and gravel stabilization. It was assumed that all design, engineering, and supervisory personnel were exempt, and that all radiation and nonradiation workers were bargaining unit employees.

[2]Materials and supplies include the tank and ancillary equipment stabilization materials and the materials used in barrier construction over the tanks and over the LLW Vaults (in the Extensive Pretreatment and TPA Preferred Alternatives). They include only materials that cannot be bought locally (asphalt, asphalt coating and geotextile fabric for the barrier; fly ash for the grout mix). All other materials for stabilization and barrier construction are listed in local purchases. These numbers were calculated from Appendix A, Barrier Cost by Component. Asphalt would cost $27,800,000 for tank barriers, $45,300,000 for extensive pretreatment grout, $8,500,000 for extensive pretreatment glass, and $8,100,000 for the Tri-Party Agreement glass. Geotextiles would cost $717,000 for tank barriers, $1,700,000 for extensive pretreatment grout, $284,000 for extensive pretreatment glass, and $253,000 for Tri-Party Alternative glass. Fly ash would cost $5,600,000 for the grout stabilization option (both for tanks and ancillary equipment); it would cost $137,000 for the gravel stabilization option (for the 55,000-gallon tanks and for ancillary equipment). The cost of the grout option is listed first, and the cost of the gravel option is listed second.

Table 5-9. Comparison of Alternatives by Capital Cost Component (Millions of 1995 Dollars).

Notes (continued)

[7]Equipment is the cost of the dry mix plant and the concrete batch plant for the grout stabilization option, and the cost of the concrete batch plant, the dry mix plant, and the gravel slinger for the gravel stabilization option. The dry mix plant and the concrete batch plant are assumed to cost $250,000, and the gravel slinger is assumed to cost $100,000. All other heavy construction equipment and light-duty vehicles are assumed to be already onsite and do not have to be purchased.

[8]Local purchases include the Type I/II cement, the sand, and the gravel used in tank and ancillary equipment stabilization, and all barrier materials (with the exceptions of asphalt, asphalt coating, and the geotextile fabric—these costs are reflected in materials/supplies). Local purchases of material for tank barriers include $57,500,000 for barrier material; for grout stabilization, the cost is $25,400,000, and for gravel stabilization, the cost is $17,000,000. The cost of the grout stabilization is listed first; gravel stabilization is second.

For more backup information, see Appendix A, Figures A2, A3, and A4; and Tables A3-A9 and A11.

Table 5-9 Comparison of Alternatives by Capital Cost Component ($ millions, 1995)

Capital Cost Component	In Situ Disposal	Extensive Pretreatment Option A Grout/Gravel	Extensive Pretreatment Option B Grout/Gravel	No Separations Grout/Gravel	Tri-Party Agreement Preferred Alternative Grout/Gravel
Labor	$29.5	$52.1/$58.1	$97.9/$104	$42.7/$48.7	$51.6/$57.6
Materials & Supplies	$28.5	$42.9/$37.4	$81.1/$75.6	$34.1/$28.6	$42.5/$37.0
Equipment	n/a	$0.25/$0.35	$0.25/$0.35	$0.25/$0.35	$0.25/$0.35
Local Purchases	$57.5	(3) ~~$[illegible]~~	$130/$121	(1) $82.9/$74.5	(2) ~~$42.5/$34.1~~ 128.3/11
TOTAL	$115.5	~~$139/$131~~ 178.1/170.5	$309/$301	$160/$152	~~$137/$129~~ ~~[illegible]~~ 177.2/169.4

122.3/113.9

Replacement Table.

Notes

(1) Minimum Cost for Ex-Situ Alt

(2) Costs cant go down for TPA. It appears that 40.4 was subtracted instead of added. So add 40.4 to ~~TPA~~ No Sepns local purchases, making them 123.3/114.9 for TPA

(3) Same must be done for Ext Spns, Option A. Δ = 39.4 in this case.

Table 5-10. Comparison of Alternatives by Monitoring and Maintenance Cost Component (Millions of 1995 Dollars).[1,2]

Monitoring and Maintenance Cost Component	In Situ Disposal	Extensive Pretreatment Option A	Extensive Pretreatment Option B	No Separations	Tri-Party Agreement Preferred Alternative
Labor[3]	0.39	0.40	0.40	0.39	0.40
Materials/supplies[4]	0.011	0.012	0.016	0.011	0.012
Equipment[3,5]	0.030	0.030	0.030	0.030	0.030
Local purchases[4]					
Total	0.43	0.44	0.45	0.43	0.44

Notes:

[1]See Appendix A for details on the calculations.

[2]Monitoring and maintenance applies to all phases of the closure package (tank stabilization, ancillary equipment stabilization, and barrier construction).

[3]The labor rates are based on an average wage of $130,000 per year for supervisors, and $60,000 per year for laborers and a clerk/secretary.

[4]All materials and supplies are local purchases.

[5]Equipment costs are based on one tractor with attachments and three pickup trucks, to be replaced once every five years.

For additional backup information, see Appendix A, Figures A2, A3, and A4; and Tables A3 and A9.

Table 5-11. Comparison of Alternatives by Overall Schedule (Calendar Year Start/Completion Date).[1]

Activity	In Situ Disposal	Extensive Pretreatment Option A	Extensive Pretreatment Option B	No Separations	Tri-Party Agreement Preferred Alternative
Construction[2]	2013,2016/ 2030, 2033	2010/2060	2010/2030	2010/2024	2010/2034
Monitoring and maintenance[3]	2015/2133	2012/2160	2012/2130	2012/2124	2012/2134
Research and development[4]					

Notes:

[1]Based on WHC-EP-0616, *Tank Waste Technical Options Report*, (Boomer et al. 1993).

[2]The construction schedule is taken from Table 5-12 and assumes construction includes stabilization activities and barrier construction.

[3]Monitoring and maintenance scheduling assumes 100 years of operational control after the last barrier has been built.

[4]Because the stabilization methods and the barrier have been performed in engineering-scale demonstrations, the amount of research and development necessary would be negligible.

For additional backup information, see Appendix A, Figures A2, A3, and A4; and Tables A1-A9.

Boomer, K. D., A. L. Boldt, J. D. Galbraith, J. S. Garfield, C. E. Golberg, B. A. Higley, L. J. Johnson, M. J. Kupfer, R. M. Marusich, R. J. Parazin, A. N. Praga, G. W. Reddick, J. A. Reddick, E. J. Slaathaug, L. M. Swanson, T. L. Waldo, C. E. Worcester, 1993, *Tank Waste Technical Options Report*, Rev. 0, WHC-EP-0616, Westinghouse Hanford Company, Richland, Washington.

Table 5-12. Comparison of Alternatives by Unit Process: Sequence of Construction (Calendar Year: Start/Completion Date).[1]

Unit Process	In Situ Disposal: Chemical, Vitrification	Extensive Pretreatment Option A[2]	Extensive Pretreatment Option B[2]	No Separations	Tri-Party Agreement Preferred Alternative
Barrier construction	2013,2016/ 2030,2033	2024/2060	2024/2030	n/a	2028/2034
Emptied SST closure[4]	n/a	2010/2024	2010/2024	2010/2024	2010/2024
Emptied DST closure[5]	n/a	2019/2023	2019/2023	2018/2022	2023/2027

Notes:

n/a = not applicable
SST = single-shell tank
DST = double-shell tank

[1]Based on WHC-EP-0616, *Tank Waste Technical Options Report*, (Boomer et al. 1993).

[2]The start/completion dates for barrier construction for the in-situ disposal alternative is based on WHC-SD-WM-EV-101 (McConville 1995). In situ chemical stabilization decontamination and decommissioning ends in 2013, and barrier construction over the tanks begins immediately after that task; it ends in 2030. In situ vitrification decontamination and decommissioning ends in 2016, and barrier construction over the tanks begins immediately after that task. It ends in 2033. 2016-2033

[3]The start and completion dates for barrier construction for the extensive pretreatment alternatives and the Tri-Party Agreement preferred alternative are based upon the assumption that no barrier construction over the low-level waste vaults can begin until decontamination and decommissioning activities for the facilities end.

[4]The start and completion dates for emptied SST closure are based on the Tank Farm Retrieval Sequence schedule found in WHC-SD-WM-ER-193. This schedule is reproduced in Appendix A. These figures reflect work occurring sequentially (that is, no parallel operations were used). Tank stabilization and ancillary equipment stabilization begin as soon as Tank Farm retrieval operations end; barrier construction begins as soon as tanks and ancillary equipment are stabilized.

[5]The start and completion dates for emptied DST closure are based upon the assumption that no tank or ancillary equipment stabilization can begin until treatment operations end, and no barrier construction can begin until tanks and ancillary equipment have been stabilized for each tank cluster. This assumption was used because no schedule was generated for the retrieval sequence of the DSTs. These figures reflect work occurring sequentially (that is, no parallel operations were used).

For additional backup information, see Appendix A, Tables A1-A9 and A-11.

Table 5-12. Comparison of Alternatives by Unit Process: Sequence of Construction (Calendar Year: Start/Completion Date).[1]

Boomer, K. D., A. L. Boldt, J. D. Galbraith, J. S. Garfield, C. E. Golberg, B. A. Higley, L. J. Johnson, M. J. Kupfer, R. M. Marusich, R. J. Parazin, A. N. Praga, G. W. Reddick, J. A. Reddick, E. J. Slaathaug, L. M. Swanson, T. L. Waldo, C. E. Worcester, 1993, *Tank Waste Technical Options Report*, Rev. 0, WHC-EP-0616, Westinghouse Hanford Company, Richland, Washington.

McConville, C.M., 1995, *Tank Waste Remediation System Environmental Impact Statement for In Situ Treatment and Disposal of Radioactive Waste in Hanford Site Underground Storage Tanks*, WHC-SD-WM-EV-101, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Table A11. Barrier Cost by Component (1994 Dollars)
(Backup for Table 5-1, 5-2D, 5-8 and 5-9).

BACKUP FOR BARRIER COST BY COMPONENT
(IN 1994 DOLLARS)

MATERIAL	241-A	241-AX	241-B	241-BX	241-BY	241-C	241-S	241-SX	241-T	241-TX	241-TY	241-U
Det Design	128,328	98,238	217,128	209,901	212,377	252,430	214,450	256,908	217,128	320,621	129,380	212,285
Eng/Impact	256,652	196,475	434,256	419,809	424,754	504,860	428,912	513,815	434,256	641,242	259,160	424,571
SRDI Test	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759
ENG SUBTOTAL	444,737	354,472	802,043	889,472	696,890	817,049	703,127	830,482	802,043	1,021,622	448,498	706,615
Site Work	78,377	58,706	172,756	136,295	140,182	177,304	142,070	174,752	172,756	241,396	77,322	167,975
Base Course	43,653	33,757	83,514	71,072	71,897	85,173	72,587	86,743	83,514	107,758	44,274	81,610
Asphalt	1,096,642	844,178	2,088,454	1,777,317	1,797,943	2,129,936	1,815,190	2,169,204	2,088,454	2,694,759	1,107,162	2,045,832
Drain Gravel	81,837	71,400	170,807	148,155	147,801	174,096	148,167	177,408	170,807	216,831	92,666	167,430
Basalt	1,202,708	945,832	2,147,732	1,858,531	1,878,404	2,188,453	1,884,407	2,234,904	2,147,732	2,710,535	1,213,411	2,108,113
Gravel Filter	48,891	34,881	109,292	89,737	90,875	111,865	92,061	113,354	109,292	147,461	48,475	106,013
Sand Filter	32,381	22,969	73,108	59,896	60,735	74,858	61,466	75,812	73,108	98,695	32,772	71,296
Geotextile	25,329	17,863	57,186	46,853	47,503	58,556	48,079	59,301	57,186	77,357	25,635	55,770
Lower SA	140,791	87,030	337,489	272,967	276,872	340,007	280,558	349,531	337,489	403,456	142,614	324,634
Upper SA	175,202	122,872	405,196	330,262	334,981	415,123	339,145	420,026	405,196	551,469	177,362	384,834
Road	9,378	7,883	13,600	12,483	12,558	13,758	12,618	14,207	13,600	15,796	9,440	13,444
CON SUBTOTAL	2,943,589	2,257,571	5,659,114	4,803,570	4,858,848	5,773,150	4,907,349	5,875,242	5,659,114	7,327,814	2,972,173	5,541,655
TOTAL	3,388,326	2,612,043	6,461,157	5,693,042	5,556,838	6,590,199	5,610,476	6,705,724	6,461,157	8,349,336	3,420,672	6,328,470

MATERIAL	DST AN	DST AP	DST AW	DST AY	DST AZ	DST SY	EX PAE OPT B	EX PAE OPT A	TPA GLASS	TOTALS
Det Design	180,430	168,913	134,841	88,730	88,730	100,770	5,158,499	1,038,855	883,434	11,157,581
Eng/Impact	360,860	337,825	269,683	133,460	133,460	201,540	11,713,798	2,077,708	1,966,867	22,315,164
SRDI Test	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759	59,759	1,254,939
ENG SUBTOTAL	601,049	566,497	464,283	259,949	259,949	362,069	17,930,456	3,176,323	3,010,060	34,727,684
Site Work	115,847	101,290	80,757	40,402	40,402	60,224	14,400,406	1,265,455	1,144,522	18,869,690
Base Course	61,239	57,465	46,036	23,178	23,178	34,607	1,810,810	340,783	323,395	3,566,724
Asphalt	1,531,415	1,437,028	1,151,226	579,620	579,620	865,423	45,265,770	8,521,531	8,087,188	89,693,895
Drain Gravel	126,527	118,274	90,224	50,124	50,124	73,174	3,528,642	675,589	641,877	7,140,040
Basalt	1,621,323	1,548,869	1,257,165	677,616	677,616	987,401	50,662,065	7,835,675	7,473,781	95,248,595
Gravel Filter	75,005	67,854	52,009	20,118	20,118	38,064	3,145,201	537,960	507,163	5,565,529
Sand Filter	49,874	45,187	34,475	13,090	13,090	23,783	2,136,698	363,657	342,727	3,759,882
Geotextile	39,080	35,330	26,967	10,239	10,239	18,603	1,671,353	284,457	268,088	2,941,104
Lower SA	225,326	200,592	150,661	50,600	50,600	100,731	10,776,043	1,783,667	1,677,545	18,389,664
Upper SA	274,365	248,548	186,919	67,667	67,667	127,293	12,268,394	2,065,067	1,944,652	21,320,393
Road	11,341	11,341	9,574	6,340	6,340	8,007	72,454	29,599	29,064	332,624
CON SUBTOTAL	4,131,552	3,668,957	3,092,133	1,539,194	1,539,194	2,315,310	133,555,045	23,703,635	22,440,040	254,765,649
TOTAL	4,732,601	4,235,454	3,556,416	1,799,143	1,799,143	2,677,379	151,165,501	26,879,958	25,450,100	289,493,335

NOTE. (1) The above design and construction costs are 1993 dollars escalated by a 2.8% inflation factor, and include a 15% contingency.

(2) The costs for EPT Option A, EPT Option B, and TPA Glass do not include the costs for barriers over the tank farms; they are strictly the costs of the barriers over the LLW Vaults.