AR TARGET SHEET

The following document was too large to scan as one unit, therefore it has been broken down into sections.

DOCUMENT # NA

EDMC # 42753

SECTION 1 OF 2

0042753

1 of 2

JACOBS ENGINEERING GROUP, INC. 1995

(DATA ENGINEERING REQUESTS)

JAN 1996
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EDMC

Request Number 01

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: David Serot Date: 12/12/94

Phone Number: 375-3055 Fax Number: ASI

Requested Information: Please provide the equivalent number of MEN per calendar year for each alternate. Subdivide the alternates into const., opr., D&D, and M&M phases and provide information by the labor category.

Need Date: 12/13/94

Response: See attached: 1) Minimal Pretreatment Waste Retrieval Transfer 2) Minimal Pretreatment 3) TPA Waste Retrieval Transfer 4) TPA

Data Source/Accuracy: Data sources were the Rev A (draft) issues for the TPA Minimum Pretreatment and Waste Recovery and Transfer engineering packages. The remaining alternatives have not been issued. Substantial revisions to all numbers are expected.

Prepared By: Jim Goodwin Date Sent/Faxed: 12/21/94

Concurrence: Marc E. Nelson
Marc Nelson - Deputy Project Manager

The data in the sources will be revised.

enginleninfrq.01

MEMORANDUM

TO: Dave Murray

December 20, 1994
94-JG-002

FROM: Jim Goodwin

SUBJECT: MANPOWER REQUIREMENT TABLES

Dr. Serot has recently requested information on manpower requirements for the various TWRS Alternatives. The attached tables are our reply.

Dr. Serot's initial request was for the equivalent number of men by the fiscal year for each alternative. He also wanted to discuss further breakdown of the manpower by administrative workers, trades, operators, etc.

After some initial discussion on what data had been requested from WHC, he decided that he could work with the equivalent number of men by the calendar year. The work classifications available in the engineering packages are exempt and non-exempt and radiation and non-radiation workers.

We found much of the information requested for the Minimal Pretreatment, TPA, and the Retrieval and Transfer Waste engineering packages distributed among several tables and footnotes in those packages. There was so little information on manhours supplied in the engineering packages for the other alternatives that we agreed to defer our reply to his request until more information was made available.

When we attempted to validate the data in the tables we found that we could not trace most of the data to the appendix and that the development of the data in the appendix could not be followed. It may be correct, but the logic was not explained clearly enough to be usable. In addition we have questions about wage rates as high as $85 per hour which were used to develop manhours from the capital estimate and why only some sections of the capital estimate were used. Our conclusion after this exercise was that we cannot validate the tables. In another discussion with Dr. Serot we agreed that we would provide information from the tables without Jacobs comment on the quality of the data. Dr. Serot will use the data to test run his program and Jacobs will provide better data when it becomes available.

Specific information that we need in order to certify that the data Jacobs provides to our team members is reasonable and appropriate follow.

1. Complete staffing tables should appear in the appendix to the engineering data packages in sufficient detail to allow Jacobs to see that all of the functions of TWRS are staffed and do not overlap. The staffing tables should demonstrate a full staff for a freestanding TWRS program from waste recovery to
site monitoring and maintenance after disposal or the delivery to Yucca Mt. - including administrative personnel. A more staightforward presentation of cost (than that provided in the present appendix) would simply extend this table with projected wages.

2. Jacobs needs WHC's estimate of the distribution of this staff by the calendar year for each Alternative.

3. While it need not be included in an appendix, Jacobs needs a complete capital estimate for each Alternative. A R.O.M. estimate is acceptable, but it must include the entire project as described above.

4. We need a definition of what will be done to D&D the facilities which were constructed or used by each Alternative as well as a reasonably developed cost for doing it.

5. We have two annual manhour distributions for Waste Recovery & Treatment. The first Jacobs derived from Table 6-2 to be consistent with the other tables. The second is a figure on page B-9 of the appendix (B-10 for Minimal Pretreatment). The second appears to have the more realistic manhour distribution, but the hours total to approximately twice the first table. This is for WHC's information for comment on their draft issue. We need the next issues to be internally consistent

6. We also have two values for the number of working hours in a year which have been used by WHC, 2000 hours per year and 1836 hours per year. WHC must resolve.

WHC needs to include this information in all of the Alternatives, and to develop the alternatives to parallel, consistent packages. But, because this (possibly incorrect) information has been provided to one of our teaming partners we need a specific reply to each of these points to ensure that the earlier information which we provided is corrected.

cc: D. Serot, ASI
Project File

Attachments: Manpower Requirement Tables

TPA; WASTE RETRIEVAL AND TRANSFER
CONSTRUCTION PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE MINIMAL PRETREATMENT SECTION OF THE REV A DRAFT OF THE WASTE RETRIEVAL AND TRANSFER PACKAGE
REV 0 Dec 14, 1994 JWG

YEAR (NOTE 1)	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
% MH EXPENDED PER YR, DESIGN (NOTE 5)	5%	10%	10%	10%	10%	10%	10%	10%	5%	4%	3%	2%	2%	2%	2%	1%	1%	1%	1%	1%	100%
% MH EXPENDED PER YR, CONST. (NOTE 5)	3%	4%	5%	6%	7%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	5%	4%	3%	2%	1%	100%

	TOTAL MH (NOTE 2)	EQUIV TOTAL MAN*YR (NOTE 3)	EQUIVALENT MEN (NOTE 6)																				TOTAL
DESIGN & ENGR	6,000,000	3,268	163	327	327	327	327	327	327	327	163	131	98	65	65	65	65	33	33	33	33	33	3,268
CONSTRUCTION																							
RAD WORKER	600,000	327	10	13	16	20	23	20	20	20	20	20	20	20	20	20	20	16	13	10	7	3	327
NONRADIATION WORKER	15,000,000	8,170	245	327	408	490	572	490	490	490	490	490	490	490	490	490	490	408	327	245	163	82	8,170
SUPERVISORY	2,000,000	1,089	33	44	54	65	76	65	65	65	65	65	65	65	65	65	65	54	44	33	22	11	1,089
TOTAL	23,600,000	12,854	451	710	806	902	998	902	902	902	739	706	673	641	641	641	641	512	416	320	224	129	12,854

NOTES:
1. SCHEDULE FROM TABLE 6-22
2. TOTAL MANHOURS FROM TABLE 6-8
3. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND TPA (2000 vs 1836). WHC NEEDS TO MAKE A GLOBAL DECISION. 1836 MANHOURS PER YEAR FROM PAGE B-8
4. WE NEED TO SEE THE STAFFING TABLES TO VERIFY THAT THESE MANHOUR ESTIMATES ARE COMPLETE.
5. THE MANHOUR DISTRIBUTION IS BY JEG. WE NEED THIS INFO FROM WHC
6. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)
7. INCLUDES UNDERGROUND BARRIERS

TPA; WASTE RETRIEVAL AND TRANSFER
OPERATING PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE MINIMAL PRETREATMENT SECTION OF THE REV A DRAFT OF THE WASTE RETRIEVAL AND TRANSFER PACKAGE
REV 0 Dec 14, 1994 JWG

YEAR (NOTE 1)			2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
% MH EXPENDED PER YR (NOTE 5)			3%	3%	3%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
	TOTAL MH (NOTE 2)	EQUIV TOTAL MAN*YR (NOTE 3)	EQUIVALENT MEN (NOTE 6)																					
NONEXEMPT																								
RAD WORKER	35,000,000	19,063	572	572	572	763	763	763	763	763	763	763	763	763	763	763	763	763	763	763	763	763	763	763
NONRAD WORKER	12,000,000	6,536	196	196	196	261	261	261	261	261	261	261	261	261	261	261	261	261	261	261	261	261	261	261
EXEMPT																								
RAD WORKER	6,000,000	3,268	98	98	98	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131
NONRAD WORKER	14,000,000	7,625	229	229	229	305	305	305	305	305	305	305	305	305	305	305	305	305	305	305	305	305	305	305
TOTAL	67,000,000	36,492	1,095	1,095	1,095	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460

NOTES:
1. SCHEDULE FROM TABLE 6-22
2. TOTAL MANHOURS FROM TABLE 6-2
3. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND TPA (2000 vs 1836). WHC NEEDS TO MAKE A GLOBAL DECISION.
   1836 MANHOURS IN A YEAR FROM PAGE B-8
4. WE NEED TO SEE THE STAFFING TABLES TO VERIFY THAT THESE MANHOUR ESTIMATES ARE COMPLETE.
5. MANHOUR DISTRIBUTION ESTIMATED BY JACOBS. WE NEED THIS INFO FROM WHC
6. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

TPA WRT OPR MH

2023	2024	2025	2026	2027	
3%	3%	3%	3%	3%	100%
					TOTAL
572	572	572	572	572	19,063
196	196	196	196	196	6,536
98	98	98	98	98	3,268
229	229	229	229	229	7,625
1,095	1,095	1,095	1,095	1,095	36,492

TPA WRT OPR MH

TPA
CONSTRUCTION PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING HOURS AND SCHEDULE FROM REV A DRAFT OF THE TPA ENGINEERING PACKAGE
REV 0 Dec 14, 1994 JWG

YEAR (NOTE 1)			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	
% MH EXPENDED PER YR, DESIGN (NOTE 5)			15%	20%	30%	20%	5%	2%	2%	2%	2%	1%	1%	100%
% MH EXPENDED PER YR, CONST. (NOTE 5)			3%	6%	7%	9%	10%	12%	14%	16%	10%	8%	5%	100%
	TOTAL MH (NOTE 2)	EQUIV TOTAL MAN*YR (NOTE 3)	EQUIVALENT MEN (NOTE 6)											TOTAL
DESIGN & ENGR	10,000,000	5000	750	1000	1500	1000	250	100	100	100	100	50	50	5,000
CONSTRUCTION														
NONRADIATION WORKER	24,000,000	12000	360	720	840	1080	1200	1440	1680	1920	1200	960	600	12,000
SUPERVISORY	5,600,000	2800	84	168	196	252	280	336	392	448	280	224	140	2,800
TOTAL	39,600,000	19,800	1,194	1,888	2,536	2,332	1,730	1,876	2,172	2,468	1,580	1,234	790	19,800

NOTES:
1. SCHEDULE FROM TABLE 10-24
2. TOTAL MANHOURS FROM TABLE 10-10
3. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND TPA (2000 vs 1836). WHC NEEDS TO MAE A GLOBAL DECISION
   2000 MANHOURS IN A YEAR, FROM TABLE 10-2
4. WE NEED TO SEE THE STAFFING TABLES TO VERIFY THAT THESE MANHOUR ESTIMATES ARE COMPLETE.
5. THE MANHOUR DISTRIBUTION IS BY JEG. WE NEED THIS INFO FROM WHC
6. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

TPA
OPERATING PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE REV A DRAFT OF THE TPA PACKAGE
NOTE THAT THE CALCULATIONS ARE BASED ON MANHOURS PER YEAR AND NOT TOTAL MANHOURS
REV 0 Dec 16, 1994 JWG

YEAR (NOTE 1)		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028			
% MH OF MATURE YEAR (NOTE 6)		20%	40%	60%	80%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	80%	60%	40%	20%			
	TOTAL MH/YR (NOTE 2)	EQUIV MEN/YR (NOTE 4)	EQUIVALENT MEN (NOTE 7)																										TOTAL
NONEXEMPT																													
RAD WORKER	830,000	415	83	166	249	332	415	415	415	415	415	415	415	415	415	415	415	415	415	415	415	415	332	249	166	83	8,715		
NONRAD WORKER	120,000	60	12	24	36	48	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	48	36	24	12	1,260		
RAD WORKER	440,000	220	44	88	132	176	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	176	132	88	44	4,620		
NOFRAD WORKER	58,000	29	6	12	17	23	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	23	17	12	6	609		
TOTAL	1,448,000	724	145	290	434	579	724	724	724	724	724	724	724	724	724	724	724	724	724	724	724	724	579	434	290	145	15,204		

NOTES:
1. SCHEDULE FROM TABLE 10-24
2. MANHOURS PER YEAR FROM TABLE 10-3
3. THE MANHOURS PER YEAR FROM TABLE 10-3 IS ASSUMMED TO BE A MATURE YEAR
4. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND TPA (2000 vs 1836). WHC NEEDS TO MAKE A GLOBAL DECISION. 2000 MANHOURS IN A YEAR, FROM TABLE 10-2
5. WE NEED TO SEE THE STAFFING TABLES TO VERIFY THAT THESE MANHOUR ESTIMATES ARE COMPLETE.
6. MANHOUR DISTRIBURION ESTIMATED BY JACOBS. WE NEED THIS INFO FROM WHC
7. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

TPA; WASTE RETRIEVAL AND TRANSFER
DECONTAMINATING AND DECOMISSIONING PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE MINIMAL PRETREATMENT SECTION OF THE REV A DRAFT OF THE WASTE RETRIEVAL AND TRANSFER PACKAGE
REV 0 Dec 16, 1994 JWG

YEAR (NOTE 1)	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	
% MH EXPENDED PER YEAR (NOTE 5)	5%	5%	5%	5%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	5%	5%	5%	5%	100%

	TOTAL MH (NOTE 4)	EQUIV MEN*YR (NOTE 2)	EQUIVALENT MEN (NOTE 6)																	TOTAL
D&D LABOR	9,810,000	5,343	267	267	267	267	321	321	321	321	321	321	321	321	321	321	267	267	267	267	5,343

NOTES:
1. SCHEDULE FROM TABLE 6-22
2. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND TPA (2000 vs 1836).
   WHC NEEDS TO MAKE A GLOBAL DECISION
   1836 MAN HOURS IN A YEAR FROM FOOTNOTES FOR PAGE 8-8
3. WE NEED TO SEE THE STAFFING TABLES TO VERIFY IF THESE MANHOUR ESTIMATES ARE COMPLETE.
4. FOOTNOTES FOR TABLE 6-21 SPECIFY THE FOLLOWING LABOR COSTS FOR D&D:
   30 % OF CAPITAL (EX CONTINGENCY); TABLE 6-17
   NOTE THE BASIS IS DIFFERENT THAN THE TPA PROCESS ASSUMPTION. THREE YEARS OF OPERATING LABOR IS NOT INCLUDED
   JACOBS ASSUMES THAT CAPITAL IS 60% LABOR AND THAT THE LABOR RATE IS 60 $/HR.

   30% OF CAPITAL AT 60% LABOR, MILLIONS 30% X 3,270 X 60% = $589
   TOTAL LABOR HOURS AT 60 $/HR 9810000

5. MANHOUR DISTRIBURIION ESTIMATED BY JACOBS. WE NEED THIS INFO FROM WHC
6. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)
7. D&D SCOPE IS UNDEFINED AND COST ESTIMATES ARE A WAG. WHC TO RESOLVE

TPA; WASTE RETRIEVAL AND TRANSFER
MONITORING AND MAINTENANCE PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE MINIMAL PRETREATMENT SECTION OF THE REV A DRAFT OF THE WASTE RETRIEVAL AND TRANSFER PACKAGE
REV 0 Dec 14, 1994 JWG

YEAR (NOTE 1)	0	1	2	3	4	5	6	7	8	9	10	94	95	96	97	98	99	100	TOTAL
	MH (NOTE 2)	EQUIV MEN/YR (NOTE 3)	-------- EQUIVALENT MEN (NOTE 4)																
NONEXEMPT																			
RAD WORKER	0	0																	0
NONRAD WORKER	0	0																	
EXEMPT																			
RAD WORKER	0	0																	
TOTAL	0	0																	

NOTE: 1. THERE IS NO SCHEDULE FOR THIS PHASE
2. THERE IS A MANHOUR CHART, 6-13, BUT NO HOURS ARE ENTERED
3. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND TPA (2000 vs 1836). WHC NEEDS TO MAKE A GLOBAL DECIS 1836 MANHOURS IN A YEAR FROM PAGE 8-8
4. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

TPA
DECONTAMINATING AND DECOMISSIONING PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE REV A DRAFT OF THE TPA PACKAGE
REV 0 Dec 16, 1994 JWG

YEAR (NOTE 1)			2028	2029	2030	2031	2032	2033	
% MH EXPENDED PER YEAR (NOTE 5)			10%	18%	26%	26%	15%	5%	100%
	TOTAL MH (NOTE 4)	EQUIV MEN*YR (NOTE 2)	-------- EQUIVALENT MEN (NOTE 6)						----------
D&D LABOR	14,340,000	7,170	717	1291	1864	1864	1076	359	7,170

NOTES:
1. SCHEDULE FROM TABLE 10-24
2. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND TPA (2000 vs 183
   2000 MAN HOURS IN A YEAR FROM FOOTNOTES FOR TABLE 10-2
3. WE NEED TO SEE THE STAFFING TABLES TO VERIFY IF THESE MANHOUR ESTIMATES ARE COMPLETE.
4. FOOTNOTES FOR TABLE 10-19 SPECIFY THE FOLLOWING COSTS FOR D&D:
   THREE YEARS OF OPERATIONAL LABOR COSTS; FROM TABLE 10.21
   30 % OF CAPITAL (EX CONTINGENCY); TABLE 10.19
   JACOBS ASSUMES THAT CAPITAL IS 60% LABOR AND THAT THE LABOR RATE IS 60 $/HR.

THREE YEARS OF OPERATIONAL LABOR COSTS, MILLION		3 X	72	=	$216
30% OF CAPITAL AT 60% LABOR, MILLIONS	30% X	3,580 X	60%	=	$644
TOTAL LABOR COST, MILLIONS					$860
TOTAL LABOR HOURS AT 60 $/HR					14,340,000

5. MANHOUR DISTRIBURIION ESTIMATED BY JACOBS. WE NEED THIS INFO FROM WHC
6. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)
7. D&D SCOPE IS UNDEFINED AND COST ESTIMATES ARE A WAG. WHC TO RESOLVE

TPA
MONITORING AND MAINTENANCE PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE REV A DRAFT OF THE TPA PACKAGE
NOTE THAT THE CALCULATIONS ARE BASED ON MANHOURS PER YEAR AND NOT TOTAL MANHOURS
REV 0 Dec 16, 1994 JWG

	MH/YR (NOTE 2)	EQUIV MEN/YR (NOTE 3)	EQUIVALENT MEN (NOTE 6)																											
YEAR (NOTE 1)			2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054
NONEXEMPT																														
RAD WORKER	16,000	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
NONRAD WORKER	2,000	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
EXEMPT																														
RAD WORKER	2,000	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
TOTAL	20,000	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

NOTES:
1. SCHEDULE FROM TABLE 10-24
2. MANHOURS PER YEAR FROM TABLE 10-15
3. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND TPA (2000 vs 1836). WHC NEEDS TO MAKE A GLOBAL DECISION. 2000 MANHOURS IN A YEAR, FROM TABLE 10-2
4. WE NEED TO SEE THE STAFFING TABLES TO VERIFY THAT THESE MANHOUR ESTIMATES ARE COMPLETE.
5. MANHOUR DISTRIBURION ESTIMATED BY JACOBS. WE NEED THIS INFO FROM WHC
6. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	20
8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	1

TPA M&M MH

2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	21
8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	1

TPA M&M MH

2125	2126	2127	2128	----- TOTAL
8	8	8	8	808
1	1	1	1	101
1	1	1	1	101
10	10	10	10	1,010

TPA M&M MH

MINIMAL PRETREATMENT; WASTE RETRIEVAL AND TRANSFER
CONSTRUCTION PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE MINIMAL PRETREATMENT SECTION OF THE REV A DRAFT OF THE WASTE RETRIEVAL AND TRANSFER PACKAGE

	YEAR (NOTE 1)		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
% MH EXPENDED PER YR, DESIGN (NOTE 5)			5%	10%	10%	10%	10%	10%	10%	10%	5%	4%	3%	2%	2%	2%	2%	1%	1%	1%	1%	1%	100%
% MH EXPENDED PER YR, CONST. (NOTE 5)			3%	4%	5%	6%	7%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	5%	4%	3%	2%	1%	100%
	TOTAL MH (NOTE 2)	EQUIV TOTAL MAN*YR (NOTE 3)	EQUIVALENT MEN																				TOTAL
DESIGN & ENGR	6,000,000	3,268	163	327	327	327	327	327	327	327	163	131	98	65	65	65	65	33	33	33	33	33	3,268
CONSTRUCTION																							
RAD WORKER	600,000	327	10	13	16	20	23	20	20	20	20	20	20	20	20	20	20	16	13	10	7	3	327
NONRADIATION WORKER	15,000,000	8,170	245	327	408	490	572	490	490	490	490	490	490	490	490	490	490	408	327	245	163	82	8,170
SUPERVISORY	2,000,000	1,089	33	44	54	65	76	65	65	65	65	65	65	65	65	65	65	54	44	33	22	11	1,089
TOTAL	23,600,000	12,854	451	710	806	902	998	902	902	902	739	706	673	641	641	641	641	512	416	320	224	129	12,854

NOTES:
1. SCHEDULE FROM TABLE 6-22
2. TOTAL MANHOURS FROM TABLE 6-8
3. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND TPA (2000 vs 1836). WHC NEEDS TO MAKE A GLOBAL DECISION. 1836 MANHOURS PER YEAR FROM PAGE B-8
4. WE NEED TO SEE THE STAFFING TABLES TO VERIFY THAT THESE MANHOUR ESTIMATES ARE COMPLETE.
5. THE MANHOUR DISTRIBUTION IS BY JEG. WE NEED THIS INFO FROM WHC
6. INCLUDES UNDERGROUND BARRIERS

MIN PRE WRT CONST MH

MINIMAL PRETREATMENT; WASTE RETRIEVAL AND TRANSFER
OPERATING PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE MINIMAL PRETREATMENT SECTION OF THE REV A DRAFT OF THE WASTE RETRIEVAL AND TRANSFER PACKAGE

YEAR (NOTE 1)			2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	
% MH EXPENDED PER YR (NOTE 5)			3%	4%	5%	6%	7%	7%	7%	7%	6%	6%	6%	6%	6%	6%	6%	5%	4%	3%	100%
	TOTAL MH (NOTE 2)	EQUIV TOTAL MAN*YR (NOTE 3)	EQUIVALENT MEN																		TOTAL
NONEXEMPT																					
RAD WORKER	33,000,000	17,974	539	719	899	1078	1258	1258	1258	1258	1078	1078	1078	1078	1078	1078	1078	899	719	539	17,974
NONRAD WORKER	12,000,000	6,536	196	261	327	392	458	458	458	458	392	392	392	392	392	392	392	327	261	196	6,536
EXEMPT																					
RAD WORKER	5,000,000	2,723	82	109	136	163	191	191	191	191	163	163	163	163	163	163	163	136	109	82	2,723
NONRAD WORKER	13,000,000	7,081	212	283	354	425	496	496	496	496	425	425	425	425	425	425	425	354	283	212	7,081
TOTAL	63,000,000	34,314	1,029	1,373	1,716	2,059	2,402	2,402	2,402	2,402	2,059	2,059	2,059	2,059	2,059	2,059	2,059	1,716	1,373	1,029	34,314

NOTES:
1. SCHEDULE FROM TABLE 6-22
2. TOTAL MANHOURS FROM TABLE 6-2
3. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND TPA (2000 vs 1836). WHC NEEDS TO MAKE A GLOBAL DECISION. 1836 MANHOURS IN A YEAR FROM PAGE B-8
4. WE NEED TO SEE THE STAFFING TABLES TO VERIFY THAT THESE MANHOUR ESTIMATES ARE COMPLETE.
5. MANHOUR DISTRIBUTION ESTIMATED BY JACOBS. WE NEED THIS INFO FROM WHC

MINIMAL PRETREATMENT; WASTE RETRIEVAL AND TRANSFER
DECONTAMINATING AND DECOMISSIONING PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE MINIMAL PRETREATMENT SECTION OF THE REV A DRAFT OF THE WASTE RETRIEVAL AND TRANSFER PACK

YEAR (NOTE 1)			2012	2013	2014	2015	2016	2017	2018	2019	2020	
% MH EXPENDED PER YEAR (NOTE 5)			5%	10%	15%	15%	15%	14%	10%	10%	6%	100%
	TOTAL MH (NOTE 4)	EQUIV MEN*YR (NOTE 2)	EQUIVALENT MEN									TOTAL
D&D LABOR	9,810,000	5,343	267	534	801	801	801	748	534	534	321	5,343

NOTES:
1. SCHEDULE FROM TABLE 6-22
2. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND TPA (2000 vs 1836).
   WHC NEEDS TO MAKE A GLOBAL DECISION
   1836 MAN HOURS IN A YEAR FROM FOOTNOTES FOR PAGE B-8
3. WE NEED TO SEE THE STAFFING TABLES TO VERIFY IF THESE MANHOUR ESTIMATES ARE COMPLETE.
4. FOOTNOTES FOR TABLE 6-21 SPECIFY THE FOLLOWING LABOR COSTS FOR D&D:
   30 % OF CAPITAL (EX CONTINGENCY); TABLE 6-17
   NOTE THE BASIS IS DIFFERENT THAN THE MINIMAL PRETREATMENT PROCESS ASSUMPTION. THREE YEARS OF OPERATING LABOR IS NOT INCL
   JACOBS ASSUMES THAT CAPITAL IS 60% LABOR AND THAT THE LABOR RATE IS 60 $/HR.

   30% OF CAPITAL AT 60% LABOR, MILLIONS 30% X 3,270 X 60% = $589
   TOTAL LABOR HOURS AT 60 $/HR 9,810,000

5. MANHOUR DISTRIBURIION ESTIMATED BY JACOBS. WE NEED THIS INFO FROM WHC
6. D&D SCOPE IS UNDEFINED AND COST ESTIMATES ARE A WAG. WHC TO RESOLVE

MIN PRE WRT D&D MH

MINIMAL PRETREATMENT; WASTE RETRIEVAL AND TRANSFER
MONITORING AND MAINTENANCE PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE MINIMAL PRETREATMENT SECTION OF THE REV A DRAFT OF THE WASTE RETRIEVAL AND TRANSFER PACKAGE

YEAR (NOTE 1)			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
	MH (NOTE 2)	EQUIV MEN/YR (NOTE 3)	-------- EQUIVALENT MEN																					
NONEXEMPT																								
RAD WORKER	0	0																						0
NONRAD WORKER	0	0																						
EXEMPT																								
RAD WORKER	0	0																						
TOTAL	0	0																						

NOTE: 1. THERE IS NO SCHEDULE FOR THIS PHASE
2. THERE IS A MANHOUR CHART, 6-13, BUT NO HOURS ARE ENTERED
3. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND TPA (2000 vs 1836). WHC NEEDS TO MAKE A GLOBAL DECIS
1836 MANHOURS IN A YEAR FROM PAGE B-8

MINIMAL PRETREATMENT
CONSTRUCTION PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING HOURS AND SCHEDULE FROM REV A DRAFT OF THE MINIMAL PRETREATMENT ENGINEERING PACKAGE
REV 0 Dec 21, 1994 JWG

YEAR (NOTE 1)			1997	1998	1999	2000	2001	2002	
% MH EXPENDED PER YR, DESIGN (NOTE 5)									0%
% MH EXPENDED PER YR, CONST. (NOTE 5)			10%	15%	25%	25%	15%	10%	100%
	TOTAL MH (NOTE 2)	EQUIV TOTAL MAN*YR (NOTE 3)	EQUIVALENT MEN (NOTE 6)						TOTAL
DESIGN & ENGR	0	0	0	0	0	0	0	0	0
CONSTRUCTION									
EQ/FAC INSTALL (PRIME CONTRACTOR)	15,400,000	7700	770	1,155	1,925	1,925	1,155	770	7,700
SUBCONTRACT	11,800,000	5900	590	885	1,475	1,475	885	590	5,900
CONSTRUCTION MGMT	1,720,000	860	86	129	215	215	129	86	860
PROJECT MGMT	689,000	344.50	34	52	86	86	52	34	345
TOTAL	29,609,000	14,805	1,480	2,221	3,701	3,701	2,221	1,480	14,805

NOTES:
1. SCHEDULE FROM TABLE 7-23
2. TOTAL MANHOURS FROM TABLE 7-9
3. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND MINIMAL PRETREATMENT (2000 vs 1836). WHC NEEDS TO MAE A GLOBAL DECISION
   2000 MANHOURS IN A YEAR, FROM TABLE 7-14
4. WE NEED TO SEE THE STAFFING TABLES TO VERIFY THAT THESE MANHOUR ESTIMATES ARE COMPLETE.
5. THE MANHOUR DISTRIBUTION IS BY JEG. WE NEED THIS INFO FROM WHC
6. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

MINIMAL PRETREATMENT
OPERATING PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING HOURS AND SCHEDULE FROM REV A DRAFT OF THE MINIMAL PRETREATMENT ENGINEERING PACKAGE
REV 0 Dec 15, 1994 JWG

	YEAR (NOTE 1)		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	
% MH OF MATURE	YEAR (NOTE 6)		20%	40%	60%	80%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
	TOTAL MH/YR (NOTE 2)	EQUIV MEN/YR (NOTE 4)	EQUIVALENT MEN (NOTE 7)															TOTAL
NONEXEMPT																		
RAD WORKER	506,000	253	51	101	152	202	253	253	253	253	253	253	253	253	253	253	253	3,289
NONRAD WORKER	116,000	58	12	23	35	46	58	58	58	58	58	58	58	58	58	58	58	754
RAD WORKER	344,000	172	34	69	103	138	172	172	172	172	172	172	172	172	172	172	172	2,236
NONRAD WORKER	52,000	26	5	10	16	21	26	26	26	26	26	26	26	26	26	26	26	338
TOTAL	1,018,000	509	102	204	305	407	509	509	509	509	509	509	509	509	509	509	509	6,617

NOTES:
1. SCHEDULE FROM TABLE 7-23
2. MANHOURS PER YEAR FROM TABLE 7-3
3. THE MANHOURS PER YEAR FROM TABLE 7-3 IS ASSUMED TO BE A MATURE YEAR
4. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND MINIMAL PRETREATMENT (2000 vs 1836).
   WHC NEEDS TO MAKE A GLOBAL DECISION
   2000 MANHOURS IN A YEAR, FROM TABLE 7-14
5. WE NEED TO SEE THE STAFFING TABLES TO VERIFY THAT THESE MANHOUR ESTIMATES ARE COMPLETE.
6. MANHOUR DISTRIBUTION ESTIMATED BY JACOBS. WE NEED THIS INFO FROM WHC
   JACOBS ASSUMED A 20% PER YEAR MANPOWER BUILDUP ON STARTUP AND THAT THE FULL MANPOWER COMPONENT WOULD BE ABSORBED BY D&D UPON SHUTDOWN
7. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

MINIMAL PRETREATMENT

DECONTAMINATING AND DECOMMISSIONING PERSONNEL ESTIMATE

ESTIMATED BY JACOBS USING HOURS AND SCHEDULE FROM REV A DRAFT OF THE MINIMAL PRETREATMENT ENGINEERING PACKAGE

REV 0 Dec 16, 1994 JWG

YEAR (NOTE 1)			2019	2020	2021	2022	2023	
% MH EXPENDED PER YEAR (NOTE 5)			15%	25%	30%	20%	10%	100%
	TOTAL MH (NOTE 4)	EQUIV MEN*YR (NOTE 2)	EQUIVALENT MEN (NOTE 6)					
D&D LABOR	10,427,000	5,214	782	1303	1564	1043	521	5,214

NOTES:
1. SCHEDULE FROM TABLE 7-23
2. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND MINIMAL PRETREATMEN
   WHC NEEDS TO MAKE A GLOBAL DECISION
   2000 MAN HOURS IN A YEAR FROM FOOTNOTES FOR TABLE 7-14
3. WE NEED TO SEE THE STAFFING TABLES TO VERIFY IF THESE MANHOUR ESTIMATES ARE COMPLETE.
4. FOOTNOTES FOR TABLE 7-18 SPECIFY THE FOLLOWING COSTS FOR D&D:
   THREE YEARS OF OPERATIONAL LABOR COSTS; FROM TABLE 7-20
   30 % OF CAPITAL (EX CONTINGENCY); TABLE 7-19
   JACOBS ASSUMES THAT CAPITAL IS 60% LABOR AND THAT THE LABOR RATE IS 60 $/HR.

THREE YEARS OF OPERATIONAL LABOR COSTS, MILLIONS		3 X	52	=	$156
30% OF CAPITAL AT 60% LABOR, MILLIONS	30% X	2,609 X	60%	=	$470
TOTAL LABOR COST, MILLIONS					$626
TOTAL LABOR HOURS AT 60 $/HR					10,427,000

5. MANHOUR DISTRIBUTION ESTIMATED BY JACOBS. WE NEED THIS INFO FROM WHC
6. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)
7. D&D SCOPE IS UNDEFINED AND COST ESTIMATES ARE A WAG. WHC TO RESOLVE

MINIMAL PRETREATMENT
MONITORING AND MAINTENANCE PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING HOURS AND SCHEDULE FROM REV A DRAFT OF THE MINIMAL PRETREATMENT ENGINEERING PACKAGE
NOTE THAT THE CALCULATIONS ARE BASED ON MANHOURS PER YEAR AND NOT TOTAL MANHOURS
REV 0 Dec 15, 1994 JWG

	MH/YR (NOTE 2)	EQUIV MEN/YR (NOTE 3)	EQUIVALENT MEN (NOTE 6)												TOTAL
YEAR (NOTE 1)			2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033		
NONEXEMPT															
RAD WORKER	16,000	8	8	8	8	8	8	8	8	8	8	8	8		88
NONRAD WORKER	2,000	1	1	1	1	1	1	1	1	1	1	1	1		11
EXEMPT															
RAD WORKER	2,000	1	1	1	1	1	1	1	1	1	1	1	1		11
TOTAL	20,000	10	10	10	10	10	10	10	10	10	10	10	10		110

NOTES:
1. SCHEDULE FROM TABLE 7-23
2. MANHOURS PER YEAR FROM TABLE 7-14
3. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND MINIMAL PRETREATMENT (2000 vs 1836). WHC NEEDS TO MAKE A GLOBAL 2000 MANHOURS IN A YEAR, FROM TABLE 7-14
4. WE NEED TO SEE THE STAFFING TABLES TO VERIFY THAT THESE MANHOUR ESTIMATES ARE COMPLETE.
5. MANHOUR DISTRIBUTION ESTIMATED BY JACOBS. WE NEED THIS INFO FROM WHC
6. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

Request Number 002

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Tirzo Gonzalez & Larry Dean Date: 12/12/94

Phone Number: 946-7112 Fax Number: 943-6812

Request Information: Will need engineering drawings with "footprints" for first two alternatives. will also need all staging areas location and locations of other areas where ground disturbances/impacts will occur at TWRS site.

Need Date: 1/6/95

Response: Attached maps and plot plans given to Larry Dean and Tirzo Gonzalez. CAD file will be transmitted when available from WHC.

Data Source/Accuracy:

WHC Preliminary Data Packages.

Prepared By: D. Murray & C. Henderson Date Sent/Faxed: 1/1/795

Concurrence: Marc Nelson
Marc Nelson - Deputy Project Manager

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ADVANCED SCIENCES, INC.

FAX COVER SHEET

No. of Pages: 2

To: Dr. Dave Murray

Date: 12/12/94

Time: 2:34 PM

Fax: 509-736-7504

From: Tiago González

Comments: Will need Engineering Footprints for the 1st Two TWRS alternatives w/ all areas where ground disturbing impacts are anticipated (i.e. laydown areas, subsurface utilities, on site-borrow areas, etc.) Call if you have any questions. Thanx

Tiago

1777 Terminal Dr.
Richland, WA 99352
(509) 946-7112
Fax: (509) 943-6812

Seasons Greetings

MEMORANDUM

To: Arrie Bachrach 95-DM-001
From: Dave Murray
Date: January 18, 1995
Subject: ASI Meeting

During the January 17, 1995 meeting with Colin Henderson (JEG), Larry Dean (ASI), and Tirzo Gonzalez (ASI), location of treatment facilities was discussed. Larry and Tirzo were given copies of the following maps:

1. Figure A-5 Slurry Transfer Piping and Facilities Layout (Sheet 1 of 8)
2. Figure A-5 Slurry Transfer Piping and Facilities Layout (Sheet 2 of 8)
3. Figure A-5 Slurry Transfer Piping and Facilities Layout (Sheet 3 of 8)
4. Figure A-5 Slurry Transfer Piping and Facilities Layout (Sheet 4 of 8)
5. Figure A-5 Slurry Transfer Piping and Facilities Layout (Sheet 5 of 8)
6. Figure A-6 Slurry Transfer Piping and Facilities Layout (Sheet 6 of 8)
7. Figure A-7 Slurry Transfer Piping and Facilities Layout (Sheet 7 of 8)
8. Figure A-8 Slurry Transfer Piping and Facilities Layout (Sheet 8 of 8)
9. Figure 2-3 Site Plan (No Pretreatment)
10. Figure 5-2 Disturbed Areas (TPA Alternative)

Larry and Tirzo agreed that these maps were the information they required. Jacobs will give them CAD files when they become available from WHC.

Request Number 003

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: ESE John Horton/John Shrock

Date: 12/13/94

Phone Number: (509) 375-6162/ (904) 332-3318 Ext. 6607

Fax Number: (509) 375-5446/ (904) 333-6631

Request Information: See attached

Need Date: 12/20/94

Response: See attached

Data Source/Accuracy:

Prepared By: J. Goodwin, C. Henderson CH.

Date Sent/Faxed: 02/17/95

Concurrence: Marc C. Nelson
Marc Nelson - Deputy Project Manager

engine\eninfrq.003

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.
MEMORANDUM

TO: Dave Murray, JEG
FROM: John Horton

DATE: December 13, 1994

SUBJECT: Engineering Data Request for Air Quality Impacts Analysis

Attached is a list of data requested for Air Quality Impacts analysis. The ESE Air Quality Team in Gainesville, Florida has reviewed the Westinghouse Engineering Data Packages and drawn a number of assumptions. Those assumptions are outlined in the enclosed document with requests for clarification where necessary.

Please contact me if there are any questions. For questions that arise after this friday, December 16, please contact John Shrock or John Kuhn in the ESE Gainesville office.

Items for data request package

1. Are we to assume there are no releases of volatile hazardous air pollutants (HAPs) and air toxics (solvents, etc.) from the treatment or transfer processes? Note that on page 3-4, Section 3.1.2 of the minimal pretreatment package, the statement is made "...there (in the melter section) volatiles and semivolatiles are burned off..." Although the combustion process will be hot enough to destroy a large portion of the VOCs, some amount will likely get through. We understand that additional controls, such as an afterburner, will be added if necessary. Does this imply that the unit will be designed to meet a particular destruction efficiency? If this is the case, what is the criteria for level of control, e.g., regulatory emission limit or risk based? What should we assume?

2. The liquid wastes go through an evaporation stage prior to the vitrification unit. If volatiles are present, they would be driven off during the evaporation stage, and may also be released during retrieval and transfer operations as well. No mention or quantification of these is given in the package. ESE requests that identification of these constituents and their emission rates be given, if applicable.

3. From review of the data packages, it appears that all operating emissions from the vitrification facility processes (with the exception of PM10 emissions from cooling towers, and VOC emissions from kerosene storage tanks) eventually occur through the building HVAC systems. These emissions are summarized in Tables 7-5 and 7-6 in the No Pretreatment Data Package, and Tables 10-6 and 10-7 of the TPA Data Package. These emissions appear to correspond to flow streams 702 and 706 (No Pretreatment and TPA). We would like confirmation of this assumption, and we request simplified flow diagrams of the vitrification processes, identifying the points at which atmospheric releases occur. Additionally, we request clarification of the locations of any external release points, the volumetric flow rate and temperature of the release, and the emission point height and geometry.

4. Tables 10-6 (TPA) and 7-5 (No Pretreatment) list annual emissions of "HAPs (metals)". We request that the speciation of these metal HAPs be given.

5. Do the PM10 emissions from the vitrification process cooling towers (TPA and No Pretreatment options) consist only of water, or are other pollutants expected to be emitted?

6. The data packages state that the ultimate locations of the vitrification facilities have not yet been determined. Will a most probable sit be chosen for the purposes of this

ENGINEERING DATA REQUEST 003

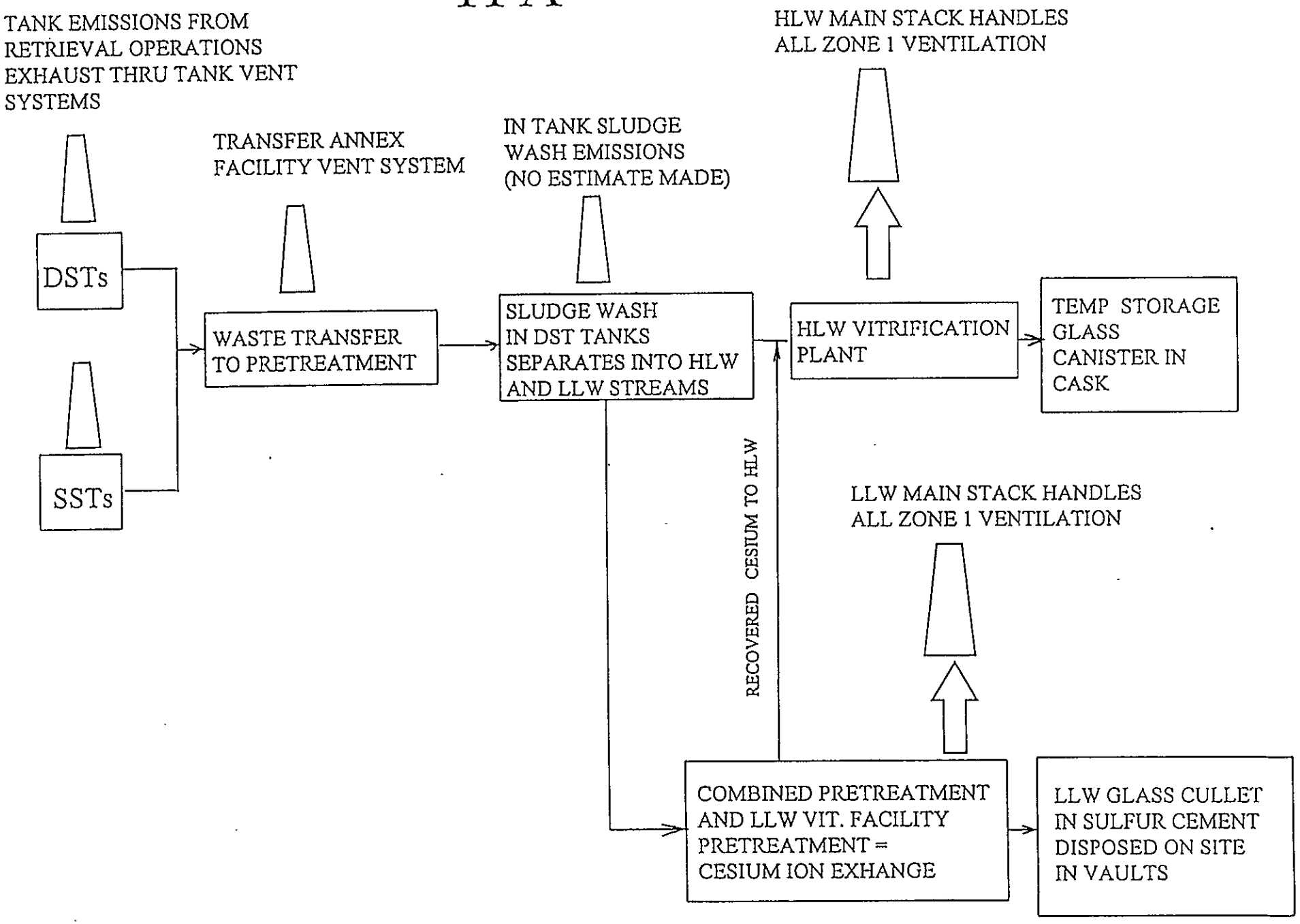
REQUESTED BY: JOHN SHROCK/ESE

SUBJECT: HAPS

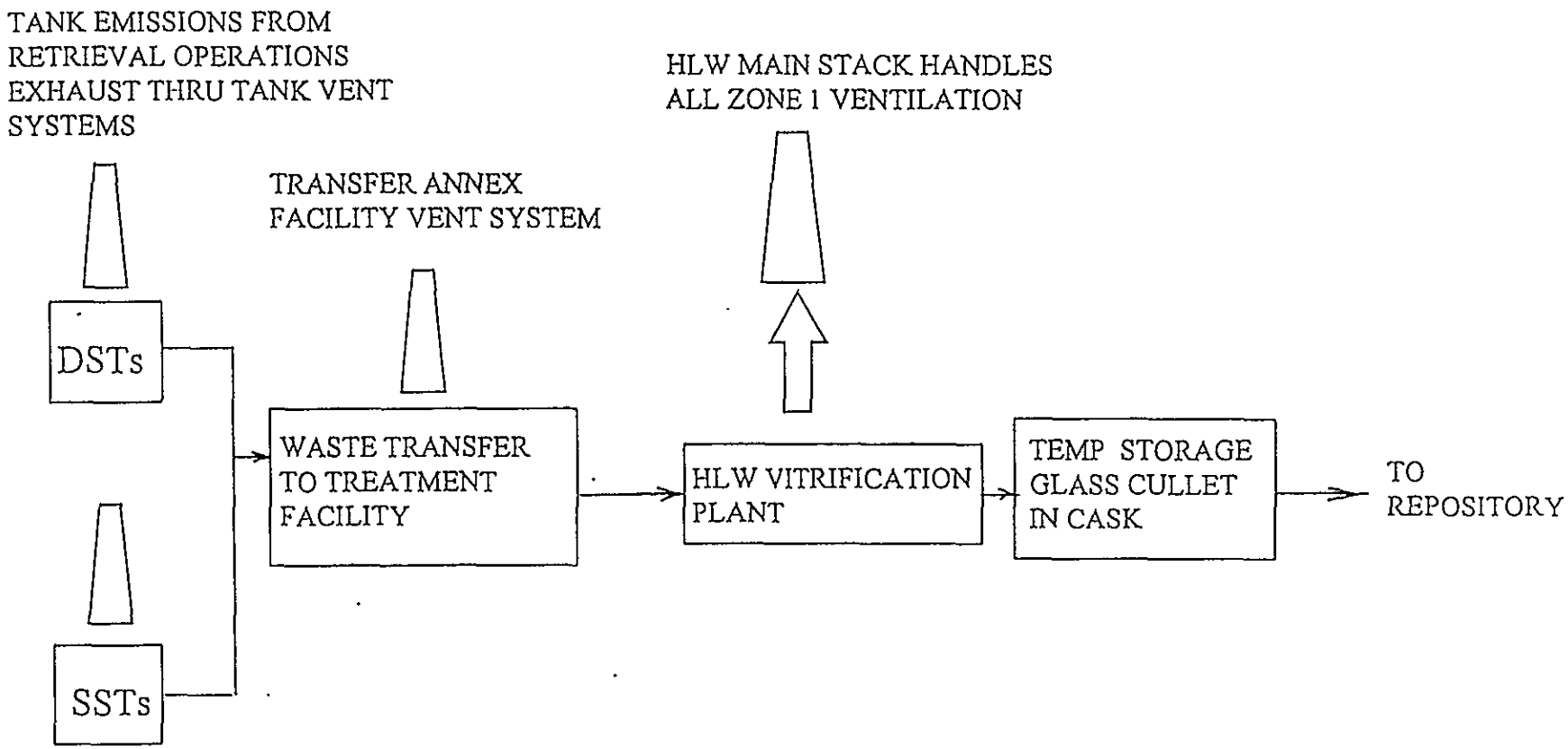
The general sources of emissions are shown on the attached simplified flowsheets. All releases, except for the cooling tower (which is not shown), are through sampled stacks. All emissions are also treated under ALARA criteria before releasing, but we have no information on HAPS from WHC.

Jacobs is requesting additional information from WHC on specific HAPS and their concentrations.

TPA


TANK EMISSIONS FROM RETRIEVAL OPERATIONS EXHAUST THRU TANK VENT SYSTEMS
TRANSFER ANNEX FACILITY VENT SYSTEM
IN TANK SLUDGE WASH EMISSIONS (NO ESTIMATE MADE)
HLW MAIN STACK HANDLES ALL ZONE 1 VENTILATION
DSTs
SSTs
WASTE TRANSFER TO PRETREATMENT
SLUDGE WASH IN DST TANKS SEPARATES INTO HLW AND LLW STREAMS
HLW VITRIFICATION PLANT
TEMP STORAGE GLASS CANISTER IN CASK
RECOVERED CESIUM TO HLW
LLW MAIN STACK HANDLES ALL ZONE 1 VENTILATION
COMBINED PRETREATMENT AND LLW VIT. FACILITY PRETREATMENT = CESIUM ION EXHANGE
LLW GLASS CULLET IN SULFUR CEMENT DISPOSED ON SITE IN VAULTS

MINIMUM PRETREATMENT



Request Number 004

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: ESE John Horton/John Shrock

Date: 12/13/94

Phone Number: (509) 375-6162/ (904) 332-3318 Ext. 6607

Fax Number: (509) 375-5446/ (904) 333-6631

Request Information: See attached

Need Date: 12/20/94

Response: See attached

Data Source/Accuracy:

Prepared By: J. Goodwin, C. Henderson CH.

Date Sent/Faxed: 02/17/95

Concurrence: Marc E. Nelson
Marc Nelson - Deputy Project Manager

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ENVIRONMENTAL SCIENCE & ENGINEERING, INC.
MEMORANDUM

TO: Dave Murray, JEG
FROM: John Horton

DATE: December 13, 1994

SUBJECT: Engineering Data Request for Air Quality Impacts Analysis

Attached is a list of data requested for Air Quality Impacts analysis. The ESE Air Quality Team in Gainesville, Florida has reviewed the Westinghouse Engineering Data Packages and drawn a number of assumptions. Those assumptions are outlined in the enclosed document with requests for clarification where necessary.

Please contact me if there are any questions. For questions that arise after this friday, December 16, please contact John Shrock or John Kuhn in the ESE Gainesville office.

Items for data request package

1. Are we to assume there are no releases of volatile hazardous air pollutants (HAPs) and air toxics (solvents, etc.) from the treatment or transfer processes? Note that on page 3-4, Section 3.1.2 of the minimal pretreatment package, the statement is made "...there (in the melter section) volatiles and semivolatiles are burned off..." Although the combustion process will be hot enough to destroy a large portion of the VOCs, some amount will likely get through. We understand that additional controls, such as an afterburner, will be added if necessary. Does this imply that the unit will be designed to meet a particular destruction efficiency? If this is the case, what is the criteria for level of control, e.g., regulatory emission limit or risk based? What should we assume?

2. The liquid wastes go through an evaporation stage prior to the vitrification unit. If volatiles are present, they would be driven off during the evaporation stage, and may also be released during retrieval and transfer operations as well. No mention or quantification of these is given in the package. ESE requests that identification of these constituents and their emission rates be given, if applicable.

3. From review of the data packages, it appears that all operating emissions from the vitrification facility processes (with the exception of PM10 emissions from cooling towers, and VOC emissions from kerosene storage tanks) eventually occur through the building HVAC systems. These emissions are summarized in Tables 7-5 and 7-6 in the No Pretreatment Data Package, and Tables 10-6 and 10-7 of the TPA Data Package. These emissions appear to correspond to flow streams 702 and 706 (No Pretreatment and TPA). We would like confirmation of this assumption, and we request simplified flow diagrams of the vitrification processes, identifying the points at which atmospheric releases occur. Additionally, we request clarification of the locations of any external release points, the volumetric flow rate and temperature of the release, and the emission point height and geometry.

4. Tables 10-6 (TPA) and 7-5 (No Pretreatment) list annual emissions of "HAPs (metals)". We request that the speciation of these metal HAPs be given.

5. Do the PM10 emissions from the vitrification process cooling towers (TPA and No Pretreatment options) consist only of water, or are other pollutants expected to be emitted?

6. The data packages state that the ultimate locations of the vitrification facilities have not yet been determined. Will a most probable sit be chosen for the purposes of this

ENGINEERING DATA REQUEST 004

REQUESTED BY: JOHN SHROCK/ESE

SUBJECT: VOC EMISSION

The information on organic volatiles that ESE requests is not available in the Minimal Pretreatment, TPA and Waste Retrieval and Transfer data packages. The engineering packages provide only rad and non rad emissions of inorganic material. Note the footnote in the emission tables that says "VOC emissions for main process and other auxiliary sources are not currently defined."

Those volatiles that are not destroyed during vitrification and any future equipment added for VOC destruction will be released through the facilities main process stack. Jacobs will request that WHC provide clarification on the emission rate and identification of organic compounds.

MEMORANDUM

TO: John Horton
John Shrock

February 15,1995
95-DM-006

FROM: Dave Murray

SUBJECT: ENGINEERING INFORMATION REQUESTS

In response to your inquiry we are enclosing the completed Engineering Information Request Numbers 003-016. Should you have any questions, please contact me at (509) 736-0616.

cc: Project File

Attachments: Engineering Information Request Numbers 003-016

DM:CCM:ns

Request Number 005

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: ESE John Horton/John Shrock

Date: 12/13/94

Phone Number: (509) 375-6162/ (904) 332-3318 Ext. 6607

Fax Number: (509) 375-5446/ (904) 333-6631

Request Information: See attached

Need Date: 12/20/94

Response: See attached

Data Source/Accuracy: Data is from the No Separations and TPA packages. The data will be updated when WHC issues the approved draft of the engineering package.

Prepared By: J. Goodwin, C. Henderson

Date Sent/Faxed: 02/17/95

Concurrence: Marc C. Nelson
Marc Nelson - Deputy Project Manager

engin\eninfrq.005

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.
MEMORANDUM

TO: Dave Murray, JEG
FROM: John Horton

DATE: December 13, 1994

SUBJECT: Engineering Data Request for Air Quality Impacts Analysis

Attached is a list of data requested for Air Quality Impacts analysis. The ESE Air Quality Team in Gainesville, Florida has reviewed the Westinghouse Engineering Data Packages and drawn a number of assumptions. Those assumptions are outlined in the enclosed document with requests for clarification where necessary.

Please contact me if there are any questions. For questions that arise after this friday, December 16, please contact John Shrock or John Kuhn in the ESE Gainesville office.

Items for data request package

1. Are we to assume there are no releases of volatile hazardous air pollutants (HAPs) and air toxics (solvents, etc.) from the treatment or transfer processes? Note that on page 3-4, Section 3.1.2 of the minimal pretreatment package, the statement is made "...there (in the melter section) volatiles and semivolatiles are burned off..." Although the combustion process will be hot enough to destroy a large portion of the VOCs, some amount will likely get through. We understand that additional controls, such as an afterburner, will be added if necessary. Does this imply that the unit will be designed to meet a particular destruction efficiency? If this is the case, what is the criteria for level of control, e.g., regulatory emission limit or risk based? What should we assume?

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3. From review of the data packages, it appears that all operating emissions from the vitrification facility processes (with the exception of PM10 emissions from cooling towers, and VOC emissions from kerosene storage tanks) eventually occur through the building HVAC systems. These emissions are summarized in Tables 7-5 and 7-6 in the No Pretreatment Data Package, and Tables 10-6 and 10-7 of the TPA Data Package. These emissions appear to correspond to flow streams 702 and 706 (No Pretreatment and TPA). We would like confirmation of this assumption, and we request simplified flow diagrams of the vitrification processes, identifying the points at which atmospheric releases occur. Additionally, we request clarification of the locations of any external release points, the volumetric flow rate and temperature of the release, and the emission point height and geometry.

4. Tables 10-6 (TPA) and 7-5 (No Pretreatment) list annual emissions of "HAPs (metals)". We request that the speciation of these metal HAPs be given.

5. Do the PM10 emissions from the vitrification process cooling towers (TPA and No Pretreatment options) consist only of water, or are other pollutants expected to be emitted?

6. The data packages state that the ultimate locations of the vitrification facilities have not yet been determined. Will a most probable sit be chosen for the purposes of this

MEMORANDUM

TO: John Horton
John Shrock

February 15,1995
95-DM-006

FROM: Dave Murray

SUBJECT: ENGINEERING INFORMATION REQUESTS

In response to your inquiry we are enclosing the completed Engineering Information Request Numbers 003-016. Should you have any questions, please contact me at (509) 736-0616.

cc: Project File

Attachments: Engineering Information Request Numbers 003-016

DM:CCM:ns

ENGINEERING DATA REQUEST 005

REQUESTED BY: JOHN SHROCK/ESE

See attached sheets and data request 003.

Per telecon with WHC engineers on 1/6/95 the following stack of information was identified:

Minimum Pretreatment - The facility will have two stacks, one stack will be for zone one or process offgas and one stack will be for zone two and three ventilation. The stack for zones two and three should not exhaust anything other than clean ventilation air during normal operations. The zone one stack will be the source of emissions. Both stacks are 180' high. The stacks are adjacent to the west wall of the vitrification building towards the center. The stack coordinates are N41,000, W50,750 in Hanford Coordinates.

TPA Alternative - Both the HLW and LLW vitrification facilities will have two stacks that function in the same manner as explained above for the Minimal Pretreatment case. The LLW vitrification facility process stack coordinates are W51,750, N50,750 in Hanford coordinates. The HLW facility process stack coordinates are W50,800, N41,000 in Hanford coordinates. The current design of the facilities has all of the stacks at 180' in height.

The heights of the nearby facilities are as follows:

Minimum Pretreatment vitrification facility height 51' high
TPA LLW vitrification facility 83' high
TPA HLW vitrification facility 100' high

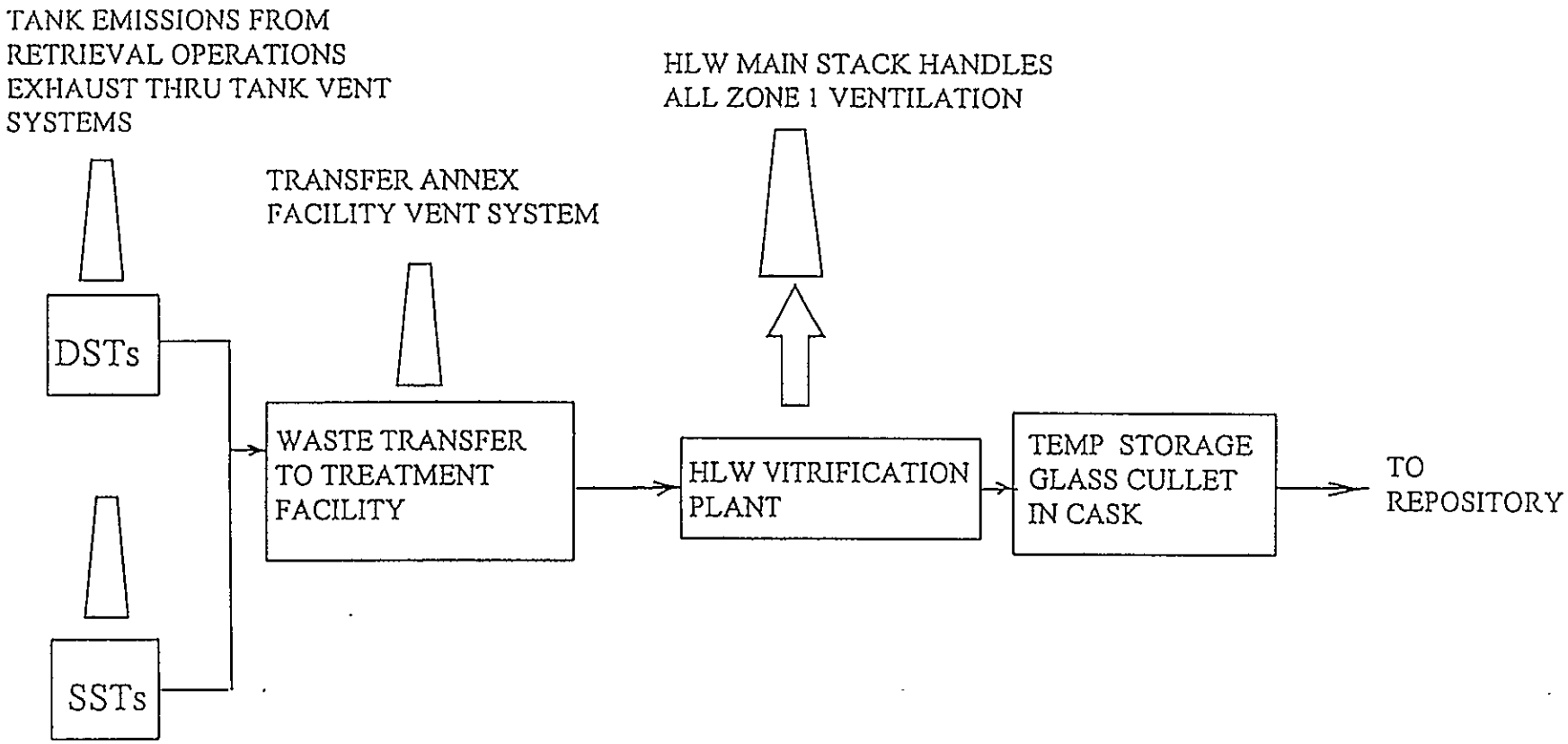
Using the information in the Fluor mass balances the following were calculated:

Minimal Pretreatment stack flow is a combination of streams 645+702+706+522+434 equal to 21,930 SCFM at 368 degrees F.

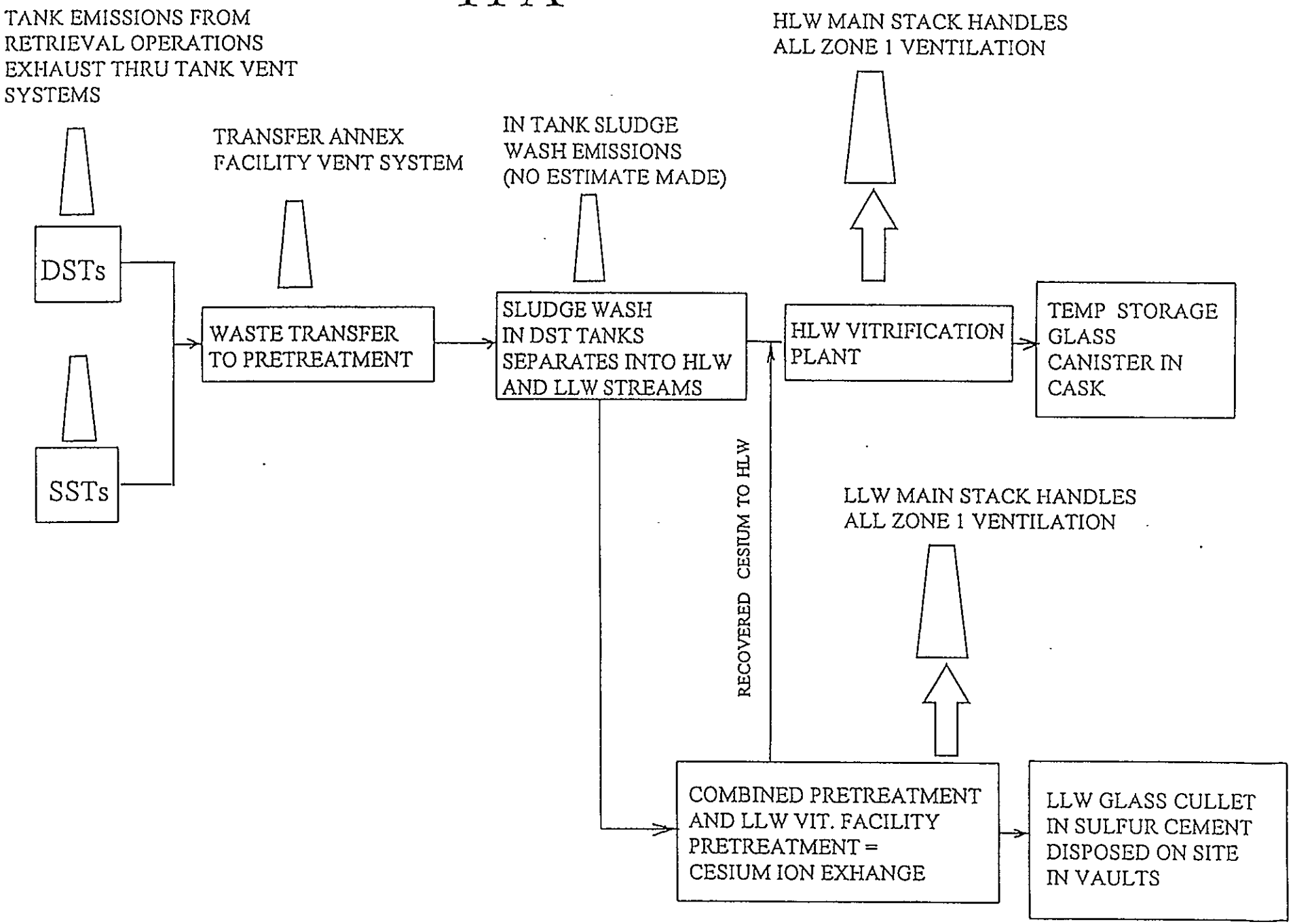
TPA separations and LLW stack flow is a combination of streams 645+702+706+ 522 + 434+ and is equal to 24,556 SCFM at 343 degrees F.

TPA HLW vitrification facility stack flow is a combination of streams 645+702+706 and is equal to 3,932 SCFM at 178 degrees F.

MINIMU PRETREATMENT



TPA


TANK EMISSIONS FROM RETRIEVAL OPERATIONS EXHAUST THRU TANK VENT SYSTEMS
TRANSFER ANNEX FACILITY VENT SYSTEM
IN TANK SLUDGE WASH EMISSIONS (NO ESTIMATE MADE)
HLW MAIN STACK HANDLES ALL ZONE 1 VENTILATION
DSTs
SSTs
WASTE TRANSFER TO PRETREATMENT
SLUDGE WASH IN DST TANKS SEPARATES INTO HLW AND LLW STREAMS
HLW VITRIFICATION PLANT
TEMP STORAGE GLASS CANISTER IN CASK
RECOVERED CESIUM TO HLW
LLW MAIN STACK HANDLES ALL ZONE 1 VENTILATION
COMBINED PRETREATMENT AND LLW VIT. FACILITY PRETREATMENT = CESIUM ION EXHANGE
LLW GLASS CULLET IN SULFUR CEMENT DISPOSED ON SITE IN VAULTS

Request Number 006

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: ESE John Horton/John Shrock

Date: 12/13/94

Phone Number: (509) 375-6162/ (904) 332-3318 Ext. 6607

Fax Number: (509) 375-5446/ (904) 333-6631

Request Information: See attached

Need Date: 12/20/94

Response: See attached

Data Source/Accuracy:

Prepared By: J. Goodwin, C. Henderson

Date Sent/Faxed: 02/17/95

Concurrence: Marc E. Nelson
Marc Nelson - Deputy Project Manager

engine\eninfrq.006

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.
MEMORANDUM

TO: Dave Murray, JEG
FROM: John Horton

DATE: December 13, 1994

SUBJECT: Engineering Data Request for Air Quality Impacts Analysis

Attached is a list of data requested for Air Quality Impacts analysis. The ESE Air Quality Team in Gainesville, Florida has reviewed the Westinghouse Engineering Data Packages and drawn a number of assumptions. Those assumptions are outlined in the enclosed document with requests for clarification where necessary.

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Items for data request package

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3. From review of the data packages, it appears that all operating emissions from the vitrification facility processes (with the exception of PM10 emissions from cooling towers, and VOC emissions from kerosene storage tanks) eventually occur through the building HVAC systems. These emissions are summarized in Tables 7-5 and 7-6 in the No Pretreatment Data Package, and Tables 10-6 and 10-7 of the TPA Data Package. These emissions appear to correspond to flow streams 702 and 706 (No Pretreatment and TPA). We would like confirmation of this assumption, and we request simplified flow diagrams of the vitrification processes, identifying the points at which atmospheric releases occur. Additionally, we request clarification of the locations of any external release points, the volumetric flow rate and temperature of the release, and the emission point height and geometry.

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MEMORANDUM

TO: John Horton
John Shrock

February 15,1995
95-DM-006

FROM: Dave Murray

SUBJECT: ENGINEERING INFORMATION REQUESTS

In response to your inquiry we are enclosing the completed Engineering Information Request Numbers 003-016. Should you have any questions, please contact me at (509) 736-0616.

cc: Project File

Attachments: Engineering Information Request Numbers 003-016

DM:CCM:ns

ENGINEERING DATA REQUEST 6

REQUESTED BY: J SHROCK/ ESE

SUBJECT: HAPS

See response to data request number 3.

Request Number 007

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: ESE John Horton/John Shrock

Date: 12/13/94

Phone Number: (509) 375-6162/ (904) 332-3318 Ext. 6607

Fax Number: (509) 375-5446/ (904) 333-6631

Request Information: See attached

Need Date: 12/20/94

Response: See attached

Data Source/Accuracy:

Prepared By: J. Goodwin, C. Henderson

Date Sent/Faxed: 02/17/95

Concurrence: Marc Nelson - Deputy Project Manager

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ENVIRONMENTAL SCIENCE & ENGINEERING, INC.
MEMORANDUM

TO: Dave Murray, JEG
FROM: John Horton

DATE: December 13, 1994

SUBJECT: Engineering Data Request for Air Quality Impacts Analysis

Attached is a list of data requested for Air Quality Impacts analysis. The ESE Air Quality Team in Gainesville, Florida has reviewed the Westinghouse Engineering Data Packages and drawn a number of assumptions. Those assumptions are outlined in the enclosed document with requests for clarification where necessary.

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ENGINEERING DATA REQUEST 007

REQUEST BY: JOHN SHROCK/ESE

SUBJECT: COOLING TOWERS

Review of the flow sheets and equipment lists indicate that only non-contact process water used in heat exchangers goes to the cooling tower and thus emissions should be primarily water.

Cooling towers are frequently dosed at the part per million level with mildew and corrosion inhibitors. These chemicals are standard additives to cooling towers and will be present in the emissions in very small quantities. ESE should use typical values for other cooling towers for these emissions.

MEMORANDUM

TO: John Horton
John Shrock

February 15,1995
95-DM-006

FROM: Dave Murray

SUBJECT: ENGINEERING INFORMATION REQUESTS

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cc: Project File

Attachments: Engineering Information Request Numbers 003-016

DM:CCM:ns

Request Number 008

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: ESE John Horton/John Shrock

Date: 12/13/94

Phone Number: (509) 375-6162/ (904) 332-3318 Ext. 6607

Fax Number: (509) 375-5446/ (904) 333-6631

Request Information: See attached

Need Date: 12/20/94

Response: See attached

Data Source/Accuracy:

Prepared By: J. Goodwin, C. Henderson

Date Sent/Faxed:

Concurrence:
Marc Nelson - Deputy Project Manager

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ENVIRONMENTAL SCIENCE & ENGINEERING, INC.
MEMORANDUM

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FROM: John Horton

DATE: December 13, 1994

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study, or are we to consider all candidate locations that have been proposed? We request guidance on this issue.

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9. We request a quantification of fugitive dust releases during construction of the retrieval/transfer facilities, or an opinion that these releases need not be analyzed.

10. Significant quantities of concrete are specified for construction activities. Will batch plants be built onsite to produce the concrete? If so, the location and emissions of these activities are requested. This should include emissions resulting from activities resulting from onsite mining, handling, and transport of raw materials.

11. We request clarification of the retrieval/transfer operations construction schedules. In particular, will the transfer pipelines be built in entirety before waste retrieval operations begin, or will piping be constructed as required during the project duration?

12. The Waste Retrieval/Transfer engineering package gives emissions of pollutants for the construction activities, but does not specify the proportions that result from construction of pipelines and from the construction of retrieval equipment. We request that emissions be broken down for each of these activities. Additionally, we would like information on what (if any) releases can be expected from decommissioning of the tanks after they are emptied.

13. Do the construction emissions given in the Retrieval/Transfer data package include releases from barrier construction?

14. Several retrieval methods are discussed in the data package. Do the retrieval emissions given represent one particular

MEMORANDUM

TO: John Horton
John Shrock

February 15,1995
95-DM-006

FROM: Dave Murray

SUBJECT: ENGINEERING INFORMATION REQUESTS

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cc: Project File

Attachments: Engineering Information Request Numbers 003-016

DM:CCM:ns

ENGINEERING DATA REQUEST 008

REQUESTED BY : JOHN SHROCK/ESE

SUBJECT: SITING

A most probable site, designated as site C in the siting studies, located in the 200 East area will be used for the EIS. Site locations are shown in the site plans located in the engineering data packages.

Request Number 009

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: ESE JOHN SHROCK JOHN HORTON Date: 12-13-94

Phone Number: 904 - 332 - 3318 EXT 6607 (509-375-6162) Fax Number: 904 - 333 - 6631 (509-375-5446)

Requested Information: SEE ATTACHED

Need Date: 12-20-94

Response:

Data Source/Accuracy:

Prepared By: Colin Henderson Date Sent/Faxed:

Concurrence: Marc E. Nelson
Marc Nelson - Deputy Project Manager

Request Number 009

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: ESE John Horton/John Shrock

Date: 12/13/94

Phone Number: (509) 375-6162/ (904) 332-3318 Ext. 6607

Fax Number: (509) 375-5446/ (904) 333-6631

Request Information: See attached

Need Date: 12/20/94

Response: See attached

Data Source/Accuracy: Information is from the No Separations and the TPA packages. The information will be reviewed and updated when WHC issues their approved engineering package.

Prepared By: J. Goodwin, C. Henderson

Date Sent/Faxed: 02/17/95

Concurrence: Marc E. Nelson
Marc Nelson - Deputy Project Manager

engin\eninfrq.009

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.
MEMORANDUM

TO: Dave Murray, JEG
FROM: John Horton

DATE: December 13, 1994

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ENGINEERING DATA REQUEST 009

REQUESTED BY: JOHN SHROCK/ESE

SUBJECT: TPA STACK EMISSIONS

The TPA alternative will have a total of four stacks. Two at the HLW facility and two at the LLW facility, however, during normal operations only one stack at each facility will be an emission release point.

It is unclear from the flow sheets how emissions were calculated. WHC engineers agreed that the tables and the material balances did not agree. Both the material balances and the emission tables will change in the next release of packages. We can separate the emissions from the HLW and LLW plants using the material balances (see spreadsheet output provided for data request no. 005).

There may also be a separate ventilation exhaust point associated with the sulfur vault ventilation system (WHC engineer is checking on this per telecon 1/6/95).

Per discussion with WHC engineer on 1/12/95 the vault emissions will be pulled back through the ventilation system for the sulfur decantation vault and exhausted through the process stack.

We agree that the emissions for the two processes are unclear and are requesting clarification from WHC. Emissions for each process will be reported separately.

Request Number 010

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: ESE John Horton/John Shrock

Date: 12/13/94

Phone Number: (509) 375-6162/ (904) 332-3318 Ext. 6607

Fax Number: (509) 375-5446/ (904) 333-6631

Request Information: See attached

Need Date: 12/20/94

Response: See attached

Data Source/Accuracy:

Prepared By: J. Goodwin, C. Henderson

Date Sent/Faxed: 02/07/95

Concurrence: Marc C. Nelson
Marc Nelson - Deputy Project Manager

engin\eninfrq.010

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.
MEMORANDUM

TO: Dave Murray, JEG
FROM: John Horton

DATE: December 13, 1994

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ENGINEERING DATA REQUEST 010

REQUESTED BY: JOHN SHROCK/ESE

SUBJECT: MELTER TYPE

ESE
~~EIS~~ request clarification of the processes in the HLW stream (of the TPA Alternate) that require SO_2 and NO_X control.

The TPA Alternate flowsheets mistakenly show a fuel fired melter in the HLW system. The furnace is intended to be used is a cold cap, Joule melter. There will be no products of combustion from kerosene in this system. WHC will revise the flowsheet.

SO_2 and NO_X may still require control due to the sulphates and nitrates present in the waste.

MEMORANDUM

TO: John Horton
John Shrock

February 15,1995
95-DM-006

FROM: Dave Murray

SUBJECT: ENGINEERING INFORMATION REQUESTS

In response to your inquiry we are enclosing the completed Engineering Information Request Numbers 003-016. Should you have any questions, please contact me at (509) 736-0616.

cc: Project File

Attachments: Engineering Information Request Numbers 003-016

DM:CCM:ns

Request Number 011

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: ESE John Shrock

Date: 12/13/94

Phone Number: (904) 332-3318 Ext. 6607

Fax Number: (904) 333-6631

Request Information: Fugitive dust from Retrieval/Transfer facility construction

Need Date: 12/20/94

Response: See attached

Data Source/Accuracy: Data source is WHC's No Separations alternative engineering package. The accuracy is unknown. The data will be reviewed when WHC issues the approved engineering packages.

Prepared By: J. Goodwin, C. Henderson

Date Sent/Faxed: 02/17/95

Concurrence: Marc R. Nelson

Marc Nelson - Deputy Project Manager

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ENVIRONMENTAL SCIENCE & ENGINEERING, INC.
MEMORANDUM

TO: Dave Murray, JEG
FROM: John Horton

DATE: December 13, 1994

SUBJECT: Engineering Data Request for Air Quality Impacts Analysis

Attached is a list of data requested for Air Quality Impacts analysis. The ESE Air Quality Team in Gainesville, Florida has reviewed the Westinghouse Engineering Data Packages and drawn a number of assumptions. Those assumptions are outlined in the enclosed document with requests for clarification where necessary.

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ENGINEERING DATA REQUEST 011

REQUESTED BY: JOHN SHROCK/ESE

SUBJECT: FUGITIVE DUST FROM RETRIEVAL/TRANSFER FACILITY CONSTRUCTION

Waste Retrieval and Transfer Facilities and the Waste Sampling and Storage Facility would be constructed first and the piping would be routed as required to support retrieval throughout the retrieval (operations) period. Tank waste recovery facilities will also be constructed and relocated from tank to tank during the operations period.

Using the schedules in the Waste Retrieval and Transfer data packages the following dates were found. Construction start 1998 for Minimum Pretreatment and TPA, Retrieval Operations start 2003 for Minimum Pretreatment and TPA. These dates are the construction period of the four Waste Transfer Annexes and the Waste Storage and Sampling facility.

The coordinates for the 200West Transfer Annexes are:
1@N36,100, W75,250
1@N43,000, W75,600

The coordinates for the 200West Sampling and Storage facility is:
N37,600, W75,400

The coordinates for the 200East Transfer Annexes are:
1@N42,250, W48,200
1@N46,200, W52,900

Construction of retrieval facilities at the tank sites is intended to be a fairly level activity throughout the 19 year construction period 1998/2017.

Fugitive dust can be estimated from the attached equipment schedule.

Also see engineering information request 014.

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CONST EQUIP - DIESEL UNLESS OTHERWISE NOTED

		YR 1		YR 2		YR 3		YR 4		YR 5
		AVAIL UNITS	OPR UNITS	AVAIL UNITS	OPR UNITS	AVAIL UNITS	OPR UNITS	AVAIL UNITS	OPR UNITS	AVAIL UNITS	OPR UNITS
1 DOZER, CAT D9	460 HP	2	1.30								
3 DOZER, CAT D8	335 HP	4	1.75	1	.40	1	.40				
3 DOZER, CAT D6	165 HP			1	.28	1	.28	1	.28		
5 DOZER, UTILITY	65 HP	5	1.48	5	1.48	5	1.48	5	1.48	5	1.48
3 LOADER, CAT 966	200 HP	3	.34	6	1.54	6	1.54	6	1.54	2	.28
5 LOADER, 2CY	120 HP	4	.93	4	.93	4	.93	4	.93	4	.93
1 BACKHOE, CAT 235B	215 HP	1	.50								
5 BACKHOE, 4CY	120 HP	4	.28	4	.28	4	.28	4	.28	4	.28
5 LOADER/BACKHOE, UTILITY	65 HP	6	1.76	6	1.76	6	1.76	6	1.76	6	1.76
5 BACKHOE, UTILITY	65 HP	4	.93	4	.93	4	.93	4	.93	4	.93
1 SCRAPER, CAT 637E	460 HP	6	3.60								
3 ELEVATING SCRAPER, CAT 623E	330 HP	4	2.90	2	.60						
1 SCRAPER, TWIN ENGINE	250 HP	6	3.60								
1 TOWED VIBTATING ROLLER, GAS	50 HP	1	.65								
3 MOTOR GRADER, CAT 14G	200 HP	2	2.02	1	.60						
5 MOTOR GRADER	125 HP	4	2.04	4	2.04	4	2.04	4	2.04	4	2.04
1 COMPACTOR, CAT 815B	210 HP	1	.73								
5 COMPACTOR, GAS	40 HP	20	5.93	20	5.93	20	5.93	20	5.93	20	5.93
5 COMPACTOR, WALKING, GAS	5 HP	60	17.78	60	17.78	60	17.78	60	17.78	60	17.78
3 DUMP TRUCK, 10 YD	250 HP	8	6.50	10	8.96	10	8.96	5	1.96		
3 CONCRETE MIX TRUCKS	250 HP			4	2.59	4	2.59	4	2.59		
5 CRANE	100 TO	2	.56	2	.56	2	.56				
5 CRANE	50 TO	5	1.48	5	1.48	5	1.48	5	1.48	5	1.48
5 CRANE	25 TO	10	4.44	10	4.44	10	4.44	10	4.44	10	4.44
5 CRANE	15 TO	10	5.93	10	5.93	10	5.93	10	5.93	10	5.93
5 FORKLIFT	15 TO	4	.93	4	.93	4	.93	4	.93	4	.93
5 FORKLIFT	10 TO	4	1.20	4	1.20	4	1.20	4	1.20	4	1.20
5 FORKLIFT	6 TO	4	1.48	4	1.48	4	1.48	4	1.48	4	1.48
5 FORKLIFT	4 TO	6	2.69	6	2.69	6	2.69	6	2.69	6	2.69
5 FORKLIFT	2 TO	10	3.33	10	3.33	10	3.33	10	3.33	10	3.33
5 PUMPS, 6", ELECT	10 HP	10	1.48	10	1.48	10	1.48	10	1.48	10	1.48
5 PUMPS, 2", ELECT	5 HP	20	5.93	20	5.93	20	5.93	20	5.93	20	5.93
5 PUMPS, 1", ELECT	2 HP	40	11.85	40	11.85	40	11.85	40	11.85	40	11.85
5 AIR COMPRESSOR	600 CF	10	2.22	10	2.22	10	2.22	10	2.22	10	2.22
5 AIR COMPRESSOR	250 CF	20	7.41	20	7.41	20	7.41	20	7.41	20	7.41
5 AIR COMPRESSOR, GAS	100 CF	20	10.37	20	10.37	20	10.37	20	10.37	20	10.37
5 WELDER, GASOLINE	200 HP	80	29.63	80	29.63	80	29.63	80	29.63	80	29.63
5 WELDER, GASOLINE	90 HP	60	31.11	60	31.11	60	31.11	60	31.11	60	31.11
5 GENERATORS	250 KW	10	1.48	10	1.48	10	1.48	10	1.48	10	1.48
5 GENERATORS	100 KW	10	1.48	10	1.48	10	1.48	10	1.48	10	1.48
5 GENERATORS, GAS	10 KW	15	3.33	15	3.33	15	3.33	15	3.33	15	3.33
5 GENERATORS, GAS	5 KW	20	5.93	20	5.93	20	5.93	20	5.93	20	5.93
5 GENERATORS, GAS	.50 KW	20	8.89	20	8.89	20	8.89	20	8.89	20	8.89
5 LIGHT PLANT, GAS	10 KW	50	25.93	50	25.93	50	25.93	50	25.93	50	25.93
5 LOW BOY WITH TRACTOR	400 HP	2	1.39	2	1.39	2	1.39	2	1.39	2	1.39
5 40' FLOAT AND TRACTOR	350 HP	10	29.63	10	29.63	10	29.63	10	29.63	10	29.63
5 MECHANICS TRUCK	250 HP	6	37.82	5	37.04	5	37.04	5	37.04	5	37.04
5 FUEL/LUB TRUCK	250 HP	5	37.04	5	37.04	5	37.04	5	37.04	5	37.04
			MILES		MILES		MILES		MILES		MILES
5 PICKUP, 3/4 TON, GAS	250 HP	26	30,000	25	30,000	25	30,000	25	30,000	25	30,000
5 PICKUP, 1/2 TON, GAS	200 HP	50	30,000	50	30,000	50	30,000	50	30,000	50	30,000
5 FLATBED, 5 TON,GAS	350 HP	10	30,000	10	30,000	10	30,000	10	30,000	10	30,000
5 FLATBED, 3 TON, GAS	300 HP	20	40,000	20	40,000	20	40,000	20	40,000	20	40,000
5 WATER TANKER, 5000 GAL	300 HP	3	40,000	2	40,000	2	40,000	2	40,000	2	40,000
5 SHUTTLE BUS, GAS	250 HP	10	48,000	10	48,000	10	48,000	10	48,000	10	48,000
5 VAN, GAS	200 HP	10	72,000	10	72,000	10	72,000	10	72,000	10	72,000

MEMORANDUM

TO: John Horton
John Shrock

February 15,1995
95-DM-006

FROM: Dave Murray

SUBJECT: ENGINEERING INFORMATION REQUESTS

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Attachments: Engineering Information Request Numbers 003-016

DM:CCM:ns

Request Number 012

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: ESE John Horton/John Shrock

Date: 12/13/94

Phone Number: (509) 375-6162/ (904) 332-3318 Ext. 6607

Fax Number: (509) 375-5446/ (904) 333-6631

Request Information: See attached

Need Date: 12/20/94

Response: See attached

Data Source/Accuracy: Data source is WHC's No Separations alternative engineering package. The accuracy is unknown. The data will be reviewed when WHC issues the approved engineering package.

Prepared By: J. Goodwin, C. Henderson

Date Sent/Faxed: 02/17/95

Concurrence: Marc E. Nelson
Marc Nelson - Deputy Project Manager

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ENVIRONMENTAL SCIENCE & ENGINEERING, INC.
MEMORANDUM

TO: Dave Murray, JEG
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ENGINEERING DATA REQUEST 012

REQUESTED BY: JOHN SHROCK/ESE

SUBJECT: BATCH PLANT

Will batch plants be built onsite to produce the concrete (for construction)? If so, where will they be located and what are the emissions.

Answer:
Batch plants will be brought in and erected in an area west of 200 East. The area is shown on the site maps and is alternately called a borrow pit and an aggregate pit. On direct questioning WHC has stated that is actually an aggregate pit.

Tables for both the No Separations and the Minimum Separation (TPA) alternatives are attached which provide fugitive dust emissions for clearing and grubbing of the overall site, construction for the overall site, aggregate pit excavation and batch plant operation.

Cement will be imported in bulk. Sand will also be imported but a local source has not been identified.

Note: No Separations page B4-10 and TPA page C-51 of the formal draft issues are provided.

10 Fugitive Emissions (metric tons)		
	No Pretreatment	TPA
I. Clear and Grub		
A) Bulldozer grading	5.1	
B) Paved road traffic	7.8	
II. Construction Site Excavation		
A) Unpaved road traffic	176	
B) Scraper unloading	2.6	
C) Dozer grading	6.4	
D) Wind Erosion (storage & waste piles)	42.1	
III. Aggregate Borrow Pit Excavation		
A) Dump truck loading, truck unloading & crusher loading	1.6	
B) Unpaved road traffic	1.4	
IV. Batch Plant Operation		
A) Dump truck unloading	Included in IIIA	
B) Batch plant operation	10.4	
C) Wind erosion (aggregate & sand piles)	0.1	
D) Paved road traffic	100.2	
E) Unpaved road traffic	0.86	
TOTAL (tonnes)	355	497[1]

Fugitive dust (PM_{10} emissions) resulting from the construction of the "No Pretreatment" and "TPA Preferred Alternative" facilities are divided into four categories of construction activities - I) clearing and grubbing, II) construction site excavation, III) aggregate borrow pit excavation and IV) batch plant operation. All equations used to estimate particulate emissions, unless otherwise indicated, are taken from the EPA Air/Superfund National Technical Guidance Study Series, "Estimation of Air Impacts from Area Sources of Particulate Matter Emissions at Superfund Sites," EPA-451/R-93-004, April 1993. This document is referred to as "Ref. Doc." throughout the calculation.

Total PM_{10} Fugitive Emissions (metric tons)		
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B) Batch plant operation	10.4	
C) Wind erosion (aggregate & sand piles)	0.1	
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TOTAL (tonnes)	355	497[1]

(1) TPA Fugitive Dust Emissions = 1.4 x No Pretreatment Emissions

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Data Source/Accuracy:

Prepared By: J. Goodwin, C. Henderson

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Marc Nelson - Deputy Project Manager

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ENGINEERING DATA REQUEST 013

REQUESTED BY: JOHN SHROCK/ESE

SUBJECT: RETRIEVAL/TRANSFER CONSTRUCTION AND OPERATION SCHEDULE

See Data Request 011

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John Shrock

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95-DM-006

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Marc Nelson - Deputy Project Manager

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ENGINEERING DATA REQUEST 014

REQUESTED BY: JOHN SHROCK/ESE

SUBJECT: CONSTRUCTION EMISSIONS DURING RETRIEVAL

ESE requests that the Waste Retrieval and Transfer construction emissions be broken down for pipeline construction and the construction of retrieval equipment (retrieval facilities?). ESE also requests information on what (if any) releases can be expected from decommissioning the tanks after they are empties.

Answer:
The Retrieval/Transfer construction will be in two phases.

1) Construction of 4 Transfer Annexes and a Sampling/Storage Building.

2) Construction of 40 or more Tank Retrieval Facilities with installation of associated transfer piping.

The Transfer Annexes and the Sampling/Storage building are substantial concrete structures while the Tank Retrieval Facilities are steel structures which will be moved from tank to tank.

The following estimate of construction emissions are based on the No Separations Alternative construction data.

Jacobs has not addressed decommissioning the tanks because it is currently out of scope.

Also see engineering information request 011.

FEB 7, 1995

NO PRETREATMENT EMISSIONS KILOGRAMS
MINIMUM PRETREATMENT EMISSIONS ARE THE SAME

PHASE I CONSTRUCTION, FOUR TRANSFER ANNEXES AND THE STORAGE/SAMPLING STATION

	CO	HC	NO_X	ALDEHYDES	SO_2	PARTICULATE
TOTAL YR 1	27,981	47,688	48,800	1,766	677	4,152
TOTAL YR 2	23,260	46,992	48,800	1,482	355	3,337
TOTAL YR 3	23,260	46,992	48,800	1,482	355	3,337
TOTAL YR 4	23,260	46,992	48,800	1,482	355	3,337
TOTAL YR 5	21,337	46,738	44,196	1,363	272	3,045
GRAND TOT	119,099	235,402	239,398	7,576	2,015	17,210

PHASE II CONSTRUCTION, TANK RETRIEVAL FACILITIES

PER YEAR, TYPICAL OF 19 YEARS FOR NO SEPARATION ALTERNATIVE AND
14 YEARS OF THE TPA ALTERNATIVE.

CO	HC	NO_X	ALDEHYPES	SO_2	PARTICULATE
2,326	4,699	4,880	148	36	334

NOTE: ESTIMATE BY JEG. BASIS IS NO SEPARATIONS ALTERNATIVE, 11/94 DRAFT, PAGE B4-3

Request Number 015

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: ESE John Horton/John Shrock

Date: 12/13/94

Phone Number: (509) 375-6162/ (904) 332-3318 Ext. 6607

Fax Number: (509) 375-5446/ (904) 333-6631

Request Information: See attached

Need Date: 12/20/94

Response: See attached

Data Source/Accuracy:

Prepared By: J. Goodwin, C. Henderson

Date Sent/Faxed: 02/17/95

Concurrence: Marc E. Nelson
Marc Nelson - Deputy Project Manager

enginleninfrq.015

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.
MEMORANDUM

TO: Dave Murray, JEG
FROM: John Horton

DATE: December 13, 1994

SUBJECT: Engineering Data Request for Air Quality Impacts Analysis

Attached is a list of data requested for Air Quality Impacts analysis. The ESE Air Quality Team in Gainesville, Florida has reviewed the Westinghouse Engineering Data Packages and drawn a number of assumptions. Those assumptions are outlined in the enclosed document with requests for clarification where necessary.

Please contact me if there are any questions. For questions that arise after this friday, December 16, please contact John Shrock or John Kuhn in the ESE Gainesville office.

study, or are we to consider all candidate locations that have been proposed? We request guidance on this issue.

7. Emissions from the vitrification processes for the TPA alternative are given (Tables 10-6 and 10-7), but are not broken down into which emissions occur from the HLW and LLW process streams. Are the waste streams from the LLW and HLW processes combined before external release? (note that emissions to HVAC from LLW processes appear to be waste stream 702 and 706 on pg 7-17/7-18 of TPA package, and from HLW processes appear to be also designated as streams 702 and 706 on page 7-39/7-40 of TPA package). If not, we request that emissions for these processes be reported separately.

8. The process description for the TPA alternative indicates that the LLW will be vitrified in a kerosene-fueled melter, while the HLW will be vitrified in a "Joule" (electric) melter. However, controls for SO_2 and NO_x are specified for the HLW process. We request clarification of the processes in the HLW stream that require SO_2 and NO_x control.

9. We request a quantification of fugitive dust releases during construction of the retrieval/transfer facilities, or an opinion that these releases need not be analyzed.

10. Significant quantities of concrete are specified for construction activities. Will batch plants be built onsite to produce the concrete? If so, the location and emissions of these activities are requested. This should include emissions resulting from activities resulting from onsite mining, handling, and transport of raw materials.

11. We request clarification of the retrieval/transfer operations construction schedules. In particular, will the transfer pipelines be built in entirety before waste retrieval operations begin, or will piping be constructed as required during the project duration?

12. The Waste Retrieval/Transfer engineering package gives emissions of pollutants for the construction activities, but does not specify the proportions that result from construction of pipelines and from the construction of retrieval equipment. We request that emissions be broken down for each of these activities. Additionally, we would like information on what (if any) releases can be expected from decommissioning of the tanks after they are emptied.

13. Do the construction emissions given in the Retrieval/Transfer data package include releases from barrier construction?

14. Several retrieval methods are discussed in the data package. Do the retrieval emissions given represent one particular

ENGINEERING DATA REQUEST 015

REQUESTED BY: JOHN SHROCK/ESE

SUBJECT: EMISSIONS FROM BARRIER CONSTRUCTION

The construction emissions in the Retrieval data package do not include releases from the construction of the barriers. We addressed this during the package reviews with WHC. Barriers will not be a component of any alternative; they are being deleted.

MEMORANDUM

TO: John Horton
John Shrock

February 15,1995
95-DM-006

FROM: Dave Murray

SUBJECT: ENGINEERING INFORMATION REQUESTS

In response to your inquiry we are enclosing the completed Engineering Information Request Numbers 003-016. Should you have any questions, please contact me at (509) 736-0616.

cc: Project File

Attachments: Engineering Information Request Numbers 003-016

DM:CCM:ns

Request Number 016

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: ESE John Horton/John Shrock

Date: 12/13/94

Phone Number: (509) 375-6162/ (904) 332-3318 Ext. 6607

Fax Number: (509) 375-5446/ (904) 333-6631

Request Information: See attached

Need Date: 12/20/94

Response: See attached

Data Source/Accuracy:

Prepared By: J. Goodwin, C. Henderson

Date Sent/Faxed: 02/17/95

Concurrence: Marc Nelson - Deputy Project Manager

engin\eninfrq.016

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.
MEMORANDUM

TO: Dave Murray, JEG
FROM: John Horton

DATE: December 13, 1994

SUBJECT: Engineering Data Request for Air Quality Impacts Analysis

Attached is a list of data requested for Air Quality Impacts analysis. The ESE Air Quality Team in Gainesville, Florida has reviewed the Westinghouse Engineering Data Packages and drawn a number of assumptions. Those assumptions are outlined in the enclosed document with requests for clarification where necessary.

Please contact me if there are any questions. For questions that arise after this friday, December 16, please contact John Shrock or John Kuhn in the ESE Gainesville office.

study, or are we to consider all candidate locations that have been proposed? We request guidance on this issue.

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12. The Waste Retrieval/Transfer engineering package gives emissions of pollutants for the construction activities, but does not specify the proportions that result from construction of pipelines and from the construction of retrieval equipment. We request that emissions be broken down for each of these activities. Additionally, we would like information on what (if any) releases can be expected from decommissioning of the tanks after they are emptied.

13. Do the construction emissions given in the Retrieval/Transfer data package include releases from barrier construction?

14. Several retrieval methods are discussed in the data package. Do the retrieval emissions given represent one particular

retrieval method, an average of several, or the worst-case situation? It is likely that emissions would vary depending on the retrieval method being used.

ENGINEERING DATA REQUEST 016

REQUESTED BY: JOHN SHROCK/ESE

SUBJECT: RETRIEVAL METHOD

Several retrieval methods are discussed in the data package. Do the retrieval methods given represent one particular retrieval method, an average of several, or worst-case situation?

Answer:

The air emissions are based on sluicing operations and should be valid (slightly conservative) for other combination of retrieval methods planned. Emissions should be slightly lower for arm based retrieval methods.

The general approach envisioned by WHC is to use hydraulic sluicing as the primary method to remove the waste from the tanks. If 99% of the material cannot be removed by this method they will deploy a mechanical arm to complete the job. There is no backup to the mechanical arm if it can't complete removal to 99%.

MEMORANDUM

TO: John Horton
John Shrock

February 15,1995
95-DM-006

FROM: Dave Murray

SUBJECT: ENGINEERING INFORMATION REQUESTS

In response to your inquiry we are enclosing the completed Engineering Information Request Numbers 003-016. Should you have any questions, please contact me at (509) 736-0616.

cc: Project File

Attachments: Engineering Information Request Numbers 003-016

DM:CCM:ns

Request Number 017

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Joan Young

Date: 12/20/94

Phone Number: 946-7112

Fax Number: 943-6812

Request Information: See Attached

Need Date: 1/15/94

Response: See Attached - No health impacts are to be calculated for construction emissions.

Data Source/Accuracy: Data Package - Preliminary

Prepared By: C. Henderson

Date Sent/Faxed: 1/27/95

Concurrence: Marc Nelson

Marc Nelson - Deputy Project Manager

engin\eninfrq.017

Date: December 20, 1994

To: Dave Murray

From: J.J. Davis

Subject: DATA REQUEST FOR RISK ASSESSMENT MODELING

We have identified some several data needs which are described in the remainder of this memo.

1. ELECTRONIC COPY OF NONRADIOLOGICAL ROUTINE RELEASES FROM THE VITRIFICATION PLANT

The data package for "No Pretreatment" (pp. B4-4 to B4-9) contains a table showing the nonradiological routine releases from the vitrification plant. However, the print size is too small to read. We need a readable copy of this table, preferably in electronic form.

2. SIMPLIFIED SCHEMATIC FOR THE "NO PRETREATMENT AND TPA" ALTERNATIVES ILLUSTRATING FACILITY CONFIGURATIONS, LOCATIONS, AND POINTS OF RELEASE FOR EMISSIONS TO THE STACK(S) AND VENT(S) (PREFERABLY OVERLAID OVER A SITE MAP)

The risk calculation requires knowledge of the offgas volumes and concentrations at the point of release to the environment. This release point depends on the facility configuration. For example, if LLW Pretreatment and LLW vitrification are combined in one facility with one stack, the stack locations and concentrations will be different than if these processes are located in separate facilities. This same logic applies to emissions from ventilation ducts.

For the purposes of assessing risk from routine operations, a simplified process flow diagram that schematic that illustrates the systems configuration (e.g. shows the waste tanks, process buildings, outside storage tanks, transfer lines, LLW disposal vault, HLW storage facility, and their associated stacks and vents) is required. This schematic should primarily be a visual representation of the facilities, rather than a process flow diagram. Each point of release should be indicated on the schematic. The volume and concentration of effluents should be specified at each point of routine release to the environment in a corresponding table(s).

3. SUMMARY OF SHIELDING AND MAINTENANCE REQUIREMENTS

Please specify shielding and maintenance requirements for each major process activity or facility in a summary table. This table will allow ASI determine where there is potential for routine exposure to chemicals or radioactivity. For example, indicate if the vitrification facilities are fully shielded. Also, state whether the facility will be remotely or contact maintained (e.g., occupational exposures will much lower than if the facilities are lightly shielded or contact maintained). An example table for this information is provided as attachment One.

4. IDENTIFY MAXIMALLY EXPOSED WORKER AND ASSOCIATED DOSE OR PROVIDE SUPPORTING DATA TO ALLOW IDENTIFICATION OF MAXIMALLY EXPOSED WORKER

The maximally exposed worker must be identified. If this cannot be specified directly, then the supporting information requested below should be provided.

Operational or maintenance procedures should be briefly described for the activities with significant potential for worker exposure to chemicals or radionuclides. An example chart is provided as Attachment Two.

Some specific questions to address include:

a. How often will the melter be changed and will it remain in the vitrification plant until closure or will it be replaced and decontaminated?
b. If it removed and decontaminated, will there be any exposures to chemicals or radionuclides.
c. How often will the offgas treatment systems be cleaned and maintained?
d. If there is cleanout of scale in the melter offgas treatment system, will it require contact maintenance?
e. Will there be operator contact during retrieval of the waste when the sluicing equipment is being introduced or removed from the tanks?

5. POST REMEDIATION EMISSIONS

a. Will there be emissions to the air from the LLW Disposal vaults or from the tank residuals? For example, will radon gas or other gases be emitted that result from decay of the LLW?
b. Will there be emissions to the air from the HLW during storage awaiting transportation to Yucca Mountain?

6. SPECIFY THE EVAPORATOR CAPACITY DURING OPERATION AND THE RADIOACTIVE AND NON-RADIOACTIVE RELEASES FROM THE EVAPORATOR INCLUDING TRITIUM RELEASES. ALSO SPECIFY THE DURATION OF EVAPORATOR OPERATION DURING THE LIFE OF THE TWRS PROJECT.

7. PROVIDE RATIONALE FOR INCLUDING ONLY Cs, Sr, and I-129 AS ROUTINE RELEASES FROM THE MINIMAL PRETREATMENT AND TPA ALTERNATIVE.

Table 6-5 attached lists emissions from the retrieval and transfer of waste for the TWRS EIS alternatives. Only the radionuclides listed above are present. This does not seem to be correct.

8. MSDS DATA SHEETS (NOT NEEDED)

We have considered the JEG request to identify the MSDS needed for the risk assessment effort. We currently believe that the MSDS cannot provide us with useful information because the chemicals identified are in solution (listed as ions, not chemical compounds). MSDS do not exist for these chemical forms.

Attachment One

OUTLINE OF PROPOSED SUMMARY TABLE FOR SHIELDING AND MAINTENANCE SUMMARY

Action Alternative	TWRS PROCESS SHIELDING AND MAINTENANCE REQUIREMENTS								
	Transfer Liquids Out of Tank	Evaporate Liquids	Transfer Waste to Pretreat	Pretreat Waste	Additional Waste Transfer	LLW Vitrification	HLW Vitrification	Onsite Waste Storage	Cover Tanks with Multi-Layer Barrier
1. TPA Preferred									
2. No Pretreatment									

Attachment Two

ACTIVITY	ACTIVITIES RESULTING IN MAXIMUM WORKER EXPOSURES	DURATION OF EXPOSURE	INTERNAL AND EXTERNAL DOSE (BY CONSTITUENT)
Retrieval	Installation and removal of sluicing arm	x persons for approximately x hours/year exposed to gamma radiation	
Pretreatment	Installation and removal of ion exchange resins		
Vitrification	Routine melter and offgas system clean out		
LLW Disposal	Deposition of canister into vault		
Example chart only			

cc: Alex Nazarali
Joan Young
Andy Stanley
Reed Kaldor
John Horton
John Shrock
Mike Harker
File 587.2.11.2.2
File 587.2.11.2.5

DATA REQUEST 17

REQUESTED BY : J. YOUNG /ASI

ELECTRONIC COPY OF NONRADIOLOGICAL ROUTING RELEASES FROM THE VITRIFICATION PLANT.

The pages referenced No Pretreatment pages B4-4 to B4-9 are the construction emission estimates broken down by year. Attached are 11 x 17 copies of the pages that are slightly better, some pages are legible. These breakdowns are summarized on an annual basis on page B4-3.

Year 1 of Construction

Hanford Waste Vitrification Project - Environmental Impact Statement   Fluor Daniel Environmental Services

Construction Equipment Non-Radiological Emissions Estimates contract #04-436303-2013-052

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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Years 2-4 of Construction

Hanford Waste Vitrification Project - Environmental Impact Statement Fluor Daniel Environmental Services
Construction Equipment Non-Radiological Emissions Estimates contract #04-436303-2013-052

Equipment Description	Rated Power (hp)	AP-42 Category	Number of Units	Total Usage	emission factor units	Carbon Monoxide CO factor	Carbon Monoxide CO emissions (kg)	Exhaust Hydrocarbons Exh HC factor	Exhaust Hydrocarbons Exh HC emissions (kg)	Fugitive Hydrocarbons Fug HC factor	Fugitive Hydrocarbons Fug HC emissions (kg)	Nitrogen Oxides as NOx NOx factor	Nitrogen Oxides as NOx NOx emissions (kg)	Aldehydes as HCHO Aldehydes factor	Aldehydes as HCHO Aldehydes emissions (kg)	Sulfur Oxides as SO2 SOx factor	Sulfur Oxides as SO2 SOx emissions (kg)	Particulate Matter Particulate factor	Particulate Matter Particulate emissions (kg)
D6 Dozer	335	wheeled dozer D	1	920 hr	g/hr	616.1	731.443	86.64	79.9[illegible]	-	0	1819	1734.03	29.5	27.14	-	-	73	69
966 FE Loader	200	wheeled loader D	4	8160 hr	g/hr	239.1	2131.17	113.2	923.462	-	0	834.2	7002.15	10.8	133.403	-	-	27.9	633.664
10 cy Dump Truck	330	off highway truck D	10	12730 hr	g/hr	814.1	10321	86.64	1103.43		0	1819	24049	31	649.33	-	-	116	1474.68
Cat 623E Scraper	330	scraper D	4	610 hr	g/hr	361.3	346.396	116.2	71.1713	-	0	1741	1061.15	65	39.63	-	-	184	113.24
Cat 14G Motor Grader	200	motor grader D	1	130 hr	g/hr	62.46	10.269	17.07	2.7103	-	0	324.4	48.6643	3.54	0.453	-	-	27.2	4.355
¾ ton Pickup	230	LDGT1	1	3000 mi	g/mi	10.33	30.33	0.71	2.43	0.39	1.77	7.06	2.11	-	-	-	-	-	-
Cat D6 Dozer	165	wheeled dozer D	1	1110 hr	g/hr	816.6	1674.43	86.94	137.87	-	0	1819	3419.38	29.5	33.395	-	-	73	133.73
5 cy Concrete Mixer Trucks	330	off highway truck D	4	16400 hr	g/hr	816.6	13721.6	86.64	1431.91		0	1819	31737.9	31	836.8	-	-	116	1948.8
Totals			36		No Pretreatment Baseline		24136.1		3408.24		1.77		49060.3		1100.03		1332.1		4342.39

type description: LDG - light duty gasoline

5 Year Duration of Construction

Hanford Waste Vitrification Project - Environmental Impact Statement Fluor Daniel Environmental Services
Construction Equipment Non-Radiological Emissions Estimates contract #04-436303-2013-052

Equipment Description	Rated Power (hp)	AP-42 Category	Number of Units	Total Usage	emission factor units	Carbon Monoxide CO factor	Carbon Monoxide CO emissions (kg)	Exhaust Hydrocarbons Exh HC factor	Exhaust Hydrocarbons Exh HC emissions (kg)	Fugitive Hydrocarbons Fug HC factor	Fugitive Hydrocarbons Fug HC emissions (kg)	Nitrogen Oxides as NOx NOx factor	Nitrogen Oxides as NOx NOx emissions (kg)	Aldehydes as NCHO Aldehydes factor	Aldehydes as NCHO Aldehydes emissions (kg)	Sulfur Oxides as SO2 SOx factor	Sulfur Oxides as SO2 SOx emissions (kg)	Particulate Matter Particulate factor	Particulate Matter Particulate emissions (kg)
Utility Dozer	65	wheeled dozer D	5	18000 hr	g/hr	816.8	13069	66.86	1189.44	-	0	1819	30226.6	29.5	472	-	-	73	1200
Utility Loader/Backhoe	65	wheeled loader D	6	19000 hr	g/hr	239.6	4933.02	113.2	2330.33	-	0	152.3	16303.6	18.8	337.2	-	-	77.9	1480.1
Backhoe - 1 cy	65	wheeled loader D	4	10000 hr	g/hr	239.6	2393.8	113.2	1131.3	-	0	152.3	8181.9	18.8	181	-	-	77.9	779
Backhoe - 2 cy	120	wheeled loader D	2	3000 hr	g/hr	239.6	718.74	113.2	339.38	-	0	152.3	2374.37	18.8	36.4	-	-	77.9	233.7
Loader - 3 cy	120	wheeled loader D	6	10000 hr	g/hr	239.6	2393.8	113.2	1131.3	-	0	152.3	8181.9	18.8	181	-	-	77.9	779
Loader - 4 cy	200	wheeled loader D	2	3000 hr	g/hr	239.6	718.74	113.2	339.38	-	0	152.3	2374.37	18.8	36.4	-	-	77.9	233.7
Crane - 15 ton	150	miscellaneous D	10	64000 hr	g/hr	306.4	19607.7	69.33	4438.4	-	0	767.3	49107.2	13.9	889.6	-	-	63.2	4044.8
Crane - 25 ton	145	miscellaneous D	10	48000 hr	g/hr	306.4	14703.8	69.33	3328.8	-	0	767.3	36830.4	13.9	667.2	-	-	63.2	3033.6
Crane - 50 ton	200	miscellaneous D	3	16000 hr	g/hr	306.4	4901.92	69.33	1109.6	-	0	767.3	12276.8	13.9	222.4	-	-	63.2	1011.2
Crane - 100 ton	300	miscellaneous D	2	6000 hr	g/hr	306.4	1838.22	69.33	416.1	-	0	767.3	4603.8	13.9	83.4	-	-	63.2	379.2
Forklift - 2 ton	60	wheeled loader D	10	56000 hr	g/hr	239.6	14336.3	113.2	6337.33		0	152.3	43018.6	18.8	1052.8	-	-	77.9	4363.4
Forklift - 4 ton	70	wheeled loader D	6	29000 hr	g/hr	239.6	7227.92	113.2	3141.93	-	0	152.3	24487.5	18.8	545.2	-	-	77.9	2239.6
Forklift - 6 ton	100	wheeled loader D	4	16000 hr	g/hr	239.6	4133.21	113.2	1810.72	-	0	152.3	13731	18.8	300.8	-	-	77.9	1244.4

Equipment Description	Rated Power (hp)	AP-42 Category	Number of Units	Total Usage	emission factor units	Carbon Monoxide CO factor	Carbon Monoxide CO emissions (lb)	Exhaust Hydrocarbons Exh HC factor	Exhaust Hydrocarbons Exh HC emissions (lb)	Fugitive Hydrocarbons Fug HC factor	Fugitive Hydrocarbons Fug HC emissions (lb)	Nitrogen Oxides as NOx NOx factor	Nitrogen Oxides as NOx NOx emissions (lb)	Aldehydes as HCHO Aldehyde factor	Aldehydes as HCHO Aldehyde emissions (lb)	Sulfur Oxides as SO2 SOx factor	Sulfur Oxides as SO2 SOx emissions (lb)	Particulate Matter Particulate factor	Particulate Matter Particulate emissions (lb)
Forklift - 30 ton	130	wheeled loader D	4	13000 hr	g/hr	239.4	3374.34	113.3	1431.18	-	0	531.3	10134.3	19.8	344.4	-	-	77.9	1013.7
Forklift - 15 ton	130	wheeled loader D	4	10000 hr	g/hr	239.4	2593.8	113.3	1101.5	-	0	434.3	3301.9	18.1	316	-	-	77.9	779
Mobile Crusher	133	motor grader D	4	33000 hr	g/hr	61.46	1306.32	10.07	392.34	-	0	334.4	7132.46	3.34	121.11	-	-	27.3	409.1
Pumps - 1"	3	IC gasoline	40	12000 hr	g/hp * hr	199	20944	6.68	1710.03	2.99	363.44	3.18	1320.96	0.22	36.33	-	-	0.327	83.312
Pumps - 2"	5	IC gasoline	20	64000 hr	g/hp * hr	199	63490	6.68	2137.6	2.99	954.8	3.18	1651.3	0.22	70.4	-	-	0.327	104.64
Pumps - 4"	10	IC gasoline	10	16000 hr	g/hp * hr	199	31840	6.68	1068.8	2.99	478.4	3.18	825.6	0.22	35.2	-	-	0.327	52.32
Totals			133		No Pretreatment Baseline		343942		33122.1		2209.44		39014		5793.6		5179.8		3634

type footnotes: EDG - light duty gasoline

5 Year Duration of Construction

Hanford Waste Vitrification Project - Environmental Impact Statement Fluor Daniel Environmental Services
Construction Equipment Non-Radiological Emissions Estimates contract #04-436303-2013-052

Equipment Description	Rated Power (hp)	AP-42 Category	Number of Units	Total Usage	emission factor units	Carbon Monoxide CO factor	Carbon Monoxide CO emissions (lbs)	Exhaust Hydrocarbons Exh HC factor	Exhaust Hydrocarbons Exh HC emissions (lbs)	Fugitive Hydrocarbons Fug HC factor	Fugitive Hydrocarbons Fug HC emissions (lbs)	Nitrogen Oxides as NOx factor	Nitrogen Oxides as NOx emissions (lbs)	Aldehydes as HCHO Aldehydes factor	Aldehydes as HCHO Aldehydes emissions (lbs)	Sulfur Oxides as SO2 SOx factor	Sulfur Oxides as SO2 SOx emissions (lbs)	Particulate Matter Particulate factor	Particulate Matter Particulate emissions (lbs)
Air Comp - 100 cfm	30	IC gasoline	30	112000 hr	g/hp/hr	199	1114400	6.68	37404	2.99	16744	3.16	28996	0.22	1232	-	-	0.327	1831.2
Air Comp - 250 cfm	90	IC diesel	30	90000 hr	g/hp/hr	3.03	73816	1.13	8824	0.92	164	14	105800	0.31	1512	-	-	1	7500
Air Comp - 600 cfm	180	IC diesel	10	36000 hr	g/hp/hr	3.03	13099.8	1.13	4111.4	0.92	66.4	14	42480	0.31	907.2	-	-	1	4320
Welder - 200 amp	100	IC gasoline	60	336000 hr	g/hp/hr	199	6686400	6.68	224424	2.99	100464	3.16	173376	0.22	7392	-	-	0.327	10987.2
Welder - 400 amp	200	IC gasoline	60	320000 hr	g/hp/hr	199	12736000	6.68	427520	2.99	191360	3.16	330240	0.22	14080	-	-	0.327	20944
Generator - 0.5 kW	1	IC gasoline	30	96000 hr	g/hp/hr	199	95520	6.68	3206.4	2.99	1433.3	3.16	2476.8	0.22	105.6	-	-	0.327	156.96
Generator - 5 kW	30	IC gasoline	30	64000 hr	g/hp/hr	199	637440	6.68	21395.2	2.99	9563.6	3.16	16524.8	0.22	704.0	-	-	0.327	1047.36
Generator - 10 kW	30	IC gasoline	13	26000 hr	g/hp/hr	199	258960	6.68	8690.6	2.99	3885.3	3.16	6715.2	0.22	286.0	-	-	0.327	425.44
Generator - 100 kW	73	IC diesel	10	10000 hr	g/hp/hr	3.03	3636	1.13	1356	0.92	24	14	14000	0.31	232	-	-	1	1500
Generator - 150 kW	130	IC diesel	10	16000 hr	g/hp/hr	3.03	7272	1.13	2712	0.92	48	14	28000	0.31	504	-	-	1	2400
Light Plants - 10 kW	30	IC gasoline	30	280000 hr	g/hp/hr	199	1116400	6.68	37464	2.99	16744	3.16	28996	0.22	1232	-	-	0.327	1831.2
Compressor - Walk	3	IC gasoline	60	192000 hr	g/hp/hr	199	191040	6.68	6412.8	2.99	2870.4	3.16	4943.6	0.22	211.2	-	-	0.327	313.92
Compressor - Bike	30	IC gasoline	30	64000 hr	g/hp/hr	199	509440	6.68	17100.8	2.99	7654.4	3.16	13190.4	0.22	563.2	-	-	0.327	837.12
Total			995		No Pretreatment Baseline		22363434		750133		341041		630146		27230.4		1320.9		35130.3

type description LDG light duty gasoline

5 Year Duration of Construction

Hanford Waste Vitrification Project - Environmental Impact Statement Fluor Daniel Environmental Services
Construction Equipment Non-Radiological Emissions Estimates contract #04-436303-2013-052

Equipment Description	Rated Power (hp)	AP-42 Category	Number of Units	Total Usage	emission factor units	Carbon Monoxide CO factor	Carbon Monoxide CO emissions (kg)	Exhaust Hydrocarbons Exh HC factor	Exhaust Hydrocarbons Exh HC emissions (kg)	Fugitive Hydrocarbons Fug HC factor	Fugitive Hydrocarbons Fug HC emissions (kg)	Nitrogen Oxides as NOx NOx factor	Nitrogen Oxides as NOx NOx emissions (kg)	Aldehydes as HCHO Aldehydes factor	Aldehydes as HCHO Aldehydes emissions (kg)	Sulfur Oxides as SO2 SOx factor	Sulfur Oxides as SO2 SOx emissions (kg)	Particulate Matter Particulate factor	Particulate Matter Particulate emissions (kg)
[illegible] Pickup	200	LDGT1	30	1600000 mi	g/mi	10.25	16400	0.81	1296	0.39	944	1.06	1696	-	-	-	-	-	-
[illegible] Pickup	230	LDGT1	23	400000 mi	g/mi	10.25	8200	0.81	648	0.39	472	1.06	848	-	-	-	-	-	-
3 ton Flat bed	300	HDGV	20	800000 mi	g/mi	16.16	12928	1.42	1136	1.39	1272	3.1	4080	-	-	-	-	-	-
3 ton Flat bed	330	HDGV	19	330000 mi	g/mi	16.16	3131.2	1.42	454.1	1.39	308.8	3.1	1977	-	-	-	-	-	-
40" Flat and Tractor	330	HDDV	18	330000 mi	g/mi	1.67	2774.4	2.33	809.6	-	0	11.44	3660.8	-	-	-	-	-	-
Low Boy with Tractor	400	HDDV	2	15000 mi	g/mi	1.67	150.03	2.33	31.93	-	0	11.44	171.6	-	-	-	-	-	-
Shuttle Bus	230	LDGT1	10	480000 mi	g/mi	10.25	4920	0.81	388.8	0.39	283.2	1.06	508.8	-	-	-	-	-	-
Van	300	LDGT1	10	720000 mi	g/mi	10.25	7380	0.81	583.2	0.39	424.8	1.06	763.2	-	-	-	-	-	-
Fuel/Service Truck	230	LDDT	3	400000 mi	g/mi	1.33	612	0.43	232	-	0	1.09	436	-	-	-	-	-	-
Mechanic's Truck	230	LDDT	3	400000 mi	g/mi	1.33	612	0.43	232	-	0	1.09	436	-	-	-	-	-	-
Water Truck	300	HDDV	2	90000 mi	g/mi	1.67	693.6	2.33	202.4	-	0	11.44	913.2	-	-	-	-	-	-
Totals			147		No Protectional Baseline		39821.3		6060.31		3904.1		13147.6		0		2196.4		0

type description LDO - light duty gasoline

Request Number 018

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Joan Young

Date: 12/20/94

Phone Number: 946-7112

Fax Number: 943-6812

Request Information: Simplified Schematic for the "No Pretreatment and TPA" Alternatives illustrating facility configurations, locations, and points of release for emissions to the stack(s) and vent(s) (preferably overlaid over a Site map). (See Attached)

Need Date: 1/15/95

Response: See Attached

Data Source/Accuracy: Data Packages - Preliminary

Prepared By: C. Henderson

Date Sent/Faxed: 1/27/95

Concurrence: Marc Nelson

Marc Nelson - Deputy Project Manager

engin\eninfrq.018

ASI Memorandum December 21, 1994

To: Dave Murray, JEG

From: J.J. Davis, ASI

Subject: DATA REQUEST FOR RISK ASSESSMENT MODELING

We have identified some data needs which are described in the remainder of this memo.

1. ELECTRONIC COPY OF NONRADIOLOGICAL ROUTINE RELEASES FROM THE VITRIFICATION PLANT

The data package for "No Pretreatment" (pp. B4-4 to B4-9) contains a table showing the nonradiological routine releases from the vitrification plant. However, the print size is too small to read. We need a readable copy of this table, preferably in electronic form.

2. SIMPLIFIED SCHEMATIC FOR THE "NO PRETREATMENT AND TPA" ALTERNATIVES ILLUSTRATING FACILITY CONFIGURATIONS, LOCATIONS, AND POINTS OF RELEASE FOR EMISSIONS TO THE STACK(S) AND VENT(S) (PREFERABLY OVERLAID OVER A SITE MAP)

The risk calculation requires knowledge of the off-gas volumes and concentrations at the point of release to the environment. This release point depends on the facility configuration. For example, if LLW pretreatment and LLW vitrification are combined in one facility with one stack, the stack locations and concentrations will be different than if these processes are located in separate facilities. This same logic applies to emissions from ventilation ducts.

For the purposes of assessing risk from routine operations, a simplified process flow diagram that illustrates the systems configuration (e.g. shows the waste tanks, process buildings, outside storage tanks, transfer lines, LLW disposal vault, HLW storage facility, and their associated stacks and vents) is required. This schematic should primarily be a visual representation of the facilities, rather than a process flow diagram. Each point of release should be indicated on the schematic. The volume and concentration of effluents should be specified at each point of routine release to the environment in a corresponding table(s).

3. SUMMARY OF SHIELDING AND MAINTENANCE REQUIREMENTS

Please specify shielding and maintenance requirements for each major process activity or facility in a summary table. This table will allow ASI to determine where there is potential for routine exposure to chemicals or radioactivity. For example, indicate if the vitrification facilities are fully shielded. Also, state whether the facility will be remotely or contact maintained (e.g., occupational exposures will be much lower than if the facilities are lightly shielded or contact maintained). An

DATA REQUEST 18

REQUESTED BY: J YOUNG/ASI

SIMPLIFIED SCHEMATIC

A simplified schematic and block flow diagram is still in work. As an interim source of information stack location, height and release information is provided for the TPA and No Pretreatment alternatives. This is identical information provided to ESE and we will update both ASI and ESE as additional information becomes available.

AIR DATA REQUEST PACKAGE

1A. It is not reasonable to assume that there will be no release of toxic air pollutants and volatile hazardous air pollutants from the transfer and treatment processes.

WHC was requested to supply air emission data for each alternative in response to JEG data request section 3.1.

The following is our understanding of what is included in the Waste Retrieval and Transfer, Minimal Pretreatment, and TPA data packages with regard to air emissions.

> Waste Retrieval and Transfer- Table 6-4 Non Rad Operating Emissions, Table 6-5 Radiological Operating Emissions
>
> The non rad operating emissions were taken from engineering support data for the HDW EIS. Non radioactive emissions for waste retrieval and transfer should be estimated as a factor of the normal operating non rad emissions similar to the method outlined in the notes for table 6-5, "estimate aerosol production during sluicing operations would be on the order of 1000 times the aerosols produced during normal operations".
>
> Minimal Pretreatment - Table 7-5 Non Rad Operating Emissions, Table 7-6 Radiological Operating Emissions. Table 7-5 and Table 7-6 do not agree with material balance in appendix of document.
>
> TPA Alternative - Table 10-6 Non Rad Operating Emissions, Table 10-7 Radiological Operating Emissions. Table 10-6 and 10-7 do not agree with material balance.
>
> The Minimal Pretreatment and TPA tables give the overall emissions. We will have to estimate the emission rates using the material balance and the nominal plant operating rate for average emissions and the peak capacity for peak emission rates.
>
> Note for both Minimal Pretreatment and TPA the footnotes state "VOC emissions shown are for kerosene handling. **VOC emissions for main processes and other auxiliary sources are not currently defined.**"

History: Currently tank farm operations lack the capability to monitor and control emissions of hazardous pollutants (other than HEPA filter control of particulates). The following paragraph is from the statement of need for project W-314. Project W-314 will add tank ventilation systems with the capability to monitor and control emissions to regulatory requirements.

> The majority of the existing ventilation systems do not have the ability to control or monitor for hazardous chemical emissions, therefore Hanford cannot statistically report the quantity or identity of these emissions being exhausted into the atmosphere. The tank farm with the most monitoring equipment is the SY Farm, specifically Tank 101-SY. However, only the quantity of hydrogen, ammonia and volatile organic compounds

(VOCs) produced in this tank are monitored, although the exhausted air contains many other compounds which are not monitored. Actual characterization of the air being expelled by the ventilation systems in this study have not been performed in sufficient detail to allow a comprehensive comparison of the exhausted air constituents to the regulatory lists, such as WAC-173-460. Without this information, the exposure of site workers to possible hazardous compounds being exhausted are relatively unknown." (WHC-SD-WM-ES-284 Rev 0)

1B. The offgas temperatures for the combustion melter is in the range of an incinerator (2476 deg F). No data on retention times or decontamination factors are given. It is our understanding that additional controls will be added to the offgas treatment train if/as required to meet emission standards.

1C and 1D. The tank ventilation and process plant offgas treatment systems will have to be designed to comply with WAC-173-460 Controls for New Sources of Toxic Air Pollutants. WAC-173-460 establishes TAP emission concentration levels of three types. Risk based levels are established for Class A TAPs. Threshold based or special acceptable source impact levels are established for Class B TAPs as outlined in WAC-173-460-110.

1E. You should assume that the facility will comply with the requirements of WAC-173-400 and WAC-173-460.

3A. The Minimal Pretreatment data package received 11/8/94 has one set of flowsheets in section 4.0. The following streams are components of the stack flows for the Minimal Pretreatment data package. Streams 702,706, 645, 522, and 434.

The TPA data package received 11/8/94 has flowsheets for HLW and LLW in section 7.0 from Fluor and flowsheets for HLW and LLW from WHC in appendix A.

In section 7.0
Separations and LLW streams = 645 + 702 + 706 + 434 + 522
HLW = 645 + 702 + 706

The pretreatment emissions associated with in-tank sludge wash are not estimated in the above streams. The emissions from in-tank sludge wash will be exhausted through the DST tank ventilation systems. These emissions will be released from existing DST farms in the 200E area. I asked WHC engineer on 1/6 for confirmation that this was not in the package. He confirmed this and will look into how these emissions can be estimated. Emissions from pretreatment streams not associated with in-tank sludge washing will be exhausted through the LLW process stack.

3B. See attached sheets

3C. Per telecon with WHC engineers on 1/6/95 the following stack information was identified:

Minimum Pretreatment- The facility will have 2 stacks, one stack will be for zone 1 or process offgas and one stack will be for zones 2 and 3 ventilation. The stack for zones 2 and 3 should not exhaust anything other than clean ventilation air during normal operations. The zone 1 stack will be the source of emissions. Both stacks are 180' high. The stacks are adjacent to the west wall of the vitrification building towards the center. The stack coordinates are N41,000 , W50,750 in Hanford coordinates.

TPA alternative- Both the HLW and LLW vitrification facilities will have 2 stacks that function in the same manner as explained above for the Minimal Pretreatment case. The LLW vitrification facility process stack coordinates are W51,750 , N50,750 in Hanford coordinates. The HLW facility process stack coordinates are W50,800 , N41,000 in Hanford coordinates. The current design of the facilities has all of the stacks at 180' in height.

The heights of the nearby facilities are as follows:

Min Pre Treatment vitrification facility height 51' high

TPA LLW vitrification facility 83' high
TPA HLW vitrification facility 100' high

Using the information in the Fluor mass balances the following were calculated:

Minimal Pretreatment stack flow is a combination of streams 645+702+706+522+434 equal to 21,930 SCFM at 368 deg F.

TPA separations and LLW stack flow is a combination of streams 645+702+706+522+434 and is equal to 24,556 SCFM at 343 deg F.

TPA HLW vitrification facility stack flow is a combination of streams 645+702+706 and is equal to 3932 SCFM at 178 deg F.

5. Cooling Towers - Review of the flow sheets and equipment lists indicate that only non-contact process water used in heat exchangers goes to the cooling tower and thus emissions should be just water.

7. The TPA alternative will have four stacks total. Two at the HLW facility and two at the LLW facility, however, only one stack at each facility will be an emission release point during normal operations. I can't follow how emissions were calculated from the flow sheets. WHC engineers agreed that the tables and the material balances did not agree. Both the material balances and the emission tables will change in next release of the packages. We can separate the emissions from the HLW and LLW plants using the material balances (see spreadsheet output provided for data request no. 5).

There may also be a separate ventilation exhaust point associated with sulfur vault ventilation system (WHC engineer is checking on this per telecon 1/6).

Per discussion with WHC engineer on 1/12/95 the vault emissions will be pulled back through the ventilation system for the sulfur decantation vault and exhausted through the process stack.

9. During the review of the data packages JEG brought up the issue regarding the construction emissions in the data package. The emission estimates were taken directly from the HDW EIS. The retrieval alternative in the HDW EIS was not as construction intensive as the current retrieval alternative (waste transfer facilities, pipelines). WHC took the action to review and revise at 1/31/95 release.

I talked to WHC engineer on 1/5 to talk about this issue. We concluded that the Waste Retrieval and Transfer facilities and the Waste Sampling and Storage Facility would be constructed first and the piping would be routed as required to support retrieval throughout the retrieval period. A conservative approach may be to model the construction emissions as point sources from distributed between each of the five transfer related facilities over a shorter time period. Note also that as the packages are currently the construction emissions from Retrieval and Transfer are very small in comparison to the main alternative. For example particulates = 0.2% of Min. PT, SOx = 0.8% of Min PT, CO =0.03% Min PT. , also the construction emissions for TPA are higher than Minimum Pretreatment so the percentages get smaller.

Using the schedules in the Waste Retrieval and Transfer data packages the following dates were found construction start 1998 for Min PT and TPA, Retrieval Operations start 2003 for Min PT and TPA. These dates should be the construciton period of the 4 Waste Transfer Annexes and the Waste Storage and Sampling facility.

The coordinates for the 200West Transfer Annexes are:
1@ N36,100 , W75,250
1@ N43,000 , W75,600

The coordinates for the 200West Sampling and Storage facility is:
N37,600 , W75,400

The coordinates for the 200East Transfer Annexes are:
1@ N42,250 , W48,200
1@ N46,200 , W52,900

11. Construction is intended to be a fairly level activity throughout the 19 year construction period 1998/2017. Table 6-27 provides a breakdown by unit process.
See response to number 9.

13. The construction emissions in the Retrieval data package do not include releases from the construction of the barriers. We addressed this during the package reviews with WHC. This should be fixed in the next release of the Waste Retrieval and Transfer data package.

TPA HLW stack flows								
LIQUID COMPONENTS								
	Regulated	stream						
		907	917	totals mt	ANNUAL AVE	24 hour avg.	peak hourly	peak conc.
VOLUME					TOTAL/19	ann ave/219	(daily ave/24)x1.3	peak hourly/stack flow
SP. GRAVITY				metric tons	kg/year	kg/ 24 hr	kg/hr	grams/cubic meter
MASS FLOW MT		1.86E+05	2.85E+04	2.15E+05	1.13E+07	5.16E+04	2.79E+03	4.18E+02
Al	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cr	WAC-460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Si				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
P	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NO2, NO3	PP			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs and Ba				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr and Y				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tc				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TRU				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total MCi				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ag+	WAC-460-130			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Al+3	WAC-460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Am+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
As+5	WAC-460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba+2	WAC-460 ?			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Be+2	40CFR/WAC460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bi+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C 14				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ca+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cd+2	WAC-460-130			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ce+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cl-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cl2	WAC-460-160	3.48		3.48E+00	1.83E+02	8.36E-01	4.53E-02	6.78E-03

Cm+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO	WAC-460-160	2.53E+02		2.53E+02	1.33E+04	6.08E+01	3.29E+00	4.93E-01
CO+3	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO2	WAC-460-160	2.04E+04		2.04E+04	1.07E+06	4.90E+03	2.66E+02	3.97E+01
Co3-2	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cr+3	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cu+2	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F2	WAC-460-160	5.86E+01		5.86E+01	3.08E+03	1.41E+01	7.63E-01	1.14E-01
Fe+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FeCn6-3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H2O		2.94E+03		2.94E+03	1.55E+05	7.07E+02	3.83E+01	5.73E+00
H2S	WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg+2	WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I2	WAC-460	0.00335		3.35E-03	1.76E-01	8.05E-04	4.36E-05	6.53E-06
K+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kerosene				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Li+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mg+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MnO2	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mo+6				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
N2		1.28E+05	2.25E+04	1.51E+05	7.92E+06	3.62E+04	1.96E+03	2.93E+02
Na+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb+5		1.73E+01		1.73E+01	9.11E+02	4.16E+00	2.25E-01	3.37E-02
NH3	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni+3	WAC-460-130	9.66E-02		9.66E-02	5.08E+00	2.32E-02	1.26E-03	1.88E-04
NO	PP	4.29		4.29E+00	2.26E+02	1.03E+00	5.58E-02	8.36E-03
NO2	PP			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NO3-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Np+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
O2		3.38E+04	5.99E+03	3.98E+04	2.09E+06	9.56E+03	5.18E+02	7.75E+01
OH-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pb+4	WAC/40CFR			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Re+7				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rh+3	WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb+5	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Se+6	WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Si+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sm+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn+4	WAC-460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SO2	PP	4.51		4.51E+00	2.37E+02	1.08E+00	5.87E-02	8.79E-03
SO4-2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
S				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TcO2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TcO4-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te+6	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Th+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ti+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ti+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOC				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UO2+2	WAC-460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V+5				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W+6	WAC460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZN+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZRO2:2H2O				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SOLIDS COMPONENTS				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Mass Flow		6.11E-08	1.15E-02	1.15E-02	6.05E-01	2.76E-03	1.50E-04	2.24E-05
Al (summary)	WAC460-160	2.14E-09	4.01E-04	4.01E-04	2.11E-02	9.64E-05	5.22E-06	7.81E-07
Fe (summary)		2.19E-09	4.09E-04	4.09E-04	2.15E-02	9.83E-05	5.32E-06	7.97E-07
Cr (summary)	WAC460-160	9.23E-11	1.87E-05	1.87E-05	9.84E-04	4.49E-06	2.43E-07	3.64E-08
Na (summary)		5.07E-09	9.49E-04	9.49E-04	4.99E-02	2.28E-04	1.24E-05	1.85E-06

Si (summary)		1.32E-08	1.21E-04	1.21E-04	6.37E-03	2.91E-05	1.58E-06	2.36E-07
P (summary)	WAC460-160	6.46E-10		6.46E-10	3.40E-08	1.55E-10	8.41E-12	1.26E-12
NO2, NO3	PP			5.01E-05	2.64E-03	1.20E-05	6.52E-07	9.76E-08
Cs and Ba		2.48E-10	5.01E-05	6.96E-05	3.66E-03	1.67E-05	9.06E-07	1.36E-07
Sr and Y		3.44E-10	6.96E-05	4.98E-09	2.62E-07	1.20E-09	6.49E-11	9.71E-12
Tc		2.29E-14	4.64E-09	4.64E-09	2.44E-07	1.12E-09	6.04E-11	9.04E-12
TRU		4.88E-13	9.88E-08	9.88E-08	5.20E-06	2.37E-08	1.29E-09	1.93E-10
Total MCi		1.30E-08	2.63E-03	2.63E-03	1.38E-01	6.32E-04	3.42E-05	5.12E-06
Ag+	WAC460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ag2O	WAC460-160	1.10E-12	2.22E-07	2.22E-07	1.17E-05	5.34E-08	2.89E-09	4.33E-10
Al+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Al2O3		4.05E-09	7.58E-04	7.58E-04	3.99E-02	1.82E-04	9.87E-06	1.48E-06
Am+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Am2O3		1.11E-13	2.25E-08	2.25E-08	1.18E-06	5.41E-09	2.93E-10	4.38E-11
As+5	WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
As2O5		2.50E-12	5.06E-07	5.06E-07	2.66E-05	1.22E-07	6.59E-09	9.86E-10
B+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2O3	WAC-460-160	5.94E-09	1.11E-03	1.11E-03	5.84E-02	2.67E-04	1.44E-05	2.16E-06
Ba+2	?			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaO	WAC	5.70E-12	1.15E-06	1.15E-06	6.05E-05	2.76E-07	1.50E-08	2.24E-09
Be+2	40CFR/WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BeO		6.38E-14	1.29E-08	1.29E-08	6.79E-07	3.10E-09	1.68E-10	2.51E-11
Bi+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bi2O3		5.49E-10	1.11E-04	1.11E-04	5.84E-03	2.67E-05	1.44E-06	2.16E-07
C 14				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ca+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CANCRINITE				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CaO	WAC-460-160	5.86E-10	1.10E-04	1.10E-04	5.79E-03	2.64E-05	1.43E-06	2.14E-07
Cd+2	WAC-460-130			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CdO		2.39E-11	4.83E-06	4.83E-06	2.54E-04	1.16E-06	6.29E-08	9.41E-09
Ce+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ce2O3		7.41E-10	1.39E-04	1.39E-04	7.32E-03	3.34E-05	1.81E-06	2.71E-07
Cl-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm2O3		6.39E-17		6.39E-17	3.36E-15	1.54E-17	8.32E-19	1.25E-19

Co+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co2O3		2.68E-12	5.42E-07	5.42E-07	2.85E-05	1.30E-07	7.06E-09	1.06E-09
Co3-2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cr+3	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cr2O3		1.35E-10	2.73E-05	2.73E-05	1.44E-03	6.56E-06	3.55E-07	5.32E-08
Cs+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs2O		3.20E-12	6.47E-07	6.47E-07	3.41E-05	1.55E-07	8.42E-09	1.26E-09
Cu	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cu+2	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CuO		2.39E-12	4.83E-07	4.83E-07	2.54E-05	1.16E-07	6.29E-09	9.41E-10
CuSO4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F-	WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe2O3	WAC-460-160	3.12E-09	5.85E-04	5.85E-04	3.08E-02	1.41E-04	7.62E-06	1.14E-06
H+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg+2	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-	WAC ?			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
K+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
K2O		5.90E-11	1.19E-05	1.19E-05	6.26E-04	2.86E-06	1.55E-07	2.32E-08
La+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La2O3		1.13E-10	2.28E-05	2.28E-05	1.20E-03	5.48E-06	2.97E-07	4.44E-08
Li+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Li2O		2.16E-11	3.08E-04	3.08E-04	1.62E-02	7.40E-05	4.01E-06	6.00E-07
Mg+2		5.17E-10		5.17E-10	2.72E-08	1.24E-10	6.73E-12	1.01E-12
MgO	WAC-460-160		4.37E-06	4.37E-06	2.30E-04	1.05E-06	5.69E-08	8.51E-09
MnO2	WAC-460-160	1.93E-11	9.68E-05	9.68E-05	5.09E-03	2.33E-05	1.26E-06	1.89E-07
Mo+6				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MoO3		6.83E-09	3.91E-06	3.92E-06	2.06E-04	9.41E-07	5.10E-08	7.63E-09
Na+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na20		2.35E-18	1.28E-03	1.28E-03	6.74E-02	3.08E-04	1.67E-05	2.49E-06
Nb+5				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb2O5				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni+3	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni2FeCN6				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni2O3		3.52E-11	7.11E-06	7.11E-06	3.74E-04	1.71E-06	9.26E-08	1.39E-08

NiO		6.10E-10	1.14E-04	1.14E-04	6.00E-03	2.74E-05	1.48E-06	2.22E-07
NO2-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NO3-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Np+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NpO2		1.22E-13	2.46E-08	2.46E-08	1.29E-06	5.91E-09	3.20E-10	4.79E-11
OH-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
P2O5		1.48E-09	2.77E-04	2.77E-04	1.46E-02	6.66E-05	3.61E-06	5.40E-07
P2O5:24H2O				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pb+4	PP/WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pb02	WAC	8.46E-11	1.71E-05	1.71E-05	9.00E-04	4.11E-06	2.23E-07	3.33E-08
PO4-3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PuO2		7.03E-13	1.42E-07	1.42E-07	7.47E-06	3.41E-08	1.85E-09	2.77E-10
Rb+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RbO2		9.35E-15	1.89E-09	1.89E-09	9.95E-08	4.54E-10	2.46E-11	3.68E-12
Re+7				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Re2O7		1.25E-13	2.53E-08	2.53E-08	1.33E-06	6.08E-09	3.29E-10	4.93E-11
Rh+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rh2O3		1.32E-12	2.67E-07	2.67E-07	1.41E-05	6.42E-08	3.48E-09	5.20E-10
Ru+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru2O3		1.63E-12	3.29E-07	3.29E-07	1.73E-05	7.91E-08	4.28E-09	6.41E-10
Sb+5				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb2O5		6.01E-12	1.22E-06	1.22E-06	6.42E-05	2.93E-07	1.59E-08	2.38E-09
Se+6				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SeO3		7.35E-12	1.49E-06	1.49E-06	7.84E-05	3.58E-07	1.94E-08	2.90E-09
Si+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SiO2		2.82E-08	5.28E-03	5.28E-03	2.78E-01	1.27E-03	6.87E-05	1.03E-05
Sm+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sm2O3		9.26E-14	1.87E-08	1.87E-08	9.84E-07	4.49E-09	2.43E-10	3.64E-11
Sn+4	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SnO2		4.63E-14	9.36E-09	9.36E-09	4.93E-07	2.25E-09	1.22E-10	1.82E-11
SO4-2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SrO		1.09E-10	2.20E-05	2.20E-05	1.16E-03	5.29E-06	2.86E-07	4.29E-08
Tc2O7		2.12E-12	4.28E-07	4.28E-07	2.25E-05	1.03E-07	5.57E-09	8.34E-10

TcO4-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te+6	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TeO3	WAC-460-160	8.45E-13	1.71E-07	1.71E-07	9.00E-06	4.11E-08	2.23E-09	3.33E-10
Th+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ThO2		3.84E-11	7.77E-06	7.77E-06	4.09E-04	1.87E-06	1.01E-07	1.51E-08
Ti+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TiO2		1.83E-12	3.70E-07	3.70E-07	1.95E-05	8.89E-08	4.82E-09	7.21E-10
Ti+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ti2O3		1.45E-11	2.94E-06	2.94E-06	1.55E-04	7.07E-07	3.83E-08	5.73E-09
TOC				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UO2+2	WAC-460		7.77E-04	7.77E-04	4.09E-02	1.87E-04	1.01E-05	1.51E-06
UO3	WAC-460	4.15E-09		4.15E-09	2.18E-07	9.97E-10	5.40E-11	8.09E-12
V+5				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V2O5	WAC-460-160	1.72E-13	3.48E-08	3.48E-08	1.83E-06	8.36E-09	4.53E-10	6.78E-11
WO2		4.26E-11	8.61E-06	8.61E-06	4.53E-04	2.07E-06	1.12E-07	1.68E-08
WO3		2.01E-14	4.06E-09	4.06E-09	2.14E-07	9.76E-10	5.29E-11	7.91E-12
ZN+2	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZNO	WAC-460-160	4.56E-12	9.23E-07	9.23E-07	4.86E-05	2.22E-07	1.20E-08	1.80E-09
ZRO2	WAC-460-160	2.01E-09	3.77E-04	3.77E-04	1.98E-02	9.06E-05	4.91E-06	7.35E-07
ZRO2:2H2O				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
material balance based on data package recvd 11/8/94								
annual average based on 19 year operations period								
24 hour ave. based on annual ave/number of operationg days per year (365 days @ 60% OE=219 days)								
peak hourly rate based on plant capacity of 20 mt /operating day								

TPA combined Separations and LLW stack flows								
LIQUID COMPONENTS								
	Regulated	stream						
		907	917	totals mt	ANNUAL AVE	24 hour avg.	peak hourly	peak conc.
VOLUME					TOTAL/23 year	ann ave/219	(daily ave/24)x2.6	peak hrly/stack flow
SP. GRAVITY				metric tons	kg/year	kg/ 24 hr	kg/hr	grams / cubic meter
MASS FLOW MT		3.17E+06	5.03E+05	3.67E+06	1.60E+08	7.29E+05	7.90E+04	1.89E+03
Al	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cr	WAC-460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Si				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
P	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NO2, NO3	PP	2.10E+01		2.10E+01	9.13E+02	4.17E+00	4.52E-01	1.08E-02
Cs and Ba				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr and Y				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tc				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TRU				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total MCi				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ag+	WAC-460-130			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Al+3	WAC-460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Am+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
As+5	WAC-460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba+2	WAC-460 ?			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Be+2	40CFR/WAC460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bi+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C 14				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ca+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cd+2	WAC-460-130			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ce+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cl-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cl2	WAC-460-160	4.84E+02		4.84E+02	2.10E+04	9.61E+01	1.04E+01	2.49E-01

Cm+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO	WAC-460-160	2.47E+03		2.47E+03	1.07E+05	4.90E+02	5.31E+01	1.27E+00
CO+3	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO2	WAC-460-160	1.95E+05		1.95E+05	8.48E+06	3.87E+04	4.19E+03	1.01E+02
Co3-2	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cr+3	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cu+2	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F2	WAC-460-160	1.11E+03		1.11E+03	4.83E+04	2.20E+02	2.39E+01	5.72E-01
Fe+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FeCn6-3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H+		3.42E-01		3.42E-01	1.49E+01	6.79E-02	7.36E-03	1.76E-04
H2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H2O		6.08E+04		6.08E+04	2.64E+06	1.21E+04	1.31E+03	3.13E+01
H2S	WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg+2	WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I2	WAC-460	2.33E-01		2.33E-01	1.01E+01	4.63E-02	5.01E-03	1.20E-04
K+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kerosene				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Li+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mg+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MnO2	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mo+6				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
N2		2.30E+06	3.97E+05	2.70E+06	1.17E+08	5.35E+05	5.80E+04	1.39E+03
Na+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb+5				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NH3	WAC-460-160	1.87E+01		1.87E+01	8.13E+02	3.71E+00	4.02E-01	9.64E-03
Ni+3	WAC-460-130			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NO	PP	3.43		3.43E+00	1.49E+02	6.81E-01	7.38E-02	1.77E-03
NO2	PP	1.45E+02		1.45E+02	6.30E+03	2.88E+01	3.12E+00	7.47E-02
NO3-		2.10E+01		2.10E+01	9.13E+02	4.17E+00	4.52E-01	1.08E-02

Np+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
O2		6.03E+05	1.06E+05	7.09E+05	3.08E+07	1.41E+05	1.52E+04	3.65E+02
OH-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pb+4	WAC/40CFR			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Re+7				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rh+3	WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb+5	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Se+6	WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Si+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sm+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn+4	WAC-460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SO2	PP	2.08E+02		2.08E+02	9.04E+03	4.13E+01	4.47E+00	1.07E-01
SO4-2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
S				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TcO2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TcO4-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te+6	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Th+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ti+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ti+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOC				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UO2+2	WAC-460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V+5				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W+6	WAC460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZN+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZRO2:2H2O				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SOLIDS COMPONENTS				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Mass Flow		1.09E-06	2.02E-01	2.02E-01	8.78E+00	4.01E-02	4.34E-03	1.04E-04
Al (summary)	WAC460-160	1.11E-08	2.05E-03	2.05E-03	8.91E-02	4.07E-04	4.41E-05	1.06E-06
Fe (summary)		4.38E-11	4.68E-06	4.68E-06	2.03E-04	9.29E-07	1.01E-07	2.41E-09
Cr (summary)	WAC460-160	3.53E-10	6.49E-05	6.49E-05	2.82E-03	1.29E-05	1.40E-06	3.35E-08
Na (summary)		2.02E-07	3.75E-02	3.75E-02	1.63E+00	7.44E-03	8.07E-04	1.93E-05

Si (summary)		2.81E-07	5.21E-02	5.21E-02	2.27E+00	1.03E-02	1.12E-03	2.69E-05
P (summary)	WAC460-160	4.50E-09	8.32E-04	8.32E-04	3.62E-02	1.65E-04	1.79E-05	4.29E-07
NO2, NO3	PP			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs and Ba		1.04E-10	2.04E-05	2.04E-05	8.87E-04	4.05E-06	4.39E-07	1.05E-08
Sr and Y		7.17E-12	7.39E-07	7.39E-07	3.21E-05	1.47E-07	1.59E-08	3.81E-10
Tc		7.72E-14	1.54E-08	1.54E-08	6.70E-07	3.06E-09	3.31E-10	7.94E-12
TRU		2.71E-14	4.43E-09	4.43E-09	1.93E-07	8.79E-10	9.53E-11	2.28E-12
Total MCi		1.11E-10	2.11E-05	2.11E-05	9.17E-04	4.19E-06	4.54E-07	1.09E-08
Ag+	WAC460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ag2O	WAC460-160	1.00E-13	1.78E-08	1.78E-08	7.74E-07	3.53E-09	3.83E-10	9.18E-12
Al+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Al2O3		2.10E-08	3.87E-03	3.87E-03	1.68E-01	7.68E-04	8.32E-05	1.99E-06
Am+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Am2O3		6.68E-15	1.11E-09	1.11E-09	4.83E-08	2.20E-10	2.39E-11	5.72E-13
As+5	WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
As2O5		7.59E-13	1.47E-07	1.47E-07	6.39E-06	2.92E-08	3.16E-09	7.58E-11
B+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2O3	WAC-460-160	1.20E-07	2.23E-02	2.23E-02	9.70E-01	4.43E-03	4.80E-04	1.15E-05
Ba+2	?			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaO	WAC	9.32E-13	1.75E-07	1.75E-07	7.61E-06	3.47E-08	3.76E-09	9.02E-11
Be+2	40CFR/WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BeO		5.90E-15	1.05E-09	1.05E-09	4.57E-08	2.08E-10	2.26E-11	5.41E-13
Bi+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bi2O3		1.86E-10	3.62E-05	3.62E-05	1.57E-03	7.19E-06	7.79E-07	1.87E-08
C 14				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ca+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CANCRINITE				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CaO	WAC-460-160	8.63E-09	1.60E-03	1.60E-03	6.96E-02	3.18E-04	3.44E-05	8.25E-07
Cd+2	WAC-460-130			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CdO		6.66E-12	1.28E-06	1.28E-06	5.57E-05	2.54E-07	2.75E-08	6.60E-10
Ce+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ce2O3		1.46E-11	1.54E-06	1.54E-06	6.70E-05	3.06E-07	3.31E-08	7.94E-10
Cl-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm2O3		1.85E-18		1.85E-18	8.04E-17	3.67E-19	3.98E-20	9.54E-22

Co+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co2O3		2.13E-13	3.72E-08	3.72E-08	1.62E-06	7.39E-09	8.00E-10	1.92E-11
Co3-2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cr+3	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cr2O3		5.16E-10	9.48E-05	9.48E-05	4.12E-03	1.88E-05	2.04E-06	4.89E-08
Cs+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs2O		1.35E-12	2.63E-07	2.63E-07	1.14E-05	5.22E-08	5.66E-09	1.36E-10
Cu	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cu+2	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CuO		7.21E-13	1.40E-07	1.40E-07	6.09E-06	2.78E-08	3.01E-09	7.22E-11
CuSO4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F-	WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe2O3	WAC-460-160	6.26E-11	6.68E-06	6.68E-06	2.90E-04	1.33E-06	1.44E-07	3.44E-09
H+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg+2	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-	WAC ?			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
K+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
K2O		4.31E-09	8.62E-04	8.62E-04	3.75E-02	1.71E-04	1.85E-05	4.44E-07
La+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La2O3		2.22E-12	2.17E-07	2.17E-07	9.43E-06	4.31E-08	4.67E-09	1.12E-10
Li+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Li2O		4.32E-08	7.96E-03	7.96E-03	3.46E-01	1.58E-03	1.71E-04	4.10E-06
Mg+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MgO	WAC-460-160	4.58E-09	1.59E-03	1.59E-03	6.91E-02	3.16E-04	3.42E-05	8.20E-07
MnO2	WAC-460-160	5.54E-11	1.09E-05	1.09E-05	4.74E-04	2.16E-06	2.34E-07	5.62E-09
Mo+6				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MoO3		1.26E-11	2.48E-06	2.48E-06	1.08E-04	4.92E-07	5.33E-08	1.28E-09
Na+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na20		2.73E-07	5.06E-02	5.06E-02	2.20E+00	1.00E-02	1.09E-03	2.61E-05
Nb+5				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb2O5		2.36E-20		2.36E-20	1.03E-18	4.69E-21	5.08E-22	1.22E-23
Ni+3	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni2FeCN6				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni2O3		2.44E-12	4.17E-07	4.17E-07	1.81E-05	8.28E-08	8.97E-09	2.15E-10

NiO		6.31E-12	1.23E-07	1.23E-07	5.35E-06	2.44E-08	2.65E-09	6.34E-11
NO2-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NO3-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Np+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NpO2		1.47E-14	2.71E-09	2.71E-09	1.18E-07	5.38E-10	5.83E-11	1.40E-12
OH-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
P2O5		1.03E-08	1.91E-03	1.91E-03	8.30E-02	3.79E-04	4.11E-05	9.85E-07
P2O5:24H2O				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pb+4	PP/WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pb02	WAC	8.76E-12	1.58E-06	1.58E-06	6.87E-05	3.14E-07	3.40E-08	8.14E-10
PO4-3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PuO2		3.10E-14	4.78E-09	4.78E-09	2.08E-07	9.49E-10	1.03E-10	2.46E-12
Rb+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RbO2		2.16E-13	4.31E-08	4.31E-08	1.87E-06	8.56E-09	9.27E-10	2.22E-11
Re+7				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Re2O7		1.65E-14	3.06E-09	3.06E-09	1.33E-07	6.08E-10	6.58E-11	1.58E-12
Rh+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rh2O3		5.25E-14	7.85E-09	7.85E-09	3.41E-07	1.56E-09	1.69E-10	4.05E-12
Ru+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru2O3		1.02E-13	1.71E-08	1.71E-08	7.43E-07	3.39E-09	3.68E-10	8.81E-12
Sb+5				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb2O5		2.54E-13	3.88E-08	3.88E-08	1.69E-06	7.70E-09	8.34E-10	2.00E-11
Se+6				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SeO3		2.31E-12	4.48E-07	4.48E-07	1.95E-05	8.89E-08	9.64E-09	2.31E-10
Si+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SiO2		6.02E-07	1.11E-01	1.11E-01	4.83E+00	2.20E-02	2.39E-03	5.72E-05
Sm+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sm2O3		1.94E-15	2.01E-10	2.01E-10	8.74E-09	3.99E-11	4.32E-12	1.04E-13
Sn+4	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SnO2		1.63E-14	3.18E-09	3.18E-09	1.38E-07	6.31E-10	6.84E-11	1.64E-12
SO4-2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SrO		2.26E-12	2.33E-07	2.33E-07	1.01E-05	4.63E-08	5.01E-09	1.20E-10
Tc2O7			1.42E-06	1.42E-06	6.17E-05	2.82E-07	3.05E-08	7.32E-10

TcO4-		7.12E-12		7.12E-12	3.10E-10	1.41E-12	1.53E-13	3.67E-15
Te+6	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TeO3	WAC-460-160	2.72E-14	3.47E-09	3.47E-09	1.51E-07	6.89E-10	7.46E-11	1.79E-12
Th+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ThO2		8.92E-13	1.01E-07	1.01E-07	4.39E-06	2.01E-08	2.17E-09	5.21E-11
Ti+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TiO2		4.77E-14	5.85E-09	5.85E-09	2.54E-07	1.16E-09	1.26E-10	3.02E-12
Ti+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ti2O3		1.00E-12	1.71E-07	1.71E-07	7.43E-06	3.39E-08	3.68E-09	8.81E-11
TOC				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UO2+2	WAC-460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UO3	WAC-460	2.85E-10	4.93E-05	4.93E-05	2.14E-03	9.79E-06	1.06E-06	2.54E-08
V+5				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V2O5	WAC-460-160	4.49E-14	8.65E-09	8.65E-09	3.76E-07	1.72E-09	1.86E-10	4.46E-12
WO2		4.76E-13	9.26E-09	9.26E-09	4.03E-07	1.84E-09	1.99E-10	4.77E-12
WO3		1.04E-11	2.08E-06	2.08E-06	9.04E-05	4.13E-07	4.47E-08	1.07E-09
ZN+2	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZNO	WAC-460-160	2.82E-12	5.55E-07	5.55E-07	2.41E-05	1.10E-07	1.19E-08	2.86E-10
ZRO2	WAC-460-160	6.64E-11	9.53E-06	9.53E-06	4.14E-04	1.89E-06	2.05E-07	4.91E-09
ZRO2:2H2O				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
material balance based on data package revcd. 11/8/94								
annual ave based on 23 year operations period								
24 hour ave. based on annual ave/number of operating days per year (365 days@60% OE=219 days)								
peak hourly rate based on plant capacity of 200 mt/operating day								

No Separations Stack Flows								
LIQUID COMPONENTS								
	Regulated	stream						
		907	917	totals mt	ANNUAL AVE	24 hour avg.	peak hourly	peak hourly concentration
VOLUME					TOTAL/14 year	ann ave/219	(daily ave/24)x1.7	peak hourly/stack flow rate
SP. GRAVITY				metric tons	kg/year	kg/ 24 hr	kg/hr	grams/ cubic meter
MASS FLOW MT		2.88E+06	4.63E+05	3.34E+06	2.39E+08	1.09E+06	7.72E+04	2.07E+03
Al	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cr	WAC-460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Si				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
P	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NO2, NO3	PP			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs and Ba				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr and Y				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tc				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TRU				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total MCi				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ag+	WAC-460-130			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Al+3	WAC-460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Am+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
As+5	WAC-460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba+2	WAC-460 ?			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Be+2	40CFR/WAC460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bi+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C 14				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ca+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cd+2	WAC-460-130			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ce+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cl-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cl2	WAC-460-160	4.87E+02		4.87E+02	3.48E+04	1.59E+02	1.13E+01	3.02E-01

Cm+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO	WAC-460-160	2.30E+03		2.30E+03	1.64E+05	7.50E+02	5.31E+01	1.43E+00
CO+3	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO2	WAC-460-160	1.82E+05		1.82E+05	1.30E+07	5.94E+04	4.20E+03	1.13E+02
CO3-2	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cr+3	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cu+2	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F2	WAC-460-160	1.17E+03		1.17E+03	8.36E+04	3.82E+02	2.70E+01	7.25E-01
Fe+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FeCn6-3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H2O		4.81E+04		4.81E+04	3.44E+06	1.57E+04	1.11E+03	2.98E+01
H2S	WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg+2	WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I2	WAC-460	2.36E-01		2.36E-01	1.69E+01	7.70E-02	5.45E-03	1.46E-04
K+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kerosene				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Li+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mg+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MnO2	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mo+6				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
N2		2.10E+06	3.66E+05	2.47E+06	1.76E+08	8.04E+05	5.70E+04	1.53E+03
Na+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb+5				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NH3	WAC-460-160	1.87E+01		1.87E+01	1.34E+03	6.10E+00	4.32E-01	1.16E-02
Ni+3	WAC-460-130			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NO	PP	3.52E+02		3.52E+02	2.51E+04	1.15E+02	8.13E+00	2.18E-01
NO2	PP	1.40E+02		1.40E+02	1.00E+04	4.57E+01	3.23E+00	8.68E-02
NO3-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Np+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
O2		5.48E+05	9.72E+04	6.45E+05	4.61E+07	2.10E+05	1.49E+04	4.00E+02
OH-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pb+4	WAC/40CFR			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Re+7				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rh+3	WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb+5	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Se+6	WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Si+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sm+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn+4	WAC-460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SO2	PP	1.27E+03		1.27E+03	9.07E+04	4.14E+02	2.93E+01	7.87E-01
SO4-2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
S				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TcO2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TcO4-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te+6	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Th+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ti+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ti+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOC				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UO2+2	WAC-460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V+5				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W+6	WAC460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZN+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZRO2:2H2O				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SOLIDS COMPONENTS				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Mass Flow		9.94E-07	1.86E-01	1.86E-01	1.33E+01	6.07E-02	4.30E-03	1.15E-04
Al (summary)	WAC460-160	1.31E-08	2.45E-03	2.45E-03	1.75E-01	7.99E-04	5.66E-05	1.52E-06
Fe (summary)		2.21E-09	4.13E-04	4.13E-04	2.95E-02	1.35E-04	9.54E-06	2.56E-07
Cr (summary)	WAC460-160	4.45E-10	8.33E-05	8.33E-05	5.95E-03	2.72E-05	1.92E-06	5.16E-08
Na (summary)		1.84E-07	3.45E-02	3.45E-02	2.46E+00	1.13E-02	7.97E-04	2.14E-05

Si (summary)		2.49E-07	4.65E-02	4.65E-02	3.32E+00	1.52E-02	1.07E-03	2.88E-05
P (summary)	WAC460-160	5.09E-09	9.52E-04	9.52E-04	6.80E-02	3.11E-04	2.20E-05	5.90E-07
NO2, NO3	PP			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs and Ba (MCi)		2.50E-10	5.05E-05	5.05E-05	3.61E-03	1.65E-05	1.17E-06	3.13E-08
Sr and Y (MCi)		3.48E-10	7.03E-05	7.03E-05	5.02E-03	2.29E-05	1.62E-06	4.36E-08
Tc (MCi)		9.91E-14	2.00E-08	2.00E-08	1.43E-06	6.52E-09	4.62E-10	1.24E-11
TRU (MCi)		5.10E-13	1.03E-07	1.03E-07	7.36E-06	3.36E-08	2.38E-09	6.39E-11
Total MCi		6.11E-10	1.24E-04	1.24E-04	8.86E-03	4.04E-05	2.86E-06	7.69E-08
Ag+	WAC460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ag2O	WAC460-160	1.19E-12	2.40E-07	2.40E-07	1.71E-05	7.83E-08	5.54E-09	1.49E-10
Al+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Al2O3		2.47E-08	4.62E-03	4.62E-03	3.30E-01	1.51E-03	1.07E-04	2.86E-06
Am+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Am2O3		1.17E-13	2.36E-08	2.36E-08	1.69E-06	7.70E-09	5.45E-10	1.46E-11
As+5.	WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
As2O5		3.23E-12	6.52E-07	6.52E-07	4.66E-05	2.13E-07	1.51E-08	4.04E-10
B+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2O3	WAC-460-160	1.06E-07	1.98E-02	1.98E-02	1.41E+00	6.46E-03	4.57E-04	1.23E-05
Ba+2	?			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaO	WAC	6.56E-12	1.33E-06	1.33E-06	9.50E-05	4.34E-07	3.07E-08	8.25E-10
Be+2	40CFR/WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BeO		6.90E-14	1.40E-08	1.40E-08	1.00E-06	4.57E-09	3.23E-10	8.68E-12
Bi+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bi2O3		7.86E-10	1.47E-04	1.47E-04	1.05E-02	4.79E-05	3.40E-06	9.11E-08
C 14				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ca+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CANCRINITE				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CaO	WAC-460-160	8.17E-09	1.53E-03	1.53E-03	1.09E-01	4.99E-04	3.53E-05	9.49E-07
Cd+2	WAC-460-130			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CdO		3.02E-11	6.11E-06	6.11E-06	4.36E-04	1.99E-06	1.41E-07	3.79E-09
Ce+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ce2O3		7.48E-10	1.40E-04	1.40E-04	1.00E-02	4.57E-05	3.23E-06	8.68E-08
Cl-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm2O3		6.51E-17		6.51E-17	4.65E-15	2.12E-17	1.50E-18	4.04E-20

Co+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co2O3		2.86E-12	5.79E-07	5.79E-07	4.14E-05	1.89E-07	1.34E-08	3.59E-10
Co3-2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cr+3	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cr2O3		6.51E-10	1.22E-04	1.22E-04	8.71E-03	3.98E-05	2.82E-06	7.56E-08
Cs+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs2O		3.22E-12	6.52E-07	6.52E-07	4.66E-05	2.13E-07	1.51E-08	4.04E-10
Cu	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cu+2	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CuO		3.07E-12	6.22E-07	6.22E-07	4.44E-05	2.03E-07	1.44E-08	3.86E-10
CuSO4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F-	WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe2O3	WAC-460-160	3.16E-09	5.91E-04	5.91E-04	4.22E-02	1.93E-04	1.37E-05	3.66E-07
H+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg+2	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-	WAC ?			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
K+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
K2O		4.32E-09	8.74E-04	8.74E-04	6.24E-02	2.85E-04	2.02E-05	5.42E-07
La+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La2O3		1.14E-10	2.30E-05	2.30E-05	1.64E-03	7.50E-06	5.31E-07	1.43E-08
Li+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Li2O		3.78E-08	7.07E-03	7.07E-03	5.05E-01	2.31E-03	1.63E-04	4.38E-06
Mg+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MgO	WAC-460-160	7.58E-09	1.42E-03	1.42E-03	1.01E-01	4.63E-04	3.28E-05	8.80E-07
MnO2	WAC-460-160	5.75E-10	1.08E-04	1.08E-04	7.71E-03	3.52E-05	2.50E-06	6.70E-08
Mo+6				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MoO3		3.16E-11	6.39E-06	6.39E-06	4.56E-04	2.08E-06	1.48E-07	3.96E-09
Na+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na20		2.49E-07	4.65E-02	4.65E-02	3.32E+00	1.52E-02	1.07E-03	2.88E-05
Nb+5				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb2O5		2.39E-18		2.39E-18	1.71E-16	7.80E-19	5.52E-20	1.48E-21
Ni+3	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni2FeCN6				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni2O3		3.72E-11	7.52E-06	7.52E-06	5.37E-04	2.45E-06	1.74E-07	4.66E-09

NiO		6.10E-10	1.14E-04	1.14E-04	8.14E-03	3.72E-05	2.63E-06	7.07E-08
NO2-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NO3-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Np+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NpO2		1.35E-13	2.73E-08	2.73E-08	1.95E-06	8.90E-09	6.31E-10	1.69E-11
OH-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
P2O5		1.16E-08	2.18E-03	2.18E-03	1.56E-01	7.11E-04	5.04E-05	1.35E-06
P2O5:24H2O				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pb+4	PP/WAC			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pb02	WAC	9.23E-11	1.87E-05	1.87E-05	1.34E-03	6.10E-06	4.32E-07	1.16E-08
PO4-3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PuO2		7.26E-13	1.47E-07	1.47E-07	1.05E-05	4.79E-08	3.40E-09	9.11E-11
Rb+				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RbO2		2.23E-13	4.50E-08	4.50E-08	3.21E-06	1.47E-08	1.04E-09	2.79E-11
Re+7				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Re2O7		1.40E-13	2.83E-08	2.83E-08	2.02E-06	9.23E-09	6.54E-10	1.75E-11
Rh+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rh2O3		1.36E-12	2.75E-07	2.75E-07	1.96E-05	8.97E-08	6.35E-09	1.70E-10
Ru+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru2O3		1.71E-12	3.46E-07	3.46E-07	2.47E-05	1.13E-07	7.99E-09	2.15E-10
Sb+5				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb2O5		6.20E-12	1.25E-06	1.25E-06	8.93E-05	4.08E-07	2.89E-08	7.75E-10
Se+6				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SeO3		9.56E-12	1.93E-06	1.93E-06	1.38E-04	6.29E-07	4.46E-08	1.20E-09
Si+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SiO2		5.32E-07	9.95E-02	9.95E-02	7.11E+00	3.25E-02	2.30E-03	6.17E-05
Sm+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sm2O3		9.35E-14	1.89E-08	1.89E-08	1.35E-06	6.16E-09	4.37E-10	1.17E-11
Sn+4	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SnO2		6.19E-14	1.25E-08	1.25E-08	8.93E-07	4.08E-09	2.89E-10	7.75E-12
SO4-2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr+2				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SrO		1.10E-10	2.22E-05	2.22E-05	1.59E-03	7.24E-06	5.13E-07	1.38E-08
Tc2O7		9.14E-12	1.85E-06	1.85E-06	1.32E-04	6.03E-07	4.27E-08	1.15E-09

TcO4-				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te+6	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TeO3	WAC-460-160	8.63E-13	1.75E-07	1.75E-07	1.25E-05	5.71E-08	4.04E-09	1.08E-10
Th+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ThO2		3.89E-11	7.87E-06	7.87E-06	5.62E-04	2.57E-06	1.82E-07	4.88E-09
Ti+4				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TiO2		1.86E-12	3.76E-07	3.76E-07	2.69E-05	1.23E-07	8.69E-09	2.33E-10
Ti+3				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ti2O3		1.54E-11	3.11E-06	3.11E-06	2.22E-04	1.01E-06	7.19E-08	1.93E-09
TOC				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UO2+2	WAC-460			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UO3	WAC-460	4.41E-09	8.26E-04	8.26E-04	5.90E-02	2.69E-04	1.91E-05	5.12E-07
V+5				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V2O5	WAC-460-160	2.15E-13	4.34E-08	4.34E-08	3.10E-06	1.42E-08	1.00E-09	2.69E-11
WO2		4.26E-11	8.61E-06	8.61E-06	6.15E-04	2.81E-06	1.99E-07	5.34E-09
WO3		1.03E-11	2.09E-06	2.09E-06	1.49E-04	6.82E-07	4.83E-08	1.30E-09
ZN+2	WAC-460-160			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZNO	WAC-460-160	7.30E-12	1.48E-06	1.48E-06	1.06E-04	4.83E-07	3.42E-08	9.18E-10
ZRO2	WAC-460-160	2.06E-09	3.86E-04	3.86E-04	2.76E-02	1.26E-04	8.92E-06	2.39E-07
ZRO2:2H2O				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		material balance based on data package recvd. 11/8/94						
		annual ave based on 14 year operations period						
		24 hour ave. based on annual ave/number of operating days per year (365 days @ 60% OE)						
		peak hourly rate based on plant capacity of 200 mt /operting day						

Request Number 019

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Joan Young

Date: 12/20/94

Phone Number: 946-7112

Fax Number: 943-6812

Request Information: Summary of shielding and maintenance requirements. (See Attached)

Need Date: 1/15/95

Response: See Attached - Please discuss approach to this issue with Mike Harker.

Data Source/Accuracy: Data Packages - Preliminary

Prepared By: C. Henderson

Date Sent/Faxed: 1/27/95

Concurrence: Marc Nelson
Marc Nelson - Deputy Project Manager

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ASI Memorandum December 21, 1994

To: Dave Murray, JEG

From: J.J. Davis, ASI

Subject: DATA REQUEST FOR RISK ASSESSMENT MODELING

We have identified some data needs which are described in the remainder of this memo.

1. ELECTRONIC COPY OF NONRADIOLOGICAL ROUTINE RELEASES FROM THE VITRIFICATION PLANT

The data package for "No Pretreatment" (pp. B4-4 to B4-9) contains a table showing the nonradiological routine releases from the vitrification plant. However, the print size is too small to read. We need a readable copy of this table, preferably in electronic form.

2. SIMPLIFIED SCHEMATIC FOR THE "NO PRETREATMENT AND TPA" ALTERNATIVES ILLUSTRATING FACILITY CONFIGURATIONS, LOCATIONS, AND POINTS OF RELEASE FOR EMISSIONS TO THE STACK(S) AND VENT(S) (PREFERABLY OVERLAID OVER A SITE MAP)

The risk calculation requires knowledge of the off-gas volumes and concentrations at the point of release to the environment. This release point depends on the facility configuration. For example, if LLW pretreatment and LLW vitrification are combined in one facility with one stack, the stack locations and concentrations will be different than if these processes are located in separate facilities. This same logic applies to emissions from ventilation ducts.

For the purposes of assessing risk from routine operations, a simplified process flow diagram that illustrates the systems configuration (e.g. shows the waste tanks, process buildings, outside storage tanks, transfer lines, LLW disposal vault, HLW storage facility, and their associated stacks and vents) is required. This schematic should primarily be a visual representation of the facilities, rather than a process flow diagram. Each point of release should be indicated on the schematic. The volume and concentration of effluents should be specified at each point of routine release to the environment in a corresponding table(s).

3. SUMMARY OF SHIELDING AND MAINTENANCE REQUIREMENTS

Please specify shielding and maintenance requirements for each major process activity or facility in a summary table. This table will allow ASI to determine where there is potential for routine exposure to chemicals or radioactivity. For example, indicate if the vitrification facilities are fully shielded. Also, state whether the facility will be remotely or contact maintained (e.g., occupational exposures will be much lower than if the facilities are lightly shielded or contact maintained). An

example table for this information is provided as attachment A.

4. IDENTIFY MAXIMALLY EXPOSED WORKER AND ASSOCIATED DOSE OR PROVIDE SUPPORTING DATA TO ALLOW IDENTIFICATION OF MAXIMALLY EXPOSED WORKER

The maximally exposed worker must be identified. If this cannot be specified directly, then the supporting information requested below should be provided.

Operational or maintenance procedures should be briefly described for the activities with significant potential for worker exposure to chemicals or radionuclides. An example chart is provided as Attachment B.

Some specific questions to address include:

a. How often will the melter be changed and will it remain in the vitrification plant until closure or will it be replaced and decontaminated?

b. If it is removed and decontaminated, will there be any exposure to chemicals or radionuclides.

c. How often will the off-gas treatment systems be cleaned and maintained?

d. If there is clean-out of scale in the melter off-gas treatment system, will it require contact maintenance?

e. Will there be operator contact during retrieval of the waste when the sluicing equipment is being introduced or removed from the tanks?

5. POST REMEDIATION EMISSIONS

a. Will there be emissions to the air from the LLW disposal vaults or from the tank residuals? For example, will radon gas or other gases be emitted that result from decay of the LLW?

b. Will there be emissions to the air from the HLW during storage awaiting transportation to Yucca Mountain?

6. EVAPORATOR CAPACITY AND THE RADIOACTIVE AND NON-RADIOACTIVE RELEASES

Specify the evaporator capacity during operation and the radioactive and non-radioactive releases from the evaporator, including tritium releases. Also specify the duration of evaporator operation during the life of the TWRS project.

Attachment A

OUTLINE OF PROPOSED SUMMARY TABLE FOR SHIELDING AND MAINTENANCE SUMMARY

Action Alternative	TWRS PROCESS SHIELDING AND MAINTENANCE REQUIREMENTS								
	Transfer Liquids Out of Tank	Evaporate Liquids	Transfer Waste to Pretreat	Pretreat Waste	Additional Waste Transfer	LLW Vitrification	HLW Vitrification	Onsite Waste Storage	Cover Tanks with Multi-Layer Barrier
1. TPA Preferred									
2. No Pretreatment									

DATA REQUEST NO. 19

REQUESTED BY: J. YOUNG/ ASI

SUMMARY OF SHIELDING AND MAINTENANCE REQUIREMENTS

Per previous discussions relative to this subject it has been determined that this information is not required and was requested to aid in evaluation of worker doses. This information is generally not available in the engineering data packages. The No Pretreatment data packages briefly addresses the different zones of the vitrification plant with regards to remote or contact maintenance, but no quantitative information is provided.

No specific information regarding shielding and maintenance requirements is being provided.

Request Number 020

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Joan Young

Date: 12/20/94

Phone Number: 946-7112

Fax Number: 943-6812

Request Information: Identify maximally exposed worker and associated dose or provide supporting data to allow identification of maximally exposed worker. (See Attached)

Need Date: 1/15/95

Response: See Attached

Data Source/Accuracy: Data Packages - Preliminary

Prepared By: C. Henderson

Date Sent/Faxed: 1/27/95

Concurrence: Marc Nelson
Marc Nelson - Deputy Project Manager

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example table for this information is provided as attachment A.

4. IDENTIFY MAXIMALLY EXPOSED WORKER AND ASSOCIATED DOSE OR PROVIDE SUPPORTING DATA TO ALLOW IDENTIFICATION OF MAXIMALLY EXPOSED WORKER

The maximally exposed worker must be identified. If this cannot be specified directly, then the supporting information requested below should be provided.

Operational or maintenance procedures should be briefly described for the activities with significant potential for worker exposure to chemicals or radionuclides. An example chart is provided as Attachment B.

Some specific questions to address include:

a. How often will the melter be changed and will it remain in the vitrification plant until closure or will it be replaced and decontaminated?

b. If it is removed and decontaminated, will there be any exposure to chemicals or radionuclides.

c. How often will the off-gas treatment systems be cleaned and maintained?

d. If there is clean-out of scale in the melter off-gas treatment system, will it require contact maintenance?

e. Will there be operator contact during retrieval of the waste when the sluicing equipment is being introduced or removed from the tanks?

5. POST REMEDIATION EMISSIONS

a. Will there be emissions to the air from the LLW disposal vaults or from the tank residuals? For example, will radon gas or other gases be emitted that result from decay of the LLW?

b. Will there be emissions to the air from the HLW during storage awaiting transportation to Yucca Mountain?

6. EVAPORATOR CAPACITY AND THE RADIOACTIVE AND NON-RADIOACTIVE RELEASES

Specify the evaporator capacity during operation and the radioactive and non-radioactive releases from the evaporator, including tritium releases. Also specify the duration of evaporator operation during the life of the TWRS project.

Attachment B

ACTIVITY	ACTIVITIES RESULTING IN MAXIMUM WORKER EXPOSURES	DURATION OF EXPOSURE	INTERNAL AND EXTERNAL DOSE (BY CONSTITUENT)
Retrieval	Installation and removal of sluicing arm	x persons for approximately x hours/year exposed to gamma radiation	
Pretreatment	Installation and removal of ion exchange resins		
Vitrification	Routine melter and off-gas system clean out		
LLW Disposal	Deposition of canister into vault		
Example chart only			

DATA REQUEST 20

REQUESTED BY: J YOUNG/ASI

MAXIMALLY EXPOSED WORKER DOSE

ATTACHED ARE THE FOLLOWING:

No Pretreatment Table 7-26

TPA Table 10-27

Table P5-1 Occupational Radiological Exposures from Technical Options Report

Table P5-1 has estimated rad exposures for the retrieval and transfer of the SST and DST wastes for construction, operations, and D&D phases of the project. The waste retrieval and transfer data package received from WHC did not contain any dose information.

All we have at the present time for maximum doses are the administrative dose of 200 mrem/yr and the maximum allowable of 500 mrem/yr.

Table 7-26. Comparison of Alternatives by Unit Process: Radiation Dose at Facility (mrem).

Unit Process	no pretreatment	TPA Preferred Alternative
Pumping/Sluicing	*	
Hydraulic Retrieval	*	
Sludge Wash	0	
Cesium Removal	0	
Other Radionuclide Removal	0	
LLW Vitrification	0	
LLW Disposal	0	
HLW Vitrification	2.14×10^6	
HLW Transportation	*	
HLW Disposal	*	
Emptied SST Closure	*	
Emptied DST Closure	*	

*Denotes data is out of the scope of this document.

[1]Average whole body deep exposure to operational personnel at the PUREX plant during 1986 was 200 mrem/year. Assuming this average is similar to operating the HLW vitrification plant: (200 mrem/year/person)(10,700 person-years) = 2.14×10^6 mrem

[2]Maximum radiation exposure to a radiation worker is 500 mrem/yr.

Table 10-26 Construction Equipment Schedule. (Units)

Construction equipment type	Tri-Party Agreement preferred alternative
Heavy duty diesel equipment	90
Light duty [a] diesel equipment	215
Light duty gasoline vehicles	210
Small gasoline engines	630
Construction[b] noise (dcbls)	85

[a]Light duty diesel equipment has been added to this chart. It represents diesel engine equipment that runs at idle speed for a major portion of its time (for instance lift cranes).

[b]Represents noise near a twin engine scraper with 2 push dozers.

Table 10-27. Unit Process: Radiation Dose at Facility. (mremr)[a]

Unit process	Tri-Party Agreement preferred alternative
Sludge wash	6.4×10^4 [b]
Cesium removal	1.4×10^5 [c]
Other radionuclide removal	N/A
LLW vitrification	1.5×10^6 [d]
LLW disposal	3.7×10^4 [e]
HLW vitrification	1.3×10^6 [f]
HLW transportation	0
HLW disposal	0

[a]Maximum radiation exposure to a radiation worker is 500 mrem/yr. Calculations assumes 1986 PUREX plant whole body deep exposure average (200 mrem/yr) applies to all operating personnel.

[b]14 persons x 200 mrem/year x 23 year = 6.4×10^4 mrem

[c]30 persons x 200 mrem/year x 23 year = 1.4×10^5 mrem

[d]316 persons x 200 mrem/year x 23 year = 1.5×10^6 mrem

[e]8 persons x 200 mrem/year x 23 year = 3.7×10^4 mrem

[f]354 persons x 200 mrem/year x 19 year = 1.3×10^6 mrem

Table P5-1. Occupational Radiological Exposures. (sheet 2 of 3)

	Rad Doses (manrem)				
OPTION	Construction	Operations	D & D	Transportation (Rail) per km	Option Totals
ON-SITE DISPOS.					
Salt-Grout		1.32E+03	3.96E+02		1.71E+03
Disposal Vault (for one unit)					0.00E+00
Salt-Polyethylene		4.46E+03	1.26E+03		6.71E+03
Salt Polyethylene Disposal (for one u					0.00E+00
Mineral-Grout		1.72E+03	6.33E+02		2.36E+03
Mineral Grout Disposal (for one unit)					0.00E+00
Containerized Glass		1.86E+03	8.01E+02		2.64E+03
Containerized Glass Disposal (for one					0.00E+00
Soil Melt Slurry Injection		3.06E+03	7.74E+02		3.83E+03
Glass in Sulfur		1.42E+03	6.81E+02		2.10E+03
Glass in Sulfur Disposal (for one unit)					0.00E+00
Ceramic in Grout		1.63E+03	7.37E+02		2.36E+03
Ceramic in Grout Disposal (for one u					0.00E+00
Receipt & Sample Vaults (for one unit)					0.00E+00
OFF-SITE DISPOS					
HWVP (2.4t)		4.86E+03	7.76E+02	6.66E+01	6.70E+03
HWVP (3X)		1.74E+03	6.30E+02	6.00E+00	2.37E+03
# Cs/Sr Capsule Hand, Facil.		1.63E+02	1.72E+02		3.26E+02
Large Melter (HWVP 4x)		4.43E+03	1.22E+03	8.39E+01	5.74E+03
Multi Melter (24x9t)		9.02E+03	4.52E+03	8.00E+02	1.43E+04
HIP 6.1t		4.16E+03	7.97E+02	2.60E+01	5.01E+03
Cerm. pellet 66t		6.22E+03	8.32E+02	7.40E+02	7.79E+03
Storage Pad (for one unit)					0.00E+00
Glass-Cullet		3.39E+02	1.36E+02	5.90E+01	6.36E+02
Storage Pad (for one unit)					0.00E+00
Calcine		6.23E+03	2.32E+03	4.43E+02	8.99E+03
Storage Pad (for one unit)					0.00E+00
Storage Module (for one unit)					
DWPF MODIFICATIONS		1.74E+03	6.09E+02		2.26E+03
Casks (10m3)				4.60E+01	4.60E+01
Canisters (.62m3)				6.00E+00	6.00E+00
SST CLOSURE					
# *REMOVAL/TRANSFER*					
Mechanical Arm		2.26E+03			2.26E+03
Single Tank Struc.	8.94E+03	1.74E+03	1.16E+03		1.28E+04
Multi-Tank Struc.	1.16E+04	1.61E+03	1.34E+03		1.43E+04
Large/Full T.F.	5.34E+03	1.02E+03	1.33E+03		7.68E+03
Container Transport System	1.87E+02	7.08E+02	2.17E+02	4.90E-01	1.12E+03
In-Situ Treatments					
# Stabilization of Empty Tanks					
* Grout Fill Tanks	7.60E+01	2.77E+02	7.64E+01		4.27E+02
* Gravel Fill Tanks	6.30E+01	2.77E+02	7.88E+01		4.18E+02
# Stabilize RPP Units					
In Situ Soil Immobilization	1.86E+03	3.72E+02	3.84E+02		2.72E+03
Wash/Decon of RPP's		4.04E+03			4.04E+03
In Situ Washing/Soil		1.43E+03			1.43E+03
Barriers (Closure)	1.34E+02	2.18E+03			2.31E+03

Table P5-1. Occupational Radiological Exposures. (sheet 1 of 3)

		Rad Doses (manrem)				
	OPTION	Construction	Operations	D & D	Transportation (Rail) per km	Option Totals
	RETRIEVAL					
#	SST					
	Mechanical		6.61E+03			6.61E+03
	Pneumatic		6.61E+03			6.61E+03
	Hydraulic/Arm Based		6.61E+03			6.61E+03
	Sluicers	1.30E+03	6.44E+02			1.94E+03
	Barrier (S)	6.10E+01				6.10E+01
#	DST					
	Mixer Pumps	6.13E+02	6.87E+01			7.02E+02
	Sluicers	2.38E+02				2.38E+02
	WASTE TRANSFER					0.00E+00
#	Slurry	1.01E+03	8.70E+02	3.73E+02		2.26E+03
	Waste Transfer Annex	7.74E+02	9.18E+02	2.98E+02		1.99E+03
	Waste Staging Facility	1.46E+02	4.71E+02	1.44E+02		7.61E+02
#	Cask/Tank Waste					0.00E+00
	Container Waste Transfer Facility		6.78E+02	3.03E+02	1.76E-01	9.81E+02
	Container Transport System		5.74E+02	1.84E+02	1.76E-01	7.59E+02
	SUPPORT FAC.'s					0.00E+00
#	Single Tank Serus.	1.14E+04	2.76E+02	1.42E+03		1.31E+04
#	Multi-Tank Serus.	1.06E+04	4.10E+02	1.11E+03		1.24E+04
#	Large/Full T.F.	4.88E+03	2.76E+02	1.02E+03		6.17E+03
#	Bridge/Arm Based	2.90E+03	2.76E+02	7.35E+02		3.91E+03
	SEPARATIONS					
	In-Tank SWA (a)		2.88E+02	9.79E+01		3.86E+02
	In-Tank SWB (a)		5.04E+02	2.62E+02		7.67E+02
	Sludge Wash A		1.26E+03	6.41E+02		1.91E+03
	Sludge Wash B		1.59E+03	8.55E+02		2.44E+03
	Sludge Wash C		2.06E+03	1.16E+03		3.21E+03
	Sludge Wash D		2.00E+03	9.66E+02		2.97E+03
	SOLEX A		2.48E+03	1.22E+03		3.71E+03
	SOLEX B		8.27E+03	1.60E+03		9.87E+03
	SOLEX C		2.76E+03	1.64E+03		4.38E+03
	SOLEX D		2.74E+03	1.40E+03		4.13E+03
	CLEAN					
	CPU Supernatant		3.66E+03	8.62E+02		4.52E+03
	Sludge Control Facility		2.76E+03	1.50E+03		4.26E+03
	Maintenance		1.16E+03	3.64E+02		1.52E+03
	IPM		1.27E+03	6.93E+02		1.96E+03
	CPU (Canyon)		3.17E+03	7.86E+02		3.96E+03
	CPU (Mobile)		4.66E+03	1.17E+03		5.82E+03
	TANK WASTE SAFETY					
	SCWO		1.13E+03	3.38E+02		1.47E+03
	INCINERATION		1.12E+03	2.81E+02		1.41E+03
	MITIGATION					
	SST'S	1.67E+02	7.82E+00			1.76E+02
	DST'S	3.93E+01	7.92E+00			4.73E+01
	MWTF (W-236)		3.04E+02	2.16E+02		5.19E+02
	NEW EVAPORATOR		5.28E+02	1.69E+02		6.97E+02
	TANK FARM UPGRADES		0.00E+00	4.26E+02		4.26E+02

Request Number 022

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Joan Young

Date: 12/20/94

Phone Number: 946-7112

Fax Number: 943-6812

Request Information: Evaporator capacity and the radioactive and non-radioactive releases.

(See Attached)

Need Date: 1/15/95

Response:

Data Source/Accuracy: Data Packages - Preliminary

Prepared By: C. Henderson CH

Date Sent/Faxed: 1/27/95

Concurrence: Marc Nelson Marc E. Nelson
Marc Nelson - Deputy Project Manager

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example table for this information is provided as attachment A.

4. IDENTIFY MAXIMALLY EXPOSED WORKER AND ASSOCIATED DOSE OR PROVIDE SUPPORTING DATA TO ALLOW IDENTIFICATION OF MAXIMALLY EXPOSED WORKER

The maximally exposed worker must be identified. If this cannot be specified directly, then the supporting information requested below should be provided.

Operational or maintenance procedures should be briefly described for the activities with significant potential for worker exposure to chemicals or radionuclides. An example chart is provided as Attachment B.

Some specific questions to address include:

a. How often will the melter be changed and will it remain in the vitrification plant until closure or will it be replaced and decontaminated?

b. If it is removed and decontaminated, will there be any exposure to chemicals or radionuclides.

c. How often will the off-gas treatment systems be cleaned and maintained?

d. If there is clean-out of scale in the melter off-gas treatment system, will it require contact maintenance?

e. Will there be operator contact during retrieval of the waste when the sluicing equipment is being introduced or removed from the tanks?

5. POST REMEDIATION EMISSIONS

a. Will there be emissions to the air from the LLW disposal vaults or from the tank residuals? For example, will radon gas or other gases be emitted that result from decay of the LLW?

b. Will there be emissions to the air from the HLW during storage awaiting transportation to Yucca Mountain?

6. EVAPORATOR CAPACITY AND THE RADIOACTIVE AND NON-RADIOACTIVE RELEASES

Specify the evaporator capacity during operation and the radioactive and non-radioactive releases from the evaporator, including tritium releases. Also specify the duration of evaporator operation during the life of the TWRS project.

DATA REQUEST 22

REQUESTED BY: J YOUNG/ASI

EVAPORATOR CAPACITY AND RELEASES

The evaporators used for both the TPA and No Pretreatment are located in the vitrification facilities and the air emissions associated with evaporator operations will be combined with the process offgas and exhausted through the main process stack.

The condensed liquids from evaporator operations will be batched over to the LETF for treatment and eventual discharge to the ground in the 200 West area. We currently have no information on the discharge location or the estimated tritium releases. We have asked WHC for this in past meetings and will formally request.

Request Number 023

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Joan Young

Date: 12/20/94

Phone Number: 946-7112

Fax Number: 943-6812

Request Information: Provide rationale for including only Cs-137, Sr-90, and I-129 as routine releases from the Minimal Pretreatment and TPA Alternative. (See Attached)

Need Date: 1/15/95

Response: List attached. Rationale to be provided by WHC.

Data Source/Accuracy: Data Package - Preliminary

Prepared By: C. Henderson

Date Sent/Faxed: 1/27/95

Concurrence: Marc Nelson Marc E Nelson
Marc Nelson - Deputy Project Manager

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7. PROVIDE RATIONALE FOR INCLUDING ONLY Cs-137, Sr-90, and I-129 AS ROUTINE RELEASES FROM THE MINIMAL PRETREATMENT AND TPA ALTERNATIVE

Attachment C, shows Table 6-5 of "*Waste Retrieval and Transfer Engineering Data Package for the Tank Waste Remediation System Environmental Impact Statement*" WHC-SD-WM-EV-097, Rev A (DRAFT). It lists emissions from the retrieval and transfer of waste for the TWRS EIS alternatives. Only the radionuclides listed above are present. This does not seem to be correct because numerous other radionuclides are present in the tanks and retrieval of only selected radionuclides is not technically feasible. We need some rationale for stating that the remainder of the tank inventory will not cause any routine releases and that the radionuclides listed in this table as "0" Ci/y released to the air are below some level which is low enough to be considered "no release."

8. MSDS DATA SHEETS (NOT NEEDED)

We have considered the JEG request to identify the MSDS needed for the risk assessment effort. We currently believe that the MSDS cannot provide us with useful information because the chemicals identified are in solution (listed as ions, not chemical compounds). MSDS do not exist for these chemical forms.

cc: Alex Nazarali
Joan Young
Andy Stanley
Reed Kaldor
John Horton
John Shrock
Mike Harker
File 2.11.2.2
File 2.11.2.5

Table 6-5. Comparison of Alternatives by Radiological Operating Emissions for Retrieval and Transfer (Ci/y). (2 sheets)

Radionuclide	Continued Storage		In Situ Disposal		Extensive Pretreatment		Minimal Pretreatment		TRPA Preferred Alternative	
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
241Am	0	0	0	0	0	5E-1	0	5E-1	0	5E-1
14C	0	0	0	0	0	5E+1	0	5E+1	0	5E+1
137Cs	5E-5	0	0	0	2E-3	4E+3	2E-3	4E+3	2E-3	4E+3
129I	9E-5	0	0	0	4E-3	5E-2	4E-3	5E-2	4E-3	5E-2
239,240Pu	0	0	0	0	0	2	0	2	0	2
106Ru	0	0	0	0	0	5E-6	0	5E-6	0	5E-6
151Sm	0	0	0	0	0	0	0	0	0	0
90Sr	1E-5	0	0	0	5E-4	7	5E-4	7	5E-4	7
99Tc	0	0	0	0	0	5	0	5	0	5
93Zr	0	0	0	0	0	0	0	0	0	0

DATA REQUEST 23

REQUESTED BY: J YOUNG/ASI

RATIONALE FOR INCLUDING LIMITED NUCLIDES FOR RETRIEVAL AND TRANSFER

JEG will make a request for the rationale behind the limited list of nuclides from WHC.

P5.0 OCCUPATIONAL RADIOLOGICAL EXPOSURES

For purposes of evaluation of options, the annual occupational exposure should be taken to be 400 mrem for radiation workers. Doses for those workers who occasionally go into radiation zones (engineering staff, first line managers) should be assumed to be 40 mrem and the doses for those workers who rarely go into radiation zones (clerical staff, administrative personnel) should be assumed to be 7 mrem. This is based on data from Hanford operations from 1978 through 1986 (Decker and Wirth 1987). Table P5-1 provides the results of dose calculations for each function/option being analyzed.

Data Req 20

Request Number 24

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Tiro Gonzalez Date: 1-9-95

Phone Number: 946-7112 Fax Number: 509-943-6812

Request Information: Need to know if ANY buildings or structures within the TWRS 200 E project area are going to be modified or altered in construction of the TWRS.

Need Date: ASAP (1-13-95 latest)

Response: Communication Record Form attached

Data Source/Accuracy: Blaine Barton, WHC

Prepared By: R. Murray Date Sent/Faxed: 1/17/95

Concurrence: Marc E. Nelson
Marc Nelson - Deputy Project Manager

TWRS EIS
COMMUNICATION RECORD

Date of telephone conversation:	January 11, 1995

Participants or Attendees (with organization):

Dave Murray, JEG
Blaine Barton, WHC

Subject(s) Discussed/Summary of Discussions:

1) We need to know if any building or structures in the 200 E proposed project area are going to be modified or altered during construction of the TWRS facilities.

Answer: The facilities will be constructed in previously used areas. These do not presently contain any structures, so no building or structures will be modified or altered.

2) JEG needs to know the date that the WESF facilities are to be shut down or deactivated. This impacts the need for temporary capsule storage.

Answer: WESF will be shut down when the capsules have all been removed. The most sensible idea is to remove the capsules from the basins on an as-needed basis for further processing, rather than removing all the capsules from the basins and overpacking them for dry storage.

Issues/Concerns Identified: (Unresolved questions)

Required Actions:

Prepared/Recorded By: Dave Murray **Date:** January 11, 1995

Distribution:

C. C. Haass, DOE-RL, S7-51
Participants

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Request Number 025

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Phil Rogers

Date: 1/6/95

Phone Number: (309) 790-0770

Fax Number: (303) 790-4411

Request Information: See attached

Need Date: 1/11/95

Response: See attached

Data Source/Accuracy:

Prepared By: C. Henderson, D. Murray

Date Sent/Faxed: 2/9/95

Concurrence: Marc E. Nelson

Marc Nelson - Deputy Project Manager

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VADOSE ZONE FLOW AND TRANSPORT MODEL PARAMETER DATA REQUEST

For each of the eight source areas (Figure 1) and the LLW Burial site (associated with the TPA alternative) we are requesting the following site specific or waste source specific data sets for vadose zone flow and transport modeling. It would be useful to provide any simplifying assumptions that were used to derive or justify any particular data set.

The most important information that is needed is the release flux of water and concentration of radionuclides and chemicals from each waste source for each of the remediation alternatives. The fluxes should be available as part of the engineered control specifications for each remedial alternative. We expect that there will be a different flux for each of the following:

- Low Level Waste Burial facility
- Waste Retrieval Operations (e.g. sluicing operations from the single shell tanks
- Tank contaminants (e.g., 1% and 5%) that cannot or are assumed not to be removed

The computer code VAM2D will be used to model vadose zone flow and transport. The modeling will require the following input parameters:

SITE GEOMETRY

- Map layout - We need location and area of each of the eight source areas associated with the 177 tanks. The approximate areas have already been determined (see Figure 1). Corner point coordinates in state plane (or whatever is our standard) are still needed for each of the eight source areas. We also need LLW burial site location and coordinates.

- Cross-sections - for each of the source areas and the LLW burial site we need the depth of the base of each waste source or representative source (i.e. depth of point of release). We also need representative geologic cross sections through each of the 8 source areas and the LLW burial site. The cross sections should include: a delineation of the hydrostratigraphic units under each area, their thicknesses, and depth to the water table (thickness of the vadose zone).

The following information will be required for the modeling but will be obtained by the modeling staff (i.e., Joe Griffin, Charlene Regenhardt and Phil Rogers).

POROUS MEDIUM PROPERTIES FOR EACH MAJOR HYDROSTRATIGRAPHIC UNIT

- Saturated horizontal hydraulic conductivity. K_h (LT^{-1})
- Saturated vertical hydraulic conductivity K_v (LT^{-1})
- Specific Storage S_s (L^{-1})
- Saturated Water Content θ_s (Volumetric ratio of water to solid matrix)
- Longitudinal and transverse dispersivity α_L and α_T (L)
- Free water molecular diffusion coefficient D_o (L^2T^{-1})
- Effective porosity ϕ (unitless)
- Bulk density ρ_B (ML^{-3})

CONSTITUITIVE RELATIONSHIPS FOR EACH MAJOR STRATIGRAPHIC UNIT

- Parameter n from Brooks-Corey relation (unitless)
- Air entry pressure head ψ_a (unitless)
- Parameters α, β, and γ of van Genuchten relation (unitless)

INITIAL AND BOUNDARY CONDITIONS

- Initial pressure head distribution ψ_0 (L)
- Prescribed values of pressure head ψ_0 (L)
- Prescirbed values of nodal water flux (L^3T^{-1})
- Initial concentration of chemicals and radionuclides at the point of release C_0 (ML^{-3})

PROPERTIES OF SOLUTE SPECIES FOR EACH CHEMICAL AND RADIONUCLIDE

- Decay coefficient λ (T^{-1})

- Distribution coefficient K_d (L^3M^{-1})

SATURATION OF FLUID PHASE S_w (Unitless)

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VADOSE ZONE FLOW AND TRANSPORT MODEL PARAMETER DATA REQUEST

For each of the eight source areas (Figure 1) and the LLW Burial site (associated with the TPA alternative) we are requesting the following site specific or waste source specific data sets for vadose zone flow and transport modeling. It would be useful to provide any simplifying assumptions that were used to derive or justify any particular data set.

The most important information that is needed is the release flux of water and concentration of radionuclides and chemicals from each waste source for each of the remediation alternatives. The fluxes should be available as part of the engineered control specifications for each remedial alternative. We expect that there will be a different flux for each of the following:

- Low Level Waste Burial facility
- Waste Retrieval Operations (e.g. sluicing operations from the single shell tanks
- Tank contaminants (e.g., 1%) that cannot or are assumed not to be removed

The computer code VAM3D-CG will be used to model vadose zone flow and transport. The modeling will require the following input parameters:

SITE GEOMETRY

- Map layout - We need location and area of each of the eight source areas associated with the 177 tanks. The approximate areas have already been determined (see Figure 1). Corner point coordinates in state plane (or whatever is our standard) are still needed for each of the eight source areas. We also need LLW burial site location and coordinates.

- Cross-sections - for each of the source areas and the LLW burial site we need the depth of the base of each waste source or representative source (i.e. depth of point of release). We also need representative geologic cross sections through each of the 8 source areas and the LLW burial site. The cross sections should include: a delineation of the hydrostratigraphic units under each area, their thicknesses, and depth to the water table (thickness of the vadose zone).

POROUS MEDIUM PROPERTIES FOR EACH MAJOR HYDROSTRATIGRAPHIC UNIT

- Saturated horizontal hydraulic conductivity, K_h (LT^{-1})

- Saturated vertical hydraulic conductivity K_v (LT^{-1})

- Specific Storage S_s (L^{-1})

- Saturated Water Content θ_s (Volumetric ratio of water to solid matrix)

- Longitudinal and transverse dispersivity α_L and α_T (L)
- Free water molecular diffusion coefficient D_o (L^2T^{-1})
- Effective porosity ϕ (unitless)
- Bulk density ρ_B (ML^{-3})

CONSTITUITIVE RELATIONSHIPS FOR EACH MAJOR STRATIGRAPHIC UNIT

- Parameter n from Brooks-Corey relation (unitless)
- Air entry pressure head ψ_a (unitless)
- Parameters α, β, and γ of van Genuchten relation (unitless)

INITIAL AND BOUNDARY CONDITIONS

- Initial pressure head distribution ψ_0 (L)
- Prescribed values of pressure head ψ_0 (L)
- Prescirbed values of nodal water flux (L^3T^{-1})
- Initial concentration of chemicals and radionuclides at the point of release C_0 (ML^{-3})

PROPERTIES OF SOLUTE SPECIES FOR EACH CHEMICAL AND RADIONUCLIDE

- Decay coefficient λ (T^{-1})
- Distribution coefficient K_d (L^3M^{-1})

SATURATION OF FLUID PHASE S_w (Unitless)

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DRAFT--FOR INTERNAL REVIEW AND COMMENT

TO: Marc Nelson

FROM: Phil Rogers Phil Rogers

DATE: 12/2/94

cc: Alex Nazarali
Dave Murray
Arrie Bachrach
John Horton
Andy Stanley

re: Recommended source descritization for no action and in situ alternatives

EXECUTIVE SUMMARY

The recommendations of this paper are to descritize the waste from the 177 tanks into eight source areas: three source areas in the 200 West Area and five source areas in the 200 East Area (Figure 1). The approach is sufficiently robust to allow for source data modifications/refinements by Westinghouse Hanford Company (WHC), provides level of detail commensurate with the complex hydrogeologic setting, and is consistent with the current level of source data detail as provided by WHC (WHC Internal Memo No. 7E330-94-038, TWRS Process Design to Distribution, 10/26/95).

PURPOSE

The purpose of this paper is to document the rationale for descritization of the contaminant sources from the 177 tanks. Potential approaches range from: 1) modeling each of the 177 tanks as a discrete source, 2) modeling each tank farm as a discrete source, 3) combining tank farms and modeling each group of tank farms as a discrete source, and 4) combining all the tanks in 200 East into one source and all the tanks in 200 West into one source. The rational for the recommended source descritization is presented in the following.

HYDROGEOLOGIC CONSIDERATIONS

The selection of contaminant source locations and associated detail must take into account the hydrogeologic conditions of the 200 Areas and Hanford Site. The hydrogeologic factors that influence descritization of the contaminant sources from the 177 tanks are the following:

- The lateral variations of the vadose zone and
- Groundwater flow direction in the unconfined aquifer.

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Source Locations

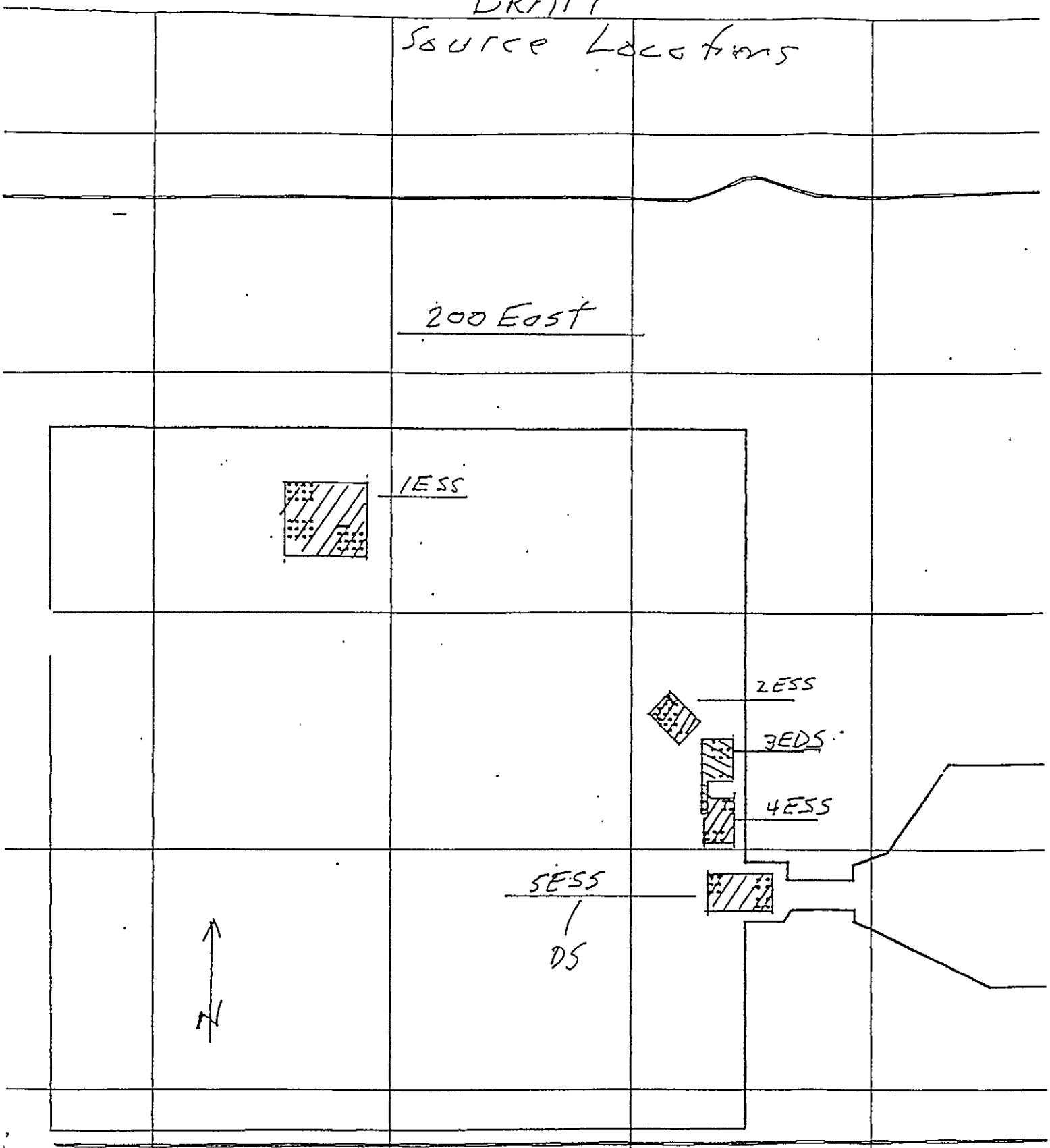

Figure 1 Proposed Source Locations
Sheet 1 of 2

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Source Locations

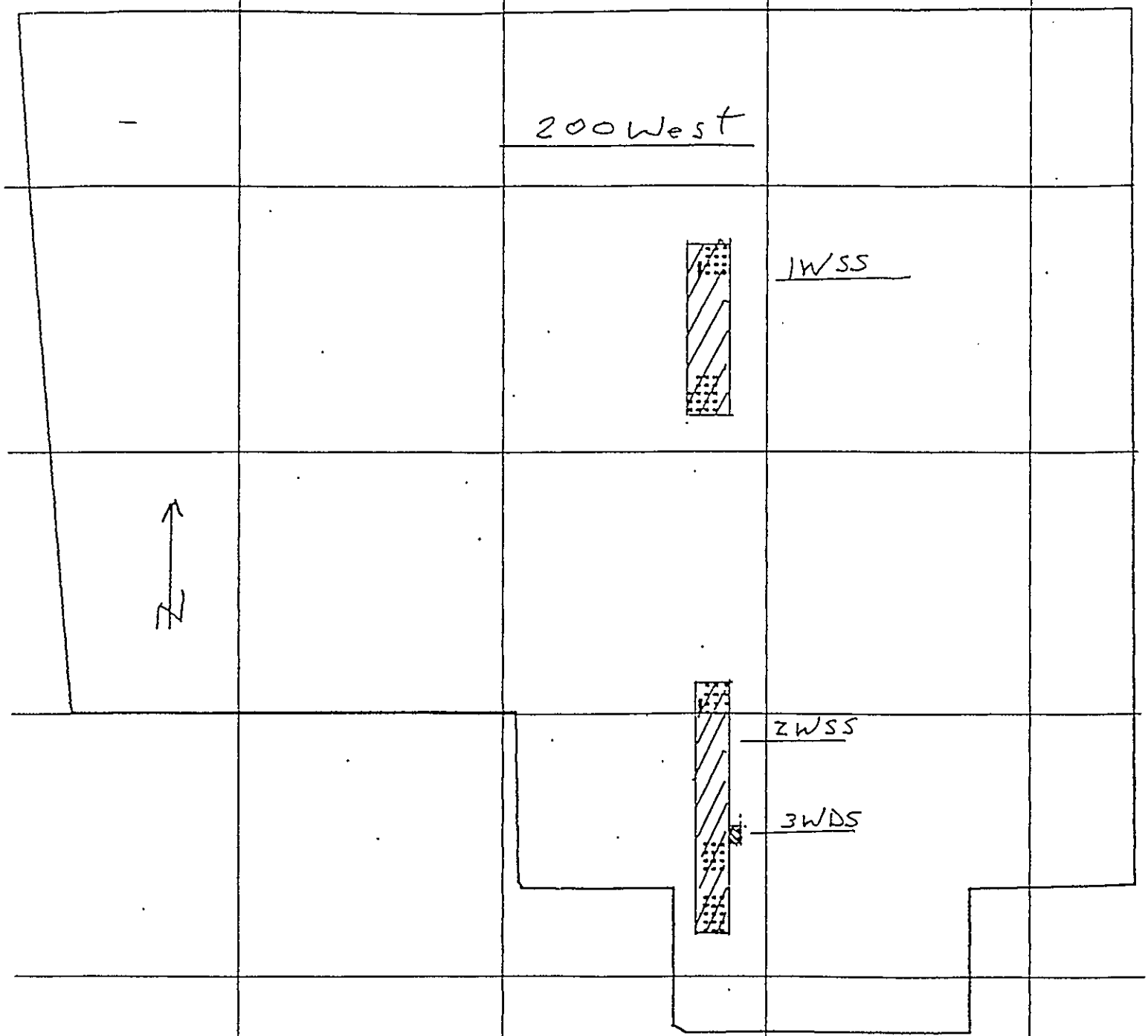

Figure 1 Proposed Source Locations

Sheet 2 of 2

Vadose zone properties important to contaminant transport include permeability, strata thicknesses, overall thickness, and moisture content. These properties are understood on only a gross or large-scale basis at the Hanford Site. The available level of detail allows for vadose characterization of large areas such as the whole or major portions of the 200 West and 200 East Areas. Some of the vadose zone characteristics, such as overall thickness or in some cases individual strata thicknesses, may be refined at selected locations within the 200 Areas based on nearby borings, wells, and piezometers. However, the level of available vadose zone information does not allow for detailed development of separate vadose zone models for each tank or even each tank farm.

Groundwater flow direction on the Hanford Site can be inferred from the water level map shown on Figure 2 and has been interpreted by PNL using and numerical groundwater flow model. The PNL work is presented as a series of streamlines on Figure 3. The most rigorous analysis of contaminant transport in the unconfined aquifer requires that each of the 177 tanks be represented by a discrete source. A simplification, that is also conservative, is to represent sources areas as groups of tanks (i.e., tank farms) or as groups of tank farms. This is conservative because more potential flow paths are included in the analysis than would be impacted if only discrete tank locations (point sources) were considered.

CONTAMINANT SOURCE DATA CONSIDERATIONS

The current data provided by WHC (WHC Internal Memo No. 7E330-94-038, TWRS Process Design to Distribution, 10/26/95) provides contaminant inventory on the basis of total inventory for single-shell tanks (SST) and total inventory for double-shell tanks (DST). Review of the above referenced document also reveals that the sources in the DSTs are markedly different in some respects than the source in the SSTs. For instance, there are 86 radionuclides/isotopes in the SSTs and, by comparison, only 12 radionuclides/isotopes in the DSTs. Two recommendations are drawn from these data:

1) Source areas for modeling should consider the DSTs and the SSTs separately. This is prudent based on the existing data and could save effort in the future should WHC refine or modify the source data information.

2) The current data does not warrant a tank-by-tank analysis because it is provided as total inventory in DSTs and total inventory in SSTs.

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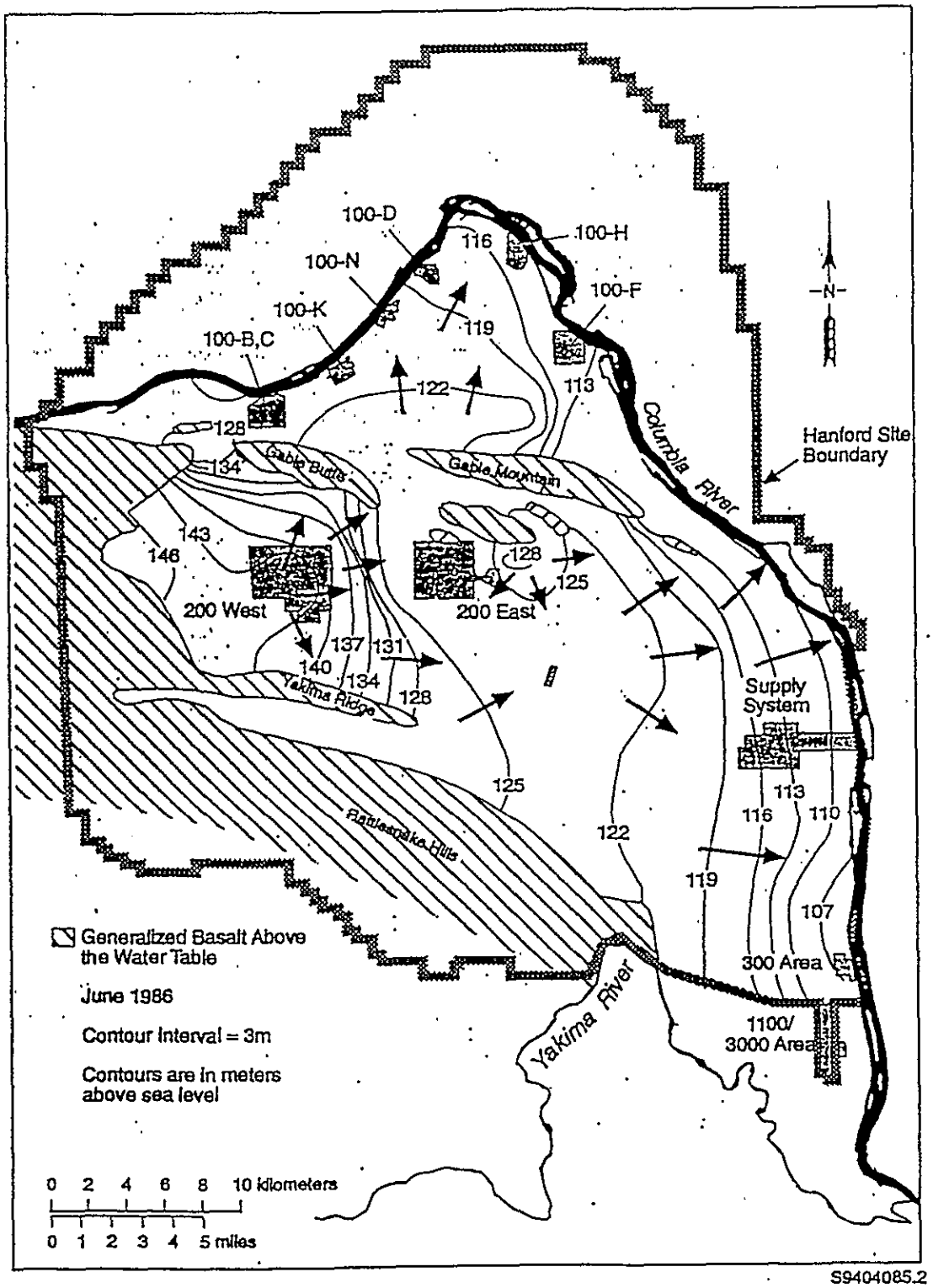

Figure 2 Water-Table Map and Flow Directions at the Hanford Site (from Freshley and Graham 1988)

Source: Schramke, et al. 1994

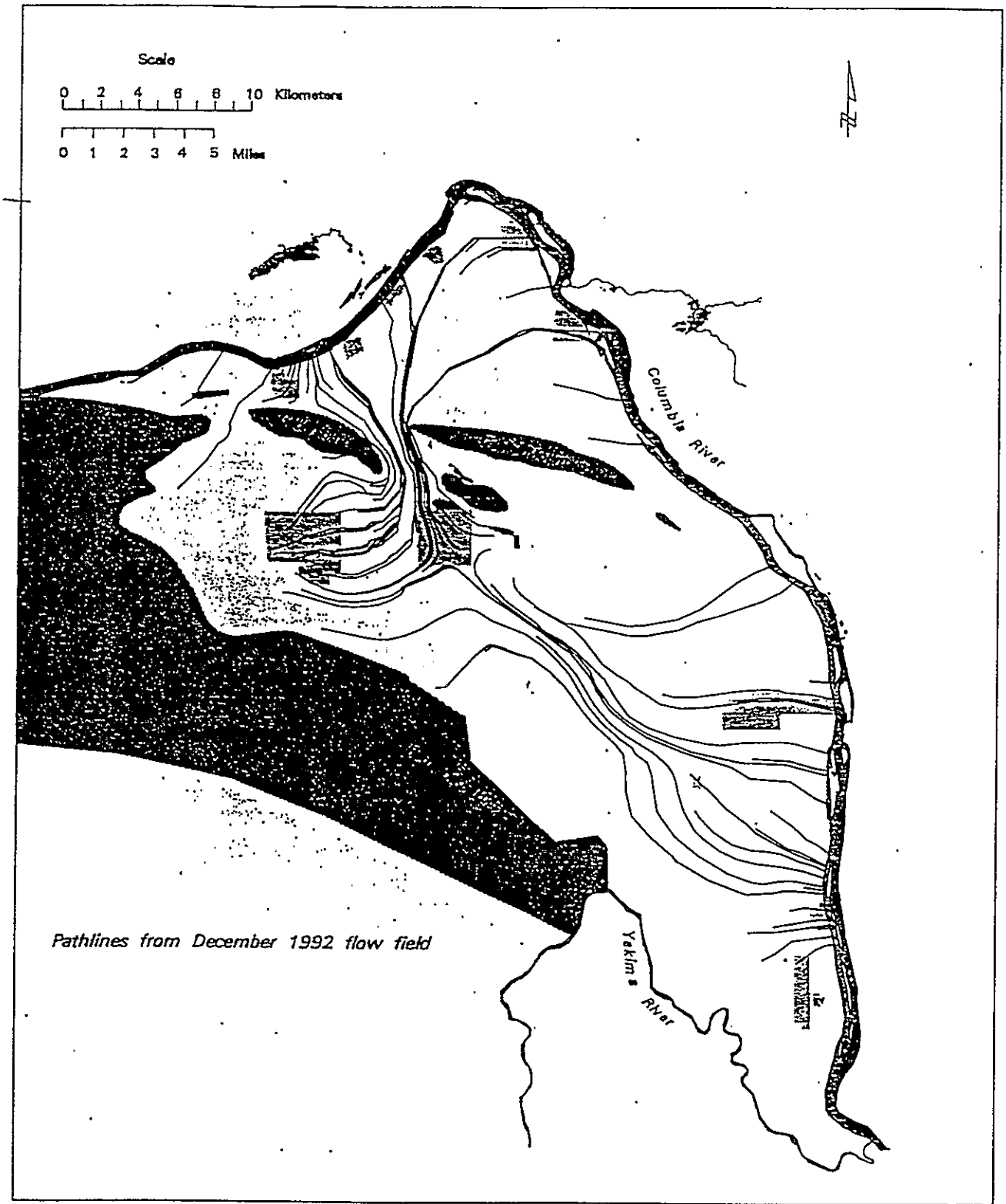

Figure 3 Streamlines in the Unconfined Aquifer simulated with CFEST

Source: HRA EIS, unpublished

RECOMMENDED APPROACH

It is recommended that the 177 tanks be grouped into eight source areas (see Figure 1) based on their proximity to each other and the type of tank (DST or SST). The base-case source for each of the eight areas is then determined by pro-rating the total source by the sum of the volume contained in the tanks in each area. The volume data is assumed to be readily available from WHC.

It is important that, for each source area, a source term for modeling is selected that is at least as high as the highest likely pro-rated source. This is necessary because of the unit-risk approach being used for this EIS. With this approach, we can scale down with confidence but generally, cannot scale up with the same confidence. This is best illustrated with an example. Assume, for source area 1WSS (see Figure 1), the initial concentration of I-129 is 1000 Ci and that the modeling results indicate that the I-129 concentration in groundwater at some x,y coordinated and time t is 1 Ci. If the source is later found to be 500 Ci instead of 1000, then the predicted concentration at the same x,y,t is 0.5 Ci. Scaling up is potentially problematic because, near the edges of the groundwater plume the predicted concentration of I-129 is rounded to zero.

REFERENCES

1. Westinghouse Hanford Company, Internal Memo No. 7E330-94-038, from TWRS Process Design to G.K. Allen, et al, October 26, 1994.

2. Schramke, J. A., C. S Glantz, and G. R. Holdren, "Hanford Site Environmental Settings Data Developmend for Unit Risk Factor Methodology in Support of the Programmatic Environmental Impact Statement (PEIS)", Pacific Northwest Laboratory, PNL-9801/UC-402, May 1994.

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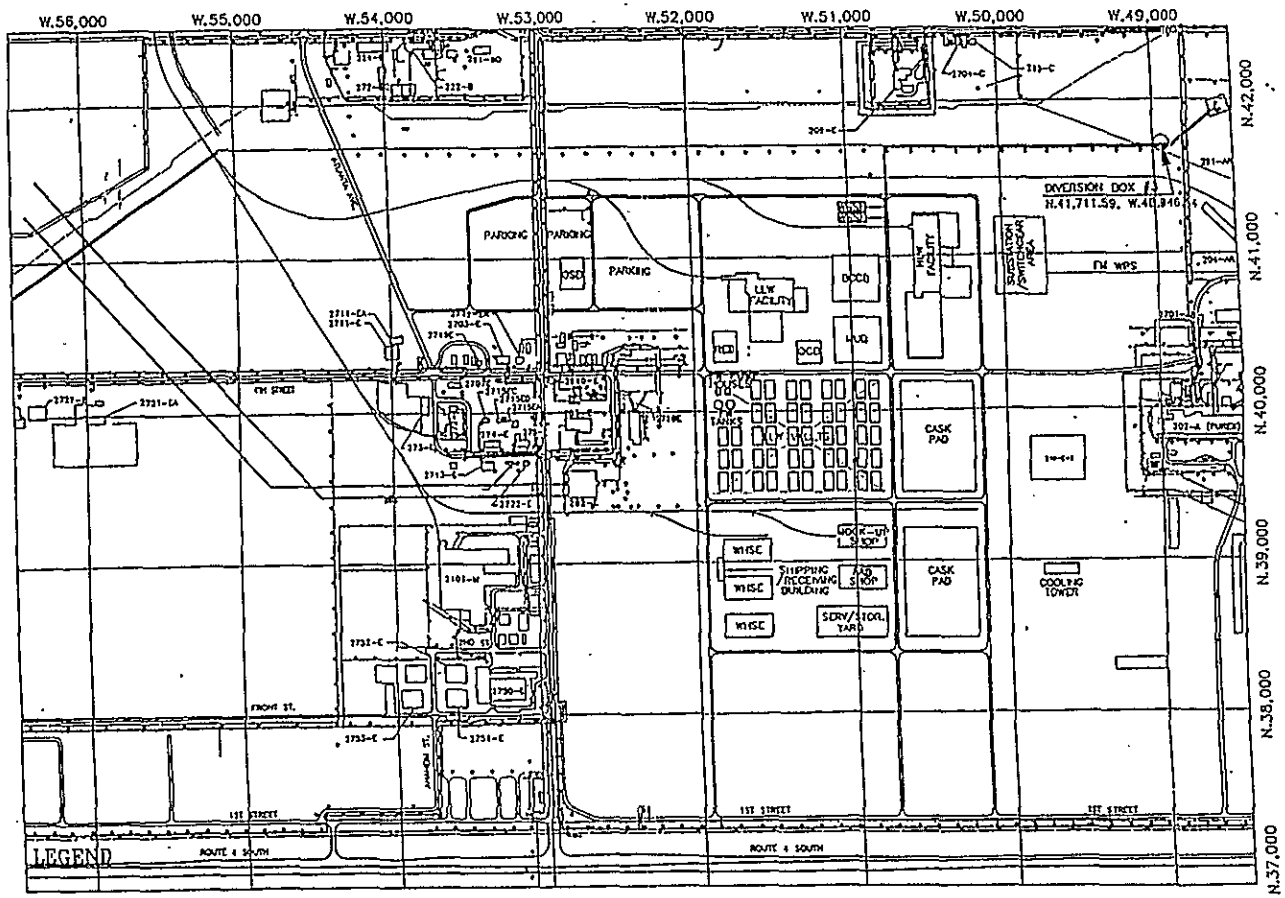
Waste tank coord locations in 8 tank groups plus TPA case LLW disposal site coordinates.

	STATE PLANE COORDINATES				
				AREA	
	NORTH	WEST		SQ METERS	
1WSS				91000	
CENTER	136,460	566,780			
CORNERS	136130	566710			
	136130	566850			
	136780	566710			
	136780	566850			
2WSS				104500	
CENTER	134680	566810			
CORNERS	135120	566750			
	135120	566860			
	134170	566750			
	134170	566860			
3WDS				4200	
CENTER	134540	566890			
CORNERS	134510	566860			
	134510	566920			
	134580	566860			
	134580	566890			
1ESS				89600	
CENTER	137400	573720			
CORNERS	137250	573880			
	137250	573560			
	137530	573880			
	137530	573560			
2ESS				12250	
CENTER	136560	575170			
	136480	575160			
	136560	575090			
	136560	575240			
	136650	575160			
4ESS				20600	
CENTER	136130	575380			
CORNERS	136030	575310			

Waste tank coord locations in 8 tank groups plus TPA case LLW disposal site coordinates.

	136030	575430			
	136160	575310			
	136160	575330			
	136210	575330			
	136210	575430			
3EDS				26000	
CENTER	136320	575380			
CORNERS	136160	575300			
	136160	575330			
	136290	575330			
	136290	575430			
	136460	575430			
	136460	575300			
5EDS				40500	
CENTER	135820	575460			
CORNERS	135750	575320			
	135750	575590			
	135900	575320			
	135900	575590			
DISPOSAL VAULTS FOR LLW UNDER TPA CASE				92520	
CENTER	135616	574256			
CORNERS	135746	574070			
	135746	574430			
	135489	574430			
	135489	574070			

Figure 5-1. Site Plan.



200 EAST AREA

LEGEND

DCCD	BULK HANDLING & COLD CHEM MAKE-UP BUILDING
FAB	FABRICATION
FW	FIREWATER
HLW	HIGH LEVEL WASTE VITRIFICATIO
LLW	LOW LEVEL WASTE VITRIFICATIO
MUB	MECHANICAL UTILITIES BUILDING
OCD	OPERATIONS CONTROL BUILDING
OSD	OPERATIONS SUPPORT BUILDING
RCD	REGULATED ENTRANCE BUILDING
WSSF	WASTE STAGING AND SAMPLING FACILITY
SERV/STOR	SERVICE/STORAGE
WHSE	WAREHOUSE

CASE 8A EIS

U.S.DEPARTMENT OF

FLUOR DANIEL, INC. ADVANCED TECHNOLOGY

EIS
TPA PREFERRED ALT
SITE PLAN

ES-ALT8A-03

5-3/5-4

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE: Computer Science and Radiation Technology,
TITLE: Database Manager and Health Physicist

ORIGINATOR: Mitchell Pelton and Johnny Davis

DATE: 1/27/95
REVISION NO: 0

OBJECTIVE: Aggregate the tank farm inventories given by WHC memo (Golberg 12/26/94) into the specified groupings as outline by the ESE memo (Rogers 12/2/94). Also since no inventories were given for double shell tanks in 1995, back calculate them from 1999 to 1995.

METHODOLOGY: Data was received in an EXCEL 4.0 workbook and thus manipulated with the same. Find which tank farms are associated with which grouping and add those inventories together. Back calculation for radionuclides is explained further in the text of this memo.

ASSUMPTIONS: No decay chains were used in back calculating radionuclide inventories from 1999 to 1995.

SIGNATURE

Table 6
Aggregated Inventory (Metric Tons) of Nonradioactive Chemicals for Double Shell Tanks

Chemical	5EDS		3EDS		3WDS		Total	
	Soluble	Insoluble	Soluble	Insoluble	Soluble	Insoluble	Soluble	Insoluble
Ag+	1.18E-01	1.32E+00	2.10E-01			5.80E-02	3.28E-01	1.36E+00
Al+3		4.29E+01		1.05E+01		1.44E+01		6.78E+01
As+5	7.44E-01	2.97E-01	2.60E-02			2.01E-01	7.70E-01	4.98E-01
B+3	1.01E-01	9.17E-01	6.64E-02		3.52E-01	7.66E-02	5.19E-01	9.94E-01
Ba+2	7.01E-01	2.41E+00	6.16E-02	6.80E-01	2.93E-02	3.26E-03	7.91E-01	3.09E+00
Be+2	5.97E-02	7.47E-03	2.22E-02	1.39E-04			8.19E-02	7.61E-03
Bi+3	1.74E+00		5.21E-01				2.26E+00	
Co+2	5.19E+00	7.96E+00	6.02E-01	1.79E+00	4.48E+00	1.74E+00	1.03E+01	1.15E+01
Cd+2	9.68E-02	5.77E+00	7.05E-02			2.42E-01	1.67E-01	6.01E+00
Ce+3	2.26E-02	2.78E+00				2.64E-01	2.26E-02	3.04E+00
Cr+3		9.31E+00		7.84E-01		2.40E+01		3.41E+01
Cu+2	7.32E-02	4.05E-01	1.04E-01			3.42E-01	1.77E-01	7.46E-01
Fe+3	3.10E+00	1.32E+02	8.18E-01	1.92E+00	4.17E+00	8.27E+00	8.09E+00	1.42E+02
Hg+	5.75E-02		9.43E-04				5.84E-02	
K+	1.48E+02	1.79E+00	3.60E+02	1.80E+01	3.72E+01	3.76E-01	5.46E+02	2.02E+01
La+	2.19E-01	1.96E+01		1.35E+00		9.89E-02	2.19E-01	2.10E+01
Li+	2.13E-03	2.26E-02			3.64E-03	1.96E-03	5.77E-03	2.46E-02
Mg+2	5.26E-01	9.53E+00	3.92E-01	1.00E+00	4.67E-02	4.62E-01	9.65E-01	1.10E+01
Mn+4	6.11E+00	1.48E+01	1.53E-01	9.50E-01	1.42E+00	2.29E+00	7.69E+00	1.80E+01
Mo+6	3.82E+00	2.09E-01	2.72E-01	5.25E-01	7.85E-01	6.71E-02	4.87E+00	8.01E-01
Na+	6.00E+03	6.51E+01	2.80E+03	1.36E+02	2.13E+03	2.85E+01	1.09E+04	2.30E+02
Nd+3		1.19E+01				1.17E-01		1.20E+01
Ni+2	3.34E+00	5.03E+00	1.81E-01	4.30E-01	5.54E-01	1.11E+00	4.07E+00	6.57E+00
Pb+4	5.63E-01	2.95E+00	1.39E+00			3.34E-01	1.96E+00	3.28E+00
Pd		1.20E+00						1.20E+00
Rb	6.14E-02	2.56E-03					6.14E-02	2.56E-03
Re	4.01E-03	3.25E-02		2.14E-01			4.01E-03	2.46E-01
Rh	1.20E-02	7.34E-02		1.47E+00		1.38E-01	1.20E-02	1.68E+00
Ru	2.60E-02	2.63E-01		8.35E-01		1.36E-01	2.60E-02	1.23E+00
Sb	6.21E-01	1.51E+00		1.35E+00		9.82E-02	6.21E-01	2.96E+00
Se	1.21E+00	7.20E-01	2.20E-03	2.59E+00		6.37E-01	1.21E+00	3.95E+00
SiO3-	1.03E+01	1.99E+02	5.13E+00	9.32E+00	7.15E-02	6.01E+00	1.55E+01	2.14E+02
Sn	3.21E-05		3.81E-04				4.13E-04	
Te	5.40E-03	6.21E-02		1.13E+00		1.03E-01	5.40E-03	1.30E+00
Th	2.02E-02	3.83E-01		2.55E+00		6.24E-01	2.02E-02	3.56E+00
Ti	6.24E-02	2.00E-01	2.23E-02	2.57E-01		3.86E-02	8.47E-02	4.96E-01
Tl	2.33E-01	3.65E+00		2.92E+01		5.49E-01	2.33E-01	3.34E+01
UO2+2	2.19E+00	7.91E-01	1.36E+00	2.60E+01			3.54E+00	2.68E+01
V+5	6.20E-02	8.09E-03		1.66E-01		1.37E-02	6.20E-02	1.88E-01
W+6	7.47E-01						7.47E-01	
Zn+2	3.50E-01	4.20E-01	2.14E+00	2.80E-01	1.10E+00	2.45E-01	3.59E+00	9.45E-01
Zr+4	2.30E-01	1.85E+01	2.18E-01	2.58E+02		1.85E-01	4.48E-01	2.77E+02
Al(OH)4-2	2.44E+03		8.34E+02		1.19E+03		4.47E+03	
CO3-2	9.41E+02	5.17E+01	8.43E+02	3.00E+00	8.39E+01	3.61E+00	1.87E+03	5.83E+01
Cl-	1.47E+02	5.75E-01	5.24E+01	3.60E-02	7.41E+01	8.77E-01	2.73E+02	1.49E+00
Cr(OH)4-	4.06E+01		1.14E+01		6.01E+01		1.12E+02	
F-	3.56E+01	6.39E-01	3.02E+02	1.81E+01	8.63E+00	3.63E-01	3.46E+02	1.91E+01
SO4-2	2.77E+02	1.96E+00	7.10E+01	1.25E+00	3.83E+01	3.46E+00	3.86E+02	6.68E+00
NO3-	4.43E+03	2.04E+01	2.19E+03	8.28E+00	1.03E+03	1.04E+01	7.65E+03	3.91E+01
NO2-	1.94E+03	5.06E+00	8.88E+02	8.94E-01	2.44E+02	2.46E+00	3.07E+03	8.42E+00
PO4-3	7.13E+01	1.40E+01	7.44E+01	4.57E-01	6.63E+01	7.16E+00	2.12E+02	2.16E+01
OH-	9.99E+02	2.45E+01	6.97E+02	5.96E+01	2.03E+02	3.87E+01	1.90E+03	1.23E+02
TOC	8.08E+02	6.25E+01	5.48E+01	4.60E+00	1.28E+02	1.29E+00	9.90E+02	6.84E+01
Total	1.83E+04	7.45E+02	9.19E+03	6.04E+02	5.31E+03	1.60E+02	3.28E+04	1.51E+03
H2O	2.76E+04		4.88E+04		9.51E+03		8.59E+04	
Grand Total	4.59E+04	7.45E+02	5.80E+04	6.04E+02	1.48E+04	1.60E+02	1.19E+05	1.51E+03
Volume, Liters	3.51E+07		5.06E+07		9.60E+06		9.53E+07	

Tank Waste Current Source Inventory
January 27, 1995

Introduction

The purpose of this paper is to offer recommendations on the current source inventory to be used in the Tank Waste Remediation System (TWRS) Environmental Impact Statement (EIS). Current source inventory, as used here, refers to the inventory of tank constituents available for release into the environment at the current time. This initial inventory is an important requirement for the fate and transport modeling and, ultimately, the risk assessment for the TWRS EIS.

To support the risk assessment group in assessing risk from exposure to tank constituents, the fate and transport modeling group(s) must first model the changes in contaminant concentrations resulting from the movement of contaminants through the environment from the source (tanks) to the receptor. To execute the fate and transport model, a release term describing the amount of each tank constituent actually released into the environment must first be developed. The release term will be some fraction of the inventory available for release, and can thus be calculated from the current source inventory presented in this paper. Calculation of release terms is the responsibility of the fate and transport modeling group(s) and will not be further addressed in this paper.

Aggregated Source Areas

The range of available approaches for representing the contaminant sources in the 177 tanks has been reviewed in a previous paper (Rogers, 1994). That paper recommends against representing each tank as a discrete source and instead recommends that contaminant source locations be defined by combining tank farms and considering each group of tank farms as a discrete source. The 177 tanks are grouped into eight source areas, three in the 200 West Area and five in the 200 East Area, each of which contains groups of either single-shell tank (SST) farms or double-shell tank (DST) farms (Figure 1). The eight source areas are defined on the basis of tank farm location, tank type (SST or DST), hydrogeolgy, and source data considerations. A detailed discussion of the rationale for defining the source areas is provided in Rogers (1994).

Use of the eight source areas as recommended in Rogers (1994) appears fully compatible with the planned strategy for conducting the risk assessment as outlined in JEG (1994). It is therefore assumed that these source areas are to be used in the TWRS EIS. In the following paragraphs, aggregated current source inventories are generated for each of the eight source areas defined in Rogers (1994). Should the source areas later be modified, corresponding modifications to the current source inventories can easily be made.

Sources of Data and Recommended Method for Generating Current Source Inventories

Rogers (1994) recommends that source inventories for the eight source areas be determined by pro-rating the total source by the sum of the volume contained in the tanks in each area. At the time this recommendation was made, the contaminant source data available from Westinghouse Hanford Company (WHC [Goldberg, 1994a]) displayed tank inventories only on a total tank basis (i.e., total inventory for SSTs and total inventory for DSTs). WHC has subsequently updated the total-tank source data (Goldberg, 1994b) (see Tables 1 and 2). More importantly, WHC has also provided computer spreadsheets containing tank-by-tank and farm-by-farm inventories for DSTs and SSTs, respectively, to Advanced Sciences, Inc. (ASI) (Young, 1994; Pelton, 1994).

A disadvantage with determining current source inventories by volume ratio, as recommended in Rogers (1994), is that it could result in allocating mass for certain contaminants to source areas where no such mass actually resides. This would lead to inaccurate representation of the risk originating from a given source area. The tank-by-tank and farm-by-farm inventories provided in the WHC spreadsheets eliminate the need to use volume ratios to allocate tank inventories and make it possible to generate aggregated current source inventories for each of the eight source areas that accurately allocate contaminant mass. The current source inventories presented herein are therefore generated using the WHC tank-by-tank and farm-by-farm inventories.

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Decay Dates

The current assumption is that the year 1995 will be used as the starting time (T_0) for the TWRS EIS risk assessment. The radionuclide data provided by WHC for SSTs were decayed to a range of dates, including 1995. The radionuclide data provided by WHC for DSTs, however, were decayed only to December 31, 1999. ASI has performed a calculation to convert the WHC inventories for DSTs to a December 31, 1995 decay date. The calculation was performed using the simple decay equation as follows:

$$I_{(1995)} = I_{(1999)} \times e^{+\lambda t}$$

where

$I_{(1995)}$ = Inventory year 1995
$I_{(1999)}$ = Inventory year 1999
λ = Decay Constant = $\ln 2/T_{1/2}$
t = Decay Duration (1999 - 19995 = 4 years)
$T_{1/2}$ = Radionuclide Half Life

Current Source Inventory for Single-shell Tanks

Five of the eight source areas are comprised of groups of single-shell tank farms (Figure 1). Current source inventories for the five SST source areas are shown in Tables 3 and 4. Table 3 shows the aggregated inventory of radionuclides for the five areas decayed to 12/31/95

(totals decayed to 12/31/99 are also included for comparison purposes); Table 4 shows the aggregated inventory of nonradioactive chemicals. The inventories were generated by summing the data provided in the WHC farm-by-farm inventories for the single-shell tank farms in each source area. The total column in Table 3 (12/31/99) and Table 4 must be the same as the totals listed in Tables 1 and 2, respectively, for SST waste.

Current Source Inventory for Double-shell Tanks

Three of the eight source areas contain groups of double-shell tank farms (Figure 1). Current source inventories for the three DST source areas are shown in Tables 5 and 6. Table 5 shows the aggregated inventory of radionuclides for the three areas decayed to 12/31/95 (totals decayed to 12/31/99 are also included for comparison purposes); Table 6 shows the aggregated inventory of nonradioactive chemicals. The inventories were generated by summing the data provided in the WHC tank-by-tank inventories for the double-shell tanks in each source area. The total column in Table 5 (12/31/99) and Table 6 must be the same as the totals listed in Tables 1 and 2, respectively, for DST waste.

References

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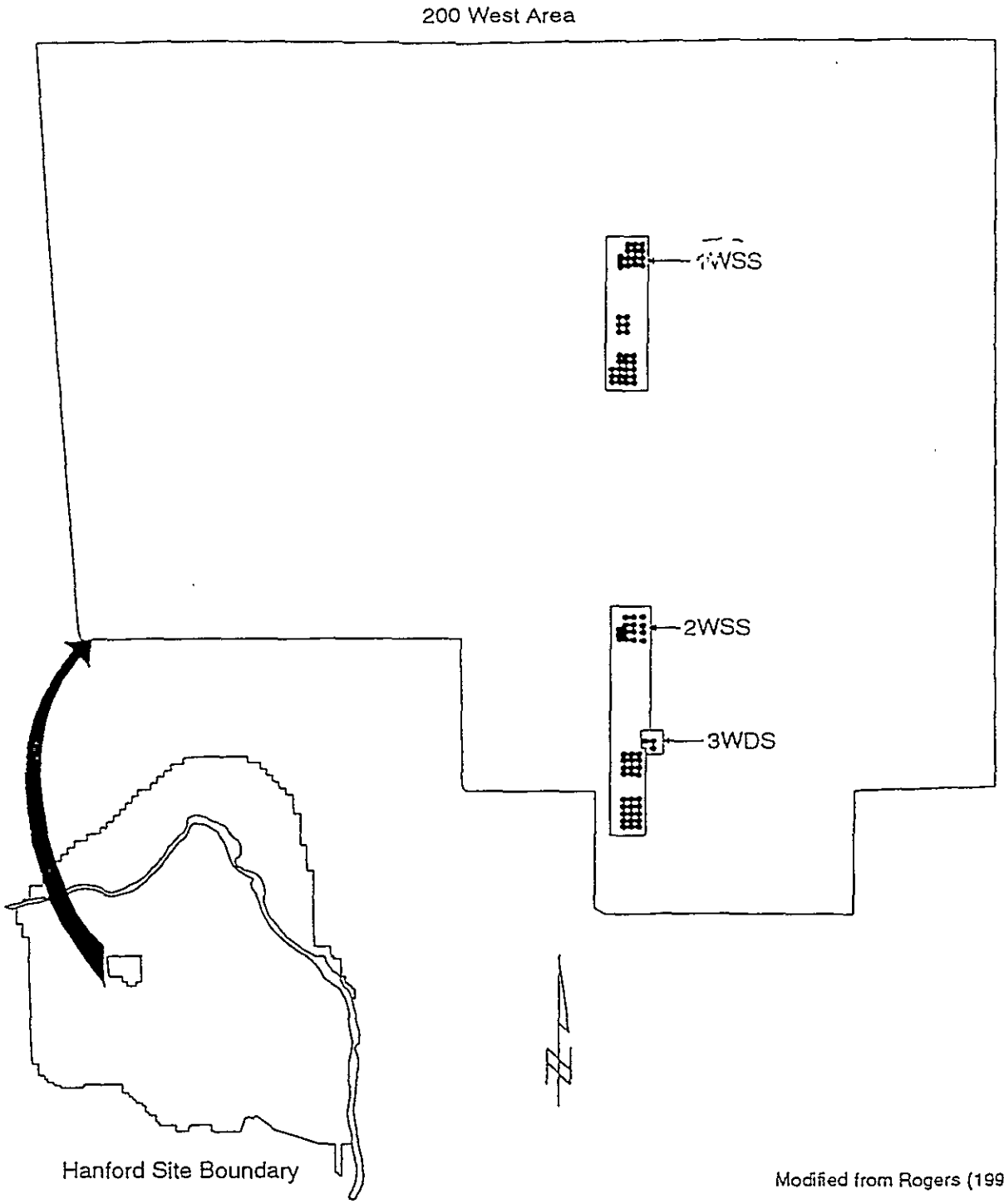
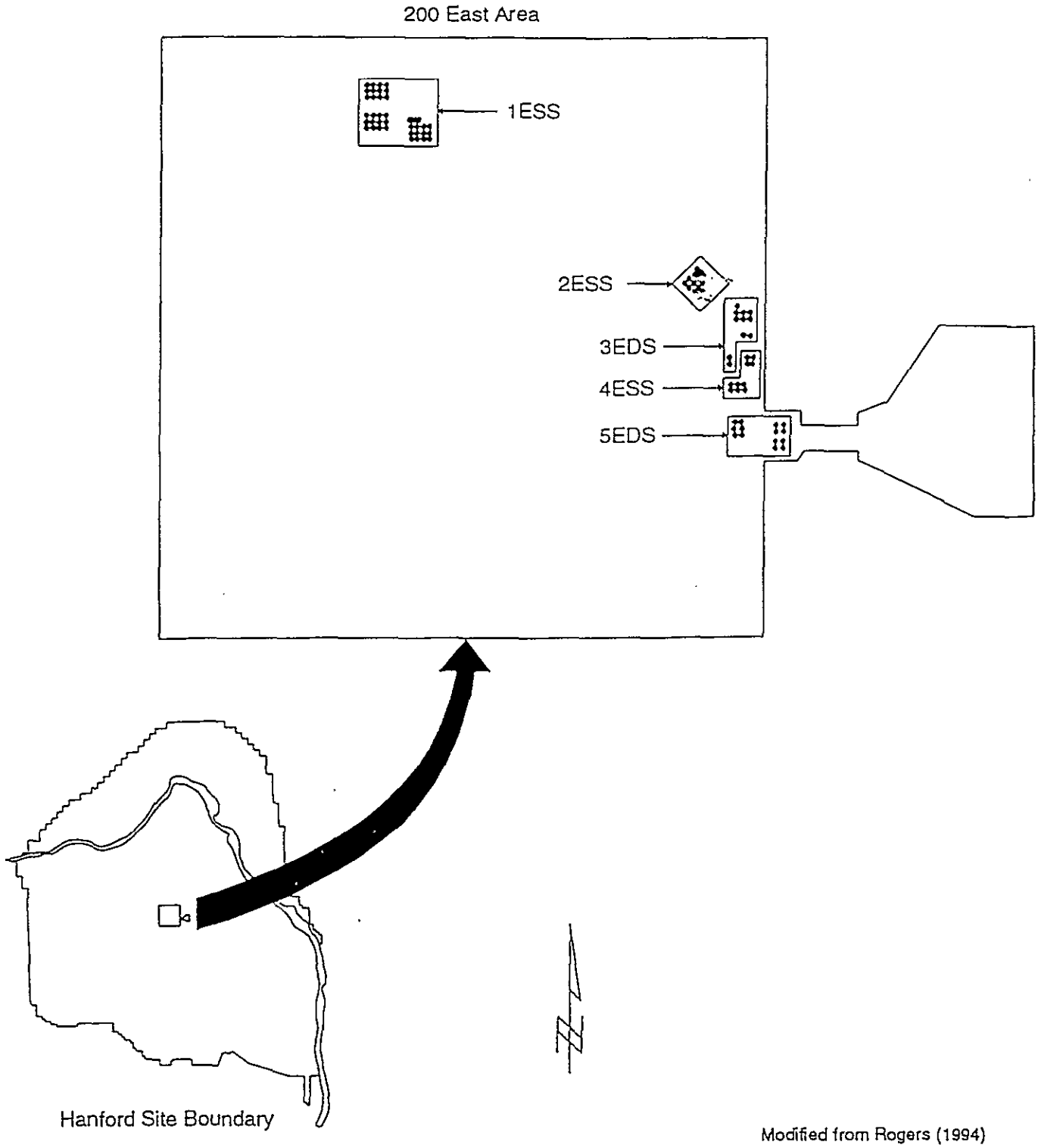
Figure 1
Source Locations
(Sheet 1 of 2)



Modified from Rogers (1994)

Figure 1
Source Locations
(Sheet 2 of 2)



Modified from Rogers (1994)

Table 1
Total Inventory (Curies) of Radionuclides for Single and Double-Shell Tanks
Sheet 1 of 2

Decayed to 12/31/99				
Radionuclides	SST	DST		
Ci	Total	Soluble	Insoluble	Total
Ac-225	1.98E-05			
Ac-227	2.21E-02			
Am-241 (2)	3.30E+04	5.31E+03	6.54E+04	7.07E+04
Am-242	6.82E+01			
Am-242m	6.86E+01			
Am-243	3.32E+01			
At-217	1.98E-05			
Ba-137m	7.68E+06	2.48E+07	6.49E+05	2.54E+07
Bi-210	7.17E-08			
Bi-211	2.21E-02			
Bi-212	3.72E-14			
Bi-213	1.98E-05			
Bi-214	2.70E-07			
C-14 (2)	3.00E+03	3.45E+02	1.99E+03	2.34E+03
Cm-242	5.66E+01			— · —
Cm-244	1.18E+02			
Cm-245	1.04E-02			
Cs-135	1.45E+02			
Cs-137	8.12E+06	2.61E+07	6.83E+05	2.68E+07
Eu-154		5.37E+04	1.44E+03	5.51E+04
Fr-221	1.98E-05			
Fr-223	3.06E-04			
I-129 (2)	1.60E+01			
Nb-93m	3.20E+03			
Ni-59	5.03E+03			
Ni-63	2.69E+05			
Np-237	6.97E+01			
Np-238	3.26E-01			
Np-239	3.32E+01			
Pa-231	3.80E-02			
Pa-233	6.97E+01			
Pa-234	7.69E-01			
Pa-234m	4.81E+02			
Pb-209	1.98E-05			
Pb-210	7.17E-08			
Pb-211	2.21E-02			
Pb-212	3.72E-14			
Pb-214	2.70E-07			
Pd-107	8.65E+01			
Po-210	7.17E-08			
Po-211	6.04E-05			
Po-212	2.38E-14			
Po-213	1.94E-05			
Po-214	2.70E-07			
Po-215	2.21E-02			
Po-216	3.72E-14			
Po-218	2.70E-07			
Pu-238	1.08E+03			
Pu-239 (2)	1.80E+04	1.31E+03	7.05E+03	8.36E+03
Pu-240 (2)	4.30E+03	3.28E+02	2.07E+03	2.40E+03
Pu-241	3.55E+04	7.76E+02	3.86E+04	3.94E+04
Pu-242	4.32E-04			
Ra-223	2.21E-02			

Source: Golberg (1999b)

Table 1
Total Inventory (Curies) of Radionuclides for Single and Double Shell Tanks
Sheet 2 of 2

Decayed to 12/31/99				
Radionuclides	SST	DST		
Ci	Total	Soluble	Insoluble	Total
Ra-224	3.72E-14			
Ra-225	1.98E-05			
Ra-226	2.70E-07			
Ra-228	7.42E-14			
Rh-106	3.79E-02			
Rn-219	2.21E-02			
Rn-220	3.72E-14			
Rn-222	2.70E-07			
Ru-106	3.79E-02			
Sb-126	8.78E+01			
Sb-126m	6.27E+02			
Se-79	9.11E+02			
Sm-151 (2)	6.30E+05			
Sn-126	6.27E+02			
Sr-90 (2)	4.36E+07	6.15E+05	9.47E+06	1.01E+07
Tc-99 (2)	1.10E+04	2.07E+04	3.99E+02	2.11E+04
Th-227	2.18E-02			
Th-228	3.72E-14			
Th-229	1.98E-05			
Th-230	3.90E-05			
Th-231	2.06E+01			
Th-232	6.42E-13			
Th-234	4.81E+02			
Tl-207	2.21E-02			
Tl-208	1.34E-14			
Tl-209	4.28E-07			
U-233	1.21E-02			
U-234	2.12E-01			
U-235	2.06E+01			
U-236	2.88E-03			
U-237	8.69E-01			
U-238	4.81E+02			
Y-90	4.36E+07	6.15E+05	9.47E+06	1.01E+07
Zr-93	3.94E+03			
Total	1.04E+08	5.22E+07	2.04E+07	7.26E+07

Source: Golberg (1999b)

Table 2
Total Inventory (Metric Tons) of Nonradioactive Chemicals for Single and Double-Shell Tanks

Chemical Metric Tons	SST (1)				DST (2)	
	Sludge	Saltcake	Interstitial Liquid	Total	Soluble	Insoluble
Ag+					3.28E-01	1.38E+00
Al(OH)4-	6.25E+02	1.25E+03	1.08E+03	2.96E+03	4.47E+03	
Al+3 (3)	1.99E+03			1.99E+03		6.78E+01
As+5					7.70E-01	4.98E-01
B+3					5.19E-01	9.94E-01
Ba+2					7.91E-01	3.09E+00
Be+2					8.19E-02	7.61E-03
Bi+3	2.61E+02			2.61E+02	2.26E+00	
Ca+2	1.28E+02			1.28E+02	1.03E+01	1.15E+01
Cd+2	3.84E+00			3.84E+00	1.67E-01	6.01E+00
Ce+3	2.35E+02			2.35E+02	2.26E-02	3.04E+00
Cl-	4.00E+01			4.00E+01	2.73E+02	1.49E+00
CO3-2	1.15E+03	4.13E+02	9.37E+01	1.66E+03	1.87E+03	5.83E+01
Cr+3	8.63E+01			8.63E+01		3.41E+01
CrO4-2			5.06E+01	5.06E+01	9.05E+01	
Cu+2					1.77E-01	7.46E-01
F-	8.00E+02		1.18E+01	8.12E+02	3.46E+02	1.91E+01
Fe(CN)6-4	3.22E+02			3.22E+02		
Fe+3	6.27E+02			6.27E+02	8.09E+00	1.42E+02
Hg+	9.00E-01			9.00E-01	5.84E-02	
K+					5.46E+02	2.02E+01
La+					2.19E-01	2.10E+01
Li+					5.77E-03	2.46E-02
Mg+2					9.65E-01	1.10E+01
Mn+4	1.20E+02			1.20E+02	7.69E+00	1.80E+01
Mo+6					4.87E+00	8.01E-01
Na+	1.58E+04	3.39E+04	5.44E+03	5.52E+04	1.09E+04	2.30E+02
Ni+2	1.78E+02			1.78E+02	4.07E+00	6.57E+00
NO2-	2.00E+03	1.53E+03	3.00E+03	6.53E+03	3.07E+03	8.42E+00
NO3-	1.48E+04	8.03E+04	4.32E+03	9.94E+04	7.65E+03	3.91E+01
OH-	4.22E+03	8.51E+02	7.45E+02	5.82E+03	1.90E+03	1.23E+02
Pb+4					1.96E+00	3.28E+00
PO4-3	3.89E+03	6.43E+02	2.03E+02	4.74E+03	2.12E+02	2.16E+01
SiO3-	1.21E+03			1.21E+03	1.53E+01	2.14E+02
SO4-2	5.01E+02	1.15E+03		1.65E+03	3.86E+02	6.68E+00
Sr+2	3.60E+01			3.60E+01		
TOC (4)			4.73E+02	4.73E+02	9.90E+02	6.84E+01
UO2+2					3.54E+00	2.68E+01
V+5					6.20E-02	1.88E-01
W+4	1.44E+01			1.44E+01	7.47E-01	
Zn+2					3.59E+00	9.45E-01
Zr+4	2.46E+02			2.46E+02	4.48E-01	2.77E+02
Total	4.93E+04	1.20E+05	6.52E+03	1.76E+05	3.28E+04	1.45E+03
H2O	2.62E+04	1.40E+04	4.80E+03	4.50E+04	8.59E+04	
Total w/H2O	7.55E+04	1.34E+05	1.13E+04	2.21E+05	1.19E+05	

Source: Goldberg (1999b)

Table 3
Aggregated Inventory (Curies) of Radionuclides for Single Shell Tanks
Sheet 1 of 2

Radionuclide	Decayed to 12/31/1995					Total	
Ci	1WSS	2WSS	1ESS	2ESS	4ESS	12/31/95	12/31/99
Ac-225	1.72E-06	2.88E-06	6.03E-06	2.25E-06	2.84E-06	1.57E-05	1.98E-05
Ac-227	5.18E-03	4.26E-03	8.84E-03	1.55E-03	2.77E-04	2.01E-02	2.21E-02
Am-241	2.26E+03	1.26E+04	9.96E+03	1.29E+04	6.14E+03	4.39E+04	3.30E+04
Am-242	2.68E+00	1.94E+01	1.88E+01	2.00E+01	8.67E+00	6.95E+01	6.82E+01
Am-242m	2.69E+00	1.95E+01	1.89E+01	2.01E+01	8.71E+00	6.98E+01	6.86E+01
Am-243	1.02E+00	7.82E+00	9.57E+00	1.16E+01	3.12E+00	3.32E+01	3.32E+01
At-217	1.72E-06	2.88E-06	6.03E-06	2.25E-06	2.84E-06	1.57E-05	1.98E-05
Ba-137m	8.44E+05	3.78E+06	3.54E+06	1.26E+05	1.37E+05	8.42E+06	7.66E+06
Bi-210	1.50E-08	1.16E-08	1.34E-08	7.03E-09	2.81E-09	4.99E-08	7.17E-08
Bi-211	5.18E-03	4.26E-03	8.84E-03	1.55E-03	2.77E-04	2.01E-02	2.21E-02
Bi-212							3.72E-14
Bi-213	1.72E-06	2.88E-06	6.03E-06	2.25E-06	2.84E-06	1.57E-05	1.98E-05
Bi-214	6.08E-08	5.03E-08	5.20E-08	2.98E-08	1.58E-08	2.09E-07	2.70E-07
C-14	1.95E+03	3.37E+03	1.26E+04	1.48E+03	1.25E+03	2.06E+04	3.00E+03
Cm-242	2.22E+00	1.61E+01	1.56E+01	1.66E+01	7.19E+00	5.76E+01	5.66E+01
Cm-244	3.22E+00	2.39E+01	5.01E+01	5.34E+01	7.20E+00	1.38E+02	1.18E+02
Cm-245	2.08E-04	1.74E-03	3.83E-03	4.09E-03	5.51E-04	1.04E-02	1.04E-02
Cs-135	2.07E+01	6.79E+01	5.27E+01	1.61E+00	2.13E+00	1.45E+02	1.45E+02
Cs-137	8.93E+05	3.99E+06	3.74E+06	1.33E+05	1.44E+05	8.90E+06	8.12E+06
Fr-221	1.72E-06	2.88E-06	6.03E-06	2.25E-06	2.84E-06	1.57E-05	1.98E-05
Fr-223	7.15E-05	5.88E-05	1.22E-04	2.14E-05	3.82E-06	2.78E-04	3.06E-04
I-129	5.19E+00	1.34E+01	2.79E+01	1.82E+00	5.21E-01	4.88E+01	1.60E+01
Nb-93m	8.54E+01	6.76E+02	3.71E+02	4.05E+02	1.50E+03	3.04E+03	3.20E+03
Ni-59		1.71E+03	3.33E+03			5.03E+03	5.03E+03
Ni-63	6.83E+03	4.86E+04	5.30E+04	5.87E+04	1.09E+05	2.76E+05	2.69E+05
Np-237	8.26E+00	1.10E+01	4.96E+01	3.37E-01	4.48E-01	6.96E+01	6.97E+01
Np-238	1.28E-02	9.26E-02	9.00E-02	9.55E-02	4.15E-02	3.32E-01	3.26E-01
Np-239	1.02E+00	7.82E+00	9.57E+00	1.16E+01	3.12E+00	3.32E+01	3.32E+01
Pa-231	9.61E-03	7.33E-03	1.53E-02	3.38E-03	6.37E-04	3.62E-02	3.80E-02
Pa-233	8.26E+00	1.10E+01	4.96E+01	3.37E-01	4.48E-01	6.96E+01	6.97E+01
Pa-234	2.75E-01	1.03E-01	2.61E-01	1.03E-01	2.64E-02	7.69E-01	7.69E-01
Pa-234m	1.72E+02	6.47E+01	1.63E+02	6.45E+01	1.65E+01	4.81E+02	4.81E+02
Pb-209	1.72E-06	2.88E-06	6.03E-06	2.25E-06	2.84E-06	1.57E-05	1.98E-05
Pb-210	1.50E-08	1.16E-08	1.34E-08	7.03E-09	2.81E-09	4.99E-08	7.17E-08
Pb-211	5.18E-03	4.26E-03	8.84E-03	1.55E-03	2.77E-04	2.01E-02	2.21E-02
Pb-212							3.72E-14
Pb-214	6.08E-08	5.03E-08	5.20E-08	2.98E-08	1.58E-08	2.09E-07	2.70E-07
Pd-107	9.03E+00	2.33E+01	4.95E+01	3.66E+00	9.74E-01	8.65E+01	8.65E+01
Po-210	1.50E-08	1.16E-08	1.34E-08	7.03E-09	2.81E-09	4.99E-08	7.17E-08
Po-211	1.41E-05	1.16E-05	2.41E-05	4.24E-06	7.56E-07	5.49E-05	6.04E-05
Po-212							2.38E-14
Po-213	1.69E-06	2.81E-06	5.90E-06	2.20E-06	2.78E-06	1.54E-05	1.94E-05
Po-214	6.08E-08	5.03E-08	5.20E-08	2.98E-08	1.58E-08	2.09E-07	2.70E-07
Po-215	5.18E-03	4.26E-03	8.84E-03	1.55E-03	2.77E-04	2.01E-02	2.21E-02
Po-216							3.72E-14
Po-218	6.08E-08	5.03E-08	5.20E-08	2.98E-08	1.58E-08	2.09E-07	2.70E-07
Pu-238	2.10E+02	2.96E+02	1.85E+02	1.99E+02	2.24E+02	1.11E+03	1.08E+03
Pu-239	2.52E+03	4.35E+03	3.52E+03	5.87E+03	5.57E+03	2.18E+04	1.80E+04
Pu-241	3.92E+03	6.36E+03	8.46E+03	1.32E+04	1.11E+04	4.30E+04	3.55E+04
Pu-242	1.33E-05	9.59E-05	9.32E-05	9.89E-05	4.29E-05	3.44E-04	4.32E-04
Ra-223	5.18E-03	4.26E-03	8.84E-03	1.55E-03	2.77E-04	2.01E-02	2.21E-02
Ra-224							3.72E-14
Ra-225	1.72E-06	2.88E-06	6.03E-06	2.25E-06	2.84E-06	1.57E-05	1.98E-05
Ra-226	6.08E-08	5.03E-08	5.20E-08	2.98E-08	1.58E-08	2.09E-07	2.70E-07

Table 3
Aggregated Inventory (Curies) of Radionuclides for Single Shell Tanks
Sheet 2 of 2

Radionuclide	Decayed to 12/31/1995					Total	
Ci	1WSS	2WSS	1ESS	2ESS	4ESS	12/31/95	12/31/99
Ra-228							7.42E-14
Rh-106	6.11E-05	1.70E-02	8.25E-02	9.73E-02	3.97E-01	5.94E-01	3.79E-02
Rn-219	5.18E-03	4.26E-03	8.84E-03	1.55E-03	2.77E-04	2.01E-02	2.21E-02
Rn-220							3.72E-14
Rn-222	6.08E-08	5.03E-08	5.20E-08	2.98E-08	1.58E-08	2.09E-07	2.70E-07
Ru-106	6.11E-05	1.70E-02	8.25E-02	9.73E-02	3.97E-01	5.94E-01	3.79E-02
Sb-126	7.94E+00	2.33E+01	6.71E+00	1.39E+01	3.59E+01	8.78E+01	8.78E+01
Sb-126m	5.67E+01	1.66E+02	4.79E+01	9.96E+01	2.57E+02	6.27E+02	6.27E+02
Se-79	9.71E+01	2.51E+02	5.21E+02	3.23E+01	9.51E+00	9.11E+02	9.11E+02
Sm-151	6.43E+04	1.89E+05	5.63E+04	1.04E+05	2.55E+05	6.69E+05	6.30E+05
Sn-126	5.67E+01	1.66E+02	4.79E+01	9.96E+01	2.57E+02	6.27E+02	6.27E+02
Sr-90	1.51E+06	1.45E+07	8.41E+06	4.95E+06	1.92E+07	4.85E+07	4.36E+07
Tc-99	3.39E+03	8.74E+03	1.81E+04	1.13E+03	3.32E+02	3.17E+04	1.10E+04
Th-227	5.11E-03	4.20E-03	8.72E-03	1.53E-03	2.73E-04	1.98E-02	2.18E-02
Th-228							3.72E-14
Th-229	1.72E-06	2.88E-06	6.03E-06	2.25E-06	2.84E-06	1.57E-05	1.98E-05
Th-230	9.00E-06	7.86E-06	7.51E-06	4.51E-06	3.11E-06	3.20E-05	3.90E-05
Th-231	7.22E+00	2.93E+00	6.92E+00	2.81E+00	6.98E-01	2.06E+01	2.06E+01
Th-232	1.85E-14	3.57E-14	3.13E-14	5.59E-14	5.27E-14	1.94E-13	6.42E-13
Th-234	1.72E+02	6.47E+01	1.63E+02	6.45E+01	1.65E+01	4.81E+02	4.81E+02
Tl-207	5.16E-03	4.25E-03	8.82E-03	1.55E-03	2.76E-04	2.01E-02	2.21E-02
Tl-208							1.34E-14
U-233	1.20E-03	1.75E-03	5.91E-03	8.07E-04	1.18E-03	1.08E-02	1.21E-02
U-234	4.91E-02	4.59E-02	4.31E-02	3.04E-02	2.52E-02	1.94E-01	2.12E-01
U-235	7.22E+00	2.93E+00	6.92E+00	2.81E+00	6.98E-01	2.06E+01	2.06E+01
U-236	2.16E-04	4.18E-04	3.67E-04	6.54E-04	6.17E-04	2.27E-03	2.88E-03
U-238	1.72E+02	6.47E+01	1.63E+02	6.45E+01	1.65E+01	4.81E+02	4.81E+02
Y-90	1.51E+06	1.45E+07	8.41E+06	4.95E+06	1.92E+07	4.85E+07	4.36E+07
Zr-93	4.54E+01	8.00E+02	2.42E+02	5.63E+02	2.29E+03	3.94E+03	3.94E+03
Total	4.85E+06	3.70E+07	2.43E+07	1.04E+07	3.90E+07	1.16E+08	1.04E+08

Table 4
Aggregated Inventory (Metric Tons) of Nonradioactive Chemicals for Single Shell Tanks

Chemical	1WSS	2WSS	1ESS	2ESS	4ESS	Total
Ag (1)	4.11E-08	6.46E-08	2.00E-07	8.91E-09	2.68E-09	3.17E-07
Al (1)	3.32E+02	1.11E+03	8.04E+02	3.87E+02	2.64E+01	2.56E+03
Al+3	7.12E+01	7.24E+02	5.92E+02	5.80E+02	2.53E+01	1.99E+03
AlO2-	4.54E+02	1.07E+03	7.19E+02	7.58E+01	1.81E+01	2.34E+03
Ba+2 (1)	3.58E-02	1.70E-01	1.02E-01	1.09E-01	1.90E-01	6.07E-01
Bi+3	1.66E+02	2.80E-01	9.43E+01	5.95E-01		2.61E+02
C2H3O3 (1)	5.31E+00	2.85E+00	3.23E-01	1.19E-01	2.97E+00	1.16E+01
C6H5O7 (1)	5.45E+02	6.59E+02	1.23E+03	1.10E+02	2.42E+01	2.56E+03
CO3-2	7.07E+02	1.60E+02	6.40E+02	6.20E+01	3.80E+01	1.51E+03
Ca+2	1.98E-01	5.82E+00	5.47E+01	6.59E+01	1.54E+00	1.28E+02
Cd+2 (2)						
Ce+3	1.16E+02	3.16E+01	8.82E+01	2.64E-01	1.75E+00	2.38E+02
Cl-	2.19E+01	5.41E+00	1.26E+01	4.01E-02	6.03E-02	4.00E+01
Cr+3	1.26E+00	8.33E+01	7.25E-01	1.65E-01	8.24E-01	8.63E+01
CrO4-2	3.12E-01	2.07E+01	1.80E-01	4.10E-02	2.04E-01	2.14E+01
EDTA (1)	4.07E+01	2.18E+01	2.48E+00	9.11E-01	2.27E+01	8.86E+01
F-	1.44E+02	3.00E+01	2.32E+02	4.00E+02	3.08E-01	8.06E+02
Fe+3	1.70E+02	8.18E+01	1.42E+02	5.55E+01	1.78E+02	6.27E+02
Fe(CN)6-4	2.19E+00	1.37E+00	2.48E+02	7.00E+01	5.30E-02	3.22E+02
HEDTA (1)	7.41E+01	3.98E+01	4.95E+00	1.65E+00	4.13E+01	1.62E+02
Hg+ (2)						
K+ (1)	5.00E+00	2.53E+01	2.89E+01	1.84E-01	4.52E-01	5.99E+01
La+ (1)	1.48E+00		3.99E-01			1.88E+00
Mn+4	2.10E+01	1.13E+01	1.31E+01	5.12E+01	2.35E+01	1.20E+02
Na+	1.45E+04	2.11E+04	1.16E+04	2.10E+03	3.78E+03	5.31E+04
Ni+2	5.02E+00	3.33E+00	1.25E+02	4.40E+01	9.93E-01	1.78E+02
NO2-	1.76E+03	8.01E+02	2.06E+03	4.74E-01	2.32E+02	4.85E+03
NO3-	2.63E+04	4.55E+04	1.89E+04	2.59E+02	4.89E+03	9.59E+04
OH-	4.53E+02	2.30E+03	1.04E+03	1.42E+03	1.74E+02	5.39E+03
PO4-3	2.67E+03	1.10E+02	1.81E+03	2.98E+01	8.61E-01	4.62E+03
Pb (1)	2.35E+00	3.86E+00	4.23E+02	6.82E+00	1.03E-01	4.36E+02
SiO3-	5.60E+02	2.40E+02	4.04E+02	7.07E-01	2.09E+00	1.21E+03
Sn (1)			5.37E-03			5.37E-03
SO4-2	6.34E+02	2.48E+02	5.53E+02	1.34E+02	8.35E+01	1.65E+03
Sr+2	9.38E-04	6.98E-02	3.59E+01	2.53E-02	5.78E-02	3.60E+01
W+4 (2)						
Zr+4	1.40E+01	2.31E+01	6.50E+00	2.03E+02	1.28E-01	2.46E+02

Table 5
Aggregated Inventory (Curies) of Radionuclides for Double Shell Tanks

Decayed to 12/31/1995								
Radionuclide	3WDS		3EDS		5EDS		Total	
Ci	Soluble	Insoluble	Soluble	Insoluble	Soluble	Insoluble	12/31/95	12/31/99
Na, kgs	1.30E+06	2.01E+04	5.93E+06	3.80E+04	2.57E+06	1.36E+05	9.99E+06	9.99E+06
C-14		8.06E-01	3.40E+02	1.98E+03	5.23E+00		2.33E+03	2.33E+03
Sr-90	2.16E+04	3.95E+04	6.41E+05	1.03E+07	1.34E+04	5.62E+04	1.11E+07	1.01E+07
Y-90	2.16E+04	3.95E+04	6.41E+05	1.03E+07	1.34E+04	5.62E+04	1.11E+07	1.01E+07
Tc-99	3.66E+03		1.54E+04	3.99E+02	1.60E+03		1.74E+04	2.11E+04
Cs-137	3.63E+06	3.91E+04	2.13E+07	5.44E+05	3.73E+06	1.66E+05	2.94E+07	2.68E+07
Ba-137	3.63E+06	3.91E+04	2.13E+07	5.44E+05	3.73E+06	1.66E+05	2.94E+07	2.55E+07
Eu-154	4.34E+02	4.38E+00	7.14E+04	1.93E+03	5.33E+02		7.43E+04	5.51E+04
Np-237		3.79E-01	6.76E+00	3.83E+01	1.02E-01	3.98E-02	4.56E+01	4.56E+01
Pu-238		1.05E+03	1.65E+02	5.12E+00	1.40E+02	5.46E+01	1.42E+03	1.37E+03
Pu-239	2.02E+01	2.12E+03	1.22E+03	3.72E+03	6.27E+01	1.22E+03	8.36E+03	8.36E+03
Pu-240	5.06E+00	7.59E+02	3.07E+02	9.64E+02	1.57E+01	3.44E+02	2.39E+03	2.39E+03
Pu-241	9.47E+00	1.85E+04	7.43E+02	1.00E+04	2.86E+01	1.03E+04	3.97E+04	3.94E+04
Am-241	1.63E+02	1.17E+04	5.03E+03	5.37E+04	1.47E+02	3.51E+02	7.11E+04	7.07E+04
Total	8.60E+06	2.11E+05	4.99E+07	2.18E+07	1.01E+07	5.93E+05	9.12E+07	8.27E+07

Figure H8-2. Glass in Sulfu
Facility Layout.
(sheet 10 of 10)

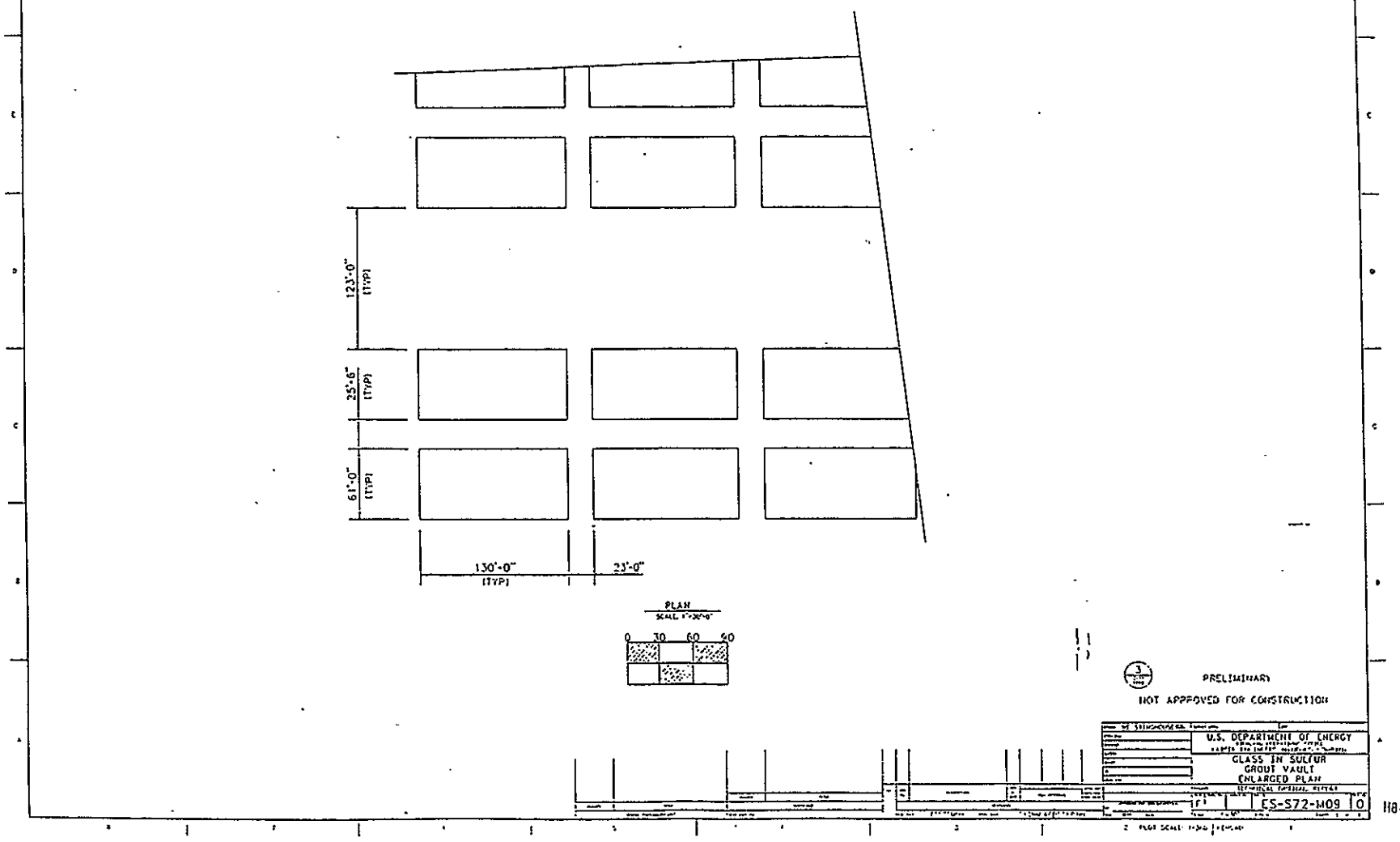
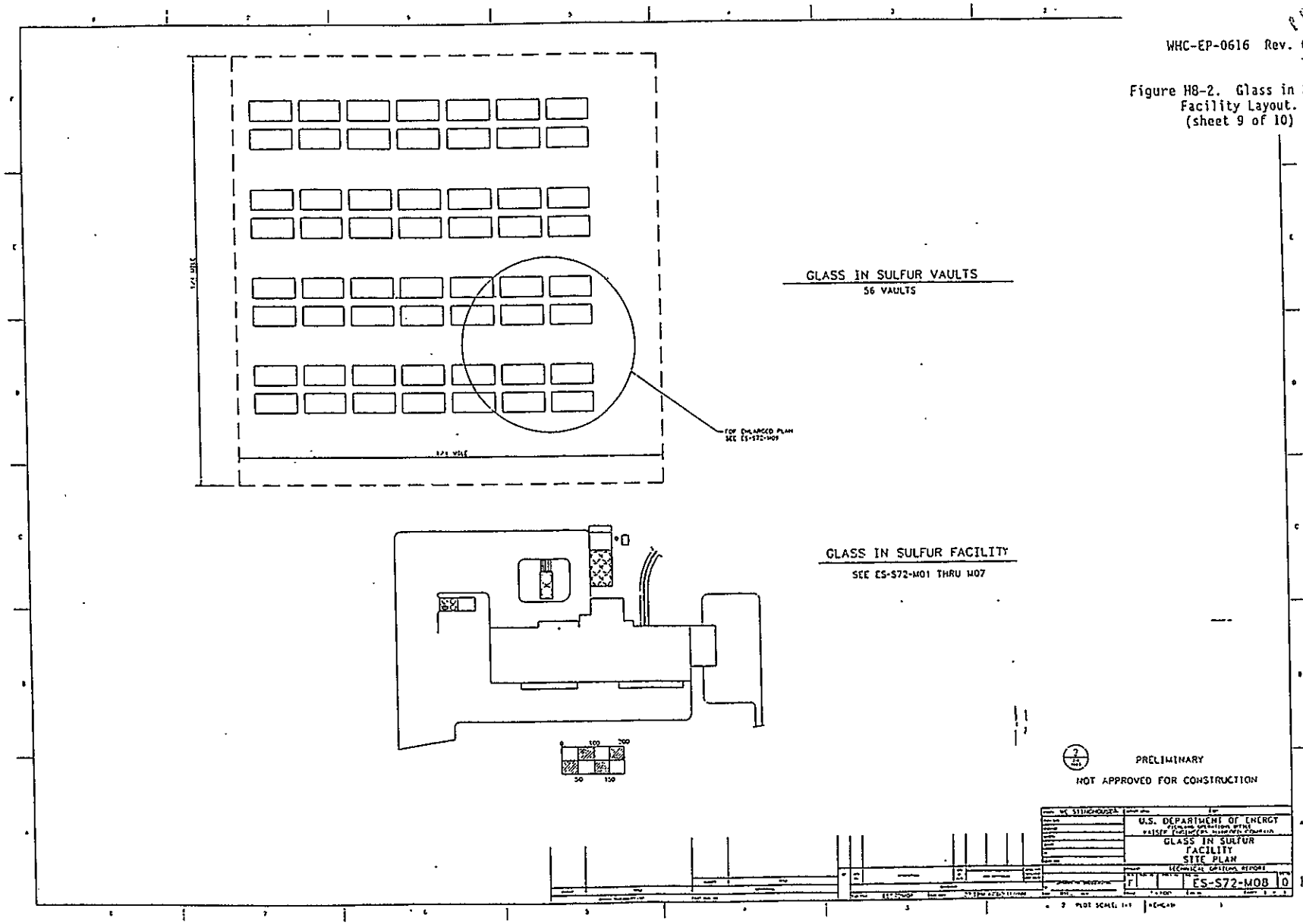


Figure H8-2. Glass in Sulfur Facility Layout. (sheet 9 of 10)



TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE ENGINEERING "TANK POST REMEDIATION FLUX"

ORIGINATOR COLIN HENDERSON DATE 2/2/95

REVISION NO. _____

OBJECTIVE Estimate POST REMEDIATION EMISSIONS RESULTING FROM TANK Residuals OF 1% & 5%.

METHODOLOGY See ATTACHED

ASSUMPTIONS See Attached

(Continue on another sheet if necessary)

Colin Henderson
SIGNATURE

CALCULATION & RESULTS ATTACHED

PRELIMINARY

JACOBS\FORMS\CALCVR.SHT

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT

BY _____ CHKD. _____

SHEET NO. 2/10

JOB NO. _____

METHODOLOGY-

A) CALCULATE VOLUMETRIC FLOW INTO TANKS

B) CALCULATE TIME REQUIRED TO DISSOLVE NITRATE

C) CALCULATE TIME REQUIRED TO BREACH BARRIER

D CALCULATE CONCENTRATIONS IN SATURATED SOLUTIONS RELEASED FROM TANKS.

REFERENCES:

SERNE, R.J AND M.I WOOD 1990 Hanford WASTE FORM Releases and Sediment interactions, PNL 7297, BATELLE PACIFIC NORTHWEST LABORATORY, RICHLAND WA

PELTON M AND J DAVIS 1/27/95 Aggregate TANK FARM inventories

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 3/16

BY _____ CHKD. _____ JOB NO. _____

POST REMEDIATION RELEASE ASSUMPTIONS

1. INVENTORY 1% AND 5% OF CURRENT INVENTORY

2. SOLUBILITY OF EACH element is proportional to the SOLUBILITY of NO_3^- · (360 g/l) Congruent dissolution (Serne & Wood 1990)

3. RECHARGE Rate .05 cm/yr for first 1000 yrs.
   .10 cm/yr for 1000 + yrs.
   HANFORD BARRIER FAILS AFTER 1,000 YEARS.

4 ASSUME BARRIER 5 m thick.

5. Release Point 50 ft. below Surface.

6. Time for Water to Reach Waste after penetrating barrier equals 0.

7. TANK AND CONCRETE WILL HAVE FAILED AFTER 500 YEARS.

8. CONCENTRATIONS IN TANK GROUPS ARE AS SHOWN IN REFERENCE 2.

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 4/16

BY _____ CHKD. _____ JOB NO. _____

1. TANK AREAS.
GROUP

1WSS. 40 tanks 36 @ 75' dia 4 @ 20' dia.

1 ft = 30.48 cm.

$$\Sigma \text{AREA} = 36\left(\pi \cdot \frac{(75(30.48))^2}{4}\right) + 4\left(\pi \frac{(20(30.48))^2}{4}\right)$$

$$= 147.8E6 + 1.167E6 \text{ cm}^2$$

1WSS = 149.0 E6 cm² ←

2WSS = 43 tanks. 39 @ 75'ϕ + 4 @ 20'ϕ

$$\text{AREA} = \Sigma 39[4.1E6] + 4(.292E6) \text{ cm}^2$$

2WSS AREA = 161.1 E6 cm² ←

1ESS = 40 tanks. = 36 @ 75'ϕ & 4 @ 20'ϕ

$$\text{AREA} = 36[4.1E6] + 1.167E6 \text{ cm}^2$$

1ESS AREA = 148.8E6 cm². ←

2ESS. = 16 TANKS. 12 @ 75'ϕ 4 @ 20'ϕ

$$\text{AREA} = 12(4.1E6] + 1.167E6$$

2ESS = 50.4 E6 cm² ←

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 5/16

BY _____ CHKD. _____ JOB NO. _____

4ESS 10 TANKS. 10@ 75'φ

4ESS. AREA = 10 (4.1E6) = 41E6 cm² ←

2. VOLUMETRIC INFILTRATION.

1WSS ΔT .05 cm/yr

Q= .05cm/yr (149E6 cm²)(1 l / 1000 cc)

Q= 7450 l/yr. ← at .05 cm/yr

ΔT .1 cm/yr

Q= 14900 l/yr ← at .10 cm/yr

2WSS

A= 161E6 cm²

@ .05cm/yr Q= 161E6 cm² (.05 cm/yr)(1 l / 1000 cc)

Q= 8,050 l/yr ← at .05 cm/yr

@ .10 cm/yr Q= 16,100 l/yr. ← at .10 cm/yr

1ESS

A= 148.8E6 cm²

@ .05 cm/yr Q= (148.8E6 cm²)(.05 cm/yr)(1 l / 1000 cm³) = 7,440 l/yr.

Q=7440 l/yr ← at .05 cm/yr

at .10 cm/yr Q= 14880 l/yr. ←

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. -6/16

BY _____ CHKD. _____ JOB NO. _____

2ESS

$A = 50.4E6\ cm^2$

@ .05 cm/yr $Q = 50.4E6\ cm^2 (.05\ cm/yr)(1/1000) = 2{,}520\ l/yr$

$Q = 2520\ l/yr$ ← at .05 cm/yr

@ .10 cm/yr $Q = 5040\ l/yr$ ←

4ESS $A = 41E6\ cm^2$

@ .05 cm/yr $Q = 41E6\ cm^2 (.05\ cm/yr)(1/1000) = 2050\ l/yr.$

$Q = 2050\ l/yr$ ← at .05 cm/yr

at .10 cm/yr $Q = 4100\ l/yr.$ ← at .10 cm/yr

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 7/16

BY _____ CHKD. _____ JOB NO. _____

3, POST REMEDIATION NITRATE INVENTORY. (1% Residual)

1WSS 263 MT (10^6 g)

2WSS 455 MT ($\times 10^6$ g)

1ESS 189 MT (10^6 g)

2ESS 2.59 MT (10^6 g)

4ESS. 48.9 MT (10^6 g)

SOLUBILITY = 360 g/L

4, TIME REQUIRED to dissolve NITRATE.

$$\text{Time (yrs)} = \frac{\text{Inventory}}{\text{Solubility (Infiltration)}}$$

FOR 1WSS

$$\text{Time yrs} = \frac{263 \times 10^6 \text{ g}}{(360 \text{ g/L})(7450 \text{ l/yr})} = 98 \text{ years.} \leftarrow \text{at .05 cm/yr}$$

$(263E6)/(360 \times 14900) = .49$ yrs @ 0.1 cm/yr ←

2WSS.

$$\text{Time} = \frac{455E6 \text{ g}}{360(8050)} = 157 \text{ years.} \leftarrow \text{at .05 cm/yr}$$

$455E6/(360 \times 16100) = 78$ yrs @ 0.1 cm/yr ←

1ESS

$$\text{Time} = \frac{189E6 \text{ g}}{360(7440 \text{ l/yr})} = 71 \text{ years.} \leftarrow \text{at .05 cm/yr}$$

$189E6/(360 \times 14880) = 35$ yrs at 0.1 cm/yr ←

2ESS.

$$\text{Time} = 2.59E6 \text{ g}/360(2520 \text{ l/yr}) = 3 \text{ yrs.} \leftarrow \text{at .05 cm/yr}$$

$= 2.59E6/(360 \times 5000 \text{ l/yr}) = 1.5$ yrs at 0.1 cm/yr

FORM 91-005-1 (4/81)

4ESS

TIME = 48.9E6g / 360 (2050 l/yr) = 66 years. — at .05cm/yr.

= 48.9E6 / (360 × 4100 l/yr) = 33 yrs @ 0.1 cm/yr

5. TIME REQUIRED TO Breach Barrier

First 1000 yrs. Water goes 1000(.05 cm/yr) = 50cm.

then infiltration goes to .10 cm/yr.

$$\text{Time} = \frac{500\text{ cm} - 50\text{ cm}}{.10\text{ cm/yr}} + 1000\text{ yrs.}$$

Time = 5,500 yrs.

Assume time to reach waste once barrier is breached is 0.

RESULTS FOR SSTs

AT TIME = 5,500 years. the tanks begin to release waste to VADOSE ZONE. THE Concentration of the release will be Saturated at the concentrations shown ON TABLES 1 and 2 attached. The duration OF Release will be as follows:

1WSS – 49 years	for 1% Residual	24.5 yr	for 5% residual
2WSS – 78 years		390 yr	
1ESS – 35 years		175 yr	
2ESS – 1.5 years		7.5 yr	
4ESS – 33 years.		165 yr	

NOTE: TABLE 1 & 2 ARE From Retrieval leakage Estimate.
NOTE For 5% Residual the Concentration leaking will be the Same.

Table 1

Tank Release Concentration grams/ liter for Radionuclides

Solubility Calculation — For each tank group solubility = (mass elem/mass nitrate)x360 g/l

# of Tanks	40	43	40	16	10
grams	1WSS	2WSS	1ESS	2ESS	4ESS
Ac-225	4.07E-19	3.92E-19	1.98E-18	5.38E-17	2.82E-13
Ac-227	9.80E-13	4.66E-13	2.33E-12	2.98E-11	3.03E-14
Ac-228	1.13E-07	3.65E-07	6.95E-07	6.58E-05	1.66E-06
Am-241	1.07E-08	4.47E-08	1.05E-07	8.09E-06	1.86E-07
Am-242	4.58E-12	1.91E-11	4.48E-11	3.47E-09	7.98E-11
Am-243	6.99E-08	3.11E-07	9.16E-07	8.13E-05	1.16E-06
At-217	1.47E-26	1.41E-26	7.13E-26	1.94E-24	1.30E-25
Ba-135m	1.44E-06	3.71E-06	8.37E-06	2.18E-05	1.25E-06
Ba-137m	3.83E-25	1.71E-25	4.75E-25	1.82E-23	3.86E-25
Bi-210	5.72E-16	2.72E-16	1.36E-15	1.74E-14	1.64E-16
Bi-211					
Bi-212	1.62E-19	1.56E-19	7.87E-19	2.14E-17	1.43E-18
Bi-213	6.03E-20	2.88E-20	7.18E-20	3.00E-18	8.41E-20
Bi-214	6.06E-13	6.05E-13	5.44E-12	4.66E-11	2.09E-12
C-14	6.83E-09	2.86E-08	6.68E-08	5.17E-06	1.19E-07
Cm-242	1.33E-11	5.73E-11	2.89E-10	2.25E-08	1.61E-10
Cm-244	3.52E-14	1.71E-13	9.02E-13	7.04E-11	5.02E-13
Cm-245	1.64E-06	3.12E-06	5.84E-06	1.30E-05	9.12E-07
Cs-135	1.06E+01	2.75E+01	6.20E+01	1.61E+02	9.24E+00
Cs-137	2.73E-16	2.63E-16	1.33E-15	3.61E-14	2.42E-15
Fr-221	5.53E-21	2.63E-21	1.31E-20	1.68E-19	1.59E-21
Fr-223	1.84E-15	2.74E-15	1.38E-14	6.56E-14	9.93E-16
I-129	6.64E-03	3.04E-02	4.02E-02	3.20E+00	6.29E-01
Nb-93m		5.14E-08	2.41E-07		
Ni-59	1.16E-03	4.77E-03	1.25E-02	1.01E+00	9.95E-02
Ni-63	1.92E-09	1.48E-09	1.61E-08	7.96E-09	5.61E-10
Np-237	2.49E-07	1.04E-06	2.44E-06	1.89E-04	4.34E-06
Np-238	5.37E-14	2.39E-13	7.04E-13	6.25E-11	8.88E-13
Np-239	5.67E-16	2.50E-16	1.25E-15	2.02E-14	2.02E-16
Pa-231	2.40E-06	1.84E-06	2.00E-05	9.92E-06	6.99E-07
Pa-233	1.82E-13	3.96E-14	2.40E-13	6.93E-12	9.39E-14
Pa-234	1.18E-10	2.57E-11	1.56E-10	4.51E-09	6.10E-11
Pa-234m	3.44E-23	3.32E-23	1.67E-22	4.55E-21	3.05E-22
Pb-209	4.48E-21	2.00E-21	5.56E-21	2.13E-19	4.51E-21
Pb-210	9.28E-13	4.41E-13	2.20E-12	2.82E-11	2.67E-13
Pb-211					
Pb-212	6.03E-20	2.88E-20	7.18E-20	3.00E-18	8.41E-20
Pb-214	3.77E-15	5.61E-15	2.88E-14	1.55E-13	2.19E-15
Pd-107	4.00E-13	1.79E-13	4.96E-13	1.90E-11	4.03E-13
Po-210	4.31E-17	2.05E-17	1.02E-16	1.31E-15	1.24E-17
Po-211					
Po-212	1.30E-31	1.25E-31	6.31E-31	1.72E-29	1.15E-30
Po-213	6.61E-32	3.16E-32	7.87E-32	3.29E-30	9.21E-32
Po-214	2.20E-25	1.05E-25	5.23E-25	6.70E-24	6.33E-26
Po-216					
Po-218	2.94E-24	1.40E-24	3.50E-24	1.46E-22	4.10E-24
Pu-236	5.41E-09	4.41E-09	6.63E-09	5.20E-07	3.10E-08
Pu-238	2.02E-06	2.01E-06	3.92E-06	4.77E-04	2.40E-05
Pu-239	1.08E-04	1.20E-04	2.54E-04	3.31E-02	1.65E-03
Pu-240	2.36E-04	2.22E-04	7.10E-04	8.07E-02	3.59E-03
Pu-241	1.76E-15	7.37E-15	1.72E-14	1.33E-12	3.07E-14
Pu-242	1.80E-08	8.57E-09	4.29E-08	5.49E-07	5.19E-09
Ra-223					
Ra-224	1.47E-19	1.41E-19	7.13E-19	1.94E-17	1.30E-18
Ra-225	2.12E-20	1.01E-20	2.53E-20	1.06E-18	2.96E-20
Ra-226					
Ra-228	3.08E-15	4.93E-13	5.78E-12	4.97E-10	1.07E-10

Table 1

Tank Release Concentration grams/ liter for Radionuclides

Rh-106	2.00E-20	9.49E-21	4.75E-20	6.08E-19	5.74E-21
Rn-219					
Rn-220	9.04E-25	4.32E-25	1.08E-24	4.50E-23	1.26E-24
Rn-222	5.43E-18	8.72E-16	1.02E-14	8.78E-13	1.90E-13
Ru-106	3.25E-11	5.52E-11	3.83E-11	5.80E-09	7.92E-10
Sb-126	9.29E-12	1.58E-11	1.09E-11	1.66E-09	2.26E-10
Sb-126m	1.69E-14	2.53E-14	1.27E-13	5.72E-13	8.92E-15
Se-79	1.26E-02	2.15E-02	1.54E-02	2.08E+00	2.70E-01
Sm-151	2.95E-08	5.00E-08	3.47E-08	5.26E-06	7.19E-07
Sn-126	7.32E-01	4.05E+00	5.66E+00	2.43E+02	4.99E+01
Sr-90	3.34E-07	4.98E-07	2.49E-06	1.13E-05	1.76E-07
Tc-99	4.14E-09	1.97E-09	9.83E-09	1.26E-07	1.19E-09
Th-227					
Th-228	2.88E-17	2.78E-17	1.40E-16	3.81E-15	2.55E-16
Th-229	5.81E-13	2.94E-13	6.75E-13	2.96E-11	1.08E-12
Th-231	1.87E-11	4.39E-12	2.49E-11	7.38E-10	9.71E-12
Th-232	2.30E-15	2.57E-15	5.42E-15	7.06E-13	3.53E-14
Th-233	6.50E-14	1.41E-14	8.58E-14	2.48E-12	3.36E-14
Th-234	3.06E-15	1.45E-15	7.27E-15	9.32E-14	8.80E-16
Tl-208					
Tl-209	1.25E-24	1.20E-24	6.07E-24	1.65E-22	1.10E-23
U-232	7.67E-13	6.48E-13	5.26E-12	5.24E-11	4.05E-12
U-233	6.97E-08	3.77E-08	8.51E-08	4.38E-06	1.92E-07
U-234	1.58E-05	3.72E-06	2.11E-05	6.26E-04	8.23E-06
U-235	1.37E-06	1.53E-06	3.23E-06	4.21E-04	2.10E-05
U-236	2.03E-05	1.91E-05	6.11E-05	6.95E-03	3.09E-04
U-237	2.89E-11	6.28E-12	3.81E-11	1.10E-09	1.49E-11

Table 2
Chemical Release Concentrations Nonradioactive Chemicals for Single Shell Tanks

concentration grams/liter

Chemical	1WSS	2WSS	1ESS	2ESS	4ESS
Ag	5.63E-10	5.11E-10	3.80E-09	1.24E-08	1.97E-10
Al	4.55E+00	8.75E+00	1.53E+01	5.37E+02	1.94E+00
Al+3	9.75E-01	5.73E+00	1.13E+01	8.06E+02	1.87E+00
AlO2-	6.23E+00	8.47E+00	1.37E+01	1.05E+02	1.34E+00
Ba+2	4.91E-04	1.34E-03	1.95E-03	1.52E-01	1.40E-02
Bi+3	2.28E+00	2.21E-03	1.79E+00	8.27E-01	
C2H3O3	7.28E-02	2.25E-02	6.15E-03	1.65E-01	2.19E-01
C6H5O7	7.47E+00	5.21E+00	2.33E+01	1.53E+02	1.79E+00
CO3-2	9.68E+00	1.27E+00	1.22E+01	8.62E+01	2.80E+00
Ca+2	2.72E-03	4.60E-02	1.04E+00	9.16E+01	1.13E-01
Cd+2					
Ce+3	1.59E+00	2.50E-01	1.68E+00	3.67E-01	1.29E-01
Cl-	3.00E-01	4.28E-02	2.40E-01	5.58E-02	4.44E-03
Cr+3	1.73E-02	6.59E-01	1.38E-02	2.30E-01	6.07E-02
CrO4-2	4.28E-03	1.63E-01	3.42E-03	5.69E-02	1.50E-02
EDTA	5.58E-01	1.73E-01	4.71E-02	1.27E+00	1.67E+00
F-	1.97E+00	2.38E-01	4.42E+00	5.56E+02	2.27E-02
Fe+3	2.33E+00	6.47E-01	2.70E+00	7.72E+01	1.31E+01
Fe(CN)6-4	3.00E-02	1.08E-02	4.72E+00	9.73E+01	3.90E-03
HEDTA	1.01E+00	3.14E-01	9.41E-02	2.30E+00	3.04E+00
Hg+					
K+	6.85E-02	2.00E-01	5.50E-01	2.56E-01	3.33E-02
La+	2.03E-02		7.60E-03		
Mn+4	2.87E-01	8.92E-02	2.49E-01	7.12E+01	1.73E+00
Na+	1.99E+02	1.67E+02	2.20E+02	2.92E+03	2.78E+02
Ni+2	6.88E-02	2.64E-02	2.37E+00	6.12E+01	7.31E-02
NO2-	2.41E+01	6.33E+00	3.92E+01	6.59E-01	1.71E+01
NO3-	3.60E+02	3.60E+02	3.60E+02	3.60E+02	3.60E+02
OH-	6.20E+00	1.82E+01	1.98E+01	1.97E+03	1.28E+01
PO4-3	3.66E+01	8.70E-01	3.44E+01	4.14E+01	6.34E-02
Pb	3.22E-02	3.06E-02	8.04E+00	9.48E+00	7.60E-03
SiO3-	7.67E+00	1.90E+00	7.68E+00	9.83E-01	1.54E-01
Sn			1.02E-04		
SO4-2	8.68E+00	1.96E+00	1.05E+01	1.86E+02	6.15E+00
Sr+2	1.28E-05	5.52E-04	6.82E-01	3.52E-02	4.25E-03
W+4					
Zr+4	1.92E-01	1.83E-01	1.24E-01	2.82E+02	9.41E-03

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 12/16

BY _____ CHKD. _____ JOB NO. _____

DSTs

3WDS - 3 TANKS.

3EDS = 11 TANKS

5EDS = 14 TANKS.

$$\text{AREA PER TANK} = \frac{\pi(75 \times 30.48)^2}{4} = 4.1E6 \text{ cm}^2$$

1. 3WDS · AREA = 3(4.1E6 cm²) = 12.3E6 cm²

3EDS = 11(4.1E6 cm²) = 45.1E6 cm²

5EDS = 14(4.1E6 cm²) = 57.4E6 cm²

2. VOLUMETRIC INFILTRATION at (0.1 cm/yr)

3WDS Q = 0.1 cm/yr (12.3E6 cm²)(1 l/1000 cc) = 1230 l/yr.

Q = 1230 l/yr

3EDS Q = 0.1 cm/yr (45.1E6 cm²)(1 l/1000 cc) = 4510 l/yr

Q = 4510 l/yr.

5EDS Q = 0.1 cm/yr (57.4E6 cm²)(1 l/1000 cc) = 5740 l/yr.

Q = 5740 l/yr

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 13/16

BY _____ CHKD. _____ JOB NO. _____

3. POST REMEDIATION NITRATE INVENTORY.

	INVENTORY	1%	5%
3WDS	1040 MT	10.4 MT	52 MT.
3EDS	2198 MT	21.98 MT	110 MT
5EDS	4450 MT	44.5 MT (10^6 g)	222.5 MT

SOLUBILITY NO_3^- = 360 g/L

4. TIME REQ to dissolve NO_3^-.

$$\text{TIME} = \frac{\text{INVENTORY}}{\text{SOLUBILITY (INFILTRATION)}}$$

FOR 3WDS.

1% → $\text{TIME} = \frac{10.4E6\ g}{360 g/L\ (1230\ l/yr)}$ = 23.5 years for 1% residual

5% TIME = 5x(1% TIME) = 118 years.

FOR 3EDS.

1% → $\text{TIME} = \frac{21.98E6\ g}{360 g/L\ (4510\ l/yr)}$ = 13.5 years for 1%

5% TIME = 13.5 (5) = 67.5 or 68 years.

FOR 5EDS

1% TIME = $\frac{44.5E6\ g}{360\ (5740\ l/yr)}$ = 21.5 years for 1%.

5% TIME = 5(21.5) = 107.5 or 108 years.

FORM 91-005-1 (4/81)

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 14/16

BY _____ CHKD. _____ JOB NO. _____

RESULTS FOR DSTs

AT TIME = 5,500 years the tanks begin to release waste into the VADOSE ZONE. THE CONCENTRATION of the RELEASE WILL BE SATURATED at the CONCENTRATIONS SHOWN ON TABLES 3 and 4 for DSTs attached. THE DURATION OF THE RELEASE IS AS FOLLOWS:

	1% Residual	5% Residual
3WDS	23.5 years	118 years
3EDS	13.5 years	68 years
5EDS	21.5 years	108 years.

Table 3
DST Tank Release Concentration grams/ liter for Radionuclides

DST INVENTORY RADIONUCLIDES IN GRAMS

Decayed to 12/31/1995				
Radionuclide	ACT Ci/g	3WDS	3EDS	5EDS
grams				
C-14	4.45	1.81E-01	5.22E+02	1.18E+00
Sr-90	139	4.39E+02	7.89E+04	5.01E+02
Y-90	5140	1.19E+01	2.13E+03	1.35E+01
Tc-99	0.0169	2.17E+05	9.37E+05	9.46E+04
Cs-137	86.4	4.24E+04	2.53E+05	4.51E+04
Ba-137	537000000	6.82E-03	4.07E-02	7.25E-03
Eu-154	270	1.62E+00	2.72E+02	1.97E+00
Np-237	0.000704	5.39E+02	6.40E+04	2.02E+02
Pu-238	17.1	6.15E+01	9.98E+00	1.14E+01
Pu-239	0.0619	3.45E+04	7.99E+04	2.07E+04
Pu-240	0.227	3.36E+03	5.60E+03	1.58E+03
Pu-241	103	1.80E+02	1.05E+02	1.00E+02
Am-241	3.43	3.47E+03	1.71E+04	1.45E+02

CONCENTRATION IN GRAMS/LITER = (MASS NUCLIDE/MASS NO3)*360

Radionuclide		3WDS	3EDS	5EDS
NO3 mass g		1.04E+09	2.20E+09	4.45E+09
C-14		6.27E-08	8.56E-05	9.52E-08
Sr-90		1.52E-04	1.29E-02	4.05E-05
Y-90		4.11E-06	3.49E-04	1.10E-06
Tc-99		7.50E-02	1.54E-01	7.66E-03
Cs-137		1.47E-02	4.14E-02	3.65E-03
Ba-137		2.36E-09	6.66E-09	5.87E-10
Eu-154		5.61E-07	4.45E-05	1.60E-07
Np-237		1.86E-04	1.05E-02	1.63E-05
Pu-238		2.13E-05	1.63E-06	9.22E-07
Pu-239		1.20E-02	1.31E-02	1.67E-03
Pu-240		1.16E-03	9.17E-04	1.28E-04
Pu-241		6.23E-05	1.71E-05	8.12E-06
Am-241		1.20E-03	2.80E-03	1.17E-05

Table 4
Tank Release Concentration grams/liter for Non Rad Chemicals

CONCENTRATION GRAMS/LITER

Chemical	5EDS	3EDS	3WDS
Ag+	1.16E-01	3.43E-02	2.01E-02
Al+3	3.47E+00	1.72E+00	5.00E+00
As+5	8.42E-02	4.26E-03	6.97E-02
B+3	8.23E-02	1.09E-02	1.48E-01
Ba+2	2.52E-01	1.22E-01	1.13E-02
Be+2	5.43E-03	3.66E-03	
Bi+3	1.40E-01	8.53E-02	
Ca+2	1.06E+00	3.92E-01	2.15E+00
Cd+2	4.75E-01	1.16E-02	8.36E-02
Ce+3	2.27E-01		9.12E-02
Cr+3	7.53E-01	1.28E-01	8.32E+00
Cu+2	3.86E-02	1.71E-02	1.18E-01
Fe+3	1.09E+01	4.48E-01	4.31E+00
Hg+	4.65E-03	1.54E-04	
K+	1.21E+01	6.19E+01	1.30E+01
La+	1.60E+00	2.21E-01	3.42E-02
Li+	2.00E-03		1.94E-03
Mg+2	8.13E-01	2.28E-01	1.76E-01
Mn+4	1.69E+00	1.81E-01	1.28E+00
Mo+6	3.26E-01	1.31E-01	2.95E-01
Na+	4.91E+02	4.81E+02	7.48E+02
Nd+3	9.61E-01		4.04E-02
Ni+2	6.77E-01	1.00E-01	5.75E-01
Pb+4	2.84E-01	2.28E-01	1.16E-01
Pd	9.70E-02		
Rb	5.18E-03		
Re	2.95E-03	3.50E-02	
Rh	6.91E-03	2.41E-01	4.78E-02
Ru	2.33E-02	1.37E-01	4.70E-02
Sb	1.72E-01	2.21E-01	3.40E-02
Se	1.56E-01	4.25E-01	2.20E-01
SiO3-	1.69E+01	2.37E+00	2.10E+00
Sn	2.60E-06	6.24E-05	
Te	5.46E-03	1.85E-01	3.56E-02
Th	3.26E-02	4.18E-01	2.16E-01
Ti	2.13E-02	4.58E-02	1.34E-02
Tl	3.14E-01	4.79E+00	1.90E-01
UO2+2	2.41E-01	4.48E+00	
V+5	5.67E-03	2.72E-02	4.74E-03
W+6	6.04E-02		
Zn+2	6.23E-02	3.95E-01	4.66E-01
Zr+4	1.51E+00	4.23E+01	6.39E-02
Al(OH)4-2	1.97E+02	1.37E+02	4.13E+02
CO3-2	8.03E+01	1.38E+02	3.03E+01
Cl-	1.19E+01	8.59E+00	2.59E+01
Cr(OH)4-	3.28E+00	1.87E+00	2.08E+01
F-	2.93E+00	5.24E+01	3.11E+00
SO4-2	2.26E+01	1.18E+01	1.45E+01
NO3-	3.60E+02	3.60E+02	3.60E+02
NO2-	1.57E+02	1.46E+02	8.51E+01
PO4-3	6.91E+00	1.23E+01	2.54E+01
OH-	8.28E+01	1.24E+02	8.37E+01
TOC	7.04E+01	9.73E+00	4.46E+01

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE ENGINEERING ; FLUX FROM TANKS DURING RETRIEVAL

ORIGINATOR COLIN HENDERSON DATE

REVISION NO.

OBJECTIVE DETERMINE FLUX and Concentration of leakage ASSOCIATED WITH RETRIEVAL of SSTs.

METHODOLOGY See ATTACHED

ASSUMPTIONS SEE ATTACHED

(Continue on another sheet if necessary)

Colin Henderson
SIGNATURE

CALCULATION & RESULTS ATTACHED

PRELIMINARY

JACOBS\FORMS\CALCVR.SHT

METHOD:

— CALCULATE THE SOLUBILITY OF TANK CONSTITUENTS BASED ON THE RATIO OF THE MASS OF EACH CONSTITUENT TO THE MASS OF NITRATE MULTIPLIED BY SOLUBILITY OF NO_3

— SOLUBILITY . . NO_3 = 360 g/L (Serne & Wood 1990)

— CONVERT RADIONUCLIDES from Ci to grams using SPECIFIC ACTIVITY CHART FROM ASI. (ATTACHED) AND FROM WHC-EP-0063-4 Appendix C

— THE TANK INVENTORY provided ON DISK BY ASI.

ASSUMPTIONS

1. LEAKAGE VOLUME PER TANK = 15140 l (4,000 gal)

   BASED ON Waste Retrieval and transfer data package WHICH USED 1/10 of LEAKAGE VOL Estimated for TANK 106C

2. RETRIEVAL DUESTION IS 15 YR (2003/2018)

3. SOLUBILITIES are proportional to mass Ratio of Each CONSTITUENT TO NITRATE.

4. LEAKAGE IS saturated WITH CONTAMINANTS.

5. NO LEAKAGE FROM DSTs

6. RADIONUCLIDES Decayed to 1995 USED AS INVENTORY DOES NOT CORRESPOND TO RETRIEVAL DATE.

RESULTS:

FOR EACH TANK GROUP THE Release Concentration is taken from TABLE 1 FOR RADIONUCLIDES AND TABLE 2 for CHEMICALS. BOTH TABLES ARE IN grams/liter, THE ANNUAL LEAKAGE FROM EACH TANK GROUP IS FROM TABLE 3.

TABLE 1A Provided for Reference and is the inventory in grams, Specific Activity Shown IN left hand Column.

Table 1
Tank Release Concentration grams/ liter for Radionuclides

Solubility Calculation — For each tank group solubility = (mass elem/mass nitrate)x360 g/l

# of Tanks	40	43	40	16	10
grams	1WSS	2WSS	1ESS	2ESS	4ESS
Ac-225	4.07E-19	3.92E-19	1.98E-18	5.38E-17	2.82E-13
Ac-227	9.80E-13	4.66E-13	2.33E-12	2.98E-11	3.03E-14
Ac-228	1.13E-07	3.65E-07	6.95E-07	6.58E-05	1.66E-06
Am-241	1.07E-08	4.47E-08	1.05E-07	8.09E-06	1.86E-07
Am-242	4.58E-12	1.91E-11	4.48E-11	3.47E-09	7.98E-11
Am-243	6.99E-08	3.11E-07	9.16E-07	8.13E-05	1.16E-06
At-217	1.47E-26	1.41E-26	7.13E-26	1.94E-24	1.30E-25
Ba-135m	1.44E-06	3.71E-06	8.37E-06	2.18E-05	1.25E-06
Ba-137m	3.83E-25	1.71E-25	4.75E-25	1.82E-23	3.86E-25
Bi-210	5.72E-16	2.72E-16	1.36E-15	1.74E-14	1.64E-16
Bi-211					
Bi-212	1.62E-19	1.56E-19	7.87E-19	2.14E-17	1.43E-18
Bi-213	6.03E-20	2.88E-20	7.18E-20	3.00E-18	8.41E-20
Bi-214	6.06E-13	6.05E-13	5.44E-12	4.66E-11	2.09E-12
C-14	6.83E-09	2.86E-08	6.68E-08	5.17E-06	1.19E-07
Cm-242	1.33E-11	5.73E-11	2.89E-10	2.25E-08	1.61E-10
Cm-244	3.52E-14	1.71E-13	9.02E-13	7.04E-11	5.02E-13
Cm-245	1.64E-06	3.12E-06	5.84E-06	1.30E-05	9.12E-07
Cs-135	1.06E+01	2.75E+01	6.20E+01	1.61E+02	9.24E+00
Cs-137	2.73E-16	2.63E-16	1.33E-15	3.61E-14	2.42E-15
Fr-221	5.53E-21	2.63E-21	1.31E-20	1.68E-19	1.59E-21
Fr-223	1.84E-15	2.74E-15	1.38E-14	6.56E-14	9.93E-16
I-129	6.64E-03	3.04E-02	4.02E-02	3.20E+00	6.29E-01
Nb-93m		5.14E-08	2.41E-07		
Ni-59	1.16E-03	4.77E-03	1.25E-02	1.01E+00	9.95E-02
Ni-63	1.92E-09	1.48E-09	1.61E-08	7.96E-09	5.61E-10
Np-237	2.49E-07	1.04E-06	2.44E-06	1.89E-04	4.34E-06
Np-238	5.37E-14	2.39E-13	7.04E-13	6.25E-11	8.88E-13
Np-239	5.67E-16	2.50E-16	1.25E-15	2.02E-14	2.02E-16
Pa-231	2.40E-06	1.84E-06	2.00E-05	9.92E-06	6.99E-07
Pa-233	1.82E-13	3.96E-14	2.40E-13	6.93E-12	9.39E-14
Pa-234	1.18E-10	2.57E-11	1.56E-10	4.51E-09	6.10E-11
Pa-234m	3.44E-23	3.32E-23	1.67E-22	4.55E-21	3.05E-22
Pb-209	4.48E-21	2.00E-21	5.56E-21	2.13E-19	4.51E-21
Pb-210	9.28E-13	4.41E-13	2.20E-12	2.82E-11	2.67E-13
Pb-211					
Pb-212	6.03E-20	2.88E-20	7.18E-20	3.00E-18	8.41E-20
Pb-214	3.77E-15	5.61E-15	2.88E-14	1.55E-13	2.19E-15
Pd-107	4.00E-13	1.79E-13	4.96E-13	1.90E-11	4.03E-13
Po-210	4.31E-17	2.05E-17	1.02E-16	1.31E-15	1.24E-17
Po-211					
Po-212	1.30E-31	1.25E-31	6.31E-31	1.72E-29	1.15E-30
Po-213	6.61E-32	3.16E-32	7.87E-32	3.29E-30	9.21E-32
Po-214	2.20E-25	1.05E-25	5.23E-25	6.70E-24	6.33E-26
Po-216					
Po-218	2.94E-24	1.40E-24	3.50E-24	1.46E-22	4.10E-24
Pu-236	5.41E-09	4.41E-09	6.63E-09	5.20E-07	3.10E-08
Pu-238	2.02E-06	2.01E-06	3.92E-06	4.77E-04	2.40E-05
Pu-239	1.08E-04	1.20E-04	2.54E-04	3.31E-02	1.65E-03
Pu-240	2.36E-04	2.22E-04	7.10E-04	8.07E-02	3.59E-03
Pu-241	1.76E-15	7.37E-15	1.72E-14	1.33E-12	3.07E-14
Pu-242	1.80E-08	8.57E-09	4.29E-08	5.49E-07	5.19E-09
Ra-223					
Ra-224	1.47E-19	1.41E-19	7.13E-19	1.94E-17	1.30E-18
Ra-225	2.12E-20	1.01E-20	2.53E-20	1.06E-18	2.96E-20
Ra-226					
Ra-228	3.08E-15	4.93E-13	5.78E-12	4.97E-10	1.07E-10

Table 1

Tank Release Concentration grams/ liter for Radionuclides

Rh-106	2.00E-20	9.49E-21	4.75E-20	6.08E-19	5.74E-21
Rn-219					
Rn-220	9.04E-25	4.32E-25	1.08E-24	4.50E-23	1.26E-24
Rn-222	5.43E-18	8.72E-16	1.02E-14	8.78E-13	1.90E-13
Ru-106	3.25E-11	5.52E-11	3.83E-11	5.80E-09	7.92E-10
Sb-126	9.29E-12	1.58E-11	1.09E-11	1.66E-09	2.26E-10
Sb-126m	1.69E-14	2.53E-14	1.27E-13	5.72E-13	8.92E-15
Se-79	1.26E-02	2.15E-02	1.54E-02	2.08E+00	2.70E-01
Sm-151	2.95E-08	5.00E-08	3.47E-08	5.26E-06	7.19E-07
Sn-126	7.32E-01	4.05E+00	5.66E+00	2.43E+02	4.99E+01
Sr-90	3.34E-07	4.98E-07	2.49E-06	1.13E-05	1.76E-07
Tc-99	4.14E-09	1.97E-09	9.83E-09	1.26E-07	1.19E-09
Th-227					
Th-228	2.88E-17	2.78E-17	1.40E-16	3.81E-15	2.55E-16
Th-229	5.81E-13	2.94E-13	6.75E-13	2.96E-11	1.08E-12
Th-231	1.87E-11	4.39E-12	2.49E-11	7.38E-10	9.71E-12
Th-232	2.30E-15	2.57E-15	5.42E-15	7.06E-13	3.53E-14
Th-233	6.50E-14	1.41E-14	8.58E-14	2.48E-12	3.36E-14
Th-234	3.06E-15	1.45E-15	7.27E-15	9.32E-14	8.80E-16
Tl-208					
Tl-209	1.25E-24	1.20E-24	6.07E-24	1.65E-22	1.10E-23
U-232	7.67E-13	6.48E-13	5.26E-12	5.24E-11	4.05E-12
U-233	6.97E-08	3.77E-08	8.51E-08	4.38E-06	1.92E-07
U-234	1.58E-05	3.72E-06	2.11E-05	6.26E-04	8.23E-06
U-235	1.37E-06	1.53E-06	3.23E-06	4.21E-04	2.10E-05
U-236	2.03E-05	1.91E-05	6.11E-05	6.95E-03	3.09E-04
U-237	2.89E-11	6.28E-12	3.81E-11	1.10E-09	1.49E-11

Table 1A
Tank Contents in grams for Radionuclides

RADIONUCLIDE MASS INVENTORY (grams) BY TANK GROUP.

Specific	Radionuclide	Decayed to 12/31/1995 (grams)				
Activity	# of Tanks	40	43	40	16	10
ci/gram	grams	1WSS	2WSS	1ESS	2ESS	4ESS
5.80E+04	Ac-225	2.97E-11	4.96E-11	1.04E-10	3.87E-11	4.89E-11
7.23E+01	Ac-227	7.16E-05	5.89E-05	1.22E-04	2.15E-05	3.83E-06
2.73E+02	Ac-228	8.28E+00	4.62E+01	3.65E+01	4.74E+01	2.25E+01
3.43E+00	Am-241	7.80E-01	5.64E+00	5.49E+00	5.82E+00	2.53E+00
8.04E+03	Am-242	3.34E-04	2.42E-03	2.35E-03	2.50E-03	1.08E-03
1.99E-01	Am-243	5.10E+00	3.93E+01	4.81E+01	5.85E+01	1.57E+01
1.61E+12	At-217	1.07E-18	1.79E-18	3.75E-18	1.39E-18	1.76E-18
8.05E+03	Ba-135m	1.05E+02	4.69E+02	4.40E+02	1.57E+01	1.70E+01
5.37E+08	Ba-137m	2.80E-17	2.16E-17	2.49E-17	1.31E-17	5.24E-18
1.24E+05	Bi-210	4.18E-08	3.43E-08	7.13E-08	1.25E-08	2.23E-09
4.18E+08	Bi-211					
1.46E+05	Bi-212	1.18E-11	1.97E-11	4.13E-11	1.54E-11	1.94E-11
1.38E+04	Bi-213	4.41E-12	3.64E-12	3.77E-12	2.16E-12	1.14E-12
4.41E+07	Bi-214	4.43E-05	7.65E-05	2.85E-04	3.35E-05	2.84E-05
4.45E+00	C-14	4.99E-01	3.61E+00	3.51E+00	3.72E+00	1.62E+00
3.30E+03	Cm-242	9.75E-04	7.24E-03	1.52E-02	1.62E-02	2.18E-03
8.08E+01	Cm-244	2.57E-06	2.16E-05	4.73E-05	5.06E-05	6.82E-06
1.72E-01	Cm-245	1.20E+02	3.95E+02	3.07E+02	9.37E+00	1.24E+01
1.15E-03	Cs-135	7.76E+08	3.47E+09	3.25E+09	1.16E+08	1.25E+08
8.64E+01	Cs-137	2.00E-08	3.33E-08	6.98E-08	2.60E-08	3.29E-08
1.77E+08	Fr-221	4.04E-13	3.32E-13	6.90E-13	1.21E-13	2.16E-14
3.86E+07	Fr-223	1.34E-07	3.47E-07	7.22E-07	4.72E-08	1.35E-08
1.76E-04	I-129	4.85E+05	3.84E+06	2.11E+06	2.30E+06	8.55E+06
2.63E+02	Nb-93m		6.49E+00	1.26E+01		
8.07E-02	Ni-59	8.47E+04	6.02E+05	6.57E+05	7.28E+05	1.35E+06
5.88E+01	Ni-63	1.41E-01	1.87E-01	8.43E-01	5.73E-03	7.63E-03
7.04E-04	Np-237	1.82E+01	1.32E+02	1.28E+02	1.36E+02	5.89E+01
2.59E+05	Np-238	3.92E-06	3.02E-05	3.69E-05	4.50E-05	1.21E-05
2.32E+05	Np-239	4.14E-08	3.16E-08	6.58E-08	1.46E-08	2.75E-09
4.72E-02	Pa-231	1.75E+02	2.33E+02	1.05E+03	7.14E+00	9.50E+00
2.07E+04	Pa-233	1.33E-05	5.00E-06	1.26E-05	4.99E-06	1.28E-06
1.99E+04	Pa-234	8.64E-03	3.25E-03	8.19E-03	3.24E-03	8.29E-04
6.86E+08	Pa-234m	2.51E-15	4.19E-15	8.79E-15	3.27E-15	4.14E-15
4.59E+04	Pb-209	3.27E-13	2.53E-13	2.92E-13	1.53E-13	6.13E-14
7.64E+01	Pb-210	6.78E-05	5.57E-05	1.16E-04	2.03E-05	3.62E-06
2.47E+07	Pb-211					
1.38E+04	Pb-212	4.41E-12	3.64E-12	3.77E-12	2.16E-12	1.14E-12
3.28E+07	Pb-214	2.75E-07	7.10E-07	1.51E-06	1.12E-07	2.97E-08
5.14E-04	Pd-107	2.92E-05	2.26E-05	2.61E-05	1.37E-05	5.47E-06
4.49E+03	Po-210	3.15E-09	2.59E-09	5.38E-09	9.44E-10	1.68E-10
1.04E+11	Po-211					
1.78E+17	Po-212	9.48E-24	1.58E-23	3.31E-23	1.23E-23	1.56E-23
1.26E+16	Po-213	4.83E-24	3.99E-24	4.13E-24	2.37E-24	1.25E-24
3.22E+14	Po-214	1.61E-17	1.32E-17	2.75E-17	4.82E-18	8.60E-19
3.57E+11	Po-216					
2.83E+08	Po-218	2.15E-16	1.78E-16	1.84E-16	1.05E-16	5.57E-17
5.31E+02	Pu-236	3.95E-01	5.58E-01	3.48E-01	3.74E-01	4.21E-01
1.71E+01	Pu-238	1.48E+02	2.54E+02	2.06E+02	3.43E+02	3.26E+02
6.19E-02	Pu-239	7.86E+03	1.52E+04	1.33E+04	2.38E+04	2.24E+04
2.27E-01	Pu-240	1.73E+04	2.80E+04	3.73E+04	5.81E+04	4.88E+04
1.03E+02	Pu-241	1.29E-07	9.31E-07	9.05E-07	9.60E-07	4.17E-07
3.93E-03	Pu-242	1.32E+00	1.08E+00	2.25E+00	3.95E-01	7.04E-02
5.12E+04	Ra-223					
1.61E+05	Ra-224	1.07E-11	1.79E-11	3.75E-11	1.39E-11	1.76E-11
3.92E+04	Ra-225	1.55E-12	1.28E-12	1.33E-12	7.60E-13	4.02E-13

Table 1A
Tank Contents in grams for Radionuclides

9.88E-01	Ra-226					
2.72E+02	Ra-228	2.25E-07	6.24E-05	3.03E-04	3.58E-04	1.46E-03
3.55E+09	Rh-106	1.46E-12	1.20E-12	2.49E-12	4.37E-13	7.80E-14
1.30E+10	Rn-219					
9.21E+08	Rn-220	6.60E-17	5.46E-17	5.65E-17	3.24E-17	1.71E-17
1.54E+05	Rn-222	3.97E-10	1.10E-07	5.36E-07	6.32E-07	2.58E-06
3.34E+03	Ru-106	2.38E-03	6.97E-03	2.01E-03	4.18E-03	1.08E-02
8.35E+04	Sb-126	6.79E-04	1.99E-03	5.74E-04	1.19E-03	3.08E-03
7.85E+07	Sb-126m	1.24E-06	3.20E-06	6.64E-06	4.11E-07	1.21E-07
6.96E-02	Se-79	9.24E+05	2.72E+06	8.09E+05	1.50E+06	3.67E+06
2.63E+01	Sm-151	2.16E+00	6.32E+00	1.82E+00	3.79E+00	9.76E+00
2.83E-02	Sn-126	5.35E+07	5.12E+08	2.97E+08	1.75E+08	6.78E+08
1.39E+02	Sr-90	2.44E+01	6.29E+01	1.30E+02	8.15E+00	2.39E+00
1.69E-02	Tc-99	3.02E-01	2.48E-01	5.16E-01	9.06E-02	1.62E-02
3.07E+04	Th-227					
8.19E+02	Th-228	2.11E-09	3.51E-09	7.36E-09	2.74E-09	3.47E-09
2.12E-01	Th-229	4.24E-05	3.71E-05	3.54E-05	2.13E-05	1.47E-05
5.29E+03	Th-231	1.36E-03	5.55E-04	1.31E-03	5.31E-04	1.32E-04
1.10E-07	Th-232	1.68E-07	3.24E-07	2.85E-07	5.08E-07	4.79E-07
3.62E+07	Th-233	4.75E-06	1.79E-06	4.50E-06	1.78E-06	4.56E-07
2.31E+04	Th-234	2.24E-07	1.84E-07	3.82E-07	6.70E-08	1.20E-08
2.96E+08	Tl-208					
4.09E+08	Tl-209	9.11E-17	1.52E-16	3.18E-16	1.19E-16	1.50E-16
2.14E+01	U-232	5.60E-05	8.19E-05	2.76E-04	3.77E-05	5.50E-05
9.64E-03	U-233	5.09E+00	4.76E+00	4.47E+00	3.15E+00	2.61E+00
6.24E-03	U-234	1.16E+03	4.70E+02	1.11E+03	4.50E+02	1.12E+02
2.16E-06	U-235	1.00E+02	1.93E+02	1.70E+02	3.03E+02	2.86E+02
6.46E-05	U-236	1.49E+03	2.41E+03	3.21E+03	5.00E+03	4.20E+03
8.15E+04	U-237	2.11E-03	7.94E-04	2.00E-03	7.92E-04	2.02E-04

Table 2
Chemical Release Concentrations Nonradioactive Chemicals for Single Shell Tanks

solubility grams/liter

Chemical	1WSS	2WSS	1ESS	2ESS	4ESS
Ag (1)	5.63E-10	5.11E-10	3.80E-09	1.24E-08	1.97E-10
Al (1)	4.55E+00	8.75E+00	1.53E+01	5.37E+02	1.94E+00
Al+3	9.75E-01	5.73E+00	1.13E+01	8.06E+02	1.87E+00
AlO2-	6.23E+00	8.47E+00	1.37E+01	1.05E+02	1.34E+00
Ba+2 (1)	4.91E-04	1.34E-03	1.95E-03	1.52E-01	1.40E-02
Bi+3	2.28E+00	2.21E-03	1.79E+00	8.27E-01	
C2H3O3 (1)	7.28E-02	2.25E-02	6.15E-03	1.65E-01	2.19E-01
C6H5O7 (1)	7.47E+00	5.21E+00	2.33E+01	1.53E+02	1.79E+00
CO3-2	9.68E+00	1.27E+00	1.22E+01	8.62E+01	2.80E+00
Ca+2	2.72E-03	4.60E-02	1.04E+00	9.16E+01	1.13E-01
Cd+2 (2)					
Ce+3	1.59E+00	2.50E-01	1.68E+00	3.67E-01	1.29E-01
Cl-	3.00E-01	4.28E-02	2.40E-01	5.58E-02	4.44E-03
Cr+3	1.73E-02	6.59E-01	1.38E-02	2.30E-01	6.07E-02
CrO4-2	4.28E-03	1.63E-01	3.42E-03	5.69E-02	1.50E-02
EDTA (1)	5.58E-01	1.73E-01	4.71E-02	1.27E+00	1.67E+00
F-	1.97E+00	2.38E-01	4.42E+00	5.56E+02	2.27E-02
Fe+3	2.33E+00	6.47E-01	2.70E+00	7.72E+01	1.31E+01
Fe(CN)6-4	3.00E-02	1.08E-02	4.72E+00	9.73E+01	3.90E-03
HEDTA (1)	1.01E+00	3.14E-01	9.41E-02	2.30E+00	3.04E+00
Hg+ (2)					
K+ (1)	6.85E-02	2.00E-01	5.50E-01	2.56E-01	3.33E-02
La+ (1)	2.03E-02		7.60E-03		
Mn+4	2.87E-01	8.92E-02	2.49E-01	7.12E+01	1.73E+00
Na+	1.99E+02	1.67E+02	2.20E+02	2.92E+03	2.78E+02
Ni+2	6.88E-02	2.64E-02	2.37E+00	6.12E+01	7.31E-02
NO2-	2.41E+01	6.33E+00	3.92E+01	6.59E-01	1.71E+01
NO3-	3.60E+02	3.60E+02	3.60E+02	3.60E+02	3.60E+02
OH-	6.20E+00	1.82E+01	1.98E+01	1.97E+03	1.28E+01
PO4-3	3.66E+01	8.70E-01	3.44E+01	4.14E+01	6.34E-02
Pb (1)	3.22E-02	3.06E-02	8.04E+00	9.48E+00	7.60E-03
SiO3-	7.67E+00	1.90E+00	7.68E+00	9.83E-01	1.54E-01
Sn (1)			1.02E-04		
SO4-2	8.68E+00	1.96E+00	1.05E+01	1.86E+02	6.15E+00
Sr+2	1.28E-05	5.52E-04	6.82E-01	3.52E-02	4.25E-03
W+4 (2)					
Zr+4	1.92E-01	1.83E-01	1.24E-01	2.82E+02	9.41E-03

TABLE 3

SST RETRIEVAL LEAK ESTIMATES

TANK GROUP	1WSS	2WSS	1ESS	2ESS	4ESS
NO. TANKS	40	43	40	16	10
RETRIEVAL LEAK VOLUME (LITERS)	605600	651020	605600	242240	151400
RETRIEVAL LEAK RATE (LITERS/YR)	40373	43401	40373	16149	10093
SST RETRIEVAL OPERATIONS =15 YRS MIN PRETREAT AND TPA					
SST RETRIEVAL PERIOD 2003/2018					

(DK-ADJ.XLW)Radnuclide Data

Atomic Weight (A)	Isotope	Half-Life (T)	Units	Specific Activity (TBq/g)	Specific Activity (Ci/g)	Decay Constant (per day)
3	H-3	1.24E+01	y	3.57E+02	9.64E+03	1.54E-04
7	Be-7	53.440	d	1.29E+04	3.49E+05	1.30E-02
11	C-11	20.380	m	3.10E+07	8.38E+08	4.90E+01
13	N-13	9.970	m	5.36E+07	1.45E+09	1.00E+02
14	C-14	5.73E+03	y	1.65E-01	4.45E+00	3.31E-07
16	N-16	7.20E+00	s	3.62E+09	9.78E+10	8.32E+03
18	F-18	1.829	h	3.50E+04	9.47E+05	9.10E+00
22	Na-22	2.60E+00	y	2.31E+02	6.24E+03	7.29E-04
24	Na-24	15.000	h	3.20E+03	8.66E+04	1.11E+00
32	P-32	14.290	d	1.06E+04	2.85E+05	4.85E-02
35	S-35	87.440	d	1.58E+03	4.26E+04	7.93E-03
36	Cl-36	3.01E+05	y	1.22E-03	3.30E-02	6.30E-09
41	Ar-41	1.827	h	1.54E+04	4.16E+05	9.11E+00
42	K-42	51.500	d	2.23E+03	6.03E+04	1.35E-02
45	Ca-45	163.000	d	6.58E+02	1.78E+04	4.25E-03
46	Sc-46	83.830	d	1.25E+03	3.38E+04	8.27E-03
51	Cr-51	27.704	d	3.42E+03	9.23E+04	2.50E-02
54	Mn-54	312.500	d	2.86E+02	7.73E+03	2.22E-03
55	Fe-55	2.70E+00	y	8.90E+01	2.41E+03	7.03E-04
56	Mn-56	2.579	h	7.99E+03	2.16E+05	6.45E+00
57	Co-57	270.900	d	3.13E+02	8.45E+03	2.56E-03
59	Ni-59	7.50E+04	y	2.99E-03	8.07E-02	2.53E-08
59	Fe-59	44.529	d	1.84E+03	4.97E+04	1.56E-02
60	Co-60	5.27E+00	y	4.18E+01	1.13E+03	3.60E-04
63	Ni-63	1.00E+02	y	2.10E+00	5.66E+01	1.90E-05
64	Cu-64	12.701	h	1.42E+03	3.84E+04	1.31E+00
65	Zn-65	243.900	d	3.04E+02	8.23E+03	2.84E-03
65	Ni-65	2.520	h	7.04E+03	1.90E+05	6.60E+00
72	Ga-72	14.100	h	1.14E+03	3.07E+04	1.18E+00
76	As-76	26.320	h	5.77E+02	1.56E+04	6.32E-01
79	Se-79	6.50E+04	y	2.57E-03	6.96E-02	2.92E-08
82	Br-82	35.300	h	3.99E+02	1.08E+04	4.71E-01
86	Rb-86	18.660	d	3.01E+03	8.13E+04	3.71E-02
89	Sr-89	50.500	d	1.07E+03	2.90E+04	1.37E-02
90	Sr-90	2.85E+01	y	5.13E+00	1.39E+02	6.64E-05
90	Y-90	64.100	h	2.00E+02	5.41E+03	2.60E-01
92	Y-92	3.540	h	3.54E+03	9.56E+04	4.70E+00
92	Sr-92	2.710	h	4.63E+03	1.25E+05	6.14E+00
93	Nb-93m	1.46E+01	y	9.73E+00	2.63E+02	1.30E-04
93	Zr-93	1.53E+06	y	9.29E-05	2.51E-03	1.24E-09
95	Zr-95	63.960	d	7.94E+02	2.15E+04	1.08E-02
95	Nb-95	35.150	d	1.45E+03	3.91E+04	1.97E-02
99	Mo-99	66.000	h	1.77E+02	4.77E+03	2.52E-01
99	Tc-99m	6.020	h	1.94E+03	5.23E+04	2.76E+00
99	Tc-99	2.13E+05	y	6.27E-04	1.69E-02	8.91E-09
103	Ru-103	39.280	d	1.19E+03	3.22E+04	1.76E-02
106	Ru-106	368.200	d	1.24E+02	3.34E+03	1.88E-03

(DK-ADJ.XLW)Radnuclide Data

Atomic Wieght (A)	Isotope	Half-Life (T)	Units	Specific Activity (TBq/g)	Specific Activity (Ci/g)	Decay Constant (per day)
106	Rh-106	2.89E+01	s	1.31E+08	3.55E+09	2.00E+03
107	Pd-107	6.50E+06	y	1.90E-05	5.14E-04	2.92E-10
110	Ag-110m	249.900	d	1.76E+02	4.75E+03	2.77E-03
110	Ag-110	2.46E+01	s	1.54E+08	4.17E+09	2.43E+03
123	I-123	13.200	h	7.11E+02	1.92E+04	1.26E+00
125	I-125	60.140	d	6.42E+02	1.74E+04	1.15E-02
126	Sb-126	12.400	d	3.09E+03	8.35E+04	5.59E-02
126	Sb-126m	19.000	m	2.90E+06	7.85E+07	5.25E+01
126	Sn-126	1.00E+05	y	1.05E-03	2.83E-02	1.90E-08
129	I-129	1.57E+07	y	6.52E-06	1.76E-04	1.21E-10
131	I-131	8.040	d	4.58E+03	1.24E+05	8.62E-02
132	Te-132	76.200	h	1.12E+02	3.02E+03	2.13E-01
132	I-132	2.300	h	3.80E+03	1.03E+05	7.23E+00
133	Ba-133	1.05E+01	y	9.46E+00	2.56E+02	1.81E-04
133	Xe-133	5.245	d	6.92E+03	1.87E+05	1.32E-01
133	I-133	20.800	h	4.17E+02	1.13E+04	8.00E-01
133	Te-133	12.450	m	4.20E+06	1.13E+08	8.02E+01
134	Cs-134	2.06E+00	y	4.78E+01	1.29E+03	9.20E-04
135	I-135	6.610	h	1.29E+03	3.49E+04	2.52E+00
135	Ba-135m	28.700	h	2.98E+02	8.05E+03	5.60E-01
135	Cs-135	2.30E+06	y	4.26E-05	1.15E-03	8.25E-10
136	Cs-136	13.100	d	2.71E+03	7.32E+04	5.29E-02
137	Cs-137	3.02E+01	y	3.20E+00	8.64E+01	6.29E-05
137	Ba-137m	2.552	m	1.99E+07	5.37E+08	3.91E+02
140	Ba-140	12.740	d	2.71E+03	7.31E+04	5.44E-02
140	La-140	40.272	h	2.05E+02	5.53E+03	4.13E-01
141	Ce-141	32.501	d	1.05E+03	2.85E+04	2.13E-02
143	Ce-144	284.800	d	1.19E+02	3.21E+03	2.44E-03
143	Pr-143	13.560	d	2.49E+03	6.73E+04	5.11E-02
143	Ce-143	33.000	h	2.44E+02	6.61E+03	5.04E-01
144	Pr-144	17.280	m	2.79E+06	7.55E+07	5.78E+01
147	Pm-147	2.62E+00	y	3.43E+01	9.26E+02	7.23E-04
151	Sm-151	9.00E+01	y	9.72E-01	2.63E+01	2.11E-05
154	Eu-154	8.590	y	9.99E+00	2.70E+02	2.21E-04
181	Ta-181	121.200	d	2.20E+02	5.95E+03	5.72E-03
182	Ta-182	115.000	d	2.31E+02	6.23E+03	6.03E-03
185	W-185	75.100	d	3.47E+02	9.39E+03	9.22E-03
192	Ir-192	74.020	d	3.40E+02	9.18E+03	9.36E-03
198	Au-198	2.696	d	9.04E+03	2.44E+05	2.57E-01
199	Au-199	3.139	d	7.73E+03	2.09E+05	2.21E-01
203	Hg-203	46.600	d	5.10E+02	1.38E+04	1.49E-02
204	Tl-204	3.78E+00	y	1.71E+01	4.63E+02	5.02E-04
207	Tl-207	4.770	m	7.04E+06	1.90E+08	2.09E+02
208	Tl-208	3.053	m	1.09E+07	2.96E+08	3.27E+02
209	Pb-209	3.253	h	1.70E+03	4.59E+04	5.11E+00
209	Tl-209	2.200	m	1.51E+07	4.09E+08	4.54E+02
210	Pb-210	2.23E+01	y	2.83E+00	7.64E+01	8.53E-05

(DK-ADJ.XLW)Radnuclide Data

Atomic Weight (A)	Isotope	Half-Life (T)	Units	Specific Activity (TBq/g)	Specific Activity (Ci/g)	Decay Constant (per day)
210	Bi-210	5.012	d	4.59E+03	1.24E+05	1.38E-01
210	Po-210	138.378	d	1.66E+02	4.49E+03	5.01E-03
211	Bi-211	2.130	m	1.55E+07	4.18E+08	4.69E+02
211	Pb-211	36.100	m	9.12E+05	2.47E+07	2.76E+01
211	Po-211	5.16E-01	s	3.83E+09	1.04E+11	1.16E+05
212	Po-212	2.98E-07	s	6.60E+15	1.78E+17	2.01E+11
212	Bi-212	1.009	h	5.39E+03	1.46E+05	1.65E+01
212	Pb-212	10.643	h	5.11E+02	1.38E+04	1.56E+00
213	Bi-213	45.650	m	7.15E+05	1.93E+07	2.19E+01
213	Po-213	4.20E-06	s	4.66E+14	1.26E+16	1.43E+10
214	Bi-214	19.900	m	1.63E+06	4.41E+07	5.02E+01
214	Pb-214	26.800	m	1.21E+06	3.28E+07	3.72E+01
214	Po-214	1.64E-04	s	1.19E+13	3.22E+14	3.66E+08
215	Po-215	1.78E-03	s	1.09E+12	2.95E+13	3.37E+07
216	Po-216	1.46E-01	s	1.32E+10	3.57E+11	4.10E+05
217	At-217	3.23E-02	s	5.95E+10	1.61E+12	1.85E+06
218	Po-218	3.050	m	1.05E+07	2.83E+08	3.27E+02
219	Rn-219	3.96E+00	s	4.81E+08	1.30E+10	1.51E+04
220	Rn-220	5.56E+01	s	3.41E+07	9.21E+08	1.09E+03
221	Fr-221	4.800	m	6.55E+06	1.77E+08	2.08E+02
222	Rn-222	3.824	d	5.69E+03	1.54E+05	1.81E-01
223	Fr-223	21.800	m	1.43E+06	3.86E+07	4.58E+01
223	Ra-223	11.434	d	1.89E+03	5.12E+04	6.06E-02
224	Ra-224	3.620	d	5.95E+03	1.61E+05	1.91E-01
225	Ac-225	10.000	d	2.15E+03	5.80E+04	6.93E-02
225	Ra-225	14.800	d	1.45E+03	3.92E+04	4.68E-02
226	Ra-226	1.60E+03	y	3.65E-02	9.88E-01	1.16E-06
227	Th-227	18.718	d	1.14E+03	3.07E+04	3.70E-02
227	Ac-227	2.18E+01	y	2.67E+00	7.23E+01	8.72E-05
228	Ra-228	5.75E+00	y	1.01E+01	2.72E+02	3.30E-04
228	Th-228	1.91E+00	y	3.03E+01	8.19E+02	9.92E-04
228	Ac-228	6.130	h	8.25E+02	2.23E+04	2.71E+00
229	Th-229	7.34E+03	y	7.86E-03	2.12E-01	2.59E-07
230	Th-230	7.70E+04	y	7.46E-04	2.02E-02	2.46E-08
231	Th-231	25.520	h	1.96E+02	5.28E+03	6.52E-01
231	Pa-231	3.28E+04	y	1.75E-03	4.72E-02	5.79E-08
232	Th-232	1.41E+10	y	4.05E-09	1.10E-07	1.35E-13
232	U-232	7.20E+01	y	7.91E-01	2.14E+01	2.64E-05
233	U-233	1.59E+05	y	3.57E-04	9.64E-03	1.19E-08
233	Pa-233	27.000	d	7.67E+02	2.07E+04	2.57E-02
233	Th-233	22.300	m	1.34E+06	3.62E+07	4.49E+01
234	U-234	2.45E+05	y	2.31E-04	6.24E-03	7.76E-09
234	Th-234	24.100	d	8.56E+02	2.31E+04	2.86E-02
234	Pa-234	6.700	h	7.36E+02	1.99E+04	2.48E+00
234	Pa-234m	1.170	m	2.54E+07	6.86E+08	8.53E+02
235	U-235	7.04E+08	y	7.99E-08	2.16E-06	2.70E-12
236	U-236	2.34E+07	y	2.39E-06	6.46E-05	8.10E-11

(DK-ADJ.XLW)Radnuclide Data

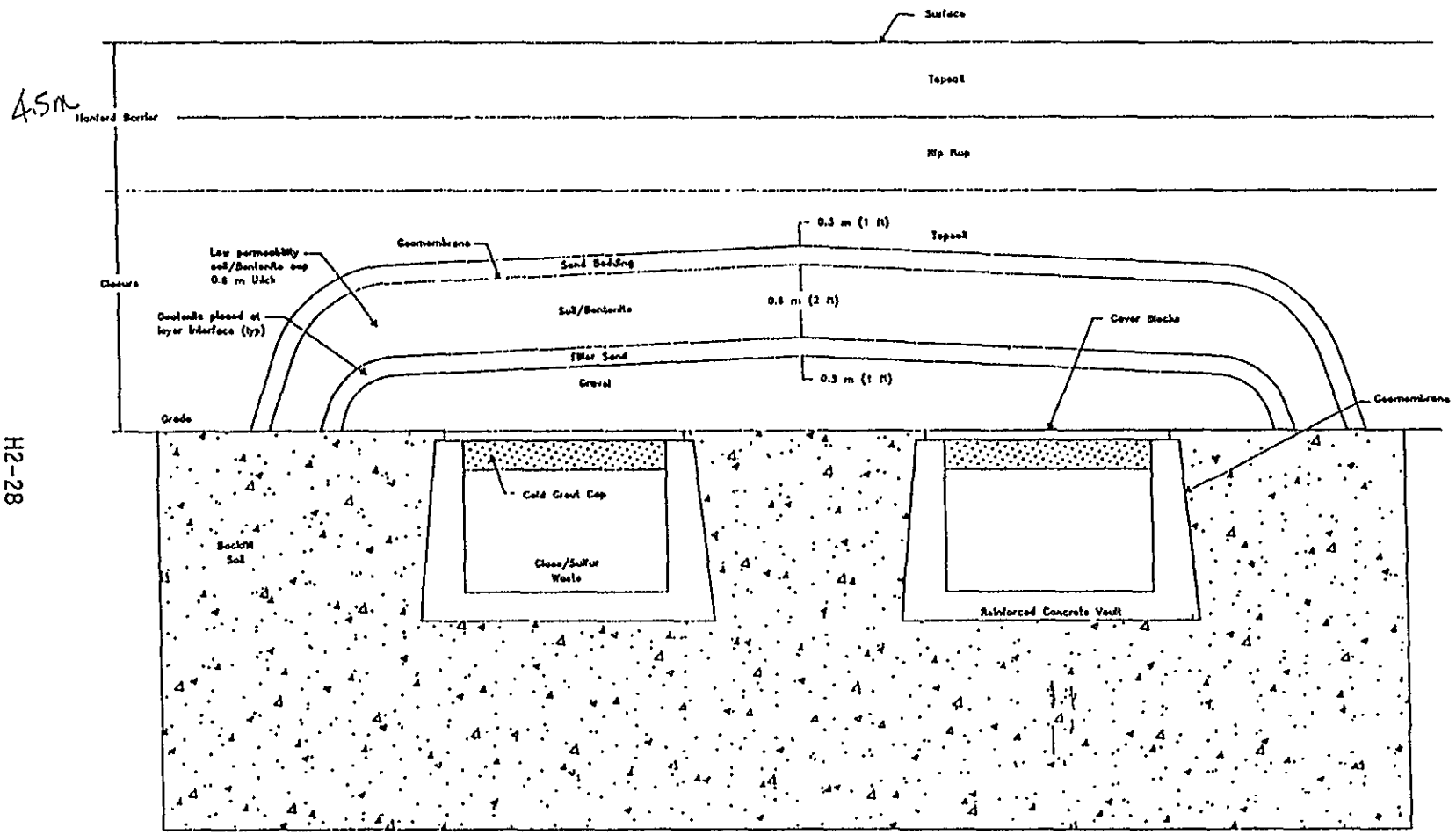
Atomic Wieght (A)	Isotope	Half-Life (T)	Units	Specific Activity (TBq/g)	Specific Activity (Ci/g)	Decay Constant (per day)
236	Pu-236	2.85E+00	y	1.96E+01	5.31E+02	6.66E-04
237	U-237	6.750	d	3.02E+03	8.15E+04	1.03E-01
237	Np-237	2.14E+06	y	2.61E-05	7.04E-04	8.87E-10
238	U-238	4.47E+09	y	1.24E-08	3.36E-07	4.25E-13
238	Pu-238	8.77E+01	y	6.33E-01	1.71E+01	2.16E-05
238	Np-238	2.117	d	9.58E+03	2.59E+05	3.27E-01
239	Pu-239	2.41E+04	y	2.29E-03	6.19E-02	7.86E-08
239	Np-239	2.355	d	8.57E+03	2.32E+05	2.94E-01
240	Pu-240	6.57E+03	y	8.38E-03	2.27E-01	2.89E-07
241	Am-241	4.32E+02	y	1.27E-01	3.43E+00	4.39E-06
241	Pu-241	1.44E+01	y	3.81E+00	1.03E+02	1.32E-04
242	Am-242	16.020	h	2.98E+02	8.04E+03	1.04E+00
242	Am-242m	1.52E+02	y	3.59E-01	9.71E+00	1.25E-05
242	Cm-242	163.200	d	1.22E+02	3.30E+03	4.25E-03
242	Pu-242	3.76E+05	y	1.45E-04	3.93E-03	5.05E-09
243	Am-243	7.38E+03	y	7.37E-03	1.99E-01	2.57E-07
244	Cm-244	1.81E+01	y	2.99E+00	8.08E+01	1.05E-04
245	Cm-245	8.50E+03	y	6.35E-03	1.72E-01	2.23E-07
252	Cf-252	2.64E+00	y	1.99E+01	5.37E+02	7.19E-04

REFERENCES.

SERNE, R.J. AND M.I. Wood, 1990 HANFORD WASTE FORM RELEASES AND SEDIMENT INTERACTIONS PNL 7297, BATTELLE PACIFIC NORTHWEST LABORATORY, RICHLAND WASHINGTON.

WASTE RETRIEVAL AND TRANSFER DATA PACKAGE EA FREDENBURG, WHC-SD-WM-EV-097 RevA Draft RECVD 11/8/94.

Figure H2-7. Glass in Sulfur Disposal.



Glass/Sulfur Disposal

Request Number 026

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Keith Lusk

Date: 01/17/95

Phone Number: 619-560-8552

Fax Number: 619-560-8538

Request Information: Request the following information for the Minimum Pretreat and TPA Preferred Alternatives: Locations, sizes, and descriptions of new facilities to be (constructed, estimated utility usage (gas, water, etc.).

Need Date: ASAP

Response: See attached request number 026.

Data Source/Accuracy:

Prepared By:

Date Sent/Faxed:

Concurrence: Marc Nelson

Marc Nelson - Deputy Project Manager

egfrm.026

No Pretreatment

Table 7-4. Comparison of Alternatives by Operating Resource Requirements (Units As Indicated).

Operating Resource	no pretreatment	TPA Preferred Alternative
Land (m^2)		
Surface committed	0[1]	63,193[1]
Permanently		
Water (m^3/yr) Total	1,299,000	2,379,000
Raw Water (m^3/yr)	1,190,000[2]	2,120,000[2]
Sanitary Water (m^3/yr)	109,000[3]	259,000[3]
Energy		
Electrical (GWh/yr)	665[4]	1,019[5]
Kerosene (m^3/yr)	13,600[6]	13,600[6]

Table 7-4. Comparison of Alternatives by Operating Resource Requirements (Units As Indicated).

Materials[7]		
Glass Former (Mg/yr) Total	52,800	58,340
Silica (Mg/yr)	40,550	44,800
Boron Oxide (Mg/yr)	8,170	9,030
Lithium Oxide (Mg/yr)	2,900	3,210
Calcium Oxide (Mg/yr)	590	650
Magnesium Oxide (Mg/yr)	590	650
Bulk Frit (Mg/yr)	0	10
50% Nitric Acid (m^3/yr)	45[8]	745[8]
50% Sodium Hydroxide (m^3/yr)	19[9]	3,220[9]
Potassium Permanganate (Mg/yr)	1.2[10]	3.6[10]
Sodium Nitrite (Mg/yr)	0	1,050[11]
Flocculant (Mg/yr)	0	14.3
Offgas Treatment Chemical	Not Defined	Not Defined
100% Glycolic Acid (Mg/yr)	0	574[12]
Oxalic Acid (Mg/yr)	2.3[10]	6.9[10]
Trisodium Phosphate (Mg/yr)	136[10]	409[10]
Antifoam Solution	Not Defined	Not Defined
Ammonia (Mg/yr)	1,710	1,930
Oxygen (Mg/yr)	36,300[6]	36,300[6]
Bulk Sulfur Cement		
Sulfur (Mg/yr)	0	24,000
Dicyclopentadiene (Mg/yr)	0	640
Oligomer (Mg/yr)	0	640
Ion Exchange Media (m^3/yr)	0	16[13]
Concrete (m^3)	0	160,100[14]
Steel (Mg)	0	19,200[14]

Table 7-4. Comparison of Alternatives by Operating Resource Requirements (Units As Indicated).

[1]"Surface committed permanently" is defined as that remaining after D&D. D&D is assumed to remove all buildings, facilities, etc., except the LLW vaults in the Tri-Party Agreement preferred alternative. Reference Dwg. ES-ALT8A-08, Sheet 2.

[2]Raw water usage is for cooling tower makeup. The makeup for loss through evaporation, bleedoff and drift is based on a cooling tower duty of 605 GWh/yr and 842 GWh/yr for the no pretreatment and Tri-Party Agreement preferred alternative, respectively.

[3]Sanitary water usage includes potable water, process water, demineralized water, utility station water and water for HVAC air humidification. For users and quantities, refer to Table A and Table C for no pretreatment case and Tri-Party Agreement preferred alternative case respectively. Potable water usage is based on assuming 20 gallons per day per person with an additional 10 percent contingency. The total onsite population is 506 and 708 for no pretreatment case and Tri-Party Agreement preferred alternative case respectively. Process water usage is based on cold chemicals makeup, and decon and equipment flushing requirements. The demineralized water usage is based on makeup requirements for the electric steam generators, melter cooling water system, process cooling water system, and process chilled water system. Sanitary water usage for utility stations is based on assuming continuous flow at 0.00379 m^3/min (1 gpm) for each of the TWRS treatment facilities.

[4]The electrical load for the no pretreatment case consists of:

(a)	Process	510 GWh/yr	(Includes process electric heaters, electric steam generators, compressors, blowers, agitators and pumps.)
(b)	HVAC	113 GWh/yr	(Includes HVAC usage for the process building and ancillary buildings.)
(c)	Mechanical	7 GWh/yr	(For operation of cranes, MSMs and other miscellaneous mechanical equipment. Average requirement is assumed to be 27 percent of the maximum requirement.)
(d)	Electrical	35 GWh/yr	(Includes lighting, UPS and miscellaneous electrical equipment requirement.)

[5]The electrical load for the Tri-Party Agreement preferred alternative case consists of:

(a)	Process	712 GWh/yr	(Includes HLW Joule-heated Melters, process electric heaters, electric steam generators, compressors, blowers, agitators and pumps.)
(b)	HVAC	229 GWh/yr	(Includes HVAC usage for the process building and ancillary buildings.)
(c)	Mechanical	7 GWh/yr	(For operation of cranes, MSMs and other miscellaneous mechanical equipment. Average requirement is assumed to be 27 percent of the maximum requirement.)
(d)	Electrical	71 GWh/yr	(Includes lighting, UPS and miscellaneous electrical equipment requirement.)

[6]Kerosene and Oxygen are used only by the combustion melter and not by the Joule-heated melter. The HLW melters for the Tri-Party Agreement preferred alternative case are Joule-heated.

[7]Generally, material requirements are based on the WHC material balances and the facility design capacities. The exceptions are the concrete and steel for LLW vault construction, and the decon chemicals (nitric acid, sodium hydroxide, potassium permanganate, oxalic acid and trisodium phosphate) requirements.

[8]The nitric acid requirement for decon for each facility is based on the estimated needs for a HLW facility (HWVP). For the no pretreatment case, 45 m^3/yr of 50% nitric acid is assumed for decon. For the Tri-Party Agreement preferred alternative, 655 m^3/yr is used for the separations process and 90 m^3/yr is assumed for decon: 45 m^3/yr in the combined separations/LLW facility and 45 m^3/yr in the HLW facility.

[9]The sodium hydroxide requirement for decon for each facility is based on the estimated needs for a HLW facility (HWVP). For the no pretreatment case, 19 m^3/yr of 50% sodium hydroxide is assumed for decon. For the Tri-Party Agreement preferred alternative, 2,180 m^3/yr is used in the sludge wash process, 1,002 m^3/yr is used for the separations process and 38 m^3/yr is assumed for decon: 19 m^3/yr for the combined separations/LLW facility and 19m^3/yr for the HLW facility.

[10]Potassium permanganate, oxalic acid and trisodium phosphate are used in the facilities for decon only. Their requirement for each of the TWRS treatment facilities is based on the estimated needs for a HLW facility (HWVP).

[11]Most of the sodium nitrite (1,040 Mg/year) is used for Pretreatment. A small amount (10 Mg/year) is used in the sludge wash process.

[12]Glycolic acid is added to adjust the reduction potential of the 20 Mg/d HLW melter (High Temperature or Stirred Melter) . One mole of glycolic acid is added per mole of nitrate or nitrite in the feed slurry. The combustion melter associated with the no pretreatment case does not require glycolic acid addition because its reduction potential is assumed to be regulated by controlling excess oxygen addition to the melter.

[13]The ion exchange media requirement (for low Cesium DF) is based on the Tank Waste Remediation System Facilities Configuration Studies, June 1994, Table 4.1-4. Consumables for Detached Separation Facility. The ion exchange media is regenerable but must be periodically replaced.

[14]Based on the quantities for the expense funded LLW vaults. The quantities listed are totals over the plant life, not annual consumptions.

No Pretreatment

Table 7-10. Comparison of Alternatives by Construction Resource Requirements (Units As Indicated).

Construction Resource	no pretreatment	TPA Preferred Alternative
Land (ha)		
Surface committed		
Temporarily	60 Hectares	81 Hectares
Permanently	55 Hectares	77 Hectares
Water (m_3)		
source of water	23 Hectare Meters	30 Hectare Meters
Energy		
Electrical (Gwh)	30 Gwh[1]	45 Gwh[1]
Propane (m3)	0	0
Diesel fuel (liters)	11.8 MM	17.4 MM
Gasoline (liters)	5.1 MM	7.6 MM
Materials		
Concrete (m3)	207,413	312,520
Steel:		
Carbon Steel (M/T)	51,155	78,055
Stainless Steel (M/T)	8,612	14,902
Hastelloy/Incl (M/T)	1,513	2,281
Excavation (m3)	777 M[2]	869 M[2]
Riprap (m3)	0	0
Structure backfill (m3)	573 M[3]	658 M[3]
Total Contaminated Material (m^3)	40 M[4]	60 M[4]

[1]Electrical service will require approximately 2.5 Km of 13.8 KV overhead power line.

[2]Excavation represents structural excavation for building construction.

[3]Structure backfill is at the buildings.

[4]Contaminated material is concrete and steel that will become contaminated during operations.

Table 10-4. Operating Resource Requirements. (Units As Indicated) (2 sheets)

Operating resource	Tri-Party Agreement preferred alternative
Land (m^2)	
Surface committed permanently	6.3×10^4 [a]
Water (m^3) Total	3.3×10^7
Raw Water (m^3)	3.0×10^7 [b]
Sanitary Water (m^3)	3.6×10^6 [c]
Energy	
Electrical (GWh)	1.4×10^4 [d]
Kerosene (m^3)	1.9×10^5 [e]
Material	
Glass Former (Mg) Total	8.2×10^5
Silica (Mg)	6.3×10^5
Boron Oxide (Mg)	1.3×10^5
Lithium Oxide (Mg)	4.5×10^4
Calcium Oxide (Mg)	9.1×10^3
Magnesium Oxide (Mg)	9.1×10^3
Bulk Frit (Mg)	140
50% Nitric Acid (m^3)	1.0×10^4 [g]
50% Sodium Hydroxide (m^3)	4.5×10^4 [h]
Potassium Permanganate (Mg)	50[i]
Sodium Nitrite (Mg)	1.5×10^4 [j]
Flocculent (Mg)	200
Offgas treatment chemical	Not Defined
100% glycolic acid (Mg)	8.0×10^3 [k]
Oxalic acid (Mg)	97 [i]

Table 10-4. Operating Resource Requirements. (Units As Indicated) (2 sheets)

Operating resource	Tri-Party Agreement preferred alternative
Material (Continued)	
Trisodium phosphate (Mg)	5.7×10^3 [i]
Antifoam solution	Not Defined
Ammonia (Mg)	2.7×10^4
Oxygen (Mg)	5.1×10^5 [c]
Bulk sulfur cement	3.4×10^5
sulfur (Mg)	9.0×10^3
dicyclopentadiene (Mg)	9.0×10^3
oligomer (Mg)	220 l
Ion exchange media (m^3)	
Concrete (m^3)	1.6×10^5 [m]
Steel (Mg)	1.9×10^4 [m]

[a]"Surface committed permanently" is that remaining after D&D, which is assumed to remove all buildings, facilities, etc., except the LLW vaults in the Tri-Party Agreement preferred alternative (Reference Drawing ES-ALT8A-08, Sheet 2.

[b]Raw water is for cooling tower makeup. Makeup for evaporation loss, bleedoff, and drift is based on a cooling tower duty of 842 GWh/yr.

[c]Sanitary water includes potable water, process water, demineralized water, utility station water, and water for HVAC air humidification. For users and quantities, refer to Table C for Tri-Party Agreement preferred alternative case. Potable water use is based on the assumption of 20 gal/day/person with an additional 10% contingency. The total onsite population is 708 for the Tri-Party Agreement preferred alternative case. Process water usage is based on cold chemical makeup, decon, and equipment flushing requirements. Demineralized water use is based on makeup requirements for electric steam generators, melter cooling water system, process cooling water system, and process chilled water system. Sanitary water use for utility stations is based on the assumption of continuous flow at 0.00379 m^3/min (1 gal/min) for each of the TWRS treatment facilities.

Table 10-4. Operating Resource Requirements. (Units As Indicated) (2 sheets)

Operating resource	Tri-Party Agreement preferred alternative

[d]Electrical load for the Tri-Party Agreement preferred alternative case is (1) Process (712 GWh/yr), including HLW joule-heated melters, electric heaters, electric steam generators, compressors, blowers, agitators, and pumps; (2) HVAC (229 GWh/yr), including use for process building and ancillary buildings; (3) Mechanical (7 GWh/yr) for operation of cranes, MSMs, and other miscellaneous mechanical equipment, with average requirements assumed to be 27% of the maximum requirement; (4) Electrical (71 GWh/yr) including lighting, UPS, and miscellaneous electrical equipment.

[e]Kerosene and oxygen are used only by the combustion melter and not by the joule-heated melter. HLW melters for the Tri-Party Agreement preferred alternative case are joule-heated.

[f]Generally, material requirements are based on WHC material balances and the facility design capacities. Exceptions are concrete and steel for LLW vault construction, and decon chemical requirements (i.e., nitric acid, sodium hydroxide, potassium permanganate, oxalic acid, and trisodium phosphate).

[g]The nitric acid requirement for decon is based on the estimated need for a HLW facility (HWVP). For the Tri-Party Agreement preferred alternative, 655 m^3/yr is used for separations and 90 m^3/yr is assumed for decon (45 m^3/yr in the combined separations/LLW facility and 45 m^3/yr in the HLW facility).

[h]The sodium hydroxide requirement for decon is based on the estimated need for a HLW facility (HWVP). For the Tri-Party Agreement preferred alternative, 2,180 m^3/yr is used in sludge washing, 1,002 m^3/yr is used for separations, and 38 m^3/yr is assumed for decon (19 m^3/yr for the combined separations/LLW facility and 19m^3/yr for the HLW facility).

[i]Potassium permanganate, oxalic acid, and trisodium phosphate are used in the facilities for decon only. The requirement for each TWRS treatment facility is based on estimated need for a HLW facility (HWVP).

[j]Sodium nitrite is mostly used for pretreatment (1,040 Mg/yr); a small use (10 Mg/yr) is in sludge washing.

Table 10-11. Construction Resource Requirements. (Units As Indicated)

Construction resource	Tri-Party Agreement preferred alternative
Land (ha)	
Surface committed	
Temporarily	81 Hectares
Permanently	77 Hectares
Water (m^3) source of water	30 Hectare Meters
Energy	
Electrical (Gwh)	45 Gwh[a]
Propane (m^3)	0
Diesel fuel (L)	17.4 MM
Gasoline (L)	7.6 MM
Materials	
Concrete (m^3)	312,520
Steel	
Carbon Steel (M/T)	78,055
Stainless Steel (M/T)	14,902
Hastelloy/Incl (M/T)	2,281
Excavation (m^3)	869 M[b]
Riprap (m^3)	0
Structure backfill (m^3)	658 M[c]
Total Contaminated Material (m^3)	60 M[d]

See Appendix C for calculational details.

[a]Electrical service will require approximately 2.5 Km of 13.8 KV overhead power line.
[b]Excavation represents structural excavation for building construction.
[c]Structure backfill is at the buildings.
[d]Contaminated material is concrete and steel that will become contaminated during operations.

FACILITIES

TPA

OSB - Operations Support Bldg. ~26,00 sqft.
LLW - Low Level Waste Vitrification facility ~140,00 sqft.
REB - Regulated Entrance Building
OCB - Operations Control Bldg.
WSF - Waste Staging Facility
HLW - High Level Waste Vitrification Facility
MUB - Mock Up Building
FW Pump Houses - Fire Water Pump Houses
LLW Vaults - Low Level Waste Disposal Vaults
Bulk Cold Chemical
Cask PAD -
Cooling Tower -
Substation/Switch Gear Bldg.

Minimum Pretreatment

For Minimum Pretreatment the acronyms are the same.

Vitrification Facility ~284,000 sqft.

Note: The above facility areas are estimates based on scaling off of the site plans.

Colin Henderson

Figure 5-2. Disturbed Areas.

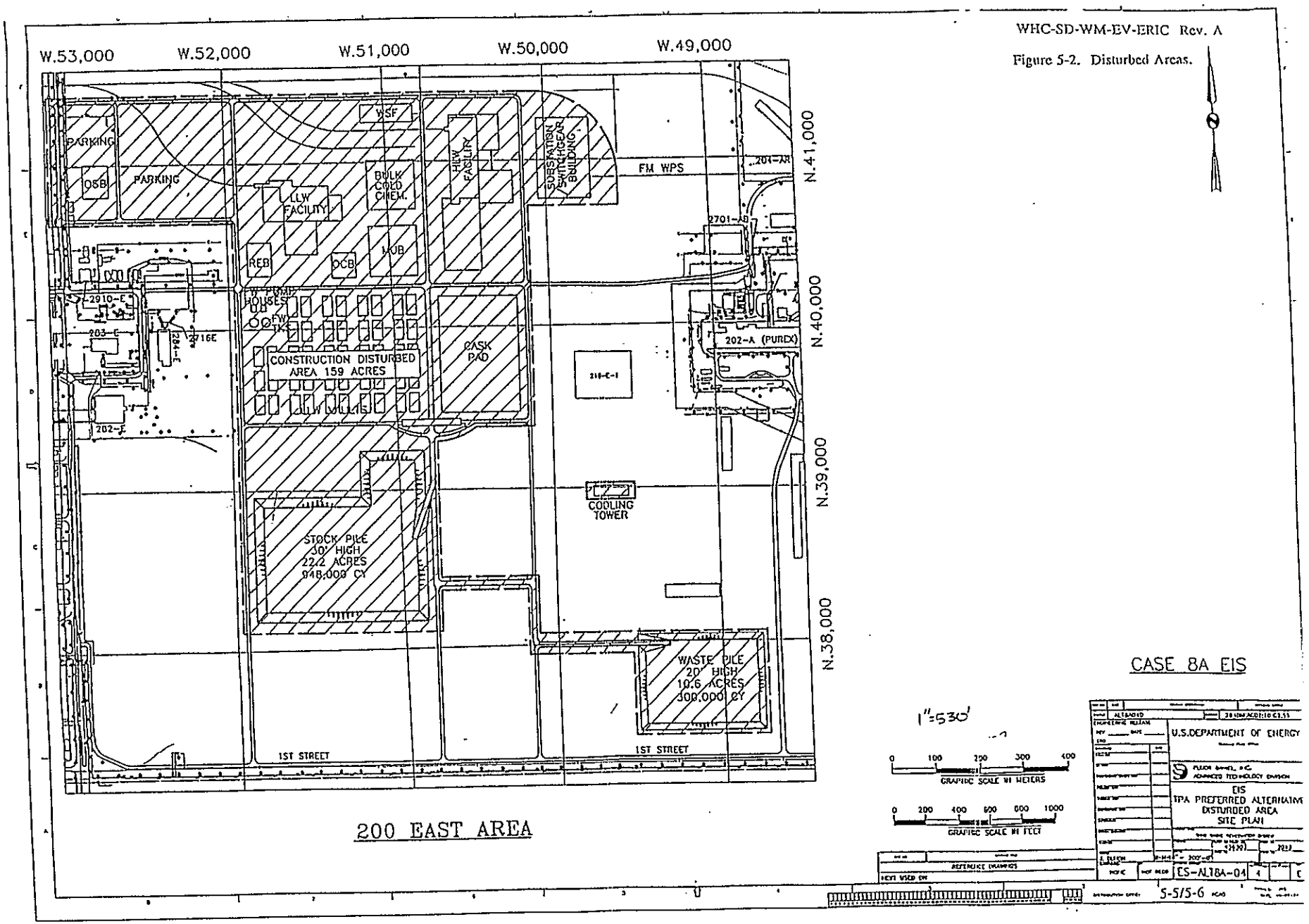
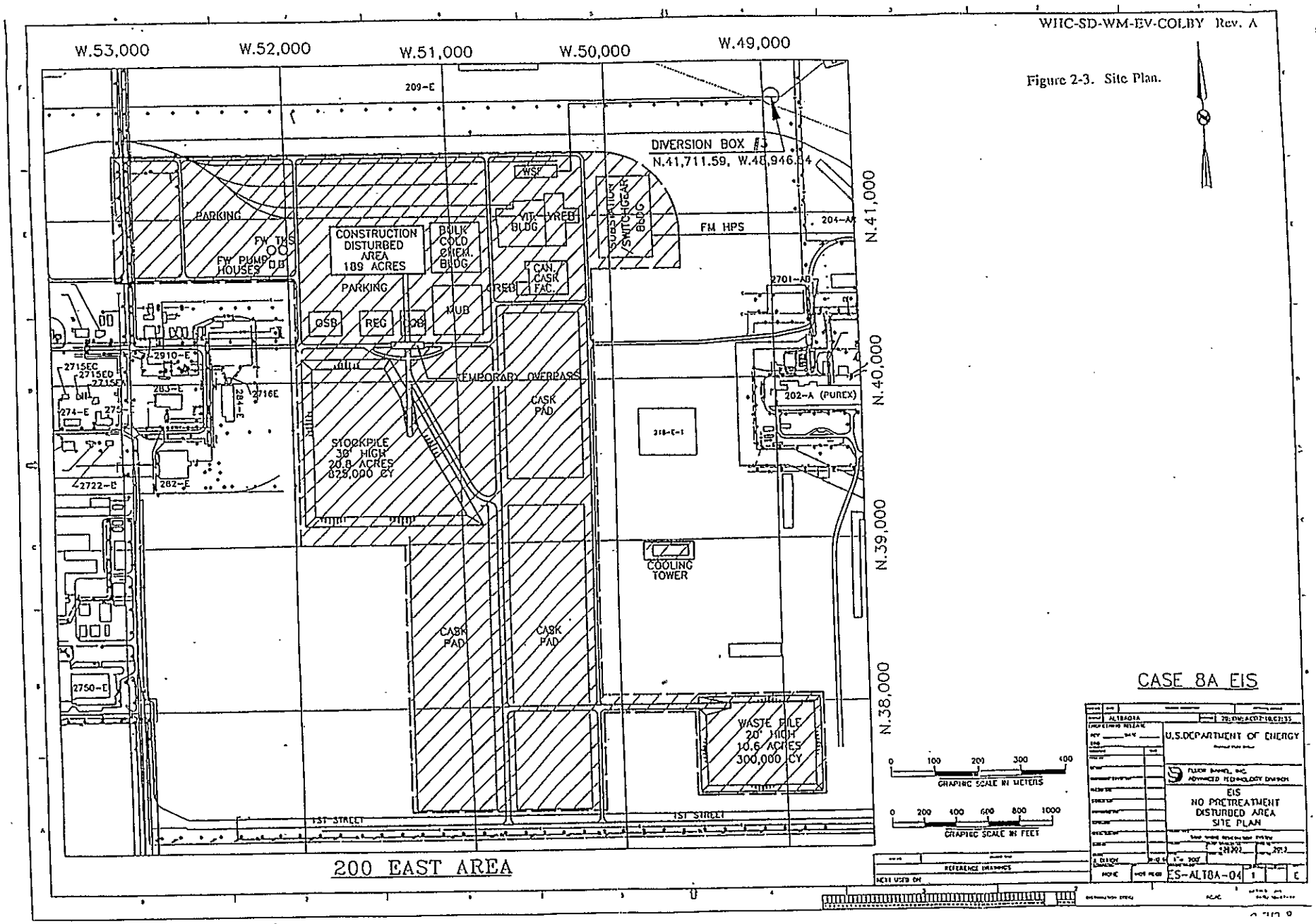


Figure 2-3. Site Plan.



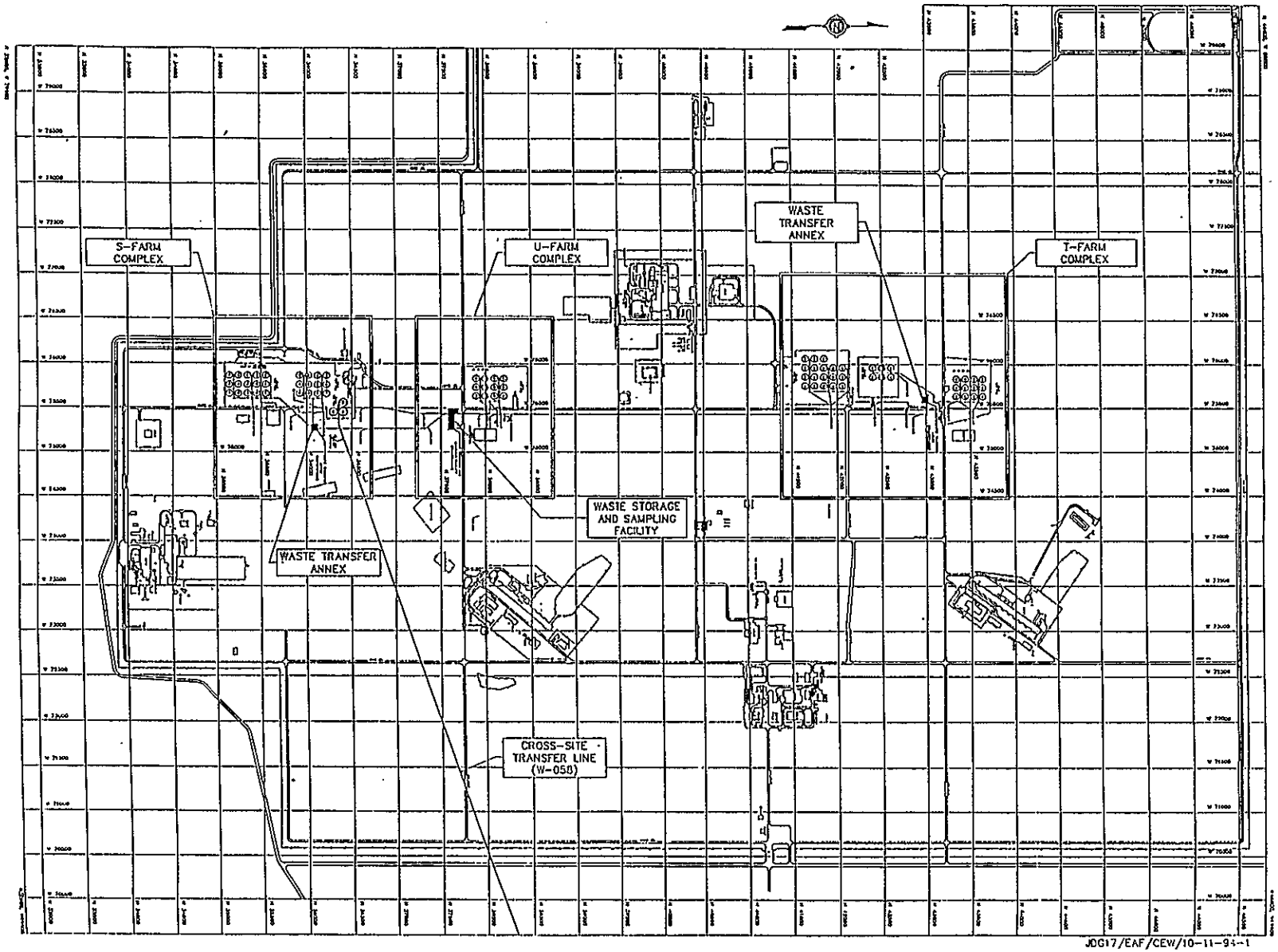


Figure A-5. Slurry Transfer Piping and Facilities Layout. (Sheet 1 of 8)

TRANSFER FACILITIES & PIPELINES IN 200W

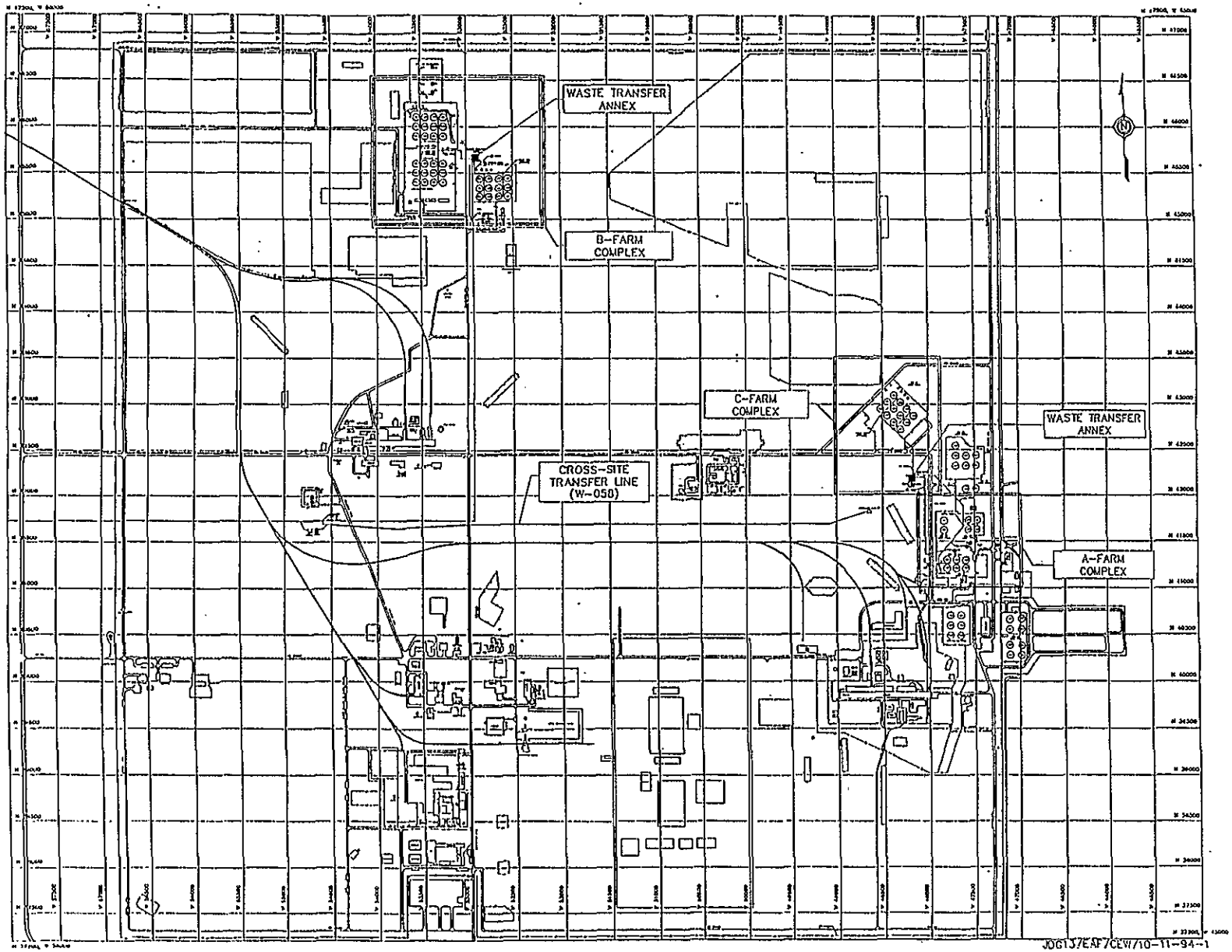
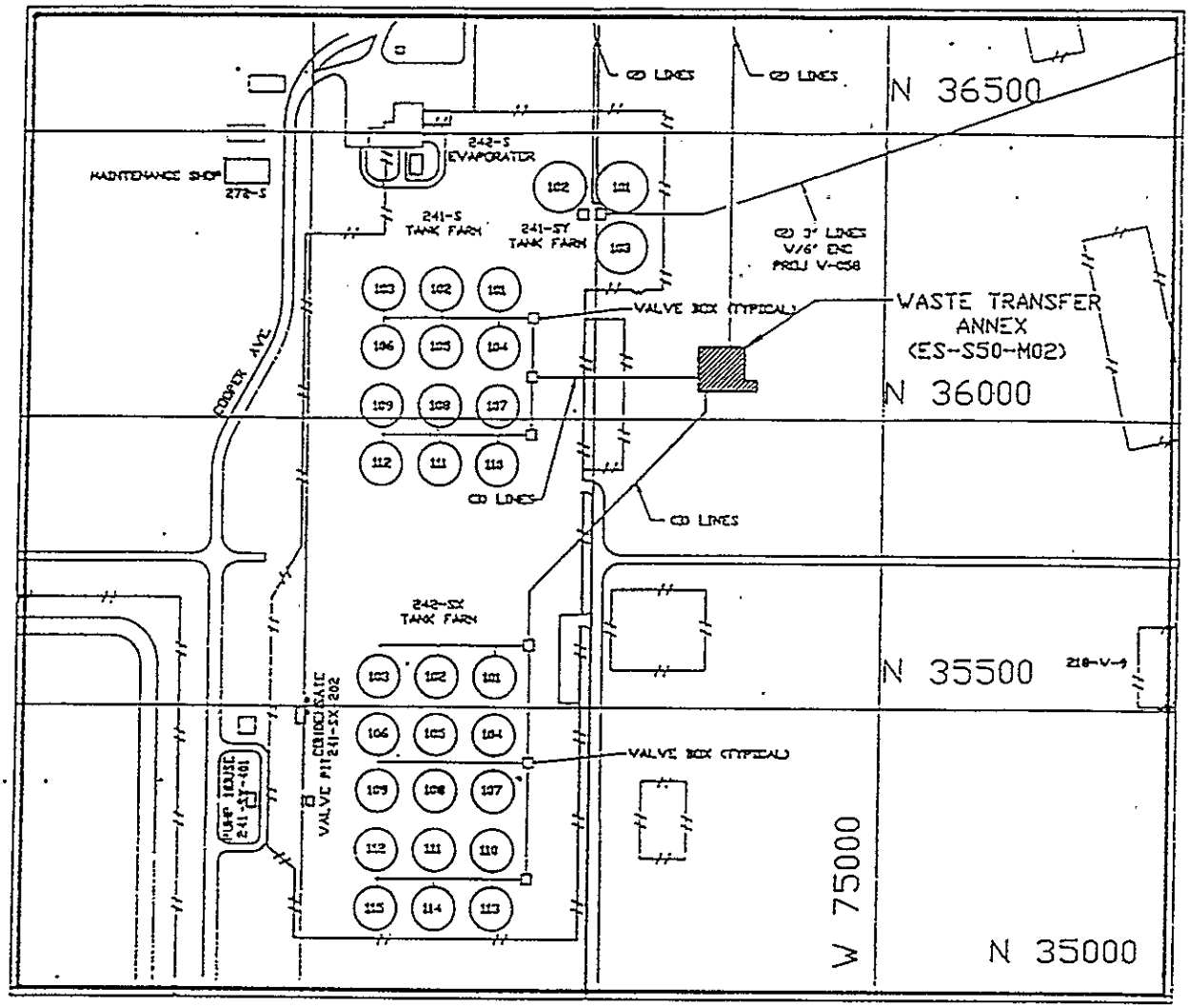


Figure A-5. Slurry Transfer Piping and Facilities Layout. (Sheet 5 of 8)

TRANSFER FACILITIES AND PIPELINES 200 EAST

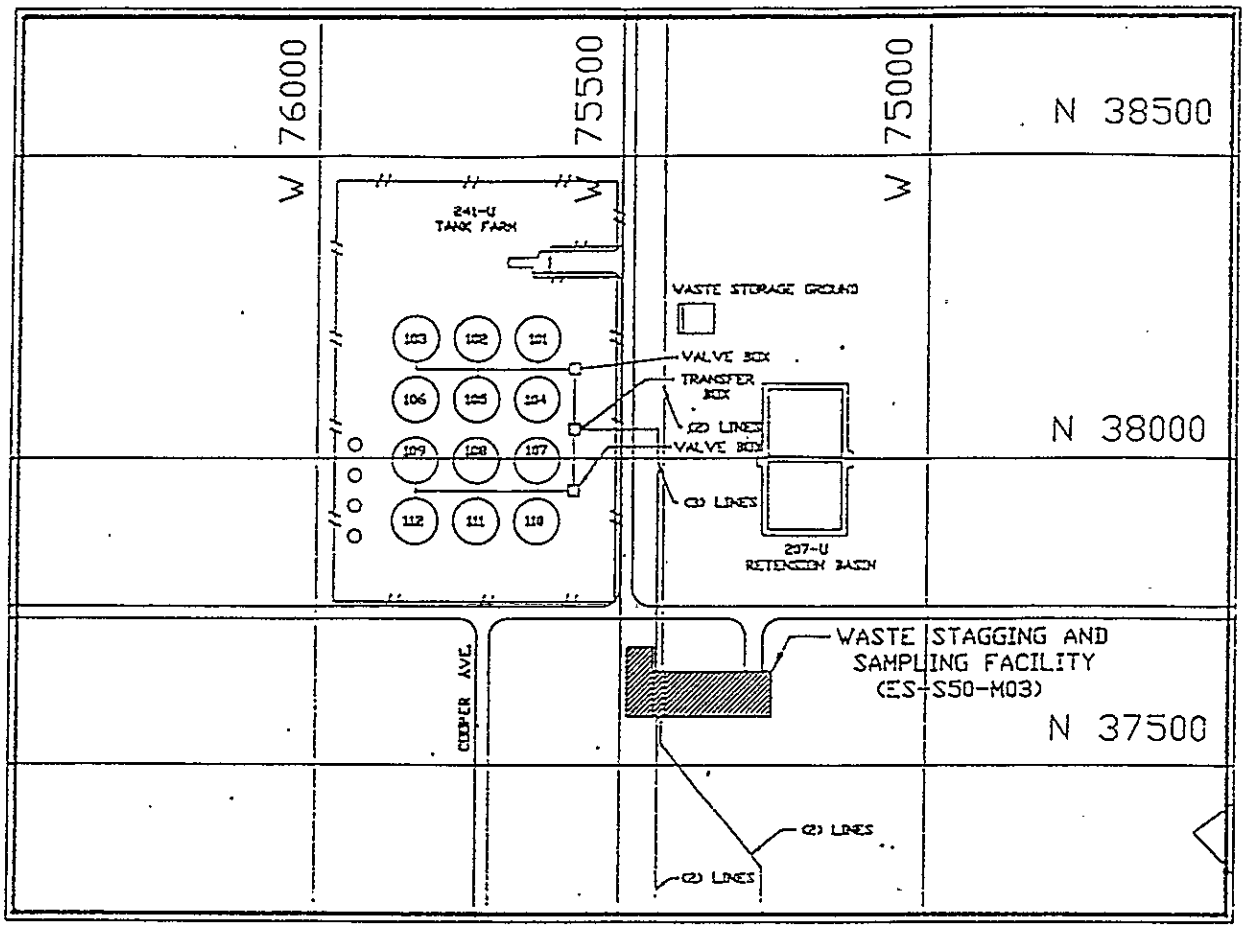
Figure A-5. Slurry Transfer Piping and Facilities Layout. (Sheet 2 of 8)



JDG20/EAF/CEW/10-11-94-1

200W

Figure A-5. Slurry Transfer Piping and Facilities Layout. (Sheet 3 of 8)

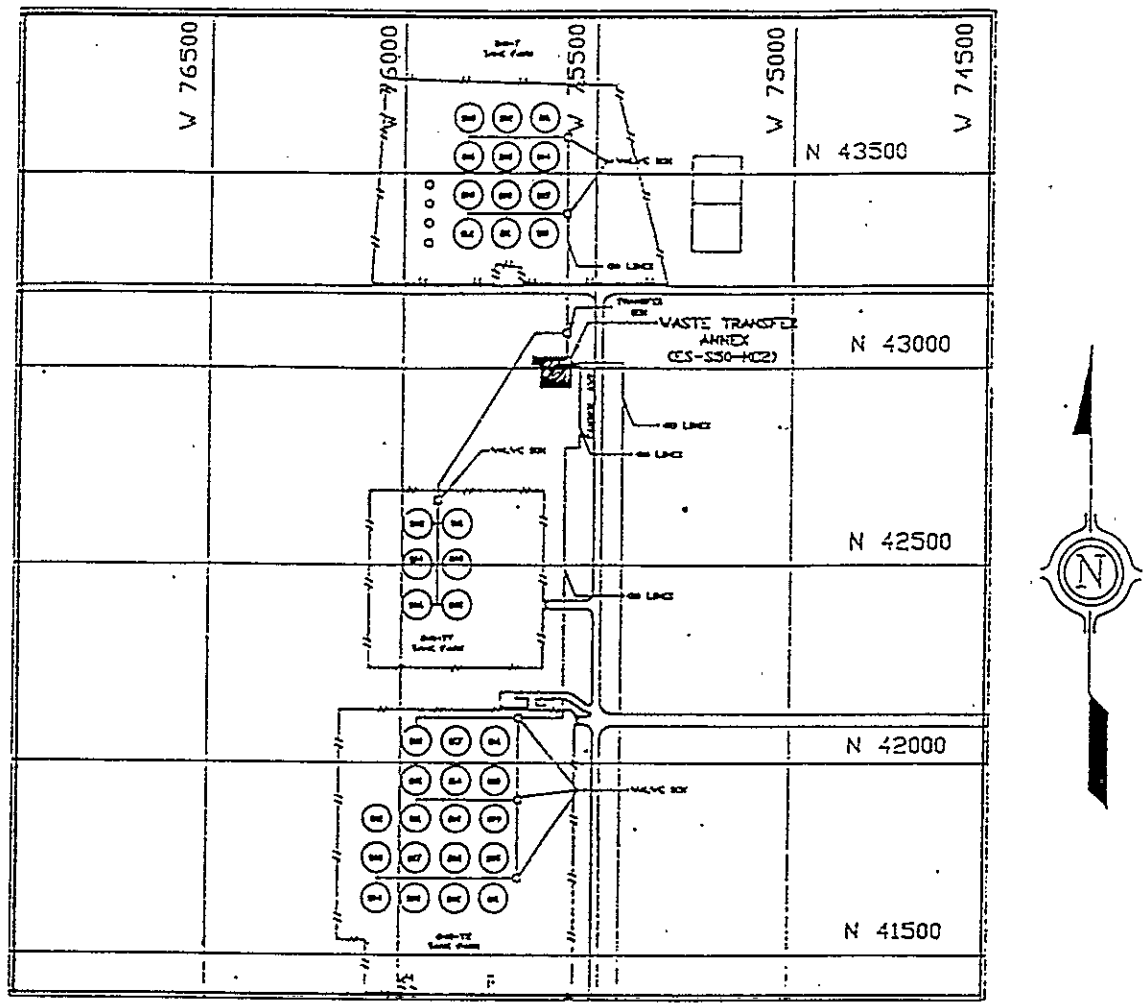


JDG19/EAF/CEW/10-11-94-1

Waste Staging and Sampling Facility Area = 19,500 sq ft Plan area Calculated from TOR

200W

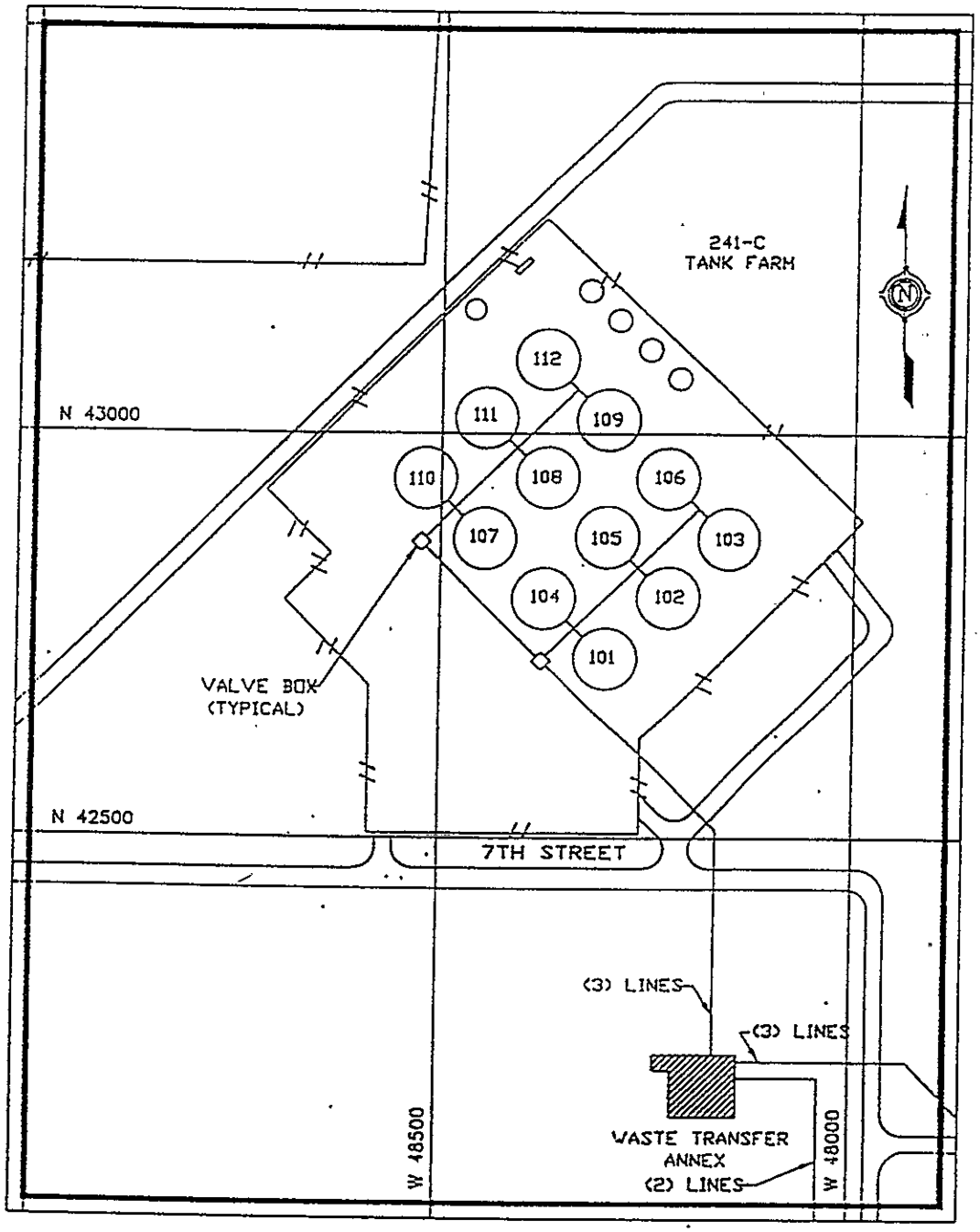
Figure A-5. Slurry Transfer Piping and Facilities Layout. (Sheet 4 of 8)



JDG18/EAF/CEW/10-11-94-1

200 West

Figure A-5. Slurry Transfer Piping and Facilities Layout. (Sheet 7 of 8)

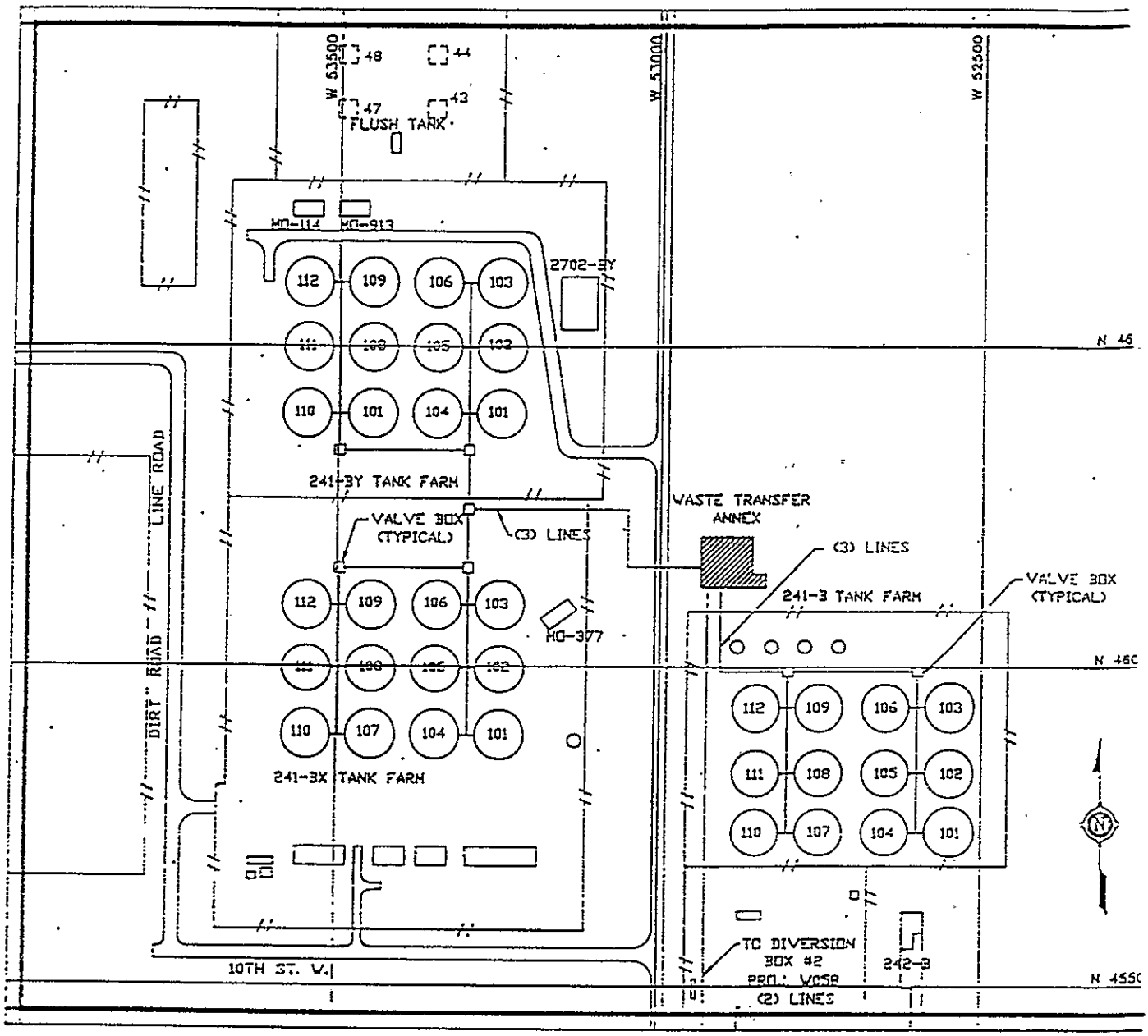


All TRANSFER ANNEXES
are 6740 sq ft
Plan Area.
Calculated from TOR

JDG15/EAF/CEW/10-11-94-1

200E

Figure A-5. Slurry Transfer Piping and Facilities Layout. (Sheet 8 of 8)



200E

Request Number 027

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Ray Hrenko

Date: 01/17/95

Phone Number: 619-557-5270 ext. 512

Fax Number: 619-557-6939

Request Information: New facility size: area of disturbance (construction & adjacent disturbance) including road & rail improvements; map showing site locations of facilities & construction; disposal storage areas (location size); a list of new facilities & their use & purpose.

Need Date: 01/20/95

Response: See attached resource tables for construction and operation of both alternatives (TPA & No Pretreat.). See attached maps for facilities location and sizes . Don't expect any major additions to road & rail networks. Rail spurs will be built connecting facilities with existing lines as shown on site plans inside affected areas.

Data Source/Accuracy: Minimum Pretreatment, Waste Retrieval and Transfer and TPA data packages, Preliminary Quality information

Prepared By: Colin Henderson C.H.

Date Sent/Faxed: 01/25/95 (fedex)

Concurrence: Marc E. Nelson
Marc Nelson - Deputy Project Manager

egfrm.027

Request Number: 528

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: M Nelson

Date: 1/24/95

Phone Number:

Fax Number:

Request Information: Remediation action costs broken down into the categories on the attached sheets. Indicate accuracy (ROM, ± 50% etc). If no data is available a best guess would be good enough for now

Need Date: 1/27/95

Deleted

Response:

Data Source/Accuracy:

Prepared By:

Date Sent/Faxed:

Concurrence:

Marc Nelson - Deputy Project Manager

Request Number 029

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Joan Young

Date: 1/23/95

Phone Number: 946-7112

Fax Number:

Request Information: Post remediation source inventory - see attached memo

Need Date: 2/17/95

Response: See attached sheet.

Data Source/Accuracy:

Prepared By: C. Henderson, D. Murray

Date Sent/Faxed: 1/9/95

Concurrence: Marc E. Nelson
Marc Nelson - Deputy Project Manager

engine\eninfrq.029

Date: January 24, 1995

To: Dave Murray

From: Joan Young

Subject: DATA REQUEST FOR RISK ASSESSMENT MODELING

We have identified the following data requirements.

POST REMEDIATION SOURCE TERM INVENTORY FOR THE TPA AND MINIMUM PRETREATMENT ALTERNATIVES

Please provide a summary of the post remediation source inventory (from closure to $T_{10,000}$) for the TPA and Minimum Pretreatment alternatives. This includes a description of the following source inventories:

a) tank farms -- this includes all sources of contamination remaining in the tank farms after closure. A brief position paper is attached with a recommendation that the source inventory for release to the groundwater be 1% and 5% of the total tank inventory. These values will characterize all contamination likely to remain in the ground after closure from a variety of tank farm residuals. If there will be post closure emissions to the atmosphere, these emissions must also be provided.

b) process facilities -- this source inventory will characterize the levels of contamination likely to remain in the ground after demolition of TWRS process facilities. The location of this contamination on the Hanford Site must also be specified. If there will be post closure emissions to the atmosphere from demolished TWRS facilities, these emissions must also be provided.

c) LLW disposal facility -- this source inventory must characterize releases to the ground from the LLW disposal vaults and the location of these vaults on the Hanford Site. A previous data request asks for a description of the air emissions, so the request will not be repeated in this memo.

d) misc. underground storage tanks -- this source inventory must characterize releases to the air and groundwater from the MUSTs at Hanford, and the location of these releases.

These source inventories should be converted into source/release terms. To do this, information on the dates, rates, and locations of release of these inventories into the environment (from closure to $T_{10,000}$) should also be provided with the post remediation source inventory for ASI review by 2/17/95.

cc: Alex Nazarali
Joan Young
Andy Stanley

587.JAC\C-00003.JJD

Reed Kaldor
John Horton
John Shrock
Mike Harker
Phil Rogers
File 587.2.11.2.2
File 587.2.11.2.5

587.JAC\C-00003.JJD

MEMORANDUM

TO: Joan Young

February 9, 1995
95-DM-003

FROM: Dave Murray

SUBJECT: DATA REQUEST FOR RISK ASSESSMENT MODELING

The following is a reply to your memo of January 24, 1994, same subject. The discussion of the source inventories is in the same order as your attached memo.

a) Tank Farms - Attached is a copy of the calculation entitled "Flux From Tanks During Retrieval" that has been sent to Phil Rogers, ESE. It shows the concentrations of ions that will be released from the tanks, the time that release will commence after a Hanford Barrier has been placed over the tanks; and the duration of release from each tank group. The air emissions from the tanks can safely be assumed to be zero for the two alternative PDEIS that we are currently working on.

b) Process Facilities - According to Blaine Barton, WHC Project Manager for the Engineering Data Packages, the closure of the processing facilities will consist of removal of the process equipment; D&D of the facility; after which the facility will be "entombed" (presumably covered with an engineered barrier). The inventory in the closed process facilities will be negligible compared to the inventory in the tanks or vaults, and for the purposes of the two alternative PDEIS that we are now working on, the process facility inventory can safely assumed to be zero for both air and water emissions. Environmental impacts of D&D are outside the scope of the TWRS EIS.

c) LLW Disposal Facility - Also attached is a copy of a calculation entitled "Flux From TPA LLW Vaults" that has been sent to Phil Rogers, ESE. It shows the time required for release to commence from the LLW vaults; the duration of release; and the concentrations of ions that will be released from the vaults. One can safely assume zero air emissions from the LLW vaults for the purposes of the two alternative PDEIS that we are currently working on.

d) Miscellaneous Underground Storage Tanks - At present we have no inventory data concerning the contents of the MUST's. The available data indicates that in all fifty of the MUST's there is slightly more than 35,000 gal of supernate, and slightly more that 205,000 gal of sludge. The total volume of sludge and supernate in 25 of these tanks would be expected to be on the order of 120,000 gal. Leaving 5% of the inventory in these tanks as a residue would amount to 6,000 gal (22710 liters). Compared to the inventory of the SST's and DST's, the air and water emissions from the MUST's can safely be assumed to be zero for the purposes of the two alternative PDEIS that we are currently working on. To date, we have not been informed of the number and locations of the MUST's that will be included in the TWRS EIS.

cc: Project File

Attachments: Engineering Information Request 029
Engineering Calculation: Tank Post Remediation Flux
Engineering Calculation: Flux from TPA LLW Vaults

DM:dm

January 23, 1995

Tank Waste Source Inventory for Post Remediation for TPA and No Pretreatment Alternatives

The purpose of position paper is to recommend a post remediation source inventory for tank wastes.

Typical Source Inventory

A typical list of the constituents of the tank waste source inventory is described in Table 1, based on information in WHC-SD-WM-ES-300, Rev. 1.

Table 1. Post Remediation Source Inventory

Source	Tank Component		Estimated % of Total Source Inventory
	DSTs	SSTs	
Tank Residual	Mixture of Tank Solids from Both SSTs and DSTs	Sludge	Bottom 3"
Between Tank and Concrete	None	Interstitial Liquids	1" of liquid and entrained tank solids
In Concrete	None	Advected Interstitial Liquids	Less than 1%
New Leaks	None	Mixture of Tank Constituents	Averages somewhere between 10,000 gal and 40,000 gal

A strategy to estimate these quantities for the TWRS EIS is described below.

Tank Residuals After Remediation

TPA milestone M-45-00 states that tank residues after retrieval of SSTs will not exceed 360 cubic feet in each of the 100 series tanks, 30 cubic feet in each of the 200 series tanks, or the limit of waste retrieval technology capability, whichever is less. According to a phone conversation with

Blaine Barton of WHC (Jan. 13, 1995), this represents approximately 1" of waste on the bottom of the tank. This waste will be comprised primarily of sludge (washed or unwashed, depending on the alternative).

The percentage of total sludge inventory represented by the TPA milestone could be estimated for each tank by the following equation:

$$[(R * D) / T] \times 100 = P$$

where:
R = Volume of tank residue
T = Total weight of sludge in tank in pounds
D = Density of sludge in pcf
P = Percentage of inventory remaining in tank

For the SSTs, P would vary from 0% to 100% of the sludge inventory depending on the tank. [Note: Not sure what the average would be.]

The TPA reportedly states that 1% by volume of the total tank inventory is an acceptable amount of tank residual. According to Blaine Barton (phone conversation on Jan. 13, 1995), this is approximately 3 times more volume than the amount specified in M-45-00 or 3 inches in the bottom of the tank. A more conservative calculation would be to estimate the source inventory for 3" of tank residual. The P would vary from 0% to 100%, however, the average amount of sludge remaining in the tanks would be greater. (Note: this average should also be determined).

Tank Leaks in Void and During Retrieval

A significant source of post remediation source inventory from the SST farms will be from tank leaks from the void below the steel liner and tank leaks during retrieval.

Tank leaks can be estimated from WHC-SD-WM-ES-300, Rev. 1. About 40% of the SSTs are assumed to leak during retrieval. This study estimates that leaks average from 10,000 gal to 40,000 gal per SST. The leaks consist of the liquids (and some diluted tank solids). According to Ed Fredenburg (phone conversation on January 18, 1995), the SSTs contain an average of 250,000 gal/tank of liquids. If an average leak is 11,000 gal for 40% of the tanks, this is about 2% of the tank liquid inventory (or 1% at half dilution).

Recommended Approach and Actions

ASI proposes to use the following strategy to estimate the inventory of residuals remaining in the tank.

1. A post remediation source term will be calculated or both 1% and 5% of the current SST inventory (by weight or curies as provided by C. Golberg). The insoluble portion of this inventory is comprised of the tank residual for both the SSTs. The liquid portion of the inventory results from tank leaks during retrieval, tank liquids in the void space below the steel liner, and tank constituents in the concrete.

2. No requirements have been established for retrieval of the DSTs. However, the post remediation source term for the DSTs will be developed that contains only solids, since leaks and advection will not occur. Since DSTs will be washed and reused to store SSTs, the inventory will be a homogenous mixture of solids from all tanks and representing both 1% and 5% of the total tank inventory.

WHC. January 1995. Feasibility Study of Tank Leakage Mitigation Using Subsurface Barriers. WHC-SD-WM-ES-300, Rev.1.

WHC. October 1993. Risk-Based Preliminary Assessment Supporting Closure of the Hanford Site Single-Shell Tanks as Landfills. WHC-EP-0692.

[30] From: Edward A Fredenburg at ~WHC352 1/19/95 1:55PM (3174 bytes: 58 ln)
To: ^Advanced Sciences Inc at ~DOE_HANFORD_1
Subject: For Joan Young
---------- Message Contents ----------

Comments on "Tank Waste Source Inventory for Post Remediation for TPA and No Pretreatment Alternates"

1) In Table 1, far right column: I assume these represent average conditions, per tank.

2) Table 1, Tank Component, SSTs: Some SSTs contain little or no sludge (ref. WHC-EP-0182-XX), e.g., TX farm, so "Bottom 3" may be sludge only, saltcake only, or sludge and saltcake.

3) Table 1, "In Concrete": Less than 1% of what--initial liquid inventory?

4) Table 1 doesn't include (a) existing contamination in soil from previous leaks, or (b) contamination in tank farm ancillary equipment, which may be left in place. The closure data package, which was provided to JEG last week, addresses options for closure of tanks and ancillary equipment. You might want to take a look at it--except I don't think it has any information on existing contamination in soil. Whether or not contaminated soil is treated to remove or immobilize contaminants, and whether or not ancillary equipment is retrieved, or contained waste immobilized, is probably not dependent on which of the 5 EIS alternatives is selected. But, if you're going to analyze long term releases for the source terms you've identified in Table 1, you are already making some assumptions about tank closure. So you probably need to include in this analysis the existing contamination in soil and contamination in ancillary equipment, based on the scenarios described in the closure data package.

5) Tank Leaks in Void and During Retrieval (2nd page): The first paragraph addresses tank leaks from the void below the steel liner. The 2nd paragraph only addresses tank leaks during retrieval.

6) Same section, 2nd paragraph: Assumptions used for tank leaks should be consistent with the Backup to Table 6-5, on page B-42 of the retrieval data package. In the revised data package (due end of January) I estimate total leakage from all SSTs by radionuclide, as follows:

C-14 ..... 50 Ci
Sr-90 ..... 50 Ci
Tc-99 ..... 14 Ci
Ru-106 ..... 4 x 10-5 Ci
Sb-125 ..... 0.16 Ci
I-129 ..... 0.013 Ci
Cs-137 ..... 105 Ci
Pu-239/240 ... 13 Ci
Am-241 ..... 2.8 Ci

7) Recommended Approach and Actions (2nd page): What does "both the SSTs" mean?

8) Same Section, item 1: See comment 4 above.

9) Same Section, item 2: Whatever assumptions are used for amount of residual waste in SSTs should also be used for DSTs.

10) Same Section, item 2 (page 3): DSTs won't necessarily be washed, but they will be used as receiver tanks for interim storage of SST waste (not for storage of SSTs).

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE ENGINEERING "TANK POST Remediation FLUX"

ORIGINATOR COLIN HENDERSON DATE 2/2/95

REVISION NO. _____

OBJECTIVE Estimate POST Remediation Emissions Resulting FROM TANK Residuals Of 1% & 5%.

METHODOLOGY See ATTACHED

ASSUMPTIONS See Attached

(Continue on another sheet if necessary)

Colin Henderson
SIGNATURE

CALCULATION & RESULTS ATTACHED

PRELIMINARY

JACOBS\FORMS\CALCVR.SHT

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 2 / 16

BY _____ CHKD. _____ JOB NO. _____

METHODOLOGY -

A) CALCULATE VOLUMETRIC FLOW INTO TANKS

B) CALCULATE TIME REQUIRED TO DISSOLVE NITRATE

C) CALCULATE TIME REQUIRED TO BREACH BARRIER

D CALCULATE CONCENTRATIONS IN SATURATED SOLUTIONS RELEASED FROM TANKS.

REFERENCES:

SERNE, R.J AND M.I WOOD 1990 Hanford WASTE FORM Releases and Sediment interactions, PNL 7297, BATELLE PACIFIC NORTHWEST LABORATORY, RICHLAND WA

PELTON M AND J DAVIS 1/27/95 Aggregate TANK FARM inventories

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 3/16

BY _____ CHKD. _____ JOB NO. _____

POST REMEDIATION RELEASE ASSUMPTIONS

1. INVENTORY 1% AND 5% OF CURRENT INVENTORY

2. SOLUBILITY OF EACH element is proportional to the SOLUBILITY of NO_3^- (360 g/l) Congruent dissolution (Serne & Wood 1990)

3. RECHARGE Rate .05 cm/yr for first 1000 yrs.
   .10 cm/yr for 1000 + yrs.
   HANFORD BARRIER FAILS AFTER 1,000 YEARS.

4 ASSUME BARRIER 5 m thick.

5. Release Point 50 ft below Surface.

6. Time for Water to Reach Waste after penetrating barrier equals 0.

7. TANK AND CONCRETE WILL HAVE FAILED AFTER 500 YEARS.

8. CONCENTRATIONS IN TANK GROUPS ARE AS SHOWN IN REFERENCE 2.

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 4/16

BY _____ CHKD. _____ JOB NO. _____

1. TANK AREAS.
GROUP

1WSS. 40 tanks 36 @ 75' dia 4 @ 20' dia.

1 ft = 30.48 cm

$$\Sigma \text{AREA} = 36\left(\pi \frac{(75(30.48))^2}{4}\right) + 4\left(\pi \frac{(20(30.48))^2}{4}\right)$$

$$= 147.8E6 + 1.167E6 \text{ cm}^2$$

1WSS = 149.0 E6 cm² ←

2WSS = 43 tanks. 39 @ 75'ϕ + 4 @ 20'ϕ

$$\text{AREA} = \Sigma 39[4.1E6] + 4(.292E6) \text{ cm}^2$$

2WSS AREA = 161.1 E6 cm² ←

1ESS = 40 tanks. = 36 @ 75'ϕ + 4 @ 20'ϕ

$$\text{AREA} = 36[4.1E6] + 1.167E6 \text{ cm}^2$$

1ESS AREA = 148.8E6 cm² ←

2ESS = 16 TANKS. 12 @ 75'ϕ 4 @ 20'ϕ

$$\text{AREA} = 12(4.1E6) + 1.167E6$$

2ESS = 50.4 E6 cm² ←

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 5/16

BY _____ CHKD. _____ JOB NO. _____

4ESS 10 TANKS. 10@ 75'φ

4ESS. AREA = 10 (4.1E6) = 41E6 cm² ←

2. VOLUMETRIC INFILTRATION.

1WSS ΔT .05 cm/yr

Q= .05cm/yr (149E6 cm²)(1 l / 1000 cc)

Q= 7450 l/yr. ← at .05 cm/yr

ΔT .1 cm/yr

Q= 14900 l/yr. ← at .10 cm/yr

2WSS

A= 161E6 cm²

@ .05cm/yr Q= 161E6 cm² (.05 cm/yr)(1 l / 1000 cc)

Q= 8,050 l/yr ← at .05 cm/yr

@ .10 cm/yr

Q= 16,100 l/yr. ← at .10 cm/yr

1ESS

A= 148.8E6 cm²

@ .05 cm/yr Q= (148.8E6 cm²)(.05 cm/yr)(1 l / 1000 cm²) = 7,440 l/yr.

Q= 7440 l/yr ← at .05 cm/yr

at .10 cm/yr Q= 14880 l/yr. ←

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. -6/16

BY _____ CHKD. _____ JOB NO. _____

2ESS

$A = 50.4E6\ cm^2$

@ .05 cm/yr $Q = 50.4E6\ cm^2 (.05\ cm/yr)(1/1000) = 2{,}520\ l/yr$

$Q = 2520\ l/yr$ ← at .05 cm/yr

@ .10 cm/yr $Q = 5040\ l/yr$

4ESS $A = 41E6\ cm^2$

@ .05 cm/yr $Q = 41E6\ cm^2 (.05\ cm/yr)(1/1000) = 2050\ l/yr$

$Q = 2050\ l/yr$ ← at .05 cm/yr

at .10 cm/yr $Q = 4100\ l/yr$ ← at .10 cm/yr

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 7/16

BY _____ CHKD. _____ JOB NO. _____

3, POST REMEDIATION NITRATE INVENTORY. (1% Residual)

1WSS 263 MT (10^6 g)

2WSS 455 MT ($\times 10^6$ g)

1ESS 189 MT (10^6 g)

2ESS 2.59 MT (10^6 g)

4ESS. 48.9 MT (10^6 g)

SOLUBILITY = 360 g/L

4, TIME REQUIRED to dissolve NITRATE.

$$\text{Time (yrs)} = \frac{\text{Inventory}}{\text{Solubility (Infiltration)}}$$

FOR 1WSS

$$\text{Time yrs} = \frac{263 \times 10^6 \text{ g}}{(360 \text{ g/L})(7450 \text{ l/yr})} = 98 \text{ years} \leftarrow \text{at } .05 \text{ cm/yr}$$

(263E6)/(360 X 14900) = 49 yrs @ 0.1 cm/yr ←

2WSS.

$$\text{Time} = \frac{455 \text{E6 g}}{360 (8050)} = 157 \text{ years.} \leftarrow \text{at } .05 \text{ cm/yr}$$

455E6/(360 X 16100) = 78 yrs @ 0.1 cm/yr ←

1ESS

$$\text{Time} = \frac{189 \text{E6 g}}{360 (7440 \text{ l/yr})} = 71 \text{ years} \leftarrow \text{at } .05 \text{ cm/yr}$$

189E6/(360 X 14880) = 35 yrs at 0.1 cm/yr ←

2ESS.

$$\text{Time} = 2.59 \text{E6 g}/360 (2520 \text{ l/yr}) = 3 \text{ yrs.} \leftarrow \text{at } .05 \text{ cm/yr}$$

= 2.59E6/(360 X 5040 l/yr) = 1.5 yrs at 0.1 cm/yr

4ESS

TIME = 48.9E6g/360 (2050 l/yr) = 66 years. ← at .05cm/yr.

= 48.9E6/(360 × 4100 l/yr) = 33 yrs @ 0.1 cm/yr

5. TIME REQUIRED TO Breach Barrier

First 1000 yrs. Water goes 1000(.05 cm/yr) = 50cm.

then infiltration goes to .10 cm/yr.

$$\text{Time} = \frac{500\text{ cm} - 50\text{ cm}}{.10\text{ cm/yr}} + 1000\text{ yrs.}$$

Time = 5,500 yrs.

Assume time to reach waste once barrier is breached is 0.

RESULTS FOR SSTs

AT TIME = 5,500 years. the tanks begin to release waste to VADOSE ZONE. THE Concentration of the release will be Saturated at the concentrations shown ON TABLES 1 and 2 attached. The duration OF Release will be as follows:

1WSS	49 years	245 yr	for 5% residual
2WSS	78 years	390 yr	
1ESS	35 years	175 yr	
2ESS	1.5 years	7.5 yr	
4ESS	33 years	165 yr	

for 1% Residual

NOTE: TABLE 1 & 2 ARE FROM Retrieval leakage Estimate.

NOTE FOR 5% Residual the Concentration leaking will be the Same.

PS 9/16

Table 1

Tank Release Concentration grams/ liter for Radionuclides

Solubility Calculation — For each tank group solubility = (mass elem/mass nitrate)x360 g/l

# of Tanks	40	43	40	16	10
grams	1WSS	2WSS	1ESS	2ESS	4ESS
Ac-225	4.07E-19	3.92E-19	1.98E-18	5.38E-17	2.82E-13
Ac-227	9.80E-13	4.66E-13	2.33E-12	2.98E-11	3.03E-14
Ac-228	1.13E-07	3.65E-07	6.95E-07	6.58E-05	1.66E-06
Am-241	1.07E-08	4.47E-08	1.05E-07	8.09E-06	1.86E-07
Am-242	4.58E-12	1.91E-11	4.48E-11	3.47E-09	7.98E-11
Am-243	6.99E-08	3.11E-07	9.16E-07	8.13E-05	1.16E-06
At-217	1.47E-26	1.41E-26	7.13E-26	1.94E-24	1.30E-25
Ba-135m	1.44E-06	3.71E-06	8.37E-06	2.18E-05	1.25E-06
Ba-137m	3.83E-25	1.71E-25	4.75E-25	1.82E-23	3.86E-25
Bi-210	5.72E-16	2.72E-16	1.36E-15	1.74E-14	1.64E-16
Bi-211					
Bi-212	1.62E-19	1.56E-19	7.87E-19	2.14E-17	1.43E-18
Bi-213	6.03E-20	2.88E-20	7.18E-20	3.00E-18	8.41E-20
Bi-214	6.06E-13	6.05E-13	5.44E-12	4.66E-11	2.09E-12
C-14	6.83E-09	2.86E-08	6.68E-08	5.17E-06	1.19E-07
Cm-242	1.33E-11	5.73E-11	2.89E-10	2.25E-08	1.61E-10
Cm-244	3.52E-14	1.71E-13	9.02E-13	7.04E-11	5.02E-13
Cm-245	1.64E-06	3.12E-06	5.84E-06	1.30E-05	9.12E-07
Cs-135	1.06E+01	2.75E+01	6.20E+01	1.61E+02	9.24E+00
Cs-137	2.73E-16	2.63E-16	1.33E-15	3.61E-14	2.42E-15
Fr-221	5.53E-21	2.63E-21	1.31E-20	1.68E-19	1.59E-21
Fr-223	1.84E-15	2.74E-15	1.38E-14	6.56E-14	9.93E-16
I-129	6.64E-03	3.04E-02	4.02E-02	3.20E+00	6.29E-01
Nb-93m		5.14E-08	2.41E-07		
Ni-59	1.16E-03	4.77E-03	1.25E-02	1.01E+00	9.95E-02
Ni-63	1.92E-09	1.48E-09	1.61E-08	7.96E-09	5.61E-10
Np-237	2.49E-07	1.04E-06	2.44E-06	1.89E-04	4.34E-06
Np-238	5.37E-14	2.39E-13	7.04E-13	6.25E-11	8.88E-13
Np-239	5.67E-16	2.50E-16	1.25E-15	2.02E-14	2.02E-16
Pa-231	2.40E-06	1.84E-06	2.00E-05	9.92E-06	6.99E-07
Pa-233	1.82E-13	3.96E-14	2.40E-13	6.93E-12	9.39E-14
Pa-234	1.18E-10	2.57E-11	1.56E-10	4.51E-09	6.10E-11
Pa-234m	3.44E-23	3.32E-23	1.67E-22	4.55E-21	3.05E-22
Pb-209	4.48E-21	2.00E-21	5.56E-21	2.13E-19	4.51E-21
Pb-210	9.28E-13	4.41E-13	2.20E-12	2.82E-11	2.67E-13
Pb-211					
Pb-212	6.03E-20	2.88E-20	7.18E-20	3.00E-18	8.41E-20
Pb-214	3.77E-15	5.61E-15	2.88E-14	1.55E-13	2.19E-15
Pd-107	4.00E-13	1.79E-13	4.96E-13	1.90E-11	4.03E-13
Po-210	4.31E-17	2.05E-17	1.02E-16	1.31E-15	1.24E-17
Po-211					
Po-212	1.30E-31	1.25E-31	6.31E-31	1.72E-29	1.15E-30
Po-213	6.61E-32	3.16E-32	7.87E-32	3.29E-30	9.21E-32
Po-214	2.20E-25	1.05E-25	5.23E-25	6.70E-24	6.33E-26
Po-216					
Po-218	2.94E-24	1.40E-24	3.50E-24	1.46E-22	4.10E-24
Pu-236	5.41E-09	4.41E-09	6.63E-09	5.20E-07	3.10E-08
Pu-238	2.02E-06	2.01E-06	3.92E-06	4.77E-04	2.40E-05
Pu-239	1.08E-04	1.20E-04	2.54E-04	3.31E-02	1.65E-03
Pu-240	2.36E-04	2.22E-04	7.10E-04	8.07E-02	3.59E-03
Pu-241	1.76E-15	7.37E-15	1.72E-14	1.33E-12	3.07E-14
Pu-242	1.80E-08	8.57E-09	4.29E-08	5.49E-07	5.19E-09
Ra-223					
Ra-224	1.47E-19	1.41E-19	7.13E-19	1.94E-17	1.30E-18
Ra-225	2.12E-20	1.01E-20	2.53E-20	1.06E-18	2.96E-20
Ra-226					
Ra-228	3.08E-15	4.93E-13	5.78E-12	4.97E-10	1.07E-10

Table 1

Tank Release Concentration grams/ liter for Radionuclides

Rh-106	2.00E-20	9.49E-21	4.75E-20	6.05E-19	5.74E-21
Rn-219					
Rn-220	9.04E-25	4.32E-25	1.08E-24	4.50E-23	1.26E-24
Rn-222	5.43E-18	8.72E-16	1.02E-14	8.78E-13	1.90E-13
Ru-106	3.25E-11	5.52E-11	3.83E-11	5.80E-09	7.92E-10
Sb-126	9.29E-12	1.58E-11	1.09E-11	1.66E-09	2.26E-10
Sb-126m	1.69E-14	2.53E-14	1.27E-13	5.72E-13	8.92E-15
Se-79	1.26E-02	2.15E-02	1.54E-02	2.08E+00	2.70E-01
Sm-151	2.95E-08	5.00E-08	3.47E-08	5.26E-06	7.19E-07
Sn-126	7.32E-01	4.05E+00	5.66E+00	2.43E+02	4.99E+01
Sr-90	3.34E-07	4.98E-07	2.49E-06	1.13E-05	1.76E-07
Tc-99	4.14E-09	1.97E-09	9.83E-09	1.26E-07	1.19E-09
Th-227					
Th-228	2.88E-17	2.78E-17	1.40E-16	3.81E-15	2.55E-16
Th-229	5.81E-13	2.94E-13	6.75E-13	2.96E-11	1.08E-12
Th-231	1.87E-11	4.39E-12	2.49E-11	7.38E-10	9.71E-12
Th-232	2.30E-15	2.57E-15	5.42E-15	7.06E-13	3.53E-14
Th-233	6.50E-14	1.41E-14	8.58E-14	2.48E-12	3.36E-14
Th-234	3.06E-15	1.45E-15	7.27E-15	9.32E-14	8.80E-16
Tl-208					
Tl-209	1.25E-24	1.20E-24	6.07E-24	1.65E-22	1.10E-23
U-232	7.67E-13	6.48E-13	5.26E-12	5.24E-11	4.05E-12
U-233	6.97E-08	3.77E-08	8.51E-08	4.38E-06	1.92E-07
U-234	1.58E-05	3.72E-06	2.11E-05	6.26E-04	8.23E-06
U-235	1.37E-06	1.53E-06	3.23E-06	4.21E-04	2.10E-05
U-236	2.03E-05	1.91E-05	6.11E-05	6.95E-03	3.09E-04
U-237	2.89E-11	6.28E-12	3.81E-11	1.10E-09	1.49E-11

Table 2
Chemical Release Concentrations Nonradioactive Chemicals for Single Shell Tanks

concentration grams/liter

Chemical	1WSS	2WSS	1ESS	2ESS	4ESS
Ag	5.63E-10	5.11E-10	3.80E-09	1.24E-08	1.97E-10
Al	4.55E+00	8.75E+00	1.53E+01	5.37E+02	1.94E+00
Al+3	9.75E-01	5.73E+00	1.13E+01	8.06E+02	1.87E+00
AlO2-	6.23E+00	8.47E+00	1.37E+01	1.05E+02	1.34E+00
Ba+2	4.91E-04	1.34E-03	1.95E-03	1.52E-01	1.40E-02
Bi+3	2.28E+00	2.21E-03	1.79E+00	8.27E-01	
C2H3O3	7.28E-02	2.25E-02	6.15E-03	1.65E-01	2.19E-01
C6H5O7	7.47E+00	5.21E+00	2.33E+01	1.53E+02	1.79E+00
CO3-2	9.68E+00	1.27E+00	1.22E+01	8.62E+01	2.80E+00
Ca+2	2.72E-03	4.60E-02	1.04E+00	9.16E+01	1.13E-01
Cd+2					
Ce+3	1.59E+00	2.50E-01	1.68E+00	3.67E-01	1.29E-01
Cl-	3.00E-01	4.28E-02	2.40E-01	5.58E-02	4.44E-03
Cr+3	1.73E-02	6.59E-01	1.38E-02	2.30E-01	6.07E-02
CrO4-2	4.28E-03	1.63E-01	3.42E-03	5.69E-02	1.50E-02
EDTA	5.58E-01	1.73E-01	4.71E-02	1.27E+00	1.67E+00
F-	1.97E+00	2.38E-01	4.42E+00	5.56E+02	2.27E-02
Fe+3	2.33E+00	6.47E-01	2.70E+00	7.72E+01	1.31E+01
Fe(CN)6-4	3.00E-02	1.08E-02	4.72E+00	9.73E+01	3.90E-03
HEDTA	1.01E+00	3.14E-01	9.41E-02	2.30E+00	3.04E+00
Hg+					
K+	6.85E-02	2.00E-01	5.50E-01	2.56E-01	3.33E-02
La+	2.03E-02		7.60E-03		
Mn+4	2.87E-01	8.92E-02	2.49E-01	7.12E+01	1.73E+00
Na+	1.99E+02	1.67E+02	2.20E+02	2.92E+03	2.78E+02
Ni+2	6.88E-02	2.64E-02	2.37E+00	6.12E+01	7.31E-02
NO2-	2.41E+01	6.33E+00	3.92E+01	6.59E-01	1.71E+01
NO3-	3.60E+02	3.60E+02	3.60E+02	3.60E+02	3.60E+02
OH-	6.20E+00	1.82E+01	1.98E+01	1.97E+03	1.28E+01
PO4-3	3.66E+01	8.70E-01	3.44E+01	4.14E+01	6.34E-02
Pb	3.22E-02	3.06E-02	8.04E+00	9.48E+00	7.60E-03
SiO3-	7.67E+00	1.90E+00	7.68E+00	9.83E-01	1.54E-01
Sn			1.02E-04		
SO4-2	8.68E+00	1.96E+00	1.05E+01	1.86E+02	6.15E+00
Sr+2	1.28E-05	5.52E-04	6.82E-01	3.52E-02	4.25E-03
W+4					
Zr+4	1.92E-01	1.83E-01	1.24E-01	2.82E+02	9.41E-03

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 12/16

BY _____ CHKD. _____ JOB NO. _____

DSTs

3WDS - 3 TANKS.

3EDS = 11 TANKS

5EDS = 14 TANKS.

$$\text{AREA PER TANK} = \frac{\pi(75 \times 30.48)^2}{4} = 4.1E6\ cm^2$$

1. 3WDS · AREA = 3(4.1E6 cm²) = 12.3E6 cm²

3EDS = 11(4.1E6 cm²) = 45.1E6 cm²

5EDS = 14(4.1E6 cm²) = 57.4E6 cm²

2. VOLUMETRIC INFILTRATION. at (0.1 cm/yr)

3WDS Q = 0.1 cm/yr (12.3E6 cm²)(1 l/1000 cc) = 1230 l/yr.

Q = 1230 l/yr

3EDS Q = 0.1 cm/yr (45.1E6 cm²)(1 l/1000 cc) = 4510 l/yr

Q = 4510 l/yr.

5EDS Q = 0.1 cm/yr (57.4E6 cm²)(1 l/1000 cc) = 5740 l/yr.

Q = 5740 l/yr.

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 13/16

BY _____ CHKD. _____ JOB NO. _____

3. POST REMEDIATION NITRATE INVENTORY.

	INVENTORY	1%	5%
3WDS	1040 MT	10.4 MT	52 MT
3EDS	2198 MT	21.98 MT	110 MT
5EDS	4450 MT	44.5 MT (10^6 g)	222.5 MT

SOLUBILITY NO_3^- = 360 g/L

4. TIME... REQ to dissolve NO_3^-...

$$\text{Time} = \frac{\text{INVENTORY}}{\text{SOLUBILITY (INFILTRATION)}}$$

FOR 3WDS.

1% → $\text{Time} = \frac{10.4E6\ g}{360 g/L\ (1230\ l/yr)}$ = 23.5 years for 1% residual

5% Time = 5x(1% Time). = 118 years.

FOR 3EDS.

1% → $\text{Time} = \frac{21.98E6\ g}{360 g/L\ (4510\ l/yr)}$ = 13.5 years for 1%

5% TIME = 13.5 (5) = 67.5 or 68 years.

FOR 5EDS.

1% TIME = $\frac{44.5E6\ g}{360\ (5740\ l/yr)}$ = 21.5 years for 1%.

5% TIME = 5(21.5) = 107.5 or 108 years.

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. 14/16

BY _____ CHKD. _____ JOB NO. _____

RESULTS FOR DSTs

AT TIME = 5,500 years the tanks begin to release waste into the VADOSE ZONE. THE CONCENTRATION of the RELEASE WILL BE SATURATED at the CONCENTRATIONS SHOWN ON TABLES 3 and 4 for DSTs attached. THE DURATION OF THE RELEASE IS AS FOLLOWS:

	1% Residual	5% Residual
3WDS	23.5 years	118 years
3EDS	13.5 years	68 years
5EDS	21.5 years	108 years.

Table 3
DST Tank Release Concentration grams/ liter for Radionuclides

DST INVENTORY RADIONUCLIDES IN GRAMS

Decayed to 12/31/1995				
Radionuclide	ACT Ci/g	3WDS	3EDS	5EDS
grams				
C-14	4.45	1.81E-01	5.22E+02	1.18E+00
Sr-90	139	4.39E+02	7.89E+04	5.01E+02
Y-90	5140	1.19E+01	2.13E+03	1.35E+01
Tc-99	0.0169	2.17E+05	9.37E+05	9.46E+04
Cs-137	86.4	4.24E+04	2.53E+05	4.51E+04
Ba-137	537000000	6.82E-03	4.07E-02	7.25E-03
Eu-154	270	1.62E+00	2.72E+02	1.97E+00
Np-237	0.000704	5.39E+02	6.40E+04	2.02E+02
Pu-238	17.1	6.15E+01	9.98E+00	1.14E+01
Pu-239	0.0619	3.45E+04	7.99E+04	2.07E+04
Pu-240	0.227	3.36E+03	5.60E+03	1.58E+03
Pu-241	103	1.80E+02	1.05E+02	1.00E+02
Am-241	3.43	3.47E+03	1.71E+04	1.45E+02

CONCENTRATION IN GRAMS/LITER = (MASS NUCLIDE/MASS NO3)*360

Radionuclide		3WDS	3EDS	5EDS
NO3 mass g		1.04E+09	2.20E+09	4.45E+09
C-14		6.27E-08	8.56E-05	9.52E-08
Sr-90		1.52E-04	1.29E-02	4.05E-05
Y-90		4.11E-06	3.49E-04	1.10E-06
Tc-99		7.50E-02	1.54E-01	7.66E-03
Cs-137		1.47E-02	4.14E-02	3.65E-03
Ba-137		2.36E-09	6.66E-09	5.87E-10
Eu-154		5.61E-07	4.45E-05	1.60E-07
Np-237		1.86E-04	1.05E-02	1.63E-05
Pu-238		2.13E-05	1.63E-06	9.22E-07
Pu-239		1.20E-02	1.31E-02	1.67E-03
Pu-240		1.16E-03	9.17E-04	1.28E-04
Pu-241		6.23E-05	1.71E-05	8.12E-06
Am-241		1.20E-03	2.80E-03	1.17E-05

Table 4

Tank Release Concentration grams/liter for Non Rad Chemicals

CONCENTRATION GRAMS/LITER

Chemical	5EDS	3EDS	3WDS
Ag+	1.16E-01	3.43E-02	2.01E-02
Al+3	3.47E+00	1.72E+00	5.00E+00
As+5	8.42E-02	4.26E-03	6.97E-02
B+3	8.23E-02	1.09E-02	1.48E-01
Ba+2	2.52E-01	1.22E-01	1.13E-02
Be+2	5.43E-03	3.66E-03	
Bi+3	1.40E-01	8.53E-02	
Ca+2	1.06E+00	3.92E-01	2.15E+00
Cd+2	4.75E-01	1.16E-02	8.36E-02
Ce+3	2.27E-01		9.12E-02
Cr+3	7.53E-01	1.28E-01	8.32E+00
Cu+2	3.86E-02	1.71E-02	1.18E-01
Fe+3	1.09E+01	4.48E-01	4.31E+00
Hg+	4.65E-03	1.54E-04	
K+	1.21E+01	6.19E+01	1.30E+01
La+	1.60E+00	2.21E-01	3.42E-02
Li+	2.00E-03		1.94E-03
Mg+2	8.13E-01	2.28E-01	1.76E-01
Mn+4	1.69E+00	1.81E-01	1.28E+00
Mo+6	3.26E-01	1.31E-01	2.95E-01
Na+	4.91E+02	4.81E+02	7.48E+02
Nd+3	9.61E-01		4.04E-02
Ni+2	6.77E-01	1.00E-01	5.75E-01
Pb+4	2.84E-01	2.28E-01	1.16E-01
Pd	9.70E-02		
Rb	5.18E-03		
Re	2.95E-03	3.50E-02	
Rh	6.91E-03	2.41E-01	4.78E-02
Ru	2.33E-02	1.37E-01	4.70E-02
Sb	1.72E-01	2.21E-01	3.40E-02
Se	1.56E-01	4.25E-01	2.20E-01
SiO3-	1.69E+01	2.37E+00	2.10E+00
Sn	2.60E-06	6.24E-05	
Te	5.46E-03	1.85E-01	3.56E-02
Th	3.26E-02	4.18E-01	2.16E-01
Ti	2.13E-02	4.58E-02	1.34E-02
Tl	3.14E-01	4.79E+00	1.90E-01
UO2+2	2.41E-01	4.48E+00	
V+5	5.67E-03	2.72E-02	4.74E-03
W+6	6.04E-02		
Zn+2	6.23E-02	3.95E-01	4.66E-01
Zr+4	1.51E+00	4.23E+01	6.39E-02
Al(OH)4-2	1.97E+02	1.37E+02	4.13E+02
CO3-2	8.03E+01	1.38E+02	3.03E+01
Cl-	1.19E+01	8.59E+00	2.59E+01
Cr(OH)4-	3.28E+00	1.87E+00	2.08E+01
F-	2.93E+00	5.24E+01	3.11E+00
SO4-2	2.26E+01	1.18E+01	1.45E+01
NO3-	3.60E+02	3.60E+02	3.60E+02
NO2-	1.57E+02	1.46E+02	8.51E+01
PO4-3	6.91E+00	1.23E+01	2.54E+01
OH-	8.28E+01	1.24E+02	8.37E+01
TOC	7.04E+01	9.73E+00	4.46E+01

TRANSMIT CONFIRMATION REPORT

NO.	:	009
RECEIVER	:	13037904411-/47101
TRANSMITTER	:	JACOBS ENG GRP HANFORD
DATE	:	FEB 07'95 17:39
DURATION	:	06'45
MODE	:	STD
PAGES	:	17
RESULT	:	OK

TWRS EIS
CALCULATION COVER SHEET

DISCIPLINE & TITLE Engineering - Flux From TPA LLW Vaults

ORIGINATOR D. Murray DATE 2/1/95

REVISION NO. 0

OBJECTIVE Estimate the concentration of radionuclides released from the LLW vaults, and time required for release

METHODOLOGY See p1

ASSUMPTIONS 1. Cullet/sulfur waste form is stored in vaults similar to grout vaults
2. All concrete structures fail after 500 yrs
3 Hanford Barrier fails after 1000 yrs
4 Recharge rate is 0.05 cm/yr until barrier fails, it then becomes 0.1 cm/yr

(Continue on another sheet if necessary) (cont. p3)

David J Murray
SIGNATURE

CALCULATION & RESULTS ATTACHED

JACOBS ENGINEERING GROUP INC.

DATE 2/1/95 SUBJECT Flux From TPA LLW Vaults SHEET NO. 2/11

BY [illegible] CHKD. _____ JOB NO. 01K47101

Methodology

A. Calculate time for water/leach solution to reach vaults

B. Calculate release time of radionuclides

C. Calculate feed rate of liquid into vaults

D. Calculate number of vaults required

E. Calculate amount leached per year, and total mass dissolved. Compare with solubility tables

F. Calculate concentrations of ions in solution

JACOBS ENGINEERING GROUP INC.

DATE 2/1/95 SUBJECT SHEET NO. 3/11

BY DPM CHKD. Flux From TPA LLW Vaults JOB NO. 01K47101

Assumptions (cont)

5. Vitrified waste is uniform spheres, 1 cm in dia. Packing fraction is 0.7
6. Glass will have composition shown in TPA Eng. Data Pkg
7. Matrix is 95% sulfur + 5% organic binders
8. The vaults are 15 m below the surface of the barrier
9. Leaching commences when the recharge reaches the vaults
10. Leach products form in the same proportion as in the glass
11. Release time is approximated by $\left(\frac{\text{Particle Radius}}{\text{Corrosion Rate}}\right)$ (Ref 1)
12. Corrosion rate is 3×10^{-6} cm/yr
13. Glass density = 2.6 g/cm^3
14. Vaults are 37 m × 15 m × 10 m deep
15. Soln. resulting from dissolution of glass will contain the ions shown in the ASPEN tables in the TPA Eng Data Pkg
16. Radioactive decay is not taken into account

References

1. R.A. Kornesky, et al. Impacts of Disposal System Design Options on Low Level Glass Waste Disposal System Performance (Working Draft) July 29, 1994
2. John A. Dean, ed., Lange's Handbook of Chemistry McGraw-Hill, 11th Edition

JACOBS ENGINEERING GROUP INC.

DATE 2/1/95 SUBJECT Flux From TPA LLW Vaults SHEET NO. 4/11

BY [illegible] CHKD. JOB NO. 01K47101

Calculation

① How far will recharge penetrate in the 1st thousand years?

$$\frac{.05\ cm}{yr} \times 1{,}000\ yrs = 50\ cm = 0.5\ m$$

② How long will it take for recharge to reach vaults?

$$t = d/r = \frac{14.5\ m}{0.1\ cm/yr} = \frac{1450\ cm}{0.1\ cm/yr} = 14{,}500\ yrs$$

③ What is the release time?

$$t \cong \frac{0.5\ cm}{3 \times 10^{-6}\ r} = 1.7 \times 10^{5}\ yrs\ (\text{Assumption 11})$$

④ What is liquid feed rate on top of one vault?

$$Q = VA = \frac{.1\ cm}{yr} \times (15 \times 37)\ m^2 \times \frac{10^4\ cm^2}{m^2}$$

$$= 555{,}000\ \frac{cm^3}{yr} \times \frac{1\ liter}{1000\ cm^3} = 555\ \frac{liters}{yr}$$

⑤ What is the vol of LLW spheres in one vault?

$$V = 0.7\,LWH = 0.7(37 \times 15 \times 10) = 3{,}885\ m^3$$

JACOBS ENGINEERING GROUP INC.

DATE 2/1/95 SUBJECT Flux From TPA LLW Vaults SHEET NO. 5/11

BY AJM CHKD. JOB NO. 01K47101

(6) How many vaults are required?

$V = LWH = 5{,}550\ m^3$ = vol of one vault

From data pkg, p 10-3, vol of LLW mix $= 2.27 \times 10^5\ m^3$

$$\text{Vaults} = 2.27 \times 10^5\ m^3 \times \frac{\text{vault}}{5{,}550\ m^3} = 40.9 \text{ vaults}$$

(7) From data pkg, p A-114, total mass of cullet $= 4.00 \times 10^5$ MT

$$4 \times 10^5\ MT \times \frac{m^3}{2.6\ MT} = 154{,}000\ m^3 \text{ cullet}$$

(8) Vol of cullet/sulfur mix $= \frac{154{,}000}{.7} = 220{,}000\ m^3$ mix

Checks with $227{,}000\ m^3$ mix from step (6)

(9) Wt of LLW spheres in one vault

$= 4 \times 10^5\ MT / 40.9 = 9779.9$ call it 9780 MT

$$\text{Total solution flow} = 555\ \frac{L}{yr \cdot vault} \times 40.9 \text{ vaults} = 22700\ L/yr$$

(10) Amount leached in a yr (from one vault) $= \frac{9780\ MT}{170{,}000\ yrs}$

$= .0575\ MT/yr$

$= 57{,}500\ g/yr$

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DATE 2/2/95 SUBJECT Flux From TPA LLW Vaults SHEET NO. 6/11

BY [illegible] CHKD. JOB NO. 01K47101

(11) Dissolved concentration = $\frac{57500\ g/yr}{555\ liters/yr}$

= 104 g/L total

From p10-107 of Lange, this doesn't exceed the solubility of sodium silicate (Ref 2)

(12) From all vaults (total inventory) what fraction is leached every year?

$$\frac{1}{170{,}000} = 5.88 \times 10^{-6}\ yr^{-1}$$

(13) Multiplying the glass components by this fraction will give the metric tons per year of each component, which when divided by total flow will give the concentration in the leach product.

For total mass, for example

$$4 \times 10^5\ \cancel{MT} \times \left\{ \frac{5.88 \times \cancel{10^{-6}}\ \cancel{yr^{-1}} \times \frac{\cancel{10^6}\ g}{\cancel{MT}}}{\frac{555\ L}{\cancel{yr}\ \cancel{vault}} \times 40.9\ \cancel{vaults}} \right\} \rightarrow 2.59 \times 10^{-4}$$

Combined Factor

$$= 104\ \frac{g}{L}\ \text{total solids}$$

(14) To get the concentrations of ions in soln, the metric tons of oxides must be converted to metric tons of the element

For Sm as an example, table shows
3.98×10^{-4} MT Sm_2O_3

Then 3.98×10^{-4} MT Sm_2O_3 $\times \frac{2 \times 150}{(2 \times 150) + (3 \times 16)}$ $\frac{\text{MT Sm}}{\text{MT } Sm_2O_3}$

Subscript of Sm — At wt of SM — Subscript of O — At of O

$= 3.43 \times 10^{-4}$ MT Sm

(15) Now multiply by conversion fraction from step (13)

$(3.43 \times 10^{-4})(2.59 \times 10^{-4}) = 8.89 \times 10^{-8} \frac{g}{L} Sm^{+3}$

Results

At 14,500 yrs after a barrier is emplaced, the leach vaults begin to release solution to the vadose zone

This continues for 170,000 yrs until all of the LL glass is leached

The total flow of leachate is 22,700 L/yr

The concentrations of elements in the leachate are shown in the following table in the column titled "Conc. g/L"

	Estimated Vaults Release Concentrations, g/L					
Glass Component	Metric Tons	Conc. g/L	Ionic Form	Metal Subscript	Metal At Wt	Oxygen Subscript
Ag2O	3.52E-02	8.49E-06	Ag+1	2	108	1
Al2O3	7.65E+03	1.05E+00	Al+3	2	27	3
Am2O3	2.20E-03	5.19E-07	Am+3	2	243	3
As2O5	2.90E-01	4.90E-05	As+5	2	75	5
B2O3	4.41E+04	1.02E+01	B+3	2	209	3
BaO	3.46E-01	8.02E-05	Ba+2	1	137	1
BeO	2.08E-03	1.94E-07	Be+2	1	9	1
Bi2O3	7.16E+01	1.66E-02	Bi+3	2	209	3
CaO	3.16E+03	5.85E-01	Ca+2	1	40	1
CdO	2.54E+00	5.76E-04	Cd+2	1	112	1
Ce2O3	3.05E+00	6.74E-04	Ce+3	2	140	3
Cm2O3	4.76E-07	1.12E-10	Cm+3	2	247	3
Co2O3	7.35E-02	1.35E-05	Co+3	2	59	3
Cr2O3	1.88E+02	3.33E-02	Cr+3	2	52	3
Cs2O	5.20E-01	1.27E-04	Cs+1	2	133	1
CuO	2.76E-01	5.72E-05	Cu+2	1	64	1
Fe2O3	1.32E+01	2.39E-03	Fe+3	2	56	3
K2O	1.70E+03	3.65E-01	K+1	2	39	1
La2O3	4.29E-01	9.48E-05	La+3	2	139	3
Li2O	1.57E+04	1.90E+00	Li+1	2	7	1
MgO	3.15E+03	4.90E-01	Mg+2	1	24	1
MnO2	2.16E+01	3.54E-03	Mn+4	1	55	2
MoO3	4.90E+00	8.46E-04	Mo+6	1	96	3
Na2O	1.00E+05	1.92E+01	Na+1	2	23	1
Ni2O3	8.25E-01	1.52E-04	Ni+3	2	59	3
NiO	2.43E-01	4.95E-05	Ni+3	1	59	1
NpO2	5.35E-03	1.22E-06	Np+4	1	237	2
P2O5	3.77E+03	6.53E-01	PO4-3	2	31	5
PbO2	3.13E+00	7.02E-04	Pb+4	1	207	2
PuO2	9.46E-03	2.16E-06	Pu+4	1	242	2
RbO2	8.53E-02	1.61E-05	Rb+4	1	85	2
Re2O7	6.05E-03	1.20E-06	Re+7	2	186	7
Rh2O3	1.55E-02	3.26E-06	Rh+3	2	103	3
Ru2O3	3.37E-02	7.05E-06	Ru+3	2	101	3
Sb2O5	7.67E-02	1.50E-05	Sb+5	2	122	5
SeO3	8.86E-01	1.43E-04	Se+6	1	79	3
SiO2	2.20E+05	2.66E+01	Si+4	1	28	2
Sm2O3	3.98E-04	8.89E-08	Sm+3	2	150	3
SnO2	6.28E-03	1.28E-06	Sn+4	1	119	2
SrO	4.61E-01	1.01E-04	Sr+2	1	88	1
Tc2O7	2.81E+00	3.83E-04	TcO4-1	2	99	7
TeO3	7.41E-03	1.40E-06	Te+6	1	128	3
ThO2	2.00E-01	4.55E-05	Th+4	1	232	2
TiO2	1.16E-02	1.80E-06	Ti+4	1	48	2
Tl2O3	3.39E-01	7.86E-05	Tl+3	2	204	3
UO3	9.74E+01	2.38E-02	UO2+2	1	238	3
V2O5	1.71E-02	2.48E-06	V+5	2	51	5
WO2	1.83E-02	5.44E-06	WO4-2	1	184	2
WO3	4.12E+00	1.14E-03	WO4-2	1	184	3
ZnO	1.10E+00	2.29E-04	Zn+2	1	65	1
ZrO2	1.86E+01	4.19E-03	ZrO+2	1	91	2
VAULTCON.WKS						

Stream Name	436	437	438	439	440	441	442	443	444	445
Solid Components										
Total Mass Flow, (MT)	4.00E+00	4.00E+05	4.00E+01	4.00E+05	4.00E+05	3.32E+05		4.00E+01	4.00E+01	
Al, (MT)	4.05E-02	4.05E+03	4.05E-01	4.05E+03	4.05E+03	4.05E+03		4.05E-01	4.05E-01	
Fe, (MT)	9.24E-05	9.25E+00	9.25E-04	9.25E+00	9.25E+00	9.25E+00		9.25E-04	9.25E-04	
Cr, (MT)	1.25E-03	1.25E+02	1.25E-02	1.25E+02	1.25E+02	1.25E+02		1.25E-02	1.25E-02	
Ni, (MT)	7.42E-01	7.42E+04	7.42E+00	7.42E+04	7.42E+04	7.42E+04		7.42E+00	7.42E+00	
Si, (MT)	1.00E+00	1.00E+05	1.00E+01	1.00E+05	1.00E+05	1.00E+05		1.00E+01	1.00E+01	
P? (MT)	1.65E-02	1.65E+03	1.65E-01	1.65E+03	1.65E+03	1.65E+03		1.65E-01	1.65E-01	
NO2-, and NO3-, (MT)										
Cs and Ba, (MCl)	4.00E-04	4.00E+01	4.00E-03	4.00E+01	4.00E+01	4.00E+01		4.00E-03	4.00E-03	
Sr and Y, (MCl)	1.46E-05	1.46E+00	1.46E-04	1.46E+00	1.46E+00	1.46E+00		1.46E-04	1.46E-04	
Tc, (MCl)	3.05E-07	3.05E-02	3.05E-06	3.05E-02	3.05E-02	3.05E-02		3.05E-06	3.05E-06	
RU, (MCl)	8.77E-08	8.77E-03	8.77E-07	8.77E-03	8.77E-03	8.77E-03		8.77E-07	8.77E-07	
Total MCl	4.17E-04	4.16E+01	4.16E-03	4.16E+01	4.16E+01	4.16E+01		4.16E-03	4.16E-03	
Ag+, (MT)										
Ag2O, (MT)	3.52E-07	3.52E-02	3.52E-06	3.52E-02	3.52E-02	3.52E-02		3.52E-06	3.52E-06	
Al+3, (MT)										
Al2O3, (MT)	7.65E-02	7.65E+03	7.65E-01	7.65E+03	7.65E+03	7.65E+03		7.65E-01	7.65E-01	
Am+3, (MT)										
Am2O3, (MT)	2.20E-08	2.20E-03	2.20E-07	2.20E-03	2.20E-03	2.20E-03		2.20E-07	2.20E-07	
As+5, (MT)										
As2O5, (MT)	2.91E-06	2.91E-01	2.91E-05	2.91E-01	2.91E-01	2.91E-01		2.91E-05	2.91E-05	
B+3, (MT)										
B2O3, (MT)	4.41E-01	4.41E+04	4.41E+00	4.41E+04	4.41E+04	4.41E+04		4.41E+00	4.41E+00	
Ba+2, (MT)										
BaO, (MT)	3.46E-06	3.46E-01	3.46E-05	3.46E-01	3.46E-01	3.46E-01		3.46E-05	3.46E-05	
Be+2, (MT)										
BeO, (MT)	2.06E-08	2.06E-03	2.06E-07	2.06E-03	2.06E-03	2.06E-03		2.06E-07	2.06E-07	
Bi+3, (MT)										
Bi2O3, (MT)	7.16E-04	7.16E+01	7.16E-03	7.16E+01	7.16E+01	7.16E+01		7.16E-03	7.16E-03	
Carbon-14, (MT)										
Ca+2, (MT)										
Cancrinite, (MT)										
CaO, (MT)	3.16E-02	3.16E+03	3.16E-01	3.16E+03	3.16E+03	3.16E+03		3.16E-01	3.16E-01	
Cd+2, (MT)										
CdO, (MT)	2.54E-05	2.54E+00	2.54E-04	2.54E+00	2.54E+00	2.54E+00		2.54E-04	2.54E-04	
Ce+3, (MT)										
Ce2O3, (MT)	3.05E-05	3.05E+00	3.05E-04	3.05E+00	3.05E+00	3.05E+00		3.05E-04	3.05E-04	
Cl-, (MT)										
Cm+3, (MT)										
Cm2O3, (MT)	4.76E-12	4.76E-07	4.76E-11	4.76E-07	4.76E-07	4.76E-07		4.76E-11	4.76E-11	
CO+3, (MT)										
CO2O3, (MT)	7.35E-07	7.35E-02	7.35E-06	7.35E-02	7.35E-02	7.35E-02		7.35E-06	7.35E-06	
CO3-2, (MT)										
Cr+3, (MT)										
Cr2O3, (MT)	1.87E-03	1.88E+02	1.88E-02	1.88E+02	1.88E+02	1.88E+02		1.88E-02	1.88E-02	
Cs+, (MT)										
Cs2O, (MT)	5.20E-06	5.20E-01	5.20E-05	5.20E-01	5.20E-01	5.20E-01		5.20E-05	5.20E-05	
Cu, (MT)										
Cu+2, (MT)										
CuO, (MT)	2.76E-06	2.76E-01	2.76E-05	2.76E-01	2.76E-01	2.76E-01		2.76E-05	2.76E-05	
CuSO4, (MT)										
F-, (MT)										
Fe+3, (MT)										
Fe2O3, (MT)	1.32E-04	1.32E+01	1.32E-03	1.32E+01	1.32E+01	1.32E+01		1.32E-03	1.32E-03	
H+, (MT)										
Hg+2, (MT)										
I-, (MT)										
K+, (MT)										
K2O, (MT)	1.70E-02	1.70E+03	1.70E-01	1.70E+03	1.70E+03	1.70E+03		1.70E-01	1.70E-01	
La+3, (MT)										
La2O3, (MT)	4.29E-06	4.29E-01	4.29E-05	4.29E-01	4.29E-01	4.29E-01		4.29E-05	4.29E-05	
Li+, (MT)										
Li2O, (MT)	1.57E-01	1.57E+04	1.57E-00	1.57E+04	1.57E+04	1.57E+04		1.57E+00	1.57E+00	
Mg+2, (MT) MgtZ										
MgO, (MT) MgO	3.15E-02	3.15E+03	3.15E-01	3.15E+03	3.15E+03	3.15E+03		3.15E-01	3.15E-01	
? — Mn+2, (MT) MnO2	2.16E-04	2.16E+01	2.16E-03	2.16E+01	2.16E+01	2.16E+01		2.16E-03	2.16E-03	
Mo+3, (MT)										
? — MoO3, (MT) Mo+6 MoO3	4.90E-05	4.90E+00	4.90E-04	4.90E+00	4.90E+00	4.90E+00		4.90E-04	4.90E-04	
Na+, (MT)										
Na2O, (MT)	1.00E+00	1.00E+05	1.00E+01	1.00E+05	1.00E+05	1.00E+05		1.00E+01	1.00E+01	
Nb+5, (MT)										
Nb2O5, (MT)										
Ni+3, (MT)										
Ni2FeO4, (MT)										
NiO, (MT)	8.25E-06	8.25E-01	8.25E-05	8.25E-01	8.25E-01	8.25E-01		8.25E-05	8.25E-05	
NO, (MT)	2.43E-06	2.43E-01	2.43E-05	2.43E-01	2.43E-01	2.43E-01		2.43E-05	2.43E-05	
NO2-, (MT)										
NO3-, (MT)										
Np+4, (MT)										
NpO2, (MT)	5.35E-08	5.35E-03	5.35E-07	5.35E-03	5.35E-03	5.35E-03		5.35E-07	5.35E-07	
OH-, (MT)										
P2O5, (MT)	3.77E-02	3.77E+03	3.77E-01	3.77E+03	3.77E+03	3.77E+03		3.77E-01	3.77E-01	
P2O5:24H2O:44H2O (MT)										
Pb+4, (MT)										
PbO2, (MT)	3.13E-05	3.13E+00	3.13E-04	3.13E+00	3.13E+00	3.13E+00		3.13E-04	3.13E-04	
Pd+3, (MT)										
Poly, (MT)										
Pu+4, (MT)										
PuO2, (MT)	9.46E-08	9.46E-03	9.46E-07	9.46E-03	9.46E-03	9.46E-03		9.46E-07	9.46E-07	
Rb+, (MT)										

Stream Name	436	437	438	439	440	441	442	443	444	445
Solid Components										
RSO2, (MT)	6.5E-07	6.5E-02	6.5E-06	6.5E-02	6.5E-02	6.5E-02		6.5E-06	6.5E-06	
Re+7, (MT)										
Re2O7, (MT)	6.05E-08	6.05E-03	6.05E-07	6.05E-03	6.05E-03	6.05E-03		6.05E-07	6.05E-07	
Rh+3, (MT)										
Rh2O3, (MT)	1.55E-07	1.55E-02	1.55E-06	1.55E-02	1.55E-02	1.55E-02		1.55E-06	1.55E-06	
Ru+3, (MT)										
Ru2O3, (MT)	3.37E-07	3.37E-02	3.37E-06	3.37E-02	3.37E-02	3.37E-02		3.37E-06	3.37E-06	
Sb+5, (MT)										
Sb2O5, (MT)	7.67E-07	7.67E-02	7.67E-06	7.67E-02	7.67E-02	7.67E-02		7.67E-06	7.67E-06	
Se+6, (MT)										
SeO3, (MT)	8.85E-06	8.66E-01	8.66E-05	8.66E-01	8.66E-01	8.66E-01		8.66E-05	8.66E-05	
Si+4, (MT)										
SiO2, (MT)	2.20E+00	2.20E+05	2.20E+01	2.20E+05	2.20E+05	2.20E+05		2.20E+01	2.20E+01	
Sn+4, (MT)										
SnO2, (MT)	3.98E-09	3.98E-04	3.98E-08	3.98E-04	3.98E-04	3.98E-04		3.98E-08	3.98E-08	
Sr+2, (MT)										
SrCO3, (MT)	6.25E-08	6.25E-03	6.25E-07	6.25E-03	6.25E-03	6.25E-03		6.25E-07	6.25E-07	
SO4-2, (MT)										
Sr+2, (MT)										
SrO, (MT)	4.61E-06	4.61E-01	4.61E-05	4.61E-01	4.61E-01	4.61E-01		4.61E-05	4.61E-05	
S, (MT)						1.32E+05				
Tc2O7, (MT)	2.81E-05	2.81E+00	2.81E-04	2.81E+00	2.81E+00	2.81E+00		2.81E-04	2.81E-04	
TcO4-, (MT)										
Te+6, (MT)										
TeO3, (MT)	7.40E-08	7.41E-03	7.41E-07	7.41E-03	7.41E-03	7.41E-03		7.41E-07	7.41E-07	
Th+4, (MT)										
ThO2, (MT)	2.00E-06	2.00E-01	2.00E-05	2.00E-01	2.00E-01	2.00E-01		2.00E-05	2.00E-05	
Ti+4, (MT)										
TiO2, (MT)	1.16E-07	1.16E-02	1.16E-06	1.16E-02	1.16E-02	1.16E-02		1.16E-06	1.16E-06	
Tl+3, (MT)										
Tl2O3, (MT)	3.39E-06	3.39E-01	3.39E-05	3.39E-01	3.39E-01	3.39E-01		3.39E-05	3.39E-05	
UO2, (MT)										
UO2+2, (MT)										
UO3, (MT)	9.74E-04	9.74E+01	9.74E-03	9.74E+01	9.74E+01	9.74E+01		9.74E-03	9.74E-03	
V+5, (MT)										
V2O5, (MT)	1.71E-07	1.71E-02	1.71E-06	1.71E-02	1.71E-02	1.71E-02		1.71E-06	1.71E-06	
WO2, (MT)	1.83E-07	1.83E-02	1.83E-06	1.83E-02	1.83E-02	1.83E-02		1.83E-06	1.83E-06	
WO3, (MT)	4.11E-05	4.12E+00	4.12E-04	4.12E+00	4.12E+00	4.12E+00		4.12E-04	4.12E-04	
Zn+2, (MT)										
ZnO, (MT)	1.10E-05	1.10E+00	1.10E-04	1.10E+00	1.10E+00	1.10E+00		1.10E-04	1.10E-04	
ZrO2, (MT)	1.66E-04	1.66E+01	1.67E-03	1.67E+01	1.67E+01	1.66E+01		1.67E-03	1.67E-03	
ZrO2:2H2O, (MT)										

Table 10-1. Average Radionuclide Inventory in the Final Glass Form (Ci/m^3).[a]

Radionuclide inventory[b]	TPA preferred alternative	
	LLW glass	HLW glass
^{241}Am	3.03E-02	1.63E+01
^{243}Am	2.04E-05	1.10E-02
^{14}C		
^{244}Cm	1.31E-05	1.86E-02
^{135}Cs		
^{137}Cs	1.03E+00	5.89E+03
^{129}I		
^{63}Ni	5.52E-03	3.54E+01
^{237}Np	2.67E-05	6.45E-03
^{238}Pu	9.25E-05	7.30E-02
^{239}Pu	3.68E-03	2.90E+00
^{240}Pu	8.99E-04	7.09E-01
^{241}Pu	9.46E-03	7.46E+00
^{226}Ra		
^{106}Ru	5.00E-06	2.57E-03
^{151}Sm	3.20E-02	7.89E+01
^{126}Sn	6.37E-04	4.98E-02
^{90}Sr	3.23E+00	8.07E+03
^{99}Tc	1.36E-01	1.09E+00
^{230}Th		
^{233}U	1.49E-09	6.25E-07
^{234}U	4.10E-08	1.72E-05
^{235}U	5.28E-06	2.22E-03
^{238}U	1.21E-04	5.09E-02
^{93}Zr	1.13E-03	4.76E-01
Total (m3)[c]	2.27E+05	8.53E+03

[a]Values are calculated from the material balance. Percentages of the feed of each component in the final streams were determined. These percentages were then used along with the inventory data to determine the final values.

[b]Curies from decay daughter products are not included.

[c]Volumes of HLW and LLW taken from material balance. Streams used were final disposal streams (TPA LLW includes sulfur cement).

Request Number 030

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Mike Harker Date: 01/26/95

Phone Number: (509) 736-0616 Fax Number: (509) 736-7504

Request Information: Please provide the equivalent number of MEN per calendar year for each alternate. Subdivide the alternates into const., opr., D&D, and M&M phases and provide information by the labor category.

Need Date: 01/27/95

Response: See attached: 1) Minimal Pretreatment Waste Retrieval Transfer 2) Minimal Pretreatment 3) TPA Waste Retrieval Transfer 4) TPA

Data Source/Accuracy: Data sources were the Rev A (draft) issues for the TPA Minimum Pretreatment and Waste Recovery and Transfer engineering packages. The remaining alternatives have not been issued. Substantial revisions to all numbers are expected.

Prepared By: Jim Goodwin Date Sent/Faxed: 01/26/95

Concurrence: Marc Nelson
Marc Nelson - Deputy Project Manager

The construction schedule is a ten-hour day, five days per week for both TPA and No Separation alternative.

The operating schedule is three shifts, seven days a week. Operating personnel schedules are attached. Assume that half of the non-exempt workers are on shiftwork and the other half are on day shift, five days a week.

NO ACTION
MANPOWER ES. .E
ESTIMATED BY JACOBS USING HOURS AND SCHEDULE FROM REV B DRAFT OF THE NO DISPOSAL ACTION ENGINEERING PACKAGE
REV 0 Apr 8, 1995 JWG

	TOTAL MH	EQUIV TOTAL MAN*YR (NOTE 4)	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
YEAR (NOTE 1)																						
% MH EXPENDED PER YR, DESIGN (NOTE 2)																						
% MH EXPENDED PER YR, CONST. (NOTE 2)																						
			EQUIVALENT MEN (NOTE 7)																			
DESIGN & ENGR (NOTE 5)	750,000	375	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CONSTRUCTION (NOTE 5)																						
NONEXEMPT	1,875,000	937.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EXEMPT	3,750,000	1875	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUPERVISION	1,125,000	562.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OPERATION (NOTE 6)																						
EXEMPT																						
RAD WORKER			89	90	92	89	90	88	97	97	97	96	95	95	95	95	95	95	95	95	95	95
NONRAD WORKER			354	358	366	358	358	352	388	388	386	384	379	379	379	379	379	379	379	379	379	379
NON-EXEMPT																						
RAD WORKER			416	422	431	421	422	414	457	456	455	452	446	446	446	446	446	446	446	446	446	446
NONRAD WORKER			89	90	92	90	90	89	98	97	97	97	95	95	95	95	95	95	95	95	95	95
TOTAL	7,500,000	3,750	948	960	981	958	960	943	1,040	1,038	1,035	1,029	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015

NOTES:
1. SCHEDULE FROM TABLE 5-21
2. THE MANHOUR DISTRIBUTION WAS ESTIMATED BY JACOBS
3.
4. JACOBS ASSUMES 2000 WORKING MANHOURS PER YEAR
5. TOTAL MANHOURS FROM TABLE 5-8. JACOBS ASSUMES 10% OF THE TOTAL HOURS ARE ENGINEERING, 25% ARE EXEMPT, 50% ARE NON-EXEMPT AND 15% ARE SUPERVISI
6. MANHOURS FROM TANK WASTE OPERATIONS DATA (SPREADSHEET) -- NO DISPOSAL ACTION IN THE ROUTINE OPERATIONS DATA PACKAGE.
7. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
																30%	40%	10%	10%	10%	10%	10%			
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	113	150	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94	94	94	94	94	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	188	188	188	188	188	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56	56	56	56	56	0	0	0
95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379
446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446
95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,128	1,165	1,353	1,353	1,353	1,353	1,353	1,015	1,015	1,015

2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379
446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446
95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015

2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086
																		10%	20%			
																			10%	10%	10%	10%
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38	75	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94	94	94	94
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	188	188	188	188
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56	56	56	56
95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379	379
446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446	446
95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,053	1,428	1,353	1,353	1,353

2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	
10%											100%
											100%
											TOTAL
0	0	0	0	0	0	0	0	0	0	0	375
94	0	0	0	0	0	0	0	0	0	0	938
188	0	0	0	0	0	0	0	0	0	0	1,875
56	0	0	0	0	0	0	0	0	0	0	563
95	95	95	95	95	95	95	95	95	95	95	9,760
379	379	379	379	379	379	379	379	379	379	379	38,939
446	446	446	446	446	446	446	446	446	446	446	45,824
95	95	95	95	95	95	95	95	95	95	95	9,764
1,353	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	108,037

ISV, INCLUDING CLOSURE
IN SITU VITRIFICATION PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING HOURS AND SCHEDULE FROM REV B DRAFT OF THE IN SITU VITRIFICATION TECHNICAL DATA PACKAGE DATED FEB 1995 AND FROM REV B DRAFT OF THE CLOSURE TECHNICAL DATA PACKAGE DATED MARCH 1995
REV 0 Apr. 8, 1995 JWG

YEAR	1998	1999	2000	2001	2002	2003	2004	2005
% MANHOURS EXPENDED PER YR FOR R & D (NOTE 1)	5%	10%	15%	20%	20%	15%	15%	
% MANHOURS EXPENDED PER YR FOR CONST DESIGN (NOTE 2)	5%	10%	15%	20%	20%	15%	15%	
% MANHOURS EXPENDED PER YR FOR CONST (NOTE 2)	2%	4%	6%	6%	6%	6%	8%	10%
% MANHOURS EXPENDED PER YR FOR OPR (NOTE 3)			6%	6%	6%	6%	6%	6%
% MANHOURS EXPENDED PER YR FOR CLOSURE DESIGN (NOTE 4)								
% MANHOURS EXPENDED PER YR FOR CLOSURE (D&D) (NOTE 4)								
% MANHOURS EXPENDED PER YR FOR MON & MAINT (NOTE 2)								

	TOTAL MH	EQUIV TOTAL MAN*YR (NOTE 8)	EQUIVALENT MEN (NOTE 9)							
RESEARCH AND DEVELOPMENT (NOTE 1)	785,000	393	20	39	59	79	79	59	59	0
CONSTRUCTION (NOTE 5)										
DESIGN & ENGR	8,800,000	4400	220	440	660	880	880	660	660	0
NONEXEMPT NONRAD W'KR	26,400,000	13200	264	528	792	792	792	792	1056	1320
EXEMPT NONRAD WORKER	2,200,000	1100	22	44	66	66	66	66	88	110
SUPERVISION	6,600,000	3300	66	132	198	198	198	198	264	330
VITRIFICATION OPERATION (NOTE 6)										
EXEMPT RAD	3,600,000	1800	0	0	108	108	108	108	108	108
EXEMPT NONRAD	2,200,000	1100	0	0	66	66	66	66	66	66
NONEXEMPT RAD	8,900,000	4450	0	0	267	267	267	267	267	267
NON EXEMPT NONRAD	1,400,000	700	0	0	42	42	42	42	42	42
ROUTINE OPERATION (NOTE 12)										
EXEMPT RAD			89	90	88	97	97	97	96	95
EXEMPT NONRAD			358	358	352	388	388	386	384	379
NONEXEMPT RAD			421	422	414	457	456	455	452	446
NON EXEMPT NONRAD			90	90	89	98	97	97	97	95
CLOSURE (NOTE 7)										
DESIGN/ENGINEERING	208,000	104	0	0	0	0	0	0	0	0
NONEXEMPT RAD	364,000	182	0	0	0	0	0	0	0	0
SUPERVISION	65,000	33	0	0	0	0	0	0	0	0
MONITORING AND MAINTENANCE (NOTE 11)		6	0	0	0	0	0	0	0	0
TOTAL			1,550	2,143	3,201	3,538	3,536	3,293	3,639	3,258

NOTES:

1. SCHEDULE AND MANHOURS FROM SECTION 4.2.3, IN SITU. JACOBS ASSUMES AN AVERAGE WAGE OF $85 PER HOUR.
2. SCHEDULE FROM TABLE 7-21, IN SITU. DISTRIBUTION ESTIMATED BY JACOBS
3. MANHOUR DISTRIBUTION FROM FIG 8-1, IN SITU.
4. BARRIER CONSTRUCTION SCHEDULE FROM TABLE 5-12, CLOSURE DATA PACKAGE, IN SITU DISPOSAL. MANHOUR DIST. ASSUMED BY JACOBS
5. DATA FROM FIGURE 7-8, IN SITU. JACOBS ASSUMES 20% OF THE TOTAL HOURS ARE ENGINEERING, 60% ARE RAD WORKERS, 5% ARE NON RAD WORKERS AND 15% ARE SUPERVISION.
6. OPERATIONAL MANHOURS FROM TABLE 7-3, IN SITU.
7. DATA FROM FIGURE 5-20, CLOSURE DATA PACKAGE, IN SITU DISPOSAL.
8. JACOBS ASSUMES 2000 MANHOURS PER YEAR
9. GENERAL CALCULATION: (EQUIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)
10.
11. SEE TABLE 5-7 IN THE CLOSURE DATA PACKAGE
12. DATA FROM TANK FARM OPTIONS DATA -- IN SITU VITRIFICATION; ROUTINE OPERATIONS DATA PACKAGE.

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2024 TO 2124	
															100%
															100%
10%	10%	7%	4%	3%	3%	3%	3%	3%	3%	3%					100%
6%	7%	6%	6%	6%	6%	6%	6%	5%	5%	5%					100%
				20%	30%	30%	20%								100%
							5%	10%	15%	20%	20%	15%	15%		100%
														100	
															TOTAL
0	0	0	0	0	0	0	0	0	0	0	0	0	0		393
0	0	0	0	0	0	0	0	0	0	0	0	0	0		4,400
1320	1320	924	528	396	396	396	396	396	396	396	0	0	0		13,200
110	110	77	44	33	33	33	33	33	33	33	0	0	0		1,100
330	330	231	132	99	99	99	99	99	99	99	0	0	0		3,300
108	126	108	108	108	108	108	108	90	90	90	0	0	0		1,800
66	77	66	66	66	66	66	66	55	55	55	0	0	0		1,100
267	312	267	267	267	267	267	267	223	223	223	0	0	0		4,450
42	49	42	42	42	42	42	42	35	35	35	0	0	0		700
89	87	77	76	75	74	71	70	70	66	67	67	44	22		1,704
357	348	308	306	300	296	285	281	279	266	266	266	177	89		6,817
420	410	363	360	353	348	335	331	329	313	313	313	209	105		8,025
90	88	78	77	75	74	72	71	70	67	67	67	45	22		1,716
0	0	0	0	21	31	31	21	0	0	0	0	0	0		104
0	0	0	0	0	0	0	9	18	27	36	36	27	27		182
0	0	0	0	0	0	0	2	3	5	7	7	5	5		33
0	0	0	0	0	0	0	0	0	0	0	0	0	0	600	600
3,199	3,257	2,541	2,006	1,835	1,834	1,805	1,796	1,700	1,675	1,686	756	507	270	600	49,623

TPA; WASTE RETRIEVAL AND TRANSFER
CONSTRUCTION PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE TPA SECTION OF THE REV B DRAFT OF THE WASTE RETRIEVAL AND TRANSFER PACKAGE DATED JANUARY 1995
REV 1 Mar 22, 1995 JWG

YEAR (NOTE 1)			1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
% MH EXPENDED PER YR, DESIGN (NOTE 5)			5%	10%	10%	10%	10%	10%	10%	10%	5%	4%	3%	2%	2%	2%	2%	1%	1%	1%	1%	1%	100%
% MH EXPENDED PER YR, CONST. (NOTE 5)			3%	4%	5%	6%	7%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	5%	4%	3%	2%	1%	100%
	TOTAL MH (NOTE 2)	EQUIV TOTAL MAN*YR (NOTE 3)	EQUIVALENT MEN (NOTE 5)																				TOTAL
DESIGN & ENGR	6,000,000	3,000	150	300	300	300	300	300	300	300	150	120	90	60	60	60	60	30	30	30	30	30	3,000
CONSTRUCTION																							
RAD WORKER	600,000	300	9	12	15	18	21	18	18	18	18	18	18	18	18	18	18	15	12	9	6	3	300
NONRADIATION WORKER	12,600,000	6,300	189	252	315	378	441	378	378	378	378	378	378	378	378	378	378	315	252	189	126	63	6,300
SUPERVISORY	2,000,000	1,000	30	40	50	60	70	60	60	60	60	60	60	60	60	60	60	50	40	30	20	10	1,000
TOTAL	21,200,000	10,600	378	604	680	756	832	756	756	756	606	576	546	516	516	516	516	410	334	258	182	106	10,600

NOTES:
1. SCHEDULE FROM TABLE 5-21
2. TOTAL MANHOURS FROM TABLE 5-6. USED THE WORK DISTRIBUTION FROM FEVISION A FOR DESIGN, RAD & NONRAD WORKER AND SUPERVISION ADJUSTED TOTAL TO REV B TOTALS BY ADJUSTING NONRAD WORKERS AND BY DELETING SUBSURFACE BARRIERS
3. THE NUMBER OF MAN HOURS PER YEARS ARE ASSUMED TO BE 2000.
4. THE MANHOUR DISTRIBUTION IS BY JEG
5. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)
6. EXCLUDES UNDERGROUND BARRIERS

TPA WRT CONST MH

TPA; WASTE RETRIEVAL AND TRANSFER
OPERATING PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE TPA SECTION OF THE REV B DRAFT OF THE WASTE RETRIEVAL AND TRANSFER PACKAGE DATED JANUARY 1995
REV 1 Mar 22, 1995 JWG

YEAR (NOTE 1)			2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
% MH EXPENDED PER YR (NOTE 1)			1%	2%	2%	2%	2%	2%	2%	2%	7%	8%	8%	8%	8%	8%	8%	8%	8%	7%	2%	1%	1%	1%
	TOTAL MH (NOTE 2)	EQUIV TOTAL MAN*YR (NOTE 3)	EQUIVALENT MEN (NOTE 4)																					
NONEXEMPT																								
RAD WORKER	34,000,000	17,000	170	340	340	340	340	340	340	340	1190	1360	1360	1360	1360	1360	1360	1360	1360	1190	340	170	170	170
NONRAD WORKER	12,000,000	6,000	60	120	120	120	120	120	120	120	420	480	480	480	480	480	480	480	480	420	120	60	60	60
EXEMPT																								
RAD WORKER	6,000,000	3,000	30	60	60	60	60	60	60	60	210	240	240	240	240	240	240	240	240	210	60	30	30	30
NONRAD WORKER	13,000,000	6,500	65	130	130	130	130	130	130	130	455	520	520	520	520	520	520	520	520	455	130	65	65	65
TOTAL	65,000,000	32,500	325	650	650	650	650	650	650	650	2,275	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,275	650	325	325	325

NOTES:
1. SCHEDULE FROM TABLE 5.1 BACKUP, PAGE A11.
2. TOTAL MANHOURS FROM TABLE 5-2
3. THE NUMBER OF MAN HOURS PER YEARS ARE ASSUMED TO BE 2000.
4. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

2023	2024	
1%	1%	100%
		TOTAL
170	170	17,000
60	60	6,000
30	30	3,000
65	65	6,500
325	325	32,500

TPA WRT OPR MH

TPA; WASTE RETRIEVAL AND TRANSFER

DECONTAMINATING AND DECOMISSIONING PERSONNEL ESTIMATE

ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE TPA SECTION OF THE REV B DRAFT OF THE WASTE RETRIEVAL AND TRANSFER PACKAGE DATED JANUARY 1995

REV 1 Mar 23, 1995 JWG

YEAR (NOTE 1)		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026			
% MH EXPENDED PER YEAR (NOTE 4)		5%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	6%	5%	100%		
	TOTAL MH	EQUIV MEN*YR (NOTE 2)	EQUIVALENT MEN (NOTE 5)														TOTAL		
D&D LABOR	9,810,000	4,905	245	343	343	343	343	343	343	343	343	343	343	343	294	245	4,905		

NOTES:
1. SCHEDULE FROM TABLE 5-17
2. THE NUMBER OF MAN HOURS PER YEARS ARE ASSUMED TO BE 2000.
3. FOOTNOTES FOR TABLE 6-21 (OF REV A) SPECIFY THE FOLLOWING LABOR COSTS FOR D&D:
   30 % OF CAPITAL (EX CONTINGENCY); TABLE 5-14
   NOTE THE BASIS IS DIFFERENT THAN THE TPA PROCESS ASSUMPTION. THREE YEARS OF OPERATING LABOR IS NOT INCLUDED
   JACOBS ASSUMES THAT CAPITAL IS 60% LABOR AND THAT THE LABOR RATE IS 60 $/HR.

   30% OF CAPITAL AT 60% LABOR, MILLIONS 30% X 3,270 X 60% = $589
   TOTAL LABOR HOURS AT 60 $/HR 9810000

4. MANHOUR DISTRIBURIION ESTIMATED BY JACOBS.
5. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)
6. D&D IS NOT DISCUSSED IN THE TEXT, THE SCOPE IS UNDEFINED AND COST ESTIMATES ARE VERY ROUGH.

TPA; WASTE RETRIEVAL AND TRANSFER
MONITORING AND MAINTENANCE PERSONNEL ESTIMATE

M&M ARE DECLARED "NA" IN TABLE 5-17 AND ARE NOT DEISCUSSED IN THE TEXT. PRESUMABLY THE CLOSURE ACTION IS STARTED IMMEDIATELY AFTER OPERATIONS CEASE.

TPA

CONSTRUCTION PERSONNEL ESTIMATE

ESTIMATED BY JACOBS USING HOURS AND SCHEDULE FROM REV B DRAFT OF THE TPA ENGINEERING PACKAGE DATED MARCH 1995

REV 1 Mar 23, 1995 JWG

YEAR (NOTE 1)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
% MH EXPENDED PER YR, DESIGN (NOTE 4)	8%	12%	15%	15%	15%	15%	10%	5%	2%	1%	1%	1%	1%	1%	102%
% MH EXPENDED PER YR, CONST. (NOTE 1)	3%	6%	9%	9%	15%	13%	12%	11%	11%	5%	3%	2%	1%	0%	100%

	TOTAL MH (NOTE 2)	EQUIV TOTAL MAN*YR (NOTE 3)	EQUIVALENT MEN (NOTE 5)														TOTAL
DESIGN & ENGR	10,000,000	5000	400	600	750	750	750	750	500	250	100	50	50	50	50	50	5,100
CONSTRUCTION																	
NONRADIATION WORKER	24,000,000	12000	360	720	1080	1080	1800	1560	1440	1320	1320	600	360	240	120	0	12,000
SUPERVISORY	5,600,000	2800	84	168	252	252	420	364	336	308	308	140	84	56	28	0	2,800
TOTAL	39,600,000	19,800	844	1,488	2,082	2,082	2,970	2,674	2,276	1,878	1,728	790	494	346	198	50	19,900

NOTES:
1. SCHEDULE AND DISTRIBUTION FROM FIGURE 10-1
2. TOTAL MANHOURS FROM TABLE 9-9
3. ASSUMED 2000 MAN HOURS PER YEAR
4. THE DESIGN MANHOUR DISTRIBUTION IS BY JEG.
5. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

TPA
OPERATING PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE REV B DRAFT OF THE TPA PACKAGE DATED MARCH 1995

REV 1 Mar 23, 1995 JWG

	TOTAL MH (NOTE 2)	EQUIV MEN/YR (NOTE 3)	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
YEAR (NOTE 1)			1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
% MH EXPENDED PER YEAR (NOTE 6)			1%	1%	1%	2%	2%	4%	4%	5%	5%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	6%	5%	5%	4%	4%	2%	1%
			EQUIVALENT MEN (NOTE 4)																										
NONEXEMPT																													
RAD WORKER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NONRAD WORKER	3,500,000	1,750	18	18	18	35	35	70	70	88	88	70	70	70	70	70	70	70	70	70	70	70	105	88	88	70	70	35	18
EXEMPT																													
RAD WORKER	27,000,000	13,500	135	135	135	270	270	540	540	675	675	540	540	540	540	540	540	540	540	540	540	540	810	675	675	540	540	270	135
NONRAD WORKER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	30,500,000	15,250	153	153	153	305	305	610	610	763	763	610	610	610	610	610	610	610	610	610	610	610	915	763	763	610	610	305	153

NOTES:
1. SCHEDULE FROM FIGURE 10-2
2. TOTAL MANHOURS FROM TABLE 9-3
3. ASSUMED 2000 MAN HOURS PER YEAR FOR OPERTIONS
4. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	
1%	1%	1%								.20%	.20%	.20%	.20%	.20%	.20%	100%
																TOTAL
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	18	18	0	0	0	0	0	0	0	4	4	4	4	4	4	1,754
135	135	135	0	0	0	0	0	0	0	27	27	27	27	27	27	13,527
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
153	153	153	0	0	0	0	0	0	0	31	31	31	31	31	31	15,281

TPA OPR MH

TPA
DECONTAMINATION AND DECOMISSIONING PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE REV B DRAFT OF THE TPA PACKAGE DATED MARCH 1995

REV 1 Mar 22, 1995 JWG

	TOTAL MH (NOTE 2)	EQUIV MEN/YR (NOTE 3)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	TOTAL
YEAR (NOTE 1)			EQUIVALENT MEN (NOTE 5)										
% MH EXPENDED PER YEAR (NOTE 6)			4%	8%	12%	13%	13%	13%	13%	12%	8%	4%	100%
NONEXEMPT													
RAD WORKER	2,226,000	1,113	45	89	134	145	145	145	145	134	89	45	1,113
NONRAD WORKER	226,200	113	5	9	14	15	15	15	15	14	9	5	113
EXEMPT													
RAD WORKER	1,484,000	742	30	59	89	96	96	96	96	89	59	30	742
NONRAD WORKER	150,800	75	3	6	9	10	10	10	10	9	6	3	75
TOTAL	4,087,000	2,044	82	163	245	266	266	266	266	245	163	82	2,044

NOTES:
1. SCHEDULE FROM TABLE 9-20
2. TOTAL MANHOURS FROM TABLE F-8. JACOBS ASSUMES THAT 40% ARE EXEMPT.
3. ASSUMED 2000 WORKING MAN HOURS PER YEAR.
4. THE MANHOUR DISTRIBUTION IS BY JEG.
5. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

GENERAL NOTE: TABLE 9-20 ASSUMES 5 YEARS FOE D&D (NOTE 4) WHILE TABLE F-6 ASSUMES 2 YEARS WE MADE NO ASSUMPTIONS AND USED THE RAW DATA.

TPA
MONITORING AND MAINTENANCE PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE REV B DRAFT OF THE TPA PACKAGE DATED MARCH 1995

REV 1 Mar 22, 1995 JWG

	YEAR (NOTE 1)		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	
% MH EXPENDED PER YEAR (NOTE 6)			8%	8%	8%	8%	8%	8%	8%	8%	8%	7%	7%	7%	7%	100%
	TOTAL MH (NOTE 2)	EQUIV MEN/YR (NOTE 3)	EQUIVALENT MEN (NOTE 5)													TOTAL
NONEXEMPT																
RAD WORKER	26,100	13	1	1	1	1	1	1	1	1	1	1	1	1	1	13
NONRAD WORKER	104,400	52	4	4	4	4	4	4	4	4	4	4	4	4	4	52
EXEMPT																
RAD WORKER	17,400	9	1	1	1	1	1	1	1	1	1	1	1	1	1	9
NONRAD WORKER	69,600	35	3	3	3	3	3	3	3	3	3	2	2	2	2	35
TOTAL	217,500	109	9	9	9	9	9	9	9	9	9	8	8	8	8	109

NOTES:
1. SCHEDULE FROM TABLE 9-20
2. TOTAL MANHOURS FROM TABLE F-8. JACOBS ASSUMES THAT 40% ARE EXEMPT.
3. ASSUMED 2000 WORKING MAN HOURS PER YEAR.
4. THE MANHOUR DISTRIBUTION IS BY JEG.
5. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

TPA CLOSURE
TANK FARM CLOSURE PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING HOURS AND SCHEDULE FROM REV B DRAFT OF THE CLOSURE TECHNICAL DATA PACKAGE DATED MARCH 1995
REV 0 Apr 8, 1995 JWG

YEAR (NOTE 1)			2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
% MH EXPEND PER YR, TK STAB DSGN (NOTE 6)			5%	6%	7%	8%	8%	8%	8%	8%	8%	8%	8%	7%	6%	5%		
% MH EXPENDED PER YR, TANK STAB (NOTE 6)			3%	4%	5%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%
% MH EXPEND PER YR, BARRIER DSGN (NOTE 6)							5%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%
% MH EXPENDED PER YR, BARRIER (NOTE 6)																		
% MH EXPENDED PER YR, M&M (NOTE 6)					1	1	1	1	1	1	1	1	1	1	1	1	1	1
	TOTAL MH	EQUIV TOTAL MAN*YR	EQUIVALENT MEN (NOTE 7)															
TANK STABILIZATION WITH CONCRETE (NOTE 2)																		
DESIGN & ENGR	96,000	48	2	3	3	4	4	4	4	4	4	4	4	3	3	2	0	0
RAD WORKER	18,000	9	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
NONRADIATION WORKER	1,300	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUPERVISION	23,000	12	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BARRIER CONSTRUCTION (NOTE 3)																		
DESIGN	266,000	133	0	0	0	0	7	9	9	9	9	9	9	9	9	9	9	9
RAD WORKER	488,000	244	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUPERVISION	86,000	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M&M (NOTE 4)																		
RAD WORKER	11,000	6	0	0	6	6	6	6	6	6	6	6	6	6	6	6	6	6
TOTAL	989,300		3	4	10	11	17	20	20	20	20	20	20	19	19	18	16	16

NOTES:
1. SCHEDULE FROM FIGURES 5-11 and 5-12
2. TOTAL MANHOURS FROM TABLE 5-2B. GROUT STABILIZATION OF BOTH TANKS AND EQUIPMENT IS ASSUMED.
3. TOTAL MANHOURS FROM 5-2D
4. MANHOURS FROM 5-7. THIS TABLE IS IN STAFF HOURS PER YEAR
5. ASSUMED 2000 MAN HOURS PER YEAR
6. THE DESIGN MANHOUR DISTRIBUTION IS BY JEG.
7. GENERAL CALCULATION: (EQUIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

2026	2027	2028	2029	2030	2031	2032	2033	2034	2035 TO 2134	
										100%
5%	5%									100%
7%	6%	5%								100%
		5%	10%	20%	30%	20%	10%	5%		100%
1	1	1	1	1	1	1	1	1	100	
										TOTAL
0	0	0	0	0	0	0	0	0	0	48
0	0	0	0	0	0	0	0	0	0	9
0	0	0	0	0	0	0	0	0	0	1
1	1	0	0	0	0	0	0	0	0	12
9	8	7	0	0	0	0	0	0	0	133
0	0	12	24	49	73	49	24	12	0	244
0	0	2	4	9	13	9	4	2	0	43
6	6	6	6	6	6	6	6	6	550	677
16	15	27	34	63	92	63	34	20	550	1,166

CAPSULE DRY STORAGE (NO ACTION)
PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING HOURS AND SCHEDULE FROM REV B DRAFT OF THE CAPSULE ENGINEERING PACKAGE DATED FEBRUARY 1995
REV 0 Apr 6, 1995 JWG

		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
% MH EXPENDED PER YR, DESIGN (NOTE 1)		40%	60%															
% MH EXPENDED PER YR, CONST. (NOTE 1)		5%	20%	20%	20%	10%	10%	10%	5%									
% MH EXPENDED PER YR, PKG (NOTE 1)										5%	5%	5%	5%	5%	5%	5%	5%	5%
% MH EXPENDED PER YR, STORAGE (NOTE 1)										2%	2%	2%	2%	2%	2%	2%	2%	2%
	EQUIV TOTAL MAN*YR	EQUIVALENT MEN (NOTE 4)																
DESIGN & ENGR (NOTE 2)	15	6	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CONSTRUCTION (NOTE 2)																		
NONRADIATION WORKER	70	4	14	14	14	7	7	7	4	0	0	0	0	0	0	0	0	0
SUPERVISORY	15	1	3	3	3	2	2	2	1	0	0	0	0	0	0	0	0	0
PACKAGING OPERATIONS (NOTE 3)																		
RAD	140	0	0	0	0	0	0	0	0	7	7	7	7	7	7	7	7	7
NONRAD	54	0	0	0	0	0	0	0	0	3	3	3	3	3	3	3	3	3
DRY STORAGE (NOTE 3)																		
RAD	700	0	0	0	0	0	0	0	0	14	14	14	14	14	14	14	14	14
NONRAD	190	0	0	0	0	0	0	0	0	4	4	4	4	4	4	4	4	4
TOTAL	1,184	10	26	17	17	9	9	9	4	28	28	28	28	28	28	28	28	28

NOTES:

1. SCHEDULE TAKEN FROM FIGURE 3-2. MANHOUR DISTRIBUTION ESTIMATED BY JACOBS
2. CONSTRUCTION MANYEARS FROM TABLE 4-2. JACOBS ASSUMES THAT 15% OF CONSTRUCTION MANHOURS WILL BE DESIGN AND THAT 15% WILL BE SUPERVISION AND STAFF.
3. OPERATIONAL AND STORAGE/DISPOSAL MAN YEARS FROM TABLE 4-5
4. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

CAPSULE DRY STORAGE MANHOURS

2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 TO 2090	TOTAL
												100%
												100%
5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%		100%
2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	60%	100%
0	0	0	0	0	0	0	0	0	0	0	0	15
0	0	0	0	0	0	0	0	0	0	0	0	70
0	0	0	0	0	0	0	0	0	0	0	0	15
7	7	7	7	7	7	7	7	7	7	7	0	140
3	3	3	3	3	3	3	3	3	3	3	0	54
14	14	14	14	14	14	14	14	14	14	14	420	700
4	4	4	4	4	4	4	4	4	4	4	114	190
28	28	28	28	28	28	28	28	28	28	28	534	1,184

CAPSULE DRY STORAGE MANHOURS

CAPSULE OVERP) SHIP MANHOURS (AKA NO IMMOBILIZATION OR CAPSULE TPA)
PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING HOURS AND SCHEDULE FROM REV B DRAFT OF THE CAPSULE ENGINEERING PACKAGE DATED FEBRUARY 1995
REV 0 Apr 6, 1995 JWG

		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
% MH EXPENDED PER YR, DESIGN (NOTE 1)		40%	60%																
% MH EXPENDED PER YR, CONST. (NOTE 1)		5%	20%	20%	20%	10%	10%	10%	5%										
% MH EXPENDED PER YR, PKG (NOTE 1)										6%	6%	6%	6%	6%	5%	5%	5%	5%	5%
% MH EXPENDED PER YR, STORAGE (NOTE 1)										4%	4%	4%	4%	4%	4%	4%	3%	3%	3%
% MH EXPENDED PER YR, SHIPPING (NOTE 1)																			
	EQUIV TOTAL MAN*YR	EQUIVALENT MEN (NOTE 4)																	
DESIGN & ENGR (NOTE 2)	15	6	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CONSTRUCTION (NOTE 2)																			
NONRADIATION WORKER	70	4	14	14	14	7	7	7	4	0	0	0	0	0	0	0	0	0	0
SUPERVISORY	15	1	3	3	3	2	2	2	1	0	0	0	0	0	0	0	0	0	0
PACKAGING OPERATIONS (NOTE 3)																			
RAD	140	0	0	0	0	0	0	0	0	8	8	8	8	8	7	7	7	7	7
NONRAD	54	0	0	0	0	0	0	0	0	3	3	3	3	3	3	3	3	3	3
DRY STORAGE (NOTE 3)																			
RAD	700	0	0	0	0	0	0	0	0	28	28	28	28	28	28	28	21	21	21
NONRAD	190	0	0	0	0	0	0	0	0	8	8	8	8	8	8	8	6	6	6
SHIPPING (NOTE 5)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1,184	10	26	17	17	9	9	9	4	47	47	47	47	47	45	45	36	36	36

NOTES:

1. SCHEDULE TAKEN FROM FIGURE 3-2. MANHOUR DISTRIBUTION ESTIMATED BY JACOBS
2. CONSTRUCTION MANYEARS FROM TABLE 4-2. JACOBS ASSUMES THAT 15% OF CONSTRUCTION MANHOURS WILL BE DESIGN AND THAT 15% WILL BE SUPERVISION AND STAFF.
3. OPERATIONAL AND STORAGE/DISPOSAL MAN YEARS FROM TABLE 4-5
4. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)
5.
6. THERE ARE NO D&D MANHOURS OR SCHEDULE BECAUSE THE WESF FACILITY WILL BE RETROFIT FOR THE OVERPACK OPERATION.

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	
																					100%
																					100%
5%	5%	5%	5%	5%	5%	5%	5%	5%													100%
3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	100%
															16%	17%	17%	17%	17%	16%	100%
																					TOTAL
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
7	7	7	7	7	7	7	7	7	0	0	0	0	0	0	0	0	0	0	0	0	140
3	3	3	3	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	54
21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	700
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	190
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
36	36	36	36	36	36	36	36	36												27	1,184

OVERPACK & SHIP MANHOURS

ENGINEERING INFORMATION REQUEST 061

Supplemental Information

Capsules Vitrify with Tank Waste alternative:

The staffing levels developed for the Capsules Overpack and Ship alternative should be used for the Vitrify with Tank Waste alternative. The schedule for both alternatives is approximately the same and so the annual staffing levels are assumed to be identical.

The engineering data package for the capsules does not provide staffing estimates for the Vitrify with Tank Waste alternative and notes that the estimate would be insignificant as compared to the Extensive Retrieval (Ex Situ Vitrification) alternative [formerly the TPA alternative]. This is a true statement however, this approach does not provide a basis for comparing the Capsules Vitrify with Tank Waste alternative with the other capsule alternatives. The staffing levels for each of the capsule alternatives should be similar since each alternatives (except No Action) involves capsule retrieval, inspection, placement into an overpack or a transportation cask, transport, and handling.

Request Number 031

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: William Elzinga

Date: 12/21/94

Phone Number: 314-567-4600

Fax Number: 314-567-5030

Request Information: 1) List of construction equipment used for each alternative, and measured noise levels @ 50 feet (each piece of machinery). 2) See attached sheet.

Need Date: 01/15/95

Response: See attached.

Data Source/Accuracy:

Construction equipment list from Min. Pretreat and TPA data packages (appendix) transportation table from Mike Harker.

Prepared By: Colin Henderson CH

Date Sent/Faxed: 01/16/95

Concurrence: Marc E. Nelson
Marc Nelson - Deputy Project Manager

engin\eninfrq.031

MEMORANDUM

To: John Horton

From: William Elzinga

Date: 12-21-94

Subject: Information Request for TWRS EIS

John, please find attached a copy of the information request for the noise analysis for the above referenced project. Give me a call if you have any questions.

Post-it® Fax Note 7671	Date	# of pages ▶ 3
To CALIN HENDERSON	From W. ELZINGA	
Co./Dept.	Co. ESE - STL.	
Phone #	Phone #	
Fax # 509-736-7504	Fax # 894-6001-x 0106	

TWRS EIS

NOISE ANALYSIS INFORMATION REQUEST

Noise emission data are requested for the following systems as they apply to each of the alternatives being considered:

- Retrieval and Transfer Systems
- Operation of Evaporator, Chiller and Exhauster Units,
- Operation of Vitrification Plant
- Operation of Separator
- Capsule Retrieval/Packaging Station Operation
- Anticipated Truck Volume for Off-site Transport

ENGINEERING DATA REQUEST 31

REQUESTED BY: WILLIAM ELZINGA/ESE

SUBJECT: NOISE

For No Pretreatment Alternative the construction equipment schedule is as follows:

No Pretreatment Alternative
Five-Year Construction Schedule
Construction Equipment List

YEAR ONE OF CONSTRUCTION
The following equipment will be used during the first year of construction:

1. 3/4 ton pickup: 1 unit, total usage: 64,800 mi.
2. D8 dozer: 335 hp, 4 units, total usage: 3,770 hours.
3 Cat 966 loader: 200 hp, 1 unit, total use 120 hours.
4. Ten-cy dump truck: 250 hp, 8 units, total use 960 hours.
5. Cat D9 dozer: 460 hp, 2 units, usage: 2,800 hours.
6. Cat 637E scraper: 460 hp, 6 units, usage: 7,780 hours.
7. Scraper twin engine: 250 hp, 6 units, usage: 7,780 hours.
8. Towed vibratory roller:50 hp, 1 unit, usage: 1,400 hours.
9. Cat 14G motor grader:200 hp, 2 units, usage: 4,370 hours.
10. Cat 235B backhoe: 215 hp, 1 unit, usage: 80 hours.
11. Cat 623E elevating scraper:330 hp, 4 units, usage: 6,270 hours.
12. Cat 815B compactor: 210 hp, 1 unit, usage: 1,570 hours.
13. 5,000 gallon water tanker:300 hp, 1 unit, usage:1,570 hours.
14. Mechanics truck: 250 hp, 1 unit, usage: 1,650 hours.
15. Fuel/lube truck: 250 hp, 1 unit, usage: 2,480 hours.

YEAR TWO-FOUR OF CONSTRUCTION
The following equipment and usage will take place in years two-four of the construction period:

1. D8 dozer: 335 hp, 1 unit, usage: 920 hours.
2. 966 Front-end loader: 200 hp, 4 units, usage: 8,160 hours.
3. Ten-cy dump truck: 250 hp, 10 units, usage: 12,730 hours.
4. Cat 623E scraper: 330 hp, 4 units, usage: 610 hours.
5. Cat 14G motor grader:200 hp, 1 unit, usage: 150 hours.
6. 3/4 ton pickup: 250 hp, 1 unit, usage: 3,000 miles.
7. Cat D6 dozer: 165 hp, 1 unit, usage:1,810 hours.

8. Eight-cy concrete mixer trucks:250 hp, 4 units, usage: 16,800 hours.

Five-year duration. The following will be used throughout the five-year construction period:

1.	Utility dozer:	65 hp, 5 units, total usage: 16,000 hours.
2.	Utility loader/backhoe:	65 hp, 6 units, usage: 19,000 hours total.
3.	Backhoe:	65 hp, 4 units, usage: 10,000 hours.
4.	Backhoe:	120 hp, 4 units, 3,000 hours total use.
5.	Loader:	120 hp, 4 units, 10,000 hours total use.
6.	Loader:	200 hp, 2 units, 3,000 hours.
7.	Crane:	15 ton, 10 units, 64,000 hours.
8.	Crane:	25 ton, 10 units, 48,000 hours.
9.	Crane:	50 ton, 5 units, 16,000 hours.
10.	Crane:	100 ton, 2 units, 6,000 hours.
11.	Forklift:	2 ton, 10 units, 36,000 hours.
12.	Forklift:	4 ton, 6 units, 29,000 hours.
13.	Forklift:	6 ton, 4 units, 16,000 hours.
14.	Forklift:	10 ton, 4 units, 13,000 hours.
15.	Forklift:	15 ton, 4 units, 10,000 hours.
16.	Motor grader:	125 hp, 4 units, 22,000 hours.
17.	Pumps:	1", 2 hp, gas, 40 units, 128,000 hours.
18.	Pumps:	2", 5 hp, gas, 20 units, 64,000 hours.
19.	Pumps:	6", 10 hp, gas, 10 units, 16,000 hours.
20.	Air comp:	100 cfm, 50 hp, gas, 20 units, 112,000 hours.
21.	Air comp:	250 cfm, 90 hp, diesel, 20 units, 80,000 hours.
22.	Air comp:	600 cfm, diesel, 10 units.
23.	Welder:	90 hp, 60 units, 336,000 hours, gas power.
24.	Welder:	200 hp, gas, 80 units, 320,000 hours.
25.	Generators:	0.5 kW, gas, 20 units, 96,000 hours
		5 kW, 10 hp, gas, 20 units, 64,000 hours
		10 kW, 20 hp, Gas, 15 units, 36,000 hours
		100 kW, 75 hp, diesel, 10 units, 16,000 hours
		250 kW, 150 hp, diesel, 10 units, 16,000 hours.
26.	Light plant:	10 kW, 20 hp, gas, 50 units, 280,000 hours.
27.	Compactors:	5 hp, gas, 60 units, 192,000 hours
		40 hp, gas, 20 units, 64,000 hours.
28.	Trucks:	1/2 ton P.U., 50 units, 1,600,000 miles.
		3/4 ton P.U., 25 units, 800,000 miles.
		3 ton flat bed, 20 units, 800,000 miles.
		5 ton flat bed, 10 units, 320,000 miles.
		40 foot float and tractor, 10 units, 320,000 miles.
		Low boy with tractor, 2 units, 15,000 miles.
		Shuttle bus, 10 units, 480,000 miles.
		Van, 10 units, 720,000 miles.
		Fuel truck, 5 units, 400,000 miles.

Mechanics truck, 5 units; 400,000 miles.
Water truck, 2 units, 80,000 miles.

For equipment usage see attached breakdown which gives by year a list of equipment size, number of units available (this will be peak usage), and operating units (this is the average usage for the year).

For TPA Alternative, the equipment list during construction is the same.

The TPA case used a factor of 1.4 to estimate the emissions during construction from the minimal pretreatment construction equipment list. Therefore the TPA case will use a combination of increased equipment numbers and utilization to get the 40%. For TPA multiply the numbers of available numbers and available numbers by 1.4 to get TPA usage.

The above lists do not account for construction equipment required for waste retrieval and transfer. The same general type of equipment should be used. The number of units/year for construction equipment for retrieval and transfer is shown on table 6-24 attached.

Noise emissions for all operations within the processing facilities will be very minimal just outside the facilities due to the amount of radiation shielding required.

CONST4EQ

CONST EQUIP - DIESEL UNLESS OTHERWISE NOTED

			YR 1		YR 2		YR 3		YR 4		YR 5
		AVAIL UNITS	OPR UNITS	AVAIL UNITS	OPR UNITS	AVAIL UNITS	OPR UNITS	AVAIL UNITS	OPR UNITS	AVAIL UNITS	OPR UNITS
1 DOZER, CAT D9	460 HP	2	1.30								
3 DOZER, CAT D8	335 HP	4	1.75	1	.40	1	.40				
3 DOZER, CAT D6	165 HP			1	.28	1	.28	1	.28		
5 DOZER, UTILITY	65 HP	5	1.48	5	1.48	5	1.48	5	1.48	5	1.48
3 LOADER, CAT 966	200 HP	3	.34	6	1.54	6	1.54	6	1.54	2	.28
5 LOADER, 2CY	120 HP	4	.93	4	.93	4	.93	4	.93	4	.93
1 BACKHOE, CAT 235B	215 HP	1	.50								
5 BACKHOE, 4CY	120 HP	4	.28	4	.28	4	.28	4	.28	4	.28
5 LOADER/BACKHOE, UTILITY	65 HP	6	1.76	6	1.76	6	1.76	6	1.76	6	1.76
5 BACKHOE, UTILITY	65 HP	4	.93	4	.93	4	.93	4	.93	4	.93
1 SCRAPER, CAT 637E	460 HP	6	3.60								
3 ELEVATING SCRAPER, CAT 623E	330 HP	4	2.90	2	.60						
1 SCRAPER, TWIN ENGINE	250 HP	6	3.60								
1 TOWED VIBTATING ROLLER, GAS	50 HP	1	.65								
3 MOTOR GRADER, CAT 14G	200 HP	2	2.02	1	.60						
5 MOTOR GRADER	125 HP	4	2.04	4	2.04	4	2.04	4	2.04	4	2.04
1 COMPACTOR, CAT 815B	210 HP	1	.73								
5 COMPACTOR, GAS	40 HP	20	5.93	20	5.93	20	5.93	20	5.93	20	5.93
5 COMPACTOR, WALKING, GAS	5 HP	60	17.78	60	17.78	60	17.78	60	17.78	60	17.78
3 DUMP TRUCK, 10 YD	250 HP	8	6.50	10	8.96	10	8.96	5	1.96		
3 CONCRETE MIX TRUCKS	250 HP			4	2.59	4	2.59	4	2.59		
5 CRANE	100 TO	2	.56	2	.56	2	.56				
5 CRANE	50 TO	5	1.48	5	1.48	5	1.48	5	1.48	5	1.48
5 CRANE	25 TO	10	4.44	10	4.44	10	4.44	10	4.44	10	4.44
5 CRANE	15 TO	10	5.93	10	5.93	10	5.93	10	5.93	10	5.93
5 FORKLIFT	15 TO	4	.93	4	.93	4	.93	4	.93	4	.93
5 FORKLIFT	10 TO	4	1.20	4	1.20	4	1.20	4	1.20	4	1.20
5 FORKLIFT	6 TO	4	1.48	4	1.48	4	1.48	4	1.48	4	1.48
5 FORKLIFT	4 TO	6	2.69	6	2.69	6	2.69	6	2.69	6	2.69
5 FORKLIFT	2 TO	10	3.33	10	3.33	10	3.33	10	3.33	10	3.33
5 PUMPS, 6", ELECT	10 HP	10	1.48	10	1.48	10	1.48	10	1.48	10	1.48
5 PUMPS, 2", ELECT	5 HP	20	5.93	20	5.93	20	5.93	20	5.93	20	5.93
5 PUMPS, 1", ELECT	2 HP	40	11.85	40	11.85	40	11.85	40	11.85	40	11.85
5 AIR COMPRESSOR	600 CF	10	2.22	10	2.22	10	2.22	10	2.22	10	2.22
5 AIR COMPRESSOR	250 CF	20	7.41	20	7.41	20	7.41	20	7.41	20	7.41
5 AIR COMPRESSOR, GAS	100 CF	20	10.37	20	10.37	20	10.37	20	10.37	20	10.37
5 WELDER, GASOLINE	200 HP	80	29.63	80	29.63	80	29.63	80	29.63	80	29.63
5 WELDER, GASOLINE	90 HP	60	31.11	60	31.11	60	31.11	60	31.11	60	31.11
5 GENERATORS	250 KW	10	1.48	10	1.48	10	1.48	10	1.48	10	1.48
5 GENERATORS	100 KW	10	1.48	10	1.48	10	1.48	10	1.48	10	1.48
5 GENERATORS, GAS	10 KW	15	3.33	15	3.33	15	3.33	15	3.33	15	3.33
5 GENERATORS, GAS	5 KW	20	5.93	20	5.93	20	5.93	20	5.93	20	5.93
5 GENERATORS, GAS	.50 KW	20	8.89	20	8.89	20	8.89	20	8.89	20	8.89
5 LIGHT PLANT, GAS	10 KW	50	25.93	50	25.93	50	25.93	50	25.93	50	25.93
5 LOW BOY WITH TRACTOR	400 HP	2	1.39	2	1.39	2	1.39	2	1.39	2	1.39
5 40' FLOAT AND TRACTOR	350 HP	10	29.63	10	29.63	10	29.63	10	29.63	10	29.63
5 MECHANICS TRUCK	250 HP	6	37.82	5	37.04	5	37.04	5	37.04	5	37.04
5 FUEL/LUB TRUCK	250 HP	5	37.04	5	37.04	5	37.04	5	37.04	5	37.04
			MILES		MILES		MILES		MILES		MILES
5 PICKUP, 3/4 TON, GAS	250 HP	26	30,000	25	30,000	25	30,000	25	30,000	25	30,000
5 PICKUP, 1/2 TON, GAS	200 HP	50	30,000	50	30,000	50	30,000	50	30,000	50	30,000
5 FLATBED, 5 TON,GAS	350 HP	10	30,000	10	30,000	10	30,000	10	30,000	10	30,000
5 FLATBED, 3 TON, GAS	300 HP	20	40,000	20	40,000	20	40,000	20	40,000	20	40,000
5 WATER TANKER, 5000 GAL	300 HP	3	40,000	2	40,000	2	40,000	2	40,000	2	40,000
5 SHUTTLE BUS, GAS	250 HP	10	48,000	10	48,000	10	48,000	10	48,000	10	48,000
5 VAN, GAS	200 HP	10	72,000	10	72,000	10	72,000	10	72,000	10	72,000

Table 6-24. Comparison of Alternatives by Construction Equipment Schedule for Retrieval and Transfer: (units/year).

Construction Equipment Type	Continued Storage	In Situ Disposal	Extensive Pretreatment	Minimal Pretreatment	TPA Preferred Alternative
Diesel construction equipment	4[1]	0	12[1]	12[1]	12[1]
Heavy-duty diesel equipment	0	0	0	0	0
Light-duty gasoline vehicles	10[2]	0	40[2]	40[2]	40[2]
Small gasoline engines	12[3]	0	36[3]	36[3]	36[3]

Notes:

[1]Two diesel-powered cranes are assumed in 200E and 200W areas (4 total) for installation of mixer pumps and miscellaneous service for DST retrieval construction. In addition, an equal number of diesel-powered cranes are assumed needed in 200E and 200W for installation of SST retrieval systems. For construction of SST transfer lines, two diesel-powered back hoes are assumed required for trenching in 200E and 200W areas (4 total).

[2]One light-duty gasoline vehicle is assumed required for each 20 construction persons. An average of 200 construction persons are assumed for DST retrieval construction based on an estimated $940 million capital cost (see Table 6-17), 18-year construction period (see Table 6-23), 7350 construction manhours per $1 million total estimated cost (see Appendix B, Backup to Table 6-7), and 1836 manhours per full-time equivalent. An average of 600 construction persons are assumed required for SST and MUST retrieval and transfer construction based on $3,250 - $940 = $2,310 million capital cost (see Appendix B, Backup to Table 6-7), 7350 construction manhours per $1 Million total estimated cost (see Appendix B, Backup to Table 6-7 Construction Personnel Manhours), and 1836 manhours per full-time equivalent.

[3]Small gasoline engines are estimated to be required at a ratio of 3 for each diesel-powered construction equipment unit.

Table XXXX. Comparison of Anticipated Transportation (km) Between Alternatives

Transportation Activity	Alternative			
	TPA		No Pretreatment	
	Onsite	Offsite	Onsite	Offsite
Construction	3.0E+5 km truck 30,400 trips (3.5 yr)	4.5E+6 km truck 27,000 trips (3.5 yr)	2.0E+5 km truck 20,200 trips (3.5 yr)	3.8E+6 km truck 18,000 trips (3.5 yr)
Waste Transport	3.4E+4 km truck 1,060 trips (14 yr)	7.3E+5 km rail 171 trips (14 yr)	3.4E+4 km truck 1,060 trips (14 yr)	9.6E+6 km rail 2,249 trips (44 yr)
Process Chemical/Material Shipments	2.6E+5 km truck 21,000 trips (14 yr)	1.62E+8 km truck 208,428 trips (14 yr) or 3.34E+6 km rail 4,169 trips (14 yr)	-	1.6E+8 km truck 201,103 TRIPS 3.2E+6 km rail 4,022 TRIPS (14 yr)

ENGINEERING DATA REQUEST 31

REQUESTED BY: WILLIAM ELZINGA/ASI

SUBJECT: NOISE

For No Pretreatment Alternative the construction equipment schedule is as follows:

No Pretreatment Alternative
Five-Year Construction Schedule
Construction Equipment List

1.	Utility dozer:	65 hp, 5 units, total usage: 16,000 hours.
2.	Utility loader/backhoe:	65 hp, 6 units, usage: 19,000 hours total.
3.	Backhoe:	65 hp, 4 units, usage: 10,000 hours.
4.	Backhoe:	120 hp, 4 units, 3,000 hours total use.
5.	Loader:	120 hp, 4 units, 10,000 hours total use.
6.	Loader:	200 hp, 2 units, 3,000 hours.
7.	Crane:	15 ton, 10 units, 64,000 hours.
8.	Crane:	25 ton, 10 units, 48,000 hours.
9.	Crane:	50 ton, 5 units, 16,000 hours.
10.	Crane:	100 ton, 2 units, 6,000 hours.
11.	Forklift:	2 ton, 10 units, 36,000 hours.
12.	Forklift:	4 ton, 6 units, 29,000 hours.
13.	Forklift:	6 ton, 4 units, 16,000 hours.
14.	Forklift:	10 ton, 4 units, 13,000 hours.
15.	Forklift:	15 ton, 4 units, 10,000 hours.
16.	Motor grader:	125 hp, 4 units, 22,000 hours.
17.	Pumps:	1", 2 hp, gas, 40 units, 128,000 hours.
18.	Pumps:	2", 5 hp, gas, 20 units, 64,000 hours.
19.	Pumps:	6", 10 hp, gas, 10 units, 16,000 hours.
20.	Air comp:	100 cfm, 50 hp, gas, 20 units, 112,000 hours.
21.	Air comp:	250 cfm, 90 hp, diesel, 20 units, 80,000 hours.
22.	Air comp:	600 cfm, diesel, 10 units.
23.	Welder:	90 hp, 60 units, 336,000 hours, gas power.
24.	Welder:	200 hp, gas, 80 units, 320,000 hours.
25.	Generators:	0.5 kW, gas, 20 units, 96,000 hours
		5 kW, 10 hp, gas, 20 units, 64,000 hours
		10 kW, 20 hp, Gas, 15 units, 36,000 hours
		100 kW, 75 hp, diesel, 10 units, 16,000 hours
		250 kW, 150 hp, diesel, 10 units, 16,000 hours.

26.	Light plant:	10 kW, 20 hp, gas, 50 units, 280,000 hours.
27.	Compactors:	5 hp, gas, 60 units, 192,000 hours
		40 hp, gas, 20 units, 64,000 hours.
28.	Trucks:	1/2 ton P.U., 50 units
		3/4 ton P.U., 25 units
		3 ton flat bed, 20 units
		5 ton flat bed, 10 units
		40 foot float and tractor, 10 units
		Low boy with tractor, 2 units
		Shuttle bus, 10 units
		Van, 10 units
		Fuel truck, 5 units
		Mechanics truck, 5 units
		Water truck, 2 units.

For TPA Alternative, the equipment list during construction is the same but usage is a little more.

Five-Year Duration of Construction

1.	Utility dozer:	65 hp, 5 units, 16,000 hours.
2.	Utility loader/backhoe:	65 hp, 6 units, 19,000 hours.
3.	Backhoe:	1cy, 65 hp, 4 units, 10,000 hours.
4.	Backhoe:	2 cy, 120 hp, 2 units, 1,000 hours.
5.	Loader:	2 cy, 120 hp, 4 units, 10,000 hours.
6.	Loader:	4 cy, 200 hp, 2 units, 3,000 hours.
7.	Crane:	15 ton, 150 hp, 10 units, 64,000 hours.
8.	Crane:	25 ton, 185 hp, 10 units, 48,000 hours.
9.	Crane:	50 ton, 200 hp, 5 units, 16,000 hours.
10.	Crane:	100 ton, 300 hp, 2 units, 6,000 hours.
11.	Forklift:	2 ton, 60 hp, 10 units, 56,000 hours.
12.	Forklift:	4 ton, 70 hp, 6 units, 29,000 hours.
13.	Forklift:	6 ton, 100 hp, 4 units, 16,000 hours.
14.	Forklift:	10 ton, 130 hp, 4 units, 18,000 hours.
15.	Forklift:	15 ton, 150 hp, 4 units, 10,000 hours.
16.	Motor grader:	125 hp, 4 units, 22,000 hours.
17.	Pumps:	1", 2 hp, 40 units, 128,000 hours.
18.	Pumps:	2", 5 hp, 20 units, 64,000 hours.
19.	Pumps:	6", 10 hp, 10 units, 16,000 hours.
20.	Air comp:	100 cfm, 50 hp, 20 units, 112,000 hours.
21.	Air comp:	250 cfm, 90 hp, 20 units, 80,000 hours.
22.	Air comp:	600 cfm, 180 hp, 10 units, 24,000 hours.
23.	Welders:	200 amp, 100 hp, 60 units, 336,000 hours.

24.	Welders:	400 amp, 200 hp, 20 units, 320,000 hours.
25.	Generators:	0.5kW, 5 hp, 20 units, 96,000 hours.
26.	Generators:	5kW, 10 hp, 20 units, 64,000 hours.
27.	Generators:	10kW, 20 hp, 15 units, 36,000 hours.
28.	Generators:	100 kW, 75 hp, 10 units, 16,000 hours.
29.	Generators:	250 kW, 150 hp, 10 units, 16,000 hours.
30.	Light plants:	10 kW, 20 hp, 50 units, 280,000 hours.
31.	Compactors:	walk, 5 hp, 60 units, 192,000 hours.
32.	Compactors:	ride, 40 hp, 20 units, 64,000 hours.
33.	1/2 ton pick up:	200 hp, 50 units, 1,600,000 mi.
34.	3/4 ton pick up:	250 hp, 25 units, 800,000 mi.
35.	3 ton flat bed:	300 hp, 20 units, 800,000 mi.
36.	5 ton flat bed:	350 hp, 10 units, 320,000 mi.
37.	40 float and tractor:	350 hp, 10 units, 320,000 mi.
38.	Low boy with tractor:	400 hp, 2 units, 15,000 mi.
39.	Shuttle bus:	250 hp, 10 units, 480,000 mi.
40.	Van:	200 hp, 10 units, 720,000 mi.
41.	Fuel/service truck:	250 hp, 5 units, 400,000 mi.
42.	Mechanic's truck:	250 hp, 5 units, 400,000 mi.
43.	Water trucks:	300 hp, 2 unit, 80,000 mi.

This does not account for construction equipment required for waste retrieval and transfer. The same type of equipment should be used. The number of units/year for construction equipment for retrieval and transfer is shown on table 6-24 attached.

Noise emissions for all operations within the processing facilities will be very minimal just outside the facilities due to the amount of radiation slielding required.

Table XXXX. Comparison of Anticipated Transportation (km) Between Alternatives

Transportation Activity	Alternative			
	TPA		No Pretreatment	
	Onsite	Offsite	Onsite	Offsite
Construction	3.0E+5 km truck 30,400 trips (3.5 yr)	4.5E+6 km truck 27,000 trips (3.5 yr)	2.0E+5 km truck 20,200 trips (3.5 yr)	3.8E+6 km truck 18,000 trips (3.5 yr)
Waste Transport	3.4E+4 km truck 1,060 trips (14 yr)	7.3E+5 km rail 171 trips (14 yr)	3.4E+4 km truck 1,060 trips (14 yr)	9.6E+6 km rail 2,249 trips (44 yr)
Process Chemical/Material Shipments	2.6E+5 km truck 21,000 trips (14 yr)	1.62E+8 km truck 208,428 trips (14 yr) or 3.34E+6 km rail 4,169 trips (14 yr)	-	1.6E+8 km truck 201,103 TRIPS 3.2E+6 km rail 4,022 TRIPS (14 yr)

TRANSMIT CONFIRMATION REPORT

NO.	:	004
RECEIVER	:	314 567 5030
TRANSMITTER	:	JACOBS ENG GRP HANFORD
DATE	:	JAN 31'95 12:53
DURATION	:	02'55
MODE	:	STD
PAGES	:	07
RESULT	:	OK

Jacobs Engineering Group Inc.

3250 West Clearwater
Kennewick, Washington 99336

Telehone: (509) 736-0616
Fax: (509) 736-6801

FAX TRANSMISSION COVER SHEET

Date: 01/31/95

To: W. Elzinga

Fax: 314 567 5030

Subject: Engineering Information Request 031

Sender: Colin Henderson

YOU SHOULD RECEIVE 7 PAGE(S), INCLUDING THIS COVER SHEET. IF YOU DO NOT RECEIVE ALL THE PAGES, PLEASE CALL .

MEMORANDUM

TO: William Elzinga

FROM: Dave Murray

SUBJECT: ENGINEERING INFORMATION REQUEST

February 15,1995
95-DM-005

In response to your inquiry we are enclosing the completed Engineering Information Request Number 031. Should you have any questions, please contact me at (509) 736-0616.

cc: Project File

Attachments: Engineering Information Request Number 031

DM:CCM:ns

Request Number 032

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Joan Young

Date: 1/23/95

Phone Number: 946-7112

Fax Number:

Request Information: Post remediation source inventory - see attached memo

Need Date: 2/17/94

Same as #29

Response:

Deleted

Data Source/Accuracy:

Prepared By:

Date Sent/Faxed:

Concurrence:
Marc Nelson - Deputy Project Manager

engin\eninfrq.032

Request Number 033

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Phil Rogers/ESE

Date: 01/31/95

Voice: (303) 790-0770

Phone Number: (303) 790-0770

Fax Number: (303) 790-4411

Request Information: Volume of materials shown on the attached table and area of land corresponding to disturbances at the tank farms LLW burial site and treatment facilities.

Need Date: 02/15/95

Response: See attached memo - Goodwin to Murray dated 02/23/95.

Data Source/Accuracy:

Prepared By: J. Goodwin

Date Sent/Faxed: 02/27/95

Concurrence: Marc Nelson - Deputy Project Manager

engin\eninfrq.033

MEMORANDUM

TO: Dave Murray

FROM: Jim Goodwin

February 23, 1995
95-JG-001

SUBJECT: DATA REQUEST NO. 033; DISTURBED AREAS AND FILL VOLUMES FOR HANFORD CAPS.

The request is phrased in terms of blanks to be filled in on two data sheets, 5-XX and 5-2X.

Table 5-XX

The need for in situ data is noted and will be supplied to ESE when available from WHC.

The cap for the TPA LLW permanent disposal is an engineered soil structure that has 9 layers. These layers are listed below in order from the top to the bottom layer. The information was provided by Patricia Scanlon at 373-6869.

Layer	Cubic Meters
Upper Silt	75,000
Lower Silt (15% gravel)	73,000
Sand Filter	12,000
Gravel Filter	23,000
Basalt (Rip-Rap)	163,000
Drain Gravel	27,000
Asphalt	13,000
Base Course	9,000
Fill	110,000
Total	505,000

We assume that the asphalt layer will be mixed onsite in a mobile batch plant. To make the asphalt layer, bituminous material will be brought to the Site, but 13,000 cubic meters of local sand will be consumed.

We also assume that all of the permanent disposal sites on the Hanford Site will be capped by a Hanford Cap.

JG\95MEMO.001\12.3

Table 5-2X

Jacobs has noted the need for data on the No Action, In Situ, and Extensive Pretreatment alternatives. This will be supplied to ESE when available from WHC.

While not part of the current scope, the tank farms will eventually be remediated and can be considered a temporary disturbance. The total tank farm area data is the same for the No Pretreatment and TPA alternatives (as well as the Extensive Pretreatment alternative). As determined by Patricia Scanlon, the total combined tank farm area is 43.08 acres or 174,000 square meters.

The treatment facility areas come in two categories. The overall processing site can be considered to be temporarily disturbed, but the waste treatment buildings will be considered a long term disturbance. D&D for these buildings is a part of the TWRS scope, but the method has not been specified yet by WHC. We are assuming at this point that only the buildings will be decontaminated, entombed, and covered by a Hanford Cap.

Jacobs has scaled the following areas from the drawings in the Rev. A, Draft issues of the TPA and the No Pretreatment reports.

	TPA	No Pretreatment
Overall Site (Temporary)	159 acres	189 acres
Treatment Facilities (Permanent)		
LLW	2 acres	NA
HLW	3 acres	2 acres
WSF	2 acres	1 acre
LLW disposal (Permanent)	27 acres	NA

cc: Project File

JG:cm

TABLE 5-XX

GEOLOGIC MATERIAL REQUIRED FOR ALL
ALTERNATIVES FROM AVAILABLE ONSITE SOURCES

NO ACTION	*IN SITU*	NO PRE-TREATMENT	TPA (Preferred)	EXTENSIVE PRE-TREATMENT
No geologic resources required	• Gravel fill option ____ cubic meters gravel for tank fill ____ cubic meters gravel for cap ____ cubic meters sand for cap ____ cubic meters riprap for cap	NA[3]	• Tanks NA[3]	NA[3]
	• Grout option[1] ____ cubic meters gravel for cap. ____ cubic meters sand for cap ____ cubic meters riprap for cap		• LLW Disposal ____ cubic meters gravel for cap ____ cubic meters sand for cap ____ cubic meters riprap for cap	
	• Vitrification option[2] ____ cubic meters gravel for cap ____ cubic meters sand for cap ____ cubic meters riprap for cap			

[1] Assume geologic resources needed for grout mix are imported from offsite.
[2] Assume geologic resources needed for frit makeup are imported from offsite.
[3] Final disposition of the tanks under these options has not been determined and is a closure issue, not part of this evaluation.

TABLE 5-2X

ESTIMATED AREAS OF TEMPORARY AND ~~LONG-TERM~~ PERMANENT SOIL DISRUPTION FOR ALL ALTERNATIVES

NO ACTION	*IN SITU*	NO PRE-TREATMENT	TPA (Preferred)	EXTENSIVE PRE-TREATMENT
____ acres[1] (temporary)	• Gravel fill option ____ acres for cap (~~long-term~~) permanent	• Tanks ____ acres (temporary) • Treatment Facilities — acres (permanent	• Tanks ____ acres (temporary)	• Tanks ____ acres (temporary) • Treatment Facilities — acres (permanent)
	• Grout option ____ acres (temporary)		• LLW Disposal ____ acres for cap (~~long-term~~) permanent • Treatment Facilities — acres (permanent	
	• Vitrification option ____ acres (temporary)			

[1] Assume each of the current single-shell tanks will be replaced with double-shell tanks. The disturbed areas are for both the existing single-shell tanks and the replacement double-shell tanks.

Request Number 034

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Phil Rogers Date: 2/2/95

Phone Number: (303)790-0770 Fax Number: (303) 795-4411

Request Information: ~~[illegible]~~ diameters of each of the 177 tanks. Please group the tanks by source area (1-8) and provide tank ID.

Need Date: 2/8/95

Response: SEE ATTACHED

Data Source/Accuracy: DATA FROM WHC-SD-WM-TI-648 & WHC-ED-0182-69

Prepared By: ~~Phil Rogers~~ COLIN HENDERSON Date Sent/Faxed: ~~2/2/95~~

Concurrence: Marc R. Nelson
Marc Nelson - Deputy Project Manager

ENGINEERING DATA REQUEST 34

REQUESTED BY: PHIL ROGERS

SUBJECT: TANK DIAMETERS

The following table provides the tank inner diameter listed by tank group.
Attached are sketches of the different tank types.

TANK GROUP	CAPACITY (KGAL)	NUMBER OF TANKS	INSIDE DIAMETER
1WSS	530	12	75
	758	24	75
	55	4	20
2WSS	530	12	75
	55	4	20
	758	12	75
	1,000	15	75
1ESS	758	12	75
	55	4	20
	530	24	75
2ESS	530	12	75
	55	4	20
4ESS	1,000	10	75
3WDS	1,160	3	75
3EDS	1,160	7	75
	1,000	4	75
5EDS	1,160	14	75

Figure 4-2. Typical Single-Shell Tank (100 Series) Configuration (241-B,-BX, -C, -T, and -U).

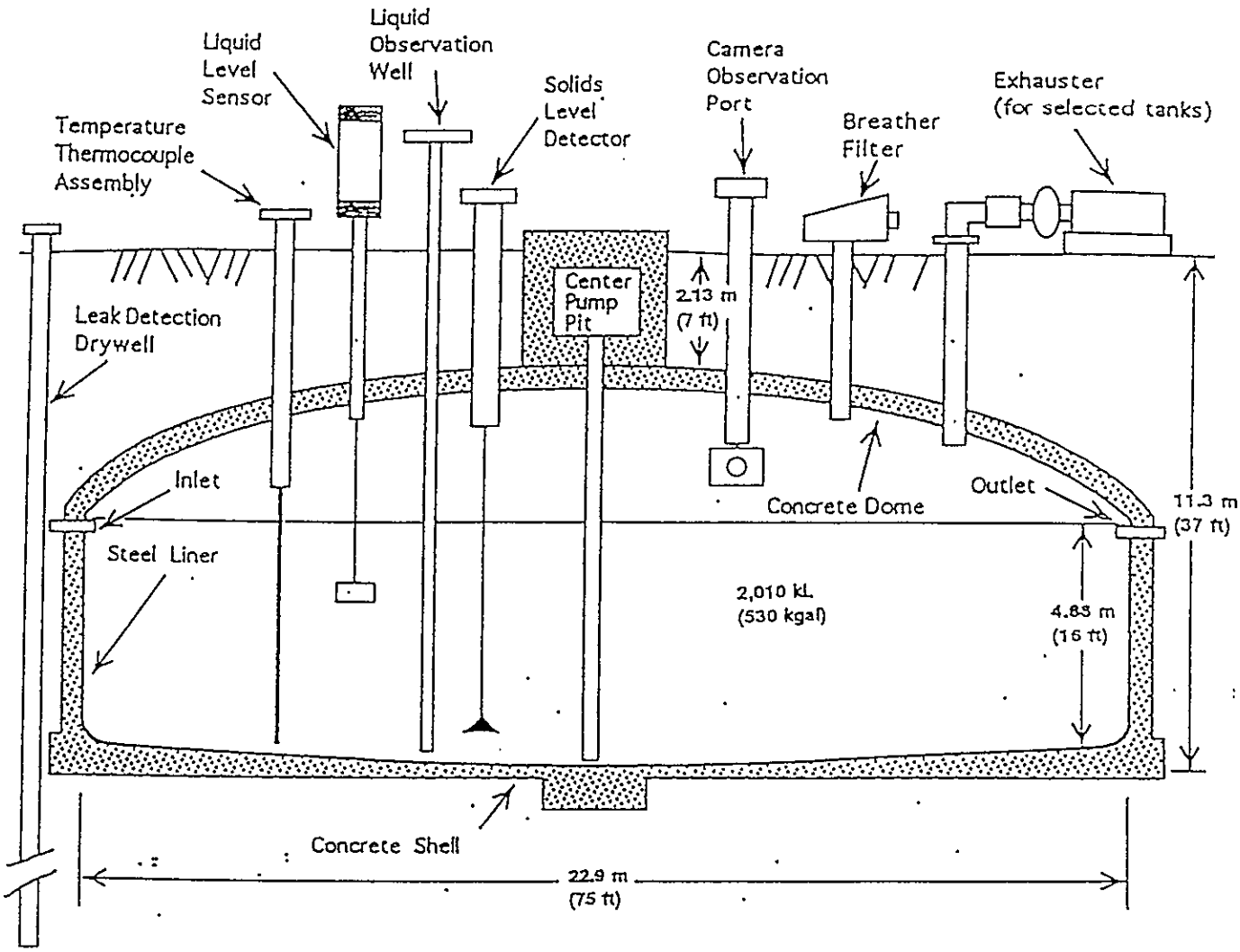


Figure 4-3. Typical Single-Shell Tank (200 Series) Configuration (241-B, -C, -T, -U).

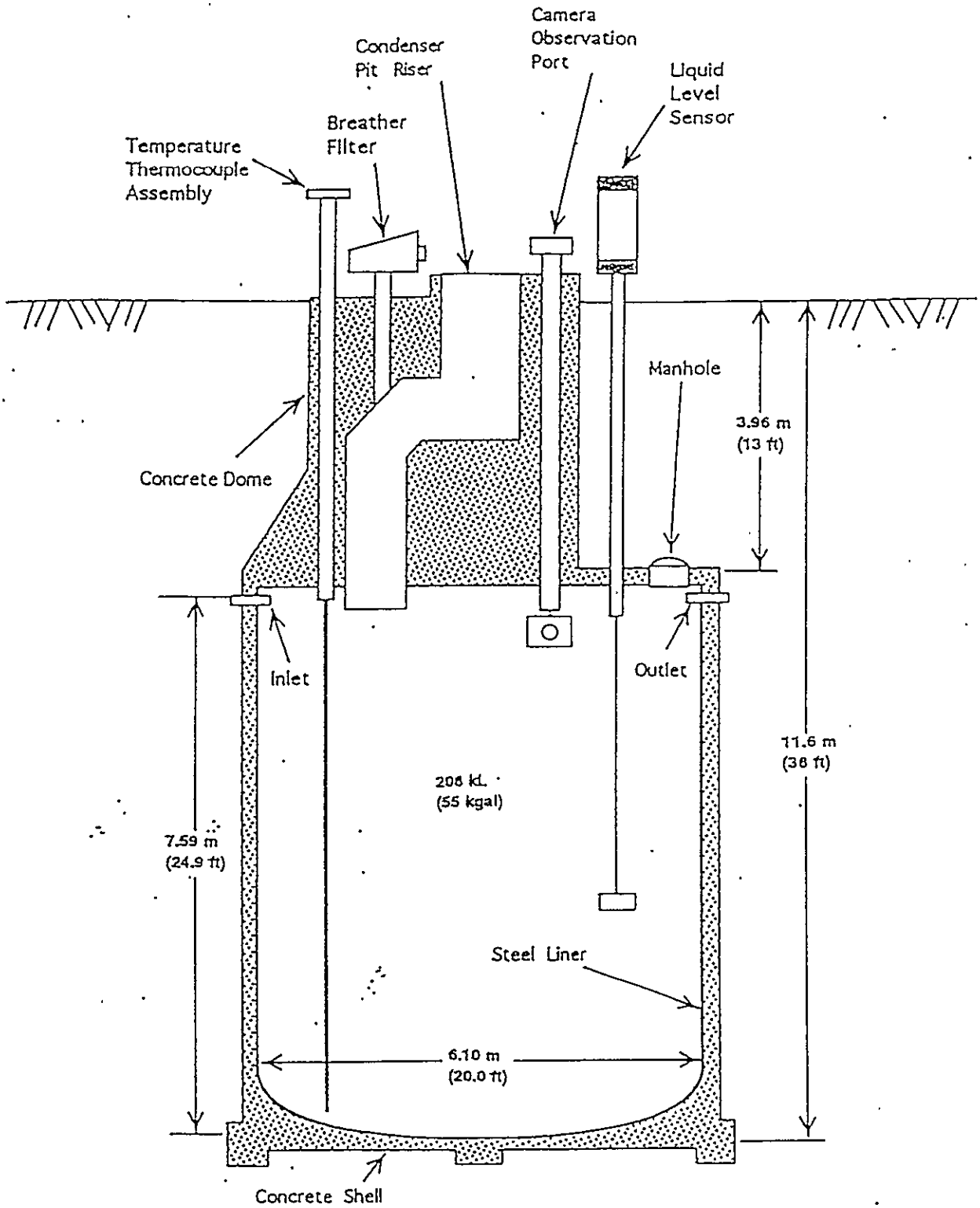


Figure 4-4. Typical Single-Shell Tank Configuration (241-BY, -S, -TX, and -TY).

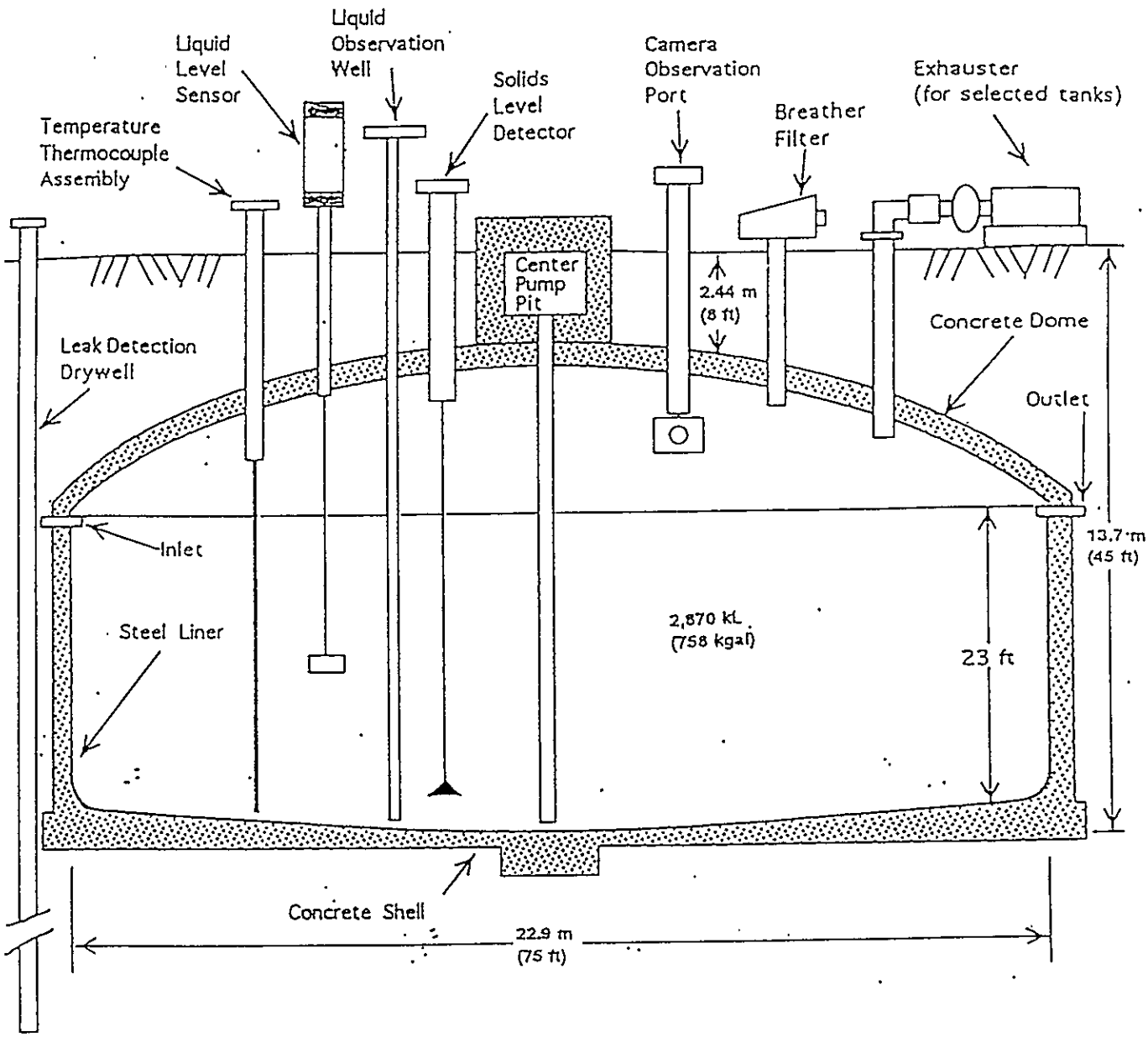


Figure 4-5. Typical Single-Shell Tank Configuration (241-A, -AX, -SX).

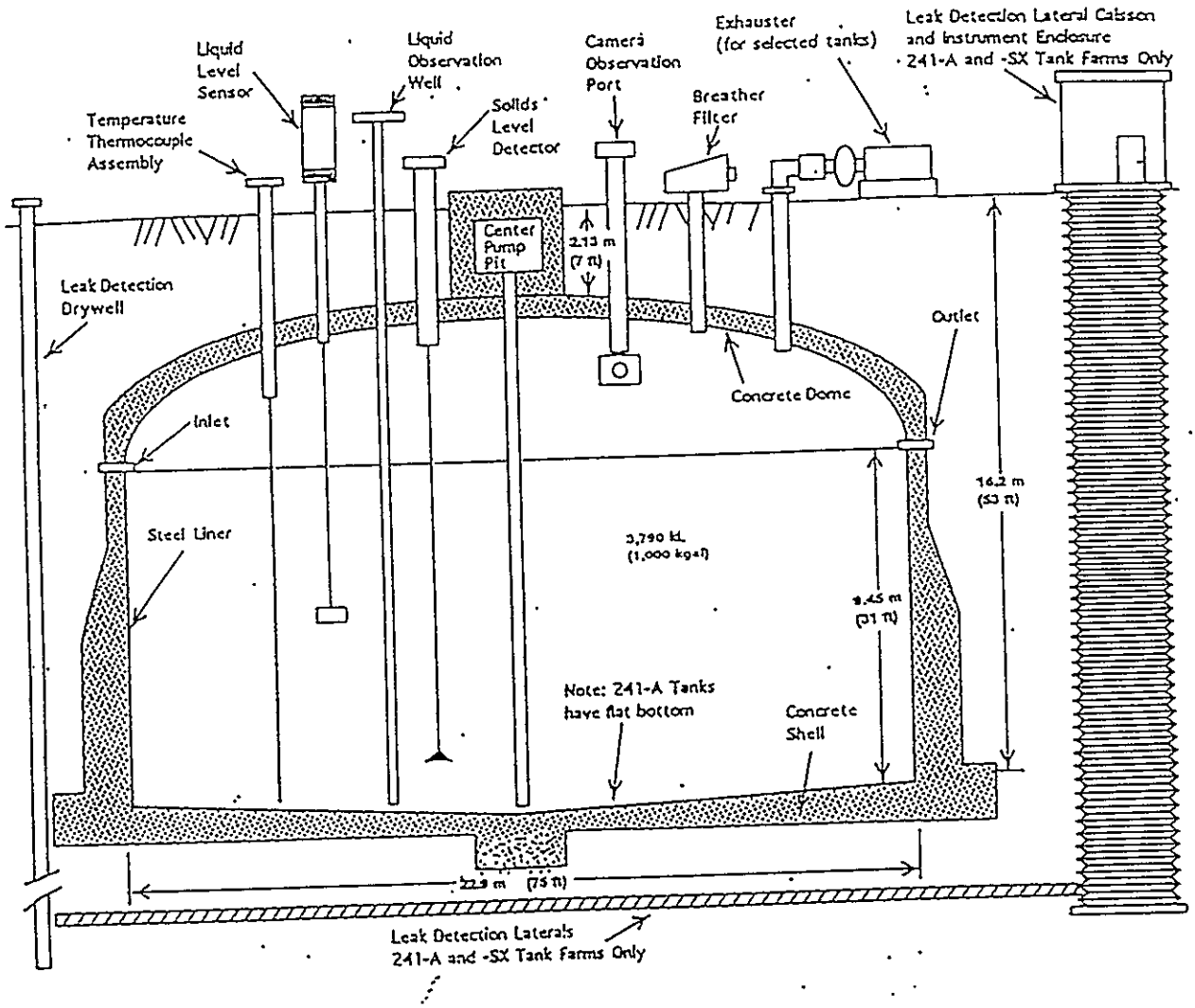
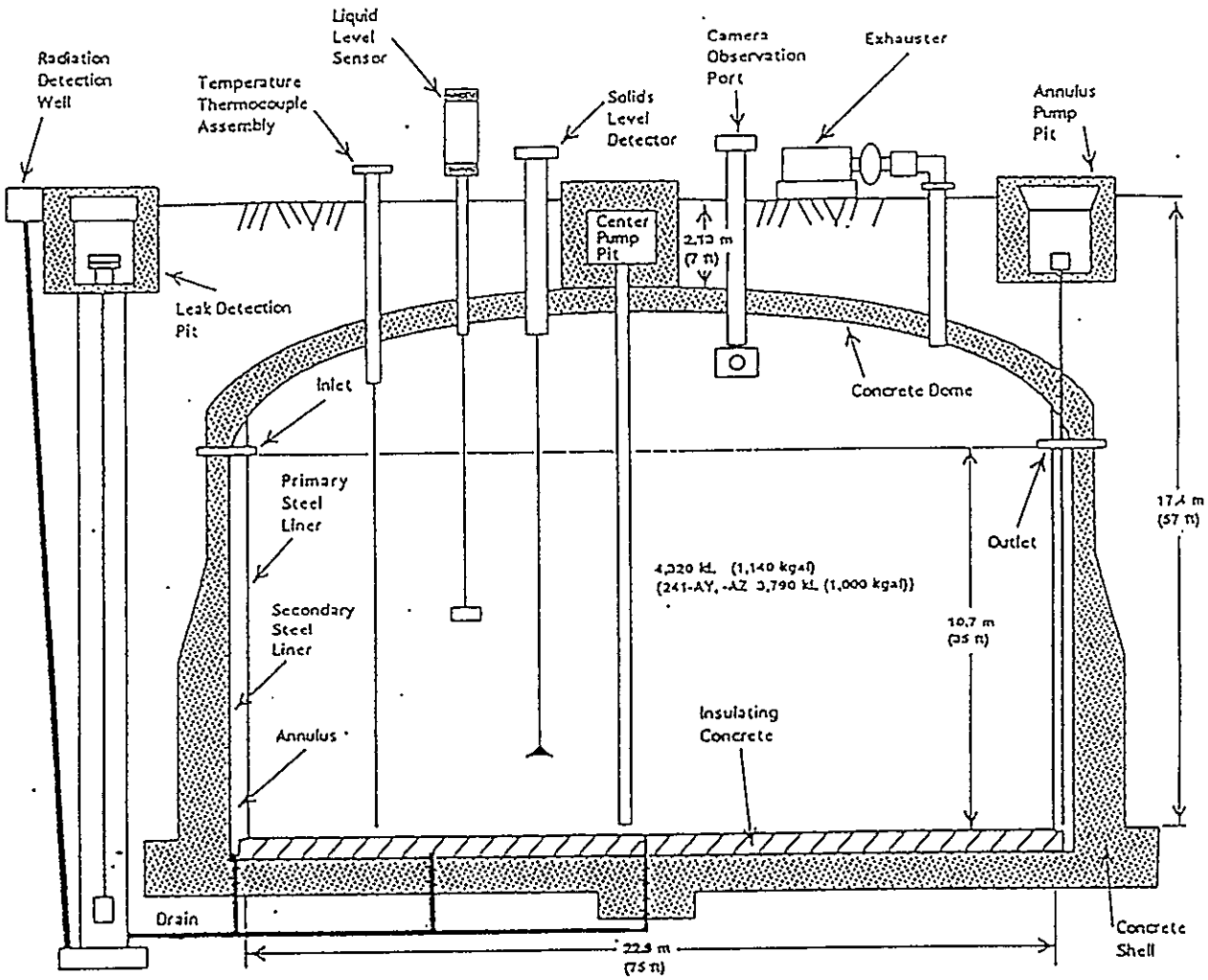


Figure 4-6. Typical Double-Shell Tank Configuration.



Request Number 035

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Arrie Bachrach Date: 2/7/95

Phone Number: N/A Fax Number: N/A

Request Information: Dimensions of facilities associated with TPA and Minimum Pretreatment Alternatives. Need horizontal dimensions (approx.), approximate height, (and number and height of stacks) for each facility. Also brief description (same kind of data) for transfer/sampling annexes in 200W (assume they are small but need data). This data needed for visual resources impacts.

Need Date: 2/14/95

Response: See attached.

Data Source/Accuracy: Source preliminary data packages and verbal info. from WHC (stack number and heights).

Prepared By: Colin Henderson Date Sent/Faxed: 02/17/95

Concurrence: Marc E. Nelson
Marc Nelson - Deputy Project Manager

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TPA
Facilities:

HLW Vitrification Plant - 511' x 175' x 100' (above grade)
(53 m x 156 m x 30.48 m above grade)
Two stacks each one 180' high (54.8 m).

LLW Pretreatment Vitrification Plant - 323' x 248' x 63' height (above grade)
(98.5 m x 75.6 m x 19.2 m above grade)
Two stacks each 180' high (54.8 m).

Waste staging/Sampling facility (should be below grade).

Bulk handling and cold chemical make up building - 8361 m^2 (89964 sq ft) floor space, single story, chemical storage and make up.

Substation - 119m x 149m (390 ft x 489 ft) will bring in the overhead high voltage lines.

Mechanical utilities building - 1 story, 8281 m^2 (89103 sq ft), houses utilities such as air, chilled water, steam.

Operations control building - Central control rooms, 2090 m^2 (22488 sq ft) floor space.

Regulated entrance building - 6503 m^2 (69972 sq ft) space, single point of entry for maintenance and operations personnel.

Operation support building (Administrative building) - 5574 m^2 (59976 sq ft) floor space, 40% office, 60% misc.

Fabrication shop - 1 story, 46 m x 91 m (4186 m^2 floor space), (151 ft x 298 ft, 45000 sq ft).

Mockup shop - 1 story, 46 m x 91 m (4186 m^2 floor space), (151 ft x 298 ft, 45000 sq ft).

Shipping/Receiving building - No size given.

Three-warehouses - 1 story at 41 m x 91 m (3731 m^2) for each warehouse, (134 ft x 298 ft, 39932 sq ft).

Two-case storage pads - 145 m x 213 m each (476 ft x 699 ft).

46 LLW vaults - Will be built below grade.

Fire water - Pump houses and tanks - small.

Cooling tower - 61 m x 61 m (200 ft x 200 ft).

Switch gear/Generator building - 1 story, 8281 m^2 floor space (89100 sq ft).

WASTE RETRIEVAL AND TRANSFER

Facilities:

Waste retrieval annex - 30.8 m x 24 m x 10 m above grade
(101' x 79' x 33' above grade)
(4 annexes total, 2 in 200E, 2 in 200W supports tank sluicing).

The retrieval annexes will be located close to the tanks farms and will support sluicing operations.

Waste staging and sampling facility - 72 m x 35.7 m x 12.2 m above grade (1 in 200W)
(237' x 117' x 40' above grade)

The waste storage and sampling facility will collet wastes form the sluicing operations and will transfer wastes in batches to the cross site transfer line for transfer to the vitrification facility.

MINIMUM PRETREATMENT

Vitrification building - 92 m x 67.7 m x 17.07 m (max. above grade height on Vit Building).
(302 ft x 222 ft x 56 ft).
Two stacks - 180 feet high (54.8 m).

Analytical facility and manipulator building (adjacent to Vit Building).
102 m x 66 m x 26.2 m (height above ground).
(335 ft x 216 ft x 86 ft above ground height).

Canister storage regulated entrance (adjacent to Vitrification Building).
23.6 m x 23.6 m x 6.1 m (height above ground), (77 ft x 77 ft x 20 ft above ground).

Canister and cask handling facility - 78.03 m x 61 m x 28.04 m (max. height above ground).
(256 ft x 200 ft x 92 ft heigh above ground).

There is no text description of the support facilities function and size in the minimal pretreatment data package. Based on the site plan and best estimate the following facilities are approximately the same for the minimal pretreatment alternative as outlined for the TPA Alternative.

1. Substation/Switchgear.
2. Operations Support Building.
3. Regulated Entrance Building.
4. Operations Control Building.
5. Mechanical Utilities Building.
6. Bulk Handling and Cold Chemical Make Up Building.
7. Fire Water tanks and Pumphouses.
8. Warehouses.
9. Shipping Receiving Building.
10. Mock Up Shop.
11. Fab Shop.
12. Waste Staging Sampling Facility (should be underground tanks): will be about 1/2 the size of the TPA Waste Staging Sampling Facility.

The difference will be the Cask Storage Pads, which for the Minimum Pretreatment are the following sizes:

2 at 475ft x 1,800ft (144.8 m x 548.6 m).
1 at 475ft x 1,000ft (144.8 m x 304.8 m).

Figure 2-4. High-Level Waste Vitrification Facility Rendering.

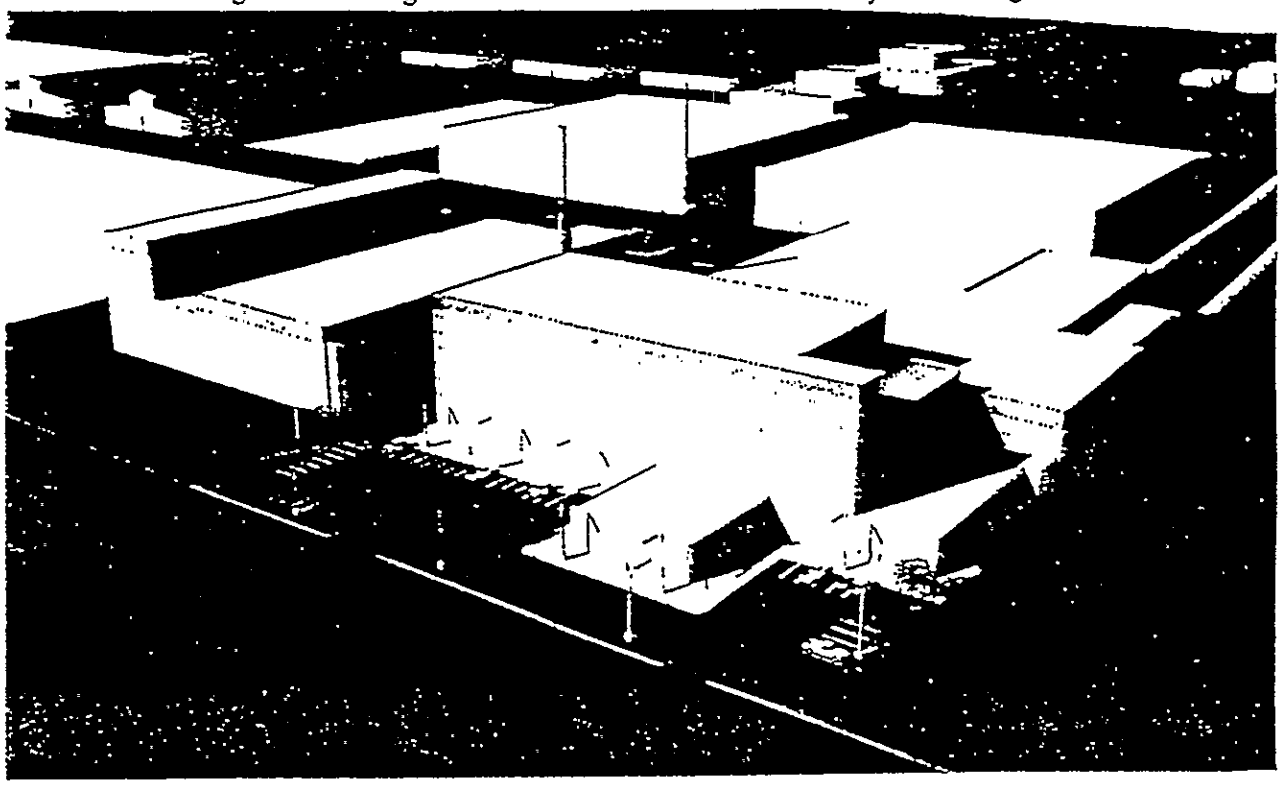


Figure 6-2. Artists Rendering of Pretreatment/Low-Level Waste Facility.

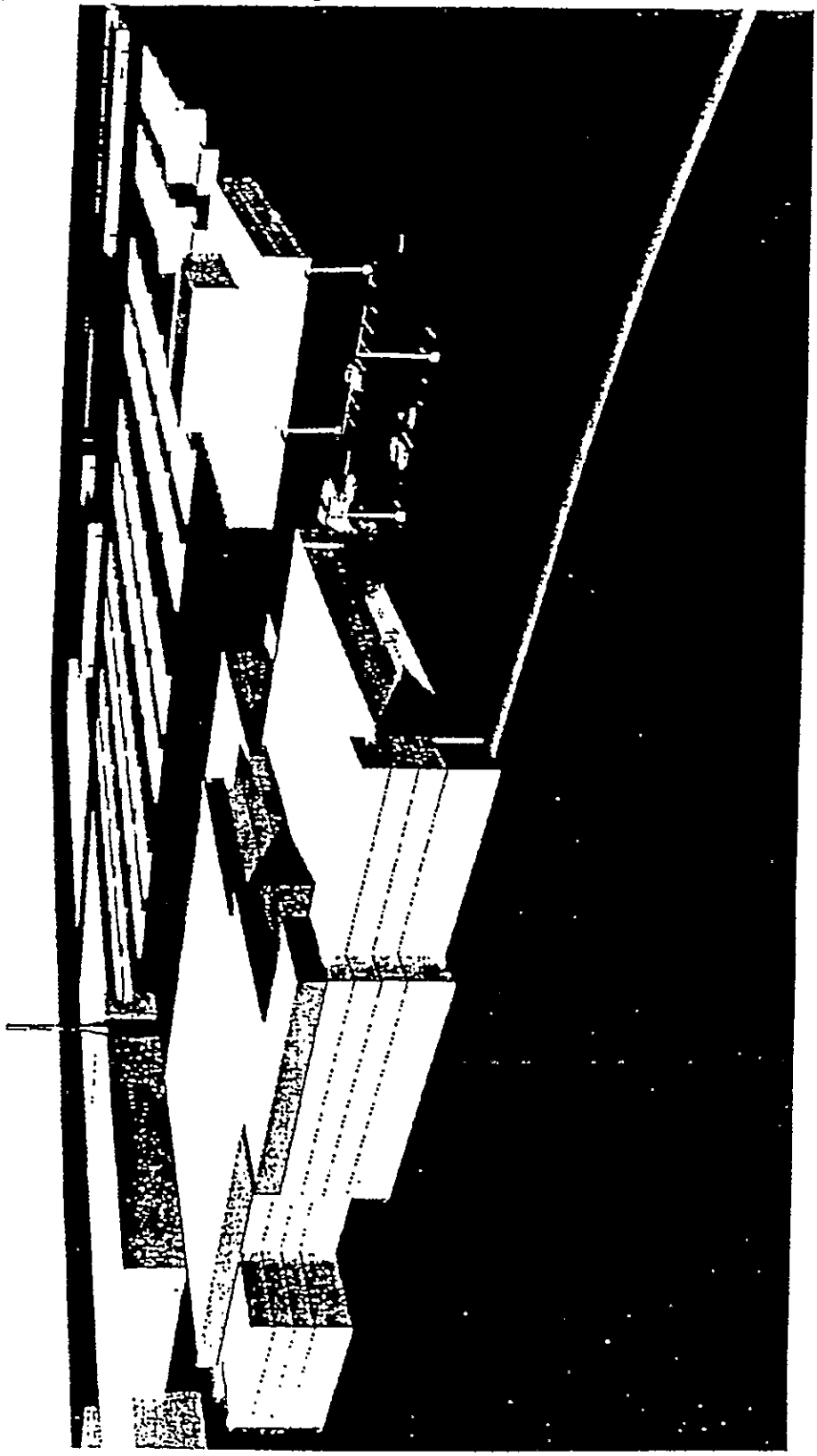


Figure 6-4. Artists Rendering of High-Level Waste Facility. (2 sheets)

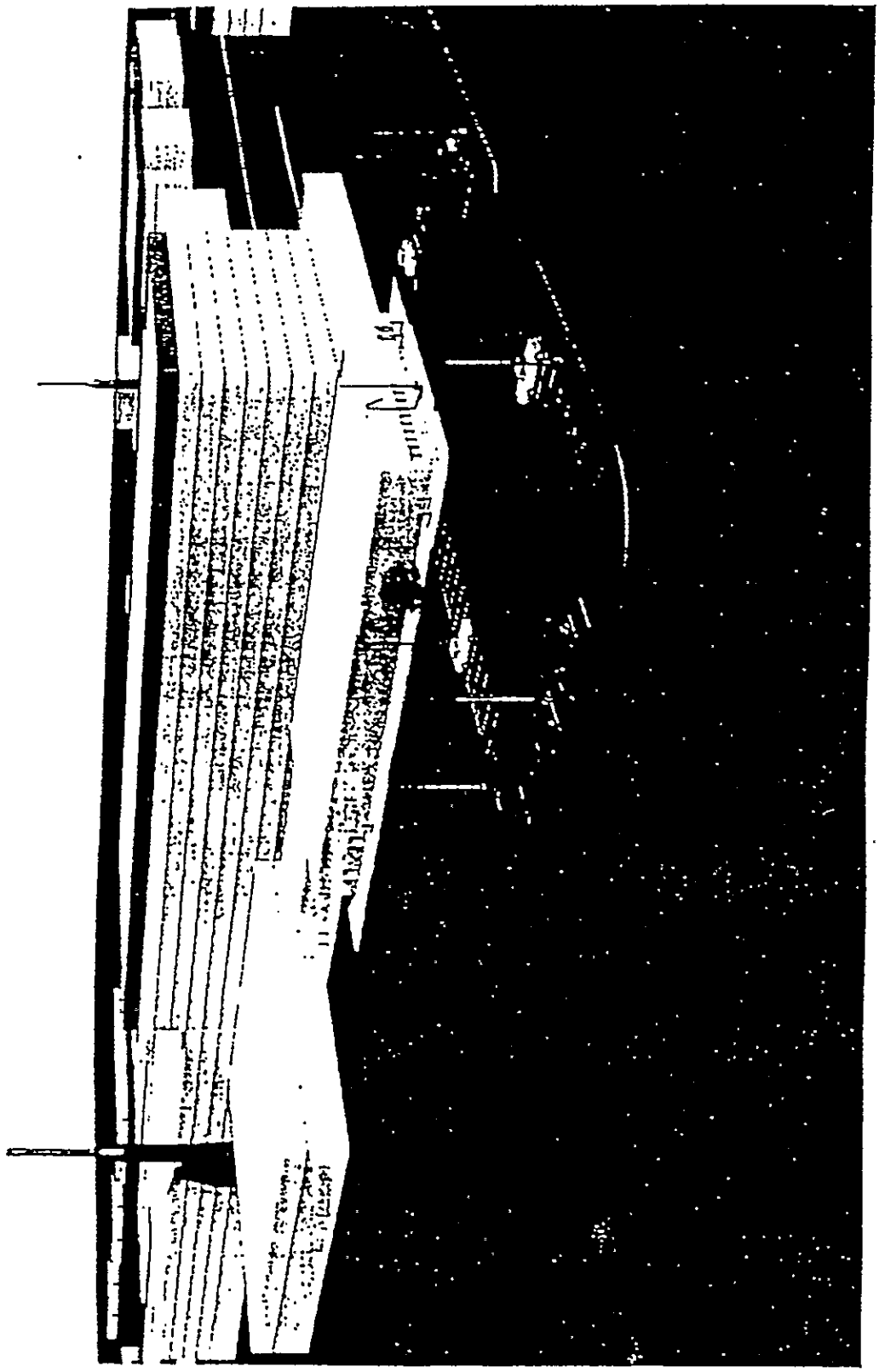


Figure 6-4. Artists Rendering of High-Level Waste Facility. (2 sheets)

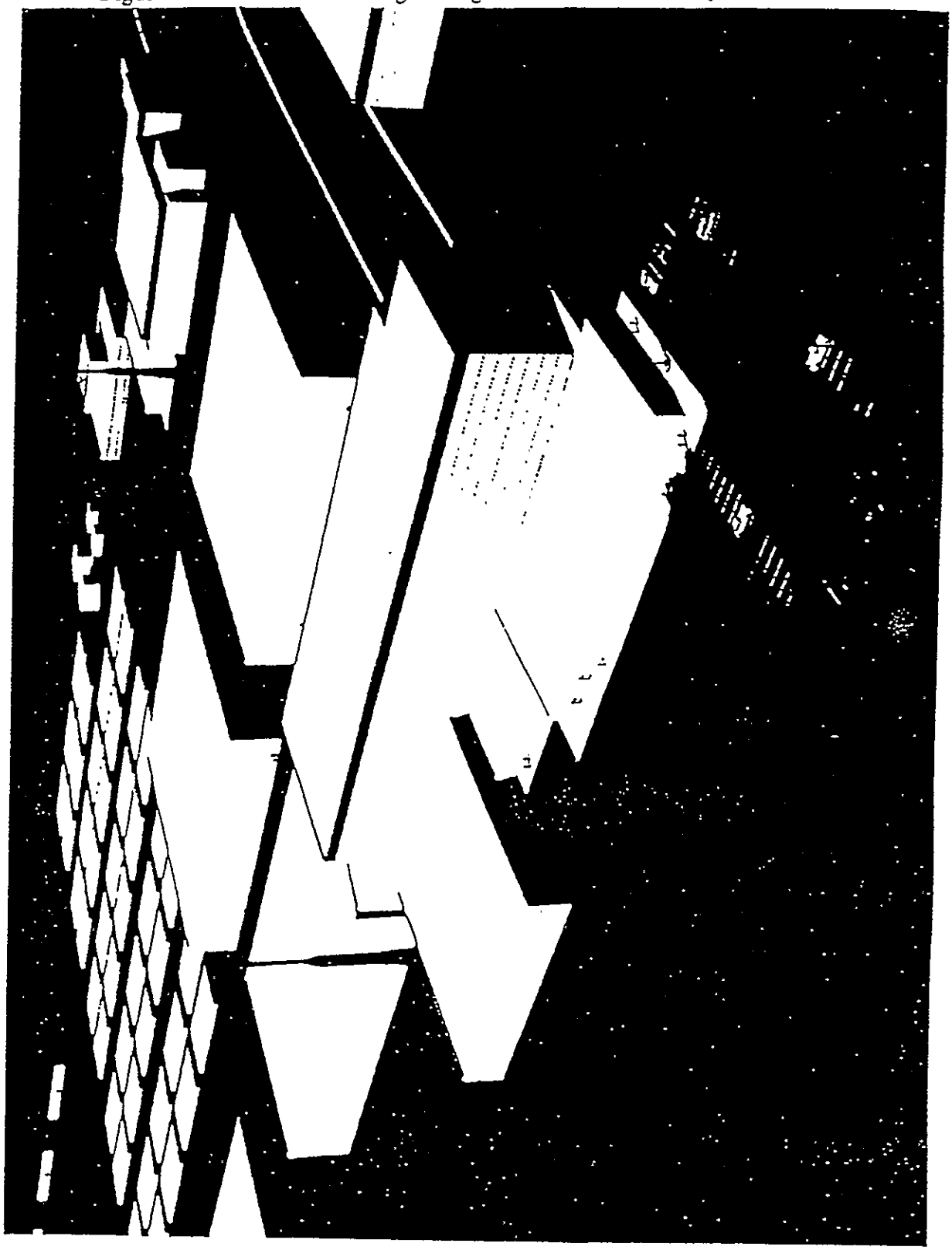
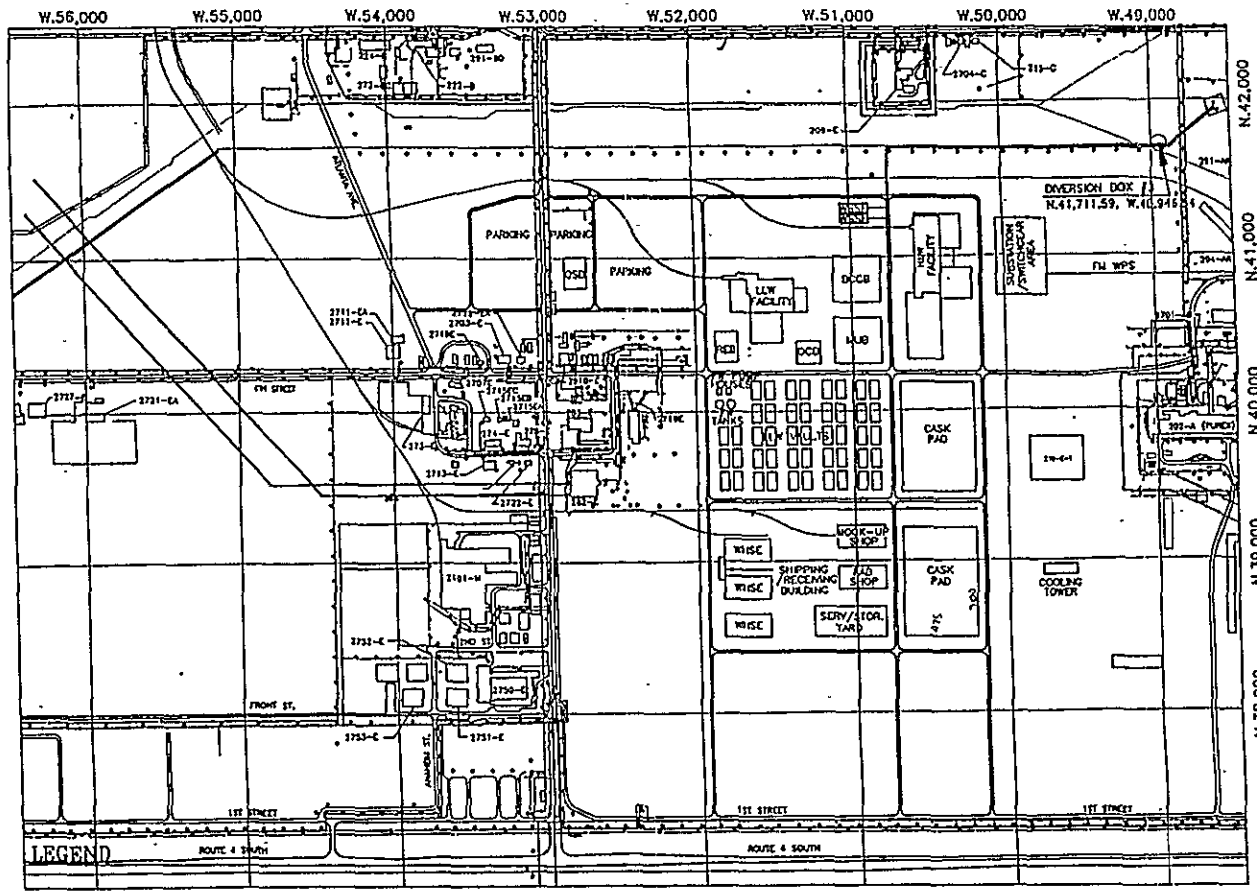


Figure 5-1. Site Plan.



200 EAST AREA

LEGEND

BCCD	BULK HANDLING & COLD CHEMICAL
	WAKE-UP BUILDING
FAB	FABRICATION
FW	FIREWATER
HLW	HIGH LEVEL WASTE VITRIFICATION
LLW	LOW LEVEL WASTE VITRIFICATION
MUB	MECHANICAL UTILITIES BUILDING
OCB	OPERATIONS CONTROL BUILDING
OSD	OPERATIONS SUPPORT BUILDING
RCB	REGULATED ENTRANCE BUILDING
WSSF	WASTE STAGING AND
	SAMPLING FACILITY
SERV/STOR	SERVICE/STORAGE
WISE	WAREHOUSE

CASE 8A EIS

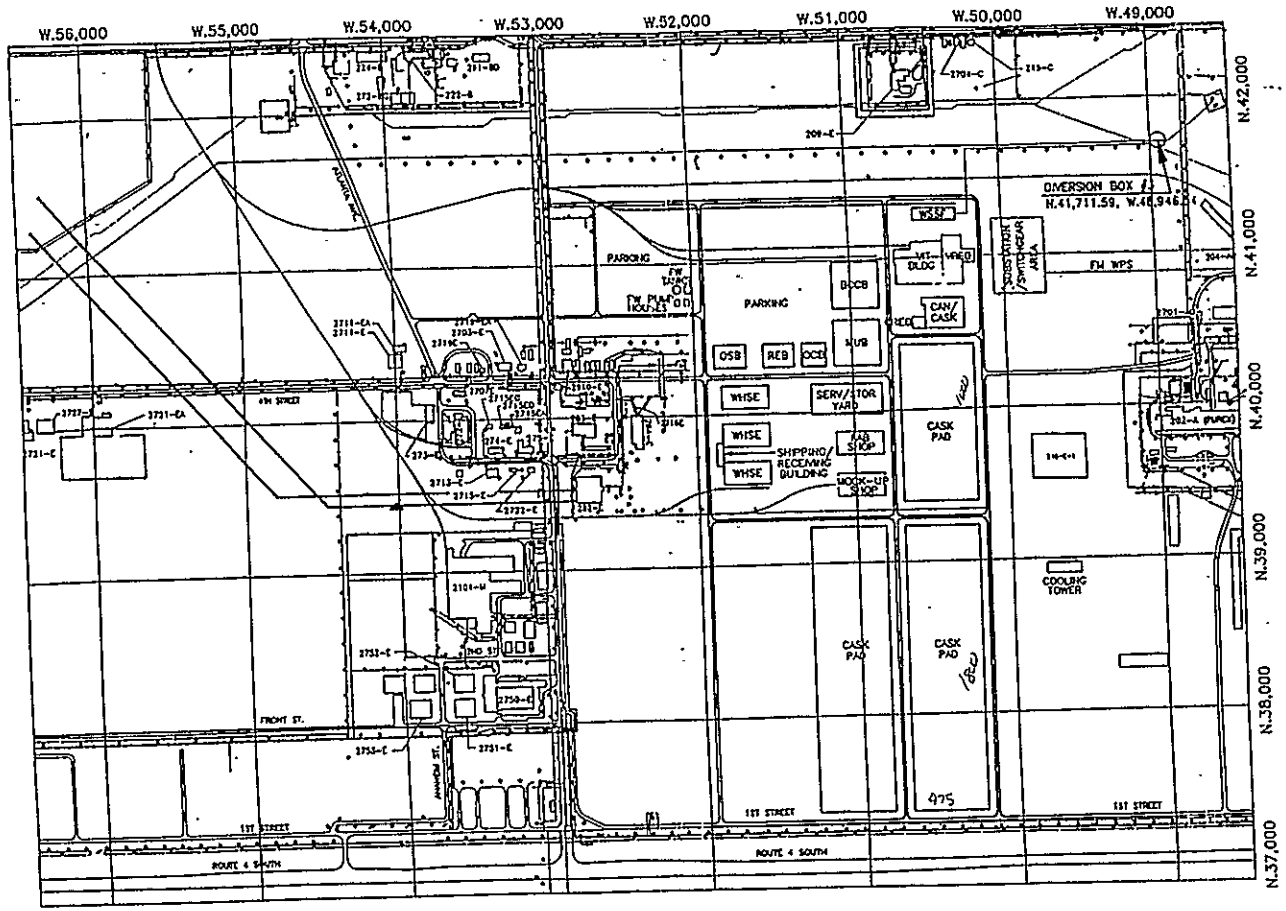
U.S.DEPARTMENT OF EN

FLUOR DANIEL, INC.
ADVANCED TECHNOLOGY DIVI

EIS
TPA PREFERRRED ALTER
SITE PLAN

ES-ALT8A-03 2

5-3/5-4



200 EAST AREA

Figure 2-2. Temporary Facilities.

LEGEND

BCCB	BULK HANDLING & COLD CHEMICAL MAKE-UP BUILDING
CAN/CASK	CASK/CANISTER FACILITY
CREB	CASK/CANISTER REGULATED ENTRANCE BUILDING
FAB	FABRICATION
FW	FIREWATER
MUB	MECHANICAL UTILITIES BUILDING
OCB	OPERATIONS CONTROL BUILDING
OSB	OPERATIONS SUPPORT BUILDING
REB	REGULATED ENTRANCE BUILDING
WSSF	WASTE STAGING AND SAMPLING FACILITY
SERV/STOR	SERVICE/STORAGE
VIT BLDG	VITRIFICATION BUILDING
VREB	VITRIFICATION REGULATED ENTRANCE BUILDING
WHISE	WAREHOUSE

CASE 8A EIS

U.S.DEPARTMENT OF ENERGY

FLUOR DANIEL, INC. ADVANCED TECHNOLOGY DIVISION

EIS
NO PRETREATMENT
SITE PLAN

ES-ALT8A-03

MEMORANDUM

TO: Arrie Bachrach

February 15,1995
95-DM-007

FROM: Dave Murray

SUBJECT: **ENGINEERING INFORMATION REQUEST**

In response to your inquiry we are enclosing the completed Engineering Information Request Number 035.

cc: Project File

Attachments: Engineering Information Request Number 035

DM:CCM:ns

DM\95MEMO.00712.3\6.1.1

Request Number 036

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: M. Harker/A. Bachrach Date: 2/8/95

Phone Number: N/A Fax Number: N/A

Request Information: For all alternatives (TPA and Min. Pretreatment now): We have total peak workforce for construction and operations phase.

Peak of Construction Phase: Out of total workforce, what percentage will work five day/single daytime shift schedule? i.e., are there multiple shifts planned? More than five day schedule? If other than five-day/daytime schedule, what proportion will be working weekday/daytime schedule?

Peak of Operation Phase: Given seven-day/three shift operation, what is breakdown by day and shift, i.e., what is total workforce on weekday/daytime shift? (percentage of total workforce is acceptable data for peak assuming that a formal request to WHC is needed.

Need Date: 2/20/95

Response: See attached

Data Source/Accuracy:

Prepared By: Jim Goodwin Date Sent/Faxed:

Concurrence: Marc C. Nelson
Marc Nelson - Deputy Project Manager

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The construction schedule is a ten-hour day, five days per week for both TPA and No Separation alternative.

The operating schedule is three shifts, seven days a week. Operating personnel schedules are attached. Assume that half of the non-exempt workers are on shiftwork and the other half are on day shift, five days a week.

TPA
OPERATING PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE REV A DRAFT OF THE TPA PACKAGE
NOTE THAT THE CALCULATIONS ARE BASED ON MANHOURS PER YEAR AND NOT TOTAL MANHOURS
REV 0 Dec 16, 1994 JWG

YEAR (NOTE 1)			2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028			
% MH OF MATURE YEAR (NOTE 6)			20%	40%	60%	80%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	80%	60%	40%	20%			
	TOTAL MH/YR (NOTE 2)	EQUIV MEN/YR (NOTE 4)	EQUIVALENT MEN (NOTE 7)																											TOTAL
NONEXEMPT																														
RAD WORKER	830,000	415	83	166	249	332	415	415	415	415	415	415	415	415	415	415	415	415	415	415	415	415	415	332	249	166	83			8,715
NONRAD WORKER	120,000	60	12	24	36	48	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	48	36	24	12			1,260
Exempt																														
RAD WORKER	440,000	220	44	88	132	176	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220	176	132	88	44			4,620
NOFRAD WORKER	58,000	29	6	12	17	23	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	23	17	12	6			609
TOTAL	1,448,000	724	145	290	434	579	724	724	724	724	724	724	724	724	724	724	724	724	724	724	724	724	724	579	434	290	145			15,204

NOTES:
1. SCHEDULE FROM TABLE 10-24
2. MANHOURS PER YEAR FROM TABLE 10-3
3. THE MANHOURS PER YEAR FROM TABLE 10-3 IS ASSUMMED TO BE A MATURE YEAR
4. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND TPA (2000 vs 1836). WHC NEEDS TO MAKE A GLOBAL DECISION. 2000 MANHOURS IN A YEAR, FROM TABLE 10-2
5. WE NEED TO SEE THE STAFFING TABLES TO VERIFY THAT THESE MANHOUR ESTIMATES ARE COMPLETE.
6. MANHOUR DISTRIBURIION ESTIMATED BY JACOBS. WE NEED THIS INFO FROM WHC
7. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

TPA; WASTE RETRIEVAL AND TRANSFER
OPERATING PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE MINIMAL PRETREATMENT SECTION OF THE REV A DRAFT OF THE WASTE RETRIEVAL AND TRANSFER PACKAGE
REV 0 Dec 14, 1994 JWG

YEAR (NOTE 1)			2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
% MH EXPENDED PER YR (NOTE 5)			3%	3%	3%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
	TOTAL MH (NOTE 2)	EQUIV TOTAL MAN*YR (NOTE 3)	EQUIVALENT MEN (NOTE 6)																					
NONEXEMPT																								
RAD WORKER	35,000,000	19,063	572	572	572	763	763	763	763	763	763	763	763	763	763	763	763	763	763	763	763	763	763	763
NONRAD WORKER	12,000,000	6,536	196	196	196	261	261	261	261	261	261	261	261	261	261	261	261	261	261	261	261	261	261	261
EXEMPT																								
RAD WORKER	6,000,000	3,268	98	98	98	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131
NONRAD WORKER	14,000,000	7,625	229	229	229	305	305	305	305	305	305	305	305	305	305	305	305	305	305	305	305	305	305	305
TOTAL	67,000,000	36,492	1,095	1,095	1,095	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460

NOTES:
1. SCHEDULE FROM TABLE 6-22
2. TOTAL MANHOURS FROM TABLE 6-2
3. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND TPA (2000 vs 1836). WHC NEEDS TO MAKE A GLOBAL DECISION.
   1836 MANHOURS IN A YEAR FROM PAGE B-8
4. WE NEED TO SEE THE STAFFING TABLES TO VERIFY THAT THESE MANHOUR ESTIMATES ARE COMPLETE.
5. MANHOUR DISTRIBUTION ESTIMATED BY JACOBS. WE NEED THIS INFO FROM WHC
6. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

TPA WRT OPR MH

2023	2024	2025	2026	2027	
3%	3%	3%	3%	3%	100%
					TOTAL
572	572	572	572	572	19,063
196	196	196	196	196	6,536
98	98	98	98	98	3,268
229	229	229	229	229	7,625
1,095	1,095	1,095	1,095	1,095	36,492

TPA WRT OPR MH

MINIMAL PRETREATMENT
OPERATING PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING HOURS AND SCHEDULE FROM REV A DRAFT OF THE MINIMAL PRETREATMENT ENGINEERING PACKAGE
REV 0 Dec 15, 1994 JWG

	YEAR (NOTE 1)		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018		
% MH OF MATURE	YEAR (NOTE 6)		20%	40%	60%	80%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%		
	TOTAL MH/YR (NOTE 2)	EQUIV MEN/YR (NOTE 4)	EQUIVALENT MEN (NOTE 7)															TOTAL	
NONEXEMPT																			
RAD WORKER	506,000	253	51	101	152	202	253	253	253	253	253	253	253	253	253	253	253	3,289	
NONRAD WORKER	116,000	58	12	23	35	46	58	58	58	58	58	58	58	58	58	58	58	754	
Exempt RAD WORKER	344,000	172	34	69	103	138	172	172	172	172	172	172	172	172	172	172	172	2,236	
NONRAD WORKER	52,000	26	5	10	16	21	26	26	26	26	26	26	26	26	26	26	26	338	
TOTAL	1,018,000	509	102	204	305	407	509	509	509	509	509	509	509	509	509	509	509	6,617	

NOTES:
1. SCHEDULE FROM TABLE 7-23
2. MANHOURS PER YEAR FROM TABLE 7-3
3. THE MANHOURS PER YEAR FROM TABLE 7-3 IS ASSUMED TO BE A MATURE YEAR
4. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND MINIMAL PRETREATMENT (2000 vs 1836).
   WHC NEEDS TO MAKE A GLOBAL DECISION
   2000 MANHOURS IN A YEAR, FROM TABLE 7-14
5. WE NEED TO SEE THE STAFFING TABLES TO VERIFY THAT THESE MANHOUR ESTIMATES ARE COMPLETE.
6. MANHOUR DISTRIBUTION ESTIMATED BY JACOBS. WE NEED THIS INFO FROM WHC
   JACOBS ASSUMED A 20% PER YEAR MANPOWER BUILDUP ON STARTUP AND THAT THE FULL MANPOWER COMPONENT WOULD BE ABSORBED BY D&D UPON SHUTDOWN
7. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

MINIMAL PRETREATMENT; WASTE RETRIEVAL AND TRANSFER
OPERATING PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING MANHOURS AND SCHEDULE FROM THE MINIMAL PRETREATMENT SECTION OF THE REV A DRAFT OF THE WASTE RETRIEVAL AND TRANSFER PACKAGE

YEAR (NOTE 1)			2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	
% MH EXPENDED PER YR (NOTE 5)			3%	4%	5%	6%	7%	7%	7%	7%	6%	6%	6%	6%	6%	6%	6%	5%	4%	3%	100%
	TOTAL MH (NOTE 2)	EQUIV TOTAL MAN*YR (NOTE 3)	EQUIVALENT MEN																		TOTAL
NONEXEMPT																					
RAD WORKER	33,000,000	17,974	539	719	899	1078	1258	1258	1258	1258	1078	1078	1078	1078	1078	1078	1078	899	719	539	17,974
NONRAD WORKER	12,000,000	6,536	196	261	327	392	458	458	458	458	392	392	392	392	392	392	392	327	261	196	6,536
EXEMPT																					
RAD WORKER	5,000,000	2,723	82	109	136	163	191	191	191	191	163	163	163	163	163	163	163	136	109	82	2,723
NONRAD WORKER	13,000,000	7,081	212	283	354	425	496	496	496	496	425	425	425	425	425	425	425	354	283	212	7,081
TOTAL	63,000,000	34,314	1,029	1,373	1,716	2,059	2,402	2,402	2,402	2,402	2,059	2,059	2,059	2,059	2,059	2,059	2,059	1,716	1,373	1,029	34,314

NOTES:
1. SCHEDULE FROM TABLE 6-22
2. TOTAL MANHOURS FROM TABLE 6-2
3. THE NUMBER OF MAN YEARS ARE AT VARIANCE BETWEEN THE WASTE RETRIEVAL AND TPA (2000 vs 1836). WHC NEEDS TO MAKE A GLOBAL DECISION. 1836 MANHOURS IN A YEAR FROM PAGE B-8
4. WE NEED TO SEE THE STAFFING TABLES TO VERIFY THAT THESE MANHOUR ESTIMATES ARE COMPLETE.
5. MANHOUR DISTRIBUTION ESTIMATED BY JACOBS. WE NEED THIS INFO FROM WHC

MIN PRE WRT OPR MH

MEMORANDUM

TO: Arrie Bachrach
Mike Harker

February 15,1995
95-DM-004

FROM: Dave Murray

SUBJECT: **ENGINEERING INFORMATION REQUEST**

In response to your inquiry we are enclosing the completed Engineering Information Request Number 036.

cc: Project File

Attachments: Engineering Information Request Number 036

DM:CCM:ns

DM\95MEMO.004\12.3\6.1.1

Request Number 037

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: David E. Serot Date: 3/13/95

Phone Number: 375-3055 Fax Number: 375-4838

Request Information: 1) Equivalent number of workers per calendar year currently employed on the TWRS project (for management, tank monitoring, maintenance etc.) and forecasts of equivalent number of workers per calendar year through the end of TWRS remediation. 2) Equivalent number of workers per calendar year for each of the TWRS alternatives. Alternatives needed to meet the PDEIS target date are: a)Tank Wastes - No Action, In Situ, Selective Retrieval, and Maximum Retrieval b) Capsules - No Action, Overpack and Ship, and Vitrify with High-Level Tank Wastes (TPA). Subdivide each alternative into Waste Retrieval and Transfer Stage and Waste Treatment Stage as appropriate for each alternative. Subdivide each stage into Construction, Operations, D&D, and M&M phases.

Need Date: 4/7/95

Response:

Data Source/Accuracy:

Prepared By: Jim Goodwin CH. Date Sent/Faxed: 4/7/95

Concurrence: Marc E. Nelson
Marc Nelson - Deputy Project Manager

enginleninfrqleninfrq.037

Please type this onto a Info. Request form.

037

Requested By: David E. Serot

Date : 3/13/95

Phone Number: 375-3055

Fax Number: ASI

Requested Information:

1. Equivalent number of workers per calender year currently employed on the TWRS project (for management, tank monitoring and maintenance, etc) and forecasts of equivalent number of workers per calender year through the end of TWRS remediation. These workers are separate from TWRS remediation alternatives.

2. Equivalent number of workers per calender year for each of the TWRS alternatives. Alternatives needed to meet the PDEIS target date are:

Tank Wastes: No Action
Tank Wastes: In Situ Vitrification
Tank Wastes: Selective Retrieval
Tank Wastes: Maximum Retrieval

Capsules: No Action
Capsules: Overpack and Ship
Capsules: Vitrify with High Level Tank Wastes (TPA)

Subdivide each alternative into

Waste Retrieval and Transfer Stage
Waste Treatment Stage

as appropriate for each alternative.

Subdivide each stage into

Construction
Operations
D&D
M&M

phases.

Need Date: 4/7

CAPSULE DRY STORAGE (NO ACTION)
PERSONNEL ESTIMATE
ESTIMATED BY JACOBS USING HOURS AND SCHEDULE FROM REV B DRAFT OF THE CAPSULE ENGINEERING PACKAGE DATED FEBRUARY 1995
REV 0 Apr 6, 1995 JWG

		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
% MH EXPENDED PER YR, DESIGN (NOTE 1)		40%	60%															
% MH EXPENDED PER YR, CONST. (NOTE 1)		5%	20%	20%	20%	10%	10%	10%	5%									
% MH EXPENDED PER YR, PKG (NOTE 1)										5%	5%	5%	5%	5%	5%	5%	5%	5%
% MH EXPENDED PER YR, STORAGE (NOTE 1)										2%	2%	2%	2%	2%	2%	2%	2%	2%
	EQUIV TOTAL MAN*YR	EQUIVALENT MEN (NOTE 4)																
DESIGN & ENGR (NOTE 2)	15	6	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CONSTRUCTION (NOTE 2)																		
NONRADIATION WORKER	70	4	14	14	14	7	7	7	4	0	0	0	0	0	0	0	0	0
SUPERVISORY	15	1	3	3	3	2	2	2	1	0	0	0	0	0	0	0	0	0
PACKAGING OPERATIONS (NOTE 3)																		
RAD	140	0	0	0	0	0	0	0	0	7	7	7	7	7	7	7	7	7
NONRAD	54	0	0	0	0	0	0	0	0	3	3	3	3	3	3	3	3	3
DRY STORAGE (NOTE 3)																		
RAD	700	0	0	0	0	0	0	0	0	14	14	14	14	14	14	14	14	14
NONRAD	190	0	0	0	0	0	0	0	0	4	4	4	4	4	4	4	4	4
TOTAL	1,184	10	26	17	17	9	9	9	4	28	28	28	28	28	28	28	28	28

NOTES:

1. SCHEDULE TAKEN FROM FIGURE 3-2. MANHOUR DISTRIBUTION ESTIMATED BY JACOBS
2. CONSTRUCTION MANYEARS FROM TABLE 4-2. JACOBS ASSUMES THAT 15% OF CONSTRUCTION MANHOURS WILL BE DESIGN AND THAT 15% WILL BE SUPERVISION AND STAFF.
3. OPERATIONAL AND STORAGE/DISPOSAL MAN YEARS FROM TABLE 4-5
4. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)

CAPSULE DRY STORAGE MANHOURS

2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 TO 2090	
												100%
												100%
5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%		100%
2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	60%	100%
												TOTAL
0	0	0	0	0	0	0	0	0	0	0	0	15
0	0	0	0	0	0	0	0	0	0	0	0	70
0	0	0	0	0	0	0	0	0	0	0	0	15
7	7	7	7	7	7	7	7	7	7	7	0	140
3	3	3	3	3	3	3	3	3	3	3	0	54
14	14	14	14	14	14	14	14	14	14	14	420	700
4	4	4	4	4	4	4	4	4	4	4	114	190
28	28	28	28	28	28	28	28	28	28	28	534	1,184

CAPSULE DRY STORAGE MANHOURS

..CAPSULE OVERP 'D SHIP MANHOURS (AKA NO IMMOBILIZATION OR CAPSULE TPA)
PERSONNEL ES'
ESTIMATED BY 5 USING HOURS AND SCHEDULE FROM REV B DRAFT OF THE CAPSULE ENGIN G PACKAGE DATED FEBRUARY 1995
REV 0 Apr 6, 1995 JWG

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
% MH EXPENDED PER YR, DESIGN (NOTE 1)	40%	60%																
% MH EXPENDED PER YR, CONST. (NOTE 1)	5%	20%	20%	20%	10%	10%	10%	5%										
% MH EXPENDED PER YR, PKG (NOTE 1)									6%	6%	6%	6%	6%	5%	5%	5%	5%	5%
% MH EXPENDED PER YR, STORAGE (NOTE 1)									4%	4%	4%	4%	4%	4%	4%	3%	3%	3%
% MH EXPENDED PER YR, SHIPPING (NOTE 1)																		

	EQUIV TOTAL MAN*YR	EQUIVALENT MEN (NOTE 4)																	
DESIGN & ENGR (NOTE 2)	15	6	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CONSTRUCTION (NOTE 2)																			
NONRADIATION WORKER	70	4	14	14	14	7	7	7	4	0	0	0	0	0	0	0	0	0	0
SUPERVISORY	15	1	3	3	3	2	2	2	1	0	0	0	0	0	0	0	0	0	0
PACKAGING OPERATIONS (NOTE 3)																			
RAD	140	0	0	0	0	0	0	0	0	8	8	8	8	8	7	7	7	7	7
NONRAD	54	0	0	0	0	0	0	0	0	3	3	3	3	3	3	3	3	3	3
DRY STORAGE (NOTE 3)																			
RAD	700	0	0	0	0	0	0	0	0	28	28	28	28	28	28	28	21	21	21
NONRAD	190	0	0	0	0	0	0	0	0	8	8	8	8	8	8	8	6	6	6
SHIPPING (NOTE 5)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1,184	10	26	17	17	9	9	9	4	47	47	47	47	47	45	45	36	36	36

NOTES:

1. SCHEDULE TAKEN FROM FIGURE 3-2. MANHOUR DISTRIBUTION ESTIMATED BY JACOBS
2. CONSTRUCTION MANYEARS FROM TABLE 4-2. JACOBS ASSUMES THAT 15% OF CONSTRUCTION MANHOURS WILL BE DESIGN AND THAT 15% WILL BE SUPERVISION AND STAFF.
3. OPERATIONAL AND STORAGE/DISPOSAL MAN YEARS FROM TABLE 4-5
4. GENERAL CALCULATION: (EQIVALENT TOTAL MAN YR) X (% EXPENDED PER YEAR)
5.
6. THERE ARE NO D&D MANHOURS OR SCHEDULE BECAUSE THE WESF FACILITY WILL BE RETROFIT FOR THE OVERPACK OPERATION.

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	
																					100%
																					100%
5%	5%	5%	5%	5%	5%	5%	5%	5%													100%
3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	100%
															16%	17%	17%	17%	17%	16%	100%
																					TOTAL
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
7	7	7	7	7	7	7	7	7	0	0	0	0	0	0	0	0	0	0	0	0	140
3	3	3	3	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	54
21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	700
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	190
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
36	36	36	36	36	36	36	36	36												27	1,184

OVERPACK & SHIP MANHOURS

Request Number 038

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Joan Young

Date: 03/20/95

Phone Number: (509) 946-7112

Fax Number: (509) 943-6812

Request Information: Data request for modeling risk before and after remediation.

Item #1 **Priority A**

Need Date: 04/07/95

Response: See attached.

Data Source/Accuracy: TPA, Insitu, and capsule data packages. Aspen model output for ISV used. Aggregated tank inventory used for residuals. Accuracy of data not defined, the ISV + data is more uncertain than the other data.

Prepared By: Colin Henderson CH.

Date Sent/Faxed: 4/7/95

Concurrence: Marc E. Nelson

Marc Nelson - Deputy Project Manager

engin\eninfrq.038

Date: March 21, 1995

To: Dave Murray

From: Joan Young

Subject: DATA REQUEST FOR MODELING OF POST REMEDIATION RISK

Post remediation risk is the risk from inhalation, ingestion, and direct exposure to radiation and chemicals during long term disposal of the tank residuals and treated radioactive wastes. The receptors are land users such as a residential farmer, an industrial worker, and recreation users. We have identified the following data requirements. The items are listed in priority from greatest to least. Items 1 and 2 are mandatory and must be provided to ASI. Item 3 is important, but not mandatory.

1. POST REMEDIATION SOURCE TERM INVENTORY FOR NO ACTION, ISV, AND CS AND SR CAPSULES

Please provide a summary of the post remediation source inventory for the No Action, ISV, and Cs and Sr Capsules Alternatives. These source inventories should be converted into source/release terms by JEG and ESE. The following source inventories are requested:

For No Action and ISV Alternatives:

a) tank farms -- this includes all sources of contamination remaining in the tank farms after loss of institutional controls (for No Action) or closure (for ISV). For no action, some of the liquids may be removed and some of the tank contents may be transferred to other tanks. For ISV, some of the constituents may volatilize. Revised inventory estimates or guidelines for estimating these amounts from current inventories are needed.

For the TPA, No Action, ISV, and Cs and Sr Capsule Alternatives:

b) process facilities -- information on the post remediation source inventory for TWRS process facilities is needed for the TPA, No Action, ISV, and Cs and Sr Capsule Alternatives. This source inventory will characterize the levels of contamination likely to remain in the ground after demolition of process facilities, including the Waste Encapsulation and Storage Facility (WESF) in the 200 East Area. The location of this contamination on the Hanford Site must also be specified.

For the Cs and Sr Capsules (No Action) Alternative:

c) cesium and strontium capsules -- the source inventory must be provided for the cesium chloride and strontium fluoride capsules stored in water basins at the WESF.

For all Alternatives:

d) secondary wastes -- an estimate of the secondary wastes that are generated and that should be included in the inventory from process operations or D&D is needed.

2. CONTAMINATED MEDIA AND CONCENTRATION OF CONTAMINANTS IN THE CONTAMINATED MEDIA FOR TIME INTERVALS OF INTEREST TO TWRS EIS

For all Alternatives:

The media contaminated by post remediation releases to the environment (groundwater, soil (surface), soil (deep), surface water, and air), the concentration of these contaminants in each medium for each grid cell location must be stated for the following time frames: T_0, $T_{Closure}$, T_{100}, T_{300}, T_{500}, T_{1000}, $T_{10,000}$.

3. SUMMARY OF VOLUME OF RADIOACTIVE WASTE GENERATED BY EACH ALTERNATIVE

A summary of the volume of radioactive waste generated by each alternative is desired. The following information is requested for TPA, No Action, ISV, and Cs and Sr Capsules Alternatives:

a. No. of HLW Canisters Produced
b. Volume of HLW Produced
c. Volume of LLW Produced
d. No. of LLW Storage Vaults
e. Volume of Waste Left in Tanks
f. Time Treatment Begins
g. Time Treatment Ends

4. ATMOSPHERIC EMISSIONS FROM TANK RESIDUALS AND LLW DISPOSAL VAULTS AFTER CLOSURE

For ISV Alternative:

The assumption is that there will be no atmospheric emissions from tank residuals after closure. Please verify that this is correct.

For No Action Tanks and Cs and Sr Capsules (No Action):

Data Request 38

Post remediation inventory for the No Action, In Situ Vitrification, and Capsule alternatives.

A) **For Tank Farms.**

1. Under No Action the following situation will exist:
   - The SSTs will have been saltwell pumped and isolated. The inventory for the SSTs will correspond to the aggregated inventory by tank group as amended.
   - The DSTs will have been retanked two times during the 100 year period. Twenty-six DSTs of 1,000,000 gal capacity will be built for each retanking campaign. Each retanking campaign will also include a new evaporator and associated transfer lines. After the 100 year mark the following will be left over from DST wastes:
     28 existing DSTs with 1 percent of existing inventory.
     26 DSTs with a residual of 0.99 percent of existing DST inventory.
     26 DSTs with an inventory of 98.01 percent of existing DST inventory.
   - The post remediation inventory is provided in the attached tables for DSTs.

2. For ISV the following scenario will exist:
   The SSTs will be saltwell pumped.
   The DSTs will be evaporated through the 242-A evaporator.
   The ISV Residual inventory is provided in the attached model output from WHC. The vitrified waste is stream No. 5.

B) **For the Process Facilities.**

1. TPA Alternative:
   From TPA Table 9.15 (attached) the quantity and disposition of contaminated treatment/storage facility materials is listed. It appears that all contaminated facility materials will be sent to the LLW burial grounds.

2. No Action:
   The process facilities built under the No Action alternative include two sets of retrieval, transfer, and evaporator facilities used during DST retanking operations. Table 5.15 (attached) from the No Action data package shows the quantity and disposition of contaminated materials at the treatment/storage

facilities. It appears that all contaminated materials will be sent to the LLW burial grounds.

3. In Situ Vitrification:
   Table 7.15 (attached) from the In Situ data package shows the quantity and disposition of contaminated facilities. It appears that contaminated materials from D&D will be sent to the LLW burial grounds.

4. Cs/Sr Capsule Process Facilities:
   The Cesium/Strontium Capsule package does not provide quantification or disposition of contaminated materials during the D&D phase of the capsule project.

   For the capsules it is being assumed that all processing of capsules will be done at either WESF or in a cell at the HLW Vitrification plant. Under this assumption the two process facilities potentially contaminated during operations are WESF and the undefined cell at the HLW plant. D&D of WESF is not in the EIS scope. D&D of the HLW Vitrification plant is covered in the TPA package and any incremental increase due to the capsules has not been determined and will be insignificant with respect to D&D of the HLW plant.

5. Location of the Process Facilities on the Hanford Site:
   The location of the LLW burial grounds where the contaminated material will be disposed of has not been addressed in any of the data packages. If the assumption that all contaminated material will be taken to a LLW burial ground during D&D is valid, then there will be no contamination associated with facility closure.

C. Inventory for Cs/Sr Capsules Stored at WESF.

The capsule inventory is as follows:

601 Strontium Capsules @ 23.01 Mci in 12/31/94.
1328 Cesium Capsules @ 53.4 Mci in 12/31/94.

Decayed to 1995

601 Strontium Capsules @ 22.46 Mci in 12/31/95.
1328 Cesium Capsules @ 52.2 Mci in 12/31/95.

D. Secondary Wastes.

Using the following definition for secondary waste: any waste or waste stream that is a by-product of the treatment process producing the primary waste (glass).

Under this definition, best available information or secondary waste streams is provided in the estimates for air emissions and effluent from the treatment plant.

NO ACTION POST REMEDIATION CHEMICAL INVENTORY FOR DSTS

						RESIDUAL INVENTORY IN ORIGINAL 28 DSTS				
						RESISUAL=1% OF ORIGINAL INVENTORY				
DST CHEM INVENTORY (METRIC TONS)						METRIC TONS				
Chemical	5EDS	3EDS	3WDS	DST		Chemical	5EDS	3EDS	3WDS	DST
	TOTAL	TOTAL	TOTAL	TOTAL			TOTAL	TOTAL	TOTAL	TOTAL
Ag+	1.44E+00	2.10E-01	5.80E-02	1.71E+00			0.01438	0.0021	0.00058	0.01706
Al+3	4.29E+01	1.05E+01	1.44E+01	6.78E+01			0.429	0.105	0.144	0.678
As+5	1.04E+00	2.60E-02	2.01E-01	1.27E+00			0.01041	0.00026	0.00201	0.01268
B+3	1.02E+00	6.64E-02	4.29E-01	1.51E+00			0.01018	0.000664	0.004286	0.01513
Ba+2	3.11E+00	7.42E-01	3.26E-02	3.89E+00			0.03111	0.007416	0.000326	0.038852
Be+2	6.72E-02	2.23E-02	0.00E+00	8.95E-02			0.000672	0.000223	0	0.000895
Bi+3	1.74E+00	5.21E-01	0.00E+00	2.26E+00			0.0174	0.00521	0	0.02261
Ca+2	1.32E+01	2.39E+00	6.22E+00	2.18E+01			0.1315	0.02392	0.0622	0.21762
Cd+2	5.87E+00	7.05E-02	2.42E-01	6.18E+00			0.058668	0.000705	0.00242	0.061793
Ce+3	2.80E+00	0.00E+00	2.64E-01	3.07E+00			0.028026	0	0.00264	0.030666
Cr+3	9.31E+00	7.84E-01	2.40E+01	3.41E+01			0.0931	0.00784	0.24	0.34094
Cu+2	4.78E-01	1.04E-01	3.42E-01	9.24E-01			0.004782	0.00104	0.00342	0.009242
Fe+3	1.35E+02	2.74E+00	1.24E+01	1.50E+02			1.351	0.02738	0.1244	1.50278
Hg+	5.75E-02	9.43E-04	0.00E+00	5.84E-02			0.000575	9.43E-06	0	0.000584
K+	1.50E+02	3.78E+02	3.76E+01	5.65E+02			1.4979	3.78	0.37576	5.65366
La+	1.98E+01	1.35E+00	9.89E-02	2.13E+01			0.19819	0.0135	0.000989	0.212679
Li+	2.47E-02	0.00E+00	5.60E-03	3.03E-02			0.000247	0	0.000056	0.000303
Mg+2	1.01E+01	1.39E+00	5.09E-01	1.20E+01			0.10056	0.01392	0.005087	0.119567
Mn+4	2.09E+01	1.10E+00	3.71E+00	2.57E+01			0.2091	0.01103	0.0371	0.25723
Mo+6	4.03E+00	7.97E-01	8.52E-01	5.68E+00			0.04029	0.00797	0.008521	0.056781
Na+	6.07E+03	2.94E+03	2.16E+03	1.12E+04			60.651	29.36	21.585	111.596
Nd+3	1.19E+01	0.00E+00	1.17E-01	1.20E+01			0.119	0	0.00117	0.12017
Ni+2	8.37E+00	6.11E-01	1.66E+00	1.06E+01			0.0837	0.00611	0.01664	0.10645
Pb+4	3.51E+00	1.39E+00	3.34E-01	5.24E+00			0.03513	0.0139	0.00334	0.05237
Pd	1.20E+00	0.00E+00	0.00E+00	1.20E+00			0.012	0	0	0.012
Rb	6.40E-02	0.00E+00	0.00E+00	6.40E-02			0.00064	0	0	0.00064
Re	3.65E-02	2.14E-01	0.00E+00	2.51E-01			0.000365	0.00214	0	0.002505
Rh	8.54E-02	1.47E+00	1.38E-01	1.69E+00			0.000854	0.0147	0.00138	0.016934
Ru	2.89E-01	8.35E-01	1.36E-01	1.26E+00			0.00289	0.00835	0.00136	0.0126
Sb	2.13E+00	1.35E+00	9.82E-02	3.58E+00			0.02131	0.0135	0.000982	0.035792
Se	1.93E+00	2.59E+00	6.37E-01	5.16E+00			0.0193	0.025922	0.00637	0.051592
SiO3-	2.09E+02	1.45E+01	6.08E+00	2.30E+02			2.093	0.1445	0.060815	2.298315
Sn	3.21E-05	3.81E-04	0.00E+00	4.13E-04			3.21E-07	3.81E-06	0	4.13E-06
Te	6.75E-02	1.13E+00	1.03E-01	1.30E+00			0.000675	0.0113	0.00103	0.013005
Th	4.03E-01	2.55E+00	6.24E-01	3.58E+00			0.004032	0.0255	0.00624	0.035772
Ti	2.62E-01	2.79E-01	3.86E-02	5.80E-01			0.002624	0.002793	0.000386	0.005803
Tl	3.88E+00	2.92E+01	5.49E-01	3.36E+01			0.03883	0.292	0.00549	0.33632
UO2+2	2.98E+00	2.74E+01	0.00E+00	3.03E+01			0.02981	0.2736	0	0.30341
V+5	7.01E-02	1.66E-01	1.37E-02	2.50E-01			0.000701	0.00166	0.000137	0.002498
W+6	7.47E-01	0.00E+00	0.00E+00	7.47E-01			0.00747	0	0	0.00747
Zn+2	7.70E-01	2.42E+00	1.35E+00	4.54E+00			0.0077	0.0242	0.01345	0.04535
Zr+4	1.87E+01	2.58E+02	1.85E-01	2.77E+02			0.1873	2.58218	0.00185	2.77133
Al(OH)4-2	2.44E+03	8.34E+02	1.19E+03	4.46E+03			24.4	8.34	11.9	44.64
CO3-2	9.93E+02	8.46E+02	8.75E+01	1.93E+03			9.927	8.46	0.8751	19.2621
Cl-	1.48E+02	5.24E+01	7.50E+01	2.75E+02			1.47575	0.52436	0.74977	2.74988
Cr(OH)4-	4.06E+01	1.14E+01	6.01E+01	1.12E+02			0.406	0.114	0.601	1.121
F-	3.62E+01	3.20E+02	8.99E+00	3.65E+02			0.36239	3.201	0.08993	3.65332
SO4-2	2.79E+02	7.23E+01	4.18E+01	3.93E+02			2.7896	0.7225	0.4176	3.9297
NO3-	4.45E+03	2.20E+03	1.04E+03	7.69E+03			44.504	21.9828	10.404	76.8908
NO2-	1.95E+03	8.89E+02	2.46E+02	3.08E+03			19.4506	8.88894	2.4646	30.80414
PO4-3	8.53E+01	7.49E+01	7.35E+01	2.34E+02			0.853	0.74857	0.7346	2.33617
OH-	1.02E+03	7.57E+02	2.42E+02	2.02E+03			10.235	7.566	2.417	20.218
TOC	8.71E+02	5.94E+01	1.29E+02	1.06E+03			8.705	0.594	1.2929	10.5919

For Response A1

NO ACTION POST REMEDIATION CHEMICAL INVENTORY FOR DSTS

RESIDUAL INVENTORY				RESIDUAL INVENTORY						
IN THE FIRST GROUP OF DST				IN THE SECOND GROUP OF DST						
REPLACEMENT TANKS (26 TANKS)				REPLACEMENT TANKS (26 TANKS) 98% OF ORIGINAL INVENTORY						
DST					DST					
TOTAL METRIC TONS					TOTAL METRIC TONS					
0.01764					1.67188					
0.822					66.444					
0.01469					1.24264					
0.019416					1.48274					
0.039177					3.807457					
0.000895					0.087719					
0.02261					2.21578					
0.27982					21.32676					
0.064213					6.055714					
0.033306					3.005268					
0.58094					33.41212					
0.012662					0.905716					
1.62718					147.2724					
0.000584					0.057274					
6.02942					554.0587					
0.213668					20.84254					
0.000359					0.029723					
0.124654					11.71757					
0.29433					25.20854					
0.065302					5.564538					
133.181					10936.41					
0.12134					11.77666					
0.12309					10.4321					
0.05571					5.13226					
0.012					1.176					
0.00064					0.062681					
0.002505					0.2455					
0.018314					1.659532					
0.01396					1.2348					
0.036774					3.507616					
0.057962					5.056016					
2.35913					225.2349					
4.13E-06					0.000405					
0.014035					1.27449					
0.042012					3.505656					
0.006189					0.568694					
0.34181					32.95936					
0.30341					29.73418					
0.002635					0.244794					
0.00747					0.73206					
0.0588					4.4443					
2.77318					271.5903					
56.54					4374.72					
20.1372					1887.686					
3.49965					269.4882					
1.722					109.858					
3.74325					358.0254					
4.3473					385.1106					
87.2948					7535.298					
33.26874					3018.806					
3.07077					228.9447					
22.635					1981.364					
11.8848					1038.006					

NO ACTION POST REMEDIATION RAD INVENTORY FOR DSTS

DST RADIONUCLIDE INVENTORY IN CURIES

Decayed to 12/31/1995

Radionuclide	3WDS		3WDS	3EDS		3EDS	5EDS		5EDS	Total	
Ci	Soluble	Insoluble	TOTAL	Soluble	Insoluble	TOTAL	Soluble	Insoluble	TOTAL	12/31/95	12/31/99
Na, kgs	1.30E+06	2.01E+04	1.32E+06	5.93E+06	3.80E+04	5.96E+06	2.57E+06	1.36E+05	2.70E+06	9.99E+06	9.99E+06
C-14	0.00E+00	8.06E-01	8.06E-01	3.40E+02	1.98E+03	2.32E+03	5.23E+00	0.00E+00	5.23E+00	2.33E+03	2.33E+03
Sr-90	2.16E+04	3.95E+04	6.10E+04	6.41E+05	1.03E+07	1.10E+07	1.34E+04	5.62E+04	6.96E+04	1.11E+07	1.01E+07
Y-90	2.16E+04	3.95E+04	6.10E+04	6.41E+05	1.03E+07	1.10E+07	1.34E+04	5.62E+04	6.96E+04	1.11E+07	1.01E+07
Tc-99	3.66E+03	0.00E+00	3.66E+03	1.54E+04	3.99E+02	1.58E+04	1.60E+03	0.00E+00	1.60E+03	1.74E+04	2.11E+04
Cs-137	3.63E+06	3.91E+04	3.66E+06	2.13E+07	5.44E+05	2.18E+07	3.73E+06	1.66E+05	3.89E+06	2.94E+07	2.68E+07
Ba-137	3.63E+06	3.91E+04	3.66E+06	2.13E+07	5.44E+05	2.18E+07	3.73E+06	1.66E+05	3.89E+06	2.94E+07	2.55E+07
Eu-154	4.34E+02	4.38E+00	4.38E+02	7.14E+04	1.93E+03	7.33E+04	5.33E+02	0.00E+00	5.33E+02	7.43E+04	5.51E+04
Np-237	0.00E+00	3.79E-01	3.79E-01	6.76E+00	3.83E+01	4.50E+01	1.02E-01	3.98E-02	1.42E-01	4.56E+01	4.56E+01
Pu-238	0.00E+00	1.05E+03	1.05E+03	1.65E+02	5.12E+00	1.71E+02	1.40E+02	5.46E+01	1.95E+02	1.42E+03	1.37E+03
Pu-239	2.02E+01	2.12E+03	2.14E+03	1.22E+03	3.72E+03	4.94E+03	6.27E+01	1.22E+03	1.28E+03	8.36E+03	8.36E+03
Pu-240	5.06E+00	7.59E+02	7.64E+02	3.07E+02	9.64E+02	1.27E+03	1.57E+01	3.44E+02	3.60E+02	2.39E+03	2.39E+03
Pu-241	9.47E+00	1.85E+04	1.85E+04	7.43E+02	1.00E+04	1.08E+04	2.86E+01	1.03E+04	1.03E+04	3.97E+04	3.94E+04
Am-241	1.63E+02	1.17E+04	1.19E+04	5.03E+03	5.37E+04	5.87E+04	1.47E+02	3.51E+02	4.98E+02	7.11E+04	7.07E+04
Total	8.60E+06	2.11E+05	8.81E+06	4.99E+07	2.18E+07	7.18E+07	1.01E+07	5.93E+05	1.06E+07	9.12E+07	8.27E+07

RESIDUAL INVENTORY IN 28 ORIGINAL DSTs
RESIDUAL = 1% OF CURRENT INVENTORY
Decayed to 12/31/1995

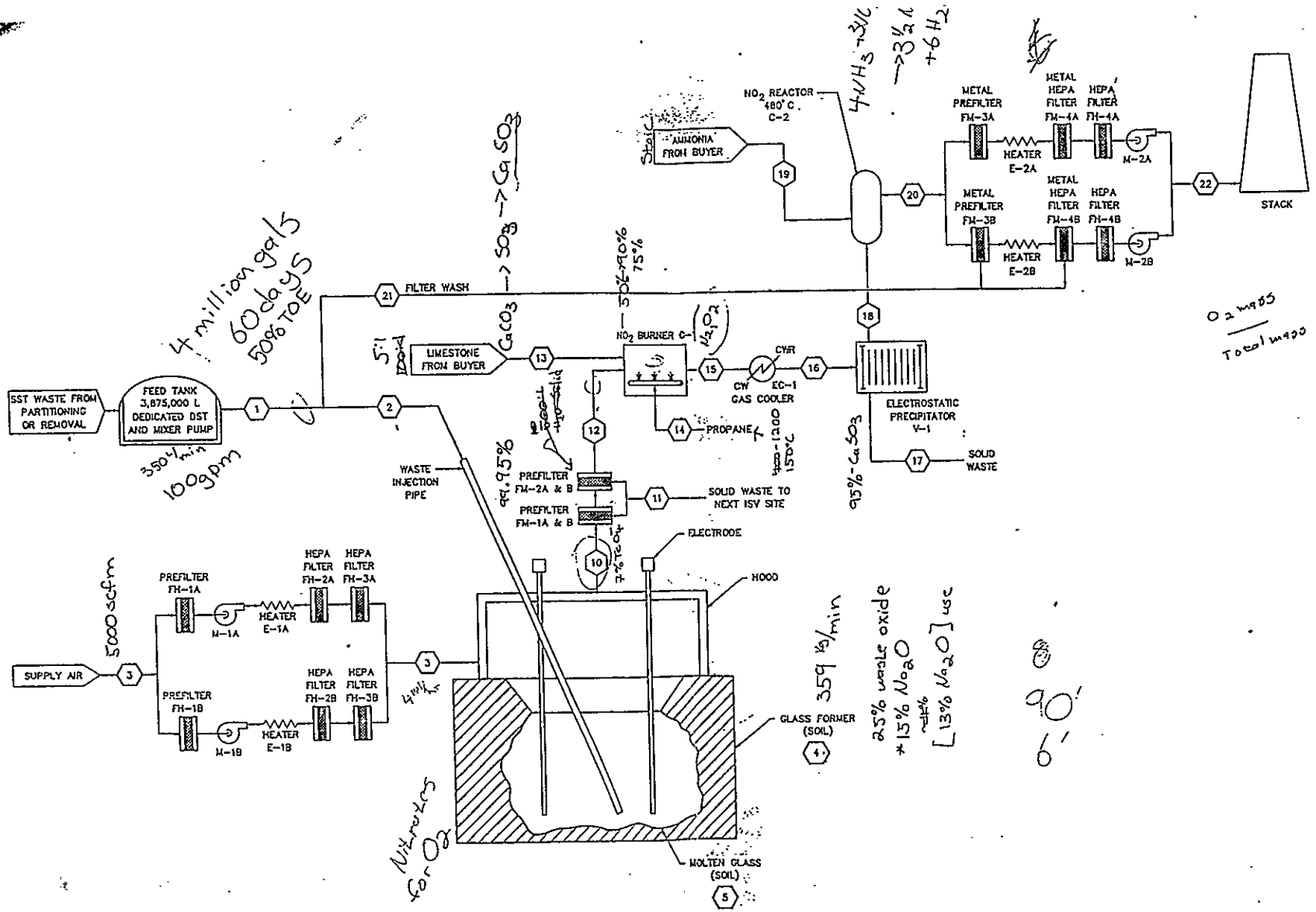
Radionuclide	3WDS	3EDS	5EDS	TOTAL
Ci				
, kgs	1.32E+04	5.96E+04	2.70E+04	9.99E+04
-14	8.06E-03	2.32E+01	5.23E-02	2.33E+01
Sr-90	6.10E+02	1.10E+05	6.96E+02	1.11E+05
Y-90	6.10E+02	1.10E+05	6.96E+02	1.11E+05
Tc-99	3.66E+01	1.58E+02	1.60E+01	2.11E+02
Cs-137	3.66E+04	2.18E+05	3.89E+04	2.94E+05
Ba-137	3.66E+04	2.18E+05	3.89E+04	2.94E+05
Eu-154	4.38E+00	7.33E+02	5.33E+00	7.43E+02
Np-237	3.79E-03	4.50E-01	1.42E-03	4.56E-01
Pu-238	1.05E+01	1.71E+00	1.95E+00	1.42E+01
Pu-239	2.14E+01	4.94E+01	1.28E+01	8.36E+01
Pu-240	7.64E+00	1.27E+01	3.60E+00	2.39E+01
Pu-241	1.85E+02	1.08E+02	1.03E+02	3.97E+02
Am-241	1.19E+02	5.87E+02	4.98E+00	7.11E+02
Total	8.81E+04	7.18E+05	1.06E+05	9.12E+05

RESIDUAL INVENTORY IN FIRST GROUP
OF DST REPLACEMENT TANKS (26 TANKS)
DECAYED TO 12/31/95

Radionucli	TOTAL
Ci	
Na, kgs	99910.92
C-14	23.30806
Sr-90	110913.9
Y-90	110913.9
Tc-99	211
Cs-137	294071.5
Ba-137	294071.5
Eu-154	742.7761
Np-237	0.455693
Pu-238	14.17277
Pu-239	83.6
Pu-240	23.942
Pu-241	396.5076
Am-241	711.1363
Total	912088.5

NO ACTION POST REMEDIATION RAD INVENTORY FOR DSTS

ESIDUALINVENTORY IN THE SECOND GROUP	
OF DST REPLACEMENT TANKS (26 TANKS) 98%	
OF ORIGINAL INVENTORY	
Decayed to 12/31/1995	
Radionuclide	
Ci	
Na, kgs	97912.7
C-14	22.8419
Sr-90	108695.6
Y-90	108695.6
Tc-99	206.78
Cs-137	288190
Ba-137	288190
Eu-154	727.9206
Np-237	0.446579
Pu-238	13.88932
Pu-239	81.928
Pu-240	23.46316
Pu-241	388.5775
Am-241	696.9135
Total	893846.7



SLURRY INJECTION IN-SITU VITRIFICATION PROCESS DIAGRAM SHEET 1
(SLURRY ISV)

Units of this run are shown below

RESPONSE A2 ISV RESIDUAL INVENTORY

STREAM NAME / LIQUID COMPONENTS	1	2	3	4	5	10	11	12	13	14
and Ba, (MCi)	6.28E+01	6.28E+01								
and Y, (MCi)	2.10E+00	2.10E+00								
Tc, (MCi)	2.61E-02	2.61E-02			1.59E-02					
Am, (MCi)	8.61E-03	8.61E-03								
Np, (MCi)	1.03E-05	1.03E-05								
Pu-239, (MCi)	1.67E-03	1.67E-03								
Pu-240, (MCi)	4.14E-04	4.14E-04								
Pu-241, (MCi)	1.49E-03	1.49E-03								
Total TRU, (MCi)	1.22E-02	1.22E-02								
Total MCi	6.49E+01	6.49E+01			1.59E-02					
Total Mass Flow, (MT)	3.00E+05	3.01E+05	2.74E+05		1.24E+00	4.87E+05		4.87E+05		1.09E+04
Total Cr, (MT)	5.15E+01	5.15E+01								
Total Na, (MT)	6.51E+04	6.51E+04								
Total Si, (MT)	5.65E+00	5.65E+00								
Total P, (MT)	8.42E+02	8.42E+02								
Total NO2-, (MT)	9.54E+03	9.54E+03								
Total NO3-, (MT)	1.06E+05	1.06E+05								
AG+	3.28E-01	3.28E-01								
AL(OH)4-	4.83E+03	4.83E+03								
AM+3	2.51E-03	2.51E-03								
AS+5	7.70E-01	7.70E-01								
B+3	5.19E-01	5.19E-01								
BA+2	7.91E-01	7.91E-01								
BE+2	8.19E-02	8.19E-02								
BI+3	6.76E+01	6.76E+01								
C14	7.43E-04	7.43E-04								1.09E+04
C3H8										
CA+2	1.67E+01	1.67E+01								
CD+2	2.09E+00	2.09E+00								
CE+3	2.37E+00	2.37E+00								
CL-	3.11E+02	3.11E+02				3.15E+02		3.15E+02		
CL2						8.65E+03		8.65E+03		
CO2										
CO3-2	3.37E+03	3.37E+03								
CR(OH)4-	1.19E+02	1.19E+02								
CS+	8.19E-01	8.19E-01								
CU+2	1.77E-01	1.77E-01								
F-	1.12E+03	1.12E+03								
F2						1.18E+03		1.18E+03		
FE+3	1.44E+01	1.44E+01								
H2O	9.60E+04	9.73E+04				1.09E+05		1.08E+05		
HG						9.58E-01		9.58E-01		
HG+2	9.49E-01	9.49E-01								
I-	5.46E+02	5.46E+02								
I2						5.66E+02		5.66E+02		
K+	2.19E-01	2.19E-01								
LA+3	2.19E-01	2.19E-01								
LI+	5.77E-03	5.77E-03								
MG+2	9.65E-01	9.65E-01								
MNO2	2.17E+01	2.17E+01								
MO+6	4.87E+00	4.87E+00								
N2			2.17E+05			2.40E+05		2.40E+05		
NA+	6.51E+04	6.51E+04								
NH3										
NI+3	4.07E+00	4.07E+00								
NO						3.20E+02		3.20E+02		
NO2						1.34E+04		1.34E+04		
NO2-	9.54E+03	9.54E+03								
NO3-	1.06E+05	1.06E+05								
NP+4	1.46E-02	1.46E-02								
O2			5.75E+04			1.14E+05		1.14E+05		
OH-	6.44E+03	6.44E+03								
PB+4	1.96E+00	1.96E+00								
PO4-3	2.58E+03	2.58E+03								
PU+4	2.88E-02	2.88E-02								
[illegible]+4	5.65E+00	5.65E+00								
[illegible]2						1.36E+03		1.36E+03		
[illegible]	2.01E+03	2.01E+03								
[illegible]	3.75E-01	3.75E-01								
[illegible]LO2					1.24E+00					
TCO4-	2.52E+00	2.52E+00								
TOC	1.42E+03	1.42E+03								
UO2+2	8.52E+01	8.52E+01								
V+5	6.20E-02	6.20E-02								
W+6	7.47E-01	7.47E-01								

ZN+2	3.59E-00	3.59E-00							
ZR+4	4.48E-01	4.48E-01							
ZRO2:2H2	2.15E-01	2.15E-01							

STREAM NAME SOLID COMPONENTS	1	2	3	4	5	10	11	12	13	14
and Ba, (MCi)	5.28E+00	5.28E+00			6.32E+01	4.75E+00	4.75E+00	1.43E-03		
and Y, (MCi)	1.05E+02	1.05E+02			1.07E+02	1.07E-01	1.07E-01	3.22E-05		
Tc, (MCi)	5.89E-03	5.89E-03			1.48E-02	1.11E-03	1.11E-03	3.34E-07		
Am, (MCi)	9.51E-02	9.51E-02			1.04E-01	1.04E-04	1.04E-04	3.11E-08		
Np, (MCi)	9.29E-05	9.29E-05			1.03E-04	1.03E-07	1.03E-07	3.10E-11		
Pu-239, (MCi)	2.47E-02	2.47E-02			2.63E-02	2.64E-05	2.64E-05	7.91E-09		
Pu-240, (MCi)	6.28E-03	6.28E-03			6.69E-03	6.70E-06	6.69E-06	2.01E-09		
Pu-241, (MCi)	7.34E-02	7.34E-02			7.48E-02	7.48E-05	7.48E-05	2.25E-08		
Total TRU, (MCi)	2.00E-01	2.00E-01			2.12E-01	2.12E-04	2.12E-04	6.35E-08		
Total MCi	1.11E+02	1.11E+02			1.71E+02	4.86E+00	4.86E+00	1.46E-03		
Total Mass Flow, (MT)	1.94E+04	1.98E+04		1.08E+06	1.19E+06	1.19E+03	1.19E+03	3.56E-01	1.07E+04	
Total Cr, (MT)	1.32E+02	1.32E+02			1.84E+02	1.84E-01	1.84E-01	5.51E-05		
Total Na, (MT)	1.24E+03	1.24E+03			6.62E+04	6.63E+01	6.63E+01	1.99E-02		
Total Si, (MT)	5.24E+02	5.24E+02		5.04E+05	5.04E+05	5.04E+02	5.04E+02	1.51E-01		
Total P, (MT)	7.80E+02	7.80E+02			1.62E+03	1.62E+00	1.62E+00	4.87E-04		
Total NO2-, (MT)	7.38E+01	7.38E+01								
Total NO3-, (MT)	1.03E+03	1.03E+03								
AG+	1.38E+00	1.38E+00								
AG2O					1.83E+00	1.83E-03	1.83E-03	5.49E-07		
AL+3	2.37E+03	2.37E+03								
AL2O3		1.18E-04			7.87E+03	7.88E+00	7.87E+00	2.36E-03		
AM+3	2.77E-02	2.77E-02								
AM2O3					3.32E-02	3.32E-05	3.32E-05	9.97E-09		
AS+5	4.98E-01	4.98E-01								
AS2O5					1.94E+00	1.95E-03	1.94E-03	5.84E-07		
B+3	9.94E-01	9.94E-01								
B2O3		7.31E-08			4.87E+00	4.87E-03	4.87E-03	1.46E-06		
BA+2	3.09E+00	3.09E+00								
BAO		6.50E-08			4.33E+00	4.33E-03	4.33E-03	1.30E-06		
BE+2	7.61E-03	7.61E-03								
BEO					2.48E-01	2.48E-04	2.48E-04	7.45E-08		
BI+3	1.96E+02	1.96E+02								
BI2O3		4.41E-06			2.94E+02	2.94E-01	2.94E-01	8.81E-05		
4	4.53E-04	4.53E-04								
2	1.33E+02	1.33E+02								
CACO3									1.07E+04	
CASO4		1.42E+02			1.42E+02					
CANCRINI	2.70E+03	2.70E+03								
CAO		2.40E+02			4.49E+02	4.50E-01	4.50E-01	1.35E-04		
CD+2	7.93E+00	7.93E+00								
CDO		1.72E-07			1.14E+01	1.14E-02	1.14E-02	3.43E-06		
CE+3	2.35E+02	2.35E+02								
CE2O3		4.17E-06			2.78E+02	2.78E-01	2.78E-01	8.35E-05		
CL-	3.49E+00	3.49E+00								
CO3-2	2.25E+02	2.25E+02								
CR+3	1.32E+02	1.32E+02								
CR2O3		4.03E-06			2.68E+02	2.68E-01	2.68E-01	8.05E-05		
CS+	9.25E-02	9.25E-02								
CS2O		1.01E-06			8.97E-01	6.76E-02	6.75E-02	2.03E-05		
CU+2	7.46E-01	7.46E-01								
CUO		1.73E-08			1.15E+00	1.16E-03	1.16E-03	3.47E-07		
F-	5.97E+01	5.97E+01								
FE+3	7.63E+02	7.63E+02								
FE2O3		1.85E-05			1.23E+03	1.23E+00	1.23E+00	3.70E-04		
HG+2	9.00E-03	9.00E-03								
I-	2.08E+01	2.02E+01								
K+	2.10E+01	2.10E+01								
K2O					2.56E+01					
LA+3	2.10E+01	2.10E+01								
LA2O3		3.73E-07			2.49E+01	2.49E-02	2.49E-02	7.47E-06		
LI+	2.46E-02	2.46E-02								
LI2O					6.53E-02	6.53E-05	6.53E-05	1.96E-08		
MG+2	1.10E+01	1.10E+01								
MGO		2.98E-07			1.98E+01	1.98E-02	1.98E-02	5.95E-06		
MNO2	2.09E+02	2.09E+02			2.30E+02	2.31E-01	2.31E-01	6.92E-05		
MO+6	8.01E-01	8.01E-01								
O3		1.28E-07			8.50E+00	8.51E-03	8.51E-03	2.55E-06		
	7.77E+02	7.77E+02								
2O		1.34E-03			8.93E+04	8.94E+01	8.93E+01	2.68E-02		
NI+3	6.57E+00	6.57E+00								
NI2FECN6	5.00E+02	5.00E+02								
NI2O3					1.50E+01					
NIO		3.40E-06			2.27E+02	2.27E-01	2.27E-01	6.81E-05		
NO2-	7.38E+01	7.38E+01								
NO3-	1.03E+03	1.03E+03								
NP+4	1.32E-01	1.32E-01								

NPO2					1.66E-01	1.66E-04	1.66E-04	4.99E-08		
OH-	5.00E+03	5.00E-03								
P2O5		5.57E-05			3.71E+03	3.71E-00	3.71E-00	1.11E-03		
P2O5:24W	5.21E-01	5.21E-01								
PB+4	3.28E+00	3.28E+00								
PBO2		9.07E-08			6.04E+00	6.05E-03	6.05E-03	1.82E-06		
-3	2.39E+03	2.39E+03								
	4.27E-01	4.27E-01								
2					5.16E-01	5.16E-04	5.16E-04	1.55E-07		
SI+4	7.90E+01	7.90E+01								
SIO2		1.62E-02		1.09E+06	1.08E+06	1.08E+03	1.08E+03	3.24E-01		
SO4-2	3.97E+01	3.97E+01								
SR+2	3.64E+01	3.64E+01								
SRO		6.36E-07			4.33E+01	4.33E-02	4.33E-02	1.30E-05		
TC2O7		1.54E-06			1.37E+00	1.03E-01	1.03E-01	3.09E-05		
TCO4-	5.68E-01	5.68E-01								
TOC	1.16E+02	1.16E+02								
UO2+2	1.58E+03	1.58E+03								
UO3		2.64E-05			1.76E+03	1.76E+00	1.76E+00	5.29E-04		
V+5	1.68E-01	1.88E-01								
V2O5					4.46E-01	4.46E-04	4.46E-04	1.34E-07		
WO2					4.41E-01	4.41E-04	4.41E-04	1.32E-07		
WO3					9.41E-01	9.42E-04	9.42E-04	2.83E-07		
ZN+2	9.45E-01	9.45E-01								
ZNO		8.47E-08			5.64E+00	5.65E-03	5.64E-03	1.69E-06		
ZR+4	2.77E+02	2.77E+02								
ZRO2		1.06E-05			7.07E+02	7.07E-01	7.07E-01	2.12E-04		
ZRO2:2H2	4.09E+02	4.09E+02								

1

to WGP

STREAM NAME LIQUID COMPONENTS	15	16	17	18	19	20	21	22
Cs and Ba, (MCi)								
Sr and Y, (MCi)								
Tc, (MCi)								
Am, (MCi)								
Np, (MCi)								
Pu-239, (MCi)								
Pu-240, (MCi)								
Pu-241, (MCi)								
al TRU, (MCi)								
al MCi								
Total Mass Flow, (MT)	5.01E+05	5.01E+05		5.01E+05	6.84E+02	5.02E+05	1.27E+03	5.00E+05
Total Cr, (MT)								
Total Na, (MT)								
Total Si, (MT)								
Total P, (MT)								
Total NO2-, (MT)								
Total NO3-, (MT)								
AG+								
AL(OH)4-								
AM+3								
AS+5								
B+3								
BA+2								
BE+2								
BI+3								
C14								
C3H8								
CA+2								
CD+2								
CE+3								
CL-								
CL2	3.15E+02	3.15E+02		3.15E+02		3.15E+02		3.15E+02
CO2	4.61E+04	4.61E+04		4.61E+04		4.61E+04		4.61E+04
CO3-2								
CR(OH)4-								
CS+								
CU+2								
F-								
F2	1.18E+03	1.18E+03		1.18E+03		1.18E+03		1.18E+03
FE+3								
H2O	1.26E+05	1.26E+05		1.26E+05		1.27E+05	1.27E+03	1.25E+05
	9.58E-01	9.58E-01		9.58E-01		9.58E-01		9.58E-01
2								
H2	5.66E+02	5.66E+02		5.66E+02		5.66E+02		5.66E+02
K+								
LA+3								
LI+								
MG+2								
MNO2								
MO+6								

Table 9-15. Decommissioning of Contaminated Treatment/Storage Facilities. (Metric Kilo-Tons)

Item	Tri-Party Agreement Preferred Alternative
Steel Quantity Disposition	17 LLW burial grounds
Concrete Quantity Disposition	36 LLW burial grounds
Soil Quantity Disposition	0
Debris Quantity Disposition	2.6 LLW burial grounds

TPA

RESPONSE B1

F.10 Backup for Tables 9-14 and 9-15

- Plant has been operated without accident.
- Spills have been properly cleaned up and have been decontaminated.
- The cell liner has not been breached during plant operation.
- The vitrification buildings, their dedicated facilities and the receipt/sample facilities:
  - 5% of concrete is contaminated.
  - 5% of carbon steel is contaminated.
  - 85% of stainless steel is contaminated.
  - 100% of hastelloy/inconnel is contaminated.
- Centralized facilities:
  - No concrete contamination.
  - No steel contamination.
- No soil contamination
- Debris = 5% of contaminated/non-contaminated concrete + steel quantities.
- One M^3 of concrete = 732 kilograms, say .75 kilotons.
- All installed quantities of concrete and steel are taken from the construction quantity backup table.

TPA Back Up

Table 5-15. Decommissioning of Contaminated Treatment/Storage Facilities (Units as Indicated).

Item	No Disposal Action
Steel Quantity Disposition	20 t Low-level waste burial ground
Concrete Quantity Disposition	150 m^3 Low-level waste burial ground
Soil Quantity Disposition	0
Debris Quantity Disposition	140 m^3 Low-level waste burial ground

Notes:

m^3 = cubic meters
t = metric tons

As a part of this alternative, the current double-shell tanks and the new double-shell tanks would be left in place; therefore, no decontamination and decommissioning work would be done on them. The abandoned double-shell tanks may be filled with grout or gravel. Details of the closure of the double-shell tanks are in the *Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Study* (Scanlon et al. 1995)

The two high-level waste evaporators built as part of this alternative would be decommissioned. The entries in this table are for those evaporators. The following assumptions were made for decommissioning: 5 percent of the concrete and steel will remain contaminated; 85 percent of the stainless steel will remain contaminated; 5 percent of the decontaminated steel and concrete will be debris; and the evaporators will be entombed in place so no contaminated soil would need to be removed.

Scanlon, P.L., H. Hampt and W.A. Skelly, 1995, *Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Study*, WHC-SD-WM-EV-107, Rev. B, Westinghouse Hanford Company, Richland, Washington.

RESPONSE B2

Table 7-15. Comparison of Alternatives by Decommissioning of Contaminated Treatment Facilities and Equipment (Metric Tons).[1]

Item	In Situ Chemical Stabilization[2]	Drying and Gravel Fill[3]	In Situ Vitrification[4]
Steel Quantity	2.6 E5	1.6 E3	2.6 E5
Concrete Quantity	3.2 E5	--	3.2 E5
Soil Quantity	8.8 E5	--	8.8 E5
Disposition	low-level waste burial grounds	low-level waste burial grounds	low-level waste burial grounds

Notes:

[1]All Tank Farm Confinement Facilities (TFCF) and everything contained under the TFCFs are assumed to be contaminated.

[2]TFCF = 2.6 E5 metric tons steel
= 3.2 E5 metric tons concrete
= 8.8 E5 metric tons soil

Mixing Equipment = 7.5 E2 metric tons steel

[3]Assumes 20 percent of drying systems become contaminated:
= 1.6 E3 metric tons steel

[4]TFCF = 2.6 E5 metric tons steel
= 3.2 E5 metric tons concrete
= 8.8 E5 metric tons soil

Assumes 90 percent of in situ vitrification equipment becomes contaminated:
= 8.2 E2 metric tons steel

RESPONSE B3

Request Number 039

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Joan Young

Date: 03/20/95

Phone Number: (509) 946-7112

Fax Number: (509) 943-6812

Request Information: Data request for modeling risk before and after remediation.

Item #2 Priority A

Need Date: 04/07/95

Response: See attached.

Data Source/Accuracy:

Prepared By: C. Henderson

Date Sent/Faxed: 4/7/95

Concurrence: Marc E. Nelson
Marc Nelson - Deputy Project Manager

c) cesium and strontium capsules -- the source inventory must be provided for the cesium chloride and strontium fluoride capsules stored in water basins at the WESF.

For all Alternatives:

d) secondary wastes -- an estimate of the secondary wastes that are generated and that should be included in the inventory from process operations or D&D is needed.

2. CONTAMINATED MEDIA AND CONCENTRATION OF CONTAMINANTS IN THE CONTAMINATED MEDIA FOR TIME INTERVALS OF INTEREST TO TWRS EIS

For all Alternatives:

The media contaminated by post remediation releases to the environment (groundwater, soil (surface), soil (deep), surface water, and air), the concentration of these contaminants in each medium for each grid cell location must be stated for the following time frames: T_0, $T_{Closure}$, T_{100}, T_{300}, T_{500}, T_{1000}, $T_{10,000}$.

3. SUMMARY OF VOLUME OF RADIOACTIVE WASTE GENERATED BY EACH ALTERNATIVE

A summary of the volume of radioactive waste generated by each alternative is desired. The following information is requested for TPA, No Action, ISV, and Cs and Sr Capsules Alternatives:

a. No. of HLW Canisters Produced
b. Volume of HLW Produced
c. Volume of LLW Produced
d. No. of LLW Storage Vaults
e. Volume of Waste Left in Tanks
f. Time Treatment Begins
g. Time Treatment Ends

4. ATMOSPHERIC EMISSIONS FROM TANK RESIDUALS AND LLW DISPOSAL VAULTS AFTER CLOSURE

For ISV Alternative:

The assumption is that there will be no atmospheric emissions from tank residuals after closure. Please verify that this is correct.

For No Action Tanks and Cs and Sr Capsules (No Action):

Data Request 39

The concentration of contaminants at each grid cell location for times T_0, $T_{closvie}$, T_{100}, T_{300}, T_{800}, T_{1000}, $T_{10,000}$ will be provided following air and groundwater modeling efforts by ESE. These are deliverables that are scheduled in the May time frame. See a current schedule for actual dates.

Request Number 040

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Joan Young

Date: 3/20/95

Phone Number: 946-7112

Fax Number: 943-6812

Request Information: Data request for modeling risk before and after remediation.

Item 3. Priority B

Need Date: 4/7/95

Response: See attached.

Data Source/Accuracy: Data from engineering data packages and waste tank summary.

Prepared By: Colin Henderson

Date Sent/Faxed:

Concurrence: Marc C Nelson
Marc Nelson - Deputy Project Manager

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c) cesium and strontium capsules -- the source inventory must be provided for the cesium chloride and strontium fluoride capsules stored in water basins at the WESF.

For all Alternatives:

d) secondary wastes -- an estimate of the secondary wastes that are generated and that should be included in the inventory from process operations or D&D is needed.

2. CONTAMINATED MEDIA AND CONCENTRATION OF CONTAMINANTS IN THE CONTAMINATED MEDIA FOR TIME INTERVALS OF INTEREST TO TWRS EIS

For all Alternatives:

The media contaminated by post remediation releases to the environment (groundwater, soil (surface), soil (deep), surface water, and air), the concentration of these contaminants in each medium for each grid cell location must be stated for the following time frames: T_0, $T_{Closure}$, T_{100}, T_{300}, T_{500}, T_{1000}, $T_{10,000}$.

3. SUMMARY OF VOLUME OF RADIOACTIVE WASTE GENERATED BY EACH ALTERNATIVE

A summary of the volume of radioactive waste generated by each alternative is desired. The following information is requested for TPA, No Action, ISV, and Cs and Sr Capsules Alternatives:

a. No. of HLW Canisters Produced
b. Volume of HLW Produced
c. Volume of LLW Produced
d. No. of LLW Storage Vaults
e. Volume of Waste Left in Tanks
f. Time Treatment Begins
g. Time Treatment Ends

4. ATMOSPHERIC EMISSIONS FROM TANK RESIDUALS AND LLW DISPOSAL VAULTS AFTER CLOSURE

For ISV Alternative:

The assumption is that there will be no atmospheric emissions from tank residuals after closure. Please verify that this is correct.

For No Action Tanks and Cs and Sr Capsules (No Action):

DATA REQUEST 040

TPA

a. Number of HLW canisters = 6,800 canisters
HLW glass canister = .66 m ID by 4.57 m tall
There are four canisters in a Hanford Multipurpose Cask (HMPC). The canisters will be placed in casks for storage and shipment to Yucca Mountain.
Number of casks (MPCs) = 1,700

b. Volume of HLW produced
From Table 9-1 pages 9-3 of TPA data package.
Volume HLW glass = 9.4 E3 m^3

c. Volume of LLW produced
From Table 9-1 pages 9-3
Volume LLW glass = 2.2E5m^3 (includes sulfur cement)
= 1.46E5* m^3 (without sulfur cement)

d. Number of LLW disposal vaults.
From the Site plan the number of LLW vaults = 46

e. Volume of waste left in the tanks.
The volume of waste left in the tanks equals 1% of current volume based on 99% retrieval and a uniform waste density.

- Using the Waste Tank Summary (WHC-EP-0182-81 Table E4)
- Requirement of no more than 190 m^3 (50,160 gallons) residual liquid after saltwell pumping. (WHC-SD-WM-EV-099 Rev. B pages 1-2)
- The maximum residuals should be:

* LLW glass volume = 3.87E5 mt x 1000 kg/mt x 1/2643 kg/m^3

200 East

Tank Farm	Total Waste (kgal)	Residual (kgal)*
A (SST)	1,537	15.37
AN (DST)	6,562	65.62
AP (DST)	4,194	41.94
AW (DST)	3,849	38.49
AX (SST)	906	9.06
AY (DST)	1,668	16.68
AZ (DST)	1,911	19.11
B (SST)	2,057	20.57
BX (SST)	1,548	15.48
BY (SST)	4,744	47.44
C (CCT)	2,131	21.31

200 West

Tank Farm	Total Waste (kgal)	Residual (kgal)**
S (SST)	5,510	55.1
SX (SST)	4,425	44.25
SY (DST)	2,608	26.08
T (SST)	2,209	20.29
TX (SST)	7,009	70.09
TY (SST)	638	6.38
U (SST)	3,350	33.50

* Assume no additional saltwell pumping, on a tank farm basis all SST farms are below the above mentioned requirement.

** Assumes 1% of current inventory.

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f. Treatment begins and ends.
LLW Vitrification operates between 6/2005-12/2019.
HLW Vitrification operates between 12/2005-12/2023.

g. Treatment begins and ends.
LLW Vitrification operates between 6/2005-12/2019.
HLW Vitrification operates between 12/2005-12/2023.

No Action

a. No HLW canister = 0

b. Volume HLW produced = 0

c. Volume LLW produced = 0

d. No LLW disposal vaults = 0

e. Volume of waste left in tanks.
The 1% residual is valid for the current DSTs and the same residual will be left in the first set of replacement DSTs constructed.

After the 100 year period, the following will exist for No Action:
SSTs: will contain current inventory.
DSTs: the DST wastes will have been retanked two times so 98% of existing waste would be in 26 DSTs. There would be 54 (28+26) DSTs with a 1% residual. The empty DSTs would be deactivated and isolated.

f. No treatment is associated with No Action.
Retanking is scheduled as follows for DSTs:
1st campaign 6/2037-6/2042
2nd campaign 6/2087 - 6/2092

g. No treatment is associated with No Action.
Retanking is scheduled as follows for DSTs:
1st campaign 6/2037-6/2042
2nd campaign 6/2087 - 6/2092

ISV

a. No HLW canisters produced = 0

b. Volume of HLW produced = 3.8E6 m^3
(assume all vitrified product is HLW)

c. Volume LLW = 0

d. No Vaults for LLW disposal = 0

e. Volume waste left in tanks
Assume all the waste in the tanks as well as the tank and surrounding soil to a depth of 18 meters is vitrified.

f. Time treatment begins = 2005 (vitrification)
The alternative overall construction begins 1998.
Operation begins 2000.

g. Time treatment ends 2016.

Capsules

a. Number of HLW canister?
No Action= 584 canisters
No Immobilization = 509 canisters
Extensive Immobilization = between 18 and 133 canisters.

b. The above mentioned canisters are all 1.259 m^3 in volume. However, for No Action and No Immobilization, the existing capsules (volume = 2.45 m^3) are stacked axially inside the canisters during overpack operations. For vitrification the number of canisters is dependent on the waste loading in the glass.

c. N/A

d. For No Action the overpacked canisters will be placed in one of 672 drywells (584 + 15% contingency).

e. N/A

f. Time treatment begins:
No Action - N/A (capsule packaging operation begin 2010).
No Immobilization - N/A (capsule packaging operation begins 2010).
Extensive Immobilization - No schedule provided (should correspond to date for HLW vitrification for TPA).

g. Time Treatment ends:
No Action - N/A (capsule packaging ends 2029).
No Immobilization - N/A (capsule packaging ends 2028).
Extensive Immobilization - no schedule provided.

Request Number 41

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Joan Young Date: 3/20/95

Phone Number: 946-7112 Fax Number: 943-6812

Requested Information: Data request for modelling risk before and after remediation
Item 4 Priority C.

Need Date: 4/7/95

Response:

Data Source/Accuracy:

Prepared By: Dave Murray Colin Heal Date Sent/Faxed:

Concurrence: Marc E. Nelson
Marc Nelson - Deputy Project Manager

c) cesium and strontium capsules -- the source inventory must be provided for the cesium chloride and strontium fluoride capsules stored in water basins at the WESF.

For all Alternatives:

d) secondary wastes -- an estimate of the secondary wastes that are generated and that should be included in the inventory from process operations or D&D is needed.

2. CONTAMINATED MEDIA AND CONCENTRATION OF CONTAMINANTS IN THE CONTAMINATED MEDIA FOR TIME INTERVALS OF INTEREST TO TWRS EIS

For all Alternatives:

The media contaminated by post remediation releases to the environment (groundwater, soil (surface), soil (deep), surface water, and air), the concentration of these contaminants in each medium for each grid cell location must be stated for the following time frames: T_0, $T_{Closure}$, T_{100}, T_{300}, T_{500}, T_{1000}, $T_{10,000}$.

3. SUMMARY OF VOLUME OF RADIOACTIVE WASTE GENERATED BY EACH ALTERNATIVE

A summary of the volume of radioactive waste generated by each alternative is desired. The following information is requested for TPA, No Action, ISV, and Cs and Sr Capsules Alternatives:

a. No. of HLW Canisters Produced
b. Volume of HLW Produced
c. Volume of LLW Produced
d. No. of LLW Storage Vaults
e. Volume of Waste Left in Tanks
f. Time Treatment Begins
g. Time Treatment Ends

4. ATMOSPHERIC EMISSIONS FROM TANK RESIDUALS AND LLW DISPOSAL VAULTS AFTER CLOSURE

For ISV Alternative:

The assumption is that there will be no atmospheric emissions from tank residuals after closure. Please verify that this is correct.

For No Action Tanks and Cs and Sr Capsules (No Action):

Please indicate if there will be air emissions after closure from the No Action Alternatives for the tank farms or WESF.

For Cs and Sr Capsules (Both TPA and Over Pack and Ship):

The assumption is that there will be no atmospheric emissions after closure, because all Cs and Sr waste will be shipped offsite for these subalternatives. Please confirm that this is correct.

cc: Alex Nazarali
Andy Stanley
Reed Kaldor
Mitch Pelton
John Shrock
Mike Harker
Phil Rogers
File 587.2.11.2.2
File 587.2.11.2.5

EIR #41 Atmospheric Emissions From Tank Residuals and LLW Disposal vaults After Closure.

For ISV: There are assumed to be no atmospheric emissions from the vitrified tanks for two reasons: all volatile materials will have been removed from the tanks during the ISV process and treated in an offgas treatment system; and the vitrified remains of the tanks will be covered with a Hanford barrier.

For No Action Tanks: There will be volatile and radioactive emissions from the tanks which are assumed to be similar to those measured at present. The complete answers to these two situations are found in the answers to EIR's 55 & 57. (Attached).

For No Action Capsules: There will be no emissions from the capsules which will ultimately be sealed into drywell enclosures.

For Vitrified Capsules: The capsule contents will be blended with the HLW and vitrified. All emissions will be treated in the offgas system, and the vitrified materials will be shipped offsite to a geologic repository, so no atmospheric emissions are assumed.

For Overpacked and Shipped Capsules: No atmospheric emissions are assumed during the overpacking operations, and the overpacked capsules are shipped offsite to a geologic repository.

DATA REQUEST 055

The attached calculation estimates the concentration and volume of gas released from a selected number of tanks. These VOC emissions are a result of storing the waste in the tanks and are not specifically related to extensive retrieval operations. These emissions can be viewed as on going until the wastes are removed from the tanks.

During the retrieval process an exhauster will be hooked up to the ventilation system of the tank being retrieved. Those tanks that will have waste retrieval operations going on will have active ventilation. This will tend to increase the overall mass of VOC emitted, from both the increased air flow and stirring the wastes up with the sluicer. The increase in mass will be at a significantly lower concentration than that seen in the head space data for tank C-103.

An actively ventilated tank has a ventilation flow rate of 500-1600 cubic meters per hour. The passively vented tank estimate for ventilation flow is 0.33 cubic meters per hour. This represents a 1500-4800 fold increase in air flow from the tank.

Another point is that the wastes have been sitting in the tanks for a number of years and most of the wastes have been through an evaporator, thus the majority of the volatiles have already left the tanks. The VOCs coming out of the tanks now may be decay products of the heavier organics in the tanks.

The following method to estimate the VOC emissions from a tank during retrieval is as follows:

- assume that the mass of VOC emitted from a tank remains constant
- the ventilation flow rate goes from 0.33 cu meter/hr to 4000 cu. meters/hr
- two of the organic tanks get retrieved per year once retrieval operations begin
- to maintain a constant mass emission per tank the concentration of the organic from the C-103 head space data should be ratioed by (0.083/4000) 2.1E-5. This is the annual average volumetric flow from a passively ventilated tank divided by the volumetric flow of an actively ventilated tank.

To estimate organic emissions during evaporator operations, we asked WHC for organic emissions data from 242A evaporator operations (currently operating). WHC replied that organic emissions from the evaporator are not measured but instead are reported based on calculations using the feed stream concentrations. The calculations for recent evaporator runs ar not yet completed, but should be done in the next few weeks.

Using the attached calculation the following table is developed for organic emissions.

Pollutant	Source	Peak Hourly Volume Released (m3/hr)	Annual Average volume of release (m3/yr)	Chronological Phase
see note 1	TF9E (1 tank)	0.33	720	see note 2
"	TF8E (1 tank)	0.33	720	"
"	TF3E (1 tank)	0.33	720	"
"	TF4E (2 tank)	0.66	1450	"
"	TF5W (2 tanks)	0.66	1450	"
"	TF6W (2 tanks)	0.66	1450	"
"	TF1W (1 tank)	0.33	720	"
"	TF3W (2 tanks)	0.66	1450	"
"	TF2W (1 tank)	0.33	720	"
"	TF4W (7 tanks)	2.31	5060	"
see note 3	any source	4000		during retrieval
see note 3	any source	4000		during retrieval

Note 1: The organic compounds and their concentrations are assumed to be those for the mid point data from Tank C-103 head space analysis. (see attached table)

Note 2: These emissions should remain constant until retrieval operations begin in 2003. These emissions should decline approximately 6-7% per year between 2003 and 2015 due to tank retrieval. After 2018 VOC emissions from the tanks should go to zero.

Note 3: At any time during retrieval operations two organic tanks may be subject to retrieval operations. These tanks could come from any two source areas. These tanks will have organic compounds identified in the Tank C-103 headspace analysis. The concentration of these compounds will be ratioed down from the mid point concentrations identified for Tank C-103 by the factor 2.07E-5.

TABLE 5.3.1 SOURCE TYPES AND LOCATIONS.

TANK FARM	SOURCE NAME **	SOURCE LOCATION*		ELEVATION OF CENTER (m)	SOURCE TYPE
		x coord.	y coord.		
BY	TF1E	573556	137442	200	AREA
BX	TF2E	573556	137282	200	AREA
B	TF3E	573771	137252	200	AREA
C	TF4E	575075	136493	200	AREA
AN	TF5E	575332	136378	205	AREA
AZ	TF6E	575365	136279	205	AREA
AY	TF7E	575281	136157	205	AREA
AX	TF8E	575380	136159	205	AREA
A	TF9E	575310	136015	210	AREA
AW	TF10E	575304	135806	210	AREA
AP	TF11E	575481	135747	210	AREA
T	TF1W	566738	136662	210	AREA
TY	TF2W	566715	136373	210	AREA
TX	TF3W	566689	136146	210	AREA
U	TF4W	566744	135000	205	AREA
S&SY	TF5W	566750	134399	205	AREA
SX	TF6W	566746	134162	205	AREA
	TA1W	566833	136570	210	AREA
	TA2W	566886	134878	205	AREA
	TA3W	566930	134444	205	AREA
	TA1E	573755	137383	200	AREA
	TA2E	575163	136336	200	AREA
SITE C	PROC	573879	135229	215	AREA
	BTCH	571332	135953	225	AREA
	SMIN	574425	135978	215	AREA
	ST-L	574120	135901	215	AREA
	ST-H	574410	135978	215	AREA

Notes: * Location of area sources represents southwest corner of area (coordinates in meters)
** Tank farm sources have the prefix "TF", transfer annex areas have the prefix "TA"; source IDs ending in "E" are located in the 200 East area, while those ending in "W" are located in the 200 West area. Other sources are defined as follows:

PROC = Vitrification process facility construction emissions
BTCH = Concrete batch plant emissions
SMIN = Minimal pretreatment process stack
ST-L = TPA low level waste process stack
ST-H = TPA high level waste process stack

Coordinate locations are given consistent with ASI coordinate system.

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BY _____ CHKD. _____ JOB NO. _____

METHOD FOR ESTIMATING VOC RELEASES:

- Assume all organic emissions come from the 20 organic watch list tanks (>3% TOC)

- Assume that the concentration on actively vented tanks is small and will therefore be neglected. The actual mass of VOC from active ventilated tanks may be higher but concentration should be much lower than passi
- The following are the organic watch list tanks:

A101 (A)	SX103 (A)	U105 (P)
AX102 (P)	SX106 (A)	U106 (P)
B103 (P)	T111 (P)	U107 (P)
C102 (P)	TX105 (P)	U111 (P)
C103 (P)	TX118 (P)	U203 (P)
S102 (P)	TY104 (P)	U204 (P)
S111 (P)	U103 (P)	

(P) = PASSIVELY Vented (A) = ACTIVE VENT

- 17 OUT OF 20 TANKS ARE PASSIVELY VENTED.

- TANK C103 IS ON THE ABOVE LIST AND IS THOUGHT to be an organic tank with some of the highest vapor concentrations (WHC-SD-WM-SARR-011)
- ASSUME OTHER TANKS DO NOT HAVE ANY VOC EMISSIONS.

Approach: Calculate the headspace volume in a typical tank. Assume an atmospheric pressure change and calculate the volume of air exchanged between the tank and the atmosphere.

Assume the air coming out of the tanks contains organics at a concentration equal to the midpoint data collected for tank C103 (Ref WHC-SD-WM-SARR-011)

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Volume of Release.

- Tank breaths as a function of atmospheric pressure changes.

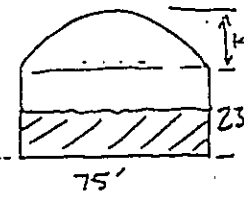
Volume of RELEASE:

$$PV = nRT \quad \text{or} \quad \frac{P_1V_1}{RT_1} = \frac{P_2V_2}{RT_2}$$

- Assume Temp inside the tank remains Constant

$$P_1V_1 = P_2V_2$$

$$V_2 = \frac{P_1V_1}{P_2}$$



Assume tank is ½ full of waste.

Vapor space = ½ tank Capacity + dome Volume.

$$\text{Vapor Space} = \frac{\pi d^2}{4}h + \frac{1}{6}\pi h\left(3(r^2) + h^2\right)$$

$$= \frac{\pi\, 75^2}{4}(11.5) + \frac{1}{6}\pi(14)\left(3(37.5)^2 + 14^2\right)$$

$$\text{Vapor Space} = 50805 + 32360 = 83.165\ ft^3$$

$$\text{Vapor Space} = 83.165\ ft^3\left(.02832\ m^3/ft^3\right) = 2355\ m^3$$

$$\text{Vapor Space} = 2355\ m^3$$

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if $\Delta P = 1/10$ IN of Hg $= \frac{1}{10}'' \left(\frac{.4912 \text{ psi}}{\text{IN Hg}}\right) = .05$ psi

$$V_2 = \frac{14.7 \text{ psi}}{14.65 \text{ psi}} (V_1) = 1.0034\ V_1$$

$$V_2 = 1.0034\ (2355\ m^3) = 2363\ m^3$$

$$\Delta V = 2363 m^3 - 2355 m^3 = 8\ m^3$$

if the ΔP occurs in a 24 hr period

the hourly flow rate is:

$$8\ m^3/24 hr = 0.33\ m^3/hr.$$

∴ this $0.33\ m^3/hr$ should be peak hourly in light of the following.

The hourly emission is:

$$17 \text{ tanks} \times 0.33\ m^3/hr = 5.6\ m^3/hr.$$

Release Volume = $5.6\ m^3/hr$

Release Concentration = mid pt data from attached table

This method estimates an hourly emission rate of .017 Kg Voc/hr. OR .04 Kg Voc/24 hr.

WHC OPS DATA Estimates 0.68 Kg VOC emissions for 1995.

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AT 0.4 kg VOC/day the ANNUAL Emission would be 146 kg VOC/yr.

Since the pressure change will not occur every day conservatively assume that the pressure changes 50% of the time, and half the time air must be sucked into the tank.

Annual release per tank = 0.33 m^3/hr x 24 hr/day x 365 day/yr x 0.5

Annual Release per tank = 723 m^3/yr/tank

Annual Average Volume flow from tank = .083 m^3/hr.

AS A CHECK OF THE METHOD ESTIMATE ANNUAL VOC EMISSIONS.

$$20 \text{ tanks} \times 723 \frac{m^3 \text{ Headspace air}}{yr/tank} \times 3080 \, mg/m^3 \times \frac{1 g}{1000 mg} \times \frac{1 kg}{1000 g}$$

= 44.5 kg VOC/yr.

This is Higher than the 0.68 kg VOC/yr. emission estimate in the WHC current operations data tables.

TABLE 1. PRELIMINARY DATA FOR C-103 HEADSPACE

CHEMICAL	MAXIMUM DATA POINT (mg/m^3)	MID DATA POINT (mg/m^3)	MINIMUM DATA POINT (mg/m^3)
Acetone	299	77	0.44
Acetonitrile	182	30	0.20
Ammonia	202	202	202
Benzene	21	4.1	0.05
1,3-Butadiene	0.32	0.30	0.22
Butanal	176	7.4*	7.4*
Butanol (n-butyl alcohol)	597	198	0.64
Hexane	187	12	0.50
2-Hexanone (methyl n-butyl ketone)	32	10	0.03
Methylene chloride (dichloromethane)	318	33	0.02
Dodecane	3713	1376	16
Tridecane	4500	1090	82
Propane nitrile	132	29	0.06
Tributylphosphate	302	12	1.3

* The mid and minimum data points for butanal are the same because of the nature of the data and the method used to determine these points.

As new data become available, they should be incorporated into the release consequence calculations. Current Tri-Party Agreement milestones for characterization are as follows (Osborne 1994):

- o M-40-06 Complete vapor sampling and characterization of tank 241-C-103 by August 30, 1994.
- o M-40-08 Complete vapor sampling and characterization of all Organic Watch List tanks by November 1995.
- o M-40-03 Complete vapor sampling and characterization of all Ferrocyanide Watch List tanks by November 1995.

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No Action Alternative - Tanks

For No Action the following activities will take place:

SST wastes will be left in place following the completion of salt well pumping.

DST wastes will be retrieved and transferred into new DSTs twice during the 100 year period where institutional control will be maintained.

The following activities will be completed for DST wastes:

Construction

Note: The following will be constructed for each retrieval campaign. (Each construction activity will take place twice)

Build DST transfer piping

- connect existing DST facilities to new tank farms and new evaporator
- Build replacement evaporator
- Build tank retrieval systems
- Build new tanks
  - 26 new DSTs will replace existing 28 DSTs
  - Diesel generator building
  - Gas sampling and stack monitoring facilities
  - Administration building
  - Possible weather enclosure over tank farm
  - Tank ventilation systems

Operation

Retrieve DST wastes

- Direct transfer supernate to new DSTs
- Add dilution liquids to remaining wastes, run mixer pumps and slurry pump to evaporator
- Process slurry through evaporator
- Retrieve 99% of DST waste

Monitor SSTs

Operate Evaporator

- Evaporate all slurry transfer to maintain waste volume
- Treat condensate of liquid effluent treatment facility

From the No Action Data Package the following emissions estimated are made:

Non Radiological Operating Emissions: (For additional tank emission data see Request No. 55)

- Table 5-5 attached
- These emissions were taken from the HDW EIS and represent an estimate for emissions associated with tank farm surveillance during the 100 year institutional control period
- These emissions appear to be vehicle emissions
- If these are to be modeled, they can be divided by 100 to get an average annual emission. A peak emission could be estimated using the following factor:

$$\frac{\text{Non Rad Operating Emission}}{18\ \text{(tank farms)}} \times \frac{1}{100\ \text{yrs}} \times \frac{1\ \text{yr}}{2{,}000\ \text{hrs}} \times 2\ \text{(peak factor)}$$

Emission quantity X 5.6×10^{-7} (peak hourly emission) kg/hr - tank farm

Thus the peak hourly emission for any of the pollutants in table 5-5 can be calculated using the above factor.

Emissions will be very small.. For example: The CO estimate is for 710 kg.

The CO peak hourly emission rate per tank farm is:

$$710\ \text{kg} \times 5.6 \times 10^{-7} = 4 \times 10^{-4}\ \text{kg/hr}$$

Radiological Operating Emissions:

- Table 5-6 attached
- Memo and attached hand calculation from Chris Memg (WHC) to Dave Murray (attached)
- Engineering data package Appendix B (attached)

The following points should be made for the radiological operating emissions:

- The radiological emissions are estimated using measured emission data for the tank farms in 1993. Emission data was obtained only for areas 3EDS and 5EDS (3DS = tank farms AN, AY, AZ, sources TF5E, TF6E, TF7E), (5EDS = tank farms AP, AW, sources TF10E, TF11E)

The memo noted above states that the emissions from other tank farms were either below detection or below reportable amounts.

- The quantities reported in table 5-6 are for the 100 year institutional control period
- Appendix B summarizes the calculations for determining the emissions based on the measured 1993 data

- Annual emissions can be calculated for any year using the following expression:

$$N = No e^{-\lambda t}; \qquad \lambda = \frac{\ell n 2}{t^{1/2}}$$

For Cs, $N = 5.3 \times 10^{-5}$ Ci $\times e^{-.0231t}$ (t in years from 1995)

Sr, $N = 8.4 \times 10^{-6}$ Ci $\times e^{-.0247t}$ (t in years from 1995)

I, $N = 4.6 \times 10^{-5} \times e^{-4.08 \times 10^{-8}t}$ (t in years from 1995)

- The air emission from tank farms are not a result of any processing activities and should remain constant throughout the 100 year period without any peaks.

- The radiological air emissions from tank farms can be identified as follows:

Pollutant	Source ID	Peak Hourly	Annual Average (Ci)	Phase
Cs 137	TF5E	-	$1.06 \times 10^{-5} e^{-.0231t}$	Yrs 1995-2042
Cs 137	TF6E	-	$1.06 \times 10^{-5} e^{-.0231t}$	Yrs 1995-2042
Cs 137	TF7E	-	$1.06 \times 10^{-5} e^{-.0231t}$	Yrs 1995-2042
Cs 137	TF10E	-	$1.06 \times 10^{-5} e^{-.0231t}$	Yrs 1995-2042
Cs 137	TF11E	-	$1.06 \times 10^{-5} e^{-.0231t}$	Yrs 1995-2042
Sr 90	TF5E	-	$1.68 \times 10^{-6} e^{-.0247t}$	Yrs 1995-2042
Sr 90	TF6E	-	$1.68 \times 10^{-6} e^{-.0247t}$	Yrs 1995-2042
Sr 90	TF7E	-	$1.68 \times 10^{-6} e^{-.0247t}$	Yrs 1995-2042
Sr 90	TF10E	-	$1.68 \times 10^{-6} e^{-.0247t}$	Yrs 1995-2042
Sr 90	TF11E	-	$1.68 \times 10^{-6} e^{-.0247t}$	Yrs 1995-2042
I 129	TF5E	-	$9.2 \times 10^{-6} e^{-4.04E-4t}$	Yrs 1995-2042
I 129	TF6E	-	$9.2 \times 10^{-6} e^{-4.04E-4t}$	Yrs 1995-2042
I 129	TF7E	-	$9.2 \times 10^{-6} e^{-4.04E-4t}$	Yrs 1995-2042
I 129	TF10E	-	$9.2 \times 10^{-6} e^{-4.04E-4t}$	Yrs 1995-2042
I 129	TF11E		$9.2 \times 10^{-6} e^{-4.04E-4t}$	Yrs 1995-2042

After the year 2042 all DST wastes will have been retanked into new DSTs located in the same area as the TPA vitrification facilities.

Making the assumption that all releases from the new DST tank farms will occur from the TPA HLW vitrification stack source location the following table is developed.

Pollutant	Source	Peak Hourly	Annual Average (Ci)	Phase
Cs 137	ST-H	-	$5.3 \times 10^{-5} e^{-.02311}$	Yrs 2042-2095
Sr 90	ST-H	-	$8.4 \times 10^{-4} e^{-.02476}$	Yrs 2042-2095
I 129	ST-H	-	$4.6 \times 10^{-5} e^{-4.04E-4t}$	Yrs 2042-2095

Note the emissions for any given year falling in the phase noted can be calculated by subtracting the year from 1995 and using the result ~~as~~ to evaluate the expression in the annual average column for the pollutant of interest. This was done because of the continuously changing emissions resulting from the short half life of Cs & Sr.

For evaporator emissions the following breakdown applies:

Pollutant	Source	Peak Hourly* Ci/Hr	Annual Average** Ci/Yr	Phase
Cs 137	ST-H	6.3×10^{-7}	2.76×10^{-3}	Yrs 2037-2042
H 3	ST-H	9×10^{-3}	39	Yrs 2037-2042
Sr 90	ST-H	7×10^{-7}	3.1×10^{-3}	Yrs 2037-2042
I 129	ST-H	6×10^{-7}	2.72×10^{-3}	Yrs 2037-2042
Total Beta	ST-H	4×10^{-10}	1.9×10^{-6}	Yrs 2037-2042
Total Alpha	ST-H	4.6×10^{-10}	2×10^{-6}	Yrs 2037-2042
Cs 137	ST-H	2×10^{-7}	8.7×10^{-4}	Yrs 2087-2092
H 3	ST-H	5.3×10^{-4}	2.3	Yrs 2087-2092
Sr 90		2×10^{-7}	9×10^{-4}	Yrs 2087-2092
I 129		6.2×10^{-7}	2.7×10^{-3}	Yrs 2087-2092
Total Beta		1.2×10^{-10}	5.4×10^{-7}	Yrs 2087-2092
Total Alpha		4.7×10^{-10}	2.08×10^{-6}	Yrs 2087-2092

***Peak Hourly**: Annual Average X 1 yr/365 days X 1 day/24 hrs X 2 (peak factor).
**** Annual Average**: Evaporator estimate (10 yr)/5 yrs operation period. These evaporator emissions were annualized without using the decay equations.

<u>For Construction Emissions:</u>

The new tanks will be located in the same area as the TPA facilities so the source for No Action should correspond to PROC (ESE source area for TPA construction emissions).

The construction duration is 6/2033 - 6/2037 and 6/2083 - 6/2087.

Pollutant	Source	Peak Hourly	Annual Average	Phase
Particulate	PROC	16.25 kg/hr	16,250 kg	Construction
SO_x	PROC	2 kg/hr	2,000 kg	Construction
CO	PROC	4,500 kg/hr	4,500,000kg	Construction
Hydrocarbons	PROC	225 kg/hr	225,000 kg	Construction
NO_x	PROC	237 kg/hr	237,500 kg	Construction
Aldehydes-(HCHO)	PROC	7.4 kg/hr	7,375 kg	Construction
Organic Acids	PROC	0	0	Construction
Thermal (J)	PROC	9.5×10^{10} J/hr	9.5×10^{13} (J)	Construction
Fugitive dust	PROC	.07 mt/hr	68.75 metric ton	Construction

Peak Hourly: Annual Average X 1/365 days X 1 day/8 hrs X 3 peak factor.
Peak Hourly: Annual Average X .001.
Annual Average: Total estimate/8 years.

NOTE: SEE TABLE 5-11 attached.

Figure 1-5. No Disposal Action Alternative Flowsheet.

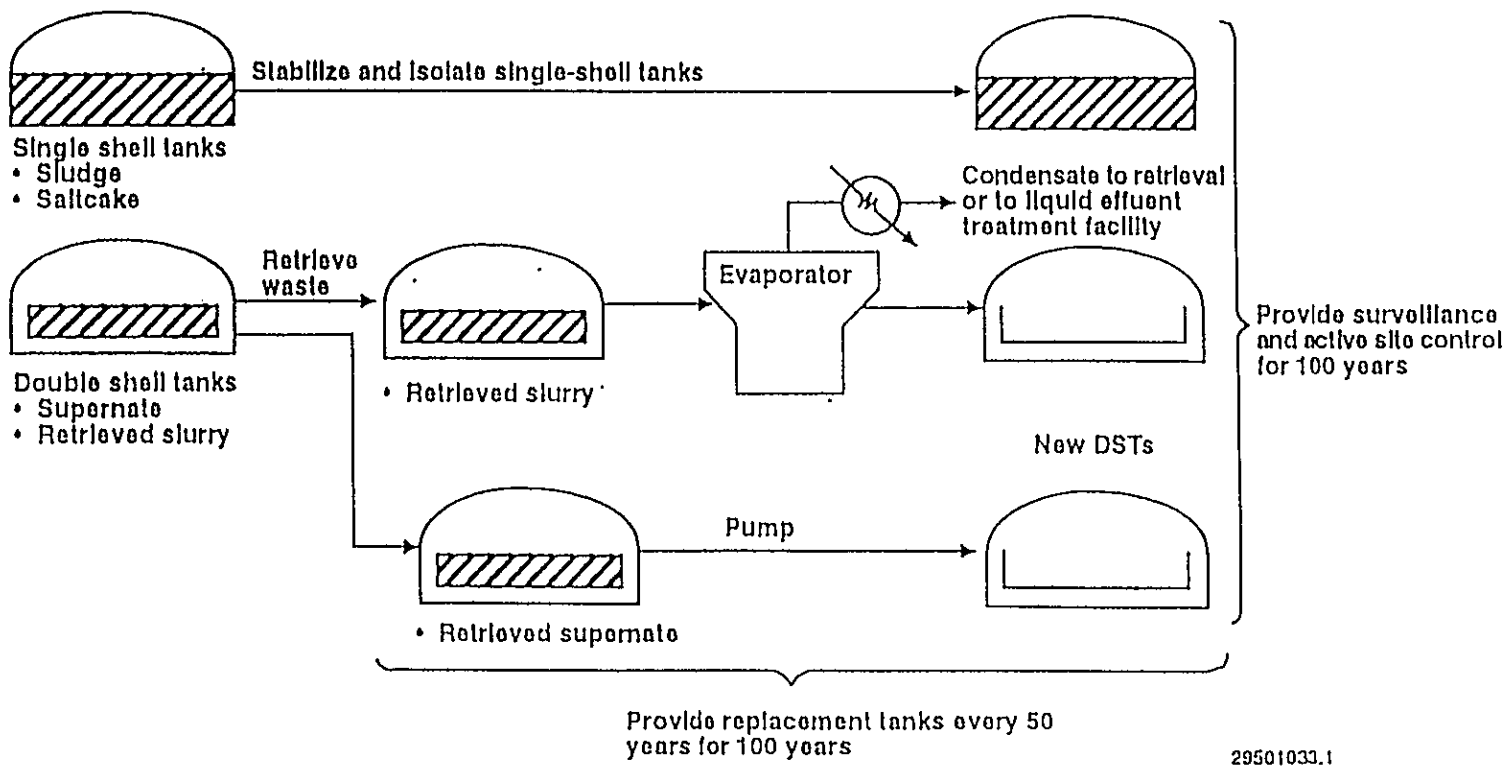


Table 5-5. Nonradiological Operating Emissions
(Units as Indicated).

Item	No Disposal Action[1]
Thermal releases	1.1×10^{13} J
Particulate	20 kg
Volatile organic compounds	68 kg
Fugitive dust	n/a
Toxic Air Pollutants[2]	not available
NOx (as nitrogen dioxide)	.77 kg
SOx (as sulfur dioxide)	12 kg
Carbon Monoxide	710 kg

Notes:

J = joule
kg = kilogram

[1]The values for these emissions (over the 100-year period) were taken from RHO-RE-ST-30 P, Table 4-17, pages 4-24 and 4-25 (*Hanford Defense Waste Disposal Alternatives: Engineering Support Data for the HDW-EIS*.

[2]The list of Toxic Air Pollutants present in the tank farms has not been completed yet. The final list will include only those species that are present in sufficient quantities to be regulated. Vapor characterization of Tank 241-C-103 head space is being used as a worst case to estimate the amount of Toxic Air Pollutants given off by the tank farms. The data for the Toxic Air Pollutants will be in the soon to be released Draft Tank Farms Air Operating Permit.

RHO, 1985, *Hanford Defense Waste Disposal Alternatives: Engineering Support Data for the HDW-EIS*, RHO-RE-ST-30 P, Rockwell Hanford Operations, Richland, Washington.

Table 5-6. Radiological Operating Emissions (Ci). for 100 yr's

Radionuclide[1]	No Disposal Action		
	Air Emissions from Tank Farms[2]	Air Emissions from Evaporator[3]	Water Emissions from Evaporator[4]
^{241}Am	0	n/a	0
^{14}C	0	n/a	0
^{137}Cs	2.1E-03	n/a	1.8E-02
^{3}H	Below Detection[5]	n/a[6]	2.1E02
^{129}I	4.6E-03	n/a	2.7E-02
^{239}Pu, ^{240}Pu	0	n/a	0
^{106}Ru	0	n/a	0
^{151}Sm	0	n/a	0
^{90}Sr	3.1E-04	n/a	2.0E-02
^{99}Tc	0	n/a	0
^{93}Zr	0	n/a	0
Total Alpha	n/a	2.1E-05	n/a
Total Beta	n/a	1.2E-05	n/a
Percent PM-10[7]	100	n/a	n/a

Notes:

[1]All values in Ci except for percent PM-10.

[2]Starting air releases for tank farms were taken from WHC-EP-0527-3, *Environmental Releases for Calendar Year 1993* (Thomas and Curn 1994). The release values were then decayed and summed over the 100-year period (see Appendix B).

[3]These releases were below the trip point for reporting individual radionuclides so total alpha and beta were reported in the *Westinghouse Hanford Company Effluent Releases and Solid Waste Management Report for 1987: 200/600/1100 Areas* (Coony et al.).

[4]These releases were based on the yearly releases of the evaporator while processing approximately 41,600 m^3 (11 million gal) of waste in a year as reported in the *Westinghouse Hanford Company Effluent Releases and Solid Waste Management Report for 1987: 200/600/1100 Areas* (Coony et al.). To evaporate 416,000 m^3 (110 million gal) of waste (at a 3-to-1 dilution) at 41,600 m^3 (11 million gal) a year, requires the equivalent of 10 years of operation for each retanking or 20 years of emissions at this level. The releases were calculated by decaying the 1987 releases to the point of evaporation and summing the releases over the evaporator operation while decaying the radionuclide during the evaporation (see Appendix B). The actual evaporation for retanking is scheduled for 5 years each time so the emissions may be more concentrated while remaining within release limits.

Table 5-6. Radiological Operating Emissions (Ci).

Notes: (Continued)

[5]Table 2-1 of the *Environment Releases for Calendar Year 1993* (Thomas and Curn 1994) indicates that air sampling was not done for tritium in the 200 Areas based on its known absence or extremely low concentrations and dose impact.

[6]No separate air emissions were compiled for different radionuclides in the *Westinghouse Hanford Company Effluent Releases and Solid Waste Management report for 1987: 200/600/1100 Areas* (Coony et al.); therefore, the tritium releases are contained in the total Beta entry in this column.

[7]Percent PM-10 is 100 percent as all released particulates are less than 10 microns.

Coony, F. M., D. B. Howe, and L. J. Voigt, 1988, *Westinghouse Hanford Company Effluent Releases and Solid Waste Management Report for 1987: 200/600/1100 Areas*, WHC-EP-0141, Westinghouse Hanford Compant, Richland, Washington.

Thomas S. J. and B. L. Curn, 1994, *Environmental Releases for Calendar Year 1993*, WHC-EP-0527-3, Westinghouse Hanford Company, Richland, Washington.

Table 5-10. Nonradiological Construction Emissions (units as indicated).

Construction Emission Pollutant	No Disposal Action[1]
Particulate (kg)	130,000
SO_x as sulfur dioxide (SO_2) (kg)	16,000
Carbon monoxide (kg)	36,000,000
Hydrocarbons (kg) (exhaust and fugitive)	1,800,000
NO_x as nitrogen dioxide (NO_2) (kg)	1,900,000
Aldehydes (kg) (as HCHO)	59,000
Organic acids (kg)	0
Thermal releases (J)	7.60×10^{14}
Fugitive dust (t)	550

Notes:

J = joule
kg = kilogram
NO_x = Nitrous oxides
SO_x = Sulfurous oxides
t = metric ton

[1]The values in this table were factored from the No Separations alternative by using a ratio of the construction costs.

Table 5-11. Transportation of Earthen Borrow Construction Material (Units as Indicated).

Item	No Disposal Action
Borrow source location (state)	3 km NW of site
Route location (state mileage)	Route 3 to Route 4 (5 Km)
Road type (gravel or asphalt)	Gravel, level
Total number of trips	
Truck[1]	31,000
Train	0
Barge	0
New road construction (miles)	0
Load volumes (m^3)	6.1

Notes:

km = kilometer
m^3 = cubic meter
NW = northwest

[1]The values in this table were factored from the No Separations alternative by using a ratio of the construction costs.

Note: The 31,000 trips indicated above should result in fugitive dust emissions that are split between the borrow site and the construction site. This is NOT shown on the Response to the Engineering Information Request page 4 "Construction Emissions by source". Since the fugitive dust estimate is factored from the No Separations data package, the fugitive dust estimate can be split between the borrow site & construction site in a similar manner to the TPS or No Separations data. Using No Separations data pkg 32% fugitive dust comes from borrow pit and batch plant operations.

Table 5-21. Overall Schedule (Calendar Year Start/Completion Date).

Activity	No Disposal Action[1]
Construction	06/2033 - 06/2037 06/2083 - 06/2087
Tank retrieval and re-evaporation	06/2037 - 06/2042 06/2087 - 06/2092
Decontamination and decommissioning	06/2042 - 06/2047 06/2092 - 06/2097
Monitoring and maintenance	01/1995 - 01/2095
Research and development	n/a

Notes:

[1]Figure 2-2 is a representation of the above schedule.

APPENDIX B

CALCULATION OF RADIOLOGICAL RELEASES TO AIR AND WATER FROM THE TANK FARMS AND EVAPORATOR OVER THE FIRST 100 YEARS

The amount of a radionuclide at a given time in its decay life is represented by:

$$N = N^o \, e^{-\lambda t}$$

where:

N	=	the amount of the radionuclide at time t
N°	=	the amount of the radionuclide at time zero
λ	=	the decay constant

$$\lambda = \frac{\ln 2}{t_{1/2}}$$

$t_{1/2}$	=	the half life or the amount of time before half the original amount of radionuclides decay

To find the amount of environmental releases over a 100-year period the decay equation is integrated over 100 years.

$$\int_0^{100} N^o \, e^{-\lambda t} \, dt = N^o \int_0^{100} e^{-\lambda t} \, dt =$$

$$= N^o \left[\frac{-e^{-\lambda t}}{\lambda}\right]_0^{100} =$$

$$= - N^o \left[\frac{e^{-\lambda 100}}{\lambda} - \frac{e^0}{\lambda}\right] =$$

$$= N^{\circ}\left[\frac{e^{0}}{\lambda} - \frac{e^{-\lambda 100}}{\lambda}\right]$$

$$for\ ^{137}Cs\quad t_{1/2} = 30\ years\quad so\quad \lambda = \frac{\ln 2}{30\ y} = 0.0231\ y^{-1}$$

$$for\ ^{90}Sr\quad t_{1/2} = 28.1\ years\quad so\quad \lambda = \frac{\ln 2}{28.1\ y} = 0.0247\ y^{-1}$$

$$for\ ^{129}I\quad t_{1/2} = 1.7X10^{7}\ years\quad so\quad \lambda = \frac{\ln 2}{1.7X10^{7}\ y} = 4.08X10^{-8}\ y^{-1}$$

Current yearly tank farm air releases are:

$^{137}Cs = 5.3 \text{ X } 10^{-5}$ Ci

$^{90}Sr = 8.4 \text{ X } 10^{-6}$ Ci

$^{129}I = 4.6 \text{ X } 10^{-5}$ Ci

Tank Farm releases for 100 years for each of these radionuclides are:

for ^{137}Cs

$$5.3X10^{-5}\ Ci\left[\frac{1}{0.0231} - \frac{e^{-0.0231(100)}}{0.0231}\right] = 2.1X10^{-3}\ Ci$$

for ^{90}Sr

$$8.4X10^{-6}\ Ci\left[\frac{1}{0.0247} - \frac{e^{-0.0247(100)}}{0.0247}\right] = 3.1X10^{-4}\ Ci$$

for ^{129}I

$$4.6X10^{-5}\ Ci[\frac{1}{4.1X10^{-8}} - \frac{e^{-4.1X10^{-4}(100)}}{4.1X10^{-8}}] = 4.6X10^{-5}\ Ci$$

Yearly evaporator liquid releases for 1987 are:

$^{3}H = 4.30 \times 10^{2}$ Ci

$^{137}Cs = <4.91 \times 10^{-3}$ Ci

$^{90}Sr = <6.07 \times 10^{-3}$ Ci

$^{129}I = <1.36 \times 10^{-3}$ Ci

Yearly evaporator air releases for 1987 are:

Total Alpha = 1.04×10^{-6} Ci

Total Beta = 3.63×10^{-6} Ci

The first evaporation connected to retanking occurs in 2037. The releases above will be decayed to that time (50 years). The decayed releases then will be summed and decayed over the first ten year operation of the evaporator. The releases then will be decayed to the beginning of the second evaporation which starts in 2087 (another 50 years). The decayed releases then will be summed and decayed over the second ten year operation of the evaporator.

$$N = N^{o}\ e^{-\lambda t}$$

where:

N = the amount of the radionuclide at time t
N° = the amount of the radionuclide at time zero
λ = the decay constant

$$\lambda = \frac{\ln 2}{t_{1/2}}$$

$t_{1/2}$ = the half life or the amount of time before half the original amount of radionuclides decay

$$\text{for } ^{137}Cs \quad t_{1/2} = 30 \text{ years} \quad \text{so} \quad \lambda = \frac{\ln 2}{30 \text{ y}} = 0.0231 \text{ y}^{-1}$$

$$\text{for } ^{90}Sr \quad t_{1/2} = 28.1 \text{ years} \quad \text{so} \quad \lambda = \frac{\ln 2}{28.1 \text{ y}} = 0.0247 \text{ y}^{-1}$$

$$\text{for } ^{129}I \quad t_{1/2} = 1.7X10^{7} \text{ years} \quad \text{so} \quad \lambda = \frac{\ln 2}{1.7X10^{7} \text{ y}} = 4.08X10^{-8} \text{ y}^{-1}$$

$$\text{for } ^{3}H \quad t_{1/2} = 12.3 \text{ years so } \lambda = \frac{\ln 2}{12.3 \text{ y}} = 0.0564 \text{ y}^{-1}$$

Therefore, the amount of the radionuclides after 50 years is:

for ^{3}H

$$N = 4.3X10^{2} \text{ Ci } e^{-0.0564(50)} = 25.7 \text{ Ci}$$

for ^{137}Cs

$$N = 4.91X10^{-3} \ Ci \ e^{-0.0231(50)} = 1.55X10^{-3} \ Ci$$

for ^{90}Sr

$$N = 6.07X10^{-3} \ Ci \ e^{-0.0247(50)} = 1.77X10^{-3} \ Ci$$

for ^{129}I

$$N = 1.36X10^{-3} \ Ci \ e^{-4.1X10^{-8}(50)} = 1.36X10^{-3} \ Ci$$

for Total Beta (decay the same as ^{90}Sr)

$$N = 3.63X10^{-6} \ Ci \ e^{-0.0247(50)} = 1.06X10^{-6} \ Ci$$

for Total Alpha (decay the same as Pu $t_{1/2}$ = 24,400 y $\lambda = 2.84 \times 10^{-5}$)

$$N = 1.04 X 10^{-6}\ Ci\ \ e^{-2.84 X 10^{-5}(50)} = 1.04 X 10^{-6}\ Ci$$

First evaporator releases over a 10 year period are calculated below:

$$N = N^{\circ}\ [\frac{e^{0}}{\lambda} - \frac{e^{-\lambda 10}}{\lambda}]$$

Evaporator releases for 10 years for each of these radionuclides are:

for ^{137}Cs

$$Total = 1.55 X 10^{-3}\ Ci [\frac{1}{0.0231} - \frac{e^{-0.0231(10)}}{0.0231}] = 1.38 X 10^{-2}\ Ci$$

for ^{3}H

$$25.7\ \text{Ci}\ [\frac{1}{0.0564} - \frac{e^{-0.0564(10)}}{0.0564}] = 196.4\ \text{Ci}$$

for ^{90}Sr

$$1.77 X 10^{-3}\ Ci [\frac{1}{0.0247} - \frac{e^{-0.0247(10)}}{0.0247}] = 1.56 X 10^{-2}\ Ci$$

for ^{129}I

$$1.36 X 10^{-3}\ Ci [\frac{1}{4.1 X 10^{-8}} - \frac{e^{-4.1 X 10^{-8}(10)}}{4.1 X 10^{-8}}] = 1.36 X 10^{-2}\ Ci$$

for Total Beta

$$1.06 X 10^{-6}\ Ci [\frac{1}{0.0247} - \frac{e^{-0.0247(10)}}{0.0247}] = 9.36 X 10^{-6}\ Ci$$

for Total Alpha

$$1.04X10^{-6}\ Ci[\frac{1}{2.84X10^{-5}} - \frac{e^{-2.84X10^{-5}(10)}}{2.84X10^{-5}}] = 1.04X10^{-5}\ Ci$$

The second evaporation will occur after another 50 years of decay. Release concentrations after the second 50 years are:

$$N = N^{o}\ e^{-\lambda t}$$

for ^{137}Cs

$$N = 1.55X10^{-3}\ Ci\ e^{-0.0231(50)} = 4.87X10^{-4}\ Ci$$

for ^{3}H

$$N = 25.7\ e^{-0.0564(50)} = 1.53\ Ci$$

for ^{90}Sr

$$N = 1.77X10^{-3}\ Ci\ e^{-0.0247(50)} = 5.14X10^{-4}\ Ci$$

for ^{129}I

$$N = 1.36X10^{-3}\ Ci\ e^{-4.1X10^{-4}(50)} = 1.36X10^{-3}\ Ci$$

for Total Beta (decay the same as ^{90}Sr)

$$N = 1.06X10^{-6}\ Ci\ e^{-0.0247(50)} = 3.08X10^{-7}\ Ci$$

for Total Alpha (decay the same as Pu $t^{1/2} = 24{,}400$ y $\lambda = 2.84 \times 10^{-5}$)

$$N = 1.04X10^{-6}\ Ci\ e^{-2.84X10^{-5}(50)} = 1.04X10^{-6}\ Ci$$

Second evaporator releases over a 10 year period are calculated below:

$$N = N^{o} \cdot [\frac{e^{0}}{\lambda} - \frac{e^{-\lambda 10}}{\lambda}]$$

Evaporator releases for 10 years for each of these radionuclides are:

for ^{137}Cs

$$4.87X10^{-4}\ Ci[\frac{1}{0.0231} - \frac{e^{-0.0231(10)}}{0.0231}] = 4.35X10^{-3}\ Ci$$

for ^{3}H

$$1.53\ \text{Ci}\ [\frac{1}{0.0564} - \frac{E^{-0.0564(10)}}{0.0564}] = 11.7\ \text{Ci}$$

for ^{90}Sr

$$5.14X10^{-4}\ Ci[\frac{1}{0.0247} - \frac{e^{-0.0247(10)}}{0.0247}] = 4.56X10^{-3}\ Ci$$

for ^{129}I

$$1.36X10^{-3}\ Ci[\frac{1}{4.1X10^{-8}} - \frac{e^{-4.1X10^{-4}(10)}}{4.1X10^{-8}}] = 1.36X10^{-2}\ Ci$$

for Total Beta

$$3.08X10^{-7}\ Ci[\frac{1}{0.0247} - \frac{e^{-0.0247(10)}}{0.0247}] = 2.72X10^{-6}\ Ci$$

for Total Alpha

$$1.04X10^{-6}\ Ci[\frac{1}{2.84X10^{-5}} - \frac{e^{-2.84X10^{-5}(10)}}{2.84X10^{-5}}] = 1.04X10^{-5}\ Ci$$

Total releases for the evaporator is a sum of the first and second evaporator operation releases:
for ^{137}Cs

$$<1.38 \times 10^{-2} + <4.35 \times 10^{-3} = <1.8 \times 10^{-2} \text{ Ci}$$

for ^{3}H

$$196 \text{ Ci} + 12 \text{ Ci} = 210 \text{ Ci}$$

for ^{90}Sr

$$<1.56 \times 10^{-2} + <4.56 \times 10^{-3} = <2.0 \times 10^{-2} \text{ Ci}$$

for ^{129}I

$$<1.36 \times 10^{-2} + <1.36 \times 10^{-2} = <2.7 \times 10^{-2} \text{ Ci}$$

for Total Beta

$$9.36 \times 10^{-6} + 2.72 \times 10^{-6} = 1.2 \times 10^{-5} \text{ Ci}$$

for Total Alpha

$$1.04 \times 10^{-5} + 1.04 \times 10^{-5} = 2.1 \times 10^{-5} \text{ Ci}$$

DON'T SAY IT --- *Write It!*

DATE: 3/31/95

TO: Dave Murray

FROM: Chris Heng H5-27

Telephone: 376-2947

cc: Ed Fredenburg

SUBJECT: No Disposal Action - Open item - radioactive emissions

The air operating emissions from 1993 for the tank farms (Table 5-6) had data for areas 3EDS and 5EDS. No emission data was given for the other areas. This indicates that the amounts released may have been so low they were not detectable or the releases were below reportable amounts.

The releases of tritium are associated with the operation of the evaporator. The evaporator releases and calculations remain the same and were not identified in the areas given. The tank farm releases and evaporator releases are separate in Table 5-6.

Please find attached the calculations for the releases from the areas where data was available.

Also, find attached the updated tables discussed earlier.

3EDS -

^{137}Cs	5.3 E - 5	Ci	Released in 1993
^{129}I	4.6 E - 5	Ci	
^{90}Sr	8.32 E - 6	Ci	

See Appendix B of WHC-SD-WM-EV-099 Ref. B for deffinitions. and equations (decay + integration).

Tank Farm release for 100 years for each of these radionuclides are:

for ^{137}Cs

$$5.3\,E-5\ Ci\left[\frac{1}{0.0231} - \frac{e^{-0.0231(100)}}{0.0231}\right] = 2.1\,E-3\ Ci$$

for ^{129}I

$$4.6\,E-5\ Ci\left[\frac{1}{4.1\times10^{-8}} - \frac{e^{-4.1\times10^{-8}(100)}}{4.1\times10^{-8}}\right] = 4.6\,E-3\ Ci$$

for ^{90}Sr

$$8.32\,E-6\ Ci\left[\frac{1}{0.0247} - \frac{e^{-0.0247(100)}}{0.0247}\right] = 3.08\,E-4\ Ci$$

5EOS

^{137}Cs	1.6 E -7 Ci	Released in 1993
^{129}I	Not Detected	
^{90}Sr	9.3 E -8 Ci	

Tank Farm releases for 100 yrs for each of these radionuclides are:

for ^{137}Cs

$$1.6\,E{-7}\ Ci\left[\frac{1}{0.0231} - \frac{e^{-0.0231(100)}}{0.0231}\right] = 6.2\,E{-6}\ Ci$$

for ^{90}Sr

$$9.3\,E{-8}\ Ci\left[\frac{1}{0.0247} - \frac{e^{-0.0247(100)}}{0.0247}\right] = 3.4\,E{-6}\ Ci$$

Table 5-9. Construction Resource Requirements (Units As Indicated).

[illegible]	No Disposal Action
Land (m^2)[1]	
Surface committed	
Temporarily	360,000[2]
Permanently	190,000
Water (m^3)[3]	17,000
Energy[3]	
Electrical (GWh)	0.4
Propane (m^3)	7,500
Diesel fuel (m^3)	63
Gasoline (m^3)	86
Materials[4]	
Concrete (m^3)	120,000
Steel:	
Carbon steel (t)	12,000
Stainless steel (t)	22
Hastelloy (t)	0
Excavation (m^3)	3,700,000
Riprap (m^3)	0
Structure backfill (m^3)	3,500,000[5]
Total Contaminated Material (m^3)	0

Table 5-15. Decommissioning of Contaminated Treatment/Storage Facilities (Units as Indicated).

Item	No Disposal Action
Steel Quantity Disposition	20 t Low-level waste burial ground
Concrete Quantity Disposition	150 m^3 Low-level waste burial ground
Soil Quantity Disposition	0
Debris Quantity Disposition	140 m^3 Low-level waste burial ground

Notes:

m^3 = cubic meters
t = metric tons

As a part of this alternative, the current double-shell tanks and the new double-shell tanks would be left in place; therefore, no decontamination and decommissioning work would be done on them. The abandoned double-shell tanks may be filled with grout or gravel. Details of the closure of the double-shell tanks are in the *Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Study* (Scanlon et al. 1995)

The two high-level waste evaporators built as part of this alternative would be decommissioned. The entries in this table are for those evaporators. The following assumptions were made for decommissioning: 5 percent of the concrete and steel will remain contaminated; 85 percent of the stainless steel will remain contaminated; 5 percent of the decontaminated steel and concrete will be debris; and the evaporators will be entombed in place so no contaminated soil would need to be removed.

Scanlon, P.L., H. Hampt and W.A. Skelly, 1995, *Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Study*, WHC-SD-WM-EV-107, Rev. B, Westinghouse Hanford Company, Richland, Washington.

Request Number 042

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Joan Young (ASI) Date: 3/20/95

Phone Number: (509)946-7112 Fax Number: (509)943-6812

Request Information: Data request for modelling of risk from routine operations.

Item 1 Priority A

Need Date: 4/7/95

Response: see attached

Data Source/Accuracy:

Prepared By: Colin Henderson Date Sent/Faxed:

Concurrence: Marc E. Nelson
Marc Nelson - Deputy Project Manager

engin\eninfrq.055

Date: March 21, 1995

To: Dave Murray

From: Joan Young

Subject: DATA REQUEST FOR MODELLING OF RISK FROM ROUTINE OPERATIONS

The TWRS EIS considers risks to the remediation worker, nearby worker, and the public. Risks to the remediation worker are from direct exposure to radiation and chemicals during the work day. Risks to the nearby worker and the public are assumed to result from ingestion and inhalation of radioactive, toxic, and/or hazardous atmospheric emissions from tanks, process stacks, and vents. Receptors and dose calculations are further described in Attachment One. Please address the following questions or data requirements, so that these risks can be estimated for the No Action, ISV, Cs and Sr Capsules, and the TPA (if changed) Alternatives. The items are listed from greatest to least priority. Items 1 and 2 are mandatory. The remaining items are important, but they are not mandatory.

1. PROVIDE THE AMOUNT, PATHWAY, AND LOCATION FOR RELEASES TO THE ENVIRONMENT. A SIMPLIFIED SCHEMATIC AND/OR DATA TABLE IS RECOMMENDED THAT PROVIDES FACILITY CONFIGURATIONS, LOCATIONS OF RELEASE, RELEASE AMOUNTS, AND DURATIONS OF RELEASE FOR ATMOSPHERIC EMISSIONS FROM THE TANK FARMS, STACK(S), AND VENT(S)

For No Action, Cs and Sr Capsules, and ISV Alternatives:

For the purposes of assessing risk to the nearby worker and the public from routine operations, a simplified process schematic and/or a data table is needed that provides the systems configuration (e.g. locations of process buildings, outside storage tanks, transfer lines, LLW disposal vault, HLW storage facility, and their associated stacks and vents), locations of releases, the volumes and concentrations of effluents at release locations, and the duration of the releases.

2. IDENTIFY NUMBER OF AVERAGE AND MAXIMALLY EXPOSED WORKERS AND ASSOCIATED DOSE

For TPA:

For the TPA Alternative, it was assumed that occupational radiological exposure resulted in the same average whole body deep dose as for the PUREX plant during 1986 (WHC 1995, Table 7-26). Dose was 200 mrem/year to the average worker and 500 mrem/year to the maximally-exposed worker (maximally exposed individual or worker, MEI). Please verify that this assumption is acceptable for the TPA Alternative.

DATA REQUEST 042

Emissions during operations:

Extensive Retrieval- Ex Situ Vitrification Alternative

The operating emissions for this alternative are being revised. We are waiting for WHC to provide stack numbers, locations, and flow rates. Updated emissions data for this alternative will be provided at a future date.

Note: The material balance in the data package changed between revisions, mainly to get agreement between the input stream in the material balance and the inventory data supplied by WHC. The changes should be minor.

No Action Tanks

See attached data request 57.

Capsule Alternatives

See attached data requests 58, 59, 60.

Note: request 60 is awaiting additional information from WHC and will be provided at a future date.

Minimal Retrieval - In Situ Vitrification Alternative

See attached data request 56.

JACOBS ENGINEERING GROUP INC.

DATE _____ SUBJECT _____ SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

ATTACHMENT TO DATA REQUEST 056.

The method used by WHC to calculate Rad emissions during ISV OPERATIONS TREATS ALL RADIONUCLIDES THE SAME. The C14 and I129 WILL GO UP THE STACK During OPERATIONS.

The TPA DATA PACKAGE ASSUMES THE Entire inventory of C14 AND I129 WILL Go up the VITRIFICATION PLANT STACKS. (See TABLE 9-6 attached)

Using this methodology the ISV operating air emissions for C14 and I129 should be as follows:

I129 Inventory = 16 Ci
Annual Emission = 16 ci/9 = 1.8 ci/yr
Peak Emission = 5.7×10^{-4} ci/hr

C14 Inventory 5.3E3 Ci
ANNUAL Emission = 590 Ci/yr
Peak Emission = 0.19 ci/hr

These Emissions for C14 and I129 replace the emissions noted in the body of the response.

FORM 91-005-1 (4/81)

Table 9-6. Radiological Operating Emissions. (Ci)

Radionuclide[1]	Tri-Party Agreement Preferred Alternative	
	Air[2]	Water[3]
^{241}Am	5.3E-02	4.2E-4
^{14}C	5.3E+03	n/a[4]
^{137}Cs	2.5E+01	6.9E-2
^{129}I	1.6E+01	3.5E-4
$^{239,240}Pu$	1.7E-02	4.2E-4
^{106}Ru	1.9E-08	1.0E-2
^{151}Sm	3.2E-01	NA
^{90}Sr	2.7E+01	2.8E-3
^{99}Tc	1.6E-02	n/a
^{93}Zr	1.8E-01	n/a
%PM-10[5]	2.67E-01	- -[6]

Notes:

[1]All values in Ci except for % PM-10 which is in metric tonnes

[2]Air values taken from material balances (Streams 907 and 917 in Appendix A)

[3]Water values are based on effluent streams from both Pretreatment/low-level waste (LLW) and high-level waste (HLW) flowsheets (Streams 807 and 802 respectively) and design basis for Liquid Effluent Treatment Facility (LETF) C-018. Yearly flowrates of these streams were calculated. Engineering judgement set the total amount of effluent to be processed by the LETF equal to 20% of the flow for all but one year of operation. For the last year, 100% was to be processed. The composition of the effluent was assumed to be comparable to the feed set in the design basis. Therefore the concentrations of radionuclides/chemicals in the discharge in the design sheet equals what the discharge would be for the process effluent.

Request Number: 56 By: John Kuhn (ESE) @ (904)332-3318 Date: 3/20/95 TWRS EIS (01-K471-01) Responded By: Michael Chang @ (818)568-7173

Alternative- Minimal Retrieval (In-Situ Vitrification)

Item # Request Information	Responses	Source of Responses
1. Description of the processes (including construction activities) indicating their nature/location	In situ disposal is defined as disposal of tank waste within existing SSTs and DSTs, it would leave all waste in place. All salt well pumping will be completed by the year 2000 before in-situ disposal would begin. Approximately 20,000 cubic meters of liquid will be jet pumped from the SSTs and placed in the DSTs during the salt well pumping process. In situ vitrification (ISV) would use joule heating to melt waste in place into a single block of glass. Hanford sand would serve as the glass former. The stability of the melt would reduce the rate of radionuclide release to the environment. The hazardous waste is immobilized in the tank system at closure. The ISV consist of:	Section 2.0 Section 3.0 Section 4.1 Fig. 4-1 Section 4.2
	Process / Location	
	a. Send all pumpable liquid from DSTs to the 242-A Evaporator @ vicinity of A-Tanks	
	b. Construct tank farm confinement facilities @ vicinity of 18 tank farms	Fig. 4-3
	c. Fill tank voids with Hanford Site sand sand excavated from Pit 30(200E-200W)	
	d. Vitrification @ 177 underground tanks	Fig. 4-2
	e. Install Barriers @ 18 tank farms	
	Assuming (4) ISV systems would be used with at least (2) in continuous operation, vitrification of all 177 tanks would be completed within 5 years.	Section 4.2.3.2
	The final step of in situ would be the installation of infiltration barriers to mark the vitrified site and prevent intrusion. The closure barrier would be horizontal, slightly abovegrade, engineered structures whose function would be to provide isolation of the waste site from the accessible environment.	Section 4.2.4
2. Emissions of all regulated pollutants from each of the processes in: peak hourly and average annual emissions. Also assign emissions to 27 identified sources locations per Washington State Coordinates grid system used by ASI.	See Table 56-A listed below.	
3. A chronological description of the processes and emissions and numbers of stacks	a. The only construction required for ISV would be that of TFCF.	Section: 4.2.3.1
	b. No construction would be necessary for sand excavation because it was assumed that excavating and crushing equipment would already be in place from other contracts.	
	c. Construction would run from Year 1998 to Year 2016. Operation: Year 2005 to 2016	

d. Vitrification process is in sequence: from tanks to tanks within a tank farm; then from tank farm to tank farm.
e. Construction of TFCF adjacent to a tank farm would precede operation of that tank farm.
f. Emissions from Construction/Operation are listed below: Table 56-A.
g. One stack for each TFCF. One TFCF for each tank farm. There will be a total of eighteen (18) stacks. However, only one stack will release pollutant at a given time. Fig. 4-2

Table 56-A Emissions from In-Situ Vitrification Alternative

Pollutant	Type Pollutant	Grand Total Pollutant	Source ID (Note 1)*	Peak Hourly Emission Rate	Annual Average Emission Rate	Chronological Phase	Source of Data (Note 2)* (Note 3)*
Particulate (kg)	Nonradiological	6.1 E7	TF(1-10)E, TF(1-6)W	2.2 E3	3.4 E6	Construction	Table 7-10 Table 7-26 (1998 - 2016)
Sox (kg)	Nonradiological	7.8 E7	TF(1-10)E, TF(1-6)W	2.8 E3	4.3 E6	Construction	Table 7-10 Table 7-26 (1998 - 2016)
CO (kg)	Nonradiological	3.4 E9	TF(1-10)E, TF(1-6)W	1.2 E5	1.9 E8	Construction	Table 7-10 Table 7-26 (1998 - 2016)
HCs (kg)	Nonradiological	2.5 E8	TF(1-10)E, TF(1-6)W	9.0 E3	1.4 E7	Construction	Table 7-10 Table 7-26 (1998 - 2016)
Nox (kg)	Nonradiological	6.2 E8	TF(1-10)E, TF(1-6)W	2.2 E4	3.4 E7	Construction	Table 7-10 Table 7-26 (1998 - 2016)
Aldehydes (kg)	Nonradiological	1.8 E7	TF(1-10)E, TF(1-6)W	6.5 E2	1.0 E6	Construction	Table 7-10 Table 7-26 (1998 - 2016)
Organic acids (kg)	Nonradiological	4.0 E6	TF(1-10)E, TF(1-6)W	1.4 E2	2.2 E5	Construction	Table 7-10 Table 7-26 (1998 - 2016)
Thermal release (J)	Nonradiological	1.2 E18	TF(1-10)E, TF(1-6)W	4.3 E13	6.7 E16	Construction	Table 7-10 Table 7-26 (1998 - 2016)
Particulate (kg)	Nonradiological	< 1 E3	TF(1-10)E, TF(1-6)W	4.5 E-2	< 1.1 E2	Operation	Table 7-5 (Footnote 1,4)* Table 7-25 (2005 - 2016)
Sox (kg)	Nonradiological	0	TF(1-10)E, TF(1-6)W	0	0	Operation	Table 7-5 (Footnote 1,4)* Table 7-25 (2005 - 2016)
CO (kg)	Nonradiological	0	TF(1-10)E, TF(1-6)W	0	0	Operation	Table 7-5 (Footnote 1,4)* Table 7-25 (2005 - 2016)
HCs (kg)	Nonradiological	< 1.1 E1	TF(1-10)E, TF(1-6)W	5.0 E-4	< 1.2	Operation	Table 7-5 (Footnote 1,4)* Table 7-25 (2005 - 2016)

Nox (kg)	Nonradiological	< 3.6 E5	TF(1-10)E, TF(1-6)W	1.6 E1	< 4 E4	Operation	Table 7-5 (Footnote 1,4)* Table 7-25 (2005 - 2016)
Aldehydes (kg)	Nonradiological	0	TF(1-10)E, TF(1-6)W	0	0	Operation	Table 7-5 (Footnote 1,4)* Table 7-25 (2005 - 2016)
Organic (kg) Acids	Nonradiological	0	TF(1-10)E, TF(1-6)W	0	0	Operation	Table 7-5 (Footnote 1,4)* Table 7-25 (2005 - 2016)
Thermal releases (J)	Nonradiological	1.6 E16	TF(1-10)E, TF(1-6)W	7.2 E11	1.7 E15	Operation	Table 7-5 (Footnote 1,4)* Table 7-25 (2005 - 2016)
NH3 (kg)	Nonradiological	5.6 E4	TF(1-10)E, TF(1-6)W	2.5	6.2 E3	Operation	Table 7-5 (Footnote 1,4)* Table 7-25 (2005 - 2016)
241 Am (Ci)	Radiological	9.4 E-6	TF(1-10)E, TF(1-6)W	4.3 E-10	1.04 E-6	Operation	Table 7-6 (Footnote 1,4)* Table 7-25 (2005 - 2016)
14 C (Ci)	Radiological	4.8 E-7	TF(1-10)E, TF(1-6)W	2.2 E-11	5.3 E-8	Operation	Table 7-6 (Footnote 1,4)* Table 7-25 (2005 - 2016)
137 Cs (Ci)	Radiological	3.1 E-3	TF(1-10)E, TF(1-6)W	1.4 E-7	3.4 E-4	Operation	Table 7-6 (Footnote 1,4)* Table 7-25 (2005 - 2016)
129 I (Ci)	Radiological	1.4 E-9	TF(1-10)E, TF(1-6)W	6.3 E-14	1.6 E-10	Operation	Table 7-6 (Footnote 1,4)* Table 7-25 (2005 - 2016)
239, 240 Pu (Ci)	Radiological	3.0 E-6	TF(1-10)E, TF(1-6)W	1.4 E-10	3.3 E-7	Operation	Table 7-6 (Footnote 1,4)* Table 7-25 (2005 - 2016)
106 Ru (Ci)	Radiological	3.4 E -12	TF(1-10)E, TF(1-6)W	1.5 E-16	3.8 E-13	Operation	Table 7-6 (Footnote 1,4)* Table 7-25 (2005 - 2016)
151 Sm (Ci)	Radiological	5.7 E-5	TF(1-10)E, TF(1-6)W	2.6 E-9	6.3 E-6	Operation	Table 7-6 (Footnote 1,4)* Table 7-25 (2005 - 2016)
90 Sr (Ci)	Radiological	4.8 E-3	TF(1-10)E, TF(1-6)W	2.2 E-7	5.3 E-4	Operation	Table 7-6 (Footnote 1,4)* Table 7-25 (2005 - 2016)
99 Tc (Ci)	Radiological	2.9 E-6	TF(1-10)E, TF(1-6)W	1.3 E-10	3.2 E-7	Operation	Table 7-6 (Footnote 1,4)* Table 7-25 (2005 - 2016)
241 Zr (Ci)	Radiological	3.5 E-7	TF(1-10)E, TF(1-6)W	1.6 E-11	3.9 E-8	Operation	Table 7-6 (Footnote 1,4)* Table 7-25 (2005 - 2016)
% PM-10^5	Radiological	100%	TF(1-10)E, TF(1-6)W	100%	100%	Operation	Table 7-6 (Footnote 1,4)* Table 7-25 (2005 - 2016)

***Notes:**

1. Those presented under "Source ID" represent the 18 tank farms at 200 E and 200 W. The sequence of the tank farm operation/construction (chronologic phase) is not determined at this time. The tank farm area as a whole is the emission source. See the attached Table 5.3.1 and the map for the tank farm locations/coordinates/and elevations.
2. The operating life including startup and decontamination/decommissioning used to derive annual average emission rate is based on 9 years. [startup = 3 yrs (2005-2008) = 2 equivalent operating years; decontamination/decommissioning = 3 years (2013-2016) = 2 equivalent operating years)
3. Construction phase (1998-2016) and operation phase (2005-2016) are chronologically overlapping (2005-2016). The emission rates are additive for the annual average emission rates during the overlapping years.

Assumptions:

1. The peak hourly emission rate is based on the following assumptions:
   a. Construction hours are based on 10 average hours/day ,5 days/week, six(6) holidays/year. Construction hours = 1550 hours/year.
   b. Operation hours are based on 60 % operating efficiency. Also the additional 40% margin applicable to the "No Separation Alternative" will be assumed. In addition, the nine (9) operating years will be shorten to seven (7) years because the startup and decontamination/decommissioning are assumed half of the full operation emission rate. Operation hours = 24 x 365 x 60% x 60% = 3154 (hours/year)

Attachments:

1. "Tank Farm Locations within the Hanford Site" on Page 5 -- from WHC-SD-WM-TI-648 REV 0 Figure 4-1
2. "Source Types and Locations" on Page 6 -- Table 5.3.1
3. "In Situ Vitrification Flow Diagram" on Page 7 -- from WHC-SD-WM-EV-101 Rev. B Figure 4-1
4. "In Situ Vitrification Facility Layout (1 of 5)" on Page 8 -- from WHC-SD-WM-EV-101 Rev. B Figure 4-2
5. "Tank Farm Confinement Facility (Sheet 1 of 3)" on Page 9 -- from WHC-SD-WM-EV-101 Rev. B Figure 4-3

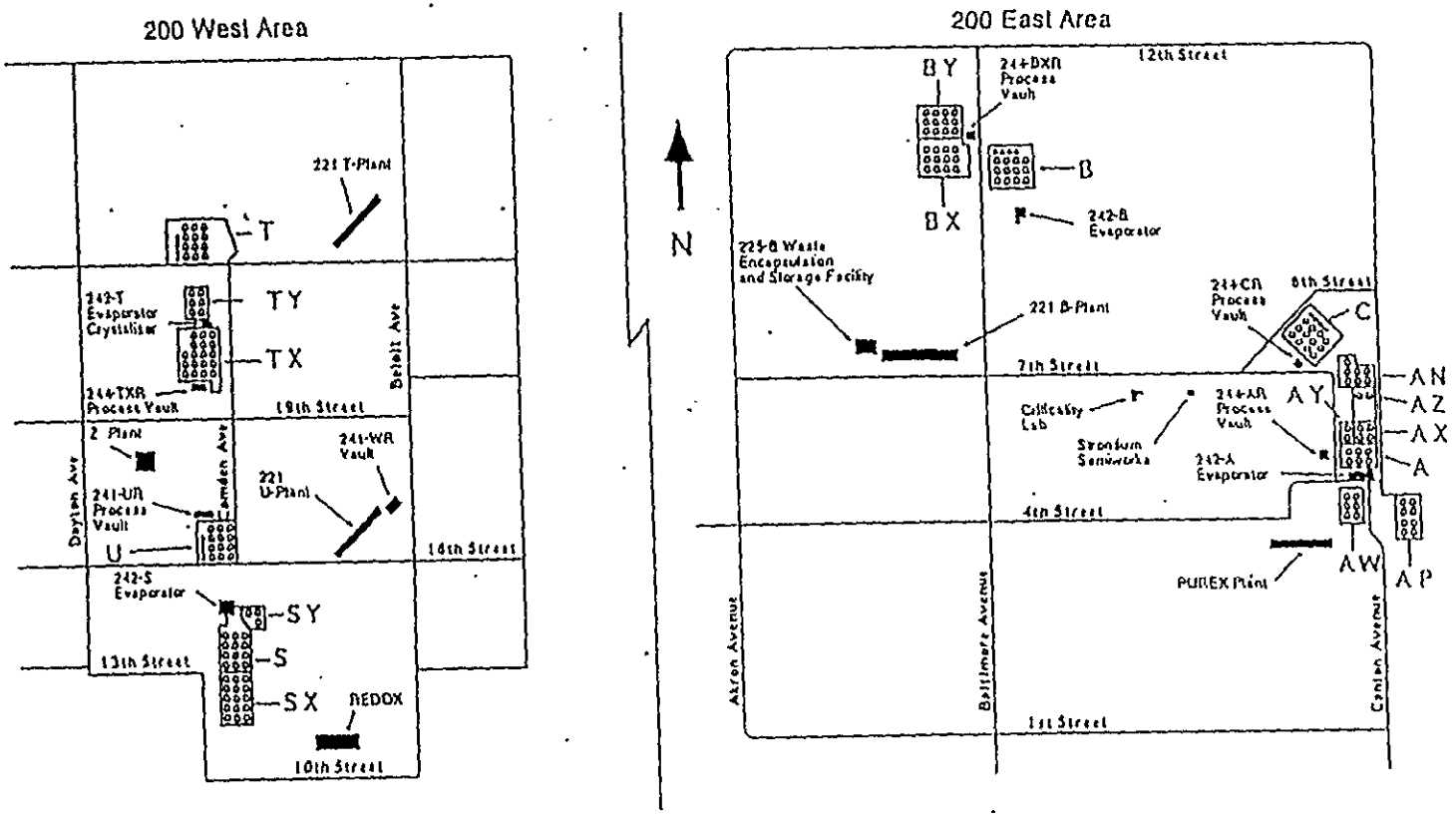


Figure 4-1. Tank Farm Locations within the Hanford Site. (Brevick et al., 1994a)

Page 5

TABLE 5.3.1 SOURCE TYPES AND LOCATIONS.

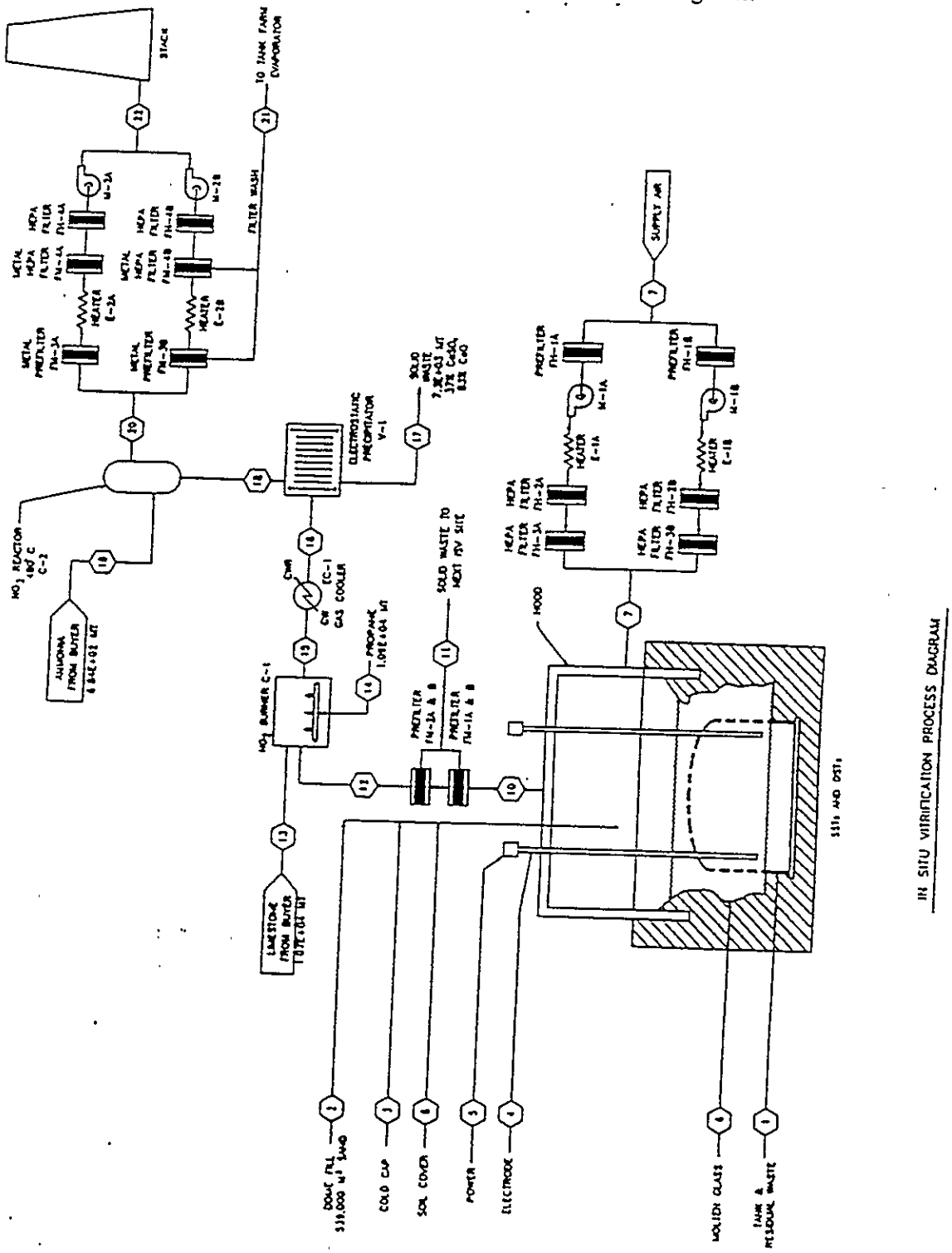
TANK FARM	SOURCE NAME **	SOURCE LOCATION*		ELEVATION OF CENTER (m)	SOURCE TYPE
		x coord.	y coord.		
BY	TF1E	573556	137442	200	AREA
BX	TF2E	573556	137282	200	AREA
B	TF3E	573771	137252	200	AREA
C	TF4E	575075	136493	200	AREA
AN	TF5E	575332	136378	205	AREA
AZ	TF6E	575365	136279	205	AREA
AY	TF7E	575281	136157	205	AREA
AX	TF8E	575380	136159	205	AREA
A	TF9E	575310	136015	210	AREA
AW	TF10E	575304	135806	210	AREA
AP	TF11E	575481	135747	210	AREA
T	TF1W	566738	136662	210	AREA
TY	TF2W	566715	136373	210	AREA
TX	TF3W	566689	136146	210	AREA
U	TF4W	566744	135000	205	AREA
S&SY	TF5W	566750	134399	205	AREA
SX	TF6W	566746	134162	205	AREA
	TA1W	566833	136570	210	AREA
	TA2W	566886	134878	205	AREA
	TA3W	566930	134444	205	AREA
	TA1E	573755	137383	200	AREA
	TA2E	575163	136336	200	AREA
SITE	PROC	573879	135229	215	AREA
	BTCH	571332	135953	225	AREA
	SMIN	574425	135978	215	AREA
	ST-L	574120	135901	215	AREA
	ST-H	574410	135978	215	AREA

Notes: * Location of area sources represents southwest corner of area (coordinates in meters)
** Tank farm sources have the prefix "TF", transfer annex areas have the prefix "TA"; source IDs ending in "E" are located in the 200 East area, while those ending in "W" are located in the 200 West area. Other sources are defined as follows:

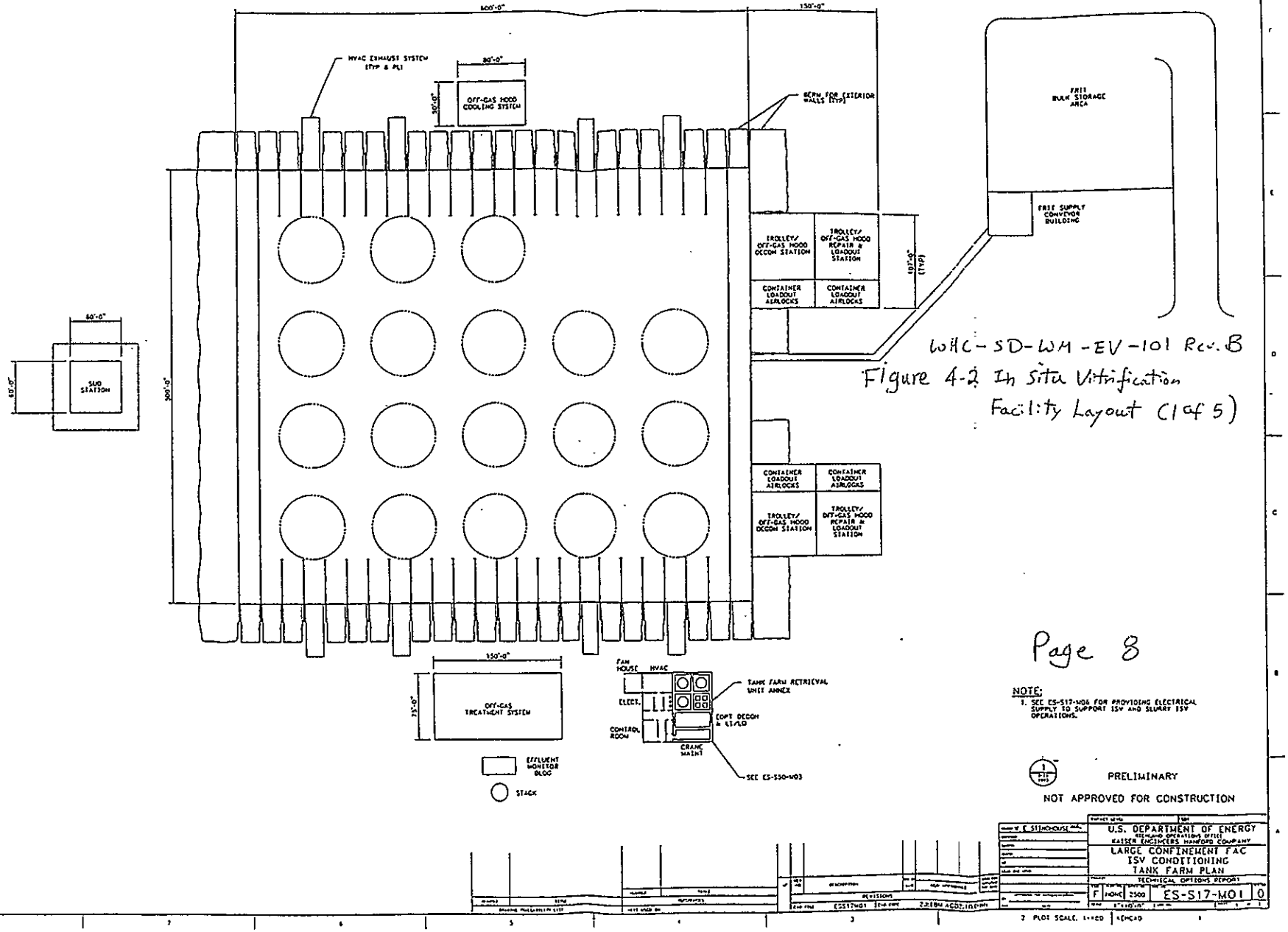
PROC = Vitrification process facility construction emissions
BTCH = Concrete batch plant emissions
SMIN = Minimal pretreatment process stack
ST-L = TPA low level waste process stack
ST-H = TPA high level waste process stack

Coordinate locations are given consistent with ASI coordinate system.

Figure 4-1. In Situ Vitrification Flow Diagram.



Page 7



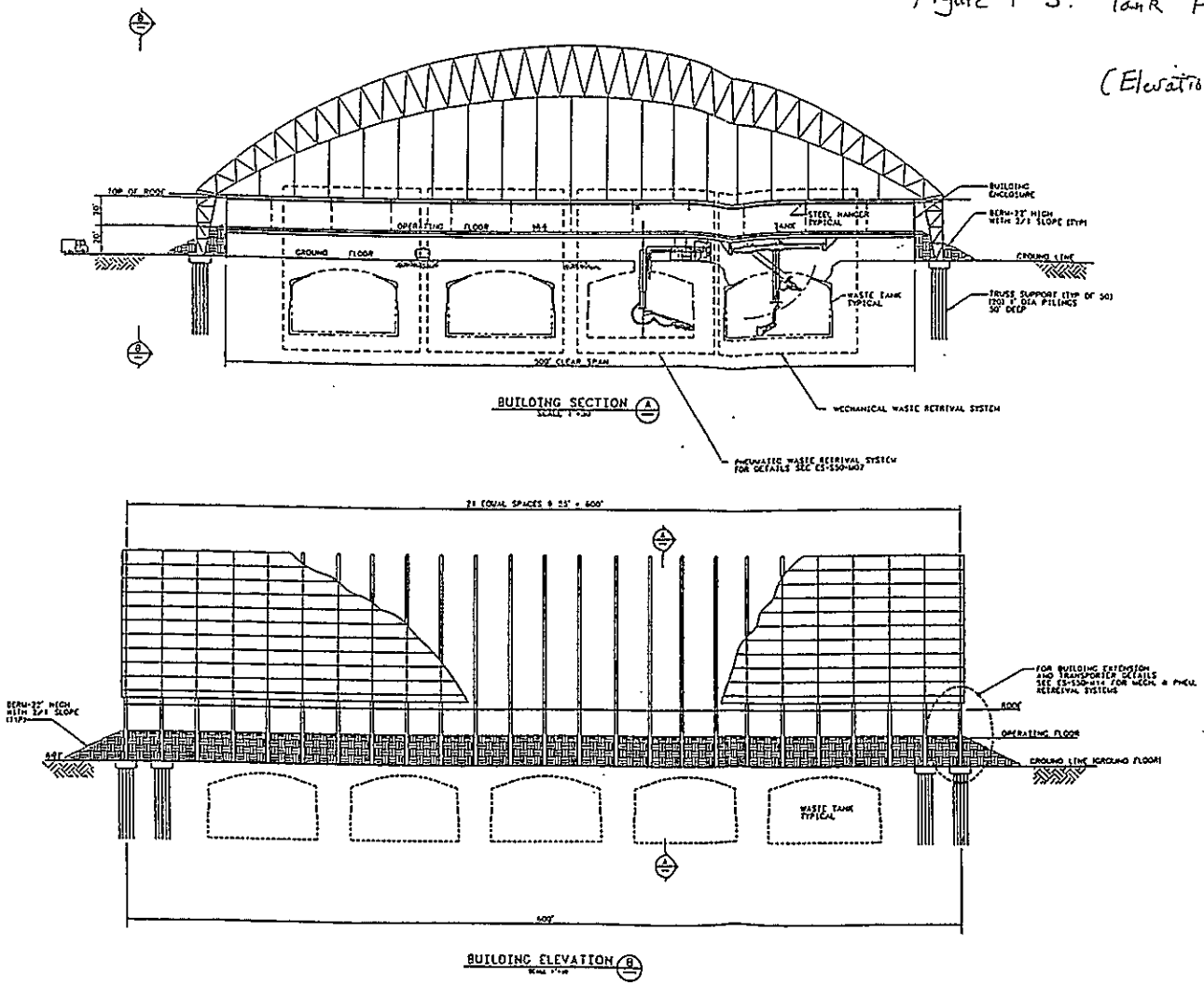
WHC-SD-WM-EV-101 Rev. B

Figure 4-2 In Situ Vitrification Facility Layout (1 of 5)

Page 8

NOTE:
1. SEE ES-S17-M06 FOR PROVIDING ELECTRICAL SUPPLY TO SUPPORT ISV AND SLURRY ISV OPERATIONS.

Figure 4-3. Tank Farm Confinement Facility (Sheet 1 of 3) (Elevation and Section)



Page 9

PRELIMINARY

NOT APPROVED FOR CONSTRUCTION

U.S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
KAISER ENGINEERS HANFORD COMPANY

LARGE CONFINEMENT FAC
STRUCTURAL
ELEVATION & SECTION

TECHNICAL OPTIONS REPORT

F 200C 1000 ES-S50-M02 0

1"=30'

ES-S50-M02

PLOT SCALE: 1=20

KENCAD

DATA REQUEST 57

No Action Alternative - Tanks

For No Action the following activities will take place:

SST wastes will be left in place following the completion of salt well pumping.

DST wastes will be retrieved and transferred into new DSTs twice during the 100 year period where institutional control will be maintained.

The following activities will be completed for DST wastes:

Construction

Note: The following will be constructed for each retrieval campaign. (Each construction activity will take place twice)

Build DST transfer piping

- connect existing DST facilities to new tank farms and new evaporator
- Build replacement evaporator
- Build tank retrieval systems
- Build new tanks
  - 26 new DSTs will replace existing 28 DSTs
  - Diesel generator building
  - Gas sampling and stack monitoring facilities
  - Administration building
  - Possible weather enclosure over tank farm
  - Tank ventilation systems

Operation

Retrieve DST wastes

- Direct transfer supernate to new DSTs
- Add dilution liquids to remaining wastes, run mixer pumps and slurry pump to evaporator
- Process slurry through evaporator
- Retrieve 99% of DST waste

Monitor SSTs

Operate Evaporator

- Evaporate all slurry transfer to maintain waste volume
- Treat condensate of liquid effluent treatment facility

From the No Action Data Package the following emissions estimated are made:

<u>Non Radiological Operating Emissions:</u> (For additional tank emission data see Request No. 55)

- Table 5-5 attached
- These emissions were taken from the HDW EIS and represent an estimate for emissions associated with tank farm surveillance during the 100 year institutional control period
- These emissions appear to be vehicle emissions
- If these are to be modeled, they can be divided by 100 to get an average annual emission. A peak emission could be estimated using the following factor:

$$\frac{\text{Non Rad Operating Emission}}{18\ \text{(tank farms)}} \times \frac{1}{100\ \text{yrs}} \times \frac{1\ \text{yr}}{2{,}000\ \text{hrs}} \times 2\ \text{(peak factor)}$$

Emission quantity X 5.6×10^{-7} (peak hourly emission) kg/hr - tank farm

Thus the peak hourly emission for any of the pollutants in table 5-5 can be calculated using the above factor.

Emissions will be very small. For example: The CO estimate is for 710 kg.

The CO peak hourly emission rate per tank farm is:

$$710\ \text{kg} \times 5.6 \times 10^{-7} = 4 \times 10^{-4}\ \text{kg/hr}$$

<u>Radiological Operating Emissions:</u>

- Table 5-6 attached
- Memo and attached hand calculation from Chris Memg (WHC) to Dave Murray (attached)
- Engineering data package Appendix B (attached)

The following points should be made for the radiological operating emissions:

- The radiological emissions are estimated using measured emission data for the tank farms in 1993. Emission data was obtained only for areas 3EDS and 5EDS (3DS = tank farms AN, AY, AZ, sources TF5E, TF6E, TF7E), (5EDS = tank farms AP, AW, sources TF10E, TF11E)

The memo noted above states that the emissions from other tank farms were either below detection or below reportable amounts.

- The quantities reported in table 5-6 are for the 100 year institutional control period
- Appendix B summarizes the calculations for determining the emissions based on the measured 1993 data

- Annual emissions can be calculated for any year using the following expression:

$$N = No e^{-\lambda t}; \qquad \lambda = \frac{\ell n 2}{t^{1/2}}$$

For Cs, $N = 5.3 \times 10^{-5}$ Ci $\times e^{-.0231t}$ (t in years from 1995)

Sr, $N = 8.4 \times 10^{-6}$ Ci $\times e^{-.0247t}$ (t in years from 1995)

I, $N = 4.6 \times 10^{-5} \times e^{-4.08 \times 10^{-8}t}$ (t in years from 1995)

- The air emission from tank farms are not a result of any processing activities and should remain constant throughout the 100 year period without any peaks.

- The radiological air emissions from tank farms can be identified as follows:

Pollutant	Source ID	Peak Hourly	Annual Average (Ci)	Phase
Cs 137	TF5E	-	$1.06 \times 10^{-5} e^{-.0231t}$	Yrs 1995-2042
Cs 137	TF6E	-	$1.06 \times 10^{-5} e^{-.0231t}$	Yrs 1995-2042
Cs 137	TF7E	-	$1.06 \times 10^{-5} e^{-.0231t}$	Yrs 1995-2042
Cs 137	TF10E	-	$1.06 \times 10^{-5} e^{-.0231t}$	Yrs 1995-2042
Cs 137	TF11E	-	$1.06 \times 10^{-5} e^{-.0231t}$	Yrs 1995-2042
Sr 90	TF5E	-	$1.68 \times 10^{-6} e^{-.0247t}$	Yrs 1995-2042
Sr 90	TF6E	-	$1.68 \times 10^{-6} e^{-.0247t}$	Yrs 1995-2042
Sr 90	TF7E	-	$1.68 \times 10^{-6} e^{-.0247t}$	Yrs 1995-2042
Sr 90	TF10E	-	$1.68 \times 10^{-6} e^{-.0247t}$	Yrs 1995-2042
Sr 90	TF11E	-	$1.68 \times 10^{-6} e^{-.0247t}$	Yrs 1995-2042
I 129	TF5E	-	$9.2 \times 10^{-6} e^{-4.08E-8t}$	Yrs 1995-2042
I 129	TF6E	-	$9.2 \times 10^{-6} e^{-4.08E-8t}$	Yrs 1995-2042
I 129	TF7E	-	$9.2 \times 10^{-6} e^{-4.08E-8t}$	Yrs 1995-2042
I 129	TF10E	-	$9.2 \times 10^{-6} e^{-4.08E-8t}$	Yrs 1995-2042
I 129	TF11E		$9.2 \times 10^{-6} e^{-4.08E-8t}$	Yrs 1995-2042

After the year 2042 all DST wastes will have been retanked into new DSTs located in the same area as the TPA vitrification facilities.

Making the assumption that all releases from the new DST tank farms will occur from the TPA HLW vitrification stack source location the following table is developed.

Pollutant	Source	Peak Hourly	Annual Average (Ci)	Phase
Cs 137	ST-H	-	$5.3 \times 10^{-5} e^{-.0231t}$	Yrs 2042-2095
Sr 90	ST-H	-	$8.4 \times 10^{-6} e^{-.0247t}$	Yrs 2042-2095
I 129	ST-H	-	$4.6 \times 10^{-5} e^{-4.04E-8t}$	Yrs 2042-2095

Note the emissions for any given year falling in the phase noted can be calculated by subtracting the year from 1995 and using the result ~~as~~ to evaluate the expression in the annual average column for the pollutant of interest. This was done because of the continuously changing emissions resulting from the short half life of Cs & Sr.

For evaporator emissions the following breakdown applies:

Pollutant	Source	Peak Hourly* Ci/Hr	Annual Average** Ci/Yr	Phase
Cs 137	ST-H	6.3×10^{-7}	2.76×10^{-3}	Yrs 2037-2042
H 3	ST-H	9×10^{-3}	39	Yrs 2037-2042
Sr 90	ST-H	7×10^{-7}	3.1×10^{-3}	Yrs 2037-2042
I 129	ST-H	6×10^{-7}	2.72×10^{-3}	Yrs 2037-2042
Total Beta	ST-H	4×10^{-10}	1.9×10^{-6}	Yrs 2037-2042
Total Alpha	ST-H	4.6×10^{-10}	2×10^{-6}	Yrs 2037-2042
Cs 137	ST-H	2×10^{-7}	8.7×10^{-4}	Yrs 2087-2092
H 3	ST-H	5.3×10^{-4}	2.3	Yrs 2087-2092
Sr 90		2×10^{-7}	9×10^{-4}	Yrs 2087-2092
I 129		6.2×10^{-7}	2.7×10^{-3}	Yrs 2087-2092
Total Beta		1.2×10^{-10}	5.4×10^{-7}	Yrs 2087-2092
Total Alpha		4.7×10^{-10}	2.08×10^{-6}	Yrs 2087-2092

***Peak Hourly**: Annual Average X 1 yr/365 days X 1 day/24 hrs X 2 (peak factor).
**** Annual Average**: Evaporator estimate (10 yr)/5 yrs operation period. These evaporator emissions were annualized without using the decay equations.

<u>For Construction Emissions:</u>

The new tanks will be located in the same area as the TPA facilities so the source for No Action should correspond to PROC (ESE source area for TPA construction emissions).

The construction duration is 6/2033 - 6/2037 and 6/2083 - 6/2087.

Pollutant	Source	Peak Hourly	Annual Average	Phase
Particulate	PROC	16.25 kg/hr	16,250 kg	Construction
SO_x	PROC	2 kg/hr	2,000 kg	Construction
CO	PROC	4,500 kg/hr	4,500,000kg	Construction
Hydrocarbons	PROC	225 kg/hr	225,000 kg	Construction
NO_x	PROC	237 kg/hr	237,500 kg	Construction
Aldehydes-(HCHO)	PROC	7.4 kg/hr	7,375 kg	Construction
Organic Acids	PROC	0	0	Construction
Thermal (J)	PROC	9.5×10^{10} J/hr	9.5×10^{13} (J)	Construction
Fugitive dust	PROC	.07 mt/hr	68.75 metric ton	Construction

Peak Hourly: Annual Average X 1/365 days X 1 day/8 hrs X 3 peak factor.
Peak Hourly: Annual Average X .001.
Annual Average: Total estimate/8 years.

NOTE: SEE TABLE 5-11 attached.

Figure 1-5. No Disposal Action Alternative Flowsheet.

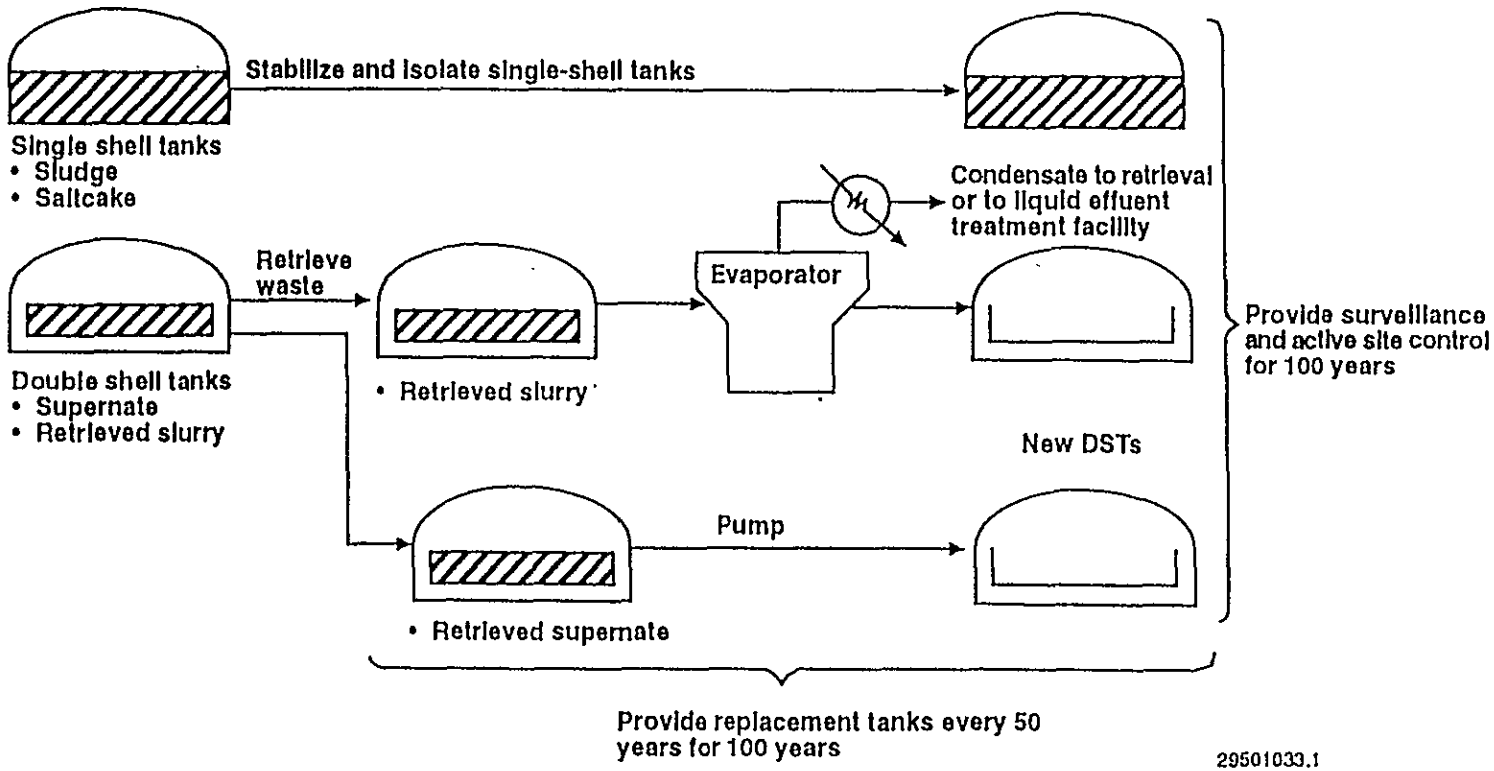


Table 5-5. Nonradiological Operating Emissions
(Units as Indicated).

Item	No Disposal Action[1]
Thermal releases	1.1×10^{13} J
Particulate	20 kg
Volatile organic compounds	68 kg
Fugitive dust	n/a
Toxic Air Pollutants[2]	not available
NOx (as nitrogen dioxide)	77 kg
SOx (as sulfur dioxide)	12 kg
Carbon Monoxide	710 kg

Notes:

J = joule
kg = kilogram

[1]The values for these emissions (over the 100-year period) were taken from RHO-RE-ST-30 P, Table 4-17, pages 4-24 and 4-25 (*Hanford Defense Waste Disposal Alternatives: Engineering Support Data for the HDW-EIS.*

[2]The list of Toxic Air Pollutants present in the tank farms has not been completed yet. The final list will include only those species that are present in sufficient quantities to be regulated. Vapor characterization of Tank 241-C-103 head space is being used as a worst case to estimate the amount of Toxic Air Pollutants given off by the tank farms. The data for the Toxic Air Pollutants will be in the soon to be released Draft Tank Farms Air Operating Permit.

RHO, 1985, *Hanford Defense Waste Disposal Alternatives: Engineering Support Data for the HDW-EIS*, RHO-RE-ST-30 P, Rockwell Hanford Operations, Richland, Washington.

Table 5-10. Nonradiological Construction Emissions (units as indicated).

Construction Emission Pollutant	No Disposal Action[1]
Particulate (kg)	130,000
SO_x as sulfur dioxide (SO_2) (kg)	16,000
Carbon monoxide (kg)	36,000,000
Hydrocarbons (kg) (exhaust and fugitive)	1,800,000
NO_x as nitrogen dioxide (NO_2) (kg)	1,900,000
Aldehydes (kg) (as HCHO)	59,000
Organic acids (kg)	0
Thermal releases (J)	7.60×10^{14}
Fugitive dust (t)	550

Notes:

J = joule
kg = kilogram
NO_x = Nitrous oxides
SO_x = Sulfurous oxides
t = metric ton

[1]The values in this table were factored from the No Separations alternative by using a ratio of the construction costs.

Table 5-11. Transportation of Earthen Borrow Construction Material (Units as Indicated).

Item	No Disposal Action
Borrow source location (state)	3 km NW of site
Route location (state mileage)	Route 3 to Route 4 (5 Km)
Road type (gravel or asphalt)	Gravel, level
Total number of trips Truck[1] Train Barge	 31,000 0 0
New road construction (miles)	0
Load volumes (m^3)	6.1

Notes:

km = kilometer
m^3 = cubic meter
NW = northwest

[1]The values in this table were factored from the No Separations alternative by using a ratio of the construction costs.

NOTE: The 31,000 trips indicated above should result in fugitive dust emissions that are split between the borrow site and the construction site. This is NOT shown on the Response to the Engineering Information Request page 4 "Construction Emissions by source". Since the fugitive dust estimate is factored from the No Separations data package, the fugitive dust estimate can be split between the borrow site & construction site in a similar manner to the TPA or No Separations data. Using No Separations data pkg 32% fugitive dust comes from borrow pit and batch plant operations.

Table 5-21. Overall Schedule (Calendar Year Start/Completion Date).

Activity	No Disposal Action[1]
Construction	06/2033 - 06/2037 06/2083 - 06/2087
Tank retrieval and re-evaporation	06/2037 - 06/2042 06/2087 - 06/2092
Decontamination and decommissioning	06/2042 - 06/2047 06/2092 - 06/2097
Monitoring and maintenance	01/1995 - 01/2095
Research and development	n/a

Notes:

[1]Figure 2-2 is a representation of the above schedule.

Table 5-6. Radiological Operating Emissions (Ci). for 100yr's

Radionuclide[1]	No Disposal Action		
	Air Emissions from Tank Farms[2]	Air Emissions from Evaporator[3]	Water Emissions from Evaporator[4]
^{241}Am	0	n/a	0
^{14}C	0	n/a	0
^{137}Cs	2.1E-03	n/a	1.8E-02
^{3}H	Below Detection[5]	n/a[6]	2.1E02
^{129}I	4.6E-03	n/a	2.7E-02
^{239}Pu, ^{240}Pu	0	n/a	0
^{106}Ru	0	n/a	0
^{151}Sm	0	n/a	0
^{90}Sr	3.1E-04	n/a	2.0E-02
^{99}Tc	0	n/a	0
^{93}Zr	0	n/a	0
Total Alpha	n/a	2.1E-05	n/a
Total Beta	n/a	1.2E-05	n/a
Percent PM-10[7]	100	n/a	n/a

Notes:

[1]All values in Ci except for percent PM-10.

[2]Starting air releases for tank farms were taken from WHC-EP-0527-3, *Environmental Releases for Calendar Year 1993* (Thomas and Curn 1994). The release values were then decayed and summed over the 100-year period (see Appendix B).

[3]These releases were below the trip point for reporting individual radionuclides so total alpha and beta were reported in the *Westinghouse Hanford Company Effluent Releases and Solid Waste Management Report for 1987: 200/600/1100 Areas* (Coony et al.).

[4]These releases were based on the yearly releases of the evaporator while processing approximately 41,600 m^3 (11 million gal) of waste in a year as reported in the *Westinghouse Hanford Company Effluent Releases and Solid Waste Management Report for 1987: 200/600/1100 Areas* (Coony et al.). To evaporate 416,000 m^3 (110 million gal) of waste (at a 3-to-1 dilution) at 41,600 m^3 (11 million gal) a year, requires the equivalent of 10 years of operation for each retanking or 20 years of emissions at this level. The releases were calculated by decaying the 1987 releases to the point of evaporation and summing the releases over the evaporator operation while decaying the radionuclide during the evaporation (see Appendix B). The actual evaporation for retanking is scheduled for 5 years each time so the emissions may be more concentrated while remaining within release limits.

Table 5-6. Radiological Operating Emissions (Ci).

Notes: (Continued)

[5]Table 2-1 of the *Environment Releases for Calendar Year 1993* (Thomas and Curn 1994) indicates that air sampling was not done for tritium in the 200 Areas based on its known absence or extremely low concentrations and dose impact.

[6]No separate air emissions were compiled for different radionuclides in the *Westinghouse Hanford Company Effluent Releases and Solid Waste Management report for 1987: 200/600/1100 Areas* (Coony et al.); therefore, the tritium releases are contained in the total Beta entry in this column.

[7]Percent PM-10 is 100 percent as all released particulates are less than 10 microns.

Coony, F. M., D. B. Howe, and L. J. Voigt, 1988, *Westinghouse Hanford Company Effluent Releases and Solid Waste Management Report for 1987: 200/600/1100 Areas*, WHC-EP-0141, Westinghouse Hanford Compant, Richland, Washington.

Thomas S. J. and B. L. Curn, 1994, *Environmental Releases for Calendar Year 1993*, WHC-EP-0527-3, Westinghouse Hanford Company, Richland, Washington.

APPENDIX B

CALCULATION OF RADIOLOGICAL RELEASES TO AIR AND WATER FROM THE TANK FARMS AND EVAPORATOR OVER THE FIRST 100 YEARS

The amount of a radionuclide at a given time in its decay life is represented by:

$$N = N^o \, e^{-\lambda t}$$

where:

N = the amount of the radionuclide at time t
N° = the amount of the radionuclide at time zero
λ = the decay constant

$$\lambda = \frac{\ln 2}{t_{1/2}}$$

$t_{1/2}$ = the half life or the amount of time before half the original amount of radionuclides decay

To find the amount of environmental releases over a 100-year period the decay equation is integrated over 100 years.

$$\int_0^{100} N^o \, e^{-\lambda t} \, dt = N^o \int_0^{100} e^{-\lambda t} \, dt =$$

$$= N^o \left[\frac{-e^{-\lambda t}}{\lambda}\right]_0^{100} =$$

$$= - N^o \left[\frac{e^{-\lambda 100}}{\lambda} - \frac{e^0}{\lambda}\right] =$$

$$= N^{\circ}\left[\frac{e^{0}}{\lambda} - \frac{e^{-\lambda 100}}{\lambda}\right]$$

$$for\ ^{137}Cs\quad t_{1/2} = 30\ years\quad so\quad \lambda = \frac{\ln 2}{30\ y} = 0.0231\ y^{-1}$$

$$for\ ^{90}Sr\quad t_{1/2} = 28.1\ years\quad so\quad \lambda = \frac{\ln 2}{28.1\ y} = 0.0247\ y^{-1}$$

$$for\ ^{129}I\quad t_{1/2} = 1.7X10^{7}\ years\quad so\quad \lambda = \frac{\ln 2}{1.7X10^{7}\ y} = 4.08X10^{-8}\ y^{-1}$$

Current yearly tank farm air releases are:

$$^{137}Cs = 5.3 \text{ X } 10^{-5} \text{ Ci}$$

$$^{90}Sr = 8.4 \text{ X } 10^{-6} \text{ Ci}$$

$$^{129}I = 4.6 \text{ X } 10^{-5} \text{ Ci}$$

Tank Farm releases for 100 years for each of these radionuclides are:

for ^{137}Cs

$$5.3X10^{-5}\ Ci\left[\frac{1}{0.0231} - \frac{e^{-0.0231(100)}}{0.0231}\right] = 2.1X10^{-3}\ Ci$$

for ^{90}Sr

$$8.4X10^{-6}\ Ci\left[\frac{1}{0.0247} - \frac{e^{-0.0247(100)}}{0.0247}\right] = 3.1X10^{-4}\ Ci$$

for ^{129}I

$$4.6X10^{-5}\ Ci[\frac{1}{4.1X10^{-8}} - \frac{e^{-4.1X10^{-8}(100)}}{4.1X10^{-8}}] = 4.6X10^{-3}\ Ci$$

Yearly evaporator liquid releases for 1987 are:

$^{3}H = 4.30 \times 10^{2}$ Ci

$^{137}Cs = <4.91 \times 10^{-3}$ Ci

$^{90}Sr = <6.07 \times 10^{-3}$ Ci

$^{129}I = <1.36 \times 10^{-3}$ Ci

Yearly evaporator air releases for 1987 are:

Total Alpha = 1.04×10^{-6} Ci

Total Beta = 3.63×10^{-6} Ci

The first evaporation connected to retanking occurs in 2037. The releases above will be decayed to that time (50 years). The decayed releases then will be summed and decayed over the first ten year operation of the evaporator. The releases then will be decayed to the beginning of the second evaporation which starts in 2087 (another 50 years). The decayed releases then will be summed and decayed over the second ten year operation of the evaporator.

$$N = N^{o}\ e^{-\lambda t}$$

where:

N = the amount of the radionuclide at time t
N° = the amount of the radionuclide at time zero
λ = the decay constant

$$\lambda = \frac{\ln 2}{t_{1/2}}$$

$t_{1/2}$ = the half life or the amount of time before half the original amount of radionuclides decay

$$\text{for } ^{137}Cs \quad t_{1/2} = 30 \text{ years} \quad \text{so} \quad \lambda = \frac{\ln 2}{30 \text{ y}} = 0.0231 \text{ y}^{-1}$$

$$\text{for } ^{90}Sr \quad t_{1/2} = 28.1 \text{ years} \quad \text{so} \quad \lambda = \frac{\ln 2}{28.1 \text{ y}} = 0.0247 \text{ y}^{-1}$$

$$\text{for } ^{129}I \quad t_{1/2} = 1.7X10^{7} \text{ years} \quad \text{so} \quad \lambda = \frac{\ln 2}{1.7X10^{7} \text{ y}} = 4.08X10^{-8} \text{ y}^{-1}$$

$$\text{for } ^{3}H \quad t_{1/2} = 12.3 \text{ years so } \lambda = \frac{\ln 2}{12.3 \text{ y}} = 0.0564 \text{ y}^{-1}$$

Therefore, the amount of the radionuclides after 50 years is:

for ^{3}H

$$N = 4.3X10^{2} \text{ Ci } e^{-0.0564(50)} = 25.7 \text{ Ci}$$

for ^{137}Cs

$$N = 4.91X10^{-3} \ Ci \ e^{-0.0231(50)} = 1.55X10^{-3} \ Ci$$

for ^{90}Sr

$$N = 6.07X10^{-3} \ Ci \ e^{-0.0247(50)} = 1.77X10^{-3} \ Ci$$

for ^{129}I

$$N = 1.36X10^{-3} \ Ci \ e^{-4.1X10^{-8}(50)} = 1.36X10^{-3} \ Ci$$

for Total Beta (decay the same as ^{90}Sr)

$$N = 3.63X10^{-6} \ Ci \ e^{-0.0247(50)} = 1.06X10^{-6} \ Ci$$

for Total Alpha (decay the same as Pu $t_{1/2}$ = 24,400 y λ = 2.84 X 10^{-5})

$$N = 1.04X10^{-6}\ Ci\ \ e^{-2.84X10^{-5}(50)} = 1.04X10^{-6}\ Ci$$

First evaporator releases over a 10 year period are calculated below:

$$N = N^{o}\ [\frac{e^{0}}{\lambda} - \frac{e^{-\lambda 10}}{\lambda}]$$

Evaporator releases for 10 years for each of these radionuclides are:

for ^{137}Cs

$$Total = 1.55X10^{-3}\ Ci[\frac{1}{0.0231} - \frac{e^{-0.0231(10)}}{0.0231}] = 1.38X10^{-2}\ Ci$$

for ^{3}H

$$25.7\ \text{Ci}\ [\frac{1}{0.0564} - \frac{e^{-0.0564(10)}}{0.0564}] = 196.4\ \text{Ci}$$

for ^{90}Sr

$$1.77X10^{-3}\ Ci[\frac{1}{0.0247} - \frac{e^{-0.0247(10)}}{0.0247}] = 1.56X10^{-2}\ Ci$$

for ^{129}I

$$1.36X10^{-3}\ Ci[\frac{1}{4.1X10^{-8}} - \frac{e^{-4.1X10^{-8}(10)}}{4.1X10^{-8}}] = 1.36X10^{-2}\ Ci$$

for Total Beta

$$1.06X10^{-6}\ Ci[\frac{1}{0.0247} - \frac{e^{-0.0247(10)}}{0.0247}] = 9.36X10^{-6}\ Ci$$

for Total Alpha

$$1.04X10^{-6}\ Ci[\frac{1}{2.84X10^{-5}} - \frac{e^{-2.84X10^{-5}(10)}}{2.84X10^{-5}}] = 1.04X10^{-5}\ Ci$$

The second evaporation will occur after another 50 years of decay. Release concentrations after the second 50 years are:

$$N = N^{o}\ e^{-\lambda t}$$

for ^{137}Cs

$$N = 1.55X10^{-3}\ Ci\ e^{-0.0231(50)} = 4.87X10^{-4}\ Ci$$

for ^{3}H

$$N = 25.7\ e^{-0.0564(50)} = 1.53\ Ci$$

for ^{90}Sr

$$N = 1.77X10^{-3}\ Ci\ \ e^{-0.0247(50)} = 5.14X10^{-4}\ Ci$$

for ^{129}I

$$N = 1.36X10^{-3}\ Ci\ e^{-4.1X10^{-8}(50)} = 1.36X10^{-3}\ Ci$$

for Total Beta (decay the same as ^{90}Sr)

$$N = 1.06X10^{-6}\ Ci\ \ e^{-0.0247(50)} = 3.08X10^{-7}\ Ci$$

for Total Alpha (decay the same as Pu $t^{1/2}$ = 24,400 y $\lambda = 2.84 \times 10^{-5}$)

$$N = 1.04X10^{-6}\ Ci\ \ e^{-2.84X10^{-5}(50)} = 1.04X10^{-6}\ Ci$$

Second evaporator releases over a 10 year period are calculated below:

$$N = N^{o} \cdot [\frac{e^{0}}{\lambda} - \frac{e^{-\lambda 10}}{\lambda}]$$

Evaporator releases for 10 years for each of these radionuclides are:

for ^{137}Cs

$$4.87X10^{-4}\ Ci[\frac{1}{0.0231} - \frac{e^{-0.0231(10)}}{0.0231}] = 4.35X10^{-3}\ Ci$$

for ^{3}H

$$1.53\ \text{Ci}\ [\frac{1}{0.0564} - \frac{E^{-0.0564(10)}}{0.0564}] = 11.7\ \text{Ci}$$

for ^{90}Sr

$$5.14X10^{-4}\ Ci[\frac{1}{0.0247} - \frac{e^{-0.0247(10)}}{0.0247}] = 4.56X10^{-3}\ Ci$$

for ^{129}I

$$1.36X10^{-3}\ Ci[\frac{1}{4.1X10^{-8}} - \frac{e^{-4.1X10^{-8}(10)}}{4.1X10^{-8}}] = 1.36X10^{-2}\ Ci$$

for Total Beta

$$3.08X10^{-7}\ Ci[\frac{1}{0.0247} - \frac{e^{-0.0247(10)}}{0.0247}] = 2.72X10^{-6}\ Ci$$

for Total Alpha

$$1.04X10^{-6}\ Ci[\frac{1}{2.84X10^{-5}} - \frac{e^{-2.84X10^{-5}(10)}}{2.84X10^{-5}}] = 1.04X10^{-5}\ Ci$$

Total releases for the evaporator is a sum of the first and second evaporator operation releases:

for ^{137}Cs

$$<1.38 \times 10^{-2} + <4.35 \times 10^{-3} = <1.8 \times 10^{-2} \text{ Ci}$$

for ^{3}H

$$196 \text{ Ci} + 12 \text{ Ci} = 210 \text{ Ci}$$

for ^{90}Sr

$$<1.56 \times 10^{-2} + <4.56 \times 10^{-3} = <2.0 \times 10^{-2} \text{ Ci}$$

for ^{129}I

$$<1.36 \times 10^{-2} + <1.36 \times 10^{-2} = <2.7 \times 10^{-2} \text{ Ci}$$

for Total Beta

$$9.36 \times 10^{-6} + 2.72 \times 10^{-6} = 1.2 \times 10^{-5} \text{ Ci}$$

for Total Alpha

$$1.04 \times 10^{-5} + 1.04 \times 10^{-5} = 2.1 \times 10^{-5} \text{ Ci}$$

DON'T SAY IT --- *Write It!*

DATE: 3/31/95

TO: Dave Murray

FROM: Chris Meng H5-27

Telephone: 376-2947

cc: Ed Fredenburg

SUBJECT: No Disposal Action - Open item - radioactive emissions

The air operating emissions from 1993 for the tank farms (Table 5-6) had data for areas 3EDS and 5EDS. No emission data was given for the other areas. This indicates that the amounts released may have been so low they were not detectable or the releases were below reportable amounts.

The releases of tritium are associated with the operation of the evaporator. The evaporator releases and calculations remain the same and were not identified in the areas given. The tank farm releases and evaporator releases are separate in Table 5-6.

Please find attached the calculations for the releases from the areas where data was available.

Also, find attached the updated tables discussed earlier.

1993 - year of data

3EDS -

^{137}Cs	5.3 E - 5	Ci	Released in 1993
^{129}I	4.6 E - 5	Ci	
^{90}Sr	8.32 E - 6	Ci	

See Appendix B of WHC-SD-WM-EV-099 Part B for deffinitions. and equations (decay + integration).

Tank Farm releases for 100 years for each of these radionuclides are:

for ^{137}Cs

$$5.3\,E-5\ Ci\left[\frac{1}{0.0231} - \frac{e^{-0.0231(100)}}{0.0231}\right] = 2.1\,E-3\ Ci$$

for ^{129}I

$$4.6\,E-5\ Ci\left[\frac{1}{4.1\times10^{-8}} - \frac{e^{-4.1\times10^{-8}(100)}}{4.1\times10^{-8}}\right] = 4.6\,E-3\ Ci$$

for ^{90}Sr

$$8.32\,E-6\ Ci\left[\frac{1}{0.0247} - \frac{e^{-0.0247(100)}}{0.0247}\right] = 3.08\,E-4\ Ci$$

5EOS

^{137}Cs	1.6 E -7	Ci	Released in 1993
^{129}I	Not Detected		
^{90}Sr	9.3 E -8	Ci	

Tank Farm releases for 100 yrs for each of these radionuclides are:

for ^{137}Cs

$$1.6\,E-7\ Ci\left[\frac{1}{0.0231}-\frac{e^{-0.0231(100)}}{0.0231}\right]=6.2\,E-6\ Ci$$

for ^{90}Sr

$$9.3\,E-8\ Ci\left[\frac{1}{0.0247}-\frac{e^{-0.0247(100)}}{0.0247}\right]=3.4\,E-6\ Ci$$

Table 5-9. Construction Resource Requirements (Units As Indicated).

Resource Requirement	No Disposal Action
Land (m^2)[1]	
Surface committed	
Temporarily	360,000[2]
Permanently	190,000
Water (m^3)[3]	17,000
Energy[3]	
Electrical (GWh)	0.4
Propane (m^3)	7,500
Diesel fuel (m^3)	63
Gasoline (m^3)	86
Materials[4]	
Concrete (m^3)	120,000
Steel:	
Carbon steel (t)	12,000
Stainless steel (t)	22
Hastelloy (t)	0
Excavation (m^3)	3,700,000
Riprap (m^3)	0
Structure backfill (m^3)	3,500,000[5]
Total Contaminated Material (m^3)	0

Table 5-15. Decommissioning of Contaminated Treatment/Storage Facilities (Units as Indicated).

Item	No Disposition
Steel Quantity Disposition	20 t Low-level waste burial ground
Concrete Quantity Disposition	150 m^3 Low-level waste burial ground
Soil Quantity Disposition	0
Debris Quantity Disposition	140 m^3 Low-level waste burial ground

Notes:

m^3 = cubic meters
t = metric tons

As a part of this alternative, the current double-shell tanks and the new double-shell tanks would be left in place; therefore, no decontamination and decommissioning work would be done on them. The abandoned double-shell tanks may be filled with grout or gravel. Details of the closure of the double-shell tanks are in the *Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Study* (Scanlon et al. 1995)

The two high-level waste evaporators built as part of this alternative would be decommissioned. The entries in this table are for those evaporators. The following assumptions were made for decommissioning: 5 percent of the concrete and steel will remain contaminated; 85 percent of the stainless steel will remain contaminated; 5 percent of the decontaminated steel and concrete will be debris; and the evaporators will be entombed in place so no contaminated soil would need to be removed.

Scanlon, P.L., H. Hampt and W.A. Skelly, 1995, *Closure Technical Data Package for the Tank Waste Remediation System Environmental Impact Study*, WHC-SD-WM-EV-107, Rev. B, Westinghouse Hanford Company, Richland, Washington.

DATA REQUEST 058

The Extensive Immobilization alternative for the cesium and strontium capsules involves the following activities:

- Retrieve capsules from WESF;
- Build or modify a cell in the HLW vitrification facility to provide equipment to cut up capsules, remove contents, chemically treat contents if required, and feed capsule materials into the HLW melter food stream;
- Put capsules in a transportation cask and transport from WESF to the HLW plant;
- Cut up capsules, chemically treat if required, and feed into HLW melter feed; and
- Vitrify capsule contents with tank wastes.

No emissions for the construction or operations phases are provided in this data request. The construction emissions will be less than the uncertainty associated with the TPA construction emissions. The operating emissions will be treated and released with the HLW offgas system and should not significantly increase the stack emissions.

The cesium and strontium capsules engineering data package does not provide estimates for construction related emissions or operating emissions. The rationale provided in the data package is that the additional volume from the capsules is so small compared to the tank wastes that the additional impacts are insignificant.

From EIR #59

The following are specific data requests for the Cs and Sr Capsules - No Immobilization TWRS alternative.

1. A description of the processes involved in the No Immobilization alternative (including construction activities), indicating their nature and location. We feel that it would be useful to include applicable descriptive text and figures from the Engineering Data Package for this alternative.

2. Emissions of all regulated pollutants from each of the processes identified in item 1. Peak hourly and average annual emissions are required. These emissions should be assigned, if possible, to one of the 27 sources identified in the attached sheet and description. If a process occurs at a location other than the 27 identified source locations, please indicate the location of these sources. The preferred format for source locations is the coordinate grid system used by ASI (Washington State Coordinates).

3. A chronological description of the processes and emissions listed in items 1 and 2. For example, at how many tank farm locations will processes occur at one time? Will the duration of the project involve phases in which distinctly different emissions sources will be involved? If so, emissions from each phase should be given separately.

Ideally, the data would be presented in the following format:

Pollutant	Source ID	Peak Hourly Emission Rate	Annual Average Emission Rate	Chronologic Phase

TABLE 5.3.1 SOURCE TYPES AND LOCATIONS.

SOURCE NAME **	SOURCE LOCATION*		ELEVATION OF CENTER (m)	SOURCE TYPE
	x coord.	y coord.		
TF1E	573556	137442	200	AREA
TF2E	573556	137282	200	AREA
TF3E	573771	137252	200	AREA
TF4E	575075	136493	200	AREA
TF5E	575332	136378	205	AREA
TF6E	575365	136279	205	AREA
TF7E	575281	136157	205	AREA
TF8E	575380	136159	205	AREA
TF9E	575310	136015	210	AREA
TF10E	575304	135806	210	AREA
TF11E	575481	135747	210	AREA
TF1W	566738	136662	210	AREA
TF2W	566715	136373	210	AREA
TF3W	566689	136146	210	AREA
TF4W	566744	135000	205	AREA
TF5W	566750	134399	205	AREA
TF6W	566746	134162	205	AREA
TA1W	566833	136570	210	AREA
TA2W	566886	134878	205	AREA
TA3W	566930	134444	205	AREA
TA1E	573755	137383	200	AREA
TA2E	575163	136336	200	AREA
PROC	573879	135229	215	AREA
BTCH	571332	135953	225	AREA
SMIN	574425	135978	215	AREA
ST-L	574120	135901	215	AREA
ST-H	574410	135978	215	AREA

Notes: * Location of area sources represents southwest corner of area (coordinates in meters)
** Tank farm sources have the prefix "TF", transfer annex areas have the prefix "TA"; source IDs ending in "E" are located in the 200 East area, while those ending in "W" are located in the 200 West area. Other sources are defined as follows:

PROC = Vitrification process facility construction emissions
BTCH = Concrete batch plant emissions
SMIN = Minimal pretreatment process stack
ST-L = TPA low level waste process stack
ST-H = TPA high level waste process stack

Coordinate locations are given consistent with ASI coordinate system.

DATA REQUEST 59

Construction Activities

The only construction activity for Cesium and Strontium Capsules - No Immobilization TWRS alternative is the construction of capsule packaging facility. This will be a modification of the existing waste encapsulation storage facility (WESF). The duration of construction is for a period of seven years.

The capsule packaging facility is envisioned as a series of three hot cells, each 4.9-m wide and 3-m, 14-m, and 7-m long, respectively. The cells will be housed in a facility that is 43-m long, 14-m high, and occupies approximately 1,100 m^2 of surface area. The thick high density, concrete shielding wall of the hot cells will have an estimated eight viewing windows. Four manipulator pairs will be required. See attached Figure A1-1. Process flowsheet for the capsule packing facility.

For construction and location of capsule packaging facility see attached: Figure 4-1 and Figure D-5.

See the attached Figure 3-3 for the process flowsheet.

Figure 3-3. Flowsheet for Tri-Party Agreement Alternative for Storing and Disposing of Cesium Strontium Capsules (Preferred Alternative).

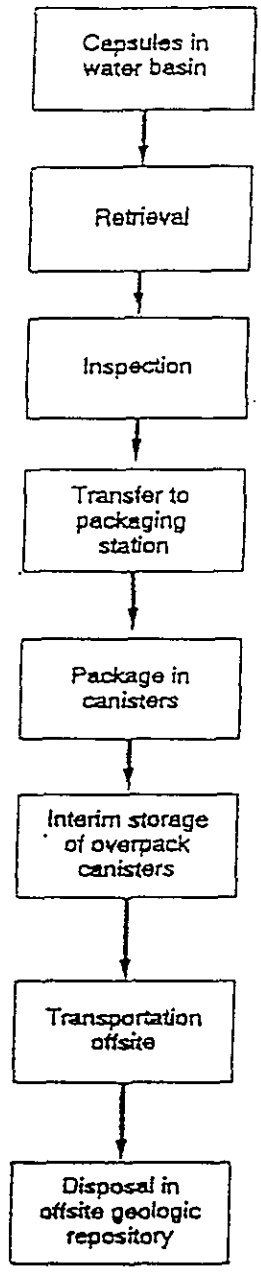


Table 59-A. Nonradioactive Emissions for the Construction Phase for Cesium and Strontium Capsules

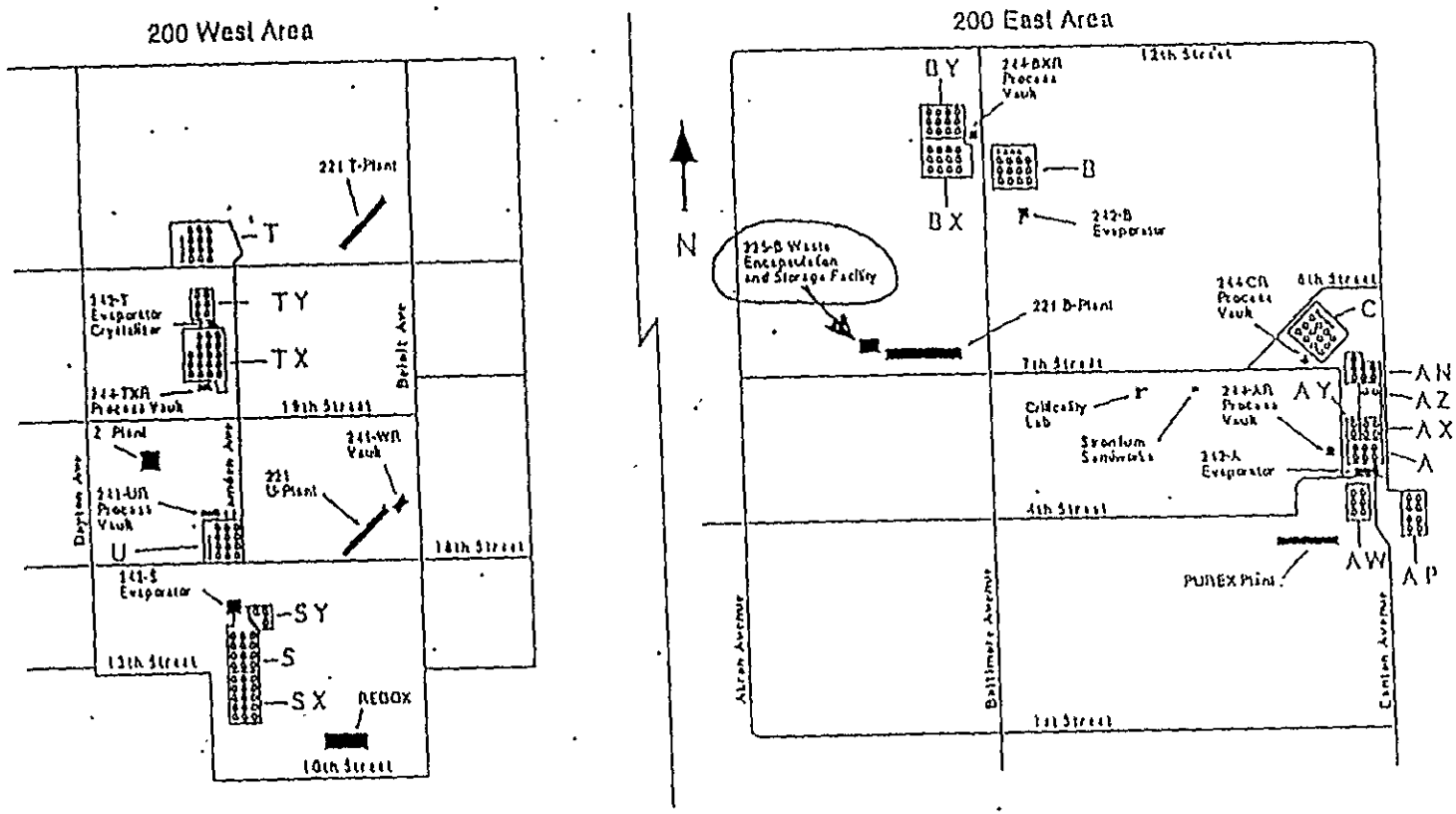
Pollutant	Source ID[1]	Peak Hourly Emission Rate	Annual Average Emission Rate	Chronologic Phase
Carbon Monoxide	W 573400 N 136400	5.0 kg	3,428.5 kg	Construction
Hydrocarbons	W 573400 N 136400	0.19 kg	128.6 kg	Construction
NO_x	W 573400 N 136400	0.19 kg	128.6 kg	Construction
SO_x	W 573400 N 136400	0.0 kg	0.0 kg	Construction
Particulates	W 573400 N 136400	0.02 kg	14.3 kg	Construction
Thermal	W 573400 N 136400	1.15E-3 TJ	0.78 TJ	Construction

[1]See attached 200 East Area map.

Table 59-B. Nonradioactive Emissions for the Operational Phase for Cesium and Strontium Capsules

Pollutant	Source ID	Peak Hourly Emission Rate	Annual Average Emission Rate	Chronologic Phase
Carbon Monoxide	W 573400 N 136400	0.16 kg	489.0 kg	Operation
Hydrocarbons	W 573400 N 136400	0.05 kg	144.4 kg	Operation
NO_x	W 573400 N 136400	0.79 kg	2,445.4 kg	Operation
SO_x	W 573400 N 136400	HOLDING FOR INFORMATION FROM WHC		
Particulates	W 573400 N 136400	0.12 kg	372.2 kg	Operation
Thermal	W 573400 N 136400	1.09E-2 TJ	33.9 TJ	Operation

Figure 4-1. Tank Farm Locations within the Hanford Site. (Bravick et al., 1994a)



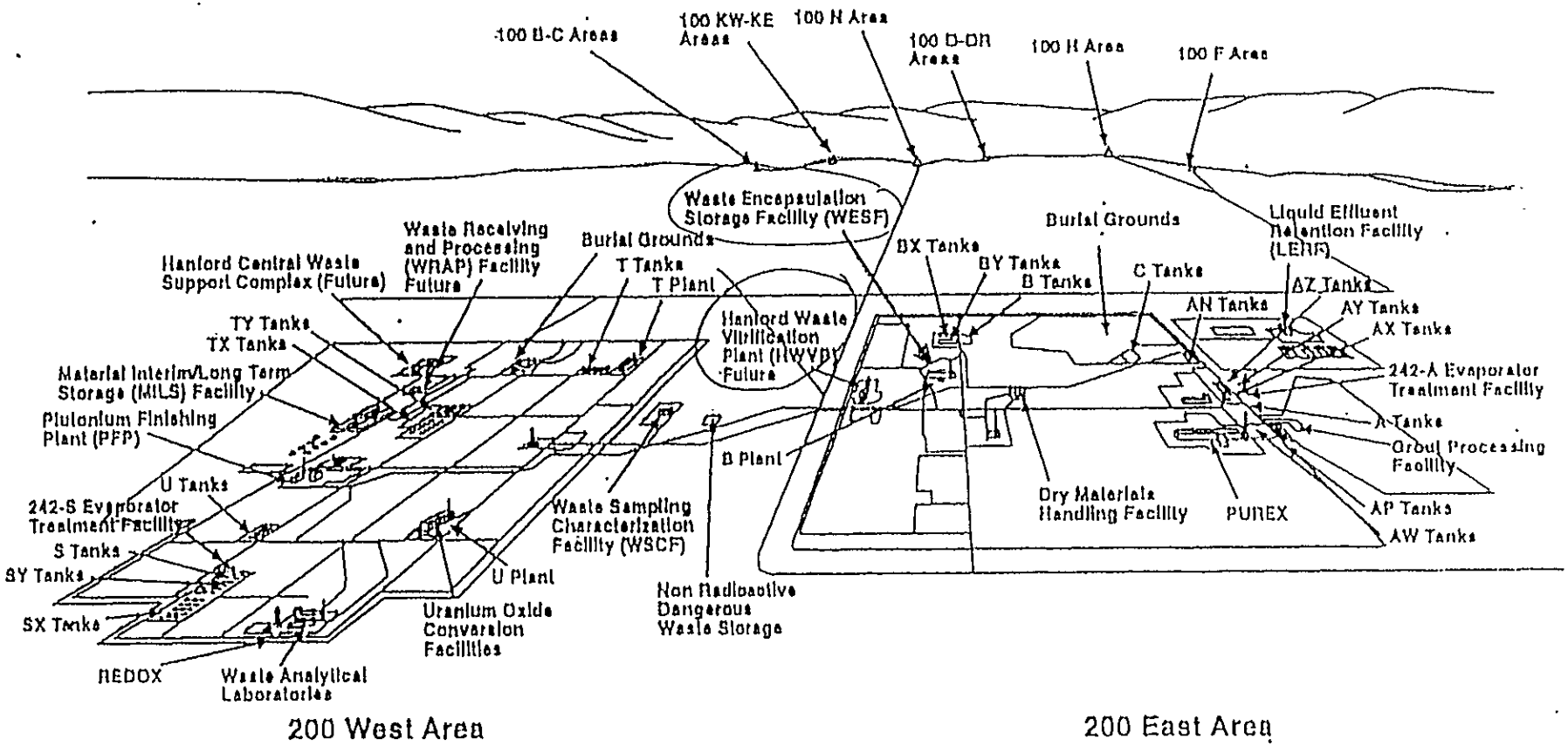


Figure D-4. Storage and Disposal Operations - 200 Area Facilities

29410035.1bw

D19500730 1

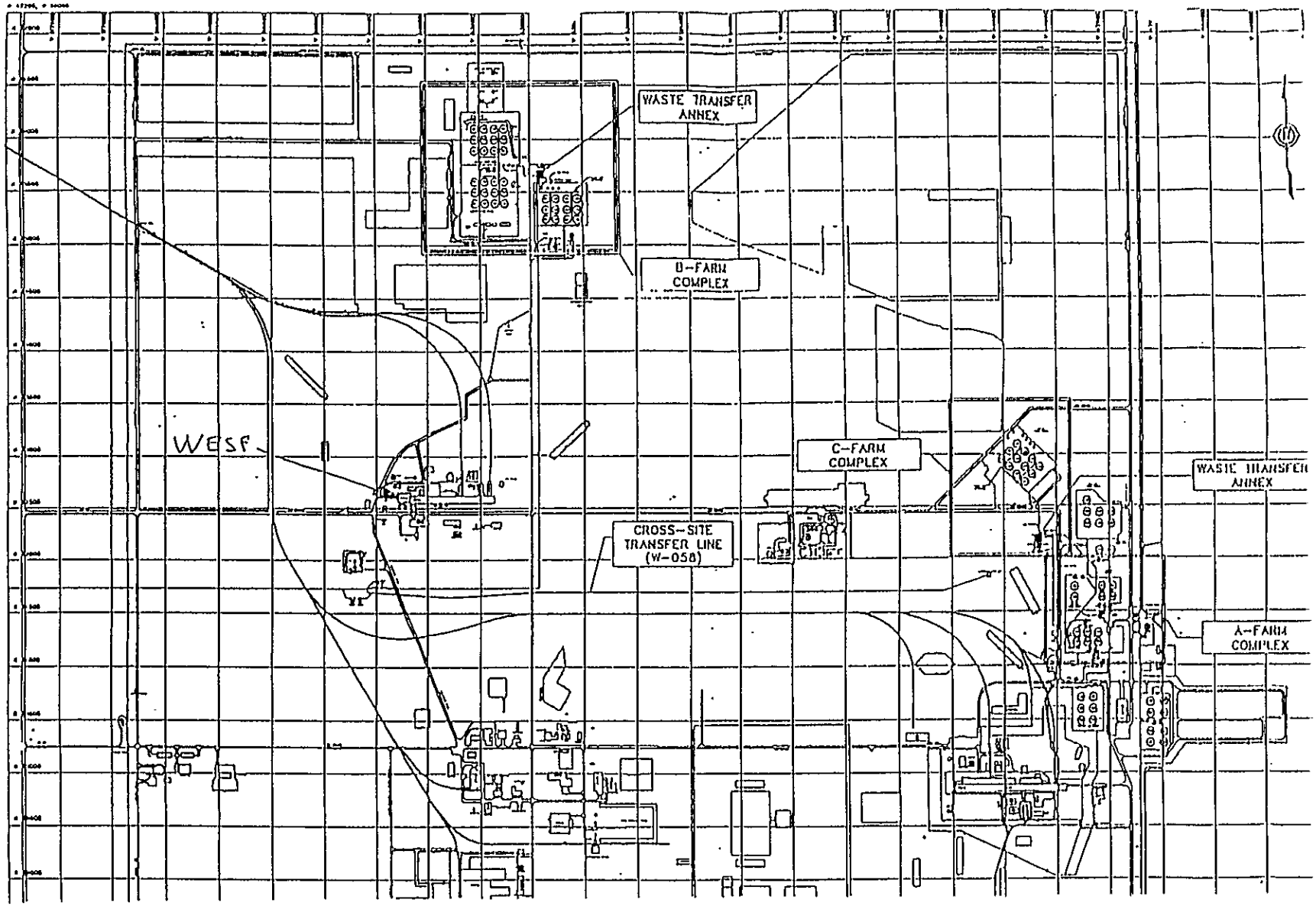
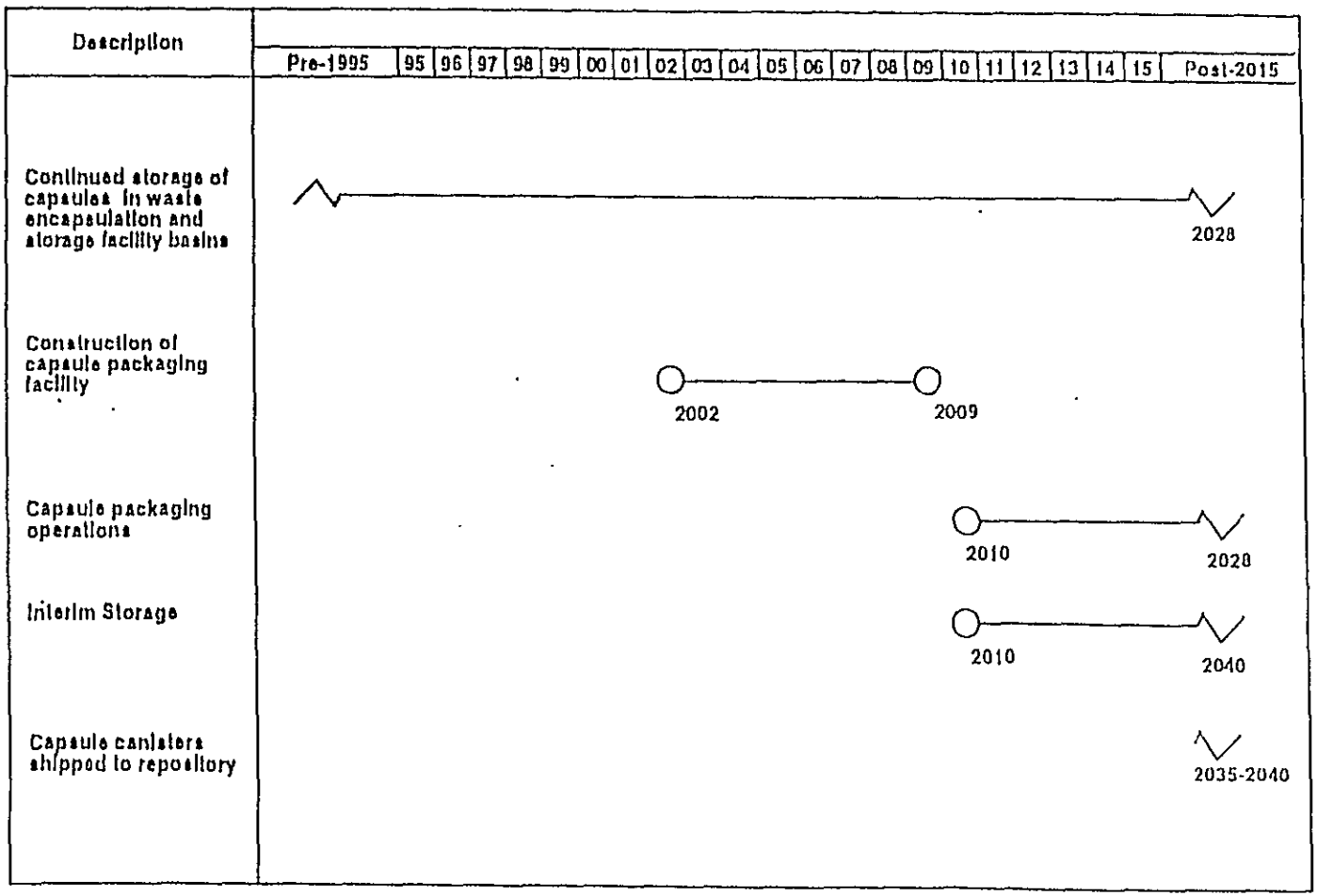

WASTE TRANSFER ANNEX
B-FARM COMPLEX
WESF
C-FARM COMPLEX
WASTE TRANSFER ANNEX
CROSS-SITE TRANSFER LINE (W-058)
A-FARM COMPLEX

Figure 3-4. Schedule of Activities for the Tri-Party Agreement Alternative: Storage and Disposal of Cesium Strontium Capsules (Preferred Alternative).



29502004.1

ENGINEERING INFORMATION REQUEST 42

SUPPLEMENT

Extensive Retrieval -Ex Situ Vitrification Alternative

Attached are the operating emissions from the HLW and LLW vitrification plants. Differences between the current emission estimates and previous estimates are due to updated model runs from WHC using the latest inventory, changes in some of the flow rates of the streams going up the stack (affects concentration), addition of C14 and I129 into the spread sheet per the material balance for separations. The C14 does not show up in the material balance streams exiting the stack.

The gas flow rates for the stacks will be higher than current estimates due to the lack of detail in the data available. For example, streams 903 and 911 for both the HLW and LLW plant are not modeled in the material balance. A review of the equipment list in the data package shows:

LLW Stream 903 blower with 1000 scfm capacity
LLW Stream 911 blower with 22,000 scfm capacity

The gas flow rates for the HLW plant will be lower because the flow sheet and material balance in the Rev B data package continues to show a fuel fired melter with combustion air supplied by 100% oxygen.

Capsule Alternatives

Data request 60 attached provides process information and emission rates for the Cs and Sr capsules - No Action Alternative.

TPA STACK STREAMS

SEPARATIONS AND LLW VITRIFICATION

STREAMS
907=702+706+434+522+645+903
917=911+914
factor=(200 mt/day/3.87E5)*91.0583lb/hr=4.747E-2

	702	706	434	522	645	903	sum of streams	907
MT gas	1.39E+04	0	2.70E+06	0	2.61E+05	0		3.05E+06
MT solid	0	0	1.94E-03	0	1.55E-04	0		1.05E-06
Total MT	1.39E+04	0.00E+00	2.70E+06	0.00E+00	2.61E+05	0.00E+00	3.05E+06	3.05E+06
Factor	4.75E-02	4.75E-02	4.75E-02	4.75E-02	4.75E-02	4.75E-02		4.75E-02
mass flow rate (lb/hr)	659.633	0	131966.6	0	12389.67	0		144783.5
molecular weight	27.63	28.26	28.76	28.76	37.61			29.5
temperature deg F	177	130	436	442	150			420.4270
flow scfm	153.187		29433.64	0	2113.125		31699.95	31482.25

HLW STREAMS

TPA HLW STREAMS	702	706	340	522	645	903		907
MT gas	7.19E+02	0	1.00E+05	0	2.09E+04	0		2.02E+05
MT solid	0	0	1.26E-04	0	9.09E-06	0		6.70E-08
Total MT	7.19E+02	0.00E+00	1.00E+05	0.00E+00	2.09E+04	0.00E+00	2.02E+05	2.02E+05
Factor	7.32E-02	7.32E-02	7.32E-02	7.32E-02	7.32E-02	7.32E-02		7.32E-02
mass flow rate (lb/hr)	52.6300	0	13176	0	1529.88	0		14706.4
molecular weight	27.63	28.26	28.75	28.75	38.13			29.66229
Temperature deg F	100	130	447	447	150			423.7172
flow scfm	12.21070	0	2939.770	0	257.3708		3209.367	3197.618

Note: the 150 deg F temp for streams 917 (both HLW and LLW) is a best estimate, no data was provided

TPA STACK STREAMS

SEPARATIONS AND LLW VITRIFICATION

STREAMS
907=702+706+434+522+645+903
917=911+914
factor=(200 mt/day/3.87E5)*91.0583lb/hr=4.747E-2

	911	914	917	total flow 907+917 scfm	total flow acfm
MT gas	0	4.07E+05	4.07E+05		
MT solid	0	3.92E+02	1.96E-01		
Total MT	0.00E+00	4.07E+05	4.07E+05		
Factor	4.75E-02	4.75E-02	4.75E-02		
mass flow rate (lb/hr)	0	23136.5	23117.9	167901.40	
molecular weight	29	29	29		
temperature deg F			150	302.64	
flow scfm		5117.624	5113.51	36595.76	50404

TPA HLW STREAMS	911	914	917			
MT gas	0	3.16E+04	3.16E+04			
MT solid	0	2.54E+01	1.27E-02			
Total MT	0.00E+00	3.16E+04	3.16E+04			
Factor	7.32E-02	7.32E-02	7.32E-02			
mass flow rate (lb/hr)	0	2314.970	2313.121		17009.52	
molecular weight	29	29	29			
Temperature deg F			150		385.96	
flow scfm	0	512.06	511.65		3709.26	5943

TPA HLW stack flows								
LIQUID COMPONENTS								
	Regulated	stream						
		907	917	totals ml	ANNUAL AVE	24 hour avg.	peak hourly	peak conc.
VOLUME					TOTAL/23 year	ann ave/219	(daily ave/24)x2.6	peak hrly/stack flow
SP. GRAVITY				metric tons	kg/year	kg/ 24 hr	kg/hr	grams / cubic meter
Cs and Ba,(MCi)								
Sr and Y, (MCi)								
Tc, (MCi)								
Am, (MCi)								
Np, (MCi)								
Pu-239, (MCi)								
Pu-240, (MCi)								
Pu-241, (MCi)								
TRU, (MCi)								
Total MCi								
Total Mass Flow,(MT)		2.02E+05	3.16E+04	233600	1.02E+07	4.64E+04	5.02E+03	4.98E+02
Total Cr, (MT)								
Total Na, (MT)	WAC-460-160							
Total Si,(MT)	PP							
Total P, (MT)								
Total NO2-, (MT)								
Total NO3-, (MT)								
Ag+	WAC-460-130							
Al(OH)4-	WAC-460							
Am+3								
As+5	WAC-460							
B+3								
Ba+2	WAC-460 ?							
Be+2	40CFR/WAC460							
Bi+3								
C 14				4.54E-04	1.97E-02	9.01E-05	9.76E-06	9.67E-07
Ca+2								
Cd+2	WAC-460-130							
Ce+3								

Cl-								
Cl2	WAC-460-160	4.17E+00		4.17	1.81E+02	8.28E-01	8.97E-02	8.88E-03
CO	WAC-460-160	2.03E+02		203	8.83E+03	4.03E+01	4.37E+00	4.32E-01
CO2	WAC-460-160	1.69E+04		16900	7.35E+05	3.36E+03	3.63E+02	3.60E+01
CO3-2	WAC-460-160							
Cr(OH)4-	WAC-460-160							
Cs+								
Cu+2	WAC-460-160							
F-								
F2	WAC-460-160	6.21E+01		62.1	2.70E+03	1.23E+01	1.34E+00	1.32E-01
Fe+3								
H2								
H2O		3.14E+03		3140	1.37E+05	6.23E+02	6.75E+01	6.69E+00
H2S	WAC							
Hg	WAC-460-160							
Hg+2	WAC							
I-								
I2	WAC-460	2.14E+01		21.4	9.30E+02	4.25E+00	4.60E-01	4.56E-02
K+								
Kerosene								
La+3								
Li+								
Mg+2								
MnO2	WAC-460-160							
Mo+6								
N2		1.42E+05	2.50E+04	167000	7.26E+06	3.32E+04	3.59E+03	3.56E+02
Na+								
NH3	WAC-460-160	1.83E+01		18.3	7.96E+02	3.63E+00	3.94E-01	3.90E-02
Ni+3	WAC-460-130							
NO	PP	9.98E-02		0.0998	4.34E+00	1.98E-02	2.15E-03	2.13E-04
NO2	PP	4.28E+00		4.28	1.86E+02	8.50E-01	9.21E-02	9.12E-03
NO2-								
NO3-								
Np+4								
O2		3.95E+04	6.63E+03	46130	2.01E+06	9.16E+03	9.92E+02	9.82E+01
OH-								
Pb+4	WAC/40CFR							

PO4-3								
POLY								
Pu+4								
S								
Si+4								
SO2	PP	4.60E+00		4.6	2.00E+02	9.13E-01	9.89E-02	9.80E-03
SO4-2								
Sr+2								
S								
TcO2								
TcO4-								
TOC								
UO2+2	WAC-460							
V+5								
W+6	WAC460							
ZN+2								
Zr=4								
ZRO2:2H2O								
SOLIDS COMPONENTS								
Cs and Ba,(MCi)		1.69E-10	3.41E-05	3.41E-05	1.46E-03	6.77E-06	7.33E-07	7.26E-08
Sr and Y, (MCi)		2.64E-10	5.33E-05	5.33E-05	2.32E-03	1.06E-05	1.15E-06	1.14E-07
Tc, (MCi)		1.48E-14	2.99E-09	2.99E-09	1.30E-07	5.94E-10	6.43E-11	6.37E-12
Am, (MCi)		2.38E-13	4.81E-08	4.81E-08	2.09E-06	9.55E-09	1.03E-09	1.02E-10
Np, (MCi)		2.32E-16	4.70E-11	4.7E-11	2.04E-09	9.33E-12	1.01E-12	1.00E-13
Pu-239, (MCi)		6.17E-14	1.25E-08	1.25E-08	5.43E-07	2.48E-09	2.69E-10	2.66E-11
Pu-240, (MCi)		1.57E-14	3.18E-09	3.18E-09	1.38E-07	6.31E-10	6.84E-11	6.77E-12
Pu-241, (MCi)		1.83E-13	3.71E-08	3.71E-08	1.61E-06	7.37E-09	7.98E-10	7.90E-11
TRU, (MCi)		4.99E-13	1.01E-07	1.01E-07	4.39E-06	2.01E-08	2.17E-09	2.15E-10
Total MCi		4.33E-10	8.75E-05	8.75E-05	3.80E-03	1.74E-05	1.88E-06	1.86E-07
Total Mass Flow,(MT)		6.78E-08	1.27E-02	0.0127	5.52E-01	2.52E-03	2.73E-04	2.70E-05
Total Cr, (MT)		9.91E-11	2.00E-05	2E-05	8.70E-04	3.97E-06	4.30E-07	4.26E-08
Total Na, (MT)	WAC-460-160	6.29E-09	1.18E-03	0.00118	5.13E-02	2.34E-04	2.54E-05	2.51E-06
Total Si,(MT)	PP	1.57E-08	2.95E-03	0.00295	1.28E-01	5.86E-04	6.34E-05	6.28E-06
Total P, (MT)		7.33E-10	1.37E-04	0.000137	5.96E-03	2.72E-05	2.95E-06	2.92E-07
Total NO2-, (MT)								
Total NO3-, (MT)								

Ag+								
Ag2O		3.70E-12	7.48E-07	7.48E-07	3.25E-05	1.49E-07	1.61E-08	1.59E-09
Al+3								
Al2O3		4.68E-09	8.76E-04	0.000876	3.81E-02	1.74E-04	1.88E-05	1.87E-06
Am+3								
Am2O3		7.62E-14	1.54E-08	1.54E-08	6.70E-07	3.06E-09	3.31E-10	3.28E-11
As+5	WAC							
As2O5		1.92E-12	3.88E-07	3.88E-07	1.69E-05	7.70E-08	8.34E-09	8.26E-10
B+3								
B2O3	WAC-460-160	4.75E-09	8.89E-04	0.000889	3.87E-02	1.76E-04	1.91E-05	1.89E-06
Ba+2	?							
BaO	WAC	8.63E-12	1.76E-06	1.76E-06	7.65E-05	3.49E-07	3.79E-08	3.75E-09
Be+2	40CFR/WAC							
BeO		5.40E-14	1.09E-08	1.09E-08	4.74E-07	2.16E-09	2.34E-10	2.32E-11
Bi+3								
Bi2O3		5.47E-10	1.11E-04	0.000111	4.83E-03	2.20E-05	2.39E-06	2.36E-07
C 14								
Ca+2								
CANCRINITE								
CaO	WAC-460-160	5.11E-10	9.57E-05	9.57E-05	4.16E-03	1.90E-05	2.06E-06	2.04E-07
Cd+2	WAC-460-130							
CdO		2.27E-11	4.58E-06	4.58E-06	1.99E-04	9.09E-07	9.85E-08	9.75E-09
Ce+3								
Ce2O3		7.44E-10	1.39E-04	0.000139	6.04E-03	2.76E-05	2.99E-06	2.96E-07
Cl-								
CO3-2								
Cr+3	WAC-460-160							
Cr2O3		1.45E-10	2.93E-05	2.93E-05	1.27E-03	5.82E-06	6.30E-07	6.24E-08
Cs+								
Cs2O		2.40E-12	4.84E-07	4.84E-07	2.10E-05	9.61E-08	1.04E-08	1.03E-09
Cu	WAC-460-160							
Cu+2	WAC-460-160							
CuO		2.34E-12	4.72E-07	4.72E-07	2.05E-05	9.37E-08	1.02E-08	1.01E-09
CuSO4								
F-	WAC							
Fe+3								
Fe2O3	WAC-460-160	3.27E-09	6.13E-04	0.000613	2.67E-02	1.22E-04	1.32E-05	1.31E-06

Hg+2	WAC-460-160							
I-	WAC 7							
K+								
K2O		6.32E-11	1.28E-05	1.28E-05	5.57E-04	2.54E-06	2.75E-07	2.73E-08
La+3								
La2O3		6.16E-11	1.25E-05	1.25E-05	5.43E-04	2.48E-06	2.69E-07	2.66E-08
Li+								
Li2O		1.36E-09	2.54E-04	0.000254	1.10E-02	5.04E-05	5.46E-06	5.41E-07
Mg+2								
MgO	WAC-460-160	4.70E-11	9.51E-06	9.51E-06	4.13E-04	1.89E-06	2.05E-07	2.03E-08
MnO2	WAC-460-160	5.64E-10	1.06E-04	0.000106	4.61E-03	2.10E-05	2.28E-06	2.26E-07
Mo+6								
MoO3		3.04E-12	6.16E-07	6.16E-07	2.68E-05	1.22E-07	1.32E-08	1.31E-09
Na+								
Na20		8.48E-09	1.59E-03	0.00159	6.91E-02	3.16E-04	3.42E-05	3.39E-06
Ni+3	WAC-460-160							
Ni2FeCN6								
Ni2O3		2.32E-11	4.69E-06	4.69E-06	2.04E-04	9.31E-07	1.01E-07	9.99E-09
NiO		6.12E-10	1.15E-04	0.000115	5.00E-03	2.28E-05	2.47E-06	2.45E-07
NO2-								
NO3-								
Np+4								
NpO2		3.74E-13	7.56E-08	7.56E-08	3.29E-06	1.50E-08	1.63E-09	1.61E-10
OH-								
P2O5		1.68E-09	3.14E-04	0.000314	1.37E-02	6.23E-05	6.75E-06	6.69E-07
P2O5:24H2O								
Pb+4	PP/WAC							
PbO2	WAC	9.48E-12	1.92E-06	1.92E-06	8.35E-05	3.81E-07	4.13E-08	4.09E-09
PO4-3								
Pu+4								
PuO2		1.21E-12	2.45E-06	2.45E-06	1.07E-04	4.86E-07	5.27E-08	5.22E-09
Si+4								
SiO2		3.37E-08	6.31E-03	0.00631	2.74E-01	1.25E-03	1.36E-04	1.34E-05
SO4-2								
Sr+2								
SrO		1.07E-10	2.17E-05	2.17E-05	9.43E-04	4.31E-06	4.67E-07	4.62E-08
Tc2O7		1.36E-12	2.76E-07	2.76E-07	1.20E-05	5.48E-08	5.94E-09	5.88E-10

TcO4-								
TOC								
UO2+2	WAC-460							
UO3	WAC-460	4.52E-09	8.46E-04	0.000846	3.60E-02	1.68E-04	1.82E-05	1.80E-06
V+5								
V2O5	WAC-460-160	8.39E-13	1.70E-07	1.7E-07	7.39E-06	3.38E-08	3.66E-09	3.62E-10
WO2		1.10E-12	2.23E-07	2.23E-07	9.70E-06	4.43E-08	4.80E-09	4.75E-10
WO3		5.16E-15	1.04E-09	1.04E-09	4.52E-08	2.06E-10	2.24E-11	2.22E-12
ZN+2	WAC-460-160							
ZNO	WAC-460-160	2.97E-12	6.00E-07	6E-07	2.61E-05	1.19E-07	1.29E-08	1.28E-09
Zr+4								
ZRO2	WAC-460-160	1.86E-09	3.49E-04	0.000349	1.52E-02	6.93E-05	7.51E-06	7.43E-07
ZRO2:2H2O								
material balance based on TPA data package Rev B revcd. 3/16/95								
annual ave based on 23 year operations period								
24 hour ave. based on annual ave/number of operating days per year (365 days@60% OE=219 days)								
peak hourly rate based on plant capacity of 20 mt/operating day								

TPA LLW stack flows								
LIQUID COMPONENTS								
	Regulated	stream						
		907	917	totals ml	ANNUAL AVE	24 hour avg.	peak hourly	peak conc.
VOLUME					TOTAL/19	ann ave/219	(daily ave/24)x1.3	peak hourly/stack flow
SP. GRAVITY				metric tons	kg/year	kg/ 24 hr	kg/hr	grams/cubic meter
MASS FLOW MT		3.05E+06	4.87E+05	3.54E+06	1.86E+08	8.50E+05	4.60E+04	4.64E+02
Total Cr	WAC-460							
Total Na								
Total Si								
Total P	WAC-460-160							
Total NO2-,(MT)	PP							
Total NO3-, (MT)		2.05E+01		2.05E+01	1.08E+03	4.93E+00	2.67E-01	2.69E-03
Cs and Ba, (MCi)								
Sr and Y, (MCi)								
Tc, (MCi)								
Am, (MCi)								
Np, (MCi)								
Pu-239,(MCi)								
Pu-240,(MCi)								
Pu-241,(MCi)								
Total TRU, (MCi)								
Total (MCi)								
Ag+	WAC-460-130							
Al+3	WAC-460							
Am+3								
As+5	WAC-460							
B+3								
Ba+2	WAC-460 ?							
Be+2	40CFR/WAC460							
Bi+3								
C 14				7.46E-04	3.93E-02	1.79E-04	9.71E-06	9.79E-08
Ca+2								
Cd+2	WAC-460-130							
Ce+3								

Cl-								
Cl2	WAC-460-160	3.10E+02		3.10E+02	1.63E+04	7.45E+01	4.04E+00	4.07E-02
Cm+3								
CO	WAC-460-160	2.35E+03		2.35E+03	1.24E+05	5.65E+02	3.06E+01	3.08E-01
CO2		1.89E+05		1.89E+05	9.95E+06	4.54E+04	2.46E+03	2.48E+01
CO3-2	WAC-460-160							
Cr(OH)4-	?							
Cs+								
Cu+2	WAC-460-160							
DPCD								
F-								
F2	WAC-460-160	1.12E+03		1.12E+03	5.89E+04	2.69E+02	1.46E+01	1.47E-01
Fe+3								
H+		3.33E-01		3.33E-01	1.75E+01	8.00E-02	4.33E-03	4.37E-05
H2								
H2O		5.83E+04		5.83E+04	3.07E+06	1.40E+04	7.59E+02	7.65E+00
H2S	WAC							
Hg	WAC-460-160							
Hg+2	WAC							
I-								
I2	WAC-460	5.45E+02		5.45E+02	2.87E+04	1.31E+02	7.09E+00	7.15E-02
K+								
Kerosene								
La+3								
Li+								
Mg+2								
MnO2	WAC-460-160							
Mo+6								
N2		2.21E+06	3.85E+05	2.60E+06	1.37E+08	6.24E+05	3.38E+04	3.40E+02
Na+								
Nb+5								
NH3	WAC-460-160	1.63E+01		1.63E+01	8.58E+02	3.92E+00	2.12E-01	2.14E-03
Ni+3	WAC-460-130	9.66E-02		9.66E-02	5.08E+00	2.32E-02	1.26E-03	1.27E-05
NO	PP	3.11E+00		3.11E+00	1.64E+02	7.47E-01	4.05E-02	4.08E-04
NO2	PP	1.39E+02		1.39E+02	7.32E+03	3.34E+01	1.81E+00	1.82E-02
NO2-								
NO3-		2.05E+01		2.05E+01	1.08E+03	4.93E+00	2.67E-01	2.69E-03

Np+4								
O2		5.95E+05	1.02E+05	6.97E+05	3.67E+07	1.68E+05	9.07E+03	9.14E+01
OH-								
OLIGIMER								
Pb+4	WAC/40CFR							
PO4-3								
POLY								
Pu+4								
Si+4								
SO2	PP	2.09E+02		2.09E+02	1.10E+04	5.02E+01	2.72E+00	2.74E-02
SO4-2								
Sr+2								
S								
TcO2								
TcO4-								
TOC								
UO2+2	WAC-460							
V+5								
W+6	WAC460							
ZN+2								
Zr+4								
ZRO2:2H2O								
SOLIDS COMPONENTS								
Cs and Ba, (MCi)		1.23E-12	2.49E-07	2.49E-07	1.31E-05	5.98E-08	3.24E-09	3.27E-11
Sr and Y, (MCi)		4.74E-12	9.59E-07	9.59E-07	5.05E-05	2.30E-07	1.25E-08	1.26E-10
Tc, (MCi)		6.48E-14	1.31E-08	1.31E-08	6.89E-07	3.15E-09	1.71E-10	1.72E-12
Am, (MCi)		2.15E-14	4.35E-09	4.35E-09	2.29E-07	1.05E-09	5.66E-11	5.71E-13
Np, (MCi)		2.58E-17	5.21E-12	5.21E-12	2.74E-10	1.25E-12	6.78E-14	6.83E-16
Pu-239, (MCi)		4.17E-17	8.43E-10	8.43E-10	4.44E-08	2.03E-10	1.10E-11	1.11E-13
Pu-240, (MCi)		1.03E-15	2.09E-10	2.09E-10	1.10E-08	5.02E-11	2.72E-12	2.74E-14
Pu-241,(MCi)		3.71E-15		3.71E-15	1.95E-13	8.92E-16	4.83E-17	4.87E-19
Total TRU,(MCi)		3.04E-14	5.41E-09	5.41E-09	2.85E-07	1.30E-09	7.04E-11	7.10E-13
Total MCI		6.07E-12	1.23E-06	1.23E-06	6.47E-05	2.96E-07	1.60E-08	1.61E-10
Total Mass Flow (MT)		1.05E-06	1.96E-01	1.96E-01	1.03E+01	4.71E-02	2.55E-03	2.57E-05
Total Cr (MT)	WAC460-160	3.89E-10	7.28E-05	7.28E-05	3.83E-03	1.75E-05	9.48E-07	9.55E-09
Total Na (MT)		1.94E-07	3.63E-02	3.63E-02	1.91E+00	8.72E-03	4.73E-04	4.76E-06

Total Si (MT)		2.89E-07	5.41E-02	5.41E-02	2.85E+00	1.30E-02	7.04E-04	7.10E-06
Total P (MT)	WAC460-160	3.65E-09	6.83E-04	6.83E-04	3.59E-02	1.64E-04	8.89E-06	8.96E-08
Total NO2-, (MT)	PP							
Total NO3-, (MT)								
Ag+	WAC460-160							
Ag2O	WAC460-160	8.79E-13	1.78E-07	1.78E-07	9.37E-06	4.28E-08	2.32E-09	2.33E-11
Al+3								
Al2O3		5.23E-08	9.79E-03	9.79E-03	5.15E-01	2.35E-03	1.27E-04	1.28E-06
Am+3								
Am2O3		6.89E-15	1.39E-09	1.39E-09	7.32E-08	3.34E-10	1.81E-11	1.82E-13
As+5	WAC							
As2O5		2.95E-12	5.96E-07	5.96E-07	3.14E-05	1.43E-07	7.76E-09	7.82E-11
B+3								
B2O3	WAC-460-160	4.17E-12	8.43E-07	8.43E-07	4.44E-05	2.03E-07	1.10E-08	1.11E-10
Ba+2	?							
BaO	WAC	2.20E-12	4.46E-07	4.46E-07	2.35E-05	1.07E-07	5.81E-09	5.85E-11
Be+2	40CFR/WAC							
BeO		5.67E-13	1.15E-07	1.15E-07	6.05E-06	2.76E-08	1.50E-09	1.51E-11
Bi+3								
Bi2O3		1.88E-10	3.80E-05	3.80E-05	2.00E-03	9.13E-06	4.95E-07	4.98E-09
C 14								
Ca+2								
CANCRINITE								
CaO	WAC-460-160	1.05E-07	1.96E-02	1.96E-02	1.03E+00	4.71E-03	2.55E-04	2.57E-06
Cd+2	WAC-460-130							
CdO		5.95E-12	1.20E-06	1.20E-06	6.32E-05	2.88E-07	1.56E-08	1.57E-10
Ce+3								
Ce2O3		6.97E-12	1.41E-06	1.41E-06	7.42E-05	3.39E-07	1.84E-08	1.85E-10
Cl-								
Co3-2								
Cr+3	WAC-460-160							
Cr2O3		5.68E-10	1.06E-04	1.06E-04	5.58E-03	2.55E-05	1.38E-06	1.39E-08
Cs+								
Cs2O		1.71E-14	3.45E-09	3.45E-09	1.82E-07	8.29E-10	4.49E-11	4.53E-13
Cu	WAC-460-160							
Cu+2	WAC-460-160							
CuO		5.53E-13	1.12E-07	1.12E-07	5.89E-06	2.69E-08	1.46E-09	1.47E-11

CuSO4								
F-	WAC							
Fe+3								
Fe2O3	WAC-460-160	5.14E-11	1.04E-05	1.04E-05	5.47E-04	2.50E-06	1.35E-07	1.36E-09
Hg+2	WAC-460-160							
I-	WAC ?							
K+								
K2O		6.62E-13	1.43E-07	1.43E-07	7.53E-06	3.44E-08	1.86E-09	1.88E-11
La+3								
La2O3		6.45E-13	1.30E-07	1.30E-07	6.84E-06	3.12E-08	1.69E-09	1.71E-11
Li+								
Li2O		3.10E-14	6.27E-09	6.27E-09	3.30E-07	1.51E-09	8.16E-11	8.22E-13
Mg+2								
MgO	WAC-460-160	4.00E-12	8.08E-07	8.08E-07	4.25E-05	1.94E-07	1.05E-08	1.06E-10
MnO2	WAC-460-160	5.41E-11	1.09E-05	1.09E-05	5.74E-04	2.62E-06	1.42E-07	1.43E-09
Mo+6								
MoO3		1.82E-11	3.69E-06	3.69E-06	1.94E-04	8.87E-07	4.80E-08	4.84E-10
Na+								
Na20		2.62E-07	4.90E-02	4.90E-02	2.58E+00	1.18E-02	6.38E-04	6.43E-06
Ni+3	WAC-460-160							
Ni2FeCN6								
Ni2O3		1.43E-11	2.89E-06	2.89E-06	1.52E-04	6.95E-07	3.76E-08	3.79E-10
NiO		3.74E-14	7.57E-09	7.57E-09	3.98E-07	1.82E-09	9.85E-11	9.93E-13
NO2-								
NO3-								
Np+4								
NpO2		4.15E-14	8.38E-09	8.38E-09	4.41E-07	2.01E-09	1.09E-10	1.10E-12
OH-								
P2O5		8.35E-09	1.56E-03	1.56E-03	8.21E-02	3.75E-04	2.03E-05	2.05E-07
P2O5:24H2O								
Pb+4	PP/WAC							
PbO2	WAC	5.65E-12	1.14E-06	1.14E-06	6.00E-05	2.74E-07	1.48E-08	1.50E-10
PO4-3								
Pu+4								
PuO2		8.15E-14	1.65E-08	1.65E-08	8.68E-07	3.97E-09	2.15E-10	2.16E-12
S								
Si+4								

SiO2		6.18E-07	1.16E-01	1.16E-01	6.11E+00	2.79E-02	1.51E-03	1.52E-05
SO4-2								
Sr+2								
SrO		1.00E-12	2.02E-07	2.02E-07	1.06E-05	4.85E-08	2.63E-09	2.65E-11
Tc2O7		5.98E-12	1.21E-06	1.21E-06	6.37E-05	2.91E-07	1.58E-08	1.59E-10
TcO4-								
TOC								
UO2+2	WAC-460							
UO3	WAC-460	2.26E-10	4.56E-05	4.56E-05	2.40E-03	1.10E-05	5.94E-07	5.98E-09
V+5								
V2O5	WAC-460-160	2.76E-13	5.59E-08	5.59E-08	2.94E-06	1.34E-08	7.28E-10	7.33E-12
WO2		7.27E-17		7.27E-17	3.83E-15	1.75E-17	9.46E-19	9.54E-21
WO3		2.35E-12	4.75E-07	4.75E-07	2.50E-05	1.14E-07	6.18E-09	6.23E-11
ZN+2	WAC-460-160							
ZNO	WAC-460-160	1.12E-11	2.25E-06	2.25E-06	1.18E-04	5.41E-07	2.93E-08	2.95E-10
Zr+4								
ZRO2	WAC-460-160	3.25E-09	3.28E-07	3.31E-07	1.74E-05	7.96E-08	4.31E-09	4.35E-11
ZRO2:2H2O								
material balance based on TPA data package Rev B recvd 3/16/95								
annual average based on 19 year operations period								
24 hour ave. based on annual ave/number of operationg days per year (365 days @ 60% OE=219 days)								
peak hourly rate based on plant capacity of 200 ml /operating day								

Request Number 043

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: John Young

Date: March 20, 1995

Phone Number: (509) 946-7112

Fax Number: (509) 943-6812

Request Information: Data request for modelling of risk from routine operations.

Item 2 on attached memo, Young to Murray 3/21/95

Need Date: April 7, 1995

Response: See attached response sheets 1 thru 6.

Data Source/Accuracy:

Prepared By: Jim Goodwin

Date Sent/Faxed:

Concurrence: Marc C. Nelson

Marc Nelson - Deputy Project Manager

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Date: March 21, 1995

To: Dave Murray

From: Joan Young

Subject: DATA REQUEST FOR MODELLING OF RISK FROM ROUTINE OPERATIONS

The TWRS EIS considers risks to the remediation worker, nearby worker, and the public. Risks to the remediation worker are from direct exposure to radiation and chemicals during the work day. Risks to the nearby worker and the public are assumed to result from ingestion and inhalation of radioactive, toxic, and/or hazardous atmospheric emissions from tanks, process stacks, and vents. Receptors and dose calculations are further described in Attachment One. Please address the following questions or data requirements, so that these risks can be estimated for the No Action, ISV, Cs and Sr Capsules, and the TPA (if changed) Alternatives. The items are listed from greatest to least priority. Items 1 and 2 are mandatory. The remaining items are important, but they are not mandatory.

1. PROVIDE THE AMOUNT, PATHWAY, AND LOCATION FOR RELEASES TO THE ENVIRONMENT. A SIMPLIFIED SCHEMATIC AND/OR DATA TABLE IS RECOMMENDED THAT PROVIDES FACILITY CONFIGURATIONS, LOCATIONS OF RELEASE, RELEASE AMOUNTS, AND DURATIONS OF RELEASE FOR ATMOSPHERIC EMISSIONS FROM THE TANK FARMS, STACK(S), AND VENT(S)

For No Action, Cs and Sr Capsules, and ISV Alternatives:

For the purposes of assessing risk to the nearby worker and the public from routine operations, a simplified process schematic and/or a data table is needed that provides the systems configuration (e.g. locations of process buildings, outside storage tanks, transfer lines, LLW disposal vault, HLW storage facility, and their associated stacks and vents), locations of releases, the volumes and concentrations of effluents at release locations, and the duration of the releases.

2. IDENTIFY NUMBER OF AVERAGE AND MAXIMALLY EXPOSED WORKERS AND ASSOCIATED DOSE

For TPA:

For the TPA Alternative, it was assumed that occupational radiological exposure resulted in the same average whole body deep dose as for the PUREX plant during 1986 (WHC 1995, Table 7-26). Dose was 200 mrem/year to the average worker and 500 mrem/year to the maximally-exposed worker (maximally exposed individual or worker, MEI). Please verify that this assumption is acceptable for the TPA Alternative.

3 OPTION >

For the No Action, ISV, and Cs and Sr Capsules Alternatives:

The dose to the average and maximally exposed remediation worker must be identified as well as the associated sources for the No Action, ISV, and Cs and Sr Capsules Alternatives. The source for the remediation worker is the amount of radionuclides or hazardous chemicals resulting in an average and a maximum occupational exposure. Please provide the sources, the average and maximum occupational doses, the number of workers exposed, and the duration of exposure.

3. IDENTIFICATION OF ROUTINE EMISSIONS DURING TANK CLOSURE

For TPA and ISV Alternatives:

There may be routine remediation worker exposures and/or releases during tank closure. ISV and TPA Alternatives will require barriers for tank farms and/or LLW disposal vaults. TPA will also require backfilling of voids created by the removal of tank wastes. Closure may potentially include removal and D&D of contaminated soils, in-tank equipment, and equipment around the tanks. Please provide the source terms for routine risks from tank closure and from excavating quarry sites and borrow sources or the rationale for excluding these actions from the analysis.

4. CONFIRM THE FOLLOWING ASSUMPTIONS FOR CALCULATING RISK FROM ROUTINE OPERATIONS OF TWRS PROCESSES

For the No Action, ISV, and Cs and Sr Capsules Alternatives:

a. It will be assumed that there are no risks to the remediation worker, nearby worker, or the public from liquid effluents, because all liquid releases will be sent to the liquid effluent treatment facility.

b. There will be no risk to the remediation worker from direct exposure to hazardous or toxic chemicals during TWRS separation and treatment processes, since there is limited use of hazardous or toxic chemical compounds in TWRS process operations.

c. There will be no risk to the nearby worker and the public from inhalation and ingestion of hazardous and toxic chemicals released to the atmosphere, because atmospheric emissions of these compounds will be tightly controlled.

5. PROVIDE RATIONALE FOR EXCLUDING HAZARDOUS CHEMICAL EMISSIONS FROM THE TANK FARMS DURING RETRIEVAL AND IN TANK SLUDGE WASHING

For the TPA, No Action, and ISV Alternatives:

Hazardous and toxic chemical emissions or exposures from the tank farms have not been addressed in the engineering data packages received to date. According to ASI Engineering Data

DATA REQUEST 43

Response

For TPA
Occupational radiological exposure dose of 200 mrem/year to the average worker and 500 mrem/year to the maximally exposed worker is an acceptable assumption for the TPA alternative.

For No Action, ISV and Capsule Options:

The source is not defined in the engineering package provided by WHC, but the average exposure is 200 mrem/yr and the maximum is 500 mrem/yr.

For No Disposal Action Alternatives:

Unit Process	No. of Workers Exposed	Duration of Exposure (Years)
Tank Farm Operations	196	100
Evaporator Operations	42	10

For In Situ Vitrification (ISV) Alternatives:

Unit Process	No. of Workers Exposed	Duration of Exposure (Years)
Double-Shell Tank Evaporation	58	5
Confinement Facility	Included in vitrification	Included in vitrification
Vitrification	700	5
Operations and Maintenance	12,000	17
Characterization	2,400	17

Option A: No Action - Safe Management in Drywell Storage

Unit Process	No. of Workers Exposed	Duration of Exposure (Years)
Cs & Sr Capsules Retrieval/Repacking/Drywell Storage	44	19
Surveillance	6	80

Option B: No Immobilization - Overpacked and Offsite Shipment

Unit Process	No. of Workers Exposed	Duration of Exposure (Years)
Cs & Sr Capsules Retrieval/Repacking/Onsite Interim Storage	47 (6)	18
Interim Storage/Surveillance	15 (6)	30
Offsite Transportation to Geologic Repository	INFO TO BE PROVIDED LATER	5

Request Number 044

Jacobs Engineering Group
Engineering Information Request - TWRS EIS

Requested By: Joan Young

Date: 3/20/95

Phone Number: 946-7112

Fax Number: 943-6812

Request Information: Data request for modeling of risk from routine operations.

Item 3, Priority B

Need Date: 4/7/95

Response: See attached.

Data Source/Accuracy: The emissions during closure operations are estimated for dust and vehicle emissions relative to barrier and tank fill materials. No emissions of hazardous and radiological components from tanks are estimated. Data accuracy is not specified

Prepared By: Colin Henderson

Date Sent/Faxed:

Concurrence: Marc E. Nelson
Marc Nelson - Deputy Project Manager

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For the No Action, ISV, and Cs and Sr Capsules Alternatives:

The dose to the average and maximally exposed remediation worker must be identified as well as the associated sources for the No Action, ISV, and Cs and Sr Capsules Alternatives. The source for the remediation worker is the amount of radionuclides or hazardous chemicals resulting in an average and a maximum occupational exposure. Please provide the sources, the average and maximum occupational doses, the number of workers exposed, and the duration of exposure.

3. IDENTIFICATION OF ROUTINE EMISSIONS DURING TANK CLOSURE

For TPA and ISV Alternatives:

There may be routine remediation worker exposures and/or releases during tank closure. ISV and TPA Alternatives will require barriers for tank farms and/or LLW disposal vaults. TPA will also require backfilling of voids created by the removal of tank wastes. Closure may potentially include removal and D&D of contaminated soils, in-tank equipment, and equipment around the tanks. Please provide the source terms for routine risks from tank closure and from excavating quarry sites and borrow sources or the rationale for excluding these actions from the analysis.

4. CONFIRM THE FOLLOWING ASSUMPTIONS FOR CALCULATING RISK FROM ROUTINE OPERATIONS OF TWRS PROCESSES

For the No Action, ISV, and Cs and Sr Capsules Alternatives:

a. It will be assumed that there are no risks to the remediation worker, nearby worker, or the public from liquid effluents, because all liquid releases will be sent to the liquid effluent treatment facility.

b. There will be no risk to the remediation worker from direct exposure to hazardous or toxic chemicals during TWRS separation and treatment processes, since there is limited use of hazardous or toxic chemical compounds in TWRS process operations.

c. There will be no risk to the nearby worker and the public from inhalation and ingestion of hazardous and toxic chemicals released to the atmosphere, because atmospheric emissions of these compounds will be tightly controlled.

5. PROVIDE RATIONALE FOR EXCLUDING HAZARDOUS CHEMICAL EMISSIONS FROM THE TANK FARMS DURING RETRIEVAL AND IN TANK SLUDGE WASHING

For the TPA, No Action, and ISV Alternatives:

Hazardous and toxic chemical emissions or exposures from the tank farms have not been addressed in the engineering data packages received to date. According to ASI Engineering Data

DATA REQUEST 044

The following assumptions and statement from the closure data package are provided as background.

a. Ancillary equipment would be grout filled for stabilization in all treatment alternatives. Ancillary equipment would not be excavated or packaged.

b. Surface barriers would be placed over SSTs and DSTs for all alternatives except No Disposal Action alternative. Barriers will also be placed over the LLW vaults for the maximum retrieval Ex Situ Vitrification alternative.

c. No soil remediation will be required for this package.

d. Because tank filling will displace vapors from the tanks HEPA filtration will be attached to one vent pipe on each tank. The remaining vents would be sealed.

e. For gravel fill operations a series of cyclone separators will remove particulate from exhaust prior to HEPA filtration.

The non-radiological emissions are reported on the attached Table 5.4. The non-radiological emissions are a result of borrow/quarry site material excavation and transportation to the tank farm and material placement.

While it is certain that there will be some hazardous chemical and radiological emissions from the tanks during the operational phase of tank closure these emissions are not estimated in the data package.

Table 5-4. Comparison of Alternatives by Non-radiological Barrier Construction Emissions (Units as Indicated).

Construction Emission Pollutant	In Situ Disposal	Extensive Pretreatment Option A	Extensive Pretreatment Option B	No Separations	Tri-Party Agreement Preferred Alternative
Particulates (kg)	156,000	209,000	486,000	156,000	206,000
SO_x (as SO_2) (kg)	276,000	369,000	859,000	276,000	364,000
CO (kg)	1,110,000	1.480,000	3,430,000	1,110,000	1,460,000
Hydrocarbons (exhaust & fugitive) (kg)	119,000	159,000	369,000	119,000	157,000
NO_x (as NO_2) (kg)	2,540,000	3,400,000	7,920,000	2,540,000	3,360,000
Aldehydes (as HCHO) (kg)	68,000	91,100	212,000	68,000	89,800
Organic acids (kg)	n/a	n/a	n/a	n/a	n/a
Thermal releases (J)	930,000,000	621,000,000	185,000,000	930,000,000	638,000,000
Fugitive dust (t)	3,095	4,114	9,079	3,095	4,090

Note:

kg = kilograms
n/a = not applicable
J = joules
t = metric ton

See Appendix A (Dozer Grading Emissions, Paved Road Traffic Particulate Emissions, Unpaved Road Traffic Particulate Emissions, Fugitive Dust Emissions for Material Transfer, and Clearing and Grubbing Emissions) for construction emission calculations.

For additional backup information, see Appendix A, Figures A2, A3, and A4; and Tables A8, A9, and A10.

Table A10. Nonradiological Barrier Construction Emissions (10 sheets). (Backup to Table 5-4).

BACKUP FOR EMISSIONS CALCULATIONS

SCHEDULE IN DAYS FOR EACH BARRIER LAYER

BARRIER LAYER	SCHEDULE: TANK FARMS	SCHEDULE: EPT OPT B	SCHEDULE: EPT OPT A	SCHEDULE: TPA CLASS
Site Grading	252.26	2202.80	421.52	405.05
Base Course	8.76	23.05	11.46	11.31
Asphalt	43.08	157.17	61.87	60.74
Top Coating	215.70	786.20	309.60	304.00
Drainage Layer	25.14	63.82	32.55	32.17
Basalt	2406.96	5588.78	3091.25	3021.55
Filter Layers	68.19	225.07	94.96	93.43
Lower Silt	585.02	2102.53	836.13	821.35
Upper Silt	592.00	2033.36	834.54	820.48
Road Base	1.53	4.83	1.77	1.74
TOTAL DAYS	4198.66	13166.63	5655.71	5571.82

EQUIPMENT USAGE FOR EACH BARRIER LAYER

BARRIER LAYER	D6 DOZER (hours per day for each layer)	BACKHOE (hours per day for each layer)	COMPACTOR (hours per day for each layer)	GRADER (hours per day for each layer)	LOADER (hours per day for each layer)	DUMP TRUCKS (hours per day for each layer)
Site Grading	8		4	8	4	40
Base Course		8	4		4	40
Asphalt			4			32
Top Coating						16
Drainage Layer		8	4	8	4	40
Basalt	8				4	40
Gravel Filter		8	4	8	4	40
Lower Silt		4			4	40
Upper Silt		4			4	40
Road Base			4	4	4	16
HOURS USAGE/BARRIER	16	32	24	28	32	344

EQUIPMENT USAGE FOR EACH BARRIER LAYER (TANK FARMS)

BARRIER LAYER	D6 DOZER (hours' usage/total barriers)	BACKHOE (hours' usage/total barriers)	COMPACTOR (hours' usage/total barriers)	GRADER (hours' usage/total barriers)	LOADER (hours' usage/total barriers)	DUMP TRUCKS (hours' usage/total barriers)
Site Grading	2018.08		1009.04	2018.08	1009.04	10090.4
Base Course		70.08	35.04		35.04	350.4
Asphalt			172.32			1378.56
Top Coating						3451.2
Drainage Layer		201.12	100.56	201.12	100.56	1005.6
Basalt	19255.84				9627.92	96279.2
Gravel Filter		545.52	272.76	545.52	272.76	2727.6
Lower Silt		2340.08			2340.08	23400.8
Upper Silt		2368			2368	23680
Road Base			6.12	6.12	6.12	24.48
HOURS USAGE/BARRIER	21273.92	5524.8	1595.84	2770.84	15759.52	162388.24

EQUIPMENT USAGE FOR EACH BARRIER LAYER (EXTENSIVE PRETREATMENT: OPTION B)

BARRIER LAYER	D6 DOZER (hours' usage/total barriers)	BACKHOE (hours' usage/total barriers)	COMPACTOR (hours' usage/total barriers)	GRADER (hours' usage/total barriers)	LOADER (hours' usage/total barriers)	DUMP TRUCKS (hours' usage/total barriers)
Site Grading	17622.4		8811.2	17622.4	8811.2	88112
Base Course		184.4	92.2		92.2	922
Asphalt			626.88			5029.44
Top Coating						12579.2
Drainage Layer		510.56	255.28	510.56	255.28	2552.8
Basalt	44558.24				22279.12	222791.2
Gravel Filter		1800.56	900.28	1800.56	900.28	9002.8
Lower Silt		8410.12			8410.12	84101.2
Upper Silt		8133.52			8133.52	81335.2
Road Base			8.36	8.36	8.36	33.44
HOURS USAGE/BARRIER	62180.64	19039.16	10696	19941.88	48890.08	506459.28

EQUIPMENT USAGE FOR EACH BARRIER LAYER (EXTENSIVE PRETREATMENT: OPTION A)

BARRIER LAYER	D6 DOZER (hours' usage/total barriers)	BACKHOE (hours' usage/total barriers)	COMPACTOR (hours' usage/total barriers)	GRADER (hours' usage/total barriers)	LOADER (hours' usage/total barriers)	DUMP TRUCKS (hours' usage/total barriers)
Site Grading	3372.16		1686.08	3372.16	1686.08	16860.8
Base Course		91.68	45.84		45.84	458.4
Asphalt			247.48			1979.84
Top Coating						4953.6
Drainage Layer		260.4	130.2	260.4	130.2	1302
Basalt	24410				12205	122050
Gravel Filter		759.84	379.92	759.84	379.92	3799.2
Lower Silt		3344.52			3344.52	33445.2
Upper Silt		3338.32			3338.32	33383.2
Road Base			7.08	7.08	7.08	28.32
HOURS USAGE/BARRIER	27782.16	7794.76	2496.6	4399.48	21136.96	218260.56

Table A10. Nonradiological Barrier Construction Emissions (10 sheets). (Backup to Table 5-4).

EQUIPMENT USAGE FOR EACH BARRIER LAYER (TPA GLASS)

BARRIER LAYER	D6 DOZER (hours' usage/total barriers)	BACKHOE (hours' usage/total barriers)	COMPACTOR (hours' usage/total barriers)	GRADER (hours' usage/total barriers)	LOADER (hours' usage/total barriers)	DUMP TRUCKS (hours' usage/total barriers)
Site Grading	3240.4		1620.2	3240.4	1620.2	1620.2
Base Course		90.48	45.24		45.24	452.4
Asphalt			242.96			1943.68
Top Coating						4864
Drainage Layer		257.36	128.68	257.36	128.68	1286.8
Basalt	24172.4				12066.2	120662
Gravel Filter		747.44	373.72	747.44	373.72	3737.2
Lower Silt		3285.4			3285.4	32854
Upper Silt		3281.92			3281.92	32819.2
Road Base			6.96	6.96	6.96	27.84
HOURS USAGE/BARRIER	27412.8	7662.6	2417.76	4252.16	20828.32	215049.12

NOTE: These calculations assume a five day workweek consisting of 8-hour days

Table A10. Nonradiological Barrier Construction Emissions (10 sheets). (Backup to Table 5-4).

PAVED ROAD TRAFFIC PARTICULATE EMISSIONS

TANK FARM	BARRIER LAYER	VOLUME (cu yd)	VOLUME (cu m)	SILT LOAD (g/sq m)	NUMBER OF TRIPS	ROUND TRIP (miles)	ROUND TRIP (km)	EF (g/km)
A	Grading Fill	7500	5734.50	8	750	6	9.66	194.80
	Base Course	1600	1223.36	8	160	6	9.66	194.80
	Drainage Gravel	5400	4128.84	8	540	6	9.66	194.80
	Fractured Basalt	34300	26225.78	5	3430	38	61.15	169.18
	Filter Media	4400	3364.24	8	440	6	9.66	194.80
	Topsoil	16900	12921.74	20	1690	28	45.06	256.44
	Road Base	300	229.38	5	30	38	61.15	169.18
AX	Grading Fill	5200	3975.92	8	520	6	9.66	194.80
	Base Course	1300	993.98	8	130	6	9.66	194.80
	Drainage Gravel	4200	3211.32	8	420	6	9.66	194.80
	Fractured Basalt	27000	20644.20	5	2700	38	61.15	169.18
	Filter Media	3100	2370.26	8	310	6	9.66	194.80
	Topsoil	11700	8945.82	20	1170	28	45.06	256.44
	Road Base	300	229.38	5	30	38	61.15	169.18
B	Grading Fill	19800	15139.08	8	1980	6	9.66	194.80
	Base Course	3100	2370.26	8	310	6	9.66	194.80
	Drainage Gravel	10000	7646.00	8	1000	6	9.66	194.80
	Fractured Basalt	61200	46793.52	5	6120	38	61.15	169.18
	Filter Media	9800	7493.08	8	980	6	9.66	194.80
	Topsoil	39900	30507.54	20	3990	28	45.06	256.44
	Road Base	500	382.30	5	50	38	61.15	169.18
BX	Grading Fill	15400	11774.84	8	1540	6	9.66	194.80
	Base Course	2700	2064.42	8	270	6	9.66	194.80
	Drainage Gravel	8500	6499.10	8	850	6	9.66	194.80
	Fractured Basalt	53000	40523.80	5	5300	38	61.15	169.18
	Filter Media	8000	6116.80	8	800	6	9.66	194.80
	Topsoil	31400	24008.44	20	3140	28	45.06	256.44
	Road Base	400	305.84	5	40	38	61.15	169.18
BY	Grading Fill	15600	11927.76	8	1560	6	9.66	194.80
	Base Course	2700	2064.42	8	270	6	9.66	194.80
	Drainage Gravel	8600	6575.56	8	860	6	9.66	194.80
	Fractured Basalt	53600	40982.56	5	5360	38	61.15	169.18
	Filter Media	8200	6269.72	8	820	6	9.66	194.80
	Topsoil	31800	24314.28	20	3180	28	45.06	256.44
	Road Base	400	305.84	5	40	38	61.15	169.18
C	Grading Fill	20400	15597.84	8	2040	6	9.66	194.80
	Base Course	3200	2446.72	8	320	6	9.66	194.80
	Drainage Gravel	10200	7798.92	8	1020	6	9.66	194.80
	Fractured Basalt	62300	47634.58	5	6230	38	61.15	169.18
	Filter Media	10000	7646.00	8	1000	6	9.66	194.80
	Topsoil	40900	31272.14	20	4090	28	45.06	256.44
	Road Base	500	382.30	5	50	38	61.15	169.18
S	Grading Fill	15900	12157.14	8	1590	6	9.66	194.80
	Base Course	2700	2064.42	8	270	6	9.66	194.80
	Drainage Gravel	8700	6652.02	8	870	6	9.66	194.80
	Fractured Basalt	54000	41288.40	5	5400	38	61.15	169.18
	Filter Media	8200	6269.72	8	820	6	9.66	194.80
	Topsoil	33200	25384.72	20	3320	28	45.06	256.44
	Road Base	500	382.30	5	50	38	61.15	169.18
SX	Grading Fill	20000	15292.00	8	2000	6	9.66	194.80
	Base Course	3200	2446.72	8	320	6	9.66	194.80
	Drainage Gravel	10400	7951.84	8	1040	6	9.66	194.80
	Fractured Basalt	63700	48705.02	5	6370	38	61.15	169.18
	Filter Media	10200	7798.92	8	1020	6	9.66	194.80
	Topsoil	41300	31577.98	20	4130	28	45.06	256.44
	Road Base	500	382.30	5	50	38	61.15	169.18
T	Grading Fill	19800	15139.08	8	1980	6	9.66	194.80
	Base Course	3100	2370.26	8	310	6	9.66	194.80
	Drainage Gravel	10000	7646.00	8	1000	6	9.66	194.80
	Fractured Basalt	61200	46793.52	5	6120	38	61.15	169.18
	Filter Media	9800	7493.08	8	980	6	9.66	194.80
	Topsoil	39900	30507.54	20	3990	28	45.06	256.44
	Road Base	500	382.30	5	50	38	61.15	169.18
TX	Grading Fill	28600	21867.56	8	2860	6	9.66	194.80
	Base Course	4000	3058.40	8	400	6	9.66	194.80
	Drainage Gravel	12800	9786.88	8	1280	6	9.66	194.80
	Fractured Basalt	77300	59103.58	5	7730	38	61.15	169.18
	Filter Media	13200	10092.72	8	1320	6	9.66	194.80
	Topsoil	54500	41670.70	20	5450	28	45.06	256.44
	Road Base	600	458.76	5	60	38	61.15	169.18
TY	Grading Fill	7600	5810.96	8	760	6	9.66	194.80
	Base Course	1700	1299.82	8	170	6	9.66	194.80
	Drainage Gravel	5400	4128.84	8	540	6	9.66	194.80
	Fractured Basalt	34600	26455.16	5	3460	38	61.15	169.18
	Filter Media	4400	3364.24	8	440	6	9.66	194.80
	Topsoil	17200	13151.12	20	1720	28	45.06	256.44
	Road Base	300	229.38	5	30	38	61.15	169.18

Table A10. Nonradiological Barrier Construction Emissions (10 sheets). (Backup to Table 5-4).

U	Grading Fill	19200	14680.32	8	1920	6	9.66	194.80
	Base Course	3100	2370.26	8	310	6	9.66	194.80
	Drainage Gravel	9800	7493.08	8	980	6	9.66	194.80
	Fractured Basalt	60100	45952.46	5	6010	38	61.15	169.18
	Filter Media	9600	7340.16	8	960	6	9.66	194.80
	Topsoil	38900	29742.94	20	3890	28	45.06	256.44
	Road Base	500	382.30	5	50	38	61.15	169.18
DST AN	Grading Fill	12500	9557.50	8	1250	6	9.66	194.80
	Base Course	2300	1758.58	8	230	6	9.66	194.80
	Drainage Gravel	7400	5658.04	8	740	6	9.66	194.80
	Fractured Basalt	46200	35324.52	5	4620	38	61.15	169.18
	Filter Media	6700	5122.62	8	670	6	9.66	194.80
	Topsoil	26800	20491.28	20	2680	28	45.06	256.44
	Road Base	400	305.84	5	40	38	61.15	169.18
DST AP	Grading Fill	10700	8181.22	8	1070	6	9.66	194.80
	Base Course	2200	1682.12	8	220	6	9.66	194.80
	Drainage Gravel	7000	5352.20	8	700	6	9.66	194.80
	Fractured Basalt	44100	33718.66	5	4410	38	61.15	169.18
	Filter Media	6100	4664.06	8	610	6	9.66	194.80
	Topsoil	24000	18350.40	20	2400	28	45.06	256.44
	Road Base	400	305.84	5	40	38	61.15	169.18
DST AW	Grading Fill	8000	6116.80	8	800	6	9.66	194.80
	Base Course	1700	1299.82	8	170	6	9.66	194.80
	Drainage Gravel	5600	4281.76	8	560	6	9.66	194.80
	Fractured Basalt	35800	27372.68	5	3580	38	61.15	169.18
	Filter Media	4600	3517.16	8	460	6	9.66	194.80
	Topsoil	18100	13839.26	20	1810	28	45.06	256.44
	Road Base	300	229.38	5	30	38	61.15	169.18
DST AY	Grading Fill	2900	2217.34	8	290	6	9.66	194.80
	Base Course	900	688.14	8	90	6	9.66	194.80
	Drainage Gravel	2900	2217.34	8	290	6	9.66	194.80
	Fractured Basalt	19300	14756.78	5	1930	38	61.15	169.18
	Filter Media	1800	1376.28	8	180	6	9.66	194.80
	Topsoil	6300	4816.98	20	630	28	45.06	256.44
	Road Base	200	152.92	5	20	38	61.15	169.18
DST AZ	Grading Fill	2900	2217.34	8	290	6	9.66	194.80
	Base Course	900	688.14	8	90	6	9.66	194.80
	Drainage Gravel	2900	2217.34	8	290	6	9.66	194.80
	Fractured Basalt	19300	14756.78	5	1930	38	61.15	169.18
	Filter Media	1800	1376.28	8	180	6	9.66	194.80
	Topsoil	6300	4816.98	20	630	28	45.06	256.44
	Road Base	200	152.92	5	20	38	61.15	169.18
DST SY	Grading Fill	5400	4128.64	8	540	6	9.66	194.80
	Base Course	1300	993.98	8	130	6	9.66	194.80
	Drainage Gravel	4300	3287.78	8	430	6	9.66	194.80
	Fractured Basalt	27600	21102.96	5	2760	38	61.15	169.18
	Filter Media	3200	2446.72	8	320	6	9.66	194.80
	Topsoil	12300	9404.58	20	1230	28	45.06	256.44
	Road Base	300	229.38	5	30	38	61.15	169.18
EPT OPTION B	Grading Fill	1835800	1403652.68	8	183580	6	9.66	194.80
	Base Course	67800	51839.88	8	6780	6	9.66	194.80
	Drainage Gravel	206300	157736.98	8	20630	6	9.66	194.80
	Fractured Basalt	1096700	838536.82	5	109670	38	61.15	169.18
	Filter Media	283400	216667.64	8	28340	6	9.66	194.80
	Topsoil	1239100	947415.86	20	123910	28	45.06	256.44
	Road Base	2600	1987.96	5	260	38	61.15	169.18
EPT OPTION A	Grading Fill	159300	121800.78	8	15930	6	9.66	194.80
	Base Course	12800	9786.88	8	1280	6	9.66	194.80
	Drainage Gravel	39500	30201.70	8	3950	6	9.66	194.80
	Fractured Basalt	223400	170811.64	5	22340	38	61.15	169.18
	Filter Media	48400	37006.64	8	4840	6	9.66	194.80
	Topsoil	206800	158119.28	20	20680	28	45.06	256.44
	Road Base	1100	841.06	5	110	38	61.15	169.18
TPA GLASS	Grading Fill	143600	109949.48	8	14360	6	9.66	194.80
	Base Course	12100	9251.66	8	1210	6	9.66	194.80
	Drainage Gravel	37500	28672.50	8	3750	6	9.66	194.80
	Fractured Basalt	213100	162936.26	5	21310	38	61.15	169.18
	Filter Media	45600	34865.76	8	4560	6	9.66	194.80
	Topsoil	194700	148867.62	20	19470	28	45.06	256.44
	Road Base	1000	764.60	5	100	38	61.15	169.18

NOTES:

(1) The silt load is the amount of silt on the paved road in grams per square meter.

(2) The emission factor is the amount of PM10 particles in grams/vehicle kilometer traveled. This factor was found by solving the equation: EF = 220*[(silt load)/12]^0.3.

(3) The tonnes of dust emitted was found by multiplying the number of trips by the kilometers/trip by the EF, and then dividing by 10^6 grams/tonne.

(4) This table was generated using equations in EPA 451/R-93-004, "Estimation of Air Impacts from Area Sources of Particulate Matter Emissions at Superfund Sites," Report ASF-32, p 6.

Table A10. Nonradiological Barrier Construction Emissions (10 sheets). (Backup to Table 5-4).

UNPAVED ROAD TRAFFIC PARTICULATE EMISSIONS

TANK FARM	BARRIER LAYER	VOLUME (yd^3)	VOLUME (m^3)	SILT LOAD (%)	NUMBER OF TRIPS	ROUND TRIP (miles)	ROUND TRIP (km)	EF (g/km)
A	Grading Fill	7500	5734.50	15	750	1	1.61	1108.84
	Base Course	1600	1223.36	15	160	1	1.61	1108.84
	Drainage Gravel	5400	4128.84	15	540	1	1.61	1108.84
	Fractured Basalt	34300	26225.78	12	3430	6	9.66	887.07
	Filter Media	4400	3364.24	15	440	1	1.61	1108.84
	Topsoil	16900	12921.74	18	1690	6	9.66	1330.61
	Road Base	300	229.38	15	30	6	9.66	1108.84
AX	Grading Fill	5200	3975.92	15	520	1	1.61	1108.84
	Base Course	1300	993.98	15	130	1	1.61	1108.84
	Drainage Gravel	4200	3211.32	15	420	1	1.61	1108.84
	Fractured Basalt	27000	20644.20	12	2700	6	9.66	887.07
	Filter Media	3100	2370.26	15	310	1	1.61	1108.84
	Topsoil	11700	8945.82	18	1170	6	9.66	1330.61
	Road Base	300	229.38	15	30	6	9.66	1108.84
B	Grading Fill	19800	15139.08	15	1980	1	1.61	1108.84
	Base Course	3100	2370.26	15	310	1	1.61	1108.84
	Drainage Gravel	10000	7646.00	15	1000	1	1.61	1108.84
	Fractured Basalt	61200	46793.52	12	6120	6	9.66	887.07
	Filter Media	9800	7493.08	15	980	1	1.61	1108.84
	Topsoil	39900	30507.54	18	3990	6	9.66	1330.61
	Road Base	500	382.30	15	50	6	9.66	1108.84
BX	Grading Fill	15400	11774.84	15	1540	1	1.61	1108.84
	Base Course	2700	2064.42	15	270	1	1.61	1108.84
	Drainage Gravel	8500	6499.10	15	850	1	1.61	1108.84
	Fractured Basalt	53000	40523.60	12	5300	6	9.66	887.07
	Filter Media	8000	6116.80	15	800	1	1.61	1108.84
	Topsoil	31400	24008.44	18	3140	6	9.66	1330.61
	Road Base	400	305.84	15	40	6	9.66	1108.84
BY	Grading Fill	15600	11927.76	15	1560	1	1.61	1108.84
	Base Course	2700	2064.42	15	270	1	1.61	1108.84
	Drainage Gravel	8600	6575.56	15	860	1	1.61	1108.84
	Fractured Basalt	53600	40982.56	12	5360	6	9.66	887.07
	Filter Media	8200	6269.72	15	820	1	1.61	1108.84
	Topsoil	31800	24314.28	18	3180	6	9.66	1330.61
	Road Base	400	305.84	15	40	6	9.66	1108.84
C	Grading Fill	20400	15597.84	15	2040	1	1.61	1108.84
	Base Course	3200	2446.72	15	320	1	1.61	1108.84
	Drainage Gravel	10200	7798.92	15	1020	1	1.61	1108.84
	Fractured Basalt	62300	47634.58	12	6230	6	9.66	887.07
	Filter Media	10000	7646.00	15	1000	1	1.61	1108.84
	Topsoil	40900	31272.14	18	4090	6	9.66	1330.61
	Road Base	500	382.30	15	50	6	9.66	1108.84
S	Grading Fill	15900	12157.14	15	1590	1	1.61	1108.84
	Base Course	2700	2064.42	15	270	1	1.61	1108.84
	Drainage Gravel	8700	6652.02	15	870	1	1.61	1108.84
	Fractured Basalt	54000	41288.40	12	5400	6	9.66	887.07
	Filter Media	8200	6269.72	15	820	1	1.61	1108.84
	Topsoil	33200	25384.72	18	3320	6	9.66	1330.61
	Road Base	500	382.30	15	50	6	9.66	1108.84
SX	Grading Fill	20000	15292.00	15	2000	1	1.61	1108.84
	Base Course	3200	2446.72	15	320	1	1.61	1108.84
	Drainage Gravel	10400	7951.84	15	1040	1	1.61	1108.84
	Fractured Basalt	63700	48705.02	12	6370	6	9.66	887.07
	Filter Media	10200	7798.92	15	1020	1	1.61	1108.84
	Topsoil	41300	31577.98	18	4130	6	9.66	1330.61
	Road Base	500	382.30	15	50	6	9.66	1108.84
T	Grading Fill	19800	15139.08	15	1980	1	1.61	1108.84
	Base Course	3100	2370.26	15	310	1	1.61	1108.84
	Drainage Gravel	10000	7646.00	15	1000	1	1.61	1108.84
	Fractured Basalt	61200	46793.52	12	6120	6	9.66	887.07
	Filter Media	9800	7493.08	15	980	1	1.61	1108.84
	Topsoil	39900	30507.54	18	3990	6	9.66	1330.61
	Road Base	500	382.30	15	50	6	9.66	1108.84
TX	Grading Fill	28600	21867.56	15	2860	1	1.61	1108.84
	Base Course	4000	3058.40	15	400	1	1.61	1108.84
	Drainage Gravel	12800	9786.88	15	1280	1	1.61	1108.84
	Fractured Basalt	77300	59103.58	12	7730	6	9.66	887.07
	Filter Media	13200	10092.72	15	1320	1	1.61	1108.84
	Topsoil	54500	41670.70	18	5450	6	9.66	1330.61
	Road Base	600	458.76	15	60	6	9.66	1108.84
TY	Grading Fill	7600	5810.96	15	760	1	1.61	1108.84
	Base Course	1700	1299.82	15	170	1	1.61	1108.84
	Drainage Gravel	5400	4128.84	15	540	1	1.61	1108.84
	Fractured Basalt	34600	26455.16	12	3460	6	9.66	887.07
	Filter Media	4400	3364.24	15	440	1	1.61	1108.84
	Topsoil	17200	13151.12	18	1720	6	9.66	1330.61
	Road Base	300	229.38	15	30	6	9.66	1108.84

Table A10. Nonradiological Barrier Construction Emissions (10 sheets). (Backup to Table 5-4).

U	Grading Fill	19200	14680.32	15	1920	1	1.61	1108.84
	Base Course	3100	2370.26	15	310	1	1.61	1108.84
	Drainage Gravel	9800	7493.08	15	980	1	1.61	1108.84
	Fractured Basalt	60100	45952.46	12	6010	6	9.66	887.07
	Filter Media	9600	7340.16	15	960	1	1.61	1108.84
	Topsoil	38900	29742.94	18	3890	6	9.66	1330.61
	Road Base	500	382.30	15	50	6	9.66	1108.84
DST AN	Grading Fill	12500	9557.50	15	1250	1	1.61	1108.84
	Base Course	2300	1758.58	15	230	1	1.61	1108.84
	Drainage Gravel	7400	5658.04	15	740	1	1.61	1108.84
	Fractured Basalt	46200	35324.52	12	4620	6	9.66	887.07
	Filter Media	6700	5122.82	15	670	1	1.61	1108.84
	Topsoil	26800	20491.28	18	2680	6	9.66	1330.61
	Road Base	400	305.84	15	40	6	9.66	1108.84
DST AP	Grading Fill	10700	8181.22	15	1070	1	1.61	1108.84
	Base Course	2200	1682.12	15	220	1	1.61	1108.84
	Drainage Gravel	7000	5352.20	15	700	1	1.61	1108.84
	Fractured Basalt	44100	33718.66	12	4410	6	9.66	887.07
	Filter Media	6100	4664.06	15	610	1	1.61	1108.84
	Topsoil	24000	18350.40	18	2400	6	9.66	1330.61
	Road Base	400	305.84	15	40	6	9.66	1108.84
DST AW	Grading Fill	8000	6116.80	15	800	1	1.61	1108.84
	Base Course	1700	1299.82	15	170	1	1.61	1108.84
	Drainage Gravel	5600	4281.76	15	560	1	1.61	1108.84
	Fractured Basalt	35800	27372.68	12	3580	6	9.66	887.07
	Filter Media	4600	3517.16	15	460	1	1.61	1108.84
	Topsoil	18100	13839.26	18	1810	6	9.66	1330.61
	Road Base	300	229.38	15	30	6	9.66	1108.84
DST AY	Grading Fill	2900	2217.34	15	290	1	1.61	1108.84
	Base Course	900	688.14	15	90	1	1.61	1108.84
	Drainage Gravel	2900	2217.34	15	290	1	1.61	1108.84
	Fractured Basalt	19300	14756.78	12	1930	6	9.66	887.07
	Filter Media	1800	1376.28	15	180	1	1.61	1108.84
	Topsoil	6300	4816.98	18	630	6	9.66	1330.61
	Road Base	200	152.92	15	20	6	9.66	1108.84
DST AZ	Grading Fill	2900	2217.34	15	290	1	1.61	1108.84
	Base Course	900	688.14	15	90	1	1.61	1108.84
	Drainage Gravel	2900	2217.34	15	290	1	1.61	1108.84
	Fractured Basalt	19300	14756.78	12	1930	6	9.66	887.07
	Filter Media	1800	1376.28	15	180	1	1.61	1108.84
	Topsoil	6300	4816.98	18	630	6	9.66	1330.61
	Road Base	200	152.92	15	20	6	9.66	1108.84
DST SY	Grading Fill	5400	4128.84	15	540	1	1.61	1108.84
	Base Course	1300	993.98	15	130	1	1.61	1108.84
	Drainage Gravel	4300	3287.78	15	430	1	1.61	1108.84
	Fractured Basalt	27600	21102.96	12	2760	6	9.66	887.07
	Filter Media	3200	2446.72	15	320	1	1.61	1108.84
	Topsoil	12300	9404.58	18	1230	6	9.66	1330.61
	Road Base	300	229.38	15	30	6	9.66	1108.84
EPT OPT B	Grading Fill	1835600	1403652.68	15	183560	1	1.61	1108.84
	Base Course	67600	51639.88	15	6760	1	1.61	1108.84
	Drainage Gravel	206300	157736.98	15	20630	1	1.61	1108.84
	Fractured Basalt	1096700	838536.82	12	109670	6	9.66	887.07
	Filter Media	283400	216687.64	15	28340	1	1.61	1108.84
	Topsoil	1239100	947415.86	18	123910	6	9.66	1330.61
	Road Base	2600	1987.96	15	260	6	9.66	1108.84
EPT OPT A	Grading Fill	159300	121800.78	15	15930	1	1.61	1108.84
	Base Course	12800	9786.88	15	1280	1	1.61	1108.84
	Drainage Gravel	39500	30201.70	15	3950	1	1.61	1108.84
	Fractured Basalt	223400	170811.64	12	22340	6	9.66	887.07
	Filter Media	48400	37006.64	15	4840	1	1.61	1108.84
	Topsoil	206800	158119.28	18	20680	6	9.66	1330.61
	Road Base	1100	841.06	15	110	6	9.66	1108.84
TPA GLASS	Grading Fill	143800	109949.48	15	14380	1	1.61	1108.84
	Base Course	12100	9251.66	15	1210	1	1.61	1108.84
	Drainage Gravel	37500	28672.50	15	3750	1	1.61	1108.84
	Fractured Basalt	213100	162936.26	12	21310	6	9.66	887.07
	Filter Media	45600	34865.76	15	4560	1	1.61	1108.84
	Topsoil	194700	148867.62	18	19470	6	9.66	1330.61
	Road Base	1000	764.60	15	100	6	9.66	1108.84

NOTES:

(1) The mean vehicle speed, S, is estimated at 40.2 km/hr (25 mph).

(2) The mean vehicle weight, W is estimated at 33.86 Mg; the mean number of wheels/vehicle, w, is assumed to be 18

(3) The number of days with > 0.01 inches of precipitation, p, is assumed to be 90.

(4) The control efficiency of road watering, c, is assumed to be 81.5%.

(5) The PM10 Emission Factor is found from the equation EF = 610*(s/12)*(S/48)*((W/2.7)^0.7)*((w/4)^0.5)*(365 - p/365)*(100 - c/

(6) The total mass of dust emitted is calculated by the number of trips*distance/round trip*emission factor; this number is divided by 10^6 to get the mass in tonnes

(7) This table was generated using the equations in EPA 451/R-93-004, "Estimation of Air Impacts from Area Sources of Particulate Matter Emissions at Superfund Sites," Report ASF-32, p 6.

Table A10. Nonradiological Barrier Construction Emissions (10 sheets). (Backup to Table 5-4).

FUGITIVE DUST EMISSIONS FROM MATERIAL TRANSFERS FOR BARRIER CONSTRUCTION

TANK FARM	BARRIER LAYER	# OF TRANSFERS	FROM WHERE	K	U (m/sec)	X H2O (%)	M (kg)	EF (tonne)
SSTs	Grading Fill	4	Pit 30	0.35	5.68	3	2.86E+08	1.25
	Base Course	4	Pit 30	0.35	5.68	3	4.77E+07	0.21
	Drainage Gravel	4	Pit 30	0.35	5.68	3	1.50E+08	0.65
	Fractured Basalt	4	Vernita Quarry	0.35	5.68	2	9.91E+08	7.62
	Filter Media	4	Pit 30	0.35	5.68	3	1.43E+08	0.62
	Topsoil	4	McGee Ranch	0.35	5.68	8	4.30E+08	0.47
	Road Base	3	Vernita Quarry	0.35	5.68	3	8.18E+06	0.04
DSTs	Grading Fill	4	Pit 30	0.35	5.68	3	6.24E+07	0.27
	Base Course	4	Pit 30	0.35	5.68	3	1.35E+07	0.06
	Drainage Gravel	4	Pit 30	0.35	5.68	3	4.36E+07	0.19
	Fractured Basalt	4	Vernita Quarry	0.35	5.68	2	2.97E+08	2.28
	Filter Media	4	Pit 30	0.35	5.68	3	3.50E+07	0.15
	Topsoil	4	McGee Ranch	0.35	5.68	8	1.01E+08	0.11
	Road Base	3	Vernita Quarry	0.35	5.68	3	2.92E+06	0.01
EPT Opt B	Grading Fill	4	Pit 30	0.35	5.68	3	2.70E+09	11.76
	Base Course	4	Pit 30	0.35	5.68	3	9.96E+07	0.43
	Drainage Gravel	4	Pit 30	0.35	5.68	3	2.98E+08	1.30
	Fractured Basalt	4	Vernita Quarry	0.35	5.68	2	1.69E+09	12.99
	Filter Media	4	Pit 30	0.35	5.68	3	4.09E+08	1.78
	Topsoil	4	McGee Ranch	0.35	5.68	8	1.34E+09	1.48
	Road Base	3	Vernita Quarry	0.35	5.68	3	3.99E+06	0.02
EPT Opt A	Grading Fill	4	Pit 30	0.35	5.68	3	2.34E+08	1.02
	Base Course	4	Pit 30	0.35	5.68	3	1.87E+07	0.08
	Drainage Gravel	4	Pit 30	0.35	5.68	3	5.71E+07	0.25
	Fractured Basalt	4	Vernita Quarry	0.35	5.68	2	3.45E+08	2.65
	Filter Media	4	Pit 30	0.35	5.68	3	6.99E+07	0.30
	Topsoil	4	McGee Ranch	0.35	5.68	8	2.23E+08	0.25
	Road Base	3	Vernita Quarry	0.35	5.68	3	1.63E+06	0.01
TPA Glass	Grading Fill	4	Pit 30	0.35	5.68	3	2.11E+08	0.92
	Base Course	4	Pit 30	0.35	5.68	3	1.77E+07	0.08
	Drainage Gravel	4	Pit 30	0.35	5.68	3	5.42E+07	0.24
	Fractured Basalt	4	Vernita Quarry	0.35	5.68	2	3.29E+08	2.53
	Filter Media	4	Pit 30	0.35	5.68	3	6.59E+07	0.29
	Topsoil	4	McGee Ranch	0.35	5.68	8	2.09E+08	0.23
	Road Base	3	Vernita Quarry	0.35	5.68	3	1.60E+06	0.01

NOTES:

(1) The four transfers for Grading Fill include (1) excavation and loading into trucks; (2) using the grizzly to eliminate oversized material; (3) transfer the material into trucks; and (4) hauling and placing.

(2) The four transfers for Base Course include (1) excavation and loading into trucks; (2) screening to specification; (3) transfer the material into trucks; and (4) hauling and placing.

(3) The four transfers for Drainage Gravel include (1) excavation and loading into trucks; (2) screening to specification; (3) transfer the material into trucks; and (4) hauling and placing.

(4) The four transfers for Fractured Basalt include (1) excavation and loading into trucks; (2) using the grizzly to eliminate oversized material; (3) transfer the material into trucks; and (4) hauling and placing.

(5) The four transfers for Filter Media include (1) excavation and loading into trucks; (2) screening to specification; (3) transfer the material into trucks; and (4) hauling and placing.

(6) The four transfers for Topsoil include (1) excavation and loading into trucks; (2) stockpile the material at Pit 30; (3) transfer the material into trucks; and (4) hauling and placing.

(7) The three transfers for Road Base include (1) screening to specifications; (2) transfer the materials into trucks; and (3) hauling and placing.

(8) K is a particle size multiplier that is specific to PM10 (less than 10 micron) particles. It is unitless.

(9) M is the mass of barrier material handled, in kg.

(10) U is the mean wind speed, assumed to be 5.68 m/sec.

(11) X H2O is the percentage of moisture content in the soil.

(12) The emissions from transfer operations follows the equation: E = K*0.0016*M*[(U/2.2)^1.3]/[(X H2O/2)^1.4]. This gives the emissions in grams, which have been converted to kg by dividing by 1000.

(13) This table was generated using the equations in EPA 451/R-93-004, "Estimation of Air Impacts from Area Sources of Particulate Matter Emissions at Superfund Sites," Report ASF-32, p 6.

Table A10. Nonradiological Barrier Construction Emissions (10 sheets). (Backup to Table 5-4).

CLEARING AND GRUBBING EMISSIONS (BASED ON DAYS OF DOZER OPERATION)

TANK FARM	AREA (acres)	TIME (days)	EMISSIONS (tonne)
A	1.12	7.97	0.07
AX	0.73	5.53	0.05
B	3.00	21.04	0.18
BY	2.41	16.58	0.14
BX	2.37	16.36	0.14
C	3.08	21.68	0.19
S	2.44	16.89	0.15
SX	3.09	21.25	0.18
T	3.00	21.04	0.18
TY	1.13	8.08	0.07
TX	4.22	30.39	0.26
U	2.91	20.40	0.18
TOTAL:			1.79
AN	1.92	13.28	0.11
AP	1.65	11.37	0.10
AW	1.21	8.50	0.07
AY	0.31	3.08	0.03
AZ	0.31	3.08	0.03
SY	0.76	5.74	0.05
TOTAL:			0.39
EPT GROUT	16.46	152.79	2.82
EPT GLASS	17.56	169.26	3.12
TPA GLASS	111.03	1950.54	35.95

NOTES:

(1) For both the SSTs and the DSTs, the silt content is assumed to be 6%, and the soil moisture content is assumed to be 3%.

(2) For the LLW Vaults, the silt content is assumed to be 10%, and the soil moisture content is assumed to be 3%.

Table A10. Nonradiological Barrier Construction Emissions (10 sheets). (Backup to Table 5-4).

DOZER GRADING EMISSIONS

TANK FARM	ASPHALT (acres)	ASPHALT (days)	ASPHALT (tonnes)	DRAINAGE (acres)	DRAINAGE (days)	DRAINAGE (tonnes)	BASALT (acres)	BASALT (days)	BASALT (tonnes)
A	1.12	0.34	0.001	1.12	1.01	0.004	1.12	98.92	0.71
AX	0.73	0.27	0.001	0.73	0.79	0.003	0.73	77.87	0.56
B	3.00	0.65	0.003	3.00	1.88	0.008	3.00	176.50	1.28
BY	2.41	0.57	0.002	2.41	1.61	0.007	2.41	154.58	1.12
BX	2.37	0.57	0.002	2.37	1.59	0.007	2.37	152.85	1.11
C	3.08	0.67	0.003	3.08	1.91	0.008	3.08	179.67	1.30
S	2.44	0.57	0.002	2.44	1.63	0.007	2.44	155.73	1.13
SX	3.09	0.67	0.003	3.09	1.95	0.008	3.09	183.71	1.33
T	3.00	0.65	0.003	3.00	1.88	0.008	3.00	176.50	1.28
TY	1.13	0.36	0.001	1.13	1.01	0.004	1.13	99.78	0.72
TX	4.22	0.84	0.003	4.22	2.40	0.010	4.22	222.93	1.61
U	2.91	0.65	0.003	2.91	1.84	0.008	2.91	173.36	1.25
SUBTOTAL SST:	29.50	6.81	0.027	29.50	19.50	0.082	29.50	1852.40	13.40
AN	1.92	0.48	0.002	1.92	1.39	0.006	1.92	133.24	0.96
AP	1.65	0.46	0.002	1.65	1.31	0.005	1.65	127.18	0.92
AW	1.21	0.36	0.001	1.21	1.05	0.004	1.21	103.24	0.75
AY	0.31	0.19	0.001	0.31	0.54	0.002	0.31	55.66	0.40
AZ	0.31	0.19	0.001	0.31	0.54	0.002	0.31	55.66	0.40
SY	0.76	0.27	0.001	0.76	0.81	0.003	0.76	79.60	0.58
SUBTOTAL DST:	6.16	1.95	0.008	6.16	5.64	0.022	6.16	2406.98	4.01
TOTAL TANKS:	35.66	8.76	0.035	35.66	25.14	0.104	35.66	4259.38	17.410

TANK FARM	FILTER (acres)	FILTER (days)	FILTER (tonnes)	TOPSOIL (acres)	TOPSOIL (days)	TOPSOIL (tonnes)	ROAD (acres)	ROAD (days)	ROAD (tonnes)
A	1.12	2.44	0.010	1.12	40.29	2.43	1.12	0.06	<0.001
AX	0.73	1.72	0.007	0.73	27.89	1.68	0.73	0.06	<0.001
B	3.00	5.43	0.022	3.00	95.20	5.75	3.00	0.11	<0.001
BY	2.41	4.54	0.045	2.41	78.25	4.72	2.41	0.09	<0.001
BX	2.37	4.43	0.018	2.37	77.29	4.67	2.37	0.09	<0.001
C	3.08	5.54	0.023	3.08	97.58	5.89	3.08	0.11	<0.001
S	2.44	4.54	0.019	2.44	79.21	4.78	2.44	0.11	<0.001
SX	3.09	5.65	0.023	3.09	98.55	5.95	3.09	0.11	<0.001
T	3.00	5.43	0.022	3.00	95.20	5.75	3.00	0.11	<0.001
TY	1.13	2.44	0.010	1.13	41.02	2.48	1.13	0.06	<0.001
TX	4.22	7.31	0.030	4.22	130.05	7.85	4.22	0.13	<0.001
U	2.91	5.31	0.022	2.91	92.81	5.60	2.91	0.11	<0.001
SUBTOTAL SST:	29.50	54.78	0.251	29.50	953.34	57.55	29.50	1.15	<0.010
AN	1.92	3.71	0.015	1.92	63.93	3.86	1.92	0.09	<0.001
AP	1.65	3.38	0.014	1.65	57.25	3.46	1.65	0.09	<0.001
AW	1.21	2.55	0.010	1.21	43.16	2.61	1.21	0.06	<0.001
AY	0.31	1.00	0.004	0.31	15.01	0.91	0.31	0.04	<0.001
AZ	0.31	1.00	0.004	0.31	15.01	0.91	0.31	0.04	<0.001
SY	0.76	1.77	0.007	0.76	29.32	1.77	0.76	0.06	<0.001
SUBTOTAL DST:	6.16	13.41	0.054	6.16	223.68	13.52	6.16	0.38	<0.005
TOTAL TANKS:	35.66	68.19	0.305	35.66	1177.02	71.07	35.66	1.53	<0.020

LLW VAULTS	ASPHALT (acres)	ASPHALT (days)	ASPHALT (tonnes)	DRAINAGE (acres)	DRAINAGE (days)	DRAINAGE (tonnes)	BASALT (acres)	BASALT (days)	BASALT (tonnes)
EPT GROUT	111.03	14.29	0.059	111.03	38.68	0.159	111.03	3162.80	22.89
EPT GLASS	17.56	2.70	0.011	17.56	7.41	0.030	17.56	644.27	4.66
TPA GLASS	16.46	2.55	0.010	16.46	7.03	0.029	16.46	614.57	4.45

LLW VAULTS	FILTER (acres)	FILTER (days)	FILTER (tonnes)	TOPSOIL (acres)	TOPSOIL (days)	TOPSOIL (tonnes)	ROAD (acres)	ROAD (days)	ROAD (tonnes)
EPT GROUT	111.03	156.88	0.644	111.03	2958.89	178.62	111.03	0.56	0.002
EPT GLASS	17.56	26.79	0.110	17.56	493.69	29.80	17.56	0.24	0.001
TPA GLASS	16.46	25.24	0.104	16.46	464.81	28.06	16.46	0.21	0.001

NOTE:

(1) The barrier layers are assumed to all consist of 5% silt, except for the topsoil layer, which consists of 75% silt.

(2) The soil moisture content is assumed to be 3% in the asphalt base course, the drainage layer, the graded filter layer, and the road base; it is assumed to be 2% in the basalt layer, and 8% in the topsoil layers.

(3) All emissions calculations were based on EPA 451/R-93-004, "Estimation of Air Impacts from Area Sources of Particulate Matter Emissions at Superfund Sites," Report ASF-32.