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U.S. Department of Energy, Richland Operations Office					
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G. M. Neath	S7-52	X			
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Page 1 of 1

1. EDT 606393

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) Waste Tanks Process Engineering	4. Related EDT No.: N/A
5. Proj./Prog./Dept./Div.: W-058 CSTS 71310/D8C04	6. Cog. Engr.: D. V. Vo	7. Purchase Order No.: N/A
8. Originator Remarks: For approval. Comments have been incorporated.		9. Equip./Component No.: N/A
		10. System/Bldg./Facility: N/A
11. Receiver Remarks:		12. Major Assm. Dwg. No.: N/A
		13. Permit/Permit Application No.: N/A
		14. Required Response Date: 05/12/95

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-W058-TA-001	N/A	0	Replacement of the Cross-Site Transfer System Liquid Waste Transport Alternatives Evaluation, Project W-058	N/A	1,2		

16. KEY

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		QA				G. F. Howden			G3-20	3	
		Safety				(RL) G. M. Neath			S7-52	3	
		Env.				(MACTEC) D. S. Rewinkel			S7-72	3	
1	1	E. M. Epperson	EM Epperson	5/5/95	B4-08	S. D. Riesenweber			R2-76	3	
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BD-7400-172-2 (04/94) GEF097

RELEASE AUTHORIZATION

Document Number:	WHC-SD-W058-TA-001, Rev. 0
Document Title:	Replacement of the Cross-Site Transfer System Liquid Waste Transport Alternatives Evaluation, Project W-058
Release Date:	May 12, 1995

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

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SUPPORTING DOCUMENT		1. Total Pages 68
2. Title Replacement of the Cross-Site Transfer System Liquid Waste Transport Alternatives Evaluation, Project W-058	3. Number WHC-SD-W058-TA-001	4. Rev No. 0
5. Key Words Cross-site, cross-country, aboveground, underground, rail, French LR-56, trailer, tanker, cask, buried pipe, process pipe, slurry transport, transfer, liquid waste, tank waste, 204-AR, SY Tank Farm, high level, low level, CSTS, W-058, A Tank Farm Complex	6. Author Name: D. V. Vo Signature Organization/Charge Code 71310/D8004	

7. Abstract

This document examines high-/low-level radioactive liquid waste transport alternatives. Radioactive liquid waste will be transported from the 200 West Area to the 200 East Area and within the 200 East Areas for safe storage and disposal. The radioactive waste transport alternatives are the Aboveground Transport System (French LR-56 Cask System [3,800 L {1,000 gal}], 19,000-L (5,000-gal) trailer tanker system, 75,700-L (20,000-gal) rail tanker system) and Underground Transport System (buried pipe [unlimited transfer volume capability]). The evaluation focused on the following areas: initial project cost, operational cost, secondary waste generation, radiation exposure, and final decommissioning. The evaluation was based on the near term (1995 to 2005) estimated volume of 49.509 million L (13.063 million gal) and long term (1995 to 2028) estimated volume of 757.1 million L (200 million gal). The conclusion showed that the buried pipe (Underground Transport System) resulted in the lowest overall total cost for near and long term, the trailer container resulted in the highest total cost for near and long term, and the French truck was operationally impractical and cost prohibitive.

8. RELEASE STAMP

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A-6400-073 (08/94) WEF124

WHC-SD-W058-TA-001
Revision 0

REPLACEMENT OF THE CROSS-SITE TRANSFER SYSTEM LIQUID WASTE TRANSPORT ALTERNATIVE EVALUATION, PROJECT W-058

D. V. Vo
E. M. Epperson

May 1995

Westinghouse Hanford Company
Richland, Washington

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EXECUTIVE SUMMARY

This report is an evaluation of high-/low-level radioactive liquid waste transport alternatives. The high-/low-level radioactive liquid waste will be transported from the 200 West Area to the 200 East Area and within the 200 East Areas for safe storage and disposal. This evaluation is required to document the results in response to a question raised during the comment period of the *Environmental Impact Statement for Safe Interim Storage of Hanford Tank Waste*.[1]

A previous study[2] provided the foundation for this evaluation. The study investigated the technical feasibility and likelihood of approval for shipping large (19,000 L [5,000 gal]) samples of actual tank waste from the 200 Areas to hot cell facilities in other areas on the Hanford Site. The study provided the estimated cost of the load/unloading facility and the risk assessment that were used in this evaluation.

The high-/low-level radioactive waste transport alternatives are the Aboveground Transport System (AGTS) and Underground Transport System (UGTS). The AGTS methods considered were an "off-the-shelf" shielded French LR-56 Cask System (3,800 L [1,000 gal]), a conceptual 19,000-L (5,000-gal) shielded trailer tanker system (truck), and a conceptual 37,850-L (10,000-gal) shielded rail tanker system. The UGTS method considered is a 60% design buried pipe system with unlimited transfer volume capability.

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[1]DOE, 1994, *Environmental Impact Statement for Safe Interim Storage of Hanford Tank Waste*, DOE/EIS-0212, Washington State Department of Ecology and U.S. Department of Energy, Richland Operations Office, Olympia, Washington.

[2]Howden, G. F., 1993, *Pilot Plant Hot Test Facility Siting Study*, WHC-SD-WM-TA-143, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

The evaluation investigated the estimated high-/low-level radioactive waste transport volume requirement for near term (1995 to 2005) of 49.509 million L (13.063 million gal) and long term (1995 to 2028) of 757.1 million L (200 million gal). The evaluation focused on the following areas: initial project cost, operational cost, secondary waste generation due to flushing, radiation exposure to personnel, and final decontamination and decommissioning (D&D). The operational cost, secondary waste generation, radiation exposure, and D&D bases were developed to estimate a cost basis for comparison with the initial project cost.

The detailed comparison of the three main candidate methods (buried pipe, trailer tanker car, and rail tanker car) are provided in Sections 2.0 and 3.0 of this report. The French LR-56 cask (truck) was not included in the detailed comparison because the large number of trips required made it impractical and uneconomical.

The buried pipe (UGTS) resulted in the lowest overall total cost for near term (1995 to 2005) and long term (1995 to 2028) as shown in Table 2-10. The higher initial project cost and final D&D costs for the UGTS are offset by the lower operational, evaporation, and radiation exposure costs which result in a lowest overall total cost. The rail tanker car method (AGTS) appeared to have the next lowest overall total cost. However, the high radiation exposure to tank farm workers for routine operation is a concern for the long-term, accident administrative control during transport of high-level liquid radioactive waste, and a fully loaded shielded 37,850-L (10,000-gal) rail tanker car nearly exceeding the railroad loading requirement. The trailer tanker car (AGTS) resulted in the highest total cost for near term (1995 to

2005) and long term (1995 to 2028) as shown in Table 2-10. Even without taking credit for radiation exposure cost, the UGTS buried pipe system for the total Hanford Site cleanup (1995 to 2028) total estimated cost is 65% less expensive than the lowest AGTS (rail tanker system). During the lowest demanded year (2003) for transport of liquid waste, rail tanker car and trailer tanker car roundtrips required travel distances exceeding the estimated yearly allowable AGTS mileage limit of 400 km (250 miles) for transport of high-level radioactive waste that was set as a limit for an incredible accident scenario without imposing administrative controls. Note that the AGTS mileage was based on the Howden document preliminary risk assessment. Therefore, actual mileage limits may be different than those presented here.

The buried pipe (UGTS) design is approximately 60% complete. The *Preliminary Safety Analysis Report for Replacement of the Cross-Site Transfer System, Project W-058* revision[1] and a system engineering design requirements document are being prepared. Also, the environmental documentation for the UGTS is well underway. The integrated Project W-058 is supporting Tri-Party Agreement Operational Milestone M-43-07C of February 1998. Thus, there is no technical uncertainty associated with UGTS. In contrast, there are several uncertainties associated with the AGTS. The first one is related to the preparation of the project documents as required by DOE Order 4700.1.[2] These documents have not been prepared for the AGTS, which may impact the estimated

[1]Kidder, R. J., 1993, *Preliminary Safety Analysis Report for Replacement of the Cross-Site Transfer System, Project W-058*, WHC-SD-W058-PSAR-001, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

[2]DOE, 1987, *Project Management System*, DOE Order 4700.1, U.S. Department of Energy, Washington, D.C.

cost and/or schedule. The second uncertainty is the estimated project cost for AGTS, which was based on preconceptual ideas. The third uncertainty is related to meeting the Tri-Party Agreement Operational milestone by February 1998. This is the biggest uncertainty because the Conceptual Design, Title I (Preliminary Design), Title II (Definitive Design), and construction activities have not been started. The fourth uncertainty is related to resolution of technical issues such as radiation exposure, additional accident administrative control during transport, a shielded 37,850-L (10,000-gal) rail tanker car exceeding the railroad loading requirements, remote operations (connect/disconnect), and seismically qualified equipment.

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REPLACEMENT OF THE CROSS-SITE TRANSFER SYSTEM LIQUID WASTE TRANSPORT ALTERNATIVES EVALUATION, PROJECT W-058

1.0 INTRODUCTION

1.1 SCOPE

This study was initiated in response to a question on the *Environmental Impact Statement for Safe Interim Storage of Hanford Tank Waste* (DOE 1994) (regarding the technical basis for preferring pipeline transport of Watch List waste to rail tanker car or trailer tanker car transport). This study includes information on volume projections, system descriptions, personnel exposure, technical uncertainties and costs associated with transportation of radioactive liquid waste from the 200 West Area to the 200 East Area and within the 200 East Area by the Aboveground Transport System (AGTS) versus the Underground Transport System (UGTS). The AGTS considered in this study was the French LR-56 cask, trailer tanker car, and rail tanker car with the required load/unload facilities. The UGTS used in this study was buried pipes with associated diversion boxes that connect from the SY Tank Farm to the 244-A Lift Station.

1.1.1 Waste, Volume, and Source

A near-term (1995 to 2005) liquid waste transfer estimated volume (Toth 1995, Hanlon 1994, Strode 1994) was developed and the details are shown in Table 1-1. During this period, the estimated total waste volume of 49.509 million L (13.063 million gal) is scheduled for transporting from the 200 West Area to the 200 East Area and within the 200 East Area. The total estimated volume includes mostly facility-generated waste, decommissioning cleanout, SY Tank Farm retrieval, and facility flushes. Table 1-1 identifies the facilities from which the waste originates and the quantity of waste associated with the respective facility.

A long-term (1995 to 2028) liquid waste transfer estimated volume of 757.1 million L (200 million gal) (Brantley 1994) was also considered in the evaluation. The long-term estimated volume includes the estimated near-term transfers, single-shell tank retrieval, and transfer from safe storage to disposal facilities.

1.1.2 Schedule

The schedule driver is the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1994) Milestone M-43-07C, "Replacement of Cross-Site Transfer System Operational by February 1998." As described in WHC-SD-WM-EV-094, *Tank Waste Remediation System Transfer Facility Compliance Plan* (Hansen 1994), replacement of the existing cross-site transfer

Table 1-1. Projected Volume and Source of Radioactive Liquid Waste--1995 to 2005.

SOURCE	YEARLY VOLUME (gallons)											TOTAL VOLUME (gal.)
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	
Facility Generation												
S-Plant	216000	216000	216000	216000	216000	216000	216000	216000	216000	216000	216000	2376000
T-Plant	180000	180000	180000	180000	180000	180000	180000	180000	180000	180000	180000	1980000
PFP Laboratory w/solid	36000	36000	36000	36000	36000	36000	36000	36000	36000	36000	36000	396000
PFP Stabilization w/flush	0	0	31000	278000	210000	42000	0	0	0	0	0	561000
SY Tank Farm												
TK 101-SY Diln/Retrieval	0	0	0	0	0	0	0	0	0	0	0	0
TK 101-SY *	0	0	0	0	0	0	0	0	0	0	0	0
TK 102-SY *	450000	0	0	312000	0	0	0	0	0	0	0	762000
TK 103-SY Diln/Retrieval	0	0	0	0	0	0	0	0	0	0	0	0
TK 103-SY *	0	0	0	0	0	0	0	0	0	0	0	0
Flushes												
SWL Pump. w/o flush (200W)**	111000	736000	534000	809000	258000	26000	0	0	0	0	0	2474000
SST Solids Retrv(200W from TX)**	0	0	0	0	0	0	0	0	0	800000	1200000	2000000
Fac.Gen.+SWL+TCO(200W)	37000	100000	79000	107000	52000	29000	26000	26000	26000	26000	26000	534000
TF lines, cross-site, ALC(200W)***	180000	180000	180000	180000	180000	180000	180000	180000	180000	180000	180000	1980000
TOTAL VOLUME (gallons)	1210000	1448000	1256000	2118000	1132000	709000	638000	638000	638000	1438000	1838000	13063000

Unless otherwise flagged, data reported here is from the "Double Shell Tank Inventory and Available Space" report, by A.D. Toth, 12/28/1994
*Waste Tank Summary Report for Month Ending, by B.M. Hanlon, WHC-EP-0182-81, 12/31/1994
**Operational Waste Volume Projection, by J.N. Strode, WHC-SD-WM-ER-029, Rev. 20, Table 3, 09/12/1994
*** Tank Farm lines, cross-site, Air Lift Circulator water flush/injection is equally divided between 200W and 200E

TERMS/ACRONYMS
ALC = Air Lift Circulator
PFP = Plutonium Finishing Plant
SST = Single-Shell Tank
SWL = Salt-Well Liquid
TCO = Terminal Clean Out
TF = Tank Farm
TK = tank

lines is required because the existing system does not comply with current environmental regulations and portions of the line are nearing the end of their design life.

1.2 ASSUMPTIONS

The following assumptions were made in preparing this study.

- Identical quantities of liquid waste are used for the AGTS and the UGTS.
- Personnel exposure was based on a surface dose of 200 mrem/h for the LR-56 Cask System (Smith 1994) and the same surface dose for rail tanker car and trailer tanker car systems. Personnel exposure was based on a surface dose of <0.05 mrem/h for the outside of the UGTS diversion boxes (Brantley 1994).
- The AGTS options include an "off-the-shelf" 3,800-L (1,000-gal) shielded French truck, a conceptual 19,000-L (5,000-gal) shielded trailer tanker car, and a conceptual 37,850-L (10,000-gal) shielded rail tanker car.
- The AGTS consists of two load/unload facilities located at the SY Tank Farm, and the A Tank Farm Complex.
- The UGTS consists of four diversion boxes located near the SY Tank Farm, existing vent station, B Plant, and the A Tank Farm Complex.
- Decontamination and decommissioning (D&D) of two of the load/unload facilities (AGTS) is equivalent to four of the diversion boxes (UGTS).
- The design and fabrication cost of the trailer tanker car and rail tanker car is the same as the French truck (LR-56), which is approximately $2.5 million.
- Before release of the trailer tanker car or rail tanker car from the load/unload facility, radiological surveys to monitor for contamination and surface decontamination during upset conditions are required by HSRCM-1, *Hanford Site Radiological Control Manual* (WHC 1994). The radiological surveys and any surface decontamination will be contact handled.

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2.0 DISCUSSION

2.1 SYSTEM DESCRIPTIONS

Brief descriptions of the AGTS and the UGTS are given below. Additional details on each system may be found in the reference listed with each system. The modes of potential transport systems include the following:

- Shielded French LR-56 cask (modified off-the-shelf)
- Shielded trailer tanker car (conceptual)
- Shielded rail tanker car - truck (conceptual)
- Shielded buried pipe (60% design).

Two load/unload facilities are required to support the AGTS. The conceptual design of the facility is shown in Figure 2-1. Because the AGTS is required to operate daily, the facility will be designed to minimize radiation exposure as required by DOE Order 6430.1A, *General Design Criteria* (DOE 1989). These facilities would be located at the SY Tank Farm, and at the 204-AR near the A Tank Farm Complex. Additional details can be obtained from pages 5-21, 5-24, and 5-25 and Appendix B, Sections 3.1 and 3.2.2, of WHC-SD-WM-TA-143 (Howden 1993). Some major design features of the load/unload facilities include the following:

- Remotely connect and disconnect the pump, and maintain transfer pumps and valves using master/slave manipulators

- Drive-through load/unload shielded cells

- Remotely operated equipment (bridge-mounted electromechanical manipulator, crane) in load/unload cells for recovery from upset conditions

- Shielded doors at each end of load/unload cells and a second set of outer doors to provide a double air barrier in the event of a spill

- Zoning ventilation for trailer/rail cell, pump/valve cell, and solid waste handing cell to provide secondary confinement

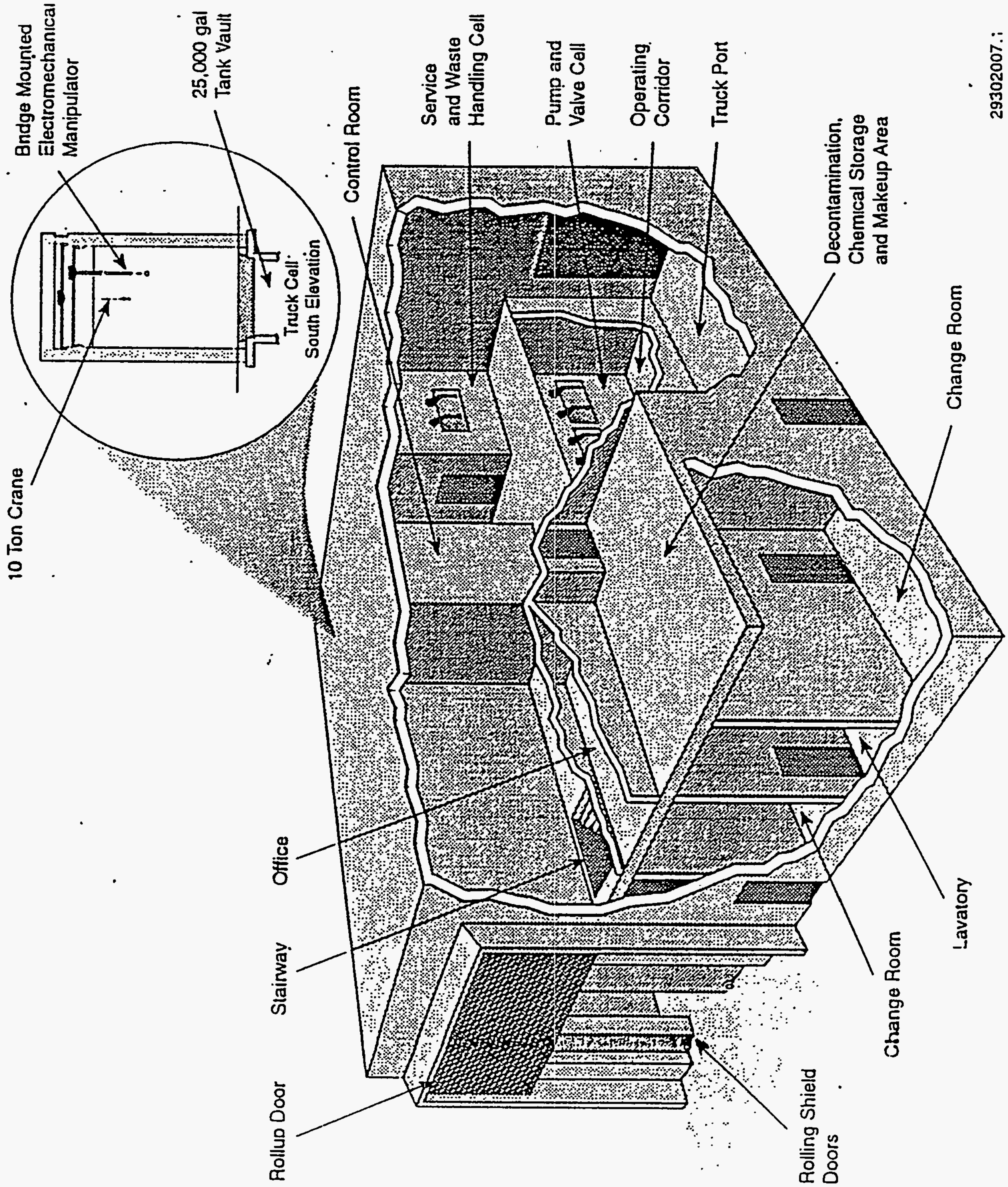
- Sample storage capability (94,600 L [25,000 gal]).

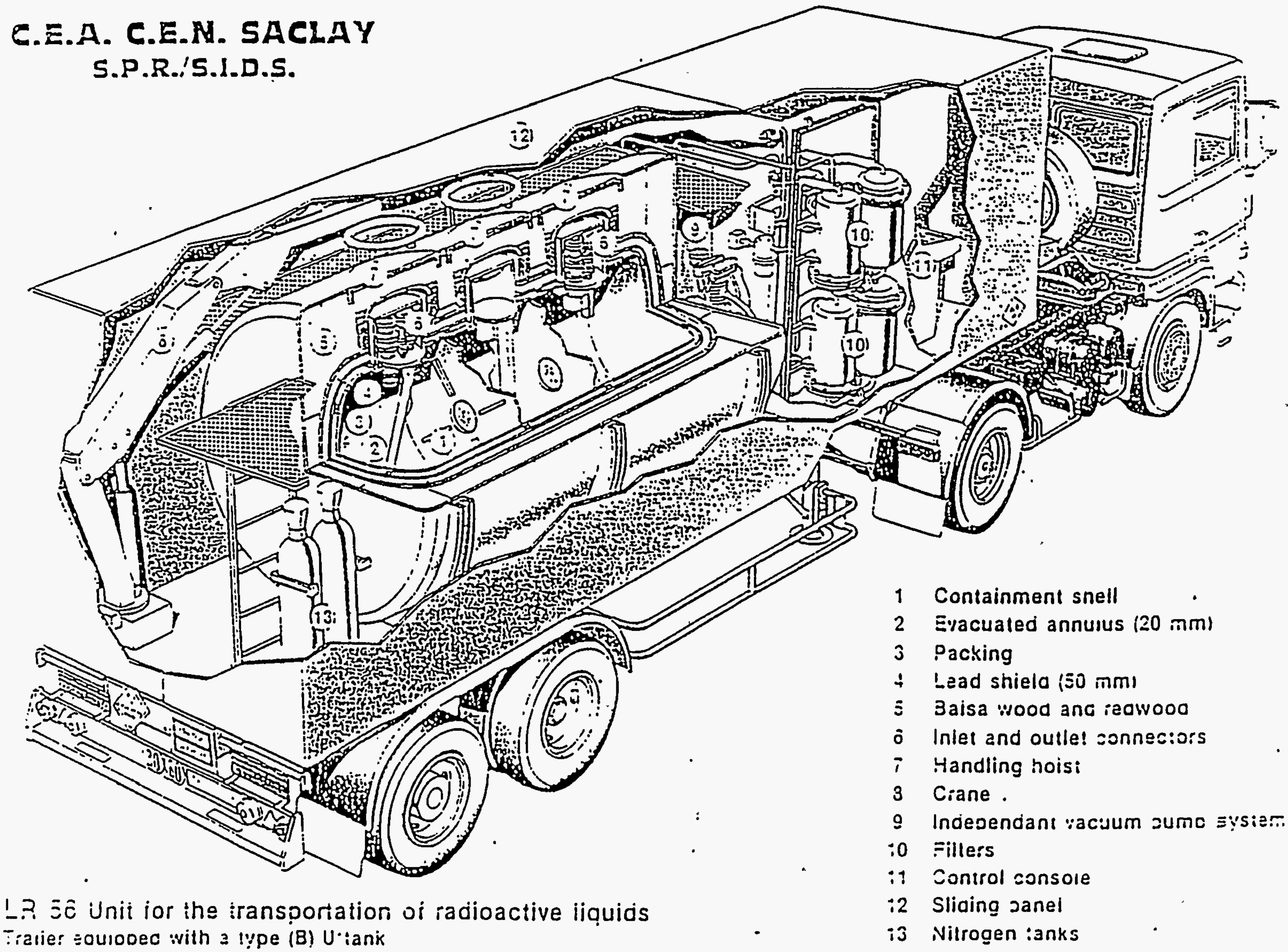
The existing low-level waste unloading facility 204-AR will require modification to incorporate the above features for high-level waste activities.

2.1.1 French LR-56 Cask

The French truck is a 3,800-L (1,000-gal) capacity, shielded (5.1 cm [2 in.] of lead equivalent) container mounted on a trailer tanker car. The truck comes equipped with pumps, sampling devices, valves, etc. The truck is an "off-the-shelf" item and would require no design efforts (Figure 2-2). Detailed descriptions and cost can be obtained from WHC-SD-WM-TA-143, *Pilot Plant Hot Test Facility Siting Report*, Appendix M (Howden 1993). The French truck will use the existing road connected between the 200 West and 200 East Areas.

Figure 2-1. Proposed Aboveground Transportation System Transporter Load/Unload Facility.





LR 56 Unit for the transportation of radioactive liquids
Trailer equipped with a type (B) U'tank

Figure 2-2. High-Level Liquid Waste Transporter.

2.1.2 Trailer Tanker Car - Truck

This is a 19,000-L (5,000-gal) capacity, shielded (5.1 cm [2 in.] of lead) double-shell steel tank (about 2.4 m [8 ft] in diameter by 4.9 m [16 ft] long) mounted on a special low-boy heavy-duty trailer (Figure 2-3). Design and procurement activities would be required for this system. Detailed information can be obtained from WHC-SD-WM-TA-143, Appendix B, Section 3.2.3, pages B-14 through B-23 (Howden 1993). The trailer tanker car will use the existing road connected between the 200 West and 200 East Areas with approximately 1.5 km (4,800 ft) of potential additional new road in the 200 East Area to avoid sharp road curves and proximity to existing office trailers (Trost 1995). The road distance from the SY Tank Farm facility to the A Tank Farm complex is 10.7 km (6.7 miles) and from the B Plant facility to the A Tank Farm complex is 1.9 km (1.2 miles). The actual road layout is shown in Figure 2-4.

2.1.3 Rail Tanker Car

The rail tanker car is a 37,850-L (10,000-gal) capacity, shielded (5.1 cm [2 in.] of lead equivalent) double-shell tank mounted on a special rail flat-car. This is a special shielded trailer tanker car and would require design modification and procurement activities. The non-shielded 75,700-L (20,000-gal) rail tanker is shown in Figure 2-5. The rail tanker car will use the existing railroad connected between the 200 West Area and the 200 East Area with approximately 0.7 km (2,200 ft) of additional new railroad to provide rail spurs to the SY Tank Farm, B Plant, and A Tank Farm Complex (Trost 1995). The rail distance from the SY Tank Farm facility to the A Tank Farm Complex is 15.5 km (9.7 miles), and 5.0 km (3.1 miles) from the B Plant facility to the A Tank Farm Complex. The actual rail layout is shown in Figure 2-6.

2.1.4 Buried Pipe

The UGTS pipe-in-pipe has two parallel buried pipes connecting the SY Tank Farm at 241-SY-A and -B valve boxes in the 200 West Area with the 244-A Lift Station and 241-AR-151 diversion box in the 200 East Area. A third pipe connects B Plant with the cross-site transfer system in the 200 East Area. The route is approximately 10.4 km (6.5 miles) long. The actual buried pipe route is shown in Figure 2-7. The system consists of 7.6-cm (3-in.) diameter 304L stainless steel pipes encased in 15.2-cm (6-in.) diameter carbon steel buried pipes with leak detection, three diversion boxes with booster pumps in two of the diversion boxes, and a vent station. The diversion boxes would be located near the SY Tank Farm, near B Plant, and at the A Tank Farm Complex, whereas the vent station is located at the highest point in the 600 Area. The replacement of the cross-site transfer system block diagram is shown in Figure 2-8 and additional details can be obtained from WHC-SD-W058-FDC-001, *Functional Design Criteria for Project W-058, Replacement of Cross-Site Transfer System* (Brantley 1994). The design of the facility is shown in Figure 2-9. Some major design features of the diversion boxes include the following:

Figure 2-3. Illustration of the 20,000-L (5,000-Gal) Tank Mounted on a Heavy-Duty Trailer.

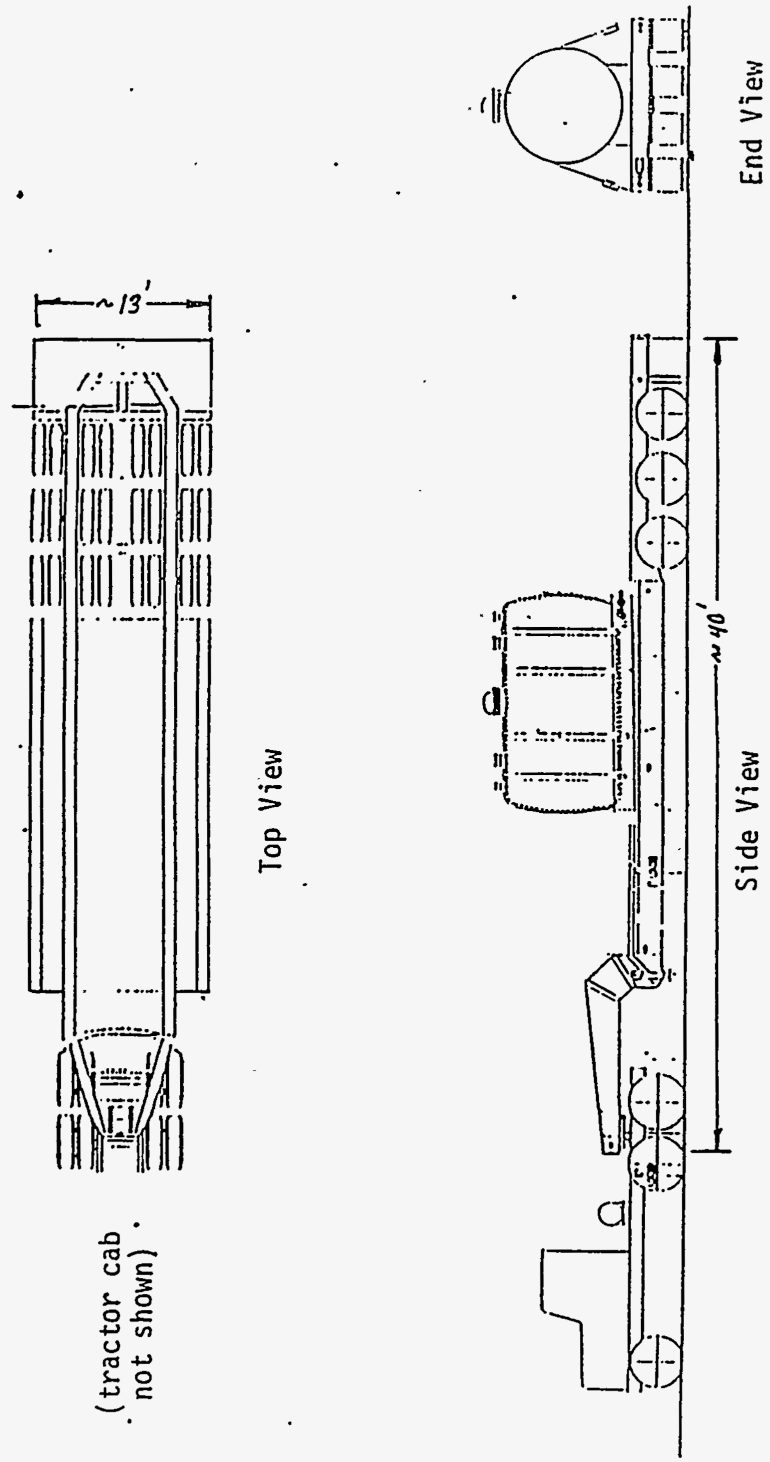


Figure 2-4. Road Layout.

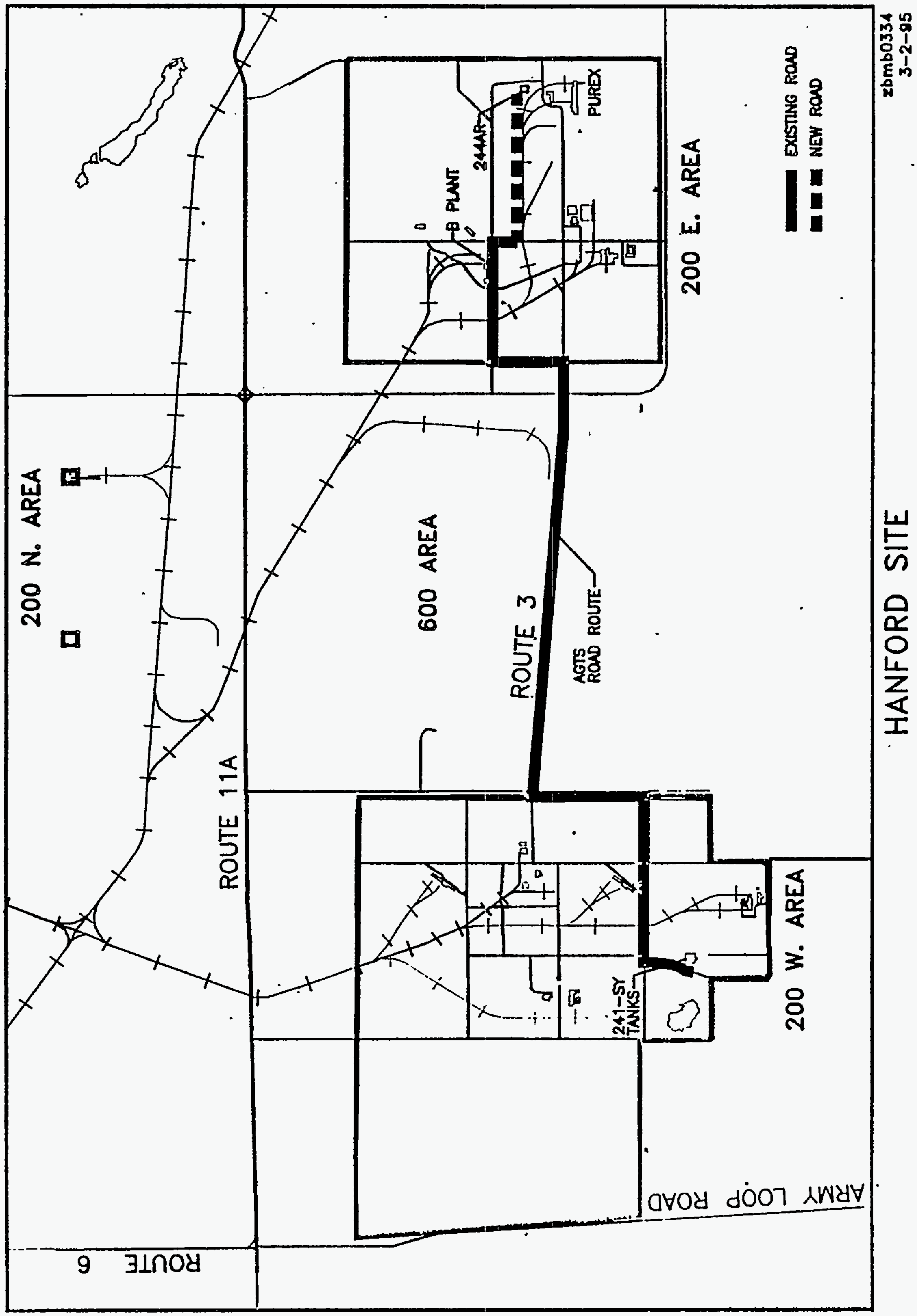


Figure 2-5. Low-Level Liquid Transporter (Requires Shielding for High-Level).

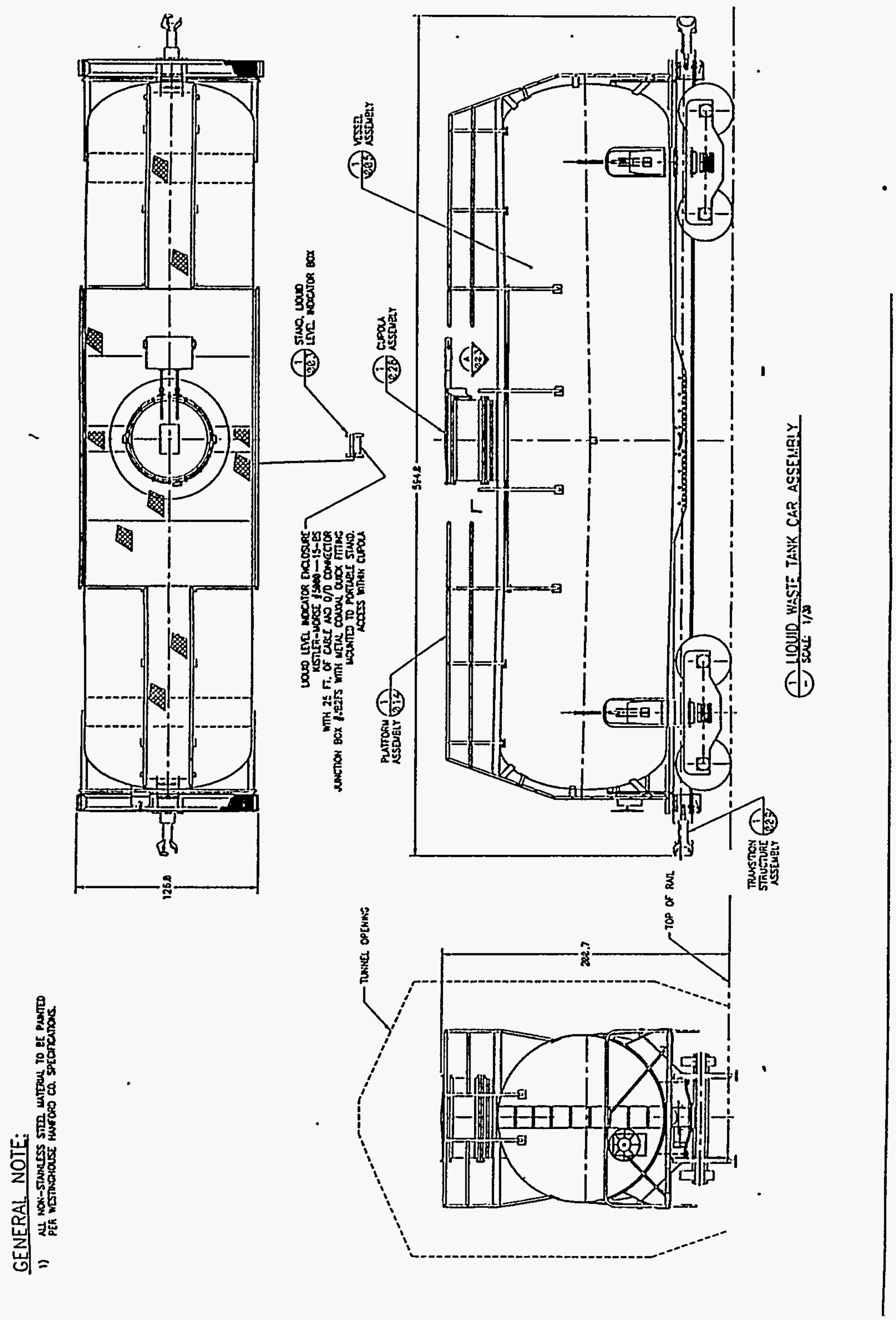
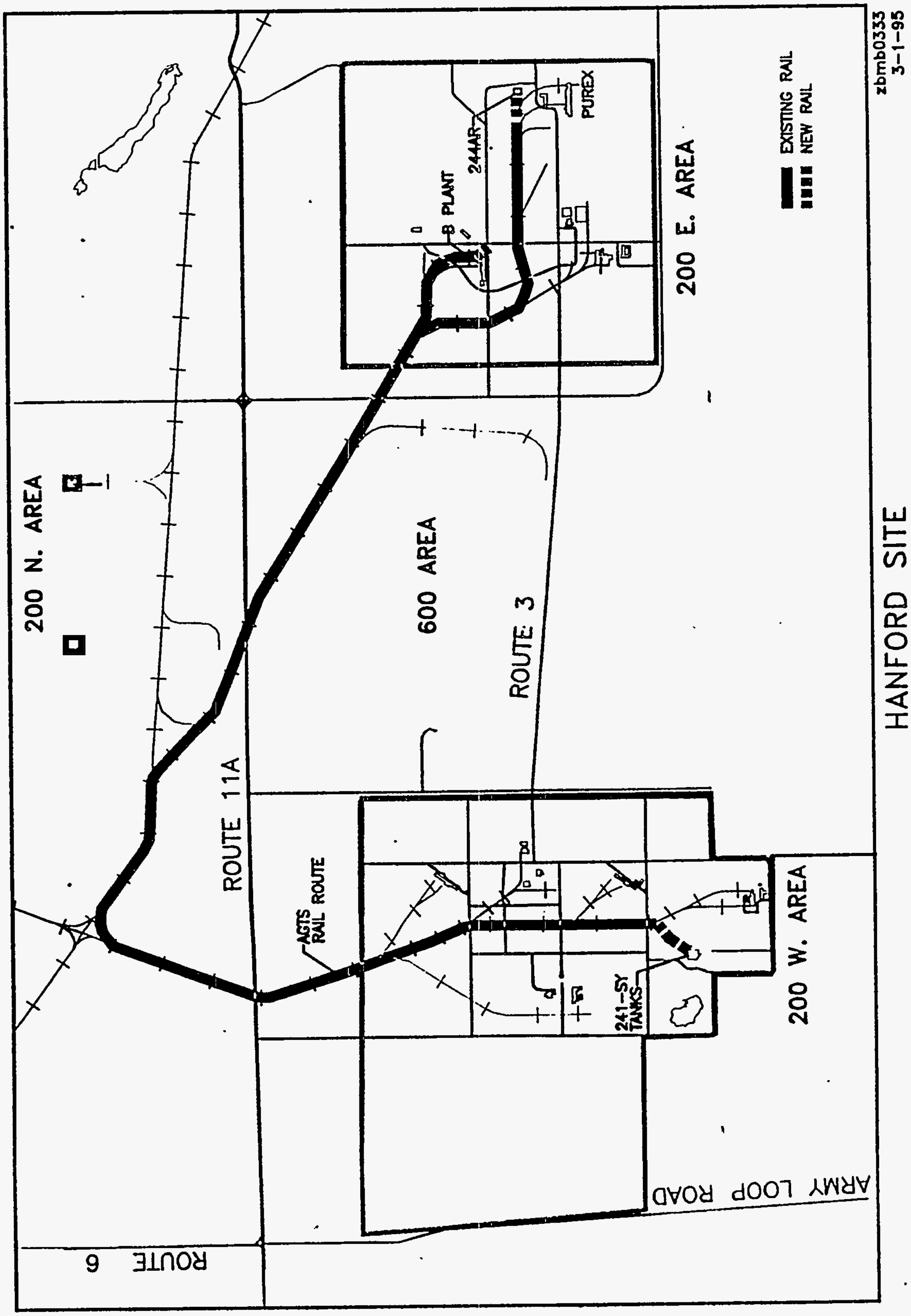
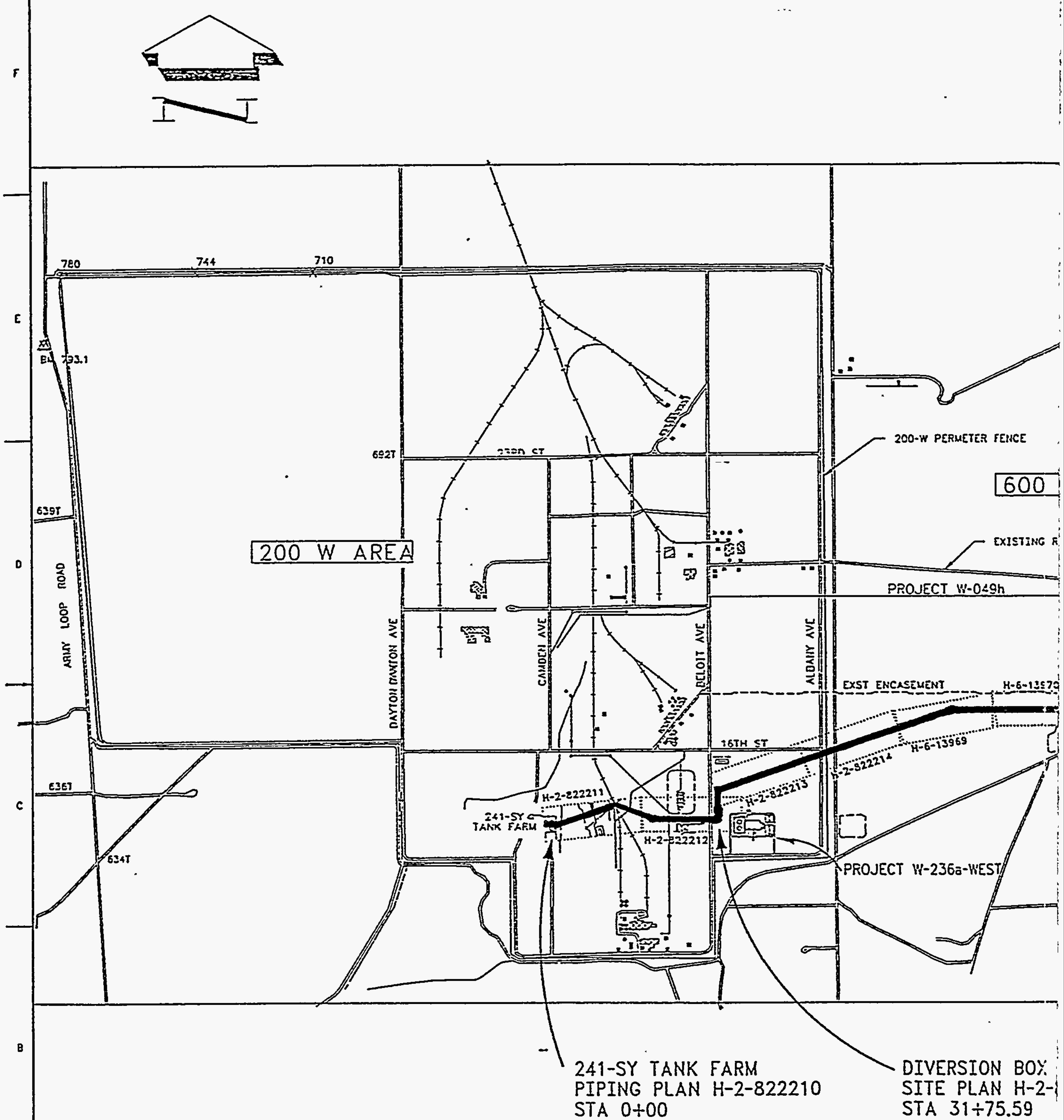


Figure 2-6. Rail Layout.





CONTROL MONUMENT	COORDINATES	
	200-WEST AREA (FEET)	WCS83S/1991 (METERS)
2W-48	N 37,199.92 W 72,800.31	N 134,801.710 E 567,707.161
2W-143	N 38,071.73 W 70,720.95	N 135,068.981 E 568,340.204

CONTROL MONUMENT	COORDINATES	
	200-EAST AREA (FEET)	WCS83S/1991 (METERS)
2E-8	N 41,809.11 W 53,951.92	N 136,221.701 E 573,447.955
HWVP-3	N 40,950.18 W 56,725.10	N 135,957.535 E 572,603.534

Figure 2-7. Buried Pipe Route.

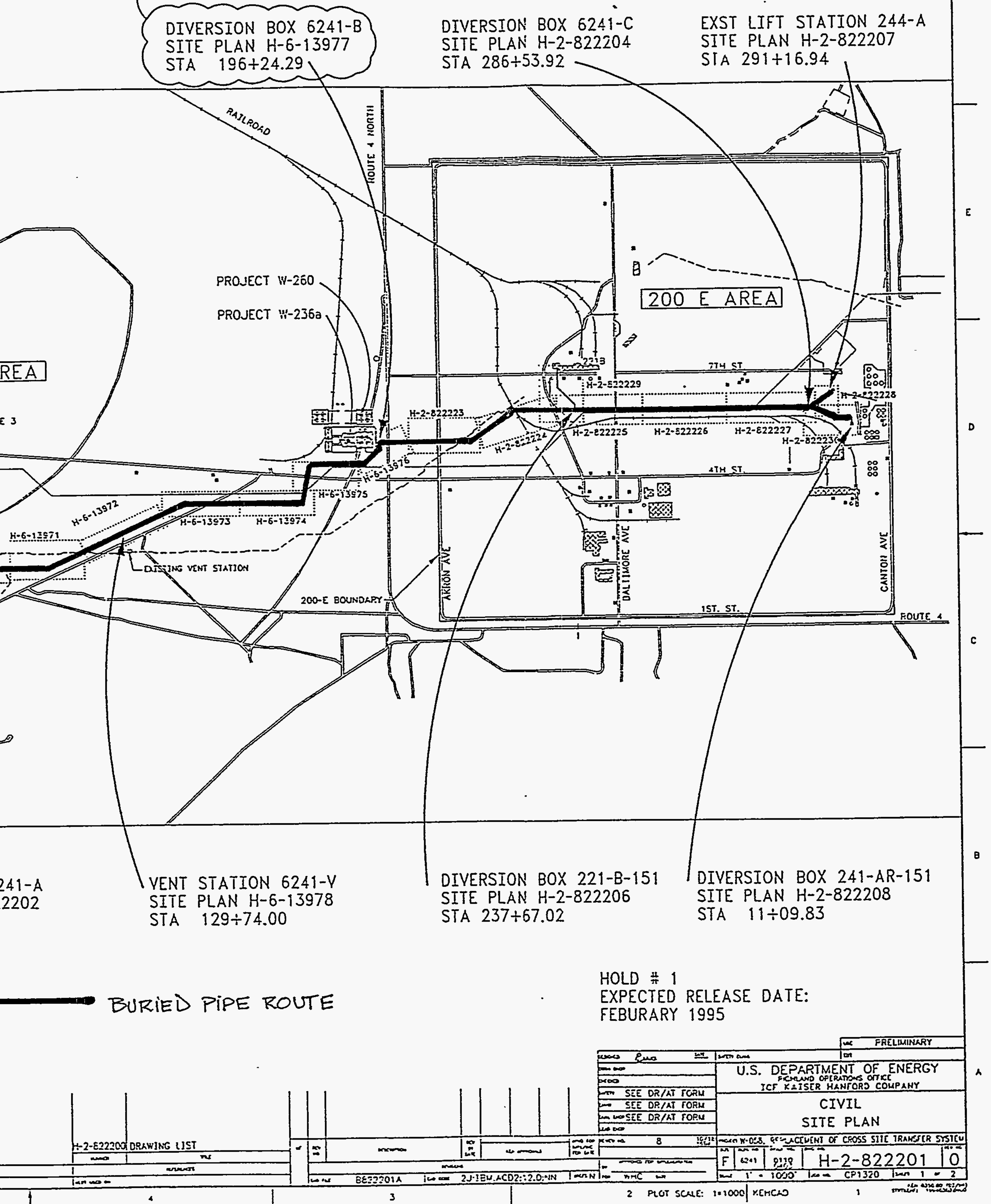


Figure 2-8. Replacement of Cross-Site Transfer System.

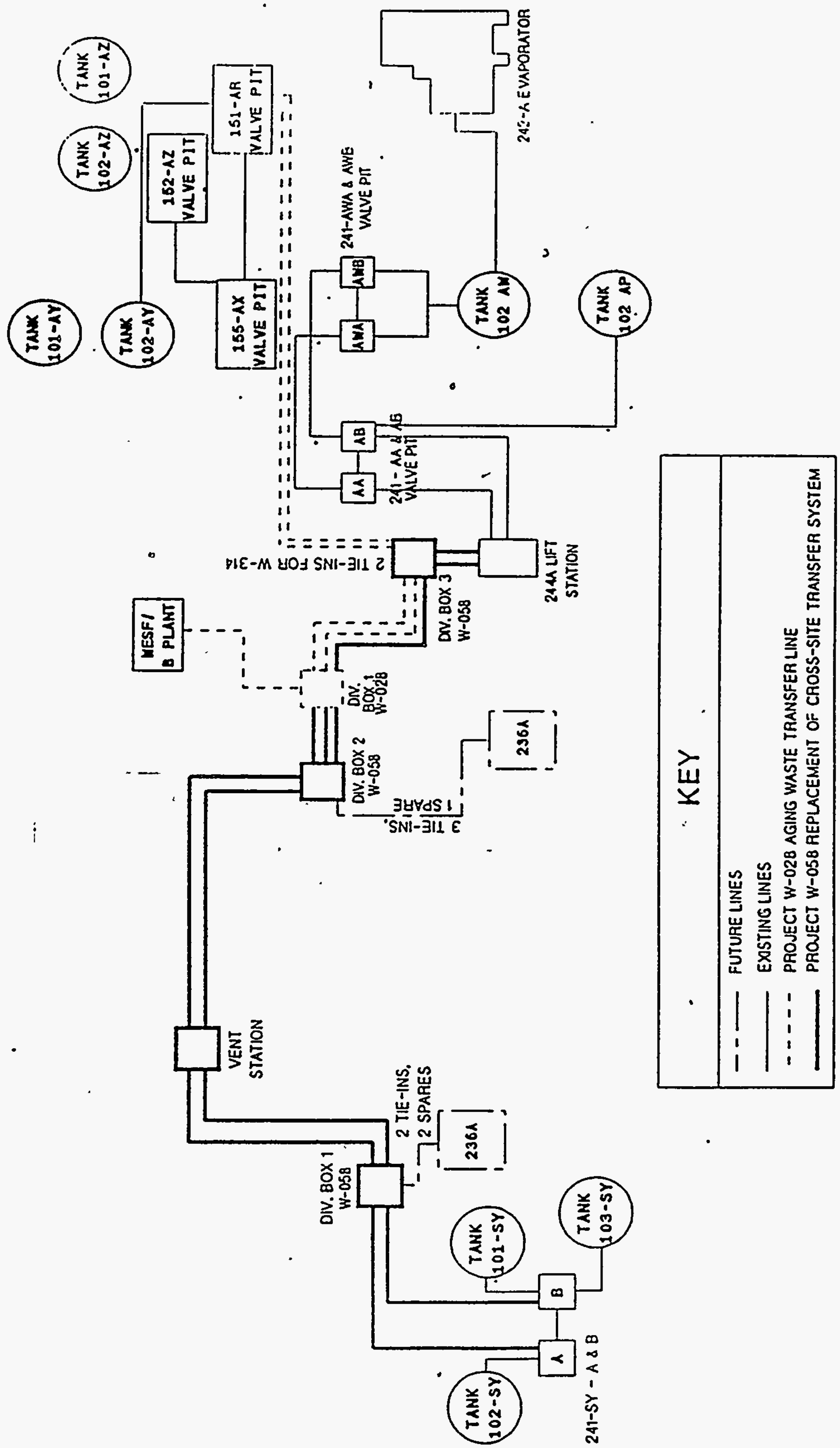
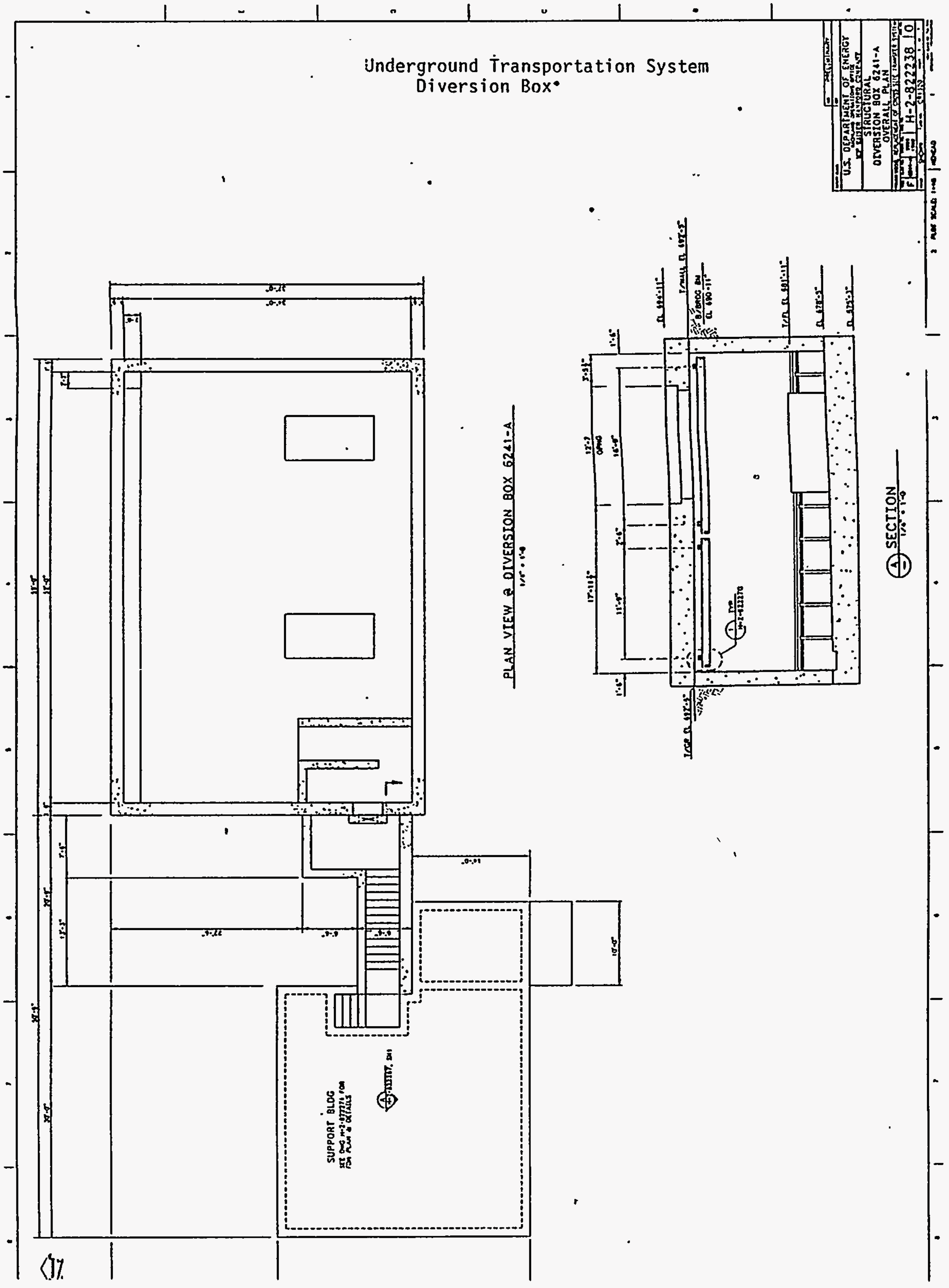


Figure 2-9. Underground Transportation System Diversion Box.



- Operation of the system is automated by using a monitor control system
- Shielded floor and flush capability for contact-handled maintenance of transfer pumps, valves, and instruments
- Portable ventilation system for maintenance
- Permanent greenhouse and instrument building.

2.2 COSTS AND COMPARISONS

The data used to develop the various costs associated with each mode of waste transport are shown later in this section. The French truck was eliminated from further analysis because its limited capacity resulted in an excessive number of trips (see Table 2-1) making it noncompetitive relative to the other modes of transport. The types of costs involved include the following:

- Project
- Operational
- Evaporation (disposal of flush water)
- Personnel exposure
- Decommissioning
- Summary.

2.2.1 Project Cost Comparison

The project cost for each transport mode is shown in Table 2-2. The project cost to go ranges from $49.2 million for the UGTS, $31.9 million for the rail tanker system, and $34.9 million for the trailer tanker system. The UGTS costs include the pipeline, diversion boxes, vent station, pumps, and leak detectors. The AGTS costs include the vehicles, load/unload stations, portion of new road, and a rail spur.

2.2.2 Operational Cost Comparison

The expenses as the result of supporting personnel to transfer liquid waste (regardless of mode) are considered as operational costs. The support personnel are typically operations, engineering, health physics, maintenance, quality assurance, safety, and others.

As shown in Tables 2-3 and 2-4, the cost of transporting radioactive liquid waste via the UGTS is $0.17/L ($0.63/gal). This compares favorably to the least expensive AGTS mode (rail tanker) of $0.30/L ($1.15/gal).

2.2.3 Evaporation Cost Comparison

After each transfer of radioactive liquid waste the transferring vehicle (regardless of mode) will require flushing. Tables 2-5 and 2-6 show the

Table 2-1. Number of Transfers/Trips--1995 to 2005.

CAPACITY (gal/transfer)	
Buried Pipe	500000
French Truck	1000
Trailer Container	5000
Rail Container	10000

ROUTE DISTANCE--ONE WAY(mile)*	SY to A Farm Comp
Buried Pipe	6.50
French Truck	6.70
Trailer Container	6.70
Rail Container	9.70

METHOD	YEAR 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	TOTAL TRANSFER/TRIP (1995-2005)	AVERAGE TRANSFER/TRIP PER YEAR
	YEARLY TRANSFERS/TRIPS(SY TANK FARM TO A FARM COMPLEX)												
200W To 200E Transfer (gal) via	1210000	1448000	1256000	2118000	1132000	709000	638000	638000	638000	1438000	1838000		
BURIED PIPE	2	3	3	4	2	1	1	1	1	3	4	26	2
FRENCH TRUCK	1210	1448	1256	2118	1132	709	638	638	638	1438	1838	13063	1188
TRAILER CONTAINER	242	290	251	424	226	142	128	128	128	288	368	2613	238
RAIL CONTAINER	121	145	126	212	113	71	64	64	64	144	184	1306	119
METHOD	ROUND-TRIP TOTAL YEARLY TRANSFER MILEAGE (mile)											TOTAL MILEAGE (mile) (1995-2005)	AVERAGE MILEAGE PER YEAR (mile)
BURIED PIPE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
FRENCH TRUCK	16214	19403	16830	28381	15169	9501	8549	8549	8549	19269	24629	175044	15913
TRAILER CONTAINER	3243	3881	3366	5676	3034	1900	1710	1710	1710	3854	4926	35009	3183
RAIL CONTAINER	2347	2809	2437	4109	2196	1375	1238	1238	1238	2790	3566	25342	2304

* Estimate Road and Rail Distances, by E. T. Trost, 01/26/95

Table 2-2. Capital Cost Comparison--1995 to 2005.

GIVEN

Pipe/Route Length Addition (mile)		
Buried Pipe:	6.5	(SY Tank Farm To 244-A-Lift Station)
Truck:	0.92	(Use 200 Area Existing Road)
Rail:	0.42	(Rail Spurs to SY and A TF Complex)
Minimum Required New Facility		
Buried Pipe (Diversion Box):	4	(DB#1, Vent Station, MWTF-East, DB#3)
Truck (Load/Unload):	1	(SY Tank Farm)
Rail(Load/Unload):	1	(SY Tank Farm)
Minimum Modified Facility		
Buried Pipe (Diversion Box):	0	
Truck (Load/Unload):	1	(204-AR)
Rail(Load/Unload):	1	(204-AR)
Pipe/Required Transportation Vehicle		
Buried Pipe (Pumps, Leak Det., etc.):	1	(Include spare capability)
Truck:	3	(1 spare)
Rail:	2	(1 spare)

COST PER UNIT

Pipe/Route Construction Cost Per Length ($/mile)		
Buried Pipe:		1478000
Truck:*		1000000
Rail:*		1000000
Facility Cost ($/facility)	**Upgrade Existing**	**New Facility**
Buried Pipe (Diversion Box):	N/A	5000000
Truck (Load/Unload):**	9000000	17500000
Rail(Load/Unload):**	9000000	17500000
Pipe/Transportation Vehicle Cost ($/each)		
Buried Pipe (Pump, Leak Det., etc.):		10014000
Truck:***		2500000
Rail:***		2500000

Method	Project Cost ($)			Total Project Cost ($)	
	Route	Facility	Vehicle/Other		
Buried Pipe ****	19214000	20000000	10014000	49228000	(Escalated 1995)
Truck	920000	26500000	7500000	34920000	(Escalated 1993)
Rail	420000	26500000	5000000	31920000	(Escalated 1993)

* Estimate Road and Rail Construction, by E. T. Trost, 01/26/95
** Pilot Plant Hot Test Facility Siting Study, by G. F. Howden, WHC-SD-WM-TA-143 Rev. 0, Table 5-2, 11/18/1993
*** W. A. Brooks provides the French truck transporter LR-56 (1000 gallons capacity) estimated cost, 02/14/95
**** Total Estimated W-058 Project Costs is $52700000. However, the Project had spent $3472000

Table 2-3. Operational Cost Comparison--1995 to 2005.

GIVEN

Est. Total Volume Of Rad. Waste To Be Transported In 200 Areas (1995–2005)

Total Volume: 13063000

COST PER UNIT

Liq. Waste Transport Operational Cost Per Volume ($/gallon)*

Buried Pipe:	0.63
Truck:	1.69
Rail:	1.69

Method	Operation Cost ($) (1995–2005)
Buried Pipe	8229690
Truck	22076470
Rail	22076470

* See Appendix A – Design Calculation "Operational Cost Comparison Bases," by D. V. Vo 2/13/95

Table 2-4. Operational Cost Comparison--1995 to 2028.

GIVEN

Est. Total Volume Of Rad. Waste To Be Transported In 200 Areas (1995-2028)
Total Volume: 200000000 **

COST PER UNIT

Liq. Waste Transport Operational Cost Per Volume ($/gallon)*

Buried Pipe:	0.63
Truck:	1.69
Rail:	1.69

Method	Operation Cost ($) (1995-2028)
Buried Pipe	126000000
Truck	338000000
Rail	338000000

* See Appendix A - Design Calculation "Operational Cost Comparison Bases," by D. V. Vo 2/13/95
** Functional Design Criteria For Project W-058, Replacement Of Cross-Site Transfer System, by W. M. Brantley, WHC-SD-W058-FDC-001, Rev. 2, 08/26/94

Table 2-5. Evaporation Cost Comparison--1995 to 2005.

GIVEN

Total Number Of Trips or Transfers (Table 2)

Buried Pipe:	26	(SY to A Farm Complex)
Truck:	2613	(SY to A Farm Complex)
Rail:	1306	(SY to A Farm Complex)

Flush Water Volume (gallon)/Transfer*

Buried Pipe:	32000
Truck:	4300
Rail:	4900

COST PER UNIT

Waste Water Evaporation Cost ($/gallon)*

Buried Pipe:	2.52
Truck:	2.52
Rail:	2.52

Flush Water Evaporation Cost ($/transfer)

Buried Pipe (1 Volume Fill and 1 Volume Flush):	80640
Truck (1 Volume Flush):	10836
Rail (1 Volume Flush):	12348

Method	Evaporation Cost ($) (flush water)
Buried Pipe	2106801
Truck	28310134
Rail	16130192

* See Appendix B -- Design Calculation "Evaporation Cost Comparison Bases," by D. V. Vo 2/10/95

Table 2-6. Evaporation Cost Comparison--1995 to 2028.

GIVEN

Total Number Of Trips or Transfers

Buried Pipe:	400 (SY to A Farm Complex)
Truck:	40000 (SY to A Farm Complex)
Rail:	20000 (SY to A Farm Complex)

Flush Water Volume (gallon)/Transfer*

Buried Pipe:	32000
Truck:	4300
Rail:	4900

COST PER UNIT

Waste Water Evaporation Cost ($/gallon)*

Buried Pipe:	2.52
Truck:	2.52
Rail:	2.52

Flush Water Evaporation Cost ($/transfer)

Buried Pipe (1 Volume Fill and 1 Volume Flush):	80640
Truck (1 Volume Flush):	10836
Rail (1 Volume Flush):	12348

Method	Evaporation Cost ($) (flush water)
Buried Pipe	32256000
Truck	433440000
Rail	246960000

* See Appendix B – Design Calculation "Evaporation Cost Comparison Bases," by D. V. Vo 2/10/95

quantity of flush water required for each mode of transport and the cost to dispose of (evaporate) the flush water. The unit cost of evaporation is the same regardless of the transport mode. The total cost for evaporation is less for the UGTS because less flush water is required in transporting 49.509 million L (13.063 million gal) of waste via UGTS than AGTS.

2.2.4 Personnel Exposure Cost Comparison

The detriment associated with radiation exposure to personnel is expressed in dollar value. The cost related to radiation exposure due to radiological survey is shown in Tables 2-7 and 2-8. The tables show that the buried pipe mode of waste transport is more cost efficient than the AGTS, because the UGTS is operated remotely via a monitor control system and it has been designed to have a very small radiation surface dose. Dollar costs are the principal factor, although the acceptability of a policy of "burning out" workers is debatable and is an issue under as low as reasonably achievable (ALARA) principles. If those costs are not included, the rail mode has a small economic advantage during the 1995 to 2005 time frame. However, when the time frame is extended to 2028 the UGTS has a large dollar advantage over the AGTS with or without the personnel replacement costs.

The UGTS and the AGTS will address ALARA considerations to minimize personnel radiation exposure. The UGTS will be designed to have a maximum surface dosage of 0.05 mrem/h and the AGTS will have sufficient shielding to limit surface dosage to 200 mrem/h. For the AGTS, a radiological smear survey is required to be performed on the cupola (inside), cupola (outside), platform (deck), underplatform, walk platform, handrails, ladder, tanker sides, tanker ends, belly/drain, coupling/knuckle, assembly and lever, hand braker, wheel truck assemblies, and wheels. Because several of the survey areas do not directly contact the tanker car surface, a radiation exposure dose versus distance calculation was done (Figure 2-10). Therefore, the selected average radiation exposure dose of 100 mrem/h at approximately 75 cm (2.5 ft) from the cask is used in this evaluation. Westinghouse Hanford Company guidelines assign a cost of $2,500/man-rem for health effects and $22,500/man-rem for replacement personnel (the cost of replacing the individual worker in the specific work force who has approached a preset limit). The replacement personnel cost is based on the average weekly wages and benefits and assumes 12 person-weeks to train each affected worker. These numbers were used in computing the costs for personnel exposure. Thus, the personnel health ($2,500/man-rem) associated cost is designated as the lower cost and the replacement personnel ($22,500/man-rem) associated cost is designated as the upper cost in the evaluation. However, it is assumed that the upper cost can be reduced to $11,250/man-rem by proper planning and managing of proposed personnel.

2.2.5 Decommissioning Cost Comparison

Regardless of the transport mode employed, decommissioning will be required. Decommissioning costs for each mode of transport are shown in Table 2-9. The costs for decommissioning of the buried pipe (UGTS) are about $17.7 million compared to $1.3 million and $2.1 million for trailer tanker

Table 2-7. Radiation Exposure Cost Comparison--1995 to 2005.

GIVEN

Total Number Of Health Physis Technician Require To Survey The Transporter *

Buried Pipe:	0	
Truck:	2	
Rail:	2	

Estimated Radiological Survey Time (hour)/Person*

Buried Pipe:	0	
Truck:	8	(survey before leaving and before unloading)
Rail:	8	(survey before leaving and before unloading)

Total Number Of Trips or Transfers (Table 2)

Buried Pipe:	26	(SY to A Farm Complex)
Truck:	2613	(SY to A Farm Complex)
Rail:	1306	(SY to A Farm Complex)

COST PER UNIT

Rad. Exposure Cost($/Person-Rem)**	Lower	Upper	Upper (Proper mgmt
Buried Pipe:	2500	22500	11250
Truck:	2500	22500	11250
Rail:	2500	22500	11250

Radiation Surface Dose (mRem/hr)*	
Buried Pipe:	0.05
Truck:	100
Rail:	100

Method	Radiation Exposure Cost ($)		
	Lower	Upper	Upper (with proper management)
Buried Pipe	0	0	0
Truck	10450400	94053600	47026800
Rail	5225200	47026800	23513400

Note: Survey time does not inlude the remaining 8 hours when the transporter is not full (i.e. after unloading and before loading of liquid waste)

* See Appendix C – Design Calculation "Radiation Exposure Cost Comparison Bases," by D. V. Vo 2/10/95

** Cost Benefit Analysis at Westinghouse Hanford Company, by R. L. Brown and C. J. Stephân, WHC-SA-1533-FP, April 1992.

Table 2-8. Radiation Exposure Cost Comparison--1995 to 2028.

GIVEN

Total Number Of Health Physis Technician Require To Survey The Transporter *

Buried Pipe:	0
Truck:	2
Rail:	2

Estimated Radiological Survey Time (hour)/Person*

Buried Pipe:	0
Truck:	8 (survey before leaving and before unloading)
Rail:	8 (survey before leaving and before unloading)

Total Number Of Trips or Transfers (Table 2)

Buried Pipe:	400 (SY to A Farm Complex)
Truck:	40000 (SY to A Farm Complex)
Rail:	20000 (SY to A Farm Complex)

COST PER UNIT

Rad. Exposure Cost($/Person-Rem)*	**Lower**	**Upper**	(Proper mgmt **Upper**
Buried Pipe:	2500	22500	11250
Truck:	2500	22500	11250
Rail:	2500	22500	11250

Radiation Surface Dose (mRem/hr)*

Buried Pipe:	0.05
Truck:	100
Rail:	100

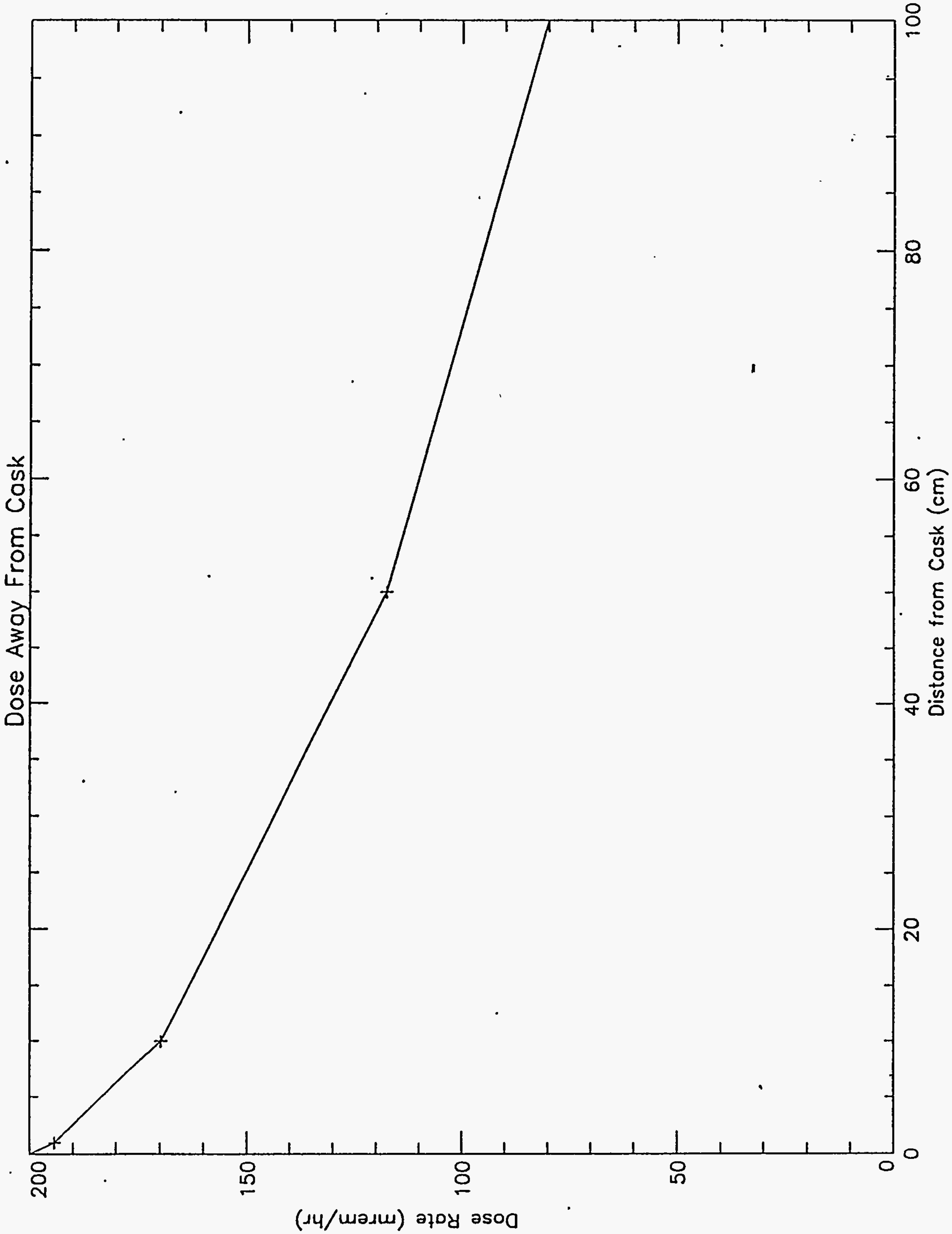
Method	Radiation Exposure Cost ($)		
	Lower	Upper	Upper (with proper management)
Buried Pipe	0	0	0
Truck	160000000	1440000000	720000000
Rail	80000000	720000000	360000000

Note: Survey time does not inlude the remaining 8 hours when the transporter is not full (i.e. after unloading and before loading of liquid waste)

* See Appendix C – Design Calculation "Radiation Exposure Cost Comparison Bases," by D. V. Vo 2/10/95

** Cost Benefit Analysis at Westinghouse Hanford Company, by R. L. Brown and C. J. Stephan, WHC-SA-1533-FP, April 1992.

Figure 2-10. Aboveground Transportation System--Radiological Surface Dose versus Distance Away from the Cask.



cars and rail tanker cars, respectively. As stated in Section 1.2, the D&D cost of the load/unload facilities (AGTS) as compared to the diversion boxes (UGTS) was assumed to be equal.

2.2.6 Summary Cost Comparison

The UGTS (buried pipe) has the lowest overall total cost for near term (1995 to 2005) and long term (1995 to 2028) as shown in Table 2-10. The UGTS higher initial project cost and final D&D costs have been offset by the lower operational, evaporation, and radiation exposure costs which resulted in the lowest overall total cost.

For the near-term (1995 to 2005) waste transfer, the total lower estimated cost for buried pipe (UGTS) is 8% less than the rail tanker (AGTS) method. However, the percentage cost differential increases to 40% for near-term and upper radiation exposure, 69% for long-term and lower radiation exposure, and 84% for long-term and upper radiation exposure as shown in Table 2-10. NOTE: The rail tanker system (AGTS) upper radiation exposure percentage is a higher cost than the buried pipe (UGTS) and is reduced from 40% to 25% for near term and from 84% to 78% for long term because of anticipated proper planning and managing of exposed personnel. Even though the rail tanker car method appeared to have the next lowest overall total cost for near term (i.e., approximately 49.509 million L [13.063 million gal] or less), the high radiation exposure to tank farm workers for routine operation is a concern for the long term.

The AGTS (trailer tanker car) has the highest total cost for near term (1995 to 2005) and long term (1995 to 2028) as shown in Table 2-10.

For the total Hanford Site cleanup (1995 to 2028), the UGTS is considerably less expensive (65%) than any AGTS even without taking credit for radiation exposure cost as shown in Table 2-10.

Table 2-9. Decommissioning Cost Comparison--1995 to 2005.

GIVEN

Total Estimated Lenght Of Process Pipe (ft)*

Buried Pipe:	64500 (All spare)
Truck:	3973 (1 spare)
Rail:	3972 (1 spare)

Required Transportation Vehical

Buried Pipe:	0
Truck:	3 (7' x 18')
Rail:	2 (12' x 44')

COST PER UNIT

Solid Waste Disposal Rate (FY 95) for Radiation Mix Waste – ($/ft3)*

Buried Pipe:	173
Truck:	173
Rail:	173

Buried Pipe Remove and Package Cost ($/ft)*

Buried Pipe:	154
Truck:	154
Rail:	154

Method	Facility D & D Cost ($)	Pipe Remove Cost ($)	Pipe Disposal Cost ($)	Vehical Disposal Cost ($)	Summary D & D Cost ($)
Buried Pipe	Same **	9933000	2190965	0	12123965
Truck	Same **	611842	134957	359522	1106321
Rail	Same **	611688	134923	1721792	2468403

* See Appendix D – Design Calculation "Decommissioning Cost Comparison Bases," by D. V. Vo 2/10/95
** The facility disposal cost is ASSUMED to be equal

Table 2-10. Summary Cost Comparison.

SUMMARY COST COMPARISON (1995 - 2005)

Method	Project Cost ($)	Operation Cost ($)	Evaporation Cost ($) (flush water)	Radiation Exposure ($) Lower	Radiation Exposure ($) Upper	Radiation Exposure ($) Upper (with proper mgmt)	Summary D&D Cost ($)*	TOTAL ESTIMATED COST ($) Lower	TOTAL ESTIMATED COST ($) Upper	TOTAL ESTIMATED COST ($) Upper (with proper mgmt)
Buried Pipe *	49228000	8229690	2106801	0	0	0	12123965	71688455	71688455	71688455
Truck	34920000	22076470	28310134	10450400	94053600	47026800	1106321	96863324	180466524	133439724
Rail	31920000	22076470	16130192	5225200	47026800	23513400	2468403	77820265	119621865	96108465

Method	TOTAL COST DEVIATION PERCENTAGE (%) Lower	Upper	Upper (with proper mgmt)
Buried Pipe	0	0	0
Truck	35	152	86
Rail	9	67	34

SUMMARY COST COMPARISON (1995 - 2028)

Method	Project Cost ($)	Operation Cost ($)	Evaporation Cost ($) (flush water)	Radiation Exposure ($) Lower	Radiation Exposure ($) Upper	Radiation Exposure ($) Upper (with proper mgmt)	Summary D&D Cost ($)*	TOTAL ESTIMATED COST ($) Lower	TOTAL ESTIMATED COST ($) Upper	TOTAL ESTIMATED COST ($) Upper (with proper mgmt)
Buried Pipe *	49228000	126000000	32256000	0	0	0	12123965	219607965	219607965	219607965
Truck	34920000	338000000	433440000	160000000	1440000000	720000000	1106321	967466321	2247466321	1527466321
Rail	31920000	338000000	246960000	80000000	720000000	360000000	2468403	699348403	1339348403	979348403

Method	TOTAL COST DEVIATION PERCENTAGE (%) Lower	Upper	Upper (with proper mgmt)
Buried Pipe	0	0	0
Truck	341	923	596
Rail	218	510	346

* Decommision cost does not include the diversion box or loading/unloading facilities

3.0 CONCLUSIONS

The AGTS versus UGTS evaluation has resulted in the following specific and overall conclusions.

3.1 SPECIFIC CONCLUSIONS

1. A total of 13,063 trips (Table 2-1) are required to transfer the 49.509 million L (13.063 million gal) of radioactive liquid waste in 11 years using the 3,800-L (1,000-gal) capacity French truck. Based on the number of required trips, it is impractical and uneconomical to use the French truck system to routinely transport radioactive liquid waste from the 200 West Area to the 200 East Area and within the 200 East Area. Thus, the buried pipe system, trailer tanker system, and rail tanker system were the three methods selected for further evaluation.

2. The project (Table 2-2) and D&D costs (Table 2-9) for AGTS and UGTS are fixed (that is, independent from the estimated total transfer volume). The UGTS requires higher project cost to go than the AGTS rail tanker system and trailer tanker system costs by 35% and 29%, respectively. The final D&D costs for the UGTS are 79% and 91% greater than the AGTS rail and trailer, respectively. NOTE: The initial project costs and final D&D costs are the same to transfer either 3.8 L (1 gal) or 757.1 million L (200 million gal).

3. The UGTS requires much less personnel support relative to the AGTS for the same capacities. Therefore, the UGTS buried pipe operational costs are 63% (for the near term) and 68% (for the long term) less than the AGTS rail tanker system and trailer tanker system, respectively. The operational cost details are shown in Tables 2-3 and 2-4.

4. The UGTS generates the least amount of secondary waste (flush water) in transferring of radioactive liquid waste (near term - 49.509 million L [13.063 million gal] and long term - 757.1 million L [200 million gal]) from the 200 West Area to the 200 East Area and within the 200 East Area. Because of limited available double-shell tank space, generation of the radioactive liquid waste must be minimized. The evaporation cost comparison is shown in Tables 2-5 and 2-6. The UGTS buried pipe evaporation costs are approximately 8 times and 13 times less than the AGTS rail tanker system and trailer tank system for near and long term.

5. During routine transfer, there is essentially no personnel radiation exposure (ALARA) associated with the UGTS (buried pipe), whereas the AGTS total estimated radiation exposure is 2,090 man-rem (rail tanker car) and 4,180 man-rem (trailer tanker car) for near term as shown in Table 2-7. Because the Westinghouse Hanford Company Radiological Administrative Control Level is set at 5 rem/year per radiological worker (i.e., whole body) (WHC 1994), the estimated

radiation exposure equates to a yearly average number of "burned out" personnel of 38 (rail tanker car) and 76 (trailer tanker car).

3.2 OVERALL CONCLUSIONS

1. The UGTS (buried pipe) has the lowest overall total cost for near term (1995 to 2005) and long term (1995 to 2028) as shown in Table 2-10. The UGTS higher initial project cost and final D&D costs have been offset by the least operational, evaporation, and radiation exposure costs which resulted in the lowest overall total cost.

2. The rail trailer system method (AGTS) appeared to have the next lowest overall total cost. However, the high radiation exposure to tank farm workers for routine operation is a concern for the long term and accident administrative control during transport of high-level radioactive waste.

3. The AGTS (trailer tanker car) has the highest total cost for near term (1995 to 2005) and long term (1995 to 2028) as shown in Table 2-10.

4. For the total Hanford Site cleanup (1995 to 2028), the UGTS is considerably less expensive (65%) than any AGTS even without taking credit for radiation exposure cost as shown in Table 2-10.

5. The risk assessment for the cross-site AGTS (Howden 1993) limited annual mileage for transporting radioactive sludge (without dilution) to <400 km (250 miles).* The annual mileage limitation was set so that the accidental release frequency is considered incredible (i.e., $<10^{-6}$/yr) without imposing administrative controls. The lowest demanded year for transport of liquid waste is 2003. The estimated total yearly (2003) transfer distance (roundtrip) is 1,019 km (637 miles) for rail tanker car and 2,782 km (1,739 miles) for trailer tanker car (Table 2-1). Rail tanker car and trailer tanker car roundtrips required travel distances that will have exceeded the yearly allowable AGTS limit of 400 km (250 miles). Therefore, other stringent administrative controls (fire trailer escort, barricade road crossing, etc.) are required to increase the allowable mileage which will increase the operational cost.

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*Note that the criteria for the Howden document were preliminary, and have since been formally documented in WHC-SD-TP-RPT-001 (Mercado 1994). A new risk assessment would be needed as part of any formal safety documentation (i.e., safety analysis report for packaging) for a selected AGTS. Therefore, actual mileage limits may be different than those presented here.

4.0 TECHNICAL UNCERTAINTIES

4.1 UGTS

The buried pipe (UGTS) design is approximately 60% complete. The Preliminary Safety Analysis Report (Kidder 1993) revision and a system engineer design requirement document are being prepared. Also, the environmental documentation for the UGTS is underway. The integrated Project W-058 is supporting the Tri-Party Agreement Operational Milestone M-43-07C of February 1998 as well as other programmatic milestones. Thus, there is no technical uncertainty associated with the UGTS.

4.2 AGTS

The following technical uncertainties are associated with the AGTS. The preparation of the documents as described in Section 4.1 are required by DOE Order 4700.1, *Project Management System* (DOE 1987). However, these documents have not been prepared for the AGTS. The estimated cost associated with the AGTS Conceptual Design Report would be $200,000 to $500,000 and it would take about a year to complete. The estimated project cost for AGTS was based on preconceptual ideas. Conceptual Design, Title I (Preliminary Design), Title II (Definitive Design), and construction activities have not been started to meet the Tri-Party Agreement Operational milestone. This is the major uncertainty. Other technical issues, such as radiation exposure, additional accident administrative control during transport, a shielded 37,850-L (10,000-gal) rail tanker car exceeding the rail truck loading requirements, remote operations (connect/disconnect), seismically qualified equipment, etc., all require resolution.

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5.0 REFERENCES

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Toth, A. G., 1994, *Double Shell Tank Inventory and Available Space* (Memorandum to T. R. Sheridan, U.S. Department of Energy-Headquarters, December 28), U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Trost, E. T., 1995, Personal Communication, Westinghouse Hanford Company, Richland, Washington.

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APPENDIX A

OPERATIONAL COST COMPARISON BASES

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DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 1 of ______

(4) Building ______ (5) Rev. ______ (6) Job No. ______

(7) Subject OPERATIONAL COST COMPARISON

(8) Originator [illegible] Date [illegible]

(9) Checker EDWARD H EPPELSON Date ______

(10) ESTIMATED LIQUID WASTE TRANSPORT OPERATIONAL COST PER VOLUME.

ASSUMPTIONS: 1) THE COST IS BASED ON ORGANIZATION SUPPORTS FOR EACH TRANSFER

ESTIMATED OPERATIONAL COST PER VOLUME = $ SUPPORT COST / TRANSFER CAPACITY

A) FOR BURIED PIPING

BASED ON THE PROVIDED FAX (BELOW) FROM MIKE SUTEY, CROSS-SITE TRANSFER COG. ENGR.,

Craft (Man-Days)

	Eng/Planner	Oper	HPT	Rigger	Crane	Drivers	QC	RPTs	PICs	Elec	Pipe	Insu	Totals
WTF Transfer Procedure Development	105												105
WTF Prepartory Transfers	80	80											160
WFT Prep Repairs/Upgrades		4	3							12	2		21
WTF Prep Pressure Test		120	50	60	20	40	20	20	20	20	20	30	420
Cross-Site Transfer RR	20												20
Sampling	30	12	3					3	3		6		57
Cross-Site Transfer	15	180	75	90	30	60	30	30	30	30	30	30	630
													0
Totals	250	396	131	150	50	100	50	53	53	62	58	60	1413
10% Contingency	25	40	13	15	5	10	5	5	5	6	6	6	141.3
Augmented Total	275	436	144	165	55	110	55	58	58	68	64	66	1554

AND 1 MAN-DAY EQUIVALENT TO 8 MAN-HOURS. THE EXEMPT RATE IS $35/hr AS INDICATED IN PAGE 5.

ESTIMATED OPERATIONAL COST FOR BURIED PIPING = [630 man-day × 10% cont. × 8 hrs/day × $35/hrs] / 400000 gal

= $0.49 /gallons ←

HOWEVER, THE ABOVE GROUND TRANSFER OF RAD. LIQ. VALUE ENGR. STUDY (Pg 4) by HENG ANALYSIS GROUP ON 03/11/1994 WAS REFERENCED AN ESTIMATED COST OF **$0.63/gallons** ←

BD-6400-060.1 (12/87)

DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 2 of ______

(4) Building ______ (5) Rev. ______ (6) Job No. ______

(7) Subject OPERATIONAL COST COMPARISON

(8) Originator Douglas V. Vo Date 02/13/95

(9) Checker Edward M. Epperson Date ______

(10)

B/ FOR TRUCK TRANSPORT

BASED ON THE PROVIDED CC:MAIL BELOW.

[10] From: Michelle D Rollison at ~WHC168 12/7/94 1:16PM (1882 bytes: 40 ln)
To: Larry D Goodwin at ~WHC169
Subject: SHIPPING COSTS FOR 219-S TO 204-AR SHIPMENTS
------------------------------ Message Contents ------------------------------

Text item 1: Text_1

Enserch Environmental - Please forward to Mike Hoxie Thanks.

Here are the personnel costs for the subject shipments and does not include long term storage or equipment costs:

		hour (Bargaining vs exempt)	
o	Lab Analyses	24B	$750
o	Calculations	24E	$847
o	Operators at 219-S	24B	$750
o	Pipefitters	4B	$125
o	Teamsters	8B	$250
o	204-Ar Personnel	64B	$2000
o	204-Ar Personnel	32E	$1130
o	Millwright	4B	$125
o	Cog Engineer	24E	$847
o	HPT	16B	$500
o	Haz Material Control	8B	$250
o	Packaging & Transport	4E	$141
	Subtotal	236 hrs [illegible]	$7715
	10% Contingency		$ 770
	Total		$8485

Bargaining = B @ $31.2[illegible]/hr; Exempt = E @ $[illegible]/hr } Telephone conversation with Michelle Rollison on 03/[illegible]/95 @ [illegible] AM

These costs are approximations. If the road has to be barricaded the cost per shipment goes up significantly (~$3000). Call if you have any questions.

Michelle,

Let us assume that the Wye and Yakima Barricades come down and shipments cost $11,500 each. The labs portion of the underground line to tank farms is @ $2,000,000. Let's also assume ten shipments a year (more than likely a high number). The line will pay for itself around April 1, 2013.

PF

ESTIMATED OPERATIONAL COST FOR TRUCK = $8485 / 5000 mi

= $1.69 / gallon ←

NOTE: The above estimated volume is within the range of $1.40/gal to $2.00/gal as listed in the MENG value Engr. report (Page 4)

DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 3 of ______
(4) Building ______ (5) Rev. ______ (6) Job No. ______
(7) Subject OPERATIONAL COST COMPARISON
(8) Originator Douglas V. Vo Date 02/13/95
(9) Checker Edward E. Edderson Date ______

(10)

C/ FOR RAIL TRANSPORT

BASED ON THE PROVIDED CC:MAIL BELOW.

[65] From: Leonard T (TY) Blackford at ~WHC229 2/13/95 3:33PM (1118 bytes: 23 ln
)
To: Douglas V (Doug) Vo at ~KEH16
cc: Paul J Crane
Subject: RAILCAR COSTS FOR TURNARAOUND
------------------------------ Message Contents ------------------------------

Doug;

Sorry for the delay but had trouble relocating data.

The following is a cost estimate for railcar turnaround at 221-T. This estimate was developed last year as part of a ECCEL item submitted when we received our TSD permit.

Cost are for one time turnaround of one railcar:

Bargaining unit labor: $3879 (192hrs)
Health Physics Labor: $1607 (84 hrs)
Exempt Labor/Support: $2604 (108 hrs)
Laboratory Analysis : $15,000 (based on past costs)

Total costs per transfer: $23,090

Approximately 2 transfers per year at this time.

Let me know if I can be of any further assistance:

L. Ty Blackford
Manager/ T Plant Engineering

ESTIMATED OPERATIONAL COST FOR RAIL = $23,010 / 10,000 gallons
= $2.30 / gallon

NOTE: THE ESTIMATED OPERATIONAL COST RANGE AS SHOWN IN THE MENG VALUE ENGR. REPORT (Pg 4) IS $0.74/gal TO $1.11/gal. SINCE THE CALCULATED COST ABOVE IS MORE ACCURATE ~~IT WILL BE USED IN THE EVALUATION~~ BUT OUTSIDE OF THE MENG VALUE ENGR ESTIMATED RANGE, THE ESTIMATED RAIL OPERATIONAL COST IS ASSUMED TO BE THE SAME AS TRUCK ($1.69/gallon)

SD-6400 060 (12.87)

DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 4 of ______

(4) Building ______ (5) Rev. ______ (6) Job No. ______

(7) Subject OPERATIONAL COST COMPARISON

(8) Originator [illegible] Date 02/13/95

(9) Checker [illegible] Date ______

(10) FOR COMPARISON, BELOW IS THE LISTED OPERATIONAL COST PER VOLUME.

WESTINGHOUSE HANFORD COMPANY
ABOVE GROUND TRANSFER OF RADIOACTIVE LIQUIDS
VALUE ENGINEERING STUDY

TRANSPORT LIQUIDS COST SUMMARY ATTACHMENT II

TRANSPORT LIQUIDS COST SUMMARY									
OPERATIONAL COSTS						LOW LEV			PSRS
			25 mi	10 mi	TANK	TANK			PILOT
			RAIL	RAIL	TRUCK	TRUCK	CASK	PIPE	CASK
FUNCTION		GAL:	19000	19000	5000	5000	1000	1500000	7
LOAD									
PACKAGE LIQUID			$ 2000	2000	3000	1500	1500	200000	6000
MOUNT CARRIAGE			NA	NA	NA	NA	500	incl abv	Incl abv
MOVE									
MOVE CARRIAGE		(SECURITY	3000	3000	3000		3000	incl abv	3000
		($ per hr)	1000	1000	250	100	250		250
		HRS	14	10	4	4	4		4
		TOT HRLY	14000	10000	1000	400	1000	NA	1000
UNLOAD									
UNLOAD CARRIAGE			NA	NA	NA	NA	200	incl abv	Incl abv
EMPTY CONTAINER			2000	2000	3000	1500	2000	incl abv	2000
CLEAN CONTAINER			incl abv	incl abv	incl	incl abv	incl abv	incl abv	1200
RETURN									
MOUNT CARRIAGE			NA	NA	NA	NA	neg	NA	neg
MOVE CARRIAGE			NA	NA	NA	NA	1000	NA	1000
UNLOAD CARRIAGE			NA	NA	NA	NA	neg	NA	neg
MAINT. CONTAINER			incl abv	incl abv	incl abv	incl abv	5000	750000	7000
TOT per shipment		south of V	21000	17000	10000	3400	14200	950000	21200
		north of w	18000	14000	7000	3400	11200	950000	18200
$ per gal		south of w	$1.11	$0.89	$2.00	$0.68	$14.20	$0.63	$3,028.57
		north of w	$0.95	$0.74	$1.40	$0.68	$11.20	$0.63	$2,600.00
		at 3000gd	$7.00	$5.67					

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MENG
ANALYSIS GROUP
VALUE ENGINEERING • CONSTRUCTION RESEARCH

BD-6400-060.1 (12/87)

DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 5 of ____
(4) Building ______ (5) Rev. ______ (6) Job No. ______
(7) Subject OPERATIONAL COST COMPARISON
(8) Originator DOUGLAS V. VO Date 07/17/95
(9) Checker EDWARD M. EPPERSON Date ______

(10)

D/ OPERATIONAL COST EXAMPLE CALCULATION

OPERATIONAL COST ($) = (TOTAL VOLUME) (OPERATIONAL UNIT COST PER VOLUME)
(gallons) ($/gallon)

BD-6400-060.1 (12/87)

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APPENDIX B

EVAPORATION COST COMPARISON BASES

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DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 1 of ______

(4) Building ______ (5) Rev. ______ (6) Job No. ______

(7) Subject EVAPORATION COST COMPARISON [illegible]

(8) Originator DOUGLAS V. VO Date 2/10/95

(9) Checker EDWARD M. EPPERSON Date ______

(10) References: 1) CC:mail message from Brian Tucker to Douglas Vo

2) FINANCIAL DATA SYSTEM, Report FDS 202 M00, 12/29/94

Ⓘ ESTIMATED WASTE WATER EVAPORATION COST PER VOLUME ($ / GALLON)

A/ THE EVAPORATION COST PER VOLUME IS BETWEEN $3.21/gal to $ 6.21/gal. AS DESCRIBED IN Reference 1 below.

```
[58] From: Brian J Tucker at ~WHC82 2/1/95 3:09PM (1132 bytes: 23 ln)
To: Douglas V (Doug) Vo at ~KEH16
cc: Brian J Tucker
Subject: Evaporator Cost Analysis
------------------------------- Message Contents ---------------------
          Doug,

          As we discussed over the phone this afternoon, I have
          estimated the cost per gallon to process waste through the
          242-A Evaporator using current and projected budgets, and
          campaign waste volumes.  The FY 96 waste volume is a
          somewhat reliable estimate provided by Tank Farms
          Engineering.  The FY 97, 98, and 99 waste volumes are pure
          estimates.

          1N1A budget/Volume treated = Cost per gallon

          FY 95: $12.85M/2.035 M gallons = $6.31

          FY 96: $12.85M/3 M gallons = $4.28

          Cost per gallon in FY 97, 98, and 99 will be $3.21 assuming
          4 M gallons processed per year and annual budgets of
          $12.85M.

          I hope this is helpful.

                                        Brian Tucker
```


BD-6400-060.1 (12/87)

DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 2 of ______
(4) Building ______ (5) Rev. ______ (6) Job No. ______
(7) Subject EVAPORATION COST COMPARISON BASES
(8) Originator DOUGLAS V. VO Date 2/1/95
(9) Checker EDWARD M. EPPERSON Date ______

(10) B/ RE-ESTIMATE THE WASTE WATER EVAPORATION COST

- THERE ARE TWO CAMPAIGNS PLANNED IN FY 1995. THE FIRST CAMPAIGN WAS DONE ON 11/94 WITH THE TOTAL EVAPORATE VOLUMES OF 2.79 GALLONS AND THE NEXT CAMPAIGN IS SCHEDULED FOR 06/95 WITH A TARGET EVAPORATION VOLUME OF 2.04 GALLONS. PAGE 3 IS THE DETAIL CC:MAIL MESSAGE FROM THE 242-A EVAPORATOR PROCESS ENGINEER (ELVIS LE).
- EXPECTED FY 1995 FUNDING FOR THE 242-A EVAPORATOR IS $12,174,000

FDSP202M00 Financial Data System 02/02/1995 23:43:09
Data as of: 02/02/1995 Activity / / Page: 46

		CM BUDGET	CM ACTUALS	CM VARIANCE	FYTD BUDGET	FYTD ACTUALS	FYTD VARIANCE	CURRENT FY BAC	EXPECTED FY FUNDS
1N1A	242-A/AP&AW TANK FAR HR	19,803	15,617	4,186	73,428	56,051	17,377	224,728	---
	ST	117.2	89.8	27.4	122.5	91.0	31.5	119.9	---
	$	1,201.5	1,003.8	197.7	4,479.9	3,277.4	1,202.6	13,433.9	12,174.0
	GA/CSP	182.7	165.5	17.2	744.4	569.4	175.0	2,115.5	---
	TOT $	1,384.2	1,169.3	214.9	5,224.3	3,846.7	1,377.6	15,549.4	12,174.0

∴ RE-ESTIMATED EVAPORATION COST ($) = $12,174,000 / 4,830,000 gallons

ESTIMATED EVAPORATION COST ($) = **$2.52/gallons** ←

BD-6400-060 1 (12/87)

DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 3 of ____
(4) Building ______ (5) Rev. ______ (6) Job No. ______
(7) Subject EVAPORATION COST COMPARISON BASES
(8) Originator DOUGLAS V. VO Date 2/10/95
(9) Checker EDWARD M. EDDERSON Date ______

(10) BELOW IS THE ACTUAL WASTE VOLUME REDUCTION INFORMATION FOR FY 94 & 95.

[70] From: Elvis Q Le at ~WHC338 2/9/95 12:41PM (1793 bytes: 33 ln)
To: Douglas V (Doug) Vo at ~KEH16
cc: Elvis Q Le
Subject: Evaporator Campaigns 94-95

------------------------------ Message Contents ------------------------------

Per your request, I am writting to summarize our ealier conversation regarding to Evaporator Campaigns 94-95.

Campaign 94-1 took place between April 15 and June 14, 1994. From an available 2.87 million gallons of dilute waste contained in 102-AW, 106-AW and 103-AP, an overall Waste Volume Reduction (WVR) of 2.39 million gallons (83% WVR factor) was achieved. The post-run document (WHC-SD-WM-PE-053, Rev.0) was issued on September 30, 1994 to summarize the results of 242-A Evaporator Campaign 94-1 as required per WHC-IP-0842 Section 8.12, subsection 6.2 "Process Evaluation Report".

Campaign 94-2 was started on September 22, 1994 and completed on November 19, 1994. Approximately 3.21 million gallons of dilute waste from 101-AP, 107-AP, 108-AP and tank heels from 102-AW and 106-AW were processed, achieving the WVRF goal of 87% (2.79 million gallons). A post-run document is currently being prepared to fulfill WHC-IP-0842 requirement of "Process Evaluation Report".

Campaign 95-1 start-up date is presently scheduled on June 1, 1995. Approximately 2.43 million gallons of dilute waste from 106-AP, 107-AP, and 106-AW will be processed. Based on a preliminary projection, a WVF of 2.04 million gallons can be achieved.

Campaign 96-1 is tentatively scheduled on October 1, 1995. About 830,000 gallons of dilute complexed waste from 101-AY will be processed. Based on its unique characteristic in nature, it is projected that a WVF of 620,000 gallons can be achieved.

Please let me know if I can be futher of assistance.

Elvis Le
242-A Evaporator

DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 4 of ______
(4) Building ______ (5) Rev. ______ (6) Job No. ______
(7) Subject EVAPORATION COST COMPARISON BASES
(8) Originator [illegible] Date [illegible]
(9) Checker EDWARD M. EPPERSON Date ______

(II) ESTIMATED FLUSH VOLUME

(10)

1) TRANSFER TANK 102 LIQUID WASTE TO TANK FARM "LO-100-160"
2) PERFORM LIQUID WASTE TRANSFER FROM TANK 15-1 TO RAIL CAR IN RAIL TUNNEL "TO-100-029" REV #1
3) TRANSFER FROM 204AR TANK TRAILER TO TANK FARM "TO-290-120" REV. B0
4) TRANSFER FROM 204AR RAIL CAR TO TANK FARM "TO-290-130" REV D0
5) CROSS SITE TRANSFER PROCEDURE 102SY to 102 AZ, 101AN, 103-AN, OR 102-SY VIA 244-S "TO-025-090" REV. A-13
6) WASTE TRANSFER LINE PREHEATING CALCULATION "W-058-023" 12/1/93

A/ CROSS-SITE TRANSFER FLUSH WATER GENERATION ESTIMATED VOLUME

BURIED PIPE ESTIMATED VOLUME (gallons) = PREHEAT (Ref 5) + FLUSH (Ref 6)
= 12,000 gallons + 20,000 gallons
= **32,000 gallons** ←

B/ RAIL/TRUCK CAR FLUSH WATER.

RAIL/TRUCK ESTIMATED VOLUME (gallons) = FLUSH LINE @ LOADING STATION (Ref. 1 OR 2) + FLUSH VESSEL & LINE @ UNLOADING ST. (Ref 3 or 4)

→ [1] RAIL ESTIMATED VOLUME (gallons) (FOR DECON WASTE) = 350 gallons + (2100 gallons)
= 2450 gallons

RAIL ESTIMATED VOLUME (gallons) (FOR HLW SLURRY) = 2450 gallons x 100% CONTINGENCY
= **4900 gallons** ←

→ [2] TRUCK ESTIMATED VOLUME (gallons) (FOR LAB. WASTE) = 50 gallons + 2100 gallons

TRUCK ESTIMATED VOLUME (gallons) (FOR HLW SLURRY) = 2150 gallons × 100% CONTINGENCY
= **4300 gallons** ←

(III) EVAPORATION COST EXAMPLE CALCULATION

EVAPORATION COST ($) = (TOTAL # TRIPS) (Trip) (FLUSH VOL/TRIP) (gallons/trip) (FLUSH WATER EVAPORATION UNIT COST PER VOLUME) ($/gallon)

BD-6400-060 1 (12/87)

APPENDIX C

RADIATION EXPOSURE COST COMPARISON BASES

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DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 1 of ______

(4) Building ______ (5) Rev. ______ (6) Job No. ______

(7) Subject RADIATION EXPOSURE COST COMPARISON BASES

(8) Originator [illegible], V. VO Date [illegible]

(9) Checker EDWARD M. EMERSON Date ______

(10) References: 1) FUNCTIONAL DESIGN CRITERIA FOR PROJECT W-058, REPLACEMENT OF CROSS-SITE TRANSFER SYSTEM, by W.M. Brantley, WHC-SD-W058-FDC-001, REV. 2, 08/26/94.

2) PACKAGING DESIGN CRITERIA FOR THE LR-56 CASK SYSTEM, by R.J. SMITH, WHC-SD-TP-PDC-021, REV. 0, 03/15/94.

3) SHIPPING COSTS FOR 219-S TO 204-AR SHIPMENTS, cc:mail FROM M.D. ROLLISON TO L.D. GOODWIN, 12/07/94. (SEE OPERATIONAL COST COMPARISON BASES CALCULATION FOR DETAIL).

(A) NUMBER OF HPT REQUIRED TO SURVEY

1) PER TELEPHONE CONFERENCE BETWEEN D.V. VO AND T.K. RAVENCRAFT, IT WAS INDICATED THAT 2 HPTs ARE PERFORMED RADIOLOGICAL SURVEY BEFORE THE LIQUID WASTE GET UNLOAD AND ALLOW THE RAIL OR TRUCK LEAVING THE FACILITIES.

∴ **2 HPTs FOR RAIL/TRUCK**

2) BURIED PIPE IS BEING DESIGN FOR REMOTE OPERATION AND DOES NOT REQUIRED RADIOLOGICAL SURVEY.

∴ **0 HPTs FOR BURIED PIPE**

(B) REFERENCE 3 SHOWS TOTAL 16 HOURS OF HPT SUPPORT

∴ ESTIMATED RADIOLOGICAL SURVEY TIME = **8 HOURS/TRANSFER**

(C)

1) PACKAGING DESIGN CRITERIAL FOR THE LR-56 CASK SYSTEM SPECIFIED ≤ 200 mRem/hr SURFACE DOSE OF THE CONTAINER. THIS CRITERIA IS BASED ON DEPARTMENT OF TRANSPORTATION REGULATION 49 CFR PART 173.441.

∴ FOR HIGH LEVEL WASTE TRANSPORTER SURFACE DOSE = **200 mRem/hr**

BD-6400-060.1 (12/87)

DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 2 of ______
(4) Building ______ (5) Rev. ______ (6) Job No. ______
(7) Subject RADIATION EXPOSURE COST COMPARISON BASES
(8) Originator DOUGLAS V. VO Date 02/10/95
(9) Checker EDWARD M. EPPERSON Date ______

(10)

2) REFERENCE 1 SPECIFIED THE SURFACE DOSE FOR BURIED PIPE SYSTEM TO BE

0.05 mRem/hr

③ RADIATION EXPOSURE COST EXAMPLE CALCULATION

RADIATION EXPOSURE COST ($) = (TOTAL # OF TRIP)(PERSONNEL/TRIP)(TIME/PERSONNEL)(DOSE)(RAD UNIT COST PER man-Rem)

(TRIP) (PERSON/TRIP) (HOUR/PERSON) (mRem/hr)(Rem/1000 mRem)($/man-Rem)

BD-6400-060 1 (12/87)

APPENDIX D

DECOMMISSIONING COST COMPARISON BASES

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DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 1 of ______
(4) Building ______ (5) Rev. ______ (6) Job No. ______
(7) Subject DECOMMISSIONING COST COMPARISON BASES
(8) Originator Douglas Ho Date 02/10/95
(9) Checker EDWARD M EDDERSON Date ______

(10) i ABOVEGROUND TRANSPORTATION ESTIMATED QUANTITIES AND COST FOR D & D

(I) PROCESS PIPING FROM 204AR TO VALVEPIT 241-A-A (3" SST x 6" C/S ENC.)

References: SK-2-4263 & 6430.1A

Lenght (East-west) : W 47764.50 - W 48124.17 = 360'

Lenght (North-South) : (N 41136 - N 41040)2 = 192'

Lenght (INSIDE BLDG-20%): 110'

TOTAL LENGHT (3" SST ENCASED IN 6" CS PIPE) = 662'

SPARE FOR SLURRY TRANSPORT (6430.1A - 1323 - 5.2) = 662'

PROCESS PIPING = 1324 Ft

TOTAL PROCESS PIPING = **2648 FT FOR 2 FACILITIES** ←

(II) TRUCK / RAIL TRANSPORTER

Reference : Drawing D-Ø883AØ Ø5, Rev. Ø, by HAMILTON ENGR INC. SEATTLE

ASSUMPTION: 1) RAIL CAR CAN BE DISPOSED AS A WHOLE. (SAME FOR TRUCK)

2) NO PACKAGING IS REQUIRED TO DISPOSE OF A RADIOACTIVE MIXED WASTE RAIL CAR (SAME FOR TRUCK)

3) THE HIGH LEVEL LIQUID WASTE RAIL CAR WILL HAVE THE SAME DIMENSION AS THE DESIGNED DOUBLE-WALLED CONTAINMENT LOW LEVEL LIQUID WASTE RAIL CAR (WITHOUT SHIELDING) - (SAME FOR TRUCK)

RAIL CAR DECOMMISSION COST($) = PACKAGE COST($) + DISPOSED COST($)

= Ø + (AREA)(LENGHT) (RMW DISPOSE RATE)

= Ø + $(\pi \times 6'^2)(44')(\$173/FT^3)$

= **\$ 860,397 / RAIL CAR** ←

TRUCK CAR DECOMMISSION COST($) = Ø + $(\pi \times 3.5'^2)(18)(\$173/FT^3)$

= **\$ 119841 / TRUCK CAR** ←

BD 6400 060

DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 2 of ______
(4) Building ______ (5) Rev. ______ (6) Job No. ______
(7) Subject DECOMMISSIONING COST COMPARISON RATES
(8) Originator [illegible] V. VO Date 02/10/95
(9) Checker [illegible] M. EPPERSON Date ______

(10) ii BURIED PIPING ESTIMATED QUANTITIES AND COST FOR D & D

(I) PROCESS PIPING FROM SY TANK FARM TO 244A-LIFT & 151AR (W058 & W028)

A/ FOR W058 – References: TITLE I COST ESTIMATE, 08/05/93, W058PAA5
CHANGE REQUEST W-058-036 Rev. Φ, APPROVED 9/15/95

PIPING SPOOL (3" SST × 6" C/S ENCASEMENT) = 68390' + 2000' + 5642' = 76032'

VENT LINE REMOVE PER CR-036 = 14100'

∴ TOTAL W058 ESTIMATED PIPING SPOOL = 61932' ←

B/ FOR W028 – References: CHANGE REQUEST (CR-W028-060, REV Φ) 11/14/94, W028RAB3

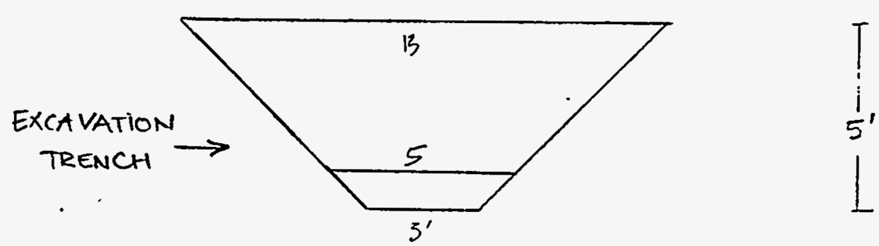
PIPING SPOOL (3" SST × 6" C/S ENCASEMENT) = 900' + 11000' + 1930' = 13830' ←

C/ TOTAL PIPING SPOOL FOR BOTH W058 AND W028 = **75762'**

(II) ESTIMATED COST FOR PIPING REMOVED AND PACKAGE FOR BURIED GROUND

⟹ ESTIMATED COST($) = EXCAVATION COST + CUT PIPES + PACKAGE + OTHER MATERIALS

A/ EXCAVATION COST ($) = MACHINE (First four feet) + HAND (Last 2 Feet) + BACKFILL



$$\text{EXCAVATION COST}(\$) = \left[\tfrac{1}{2}(13'+5')\times 4'\times 75762'\right]\left[\frac{1\,yd}{3'}\right]^3\left[\frac{\$65}{10\,yd^3}\right] + \left[\tfrac{1}{2}(5+3)1\times 75762\right]\left[\frac{1\,yd}{3'}\right]^3\left[\frac{\$166}{[illegible]}\right]$$

$$= \$656604 + \$1863184 + \$656604 = \$2519,7[illegible]$$

DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 3 of ______
(4) Building ______ (5) Rev. ______ (6) Job No. ______
(7) Subject ______
(8) Originator [illegible] V. Vo Date [illegible]
(9) Checker [illegible] Date ______

(10) B/ PER TELEPHONE CONVERSATION WITH NORMAN WILLIS (372-0669) - WASTE CNT.- 4x4x8

CUT PIPES COST (\$) = (TOTAL # OF CUT)(TIME/CUT)(\$/TIME)(# OF LABOR)

= (75762'/8'/CUT)(2 HOURS/CUT)(\$50/HRS)(3) = \$2,841,075

THE THREE LABORS ARE: 2 PIPE FITTER, 1 HPT

C/ PACKAGE THE CUT UP SECTION IN THE SOLID WASTE CONTAINER (INC. FILL VOID)

PACKAGE COST (\$) = (75762'/8'/CUT)(1 HOURS/CUT)(\$50/HRS)(3) = \$1,420,538

D/ OTHER MATERIALS

MATERIALS COST (\$) = OVER PACK CONTAINER + FRESH AIR + HHSR + TOOLS + OTHER

$= \left(\frac{9470 \text{ SECTIONS}}{32 \text{ SEC./BOX}}\right)(2000\$) + \$300{,}000 + \$100{,}000$

= \$991,890

∴ ESTIMATED COST (\$) = EXCAVATION + CUT PIPE + PACKAGE + OTHER + 50% CONTINGENCY

= \$2,519,788 + \$2,841,075 + \$1,420,538 + \$991,890 + \$3,886,645

REMOVE & PACKAGE EST. COST (\$) = \$11,659,936 FOR 75762' OF PIPE

REMOVE & PACKAGE EST. COST PER LINEAR FOOT = **\$154/FT**

DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 4 of ______
(4) Building ______ (5) Rev. ______ (6) Job No. ______
(7) Subject DECOMMISSIONING COST COMPARISON BASES
(8) Originator [illegible] V. VO Date [illegible]/10/95
(9) Checker EDWARD [illegible] EDERSON Date ______

(10) iii FROM FORREST DAY (ICF-KH ESTIMATOR) THE TABLE BELOW WAS OBTAINED

For five year planning purposes, Solid Waste Programs estimates the FY95 - FY99 Storage Disposal Rates as follows:

	FY95	FY96	FY97	FY98	FY99
LLW ($/ft3)	60	72	86	104	124
	.20	20	21	20	
RMW ($/ft3)	173	207	249	299	358
TRU ($/ft3)	125	150	180	216	260
HAZ ($/container	469	563	676	811	973

SINCE THE ESTIMATED PROJECT CAPITAL COSTS WERE ESCALATED TO 1995 FOR BURRIED PIPE AND 1993 FOR TRUCK/RAIL, THE FY95 DISPOSAL RATE WAS SELECTED FOR CONSISTENT DOLLAR VALUE.

iiii DECOMMISSIONING COST EXAMPLE CALCULATION

REMOVAL COST ($) - PIPE = (TOTAL LENGHT) (BURIED PIPE REMOVAL & PACKAGE UNIT COST)
(feet) ($/foot)

DIPOSAL COST ($) - PIPE = (TOTAL LENGHT) (AREA OF 6" DIAMETER PIPE) (DISPOSAL UNIT COST PER VOLUME)
(ft) (ft^2) ($/ft^3$)

DISPOSAL COST ($) VEHICAL = (TOTAL LENGHT) (AREA OF THE CONTAINER) (DISPOSAL UNIT [illegible])