ENGINEERING CHANGE NOTICE

Page 1 of 21. ECN **636877**Proj.
ECN

2. ECN Category (mark one) ☐ Supplemental ☒ Direct Revision ☐ Change ECN ☐ Temporary ☐ Standby ☐ Supersedeure ☐ Cancel/Void	3. Originator's Name, Organization, MSIN, and Telephone No. S A Krieg NUMATEC 376-0971 H6-12		4. USQ Required? ☐ Yes ☒ No	5. Date 7/9/98
	6. Project Title/No./Work Order No. HTI/D25E4		7. Bldg./Sys./Fac. No. NA	8. Approval Designator NA
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) HNF-2693 Revision 0		10. Related ECN No(s). NA	11. Related PO No. NA
12a. Modification Work ☐ Yes (fill out Blk. 12b) ☒ No (NA Blks. 12b, 12c, 12d)	12b. Work Package No. NA	12c. Modification Work Complete NA Design Authority/Cog. Engineer Signature & Date		12d. Restored to Original Condition (Temp. or Standby ECN only) NA Design Authority/Cog. Engineer Signature & Date

13a. Description of Change
 Revisions to body of document; Replace table 1; Add figure 1; Add tables A-1 through A-5; revise appendices A, B, and C; add telecon memo to appendix E.

13b. Design Baseline Document? ☐ Yes ☒ No

14a. Justification (mark one)

Criteria Change ☒	Design Improvement ☐	Environmental ☐	Facility Deactivation ☐
As-Found ☐	Facilitate Const ☐	Const. Error/Omission ☐	Design Error/Omission ☐

14b. Justification Details

New waste retrieval rates (table A-5) resulted in recalculation of data in study.

15. Distribution (include name, MSIN, and no. of copies)

See distribution sheet

RELEASE STAMP

636877

A-7900-013-3 (05/96) GEF096

AX Tank Farm Waste Retrieval Alternatives Cost Estimates

S. A. Krieg

Numatec Hanford Corporation, Richland, WA 99352

U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 636877

UC: 721

Org Code: 7C260

Charge Code: D25E4

B&R Code: EW3130010

Total Pages: 126

Key Words: Hanford Tanks Initiative, single-shell tanks, retrieval

Abstract: This report presents the estimated costs associated with retrieval of the wastes from the four tanks in AX Tank Farm. The engineering cost estimates developed for this report are based on previous cost data prepared for Project W-320 and the HTI 241-C-106 Heel Retrieval System. The costs presented in this report address only the retrieval of the wastes from the four AX Farm tanks. This includes costs for equipment procurement, fabrication, installation, and operation to retrieve the wastes. The costs to modify the existing plant equipment and systems to support the retrieval equipment are also included. The estimates do not include operational costs associated with pumping the waste out of the waste receiver tank (241-AV-102) between AX Farm retrieval campaigns or transportation, processing, and disposal of the retrieved waste.

TRADEMARK DISCLAIMER. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

Printed in the United States of America. To obtain copies of this document, contact: Document Control Services, P.O. Box 950, Mailstop H6-08, Richland WA 99352, Phone (509) 372-2420; Fax (509) 376-4989.

Jessie Cardal 7-21-98
Release Approval Date

Release Stamp

Approved for Public Release

HNF-2693
Revision 1

AX TANK FARM WASTE RETRIEVAL ALTERNATIVES COST ESTIMATES

July 1998

S. A. Krieg
Numatec Hanford Corporation
Richland, Washington

Prepared for
U.S. Department of Energy
Richland, Washington

This page intentionally left blank.

CONTENTS

1.0 INTRODUCTION	1
1.1 BACKGROUND	1
1.2 PURPOSE AND SCOPE	1
2.0 SUMMARY	2
3.0 RETRIEVAL SYSTEMS DESCRIPTIONS	5
4.0 RISKS AND UNCERTAINTIES	6
5.0 ASSUMPTIONS	7
6.0 WASTE MEASUREMENT TECHNIQUES	8
7.0 REFERENCES	9

LIST OF FIGURES

1. AX Tank Farm Waste Process Flowchart.	3
---	---

LIST OF TABLES

1. Tank Waste Retrieval Cost Summary Estimate For AX Farm - K\$.	4
2. Estimated AY Farm Cost and Worker-Hour Breakdown (all 4 tanks)	5
3. AX Farm Retrieval Methods.	5

LIST OF TERMS

ALC	Air lift circulator
BOP	Balance of Plant
CCTV	Closed-circuit television
D&D	Decontamination and decommissioning
DOE	U.S. Department of Energy
DST	Double-shell tank
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
FDNW	Fluor Daniel Northwest
HTI	Hanford Tanks Initiative
HVAC	Heating, ventilating, and air conditioning
LLCE	Long-length contaminated equipment
ORR	Operational Readiness Review
PHMC	Project Hanford Management Contractor
PNNL	Pacific Northwest National Laboratory
PPS	Past-Practice Sluicing
ROM	Rough order of magnitude
RPECA	Retrieval Performance Evaluation Criteria Alternatives
TWRS	Tank Waste Remediation System

AX TANK FARM WASTE RETRIEVAL ALTERNATIVES COST ESTIMATES

1.0 INTRODUCTION

1.1 BACKGROUND

In 1996, the U.S. Department of Energy (DOE) implemented a five-year demonstration project known as the Hanford Tanks Initiative (HTI). The scope of HTI is to:

(1) demonstrate alternate retrieval technologies for tank waste; (2) retrieve hard-heel waste from tank 241-C-106 and assess compliance with retrieval performance evaluation criteria for that activity; (3) characterize residual waste in tank 241-AX-104 and assess compliance with retrieval performance criteria for that tank; and (4) develop retrieval performance evaluation criteria supporting readiness to close single-shell tanks (SSTs) in the future. The HTI mission is to minimize technical uncertainties and programmatic risks by conducting demonstrations to characterize and remove tank waste using technologies and methods that will be needed in the future to carry out tank waste remediation and tank farm closure.

The HTI team is comprised of representatives from the Project Hanford Management Contractors (PHMC), Pacific Northwest National Laboratory (PNNL), and private consultants. The team is working closely with the Washington State Department of Ecology (Ecology), various northwest stakeholders, and native American tribes to identify and develop waste retrieval performance criteria for subsequent formulation of acceptable closure criteria and standards for tank farms.

1.2 PURPOSE AND SCOPE

The purpose of this task is to develop the estimated costs associated with retrieval of the wastes from the four tanks in AX Tank Farm. The *Waste Retrieval and Transfer Engineering Data Package for the Tank Waste Remediation System Environmental Impact Statement* (Fredenburg 1995) served as a basis for retrieval data in the Tank Waste Remediation System (TWRS) Environmental Impact Statement (EIS). The sluicing cost data in that document were developed from Project W-320. To evaluate the impacts of retrieval alternatives associated with the Retrieval Performance Evaluation Criteria Alternatives (RPECA), additional costing information needs to be developed.

The engineering cost estimates developed for this report are based on previous cost data prepared for Project W-320 and the HTI 241-C-106 Heel Retrieval System. The costs presented in this report address only the retrieval of the wastes from the four AX farm tanks. This includes costs for equipment procurement, fabrication, installation, and operation to

retrieve the wastes. The costs to modify the existing plant equipment and systems to support the retrieval equipment are also included. The estimates do not include operational costs associated with pumping the waste out of the waste receiver tank (241-AY-102) between AX Farm retrieval campaigns or transportation, processing, and disposal of the retrieved waste.

The overall AX Farm waste flow path is shown in Figure 1. Only the costs associated with the items under the "Retrieve AX Farm Waste" block are included in this study.

Water spray/salt-well pumping is currently under consideration as the baseline retrieval process for sound (non-leaking) SSTs containing salt cake, however the current baseline retrieval process is Past-Practice Sluicing (PPS). Evaluation of Salt Well pumping was not included in this study because 1) it is inconsistent with current baseline retrieval process and 2) it would be unable to retrieve tanks 241-AX-101 and 241-AX-103 down to a residual waste volume of 10.2 m^3 (360 ft^3) due to the insolubles in the tanks. If salt well pumping were to become the baseline retrieval process and resulted in lower costs for retrieving the salt cake in 241-AX-101 and 241-AX-103, the cost reduction would apply only to the 102 m^3 ($3,600 \text{ ft}^3$) residual waste retrieval level, since salt well pumping technology is incapable of retrieving down to 10.2 m^3 (360 ft^3) of residual waste.

2.0 SUMMARY

Cost estimates are presented for three levels of waste retrieval. These retrieval levels are 102 m^3 ($3,600 \text{ ft}^3$), 10.2 m^3 (360 ft^3), and 1.0 m^3 (36 ft^3) of residual waste in each tank. The cost estimates are rough order of magnitude (ROM) estimates prepared by HTI engineers for comparative purposes in the evaluation of RPECA and are not for budgetary use. The estimated expense and capital costs, including escalation and contingency, for the three levels of waste retrieval are summarized in Table 1. Details of the estimates are included in Appendices A through D.

The data are also broken down by Decontamination and Decommissioning (D&D) costs, PHMC operating costs, PHMC operating worker-hours, and PHMC installation worker-hours. The summary of this data breakdown is shown in Table 2. Details of these cost and worker-hour breakdowns are included in Appendix D. The costs include both contingency and escalation. The worker-hours include contingency only.

Figure 1. AX Tank Farm Waste Process Flowchart.

Table 1. Tank Waste Retrieval Cost Summary Estimate For AX Farm - K\$.

	Task description	3,600 ft ³ ⁽¹⁾		360 ft ³ ⁽¹⁾		36 ft ³ ⁽¹⁾	
		EXP ⁽²⁾	CAP ⁽³⁾	EXP ⁽²⁾	CAP ⁽³⁾	EXP ⁽²⁾	CAP ⁽³⁾
1	LLCE removal of tank equipment	843	1,075	1,162	1,656	1,162	1,656
2	Purchase/install sluicing systems and equipment for tanks AX-101 and AX-103	18,446	4,000	18,446	4,000	18,446	4,000
3	Design/install control room for sluicers	109	95	109	95	109	95
4	Purchase and install vehicle retrieval system in AX-104	3,042	5,500	5,942	5,500	5,942	5,500
5	Design/fabricate/install HVAC system for tanks AX-101, 102, 103, and 104.	282	700	382	700	382	700
6	Design/install 2000 ft of 4 in. dia waste transfer lines.	455	455	490	490	490	490
7	Design/install new waste transfer jumper pit on west side of AX farm	284	50	284	50	284	50
8	Refurbish 11 pits in AX and AY farms	11,500	2,000	14,500	2,000	14,500	2,000
9	PHMC BOP modifications/installations	3,476	896	4,223	1,120	4,223	1,120
10	Safety & Permitting	1,393	NA	1,393	NA	1,393	NA
11	Sluicing Operational Costs	2,409	NA	2,470	NA	2,470	NA
12	Vehicle Operational Costs	592	NA	3,699	NA	10,871	NA
SUB-TOTAL		42,831	14,771	53,100	15,611	60,272	15,611
TOTAL		57,602		68,711		75,883	
TOTAL WITH CONTINGENCY & ESCALATION		114,964		137,136		151,450	

BOP = Balance of Plant

HVAC = Heating, ventilating, and air conditioning

LLCE = Long-length contaminated equipment

PHMC = Project Hanford Management Contractor

¹Cubic feet of residual waste

²Expense Costs

³Capital Costs.

Table 2. Estimated AY Farm Cost and Worker-Hour Breakdown (all 4 tanks).

	102 m ³ (3,600 ft ³)	10.2 m ³ (360 ft ³)	1.0 m ³ (36 ft ³)
PHMC operating cost	\$5,449,000	\$12,729,000	\$18,553,000
PHMC operating worker-hours	38,619	66,760	128,726
PHMC installation worker-hours	241,970	325,528	325,528
D&D	\$1,008,000	\$1,184,000	\$1,184,000

D&D = Decontamination and decommissioning

PHMC = Project Hanford Management Contractor.

A summary of the retrieval methods that are assumed to be used on each of the tanks for the three residual waste levels is shown in Table 3. Note that tanks 241-AX-102 and 241-AX-104 are assumed leakers and that the current waste inventory in 241-AX-104 is less than 102 m³ (3,600 ft³). The current waste volume inventories in the AX Farm tank are as follows:

241-AX-101 2,839,000 L (750,000 gal)
 241-AX-102 124,900 L (33,000 gal)
 241-AX-103 423,900 L (112,000 gal)
 241-AX-104 26,495 L (7,000 gal).

Table 3. AX Farm Retrieval Methods.

Residual waste	241-AX-101	241-AX-102	241-AX-103	241-AX-04
102 m ³ (3,600 ft ³)	*PPS	Vehicle	*PPS	NA
10.2 m ³ (360 ft ³)	*PPS/Vehicle	Vehicle	*PPS/Vehicle	Vehicle
1.0 m ³ (36 ft ³)	*PPS/Vehicle	Vehicle	*PPS/Vehicle	Vehicle

NA = Not applicable

*Past-Practice Sluicing (PPS) includes two sluicers in each tank.

3.0 RETRIEVAL SYSTEMS DESCRIPTIONS

An updated PPS system is employed by project W320 as the method to remove the majority of the high-heat waste from tank 241-C-106. For AX Farm retrieval, the W-320 sluicing process is modified by using two sluicers in tanks 241-AX-101 and 241-AX-103.

This is made necessary by the air lift circulators (ALCs) that obstruct portions of the tanks from the sluicing jets and to improve the sluicing efficiency. Double-shell tank (DST) 241-AY-102 is the receiver tank for the waste retrieved from AX Farm. Only one of the sluicers will be in operation at any given time. Tank 241-AY-102 will be charged with about 1,514,000 L (400,000 gal) of water that will be recirculated to AX Farm at a rate of 1,135 L/min (300 gal/min) through new waste transfer lines.

The vehicle retrieval system is a "second generation" version of the 241-C-106 Heel Retrieval System. This system consists of a retrieval vehicle that is lowered into the tank through a riser and retrieves the waste with a sluicing head employing high pressure water jets to break up the waste. The system includes tools that can clean the sides of the tank, clean the internal and external ALC surfaces, and cut-off the thermocouple wells that protrude below the ALCs.

4.0 RISKS AND UNCERTAINTIES

There are considerable risks and uncertainties associated with assuming that the vehicle-based retrieval system is capable of retrieving waste to the required degree. It is unlikely that a volume of 1.0 m^3 (36 ft^3) of residual waste can be achieved with current technologies. The 1996 National Research Council report *Barriers To Science, Technical Management of the Department of Energy Environmental Remediation Program* (NRC 1996) contains the following statement regarding retrieval of Hanford tank wastes: "The committee has seen no analysis demonstrating that essentially complete waste removal is technically achievable or even advisable for all of many of the tanks." The statement remains as true today as it was two years ago. Operation of the Project W-320 sluicing system in tank 241-C-106 (scheduled to start in August 1998) and operation of the HTI 241-C-106 Heel Retrieval System vehicle (scheduled to start in October 1999) will provide factual data on the capabilities of these systems to retrieve waste from the Hanford SSTs. The data in this study should be reviewed and updated at the conclusion of those projects. Several of the more important risks/uncertainties related to this study are listed below:

1. **Technical Capability.** There are considerable risks in assuming that any currently available technology can retrieve waste to a level approaching 1.0 m^3 (36 ft^3). The effectiveness of the vehicle-based retrieval system has not yet been demonstrated in a Hanford waste tank and remains unknown. Further, there is considerable uncertainty that removal to these levels can be verified.
2. **Tank Obstructions.** There are also considerable uncertainties associated with the ability of the vehicle-based system to retrieve waste among the 22 ALCs that are in the AX Farm tanks. There is space for the vehicle to operate below the ALCs (after the thermocouple wells have been cut), but the umbilical management problems will be challenging.

3. **Air Lift Circulators.** The question of the ability of the vehicle to remove the waste from the interior of the 76-cm (30-in.) diameter ALCs (pipe) also remains unanswered and un-demonstrated. To achieve the 1.0 m^3 (36 ft^3) residual waste volume, essentially all of the waste will have to be removed from the interior and exterior surfaces of the ALCs.
4. **Water Limitations.** An additional risk associated with the estimates presented in this report is the uncertainty in assuming that the vehicle based retrieval system will be capable of reducing the waste inventory to 1.0 m^3 (36 ft^3) without using excess amounts of water in the retrieval process. Water addition limitations could be a barrier to achieving a final clean-out to 1.0 m^3 (36 ft^3) of waste.
5. **Operational Time.** Another uncertainty involves the assumed operating times required for the vehicle based system to clean out the tanks to the various residual waste levels. The assumed times (and associated retrieval rates) are based on engineering judgement, discussions with personnel familiar with the 241-C-106 heel retrieval task, and experience at the Gunit and Associated Tanks (GAAT) at Oak Ridge National Laboratory. Increased retrieval times would drive up the costs and the potential increase in cost could be dramatic for the 1.0 m^3 (36 ft^3) case.
6. **Salt Cake Sluicing.** Past sluicing experience at Hanford has been with sludge types of waste. The assumption that PPS will retrieve the large majority of the salt cake from tanks 241-AX-101 and 241-AX-103 is not backed up with actual experience. This lack of experience along with the limited knowledge of the present salt cake properties results in significant uncertainties in the ability of the sluicing system to perform satisfactorily.

5.0 ASSUMPTIONS

The assumptions listed below were adopted as the planning basis for the cost estimates developed in this report.

1. PPS will not be an acceptable retrieval process for tanks 241-AX-102 and 241-AX-104 because 1) they are classified as leakers and 2) the small volumes of waste in these tanks can be more cost effectively retrieved by a vehicle system.
2. PPS will be the process used to retrieve the waste from tanks 241-AX-101 and 241-AX-103 to 102 m^3 ($3,600 \text{ ft}^3$) of residual waste.

3. The "next generation" vehicle-based HTI 241-C-106 Heel Retrieval System will be used to retrieve the wastes from tanks 241-AX-102 and 241-AX-104.
4. PPS will not be capable of retrieving tanks 241-AX-101 and 241-AX-103 to 10.2 m³ (360 ft³) or less of residual waste. There are 22 ALCs in each of the AX Farm tanks. These are 76-cm (30-in.) diameter pipes that "shadow" a significant portion of the tank volume from the sluicing jet and limit the amount of waste that can be retrieved without removal of the ALCs.
5. Retrieval to the 1.0 m³ (36 ft³) residual waste level will employ the same techniques as for the 10.2 m³ (360 ft³) level. The difference is the additional operating time required to accomplish the desired residual waste level.
6. Tank 241-AY-102 will be the receiver tank for all of the retrieved waste.
7. The W-320 slurry distributor in tank 241-AY-102 will be reused for AX Farm retrieval.
8. The W-320 Slurry pump in tank 241-AY-102 will be replaced with a new pump appropriately sized for retrieval of AX Farm (radiation damage will render the W-320 pump unusable).
9. A new above ground waste transfer pit will be required for flow diversion (using jumpers) from the AX Farm tanks.
10. Retrieval of tank 241-C-106 hard heel, by HTI, will successfully demonstrate the capability of the retrieval system to reach the 10.2 m³ (360 ft³) residual waste volume.
11. Waste transportation, processing, and disposal costs are part(s) of other work packages.

6.0 WASTE MEASUREMENT TECHNIQUES

There are two developed, practical technologies for obtaining volume measurements of the waste (see Appendix E telecon memo). These technologies include the use of surface measurement tools and subsequent calculation of the waste volume. The surface measurement methods are photogrammetry and video cameras. These provide topographical maps of the waste surface that results in conservative estimates the actual waste volume. Surface roughness of the waste, actual location of the tank walls and floor (relative to the waste surface), and waste adhering to the surfaces of the ALC all contribute to the inaccuracies of

the measurements. The best accuracy that can be expected from using these systems in the AX farm tanks is about $10.2 \text{ m}^3 \pm 5.1 \text{ m}^3$ ($360 \text{ ft}^3 \pm 180 \text{ ft}^3$).

In summary, there is no practical system that can measure residual waste volumes down to 1.0 m^3 (36 ft^3). To illustrate the problem, a thin film of waste 0.013 cm (0.005 in.) thick evenly distributed over the interior surfaces of the tank walls and floor, and the ALCs results in 1.0 m^3 (36 ft^3) of residual waste.

A third system (Structured Light System) has the potential to measure residual waste volumes down to $5.1 \text{ m}^3 \pm 2.6 \text{ m}^3$ ($180 \text{ ft}^3 \pm 90 \text{ ft}^3$), but requires development and repackaging for use in a AX farm tank. The Structured Light System could be used in conjunction with vehicle on-board sensors to improve the overall accuracy, but it would not approach 1.0 m^3 (36 ft^3). Typical vehicle on-board sensors include video cameras, magnetometers, and waste depth gages. Development of a structured light system is not currently funded.

7.0 REFERENCES

- Fredenburg, E. A., 1995, *Waste Retrieval and Transfer Engineering Data Package for the Tank Waste Remediation System Environmental Impact Statement*, WHC-SD-WM-EV-097, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Manderbach, M. W., 1997a, *Cost Normalization Unit Estimates*, LMHC96WO-0006, CO-98-TWRS-098, letter to T. H. May (December 31), Fluor Daniel Northwest Inc., Richland, Washington.
- Manderbach, M. W., 1997b, *W320 Scrub Study Estimate*, TR-HTI-002, Fluor Daniel Northwest, Richland, Washington.
- May, T. H., 1997, *Hanford Tanks Initiative Retrieval Demonstration Project Design Concept*, HNF-SD-HTI-ES-001, Rev. 0, Numatec Hanford Corporation, Richland, Washington.
- NRC, 1996, *Barriers To Science, Technical Management of the Department of Energy Environmental Remediation Program*, National Research Council, Washington, D.C.
- Becker, D. L., 1997, *AX Farms Waste Inventory Study for Hanford Tanks Initiative*, HNF-SD-HTI-TI-001, Numatec Hanford Corporation, Richland, Washington.

This page intentionally left blank.

APPENDIX A

COST ESTIMATE DETAILS FOR 102 m³ (3,600 ft³) RESIDUAL WASTE LEVEL

This page intentionally left blank.

APPENDIX A

102 m³ (3,600 ft³) COST DETAILSRetrieval to 102 m³ (3,600 ft³) Residual Waste--Cost Summary. (2 Sheets)

	Task description	Cost
1	LLCE removal of tank equipment	1,918,000
2	Procurement and installation of sluicing systems and equipment for tanks 241-AX-101 and 241-AX-103	22,446,000
3	Design/fabricate/install control room (trailer) for sluicers	204,000
4	Purchase and install vehicle retrieval system in 241-AX-104	8,542,000
5	Design/fabricate/install HVAC system for tanks 241-AX-101, 102, and 103	982,000
6	Design/install approximately 610 m (2,000 ft) of 10-cm (4-in.) diameter waste transfer lines between 241-AY-102 and 241-AX-101, 102, and 103	910,000
7	Design/install new waste transfer jumper pit on west side of AX farm (Manderbach 1997a)	334,000
8	Decontaminate and clean out 9 pits in AX and AY farms based on W-320 experience.	13,500,000
9	PHMC BOP modifications/installations	4,372,000
10	Safety and Permitting	1,393,000
11	Sluicing Operational Costs	2,409,000
12	Vehicle Operational Costs	592,000
	TOTAL	57,602,000

BOP = Balance of Plant

CCTV = Closed-circuit television

HVAC = Heating, ventilating, and air conditioning

LLCE = Long-length contaminated equipment

PHMC = Project Hanford Management Contractor.

Contingency and escalation are assumed to be the same as used by Fluor Daniel Northwest (FDNW) in the preparation of the Project Design Concepts (May 1997). These are as follows:

Escalation is 5.3 percent for FY 1999 through FY 2006 (8 years) for a total escalation of 51.2 percent.

32 percent contingency

TOTAL RETRIEVAL COST $\$57,602,000 \times 1.512 \times 1.32 = \$114,964,000$

DB\3600-TBL

1. **102 m³ (3,600 ft³) Long-Length Contaminated Equipment Removal**

There are 6 pieces of Long-Length Contaminated Equipment (LLCE) that will be removed from the tank pits in AX farm. These will be removed with the existing LLCE system and packaged for burial or disposal as required.

The estimated cost for the setup of the LLCE, removal of the item from the waste tank, packaging, and burial/storage is \$418,000 for the initial item based on the slurry pump and sluicer removal estimates contained in Manderbach (1997a). Costs for subsequent items are \$300,000 each accounting for lessons learned on the initial removal.

Tank 241-AY-102 slurry pump removal	\$418,000
Tank 241-AX-101 pit 01A steam coil	\$300,000
Tank 241-AX-101 pit 01B Sluicer	\$300,000
Tank 241-AX-102 pit 02A Sluicer	\$300,000
Tank 241-AX-102 pit 02B Pump	\$300,000
Tank 241-AX-103 pit 03A Sluicer	\$300,000
TOTAL (for 102 m ³ [3,600 ft ³] case)	\$1,918,000

DB\3600LLCE

2. 102 m³ (3,600 ft³) Sluicing Equipment Fabricate/Installation Costs

The cost estimate for the design/fabrication and installation of sluicing systems on tanks 241-AX-101 and 241-AX-102 is based on the enhanced sluicing cost estimate for 241-C-106 prepared by FDNW for Job no. E20144 (file no. Z437SAE2) (summary sheet attached). The estimate was modified as detailed below to more accurately reflect the AX farm conditions.

The total projected cost estimate without escalation or contingency is \$34,140,000 including site allocations. The following items were removed from the estimate as redundant or not applicable:

Regulatory compliance	1,281,000
Accident analysis	650,000
Pump pit 241-C-06A	2,303,000
Heel pit 241-C-06B	1,967,000
Sluice pit 241-C-06C	1,922,000
Enc'd pipe pump to heel pit	298,000
Enc'd pipe heel to sluice pit	223,000
Heel jet removal	618,000
Sluicer removal	594,000
Vendor perform retrieval	2,000,000
Vendor Demobilization	500,000
Ready tank for closure	2,500,000
SUB-TOTAL	14,856,000

The following items were added to the estimate to account for operation in two tanks:

Vendor equipment	2,000,000
Vendor equipment installation	1,162,000
SUB-TOTAL	3,162,000

$$\text{TOTAL } (34,140,000 + 3,162,000 - 14,856,000) = \$22,446,000$$

DB\3600.SLU

FLUOR DANIEL NORTHWEST, INC.
NUMATEC HANFORD CORPORATION
JOB NO. E20144
FILE NO. 2437SAE2

** TEST - INTERACTIVE ESTIMATING **
CONCEPT 1 - ENHANCED SLUICING
ORDER OF MAGNITUDE
PHMCR01 - PROJECT COST SUMMARY

PAGE 1 OF 20
DATE 04/07/97 17:51:46
BY TLK, JJM, RMO, CDL

SORT	DESCRIPTION	ESCALATED		CONTINGENCY	TOTAL
		TOTAL COST		TOTAL	DOLLARS
DESH	DE&S HANFORD, INC.	820,000	30	250,000	1,070,000
FDNH	FLUOR DANIEL NORTHWEST	17,290,000	33	5,780,000	23,070,000
LMHC	LOCKHEED MARTIN HANFORD CORP.	1,080,000	30	320,000	1,400,000
NHI	NUMATEC HANFORD CORPORATION	9,270,000	33	3,100,000	12,370,000
SUBTOTAL		28,460,000	33	9,450,000	37,910,000
SITE	SITE ALLOCATIONS	5,680,000	33	1,850,000	7,530,000
	ROUNDING	(40,000)			(40,000)
TOTAL PROJECT COST (TPC)		34,140,000	33	11,300,000	45,400,000

BEST AVAILABLE COPY

HNF-2693
Revision 1

TYPE OF ESTIMATE	ORDER OF MAGNITUDE	4/7/97	REMARKS:	Subject to change.
FDNH LEAD ESTIMATOR	ESTIMATING MANAGER	<i>[Signature]</i>		
PROJECT MANAGER		<i>[Signature]</i> for M. MANDERLICH 4/8/97		
CLIENT				

(ROUNDED/ADJUSTED TO THE NEAREST * 10,000 / 100,000 * - PERCENTAGES NOT RECALCULATED TO REFLECT ROUNDING)

A-7

3. 102 m³ (3,600 ft³) Sluicer Control Room

The estimated cost for the control room/lunch room is taken from the 1994 W-320 estimate (Job no. W-320/ER4319 page 23 attached). One control room for the sluicer systems used in tanks 241-AX-101 and 241-AX-103 is adequate. This control room would be located outside the tank farm boundaries.

The W-320 control room was not installed (a mobile office was modified) so the costs for the control room are not included in the later estimates.

From page 23 of the estimate (rounded) \$204,000

DB\3600.CNT

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. W-320/ER4319
FILE NO. W320PBD7

** TEST - INTERACTIVE ESTIMATING **
TANK 241-C-106 SLUICING REVISION #1
40% PRELIMINARY ESTIMATE
DOE_R04 - COST CODE ACCOUNT SUMMARY

PAGE 23 OF 32
DATE 10/21/94 07:56:21
BY GDC/JPH/DKH/CDL/KDE

COST CODE/WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION % TOTAL	SUB TOTAL	CONTINGENCY % TOTAL	TOTAL DOLLARS
3490	AY EQUIPMENT	7860	0	7860	0.00	0	20	1572
3510	HYDRAULIC TRAILER/STRONGBACK	493220	0	493220	0.00	0	1	6438
3560	CEMETIC FABRICATION	660184	0	660184	0.00	0	2	14198
4212	CNTRL RH INSTR. INSTALLATION	713564	0	713564	1.60	11417	25	181246
4221	TRANSFER LINE	1259047	271846	1530893	1.60	24495	25	380369
4222	SERVICE BLOC.	6403	1306	7709	1.61	124	20	1567
4223	CONTROL RH/LUNCH RH	204417	41701	246118	1.60	3938	20	50011
4313	CORE DRILLS	499806	0	499806	3.61	18043	28	144076
4314	PIT SLEEVE/EHDOS	102622	0	102622	3.61	3704	30	31898
4315	JUMPERS	372617	0	372617	3.61	13451	30	115821
4322	ENCASED PIPING INSTALLATION	254481	0	254481	3.61	9107	30	79100
4324	C- FARM INSTRUMENT AIR & VENT	39131	0	39131	3.61	1412	30	12163
4330	C-FARM ELECTRICAL	869740	0	869740	3.61	31397	20	180227
4341	HASF ROCK-UP	247311	0	247311	3.61	8928	20	51248
4343	SLUICING EQUIP.	512504	0	512504	3.61	18501	30	159302
4351	CHILLER SKID	40418	0	40418	3.61	1459	30	12563
4352	PROCESS SKID	237120	0	237120	3.61	8560	22	53764
4353	EXHAUST SYSTEM	4549	0	4549	3.61	164	30	1414
4354	FOG SUPPRESSION SYS	54897	0	54897	3.61	1981	25	14221
4356	DIRECTED AIR SYSTEM	13308	0	13308	3.61	481	25	3447
4357	EXISTING AIR INLET MOD'S	7917	0	7917	3.61	286	25	2051
4411	MISC PADS	218925	0	218925	3.89	8516	25	56924
4412	MISC. INSTRUMENTATION	134525	0	134525	3.89	5233	30	41927
4413	PIT SLEEVE/ EHDOS	35161	0	35161	3.89	1368	30	10959
4414	JUMPERS	248235	0	248235	3.89	9657	30	77368
4416	PIT BACKFILL	711	0	711	3.94	28	30	222
4421	EXCAVATION - PIPING	8459	0	8459	3.89	329	30	7808
4422	ENCASED PIPING INSTALLATION	48398	0	48398	3.89	1883	30	50281
4423	BACKFILL PIPING	2339	0	2339	3.89	91	30	2430
4430	AY-FARM ELECTRICAL	366957	0	366957	3.89	14274	20	76247
4509	HVAC SKID PROCUREMENT	857899	0	857899	2.46	21104	20	175801
4510	SLUICING EQUIP. PROCUREMENT	1017615	0	1017615	2.46	25033	15	156398
4543	SLUICING EQUIPMENT C-106	2581207	0	2581207	2.46	63498	15	396706
4604	COLD TESTING	1505123	0	1505123	0.12	1749	11	155567
4605	FABRICATION/INSTALLATION	3307896	0	3307896	0.14	4597	11	376368
4606	GENERAL CONSTRUCTION SUPPORT-ERS	936509	0	936509	2.17	20322	10	191366
4610	CONTAINER TRAILER FAB CTC	49598	0	49598	0.00	0	10	4960
4700	GENERAL CONSTRUCTION SUPPORT-SLUICE	384220	0	384220	2.17	8338	20	78512
4777	GENERAL & TECH. SERVICES-SLUICING	589588	0	589588	2.17	12795	20	120477
TOTAL 700	SPECIAL EQUIP/PROCESS SYSTEM	19783677	314853	20098530	1.77	356343	17	3576571
								24031443

HNF-2693
Revision 1

A-9
BEST AVAILABLE COPY

4. 102 m³ (3,600 ft³) Vehicle Retrieval System Costs**Vendor Costs**

The vendor cost estimate is based on the two vendor systems currently being designed for the retrieval of the heel in tank 241-C-106. This also assumes that the same type of service contract will be used to procure the retrieval systems for the AX farm as is being used for the procurement of the 241-C-106 vehicle retrieval system.

Vendor supplied system/equipment

Design, fabrication, testing, and delivery of a vehicle based retrieval system ready to install in the AX farm (based on discussions with HTI 241-C-106 Heel Retrieval System Engineers). \$5,500,000

Pre-operational work at AX farm

Operational Readiness Review (ORR), training, and acceptance testing based on 6-month duration. Three person vendor crew, four shifts, and four person home office support on one shift.

Labor (16 persons @ \$75/hr for 24 weeks) \$1,152,000

Per diem (16 persons @ \$80/day for 24 weeks) \$30,700

Warehouse and office rental in the Tri-Cities area.

Twelve month duration based on the use of one vehicle in 241-AX-102.

\$60,000

Sub-total \$6,700,000

PHMC Bid and Award

Based on HTI 241-C-106 Heel Retrieval System costs \$200,000

PHMC Contract Management

Based on HTI 241-C-106 Heel Retrieval System costs \$400,000

PHMC ORR/ATP

Based on HTI 241-C-106 Heel Retrieval System costs \$400,000

HNF-2693

Revision 1

Sub-total

\$1,000,000

Installation Costs

The estimated cost to install a vehicle based retrieval system in 241-AX-104 is assumed to be the same as for Tank 241-C-106. The installation costs in 241-C-106 is from sheet 17 (attached) of the HTI baseline estimate. This does not include the costs to modify the farm/tank for acceptance of the vehicle system.

Sub-Total

\$842,500

TOTAL

\$8,542,000

DB\3600.VEH

Activity ID	Activity Description	Orig Dur	Rem Dur	%	Early Start	Early Finish	Budgeted Cost	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20
R255OS0135	INCRP COMMENTS/FINALIZE	25	25	0	29MAR99	30APR99	0.00																					
R255OS0140	SUBMIT FINAL PKG FOR REVIEW (90%)	0	0	0		30APR99	0.00																					
R255OS0145	REVIEW/COMMENTS	10	10	0	03MAY99	14MAY99	0.00																					
R255OS0150	SUBMIT PKG FOR APPROVAL	0	0	0		14MAY99	0.00																					
R255OS0155	Stage 1 Design Approval	10	10	0	17MAY99	28MAY99	0.00																					
R255OS0160	Stage 1 Design Approved	0	0	0		28MAY99	0.00																					
11131020505030102 Stage 2 Design																												
R255OS0205	STAGE 2 DESIGN ACTIVITIES	130	130	0	11MAR99	14SEP99	1,315,710.00																					
R255OS0210	STAGE 2 DESIGN PLAN	20	20	0	11MAR99	07APR99	0.00																					
R255OS0215	PREPARE 60% DESIGN PKG (STAGE 2)	60	60	0	08APR99	01JUL99	0.00																					
R255OS0220	INCRP COMMENTS/FINALIZE	30	30	0	06JUL99	16AUG99	0.00																					
R255OS0225	SUBMIT FINAL PKG FOR REVIEW	0	0	0		16AUG99	0.00																					
R255OS0230	REVIEW/COMMENT	10	10	0	17AUG99	30AUG99	0.00																					
R255OS0235	SUBMIT PKG FOR APPROVAL	0	0	0		30AUG99	0.00																					
R255OS0240	STAGE 2 DESIGN APPROVAL	10	10	0	31AUG99	14SEP99	0.00																					
1113102050503022 Construction																												
R255OS0301	Install Retrieval System In C-106	42	42	0	06MAR00	02MAY00	842,441.33																					

INCRP COMMENTS/FINALIZE

SUBMIT FINAL PKG FOR REVIEW (90%)

REVIEW/COMMENTS

SUBMIT PKG FOR APPROVAL

Stage 1 Design Approval

Stage 1 Design Approved

STAGE 2 DESIGN ACTIVITIES
102CL50S

STAGE 2 DESIGN PLAN

PREPARE 60% DESIGN PKG (STAGE 2)

INCRP COMMENTS/FINALIZE

SUBMIT FINAL PKG FOR REVIEW

REVIEW/COMMENT

SUBMIT PKG FOR APPROVAL

STAGE 2 DESIGN APPROVAL

Install Retrieval System In C-106
102CL50SHNF-2693
Revision 1

5. 102 m³ (3,600 ft³) HVAC System Design/Installation Costs

The estimate for a new AX farm HVAC system is based on the FDNW W-320 HVAC skid estimate contained in file no. W320PDA4, job no. W-320/P7448M (page 14 attached). Assume the AX farm HVAC is of the same magnitude and will cost the same. The increased cost of connecting to the 3 tanks in AX farm is offset by the reduced design costs associated with using the existing W-320 design.

AX Farm HVAC System	1 ea
TOTAL	\$982,000

DB\3600HVAC

PAGE 14 OF 35
DATE 07/25/85 05:11:06
BY KE/DH/JH/BR/CL/RX/RK

** IEST - INTERACTIVE ESTIMATING **
TANK 241-C-106 SLUICING
901 PRELIMINARY ESTIMATE
DOE-R02 - WORK BREAKDOWN STRUCTURE SUMMARY

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. W-320/P7448H
FILE NO. W320PDA1

WBS DESCRIPTION	ESTIMATE	SUBTOTAL	ONSITE	SUB TOTAL	ESCALATION	SUB TOTAL	CONTINGENCY	TOTAL DOLLARS
4509AC PROCESS BUILDING PROCUREMENT	494446	0	494446	1.74	8603	502049	5	25152
4509AC CHILLER SKID PROCUREMENT	280231	0	280231	1.74	4876	285107	5	14255
SUBTOTAL 4509 HVAC SKID PROCUREMENT	982030	0	982030	1.74	17087	999117	5	49955
4510AB PURCHASE PUMP	1140475	0	1140475	1.74	19844	1160319	15	174048
4510AC ELECTRICAL EQUIPMENT PROCUREMENT	629535	0	629535	1.73	10894	640429	15	95552
SUBTOTAL 4510 SLUICING EQUIP. PROCUREMENT	1770010	0	1770010	1.74	30738	1800748	15	269600
454310 SLUICING EQUIPMENT C-106	804052	0	804052	1.74	13991	818043	25	204511
SUBTOTAL 4543 SLUICING EQUIPMENT C-106	804052	0	804052	1.74	13991	818043	25	204511
SUBTOTAL 45 EXPENSE PROCUREMENT	4113496	0	4113496	1.50	61816	4175312	13	553563
461500 PIT DECON - MUCK-UP	339246	0	339246	0.00	0	339246	30	98774
461510 PIT DECON - C-106 FARM	520352	0	520352	0.00	0	520352	30	156076
461520 PIT DECON - AY-102 FARM	527252	0	527252	0.00	0	527252	30	158176
SUBTOTAL 4615 PIT DECON	1376750	0	1376750	0.00	0	1376750	30	413026
SUBTOTAL 46 PIT DECON	1376750	0	1376750	0.00	0	1376750	30	413026
470000 CONSTRUCTION SERVICES - CTD	62326	0	62326	0.00	0	62326	0	0
470010 GENERAL CONSTRUCTION SUPPORT	762849	0	762849	2.35	17902	780751	18	140760
SUBTOTAL 4700 CONSTRUCTION SERVICES	825175	0	825175	2.17	17902	843077	17	140760
477700 EQUIPMENT USAGE	315813	0	315813	2.61	8243	324056	20	64811
477710 EQUIPMENT SUPPORT FOR CONSTR	456445	0	456445	2.61	12957	505402	20	103480
477720 EQUIPMENT SUPPORT	999967	0	999967	2.61	26099	1026066	20	205214
477730 QUALITY SUPPORT	161500	0	161500	2.61	4215	165715	20	33143
SUBTOTAL 4777 GENERAL & TECH. SERVICES	1973725	0	1973725	2.61	51514	2025239	20	405048
SUBTOTAL 47 CONSTRUCTION SERVICES	2798900	0	2798900	2.48	69416	2868316	19	545808

6. 102 m³ (3,600 ft³) Waste Transfer Line

Description	Length
241-AY-102	
Pit 02A to new valve pit	76 m (250 ft)
Pit 02E to new valve pit	72 m (235 ft)
241-AX-101	
Pit 01A to new valve pit	67 m (220 ft)
Pit 01B to new valve pit	61 m (200 ft)
Pit 01D to new valve pit	56 m (185 ft)
241-AX-102	
Pit 02A to new valve pit	58 m (190 ft)
Pit 02B to new valve pit	50 m (165 ft)
241-AX-103	
Pit 03A to new valve pit	38 m (125 ft)
Pit 03C to new valve pit	41 m (135 ft)
Pit 03D to new valve pit	29 m (95 ft)
241-AX-104	
None Required for 3,600 case	--
Total line length	555 m (1,820 ft)
Cost	\$910,000

Note 1: Fabrication and installation cost for the waste transfer line is \$3,279/m (\$1,000/ft) for a double line based on W-320 experience.

Note 2: Each pit above requires core drill and nozzle installation, i.e., 10 each for the 102 m³ (3,600 ft³) case.

\3600.LIN

7. 102 m³ (3,600 ft³) Pit Design/Installation Costs

The estimate for a new AX farm above grade transfer line (jumper) pit is based on the pit cover block fabrication and caisson/slab support for the manipulator arm costs contained in the *Cost Normalization Unit Estimates* (Manderbach 1997a). Assume same cover block costs and that the pit will cost the same as the manipulator slab.

Cover block	\$102,000
Pit	\$232,000
TOTAL	\$334,000

DB\3600.PIT

8. 102 m³ (3,600 ft³) Pit Decontamination Costs

For the 102 m³ (3,600 ft³) case, 8 pits in AX farm and the pump pit at 241-AY-102 are used for the retrieval activities.

Discussed the condition and radiation levels in the pits with Dave Bragg in a Telecon 4/20/98 as summarized below.

Dave is not aware on any record of the activities that have been carried out in the last 15 years in the pits. Dave indicated that the pits probably haven't been opened in the last 15-20 years. Dave has no information on the pits as compared to the 241-C-106 pits that were decontaminated for Project W-320. Dave stated that John W. Bailey might have some recollection of the AX farm retrieval sluicing activities and that he would be a good source to try. John Bailey indicated that the pits in AX farm should be in better condition than those in C Farm (the drains should work).

For the purposed of preparing this estimate, will assume that the pits are in comparable condition to the 241-C-106 pits. From the FDNW estimate for the Vehicle Based Retrieval System, Job no. E20144 (file Z437SAF2), the allocated cost for decontamination of the pits is \$1,500,000 each (page 7, item 7E-4 attached).

TOTAL	(9 pits)	\$13,500,000
-------	----------	--------------

DB\3600.DCN

FLOOR DANIEL NORTHWEST, INC.
NUHATEC HANFORD CORPORATION
JOB NO. E20144
FILE NO. 2437SAF2

** TEST - INTERACTIVE ESTIMATING **
CONCEPT 2 - VEHICLE BASED WASTE RETRIEVAL
S T U D Y R O M
PHMCRO3 - ESTIMATE BASIS SHEET

PAGE 7 OF 16
DATE 04/15/97 07:42:17
BY TLW, JJM, RNO, CDL

MBS.310 (ON SITE CONSTRUCTION) A CONTINGENCY OF 33% HAS BEEN APPLIED BECAUSE OF LIMITED INFORMATION AVAILABLE ON THE RADIATION LEVELS THAT WILL BE ENCOUNTERED DURING PIPE INSTALLATION, PIT MODIFICATIONS AND DECONTAMINATION, PIT MODIFICATIONS, AND UNDERGROUND OBSTRUCTIONS THAT MAY BE ENCOUNTERED DURING CONSTRUCTION. THE ENHANCED SLUICER COST IS BASED UPON VERBAL ALLOWANCES PROVIDED BY THE ENGINEER AND WITHOUT VENDOR INPUT.

6. ROUNDING

THE PROJECT COST SUMMARY REPORT IS SUMMARIZED AND ADJUSTED/ROUNDED AS FOLLOWS:
THE ESCALATED TOTAL COST COLUMN, CONTINGENCY TOTAL COLUMN AND TOTAL DOLLARS COLUMN SUB-TOTALS ARE SUMMARIZED BY CONTRACTOR. THE COLUMN SUBTOTALS ARE ADJUSTED/ROUNDED TO THE NEAREST \$1,000/\$10,000. THE PROJECT TOTAL SUMMARY LINE TOTALS ARE ADJUSTED/ROUNDED TO THE NEAREST \$10,000/\$100,000.

7. REMARKS

MAJOR ASSUMPTIONS WHICH HAVE BEEN MADE IN THE PREPARATION OF THIS ESTIMATE ARE AS FOLLOWS:

- A.) THE TEMPORARY CHANGE ROOM TRAILER, MOBILE DRILL RIG AND ASSOCIATED EQUIPMENT, VACUUM TRUCK (GUZZLER), AND CRANES WILL BE FURNISHED TO THE PROJECT AT NO COST EXCEPT FOR THE SET UP COSTS.
- B.) BURNOUT COSTS ARE NOT INCLUDED IN THIS COST ESTIMATE BY DIRECTION OF PHMC. IF BURNOUT IS ADDED ITS COST IS APPROXIMATELY \$2.5M AND IS BASED UPON AN ASSUMED 10mr READING AT THE UPPER SECTION OF THE CASING AND 25mr AT THE LOWER SECTION OF THE CASING, (REF. C.C. MAIL). OTHER CONSTRUCTION WORK, INSIDE THE FARM FENCE, WAS ESTIMATED AS 10mr. RAD LEVELS ABOVE 25mr IS NOT ANTICIPATED.
- C.) ALL CONTAMINATED SOIL WAS ASSUMED TO BE LOW RAD AND WAS ESTIMATED AS BACKFILL ONLY (BURIAL IN BARRELS NOT INCL.).
- D.) THE TOTAL NUMBER OF DRAININGS, BY DISCIPLINE, AND AN ALLOWANCE OF 150 MAN HOURS EQCM WAS PROVIDED BY ENGINEERING.
- E.) ITEMS THAT ARE NOT INCLUDED IN THIS COST ESTIMATE:
 1. FLAMMABLE GAS. IT IS ASSUMED THAT THIS WAS COVERED IN THE W-320 PROJECT.
 2. CONTROL ROOM. THE CONTROL ROOM PROVIDED IN W-320 WILL BE USED.
 3. AFTER OPERATIONS IS COMPLETE, THE EQUIPMENT WILL BE ABANDONED IN PLACE (EXCEPT ENHANCED SLUICER).
 4. CLEANING, PAINTING AND OTHER SIMILAR MODIFICATIONS OF PITS. AN ALLOWANCE OF \$1.5M (BASED UPON W-320 LESSONS LEARNED) PER PIT FOR DECONTAMINATION IS INCLUDED.
 5. THE HVAC SYSTEM THAT W-320 INSTALLED IS NOT MODIFIED AND IS NOT INCLUDED IN THIS COST ESTIMATE.
 6. SPARE PARTS.
 7. ADDITIONAL REMOTE CAMERAS AS THIS WAS INSTALLED BY W-320.
- F.) PIPING ALLOWANCES ARE FOR NORMAL PIPING AND ARE NOT ASME, SECTION 3 (W-STAMPED).
- G.) W-320 REPLACEMENT ITEMS FOR FAILED EQUIPMENT ARE AN ENGINEERING ALLOWANCE OF \$300,000.
- H.) EXISTING PIT CONDITIONS ARE UNKNOWN AND THE WASH DOWN ALLOWANCE OF 200MH IS ONLY AN ALLOWANCE. IT SHOULD BE NOTED THAT PROJECT W-320 EXPERIENCED HIGHER HOURS DUE TO POOR PIT CONDITIONS.
- I.) AN ALLOWANCE OF APPROXIMATELY \$.5M (BASED ON W-320 LESSONS LEARNED) PER PIT FOR DECONTAMINATION IS INCLUDED.
- J.) ESCALATION IS BASED ON A MIDPOINT OF ALL STAGES OF CONSTRUCTION (4-1-99).

A-18

BEST AVAILABLE COPY

HNF-2693
Revision 1

9. 102 m³ (3.600 ft³) BOP Mods/Installation

The unit costs used in this section were taken from the FDNW *Cost Normalization Unit Estimates* (Manderbach 1997a).

Waste Transfer Line Jumpers

Six jumpers will be required in the new transfer pit to route the six lines coming from the 3 tanks (241-AX-101, 241-AX-102, and 241-AX-103).

Eight jumpers will be required for the pits in AX farm and two required at 241-AY-102.

TOTAL JUMPERS REQUIRED	16 @ \$56,000 ea
TOTAL COST	\$896,000

Cover Block Removal

Remove the cover blocks from the eight pits in AX farm (3 on each tank)

Remove/replace the cover blocks from the pump pit on 241-AY-102 for replacement of the pump due to radiation damage and the sluice pit for core drilling.

TOTAL COVER BLOCKS REMOVED	10 @ \$77,300 ea
TOTAL COST	\$773,000

Cover Block Fabrication

Fabricate and install new cover blocks for the eight pits in AX farm (3 each on 241-AX-101, 241-AX-103, and 2 each on 241-AX-102).

TOTAL COVER BLOCKS FABRICATED	8 @ \$102,500 ea
TOTAL COST	\$820,000

Cover Block Disposal

Dispose of the eight cover blocks removed from the pits in AX farm (3 on each tank).

TOTAL COVER BLOCKS DISPOSED	8 @ \$54,800 ea
TOTAL COST	\$438,000

Greenhouse Setup/Teardown

Setup and teardown of greenhouses and shield walls on the eight pits in AX farm and two pits at 241-AY-102.

TOTAL GREENHOUSE SETUP/TEARDOWN 10 @ \$79,400 ea

TOTAL COST \$794,000

Pit Core Drill

Core drill the 8 pits in AX farm and two pits at 241-AY-102 for the waste transfer lines.

TOTAL CORE DRILLS 10 @ \$29,200 ea

TOTAL COST \$292,000

Concrete Pads

Install concrete mounting pads at the 3 AX farm tanks. Assume 9.3 m^2 (100 ft^2) total at each tank.

TOTAL CONCRETE PADS $27.9 \text{ m}^2 @ \$860 \text{ m}^2$ ($300 \text{ ft}^2 @ \$79 \text{ ft}^2$)

TOTAL COST \$24,000

CCTV Installation/Removal

Install CCTV units in the three AX farm tanks.

TOTAL CCTV INSTALLATIONS 3 @ \$52,000 ea

TOTAL COST \$156,000

241-AY-102 Pump Replacement

Replace the supernate pump in 241-AY-102 (due to radiation damage). The cover block removal, pump removal, and greenhouse setup/teardown are covered in the previous items. Assume pump disposal cost are comparable to cover block disposal costs from Manderbach (1997a).

241-AY-102 PUMP INSTALLATION	1 each @ \$125,000
241-AY-102 PUMP DISPOSAL	1 each @ \$54,800
TOTAL COST	\$179,000
 TOTAL PHMC BOP COSTS	 \$4,372,000

\3600BOP

10. 102 m³ (3,600 ft³) Safety and Permitting Costs

The estimates for the safety and permitting costs are based on the HTI heel retrieval baseline estimate (pages 9, 10, 11 attached). The AX farm retrieval safety efforts are considered to be approximately double those of the baseline estimate. Additionally, \$750,000 is included for Basis of Interim Operation (BIO) amendment activities. The estimate is also based on a 3-year project duration.

Safety	
Management (assuming 3-year duration)	180,000
USQ	15,000
HI&E	48,000
Safety Equipment Lists	52,000
BIO amendment	750,000
SUB TOTAL	\$1,045,000
Permitting	
Management	90,000
NEPA supplement analysis	N/A
Air Permits (NOC) \$43k ea tank	129,000
Air Permits (NOC) \$43k ea for the pits at each tank	129,000
SUB TOTAL	348,000
TOTAL	\$1,393,000

BIO = Basis of Interim Operation

HI&E = Hazard identification and evaluation

NEPA = National Environmental Policy Act

NOC = Notice of Construction

USQ = Unreviewed Safety Question.

DB\3600.SAF

NOTES ON CONTRIBUTORS

Activity ID	Activity Description	Orig Dur	Item Dur	%	Early Start	Early Finish	Budgeted Cost	Notes
R255OR0255	USQ/D Vendor 1	20	20	0	03APR98	30APR98	7,530.88	USQ/D Vendor 1 AIA Milestone T-4-98-522 FY01-FY02-FY03-FY04-FY05-FY06-FY07-FY08-FY09-FY10-FY11-FY12-FY13-FY14-FY15-FY16-FY17-FY18-FY19-FY20
R255OR0257	USQ/D Vendor 2	20	20	0	03APR98	30APR98	7,530.88	USQ/D Vendor 2 Milestone T-4-98-522 FY01-FY02-FY03-FY04-FY05-FY06-FY07-FY08-FY09-FY10-FY11-FY12-FY13-FY14-FY15-FY16-FY17-FY18-FY19-FY20
R255OR0259	Identify SSC's and Prepare SEL Vendor 1	60	60	0	01MAY98	28JUL98	26,029.68	Identify SSC's and Prepare SEL Vendor 1 Milestone T-4-98-522 FY01-FY02-FY03-FY04-FY05-FY06-FY07-FY08-FY09-FY10-FY11-FY12-FY13-FY14-FY15-FY16-FY17-FY18-FY19-FY20
R255OR0261	Identify SSC's and Prepare SEL Vendor 2	60	60	0	01MAY98	28JUL98	26,029.68	Identify SSC's and Prepare SEL Vendor 2 Milestone T-4-98-522 FY01-FY02-FY03-FY04-FY05-FY06-FY07-FY08-FY09-FY10-FY11-FY12-FY13-FY14-FY15-FY16-FY17-FY18-FY19-FY20
R255OR0262	Comp Pre SEL for Retrieval Design Vendors 1 & 2	0	0	0	28JUL98	28JUL98	0.00	Comp Pre SEL for Retrieval Design Vendors 1 & 2 Milestone T-4-98-522 FY01-FY02-FY03-FY04-FY05-FY06-FY07-FY08-FY09-FY10-FY11-FY12-FY13-FY14-FY15-FY16-FY17-FY18-FY19-FY20
R255OR0263	Hazard Identification & Analysis	40	40	0	29OCT98	29DEC98	23,531.60	Hazard Identification & Analysis Milestone T-4-98-522 FY01-FY02-FY03-FY04-FY05-FY06-FY07-FY08-FY09-FY10-FY11-FY12-FY13-FY14-FY15-FY16-FY17-FY18-FY19-FY20
R255OR0265	USQ/D	20	20	0	30DEC98	27JAN99	7,403.20	USQ/D Milestone T-4-98-522 FY01-FY02-FY03-FY04-FY05-FY06-FY07-FY08-FY09-FY10-FY11-FY12-FY13-FY14-FY15-FY16-FY17-FY18-FY19-FY20
R255OR0267	Identify SSC's and Prepare SEL	60	60	0	26JAN99	22APR99	25,382.40	Identify SSC's and Prepare SEL Milestone T-4-98-522 FY01-FY02-FY03-FY04-FY05-FY06-FY07-FY08-FY09-FY10-FY11-FY12-FY13-FY14-FY15-FY16-FY17-FY18-FY19-FY20
R255OR0268	Comp Prelim SEL for Sel C-108 Retrieval Vendor	0	0	0	23APR99	23APR99	0.00	Comp Prelim SEL for Sel C-108 Retrieval Vendor Milestone T-4-98-522 FY01-FY02-FY03-FY04-FY05-FY06-FY07-FY08-FY09-FY10-FY11-FY12-FY13-FY14-FY15-FY16-FY17-FY18-FY19-FY20
R255OR0270	USQ/D	40	40	0	15SEP99	09NOV99	7,254.24	USQ/D Milestone T-4-98-522 FY01-FY02-FY03-FY04-FY05-FY06-FY07-FY08-FY09-FY10-FY11-FY12-FY13-FY14-FY15-FY16-FY17-FY18-FY19-FY20
R255OR0300	Characterization Safety Analysis	40	40	0	01OCT98	25NOV98	22,474.00	Characterization Safety Analysis Milestone T-4-98-522 FY01-FY02-FY03-FY04-FY05-FY06-FY07-FY08-FY09-FY10-FY11-FY12-FY13-FY14-FY15-FY16-FY17-FY18-FY19-FY20
R255OR0303	Hazard Identification & Analysis ITS	20	20	0	30NOV98	29DEC98	6,874.40	Hazard Identification & Analysis ITS Milestone T-4-98-522 FY01-FY02-FY03-FY04-FY05-FY06-FY07-FY08-FY09-FY10-FY11-FY12-FY13-FY14-FY15-FY16-FY17-FY18-FY19-FY20
R255OR0305	USQ/D ITS	60	60	0	30DEC98	25MAR99	23,796.00	USQ/D ITS Milestone T-4-98-522 FY01-FY02-FY03-FY04-FY05-FY06-FY07-FY08-FY09-FY10-FY11-FY12-FY13-FY14-FY15-FY16-FY17-FY18-FY19-FY20
R255OR0307	Identify SSC's and Prepare SEL ITS	0	0	0	15JUN99	15JUN99	0.00	Identify SSC's and Prepare SEL ITS Milestone T-4-98-522 FY01-FY02-FY03-FY04-FY05-FY06-FY07-FY08-FY09-FY10-FY11-FY12-FY13-FY14-FY15-FY16-FY17-FY18-FY19-FY20
R255OR0309	Comp Prelim Safety Equip List for In-tank System	20	20	0	01OCT97	05NOV97	10,589.24	Comp Prelim Safety Equip List for In-tank System Milestone T-4-98-522 FY01-FY02-FY03-FY04-FY05-FY06-FY07-FY08-FY09-FY10-FY11-FY12-FY13-FY14-FY15-FY16-FY17-FY18-FY19-FY20
R255OR0300	Identify SSC's and Prepare SEL ITS	60	60	0	30DEC98	25MAR99	23,796.00	Identify SSC's and Prepare SEL ITS Milestone T-4-98-522 FY01-FY02-FY03-FY04-FY05-FY06-FY07-FY08-FY09-FY10-FY11-FY12-FY13-FY14-FY15-FY16-FY17-FY18-FY19-FY20
R255OR0300	Comp Prelim Safety Equip List for In-tank System	20	20	0	01OCT97	05NOV97	10,589.24	Comp Prelim Safety Equip List for In-tank System Milestone T-4-98-522 FY01-FY02-FY03-FY04-FY05-FY06-FY07-FY08-FY09-FY10-FY11-FY12-FY13-FY14-FY15-FY16-FY17-FY18-FY19-FY20
R255OR0300	Cone Penetrometer Safety Documentation	20	20	0	01OCT97	05NOV97	10,589.24	Cone Penetrometer Safety Documentation Milestone T-4-98-522 FY01-FY02-FY03-FY04-FY05-FY06-FY07-FY08-FY09-FY10-FY11-FY12-FY13-FY14-FY15-FY16-FY17-FY18-FY19-FY20

Activity ID	Activity Description	Orig. Dir.	Rev. %	Early Start	Early Finish	Budgeted Cost	Comments
R255OP0400	LDUA / ERREE Authorization Basis	40	40	0 17NOV97	16JAN98	15,405.60	LDUA / ERREE Authorization Basis FY0001-FY021-FY061-FY081-FY101-FY121-FY141-FY161-FY181-FY201
11131102105030201	Permitting Management	251	251	0 01OCT97	30SEP98	24,475.36	Permitting Management FY0001-FY021-FY061-FY081-FY101-FY121-FY141-FY161-FY181-FY201
R255OP0110	Permitting Management	251	251	0 01OCT97	30SEP98	24,475.36	Permitting Management FY0001-FY021-FY061-FY081-FY101-FY121-FY141-FY161-FY181-FY201
R255OP0115	Cone Penetrometer Permitting Support	19	19	0 03NOV97	01DEC97	3,594.30	Cone Penetrometer Permitting Support FY0001-FY021-FY061-FY081-FY101-FY121-FY141-FY161-FY181-FY201
R255OP0120	Permitting Plan Update	62	62	0 02JAN99	31MAR98	14,459.44	Permitting Plan Update FY0001-FY021-FY061-FY081-FY101-FY121-FY141-FY161-FY181-FY201
R255OP0125	PERMITTING MANAGEMENT	251	251	0 01OCT98	30SEP99	24,060.40	PERMITTING MANAGEMENT FY0001-FY021-FY061-FY081-FY101-FY121-FY141-FY161-FY181-FY201
R255OP0130	Permitting Plan Update	62	62	0 04JAN99	31MAR99	14,408.85	Permitting Plan Update FY0001-FY021-FY061-FY081-FY101-FY121-FY141-FY161-FY181-FY201
R255OP0135	Permitting Management	251	251	0 01OCT99	29SEP00	23,368.80	Permitting Management FY0001-FY021-FY061-FY081-FY101-FY121-FY141-FY161-FY181-FY201
R255OP0140	Permitting Plan Update	63	63	0 04JAN00	31MAR00	14,408.30	Permitting Plan Update FY0001-FY021-FY061-FY081-FY101-FY121-FY141-FY161-FY181-FY201
R255OP0145	Permitting Management	250	250	0 02OCT00	28SEP01	23,530.60	Permitting Management FY0001-FY021-FY061-FY081-FY101-FY121-FY141-FY161-FY181-FY201
R255OP0150	Start Maintaining Administrative Record	0	0	0 13JUN01		0.00	Start Maintaining Administrative Record FY0001-FY021-FY061-FY081-FY101-FY121-FY141-FY161-FY181-FY201
11131102105030202	Permitting Management	94	94	0 01OCT97	17FEB98	19,063.14	Permitting Management FY0001-FY021-FY061-FY081-FY101-FY121-FY141-FY161-FY181-FY201
R255OP0225	Finish C-106 Retrieval NEPA Supplement Anal	1	1	0 01OCT97	01OCT97	0.00	Finish C-106 Retrieval NEPA Supplement Anal FY0001-FY021-FY061-FY081-FY101-FY121-FY141-FY161-FY181-FY201
R255OP0235	RL Panel Review	14	14	0 02OCT97	21OCT97	0.00	RL Panel Review FY0001-FY021-FY061-FY081-FY101-FY121-FY141-FY161-FY181-FY201
R255OP0237	Incorporate Comments	14	14	0 02OCT97	21OCT97	0.00	Incorporate Comments FY0001-FY021-FY061-FY081-FY101-FY121-FY141-FY161-FY181-FY201
R255OP0238	Transmit Draft SA to Ecology/Tribes	0	0	0	21OCT97	0.00	Transmit Draft SA to Ecology/Tribes FY0001-FY021-FY061-FY081-FY101-FY121-FY141-FY161-FY181-FY201
R255OP0239	Ecology/Tribes Review/Comment	35	35	0 22OCT97	11DEC97	0.00	Ecology/Tribes Review/Comment FY0001-FY021-FY061-FY081-FY101-FY121-FY141-FY161-FY181-FY201

11. 102 m³ (3,600 ft³) Sluicer Operational Costs

The estimate for operating the sluicer in tanks 241-AX-101 and 241-AX-103 is based on the data in tables A1 through A-5. Estimates are based on operating 7 days per week and 24 hours per day.

AX-101 Operational time 167.4 days (23.9 weeks)

AX-103 Operational time 54.6 days (7.8 weeks)

5 person crew X 4 shifts X 40 hrs/wk X 31.7 weeks X \$95/hr

TOTAL	\$2,409,000
--------------	--------------------

DB\3600.OPS

12. 102 m³ (3,600 ft³) Vehicle Operational Costs

For the 102 m³ (3,600 ft³) case, the vehicle is used only in 241-AX-102.

The estimate for operating the vehicle in tank 241-AX-102 is based on the data in tables A1 through A-5.

AX-102 Operational Time 0.4 days (0.06 weeks)

The vendor labor costs are based on a 3 man crew, 4 shifts, and a 4 man home office support for 0.06 weeks of retrieval time (the labor through the ORR is included with in the installation costs)

There are an additional 4 weeks of time required for the dismantling and removal of the retrieval system for a total of 8 weeks.

16 persons @\$75/hr X 40 hrs/wk for 4.06 weeks	\$195,000
--	-----------

Per diem (12 persons @ \$80/day X 7 days/wk X 4.06 wk)	\$ 27,000
--	-----------

PHMC labor costs are for a 6 man crew, four shifts, for the 4.06 weeks retrieval and dismantling time.

24 persons @ \$95/hr X 40 hr/wk for 4.06 weeks	\$370,000
--	-----------

TOTAL	\$592,000
-------	-----------

DB\3600VEH.OPS

CALCULATED WASTE RETRIEVAL TIMES FOR AX TANK FARM ARE BASED ON THE FOLLOWING INITIAL WASTE VOLUME INVENTORIES.

AX-101	750,000 gals.
AX-102	33,000 gals
AX-103	112,000 gals
AX-104	7,000 gals

The waste retrieval times are based on the rates shown in table A-5. The rates are based on the assumption that an offsite retrieval vendor will design, fabricate, and operate the vehicle retrieval system similar to the C-106 Heel retrieval system (PHMC personnel will operate the sluicing system). The retrieval rates are net rates and include maintenance downtime and operating efficiencies. The retrieval time is calculated assuming that the retrieval system is operated 24 hours per day, 7 days per week.

The vehicle system retrieval rates in table A-5 were developed in discussions with retrieval personnel working with the HTI C-106 Heel Retrieval vendor and are based on engineering judgement, vendor experience, and experience at the Savanna River "Gunnite and Associated Tanks" (GAAT) retrieval project. The Sluicing system retrieval times are based on past experience with sluicing the Single Shell Tanks in the 1960's and 1970's.

Table A-1. Retrieval Times for 241-AX-101 (Based on Table A-5).

Retrieval Method	Retrieved volume (gals)	Retrieval rate (gal/min)	Retrieval time (days)
Sluice	750,000 - 27,000	3.0	167.4
Sluice	27,000 - 17,000	2.5	2.8
Vehicle	17,000 - 2,700	0.5	19.9
Vehicle	2,700 - 2,100	0.5	0.8
Vehicle	2100 - 270	0.015	84.7

Table A-2. Retrieval Times for 241-AX-102 (Based on Table A-5).

Retrieval method	Retrieved volume (gals)	Retrieval rate (gal/min)	Retrieval time (days)
Vehicle	33,000 - 27,000	10.0	0.4
Vehicle	27,000 - 17,000	6.5	1.1
Vehicle	17,000 - 2,700	0.5	19.9
Vehicle	2,700 - 2,100	0.5	0.8
Vehicle	2100 - 270	0.015	84.7

Table A-3. Retrieval Times for 241-AX-103 (Based on Table A-5).

Retrieval method	Retrieved volume (gals)	Retrieval rate (gal/min)	Retrieval time (days)
Sluice	112,000 - 27,000	3.0	54.6
Sluice	27,000 - 17,000	2.5	2.8
Vehicle	17,000 - 2,700	0.5	19.9
Vehicle	2,700 - 2,100	0.5	0.8
Vehicle	2100 - 270	0.015	84.7

Table A-4. Retrieval Times for 241-AX-104 (Based on Table A-5).

Retrieval method	Retrieved volume (gals)	Retrieval rate (gal/min)	Retrieval time (days)
Vehicle	7,000 - 2,700	0.5	6.0
Vehicle	2,700 - 2,100	0.5	0.8
Vehicle	2100 - 270	0.015	84.7

Table A-5. AX Farm Assumed Retrieval Rates.
(Gallons per minute)

Waste volume (gal)	Salt cake		Sludge	
	PPS	Vehicle	PPS	Vehicle
>27,000	3.0	10 ⁽¹⁾	3.0	10 ⁽¹⁾
27,000 to 17,000	2.5	6.5	2.5	6.5
17,000 TO 2700	0.25 ⁽²⁾	0.5	0.25 ⁽²⁾	0.5
2,700 to 2,100	0.0	0.5	0.0	0.5
2100 TO 270	0.0	0.015	0.0	0.015

¹Vehicle used above 27,000 gal only on AX-102 (assumed leaker).

²For Past Practice Sluicing (PPS), the retrieval rate in the AX farm tanks drops to zero at 5000 gallons of residual waste due to the "shadow effect" of the air lift circulators and inefficiencies at low waste volumes.

³3600 ft³ = 27,000 gal; 360 ft³ = 2,700 gal; 36 ft³ = 270 gal.

⁴Due to lack of experience with sluicing salt cake at Hanford, the rate of salt cake retrieval is assumed to be the same as for sludge.

⁵The residual sluicing heel achieved in the 1970's (using 3 sluicers) exceeded 10.2 m³ (360 ft³) in all four AX farm tanks.

APPENDIX B

COST ESTIMATE DETAILS FOR 10.2 m³ (360 ft³) RESIDUAL WASTE LEVELS

HNF-2693

Revision 1

This page intentionally left blank.

APPENDIX B**10.2 m³ (360 ft³) COST DETAILS**Retrieval to 10.2 m³ (360 ft³) Residual Waste--Cost Summary. (2 Sheets)

	Task description	Cost
1	LLCE removal of tank equipment	2,818,000
2	Procurement and installation of sluicing systems and equipment for tanks 241-AX-101 and 241-AX-103	22,446,000
3	Design/fabricate/install control room for sluicers	204,000
4	Purchase vehicle retrieval system and install in all 4 AX farm tanks	11,442,000
5	Design/fabricate/install HVAC system for tanks 241-AX-101, 102, 103, and 104.	1,082,000
6	Design/install approximately 610 m (2,000 ft) of 10-cm (4-in. diameter waste transfer lines between 241-AY-102 and 241-AX-101, 102, 103, and 104	980,000
7	Design/install new waste transfer jumper pit on west side of AX farm	334,000
8	Decontaminate and clean out 11 pits in AX and AY farms based on W-320 experience.	16,500,000
9	PHMC BOP modifications/installations	5,343,000
10	Safety and Permitting	1,393,000
11	Sluicing Operational Costs	2,470,000
12	Vehicle Operational Costs	3,699,000
	TOTAL	68,711,000

BOP = Balance of plant

CCTV = Closed-Circuit Television

HVAC = Heating, ventilating, and air conditioning

LLCE = Long-Length Contaminated Equipment

PHMC = Project Hanford Management Contractor

TBD = To be determined.

HNF-2693
Revision 1

Contingency and escalation are assumed to be the same as used by FDNW in the preparation of the Project Design Concepts (May 1997). These are as follows:

Escalation is 5.3 percent for FY 1999 through FY 2006 (8 years) for a total escalation of 51.2 percent

32 percent contingency

$$\begin{aligned}\text{TOTAL RETRIEVAL COST } \$68,711,000 \times 1.512 \times 1.32 \\ = \$137,136,000\end{aligned}$$

DB\360-TBL

1. 10.2 m³ (360 ft³) Long-Length Contaminated Equipment Removal

There are 6 pieces of Long-Length Contaminated Equipment (LLCE) that will be removed from the tank pits in AX farm. These will be removed with the existing LLCE system and packaged for burial or disposal as required.

The slurry pump in 241-AY-102 requires removal for replacement due to radiation damage.

In addition, one of the sluicers in 241-AX-101 and 241-AX-103 will need to be removed to provide access for the vehicle.

The estimated cost for the setup of the LLCE, removal of the item from the waste tank, packaging, and burial/storage is \$418,000 for the initial item based on Manderbach (1997a). Costs for subsequent items are \$300,000 each.

Tank 241-AY-102 slurry pump removal	\$418,000
Tank 241-AX-101 pit 01A steam coil	\$300,000
Tank 241-AX-101 pit 01B Sluicer	\$300,000
Tank 241-AX-102 pit 02A Sluicer	\$300,000
Tank 241-AX-102 pit 02B Pump	\$300,000
Tank 241-AX-103 pit 03A Sluicer	\$300,000
Tank 241-AX-104 pit 04A Sluicer	\$300,000
Remove 241-AX-101 new sluicer for vehicle access	\$300,000
Remove 241-AX-103 new sluicer for vehicle access	\$300,000
TOTAL (for 10.2 m ³ [360 ft ³] case)	\$2,818,000

DB\360LLCE

2. 10.2 m³ (360 ft³) Sluicing Equipment fabricate/installation costs

The cost estimate for the design/fabrication and installation of sluicing systems on tanks 241-AX-101 and 241-AX-102 is based on the enhanced sluicing cost estimate for 241-C-106 prepared by FDNW for Job no. E20144 (file no. Z437SAE2) (summary sheet attached). The estimate was modified as detailed below to more accurately reflect the AX farm conditions.

The Total projected cost estimate without escalation or contingency is \$34,140,000 including site allocations. The following items were removed from the estimate as redundant or not applicable:

Regulatory compliance	1,281,000
Accident analysis	650,000
Pump pit 241-C-06A	2,303,000
Heel pit 241-C-06B	1,967,000
Sluice pit 241-C-06C	1,922,000
Enc'd pipe pump to heel pit	298,000
Enc'd pipe heel to sluice pit	223,000
Heel jet removal	618,000
Sluicer removal	594,000
Vendor perform retrieval	2,000,000
Vendor Demobilization	500,000
Ready tank for closure	2,500,000
SUB-TOTAL	14,856,000

The following items were added to the estimate to account for operation in two tanks:
Vendor equipment 2,000,000

Vendor equipment installation 1,162,000

SUB-TOTAL 3,162,000

TOTAL (34,140,000 + 3,162,000 - 14,856,000) = \$22,446,000

FLUOR DANIEL NORTHWEST, INC.
NUMATEC HANFORD CORPORATION
JOB NO. E20144
FILE NO. Z437SAE2

** IEST - INTERACTIVE ESTIMATING **
CONCEPT 1 - ENHANCED SLUICING
ORDER OF MAGNITUDE
PHMCR01 - PROJECT COST SUMMARY

PAGE 1 OF 20
DATE 04/07/97 17:51:46
BY TLW, JJM, RNO, CDL

SORT	DESCRIPTION	ESCALATED	CONTINGENCY		TOTAL
		TOTAL COST		TOTAL	DOLLARS
DESH	DELS HANFORD, INC.	820,000	30	250,000	1,070,000
PDNH	FLUOR DANIEL NORTHWEST	17,290,000	33	5,780,000	23,070,000
LMHC	LOCKHEED MARTIN HANFORD CORP.	1,080,000	30	320,000	1,400,000
NHI	NUMATEC HANFORD CORPORATION	9,270,000	33	3,100,000	12,370,000
SUBTOTAL		28,460,000	33	9,450,000	37,910,000
SITE	SITE ALLOCATIONS	5,680,000	33	1,850,000	7,530,000
	ROUNDING	(40,000)			(40,000)
TOTAL PROJECT COST (TPC)		34,140,000	33	11,300,000	45,440,000

BEST AVAILABLE COPY

HNF-2693
Revision 1

TYPE OF ESTIMATE	ORDER OF MAGNITUDE	4/7/97	REMARKS: Subject to change.
PDNH LEAD ESTIMATOR	ESTIMATING MANAGER	<i>[Signature]</i>	
PROJECT MANAGER	<i>[Signature]</i> M. MASOCCO	4/8/97	
CLIENT			

(ROUNDED/ADJUSTED TO THE NEAREST * 10,000 / 100,000 * - PERCENTAGES NOT RECALCULATED TO REFLECT ROUNDING)

B-7

3. 10.2 m³ (360 ft³) Sluicer Control Room

The estimated cost for the control room/lunch room is taken from the 1994 W-320 estimate (Job no. W-320/ER4319 page 23 attached). One control room for the systems used in tanks 241-AX-101 and 241-AX-103 is adequate. This control room would be located outside the tank farm boundaries.

The W-320 control room was not installed (a mobile office was modified) so the costs for the control room are not included in the later estimates.

From page 23 of the estimate (rounded) \$204,000

DB\360.CNT

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. W-320/ER4319
FILE NO. W320PBD7

** TEST - INTERACTIVE ESTIMATING **
TANK 241-C-106 SLUICING REVISION #1
40% PRELIMINARY ESTIMATE
DOE_R04 - COST CODE ACCOUNT SUMMARY

PAGE 23 OF 32
DATE 10/21/94 07:56:21
BY GDC/JPH/DKM/CDL/XDE

COST CODE/WD5	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION % TOTAL	SUB TOTAL	CONTINGENCY % TOTAL	TOTAL DOLLARS
3490	AY EQUIPMENT	7860	0	7860	0.00	0	20	1572
3510	HYDRAULIC TRAILER/STRONGBACK	493220	0	493220	0.00	0	1	6430
3560	CEMENT FABRICATION	660184	0	660184	0.00	0	2	14198
4212	CHTL RH INSTR. INSTALLATION	713564	0	713564	1.60	11417	25	181246
4221	TRANSFER LINE	1259047	271846	1530893	1.60	24495	25	388369
4222	SERVICE BLDG.	6403	1306	7709	1.61	124	20	1567
4223	CONTROL RH/LUNCH RH	204417	41701	246118	1.60	3930	20	50011
4313	CORE DRILLS	499806	0	499806	3.61	18043	28	144076
4314	PIT SLEEVE/EHDS	102622	0	102622	3.61	3704	30	31898
4315	JUMPERS	372617	0	372617	3.61	13451	30	115821
4322	ENCASED PIPING INSTALLATION	254481	0	254481	3.61	9187	30	79100
4324	C- FARM INSTRUMENT AIR & VENT	39131	0	39131	3.61	1412	30	12163
4330	C-FARM ELECTRICAL	869740	0	869740	3.61	31397	20	180227
4341	MASF HOCK-UP	247311	0	247311	3.61	8928	20	51248
4343	SLUICING EQUIP.	512504	0	512504	3.61	18501	30	159382
4351	CHILLER SKID	40418	0	40418	3.61	1459	30	12563
4352	PROCESS SKID	237120	0	237120	3.61	8560	22	53764
4353	EXHAUST SYSTEM	4549	0	4549	3.61	164	30	1414
4354	FOG SUPPRESSION SYS	54897	0	54897	3.61	1981	25	14221
4356	DIRECTED AIR SYSTEM	13308	0	13308	3.61	481	25	3447
4357	EXISTING AIR INLET MOD'S	7917	0	7917	3.61	286	25	2051
4411	HISC-PADS	218925	0	218925	3.89	8516	25	56924
4412	HISC. INSTRUMENTATION	134525	0	134525	3.89	5233	30	41927
4413	PIT SLEEVE/ EHDS	35161	0	35161	3.89	1368	30	10959
4414	JUMPERS	248235	0	248235	3.89	9657	30	77368
4416	PIT BACKFILL	711	0	711	3.89	28	30	222
4421	EXCAVATION - PIPING	8459	0	8459	3.89	329	30	2637
4422	ENCASED PIPING INSTALLATION	48398	0	48398	3.89	1803	30	15084
4423	BACKFILL PIPING	2339	0	2339	3.89	91	30	729
4430	AY-FARM ELECTRICAL	366957	0	366957	3.89	14274	20	76247
4509	HVAC SKID PROCUREMENT	857899	0	857899	2.46	21104	20	175801
4510	SLUICING EQUIP. PROCUREMENT	1017615	0	1017615	2.46	25033	15	156398
4543	SLUICING EQUIPMENT C-106	2581207	0	2581207	2.46	63498	15	396706
4604	COLD TESTING	1505123	0	1505123	0.12	1749	10	155567
4605	FABRICATION/INSTALLATION	3307896	0	3307896	0.14	4597	11	376368
4606	GENERAL CONSTRUCTION SUPPORT-ERS	936509	0	936509	2.17	20322	20	191366
4610	CONTAINER TRAILER FAB CTC	49598	0	49598	0.00	0	10	4960
4700	GENERAL CONSTRUCTION SUPPORT-SLUICE	384220	0	384220	2.17	8338	20	78512
4777	GENERAL & TECH. SERVICES-SLUICING	589588	0	589588	2.17	12795	20	120477
TOTAL 700 SPECIAL EQUIP/PROCESS SYSTEM		19783677	314853	20098530	1.77	356343	17	3576571
						20454072		24031443

HNF-2693
Revision 1

B-9
TEST AVAILABLE COPY

4. 10.2 m³ (360 ft³) Vehicle Retrieval System costs**Vendor Costs**

The vendor cost estimate is based on the two vendor systems currently being designed for the retrieval of the heel in tank 241-C-106. This also assumes that the same type of service contract will be used to procure the retrieval systems for the AX farm as is being used for the procurement of the 241-C-106 vehicle retrieval system.

Vendor supplied system/equipment

Design, fabrication, testing, and delivery of a vehicle based retrieval system ready to install in the AX farm (based on discussions with HTI 241-C-106 Heel Retrieval System Engineers).

\$5,500,000

Pre-operational work at AX farm

ORR, training, and acceptance testing based on 6 month duration. Three person vendor crew, four shifts, and four person home office support on one shift.

Labor (16 persons @ \$75/hr for 24 weeks) \$1,152,000

Per diem (16 persons @ \$80/day for 24 weeks) \$30,700

Warehouse and office rental in the Tri-Cities area.

Eighteen month duration based on the use of one vehicle that is moved tank to tank
\$90,000

Sub-total \$6,772,000

PHMC Bid and Award

Based on HTI 241-C-106 Heel Retrieval System costs \$200,000

PHMC Contract Management

Based on HTI 241-C-106 Heel Retrieval System costs \$400,000

PHMC ORR/ATP

Based on HTI 241-C-106 Heel Retrieval System costs	\$400,000
Three additional ATP/OTPs after vehicle moved	\$300,000
Sub-total	\$1,300,000

Installation Costs

The estimated cost to install a vehicle based retrieval system in 241-AX-101, 102.103, and. 104 is assumed to be the same as for tank 241-C-106. The installation costs in 241-C-106 is from sheet 17 (attached) of the HTI baseline estimate. This does not include the costs to modify the farm/tank for acceptance of the vehicle system.

Four at	\$842,500 each
Sub-total	\$3,370,000
TOTAL	\$11,442,000

DB\360.VEH

Activity ID	Activity Description	Orig Dur	Rem Dur	Early Start	Early Finish	Budgeted Cost	Activity Notes
R2550S0135	INCRP COMMENTS/FINALIZE	25	25	0 29MAR99	30APR99	0.00	INCRP COMMENTS/FINALIZE
R2550S0140	SUBMIT FINAL PKG FOR REVIEW (90%)	0	0	0	30APR99	0.00	SUBMIT FINAL PKG FOR REVIEW (90%)
R2550S0145	REVIEW/COMMENTS	10	10	0 03MAY99	14MAY99	0.00	REVIEW/COMMENTS
R2550S0150	SUBMIT PKG FOR APPROVAL	0	0	0	14MAY99	0.00	SUBMIT PKG FOR APPROVAL
R2550S0155	Stage 1 Design Approval	10	10	0 17MAY99	29MAY99	0.00	Stage 1 Design Approval
R2550S0160	Stage 1 Design Approved	0	0	0	29MAY99	0.00	Stage 1 Design Approved
R2550S0205	STAGE 2 DESIGN ACTIVITIES	130*	130*	0 11MAR99	14SEP99	1,315,710.08	STAGE 2 DESIGN ACTIVITIES
R2550S0210	STAGE 2 DESIGN PLAN	20	20	0 11MAR99	07APR99	0.00	STAGE 2 DESIGN PLAN
R2550S0215	PREPARE 60% DESIGN PKG (STAGE 2)	60	60	0 08APR99	01JUL99	0.00	PREPARE 60% DESIGN PKG (STAGE 2)
R2550S0220	INCRP COMMENTS/FINALIZE	30	30	0 06JUL99	16AUG99	0.00	INCRP COMMENTS/FINALIZE
R2550S0225	SUBMIT FINAL PKG FOR REVIEW	0	0	0	16AUG99	0.00	SUBMIT FINAL PKG FOR REVIEW
R2550S0230	REVIEW/COMMENT	10	10	0 17AUG99	30AUG99	0.00	REVIEW/COMMENT
R2550S0235	SUBMIT PKG FOR APPROVAL	0	0	0	30AUG99	0.00	SUBMIT PKG FOR APPROVAL
R2550S0240	STAGE 2 DESIGN APPROVAL	10	10	0 31AUG99	14SEP99	0.00	STAGE 2 DESIGN APPROVAL
R2550S0301	Installation Retrieval System In C-106	42	42	0 06MAR00	02MAY00	842,441.33	Installation Retrieval System In C-106

5. 10.2 m³ (360 ft³) HVAC System Design/Installation Costs

The estimate for a new AX farm HVAC system is based on the FDNW W-320 HVAC skid estimate contained in file no. W320PDA4, job no. W-320/P7448M (page 14 attached). This is the same as for the 102 m³ (3,600 ft³) case with an additional \$100,000 to connect the system to 241-AX-104.

AX Farm HVAC System for three tanks	\$982,000
Additional cost to connect to 241-AX-104	\$100,000
TOTAL	\$1,082,000

DB\360HVAC

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. H-320/P7448H
FILE NO. H320PDA4

** TEST - INTERACTIVE ESTIMATING **
TANK 241-C-106 SLUICING
901 PRELIMINARY ESTIMATE
DOE_R02 - WORK BREAKDOWN STRUCTURE SUMMARY

PAGE: 14 OF 35
DATE 07/25/95 15:11:06
BY KE/DH/JM/LR/CL/RO/KR

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ON-SITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
4509AD	PROCESS BUILDING PROCUREMENT	494446	0	494446	1.74	8603	503049	5	25152	528202
4509AC	CHILLER SKID PROCUREMENT	80231	0	280231	1.74	4876	285107	5	14255	299362
	SUBTOTAL 4509 HVAC SKID PROCUREMENT	576677	0	782030	1.74	17087	999117	5	49955	1049073
4510AD	PURCHASE PUMP	114475	0	1140475	1.74	19844	1160319	15	174048	1334367
4510AC	ELECTRICAL EQUIPMENT PROCUREMENT	629535	0	629535	1.73	10894	640429	15	95552	735981
	SUBTOTAL 4510 SLUICING EQUIP. PROCUREMENT	1770010	0	1770010	1.74	30738	1800748	15	269600	2070348
454310	SLUICING EQUIPMENT C-106	804052	0	804052	1.74	13991	818043	25	204511	1022553
	SUBTOTAL 4543 SLUICING EQUIPMENT C-106	804052	0	804052	1.74	13991	818043	25	204511	1022553
	SUBTOTAL 45 EXPENSE PROCUREMENT	4113496	0	4113496	1.50	61816	4175312	13	553563	4728875
461500	PIT DECON - HOCK-UP	329246	0	329246	0.00	0	329246	30	98774	428020
461510	PIT DECON - C-106 FARM	520252	0	520252	0.00	0	520252	30	156076	676328
461520	PIT DECON - AY-102 FARM	527252	0	527252	0.00	0	527252	30	158176	685428
	SUBTOTAL 4615 PIT DECON	1376750	0	1376750	0.00	0	1376750	30	413026	1789776
	SUBTOTAL 46 PIT DECON	1376750	0	1376750	0.00	0	1376750	30	413026	1789776
470000	CONSTRUCTION SERVICES - CTD	62326	0	62326	0.00	0	62326	0	0	62326
470010	GENERAL CONSTRUCTION SUPPORT	762849	0	762849	2.35	17902	780751	18	140760	921510
	SUBTOTAL 4700 CONSTRUCTION SERVICES	825175	0	825175	2.17	17902	843077	17	140760	983836
477700	EQUIPMENT USAGE	315813	0	315813	2.61	8243	324056	20	64811	388867
477710	MANAGEMENT SUPPORT FOR CONSTR	496445	0	496445	2.61	12957	509402	20	101880	611283
477720	CF SUPPORT	999967	0	999967	2.61	26099	1026066	20	205214	1231279
477730	QUALITY SUPPORT	161500	0	161500	2.61	4215	165715	20	33143	198858
	SUBTOTAL 4777 GENERAL & TECH. SERVICES	1973725	0	1973725	2.61	51514	2025239	20	405048	2430287
	SUBTOTAL 47 CONSTRUCTION SERVICES	2798900	0	2798900	2.48	69416	2868316	19	545808	3414123

HNF-2693
Revision 1

B-14

6. 10.2 m³ (360 ft³) Waste Transfer Line

Description	Length
241-AY-102	
Pit 02A to new valve pit	76 m (250 ft)
Pit 02E to new valve pit	72 m (235 ft)
241-AX-101	
Pit 01A to new valve pit	67 m (220 ft)
Pit 01B to new valve pit	61 m (200 ft)
Pit 01D to new valve pit	56 m (185 ft)
241-AX-102	
Pit 02A to new valve pit	58 m (190 ft)
Pit 02B to new valve pit	50 m (165 ft)
241-AX-103	
Pit 03A to new valve pit	38 m (125 ft)
Pit 03C to new valve pit	41 m (135 ft)
Pit 03D to new valve pit	29 m (95 ft)
241-AX-104	
Pit 04A to new valve pit	__ m (90 ft)
Pit 04D to new valve pit	21 m (70 ft)
TOTAL LINE LENGTHS IN FEET	598 m (1,960 ft)
COST	\$980,000

Note 1: Fabrication and installation cost for the waste transfer line is \$3,279/m (\$1,000/ft) for a double line.

Note 2: Each pit above requires core drill and nozzle installation, i.e., 12 each for the 10.2 m³ (360 ft³) case.

\360.LIN

7. 10.2 m³ (360 ft³) Pit Design/Installation Costs

The estimate for a new AX farm above grade transfer line (jumper) pit is based on the pit cover block fabrication and caisson/slab support for the manipulator arm costs contained in the *Cost Normalization Unit Estimates* (Manderbach 1997a). Assume same cover block costs and that the pit will cost the same as the manipulator slab.

Cover block	\$102,000
Pit	\$232,000
TOTAL	\$334,000

DB\360.PIT

8. 10.2 m³ (360 ft³) Pit Decontamination Costs

For the 10.2 m³ (360 ft³) case, 10 pits in AX farm and the pump pit at 241-AY-102 are used for the retrieval activities.

Discussed the condition and radiation levels in the pits with Dave Bragg in a Telecon 4/20/98 as summarized below.

Dave is not aware on any record of the activities that have been carried out in the last 15 years in the pits. Dave indicated that the pits probably haven't been opened in the last 15-20 years. Dave has no information on the pits as compared to the 241-C-106 pits that were decontaminated for Project W-320. Dave stated that John W. Bailey might have some recollection of the AX farm retrieval sluicing activities and that he would be a good source to try. John Bailey indicated that the pits in AX farm should be in better condition than those in C Farm (the drains should work).

For the purpose of preparing this estimate, will assume that the pits are in comparable condition to the 241-C-106 pits. From the FDNW estimate for the Vehicle Based Retrieval System, Job no. E20144 (file Z437SAF2), the allocated cost for decontamination of the pits is \$1,500,000 each (page 7, item 7E-4 attached).

TOTAL	(11 pits)	\$16,500,000
-------	-----------	--------------

DB\360.DCN

FLUOR DANIEL NORTHWEST, INC.
NUMATEC HANFORD CORPORATION
JOB NO. E20144
FILE NO. Z437SAF2

** TEST - INTERACTIVE ESTIMATING **
CONCEPT 2 - VEHICLE BASED WASTE RETRIEVAL
STUDY - - - R O M
PHMCR03 - ESTIMATE BASIS SHEET

PAGE 7 OF 16
DATE 04/15/97 07:42:17
BY TLW, JJM, RMO, CDL

MDS.310 (ON SITE CONSTRUCTION) A CONTINGENCY OF 3% HAS BEEN APPLIED BECAUSE OF LIMITED INFORMATION AVAILABLE ON THE RADIATION LEVELS THAT WILL BE ENCOUNTERED DURING PIPE INSTALLATION, FIT MODIFICATIONS AND DECONTAMINATION, FIT MODIFICATIONS, AND UNDERGROUND OBSTRUCTIONS THAT MAY BE ENCOUNTERED DURING CONSTRUCTION. THE ENHANCED SLUICER COST IS BASED UPON VERBAL ALLOWANCES PROVIDED BY THE ENGINEER AND WITHOUT VENDOR INPUT.

6. ROUNDING

THE PROJECT COST SUMMARY REPORT IS SUMMARIZED AND ADJUSTED/ROUNDED AS FOLLOWS:
THE ESCALATED TOTAL COST COLUMN, CONTINGENCY TOTAL COLUMN AND TOTAL DOLLARS COLUMN SUB-TOTALS ARE SUMMARIZED BY CONTRACTOR. THE COLUMN SUBTOTALS ARE ADJUSTED/ROUNDED TO THE NEAREST \$1,000/\$10,000. THE PROJECT TOTAL SUMMARY LINE TOTALS ARE ADJUSTED/ROUNDED TO THE NEAREST \$10,000/\$100,000.

7. REMARKS

MAJOR ASSUMPTIONS WHICH HAVE BEEN MADE IN THE PREPARATION OF THIS ESTIMATE ARE AS FOLLOWS:

- A.) THE TEMPORARY CHANGE ROOM TRAILER, MOBILE DRILL RIG AND ASSOCIATED EQUIPMENT, VACUUM TRUCK (GUZZLER), AND CRANES WILL BE FURNISHED TO THE PROJECT AT NO COST EXCEPT FOR THE SET UP COSTS.
- B.) BURNOUT COSTS ARE NOT INCLUDED IN THIS COST ESTIMATE BY DIRECTION OF PHMC. IF BURNOUT IS ADDED ITS COST IS APPROXIMATELY \$2.5M AND IS BASED UPON AN ASSUMED 10M² READING AT THE UPPER SECTION OF THE CASING AND 25M² AT THE LOWER SECTION OF THE CASING, (REF. C.C. MAIL). OTHER CONSTRUCTION WORK, INSIDE THE FARM FENCE, WAS ESTIMATED AS 10M². RAD LEVELS ABOVE 25M² IS NOT ANTICIPATED.
- C.) ALL CONTAMINATED SOIL WAS ASSURED TO BE LOW RAD AND WAS ESTIMATED AS BACKFILL ONLY (BURIAL IN BARRELS NOT INCL.).
- D.) THE TOTAL NUMBER OF DRAWINGS, BY DISCIPLINE, AND AN ALLOWANCE OF 150 MAN HOURS EACH WAS PROVIDED BY ENGINEERING.
- E.) ITEMS THAT ARE NOT INCLUDED IN THIS COST ESTIMATE:
 1. FLAMMABLE GAS. IT IS ASSUMED THAT THIS WAS COVERED IN THE W-320 PROJECT.
 2. CONTROL ROOM. THE CONTROL ROOM PROVIDED IN W-320 WILL BE USED.
 3. AFTER OPERATIONS IS COMPLETE, THE EQUIPMENT WILL BE ABANDONED IN PLACE (EXCEPT ENHANCED SLUICER).
 4. CLEANING, PAINTING AND OTHER SIMILAR MODIFICATIONS OF PITS. AN ALLOWANCE OF \$1.5M (BASED UPON W-320 LESSONS LEARNED) PER PIT FOR DECONTAMINATION IS INCLUDED.
 5. THE HVAC SYSTEM THAT W-320 INSTALLED IS NOT MODIFIED AND IS NOT INCLUDED IN THIS COST ESTIMATE.
 6. SPARE PARTS.
 7. ADDITIONAL REMOTE CAMERAS AS THIS WAS INSTALLED BY W-320.
- F.) PIPING ALLOWANCES ARE FOR NORMAL PIPING AND ARE NOT ASME, SECTION 3 (N-STAMPED).
- G.) W-320 REPLACEMENT ITEMS FOR FAILED EQUIPMENT ARE AN ENGINEERING ALLOWANCE OF \$300,000.
- H.) EXISTING PIT CONDITIONS ARE UNKNOWN AND THE WASH DOWN ALLOWANCE OF 200MH IS ONLY AN ALLOWANCE. IT SHOULD BE NOTED THAT PROJECT W-320 EXPERIENCED HIGHER MANHOURS, DUE TO POOR PIT CONDITIONS.
- I.) AN ALLOWANCE OF APPROXIMATELY \$5M (BASED ON W-320 LESSONS LEARNED) PER PIT FOR DECONTAMINATION IS INCLUDED.
- J.) ESCALATION IS BASED ON A MIDPOINT OF ALL STAGES OF CONSTRUCTION (4-1-99).

B-18

BEST AVAILABLE COPY

HNF-2693
Revision 1

9. 10.2 m³ (360 ft³) BOP Mods/Installation

The unit costs used in this section were taken from the FDNW *Cost Normalization Unit Estimates* (Manderbach 1997a).

Waste Transfer Line Jumpers

Eight jumpers will be required in the new transfer pit to route the eight lines coming from the 4 tanks (241-AX-101, 241-AX-102, 241-AX-103, and 241-AX-104).

Ten jumpers will be required for the pits in AX farm and two required at 241-AY-102.

TOTAL JUMPERS REQUIRED	20 @ \$56,000 ea
------------------------	------------------

TOTAL	COST	\$1,120,000
-------	------	-------------

Cover Block Removal

Remove the cover blocks from the ten pits in AX farm (3 each on 241-AX-101 and 241-AX-103; 2 each on 241-AX-102 and 241-AX-104)

Remove/replace the cover blocks from the pump pit on 241-AY-102 for replacement of the pump due to radiation damage and the sluice pit for core drilling.

TOTAL COVER BLOCKS REMOVED	12 @ \$77,300 ea
----------------------------	------------------

TOTAL	COST	\$928,000
-------	------	-----------

Cover Block Fabrication

Fabricate and install new cover blocks for the ten pits in AX farm (3 each on 241-AX-101, 241-AX-103, and 2 each on 241-AX-102, 241-AX-104).

TOTAL COVER BLOCKS FABRICATED	10 @ \$102,500 ea
-------------------------------	-------------------

TOTAL	COST	\$1,025,000
-------	------	-------------

Cover Block Disposal

Dispose of the ten cover blocks removed from the pits in AX farm.

TOTAL COVER BLOCKS DISPOSED	10 @ \$54,800 ea
-----------------------------	------------------

TOTAL	COST	\$548,000
-------	------	-----------

Greenhouse Setup/Teardown

Setup and teardown of greenhouses and shield walls on the ten pits in AX farm and two pits at 241-AY-102.

TOTAL GREENHOUSE SETUP/TEARDOWN 12 @ \$79,400 ea

TOTAL COST \$953,000

Pit Core Drill

Core drill the 10 pits in AX farm and two pits at 241-AY-102 for the waste transfer lines.

TOTAL CORE DRILLS 12 @ \$29,200 ea

TOTAL COST \$350,000

Concrete Pads

Install concrete mounting pads at the 4 AX farm tanks. Assume 9.3 m^2 (100 ft^2) total at each tank.

TOTAL CONCRETE PADS 37.2 m^2 @ \$850/ m^2 (400 ft^2 @ \$79 ft^2)

TOTAL COST \$32,000

CCTV Installation/Removal

Install CCTV units in the four AX farm tanks.

TOTAL CCTV INSTALLATIONS 4 @ \$52,000 ea

TOTAL COST \$208,000

241-AY-102 Pump Replacement

Replace the supernate pump in 241-AY-102 (due to radiation damage). The cover block removal, pump removal, and greenhouse setup/teardown are covered in the previous items. Assume pump disposal cost are comparable to cover block disposal costs from Manderbach (1997a).

241-AY-102 PUMP INSTALLATION	1 each @ \$125,000
------------------------------	--------------------

241-AY-102 PUMP DISPOSAL	1 each @ \$54,800
--------------------------	-------------------

TOTAL COST	\$179,000
------------	-----------

TOTAL PHMC BOP Modifications/Installations \$5,343,000

\360BOP

10. 10.2 m³ (360 ft³) Safety and Permitting Costs

The estimates for the safety and permitting costs are based on the HTI heel retrieval baseline estimate (pages 9, 10, 11 attached). The AX farm retrieval safety efforts are considered to be approximately double those of the baseline estimate. Additionally, \$750,000 is included for USQ amendment activities. The estimate is also based on a 3-year project duration.

Safety

Management (assuming 3-year duration)	180,000
USQ	15,000
HI&E	48,000
Safety Equipment Lists	52,000
BIO amendment	750,000

Sub-total	\$1,045,000

Permitting

Management	90,000
NEPA supplement analysis	N/A
Air Permits (NOC) \$43k ea tank	129,000
Air Permits (NOC) for the pits at each tank (\$43k ea)	129,000

Sub-total	\$ 348,000
TOTAL	\$1,393,000

DB\360.SAF

Oct 10 4 1000 PM

Activity ID	Activity Description	Orig Dir	Rem Dir	%	Early Start	Early Finish	Budgeted Cost	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20
R255OR0255	USQ/D Vendor1	20	20	0	03APR98	30APR98	7,530.08	USQ/D Vendor1																				
R255OR0257	USQ/D Vendor 2	20	20	0	03APR98	30APR98	7,530.08	USQ/D Vendor 2																				
R255OR0259	Identify SSC's and Prepare SEL Vendor 1	60	60	0	01MAY98	28JUL98	26,029.68	Identify SSC's and Prepare SEL Vendor 1																				
R255OR0261	Identify SSC's and Prepare SEL Vendor 2	60	60	0	01MAY98	28JUL98	26,029.68	Identify SSC's and Prepare SEL Vendor 2																				
R255OR0262	Comp Pre SEL for Retrieval Design Vendors 1 & 2	0	0	0		28JUL98	0.00	Comp Pre SEL for Retrieval Design Vendors 1 & 2																				
R255OR0263	Hazard Identification & Analysis	40	40	0	29OCT98	29DEC98	23,531.60	Hazard Identification & Analysis																				
R255OR0265	USQ/D	20	20	0	30DEC98	27JAN99	7,403.20	USQ/D																				
R255OR0267	Identify SSC's and Prepare SEL	60	60	0	28JAN99	22APR99	25,382.40	Identify SSC's and Prepare SEL																				
R255OR0268	Compt Prelim SEL for Sel C-106 Retrieval Vendor	0	0	0		23APR99	0.00	Compt Prelim SEL for Sel C-106 Retrieval Vendor																				
R255OR0270	USQ/D	40	40	0	15SEP99	09NOV99	7,254.24	USQ/D																				
1113310205030103 Characterization Safety																												
R255OR0360	Hazard Identification & Analysis ITS	40	40	0	01OCT98	25NOV98	22,474.00	Hazard Identification & Analysis ITS																				
R255OR0365	USQ/D ITS	20	20	0	30NOV98	29DEC98	6,874.40	USQ/D ITS																				
R255OR0370	Identify SSC's and Prepare SEL ITS	60	60	0	30DEC98	25MAR99	23,796.00	Identify SSC's and Prepare SEL ITS																				
R255OR0380	Compt Prelim Safety Equip List for In-tank System	0	0	0		15JUN99	0.00	Compt Prelim Safety Equip List for In-tank System																				
R255OR0390	Cone Penetrometer Safety Documentation	26	26	0	01OCT97	05NOV97	10,589.24	Cone Penetrometer Safety Documentation																				

Activity ID	Activity Description	Orig. Dur.	Rem. Dur.	Early Start	Early Finish	Budgeted Cost	Actual Cost	Comments
R255OP0400	LQJA / EREE Authorization Basis	40	40	017NOV97	16JAN98	15,405.60	15,405.60	LOJA EREE Authorization Basis 17102CL50P01
1113110205030202	Permitting Management	251	251	0101OCT97	30SEP98	24,475.36	24,475.36	Permitting Management 17102CL50P01
R255OP0115	Core Penetration Permitting Support	19	19	0103NOV97	01DEC97	3,594.30	3,594.30	Core Penetration Permitting Support 17102CL50P03
R255OP0120	Permitting Plan Update	62	62	0102JAN98	31MAR98	14,459.44	14,459.44	Permitting Plan Update 17102CL50P01
R255OP0125	PERMITTING MANAGEMENT	251	251	0101OCT98	30SEP99	24,060.40	24,060.40	PERMITTING MANAGEMENT 17102CL50P01
R255OP0130	Permitting Plan Update	62	62	0104JAN99	31MAR99	14,400.65	14,400.65	Permitting Plan Update 17102CL50P01
R255OP0135	Permitting Management	251	251	0101OCT99	29SEP00	23,368.00	23,368.00	Permitting Management 17102CL50P01
R255OP0140	Permitting Plan Update	63	63	0104JAN00	31MAR00	14,400.30	14,400.30	Permitting Plan Update 17102CL50P01
R255OP0145	Permitting Management	250	250	0102OCT00	20SEP01	20,538.60	20,538.60	Permitting Management 17102CL50P01
R255OP0150	Start Maintaining Administrative Record	0	0	013JUN01		0.00	0.00	Start Maintaining Administrative Record
111311021050310202	Retrieval Permitting	94	94	0101OCT97	17FEB98	10,063.14	10,063.14	Finish C-106 Retrieval NEPA Supplement Anal 17102CL50P02
R255OP0225	Finish C-106 Retrieval NEPA Supplement Anal	94	94	0101OCT97	17FEB98	10,063.14	10,063.14	Finish C-106 Retrieval NEPA Supplement Anal 17102CL50P02
R255OP0236	RL Panel Review	1	1	0101OCT97	01OCT97	0.00	0.00	RL Panel Review
R255OP0237	Incorporate Comments	14	14	0102OCT97	21OCT97	0.00	0.00	Incorporate Comments
R255OP0238	Transmit Draft SA to Ecology/Tribes	0	0		21OCT97	0.00	0.00	Transmit Draft SA to Ecology/Tribes
R255OP0239	Ecology/Tribes Review/Comment	35	35	0122OCT97	11DEC97	0.00	0.00	Ecology/Tribes Review/Comment

11. 10.2 m³ (360 ft³) Sluicer Operational Costs

The estimate for operating the sluicer in tanks 241-AX-101 and 241-AX-103 is based on the data in tables A-1 through A-5. Estimates are based on operating 7 days per week and 24 hours per day.

AX-101 Operational time 170.2 days (24.3 wks)

AX-103 Operational time 57.4 days (8.2 wks)

5 person crew X 4 shifts X 40 hrs/wk X 32.5 weeks X \$95/hr

TOTAL \$2,470,000

DB\360.OPS

12. 10.2 m³ (360 ft³) Vehicle Operational Costs

For the 10.2 m³ (360 ft³) case, the vehicle is used in all four AX farm tanks. The estimate for vehicle operating time is based on the data in tables A-1 through A-5.

AX-101 Operational time	19.9 days
AX-102 Operational time	21.4 days
AX-103 Operational time	19.9 days
AX-104 Operational time	6.0 days
Total	67.2 days (9.6 wks)

The vendor labor costs are based on a 3 man crew, 4 shifts, and a 4 man home office support for 9.6 weeks of retrieval time at each tank (the labor through the ORR is included with in the installation costs).

There are 4 weeks required to move the system from tank to tank.

There are an additional 4 weeks of time required for the dismantling and removal of the retrieval system.

The total time required is:

Retrieve four tanks	9.6 weeks
Move system 3 times	12 weeks
Dismantle system	4 weeks

TOTAL	25.6 weeks
16 persons @\$75/hr X 40 hr/wk for 25.6 weeks	\$1,229,000
Per diem (12 persons @\$80/day)	\$172,000

Sub-total	\$1,401,000

PHMC labor costs are for a 6 man crew, four shifts, for the 25.6 weeks retrieval and dismantling time.

24 persons @ \$95/hr for 25.2 weeks	\$2,298,000
TOTAL	\$3,699,000

HNF-2693
Revision 1

This page intentionally left blank.

APPENDIX C

COST ESTIMATE DETAILS FOR 1.0 m³ (36 ft³) RESIDUAL WASTE LEVEL

HNF-2693
Revision 1

This page intentionally left blank.

APPENDIX C

1.0 m³ (36 ft³) COST DETAILSRetrieval to 1.0 m³ (36 ft³) Residual Waste--Cost Summary. (2 Sheets)

	Task Description	Cost
1	LLCE removal of tank equipment	2,818,000
2	Procurement and installation of sluicing systems and equipment for tanks 241-AX-101 and 241-AX-103	22,446,000
3	Design/fabricate/install control room for sluicers	204,000
4	Purchase and install vehicle retrieval system in 241-AX-104	11,442,000
5	Design/fabricate/install HVAC system for tanks 241-AX-101, 102, 103, and 104.	1,082,000
6	Design/install approximately 610 m (2,000 ft) of 10-cm (4-in.) diameter waste transfer lines between 241-AY-102 and 241-AX-101, 102, 103, and 104.	980,000
7	Design/install new waste transfer jumper pit on west side of AX farm	334,000
8	Decontaminate and clean out 11 pits in AX and AY farms based on W-320 experience.	16,500,000
9	PHMC BOP modifications/installations	5,343,000
10	Safety and Permitting	1,393,00
11	Sluicing Operational Costs	2,470,000
12	Vehicle Operational Costs	10,871,000
	TOTAL	75,883,000

BOP = Balance of Plant

CCTV = Closed-circuit television

HVAC = Heating, ventilating, and air conditioning

LLCE = Long-length contaminated equipment

PHMC = Project Hanford Management Contractor.

Contingency and escalation are assumed to be the same as used by FDNW in the preparation of the Project Design Concepts (May 1997). These are as follows:

Escalation is 5.3 percent for FY 1999 through FY 2006 (8 years) for a total escalation of 51.2 percent

32 percent contingency

$$\begin{aligned}\text{TOTAL RETRIEVAL COST } 75,883,000 \times 1.512 \times 1.32 \\ = \$151,450,000\end{aligned}$$

DB\36-TBL

1. 1.0 m³ (36 ft³) Long-Length Contaminated Equipment Removal

There are 6 pieces of Long-Length Contaminated Equipment (LLCE) that will be removed from the tank pits in AX farm. These will be removed with the existing LLCE system and packaged for burial or disposal as required.

The slurry pump in 241-AY-102 requires removal for replacement, due to radiation damage.

In addition, one of the sluicers in 241-AX-101 and 241-AX-103 will need to be removed to provide access for the vehicle.

The estimated cost for the setup of the LLCE, removal of the item from the waste tank, packaging, and burial/storage is \$418,000 for the initial item based on Manderbach (1997a). Costs for subsequent items are \$300,000 each.

Tank 241-AY-102 slurry pump removal	\$418,000
Tank 241-AX-101 pit 01A steam coil	\$300,000
Tank 241-AX-101 pit 01B Sluicer	\$300,000
Tank 241-AX-102 pit 02A Sluicer	\$300,000
Tank 241-AX-102 pit 02B Pump	\$300,000
Tank 241-AX-103 pit 03A Sluicer	\$300,000
Tank 241-AX-104 pit 04A Sluicer	\$300,000
Remove 241-AX-101 new sluicer for vehicle access	\$300,000
Remove 241-AX-103 new sluicer for vehicle access	\$300,000
TOTAL (for 1.0 m³ [36 ft³] case)	\$2,818,000

DB\36LLCE

2. 1.0 m³ (36 ft³) Sluicing Equipment Fabricate/Installation Costs

The cost estimate for the design/fabrication and installation of sluicing systems on tanks 241-AX-101 and 241-AX-102 is based on the enhanced sluicing cost estimate for 241-C-106 prepared by FDNW for Job no. E20144 (file no. Z437SAE2) (summary sheet attached). The estimate was modified as detailed below to more accurately reflect the AX farm conditions.

The Total projected cost estimate without escalation or contingency is \$34,140,000 including site allocations. The following items were removed from the estimate as redundant or not applicable:

Regulatory compliance	1,281,000
Accident analysis	650,000
Pump pit 241-C-06A	2,303,000
Heel pit 241-C-06B	1,967,000
Sluice pit 241-C-06C	1,922,000
Enc'd pipe pump to heel pit	298,000
Enc'd pipe heel to sluice pit	223,000
Heel jet removal	618,000
Sluicer removal	594,000
Vendor perform retrieval	2,000,000
Vendor Demobilization	500,000
Ready tank for closure	2,500,000
SUB-TOTAL	14,856,000

The following items were added to the estimate to account for operation in two tanks:

Vendor equipment	2,000,000
Vendor equipment installation	1,162,000
SUB-TOTAL	3,162,000

$$\text{TOTAL } (34,140,000 + 3,162,000 - 14,856,000) = \$22,446,000$$

FLUOR DANIEL NORTHWEST, INC.
 NUNATEC HANFORD CORPORATION
 JOB NO. E20144
 FILE NO. Z437SAE2

** TEST - INTERACTIVE ESTIMATING **
 CONCEPT 1 - ENHANCED SLUICING
 ORDER OF MAGNITUDE
 PHMCR01 - PROJECT COST SUMMARY

PAGE 1 OF 20
 DATE 04/07/97 17:51:46
 BY TLW, JJM, RHO, CDL

SORT	DESCRIPTION	ESCALATED	CONTINGENCY		TOTAL
		TOTAL COST	%	TOTAL	DOLLARS
DESH	DE&S HANFORD, INC.	820,000	30	250,000	1,070,000
PDNH	FLUOR DANIEL NORTHWEST	17,290,000	33	5,780,000	23,070,000
LMHC	LOCKHEED MARTIN HANFORD CORP.	1,080,000	30	320,000	1,400,000
NHT	NUNATEC HANFORD CORPORATION	9,270,000	33	3,100,000	12,370,000
SUBTOTAL		28,460,000	33	9,450,000	37,910,000
SITE	SITE ALLOCATIONS	5,680,000	33	1,850,000	7,530,000
	ROUNDING	(40,000)			(40,000)
TOTAL PROJECT COST (TPC)		34,140,000	33	11,300,000	45,400,000

HNF-2693
 Revision 1

TYPE OF ESTIMATE ORDER OF MAGNITUDE 4/7/97
 PDNH LEAD ESTIMATOR *TLW*
 ESTIMATING MANAGER *CDL*
 PROJECT MANAGER *CDL* for *M. Masolek* 4/8/97
 CLIENT

REMARKS: Subject to change.

(ROUNDED/ADJUSTED TO THE NEAREST * 10,000 / 100,000 * - PERCENTAGES NOT RECALCULATED TO REFLECT ROUNDING)

3. 1.0 m³ (36 ft³) Sluicer Control Room

The estimated cost for the control room/lunch room is taken from the 1994 W-320 estimate (Job no. W-320/ER4319 page 23 attached). One control room for the systems used in tanks 241-AX-101 and 241-AX-103 is adequate. This control room would be located outside the tank farm boundaries.

The W-320 control room was not installed (a mobile office was modified) so the costs for the control room are not included in the later estimates.

From page 23 of the estimate (rounded)	\$204,000
--	-----------

DB\36.CNT

PAGE 23 OF 32
DATE 10/21/94 07:56:21
BY GDC/JPH/DKH/CDL/XDE

HNF-2693
Revision 1

4. 1.0 m³ (36 ft³) Vehicle Retrieval System costs**Vendor Costs**

The vendor cost estimate is based on the two vendor systems currently being designed for the retrieval of the heel in tank 241-C-106. This also assumes that the same type of service contract will be used to procure the retrieval systems for the AX farm as is being used for the procurement of the 241-C-106 vehicle retrieval system.

Vendor supplied system/equipment

Design, fabrication, testing, and delivery of a vehicle based retrieval system ready to install in the AX farm (based on discussions with HTI 241-C-106 Heel Retrieval System Engineers).

\$5,500,000

Pre-operational work at AX farm

ORR, training, and acceptance testing based on 6 month duration. Three person vendor crew, four shifts, and four person home office support on one shift.

Labor (16 persons @ \$75/hr for 24 weeks) \$1,152,000

Per diem (16 persons @ \$80/day for 24 weeks) \$30,700

Warehouse and office rental in the Tri-Cities area.

Eighteen month duration based on the use of one vehicle that is moved tank to tank

\$90,000

Sub-total \$6,772,000

PHMC Bid and Award

Based on HTI 241-C-106 Heel Retrieval System costs \$200,000

PHMC Contract Management

Based on HTI 241-C-106 Heel Retrieval System costs \$400,000

PHMC ORR/ATP

Based on HTI 241-C-106 Heel Retrieval System costs	\$400,000
Three additional ATP/OTPs after vehicle moved	\$300,000
Sub-total	\$1,300,000

Installation Costs

The estimated cost to install a vehicle based retrieval system in 241-AX-101, 102, 103, and 104 is assumed to be the same as for tank 241-C-106. The installation costs in 241-C-106 is from sheet 17 (attached) of the baseline estimate. This does not include the costs to modify the farm/tank for acceptance of the vehicle system.

Four at	\$842,500 each
Sub-total	\$3,370,000
TOTAL	\$11,442,000

DB\36.VEH

HNF-2693
Revision 1

Activity ID	Activity Description	Orig. Dur.	Rev. Dur.	%	Early Start	Early Finish	Budgeted Cost	Activity Comments/Finalize
R255OS0135	INCCORP COMMENTS/FINALIZE	25	25	0	29MAR99	30APR99	0.00	1
R255OS0140	SUBMIT FINAL PKG FOR REVIEW (90%)	0	0	0		30APR99	0.00	2
R255OS0145	REVIEW/COMMENTS	10	10	0	03MAY99	14MAY99	0.00	3
R255OS0150	SUBMIT PKG FOR APPROVAL	0	0	0		14MAY99	0.00	4
R255OS0155	Stage 1 Design Approval	10	10	0	17MAY99	28MAY99	0.00	5
R255OS0160	Stage 1 Design Approved	0	0	0		28MAY99	0.00	6
R255OS0205	STAGE 2 DESIGN ACTIVITIES	130	130	0	11MAY99	14SEP99	1,315,713.00	7
R255OS0210	STAGE 2 DESIGN PLAN	20	20	0	11MAY99	07APR99	0.00	8
R255OS0215	PREPARE 60% DESIGN PKG (STAGE 2)	60	60	0	08APR99	01JUL99	0.00	9
R255OS0220	INCCORP COMMENTS/FINALIZE	30	30	0	06JUL99	16AUG99	0.00	10
R255OS0225	SUBMIT FINAL PKG FOR REVIEW	0	0	0		16AUG99	0.00	11
R255OS0230	REVIEW/COMMENT	10	10	0	17AUG99	30AUG99	0.00	12
R255OS0235	SUBMIT PKG FOR APPROVAL	0	0	0		30AUG99	0.00	13
R255OS0240	STAGE 2 DESIGN APPROVAL	10	10	0	31AUG99	14SEP99	0.00	14
R255OS0301	Install Retrieval System in C-106	42	42	0	06MAY00	02MAY00	842,411.33	15

5. 1.0 m³ (36 ft³) HVAC System Design/Installation Costs

The estimate for a new AX farm HVAC system is based on the FDNW W-320 HVAC skid estimate contained in file no. W320PDA4, job no. W-320/P7448M (page 14 attached). This is the same as for the 162 m³ (3,600 ft³) case with an additional \$100,000 to connect the system to 241-AX-104.

AX Farm HVAC System for three tanks	\$982,000
Additional cost to connect to 241-AX-104	\$100,000
TOTAL	<u>\$1,082,000</u>

DB\36HVAC

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. W-320/P7448H
FILE NO. W320PDA1

** TEST - INTERACTIVE ESTIMATING **
TANK 241-C-106 SLUICING
901 PRELIMINARY ESTIMATE
DOE_R02 - WORK BREAKDOWN STRUCTURE SUMMARY

PAGE 14 OF 35
DATE 07/25/95 15:11:06
BY KE/DH/JM/LR/CL/RO/KR

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION % TOTAL	SUB TOTAL	CONTINGENCY % TOTAL	TOTAL DOLLARS
4509AD	PROCESS BUILDING PROCUREMENT	494446	0	494446	1.74	8603	5	528202
4509AC	CHILLER SKID PROCUREMENT	280231	0	280231	1.74	4876	5	299362
	SUBTOTAL 4509 HVAC SKID PROCUREMENT	982030	0	982030	1.74	17087	5	1049073
4510AB	PURCHASE PUMP	1140475	0	1140475	1.74	19844	15	1334367
4510AC	ELECTRICAL EQUIPMENT PROCUREMENT	629535	0	629535	1.73	10894	15	735981
	SUBTOTAL 4510 SLUICING EQUIP. PROCUREMENT	1770010	0	1770010	1.74	30738	15	2070348
454310	SLUICING EQUIPMENT C-106	804052	0	804052	1.74	13991	25	1022553
	SUBTOTAL 4543 SLUICING EQUIPMENT C-106	804052	0	804052	1.74	13991	25	1022553
	SUBTOTAL 45 EXPENSE PROCUREMENT	4113496	0	4113496	1.50	61816	23	4728875
461500	PIT DECON - HOCK-UP	329246	0	329246	0.00	0	30	428020
461510	PIT DECON - C-106 FARM	520252	0	520252	0.00	0	30	676328
461520	PIT DECON - AY-102 FARM	527252	0	527252	0.00	0	30	685428
	SUBTOTAL 4615 PIT DECON	1376750	0	1376750	0.00	0	30	1789776
	SUBTOTAL 46 PIT DECON	1376750	0	1376750	0.00	0	30	1789776
470000	CONSTRUCTION SERVICES - CTD	62326	0	62326	0.00	0	0	62326
470010	GENERAL CONSTRUCTION SUPPORT	762049	0	762049	2.35	17902	18	921510
	SUBTOTAL 4700 CONSTRUCTION SERVICES	825175	0	825175	2.17	17902	17	983836
477700	EQUIPMENT USAGE	315813	0	315813	2.61	8243	20	388867
477710	MANAGEMENT SUPPORT FOR CONSTR	496445	0	496445	2.61	12957	20	611283
477720	CF SUPPORT	999967	0	999967	2.61	26099	20	1231279
477730	QUALITY SUPPORT	161500	0	161500	2.61	4215	20	198858
	SUBTOTAL 4777 GENERAL & TECH. SERVICES	1973725	0	1973725	2.61	51514	20	2430287
	SUBTOTAL 47 CONSTRUCTION SERVICES	2798900	0	2798900	2.48	69416	19	3414123

HNF-2693
Revision 1

C-14
EST
ANALYSIS
SUMMARY

6. 1.0 m³ (36 ft³) Waste Transfer Line

Description	Length
241-AY-102	
Pit 02A to new valve pit	76 m (250 ft)
Pit 02E to new valve pit	72 m (235 ft)
241-AX-101	
Pit 01A to new valve pit	67 m (220 ft)
Pit 01B to new valve pit	61 m (200 ft)
Pit 01D to new valve pit	56 m (185 ft)
241-AX-102	
Pit 02A to new valve pit	58 m (190 ft)
Pit 02B to new valve pit	50 m (165 ft)
241-AX-103	
Pit 03A to new valve pit	38 m (125 ft)
Pit 03C to new valve pit	41 m (135 ft)
Pit 03D to new valve pit	29 m (95 ft)
241-AX-104	
Pit 04A to new valve pit	28 m (90 ft)
Pit 04D to new valve pit	22 (70 ft)
TOTAL LINE LENGTHS	598 m (1,960 ft)
COST	\$980,000

Note 1: Fabrication and installation cost for the waste transfer line is \$3,279/m (\$1,000/ft) for a double line.

Note 2: Each pit above requires core drill and nozzle installation i.e. 12 each for the 1.0 m (36 ft³) case.

\36.LIN

7. 1.0 m³ (36 ft³) Pit Design/Installation Costs

The estimate for a new AX farm above grade transfer line (jumper) pit is based on the pit cover block fabrication and caisson/slab support for the manipulator arm costs contained in the *Cost Normalization Unit Estimates* (Manderbach 1997a). Assume same cover block costs and that the pit will cost the same as the manipulator slab.

Cover block	\$102,000
Pit	\$232,000
TOTAL	\$334,000

DB\36.PIT

8. 1.0 m³ (36 ft³) Pit Decontamination Costs

For the 1.0 m³ (36 ft³) case, 10 pits in AX farm and the pump pit at 241-AY-102 are used for the retrieval activities.

Discussed the condition and radiation levels in the pits with Dave Bragg in a Telecon 4/20/98 as summarized below.

Dave is not aware on any record of the activities that have been carried out in the last 15 years in the pits. Dave indicated that the pits probably haven't been opened in the last 15-20 years. Dave has no information on the pits as compared to the 241-C-106 pits that were decontaminated for Project W-320. Dave stated that John W. Bailey might have some recollection of the AX farm retrieval sluicing activities and that he would be a good source to try. John Bailey indicated that the pits in AX Farm should be in better condition than those in C Farm (the drains should work).

For the purposed of preparing this estimate, will assume that the pits are in comparable condition to the 241-C-106 pits. From the FDNW estimate for the Vehicle Based Retrieval System, Job no. E20144 (file Z437SAF2), the allocated cost for decontamination of the pits is \$1,500,000 each (page 7, item 7E-4 attached).

TOTAL	(11 pits)	\$16,500,000
-------	-----------	--------------

DB\36.DCN

FLUOR DANIEL NORTHWEST, INC.
NUMATEC HANFORD CORPORATION
JOB NO. E26144
FILE NO. 2437SAP2

.. TEST - INTERACTIVE ESTIMATING ..
CONCEPT 2 - VEHICLE BASED WASTE RETRIEVAL
S T U D Y - - R O M
PHMCROJ - ESTIMATE BASIS SHEET

PAGE 7 OF 16
DATE 04/15/97 07:42:17
BY TLW, JJM, RMO, CGL

WDS J10 (ON SITE CONSTRUCTION) A CONTINGENCY OF 33% HAS BEEN APPLIED BECAUSE OF LIMITED INFORMATION AVAILABLE ON THE RADIATION LEVELS THAT WILL BE ENCOUNTERED DURING PIPE INSTALLATION, PIT MODIFICATIONS AND DECONTAMINATION, PIT MODIFICATIONS, AND UNDERGROUND OBSTRUCTIONS THAT MAY BE ENCOUNTERED DURING CONSTRUCTION. THE ENHANCED SLICER COST IS BASED UPON VERBAL ALLOWANCES PROVIDED BY THE ENGINEER AND WITHOUT VENDOR INPUT.

6. ROUNDING

THE PROJECT COST SUMMARY REPORT IS SUMMARIZED AND ADJUSTED/ROUNDED AS FOLLOWS:

THE ESCALATED TOTAL COST COLUMN, CONTINGENCY TOTAL COLUMN AND TOTAL DOLLARS COLUMN SUB-TOTALS ARE SUMMARIZED BY CONTRACTOR. THE COLUMN SUBTOTALS ARE ADJUSTED/ROUNDED TO THE NEAREST \$1,000/\$10,000. THE PROJECT TOTAL SUMMARY LINE TOTALS ARE ADJUSTED/ROUNDED TO THE NEAREST \$10,000/\$100,000.

7. REMARKS

MAJOR ASSUMPTIONS WHICH HAVE BEEN MADE IN THE PREPARATION OF THIS ESTIMATE ARE AS FOLLOWS:

- A.) THE TEMPORARY CHANGE ROOM TRAILER, MOBILE DRILL RIG AND ASSOCIATED EQUIPMENT, VACUUM TRUCK (GUZZLER), AND CRANES WILL BE FURNISHED TO THE PROJECT AT NO COST EXCEPT FOR THE SET UP COSTS.
- B.) BURNOUT COSTS ARE NOT INCLUDED IN THIS COST ESTIMATE BY DIRECTION OF PHMC. IF BURNOUT IS ADDED ITS COST IS APPROXIMATELY \$2.5M AND IS BASED UPON AN ASSUMED 10M² READING AT THE UPPER SECTION OF THE CASING AND 25M² AT THE LOWER SECTION OF THE CASING, (REF. C.C. MAIL). OTHER CONSTRUCTION WORK, INSIDE THE FARM FENCE, WAS ESTIMATED AS 10M². RAD LEVELS ABOVE 25M² IS NOT ANTICIPATED.
- C.) ALL CONTAMINATED SOIL WAS ASSUMED TO BE LOW RAD AND WAS ESTIMATED AS BACKFILL ONLY (BURIAL IN BARRELS NOT INCL.).
- D.) THE TOTAL NUMBER OF DRAWINGS, BY DISCIPLINE, AND AN ALLOWANCE OF 150 MAN HOURS EQCH WAS PROVIDED BY ENGINEERING.
- E.) ITEMS THAT ARE NOT INCLUDED IN THIS COST ESTIMATE:
 1. FLAMMABLE GAS. IT IS ASSUMED THAT THIS WAS COVERED IN THE W-320 PROJECT.
 2. CONTROL ROOM. THE CONTROL ROOM PROVIDED IN W-320 WILL BE USED.
 3. AFTER OPERATIONS IS COMPLETE, THE EQUIPMENT WILL BE ABANDONED IN PLACE (EXCEPT ENHANCED SLICER).
 4. CLEANING, PAINTING AND OTHER SIMILAR MODIFICATIONS OF PITS. AN ALLOWANCE OF \$1.5M (BASED UPON W-320 LESSONS LEARNED) PER PIT FOR DECONTAMINATION IS INCLUDED.
 5. THE HVAC SYSTEM THAT W-320 INSTALLED IS NOT MODIFIED AND IS NOT INCLUDED IN THIS COST ESTIMATE.
 6. SPARE PARTS.
 7. ADDITIONAL REMOTE CAMERAS AS THIS WAS INSTALLED BY W-320.
- F.) PIPING ALLOWANCES ARE FOR NORMAL PIPING AND ARE NOT ASME, SECTION 3 (IN-STAMPED).
- G.) W-320 REPLACEMENT ITEMS FOR FAILED EQUIPMENT ARE AN ENGINEERING ALLOWANCE OF \$300,000.
- H.) EXISTING PIT CONDITIONS ARE UNKNOWN AND THE WASH DOWN ALLOWANCE OF 200MH IS ONLY AN ALLOWANCE. IT SHOULD BE NOTED THAT PROJECT W-320 EXPERIENCED HIGHER MANHOURS DUE TO POOR PIT CONDITIONS.
- I.) AN ALLOWANCE OF APPROXIMATELY \$1.5M (BASED ON W-320 LESSONS LEARNED) PER PIT FOR DECONTAMINATION IS INCLUDED.
- J.) ESCALATION IS BASED ON A MIDPOINT OF ALL STAGES OF CONSTRUCTION (4-1-97).

HNF-2693
Revision 1

C-18

RECEIVED
NUMATEC
COPY

9. 1.0 m³ (36 ft³) BOP Mods/Installation

The unit costs used in this section were taken from the FDNW *Cost Normalization Unit Estimates* (Manderbach 1997a).

Waste Transfer Line Jumpers

Eight jumpers will be required in the new transfer pit to route the eight lines coming from the 4 tanks (241-AX-101, 241-AX-102, 241-AX-103, and 241-AX-104).

Ten jumpers will be required for the pits in AX farm and two required at 241-AY-102.

TOTAL JUMPERS REQUIRED	20 @ \$56,000 ea
------------------------	------------------

TOTAL	COST	\$1,120,000
-------	------	-------------

Cover Block Removal

Remove the cover blocks from the ten pits in AX farm (3 each on 241-AX-101 and 241-AX-103; 2 each on 241-AX-102 and 241-AX-104)

Remove/replace the cover blocks from the pump pit on 241-AY-102 for replacement of the pump due to radiation damage and the sluice pit for core drilling.

TOTAL COVER BLOCKS REMOVED	12 @ \$77,300 ea
----------------------------	------------------

TOTAL	COST	\$928,000
-------	------	-----------

Cover Block Fabrication

Fabricate and install new cover blocks for the ten pits in AX farm (3 each on 241-AX-101, 241-AX-103, and 2 each on 241-AX-102, 241-AX-104).

TOTAL COVER BLOCKS FABRICATED	10 @ \$102,500 ea
-------------------------------	-------------------

TOTAL	COST	\$1,025,000
-------	------	-------------

Cover Block Disposal

Dispose of the ten cover blocks removed from the pits in AX farm.

TOTAL COVER BLOCKS DISPOSED	10 @ \$54,800 ea
-----------------------------	------------------

TOTAL COST	\$548,000
------------	-----------

Greenhouse Setup/Teardown

Setup and teardown of greenhouses and shield walls on the ten pits in AX farm and two pits at 241-AY-102.

TOTAL GREENHOUSE SETUP/TEARDOWN 12 @ \$79,400 ea

TOTAL COST \$953,000

Pit Core Drill

Core drill the 10 pits in AX farm and two pits at 241-AY-102 for the waste transfer lines.

TOTAL CORE DRILLS 12 @ \$29,200 ea

TOTAL COST \$350,000

Concrete Pads

Install concrete mounting pads at the 4 AX farm tanks. Assume 9.3 m^2 (100 ft^2) total at each tank.

TOTAL CONCRETE PADS $37.2 \text{ m}^2 @ \$850/\text{m}^2$ ($400 \text{ ft}^2 @ \$79 \text{ ft}^2$)

TOTAL COST \$32,000

CCTV Installation/Removal

Install CCTV units in the four AX farm tanks.

TOTAL CCTV INSTALLATIONS 4 @ \$52,000 ea

TOTAL COST \$208,000

241-AY-102 Pump Replacement

Replace the supernate pump in 241-AY-102 (due to radiation damage). The cover block removal, pump removal, and greenhouse setup/teardown are covered in the previous items. Assume pump disposal cost are comparable to cover block disposal costs from Manderbach (1997a).

241-AY-102 PUMP INSTALLATION	1 each @ \$125,000
------------------------------	--------------------

241-AY-102 PUMP DISPOSAL	1 each @ \$54,800
--------------------------	-------------------

TOTAL COST	\$179,000
------------	-----------

TOTAL PHMC BOP MODIFICATIONS/INSTALLATIONS \$5,343,000

\36BOP

10. 1.0 m³ (36 ft³) Safety and Permitting Costs

The estimates for the safety and permitting costs are based on the HTI heel retrieval baseline estimate (pages 9, 10, 11 attached). The AX farm retrieval safety efforts are considered to be approximately double those of the baseline estimate. Additionally, \$750,000 is included for BIO amendment activities. The estimate is also based on a 3-year project duration.

Safety

Management (assuming 3-year duration)	180,000
USQ	15,000
HI&E	48,000
Safety Equipment Lists	52,000
BIO amendment	750,000

Sub-total	\$1,045,000

Permitting

Management	90,000
NEPA supplement analysis	N/A
Air Permits (NOC) \$43k ea tank	129,000
Air Permits (NOC) for the pits at each tank (\$43k ea)	129,000

Sub-total	\$ 348,000
TOTAL	\$1,393,000

DB\36.SAF

[illegible]

HNF-2693
Revision 1

Activity ID	Activity Description	Orig. Dur.	Rem. Dur.	Early Start	Early Finish	Budgeted Cost	Activity Notes
R255OR0255	USQ/D Vendor 1	20	20	0 03APR98	30APR98	7,530.88	USQ/D Vendor 1 Milestone T-04-59-515
R255OR0257	USQ/D Vendor 2	20	20	0 03APR98	30APR98	7,530.88	USQ/D Vendor 2 Milestone T-04-59-515
R255OR0259	Identify SSC's and Prepare SEL Vendor 1	60	60	0 01MAY98	28JUL98	26,025.68	Identify SSC's and Prepare SEL Vendor 1 Milestone T-04-59-515
R255OR0261	Identify SSC's and Prepare SEL Vendor 2	60	60	0 01MAY98	28JUL98	26,025.68	Identify SSC's and Prepare SEL Vendor 2 Milestone T-04-59-515
R255OR0262	Comp Pre SEL for Retrieval Design Vendors 1 & 2	0	0	0	28JUL98	0.00	Comp Pre SEL for Retrieval Design Vendors 1 & 2 Milestone T-04-59-515
R255OR0263	Hazard Identification & Analysis	40	40	0 29OCT98	29DEC98	23,531.00	Hazard Identification & Analysis Milestone T-04-59-515
R255OR0265	USQ/D	20	20	0 30DEC98	27JAN99	7,403.20	USQ/D Milestone T-04-59-515
R255OR0267	Identify SSC's and Prepare SEL	60	60	0 28JAN99	22APR99	25,302.40	Identify SSC's and Prepare SEL Milestone T-04-59-515
R255OR0268	Comp Prelim SEL for Sel C-106 Retrieval Vendor	0	0	0	23APR99	0.00	Comp Prelim SEL for Sel C-106 Retrieval Vendor Milestone T-04-59-515
R255OR0270	USQ/D	40	40	0 15SEP99	09NOV99	7,254.24	USQ/D Milestone T-04-59-515
R255OR0360	Hazard Identification & Analysis ITS	40	40	0 01OCT98	25NOV98	22,474.00	Hazard Identification & Analysis ITS Milestone T-04-59-515
R255OR0365	USQ/D ITS	20	20	0 30NOV98	20DEC98	6,074.40	USQ/D ITS Milestone T-04-59-515
R255OR0370	Identify SSC's and Prepare SEL ITS	60	60	0 30DEC98	25MAR99	23,796.00	Identify SSC's and Prepare SEL ITS Milestone T-04-59-515
R255OR0380	Comp Prelim Safety Equip List for In-tank System	0	0	0	15JUN99	0.00	Comp Prelim Safety Equip List for In-tank System Milestone T-04-59-515
R255OR0390	Comp Prelim Safety Documentation	26	26	0 01OCT97	05NOV97	10,589.24	Comp Prelim Safety Documentation Milestone T-04-59-515

HNF-2693
Revision 1

Activity ID	Activity Description	Orig Dir	Rem Dir	%	Early Start	Early Finish	Budgeted Cost	Actual Cost	Comments
R255OP0400	LDUA / EREE Authorization Basis	40	40	0	17NOV97	16JAN98	15,405.60		LDUA / EREE Authorization Basis Δ 1D2CL50P07
1.1.3.102.05.03.02.02	Permitting Management	251	251	0	01OCT97	30SEP98	24,475.36		Permitting Management Δ 1D2CL50P01
1.1.3.102.05.03.02.01	Permitting Oversight	19	19	0	03NOV97	01DEC97	3,594.30		Cone Penetrometer Permitting Support Δ 1D2CL50P03
R255OP0110	Permitting Management	62	62	0	02JAN98	31MAR98	14,459.44		Permitting Plan Update Δ 1D2CL50P01
R255OP0120	Permitting Management	251	251	0	01OCT98	30SEP99	24,000.40		PERMITTING MANAGEMENT Δ 1D2CL50P
R255OP0125	Permitting Management	62	62	0	04JAN99	31MAR99	14,408.95		Permitting Plan Update Δ 1D2CL50P
R255OP0130	Permitting Management	251	251	0	01OCT99	29SEP00	23,368.80		Permitting Management Δ 1D2CL50P
R255OP0135	Permitting Management	63	63	0	04JAN00	31MAR00	14,408.30		Permitting Plan Update Δ 1D2CL50P
R255OP0140	Permitting Management	250	250	0	02OCT00	20SEP01	20,538.60		Permitting Management Δ 1D2CL50P
R255OP0145	Permitting Management	0	0	0	13JUN01		0.00		Start Maintaining Administrative Record Δ 1D2CL50P
1.1.3.102.05.03.02.02	Permitting Management	94	94	0	01OCT97	17FEB98	18,003.14		Finish C-106 Retrieval NEPA Supplement Anal Δ 1D2CL50P02
R255OP0225	Permitting Management	1	1	0	01OCT97	01OCT97	0.00		RL Panel Review Δ 1D2CL50P
R255OP0236	Permitting Management	14	14	0	02OCT97	21OCT97	0.00		Incorporate Comments Δ 1D2CL50P
R255OP0237	Permitting Management	0	0	0	21OCT97	21OCT97	0.00		Transmit Draft SA to Ecology/Tribes Δ 1D2CL50P
R255OP0238	Permitting Management	35	35	0	22OCT97	11DEC97	0.00		Ecology/Tribes Review/Comment Δ 1D2CL50P

11. 1.0 m³ (36 ft³) Sluicer Operational Costs

The estimate for operating the sluicer in tanks 241-AX-101 and 241-AX-103 is based on the data in tables A-1 through A-5. Estimates are based on operating 7 days per week and 24 hours per day.

AX-101 Operational time 170.2 days (24.3 wks)

AX-103 Operational time 57.4 days (8.2 wks)

5 person crew X 4 shifts X 40 hrs/wk X 32.5 weeks X \$95/hr

TOTAL \$2,470,000

DB\36.OPS

12. 1.0 m³ (36 ft³) Vehicle Operational Costs

For the 1.2 m³ (36 ft³) case, the vehicle is used in all four AX farm tanks. The estimate for vehicle operating time is based on the data in tables A-1 through A-5.

AX-101 Operational time	105.4 days
AX-102 Operational time	106.9 days
AX-103 Operational time	105.4 days
AX-104 Operational time	91.5 days
Total	409.2 days (58.5 wks)

The vendor labor costs are based on a 3 man crew, 4 shifts, and a 4 man home office support for 58.5 weeks of retrieval time at each tank (the labor through the ORR is included with in the installation costs).

There are 4 weeks required to move the system from tank to tank.

There are an additional 4 weeks of time required for the dismantling and removal of the retrieval system.

The total time required is:

Retrieve four tanks	58.5 weeks
Move system 3 times	12 weeks
Dismantle system	4 weeks
TOTAL	74.5 weeks

16 persons @\$75/hr X 40 hr/wk for 74.5 weeks \$3,576,000

Per diem (12 persons @\$80/day) \$501,000

Sub-total \$4,077,000

PHMC labor costs are for a 6 man crew, four shifts, for the 74.5 weeks retrieval and dismantling time.

24 persons @ \$95/hr for 74.5 weeks \$6,794,000

TOTAL \$10,871,000

This page intentionally left blank.

APPENDIX D

COST AND WORKER-HOUR BREAKDOWN

This page intentionally left blank.

APPENDIX D**COST AND WORKER-HOUR BREAKDOWN**

The summary of the breakdown of the costs and worker-hours for the three levels of residual waste volumes is shown below. The details of the breakdowns are shown in the remainder of the appendix. The breakdowns are for the estimates contained in Appendix A. Refer to Appendix A for the estimate basis.

	102 m ³ (3,600 ft ³)	10.2 m ³ (360 ft ³)	1.0 m ³ (36 ft ³)
Capital Cost	\$29,680,000	\$31,157,000	\$31,157,000
PHMC operating cost	\$5,546,000	\$9,590,000	\$18,489,000
PHMC operating worker-hours	38,619	66,760	128,726
PHMC installation worker-hours	241,970	325,528	325,528
D&D cost	\$1,008,000	\$1,184,000	\$1,184,000

D&D = Decontamination and decommissioning

PHMC = Project Hanford Management Contractor.

102 m³ (3,600 ft³) CAPITAL COSTS

The estimates in this appendix are a breakdown of the costs in Appendix A. Refer to Appendix A for the cost basis.

1. LLCE Removal

From Manderbach (1997a), "Slurry Pump Removal" the cost of a flexible receiver is \$212,000 and the cost of a metal burial box is \$5,000. Applying an 8 percent sales tax, the cost of the first unit is \$245,000. Subsequent units are estimated at 72 percent of the first unit or \$176,000. Cost for 6 units is $245 + .72 \times 5 \times 245$

TOTAL = \$1,075,000.

2. Sluicing Equipment Fabrication

From FDNW Enhanced Sluicing Estimate E20144, page 2, WBS 15140, the vendor cost is \$2,000,000 for each tank.

TOTAL = \$4,000,000. (for 2 tanks)

3. Sluicer Control Room

Per Appendix A, the sluicer control room costs \$204,000. Assume \$95,000 for the purchase of a Mobile Office.

TOTAL = \$95,000.

4. Vehicle Retrieval System

Per Appendix A, the vendor procurement cost is \$5.5M. Assume 100 percent capital cost.

TOTAL = \$5,500,000.

5. HVAC System

From Appendix A, the cost of the HVAC is \$982k with \$700k assumed capital costs.

TOTAL = \$700,000.

6. Waste Transfer Line

Per Appendix A, the cost of the waste transfer line is \$910k based on a vendor fabricate and install contract. Assume 50 percent is capital.

TOTAL = \$455,000.

7. New Valve Pit

The new pit and cover block design, fabrication, and installation are assumed to be PHMC tasks. Of the total cost, \$50k is assumed to be capital.

TOTAL = \$50,000.

8. Pit Decontamination

Assume \$2,000k for a vendor to design, fabricate, and deliver a pit decontamination system per PHMC specifications.

TOTAL = \$2,000,000.

9. Balance of Plant

The Jumper fabrication costs are capital expenditures. Per Appendix A, 16 jumpers at \$56K each.

TOTAL = \$896,000.

TOTAL CAPITAL COST = \$14,871,000 + CONTINGENCY AND ESCALATION

= \$29,680,000.

\3600CAP

10.2 m³ (360 ft³) CAPITAL COSTS

The estimates in this appendix are a breakdown of the costs in Appendix A. Refer to Appendix A for the cost basis.

1. LLCE Removal

From Manderbach (1997a), "Slurry Pump Removal" the cost of a flexible receiver is \$212,000 and the cost of a metal burial box is \$5,000. Applying an 8 percent sales tax, the cost of the first unit is \$245,000. Subsequent units are estimated at 72 percent of the first unit or \$176,000. Cost for 9 units is $245 + .72 \times 8 \times 245$

TOTAL = \$1,656,000.

2. Sluicing Equipment Fabrication

From FDNW Enhanced Sluicing Estimate E20144, page 2, WBS 15140, the vendor cost is \$2,000,000 for each tank.

TOTAL = \$4,000,000. (for 2 tanks)

3. Sluicer Control Room

Per Appendix A, the sluicer control room costs \$204,000. Assume \$95,000 for the purchase of a Mobile Office.

TOTAL = \$95,000.

4. Vehicle Retrieval System

Per Appendix A, the vendor procurement cost is \$5.5M. Assume 100 percent capital cost.

TOTAL = \$5,500,000.

5. HVAC System

From Appendix A, the cost of the HVAC is \$982k with \$700k assumed capital costs.

TOTAL = \$700,000.

6. Waste Transfer Line

Per Appendix A, the cost of the waste transfer line is \$980k based on a vendor fabricate and install contract. Assume 50 percent is capital.

TOTAL = \$490,000.

7. New Valve Pit

The new pit and cover block design, fabrication, and installation are assumed to be PHMC tasks. Of the total cost, \$50k is assumed to be capital.

TOTAL = \$50,000.

8. Pit Decontamination

Assume \$2,000k for a vendor to design, fabricate, and deliver a pit decontamination system per PHMC specifications.

TOTAL = \$2,000,000.

9. Balance of Plant

The Jumper fabrication costs are capital expenditures. Per Appendix A, 20 jumpers at \$56K each.

TOTAL = \$1,120,000.

TOTAL CAPITAL COST = \$15,611,000 + CONTINGENCY AND ESCALATION
= \$31,157,000.

\360CAP

1.0 m³ (36 ft³) CAPITAL COSTS

The estimates in this appendix are a breakdown of the costs in Appendix A. Refer to Appendix A for the cost basis.

1. LLCE Removal

From Manderbach (1997a), "Slurry Pump Removal" the cost of a flexible receiver is \$212,000 and the cost of a metal burial box is \$5,000. Applying an 8 percent sales tax, the cost of the first unit is \$245,000. Subsequent units are estimated at 72 percent of the first unit or \$176,000. Cost for 9 units is $245 + .72 \times 8 \times 245$

TOTAL = \$1,656,000.

2. Sluicing Equipment Fabrication

From FDNW Enhanced Sluicing Estimate E20144, page 2, WBS 15140, the vendor cost is \$2,000,000 for each tank.

TOTAL = \$4,000,000. (for 2 tanks)

3. Sluicer Control Room

Per Appendix A, the sluicer control room costs \$204,000. Assume \$95,000 for the purchase of a Mobile Office.

TOTAL = \$95,000.

4. Vehicle Retrieval System

Per Appendix A, the vendor procurement cost is \$5.5M. Assume 100 percent capital cost.

TOTAL = \$5,500,000.

5. HVAC System

From Appendix A, the cost of the HVAC is \$982k with \$700k assumed capital costs.

TOTAL = \$700,000.

6. Waste Transfer Line

Per Appendix A, the cost of the waste transfer line is \$980k based on a vendor fabricate and install contract. Assume 50 percent is capital.

TOTAL = \$490,000.

7. New Valve Pit

The new pit and cover block design, fabrication, and installation are assumed to be PHMC tasks. Of the total cost, \$50k is assumed to be capital.

TOTAL = \$50,000.

8. Pit Decontamination

Assume \$2,000k for a vendor to design, fabricate, and deliver a pit decontamination system per PHMC specifications.

TOTAL = \$2,000,000.

9. Balance of Plant

The Jumper fabrication costs are capital expenditures. Per Appendix A, 20 jumpers at \$56K each.

TOTAL = \$1,120,000.

TOTAL CAPITAL COST = \$15,611,000 + CONTINGENCY AND ESCALATION

= \$31,157,000.

\36CAP

PHMC OPERATING COSTS

Estimates in this appendix are a breakdown of the costs in Appendices A, B, and C. Refer to Appendix A for the cost basis.

102 m³ (3,600 ft³) Residual Waste

Sluicer - 5 person crew X 4 shifts X 31.7 weeks X 40 hr/wk X \$95/hr = \$2,409,000

Vehicle - 6 person crew X 4 shifts X 4.06 weeks X 40 hr/wk X \$95/hr = \$370,000

TOTAL = \$2,779,000 + contingency (32 percent) and
escalation (51.2 percent) = \$5,546,000

10.2 m³ (360 ft³) Residual Waste

Sluicer - 5 person crew X 4 shifts X 32.5 weeks X 40 hr/wk X \$95/hr = \$2,470,000

Vehicle - 6 person crew X 4 shifts X 25.6 weeks X 40 hr/wk X \$95/hr = \$2,335,000

TOTAL = \$4,805,000 + contingency and escalation = \$9,540,000

1.0 m³ (36 ft³) Residual Waste

Sluicer - 5 person crew X 4 shifts X 32.5 weeks X 40 hr/wk X \$95/hr = \$2,470,000

Vehicle - 6 person crew X 4 shifts X 74.5 weeks X 40 hr/wk X \$95/hr = \$6,974,000

TOTAL = \$9,264,000 + contingency and escalation = \$18,489,000

PHMC-OPS

PHMC OPERATING WORKER-HOURS

The estimates in this appendix are a breakdown of the costs in Appendix A. Refer to Appendix A for the cost basis.

102 m³ (3,600 ft³) Residual Waste

Sluicer - 5 person crew X 4 shifts X 31.7 weeks X 40 hr/wk = 25,360

Vehicle - 6 person crew X 4 shifts X 4.06 weeks X 40 hr/wk = 3,897

TOTAL = 29,257 + contingency (32 percent) = 38,619

10.2 m³ (360 ft³) Residual Waste

Sluicer - 5 person crew X 4 shifts X 32.5 weeks X 40 hr/wk = 26,000

Vehicle - 6 person crew X 4 shifts X 25.6 weeks X 40 hr/wk = 24,576

TOTAL = 50,576 + contingency (32 percent) = 66,760

1.0 m³ (36 ft³) Residual Waste

Sluicer - 5 person crew X 4 shifts X 32.5 weeks X 40 hr/wk = 26,000

Vehicle - 6 person crew X 4 shifts X 74.5 weeks X 40 hr/wk = 71,520

TOTAL = 97,520 + contingency (32 percent) = 128,726

PHMC-MH

102 m³ (3,600 ft³) PHMC INSTALLATION WORKER-HOURS

The estimates in this appendix are a breakdown of the costs in Appendix A. Refer to Appendix A for the basis.

1. LLCE Removal

From Manderbach (1997a), "Slurry Pump Removal" the worker-hours are 3318 for the first unit. Assume subsequent units are 72 percent of the first unit. Worker-hours for 6 units are $(3318 + .72 \times 3318 \times 5)$.

TOTAL = 15,262

2. Sluicing Equipment Fabrication

From FDNW Enhanced Sluicing Estimate E20144, page 2, WBS 152300, the installation cost is \$1,162,000. Assume 75 percent labor and 25 percent material/other for each of the 2 tanks. Worker-hours are $2 \times .75 \times \$1,162,000 \div \$95/\text{hr}$

TOTAL = 18,347 worker-hours (for 2 tanks)

3. Sluicer Control Room

Per Appendix A, the sluicer control room costs \$204,000. Assume \$90,000 for installation labor at \$95/hr. Worker-hours are $\$90,000 \div \$95/\text{hr}$.

TOTAL = 947 worker-hours

4. Vehicle Retrieval System

Per Appendix A, the vehicle installation cost is \$842,000. Assume \$700,000 installation labor. Worker-hours are $\$700,000 \div \$95/\text{hr}$.

TOTAL = 7,368 worker-hours

5. HVAC System

From Appendix A, the cost of the HVAC is \$982,000 with \$125,000 assumed installation labor costs. Worker-hours are $\$125,000 \div \$95/\text{hr}$.

TOTAL = 1,315 worker-hours.

6. Waste Transfer Line

Per Appendix A, the fabrication and installation of the waste transfer line is a vendor cost based on a vendor fabricate and install contract.

TOTAL = NA

7. New Valve Pit

The new pit and cover block design, fabrication, and installation are assumed to be PHMC tasks. Of the total \$334,000 cost, \$220,000 is assumed to be installation labor cost. Worker-hours are $\$220,000 \div \$95/\text{hr}$.

TOTAL = 2,316 worker-hours

8. Pit Decontamination

Assume 80 percent of the \$13,500,000 for the pit decontamination task is PHMC labor. Worker-hours are $.8 \times \$13,500,000 \div \$95/\text{hr}$.

TOTAL = 113,684 worker-hours

9. Balance of Plant

Per Appendix A, assume 80 percent of the cover block removal, cover block fabrication, green house set-up, core drill, concrete pads, and CCTV installation are PHMC labor costs. Worker-hours are $.8 \times (\$773,000 + \$820,000 + \$794,000 + \$292,000 + \$24,000 + \$156,000) \div \$95/\text{hr}$.

TOTAL = 24,073 worker-hours

TOTAL PHMC INSTALLATION WORKER-HOURS = 183,311 + CONTINGENCY (32 percent)

= 241,970

\3600INST

10.2 m³ (360 ft³) PHMC INSTALLATION WORKER-HOURS

The estimates in this appendix are a breakdown of the costs in Appendix A. Refer to Appendix A for the basis.

1. LLCE Removal

From Manderbach (1997a), "Slurry Pump Removal" the worker-hours are 3318 for the first unit. Assume subsequent units are 72 percent of the first unit. Worker-hours for 9 units are $(3318 + .72 \times 3318 \times 8)$.

TOTAL = 22,429

2. Sluicing Equipment Fabrication

From FDNW Enhanced Sluicing Estimate E20144, page 2, WBS 152300, the installation cost is \$1,162,000. Assume 75 percent labor and 25 percent material/other for each of the 2 tanks. Worker-hours are $2 \times .75 \times \$1,162,000 \div \$95/\text{hr}$

TOTAL = 18,347 worker-hours (for 2 tanks)

3. Sluicer Control Room

Per Appendix A, the sluicer control room costs \$204,000. Assume \$90,000 for installation labor at \$95/hr. Worker-hours are $\$90,000 \div \$95/\text{hr}$.

TOTAL = 947 worker-hours

4. Vehicle Retrieval System

Per Appendix A, the vehicle installation cost is \$842,000. Assume \$700,000 installation labor. The vehicle retrieval system is installed in all four AX farm tanks. Worker-hours are $\$700,000 \times 4 \div \$95/\text{hr}$.

TOTAL = 29,474 worker-hours

5. HVAC System

From Appendix A, the cost of the HVAC is \$982,000 with \$125,000 assumed installation labor costs for three tanks. There is an additional \$100,00 to connect the system to 241-AX-104. Worker-hours are $\$225,000 \div \$95/\text{hr}$.

TOTAL = 2,368 worker-hours.

6. Waste Transfer Line

Per Appendix A, the fabrication and installation of the waste transfer line is a vendor cost based on a vendor fabricate and install contract.

TOTAL = NA

7. New Valve Pit

The new pit and cover block design, fabrication, and installation are assumed to be PHMC tasks. Of the total \$334,000 cost, \$220,000 is assumed to be installation labor cost. Worker-hours are $\$220,000 \div \$95/\text{hr}$.

TOTAL = 2,316 worker-hours

8. Pit Decontamination

Assume 80 percent of the \$16,500,000 for the pit decontamination task is PHMC labor. Worker-hours are $.8 \times \$16,500,000 \div \$95/\text{hr}$.

TOTAL = 138,947 worker-hours

9. Balance of Plant

Per Appendix A, assume 80 percent of the cover block removal, cover block fabrication, green house set-up, core drill, concrete pads, and CCTV installation are PHMC labor costs. Worker-hours are $.8 \times (\$928,000 + \$1,025,000 + \$953,000 + \$350,000 + \$32,000 + \$208,000) \div \$95/\text{hr}$.

TOTAL = 31,874 worker-hours

TOTAL PHMC INSTALLATION WORKER-HOURS = 246,612 +
CONTINGENCY (32 percent) = 325,528

\360INST

1.0 m³ (36 ft³) PHMC INSTALLATION WORKER-HOURS

The estimates in this appendix are a breakdown of the costs in Appendix A. Refer to Appendix A for the basis.

1. LLCE Removal

From Manderbach (1997a), "Slurry Pump Removal" the worker-hours are 3318 for the first unit. Assume subsequent units are 72 percent of the first unit. Worker-hours for 9 units are $(3318 + .72 \times 3318 \times 8)$.

TOTAL = 22,429

2. Sluicing Equipment Fabrication

From FDNW Enhanced Sluicing Estimate E20144, page 2, WBS 152300, the installation cost is \$1,162,000. Assume 75 percent labor and 25 percent material/other for each of the 2 tanks. Worker-hours are $2 \times .75 \times \$1,162,000 \div \$95/\text{hr}$

TOTAL = 18,347 worker-hours (for 2 tanks)

3. Sluicer Control Room

Per Appendix A, the sluicer control room costs \$204,000. Assume \$90,000 for installation labor at \$95/hr. Worker-hours are $\$90,000 \div \$95/\text{hr}$.

TOTAL = 947 worker-hours

4. Vehicle Retrieval System

Per Appendix A, the vehicle installation cost is \$842,000. Assume \$700,000 installation labor. The vehicle retrieval system is installed in all four AX farm tanks. Worker-hours are $\$700,000 \times 4 \div \$95/\text{hr}$.

TOTAL = 29,474 worker-hours

5. HVAC System

From Appendix A, the cost of the HVAC is \$982,000 with \$125,000 assumed installation labor costs for three tanks. There is an additional \$100,00 to connect the system to 241-AX-104. Worker-hours are $\$225,000 \div \$95/\text{hr}$.

TOTAL = 2,368 worker-hours.

6. Waste Transfer Line

Per Appendix A, the fabrication and installation of the waste transfer line is a vendor cost based on a vendor fabricate and install contract.

TOTAL = NA

7. New Valve Pit

The new pit and cover block design, fabrication, and installation are assumed to be PHMC tasks. Of the total \$334,000 cost, \$220,000 is assumed to be installation labor cost. Worker-hours are $\$220,000 \div \$95/\text{hr}$.

TOTAL = 2,316 worker-hours

8. Pit Decontamination

Assume 80 percent of the \$16,500,000 for the pit decontamination task is PHMC labor. Worker-hours are $.8 \times \$16,500,000 \div \$95/\text{hr}$.

TOTAL = 138,947 worker-hours

9. Balance of Plant

Per Appendix A, assume 80 percent of the cover block removal, cover block fabrication, green house set-up, core drill, concrete pads, and CCTV installation are PHMC labor costs. Worker-hours are $.8 \times (\$928,000 + \$1,025,000 + \$953,000 + \$350,000 + \$32,000 + \$208,000) \div \$95/\text{hr}$.

TOTAL = 31,874 worker-hours

TOTAL PHMC INSTALLATION WORKER-HOURS = 246,612
+ CONTINGENCY (32 PERCENT) = 325,528

\36INST

DECONTAMINATION AND DECOMMISSIONING COSTS

The estimates in this appendix are a breakdown of the costs in Appendix A. Refer to Appendix A for the cost basis.

102 m³ (3,600 ft³) Residual Waste

Vehicle Procurement - The \$5.5M vendor cost for a vehicle retrieval system includes \$100k for D&D.

BOP Mods And Installation - The pump disposal (\$55K) and the cover block disposal (\$350k) are D&D costs.

TOTAL = \$100k + \$55k + \$350K

= \$505,000. + contingency (32 percent) and escalation.

= \$1,008,000.

360 Ft³ Residual Waste

Vehicle Procurement - The \$5.5M vendor cost for a vehicle retrieval system includes \$100k for D&D.

BOP Mods And Installation - The pump disposal (\$55K) and the cover block disposal (\$438k) D&D costs.

TOTAL = \$100k + \$55k + \$438K

= \$593,000 + contingency and escalation

= \$1,184,000.

36 Ft³ Residual Waste

Vehicle Procurement - The \$5.5M vendor cost for a vehicle retrieval system includes \$100k for D&D.

BOP Mods And Installation - The pump disposal (\$55K) and the cover block disposal (\$438k) D&D costs.

TOTAL = \$100k + \$55k + \$438K

= \$593,000 + contingency and escalation

= \$1,184,000.

\D&D

This page intentionally left blank.

APPENDIX E

MISCELLANEOUS INFORMATION

This page intentionally left blank.

APPENDIX E**MISCELLANEOUS AX TANK FARM INFORMATION**

Tank	Current volume	Waste depth	Condition
241-AX-101	2,838,750 L (750,000 gal)	6.7 m (22 ft) deep	Sound
241-AX-102	124,905 L (33,000 gal)	30 cm (12 in.) deep	Leaker
241-AX-103	423,920 L (112,000 gal)	102 cm (40 in.) deep	Sound
241-AX-104	26,495 L (7,000 gal)	6 cm (2.5 in.) deep	Leaker

Tank	Sluicing heel	Years sluiced
241-AX-101	11,355 L (3,000 gal)	1975/76
241-AX-102	26,495 L (7,000 gal)	1976/77
241-AX-103	62,452 L (16,500 gal)	1976/77
241-AX-104	26,495 L (7,000 gal)	1976/78

(Becker [1997] used as source of sluicing heel volumes)

Note that the residual sluicing heel achieved in the 1970's (using 2 sluicers) exceeded 10.2 m^3 (360 ft^3) in all four tanks.

SHADOWS

There are 22 ALCs in the AX farm tanks. These are full length pipes 76 cm (30-in.) in diameter. These "shadow" a significant portion of the tank volume from the sluicing jet.

OTHER

Tank liner height 9.9 m (32 ft-6 in.)

Flat bottom tanks

There is no active ventilation system in AX farm.

TELECON MEMO

DATE: 4/30/98

TIME:

SUBJECT: Techniques for measuring waste in the SSTs

BETWEEN: S. A. Krieg/F. R. Reich

General discussion on the techniques and capabilities of the various systems for measuring the remaining waste in the SSTs are documented as follows:

- There are two technologies that are sufficiently developed to use for waste volume measurements, video and photogrammetry.
- The best waste volume measurement we can expect with video or photogrammetry is $360 \text{ ft}^3 \pm 180 \text{ ft}^3$.
- A third technology, Topographic Mapping System (TMS), aka structured light, has the potential to measure $180 \text{ ft}^3 \pm 90 \text{ ft}^3$ of residual waste but needs development.
- It is not feasible to measure 36 ft^3 of waste remaining in a SST with any of the current technologies.
- All three of the current waste measurement technologies (video, photogrammetry, TMS) are surface measurement tools - accuracies depend on locating the tank walls, floor, etc.
- Accuracies depend on the surface contour of the waste. Less accurate measurements are obtained on rough waste surfaces than smooth ones.
- None of the three systems are able to differentiate between waste and corrosion products i.e. waste looks like rust on the surface of the tank.
- In the AX farm tanks there is a problem with the air lift circulators (ALC). The systems are unable to "see" the back of the ALCs, inside the ALCs, or the wall area in the "shadow" of the ALCs.

Fred will send me a copy of the handouts from the "HTI Waste Volume Estimate Review" of April, 1997. These handouts have a considerable amount of information that was developed by the Waste Volume Estimate Team (Fred Reich, Mike Sumsion, Dennis Goodnough, and Don Daly).

S. A. KRIEG

DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	S. A. Krieg, NHC	Date 7/15/98
Project Title/Work Order		EDT No. 636877
AX Tank Farm Waste Retrieval Alternatives Cost Estimates, HNF-2693, Rev. 1		ECN No.

Name	MSIN	Text With All Attach.	Text Only	Attach./Appendix Only	EDT/ECN Only
Central Files	B1-07	X			
DOE Reading Room	H2-53	X			
HTI Project File (2)	H6-08	X			
HTI Working File	H6-08	X			
S. K. Baker	H5-49	X			
D. L. Becker	H6-12	X			
A. M. Choho	H5-61	X			
M. Cremonini	H5-61	X			
J. C. Henderson	B1-40	X			
S. A. Krieg (3 copies)	H6-12	X			
T. H. May	H5-61	X			
L. B. McDaniel	H6-12	X			
D. L. Nichols	B1-40	X			
R. W. Root (Informatics)	H6-12	X			
W. J. Stokes	H5-03	X			
R. P. Marshall	H5-61	X			
E. A. Fredenburg	H6-12	X			