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X-OE-231, Vol. 4

MARTIN MARIETTA

Preliminary Decommissioning Study Reports

Volume 4: Gunite Storage Tanks

J. R. Horton

September 1984

Oak Ridge National Laboratory
Oak Ridge, Tennessee 37830

operated by
Martin Marietta Energy Systems, Inc.
for the
DEPARTMENT OF ENERGY

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MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

September 1984

X-OE-231, Vol. 4

ORNL/M--1921

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Engineering Division

PRELIMINARY DECOMMISSIONING STUDY REPORTS

Volume 4: GUNITE STORAGE TANKS

J. R. Horton

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Prepared for U.S. Department of Energy
under U.S. Government Contract DE-AC05-840R-21400

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1. INTRODUCTION

The six large gunite storage tanks considered as a group is one of approximately 76 facilities currently managed by the Oak Ridge National Labortories (ORNL) Surplus Facilities Management Program (SFMP). This program, as part of the Department of Energy (DOE) national SFMP, is responsible for the maintenance and surveillance and the final decommissioning of radioactively contaminated surplus ORNL facilities. A long-range planning effort is being conducted that will outline the scope and objectives of the ORNL program and establish decommissioning priorities based on health and safety concerns, budget constraints, and other programmatic constraints. In support of this SFMP planning activity, preliminary engineering assessments are being conducted for each of the ORNL surplus facilities currently managed under the program. These efforts are designed to: (1) provide an initial assessment of the potential decommissioning alternatives, (2) choose a preferred alternative and provide a justification of the decommissioning plan, including cost and schedule estimates. This report presents the results of the preliminary decommission study for the six gunite storage tanks.

2. FACILITY DESCRIPTION

Since 1943, several storage tanks have been installed at ORNL for storage of liquid radioactive waste. Twenty-one of these tanks designated as surplus are involved in the ORNL SFMP. These tanks have been divided into nine groups for SPMP consideration. The decommissioning of eight of

these groups is covered in X-OE-231, Vol. 3. The decommissioning of the group of six large gunite tanks is addressed in this report. These tanks have a nominal capacity at 170,000 gal each.

2.1 Location and Adjacent Facilities

The group of six large concrete tanks (W-5 to W-10) considered in this report are located in the south tank farm. The south tank farm is located in the approximate center of the ORNL facilities at the main Bethel Valley site (Fig. 1.) This tank farm (Fig. 2) comprises six underground tanks, constructed in 1943 of reinforced gunite, on a 60-ft center-to-center square matrix. (Gunite is a trade name for a specific method of spraying a mixture of sand, cement, and water against a form.) The three tanks in the north row are identified as W-5, W-7, and W-9, from west to east. The three tanks in the south row are identified as W-6, W-8, and W-10, from west to east. The south row of tanks is at a slightly lower elevation than the north row, conforming to the natural slope of the land. Other surplus facilities in this tank farm include accessories such as six adjacent dry wells and four concrete valve pits that are located in the vicinity of the tanks. Other facilities used in a current project to empty these tanks are described in detail elsewhere.[3] In summary, the primary equipment includes above-tank access platforms and slucing equipment such as pumps, television cameras, and control equipment.

2.2 Tank Construction

A sketch of these tanks is provided in Fig. 3. These tanks in the south tank farm (known as the 3507 area) have an inside diameter of 50 ft and

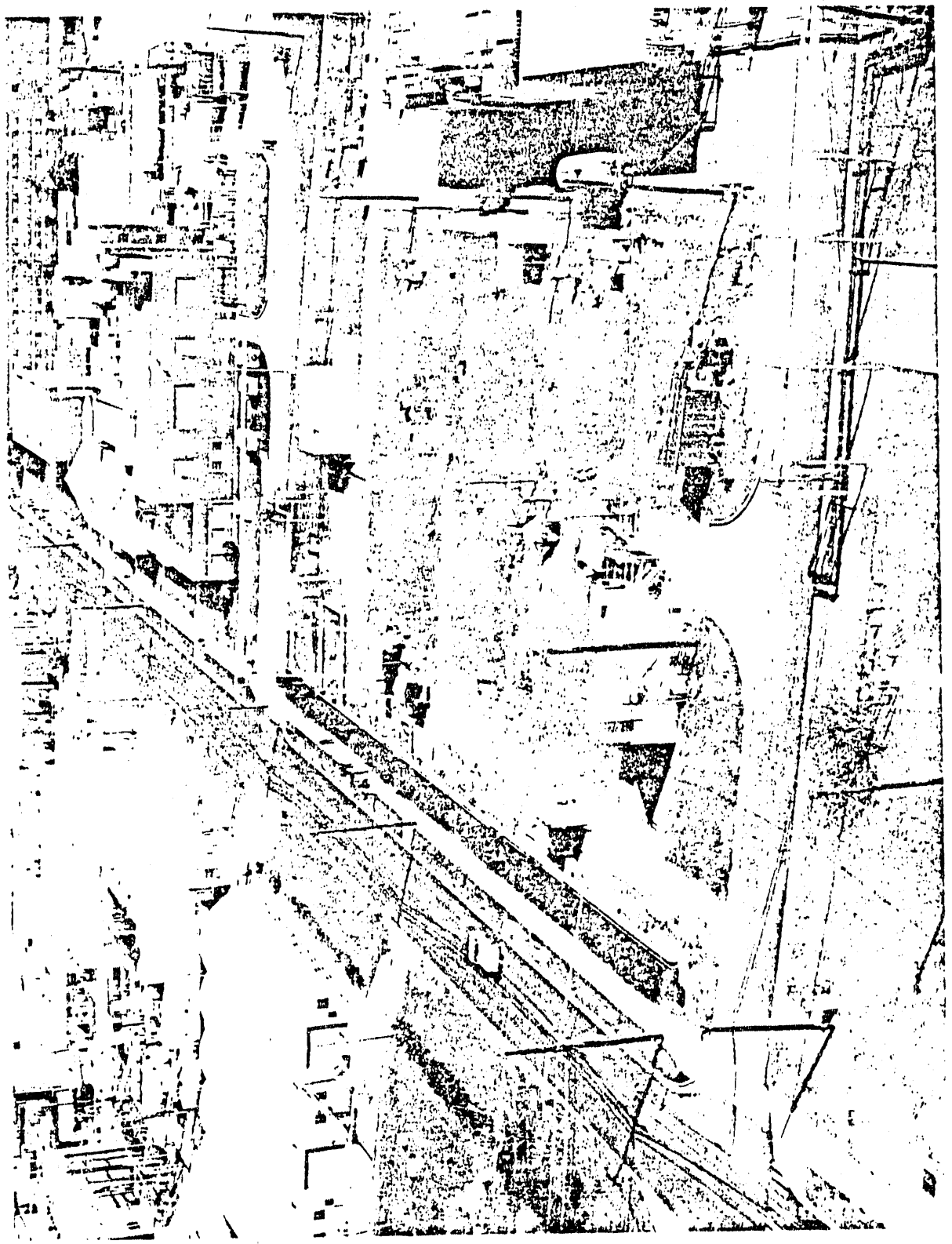


Fig. 2 Aerial view of the Gunite Storage Tanks in the south tank farm prior to sludge removal activities.

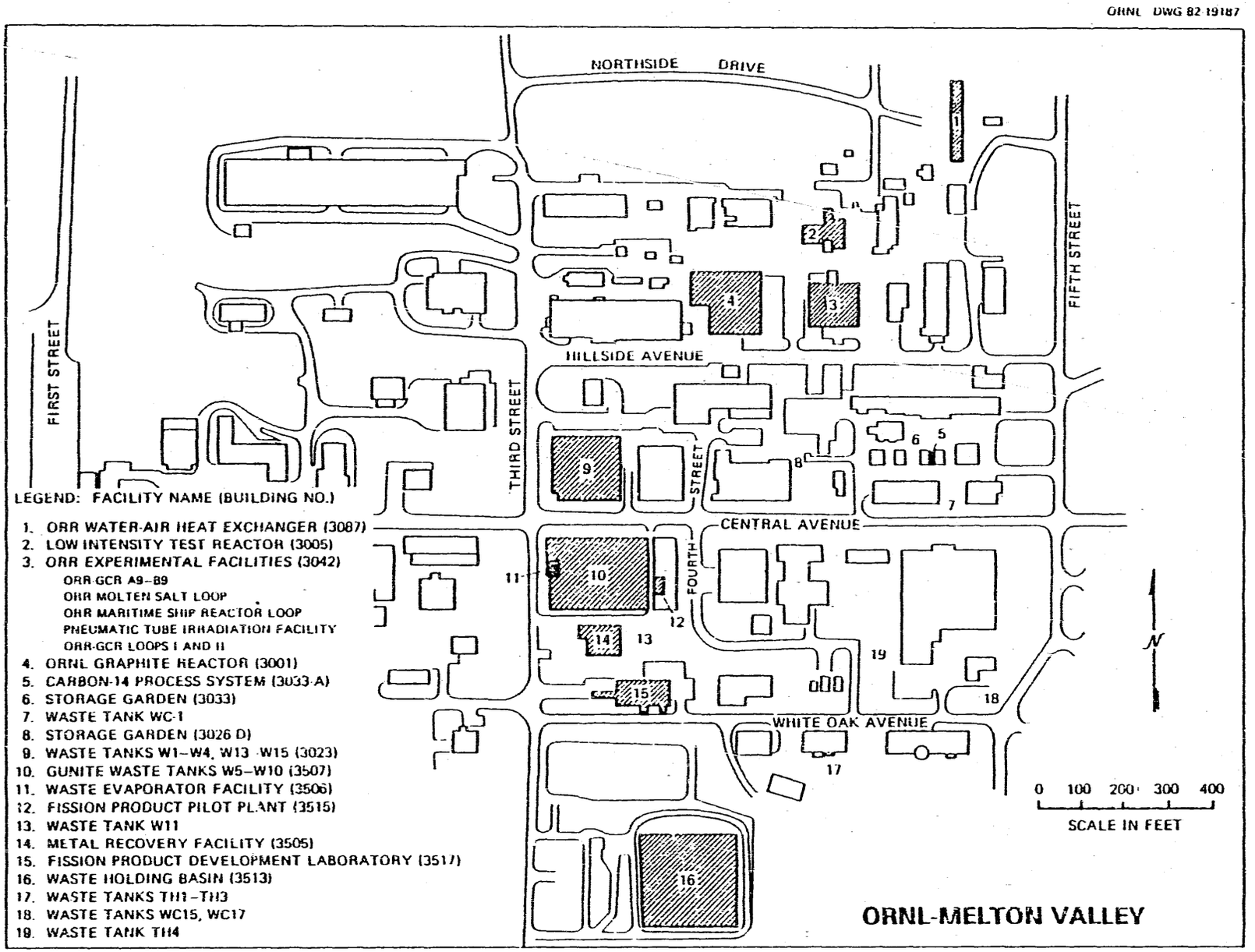


Fig. 1. Location of the Gunite Storage Tanks at the Oak Ridge National Laboratory.

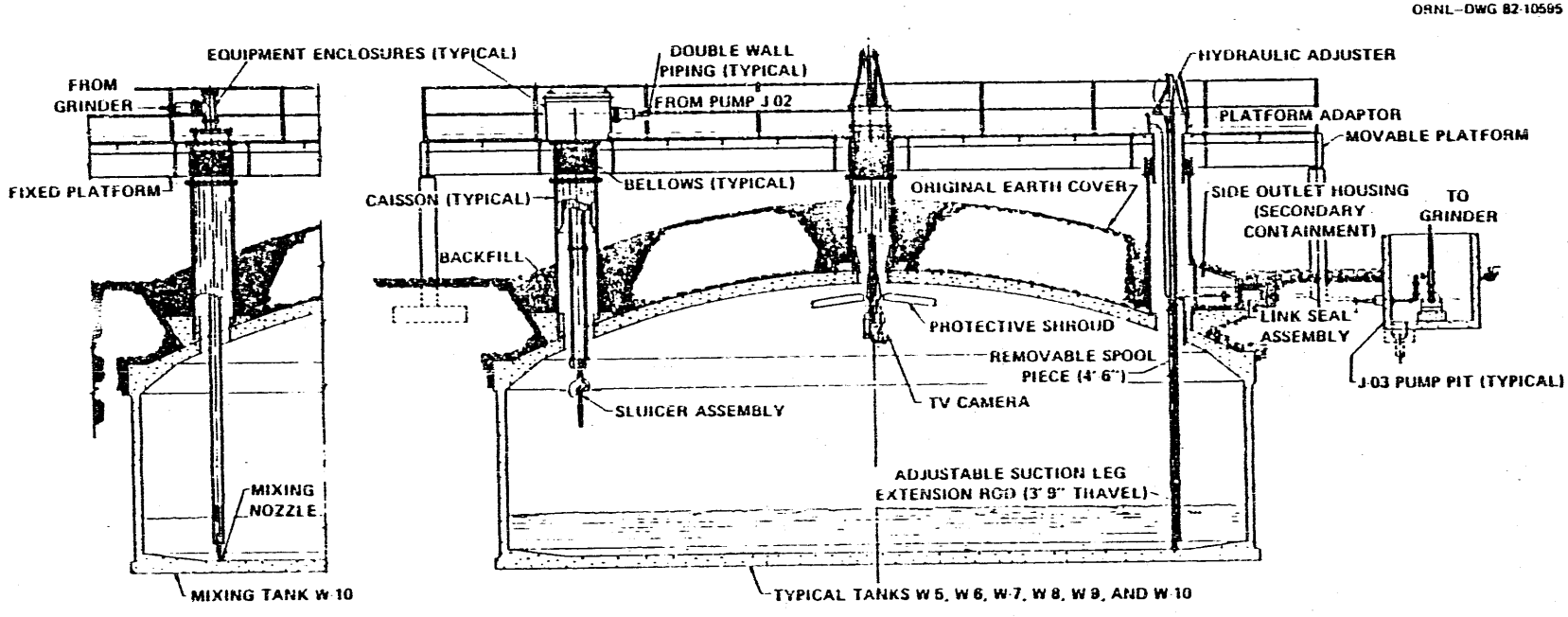


Fig. 3. Schematic view of Gunite Tank construction showing sludge removal equipment.

a vertical sidewall height of 12 ft (with reference to the tank floor at the center). The tank dome rises an additional 6 ft 3 in. at the center, has no internal supports, and is covered with about 6 ft of compacted dirt. The gunite tank sidewall is 6 in. thick; and the tank dome is believed to be 10 in. thick at the center, increasing in thickness near the tank wall. The tank does not have an interior metal liner. The roof and side walls incorporate 3/8 in. and 1/2 in. steel reinforcment. Welded #8 wire mesh on a 4 x 4 in. pattern is also used in the roof, walls, and bottom.

The tank bottoms are approximately 5 in. thick and rest on slightly sloping (1/2%) saucers that have curbs and gutters surrounding the tanks. An adjacent dry well basin is connected to the saucer under each tank, with a 6-in. vitreous clay pipe that extends into the gutters on the low side of each tank. The dry well basins are 2 ft square on the inside and 3 ft square on the outside. The dry well from the saucer drain basins extend to the surface and are covered with manhole opening covers (see Dwg. 68336).

Valve pits 206-126* and 206-135* consist of concrete boxes with overall dimensions of 4 x 5 x 7.5 ft and 3.7 x 6 x 7 ft, respectively. The thickness of the concrete boxes are 6 in. and 9 in., respectively. These valve pits incorporate plug-type valves. Pit 206-135* previously

*These numbers are original equipment numbers used on the old installation drawings only.

extended to the surface and Pit 206-110* originally had 5 ft of soil cover. Both pits now have been abandoned and are completely covered with soil.

Two additional concrete valve pits added after the initial installation are adjacent to the dry well for Tank W-7. These pits are visible from the surface. Two other pits are located approximately 40 ft northwest of Tank W-9. Two pits are located to the southeast and southwest of Tank W-6.

New facilities constructed in the area to use while emptying Tank W-5 to W-10 are described elsewhere (see Sect. 7, Ref. 3).

2.3 Tank History, Use, and Contents

During the 35 years the gunite tanks have been in service, they have contained the Low Level Liquid Waste (LLW, formerly called ILW) from a large variety of ORNL programs. The standard practice has been to neutralize all acidic LLW by the addition of NaOH or $CaCO_3$ until the liquid waste was basic, after which the LLW was transferred to one of the gunite tanks, usually one in the north row (see Sect. 7, Refs. 1 and 2). After a period of storage in the tank, the LLW would be transferred to an evaporator for concentration before the return of the LLW to another gunite tank, usually in the south row, for an additional storage period before final disposal. Organic liquid wastes are not normally routed to

*These numbers are original equipment numbers used on the old installation drawings only.

these tanks (see Sect. 7, Ref. 3). However, small quantities of organic liquid has been handled in the aqueous waste and it was once recommended that addition of a few gallons per day continue to be allowed (see Sect. 7, Ref. 4).

While the LLW was stored in the gunite tanks, various chemical salts (strontium hydroxide, barium hydroxide, various other hydroxides and carbonates, and some sulfates) precipitated because of their limited solubility in basic solutions. These precipitates accumulated in distinct sludge strata of varying compositions due to the different compositions of the LLW from the various input sources. The different sludge layers also vary in thickness. Most of this sludge material has now been removed and disposed of by hydrofracture (see Sect. 7, Ref. 4).

Most of the original valve pits have been out of service for many years since the tanks were either not in service or the functions of the valve pits were provided by newer systems.

The bulk of the sludge in the tanks has now been removed. When the emptying program began in August 1980, several additional holes were bored through the soil cover and concrete dome for inserting 34-in. diam. access shafts (see Ref. 3). These holes remain for access into the tanks.

Access is no longer available to the original valve pits. Pit 206-110* located approximately 16 ft north of the edge of Tank W-7 is no longer in use and has not been accessed since being covered with soil. Pit 206-136*, 14 ft to the east of Pit 206-110* has also been covered. Two newer pits located adjacent to the dry well for Tank W-7 extend to the surface but they are no longer in service. Dry wells located approximately 5 ft from the northwest edge of Tanks W-5, W-7, and W-9 and 5 ft from the southwest edge of Tanks W-6, W-8, and W-10 are accessible.

2.4 Radiological Characterization

These tanks contained highly radioactive material prior to being emptied in the early 1980s. Measurements taken in August 1980 through the new access holes just before removal of the tank contents was initiated provided readings of 400, 600, 900, 900, 150, and 900 mr/hr in tanks W-5 through W-10, respectively. These readings were taken above the contents at dome level. Readings taken in the opening 3 ft above the tanks were 15, 100, 50, 100, 15, and 80 mr/hr, respectively. A concrete plug drilled out of the top of one of the tanks read 80 mr/hr immediately after removal, but fell to 2 mr/hr after two days. The concrete at other parts of the tanks is likely to retain higher levels of activity. The radiation level on the access platforms above the tanks was less than 1 mr/hr, and levels around the chain-link fence surrounding the area were less than 0.5 mr/hr. A typical stainless steel transfer line located in

*These numbers are original equipment numbers used on the old installation drawings only and are not referred to by this number anywhere except there.

the vicinity of tank W-8 read 3 r/hr at 3 in. from the pipe. This agrees with levels of 2 r/hr reported as typical for plug-type valve pits.[6]

The radiation level in these tanks is now lower because most of the sludge, as well as the clear water which previously covered the sludge, has been removed by the gunite tank sludge removal project. A preliminary radiological characterization was made, after the tanks were emptied, as part of the current SFMP planning effort.[5] The inventories of residual material left in tanks W-5 through W-10 following the sludge removal activities are given in Table 1. This material includes a heel of slurried waste left after the tanks were pumped out, as well as a small layer of solids which could not be slurried. A total of 345,000 l of waste remains in the tanks. The most significant radionuclides involved are ^{90}Sr and ^{137}Cs. Tanks W-8 and W-10 have the largest inventories of residual radionuclides, with 7.8 and 7.0 kCi of ^{90}Sr, respectively. Results of a radiation survey of the tank openings and interiors are given in Table 2. Levels of 17 and 20 rad/h were found near the bottoms of tanks W-8 and W-10.

3. DECOMMISSIONING ALTERNATIVES ASSESSMENT

The gunite tanks in the south tank farm are not known to leak, but they are old, single-wall tanks that have little or no long-term reuse potential. As with other decommissioning studies of this series, an ad hoc review committee was formed to review summary descriptions of the gunite storage tanks, their condition, and the preliminary radiological

Table 1. Estimated inventory of residual waste in each tank.

Tank[a]	Type of waste[b] Slurry (ℓ)	Solids (ℓ)[d]	Total volume (ℓ)	Major radionuclides	Total inventory[c] (TBq)	(kCi)
W-5	14,000	9,700	24,000	^{90}Sr	11	0.3
				^{137}Cs	0.60	0.02
				others	0.43	0.01
W-6	39,000	19,000	58,000	^{90}Sr	76	2.0
				^{137}Cs	5.5	0.15
				others	1.6	0.04
W-7	39,000	7,800	47,000	^{90}Sr	62	1.7
				^{137}Cs	4.5	0.12
				others	1.3	0.03
W-8	39,000	3,900	43,000	^{90}Sr	290	7.8
				^{137}Cs	35	0.96
				others	5.1	0.14
W-9	54,000	0	54,000	^{90}Sr	15	0.41
				^{137}Cs	9.1	0.25
				others	2.6	0.07
W-10	120,000	0	120,000	^{90}Sr	260	7.0
				^{137}Cs	36	0.96
				others	12	0.33
Total	305,000	40,000	345,000		820	22

[a]The capacity of each tank is 6.6×10^5 ℓ.

[b]Estimated volume based on photographic information.

[c]Based on radioactivity/volume ratios multiplied by the volume shown in column 4 of this table.

[d]High density sludge.

Table 2. Radiological survey results in the waste tanks in the South Tank Farm.

Tank	TLD absorbed dose rate (rad/h)			Direct beta-gamma absorbed dose rate[a] (rad/h)
	B[b]	M[b]	S[b]	
W-5	0.74	0.76	0.94	0.015
W-6	2.5	1.2	0.03	0.020
W-7	1.8	1.6	0.83	0.300
W-8	17.0	2.5	0.62	0.150
W-9	6.5	5.6	0.22	0.100
W-10	20.0	4.4	0.43	0.250

[a]Radiation measured at the opening of the tank access with lid open.

[b]B, M, and S indicate different depth where TLD chips were placed in the tank. B indicates 0.6 m above the bottom of tank W-5 and 0.9 m above the bottom of other tanks. M and S indicate 1.8 m and 3.4 m above B, respectively.

characterization study. The decommissioning alternatives for the large gunite tanks were discussed in conjunction with alternatives for the other groups of waste tanks.[7]

Entombment and complete removal were the two primary options considered for decommissioning the gunite storage tanks. The complete removal option would involve sectioning large concrete tanks in a relatively high radiation background field. Thus, removal would entail significantly larger absorbed doses on the part of the operating personnel. On the other hand, the tanks could be entombed with only moderate personnel exposures.

Cost was also a significant factor in evaluating entombment and complete removal options. The cost estimates for removal of the other, smaller LLW collection tanks had been made prior to selection of the decommissioning mode for the large gunite tanks. Therefore, costs for removal were easily obtained along with entombment costs for the large gunite tanks. Complete removal was found to cost about 30% more than entombment.

Because of the lower personnel doses associated with entombment, lower costs, a lack of alternative land use requirements, acceptable groundwater levels, etc., entombment was selected as the most probable decommissioning mode for the gunite storage tanks.

4. DESCRIPTION OF THE DECOMMISSIONING PLAN

The six gunite tanks discussed in this report will be entombed with a grout after remote cleaning. The remotely operated equipment to be used in the cleaning, shown in Fig. 4, is concepted as being mostly "off-the-shelf" commercial robotic components.[8] The platforms previously used for the sludge removal operations will provide a base for the decommissioning equipment. Tank access will be gained through existing openings under the platforms. Procedures for removing any remaining material will be essentially the same as when the tanks were emptied earlier. Remote decontamination will be accomplished using ultra high-pressure water jet cleaning, without abrasives. However, abrasive jet scarification could be used on hot spots or hard deposits if experience indicates a need for the use of abrasives.

Once the tanks are cleaned, they will be entombed with grout. Each tank will require about 170,000 gal of grout; thus, a total of slightly over 1 million gal of grout will be required. A typical grout mixture which might be considered for use in the gunite tanks consists of 20% bentonite, 70% fly ash, and 10% cement.

The soil in the south tank farm around these tanks will be removed to a depth of approximately 1 m. The associated piping near the surface will be removed. The soil and piping will be placed in low-level waste burial. New soil will replace the old soil and the terrain returned to the natural slope in the area.

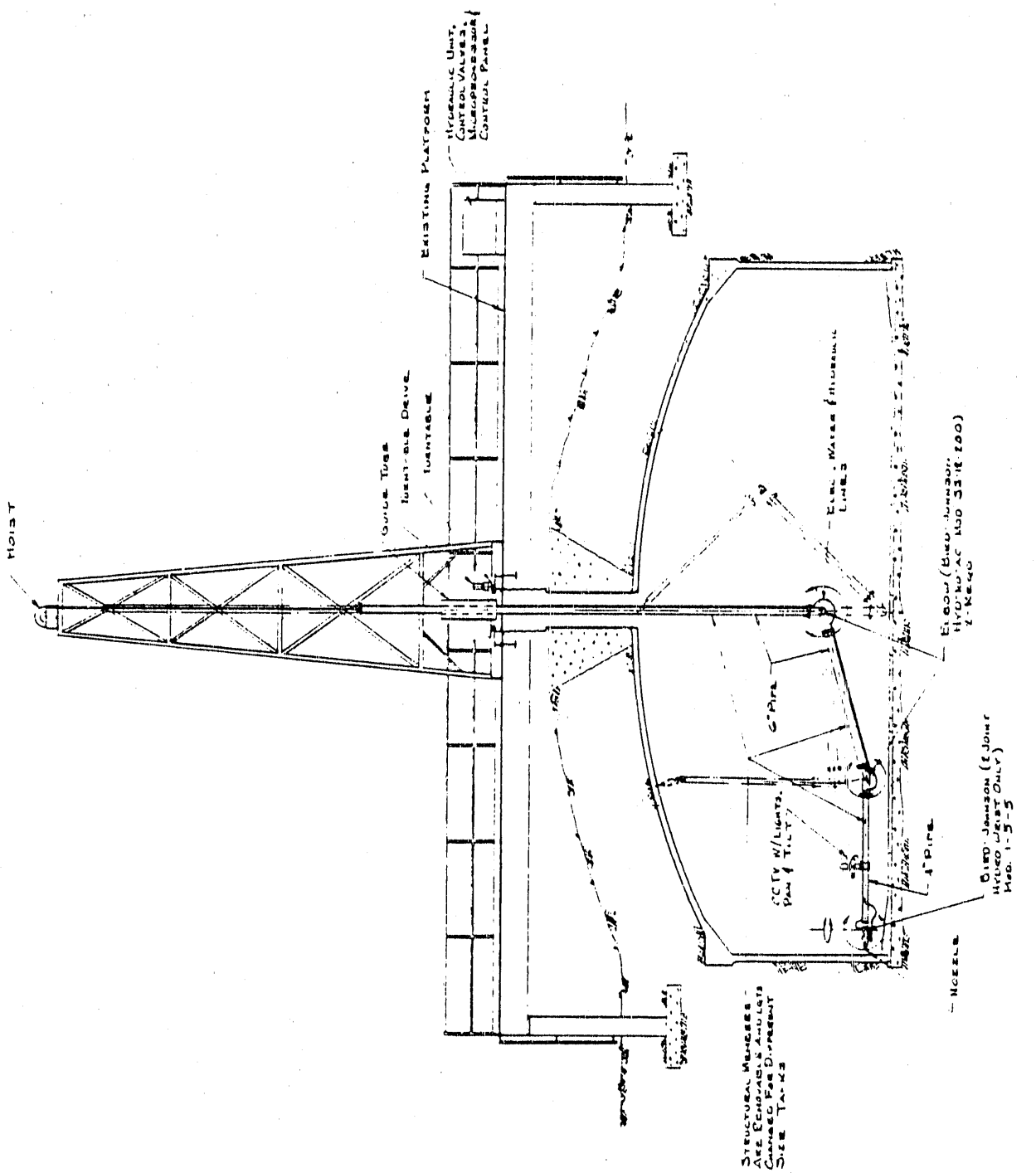


Fig. 4. Work platform and robot arm.

The general approach to decommissioning of the six large gunite tanks will be:

1. prepare a project plan, support documentation, and radiological characterization;
2. perform detail design and finalize decommissioning procedures, and
3. implement decommissioning operations.

5. COST ESTIMATE AND SCHEDULE

The primary cost for decommissioning the six large gunite tanks in the south tank farm is $5,900,000 (FY-85, first quarter dollars) plus a small portion of the $621,000 for special equipment which will be shared with other tank decommissioning projects. The estimated cost is summarized in Table 3.

Table 3. Decommissioning cost for entombing South Tank Farm gunite tanks

Engineering	810,000
Operating Contractor	3,360,000
On-Site Construction Contractor	1,730,000
TOTAL	$5,900,000

Burial ground cost at $1,609,000 is a significant part of the operating contractor's portion. Waste volumes are provided in Fig. 5. Contaminated soil accounts for 3,000 m^3 of the total 3,200 m^3 of radioactive solid waste. Metal and general rubble accounts for the other 200 m^3. A total of 835 m^3 of liquid wastes are anticipated, mostly from the cleaning operations.

The expenditures by fiscal year are provided in Fig. 5. The cost estimate worksheets are provided in Appendix I. The estimate generated for the removal option is also presented as Appendix II.

6. SCHEDULE

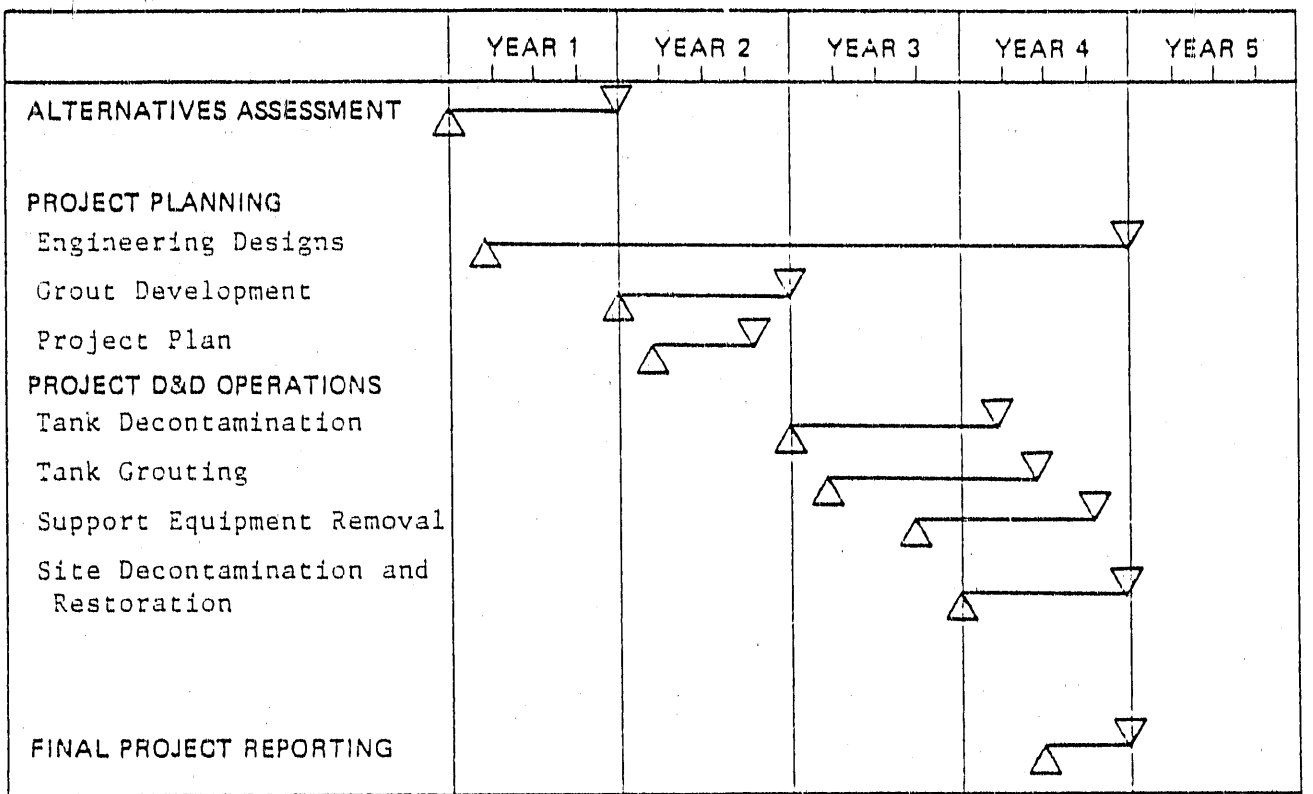
The schedule for decommissioning the six large gunite tanks is provided in Fig. 5. The first year involves characterization studies and assessments and preliminary engineering. Detailed engineering will be done in the second year and actual decommissioning operations in years three and four.

7. REFERENCES

1. L. C. Lasher, Operating Procedures for Radioactive Liquid Gaseous Waste Disposal, Third Revision, ORNL-CF-64-11-62, June 1971, p. 1-8.

2. Departmental Superintendent, Operating Procedures for Radioactive Liquid and Gaseous Waste Disposal, ORNL-CF-64-11-62, November 1964, p. 15.

ORNL-DWG 83-14840R3



PROJECT COSTS ($K)					
Annual Expense	200	600	2,425	2,425	
Capital Equipment	–	–	25	25	
Total	200	600	2,450	2,450	
WASTE VOLUME PROJECTIONS					
Solid (m^3)					
Soil (LLW)	–	–	3,000	3,000	
(TRU)	–	–	–	–	
Rubble (LLW)	–	–	100	100	
(TRU)	–	–	–	–	
Metal (LLW)	–	–	100	100	
(TRU)	–	–	–	–	
Misc. (LLW)	–	–	–	–	
(TRU)	–	–	–	–	
Total (LLW)	–	–	3,200	3,200	
(TRU)	–	–	–	–	
Liquid (m^3)					
Process Waste	–	–	–	–	
LLW	–	–	835	835	

Fig. 5. Decommissioning schedule, waste volume estimates, and costs by fiscal year.

3. Richard D. Ehrlich and Douglas MacNary, et al., Conceptual Design Report for Gunite Tank Sludge Removal, UCC-ND, X-OE-73, June 1979.

4. W. D. Burch, et al., Waste Management at ORNL: Present Practices--Immediate Needs--The Future (The Final Report of the Committee on ORNL Waste Handling Practices) ORNL-CF-72-9-1, September 1972.

5. S. F. Huang, W. A. Alexander, J. B. Watson and T. W. Oakes, Preliminary Radiological Survey of the Gunite Waste Tanks in the South Tank Farm at Oak Ridge National Laboratory, ORNL/CF-84/206, September 1984.

6. Personal communication, Charlie Guinn, ORNL Industrial Safety and Health Physics Division, to J. R. Horton, April 1983.

7. Letter, minutes of the SFMP Ad Hoc Review Committee Meeting on the Liquid LLW Waste Tanks, T. E. Myrick (Martin Marietta Energy Systems, Operations Div.) to attendees, March 13, 1984.

8. Personal communication, D. P. Kuban of the Martin Marietta Energy Systems Engineering Division, to J. R. Horton, April 1984.

APPENDIX I

COST ESTIMATE SHEETS

JOB TITLE AND BUILDING: SURPLUS FACILITIES MANAGEMENT PROGRAM

SUBTITLE: ILW COLLECTION TANKS

WORK ORDER NO.: A-2620

CATEGORY (LAND IMP., BLDG. ADD., ETC.)

CONSTRUCTION BY

LEVEL OF ESTIMATE: STUDY

LARGE CONCRETE TANKS W-5 TO W-10 (D&D FACILITY 10)

ALTERNATIVE 2: GROUTING ENTOMBMENT

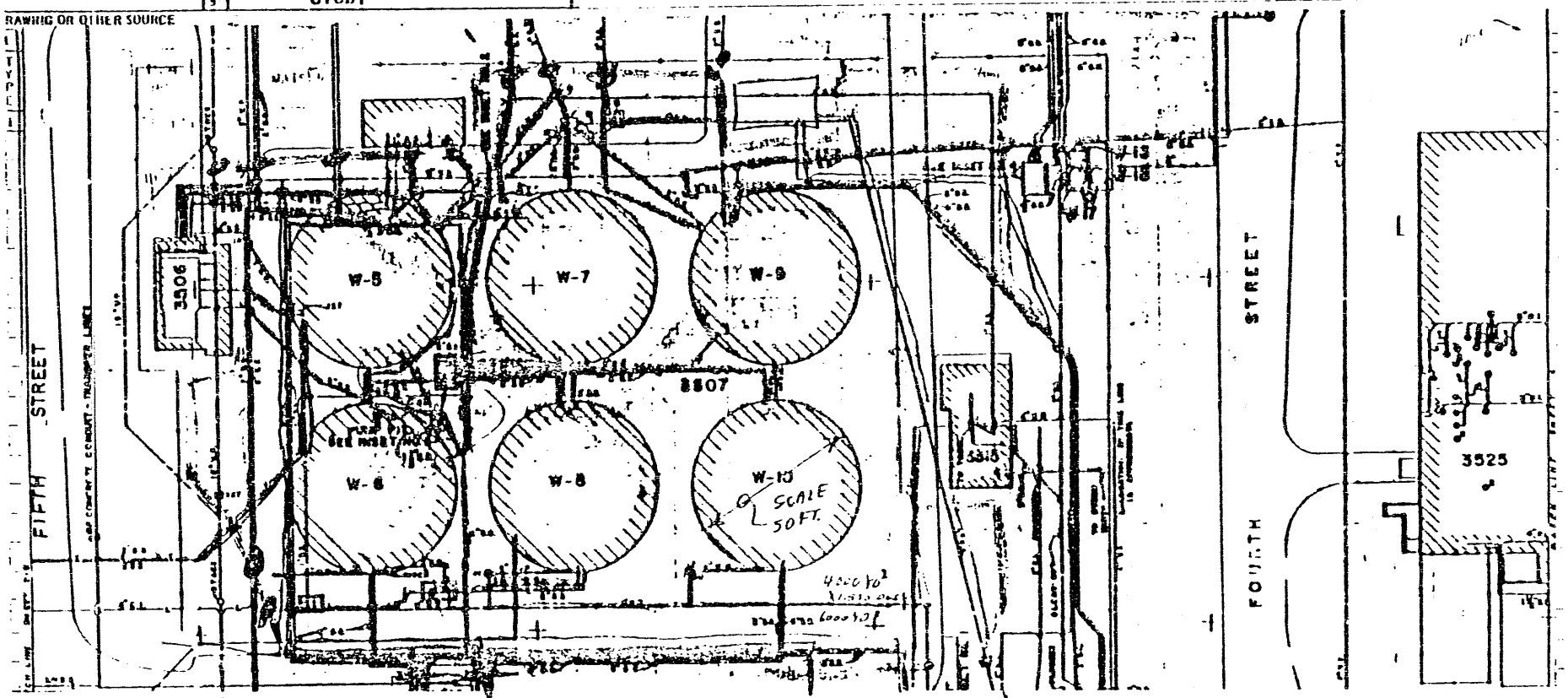
BILL OF MATERIAL NO.

BILL OF MATERIAL SHEET 1 OF 7

PROJECT ENGINEER: N. DURFEE

PRINCIPAL ENGINEER: E. PEREIZ

DRAWING OR OTHER SOURCE



TOTAL

LISTED BY | DATE | ESTIMATED BY | DATE | ESTIMATE SHEET 37

For Computer Estimates Only

CODE NO. 1

SUBPROJECT 1

ACCOUNT NO. 11

PARTICIPANT 1

JOB TITLE AND BUILDING 9 SURPLUS FACILITIES MANAGEMENT PROGRAM

WORK ORDER NO. 9 A-2620

CATEGORY (L AND INP., BLDG. ADD., ETC.) 9

CONSTRUCTION BY 9

LEVEL OF ESTIMATE 9 STUDY

SUBTITLE 10 ILW COLLECTION TANKS

LARGE CONCRETE TANKS W-5 TO W-10 (D&D FACILITY 10)

ALTERNATIVE 2: GROUTING ENTOMBMENT

BILL OF MATERIAL NO. 11

BILL OF MATERIAL SHEET OF

PROJECT ENGINEER 11 N. DURFLE

PRINCIPAL ENGINEER 11 F. PERETZ

DRAWING OR OTHER SOURCE 11

	ITEM	SHEET NO.	MATERIAL	LABOR		TOTAL	(INCL CONT. & ESCAL.) 60
1							
2	CMF					1,230,000	1,730,000
3	ONL FORCES (INCL BURIAL GROUND)					2,500,000	3,360,000
4							
5	S/T					3,780,000	5,090,000
6	ENGINEERING					600,000	810,000
7	CONTINGENCY					1,320,000	—
8							
9	S/T					5,700,000	—
10	ESCALATION TO FY 85-1					200,000	—
11							
12	TOTAL					5,900,000	5,900,000
13							
14							
15							
16							
17							
18							
19							
20							
21							

ESTIMATE SHEET 37A OF

For Computer Estimates Only

CODE NO. 1
SUBPROJECT 1
ACCOUNT NO. 1
PARTICIPANT 1 | 1

JOB TITLE AND BUILDING: 9 SURPLUS FACILITIES MANAGEMENT PROGRAM
WORK ORDER NO.: 9 A-2620
CATEGORY (LAND IMP., BLDG. ADD., ETC.): 9
CONSTRUCTION BY: 9 ORNL
LEVEL OF ESTIMATE: 9 STUDY

SUBTITLE: 41 ILW COLLECTION TANKS

LARGE CONCRETE TANKS W-5 TO W-10 (D&D FACILITY 10)

ALTERNATIVE 2: GROUTING ENTOMBMENT

BILL OF MATERIAL NO.: 41
BILL OF MATERIAL SHEET ___ OF ___
PROJECT ENGINEER: 41 N. DURFEE
PRINCIPAL ENGINEER: 41 F. PERETZ

DRAWING OR OTHER SOURCE: 1

TYPE		ITEM NO.	MATERIAL AND DESCRIPTION	QUANTITY	UNIT		MATERIAL UNIT COST	MATERIAL TOTAL	LABOR HOURS UNIT	LABOR HOURS TOTAL	LABOR RATE	CFI	TOTAL
1		1.	Remote Wash/Cleaning Equip. - Requires Development	N/A									
		2.	Hi-pressure Cleaning (Hand Held) Equip.	NA									
		3.	Remote Concrete Cutting Eq. and Accessories	NA									
		4.	Sump Pumps	3	ea		2000	6000					
		5.	Work Platform for All Sites except S Tank Farm. - Dont Own? Incl. Utilities Materials	NA									

TOTAL

LISTED BY | DATE | ESTIMATED BY | DATE | ESTIMATE SHEET 38

UCN-81255 (1 10-77)

For Computer Estimates Only

Field	Entry
CODE NO.	1
SUBPROJECT	1
ACCOUNT NO.	1
PARTICIPANT	1
JOB TITLE AND BUILDING	9 SURPLUS FACILITIES MANAGEMENT PROGRAM
WORK ORDER NO.	9 A-2620
CATEGORY (LAND IMP., BLDG. ADD., ETC.)	9
CONSTRUCTION BY	9 ORNL
LEVEL OF ESTIMATE	9 STUDY
SUBTITLE	11 ILW COLLECTION TANKS
BILL OF MATERIAL NO.	41
BILL OF MATERIAL SHEET ___ OF ___	
PROJECT ENGINEER	11 N. DURFEE
PRINCIPAL ENGINEER	11 F. PERETZ

LARGE CONCRETE TANKS W-5 TO W-10 (D&D FACILITY 10)

ALTERNATIVE 2: GROUTING ENTOMBMENT

DRAWING OR OTHER SOURCE 1 | 80 |

TYPE		ITEM NO.	MATERIAL AND DESCRIPTION	QUANTITY	UNIT	MATERIAL	MATERIAL UNIT COST	MATERIAL TOTAL	LABOR HOURS UNIT	LABOR HOURS TOTAL	LABOR RATE	C/I	LABOR TOTAL
1	7	8 10	11 38	39 46	47 50	51 56	57 63			65 72	73 78	79 80	
			Phase II										
		1.	Install Work Platform over tanks	1.5	ea					1000			
		2.	Install utilities on Platform - Connect to Temp. services and controls to trailer	5	ea					1100			
		3a	Remove contents from 10 (W-8 - W-10 Tank) to Micro-Emulsion	(Free liquid)						400			
		4	Decontaminate by Remote Cleaning Spray Eq. and Pumping - (40,716 FT^2 total)	410,000	GAL				.015	6000			
			TOTAL							8,500			

UCN 11255 (1 10-77)	LISTED BY	DATE	ESTIMATED BY	DATE	ESTIMATE SHEET 39

For Computer Estimates Only

CODE NO. 1

SUBPROJECT 1

ACCOUNT NO. 1

PARTICIPANT 1

JOB TITLE AND BUILDING 9: SURPLUS FACILITIES MANAGEMENT PROGRAM

WORK ORDER NO. 9: A-2620

CATEGORY (LAND IMP., BLDG. ADD., ETC.) 9

CONSTRUCTION BY 9: ORNL

LEVEL OF ESTIMATE 9: STUDY

SUBTITLE 41: ILW COLLECTION TANKS

LARGE CONCRETE TANKS W-5 TO W-10 (D&D FACILITY 10)

ALTERNATIVE 2: GROUTING ENTOMBMENT

BILL OF MATERIAL NO. 41

BILL OF MATERIAL SHEET OF

PROJECT ENGINEER 41: N. DURFEE

PRINCIPAL ENGINEER 41: F. PERETZ

DRAWING OR OTHER SOURCE

TYPE 1	ITEM NO. 8–10	MATERIAL AND DESCRIPTION 11–38	QUANTITY 39–46	UNIT 47–50	MATERIAL UNIT COST 51–56	MATERIAL TOTAL 57–64	LABOR HOURS UNIT	LABOR HOURS TOTAL 65–72	LABOR RATE 73–78	CFT 79–80	TOTAL
	5.	FINAL CLEAN by HIGH PRESSURE WATER SPRAY	35,000	sf			.11	3850			
	6.	FLUSH ALL PIPING LINES TO/FROM TANKS	31,000	GAL			.1	3100			
	7.	REMOVE ALL TEMP. CLEAN-UP ITEMS INSTALLED ABOVE.	1	LOT				400			
	8.	BURIAL GROUND UTILITY & MISC. STRUCTURES	6000	CY		200					1,200,000
		TOTAL						7350			

USCM-S1758 (1 10 77)

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CODE NO.	1
SUBPROJECT	1
ACCOUNT NO.	1
PARTICIPANT	1
JOB TITLE AND BUILDING	9 SURPLUS FACILITIES MANAGEMENT PROGRAM
WORK ORDER NO.	9 A-2620
CATEGORY II AND IMP. BLDG. ADD. ETC.)	9
CONSTRUCTION BY	9 ORNL
LEVEL OF ESTIMATE	9 STUDY
SUBTITLE	41 ILW COLLECTION TANKS
BILL OF MATERIAL NO.	41
BILL OF MATERIAL SHEET ___ OF ___	
PROJECT ENGINEER	41 N. DURFEE
PRINCIPAL ENGINEER	41 F. PERETZ

LARGE CONCRETE TANKS W-5 TO W-10 (D&D FACILITY 10)

ALTERNATIVE 2: GROUTING ENTOMBMENT

DRAWING OR OTHER SOURCE

TYPE		ITEM NO.	MATERIAL AND DESCRIPTION	QUANTITY	UNIT	MATERIAL	MATERIAL: UNIT COST	MATERIAL: TOTAL	LABOR: HOURS: UNIT	LABOR: HOURS: TOTAL	LABOR: RATE	LABOR: CFT	LABOR: TOTAL
1	7	8 10	11 38	39 46	47 50	51 56	57 64			65 72	73 78	79 80	
			ORNL Sub Total					6,000		15,850	55		871,800
			HP @ 25% Lab/Below NIT					10,000					215,000
			ORNL Sub Total					16,000					1,087,800
										1,102,800			
			Proj Integration*							200,000			
			Burial Ground							1,200,000			
			ORNL TOTAL							2,502,800			
			Engineering @ 25% (CPAF+ORNL)							577,000			
			(Not Incl. Burial Ground Cost)										
			*Includes Engr Development by McDaniels										

TOTAL 5.41B

UCN 31258 (1 10 77)	LISTED BY	DATE	ESTIMATED BY	DATE	ESTIMATE SHEET
					41

For Computer Estimates Only

CODE NO.

SUBPROJECT

ACCOUNT NO.

PARTICIPANT

JOB TITLE AND BUILDING: SURPLUS FACILITIES MANAGEMENT PROGRAM

SUBTITLE: ILW COLLECTION TANKS

WORK ORDER NO.: A-2620

CATEGORY (LAND IMP., BLDG. ADD., ETC.)

CONSTRUCTION BY: CPAF

LEVEL OF ESTIMATE: STUDY

LARGE CONCRETE TANKS W-5 TO W-10 (D&D FACILITY 19)

ALTERNATIVE 2: GROUTING ENTOMBMENT

BILL OF MATERIAL NO.

BILL OF MATERIAL — SHEET ___ OF ___

PROJECT ENGINEER: N. DURFEE

PRINCIPAL ENGINEER: F. PERETZ

DRAWING OR OTHER SOURCE

TYPE	ITEM NO.	MATERIAL AND DESCRIPTION	QUANTITY	UNIT	MATERIAL UNIT COST	MATERIAL TOTAL	LABOR HOURS UNIT	LABOR HOURS TOTAL	LABOR RATE	CFT	TOTAL
		Phase I									
	1.	Excavate and expose leaks in Tanks. (Presumably @ penetrations) For Both Tanks	NA								
	2.	Construct Sumps under non-repairable leaks for collection. Install Sump Pump.	NA								
	3	Excavate and Install Access Vaults for Cleaning Tanks.	NA								
	4	Install Fills for Platform	NA								
	5	Install Piping to W-10 Tank for Liquid Clean-up	NA								
		TOTAL									

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CODE NO. 1

SUBPROJECT 1

ACCOUNT NO. 1

PARTICIPANT 1

JOB TITLE AND BUILDING: SURPLUS FACILITIES MANAGEMENT PROGRAM

WORK ORDER NO.: A-2620

CATEGORY (LAND IMP. BLDG. ADD.- ETC.)

CONSTRUCTION BY: CRAF

LEVEL OF ESTIMATE: STUDY

SUBTITLE: ILW COLLECTION TANKS

LARGE CONCRETE TANKS W-5 TO W-10 (D&D FACILITY 10)

ALTERNATIVE 2: GROUTING ENTOMBMENT

BILL OF MATERIAL NO.

BILL OF MATERIAL SHEET OF

PROJECT ENGINEER: N. DURFEE

PRINCIPAL ENGINEER: F. PERETZ

DRAWING OR OTHER SOURCE

TYPE	ITEM NO.	MATERIAL AND DESCRIPTION	QUANTITY	UNIT	MATERIAL UNIT COST	MATERIAL TOTAL	LABOR HOURS UNIT	LABOR HOURS TOTAL	LABOR RATE	LABOR CFT	LABOR TOTAL
		Phase II									
		W-5 & W-10									
	5	EXCAVATE IN TANK AREA TO EXPOSE & REMOVE PIPING, STRUCTURES, ETC. (INCLS HAUL)	4,000	CY			.32	1920			
	6	DEMOLISH TANKS AND HAUL TO BURIAL GROUND, INCLS TEMP STRUCTURE OVER TANK (1760 LF ea. ESTIMATE)	NA								
	7	REMOVE VALVE PITS AND OTHER STRUCTURES. (INCLS HAUL)	8	ea			40	320			
	8	REMOVE PIPING INCL. HAUL (BY HAND)	3645	LF			.2	1800			
	9	RELOCATE PIPING REMAINING	750	LF		6 4800	.5	480			
		TOTAL				4800		4520			

LISTED BY | DATE | ESTIMATED BY | DATE | ESTIMATE SHEET 43

UCN-81253 (1 to 77)

CODE NO.	JOB TITLE AND BUILDING	SUBTITLE
1	SURPLUS FACILITIES MANAGEMENT PROGRAM	ILW COLLECTION TANKS

SUBPROJECT 1	WORK ORDER NO. A-2620	LARGE CONCRETE TANKS W-5 TO W-10 (D&D FACILITY 10)	BILL OF MATERIAL NO.
ACCOUNT NO. 1	CATEGORY (L AND IMP., BLDG. ADD., ETC.)	ALTERNATIVE 2: GROUTING ENTOMBMENT	BILL OF MATERIAL SHEET OF
PARTICIPANT 7	CONSTRUCTION BY CPAF		PROJECT ENGINEER N. DURFEE
	LEVEL OF ESTIMATE STUDY		PRINCIPAL ENGINEER F. PERETZ

DRAWING OR OTHER SOURCE

TYPE	ITEM NO.	MATERIAL AND DESCRIPTION	QUANTITY	UNIT		MATERIAL UNIT COST	MATERIAL TOTAL	LABOR HOURS UNIT	LABOR HOURS TOTAL	LABOR RATE	C/I	LABOR TOTAL
	10	Plug & Cap Lines at Terminations (To Remain)	31	ea		100	3,100	10	310			
	11	Backfill with Clean Borrow Material	6,050	CY				..	600			
	12	Grade, Seed & Mulch Area	4000	SY			400		160			
	13	Allow for Perimeter Shoring (H-Pile & Timber)		LS			6,000		600			
Not Cost per J. Henry	14	Fill Tanks with Grout 170,000 Gal each 6 Tanks - (6085 cy ...)	1300,000	GAL		.40	520,000	.0015	1950			
		TOTAL					529,500		3620			

LISTED BY	DATE	ESTIMATED BY	DATE	ESTIMATE SHEET 47

DCN 21233

Code No.	Job Title and Building	Subtitle
1	SURPLUS FACILITIES MANAGEMENT PROGRAM	ILW COLLECTION TANKS

Subproject: 1
Account No.: 1
Participant: 1
Work Order No.: A-2620
Category (Land Imp., Bldg, Add., Etc.):
Construction By: CPAF
Level of Estimate: STUDY

LARGE CONCRETE TANKS W-5 TO W-10 (D&D FACILITY 10)

ALTERNATIVE 2: GROUTING ENTOMBMENT

Bill of Material No.:
Sheet ___ of ___
Project Engineer: N. DURFEE
Principal Engineer: F. PERETZ

Drawing or Other Source:

Type	Item No.	Material and Description	Quantity	Unit	Material	Material Unit Cost	Material Total	Labor Unit	Labor Hours Total	Labor Rate	C/I	Labor Total
		Sub Total					660,300		8140	15		122,100
		SC/Lab Adj. @ 70%										85,500
		Sub Total										207,600
		HP @ 50% Lab/Allow Mat.					5,200					103,800
		CPAF Dir. Total					665,500					311,400
		Indirect @ 5% Mat/87% Lab					33,300					270,900
							698,800					582,300
		CPAF Total							1,281,100			

TOTAL

UCN 31255 | Listed By | Date | Estimated By | Date | Estimate Sheet 45

APPENDIX II

COST ESTIMATE SHEETS FOR

TANK REMOVAL OPTION

CODE NO. 1

JOB TITLE AND BUILDING 9 SURPLUS FACILITIES MANAGEMENT PROGRAM

SUBTITLE 41 ILW COLLECTION TANKS

SUBPROJECT 1

WORK ORDER NO. 9 A-2620

BILL OF MATERIAL NO. 41

ACCOUNT NO. 1

CATEGORY (L AND IMP., BLDG. ADD., ETC.) 9

BILL OF MATERIAL SHEET 1 OF 9

PARTICIPANT 1

CONSTRUCTION BY 9

PROJECT ENGINEER 41 N. DURFEE

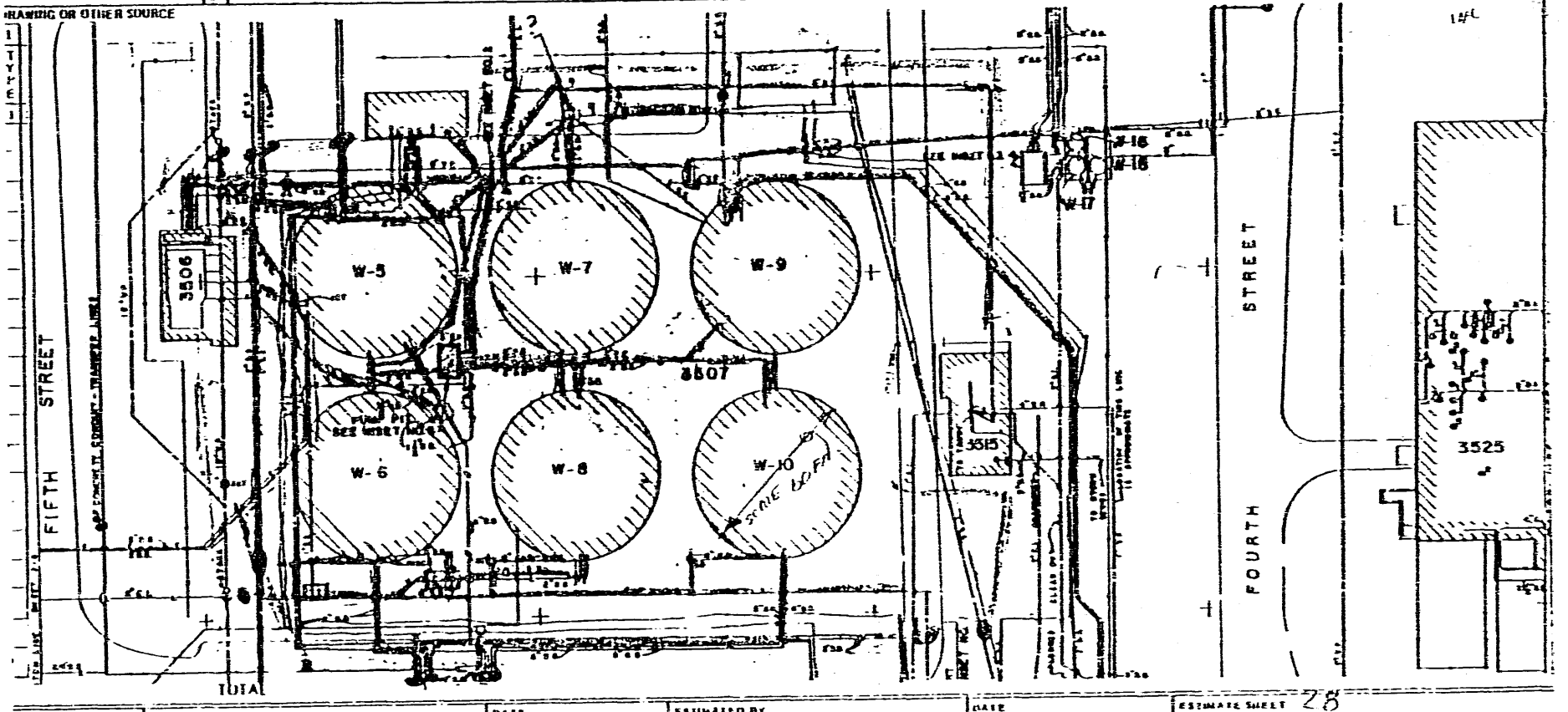
LEVEL OF ESTIMATE 9 STUDY

PRINCIPAL ENGINEER 41 F. PERETZ

LARGE CONCRETE TANKS W-5 TO W-10 (D&D FACILITY 10)

ALTERNATIVE 1: COMPLETE REMOVAL

DRAWING OR OTHER SOURCE 1



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CODE NO. 1

SUBPROJECT 1

ACCOUNT NO. 1

PARTICIPANT 1

SUB TITLE AND BUILDING: 9 SURPLUS FACILITIES MANAGEMENT PROGRAM

SUBTITLE: 41 ILW COLLECTION TANKS

WORK ORDER NO.: 9 A-2620

CATEGORY (LAND IMP.; BLDG. ADD.; ETC.): 9

CONSTRUCTION BY: 9 ORNL

LEVEL OF ESTIMATE: 9 STUDY

LARGE CONCRETE TANKS W-5 TO W-10 (D&D FACILITY 10)

ALTERNATIVE 1: COMPLETE REMOVAL

BILL OF MATERIAL NO. 41

BILL OF MATERIAL SHEET ___ OF ___

PROJECT ENGINEER: 41 N. DURFEE

PRINCIPAL ENGINEER: 41 F. PERETZ

DRAWING OR OTHER SOURCE

TYPE		ITEM NO.	MATERIAL AND DESCRIPTION	QUANTITY	UNIT	MATERIAL	MATERIAL UNIT COST	MATERIAL TOTAL	LABOR HOURS UNIT	LABOR HOURS TOTAL	LABOR RATE	CFF	LABOR TOTAL
		1.	Remote Wash/Cleaning Equip. - Requires Development	*									
		2.	Hi-pressure Cleaning (Hand Held) Equip.	*									
		3.	Abrasive Waterjet Cutting Eq. and Accessories	*									
		4.	Sump Pumps 3 [illegible]/6 tanks	3	ea		2000	6,000		–			
		5.	Work Platforms for All sites except S. Tank Farm. - [illegible] [illegible] Incl utilities materials	*									
			* SPECIAL EQ. PURCHASED ON A D&D FACILITY OR PREVIOUSLY ON HAND.										
			TOTAL										

UCN-21755 (1 16-77)

LISTED BY | DATE | ESTIMATED BY | DATE | ESTIMATE SHEET 29

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CODE NO. 1

JOB TITLE AND BUILDING 9 SURPLUS FACILITIES MANAGEMENT PROGRAM

SUBTITLE 41 ILW COLLECTION TANKS

SUBPROJECT 1

WORK ORDER NO. 9 A-2620

ACCOUNT NO. 1

CATEGORY (LAND IMP., BLDG. ADD., ETC.) 9

PARTICIPANT 7

CONSTRUCTION BY 9 OCNL

LEVEL OF ESTIMATE 9 STUDY

LARGE CONCRETE TANKS W-5 TO W-10 (D&D FACILITY 10)
ALTERNATIVE 1: COMPLETE REMOVAL

BILL OF MATERIAL NO. 41

BILL OF MATERIAL SHEET OF

PROJECT ENGINEER 41 N. DURFEE

PRINCIPAL ENGINEER 41 F. PEREZ

DRAWING OR OTHER SOURCE 1

TYPE	ITEM NO.	MATERIAL AND DESCRIPTION	QUANTITY	UNIT	MATERIAL UNIT COST	MATERIAL TOTAL	LABOR HOURS UNIT	LABOR HOURS TOTAL	LABOR RATE	LABOR CFT	LABOR TOTAL
		Phase II									
	1.	INSTALL WORK PLATFORM	5	TOTAL		-	200	1000			
		OVER TANKS W-5 TO W-9									
	2.	INSTALL UTILITIES ON	5	TOTAL		-	220	1100			
		Platform - CONNECT TO									
		TEMP. SERVICES AND									
		CONTROLS TO TRAILER									
	3a	DECANT & EVAP. W-10 FREE LIQ				-		200			
	3b	REMOVE CONTENTS FROM	NA								
		W-10 TANK TO MIXTURE									
	4	DECONTAMINATE BY REMOTE	200,000	GAL		-	40	8000			
		CLEANING SPRAY EQ. AND									
		MANIPULATE TANKS 6,7,8,9,10									

TOTAL 2400

LISTED BY DATE ESTIMATED BY DATE ESTIMATE SHEET 30

For Computer Estimates Only

CODE NO.: 1

SUBPROJECT: 1

ACCOUNT NO.: 1

PARTICIPANT: 1 | 7

JOB TITLE AND BUILDING: SURPLUS FACILITIES MANAGEMENT PROGRAM

SUBTITLE: ILW COLLECTION TANKS

WORK ORDER NO.: A-2620

CATEGORY (LAND IMP., BLDG. ADD., ETC.):

CONSTRUCTION BY: ORNL

LEVEL OF ESTIMATE: STUDY

LARGE CONCRETE TANKS W-5 TO W-10 (D&D FACILITY 10)

ALTERNATIVE 1: COMPLETE REMOVAL

BILL OF MATERIAL NO.:

BILL OF MATERIAL SHEET OF

PROJECT ENGINEER: N. DURFEE

PRINCIPAL ENGINEER: F. PEREZ

DRAWING OR OTHER SOURCE

TYPE		ITEM NO.	MATERIAL AND DESCRIPTION	QUANTITY	UNIT	MATERIAL	MATERIAL UNIT COST	MATERIAL TOTAL	LABOR HOURS UNIT	LABOR HOURS TOTAL	LABOR RATE	C	LABOR TOTAL
		5	Final Clean by High pressure water spray-tanks	35,000	SF			—	.11	3850			
		6	Flush all piping lines to/from tanks	31,000	GAL			—	.1	3100			
		7	Remove all Temp. Clean-up items installed above. Incl. Platform over T-10	1	LOT			—		400			
		8	Burial Ground soil, tanks, [illegible] and structures	14,500	CF		200	2,900,000					
			TOTAL							7350			

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UCN-5175S

For Computer Estimates Only

CODE NO.	1
SUBPROJECT	1
ACCOUNT NO.	1
PARTICIPANT	7
JOB TITLE AND BUILDING	SURPLUS FACILITIES MANAGEMENT PROGRAM
SUBTITLE	ILW COLLECTION TANKS
WORK ORDER NO.	A-2620
CATEGORY (L AND IMP.; BLDG. ADD.; ETC.)	
CONSTRUCTION BY	ORNL
LEVEL OF ESTIMATE	STUDY
BILL OF MATERIAL NO.	
BILL OF MATERIAL SHEET ___ OF ___	
PROJECT ENGINEER	N. DURFEE
PRINCIPAL ENGINEER	F. PERETZ

LARGE CONCRETE TANKS W-5 TO W-10 (D&D FACILITY 10)

ALTERNATIVE 1: COMPLETE REMOVAL

DRAWING OR OTHER SOURCE

TYPE		ITEM NO.	MATERIAL AND DESCRIPTION	QUANTITY	UNIT	MATERIAL	MATERIAL UNIT COST	MATERIAL TOTAL	LABOR HOURS UNIT	LABOR HOURS TOTAL	LABOR RATE	CFF	LABOR TOTAL
								6,000		15,850	55		871,800
			ORNL Sub Total										
			H.P. @ 25% LAB/ALLOW MAT.					10,000					218,000
								16,000					1,089,800
			ORNL SUB TOTAL										
										1,105,800			
										150,000			
			Proj. Integration							2,900,000			
			Burial Ground										
			ORNL TOTAL							4,155,800			
										545,000			
			ENGINEERING @ 25% (CPAF + ORNL)										
			NOT INCL. BURIAL GROUND										
			TOTAL										

7.1"

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				32

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CODE NO.

SUBPROJECT

ACCOUNT NO.

PARTICIPANT

JOB TITLE AND BUILDING: SURPLUS FACILITIES MANAGEMENT PROGRAM

SUBTITLE: ILW COLLECTION TANKS

WORK ORDER NO.: A-2620

CATEGORY (L AND IMP., BLDG. ADD., ETC.)

CONSTRUCTION BY: CPAF

LEVEL OF ESTIMATE: STUDY

LARGE CONCRETE TANKS W-5 TO W-10 (D&D FACILITY 10)

ALTERNATIVE 1: COMPLETE REMOVAL

BILL OF MATERIAL NO.

BILL OF MATERIAL

SHEET OF

PROJECT ENGINEER: N. DURFEE

PRINCIPAL ENGINEER: F. PERETZ

DRAWING OR OTHER SOURCE

NO.

TYPE	ITEM NO.	MATERIAL AND DESCRIPTION	QUANTITY	UNIT	MATERIAL UNIT COST	MATERIAL TOTAL	LABOR HOURS UNIT	LABOR HOURS TOTAL	LABOR RATE	CFT	TOTAL
		PHASE I									
	1.	EXCAVATE AND EXPOSE LEAKS IN TANKS. (PRESUMABLY @ PENETRATIONS). FOR EACH TANKS	NA								
	2.	CONSTRUCT SUMPS UNDER NON-REPAIRABLE LEAKS FOR COLLECTION. INSTALL SUMP PUMP.	NA								
	3	EXCAVATE AND INSTALL ACCESS PITS FOR CLEANING TANKS.	NA								
	4.	INSTALL ENDS FOR PLATFORM	NA								
	5	INSTALL PIPING TO W-10 TANK FOR LIQUID CLEAN UP	NA								
		TOTAL									

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For Computer Estimates Only

CODE NO.	1
SUBPROJECT	1
ACCOUNT NO.	1
PARTICIPANT	7
JOB TITLE AND BUILDING	9 SURPLUS FACILITIES MANAGEMENT PROGRAM
SUBTITLE	41 ILW COLLECTION TANKS
WORK ORDER NO.	9 A-2620
CATEGORY (LAND IMP., BLDG. ADD., ETC.)	9
CONSTRUCTION BY	9 CP&F
LEVEL OF ESTIMATE	9 STUDY
BILL OF MATERIAL NO.	41
BILL OF MATERIAL SHEET ___ OF ___	
PROJECT ENGINEER	41 N. DURFEE
PRINCIPAL ENGINEER	41 F. PERETZ

LARGE CONCRETE TANKS W-5 TO W-10 (D&D FACILITY 10)

ALTERNATIVE 1: COMPLETE REMOVAL

DRAWING OR OTHER SOURCE

TYPE		ITEM NO.	MATERIAL AND DESCRIPTION	QUANTITY	UNIT		MATERIAL UNIT COST	MATERIAL TOTAL	LABOR HOURS UNIT	LABOR HOURS TOTAL	LABOR RATE	C/T	LABOR TOTAL
			Phase III										
		5	Excavate W5 & W10 tank area to expose & remove piping, structures, etc. (incl. haul)	12,000	CY				.25	3000			
		6	Demolish tanks and haul to burial ground, incl. temp structure at tank (1930 LF ea. cutting)	6	ea				1200	7200			
		7	Remove valve pits and other structures. (incl. haul)	8	ea				40	320			
		8	Remove piping incl. haul	3646	LF				.25	920			
		9	Relocate remaining piping	950	LF		5	4,800	.5	480			
			TOTAL					4,800		11,920			

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UCN-11733

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CLIDE NO. 1

SUBPROJECT 1

ACCOUNT NO. 1

PARTICIPANT 7

JOB TITLE AND BUILDING 9 SURPLUS FACILITIES MANAGEMENT PROGRAM

SUBTITLE 41 ILW COLLECTION TANKS

WORK ORDER NO. 9 A-2620

CATEGORY (L AND IMP., BLDG. ADD., ETC.) 9

CONSTRUCTION BY 9 CPAF

LEVEL OF ESTIMATE 9 STUDY

LARGE CONCRETE TANKS W-5 TO W-10 (D&D FACILITY 10)
ALTERNATIVE 1: COMPLETE REMOVAL

BILL OF MATERIAL NO. 41

BILL OF MATERIAL SHEET OF

PROJECT ENGINEER 41 N. DURFEE

PRINCIPAL ENGINEER 41 F. PEREZ

DRAWING OR OTHER SOURCE 1

TYPE	ITEM NO.	MATERIAL AND DESCRIPTION	QUANTITY	UNIT	MATERIAL UNIT COST	MATERIAL TOTAL	LABOR HOURS UNIT	LABOR HOURS TOTAL	LABOR RATE	LABOR CFT	LABOR TOTAL
	10	PLUG & CAP LINES AT PENETRATIONS (TO REMAIN)	31	ea	100	3,100	10	310			
	11	BACKFILL WITH CLEAN BORROW MATERIAL	12000	CY			.1	1200			
	12	GRADE, SEED & MULCH AREA	4,000	SY	10	400	04	160			
	13	CLEAN FOR PENETRATION SHORING (H-PILE & TIMBER)	1	LS		2,000		600			
		TOTAL				5,500		2170			

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CODE NO.	1
SUBPROJECT	1
ACCOUNT NO.	1
PARTICIPANT	7
JOB TITLE AND BUILDING	SURPLUS FACILITIES MANAGEMENT PROGRAM
WORK ORDER NO.	A-2620
CATEGORY (LAND IMP. BLDG. ADD.: ETC.)	
CONSTRUCTION BY	CPAF
LEVEL OF ESTIMATE	STUDY
SUBTITLE	ILW COLLECTION TANKS
BILL OF MATERIAL NO.	
BILL OF MATERIAL SHEET ___ OF ___	
PROJECT ENGINEER	N. DURFEE
PRINCIPAL ENGINEER	F. PERETZ

LARGE CONCRETE TANKS W-5 TO W-10 (D&D FACILITY 10)

ALTERNATIVE 1: COMPLETE REMOVAL

DRAWING OR OTHER SOURCE

TYPE	ITEM NO.	MATERIAL AND DESCRIPTION	QUANTITY	UNIT	MATERIAL UNIT COST	MATERIAL TOTAL	LABOR HOURS UNIT	LABOR HOURS TOTAL	LABOR RATE	LABOR TOTAL
						10,300		10,410	15	220,400
		Sub TOTAL								154,200
		SC/LAB. FACT @ 70%								
		Sub TOTAL								374,600
		HP @ 50% LAB/DECON MAT				2,200				187,300
		CPAF DIR TOTAL				20,000				561,900
		INDIRECT @ 5% MAT/81½% LAB				1,000				501,600
						21,000				1,063,500
		CPAF TOTAL						1,084,500		
		TOTAL								

UCN 51255 (1 10-77)

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				3/6

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DATE
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