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Draft B

Evaluation of Alternatives for the Interim Stabilization of the Hexone Tanks

Prepared for the U.S. Department of Energy, Richland Operations Office
Office of Environmental Restoration

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ACRONYMS

ALARA	as low as reasonably achievable
BHI	Bechtel Hanford, Inc.
CERCLA	*Comprehensive Environmental, Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
COC	contaminant of concern
CWC	Central Waste Complex
DOE	U.S. Department of Energy
DQO	data quality objective
Ecology	Washington State Department of Ecology
EE/CA	engineering evaluation/cost analysis
HEPA	high-efficiency particulate air
LDR	land disposal requirement
NOC	notice of correction
OSHA	*Occupational Safety and Health Act of 1970*
RCRA	*Resource Conservation and Recovery Act of 1976*
REDOX	Reduction-Oxidation (Facility)
RL	U.S. Department of Energy, Richland Operations Office
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TSD	treatment, storage, and disposal
WAC	*Washington Administrative Code*

METRIC CONVERSION CHART

Into Metric Units

If You Know	*Multiply By*	*To Get*
Length		
inches	25.4	millimeters
inches	2.54	centimeters
feet	0.305	meters
yards	0.914	meters
miles	1.609	kilometers
Area		
sq. inches	6.452	sq. centimeters
sq. feet	0.093	sq. meters
sq. yards	0.836	sq. meters
sq. miles	2.6	sq. kilometers
acres	0.405	hectares
Mass (weight)		
ounces	28.35	grams
pounds	0.454	kilograms
ton	0.907	metric ton
Volume		
teaspoons	5	milliliters
tablespoons	15	milliliters
fluid ounces	30	milliliters
cups	0.24	liters
pints	0.47	liters
quarts	0.95	liters
gallons	3.8	liters
cubic feet	0.028	cubic meters
cubic yards	0.765	cubic meters
Temperature		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius
Radioactivity		
picocuries	37	millibecquerel

Out of Metric Units

If You Know	*Multiply By*	*To Get*
Length		
millimeters	0.039	inches
centimeters	0.394	inches
meters	3.281	feet
meters	1.094	yards
kilometers	0.621	miles
Area		
sq. centimeters	0.155	sq. inches
sq. meters	10.76	sq. feet
sq. meters	1.196	sq. yards
sq. kilometers	0.4	sq. miles
hectares	2.47	acres
Mass (weight)		
grams	0.035	ounces
kilograms	2.205	pounds
metric ton	1.102	ton
Volume		
milliliters	0.033	fluid ounces
liters	2.1	pints
liters	1.057	quarts
liters	0.264	gallons
cubic meters	35.315	cubic feet
cubic meters	1.308	cubic yards
Temperature		
Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity		
millibecquerels	0.027	picocuries

1.0 INTRODUCTION

The purpose of this report is to present the engineering evaluation for interim stabilization of the 276-S-141 and 276-S-142 hexone storage tanks located in the 200 West Area of the Hanford Site. The hexone tanks are managed as a *Resource Conservation and Recovery Act of 1976* (RCRA) treatment, storage, and disposal (TSD) facility and are regulated by the Washington State Department of Ecology (Ecology). In May 2000, Ecology issued a notice of correction (NOC) citing several findings concerning operation of the tank system (Ecology 2000). The NOC is included in Appendix A.

This evaluation will serve as a decision-making tool for use by Ecology. This engineering report identifies alternatives, cost estimates, and schedule considerations for implementing interim stabilization and site closure activities (i.e., either removing the tanks and/or incorporating the land into the 200-IS-1 Operable Unit [OU]). This report also documents the results of the sampling and analysis event.

1.1 PROBLEM DEFINITION/BACKGROUND

The hexone tanks are included in the 200-IS-1 OU of the Hanford Site. While awaiting alignment, characterization, and disposition of similar sites in the 200 Area, the hexone tanks have been maintained as an out-of-service tank system. The hexone tanks have been safeguarded by a nitrogen purge almost continuously since 1992. This inert gas purge mitigates the risks associated with the hazardous vapors in the tanks. The purge prevents the collection of flammable vapor mixtures and eliminates the safety hazard to workers.

In April 2000, Ecology conducted an inspection of the TSD unit encompassing the tanks. In May 2000, Ecology issued an NOC regarding the current state of the hexone tanks. The NOC required that the hexone tanks be stabilized by removing all of the potential safety hazards posed to employees by no later than December 2001. Additionally, the stabilization must include removal or deactivation of the waste. If the tanks remain in place, provisions must be made for monitoring the tanks for oxygen/organic vapors and for intrusion of liquids.

In May 2001, Ecology issued a letter that revised the required date to achieve stabilization of the hexone tanks (Ecology 2001). The current date to complete stabilization is the end of February 2002.

Consistent with the letter of response to the NOC by the U.S. Department of Energy (DOE), Richland Operations Office (RL), and Bechtel Hanford, Inc. (BHI) (see Appendix B), a number of actions are either completed or in progress, including the following:

- In September 2000, the *Data Quality Objective for 276-S-141/142 Hexone Tank Characterization/Stabilization Project* (BHI 2000a) was issued. The data quality objective

(DQO) summary report outlined a sampling and analysis strategy to provide waste verification and designation data.

- In December 2000, the *Sampling and Analysis Plan for the 276-S-141/142 Hexone Tank Characterization/Stabilization Project* (DOE-RL 2000b) was issued. The sampling and analysis plan presented the planning strategy, procedures, and implementation of the sampling and analysis strategies in support of the stabilization of the hexone tanks.

- In March 2001, the sampling event was completed, which included a video survey of the tank internals. This report includes the final results obtained from the analytical laboratories.

1.2 REPORT ORGANIZATION

This engineering report is organized as follows:

- Section 1.0 presents the purpose of the engineering report and the problem definition/background.

- Section 2.0 presents the objectives of the interim stabilization and closure activities.

- Section 3.0 presents site background information, including process history, previous investigations, and remedial actions.

- Section 4.0 presents the results of the investigation. The sample collection activities and analytical results are summarized, and the contaminants of concern (COCs) are reviewed, focusing on the associated hazards and risks.

- Section 5.0 identifies the alternatives. The key aspects of each alternative are explained, along with qualitative criteria that are used to screen the alternatives.

- Section 6.0 presents the regulatory requirements governing the corrective action, along with any related standards or requirements to be considered.

- Section 7.0 presents the comparative analysis of the alternatives. The alternatives identified in Section 5.0 are evaluated and compared to specific criteria.

- Section 8.0 presents the technical basis for and recommendation of the preferred alternative.

- Section 9.0 lists the references cited in this engineering report.

- Appendix A includes a copy of the NOC issued by Ecology, Appendix B contains a copy of the response to the NOC, and Appendix C contains cost estimating worksheets.

2.0 INTERIM STABILIZATION OBJECTIVE

Every remedial action plan must have clearly defined objectives. These objectives include identifying performance requirements, points of compliance, and acceptable time frames for implementation. Once the objectives are established, a valid comparison can be assessed.

Consistent with the NOC, the objective of this interim stabilization action for the hexone tanks is to remove all potential safety hazards to employees. The tanks need to be maintained in a safe and stable condition while they await final disposition, consistent with closure activities associated with the 200-IS-1 OU.

The NOC requires that stabilization include removal or deactivation of the residual waste material. In addition, the NOC requires that if the tanks remain in place, monitoring for organic vapors and for liquid intrusion must be addressed.

As stated in the letter of response to the NOC, the safety assessment (BHI 2000) confirms the effectiveness of the current system configuration as related to worker safety. To that end, the objective of additional interim stabilization includes increasing the level of confidence in safely maintaining the hexone tanks.

3.0 SITE BACKGROUND

3.1 SITE SETTING

The central plateau of the Hanford Site houses a number of facilities that formerly served to process irradiated nuclear fuel. Since the late 1980s, the mission at the Hanford Site has transitioned from plutonium production to environmental cleanup. The Reduction-Oxidation (REDOX) Facility (202-S Building) was constructed between 1950 and 1952 in support of the Hanford Site's plutonium production mission.

The hexone tanks (276-S-141 and 276-S-142) are located in the southeast corner of the 200 West Area in the vicinity of the REDOX building. These are carbon steel tanks with a nominal capacity of 90,849 L (24,000 gal) each. The tanks are horizontal cylinders with dished ends and shell dimensions of approximately 3.5 m (11.5 ft) in diameter by 8.5 m (28 ft) in length. The tops of the tanks are approximately 0.9 m (3 ft) below the soil surface.

3.2 PROCESS HISTORY

The REDOX facility was the first facility in which a continuous-flow, solvent-extraction process was used for the recovery of plutonium from irradiated fuel. The process was designed to separate individual product streams from associated fission products in the irradiated fuel. Processes were developed using different solvent mixtures. Hexone was used in the plutonium/uranium extraction process.

The storage tanks were installed in 1951 and were used until 1967 for storage of industrial-grade hexone. Before 1967, these tanks were not radiologically contaminated. In 1967, when the REDOX plant was shut down, the remaining radiologically contaminated solvent inventory within the nuclear fuel reprocessing system was pumped into the two underground storage tanks. Tank 276-S-141 received hexone distilled in the REDOX steam-stripping column. The 276-S-142 tank received some hexone and a mixture of kerosene and tributyl phosphate from the plant. Subsequently, the tanks were used to store these radioactively contaminated organic liquids.

In 1991, a remediation demonstration operation was completed. Pumpable liquids were removed from the tanks, distilled, and disposed. After completion of the distillation operation in 1992, each tank contained approximately 946 L (250 gal) of residual materials. This tar-like residue is believed to be distillation bottoms product containing tank-corrosion materials, tributyl phosphate, normal paraffin hydrocarbons (similar to kerosene), hexone, radionuclides, and water.

3.3 CURRENT CONFIGURATION

A RCRA Part A Permit Application (Form 3) for the hexone tanks was initially submitted to Ecology in December 1987, and most recently revised in 1994. A RCRA closure plan for the tanks was submitted in November 1992 (DOE-RL 1992). The tanks are regulated as dangerous waste tank TSD units with waste codes D001 (ignitability), F003 (listed spent solvent), and WT02 (toxicity criteria).

The tanks are vented with an approximate .61-m^3/hr (2-ft^3/hr) nitrogen purge per tank. The purge system includes Dewars of liquid nitrogen (as the source) and a manual flow control on the inlet to each tank. The exhaust includes a high-efficiency particulate air (HEPA) filter and activated carbon filter. The area is fenced off as a controlled access zone.

3.4 ACCESS AND LAND USE

The TSD unit, within which the hexone tanks are located, is a fenced area with locked gate entry. Access is restricted to authorized personnel. Access to the 200 Areas and the central plateau in general is currently restricted. The Hanford Site is routinely patrolled by the Hanford Patrol or the Benton County sheriff. The land use, as consistent with the mission at the Hanford Site, is focused on waste management and cleanup activities. These institutional controls are anticipated to be maintained for the duration of the current mission.

4.0 CHARACTERIZATION OF HAZARDS

4.1 SAMPLE COLLECTION

Characterization of the tank and residual material was required to respond to some of Ecology's inspection findings. In order for a thorough evaluation to be made, sufficient data had to be collected to adequately define the affected media.

On March 2 through 7, 2001, the tanks were sampled. The sampling event included deploying a video camera into the tanks through the .61-m (2-ft)-diameter manway to visually survey the tank internals and to guide the survey efforts. Samples were collected through the .61-m (2-ft)-diameter manway and the 10-cm (4-in.)-diameter risers of each tank.

Data were collected by the sampling and analysis effort for the following purposes:

- Verification of the conceptual model for the tank contents
- Designation and documentation of the tank residual materials (in accordance with the requirements of *Washington Administrative Code* [WAC] 173-303)
- Support to this engineering evaluation as necessary to develop stabilization alternatives.

Photographs and still frames taken from the video tape of the tank internals are shown in Figures 4-1 through 4-3. These selected photographs highlight the residual waste material. Figures 4-1 and 4-2 show residual waste material being transferred to sample containers. Figure 4-3 shows the material in the tank being scooped into the sampling tool. Of particular note is the apparent thick consistency of the material. In Figure 4-3, the material layer in the tank shows fissures from surface drying. The condition of the tank walls and interior surfaces is most clearly viewed on the videotapes (276-S-141 tank sampling, dated March 2-3, 2001 [VHS tape]; 276-S-142 tank sampling, dated March 6-7, 2001 [VHS tape]) More detail is provided in *Hexone Tanks 276-S-141 and 142, VHS Videotape Notes* (BHI 2001). (Still frames of the walls taken from the videotapes were of poor resolution and therefore are not included in this report.)

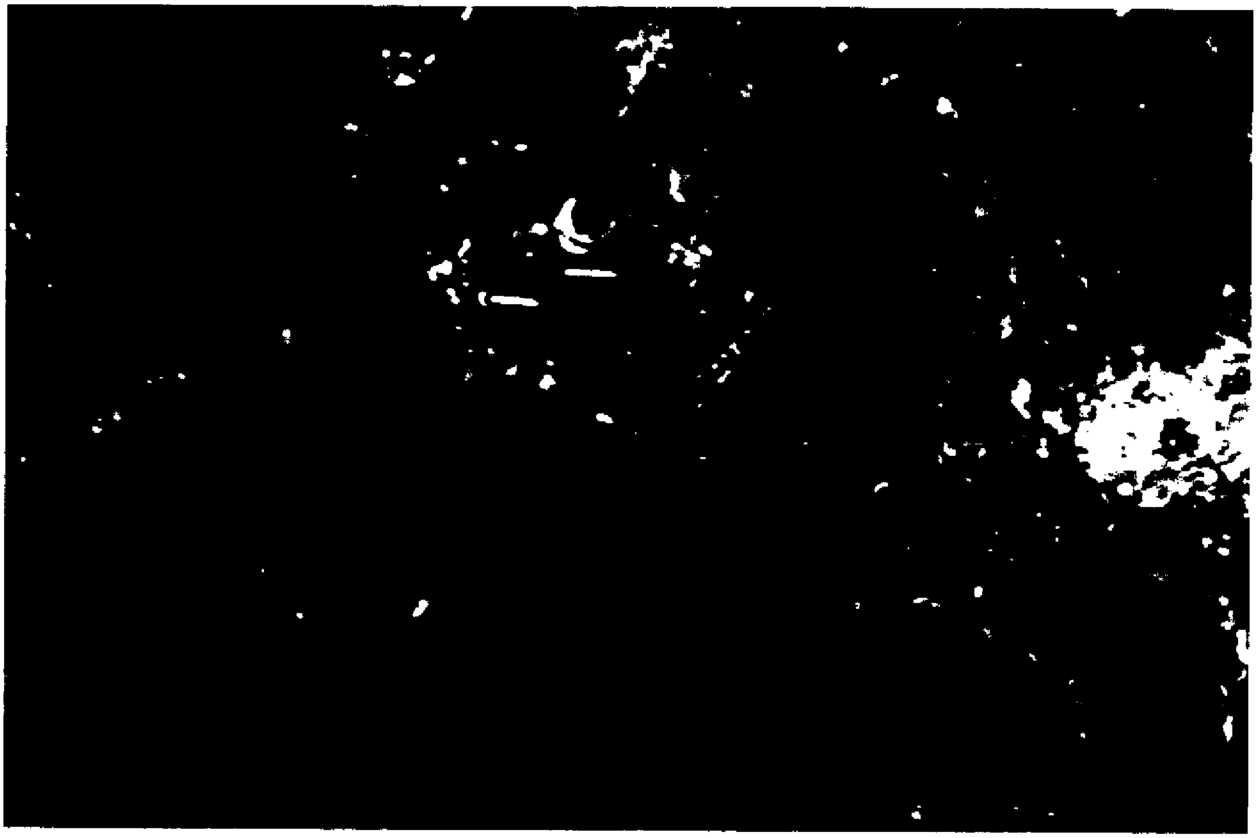
A video survey of tank 276-S-141 and 276-S-142 internals was conducted on March 2 and March 6, 2001, respectively. The survey showed that the volume of residual material in the tanks was on the low end of the anticipated range (approximately 494 L [130 gal]) (BHI 2001). No ponding of liquid was observed in the tank. The sludge appeared as a uniform tar-like layer across the bottom with a dried, cracked crust surface, which extended the length of the tank. The depth appeared to be approximately equal to the 8.25-cm (3.25-in.) diameter of the sample tool (beaker).

This is consistent with the model presented in the DQO summary report and the sampling and analysis plan (BHI 2000a, DOE-RL 2000b).

Figure 4-1. Collecting Sample from Tank 276-S-142.

Figure 4-2. Collecting Sample from Tank 276-S-141.

Figure 4-3. Sludge in Tank 276-S-142 – Surface Condition.



The video survey showed each tank to be structurally sound. The tanks' internal surfaces appeared rusted but with no apparent pits or voids. There was no evidence to suggest that either tank was leaking; however, no soil samples from around the tanks were taken.

4.2 ANALYTICAL RESULTS

The sludge collected from the 276-S-141 and 276-S-142 hexone storage tanks can be characterized as a dark-colored, mildly acidic, phosphate tar. Sludge collected on the west ends of the tanks was less viscous, with densities of 0.97 g/ml (tank 141) and 0.91 g/ml (tank 142). Sludge collected from the east ends of the tanks was more granular in texture, with densities of 1.21 g/mL (tank 141) and 1.20 g/mL (tank 142). The pH of the sludge samples ranged from 3.2 to 4.8 (standard units). The principle chemical components of the sludge include normal petroleum hydrocarbons, tributyl phosphate, iron oxide, and hexone. The principle radionuclides detected in the sludge samples include americium-141, plutonium isotopes, strontium-90, and cesium-137. The sludge in tank 142 contains approximately four times the amount of radioactive material as the sludge in tank 141.

For regulatory management and waste disposal purposes, the sludge is a radioactive mixed waste assigned with the following Federal and state hazardous waste codes:

- D001 – high total organic carbon ignitability
- D018 – benzene characteristic
- D019 – carbon tetrachloride characteristic
- D023 – o-cresol characteristic
- D024 – m-cresol characteristic
- D025 – p-cresol characteristic
- D027 – p-dichlorobenzene characteristic
- D028 – 1,2-dichloroethane characteristic
- D029 – 1,1-dichloroethylene characteristic
- D030 – 2,4-dinitrotoluene characteristic
- D032 – hexachlorobenzene characteristic
- D033 – hexachlorobutadiene characteristic
- D034 – hexachloroethane characteristic
- D036 – nitrobenzene characteristic
- D037 – pentachlorophenol characteristic
- D039 – tetrachloroethylene characteristic
- D040 – trichloroethylene characteristic
- D041 – 2,4,5-trichlorophenol characteristic
- D042 – 2,4,6-trichlorophenol characteristic
- D043 – vinyl chloride characteristic
- F003 – spent solvent listed waste (hexone)
- WT02 – Washington State characteristic toxicity
- W001 – Washington State polychlorinated biphenyl.

Final results are presented in Tables 4-1 through 4-3.

Table 4-1. 276-S Hexone Tank Sludge – Tank 141 Sludge Sample Final Results. (4 Pages)

Contaminant of Concern	West Composite Sample (B11D03/D08)	West Replicate Sample (B11D04/D09)	East Sample (B11D05/D11)
Total Metals (µg/g)			
Arsenic	24 U	24 U	49 U
Antimony	14 U	14 U	29 U
Barium	12 U	12 U	24 U
Beryllium	1.2 U	1.2 U	2.4 U
Cadmium	1.2 U	1.2 U	2.4 U
Chromium	16	9.3	16

Table 4-1. 276-S Hexone Tank Sludge – Tank 141 Sludge Sample Final Results. (4 Pages)

Contaminant of Concern	West Composite Sample (B11D03/D08)	West Replicate Sample (B11D04/D09)	East Sample (B11D05/D11)
Copper	26	18	30
Iron	29,300	21,700	85,300
Lead	24 U	24 U	54
Mercury	NA	NA	NA
Nickel	16	11	53
Phosphorus	25,500	24,100	8,950
Selenium	24 U	24 U	49 U
Silver	2.4 U	2.4 U	4.9 U
Uranium	51	48	9.6
TCLP Metals (μg/mL)			
Arsenic	0.50 U	0.50 U	0.50 U
Barium	1.6	0.66	1.3
Cadmium	0.025 U	0.025 U	0.025 U
Chromium	0.050 U	0.050 U	0.050 U
Lead	0.50 U	0.50 U	0.50 U
Mercury	0.0012 U	0.0012 U	0.0012 U
Selenium	0.50 U	0.50 U	0.50 U
Silver	0.50 U	0.50 U	0.50 U
Anions (μg/g)			
Fluoride	87	35	365
Chloride	31	17	754
Nitrite	18 U	21 U	21 U
Nitrate	24 U	27 U	27 U
Phosphate	268	135	23 U
Sulfate	25 U	27 U	27 U
Sulfides	NA	NA	NA
Cyanide	2.3 U	2.2 U	2.4 U
Volatile Organics (μg/g)			
n-butyl alcohol	1,480	1,640	1,690
1,1,2-TCA[a]	2.9	80	57

Table 4-1. 276-S Hexone Tank Sludge – Tank 141 Sludge Sample Final Results. (4 Pages)

Contaminant of Concern	West Composite Sample (B11D03/D08)	West Replicate Sample (B11D04/D09)	East Sample (B11D05/D11)
2-butanone	4.4	4.1	4.5
2-hexanone	34	34	22
Acetone	47	60	153
Hexone	8,430	9,790	13,700
Semi-Volatile Organics (μg/g)			
Aroclor 1254	7.2	7.1	3.3
DNB-phth[a]	630 U	120 J	260 J
Tributyl phosphate	55,000	41,000	11,000
NPH[b]	55,600 J	43,600 J	60,600 J
Radionuclides (pCi/g)			
Hydrogen-3	650	781	1600
Carbon-14	104	75	89
Cobalt-60	0.59 U	0.65 U	0.24 U
Total strontium	1,330	1,020	1,220
Technetium-99	11 U	11 U	4.2 U
Antimony-125	8.0	8.6	2.4
Cesium-137	74	64	115
Europium-152	2.1 U	2.9 U	1.2 U
Europium-154	194	182	38
Europium-155	53	45	8.3
Uranium-233/234	15	16	9.6 U
Uranium-235	11 U	12 U	12 U
Uranium-238	8.4	14	9.6 U
Plutonium-238	2,210	2,520	1,260
Plutonium-239/240	3,100	3,610	1,320
Americium-241	6,830	7,210	2,780
Curium-244	579	390	135

Table 4-1. 276-S Hexone Tank Sludge – Tank 141 Sludge Sample Final Results. (4 Pages)

Contaminant of Concern	West Composite Sample (B11D03/D08)	West Replicate Sample (B11D04/D09)	East Sample (B11D05/D11)
Other Analytes			
Ignitability	NA	NA	NA
Total organic carbon	>10%	>10%	>10%
pH (units)	4.8	3.2	4.8
Density (g/mL)	0.97	NA	1.21

[a] Di-n-butyl phthalate.
[b] Normal paraffin hydrocarbon (sum of all straight-chain hydrocarbons detected).
J = parameter detected below the reporting limit
NA = parameter not analyzed
TCLP = toxic characteristic leachate procedure
U = parameter not detected above the reported limit

Table 4-2. 276-S Hexone Tank Sludge – Tank 142 Sludge Sample Final Results. (3 Pages)

Contaminant of Concern	West Composite Sample (B11D06/D15)	East Sample (B11D07/D14)	Equipment Blank (B11CX1)	Equipment Blank (B11CX2)
Total Metals (μg/g)				
Arsenic	24 U	76 U	0.0032 U	0.0032 U
Antimony	14 U	46 U	0.0019 U	0.0017 U
Barium	12 U	38 U	0.00096 U	0.00059 U
Beryllium	1.2 U	3.8 U	0.00021 U	0.00035 U
Cadmium	1.2 U	3.8 U	0.00030 U	0.00030 U
Chromium	7.9	28	0.00070 U	0.00070 U
Copper	12	67	0.00060 U	0.00060 U
Iron	16,800	112,000	0.017 U	0.017 U
Lead	24 U	1,770	0.0022 U	0.0022 U
Mercury	NA	NA	0.00010 U	0.00010 U
Nickel	6.0	79	0.0011 U	0.0011 U
Phosphorous	21,300	18,400	NA	NA
Selenium	24 U	76 U	0.0031 U	0.0031 U
Silver	2.4 U	7.6 U	0.00060 U	0.00060 U
Uranium	87	296	NA	NA

Table 4-2. 276-S Hexone Tank Sludge – Tank 142 Sludge Sample Final Results. (3 Pages)

Contaminant of Concern	West Composite Sample (B11D06/D15)	East Sample (B11D07/D14)	Equipment Blank (B11CX1)	Equipment Blank (B11CX2)
TCLP Metals (µg/mL)				
Arsenic	0.50 U	0.50 U	16 U	16 U
Barium	1.4	0.81	6.5	8.4
Cadmium	0.025 U	0.025 U	1.5 U	1.5 U
Chromium	0.050 U	0.050 U	3.5 U	3.5 U
Lead	0.50 U	1.0	11 U	11 U
Mercury	0.0012 U	0.0012 U	0.10 U	0.10 U
Selenium	0.50 U	0.50 U	16 U	16 U
Silver	0.050 U	0.050 U	3.0 U	3.0 U
Anions (µg/g)				
Fluoride	160	108	0.50 U	0.50 U
Chloride	45	28	0.25 U	0.25 U
Nitrite	19 U	20 U	0.25 U	0.25 U
Nitrate	25 U	26 U	0.25 U	0.25 U
Phosphate	164	23 U	0.25 U	0.25 U
Sulfate	25 U	26 U	0.25 U	0.25 U
Sulfides	NA	NA	NA	NA
Cyanide	2.6 U	2.3 U	5.0 U	5.0 U
Volatile Organics (µg/g)				
n-butyl alcohol	1,320	1,500	0.25 U	0.25 U
1,1,2-TCA[a]	55	83	0.005 U	0.005 U
2-butanone	3.7	10	0.010 U	0.010 U
2-hexanone	33	26	0.010 U	0.010 U
Acetone	52	59	0.010 U	0.010 U
Hexone	18,200	26,600	0.010 U	0.010 U
Semi-Volatile Organics (µg/g)				
Aroclor 1254	4.4	1.4	0.0010 U	0.0010 U
DNB-phth[a]	14,000 U	89,000 U	0.010 U	0.010 U
Tributyl phosphate	65,000	44,000 J	0.022 U	0.022 U
NPH[b]	232,000 J	213,000 J	0.00010 U	0.00010 U

Table 4-2. 276-S Hexone Tank Sludge – Tank 142 Sludge Sample Final Results. (3 Pages)

Contaminant of Concern	West Composite Sample (B11D06/D15)	East Sample (B11D07/D14)	Equipment Blank (B11CX1)	Equipment Blank (B11CX2)
Radionuclides (pCi/g)				
Hydrogen-3	467	581	0.16 U	0.16 U
Carbon-14	84	85	0.046 U	0.044 U
Cobalt-60	1.0	2.1 U	0.016 U	0.008 U
Total strontium	9,020	21,600	0.00050 U	0.00050 U
Techtetium-99	15 U	49 U	0.011 U	0.012 U
Antimony-125	38	113	NA	NA
Cesium-137	1,040	1,060	0.0015 U	0.0008 U
Europium-152	2.4 U	9.3 U	0.038 U	0.022 U
Europium-154	379	874	0.052 U	0.028 U
Europium-155	75	186	0.021 U	0.021 U
Uranium-233/234	31	74	0.000026 U	0.000023 U
Uranium-235	11 U	36 U	0.000025 U	0.000022 U
Uranium-238	29	78	0.000021 U	0.000018 U
Plutonium-238	8,000	10,100	0.00024 U	0.00019 U
Plutonium-239/240	9,960	14,600	0.00024 U	0.00019 U
Americium-241	26,000	36,100	0.00024 U	0.00029 U
Curium-244	1,970	2,090	0.00030 U	0.00029 U
Other Analytes				
Ignitability (°F)	NA	NA	Not Ignitable	Not Ignitable
Total organic carbon	>10%	>10%	0.50 U	0.50 U
pH (units)	4.1	4.6	7.9	6.5
Density (g/mL)	0.91	1.20	NA	NA

[a] Di-n-butyl phthalate.
[b] Normal paraffin hydrocarbon (sum of all straight-chain hydrocarbons detected).
J = parameter detected below the reporting limit
NA = parameter not analyzed
TCLP = toxic characteristic leachate procedure
U = parameter not detected above the reported limit

Table 4-3. 276-S Hexone Tank Sludge Samples TRU Evaluation.

Contaminant of Concern	West Sample (B11D08)	Middle Sample (B11D10)	East Sample (B11D11)	North Sample (B11D12)	South Sample (B11D13)
Tank 141 Sludge TRU Final Results					
TRU Radionuclides (pCi/g)					
Plutonium-238	2,210	2,910	1,260	4,280	3,460
Plutonium-239/240	3,100	3,590	1,320	5,820	4,100
Americium-241	6,830	5,980	2,780	9,770	10,800
Curium-244	579	279	135	750	535
TRU Calculations (nCi/g)					
Total TRU	12.7	12.8	5.5	20.6	18.9
Number of samples	5				
Average TRU	14.1				
Standard deviation	5.4				
Z-statistic	1.6				
95% UCL[a]	18.0				
Tank 142 Sludge TRU Final Results					
Contaminant of Concern	**West Sample (B11D15)**	**Middle Sample (B11D17)**	**East Sample (B11D14)**	**North Sample (B11D16)**	**South Sample (B11H76)**
TRU Radionuclides (pCi/g)					
Plutonium-238	8,000	9,160	10,100	10,000	13,600
Plutonium-239/240	9,960	11,400	14,600	13,200	19,800
Americium-241	26,000	21,500	36,100	34,400	47,600
Curium-244	1,970	1,360	2,090	1,370	2,390
TRU Calculations (nCi/g)					
Total TRU	45.9	43.4	62.9	59.0	83.4
Number of samples	5				
Average TRU	58.9				
Standard deviation	14.3				
Z-statistic	1.6				
95% UCL[a]	69.4				

[a] Remedial Design Report/Remedial Action Work Plan for the 100 Area, Rev. 2, Appendix G, DOE/RL-96-17 (DOE-RL 2000a).

TRU = transuranic

UCL = upper confidence limit

The analytical results indicate that radionuclide constituents are below the transuranic concentration level of 100 nCi/g.

4.3 HAZARDS AND SAFETY EVALUATION

4.3.1 Identification of Contaminants of Concern

Contaminants of concern (COCs) are defined as those chemicals specified within the environmental regulations to be potentially threatening to the environment or human health. A COC becomes a contaminant when the COC occurs at a concentration that poses an unacceptable threat to the environment and/or to human health. Table 4-4 lists the COCs for the hexone tanks.

Table 4-4. List of Contaminants of Concern.

Radionuclides		
Americium-241	Europium-154	Total radioactive strontium
Curium-244	Europium-155	Technetium-99
Carbon-14	Hydrogen-3	Uranium-234
Cesium-137	Plutonium-238	Uranium-235
Cobalt-60	Plutonium-239/240	Uranium-238
Europium-152		
Chemicals		
Organics		
n-Butyl alcohol	2-butanone	Tributyl phosphate
Kerosene (paraffin hydrocarbons)	4-methyl-2-pentanone (hexone)	Polychlorinated biphenyls
2-propanone (acetone)	2-hexanone	
Inorganics		
Cyanide	Nitrate	Chloride
Phosphate	Nitrite	Sulfides
Sulfate		
Metals		
Mercury (total and TCLP)	Arsenic (total and TCLP)	Copper
Lead (total and TCLP)	Barium (total and TCLP)	Selenium (total and TCLP)
Nickel	Beryllium	Uranium (total)
Silver (total and TCLP)	Cadmium (total and TCLP)	
Antimony	Chromium (total and TCLP)	

Source: *Sampling and Analysis Plan for the 276-S-141/142 Hexone Tank Stabilization/Characterization Project*, DOE/RL-2000-73 (DOE-RL 2000b).
TCLP = toxic characteristic leachate procedure

The residual sludge is presently confined inside the tank and, therefore, is limited in pathways of migration to the environment. In this situation, the metals, inorganics, and radionuclides are less mobile than the organics. Some of the organics (i.e., volatile and semi-volatile compounds) are easily mobile in the vapor phase. This is the most significant risk within the tank system as currently configured. However, the purge system is engineered to address the hazards associated with the vapor phase.

4.3.2 Safety Evaluation

Safety evaluation and hazard analyses are tools for evaluating the potential threats to the environment and/or to human health resulting from potential hazards. These tools are used in the decision-making process to yield prudent, technically sound decisions that protect the environment and human health in a cost-effective manner.

Applicable hazard analysis and safety requirements for the 276-S-141 and 276-S-142 hexone tanks are documented in the approved facility safety analysis report and technical safety requirements (BHI 2000c). The facility safety requirements that comply with 10 *Code of Federal Regulations* (CFR) 830, "Nuclear Safety Management," Subpart B, "Safety Basis Requirements," are applicable to the current status of the hexone tanks.

Sample analysis data from the residual wastes has been verified to be consistent with the hazard analysis and, therefore, confirms the validity of the facility safety analysis report and technical safety requirements.

Modification to the hexone tank and appendent systems (i.e., alternatives 1, 2-2, 2-3, 3-1, 3-2, or 3-3) requires additional safety evaluation to determine the impacts to the existing safety analysis and technical safety requirements.

The current safety analysis postulates a combustion event as the worst-case release event that could threaten workers or the localized environment. The worst-case combustion event was postulated to be a deflagration. Postulated dose consequences, both chemical and radiological, were found to be relatively minor. Potential missile generation was also found to be of a minor nature.

Of particular note, the *Design Basis for Nitrogen System of the Hexone Tanks 276-S-141 and 276-S-142* (BHI 2000b) indicates that under the static or inactive status, it would take more than 600 days of ambient tank "breathing" for the oxygen level to rise sufficiently to support combustion. This considers that the purge gas is stopped when the tank oxygen level is about 6% and the tank "breathes" via average daily barometric fluctuations until the oxygen level rises to 11%. Testing indicates that the nitrogen system has maintained oxygen concentration at less than 2%.

The facility safety evaluation concluded that three relatively simple controls provide defense-in-depth to minimize risks:

- Minimize the threat of ignition source. Open flames and smoking are prohibited within 6 m (20 ft) of the fenced area.
- Maintain oxygen concentrations less than 11% to prevent combustion of hexone vapors. An operational safety margin has been established to 6.6% for the system configuration consistent with fire protection standards (NFPA 69).
- Maintain access restrictions by fencing, and administrative procedures to ensure that ignition sources are not inadvertently introduced and that appropriate work controls are applied in the immediate area of the hexone tanks.

5.0 IDENTIFICATION OF ALTERNATIVES

Engineering feasibility studies are commonly performed to develop and evaluate alternative remedies. The criteria that were used to qualify technologies for further development are presented in this section. The resulting alternatives are evaluated in Section 7.0.

Consistent with the requirements in the NOC (and as presented in Section 2.0 of this report), the overall objective of this interim stabilization action is to remove the potential safety hazard to workers associated with the hexone tanks.

The safety hazard is attributable to the organic compounds in the residual sludge in the tanks. As previously described, the residual material is confined within the shell of the underground storage tanks. Because there is no visual indication of leakage from within the tanks, institutional controls are appropriate for safeguarding the solid-phase material. Therefore, safety concerns are limited to those involving the vapor phase.

Potential remedies are qualified by the following criteria:

- Minimizes the hazard to the extent necessary to protect site workers
- Straightforward approach
- Suitable for implementation by the end of February 2002 or as agreed to by Ecology
- If interim stabilization is the choice, does not prevent future closure of the tank system
- Does not contribute to the potential migration of contamination
- Minimizes the need for maintenance.

This initial screening yields the most appropriate approach for addressing the hazard as identified. Control of the hazard can be addressed by (1) inhibiting vapor formation, (2) purging oxygen from the tanks, or (3) removing the source material.

Remote removal of residue from the tank or mixing in the tank, in place, is judged to be impractical considering commercially available technology. Some commercially available "deactivating" agents were reviewed; all required intimate mixing of the reagent with the waste material, and therefore were not considered further. Because the consistency of the residual waste material is thick, sticky, and tar-like, any treatment or action (other than complete removal) that would require physical manipulation of the residual material is considered to be impractical and unacceptable. This disqualifies any method of treatment that requires mixing of a reagent with the waste material.

Leaving the tank and remaining tank "heel" in place and performing closure of the tanks with a landfill cover may be an option under a coordinated *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) closure for the REDOX facility. However, it is not clear that this option is accommodated due to the early stage of the CERCLA process for the REDOX facility.

The RCRA regulations require that all waste be removed from TSD tanks at closure. A variance of RCRA regulation to meet the land disposal requirements (LDRs) under 40 CFR 268 cannot be clearly defined at this early point. There is no clearly appropriate treatability variance, and converting a tank storage unit into a landfill could be viewed as creating a new land disposal, thereby invoking application of the LDR treatment standards for any contained waste. Therefore, the ability to land dispose of waste that does not meet LDR treatment standards is not considered further.

Three alternatives for stabilization are as follows:

1. Stabilize by void fill in which the formation of vapor is inhibited.
2. Continue with the nitrogen purge, where current purge system collects and treats the vapor.
3. Tank removal.

Life cycle costs have been estimated to allow direct comparison of interim stabilization costs to the site closure costs. The life cycle costs will include either of two pathways as follows:

- The tanks will remain in the 200 Area as part of the 200-IS-1 OU.
- The tanks will be removed and the site closed out in accordance with a closeout verification package.

Estimates within this evaluation assume that leaving the tanks in place as part of the 200-IS-1 OU will be within the CERCLA process as noted in the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) Section 3.3 and Appendix C (Ecology et al. 1998). Work is already in progress within Ecology for integrating RCRA TSD closures into the CERCLA and RCRA corrective action processes for several operable units (i.e., 200-CW-1). The tanks would be integrated into the remedial investigation/feasibility study process and remediation for the appropriate OU. However, an obstacle associated with this approach is that the Tri-Party Agreement milestones would have to be revised.

There is no current approved date for closure of the hexone tanks. Although Ecology has approved Rev. 7 of the Hanford Site RCRA permit, RL has requested that some aspects (specific to the CWC RCRA permit) of the Tri-Party Agreement (Rev. 7) be changed or delayed. Therefore, the State Pollution Control Hearing Board has "stayed" Rev. 7 of the Tri-Party Agreement.

The current applicable Attachment 27 in Rev. 5 of the Hanford Site RCRA permit does not state a fixed, required schedule for closing the hexone tanks. Therefore, as of July 11, 2001, there is no actual approved date for closure of the hexone tanks. To help with this issue the Groundwater Project has issued a letter to Ecology explaining the Tri-Party Agreement basis within Section 3.3 for dealing with closure of the tanks under the 200-IS-1 OU (Logan 2001).

Estimates for removing the tanks for final closure of the site under a closure plan assume that the tanks and waste go to either the CWC or ERDF, under a defined CERCLA or RCRA pathway. Once the closure of the site is complete, it would then be rolled into the 200-IS-1 OU and carried through the process identified in the implementation plan for addressing the 200 Area OUs. The end-state of the land would be in concert with that for the other 200 Area OUs.

5.1 ALTERNATIVE 1: VOID FILL

This alternative consists of eliminating the void space in the tank where vapor collects. The void is filled with a suitable inert material, which sets to the shape of the tank. This inhibits the vaporization of the residual waste in the tank and eliminates the potential for accumulation of vapors, which could otherwise lead to a hazard.

The purge system would no longer be needed. The above-ground piping and equipment could be removed, including the nitrogen supply, the HEPA filter, and the carbon filters. Ongoing maintenance of active equipment would not be required. There would be no need for monitoring of liquid intrusion, and the TSD area would remain fenced. This alternative is passively safe.

The video survey of the tanks' internals showed no visual evidence of leakage. Because the tank would be filled, there would be no concern for intrusion of liquids or collection of hazardous vapors. The residue in the tanks is a gelatinous mass of low fluidity; it would remain sealed in the tank. This would not preclude any future remedial action. Impact from this alternative on possible future action would include the disposal of the additional waste created by the filler material. The tanks would be cut open to remove the waste, whether void-filled or not. The surface of the fill material at the interface with the waste would be mechanically cleaned, as would the tanks' interior surfaces. No other impacts are identified.

The following criteria were considered in selecting the fill material. The filler must be able to meet the following:

- Be chemically nonreactive with the residual waste material
- Be commercially available
- Provide long-term stability
- Be easily poured (self-leveling)
- Not preclude removal of waste required for final RCRA closure of the tank.

The filler materials that were reviewed include Portland cement (grout), sand, clay, lime, epoxy/polymer, and bitumen. All are commercial products; the cement, sand, and lime are most easily available. The cement, sand, clay, and lime are reasonably inexpensive.

Portland cement-based mixtures are very widely used in solidification of hazardous and mixed wastes. In this respect, it is proven to be stable, easy to use, and amenable to varying waste composition. The composition of a grout mixture can be modified to address varying requirements in physical properties. The cured matrix has relatively low permeability and moderate-to-high compressive strength.

Sand is used as a void filler in abandoned petroleum storage tanks. It is chemically stable and nonreactive. It can be the least expensive of these reviewed materials. Sand does not cure and remains particularly permeable. Over time, a small amount of settling can occur.

Clay is compatible with the subject wastes and is chemically stable over time. When mixed in water, the slurry is very workable. In untreated form, it can dry and shrink, thereby reducing the integrity of the matrix. Treated clays are available that modify such properties, but at a greater cost. Experimentation may be required to determine the specific clay-to-water ratio.

Lime can be used as a base for grout, similar to Portland cement. However, the cured matrix exhibits lower strength. It is compatible with the wastes and chemically stable. It is not traditionally used by itself in such application; more commonly, it is an additive to Portland cement to modify workability.

Epoxy and polymer binders have been used in solidification of radioactive waste. The high-performance capability of this matrix exceeds the level needed for this application. The cost would be notably greater than any other material considered.

Bitumen is an asphalt-based material. Its permeability, stability, and compatibility are suited to this application. However, it would need to be heated in order to be workable and its cost is not competitive. Additionally, asphalt may be regulated as a dangerous waste, creating further problems if the tanks are dug up.

This qualitative review indicates that Portland cement-based grout is the filler of choice. The Portland cement is commercially available, stable over the long term, and easily applied. The level of chemical reactivity with the residual waste material is not a concern. Void-fill of the tanks with grout will not preclude future closure actions. The alternative of void-fill is developed further with cement grout as the fill material.

Work activities considered in the development of this alternative include the following:

- Provide project management and field support management.
- Prepare engineering documents.
- Procure materials.
- Mobilize to the site.
- Modify system/remove piping and components as necessary.
- Pour grout into the tanks.
- Demobilize.

In addition, the following items are considered in developing a comparative cost:

- Materials (grout fill)
- Waste disposal (removed piping).

Additional costs were provided, which included (1) integrating the hexone TSD into the 200-IS-1 OU (see Table C-9), and (2) removing the tanks and shipping the tanks and waste to the CWC (see Table C-5). These costs were added to the interim stabilization alternative to show the projected cost up to site closure (see Section 7.4).

5.2 ALTERNATIVE 2: CONTINUE WITH THE NITROGEN PURGE

This alternative considers the continued use of the nitrogen purge system, and includes three suboptions. Alternatives based on the continued use of the purge system are considered primarily for a possible savings in surveillance and maintenance costs. The existing safety evaluation confirms the adequacy and effectiveness of the system's current configuration as related to worker safety.

5.2.1 Alternative 2-1

This alternative considers the continued use of the nitrogen purge system in its current configuration and maintaining the daily surveillance of the equipment and process. The purge system is designed to maintain an inert atmosphere inside the tanks to preclude an ignitable vapor mixture. The daily inspection serves to ensure proper flow of nitrogen, verifies adequate supply and reserve (liquid nitrogen), and provides for observation of general site conditions (guards against degradation of the equipment, which might introduce a safety hazard). The exhaust from the purge is routed through a HEPA filter and carbon filters for radiological and volatile organic contaminant emissions, respectively.

Work activities considered in the development of this alternative include the following:

- Provide project management and field support management.
- Continue surveillance and maintenance on the nitrogen system.

In addition, the following items are considered in developing a comparative cost:

- Daily surveillance of system operation
- Maintenance of system components
- Supply of nitrogen
- Periodic replacement of filters.

Additional costs were provided, which included (1) integrating the hexone TSD into the 200-IS-1 OU (see Table C-9), and (2) removing the tanks and shipping the tanks and waste to the CWC (see Table C-5). These costs were added to the interim stabilization alternative to show the projected cost up to site closure (see Section 7.4).

5.2.2 Alternative 2-2

This alternative considers the continued use of the nitrogen purge system, with some modification to the configuration as needed to extend reliability. Continued surveillance activities would be required, although at an extended interval. Periodic inspections would be conducted. The nitrogen supply would require renewal at the same rate as the current operation (twice per week). The extended reliability would be provided by remote annunciation of nitrogen flow abnormalities. The pressure and flow of the nitrogen stream would be monitored by sensors with high and low set-points. Remote alarms would be located in the control room at the 271-U Building. These would actuate if the nitrogen flow was outside of the acceptable range. The instrumentation would require periodic calibration and maintenance.

Work activities considered in the development of this alternative include the following:

- Provide project management and field support management.
- Prepare engineering documents.
- Procure materials.
- Install hardware/modify system.
- Startup/test/integrate new components.

In addition, the following items are considered in developing a comparative cost:

- Periodic surveillance of system operation
- Maintenance of system components
- Supply of nitrogen
- Periodic replacement of filters.

Additional costs were provided, which included (1) integrating the hexone TSD into the 200-IS-1 OU (see Table C-9), and (2) removing the tanks and shipping the tanks and waste to the CWC (see Table C-5). These costs were added to the interim stabilization alternative to show the projected cost up to site closure (see Section 7.4).

5.2.3 Alternative 2-3

This alternative considers the intermittent use of the nitrogen purge system with notable modification to the mode of operation. This option relies on analyses performed as part of the safety evaluation. The *Design Basis for Nitrogen System of the Hexone Tanks 276-S-141 and 276-S-142* (BHI 2000b) indicates the capacity for the system, as configured, to maintain a nonignitable vapor mixture for an extended period (over 600 days). This option would retain the purge system hardware in its current configuration but would discontinue the steady flow of purge gas. The interval for surveillance and maintenance activities would be extended to 6 months. At that interval, the oxygen level in the tank would be checked and adjusted, if necessary, to below 6% by starting the flow of purge gas. Monitoring for potential intrusion of liquid would be addressed by use of a video camera deployed in a similar manner to the recent tank entry event. The recent video survey of the tank interior indicated that each tank is structurally sound. There was no evidence to suggest that either tank is leaking. From this, engineering judgment suggests that an interval of 5 years is suitable for interim interior surveillance.

Work activities considered in the development of this option are similar to the activities listed in Section 5.2.2.

5.3 ALTERNATIVE 3: TANK REMOVAL

This alternative considers immediate removal of the tanks and clean closure of the site (instead of interim stabilization). Removal of the tanks with contained residual waste material would eliminate the source of the vapor and its safety hazards.

Three subalternatives are considered for the removed tanks as follows:

- Remove the waste and the tanks to CWC.
- Remove the waste to CWC and the tanks to ERDF.
- Remove the tank and contents to ERDF.

Each subalternative assumes the same process to remove the tank from the ground. Key aspects of the tank removal would include:

- Permitting the removal action
- Coordinating waste disposal
- Planning the work activities
- Engineering the tasks and tools
- Mobilizing to the site.

Approximately 1,755 m^3 (2,300 yd^3) of soil would be excavated from the site to remove the tanks. This is based on a 1½ to 1 slope as required by the *Occupational Safety and Health Act of 1970* (OSHA) and specified in BHI-SH-02, Vol. 3, *Safety and Health Procedures*, Procedure 3.2.10, "Excavations." The soil will be shipped to low-level burial grounds after removal of the tanks as part of closure of the site. The tanks would be removed by crane from the excavation and set down in a prepared area nearby. The tanks would be maintained with an inert gas atmosphere during these activities. A sampling and analysis plan would address characterization of the soil under the tanks. Remediation of contaminated soil would be required for final closure action of the site. Once the waste and tanks are shipped and the site remediated for final closure, the site and work area would be demobilized

Work activities considered in the development of this scenario (used with Alternative 3-1 through 3-3) include the following:

- Perform site preparation work.

- Perform plant force work review.
- Perform work activities such as work packages, job hazards analysis walkdowns, pre-jobs, mobilization, and obtaining materials for the following:
  - Remove section of asbestos and pipe from the north/south steam line east of the hexone fence (from the fence to the 276-S Building), including post and concrete foundations.
  - Identify six underground pipes that will be hot-tapped (for potential liquid removal), cut, removed, and waste disposed.
  - Excavate tanks, which includes removal of fencing and placement of temporary fencing, as necessary.
- Provide project management and field support management.
- Prepare sampling activities.
- Provide engineering support.
- Provide environmental support.
- Prepare the NOC.
- Conduct safety evaluation, authorization basis impacts, unreviewed safety question screen.
- Dispose waste.
- Clean up and demobilize.

5.3.1 Alternative 3-1

This alternative considers the relocation of the waste and the tank to the CWC as RCRA waste. This alternative would require a large-scale ventilated "greenhouse" be built around the two tanks to control potential emissions when working on the tanks. Once the tanks are in the greenhouse, they would be cut open to remove the residual waste material. The waste would be packaged in 209-L (55-gal) drums for transfer to the CWC and then to the final treatment facility. The tanks would be cut and packaged in 1.2-m by 1.2-m by 2.4-m (4-ft by 4-ft by 8-ft) wooden boxes for transfer to the CWC and then to the final treatment facility.

Work activities considered in the development of this scenario include the following:

- Activities identified in Section 5.3 for removing the tanks.

- Design, procure, construct, and test a greenhouse with exhauster and stack monitor.
- Remove tanks.
- Cut open, clean, and cut the tanks into sections.
- Perform waste disposal of tanks, soil, and waste to the CWC.
- Clean up and demobilize.

5.3.2 Alternative 3-2

This alternative considers the transfer of the waste to the CWC as CERCLA waste and transfer of the tanks to the ERDF as CERCLA waste. As stated in alternative 3-1, a large-scale ventilated "greenhouse" would be built around a tank (one at a time) to control potential emissions when working on the tanks. Once the tanks are in the greenhouse, personnel would access the tanks through the .61-m (2-ft) manway and remove the residual waste material. The waste would be packaged in 209-L (55-gal) drums for transfer to the CWC and then to the final treatment facility. The tanks would be shipped intact to the ERDF where they would be void-filled and buried.

The waste would be shipped to the CWC if it did not meet the LDRs for burial at the ERDF. For instance, if the waste needs to be burned, recovery of organics or chemical oxidation is required before burial; therefore, the waste would have to be shipped to the CWC. If there are no LDRs as stated above, alternative 3-3 may be used.

Work activities considered in the development of this scenario include the following:

- Activities identified in Section 5.3 for removing the tanks.
- Complete the greenhouse with exhauster and stack monitor required to be designed; procure material, construct and test.
- Remove tanks.
- Prepare tanks for removal to the ERDF.
- All other disposal, excluding tanks, to the CWC.
- Dispose intact tanks to the ERDF.
- Clean up and demobilize.

5.3.3 Alternative 3-3

This alternative considers the transfer of the tank with the waste still inside to the ERDF as CERCLA waste. The tanks would be shipped intact to ERDF where they would be void-filled and buried.

Work activities considered in the development of this scenario include the following:

- Activities identified in Section 5.3 for removing the tanks.
- Remove tanks.
- All other waste disposal, excluding tanks, to the CWC.
- Dispose of intact tanks to the ERDF.
- Void-fill the tanks at the ERDF.
- Clean up and demobilize.

6.0 IDENTIFICATION OF STANDARDS AND REQUIREMENTS

6.1 WASTE MANAGEMENT

The RCRA and the state dangerous waste program establish various requirements for identifying and managing dangerous waste. Underground storage tank requirements are codified in 40 CFR 265, Subpart J, for both disposition and management until approved closure occurs.

Federal regulations pertaining to hazardous wastes are identified in 40 CFR 260 through 270. Washington State regulations in *Washington Administrative Code* (WAC) 173-303 define designation of dangerous wastes (WAC 173-303–070), performance standards (WAC 173-303-283), general waste analysis (WAC 173-303-300), closure standards (WAC 173-303-610), and other general requirements for hazardous waste storage tanks.

Specific standards pertaining to operation and closure of RCRA dangerous waste tank systems (such as the hexone tanks) are established in WAC 173-303-640 and WAC 173-303–610. The *Toxic Substances Control Act of 1976* regulates the management of polychlorinated biphenyls. Regulations are codified in 40 CFR 761.

6.2 AIRBORNE EMISSIONS

The *Clean Air Act* regulates both chemical and radioactive airborne emissions. Increases in any regulated emission would require evaluation and implementation of suitable controls. These regulations are codified in 40 CFR 61, WAC 246-247, and WAC 173-400 (Federal and state, accordingly).

6.3 RADIONUCLIDE EMISSIONS

To permit radionuclide emissions that could potentially be released during interim stabilization or closure, activities are managed under WAC 246-247. The project must demonstrate (using the EPA-approved CAP-88C modeling program to calculate) a potential to emit unabated radiological dose to an offsite receptor and a worker at the Laser Inferometer Gravitational Observatory. The calculated dose is expected to be such that the emission will be less than 0.1 mrem/yr. If emissions during the interim stabilization or closure activities are to be controlled with an active ventilation system (e.g., glovebox ventilated through a HEPA vacuum), then the Hanford Site-wide portable temporary radionuclide air emission unit NOC must be used (DOE-RL 1996, 1999).

6.4 NONRADIONUCLIDE EMISSIONS

Requirements for nonradionuclide emissions are contained in two different sets of regulations, WAC 173-400-110 and WAC 173-460-040. WAC 173-400-110, Subsection (4), identifies categories of emission units that are exempt from the new source review.

WAC 173-460-040 requires new sources of emission units to obtain a NOC, unless the following condition is met: The owner or operator of a new toxic air pollutant source listed in WAC 173-460-030 (1) is not required to notify or file a notice of construction with Ecology if the new source is a minor process change that does not increase capacity, and total toxic air pollutant emissions do not exceed the emissions rates specified in small-quantity emission rate tables in WAC 173-460-080. An evaluation of the small-quantity emission rates during stabilization will not be required based on the new sampling data that is provided in this report.

6.5 WORKER PROTECTION

Worker protection standards are described in the OSHA regulations.

Personnel protection from radiation is addressed by Federal regulations (10 CFR 835). Standards, limits, and program requirements are mandated, as well as adherence to as low as reasonably achievable (ALARA) principles.

7.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

Even if the actions under consideration are not performed under CERCLA authority, criteria from the CERCLA process (with modification) were adapted for purposes of evaluating the different alternatives. Specific evaluation criteria selected were protection of human health and the environment, short-term protectiveness, long-term protectiveness, implementability, and cost.

7.1 PROTECTION OF HEALTH AND ENVIRONMENT

This criterion considers whether the alternative achieves adequate control of the risk to worker safety that is presented by the identified hazards. All considered alternatives achieve the objective of protecting worker safety and health by minimizing the flammability combustion hazard.

7.2 EFFECTIVENESS

7.2.1 Short-Term Effectiveness

This criterion considers the risk to workers and the public during implementation and the time for completing the alternative. The risk is identified as a potential deflagration. The short-term effectiveness follows:

- The effectiveness in the near term is similar for all of the alternatives. All alternatives could be done in a manner that ensures protection of workers during the implementation phase.

- If the choice involves leaving the tanks in place (alternative 1(a), 2-1(a), 2-2(a), or 2-3(a) in Table 7-1), the void fill alternative (1(a)) could present more potential hazard. This is because the work could involve opening the .61-m (2-ft) opening of the tank system (although the 10.2-cm [4-in.] opening will probably be used).

- The alternative to remove the tanks (alternative 1(b), 2-1(b), 2-2(b), 2-3(b), 3-1(b), or 3-2(b)) would provide the greatest potential risk to the workers and would present more risk than leaving the tanks in place.

- On completion of the tasks (both interim and/or closure of site), the protection-to-worker safety is effective immediately.

- For the void-fill alternative (alternative 1) and any alternative that includes the removal of the tanks (see Table 7-1), the risk hazard is eliminated.

- All interim options can be completed by February 28, 2002.
- All other alternatives cannot be completed by February 28, 2002 (see Table 7-1 for estimates of dates to remove the tanks).

7.2.2 Long-Term Effectiveness

The long-term effectiveness criterion considers whether the alternative leaves an unacceptable risk over an extended time period. All these alternatives are effective in the long term and do not specifically preclude any further actions that may be required in the future.

7.3 IMPLEMENTABILITY

This criterion is a qualitative measure of the complexity involved with completing the tasks specified in the alternative. All alternatives are straightforward in approach. The continued purge alternative 2-1 is consistent with the current conditions (operations and system configuration). Alternative 2-3 is consistent with the current configuration of system equipment. Alternatives 1 and 2-2 each require some preparatory work of equal complexity. Alternatives 3-1 through 3-3 have regulatory considerations, which could complicate using them as a near-term option as follows:

- RCRA considerations to sending waste and tanks to the CWC (subalternative 3-1)

  Regulations in WAC 173-303-610(3)(c)(iv) allow removal of wastes and dismantling of equipment at a TSD at any time, provided the activities are performed in accordance with an approved closure plan. This provision is interpreted to allow waste removal and equipment dismantling before closure plan approval, as long as the activities are eventually approved in a subsequent closure plan (51 FR 16430). In most cases, waste removal and equipment dismantling are viewed as fairly straightforward activities. Regulatory agency approval would be requested before implementing this alternative. A closure plan documenting the previously completed work and identifying any additional work to meet the RCRA closure requirements would be needed.

- RCRA considerations to sending waste to the CWC and the CERCLA impediments to sending the cleaned out tanks to the ERDF (subalternative 3-2)

  Same issue as above regarding tank dismantling prior to having an approved closure plan. Additionally, the tanks need to be cleaned to meet the LDR treatment standards prior to shipping to the ERDF. This could be done using the alternative treatment standards for debris to attain clean closure from a RCRA (but not necessarily radiological) perspective. Note, however, that the debris treatment standards are not directly applicable to intact tanks, but may be used as performance standards to achieve decontamination of equipment (Ecology 1994). Finally, a CERCLA decision document would be necessary to accommodate disposal of the tank in the ERDF. The decision document pathway would likely consist of a CERCLA waste disposal engineering evaluation/cost analysis (EE/CA), public comment, and issuance of a CERCLA action memorandum.

- CERCLA Considerations to sending the tanks and their contents to the ERDF (subalternative 3-3)

  The pathway for this action would be preparation of an EE/CA, public comment, and issuance of a CERCLA action memorandum. Administrative closure under RCRA via a closure plan could be done at a future date; this process should be identified and approved by the regulators in the CERCLA documentation. The CERCLA documentation could also serve as Ecology approval of the action as a pre-closure activity to be incorporated into the eventual closure plan.

  Addressing LDR treatment standards for the waste within the tanks would be problematic. There is no regulatory basis for an LDR treatability variance that would readily accommodate land disposal of this waste in the ERDF (note that lack of treatment capability, even if it could be shown, is not allowed as a basis for a 40 CFR 268.44 treatability variance). The CERCLA waivers also do not appear to clearly accommodate disposal of the waste in the ERDF. Thus, there is no clear regulatory pathway allowing disposal of the tank waste in the ERDF, short of meeting the LDR treatment standards.

7.4 COST CONSIDERATIONS

The economic feasibility of any remedial alternative must be considered. The cost is frequently a heavily weighted factor in determining its applicability and implementation. An alternative must be reasonably cost effective to warrant further evaluation.

Appendix C provides information used to develop site-specific cost estimates and a range of costs that can be expected for these alternatives. The cost estimates shown in Tables C-1 through C-8 were developed based on information from a number of sources, including recent experience of related tasks.

It should be noted that the cost estimates developed here are what would typically be considered a rough order-of-magnitude level. The accuracy of the estimates is subject to substantial variation because the specific details of the designs will not be known until actually implemented. As a result, actual costs will likely vary from these estimates. Cost comparisons for each alternative are shown in Table 7-1.

Table 7-1. Comparison of Costs for Alternatives.

Alternative #[1]	Date		Yearly O&M Costs (K$)	A O&M Costs for 10 Years (K$)	B One-Time Costs (K$)	A+B Interim Stabilization Costs (K$)	C Closure Costs (K$)[5]		A+B+C Total Life Cycle Cost (K$)	
	Interim Stabilization[19]	Closure[2]					Remove Tanks	Leave Tanks	Remove Tanks	Leave Tanks
1	2/28/02[3]	200 IS-1[4]	N/A	N/A	187[6]	187	2,538[7]	65[8]	2,725	252
2-1	Complete	200 IS-1[4]	83[9]	826[9]	N/A	826	2,538[7]	252[10]	3,364	1,078
2-2	2/28/02[3]	200 IS-1[4]	43[11]	430[11]	117[11]	547	2,538[7]	252[10]	3,085	799
2-3	Complete	200 IS-1[4]	41[12]	407[12]	N/A	407	2,538[7]	252[10]	2,945	659
3-1	N/A	9/18/02[16]	N/A	N/A	N/A	N/A	2,763[13]	N/A	2,763	N/A
3-2	N/A	3/13/03[17]	N/A	N/A	N/A	N/A	2,309[14]	N/A	2,309	N/A
3-3	N/A	12/10/02[18]	N/A	N/A	N/A	N/A	650[15]	N/A	650	N/A

[1] Alternatives are identified below:
1 = Void Fill the Tank
2-1 = Continue Nitrogen Purge in its Current Configuration
2-2 = Continue Use of the Nitrogen Purge System with Some Modification to the Configuration
2-3 = Intermittent Use of the Nitrogen Purge System with Notable Modification to the Mode of Operation.
3-1 = Remove Tank – CWC Disposal: Tank and Waste
3-2 = Remove Tank – CWC Disposal: Waste/ ERDF Disposal: Tank
3-3 = Remove Tank – ERDF Disposal: Tank and Waste

[2] Rough estimate of the date that the work could be completed by if all assumptions are correct.
[3] Committed completion date with Ecology.
[4] This will be closed out if the TSD is rolled up into the 200 IS-1 Operable Unit.
[5] These cost associated with future closeout of the TSD site in order to obtain anticipated life cycle costs.
[6] Refer to Table C-1 in Appendix C for an explanation of these costs.
[7] Refer to Table C-8 in Appendix C for an explanation of these costs.
[8] Refer to Table C-9 in Appendix C for an explanation of these costs.
[9] Refer to Table C-2 in Appendix C for an explanation of these costs.
[10] Refer to the combined costs from Table C-1 and Table C-9 in Appendix C for an explanation of these costs.
[11] Refer to Table C-3 in Appendix C for an explanation of these costs.
[12] Refer to Table C-4 in Appendix C for an explanation of these costs.
[13] Refer to Table C-5 in Appendix C for an explanation of these costs.
[14] Refer to Table C-6 in Appendix C for an explanation of these costs.
[15] Refer to Table C-7 in Appendix C for an explanation of these costs.
[16] Refer to Table D-1 in Appendix D for a breakdown of the closure date.
[17] Refer to Table D-2 in Appendix D for a breakdown of the closure date.
[18] Refer to Table D-3 in Appendix D for a breakdown of the closure date.
[19] Date to complete the "one-time costs" and achieve interim stabilization as identified for that alternative.
N/A = not applicable
O&M = operations and maintenance

8.0 PREFERRED ALTERNATIVE

The hexone storage tanks are considered a RCRA site either awaiting integration into a larger cleanup strategy (200 IS-1 OU) or requiring final closure per the Tri-Party Agreement. Because both strategies are still an option, neither are used to influence the preferred alternative. Each alternative diminishes the hazards associated with the vapors from the waste as follows:

- Alternative 1 – Eliminates the void space and thus eliminates the configuration that would be conducive for a deflagration.
- Alternative 2 – Reduces the oxygen to levels below the limiting oxygen content of 11% and, therefore, the tank is not conducive for a deflagration
- Alternative 3 – Removes the tanks and eliminates the hazard completely.

Alternatives 1 and 2 allow for any of the identified future closure choices for the site that might be specified as related to the closure of the tank system and characterization of the central plateau (200 IS-1 OU).

For removing the tanks as soon as possible, there appears to be regulatory issues associated with alternative 3-3. Therefore, either of the other alternatives could be chosen, depending on whether the schedule (alternative 3-1 could be completed the quickest) or the cost to complete the task (alternative 3-2 is the least expensive) is more important. However, based on the possibility that the tanks will be rolled into the 200 IS-1 OU, the additional cost to remove the tanks (up to $2,765,000) versus interim stabilization and site closure as part of the 200-IS-1 OU (as low as $245,000) justifies the need for prudence.

Therefore, the alternative of void-fill, which has the added benefit of being passive in nature, is judged to be the technically preferred alternative. In addition, the void-fill can be completed by February 28, 2002, as requested by Ecology for interim stabilization. Therefore, the alternative of choice is to provide interim stabilization by use of void-filling the tanks and integrate future closure into the 200-IS-1 OU.

9.0 REFERENCES

10 CFR 830, "Nuclear Safety Management," *Code of Federal Regulations*, as amended.

10 CFR 835, "Occupational Radiation Protection," *Code of Federal Regulations*, as amended.

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," *Code of Federal Regulations*, as amended.

40 CFR 260, "Hazardous Waste Management System: General," *Code of Federal Regulations*, as amended.

40 CFR 261, "Identification and Listing of Hazardous Waste," *Code of Federal Regulations*, as amended.

40 CFR 262, "Standards Applicable to Generators of Hazardous Waste," *Code of Federal Regulations*, as amended.

40 CFR 263, "Standards Applicable to Transporters of Hazardous Waste," *Code of Federal Regulations*, as amended.

40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*, as amended.

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*, as amended.

40 CFR 266, "Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities," *Code of Federal Regulations*, as amended.

40 CFR 268, "Land Disposal Restrictions," *Code of Federal Regulations*, as amended.

40 CFR 270, "EPA Administered Permit Programs: The Hazardous Waste Permit Program," *Code of Federal Regulations*, as amended.

40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," *Code of Federal Regulations*, as amended.

51 FR 16430, "Rules and Regulations," *Federal Register*, May 2, 1986.

BHI, 2000a, *Data Quality Objective for 276-S-141/142 Hexone Tank Characterization/ Stabilization Project*, BHI-01418, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2000b, *Design Basis for Nitrogen System of the Hexone Tanks 276-S-141 and 276-S-142*, 0200W-DB-G0003, Rev. 1, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2000c, *REDOX Facility Safety and Analysis Report*, BHI-01142, Rev. 2, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2000d, *USQ Safety Evaluation Questions: REDOX Hexone Tanks*, 0200W-US-N0144-02, Rev. 1, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2001, *Hexone Tanks 276-S-141 and 142, VHS Videotape Notes*, CCN 088368, Interoffice Memorandum from R. G. Egge, dated April 3, 2001, Bechtel Hanford, Inc., Richland, Washington.

BHI-SH-02, Vol. 3, *Safety and Health Procedures*, Bechtel Hanford, Inc., Richland, Washington.

Clean Air Act of 1955, 42 U.S.C. 7401, et seq.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et seq.

DOE-RL, 1992, *Hexone Storage and Treatment Facility Closure Plan*, DOE/RL-92-40, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1996, *Radioactive Air Emissions Notice of Construction Portable/Temporary Radioactive Air Emission Units*, DOE/RL-96-75, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1999, *Radioactive Air Emissions Notice of Construction for HEPA Filtered Vacuum Radioactive Air Emission Units*, DOE/RL-97-50, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2000a, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, DOE/RL-96-17, Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2000b, *Sampling and Analysis Plan for the 276-S-141/142 Hexone Tank Stabilization/Characterization Project*, DOE/RL-2000-73, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, 1994, *Guidance for Clean Closure of Dangerous Waste Facilities*, Publication #94-111, Washington State Department of Ecology, Olympia, Washington

Ecology, 2000, *Notice of Correction for Stabilization of Hexone Storage and Treatment Facility, BHI Docket Number 00NWPKM006*, CCN 079387, letter from R. Wilson to K. Klein, U.S. Department of Energy, Richland Operations Office, and M. C. Hughes, Bechtel Hanford, Inc., dated May 26, 2000, Washington State Department of Ecology, Olympia, Washington.

Ecology, 2001, *Notice of Correction for Stabilization of the Hexone Storage and Treatment Facility*, CCN 089928, letter from F. Jamison, Washington State Department of Ecology, to M. C. Hughes, Bechtel Hanford, Inc., and K. Klein, U.S. Department of Energy, Richland Operations Office, dated May 22, 2001, Washington State Department of Ecology, Olympia, Washington.

Ecology, EPA, and DOE, 1998, *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement), 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

Logan, 2001, *Hexone Storage and Treatment Facility (276-141/142)*, CCN 090578, letter to J. B. Hebdon, U.S. Department of Energy, Richland Operations Office, dated July 2, 2001, Bechtel Hanford, Inc., Richland, Washington.

NFPA 69, Standard on Explosion Prevention Systems, National Fire Protection Association, Quincy, Massachusetts.

Occupational Safety and Health Act of 1970, 29 U.S.C. 651, et seq.

Resource Conservation and Recovery Act of 1976, 42 U.S.C. 6901, et seq.

Toxic Substances Control Act of 1976, 15 U.S.C. 2601, et seq.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

WAC 173-400, "General Regulations for Air Pollution Sources," *Washington Administrative Code*, as amended.

WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," *Washington Administrative Code*, as amended.

WAC 246-247, "Radiation Protection – Air Emissions," *Washington Administrative Code*, as amended.

APPENDIX A

NOTICE OF CORRECTION ISSUED BY THE WASHINGTON STATE DEPARTMENT OF ECOLOGY

079387

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
1315 W. 4th Avenue • Kennewick, Washington 99336-6018 • (509) 735-7581

May 26, 2000

Mr. Keith Klein
U.S. Department of Energy
P.O. Box 550, MSIN: A7-50
Richland, Washington 99352

RECEIVED
MAY 31 2000
BY DIS

Mr. Michael C. Hughes
Bechtel Hanford, Incorporated
2250 George Washington Way, MSIN: H0-09
Richland, Washington 99352

Re: Notice of Correction for Stabilization of the Hexone Storage and Treatment Facility
BHI DOCKET NUMBER 00NWPKM006

Dear Messrs. Klein and Hughes:

On April 25, 2000, the Washington State Department of Ecology (Ecology) conducted an inspection of the Hexone Storage and Treatment Facility (HSTF). The HSTF has been managed by the U.S. Department of Energy (USDOE) and Bechtel Hanford, Incorporated (BHI) as an unfit-for-use tank system per Federal Code of Federal Regulations (CFR), 40 CFR 265.196. However, Ecology's inspection revealed that the HSTF has not been removed from service as required by 40 CFR 265.196, and has not been managed in accordance with formal agreements made with Ecology as documented in Close Out Form #16.6.2: 40.16, signed by USDOE on December 6, 1996. Furthermore, the HSTF currently poses a safety hazard to employees as the tanks contain potentially reactive and explosive dangerous waste. The HSTF is inadequately inspected to ensure the HSTF is managed safely and the waste within the HSTF tanks remain inadequately designated per Washington Administrative Code (WAC) 173-303, Dangerous Waste Regulations.

Therefore, for the reasons stated above, Ecology herein rescinds its agreement with the provisions of Close Out Form #16.6.2: 40.16. In its place, Ecology will require the HSTF be managed per the requirements set forth in this letter. Furthermore, Ecology will require that the HSTF tanks be stabilized to remove all potential safety hazards to employees no later than December 2001. Ecology will also require increased surveillance and monitoring of the HSTF until stabilization in 2001 is achieved as described in this notice of correction letter.

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Ecology's April 25, 2000, inspection revealed the following findings:

- Maintenance of an inert atmosphere (nitrogen purge) within the HSTF tanks is poorly inspected and maintained.
- Dangerous waste stored within the HSTF tanks pose a safety hazard to workers in the area, are inadequately designated per WAC 173-303-070, and are not monitored for leaks or releases to the environment.
- Other than an outdated 1992 closure plan, no activity to remove the HSTF from service and close the HSTF tanks is in place.

As a result of Ecology's April 25th inspection, USDOE and BHI have committed the following violation:

<u>VIOLATION:</u>

#1) 40 CFR, Subpart J, section 265.196, Response to leaks or spills and disposition of leaking or unfit-for-use tank systems.

USDOE and BHI failed to immediately remove the hexone tanks from service per 40 CFR, Subpart J, section 265.196 or close the hexone tanks per 40 CFR, Subpart J, 265.196(e), and by reference of this regulation, 40 CFR 265.197.

On September 9, 1996, Ecology signed Close Out Form #16.6.2:40.16 with USDOE which identified the hexone tanks (hexone storage and treatment facility or HSTF) as an unfit-for-use tank system subject to the requirements of 40 CFR 265.196, disposition of unfit-for-use tank systems. This Close Out Form included the following actions to ensure protection of human health and the environment: (1) use had ceased, (2) waste had been removed sufficient for protection of human health and the environment, (3) visible releases are not present, regulatory authorities had been informed of any known releases from the unit, (5) the units are scheduled for closure pursuant to the TPA, (6) inspections occur and are documented on a weekly basis, and (7) problems identified will be remedied. As such, this Close Out Form represented a formal agreement between Ecology and USDOE for safe management of the HSTF until the unit could be closed and to meet the requirements of 40 CFR, Subpart J, 265.196.

With regards to the specific actions listed in this Close Out Form, USDOE and BHI have failed to do the following:

- *Cease use of the hexone tanks (the hexone tanks currently store dangerous waste returned to them from treatment of the organic material that they originally contained).*

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- *Remove sufficient waste for protection of human health and the environment (the hexone tanks currently contain inadequately designated waste which is reactive and potentially explosive).*
- *Conduct and document weekly inspections (weekly inspection of the hexone tanks does not include examination of the above ground portion of the tanks system other than reading nitrogen purge feed rotometers. Furthermore, weekly inspections are insufficient to ensure the nitrogen purge system is operating adequately due to diurnal fluctuations in barometric pressure, which in turn impacts the nitrogen purge rate).*
- *Remedy problems discovered through these inspections (weekly inspection data sheets from inspections performed in 1999 and 2000 noted loose nitrogen purge system fittings and below specification nitrogen purge rates; however, no documentation of resolution to these problems were provided in the facility's operating record).*

With regards to the requirements of 40 CFR, Subpart J, section 265.196; USDOE and BHI failed to immediately remove the hexone tanks from service and the tanks continue to store dangerous waste returned to them from treatment of the organic material that they originally contained. The operating record for the HSTF indicates that releases from the hexone tanks have most likely occurred. However, USDOE and BHI have not conducted leak tests, tank integrity examinations, soil sampling, or other examination to ensure the HSTF is not currently leaking and have failed to meet the requirements of 40 CFR, Subpart J, 265.196(e), and by reference of this regulation, 40 CFR 265.197.

In general the hexone tanks fail to meet interim status requirements for tank systems as follows:

- *WAC 173-303-070, Designation of Dangerous Waste: Distilled organic waste residues stored in the hexone tanks since 1992 have not been sampled or analyzed to accurately designate the waste a dangerous or extremely dangerous waste per the procedures set forth in WAC 173-303-070. Documentation of the hexone tank waste indicates reactive or explosive constituents may be present in the waste currently stored in the hexone tanks.*
- *WAC 173-303-283, Performance Standards: The waste stored within the hexone tanks presents a credible risk of explosion or fire; however, the tanks have not been monitored, inspected, or managed adequately to prevent endangerment of the health of employees near the facility per WAC 173-303-283(3)(i).*
- *WAC 173-303-300, General Waste Analysis: The waste stored within the hexone tanks has not been sampled and analyzed to confirm the owner or operator's knowledge of the waste sufficient to properly manage the waste per WAC 173-303-300(1)(2)(4) and (5).*
- *WAC 173-303-320, General Inspection: Weekly inspections of the HSTF have not been adequate to prevent malfunctions and deterioration of facility equipment essential for maintaining safe storage of the waste within the hexone tanks. Nitrogen purge flow is inspected weekly; however, nitrogen flow rates can vary daily due to barometric pressure changes. Some inspection data sheets record nitrogen purge rates below the minimum required rate for safe management of the waste with no indication of how ling this condition had persisted to have dropped below essential safety limits on weekly inspection data sheets.*

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Some weekly inspection data sheets indicate leaks of the nitrogen purge system and other mechanical deficiencies with the nitrogen purge system; however, there is no indication if or how these deficiencies were corrected. There is no written inspection schedule specifying inspection of tank components per WAC 173-303-640 and the inspection schedule indicates ongoing surveillance of monitoring equipment that does not exist (i.e,. liquid level monitoring in the hexone tanks).

- *WAC 173-303-330, Personnel Training: The training plan for the HSTF fails to identify all employees by position, job title, and name for each job at the HSTF and does not include an adequate written description of the introductory and continuing training required for each position at the HSTF per WAC 173-303-330(2).*
- *WAC 173-303-350, Contingency Plan and Emergency Procedures: At the time of Ecology's inspection the contingency plan maintained at the entrance to the HSTF was not the current contingency plan for the facility per WAC 173-303-350(2)&(4). Current contingency planning fails to sufficiently address known explosion and fire hazards associated with the HSTF per WAC 173-303-350(1)&(3).*
- *WAC 173-303-380, Facility Recordkeeping: The operating record for the HSTF is incomplete with some records missing. Records describing resolution of deficiencies discovered through facility inspections are incomplete or non-existent and fail to meet the requirements of WAC 173-303-380(1)(e)&(f). Recordkeeping for the HSTF fails to include accurate waste volumes within the hexone tanks, accurate shipment records of waste transferred from the hexone tanks, accurate reporting of leak tests and discharges to the soil from the hexone tanks per WAC 173-303-380(1)&(2).*
- *WAC 173-303-390, Facility Reporting: The HSTF Closure Plan has not been revised since 1992 and fails to provide current closure cost estimate information for annual reporting per WAC 173-303-390(2)(f).*
- *WAC 173-303-395, Other General Requirements: The HSTF has not been managed adequately to prevent accidental ignition or reaction of ignitable or reactive waste per WAC 173-303-395(1)(a). Documentation available for the organic wastes stored within the HSTF reveal this waste may contain potentially explosive and ignitable components. However, the waste has not been sampled or analyzed to verify whether this potentially dangerous condition persists or not. The HSTF has not been inspected annually to the requirements of WAC 173-303-395(c). The HSTF's nitrogen purge system has received only one line test examination since its installation in 1992, oxygen content within the hexone tanks is not monitored, and weekly inspections conducted at the HSTF are insufficient to ensure the nitrogen purge is operating at its specified rate.*
- *WAC 173-303-640, Tank Systems: The hexone tanks within the HSTF have not been assessed to determine their integrity per WAC 173-303-640(2). The hexone tanks are direct buried steel tanks without secondary containment or leak detection per WAC 173-303-640(4)(a), (b), (c), & (d). The hexone tanks contain potentially ignitable or explosive wastes that could cause the tanks to fail; however, the controls and practices (i.e., inspections and maintenance of the nitrogen purge system) in place at the HSTF to prevent spills from the system resulting from an explosion or fire fail to meet the requirements of WAC 173-303-640(5)(a) & (b). The hexone tanks are not provided with corrosion protection (i.e., cathodic protection) and are not managed to prevent corrosion per WAC 173-303-640(5)(a). The owner and operator of*

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the HSTF have not developed or followed an inspection schedule per WAC 173-303-640(6) and failed to adhere to or revise an agreement with Ecology to perform weekly inspections of the HSTF to meet the requirements of WAC 173-303-640(6). Weekly inspection of the HSTF conducted since at least 1996 recorded that the tank system was not leaking based on inspection of non-existent liquid level monitoring equipment. The HSTF is n unfit-for-use tank system; however, the HSTF has not been removed from service per WAC 173-303-640(7)(b).

In order to correct the violations identified in this Notice of Correction, please complete the following corrective measures within the time frames specified. Failure to correct the violations described in this letter may result in the issuance of an administrative order and/or penalties per RCW 70.105.080. A request for additional time to complete the corrective measures identified in the Notice of Correction must be in writing, describe the reasons for the request for additional time, and be received by me for consideration no later than June 9, 2000.

CORRECTIVE MEASURE:

#1) 40 CFR, Subpart J, section 265.196, Response to leaks or spills and disposition of leaking or unfit-for-use tank systems.

Immediately upon receipt of this letter, USDOE and BHI must conduct daily inspections of the HSTF nitrogen purge system rotometers. These daily inspections must document the readings as found on both HSTF rotometers and document the adjusted flow rate upon completion of each daily inspection. Each inspection must include the date and time of the inspection and signature of the inspector. Original completed and signed inspection sheets must be maintained in the HSTF's operating record and be made available to Ecology inspectors immediately upon request. Should stabilization of the HSTF tanks be postponed beyond the terms set forth in this Notice of Correction Ecology may require continuous oxygen content monitoring of the vapor space within each HSTF tank until the HSTF is stabilized.

Within thirty days (30) of receipt of this letter, USDOE and BHI must complete the following actions:

- Submit a plan and schedule to Ecology for approval for stabilization of the HSTF tanks on, or before, December 2001. Stabilization of the HSTF must include removal or deactivating the waste stored within the HSTF tanks per all applicable regulations. Should the HSTF tanks remain in place after stabilization, this plan and schedule must describe installation and implementation of monitoring of the HSTF tanks at a frequency agreeable to Ecology and sufficient to monitor organic vapors and oxygen content within the vapor space of each HSTF tank. Should the HSTF tanks remain in place after stabilization, this plan and schedule must also describe installation and implementation of monitoring for intrusion of liquids into each HSTF tank at a frequency agreeable to Ecology. This plan and schedule must include a conceptual proposal for closure of the HSTF; however, a revised closure plan for the HSTF is

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not required at this time. All closure proposals must be coordinated with Ecology and the U. S. Environmental Protection Agency, Region 10.

- The plan and schedule described above must include submittal to Ecology by December 2000 of a written description of all costs, engineering evaluations, data quality objectives, sampling and analysis plans, and any other relevant documentation or planning required to complete stabilization of the HSTF on or before December 2001. This submittal will be subject to approval by Ecology.

- USDOE and BHI must implement monthly inspections of the above-ground portions of the HSTF to include inspection of all nitrogen purge feed lines to the HSTF tanks and all exhaust system ventilation lines from the HSTF tanks sufficient to ensure they are not leaking, that all fittings are tight, and the system is operating properly. These inspections may consist of "snoop" testing with soapy water, pressure testing of nitrogen feed lines, or other means sufficient to detect leaks from the HSTF nitrogen feed and ventilation system. Each inspection must include the date and time of the inspection and signature of the inspector. Original completed and signed inspection sheets must be maintained in HSTF's operating record and be made available to Ecology inspectors immediately upon request. These monthly inspections must be conducted until the HSTF tanks are stabilized.

Please complete and return the enclosed Certificate of Compliance to me by June 19, 2000. If you have any questions regarding this letter, please contact me at (509) 736-3031.

Sincerely,

Bob Wilson

Bob Wilson, Compliance Inspector
Nuclear Waste Program

cc: Craig Cameron, EPA
Tom Ferns, USDOE
Steven Wisness, USDOE
Moses Jaraysi, BHI
Mary Lou Blazek, OOE
Administrative Record: HSTF

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CERTIFICATE OF COMPLIANCE

As a legal representative of the U.S. Department of Energy, I certify to the best of my knowledge, the completion of items requested by the Washington State Department of Ecology on May 26, 2000, with regard to the inspection of the Hexone Storage and Treatment Facility located on the Hanford Site, Facility ID number WA 7890008967 as shown below.

COMPLIANCE STATUS

Corrective Measure	Date Due	Date Complete	Initials	Comments
#1	06/26/00			

Signature, USDOE-RL Representative Date

APPENDIX B

RESPONSE TO NOTICE OF CORRECTION

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

080309

00-OSS-395

JUN 26 2000

Mr. Michael A. Wilson, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
P.O. Box 47600
Olympia, Washington 98504

RECEIVED
JUN 28 2000
BY DIS

Dear Mr. Wilson:

HEXONE STORAGE AND TREATMENT FACILITY (HSTF) STABILIZATION SCHEDULE AND RESPONSE TO CORRESPONDING NOTICE OF CORRECTION (NoC)

Reference: Ecology ltr. to K. A. Klein, RL, and M. C. Hughes, BHI, from Bob Wilson, "NOC for Stabilization of the Hexone Storage and Treatment Facility," dtd. May 26, 2000.

The U.S. Department of Energy, Richland Operations Office (RL) and Bechtel Hanford, Inc. (BHI) received the referenced NoC on May 26, 1000, requiring the following corrective measures:

1. Conducting daily inspections of the nitrogen purge system rotometers immediately upon receipt of the referenced letter;
2. submitting a Stabilization Plan and Schedule for the HSTF tanks within thirty days of receipt of the referenced letter; and
3. implementing monthly inspections of the aboveground portions of the HSTF tanks.

The first corrective measure was satisfied as required upon receipt of the referenced letter and will continue on a daily basis, except for non-regularly scheduled work days, until the nitrogen purge system is shut down through the tank stabilization process.

The second corrective measure is satisfied by the submittal of the HSTF Tank Stabilization Schedule enclosed with this letter. The schedule reflects the major activities to be completed to achieve the stabilization of these tanks by December 2001. As per the verbal agreement reached during our June 6, 2000, meeting, a detailed Stabilization Plan will be submitted for the State of Washington Department of Ecology's (Ecology's) approval by May 1, 2001. This plan will include a cost analysis, engineering evaluations, data quality objectives report, a sampling and analysis report, and a detailed schedule of the stabilization alternative activities. We are committed to the completion of this project as soon as possible and no later than December 2001. If any engineering or design issues arise that might hinder our completion by this date, we will notify you of these issues and any anticipated scheduling problems that may require a time extension.

Mr. Michael A. Wilson
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The third corrective measure, to conduct monthly inspections of the aboveground portions of this tank system, will be satisfied by the monthly inspection being planned for July 2000 and consecutive monthly inspections thereafter.

Although we agree with the need to complete the stabilization of the HSTF tank system, we strongly disagree with Ecology's analysis that "the HSTF currently poses a safety hazard to employees." Under the current conditions, these tanks do not pose safety hazards to employees or the public. The latest safety assessment conducted on these tanks (USQ Safety Evaluation Questions, REDOX Hexone Tanks, DIS#: 0200W-US-N0144-02, Rev. 1, Dated: April 6, 2000) confirmed the adequacy and effectiveness of the nitrogen cover system to maintain these tanks in a safe configuration. This system has been in place since 1992 with no accidents or known conditions jeopardizing the safety of our employees, the public, or the environment. We believe that this planned stabilization project will reduce the mortgage cost of managing these tanks under an active nitrogen cover, enabling us to divert this funding to more pressing environmental cleanup activities on the Hanford Site.

With regard to Ecology's decision to rescind its agreement with the provisions of the Close Out Form #16.6.2: 40.16, we believe that it is important to recognize the importance and value of upholding such an agreement and urge Ecology to reconsider this decision. Based on this agreement, we do not believe that all the interim status requirements and violations listed in the referenced letter are applicable. Although the referenced NoC letter requires changes in the inspection frequencies and scope and adds the requirement of tank stabilization, it still does not cover all the regulatory and legal aspects that were agreed to in the "Silver Letter" Close Out Form. We recommend that the referenced agreement be reinstated as modified by the new inspection and stabilization requirements identified in the referenced letter of May 26, 2000. It is our intention to comply with the new inspection requirements and those contained in the Close Out Form, with the exception of the liquid level monitoring requirement. These actions should fulfill Ecology's requirement to correct the violations described in the referenced letter.

RL and BHI are committed to comply with the corrective measures listed in your referenced letter, and will continue to ensure the safety of our employees, the public, and the environment.

If you have any questions, please contact Cliff Clark, RL, at (509) 376-9333, or Roger Landon, BHI, at (509) 372-9209.

Steve H. Wisness, Director
Office of Site Services
DOE Richland Operations Office

for Michael C. Hughes
President
Bechtel Hanford, Inc.

Enclosure:
HSTF Tank Stabilization Schedule

cc w/encl:
M. N. Jaraysi, BHI
T. E. Logan, BHI
J. J. Wallace, Ecology
R. W. Wilson, Ecology
C. E. Cameron, EPA
D. R. Sherwood, EPA
Environmental Portal, LMSI

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HEXONE STORAGE & TREATMENT FACILITY

TANK STABILIZATION SCHEDULE

JUNE 2000

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Hexone Tanks Stabilization Schedule

The following schedule describes the activities needed to complete the stabilization of the Hexone tanks. The goal of this stabilization is to eliminate the need for an active nitrogen cover system. The stabilization work will be designed to not preclude any future closure strategies that could be designed/developed for the 200-IS-1 operable unit site.

__Step 1:__ **Data Quality Objectives (DQO):** (July 3, 2000 to September 29, 2000)

The purpose of this DQO is to determine and agree on the data needs and goals before sampling the tank waste. It is planned to invite the regulators (Ecology and EPA) to attend this DQO to participate in setting these data requirements to satisfy both the stabilization of the tanks and to support the future closure of this TSD. This activity includes the generation of the draft DQO report, and the review and approval of the final report.

__Step 2:__ **Sampling and Analysis Plan (SAP):** (October 2, 2000 to November 30, 2000)

After the completion of the DQO in Step 1, a SAP will be generated. This SAP will be generated in draft form and reviewed by the regulators prior to its finalization. Sampling will take place after the approval of the SAP, to provide the data needed to proceed with the stabilization of these tanks.

__Step 3:__ **Tank Waste Sampling:** (December 4, 2000 to January 31, 2001)

The field activities to sample the waste heel will be started after a camera is lowered in both tanks to determine the physical status of the waste heel in the bottom of the tanks. This visual inspection will determine the sampling processes to be used to extract the samples from this waste. After this determination is made, actual samples will be obtained of the waste. These samples will subsequently be sent for the appropriate analyses as required by the SAP.

__Step 4:__ **Engineering Evaluation Study:** (October, 2, 2000 to April 30, 2001)

An engineering evaluation study will be conducted to study all the viable options to stabilize the Hexone Tanks. A set of criteria that includes elements such as cost, time, and coordination with the rest of the 200-IS-1 operable unit will be applied to determine the optimum alternative/option. This engineering evaluation study will depend to a large extent on the results of the waste heel sampling and analysis. This study will also evaluate the option of achieving clean closure of this TSD to assess the related incremental cost and timing.

__Step 5:__ **Submit Stabilization Plan to Ecology:** (May 1, 2001)

This plan will include the conclusions of the Engineering Evaluation Study, including a full description of the stabilization option chosen by the study. The plan will include the construction schedule, cost analysis, and the results of the sampling and analysis.

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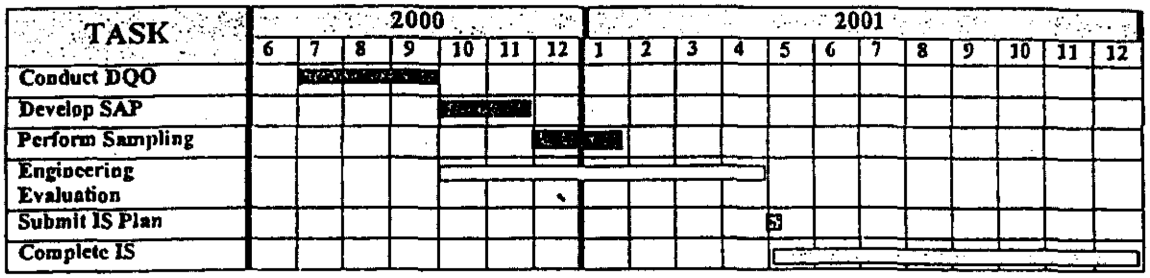
<u>Step 6:</u> **Tank Stabilization:** (May 1, 2001 to December 31, 2001 (tentative))

This is the actual stabilization fieldwork to achieve stabilization of these tanks. The optimum alternative approved by the regulators will be pursued on-site and the initial commitment is to complete all fieldwork by the end of calendar year 2001. This end date might change depending on the alternative chosen and the field construction work to be completed to achieve stabilization. Any extension to this date will be provided to Ecology for approval.



APPENDIX C

COST ESTIMATES

APPENDIX C

COST ESTIMATES

This appendix contains the cost estimate worksheets for the studied alternatives.

Table C-1. Worksheet of Costs for Alternative #1 – Void Fill with Grout. (3 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Provide management	Project management and field support management	Project manager	10	mhrs	120	1,200	Assume 2 hours/week of the project for project controls and task lead and 2 hours/ month for the managers
		Task lead	44		99	4,356	
		Field manager	10		107	1,070	
		Project controls	44		74	3,256	
Prepare engineering documents	Design package	Design engineer	120	mhrs	91	10,920	
	Air Release Calculation	Environ engineer	40		87	3,480	
	Safety evaluation/USQ	Design engineer	80		91	7,280	
	Work package/task instruction	Field engineer	160		73	11,680	
	Senior review of all above	Lead engineer	24		99	2,376	
Procure materials	Specifications	Design engineer	20	mhrs	91	1,820	
	FMR	Design engineer	10		91	910	
	Coordination with procurement	Design engineer	20		91	1,820	
Mobilize to site	JHA review and walkdown	Field superintendent	20	mhrs	74	1,480	
		Field engineer	46		73	3,358	
		Pipefitter	20		62	1,240	
		Operator	20		61	1,220	
		RCT	20		77	1,540	
		IH technician	20		69	1,380	
		RadCon engineer	20		77	1,540	
		Industrial hygiene	10		86	860	
		Design engineer	20		91	1,820	
		Environmental waste	4		62	248	
		Environmental engineer	10		87	870	
		Safety engineer	10		73	730	
		Riggers	20		62	1,240	
		Electricians	20		69	1,380	
		Crane operators	20		66	1,320	
		Carpenters	20		65	1,300	
		Heavy drivers	20		51	1,020	

Table C-1. Worksheet of Costs for Alternative #1 – Void Fill with Grout. (3 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Modify system	Modify/remove piping and components as necessary for grout pour and final configuration	Field superintendent	2	mhrs	74	148	
		Field engineer	10		3	730	
		Pipefitter	20		2	1,240	
		Operator	10		1	610	
		RCT	10		7	770	
		IH technician	10		9	690	
		Safety engineer	10		62	620	
		Riggers	10		69	690	
Pour grout into tanks	Pour grout into tanks	Field superintendent	80	mhrs	74	5,920	
		Field engineer	80		73	5,840	
		Operator	200		61	12,200	
		Pipefitter	40		62	2,480	
		RCT	200		77	15,400	
		IH technician	100		69	6,900	
		Design engineer	20		91	1,820	
		Radcon engineer	40		77	3,080	
		Riggers	40		65	2,600	
		IH	10		92	920	
		Safety	10		83	830	
Materials	Grout fill material	N/A	230	cu. yd.	$160/yd	36,800	The Portland cement-grout mix will be supplied through a pre-qualified contractor. The mix will be delivered by transit-mixer. The driver/operator will be already familiar and trained for work on the Hanford Site.

Table C-1. Worksheet of Costs for Alternative #1 – Void Fill with Grout. (3 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Waste profile/ disposal	Waste Profile	Waste management Field engineering RadCon engineering	40 4 8	mhrs	62 73 77	2,480 292 616	• Burial costs assume that the waste will fit into one 4 x 4 x 8 burial container and is going to low level burial grounds. • Remediation of any contaminated soils would be deferred to the OU process. • No soil monitoring of the site would be required
	Waste disposal (removed piping)	Heavy drivers NPO RCT Field engineer Field superintendent Burial costs	18 18 18 8 8		51 61 77 73 77 $22/Ft^3	918 1,098 1,386 584 616 2800	
Cleanup and demobilization	Cleanup and demobilize from site	Heavy driver RCT Field superintendent Nuclear process Operator	16 16 4 16	mhrs	51 77 74 61	816 1,231 297 984	
					Total	**187,120**	To obtain life cycle costs add either $65K (See Table C-9) if the tanks are left in place or $2538K (See Table C-8) if the tanks are removed for closure.

FMR = field material requisition
IH = industrial hygiene
JHA = job hazards analysis
N/A = not applicable
NPO = nuclear process operators
OU = operable unit
RadCon = radiological control
RCT = radiological control technician
USQ = unreviewed safety question

Table C-2. Worksheet of Costs for Alternative #2-1: Continue "As-Is." (3 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Provide management	Project management and field support management	Project manager Task lead Field manager	8 4 8	mhrs	120 99 107	960 396 856	
System surveillance	Daily surveillance of system operation	Operator	504	mhrs	61	30,744	The daily system surveillance includes visual survey of the site and purge system components. Nitrogen supply and flow are verified as being within acceptable limits. This surveillance is performed on all normal work days (no weekends or holidays). This task accounts for 2 hrs/day.
System maintenance	Periodic maintenance of system components (soap bubble test) includes work package preparation	Operator Pipefitter RCT Field engineer	48 48 48 30	mhrs	61 62 77 73	2,928 2,976 3,696 2,190	Monthly maintenance includes a visual survey of the site and leak test (soap bubble test) of the purge system components. This task takes 4 hr/month for each craft listed.
Supply nitrogen	Change out Dewars (supply of N)	Pipefitter Heavy driver	104 104	mhrs	62 51	6,448 5,304	Nitrogen is supplied as cryogenic liquid in Dewar containers. The average use is 1 Dewar/week (52/year). Change out of the Dewar requires a pipefitter and a teamster for 2 hr/week, respectively.

Table C-2. Worksheet of Costs for Alternative #2-1: Continue "As-Is." (3 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
	Liquid N in Dewar container (includes delivery)	N/A	52	Count	$145/Dewar	7,540	Commercial charge for full Dewars.
Replace filters	Replacement of carbon (GAC) filters	Field engineer	20	mhrs	73	1,460	Replacement of the filters occurs annually for the HEPA and semi-annually for the carbon filters. This task takes 10 hr/event for each craft listed (Field engineer, Pipefitter, Heavy driver, RCT). For the HEPA filter, this is 20 hr/year. For the carbon filters, this is 10 hr/year. The HEPA filter is a single unit. The carbon filters includes 2 filter units per change out (total of 4 items per year).
		Pipefitter	20		62	1,240	
		Heavy driver	20		51	1,020	
		RCT	20		77	1,540	
	Replacement of HEPA filter	Field engineer	10		73	730	
		Pipefitter	10		62	620	
		Heavy driver	10		51	510	
		RCT	10		77	770	
						14	
	Carbon (GAC) filters	N/A	4	Count		2,900	Based on actual costs last year.
	HEPA filter		1				

Table C-2. Worksheet of Costs for Alternative #2-1: Continue "As-Is." (3 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Waste disposal	Waste management Dispose of spent carbon filters	Waste manager N/A	20	mhrs	62	1,240 6,500	Four carbon filter units are prepared yearly for disposal by containment in an overpack. Then the items are shipped to CWC.
				Total/year		**82,568**	
				For 10-year duration		**825,680**	To obtain life cycle costs add both $65K (See table C-9) and $187K (See table C-1) if the tanks are left in place or $2538K (See Table C-8) if the tanks are removed for closure.

Notes:
1. Costs are annual OandM expenses.
2. Comparative costs are forecast as the total for a 10 year duration.

CWC = central waste complex
GAC = granular-activated carbon
HEPA = high-efficiency particulate air
mhrs = manhours
N = nitrogen
N/A = not applicable
NPO = nuclear process operator
OU = operable unit
RCT = radiological control technician

Table C-3. Worksheet of Costs for Alternative #2-2: Upgrade of Purge System. (4 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Provide management	Project management and field support management	Project manager	10	mhrs	120	1,200	
		Task lead	44		99	4,356	
		FS manager	10		107	1,070	
		Project controls	44		74	3,256	
Prepare engineering documents	Design package	Design engineer	160	mhrs	91	14,560	
	Facility mod/USQ/PSA	Nuclear engineer	120		87	10,440	
	Drawings	Design engineer	100		9173	9,100	
	Work package/task instruction	Field engineer	160		99	11,680	
	Senior review of all above	Lead engineer	24			2,376	
Procure materials	Specifications	Design engineer	20	mhrs	91	1,820	
	FMR	Design engineer	1020		91	910	
	Coordination with procurement	Design engineer			91	1,820	
Modify system/install hardware	JHA review and walkdown	Field superintendent	20	mhrs	74	1,480	
		Field engineer	46		73	3,358	
		Pipefitter	20		62	1,240	
		Operator	20		61	1,220	
		RCT	20		77	1,540	
		IH technician	20		69	1,380	
		RadCon engineering	20		77	1,540	
		IH	10		86	860	
		Design engineer	20		91	1,820	
		Environmental waste	4		62	248	
		Environmental engineering	10		87	870	
		Safety engineer	10		73	730	
		Riggers	20		62	1,240	
		Electricians	20		69	1,380	
		Carpenters	20		65	1,300	

Table C-3. Worksheet of Costs for Alternative #2-2: Upgrade of Purge System. (4 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
	Install instruments	Field superintendent	10	mhrs	74	740	
		Field engineer	36		73	2,628	
		Pipefitter	2		2	4,464	
		Operator	36		1	2,196	
		RCT	36		7	2,772	
		IH technician	20		9	1,380	
		Safety engineer	20		62	1,240	
		Riggers	20		69	1,380	
		Instrument technician	36		66	2,376	
	Install cable connection from sensors to control room	Electrician	80	mhrs	65	5,200	
		Instrument technician	20		66	1,320	
		Field engineer	80		73	5,840	
		Operators	80		61	4,880	
Start-up/test/integrate new components	Program PLC	Design engineer	36	mhrs	91	3,276	
		Instrument technician	72		66	4,752	
					Sub-Total	116,788	One time costs
System maintenance	Periodic maintenance of system components (soap bubble test) includes work package preparation	Operator	10	mhrs	61	610	Semi-annual maintenance includes a visual survey of the site and leak test (soap bubble test) of the purge system components. This task takes 5 hr/event (6 month) for each craft listed (Operator, Pipefitter, RCT).
		Pipefitter	10		62	620	
		RCT	10		77	770	
		Field engineer	30		73	2,190	

Table C-3. Worksheet of Costs for Alternative #2-2: Upgrade of Purge System. (4 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Supply nitrogen	Change out Dewars (supply of N)	Pipefitter Heavy driver	104 104	mhrs	62 51	6448 5,304	Nitrogen is supplied as cryogenic liquid in Dewar containers. The average use is 1 Dewar/week (52/year). Change-out of the Dewar requires a pipefitter and a teamster for 2 hr/week, respectively.
	Liquid N in Dewar container (includes delivery)	N/A	52	Count	$145/Dewar	7,540	Commercial costs for Dewar bottles
Replace filters	Replacement of carbon (GAC) filters Replacement of HEPA filter	Field engineer Pipefitter Heavy driver RCT Field engineer Pipefitter Heavy driver RCT	20 20 20 20 10 10 10 10	mhrs	73 62 51 77 73 62 51 77	1,460 1,240 1,020 1,540 730 620 510 770	Replacement of the filters occurs annually for the HEPA and semi-annually for the carbon filters. This task takes 10 hr/event for each craft listed (Field engineer, Pipefitter, Heavy driver, RCT). For the HEPA filter, this is 20 hr/year. For the carbon filters, this is 10 hr/year. The HEPA filter is a single unit. The carbon filters includes 2 filter units per change out (total of 4 items per year).
	Carbon (GAC) filters HEPA filter	N/A Procurement Field engineer	4 1 4 10	Count mhrs	 71 73	2,900 284 730	Based on actual costs.

Table C-3. Worksheet of Costs for Alternative #2-2: Upgrade of Purge System. (4 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Waste disposal	Waste management Dispose of spent carbon filters	Waste manager N/A	20	mhrs	62	1,240 6,500	Four carbon filter units are prepared yearly for disposal by containment in an overpack. Then the items are shipped to CWC.
					Sub-Totals	**43,026** **430,260**	Yearly costs 10 year costs
					Total	**547,048**	• One time costs + costs for 10 year period • To obtain life cycle costs add both $65K (See table C-9) and $187K (See table C-1) if the tanks are left in place or $2538K (See Table C-8) if the tanks are removed for closure.

Notes:
1. Costs are annual OandM expenses.
2. Comparative costs are forecast as the total for a 10 year duration.

CWC = central waste complex
FMR = field material requisition
GAC = granular-activated carbon
HEPA = high-efficiency particulate air
IH = industrial hygiene
JHA = job hazards analysis
mhrs = manhours
N = nitrogen
N/A = not applicable
PSA = preliminary safety assessment
RadCon = radiological control
RCT = radiological control technician
USQ = unreviewed safety question

Table C-4. Worksheet of Costs for Alternative #2-3: Intermittent Use of Purge. (2 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Provide management	Project management and field support management	Project manager	4	mhrs	120	480	
		Task lead	20		99	1,980	
		Field manager	20		107	2,140	
	PSA/USQ	Nuclear engineering	120		87	10,440	
System maintenance	Periodic maintenance of system components (soap bubble test) includes work package preparation	Operator	48	mhrs	61	2,928	Monthly maintenance includes a visual survey of the site and leak test (soap bubble test) of the purge system components. This task takes 4 hr/month for each craft listed.
		Pipefitter	48		62	2,976	
		RCT	48		77	3,696	
		Field engineer	30		73	2,190	
Supply nitrogen	Change out Dewars (supply of N)	Pipefitter	10	mhrs	62	620	Nitrogen is supplied as cryogenic liquid in Dewar containers. Change out of the Dewar requires a pipefitter and a teamster for 2 hr/tank. It is assumed that there will be 5 Dewars/year.
		Heavy driver			51	510	
	Liquid N in Dewar container (includes delivery)	N/A	5	Count	$145/Dewar	725	Commercial costs
Replace filters	Replacement of carbon (GAC) filters	Field engineering	10	mhrs	73	730	Replacement of the filters occurs annually for the HEPA and the carbon filters. This task takes 10 hr/event for each craft listed (Field engineer, Pipefitter, Heavy driver, RCT). For the HEPA filter, this is 10 hr/year. For the carbon filters, this is 10 hr/year. The HEPA filter is a single unit. The carbon filters includes 2 filter units per change out (total of 2 items per year).
		Pipefitter	10		62	620	
		Heavy driver	10		51	510	
		RCT	10		77	770	
	Replacement of HEPA filter	Field engineer	10		73	730	
		Pipefitter	10		62	620	
		Heavy driver	10		51	510	
		RCT	10		77	770	

Table C-4. Worksheet of Costs for Alternative #2-3: Intermittent Use of Purge. (2 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
	Carbon (GAC) filters HEPA filter	N/A	2 1	Count		1,900	Based on actual costs
		Procurement	4	mhrs	71	284	
		Field engineer	10		73	730	
Waste disposal	Waste management	Waste manager	2	mhrs	62	620	Two carbon filter units are prepared yearly for disposal by containment in an overpack. Then the items are shipped to CWC.
	Dispose of spent carbon filters	N/A				3,250	
				Total/year		40,729	
				For 10 year duration		407,290	To obtain life cycle costs add both $65K (See table C-9) and $187K (See table C-1) if the tanks are left in place or $2538K (See Table C-8) if the tanks are removed for closure.

Notes:
1. Costs are annual OandM expenses.
2. Comparative costs are forecast as the total for a 10 year duration.

GAC = granular-activated carbon
HEPA = high-efficiency particulate air
mhrs = manhours
N = nitrogen
N/A = not applicable
PSA = preliminary safety assessment
RCT = radiological control technician
USQ = unreviewed safety question

Table C-5. Worksheet of Costs for Sub-Alternative #3-1: Remove the Waste and the Tanks to CWC. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Provide management	Project management and field support management	Project manager	24	mhrs	120	2,880	Assume 2 hours/week of the project for project controls and task lead and 2 hours/ month for managers.
		Task lead	100		99	9,900	
		Field manager	24		107	2,568	
		Project controls	100		74	7,400	
Site prep work	Site prep work GPR	Geoscience/modeling	80	mhrs	80	6,400	GPR conducted for entire excavation site
		Nuclear process operator	40		62	2,480	
		RCT	40		77	3,080	
PFWR	Plant Force Work Review for steam pipe removal	Field engineer	8	mhrs	73	584	
Work package	Work package for steam pipe removal	Field engineer	120	mhrs	73	8,760	
Review/approve	Review/approve work package steam pipe removal	Field engineer	20	mhrs	73	1,460	
		Field superintendent	10		74	740	
JHA walkdown	JHA walkdown for steam pipe removal	Safety	10	mhrs	73	730	
		Environmental engineer	10		87	870	
		Design engineer	10		91	910	
		Field engineer	10		73	730	
		Crane operator	10		63	630	
		Heavy drivers	20		51	1,020	
		Riggers	10		62	620	
		Insulators	10		60	610	
		Nuclear Process operator	20		61	1,220	
		RCT	20		77	1,540	
		Pipefitters	10		62	620	
		Field superintendent	10		74	740	
		IH technician	10		69	690	
Order equipment/ material	Order equipment/material for steam pipe removal	Field engineer	10	mhrs	73	730	
		Procurement	4		71	284	
		Material	misc.	Mat.		1,000	

Table C-5. Worksheet of Costs for Sub-Alternative #3-1: Remove the Waste and the Tanks to CWC. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Pre-job	Pre-job for steam pipe removal	Safety	1	mhrs	73	73	
		Environmental engineer	1		87	87	
		Design engineer	1		91	91	
		Field engineer	1		73	73	
		Crane operator	1		63	63	
		Heavy driver	1		51	51	
		Rigger	1		62	62	
		Insulator	1		60	60	
		Nuclear Process operator	1		61	61	
		RCT	1		77	77	
		Pipefitter	1		62	62	
		Field superintendent	1		74	74	
		IH technician	1		69	69	
Mobilization	Mobilization for steam pipe removal	Heavy driver	8	mhrs	51	408	
		Rigger	16		62	992	
Remove steam pipe	Remove steam pipe	Field superintendent	80	mhrs	74	5,920	North/south steam line east Hexone fence has sections of asbestos removed and pipes removed from fence to 276-S Building, including post and concrete foundations.
		Crane operator	80		63	5,040	
		Heavy driver	32		51	1,632	
		Rigger	64		62	3,968	
		Insulator	160		60	9,600	
		Pipefitter	80		62	4,960	
		IH technician	80		69	5,520	
		Field engineer	40		73	2,920	
		Equipment usage cost	0			1,000	
Waste disposal	Waste disposal for steam pipe removal	Field Waste management	16	mhrs	62	992	
		Heavy driver	16		51	816	
		RCT	16		77	1,232	
Work package	Work package to excavate, tap, cut, cap, and remove 6 lines	Field engineer	120	mhrs	73	8,760	Six underground pipes identified that require hot taped, cut, removed and waste disposed of.
Review/approve	Review/approve work package remove 6 lines	Field engineer	20	mhrs	73	1,460	
		Field superintendent	10		74	740	

Table C-5. Worksheet of Costs for Sub-Alternative #3-1: Remove the Waste and the Tanks to CWC. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
JHA walkdown	JHA Walkdown for excav, tap, cut, cap and remove 6 lines	Safety	10	mhrs	73	730	
		Environmental engineer	10		87	870	
		Design engineer	10		91	910	
		Field engineer	10		73	730	
		Crane operator	10		63	630	
		Heavy driver	10		51	510	
		Rigger	20		62	1,240	
		Nuclear Process operator	10		61	610	
		RCT	10		77	770	
		Pipefitter	10		62	620	
		Field superintendent	10		74	740	
		IH technician	10		69	690	
Pre-job	Pre-job for excavate, tap, cut, cap and remove 6 lines	Safety	2	mhrs	73	146	
		Environmental engineer	2		87	174	
		Design engineer	2		91	182	
		Field engineer	2		73	146	
		Crane operator	2		63	126	
		Heavy driver	2		51	102	
		Rigger	2		62	124	
		Nuclear Process operator	2		61	122	
		RCT	2		77	154	
		Pipefitter	2		62	124	
		Field superintendent	2		74	148	
		IH technician	2		69	138	
Mobilization	Mobilization for 6 line removals	Heavy driver	8	mhrs	5	408	
Excavate lines	Excavate lines	Nuclear Process operator	72	mhrs	61	4,392	
		RCT	24		77	1,848	
		IH technician	24		69	1,656	
		Field superintendent	12		74	888	
Hot tap lines	Hot tap lines	Nuclear Process operator	24	mhrs	61	1,464	
		RCT	24		77	1,848	
		IH technician	24		69	1,656	
		Field superintendent	12		74	888	
		Pipefitter	48		62	2,926	

Table C-5. Worksheet of Costs for Sub-Alternative #3-1: Remove the Waste and the Tanks to CWC. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Cut/cap lines	Cut/cap lines	Nuclear Process operator	24	mhrs	61	1,464	
		RCT	24		77	1,848	
		IH technician	24		69	1,656	
		Field superintendent	12		74	888	
		Pipefitter	48		62	2,926	
Zero energy check and electrical disconnect	Zero energy check and electrical disconnect of pump motors	Nuclear Process operator	8	mhrs	61	458	Zero energy check of all electrical conducted and energized/deenergized systems.
		RCT	8		77	616	
		Field superintendent	4		74	296	
		Electrician	16		65	1,040	
Remove/dispose	Remove/dispose of pump/motors	Nuclear Process operator	24	mhrs	61	1,464	No petroleum products; grease/oils in pumps/motors to deal with
		RCT	24		77	1,848	
		IH technician	24		69	1,656	
		Field superintendent	12		74	888	
		Pipefitter	48		62	2,976	
		Rigger	48		62	2,976	
		Crane operator	24		63	1,512	
Waste disposal	Waste disposal for the 6 line removals	Field Waste management	16	mhrs	62	992	Asbestos removed and asbestos covered pipe can be placed into an ERDF container and shipped to ERDF.
		Heavy driver	16		51	816	
		RCT	16		77	1,232	
Pre-job	Pre-job for fence removal	Safety	1	mhrs	73	73	
		Environmental engineer	1		87	87	
		Design engineer	1		91	91	
		Crane Operator	1		63	63	
		Heavy driver	1		51	51	
		Rigger	1		62	62	
Mobilization	Mobilization for fence removal	Heavy driver	8	mhrs	51	408	
		Rigger	16		62	992	
Remove fence	Remove fence	Crane Operator	8	mhrs	63	504	
		Heavy driver	8		51	408	
		Rigger	16		62	992	
		Field superintendent	4		74	296	

Table C-5. Worksheet of Costs for Sub-Alternative #3-1: Remove the Waste and the Tanks to CWC. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Work package	Work package to excavate site and tank removal	Field engineer	120	mhrs	73	8,760	
Review/approve	Review/approve work package excavate/removal	Field engineer Field superintendent	20 10	mhrs	73 74	1,460 740	
JHA walkdown	JHA walkdown for excavate site/tank removal	Safety Environmental engineer Design engineer Field engineer Crane Operator Heavy driver Rigger Nuclear Process operator RCT Field superintendent IH technician	10 10 10 10 10 20 20 10 10 10 10	mhrs	73 87 91 73 63 51 62 61 77 74 69	730 870 910 731 628 1,020 1,239 610 769 740 690	
Order equipment/ material	Order equipment/material for excavation removal	Field engineer Procurement Material	10 4 Misc.	mhrs Ea.	73 71 	731 284 1,000	
Pre-job	Pre-job for excavate site	Safety Environmental engineer Design engineer Field engineer Crane operator Heavy driver Nuclear Process operator RCT IH technician	1 1 2 1 1 1 1 1 1	mhrs	73 87 91 73 62 51 61 77 69	73 87 182 73 63 51 61 77 69	
Mobilization	Mobilization for excavating site	Heavy driver Crane operator	16 8	mhrs	51 62	816 496	

Table C-5. Worksheet of Costs for Sub-Alternative #3-1: Remove the Waste and the Tanks to CWC. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Excavation	Excavation of tanks	Heavy driver	80	mhrs	51	4,088	• Costs include removal and refilling the hole after the work is completed
		Nuclear Process operator	80		61	4,880	
		Crane operator	80		62	4,960	
		Equipment usage cost	0			10,000	• Excavated site to be approximately 60x60x17 deep to obtain 1½ to 1% slope.
		Field superintendent	80		74	5,920	
		RCT	80		77	6,160	
		IH technician	80		69	5,520	
			80		69	5,520	
Pre-job	Pre-job for tank removal	Safety	1	mhrs	73	73	
		Environmental engineer	1		87	87	
		Design engineer	1		91	91	
		Field engineer	1		73	73	
		Crane operator	1		62	62	
		Heavy driver	1		51	51	
		Heavy Equipment operator	1		55	55	
		Nuclear Process operator	1		61	61	
		RCT	1		77	77	
		Field superintendent	1		74	74	
		IH technician	1		69	69	
		Rigger	1		69	69	
			1		62	62	

Table C-5. Worksheet of Costs for Sub-Alternative #3-1: Remove the Waste and the Tanks to CWC. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Establish crane pad	Establish crane pad	Heavy Equipment operator Heavy driver Equipment usage cost	16 32 Mat	mhrs Ea	55 51	880 1,632 800	
Design, procure, construct and test greenhouse	Design, procure, construct and test greenhouse	Subcontractor	0	mhrs	0	950,000	• 40' x 40' x 20' greenhouse with exhauster and stack monitor. Costs estimated at $25/ft^2 for the greenhouse and $5/ft^2 for construction, and testing by BHI subcontract. • Greenhouse, if utilized in summer or winter, will be designed for summer/winter work • Cost include procurement cost

Table C-5. Worksheet of Costs for Sub-Alternative #3-1: Remove the Waste and the Tanks to CWC. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Remove tanks	Remove tanks and haul to greenhouse	Field engineer	6	mhrs	73	438	• Excavation site to be enclosed with portable fencing after backfilling with clean spoils removed. • Concrete foundation for pumps removed with tank excavation. • Tanks inserted with dry ice and vented through HEPA filters on vent line while excavating. • Excavated spoil piles (non-contaminated) to be stored northwest corner of 233-S site. Near where steam header disconnected from main line. Spoil pile to be utilized to backfill tank holes along with additional fill material, as required.
		Crane operator	24		62	1,488	
		Heavy driver	80		51	4,080	
		Rigger	48		62	2,976	
		Nuclear Process operator	24		61	1,464	
		RCT	24		77	1,848	
		Field superintendent	32		74	2,368	
		IH technician	24		69	1,656	
		Equipment usage costs	Misc.	Ea		16,600	

Table C-5. Worksheet of Costs for Sub-Alternative #3-1: Remove the Waste and the Tanks to CWC. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Cut open, clean, and cut up	Cut open tanks, clean sludge and cut up tanks	Field engineer	480	mhrs	73	35,040	• Residual waste material from tank will be scooped out of the shell sections • Tank will be cut up into pieces that will fit into approved storage containers to CWC as follows: – Sludge 55 gallon tanks – Tanks 4x4x8 wooden burial boxes. • Workers will be required to use fresh air when cleaning sludge from tank and washing down tank interior.
		Nuclear Process operator	2400		61	146,400	
		RCT	1440		77	110,880	
		Field superintendent	480		74	35,520	
		IH technician					
		Pipefitter	960		69	66,240	
		Rigger	960		62	59,520	
		Crane Operator	960		62	59,520	
		Equipment usage cost	480		62	29,760	
						16,200	
Cleanup and demobilization	Cleanup and demobilize from site	Heavy driver	16	mhrs	51	816	
		RCT	16		77	1,232	
		Field superintendent	4		74	296	
		Nuclear process operator	16		61	976	

Table C-5. Worksheet of Costs for Sub-Alternative #3-1: Remove the Waste and the Tanks to CWC. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Waste disposal	Waste disposal for CWC	FDH	N/A	N/A	N/A	633,000	• Assume 10 barrels of contaminated soil per tank area 10x 2 = 20 x $1231 storage rate at CWC = $24,620 for these barrels • Waste and rinsate per tank estimated 300-400 gallons to be generated. This would equal approximately 26 barrels of waste per tank based on 15 gal/drum. 26x2 = 52 barrels total x $1231 storage rate at CWC = $64,012 for these barrels • 16 burial boxes per tank will be required for CWC storage. This includes the tanks as well as miscellaneous waste for the piping removal and any other waste generated. 16x2 = 32 boxes total x $17000 storage rate at CWC = $544,000 for these boxes

Table C-5. Worksheet of Costs for Sub-Alternative #3-1: Remove the Waste and the Tanks to CWC. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Environmental work	Environmental work to get tank and contents to ERDF, Radiological characterization, waste information in SWITS system and waste paperwork including designation, profile WSRP, SSWMI, and OWTF	Environmental Design engineer Project engineer	200 20 5	mhrs	87 91 110	17,400 1,820 550	
NOC	NOC for completing tanks removal	Environmental Design engineer Project engineer	200 100 20	mhrs	87 91 110	17,400 9,100 2,200	
Safety evaluation	Safety Evaluation for removing tanks	Nuclear Design engineer Project engineer	450 100 30	mhrs	87 91 110	39,150 9,100 3,300	Prepare Safety Evaluation with supporting calculation (assume DOE does not have a third party review)
Engineering support	Engineering support for exhaust system and monitoring.	Design engineer Project engineer Nuclear	600 30 100	mhrs	91 110 87	54,600 3,300 8,700	

Table C-5. Worksheet of Costs for Sub-Alternative #3-1: Remove the Waste and the Tanks to CWC. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Sampling	Site closure	Scientist/Specialist		mhrs	89	21,360	15 soil samples will be taken
	DQO – 4 weeks: Oct. 1	Scientist/Specialist	240		89	26,700	under the tanks (necessary to
	SAP – 5 weeks	IH technician	300		69	1,863	characterize soil for
	Collect Samples – 3 days: after 252	RCT	27		77	2,079	subsequent action)
		Operator	27		61	1,647	
			27				
	Analyze Samples $5,000/sampleX15 4 months					75,000	
	Clean up verification package and data quality assessment – 4 weeks	Scientist/Specialist	240		89	21,360	
					Total	**2,762,927**	

Notes
1. Hexone tanks, pumps and piping and waste removed for excavation approved as RCRA waste for CWC disposal.
2. All work related to excavation and tank removal is plant force.

BHI = Bechtel Hanford, Inc.
CWC = central waste complex
DOE = U.S. Department of Energy
DQO = data quality objective
ERDF = Environmental Restoration Disposal Facility
FDH = Fluor Daniel Hanford
GPR = ground-penetrating radar
HEPA = high-efficiency particulate air
IH = industrial hygiene
JHA = job hazards analysis
mhrs = manhours
NOC = notice of correction
PFWR = plant force work review
OWTF = onsite waste tracking form
RCT = radiological control technician
SAP = sampling and analysis plan
SSWMI = site-specific waste management instructions
SWITS = solid waste information tracking system
WSRP = waste shipping and receiving plan

Table C-6. Worksheet of Costs for Sub-Alternative #3-2: Remove the Waste to CWC and the Tanks to ERDF. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Provide management	Project management and field support management	Project manager Task lead Field manager Project controls	38 150 38 150	mhrs	120 99 107 74	4,560 14,850 4,066 11,100	Assume 2 hours/week of the project for project controls and task lead and 2 hours/month for managers.
Site prep work	Site prep work GPR	Geoscience/Modeling Nuclear process operator RCT	80 40 40	mhrs	80 62 77	6,400 2,480 3,080	GPR conducted for entire excavation site.
PFWR	Plant Force Work Review for steam pipe removal	Field engineer	8	mhrs	73	584	
Work package	Work package for steam pipe removal	Field engineer	120	mhrs	73	8,760	
Review/approve	Review/approve work package steam pipe removal	Field engineer Field superintendent	20 10	mhrs	73 74	1,460 740	
JHA walkdown	JHA walkdown for steam pipe removal	Safety Environmental engineer Design engineer Field engineer Crane Operator Heavy drivers Riggers Insulators Nuclear process operator RCT Pipefitters Field superintendent IH technician	10 10 10 10 10 20 10 10 20 20 10 10 10	mhrs	73 87 91 73 63 51 62 60 61 77 62 74 69	730 870 910 730 630 1,020 620 600 1,220 1,540 620 740 690	
Order equipment/ material	Order equipment/material for steam pipe removal	Field engineer Procurement Material	10 4 Misc.	Mhrs Ea.	73 71 	730 284 1,000	

Table C-6. Worksheet of Costs for Sub-Alternative #3-2: Remove the Waste to CWC and the Tanks to ERDF. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Pre-job	Pre-job for steam pipe removal	Safety	1	mhrs	73	73	
		Environmental engineer	1		87	87	
		Design engineer	1		91	91	
		Field engineer	1		73	73	
		Crane Operator	1		63	63	
		Heavy driver	1		51	51	
		Rigger	1		62	62	
		Insulator	1		60	60	
		Nuclear process operator	1		61	61	
		RCT	1		77	77	
		Pipefitter	1		62	62	
		Field superintendent	1		74	74	
		IH technician	1		69	69	
Mobilization	Mobilization for steam pipe removal	Heavy driver	8	mhrs	51	408	
		Rigger	16		62	992	
Remove steam pipe	Remove steam pipe	Field superintendent	80	mhrs	74	5,920	North/south steam line east Hexone fence has sections of asbestos removed and pipes removed from fence to 276-S Building, including post and concrete foundations.
		Crane Operator	80		63	5,040	
		Heavy driver	32		51	1,633	
		Rigger	64		62	3,960	
		Insulator	160		60	9,600	
		Pipefitter	80		62	4,960	
		IH technician	80		69	5,520	
		Field engineer	40		73	2,920	
		Equipment usage cost	0			1,000	
Waste disposal	Waste disposal for steam pipe removal	Field Waste management	16	mhrs	62	992	
		Heavy driver	16		51	816	
		RCT	16		77	1,231	
Work package	Work package to excavate, tap, cut, cap, and remove 6 lines	Field engineer	120	mhrs	73	8,760	Six underground pipes identified that require hot taped, cut, removed and waste disposed of
Review/approve	Review/approve work package remove 6 lines	Field engineer	20	mhrs	73	1,463	
		Field superintendent	10		74	743	

Table C-6. Worksheet of Costs for Sub-Alternative #3-2: Remove the Waste to CWC and the Tanks to ERDF. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
JHA walkdown	JHA Walkdown for excavate, tap, cut, cap, and remove 6 lines	Safety	10	mhrs	73	730	
		Environmental engineer	10		87	870	
		Design engineer	10		91	910	
		Field engineer	10		73	731	
		Crane Operator	10		63	628	
		Heavy driver	10		51	510	
		Rigger	20		62	1,239	
		Nuclear process operator	10		61	615	
		RCT	10		77	769	
		Pipefitter	10		62	619	
		Field superintendent	10		74	743	
		IH technician	10		69	685	
Pre-job	Pre-job for excavate, tap, cut, cap, and remove 6 lines	Safety	2	mhrs	73	146	
		Environmental engineer	2		87	174	
		Design engineer	2		91	182	
		Field engineer	2		73	146	
		Crane Operator	2		63	126	
		Heavy driver	2		51	102	
		Rigger	2		62	124	
		Nuclear process operator	2		61	123	
		RCT	2		77	154	
		Pipefitter	2		62	124	
		Field superintendent	2		74	149	
		IH technician	2		69	137	
Mobilization	Mobilization for 6 line removals	Heavy driver	8	mhrs	51	408	
Excavate lines	Excavate lines	Nuclear process operator	72	mhrs	61	4,392	
		RCT	24		77	1,846	
		IH technician	24		69	1,656	
		Field superintendent	12		74	888	
Hot tap lines	Hot tap lines	Nuclear process operator	24	mhrs	61	1,464	
		RCT	24		77	1,846	
		IH technician	24		69	1,656	
		Field superintendent	12		74	891	
		Pipefitter	48		62	2,972	

Table C-6. Worksheet of Costs for Sub-Alternative #3-2: Remove the Waste to CWC and the Tanks to ERDF. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Cut/cap lines	Cut/cap lines	Nuclear process operator	24	mhrs	61	1,464	
		RCT	24		77	1,846	
		IH technician	24		69	1,656	
		Field superintendent	12		74	891	
		Pipefitter	48		62	2,972	
Zero energy check and electrical disconnect	Zero energy check and electrical disconnect of pump motors	Nuclear process operator	8	mhrs	61	492	Zero energy check of all electrical conducted and energized/deenergized systems.
		RCT	8		77	615	
		Field superintendent	4		74	297	
		Electrician	16		65	1,041	
Remove/dispose	Remove/dispose of pump/motors	Nuclear process operator	24	mhrs	61	1,476	No petroleum products; grease/oils in pumps/motors to deal with.
		RCT	24		77	1,846	
		IH technician	24		69	1,644	
		Field superintendent	12		74	891	
		Pipefitter	48		62	2,972	
		Rigger	48		62	2,973	
		Crane Operator	24		63	1,507	
Waste disposal	Waste disposal for the 6 line removals	Field waste management	16	mhrs	62	987	Asbestos removed and asbestos covered pipe can be placed into an ERDF container and shipped to ERDF.
		Heavy driver	16		51	816	
		RCT	16		77	1,231	
Pre-job	Pre-job for fence removal	Safety	1	mhrs	73	73	
		Environmental engineer	1		87	87	
		Design engineer	1		91	91	
		Crane Operator	1		63	63	
		Heavy driver	1		51	51	
		Rigger	1		62	62	
Mobilization	Mobilization for fence removal	Heavy driver	8	mhrs	51	408	
		Rigger	16		62	991	
Remove fence	Remove fence	Crane Operator	8	mhrs	63	502	
		Heavy driver	8		51	408	
		Rigger	16		62	991	
		Field superintendent	4		74	297	

Table C-6. Worksheet of Costs for Sub-Alternative #3-2: Remove the Waste to CWC and the Tanks to ERDF. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Work package	Work package to excavate site and tank removal	Field engineer	120	mhrs	73	8,760	
Review/approve	Review/approve work package excavate/removal	Field engineer	20	mhrs	73	1,463	
		Field superintendent	10		74	743	
JHA walkdown	JHA walkdown for excavate site/tank removal	Safety	10	mhrs	73	730	
		Environmental engineer	10		87	870	
		Design engineer	10		91	910	
		Field engineer	10		73	731	
		Crane Operator	10		63	628	
		Heavy driver	20		51	1,020	
		Rigger	20		62	1,239	
		Nuclear process operator	10		61	610	
		RCT	10		77	769	
		Field superintendent	10		74	743	
		IH technician	10		69	690	
Order equipment/ material	Order equipment/material for excavation removal	Field engineer	10	mhrs	73	731	
		Procurement	4		71	284	
		Material	Misc.	Ea.		1,000	
Pre-job	Pre-job for excavate site	Safety	1	mhrs	73	73	
		Environmental engineer	1		87	87	
		Design engineer	2		91	181	
		Field engineer	1		73	73	
		Crane Operator	1		62	62	
		Heavy driver	1		51	51	
		Nuclear Process Op	1		61	61	
		RCT	1		77	77	
		IH technician	1		69	69	
Mobilization	Mobilization for excavating site	Heavy driver	16	mhrs	51	816	
		Crane Operator	8		62	496	

Table C-6. Worksheet of Costs for Sub-Alternative #3-2: Remove the Waste to CWC and the Tanks to ERDF. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Excavation	Excavation of tanks	Heavy driver Nuclear process operator Crane Operator Equipment usage cost Field superintendent RCT IH technician	80 80 80 Misc 80 80 80	mhrs Ea. mhrs	51 61 62 74 77 69	4,082 4,880 4,960 10,000 5,942 6,153 5,520	• Costs include removal and refilling the hole after the work is completed. • Excavated site to be approximately 60x60x17 deep to obtain 1½ to 1% slope.
Pre-job	Pre-job for tank removal	Safety Environmental engineer Design engineer Field engineer Crane Operator Heavy driver Heavy Equipment Operator Nuclear process operator RCT Field superintendent IH technician Rigger	1 1 1 1 1 1 1 1 1 1 1 1	mhrs	73 87 91 73 62 51 55 61 77 74 69 62	73 87 91 73 62 51 55 61 77 74 69 62	

Table C-6. Worksheet of Costs for Sub-Alternative #3-2: Remove the Waste to CWC and the Tanks to ERDF. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Design, procure, construct, and test	Design and procure greenhouse. Construct and test greenhouse and ventilation system	Subcontractor	2	Ea.	450,000	950,000	• 40' x 40' x 20' greenhouse with exhauster and stack monitor. Costs estimated at $25/ft^2 for the greenhouse and $5/ft^2 for construction, and testing by BHI subcontract. • Greenhouse, if utilized in summer or winter, will be designed for summer/winter work • Includes the procurement costs
Establish crane pad	Establish crane pad	Heavy Equipment Operator Heavy driver Equipment usage cost	16 32 Misc.	mhrs Ea.	55 51	883 1,633 800	

Table C-6. Worksheet of Costs for Sub-Alternative #3-2: Remove the Waste to CWC and the Tanks to ERDF. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Remove tanks and haul	Remove tanks and haul to greenhouse	Field engineer	6	mhrs	73	439	• Excavation site to be enclosed with portable fencing after backfilling with clean spoils removed. • Concrete foundation for pumps removed with tank excavation. • Tanks inserted with dry ice and vented through HEPA filters on vent line while excavating. • Excavated spoil piles (non-contaminated) to be stored northwest corner of 233-S site. Near where steam header disconnected from main line. Spoil pile to be utilized to backfill tank holes along with additional fill material, as required
		Crane Operator	24		62	1,488	
		Heavy driver	80		51	4,080	
		Rigger	48		62	2,973	
		Nuclear process operator	24		61	1,476	
		RCT	24		77	1,846	
		Field superintendent	32		74	2,368	
		IH technician	24		69	1,644	
		Equipment usage costs	0			16,600	

Table C-6. Worksheet of Costs for Sub-Alternative #3-2: Remove the Waste to CWC and the Tanks to ERDF. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Prep tanks for removal	Clean sludge out of tanks	Field engineer Nuclear process operator RCT Field superintendent IH technician Pipefitter Rigger Crane Operator Equipment usage cost	480 2400 1440 480 960 960 960 480	mhrs	73 61 77 74 69 62 62 62	35,040 146,400 110,880 35,520 66,240 59,520 59,520 29,760	• Residual waste material from tank will be scooped out of the shell sections • Residual waste material from tank will be scooped out from inside the tank and put into 55-gallon tanks. • Workers will be required to use fresh air when cleaning sludge from tank and washing down tank interior. • Working on bottled/fresh airlines. Tank will be disposed of intact to ERDF. • ERDF will grout fill the tanks • Assume grout costs at 160$/yd x 24,500 gallons each = $36,800 for both tanks
Tanks to ERDF	Tanks to ERDF	Field superintendent Heavy driver Equipment usage cost	8 32 0	mhrs	74 51	594 1,633 400	Tank will disposed of intact to ERDF. There are no disposal costs at ERDF.

Table C-6. Worksheet of Costs for Sub-Alternative #3-2: Remove the Waste to CWC and the Tanks to ERDF. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
All other waste disposal	All other waste disposal besides tanks to CWC	FDH	N/A	N/A	N/A	122,632	• Hexone/rad contaminated soils to be placed in barrels as waste; then shipped to CWC. • Assume 10 barrels of contaminated soil per tank area 10x 2 = 20 x $1231 storage rate at CWC = $24,620 for these barrels • Waste and rinsate per tank estimated 300-400 gallons to be generated. This would equal approximately 26 barrels of waste per tank based on 15 gal/drum. 26x2 = 52 barrels total x $1231 storage rate at CWC = $64,012 for these barrels • 1 burial boxes per tank will be required for CWC storage. This includes the miscellaneous waste for the piping removal and any other waste generated. 1x2 = 2 boxes total x $17000 storage rate at CWC = $34,000 for these boxes.

Table C-6. Worksheet of Costs for Sub-Alternative #3-2: Remove the Waste to CWC and the Tanks to ERDF. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Cleanup and demobilization	Cleanup and demobilize from site	Heavy driver RCT Field superintendent Nuclear process operator	16 16 4 16	mhrs	51 77 74 61	816 1,231 297 984	
Environmental work	Environmental work to get tank and contents to ERDF, Radiological characterization, waste information in SWITS system and waste paperwork including designation, profile WSRP, SSWMI, and OWTF	Environmental Engineer Design engineer Project engineer	200 20 5	mhrs	87 91 110	17,400 1,820 550	
NOC	NOC for completing tanks removal	Environmental engineer Design engineer Project engineer	200 100 20	mhrs	87 91 110	17,400 9,100 2,200	
Safety Evaluation	Safety Evaluation for removing tanks	Nuclear engineer Design engineer Project engineer	450 100 30	mhrs	88 91 110	39,600 9,100 3,300	Prepare Safety Evaluation with supporting calculation (assume DOE does not have a third party review)
Engineering support	Engineering support for interferences with ventilation system for greenhouse	Design engineer Project engineer Nuclear engineer	600 30 100	mhrs	91 110 87	54,600 3,300 8,700	
Sampling	Site closureDQO – 4 weeks: Oct. 1 SAP – 5 weeks Collect Samples – 3 days: after 252 Analyze Samples $5,000/sampleX15 4 months Clean up verification package and data quality assessment – 4 weeks	Scientist/specialist Scientist/specialist IH technician RCT Operator Scientist/specialist	240 300 27 27 27 240	mhrs	89 89 69 77 61 89	21,360 26,700 1,863 2,079 1647 75,000 21,360	15 soil samples will be taken under the tanks (necessary to characterize soil for subsequent action)

Table C-6. Worksheet of Costs for Sub-Alternative #3-2: Remove the Waste to CWC and the Tanks to ERDF. (12 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Profile	Put designation/profile in place to transfer tank/waste to ERDF	Environmental engineer	40	mhrs	87	3,480	
Fill Tank	*Fill void space in* 4X4X8 container at ERDF cost at $150 per yd	Material Field engineer Procurement Equipment usage cost	Misc. 10 4 Misc.	Ea mhrs Ea.	 73 71 	36,800 730 284 2,000	ERDF will grout fill the tanks Assume grout costs at 160$/yd x 24,500 gallons each = $36,800 for both tanks
EE/CA	Change destination from RCRA to CERCLA	Environmental Eng Design engineer Project engineer Task Lead	320 50 20 20	mhrs	87 91 110 99	27,840 4,550 2,200 1,980	
					Total	**2,309,241**	

1. Hexone tanks, pumps and piping removed for excavation approved as CERCLA waste for ERDF disposal.
2. Hexone pumps and piping and waste from the tanks and approved as RCRA waster for CWC disposal.

GPR = ground-penetrating radar
HEPA = high-efficiency particulate air
IH = industrial hygiene
JHA = job hazards analysis
mhrs = manhours
NOC = notice of correction
OWTF = onsite waste tracking form
PFWR = plant force work review
RCRA = Resource Conservation and Recovery Act of 1976
RCT = radiological control technician
SSWMI = site-specific wastes management instruction
SWITS = solid waste information tracking system
WSRP = waste shipping and receiving plan

Table C-7. Worksheet of Costs for Sub-Alternative #3-3: Remove the Waste and the Tanks to ERDF. (9 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Provide management	Project management and field support management	Project manager Task lead Field manager Project controls	28 120 28 120	mhrs	120 99 107 74	3370 11,880 2596 8,880	Assume 2 hours/week of the project for project controls and task lead and 2 hours/month for managers.
Site prep work	Site prep work GPR	Geoscience/Modeling Nuclear process operator RCT	80 40 40	mhrs	80 62 77	6,400 2,480 3,076	GPR conducted for entire excavation site.
PFWR	Plant Force Work Review for steam pipe removal	Field engineer	8	mhrs	73	585	
Work package	Work package for steam pipe removal	Field engineer	120	mhrs	73	8,777	Six underground pipes identified that require hot tap, cut, removed and waste disposed of.
Review/Approve	Review/Approve work package steam pipe removal	Field engineer Field superintendent	20 10	mhrs	73 74	1,463 743	
JHA walkdown	JHA walkdown for steam pipe removal	Safety Environmental engineer Design engineer Field engineer Crane Operator Heavy drivers Riggers Insulators Nuclear process operator RCT Pipefitters Field superintendent IH technician	10 10 10 10 10 20 10 10 20 20 10 10 10	mhrs	73 87 91 73 63 51 62 60 61 77 62 74 69	730 870 910 731 628 1,020 619 604 1,230 1,538 619 743 685	
Order equipment/ material	Order equipment/material for steam pipe removal	Field engineer Procurement Material	10 4 misc.	mhrs Ea.	73 71	731 284 1,000	

Table C-7. Worksheet of Costs for Sub-Alternative #3-3: Remove the Waste and the Tanks to ERDF. (9 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Pre-job	Pre-job for steam pipe removal	Safety	1	mhrs	73	73	
		Environmental engineer	1		87	87	
		Design engineer	1		91	91	
		Field engineer	1		73	73	
		Crane Operator	1		63	63	
		Heavy driver	1		51	51	
		Rigger	1		62	62	
		Insulator	1		60	60	
		Nuclear process operator	1		61	61	
		RCT	1		77	77	
		Pipefitter	1		62	62	
		Field superintendent	1		74	74	
		IH technician	1		69	69	
Mobilization	Mobilization for steam pipe removal	Heavy driver	8	mhrs	51	408	
		Rigger	16		62	991	
Remove steam pipe	Remove steam pipe	Field superintendent	80	mhrs	74	5,942	
		Crane Operator	80		63	5,022	
		Heavy driver	32		51	1,633	
		Rigger	64		62	3,964	
		Insulator	160		60	9,659	
		Pipefitter	80		62	4,953	
		IH technician	80		69	5,520	
		Field engineer	40		73	2,926	
		Equipment usage cost	Misc.	Ea.		1,000	
Waste disposal	Waste disposal for steam pipe removal	Field waste management	16	mhrs	62	987	
		Heavy driver	16		51	816	
		RCT	16		77	1,231	
Work package	Work package to excavate, tap, cut, cap and remove 6 lines	Field engineer	120	mhrs	73	8,777	
Review/Approve	Review/Approve work package remove 6 lines	Field engineer	20	mhrs	73	1,463	
		Field superintendent	10		74	743	

Table C-7. Worksheet of Costs for Sub-Alternative #3-3: Remove the Waste and the Tanks to ERDF. (9 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
JHA Walkdown	JHA Walkdown for excav, tap, cut, cap and remove 6 lines	Safety	10	mhrs	73	730	
		Environmental engineer	10		87	870	
		Design engineer	10		91	910	
		Field engineer	10		73	731	
		Crane Operator	10		63	628	
		Heavy driver	10		51	510	
		Rigger	20		62	1,239	
		Nuclear process operator	10		61	615	
		RCT	10		77	769	
		Pipefitter	10		62	619	
		Field superintendent	10		74	743	
		IH technician	10		69	685	
Pre-job	Pre-job for excavate, tap, cut, cap and remove 6 lines	Safety	2	mhrs	73	146	
		Environmental engineer	2		87	174	
		Design engineer	2		91	182	
		Field engineer	2		73	146	
		Crane Operator	2		63	126	
		Heavy driver	2		51	102	
		Rigger	2		62	124	
		Nuclear process operator	2		61	123	
		RCT	2		77	154	
		Pipefitter	2		62	124	
		Field superintendent	2		74	149	
		IH technician	2		69	137	
Mobilization	Mobilization for 6 line removals	Heavy driver	8	mhrs	51	408	
Excavate lines	Excavate lines	Nuclear process operator	72	mhrs	61	4,392	
		RCT	24		77	1,846	
		IH technician	24		69	1,644	
		Field superintendent	12		74	891	
Hot tap lines	Hot tap lines	Nuclear process operator	24	mhrs	61	1,476	
		RCT	24		77	1,846	
		IH technician	24		69	1,644	
		Field superintendent	12		74	891	
		Pipefitter	48		62	2,972	

Table C-7. Worksheet of Costs for Sub-Alternative #3-3: Remove the Waste and the Tanks to ERDF. (9 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Cut/cap lines	Cut/cap lines	Nuclear process operator RCT IH technician Field superintendent Pipefitter	24 24 24 12 48	mhrs	61 77 69 74 62	1,476 1,846 1,644 891 2,972	
Zero energy check and electrical disconnect	Zero energy check and electrical disconnect of pump motors	Nuclear process operator RCT Field superintendent Electrician	8 8 4 16	mhrs	61 77 74 65	492 615 297 1,041	Zero energy check of all electrical conducted and energized/deenergized systems.
Remove/dispose	Remove/dispose of pump/motors	Nuclear process operator RCT IH technician Field superintendent Pipefitter Rigger Crane Operator	24 24 24 12 48 48 24	mhrs	61 77 69 74 62 62 63	1,476 1,846 1,644 891 2,972 2,973 1,507	No petroleum products; grease/oils in pumps/motors to deal with. Concrete foundation for pumps removed with tank excavation.
Waste disposal	Waste disposal for the 6 line removals	Field waste management Heavy driver RCT	16 16 16	mhrs	62 51 77	987 816 1,231	• North/south steam line east Hexone fence has sections of asbestos removed and pipes removed from fence to 276-S Building, including post and concrete foundations. • Asbestos removed and asbestos covered pipe can be placed into an ERDF container and shipped to ERDF.

Table C-7. Worksheet of Costs for Sub-Alternative #3-3: Remove the Waste and the Tanks to ERDF. (9 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Pre-job	Pre-job for fence removal	Safety	1	mhrs	73	73	
		Environmental engineer	1		87	87	
		Design engineer	1		91	91	
		Crane Operator	1		63	63	
		Heavy driver	1		51	51	
		Rigger	1		62	62	
Mobilization	Mobilization for fence removal	Heavy driver	8	mhrs	51	408	
		Rigger	16		62	991	
Remove fence	Remove fence	Crane Operator	8	mhrs	63	502	Excavation site to be enclosed with portable fencing after backfilling with spoils removed.
		Heavy driver	8		51	408	
		Rigger	16		62	991	
		Field superintendent	4		74	297	
Work package	Work package to excavate site and tank removal	Field engineer	120	mhrs	73	8,777	
Review/approve	Review/approve work package excavate/removal	Field engineer	20	mhrs	73	1,463	
		Field superintendent	10		74	743	
JHA walkdown	JHA walkdown for excavate site/tank removal	Safety	10	mhrs	73	730	
		Environmental engineer	10		87	870	
		Design engineer	10		91	910	
		Field engineer	10		73	731	
		Crane Operator	10		63	628	
		Heavy driver	20		51	1,020	
		Rigger	20		62	1,239	
		Nuclear process operator	10		61	615	
		RCT	10		77	769	
		Field superintendent	10		74	743	
		IH technician	10		69	685	
Order equipment/material	Order equipment/material for excavation removal	Field engineer	10	mhrs	73	731	
		Procurement	4		71	284	
		Material	0			1,000	

Table C-7. Worksheet of Costs for Sub-Alternative #3-3: Remove the Waste and the Tanks to ERDF. (9 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Pre-job	Pre-job for excavate site	Safety	1	mhrs	73	73	
		Environmental engineer	1		87	87	
		Design engineer	2		91	91	
		Field engineer	1		73	73	
		Crane Operator	1		62	62	
		Heavy driver	1		51	51	
		Nuclear process operator	1		61	61	
		RCT	1		77	77	
		IH technician	1		69	69	
Mobilization	Mobilization for excavating site	Heavy driver	16	mhrs	51	816	
		Crane Operator	8		62	502	
Excavation	Excavation of tanks	Heavy driver	80	mhrs	51	4,082	• Tanks inserted with dry ice and vented through HEPA filters on vent line while excavating.
		Nuclear process operator	80		61	4,918	• Excavated site to be approximately 60x60x17 deep to obtain 1½ to 1% slope.
		Crane Operator	80		62	4,960	• Excavated spoil piles (non-contaminated) to be stored northwest corner of 233-S site. Near where steam header disconnected from main line. Spoil pile to be utilized to backfill tank holes along with additional fill material, as required.
		Equipment usage cost	Misc.	Ea.		10,000	
		Field superintendent	80		74	5,942	
		RCT	80		77	6,153	
		IH technician	80		69	5,482	

Table C-7. Worksheet of Costs for Sub-Alternative #3-3: Remove the Waste and the Tanks to ERDF. (9 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Pre-job	Pre-job for tank removal	Safety Environmental engineer Design engineer Field engineer Crane Operator Heavy driver Heavy Equipment Operator Nuclear process operator RCT Field superintendent IH technician Rigger	1 1 1 1 1 1 1 1 1 1 1 1	mhrs	73 87 91 73 62 51 55 61 77 74 69 62	73 87 91 73 63 51 55 61 77 74 69 62	
Establish crane pad	Establish crane pad	Heavy Equipment Operator Heavy driver Equipment usage cost	16 32 Misc.	mhrs Ea.	55 51	883 1,633 800	
Remove tanks	Remove tanks	Field engineer Crane Operator Heavy driver Rigger Nuclear process operator RCT Field superintendent IH technician Equipment usage costs	6 24 48 48 24 24 24 24 Misc.	mhrs Ea.	73 62 51 62 61 77 74 69	439 1,507 2,449 2,973 1,476 1,846 1,782 1,644 16,200	
Transport tanks	Transport tanks to ERDF	Field waste management Crane operator Heavy driver Equipment usage costs	8 0 32 Misc.	mhrs Ea.	62 62 51	494 0 1,633 200	• Tanks will disposed (with the waste still inside) to ERDF. • ERDF will grout fill the tanks. • There are no disposal costs at ERDF.
Portable fence	Put up portable fence around site	Heavy driver Rigger	16 32	mhrs	51 62	816 1,982	

Table C-7. Worksheet of Costs for Sub-Alternative #3-3: Remove the Waste and the Tanks to ERDF. (9 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Cleanup and demob	Cleanup and demob from site	Heavy driver	16	mhrs	51	816	
		RCT	16		77	1,231	
		Field superintendent	4		74	297	
		Nuclear Process operator	16		61	984	
Waste disposal	Waste disposal for excavation and tank removal	Field waste management	16	mhrs	62	987	
		Heavy driver	16		51	816	
Environmental work	Environmental work to get tank and contents to ERDF, Radiological characterization, waste information in SWITS system and waste paperwork including designation, profile WSRP, SSWMI, and OWTF	Environmental Eng	200	mhrs	87	17,400	
		Design engineer	20		91	1,820	
		Project engineer	5		110	550	
NOC	NOC for completing tanks removal	Environmental Eng	200	mhrs	87	17,400	
		Design engineer	100		91	9,100	
		Project engineer	20		110	2,200	
Safety Evaluation	*Safety Evaluation for removing* tanks	Nuclear engineer	450	mhrs	88	39,600	
		Design engineer	100		91	9,100	
		Project engineer	30		110	3,300	
Engineering support	Engineering support for interferences	Design engineer	200	mhrs	91	18,200	
		Project engineer	10		110	1,100	
		Nuclear engineer	10		88	880	
Sampling	Site closure						
	DQO – 4 weeks: Oct. 1	Scientist/Specialist	240	mhrs	89	21,360	
	SAP – 5 weeks	Scientist/Specialist	300		89	26,700	
	Collect Samples – 3 days: after 252	IH technician	27		69	1,863	
		RCT	27		77	2,079	
		operator	27		61	1,647	
	Analyze Samples					75,000	
	$5,000/sampleX15 4 months	Scientist/Specialist	240		89	21,360	
	Clean up verification package and data quality assessment – 4 weeks						

Table C-7. Worksheet of Costs for Sub-Alternative #3-3: Remove the Waste and the Tanks to ERDF. (9 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
EE/CA	Change destination from RCRA to CERCLA	Environmental Engineering Design engineer Project engineer Task Lead	320 50 20 20	mhrs	87 91 110 99	27,840 4,550 2,200 1,980	
Profile	Put designation/profile in place to transfer tank/waste to ERDF	Environmental Engineering	40	mhrs	87	3,480	
Fill Tank	Fill void space in tanks at ERDF	Field engineering Procurement Material Equipment usage cost	10 4 Misc.	mhrs Ea.	73 71	730 284 36,800 2,000	Assume grout costs at 160$/yd x 24,500 gallons each = $36,800 for both tanks.
					Total	649,888	

1. Hexone tanks, pumps and piping and waste removed for excavation as well as from the tank approved as CERCLA waste for ERDF disposal.
2. All work related to excavation and tank removal is plant force.

BHI = Bechtel Hanford, Inc.
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CWC = central waste complex
DOE = U.S. Department of Energy
EE/CA = engineering evaluation cost analysis
ERDF = environmental restoration disposal facility
FDH = Flour Daniel Hanford
GPR = ground-penetrating radar
HEPA = high-efficiency particulate air
IH = industrial hygiene
JHA = job hazards analysis
mhrs = manhours
NOC = notice of correction
OWTF = onsite waste tracking form
PFWR = plant force work review
RCRA = Resource Conservation and Recovery Act of 1976
RCT = radiological control technician
SSWMI = site-specific wastes management instruction
SWITS = solid waste information tracking system
WSRP = waste shipping and receiving plan

Table C-8. Worksheet of Costs for Alternatives #1 and 2: Long Term Tank Removals. (7 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Provide management	Project management and field support management	Project manager Task lead Field manager Project Controls	24 100 24 100	mhrs	120 99 107 74	2,880 9,900 2,568 7,400	Assume 2 hours/week of the project for project controls and task lead and 2 hours/ month for the managers
Site prep work	Site prep work GPR	Geoscience/Modeling Nuclear Process operator RCT	80 40 40	mhrs	80 62 77	6,400 2,459 3,076	GPR conducted for entire excavation site.
Pre-job	Pre-job for fence removal	Safety Environmental engineer Design engineer Crane operator Heavy driver Rigger	1 1 1 1 1 1	mhrs	73 87 91 63 51 62	73 87 91 63 51 62	
Mobilization	Mobilization for fence removal	Heavy driver Rigger	8 16	mhrs	51 62	408 991	
Remove fence	Remove fence	Crane operator Heavy driver Rigger Field superintendent	8 8 16 4	mhrs	63 51 62 74	502 408 991 297	
Work package	Work package to excavate site and tank removal	Field engineer	120	mhrs	73	8,777	
Review/approve	Review/approve work package excavate/removal	Field engineer Field superintendent	20 10	mhrs	73 74	1,463 743	

Table C-8. Worksheet of Costs for Alternatives #1 and 2: Long Term Tank Removals. (7 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
JHA walkdown	JHA walkdown for excavate site/tank removal	Safety	10	mhrs	73	730	
		Environmental engineer	10		87	870	
		Design engineer	10		91	910	
		Field engineer	10		73	731	
		Crane operator	10		63	628	
		Heavy driver	20		51	1,020	
		Rigger	20		62	1,239	
		Nuclear Process operator	10		61	615	
		RCT	10		77	769	
		Field superintendent	10		74	743	
		IH technician	10		69	685	
Order equipment/ material	Order equipment/material for excavation removal	Field engineer	10	mhrs	73	731	
		Procurement	4			284	
		Material	Misc.	Ea.		1,000	
Pre-job	Pre-job for excavate site	Safety	1	mhrs	73	73	
		Environmental engineer	1		87	87	
		Design engineer	2		91	91	
		Field engineer	1		73	73	
		Crane operator	1		62	63	
		Heavy driver	1		51	102	
		Nuclear Process operator	1		61	61	
		RCT	1		77	77	
		IH technician	1		69	69	
Mobilization	Mobilization for excavating site	Heavy driver	16	mhrs	51	816	
		Crane operator	8		62	502	
Excavation	Excavation of tanks	Heavy driver	80	mhrs	51	4,082	• Costs include removal and refilling the hole after the work is completed
		Nuclear Process operator	80		61	4,918	
		Crane operator	80		62	5,022	
		Equipment usage cost	Misc.	Ea.		10,000	
		Field superintendent	80	mhrs	74	5,942	• Excavated site to be approximately 60'x60'x17' deep to obtain 1 ½ to 1% slope
		RCT	80		77	6,153	
		IH technician	80		69	5,482	

Table C-8. Worksheet of Costs for Alternatives #1 and 2: Long Term Tank Removals. (7 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Pre-job	*Pre-job for tank removal*	*Safety*	1	mhrs	73	73	
		Environmental engineer	1		87	87	
		Design engineer	1		91	91	
		Field engineer	1		73	73	
		Crane operator	1		62	63	
		Heavy driver	1		51	51	
		Heavy Equipment operator	1		55	55	
		Nuclear Process operator	1		61	61	
		RCT	1		77	77	
		Field superintendent	1		74	74	
		IH technician	1		69	69	
		Rigger	1		62	62	
Establish crane pad	Establish crane pad	Heavy Equipment operator	16	mhrs	55	883	
		Heavy driver	32		51	1,633	
		Equipment usage cost	*Misc.*	*Ea.*		800	
Design, procure, construct and test greenhouse	Design, procure, construct and test greenhouse	Subcontractor	N/A	N/A	0	950,000	• 40' x 40' x 20' greenhouse with exhauster and stack monitor. Costs estimated at $25/ft² for the greenhouse and $5/ft² for construction, and testing *by BHI subcontract.* • Greenhouse, if utilized in summer or winter, will be designed for summer/winter work

Table C-8. Worksheet of Costs for Alternatives #1 and 2: Long Term Tank Removals. (7 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Remove tanks	Remove tanks and haul to greenhouse	Field engineer	6	mhrs	73	439	• Excavation site to be enclosed with portable fencing after backfilling with clean spoils removed. • Concrete foundation for pumps removed with tank excavation. • Tanks inserted with dry ice and vented through HEPA filters on vent line while excavating. • Excavated spoil piles (noncontaminated) to be stored northwest corner of 233-S site. Near where steam header disconnected from main line. Spoil pile to be utilized to backfill tank holes along with additional fill material, as required.
		Crane operator	24		62	1,507	
		Heavy driver	80		51	4,080	
		Rigger	48		62	2,973	
		Nuclear Process operator	24		61	1,476	
		RCT	24		77	1,846	
		Field superintendent	32		74	2,368	
		IH technician	24		69	1,644	
		Equipment usage costs	Misc.	Ea.		16,600	

Table C-8. Worksheet of Costs for Alternatives #1 and 2: Long Term Tank Removals. (7 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Cut open, clean and cut up	Cut open tanks, clean sludge and cut up tanks	Field engineer	480	mhrs	73	35,040	• Residual waste material from tank will be scooped out of the shell sections • Tank will be cut up into pieces that will fit into approved storage containers to CWC as follows: – Sludge 55 gallon tanks – Tanks 4x4x8 wooden burial boxes. • Workers will be required to use fresh air when cleaning sludge from tank and washing down tank interior.
		Nuclear Process operator	2400		61	146,400	
		RCT	1440		77	110,880	
		Field superintendent	480		74	35,520	
		IH technician	960		69	66,240	
		Pipefitter	960		62	59,520	
		Rigger	960		62	59,520	
		Crane operator	480		62	29,760	
		Equipment usage cost	Misc.	Ea.		16,200	
Cleanup and demob	Cleanup and demob from site	Heavy driver	16	mhrs	51	816	
		RCT	16		77	1,232	
		Field superintendent	4		74	296	
		Nuclear Process operator	16		61	976	

Table C-8. Worksheet of Costs for Alternatives #1 and 2: Long Term Tank Removals. (7 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Waste disposal	Waste disposal for CWC	FDH	N/A	N/A	N/A	633,000	• Assume 10 barrels of contaminated soil per tank area 10x 2 = 20 x $1231 storage rate at CWC = $24,620 for these barrels • Waste and rinsate per tank estimated 300-400 gallons to be generated. This would equal approximately 26 barrels of waste per tank based on 15 gal/drum. 26x2 = 52 barrels total x $1231 storage rate at CWC = $64,012 for these barrels • 16 burial boxes per tank will be required for CWC storage. 16x2 = 32 boxes total x $17000 storage rate at CWC = $544,000 for these boxes
Environmental work	Environmental work to get tank and contents to ERDF, Radiological characterization, waste information in SWITS system and waste paperwork including designation, profile WSRP, SSWMI, and OWTF	Environmental Design engineer Project engineer	200 20	mhrs	87 91 110	17,400 1,820 550	
NOC	NOC for completing tanks removal	Environmental Design engineer Project engineer	200 100 20	mhrs	87 91 110	17,400 9,100 2,200	

Table C-8. Worksheet of Costs for Alternatives #1 and 2: Long Term Tank Removals. (7 Pages)

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost ($)	Comments
Safety Evaluation	Safety Evaluation for removing tanks	Nuclear Design engineer Project engineer	450 100 30	mhrs	87 91 110	39,150 9,100 3,300	Prepare Safety Evaluation with supporting calculation (assume DOE does not have a third party review)
Engineering support	Miscellaneous engineering support	Design engineer Project engineer Nuclear	200 10 50	mhrs	91 110 87	18,200 1,100 4,350	
Sampling	Site closure DQO – 4 weeks: Oct. 1 SAP – 5 weeks Collect Samples – 3 days: after 252 Analyze Samples $5,000/sampleX15 4 months Clean up verification package and data quality assessment – 4 weeks	 Scientist/Specialist Scientist/Specialist IH technician RCT operator Scientist/Specialist	 240 300 27 27 27 240	 mhrs	 89 89 69 77 61 89	 21,360 26,700 1,863 2,079 1,647 75,000 21,360	15 soil samples will be taken under the tanks (necessary to characterize soil for subsequent action).
					Total	**2,538,303**	

Notes:
1. Hexone tanks, pumps and piping and waste removed for excavation approved as RCRA waste for CWC disposal.
2. All work related to excavation and tank removal is plant force.

CWC = central waste complex
DQO = data quality objective
ERDF = environmental restoration disposal facility
FDH = Flour Daniel Hanford
GPR = ground-penetrating radar
IH = industrial hygiene
JHA = job hazards analysis
mhrs = manhours
NOC = notice of correction
OWTF = onsite waste tracking form
RCT = radiological control technician
SAP = sampling and analysis plan
SSWMI = site-specific waste management instruction
SWITS = solid waste information tracking system
WSRP = waste shipping and receiving plan

Table C-9. Costs for Leaving the Tanks-in-Place (Incorporating the Hexone tanks into the 200-IS-1 OU).

Activity or Item	Description	Resource	Quantity	Units	Rate	Cost	Comments
Planning	Complete closure plan that would be included in the feasibility study and the permit modification that incorporates the record of decision into the permit.	Scientist/Specialist	730	mhrs	89	65,000	

mhrs = manhours
OU = operable unit

APPENDIX D

SCHEDULES FOR HEXONE TANK STABILIZATION ALTERNATIVES 3-1, 3-2, AND 3-3

Figure D-1. Schedule for Alternative 3-1. (3 Pages)

Activity ID	Early Start	Early Finish	Orig Dur	Rem Dur	% Comp	LEAD	Activity (FY02: O N D J F M A M J J A S; FY03: O N D J F M A M J)
HEXONE TANK STAB "ALTERNATIVE 3-1"							
HEXONE SAMPLING							
HEXONE TANK REMOVAL SITE PREP							
HXTTR010	01OCT01*	05OCT01	5	5	0	RON S	SITE PREP WORK 'GPR'
HXTTR012	01OCT01	05OCT01	5	5	0	RON S	PFWR FOR STEAM PIPE REMOVAL
ENGINEERING & ENVIRONMENTAL SUPPORT/ W							
HXTTR305	01OCT01	29MAR02	124	124	0	BOB E	ENVIRONMENTAL WORK TO GET TANK TO ERDF
HXTTR310	01OCT01	25JAN02	80	80	0	BOB E	NOC FOR COMPLETING TANK REMOVAL
HXTTR320	01OCT01	28FEB02	103	103	0	BOB E	SAFETY EVALUATION FOR REMOVING TANKS
HXTTR330	01OCT01	26APR02	144	144	0	BOB E	ENGINEERING SUPPORT FOR INTERFERENCES
HXTTR340	01OCT01	26OCT01	20	20	0	BOB E	DQO
HXTTR350	29OCT01	04DEC01	25	25	0	BOB E	SAP
STEAM PIPE REMOVAL							
HXTTR100	01OCT01	19OCT01	15	15	0	RON S	WORK PACKAGE FOR STEAM PIPE REMOVAL
HXTTR105	22OCT01	02NOV01	10	10	0	RON S	REVIEW/APPROVE WORK PACKAGE STEAM PIPE REMOVAL
HXTTR110	01OCT01	05OCT01	5	5	0	RON S	JHA WALKDOWN FOR STEAM PIPE REMOVAL
HXTTR115	08OCT01	19OCT01	10	10	0	RON S	ORDER EQUIPMENT/MATERIAL FOR STEAM PIPE REMOVAL
HXTTR120	05NOV01	05NOV01	1	1	0	RON S	PRE-JOB FOR STEAM PIPE REMOVAL
HXTTR125	05NOV01	06NOV01	2	2	0	RON S	MOBILIZATION FOR STEAM PIPE REMOVAL
HXTTR130	07NOV01	20NOV01	10	10	0	RON S	REMOVE STEAM PIPE
HXTTR135	21NOV01	26NOV01	2	2	0	RON S	WASTE DISPOSAL FOR STEAM PIPE REMOVAL

Project Start	01OCT00	Early Bar	HXD1
Project Finish	18SEP02	Progress Bar	Sheet 1 of 3
Data Date	01OCT01		SURVEILLANCE & MAINTENANCE
Run Date	02JUL01		HEXONE TANKS REMOVAL
© Primavera Systems, Inc.			" ALTERNATIVE 3-1 "

Figure D-1. Schedule for Alternative 3-1. (3 Pages)

Activity ID	Early Start	Early Finish	Orig Dur	Rem Dur	% Comp	LEAD	Description
EXCAVATE, HOT TAP, CUT, CAP & REMOVE 6 LI							
HXTTR140	22OCT01	09NOV01	15	15	0	RON S	WORK PKG TO EXCAVATE,TAP,CUT,CAP& REMOVE 6 LINES
HXTTR145	12NOV01	27NOV01	10	10	0	RON S	REVIEW/APPROVE WORK PACKAGE REMOVE 6 LINES
HXTTR150	22OCT01	26OCT01	5	5	0	RON S	UHA WALKDOWN FOR EXCAV,TAP,CUT,CAP&REMOVE 6 LINE
HXTTR160	01MAR02	01MAR02	1	1	0	RON S	PRE-JOB FOR EXCAVATE,TAP,CUT,CAP& REMOVE 6 LINES
HXTTR165	01MAR02	04MAR02	2	2	0	RON S	MOBILIZATION FOR 6 LINE REMOVALS
HXTTR167	05MAR02	07MAR02	3	3	0	RON S	EXCAVATE LINES
HXTTR169	08MAR02	12MAR02	3	3	0	RON S	HOT TAP LINES
HXTTR171	13MAR02	15MAR02	3	3	0	RON S	CUT/CAP LINES
HXTTR173	18MAR02	18MAR02	1	1	0	RON S	ZERO ENERGY CHECK&ELEC DISCONNECT OF PUMP MOTORS
HXTTR175	19MAR02	21MAR02	3	3	0	RON S	REMOVE/DISPOSE OF PUMP/MOTORS
HXTTR180	22MAR02	25MAR02	2	2	0	RON S	WASTE DISPOSAL FOR THE 6 LINE REMOVALS
FENCE REMOVAL							
HXTTR200	22MAR02	22MAR02	1	1	0	RON S	PRE-JOB FOR FENCE REMOVAL
HXTTR205	22MAR02	25MAR02	2	2	0	RON S	MOBILIZATION FOR FENCE REMOVAL
HXTTR210	26MAR02	26MAR02	1	1	0	RON S	REMOVE FENCE
EXCAVATION OF SITE							
HXTTR220	12NOV01	04DEC01	15	15	0	RON S	WORK PKG TO EXCAVATE SITE & TANK REMOVAL
HXTTR225	05DEC01	18DEC01	10	10	0	RON S	REVIEW/APPROVE WORK PACKAGE EXCAVATE/REMOVAL
HXTTR230	12NOV01	16NOV01	5	5	0	RON S	UHA WALKDOWN FOR EXCAVATE SITE/TANK REMOVAL
HXTTR235	19NOV01	04DEC01	10	10	0	RON S	ORDER EQUIPMENT/MATERIAL FOR EXCAVATION/REMOVAL
HXTTR240	19DEC01	19DEC01	1	1	0	RON S	PRE-JOB FOR EXCAVATE SITE

FY02: O N D J F M A M J J A S — FY03: O N D J F M A M J

Sheet 2 of 3

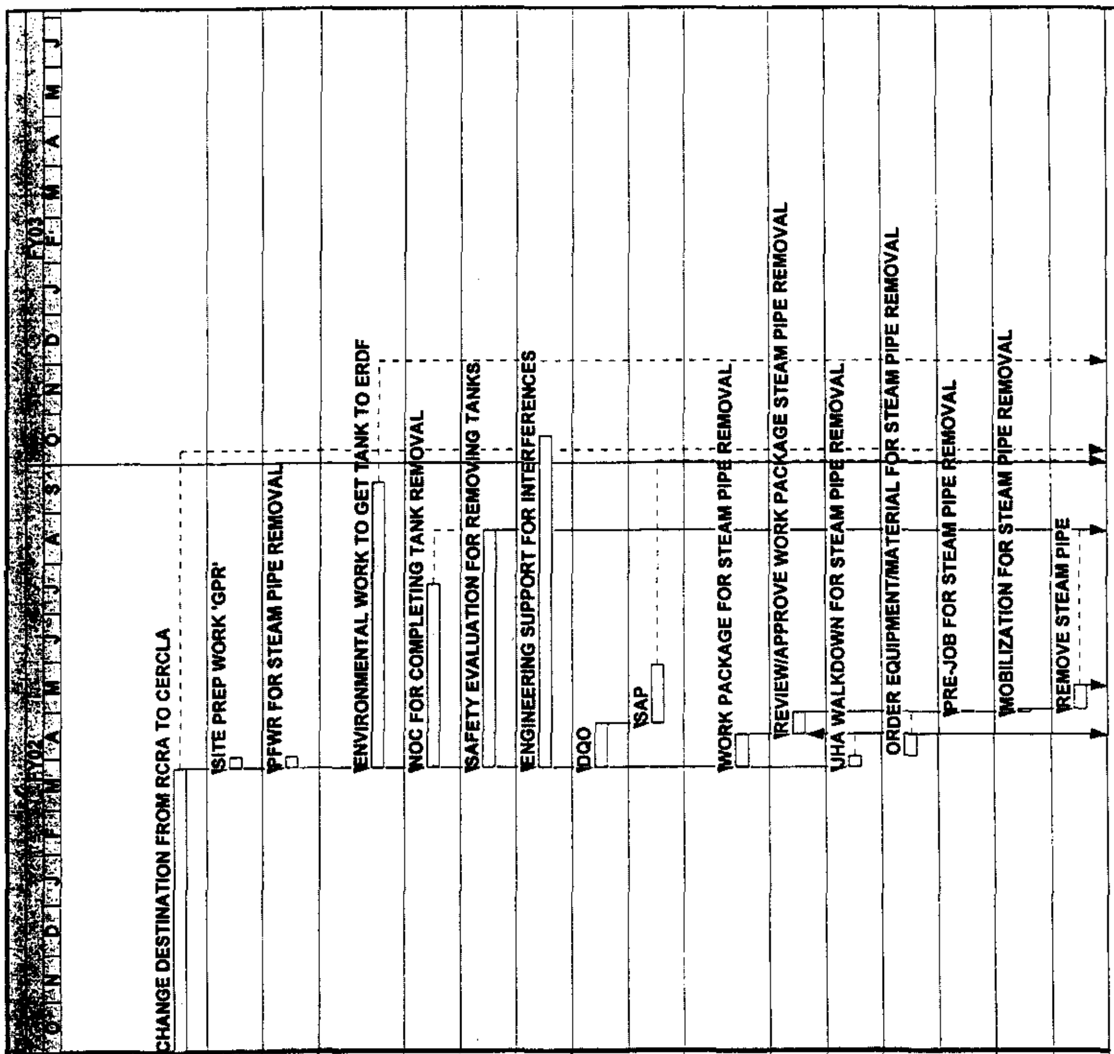
Figure D-1. Schedule for Alternative 3-1. (3 Pages)

Activity ID	Early Start	Early Finish	Orig Dur	Rem Dur	% Comp	LEAD	Description
HXTTR245	27MAR02	28MAR02	2	2	0	RON S	MOBILIZATION FOR EXCAVATING SITE
HXTTR252	29MAR02	11APR02	10	10	0	RON S	EXCAVATION OF TANKS
TANK REMOVAL							
HXTTR254	12APR02	16APR02	3	3	0	RON S	COLLECT SAMPLES AFTER EXCAVATION OF TANKS
HXTTR256	17APR02	30MAY02	31	31	0	RON S	SAMPLE ANALYSIS
HXTTR258	31MAY02	06JUN02	5	5	0	RON S	WASTE DESIGNATION & PROFILE
HXTTR260	07JUN02	07JUN02	1	1	0	RON S	PRE-JOB FOR TANK REMOVAL
HXTTR262	07JUN02	10JUN02	2	2	0	RON S	ESTABLISH CRANE PAD
HXTTR265	11JUN02	13JUN02	3	3	0	RON S	REMOVE TANKS
HAUL TO GREENHOUSE FOR DISPOSAL AT CW							
HXTTR280	18APR02	13JUN02	40	40	0	RON S	DESIGN, PROCURE, CONSTRUCT & TEST GREENHOUSE
HXTTR285	14JUN02	17JUN02	2	2	0	RON S	HAUL TO GREENHOUSE AND OFFLOAD
HXTTR290	18JUN02	11SEP02	60	60	0	RON S	CUT OPEN TANKS, CLEAN SLUDGE & CUT UP TANKS
HXTTR295	12SEP02	13SEP02	2	2	0	RON S	CLEANUP & DEMOB FROM SITE
HXTTR300	12SEP02	18SEP02	5	5	0	RON S	WASTE DISPOSAL FOR CWC

Sheet 3 of 3

Figure D-2. Schedule for Alternative 3-2. (3 Pages)

Activity ID	Early Start	Early Finish	Orig Dur	Rem Dur	% Comp	LEAD
HEXONE TANK STAB "ALTERNATIVE 3-2"						
HEXONE SAMPLING						
HEXONE TANK REMOVAL SITE PREP						
HXTTR001	01OCT01*	25MAR02	120	120	0	RON S
HXTTR010	26MAR02	01APR02	5	5	0	RON S
HXTTR012	26MAR02	01APR02	5	5	0	RON S
ENGINEERING & ENVIRONMENTAL SUPPORT / W						
HXTTR304	26MAR02	18SEP02	124	124	0	RON S
HXTTR310	26MAR02	17JUL02	80	80	0	RON S
HXTTR320	26MAR02	19AUG02	103	103	0	RON S
HXTTR330	26MAR02	16OCT02	144	144	0	RON S
HXTTR340	26MAR02	22APR02	20	20	0	RON S
HXTTR350	23APR02	28MAY02	25	25	0	RON S
STEAM PIPE REMOVAL						
HXTTR100	26MAR02	15APR02	15	15	0	RON S
HXTTR105	16APR02	29APR02	10	10	0	RON S
HXTTR110	26MAR02	01APR02	5	5	0	RON S
HXTTR115	02APR02	15APR02	10	10	0	RON S
HXTTR120	30APR02	30APR02	1	1	0	RON S
HXTTR125	30APR02	01MAY02	2	2	0	RON S
HXTTR130	02MAY02	15MAY02	10	10	0	RON S



Project Start	01OCT00	Early Bar	HX02
Project Finish	18MAR03	Progress Bar	SURVEILLANCE & MAINTENANCE
Data Date	01OCT01		HEXONE TANKS REMOVAL
Run Date	02JUL01		" ALTERNATIVE 3-2 "
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Figure D-2. Schedule for Alternative 3-2. (3 Pages)

Activity ID	Early Start	Early Finish	Orig Dur	Rem Dur	% Comp	LEAD	FY02 / FY03 (bar label)
HXTTR135	16MAY02	17MAY02	2	2	0	RON S	WASTE DISPOSAL FOR STEAM PIPE REMOVAL
EXCAVATE, HOT TAP, CUT, CAP & REMOVE 6 LI							
HXTTR140	16APR02	06MAY02	15	15	0	RON S	WORK PKG TO EXCAVATE,TAP,CUT,CAP& REMOVE 6 LINES
HXTTR145	07MAY02	20MAY02	10	10	0	RON S	REVIEW/APPROVE WORK PACKAGE REMOVE 6 LINES
HXTTR150	16APR02	22APR02	5	5	0	RON S	JHA WALKDOWN FOR EXCAV,TAP,CUT,CAP&REMOVE 6 LINE
HXTTR160	20AUG02	20AUG02	1	1	0	RON S	PRE-JOB FOR EXCAVATE,TAP,CUT,CAP& REMOVE 6 LINES
HXTTR165	20AUG02	21AUG02	2	2	0	RON S	MOBILIZATION FOR 6 LINE REMOVALS
HXTTR167	22AUG02	26AUG02	3	3	0	RON S	EXCAVATE LINES
HXTTR169	27AUG02	29AUG02	3	3	0	RON S	HOT TAP LINES
HXTTR171	30AUG02	04SEP02	3	3	0	RON S	CUT/CAP LINES
HXTTR173	05SEP02	05SEP02	1	1	0	RON S	ZERO ENERGY CHECK&ELEC DISCONNECT OF PUMP MOTORS
HXTTR175	06SEP02	10SEP02	3	3	0	RON S	REMOVE/DISPOSE OF PUMP/MOTORS
HXTTR180	11SEP02	12SEP02	2	2	0	RON S	WASTE DISPOSAL FOR THE 6 LINE REMOVALS
FENCE REMOVAL							
HXTTR200	11SEP02	11SEP02	1	1	0	RON S	PRE-JOB FOR FENCE REMOVAL
HXTTR205	11SEP02	12SEP02	2	2	0	RON S	MOBILIZATION FOR FENCE REMOVAL
HXTTR210	13SEP02	13SEP02	1	1	0	RON S	REMOVE FENCE
EXCAVATION OF SITE							
HXTTR220	07MAY02	28MAY02	15	15	0	RON S	WORK PKG TO EXCAVATE SITE & TANK REMOVAL
HXTTR225	29MAY02	11JUN02	10	10	0	RON S	REVIEW/APPROVE WORK PACKAGE EXCAVATE/REMOVAL
HXTTR230	07MAY02	13MAY02	5	5	0	RON S	JHA WALKDOWN FOR EXCAVATE SITE/TANK REMOVAL
HXTTR235	14MAY02	28MAY02	10	10	0	RON S	ORDER EQUIPMENT/MATERIAL FOR EXCAVATION/REMOVAL

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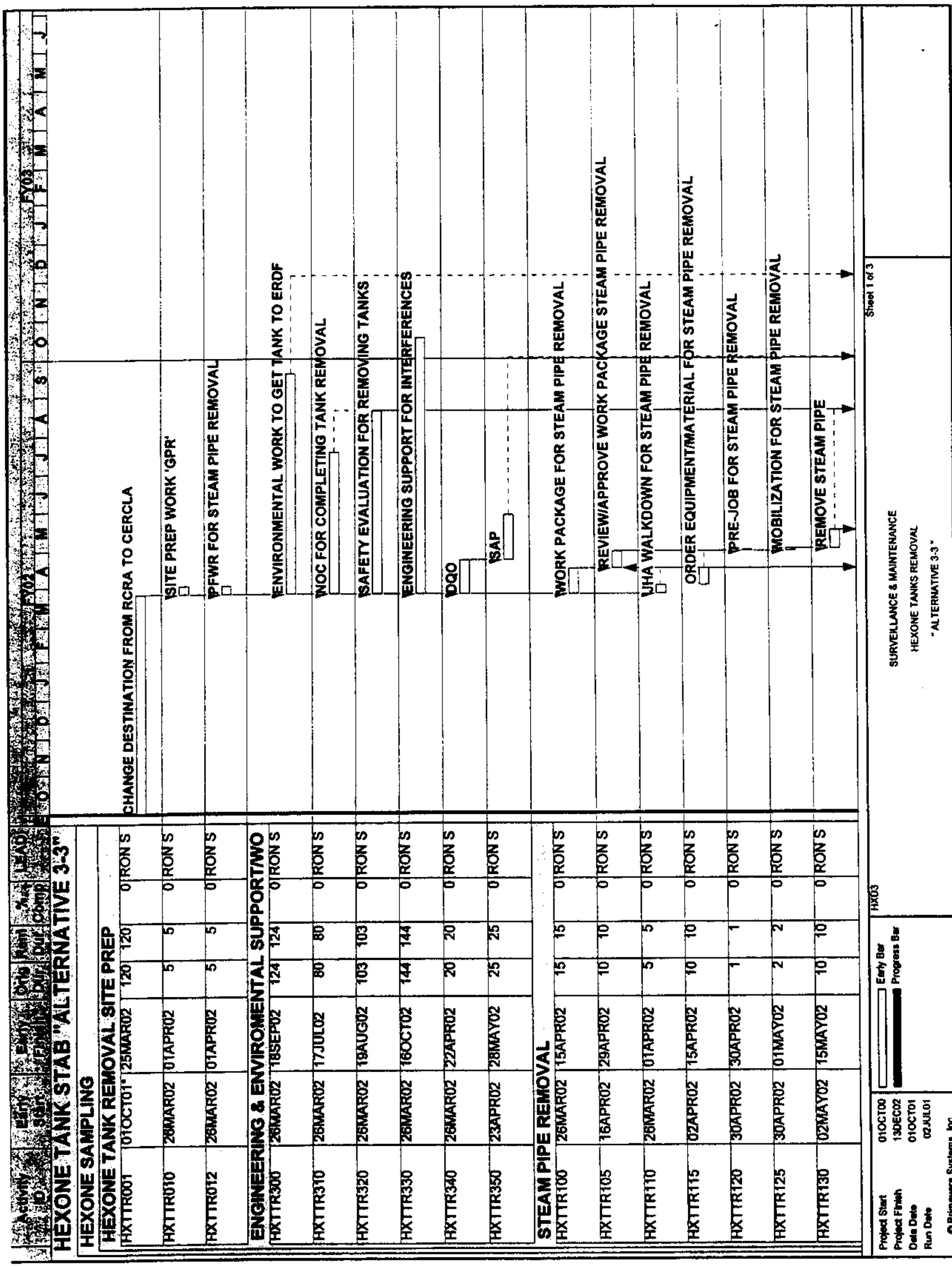
Figure D-2. Schedule for Alternative 3-2. (3 Pages)

Activity ID	Early Start	Early Finish	Orig Dur	Rem Dur	% Comp	LEAD	Activity (FY02 / FY03)
HXTTR240	12JUN02	12JUN02	1	1	0	RON S	PRE-JOB FOR EXCAVATE SITE
HXTTR245	16SEP02	17SEP02	2	2	0	RON S	MOBILIZATION FOR EXCAVATING SITE
HXTTR252	18SEP02	01OCT02	10	10	0	RON S	EXCAVATION OF TANKS
TANK REMOVAL							
HXTTR254	02OCT02	04OCT02	3	3	0	RON S	COLLECT SAMPLES AFTER EXCAVATION OF TANKS
HXTTR256	07OCT02	18NOV02	31	31	0	RON S	SAMPLE ANALYSIS
HXTTR258	19NOV02	25NOV02	5	5	0	RON S	WASTE DESIGNATION & PROFILE
HXTTR260	26NOV02	26NOV02	1	1	0	RON S	PRE-JOB FOR TANK REMOVAL
HXTTR262	26NOV02	27NOV02	2	2	0	RON S	ESTABLISH CRANE PAD
HXTTR265	02DEC02	04DEC02	3	3	0	RON S	REMOVE TANKS AND HAUL TO GREENHOUSE
HAUL TO GREENHOUSE FOR DISPOSAL AT CW							
HXTTR272	12MAR03	18MAR03	5	5	0	RON S	FILL VOID SPACE IN TANKS AT ERDF
HXTTR280	08OCT02	04DEC02	40	40	0	RON S	DESIGN, PROCURE, CONSTRUCT & TEST GREENHOUSE
HXTTR290	05DEC02	04MAR03	60	60	0	RON S	CUT OPEN TANKS, CLEAN SLUDGE & CUT UP TANKS
HXTTR295	05MAR03	11MAR03	5	5	0	RON S	TANKS TO ERDF
HXTTR300	05MAR03	06MAR03	2	2	0	RON S	ALL OTHER WASTE DISPOSAL BESIDES TANKS FOR CWC
HXTTR305	12MAR03	13MAR03	2	2	0	RON S	CLEANUP & DEMOB FROM SITE

Sheet 3 of 3

Figure D-3. Schedule for Alternative 3-3. (3 Pages)



Activity ID	Early Start	Early Finish	Orig Dur	Rem Dur	% Comp	LEAD
HEXONE TANK STAB "ALTERNATIVE 3-3"						
HEXONE SAMPLING						
HEXONE TANK REMOVAL SITE PREP						
HXTTR001	01OCT01*	25MAR02	120	120	0	RON S
HXTTR010	26MAR02	01APR02	5	5	0	RON S
HXTTR012	26MAR02	01APR02	5	5	0	RON S
ENGINEERING & ENVIROMENTAL SUPPORT/WO						
HXTTR300	26MAR02	18SEP02	124	124	0	RON S
HXTTR310	26MAR02	17JUL02	80	80	0	RON S
HXTTR320	26MAR02	19AUG02	103	103	0	RON S
HXTTR330	26MAR02	16OCT02	144	144	0	RON S
HXTTR340	26MAR02	22APR02	20	20	0	RON S
HXTTR350	23APR02	28MAY02	25	25	0	RON S
STEAM PIPE REMOVAL						
HXTTR100	26MAR02	15APR02	15	15	0	RON S
HXTTR105	16APR02	29APR02	10	10	0	RON S
HXTTR110	26MAR02	01APR02	5	5	0	RON S
HXTTR115	02APR02	15APR02	10	10	0	RON S
HXTTR120	30APR02	30APR02	1	1	0	RON S
HXTTR125	30APR02	01MAY02	2	2	0	RON S
HXTTR130	02MAY02	15MAY02	10	10	0	RON S

Figure D-3. Schedule for Alternative 3-3. (3 Pages)

Activity ID	Early Start	Early Finish	Orig Dur	Rem Dur	% Comp	LEAD	FY02 / FY03 (O N D J F M A M J J A S / O N D J F M A M J)
HXTTR135	16MAY02	17MAY02	2	2	0	RON S	WASTE DISPOSAL FOR STEAM PIPE REMOVAL
EXCAVATE, HOT TAP, CUT, CAP & REMOVE 6 LI							
HXTTR140	16APR02	06MAY02	15	15	0	RON S	WORK PKG TO EXCAVATE,TAP,CUT,CAP& REMOVE 6 LINES
HXTTR145	07MAY02	20MAY02	10	10	0	RON S	REVIEW/APPROVE WORK PACKAGE REMOVE 6 LINES
HXTTR150	16APR02	22APR02	5	5	0	RON S	JHA WALKDOWN FOR EXCAV,TAP,CUT,CAP&REMOVE 6 LINE
HXTTR160	20AUG02	20AUG02	1	1	0	RON S	PRE-JOB FOR EXCAVATE,TAP,CUT,CAP& REMOVE 6 LINES
HXTTR165	20AUG02	21AUG02	2	2	0	RON S	MOBILIZATION FOR 6 LINE REMOVALS
HXTTR167	22AUG02	26AUG02	3	3	0	RON S	EXCAVATE LINES
HXTTR169	27AUG02	29AUG02	3	3	0	RON S	HOT TAP LINES
HXTTR171	30AUG02	04SEP02	3	3	0	RON S	CUT/CAP LINES
HXTTR173	05SEP02	05SEP02	1	1	0	RON S	ZERO ENERGY CHECK&ELEC DISCONNECT OF PUMP MOTORS
HXTTR175	06SEP02	10SEP02	3	3	0	RON S	REMOVE/DISPOSE OF PUMP/MOTORS
HXTTR180	11SEP02	12SEP02	2	2	0	RON S	WASTE DISPOSAL FOR THE 6 LINE REMOVALS
FENCE REMOVAL							
HXTTR200	11SEP02	11SEP02	1	1	0	RON S	PRE-JOB FOR FENCE REMOVAL
HXTTR205	11SEP02	12SEP02	2	2	0	RON S	MOBILIZATION FOR FENCE REMOVAL
HXTTR210	13SEP02	13SEP02	1	1	0	RON S	REMOVE FENCE
EXCAVATION OF SITE							
HXTTR220	07MAY02	28MAY02	15	15	0	RON S	WORK PKG TO EXCAVATE SITE & TANK REMOVAL
HXTTR225	29MAY02	11JUN02	10	10	0	RON S	REVIEW/APPROVE WORK PACKAGE EXCAVATE/REMOVAL
HXTTR230	07MAY02	13MAY02	5	5	0	RON S	JHA WALKDOWN FOR EXCAVATE SITE/TANK REMOVAL
HXTTR235	14MAY02	28MAY02	10	10	0	RON S	ORDER EQUIPMENT/MATERIAL FOR EXCAVATION/REMOVAL

Sheet 2 of 3

Figure D-3. Schedule for Alternative 3-3. (3 Pages)

Activity ID	Early Start	Early Finish	Orig Dur	Rem Dur	% Comp	LEAD	Description
HXTTR240	12JUN02	12JUN02	1	1	0	RON S	PRE-JOB FOR EXCAVATE SITE
HXTTR245	16SEP02	17SEP02	2	2	0	RON S	MOBILIZATION FOR EXCAVATING SITE
HXTTR252	18SEP02	01OCT02	10	10	0	RON S	EXCAVATION OF TANKS
TANK REMOVAL AND TRANSPORT TO ERDF							
HXTTR254	02OCT02	04OCT02	3	3	0	RON S	COLLECT SAMPLES AFTER EXCAVATION OF TANKS
HXTTR256	07OCT02	18NOV02	31	31	0	RON S	SAMPLE ANALYSIS
HXTTR258	19NOV02	25NOV02	5	5	0	RON S	WASTE DESIGNATION & PROFILE
HXTTR260	26NOV02	26NOV02	1	1	0	RON S	PRE-JOB FOR TANK REMOVAL
HXTTR262	26NOV02	27NOV02	2	2	0	RON S	ESTABLISH CRANE PAD
HXTTR265	02DEC02	04DEC02	3	3	0	RON S	REMOVE TANKS
HXTTR270	05DEC02	06DEC02	2	2	0	RON S	TRANSPORT TANKS TO ERDF
HXTTR272	09DEC02	13DEC02	5	5	0	RON S	FILL VOID SPACE IN TANKS AT ERDF
HXTTR275	05DEC02	06DEC02	2	2	0	RON S	PUT UP PORTABLE FENCE AROUND SITE
HXTTR280	09DEC02	10DEC02	2	2	0	RON S	CLEANUP & DEMOB FROM SITE
HXTTR285	09DEC02	10DEC02	2	2	0	RON S	WASTE DISPOSAL FOR EXCAVATION & TANK REMOVAL

Sheet 3 of 3