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SILO PROJECT INDEPENDENT REVIEW TEAM DOCUMENTATION - VALUE ENGINEERING FINAL REPORT - PROJECT: REMEDIAL ACTIONS AT OPERABLE UNIT 4, FERNALD/FEMP - RECORD OF DECISION PLAN

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Value Engineering

FINAL REPORT

PROJECT:

REMEDIAL ACTIONS AT OPERABLE UNIT 4, FERNALD/FEMP

RECORD OF DECISION PLAN

DATE: January 26, 1996

UNITED STATES
DEPARTMENT OF ENERGY
Fernald Field Office

UNITED STATES
DEPARTMENT OF THE INTERIOR
Bureau of Reclamation

REMEDIAL ACTIONS AT OPERABLE UNIT FOUR
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
ORAL PRESENTATION MEETING ATTENDANCE LIST
1:00 p.m., January 12, 1996
U.S. Department of Energy - Fernald Area Office

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Value Engineering

FINAL REPORT

PROJECT:

REMEDIAL ACTIONS AT OPERABLE UNIT 4, FERNALD/FEMP

RECORD OF DECISION PLAN

DATE: January 26, 1996

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VALUE STUDY
PROJECT:

REMEDIAL ACTIONS AT OPERABLE UNIT 4

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GENERAL DISCUSSION OF VALUE ANALYSIS, ITS PURPOSE, AND THIS STUDY

Value Engineering (VE) is a problem-solving methodology originally developed by Larry Miles in 1943. In general, component features from a project or process are examined to determine pertinent functions, governing criteria, and associated costs. Then, through creativity techniques, idea analysis, and development of the remaining best ideas, alternative methods that fully meet necessary requirements at a lower cost, or with an increase in the long-term values, are proposed for adoption by the parties responsible for the project studied.

This report is the result of a "formal" Value Study Team (VST) effort. A formal VST is comprised of people with the desired expertise who are not notably involved in the project or process. The VST takes a "fresh look" at the concept to see if this examination, using value methodology applied to the current collected data, can create alternatives which can better fulfill the client needs at the greatest recognized attainable value.

Value Engineering (also known as Value Management, Value Analysis, and Value Planning) has been extremely successful for both private and Governmental entities. As a result, Government has mandated its use, through its regulatory powers, in all Governmental operations. This VE report has the substance required to demonstrate that quality VE methodology was used throughout this study, as stipulated under the mandated Governmental VE program (as recommended by the Department of Interior and Bureau of Reclamation guidance) and recommendations of practitioners in the VE profession.

VEAPP.DIS

VALUE STUDY TEAM ACKNOWLEDGMENT OF DESIGN TEAM AND CONSULTANTS

The Value Study Team (VST) wishes to express thanks and appreciation to Project Director, Mark Dehring, Mike Skriba and the other members of the OU4 team, and Nina Akgündüz, who fully and cordially provided all requested information and consultation on the project design. The success of the VST effort could not have been possible without the full cooperation shown by these personnel.

The VST wishes also to express thanks and appreciation to those listed on the Consultation Record of this report. The cooperation and helpfulness of those consulted contributed greatly to the technical foundation and support of the VST's deliberations and proposals.

The objective of using value methodology is to achieve the best value for the user of the projects designated. Only with the full team effort, as shown by all involved, can this goal can be achieved. This study represents the product of such an effort.

VETHANKS.CIT

EXECUTIVE SUMMARY

PROJECT: Remedial Actions at Operable Unit 4

General:

The Value Study Team (VST) consisted of expertise from chemical professions, construction, civil engineering, radiation technology, and waste management specializations. The team had their first group meeting on January 8, 1995. The VEST concluded the full formal team efforts on January 12, 1995, with a presentation to the DOE and Fernald Environmental Restoration Management Corporation (FERMCO) staff.

The VST made **three** formal proposals (developed to the point that the proposals were complete enough for comprehensive presentation at the completion of the study as an "alternative recommendation"). The team also identified **ten** additional items that are recommended for further study. These ideas have the potential for increasing the value of the project, but were not developed by the team into a formal recommendation due to time constraints or other factors.

Summary of Proposals:

Formal proposals are ideas which were examined in detail by the VST and determined to have significant potential to generate technical and/or economical advantages to the owners, users, and/or others affected by the project. These recommended alternatives are respectfully submitted for consideration and adoption by the involved project parties.

Due to time constraints and other factors, life-cycle potential savings value of the recommendation were not fully evaluated during the value study. However, the **total estimated initial expenditure savings** of the evaluation completed during the value study, if all independent monetary savings proposals are accepted, are estimated at about **$100 million**. In addition, all proposals have **value added** features which are expected to improve the final product. (Value added features are defined as proposal attributes that the study team believes will improve the project in non-monetary or unquantifiable ways, e. g. time, quality, and safety. Increased initial or life-cycle costs, if any, are expected to be more than offset by the apparent added nonmonetary value, and/or have undetermined cost savings which will exceed the projected increased proposal cost.) All three proposals can be essentially implemented independent of all other proposals.

A very brief description and the minimum potential value of the proposals are:

1. Optimize the Vitrification Pilot Plant (VITPP) to make it practical to transition it for use as the production plant. This proposal includes **value added** features and has the potential to reduce costs by about $52 million, after reducing the gross savings by the cost of proposal implementation and this study.

2A. Institute solidification and stabilization methods for the materials in Silo 3. This proposal includes **value added** features and has the potential to reduce costs by about $68 million, after reducing the gross savings by the cost of proposal implementation and this study. If practicable, the bentonite caps in silos 1 and 2 should be similarly treated and would also produce substantive savings.

2B. Institute alternative solidification and stabilization methods for the materials in Silos 1 and 2. This proposal has the potential to reduce costs by $96 million, after reducing the gross savings by the cost of implementation and this study. This proposal also has several value added features.

3. Ship materials to Nevada Test Site (NTS) by rail and transfer to trucks in Nevada for the final leg into NTS. This proposal is principally a value added proposal. This proposal has the potential to reduce costs by about $4 million, as estimated within the value study constraints, and after reducing the gross savings by the cost of implementation and this study.

Summary of Additional Items for Further Study.

Ten additional items for further study were also recommended. These are items that, due to time constraints, the lack of apparent large significant savings or value added during initial idea evaluations, complexity of idea, or scope of the idea (as compared to the study scope), make further investigation by the VST, within their limited time constraints, inadvisable. They are respectfully submitted for further consideration and development to add value for the project. They were not developed to the detail of the previous alternative proposals by the VST. Briefly, these ideas are:

- Recommendations to exploit site-wide potential of vacuum extrusion and stabilization technology.
- Robot performance at other sites has been of questionable value and their use at the Fernald Environmental Management Project (FEMP) should be carefully evaluated.
- Installation of a cage around each of the Silos 1 and 2 slurry intakes may avoid plugging.
- FERMCO should interact with Hanford and other similar site personnel to share their experiences.
- Silo 3 waste and the bentonite cap of all three silos should be removed from the project's vitrification process option.
- FERMCO should investigate treating Silo 3 and the bentonite materials by solidification and stabilization.
- FERMCO should visit Western Environmental Technology Office, Butte, Montana, to take advantage of the off-gas system information they have available.
- Separate high activity wastes during processing to remove "hot" wastes from bulk materials.
- Examine the optimum size of the operations and support staff for the OU4 project.
- Privatization of OU4 project's feature components.

PROJECT DESCRIPTION

PROJECT: Remedial Actions at Operable Unit 4

General

The Feed Materials Production Center (FMPC) in Fernald, Ohio, is a 1,050 acre facility about 18 miles northwest of Cincinnati, Ohio, (See Figure 1). FMPC was the manufacturing site for producing uranium-metal products for the United States' Defense Programs for more than 37 years. On July 10, 1989, production operations were indefinitely suspended and in February 1991, the Department of Energy (DOE) formally submitted its plan to permanently end production at the site. Since 1989, the primary DOE mission at the FMPC site, is to accomplish restoration of the facility grounds and achieve environmental compliance. Only about 55 acres were affected by the production process; the remaining portion of the site was leased out for livestock grazing.

In 1986, the DOE and Environmental Protection Agency (EPA) entered into a consent agreement wherein the DOE agreed to comply with various Federal and State pollution control regulations, including those under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and to address the remediation of inactive waste sites, waste storage sites, and other on-site facilities. Portions of the agreement were updated in 1990 and subsequent years. The agreement defines five Operable Units (OU): OU1, the waste pit area; OU2, other waste units; OU3, production activity areas; OU4, silos 1-4; and OU5, environmental media (Figures 2 and 3). However, recently some of the OU designations have been blurred to allow restoration activities to proceed more effectively.

The DOE overall plan is to achieve compliance with all applicable environmental requirements and clean up the inactive sites and facilities by the year 2010. The Fernald Field Office has been very aggressive in its environmental cleanup activities to meet that goal. This operation and the overall environmental site effort is referred to as the Fernald Environmental Management Project (FEMP).

The drainage area of the site lies within the north-south corridor of the 100- and 500-year Paddy's Run floodplain. The aquifer underlying the site is the Great Miami Aquifer (with about 500,000 of the local population using it) and is designated a sole source aquifer by the EPA under the provisions of the Safe Drinking Water Act (Figure 4).

Operable Unit 4

OU4 is defined as a geographic area that includes Silos 1 and 2 (K-65 Silos), Silo 3 (Metal Oxide Silo), the unused Silo 4, and their ancillary structures (Figures 2, 3, and 5). The Record of Decision (ROD) for remediation of the OU4 site was completed in December 1994.

The OU4 units are:

Silos 1 and 2 - Constructed in 1951. Silos 1 and 2 were used for the storage of radium-bearing residues which were the by-products of uranium ore processing. Silos 1 and 2 received approximately 216,300 ft^3 of residues from 1952 to 1958. Silo residues contain elevated levels of Ra-226, Pb-210, Th-230 and natural uranium. In the past Radon was known to have emanated from the silos through cracks and structural joints. The berms and subsoils surrounding the silos contain localized areas of elevated levels of Pb-210 and Po-210. A layer of Bentogrout (consisting of 30 percent bentonite clay in water) was placed over the K-65 residues to contain released radon.

Due to deterioration, in 1963 site workers repaired the concrete coating around each silo and constructed an earthen berm around them to counter-balance the outward load of the silo contents. The berm also protected the silo walls from weathering and served as a radiation shield. The berm was expanded in 1983 to reduce soil erosion.

PROJECT DESCRIPTION

PROJECT: Remedial Actions at Operable Unit 4

Other subsequent improvements to Silos 1 and 2 include; sealing the vents in the domes in 1979; installing plywood covers on the domes in 1986; and adding a polyurethane coating in 1987 to reduce weathering and to reduce radon emissions. A Radon Treatment System (RTS) was also installed to draw air from the silos, remove moisture and radon through a charcoal-adsorption process, and recirculate clean air back to the silos. The lower radon emissions, as a result of the RTS, then allowed workers to safely apply a layer of bentonite clay over the K-65 residues within the silos. The bentonite clay layer has reduced the amount of radon escaping from the silos into the environment and would help prevent the release of contaminants into the air were a natural disaster (e.g., a tornado) to occur or in the unlikely evenly event that the domes were to collapse.

Silo 3 - Constructed in 1952 and used to store dry powdery waste that was dewatered in an evaporator and spray-calcined or kiln-dried from raffinate filtrate generated during refinery operations. Silo 3 contains approximately 137,500 ft^3 of calcined residues consisting of aluminum, calcium, iron and magnesium oxides; sodium salts; 39,500 pounds each of uranium and thorium; and a very small amount of radium and other metal oxides.

Silo 4 - Constructed in 1952 and designed to receive dry materials similar to Silo 3. Silo 4 was never used. Except for rainwater infiltration, which has been observed in the past, it remains empty today. Silo 4 is not considered a current or potential threat to human health and the environment.

Ancillary Structures, supporting the silos consist of:

K-65 Decant Sump Tank and its contents.

A Radon Treatment System.

A portion of a concrete pipe trench and other concrete structures.

The earthen berm surrounding Silos 1 and 2.

The soils beneath and immediately surrounding Silos 1, 2, 3, and 4.

Perched groundwater that may be encountered in the vicinity of the silos during the implementation of cleanup activities.

Figure 1. Location Map

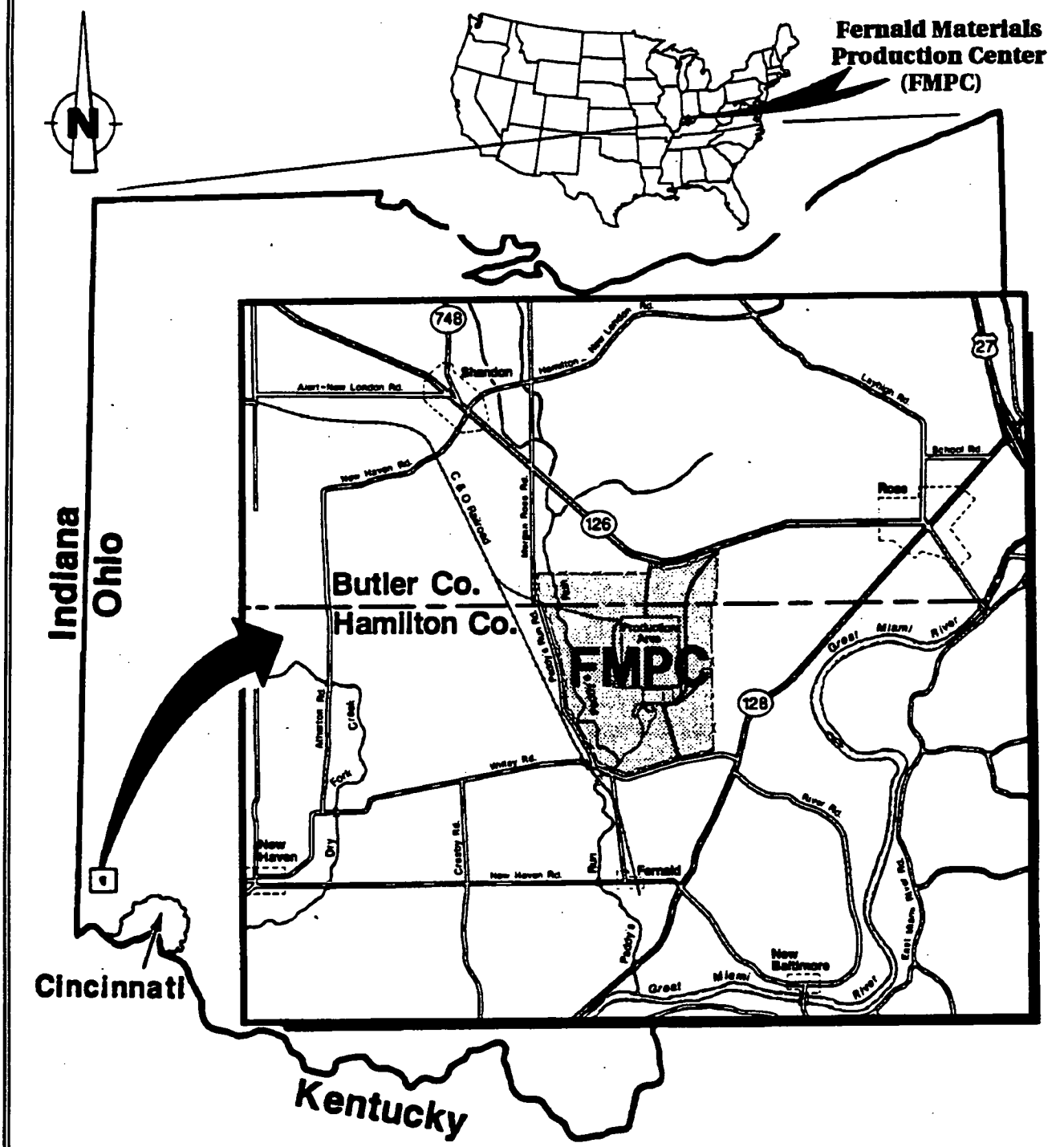

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Figure 2. FMPC Site Overview

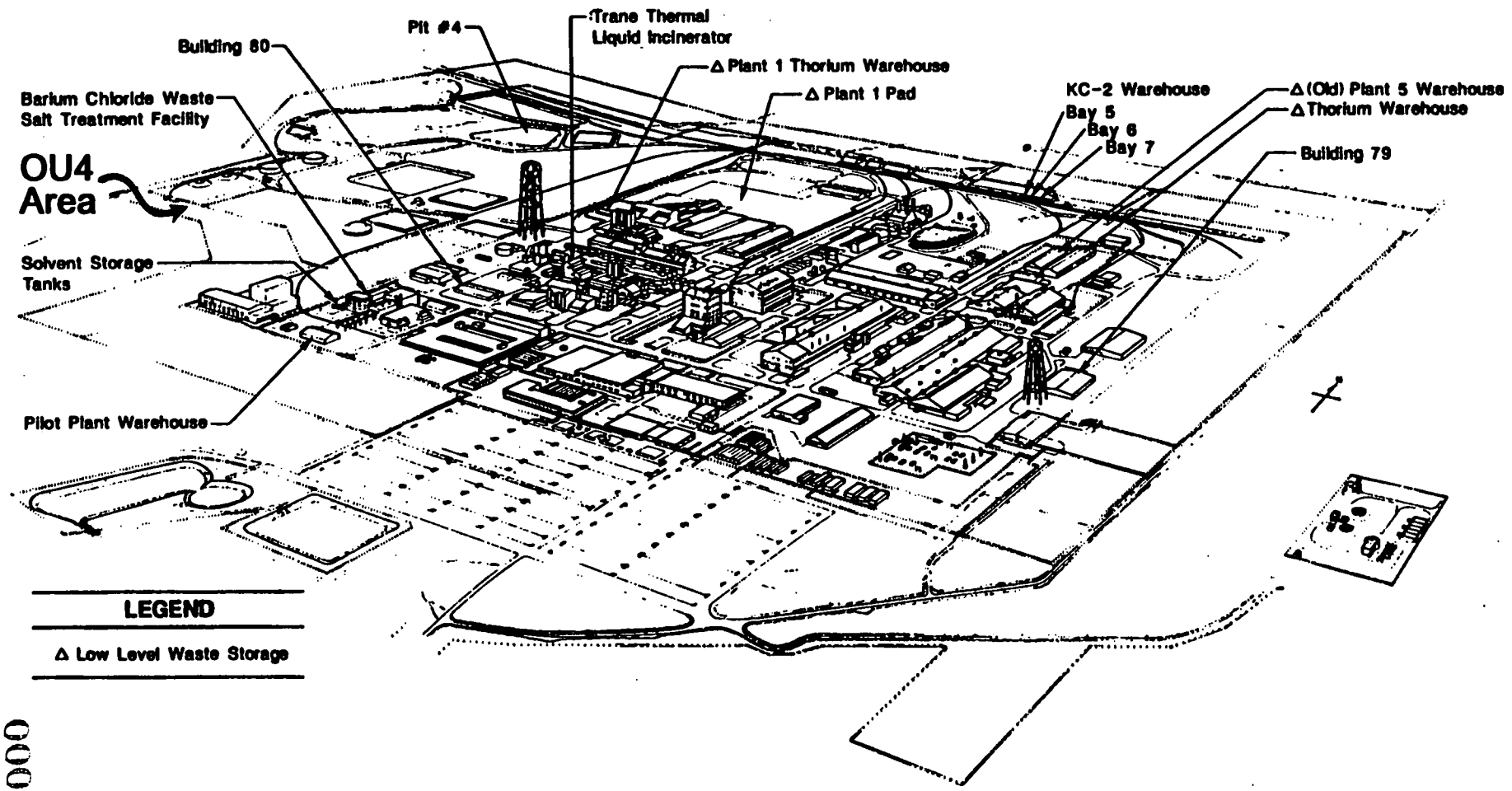

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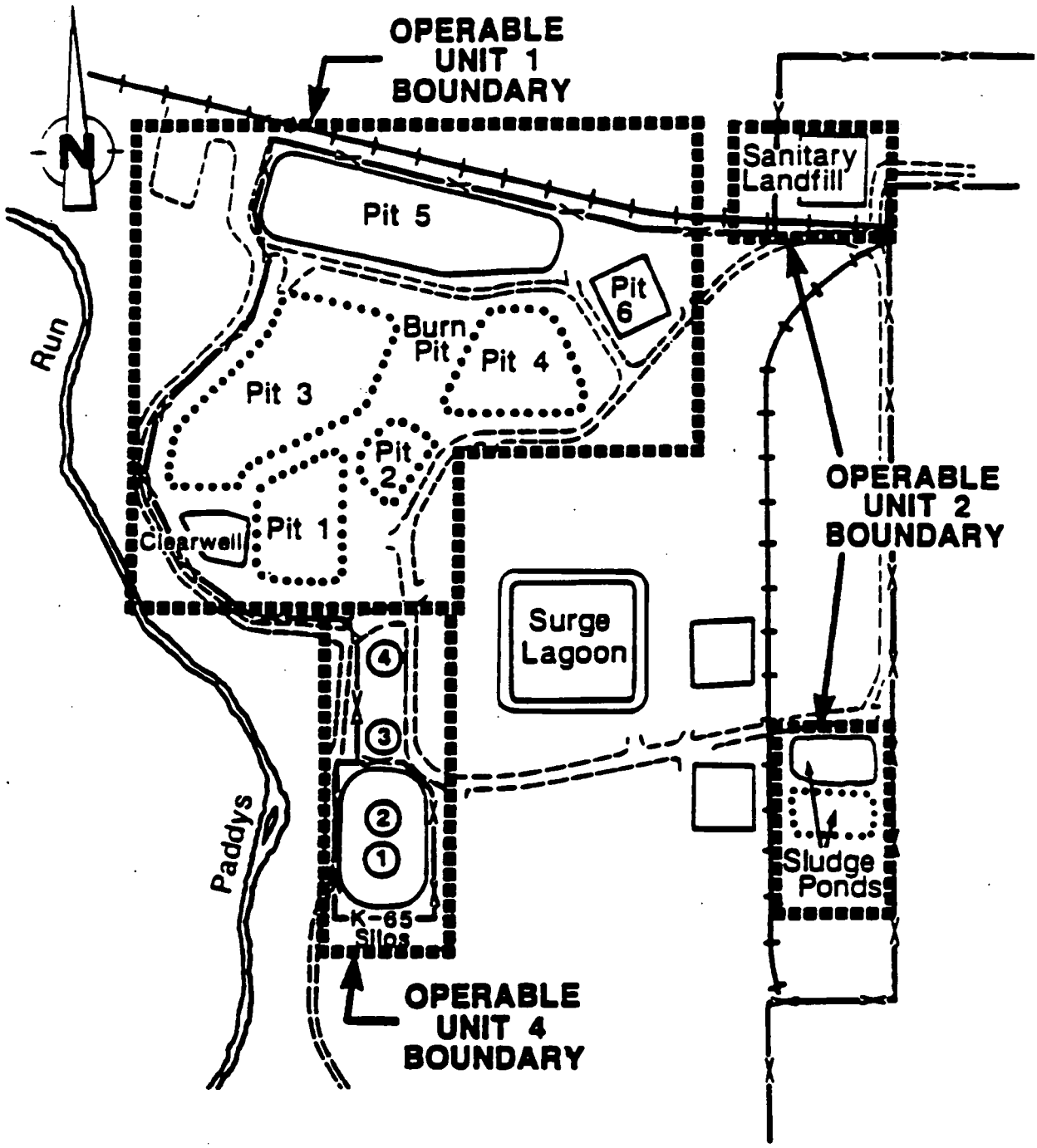
Figure 3. Operable Unit Boundaries



Waste Pit Area

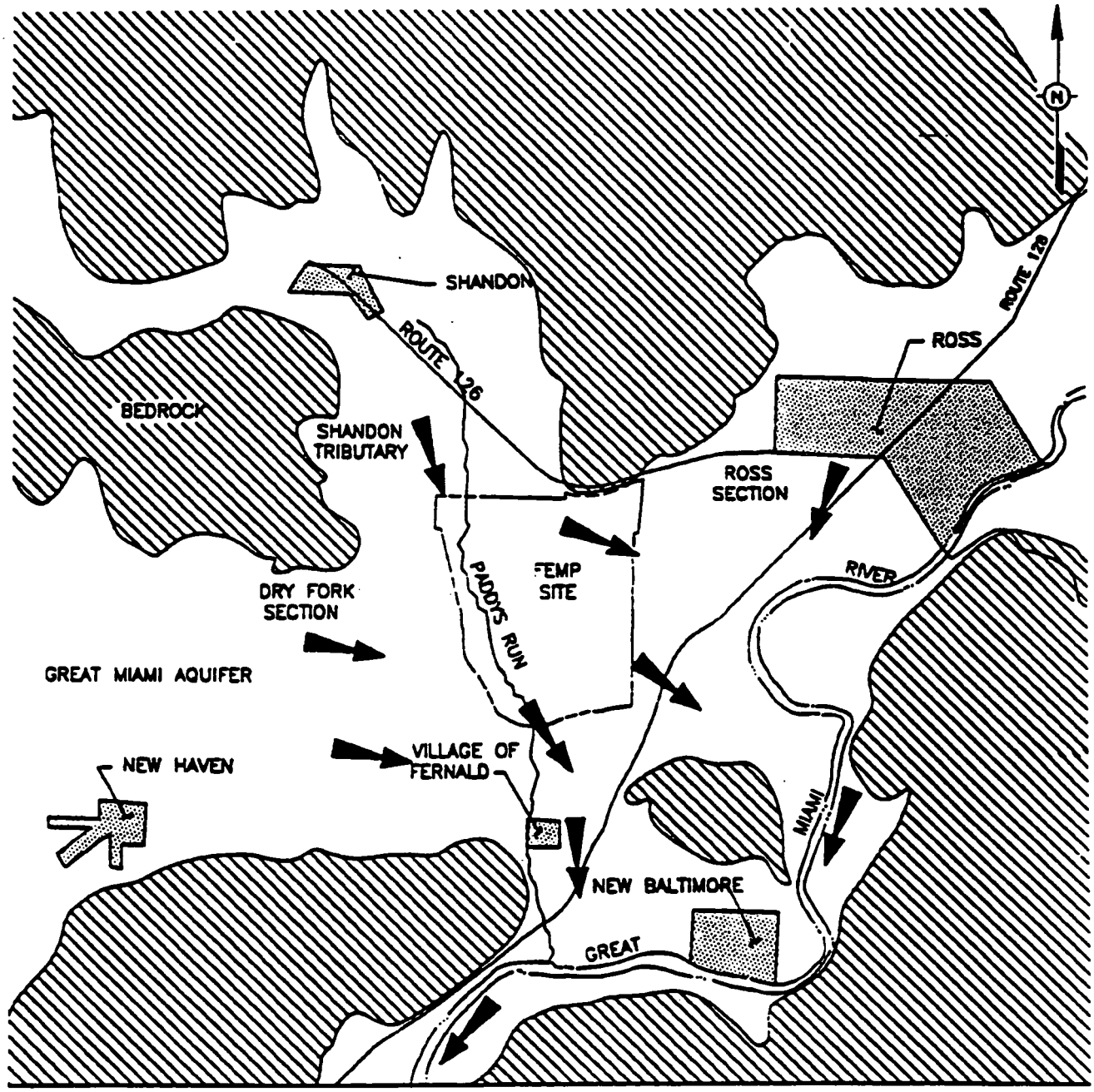
Scale in Feet: 0 250 500

LEGEND

- Covered Pits
- Railroad
- Fenceline
- Roadway

SITELMAP.PCX

Figure 4. General Aquifer Groundwater Flow at FMPC Site



SCALE

0 2500 5000 FEET

NOTE:

DIRECTION OF GROUNDWATER FLOW BASED ON APRIL 1986 WATER LEVEL CONTOURS AND GROUNDWATER MODELING OUTPUT (3DPART07.OUT)

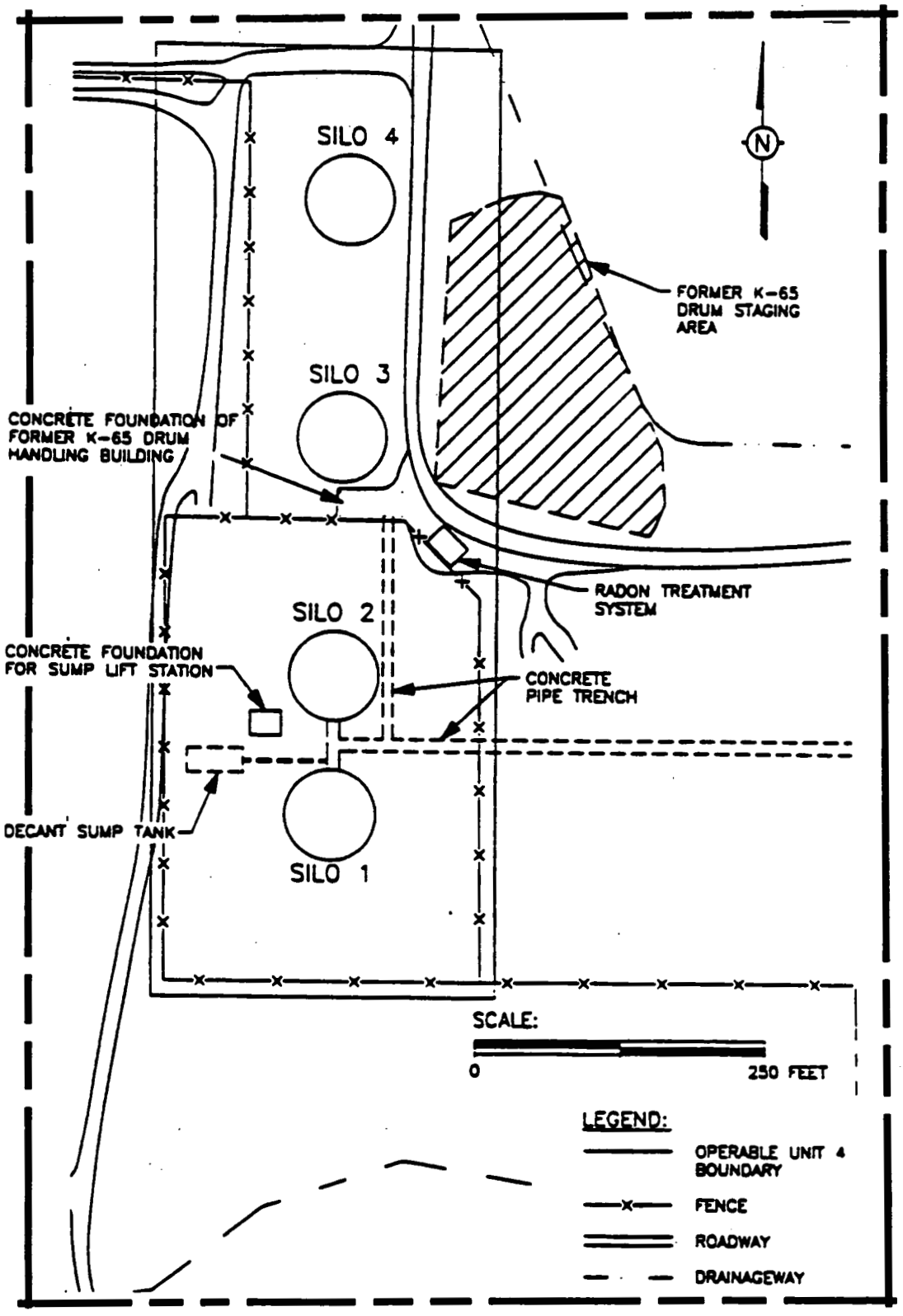
LEGEND:

GENERALIZED GROUNDWATER FLOW DIRECTION.

BEDROCK OUTSIDE GREAT MIAMI AQUIFER

AQU_MAP4.PCX

Figure 5. Operable Unit 4 Plant



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DESCRIPTION OF PRESENT PROPOSAL

PROJECT: Remedial Actions at Operable Unit 4

DESCRIPTION OF THE REMEDY: *The Record of Decision for Operable Unit 4 (OU4) was completed in December 1994. The following description of the selected remedy for OU4 is taken in whole or part from the Record of Decision.*

The materials within OU4 exhibit a wide range of properties (Figure 6 and Tables 1-5) . Most notable are the elevated direct radiation associated with the K-65 residues in Silos 1 and 2 versus the much lower direct radiation associated with cold metal oxides in Silo 3. Even more significant are the much lower levels of contamination associated with the soils and building materials, like concrete, within the OU4 Study Area. To account for these differences, and for the varied cleanup alternatives applying to each waste type, OU4 was segmented into three subunits. These subunits are described as follows:

Subunit A: Silos 1 and 2 contents (K-65 residues and bentonite clay caps) and the sludge in the decant sump tank

Subunit B: Silo 3 contents (cold metal oxides)

Subunit C: Silos 1, 2, 3, and 4 structures; contaminated soils within the OU4 boundary, including surface and subsurface soils and the earthen berm around Silos 1 and 2; the decant sump tank; the radon treatment system; the concrete pipe trench and the miscellaneous concrete structures within OU4, any debris (i.e., concrete, piping, etc.) generated through implementing cleanup of Subunits A, B,and C. and any perched groundwater encountered during remedial activities.

On the basis of the evaluation of final alternatives, the selected ROD remedial action for OU4, one of five operable units at the FEMP, is a combination of Alternatives 3A.1/Vit - Removal, Vitrification, and Off-site Disposal - Nevada Test Site (NTS); 3B.1/Vit - Removal, Vitrification, and Off-site Disposal - NTS; and 2C - Demolition, Removal and On-Property Disposal. These alternatives apply to Subunits A, B, and C, respectively. The major components of the selected remedy include:

- Removal of the contents of Silos 1, and 2, and 3 (K-65 residues) (cold metal oxides) and the decant sump tank sludge.

- Vitrification to stabilize the residues and sludges removed from all the silos and decant sump tank.

- Off-site shipment for disposal at the NTS of the vitrified contents of Silos 1, 2, 3, and the decant sump tank.

- Demolition of Silos 1, 2, 3, and 4 and decontamination, to the extent practicable, of the concrete rubble, piping and other generated construction debris.

- Removal of the earthen berms and excavation of contaminated soils within the boundary of OU4, to achieve remediation levels. Placement of clean backfill to original grade following excavation.

- Demolition of the vitrification treatment unit and associated facilities after use. Decontamination or recycling of debris prior to disposition as a part of OU5 operations.

- On-property interim storage of excavated contaminated soils and contaminated debris in a manner consistent with the approved Work Plan for Removal Action 17 (improved storage of soil and debris), pending final disposition in accordance with the Records of Decision for OU3 and OU5, respectively.

DESCRIPTION OF PRESENT PROPOSAL

PROJECT: Remedial Actions at Operable Unit 4

- Continued access controls and maintenance and monitoring of the stored waste inventories.

- Institutional controls of the OU4 area such as deed and land use restrictions.

- Potential additional treatment of stored OU4 soil and debris using OU3 and OU5 waste treatment systems.

- Pumping and treatment as required of any contaminated perched groundwater encountered during remedial activities.

- Disposal of OU4 contaminated debris and soils consistent with the ROD for OU3 and OU5, respectively.

The remedy specifies off-site disposal of vitrified contents of Silos 1, 2 and 3 at the NTS. At the time of the ROD's signing, the Department of Energy Nevada Operations Office (DOE-NV) was in the process of preparing a site-wide Environmental Impact Statement (EIS) under National Environmental Policy Act (NEPA) for the NTS. Shipments of OU4 vitrified waste are not proposed to begin until after the planned completion of the EIS for the NTS.

The planned date of completion of the EIS for the NTS is December 1995, at which time a Record of Decision is expected to be issued. Shipments of low-level waste generated from the remediation of OU4 are not proposed to begin until mid-1997, which should be after the planned completion of the NTS site-wide EIS. Given these time-frames, DOE does not anticipate the NTS EIS schedule will negatively impact the OU4 remediation schedule discussed in the OU4 ROD.

The containerized vitrified product will require interim storage at the FEMP site prior to its transportation to the NTS for disposal. The purpose of this interim storage is two-fold; first, the vitrified product will require verification sampling in order to certify that each production lot has met specific performance and waste disposal criteria; and second, the Fernald waste shipping program will need a buffer staging area where the material can be safely managed prior to its shipment to NTS. It has been anticipated that the interim storage area will be need to accommodate a maximum interim handling capacity of approximately 90 days of vitrification production.

The decision regarding the final disposition of the remaining OU4 contaminated soil, debris, and contaminated equipment from clean up will be placed in abeyance, until completion of the ROD for OU3 and OU5 remedial actions. This was done in order to take full advantage of planned and in progress waste minimization treatment processes by these operable units. This strategy also enables the integration of disposal decisions for contaminated soils and debris on a site-wide basis.

In the event that the OU3 remedy for debris and the OU5 remedy for contaminated soils can feasibly include OU4 debris and materials, a ROD amendment to the OU4 ROD will not be necessary. Should unforeseen circumstances preclude the integration of OU4 soil and debris into the OU3 and/or OU5 treatment and disposal decisions, the disposal decision for OU4 contaminated soils and debris is to be documented in a ROD amendment for OU4 in accordance with Section 117(c) of CERCLA and United States EPA guidance. Such a ROD amendment will provide the public and the EPA further opportunity to review and comment on the final disposal option for OU4 soils and debris.

DESCRIPTION OF PRESENT PROPOSAL

PROJECT: Remedial Actions at Operable Unit 4

In reaching the remedial alternative decision, the DOE evaluated other alternatives for each subunit, in addition to no action. The other alternatives were: (a) *Subunit A - Silos 1 and 2 Contents: (1)* Removal, Cement Stabilization, Off-Site Disposal at Nevada Test Site; (b) *Subunit B - Silo 3 Contents:* (1) Removal, Vitrification, On-Property Disposal; (2) Removal, Cement Stabilization, On-Property Disposal; (3) Removal, Cement Stabilization, Off-Site Disposal at Nevada Test Site; (c) *Subunit C - Silos 1, 2, 3, and 4 Structures. Soils. and Debris:* (1) Demolition, Removal, Off-Site Disposal at NTS; (2) Demolition, Removal, Off-Site Disposal at Permitted Commercial Facility.

A more detailed description of the alternatives is provided in the Decision Summary of the ROD, that was incorporated by reference in the ROD. CERCLA's nine criteria set forth in 40 CFR Part 300, of the National Oil and Hazardous Substances Pollution Contingency Plan were used to evaluate the alternatives.

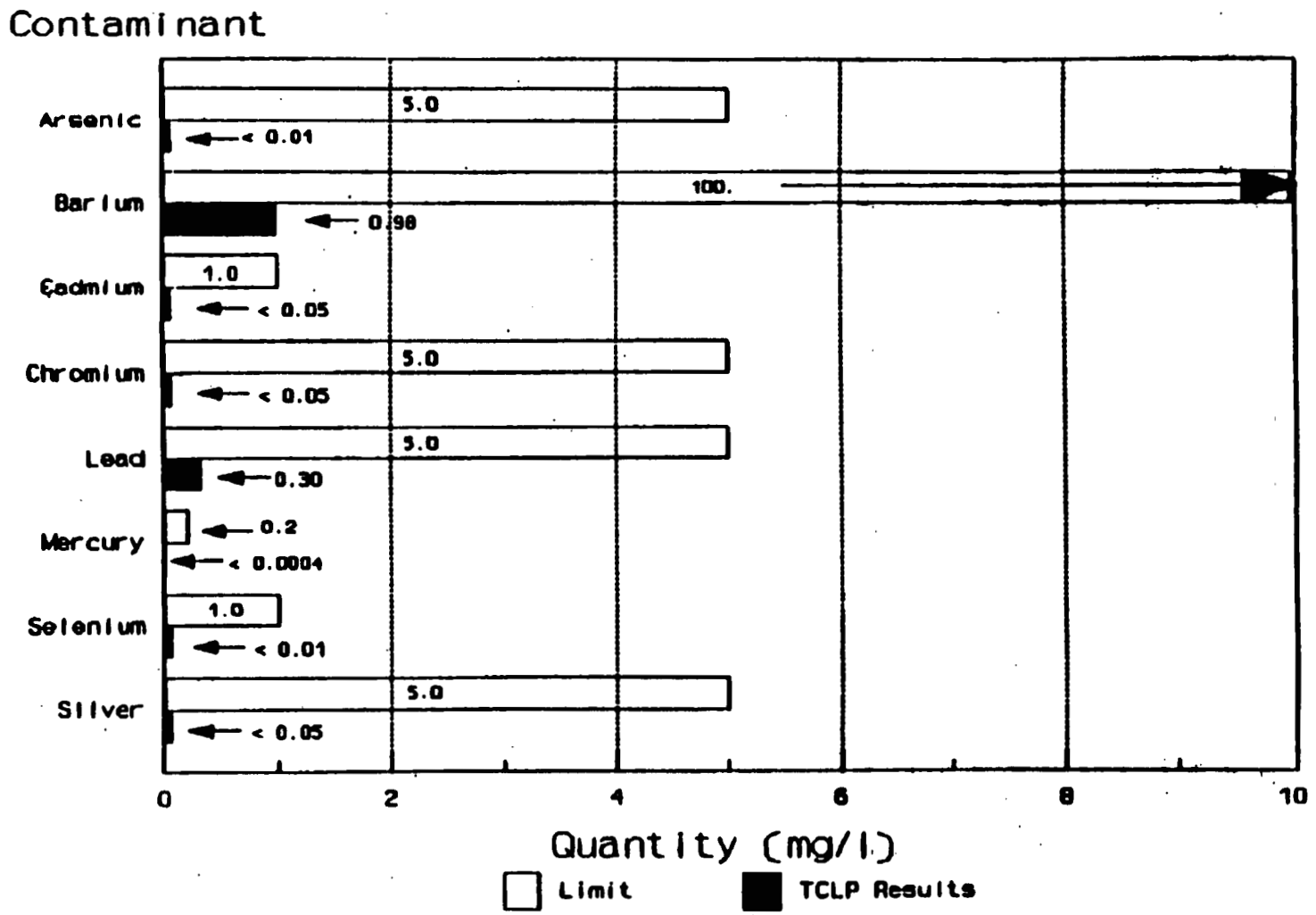
STATUTORY DETERMINATIONS

The selected remedy must protect human health and the environment, comply with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and be cost effective. The remedy should utilize permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable, and satisfy the statutory preference for remedies that employ treatment. It should also reduce toxicity, mobility, or volume as a principal element.

This selected ROD remedy will result in contaminated debris and soil being dispositioned by OU3 and OU5, respectively. Because this remedy will result in hazardous substances (i.e.. contaminated soil and debris) remaining on site, above health-based levels, a review will be conducted every 5 years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

All practical means to avoid or minimize environmental harm from implementation of the selected remedy are to be adopted. During excavation activities, sediment controls will need to be implemented to eliminate potential surface water runoff and sediment deposition to Paddy's Run. Final site layout and design will include all practicable means (e.g., sound engineering practices and proper construction practices) to minimize environmental impacts.

Figure 6. 1991 Laboratory Vitrification Testing Toxicity Characteristic Leaching Procedure (TCLP) Leachate Results for Vitrified K-65 Material: Concentration of Metals in Leachate



LEACHATE.PCX

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Table 1. Summary of Vitrification Tests for OU4 Bench-Scale Treatability Testing

SEQUENCE	TEST*	TYPE OF MATERIAL	APPROXIMATE AMOUNT OF MATERIAL	DESCRIPTION
0	Not Relevant	K-65 Silo 3 Bentogrout	As required	Small melts of approximately 100 - 150 grams each to develop glass formations for the Sequence A through D tests and to test the system and operating procedures.
A	Open	K-65	1.0 Kg	K-65 material and glass forming reagents as determined in the Sequence 0 tests. Radon concentration monitored in the off-gas stream.
A	Closed	K-65	1.0 Kg	Duplicate of the open system test. Off-gas collected for analysis.
B	Open	K-65 Bentogrout	0.5 Kg 0.5 Kg	K-65 material, Bentogrout, and glass forming reagents as determined in the Sequence 0 tests. Radon concentration monitored in the off-gas stream.
B	Closed	K-65 Bentogrout	0.5 Kg 0.5 Kg	Duplicate of the open system test. Off-gas collected for analysis.
C	Open	Silo 3	1.0 Kg	Silo 3 material and glass forming reagents as determined in the Sequence 0 tests.
C	Closed	Silo 3	1.0 Kg	Duplicate of the open system test. Off-gas collected for analysis.
D	Open	K-65 Silo 3	0.7 Kg 0.3 Kg	K-65/Silo 3 material and glass forming reagents as determined in the Sequence 0 tests. Radon concentration monitored in the off-gas stream.
D	Closed	K-65 Silo 3	0.7 Kg 0.3 Kg	Duplicate of the open system test. Off-gas collected for analysis.

* Open and Closed refers to the off-gas system configuration.

TABLE_1.HOR

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Table 2. Inorganic Composition of Silo 1 Samples (Dry Wt%)

Component in waste	Notes	Silo 1A	Silo 1B	Silo 1C	Silo 1 CMP	Average A,B,C	Range A,B,C
SiO2		52	48	48	49	50	48 - 52
PbO		10	13	13	13	12	10 - 13
BaO		6.0	6.1	6.8	6.3	6.3	6.0 - 6.8
CO2	a	1.4	3.5	4.6	na	3.2	1.4 - 4.6
Al2O3		2.6	2.7	2.6	2.6	2.6	2.6 - 2.7
Fe2O3		2.7	2.3	2.4	2.6	2.5	2.3 - 2.7
SO3	b	1.9	1.8	1.6	na	1.8	1.7 - 1.9
Na2O		1.0	2.2	2.2	1.8	1.8	1.0 - 2.2
MgO		1.2	1.2	1.1	1.2	1.2	1.1 - 1.2
P2O5		0.93	0.46	0.48	0.65	0.62	.46 - .93
K2O		0.72	0.72	0.60	0.60	0.68	.60 - .72
MoO2		0.69	0.27	0.34	0.47	0.43	.27 - .69
CaO		0.62	0.28	0.22	0.45	0.37	.22 - .62
La2O3		0.65	0.31	0.29	0.41	0.42	.29 - .65
NiO		0.29	0.51	0.45	0.41	0.42	.29 - .51
Ce2O3		0.64	0.32	0.27	0.35	0.41	.27 - .64
N2O5	c	0.23	0.42	0.21	0.29	0.29	.21 - .42
TiO2		0.35	0.24	0.25	0.28	0.28	.24 - .35
Nd2O3		0.30	0.15	0.13	0.20	0.19	.13 - .30
CoO		0.17	0.22	0.19	0.18	0.19	.17 - .22
SrO		0.075	0.089	0.084	0.081	0.082	.07 - .09
Cl	c	0.062	0.10	0.076	0.072	0.079	.06 - .10
V2O3		0.064	0.063	0.057	0.060	0.061	.06 - .06
CuO		0.053	0.063	0.055	0.052	0.057	.05 - .06
ZrO2		0.059	0.036	0.058	0.047	0.051	.04 - .06
SeO2		0.035	0.056	0.049	0.042	0.047	.04 - .06
Cr2O3		0.029	0.015	0.015	0.022	0.019	.01 - .03
MnO		0.016	0.012	0.014	0.014	0.014	.01 - .02
BeO		0.0056	0.0069	0.0056	0.0056	0.0060	.01 - .02
F	c	0.0035	0.0070	0.0040	0.0040	0.0048	.00 - .01
As2O3							
CdO							
SnO2							
ThO2							
UO2							
ZnO							
Total		85	86	86	81	86	

Notes:

(a) Determined from the difference between total carbon and total organic carbon, expressed as carbonate.

(b) Sulfate was determined as total sulfur using ICP and expressed as sulfate.

(c) Determined by ion chromotography on a leachate from the sample into distilled water.

"na" signifies "not analyzed"; a blank indicates less than detection limits.

ICP results are valid to a maximum of 2 significant figures. Typical precision is ±10%.

SILO_1.PCX

Table 3. Inorganic Composition of Silo 2 Samples (Dry Wt%)

Component in waste	Notes	Silo 2A	Silo 2B	Silo 2C	Silo 2CMP	Average A,B,C	Range A,B,C
SiO2		49	57	46	58	51	46 - 57
PbO		4.9	7.2	6.4	6.6	6.2	4.9 - 7.2
Fe2O3		8.4	3.4	6.4	5.8	6.1	3.4 - 8.4
Al2O3		3.7	3.2	3.2	3.4	3.4	3.2 - 3.7
CO2	a	3.3	3.5	3.3	na	3.4	3.3 - 3.5
BaO		1.5	3.7	3.8	3.1	3.0	1.5 - 3.8
CaO		3.1	2.2	2.2	2.7	2.5	2.2 - 3.1
MgO		2.3	1.1	1.6	1.7	1.7	1.1 - 2.3
SO3	b	1.4	0.87	2.7	na	1.7	.87 - 2.8
Na2O		0.61	0.98	1.0	0.93	0.88	.61 - 1.0
K2O		0.72	0.60	0.72	0.84	0.68	.60 - .72
P2O5		0.70	0.73	0.61	0.68	0.68	.61 - .73
N2O5	c	0.66	0.63	0.57	0.62	0.62	.57 - .66
UO2		0.45	0.51	0.45	0.51	0.47	.45 - .51
NiO		0.31	0.46	0.33	0.38	0.36	.31 - .46
TiO2		0.36	0.30	0.32	0.36	0.33	.30 - .36
Ce2O3		0.31	0.40	0.29	0.35	0.33	.29 - .40
La2O3		0.27	0.36	0.23	0.30	0.29	.23 - .36
ZrO2		0.12	0.12	0.18	0.28	0.14	.12 - .18
Nd2O3		0.16	0.19	0.13	0.23	0.16	.13 - .19
CoO		0.18	0.25	0.20	0.22	0.21	.18 - .25
CuO		0.068	0.084	0.10	0.083	0.084	.07 - .10
Cr2O3		0.12	0.037	0.10	0.080	0.083	.04 - .12
MoO2		0.040	0.12	0.079	0.077	0.080	.04 - .12
SrO		0.035	0.078	0.072	0.064	0.062	.03 - .08
As2O3		0.033	0.033	0.079	0.053	0.048	.03 - .08
SeO2		0.042	0.042	0.042	0.042	0.042	.04 - .04
MnO		0.031	0.030	0.036	0.035	0.032	.03 - .04
V2O3		0.078	0.077	0.088	0.022	0.081	.08 - .09
ZnO		0.011	0.011	0.012	0.017	0.011	.01 - .01
Cl	c	0.0080	0.0030	0.0030	0.0040	0.0047	.00 - .01
F	c	0.0030	0.0050	0.0050	0.0040	0.0043	.00 - .01
BeO							
CdO							
SnO2							
ThO2							
total		83	88	81	87	84	

Notes:

(a) Determined from the difference between total carbon and total organic carbon, expressed as carbonate.

(b) Sulfate was determined as total sulfur using ICP and expressed as sulfate.

(c) Determined by ion chromotography on a leachate from the sample into distilled water.

"na" signifies "not analyzed"; a blank indicates less than detection limits.

ICP results are valid to a maximum of 2 significant figures. Typical precision is ±10%.

SILO_2.PCX

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Table 4. Inorganic Composition of Silo 3 Samples (Dry Wt%)

Component in waste	Notes	Silo 3#1	Silo 3 #2	Silo 3 #3	Silo 3ABC	Average	Range
SO3	a,b	15	15	15	15	15	
SiO2		14	13	13	16	14	13 - 16
MgO		11	9.6	9.9	10	10	9.6 - 11
P2O5		10	8.4	9.5	9.2	9.3	8.4 - 10
Fe2O3		8.0	8.1	7.5	8.6	8.0	7.5 - 8.6
N2O5	c	6.0	6.1	6.3	6.1	6.1	6.0 - 6.3
Na2O	d	na	5.9	5.7	6.2	5.9	5.7 - 6.2
CaO		5.2	4.1	5.0	4.5	4.7	4.1 - 5.2
Al2O3		4.3	5.8	4.6	6.4	5.3	4.4 - 6.4
CO2	a,e	1.9	1.9	1.9	1.9	1.9	
K2O		1.8	2.3	1.8	1.2	1.8	1.2 - 2.3
MnO		0.65	0.70	0.62	0.72	0.67	.62 - .72
Li2O		0.45	0.51	0.46	na	0.47	.45 - .51
NiO		0.47	0.57	0.43	0.59	0.52	.43 - .59
V2O3		0.35	0.65	0.36	0.64	0.50	.35 - .65
ThO2		0.34	0.34	0.34	0.23	0.31	.23 - .34
UO2		0.23	0.34	0.34	0.45	0.34	.23 - .45
CuO		0.36	0.46	0.34	0.46	0.41	.34 - .46
CoO		0.36	0.36	0.32	0.39	0.36	.32 - .39
As2O3		0.18	0.33	0.23	0.40	0.29	.18 - .40
TiO2		0.25	0.21	0.22	0.21	0.22	.21 - .25
PbO		0.18	0.21	0.16	0.22	0.19	.16 - .22
MoO2		0.15	0.22	0.12	0.23	0.18	.12 - .23
F	c	0.077	0.090	0.10	0.053	0.079	.05 - .10
Cr2O3		0.086	0.089	0.075	0.082	0.083	.08 - .09
ZnO		0.059	0.069	0.055	0.082	0.066	.06 - .08
BaO		0.037	0.030	0.036	0.028	0.033	.03 - .04
Y2O3		0.036	0.044	0.036	na	0.039	.04 - .04
SrO		0.025	0.028	0.024	0.028	0.026	.02 - .03
ZrO2	d	na	0.018	0.020	0.014	0.017	.01 - .02
Cl	c	0.013	0.021	0.017	0.013	0.016	.01 - .02
Ce2O3		0.0000	0.023	0.012	0.035	0.018	.00 - .04
La2O3		0.0082	0.010	0.0088	0.018	0.011	.01 - .02
Nd2O3			0.012	0.0082	0.017	0.0124	.00 - .02
BeO			0.0056	0.0056	0.0069	0.0060	.00 - .01
CdO		0.0011	0.0043	0.0046	0.0074	0.0044	.00 - .01
SeO2		na	na	na	0.028	0.028	
SnO2		na	na	na			
total		81	85	84	90	87	

Notes:
(a) Sulfate and carbonate were determined from a single sample separate from these analyses.
(b) Sulfate was determined as total sulfur using ICP and expressed as sulfate.
(c) Determined by ion chromotography on a leachate from the sample into distilled water.
(d) Insufficient sample was available to perform the KOH fusion, so values for Na and Zr were not obtainable.
(e) Determined from the difference between total carbon and total organic carbon from a total carbon analysis.
"na" signifies "not analyzed"; a blank indicates less than detection limits.
ICP results are valid to a maximum of 2 significant figures. Typical precision is ±10%.

SILO_3.PCX

Table 5. Physical Properties of Silo's 1, 2 & 3 Materials

Physical Properties of K-65 Material from Silo 1

Physical Properties	SILO 1 measured value Zone A	Zone B	Zone C	±%error Zone A	Zone B	Zone C
moisture content (%)	26.9	35.3	35.9	2.6	1.2	5.0
bulk density (g/mL)						
wet, compacted	1.81	1.67	1.70	3.8	2.4	1.8
crushed dry, settled	1.00	0.91	0.90	[a]	4.4	1.9
particle apparent density						
specific gravity	2.79	2.77	2.74	2.4	0.4	1.6

Note: Only a single measurement was performed for Silo 1 Zone A.

Physical Properties of K-65 Material from Silo 2

Physical Properties	SILO 2 measured value Zone A	Zone B	Zone C	±%error Zone A	Zone B	Zone C
moisture content (%)	27.8	35.6	29.7	2.0	0.9	3.6
bulk density (g/mL)						
wet, compacted	1.87	1.71	1.92	1.4	7.1	6.3
crushed dry, settled	1.16	0.92	1.13	4.8	2.3	1.8
particle apparent density						
specific gravity	2.72	2.57	2.81	1.8	2.9	0.4

Physical Properties of Metal Oxide Material from Silo 3

Physical Properties	SILO 3 Zones ABC	±% error
moisture content (%)	4.8	1.8
bulk density (g/mL)		
wet, compacted	0.92	1.9
crushed dry, settled	0.88	1.5
particle apparent density		
specific gravity	2.86	1.0

PHYSICAL.PCX

SPECIAL CRITERIA SUMMARY

USERS:

- Local population, people affected by transportation through their localities, and final destination site population and potential developments.
- Workers involved in cleanup.

CODES:

- A large variety of Federal, State (principally Ohio, Utah, and Nevada), and local environmental and transportation codes apply to the remedy activities. See documents consulted for specifics related to those codes.

RESTRICTIONS:

- NTS has waste acceptance criteria (WAC) that must be adhered to. The EIS for the disposal at NTS is scheduled for completion in December 1995.
- If materials are to be shipped to EnviroCare of Utah, the site has WAC that must be complied with if the material is to be disposed. This criteria includes no free liquids present, (ideal from cost standpoint is 5 percent optimum moisture by Proctor Method) and detailed contaminant, and debris limits. The site's per shipment capacity limits are large, but must be followed. Issues related to the site from the State of Utah would also apply.
- Radioactive waste must be shipped off-site pursuant to Ohio Environmental Protection Agency (OEPA) requirements and the local public demand relating to the Ohio Environmental Protection Agency (OEPA) requirement.
- Union contracts of the site workers are to be adhered to as agreed previously. (Failure to comply with this provision would require significant, time consuming labor negotiations.)

DESIGN HISTORY: (RESPONSIBILITIES, COMMITMENTS, STATUS, ETC.)

Significant milestones for the OU4 project include: FMPC operations suspended in 1989, determination to formally end production notification to Congress in 1991, Envirocare site license approved for Nuclear Regulatory Commission (NRC) type materials in 1993, remedy feasibility study (final draft) completed in 1994, Final ROD completed in December 1994, and initial conceptual design planning awarded and begun in 1995.

SPECCRIT.TAB

GENERAL DISCUSSION OF VALUE METHODOLOGY PROCEDURES USED IN THE VALUE STUDY PROCESS

General

The VST team used the six-phase Value Methodology job plan in its operations. The six basic job plan phases and their operations are:

Phase 1. Information Phase

All possible information on the process and operational features within the scope of the study are collected, distributed, and analyzed. The components making up the features, their functions, and costs are determined. The criteria and limits affecting the project or projects are identified, and if necessary, ranked and/or assigned values. A Function Analysis System Technique (FAST) diagram is generated which shows the "why" and "how" and the "as the result of" or "at the same time" of functions being performed. The results are categorized, assigned to functions of note, and items for potential concentration of study team effort are identified.

Phase 2. Creativity Phase

Creativity methods such as "focused brainstorming" are used to generate the maximum quantity of ideas for consideration by the study team. This phase is also often referred to as the "speculation phase."

Phase 3. Analysis Phase

Ideas generated in the creativity phase are ordered, collected into concepts with similar features, solidified into potential alternatives for proposal, and ranked using one of a variety of techniques. The technique used for ranking in this study was performance of the function determination and study team consensus ranking. The resulting ranked potential alternatives are then evaluated with regard to their benefits, advantages, and risks.

Phase 4. Development Phase

VST members are assigned potential alternatives for further evaluated and developed into viable, efficient, and cost-effective proposals with increased value for the client and/or owner of the product or process.

The development process includes, but is not limited to, using team member expertise; consultation with staff performing the project or process; experts and outside vendors; polling others by survey or other means; consultations with the client and/or owner; and review of information resources (libraries, catalogs, and other materials). Steps required to implement the proposals are identified, and methods to resolve identified potential problems are determined. During this phase, a determination to drop a process from further consideration usually requires unanimous acceptance by the study team.

Phase 5. Presentation Phase

Items demonstrating added value, by monetary or non-monetary measurements, within the confines of the study period, are placed in report form for presentation and documentation as alternative proposals. During this phase, items recommended as alternative proposals must, generally, receive unanimous acceptance by the study team before presentation of the team's report. Items demonstrating potential added value to the client and/or owner that were not completely evaluated, due to time constraints or other reasons, are presented as "Additional Items Recommended for Further Study". The types of items may require extensive additional development activities beyond that available to the study team to determine if the items actually demonstrate the anticipated added value.

GENERAL DISCUSSION OF VALUE METHODOLOGY PROCEDURES USED IN THE VALUE STUDY PROCESS

Phase 6. Implementation Phase

The owner, users, client, and other project or process parties take the study proposals into consideration and evaluate them for implementation. The staff coordinating the Value Study activity, and if needed, VST members, assist and monitor the evaluation to help all parties in implementing the added value features. Final estimates of the value of proposals is established. The status of the final determination of the proposals is reported to the Value Program coordinating staff. (Examples of the status classifications are: accepted or partially accepted with the revised estimated value of the accepted proposal parts, "withdrawn" due to the acceptance of another preferred and accepted proposal, and rejected with the reason for the disapproval of the proposal.) Statistics and Value Program activity results are compiled and reported to organizational management and Governmental authorities to monitor the effectiveness of the Value Program and its value studies.

VEDISCUS.APP

COST MODEL AND ESTIMATE INFORMATION

The VST cost model was based on the conceptual project estimates provided by the design (or process) team as evaluated by the independent cost estimator for the selected preferred project concept. This cost model was developed by the VST and was used to focus on features with the greatest potential for savings and to highlight potential instances of value mismatch.

Unit prices were reviewed by the VST and Estimators to ensure reliability and applicability.

Cost savings and the original concept estimates are of the same general level of development. Unit costs and estimates may vary as final designs are pursued and refined.

COSTPAGE.PG

Remedial Actions at Operable Unit 4

VALUE STUDY

COST MODEL

COMPONENT/PERCENT PROJECT COST		PROJECT COST PROPORTIO
VITPP	(14.4%)	
Engineering	(0.6%)	
Equipment	(0.8%)	
Construction	(0.6%)	
Operations	(3.6%)	
Demo and decon	(6.5%)	
Startup	(2.3%)	
FRVP	(62.5%)	
Engineering	(6.6%)	
Equipment	(13.0%)	
Construction	(10.5%)	
Operations	(2.0%)	
Demo and decon	(8.7%)	
Waste Management	(21.5%)	
Waste Water Treatment	(0.3%)	
Decontaminate& Decommission	(14.4%)	
Silio and Facilities	(7.7%)	
Waste Management	(1.1%)	
Final Site Restore	(5.6%)	
Overhead	(8.7%)	
Ownership	(2.3%)	
Crew Mangement	(4.6%)	
Support Projects	(0.7%)	
Environ Mon/Cmpilance	(0.6%)	
FS/PP	(0.1%)	
ROD	(0.1%)	
RD/RA	(0.1%)	

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5*Expenditures to date have been removed for comparision purposes. File: OU4–COST.wk31

FUNCTION ANALYSIS

PROJECT: Remedial Actions at Operable Unit 4
STUDY ITEM: ROD Remedy Plan

COMPONENT	VERB (ACTIVE)	NOUN (MEASURABLE)
VITPP (Sunk $30M of $40M) (Add 20 percent to Ops cost)	*Generate *Demonstrate *Reduce Treat *Save (FRVP)[1] Train Demonstrate	Data Concept Risk Waste Money Staff Progress
Add Decontamination and Decommissioning (D&D) (VITPP Only $15M)	* Jeopardized by schedule compression due to delay	
FRVP (Cost @ $102M) (Add 20-30 percent to Eng/Equip/Const/Ops)	Restore Treat Transport Relocate Reduce	Environment Waste Waste Waste Risk
Add D&D (FRVP Only $20M)		
D&D Silos & Facs	Restore Reduce Satisfy Reduce Improve	Environment Hazard Customer Risk Aesthetics
Overhead (W/O Escalation, Contingency and D&D) (Excludes $12M cost of ROD to date)	Manage Support Track Demonstrate Manage	Progress Operations Progress Results Resources
Add Contingency (Say 20 percent = $46M)		

[1] Fernald Residues Vitrification Plant

FUNCANAL.TAB

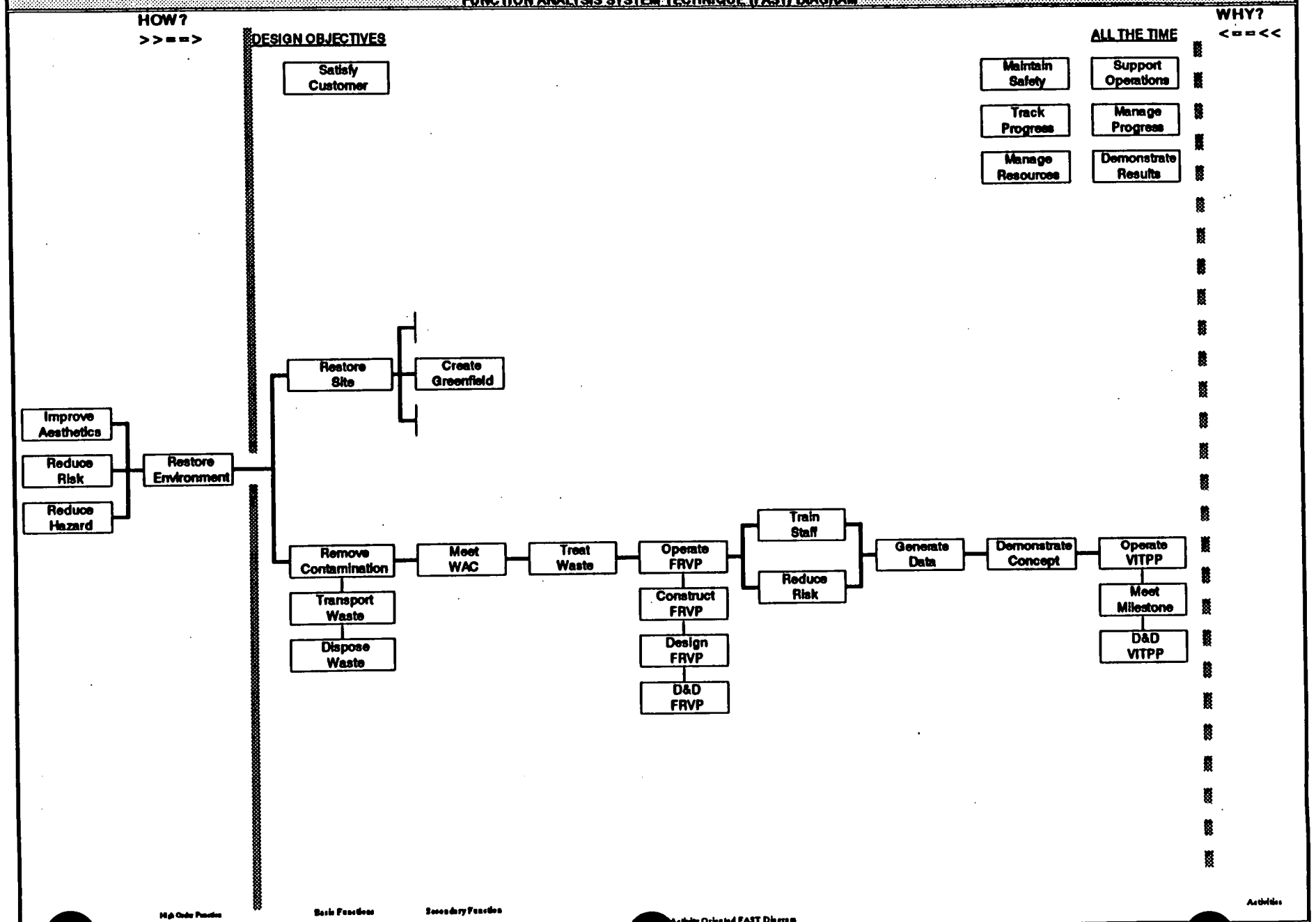
Function Analysis System Technique (FAST)

The VST used the function analysis process to generate a Function Analysis System Technique (FAST) diagram designed to show the present ROD remedy preferred alternative from a functional point of view. The function analysis and resulting FAST diagram aided the VST in identifying design features that are critical to meeting requirements that support the critical functions, and those that meet noncritical design objectives. It also assisted the team in identifying any potential instances of value mismatches.

FASTDIAG.PG

REMEDIAL ACTIONS AT OU4 – ROD PLAN

FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM



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VALUE STUDY - DISPOSITION OF IDEAS

PROJECT: Remedial Actions at Operable Unit 4

VALUE STUDY ELEMENTS CONSIDERED AS POTENTIAL PROPOSALS	
IDEA	**DISPOSITION**
• Use solidification and stabilization.	Developed and presented as Value Study Proposal No. 2.
• Pack grout with bentonite layer to mitigate radon release.	Not incorporated into proposal due to pursuit of other ideas with a higher perceived value to the project.
• Use glass as aggregate for concrete and ship to Envirocare.	Not incorporated into proposal due to pursuit of other ideas with a higher perceived value to the project.
• Prestrip Radon then process waste.	Incorporated into proposal during development.
• Cancel both vitrification plants and do solidification and stabilization.	Only cancellation of full-scale system was incorporated into proposal during development.
• Cancel Vitrification and do lime stabilization.	Incorporated into proposal during development.
• Encapsulate (Plastic, Polyethylene or bituminous).	Not incorporated into proposal due to pursuit of other ideas with a higher perceived value to the project.
• Ship loose (bulk) versus boxed materials.	Incorporated into proposal during development.
• Use low level contaminated scrap metal for boxes.	Not pursued in detail due to value study time limitations.
• Impregnated or layered top of activated carbon in/on treated material to mitigate radon release.	Incorporated into proposal during development.
• Treat Silo 3 different from Silos 1 and 2 by: - Blending with other materials, i.e., OU1/Pit 5, and then shipping. - Privatizing Silo 3 to obtain optimum benefits.	Submitted as Additional Idea for Further Study and incorporated as Value Study Proposal No 2.
• Identify "hot" spots and treat them separately from the remainder of the waste stream by: - Separating and placing some material so it can be disposed of on-site or ship to EnviroCare. - Excluding bentonite.	Submitted as Additional Idea for Further Study.
• Use compaction techniques, with additives if necessary, before shipping, e.g., vacuum extrusion.	Developed and presented as Value Study Proposal No. 2.

VALUE STUDY - DISPOSITION OF IDEAS

PROJECT: Remedial Actions at Operable Unit 4

VALUE STUDY ELEMENTS CONSIDERED AS POTENTIAL PROPOSALS	
IDEA	**DISPOSITION**
• Combine all operable units with similar materials. For example, the salt bath could be used to make glass.	Submitted as Additional Idea for Further Study.
• Cast into a block (glass) in place of "gems" such as pouring the glass into 55 gallon drums.	Incorporated into Value Study Proposal No. 1.
• Vacuum into wet cyclone to reduce contamination risk (dusting).	Incorporated into Value Study Proposal No. 1.
• Place cage around pump intakes, and examine value engineering studies at Hanford.	Submitted as Additional Idea for Further Study.
• Experience of the reliability of remote operated robot performance in tanks makes its use a risk in the proposed environment.	Submitted as Additional Idea for Further Study.
• Trade scope for schedule to correct schedule problems.	Incorporated into Value Study Proposal No. 1.
• Optimize VITPP operation by removal of Silo 3 material. Treat reduced volume through VITPP option only.	Developed and presented as Value Study Proposal No. 1.
• Prestrip Radon then process resulting waste stream.	Incorporated into Value Study Proposal No. 1.
• Do all reasonable treatment processing in VITPP and cancel FRVP activities.	Incorporated into Value Study Proposal No. 1.
• Increase the throughput of the VITPP, after pilot testing, and use it as a production facility.	Incorporated into Value Study Proposal No. 1.
• Revisit the operating cost of the VITPP because the costs seem very low	Incorporated in discussion of Value Study Proposal No. 1.
• Exchange information and share experience with others with this same problem and doing vitrification work (MSE and Savannah River Site).	Incorporated in discussion of Value Study Proposal No. 1.
• Add outside materials (flux) to the vitrification mix rather than trying to use Silo 3 materials that cause technical difficulties.	Incorporated in discussion of Value Study Proposal No. 1.

VALUE STUDY - DISPOSITION OF IDEAS

PROJECT: Remedial Actions at Operable Unit 4

VALUE STUDY ELEMENTS CONSIDERED AS POTENTIAL PROPOSALS	
IDEA	**DISPOSITION**
• Revisit off-gas system. - Optimization of piping heat retention appears to be a problem. - Is the use of desiccant necessary? - Use off-gas stream to preheat and dry the melter feed stream. - Consider control base on the ammonia slip coming out after the selective catalytic reduction (SCR). - Reevaluate need for water quench on the activated carbon filter by consulting with Mountain States Engineering (MSE) experience, Butte, Montana. - No SCR on VITPP, it will use water quench. May be possible to delete both. Discuss with MSE to determine whether quench or SCR is needed in reevaluation.	Incorporated in discussion of Value Study Proposal No. 1.
• If silo 3 materials are not vitrified, reevaluate the use of molybdenum electrodes and the high-temperature melter design.	Incorporated in discussion of Value Study Proposal No. 1.
• Use an alternative flow restricting device or pump that would avoid restricting feed materials to one-tenth inch diameter.	Incorporated in discussion of Value Study Proposal No. 1.
• If slurrying the material do not use diaphragm pumps.	Incorporated in discussion of Value Study Proposal No. 1.
• Use a Lamella settler which is common practice and the standard for fine particulate sludge settling (allows smaller footprint and a lower capital cost).	Incorporated in discussion of Value Study Proposal No. 1.
• Examine Hanford's methods of removing materials from tanks using less water.	Submitted as Additional Idea for Further Study.

VALUE STUDY - DISPOSITION OF IDEAS

PROJECT: Remedial Actions at Operable Unit 4

VALUE STUDY ELEMENTS CONSIDERED AS POTENTIAL PROPOSALS	
IDEA	**DISPOSITION**
Utilize non-slurry methods of excavation, or minimization of added water methods. - Non-slurry mechanical extraction of materials from silos. For example: an overhead clamshell, mechanical excavation to center and conveyor out; or vibrascrew. - Drill in from the side (Auger method). - Skeleton pump harbor.	Incorporated into Value Study Proposal No. 2.
• Scope and size of the project staff appear large when compared to other projects.	Submitted as Additional Idea for Further Study.
• Privatize OU4 using a performance specification based on procurement. (Silo 3 first and then Silos 1 and 2).	Submitted as Additional Idea for Further Study.
• Relieve the DOE requirements on the contractor so they can do the work faster.	Submitted as Additional Idea for Further Study.
• Perform treatability study on representative sample by an outside vendor to get real costs for cement. Cease the design for the FRVP.	Submitted as Additional Idea for Further Study.
• Send to Envirocare or alternate site such as Hanford or Barnwell.	Incorporated into Value Study Proposal No. 2 and Additional Ideas for Further Study discussions.
• Modify VITPP campaigns to recover schedule.	Incorporated into discussion on Value Study Proposal No. 1.
• Examine the benefits and costs related to railroad versus truck. Also the option of dedicated trains.	Developed and presented as Value Study Proposal No. 3.
• Examine use of containerized shipping such as tote-bins with removable box that could be reused, and shielded trucks in place of heavily shielded boxes.	Developed and presented as Value Study Proposal No. 3. Some features not fully pursued due to VST time constraints.
• Treatability study reports indicate trace levels of potential Polychlorinated Bithenyls. Should operations be modified to treat the potential presence of Polychlorinated Bithenyls and utilize a secondary combustion chamber?	Amounts of potential Polychlorinated Bithenyls is believed to be insignificant. The concept to avoid the remote potential was incorporated in Proposal Nos. 1 and 2.

VALUE STUDY - DISPOSITION OF IDEAS

PROJECT: Remedial Actions at Operable Unit 4

VALUE STUDY ELEMENTS CONSIDERED AS POTENTIAL PROPOSALS	
IDEA	**DISPOSITION**
• Shorten distance of pneumatic system length and simplify design. May be able to use wet cyclone on truck.	Incorporated into discussion on Value Study Proposal No. 1.
• Use off-gas to heat and dry slurry feed.	Incorporated into discussion on Value Study Proposal No. 1.
• Remove and stockpile the clay cap, then use it as the additive to stabilize input feed.	Incorporated into discussion on Value Study Proposal No. 1.
• Use the existing pilot cement plant for test runs. Compare head-to- head with the VITPP, solidification, and stabilization procedures.	Incorporated into discussion on Value Study Proposal No. 2.
• If vitrified gems are used, a segregation system may be used to separate the "Hot" gems to be sent to NTS and send the "Non-Hot" gems to Envirocare to reduce costs.	Submitted as Additional Idea for Further Study.

IDEASDIS.TAB

GENERAL DISCUSSION OF PROPOSALS

PROJECT: Remedial Actions at Operable Unit 4

During the VST evaluation of the OU4 project, it became clear that the contents of Silo 3 were dissimilar from Silos 1 and 2 (due to higher sulfate concentrations and lower radium concentrations). Further, it became evident that the contents of Silo 3 greatly complicated and lengthened the OU4 vitrification process. The FEMP is currently considering excluding the contents of Silo 3 from vitrification. The VST strongly supports the FEMP initiative to exclude Silo 3. Proposal No. 1 is partially contingent on excluding Silo 3 from vitrification. The effects of deleting Silo 3 from the vitrification process have the potential to save significant resources.

The VST considered several methods of eliminating Silo 3 from OU4 vitrification processing. Two major methods discussed were:

1. Add Silo 3 contents to the scope of OU1 (Pit 5).
2. Develop Silo 3 as a separate OU4 project.

The first method is currently being evaluated by FERMCO, therefore the VST did not develop this alternative further. The only comments on this method are reported under Additional Ideas for Further Study section concerning adding Silo 3 to the scope of work for OU1 remediation effort. It is also the VST's understanding that FERMCO is presently evaluating the potential to "privatize" significant portions of the OU1 remediation. The cost to add Silo 3 to this study would be low and would facilitate overall site integration.

The second method of developing a stand alone project was more thoroughly reviewed by the VST. The team agreed that a stand alone treatability study to support processing (by vacuum extrusion) Silo 3 wastes should be developed. Therefore, a separate value proposal for this alternative was prepared and will be submitted for consideration as Proposal No. 2.

The idea of creating a privatized project for the remediation of Silo 3 was also considered (see the Additional Ideas for Further Study section). Privatizing the remediation of Silo 3 would allow potential vendors to present alternative remediation strategies to the DOE, other than vitrification. It was, however, difficult for the VST to anticipate and develop these alternatives. The vacuum extrusion technology was considered the most promising of the potential technologies, and was therefore presented as Proposal No. 2 as a OU4 crew implementation item.

The VST believe that the advantages of deleting the Silo 3 material from the OU4 vitrification project are extremely significant, and it is our recommendation that the initiative to exclude Silo 3 continue to be pursued.

VALUE STUDY PROPOSAL DESCRIPTION

PROJECT: Remedial Actions at Operable Unit 4

PROPOSAL NO. 1. DELETE FERNALD RESIDUES VITRIFICATION PLANT (FRVP) EFFORT AND CONCENTRATE EFFORTS ON VITPP AND ADDITIONAL MELTER.

Background:
The current plan for remedial actions at OU4 are to vitrify all waste media materials contained within Silos 1-3, and the bentonite caps of Silos 1 and 2. The plan calls for the design, development, and testing of the VITPP and the design, development, construction, and operation of a FRVP to complete the remedial action. Design and construction of the VITPP is almost complete at the time of this value study. Due to delays, the plans now call for the design of the FRVP to begin before much of the testing operations of the VITPP are known.

Proposal:
The VST proposes the deletion of the FRVP, effort and the vitrification treatment of the Silo 3 waste and the bentonite cap from the current plans. Wastes from Silos 1 and 2 would be treated through use of the present VITPP system. This will require additional capacity for the VITPP system, but will result in better utilization of capital assets, generate cost savings, and still result in schedule attainment. The Silo 3 waste and most of the Silos 1 and 2 bentonite caps would be treated by another means, such as that proposed in Value Proposal No. 2. (FERMCO is already evaluating the possibility of taking advantage of an alternative treatment of Silo 3 waste.)

There are two major reasons to delete the FRVP from the overall OU4 project. First, because of schedule delays, it appears that the VITPP test runs to support FRVP design and fabrication have become somewhat disconnected. While the original schedule allowed VITPP data to feed directly to the FRVP design, the current schedule partially negates this benefit. Therefore, the risk associated with the FRVP will be only minimally negated by the lessons learned from the VITPP. Second, it appears that the VITPP melter may be capable of greater throughput than originally anticipated. Discussion with Ian L. Pegg of the Catholic University of America indicate that the VITPP melter may be capable of processing 5-ton/day. (For the purposes of this study, an assumed production capacity of only 3-ton/day was used.)

It appears that it is feasible to install another 3-ton/day melter similar in design and construction to the VITPP parallel to the nearly completed VITPP melter. Rudimentary throughput calculations at 3-ton/day glass production with a 80 percent waste loading and a 25 percent on-stream factor indicate that processing can be started in FY 1998 and be completed by FY 2004. This would allow the completion of the remediation of Silos 1 and 2 wastes by the year 2004, in accordance with the current schedule and Record of Decision.

The use of two 3-ton/day melters to achieve the clean-up of Silos 1 and 2 waste appear reasonable given the current capacity of the VITPP. (A predryer would be used if needed.) Additionally the use of two similar melters will increase the overall system reliability, minimize spare parts inventory, decrease training cost, and eliminate risks associated with the FRVP.

Taking advantage of equipment already on site and costs to date appears to provide cost savings of $50 million to the Government. Given the relatively short period of operation in which to amortize the equipment, it does not appear logical to expend a tremendous amount of money for a high-capacity unit that would be used for a relatively short period of time.

VALUE STUDY PROPOSAL DESCRIPTION

PROJECT: Remedial Actions at Operable Unit 4

The VST recommends that FERMCO seriously consider/investigate this option as a means for accomplishing the remediation of Silos 1 and 2 wastes and associated cost savings. (It reflects a means to trade dollars for capacity and complete the remedial activities within the desired timeframe.) Given the current budget constraints within DOE, the VST believes that possibility of achieving $50,000,000 in savings almost necessitates that FERMCO evaluate this option.

VEALTDES.TAB

VALUE STUDY
ALTERNATIVE EVALUATION PROPOSAL NO. 1

PROJECT: Remedial Actions at Operable Unit 4

COMPONENT: Vitrification System | **FUNCTION:** Waste Stabilization

ALTERNATIVE DESCRIPTION

- The VST proposes stopping the FRVP effort and increasing the capacity of the VITPP system to 6 tons/day through the installation of a second parallel melter of similar design as the VITPP, and processing waste from Silos 1 and 2 with the nearly complete VITPP system. This option should result in both cost savings and schedule attainment as well as increased reliability and decreased schedule risk.

BENEFITS	DISADVANTAGES
• Possible cost savings up to $50,000,000. • Minimizes personnel training requirements. • Increases process reliability through the use of two melters. • Minimization of spare parts requirements. • More effective use of on-site equipment on-site. • Eliminates need and risk associated with the design, construction, start up and operation of a new facility (FRVP). • Eliminates D&D of a second facility. • Continue operating a familiar facility. • More flexibility and less risk in meeting schedule milestones.	• Decreased hourly capacity when compared to the FRVP. • Does not include Silo 3 metal media. (Silo 3 treatment is included on separate Value Study Proposal. However, if schedule is extended, Silo 3 could be vitrified by this method too.) • Does not include bentonite layer. (Included in separate Value Study Proposal, but could be similarly treated if schedule impacts acceptable.) • Must operate VITPP for 6 years more than originally anticipated. However, the entire process can still be completed by 2004.

VEALTEVL.ALT

VALUE STUDY PROPOSAL NO. 1

PROJECT: Remedial Actions at Operable Unit 4	
COMPONENT: FRVP/VITPP	**FUNCTION:** Waste Stabilization
ORIGINAL CONCEPT	**VALUE STUDY CONCEPT**
• Install and operate in a pilot mode the VITPP. • Install and operate for production the FRVP.	• Install the VITPP for pilot operations and optimize the facility to operate as a production plant. • Install a second parallel melter to increase reliability of the plant. • Do not design or install FRVP. • Process Silo 3 and bentonite caps by another treatment method.

COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	$ 304,000,000	
VALUE CONCEPT (-)	$ 247,000,000	
SAVINGS	$ 57,000,000	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	$ 57,000,000	
VALUE STUDY COSTS (-)	$ 63,000	
IMPLEMENTATION COSTS (-)	$ 5,000,000 **	
NET SAVINGS	**$ 51,937,000**	

* ONLY NONRECURRING SHOWN, LIFE CYCLE COSTING NOT COMPUTED.

** Estimated investigation cost to ensure implementation of proposal is justified.

VEALTMON.TAB

IMPLEMENTATION OF PROPOSAL NO. 1

PROJECT: Remedial Actions at Operable Unit 4

CRITICAL ITEMS TO CONSIDER:

- Assembly and construction of VITPP for possible use as remediation facility.
- Thorough evaluation of the time frame for treatment of wastes with the VITPP system and the verification of schedule attainment.
- Current and complete cost estimate for both alternatives.

PROBLEMS AND HOW THEY CAN BE OVERCOME:

- The use of the existing VITPP facilities for remediation purposes may require facility modifications.

PROCEDURES: (WHO DOES WHAT)

- FERMCO should thoroughly evaluate the proposals to verify both possible savings and schedule. The evaluations should include life-cycle cost estimates as well as technical verification of the feasibility of attaining schedule milestones with a 6-ton/day VITPP.

SUMMATION OF BENEFITS AND DRAWBACKS OF THE VALUE STUDY PROPOSAL:

Benefits:

- Significant cost savings, if more than $50,000,000.
- Maintain original ROD schedule milestone.

Disadvantages:

- If Silo 3 waste included in vitrification, the schedule would need to extend beyond 2004.

VEIMPLEM.TAB

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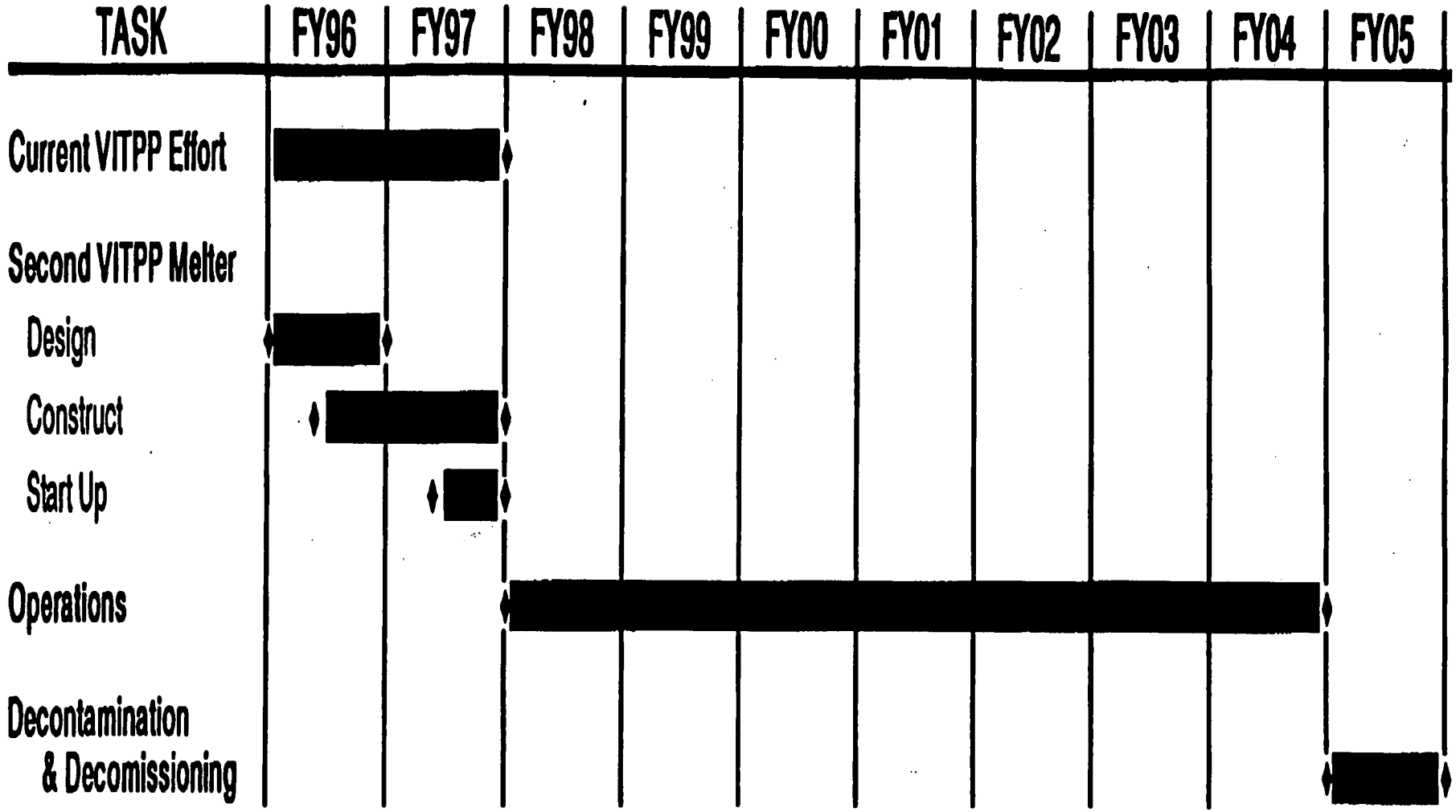
Table 6. Suggested Schedule for Value Study Proposal No. 1



IMPLEMENTATION FEATURES FOR VALUE STUDY PROPOSAL NO. 1

PROJECT: Remedial Actions at Operable Unit 4

IMPLEMENTATION FEATURES FOR PROPOSAL NO. 1. OPTIMIZE THE VITPP TO ALLOW ITS USE AS A PRODUCTION PLANT.

Background:
The VITPP is in startup testing with operation scheduled for March, 1996. The FRVP is presently scheduled to be designed and built concurrently with the VITPP.

Proposal:
Proceed with operation of the VITPP and optimize it as much as practical to allow its use as a production facility. Place the FRVP on hold until VITPP data is available to support proceeding with a 24-ton/day unit. In addition, evaluate several suggestions for: a) reducing the amount of feed materials for the vitrifier, and b) increasing the VITPP throughput. Also consider using the VITPP as a production unit and not proceeding with the FRVP. Alternatively, install a second parallel VITPP melter and use the VITPP as a production unit.

The following features were identified by the VST as methods to implement the optimization of the VITPP to be used as a production facility or to improve the schedule.

VEALTDES.TAB

VALUE STUDY
IMPLEMENTATION FEATURES FOR VALUE STUDY PROPOSAL NO. 1A

PROJECT: Remedial Actions at Operable Unit 4

COMPONENT: Plant | **FUNCTION:** Produce Glass

ALTERNATIVE DESCRIPTION

- Reduce the number of VITPP Phase I and Phase II test runs. Reduce the ten Phase I and eight Phase II runs to only those necessary to implement VITPP operation. Presently there are 91 days of Phase I operation and 64 days of Phase II, assuming a 1-ton/day throughput for testing. Perform several of the very unique R&D runs at the Catholic University. Several runs are automatically eliminated with the removal of Silo 3 metal oxides from the vitrifier feed stream.

BENEFITS	DISADVANTAGES
• Decrease required operating schedule. • Reduce costs.	• Potential for dissatisfied technical personnel due to less available test data.

VEALTEVL.ALT

VALUE STUDY
IMPLEMENTATION FEATURES FOR VALUE STUDY
PROPOSAL NO. 1B

PROJECT: Remedial Actions at Operable Unit 4	
COMPONENT: Feed System	**FUNCTION:** Feed melter
ALTERNATIVE DESCRIPTION	
• Install dryer or a similar mechanism to reduce (optimize) the water content of the feed slurry. To reduce the size or perhaps the need for a dryer, it may be possible to auger the feed into the melter rather than pump and bleed.	
BENEFITS	**DISADVANTAGES**
• Increase melter throughput. • Decrease overall schedule. • Reduce transportation and disposal costs.	• Re-engineering required. • Increase initial costs. • Initial schedule delay for modifications. (Delay should be made up by increased production capacity.)

VEALTEVL.ALT

VALUE STUDY
IMPLEMENTATION FEATURES FOR VALUE STUDY
PROPOSAL NO. 1C

PROJECT: Remedial Actions at Operable Unit 4	
COMPONENT: Melter	**FUNCTION:** Feed System
ALTERNATIVE DESCRIPTION	
• Replace the melter feed pump with a flow control device that will not be restricted to a maximum feed particle diameter of 0.1 inch.	
BENEFITS	**DISADVANTAGES**
• Increase throughput. • Eliminate potential plugging. • Simplify feed flow control. • Reduce maintenance frequency and resulting down time.	• Identify new flow control system. • Design revised melter feed system. • Procure and install new melter feed system. • Increase initial costs for VITPP. • Potential schedule impact. • Potential physical space limitations.

VEALTEVL.ALT

VALUE STUDY
IMPLEMENTATION FEATURES FOR VALUE STUDY
PROPOSAL NO. 1D

PROJECT: Remedial Actions at Operable Unit 4	
COMPONENT: Melter	**FUNCTION:** Form glass
ALTERNATIVE DESCRIPTION	
• Replace glass gems with monolith. Pour glass directly into drums or disposal containers.*	
BENEFITS	**DISADVANTAGES**
• Eliminate glass forming equipment. • May increase melter throughput. • Reduce total number of waste containers. * *This option is not compatible with gem segregation suggestion.*	• Engineer better access to pour spouts with drums. • Initial cost impact to VITPP. • Schedule for VITPP may be initially lengthened. • Possible devitrification, but may not be significant in this instance. (Must do treatability study to determine.)

VEALTEVL.ALT

VALUE STUDY
IMPLEMENTATION FEATURES FOR VALUE STUDY
PROPOSAL NO. 1E

PROJECT: Remedial Actions at Operable Unit 4	
COMPONENT: Gem machine	**FUNCTION:** Form "gems"
ALTERNATIVE DESCRIPTION	
• Install discriminator and segregator on gem cooling belt to: a) measure and determine activity of gems, and b) segregate gems having highest/lowest radioactivity.	
BENEFITS	**DISADVANTAGES**
• Reduce shielding requirements for some transfer casks/boxes. • Reduce cost of some disposal boxes. • Permit disposal of low-activity gems at EnviroCare. • Reduce disposal costs for gems transported to EnviroCare. • Reduce transportation costs for gems transported to EnviroCare through use of railroad instead of trucks.	• Additional engineering required. • Additional component procurement and installation. • Higher initial cost for VITPP. • Potential to lengthen schedule initially.

VEALTEVL.ALT

VALUE STUDY
IMPLEMENTATION FEATURES FOR VALUE STUDY
PROPOSAL NO. 1F

PROJECT: Remedial Actions at Operable Unit 4	
COMPONENT: Melter	**FUNCTION:** Form glass

ALTERNATIVE DESCRIPTION

- Use the Phase I VITPP operating tests to demonstrate methods or techniques for increasing melter throughput, improve reliability and increase on-stream time (availability). Principally, demonstrate workability of suggested improvements, and alternate treatment of Silo 1 and 2 materials.

BENEFITS	DISADVANTAGES
• Shorter operating period. • Decrease waste processing period. • Reduce costs. • Improve probability of meeting ROD schedule. • Decrease costs for tests. • Demonstrate progress.	• May require plant modifications. • May initially extend schedule (However, it should be made up during operation).

VEALTEVL.ALT

VALUE STUDY
IMPLEMENTATION FEATURES FOR VALUE STUDY
PROPOSAL NO. 1G

PROJECT: Remedial Actions at Operable Unit 4	
COMPONENT: Molybdenum Electrodes	**FUNCTION:** Melter heating

ALTERNATIVE DESCRIPTION

- Determine need for high temperature operation using molybdenum electrodes if Silo 3 material is not vitrified. Also, remove interior melter walls to provide fewer chambers, thus lowering operating temperature and increasing throughput.

BENEFITS	DISADVANTAGES
• Reduce cost of electrodes. • Increase availability of electrodes. • Higher melter throughput. • Lower melter operating temperature. • Increase melter lifetime.	• Requires reworking melter interior.

VEALTEVL.ALT

VALUE STUDY
IMPLEMENTATION FEATURES FOR VALUE STUDY
PROPOSAL NO. 1H

PROJECT: Remedial Actions at Operable Unit 4	
COMPONENT: Diaphragm pumps	**FUNCTION:** Slurry transfer
ALTERNATIVE DESCRIPTION	
• Replace diaphragm pumps with more reliable type.	
BENEFITS	**DISADVANTAGES**
• Improve reliability. • Decrease maintenance requirements. • Increase on-stream time. • Eliminate plugging. • Eliminate leakage.	• Increase initial costs. • Potential initial schedule impact. • Additional engineering design.

VEALTEVL.ALT

VALUE STUDY
IMPLEMENTATION FEATURES FOR VALUE STUDY
PROPOSAL NO. 1I

PROJECT: Remedial Actions at Operable Unit 4	
COMPONENT: Off-gas system	**FUNCTION:** Clean up off-gas
ALTERNATIVE DESCRIPTION	
• Reevaluate the VITPP off-gas system for applicability, effectiveness and efficiency. Specific areas of evaluation include: a) use off-gas to preheat melter feed stream or provide system heating requirements, b) discuss carbon bed experience with MSE, and c) complete off-gas system analysis scheduling including size and plugging.	
BENEFITS	**DISADVANTAGES**
• Increase melter efficiency /throughput by decreasing heat requirements. • Resolve carbon bed combustion concern. • Eliminate need for carbon bed water quench. • Resolve concerns surrounding off-gas system capability/capacity.	• Some redesign and process system modification. • Additional engineering time. • Could result in changes to the off-gas system.

VEALTEVL.ALT

VALUE STUDY
IMPLEMENTATION FEATURES FOR VALUE STUDY
PROPOSAL NO. 1J

PROJECT: Remedial Actions at Operable Unit 4	
COMPONENT: Pneumatic transfer	**FUNCTION:** Feed material
ALTERNATIVE DESCRIPTION	
• Include a small wet cyclone in the design of the Silo 3 feed material pneumatic removal system.	
BENEFITS	**DISADVANTAGES**
• Decrease dusting. • Improve safety.	• Will require additional engineering. • Will increase VITPP costs.

VEALTEVL.ALT

VALUE STUDY
IMPLEMENTATION FEATURES FOR VALUE STUDY
PROPOSAL NO. 1K

PROJECT: Remedial Actions at Operable Unit 4	
COMPONENT: Silos 1 and 2	**FUNCTION:** Feed material
ALTERNATIVE DESCRIPTION	
• Remove uncontaminated portion of bentonite cap from Silos 1 and 2 prior to starting K-65 material removal. Dispose of bentonite with Pit 5 material or Silo 3 material.	
BENEFITS	**DISADVANTAGES**
• Reduce volume of material to be vitrified. • Reduce vitrification time. • Reduce costs. • Reduce cost of transportation and disposal of vitrified product.	• Additional engineering required to develop removal system.

VEALTEVL.ALT

VALUE STUDY
IMPLEMENTATION FEATURES FOR VALUE STUDY
PROPOSAL NO. 1L

PROJECT: Remedial Actions at Operable Unit 4	
COMPONENT: Silo 3 materials	**FUNCTION:** Melter feed
ALTERNATIVE DESCRIPTION	
• Treat Silo 3 material with method other than vitrification. Identify other on-site wastes that might be used to replace Silo 3 material.	
BENEFITS	**DISADVANTAGES**
• More efficient and effective treatment method for Silo 3 wastes. • Reduce the volume of waste to be vitrified. • Reduce total volume of waste treatment residuals. • Reduce number of waste disposal boxes. • Reduce transportation costs. • Reduce vitrifier melter operating temperature. • Use non-molybdenum electrodes.	• Develop new vitrification waste feed streams. • Identify new vitrification waste additives.

VEALTEVL.ALT

VALUE STUDY
IMPLEMENTATION FEATURES FOR VALUE STUDY
PROPOSAL NO. 1M

PROJECT: Remedial Actions at Operable Unit 4	
COMPONENT: Silos 1 and 2	**FUNCTION:** Feed Material
ALTERNATIVE DESCRIPTION	
• Vapor strip radon gas from Silos 1 and 2 K-65 feed material prior to removal for vitrification. Install perforated PVC pipe in K-65 material and purge radon with air. Use silo carbon beds to remove radon.	
BENEFITS	**DISADVANTAGES**
• Eliminate radon prior to moving feed material. • Improve safety. • Simplify off-gas system. • Could eliminate need for process system carbon beds.	• Design, install and operate air purge system needed. • Initial cost increase to VITPP.

VEALTEVL.ALT

VALUE STUDY
IMPLEMENTATION FEATURES FOR VALUE STUDY
PROPOSAL NO. 1N

PROJECT: Remedial Actions at Operable Unit 4	
COMPONENT: Operating Support	**FUNCTION:** Form glass
ALTERNATIVE DESCRIPTION	
• Review the support required to operate the VITPP. Support should include operations, maintenance, health physics, safety, management, and technical support.	
BENEFITS	**DISADVANTAGES**
• Generates an accurate evaluation of personnel needed to operate the VITPP. • Improve probability of having needed personnel. • Improve cost estimate credibility. • Meet conduct of operations/conduct of maintenance criteria.	• Could result in increased costs if evaluation indicates inadequate staffing.

VEALTEVL.ALT

IMPLEMENTATION OF PROPOSAL NO. 1A-1N

PROJECT: Remedial Actions at Operable Unit 4
CRITICAL ITEMS TO CONSIDER:
• DOE/FERMCO approvals.
• The latest cost and schedule estimates for the FRVP.
• "Life-cycle" estimates and schedules.
• VITPP a production facility.
• Probability of the VITPP being completed on schedule and within budget.
PROBLEMS AND HOW THEY CAN BE OVERCOME:
• Demonstrate value added: [redacted] schedule.
PROCEDURES: (WHO DOES WHAT)
• DOE Area Office, Field Office and FERMCO provide needed reviews and approvals.
• FERMCO study and determine which implementation suggestions to accept.
• Project to complete studies, designs and implementation.
SUMMATION OF BENEFITS AND DRAWBACKS OF THE VALUE STUDY PROPOSAL:
• Accelerate environmental cleanup
• Reduce costs

VEIMPLEM.TAB

VALUE STUDY PROPOSAL DESCRIPTION

PROJECT: Remedial Actions at Operable Unit 4

PROPOSAL NO. 2. STABILIZATION AND VOLUME REDUCTION USING VACUUM EXTRUSION

Background:
Cost-effective treatment of the silo wastes requires a balance of: 1) sufficient treatment to mitigate radon release and satisfy toxicity characteristic leaching procedure (TCLP) durability requirements, 2) volume reduction to optimize shipping and disposal, and 3) safe and reliable design to support operations and stakeholder concurrence.

Though vitrification seemed to satisfy all of these requirements, knowledge gained since the signing of the OU4 ROD indicates significant cost growth for deployment, and subsequent technical findings which may make reevaluation prudent.

Cost increases are due to unforeseeable complications such as: 1) the need for extensive testing of the innovative melter prototype, 2) the potential for fire due to nitrate absorption in the activated carbon used for radon capture, 3) decreasing the expected volume reduction by melting from 50 or 60 percent to 20 percent due to increased glass forming additives, and 4) schedule delays.

The material in Silo 3 is radically different from the material in Silos 1 and 2 (K-65 material). By-product material from processing higher assay pitchblende ores was pumped into Silos 1 and 2 as a slurry. The resulting sludges contain significant amounts of radium which is the major concern driving the selected decision to vitrify.

Silo 3 contains very fine metal oxide powder resulting from processing normal uranium ores. The powder was pneumatically conveyed into Silo 3 and contains only negligible amounts of radium.

Vitrification of the Silo 3 contents would probably not be the selected alternative even if Silo 3 were considered apart from Silos 1 and 2. First, the radionuclide content does not warrant the expensive vitrification step for safe disposal. Second, the fact that Silo 3 contains 15 percent SO_4 makes it a very poor candidate for vitrification and has greatly complicated the processing of the K-65 material where the real problem exists. Third, stabilization of the silo wastes with lime or cement meets TCLP durability requirements for RCRA metals as proven by treatability studies. Though reduction of radium leachability was not as effective with inorganic stabilizers as vitrification, disposal in the arid environment at the NTS effectively eliminates the drinking water exposure pathway. Finally, radon release must only be delayed sufficiently to allow decay to solid-phase [redacted]. This can be readily accomplished by adding activated carbon to the stabilizing mixture or as a layer in the packaging, or both if necessary. (This concept may be patentable)

Though volume reduction by melting may still be greater than for stabilization, the added costs for shipping and disposal are believed to be more than offset by the high cost and complexity of the vitrification system. Use of the proven vacuum extraction technology developed for use at Mound would expedite treatment while eliminating many of the complexities caused by the high-temperature vitrification system.

The existing equipment at Mound could be used for treatability studies, and if successful, then used for waste treatment. The vacuum operation is ideal for containment of radioactive contamination and removal of the initial radon inventory which simplifies handling of the product for packaging and shipment.

VALUE STUDY PROPOSAL DESCRIPTION

PROJECT: Remedial Actions at Operable Unit 4

PROPOSAL NO. 2. STABILIZATION AND VOLUME REDUCTION USING VACUUM EXTRUSION

Compaction of the stabilizing mixture and use of only the minimum additives necessary to pass the TCLP test may substantially reduce the volume increase estimated from the treatability studies to develop a waste form with 500 lb/in^2 unconfined compressive strength. A rectangular waste form would maximize packing efficiency in "white metal boxes." However, extrusion as small cylinders or pellets may simplify reprocessing of off-specification product.

Innovative adaptation of commercial vacuum extrusion technology to waste streams from steel mills, power plant fly ash, and sewage sludge has resulted in a proven process for volume reducing and stabilizing sludges and powders. Thus, redeployment of this innovative stabilization technology may be cost effective over the prototype vitrification technology initially selected. This reevaluation may also expedite treatment of silo wastes and allow substantial recovery of the planned schedule.

Proposal No. 2A:
The VST proposes that the material in Silo 3 be mixed with either cement and/or lime and vacuum extruded into an optimum waste form for disposal at Envirocare, by rail if possible. If the radionuclide concentrations are too high to meet the EnviroCare WAC, then the material should be shipped to NTS in standard white metal boxes.

The VST proposes that the existing DOE-owned vacuum extrusion unit currently idle at Miamisburg be moved to Fernald. The portable equipment should be used to perform a treatability study of the Silo 3 contents to determine the optimum stabilization formulation. Next, the contents of Silo 3 should be processed at the extruders nominal 10-ton/hour production design rate.

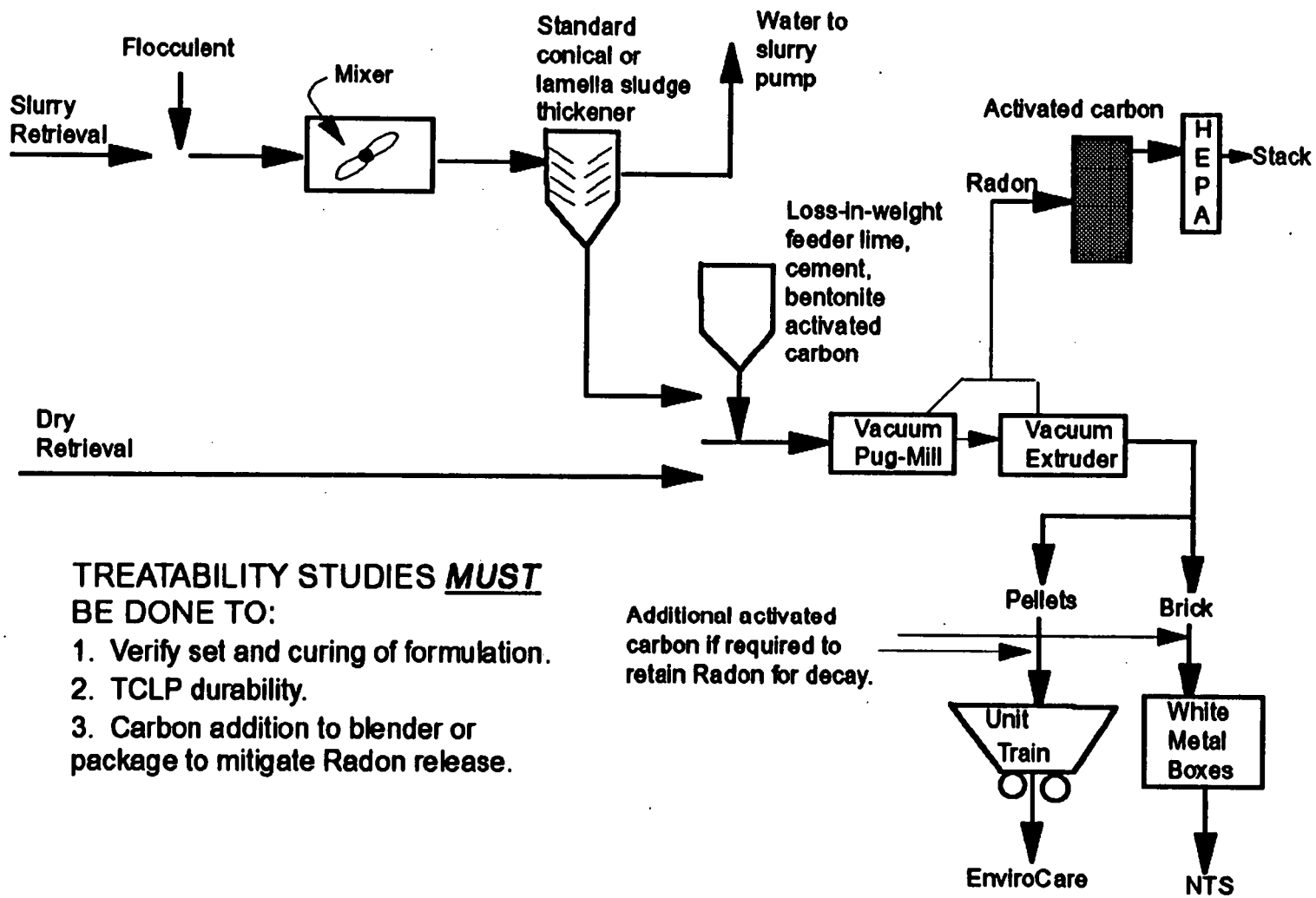
This processing is an option to blending Silo 3 waste with Pit 5 materials and would be used to support Value Proposal No. 1.

Proposal No. 2B:
The VST proposes that either during or after the processing of the Silo 3 contents, the vacuum extrusion equipment be used to test the suitability of stabilization/solidification on the K-65 material.

K-65 slurry could be pumped to the extruder with sufficient fly ash and lime/cement added to achieve solidification. The existing radon would be removed by the vacuum system and deposited on the existing carbon beds. In-growth of radon is gradual, allowing 2 hours of processing time at up to 1 percent of the initial levels, and up to 20 hours of handling time with up to 10 percent.

If the process proves more suitable than vitrification for the K-65 material, then a production capable large vitrification plant would not be required.

Figure 8. Vacuum Extrusion Stabilization Process



TREATABILITY STUDIES ***MUST*** BE DONE TO:

1. Verify set and curing of formulation.
2. TCLP durability.
3. Carbon addition to blender or package to mitigate Radon release.

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VALUE STUDY
ALTERNATIVE EVALUATION PROPOSAL NO. 2A

PROJECT: Remedial Actions at Operable Unit 4

COMPONENT: Glass Melter | **FUNCTION:** Stabilize Waste

ALTERNATIVE DESCRIPTION

- Inorganic stabilization using lime or Portland cement, and vacuum extrusion technology has been demonstrated commercially in several industrial applications, including metal oxides in the steel industry. Activated carbon used as a stabilization and/or a packing additive will retard radon release sufficiently to allow natural decay to immobile plutonium.

BENEFITS	DISADVANTAGES
• Accelerate initiation of processing from FY 2000 to FY 1997. • Large reduction in estimated life-cycle costs. • Reduce processing time from 7 years to 2 years. • Proven treatment using low temperature, basic technology and chemistry. • Equipment already capitalized and available locally. • Future recovery of radium as medical resource from a grout matrix would be much more readily accomplished than from a fused matrix. • Vacuum milling and extrusion ideally suited to capture radon and contain dust. • Equipment can be revised for other applications, minimizing D&D costs. • Low temperature avoids the potential of thermal oxidation of potential Polychlorinated Bithenyls listed in vitrification treatability studies. • Eliminate generation of NO_x • Eliminate potential for high-temperature foaming and phase separation. • Eliminate need for exotic materials. • Stabilization of Silo 3 materials allows vitrification of other materials (if necessary) at lower temperature.	• Less durable, though acceptable, waste form. • Lower radon retention may require addition of carbon to provide decay time.

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VALUE STUDY PROPOSAL NO. 2A

PROJECT: Remedial Actions at Operable Unit 4	
COMPONENT: Glass melter	**FUNCTION:** Stabilize Waste
ORIGINAL CONCEPT	**VALUE STUDY CONCEPT**
• Stabilization of Silo 3 wastes by melting at 1350°C to form vitreous high-durability waste form using an innovative melter prototype.	• Stabilization of Silo 3 wastes by ambient temperature, vacuum compaction to form an acceptable waste form with commercially developed existing technology.

COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	$ 304,000,000	
VALUE CONCEPT (-)	$ 236,000,000	
SAVINGS	$ 68,000,000	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	$ 68,000,000	
VALUE STUDY COSTS (-)	$ 63,000	
IMPLEMENTATION COSTS (-)	$ 0	
NET SAVINGS	**$ 67,937,000**	

* ONLY NONRECURRING SHOWN, LIFE CYCLE COSTING NOT COMPUTED.

VEALTMON.TAB

VALUE STUDY PROPOSAL NO. 2B

PROJECT: Remedial Actions at Operable Unit 4	
COMPONENT: Glass melter	**FUNCTION:** Stabilize Waste
ORIGINAL CONCEPT	**VALUE STUDY CONCEPT**
• Stabilization of all OU4 wastes by melting at 1350°C to form vitreous high-durability waste form using an innovative melter prototype.	• Stabilization of all OU4 wastes by ambient temperature, vacuum compaction to form an acceptable waste form at lesser cost with commercially developed existing technology.

COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	$ 304,000,000	
VALUE CONCEPT (-)	$ 208,000,000	
SAVINGS	$ 96,000,000	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	$ 96,000,000	
VALUE STUDY COSTS (-)	$ 63,000	
IMPLEMENTATION COSTS (-)	$ 0	
NET SAVINGS	**$ 95,937,000**	

* ONLY NONRECURRING SHOWN, LIFE CYCLE COSTING NOT COMPUTED.

VEALTMON.TAB

IMPLEMENTATION OF PROPOSAL NO. 2

PROJECT: Remedial Actions at Operable Unit 4

CRITICAL ITEMS TO CONSIDER:

- Treatability studies required to verify chemistry suitable for extrusion action and to satisfy TCLP.
- Addition of activated carbon to waste form or during packaging (or both) must be optimized to minimized Rn release. (This may be a patentable concept.) Cost benefit of disposal at NTS, EnviroCare, etc., and shipping by truck or rail must be optimized.

PROBLEMS AND HOW THEY CAN BE OVERCOME:

- In the case of Proposal No. 2B, renegotiation of ROD must be explained in terms of knowledge gained since ROD was signed, cost avoidance, and schedule recovery.
- Waste treatment by vitrification is jeopardized by significant cost growth.

PROCEDURES: (WHO DOES WHAT)

- Department of Energy - Ohio Field Office renegotiates ROD (Proposal No. 2B).
- FERMCO conducts treatability studies with Mound equipment and proposes new schedule for existing contractor deployment of technology or privatization via performance-based procurement.

SUMMATION OF BENEFITS AND DRAWBACKS OF THE VALUE STUDY PROPOSAL:

Benefits:

- Use of low-temperature stabilization expedites treatment with proven, yet innovative technology while eliminating unnecessary complications due to high-temperature processing.
- Use of existing and relatively standard equipment reduces life-cycle costs and may significantly expedite treatment.

Disadvantages:

- Less durable waste form.
- Lower radon retention may require addition of carbon.

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VALUE STUDY PROPOSAL DESCRIPTION

PROJECT: Remedial Actions at Operable Unit 4

PROPOSAL NO. 3. USE RAILROAD TO TRANSPORT PRODUCT TO NTS

Background:
The plan presented to the VST uses trucks to transport OU4 vitrified product to NTS.

Proposal:
This proposal is to transport the vitrified product from OU4 material by rail to the NTS. The existing rail connection between the FEMP and the Cottage Grove Line is being upgraded as a result of OU1 activities. The product would have to be transferred to truck as the last leg since there is no rail line within the NTS. While the relative amount of savings is small, when compared to the entire project, the mount is still significant and allows several non-monetary benefits.

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VALUE STUDY
ALTERNATIVE EVALUATION PROPOSAL NO. 3

PROJECT: Remedial Actions at Operable Unit 4

COMPONENT: Transportation | **FUNCTION:** Transport Waste

ALTERNATIVE DESCRIPTION

- Transport treated product via rail to NTS as much as practical.

BENEFITS	DISADVANTAGES
• Rail lines are more restricted from public access thereby a safer transportation method. • Fewer trips required thereby safer for accident probability. • Cheaper cost of rail transportation. • Potential negative public reaction from towns close to truck routes.	• Additional handling of waste increases off-loading worker exposure. • Negative public reaction near North Las Vegas Rail Yard. (May be mitigated by use of creating staging site on spur out of town.) • Would require storage of rail cars as unit trains are assembled (planned OU1 site may be used). • Local stakeholders along rail line would oppose rail shipment.

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VALUE STUDY PROPOSAL NO. 3

PROJECT: Remedial Actions at Operable Unit 4	
COMPONENT: Transportation	**FUNCTION:** Transport Waste
ORIGINAL CONCEPT	**VALUE STUDY CONCEPT**
• Transport product by truck to NTS.	• Transport product by rail and transfer to truck near NTS.

COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	$ 5,120,000	
VALUE CONCEPT (-)	$ 1,225,000	
SAVINGS	$ 3,895,000 **	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	$ 3,895,000	
VALUE STUDY COSTS (-)	$ 63,000	
IMPLEMENTATION COSTS (-)	$ 0	
NET SAVINGS	**$ 3,832,000**	

* ONLY NONRECURRING SHOWN, LIFE CYCLE COSTING NOT COMPUTED.

** Cost savings based on original concept of 1600 truck shipments at $3200/shipment with 2 boxes per shipment versus unit trains of 51 flat cars with 3 8-ft x 8-ft x 20-ft containers per flat car with 3 boxes within each container or 9 boxes per flat car for say $3500/flat car.

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IMPLEMENTATION OF PROPOSAL NO. 3

PROJECT: Remedial Actions at Operable Unit 4

CRITICAL ITEMS TO CONSIDER:

- No rail spur to NTS.
- Negative public reaction to high-level waste handling at the North Las Vegas Rail Yard.
- Local residents near FEMP rail line may oppose.

PROBLEMS AND HOW THEY CAN BE OVERCOME:

- A more remote location for intermodal transfer could be considered versus the North Las Vegas Rail Yard.
- Meeting with local residents similar to OU1 workshops.

PROCEDURES: (WHO DOES WHAT)

- DOE would control rail shipment via intermodal subcontractor.

SUMMATION OF BENEFITS AND DRAWBACKS OF THE VALUE STUDY PROPOSAL:

Benefits:

- Approximately $4,000,000,000 could be saved by transporting the OU4 material by rail versus truck.
- The accident and exposure scenarios to the general public would be reduced.

Disadvantages:

- Additional exposure due to handling.
- Potential negative reaction from public close to rail line.
- Requires short term storage of rail cars while train is assembled.

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ADDITIONAL ITEM FOR FURTHER STUDY DISCUSSION

PROJECT: Remedial Actions at Operable Unit 4

RECOMMENDATIONS FOR EXPLOITING THE SITE-WIDE POTENTIAL OF VACUUM EXTRUSION/ STABILIZATION TECHNOLOGY AT THE FEMP

Acceptance of the proposal to relocate the Miamisburg equipment (Proposal No. 2) will allow the following concepts to be tested and demonstrated at the FEMP:

I. WASTE PITS (OU1)

The wet and dry portions of the waste pits can be mixed and extruded to meet the WAC for moisture content at EnviroCare. If additional moisture removal is required, sufficient quicklime and fly ash can be added to meet the requirements.

Use of the extrusion equipment could completely eliminate the need to thermally dry any waste pit material. A commercially available 90 ton per hour extrusion plant could easily be installed on a turn-key basis as an alternative to complete privatization of the project.

II. WASTE PIT DENSIFICATION (OU1)

Some significant portion of the waste pit contents will have a bulk density of less than 70 pounds per cubic foot which will result in a penalty for low weight cars. Use of the extruder to compact the material will resolve this problem.

Control of the moisture/density relationship to within plus or minus 5 percent of the optimum is required at Envirocare or a penalty is imposed. The extrusion plant will allow this degree of control.

The true cost savings associated with volume reduction of the pit materials has not been established at Envirocare. Volume reduction of buried waste can be expected to reduce costs and minimize shipping and handling problems such as dusting, lower than optimum weight filling of containers, and avoidance of relative increased hazard of highway versus railroad movement of the waste material. However, the VST could not tie this concept down with Envirocare within the time constraints of the value study.

III. EXISTING DRUM INVENTORY

The bulk of the remaining drum inventory at Fernald consists of waste solids which could not be placed in the waste pits after they were closed by EPA in the late 1980's. Currently, the drums are being sent to NTS in white metal boxes for disposal.

Since the drums contain exactly the same material that is in the waste pits, it is proposed that they be unloaded and processed through the vacuum extruder. Ideally, the material could then be shipped with the pit waste to Envirocare by unit train. If the material for some reason still has to be shipped to NTS, the compacted waste could be loaded directly into the white metal boxes. The empty drums could be recycled and the total shipments to NTS could be reduced by 50 to 75 percent.

IV. ON-SITE ENGINEERED CELL

Large volume reductions of the materials going into the on-site cell are easily obtainable through extrusion methods. If DOE agrees to also lime stabilize the soils/sludge to retard uranium leaching, then perhaps the stakeholders would allow additional low-hazard materials such as the some of the OU1 pits to be stored on site. (Higher hazard sites such as the Silos would continue to be relocated to off-site in such plans.)

VALUE STUDY
ADDITIONAL ITEMS FOR FURTHER STUDY
(A LISTING OF ITEMS WITH POTENTIAL FOR COST OR OTHER VALUE IMPROVEMENT)

PROJECT: Remedial Actions at Operable Unit 4

DESCRIPTION	ESTIMATE OF DOLLARS INVOLVED	REMARKS
• Robot experience from other similar sites operating history.	Initial cost unspecified and life-cycle effect undetermined	• Other sites doing similar robot type operations have experienced a history of poor reliability and excessive downtime with this type equipment. Therefore, reliance on this piece of equipment may generate costly delays to the operations. • Consultations with other sites that have attempted to use this type of equipment will assist the project staff in learning how to avoid problems and may demonstrate methods to avoid the use of this troublesome equipment.
• Install cage around slurry intake.	Initial cost insignificant and life-cycle effect undetermined	• A cage around the intake would cost little and have no identified negative effect on activities. However, its addition would allow the intake to avoid plugging by debris, material clumps, or other potential litter. • Avoiding these potential pluggings of the intake will reduce the potential for delays, and costs associated with temporary shutdowns.
• Meet by teleconference or in person with Hanford staff and examine Hanford VE studies on similar activities.	Teleconference $500/hr Examine VE studies $200/each	• Hanford has done considerable work to determine methods to excavate in dry or reduced quantities of added water to the process. • Teleconferencing with Hanford, and the EM-50 waste tanks focus area to share their results, should produce ideas applicable to OU4. • Previous Value Studies and their implementation records on similar Hanford operations should be reviewed to determine if those ideas can be utilized on OU4.
• There appears to be serious concern about the off-gas system performance and fire hazards associated with the use of carbon beds.	Not computed	• MSE has employed a similar off-gas system with no incidents involving carbon bed. However, many lessons have been learned which can help minimize problems with the off-gas system. FERMCO personnel should communicate with Western Environmental Technology Office to take advantage of information gained within the complex.

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VALUE STUDY

ADDITIONAL ITEMS FOR FURTHER STUDY

(A LISTING OF ITEMS WITH POTENTIAL FOR COST OR OTHER VALUE IMPROVEMENT)

PROJECT: Remedial Actions at Operable Unit 4

DESCRIPTION	ESTIMATE OF DOLLARS INVOLVED	REMARKS
• FERMCO should investigate treatment of Silo 3 by solidification and stabilization through use of standard pug mill and pouring into boxes or drums of Silo 3.	Not computed	• If the solidification and stabilization method of Value Proposal No. 2 is not implemented, use of other cementation methods should be investigated in place of vitrification of Silo 3 materials.
• Silo 3 should be completely removed from the vitrification option for the project.	Not computed	• At the time of the Value Study, FERMCO was examining the potential of removing the material from the vitrification production stream. The VST strongly supports the continuation of FERMCO's activities in this endeavor. Silo 3 media presents significant problems to vitrification and is not the same level of waste as Silos 1 and 2. Therefore, a different method of remedy is recommended such as: - Adding the material to the waste steam of OU5, pit 5 operations, - Solidification and stabilization methods, - Other techniques identified by vendors via privatization.
• Separate high-activity wastes during processing to remove "hot" waste from bulk materials.	Potentially substantial, but not computed due to time restrictions	• There are systems that can monitor the waste stream for radium and remove that material from the bulk of the media. If such a system could remove the radium from the processing stream, significant quantities of material could be removed from the expensive treatment process and be disposed at EnviroCare. • A study to determine the applicability of this method to Silo 1 and two materials would be needed.
• Optimization of the operations and support staff for the silo project should be examined.	Not estimated	• The size of the project staff appears to be higher than on similar sites. The yearly cost of maintaining this staff is large. • A Value Study of the operation and support staff organization to relate functions required and needs should be conducted to determine the optimum staffing expertise and size. Certified Value Specialist consultants are available to assist in this task. (See team list and consultation list for contacts.)

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ADDITIONAL ITEM FOR FURTHER STUDY DISCUSSION

PROJECT: Remedial Actions at Operable Unit 4

Privatization of Operable Unit 4 Activities:

Since the scope of work of several projects at the FEMP are being evaluated for potential privatization or performance-based procurement contracts, the VST evaluated several alternatives and improvements to the OU4 remedial design concept and agreed that several of these alternatives could be privatized.

The Waste Pits Remedial Action Project (formerly OU1) is currently being evaluated for potential "privatization" efforts. The VST determined early in the study process that several of the VST Proposals could be integrated into the OU1 effort, or developed as stand-alone privatization efforts.

Consequently, the VST proposes consideration of two potential privatization strategies:

Strategy No. 1: Add the contents of Silo 3 to the scope of the OU1 project (Pit 5).

Strategy No. 2: Remove, treat, and dispose of Silo 3 as a stand-alone demonstration.

Strategy No. 1 would allow the OU1 vendor to utilize the approximately 700,000 cubic yards of contaminated waste within OU1 and OU4 Silo 3 material to develop the most appropriate blending ratios. The objective of the vendor should be to generate a waste product from OU1 Pit 5 and OU4 Silo 3 which would meet the WAC for the EnviroCare Disposal Site.

Strategy No. 2 would allow the vendor to demonstrate a viable treatment alternative for Silo 3 with the expectation that additional OU4 work could be obtained. The objective of the vendor should be to demonstrate a successful technology for the removal, treatment and disposal of OU4 Silo 3 materials such that the entire volume of Silo 3 could be remediated by the process. The contents of Silos 1 and 2 could potentially be added to the vendor's scope of work if Silo 3 materials are successfully remediated, although Silos 1 and 2 may require considerable modification to the vendor's system due to the different radiological hazards of their contents. The vendor could utilize any disposal location capable of receiving the treated product.

The performance specification under either the private sector procurements must be based on the lowest bid for the *entire* life-cycle of treatment, through placement at a suitable disposal site. This would provide the vendor a monetary incentive to cost effectively balance waste minimization with adequate treatment.

Any invitation for proof-of-principle or treatability studies must be linked to the award of follow-on work to the successful, low-cost vendor. The procurement must include obtaining adequate permitting, acceptable schedule for completion, and suitable profit based on satisfactory treatment, shipping and final disposal of wastes. Addition of the higher activity Silo 1 and 2 material should be at the option of the vendor, pending acceptance of the Silo 3 treatment and disposal by FERMCO. Final award must be based on satisfactory completion of fixed-price treatment through disposal of all Silo 1 and 2 wastes. Treatment technology should be left to the discretion of the vendor.

ADDITIONAL ITEM FOR FURTHER STUDY DISCUSSION

PROJECT: Remedial Actions at Operable Unit 4

Important point for privatization:

Due to the relatively low volume of wastes to be treated, and the capital-intensive development/construction of the proposed vitrification process, the investment is not amortized over a reasonable time period and the ratio of capital to operating dollars is inordinately high. This situation has good potential to benefit from privatization where used or developmental equipment can be deployed for treatment and the entire cost of equipment development/construction and D&D need not be borne by the treatment of one silo's wastes.

Reason to split off Silo 3:

The high sulfate content of the Silo 3 wastes necessitate higher temperature melting to preclude phase separation and foaming, which requires the design of a novel melter prototype rather than the use of proven technology. Treatment of Silo 3 wastes by blending or low-temperature stabilization eliminates the complication to vitrification while addressing the primary health risk of toxic metals. The other silo wastes may then be treated in a similar fashion if low-temperature stabilization is sufficient, or by lower temperature vitrification using a more conventional melter design.

VALUE STUDY
ALTERNATIVE EVALUATION FOR PRIVATIZATION
STRATEGY NO. 1

PROJECT: Remedial Actions at Operable Unit 4	
COMPONENT: Silo 3	**FUNCTION:** Treat Waste
ALTERNATIVE DESCRIPTION	
• Add the contents of Silo 3 to the scope of the OU1 project (Pit 5).	
BENEFITS	**DISADVANTAGES**
• Integrate well with the existing OU1 study. • The cost to evaluate would be moderate. • Reduce scope of OU4 which may schedule recovery. • Envirocare disposal will be cheaper than NTS. • Rail transport will be cheaper and safer than truck. • Low initial capital outlay.	• Will require extensive negotiation with OU1 and OU4 stakeholders. • RODs may need to be reopened for public comment. • RCRA determination of Silo 3 material may be unfavorable. • Inflexible disposal location.

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VALUE STUDY
ALTERNATIVE EVALUATION FOR PRIVATIZATION
STRATEGY NO. 2

PROJECT: Remedial Actions at Operable Unit 4	
COMPONENT: Silo 3	**FUNCTION:** Treat Waste
ALTERNATIVE DESCRIPTION	
• Remove, treat, and dispose of Silo 3 as a stand-alone demonstration.	
BENEFITS	**DISADVANTAGES**
• Allow disposal location flexibility. • The market would generate potentially successful treatment strategies. • Low initial capital outlay. • Vendor shares risk through satisfactory completion. • In line with EM-30 privatization initiative. • Procurement could reduce DOE-directive requirements to allow lower-cost completion by NRC-licensee.	• Does not integrate well with OU1 privatization strategy. • RCRA concerns.

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IMPLEMENTATION OF PRIVATIZATION STRATEGY NO. 1

PROJECT: Remedial Actions at Operable Unit 4

CRITICAL ITEMS TO CONSIDER:

- Vendor references and experience, technical support, and capital assets.
- Stakeholder concerns.
- Schedule to completion.

PROBLEMS AND HOW THEY CAN BE OVERCOME:

- Renegotiation of ROD - should be based on cost and technical knowledge gained on vitrification.
- Blending of Silo 3 and OU1 material must be carefully characterized to ensure blending provides suitable treatment for all wastes without generating mixed-wastes and without perception of treatment purely by dilution.

PROCEDURES: (WHO DOES WHAT)

- The DOE Ohio Field Office proposes renegotiation to State to expedite treatment and facilitate treatment under diminishing budget forecasts.
- The DOE Ohio Field Office procurement crafts language for request for proposals based on DOE experience with Savannah River Site M-area sludges and INEL Pit 9.

SUMMATION OF BENEFITS AND DRAWBACKS OF THE VALUE STUDY PROPOSAL:

Benefits:

- Performance based procurement should expedite treatment and disposal of Silo 3 (Potentially Silo 1 and 2) wastes while developing technological capabilities in private sector. Costs will be fixed, but not necessarily lower than current plan.
- Systems-based approach should effectively eliminate both pit and silo wastes, but caution must be exercised to maintain compliance under land disposal restriction for waste disposal.

Disadvantages:

- ROD renegotiation may not be readily accepted by stakeholders.

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IMPLEMENTATION OF PRIVATIZATION STRATEGY NO. 2

PROJECT: Remedial Actions at Operable Unit 4

CRITICAL ITEMS TO CONSIDER:

- RCRA determination of Silo 3.
- Inflexibility of disposal site WAC.
- OU1 is already considering privatization.
- Market will decide successful vendor.

PROBLEMS AND HOW THEY CAN BE OVERCOME:

- Write a descriptive performance-based specification for the privatization vendor.
- Determine the RCRA status of Silo 3 through characterization sampling and process knowledge.

PROCEDURES: (WHO DOES WHAT)

- FERMCO evaluates Value Engineering strategies.
- FERMCO prepares Commerce Business Daily announcements.
- DOE evaluates proposals with FERMCO.

SUMMATION OF BENEFITS AND DRAWBACKS OF THE VALUE STUDY PROPOSAL:

Benefits:

- Great way to introduce successful technologies into the FEMP, with limited capital investment in equipment.

Disadvantages:

- Resource Conservation Recovery Act determination and CERCLA and stakeholder concerns.

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CONSULTATION RECORD

CONSULTANT (Name, Title, Company/Address)	CONTACT INFO (Telephone, Location)	MAIN TOPIC DISCUSSED AND INFORMATION RECEIVED
Jay Roach	INTEL - Mixed Waste Focus Area (208) 526-4974	Shipping requirements
George Beitel	INTEL - Mixed Waste Focus Area (208) 526-0042	Radionuclide decay calculations
Ian L. Pegg Vitreous State Laboratory The Catholic University of America	Washington, DC (202) 319-6700	Vitrification Melter Operation
William Kelly Value Engineering Services Transworld 1861 Brevor Drive Walla Walla, WA 99362	(509) 525-2866	Value Method Consulting Services, Facilitator, Team Leading
Bernie Dull Solutions 9032 South Gray Fox Dr. Golden, CO 80439-6208	(303) 670-5620	Value Method Consulting Services, Facilitator, Team Leading
James Dziekonski President, Cost Improvement Management Services, Inc. Box 1248 Golden, CO 80492	(303) 986-6060	Value Method Consulting Services, Facilitator, Team Leading

CONSULT.REC

INFORMATION/DATA DOCUMENTS CONSULTED

DOCUMENT (Name, Author, Dates, etc.)	INFORMATION RECEIVED/USED
Detailed Analysis of Alternatives for Operable Unit 4, Task 13 Presentation, RI/FS, June 1990.	Background information and overall site situation discussions.
Proposed Plan for Remedial Actions at Operable Unit 4, DOE/EIS-0195D, February 1994.	Proposed work plan activities and approach.
Final Record of Decision for Remedial Actions at Operable Unit 4, FEMP, DOE, December 1994.	This was the basic criteria and plan document which governs the project during the VE study period. Consulted for the ROD plan, other major options considered, background for ROD, criteria, public concerns, and site information.
Fact Sheet for the *Proposed Plan for Remedial Actions at Operable Unit 4*, February 1994.	Background
Project Execution Plan (PEP) for Operable Unit 4 Vitrification Pilot Plant, 25-WP-0017, October 1995.	Proposed work plan activities and approach.

INFORMATION/DATA DOCUMENTS CONSULTED

DOCUMENT (Name, Author, Dates, etc.)	INFORMATION RECEIVED/USED
OU4 Project Notes, from a multi-disciplined team established to review the cause of the Vitrification Plant (Vit-PP) delays and cost overruns. (Undated)	Review of current implementation status, concept history and background relating to the execution of the ROD plan.
Environmental Restoration and Waste Management Five-Year Plan for FY94-FY98, Volume III Public Concerns, DOE, August 1993.	Background information for remediation process in DOE sites and master plan information.
Annual Environmental Report for Calendar Year 1990 for Feed Materials Production Center, Westinghouse Materials Company of Ohio, December 1991.	Background information for the overall site, historical operations, and environmental concerns.
FEMP Roadmap FY92, Westinghouse Environmental Management Company of Ohio, September 1991.	Background information, schedule environment, and operational flow plans for previous concepts.
Environmental Restoration and Waste Management FY93-FY97, DOE, August 1991.	Background information for remediation process in DOE sites and master plan information.
MAWS High Temperature, Melter Development, by I. L. Pegg, undated.	High temperature vitrification information.
Joule Heated Melter Systems for Low Level and Transuranic Wastes, by D. F. Bickford, October 1995.	High temperature vitrification information.
Savannah River Site M-Area Mixed Waste Vitrification Privatization, by B. W. Bowman, undated.	Vitrification information.
Glass Compositional Envelope, by I. L. Pegg, undated.	Vitrification information.
Joule-Heated Melter Systems Development, by Thomas J. Overcamp, November 1995.	Vitrification information.
Vitrification Studies on Waste Streams Containing Difficult to Vitrify Components, R. Merrill, PNL, November 1995.	Vitrification information.
An evaluation of Glass-Crystal Composite Waste Forms for the Disposal of Nuclear and Hazardous Waste Materials, by David J. Wronkiewicz, ANL, undated.	Vitrification information.
Vitrification Waste Forms and Requirements, S. Bates, INEL, November 1995.	Vitrification information.

INFORMATION/DATA DOCUMENTS CONSULTED

DOCUMENT (Name, Author, Dates, etc.)	INFORMATION RECEIVED/USED
Thermal Treatment Technologies Program/Technical Peer Review, X. Feng, PNNL, November 1995.	Vitrification information.
Vitreous Ceramic - A Complementary Waste Form to Homogeneous Glass for Treating Low-Level/Mixed Wastes, X. Feng, PNNL, undated.	Vitrification information.
Introduction to Health Physics - Second Edition, pages 84 & 89, H. Cember, Pergamon Press, New York.	Radon decay rates.

DOCUMENT.REC

REMEDIAL ACTIONS AT OPERABLE UNIT 4

RECORD OF DECISION PLAN VALUE STUDY

DESIGN TEAM BRIEFING ATTENDANCE LIST

January 8, 1996

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Gail Bingham	INTECH	(301) 903-1290
Mark Dehring	FERMCO, Fernald, OH	(513) 648-4793
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Gary D. Walters	FERMCO, Fernald, OH	(513) 648-5063

OU4_DESN.MTG

GLOSSARY

ALARA	As Low as Reasonably Achievable
ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
D&D	Decontamination and decommissioning
DOE	Department of Energy
DOE-NV	Department of Energy - Nevada Operations Office
DOE-OH	Department of Energy - Ohio Field Office
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FEMP	Fernald Environmental Management Project
FERMCO	Fernald Environmental Restoration Management Corporation
FMPC	Fernald Environmental Management Project
FRVP	Fernald Residues Vitrification Plant
NEPA	National Environmental Policy Act
NRC	Nuclear Regulatory Commission
NTS	Nevada Test Site
OEPA	Ohio Environmental Protection Agency
RCRA	Resource Conservation Recovery Act
RDR	Radon Decay Rate
ROD	Record of Decision
RTS	Radon Treatment System
SCR	Selective Catalytic Reduction
TCLP	Toxicity Characteristic Leaching Procedure
VITPP	Vitrification Pilot Plant
WAC	Waste Acceptance Criteria

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INTRODUCTION TO HEALTH PHYSICS

SECOND EDITION—REVISED AND ENLARGED

Herman Cember
Northwestern University

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$\tau_{1/2}$ $Ra^{226} = 1622$ yr

$\tau_{1/2}$ $Rn^{222} = 3.8\,d = \frac{3.8\,d}{365\,d/yr} = 0.0104$ yr

$$\lambda(Ra^{226}) = \frac{0.693}{1622} = 4.27\times10^{-4}\ yr^{-1}$$

$$\lambda(Rn^{222}) = \frac{0.693}{0.0104} = 66.6\ yr^{-1}$$

at equilibrium,

$$\lambda_{Ra} N_{Ra} = \lambda_{Rn} N_{Rn}$$

But Specific Activity = Curie = λN

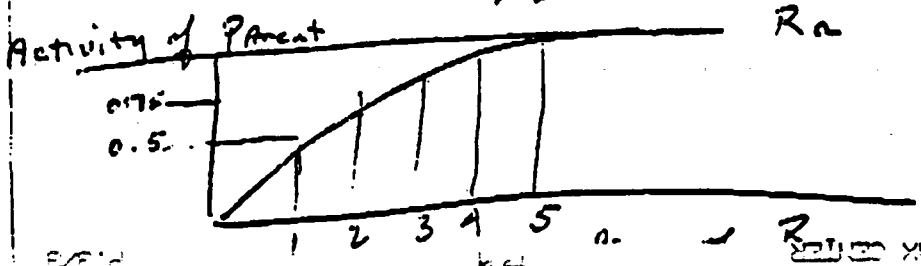
∴ at equilibrium, Rn-Activity (in curies) = Ra-Activity

for $\lambda_D << \lambda_P$

D = Daughter P = parent

$$N_D = \frac{\lambda_P N_P}{\lambda_D}\left(1 - e^{-\lambda_D t}\right)$$

(if the Daughter of Rn is ~~long lived~~ ~~Daughter~~ Ra



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INTRODUCTION TO HEALTH PHYSICS

SECOND EDITION—REVISED AND ENLARGED

Herman Cember
Northwestern University

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TABLE 4.3. URANIUM SERIES ($4n + 2$)

Nuclide	Half-life	Energy, MeV		
		Alpha[a]	Beta	Gamma (photons/trans.)[b]
$^{238}_{92}U$	4.51×10^9 y	4.18		
$^{234}_{90}Th(UX_1)$	24.10 d		0.193, 0.103	0.092(0.04) 0.063(0.03)
$^{234m}_{91}Pa(UX_2)$	1.175 m		2.31	1.0(0.015) 0.76(0.0063), I.T.
$^{234}_{91}Pa(UZ)$	6.66 h		0.5	Many weak
$^{234}_{92}U(UII)$	2.48×10^5 y	4.763		
$^{230}_{90}Th(I_o)$	8.0×10^4 y	4.685		0.068(0.0059)
$^{226}_{88}Ra$	1.622 y	4.777		
$^{222}_{86}Em(Rn)$	3.825 d	5.486		0.51 (very weak)
$^{218}_{84}Po(RaA)$	3.05 m	5.998 (99.978%)[c]	Energy not known (0.022%)[c]	0.186(0.030)
$^{218}_{85}At(RaA')$	2 s	6.63 (99.9%)[c]	Energy not known (0.1%)[c]	
$^{218}_{86}Em(RaA'')$	0.019 s	7.127		
$^{214}_{82}Pb(RaB)$	26.8 m		0.65	0.352(0.036) 0.295(0.020) 0.242(0.07)
$^{214}_{83}Bi(RaC)$	19.7 m	5.505 (0.04%)[c]	1.65, 3.7 (99.96%)[c]	0.609(0.295) 1.12(0.131)
$^{214}_{84}Po(RaC')$	1.64×10^{-4} s	7.680		
$^{210}_{81}Tl(RaC'')$	1.32 m		1.96	2.36(1) 0.783(1) 0.297(1)
$^{210}_{82}Pb(RaD)$	19.4 y		0.017	0.0467(0.045)
$^{210}_{83}Bi(RaE)$	5.00 d		1.17	
$^{210}_{84}Po(RaF)$	138.40 d	5.298		0.802(0.000012)
$^{206}_{82}Pb(RaG)$	Stable			

[a],[b],[c],[d] See footnotes under Table 4.1.

s solid → g ↔ s solid

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Supporting Documentation

CODE: D 8170

ESTIMATE WORKSHEET

FEATURE: C:\123R31\OU4_B0.WK3

OU4 COSTING DATA
VITRIFICATION
OFF-SITE DISPOSAL

12-Jan-96

PROJECT:

DIVISION:

UNIT:

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			SOURCE				
	3	DEMOLISH AND DECONTAIMATE	OU4		LS	$33,300,000.00	
		SILOS AND FACILITIES	esr	1	LS	$17,700,000.00	$17,700,000.00
		WASTE MANAGEMENT	esr	1	LS	$2,600,000.00	$2,600,000.00
		FINAL SITE RESTORATION	esr	1	LS	$13,000,000.00	$13,000,000.00
	4	ADMINISTRATION / MANAGEMENT / DISTRIBUTIVE	OU4			$19,990,000.00	
		OWNERSHIP	esr	1	LS	$5,400,000.00	$5,400,000.00
		CREW MANAGEMENT	esr	1	LS	$10,700,000.00	$10,700,[illegible]0
		SUPPORT PROJECTS	esr	1	LS	$1,720,000.00	$1,720,000.00
		ENVIRONMENTAL MONITORING / COMPLIANCE	esr	1	LS	$1,500,000.00	$1,500,000.00
		FS / PP		1	LS	$300,000.00	$300,000.00
		ROD		1	LS	$195,000.00	$195,000.00
		RD / RA		1	LS	$175,000.00	$175,000.00

QUANTITIES		PRICES	
BY	APPROVED	BY	CHECKED
DATE PREPARED	DATE	DATE 12-Jan-96	PRICE LEVEL 95

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FEATURE: C:\123R31\OU4_B0.WK3

OU4 COSTING DATA
VITRIFICATION
OFF-SITE DISPOSAL

12-Jan-96

PROJECT:

DIVISION:

UNIT:

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		SUMMARY					
		VITPP					$33,330,000.00
		FRVP					$143,800,000.00
		D&D					$33,300,000.00
		ADMINISTRATION / MANAGEMENT / DISTRIBUTIVE					$19,990,000.00
		SUBTOTAL					$230,420,000.00
		UNLISTED	+/-	10.0%			$22,580,000.00
		ESTIMATED PROJECT COST					$253,000,000.00
		CONTINGENCIES	+/-	20.0%			$51,000,000.00
		ESTIMATED FIELD COST					$304,000,000.00
		REFERENCES:					
	FS6	ALTERNATIVE COST SUMMARY SHEET					
		Removal, Stablization w/Vitrification, Off-site disposal @ NTS					
		FEB 94					
	OU4	OU4 Costs - 1/8/96					
		Total Life Cycle Costs for OU4 FY94 - FY05					
	TF	Treatment Facility [FVRP only]					
		Est. date of 95					
	#	ADS 49-B2 Operable Unit 4					
		Nov. 95					
	est	Escalation removed from number where appropriate; added					
		back in the summation					

QUANTITIES		PRICES	
	APPROVED	BY	CHECKED
DATE PREPARED	DATE	DATE 12-Jan-96	PRICE LEVEL 95

CODE: D 8170

ESTIMATE WORKSHEET

FEATURE: C:\123R31\OU4_B1.WK3

OU4 COSTING DATA
VITRIFICATION [Silos 1 & 2]
SECOND PILOT PLANT OPTION
Alt. treatment for Silo 3

12-Jan-96

PROJECT:

DIVISION:

UNIT:

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			SOURCE				
	1	VITPP [PILOT PLANTS]			LS	$107,230,000.00	
		PLANT 1					
		ENGINEERING	OU4	1	LS	$10,580,000.00	$10,580,000.00
		Less expenditures to date:	VS				($9,080,000.00)
		EQUIPMENT	OU4	1	LS	$4,830,000.00	$4,830,000.00
		Less expenditures to date:	VS				($3,000,000.00)
		CONSTRUCTION	OU4	1	LS	$14,100,000.00	$14,100,000.00
		Less expenditures to date:	VS				($12,600,000.00)
		OPERATIONS Includes waste packaging & shipments		1	LS	$23,400,000.00	$23,400,000.00
		Phase I	#4A141			$5,400,000.00	
		Phase II	TEAM			$18,000,000.00	
		STARTUP	OU4	1	LS	$5,200,000.00	$5,200,000.00
		PLANT 2					
		ENGINEERING	TEAM	1	LS	$5,000,000.00	$5,000,000.00
		EQUIPMENT	TEAM	1	LS	$6,000,000.00	$6,000,000.00
		CONSTRUCTION	TEAM	1	LS	$6,000,000.00	$6,000,000.00
		OPERATIONS		1	LS	$31,600,000.00	$31,600,000.00
		Phase II	TEAM			$6,000,000.00	
		Pack / ship / disposal	fax			$25,600,000.00	
		STARTUP	OU4	1	LS	$5,200,000.00	$5,200,000.00
		D&D [DEMOLITION & DECONTAIMINATION]	TEAM	1	LS	$20,000,000.00	$20,000,000.00
		BOTH PLANTS					
	2	FRVP					DELETED
		Alt. treatment setup for Silo 3		1	LS	$27,000,000.00	$27,000,000.00

QUANTITIES		PRICES	
BY	APPROVED	BY	CHECKED
DATE PREPARED	DATE	DATE 12-Jan-96	PRICE LEVEL 95

000081

ESTIMATE WORKSHEET

FEATURE: C:\123R31\OU4_B0.WK3

OU4 COSTING DATA
VITRIFICATION
OFF-SITE DISPOSAL

12-Jan-96

PROJECT:

DIVISION:

UNIT:

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		SUMMARY					
		VITPP					$33,330,000.00
		FRVP					$143,800,000.00
		D&D					$33,300,000.00
		ADMINISTRATION / MANAGEMENT / DISTRIBUTIVE					$19,990,000.00
		SUBTOTAL					$230,420,000.00
		UNLISTED	+/-	10.0%			$22,580,000.00
		ESTIMATED PROJECT COST					$253,000,000.00
		CONTINGENCIES	+/-	20.0%			$51,000,000.00
		ESTIMATED FIELD COST					$304,000,000.00
		REFERENCES:					
	FS6	ALTERNATIVE COST SUMMARY SHEET					
		Removal, Stablization w/Vitrification, Off-site disposal @ NTS					
		FEB 94					
	OU4	OU4 Costs - 1/8/96					
		Total Life Cycle Costs for OU4 FY94 - FY05					
	TF	Treatment Facility (FVRP only)					
		Est. date of 95					
	#	ADS 49-B2 Operable Unit 4					
		Nov. 95					
	esr	Escalation removed from number where appropriate; added					
		back in the summation					

QUANTITIES		PRICES	
	APPROVED	BY	CHECKED
DATE PREPARED	DATE	DATE 12-Jan-96	PRICE LEVEL 95

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CODE: D 8170

ESTIMATE WORKSHEET

FEATURE: C:\123R31\OU4_B1.WK3

OU4 COSTING DATA
VITRIFICATION [Silos 1 & 2]
SECOND PILOT PLANT OPTION
Alt. treatment for Silo 3

12-Jan-96

PROJECT:

DIVISION:

UNIT:

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		SUMMARY					
		VITPP					$107,230,000.00
		FRVP					DELETED
		Alt. Processing for Silo 3					$27,000,000.00
		D&D					$33,300,000.00
		ADMINISTRATION / MANAGEMENT / DISTRIBUTIVE					$19,990,000.00
		SUBTOTAL					$187,520,000.00
		UNLISTED	+/-	10.0%			$18,480,000.00
		ESTIMATED PROJECT COST					$206,000,000.00
		CONTINGENCIES	+/-	20.0%			$41,000,[illegible]0
		ESTIMATED FIELD COST					$247,000,000.00
		REFERENCES:					
	FS6	ALTERNATIVE COST SUMMARY SHEET					
		Removal, Stablization w/Vitrification, Off-site disposal @ NTS					
		FEB 94					
	OU4	OU4 Costs - 1/8/96					
		Total Life Cycle Costs for OU4 FY94 - FY05					
	TF	Treatment Facility [FVRP only]					
		Est. date of 95					
	#	ADS 49-B2 Operable Unit 4					
		Nov. 95					
	est	Escalation removed from number where appropriate; added					
		back in the summation					

QUANTITIES		PRICES	
BY	APPROVED	BY	CHECKED 000083
DATE PREPARED	DATE	DATE 12-Jan-96	PRICE LEVEL 95

ESTIMATE WORKSHEET

FEATURE: C:\123R31\OU4_B3.WK3

OU4 COSTING DATA
VAC EXTRACTION & EXTRUSION
SYSTEM [ALL 3 SILOS]
OFF-SITE DISPOSAL

12-Jan-96

PROJECT:

DIVISION:

UNIT:

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			SOURCE				
	1	VITPP [PILOT PLANT]			LS	$33,330,000.00	
		ENGINEERING	OU4	1	LS	$10,580,000.00	$10,580,000.00
		Less expenditures to date:	VS				($9,080,000.00)
		EQUIPMENT	OU4	1	LS	$4,830,000.00	$4,830,000.00
		Less expenditures to date:	VS				($3,000,000.00)
		CONSTRUCTION	OU4	1	LS	$14,100,000.00	$14,100,000.00
		Less expenditures to date:	VS				($12,600,000.00)
		OPERATIONS Includes waste packaging & shipments		1	LS	$8,300,000.00	$8,300,000.00
		Phase I	#4A141			$5,400,000.00	
		Phase II	#4A142			$2,900,000.00	
		D&D [DEMOLITION & DECONTAIMINATION]	TEAM	1	LS	$15,000,000.00	$15,000,000.00
		STARTUP	OU4	1	LS	$5,200,000.00	$5,200,000.00
	2	FRVP					DELETED

QUANTITIES		PRICES	
	APPROVED	BY	CHECKED
DATE PREPARED	DATE	DATE 12-Jan-96	PRICE LEVEL 95

ESTIMATE WORKSHEET

FEATURE: C:\123R31\OU4_B3.WK3

OU4 COSTING DATA
VAC EXTRACTION & EXTRUSION SYSTEM [ALL 3 SILOS]
OFF-SITE DISPOSAL

12-Jan-96

PROJECT:

DIVISION:

UNIT:

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		SUMMARY					
		VITPP					$33,330,000
		FRVP					Deleted
		VACUUM EXTRACTION SYSTEM					$71,000,000
		D&D					$33,300,000
		ADMINISTRATION / MANAGEMENT / DISTRIBUTIVE					$19,990,000
		SUBTOTAL					$157,620,000
		UNLISTED	+/-	10.0%			$15,380,000
		ESTIMATED PROJECT COST					$173,000,000
		CONTINGENCIES	+/-	20.0%			$35,0[illegible]
		ESTIMATED FIELD COST					$208,000,000
		REFERENCES:					
	FS6	ALTERNATIVE COST SUMMARY SHEET					
		Removal, Stablization w/Vitrification, Off-site disposal @ NTS					
		FEB 94					
	OU4	OU4 Costs - 1/8/96					
		Total Life Cycle Costs for OU4 FY94 - FY05					
	TF	Treatment Facility [FVRP only]					
		Est. date of 95					
	#	ADS 49-B2 Operable Unit 4					
		Nov. 95					
	esr	Escalation removed from number where appropriate; added					
		back in the summation					

QUANTITIES		PRICES	
BY	APPROVED	BY	CHECKED
DATE PREPARED	DATE	DATE 12-Jan-96	PRICE LEVEL 95

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from Fig 4.14 we see that the activity from Rn builds up to 50% of the Ra activity in 1 half life, or 3.8 days.

to ~95% of Ra activity in 5 half lives or 19 days

it is essentially linear over the first half life

i.e.	time	fraction of total (Maximum)
	1 hrs	0.005
	2	0.011
	10	0.05
	20	0.11
	40	0.22
	60	0.33
3.8 days	91 hrs	0.5

close, but not finite

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ESTIMATE WORKSHEET

FEATURE: C:\123R31\OU4_B3.WK3

OU4 COSTING DATA
VAC EXTRACTION & EXTRUSION
SYSTEM [ALL 3 SILOS]
OFF-SITE DISPOSAL

12-Jan-96

PROJECT:

DIVISION:

UNIT:

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			SOURCE				
	1	VITPP [PILOT PLANT]			LS	$33,330,000.00	
		ENGINEERING	OU4	1	LS	$10,580,000.00	$10,580,000.00
		Less expenditures to date:	VS				($9,080,000.00)
		EQUIPMENT	OU4	1	LS	$4,830,000.00	$4,830,000.00
		Less expenditures to date:	VS				($3,000,000.00)
		CONSTRUCTION	OU4	1	LS	$14,100,000.00	$14,100,000.00
		Less expenditures to date:	VS				($12,600,000.00)
		OPERATIONS Includes waste packaging & shipments		1	LS	$8,300,000.00	$8,300,000.00
		Phase I	#4A141			$5,400,000.00	
		Phase II	#4A142			$2,900,000.00	
		D&D [DEMOLITION & DECONTAMINATION]	TEAM	1	LS	$15,000,000.00	$15,000,000.00
		STARTUP	OU4	1	LS	$5,200,000.00	$5,200,000.00
	2	FRVP					DELETED

QUANTITIES		PRICES	
	APPROVED	BY	CHECKED 000087
DATE PREPARED	DATE	DATE 12-Jan-96	PRICE LEVEL 95

CODE: D 8170

ESTIMATE WORKSHEET

FEATURE: C:\123R31\OU4_B3.WK3

OU4 COSTING DATA
VAC EXTRACTION & EXTRUSION
SYSTEM [ALL 3 SILOS]
OFF-SITE DISPOSAL

12-Jan-96

PROJECT:

DIVISION:

UNIT:

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		PROCESSING SILO 3 MATERIALS USING VAC, EXTRENSION		1	LS	$71,000,000.00	
		TREATABILITY STUDY FOR VAC EXTRUSION		1	LS	$2,000,000.00	$2,000,000.00
		REWORK ROD & PERMITTING		1	LS	$1,000,000.00	$1,000,000.00
		SITE PREP CHECKOUT - RELOCATE AND INSTALL EQUIPMENT		1	LS	$10,000,000.00	$10,000,000.00
		EQUIPMENT MODIFICATIONS		1	LS	$2,000,000.00	$2,000,000.00
		OPERATIONS		1	LS	$1,000,000.00	$1,000,000.00
		WASTE MANAGEMENT		1	LS	$50,000,000.00	$50,000,000.00
		Transportation					
		Packaging					
		Disposal					
		Processing					
		D&D [DEMOLITION & DECONTAIMINATION]	TEAM	1	LS	$5,000,000.00	$5,000,000.00

QUANTITIES		PRICES	
BY	APPROVED	BY	CHECKED 000085
DATE PREPARED	DATE	DATE 12-Jan-96	PRICE LEVEL 95

CODE: D 8170

ESTIMATE WORKSHEET

FEATURE: C:\123R31\OU4_B2.WK3

OU4 COSTING DATA
VITRIFICATION / VAC EXTRACTION & EXTRUSION SYSTEM [SILO 3 ONLY]
OFF-SITE DISPOSAL

12-Jan-96

PROJECT:

DIVISION:

UNIT:

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			SOURCE				
	1	VITPP [PILOT PLANTS]			LS	$107,230,000.00	
		PLANT 1					
		ENGINEERING	OU4	1	LS	$10,580,000.00	$10,580,000.00
		Less expenditures to date:	VS				($9,080,000.00)
		EQUIPMENT	OU4	1	LS	$4,830,000.00	$4,830,000.00
		Less expenditures to date:	VS				($3,000,000.00)
		CONSTRUCTION	OU4	1	LS	$14,100,000.00	$14,100,000.00
		Less expenditures to date:	VS				($12,600,000.00)
		OPERATIONS Includes waste packaging & shipments		1	LS	$23,400,000.00	$23,400,000.00
		Phase I	#4A141			$5,400,000.00	
		Phase II	TEAM			$18,000,000.00	
		STARTUP	OU4	1	LS	$5,200,000.00	$5,200,000.00
		PLANT 2					
		ENGINEERING	TEAM	1	LS	$5,000,000.00	$5,000,000.00
		EQUIPMENT	TEAM	1	LS	$6,000,000.00	$6,000,000.00
		CONSTRUCTION	TEAM	1	LS	$6,000,000.00	$6,000,000.00
		OPERATIONS		1	LS	$31,600,000.00	$31,600,000.00
		Phase II	TEAM			$6,000,000.00	
		Pack / ship / disposal	fax			$25,600,000.00	
		STARTUP	OU4	1	LS	$5,200,000.00	$5,200,000.00
		D&D [DEMOLITION & DECONTAIMINATION]	TEAM	1	LS	$20,000,000.00	$20,000,000.00
		BOTH PLANTS					
	2	FRVP					DELETED

QUANTITIES		PRICES	
	APPROVED	BY	CHECKED
DATE PREPARED	DATE	DATE 12-Jan-96	PRICE LEVEL 95

0000655

CODE: D 6170

ESTIMATE WORKSHEET

FEATURE: C:\123R31\OU4_B2.WK3

OU4 COSTING DATA
VITRIFICATION / VAC EXTRACTION & EXTRUSION SYSTEM [SILO 3 ONLY]
OFF-SITE DISPOSAL

12-Jan-96

PROJECT:

DIVISION:

UNIT:

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		SUMMARY					
		VITPP					$107,230,000.00
		FRVP					DELETED
		VACUUM EXTRACTION SYSTEM					$18,500,000.00
		D&D					$33,300,000.00
		ADMINISTRATION / MANAGEMENT / DISTRIBUTIVE					$19,990,000.00
		SUBTOTAL					$179,020,000.00
		UNLISTED	+/-	10.0%			$17,980,000.00
		ESTIMATED PROJECT COST					$197,000,000.00
		CONTINGENCIES	+/-	20.0%			$39,000,000.00
		ESTIMATED FIELD COST					$236,000,000.00
		REFERENCES:					
	FS6	ALTERNATIVE COST SUMMARY SHEET					
		Removal, Stablization w/Vitrification, Off-site disposal @ NTS					
		FEB 94					
	OU4	OU4 Costs - 1/8/96					
		Total Life Cycle Costs for OU4 FY94 - FY05					
	TF	Treatment Facility [FVRP only]					
		Est. date of 95					
	#	ADS 49-B2 Operable Unit 4					
		Nov. 95					
	esr	Escalation removed from number where appropriate; added					
		back in the summation					

QUANTITIES		PRICES	
BY	APPROVED	BY	CHECKED
DATE PREPARED	DATE	DATE 12-Jan-96	PRICE LEVEL 95

000090

FEATURE: C:\123R31\OU4_B2.WK3

OU4 COSTING DATA
VITRIFICATION / VAC EXTRACTION & EXTRUSION SYSTEM [SILO 3 ONLY]
OFF-SITE DISPOSAL

12-Jan-96

PROJECT:

DIVISION:

UNIT:

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			SOURCE				
	1	VITPP [PILOT PLANTS]			LS	$107,230,000.00	
		PLANT 1					
		ENGINEERING	OU4	1	LS	$10,580,000.00	$10,580,000.00
		Less expenditures to date:	VS				($9,080,000.00)
		EQUIPMENT	OU4	1	LS	$4,830,000.00	$4,830,000.00
		Less expenditures to date:	VS				($3,000,000.00)
		CONSTRUCTION	OU4	1	LS	$14,100,000.00	$14,100,000.00
		Less expenditures to date:	VS				($12,600,000.00)
		OPERATIONS Includes waste packaging & shipments		1	LS	$23,400,000.00	$23,400,000.00
		Phase I	#4A141			$5,400,000.00	
		Phase II	TEAM			$18,000,000.00	
		STARTUP	OU4	1	LS	$5,200,000.00	$5,200,000.00
		PLANT 2					
		ENGINEERING	TEAM	1	LS	$5,000,000.00	$5,000,000.00
		EQUIPMENT	TEAM	1	LS	$6,000,000.00	$6,000,000.00
		CONSTRUCTION	TEAM	1	LS	$6,000,000.00	$6,000,000.00
		OPERATIONS		1	LS	$31,600,000.00	$31,600,000.00
		Phase II	TEAM			$6,000,000.00	
		Pack / ship / disposal	fax			$25,600,000.00	
		STARTUP	OU4	1	LS	$5,200,000.00	$5,200,000.00
		D&D [DEMOLITION & DECONTAIMINATION]	TEAM	1	LS	$20,000,000.00	$20,000,000.00
		BOTH PLANTS					
	2	FRVP					DELETED

QUANTITIES		PRICES	
BY	APPROVED	BY	CHECKED 00000
DATE PREPARED	DATE	DATE 12-Jan-96	PRICE LEVEL 95

CODE: D 8170

ESTIMATE WORKSHEET

FEATURE: C:\123R31\OU4_B2.WK3

OU4 COSTING DATA
VITRIFICATION / VAC EXTRACTION & EXTRUSION SYSTEM [SILO 3 ONLY]
OFF-SITE DISPOSAL

12-Jan-96

PROJECT:

DIVISION:

UNIT:

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		PROCESSING SILO 3 MATERIALS USING VAC. EXTRENSION		1	LS	$18,500,000.00	
		TREATABILITY STUDY FOR VAC EXTRUSION		1	LS	$2,000,000.00	$2,000,000.0
		REWORK ROD & PERMITTING		1	LS	$1,000,000.00	$1,000,000.0
		SITE PREP CHECKOUT - RELOCATE AND INSTALL EQUIPMENT		1	LS	$10,000,000.00	$10,000,000.0
		EQUIPMENT MODIFICATIONS		1	LS	$2,000,000.00	$2,000,000.0
		OPERATIONS		1	LS	$400,000.00	$400,000.0
		WASTE MANAGEMENT		1	LS	$7,000,000.00	$7,000,000.0
		Transportation				$2,000,000.00	
		Packaging				$800,000.00	
		Disposal				$3,000,000.00	
		Processing				$1,200,000.00	
		D&D [DEMOLITION & DECONTAMINATION]	TEAM	1	LS	$5,000,000.00	$5,000,000.0
		COST SAVINGS IN REDUCED FRVP OPERATIONS		1	LS	($8,900,000.00)	($8,900,000.0
		Transportation				($2,000,000.00)	
		Packaging				($800,000.00)	
		Disposal				($3,000,000.00)	
		Processing				($1,200,000.00)	
		Operations				($1,900,000.00)	

QUANTITIES		PRICES	
BY	APPROVED	BY	CHECKED 000092
DATE PREPARED	DATE	DATE 12-Jan-96	PRICE LEVEL 95