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**SILO PROJECT INDEPENDENT REVIEW TEAM NOVEMBER 14 AND 15,  
1996 MEETING AGENDA, HANDOUTS AND MEETING NOTES**

**11/14/96**

**IRT  
150  
AGENDA**

## MEETING AGENDA

**Subject:** FEMP Silos Project, Path Forward Decision  
**Date:** November 14 and 15, 1996  
**Location:** FEMP Alpha Bldg., Fernald, OH

### Thursday, November 14

8:00	Welcome / Introductions / Logistics	R. Heck
8:30	Purpose	R. Heck
8:45	Introduction to Formal Decision Process	L. Merkhofer
9:45	Break	
9:55	Project History & Status	D. Paine
11:30	Lunch	
12:00	Preparation for VITPP Tour	D. Daniels
12:30	VITPP Tour	N. Akgunduz / D. Nixon
2:30	VITPP Tour Q&A / Project History & Status - Continued	D. Paine
4:30	Meeting Concludes	

### Friday, November 15

8:00	Opening	D. Paine
8:15	FEMP Press Coverage	R. Maslin
8:30	Review and Initiation of Decision Process	L. Merkhofer
	<ul style="list-style-type: none"> <li>• Objectives</li> <li>• Alternatives</li> </ul>	
11:30	Lunch	
12:00	Decision Process (Continued)	L. Merkhofer
2:00	Meeting Assessment/Path Forward	L. Merkhofer
3:00	Meeting Concludes	

**FEMP Silos Project  
Path Forward Decision  
Distribution List**

Independent Review Team w/Attachments

Gail E. Bingham, consultant  
Gilles Chevrier, NUMATEC  
Robert Cook, consultant  
Jim Edmondson, consultant  
Carol Jantzen, WSRC  
Bob Lawrence, WVNS  
Todd Martin, HEAL  
John Plodinec, WSRC  
Bob Roal, consultant  
Ray Schumacher (alternate)  
Ben Smith, consultant

Decision Analysis Support Contractor

Lee Merkhofer, Applied Decision Analysis, Inc.  
w/Attachment

Fluor Daniel Fernald

John Bradburne w/o Attachments  
Mike Connors w/o Attachments  
Doug Daniels w/o Attachments  
Mark Dehring w/ Attachments  
Yvonne Gale w/o Attachments  
Terry Hagen w/o Attachments  
Bob Heck w/ Attachments  
Rick Maslin w/o Attachments  
Richard L. Maurer w/o Attachments  
Dennis Nixon w/o Attachments  
Don Paine w/ Attachments  
Harry Robertson w/ Attachments  
Jeff Stone w/o Attachments

Jeannie Foster w/ Attachments  
Jill Oligee w/ Attachments

DOE-FN

Nina Akgunduz w/ Attachments  
Johnny Reising w/o Attachments

FRESH w/ Attachments

Lisa Crawford  
Vicky Dastilling

Citizens Task Force

w/ Attachments  
Gloria McKinley  
Doug Sarno  
Gene Willeke

FATLAC

Robert Tabor w/ Attachments  
Rick Wilson w/ Attachments

Building Trades w/ Attachments

Lou Doll

U.S. EPA-V

Gene Jablonowski  
w/ Attachments  
Jim Saric w/o Attachments

Ohio EPA

Kelly Kaletsky w/ Attachments  
Tom Schneider w/o Attachments

Others w/ Attachments

Marc Fioravanti, IEER  
Ben Rusche, MTR Inc.  
Silos Project File 40000  
Fernald Public Reading Room

11/22/96

000002

**MEETING NOTES**

**SUBJECT:** Silos Project, Path Forward Decision

**MEETING DATE:** November 14 & 15, 1996

**LOCATION:** Fluor Daniel Fernald Office

**ISSUE DATE:** November 18, 1996

MN:WMTSP(SP):96-0028  
File Record Storage Copy 104.(35).5  
Project Number 40000

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**DISTRIBUTION:** Refer to the Attached Distribution List

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**1.0 PURPOSE**

This meeting served as a kickoff of the Silos Project path forward decision process. A team of subject matter experts (the Silos Project Independent Review Team) has been assembled to serve as an advisory group and technical resource. The Silos Project Independent Review Team consists of nine members with recognized expertise in environmental restoration programs, vitrification and cement stabilization technologies. The team includes:

1. Mr. Gail E. Bingham, consultant
2. Mr. Gilles Chevrier, NUMATEC
3. Mr. F. Robert Cook, consultant
4. Mr. James N. Edmondson, consultant
5. Mr. Robert Lawrence, West Valley Nuclear Services Co.
6. Mr. Todd Martin, Hanford Education Action League
7. Dr. John Plodinec, Westinghouse Savannah River Company (primary)  
Dr. Carol Jantzen, Westinghouse Savannah River Company (secondary)
8. Mr. Robert Roal, consultant
9. Mr. Benjamin L. Smith, consultant

The Independent Review Team will participate, along with representatives of stakeholder groups, regulatory agencies, the DOE and Fluor Daniel Fernald (FDF), in developing a Silos Project path forward decision recommendation. The process will involve a series of meetings to review project developments, review and analyze alternative path forward scenarios, and develop recommendations in support of a path forward decision. Applied Decision Analysis, Inc. will facilitate the decision analysis process.

## MEETING NOTES - Continued

## 2.0 DISCUSSION

2.1 Overview

The meeting was conducted in accordance with the attached agenda. Bob Heck, Vice President of Waste Management, Technology, and Silos Project, opened the two-day meeting with introductions of the team and other involved participants (a list of attendees is attached). Bob provided an overview of the issues currently facing the Silos Project, the objectives of the two-day meeting, and the objectives of the path forward decision process. Bob expressed the desire that the process will allow the Independent Review Team to bring their lessons learned to bear on the issues, and enable the Project to successfully complete the final remediation of the silos residues in a safe and cost effective manor. Bob introduced Dr. Lee Merkhofer of Applied Decision Analysis, Inc. Lee has substantial experience in the application of decision analysis to management of environmental issues with the DOE complex.

2.2 Introduction to Formal Decision Process

Lee Merkhofer explained the decision analysis process proposed for the development and evaluation of the path forward options. The process combines key elements--preferences, alternatives, information--with logic to arrive at a decision. There are five steps to the decision analysis process: (1) Establish decision objectives; (2) Identify decision options; (3) Specify performance measures that indicate the degree to which options achieve objectives. If performance is uncertain, all potential decision outcomes may need to be evaluated; (4) Establish the equation for combining performance measures into an overall measure of option desirability, including importance weights; and (5) Estimate decision outcomes, evaluate performance, compute overall desirability, and investigate whether differences in ratings or weights affect results.

Lee illustrated the process by describing two recent applications: one involved the siting of a hazardous waste management facility at Sandia National Laboratory, the other involved an evaluation of the tank waste retrieval systems for the single-shelled tanks at the DOE Hanford Facility. Both examples involved complex technical and environmental issues, and representatives of the DOE, regulatory agencies and stakeholders. In each case the decision analysis process successfully assisted in reaching a recommendation supported by all parties.

2.3 Vitrification Pilot Plant (VITPP) Tour

All the members of the Silos Project Independent Review Team plus the stakeholders and EPA representatives toured the Vitrification Pilot Plant. Nina Akgunduz, DOE OU4 Team Leader, and Dennis Nixon, VITPP Manager, served as tour guides.

MEETING NOTES - Continued

2.4 Project History & Status

Don Paine, Manager of the Silos Project, gave a detailed presentation on the history and current status of Operable Unit 4. Topics discussed included origin of the silos residues, development of the RI/FS and ROD, regulatory milestones, radon related issues, objectives and status of the VITPP program and the development and assessment of remediation alternatives. Questions were fielded throughout the presentation. Information requested by the team that was not included in their original packet was noted and will be provided to them.

2.5 FEMP Press Coverage

Rick Maslin, Director of Public Affairs, gave an update on the media coverage of the VITPP and the silos that began in February 1996. Most members of the Silos Project Independent Review Team are not from the Ohio area and, therefore, were not aware of the coverage.

2.6 Review and Initiation of Decision Process

Lee Merkhofer proceeded to walk the group through the first two steps of the process: Establish Decision Objectives and Identify Decision Options. A brainstorming session followed on "what's important." Over 25 objectives were submitted plus other key influencing factors. These objectives were displayed for the group as a hierarchy of path forward alternative selection criteria (draft Objectives Hierarchy attached). Don Paine presented the history and status of remediation alternatives and recommended three basic path forward alternatives be included in the decision process:

- (1) vitrify Silos 1, 2, & 3 residues;
- (2) vitrify Silos 1 & 2 residues and use cement stabilization for Silo 3 residues; and
- (3) use cement stabilization for Silos 1, 2, & 3.

Alternative (1) was the original baseline for the Silos Project. Alternative (2) was evaluated following issue of the Value Engineering report in January 1996 and has since been adopted as the current basis for the Silos Project. Alternative (3) has not received serious consideration or evaluation since the Operable Unit 4 Feasibility Study.

2.7 Path Forward

Before the next meeting Lee Merkhofer will prepare a straw man of the next step in the process, building upon the accomplishments of this initial meeting. Step 3 will specify performance measures that indicate the degree to which the alternatives achieve the objectives. By using a "decision tree," performance measures such as public risk, worker risk, and cost will be applied to all "branches" such as regulatory approval, technical

**MEETING NOTES - Continued**

success, availability of the on-site disposal facility and weighted to see if the options/alternatives still meet the objectives.

Mark Dehring, Silos Project Engineering Manager, will serve as the primary point of contact for both the Independent Review Team and Applied Decision Analysis. The next meetings are scheduled for December 12 and 13, 1996, also at the FEMP Alpha Building.

**3.0 ACTIONS**

3.1 During the course of the two-day meeting, the following information was requested by members of the Independent Review Team:

Provide the quantity and estimated value of precious metals in Silos 1, 2 and 3 residues (attached).

Provide a comparison of vitrification and cement stabilization with respect to volume reduction. Include volume, density and additives (topic will be addressed at the next meeting).

For the current baseline, provide waste disposal costs (packaging, transportation, burial, etc.). Provide a comparison of waste disposal costs to the total life cycle cost of the Silos Project (topic will be addressed at the next meeting).

Provide a cost breakdown of the VITPP. Provide a history of the Silos Project budget and schedule. This topic will be addressed at the next meeting.

The Value Engineering Final Report included a proposal involving stabilization and volume reduction using vacuum extrusion. Provide a copy of the white paper addressing this proposal (attached).

The original package of Silos Project documentation provided to the Independent Review Team did not include work plans relating to the VITPP. Provide copies of the VITPP Treatability Work Plan (distributed at the meeting and attached).

Provide the offgas composition for the VITPP (will be provided under separate cover).

Provide copies of Treatability Studies for Silos 1, 2 and 3 residues included in the original Operable Unit 4 Feasibility Study (attached).

Provide details of the Waste Acceptance Criteria for the Nevada Test Site (attached).

Provide final reports from other mixed waste cement stabilization projects at the FEMP (one final report attached).

**MEETING NOTES** - Continued

Several of the questions posed by the Independent Review Team addressed the scope and capabilities of the waste retrieval system. Provide a copy of the Silos Project Waste Retrieval System Conceptual Design Report (attached).

- 3.2 All data provided to the Silos Project Independent Review Team will be copied to the FEMP Public Reading Room.

LIST OF ATTACHMENTS

Meeting Agenda

List of Attendees

✓ Independent Review Team Names & Addresses

✓ Project History & Status Presentation by Donald Paine

✓ Introduction to Decision Analysis Presentation by Lee Merkhofer

✓ Silos Project Press Coverage (Series of Cincinnati Enquirer Articles)

✓ Objectives Hierarchy (draft)

✓ OU4 VITPP Phase I Treatability Study Work Plan, WP-25-0007, Rev. 2

Nevada Test Site Defense Waste Acceptance Criteria, Certification and Transfer Requirements, NVO-325 (Rev. 1), June 1992

Brick Maker Feasibility Evaluation/Fernald Environmental Management Project, DOE-1219-96, September 4, 1996.

The Fernald Mobile Mixed Waste Stabilization Project

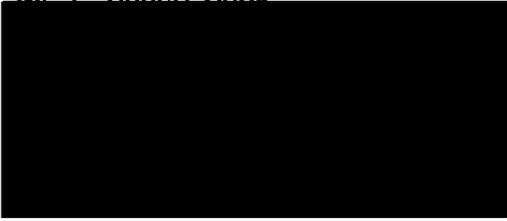
✓ Feasibility Study Report for Operable Unit 4: Appendix C--Summary of Cement Stabilization, Chemical Extraction, and Vitrification Treatability Studies; and Appendix E--Detailed Cost Estimates

Waste Retrieval System Conceptual Design Report

Table 2: Characteristics of the K-65 Residues Stored in Building 434 of the DOE-Niagara Falls Storage Site and at the FMPC, Fernald, OH (Quantity and Value of the Precious Metals in Silos 1, 2 and 3)

Independent Consultants

1. Mr. Gail E. Bingham  

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(615)364-3103 fax
10. Mr. Robert C. Roal  
Independent Consultant  
1601 Butternut Avenue  
Richland, WA 99352-2743  
(509)946-0372  
(509)946-0372 fax (call ahead to  
let him know it's coming)

TABLE 2. CHARACTERISTICS OF THE K-65 RESIDUES STORED IN BUILDING 434 OF THE DOE-NIAGARA FALLS STORAGE SITE AND AT THE FMPC, FERNALD, OH

Characteristic	FMPC Stored K-65		Niagara Falls Stored K-65	
	Litz(a)	NLO(b)	BCL(d)	NLO(b)
Dry wt, kg (tons)	-	8.79x10 <sup>6</sup> (9,690)	-	(1,757)
Estimated volume, m <sup>3</sup> (ft <sup>3</sup> )	-	5,522 (195,000)	-	(110,000)
Density, kg/m <sup>3</sup> (lb/ft <sup>3</sup> )	-	-	-	(73.6)
Uranium, ppm	1,800-3,200	600	500(e) 18,240(f) 30,000(g) 1410-1961(h)	500
Lead, ppm	60-70,000	48-52,000	35,000	95,000
Radium, ppb	280-360	200	217	180
Barium, ppm	50,000	-	30,000	-
Iron, ppm	13-18,000	-	5,000	-
Gold, ppm	65-78	<40-60	<0.2	-
Platinum, ppm	0.9-1.4	-	<0.5	6
Palladium, ppm	13-18	-	20	-
Silver, ppm	18	<20	<3	-
Copper, ppm	500-800	400-600	500	-
Cobalt, ppm	1,600-2,000	1,500-2,000	2,000	-
Nickel, ppm	3,500-3,700	2,000-3,000	3,000	-

(a) Source: Litz, 1974.  
 (b) Source: NLO, Inc., and Battelle Columbus Laboratories, 1980.  
 (c) Source: Vitro Corp., 1952.  
 (d) Same as (b) above.  
 (e) Direct gamma spectroscopy of the residue.  
 (f) X-ray diffraction of the residue.  
 (g) Spark source mass spectroscopy.  
 (h) Calculated U from Ra measurements.

\* 1.8 Troy Oz./Ton of Residue  
 (1.8)(4,262 T) = 25,672 Troy Oz. x \$380 = \$9.8 M

# **Introduction to Decision Analysis**

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**November 14, 1996**

*Presented by:*  
**Lee Merkhofer**  
**Justin Claeys**



**Applied Decision Analysis, Inc.**  
**2710 Sand Hill Road**  
**Menlo Park, CA 94025-7065**

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# **Decision analysis is formal, mathematical approach for evaluating decision options**

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- Taught in business schools
- Often used by private sector to help make major business decisions
- Recently tried on environmental problems with public participation
- Basic philosophy:
  - The best alternatives is the one that best achieves decision objectives

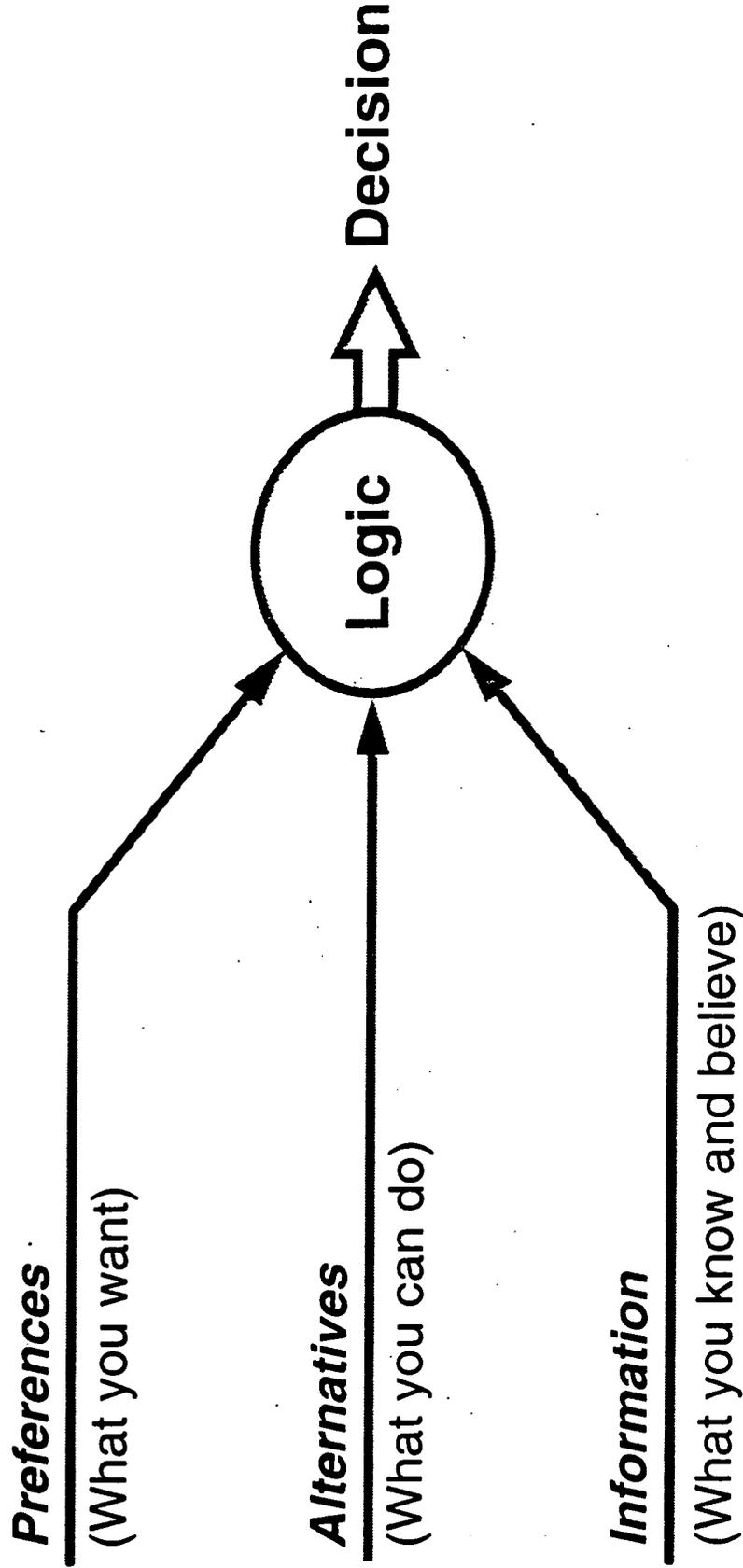
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**Decision analysis is a process for constructing and logically combining the key elements of a decision**

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## **The five step decision analysis process**

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1. Establish decision objectives
2. Identify decision options
3. Specify performance measures that indicate the degree to which options achieve objectives. If performance is uncertain, all potential decision outcomes may need to be evaluated.
4. Establish the equation for combining performance measures into an overall measure of option desirability, including importance weights
5. Estimate decision outcomes, evaluate performance, compute overall desirability, and investigate whether differences in ratings or weights affect results.

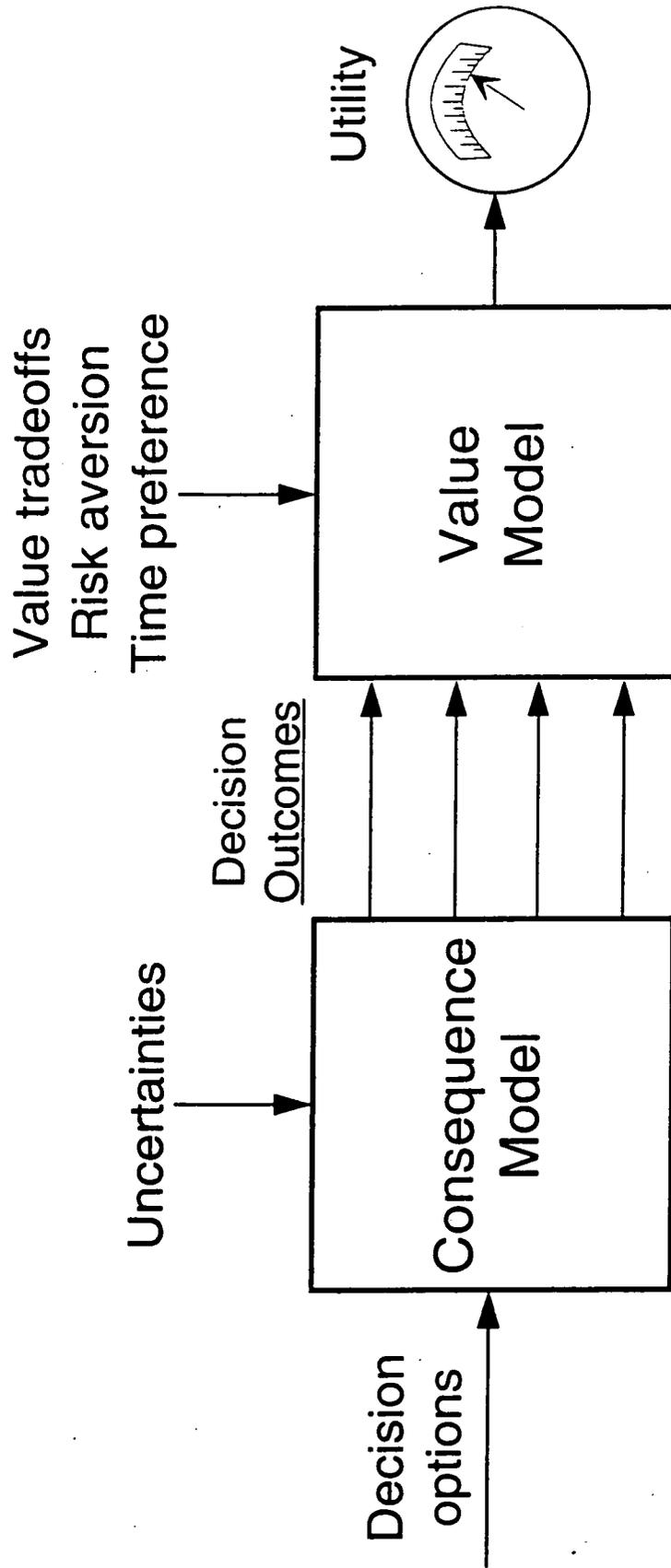
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# Following the steps produces a model of the decision

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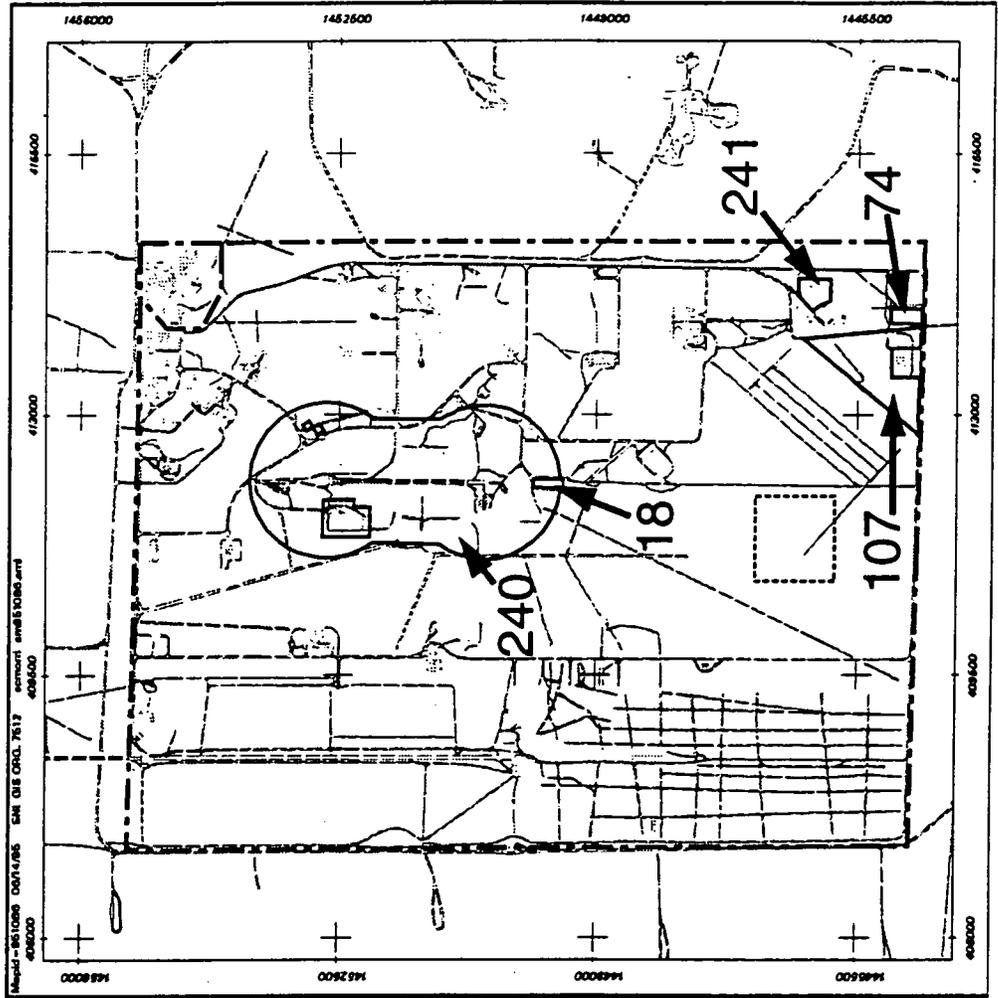


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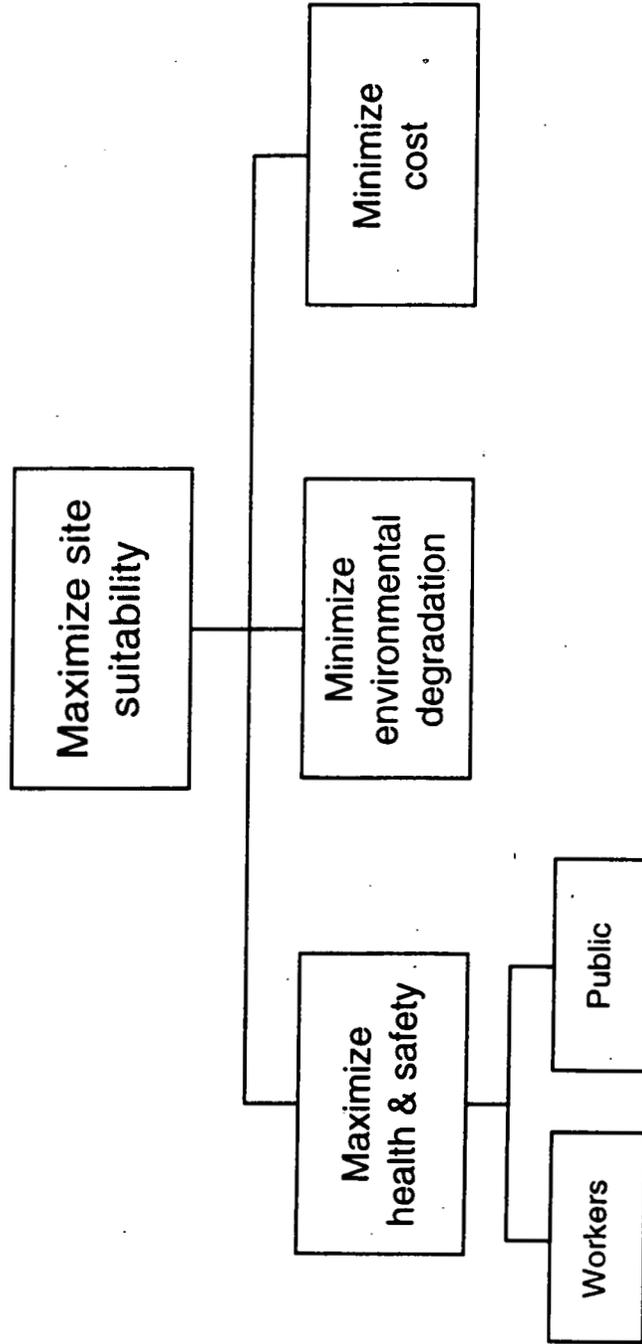


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# Step 1 (prior to 1st meeting): EPA siting criteria used to screen 156 locations down to 5 feasible siting options

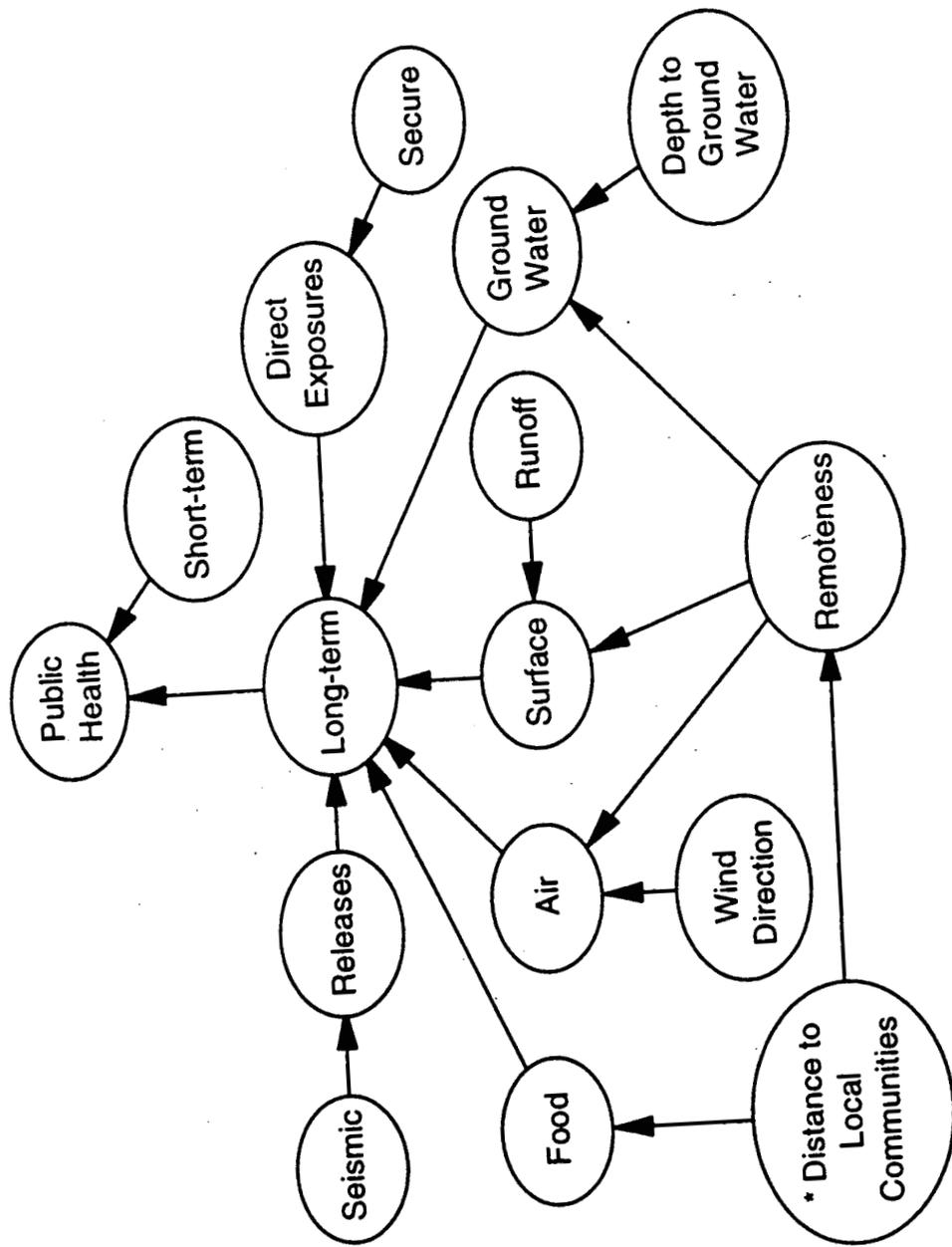


# Step 2 (1st meeting): Stakeholders agree on decision objectives



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**Step 3 (1st meeting): Facility operators identify factors influencing the degree to which options influence objectives**



# Step 4 (between 1st and 2nd meeting): Prioritization team defines rating scales and facility operator scores options

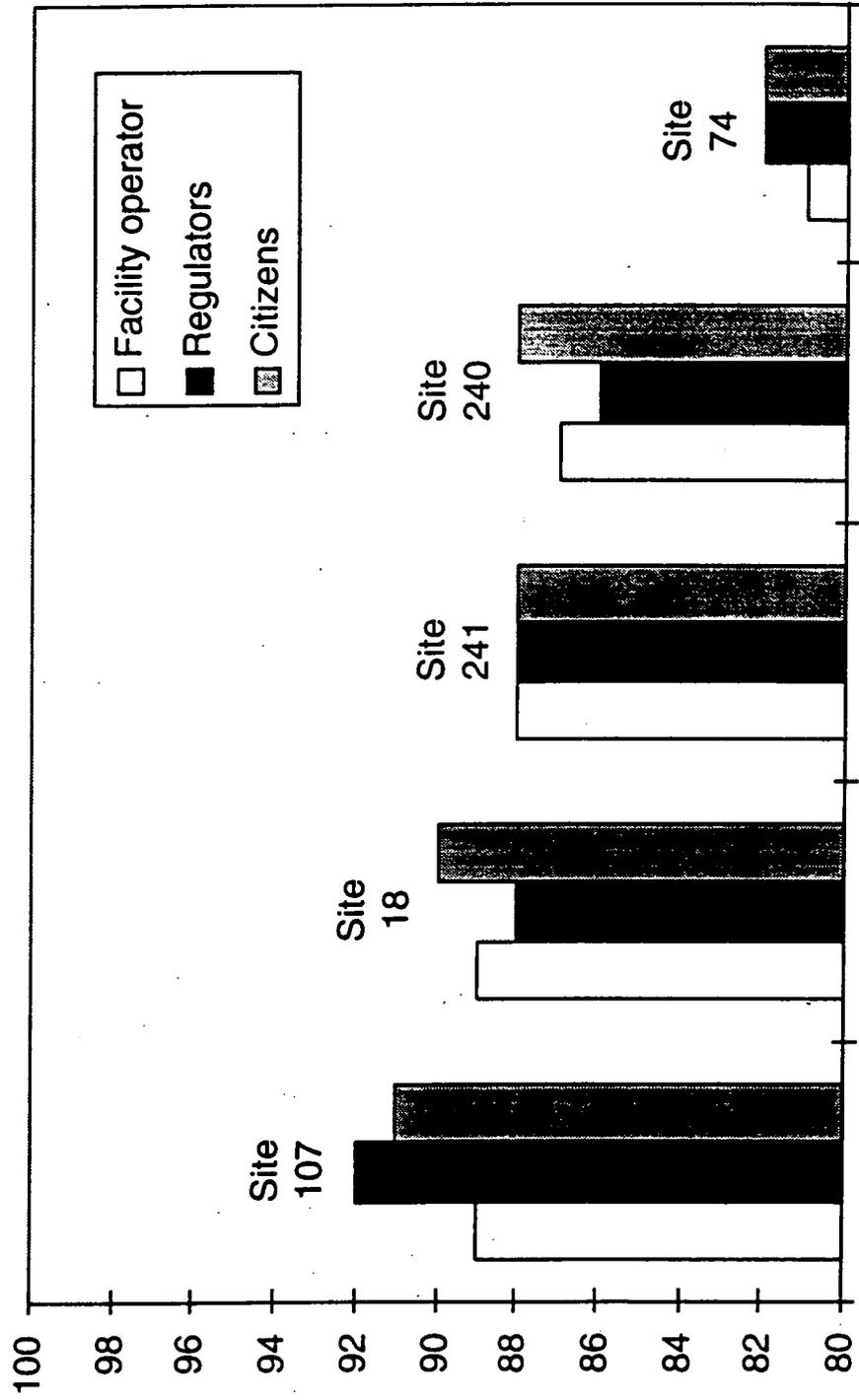
Compared to other potential sites, this site is:

Score	Site Remoteness
1	More remote from public populations than average (compared to other potential sites).
2	Midway between scores of 1 and 3.
3	About average in its remoteness from public populations.
4	Midway between scores of 3 and 5.
5	Less remote from public populations than average.

# Step 5 (2nd meeting): Stakeholders score options and determine weights and other value parameters

Objective	Performance measure	Weights		
		Facility operator	EPA	Citizens
Public health & safety	Site remoteness	5	12	20
Worker health & safety	Complexity/hazard of site activities	20	12	10
Environment	Level of existing contamination	30	30	10
Cost	Dollars	45	46	60
<b>Total</b>		<b>100</b>	<b>100</b>	<b>100</b>

# Step 6 (2nd meeting): Ratings and weights combined into overall measure of option value



## The site ranking process was conducted in 6 steps

1. Identify feasible siting options
2. Specify decision objectives
3. Identify influencing factors
4. Define rating scales and score options
5. Determine weights and other value parameters
6. Combine ratings and weights into an overall measure of option value

## Outcome

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- ◆ All participants agree on Site 107
- ◆ CAB member agrees to co-present recommendation at public meeting
- ◆ Same approach subsequently used to evaluate alternative strategies for operating the CAMU
- ◆ Permit for temporary unit approved, CAMU permit on track

*"We believe we made a difference... We steered the site selection process... Site 107 seemed to satisfy our values and concerns... Given a better understanding... gained over these months..., we concur that Sandia can safely operate a complete CAMU facility."*

— Final report, CAMU Working Group



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## **Example: Analysis of alternative remediation strategies for single shell storage tanks at Hanford**

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### **Background:**

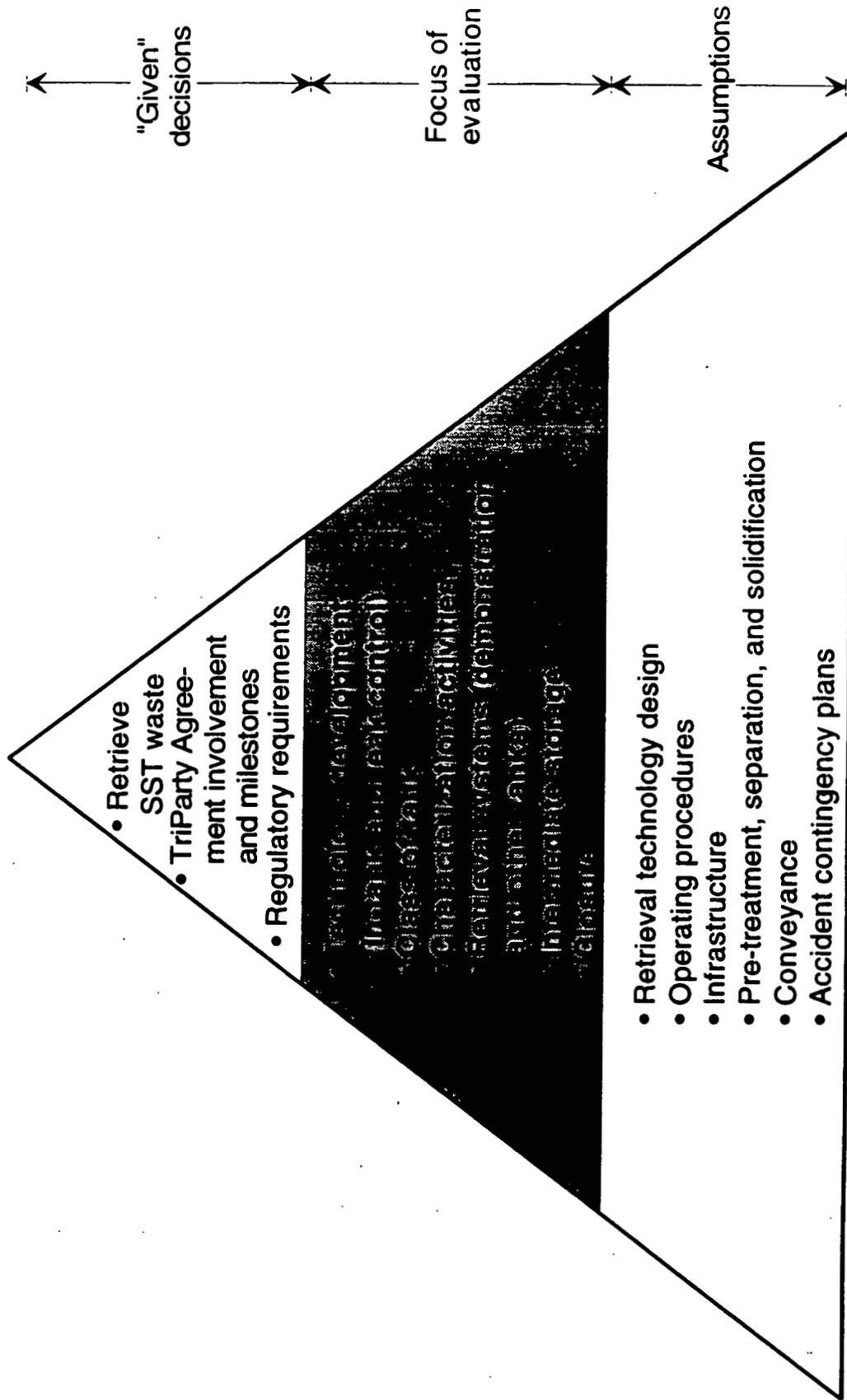
- 149 aging tanks
- Nearly half of tanks are leaking; concerns about flammability, unstable composition
- Options for removing waste are costly, unproven, or undeveloped

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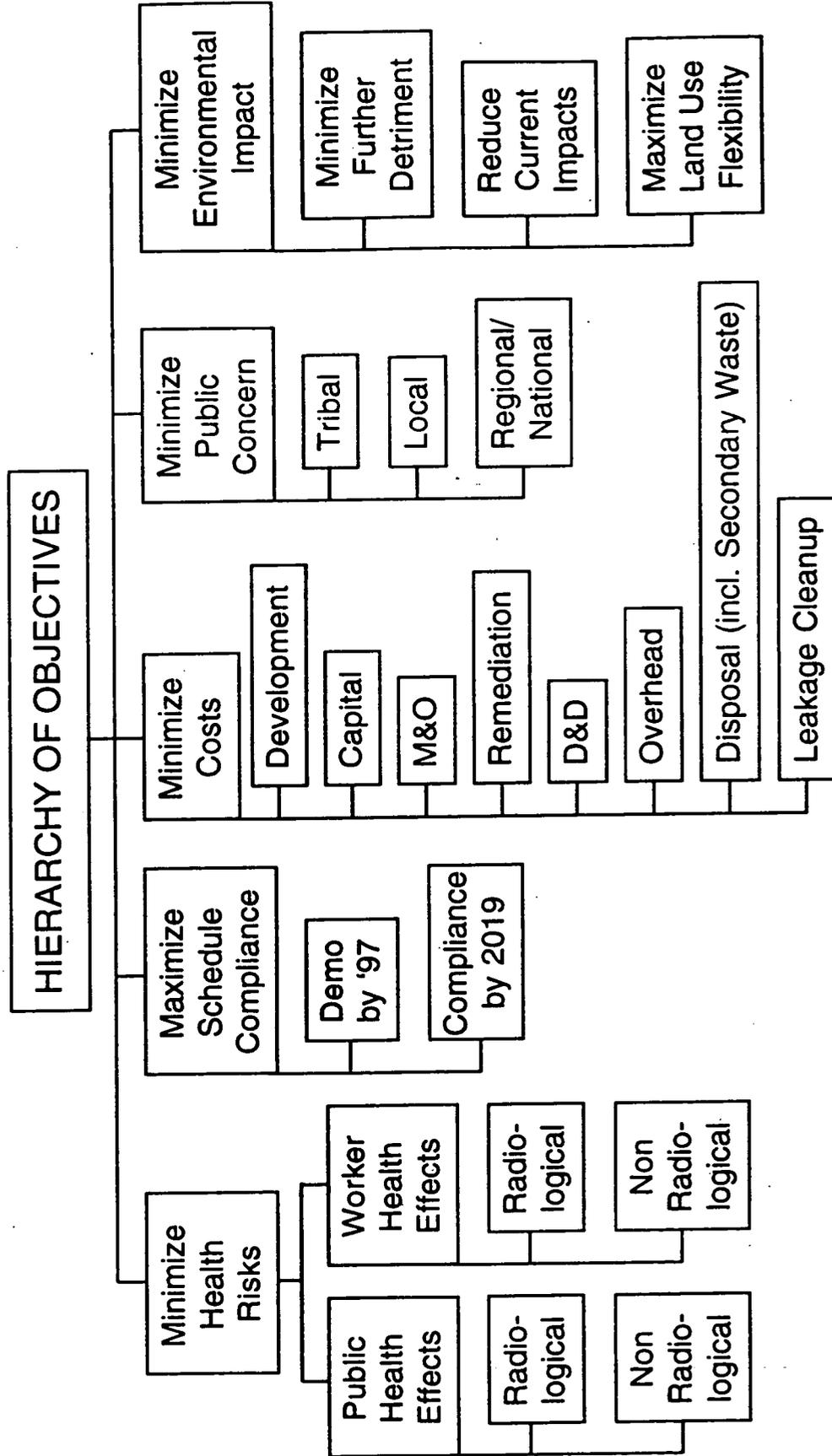


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# Step 1: Construct a decision pyramid to bound the problem and establish the assumptions for analysis



# Step 2: Develop objectives hierarchies to ensure that evaluation criteria reflect actual objectives



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# Step 3: Develop a strategy table to help create options that span the set of possibilities

KEY DECISIONS						
Technology Development		Class of Tank*	Characterization Activities	Retrieval System for Demo	Intermediate Storage	Closure
Retrieval System	Hydraulic	Sludges	Physical properties	Hydraulic	New tanks	None
	Pneumatic					
Mechanical	Liquid control and detection	Salt cake	Tank leakage	Pneumatic	Existing tanks	Remove tanks
	Ex-tank barrier	Mixture	Chemical, radiological properties	Mechanical		
Mining	Gelling fluid	Concrete-like	Physical properties and tank leakage	Hybrid		Remove tanks and remediate contaminated soils

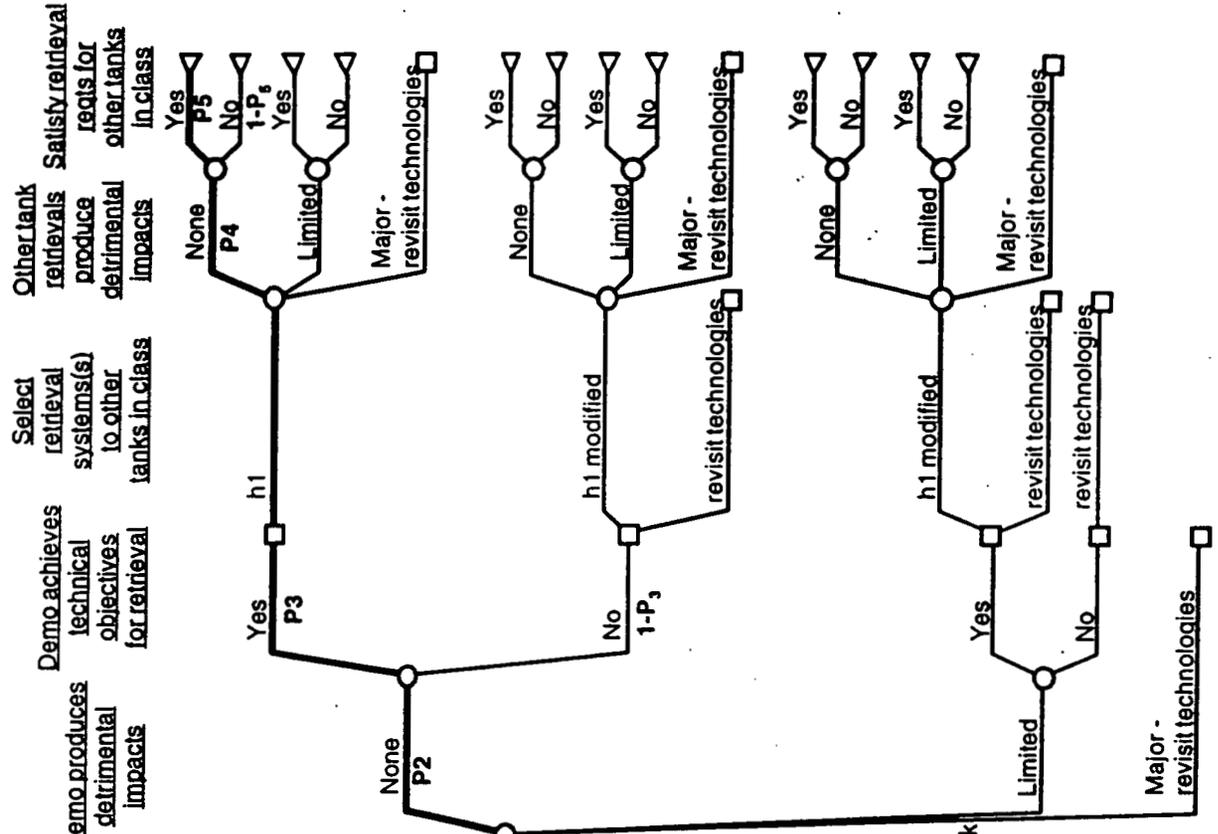
\* Class may include a description of safety issues (ferrocyanide, flammable gas, organic sales, high heat)

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# Step 4: Construct a decision tree to account for decision sequencing and uncertainties



### ASSUMED TECHNOLOGY DEVELOPMENT OPTIONS

- H1: PPS/detection
- H2: hydrogen removal, leak containment/detection
- H3: M1 w/o grabbers, combined sluicer with higher precision
- M1: positioning arms w/ end effectors, including mech conveyance from tank

### DEMONSTRATION OPTIONS

- h1: PPS + detection
- h2: PPS, detection and barriers
- h3: confined sluicing with higher precision
- m1: robotics + mechanical end effectors + mech conveyance

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# **Benefits of decision analysis**

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- 1. Produces better decisions**
  - Reduces decision making errors and biases
  - Promotes consistency and “level playing field”
  - Provides insights that suggest new alternatives
  - Controls the role of politics in decision making
  
- 2. Improves decision-making efficiency**
  - Clarifies what info is relevant and shows how to incorporate it into the decision-making process
  - Provides mechanism for meaningful stakeholder involvement
  - Promotes consensus
  - Serves as catalyst for action
  
- 3. Improves decision-making defensibility**
  - Documents underlying assumptions and logic
  - Sensitivity analysis answers “what if” questions

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# **A priority system to rank sites for a hazardous waste disposal facility**

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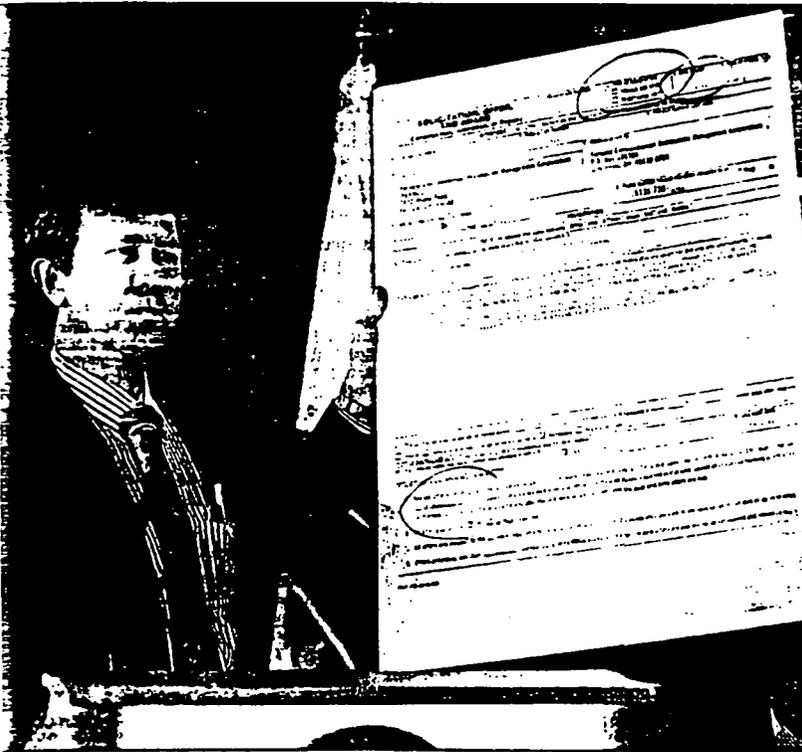
## **Project background**

- ◆ SNL proposes siting of a Corrective Action Management Unit (CAMU) as cornerstone of its site cleanup strategy
- ◆ External parties deride proposal as unacceptable. Regulators are especially discouraging
- ◆ Public participation proposed as means to build support and consensus
- ◆ Analysis must be conducted in two, one-day meetings of stakeholders (facility operator, citizens, regulators)

ENQUIRER INVESTIGATION

*Its original nuclear waste cleanup process flawed.  
FERMCO is developing another - for millions more*

# Secret plan inflates cost



The Cincinnati Enquirer Archives is keeping

News coverage: Jen Faulk, head of a Fluor Daniel review panel created to address *The Enquirer's* findings.

BY MIKE GALLAGHER  
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**T**he company hired to clean up Fernald is diverting government money to secretly develop a new process to prepare nuclear waste for disposal.

The top U.S. Department of Energy official at Fernald acknowledged Friday he just learned about the new process. If implemented, it would raise the estimated cost of disposing of 20 million pounds of radioactive wastes in two underground silos to about \$240 million. *The Enquirer* has learned.

That figure is based on cost estimates of Fluor Daniel Corp. and its subsidiary, Fernald Environmental Restoration Management Co. (FERMCO).

FERMCO estimated in September 1993 that it would cost an estimated \$90 million to clean up the waste in what are known as the K-65 silos, said Jack Craig, the Energy Department's chief at Fernald. That included about \$50 million to build and operate a full-scale processing plant. The job is considered one of the most complicated portions of the overall \$2.2 billion Fernald contract.

The secret plan by FERMCO and Fluor Daniel of Irvine, Calif. was uncovered during a six-month *Enquirer* investigation of the plant.

Fluor Daniel/FERMCO are developing the new plan because they know the original cleanup method, which would encapsulate the peanut butter-consistency waste in glass pellets, has serious flaws. The new plan involves the dehydration and powderization of the waste before it is encapsulated.

Facts about the secret plan uncovered by *The Enquirer* include:

► Fluor Daniel/FERMCO are using funds from its government contract, unbeknownst to the Energy Department, to pay for the development of the new process. Fluor Daniel/FERMCO have been billing the government for this secret work by their employees both at their Los Angeles-area headquarters and at Fernald. Documents submitted to the Energy Department show

(Please see FERNALD, Page A4)



*The Fernald  
Cleanup:  
Part III*

## INSIDE

► **RADIUM RECOVERY:** A study on how to extract medically valuable radium has been compromised by the Energy Department, the study's director says. A4

## TOMORROW

► **BUYOUTS:** Taxpayers are footing the bill for \$13 million in severance pay to 476 private employees of FERMCO. The buyouts average \$27,000 each.

"Secret plan initiates cost"  
Reporter: Mike Gallagher  
Continued

CONTINUED  
FROM PAGE A1

These people working on the original process.

► FERMCO is attempting to tie the cost increase through a proposed budgeting procedure, company sources said. That procedure would combine similar work from separate projects into single budget categories, according to internal Fluor Daniel/FERMCO documents. The new budget procedure is part of the company's accelerated cleanup proposal being prepared for the Energy Department.

► The secret plan calls for the expansion and modification of a still-to-be-built Fernald Residues Vitrification Plant (FRVP), in which the waste would be turned into the more easily disposable glass pellets.

FERMCO President Don Ofte said Fluor's design engineers are looking at options that could increase or decrease the cost of the full production plant.

"The full production plant could very well be more expensive than we first estimated. I'd be surprised if it were not," Mr. Ofte said.

But Mr. Ofte characterized the work on the new process as just systems engineering studies.

"There is no secret work," Mr. Ofte said.

He said Thursday neither he nor Fluor Daniel nor FERMCO employees had heard of the dehydration and powderization procedures.

Mr. Craig of the Energy Department said Friday he became aware of the new plan after *The Enquirer* began its investigation.

He said he has since learned that Fluor Daniel and FERMCO were charging the government for the work. He said Friday he could not confirm that all the companies' work, or the financial charges to the government, were properly authorized by the Energy Department.

"We are still investigating all that," Mr. Craig said. "I can tell you that up until recently, I knew nothing about the (Fluor Daniel/FERMCO) work on those technologies. That is something I should have been made aware of."

"After (*The Enquirer*) asked about that secret work, I spoke to our person in charge of the vitrification project," Mr. Craig said. "She said she has been told all about those studies by (Fluor Daniel/FERMCO officials) and they confirmed they were working on them."

Nevertheless, Mr. Craig said, Fluor Daniel/FERMCO officials were required to obtain written authorization from the Energy Department before initiating the studies or charging the government for the work.

"All I can tell you right now is that this is all under investigation," Mr. Craig.

Furthermore, Mr. Craig said Fluor Daniel/FERMCO officials have confirmed to his staff that the companies' most recent estimate to complete the vitrification they originally were contracted to do is more than \$180 million. Added to that is another estimated \$42.5 million to complete an ongoing pilot vitrification project.

Mr. Craig said the estimate is a gigantic leap from the companies' original September 1993 budget estimates when they claimed the entire vitrification project — including the pilot plant work — would cost about \$90 million.

The Energy Department has not agreed to authorize that much of an increase at this time, Mr. Craig quickly added.

"Those are all their (Fluor Daniel/FERMCO) estimates and we haven't been given anything on paper as yet. We have not seen the cost breakdown of their 10-year plan," Mr. Craig said.

According to internal Fluor Daniel/FERMCO documents, because of serious problems discovered while trying to build the pilot vitrification plant, the companies are designing a process that would add several more steps to the original vitrification process. The physical plant needed to accommodate the new process would have to be about four times larger than originally planned.

The new process would bring the total estimated cost of cleaning up the K-65 waste to about \$240 million, according to Fluor Daniel/FERMCO documents.

A source within Fluor Daniel said he was coming forward with details of the secret plan because his bosses "are discussing ways to tell the government ... costs will increase, but only to \$100 million, or \$130 million," not the full \$240 million.

"They are mulling around the idea to deceive the government with the lower figure, get the new contract, and then later hit them (Energy Department) with change proposals to add on the extra costs they purposely left out," he said. "That's a criminal act, as far as I'm concerned, and I just want someone to know what's happening here."

Those new processes include dehydration and powderization of the waste before funneling it into a melter where it would be superheated with the glass-making ingredients, according to Fluor Daniel/FERMCO conceptual design reports. The original plans called for the waste to be funneled directly to the melter.

Also, the original plan to produce small pellets of vitrified material has been scrapped. The new designs call for the production of "monoliths" or big blocks of vitrified waste.

Under its contract with the Energy

Department, FERMCO was to build and test a \$144 million pilot vitrification plant to ensure that the originally proposed full-scale plant would work.

But Energy Department and FERMCO records show that project is months behind schedule and the actual cost to the government has jumped to more than \$32 million just for the pilot plant. And FERMCO and government records obtained by *The Enquirer* reveal that the pilot plant's final cost now is estimated at more than \$42 million.

So far, the secret plan does not include building a new pilot plant to test the newly designed processes that Fluor Daniel/FERMCO want to incorporate, according to internal company records.

Lee Tashjian Jr., Fluor's vice president of corporate relations, declined to comment directly about the secret plan or the charges to the government for the project's new conceptual designs and financial estimate reports.

"But wouldn't it be reasonable to assume that the company hired to do that work, if they ran into problems (with the pilot plant), would be authorized under the contract to do new studies to try and fix those problems?" Mr. Tashjian responded in an interview on Feb. 2.

When told that Energy Department officials said the company would first have to notify them of any new work and then submit a change proposal requiring the Energy Department's signed approval before they could proceed, Mr. Tashjian said, "I'll have to look into this further."

During its investigation, *The Enquirer* obtained a list of the Fluor Daniel/FERMCO employees who have been assigned to work on the secret plan. Work reports and payroll records show the companies have charged their salaries and expenses to the government through the Fernald contract.

The records show those employees have been assigned to the vitrification project — called Operable Unit 4 — approved by the Energy Department and the U.S.

**"I can tell you that up until recently, I knew nothing about the (Fluor Daniel/FERMCO) work on those technologies. That is something I should have been made aware of."**

— Jack Craig, Energy Department's Fernald Area Supervisor

Environmental Protection Agency.

However, internal reports and sources from Fluor Daniel said these employees instead have been working on the secret project for months.

Fluor Daniel/FERMCO records — including several internal company memos in November and December 1995 — show Mark Deering, who heads Operable Unit 4, has been involved in high-level company discussions about when and how to tell the Energy Department about the increased costs.

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## Lobbying for longer contract

Last year, Fluor Daniel/FERMCO told the Energy Department that it could reduce the total time to complete the site-wide cleanup at Fernald from 25 years to 10 years.

Fluor Daniel/FERMCO was awarded a five-year contract in 1992 with the Energy Department holding three, one-year options to extend it. The five-year portion of the contract is up in 17 months. At that time, the government could exercise the first option, or decide to quit doing business with the companies and put the contract out to bid again.

In December, Fluor Daniel/FERMCO gave the government a schedule and cost estimate for the first two years of its 10-year proposal. The company promised to submit plans for the remaining eight years at a later date.

Mr. Ofte said the new, accelerated cleanup proposal could save taxpayers billions of dollars.

Mr. Craig and other government officials, quickly labeled the first two years of the proposal incomplete, faulty and inadequate.

Mr. Craig then asked for a revised, complete 10-year proposal by Jan. 17. Though he has received various financial "change proposal" documents from the companies, to date, he has not received the entire proposal as requested. Mr. Craig now says he expects to receive the complete 10-year proposal by the end of February.

Fluor Daniel/FERMCO hopes to "slip this plan by the Department of Energy" through change proposals designed to persuade the government to agree to a new, accelerated 10-year cleanup plan, according to a senior FERMCO management official.

## Hiding the secret

Three FERMCO officials, who spoke on the condition of anonymity, said the reason for the delay in giving the Energy Department the full 10-year proposal was two-fold:

► In the rush to complete the paperwork, the company came up with an unrealistic proposal and employees have had to re-review and re-estimate everything.

► The company purposely wants to give the entire 10-year proposal to the Energy Department as late as possible because Mr. Craig is scheduled to go before Congress in April to seek funding for the next two years. "The later the proposal is submitted, the less time the Energy Department has to review it and pick out the problem areas said one senior FERMCO official.

Part of the companies' plan to hide the estimated increase is to break the entire OU4 project into sub-projects and then combine those costs with other similar projects throughout the Fernald site, said a senior level Fluor Daniel management employee from Irvine, Calif., involved in preparing the secret plan.

One example of hiding the costs cited by the Fluor source is site preparation. "Instead of identifying a specific OU4 site prep cost, the (10-year proposal) would lump that in a category with other site wide prep work so it wouldn't necessarily be identified as OU4. They plan on doing that with all the other costs as well. There would then be no way for the government to quickly find the entire cost of OU4. They'd have a monumental chore to find all the associated costs."

Spreading the costs over a 10-year period also will mask the size of the increase, the source said. "That will make it appear that the escalated costs are more minimal. But it's nothing but a shell game. In the initial years, they will show only small increases for the (vitrification) new plan."

The Fluor source, and several FERMCO sources, said the companies' officials would at some point have to alert and receive approval from the Energy Department and the EPA to implement the changes being made in the OU4 design plans to include the new processes (dehydration and the monoliths).

"But what the public has to understand is that what Fluor Daniel and FERMCO primarily want is that extended contract from the Energy Department," said the Fluor source, who requested anonymity out of fear for his job.

"That's why they can't surface with the fact that the pilot vitrification project as it stands now doesn't work. And that the new plan will cost about \$200 million more. If that comes out they think the government will break their contract, or at the very least, not renew it. And they're probably right."

## Problems with original plan

Severe and costly technical and equipment problems on the Operable Unit 4 project sparked the secret plan, according to a review of Fluor Daniel/FERMCO internal memos and confidential reports.

A Nov. 27 story in *The Enquirer* revealed that the problems were so bad that they were expected to result in a possible 17-month delay in the pilot project.

Energy Department and FERMCO officials have said Fernald is a "guinea pig" for the vitrification process because there never has been a successful full-scale vitrification operation in the United States.

According to internal Fluor Daniel/FERMCO records, delays and overruns with the pilot project occurred because:

► To make deadlines and qualify for per-

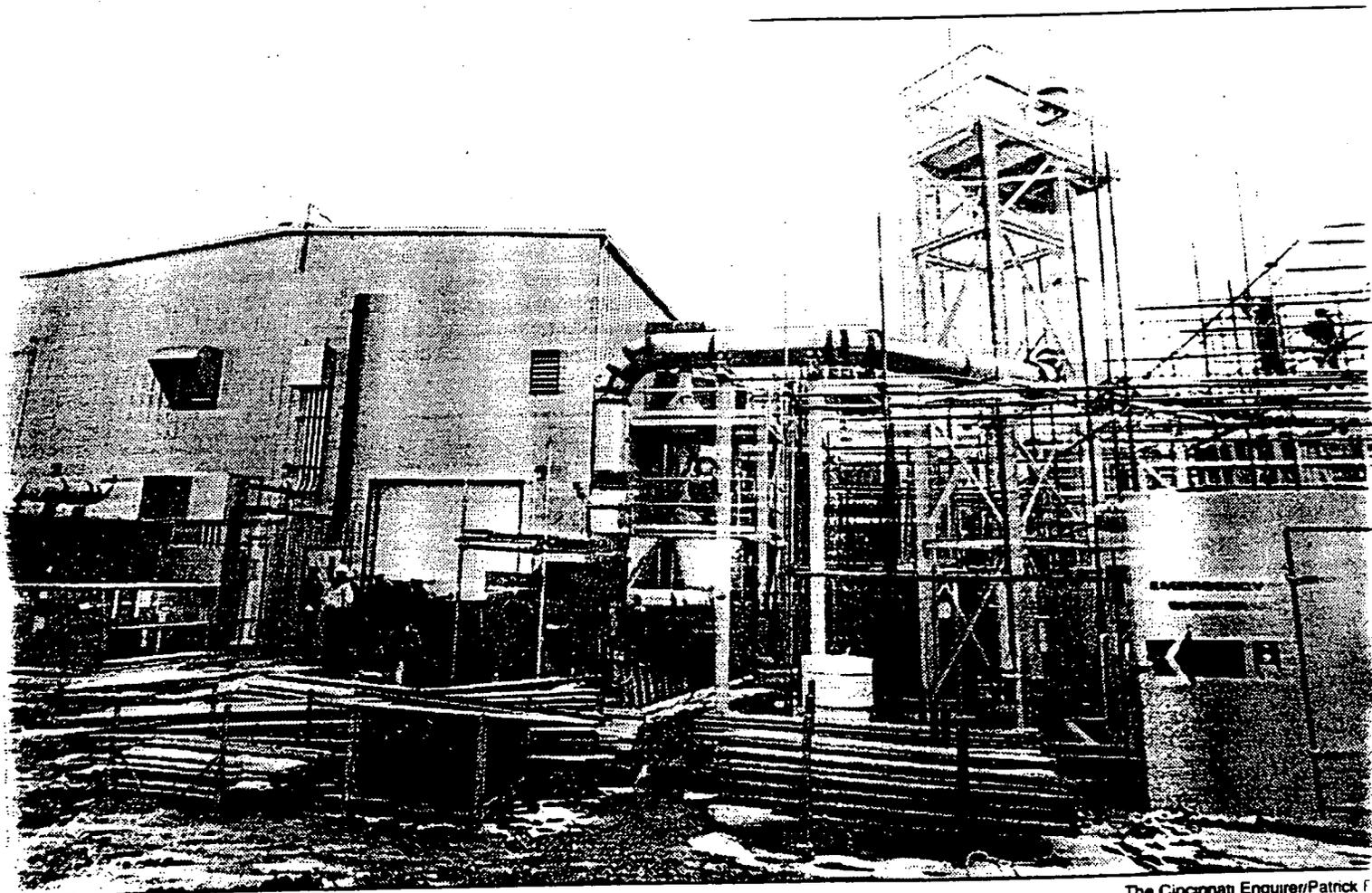
formance fees, the company bought materials before the plant design was completed. That led to numerous design problems, equipment failures and to FERMCO purchasing hundreds of thousands of dollars in unnecessary machinery.

► Technical and mechanical problems developed, including trouble with cutters designed to slice vitrified nuclear waste into small pieces after it is superheated in a large melter. In recent tests, the cutters quickly became coated with the radioactive material and unusable. There are substantial cost and safety concerns with having to replace them frequently.

► Large amounts of highly toxic and radioactive gas, called off-gas, were created when the pilot plant's melter superheated the nuclear waste and the glass-making materials. Filters, used to remove the gas, which otherwise spreads throughout the plant, have continually broken down and become contaminated. They are difficult to replace.



# Fernald: Secret cleanup plan inflates cost



The Cincinnati Enquirer/Patrick F

Construction is under way for a pilot plant at which wastes will be encapsulated in glass pellets for easier disposal.

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## DOE, FERMC0 deny secret cleanup plan

**BY MIKE GALLAGHER**  
*The Cincinnati Enquirer*

**U.S. Department of Energy officials at Fernald said Tuesday the companies hired to manage the site do not have a "secret plan" to develop new cleanup processes for radioactive waste as reported in an Enquirer story Tuesday.**

**Jack Craig, the Energy Department's chief at Fernald, said Tuesday the Energy Department is aware of those processes, including one that would dehydrate and powderize 20 million pounds of radioactive waste before encapsulating it into glass pellets.**

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**The Enquirer reported that on Thursday Mr. Craig said he was unaware of the processes until told of them by the newspaper, and that he did not know of any authorization for Fernald Environmental Restoration Management Co. (FERMCO) or its parent company, Fluor Daniel, to develop such operations.**

**"That is something I should have been aware of," Mr. Craig said Thursday in a tape-recorded interview.**

**On Friday, Mr. Craig said that he had learned that one of his subordinates had been told about the new process by Fluor Daniel - FERMCO. Because someone at the Energy Department had known of the new process, it should not be**

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**characterized as "secret," Mr. Craig said.**

**On Friday, Mr. Craig said he did not know when his subordinate had learned of the plan or if it had received formal authorization from the Energy Department.**

**On Tuesday he said he still did not know the answers to those questions.**

**In a related development, FERMC O issued a press release Tuesday in which its president, Don Ofte, denounced The Enquirer's story.**

**Mr. Ofte said Fluor Daniel - FERMC O had informed the Energy Department of their plans - including the work on dehydration and powderization - in "weekly meetings at the staff and**

**management levels."**

**But in a taped interview last Thursday, Mr. Ofte categorically denied that anyone in either company was studying or developing plans for a dehydration and powderization process.**

**"I can't find anyone who knows about that . . . Make sure I got your - dehydration and what was the second word? powderization?" Mr. Ofte asked in the interview.**

**Asked about that discrepancy, Mr. Craig said Tuesday, "You'll have to take that up with him."**

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## Company official, subcontractor say pilot plant unsafe; workers say they were told to cover up problems

### FERMCO ignored defects

BY MIKE GALLAGHER  
*The Cincinnati Enquirer*

Life-threatening structural defects have been ignored and covered up in the construction of a pilot plant that will be used to clean up radioactive wastes at Fernald.

Officials of the Fernald Environmental Restoration Management Co. (FERMCO) have known about structural flaws since the building's concrete foundation was poured in 1994, according to hundreds of the company's internal documents and more than 50 FERMCO photographs obtained by The Enquirer.

A senior FERMCO official connected to the project told The Enquirer that the danger to current and future workers is so great, the pilot plant is "a deathtrap awaiting its first victim." The official requested anonymity to protect his job.

The vice president of the construction company that did work at the plant acknowledged that areas of the building are unsafe, but said FERMCO officials refused to allow his firm to repair the flaws properly.

"That is because when mistakes were made, FERMCO was in such a damn hurry to get this project completed, they wouldn't allow us to fix the problems," said Dan Lynch, vice president of the R.E. Schweitzer Construction Co., the subcontractor that did the concrete and welding work on the plant.

"We told them things needed to be fixed, but they ignored us," he said.

Mr. Lynch said the plant's porous and chipped concrete floor and walls - including the radiation shielding walls - should have been patched or resurfaced before FERMCO had them repeatedly coated with epoxy.

"FERMCO did not want us to fix those walls and floors like they should have been because they were on this tight schedule and they didn't want to lose

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money by missing a deadline," Mr. Lynch said. "If nuclear waste spills there, I can't guarantee that it won't seep into the walls the way they are now, even with the epoxy. They should have been patched to protect against that, but FERMCO wouldn't let us."

### **Substandard work**

Known as Operable Unit 4 (OU4), the pilot plant will be used to vitrify - encapsulate in glass - radioactive sludge stored in two underground silos at Fernald.

The pilot plant is part of the \$2.2 billion Fernald cleanup contract that FERMCO was awarded by the Energy Department in 1992.

The pilot plant - estimated to cost more than \$42 million when completed - is the test model for a full-scale plant that will be built to vitrify 20 million pounds of the radioactive material at an estimated cost of \$190 million.

The original estimate for building the pilot plant was \$14.4 million. So far the government has spent about \$34 million on it. The internal documents and photographs obtained by The Enquirer were compiled by FERMCO from 1994 to the present.

The substandard work has been done primarily by employees of Schweitzer, according to FERMCO's documents. However, FERMCO management has, in many cases, allowed the defects to remain unfixed or accepted substandard repairs.

Among the flaws noted in the company's records that FERMCO managers and employees say still have not been properly repaired:

Several large sections of the building's concrete foundation and walls - including radiation-shielding walls - were built with inadequate or faulty reinforcing bars (called rebars).

Concrete floors and walls - including radiation-shielding walls - are severely chipped, cracked and filled with air pockets into which spilled waste could seep, contaminating the entire building and its workers. Industrial painters were told to put several layers of epoxy on the floor and walls to cover up the flaws. The painters said they were told to "keep quiet" about the problems.

Entire sections of walls are cracking, tilting and out of alignment. In several cases, concrete was poured in violation of temperature and timeliness requirements set by national engineering and construction organizations, resulting in substandard and damaged walls.

Substandard and faulty welds were made on pipes, structural beams, metal stairways and even tanks that eventually will hold radioactive material. Some

joints have been rewelded so many times that the metal has become brittle and is cracking. One document reveals that unqualified welders from Schweitzer were allowed to perform critical welding jobs.

Piping and other metal work throughout the pilot plant were not properly coated before installation and are beginning to rust. Workers attempting to fix the problem during the past two months failed to properly seal off the area before using a sandblaster and now hundreds of thousands of dollars worth of machinery in the pilot plant has been damaged, some irreparably.

FERMCO allowed inferior and substandard welds, concrete work, piping and equipment that violated its own required design and engineering standards to remain unfixed. FERMCO decided the standards should not apply after a problem was discovered.

FERMCO's quality assurance inspectors, looking for such things as bad welds, often conducted their inspections without the required drawings and specifications because no one had given them the materials. Tests of equipment, piping, welds, etc., often were done piecemeal and not as a complete system, in violation of U.S. Department of Energy regulations.

### 'Way behind schedule'

The senior FERMCO management source connected to the pilot plant project said that while many structural defects and building problems were identified in 1994 and 1995 by his company's engineers and included in written reports, "not all the problems were taken care of or taken care of properly.

"One of the reasons these problems have occurred is because this company (FERMCO) is in a hurry to get the pilot plant on-line," the source said. "The company only makes money if it completes various aspects of this project in a certain amount of time. Right now this (vitrification) project is way behind schedule and we have lost millions as a result."

FERMCO has "fast-tracked this project and that has meant overlooking substandard and unacceptable work by our subcontractors, or accepting faulty repairs that should have resulted in the work being completely redone," the source said. "The plant is full of problems and I'm scared that someone is going to get hurt."

In response to Enquirer questions about the problems at the pilot plant, FERMCO spokesman Jack Hoopes said Friday FERMCO has reviewed allegations reported by The Enquirer regarding the pilot plant construction activities. "FERMCO finds these allegations have no substance." In response to questions about construction problems at OU4, Jack Craig, the Energy Department's Fernald area supervisor, issued a statement Thursday.

"The Department of Energy takes The Enquirer's allegations seriously. At this

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time, we believe the best course of action is to cooperate fully with the pending General Accounting Office investigation to determine the substance of the allegations. Any problems identified by the GAO will be immediately addressed."

The GAO investigation cited by Mr. Craig was initiated by congressional leaders after a four-day Enquirer series last month detailed numerous problems with the way FERMCO and Fluor Daniel, its Irvine, Calif.-based parent company, are handling the Fernald cleanup. That series reported the companies had created inflated work and cost estimates, phony cost and performance reports, and misused control accounts and charge numbers used to bill the government. The series also reported numerous safety incidents that have occurred at the site.

### **Dangerous problems**

The structural, mechanical and safety problems uncovered by The Enquirer at the pilot vitrification plant were contained in FERMCO's deviation reports, non-conformance reports, quality control evaluation plans, and internal computerized messages between FERMCO officials assigned to the project.

While FERMCO is not required to routinely submit copies of those reports to the Energy Department, officials can request copies at any time for review, said Gary Stegner, the Energy Department's Fernald spokesman. He said he could not say whether all those reports have been reviewed by Energy Department personnel.

The reports, along with sources in the Energy Department and FERMCO, question the quality and safety of every wall in the pilot plant. FERMCO's own engineers and management officials - in their reports - voiced concern about the quality of the concrete; how and when it was poured; and the resulting chipping, cracking and air pockets.

For example, an Oct. 22, 1994, internal message from FERMCO Quality Control Specialist Steve Hurley to his boss, Frank Thompson, about the concrete work being performed that day by Schweitzer employees, said:

"They were pathetic . . . . As the (concrete) truck traversed the forms it continually moved farther from the forms until . . . the chute was too far from the forms for direct placement. (Schweitzer employees) then discharged the concrete onto the ground forming two, 3-foot high piles. Concrete was then shoveled into the forms. Concrete went 25 minutes over 90-minute limit. Thought they were going to lose the placement entirely."

Time limits are placed on how quickly concrete must be poured to prevent it from setting too fast, causing cracks, air pockets, chipping and failure to adhere to an adjoining concrete section.

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Substandard and inferior welding by Schweitzer employees also is a problem that FERMCO officials have failed to entirely address, Energy Department and FERMCO employee sources said.

Scores of welds on building support beams, pipes, and tanks that will hold radioactive material, have been found by FERMCO engineers to be inadequate or faulty, the records show. FERMCO also violated Energy Department rules by allowing the Schweitzer Co. welders to work without providing the company official certifications proving they were qualified to perform the welding tasks.

Despite a Sept. 15, 1994, internal computerized report from a FERMCO pilot plant official regarding unqualified welders who were working at the site, FERMCO continued to allow the Schweitzer employees to work without the proper documents being submitted.

The problem led FERMCO's contract administrator Robert Burns, in a June 22, 1995, letter to order Schweitzer to suspend welding work on a large, pilot plant tank because "1) An unqualified welder has welded on the tank and 2) The required procedures . . . were not in place when welding commenced."

Defending his company's work at Fernald, Ron Schweitzer, president of the construction company, said: "We vigorously refute any statements that we did anything wrong. The problems were caused by FERMCO repeatedly changing designs and work specifications on us. FERMCO did not let us do a lot of the work properly."

The records also re-vealed that FERMCO officials didn't even try to fix all the problems that were identified by their own quality assurance engineers. In many cases the FERMCO reports noting construction flaws directed the subcontractor to leave the work "as is."

Examples, cited in FERMCO's reports, include ignoring smaller-than-required welds and "corrosion allowances" in a "thickener tank shell"; failing to ensure that required pressure testing of pipes as a complete system be conducted; allowing oversized or undersized walls and doorways to remain; allowing structural steel to be delivered and erected without the painting of a required protective "field coat"; and letting concrete pourers drop the concrete more than 13 feet into forms, resulting in damaged, porous walls.

Other, more dangerous, problems also have occurred. One involves flaws in shielding walls designed to prevent workers and equipment from being exposed to high levels of radiation. Many of these walls were so badly constructed that they are filled with air holes, cracks and some have even "segregated" or broken apart from other sections of the wall, according to the reports and several FERMCO employees working at the pilot plant site.

Three Schweitzer employees who worked on pouring the pilot plant concrete told The Enquirer that because FERMCO officials were in such a rush to get

the pilot plant built, no time was given to properly "vibrate" the wet concrete poured into certain floor and wall sections to remove the air pockets from it. The three asked not to be identified in this story to protect their jobs.

One senior Schweitzer employee who helped pour the concrete, said, "I'm afraid somebody's going to get hurt, especially when that radioactive stuff starts spilling onto (floor - walls). The waste will seep into the concrete's air pockets and then the whole place will be one contaminated shell."

All three Schweitzer employees told The Enquirer that radiography (X-rays) pictures were taken only of sections of the floor and walls where the concrete was vibrated properly to eliminate air pockets. Radiography was not performed on all sections.

"Those good pictures are what was shown to the (Energy Department) if they asked to see them, and then put in the files," one worker said. "I don't believe (the Energy Department) knows the extent of the problem. Some (concrete) sections are OK and were vibrated properly, others are not. That's where the problem lies."

An employee of another subcontractor, who worked at the pilot plant from August to November 1995, said he was speaking out and agreed to be identified because the safety problems being hidden at the pilot plant "could endanger somebody's life."

"I was employed as an industrial painter at the pilot vit (vitrification) plant and it was my job to apply the epoxy on the floor and walls as an added protection in case radioactive material spills onto them once the plant is operational," said William Stidham of Cincinnati. Mr. Stidham said he was employed by the Fred DeBra Co. and A&J Painting Co. - both hired by FERMCO as subcontractors - to work on the pilot plant. FERMCO records confirm Mr. Stidham was employed at the plant site during that time.

Describing the serious safety problems at the pilot plant, Mr. Stidham said:

"The walls and floor are pockmarked with them (air pockets). . . we call them 'bug holes' and they're dangerous because radioactive material can seep in them and affect the workers and the plant," he said.

"FERMCO officials know about the concrete problems, but they told us not to worry about it," Mr. Stidham said. "They ordered me and the other guys (industrial painters) to just keep applying layer after layer of epoxy over the floor and walls to try and cover up this problem. "The trouble with that," Mr. Stidham said, "is that we can't get the epoxy in to seal up all the (air) holes - there's too many of them."

Mr. Stegner of the Energy Department said government inspectors were shown some FERMCO photographs taken of the pilot plant and radiography reports, but he could not say whether all the ones depicting structural and

mechanical problems had been reviewed by Energy Department personnel.

"We are reviewing all these things right now," Mr. Stegner said.

Gene Branham, vice president of the Fernald Atomic Trades & Labor Council, the union representing 650 workers at Fernald, confirmed workers' reports of the pilot plant's substandard concrete floor and walls. He said he also had heard workers express concern about being told to put layer after layer of epoxy on the floor and walls to try to "cover over" the problems.

"I have heard these reports from my members, but the company and (the Energy Department) apparently don't seem to want to listen," Mr. Branham said. "They (the Energy Department and FERMCO) were told verbally" of the problems, "but nothing was ever done. Hopefully somebody will investigate this now."

## PILOT PLANT TIMELINE

1992: Energy Department selects FERMCO, a company formed by Irvine, Calif.-based Fluor Daniel, as new manager of Fernald site. The \$2.2 billion contract is hailed as a model for cleaning up other nuclear weapon sites.

1994: Among other site cleanup projects, FERMCO begins building a pilot vitrification plant to test a process that will encapsulate 20 million pounds of nuclear waste in two silos in glass. Construction problems surface immediately.

Sept. 15, 1994: FERMCO officials issue report after finding that subcontractor used unqualified welders, installed inadequate reinforcing bars in radiation-shielding wall, and the wrong joint in a stabilizing footer.

Sept. 22, 1994: A FERMCO engineer discovers another incident of a radiation-shielding wall built without the required number of reinforcing bars needed to support it. FERMCO tells subcontractor to drill into wall and insert dowel rods as a way to fix problem.

Oct. 24, 1994: FERMCO subcontractor installs anchor bolts into concrete wall and more than 15 feet of the wall cracks and concrete forms tilt.

Dec. 13, 1994: Tons of structural steel were installed and erected without the required protective coating, in violation of design specifications, a FERMCO report reveals. May 12, 1995: Welds on a pilot plant tank are found to be defective and do not meet design specifications. Repairs are ordered. Latest of a long history of welding problems discovered at the pilot plant.

June 15, 1995: FERMCO misses its original pilot plant completion deadline due to construction, design and other problems. The company tells the U.S. Department of Energy that new construction completion date will be Jan. 29.

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June 22, 1995: FERMCO sends letter to R.E. Schweitzer Construction Co. ordering it to stop all welding on pilot plant tanks because unqualified welder was found working on them.

June 26, 1995: FERMCO officials detail numerous new problems discovered in construction of pilot plant, including faulty weld reinforcements; mismatched bottom shell plates of tank. Orders are given to subcontractor to start submitting written repair procedures instead of verbal ones.

July 3, 1995: FERMCO misses deadline of starting non-radioactive testing of the pilot plant. Company officials say problems leading to delay should be fixed for a new test date of March 15, 1996.

Aug. 25, 1995: FERMCO officials issue a report revealing that a subcontractor employee was forced to cut through a pipe to replace a broken gasket below a metal tank that will eventually hold radioactive material. Company quality control specialist says more pipe cutting may occur since design is flawed and that is only way to get to some gaskets. Nov. 27, 1995: The Enquirer reveals that construction, design and equipment problems could delay start-up of nuclear testing process by up to 17 months.

Nov. 28, 1995: Thomas Grumbly, then the Energy Department's assistant secretary for environmental management, calls for an investigation of FERMCO's troubles with the pilot plant. Mr. Grumbly says FERMCO deceived the Energy Department about extent of problems. Jan. 29, 1996: Promise by FERMCO officials to have construction of pilot plant completed is not met. Work to fix problems and complete work continues.

## Cleanup plant has structural flaws

The pilot vitrification plant at Fernald, which is expected to test a process to encapsulate nuclear waste in glass, has been labeled a "deathtrap" by a senior management employee of the company responsible for building it. Company records of the plant, which is under construction, reveal dangerous problems with welds, concrete walls and floors and tanks that eventually will hold radioactive waste.

*Published March 3, 1996.*

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# Key project at Fernald plagued by problems

## Design flaws, excessive costs cited in Energy Dept. report

*BY MIKE GALLAGHER  
The Cincinnati Enquirer*

A U.S. Department of Energy investigative team at Fernald found scores of financial, design, construction, testing and safety problems in a pilot project for encapsulating radioactive wastes.

The December report says Fernald Environmental Restoration Management Co. fast-tracked the project, resulting in design flaws; hid cost, design and schedule problems from the Energy Department; made repeated and costly design changes; and submitted unrealistic cost and construction schedules.

The special team also said alternative methods for cleaning up the waste should be considered because of the pilot plant's numerous problems and ballooning costs.

The team was made up of eight Energy Department employees, three Energy Department support contractors and three consultants with expertise in the areas of project management, vitrification design - construction and cost estimating. They were assembled to investigate pilot plant problems detailed in a November Enquirer report.

After reviewing the pilot plant project, the investigative team repeatedly stated that the numerous safety, planning, cost and construction concerns highlighted in its report needed to be addressed to prevent personnel injuries and additional waste of taxpayers' money.

And because the pilot plant and the proposed full-scale plant are schedule-driven: "The implications of this situation is a continual brush fire mode," the report says. "Crises (sic) management is the rule of the day, and advance planning to avoid problems seldom takes place because of continuing emergencies."

The report by the special investigative team details problems that could lead to another delay in the startup of a pilot project to encapsulate 20 million pounds of radioactive sludge into pieces of glass, a process called vitrification.

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The plant is being built by Fernald Environmental Restoration Management Co. (FERMCO). The first phase of the pilot plant operation, testing non-radioactive waste, already has been delayed twice.

The 48-page report was submitted to Energy Department headquarters in December and obtained recently by The Enquirer.

"(The Energy Department) and FERMCO need to conduct a complete review of the cost benefit analysis for vitrification, including variations of different alternatives that could result in significant savings in time and money," the report said. "There is the potential for numerous alternatives to be developed and evaluated."

In response to questions about the report, a letter signed on behalf of FERMCO President John Bradburne said, "Recently, the DOE has suggested the possibility of utilizing other alternative methods for dealing with a portion of the waste. FERMCO is currently investigating these alternatives in conjunction with DOE."

FERMCO has spent more than \$35 million in taxpayer money to design and build the troubled pilot plant, and now estimates the final cost of the project will be more than \$42 million. The company's original 1993 estimate was \$14.1 million.

Last month The Enquirer revealed that FERMCO and its parent company, Fluor Daniel Corp. of Irvine, Calif., have cheated the government out of millions of dollars and jeopardized the safety of workers and neighbors at the Fernald site. At that time The Enquirer also reported there were significant design problems with the pilot plant.

Earlier this month the newspaper also reported that structural defects have been ignored and covered up in the construction of the pilot plant. The Energy Department's investigation substantiates many of the problems with the pilot plant reported by The Enquirer during the past several weeks.

Members of Congress called for the U.S. General Accounting Office to investigate The Enquirer's findings. That probe now is under way.

The Energy Department's investigation of the pilot project was ordered by Thomas Grumbly, the department's acting undersecretary, after he read a Nov. 27 Enquirer article revealing cost, construction and safety problems that were expected to delay the completion of the project by up to 17 months.

At that time, Mr. Grumbly accused FERMCO of hiding the project's problems from the Energy Department, allowing the company to receive hundreds of thousands of dollars in performance fees that might otherwise not have been awarded.

Mr. Grumbly's investigative team found that FERMCO has spent millions of

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dollars fixing, and sometimes refixing, problems that occurred because the company "fast-tracked" the project. Among the most serious problems and concerns facing the project, according to the Energy Department team, are:

Piping designed to trap and remove radioactive "off-gas" from the plant may clog because it's too long and has too many bends in it.

Pipes bringing the wastes into the plant may get clogged with chunks of debris in the waste stream.

Operations and maintenance personnel have little or no access to the plant's processing equipment and system.

A lack of involvement by operations, maintenance and safety personnel from the outset of the pilot plant project.

A poor records management system.

Problems in planning and construction may lead to major design and structural changes before and after the planned testing of both non-radioactive and radioactive waste. Serious problems could arise because FERMCO purchased equipment for the pilot project before studies and designs were actually completed.

In its report, the team raised more than a hundred safety, reliability, equipment availability and maintenance questions about the pilot plant. FERMCO officials told the team in December they were attempting to correct the problems, but no completion date was specified, according to the report.

Jack Craig, the Energy Department's Fernald area manager, declined requests to be interviewed regarding the problems identified by the investigative team.

### **Reporting, construction trouble**

The investigative team found that many of FERMCO's monthly reports to the Energy Department about the pilot project were insufficient and didn't detail the specific trouble areas.

"As a result, unless project specific data is requested (by the Energy Department), the monthly data reports completely mask the (pilot) project data, thus making the data of limited value for project management," the report said.

The investigators also found that FERMCO projected unrealistic costs and schedules when it initially planned the vitrification project.

FERMCO also never developed contingency plans for cost and scheduling problems and provided the Energy Department with "overly optimistic" initial

cost and schedule estimates. "This led to major assumptions (by FERMCO) which were unverified and not identified with their associated risks."

The investigators also found that FERMCO buried the pilot plant problems so far down in its reporting system, that Energy Department officials had no way of knowing the scope of the trouble unless FERMCO pointed it out.

As late as July 1995, FERMCO officials continued to deceive the Energy Department's vitrification project manager and its team leader by falsely assuring them that the problems would have no impact on the project's scheduled completion date, the report revealed. Two months later, FERMCO admitted the project had serious problems that resulted in a lengthy delay.

Scores of design changes for the pilot project also have led to many problems, the investigators found.

"The significant number of design changes that have occurred and appear to be continuing are also indicative of problems within the project," the report said. "The (Energy Department) project manager noted these concerns with the FERMCO project manager on many occasions." Design reviews were conducted, the report showed, "but are also noted as inadequate." And "lack of sufficient involvement by other (FERMCO) project organizations has also led (and may continue to lead) to rework situations."

One of the most serious concerns of the investigators, according to the report, is FERMCO's effort to "fast-track" the remaining studies, testing and designs that need to be done involving running radioactive waste through the pilot plant system (Phase II) and the building of a full-scale vitrification plant (FRVP).

FERMCO's proposed schedule "is indicating activities on both the Phase II and the FRVP are being planned in such a manner as to result in major project risk," the investigators warned. FERMCO's schedule "indicates considerable overlap between the (pilot plant) and the (full-scale plant). The work plan . . . design states in numerous instances that data from the pilot plant is essential to design and procurement of the (full-scale plant). The two positions are in direct opposition."

The report warned that if FERMCO proceeds as planned, "care must be exercised to assure an honest and adequate explanation is provided as to why (pilot plant) data is no longer a prerequisite for the (full-scale plant)."

The letter signed on behalf of FERMCO President Bradburne said, "The faster that we can complete the pilot plant and gain the necessary information from its operation, the faster we can undertake the full-scale project and achieve the goal of remediation. The 'fast track' schedule for the Pilot Plant will not cause any reduction or compromise whatsoever in safety standards and procedures."

### Design concerns

The investigators also expressed concern that basic safety, construction and design steps that should have been addressed earlier in the design and building process were now more difficult, if not impossible, to change or fix.

Several of those concerns, noted in the report, were:

A lack of provisions for clearing the buildup of solids in the primary off-gas line. FERMCO's line is about 75 feet long and has several bends, while other similar projects nationwide use lines that are much shorter, sometimes only 10 feet.

No backup blower for the primary off-gas vent from the melter where the waste will be turned into the glass-like substance. "Failure of the off-gas blower could result in the escape of (radioactive) gases from the melter into the building."

Radiation shielding of the temporary storage tank needs to be evaluated.

Labels on some valves are incomplete, too small or do not exist.

Personnel must climb ladders during freezing, inclement weather in the uncovered secondary radiation containment area.

Insulation used on the melter might be carcinogenic. "This issue needs to be resolved to assure providing necessary personnel protection."

A key processing area contains numerous instances of poor maintenance planning: major valves located too close together for access; valves are too high to reach; lights are too high to replace bulbs; valves and pumps are in awkward positions. In addition, there is no obvious, easy method of correcting these situations.

On a tank that will hold radioactive material, valves are located directly beneath the center, "probably one of the more radiation-intense areas in the facility."

There are no apparent provisions for installing a permanent safety rail (at the top of the melter). Such a rail will be necessary to prevent an accidental fall.

In its report, the investigative team noted its limitations in assuring the reliability, availability and maintenance of the equipment and machinery already in place at the site. Usually, the investigators said, "engineering studies, tests or historical operating data for essential components" would be reviewed prior to equipment being purchased and installed in such a project.

"However, since the (pilot plant) equipment is already on hand and the facility is essentially complete, the standard reliability studies are not applicable," the

report said. "In addition, major system or equipment redesigns are also out of the question. At this stage of construction and startup there is little that could be done in a cost-effective manner unless a gross deficiency were discovered.

"Maintainability is based on the ability to access equipment for repair or replacement; having adequate manuals and procedures, ample spare parts, etc." according to the report. "Again, because of the (construction) stage . . . most facility and process features are fixed and significant changes are not acceptable."

*Published March 25, 1996.*

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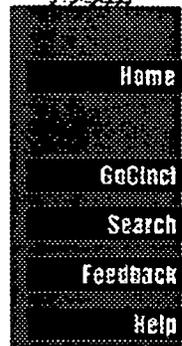


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## Fernald pilot plant cost jumps

Problems add \$14M

BY MIKE GALLAGHER  
*The Cincinnati Enquirer*

The price for a problem-plagued pilot cleanup plant at Fernald has jumped an additional \$14 million because of design, construction and testing problems, The Enquirer has learned.

This is the second increase in the estimated cost since 1993 and officials of Fernald Environmental Restoration Management Co. (FERMCO), the company hired by the government to clean up the nuclear site, said they cannot rule out further pilot plant cost increases.

The taxpayer-funded cost of completing the pilot project now is estimated at about \$56 million, an increase from the \$42 million estimated during the past year, according to internal FERMCO reports.

In 1993, FERMCO originally estimated the cost of the pilot plant at \$14.4 million.

Responding to Enquirer questions Thursday, U.S. Department of Energy officials, in a written statement, confirmed the latest increase.

"DOE is evaluating the situation," but has not yet determined how to react to it, the statement said.

Design, construction and testing problems already have caused FERMCO to miss two deadlines - in November and March - to start testing material through the pilot plant.

The Energy Department penalized FERMCO \$675,000 in November for missing that start-up. Government investigations into the pilot plant problems revealed FERMCO employees had purposely hidden the severity of the problems that led to the delays.

Some of the past problems at the pilot plant cited by the government include faulty and poorly designed pipes; misplaced valves; missing safety rails; and welding problems on tanks that will hold radioactive material.

FERMCO, also responding to Enquirer questions in writing Thursday, said the

\$14 million cost increase was due to "a change in the estimated operating efficiency of the facility."

Additionally, FERMCO also plans to delay the pilot project's completion date by another six months into 1998, a move that energy department sources said could result in possibly hundreds of thousands of dollars in penalties against the company.

The pilot plant is designed to test a vitrification process that would encapsulate about 20 million pounds of radioactive waste into glass pellets. The wastes now are stored in two silos at the 1,050-acre former uranium-processing plant.

If the pilot project is successful, FERMCO plans to use the process in a full-scale plant that will cost an estimated \$200 million.

Critics of the FERMCO vitrification project say it is a gamble of taxpayers' money because the vitrification process being developed at Fernald never has been used successfully in the United States. Even the Energy Department's Fernald area manager, Jack Craig, in earlier interviews, conceded Fernald's vitrification project may not work.

According to internal company reports, FERMCO cost and scheduling experts have determined that the pilot vitrification project cannot be completed without at least a \$14 million increase and six-month schedule delay. They have suggested issuing a "change proposal" - a formal, written request asking the Energy Department to approve the additional money and time.

However, on Thursday, senior management officials decided instead to first prepare a proposal to take funding from other site cleanup projects to use for the increased pilot plant costs, FERMCO records and senior management sources said.

If the Energy Department agrees to allow FERMCO to fund the pilot plant costs from other cleanup projects' budgets, those other projects would be delayed or halted, resulting in additional costs to the taxpayers when they are re-funded, Energy Department sources said.

FERMCO also could face additional and substantial financial penalties even if the government allows the company to raid the other projects' budgets, several Energy Department officials told The Enquirer.

"No matter what is decided or how it will be funded, taxpayers will still be footing the bill for the additional \$14 million increase," said one FERMCO senior management official.

The Energy Department would have to approve any reshuffling of funds already budgeted for other projects to pay for the pilot plant increases and whether any other Fernald cleanup project can be delayed or halted.

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*Published May 17, 1996.*

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## The Fernald Cleanup

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### Key project may be scrapped

BY MIKE GALLAGHER  
The Cincinnati Enquirer

The company cleaning up the former Fernald uranium plant may drastically alter or even scrap a failing nuclear waste cleanup process that already has cost taxpayers \$72 million.

Correspondence obtained by The Enquirer shows there are continuing problems with a vitrification plant pilot project - a key component for cleaning up the most radioactive waste.

Vitrification is a process in which radioactive material is encapsulated in pieces of glass that then can be safely shipped elsewhere for burial. A full-scale vitrification plant has been the government-approved plan to handle 20 million pounds of radioactive sludge in two Fernald silos since Fluor Daniel Fernald (formerly FERMCO) completed feasibility studies in 1993.

In an Aug. 15 letter to Jack Craig, the U.S. Energy Department's Fernald site manager, the company's president, John Bradburne, said the company is considering changing or scrapping the vitrification project because of "equipment reliability uncertainty" in the pilot plant operation.

Scrapping the vitrification process "has been discussed but no formal decision has been made yet," Energy Department spokesman Gary Stegner confirmed. "There has to be a backup plan if vitrification doesn't work."

Graham Mitchell, chief of the office of federal facilities oversight at the Ohio Environmental Protection Agency (OEPA), said a meeting is planned for next spring with the Energy Department and Fluor Daniel Fernald to discuss whether to continue with vitrification or pull the plug on the \$72 million-plus project.

The Enquirer revealed last March that the pilot vitrification plant was in trouble and that the Energy Department investigation said alternatives should be considered. Fluor Daniel Fernald and the Energy Department staff at the site repeatedly have said the project is on track.

The company originally estimated the total pilot plant project would cost only \$14.4 million. That cost now has jumped to \$42 million, and is expected to

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reach \$56 million, according to the company. Another \$30 million has been spent for research and study of the vitrification process.

Repeated requests by The Enquirer to interview Mr. Bradburne for this story were denied.

Failure of the pilot plant threatens a timely cleanup of the nuclear wastes at Fernald. A full-scale plant is supposed to be built using design, construction and processing information learned from the operation of the pilot plant.

One alternative mentioned in Mr. Bradburne's letter would be to replace the full-scale plant concept with "several smaller vitrification units."

Mr. Stegner said the Energy Department is "studying the concept" of switching from a full-scale plant to several smaller units. He added that building several smaller units was one of several alternatives looked at several years ago during feasibility studies before the decision was made to build one, full-scale vitrification plant.

But Tom Schneider, Ohio EPA's project manager at Fernald, said switching from a single full-scale vitrification plant to smaller units would represent a significant change in Fluor Daniel Fernald's plans. He said he had not seen enough data from the company to determine what it would cost to make the change, whether the project would face additional delays if implemented or whether mini-vitrification plants would even work.

The idea of scrapping the vitrification process infuriates Gene Branham, vice president of the Fernald Atomic Trades & Labor Council, which represents 700 workers at the site.

By abandoning vitrification, the more than \$72 million of taxpayers' money so far spent on the project "would have been wasted and taxpayers should scream loud and long," Mr. Branham said. "So far, (Fluor Daniel Fernald and the Energy Department) just can't get that project to work."

Mr. Stegner, of the Energy Department, said if vitrification is eliminated alternatives would be considered, including encasing the material in cement.

Fluor Daniel Fernald in February proposed encasing wastes from a third silo in cement rather than vitrifying it.

In its initial plans - approved by U.S. EPA and the Energy Department in 1993 - the company agreed it would vitrify the Silo 3 waste, along with the more radioactive and dangerous contents of Silos 1 and 2.

Cementation has been used successfully at many Energy Department cleanup sites. It is far less costly and less time consuming than vitrification but provides only a fraction of the protection from radiation and radon emissions because of the porous nature of cement, said Mr. Schneider. "That proposal is

on the table and is currently under review," he said.

Fluor Daniel began work on a \$2 billion government contract to oversee cleanup of the former uranium processing plant in 1993. From the beginning the vitrification project has been plagued by design, construction and operating problems.

Last year, the company said it could meet a U.S. EPA deadline of this Monday to complete a design project after testing the pilot plant by running non-radioactive material through it.

The company "will not meet the Sept. 30 deadline set by EPA," said Mr. Stegner of the Energy Department. "The pilot plant is not working as a complete unit. There are problems there."

The biggest problems are the pumps and piping used to move the non-radioactive material through the pilot plant to the melters, where it would then be super-heated with other additives to vitrify it, said OEPA's Mr. Schneider.

"They've also had problems with the way pipes were designed," he added. "Some of the pipes were put in with 90-degree angles and that's prevented material from flowing through properly."

"We have to have a way to get the material from inside the silos to whatever treatment system we use, whether that's vitrification, cementation or anything else," Mr. Schneider said. "This is a major problem and it has to be addressed."

Despite the continuing design, mechanical and operability problems that have prevented completion of the pilot plant, the company still says it can complete the non-radioactive material test in January. It also says it will complete the entire pilot project in 1998.

In a faxed response to Enquirer questions, the company's public relations office said: "We will review all information gathered to date and determine the most appropriate path forward."

Whether one full-scale plant or several mini-vitrification plants are later built, the project's overall costs are conservatively estimated to be more than \$240 million, according to company and Energy Department records.

## **PILOT PLANT TIMELINE**

1992: Energy Department selects FERMCO, a company formed by Irvine, Calif.-based Fluor Daniel, as new manager of Fernald site. The \$2.2 billion contract is hailed as a model for cleaning up other nuclear weapon sites.

1994: Among other site cleanup projects, FERMCO begins building a pilot

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vitrification plant to test a process that will encapsulate 20 million pounds of nuclear waste in two silos in glass. Construction problems surface immediately.

Sept. 15, 1994: FERMCO officials issue report after finding that subcontractor used unqualified welders, installed inadequate reinforcing bars in radiation-shielding wall, and the wrong joint in a stabilizing footer.

Sept. 22, 1994: A FERMCO engineer discovers another incident of a radiation-shielding wall built without the required number of reinforcing bars needed to support it. FERMCO tells subcontractor to drill into wall and insert dowel rods as a way to fix problem.

Oct. 24, 1994: FERMCO subcontractor installs anchor bolts into concrete wall and more than 15 feet of the wall cracks and concrete forms tilt.

Dec. 13, 1994: Tons of structural steel were installed and erected without the required protective coating, in violation of design specifications, a FERMCO report reveals.

May 12, 1995: Welds on a pilot plant tank are found to be defective and do not meet design specifications. Repairs are ordered. Latest of a long history of welding problems discovered at the pilot plant.

June 15, 1995: FERMCO misses its original pilot plant completion deadline due to construction, design and other problems. The company tells the U.S. Department of Energy that new construction completion date will be Jan. 29, 1996.

June 22, 1995: FERMCO sends letter to R.E. Schweitzer Construction Co. ordering it to stop all welding on pilot plant tanks because unqualified welder was found working on them.

June 26, 1995: FERMCO officials detail numerous new problems discovered in construction of pilot plant, including faulty weld reinforcements and mismatched bottom shell plates of tank. Orders given to subcontractor to start submitting written repair procedures instead of verbal ones.

July 3, 1995: FERMCO misses deadline of starting non-radioactive testing of the pilot plant. Company officials say problems leading to delay should be fixed for a new test date of March 15, 1996.

Aug. 25, 1995: FERMCO officials issue a report revealing that a subcontractor employee was forced to cut through a pipe to replace a broken gasket below a metal tank that will eventually hold radioactive material. Company quality control specialist says more pipe cutting may occur since design is flawed and that is only way to get to some gaskets.

Nov. 27, 1995: The Enquirer reveals that construction, design and equipment

problems could delay start-up of nuclear testing process by up to 17 months.

Nov. 28, 1995: Thomas Grumbly, then the Energy Department's assistant secretary for environmental management, calls for an investigation of FERMCO's troubles with the pilot plant. Mr. Grumbly says FERMCO deceived the Energy Department about extent of problems.

Jan. 29, 1996: Promise by FERMCO officials to have construction of pilot plant completed is not met. Work to fix problems and complete work continues.

March 1996: FERMCO again fails to complete construction of pilot plant - as it promised the Energy Department - due to ongoing problems.

May 17, 1996: Energy Department confirms Enquirer report that FERMCO's newest estimate to complete the troubled pilot plant jumps more than \$14 million.

July 30, 1996: Energy Department penalizes FERMCO \$810,000 for unsolved pilot plant problems for the time period Oct. 1, 1995 through March 31, 1996.

Aug. 15, 1996: In a letter to the Energy Department, FERMCO President John Bradburne says the company is considering several small vitrification plants rather than one large one. He also mentions the need to have an alternate plan in place if the vitrification project proves unsuccessful.

Sept. 10, 1996: FERMCO changes its name to Fluor Daniel Fernald.

Sept. 30, 1996: Fluor Daniel Fernald will miss an EPA regulatory milestone by not completing a design work package due to ongoing design, construction and operability problems with the pilot plant.

Fernald's vitrification project plagued by serious problems

Recent correspondence between Fluor Daniel Fernald President John Bradburne and Jack Craig, the Energy Department's Fernald site director, reveals ongoing problems with the vitrification pilot project and the possibility that it may be significantly changed or even discarded.

AUG. 15, 1996:

Letter from John Bradburne to Jack Craig discussing a "replan" for the site's vitrification project that includes switching from a proposed full-scale plant to several mini-vitrification plants. Also mentioned is the possibility of discarding the vitrification project entirely for an alternate option.

AUG. 30, 1996:

Letter from Jack Craig to John Bradburne warning the Fernald company

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president that EPA-mandated project deadlines must be complied with. Mr. Craig pointed out a significant regulatory deadline will be missed for the vit project on Sept. 30.

## FERNALD'S VITRIFICATION PROJECT PROBLEMS

The report that Energy Department and Fluor Daniel Fernald officials are considering revamping or even eliminating the site's vitrification project is the latest in a cascade of problems that have been reported since The Enquirer first broke the story on Feb. 11. Company officials have repeatedly denied or downplayed Enquirer reports detailing the project's troubles.

Feb. 11-14: The Enquirer revealed that Fluor Daniel Fernald and its parent company, Fluor Daniel Inc., have cheated the government out of millions of dollars, jeopardized the safety of workers and neighbors, and have wasted millions on a problem-plagued vitrification project at the Fernald site. The series also reported that taxpayers footed the bill for \$16 million in severance pay to 476 private employees of the company in 1993 and 1995 as a way to reduce the Fernald workforce.

Feb. 13: A secret plan was being developed by Fluor Daniel Fernald to change two major aspects of the proposed vitrification process, that, if implemented, would increase the cost of the entire vitrification project by tens of millions of dollars. The company's then-president denied the Enquirer's report, saying no such plan was being studied or developed. One week later, the company admitted the studies were being done, and implementation would increase the project's cost by millions, but declared it wasn't really a secret.

March 3: Life-threatening structural defects were ignored and covered up by Fluor Daniel Fernald employees in the construction of the vitrification pilot plant, The Enquirer reported. Hundreds of internal company documents obtained by the newspaper revealed the problems. Despite the records - and statements by the vice president of the construction company working on the plant verifying the problems - Fluor Daniel Fernald officials downplayed the seriousness of the report and said they found "no merit" to the newspaper's claims.

March 25: A special Energy Department investigative team found the Fluor Daniel Fernald pilot vitrification plant project was riddled with design, schedule and construction problems that would substantially escalate the project's multimillion-dollar costs. The team noted numerous safety problems with the plant, confirming The Enquirer's March 3 report. The team, in its report, noted for the first time that the Fernald vitrification project was so problem-plagued that the Energy Department should possibly consider scrapping vitrification and research alternate cleanup methods.

May 17: The pricetag for the pilot cleanup plant jumped an additional \$14 million because of design, construction and testing problems. Fluor Daniel

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Fernald officials, who earlier denied Enquirer reports that the problems would escalate the costs by millions, confirmed the second increase in the estimated cost since 1993. The taxpayer-funded cost of completing the pilot project is now estimated at about \$56 million, an increase from the \$42 million estimated the previous year. In 1993, the company estimated the cost of the pilot plant at \$14.4 million.

### **Vitrification costs at Fernald**

Taxpayers have paid more than \$72 million toward this problem-plagued project.

Total project estimated costs

1993: \$90 M

1996: \$240 M (+)

What taxpayers have paid to date

Feasibility study and research: \$36 M

Pilot vitrification cost to date: \$42 M

Total paid to date: \$72 M

Vitrification Pilot Plant

1993: \$14.4 M - Estimate to build pilot project

1996: \$42 M - Current spending

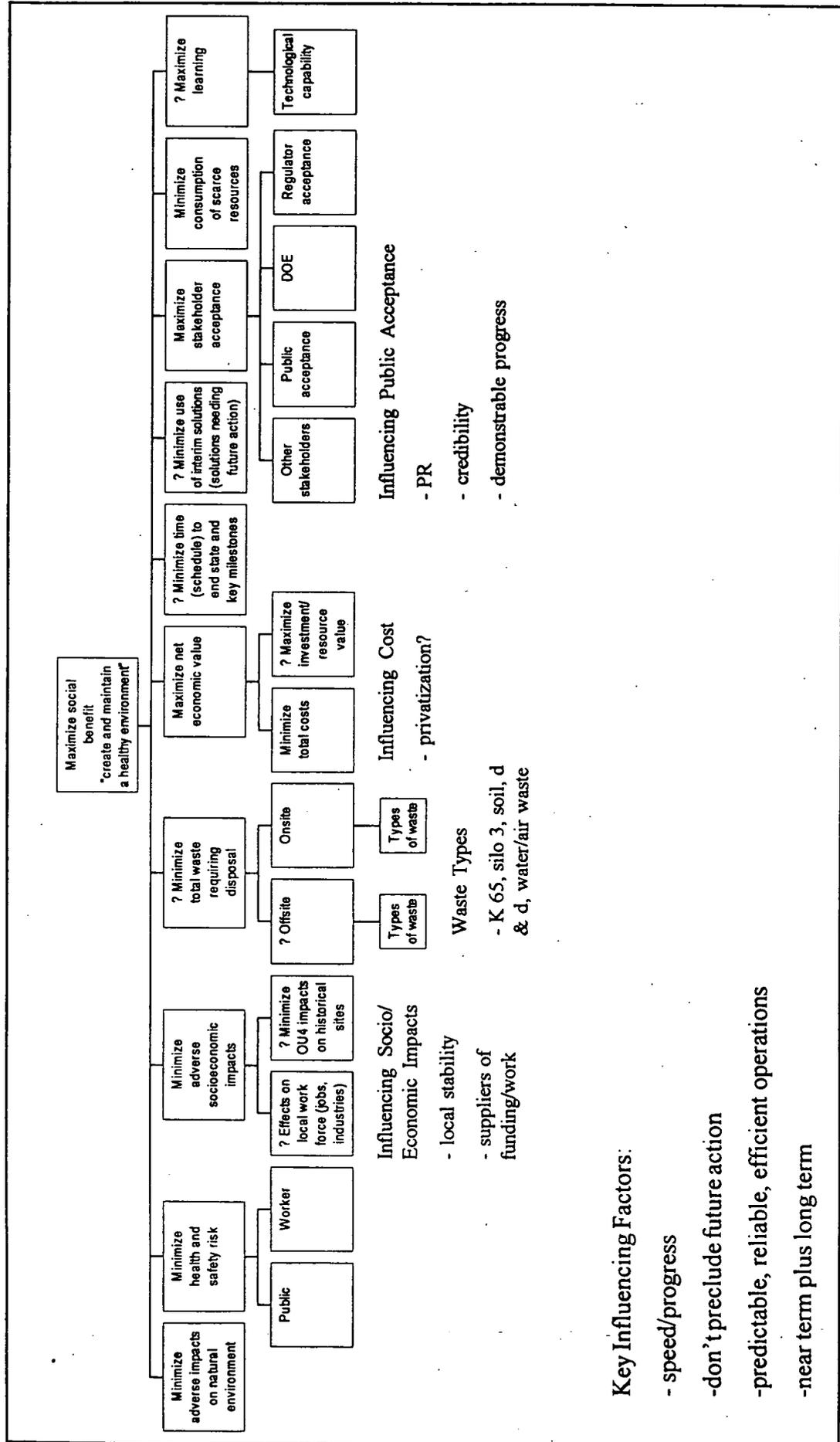
1998: \$56 M - Projected total cost

Source: News reports

*Published Sept. 29, 1996.*

Comments? Questions? Criticisms? Contact Greg Noble, online editor.  
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# Objectives Hierarchy



## Key Influencing Factors:

- speed/progress
- don't preclude future action
- predictable, reliable, efficient operations
- near term plus long term

# Operable Unit 4

## Project History & Status Presentation

by:  
Donald Paine

November 14, 1996

## Operable Unit 4

- Operable Unit 4 (OU4) is one of five operable units at the FEMP
- OU4 consists of:
  - Four concrete storage silos and their contents
  - Decant sump tank
  - Radon treatment system
  - Earthen berm surrounding Silos 1 and 2
  - Soils within OU4 boundary
  
- Silos 1 and 2 contain K-65 residues
- Silos 3 contains "cold" metal oxides
- Silo 4 is empty
- Decant sump tank contains water and sludge from the K-65 residues

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## Brief History of K-65 Silos

- Constructed during fall of 1951 and winter of 1952
- Filled during the period 1952 through 1958
- Asphaltic coating and earthen embankment added in 1964
- Berm addition to current size in 1983
- Dome covers and foam added in 1987
- Bentonite clay placed over the K-65 residues in 1991

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# Receipt and Generation of the K-65 Residues

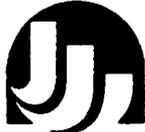
- Received in drums from Mallinckrodt Chemical Works
- Residues transferred to silos via Drum Handling Building
  - Drums dumped into tanks
  - Slurried with water
  - Pumped into Silos 1 and 2
  - Solids settled
  - Liquids decanted into decant sump tank
- FEMP generated K-65 residues pumped into silos as slurry from production area

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## Receipt and Generation of the K-65 Residues (Continued)

- Pitchblende ores came from the Shinkolobwe Mines in the Belgian Congos
  - Operated by African Metals Corporation (AMC)
- Residues generated at Mallinckrodt Chemical Works (MCW) and the FEMP
- Right to precious metals in the silos were retained by AMC until 1984
  - AMC no longer interested in the silo residues because the market value of radium had dropped dramatically

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**FLUOR DANIEL**  
**FERNALD** 

## K-65 Characteristics

- Wet gray-silty solid
- Contains elevated concentrations of radium, thorium, and lead-210
- Radon emanation rate is approximately 4500 pCi/m<sup>2</sup>/s
  - Greater than 200 times EPA limit (20 pCi/m<sup>2</sup>/s)
- Elevated concentrations of inorganics
  - Barium and Lead
- Total K-65 residues - 8012 yd<sup>3</sup> (14262 tons)
  - 4239 yd<sup>3</sup> in Silo 1 (7642 tons)
  - 3719 yd<sup>3</sup> in Silo 2 (6620 tons)
- Total bentonite clay - 878 yd<sup>3</sup> (1185 tons)
  - 467 yd<sup>3</sup> in Silo 1 (630 tons)
  - 411 yd<sup>3</sup> in Silo 2 (555 tons)
- Total waste in Silos 1 and 2 - 8890 yd<sup>3</sup> (15447 tons)

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## **Silo 3 - Cold Metal Oxides**

### **Waste Origin and Management**

- Generated only at the FEMP from 1954 through 1957
- Generated consequential to refinery operations of processing pitchblende ores and uranium concentrates
- Dried at high temperatures
- Pneumatically transferred to Silo 3 from Production Area

000069

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## Silo 3 Characteristics

- Dry powdery solid
- Mixture of metal oxides
- Much lower concentration of radionuclides
- Predominant radionuclides
  - Thorium
  - Uranium
  - Lead-210
- Leaches arsenic, chromium, cadmium, and selenium at rates exceeding RCRA limits
- Total volume of Silo 3 material - 5088 yd<sup>3</sup>
- Total volume of waste in Silos for disposal - 13978 yd<sup>3</sup> (19365 tons)

020000

# Summary of Radionuclide Analyses for Silos 1 and 2 Residues

Analyte	Frequency of Detection	Rejects	Arithmetic Mean (pCi/g)	Upper 95% C.I. on A-mean (pCi/g)	Range of Detects (pCi/g)
<b>Silo 1</b>					
Actinium-227	13/20	0	5960	7670	4320-17390
Lead-210	20/20	0	165000	202000	48980-381400
Polonium-210	13/13	0	242000	281000	144000-434000
Radium-226	20/20	0	391000	477000	89280-890700
Thorium-228	2/20	0	422	2280	835-2280
Thorium-230	24/24	0	60000	68800	10589-105372
Thorium-232	8/20	0	424	1110	661-1108
Uranium-234	21/21	0	800	932	328-1548
Uranium-235/236	14/20	0	38	54	18.1-105
Uranium-238	20/20	0	642	693	387-920
<b>Silo 2</b>					
Actinium-227	11/14	0	5100	6840	2905-10450
Protactinium-231	1/14	0	2350	4040	4041-4041
Lead-210	14/14	0	145000	190000	58160-399200
Polonium-210	8/8	0	139000	231000	55300-241000
Radium-226	14/14	0	195000	263000	657-481000
Thorium-228	5/14	0	645	7360	411-7360
Thorium-230	15/15	0	48400	76200	8365-132800
Thorium-232	3/14	0	402	985	851-985
Uranium-234	13/13	0	961	1160	121-1485
Uranium-235/236	11/13	0	73	94	35.6-172
Uranium-238	14/14	0	912	1120	46-1925

000071

# Summary of TCLP Metals Analyses for Silo 1 Residues 1990/1991

Analyte	Frequency of Detection	Rejected	Mean (mg/l)	Standard Deviation (mg/l)	Range (mg/l)	Maximum Allowable Concentration
Aluminum	12/12	0	0.314	0.067	0.228 - 0.441	NA
Antimony	12/12	0	0.093	0.019	0.067 - 0.129	NA
Arsenic	1/11	1	0.002	-	-	5.0
Barium	12/12	0	0.888	0.402	0.348 - 1.83	100.0
Beryllium	6/12	0	0.002	0.0004	0.002 - 0.003	NA
Boron	11/12	0	0.255	0.07	0.168 - 0.394	NA
Cadmium	12/12	0	0.003	0.001	0.002 - 0.005	1.0
Calcium	12/12	0	55.4	33.6	17.6 - 108	NA
Chromium	12/12	0	0.059	0.012	0.045 - 0.081	5.0
Cobalt	12/12	0	1.82	0.89	0.72 - 3.08	NA
Copper	12/12	0	0.208	0.097	0.068 - 0.404	NA
Iron	10/12	0	0.046	0.022	0.018 - 0.1	NA
Lead	8/9	3	614	221	229 - 641	5.0
Magnesium	12/12	0	8.96	2	6.12 - 13.8	NA
Manganese	12/12	0	0.163	0.07	0.067 - 0.308	NA
Mercury	1/12	0	0.0002	-	-	0.2
Molybdenum	12/12	0	0.072	0.026	0.036 - 0.108	NA
Nickel	12/12	0	3.18	1.39	1.32 - 5.57	NA
Potassium	12/12	0	10.3	5.32	2.95 - 18.3	NA
Selenium	11/11	1	0.135	0.088	0.015 - 0.308	1.0
Silicon	12/12	0	31.9	6.2	13.5 - 42.1	NA
Silver	12/12	0	0.034	0.008	0.023 - 0.048	5.0
Thallium	9/12	0	0.005	0.003	0.002 - 0.008	NA
Vanadium	12/12	0	0.023	0.005	0.017 - 0.032	NA
Zinc	12/12	0	0.128	0.079	0.02 - 0.323	NA

# Summary of TCLP Metals Analyses for Silo 2 Residues 1990/1991

Analyte	Frequency of Detection	Rejected	Mean (mg/l)	Standard Deviation (mg/l)	Range (mg/l)	Maximum Allowable Concentration
Aluminum	7/7	0	1.29	0.763	0.462 - 2.75	NA
Antimony	6/6	1	0.096	0.016	0.079 - 0.123	NA
Arsenic	8/8	0	0.084	0.11	0.003 - 0.32	5.0
Barium	8/8	0	2.96	3.3	0.157 - 8.47	100.0
Beryllium	7/7	0	0.005	0.0007	0.003 - 0.006	NA
Boron	4/4	0	0.69	0.58	0.24 - 1.5	NA
Cadmium	7/7	1	0.047	0.028	0.010 - 0.077	1.0
Calcium	7/7	0	483	276	163 - 975	NA
Chromium	8/8	0	0.129	0.036	0.086 - 0.207	5.0
Cobalt	7/7	0	3.02	2.11	1.16 - 6.16	NA
Copper	7/7	0	1.41	1.41	0.274 - 3.86	NA
Iron	7/7	0	0.076	0.012	0.053 - 0.090	NA
Lead	7/7	1	516	346	117 - 1072	5.0
Magnesium	7/7	0	15.4	6.84	7.39 - 29.6	NA
Manganese	7/7	0	0.776	0.466	0.409 - 1.92	NA
Molybdenum	7/7	0	0.058	0.027	0.034 - 0.099	NA
Nickel	7/7	0	3.48	1.45	2.04 - 5.77	NA
Potassium	5/7	0	4.032	1.18236	2.64 - 5.31	NA
Selenium	6/6	0	0.114	0.184	0.026 - 0.568	1.0
Silicon	5/5	1	16.3	5.2	12.1 - 24.3	NA
Silver	8/8	0	0.093	0.032	0.053 - 0.164	5.0
Thallium	6/7	0	0.008	0.011	0.0022 - 0.0286	NA
Vanadium	5/5	1	0.053	0.006	0.046 - 0.090	NA
Zinc	6/6	1	0.339	0.194	0.141 - 0.593	NA

000073

# Radionuclide Concentration in Silo 3 Residue

Analyte	Frequency of Detection	Rejected	Arithmetic Mean (pCi/g)	Upper 95% C.I. on A-mean (pCi/g)	Range of Detects (pCi/g)
<b>Silo 3</b>					
Actinium-227	9/9	2	618	925	234 - 1363
Lead-210	11/11	0	2620	3480	454 - 8427
Protactinium-231	9/11	0	467	627	266 - 931
Radium-224	11/11	0	290	367	64 - 453
Radium-226	11/11	0	2970	3670	467 - 6435
Radium-228	9/11	0	297	406	82 - 559
Thorium-228	7/11	0	590	747	459 - 996
Thorium-230	11/11	0	51200	60200	21010 - 71650
Thorium-232	8/11	0	656	842	411 - 1451
Uranium-234	11/11	0	1480	1730	348 - 1935
Uranium-235/236	10/11	0	93.6	117	42 - 158
Uranium-238	11/11	0	1600	1760	320 - 2043

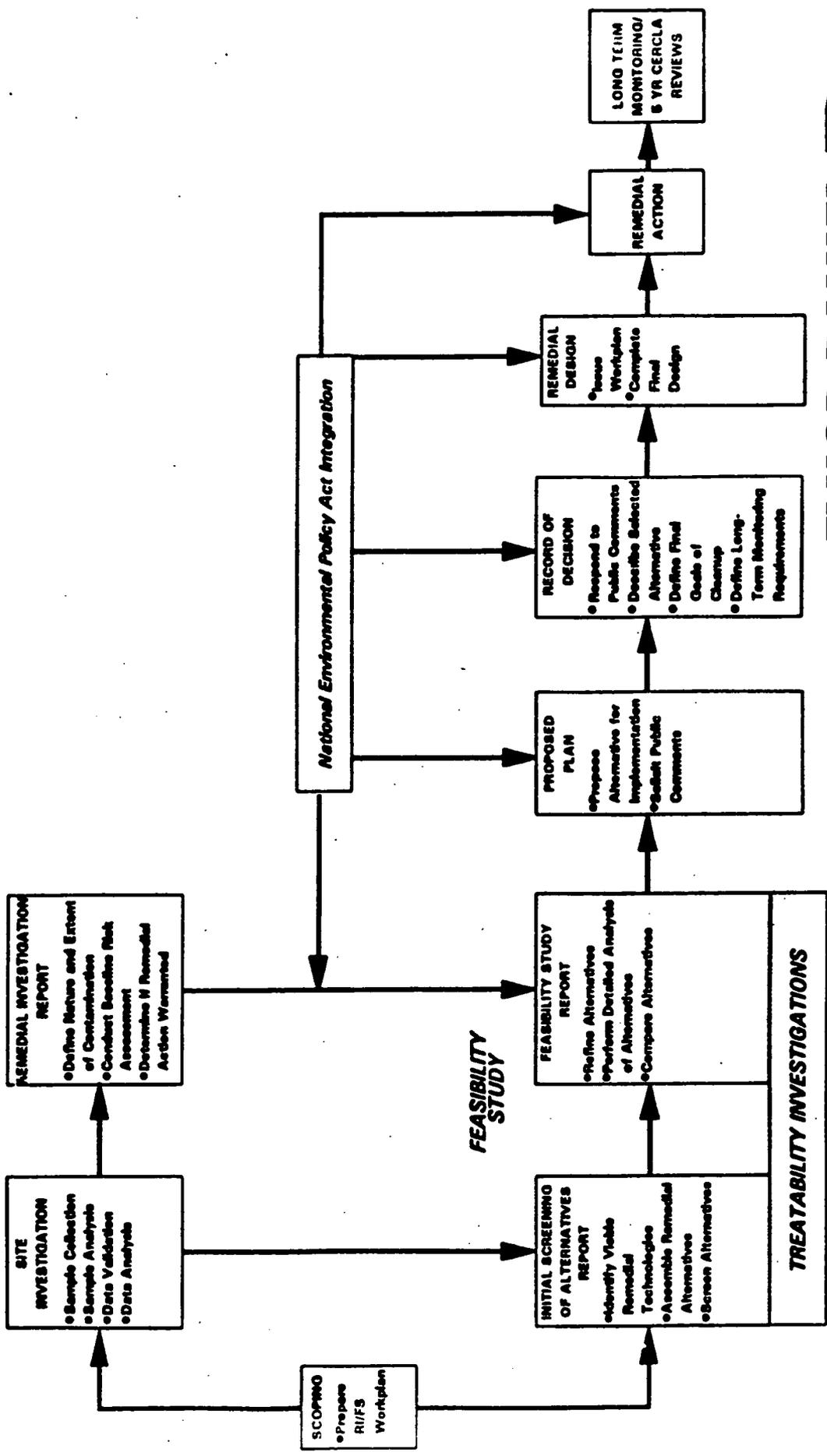
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# EP Toxicity Results for Silo 3 Residues - 1989

Analyte	Frequency of Detection	Mean (mg/l)	Standard Deviation (mg/l)	Range (mg/l)	Maximum Allowable Concentration
Arsenic	9/11	9.481	12.393	ND - 41.5	5.0
Barium	11/11	0.08	0.046	0.02 - 0.156	100.0
Cadmium	11/11	0.847	1.74	0.108 - 6.32	1.0
Chromium	11/11	5.05	3.22	0.336 - 11.9	5.0
Lead	7/11	0.239	0.327	ND - 1.01	5.0
Mercury	2/11	0.0005	0.0009	ND - 0.003	0.2
Selenium	11/11	2.65	3	0.92 - 11.7	1.0
Silver	1/11	0.007	0.008	ND - 0.032	5.0

000075

# Operable Unit 4 Environmental Restoration Process



000076

**ALTERNATIVES EVALUATED IN DETAILED ANALYSIS  
FEASIBILITY STUDY/PROPOSED PLAN - ENVIRONMENTAL IMPACT STATEMENT**

OPERABLE UNIT 4 SUBUNIT	ALTERNATIVE	DESCRIPTION
Subunit A Silo 1 and 2 contents and decant tank sludge	0A 2A/Vit 2A/Cem 3A.1/Vit 3A.1/Cem	No Action Removal, vitrification, on-property disposal Removal, cement stabilization, on-property disposal Removal, vitrification, off-site disposal at NTS Removal, cement stabilization, off-site disposal at NTS
Subunit B Silo 3 contents (cold metal oxides)	0B 2B/Vit 2B/Cem 3B.1/Vit 3B.1/Cem 4B	No Action Removal, vitrification, on-property disposal Removal, cement stabilization, on-property disposal Removal, vitrification, off-site disposal at NTS Removal, cement stabilization, off-site disposal at NTS Removal, on-property disposal
Subunit C Silo 1, 2, 3 and 4 structures, soils, debris	0C 2C 3C.1 3C.2	No Action Demolition, removal, on-property disposal Demolition, removal, off-site disposal at NTS Demolition, removal, off-site disposal at Permitted Commercial Facility

Shaded Area - Preferred Alternative

000077

# Detailed Analysis of Alternatives

Alternatives are evaluated against the following criteria:

## Threshold Criteria

- Overall Protection of Human Health and the Environment
- Compliance with Applicable or Relevant and Appropriate Requirements

## Balancing Criteria

- Long-term Effectiveness and Permanence
- Reduction of Toxicity, Mobility or Volume through Treatment
- Short-term Effectiveness
- Implementability
- Cost

000078

# Detailed Analysis of Alternatives (Continued)

## Modifying Criteria

- State Acceptance
- Community Acceptance

000079

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## **Major Components of the Selected Remedy**

- Removal of the contents of Silos 1, 2 and 3 and the decant sump tank
- Vitrification to stabilize the wastes from the silos and decant sump tank
- Off-site disposal at the Nevada Test Site of the treated waste

000080

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631

## **Why Vitrify?**

- **Significantly reduces radon emanation**
- **Reduces leachability of metals and radiological constituents**
- **Reduces volume of waste for disposal**
- **Characteristics of silo material favorable to vitrification**

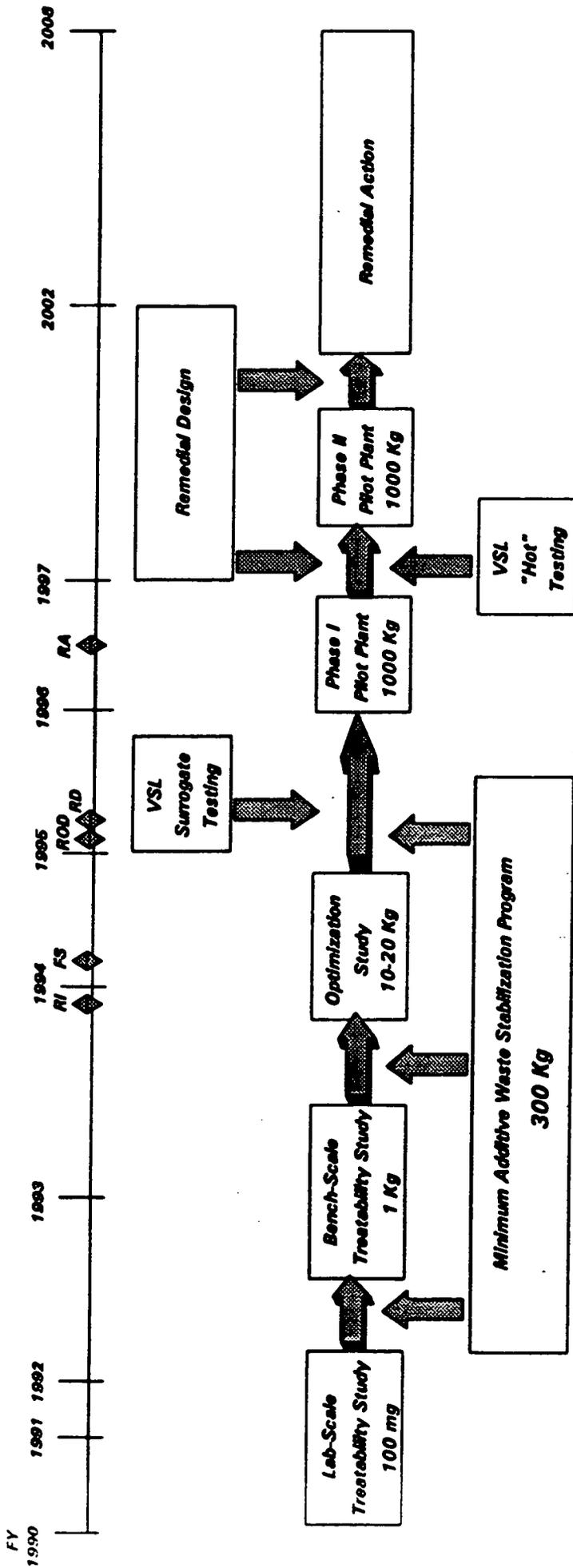
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# Why Dispose of Treated Waste at NTS?

- Long term effectiveness
- Complies with all pertinent Applicable or Relevant and Appropriate Requirements
- Land use surrounding FEMP site
- Demographics
- Climate
- Hydrogeological conditions
- Administratively favorable - existence of current waste shipping program
- Cost effective

000082

# VITRIFICATION DEVELOPMENT PROGRAM



000083

# Vitrification Pilot Plant

## What is a Pilot Plant?

- Experimental test facility
- Representative model of full-scale facility
- Provides Full-scale design information
- Defines operating parameter ranges
- Provides operability and maintainability information and experience
- Identifies system performance limitations
- Provides actual cost and schedule information

000084

# Vitrification Pilot Plant Status

- Pilot Plant Operational June 19, 1996
- Four Test Campaigns
  - Campaign I - Integrated Operational Test - Complete July 1996
  - Campaign II - Silos 1, 2, & 3 Surrogate - Complete September 1996
  - Campaign III - Silo 3 Surrogate - Eliminated
  - Campaign IV - Silo 1 & 2 Surrogate
- Complete all testing February 1997

000085

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# **Vitrification Pilot Plant Campaign I Objectives**

- Campaign I - Benign Glass Formula
- Establish Melter Control
- Synchronize Operation of Melter and Gem Machine
- Increase Glass Output to 3 Metric Tons Per Day

000086

# **Vitrification Pilot Plant Campaign I - Accomplishments**

- 12.5 Tons of Glass Produced
- 19% Operating Efficiency
- Achieved 2 tons per day Throughput Rate
- Identification of Unit Operation Optimization

780000

# Vitrification Pilot Plant Campaign 1 - Lessons Learned

- Film Cooler plugging
- Discharge Chamber plugging
- Excessive moisture/particulates in off-gas
- Gem Machine cooling/lube spray

880000

# **Vitrification Pilot Plant Campaign II Objectives**

- Campaign II - Silos 1, 2, and 3 blend surrogate
- Melter Acceptance Test
- Gem Machine Acceptance Test
- Evaluate melter normal operating efficiency

0800089

# **Vitrification Pilot Plant Campaign II - Accomplishments**

- 11 tons of glass produced
- 27% operating efficiency
- Achieved 2 tons per day throughput rate
- Identification of unit operation optimization

000090

# Vitrification Pilot Plant Campaign II - Lessons Learned

- Slurry feed composition
- Melter feed pump
- Excessive moisture/particulates in off-gas
- Lid heater
- Gem Machine feed
- Melter bottom drain replacement
- Control of Sulfate (foaming & power sink)

1500091

# Vitrification Pilot Plant Modifications

- Slurry feed system
  - Replace slurry pump
  - Simplify slurry piping routing
  - Enhance slurry tank nozzle
  
- Off-gas System
  - Heat tape and insulation lines and HEPAs
  - Remove excessive particulates
  - Reroute off-gas line

# Vitrification Pilot Plant Modifications

- Facilities
  - Install heat tracing and insulation to weatherproof plant prior to winter
- Gem Machine
  - Water cool the cutter
- Melter
  - Install larger Moyno feed pump to increase throughput rate
  - Install knife gates to provide isolation of view ports for maintenance activities
  - Replace thermowells

# **Vitrification Pilot Plant Campaign IV Objectives**

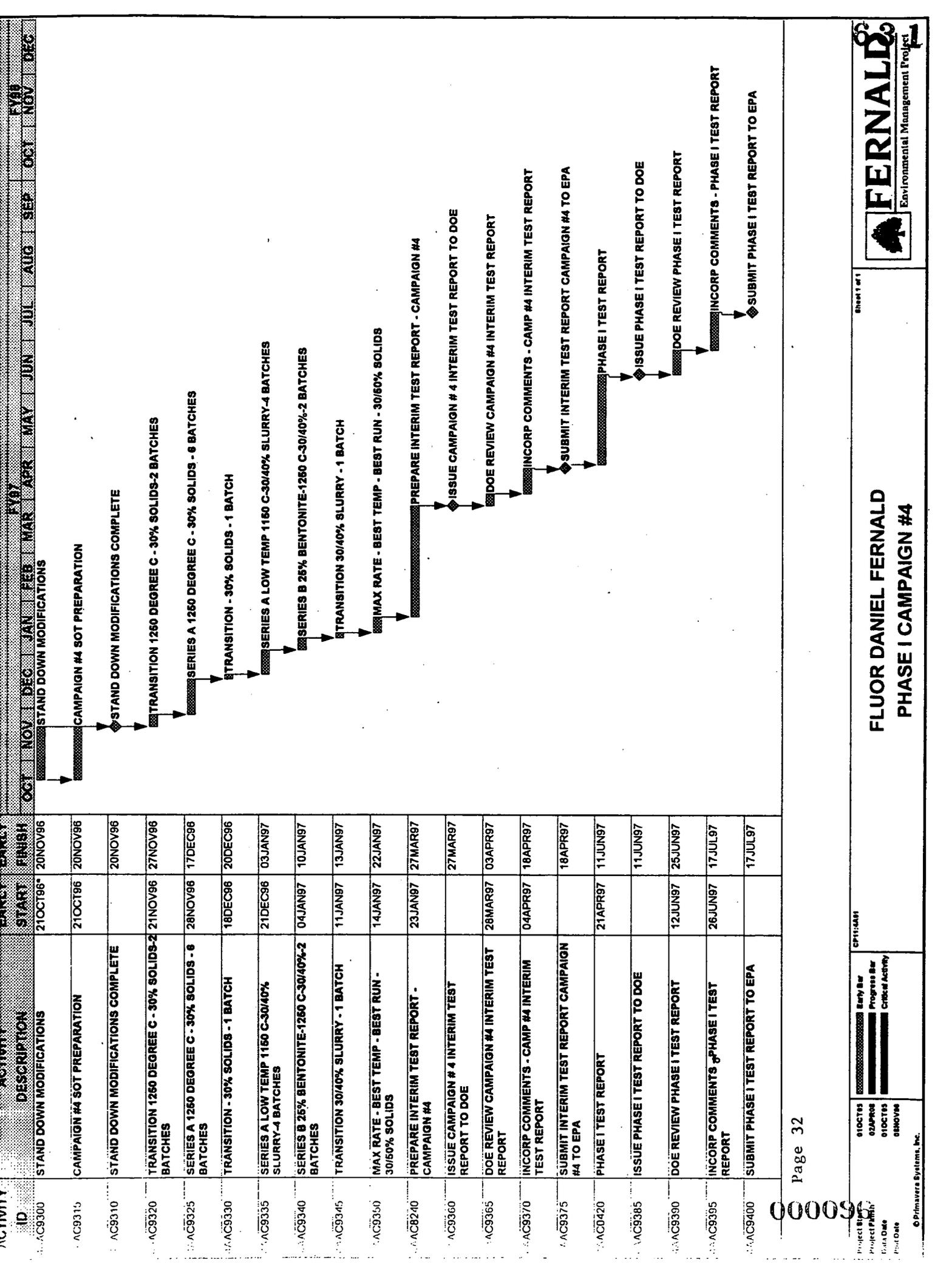
- Campaign IV - Silos 1 and 2 surrogate with bentonite (Series A and B)
- Evaluation of lead, barium, alumina and sulfates on glass-making process
- Evaluate potential for low temperature operation (1150°C)
- Evaluate melter maximum rate of production
- Evaluate electrode erosion

000094

# Silos Project

## Pilot Plant Phase I Test Data

- Glass production
- Established viable feed formula envelopes
- Established operating parameter ranges
- Identified system performance limitations
- Generated lessons learned database
- Obtained operator experience



ACTIVITY ID	ACTIVITY DESCRIPTION	START	FINISH
AC9300	STAND DOWN MODIFICATIONS	21OCT96*	20NOV96
AC9315	CAMPAIGN #4 SOT PREPARATION	21OCT96	20NOV96
AC9310	STAND DOWN MODIFICATIONS COMPLETE		20NOV96
AC9320	TRANSITION 1260 DEGREE C - 30% SOLIDS-2 BATCHES	21NOV96	27NOV96
AC9325	SERIES A 1260 DEGREE C - 30% SOLIDS - 6 BATCHES	28NOV96	17DEC96
AC9330	TRANSITION - 30% SOLIDS - 1 BATCH	18DEC96	20DEC96
AC9335	SERIES A LOW TEMP 1160 C-30/40% SLURRY-4 BATCHES	21DEC96	03JAN97
AC9340	SERIES B 25% BENTONITE-1260 C-30/40%-2 BATCHES	04JAN97	10JAN97
AC9345	TRANSITION 30/40% SLURRY - 1 BATCH	11JAN97	13JAN97
AC9350	MAX RATE - BEST TEMP - BEST RUN - 30/60% SOLIDS	14JAN97	22JAN97
AC8240	PREPARE INTERIM TEST REPORT - CAMPAIGN #4	23JAN97	27MAR97
AC9360	ISSUE CAMPAIGN # 4 INTERIM TEST REPORT TO DOE	27MAR97	27MAR97
AC9365	DOE REVIEW CAMPAIGN #4 INTERIM TEST REPORT	28MAR97	09APR97
AC9370	INCORP COMMENTS - CAMP #4 INTERIM TEST REPORT	04APR97	18APR97
AC9375	SUBMIT INTERIM TEST REPORT CAMPAIGN #4 TO EPA	18APR97	18APR97
AC0420	PHASE I TEST REPORT	21APR97	11JUN97
AC9385	ISSUE PHASE I TEST REPORT TO DOE	11JUN97	11JUN97
AC9390	DOE REVIEW PHASE I TEST REPORT	12JUN97	25JUN97
AC9395	INCORP COMMENTS - PHASE I TEST REPORT	26JUN97	17JUL97
AC9400	SUBMIT PHASE I TEST REPORT TO EPA	17JUL97	17JUL97

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**FERNALD**
  
 Environmental Management Project

Sheet 1 of 1
   
**FLUOR DANIEL FERNALD**
  
**PHASE I CAMPAIGN #4**

Project Bar: 01OCT95  
 Project Start: 02APR96  
 Project Finish: 01OCT95  
 Print Date: 08NOV96

Legend:  
 - Early Bar (dotted)  
 - Progress Bar (solid)  
 - Critical Activity (thick solid)

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## **What Brought Us To Focus On Silo 3?**

- **Vitrification delayed 17 months (November 1995)**
- **Value Engineering Study performed by DOE (January 1996)**
- **Recommendations (February 1996)**
  - **Silo 3 Alternative Study**
  - **VITPP Upgrade Study**
- **Silo 3 Alternatives were evaluated in detail**

## **The Silo 3 Report Evaluated the Following Alternatives:**

- VIT - Removal of residues from Silo 3, on-site vitrification of Silo 3 residues (blended with Silos 1 and 2 residues), off-site disposal of treated residues at the Nevada Test Site (NTS)
- Alt 1 - Removal of residues from Silo 3, on-site solidification/stabilization of Silo 3 residues, off-site disposal of treated residues at the NTS
- Alt 2 - Removal of residue from Silo 3, on-site solidification/stabilization of Silo 3 residues and disposal of treated residues at the Representative Permitted Commercial Disposal Facility (RFCDF)

850000

**The Silo 3 Report Evaluated  
the Following Alternatives:**

**(Continued)**

- Alt 3 - Removal of residues from Silo 3, off-site solidification/stabilization of Silo 3 residues and disposal of treated residues at the RPCDF
- Alt 4 - Removal of residues from Silo 3, on-site blending of Silo 3 residues with Operable Unit 1 Waste Pit 5 material, off-site disposal of blended material at the RPCDF

## **Results of Silo 3 Evaluation**

- Material in Silo 3 can be remediated sooner
- Reliable technology, proven process
- Provides waste form protective of human health and the environment

000100

## VITPP Facility Upgrade Evaluation

**Basis: Recommendation of January 1996 Value Engineering Study**

### **Objectives:**

- Evaluate feasibility of modifying VITPP for use as a production facility
- Establish limitations
- Determine technical basis, cost and schedule modifications of alternative upgrade scenarios

000101

## VITPP Facility Upgrade Evaluation

### Major Modifications

- Modification of the off-gas system to increase throughput and facilitate production operations
- Modification of slurry preparation and feed system to increase throughput and facilitate production operations
- Upgrade of the wastewater system to meet AWWT acceptance criteria at production capacity
- Upgrade gem forming equipment to increase throughput

### Added Facilities/Systems

- Bulk glass former addition system
- Facility to accommodate relocation of carbon beds
- Glass/gem handling facility
- Stand-alone laboratory to supplement/replace existing capability

## **Other Issues RD/RA Milestones**

- First missed milestone is September 30, 1996
- Request extension
- Negotiate new milestones based on path forward

000103

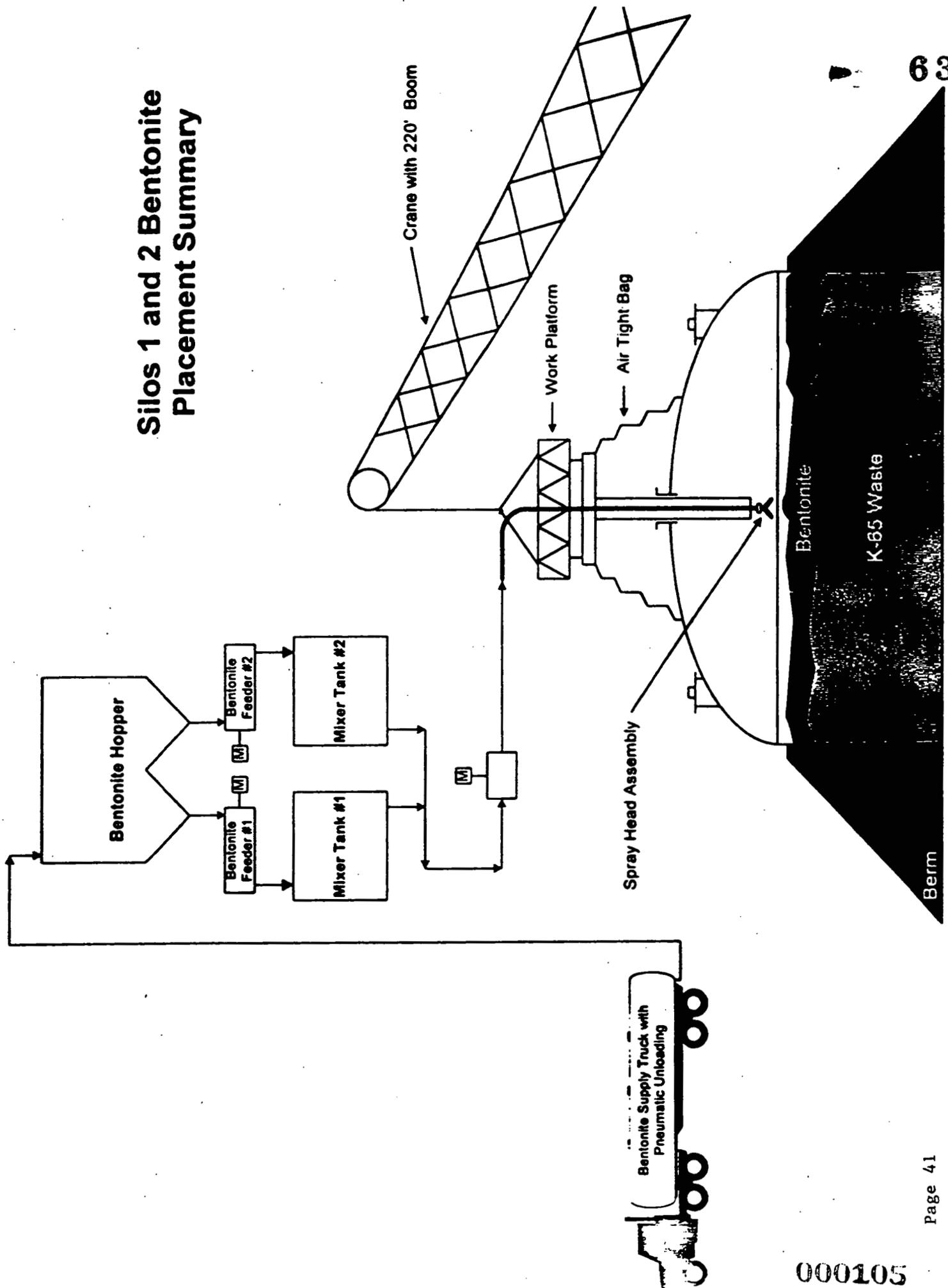
# Silos Project Deliverables and Milestones

Description	Type	Date
Radon treatment system, Title I/II design	Preliminary	30-Sept-96
Vitrification Plant, Title I design	Preliminary	04-Dec-06
Design Criteria Package	Pre-final	04-Dec-96
Submit Phase II Remedial Action Work Plan	----	07-Oct-06
Radon treatment system, Title I/II design	Pre-final	02-Jan-97
New Radon Treatment System Award/Construction	----	21-Jul-97
Vitrification Plant, Title II design	Pre-final	01-Sept-97
D&D Waste Management, Title I/II design	Pre-final	07-Dec-00
Final Site Remediation, Title I/II design	Pre-final	07-Dec-01

000104



# Silos 1 and 2 Bentonite Placement Summary



## Other Issues

### Silo 1 and 2 Headspace Concentration

- History - Chronic Radon Emissions from Silo 1 and 2
  - Sealed Vents in 1979
  - Foamed Dome in 1987
  - Added Bentonite in 1991
- Silo 1 and 2 Headspace Concentration
  - Pre-Bentonite 50,000,000 - 60,000,000 pCi/L
  - Post-Bentonite 200,000 - 300,000 pCi/L
  - Gradual Increase
- Reaching Action Levels

## K-65 Silos - Radon

- Bentonite Cap added in 1991 to attenuate radon levels in the silo's headspace.

**USEPA Goal:** Reduce the silos contribution to off-site radon emissions to a level no greater than 0.015 pCi/l above background at the location of the maximally exposed individual, at a non-FEMP location.

- Current modeled off-site contribution from K-65 silos 0.017 pCi/l (Silo 1 -  $9.45 \times 10^6$  pCi/l and Silo 2 -  $7.12 \times 10^6$  pCi/l)
- DOE Order 5400.5 allows for an annual average fenceline radon concentration of 3 pCi/l above background
- Current fenceline monitored radon levels average 0.85 pCi/l from all site sources, including background

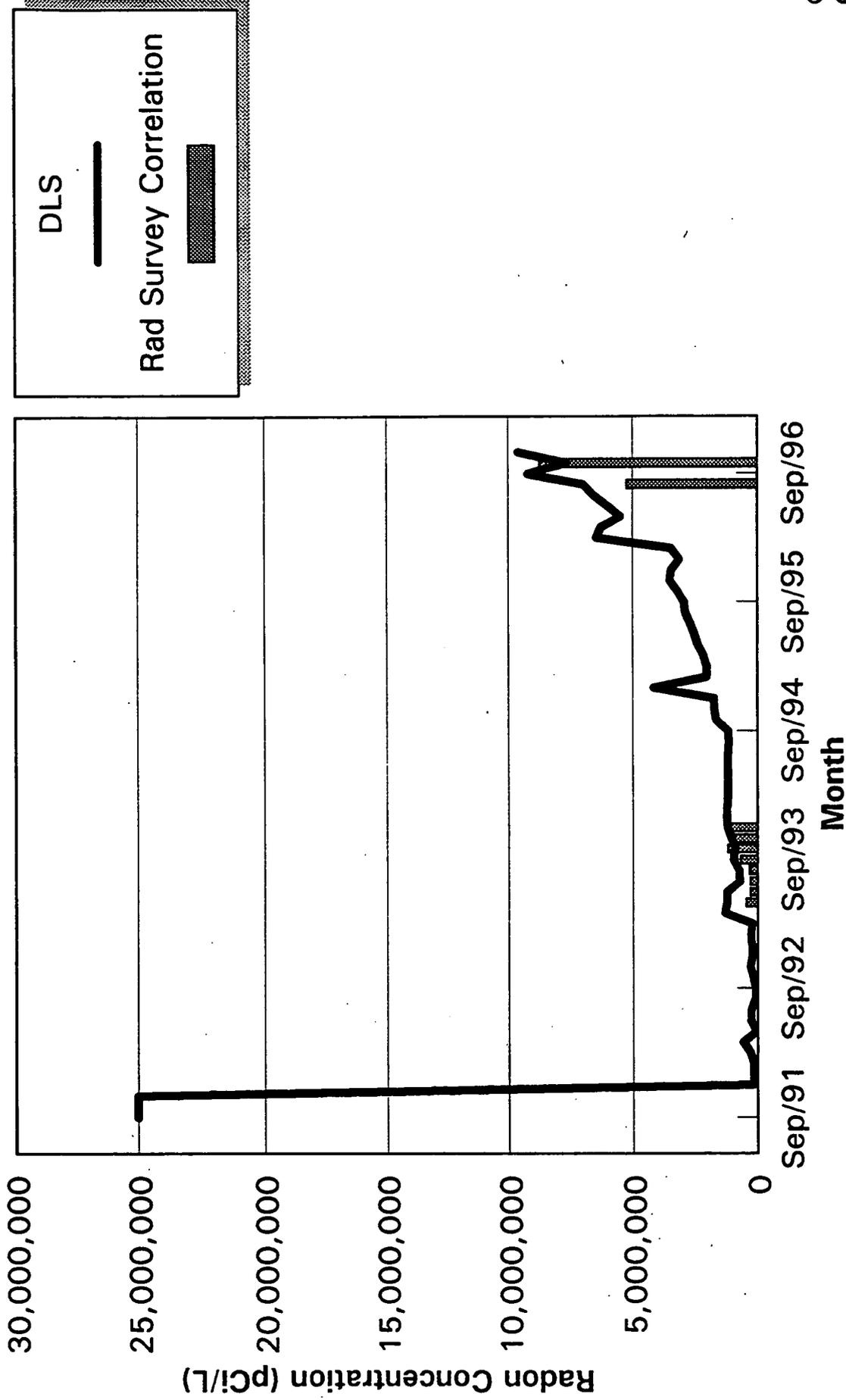
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# Silo 1 Headspace Concentration

DLS vs Radiation Survey Calculation

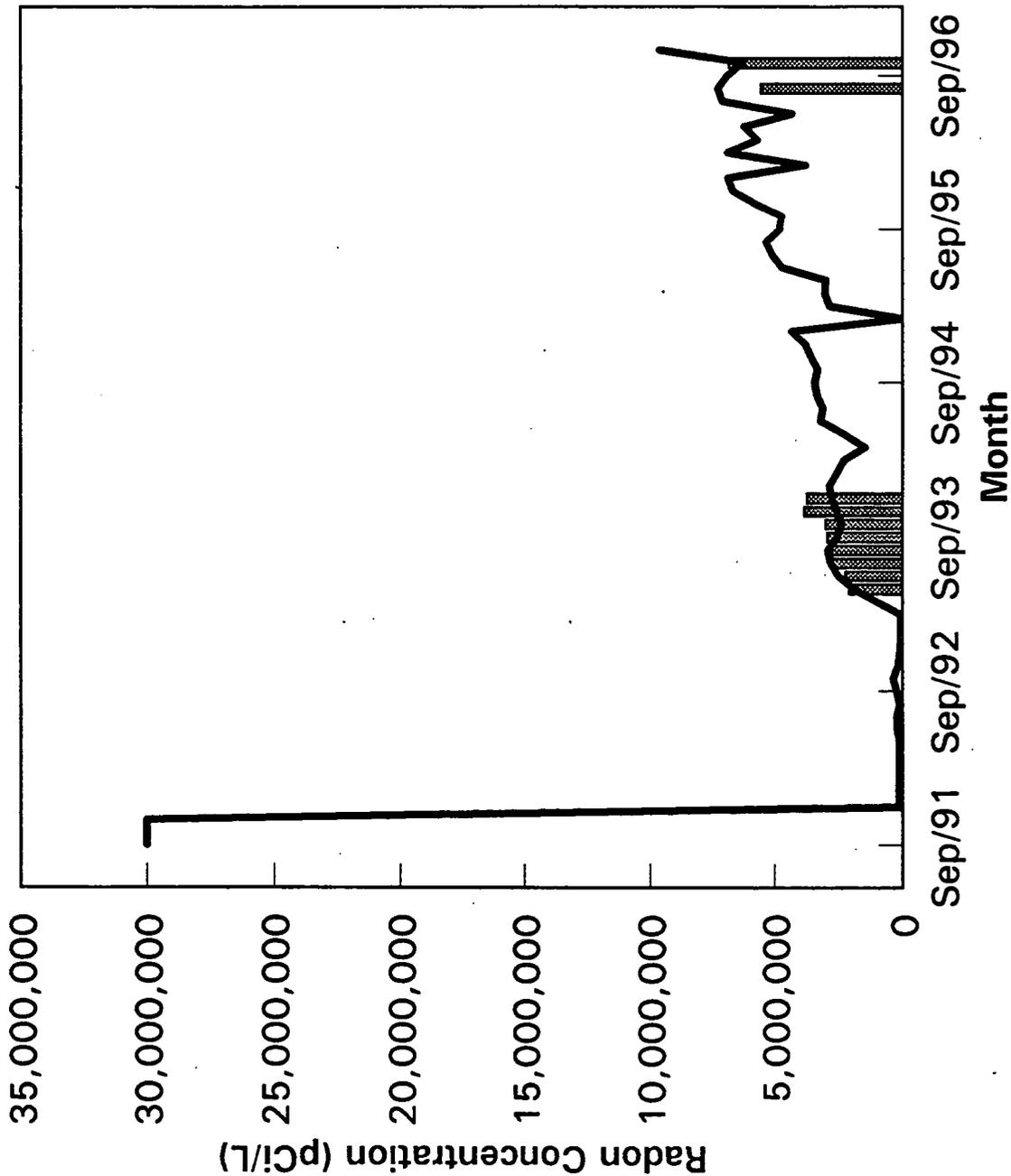


DLS

Rad Survey Correlation

# Silo 2 Headspace Concentration

DLS vs Radiation Survey Calculation



DLS  
Rad Survey Correlation

501000

# Silos Project Path Forward

- Complete Pilot Plant Phase I Operations (February 1997)
- Evaluate available data and information (February 1997 - March 1997)
  - Pilot Plant Phase I test data
  - Pilot Plant upgrade analysis
  - Silo 3 Alternatives Evaluation Report
  - Independent Technical Review Team
- Agency and Stakeholder involvement
- Reach decision on path forward

TABLE 2. CHARACTERISTICS OF THE K-65 RESIDUES STORED IN BUILDING 434 OF THE DOE-NIAGARA FALLS STORAGE SITE AND AT THE FMPC, FERNALD, OH

Characteristic	FMPC Stored K-65		Niagara Falls Stored K-65	
	Litz (a)	NLO (b)	Vitro (c)	BCL (d) NLO (b)
Dry wt, kg (tons)	-	8.79x10 <sup>6</sup> (9,690)	1.59x10 <sup>6</sup>	(1,757)
Estimated volume, m <sup>3</sup> (ft <sup>3</sup> )	-	5,522 (195,000)	3,115	(110,000)
Density, kg/m <sup>3</sup> (lb/ft <sup>3</sup> )	-	-	1,179	(73.6)
Uranium, ppm	1,800-3,200	600	2,110	500
				500 (e) 18,240 (f) 30,000 (g) 1410-1961 (h)
Lead, ppm	60-70,000	48-52,000	94,900	35,000
Radium, ppb	280-360	200	300	217
Barium, ppm	50,000	-	45,300	30,000
Iron, ppm	13-18,000	-	-	5,000
Gold, ppm	65-78	<40-60	-	<0.2
Platinum, ppm	0.9-1.4	-	-	<0.5
Palladium, ppm	13-18	-	-	20
Silver, ppm	18	<20	-	<3
Copper, ppm	500-800	400-600	-	500
Cobalt, ppm	1,600-2,000	1,500-2,000	-	2,000
Nickel, ppm	3,500-3,700	2,000-3,000	-	3,000

(a) Source: Litz, 1974.  
 (b) Source: NLO, Inc., and Battelle Columbus Laboratories, 1980.  
 (c) Source: Vitro Corp., 1952.  
 (d) Same as (b) above.  
 (e) Direct gamma spectroscopy of the residue.  
 (f) X-ray diffraction of the residue.  
 (g) Spark source mass spectroscopy.  
 (h) Calculated U from Ra measurements.

\* 1.8 Troy Oz./Ton of Residue  
 (1.8)(14,262 T) = 25,672 Troy Oz. x \$380 = \$9.8 M

000112