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SILO PROJECT INDEPENDENT REVIEW TEAM DECEMBER 12 & 13, 1996 MEETING AGENDA, HANDOUTS AND MEETING NOTES

12/12/96

IRT
150
AGENDA

AGENDA

Subject: FEMP Silos Project, Path Forward Decision
Date: December 12 & 13, 1996
Location: FEMP Alpha Bldg., Fernald OH

Thursday, December 12

8:00	Opening / Review of Objectives	R. Heck
8:30	Open Actions from Last Meeting	D. Paine
	Update of VITPP	
9:15	Decision Analysis Approach	L. Merkhofer
11:30	Lunch	
12:00	Commitee Report: Description of Alternatives	D. Paine
1:30	Committee Report: Technical Issues	H. Robertson
3:00	Committee Report: Cost & Schedule	M. Connors
4:30	Meeting Concludes	

Friday, December 13

8:00	Opening	D. Paine
8:15	Committee Report: Regulatory	T. Hagen
8:45	Committee Report: Funding & Waste Site Availability	T. Hagen
9:45	Break	
10:00	Committee Report: Health & Safety	P. Fisk
11:30	Lunch	
12:00	Open Discussion	L. Merkhofer
1:00	Assignment of Roles & Responsibilities	L. Merkhofer
2:00	Meeting Assessment / Path Forward	L. Merkhofer
3:00	Meeting Concludes	

FEMP Silos Project
Path Forward Decision
December 12 & 13, 1996 Meeting
Attendees

Independent Review Team
Gail E. Bingham, consultant
Gilles Chevrier, NUMATEC
Robert Cook, consultant
Jim Edmondson, consultant
Bob Lawrence, WVNS
Todd Martin, HEAL
John Plodinec, WSRC
Bob Roal, consultant
Ben Smith, consultant

Decision Analysis Support Contractor
Lee Merkhofer, Applied Decision Analysis, Inc.

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

Jeannie Foster
Jill Oligee

DOE-FN
Nina Akgunduz
Jack Craig
Glenn Griffiths
Johnny Reising
Gary Stegner

FRESH
Lisa Crawford
Vicky Dastillung

Citizens Task Force
Gloria McKinley
Doug Sarno
Gene Willeke

FATLAC
Robert Tabor
Rick Wilson

Building Trades
Lou Doll

U.S. EPA-V
Gene Jablonowski
Jim Saric

Ohio EPA
Kelly Kaletsky
Tom Schneider

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

Overview of Objectives
Independent Technical Review Team

- The Independent Technical Review Team (IRT) will be providing advice/recommendations to Fluor-Daniel Fernald and DOE (FDF/DOE) as aid in an internal decision making process. FDF/DOE will evaluate this input internally in determining what, if any, modifications to our current path forward (i.e. vitrification of Silos waste) should be formally proposed to the regulators and other stakeholders. Stakeholders are being asked for input during the internal decision making process in firm recognition of the vital importance of their acceptance if any path forward modifications are proposed formally.

- The IRT will aid in decision making by:

  - Reviewing current FDF/DOE recommendations to cement solidify Silo 3 and reach consensus to agree with or suggest modifications to this direction.

  - Assist with optimization of vitrification by:

    * Reviewing, commenting and providing advice on the upgrade plans for the Pilot Plant and evaluating the results from the existing Pilot Plant.
    * Providing reviews, comment, and providing advice on current technical approach to vitrification using lessons learned.

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Overview of Objectives
Independent Technical Review Team

- In light of significant uncertainties in vitrification process reliability observed to date and associated impacts on project schedule and like issues, FDF/DOE would like advice/recommendations on whether to formally re-evaluate the selected OU4 remedy. FDF/DOE would like the IRT to evaluate issues associated with vitrification implementation and identify and evaluate any potentially viable options to vitrification. In light of these evaluations, FDF/DOE would like input on the appropriateness of re-evaluating, through a formal public process, the current OU4 path forward. It is not expected that the IRT will advance a sole recommendation for a single alternative, but rather to return evaluation and advice based on their experiences for each alternative as an aid to our path forward evaluation.

  The alternatives to be considered at a minimum include:

  Alternative 1. Vitrify all three silos
  Alternative 2. Vitrify Silos 1 and 2 and cement solidify Silo 3
  Alternative 3. Use stabilization in the form of some viable option(s) for all three silos.

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Topics

- VITPP Status Update
- Silo 3 Report Update
- Silo 3 Request for Proposal

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VITPP Status Update

Campaign #1 - Benign Glass

Objectives

- Establish melter control
- Synchronize melter and gem machine
- Increase glass output

Results

- Melter control established
- Operator experience gained
- Gems produced
- Melter maximum rate achieved - 2 MT ton/day
- Total Glass Produced 21,000 pounds

Issues

- Feed Prep and Delivery System
- Melter Cooling Water
- Gobcutter Performance
- Off-gas System Performance
- Film Cooler Performance

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VITPP Status Update

Campaign # 2 - Surrogate Silos 1, 2 & 3

Objective

- Feasibility of vitrifying Silo 1, 2 & 3 surrogate
- Sulfate and phosphate handling experience
- Lead and Barium handling experience
- Melter and Gem Machine Acceptance Test

Results

- Silo 1, 2 & 3 vitrified
- Sulfate layering and foaming occurred
- No Phosphate issues
- Conditional acceptance of melter and gem machine
- Total glass produced 24,000 lbs.

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VITPP Status Update

Campaign # 2 - Surrogate Silos 1, 2 & 3 (Continued)

Issues

- Refractory Degradation
- Bottom Drain Failures
- Thermal Well Failures
- Feed Prep and Slurry Delivery System Issues
- Off-Gas System Issues
- Sulfate Foaming/Layering

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VITPP Status Update

Campaign #4 - Silo 1 & 2 Surrogate

Objectives

- Feasibility of vitrifying Silos 1 & 2 surrogate at high temperature melt
- Feasibility of vitrifying Silos 1 & 2 surrogate at low temperature melt
- Feasibility of vitrifying Silos 1 & 2 surrogate plus bentonite at high and low temperature melts
- Determine maximum rate of feed for the Silo 1 & 2 surrogate at optimum temperature

Results

- Completed two high temperature transition batches
- Completed five of six Silo 1 & 2 surrogate high temperature melts
- Significantly improved melter availability

Issues

- Foaming in side chamber
- E-Wall degradation
- Discharge chamber refractory degradation

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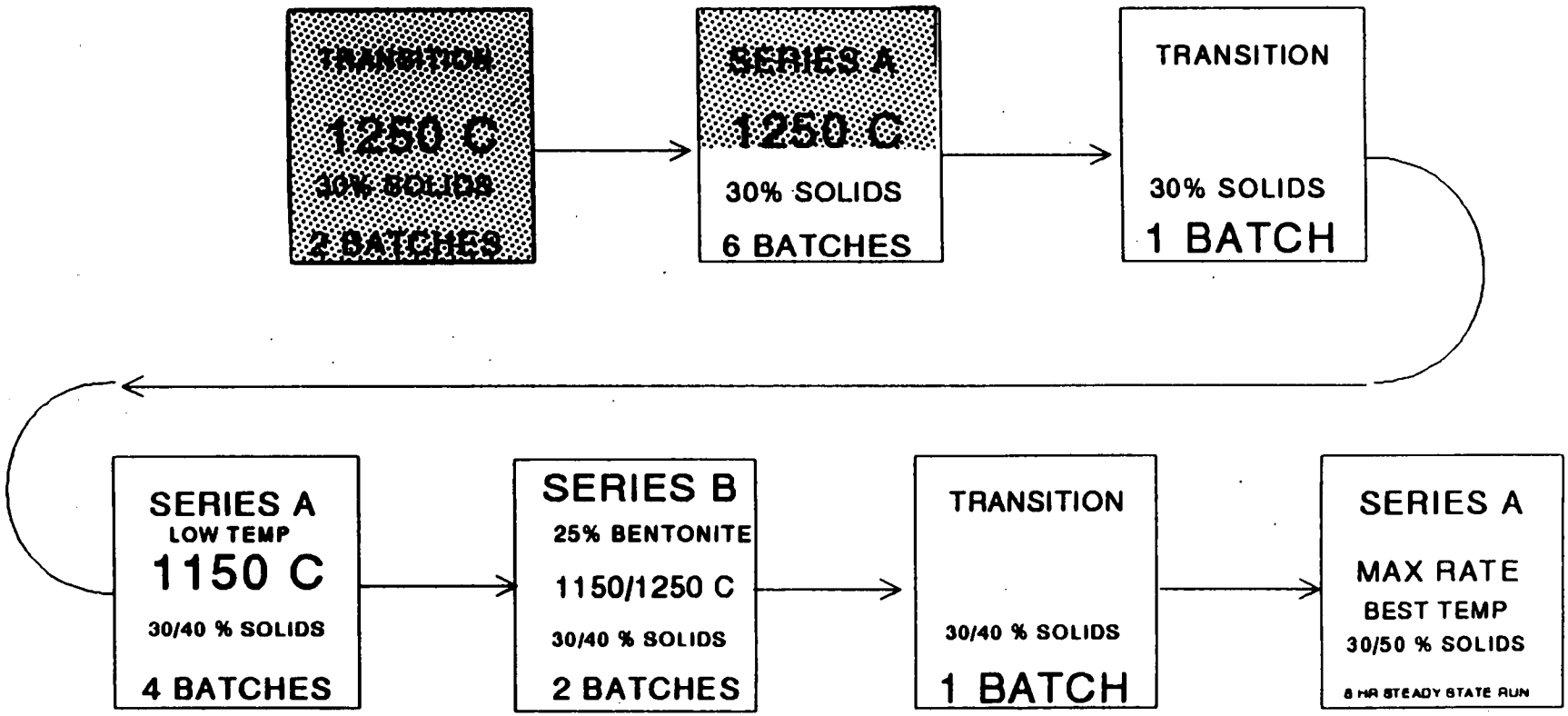
CAMPAIGN 4

SERIES A/B



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Silo 3 Request for Proposal

- Commerce Business Daily (CBD) Announcement - December 3, 1996
- Potential Qualified Vendor Submittals - January 10, 1996
- Draft Request for Proposal to Qualified Vendors - March 1, 1996

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SUMMARY OF SILO 3 REPORT

- Comparison of Vitrification/Cement Stabilization of Silo 3
- Implementability
  - * High Temperature Application
  - * Sulfate Foaming
  - * Sulfate Layering
  - * Equipment Reliability
- Mobility of Contaniments Concerns
- Waste Acceptance Criteria
- Volume Reduction
  - * Cement Stabilization Increases Volume
  - * Vitrification Decreases Volume
- Short Term Risks
- Cost & Schedule

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Proposed Decision Analysis Approach for the Silos Project

December 12, 1996

Presented by:
Lee Merkhofer

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

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Goal

Select an approach that

1. helps provide an objective and accurate comparative evaluation of alternatives
2. facilitates participation by concerned parties and promotes understanding and consensus over a course of action

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The proposed approach involves constructing a decision model

The model

- is intended to serve as an **aid** to the decision making process
- identifies and organizes information/judgments relevant to decision making
  - e.g., decision objectives, key uncertainties, value weights
- can be used to provide quantitative evaluation and sensitivity analyses

A fairly sophisticated decision model is needed to account for inherent complexities of the problem

In particular, it is necessary to account for

1. multiple decision objectives (i.e., objectives other than cost matter)
2. uncertainties regarding the ability of alternatives to achieve decision objectives

The decision model consists of a decision tree and a multicriteria value model

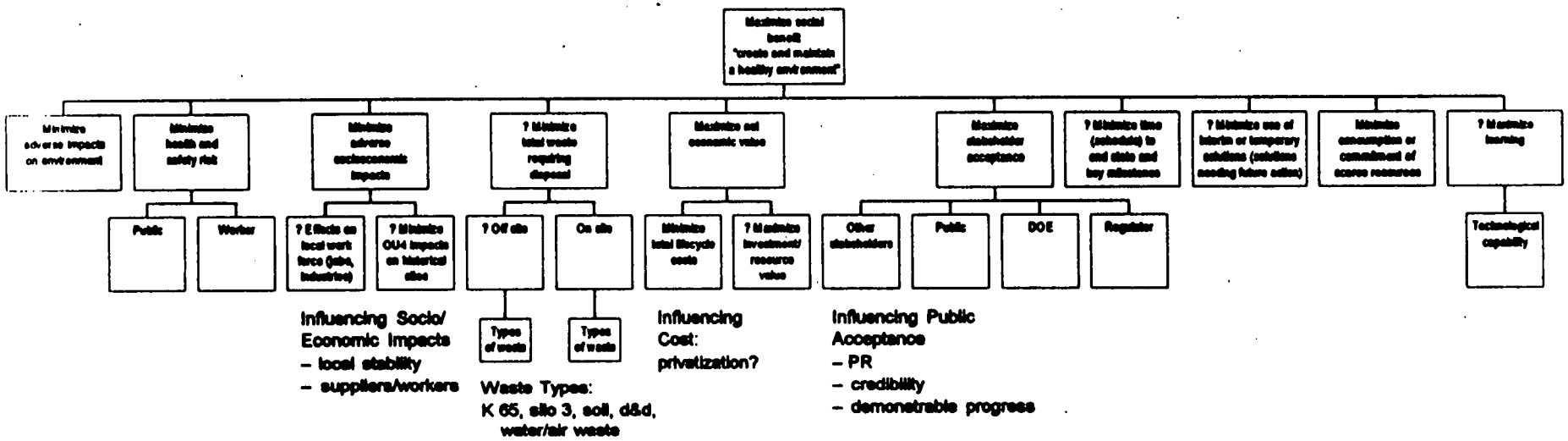
The multicriteria value model accounts for

- multiple objectives
- value weights

The decision tree accounts for

- key uncertainties

The value model represents a subset of the objectives identified in the objectives hierarchy created at the last meeting



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In general, objectives were selected that weren't identified with question marks

Also

- "minimize adverse impacts on the environment" and "minimize consumption of scarce resources" omitted because they are not likely to be significantly impacted
- "maximize stakeholder acceptance" excluded because
  - regulator acceptance addressed in decision tree
  - stakeholder representatives will be asked to express their preferences directly through establishment of weights
- "minimize quantity of waste disposed off site" added since it may be difficult to argue that off-site waste should get zero weight given assignment of a weight to on-site waste
- "minimize schedule/time" added because it is viewed by site as important ends (as well as means) objective

Resulting objectives and potential performance measures

OBJECTIVES	PERFORMANCE MEASURES
1. public health and safety	risk (exposures, numbers of health effects)
2. worker health and safety	risk (exposures, numbers of health effects)
3. total life-cycle costs	dollars
4. quantity of waste disposed on site	cubic meters (of various types)
5. quantity of waste disposed off site	cubic meters (of various types)
6. schedule/time	months to completion

Performance measures will be weighted and combined to produce an overall measure of performance

Overall performance = $weight_1$ x public risk

+ $weight_2$ x worker risk

+ $weight_3$ x cost

+ $weight_4$ x on-site waste volume

+ $weight_5$ x off-site waste volume

+ $weight_6$ x months to completion

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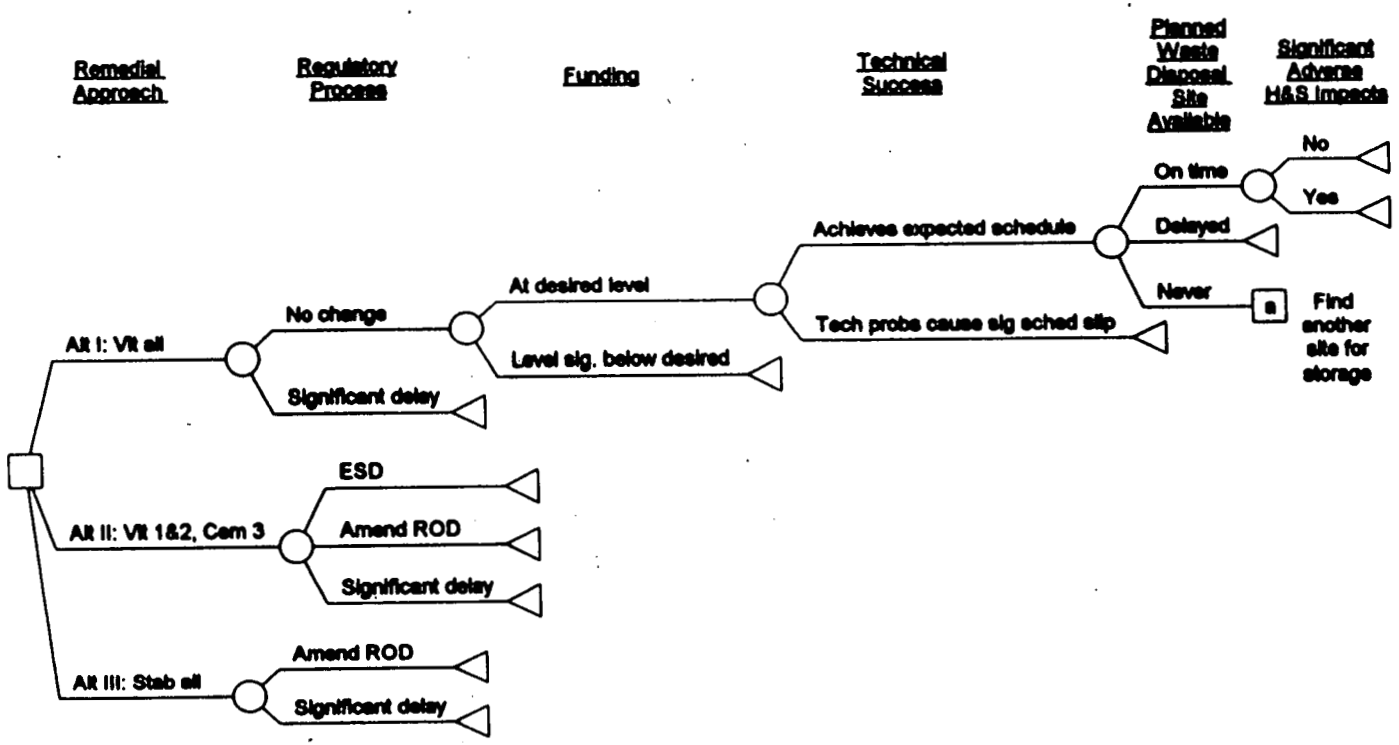
The decision tree accounts for key uncertainties impacting performance



Performance

Each path is scored on the performance measures:

- Public health and safety
- Worker health and safety
- Total life-cycle costs
- Quantity of waste disposed on-site
- Quantity of waste disposed off-site
- Schedule

◁ = the path continues similar to above

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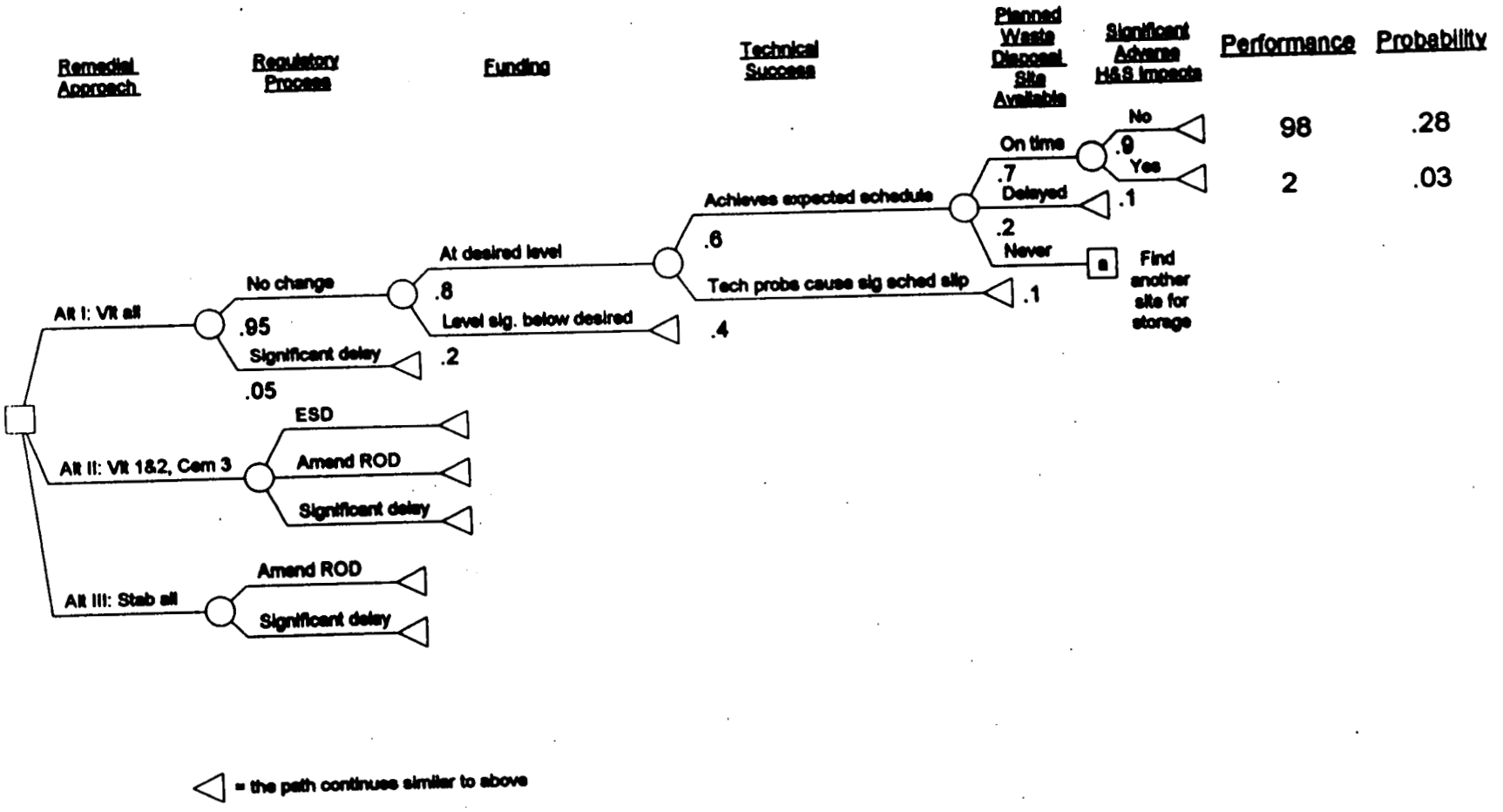
Each uncertainty is assigned probabilities



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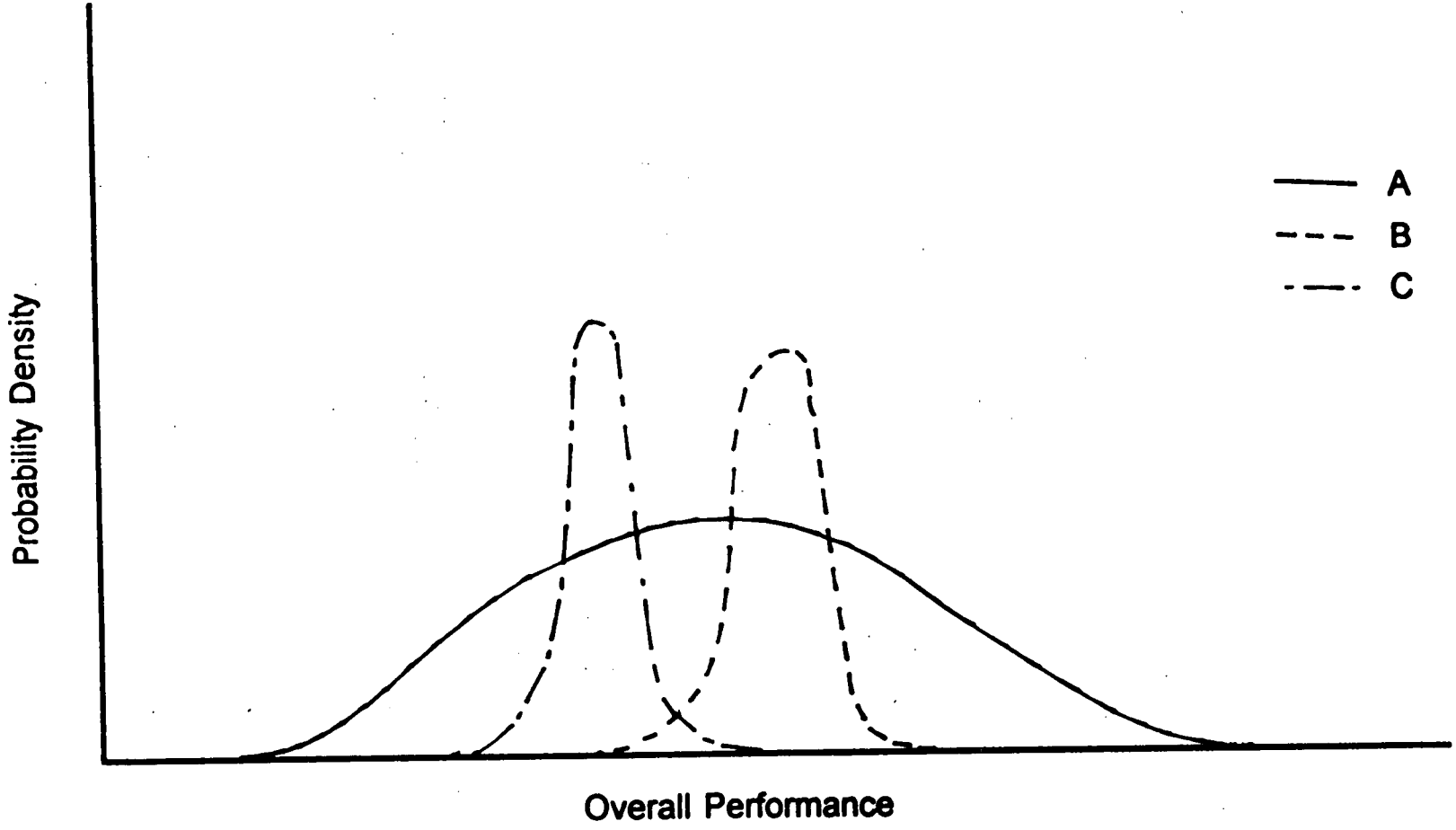
SAMPLE OUTPUT: A "risk profile" displays the uncertainty over the performance of each alternative



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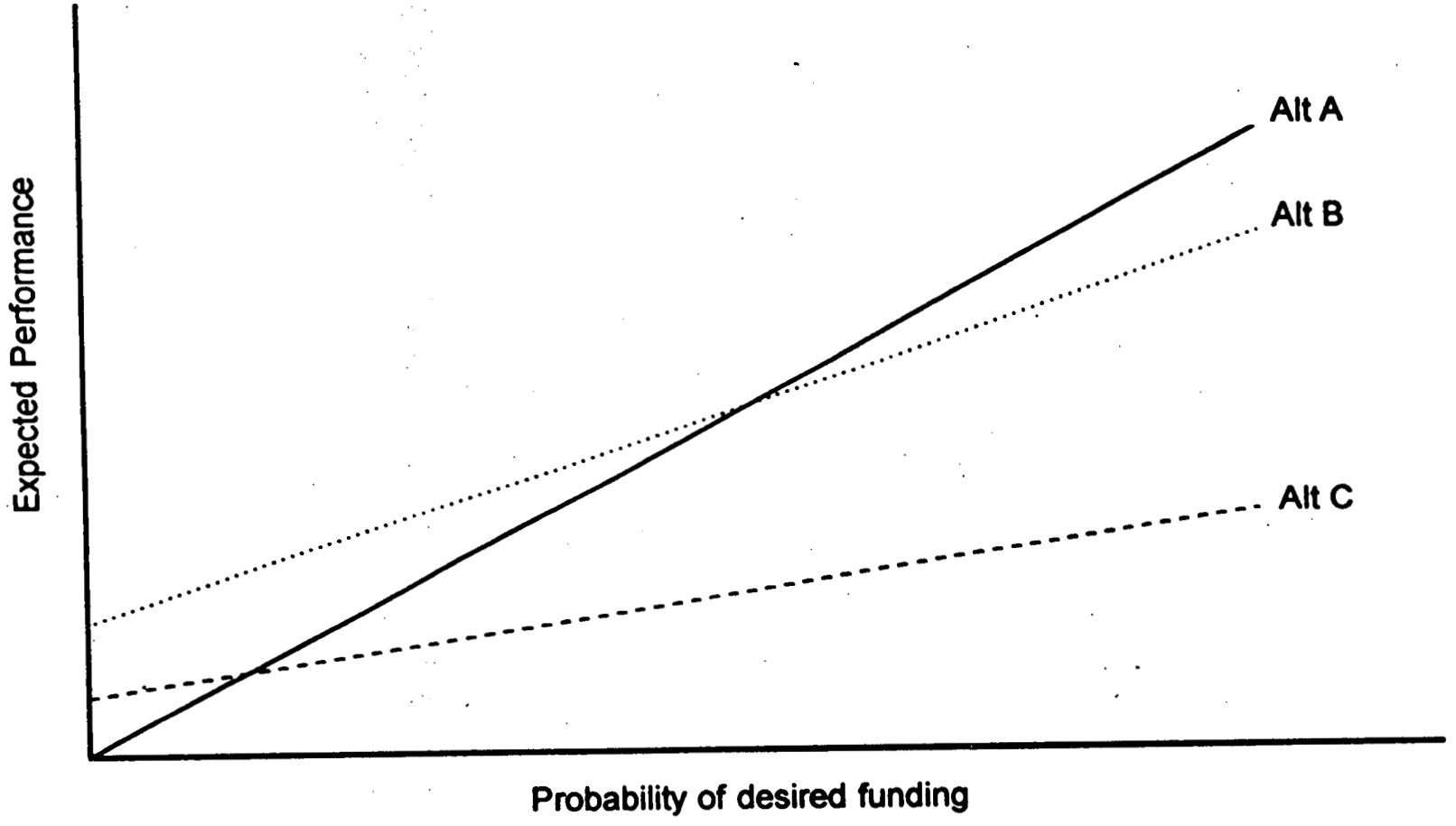
SAMPLE OUTPUT: Sensitivity analysis shows how the assumptions affect performance



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Key questions for building the decision tree

1. Are the alternatives identified the ones that should be considered?
2. Are the most critical uncertainties impacting the achievement of objectives identified in the tree?
3. Do all these uncertainties need to be represented in the tree?
4. What are the possible outcomes for each uncertainty that need to be represented?
5. What is the appropriate terminology (labels) for describing alternatives and uncertainties?

Proposed process

1. Refine decision tree
2. Estimate performance for "base-case" path
3. Estimate performance for other paths
4. Estimate probabilities for tree
5. Assign value weights
6. Evaluate and compare alternatives and conduct sensitivity analyses

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Technical committees have been established to provide required estimates

1. Core
2. Regulatory
3. Funding and Waste-Site Availability
4. Technical Issues
5. Cost and Schedule
6. Health and Safety

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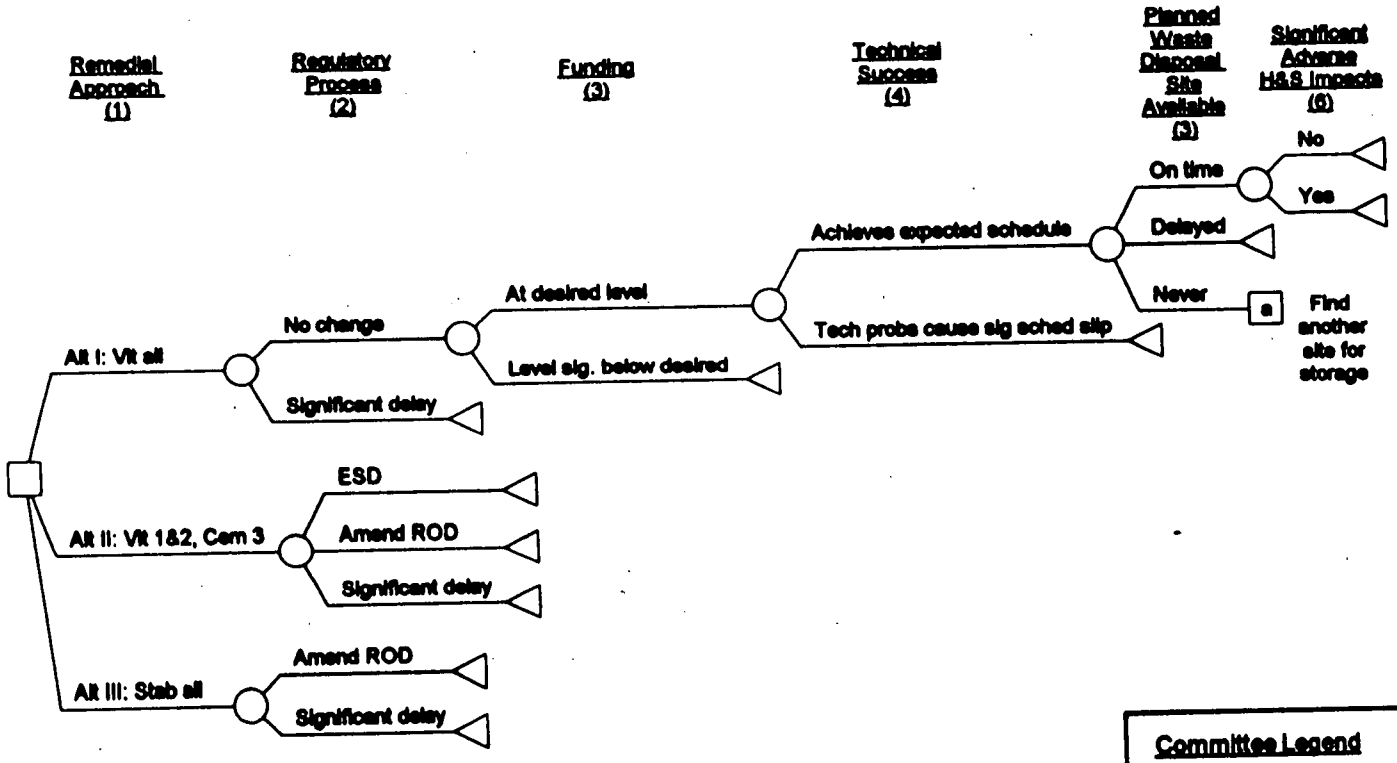
The technical committees' estimates correspond to model inputs



Performance

Each path is scored on the performance measures:

- Public health and safety (6)
- Worker health and safety (6)
- Total life-cycle costs (5)
- Quantity of waste disposed on-site (4)
- Quantity of waste disposed off-site (4)
- Schedule (5)

Committee Legend

1 = Core
2 = Regulatory
3 = Funding and Waste Site Availability
4 = Technical Issues
5 = Cost and Schedule
6 = Health and Safety

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Plan for remainder of meeting

- Review alternatives to be evaluated
- Each technical committee explains current understanding and how it will be leveraged to produce necessary estimates
- Question: Is the plan for developing information in each area appropriate? How could the plan be improved?
- Roles for Independent Review Team
- Roles for other participants

Core Committee

- Select alternatives and "optimize" design for each
- Design and implement overall approach
- Manage and coordinate effort

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Regulatory Committee

1) Review information and understanding relevant to assessing regulatory impacts.
2) For each alternative, define the possible regulatory outcomes (e.g., no change, ED, amend ROD). Identify issues impacting the regulatory outcome.
3) Provide estimates needed by other committees to determine regulatory impacts on factors that may be influenced by regulatory outcomes (e.g., impacts of regulatory outcome on schedule, costs, etch.).
4) For each alternative, estimate probability of each possible regulatory outcome.

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Cost and Schedule Committee

1) Review information and understanding relevant to assessing cost and schedule.
2) For each alternative, estimate "base-case" life-cycle cost (by year) and schedule (best estimate and uncertainty range).
3) Estimate cost and schedule for other paths through the tree (i.e., costs and schedule under other possible regulatory outcomes, funding limitations, technical delays, waste site unavailability, etch.).

Funding and Waste-Site Availability Committee

1) Review information and understanding relevant to assessing funding and waste-site availability.

2) Given cost and schedule estimates provided by Cost and Schedule Committee, define possible funding profiles (e.g., desired and level below desired). Estimate probabilities of each funding level under each possible regulatory outcome.

3) Define possible outcomes for waste-site availability.

4) Provide estimates needed by other committees to determine impacts on factors that may be influenced by waste-site availability.

5) Estimate probabilities of each possible outcome for waste-site availability for each path through the tree.

Technical Issues Committee

1) Review information and understanding relevant to assessing likelihood of technical success and quantities of waste.
2) Define parameters of technical success. Identify important waste types requiring disposal.
3) Understand all relevant factors impacting success and waste volumes.
4) Assess probability of technical success and waste volumes for the base-case paths.
5) Assess probability of technical success and waste volumes for other paths in the decision tree (best judgment and uncertainty range).
6) Provide information needed by other committees to assess impacts of failures to obtain technical success (e.g., on cost and schedule, waste disposal site availability, etc.)

Health and Safety Committee

1) Review information and understanding relevant to assessing public and worker health and safety risks.

2) Identify types of risks that (due to their potential magnitude) need to be separately assessed (e.g., retrieval risks, treatment risks, transportation risks, disposal risks).

2) For each type of risk to be included, estimate "base-case" risks.

3) Identify potential (low probability/high consequence) risk scenarios and screen them based on probability of occurrence and magnitude of impact.

4) Assess consequences and probabilities of each risk scenario that remains after screening (best estimates and uncertainty ranges).

Possible Roles

- Share experience and lessons learned
- Provide advice relevant to specific technical areas
- Suggest weights and other value judgments
- Provide overall comments and recommendations (including considerations that must be overlaid on the quantitative model)

Schedule of Tasks

December 12&13 Meeting

- develop logic for estimating probabilities and performance
- generate base case performance estimates
- begin "optimizing" design for each alternative

January 16&17 Meeting

- estimate performance for other paths through tree
- estimate probabilities for key uncertainties
- prepare for stakeholder assignment of weights (at Feb. meeting)

February 13&14 Meeting

- perform model runs
- perform sensitivity analysis

March Meeting

- generate conclusions and recommendations

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Description of Alternative Approaches

Alternative 1: Vitrification of Silo 1, 2 and 3 Residues

Alternative 2: Vitrification of Silo 1 & 2 Residues in Conjunction with Cementation of Silo 3 Residues

Alternative 3: Stabilization of Silo 1, 2 and 3 Residues.

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Description of Alternative Approaches

FACILITIES/SYSTEMS COMMON TO ALL ALTERNATIVES

Waste Retrieval System

- Based on March '96 conceptual design
- Hydraulic retrieval from Silos 1 & 2
- Pneumatic retrieval from Silo 3
- New Radon Treatment System for Radon Confinement

Support Facilities

- Included within the Scope of the Silos Project
  - Maintenance
  - Storage
  - Analytical Laboratory
  - Waste water treatment (AWWT is no longer available)

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Description of Alternative Approaches

FACILITIES/SYSTEMS COMMON TO ALL ALTERNATIVES (Continued)

Support Facilities (Continued)

- Included within the Scope of the FEMP
  - Water
  - Power
  - Sewer
  - On-site Disposal Cell

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Description of Alternative Approaches

SCENARIO DESCRIPTION
ALTERNATIVE 1: VITRIFICATION OF SILOS 1, 2 AND 3

- Mini-melter testing of Actual Silo 1, 2, and 3 materials
  - Catholic University, Vitreous State Laboratory
  - 10 Kg/day scale melter
  - Evaluation of target glass formulations

- Upgrade the Vitrification Pilot Plant Consistent with the Upgrade Evaluation
  - Upgrades to enable processing of radioactive materials
  - Modifications to increase capacity from 1 MT/d to 6 MT/d
  - Utilization as a "Proof of Process" facility
  - Demonstrated melter and support systems to be replicated in the final remediation facility
  - Following construction of the final remediation facility, VITPP to serve as a test facility (evaluate variation of feed)

- Aspects of Waste Retrieval System Design, Demonstrated on Silo 4

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Description of Alternative Approaches

SCENARIO DESCRIPTION (Continued)
ALTERNATIVE 1: VITRIFICATION OF SILOS 1, 2 AND 3

- Design & Construct Early Packages
  - Site Preparation / Underground Utilities (Complete)
  - Silo Superstructures / Waste Retrieval System
  - New Radon Treatment System
- Design, Construction, Start-Up and Operation of Final Remediation Facility
- Transportation and Disposal of Treated Waste
- Safe Shutdown, D & D of remediation facilities, contaminated soil and existing OU4 facilities & Structures

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Description of Alternative Approaches

TECHNICAL BASIS AND ASSUMPTIONS
ALTERNATIVE 1: VITRIFICATION OF SILO 1, 2 AND 3

Pilot Plant:

- Plant Capacity — 6 MT/day
- Availability — 30%

Full-scale remediation facility

- Plant Capacity
  - Plant Capacity — 18 MT/day
  - Melter Capacity — 6 MT/day
  - Number of melter trains: — 4
- Plant Operating Period: — 3 years
- Availability:
  - Feed prep system: — 70%
  - Each melter train: — 60%
  - Off-gas system: — 90%
  - Glass handling system: — 70%

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Description of Alternative Approaches

TECHNICAL BASIS AND ASSUMPTIONS (Continued)
ALTERNATIVE 1: VITRIFICATION OF SILO 1, 2 AND 3

- Operating Philosophy: 24 hr/day, 7 days/week
- Waste form: Gems
- Waste loading: 60%
- Waste packaging: SEG concrete boxes
- Disposition of waste:
  - Silo Waste: NTS by truck
  - D&D materials: Onsite cell

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Description of Alternative Approaches

SCENARIO DESCRIPTION
ALTERNATIVE 2: VITRIFICATION OF SILO 1 & 2 SOLIDIFICATION OF SILO 3

Vitrification of Silo 1 & 2 Residues

- Same as Alternative 1 Scenario for Vitrification

Cementation of Silo 3 Residues

- Treatability Study
  - Compound Analysis Testing
  - Treatability Study Testing
  - Develop Stabilization / Solidification Base Formulation for Silo 3 Residues

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Description of Alternative Approaches

SCENARIO DESCRIPTION
ALTERNATIVE 2: VITRIFICATION OF SILO 1 & 2 SOLIDIFICATION OF SILO 3

- Subcontract Silo 3 Waste Retrieval and Remediation.

  Subcontractors Scope:
  - Treatability Testing,
  - Design,
  - Construction,
  - Start-Up/RA,
  - Proof-of-Process Testing,
  - Waste Removal,
  - Facility Operations
  - Waste Packaging, Transportation, and Disposition (Responsible for Reprocessing Off-spec Waste),
  - Facility D&D and Removal of Equipment

  Subcontract Basis: Unit Price Based on Treated Waste Accepted for Disposal

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Description of Alternative Approaches

TECHNICAL BASIS AND ASSUMPTIONS
ALTERNATIVE 2: VITRIFICATION OF SILO 1 & 2 CEMENTATION OF SILO 3

Vitrification of Silo 1 & 2 Residues

- Same as Alternative 1 Scenario for Vitrification, except Plant Capacity

  - Plant Capacity 12 MT/day
  - Melter Capacity 6 MT/day
  - Number of melter trains: 3

Cementation of Silo 3 Residues

- Capacity

  - Plant Capacity: 119 MT/day
  - Mixers: 1 @ 3.28 yd; 15 minute batch time
  - Limited by container handling time (approximately 4 per hour)
  - Limited by retrieval rate

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Description of Alternative Approaches

TECHNICAL BASIS AND ASSUMPTIONS (Continued)
ALTERNATIVE 2: VITRIFICATION OF SILO 1 & 2 CEMENTATION OF SILO 3

- Plant Operating Period: 4 months (approximately)
- Availability: 100%
- Operating Philosophy: 6 hr/day (1 hr startup / 1 hr shutdown) , 5 days/week
- Waste form: Monolith
- Waste loading: 45% (dry weight)
- Waste packaging: 2.8 cubic yd. White Metal Box
- Disposition of waste:
  - Silo Waste: NTS by Truck
  - D&D materials: Responsibility of Subcontractor

SCENARIO DESCRIPTION

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Description of Alternative Approaches

ALTERNATIVE 3: STABILIZATION OF SILO 1, 2 AND 3

Same as Alternate 2 Cementation Scenario

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Description of Alternative Approaches

TECHNICAL BASIS AND ASSUMPTIONS
ALTERNATIVE 3: STABILIZATION OF SILO 1, 2 AND 3

Solidification of Silo 1 & 2

- Capacity
  - Plant Capacity: 85 MT/day
  - Mixers: 1 @ 2 yd; 15 minute batch time
  - Limited by container handling time (4 containers per hour)
- Plant Operating Period: 3 years
- Availability: 80%
- Operating Philosophy: 6 hr/day (1 hr start-up, 1 hr cleanup), 5 days/week
- Waste form: Monolith
- Waste loading: 20% (dry weight)

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Description of Alternative Approaches

TECHNICAL BASIS AND ASSUMPTIONS (Continued)
ALTERNATIVE 3: STABILIZATION OF SILO 1, 2 AND 3

- Waste packaging: Shielded and sealed container

- Disposition of waste:
  - Silo Waste: NTS by Truck
  - D&D materials: Responsibility of Subcontractor

<u>Cementation of Silo 3 Residues</u>

- Same as Alternative 2

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Technical Committee

BASIS & SUMMARY OF CURRENT UNDERSTANDING

Technical Success:

All silo material treated, shipped and disposed while meeting Applicable or Relevant Appropriate Requirements (ARARs) and Waste Acceptance Criteria (WAC) on schedule.

Current Information

- Feasibility Studies (PNL Data)
- Final Report on VSL Studies
- Pilot Plant Test Report (Campaign 1, Campaign 2 in progress)
- Silo 3 Alternative Study (Update in progress)
- Vitrification Pilot Plant Upgrade Study
- Other information as it becomes available

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Technical Committee

SCOPE OF EFFORT

- Define key parameters for technical success.
- Define relevant factors impacting these key parameters.
- Develop risks and uncertainties associated with each of the factors.
- Assess the probability of technical success for each path in the decision tree leading to the technical success node based on risks and uncertainties.
- Provide information needed by other committees and assess impacts of not achieving technical success.

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Technical Committee

APPROACH TO BE USED

- Assess significant relevant factors impacting key parameters. Using professional judgement develop a probability of attaining success.
- Estimate impact on performance measures for non-attainment of success.
- Do this for each path in the decision tree leading to the technical success node, AND for each path following the technical success node.
- Provide impacted performance measures to other technical committees.

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ISSUES & INFLUENCING FACTORS

VITRIFICATION

ENGINEERING	PROCUREMENT	CONSTRUCTION	STARTUP	RETRIEVAL
- Melter Design - Gem Machine Design - Off-Gas & Feed System Design RAM Analysis	- Vendor Selection - Melter - Gem Machine	- System Turnover (CAT) - Subcontractor Performance	- Preparation for Readiness Assessment	- Radon Containment - Variability of Silo 1 & 2 Material - Effectiveness of Houdini - Bentonite Retrieval & Transport - Berm Management

STABILIZATION

ENGINEERING	PROCUREMENT	CONSTRUCTION	STARTUP	RETRIEVAL
- Treatability - System Design Experience Equip. Reliability Waste Loading Final product reliability RAM Analysis	- Same as above	- Same as above	- Same as above	- Same as above

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Technical Committee

ISSUES & INFLUENCING FACTORS (Continued)

VITRIFICATION

TREATMENT	PACKAGING, STORAGE & TRANSPORTATION	DISPOSAL	D&D
Please refer to Page 6 & 7	- Container Integrity - Transport Method	- Meet the WAC - NTS Envirocare - OSDF	- Soil Contamination - Silo Debris - Vit Plant Debris - Contamination

STABILIZATION

TREATMENT	PACKAGING, STORAGE & TRANSPORTATION	DISPOSAL	D&D
- Proof of Process Testing	Same as above	Same as above	- Stabilization - Plant Debris - Contamination

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ISSUES & INFLUENCING FACTORS (Continued)

VITRIFICATION TREATMENT ISSUES

- Reliability of Slurry Feed Preparation and Delivery System
- Melter
  - * High Temperature Concerns
  - * Ceramic Integrity
  - * Life
  - * Sulfate Problems
  - * Control Problems
  - * Waste Loading
  - * Throughput
  - * Availability
  - * Bottom Drains
  - * Cooling Systems
- Off-Gas System
  - * Plugging/Cleaning
  - * Excessive Moisture
  - * Ability to Maintain Vacuum
  - * Radon Removal
  - * Corrosion

FLUOR DANIEL FERNALD

Technical Committee

ISSUES & INFLUENCING FACTORS (Continued)

VITRIFICATION TREATMENT ISSUES (Continued)

- Gem Machine
  - * Reliability
  - * Throughput
  - * Cooling
  - * Lubrication
- Radon Containment
- Significant Direct Exposure of Workers

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Regulatory Committee

SUMMARY OF CURRENT UNDERSTANDING

- Continuing discussions are ongoing between the Agencies, DOE and FDF in an effort to evaluate the appropriate regulatory process to be utilized.

- Tentative understandings are that:

  - No additional regulatory requirements (e.g., ESD vs. ROD Amendment) exist if the alternative outlined in the ROD is carried out (i.e., vitrification of all Silo waste);
  - If vitrification is abandoned completely (i.e., alternative 3), an amendment to the ROD would be required.

- The appropriate regulatory process for Alternative 2 remains a question at this time.

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Regulatory Committee

SCOPE OF EFFORT

- The Regulatory Committee must continue to identify uncertainties and potential ramifications of proceeding with an ESD vs. ROD Amendment for Alternative 2;

- The Committee must also consider the time required for each regulatory option and provide this input to the Cost & Schedule Committee;

- The Committee will have the following by the next meeting:

  - A definition of an ESD US a ROD Amendment
  - A draft time line (i.e., schedule) associated with each regulatory option for Alternative 2;
  - A draft time line associated with the anticipated regulatory process for Alternative 3;
  - An identification of the uncertainties associated with the regulatory process for each Alternative.

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Regulatory Committee

APPROACH TO BE USED

- Continued communication between the Agencies, DOE and FDF with regard to the appropriate path forward coupled with professional judgement

- Legal analysis of potential ramifications/vulnerabilities associated with regulatory process options

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Regulatory Committee

PRELIMINARY ISSUES AND INFLUENCING FACTORS

- Regulator acceptance of any proposed path forward
- A key regulatory question is whether pursuing a ROD Amendment opens the entire OU4 ROD or only a portion of the decision (e.g., Silo 3 treatment under Alternative 2)
- Opening the entire OU4 ROD may create uncertainty associated with the selected disposal site (i.e., NTS)
- Schedule and cost impacts associated with alternate regulatory process options

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Funding & Waste Site Availability Committee

STATUS

FUNDING:

- The Accelerated Baseline was approved in July 1996 based on an assumed constant funding level.

- In August, 1996 Department of Energy guidance was issued to reduce planning funding level. A Replan of the Baseline was initiated accordingly.

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Funding & Waste Site Availability Committee

PHASE 1 FY97 Baseline updated in accordance with reduced funding (Completed September, 1996)

- Planning funding levels are very routinely re-evaluated by DOE-HQ and ultimately, Congress

WASTE DISPOSAL:

- Plan to ship vitrified waste to NTS

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Funding & Waste Site Availability Committee

SCOPE OF WORK

FUNDING

- Define possible funding profiles

  a) Unfunded constraint
  b) Current funding limitation in DOE Guidance
  c) Others

- Estimate probability of obtaining the funding profiles

- Evaluate impacts of OU4 - required fundings on remainder of site remedial program

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Funding & Waste Site Availability Committee

WASTE DISPOSAL

- Define possible waste disposal options
  - NTS
  - Interim storage if NTS not available
  - Other sites
- Define any impacts of waste acceptance criteria or other issues dependent on Waste Disposal Site
- Estimate probability of Waste Disposal Site availability
- Give appropriate input to cost and schedule committee

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Safety & Health Committee

SCOPE OF WORK

- Baseline risks for retrieval, treatment, transportation, disposal and D&D
- Potential high consequence impacts to be determined and screened
  - Loss of process facility primary containment
  - Silo dome collapse
  - Transportation spill
- Numeric values for probability and consequence to be determined
- Scope also includes input to other committees on peripheral safety & health issues (documentation, schedule, cost)

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Safety & Health Committee

SUMMARY OF CURRENT UNDERSTANDING

- Risk information available in internal documentation for project and external generic publications - Final Hazard Analysis, Preliminary Safety Analysis Report, Transportation and Industrial Databases, etc.

- Target for the January meeting is quantification of baseline cases, remainder of cases by February meeting

APPROACH

- Most risk information will be the result of analytical models or databases, with professional judgement applied for variations of the same value

- Input to other committees will be a combination of past history and professional judgement

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Safety & Health Committee

PRELIMINARY ISSUES AND INFLUENCING FACTORS

KEY ISSUES

- Safety documentation schedule depends in design schedule
- Safety & Health risks are almost independent of treatment method (highest risk is silo storage and retrieval)

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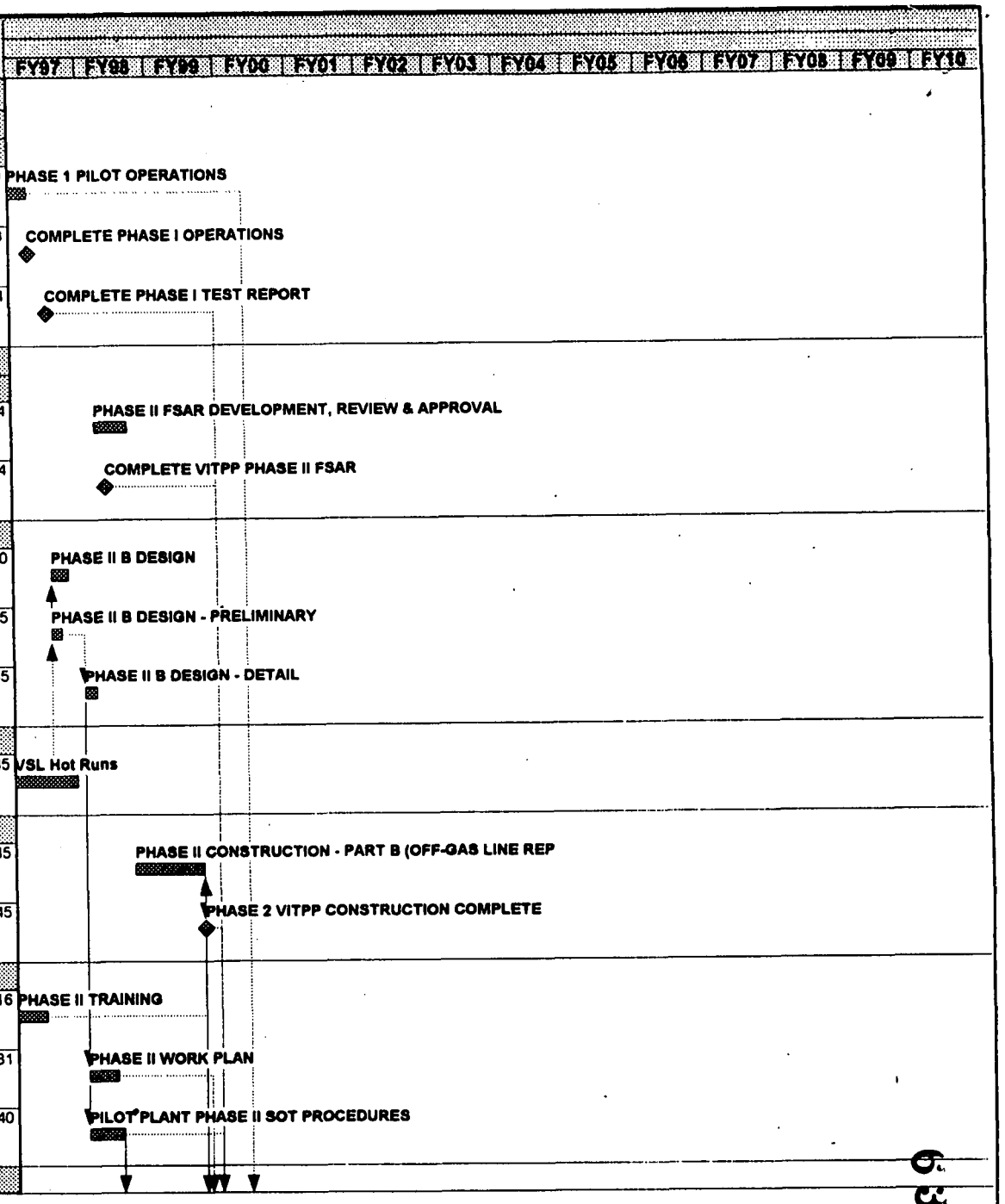
Activity ID	Activity Description	Original Duration	Early Start	Early Finish	Total Float
VITRIFICATION PILOT PLANT					
PILOT PLANT PHASE I					
OPERATIONS					
4AAC1399	PHASE 1 PILOT OPERATIONS	101	01OCT96	09JAN97	179
4AACM042	COMPLETE PHASE I OPERATIONS	0		09JAN97	123
4AACM055	COMPLETE PHASE I TEST REPORT	0		07APR97	234
PILOT PLANT PHASE II					
SAFETY ANALYSIS					
4AAFH003	PHASE II FSAR DEVELOPMENT, REVIEW & APPROVAL	120*	09DEC97	02JUN98	404
4AAFM012	COMPLETE VITPP PHASE II FSAR	0		05FEB98	734
DESIGN					
4AAF7400	PHASE II B DESIGN	60	21APR97	15JUL97	560
4AAF7401	PHASE II B DESIGN - PRELIMINARY	40	21APR97	16JUN97	225
4AAF7402	PHASE II B DESIGN - DETAIL	40	09OCT97	08DEC97	145
VSL HOT RUNS					
4AACH701	VSL Hot Runs	223*	01OCT96	21AUG97	145
CONSTRUCTION - PHASE IIB UPGRADE					
4AAF1507	PHASE II CONSTRUCTION - PART B (OFF-GAS LINE REP	249	17JUN98	15JUN99	145
4AAFM040	PHASE 2 VITPP CONSTRUCTION COMPLETE	0		15JUN99	145
PROCEDURES					
4AAF2312	PHASE II TRAINING	104	01OCT96*	04MAR97	716
4AAF7060	PHASE II WORK PLAN	102	09OCT97*	10MAR98	481
4AAF7450	PILOT PLANT PHASE II SOT PROCEDURES	124	09OCT97*	09APR98	440
OPERATIONS					



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Project Start	01OCT95
Project Finish	03APR08
Data Date	01OCT96
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Early Bar
Progress Bar
Critical Activity

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FLUOR DANIEL FERNALD
SILO PROJECT
PHASE II REPLAN

FERNALD
Environmental Management Project

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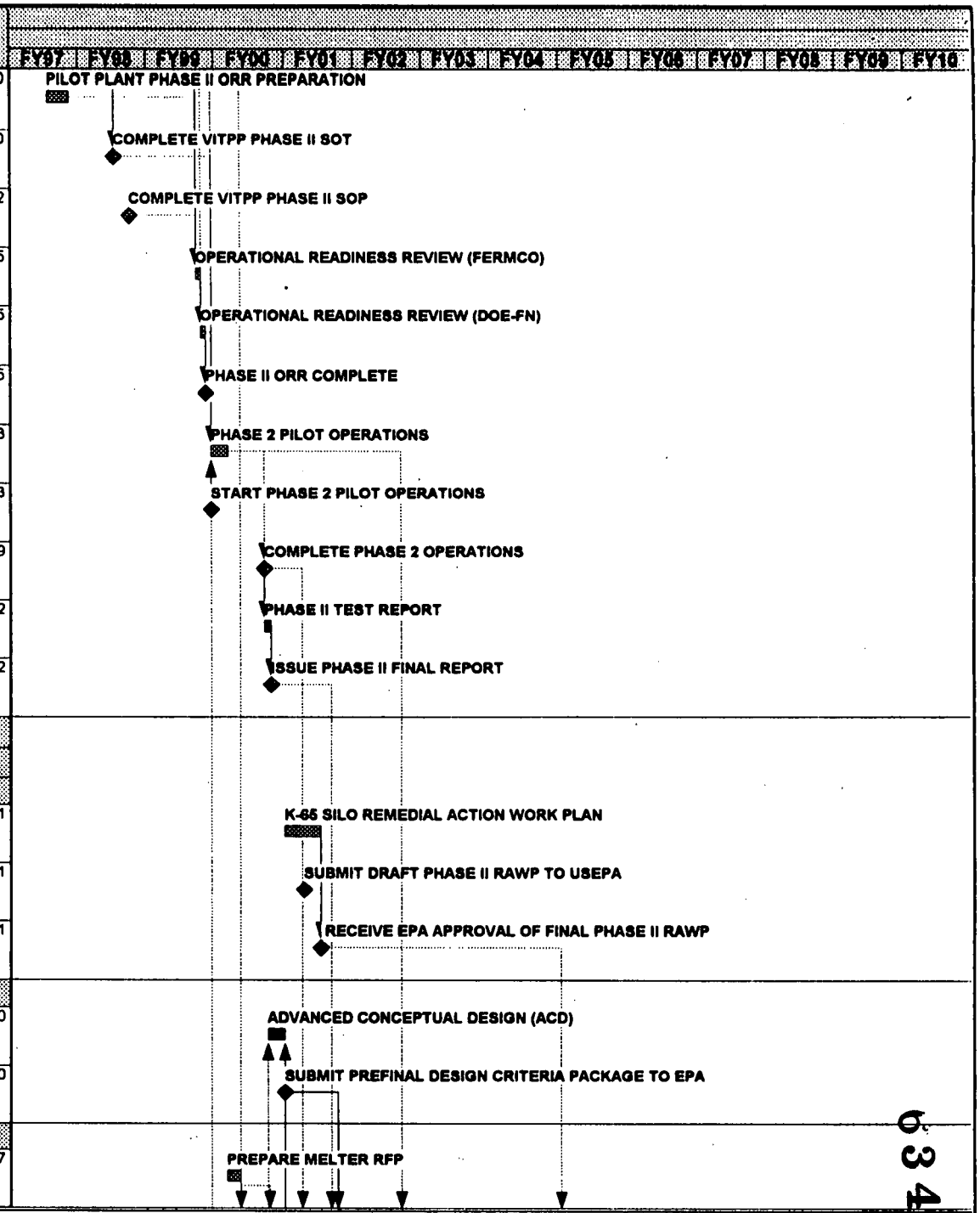
Activity ID	Activity Description	Original Duration	Early Start	Early Finish	Total Float
4AAF0425	PILOT PLANT PHASE II ORR PREPARATION	84	21APR97	18AUG97	600
4AAFM001	COMPLETE VITPP PHASE II SOT	0		09APR98	440
4AAFM051	COMPLETE VITPP PHASE II SOP	0		02JUL98	382
4AAF0427	OPERATIONAL READINESS REVIEW (FERMCO)	19	16JUN99	13JUL99	145
4AAF0430	OPERATIONAL READINESS REVIEW (DOE-FN)	22	14JUL99	12AUG99	145
4AAFM042	PHASE II ORR COMPLETE	0		12AUG99	165
4AAF0267	PHASE 2 PILOT OPERATIONS	90	11SEP99	09DEC99	493
4AAFM043	START PHASE 2 PILOT OPERATIONS	0	11SEP99		493
4AAFM044	COMPLETE PHASE 2 OPERATIONS	0		20JUN00	299
4AAF0445	PHASE II TEST REPORT	20	21JUN00	19JUL00	222
4AAFM055	ISSUE PHASE II FINAL REPORT	0		19JUL00	222
K-65 SILO REMEDIATION PROJECT					
FRVP PROJECT					
REMEDIAL ACTION WORK PLAN					
4ACCH009	K-65 SILO REMEDIAL ACTION WORK PLAN	133*	02OCT00	16APR01	871
4ACCM020	SUBMIT DRAFT PHASE II RAWP TO USEPA	0		15JAN01	871
4ACCM052	RECEIVE EPA APPROVAL OF FINAL PHASE II RAWP	0		16APR01	871
PRELIMINARY STUDIES/INVESTIGATIONS					
4ACCH004	ADVANCED CONCEPTUAL DESIGN (ACD)	60	07JUL00	29SEP00	0
4ACCM017	SUBMIT PREFINAL DESIGN CRITERIA PACKAGE TO EPA	0		29SEP00	0
MELTER SET-UP					
4ACCH031	PREPARE MELTER RFP	52	29NOV99	11FEB00	57



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Project Finish 03APR08
Data Date 01OCT96
Plot Date 13DEC96

Early Bar
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FLUOR DANIEL FERNALD
SILO PROJECT
PHASE II REPLAN

FERNALD
Environmental Management Project

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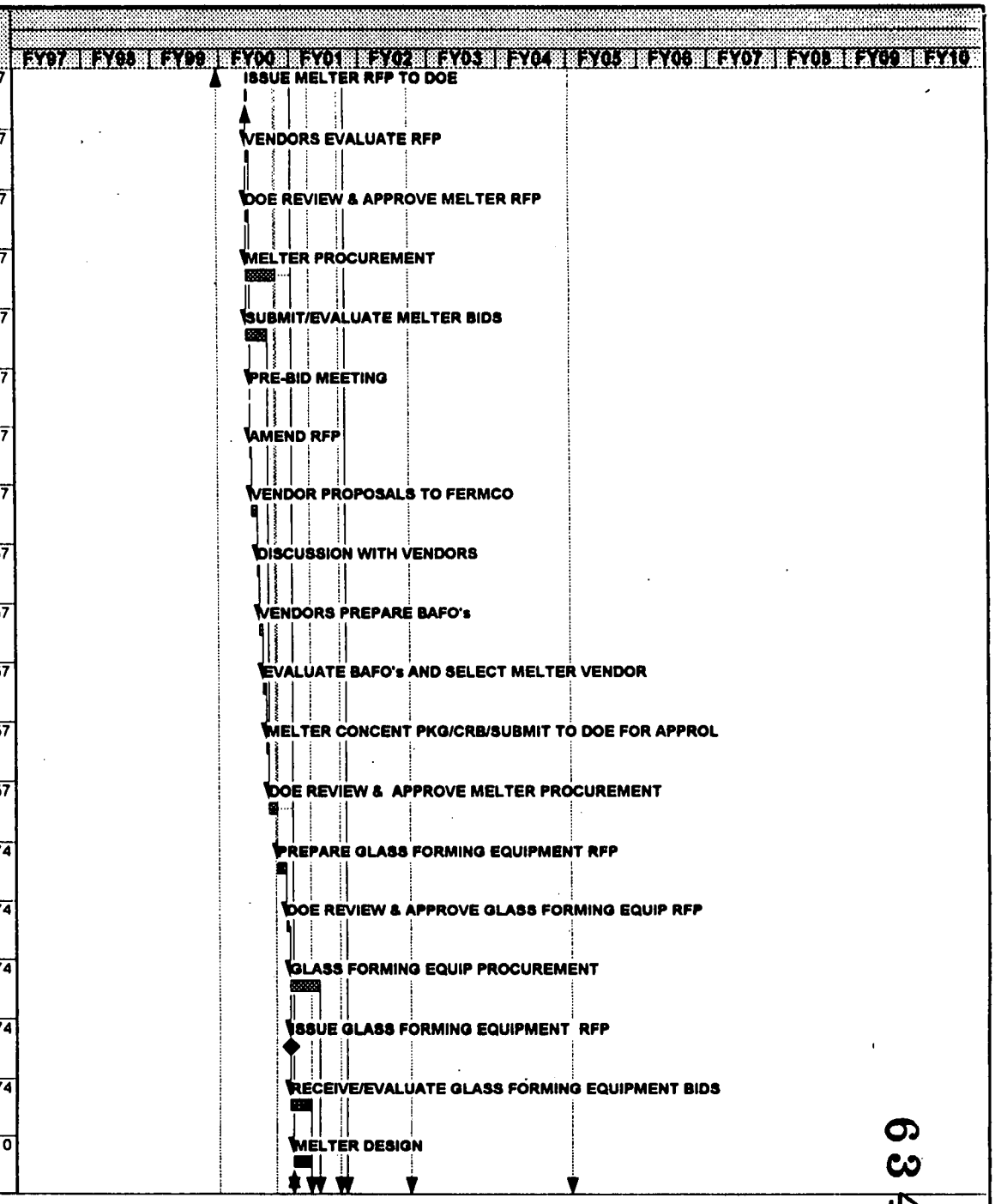
Activity ID	Activity Description	Original Duration	Early Start	Early Finish	Total Float
4ACC5002	ISSUE MELTER RFP TO DOE	1	14FEB00	14FEB00	57
4ACC5025	VENDORS EVALUATE RFP	9	14FEB00	25FEB00	57
4ACC5034	DOE REVIEW & APPROVE MELTER RFP	10	14FEB00	28FEB00	57
4ACCH005	MELTER PROCUREMENT	103	14FEB00	11JUL00	57
4ACCH007	SUBMIT/EVALUATE MELTER BIDS	74*	14FEB00	30MAY00	57
4ACC5029	PRE-BID MEETING	1	28FEB00	28FEB00	57
4ACC5032	AMEND RFP	5	29FEB00	06MAR00	57
4ACC5035	VENDOR PROPOSALS TO FERMCO	20	07MAR00	03APR00	57
4ACC5038	DISCUSSION WITH VENDORS	10	04APR00	17APR00	57
4ACC5041	VENDORS PREPARE BAFO's	9	18APR00	01MAY00	57
4ACC5044	EVALUATE BAFO's AND SELECT MELTER VENDOR	10	02MAY00	15MAY00	57
4ACC5047	MELTER CONCENT PKG/CRB/SUBMIT TO DOE FOR APPROL	10	16MAY00	30MAY00	57
4ACC5027	DOE REVIEW & APPROVE MELTER PROCUREMENT	29	31MAY00	11JUL00	57
4ACC5118	PREPARE GLASS FORMING EQUIPMENT RFP	31	13JUL00	24AUG00	274
4ACC5121	DOE REVIEW & APPROVE GLASS FORMING EQUIP RFP	10	25AUG00	08SEP00	274
4ACCH100	GLASS FORMING EQUIP PROCUREMENT	106	11SEP00	13FEB01	274
4ACCM016	ISSUE GLASS FORMING EQUIPMENT RFP	0	11SEP00		274
4ACC5124	RECEIVE/EVALUATE GLASS FORMING EQUIPMENT BIDS	76	12SEP00	03JAN01	274
4ACCH011	MELTER DESIGN	60	02OCT00	29DEC00	0



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Project Start	01OCT95	Early Bar
Project Finish	03APR08	Progress Bar
Data Date	01OCT96	Critical Activity
Plot Date	13DEC96	

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PHASE II REPLAN

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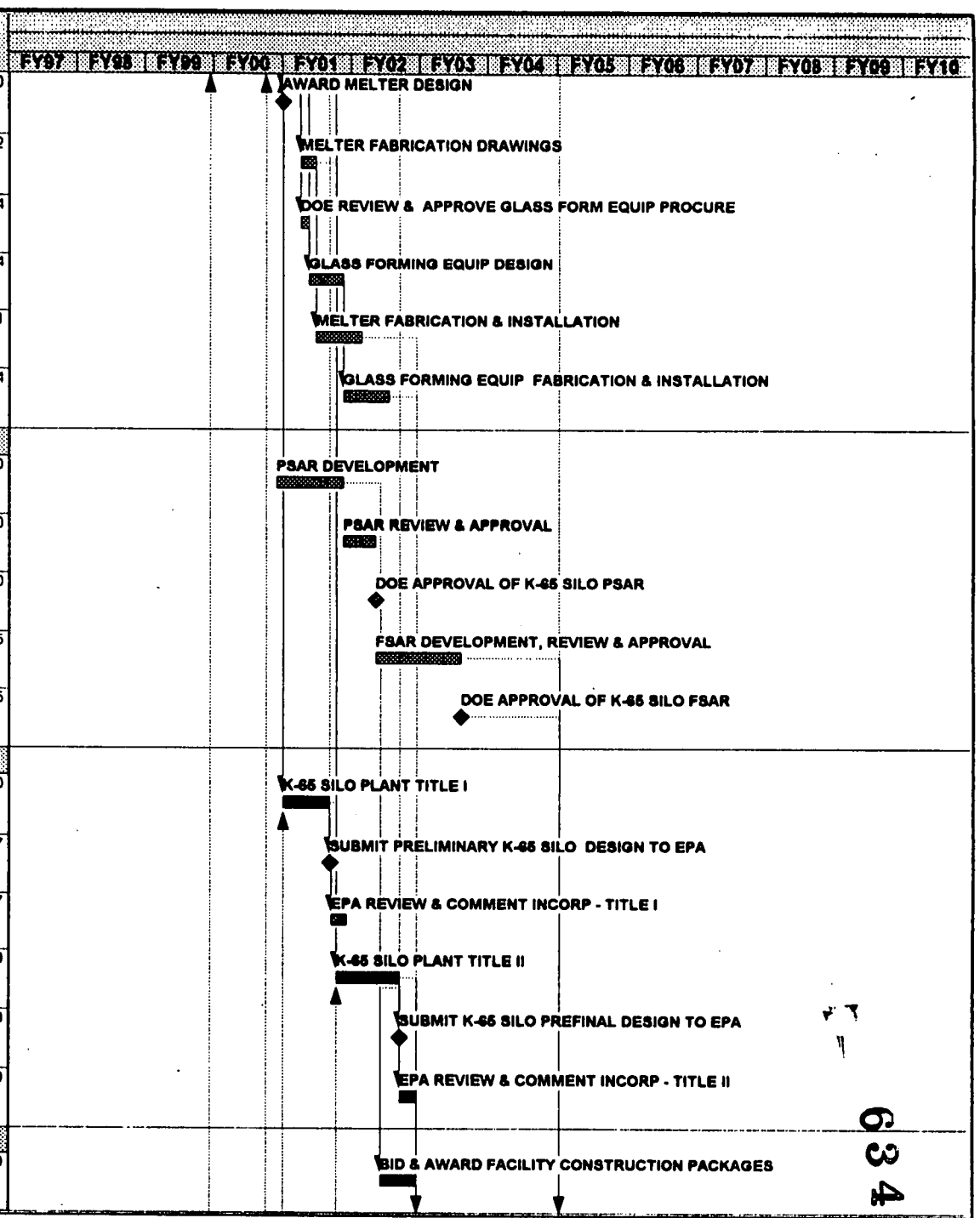
Activity ID	Activity Description	Original Duration	Early Start	Early Finish	Total Float
4ACCM012	AWARD MELTER DESIGN	0	02OCT00*		0
4ACCH006	MELTER FABRICATION DRAWINGS	59	02JAN01	26MAR01	72
4ACC5127	DOE REVIEW & APPROVE GLASS FORM EQUIP PROCURE	29	04JAN01	13FEB01	274
4ACCH101	GLASS FORMING EQUIP DESIGN	125	14FEB01	13AUG01	274
4ACCH010	MELTER FABRICATION & INSTALLATION	168	27MAR01	26NOV01	371
4ACCH102	GLASS FORMING EQUIP FABRICATION & INSTALLATION	168	14AUG01	17APR02	274
SAFETY ANALYSIS					
4ACCH022	PSAR DEVELOPMENT	239*	01SEP00	16AUG01	20
4ACCH012	PSAR REVIEW & APPROVAL	115*	17AUG01	04FEB02	20
4ACCM015	DOE APPROVAL OF K-65 SILO PSAR	0		04FEB02	20
4ACCH003	FSAR DEVELOPMENT, REVIEW & APPROVAL	315*	05FEB02	08MAY03	325
4ACCM022	DOE APPROVAL OF K-65 SILO FSAR	0		08MAY03	325
DESIGN					
4ACCH000	K-65 SILO PLANT TITLE I	171	02OCT00	08JUN01	0
4ACCM018	SUBMIT PRELIMINARY K-65 SILO DESIGN TO EPA	0		08JUN01	187
4ACC7R00	EPA REVIEW & COMMENT INCORP - TITLE I	63	11JUN01	07SEP01	187
4ACCH008	K-65 SILO PLANT TITLE II	230	10JUL01	10JUN02	0
4ACCM021	SUBMIT K-65 SILO PREFINAL DESIGN TO EPA	0		10JUN02	0
4ACC7001	EPA REVIEW & COMMENT INCORP - TITLE II	63	11JUN02	09SEP02	0
PROCUREMENT					
4ACCH600	BID & AWARD FACILITY CONSTRUCTION PACKAGES	130	06MAR02	09SEP02	0



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Environmental Management Project

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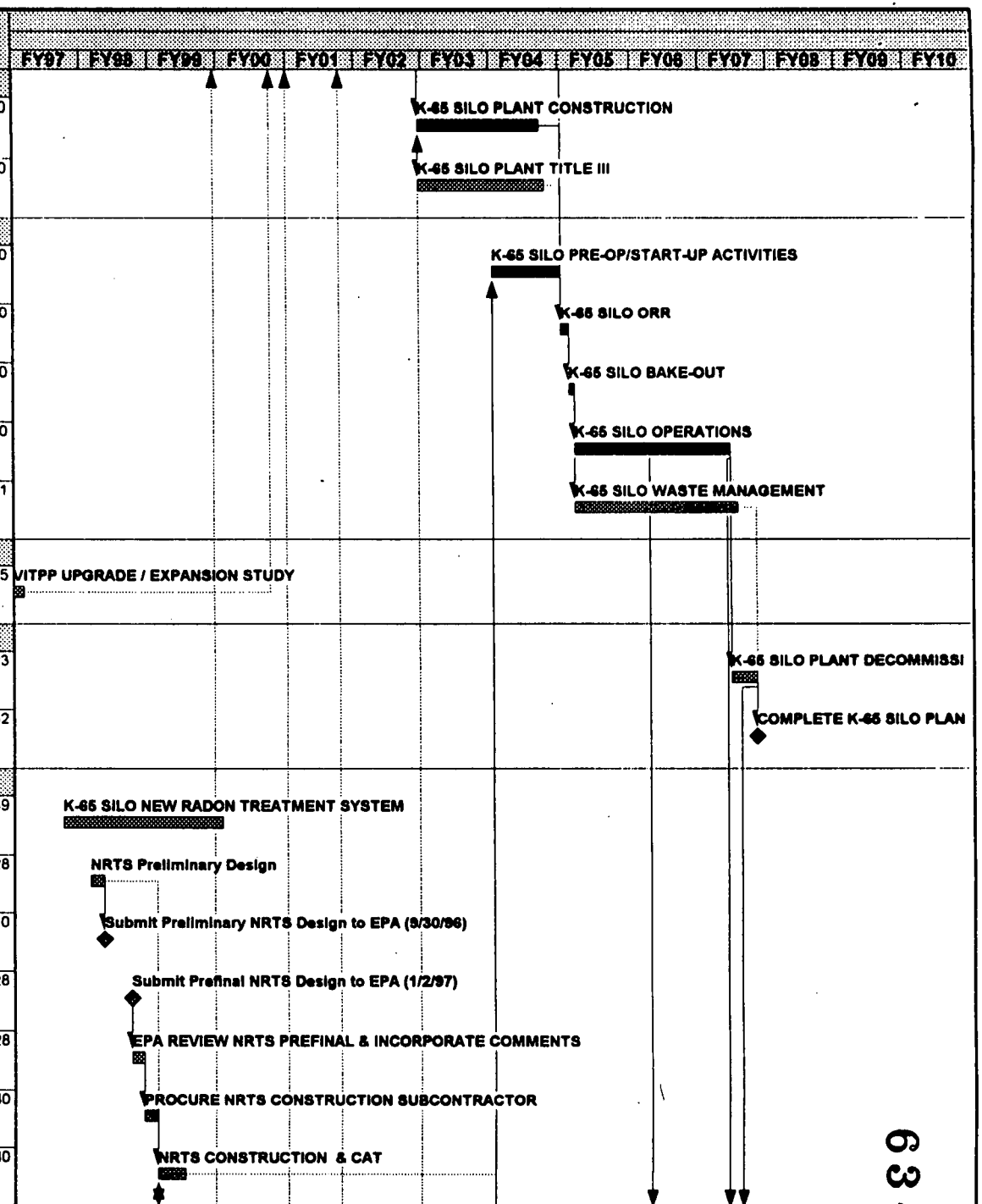
Activity ID	Activity Description	Original Duration	Early Start	Early Finish	Total Float
CONSTRUCTION					
4ACCH700	K-65 SILO PLANT CONSTRUCTION	440	10SEP02	14JUN04	0
4ACCH800	K-65 SILO PLANT TITLE III	460	10SEP02	13JUL04	60
OPERATIONS					
4ACCH500	K-65 SILO PRE-OP/START-UP ACTIVITIES	250	08OCT03	06OCT04	0
4ACC8000	K-65 SILO ORR	30	07OCT04	18NOV04	0
4ACC8100	K-65 SILO BAKE-OUT	30	19NOV04	18DEC04	0
4ACCH200	K-65 SILO OPERATIONS	824	19DEC04	22MAR07	0
4ACCH300	K-65 SILO WASTE MANAGEMENT	590	20DEC04	01MAY07	231
VITPP UPGRADE & EVALUATION					
4ACC4002	VITPP UPGRADE / EXPANSION STUDY	35*	01OCT96	19NOV96	805
DECOMMISSION					
4ACCH400	K-65 SILO PLANT DECOMMISSION	96	23MAR07	08AUG07	23
4ACJM006	COMPLETE K-65 SILO PLANT DECOMMISSION	0		08AUG07	162
NEW RADON TREATMENT SYSTEM					
4ADCH001	K-65 SILO NEW RADON TREATMENT SYSTEM	585*	20JUN97	20OCT99	849
4ADCH000	NRTS Preliminary Design	50	12NOV97	27JAN98	928
4ADCM001	Submit Preliminary NRTS Design to EPA (9/30/96)	0		27JAN98	1,010
4ADCM002	Submit Prefinal NRTS Design to EPA (1/2/97)	0		19JUN98	928
4ADC0R00	EPA REVIEW NRTS PREFINAL & INCORPORATE COMMENTS	42	22JUN98	19AUG98	928
4ADCH003	PROCURE NRTS CONSTRUCTION SUBCONTRACTOR	42	20AUG98	03NOV98	740
4ADCH005	NRTS CONSTRUCTION & CAT	80	04NOV98	31MAR99	740



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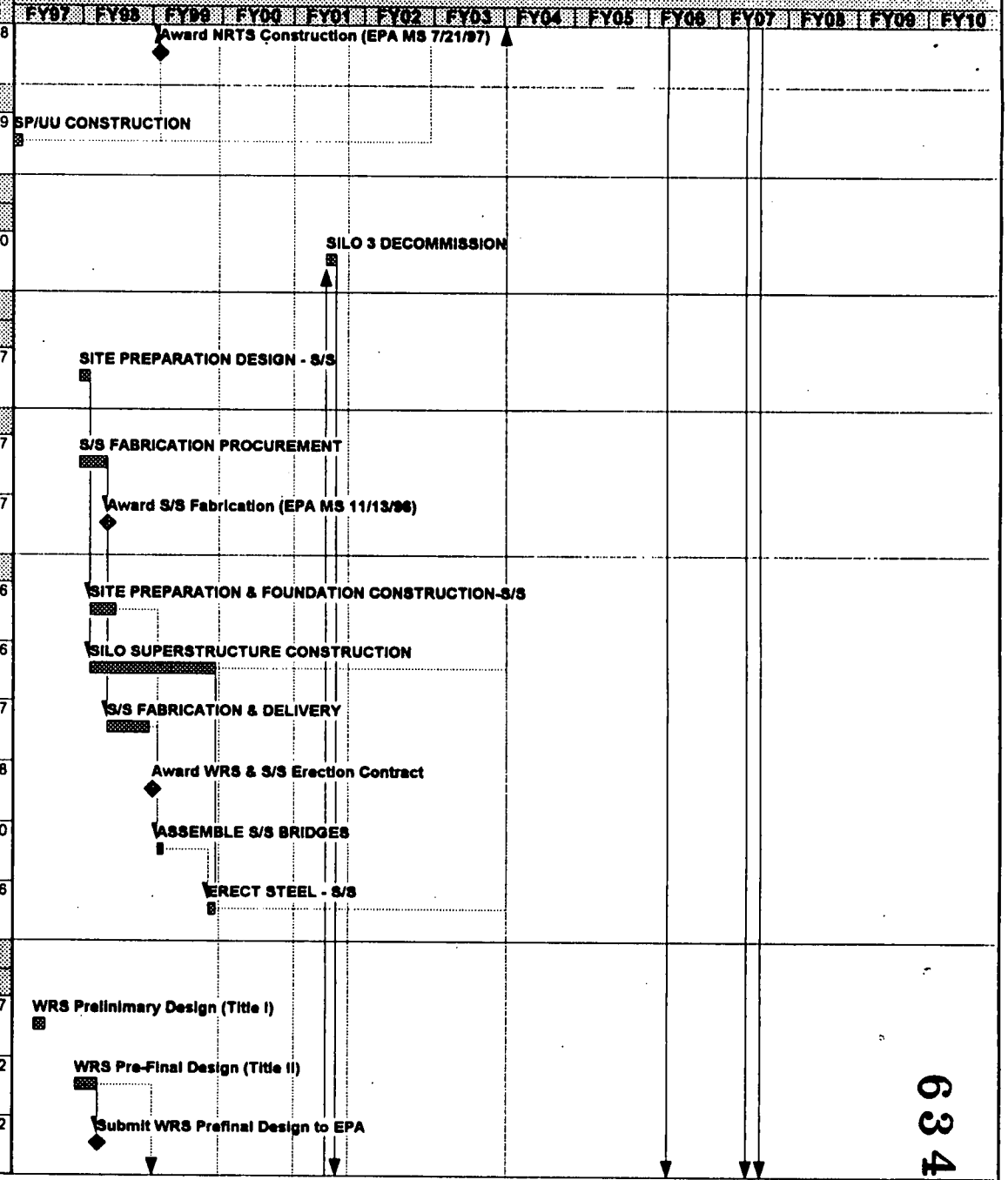
Activity ID	Activity Description	Original Duration	Early Start	Early Finish	Total Float
4ADCM003	Award NRTS Construction (EPA MS 7/21/97)	0	04NOV98		928
SITE PREP/ U/G UTILITIES					
4ADJH000	SP/UU CONSTRUCTION	33	01OCT96	15NOV96	1,419
SILO 3 STABILIZATION					
DECOMMISSION					
4ACJ2000	SILO 3 DECOMMISSION	40	16MAR01	11MAY01	820
SILO SUPERSTRUCTURE					
DESIGN					
4AEE0090	SITE PREPARATION DESIGN - S/S	40	09SEP97	03NOV97	1,037
PROCUREMENT					
4AEEH001	S/S FABRICATION PROCUREMENT	100	09SEP97	03FEB98	1,037
4AEEM002	Award S/S Fabrication (EPA MS 11/13/96)	0		03FEB98	1,037
CONSTRUCTION					
4AEE0120	SITE PREPARATION & FOUNDATION CONSTRUCTION-S/S	70	04NOV97	16MAR98	926
4AEEH150	SILO SUPERSTRUCTURE CONSTRUCTION	359*	04NOV97	24AUG99	676
4AEEH100	S/S FABRICATION & DELIVERY	121	04FEB98	10SEP98	827
4ADFM010	Award WRS & S/S Erection Contract	0	01OCT98		848
4AEE0130	ASSEMBLE S/S BRIDGES	15	29OCT98	25NOV98	800
4AEE0140	ERECT STEEL - S/S	24	14JUL99	24AUG99	676
K-65 SILO WASTE RETRIEVAL SYSTEM					
DESIGN					
4AEE0523	WRS Preliminary Design (Title I)	40	21JAN97	18MAR97	927
4AEF0500	WRS Pre-Final Design (Title II)	80	25AUG97	18DEC97	862
4AEFM005	Submit WRS Prefinal Design to EPA	0		18DEC97	862



Project Start 01OCT95
Project Finish 03APR08
Data Date 01OCT96
Plot Date 13DEC96

Early Bar
Progress Bar
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FLUOR DANIEL FERNALD
SILO PROJECT
PHASE II REPLAN

FERNALD
Environmental Management Project

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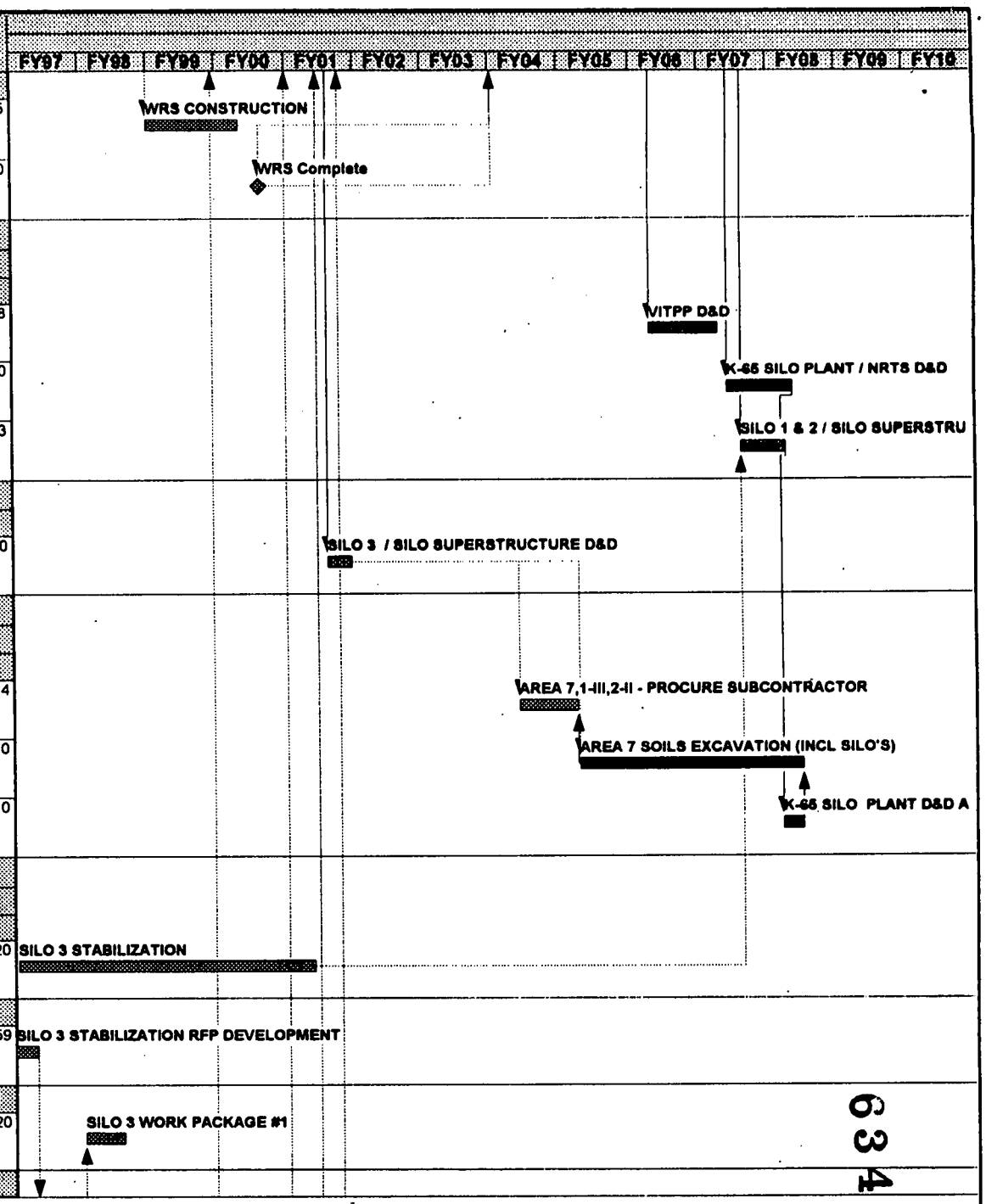
Activity ID	Activity Description	Original Duration	Early Start	Early Finish	Total Float
CONSTRUCTION					
4ADFH525	WRS CONSTRUCTION	264	01OCT98	27JAN00	735
4ADFM002	WRS Complete	0		15MAY00	850
SILO SUPERSTRUCTURE & FACILITY D&D REMEDIATION					
FINAL SITE REMEDIATION					
D&D					
4ACC9500	VITPP D&D	252	23JAN06	24JAN07	298
4ACC9800	K-65 SILO PLANT / NRTS D&D	237	05MAR07	12FEB08	0
4ACC9600	SILO 1 & 2 / SILO SUPERSTRUCTURE D&D	164	15MAY07	10JAN08	23
SILO 3 STABILIZATION					
D&D					
4ACC9650	SILO 3 / SILO SUPERSTRUCTURE D&D	88	14MAY01	17SEP01	820
FINAL SITE REMEDIATION OF OU4 AREA SOILS					
FINAL SITE REMEDIATION					
SOILS					
4ACJ1330	AREA 7,1-III,2-II - PROCURE SUBCONTRACTOR	212	26FEB04	30DEC04	814
4ACJ1335	AREA 7 SOILS EXCAVATION (INCL SILO'S)	814	03JAN05	03APR08	0
4ACJ1340	K-65 SILO PLANT D&D AT OR BELOW GRADE	75	14DEC07	03APR08	0
SILO 3 STABILIZATION					
SILO 3 STABILIZATION					
SILO 3 STABILIZATION					
4ACCH350	SILO 3 STABILIZATION	1,081*	16OCT96	14FEB01	820
SILO 3 REQUEST FOR PROPOSAL					
4ACCH201	SILO 3 STABILIZATION RFP DEVELOPMENT	82*	01OCT96	30JAN97	859
SILO 3 WORK PACKAGE #1					
4ACCH301	SILO 3 WORK PACKAGE #1	144*	09OCT97	08MAY98	820
SILO 3 PROCUREMENT					



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Project Finish 03APR08
Data Date 01OCT96
Plot Date 13DEC96

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Early Bar
Progress Bar
Critical Activity

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FLUOR DANIEL FERNALD
SILO PROJECT
PHASE II REPLAN

FERNALD
Environmental Management Project

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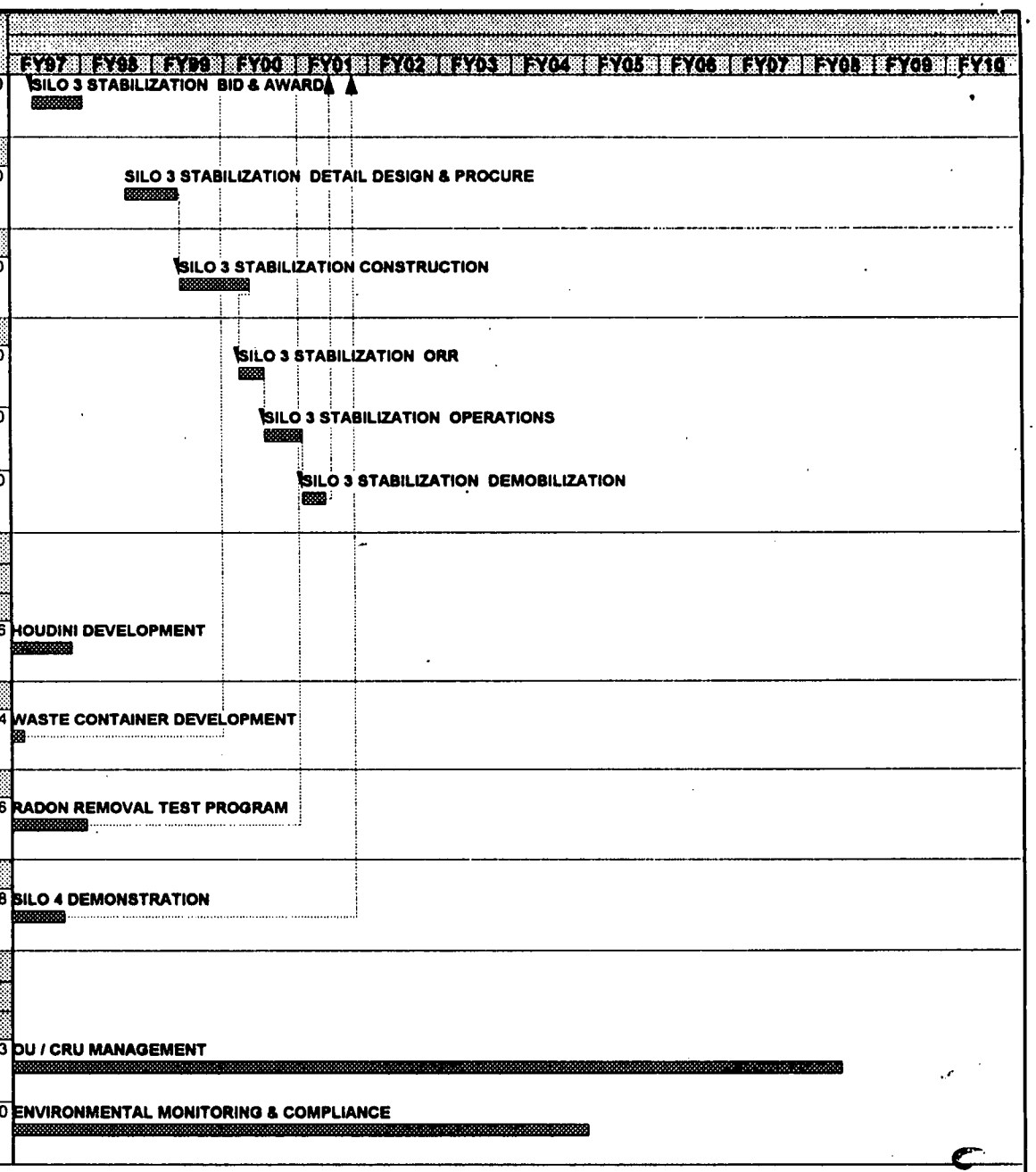
Activity ID	Activity Description	Original Duration	Early Start	Early Finish	Total Float
4ACCH210	SILO 3 STABILIZATION BID & AWARD	174*	31JAN97	08OCT97	820
DESIGN					
4ACCH230	SILO 3 STABILIZATION DETAIL DESIGN & PROCURE	186*	11MAY98	05FEB99	820
CONSTRUCTION					
4ACCH240	SILO 3 STABILIZATION CONSTRUCTION	244*	08FEB99	28JAN00	820
OPERATIONS					
4ACCH250	SILO 3 STABILIZATION ORR	86*	10DEC99	13APR00	820
4ACCH260	SILO 3 STABILIZATION OPERATIONS	131*	14APR00	19OCT00	820
4ACCH270	SILO 3 STABILIZATION DEMOBILIZATION	78*	20OCT00	14FEB01	820
SUPPORT PROJECTS					
SUPPORT PROJECTS					
HOUDINI					
4ADNH100	HOUDINI DEVELOPMENT	214*	01OCT96	08AUG97	786
WASTE CONTAINER DEVELOPMENT					
4ADPH001	WASTE CONTAINER DEVELOPMENT	46*	01OCT96	06DEC96	924
RADON REMOVAL TEST PROGRAM					
4ADRH000	RADON REMOVAL TEST PROGRAM	264	01OCT96*	20OCT97	736
SILO 4 DEMOSTRATION					
4ADSH005	SILO 4 DEMONSTRATION	143*	01OCT96	19JUN97	688
SILO'S PROJECT MGMT, FAC. OWNERSHIP, COMPLIANCE					
ENVIRONMENTAL MONITORING & COMPLIANCE					
4AFC0001	OU / CRU MANAGEMENT	2,871*	01OCT96	31MAR08	3
4AFC0002	ENVIRONMENTAL MONITORING & COMPLIANCE	2,000	01OCT96	30SEP04	60



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Project Start 01OCT95
Project Finish 03APR08
Data Date 01OCT96
Plot Date 13DEC96

Early Bar
Progress Bar
Critical Activity

Primavera Systems, Inc.

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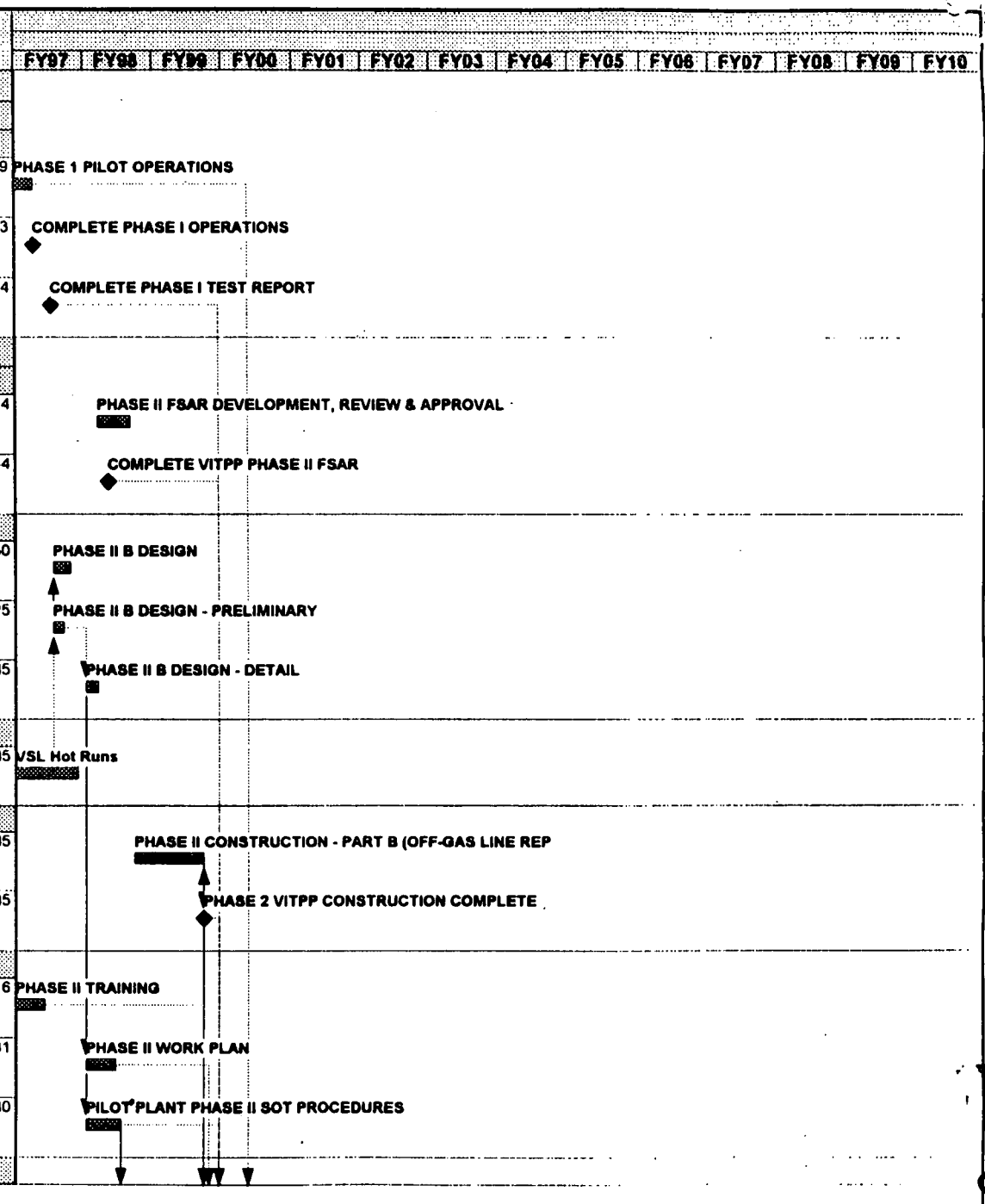
FLUOR DANIEL FERNALD
SILO PROJECT
PHASE II REPLAN

FERNALD
Environmental Management Project

Activity ID	Activity Description	Original Duration	Early Start	Early Finish	Total Float
VITRIFICATION PILOT PLANT					
PILOT PLANT PHASE I					
OPERATIONS					
4AAC1399	PHASE 1 PILOT OPERATIONS	101	01OCT96	09JAN97	179
4AACM042	COMPLETE PHASE I OPERATIONS	0		09JAN97	123
4AACM055	COMPLETE PHASE I TEST REPORT	0		07APR97	234
PILOT PLANT PHASE II					
SAFETY ANALYSIS					
4AAFH003	PHASE II FSAR DEVELOPMENT, REVIEW & APPROVAL	120*	09DEC97	02JUN98	404
4AAFM012	COMPLETE VITPP PHASE II FSAR	0		05FEB98	734
DESIGN					
4AAF7400	PHASE II B DESIGN	60	21APR97	15JUL97	560
4AAF7401	PHASE II B DESIGN - PRELIMINARY	40	21APR97	16JUN97	225
4AAF7402	PHASE II B DESIGN - DETAIL	40	09OCT97	08DEC97	145
VSL HOT RUNS					
4AACH701	VSL Hot Runs	223*	01OCT96	21AUG97	145
CONSTRUCTION - PHASE IIB UPGRADE					
4AAF1507	PHASE II CONSTRUCTION - PART B (OFF-GAS LINE REP	249	17JUN98	15JUN99	145
4AAFM040	PHASE 2 VITPP CONSTRUCTION COMPLETE	0		15JUN99	145
PROCEDURES					
4AAF2312	PHASE II TRAINING	104	01OCT96*	04MAR97	716
4AAF7060	PHASE II WORK PLAN	102	09OCT97*	10MAR98	481
4AAF7450	PILOT PLANT PHASE II SOT PROCEDURES	124	09OCT97*	09APR98	440
OPERATIONS					



Project Start	01OCT95	Early Bar
Project Finish	03APR08	Progress Bar
Data Date	01OCT96	Critical Activity
Plot Date	13DEC96	

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FLUOR DANIEL FERNALD
SILO PROJECT
PHASE II REPLAN

FERNALD
Environmental Management Project

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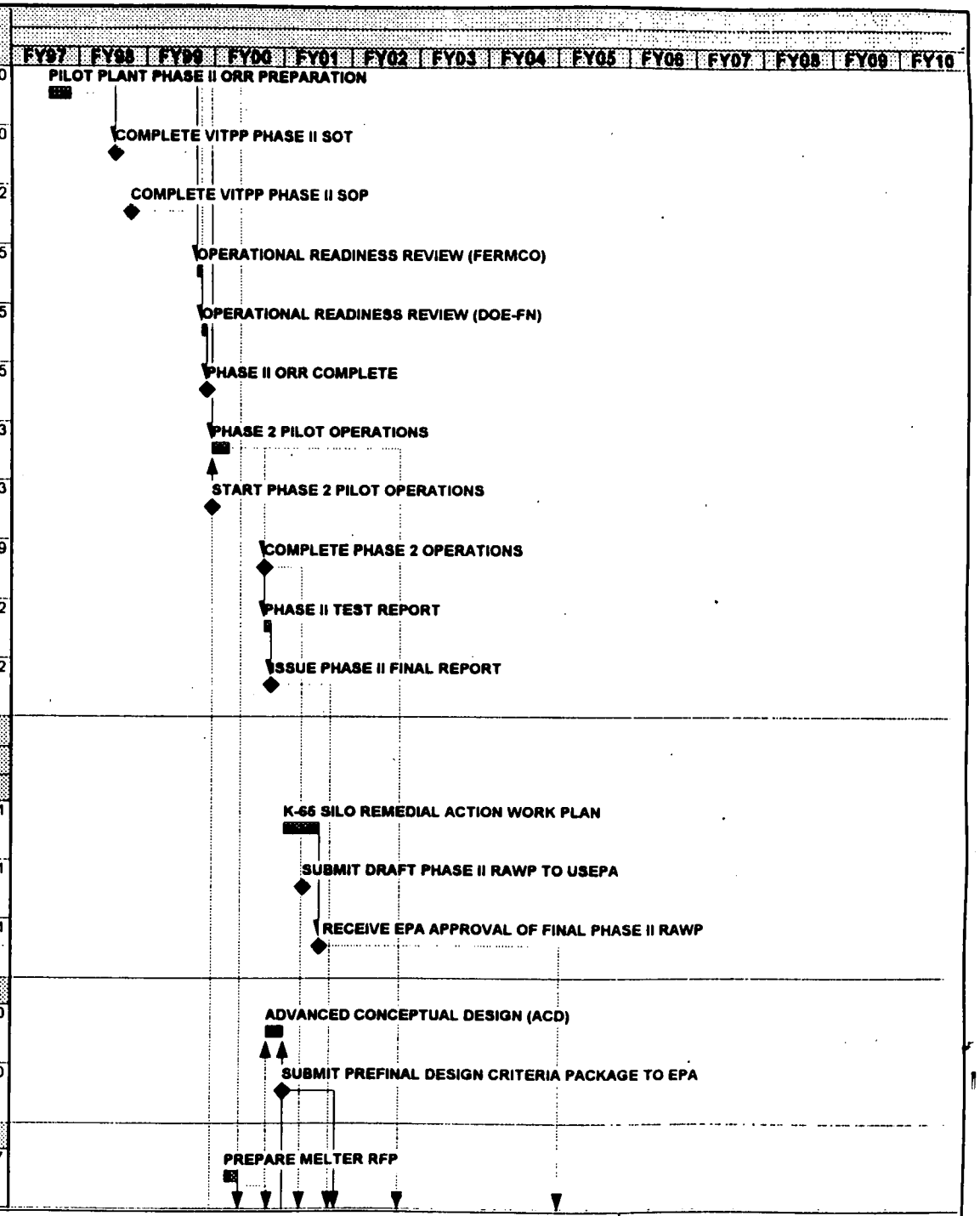
Activity ID	Activity Description	Original Duration	Early Start	Early Finish	Total Float
4AAF0425	PILOT PLANT PHASE II ORR PREPARATION	84	21APR97	18AUG97	600
4AAFM001	COMPLETE VITPP PHASE II SOT	0		09APR98	440
4AAFM051	COMPLETE VITPP PHASE II SOP	0		02JUL98	382
4AAF0427	OPERATIONAL READINESS REVIEW (FERMCO)	19	16JUN99	13JUL99	145
4AAF0430	OPERATIONAL READINESS REVIEW (DOE-FN)	22	14JUL99	12AUG99	145
4AAFM042	PHASE II ORR COMPLETE	0		12AUG99	165
4AAF0267	PHASE 2 PILOT OPERATIONS	90	11SEP99	09DEC99	493
4AAFM043	START PHASE 2 PILOT OPERATIONS	0	11SEP99		493
4AAFM044	COMPLETE PHASE 2 OPERATIONS	0		20JUN00	299
4AAF0445	PHASE II TEST REPORT	20	21JUN00	19JUL00	222
4AAFM055	ISSUE PHASE II FINAL REPORT	0		19JUL00	222
K-65 SILO REMEDIATION PROJECT					
FRVP PROJECT					
REMEDIAL ACTION WORK PLAN					
4ACCH009	K-65 SILO REMEDIAL ACTION WORK PLAN	133*	02OCT00	16APR01	871
4ACCM020	SUBMIT DRAFT PHASE II RAWP TO USEPA	0		15JAN01	871
4ACCM052	RECEIVE EPA APPROVAL OF FINAL PHASE II RAWP	0		16APR01	871
PRELIMINARY STUDIES/INVESTIGATIONS					
4ACCH004	ADVANCED CONCEPTUAL DESIGN (ACD)	60	07JUL00	29SEP00	0
4ACCM017	SUBMIT PREFINAL DESIGN CRITERIA PACKAGE TO EPA	0		29SEP00	0
MELTER SET-UP					
4ACCH031	PREPARE MELTER RFP	52	29NOV99	11FEB00	57



Project Start	01OCT95
Project Finish	03APR08
Data Date	01OCT98
Plot Date	13DEC98

Early Bar
Progress Bar
Critical Activity

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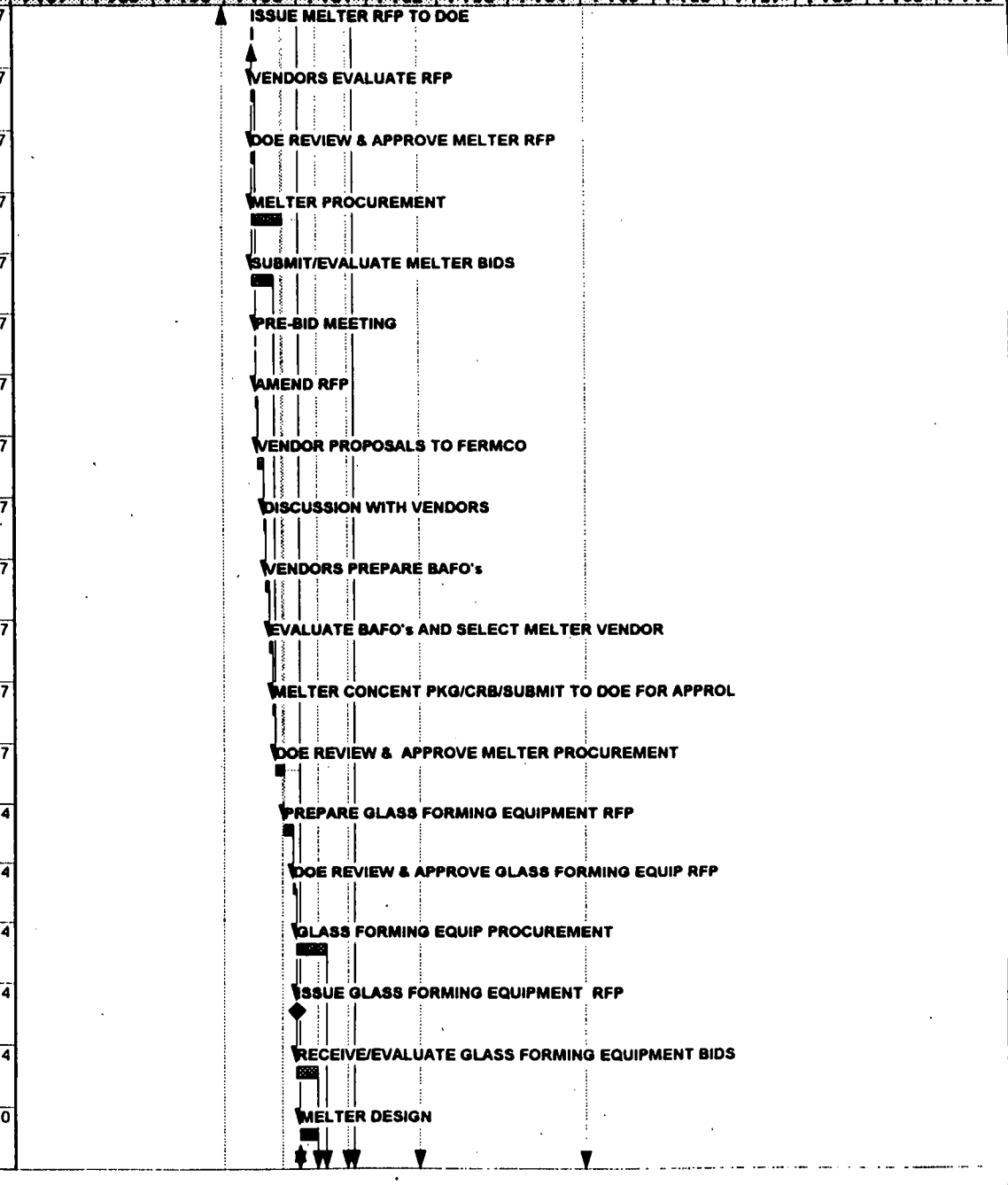
FLUOR DANIEL FERNALD
SILO PROJECT
PHASE II REPLAN

FERNALD
Environmental Management Project

Primavera Systems, Inc

Activity ID	Activity Description	Original Duration	Early Start	Early Finish	Total Float
4ACC5002	ISSUE MELTER RFP TO DOE	1	14FEB00	14FEB00	57
4ACC5025	VENDORS EVALUATE RFP	9	14FEB00	25FEB00	57
4ACC5034	DOE REVIEW & APPROVE MELTER RFP	10	14FEB00	28FEB00	57
4ACCH005	MELTER PROCUREMENT	103	14FEB00	11JUL00	57
4ACCH007	SUBMIT/EVALUATE MELTER BIDS	74*	14FEB00	30MAY00	57
4ACC5029	PRE-BID MEETING	1	28FEB00	28FEB00	57
4ACC5032	AMEND RFP	5	29FEB00	06MAR00	57
4ACC5035	VENDOR PROPOSALS TO FERMCO	20	07MAR00	03APR00	57
4ACC5038	DISCUSSION WITH VENDORS	10	04APR00	17APR00	57
4ACC5041	VENDORS PREPARE BAFO's	9	18APR00	01MAY00	57
4ACC5044	EVALUATE BAFO's AND SELECT MELTER VENDOR	10	02MAY00	15MAY00	57
4ACC5047	MELTER CONCENT PKG/CRB/SUBMIT TO DOE FOR APPROL	10	16MAY00	30MAY00	57
4ACC5027	DOE REVIEW & APPROVE MELTER PROCUREMENT	29	31MAY00	11JUL00	57
4ACC5118	PREPARE GLASS FORMING EQUIPMENT RFP	31	13JUL00	24AUG00	274
4ACC5121	DOE REVIEW & APPROVE GLASS FORMING EQUIP RFP	10	25AUG00	08SEP00	274
4ACCH100	GLASS FORMING EQUIP PROCUREMENT	106	11SEP00	13FEB01	274
4ACCM016	ISSUE GLASS FORMING EQUIPMENT RFP	0	11SEP00		274
4ACC5124	RECEIVE/EVALUATE GLASS FORMING EQUIPMENT BIDS	76	12SEP00	03JAN01	274
4ACCH011	MELTER DESIGN	60	02OCT00	29DEC00	0



Project Start	01OCT95	Early Bar
Project Finish	03APR08	Progress Bar
Data Date	01OCT96	Critical Activity
Plot Date	13DEC96	

Primavera Systems, Inc

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FLUOR DANIEL FERNALD
SILO PROJECT
PHASE II REPLAN

FERNALD
Environmental Management Project

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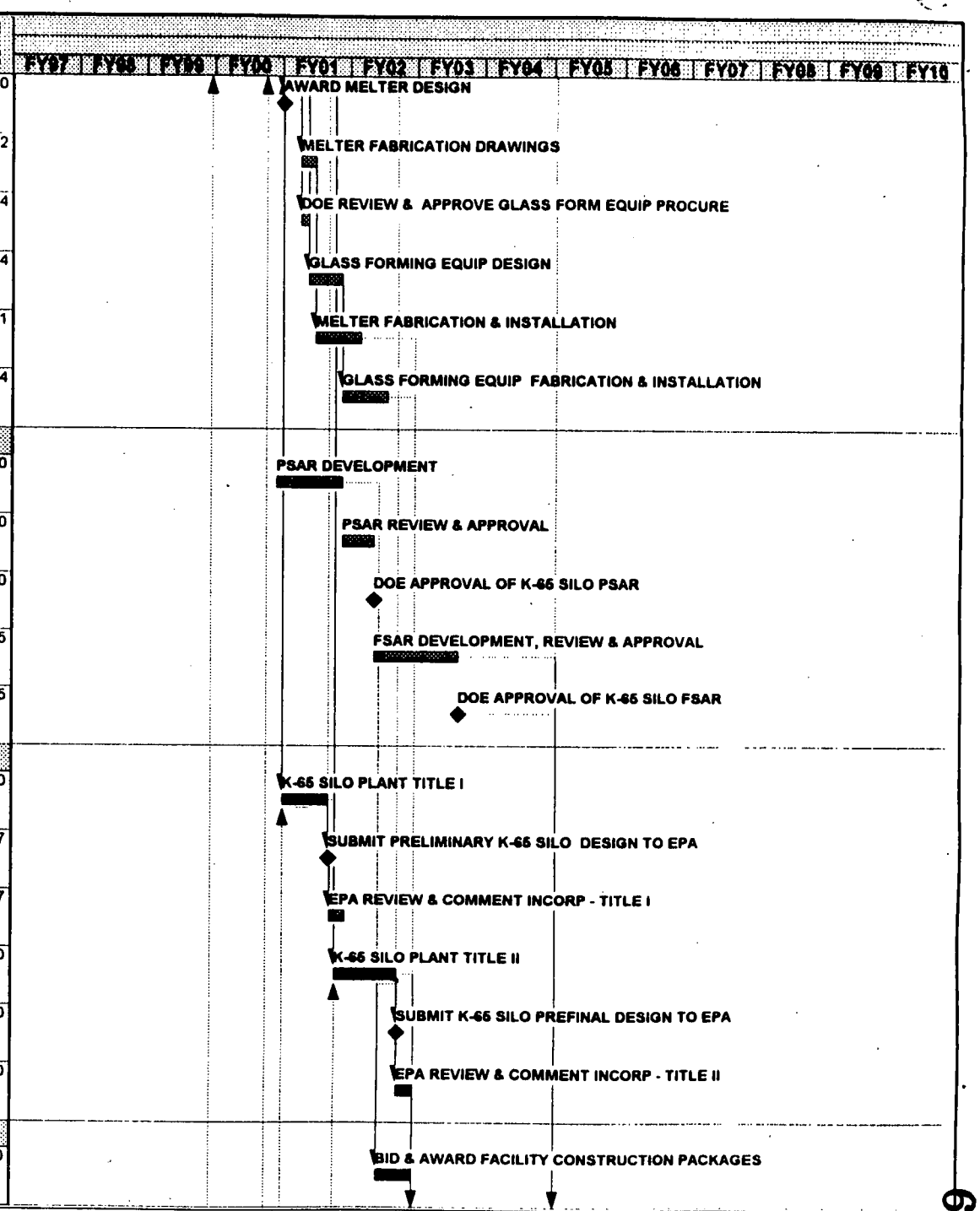
Activity ID	Activity Description	Original Duration	Early Start	Early Finish	Total Float
4ACCM012	AWARD MELTER DESIGN	0	02OCT00*		0
4ACCH006	MELTER FABRICATION DRAWINGS	59	02JAN01	26MAR01	72
4ACC5127	DOE REVIEW & APPROVE GLASS FORM EQUIP PROCURE	29	04JAN01	13FEB01	274
4ACCH101	GLASS FORMING EQUIP DESIGN	125	14FEB01	13AUG01	274
4ACCH010	MELTER FABRICATION & INSTALLATION	168	27MAR01	26NOV01	371
4ACCH102	GLASS FORMING EQUIP FABRICATION & INSTALLATION	168	14AUG01	17APR02	274
SAFETY ANALYSIS					
4ACCH022	PSAR DEVELOPMENT	239*	01SEP00	16AUG01	20
4ACCH012	PSAR REVIEW & APPROVAL	115*	17AUG01	04FEB02	20
4ACCM015	DOE APPROVAL OF K-65 SILO PSAR	0		04FEB02	20
4ACCH003	FSAR DEVELOPMENT, REVIEW & APPROVAL	315*	05FEB02	08MAY03	325
4ACCM022	DOE APPROVAL OF K-65 SILO FSAR	0		08MAY03	325
DESIGN					
4ACCH000	K-65 SILO PLANT TITLE I	171	02OCT00	08JUN01	0
4ACCM018	SUBMIT PRELIMINARY K-65 SILO DESIGN TO EPA	0		08JUN01	187
4ACC7R00	EPA REVIEW & COMMENT INCORP - TITLE I	63	11JUN01	07SEP01	187
4ACCH008	K-65 SILO PLANT TITLE II	230	10JUL01	10JUN02	0
4ACCM021	SUBMIT K-65 SILO PREFINAL DESIGN TO EPA	0		10JUN02	0
4ACC7005	EPA REVIEW & COMMENT INCORP - TITLE II	63	11JUN02	09SEP02	0
PROCUREMENT					
4ACCH600	BID & AWARD FACILITY CONSTRUCTION PACKAGES	130	06MAR02	09SEP02	0



Project Start	01OCT95
Project Finish	03APR08
Data Date	01OCT96
Plot Date	13DEC96

Primavera Systems, Inc.

Early Bar
Progress Bar
Critical Activity

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FLUOR DANIEL FERNALD
SILO PROJECT
PHASE II REPLAN

FERNALD
Environmental Management Project

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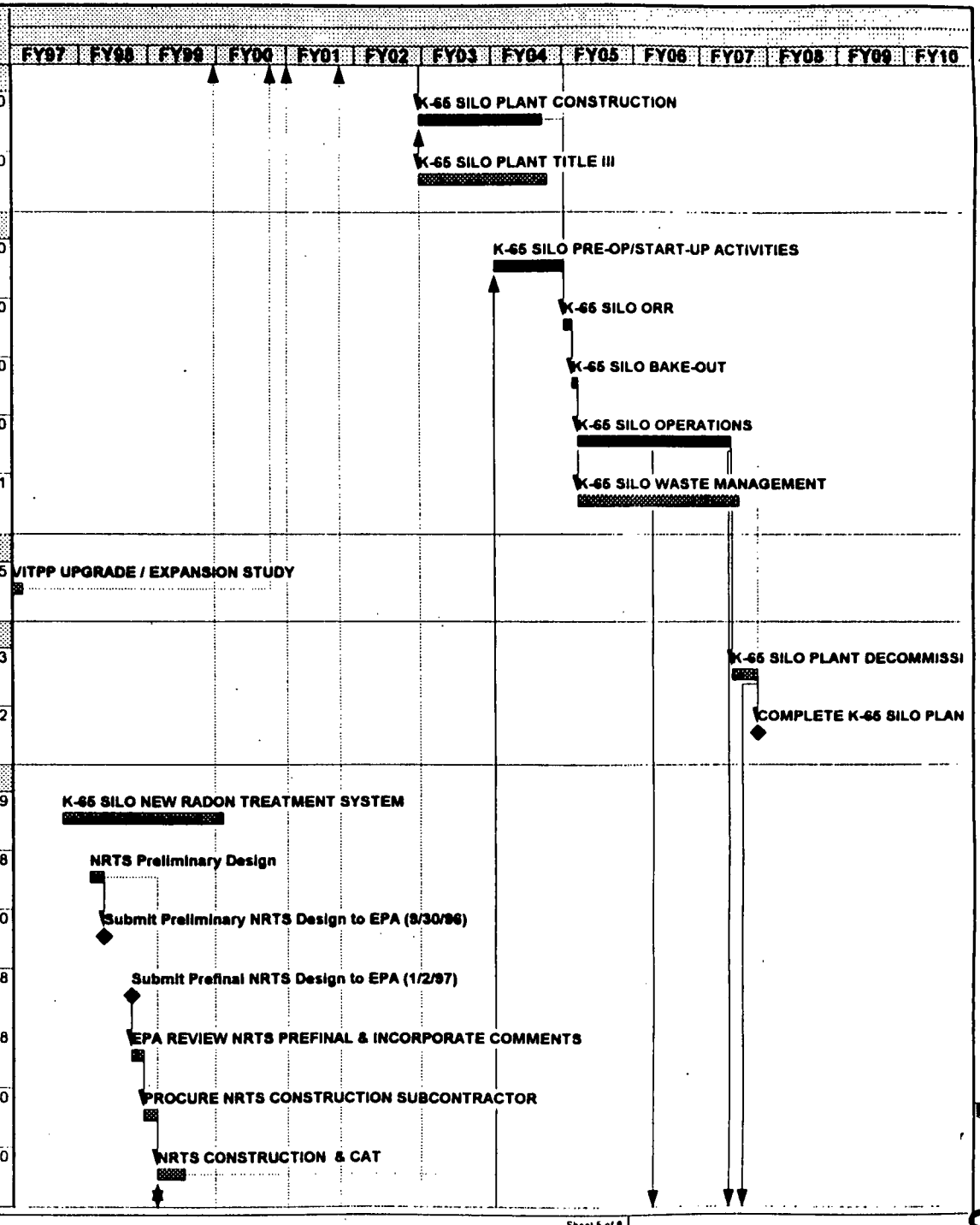
Activity ID	Activity Description	Original Duration	Early Start	Early Finish	Total Float
CONSTRUCTION					
4ACCH700	K-65 SILO PLANT CONSTRUCTION	440	10SEP02	14JUN04	0
4ACCH800	K-65 SILO PLANT TITLE III	460	10SEP02	13JUL04	60
OPERATIONS					
4ACCH500	K-65 SILO PRE-OP/START-UP ACTIVITIES	250	08OCT03	06OCT04	0
4ACC8000	K-65 SILO ORR	30	07OCT04	18NOV04	0
4ACC8100	K-65 SILO BAKE-OUT	30	19NOV04	18DEC04	0
4ACCH200	K-65 SILO OPERATIONS	824	19DEC04	22MAR07	0
4ACCH300	K-65 SILO WASTE MANAGEMENT	590	20DEC04	01MAY07	231
VITPP UPGRADE & EVALUATION					
4ACC4002	VITPP UPGRADE / EXPANSION STUDY	35*	01OCT96	19NOV96	805
DECOMMISSION					
4ACCH400	K-65 SILO PLANT DECOMMISSION	96	23MAR07	08AUG07	23
4ACJM006	COMPLETE K-65 SILO PLANT DECOMMISSION	0		08AUG07	162
NEW RADON TREATMENT SYSTEM					
4ADCH001	K-65 SILO NEW RADON TREATMENT SYSTEM	585*	20JUN97	20OCT99	849
4ADCH000	NRTS Preliminary Design	50	12NOV97	27JAN98	928
4ADCM001	Submit Preliminary NRTS Design to EPA (9/30/96)	0		27JAN98	1,010
4ADCM002	Submit Prefinal NRTS Design to EPA (1/2/97)	0		19JUN98	928
4ADCH000	EPA REVIEW NRTS PREFINAL & INCORPORATE COMMENTS	42	22JUN98	19AUG98	928
4ADCH008	PROCURE NRTS CONSTRUCTION SUBCONTRACTOR	42	20AUG98	03NOV98	740
4ADCH005	NRTS CONSTRUCTION & CAT	80	04NOV98	31MAR99	740



Project Start	01OCT95
Project Finish	03APR08
Data Date	01OCT96
Plot Date	13DEC96

Primavera Systems, Inc.

Early Bar
Progress Bar
Critical Activity

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FLUOR DANIEL FERNALD
SILO PROJECT
PHASE II REPLAN

FERNALD
Environmental Management Project

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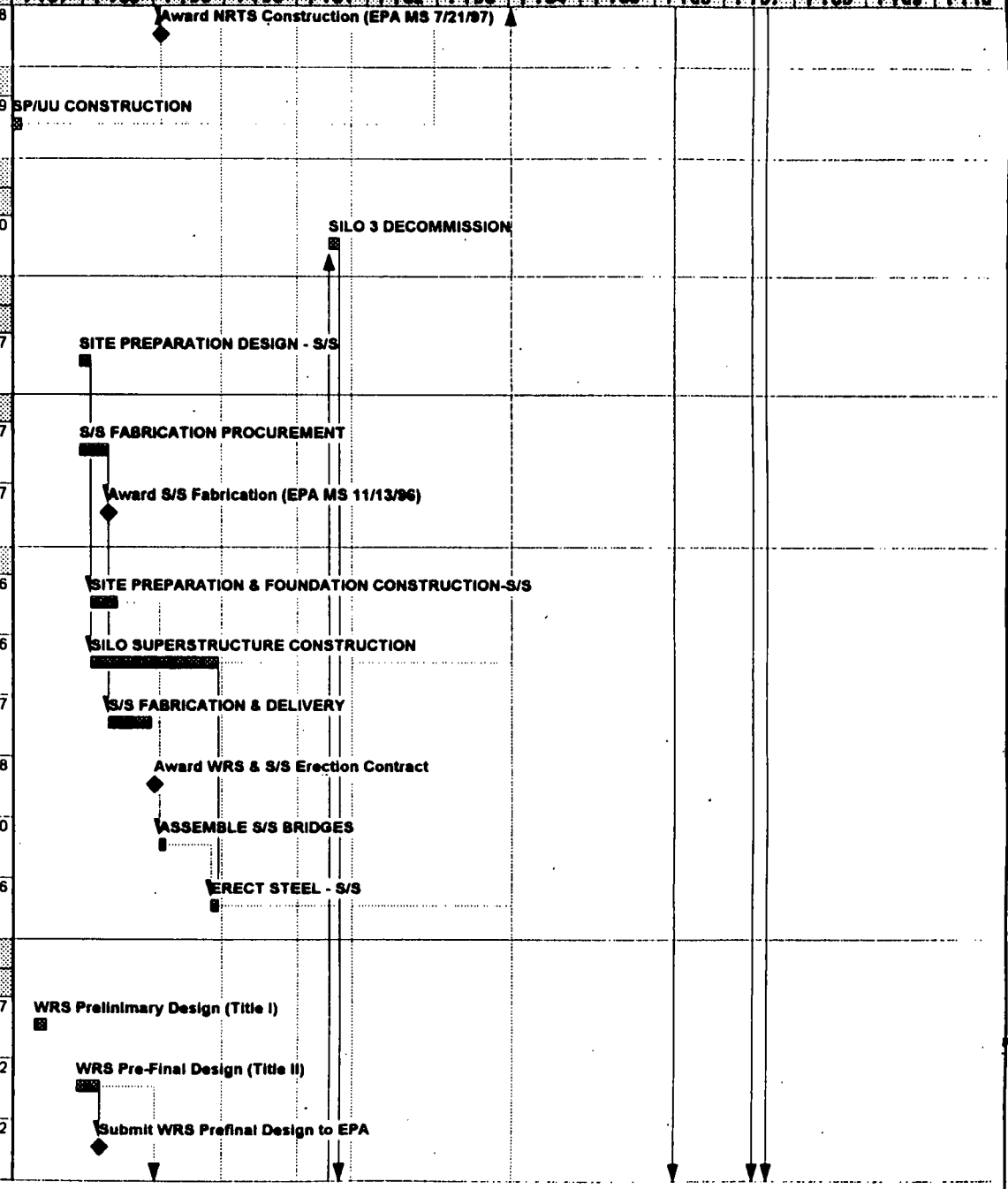
Activity ID	Activity Description	Original Duration	Early Start	Early Finish	Total Float
4ADCM003	Award NRTS Construction (EPA MS 7/21/97)	0	04NOV98		928
SITE PREP/ U/G UTILITIES					
4ADJH000	SP/UU CONSTRUCTION	33	01OCT96	15NOV96	1,419
SILO 3 STABILIZATION					
DECOMMISSION					
4ACJ2000	SILO 3 DECOMMISSION	40	16MAR01	11MAY01	820
SILO SUPERSTRUCTURE					
DESIGN					
4AEE0090	SITE PREPARATION DESIGN - S/S	40	09SEP97	03NOV97	1,037
PROCUREMENT					
4AEEH001	S/S FABRICATION PROCUREMENT	100	09SEP97	03FEB98	1,037
4AEEM002	Award S/S Fabrication (EPA MS 11/13/96)	0		03FEB98	1,037
CONSTRUCTION					
4AEE0120	SITE PREPARATION & FOUNDATION CONSTRUCTION-S/S	70	04NOV97	16MAR98	926
4AEEH150	SILO SUPERSTRUCTURE CONSTRUCTION	359*	04NOV97	24AUG99	676
4AEEH100	S/S FABRICATION & DELIVERY	121	04FEB98	10SEP98	827
4ADFM010	Award WRS & S/S Erection Contract	0	01OCT98		848
4AEE0130	ASSEMBLE S/S BRIDGES	15	29OCT98	25NOV98	800
4AEE0140	ERECT STEEL - S/S	24	14JUL99	24AUG99	676
K-65 SILO WASTE RETRIEVAL SYSTEM					
DESIGN					
4ADF0523	WRS Preliminary Design (Title I)	40	21JAN97	18MAR97	927
4ADF0500	WRS Pre-Final Design (Title II)	80	25AUG97	18DEC97	862
4ADFM005	Submit WRS Prefinal Design to EPA	0		18DEC97	862



Project Start 01OCT95
Project Finish 03APR08
Data Date 01OCT96
Plot Date 13DEC96

Early Bar
Progress Bar
Critical Activity

Primavera Systems, Inc

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FLUOR DANIEL FERNALD
SILO PROJECT
PHASE II REPLAN

FERNALD
Environmental Management Project

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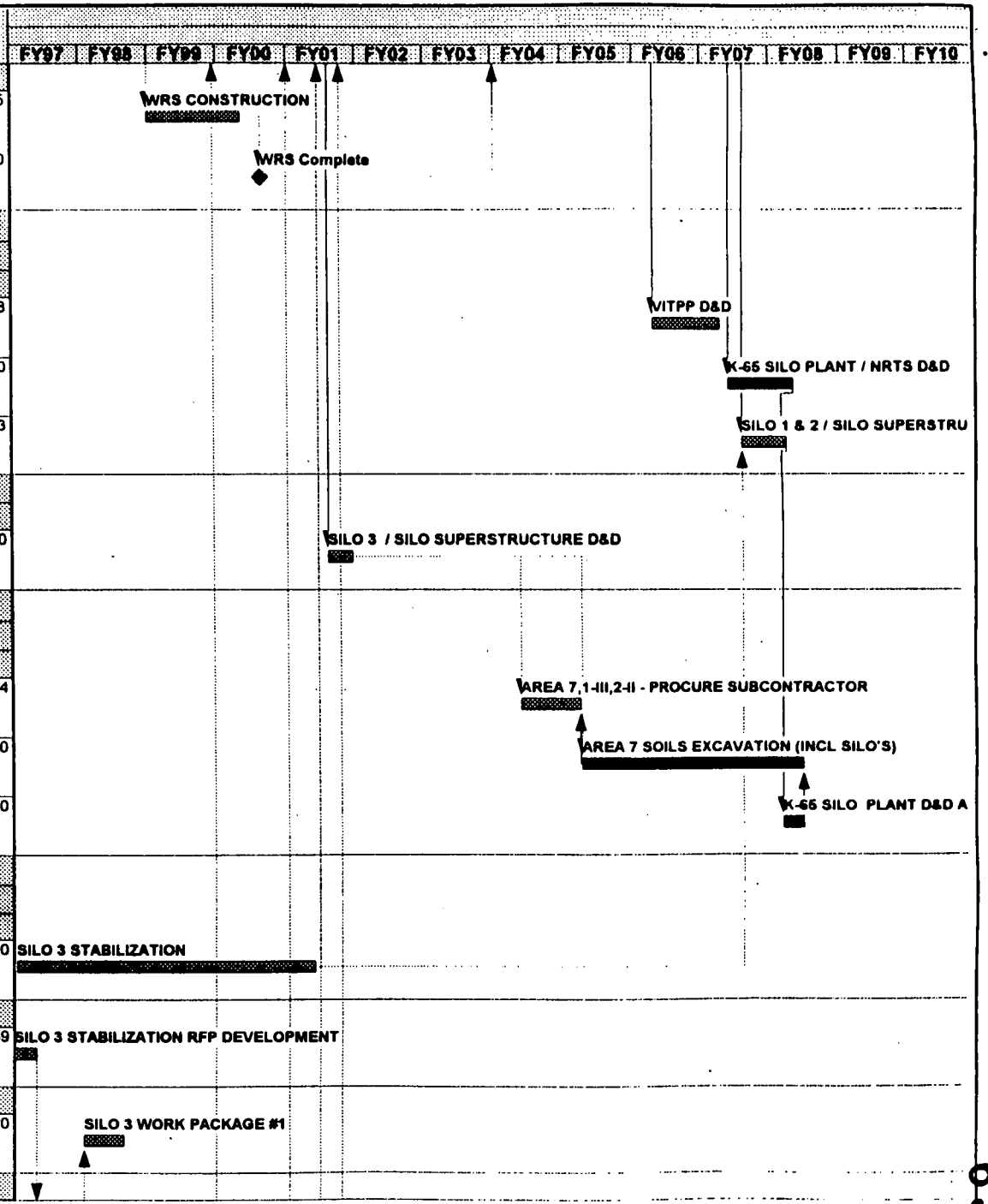
Activity ID	Activity Description	Original Duration	Early Start	Early Finish	Total Float
CONSTRUCTION					
4ADFH525	WRS CONSTRUCTION	264	01OCT98	27JAN00	735
4ADFM002	WRS Complete	0		15MAY00	850
SILO SUPERSTRUCTURE & FACILITY D&D REMEDIATION					
FINAL SITE REMEDIATION					
D&D					
4ACC9500	VITPP D&D	252	23JAN06	24JAN07	298
4ACC9800	K-65 SILO PLANT / NRTS D&D	237	05MAR07	12FEB08	0
4ACC9600	SILO 1 & 2 / SILO SUPERSTRUCTURE D&D	164	15MAY07	10JAN08	23
SILO 3 STABILIZATION					
D&D					
4ACC9650	SILO 3 / SILO SUPERSTRUCTURE D&D	88	14MAY01	17SEP01	820
FINAL SITE REMEDIATION OF OU4 AREA SOILS					
FINAL SITE REMEDIATION					
SOILS					
4ACJ1330	AREA 7,1-III,2-II - PROCURE SUBCONTRACTOR	212	26FEB04	30DEC04	814
4ACJ1335	AREA 7 SOILS EXCAVATION (INCL SILO'S)	814	03JAN05	03APR08	0
4ACJ1340	K-65 SILO PLANT D&D AT OR BELOW GRADE	75	14DEC07	03APR08	0
SILO 3 STABILIZATION					
SILO 3 STABILIZATION					
SILO 3 STABILIZATION					
4ACCH350	SILO 3 STABILIZATION	1,081*	16OCT96	14FEB01	820
SILO 3 REQUEST FOR PROPOSAL					
4ACCH201	SILO 3 STABILIZATION RFP DEVELOPMENT	82*	01OCT96	30JAN97	859
SILO 3 WORK PACKAGE #1					
4ACCH301	SILO 3 WORK PACKAGE #1	144*	09OCT97	08MAY98	820
SILO 3 PROCUREMENT					



Project Start 01OCT95
Project Finish 03APR08
Data Date 01OCT96
Plot Date 13DEC96

Early Bar
Progress Bar
Critical Activity

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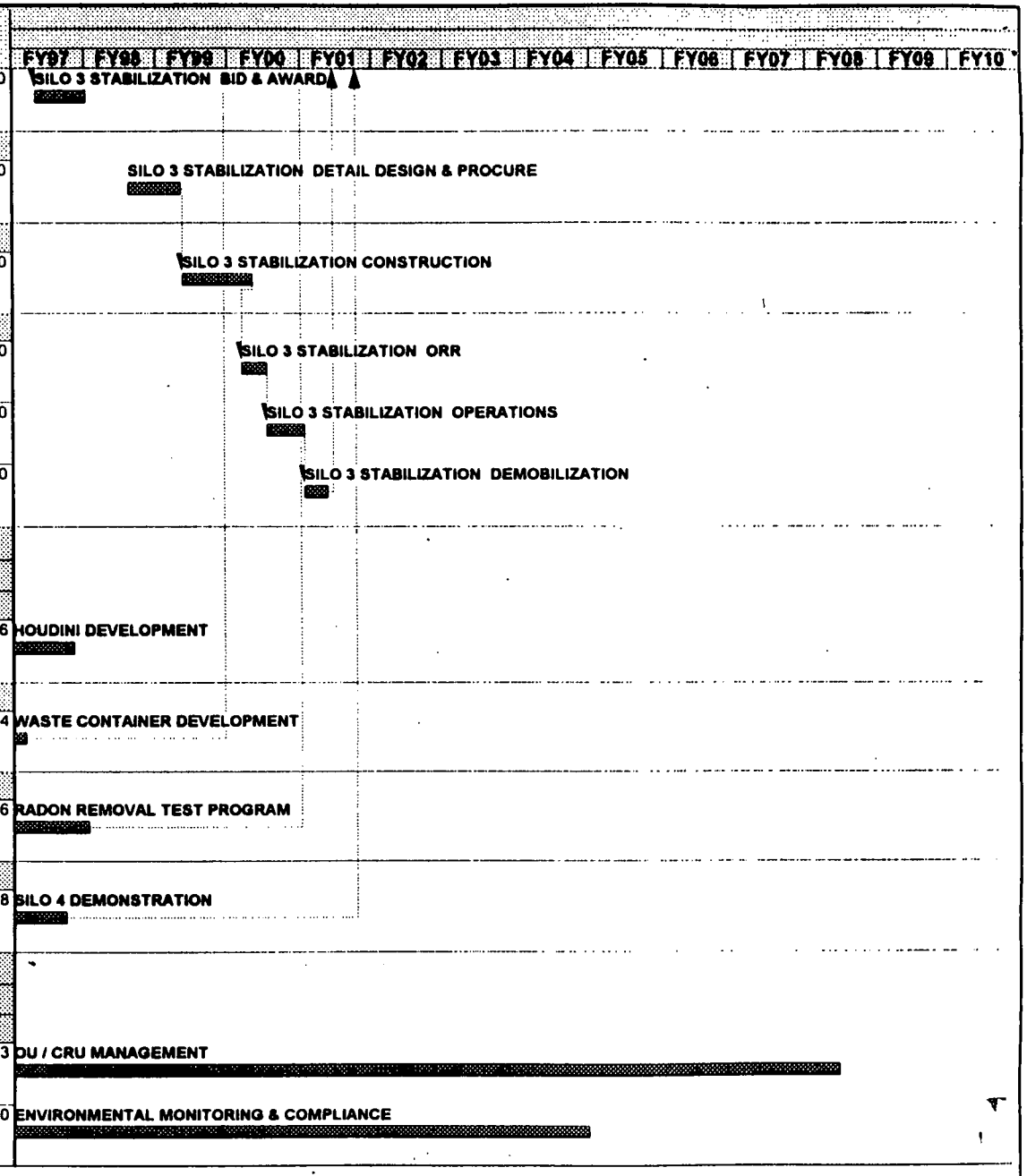
FLUOR DANIEL FERNALD
SILO PROJECT
PHASE II REPLAN

FERNALD
Environmental Management Project

Primavera Systems, Inc.

Activity ID	Activity Description	Original Duration	Early Start	Early Finish	Total Float
4ACCH210	SILO 3 STABILIZATION BID & AWARD	174*	31JAN97	08OCT97	820
DESIGN					
4ACCH230	SILO 3 STABILIZATION DETAIL DESIGN & PROCURE	186*	11MAY98	05FEB99	820
CONSTRUCTION					
4ACCH240	SILO 3 STABILIZATION CONSTRUCTION	244*	08FEB99	28JAN00	820
OPERATIONS					
4ACCH250	SILO 3 STABILIZATION ORR	86*	10DEC99	13APR00	820
4ACCH260	SILO 3 STABILIZATION OPERATIONS	131*	14APR00	19OCT00	820
4ACCH270	SILO 3 STABILIZATION DEMOBILIZATION	78*	20OCT00	14FEB01	820
SUPPORT PROJECTS					
SUPPORT PROJECTS					
HOUDINI					
4ADNH100	HOUDINI DEVELOPMENT	214*	01OCT96	08AUG97	786
WASTE CONTAINER DEVELOPMENT					
4ADPH001	WASTE CONTAINER DEVELOPMENT	46*	01OCT96	06DEC96	924
RADON REMOVAL TEST PROGRAM					
4ADPH000	RADON REMOVAL TEST PROGRAM	264	01OCT96*	20OCT97	736
SILO 4 DEMOSTRATION					
4ADSH005	SILO 4 DEMONSTRATION	143*	01OCT96	19JUN97	688
SILO'S PROJECT MGMT, FAC. OWNERSHIP, COMPLIANCE					
ENVIRONMENTAL MONITORING & COMPLIANCE					
4AFC0001	OU / CRU MANAGEMENT	2,871*	01OCT96	31MAR08	3
4AFC0000	ENVIRONMENTAL MONITORING & COMPLIANCE	2,000	01OCT96	30SEP04	60



Project Start	01OCT95	Early Bar
Project Finish	03APR08	Progress Bar
Data Date	01OCT96	Critical Activity
Plot Date	13DEC96	

Primavera Systems, Inc

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FLUOR DANIEL FERNALD
SILO PROJECT
PHASE II REPLAN

FERNALD
Environmental Management Project

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Cost & Schedule Committee

CURRENT STATUS

ALTERNATE I: The February 1996 baseline is vitrify Silos 1, 2 & 3

BASIS:

- 25 Ton/Day Melter Facility estimated November, 1995
- Waste disposal NTS
- D&D Soils disposal OSDF (On-site disposal facility)

ALTERNATE II: The Silos Project's current baseline schedule is to vitrify Silos 1 & 2 and stabilization of Silo 3.

BASIS:

- 25 Ton/Day Melter Facility estimated November, 1995
- Solidify Silo 3 Cost and Schedule input from the Silo 3 Alternative Study
- Waste disposal NTS
- D&D Soils disposal OSDF (On-site disposal facility)
- Start-up & operation resources based on Vitrification Phase I actuals

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FLUOR DANIEL FERNALD

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Cost & Schedule Committee

CURRENT STATUS (CONTINUED)

ALTERNATE III

Current cost and schedule information is rough order of magnitude from the Silos Project RI/FS Report and cost & schedule information from Hanford cement stabilization experience.

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FLUOR DANIEL FERNALD

Cost & Schedule Committee

SCOPE OF WORK

January Deliverable

- Review the current baseline to identify areas requiring updates
- Based on the NUMATEC Report re-estimate the final remediation vitrification process utilizing multiple melter trains instead of one (1) 25 ton/day melter system.
- Update the current baseline (Vitrification Silos 1 & 2, Cement Stabilization of Silo 3) by January 15, 1997.
- Develop a cost and schedule factor for Alternate I (vitrifying Silo 1, 2 &3) which can be applied to the Alternative II detail baseline by January 15, 1997.
- Utilizing the alternative scoping information, the RI/FS and Hanford cement stablization cost and schedule information use a qualitative approach to obtain the cost range for stabilization of Silos 1, 2 & 3 by January 15, 1997.

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Cost & Schedule Committee

SCOPE OF WORK (CONTINUED)

February Deliverable

- Estimate cost and schedule for other paths through the decision tree (i.e., costs and schedule under other possible regulators, funding, technical and waste disposal alternate) by February, 1997.
- Review information other committees for cost and schedule impacts.

Post Path Forward Decision

- Develop Cost & Schedule for a Rebaseline of the Silos Project to be approved by Department of Energy & Environmental Protection Agency.

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FLUOR DANIEL FERNALD

Cost & Schedule Committee

ISSUE

- Estimate cost for utilities, administration and cell modification for Silos Project activities beyond FY 2005.

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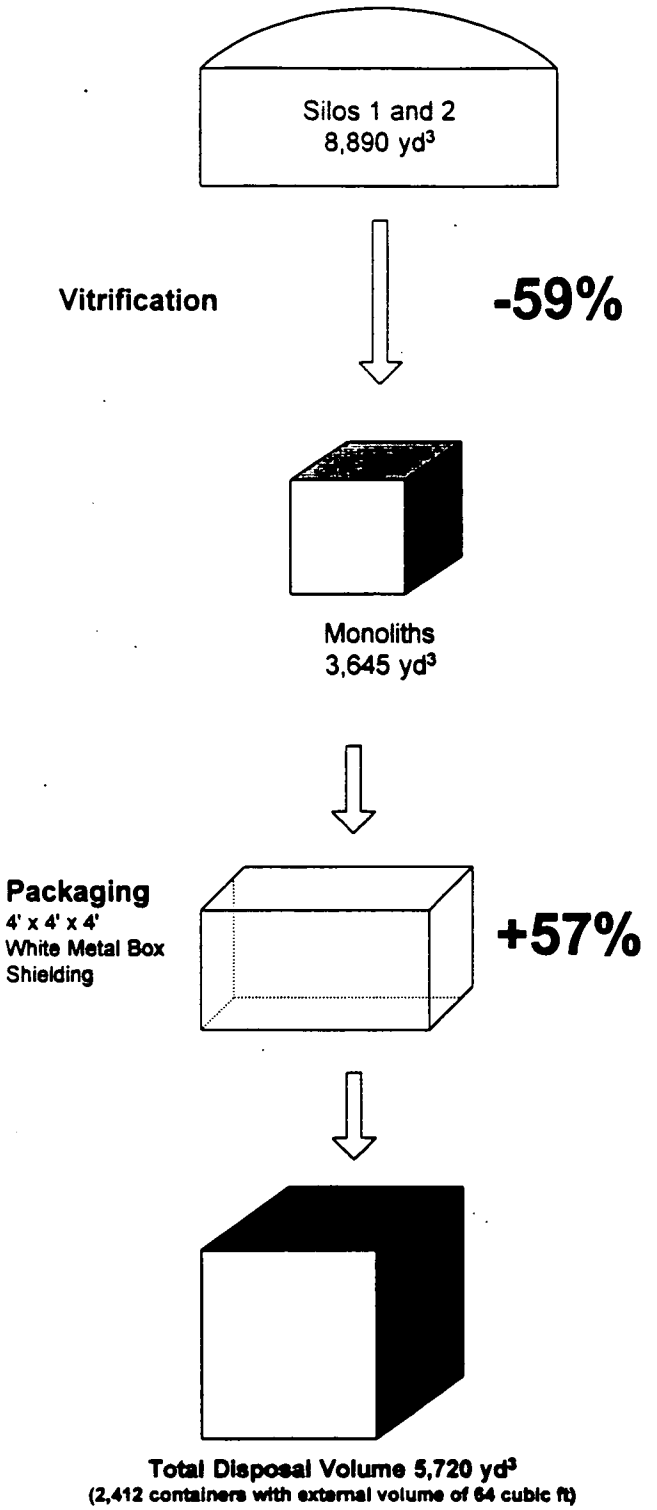
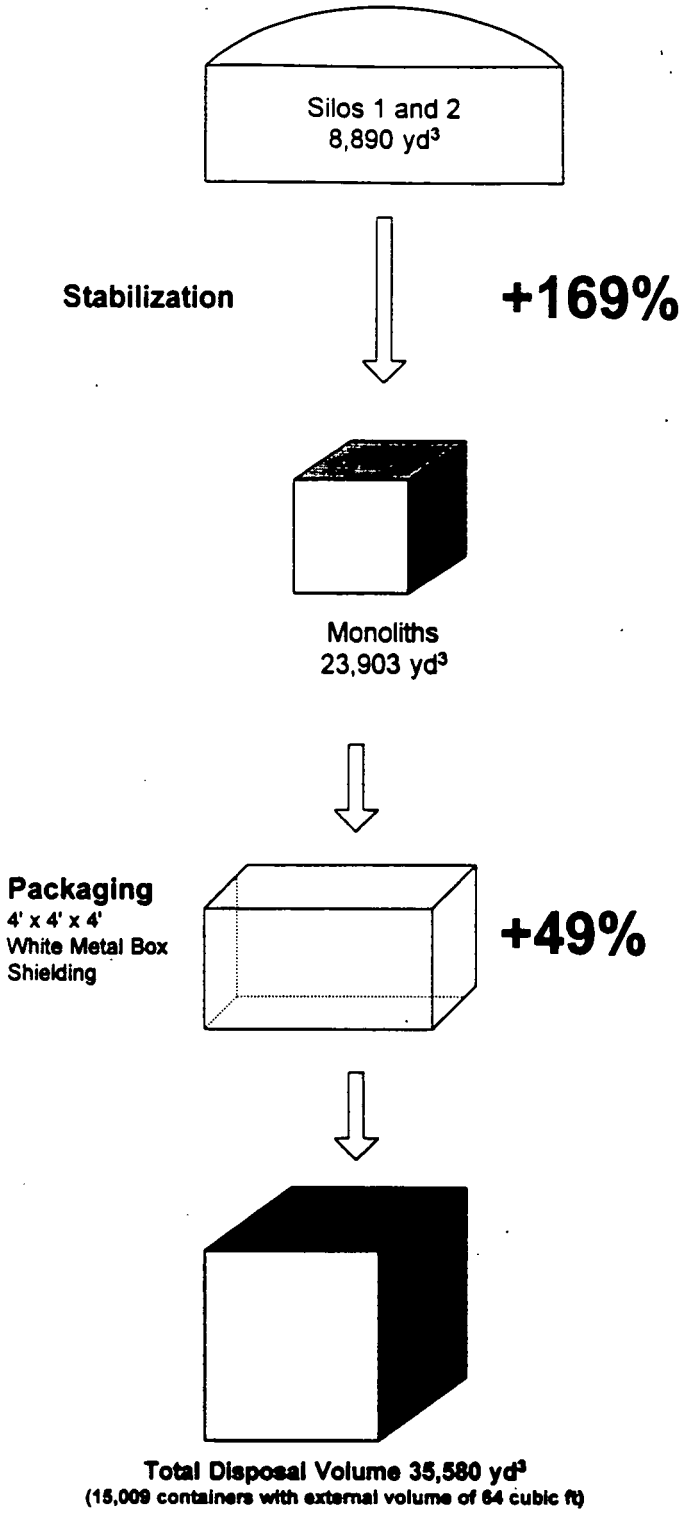
OU4 FEASIBILITY STUDY
Vitrification

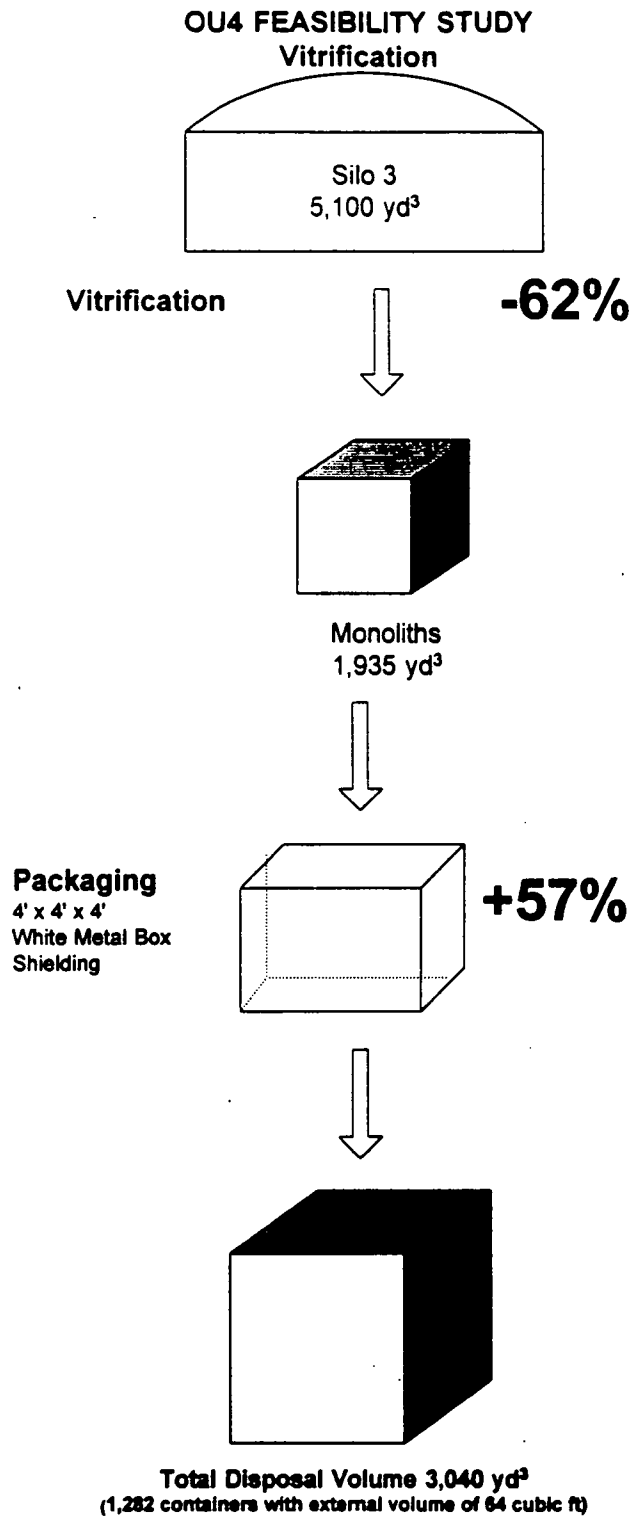


VITRIFIED SILOS 1 AND 2 DISPOSAL VOLUME BASED ON
OU4 FS Vitrification

OU4 FEASIBILITY STUDY
Cement Stabilization

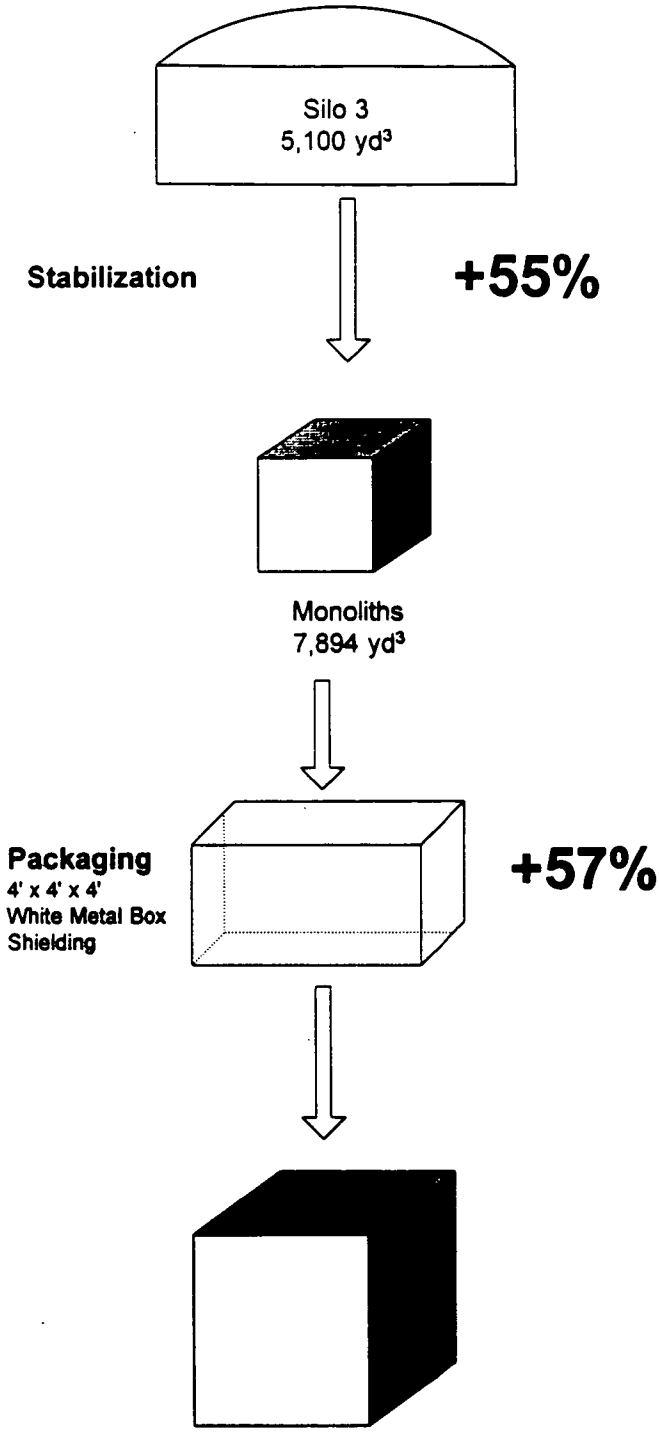


CEMENT STABILIZED SILOS 1 AND 2 DISPOSAL VOLUME BASED ON OU4 FS Cement Stabilization



VITRIFIED SILO 3 DISPOSAL VOLUME BASED ON OU4 FS Vitrification

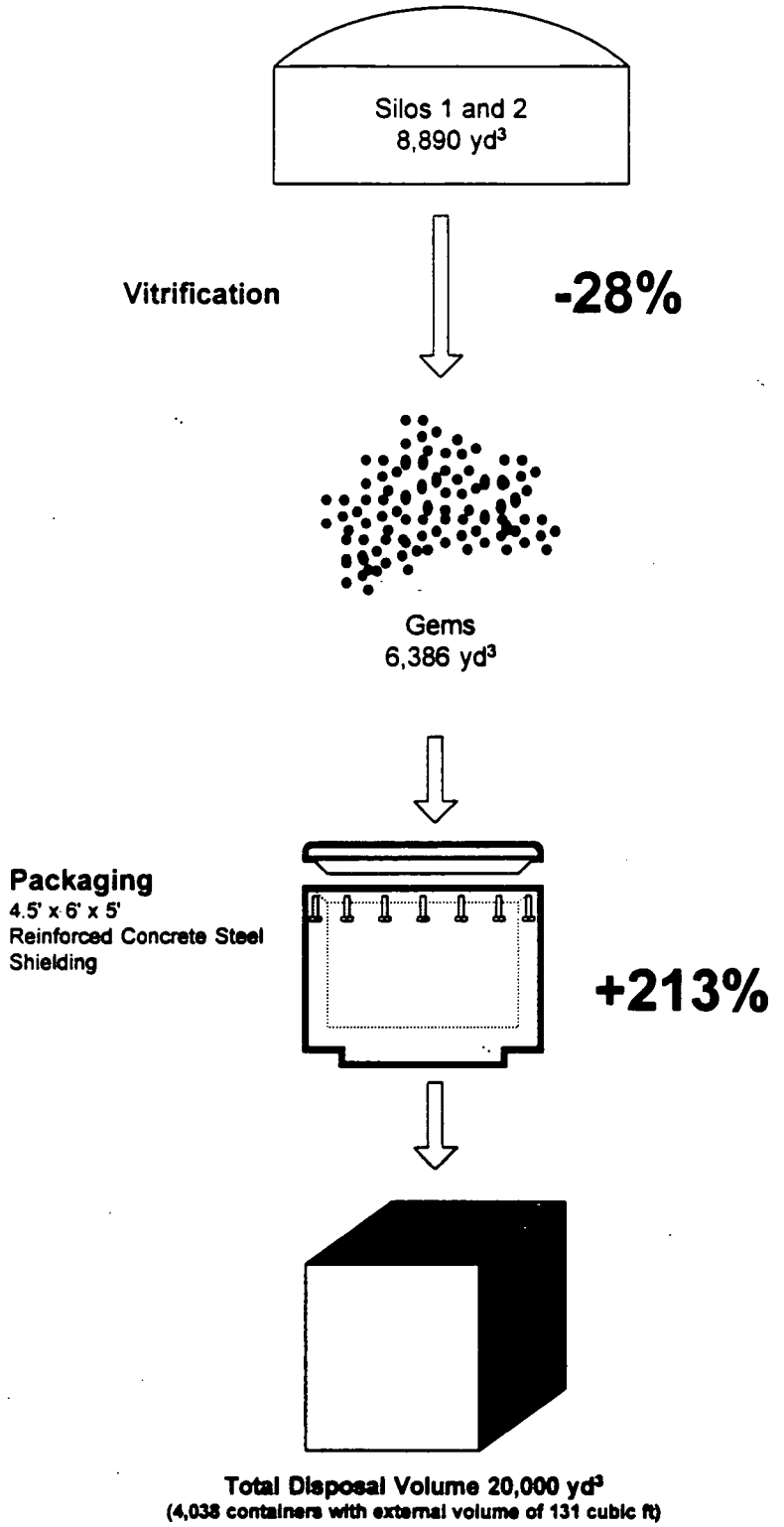
OU4 FEASIBILITY STUDY
Cement Stabilization



Total Disposal Volume 12,390 yd³
(4,957 containers with external volume of 64 cubic ft)

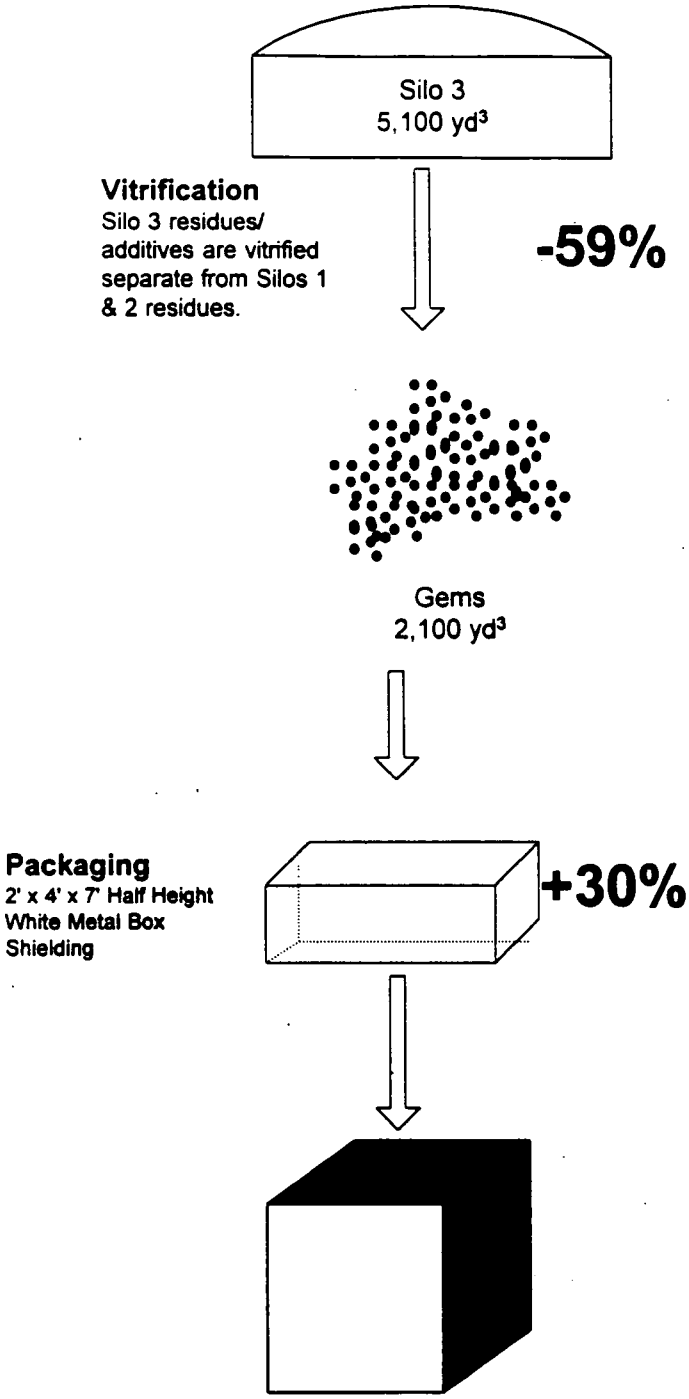
STABILIZIED SILO 3 DISPOSAL VOLUME BASED ON OU4 FS Stabilization

SILO 3 ALTERNATIVES REPORT
Vitrification



VITRIFIED SILOS 1 AND 2 DISPOSAL VOLUME BASED ON
Silo 3 Report Vitrification

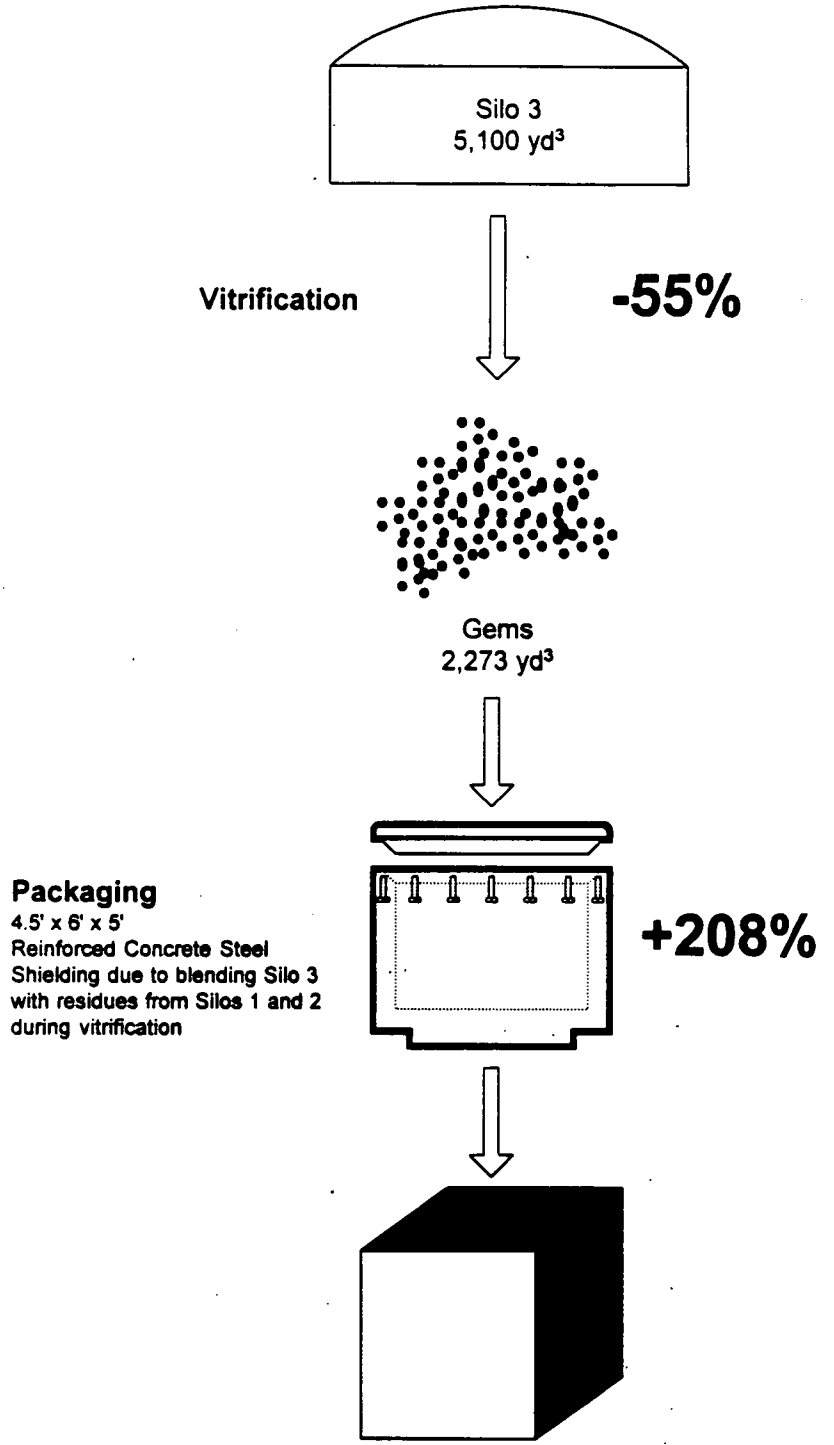
SILO 3 ALTERNATIVES REPORT
(Series C Glass Formulation)



Total Disposal Volume 2,737 yd³
(1,320 containers with external volume of 56 cubic ft)

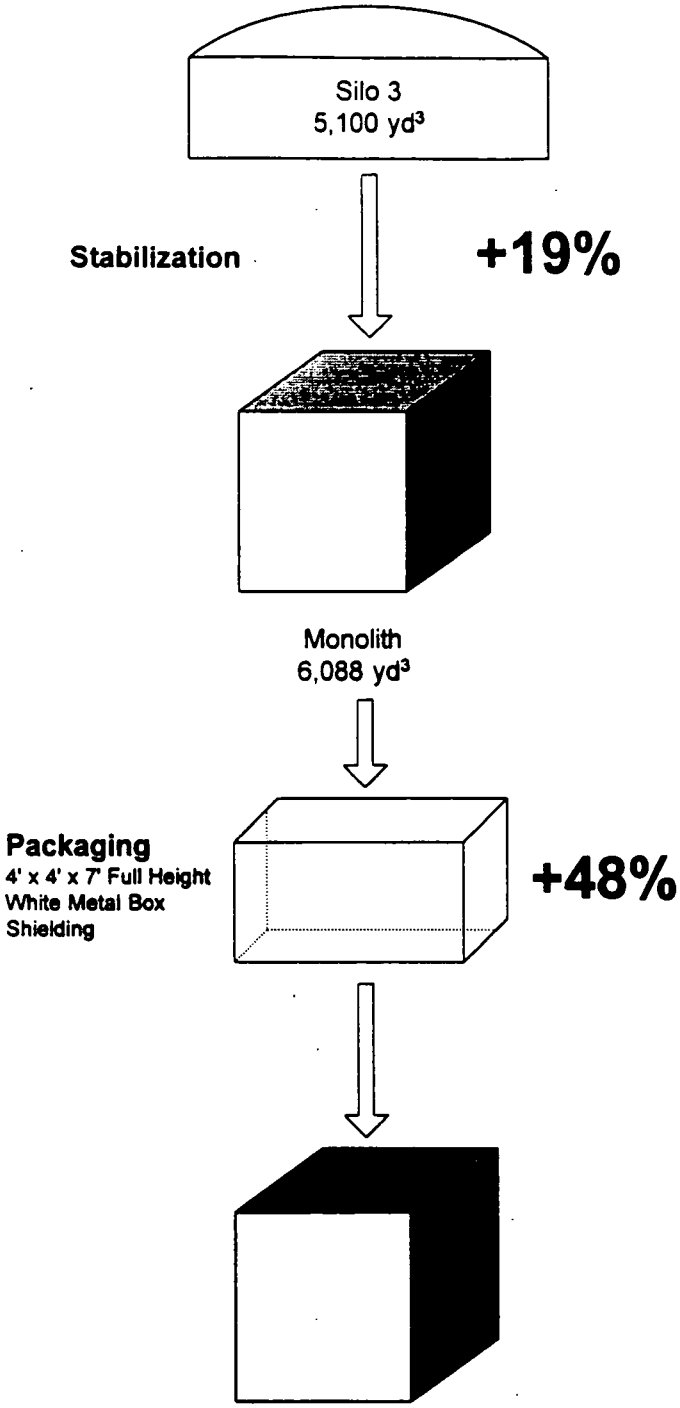
VITRIFIED SILO 3 DISPOSAL VOLUME BASED ON
Series C Glass Formulation in Silo 3 Report

SILO 3 ALTERNATIVES REPORT
(Series D Glass Formulation)



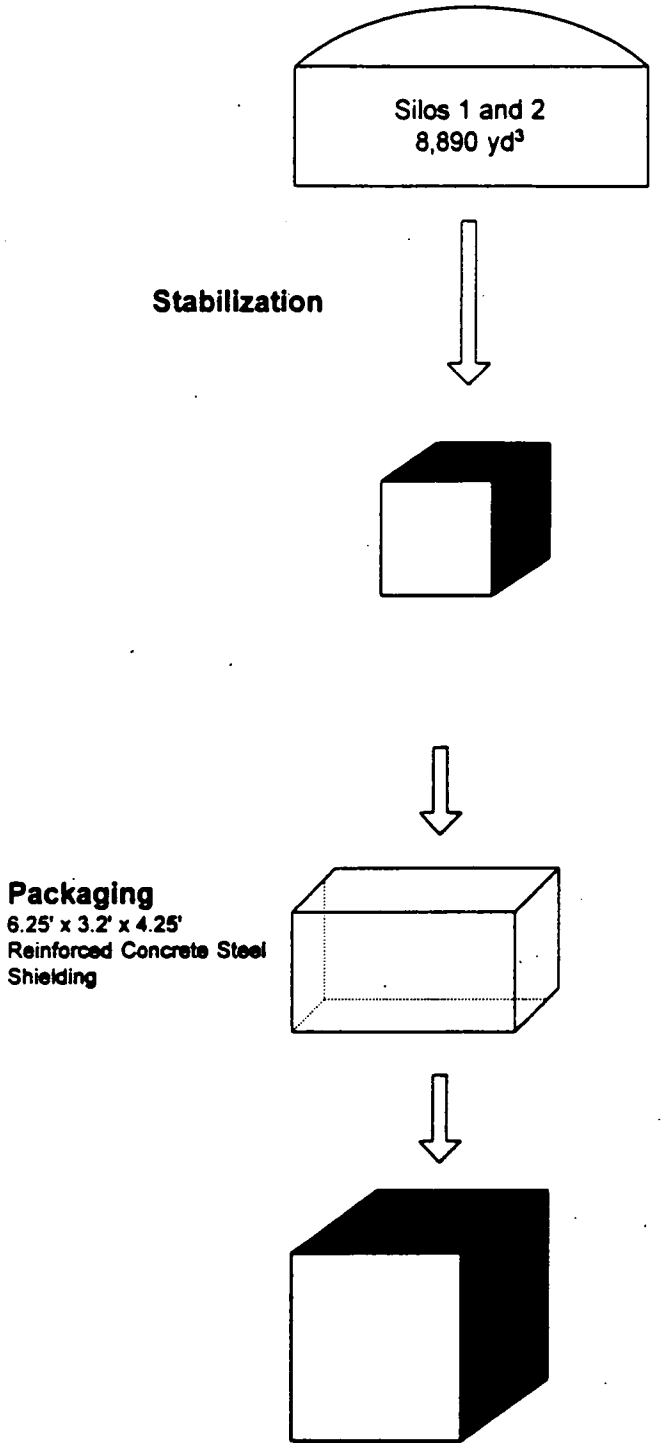
VITRIFIED SILO 3 DISPOSAL VOLUME BASED ON
Series D Glass Formulation in Silo 3 Report

SILO 3 ALTERNATIVES REPORT
Cement Stabilization



CEMENT STABILIZED SILO 3 DISPOSAL VOLUME BASED ON
Silo 3 Report Stabilization

INDEPENDENT EVALUATION TEAM STUDY
Cement Stabilization



CEMENT STABILIZED SILOS 1 AND 2 DISPOSAL VOLUME BASED ON
Independent Evaluation Team Cement Stabilization

RADON BALANCE FOR THE 1 MT/D VITRIFICATION PILOT PLANT

Fernald Environmental
FERMCO
Restoration Management Corporation

August 20, 1996

Fernald Environment Management Project
Fernald, OH

1.0 ABSTRACT

A radon balance has been developed for the Vitrification Pilot Plant Phase II operations at a production rate of 1 metric tonne per day. A BASIC computer program calculates the radon contribution from the silo material as it flows through the process to be $4.05 \cdot 10^{10}$ pCi/hr. The balance shows that $2.4 \cdot 10^{10}$ pCi/hr of radon is introduced to the carbon bed treatment system. Depending on the performance of the carbon beds, $1.91 \cdot 10^{10}$ pCi/hr - $7.33 \cdot 10^{8}$ pCi/hr of radon is predicted to flow out of the stack at concentrations of 1120 pCi/l - 43 pCi/l respectively. In addition, ~$2.0 \cdot 10^{10}$ pCi/hr of radon decays as it moves through the process and $1.5 \cdot 10^{9}$ pCi/hr is removed in the glass stream. The balance does not account for any diffusion of radon through the water and/or slurry in the tank vessels; therefore, the amount of radon going into the off-gas system is artificially high.

2.0 CALCULATIONAL FOUNDATIONS

2.1 Assumptions for the Radon Balance

- Henry's Law is used to distribute radon between air and water phases. This results in a radon air-water distribution coefficient with units of lb/lb (lb_{H20}/lb_{air}).
- Radium concentrations per November 1993 Remedial Investigation Report

2.2 Basis

- Pilot Plant Operating Conditions:
  - · Assume material balance flow rates necessary to produce 1 MT per day of glass
  - · Recycle Water Tank typically contains 2400-2700 gallons = 21,500 lbs H_2O
  - · Slurry feed tanks contain 529 gallons composed of 60wt% solids = 2880 lbs H_2O, 4320 lbs residue
  - · Thickener contains 15 MT (33,000 lbs) residue and 155,130 lbs H_2O for a total of 20,000 gallons of water and solids (~21 wt% solids composition)
  - · Furnace has 4050 lbs of residue
  - · Stack has a volumetric flow rate of 10,000 cfm and carbon beds have a volumetric flow rate of 340 cfm.
- The residues to be processed consist of Silo 2 and bentonite.

2.3 Methodology

The radon balance is one part of the overall material balance for Phase II of the Vitrification Pilot Plant operating at 1 MT per day. A series of programs written in BASIC language conduct the balance in the following order. A glass formulation program is run that determines the type of material that will be processed and its corresponding radon emanation rate, based on the radium concentration, as it flows through the Pilot Plant. A program to determine the radon source term in the specified silo is run next. The resulting information is then fed into the material balance program. The material balance program determines all solid, liquid and vapor flows except radon based on the overall processing rate desired, temperature and enthalpy data at certain points and composition data. Finally, the assumptions stated above and the information from the preceding programs are loaded into the radon balance program for analysis.

3.0 RADON BALANCE RESULTS

3.1 Radon Generation during the Vitrifcation Process

A summary of the radon generation in each vessel of the process is shown below.

Vessel	Generation Rate
Silo	1.435E+10 pCi/hr
Thickener	2.213E+10 pCi/hr
Slurry Feed Tank	2.075E+09 pCi/hr
Melter	1.945E+09 pCi/hr
Total	**4.05E+10 pCi/hr**

3.2 Decay of Radon during the Vitrification Process

A summary of the radon decay in each vessel of the process is shown below.

Vessel	Decay Rate
Silo	1.429E+10 pCi/hr
Thickener	1.741E+08 pCi/hr
Recycle Water Tank	4.538E+06 pCi/hr
Slurry Feed Tank	1.175E+06 pCi/hr
Melter	4.843E+08 pCi/hr
Sparge Tank	3.915E+05 pCi/hr
Quench Tower	1.221E+03 pCi/hr
Carbon Bed	5.01E+09 to 2.33E+10 pCi/hr
Total	**2.00E+10 to 3.83E+10 pCi/hr**

3.3 Radon Venting to Off-Gas System

A summary of the radon vented from vessels in the Vitrification Plant to the off-gas system is shown below.

Vessel	Vent Rate
Sparge Tank	6.113E+05 pCi/hr
Thickener	2.072E+10 pCi/hr
Recycle Water Tank	1.207E+09 pCi/hr
Melter	6.524E+05 pCi/hr
Slurry Feed Tank	2.078E+09 pCi/hr
Total	**2.401E+10 pCi/hr**

3.4 Carbon Bed Performance

The carbon bed radon treatment system depends on an absorption coefficient K_d expressed in m^3/kg or g/l. K_d is equal to the concentration of absorbed radon per gram of charcoal divided by the concentration of radon per liter of effluent carbon bed air. As more radon is absorbed on the carbon, there is less that will pass through the carbon bed to the stack. Higher values of K_d are observed as absorption by carbon increases. Studies conducted by Rust Geotech indicate that the value K_d can be increased by lowering the temperature of the air passing through the carbon beds. The table below illustrate the effect of the absorption process on the incoming air stream containing $2.4 \cdot 10^{10}$ pCi/hr of radon with a relative humidity of 15%.

Air Temperature (°C)	K_d (m^3/kg)	Effluent Radon Concentration (pCi/l)	Effluent Radon Flow (pCi/hr)	Stack Concentration (pCi/l)
34	1	3.29e+04	1.91e+10	1,118.6
31	2.56	2.29e+04	1.33e+10	778.6
27	4.11	1.60e+04	9.25e+09	544.0
23	5.67	1.11e+04	6.44e+09	377.4
20	7.22	7.74e+03	4.48e+09	263.2
16	8.78	5.39e+03	3.12e+09	183.3
13	10.33	3.75e+03	2.17e+09	127.5
9	11.89	2.61e+03	1.51e+09	88.7
6	13.44	1.82e+03	1.05e+09	61.9
2	15	1.27e+03	7.33e+08	43.2

4.0 ATTACHMENTS

4.1 Overall Radon Balance Diagram

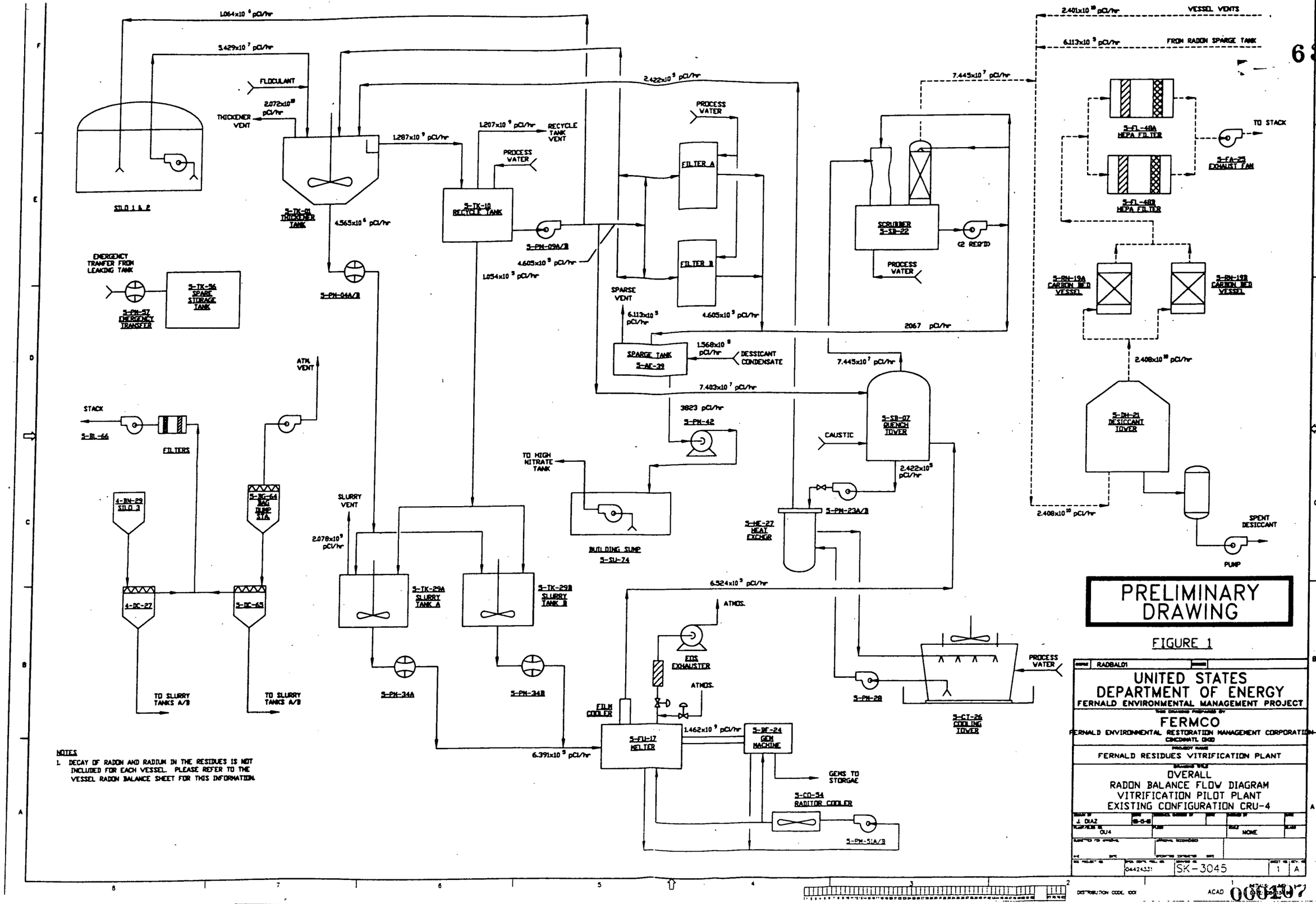
This diagram shows the progression of radon throughout the Vitrification Plant from silo to stack. The decay of radon in the Vitrification Plant as well as the generation of radon from radium-bearing residues flowing through the process are not shown.

4.2 Vessel Radon Balances

An attachment is included that shows the radon balance around each vessel in the Pilot Plant. This serves as a supplement to the overall radon balance diagram and verifies the functioning of the code. This attachment shows the radon decay and radon emanation from residues that are not shown on the overal diagram.

4.3 Radon Balance Program Output

The output file generated by the radon balance BASIC program displays all the results and inputs for the radon balance.



NOTES
1. DECAY OF RADON AND RADIUM IN THE RESIDUES IS NOT INCLUDED FOR EACH VESSEL. PLEASE REFER TO THE VESSEL RADON BALANCE SHEET FOR THIS INFORMATION.

PRELIMINARY DRAWING

FIGURE 1

RADBAL01

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

FERMCO
FERNALD ENVIRONMENTAL RESTORATION MANAGEMENT CORPORATION
CINCINNATI, OHIO

FERNALD RESIDUES VITRIFICATION PLANT

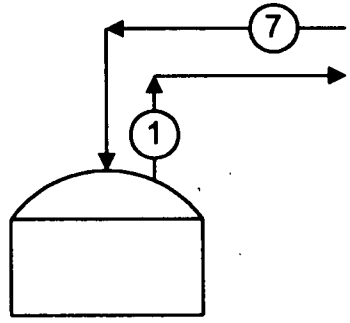
OVERALL
RADON BALANCE FLOW DIAGRAM
VITRIFICATION PILOT PLANT
EXISTING CONFIGURATION CRU-4

J. DIAZ
OU4
NONE
04424331
SK-3045
1
A

DISTRIBUTION CODE: 100
ACAD

000107

Silo



In

Stream 7 - From Recycle Water Tank (water)

$(269.7\ lb/hr)(3946\ pCi/lb) = 1.064 \cdot 10^{6}\ pCi/hr$

Radon in Silos

$(3.985 \cdot 10^{6}\ pCi/sec)(3600\ sec/hr) = 1.435 \cdot 10^{10}\ pCi/hr$

Out

Stream 1 - Slurry to Thickener

$(269.7\ lb/hr)(2.013 \cdot 10^{5}\ pCi/lb) = 5.429 \cdot 10^{7}\ pCi/hr$

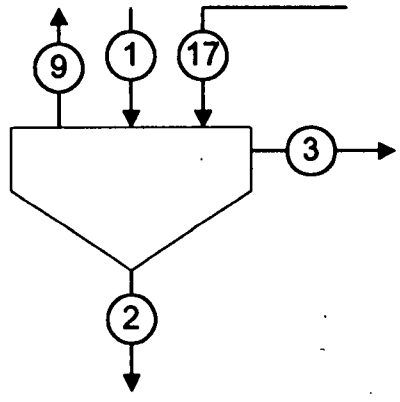
Decay in the Silos

$(7.10 \cdot 10^{4}\ lb/hr)(2.013 \cdot 10^{5}\ pCi/lb) = 1.429 \cdot 10^{10}\ pCi/hr$

IN = $1.435 \cdot 10^{10}$ pCi/hr

OUT = $1.435 \cdot 10^{10}$ pCi/hr

Thickener



In

Stream 1 - Slurry from Silos

$(269.7\ lb/hr)(2.013 \cdot 10^{5}\ pCi/lb) = 5.429 \cdot 10^{7}\ pCi/hr$

Stream 17 - Water Flow from Quench

$(18{,}807\ lb/hr)(12.88\ pCi/lb) = 2.422 \cdot 10^{5}\ pCi/hr$

Decay in Thickener Residues

$(33{,}000\ lb)(6.707 \cdot 10^{5}\ pCi/lb/hr) = 2.213 \cdot 10^{10}\ pCi/hr$

Out

Stream 2 - Thickener Underflow to Slurry Feed Tank

$(67.4\ lb/hr)(6.773 \cdot 10^{4}\ pCi/lb) = 4.565 \cdot 10^{6}\ pCi/hr$

Stream 3 - Thickener Overflow to Recycle Water Tank

$(19{,}009\ lb/hr)(6.773 \cdot 10^{4}\ pCi/lb) = 1.287 \cdot 10^{9}\ pCi/hr$

Stream 9 - Thickener Vent to Off-Gas System

$(68\ lb/hr)(4499\ lb/lb)(6.773 \cdot 10^{4}\ pCi/lb) = 2.072 \cdot 10^{10}\ pCi/hr$

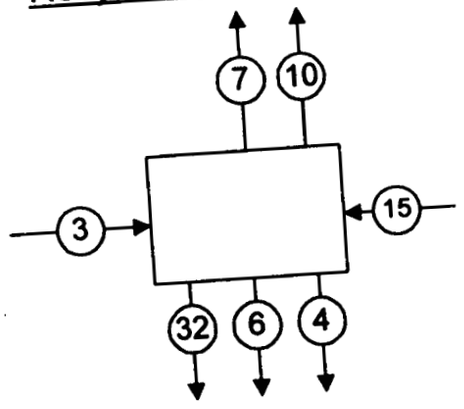
Decay in Thickener Tank

$(2.57 \cdot 10^{3}\ lb/hr)(6.773 \cdot 10^{4}\ pCi/lb) = 1.741 \cdot 10^{8}\ pCi/hr$

IN = $2.219 \cdot 10^{10}$ pCi/hr

OUT= $2.219 \cdot 10^{10}$ pCi/hr

Recycle Water Tank



In

Stream 3 - Thickener Overflow to Recycle Water Tank
(19,009 lb/hr)(6. 773 10^4 pCi/lb) = 1.287 10^9 pCi/hr

Stream 15 - Filter Backwash
= 0

Out

Stream 4 - Recycle Tank Purge
(116.7 lb/hr)(3946 pCi/lb) = 4.605 10^5 pCi/hr

Stream 6 - Recycle Water to Quench
(18,760 lb/hr)(3946 pCi/lb) = 7.403 10^7 pCi/hr

Stream 7 - Water Flow to Silos
(269.7 lb/hr)(3946 pCi/lb) = 1.064 10^6 pCi/hr

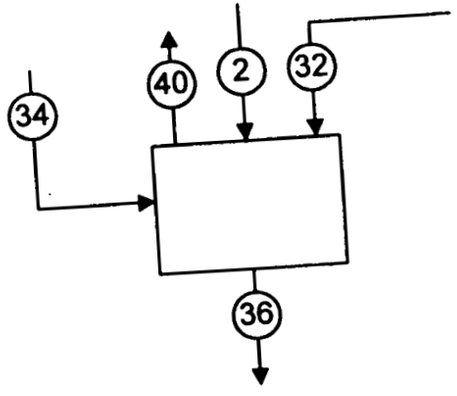
Stream 10 - Recycle Tank Vent to Off-Gas System
(68 lb/hr)(4499 pCi/lb)(3946 pCi/lb) = 1.207 10^9 pCi/hr

Stream 32 - Water Flow to Slurry Feed Tanks
(26.7 lb/hr)(3946 pCi/lb) = 1.054 10^5 pCi/hr

Radon Decay in Recycle Water Tank
(1150 lb/hr)(3946 pCi/lb) = 4.538 10^6 pCi/hr

IN = 1.288 10^9 pCi/hr
OUT= 1.288 10^9 pCi/hr

Slurry Feed Tank



In

Stream 2 - Thickener Underflow
(67.4 lb/hr)(6.773 10^4 pCi/hr) = 4.565 10^6 pCi/hr

Stream 32 - Water Flow from Recycle Water Tank
(26.7 lb/hr)(3946 pCi/lb) = 1.054 10^5 pCi/hr

Stream 34 - Additive Feed (no radon)
0

Decay in Slurry Feed Tank Residues
(4320 lb)(4.803 10^5 pCi/lb/hr) = 2.075 10^9 pCi/hr

Out

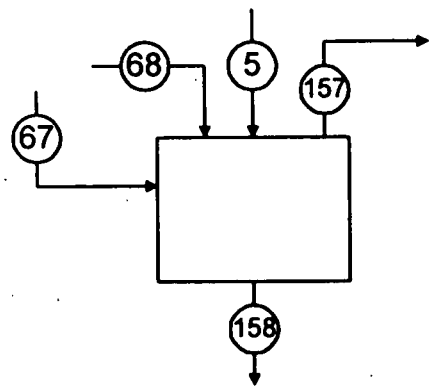
Stream 36 - Feed to Melter
(94.1 lb/hr)(6792 pCi/lb) = 6.391 10^5 pCi/hr

Stream 40 - Slurry Tank Vent to Off-Gas System
(68 lb/hr)(4499 lb/lb)(6792 pCi/lb)= 2.078 10^9 pCi/hr

Radon Decay in the Slurry Feed Tank
(173 lb/hr)(6792 pCi/lb) = 1.175 10^6 pCi/hr

IN = 2.080 10^9 pCi/hr
OUT = 2.080 10^9 pCi/hr

Sparge Tank



In

Stream 5 - Recycle Tank Water Purge

(116.7 lb/hr)(3946 pCi/lb) = $4.605 \cdot 10^5$ pCi/hr

Stream 67 - Scrubber Purge

(160.5 lb/hr)(12.88 pCi/lb) = 2067 pCi/hr

Stream 68 - Water Flow from Dessicant

(47.2 lb/hr)(3323 pCi/lb) = $1.568 \cdot 10^5$ pCi/hr

Out

Stream 157 - Sparge Air to Off-Gas System

(6.94 lb/hr)(7452 lb/lb)(11.82 pCi/lb) = $6.113 \cdot 10^5$ pCi/hr

Stream 158 - Water Flow to AWWT

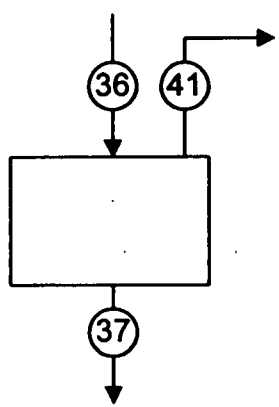
(323.4 lb/hr)(11.82 pCi/lb) = 3823 pCi/hr

Radon Decay in the Sparge Tank

$3.915 \cdot 10^5$ pCi/hr

IN = $6.193 \cdot 10^5$ pCi/hr
OUT = $6.193 \cdot 10^5$ pCi/hr

Melter



In

Stream 36 - Feed from Slurry Tank to Melter

(94.1 lb/hr)(6792 pCi/lb) = $6.391 \cdot 10^5$ pCi/hr

Decay in Melter Residues

(4050 lb)($4.803 \cdot 10^5$ pCi/lb/hr) = $1.945 \cdot 10^9$ pCi/hr

Out

Stream 37 - Glass Flow

(91.77 lb/hr)($1.593 \cdot 10^7$ pCi/lb) = $1.462 \cdot 10^9$ pCi/hr

Stream 41 - Furnace Off-Gas

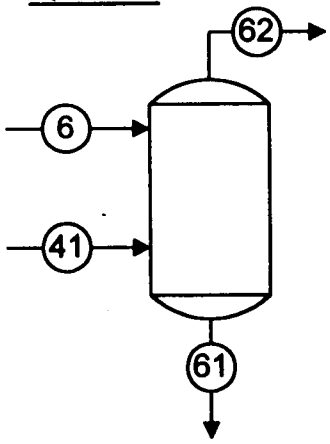
(1331.4 lb/hr)(490 pCi/lb) = $6.524 \cdot 10^5$ pCi/hr

Radon Decay in the Melter

(0.027 lb/hr)(490 pCi/lb) + (30.4 lb/hr)($1.593 \cdot 10^7$ pCi/lb) = $4.843 \cdot 10^8$ pCi/hr

IN = $1.288 \cdot 10^9$ pCi/hr
OUT = $1.288 \cdot 10^9$ pCi/hr

Quench



In

Stream 6 - From Recycle Water Tank (water)

(18,760 lb/hr)(3,946 pCi/lb) = $7.403 \cdot 10^{7}$ pCi/hr

Stream 41 - From Furnace Off-Gas (vapor & air)

(1331.4 lb/hr)(490 pCi/lb) = $6.524 \cdot 10^{5}$ pCi/hr

Out

Stream 61 - Quench Bottom Water (water)

(18,807 lb/hr)(12.88 pCi/lb) = $2.422 \cdot 10^{5}$ pCi/hr

Stream 62 - Quench Off-Gas (vapor & air)

(1284.8 lb/hr)(4499 lb/lb)(12.88 pCi/lb) = $7.445 \cdot 10^{7}$ pCi/hr

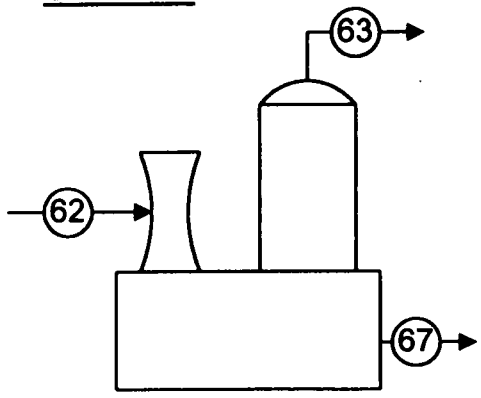
Radon Decay in the Quench

$1.221 \cdot 10^{3}$ pCi/hr

IN = $7.467 \cdot 10^{7}$ pCi/hr

OUT = $7.467 \cdot 10^{7}$ pCi/hr

Scrubber



In

Stream 62 - Quench Off-Gas (vapor & air)

(1284.8 lb/hr)(4499 lb/lb)(12.88 pCi/lb) = $7.445 \cdot 10^{7}$ pCi/hr

Out

Stream 63 - Scrubber Off-Gas (vapor & air)

(1284.8 lb/hr)(4499 lb/lb)(12.88 pCi/lb) = $7.445 \cdot 10^{7}$ pCi/hr

Stream 67 - Scrubber Purge (water)

(160.5 lb/hr)(12.88 pCi/lb) = $2.067 \cdot 10^{3}$ pCi/lb

IN = $7.445 \cdot 10^{7}$ pCi/hr

OUT = $7.445 \cdot 10^{7}$ pCi/hr

Radon Material Balance for the VITPP Process. page 1
Code name is RADONMB.BAS, and version of 7-26-96 @ 1044
Run time is 15:42:48 and the run date is 08-13-1996

Input variables (and identification) from previous calculations.

Radon-residue flux in the silo (SRN), pCi/hr = 1.435E+10
Radon sorption coefficient (KD), ml/gm = 0.000E+00
*** From code RADONS1.BAS, version of 2-8-96 @ 1629
*** Calculated on 15:23:21 at 08-13-1996

Water flow from quench (LW), lb/hr = 18807
Water vapor flow in quench off-gas (QW), lb/hr = 47.5
Water purge from quench bottoms (RF), lb/hr = 0.0
Water purge from recycle water tank (RB), lb/hr = 116.7
Water flow to the quench (RW), lb/hr = 18760
Residue flow from the silo (SR), lb/hr = 67.4
Water flow from the silo (SW), lb/hr = 269.7
Residue and bento from silos 1 & 2 (S12B), lb/hr = 67.4
Residue from silo 3 (S3FEED), lb/hr = 0.0
Additive flow (ADFEED), lb/hr = 26.7
Water flow from recycle to slurry tank (RS), lb/hr = 26.7
Thickener water overflow (TOW), lb/hr = 19009
Thickener water underflow (TSW), lb/hr = 67.4
Water flow to furnace from slurry tank (FW), lb/hr = 94.1
Furnace air flow (VOGA), lb/hr = 1237.3
Glass production rate (GR), lb/hr = 91.77
Vent temperatures (TFHENRY), F = 90.0
Quench overhead temperature (TFQVHD), F = 97.0
*** From code VITPPMB.BAS, version of 7-23-96 @ 0818
*** Calculated at 15:29:53 on 08-13-1996

Radon-from-residue in thickener, pCi/lb/hr = 6.707E+05
Radon-from-slurry in slurry & furnace, pCi/lb/hr = 4.803E+05
For glass formulation: Silo #2 C4C-03 w/ bentonite
*** From code GLASS.BAS, version of 7-17-96 @ 0617
*** Calculated at 15:11:29 on 08-13-1996

Radon Material Balance for the VITPP Process. page 2
Code name is RADONMB.BAS, and version of 7-26-96 @ 1044
Run time is 15:42:48 and the run date is 08-13-1996

Input variable (and identification) list:

1. Slurry tank air vent rate (AF), lb/hr = 68.0 (with h2o vapor)
2. Silo air vent rate (AS), lb/hr 0.0
3. Thickener air vent rate (AT), lb/hr = 68.0
4. Recycle h2o tank vent rate (AR), lb/hr = 68.0
5. Radon air-h2o dist. coeff. (HR), lb/lb = 4499 (vents at 90.0 F)
6. Radon air-h2o dist. coeff. (HRQ), lb/lb = 4499 (quench at 90.0 F)
7. Radon-on-solid sorption constant (KD), lb/lb = 0.0
8. Air mass in quench (QV), lb = 2.8
9. Water mass in quench (QL), lb = 50.0
10. Air mass in the recycle tank (RR), lb = 29.4
11. Water mass in the recycle tank (RL), lb = 21500
12. Air mass in the slurry feed tank (VF), lb = 4.5
13. Water mass in the slurry feed tank (WF), lb = 2880
14. Residue in slurry feed tank (FR), lb = 4320
15. Air mass in the thickener (VT), lb = 41.6
16. Water mass in the thickener (WT), lb = 155130
17. Residue mass in the thickener (TR), lb = 33000
18. Air mass in the furnace (VHS), lb = 3.6
19. Residue mass in the furnace (RV), lb = 4050
20. Air mass in the silo (VS), lb = 2100.0
21. Water mass in the silo (WS), lb = 20000
22. Fraction of solids Rn released in furnace (FRG) = 0.90
23. Radon decay constant (ALAMBDA), 1/hr = 7.500E-03

Radon Material Balance for the VITPP Process. page 3
Code name is RADONMB.BAS, and version of 7-26-96 @ 1044
Run time is 15:42:48 and the run date is 08-13-1996

The 7x7 matrix is:

2.70E+02	1.88E+04	-3.28E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
-7.13E+04	0.00E+00	0.00E+00	2.70E+02	0.00E+00	0.00E+00	0.00E+00
0.00E+00	0.00E+00	6.74E+01	2.67E+01	-3.06E+05	0.00E+00	0.00E+00
0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.41E+01	-1.30E+03	0.00E+00
0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.22E+02
0.00E+00	-5.80E+06	0.00E+00	1.88E+04	0.00E+00	1.30E+03	0.00E+00
0.00E+00	0.00E+00	1.90E+04	-3.26E+05	0.00E+00	0.00E+00	0.00E+00

B-vector	Decay-vector
-2.21E+10	2.57E+03
-1.43E+10	7.10E+04
-2.08E+09	1.73E+02
0.00E+00	2.70E-02
-1.95E+09	3.04E+01
0.00E+00	9.49E+01
0.00E+00	1.15E+03

Radon Material Balance for the VITPP Process. page 4
Code name is RADONMB.BAS, and version of 7-26-96 @ 1044
Run time is 15:42:48 and the run date is 08-13-1996

The calculated radon concentrations are as follows:

X(1) = 2.013E+05 pCi/lb in the silo water exit, stream #1.
X(2) = 1.288E+01 pCi/lb in the quench water exit, stream #61.
X(3) = 6.773E+04 pCi/lb in the thickener water exit, stream #2.
X(4) = 3.946E+03 pCi/lb in the recycle water tank exit, stream #6 & #7.
X(5) = 6.792E+03 pCi/lb in the slurry feed tank exit, stream #35.
X(6) = 4.900E+02 pCi/lb in the furnace off gas exit, stream #4.
X(7) = 1.593E+07 pCi/lb in the glass product exit, stream #37.

Radon balances around the vessels:

Thickener radon input, pCi/hr = 2.218694E+10
Thickener radon output, pCi/hr = 2.218694E+10
Radon decay in the thickener, pCi/hr = 1.738751E+08

Silo radon input, pCi/hr = 1.434677E+10
Silo radon output, pCi/hr = 1.434677E+10
Radon decay in the silo, pCi/hr = 1.429249E+10

Slurry feed tank input, pCi/hr = 2.079672E+09
Slurry feed tank output, pCi/hr = 2.079672E+09
Radon decay in the feed tank, pCi/hr = 1.177991E+06

Vitrification furnace input, pCi/hr = 1.945952E+09
Vitrification furnace output, pCi/hr = 1.945952E+09
Radon decay in the furnace, pCi/hr = 4.837710E+08

Quench input, pCi/hr = 7.467186E+07
Quench output, pCi/hr = 7.467186E+07
Radon decay in the quench, pCi/hr = 1.221381E+03
Purge at the quench, pCi/hr = 0.000000E+00

Recycle water tank input, pCi/hr = 1.287500E+09
Recycle water tank output, pCi/hr = 1.287500E+09
Radon decay in the H2O tank, pCi/hr = 4.551131E+06
Purge at the recycle tank, pCi/hr = 4.605207E+05

Radon Material Balance for the VITPP Process. page 5
Code name is RADONMB.BAS, and version of 7-26-96 @ 1044
Run time is 15:42:48 and the run date is 08-13-1996

Radon air-vent flows to off-gas treatment.

Radon-silo vent flow, pCi/hr = 0.000E+00
Air-phase Rn concentration, pCi/lb = 9.055E+08 (2.308E+06 pCi/L)

Radon-thickener vent flow, pCi/hr = 2.072E+10

Radon-slurry-feed-tank vent flow, pCi/hr = 2.078E+09

Radon-recycle-h2o-tank vent flow, pCi/hr = 1.207E+09 (air)

Total radon in the vents, pCi/hr = 2.401E+10
Total air-vent flow rate, lb/hr = 204 (47 ft^3/min @ 90 F)
Radon concentration in total vent, pCi/L = 2.995E+05

Radon exiting in quench gas flow, pCi/hr = 7.443E+07 (overhead)
Radon exiting in product glass, pCi/hr = 1.462E+09
Radon in the quench water purge, pCi/hr = 0.000E+00
Radon in the recycle water purge, pCi/hr = 4.605E+05

Calculate a TOTAL radon balance around the process.

Total radon decay, pCi/hr = 1.495587E+10
Total radon flow out, pCi/hr = 2.554257E+10
Total radon out, pCi/hr = 4.049844E+10 (must balance)

Total solids in system, lbs = 41370 (no silo mass)
Radon from solids, pCi/hr = 2.615273E+10
Radon from the silo, pCi/hr = 1.434571E+10
Total radon source, pCi/hr = 4.049844E+10 (must balance)

Intermediate Radon/Off-Gas Treatment System Information:

Radon exiting in the quench gas flow, pCi/hr = 7.443E+07 (to scrub)
Radon exiting in the loop purge flow, pCi/hr = 4.605E+05 (aqueous)
Radon exiting in scrub purge flow, pCi/hr = 2.067E+03
Scrubber water purge flow, lb/hr = 1.605E+02
Radon exiting scrubber overhead, pCi/hr = 7.443E+07
Radon conc. in scrubber overhead, pCi/lb = 5.793E+04
Loop water purge flow, lb/hr = 1.167E+02
Combined purge flows, lb/hr = 2.772E+02
Radon conc. in the combined purges, pCi/lb = 1.669E+03
Minimum strip air for combined purges, lb/hr = 6.161E-02
Radon conc. in the minimum strip air, pCi/lb = 7.508E+06
Radon flow in minimum strip air, pCi/hr = 4.626E+05 (small!)

Total Radon to off gas = 2.408E+10 pCi/hr at 1.617E+07 pCi/lb
in a gas flow of 1.489E+03 lb/hr, pending a scrubber design.

Radon Material Balance for the VITPP Process. page 6
Code name is RADONMB.BAS, and version of 7-26-96 @ 1044
Run time is 15:42:48 and the run date is 08-13-1996

Input list for the radon-strip balance.

1. Radon strip tank temperature, degrees F = 140.0
2. Dryer tank temperature, degrees F = 98.0
3. Dryer tank exit relative humidity, % = 15.0
4. Dryer tank gas volume, ft^3 60.0
5. Dryer tank liquid volume, ft^3 10.0
6. Radon strip tank gas volume, ft^3 = 85.0
7. Radon strip tank liquid volume, ft^3 = 85.0
8. Radon strip tank clean air feed, acfm = 0.70
9. Clean air pressure, psig = 15.0
10. Clean air temperature, degrees F = 100.0
11. Clean air humidity, lb h2o/lb air = 0.0010

Input summary from previous calculations.

Loop aqueous purge flow, lb/hr = 116.7 @ 3.95E+03 pCi radon/lb.
Scrubber aqueous purge flow, lb/hr = 160.5 @ 1.29E+01 pCi radon/lb.
Scrubber gas flow, lb/hr = 1284.8 @ 5.79E+04 pCi radon/lb.
Total radon flow in aqueous, pCi/hr = 4.63E+05 (in aqueous purges)
Vent gas flows, lb/hr = 204.0 @ 1.18E+08 pCi radon/lb.
Total gas flow to dryer, lb/hr = 1488.8 @ 1.62E+07 pCi radon/lb.
Total radon flow (in gases), pCi/hr = 2.41E+10 (in vents & off gas)
Fraction of total radon in aqueous flow = 1.92E-05

Calculated parameters and results.

Total vent air (dry) flow to dryer, lb/hr = 197.9
Water vapor in vent flow, lb/hr = 6.1
Dryer exit abs. humidity, lb/lb = 0.0059 (15% at 98 F)
Strip tank exit abs. humidity, lb/lb = 0.1521 (at 140 F, mw = 26.8)
Strip air flow rate, lb/hr = 6.02
Water flow in strip air, lb/hr = 0.92
Water exiting to the AWWT, lb/hr = 323.4
Water exiting the dessicant bottom, lb/hr = 47.2
TOTAL water entering the strip tank, lb/hr = 3.2436E+02
TOTAL water exiting the strip tank, lb/hr = 3.2436E+02
TOTAL water entering the dryer, lb/hr = 5.4499E+01
TOTAL water exiting the dryer, lb/hr = 5.4499E+01
Radon Henrys Law at the strip tank, lb/lb = 7452 (at 140 F)
Radon Henrys Law at the dryer, lb/lb = 4999 (at 98 F)

The 3x3 matrix equation is:

1.4957E+03	-5.1724E+04	0.0000E+00	2.4081E+10 (mix point)
1.4957E+03	0.0000E+00	-7.2476E+06	0.0000E+00 (dryer)
0.0000E+00	-5.2378E+04	4.7162E+01	-4.6259E+05 (stripper)

Radon Material Balance for the VITPP Process. page 7
Code name is RADONMB.BAS, and version of 7-26-96 @ 1044
Run time is 15:42:48 and the run date is 08-13-1996

Calculated radon concentrations follow:

Radon conc. in the off-gas to the dryer, pCi/lb = 1.610E+07
Radon conc. in the strip-tank h2o exit, pCi/lb = 1.182E+01
Radon conc. in the dryer bottom water, pCi/lb = 3.323E+03

Radon balance information follows:

Radon entering the strip tank, pCi/hr = 6.1929E+05
Radon exiting the strip tank, pCi/hr = 6.1929E+05 (w/ decay)
Radon decayed in the strip tank, pCi/hr = 3.9149E+03

Radon entering the dryer, pCi/hr = 2.4081E+10
Radon exiting the dryer, pCi/hr = 2.4081E+10 (w/ decay)
Radon decayed in the dryer tank, pCi/hr = 5.4811E+05

Radon Material Balance for the VITPP Process. page 8
Code name is RADONMB.BAS, and version of 7-26-96 @ 1044
Run time is 15:42:48 and the run date is 08-13-1996

Radon adsorption on carbon - parametric analysis.

Input list for radon adsorption on carbon analysis:

1. Carbon bed volume, ft^3 = 1350.0
2. Carbon bulk density, lb/ft^3 = 29.3
3. Carbon bed void fraction = 0.40
4. Lowest radon-carbon Kd to investigate, m^3/kg = 1.0
5. Highest radon-carbon Kd to investigate, m^3/kg = 15.0
6. Number of Kd's to investigate = 10

Input summary from previous calculations:

Off-gas volumetric flow rate, ft^3/hr = 20421 (w/ h2o vapor)
Radon concentration from the dryer, pCi/lb = 1.661E+07 (in the gas)
Radon concentration from the dryer, pCi/ft^3 = 1.179E+06
Radon concentration from the dryer, pCi/liter = 4.158E+04
Residence time (empty bed), hour = 0.066
TOTAL radon flow into the carbon bed, pCi/hr = 2.4080E+10 (must = out)

Radon-adsorption as a function of the adsorption coefficient, Kd:

Kd m^3/kg	C/Cz out/in	Q Sorbed pCi	Exit Radon pCi/liter	Flow Out pCi/hr	Decayed pCi/hr	TOTAL Out pCi/hr
1.00	7.92E-01	6.67E+11	3.29E+04	1.91E+10	5.01E+09	2.4080E+10
2.56	5.51E-01	1.44E+12	2.29E+04	1.33E+10	1.08E+10	2.4080E+10
4.11	3.84E-01	1.98E+12	1.60E+04	9.25E+09	1.48E+10	2.4080E+10
5.67	2.67E-01	2.35E+12	1.11E+04	6.44E+09	1.76E+10	2.4080E+10
7.22	1.86E-01	2.61E+12	7.74E+03	4.48E+09	1.96E+10	2.4080E+10
8.78	1.30E-01	2.79E+12	5.39E+03	3.12E+09	2.10E+10	2.4080E+10
10.33	9.02E-02	2.92E+12	3.75E+03	2.17E+09	2.19E+10	2.4080E+10
11.89	6.28E-02	3.01E+12	2.61E+03	1.51E+09	2.26E+10	2.4080E+10
13.44	4.37E-02	3.07E+12	1.82E+03	1.05E+09	2.30E+10	2.4080E+10
15.00	3.04E-02	3.11E+12	1.27E+03	7.33E+08	2.33E+10	2.4080E+10

C/Cz is the ratio of the exit radon concentration to the inlet.
Q Sorbed is the quantity of radon ON the carbon.
Exit Radon is the exit-radon concentration in the off gas.
Kd units of m^3/kg are equal to liter/gram.
TOTAL Out includes decay.

IRT Action Statements

1. The current baseline does not support enough design activity to assure the continuity of talent necessary to capture the lessons learned from the vitrification pilot plant. More resources must be devoted, including specialized outside consultation and design peer review, taking advantage of active vitrification projects within the DOE complex.

2. It will be necessary to re-baseline the OU4 project to move retrieval design and process testing up to a higher priority. There is a great deal of uncertainty in this area and confidence in the retrieval system is vital to the success of any remediation alternative.

3. The scheduling basis for OU4 activities relies on unrealistically optimistic assumptions. Realistic scheduling in all activities including design, regulatory processes, and construction is critical to project success.

Other issues discussed:

- how IRT can provide cogent (team) input
- what is desired form the IRT?
- importance of capturing technological risk
- team only meetings/discussions
- "time-outs" to allow IRT to produce action statements
- IRT direction for information flow
- need to transfer collective IRT wisdom
- obtain lessons learned from projects at other sites
- importance of how you organize base outcome
- possible points for early agreement
    - proceed with vit. of silos 1 and 2?
    - proceed with cementation of silo 3?
- importance of programmatic considerations
- desire for IRT comments in cost and schedule estimates for Alt. II
- priority of wrt (waste retrieval)
- desire by stakeholders to know how and why
- is cementation a less safe waste form?

Silos Project Path Forward Evaluation
Technical Committees

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FACSIMILE LEAD SHEET

No. of Pages: 2
Including Lead Sheet

DATE: November 6, 1996

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PROJECT NAME: Fernald Environmental Mgt **CONTRACT NO.:** DE-AC24-92OR21972

MESSAGE

SUBJECT: SILO 3 CONSENSUS STATEMENT

Attached is the revised Silo 3 Consensus Statement with both U.S. EPA and Ohio EPA comments incorporated. Please call with questions.

Thanks.

WEW:mhv
Attachment

c: Terry Hagen, FDF
Johnny Reising, DOE-FEMP
File Record Storage Copy 108.13 & 108.14

SILO 3 CONSENSUS STATEMENT

DOE has continued to work actively with U.S. and Ohio EPA concerning the path forward on the Silo 3 alternative treatment and for OU4 as a whole. DOE recognizes the regulator's position that a final decision on the Silo 3 alternative treatment will not be made until the Phase 1 Pilot Plant operations are concluded and a subsequent decision is made pertaining to the Silos 1 and 2 path forward.

DOE has reached preliminary agreement with U.S. and Ohio EPA on the basis of the alternative treatment (i.e. stabilization) of Silo 3. That basis is twofold: a) removing Silo 3 from Silo 1 and 2 vitrification operations significantly reduces uncertainties concerning the technical implementation of vitrification for 1 and 2; and b) stabilization of Silo 3 fully meets the remedial action objectives and presents the opportunity for schedule acceleration of Silo 3 remediation when compared to the alternative of vitrifying Silo 3 material only (plus any additives required to address the sulfate issue). The Silo 3 Alternative Evaluation Report will be revised to reflect this understanding and address other stakeholder comments. The revised Silo 3 Alternative Evaluation Report will be a "stream-lined" document to support the treatment of the Silo 3 material.

DOE and the regulators are still actively discussing the regulatory mechanism that would be used to implement the Silo 3 alternative treatment. A final decision on this question will not be made until the path forward for Silos 1 and 2 is reached. DOE and the regulators will continue to work closely with our stakeholders on this issue.

Finally, DOE and the regulators have agreed that it is appropriate to issue a draft Request for Proposal (RFP) for Silo 3 alternative treatment in the near future. Such an action will provide valuable information concerning interested vendors and proposed treatment implementation strategies. This information is directly relevant for the final Silo 3 decision. All of our stakeholders would have an opportunity to review and comment on the draft RFP.