Project File 40430

**Fluor Fernald, Inc.**

3721

# Silo 3 Project

## Rescoping Evaluation and Recommendation

40400-RP-0007, Rev. 1

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## Tables



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# Acronyms

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| | |
|---|---|
| AEA | Atomic Energy Act |
| ALARA | As Low As Reasonably Achievable |
| ASR | Auditable Safety Record |
| AWWT | Advance Wastewater Treatment |
| CEDE | Committed Effective Dose Equivalent |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| D&D | Decontamination and Dismantlement |
| DCF | Dose Conversion Factor |
| DOE | Department of Energy |
| DOE-OFO | Department of Energy – Ohio Field Office |
| DOT | Department of Transportation |
| EP | Extraction Procedure |
| EPA | Environmental Protection Agency |
| ESD | Explanation of Significant Differences |
| FEMP | Fernald Environmental Management Project |
| FTI | Framatome Technologies, Inc. |
| G&A | General and Administrative |
| GCBCTC | Greater Cincinnati Building and Construction Trades Council |
| HAR | Hazard Analysis Report |
| HC | Hazard Category |
| HCC | Hazard Category Calculations |
| HEPA | High Efficiency Particulate Air |
| INEEL | Idaho National Engineering and Environmental Laboratory |
| IP-2 | Industrial Package Type 2 |
| IRT | Independent Review Team |
| ISA | Interim Storage Area |
| LLW | Low-Level Waste |
| LSA | Low Specific Activity |
| NPDES | National Pollutant Discharge Elimination System |
| NTS | Nevada Test Site |
| ORR | Operational Readiness Review |
| OU4 | Operable Unit 4 |
| pCi/g | Pico Curies Per Gram |
| PHAR | Preliminary Hazard Analysis Report |
| PPE | Personal Protective Equipment |
| RCRA | Resource Conservation and Recovery Act |
| RD | Remedial Design |
| RFP | Request for Proposal |
| RI/FS | Remedial Investigation/Feasibility Study |
| RMRS | Rocky Mountain Remediation Services |
| ROD | Record of Decision |

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| | |
|---|---|
| TCLP | Toxicity Characteristic Leaching Procedure |
| TSR | Technical Safety Requirement |
| TRB | Technical Review Board |
| WAC | Waste Acceptance Criteria |
| WPRAP | Waste Pits Remediation Action Project |

# Executive Summary

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The objective of the Silo 3 Project Rescoping Evaluation is to propose a recommended path forward for the remediation of Silo 3. The options available for completing each phase of the remediation - retrieval, stabilization, packaging/transfer, shipping, and disposal - were evaluated, based on the key technical considerations for each phase, complexity of implementation, regulatory requirements, cost, schedule, and risk.

Based on this evaluation, a recommended technical approach has been selected:

- **Recommended Technical Approach** involves mechanical excavation of Silo 3 material, treatment using a batch mixer, packaging in supersaks, shipment by rail through Waste Pits Remediation Action Project (WPRAP), and disposal at Envirocare. It is recommended that Fluor Fernald, Inc. (Fluor Fernald) perform this scope of work, with subcontractor/teaming partner support.

Although more complex in nature, two additional scenarios were evaluated as potential back-up approaches for remediation of Silo 3. These scenarios are not recommended, but are provided for information.

Brief descriptions of each scenario follow:

- **Alternative Scenario 1** includes the modification of the Rocky Mountain Remediation Services (RMRS) design by Fluor Fernald and self-performance of the construction and operation of the treatment facility. The Silo 3 material would be retrieved, treated, packaged in boxes, and shipped by truck to Envirocare for final disposal.

- **Alternative Scenario 2** involves incorporating the treatment of Silo 3 material with the Silos 1 and 2 treatment process. The Silo 3 material would be mechanically excavated, treated in the Silos 1 and 2 treatment process, packaged in boxes and shipped by truck to Nevada Test Site (NTS) for final disposal.

Table ES-1 summarizes the results of the Silo 3 evaluation. Further details are contained in the text for each scenario.

**Table ES-1 – Evaluation Summary**

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| Scenario | Silo 3 Material Removal from FEMP | Approximate Total Project Cost | Implementation/Risk |
|---|---|---|---|
| **Recommended Technical Approach** Mechanical Excavation/Ship by Rail | 36 months* <br> * Opportunity to reduce to 28 months | $25.8 Million** <br> ** Opportunity to reduce to $23.3 Million | The majority of technical risk is associated with retrieval, although the risk is reduced by using standard construction equipment. |
| **Alternative Scenario 1** Complete RMRS Design | 42 months | $42.7 Million | The majority of technical risk is associated with retrieval and operability and maintainability of remote arm. There is a risk that anticipated volume reduction would not be achieved. |
| **Alternative Scenario 2** Combine with Silos 1 and 2 | 85 months | $43.7 Million | Additional operations extend critical path of Silos 1 and 2 by six months. The majority of technical risk is associated with retrieval. Incremental technical challenges for Silos 1 and 2 Project introduced. |

***Note:*** *Costs shown are unescalated.*

Upon acceptance of this recommendation, Fluor Fernald will begin conceptual design to further definitize the approach. Because the recommended approach described here is based on a pre-conceptual level of design, some changes to ensure implementability or meet regulatory requirements, may occur during conceptual or detailed design. If at any point during conceptual or detailed design, it is found that the proposed approach cannot meet a requirement, the approach will be re-evaluated and revised.

# Overview

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The Silo 3 Project resides in the Silos Project Division and its completion will be a major step toward the remediation of Operable Unit 4 (OU4). The purpose and goals of the Silo 3 Project are to safely remove, stabilize, transport, and dispose of Silo 3 material to meet the waste acceptance criteria (WAC) of an off-site disposal facility, in a safe, timely, efficient, and cost-effective manner.

An estimated 5,100 cubic yards of metal oxide material remains in Silo 3. The predominant radionuclide of concern identified within the material is Thorium-230 (Th-230), a radionuclide produced from the natural decay of Uranium-238. Silo 3 material is classified as 11(e)(2) byproduct material under the Atomic Energy Act (AEA) of 1954, as amended, and contains several Resource Conservation and Recovery Act (RCRA) metals. The material is considered sufficiently similar to hazardous waste and some RCRA requirements are relevant and appropriate for management and remediation of the waste. However, Silo 3 material is exempt from regulation under RCRA due to its classification as 11(e)(2) byproduct material.

The OU4 Record of Decision (ROD) was signed on December 7, 1994. The OU4 ROD identified vitrification as the selected remedy for the Silo 1, 2, and 3 material. However, due to technical issues and schedule delays associated with vitrification of the silos' material, the Department of Energy (DOE) convened a Silos Project Independent Review Team (IRT) to assist DOE, Fluor Fernald [(formerly Fluor Daniel Fernald (FDF)], regulatory agencies, and Stakeholders in reevaluating the remediation path forward for Silos 1, 2, and 3 material. As a result of the review, it was recommended that remediation of Silo 3 material be implemented separately from Silo 1 and 2 material, and in addition, that alternative stabilization technologies be considered for treatment of the Silo 3 material.

The OU4 ROD was modified for Silo 3 through the Explanation of Significant Differences (ESD) process, consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). An ESD document can be published when "differences in the remedial or enforcement action, settlement, or consent decree significantly change, but do not fundamentally alter, the remedy selected in the ROD with respect to scope, performance, or cost." Changing the selected remedy for Silo 3 material, from vitrification to an alternate stabilization process, did not fundamentally alter the remedy selected in the OU4 ROD. The ESD documents the technical justification for revising the remedy for Silo 3 from vitrification to an alternative stabilization process and substantiates the process and criteria used to evaluate the potential stabilization options. The requirements identified in the ESD for treatment and disposal of Silo 3 material are:

- "Treatment, using either a Chemical Stabilization / Solidification or a Polymer-based Encapsulation process to stabilize characteristic metals to meet RCRA Toxicity Characteristic Leaching Procedure (TCLP) limits and attain disposal facility WAC;
- Off-site disposal at either the NTS or an appropriately-permitted commercial disposal facility;" and
- Treatment may take place offsite, so long as "onsite pretreatment, in combination with packaging in accordance with Department of Transportation (DOT) regulations reduces the dispersability of thorium-bearing particulates to produce transportation risk less than $1 \times 10^{-6}$."

Fluor Fernald prepared a Request for Proposal (RFP) (F98P132339) for a contractor to provide waste stabilization services under a Firm Fixed Price/Firm Fixed-Unit Price performance-based service contract. On December 18, 1998, the Silo 3 contract was awarded to Rocky Mountain Remediation Services (RMRS). However, in early December 2000, the contract was terminated by agreement and cooperation of Fluor Fernald and RMRS; and as part of the termination agreement, RMRS provided Fluor Fernald with consideration in connection with the termination of the Silo 3 Project.

The Silo 3 Project Rescoping Evaluation was performed to assess potential paths forward for the remediation of Silo 3. To develop a recommended path forward, this evaluation identifies and evaluates, at a pre-conceptual level, technical alternatives for completing the Silo 3 scope of work in compliance with the ESD. Once the recommendation is accepted, the chosen approach will then be developed through the conceptual, preliminary and final design stages. As the design of the recommended approach progresses, refinements may be made to the approach to increase implementability and meet technical and regulatory requirements.

The decision-making process during this evaluation was divided into four steps:

1. Determine the recommended technical approach for implementing each phase of the project.
2. Determine the performance strategy (i.e., self-performance versus contracting), cost and schedule for implementing the recommended technical approach.
3. Analyze alternative scenarios as back-up approaches.
4. Determine the funding impacts of the recommended approach and alternative scenarios.

The following sections outline the implementation of these steps.

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# Step 1 - Determine the Recommended Technical Approach

## Description of Technical Alternatives

Implementability is the key to determining the recommended technical approach to completing the Silo 3 Project. To assess implementability, the project was subdivided into the major elements that define the scope of work. These elements were:

- Retrieval
- Stabilization
- Packaging/Transfer
- Shipping
- Disposal

Options were then identified for implementing each phase of work. Table 1 shows the possible remediation process alternatives, ranked in order of technical complexity.

**Table 1 – Alternative Methods**

| Retrieval | Stabilization | Packaging/ Transfer | Shipping | Disposal |
|---|---|---|---|---|
| Mechanical excavation | Passive stabilization – no mixing | Bulk transfer to WPRAP | Gondola – blended with pit material | Envirocare |
| Direct vacuum | Mixing screw or batch mixer | Supersaks | Gondola – Silo 3 material only | Nevada Test Site |
| Remote pneumatic | Continuous mixer | Boxes or drums | Truck | |
| Slurry retrieval | Combine with Silos 1 and 2 treatment | | Rail (non- gondola) | |

The alternatives are ranked vertically, from least to more technically complex. Hence, mechanical excavation is considered a simpler retrieval mechanism than direct vacuum retrieval or remote pneumatic retrieval.

A brainstorming session was held on January 4, 2001, to discuss these alternatives, brainstorm the issues involved, and develop resolutions necessary to implement these alternatives. Participants in the brainstorming session included:

- Leadership team (Executive Project Director, Closure Project Management Director, and Aquifer Restoration Project Director),
- Silo 3 Project team members and project management,
- Safety,
- Safety Analysis,
- Engineering,
- Environmental Protection,
- Waste Generators Services,
- Maintenance, and
- WPRAP.

Support for this evaluation has also been obtained from Fluor Fernald Rigging, Decontamination and Dismantlement (D&D), Technical Review Board (TRB), Radiological Controls management, Demolition Projects, Thorium Overpacking Project personnel, and Duratek Federal Services.

Discussions were held with several commercial vendors during the course of this evaluation to obtain market survey data. Vendors included:

- The IT Group
- Framatome Technologies, Inc. (FTI)
- Envirocare of Utah
- CSX
- Waste Control Specialists
- Mactec, Inc.
- RUBB, Inc. (facility)
- Universal Fabric Structures (facility)
- Cantwell Machinery (excavation/mining equipment)
- Vector Technologies (vecloader)
- Transport Plastics (supersaks)
- Technical Images (CCTV)
- Bēpex (mixer)
- J.C. Steele and Sons, Inc. (screw feeder)
- Batsner Company (conveyors)

This market survey information was factored into the assessment of alternatives.

The following sections provide information about each element in the Silo 3 work scope, what alternatives are available for completing each element, any noteworthy issues surrounding that approach, and the potential resolution to those issues, if applicable.

# RETRIEVAL

Removal of the 3,925 tons (5,088 $yd^3$) of material in Silo 3 is the first step to the remediation of Silo 3.

## Key Technical Considerations

- Silo 3 material is powdery at the top and compacted at the bottom. Prior retrieval efforts have found the material is compacted at the perimeter and does not flow freely up to 11 feet above the bottom of the silo. This compaction is expected to occur throughout the bottom of the silo.
- Due to the compaction, at least one-third of Silo 3 material, and probably two-thirds, requires mechanical agitation to obtain a flowable form. The material has not chemically reacted, rather it has compacted under its weight, and returns to its powdery form once mechanically agitated.
- Thorium-230 concentrations and small particle size create an airborne hazard for retrieval.
- Silo 3 material is 30-50% soluble in water by weight. The material exhibits some heat of hydration upon reaction with water and is hydroscopic. Whether the material will expand when reacted with water is uncertain. Silo 3 material also contains some unoxidized nitrates.
- Silo 3 is a hazard category 3 non-reactor nuclear facility based on available inventory of radioactive material. Th-230 is the radionuclide of concern.
- The Technical Safety Requirement (TSR) for the OU4 Hazard Analysis Report (HAR) requires that the dome of Silo 3 be limited to the placement of 700 pounds of equipment and personnel. Loads on the dome must be analyzed.

## Description of Retrieval Alternatives

**Mechanical excavation** involves cutting Silo 3 open and using standard construction equipment to excavate the material. A containment would be assembled adjacent to and abutting the silo opening. Reinforcement of the Silo 3 opening may be required, depending on structural evaluation. The equipment would begin operating outside the silo, and move into the silo as material is removed. For worker safety, once the excavator enters the silo, the equipment would be remotely operated or alternate equipment, such as a Gradall would be used.

Mechanical excavation, within containment, eliminates the concerns surrounding the key technical considerations identified for retrieval, requires little manpower, keeps the approach as low as reasonably achievable (ALARA), and is the least technically complex alternative identified.

*Structural Evaluation.* A preliminary structural evaluation has been conducted to verify that the structural integrity of Silo 3 would not be compromised by cutting an opening in the silo. A more detailed evaluation will be conducted to determine whether reinforcement of the opening may be required. Mechanical excavation would not require that any loads be placed on the silo dome.

*Retrieval Equipment.* An excavator would be sized to allow retrieval of material near the top of the silo, yet would be able to maneuver within the silo and remove material near the silo walls. The excavator would provide ample power to break up any bridged material and would be large enough to be able to dig itself out, if it became buried under material. Following initial retrieval, the excavator would be remotely deployed into the silo and required to travel within the silo to retrieve the remaining material. The equipment could be set in a "precision work mode" and the operation of the equipment monitored by closed-circuit television to ensure that the excavator does not contact the silo walls.

*10CFR835.1002, Facility Design and Modification* requires that during the design of new facilities or modification of existing facilities:

- optimization methods shall be used to assure that occupational exposure is maintained ALARA;
- that under normal conditions, releases to the workplace atmosphere are avoided; and
- in any situation, that the inhalation of such material by workers is controlled to levels that are ALARA.

Mechanical excavation is an acceptable retrieval approach as long as ALARA optimization is used. In the optimization process, engineering controls (e.g., confinement, ventilation, etc.) will be identified first in removing the hazard, before considering administrative controls or personal protective equipment (PPE). Additionally, the approach will be to minimize the number of personnel required to enter a potential airborne area. It would not be feasible to comply with occupational airborne radioactivity limits if no containment or method of controls were employed; therefore, containment must be utilized, in conjunction with misting, if necessary.

*Nuclear Facility Classification.* Currently Silo 3 is classified as a Hazard Category 3 (HC3) Non-reactor Nuclear Facility based on the inventory of radioactive material and on the accident analysis for a silo dome failure. The Silo 3 Preliminary Hazard Analysis Report (PHAR) and OU4 HAR assume the probability of the bounding accident (dome failure) to be unlikely. A TSR for the

OU4 Silos was developed to provide controls to reduce the probability of the bounding accident occurring. Therefore, a structural evaluation will be required to verify that cutting an opening in Silo 3 would not increase the probability of dome failure. However, based on a preliminary analysis of this retrieval approach, controls, such as containment, would be required to mitigate a potential release of exposed material, but the hazard categorization of the facility would not change.

**Direct vacuum** involves personnel vacuuming through the existing top manways of Silo 3 to retrieve material. The worker would stand directly on the dome with appropriate fall protection, or work off a manlift extended over the silo. Glove bagging, or containment around the silo would be required, as well as secondary containment around the hose. Physical support to carry the weight of the hose would also be required. The hose could be attached to the manlift or a scaffold constructed to support the hose. This scenario is similar to the current accident analysis performed to evaluate silo dome failure and would cause minimal change to the existing safety basis documentation. The approach could, however, be very labor intensive and may not be ALARA.

Due to the compaction of material in Silo 3, direct vacuum is not desirable as a stand-alone retrieval alternative. Direct vacuum through the top manways would likely be able to retrieve no more than one-third of the silo's contents. Sustained use of a vacuum retrieval would also likely encounter filter loading, due to the small particle size of the Silo 3 material. Vacuuming could, however, be implemented as an enhancement to one of the other retrieval alternatives presented here or used for housekeeping measures.

**Remote pneumatic** involves the use of a vacuum conveyance system deployed by a remote manipulator through the center access port of the silo dome. This system has been designed, through preliminary design, by RMRS and consists of mast segments with a remotely operated manipulator at the end. A gantry would be constructed over the silo to carry the load of the retrieval arm. The arm mast would be inserted into the silo in 10-foot increments and carry the vacuum hose. Additional mast segments would be deployed from a head house located on the gantry above the center manway.

Remote pneumatic retrieval is technically feasible, but costly and complex. Operability issues exist with the use of the Framatome retrieval arm, but could be mitigated with modification to the retrieval arm design. Modifications include the use of 5 and 10-foot link segments and several auxiliary tools for waste agitation and breakup (i.e., delumper, auger, chisel). The tooling would be inserted through an auxiliary port and powered by an umbilical fed through the arm mast. Concerns also exist surrounding the ability to maintain occupational exposures ALARA, due to the number of personnel required to change-out tooling and modify the vacuum hose in a potentially airborne area.

The footings for the RMRS gantry have been constructed. Fabrication of the retrieval arm has been initiated at Framatome Technologies and is about 15% complete. However, the contract between RMRS and Framatome has been terminated and design and fabrication efforts have ceased. The design and fabrication work would have to be restarted, but could be salvaged. However, significant modifications to the existing design would be required to mitigate operational risk. A sole source contract would be required with Framatome Technologies for this alternative.

**Slurry retrieval** involves the installation of a water spray system into the top of Silo 3 to wet the material and the use of a slurry pump to move Silo 3 material out of the silo.

Slurry retrieval would be difficult to implement, due to the presence of material in the silo dome. In addition, Silo 3 is not designed to hold water and does not have a sump system like Silos 1 and 2. Therefore, slurry retrieval may require installation of a groundwater monitoring system and/or slurry wall to control the migration of water from the silo into the ground. Should a Silo 3 material slurry be achieved, excess water must be removed from the material in order to meet DOT shipping regulations and disposal facility requirements. Silo 3 material is soluble in water, suggesting that waste water may exhibit the RCRA and radiological characteristics present in the material and require treatment to ensure compliance with the Fernald Environmental Management Project (FEMP) National Pollutant Discharge Elimination System (NPDES) Permit prior to sending to the Advanced Waste Waster Treatment (AWWT) facility. This would dictate the need for a waste water treatment system to pre-treat the water.

It is unknown what consistency Silo 3 material will take with the addition of large volumes of water. Given these factors, the likelihood of a Silo 3 material slurry being achieved is uncertain. Silo 3 material exhibits some heat of hydration upon reaction with water and expansion of the material when reacted with water is possible. Saturation of Silo 3 material in-situ would cause an exothermic reaction, potential material expansion, and unanalyzed failure scenarios for the silo. Due to these issues, slurry retrieval is not preferred at this time.

## STABILIZATION

Stabilization involves the treatment of Silo 3 material to meet regulatory requirements established in the ESD.

### Key Technical Considerations

- Silo 3 material is considered 11e(2) by-product material under AEA. This classification exempts Silo 3 material from regulation under RCRA [40 CFR Section 261.4(a)(4)].

- Silo 3 material must be chemically stabilized to pass TCLP to meet ESD requirements. Elimination of the treatment requirement would require a ROD amendment, which would take up to 18 months to complete.
- The four RCRA metals of concern in Silo 3 material are arsenic, cadmium, chromium, and selenium.
- RMRS will provide Envirobond™ (a proprietary phosphate formulation), in a quantity sufficient to treat 3,950 tons of Silo 3 material.
- Chemical stabilization of Silo 3 material requires water as an additive in the process.

**Description of Stabilization Alternatives**

**Passive Stabilization** involves spraying Silo 3 material with water, amended with the chemical additives required to stabilize the constituents of concern. Stabilization is presumed to occur through the contact of the additive solution with the material, but no mixing is required to aid this reaction.

Because Silo 3 material is a fine powder, it is likely that some form of mechanical assistance would be necessary to provide continuous contact between the silo material and the additive solution. Contact between the additive and Silo 3 material is required to complete the chemical reaction for stabilization and pass TCLP. Without adequate mixing, this contact cannot be ensured. Additionally, should passive stabilization be performed in-situ, the impact on the silo is uncertain due to the exothermic reaction of the Silo 3 material with water. Thus, passive stabilization is not considered technically feasible at this time. Some degree of mechanical mixing will be required.

**Mixing screw or batch mixer** would be used to mix batches of Silo 3 material with Envirobond™, ferrous sulfate, and water to stabilize the constituents of concern.

A mixing screw or batch mixer would provide mechanical mixing of the Silo 3 material, stabilizing agents and water. These pieces of equipment are commercially available and can be sized to produce the appropriate batch size, as determined by the shipping package. A batch mixer or mixing screw also allows for intermittent operation and requires less controls. Several pieces of equipment could be used for this approach, but after evaluating the treatment process, required batch sizes, and experience with the proposed equipment, the even feeder (mixing screw) and single rotor double- ribbon blender (batch mixer) seem to be the most feasible.

The even feeder has been used on-site at the WPRAP project. This piece of equipment is equipped with multiple shaft drives that turn spiral sections that are available in both a solid and notched design. These spiral sections mix the material and move the material to the discharge, which is equipped with double-bladed knife sections to break up large lumps and help force sticky materials down and through the opening.

The single rotor double-ribbon blender contains a double inner and outer ribbon design which allows material to be moved within the mixing vessel and then back-mixed in the opposite direction to allow for quicker and more thorough mixing. Different rotor designs are available, including ribbon, paddle, and screw, and the mixer can be equipped with different tools, such as high intensity sizers for delumping. The single rotor, double-ribbon blender is also being proposed for use on the Silos 1 and 2 Project.

**Continuous Mixer** could be used to stabilize a continuous feed of Silo 3 material by mixing the material with the Envirobond™, ferrous sulfate (if necessary), and water to stabilize the constituents of concern. This mixing process has been designed, through the preliminary design stage, by RMRS.

Like the mixing screw and batch mixer, the continuous mixer is commercially available and would provide mechanical mixing of the Silo 3 material, stabilizing agents and water. The continuous mixer requires additional process controls and introduces the need for maintaining steady feed rates of Silo 3 material and additives. To ensure a steady flow of material to the mixer, additional equipment is required to maintain excess capacity should retrieval slow or stop. Continuous mixers also reduce flexibility in the packaging/transfer phase, requiring automation to process the continuous feed of material for packaging. For these reasons, the use of a continuous mixer is considered less preferable than a batch mixer or mixing screw.

**Combine with Silos 1 and 2** involves incorporating the treatment of Silo 3 material with the Silos 1 and 2 treatment process. Silo 3 material would be retrieved by one of the alternatives described previously and transferred to the Silos 1 and 2 facility.

The proposed process for the stabilization of Silos 1 and 2 material is suitable for processing the Silo 3 material and is consistent with the treatment remedy for Silo 3 material described in the ESD. The incorporation of Silo 3 material into this process could introduce incremental technical challenges for the Silos 1 and 2 Project. Challenges include incorporating a dry waste (Silo 3 material) into a Silos 1 and 2 treatment process designed to handle wet material. Conceptual design for the Silos 1 and 2 process is currently underway and does not incorporate Silo 3 considerations at this time. Combining Silo 3 with Silos 1 and 2 adds six months to the critical path for Silos 1 and 2.

## PACKAGING / TRANSFER

The packaging/transfer phase of the Silo 3 Project prepares the treated Silo 3 material for shipping.

## Key Technical Considerations

- Thorium-230 concentrations and small particle size create an airborne hazard for open-air facility operations. The ability to control airborne activity during handling by wetting Silo 3 material is unknown at this time. Laboratory testing must be conducted to assess this characteristic.

- WPRAP safety basis limited to radiological facility limits. Introduction of Silo 3 material must not jeopardize WPRAP safety basis. WPRAP must remain a radiological facility.

- Silo 3 material is considered low specific activity – II (LSA-II) for shipment. The material must be packaged in Industrial Package Type 2 containers (IP-2) to meet DOT requirements or blended down by a factor of seven to meet low specific activity – I (LSA-I) classification. Any blending of Silo 3 material would be performed after treatment..

- WPRAP is currently pursuing an exemption with the DOT to allow LSA-II material to be shipped to Envirocare in the DOE-owned gondola cars. If approved, this exemption would cover Silo 3 material.

## Description of Packaging/Transfer Alternatives

**Bulk transfer to WPRAP** involves the transport of treated Silo 3 material in bulk (e.g., covered and contained dump trucks) to the WPRAP Material Handling Building, blending with waste pits material and shipment in gondola cars. The Silo 3 material must be contained and moist to prevent the spread of contamination between facilities.

IT would perform the blending and shipping scope of work under a modification to its existing WPRAP contract. Blending could occur directly in the pits, although Environmental Protection Agency (EPA) approval has not been obtained due to the radiological issues inherent with this approach.

*Hazard categorization.* Based on the HC3 inventory threshold values identified in DOE-STD-1027-92 Chg 1, approximately 7.6 tons of untreated Silo 3 material would result in classification of a facility as hazard category 3. WPRAP currently operates below this threshold, as a radiological facility.

The dose conversion factor (DCF) for Silo 3 material is calculated to be 2.9E+04 millirem (CEDE) per gram inhaled. The bounding analysis for WPRAP assumed black oxide ($U_3O_8$) as the source term, which has a DCF of 3.1E+04 mrem/gram.

Based on the inventory threshold values and DCF, it can be shown that the material characteristics of the stabilized (wetted, soil-like) Silo 3 material are similar to the waste pit material and are represented by the characteristics described by the WPRAP hazard category calculations (HCCs). A sound case can be made that Silo

3 material could be shipped and handled under the existing WPRAP Auditable Safety Report (ASR), and that WPRAP would remain a radiological facility.

However, considering that the hazard category calculations are based on bounding worst-case conditions, WPRAP operations have not and are not expected to involve materials with specific activities close to the analyzed envelope. Silo 3 Th-230 specific activity is 50,000 pCi/g on average, and ranges up to 72,000 pCi/g, which does encroach on the analyzed envelope for WPRAP operations.

*Radiological controls.* Current WPRAP operations using material with a Th-230 specific activity of about 5,000 pCi/g have proven to be difficult to manage from a radiological controls perspective. Due to the radiological constraints (airborne activity) associated with handling Silo 3 material, this alternative is not considered feasible until more data can be obtained to determine the airborne characteristics of stabilized Silo 3 material. It is possible that wetting the Silo 3 material could mitigate the airborne radioactivity problem, and that problems experienced with current WPRAP operations would not be experienced with stabilized Silo 3 material. Modifications made to WPRAP operations to address current thorium handling problems may also eliminate or mitigate the handling concerns associated with Silo 3 material. However, the feasibility of mixing Silo 3 material in an open environment, whether in the waste pit or material handling building, remains uncertain at this time.

**Supersaks** would be used to package treated Silo 3 material to provide radiological controls during shipment, loading, and disposal.

The supersaks, marketed under the name Lift Liner™, are approximately 7 x 8 x 5 ft, with a loaded capacity of 9.5 $yd^3$, and hold up to 24,000 lbs. The bags are made of a woven outer polypropylene fabric shell with a water-resistant coating and a double layer polypropylene inner liner. Four flaps fold across the top of a full bag and are secured by tie-down straps of polyester webbing. The bags are put into a loading frame and folded open, with the flaps outside the loading frame. The loading frame supports the container as it is being filled. Following filling, the flaps of the container are folded shut and secured. A lifting frame then attaches to the lifting straps on the outer fabric shell for hoisting the container from the loading frame onto a transport vehicle. These supersaks have been deployed at several Idaho National Engineering and Environmental Laboratory (INEEL) facilities and used to package low-level waste (LLW) waste from D&D activities (e.g., concrete, piping, gravel, soil), as well as asbestos. The supersaks have also been used at the Savannah River site to ship soil to Envirocare.

**Boxes or drums** could be used to package Silo 3 material in lieu of supersaks. These containers have been previously used by the FEMP, although no top loading box is currently approved for use.

The Silo 3 material must be packaged in IP-2 containers to meet DOT requirements. These containers are commercially available, but would require testing and approval to meet FEMP standards before use.

Packaging in boxes or drums has been analyzed in previous planning efforts for the Silo 3 Project and is technically feasible. However, the use of drums or boxes increases manpower needs and is labor intensive. Truck shipments are preferable for these types of packages, due to the increased handling of boxes and drums for rail shipment.

## SHIPPING

Shipment involves transporting the treated Silo 3 material to the disposal facility for final disposal.

### Key Technical Considerations

- DOE-owned gondola cars available on-site. WPRAP has rail infrastructure and personnel.
- CSX/Union Pacific rail tender is for transport of LLW and would need to be modified for transport of 11e(2) material.
- Envirocare currently cannot roll-over rail cars with Th-230 specific activities greater than 4,000 pCi/g.
- Silo 3 Th-230 specific activity (untreated) ranges from 21,010 – 71,650 pCi/g.
- Envirocare can receive supersaks of Silo 3 material containing Th-230 specific activities up to 30,000 pCi/g, without establishing additional controls during disposal.
- A unit train is currently approved to carry up to 60 rail cars.
- All shipments to NTS are currently made by truck.

### Description of Shipping Alternatives

**Gondola – blended with waste pits material** involves the blending (in bulk) of treated Silo 3 material with waste pits material and placement in gondola cars by IT for disposal at Envirocare.

The ASR for the rail loading facility is based on the same source term as the WPRAP facility safety basis described under the "Bulk transfer to WPRAP" section. Therefore, a sound case can be made that Silo 3 material could be shipped and handled under the existing rail loading facility ASR. As stated in the key technical considerations, however, Envirocare currently cannot roll-over rail cars with average Th-230 specific activities greater than the 4,000 pCi/g. Silo 3 Th-230 concentrations are 10-20 times above this limit. Based on this factor, blending Silo 3 material with waste pits material would likely prevent Envirocare from rolling over the rail cars, which makes this alternative currently infeasible. However, if this issue were to be overcome, blending Silo 3 material with waste pits material and shipping by gondola may be feasible and could be pursued as a potential improvement.

**Gondola – Silo 3 material only** involves the shipment of supersaks, filled with treated Silo 3 material, in Silo 3-dedicated gondola cars for disposal at Envirocare. The supersaks would be loaded by the Silo 3 Project into Silo 3-dedicated gondola cars at an existing rail spur outside the WPRAP facility. Following placement of the supersaks in the gondola cars, the gondola cars would be lidded, the waste manifested, and the gondola car turned over to IT. IT would be responsible for shipping the material with the unit train to Envirocare, in accordance with established WPRAP procedures. The gondola cars carrying Silo 3 material would be added to the unit train, already carrying waste pit material, and shipped in coordination with the IT schedule.

Supersaks used under the gondola shipping scenario would not be the shipment package for Silo 3 material, but a means to facilitate movement of Silo 3 material to gondola cars and handling of the material at Envirocare. No special testing of these supersaks would be required for use with Silo 3 material; however, a material compatibility determination would be made. The supersaks are currently DOT approved strong-tight containers and are designed to meet IP-2 container requirements. If necessary, although not preferred, the supersak could be considered the shipping container. However, this approach would introduce additional documentation requirements and procurement constraints.

Silo 3 material is classified by DOT as LSA-II. Silo 3 material, both untreated and treated, must be transported in a container that meets the DOT design criteria for an IP-2 container and the disposal facility requirements. Neither the supersaks, nor the gondola cars used for shipment of Silo 3 material are IP-2 containers. Therefore, an exemption to package and transport the Silo 3 material in gondola cars would have to be obtained or the packages approved as IP-2 containers.

An exemption is currently being pursued to allow shipment of radioactive LSA-II waste in strong-tight packages (gondola cars). Over the last several months, WPRAP has shipped waste by gondola car with Th-230 concentrations ranging from 1.37% to 96.8% of the LSA-I upper threshold (with an average concentration of 27.8%). The exemption would allow shipment from the FEMP of material with elevated Th-230 activity in the same gondola cars. This exemption is based on continuing the current shipment protocols implemented at WPRAP, which include:

- shipment in FEMP gondola cars, equipped with a permanent 60-mil liner, disposable poly liner, and detachable reinforced fiberglass cover);
- rail car structural inspections performed in accordance with 49 CFR, Part 215, Appendix D and maintenance of the rail cars; and
- transport by the established rail route.

There would be no increased risk resulting from the use of the gondola cars to transport the higher activity material, should the exemption be granted. The containment aspects of the rail cars to retain the radioactive contents remain unchanged. Because Th-230 is predominantly an alpha-emitter, there will be no increase in radiation levels external to the rail car. Alpha particles are effectively blocked by something as thin as a sheet of paper, so a steel rail car wall would act as an effective barrier. This exemption is being pursued under the WPRAP scope of work and is likely to be granted. If the exemption is not granted, IP-2 packages would be required for shipment.

The ASR for the rail loading facility is based on the same source term as the WPRAP facility safety basis described under the "Bulk transfer to WPRAP" section. Therefore, a sound case can be made that Silo 3 material could be shipped and handled under the existing rail loading facility ASR.

**Truck** involves the shipment of treated Silo 3 material by truck for disposal at Envirocare or NTS. Shipment by truck has been thoroughly analyzed in previous planning efforts for the Silo 3 Project, and is technically feasible.

**Rail (non-gondola)** involves the shipment of treated Silo 3 material by rail, in a vessel other than a gondola car (i.e., flat bed rail car, box car), for disposal at Envirocare.

The previous shipping alternatives described in this rescoping evaluation report capitalize on existing shipping systems at the FEMP. This alternative would require the purchase and maintenance of separate rail cars and the development of new rail procedures. Due to the novelty of this approach and the availability of more technically feasible alternatives, shipping Silo 3 material by rail in a flat bed rail car or box car is not preferred at this time.

## DISPOSAL

Final disposal of the treated Silo 3 material will be in the appropriate cell at the chosen disposal facility. Only two options currently exist for disposal – Envirocare and NTS.

### Key Technical Considerations

- The DOE Ohio Field Office (DOE-OFO) contract with Envirocare is structured for LLW and therefore would require modification for disposal of Silo 3 material, since Silo 3 material is not LLW. However, an alternative exists through the Army Corps of Engineers contract. The DOE can obtain an interagency agreement to allow the use of the Army Corps of Engineers contract for disposal of Silo 3 material. The costs for disposal are comparable between these two contracts.

- Envirocare characterizes Silo 3 material as pre-1978 generated 11e(2) material. There are potentially two disposal cells at Envirocare in which Silo 3 material could be disposed - the 11e(2) and LLW cell. Envirocare is currently requesting permission from the State of Utah to dispose this type of material in their LLW cell.

- The Envirocare WAC for disposal in the LLW cell requires that the Silo 3 material radiologically, be classified as "Class A" waste, contain less than 10% enrichment, and have U-235 concentrations below 1,900 pCi/g. Th-230 concentration limits are not of concern if Silo 3 material is disposed in the LLW cell, because at maximum Th-230 concentrations, the Silo 3 material is orders of magnitude below the 150,000 pCi/g limit.

- The main radiological consideration of the Envirocare WAC for disposal in the 11e(2) cell is Th-230. The WAC requires that Th-230 levels in Silo 3 material be less than 60,000 pCi/g per railcar composite sample. Silo 3 Th-230 specific activity ranges from 21,010 – 71, 650 pCi/g.

- NTS would dispose of Silo 3 material as a small quantity of 11e(2) by-product material in Area 5 of their facility.

- The NTS WAC requires that Silo 3 material be treated to pass TCLP and contain no free liquids.

- Packages (including supersaks) disposed at NTS must be able to withstand a uniformly distributed load of 3,375 $lb/ft^2$. NTS does not dispose of material in bulk.

**Description of Disposal Alternatives**

**Envirocare** involves the disposal of treated Silo 3 material, transported by truck or rail, at its facility in Utah. Treated Silo 3 material would be disposed in either Envirocare's 11e(2) cell or their low-level waste cell. The exact disposal cell for Silo 3 material has not been determined at this time. However, Envirocare has requested that the State of Utah allow pre-1978 generated 11e(2) material to be disposed in the LLW cell.

As stated in the shipping section, Envirocare currently reports that they cannot roll-over rail cars with Th-230 concentrations greater than 4,000 pCi/g. Based on this factor, Silo 3 material must be packaged in a container (e.g., supersak or other) that can be rolled over or be removed with a crane. Envirocare would then break the Supersaks in the cell for disposal or dump the material if shipped in a box or other hard-sided container.

Based on a review of Silo 3 material, Envirocare reports that no issues would exist for disposal of Silo 3 material in supersaks, as long as Th-230 concentrations were at or below 30,000 pCi/g. Should higher concentrations of Th-230 exist in the treated Silo 3 material, the disposal process at Envirocare may require additional controls. Currently a coordination issue exists at Envirocare with unloading supersaks from gondola cars, in order to meet the required turn-around time of the unit train.

**NTS** involves the disposal of treated Silo 3 material, transported by truck and disposed of as a small quantity of 11e(2) by-product material. NTS disposes of waste in containers, not in bulk.

Disposal at NTS has been thoroughly analyzed in previous planning efforts for the Silo 3 Project, and is technically feasible. All containers evaluated for packaging Silo 3 material (Lift Liner™ supersaks, boxes, and drums) have been used to dispose material at the NTS.

## Summary of Technical Alternatives

Based on the evaluation of the possible alternatives for implementing the Silo 3 scope of work, several options are currently not considered feasible or are not preferred, due to technical considerations, regulatory requirements, safety issues, or complexity of implementation. Table 2 identifies the alternatives that were eliminated from further consideration at this time.

**Table 2 – Eliminated Alternative Methods**

| Retrieval | Stabilization | Packaging/ Transfer | Shipping | Disposal |
|---|---|---|---|---|
| Mechanical excavation | ~~Passive stabilization – no mixing~~ | ~~Bulk transfer to WPRAP~~ | ~~Gondola – blended with pit material~~ | Envirocare |
| Direct vacuum | Mixing screw or batch mixer | Supersaks | Gondola – Silo 3 material only | Nevada Test Site |
| Remote pneumatic | Continuous mixer | Boxes or drums | Truck | |
| Slurry retrieval | Combine with Silos 1 and 2 treatment | | Rail (non-gondola) | |

# Step 2 – Determine the Performance Strategy, Cost and Schedule for Implementing the Recommended Technical Approach

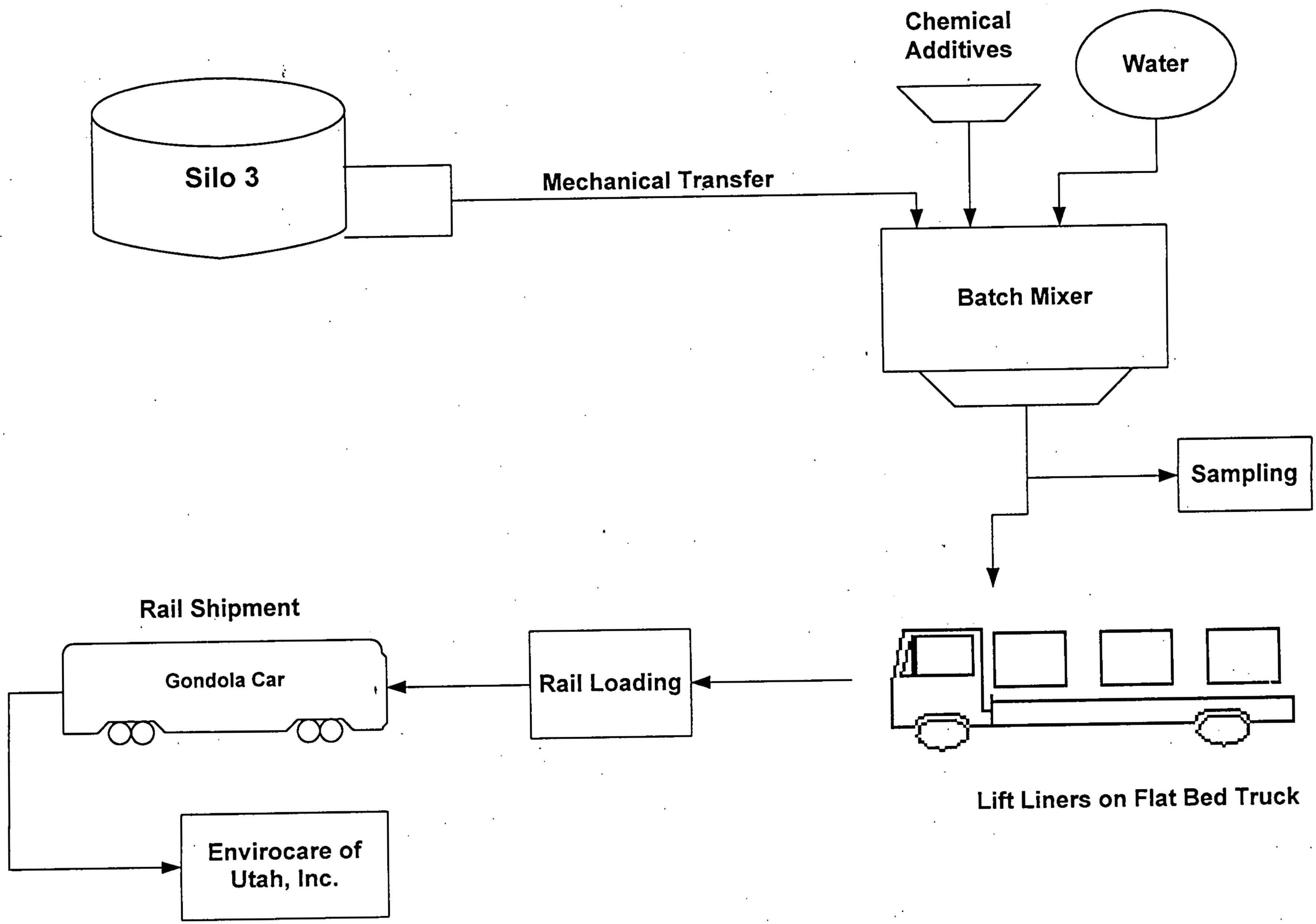
The shaded blocks in Table 3 reflect the most technically feasible scenario, considering the key technical considerations for each phase, the regulatory requirements, and the complexity of implementation. This scenario represents the recommended technical approach.

**Table 3 - Recommended Technical Approach**

| Retrieval | Stabilization | Packaging/ Transfer | Shipping | Disposal |
|---|---|---|---|---|
| Mechanical excavation | Passive stabilization – no mixing | Bulk transfer to WPRAP | Gondola – blended with pit material | Envirocare |
| Direct vacuum | Mixing screw or batch mixer | Supersaks | Gondola – Silo 3 material only | Nevada Test Site |
| Remote pneumatic | Continuous mixer | Boxes or drums | Truck | |
| Slurry retrieval | Combine with Silos 1 and 2 treatment | | Rail (non-gondola) | |

This scenario involves the retrieval and treatment of Silo 3 material and shipment of the material utilizing existing resources at the WPRAP facility. This option assumes stabilization of the Silo 3 material, packaging of treated material in supersaks (Lift Liners™), and placement of these containers in gondola cars prior to receipt at WPRAP. A conceptual process schematic of this scenario is presented in Figure 1. A pre-conceptual description of the implementation of this scenario follows.

**Figure 1**
**Silo 3 Process Flow Diagram**
**Recommended Technical Approach**



## Containment

The waste retrieval system assumed for the recommended approach involves the use of bulk retrieval equipment (excavator), with a contingency of vacuum conveyance. A containment enclosure, approximately 40' (l) x 25' (w), would be constructed abutting Silo 3 to provide radiological containment, equipment access, and ventilation controls for retrieval. Since the floor of the silo is below the existing grade, the enclosure would be installed partially below grade to allow access to the silo floor by the excavator and ensure a more effective retrieval operation. A second structure [100' (l) x 60' (w)] will be constructed adjoining the containment enclosure to house treatment equipment. This enclosure provides radiological containment and would include a radiological buffer area and ventilation controls to maintain directional airflow and allow personnel access as needed. High-efficiency particulate air (HEPA) units would be located outside the enclosures to provide the appropriate ventilation and air filtration.

The recommended approach eliminates interim storage, thus, the treatment equipment and containment can be located directly on the Interim Storage Area (ISA) pad. This eliminates placement and future demolition of additional concrete that would have been required for construction of a treatment facility elsewhere. The stack for the HEPA filters can be placed on the existing gantry footing to further eliminate concrete placement, and reduce contaminated waste that must be disposed upon completion of the project.

## Accessing the Silo

Once the enclosures are constructed, personnel will enter the containment enclosure and cut a 15' wide x 12' high opening in the side of Silo 3, using a water laser or equivalent. The Silo 3 contents would be accessed through this penetration at the base of the silo wall. Scaffolding will be erected for accessing the opening, with two "towers" on either side of the opening and a 20 ft. pick board, equipped with handrails, spanning the opening.

The opening would be laid out and cut into three vertical pieces, each 4' wide x12 ' high. The bottom of the opening can be up to two feet above the bottom of the silo and still be traversable by the retrieval equipment – an excavator. Rigging points would be installed, two per slab, for holding the concrete pieces. The concrete would first be cut along the bottom and wedges installed, followed by three vertical cuts. Bracing would be installed on outer vertical cuts to brace the silo, while the center section is removed. The excavator, equipped with a hook for lifting, would be deployed and the rigging hung on the center section. The concrete would then be cut across all three sections at the top. The center concrete piece would be removed, using the excavator, placed to the side, out of the way of the excavator and conveying equipment, and the rigging removed. The concrete would then be sprayed with encapsulant. Any material that spilled into the containment would be removed by a vacuum and/or the excavator. Rigging would then be hung on a side section, the bracing removed and the piece lifted and placed off to the side on top of the other piece. After spraying the concrete with encapsulant, rigging would be hung on the final section of concrete, the bracing removed and the piece lifted and placed to the side on top of the other pieces.

Cutting an opening in the silo wall, with reinforcing of the silo, is an activity already analyzed in the OU4 HAR (40000-RP-0028), approved on May 26, 1998.

## Retrieval

Following completion of cutting open the silo, the excavator would be deployed to excavate the material. The excavator can be equipped with a bin and conveyor, which would allow material to be scooped from the silo, dumped into the bin and conveyed to a hopper in the treatment enclosure.

Retrieval operations would be remotely controlled to the extent practical using CCTV systems. Excavation equipment with remote control operations is standard and commercially available.

As a contingency, a Vecloader will also be available to vacuum material through the existing manways on the silo dome, if needed, or from the silo opening. Material retrieved by the vecloader will be pneumatically conveyed to a hopper in the treatment enclosure. The vecloader can also be used for housekeeping.

## Stabilization

Once material is removed from Silo 3, it would be transferred to a hopper located in the treatment enclosure. The hopper would be equipped with a load cell weighing system, which provides an accurate indication of loss-in-weight for the bin's contents, ensuring the proper volume of Silo 3 material is conveyed to the batch mixer for treatment. The stabilization process requires that three solid powder materials (Silo 3 material, Envirobond™, and iron sulfate) be mixed thoroughly with water. A binding agent may be used to cause agglomeration of the Silo 3 material and reduce dusting and prevent the release of free liquids during transport. The need and ratios for the additives will be definitized through bench-scale testing, although data from RMRS may be sufficient for establishing the ratios for chemical stabilization. The stabilization process, designed by RMRS, is based upon using a minimal formulation mix which consists of approximately 3% Envirobond™, 2% iron sulfate, and 17% water on a dry weight basis. The operating recipe developed during bench-scale testing will be very stout, eliminating the need for strict process control parameters for the desired formulation.

Stabilization of the Silo 3 material will be performed as a batch process using a single rotor, double-ribbon blender. The Envirobond™, iron sulfate, and binding agent, provided to the project in bulk bags, will be dumped in a hopper and transferred to the batch mixer by screw conveyor, where the additives will be mixed with the Silo 3 material. The dry materials will be mixed and the water added to bring the mixture to optimum moisture. The ribbon blender would be capable of completely mixing a batch size of 10 $yd^3$ – the volume of one supersak. At completion of the mixing process, the stabilized Silo 3 waste would be in a moist form for transfer to supersaks (Lift Liners™).

Samples would be taken from the supersaks and used to verify WAC compliance. The sample taken from each of the three packages would be composited into one sample for analysis, similar to the graded sampling and analysis approach implemented by WPRAP.

## Packaging

The Lift Liners™ would be filled to approximately 90 percent of volumetric capacity at a filling station located adjacent to the treatment area. The Lift Liners™ are made of a woven outer polypropylene fabric shell with a water resistant coating and a double layer polypropylene inner liner. Four flaps fold across the top of a full bag and are secured by tie-down straps of polyester webbing. Loading frames are used to support the container as it is being filled.

To eliminate storage and double handling of containers, the Lift Liners™ would be assembled on flatbed trucks. Three loading frames would be placed on a flatbed truck, the bags inserted and folded open, with the flaps outside the loading frame. After inspection of the bags, the flatbed truck would transport the three Lift Liners™ to the filling station, where the packages would be filled with the stabilized waste. At this location, connections would be made between the supersaks located outside the treatment area, and the ribbon blender inside the area.

Once the container had been filled and the sample taken, the flatbed would pull out of the filling area and the flaps of the container would be folded shut and secured. The flatbed truck would transport the supersaks to an existing rail spur with access, such as the Track 12 extension, where the lifting frame would be attached and the Lift Liners™ would be transferred by mobile crane and placed in gondola cars, provided by WPRAP. The lifting frame would be attached to the lifting straps on the outer fabric shell for hoisting the container from the loading frame into the gondola cars. After a gondola car had been loaded with seven Lift Liner™ containers, it would be moved to the WPRAP facility to prepare for shipment.

## Shipment

Upon laboratory verification that the treated Silo 3 material meets WAC and the applicable DOT requirements, the material would be released for shipment from site. Should the material fail to meet the requirements, a wet/dry vacuum would be used to remove the material from the supersaks and the failed material would be re-introduced into the treatment process. No material will be shipped until laboratory analysis confirms compliance with the disposal facility WAC and DOT regulations.

## Performance Options

Options for performance of this scenario, with pros and cons, are presented in Table 4. This evaluation is not intended to serve as a formal make/buy determination. However, it is intended to serve as a basis for a formal make/buy determination, if one is required.

## Table 4 - Evaluation of Performance Options for Recommended Technical Approach

| Performance Option | Pros | Cons |
|---|---|---|
| Firm Fixed Price/Firm Fixed-Unit Price Performance-based Subcontract<br><br>Subcontractor provides turn-key service to design, construct, operate, package treated waste, and perform shutdown and D&D.<br><br>IT ships treated waste to disposal facility, under WPRAP contract. | 1. Some performance risk shifted to subcontractor due to fixed price contract. | 1. Difficulty defining scope of work to prevent or minimize changes that increase cost or schedule.<br>2. Increased price to account for subcontractor risks, contingency and profit.<br>3. Subcontractors hire same lower tier subcontractors as Fluor Fernald, but add additional level of oversight and markup.<br>4. Cannot pass down requirements adequately to support turn-key contract.<br>5. Cannot easily define cost, schedule and scope implications of needed stakeholder (regulatory, CAT, etc.) interactions and consensus building into such a contract structure.<br>6. Minimizes opportunity and increases complexity of reducing scope or project cost to DOE based on positive changes.<br>7. Increases complexity of interfacing with IT shipping, if subcontractor other than IT is used.<br>8. Reduces ability to save money and process through WPRAP facility if Envirocare handling and airborne issues are resolved.<br>9. Funds committed in advance of actual need unless subcontract is incrementally funded.<br>10. Reduces flexibility to reprioritize funding or staff from the project to meet other site priorities.<br>11. Increased project duration to allow for procurement step<br>12. Added cost for oversight of subcontractor. |

| Performance Option | Pros | Cons |
|---|---|---|
| Self-Perform, with Contracting as Required<br><br>Fluor Fernald self-perform design using teaming partners and existing subcontractors such as Parsons, Lockwood Greene and IT.<br><br>Fluor Fernald performs construction management, with subcontractor (Wise or other) for performing construction and D&D.<br><br>Fluor Fernald self-performs operations and shutdown, with FAT&LC. | 1. Fluor Fernald is knowledgeable about scope and site conditions.<br>2. Fluor Fernald knowledgeable of cost, schedule, and scope implications of stakeholder interactions.<br>3. Opportunity to reduce scope and project cost based on positive regulatory or other changes.<br>4. Can save money and process through WPRAP facility if Envirocare handling and airborne issues are resolved.<br>5. Technical expertise for discrete work items available through Fluor Fernald, teaming partners, and existing subcontractors.<br>6. Flexibility to reprioritize funding and staff from the project to meet other site priorities.<br>7. Funds committed to project when needed, not before.<br>8. Shortened schedule due to elimination of procurement step.<br>9. No redundancy in personnel to oversee subcontractor. | 1. Liability for performance placed solely on Fluor Fernald<br>2. Cost increases shared with DOE via Fluor Fernald's cost-type contract, but mitigated by Fluor Fernald's contract incentive structure. |

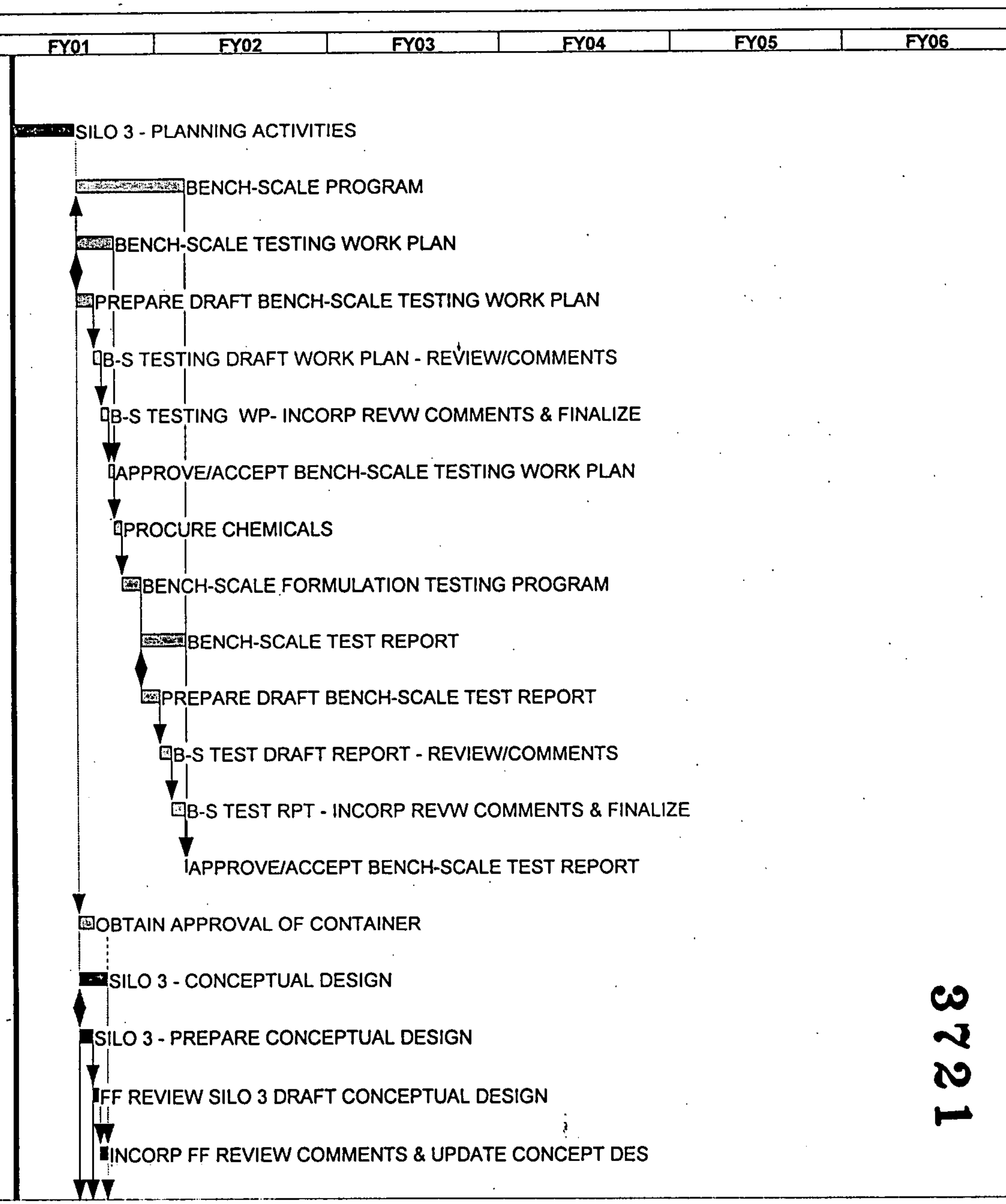
Based on this evaluation, it is recommended that this scenario be performed by Fluor Fernald, with contracting to specialty subcontractors and others as required.

**Schedule**

This scenario has been developed in greater detail since it is the recommended path forward. A proposed, pre-conceptual project schedule for the Recommended Technical Approach is attached (Figure 2). The time to complete design, construction, retrieval, treatment and shipment under this scenario is 36 months. However, some opportunities exist that may allow this time to be reduced to 28 months.

3721

| Activity ID | Activity Description | Orig Dur | Early Start | Early Finish | TF | Cal ID |
|---|---|---|---|---|---|---|
| **HS3AB SILO 3 REMEDIAL DESIGN** | | | | | | |
| **MA24 Design** | | | | | | |
| HS3B0110 | SILO 3 - PLANNING ACTIVITIES | 81 | 01DEC00 | 11APR01 | 0 | 6 |
| HS3B0300 | BENCH-SCALE PROGRAM | 143* | 16APR01 | 30NOV01 | 560 | 6 |
| HS3B0310 | BENCH-SCALE TESTING WORK PLAN | 51* | 16APR01 | 03JUL01 | 560 | 6 |
| HS3B0315 | PREPARE DRAFT BENCH-SCALE TESTING WORK PLAN | 24 | 16APR01 | 21MAY01 | 560 | 6 |
| HS3B0320 | B-S TESTING DRAFT WORK PLAN - REVIEW/COMMENTS | 9 | 22MAY01 | 05JUN01 | 560 | 6 |
| HS3B0325 | B-S TESTING WP- INCORP REVW COMMENTS & FINALIZE | 9 | 06JUN01 | 19JUN01 | 560 | 6 |
| HS3B0330 | APPROVE/ACCEPT BENCH-SCALE TESTING WORK PLAN | 9 | 20JUN01 | 03JUL01 | 560 | 6 |
| HS3B0345 | PROCURE CHEMICALS | 9 | 05JUL01 | 18JUL01 | 560 | 6 |
| HS3B0360 | BENCH-SCALE FORMULATION TESTING PROGRAM | 27 | 19JUL01 | 29AUG01 | 560 | 6 |
| HS3B0410 | BENCH-SCALE TEST REPORT | 56* | 30AUG01 | 30NOV01 | 560 | 6 |
| HS3B0415 | PREPARE DRAFT BENCH-SCALE TEST REPORT | 24 | 30AUG01 | 08OCT01 | 560 | 6 |
| HS3B0420 | B-S TEST DRAFT REPORT - REVIEW/COMMENTS | 14 | 09OCT01 | 30OCT01 | 560 | 6 |
| HS3B0425 | B-S TEST RPT - INCORP REVW COMMENTS & FINALIZE | 14 | 31OCT01 | 26NOV01 | 560 | 6 |
| HS3B0430 | APPROVE/ACCEPT BENCH-SCALE TEST REPORT | 4 | 27NOV01 | 30NOV01 | 560 | 6 |
| HS3B0595 | OBTAIN APPROVAL OF CONTAINER | 21 | 16APR01 | 16MAY01 | 15 | 6 |
| HS3B0610 | SILO 3 - CONCEPTUAL DESIGN | 36* | 16APR01 | 11JUN01 | 0 | 6 |
| HS3B0614 | SILO 3 - PREPARE CONCEPTUAL DESIGN | 18 | 16APR01 | 10MAY01 | 0 | 6 |
| HS3B0618 | FF REVIEW SILO 3 DRAFT CONCEPTUAL DESIGN | 9 | 14MAY01 | 24MAY01 | 0 | 6 |
| HS3B0622 | INCORP FF REVIEW COMMENTS & UPDATE CONCEPT DES | 9 | 29MAY01 | 11JUN01 | 0 | 6 |

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| | |
|---|---|
| Start Date | 01DEC00 |
| Finish Date | 02JUN04 |
| Data Date | 01DEC00 |
| Run Date | 27MAR01 11:06 |



Early Bar
Progress Bar
Critical Activity

ZZAC

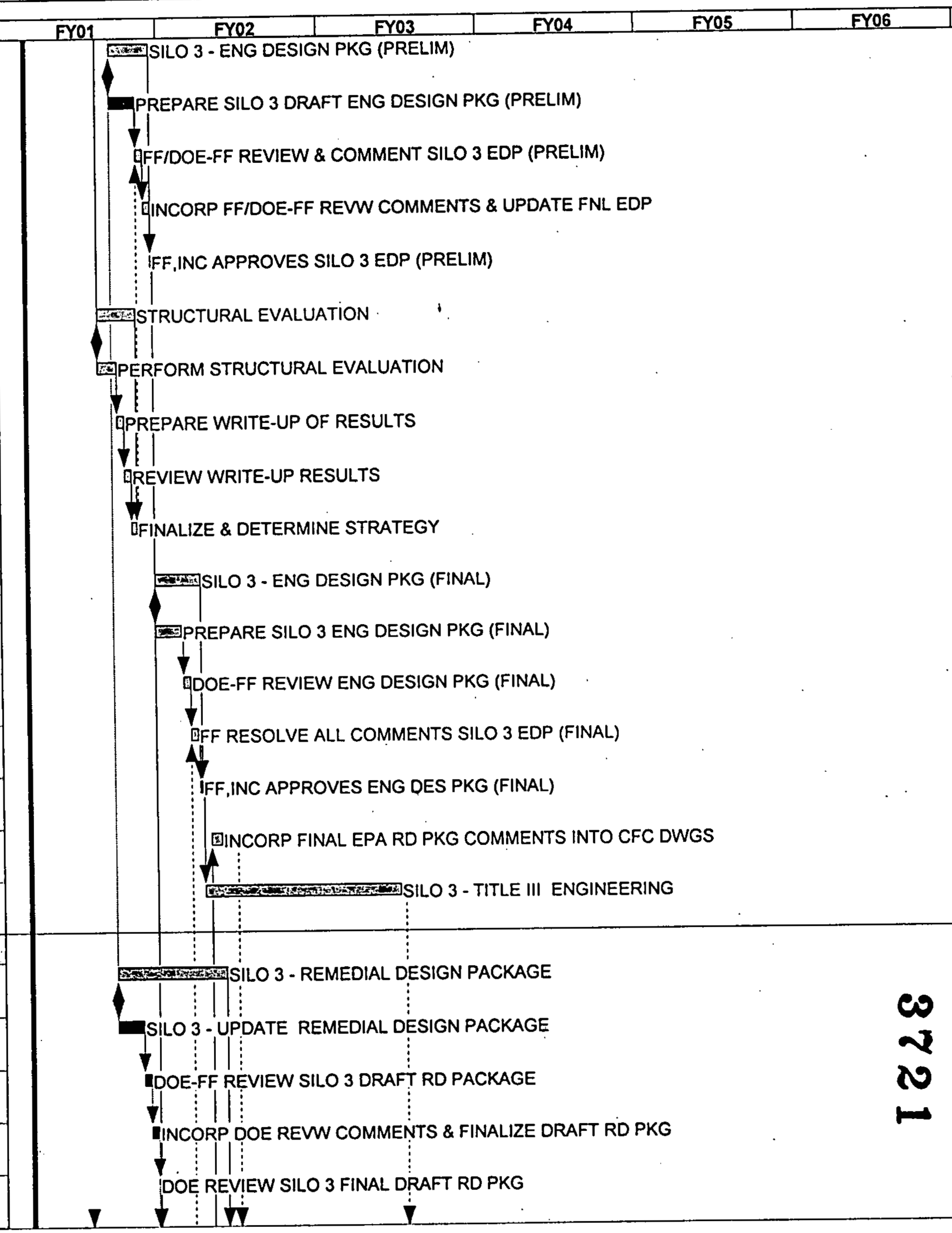


**FLUOR FERNALD**
**SILO 3**
**PROPOSED**
**BASELINE APPROACH**

FIGURE 2

3721

| Activity ID | Activity Description | Orig Dur | Early Start | Early Finish | TF | Cal ID |
|---|---|---|---|---|---|---|
| HS3B0810 | SILO 3 - ENG DESIGN PKG (PRELIM) | 60* | 12JUN01 | 13SEP01 | 7 | 6 |
| HS3B0814 | PREPARE SILO 3 DRAFT ENG DESIGN PKG (PRELIM) | 40 | 12JUN01 | 13AUG01 | 0 | 6 |
| HS3B0818 | FF/DOE-FF REVIEW & COMMENT SILO 3 EDP (PRELIM) | 9 | 14AUG01 | 27AUG01 | 7 | 6 |
| HS3B0822 | INCORP FF/DOE-FF REVW COMMENTS & UPDATE FNL EDP | 9 | 28AUG01 | 11SEP01 | 7 | 6 |
| HS3B0826 | FF,INC APPROVES SILO 3 EDP (PRELIM) | 2 | 12SEP01 | 13SEP01 | 7 | 6 |
| HS3B0910 | STRUCTURAL EVALUATION | 55* | 14MAY01 | 08AUG01 | 10 | 6 |
| HS3B0915 | PERFORM STRUCTURAL EVALUATION | 28 | 14MAY01 | 26JUN01 | 10 | 6 |
| HS3B0920 | PREPARE WRITE-UP OF RESULTS | 9 | 27JUN01 | 11JUL01 | 10 | 6 |
| HS3B0925 | REVIEW WRITE-UP RESULTS | 9 | 12JUL01 | 25JUL01 | 10 | 6 |
| HS3B0930 | FINALIZE & DETERMINE STRATEGY | 9 | 26JUL01 | 08AUG01 | 10 | 6 |
| HS3B2410 | SILO 3 - ENG DESIGN PKG (FINAL) | 64* | 17SEP01 | 31DEC01 | 7 | 6 |
| HS3B2420 | PREPARE SILO 3 ENG DESIGN PKG (FINAL) | 40 | 17SEP01 | 16NOV01 | 7 | 6 |
| HS3B2530 | DOE-FF REVIEW ENG DESIGN PKG (FINAL) | 9 | 19NOV01 | 04DEC01 | 7 | 6 |
| HS3B2640 | FF RESOLVE ALL COMMENTS SILO 3 EDP (FINAL) | 11 | 05DEC01 | 20DEC01 | 7 | 6 |
| HS3B2650 | FF,INC APPROVES ENG DES PKG (FINAL) | 4 | 26DEC01 | 31DEC01 | 7 | 6 |
| HS3B2660 | INCORP FINAL EPA RD PKG COMMENTS INTO CFC DWGS | 17 | 21JAN02 | 13FEB02 | 9 | 6 |
| HS3B2810 | SILO 3 - TITLE III ENGINEERING | 278 | 02JAN02 | 27MAR03 | 7 | 6 |
| **MA32 Remedial Design Package** | | | | | | |
| HS3B2910 | SILO 3 - REMEDIAL DESIGN PACKAGE | 156* | 12JUN01 | 21FEB02 | 25 | 6 |
| HS3B2920 | SILO 3 - UPDATE REMEDIAL DESIGN PACKAGE | 40 | 12JUN01 | 13AUG01 | 0 | 6 |
| HS3B2930 | DOE-FF REVIEW SILO 3 DRAFT RD PACKAGE | 9 | 14AUG01 | 27AUG01 | 0 | 6 |
| HS3B2940 | INCORP DOE REVW COMMENTS & FINALIZE DRAFT RD PKG | 9 | 28AUG01 | 11SEP01 | 0 | 6 |
| HS3B2950 | DOE REVIEW SILO 3 FINAL DRAFT RD PKG | 2 | 12SEP01 | 13SEP01 | 0 | 6 |

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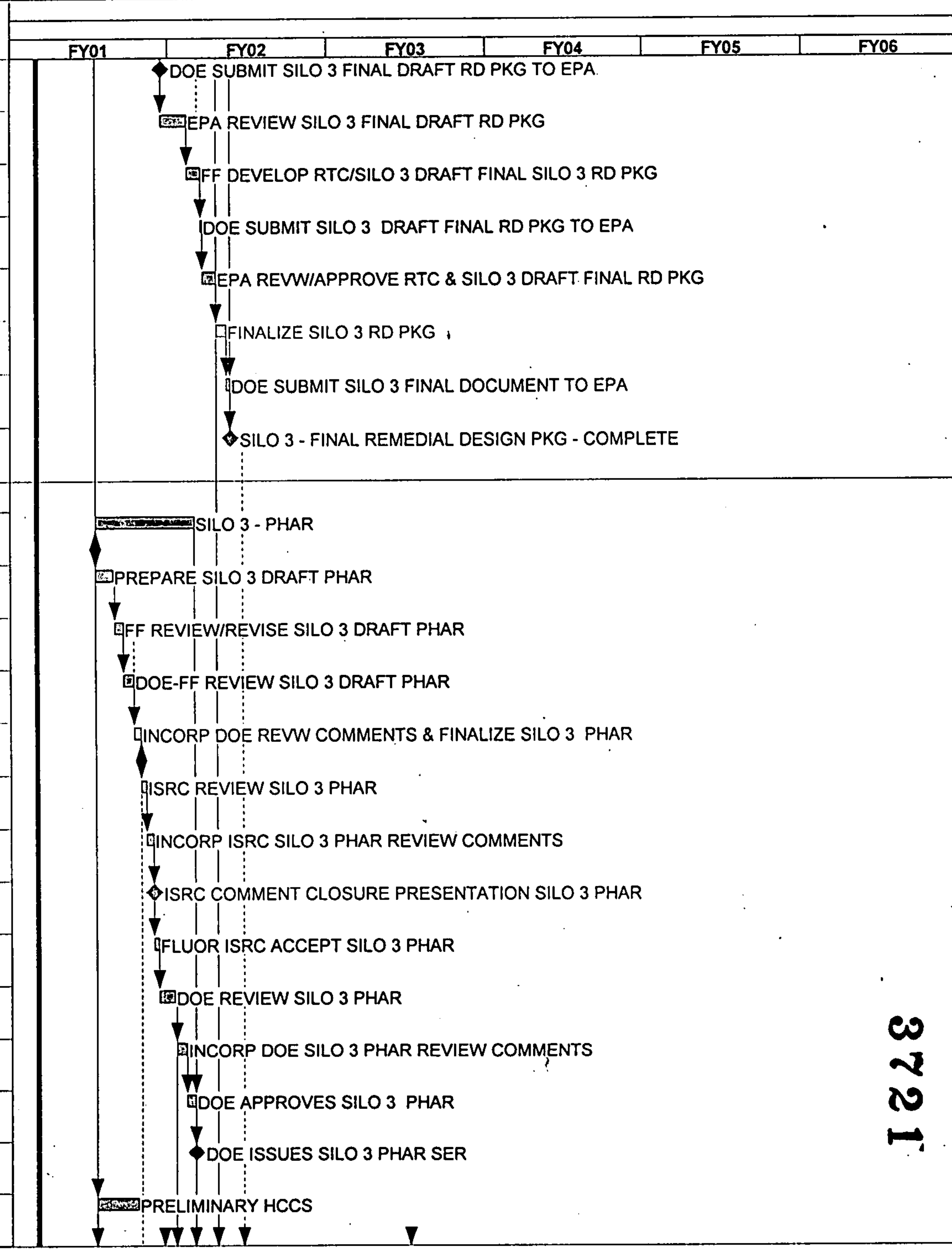
3721

| Activity ID | Activity Description | Orig Dur | Early Start | Early Finish | TF | Cal ID |
|---|---|---|---|---|---|---|
| HS3B2960 | DOE SUBMIT SILO 3 FINAL DRAFT RD PKG TO EPA | 0 | | 13SEP01 | 0 | 6 |
| HS3B2970 | EPA REVIEW SILO 3 FINAL DRAFT RD PKG | 60 | 14SEP01 | 12NOV01 | 2 | 4 |
| HS3B2980 | FF DEVELOP RTC/SILO 3 DRAFT FINAL SILO 3 RD PKG | 18 | 13NOV01 | 12DEC01 | 2 | 6 |
| HS3B2990 | DOE SUBMIT SILO 3 DRAFT FINAL RD PKG TO EPA | 4 | 13DEC01 | 18DEC01 | 2 | 6 |
| HS3B3000 | EPA REVW/APPROVE RTC & SILO 3 DRAFT FINAL RD PKG | 30 | 19DEC01 | 17JAN02 | 3 | 4 |
| HS3B3020 | FINALIZE SILO 3 RD PKG | 17 | 21JAN02 | 13FEB02 | 9 | 6 |
| HS3B3030 | DOE SUBMIT SILO 3 FINAL DOCUMENT TO EPA | 4 | 14FEB02 | 21FEB02 | 25 | 6 |
| HS3B3040 | SILO 3 - FINAL REMEDIAL DESIGN PKG - COMPLETE | 0 | | 21FEB02 | 25 | 6 |
| **MA34 PHAR Documentation** | | | | | | |
| HS3B3510 | SILO 3 - PHAR | 140* | 16APR01 | 27NOV01 | 10 | 6 |
| HS3B3520 | PREPARE SILO 3 DRAFT PHAR | 27 | 16APR01 | 24MAY01 | 10 | 6 |
| HS3B3530 | FF REVIEW/REVISE SILO 3 DRAFT PHAR | 14 | 29MAY01 | 18JUN01 | 10 | 6 |
| HS3B3540 | DOE-FF REVIEW SILO 3 DRAFT PHAR | 14 | 19JUN01 | 11JUL01 | 10 | 6 |
| HS3B3550 | INCORP DOE REVW COMMENTS & FINALIZE SILO 3 PHAR | 9 | 12JUL01 | 25JUL01 | 10 | 6 |
| HS3B3560 | ISRC REVIEW SILO 3 PHAR | 9 | 26JUL01 | 08AUG01 | 10 | 6 |
| HS3B3570 | INCORP ISRC SILO 3 PHAR REVIEW COMMENTS | 9 | 09AUG01 | 22AUG01 | 10 | 6 |
| HS3B3580 | ISRC COMMENT CLOSURE PRESENTATION SILO 3 PHAR | 0 | 23AUG01 | | 10 | 6 |
| HS3B3590 | FLUOR ISRC ACCEPT SILO 3 PHAR | 9 | 23AUG01 | 06SEP01 | 10 | 6 |
| HS3B3600 | DOE REVIEW SILO 3 PHAR | 25 | 07SEP01 | 11OCT01 | 11 | 1 |
| HS3B3620 | INCORP DOE SILO 3 PHAR REVIEW COMMENTS | 18 | 15OCT01 | 08NOV01 | 9 | 6 |
| HS3B3630 | DOE APPROVES SILO 3 PHAR | 10 | 09NOV01 | 27NOV01 | 11 | 1 |
| HS3B3640 | DOE ISSUES SILO 3 PHAR SER | 0 | | 27NOV01 | 11 | 1 |
| HS3B3700 | PRELIMINARY HCCS | 60 | 16APR01 | 18JUL01 | 14 | 6 |

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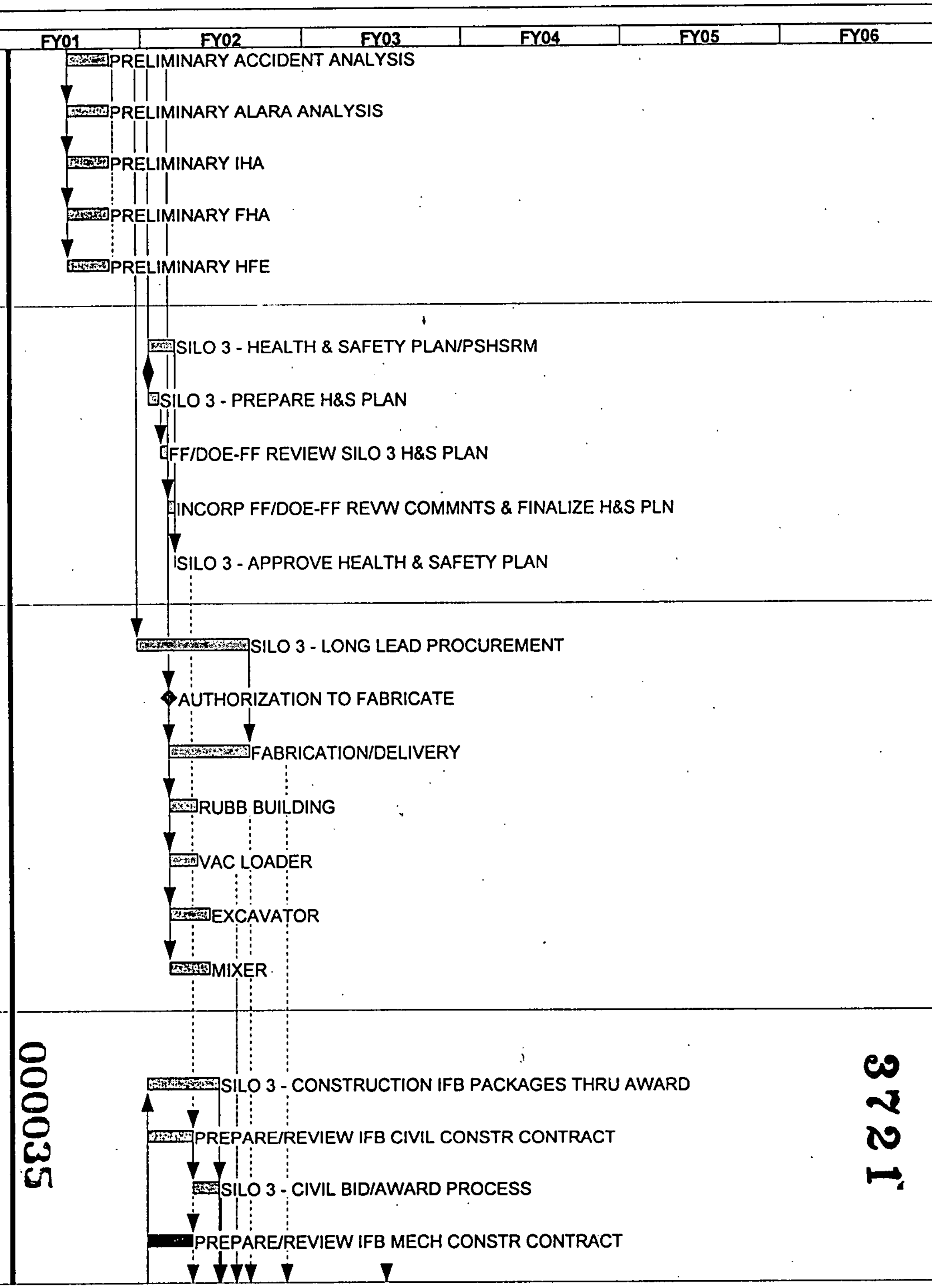
| Activity ID | Activity Description | Orig Dur | Early Start | Early Finish | TF | Cal ID |
|---|---|---|---|---|---|---|
| HS3B3710 | PRELIMINARY ACCIDENT ANALYSIS | 60 | 16APR01 | 18JUL01 | 14 | 6 |
| HS3B3720 | PRELIMINARY ALARA ANALYSIS | 60 | 16APR01 | 18JUL01 | 14 | 6 |
| HS3B3730 | PRELIMINARY IHA | 60 | 16APR01 | 18JUL01 | 14 | 6 |
| HS3B3740 | PRELIMINARY FHA | 60 | 16APR01 | 18JUL01 | 14 | 6 |
| HS3B3750 | PRELIMINARY HFE | 60 | 16APR01 | 18JUL01 | 14 | 6 |
| **MA36 Health & Safety Plan** | | | | | | |
| HS3B4210 | SILO 3 - HEALTH & SAFETY PLAN/PSHSRM | 37* | 15OCT01 | 13DEC01 | 20 | 6 |
| HS3B4220 | SILO 3 - PREPARE H&S PLAN | 18 | 15OCT01 | 08NOV01 | 20 | 6 |
| HS3B4226 | FF/DOE-FF REVIEW SILO 3 H&S PLAN | 9 | 13NOV01 | 28NOV01 | 20 | 6 |
| HS3B4232 | INCORP FF/DOE-FF REVW COMMNTS & FINALIZE H&S PLN | 9 | 29NOV01 | 12DEC01 | 20 | 6 |
| HS3B4238 | SILO 3 - APPROVE HEALTH & SAFETY PLAN | 1 | 13DEC01 | 13DEC01 | 20 | 6 |
| **MA38 Procurement** | | | | | | |
| HS3B4910 | SILO 3 - LONG LEAD PROCUREMENT | 156 | 17SEP01 | 29MAY02 | 53 | 6 |
| HS3B5110 | AUTHORIZATION TO FABRICATE | 0 | 28NOV01 | | 36 | 6 |
| HS3B5210 | FABRICATION/DELIVERY | 125 | 28NOV01 | 29MAY02 | 59 | 1 |
| HS3B5240 | RUBB BUILDING | 42 | 28NOV01 | 29JAN02 | 93 | 1 |
| HS3B5280 | VAC LOADER | 42 | 28NOV01 | 29JAN02 | 61 | 1 |
| HS3B5281 | EXCAVATOR | 63 | 28NOV01 | 28FEB02 | 40 | 1 |
| HS3B5320 | MIXER | 63 | 28NOV01 | 28FEB02 | 40 | 1 |
| **HS3AC SILO 3 CONSTRUCTION MANAGEMENT** | | | | | | |
| **MA46 Construction** | | | | | | |
| HS3C1210 | SILO 3 - CONSTRUCTION IFB PACKAGES THRU AWARD | 89* | 09OCT01 | 21MAR02 | 7 | 2 |
| HS3C1312 | PREPARE/REVIEW IFB CIVIL CONSTR CONTRACT | 54 | 09OCT01* | 17JAN02 | 7 | 2 |
| HS3C1316 | SILO 3 - CIVIL BID/AWARD PROCESS | 35 | 21JAN02 | 21MAR02 | 7 | 2 |
| HS3C1348 | PREPARE/REVIEW IFB MECH CONSTR CONTRACT | 54 | 09OCT01* | 17JAN02 | 0 | 2 |

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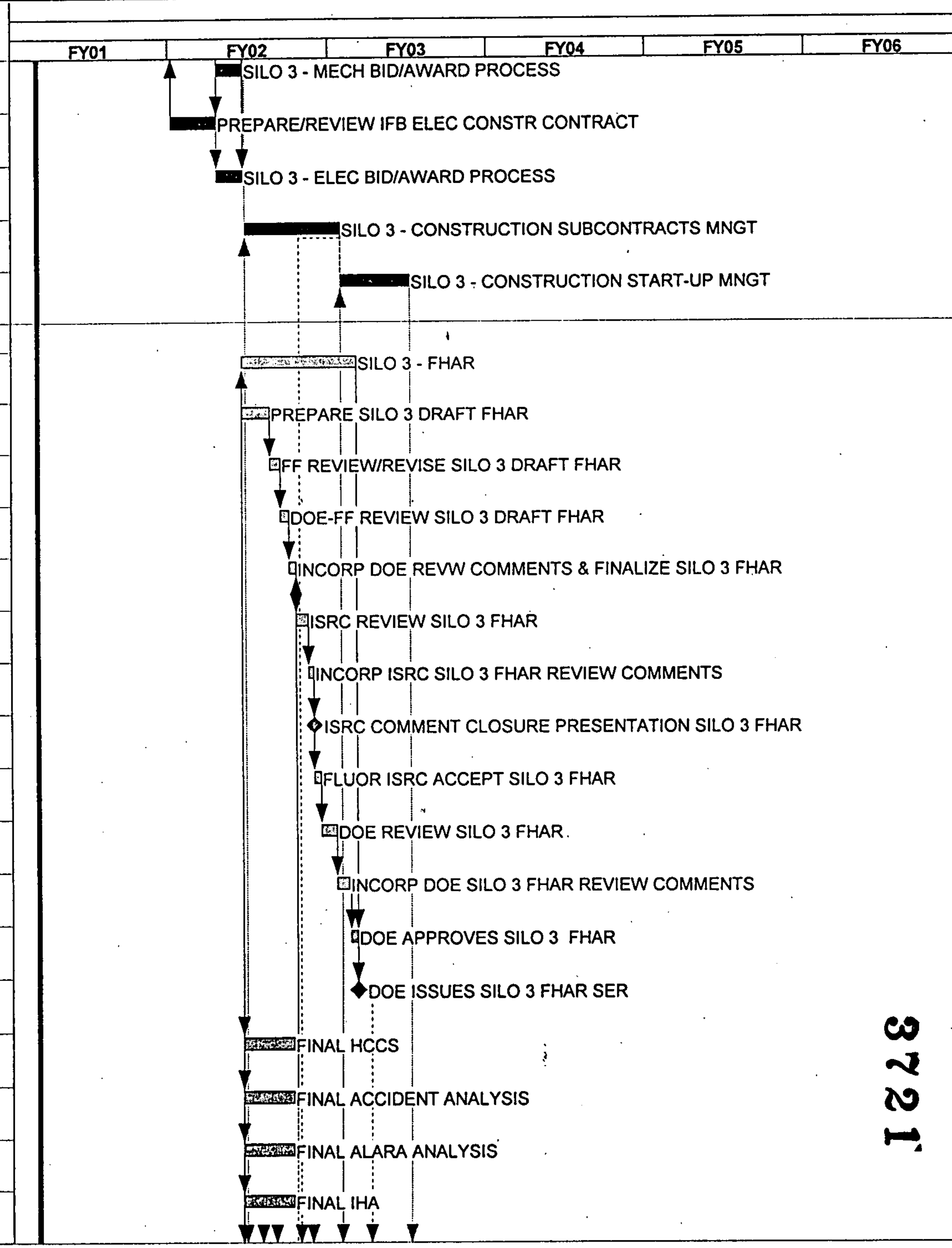
| Activity ID | Activity Description | Orig Dur | Early Start | Early Finish | TF | Cal ID |
|---|---|---|---|---|---|---|
| HS3C1352 | SILO 3 - MECH BID/AWARD PROCESS | 35 | 21JAN02 | 21MAR02 | 0 | 2 |
| HS3C1512 | PREPARE/REVIEW IFB ELEC CONSTR CONTRACT | 54 | 09OCT01* | 17JAN02 | 0 | 2 |
| HS3C1516 | SILO 3 - ELEC BID/AWARD PROCESS | 35 | 21JAN02 | 21MAR02 | 0 | 2 |
| HS3C1610 | SILO 3 - CONSTRUCTION SUBCONTRACTS MNGT | 123* | 25MAR02 | 29OCT02 | 0 | 2 |
| HS3C1660 | SILO 3 - CONSTRUCTION START-UP MNGT | 86* | 30OCT02 | 08APR03 | 0 | 2 |
| **MA52 FHAR Documentation** | | | | | | |
| HS3C2110 | SILO 3 - FHAR | 163* | 18MAR02 | 04DEC02 | 18 | 6 |
| HS3C2120 | PREPARE SILO 3 DRAFT FHAR | 40 | 18MAR02* | 17MAY02 | 18 | 6 |
| HS3C2130 | FF REVIEW/REVISE SILO 3 DRAFT FHAR | 14 | 20MAY02 | 11JUN02 | 18 | 6 |
| HS3C2140 | DOE-FF REVIEW SILO 3 DRAFT FHAR | 14 | 12JUN02 | 02JUL02 | 18 | 6 |
| HS3C2150 | INCORP DOE REVW COMMENTS & FINALIZE SILO 3 FHAR | 9 | 03JUL02 | 17JUL02 | 18 | 6 |
| HS3C2160 | ISRC REVIEW SILO 3 FHAR | 18 | 18JUL02 | 14AUG02 | 18 | 6 |
| HS3C2170 | INCORP ISRC SILO 3 FHAR REVIEW COMMENTS | 9 | 15AUG02 | 28AUG02 | 18 | 6 |
| HS3C2180 | ISRC COMMENT CLOSURE PRESENTATION SILO 3 FHAR | 0 | 29AUG02 | | 18 | 6 |
| HS3C2190 | FLUOR ISRC ACCEPT SILO 3 FHAR | 9 | 29AUG02 | 12SEP02 | 18 | 6 |
| HS3C2200 | DOE REVIEW SILO 3 FHAR | 25 | 13SEP02 | 17OCT02 | 21 | 1 |
| HS3C2220 | INCORP DOE SILO 3 FHAR REVIEW COMMENTS | 18 | 18OCT02 | 15NOV02 | 19 | 6 |
| HS3C2230 | DOE APPROVES SILO 3 FHAR | 11 | 18NOV02 | 04DEC02 | 21 | 1 |
| HS3C2240 | DOE ISSUES SILO 3 FHAR SER | 0 | | 04DEC02 | 21 | 1 |
| HS3C2400 | FINAL HCCS | 70 | 18MAR02 | 08JUL02 | 25 | 6 |
| HS3C2410 | FINAL ACCIDENT ANALYSIS | 70 | 18MAR02 | 08JUL02 | 25 | 6 |
| HS3C2420 | FINAL ALARA ANALYSIS | 70 | 18MAR02 | 08JUL02 | 25 | 6 |
| HS3C2430 | FINAL IHA | 70 | 18MAR02 | 08JUL02 | 25 | 6 |

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| Activity ID | Activity Description | Orig Dur | Early Start | Early Finish | TF | Cal ID |
|---|---|---|---|---|---|---|
| HS3C2440 | FINAL FHA | 70 | 18MAR02 | 08JUL02 | 25 | 6 |
| HS3C2450 | FINAL HFE | 70 | 18MAR02 | 08JUL02 | 25 | 6 |
| **HS3AD SILO 3 SUBCONTRACTS** | | | | | | |
| HS3D0322 | SILO 3 - CONTRACTOR MOBILIZATION | 20* | 25MAR02 | 25APR02 | 0 | 2 |
| HS3D0326 | SILO 3 - CIVIL CONTRACTOR MOBILIZATION | 20 | 25MAR02 | 25APR02 | 7 | 2 |
| HS3D0331 | SILO 3 - CONTRACTOR FIELDWORK | 103* | 29APR02 | 29OCT02 | 0 | 2 |
| HS3D0332 | SILO 3 - CIVIL CONTRACTOR FIELDWORK | 49* | 29APR02 | 24JUL02 | 7 | 2 |
| HS3D0335 | FOUNDATIONS - CIVIL | 19 | 29APR02 | 30MAY02 | 7 | 2 |
| HS3D0445 | CONTAINMENT - CIVIL | 38 | 31MAY02 | 24JUL02 | 9 | 1 |
| HS3D0526 | SILO 3 - MECH CONTRACTOR MOBILIZATION | 20 | 25MAR02 | 25APR02 | 0 | 2 |
| HS3D0532 | SILO 3 - MECH CONTRACTOR FIELDWORK | 103 | 29APR02 | 29OCT02 | 0 | 2 |
| HS3D0726 | SILO 3 - ELEC CONTRACTOR MOBILIZATION | 20 | 25MAR02 | 25APR02 | 0 | 2 |
| HS3D0732 | SILO 3 - ELEC CONTRACTOR FIELDWORK | 103 | 29APR02 | 29OCT02 | 0 | 2 |
| HS3D1210 | SILO 3 - CONSTRUCTION ACCEPTANCE TESTING | 38 | 22AUG02 | 29OCT02 | 0 | 2 |
| **HS3AE SILO 3 START-UP/START-UP REVIEW** | | | | | | |
| **MA82 Procedures/SOTS/ORR** | | | | | | |
| HS3E0030 | SILO 3 - START-UP MANAGEMENT | 193* | 25MAR02 | 11MAR03 | 0 | 2 |
| HS3E0210 | SILO 3 - OPERATING PROCEDURES | 76* | 25MAR02 | 06AUG02 | 15 | 2 |
| HS3E0214 | PREPARE SILO 3 OPERATING PROCEDURES | 48 | 25MAR02 | 17JUN02 | 1 | 2 |
| HS3E0216 | FF/DOE-FF REVIEW SILO 3 OPERATING PROCEDURES | 12 | 18JUN02 | 09JUL02 | 1 | 2 |
| HS3E0218 | INCORP FF/DOE-FF COMMNTS & REVISE OPS PROCEDURES | 12 | 10JUL02 | 30JUL02 | 15 | 2 |
| HS3E0222 | APPROVE SILO 3 OPERATING PROCEDURES | 4 | 31JUL02 | 06AUG02 | 15 | 2 |
| HS3E0226 | INCORP SOT LESSONS LEARNED INTO OPS PROCED | 17 | 04DEC02 | 07JAN03 | 0 | 2 |
| HS3E0240 | SILO 3 - MAINTENANCE PLAN | 76* | 25MAR02 | 06AUG02 | 15 | 2 |

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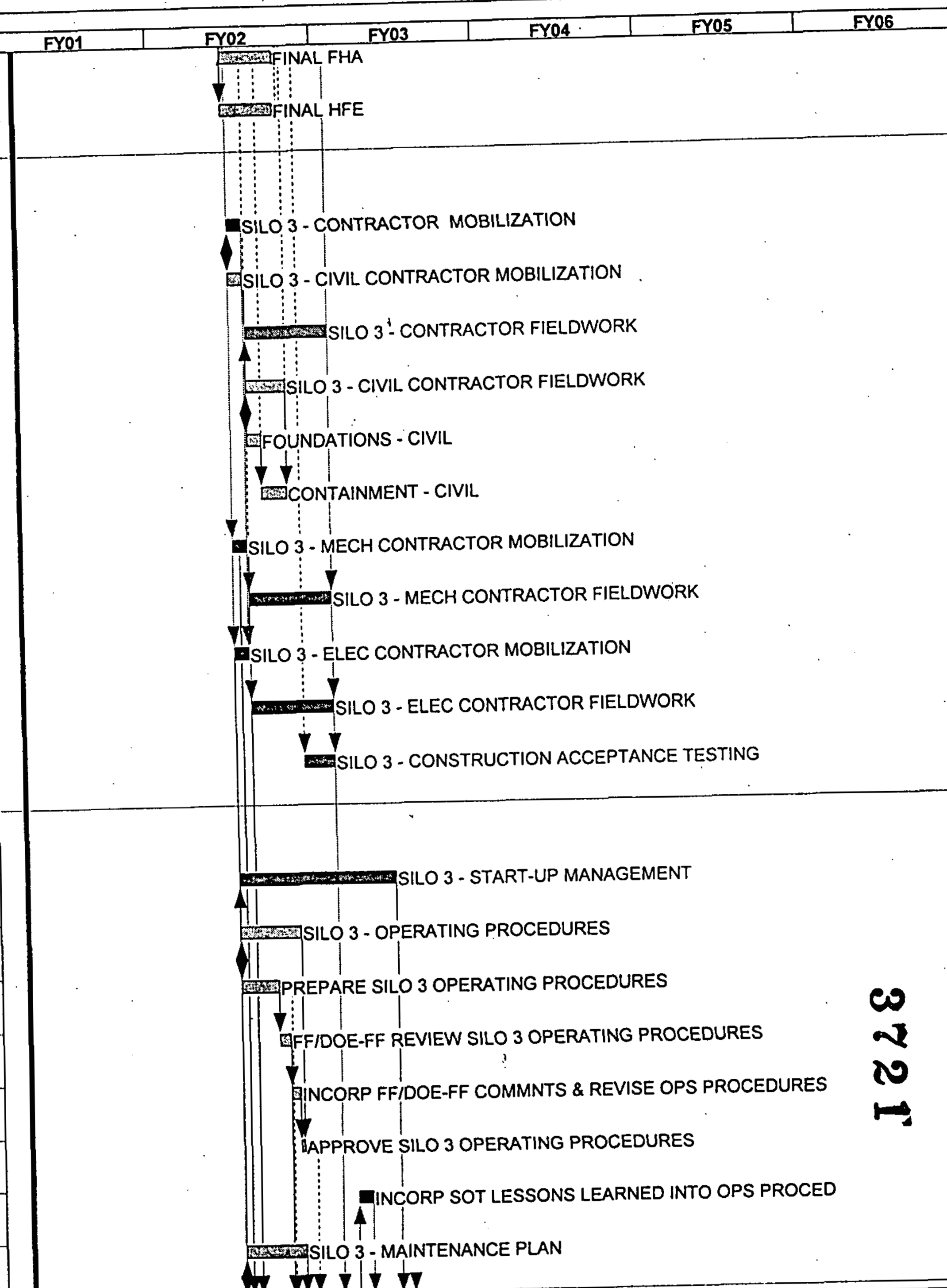


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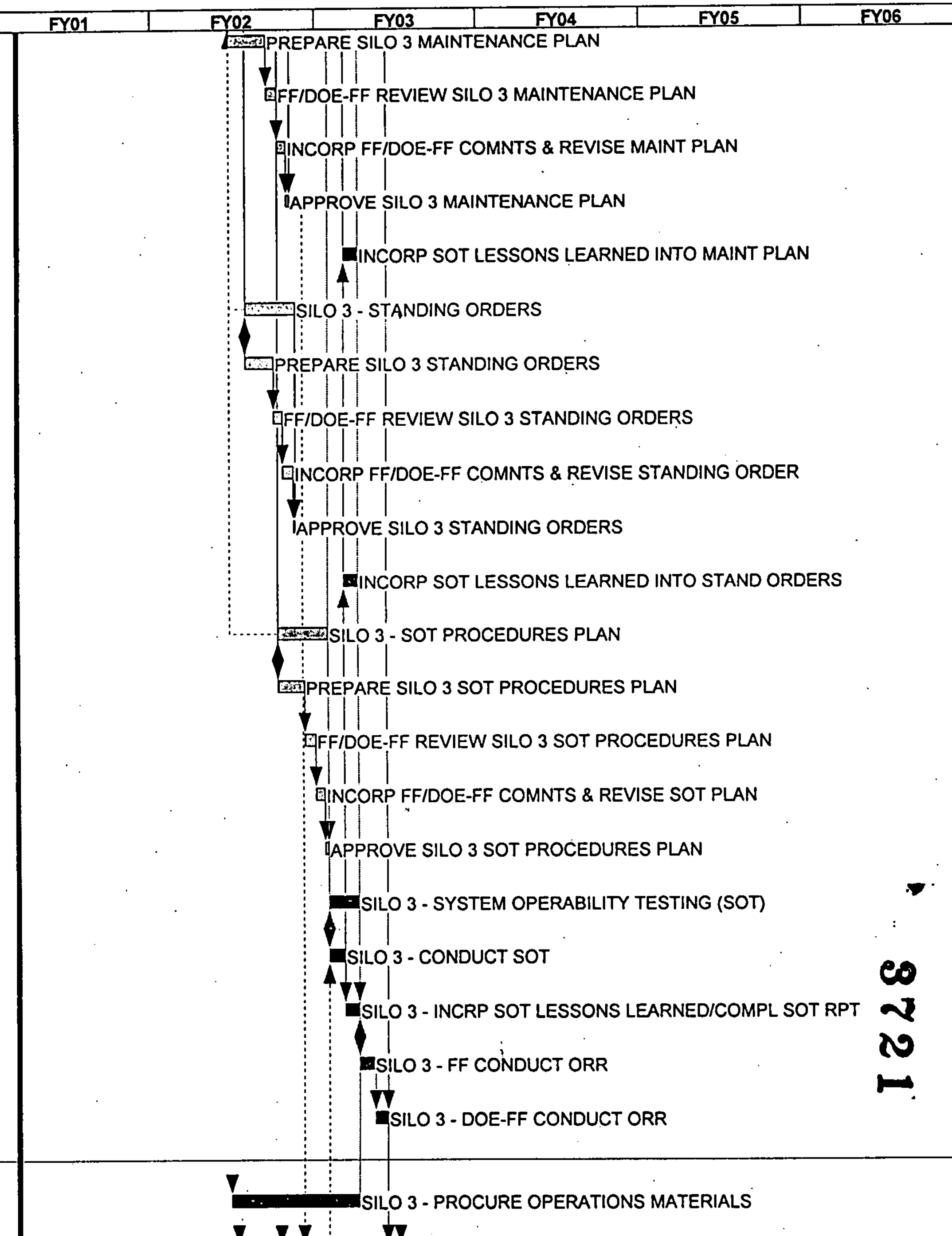
| Activity ID | Activity Description | Orig Dur | Early Start | Early Finish | TF | Cal ID |
|---|---|---|---|---|---|---|
| HS3E0244 | PREPARE SILO 3 MAINTENANCE PLAN | 48 | 25MAR02 | 17JUN02 | 15 | 2 |
| HS3E0246 | FF/DOE-FF REVIEW SILO 3 MAINTENANCE PLAN | 12 | 18JUN02 | 09JUL02 | 15 | 2 |
| HS3E0248 | INCORP FF/DOE-FF COMNTS & REVISE MAINT PLAN | 12 | 10JUL02 | 30JUL02 | 15 | 2 |
| HS3E0252 | APPROVE SILO 3 MAINTENANCE PLAN | 4 | 31JUL02 | 06AUG02 | 15 | 2 |
| HS3E0256 | INCORP SOT LESSONS LEARNED INTO MAINT PLAN | 17 | 04DEC02 | 07JAN03 | 0 | 2 |
| HS3E0270 | SILO 3 - STANDING ORDERS | 64* | 29APR02 | 20AUG02 | 7 | 2 |
| HS3E0274 | PREPARE SILO 3 STANDING ORDERS | 36 | 29APR02 | 01JUL02 | 7 | 2 |
| HS3E0276 | FF/DOE-FF REVIEW SILO 3 STANDING ORDERS | 12 | 02JUL02 | 23JUL02 | 7 | 2 |
| HS3E0278 | INCORP FF/DOE-FF COMNTS & REVISE STANDING ORDER | 12 | 24JUL02 | 13AUG02 | 7 | 2 |
| HS3E0282 | APPROVE SILO 3 STANDING ORDERS | 4 | 14AUG02 | 20AUG02 | 7 | 2 |
| HS3E0286 | INCORP SOT LESSONS LEARNED INTO STAND ORDERS | 17 | 04DEC02 | 07JAN03 | 0 | 2 |
| HS3E0900 | SILO 3 - SOT PROCEDURES PLAN | 62* | 10JUL02 | 28OCT02 | 1 | 2 |
| HS3E0908 | PREPARE SILO 3 SOT PROCEDURES PLAN | 34 | 10JUL02 | 09SEP02 | 1 | 2 |
| HS3E0916 | FF/DOE-FF REVIEW SILO 3 SOT PROCEDURES PLAN | 12 | 10SEP02 | 30SEP02 | 1 | 2 |
| HS3E0924 | INCORP FF/DOE-FF COMNTS & REVISE SOT PLAN | 12 | 01OCT02 | 21OCT02 | 1 | 2 |
| HS3E0932 | APPROVE SILO 3 SOT PROCEDURES PLAN | 4 | 22OCT02 | 28OCT02 | 1 | 2 |
| HS3E1010 | SILO 3 - SYSTEM OPERABILITY TESTING (SOT) | 35* | 30OCT02 | 07JAN03 | 0 | 2 |
| HS3E1015 | SILO 3 - CONDUCT SOT | 18 | 30OCT02 | 03DEC02 | 0 | 2 |
| HS3E1025 | SILO 3 - INCRP SOT LESSONS LEARNED/COMPL SOT RPT | 17 | 04DEC02 | 07JAN03 | 0 | 2 |
| HS3E1110 | SILO 3 - FF CONDUCT ORR | 18 | 08JAN03 | 06FEB03 | 0 | 2 |
| HS3E1160 | SILO 3 - DOE-FF CONDUCT ORR | 17 | 10FEB03 | 11MAR03 | 0 | 2 |
| **MA84 Equipment Testing & Materials** | | | | | | |
| HS3E2210 | SILO 3 - PROCURE OPERATIONS MATERIALS | 158* | 25MAR02 | 07JAN03 | 0 | 2 |

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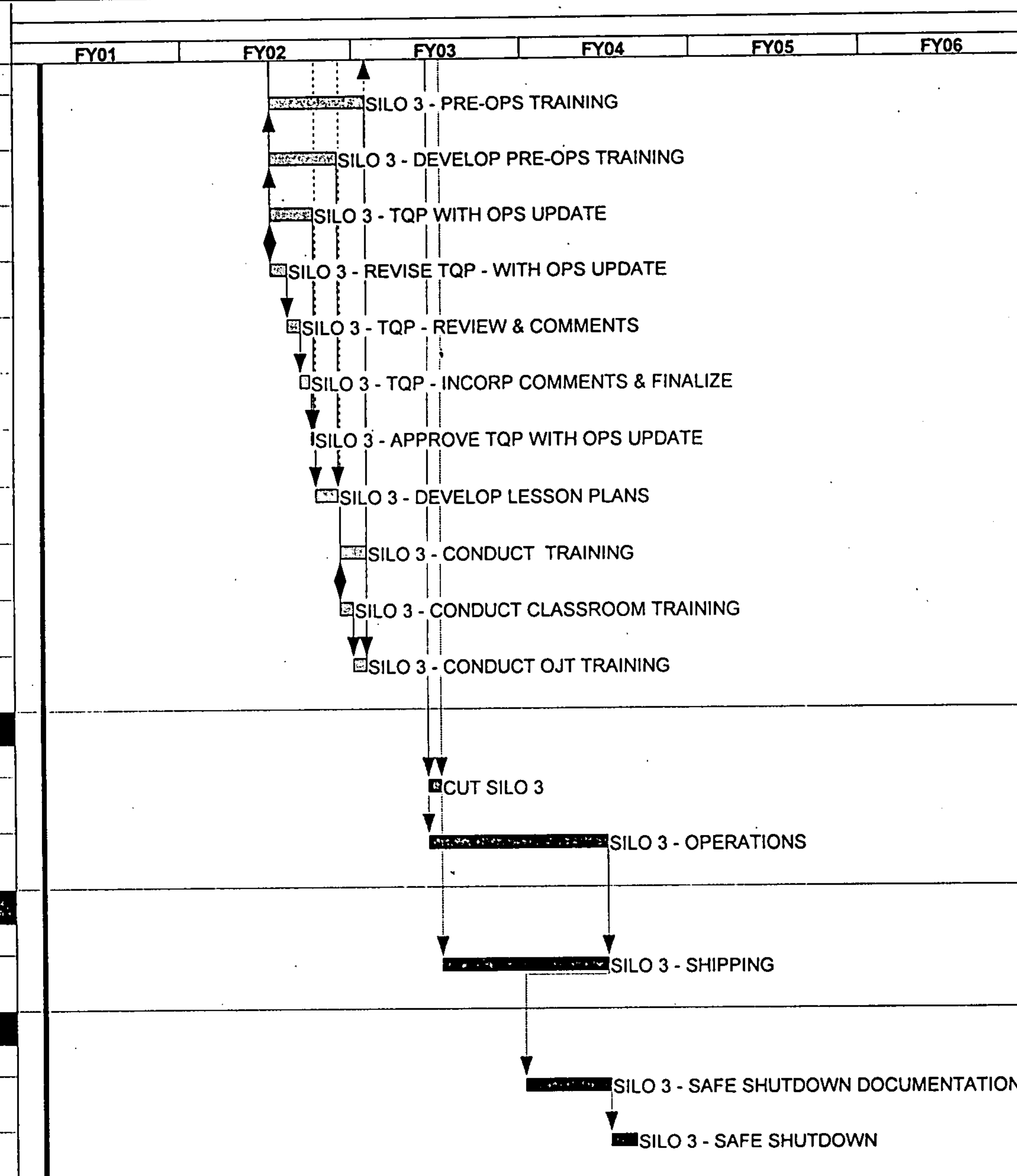
| Activity ID | Activity Description | Orig Dur | Early Start | Early Finish | TF | Cal ID |
|---|---|---|---|---|---|---|
| **MA86 Training** | | | | | | |
| HS3E3110 | SILO 3 - PRE-OPS TRAINING | 112* | 10APR02 | 28OCT02 | 1 | 2 |
| HS3E3200 | SILO 3 - DEVELOP PRE-OPS TRAINING | 80* | 10APR02 | 29AUG02 | 1 | 2 |
| HS3E3210 | SILO 3 - TQP WITH OPS UPDATE | 52* | 10APR02 | 11JUL02 | 1 | 2 |
| HS3E3214 | SILO 3 - REVISE TQP - WITH OPS UPDATE | 20 | 10APR02 | 14MAY02 | 1 | 2 |
| HS3E3218 | SILO 3 - TQP - REVIEW & COMMENTS | 14 | 15MAY02 | 10JUN02 | 1 | 2 |
| HS3E3222 | SILO 3 - TQP - INCORP COMMENTS & FINALIZE | 14 | 11JUN02 | 03JUL02 | 1 | 2 |
| HS3E3226 | SILO 3 - APPROVE TQP WITH OPS UPDATE | 4 | 08JUL02 | 11JUL02 | 1 | 2 |
| HS3E3514 | SILO 3 - DEVELOP LESSON PLANS | 28 | 15JUL02 | 29AUG02 | 1 | 2 |
| HS3E3520 | SILO 3 - CONDUCT TRAINING | 32* | 03SEP02 | 28OCT02 | 1 | 2 |
| HS3E3528 | SILO 3 - CONDUCT CLASSROOM TRAINING | 18 | 03SEP02 | 02OCT02 | 1 | 2 |
| HS3E3536 | SILO 3 - CONDUCT OJT TRAINING | 14 | 03OCT02 | 28OCT02 | 1 | 2 |
| **HS3AF SILO 3 REMEDIAL ACTION** | | | | | | |
| HS3F0510 | CUT SILO 3 | 16 | 12MAR03 | 08APR03 | 0 | 2 |
| HS3F0710 | SILO 3 - OPERATIONS | 214 | 12MAR03 | 01APR04 | 0 | 2 |
| **HS3AG SILO 3 SHIPPING** | | | | | | |
| HS3G0410 | SILO 3 - SHIPPING | 198 | 09APR03 | 01APR04 | 0 | 2 |
| **HS3AH SILO 3 SHUTDOWN** | | | | | | |
| HS3H0210 | SILO 3 - SAFE SHUTDOWN DOCUMENTATION | 110 | 07OCT03 | 05APR04 | 0 | 6 |
| HS3H0610 | SILO 3 - SAFE SHUTDOWN | 33 | 06APR04 | 02JUN04 | 0 | 2 |

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The schedule includes nine months for Remedial Design, which entails the following activities:

- Bench-Scale Testing – to develop the treatment formulation
- Conceptual Design
- Preliminary Design
- Structural Evaluation – to determine if reinforcing of the silo is required when cutting the opening
- Final Design
- Remedial Design Package development – for submission to US and Ohio EPAs
- Preliminary Hazard Analysis Report (and supporting analyses) development
- Health and Safety Plan development
- Equipment Procurement

The development of the Remedial Design (RD) Package is tied to completion of design. This puts the RD Package on the critical path.

Construction is scheduled to take seven months, from the award of subcontracts to the completion of construction acceptance testing. Construction includes the following activities:

- IFB Package development
- Final Hazard Analysis Report (and supporting analyses) development
- IFB Bid and Award
- Civil, Mechanical & Electrical Fieldwork
- Subcontract Management
- Construction Acceptance Testing

The Construction schedule allows two months after completion of design, for award of subcontracts. Opportunity exists to reduce the schedule by two months if WISE Construction can be used and the bid process eliminated.

The schedule includes seven months for Startup, which will be conducted in parallel with construction and entails the following activities:

- Operating Procedure development
- Maintenance Plan development
- Standing Orders development
- Training
- System Operability Testing (SOT) Plan/Procedure development
- SOTs
- Fluor Fernald Readiness Review (ORR)
- DOE Readiness Review (ORR)
- Procurement of Operations Materials

It is expected that minimal procedures will be required due to the limited equipment and simplicity of the operation.

The schedule includes 12 months to complete Operations, which entails:

- Cutting the Silo Opening
- Retrieval
- Treatment
- Packaging
- Shipping

The 12 month operating schedule matches the availability of excess capacity for WPRAP rail shipments and does not impact the current throughput of IT's operation. Operations is currently scheduled to take one year to complete, based on the greatest anticipated material volume in Silo 3. However, due to the uncertainty of the actual volume of material in Silo 3, the operations duration could be reduced by as much as 6 months.

The schedule also includes two months to complete Safe Shutdown activities after completion of treatment.

### Cost Estimate

A phased project estimate is presented in the discussion of Step 4 (Table 8). The total cost is estimated to be approximately $25.8 million (FY01 dollars). If the schedule improvements mentioned previously were to occur, the cost of this scenario could be reduced by as much as $2.5 million, to $23.3 million. The estimated cost includes engineering resources to complete design; equipment costs; construction labor; startup and operations labor and materials; D&D labor, equipment, and materials; and DOE costs (utilities, shipping and disposal). Cost estimates assume that the project will be completed prior to WPRAP shutdown so that WPRAP resources can be utilized.

### Risks

As in all scenarios evaluated for Silo 3, the majority of technical risk is associated with the retrieval of the Silo 3 material. Below are some of the key risks associated with this approach which will be considered during planning:

- airborne radioactivity/contamination control during material handling
- remote operation of excavator
- silo integrity
- failure to obtain DOT exemption
- rail shutdown
- turn-around-time of railcars at Envirocare
- failing TCLP
- over-engineering process to control all potential risks (e.g., redundant equipment, automated systems, climate controls, etc.)
- use of supersaks as a new container on-site
- WPRAP utilization of unit train full capacity, eliminating cars for Silo 3 material

## Other Opportunities for Improvement

Should the airborne radioactivity issues at WPRAP and Envirocare be overcome, the potential exists to reduce costs further by using bulk transfer to WPRAP, blending with waste pits material, and shipping in bulk by gondola car to Envirocare. This opportunity is projected to result in an approximately $0.4 million reduction in cost.

The potential also exists through value engineering during design to eliminate the closed mixer and use an open-pit mixing approach. This enhancement would require EPA and radiological controls support.

## Basis and Assumptions for Schedule and Cost

Management Assumptions

- No change in ROD is required
- No additional material will be retrieved from Silo 3 for treatability testing
- Stakeholder acceptance of the new approach
- Standard EPA/DOE review process and cycles
- A contract modification with IT will be executed to allow shipment through the existing WPRAP facility
- The Army Corps of Engineers contract with Envirocare will be used to allow disposal of Silo 3 material
- A DOT exemption will be obtained to allow Silo 3 material to be shipped in gondola cars as strong-tight containers
- The rail contract with Union Pacific/CSX will be modified to allow shipment of Silo 3 material
- Subcontractor support will be obtained to support design or other activities as required.

Design Approach Assumptions

- Design will be completed by Fluor Fernald or its teaming partners
- Mechanical retrieval of Silo 3 material
- One-third, and probably two-thirds, of the material in the silo requires mechanical agitation prior to removal due to the presence of compacted material
- Chemical stabilization to meet ROD requirements
- Treatment with Envirobond (provided by RMRS at no cost) and ferrous sulfate
- Material chemical and radiological characteristics fall within the range in the RI/FS
- 3,925 tons of material in Silo 3 (5,088 yd$^3$)
- Material insitu density of 58 lb/ft$^3$
- On-site treatment of the Silo 3 material
- Silo 3 material will not change the WPRAP safety basis
- The hazard category of the WPRAP facility is not changed

Design Approach Assumptions (cont.)

- The IT shipping facility will have the ability to handle the Silo 3 radiological constituents and concentrations, without any modification

Construction Assumptions

- Construction requires minimal radiological control restrictions and PPE, except limited control during excavation activities and tie-ins to existing site systems
- Process equipment will be procured and purchased by Fluor Fernald
- Utilize existing structures and utilities installed by RMRS
- Fluor Fernald will act as a general construction contractor and procure subcontractors to perform mechanical, civil, and electrical work.

Operations Assumptions

- Operations schedule based on 1 shift, 4 days per week
- An operational readiness review (ORR) will be performed on Silo 3 facilities, but not WPRAP facilities, prior to start-up
- Treated waste volume of 6,630 $yd^3$, assuming a 30% swell factor.
- Waste disposal at Envirocare at \$115.18/$yd^3$
- Waste will be packaged in 24,000 lb capacity supersaks (Lift Liner™ containers), with 9.5 $yd^3$ available capacity, and placed in gondola cars for shipment via rail to Envirocare
- No interim storage of treated material will be required prior to shipment to verify compliance with TCLP limits.
- A grab sample will be collected from the supersaks and composited with other grab samples for final sample analysis
- On-site laboratory or local off-site laboratory will be used for confirmatory analysis of treated waste samples
- Shipment must be completed by October 2004 to meet WPRAP schedule

D&D Assumptions

- 90% of Silo 3-specific equipment and facilities for Silo 3 material retrieval will be disposed in the on-site disposal cell
- D&D of Silo 3 equipment and facility and decontamination of Silo 3 structure performed by project
- Demolition of Silo 3 structure responsibility of D&D Projects
- Soil removal and demolition of concrete foundations responsibility of Soils and Water Project

# Step 3 - Analyze Alternative Scenarios as Back-up Approaches

In addition to the recommended technical approach, two alternative scenarios currently exist for remediation of Silo 3, although they are more complex in nature. These scenarios were analyzed as potential back-up approaches and are described in the following sections.

## Alternative Scenario 1 – RMRS Design

This scenario involves re-initiating the completion of the RMRS final design. The scope includes design completion, construction, start-up and operations, D&D, and waste shipping and disposal, as well as the required training of construction and operations personnel and the completion of pre-operational assessments by Fluor Fernald and the DOE. The existing design would be evaluated and modified to include design changes deemed necessary by Fluor Fernald. The shaded blocks in Table 5 reflect the approach for this scenario.

**Table 5 – Alternative Scenario 1**

| Retrieval | Stabilization | Packaging/ Transfer | Shipping | Disposal |
|---|---|---|---|---|
| Mechanical excavation | Passive stabilization – no mixing | Bulk transfer to WPRAP | Gondola – blended with pit material | Envirocare |
| Direct vacuum | Mixing screw or batch mixer | Supersaks | Gondola – Silo 3 material only | Nevada Test Site |
| Remote pneumatic | Continuous mixer | Boxes or drums | Truck | |
| Slurry retrieval | Combine with Silos 1 and 2 treatment | | Rail (non-gondola) | |

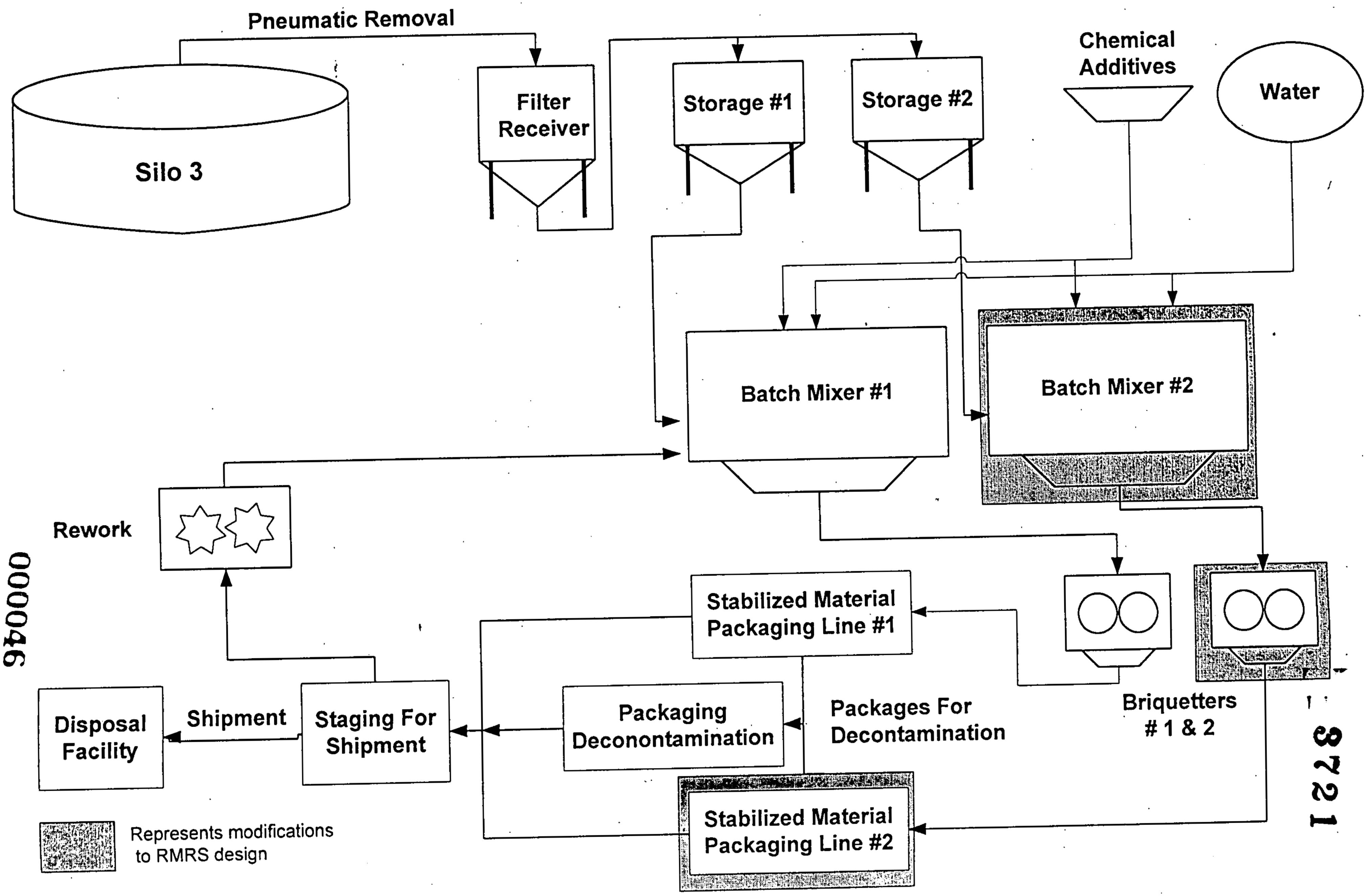
This scenario involves the retrieval of Silo 3 material using a vacuum conveyance system deployed by a remote manipulator arm. The retrieval arm would deliver the flexible portion of the conveyance system vacuum hose into Silo 3, extract the material, and transfer the material to the treatment facility.

The Silo 3 material would then be mixed with stabilizing agents and water in a continuous-feed mixer, formed into briquettes and placed into 55-gallon drums. The drums would be palletized and moved to the ISA pad for staging. The treated Silo 3 material would then be shipped by truck for final disposal at Envirocare. A conceptual process schematic is presented in Figure 3 based on a Fluor Fernald engineering assessment of RMRS' design and identification of necessary modifications.

## Performance Options

Options for performance of this scenario, if it were selected as the preferred technical approach, are presented in Table 6. This evaluation is not intended to serve as a formal make/buy determination. However, it is intended to serve as a basis for a formal make/buy determination, if one is required.

## Figure 3
## Silo 3 Process Flow Diagram
## Alternative Scenario 1



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## Table 6 - Evaluation of Performance Options for Alternative Scenario 1

| Performance Option | Pros | Cons |
|---|---|---|
| Firm Fixed Price/Firm Fixed-Unit Price Performance-based Subcontract<br><br>Subcontractor provides turn-key service to design, construct, operate, package treated waste, and perform shutdown and D&D.<br><br>Fluor Fernald ships treated waste to disposal facility. | 1. Some performance risk shifted to subcontractor due to fixed price contract. | 1. Difficulty defining scope of work to prevent or minimize changes that increase cost or schedule.<br>2. Increased price to account for subcontractor risks, contingency and profit.<br>3. Subcontractors hire same lower tier subcontractors as Fluor Fernald, but add additional level of oversight and markup.<br>4. Cannot pass down requirements adequately to support turn-key contract.<br>5. Cannot easily define cost, schedule and scope implications of needed stakeholder (regulatory, CAT, etc.) interactions and consensus building into such a contract structure.<br>6. Minimizes opportunity and increases complexity to reducing scope or project cost to DOE based on positive changes.<br>7. Funds committed in advance of actual need unless subcontract is incrementally funded.<br>8. Reduces flexibility to reprioritize funding or staff from the project to meet other site priorities.<br>9. Increased project duration to allow for procurement step<br>10. Added cost for oversight of subcontractor. |

| Performance Option | Pros | Cons |
|---|---|---|
| Self-Perform, with Contracting as Required<br><br>Fluor Fernald self-perform design using teaming partners and existing subcontractors such as Parsons, Lockwood Greene and IT.<br><br>Fluor Fernald performs construction management, with subcontractor (Wise or other) for performing construction and D&D.<br><br>Fluor Fernald self-performs operations and shutdown, with FAT&LC. | 1. Fluor Fernald is knowledgeable about scope and site conditions.<br>2. Fluor Fernald knowledgeable of cost, schedule, and scope implications of stakeholder interactions.<br>3. Opportunity to reduce scope and project cost based on positive regulatory or other changes.<br>4. Can save money and process through WPRAP facility if Envirocare handling and airborne issues are resolved.<br>5. Technical expertise for discrete work items available through Fluor Fernald, teaming partners, and existing subcontractors.<br>6. Flexibility to reprioritize funding and staff from the project to meet other site priorities.<br>7. Funds committed to project when needed, not before.<br>8. Shortened schedule due to elimination of procurement step.<br>9. No redundancy in personnel to oversee subcontractor. | 1. Liability for performance placed solely on Fluor Fernald<br>2. Cost increases shared with DOE via Fluor Fernald's cost-type contract, but mitigated by Fluor Fernald's contract incentive structure. |

Based on this evaluation, it is recommended that this scenario, if pursued, be performed by Fluor Fernald, with contracting to specialty subcontractors and others as required.

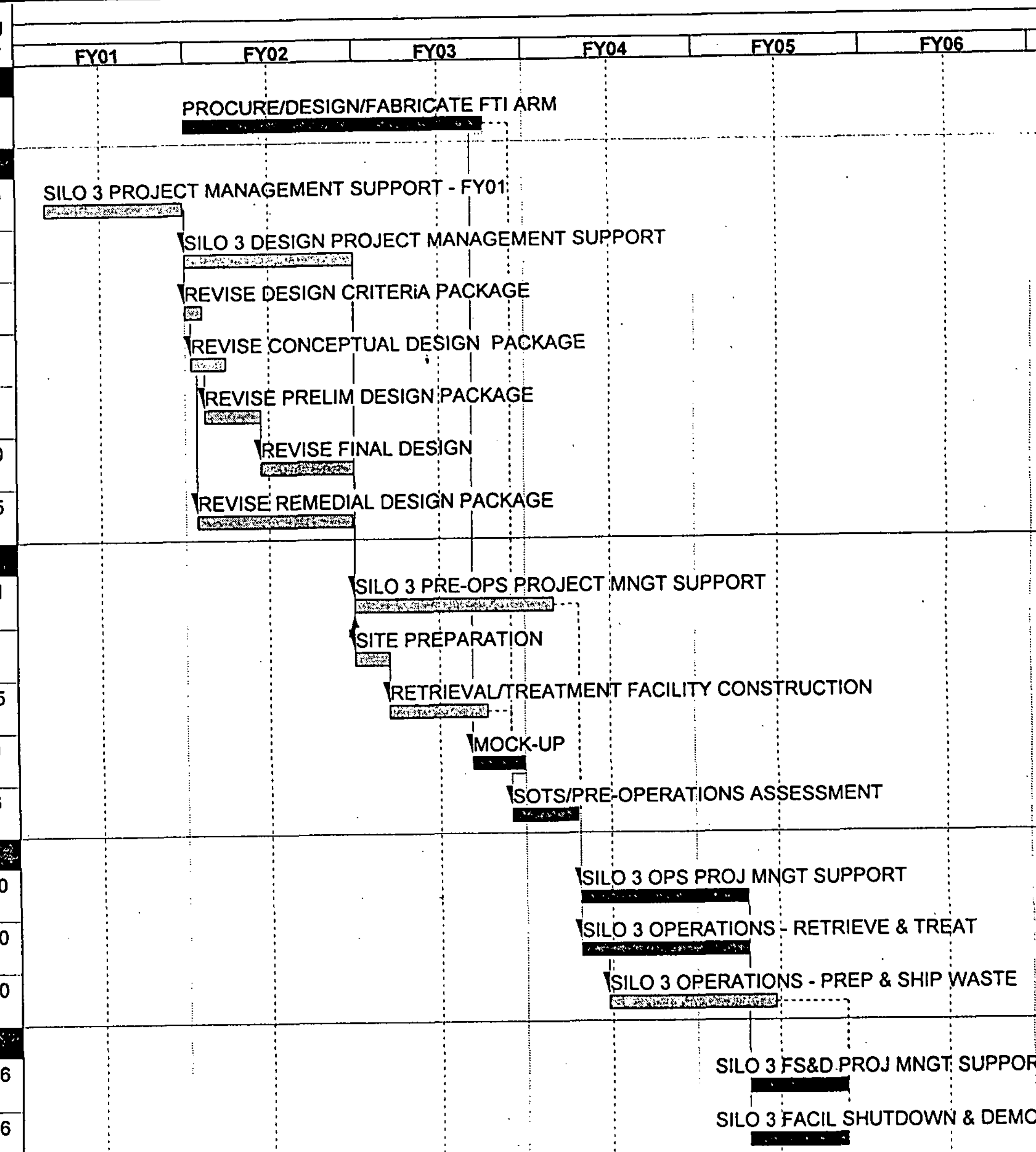
### Schedule

A project schedule for Alternative Scenario 1 is attached (Figure 4). This schedule includes 12 months to revise and complete the design, 14 months to complete construction and startup testing, 3 months to complete training and operations assessments, 12 months to perform operations, and 7 months to perform D&D. The time to complete design, construction, retrieval, treatment and shipment under this scenario is 42 months.

### Cost Estimate

A phased project estimate is presented in the discussion of Step 4 (Table 8). The total cost is estimated to be approximately $42.7 million (FY01 dollars). This cost includes engineering resources to complete design, equipment costs, construction resource and equipment, startup and operational assessment labor, operations

| Activity ID | Activity Description | Early Start | Early Finish | Orig Dur |
|---|---|---|---|---|
| **SILO 3 PROCUREMENT PROCESS** | | | | |
| 4A3P0010 | PROCURE/DESIGN/FABRICATE FTI ARM | 01OCT01* | 08JUL03 | 441 |
| **SILO 3 DESIGN** | | | | |
| 4A3R0010 | SILO 3 PROJECT MANAGEMENT SUPPORT - FY01 | 01DEC00* | 28SEP01 | 208 |
| 4A3R0015 | SILO 3 DESIGN PROJECT MANAGEMENT SUPPORT | 01OCT01 | 01OCT02 | 251 |
| 4A3S1640 | REVISE DESIGN CRITERiA PACKAGE | 01OCT01 | 09NOV01 | 30 |
| 4A3S1800 | REVISE CONCEPTUAL DESIGN PACKAGE | 15OCT01 | 28DEC01 | 50 |
| 4A3S1900 | REVISE PRELIM DESIGN PACKAGE | 13NOV01 | 12MAR02 | 80 |
| 4A3S1960 | REVISE FINAL DESIGN | 14MAR02 | 01OCT02 | 140 |
| 4A3S2009 | REVISE REMEDIAL DESIGN PACKAGE | 29OCT01 | 23SEP02 | 225 |
| **SILO 3 CONSTRUCTION & START-UP TESTING** | | | | |
| 4A3T0005 | SILO 3 PRE-OPS PROJECT MNGT SUPPORT | 02OCT02 | 02DEC03 | 291 |
| 4A3T0050 | SITE PREPARATION | 02OCT02 | 13DEC02 | 50 |
| 4A3T0100 | RETRIEVAL/TREATMENT FACILITY CONSTRUCTION | 16DEC02 | 15JUL03 | 145 |
| 4A3T0150 | MOCK-UP | 10JUN03 | 01OCT03 | 80 |
| 4A3T0200 | SOTS/PRE-OPERATIONS ASSESSMENT | 04SEP03 | 23JAN04 | 96 |
| **SILO 3 OPERATIONS** | | | | |
| 4A3U0050 | SILO 3 OPS PROJ MNGT SUPPORT | 26JAN04 | 24JAN05 | 250 |
| 4A3U0070 | SILO 3 OPERATIONS - RETRIEVE & TREAT | 26JAN04 | 24JAN05 | 250 |
| 4A3U0090 | SILO 3 OPERATIONS - PREP & SHIP WASTE | 23MAR04 | 22MAR05 | 250 |
| **SILO 3 FACILITY SHUTDOWN / DEMOB** | | | | |
| 4A3Y0150 | SILO 3 FS&D PROJ MNGT SUPPORT | 25JAN05 | 22AUG05 | 146 |
| 4A3Y0300 | SILO 3 FACIL SHUTDOWN & DEMOB | 25JAN05 | 22AUG05 | 146 |

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| Data Date | 01OCT96 |
| Run Date | 27MAR01 10:56 |



Early Bar
Progress Bar
Critical Activity

CAM2

Sheet 1 of 1

**Silo 3**
**Alternative 1**
**Project Schedule**

FERNALD
Environmental Management Project

FIGURE 4

labor and materials, D&D labor, equipment, and materials and DOE costs (utilities and disposal).

## Risks

As in all scenarios evaluated for Silo 3, the majority of technical risk is associated with the retrieval of the Silo 3 material from the silo. The following are some of the key risks associated with this approach:

- operability and maintainability of retrieval arm
- cost and schedule impacts if the design modifications have been underestimated
- arm failure
- maintaining ALARA
- air moisture in silo causes clogging of vacuum
- impact of equipment failure on continual process
- capability to remove equipment if it fails
- process control of continual process
- clogging of bag house filters
- capability of wastewater treatment system inadequate
- bridging in the briquette bin
- briquetting process does not achieve the volume reduction anticipated
- contaminated drums
- automated equipment malfunction
- keeping up with the packaging rate

## Basis and Assumptions for Schedule and Cost

Management Assumptions

- No change in ROD is required
- No additional material will be retrieved from Silo 3 for treatability testing
- Stakeholder acceptance of the approach
- Standard EPA/DOE review process and cycles

Design Approach Assumptions

- The RMRS design can be modified and final design completed within 12 months. Design modifications include: additional mixer, briquetter, packaging line and water treatment system.
- The design will be completed by Fluor Fernald or its teaming partners
- Pneumatic retrieval of the Silo 3 material
- Framatome arm (with required modifications made to improve arm operability) will be used for retrieval (sole source contract awarded and work to date salvaged)
- RMRS cost to complete design assumed as basis, with additional cost for some redesign

Design Approach Assumptions (cont.)

- One-third, and probably two-thirds, of the material in the silo requires mechanical agitation prior to removal due to the presence of compacted material
- Chemical stabilization to meet ROD requirements.
- Treatment with Envirobond (provided by RMRS at no cost)
- Material chemical and radiological characteristics fall within the range in the RI/FS
- 3,925 tons of material in Silo 3 (5,088 $yd^3$)
- Material insitu density of 58 $lb/ft^3$
- On-site treatment of the Silo 3 material
- Briquettes produced to meet radon flux criteria

Construction Assumptions

- Construction requires minimal radiological control restrictions and PPE, except limited control during excavation activities and tie-ins to existing site systems
- Process equipment will be procured and purchased by Fluor Fernald
- Utilize existing structures and utilities installed by RMRS
- Fluor Fernald will act as a general construction contractor and procure mechanical, civil, and electrical subcontractors to provide GCBCTC workers

Operations Assumptions

- Mock-up performed for operational training demonstration
- Operations schedule based on 1 shift, 4 days per week
- An ORR will be performed prior to facilities start-up
- Fluor Fernald wage labor will operate the retrieval and treatment facilities in accordance with labor agreement
- 85 weight percent waste loading
- Final waste disposal volume as packaged 6,048 $yd^3$
- Treated material will be packaged in 55-gallon drums
- Treated material disposal at Envirocare of Utah, Inc. at $115.18/$yd^3$
- Off-site laboratory will be used for confirmatory analysis of treated material samples.
- Ship treated material containers from the ISA pad
- Cost to prepare shipping area on ISA pad included in estimate
- Containers of treated material will be transported to the disposal facility via truck

D&D Assumptions

- 90% of Silo 3-specific equipment and facilities for Silo 3 material retrieval will be disposed of in the on-site disposal cell
- D&D of Silo 3 equipment and facility and decontamination of Silo 3 structure performed by project
- Demolition of Silo 3 structure responsibility of D&D Project

D&D Assumptions (cont.)

- Soil removal and demolition of concrete foundations responsibility of Soils and Water Project

## Alternative Scenario 2 - Combine with Silos 1 and 2 Treatment

Fluor Fernald is planning to treat the Silos 1 and 2 material by chemical stabilization, consistent with the treatment remedy identified in the ROD Amendment for Silos 1 and 2 Remedial Actions. The proposed process for the stabilization of the Silos 1 and 2 material is suitable for processing the retrieved material from Silo 3 and is consistent with the treatment remedy selected for Silo 3 material in the Silo 3 ESD. This scenario involves the incorporation of Silo 3 material into the Silo 1 and 2 treatment process. The shaded blocks in Table 7 reflect the approach for this scenario.

**Table 7 – Alternative Scenario 2**

| Retrieval | Stabilization | Packaging/ Transfer | Shipping | Disposal |
|---|---|---|---|---|
| Mechanical excavation | Passive stabilization – no mixing | Bulk transfer to WPRAP | Gondola – blended with pit material | Envirocare |
| Direct vacuum | Mixing screw or batch mixer | Supersaks | Gondola – Silo 3 material only | Nevada Test Site |
| Remote pneumatic | Continuous mixer | Boxes or drums | Truck | |
| Slurry retrieval | Combine with Silos 1 and 2 treatment | | Rail (non-gondola) | |

A containment structure would be constructed abutting the silo to house the retrieval equipment. A water laser would be used to cut open the silo, allowing access to the Silo 3 material. An excavator would then be deployed into the containment structure to excavate the material from the silo. Following retrieval, the Silo 3 material would be conveyed to a storage bin. A system to feed and meter the dry Silo 3 material into the Silos 1 and 2 mixer would be designed and incorporated into the stabilization process for Silos 1 and 2.

Stabilization of Silo 3 material would be accomplished by adding the Silo 3 material into the mixer along with proper additives and water and mixing to achieve a uniform consistency before the batch is discharged into the shipping container. The Silo 3 treatment components would be incorporated into the design, construction management, operations, maintenance, waste packaging, and disposition activities associated with the Silos 1 and 2 strategy. A conceptual process schematic for this approach is presented in Figure 5.

Should treatability studies indicate that there is an economic or technical benefit to blend the Silo 3 material with the Silos 1 and 2 material, then the process formulation could be adjusted accordingly.

## Performance Options

The option to utilize a design, build, operate contract for this scenario is not available. In accordance with Contract DE-AC24-01OH20115 with DOE, the Silos 1 and 2 Project will be self-performed. Self-performance of Silos 1 and 2 was a baseline improvement scenario that was incorporated into the contract.

## Schedule

A project schedule for Alternative 2 is attached (Figure 6). This schedule includes 23 months to complete Silos 1 and 2 design, 30 months to perform Silos 1 and 2 construction and startup testing, 7 months to complete Silo 3 design, and 7 months to perform Silo 3 construction and startup testing. The schedule also includes 21 months to complete operations and disposal and 12 months to perform D&D. The start and completion of treatment of Silos 1 and 2 material is not affected when Silo 3 material is treated in series; however the operations phase is extended by 6 months. Combining Silo 3 with Silos 1 and 2 extends the overall Silos 1 and 2 remediation, which remains on the critical path, by 6 months.

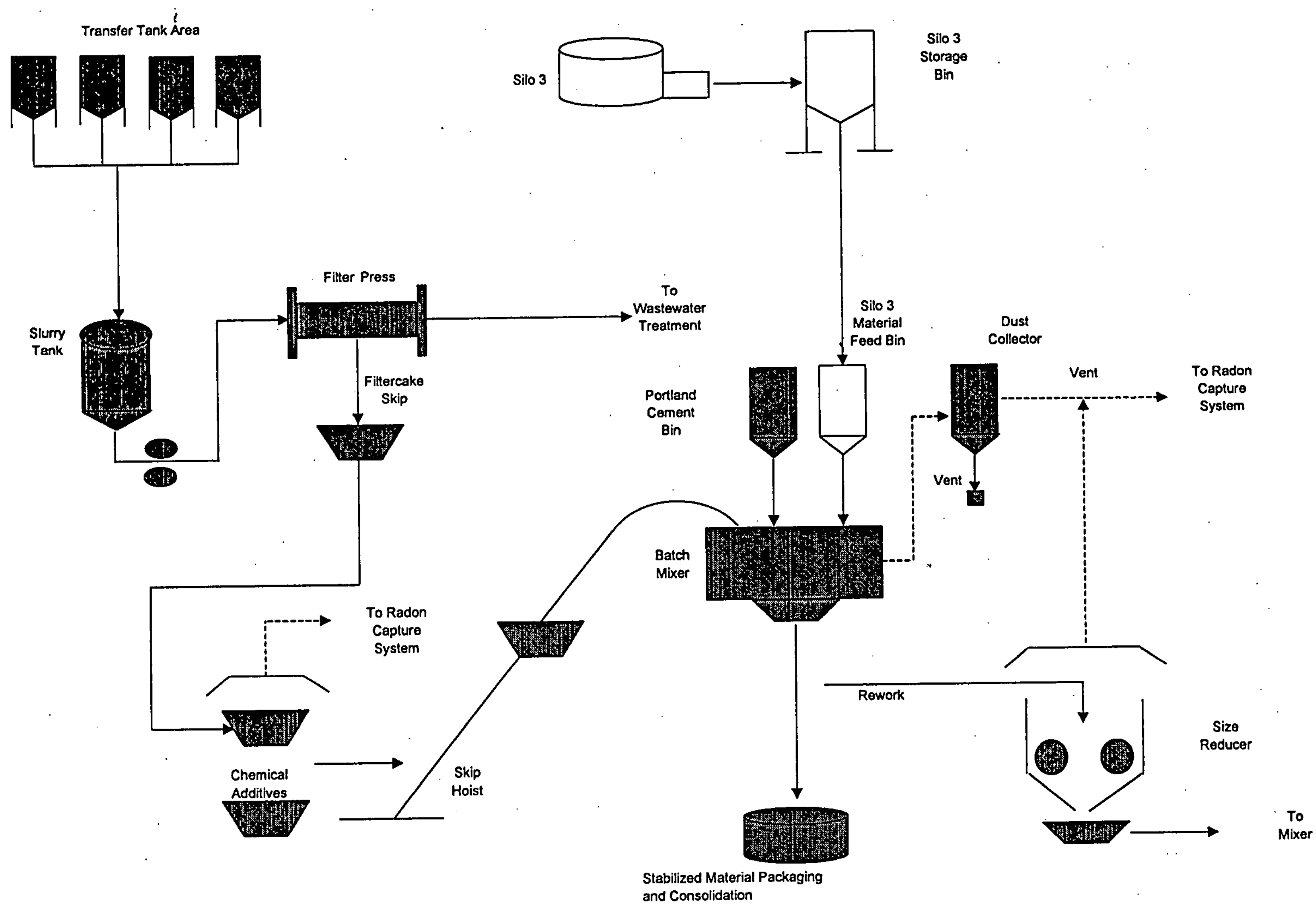
## Cost Estimate

Estimated costs for the Silo 3 portion of this scenario were based on current Silos 1 and 2 cost estimates. The total cost to be added to the Silos 1 and 2 project to complete the Silo 3 remediation concurrently is estimated at $43.7 million. A phased project estimate is presented in the discussion of Step 4 (Table 9). This cost includes engineering resources to complete design, equipment costs, construction resource and equipment, startup and operational assessment labor, operations labor and materials, D&D labor, equipment, and materials and DOE costs (utilities and disposal). This cost does not include escalation over the duration of the project.

## Risks

As in all the scenarios evaluated for Silo 3, the majority of technical risk is associated with the retrieval of the Silo 3 material from the silo and these risks are the same as

# Figure 5
# Silo 3 Process Flow Diagram
# Alternative Scenario 2

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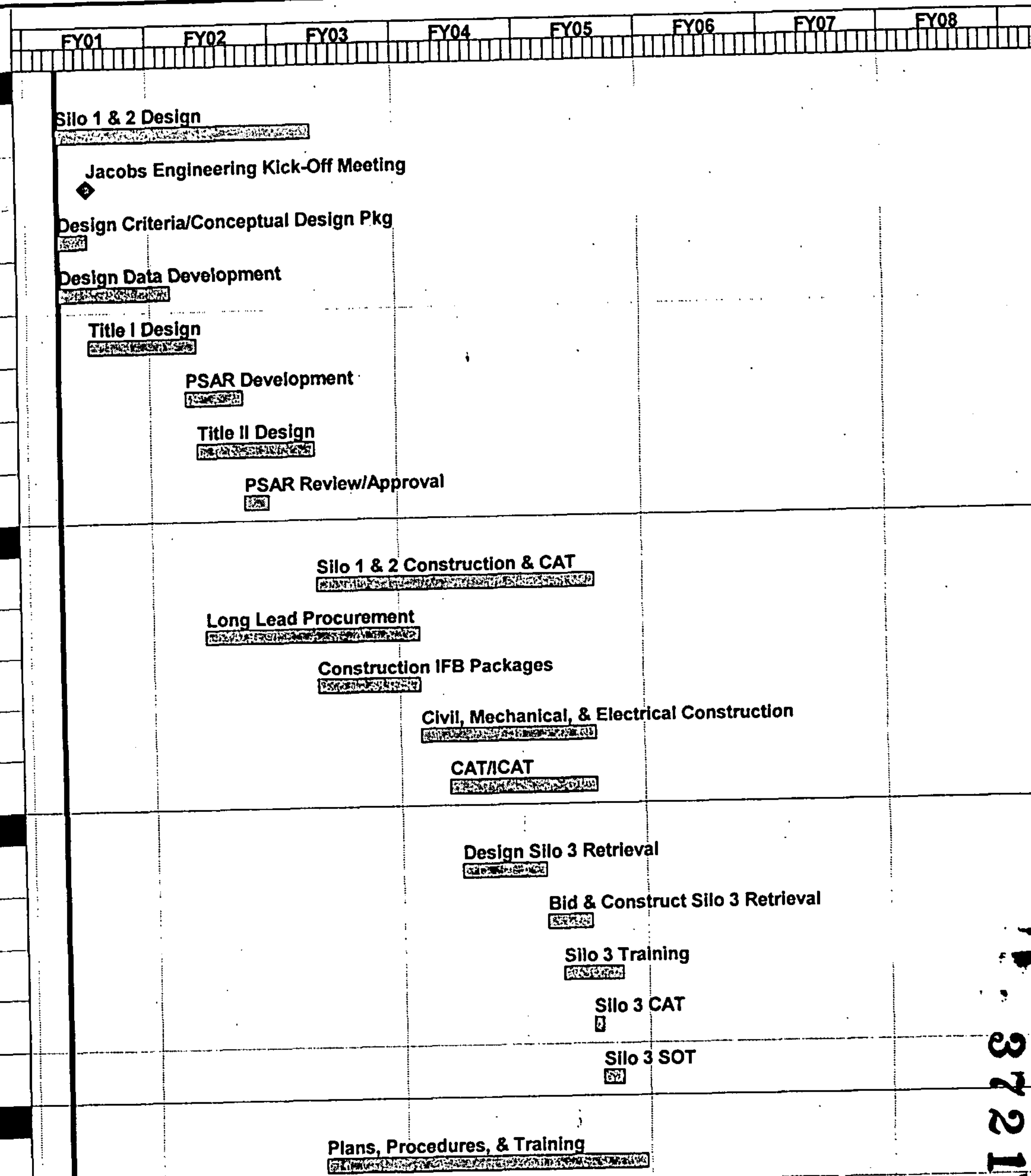
| Activity ID | Activity Description | Orig Dur | Early Start | Early Finish |
|---|---|---|---|---|
| **SILO 1 & 2 TITLE I & II DESIGN** | | | | |
| 213GQC | Silo 1 & 2 Design | 522* | 02JAN01 | 31JAN03 |
| 213GQC02 | Jacobs Engineering Kick-Off Meeting | 0 | 02APR01 | |
| 213GQC01 | Design Criteria/Conceptual Design Pkg | 63 | 02JAN01 | 30MAR01 |
| 213GQC10 | Design Data Development | 230 | 02JAN01 | 29NOV01 |
| 213GQC05 | Title I Design | 220 | 02APR01 | 15FEB02 |
| 213GQC15 | PSAR Development | 120 | 14JAN02 | 03JUL02 |
| 213GQC25 | Title II Design | 239 | 19FEB02 | 31JAN03 |
| 213GQC20 | PSAR Review/Approval | 50 | 05JUL02 | 13SEP02 |
| **SILO 1 & 2 CONSTRUCTION & CAT** | | | | |
| 213GQD | Silo 1 & 2 Construction & CAT | 568* | 03FEB03 | 10MAY05 |
| 213GQD10 | Long Lead Procurement | 441 | 05MAR02 | 05DEC03 |
| 213GQD05 | Construction IFB Packages | 211 | 03FEB03 | 04DEC03 |
| 213GQD15 | Civil, Mechanical, & Electrical Construction | 357 | 05DEC03 | 10MAY05 |
| 213GQD25 | CAT/ICAT | 305 | 23FEB04 | 10MAY05 |
| **SILO 3 INTEGRATION** | | | | |
| 213GQF05 | Design Silo 3 Retrieval | 170 | 01APR04* | 03DEC04 |
| 213GQF10 | Bid & Construct Silo 3 Retrieval | 90 | 06DEC04 | 15APR05 |
| 213GQF25 | Silo 3 Training | 125 | 17JAN05 | 14JUL05 |
| 213GQF20 | Silo 3 CAT | 20 | 18APR05 | 13MAY05 |
| 213GQF30 | Silo 3 SOT | 42 | 16MAY05 | 14JUL05 |
| **SILO 1 & 2 TRAINING & SOT** | | | | |
| 213GQD30 | Plans, Procedures, & Training | 658 | 03FEB03 | 16SEP05 |

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| Data Date | 02JAN01 |
| Run Date | 27MAR01 09:39 |

Early Bar
Progress Bar
Critical Activity

S12D

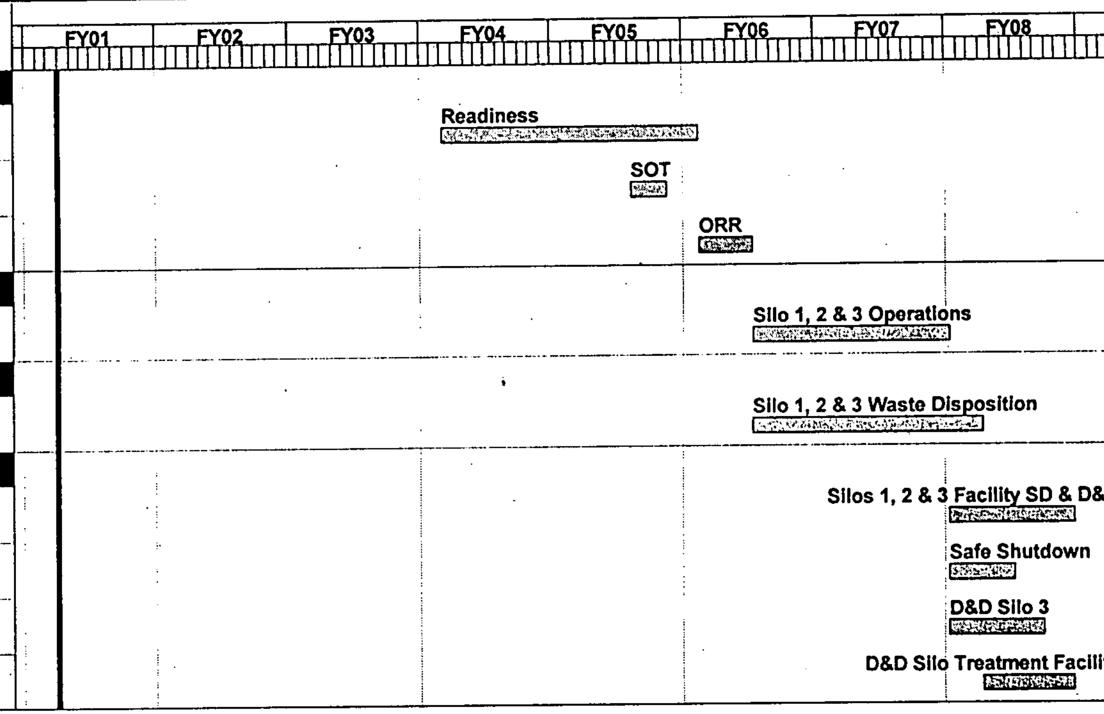
Sheet 1 of 2

**FLUOR FERNALD**

**SILO 3**
**ALTERNATIVE 2**

**FIGURE 6**

| Activity ID | Activity Description | Orig Dur | Early Start | Early Finish |
|---|---|---|---|---|
| **SILO 1 & 2 TRAINING & SOT** | | | | |
| 213GQD40 | Readiness | 488 | 05DEC03 | 15NOV05 |
| 213GQD35 | SOT | 70 | 11MAY05 | 18AUG05 |
| 213GQD45 | ORR | 99 | 15NOV05 | 10APR06 |
| **SILO 1, 2 & 3 OPERATIONS.** | | | | |
| 213GQG | Silo 1, 2 & 3 Operations | 375 | 13APR06 | 10OCT07 |
| **SILO 1, 2 & 3 WASTE DISPOSITION** | | | | |
| 213GQA | Silo 1, 2 & 3 Waste Disposition | 435 | 13APR06 | 10JAN08 |
| **SILO 1, 2 & 3 FACILITY SD & D&D** | | | | |
| 213GQA1 | Silos 1, 2 & 3 Facility SD & D&D | 240* | 11OCT07 | 25SEP08 |
| 213GQA05 | Safe Shutdown | 120 | 11OCT07 | 07APR08 |
| 213GQA15 | D&D Silo 3 | 180 | 11OCT07 | 01JUL08 |
| 213GQA10 | D&D Silo Treatment Facility | 180 | 11JAN08 | 25SEP08 |



the retrieval risks presented in the recommended technical approach. Below are some additional key risks associated with this approach:

- Extending the critical path six months, increasing the risk of not meeting the December 31, 2006 contract milestone.
- Overcomplicating the process for treating Silos 1 and 2 material by modifying a wet stabilization process to incorporate and control dry, fine particulate.

## Basis and Assumptions for Schedule and Cost

Management Assumptions

- No change in ROD is required
- No additional material will be retrieved from Silo 3 for treatability testing
- Stakeholder acceptance of the new approach
- Standard EPA/DOE review process and cycles
- Increase in project management costs due to schedule extension only. No incremental increase due to addition of Silo 3 material
- Start and completion of treatment of Silos 1 and 2 material not extended. Treatment of Silo 3 material conducted after Silos 1 and 2 campaign
- Overall extension of Silos 1 and 2 operations schedule by six months

Design Approach Assumptions

- The design will be completed by Jacobs Engineering, as a teaming partner to Fluor Fernald
- Mechanical excavation of the Silo 3 material
- One-third, and probably two-thirds, of the material in the silo requires mechanical agitation prior to removal due to the presence of compacted material
- The Silo 3 material would be conveyed to a storage bin adjacent to Silo 3 and then transported to a feed bin in the treatment facility
- Chemical stabilization to meet ROD requirements
- Silos 1 and 2 phosphate-based treatment (not Envirobond™) verified by treatability testing and used
- Material chemical and radiological characteristics fall within the range in the RI/FS
- 3,925 tons of material in Silo 3 (5,088 $yd^3$)
- Material insitu density of 58 $lb/ft^3$
- On-site treatment of the Silo 3 material
- Using Silos 1 and 2 design organization, with an incremental increase in cost for additional engineering activities

Construction Assumptions

- Construction requires minimal radiological control restrictions and PPE, except limited control during excavation activities and tie-ins to existing site systems
- Process equipment will be procured and purchased by Fluor Fernald
- Utilize existing structures and utilities installed by RMRS

Operations Assumptions

- Mock-up performed for operational training and demonstration
- Operations schedule based on two 12-hour shifts per day, 7 days per week
- An ORR will be performed prior to facilities start-up
- No increase in ORR costs with addition of Silo 3 material to Silos 1 and 2 Project
- Fluor Fernald wage labor will operate the retrieval and treatment facilities in accordance with labor agreement
- The number of operations personnel needed was estimated based on the Silos 1 and 2 Feasibility Study manpower estimates.
- Silo 3 material will be treated separately from the Silos 1 and 2 material, using Silos 1 and 2 process equipment
- 40 weight percent waste loading
- Treated material disposal at NTS at $7.50/ $ft^3$ ($202.50/$yd^3$)
- Treated material will be packaged in B-25 type containers with an internal volume of 84 $ft^3$ (external volume of 112 $ft^3$)
- Off-site laboratory will be used for confirmatory analysis of treated material samples
- The Silo 3 material would be treated through the treatment facility systems constructed for Silos 1 and 2 treatment, including additives systems, mixer, packaging systems, off-gas system, and control room.
- Waste will be transported to NTS via truck
- Operations labor burn rate of $2.5 million per month
- Consumables of $0.9 million

D&D Assumptions

- 90% of Silo 3-specific equipment and facilities for Silo 3 material retrieval will be disposed of in the on-site disposal cell
- D&D of Silo 3 equipment and facility and decontamination of Silo 3 structure performed by project
- Demolition of Silo 3 structure responsibility of D&D Project
- Soil removal and demolition of concrete foundations responsibility of Soils and Water Project

# Step 4 – Determine the Funding Impacts of the Recommended Approach and Alternative Scenarios

Table 8 shows a phased project estimate for the recommended technical approach and each alternative scenario, assuming Fluor Fernald self-performance of each option. These costs are *not* escalated.

**Table 8 – Phased Project Estimate for Each Scenario**

| Project Phase | Recommended Technical Approach | Alternative Scenario 1 | Alternative Scenario 2 |
|---|---|---|---|
| Design & Safety Basis | $2.7 | $7.6 | $2.6 |
| Construction* & ORR | $10.9 | $15.1 | $11.9 |
| Operations | $8.9 | $16.3 | $22.4 |
| D&D | $2.4 | $2.9 | $3.0 |
| DOE Costs | $0.9 | $0.8 | $3.8 |
| TOTAL | $25.8 | $42.7 | $43.7 |

* Equipment Costs are included in the Construction phase.

**Note:** All numbers are in millions and are in current year dollars. All estimates are order of magnitude. Numbers do not include general and administrative (G&A) costs.

Based on the project estimate and proposed schedule for each scenario, Table 9 shows the funding required, by year, to implement each scenario. This table was developed to show the funding impacts of each scenario, as currently scheduled. *The table does include DOE costs.*

**Table 9 – Funding Required for Each Scenario by Year**

| Scenario | Year 0 | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Total |
|---|---|---|---|---|---|---|---|---|---|
| Recommended Technical Approach | 1.8 | 8.6 | 8.9 | 6.5 | -- | -- | -- | -- | 25.8 |
| Alternative 1 | -- | 7.5 | 11.6 | 15.5 | 8.1 | -- | -- | -- | 42.7 |
| Alternative 2 | -- | -- | -- | 1.3 | 8.2 | 12.1 | 15.0 | 7.1 | 43.7 |

**Note:** All numbers are in millions and are in current year dollars.

The recommended technical approach has the least cost impact of any scenario, in any year. It should be noted that if implementation of the recommended approach is delayed, economics-of-scale associated with use of the WPRAP unit train will be lost and the overall price will increase.