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FLUOR FERNALD
SILOS PROJECT

Silo 3 Retrieval and Disposition Nuclear Health and Safety Plan

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Silo 3 Retrieval and Disposition Nuclear Health and Safety Plan

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RECORD OF ISSUE/REVISION

NOTE: The main body of the Silo 3 N-HASP (prepared by Fluor Fernald staff) determines the operable effective date for the entire N-HASP package. The appendices provided by Jacobs Engineering are stand-alone components with their own revision numbers. Outside the annual revision process, a change in an appendix does not increase the revision number for the entire document; it is considered an N-HASP PCN.

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08-25-03		0	Initial issue of N-HASP to identify hazards, controls, and mitigators for Silo 3 retrieval and disposition.

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ACRONYMS

AC: Alternating current
ACGIH: American Conference of Governmental Industrial Hygienists
AEDO: Assistant Emergency Duty Officer
ALARA: As Low As Reasonably Achievable
ANSI: American National Standards Institute
APR: Air Purifying Respirator
ASR: Auditable Safety Record
AWR: Advanced Waste Retrieval
BIO: Basis for Interim Operations
CAM: Continuous Air Monitor
CDL: Commercial Driver's License
CFR: Code of Federal Regulations
CGI: Combustible Gas Indicator
CM: Configuration Management functional area
CM: Construction Manager
CM^2: Square centimeters
COC: Constituent of concern
CONOPS: Conduct of Operations
CPC: Constituents of Potential Concern
D&D: Decommissioning and Deactivation
DAC: Derived Air Concentration
dBA: decibel
DC: Direct current
DCN: Design Change Notice
DOE: U. S. Department of Energy
DOT: Department of Transportation
dpm: disintegrations per minute
DSA: Documented Safety Analysis
EBA: Evaluation Basis Accident
ECL: Effective Concentration Limit
ED: Engineering Design functional area
EIP: Energy Isolation Plan
EMS: Emergency Message System
EMT: Emergency Medical Technician
EPA: Environmental Protection Agency
ERT: Emergency Response Team
ES&H: Environment, Safety, and Health
FAT&LC: Fernald Atomic Trades and Labor Council
FCP: Fernald Closure Project
FEMP: Fernald Environmental Management Project
FHA: Fire Hazard Analysis
FMPC: Feed Materials Production Center
GFCI: Ground Fault Circuit Interrupter
HAR: Hazard Analysis Report
HASP: Health and Safety Plan
HAZWOPER: Hazardous Waste Operations and Emergency Response
HC: Hazard Category
HCC: Hazard Category Calculation
HCC: Hazardous Chemical Classification
HEPA: High Efficiency Particulate Air (filter)
HFE: Human Factors Evaluation
HFM: Hand and Foot Monitor
HPP: Health Physics Plan
HVAC: High Volume Air Conditioning
IES: Illuminating Engineering Society of North America
IHA: Integrated Hazard Analysis
IP-2: Industrial Package Type 2
ISA: Interim Staging Area
ISM: Integrated Safety Management
K-65: Silos 1 and 2
lb/ft^3: Pounds per cubic foot
LEL: Lower Explosive Limit
LLRW: Low-level radioactive waste
mg/Kg: Milligrams per kilogram
MIP: Maintenance Implementation Plan
MRS: Mechanical Retrieval System
MSDS: Material Safety Data Sheet
N-HASP: Nuclear Health and Safety Plan
N&SS: Nuclear and System Safety functional area
NIOSH: National Institute of Occupational Safety and Health
NTS: Nevada Test Site
O&M: Operations and Maintenance
ORPS: Occurrence Reporting Processing System
ORT: Occurrence Reporting Team
OSHA: Occupational Safety and Health Administration
OU-4: Operable Unit 4 (Silos area)
PAPR: Powered Air Purifying Respirator
PAT: Proficiency Analytical Test (program)
pCi/L: Picocuries per liter
PCM: Personal Contamination Monitor
PEL-TWA: Permissible Exposure Level/Time-Weighted Average
PHAR; Preliminary Hazard Analysis Report
PID: Photo Ionization Detector
PLC: Programmable Logic Control
PM: Project Manager
PPE: Personal Protective Equipment
PRI: Potentially-releasable inventory
ppm: Parts per million
PR: Process Requirement
PRS: Pneumatic Retrieval System
PVC: Poly-vinyl chloride
PWID: Project Waste Identification and Disposition (report)
QA: Quality Assurance
QAJSP: Quality Assurance Job-Specific Plan
QAP: Quality Assurance Program
QC: Quality Control
RAD: Radiological (facility)
RCT: Radiological Control Technician
RQ: Reportable Quantities
RWP: Radiation Work Permit

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ACRONYMS

S&H: Safety and Health (department)
SAR: Safety Analysis Report
SBD: Safety Basis Documentation
SBDR: Safety Basis Documentation Review
SBIS: Safety Basis Impact Screen
SBR: Safety Basis Requirement
SCBA: Self Contained Breathing Apparatus
SE: Safety Evaluation
SER: Safety Evaluation Report
SH&Q: Safety, Health, and Quality (division)
SMSD: Safety Management System Description
SOP: Standard Operating Procedure
SPR: Safety Performance Requirement
SRC: Safety Review Committee
SSA: System Safety Analyst
SSC: Systems, Structures, and Components
SSR: Standard Startup Review
STD: Standard
SWRS: Silos Waste Retrieval System
TCLP: Toxicity Characteristic Leaching Procedure
TLD: Thermoluminescent dosimeter TLV-TWA: Threshold Limit Value/ Time-Weighted Average
TPQ: Threshold Planning Quantity
TQP: Training and Qualification Program
TSR: Technical Safety Requirement
TWA: Time-weighted average
UL: Underwriter's Laboratory
ULPA (ultra-low penetrating air) filter
USQ: Unreviewed Safety Question
USQD/SE: Unreviewed Safety Question Determination /Safety Evaluation
VitPP: Vitrification Pilot Plant
VOC: Volatile organic compound
VWMS: Vacuum Wand Management System
WSA: Waste Storage Area

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1.0 INTRODUCTION

1.1 Purpose and Scope

This Silos project-specific Nuclear Health and Safety Plan (N-HASP) was developed to ensure that hazards have been identified and that controls or mitigators will be in place to support the safe operation of Silo 3 retrieval and disposition process. The Silo 3 N-HASP is being submitted to satisfy a commitment in the U.S. Department of Energy (DOE)-approved *Decision Basis Document Implementation of 10 CFR 830 Safe Harbor Requirements for the Silos Projects,* 40000-RP-0034 [Ref. 1]. This N-HASP meets the requirements of Title 10 Code of Federal Regulations (CFR) 830.204, *Documented Safety Analysis* (DSA) [Ref. 2]; 29 CFR 1910.120 (b)(4), *Site Specific Health and Safety Plan* [Ref. 3]; and follows the general rules for HASP development as outlined in NS-0005, *Initiating, Reviewing, and Approving DOE-Approved SBDs* [Ref. 4].

The Silo 3 Retrieval and Disposition Project has been determined to qualify as a Radiological (RAD) Facility based on the analyses discussed in Appendix B, *Hazard Category Calculation*. Although Silo 3 Retrieval and Disposition qualifies as nuclear Hazard Category 3 (HC-3) based on inventory, it qualifies as RAD based on analytical consequences. Per DOE-STD-1120-98, *Integration of Environment, Safety and Health into Facility Disposition Activities* [Ref. 5], a RAD categorization/classification based on analytical consequences requires DOE approval. A more detailed discussion of the safety basis is provided in Section 5.0. Silo 3 System Safety Requirements are listed in Section 10.0.

This N-HASP is divided into two volumes. Volume One contains the standard requirements of a 29 CFR 1910.120 HASP, into which have been inserted sections addressing the Silo 3 System Safety Requirements and the Work Control Processes related to the Silo 3 process. Volume Two includes the analyses that support the Silo 3 DOE decision basis [i.e., Integrated Hazard Analysis (IHA), Hazard Category Calculations (HCC), Human Factors Evaluation (HFE), ALARA (As Low As Reasonably Achievable) Analysis, Environmental ALARA Analysis, Fire Hazards Analysis (FHA), Accident Analysis, and Health Physics Plan (HPP)]. These analyses were used to develop the Silo 3 System Safety Requirements that provide defense-in-depth. Together, Volumes One and Two comprise a DSA that meets the requirements of 10 CFR 830.204, *Nuclear Safety Management* [Ref. 6].

1.2 FCP Site History and Description

From 1952 until 1989, the Fernald site provided high-purity uranium metal products to support U.S. defense programs. Note: From 1952 until 1992, the site was called the Feed Materials Production Center (FMPC). Starting in 1992, the site was called the Fernald Environmental Management Project (FEMP). Recently, the site name was changed to the Fernald Closure Project (FCP). The FCP is operated by Fluor Fernald, Inc. (previously called Fluor Daniel Fernald, Inc.)

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Uranium production halted in 1989 because of declining demand and a recognized need to commit available resources to environmental remediation. Former uranium operations at the FMPC site were limited to a fenced 136-acre tract near the center of the site known as the (former) Production Area. Large quantities of liquid and solid wastes were generated by the various FMPC production operations. Before 1984, solid and slurried wastes from FMPC processes were stored or disposed of in the Waste Storage Area (WSA). This area, located west of the production facilities, includes: six low-level radioactive waste (LLRW) storage pits; two concrete silos with earthen berms containing K-65 residues; one concrete silo containing metal oxides; one unused concrete silo; two lime-sludge ponds; a burn pit; a clearwell; and a solid-waste landfill. The WSA is part of Operable Units 1, 2, and 4. The former Production Area and WSA are fenced and closed to the general public. The remaining 914 acres of the site consist of forest, fields, wetlands, and pasture lands.

Operable Unit 4 (OU4) is a 5.8-acre area located on the western side of the site containing the following FCP facilities and associated environmental media:

- Silos 1 and 2 and their contents (also called K-65 Silos)
- Silo 3 and its contents (also called Cold Metal Oxide Silo)
- Silo 4 (empty)
- The decant sump (an underground tank and its contents)
- A portion of a concrete pipe trench and other concrete structures (currently being decommissioned)
- An earthen berm surrounding Silos 1 and 2
- Soils beneath and immediately surrounding the silos
- Perched groundwater in the vicinity of the silos
- Remainder of the Vitrification Pilot Plant (now known as the Silos Operations & Maintenance [SOM] building) and associated operations pad
- Associated abandoned underground utilities and foundations

Silo 3 was constructed for the transfer and storage of "cold" 11e.(2) uranium processing byproduct material [as designated by the Atomic Energy Act (AEA) of 1954, as amended] generated through refinery operations at the FMPC site. The Silo 3 material is a by-product of uranium-bearing ore concentrate processing. The ore concentrates had been preprocessed through a uranium mill where a significant portion of the Ra^{226} and the gamma-emitting progeny were removed, and thus they were termed "cold" feed material. Silo 3 received metal oxide raffinates generated by all FMPC refinery operations from May 1954 until late 1957.

1.3 Silo 3 Structure, Contents, and History

1.3.1 Silo 3 Structure

Silo 3 was constructed in 1952 and is located south of the Waste Pit Area of the FCP property. Silo 3 is a free-standing, post-tensioned concrete, domed silo. It is approximately 80 feet in diameter and approximately 33 feet above ground level (apex). The floor system is approximately 17 inches of compacted clay, a 2-inch thick layer of asphaltic concrete, and an 8-inch layer of gravel, topped by 4 inches of concrete. Silo 3 does not have an underdrain system. The domed

roof tapers from 8 inches thick at the silo walls to 4 inches thick at the apex. The apex is 36 feet high from top of foundation, 33 feet above grade. The walls are 27 feet high from the top of the foundation. Silo 3 contains increased reinforcing around the dome periphery (ring beam) to support the additional loading from a dust collector that has since been removed. Silo 3 has wire-wrapped post-tensioning using 8-gauge wire drawn to 0.141 inches. Silo 3 has 46 decant ports, each with a weir and baffle system. There are 23 decant ports on the east side wall and 23 on the west side wall.

The Silo 3 pneumatic retrieval process will make use of existing dome manways. Five manways have an internal diameter of approximately 20 inches. One manway, on which a dust collector was installed, is centered on the silo dome. Four of the manways, which were used as material inlet ports, are arranged radially, about 25 feet from the center manway and 90 apart. There are two additional 24-inch internal diameter manways, one at the northern dome edge and one at the eastern dome edge. The dome also has 24 two-inch diameter sounding pipes and one 6-inch diameter vent pipe.

1.3.2 Silo 3 Contents

Silo 3 contains "cold" metal oxide waste generated from the operation of the former Feed Materials Production Center (FMPC), now known as the Fernald Closure Project (FCP). The raffinates from the solvent extraction process were de-watered using rotary vacuum filters. The filtrate wastes were then processed through evaporators, and the concentrates were further processed using either a spray calciner or rotary calciner. From plant start-up through the middle 1950s, a spray calciner processed the concentrates. Approximately 35% of the Silo 3 material is believed to have come from this process. Due to operational difficulties with the spray calciners, a rotary calciner process was implemented. In this process, the evaporator concentrates were transferred to a drum dryer and finally a rotary calciner. The calciner removed residual liquids and converted the metal nitrates to metal oxides.

The resultant fine, powdered metal oxides were transferred to Silo 3 pneumatically. Placement of these metal oxide wastes into Silo 3 began in 1954 and continued until 1957. After that, refinery process wastes were placed in on-site surface impoundments.

The Remedial Investigation conducted for Silo 3 [Ref. 7] reveals that the silo contains an estimated 5,088 yd^3 of residue. The predominant radionuclide of concern identified within the material is Thorium-230, a radionuclide produced from the natural decay of Uranium-238. Based on an estimated in situ material density ranging from 29 to 58 pounds per cubic foot (lb/ft^3), the available silo material weighs, at most, approximately 3,930 tons. The physical composition of the Silo 3 waste, based on process knowledge and visual observations, is:

- potentially dry, loose, or fine powder at the top
- compacted powder towards the central and lower portions
- potentially water-saturated powder at bottom (approximately 1 ft).

A detailed description of Silo 3 waste material inventory is provided in Section 8.19.

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1.3.3 Silo 3 History

1952: Silo 3 constructed.

1954-1957: Silo 3 received "cold" metal oxide waste materials.

1991: Removal Action [Ref. 8] initiated to ensure that all penetrations through the dome were covered and sealed. Removal of the dust collector and permanent sealing of all obvious open pathways completed January 8, 1992.

1994: *Proposed Plan for Remedial Action at Operable Unit 4* [Ref. 9] prepared by FEMP, reviewed by DOE, and approved by USEPA and OEPA. This entailed retrieval of the Silo 3 material, on-site vitrification of the material, and off-site disposal of the vitrified material.

Final Record of Decision for Remedial Actions at Operable Unit 4 [Ref. 10] prepared by FEMP, reviewed by DOE, and approved by USEPA and OEPA.

FEMP-2337, *Preliminary Safety Analysis Report* [PSAR] *for Operable Unit 4* [Silos 1-4] [Ref. 11], was prepared. Silo 3 was assigned a final hazard category of HC-3 based on the associated hazard analysis.

1998: Due to difficulties encountered with the vitrification process during equipment performance trials, alternate treatment processes were identified and investigated for Silo 3 remediation. A *Final Explanation of Significant Differences for Operable Unit 4 Silo 3 Remedial Action* [Ref. 12], that entailed an alternate treatment plan, was approved. The alternate treatment plan was defined as treatment to meet the Toxicity Characteristic Leaching Procedure (TCLP), disposal at a permitted commercial disposal facility, and of-site treatment using either chemical stabilization/solidification or a polymer-based encapsulation process.

Fluor Daniel Fernald prepared a *Hazard Analysis Report (HAR) for Operable Unit 4 Silos*, [Ref. 13]. Based on a comparison of radioactive material quantities to the threshold limits in DOE STD1027-92, hazard categorization for the OU4 Silos was determined to be HC-3.

Fluor Daniel Fernald awarded a contract to Rocky Mountain Remediation Services (RMRS) to design, construct, and perform Silo 3 remediation, including performance of the associated safety analysis and preparation of safety basis documentation.

1999-2000: RMRS conceptual and preliminary design developed. This entailed pneumatic retrieval of the Silo 3 material, chemical stabilization of RCRA metals and solidification into bricks, and off-site disposal. The treatment facility contained a large storage bin because the treatment process philosophy called for continuous mixing and treatment, requiring large a inventory of retrieved material.

2000: RMRS prepared a Preliminary Hazard Analysis Report (PHAR) for Silo 3 [Ref. 14], which assigned HC-3 to Silo 3 and the associated retrieval and treatment systems. This assignment was based on the proposed RMRS design, inventory of radioactive materials,

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and safety analyses. Segmentation was not used. The bounding accident consequence from analyzed scenarios resulted from a silo failure that released and dispersed up to one percent of the total Silo 3 inventory. Analyzed initiating events included natural phenomenon hazards (e.g., earthquake or tornado) and man-made hazards (e.g., crane failure or truck impact).

Silo 3 PHAR approved by DOE for procurement and construction.

2001: Contract with RMRS terminated by mutual agreement.

Fluor Fernald prepared the *Silo 3 Project Rescoping Evaluation and Recommendation*, 40400-RP-0007 [Ref. 15]. This report recommended mechanical retrieval (excavation) of Silo 3 material, on-site chemical stabilization treatment, packaging into soft-sided containers, and rail shipment of the material to a permitted commercial off-site disposal facility.

Fluor Fernald re-evaluated the calculations supporting the RMRS Silo 3 PHAR. This review showed that highly-conservative assumptions were used to predict consequences, thus bringing into question the justifiability of the final HC. For example, a point-source release was assumed, giving no credit to the large surface area occupied by the spilled material following a silo failure. In addition, dose-conversion factors for certain radionuclides were over-estimated based on assumptions of solubility class. Consequently, Fluor Fernald re-evaluated the HC calculation for the bounding accident identified in the PHAR (silo failure due to earthquake).

Fluor Fernald issued the *Operable Unit 4 (OU4) Silo 3 Project Auditable Safety Record*, SA-2001-1026 [Ref. 16], which classified Silo 3 and its associated remediation systems and facilities as Radiological (RAD). The ASR included a Silo 3 earthquake evaluation calculation, SA-CALC-052 [Ref. 17], that presented a potential localized radiological dose consequence below the HC-3 dose threshold. The ASR transmittal to DOE included a recommendation that limited procurement, construction, and system operability testing continue without additional preliminary documented safety analysis. Design changes, new activities, maintenance alterations, and changed/new operating procedures were screened via the Silos Project Safety Basis Impact Screen (SBIS) (see Section 6.0).

DOE reviewed ASR SA-2001-1026 and concurred with Fluor Fernald's recommendation on continuing limited procurement, construction, and system operability testing without additional preliminary documented safety analysis. However, DOE did not concur with classifying both Silo 3 and its remediation systems and facilities as Radiological (RAD). Instead, DOE requested that Fluor Fernald comply with 10 CFR 830 [Ref. 2] in the development of the Silo 3 documented safety analysis.

Fluor Fernald withdrew the ASR request to downgrade Silo 3 and its remediation facilities from HC-3 to RAD in favor of an alternative approach based on 10 CFR 830. The alternative, documented in *Decision Basis Document for Implementation of 10 CFR 830 Safe Harbor Requirements for the Silos Projects*, 40000-RP-0034 [Ref. 1], entails the preparation of this Silo 3 Nuclear Health and Safety Plan (N-HASP) prior to initiating access

to, and segmented retrieval of, Silo 3 material. The safety basis for the Silo 3 Retrieval and Disposition Project is based on the 10 CFR 830 safe harbor provision for an environmental restoration activity. This safe harbor method relies on the use of DOE-STD-1120-98, *Integration of Environment, Safety and Health into Facility Disposition Activities* [Ref. 5]. Based on this approach, Silo 3 retrieval and disposition was determined to qualify as a RAD Facility based on the analyses discussed in Appendix B, *Hazard Category Calculation*. Although Silo 3 qualifies as nuclear HC-3 based on inventory, retrieval and disposition qualifies as RAD based on analytical consequences. See Section 5.0 for a detailed discussion of this issue.

2002: Fluor Fernald teaming partner Jacobs Engineering Group initiated conceptual design of the new remediation plan, specifying pneumatic retrieval as a predecessor to mechanical retrieval to the extent needed to create a void space behind the proposed wall opening. Design data development studies were initiated to determine the optimum treatment formulas.

Envirocare of Utah proposed that untreated Silo 3 material could be received and disposed of at their facility without treatment due to the material's 11e.(2) classification.

Based on further negotiations with Envirocare and revision of the Nevada Test Site WAC, disposal without on-site or off-site treatment was pursued. The conceptual design for treatment was shelved, and a proposed design change that deleted on-site chemical stabilization treatment was approved. The Preliminary Design, Remedial Design Package, and Technical Baseline for non-treatment was submitted to the USEPA and OEPA, but was not approved.

Fernald Citizens Advisory Board (FCAB) expressed concern regarding dispersibility of the Silo 3 material in the event of a transportation accident. DOE and Fluor Fernald agreed to implement conditioning of the Silo 3 waste, prior to packaging, to reduce its dispersibility.

OEPA suggested the addition of a reducing agent, in conjunction with waste conditioning, to reduce the leachability of the RCRA component chromium VI (discussed in Section 8.19).

DOE and Fluor Fernald agree to apply a reasonable "best efforts" approach to reduction of dispersibility, and reduction of leachability of chromium VI, by adding a waste conditioning process into the current Silo 3 remediation design (i.e., application of binder/stabilizer agents [sodium lignosulfonate and ferrous sulfate] in aqueous solution to the Silo 3 material). Design changes were incorporated via Design Change Notices (DCNs).

DOE-EH-53, Office of Nuclear Safety, issues technical position NSTP-2002-2, *Methodology for Final Categorization for Nuclear Facilities from Category 3 to Radiological* [Ref. 18] This paper clarifies DOE-STD-1027 final hazard categorization and applies the methodology to classification below HC-3.

2003: 40430-RD-0014, *Revised Proposed Plan for Operable Unit 4 Silo 3 Remediation Action* [Ref. 19] prepared by Flour Fernald, reviewed by DOE, and approved by USEPA and OEPA.

Draft *Record of Decision Amendment for Operable Unit 4 Silo 3 Remediation Action* [Ref. 20] prepared by Fluor Fernald and reviewed by DOE. Following incorporation of DOE comments, the document was submitted to USEPA and OEPA and is awaiting approval.

This Silo 3 Retrieval & Disposition N-HASP developed. Upon approval, this N-HASP will be the documented safety analysis for Silo 3 remediation activities. Design changes will be evaluated via the Silo 3 Safety Basis Impact Screen (SBIS). If proposed changes have the potential to affect the Silos, positive screens will be evaluated using the Unreviewed Safety Question process (see Section 6.0).

1.4 Silo 3 Process Description

The Silo 3 Retrieval and Disposition Project consists of the following major activities. This Silo 3 N-HASP covers Operation and Maintenance (i.e., Material Removal and Packaging).

- STORAGE AND MAINTENANCE
- CONSTRUCTION
- OPERATION AND MAINTENANCE
  - * Material Removal
    - Pneumatic Retrieval
    - Mechanical Retrieval
  - * Packaging
    - Waste Conditioning
    - Container Filling
    - Filled Container Management
- DECONTAMINATION
- DEMOLITION

Silo 3 PHAR scope

Silo 3 N-HASP scope

When all Silo 3 material is removed, the equipment and structures will be dismantled, decontaminated (when appropriate), and dispositioned.

In the discussions that follow, refer to the following process flow diagram and fold-out pages. These graphics are provided for general information only. To obtain the latest versions, contact Document Control.

FIGURE 1-1: SILO 3 OPERATIONS FLOW DIAGRAM
FIGURE 1-2: SILO 3 CIVIL SITE PLAN
FIGURE 1-3: EAST ELEVATION
FIGURE 1-4: 1ST FLOOR PLAN
FIGURE 1-5: SECTION A
FIGURE 1-6: SECTION C
FIGURE 1-7: SECTION D

1.4.1 Basic Silo 3 Operation

To understand the Silo 3 radiological hazards, one must first understand the basic Silo 3 retrieval and disposition operation (see the flow diagram in **FIGURE 1-1**). Waste retrieval is accomplished by pneumatic retrieval and mechanical retrieval (the material was originally transferred into Silo 3 pneumatically). Some material handling and packaging equipment is shared by both systems. The silo itself is enclosed in a fabric structure, which provides protection from the elements to personnel operating the pneumatic retrieval system and some measure of containment should any of the waste material escape from the silo. Before Silo 3 is accessed for waste retrieval, radon concentrations in the silo headspace will be reduced by venting through the Silo 3 stack. Calculations show that release of all accumulated radon through the stack will not exceed the RQ of .1 Ci (see Appendix D, Table D.3.3).

Retrieval begins with the Vacuum Wand Management System (VWMS) and the Pneumatic Retrieval System (PRS). The VWMS consists of hoist-assisted vacuum wands inserted through existing manways on the silo dome. The VWMS is tied to the PRS inlet, which vacuums material through the manways and transfers it to the Process Building for packaging. The VWMS and PRS are also used to remove material behind the silo wall before creating a wall opening for the mechanical retrieval system.

After a reinforced concrete framework is installed on the silo wall, and a section of the silo wall is removed, the Mechanical Retrieval System (MRS) begins operation (see Section 1.4.2 on the Silo 4 Mock-up). According to 40430-PL-0002, *Access and Retrieval Strategy for the Silo 3 Project* [Ref. 21], it can be concluded that the reinforced silo (with the wall section removed) will be more structurally robust than the present (unmodified) silo wall. A mechanical excavator retrieves compacted material from the silo and transfers it to a bin located in the Excavator Room. Conveyors feed the material to the adjacent Process Building for packaging.

From a design point of view, the PRS and MRS are redundant systems. Either system has the capacity for retrieving the entire store of Silo 3 waste material. Current plans call for the PRS to be used prior to, and in conjunction with, the MRS and in conjunction with it.

A Feed Conveyor in the Process Building receives material from the PRS or MRS and discharges it to two Package Loading Stands. Each station is a semi-automated system with loading spouts, loading stands, thumper tables, weighing scales, and motorized roller conveyors for transporting the filled soft-sided containers away. An aqueous solution of ferrous sulfate and sodium lignosulfonate will be sprayed onto the material in the fill chutes to reduce the material's dispersibility and RCRA metal (chromium) mobility. No credit was taken for waste treatment in the hazard category calculations.

After a soft-sided container is filled and sealed, the container is moved to the Package Staging Conveyor. Labeled bags are then transported to the Cargo Container Bay where they are closed, labeled, and transferred into cargo containers using the bridge crane. Once a cargo container is loaded with bags and the lid is replaced, a heavy-duty forklift transports the cargo container to an interim staging area for shipment off-site.

1.4.2 Cutting a Hole in Silo 3 for Mechanical Retrieval

Note: Hole cutting is a construction activity performed by construction labor. The Silo 4 mock access demonstration was performed during the construction of the retrieval facility. However, Silo 3 wall access will occur after the operations phase has begun because the plan calls for pneumatic retrieval of material behind the intended wall opening. Therefore, there will be a short window of time when operations (authorized by this N-HASP) and construction work (authorized by the Silo 3 PHAR [Ref. 14]) will overlap.

Successfully cutting an opening in the Silo 3 wall large enough for mechanical retrieval is critical to successful project operations. The project committed to a demonstration of the work steps for cutting such an opening. This demonstration (conducted on Silo 4) was designed to verify engineering calculations, support detail vendor design, integrate multiple field activities, analyze observations, and generate lessons learned for subsequent documentation.

Design and preliminary strategies were developed through early collaboration with consultants, engineers, equipment vendors, and construction representatives, including supervisors and craftsmen. An independent structural consultant, considered an expert in reinforced concrete tank design, supported the detailed design. The project bulk powder consultant conducted modeling studies to predict material flow during scenarios that varied by material height at the time of cutting. The overall retrieval approach is documented in 40430-PL-0002, *Access and Retrieval Strategy for the Silo 3 Project* [Ref. 22]. The results of the Silo 4 demonstration are documented in 40430-RP-0028, *Silo 4 Mock-up Demonstration* [Ref. 23]. The following two subsections provide an overview of those results.

Mock Access on Silo 4

In preparation for the eventual access of the Silo 3 wall, a mock access was conducted on empty Silo 4 (located north of Silo 3). Silo 4 was built about the same time as Silo 3 by the same contractor, and has the same structural dimensions and characteristics (see Section 1.3.1). The main difference is that the Silo 4 concrete has severe freeze-thaw effects because it has been empty. However, based on the demolition of site water tanks (similarly constructed by the same contractor), the access plan was deemed feasible for Silo 3. The water tanks and Silo 3 are considered comparable in terms of good concrete quality. The added difficulty presented by good-quality concrete was factored into the observation of the Silo 4 demonstration.

A 20ft H x 15ft W opening is required for retrieving material with a remote-operated excavator. The access strategy calls for the intended wall opening to be cut into a grid pattern with a track-mounted wall saw. The outside surface of the silo wall was originally reinforced with post-tensioned wires encased in gunnite. Therefore, a concrete reinforcement frame was designed to maintain the structural integrity of the silos by maintaining the tension of the post-tensioning wires when cut, and preventing their release from the concrete. The design is conservative and provides a safety factor [Ref. 24].

The first step in the mock access was to cast-in-place the concrete reinforcement around the intended access opening. Next, some of the decant ports located on the silo wall were glove-bagged and removed because they interfered with the temporary cutting tracks and planned safety beams.

The plan calls for cutting the concrete in grid sections to facilitate removal and to reduce the amount of rubble that could get into the stored Silo 3 waste. There is also a concern that rubble and the large number of wires in the debris would foul the mechanical equipment in the retrieval bin. The grid plan also allows for concrete sections to be removed from top to bottom. This will be helpful if impacted material has to be removed as the opening is made.

A custom-designed curved tract was ordered to match the curvature of the silo. The track-saw automatically travels on the track and the depth of the cut is controlled by a tethered control. This allows the operator to maintain a safe work distance. The silo wall was scored in a grid pattern with a concrete wall saw to within one inch of the inside surface of the wall. It was determined that a cut of this depth would allow the concrete to be broken free and yet minimize worker exposure to Silo 3 material during the actual cutting. During the cutting, wedges were used to keep the sections stable.

During grid cutting, the severed wires and gunnite were removed. Horizontal beams were installed to prevent cut sections of the wall from falling on workers.

One reason the selected excavator was chosen was because it has an additional articulating joint. This provides a range of motion that allows it to work within the silo and adjoining excavator room. The machine can also articulate in a horizontal plane. This flexibility would support retrieval if only a portion of the wall can be removed due to material impacted behind the wall.

A mounting/lifting bracket was designed to be compatible with the excavator attachment mounting plate and was used for removal of some of the braces. This was found to be a quicker and much safer than using a hoist, and could be done remotely. Different types of attachments were used to secure wall sections to the excavator, and those sections were successfully removed. Due to poor concrete quality, the sections fractured rather than remaining as whole sections. However, removal of concrete sections and testing of the excavator swing area within the footprint was demonstrated.

Due to the poor condition of the concrete, the rubble was placed within Silo 4 for later on-site disposal with the other demo debris. Silo 4 concrete sections will be removed and disposed of in the OSDF as part of the Silo 3 concrete waste stream, or in alternate disposal locations as specified in the Project Waste Identification and Disposition (PWID) report.

The Silo 4 demonstration showed that:

- the reinforced opening was appropriately designed and installed.
- a concrete track saw can be used to score the concrete prior to breaking the opening.
- the excavator can support field activities during the preparation steps of cutting the opening.
- a remote-operated excavator has the break-out force and maneuverability to work in the designed space for removing concrete.

- multiple (and available) tools and attachments are required to break the concrete free and handle pieces.
- the access and retrieval strategy approach is valid.

Silo 3 Access

Note: Silo 3 hole cutting is a Construction task covered by the Silo 3 PHAR [Ref. 14]. The TSR for the silo dome live load (see Section 10.3) is unaffected by the Silo 3 hole cutting.

Silos 3 and 4 were built in the same manner at the same time by the same contractor. They have the same structural dimensions and characteristics. The main difference is the less-degraded quality of the Silo 3 concrete. Based on demolition experience with site concrete water tanks built by the same contractor, Silos 3 and 4 have been determined to present equivalent challenges that can be accessed using the same strategy. Thus, the experience of the Silo 4 demonstration (i.e., reinforcing frame and grid cutting) is directly applicable to Silo 3. A Lessons Learned report was written following the Silo 4 demonstration [Ref. 25]. Detail design has incorporated any recommendations or changes through the project design change notice (DCN) process and safety basis impact screens (SBIS) and Unreviewed Safety Question (USQ) process

Training for construction workers assigned to access Silo 3 will include removal of some remaining Silo 4 grid sections. These grid sections were left in place during the Silo 4 demonstration for this training.

If Silo 3 concrete sections meet the OSDF or WPRAP WAC, they will be removed and wrapped in plastic for staging in the Thorium laydown area until disposal in the OSDF or WPRAP as part of the Silo 3 concrete waste stream. Silo 3 concrete that does not meet the OSDF or WPRAP WAC will be containerized and shipped as part of the existing NTS profile/shipping program for "process area waste." Such concrete will be placed directly in strong-tight containers (Sea/Lands).

A number of observations made during the Silo 4 demonstration will improve the Silo 3 access process:

- The vertical cuts through the post-tensioning wires caused delamination of the one-inch shotcrete layer, which affected the mounting of the track for the horizontal cuts. Steps were revised to completely remove the post-tensioning wires and shotcrete layer in the work area (no delaminating was observed past the reinforcing frame).

- After the first track-saw cut, it was easier to remove the cut wires using a hand-held saw. The track mounting was then reset after the shotcrete was removed. Additional track mounting brackets were identified as being needed. One section of scoring cut completely through the wall. On Silo 3, this would cause contamination of the work area. This demonstrated that the project must conservatively assume that a breach will occur and dress workers in appropriate PPE. In the event of a breach, the cut location can be temporarily sealed to contain the material. Additional measurements will be made after the track is reset to check clearances and adjust for silo curvature. Cuts will be made in three passes with the depth of the last cut to be adjusted.

- Installation of the wall braces was cumbersome at Silo 4 because there was no building on which to mount rigging (a manlift was used). For Silo 3, rigging can use the excavator roof structural steel. Improved brackets that braces could slide into would allow quicker installation and removal. A mounting/lifting bracket was designed to be compatible with the excavator attachment mounting plate and was used for removal of some of the braces. This was found to be a quicker and safer than using a hoist, and could be done remotely.

- Scoring of the concrete prior to removal resulted in defined boundaries for each section and allowed for control of the amount of concrete to be removed. The freeze-thaw effects on Silo 4 concrete caused the sections to fracture rather than remaining as whole sections; however, the fracturing remained within the grid. The mounting bracket for segment removal was used and demonstrated. Adjustments were made to the bracket installation work steps. The excavator handled the pieces within the design footprint of the excavator room. The selection of excavator attachments was demonstrated and an assessment of each piece was made.

- Measurements were made for the placement of the cable management system, tethered electric line, and closed-circuit television cameras. Cameras were not available to provide views of the far side from the control area. The operator walking and visually working with the machine was used to document the views and camera locations that will be needed during Silo 3 operations.

The following recommendations will be evaluated by engineering and will be incorporated, as appropriate, into the Silo 3 equipment, design, and work planning [Ref. 23]:

1. Revise the excavator cable management location. Locate camera mounting brackets on the excavator. Paint the boom in contrasting colors for depth perception.

2. Provide additional attachments, such as a modified bucket or tools to address variable concrete conditions, including removal of rubble in addition to whole pieces.

3. Modify the mounting bracket installation.

4. Procure additional mounting brackets and longer hydraulic hoses for the wall saw.

5. Design wall braces that can be remotely removed from the Silo 3 wall opening using the excavator. The brace design will account for live load of Silo 3 material behind the wall.

6. After the final brace design is received, revise the construction traveler to incorporate redline comments and revised work steps. (A construction traveler is a subcontractor-produced, FCP-reviewed/approved work plan that outlines how construction will perform work safely.)

7. Evaluate the need for vertical as well as horizontal braces.

8. Update the safety briefing on equipment and the construction traveler. Demonstrate portions of the planned Silo 3 activity on Silo 4 prior to initiating activity on Silo 3 (using the remaining concrete grid sections).

1.4.3 Silo 3 Material Retrieval and Packaging Activities

This section provides a more detailed explanation of the operational steps of Silo 3 material retrieval and packaging.

Pneumatic Retrieval

Note: Prior to construction, the design of the pneumatic retrieval components will be evaluated against, and conform to, the Technical Safety Requirement (TSR) specified in Section 10.3. The pneumatic retrieval strategy has a demonstration plan [Ref. 26] for vacuum wand retrieval and will separately document the results.

Note: The current TSR (see Section 10.3) allows for a 700-pound live load on the silo domes. FCP has proposed an increase in this limit to 2000 pounds and is currently awaiting DOE approval. A report on increasing the allowable load limit for silo domes was prepared by an independent structural consultant specializing in concrete silos. The report concluded that the load limit of 2000 pounds proposed in Revision 2 of the TSR is justifiable [Ref. 27].

The VWMS is installed on the silo dome within a fabric enclosure structure. The VWMS consists of flexible hoses and metal tubes (vacuum wands) that will be inserted through the six existing silo dome manways. A motorized hoist will be used at each manway to assist operators in manipulating the VWMS hoses/wands. Video cameras to allow for remote viewing.

At each vacuum wand (and associated manway), an enclosure is provided with passive air supply (inlet) and process vent (outlet) hose connections. A coated fabric flexible boot is installed on the top of each enclosure to seal around the vacuum wand and prevent particulate emissions from the silo.

In order to keep silo pressure from becoming too negative, the passive air supply (from a HEPA filter) will replace air displaced during pneumatic retrieval and process vent operations. The process vent connection will normally be used to provide slight negative pressure when vacuum wand sections are added and when the pneumatic retrieval (vacuum) system is not in operation.

A vacuum relief valve on the passive air supply piping will open at 3 inches water column (WC) vacuum in the event the HEPA filter becomes plugged or does not allow sufficient air flow to alleviate silo negative pressure.

In the event of a failure of the passive air supply and/or the vacuum relief valves, the fabric flexible boots should fail (thus relieving silo negative pressure) before a silo failure occurs. Additionally, there is a pressure transmitter on the silo dome to provide an alarm if the silo pressure becomes greater than 3 inches WC vacuum. The pneumatic system also has a low-pressure switch on the blower inlet that will open a blower inlet relief valve, and a low-flow switch to shut down the blower in the vent of a plug in the pneumatic system or the passive air supply.

The PRS is contained in a steel beam/metal-sided building (the Process Building) adjacent to the silo. The PRS provides pneumatic, vacuum flow using rotary blowers. From the VWMS, the material/air stream enters the PRS baghouse collector, where material is separated from the air stream and fed by a screw conveyor and rotary airlock to the packaging screw conveyor. The air stream from the PRS baghouse collector passes through a cartridge filter, a high-efficiency particulate air (HEPA)/ ultra-low penetrating air (ULPA) filter, and rotary blower and is discharged via the Silo 3 exhaust stack. Material collected by the cartridge filter is fed by the same screw conveyor and rotary airlocks to the packaging screw conveyor.

Pneumatic retrieval will be performed to the extent practicable (i.e., as long as material can be safely and effectively removed by vacuum). Of significant importance is the use of the VWMS/PRS for removal of material from behind the silo wall, at the proposed access location, to permit safe wall opening for mechanical retrieval. The VWMS/PRS can be used prior to the MRS and in conjunction with it.

Mechanical Retrieval

The Mechanical Retrieval System (MRS) is housed in a robust concrete structure (Excavator Building) attached to the silo structure. When free-flowing material has been removed from the silo to expose the inside of the silo wall, an opening will be cut into the exposed silo wall to enable the use of a mechanical excavator (see Section 1.4.2). Compacted material remaining behind the wall will not prevent initiation of wall removal.

The selected excavator has an additional articulating joint. This provides a range of motion that allows it to work within the silo and adjoining excavator room. The machine can also articulate in a horizontal plane. This provides flexibility for supporting retrieval if only portion of the wall can be removed due to material impacted behind the wall.

The excavator can reach into the silo and loosen compacted material for vacuuming. Video cameras to allow for remote viewing. The excavator may also be used to manipulate the VWMS wand/hose to facilitate pneumatic retrieval. The remotely-operated excavator will enter the silo and dig into the waste pile. Removed material will be placed in a below-grade bin in the Excavator Room and then moved to the two packaging stations via four conveyors. Three of the conveyors are screw-type, and one is a pocketed sidewall belt conveyor. The last of the screw-type conveyors is common to the PRS.

Waste Conditioning

As the Silo 3 material is containerized, it will be conditioned by the addition of an aqueous solution to reduce dispersibility and metals mobility. The solution of ferrous sulfate, sodium lignosulfonate, and water will be sprayed onto the material in the fill chutes at the packaging stations. No credit was taken for waste treatment in the hazard category calculations.

Container Filling

Each of the two Package Loading Stands is a computer-controlled (PLC), semi-automated system with loading spouts, loading stands, thumper tables, weighing scales, sealers, and motorized roller conveyors for transporting the filled bags away from the station. There is also a camera in the area.

For both PRS- and MRS-retrieved waste, the final package is an IP-2-compliant (Industrial Package Type 2) soft-sided, sturdy-but-flexible, polypropylene bulk bag containing a sealed poly-vinyl choride (PVC) liner. The bulk bag measures 72" x 48" x 48". Waste will first be dropped through the expandable-seal fill chutes into the PVC liner bag. When full, the liner will undergo a heat-sealing procedure that ensures that none of the powdered waste is released to the adjacent work area. The sealed liner bag will move away from the fill chute to be enclosed in the outer bag. The trimmed-off neck of the liner bag will be retained by the fill chute and expelled into the next liner bag to be filled.

The PRS baghouse collector has high level switches to provide alarm at High level and shutdown at High-high level. An interlock associated with the packaging stand weight transmitters will stop the upstream conveyor, which in turn stops other upstream equipment. The operator will also be able to observe bag loading via a miniature camera inside the packaging filling head and associated monitor. The operator will also be able to feel the container as it is filled. The operator can stop the equipment when, by visual and/or touch, the bag is full. Bag-filling is totally contained. If a bag is overfilled, there will be no release of material. Excess material can be removed by using a vacuum hose or mechanical extraction at the fill chute ports. Of course, this activity will require containment (plastic bagging), a work plan, and a Radiation Work Permit (RWP).

Filled Container Management

Note: The number of filled bulk bags per Sea/Land container will be limited by the U.S. Department of Transportation (DOT) truck limit of 42,000 lbs.

After a bag is filled and closed, the bag assembly is moved to the Package Staging Conveyor. The final packages will be surveyed and decontaminated (if necessary) for transfer to a Sea/Land container. Labeled bags are then transported to the Cargo Container Bay. Bags are transferred into Sea/Land containers using the bridge crane. Video cameras to allow for remote viewing of the process and personnel.

Once a Sea/Land container is filled with bags (7 bags or less), the lid is replaced and a heavy-duty forklift transports the Sea/Land container to an Interim Staging Area (ISA). The ISA was constructed in the year 2000 east of Silo 3. It is a 1-acre, 9-inch-thick reinforced concrete pad. A portion of the pad is for container staging prior to off-site shipment. Another portion is now designated as the Process Building site. The pad has catch basins, an underground storm water drainage system, and aprons to the new infrastructure road. Modifications to the pad are required to support the current building requirements.

Staging Area for Railcar Loading

Another staging area is available for railcar loading. A concrete pad has been poured from east of the new Silos 1 & 2 Warehouse to west to the Silos 1 & 2 Remediation Facility rail lines. This area, originally part of the Silos 1 & 2 Warehouse Project, will provide a loading area for Silo 3 Project shipping. This change was approved by the Ohio EPA [Ref. 28].

On-site Transportation

Silo 3 waste material will be transported to an off-site disposal facility by truck or railcar. The on-site transportation process will be the same used for all FCP operations. The Silo 3 waste shippers will become part of the Silo 3 Project.

1.4.4 Retrieval Operations Personnel

Note: The numbers provided below reflect operations personnel planning as of the issuance of this N-HASP. These numbers relate to the data provided in the ALARA Analysis (Appendix D, Table D-8). ALARA data is based on a production rate designed to meet the closure schedule. Once Silo 3 retrieval becomes operational, a number of variables may be adjusted in order to maintain the specified production rate or to complete retrieval sooner (e.g., shift durations, workdays-per-week, crew sizes).

The Silo 3 Project will have four months of start-up and readiness operations (two months equipment/system testing; one month simulated operation using surrogate material; one month Readiness Review). During the six months of regular operations, the PRS will operate for approximately three months and the MRS will operate for approximately three months (based on the presumed layering of loose and compacted material). Silo 3 material processing will operate five days/week, 12 hours/day (i.e., a 12-hour shift).

1.5 Management Responsibility for a Safe Work Environment

Providing a safe work environment is the direct responsibility of Fluor Fernald management. Everyone must share a concern for their own safety, the safety of their co-workers, and the protection of the environment. It must be fully understood by all employees that safety shall take precedence over expediency. It is a condition of employment that all employees work safely and follow established safety rules and procedures.

It is the responsibility and policy of Fluor Fernald to provide a safe work environment for all employees. Fluor Fernald management is committed to the belief that all accidents, injuries and occupational illnesses can be prevented and if an activity cannot be performed safely, it will not be performed. Management fully supports this commitment by ensuring that every employee receives the appropriate training, personal protective equipment, and other resources necessary to execute assigned work activities in a safe and efficient manner.

Management responsibilities for safety are further discussed in Section 2.0, *Integrated Safety Management (ISM) System*.

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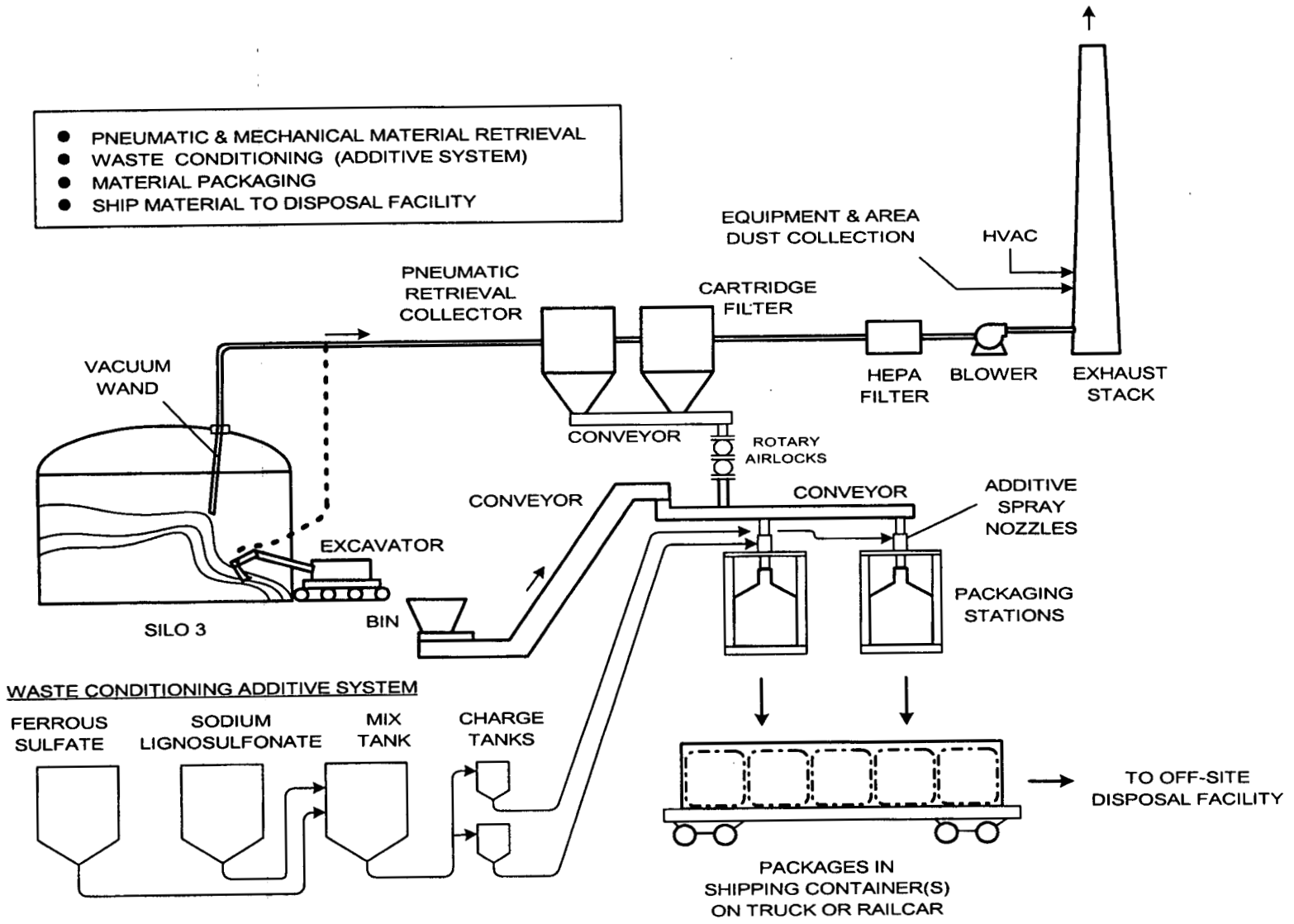
FIGURE 1-1: SILO 3 OPERATIONS FLOW DIAGRAM



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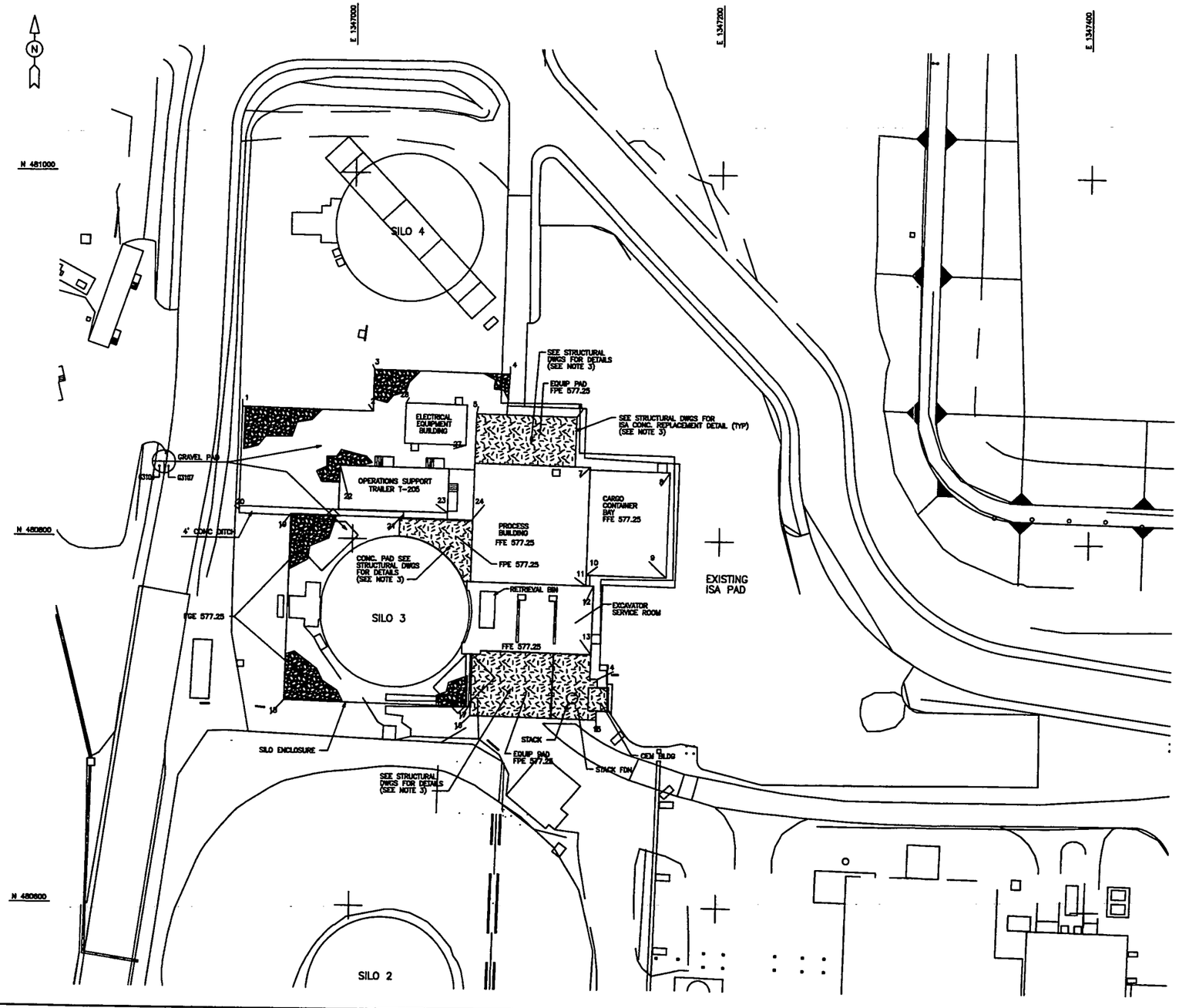

NOTES:

1. FOR GENERAL NOTES AND LEGEND SEE SHEET G3102.
2. FOR GENERAL ARRANGEMENT SEE SHEET M0001.
3. FOR STRUCTURAL FOUNDATIONS AND BUILDINGS SEE SHEET S0120.

COORDINATE LISTING

POINT NO.	NORTHING	EASTING
1	480871.54	1346938.77
2	480889.58	1347010.47
3	480892.57	1347011.10
4	480890.54	1347085.39
5	480888.71	1347087.59
6	480887.24	1347121.57
7	480839.85	1347129.07
8	480837.32	1347172.94
9	480780.01	1347171.37
10	480781.21	1347127.47
11	480775.38	1347127.31
12	480775.28	1347131.56
13	480737.94	1347130.54
14	480724.50	1347134.17
15	480702.26	1347133.56
16	480704.12	1347065.59
17	480705.98	1347064.80
18	480711.76	1346963.34
19	480813.22	1346968.12
20	480815.17	1346937.57
21	480813.28	1347027.44
22	480840.00	1346992.77
23	480814.37	1347052.10
24	480811.10	1347065.85
27	480851.35	1347061.75
28	480874.36	1347028.29

FIGURE 1-2
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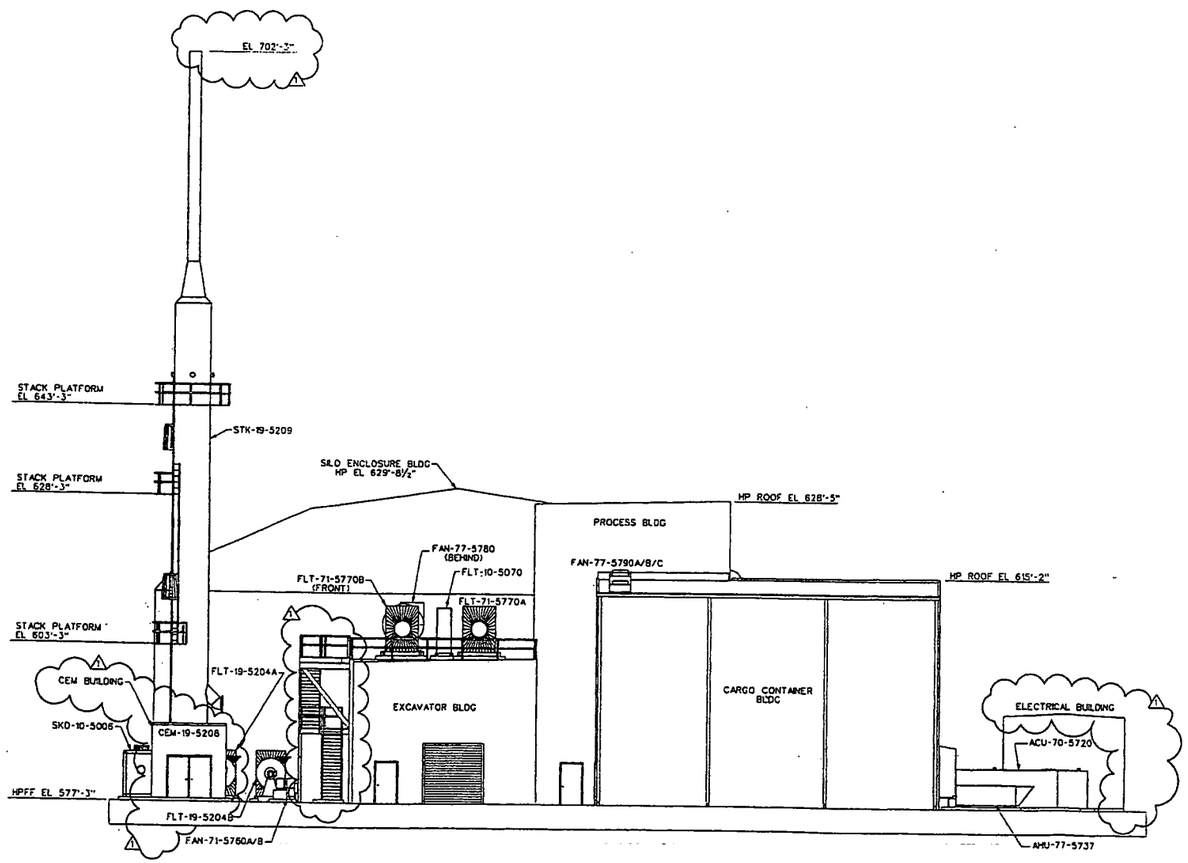
REFERENCE DRAWING NO.	THIS DRAWING PREPARED BY		DRAWING TITLE
	FLUOR FERNALD SILOS PROJECT CINCINNATI, OHIO PROJECT NAME SILOS PROJECT	UNITED STATES DEPARTMENT OF ENERGY FERNALD ENVIRONMENTAL MANAGEMENT PROJECT	CIVIL SITE PLAN SILO 3

CADFILE SK40430DCN0073			CADCODE AUTOCAD 2000		
DRAWN BY J. THOMPSON	DATE 8/13/03	DESIGNED, CHECKED BY	DATE	CHECKED BY	DATE
PLANT/BLDG. NO. OU4		FLOOR		SCALE NONE	CLASS
SUBMITTED FOR APPROVAL A-E DATE		APPROVAL RECOMMENDED OPERATING CONTRACTOR DATE		000033	
DOE PROJECT NO.	OPER. CONTR. PROJ. NO. 40430	DRAWING NO. SK40430DCN0073		SHEET NO. 1	REV. NO. A

INITIALS: JBT DATE: 8/13/03

FIGURE 1-3
Pages 23/24



EAST ELEVATION

SCALE: ¼" = 1'-0"

GENERAL NOTES:

1. ALL EQUIPMENT DESIGNATORS ARE EXPLAINED ON THE P&ID LEAD SHEETS (i.e. M0001, M0002, AND M0003).
2. ABBREVIATIONS ARE AS FOLLOWS:
   HP HIGH POINT
   EL ELEVATION
   HPFF HIGH POINT OF FINISHED FLOOR
3. ALL DIMENSIONS NOT LOCATING EQUIPMENT ARE REFERENCE ONLY.

#050

REF DWG NO.	DRAWING TITLE

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
1	REVISED PER DCN 40430-JEG-043, -034, -042	11-1-03		
0	ISSUED TO CONSTRUCTION	07/11/02	MPM	JTN

INITIALS AND DATE

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JE JACOBS

PROJECT NAME: SILO 3

DRAWING TITLE: MECHANICAL GENERAL ARRANGEMENT EAST ELEVATION

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
D. DAVIS	07/11/02	J.T. NELSON	07/11/02	MICHAEL MALONE	07/11/02

PLANT/BLDG. NO.: N/A | FLOOR: N/A | SCALE: ½" = 1'-0" | CLASS: U

SUBMITTED FOR 30% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 60% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 90% ISSUE — TECH LEAD — DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.		SHEET NO.	REV. NO.
N/A	40430				
JEG PROJECT NO. 35H19605	FILENAME 9430\1463.DGN	94X-3900-M-01463		M0002	1

DATE: 04/04/03 TIME: 09:35:46 AM
USER: DDavis
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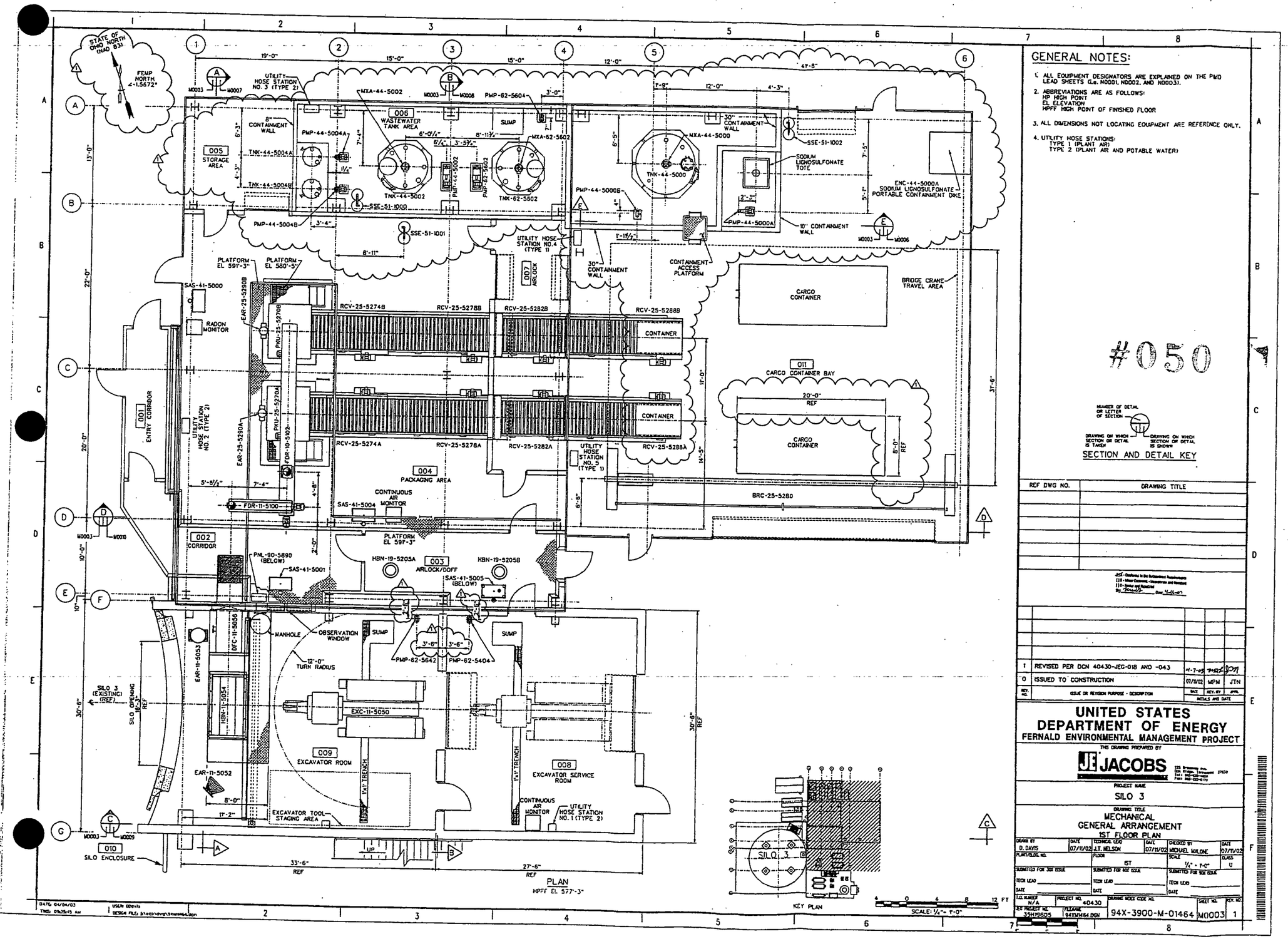
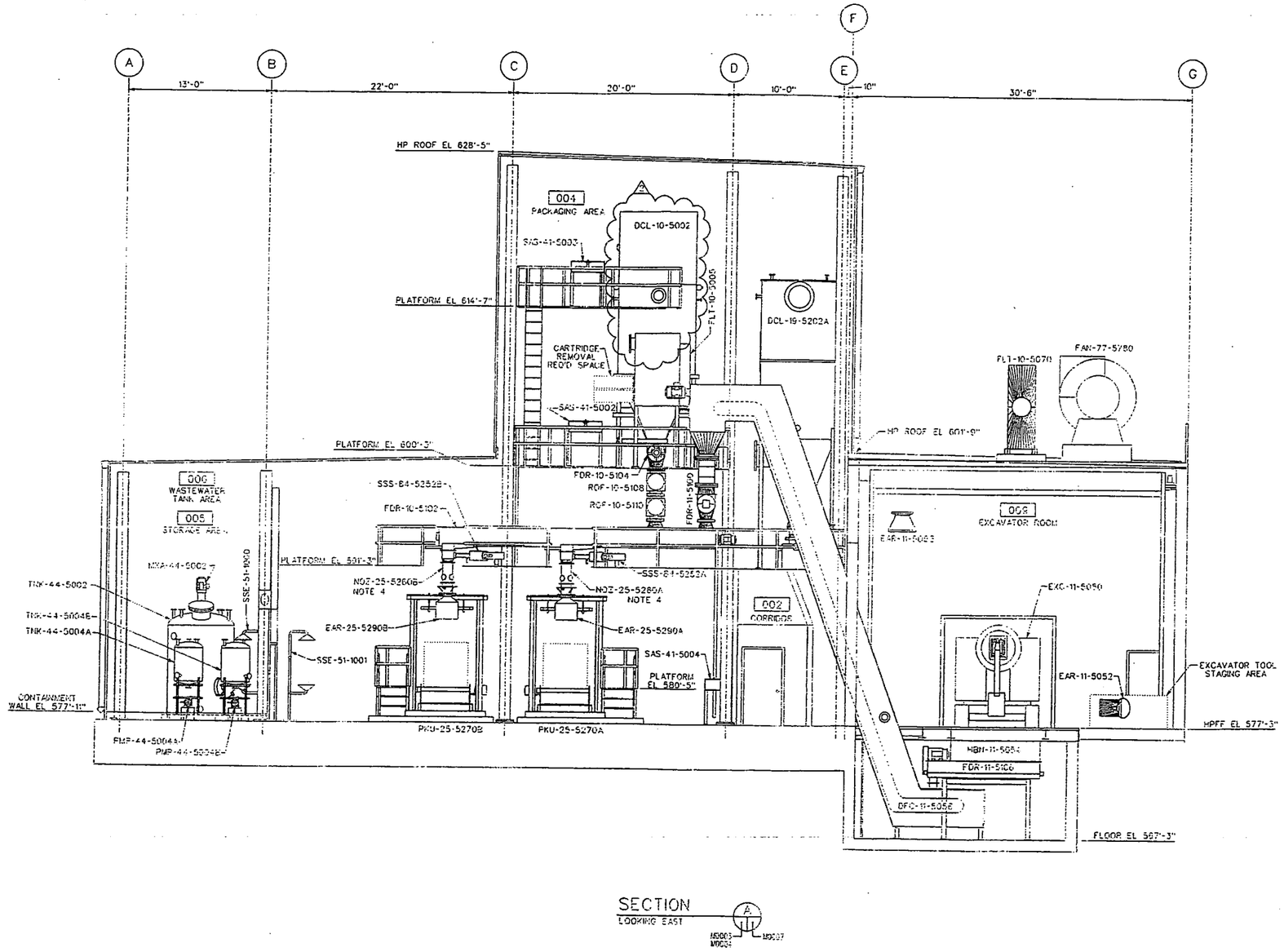


FIGURE 1-4
Pages 25/26



SECTION
LOOKING EAST

SCALE: 1/4" = 1'-0"

GENERAL NOTES:

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1. ALL EQUIPMENT DESIGNATORS ARE EXPLAINED ON THE P&ID LEAD SHEETS (i.e. N0001, N0002, AND N0003).
2. ABBREVIATIONS ARE AS FOLLOWS:
   HP HIGH POINT
   EL ELEVATION
   HPFF HIGH POINT OF FINISHED FLOOR
3. ALL DIMENSIONS NOT LOCATING EQUIPMENT ARE REFERENCE ONLY.
4. THE PACKAGING SAMPLERS MAY BE DELETED FROM THE SILO 3 DESIGN. FLUOR FERNALD, INC., IS TO BE CONSULTED BEFORE PROCUREMENT/INSTALLATION OF THIS EQUIPMENT.

FIGURE 1-5
Pages 27/28

NUMBER OF DETAIL OR LETTER OF SECTION
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN
SECTION AND DETAIL KEY

REF DWG NO.	DRAWING TITLE

#050

REV NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APP.
2	REVISED PER DCN 40430-JEG-055	6/25/03	MDL	JTH
1	REVISED PER DCN 40430-JEG-043	04/07/03	MDL	JTH
0	ISSUED TO CONSTRUCTION	07/11/02	MPM	JTH

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JACOBS

PROJECT NAME
SILO 3 000036

DRAWING TITLE
MECHANICAL
GENERAL ARRANGEMENT
SECTION A

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
D. DAVIS	07/11/02	J.T. NELSON	07/11/02	MICHAEL MALONE	07/11/02

FLUOR/BDG NO. | FLOOR N/A | SCALE 1/4" = 1'-0" | SHEET NO.

SUBMITTED FOR 30% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 60% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 90% ISSUE — TECH LEAD — DATE

T.A. NUMBER	PROJECT NO.	DRAWING NOT DCN #	SHEET NO.	REV. NO.
N/A	40430			
JE PROJECT NO. 35H19605	FILENAME 943M1467.DGN	94X-3900-M-01467	M0007	2

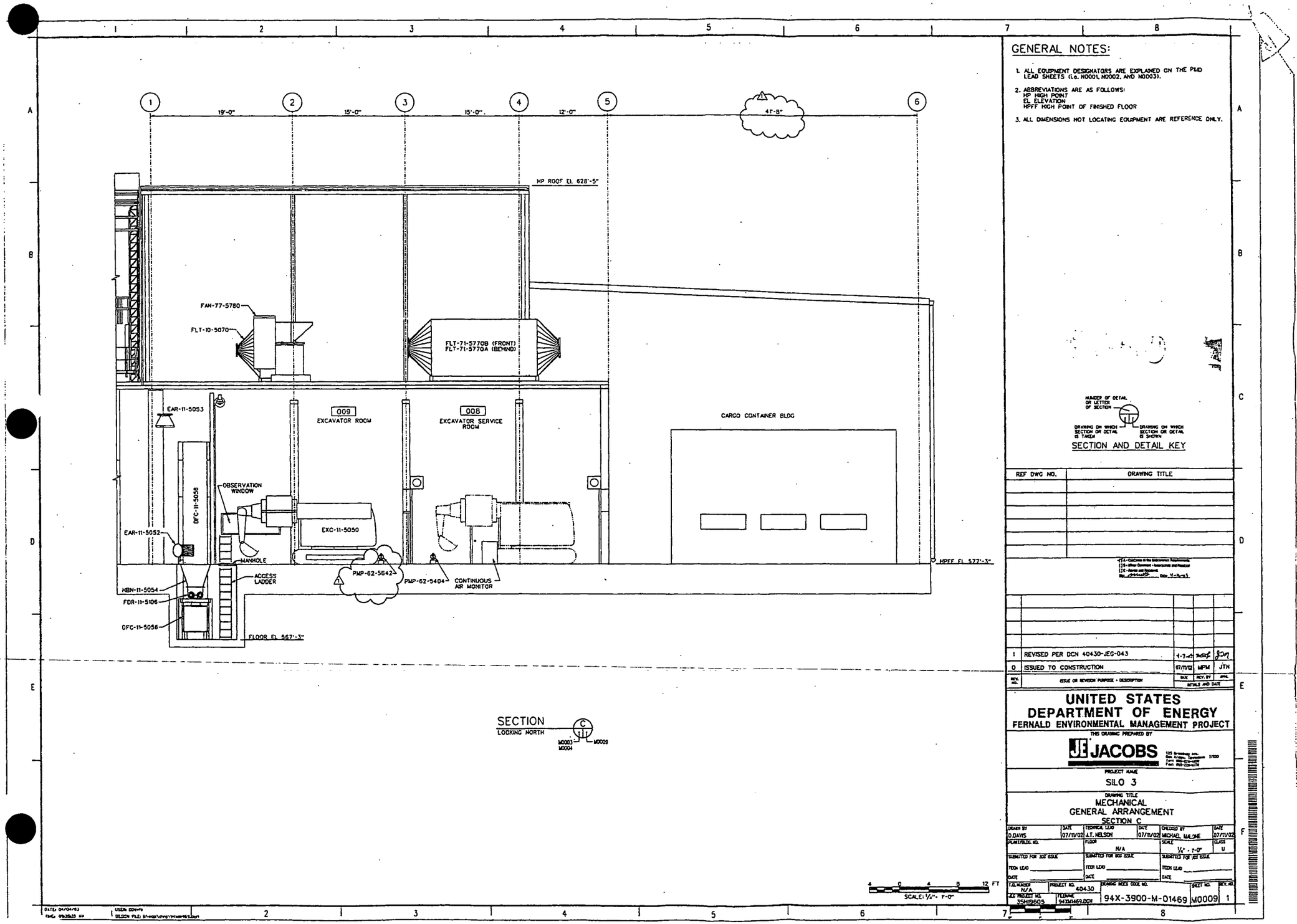
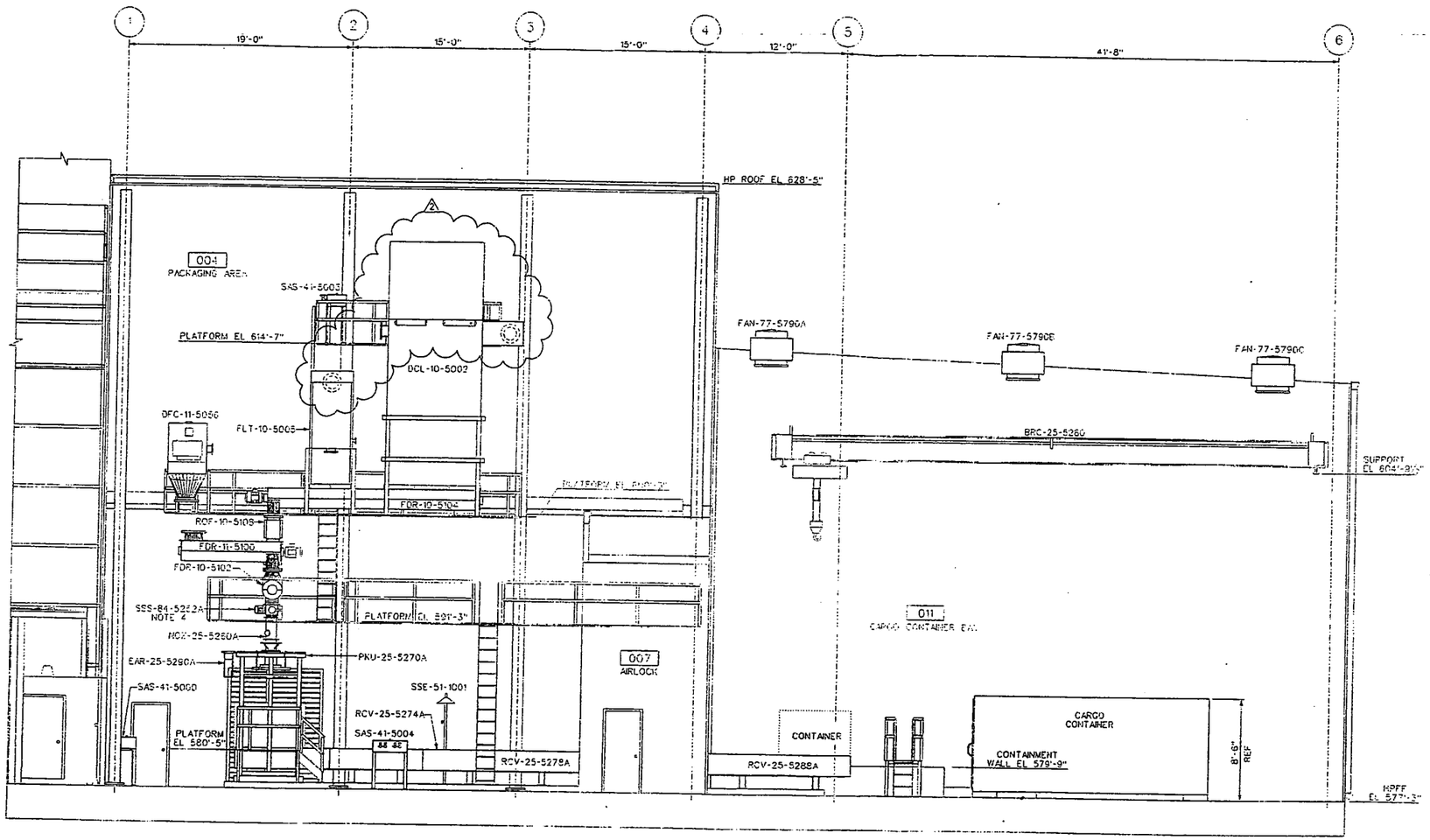


FIGURE 1-6
Pages 29/30

4997



SECTION
LOOKING NORTH

SCALE: 1/4" = 1'-0"

GENERAL NOTES:

1. ALL EQUIPMENT DESIGNATORS ARE EXPLAINED ON THE P&ID LEAD SHEETS (i.e. N0001, N0002, AND N0003).
2. ABBREVIATIONS ARE AS FOLLOWS:
   HP HIGH POINT
   EL ELEVATION
   HPFF HIGH POINT OF FINISHED FLOOR
3. ALL DIMENSIONS NOT LOCATING EQUIPMENT ARE REFERENCE ONLY.
4. THE PACKAGING SAMPLERS MAY BE DELETED FROM THE SILO 3 DESIGN. FLUOR FERNALD, INC., IS TO BE CONSULTED BEFORE PROCUREMENT/INSTALLATION OF THIS EQUIPMENT.

FIGURE 1-7
Pages 31/32

NUMBER OF DETAIL OR LETTER OF SECTION
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

SECTION AND DETAIL KEY

REF DWG NO.	DRAWING TITLE

#050-1

2	REVISED PER DCN 40430-JEG-065	4/15/05	MDL	JTN
1	REVISED PER DCN 40430-JEG-043	04/08/03	MDL	JTN
0	ISSUED TO CONSTRUCTION	07/11/02	MFM	JTN
REV NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV BY	APR.

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY:
JACOBS

PROJECT NAME
SILO 3

000038

DRAWING TITLE
MECHANICAL
GENERAL ARRANGEMENT
SECTION D

DESIGN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
D. DAVIS	07/11/02	J.T. NELSON	07/11/02	MICHAEL MALONE	07/11/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
	N/A	1/4" = 1'-0"	G

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

F.E. NUMBER	PROJECT NO.	DRAWING INDEX CODE	SHEET NO.	REVISION
N/A	40430			
J.E. PROJECT NO. 35H19805	FILENAME 94XM475.DGN	94X-3900-M-01470	M0010	2

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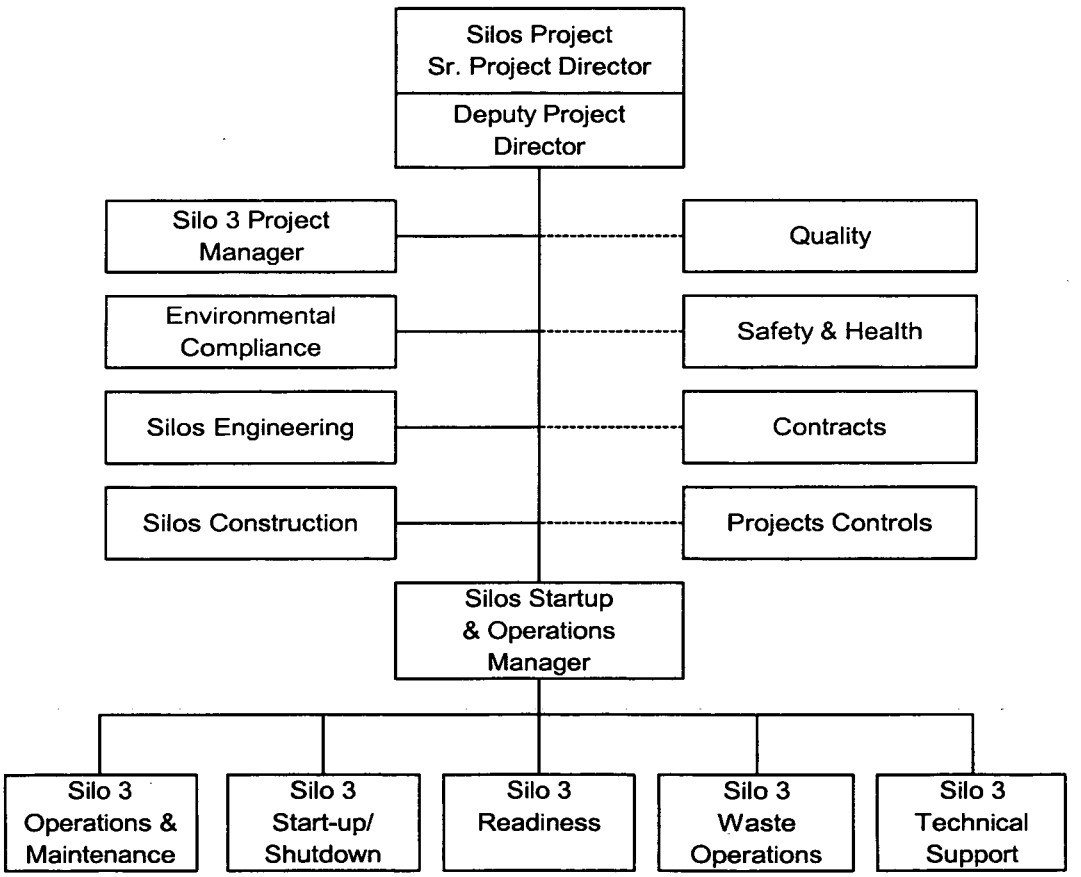
1.6 Silo 3 Project Organization

The Silo 3 Project has organized a team with the extensive technical and administrative experience necessary to successfully complete the overall Silos retrieval and disposition project. The Silos Project is divided into three sub-projects: the Advanced Waste Retrieval (AWR) Project (which includes the Radon Control System), the Silos I & 2 Remediation Project, and the Silo 3 Project. To support these projects, the Silos Project uses common technical experts. As the Silos projects continue to develop through normal execution phases, the roles and responsibilities will be appropriately transitioned to efficiently provide the required support. The Silos Project organization chart is periodically updated and maintained on the Fernald Intranet. The Silo 3 organization chart is shown **FIGURE 1-8.** Future activities not currently represented are Safe Shutdown, Decontamination and Demolition, and Soils Remediation.

FIGURE 1-8: SILO 3 PROJECT ORGANIZATION CHART



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Silos Senior Project Director (SPD)

The Silos Senior Project Director (SPD) is responsible for all aspects of the Silos Project (AWR, Silos 1 and 2 Remediation, and Silo 3). The SPD is the primary interface for the Fluor Fernald Leadership Team, the DOE, as well as the numerous regulatory agencies and community groups interested in Silos Project activities. The SPD is also the Executive Account Approval Manager for all Silos Project accounts. In keeping with the principles of Integrated Safety Management (ISM), the SPD is responsible for the safety of the worker, the public, and the environment throughout the Silos Project.

Silos Deputy Project Director (DPD)

The Silos Deputy Project Director (DPD) is responsible for assisting the SPD in all aspects of the Silos Project with specific accountability for the shared support areas of Safety, Quality, Project Controls, Reporting, and Procurement. The DPD will coordinate these support functions to ensure integration of lessons learned, implementation of the ISM principles and functions, and continuous improvement of safety and quality work processes. The DPD is the Control Account Manager (CAM) for all Silos charge accounts and will also serve as the staffing manager for the Silos Project. The DPD will function as back-up interface for Silos Project interaction with DOE, regulators, and community stakeholders. The DPD will support the SPD with optimization of resource use and achievement of critical schedule goals.

Silo 3 Project Manager (PM)

The Silo 3 Project Manager (PM) is responsible to the Silos SPD for the execution of all aspects of the Silo 3 Project, including baseline development and management, design engineering, procurement activities, technical contractor oversight and compliance management, and safe shutdown. The PM is responsible for the safe, cost-effective, and timely implementation of the work scope and functional area requirements contained in the applicable sections of the *Silos Project Execution Plan* [Ref. 29]. The PM is also responsible for the development and negotiation of key project milestones and for being responsive to applicable regulatory agencies and stakeholders. The Silo 3 PM coordinates project activities with the Silos Functional Area Managers. Additionally, the PM is the delegated CAM authority for the Silo 3 Project.

Silos Safety and Health (S&H) Manager

The Safety and Health Manager (S&H) is matrixed to the Silos Project from the Environmental Safety, Health and Quality (ESH&Q) Division. The S&H Manager is responsible to the Silos DPD for identification and resolution of safety and health issues, and for coordination of Silos Project safety and health resources with other Fluor Fernald projects, divisions, and programs. The S&H Manager supports the Silo 3 Project with regard to Occupational Safety and Health (OS&H), Radiological Engineering, Emergency Preparedness, Nuclear and Systems Safety (NSS), Fire Protection, and Security functional areas.

- For OS&H, the S&H Manager will ensure that the Silo 3 Project implements a program compliant with applicable regulatory guidelines to provide a safe working environment for team members.

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- For Radiological Engineering, the S&H Manager will ensure that the Silo 3 Project maintains a program compliant with applicable regulatory guidelines and provides a radiologically safe working environment for all team members.

- For Emergency Preparedness, the S&H Manager will ensure that the Silo 3 Project maintains plans, coordination, and programs compliant with applicable regulatory guidelines to provide a safe working environment for all team members.

- For NSS, the S&H Manager will ensure that the Silo 3 Project provides the administrative support and technical activities required for protecting the environment and health and safety of the public in the event of an accident. The S&H staff is responsible for providing guidance on required safety basis documentation, reviewing configuration management issues, and supporting hazard analyses. The analyses include the Integrated Hazard Analysis (IHA), Human Factors Evaluation (HFE), and As Low As Reasonably Achievable (ALARA) analysis, through the Safety Analysis Department.

- For Security, the S&H Manager will maintain a liaison with Fluor Fernald Security to ensure that the Silo 3 Project maintains a program compliant with applicable regulatory guidelines for personnel access and control of property.

Silos Construction Manager (CM)

The Silos Construction Manager (CM) reports to, and is responsible to, the Silos SPD for coordination of all construction activities performed in support of the Silos Project (including Silo 3). The CM will coordinate all planning, documenting, and oversight activities associated with the construction of Silo 3 systems and facilities. The CM will coordinate with the Silos EM to ensure integration of engineering deliverables to support Silo 3 construction and overall project schedules. The CM is responsible for providing constructability reviews for Silo 3 based on submittals. The CM will drive completion of the Construction Acceptance Testing (CAT) as part of the process of turnover to operations. The CM will direct the activities of Procurement and Contracts administration to meet the field needs, as well as other support areas such as field safety, quality control, and radiological support. The CM will interface with SH&Q for assurance of proper work authorization, safety, and quality in all construction activities. The CM will interface with Startup, Readiness, and Operations & Maintenance (O&M) functions to ensure timely and effective turnover of constructed systems and facilities to Operations.

Silos Engineering Manager (EM)

The Silos Engineering Manager (EM) reports to, and is responsible to, the Silos SPD. The EM Manager is responsible for ensuring that all design tasks are completed in a manner compliant with the programs and procedures of the Fluor Fernald Site Engineering Group. The Silos EM is responsible for design configuration management and design change control work processes. The Silos EM will support the Silo 3 Project Engineering Lead's efforts to appropriately document and coordinate the engineering activities. The Silos EM is also responsible for all technical studies performed for the Silo 3 Project, for overall engineering documentation, and for all support provided by Title 3 (construction support) and home office technical personnel.

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Silos Startup and Operations (S&O) Manager

The Silos Startup and Operations (S&O) Manager reports to, and is responsible to, the Silos SPD for coordination and integration of all Silos startup, readiness, operations, and maintenance functions (including Silo 3). This includes integration of the Waste Management function in Silos.

Silos Operations and Maintenance (O&M) Manager

The Silos Project Operations and Maintenance (O&M) Manager reports to the Silos S&O Manager and is responsible for ensuring operation and maintenance of all facilities required for the remediation of the silos and the material currently stored in the silos. The O&M Manager is responsible to each of the individual projects (including Silo 3) with regard to operation and maintenance of the facilities to meet the safety, schedule, quality, and regulatory goals. The O&M Manager will be responsible for project interface with FAT&LC for labor coordination and any industrial relations processes. The O&M Manager will be responsible for development and administration of all training support required to assure that all operations and support staff training requirements are identified and fulfilled.

Silos Startup/Shutdown Manager (SSM)

The Silos Startup/Shutdown Manager (SSM) reports to the Silos S&O Manager and is responsible for the startup of all facilities required for silos remediation (including Silo 3), and for validation of completion of all safety, regulatory, contractual, design, and quality requirements. The SSM plans and coordinates the transition from Silo 3 construction completion to turnover to Operations, including completion of all component and systems operational testing in accordance with a startup and test program. The completion of the Silo 3 facility startup and test program will transition the operable facility to the Silos Project O&M Manager. The SSM will ensure that lessons learned from each Silo Project startup are shared with the project functional managers for future improvement. The SSM is also responsible for operations planning in support of post-operations and safe shutdown activities.

Silos Readiness Manager (SRM)

The Silos Readiness Manager (SRM) reports to the Silos S&O Manager and is responsible for verifying that facility safety documentation is in place and that procedures, personnel, equipment, and systems support the necessary requirements for the start of operations. The SRM will develop a readiness plan of action consistent with a graded approach to minimum core requirements and ISM principles to bring the facilities to a state of readiness to safely commence operations. The SRM will coordinate self-assessment activities with all functional area leads in preparation for independent startup verification reviews and also will coordinate with any site and DOE teams involved in these processes

Silos Waste Operations (WO) Manager 4997

The Silos Waste Operations (WO) Manager reports to the Silos S&O Manager, and is responsible for:

- characterization and profiling of Silos waste.
- receiving packaging supplies, including feed materials, containers, and spare parts to support the Silos packaging operations.
- feeding empty containers into the processing facilities.
- preparing loaded containers for shipment to an offsite disposal facility.
- site-wide shipping logistics and verification of compliance with all regulatory requirements associated with hazardous waste disposition.

The WO Manager is also responsible for ensuring that a Waste Certification Group is in place to cover the special quality control functions related to compliance verification and material pedigree.

Silos Quality Manager (QM)

The Quality Manager (QM) is matrixed to the Silos DPD for coordination of all quality functional areas within the division. The QM is also responsible to the Fluor Fernald QA Manager to perform tasks in a manner compliant with the requirements of Fluor Fernald quality programs and procedures. The QM will supervise and support the efforts to appropriately document and coordinate Silo 3 Project QA/QC activities. The QM is also responsible for special quality control functions associated with packaging and shipping hazardous waste materials. The QM will ensure that lessons learned from all on-going Silos Project activities are shared with the project functional managers for future improvement.

Silos Contracts Administrator (CA)

The Contracts Administrator (CA) is matrixed to the Silos DPD and is responsible for providing contractual support to the Silos Project, including management of contracts, preparation of solicitations, evaluation of offers, contract negotiation, contract award, procurement of materials and services, and administration of contract performance and change orders.

Silos Project Controls Manager (PCM)

The Project Controls Manager (PCM) is matrixed to the Silos DPD and is responsible for establishment of a work breakdown structure, budgeting and funding the baseline scope, cost control and invoicing, baseline change management, schedule control, and resource management for the Silos Project. The PCM will develop and communicate appropriate project metrics to indicate status and performance against key project goals and requirements.

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Silos Environmental Compliance Manager (ECM)

The Environmental Compliance Manager (ECM) reports directly to the Silos SPD and is responsible for compliance with all regulatory requirements for Silos as well as other site activities. The ECM will also serve as the relationship manager with the agencies.

Silos Technical Support Manager (TSM)

The Technical Support Manager (TSM) reports directly to the S&O Manager and is responsible for procedures and programs development in support of operations. The TSM is also responsible for analytical and lab support of operations.

1.7 Silo 3 Workplace Hazards Analysis

A quantitative analysis of the hazards associated with the construction, operations, and maintenance tasks for Silo 3 was performed per Fluor Fernald requirements. Guidance was taken from 10 CFR 830 [Ref. 2], DOE-STD-1027-92 [Ref. 30], and the Occupational Safety and Health Administration (OSHA) 29 CFR 1910.119 [Ref. 31] and 29 CFR 1910.120 [Ref. 3]. The objectives of the analysis were to:

- identify and evaluate hazards contained in the facility/process to establish a sound technical basis for their control.
- establish worker safety controls to reduce and mitigate hazards.
- establish Process Requirements (PRs) to ensure that the activities remain safe in accordance with good management practices, routine conditions, and anticipated operating modes.
- establish Safety Basis Requirements (SBRs), which limit the activities based on a direct association with its analyzed safety envelope and current Hazard Categorization or classification.

The analysis was performed by a diverse team integrating all safety functional areas (radiation protection, industrial hygiene, industrial safety, nuclear safety, fire protection, and emergency preparedness) along with operations, maintenance, quality assurance, engineering, and a facility owner.
The methods used by the team to determine the safety envelope included:

- Integrated Hazard Analysis (IHA)
- Hazard Category Calculations (HCC)
- Human Factors Evaluation (HFE)
- Occupational ALARA Analysis
- Environmental ALARA Report
- Fire Hazards Analysis (FHA)
- Accident Analysis

Complete descriptions and details of these analyses can be found in Volume II of this N-HASP.

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2.0 INTEGRATED SAFETY MANAGEMENT (ISM) SYSTEM

The purpose of the Integrated Safety Management (ISM) system is to ensure the integration of safety into all facets of Silos work planning and execution. Specific responsibilities for implementation of ISM are assigned to both DOE and Fluor Fernald line management. The objective is to systematically integrate safety into management and work practices at all levels so that missions are accomplished while protecting the public, the workers, and the environment. The ISM program is described in PL-3081, *Safety Management System Description (SMSD)* [Ref. 32].

ISM is incorporated into the Silos Project and will be incorporated into any contracts awarded to support this work scope - thus assuring that the precepts of ISM flow down to all subcontractors. All subcontractors are fully expected to meet the contract requirements pertaining to the integration of environmental, safety, and health requirements into work planning and execution. Contractors are expected to work safely without accident, injury, or insult to the environment. Any contracts associated with this project will specifically state that the contractor shall ensure that management of environment, safety, and health (ES&H), pollution prevention, and waste minimization functions and activities become an integral yet visible part of their work planning and execution process. This will assure that ISM program requirements flow down to subcontractors.

The Seven Guiding Principles of ISM

1. Line Management Responsibility for Safety - All levels of management are responsible for safety. Line management is directly responsible for the protection of the public, the workers, and the environment. The term line management means all levels of leadership in the organization responsible for accomplishing a particular mission, either project or programmatic.

2. Clear Roles and Responsibilities - Clear lines of authority and responsibility for ensuring safety are established and maintained at all organizational levels. The leadership responsible for accomplishing project or programmatic work is also responsible for ES&H.

3. Competence Commensurate with Responsibilities - Personnel must possess the experience, knowledge, skills, and abilities that are necessary to perform their responsibilities.

4. Balanced Priorities - Resources are effectively used. Safety costs are an integral part of the total cost of accomplishing the work scope. Another aspect of integration is the fusion of safety planning with the business process, such as budget and resource allocation. A first step is to translate missions into work requirements in conjunction with the prioritization of budget and resources.

5. Identification of Safety Standards and Requirements - Before work is performed, the identified hazards are evaluated and an agreed-upon set of safety standards and requirements is established that will provide adequate assurance that the public, the workers, and the environment are protected from adverse consequences.

6. Hazard Controls Tailored to Work Being Performed - Administrative and engineering controls to reduce and mitigate hazards are tailored to the work being performed and identified hazards.

7. Operations Authorization - The conditions and requirements for operations to be initiated and conducted are clearly established, agreed upon, and addressed. This process is further defined in the Contractors' Work Plans and is accomplished through preparation of appropriate safety documentation and demonstrations of readiness. In addition, work control documents (e.g., Work Plans and permits) may include conditions that must be satisfied for work to proceed.

   Readiness documentation will be published separately as a part of the Silo 3 Start-up and Turnover Plan of Action. This documentation will be reviewed and approved separately by the DOE.

The Five Core Functions of ISM

1. Define the Scope of Work - Missions are translated into work, expectations are set, tasks are identified and prioritized, and resources are allocated.

2. Analyze the Hazards - Hazards associated with the work are identified, analyzed and categorized.

3. Develop and Implement Hazard Controls - The overall safety envelope is established and controls are implemented. Applicable standards and requirements are identified and agreed-upon, controls to prevent or mitigate hazards are identified, the safety envelope is established, and controls are implemented.

4. Perform Work within Controls - Documentation is to be followed to perform the work, readiness is confirmed, and work is performed safely.

5. Provide Feedback and Continuous Improvement - Feedback information from inspections, assessments and appraisals. Feedback information on the adequacy of controls is gathered, opportunities for improving the definition and planning of work are identified and implemented, and line and independent oversight is conducted. Feedback and continuous improvement is documented in the activity specific work management system.

ISM Work Authorization Flowdown for the Silo 3 Project

The following list presents the ISM flowdown of work authorization documents for the Silo 3 Retrieval and Disposition Project. This flowdown moves from sitewide authorization to general Silos Project authorization to Silo 3 operations authorization.

Sitewide Work Authorization Flowdown

- DOE Policy 450.4, *Safety Management System Policy* [Ref. 33], and the Department of Energy Acquisition Regulation (DEAR) Clause, 48 CFR 970.5204-2 [Ref. 34], requires that a safety management system shall be used to integrate safety into management and work practices at all levels.

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- DE-AC24-010H20115 [Ref. 35] is the contract between FCP and DOE which specifically identifies which standards and requirements that FCP needs to follow, as well as requiring FCP to work safely.

- RM-0016, *Management Plan* [Ref. 36], describes how FCP maintains the standards and requirements identified in Contract No. DE-AC24-010H20115. The Management Plan also lists the key site documents which serve to flow down the ISM requirements at the site.

- The *Safety Management System Description (SMSD)*, PL-3081 [Ref. 32], provides an overview of the programs, policies, and procedures used by FCP to ensure that work is performed safely.

Silos Project Work Authorization Flowdown

To facilitate the mission of "Safely restoring the Fernald site to an end state which serves the community's needs," FCP establishes projects, managed by project directors, to accomplish the required remediation activities. The Silos Project is one of the critical site projects. It is divided into three sub-projects: the Advanced Waste Retrieval (AWR) Project (including the Radon Control System), the Silos I & 2 Remediation Project, and the Silo 3 Project. Construction activities for these three sub-projects are governed by the same work authorization process:

- The *Silos Project Execution Plan*, 40000-PEP-0001 [Ref. 29], provides an overview of the Silos Project and references documents that outline how project-specific and program-specific requirements are implemented. This plan describes the project scope, requirements, roles and responsibilities, and systems for executing work in a safe manner consistent with ISM.

- CT-2.1.1, *Construction Project Planning and Construction Invitation for Bid/Request for Proposal (IFB/RFP) Preparation* [Ref. 37] governs the development of construction work packages. Once a contract is awarded, a Notice to Proceed and an Authorization to Mobilize are sent to the subcontractor. A construction kick-off meeting is held during which FCP safety and health expectations are reiterated.

- 40000-PL-0013, *Silos Construction Health and Safety Plan* [Ref. 38] governs construction activities for the AWR, Silos I & 2 Remediation, and Silo 3 Projects. The Silos Construction HASP identifies applicable OSHA, DOE, and FCP safety requirements related to construction. This HASP also covered the Silo 4 demonstration hole cutting and the Silo 3 hole cutting (which will occur after the operations phase has begun [see Operations flowdown below]).

- Based on the Silos Construction HASP and the corresponding contract (which contains a safety and health section known as "Part 8"), each subcontractor develops a work plan discussing how activities will be performed safely. The work plan is reviewed and approved by Construction and Safety & Health personnel. The Wise Services subcontractor uses work plans called "Construction Work Control Traveler Packages" to outline how they will perform work safely. Each Traveler Package is reviewed and approved by the Construction Contracts Manager, Construction Engineer, Quality Assurance, and Safety & Health personnel.

- Work permits are generated to ensure that appropriate hazards associated with construction activities are analyzed and appropriate controls are developed. The work permit also identifies other required permits (e.g., flame permit, chemical hazardous permit, penetration permit). The supervisor-in-charge and Safety & Health personnel approve each work permit.

Silo 3 Project Operations Work Authorization Flowdown

- 40430-PL-0010, *Silo 3 Retrieval and Disposition Nuclear Health and Safety Plan* (this document), identifies applicable OSHA, DOE, and FCP safety requirements. Upon DOE approval, this Silo 3 N-HASP will ensure that hazards have been identified, and that controls/mitigators will be in place, to support the safe operation of the Silo 3 retrieval and disposition process.

  Note: With one exception, operations will take place after construction is complete. Hole cutting is a construction activity performed by construction labor. The Silo 4 mock access demonstration was performed during the construction of the retrieval facility. However, Silo 3 wall access will occur after the operations phase has begun because the plan calls for pneumatic retrieval of material behind the intended wall opening. Therefore, there will be a short window of time when operations and construction work will overlap.

- Silo 3 Project standing orders and procedures have been, and will continue to be, developed to identify hazards and inform Operations personnel how to work safely. Work is initiated in accordance with procedure, usually by the supervisor.

- Readiness documentation will be published separately as a part of the Silo 3 Start-up and Turnover Plan of Action. This documentation will be reviewed and approved separately by the DOE.

3.0 WORK CONTROLS

Hazards and their control mechanisms are communicated to the Fluor Fernald workforce through standard policies, plans, and procedures. This Health & Safety Plan defines and communicates Silos project hazards and the controls required to mitigate those hazards.

At the task level, job planners are required to consider the level of competency required for each job. This includes consideration for training, experience, use of walkdowns, and pre-job briefings. Proper work planning ensures that the workers have all the materials, training, equipment, supervision, and technical support necessary to perform the assigned task successfully, safely, and efficiently.

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Individual tasks also rely on job briefings, radiological and industrial work permits, and other hazard-specific mechanisms used to protect the worker. Employees are responsible for understanding the scope of the work, including hazards and controls, prior to initiating a task. Job planners are required to consult S&H personnel in the areas of industrial, radiological, and chemical hazards to ensure that the strategy for mitigation of one hazard does not increase the risk or change the mitigation strategy for another.

All employees, including subcontractors, are involved in providing feedback through the safety work groups and/or safety representatives. This approach ensures that employees with the greatest knowledge of the work evaluate the work planning and execution processes. Safety First work groups identify and resolve issues pertaining to work process safety.

4.0 CONDUCT OF OPERATIONS

Operations activities will be organized, staffed, and administered to ensure a disciplined approach to performance of work consistent with site operations and maintenance requirements. Integrated Safety Management (ISM) core functions and guiding principles (see Section 2.0) will be integrated into management and work practices at all levels so that the workers, the public, and the environment will be protected.

The site policies and requirements established for Conduct of Operations (CONOPS) will be implemented through the Silos Project Standing Orders using a graded approach. Operations management will develop standards of performance to serve as benchmarks for accountability. Operating procedures and other definitive documentation will define requirements and the types of controls necessary for the safe and successful conduct of work. Silos Project personnel will be cognizant of safety and health requirements, including knowledge of expected hazards and the controls governing the safe operation of facilities and activities.

The operations and maintenance organizations will be adequately staffed and trained to perform operations and work activities in a safe, professional manner consistent with administrative processes, site and project operating procedures, and work control documents. The Silos O&M Group will provide management, first-line managers and supervisors, and operations and maintenance personnel. FAT&LC operators and maintenance personnel will perform operations and maintenance functions.

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5.0 SAFETY BASIS

The Safety Basis for the Silo 3 Retrieval and Disposition Project is based on the safe harbor provision in 10 CFR 830, *Nuclear Safety Management* [Ref. 6], for an environmental restoration activity. This approach satisfies a commitment in the DOE-approved *Decision Basis Document Implementation of 10 CFR 830 Safe Harbor Requirements for the Silos Projects,* 40000-RP-0034 [Ref. 1]. Per DOE's *Safety Evaluation Report* [SER] *for Implementation of 10 CFR 830 Safe Harbor Requirements for the Silos Project, 40000-RP-0034* [Ref. 39], Fluor Fernald will bring all three Silos into this safe harbor.

The 10 CFR 830 safe harbor method for environmental restoration activities relies on the use of DOE-STD-1120-98, *Integration of Environment, Safety and Health into Facility Disposition Activities* [Ref. 5]. DOE-STD-1120-98 allows certain nuclear facility remediation activities to be conducted using 29 CFR 1910.120 and 29 CFR 1926.65 requirements in lieu of the safety management requirements in the nuclear safety orders. DOE-STD-1120-98 further requires continuation of the QA rule (10 CFR 830.120 Subpart A) and the DOE Occurrence Reporting Processing System (ORPS). The contractor is required to submit to DOE documents generated under the alternative regulations for review and approval prior to work (in this case, Health and Safety Plans [HASPs]).

DOE-STD-1120-98 specifies that the DOE safety management orders applicable to the "in lieu of" alternative process include: Safety Analysis Report (SAR), Unreviewed Safety Question (USQ), Technical Safety Requirement (TSR), Training and Certification, CONOPS, and Maintenance. It further states that the Health and Safety Program and HASPs, which include elements for emergency response, training, conduct of operations, and maintenance, may be used in lieu of the nuclear safety orders.

This Silo 3 N-HASP meets the requirements of 10 CFR 830.204, *Documented Safety Analysis* (DSA), 29 CFR 1910.120 (b)(4), *Project Specific Health and Safety Plan,* and follows the general rules for HASP development as outlined in NS-0005, *Initiating, Reviewing, and Approving DOE-Approved SBDs* [Ref. 4]. The term "Nuclear HASP" does not derive from the categorization of the Silo 3 Retrieval and Disposition Project, but rather, from the integration of System Safety functions into a standard OSHA HASP.

Silo 3 N-HASP development is consistent with the technical position NSTP-2002-2, *Methodology for Final Categorization for Nuclear Facilities from Category 3 to Radiological* issued in 2002 by DOE-EH-53, Office of Nuclear Safety [Ref. 18]. This paper clarifies DOE-STD-1027 final hazard categorization and applies the methodology to classification below HC-3. It states:

> *The HC-3 threshold values for radionuclides for which the food pathway or the inhalation pathway are limiting may be revised if, based on the physical and chemical form and available dispersive energy source for the facility and its hazardous materials, the credible release fractions (airborne release fractions) can be shown to be significantly different than the values used in the EPA Technical Background Document.*

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Silo 3 retrieval and disposition has been determined to qualify as a RAD Facility based on the analyses discussed in Appendix B, *Hazard Category Calculation*. Although Silo 3 qualifies as nuclear HC-3 based on inventory, retrieval and disposition qualifies as RAD based on analytical consequences. Per DOE-STD-1120-98, *Integration of Environment, Safety and Health into Facility Disposition Activities* [Ref. 40], a RAD categorization/classification based on analytical consequences requires DOE approval. This N-HASP specifies (in Section 10.0) System Safety Requirements that provide defense-in-depth.

Volume One of this N-HASP contains the standard requirements of a 29 CFR 1910.120 HASP, into which have been inserted sections addressing the Silo 3 System Safety Requirements and the Work Control Processes related to Silo 3 process. Volume Two includes the supporting analyses performed to develop the Silo 3 System Safety Requirements (i.e., IHA, HCC, HFE, ALARA Analysis, Environmental ALARA, HFE, Accident Analysis, and HPP). Together, Volumes One and Two comprise a DSA that meets the requirements of 10 CFR 830.204, *Nuclear Safety Management*.

With DOE's approval of 40000-RP-0034, *Decision Basis Document Implementation of 10 CFR 830 Safe Harbor Requirements for the Silos Projects*, the following Silo 3 commitments have been identified:

- Proceed with development of the DSA[s] (i.e., HASP[s]), using the methodology specified in 10 CFR 830, Subpart B, Appendix A, Table 2, Item 6. Item 6 allows the use of a HASP in lieu of the SAR, USQ, TSR, Training and Certification, CONOPS, and Maintenance requirements specified in DOE Orders.

- Continue with implementation of the QA rule (10 CFR 830.120 Subpart A) and the DOE ORPS. These requirements can be met by following the site requirements documented in RM-0012, *Quality Assurance Program* [Ref. 41], and SH-0028, *Occurrence Reporting* [Ref. 42].

- Continue to analyze future activities, using the *Silos Project Safety Basis Impact Screen*, to ensure they are within the current safety envelope. If a change leads to a positive screen indicating the change could exceed the defined envelope, develop the appropriate analysis. If analysis indicates the change will be outside of the safety envelope, prepare an Unreviewed Safety Question Determination/Safety Evaluation (USQD/SE) and submit it to DOE for approval prior to implementation of the planned activity.

- Annually review and update the HASP[s], as necessary. If there are no significant changes required to the HASP[s], meet the annual update requirement via a letter to DOE stating there have been no significant changes.

The following commitment from the DOE SER 40000-RP-0034 has been identified by the Silo 3 Project as applicable to Silo 3:

- Fluor Fernald, Inc., must maintain the safety programs as described in the site Integrated Safety Management program description documented in PL-3081, *Safety Management System Description (SMSD)* [Ref. 32].

6.0 MANAGEMENT OF CHANGE

Since the Preliminary DSA (i.e., Silo 3 Preliminary Hazard Analysis Report (PHAR) [Ref. 14]) was approved, changes to the design or variations in construction from the design have been screened using the *Silos Project Safety Basis Impact Screen* (SBIS). A *Silo 3 Safety Basis Impact Screen* must be completed: (1) for changes in design requiring a Design Change Notice (DCN) per an engineering procedure; (2) for new activities; (3) for maintenance alterations; (4) for changes to approved operating procedures; and (5) prior to approval of new operating procedures. The Silo 3 screen is shown in **FIGURE 6-1**. Both the Silos Project screen and the Silo 3 screen meet the requirements of NS-0008, *Safety Basis Documentation Review (SBDR) Process* [Ref. 43].

A System Safety Analyst [SSA], qualified per Nuclear and System requirements, must complete the impact screen. After DOE approval of this N-HASP, any change that results in a YES to any of the five questions on the Silo 3 SBIS will require further evaluation. Question 1 focuses on both nuclear safety and occupational safety (e.g., the Hazards Analysis could be affected by the introduction of a new chemical in the maintenance process, requiring further evaluation). Question 1 allows the screen originator (SSA) to take an ISM approach to a potential hazard not previously identified. The evaluation will then provide input to the work plan or work permit used for the activity. Question 2 ensures that the System Safety Requirements are not affected by the change, as well as potential effects on the Silos. Questions 3, 4, and 5 evaluate potential inadequacies, effects to nearby or adjacent facilities or activities, and changes in inventory of hazardous material.

When a change or deviation requires further evaluation, either the change will not be implemented or work on the affected portion of the facility will remain suspended until an evaluation has been completed and attached to the impact screen. This screen package will then go to the Silo 3 PM for review and approval.

Because the silos themselves are HC-3 facilities, when proposed changes have the potential to affect the Silos, positive impact screens will be evaluated using USQ process per NS-0002, *Unreviewed Safety Question (USQ) Determination and Safety Evaluation System* (USQD/SE System) [Ref. 44]. Potential SBR/PR violations that affect the Silos will be evaluated using the Safety Analysis Evaluation Process in Addendum 2 of PL-3049, *Implementation Plan for SARs and TSRs at the FEMP* [Ref. 45].

All completed Safety Basis Impact Screens or USQD/SEs will be evaluated annually by Nuclear and System Safety (N&SS) staff for inclusion into this N-HASP to ensure that each document is complete and up-to-date.

Surveillances will be performed by N&SS staff and approved by the N&SS Manager to ensure that the project Safety Requirements are being implemented and the safety basis is being kept up-to-date.

Readiness activities will include a review of the SBIS process to ensure that the DCNs that were performed against the PHAR were properly incorporated into this N-HASP.

FIGURE 6-1: SILO 3 SAFETY BASIS IMPACT SCREEN (SBIS)

Description of Activity/Design Change:

Work Plan/ Design Doc. No.:	**Change Originator:**
SBIS Originator:	**SBIS Date:**

1	Will the proposed change affect any parameters used in calculations supporting the Hazard Analysis as documented in the Silo 3 N-HASP? ☐ **YES** ☐ **NO** / **EXPLAIN:**
2	Will the proposed change affect any of the System Safety Requirements in the Silo 3 N-HASP? • Safety Basis Requirements (SBRs)? • Process Requirements (PRs)? ☐ **YES** ☐ **NO** / **EXPLAIN:**
3	Does the proposed change identify a potential inadequacy (e.g., new accident, hazard) in the Silo 3 N-HASP or any potential reduction in any SBR? ☐ **YES** ☐ **NO** / **EXPLAIN:**
4	Does the proposed change affect the activities or requirements of a nearby or adjacent facility or activity operating under a different safety basis (e.g., Silos 1 & 2, RCS, TTA)? **NOTE: IF** a proposed change can potentially affect the Silos, **THEN** a USQD/safety evaluation must be completed per NS-0002 (Unreviewed Safety Question (USQ) Determination. ☐ **YES** ☐ **NO** / **EXPLAIN:**
5	Does the proposed change result in a change in the inventory or amount of hazardous material? ☐ **YES** ☐ **NO** / **EXPLAIN:**

IF the answer to ANY of these questions is **YES**, **THEN:** (1) update the analysis; (2) determine whether the change will put the project or affected project outside the safety envelope; (3) incorporate any mitigators or controls into the work plan/permit; (4) attach the updated analysis to this impact screen. **IF** the change will result in a higher hazard categorization, **THEN** a USQ must be performed per NS-0002 and submitted to the SRC, the Fluor Fernald President, and the DOE for concurrence.

6	Per this SBIS, the proposed change ☐ **DOES** ☐ **DOES NOT** impact the Silo 3 safety basis.

Signature: _____ **Date:**
System Safety Analyst

SSA: Are there descriptive changes not requiring analysis, but requiring inclusion in the annual update? ☐ **Y** ☐ **N**

NOTE: **IF** there is an impact to the safety basis, **THEN** the Project Manager's signature is required.

Signature: _____ **Date:**
Silo 3 Project Manager

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7.0 HAZARDS ASSESSMENT

The hazards assessment associated with this N-HASP will focus on the activities necessary to support operations and maintenance of Silo 3. To date, fourteen Silo 3 operations tasks have been identified for routine performance by Fluor Fernald maintenance and operations personnel:

1. Truck transport of empty containers and containerized additive materials
2. Receipt of Silo 3 bulk chemicals
3. Manipulation of the Pneumatic Retrieval System (PRS) vacuum wand and hose
4. Maneuvering of the Mechanical Retrieval System (MRS) remote control vehicle
5. Conditioning and packaging of retrieved waste
6. Loading of containerized material
7. On-site transportation of containerized waste materials
8. Maintenance of the Pneumatic Retrieval System (PRS), Air Handling Systems, and Process Vent System
9. Maintenance of motorized vehicles
10. Maintenance of conveyors, feeders, and packagers
11. Maintenance of cranes
12. Maintenance of Waste Additive System and Wastewater System
13. Maintenance of Plant/Breathing Air System
14. Shift-by-shift surveillance of Silo 3
15. Cutting a hole in the Silo 3 wall structure

The identified hazards listed below are based on the potential exposure of personnel to the Standard Industrial Hazards, chemical hazards, and radiological hazards posed during Silo 3 operations and maintenance activities. A brief description of the expected hazards and their associated controls are provided in Section 8.0. A Hazards Control Matrix is presented in Section 9.0. This matrix identifies the above tasks in conjunction with their hazards and their controls/ mitigators. The matrix forms the basis for employee briefings.

1. Slips, trips, and falls
2. Noise
3. Housekeeping
4. Illumination
5. Ergonomics
6. Head impact
7. Pinch/Crush Points
8. Ladders
9. Hand and power tools
10. Electrical
11. Hazardous energy
12. Hoisting and rigging
13. Confined space
14. Flammable material
15. Hot work
16. Compressed gas
17. Biological
18. Environmental
19. Heat and cold stress
20. Heavy Equipment
21. Radiological
22. Chemical

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8.0 HAZARDS DESCRIPTION

There are numerous physical hazards associated with the performance of Silo 3 operations and maintenance activities. Similar hazards may be encountered throughout the site. The following sub-sections provide examples of the more prevalent physical hazards and the mitigating actions for protecting personnel, the public, and the environment.

8.1 Slip, Trip, and Fall Hazards

Uneven terrain, adverse weather conditions, and inattention to housekeeping may present slip, trip, and fall hazards. The uneven surface of the Silo 3 dome presents similar hazards.

NOTE: The safety performance requirements (SPRs) in Table 8-1 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual* [Ref. 46].

TABLE 8-1: SLIP, TRIP, AND FALL HAZARD CONTROLS (SPR 2-1)

1	Maintain the floor or ground surface of work areas flat, even, and free of ice, snow, debris, and if possible, in a dry condition.
2	Keep aisles, passageways, platforms, and stairways free of materials and debris.
3	Ensure that exits, approaches to exits, and hallways are unobstructed and accessible at all times.
4	Obtain Silo Dome Access Permit before performing work on the dome surface.

8.2 Noise Hazards

Operation of Silo 3 includes running fans, generators, and other equipment that can produce loud excessive noise. The effects of excessive noise can include:

- Workers being startled, annoyed, or distracted.
- Physical damage to the ear, excessive pain, and temporary or permanent hearing loss.
- Communication interference that might increase potential hazards due to the inability to warn of danger and the proper safety precautions to be taken.

NOTE: The SPRs in Table 8-2 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual.*

TABLE 8-2: NOISE HAZARD CONTROLS (SPR 2-14)	
1	Fluor Fernald monitors for excessive noise levels using sound level meters and/or personal noise dosimeters. Areas with consistently high [>85 decibel (dBA)] noise levels shall be posted with signs notifying personnel that hearing protection is required.
2	All Silos project personnel (including visitors) must wear hearing protection in areas where noise levels are known to exceed, or are expected to exceed, an 8-hour time-weighted average (TWA) of 85 dBA.
3	All on-site personnel must comply with the Fluor Fernald Hearing Conservation Program (available for review from the Silos S&H representative).
4	In some cases, the use of hearing protection may impede workers' ability to hear messages broadcast over the Emergency Message System (EMS). When EMS messages cannot be heard, use alternative methods of communication to ensure that personnel are made aware of these messages in a timely manner. Alternatives: the radios; visual indicators such as flashing lights or waving arms; direct conversation.

8.3 Housekeeping Hazards

Failure to maintain personnel access-ways free of obstructions and failure to maintain the work area free of debris are potential housekeeping hazards.

NOTE: The SPRs in Table 8-3 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual.*

TABLE 8-3: HOUSEKEEPING HAZARD CONTROLS (SPR 2-1)	
1	Maintain work areas in a clean, orderly, and sanitary condition.
2	Maintain floor and work surfaces free of walking and tripping hazards.
3	All tools shall be put away and debris cleaned-up at the completion of assigned work.

TABLE 8-3: HOUSEKEEPING HAZARD CONTROLS (SPR 2-1)	
4	Use appropriate containers for waste disposal.
5	Keep stairways, passageways, access ways free of materials, supplies, and obstructions at all times.

8.4 Illumination Hazards

The Illumination standards from 29 CFR 1926.56 [Ref. 47] specified in the following table will be observed. In areas of suspected insufficient lighting, Industrial Hygiene will be contacted prior to implementation of field activities and temporary lighting will be provided.

TABLE 8-4: ILLUMINATION HAZARD CONTROLS

Item No.	Foot-Candles	Area or Operation
1	5	General site area
2	3	General construction areas, concrete placement, excavation and waste areas, access ways, active storage areas, loading platforms, refueling, and fuel maintenance areas.
3	5	Indoors: warehouses, corridors, hallways, and exit ways.
4	5	Tunnels, shafts, and general underground work areas: (exception: minimum of 10 foot-candles is required at tunnel and shaft heading during drilling, mucking, and scaling. Bureau of Mines approved cap lights will be acceptable for use in the tunnel heading.)
5	10	General construction plant and shops (e.g., batch plants, screening plants, mechanical and electrical equipment rooms, carpenter shops, rigging lofts and active storerooms, barracks, or living quarters, locker or dressing rooms, mess halls, and indoor toilets and workrooms.)
6	30	First aid stations, infirmaries and offices.

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8.5 Ergonomic Hazards

The requirements of the ergonomics program is to reduce or eliminate personnel exposures that could result in occupational injuries and illnesses. The focus of the program is to make the job fit the person, not the person fit the job, and thereby eliminate or reduce musculoskeletal disorders in the workplace. The FCP designs work methods to reduce static, extreme and awkward postures, repetitive motions, and excessive force. Engineering techniques, where feasible, are the preferred method of control.

NOTE: The SPRs in Table 8-5 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual.*

TABLE 8-5: ERGONOMIC HAZARD CONTROLS (SPR 2-6)

1	Enhance the workplace by implementing, evaluating, and assessing wellness, fitness, and Video Display Terminal (VDT) ergonomics.
2	Present a VDT ergonomics training session to VDT users when requested.
3	Provide training on ergonomics and other hazards associated with a job or process, their prevention or control, and their medical consequences.
4	Perform workstation assessments upon employee requests or as a result of employee injury.
5	Perform workstation analysis to identify existing hazards and conditions, operations that create hazards, and areas where hazards may develop. • Conduct an analysis of injury and illness records. • Conduct comprehensive, qualitative baseline screening surveys. • Analyze all planned new and altered equipment. • Perform a routine ergonomics job-factor analysis.
6	Recommend how to improve or eliminate hazards.
7	Conduct regular safety audits with emphasis on ergonomics.
8	Support acquisitions as necessary.

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8.6 Head Impact Hazards

During the performance of work in the Silo 3 facility, opportunities exist for personnel to impact their heads on piping, structural supports, etc. Therefore, head protection must be worn, as required by the work control documents.

NOTE: The SPRs in Table 8-6 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual*.

TABLE 8-6: HEAD IMPACT HAZARD CONTROLS (SPR 2-2)

1	Wear hard hats when: • designated on the FCP Work Permit or any other applicable document. • in posted area such as construction and crane operation areas. • operating a powered mobile lift platform. • working under personnel in elevated locations (6 feet or higher) or where overhead hazards exist. • within the swing radius of a mobile crane or aerial lift. • in (or under) the basket of an aerial platform. • in or near an excavation. • in manholes or other confined spaces where overhead hazards exist.
2	Wear hard hats that are in good condition.
3	Throw away damaged hard hats (i.e., cracked, ragged, worn, or defective).
4	Do not alter hard hats.
5	Wear hard hats brim to the front. • Welder hats may have to be reversed to accommodate welding face shields. • When not welding, wear hats brim to front. • Surveyors hats have to be reversed to accommodate use of transit.
6	Cowboys style hard hats are not approved for use at the FCP.

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8.7 Pinch Point, Puncture/Cut Hazards

Workers are provided, and required to wear, leather work gloves or other styles of gloves appropriate for the type of work they are performing. Work area walkdowns are used to develop measures to prevent injuries by identifying potential pinch points and sharp edges so that incidental contact is avoided.

NOTE: The SPRs in Table 8-7 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual.*

TABLE 8-7: PINCH POINT, PUNCTURE/CUT HAZARD CONTROLS (SPR 2-1, 4-1, 4-2)	
1	Workers will be trained to perform tasks safely.
2	Workers will be trained to perform tasks in accordance with standard operating procedures.
3	Workers will wear proper PPE.
4	Workers will be briefed on the hazards of their work area prior to initiating work.

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8.8 Ladder Hazards

Portable ladders may be used to access equipment components for the purpose of maintenance and repairs. Ladders may also be used as a means of temporary entry and exit from an elevated work location.

NOTE: The SPRs in Table 8-8 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual.*

TABLE 8-8: LADDER HAZARD CONTROLS (SPR 3-6)	
1	Ladders must be inspected before use.
2	Tie off straight ladders or extension ladders when setting them up for use.
3	Portable ladders are inspected at least once each quarter by an individual designated by Fluor Fernald Management as a competent person. An inspection tag identifying the inspector must be affixed to the ladder.
4	Personnel shall not use any ladder that does not have an inspection tag attached.
5	Immediately tag defective ladders DANGER-UNSAFE-DO NOT USE and remove them from service.
6	Do not use ladders where there is a possibility of contact with electrical wiring or energized equipment.
7	Implement fall protection when working at heights of 6 feet or more.
8	Ladders shall not be positioned in front of doorways.

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8.9 Hand and Power Tool Hazards

The use of hand and portable power tools present such hazards as cuts and abrasions from unguarded points of operation, eye hazard from flying debris, ergonomic hazard from poor design or improper use, and electrical shock from defective components. Some examples of defective tools are:

- wrenches with sprung jaws that will permit slippage
- mushroomed heads on impact tools such as hammers and chisels
- wooden handles that are loose, cracked, or splintered
- electrical cords that are frayed, cut, or have the ground pin removed
- tools with guards removed
- hydraulic tools with leaking cylinders

NOTE: The SPRs in Table 8-9 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual.*

TABLE 8-9: HAND AND POWER TOOL HAZARD CONTROLS (SPR 4-1)

1	All hand and power tools shall be maintained in a safe condition.
2	Personnel unfamiliar with power tool operation must be instructed on its operation or read the manufacturer's instructions prior to its use. Manufacturers' operations manuals for power tools can be obtained by contacting the Fluor Fernald supervisor assigning the work.
3	Users shall inspect tools prior to use.
4	Use the equipment as directed in the manufacturer's/owner's safety manual unless an approved plan or procedure specifies using an alternate acceptable method.
5	Ensure guards are in-place and used properly.
6	Tag unsafe or defective equipment with a DANGER-UNSAFE-DO NOT USE tag, remove from service, and notify Leadership/Supervision of its condition.
7	Workers shall not wear loose-fitting clothing, neckties, or jewelry when working with power tools. Watches and wedding rings are acceptable.
8	Power tools shall be stored at assigned locations.

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TABLE 8-9: HAND AND POWER TOOL HAZARD CONTROLS (SPR 4-1)	
9	Disconnect the power tool from the power source when not being used.
10	Keep electrical cords off the floor and away from possible snagging hazards.

8.10 Electrical Hazards

The use of electrical power is essential to Silo 3 operations. Maintenance and repairs on electrical circuits and other components are Silo 3 maintenance activities that present the highest potential for worker exposure to electrical hazards.

NOTE: The SPRs in Table 8-10 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual.*

TABLE 8-10: ELECTRICAL HAZARD CONTROLS (SPR 5-1)	
1	Only electrically-qualified persons will verify that electrical equipment is suitable for its intended purpose as evidenced by listing, labeling, or certification for that purpose.
2	All electrical equipment shall be operated in accordance with the manufacturer's instructions.
3	Unless specifically exempted by OSHA, a Ground Fault Circuit Interrupter (GFCI) shall be used on each 15- and 20-ampere, 120-volt circuit at the Silos. The GFCI shall be placed at the source of the electrical services to protect both the cord and the devices connected.
4	All electrical appliances shall be Underwriter's Laboratory (UL)-listed for the potential hazards of the atmospheres in which they will be used. Electric tools and equipment (saws, drills, compressors, etc.) will be double-insulated or grounded. All electrical connections shall be made through a GFCI.
5	Fire extinguishers consistent with OSHA 1926.150 [Ref. 48] shall be maintained in sufficient number to allow on-site personnel to extinguish incipient fires.
6	Prior to use, electrical equipment shall be inspected for proper insulation, damage, defects, and operability.
7	Electrical equipment operating at 50 volts or more shall be guarded against accidental contact.

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TABLE 8-10: ELECTRICAL HAZARD CONTROLS (SPR 5-1)	
8	On-site electrical equipment shall be bonded and grounded, spark-proof, and explosion-resistant, as appropriate.
9	Electrical equipment shall be de-energized before inspection or maintenance.
10	All electrical tools shall be inspected frequently. Defective tools or questionable tools shall be removed from service and a warning tag applied.
11	Personnel using equipment such as ladders and cranes shall maintain a minimum safe distance of 10 feet from energized overhead lines.
12	Personnel shall wear proper protective equipment in accordance with work permits, safe work plans, or other applicable documents.

8.11 Hazardous Energy

Sources of hazardous energy are present throughout the Silos. Some examples of energy sources include:

- Potential (silo wall post-tensioned reinforcing wires)
- Electrical (throughout the project)
- Radiofrequency (waste package heat sealers)
- Stored (batteries)
- Mechanical (conveyors)
- Hydraulic (remote controlled excavator used for removing material from Silo 3)
- Chemical (to be used in the Waste Additive System)

NOTE: The SPRs in Table 8-11 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual*.

TABLE 8-11: HAZARDOUS ENERGY CONTROLS (SPR 2-11)	
1	Whenever it is necessary to perform maintenance or emergency repairs on hazardous energy systems such as those described above, the hazardous energy system shall be isolated per the OP-0004, *Fluor Fernald Lockout Tagout* [Ref. 49].
2	Personnel who perform hazardous energy isolation shall be trained per the Lockout/Tagout procedure.

8.12 Hoisting and Rigging Hazards

Hoists and rigging may be necessary to repair or replace system components. A bridge crane will routinely lift completed waste packages into Sea/Lands and close the Sea/Land lids.

NOTE: The SPRs in Table 8-12 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual.*

TABLE 8-12: HOISTING AND RIGGING HAZARD CONTROLS (SPR 7-9)

1	The rated capacity shall be permanently marked on the hoist or load block.
2	Hoists shall have labels affixed that display the word "Warning" or other legend to bring the label to the attention of the operator. The label shall contain the cautionary language specified in RM-0045, *Fluor Fernald Hoisting & Rigging Manual* [Ref. 50]
3	Manual-lever-operated hoists shall be equipped with a load-controlling mechanism capable of functioning under normal conditions with test loads up to 125% of rated capacity.
4	Hand chains shall be capable of withstanding, without permanent distortion, a force of three times the pull required to lift the rated load.
5	Web straps shall be made of nylon, polyester, or similar synthetic material.
6	Nylon and polyester web straps shall not be exposed to an ambient temperature >200° F.
7	Electric-powered hoists shall be marked with the voltage of the alternating current (AC) or direct current (DC) power supply and the circuit capacity.
8	Air-powered hoists shall be marked with the rated air pressure.
9	Positive-type safety latches that prevent the hook from opening shall be used.
10	The lift shall be barricaded in a manner that prevents workers from being struck by falling objects.
11	The operator shall inspect hoists and rigging at the beginning of each shift or prior to first use. Inspections shall be performed per RM-0045, *Fluor Fernald Hoisting & Rigging Manual.*
12	All loads shall be centered.

TABLE 8-12: HOISTING AND RIGGING HAZARD CONTROLS (SPR 7-9)	
13	Softeners shall be used to prevent cutting nylon and polyester web straps.
14	If more than 1,000 pounds is supported from a structural steel beam, calculations shall be performed to verify the structural adequacy of the beam.
15	If any load is supported from a concrete beam, calculations shall be performed to verify the structural adequacy of the beam.

8.13 Confined Space Hazards

Confined spaces are evaluated and appropriately posted by Industrial Health & Safety Representatives. The excavator pit, various tanks (including the washwater tanks, additive blend tanks, ferrous sulfate tank, etc.), and electrical manholes are identified as confined spaces.

NOTE: The SPRs in Table 8-13 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual*.

TABLE 8-13: CONFINED SPACE HAZARD CONTROLS (SPR 12-3)	
1	The Industrial Health & Safety Representatives will evaluate the workplace to determine if spaces are permit-required. If permit-required spaces exist, affected personnel shall be informed of their location and their specific dangers. Appropriate signage is shown above.
2	All confined space entry permits shall be performed per the Fluor Fernald Confined Space Entry Program, which can be reviewed by contacting the Silos Industrial Health and Safety Representatives.
3	All workers entering confined spaces shall receive training on confined space entry procedures before performing work.

TABLE 8-13: CONFINED SPACE HAZARD CONTROLS (SPR 12-3)	
4	A person who meets the criteria for designation as a Qualified Person shall evaluate the space. The Qualified Person shall have been trained in confined space entry procedures, supervised field training in the evaluation of confined spaces, and experience in conducting confined space evaluations.
5	An initial hazard assessment will be conducted that includes atmospheric testing for oxygen deficiency, flammable gas concentrations, and toxic gases. No entry shall be permitted if the flammable gas concentration exceeds 10% of the Lower Explosive Limit (LEL).
6	A confined space entry permit will be completed by the Qualified Person and posted at the entrance to the space. Required safety equipment shall be specified on this permit.
7	Before entry, a communication protocol shall be established and reviewed between the persons entering the space and the outside standby personnel.
8	Before entry, a safety meeting will be conducted with all personnel involved with the entry to review all of the hazards and precautions associated with entry.
9	Any person who is to enter a permit-required confined space shall wear a harness and lifeline. A standby person provided with equivalent protection and training for entry in case of an emergency shall man the lifeline.

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8.14 Flammable Material Hazards

Flammable materials (e.g., diesel fuel used for heavy equipment, paints used for protective coatings, solvents and thinners) are in use throughout the Silos.

NOTE: The SPRs in Table 8-14 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual*.

TABLE 8-14: FLAMMABLE MATERIAL HAZARD CONTROLS (SPR 11-10)	
1	Sources of ignition are prohibited in areas where flammable materials are present.
2	Flammable material storage locations shall be posted with warning signs Flammable Liquid and No Smoking.
3	On-site equipment shall be bonded and grounded, spark-proof and explosion-resistant, as appropriate. Particular attention to bonding and grounding is given to the transfer of flammable/combustible liquids.
4	For the purposes of fire protection and prevention, persons shall only smoke in designated areas.
5	Portable fire extinguishers are provided in sufficient numbers to allow on-site personnel to extinguish fires. Only personnel trained in the proper use of these fire extinguishers shall use them.

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8.15 Hot Work Hazards

Hot work activities (e.g., welding and thermal cutting, grinding) will normally be performed only during maintenance of Silo 3 components, and will not be conducted on a routine basis.

NOTE: The SPRs in Table 8-15 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual.*

TABLE 8-15: HOT WORK HAZARD CONTROLS (SPR 11-7)	
1	Hot work activities will be performed in a manner that provides for the protection of the workers, the public, and the environment. This is accomplished using only trained/qualified persons in the performance of hot work and obtaining an approved Hot Work Permit from Fluor Fernald Fire Protection.

8.16 Compressed Gas Hazards

Compressed gases may be used at the Silos to support maintenance activities. These typically include the oxygen and acetylene cylinders used for hot-work activities.

NOTE: The SPRs in Table 8-16 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual.*

TABLE 8-16: COMPRESSED GAS HAZARD CONTROLS (SPR 8-3)	
1	Prior to handling or using compressed gases, the handler or user shall review the appropriate Material Safety Data Sheet (MSDS) to become knowledgeable of the hazardous properties so that a safe, controlled operation can be maintained.
2	Unless otherwise labeled, compressed gas cylinders shall be considered full and handled accordingly.
3	Cylinders shall be moved by tilting and rolling them on their bottom edges when manually relocating them.

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TABLE 8-16: COMPRESSED GAS HAZARD CONTROLS (SPR 8-3)	
4	Valve protectors shall not be used to lift cylinders from one vertical position to another.
5	When work is finished, when cylinders are empty, or when cylinders are moved at any time, the cylinder valve shall be closed and the cylinder cap installed.
6	Compressed gas cylinders, whether full or empty, shall not be used as rollers, supports, or for any purpose other than the purpose for which they were designed.
7	Suitable cylinder truck, chain, or other steadying device shall be used to prevent cylinders from falling while in use or in storage.
8	Cylinder markings, such as labels and serial numbers, shall not be removed or altered in any way.
9	All empty cylinders must be labeled "Empty."
10	Precautions must be taken to prevent sparks, molten metal, electrical currents, excessive heat, or flames from coming in contact with compressed gas cylinders
11	Compressed gas cylinders shall be stored in areas approved for that purpose. Storage areas must be well ventilated and protected from extreme weather conditions to minimize rusting, freezing, continuous exposure to direct sunlight, and contact with the ground. This does not preclude exterior storage.
12	Oxygen cylinders shall be stored a minimum distance of 20 feet from any other fuel gas cylinders or combustible materials (especially oil and grease), or be separated by a non-combustible barrier at least 5 feet high with a fire resistance rating of at least 30 minutes.
13	Compressed gas cylinders shall be secured and stored in an upright position.
14	Never use oil and grease as lubricating agent on valves or attachments to oxygen cylinders.
15	Never locate compressed gas cylinders in an unventilated area.
16	Never attempt to mix gases in a cylinder or use a cylinder for any purpose other than that for which it was intended.
17	Never use oxygen for a substitute for compressed air.
18	Never use an open flame or any other source of ignition to test for cylinder leaks.

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TABLE 8-16: COMPRESSED GAS HAZARD CONTROLS (SPR 8-3)	
19	Cylinders containing oxygen or acetylene or other fuel gases shall not be taken into confined spaces.

8.17 Biological Hazards

Fluor Fernald uses the following controls to protect on-site personnel from the biological hazards associated with Silos project operations.

NOTE: The SPRs in Table 8-17 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual.*

TABLE 8-17: BIOLOGICAL HAZARD CONTROLS (SPR 10-1)	
1	Wild animals (e.g., deer, stray dogs, cats, geese, skunks, raccoons, snakes, and mice) may be encountered at the Silos. On-site personnel are instructed to use discretion and avoid all contact with wild animals. Should these animals present a problem, efforts will be made to trap them and remove them from the site.
2	Insects (e.g., mosquitoes, chiggers, ticks, bees, and wasps) may be found at the site during the warmer months of the year. If insects present a problem, insect sprays will be used to remove them.
3	Poisonous plants (e.g., poison ivy and poison oak) may be encountered at the Silos. Workers will be instructed on how to recognize these plants and to avoid contact with them. When found, these hazards will be removed.

8.18 Environmental Hazards

Extreme ambient temperatures and adverse weather (i.e., high winds, lightning, heavy rains, extreme heat or cold, poor visibility, and hail/ice/snow storms) are hazards that may be encountered at the Silos. Since some of the Silos activities occur outdoors or outside of temperature-controlled environments, control measures must be put in place to protect the workers.

NOTE: The SPRs in Table 8-18 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual*.

TABLE 8-18: ENVIRONMENTAL HAZARD CONTROLS (SPR 2-14)

1	In the event of adverse weather conditions, the Fluor Fernald S&H Representative will determine if operations may continue without the potential for injury to personnel.
2	Weather-affected work (e.g., work in open locations) shall be stopped if lightning, heavy persistent rain, limited visibility, heavy snow, or other adverse weather conditions are observed in the area of the Silos.
3	Any operation involving the use of cranes, man lifts, or personnel working at heights shall be suspended when wind velocity reaches 25 mph.

8.19 Heat and Cold Stress Hazards

Because maintenance and operations activities are conducted year round, there is the potential for worker exposure to extreme temperatures and the associated heat and cold stress hazards.

Heat stress can present a major hazard at the Silos, especially for workers wearing protective clothing. The same protective materials that shield the body from chemical or radiological exposure also limit the dissipation of body heat and moisture. Therefore, personal protective clothing can create a hazardous condition. Depending on the ambient conditions and the work being performed, heat stress can occur very rapidly (within as little as 15 minutes). Heat stress can pose as great a danger to worker health and safety as chemical exposure.

Cold stress is an important consideration when planning and conducting silo activities during the winter months. Low ambient temperatures can result in health effects ranging from reduced mental alertness and reduction of the ability to make rational decisions to loss of consciousness with the threat of fatal consequences.

NOTE: The SPRs in Table 8-19 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual*.

TABLE 8-19: HEAT AND COLD STRESS HAZARD CONTROLS (SPR 12-9/10)	
1	Fluor Fernald has developed a Heat Stress Program to ensure that on-site personnel are made aware of the signs and symptoms of heat stress and are provided with the appropriate protection against the heat stress hazards. When conditions exist that may present a heat stress hazard, the Industrial Health & Safety Representatives will monitor the work environment and provide controls to protect the work force, such as: • Specified stay times • Cool vests • Access to cool-down areas
2	Fluor Fernald has developed a Cold Stress Program to ensure that on-site personnel are made aware of the signs and symptoms of cold stress. When conditions exist that may present a cold stress hazard, the Silos Industrial Health & Safety Representatives will monitor the work environment and provide controls to protect the work force, such as: • Specified stay times • Cold-weather gear • Heaters • Access to a heated environment

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8.20 Heavy Equipment Hazards

Heavy Equipment will be operated on a routine basis at Silo 3 for transporting and delivering materials and handling shipping conveyances (Sea/Lands).

NOTE: The SPRs in Table 8-20 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual*.

TABLE 8-20: HEAVY EQUIPMENT HAZARD CONTROLS (SPR 7- 2, 7- 3, and 7 - 7)

1	Motor vehicle operators must have a Commercial Driver License (CDL) to operate a vehicle weighing 26,001 pounds or greater.
2	When operating vehicles at the FCP, operators must obey all FCP posted speed limits.
3	When operating vehicles at the FCP, operators must obey all FCP traffic safety rules, such as: • Use proper methods of access and egress. • Always keep torsos and extremities within the confines of vehicles. • Wear seat belts at all times. • Never leave an operating vehicle unattended. • Turn on lights between sunset and sunrise prior to operating the vehicle onsite.
4	Vendor vehicles must be loaded and unloaded entirely by vendor employees or entirely by qualified site personnel.
5	Regardless of load content, the vendor and the site are jointly responsible for ensuring that the load is safe and meets all Department of Transportation (DOT) requirements prior to leaving the site.
6	Vehicles are not to be unloaded until the vehicle has been secured by the vendor (i.e., doors or tailgates opened and secured, wheels chocked, etc.)

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8.21 Radiological Hazards

The Fluor Fernald Radiological Control Department is responsible for providing radiological protection for the workers and the environment. Radiological Control provides support personnel, air monitoring, personal sampling, internal and external dosimetry, radiological surveys/monitoring, and job oversight. These activities are implemented through site radiological procedures, Radiation Work Permits (RWPs), and the HPP in Appendix H of this N-HASP.

Potential general occupational radiological hazards for the Silo 3 Project include:

- Airborne Radioactivity (inhalation of radioactive material)
  - Radioactive particulates (alpha from Th-230) generated as a result of the retrieval and packaging activities
  - Radon gas emanating from the Silo 3 material
  - Radon gas potentially emanating from other site sources (e.g., Silos 1 and 2)
- Contamination
  - Skin contamination
  - Injection of radioactive material
  - Spread of contamination to previously-uncontaminated areas
  - Clothing contamination
- External Radiation
  - Radiation exposure from gamma rays generated by the Silo 3 material
  - Gamma radiation from other site sources (AWR Project, Silos 1 and 2)

Airborne Radioactivity

Control of airborne radioactivity is a major objective of the Silo 3 Retrieval and Disposition Project. The most significant radiological hazard associated with Silo 3 material is the inhalation of Thorium-230. If a worker received an uptake from Silo 3 material, more than 80 percent of the dose would result from Th-230. Therefore Thorium-230 is the isotope of concern. The controls for Silo 3 radiological hazards are presented in **TABLE 8-23**.

Silo 3 residue continually releases Radon-222. The total radon inventory in the Silo 3 headspace will be released to the atmosphere under controlled conditions via the exhaust stack. However, the ventilation systems are designed so that very few project operations will be conducted in airborne radioactive areas with radon concentrations exceeding 10 percent of the Derived Air Concentration (DAC), and thus, requiring respiratory protection.

Whenever radiological contamination is an issue, airborne radioactivity is also a concern due to suspension of radioactive contamination (see Contamination section below).

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Contamination

The isotope of concern for contamination and airborne radioactivity inside the Silo 3 waste retrieval facility is Th-230. Although the facility was designed to minimize loose surface contamination and airborne radioactivity, some areas will be posted and controlled as Contamination Areas and Airborne Radioactivity areas.

With the following exceptions, the entire Silo 3 waste retrieval facility will initially be posted as an Airborne Radioactivity Area when operations begin. One possible exception is the Cargo Bay Loading Area. Planned exceptions include the Control Room, the Personal Protective Equipment (PPE) Room, and the Control Point Area. These three locations will be maintained as radiologically-controlled areas where loose surface contamination must be kept below 20 disintegrations per minute (dpm)/100 square centimeters (cm^2) (alpha). Another exception is the Additive and Wastewater Tank Area, which is isolated from the Packaging Area by walls and doors. Ventilation in this area is not part of the HEPA/ULPA-filtered ventilation system; it ventilates unfiltered to the outside.

Respiratory protection will be required until adequate documentation has been gathered to prove that the facility design and controls are adequate. However, it is likely that the Excavator Room will always be an Airborne Radioactivity Area.

The Packaging Room, Cargo Bay Loading Area, Vacuum Retrieval Wand, and the remote excavation process are designed to implement an operating philosophy of minimal or no contamination. The highest contamination levels and potential airborne radioactivity hazards are expected:

- in the Excavator Room.
- in the Excavator Service Room when excavator maintenance is being performed.
- whenever a system is breached for maintenance.

An airlock/doffing area is provided for personnel exiting the Excavator Service Room. This area allows workers to doff outer layers of PPE and perform personnel monitoring in an effort to keep contamination/airborne radioactivity levels ALARA in the remainder of the facility. When performing a system breach that potentially involves Silo 3 residues, a High Contamination Area will be set up. Controls will be put in place to prevent the spread of contamination to the remainder of the facility.

External Radiation

Silo 3 material does not present a very high gamma exposure hazard. However, due to the amount of material to be processed (5,100 yd^3), and the amount of time the workers will spend in the vicinity of the material, external whole-body gamma radiation exposure is of concern. **TABLE 8-18** shows the anticipated radiation dose rates for selected Silo 3 operator stations. Details on radiation exposure are presented in Appendix D, *Occupational ALARA Analysis for Silo 3*, Table D.8. The Silo 3 dose rates will be measured and documented on the surveys appended to the RWP for entry into the Silo 3 operating areas.

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TABLE 8-21: ANTICIPATED DOSE RATES AT SELECTED OPERATOR STATIONS (See Appendix D for details on task-specific dose rates)	
Location	**Expected Dose Rate (mR/hr)**
On top of dome performing pneumatic retrieval using vacuum wand	1.9
Remote Operator Station adjacent to the Excavator Room	0.4
Packaging Room	0.4
Cargo Bay Area with full container in area	1.1 average

TABLE 8-22 shows the expected operational and maintenance collective doses determined by modeling the Silo 3 systems.

TABLE 8-22: ANTICIPATED COLLECTIVE DOSE FOR SILO 3 OPERATIONS AND MAINTENANCE	
Location	**Expected Collective Dose (person-rem)**
Primary Operations (6 months)	6.25
Primary Maintenance & Inspection (6 months)	0.66
TOTAL OPERATIONS AND MAINTENANCE (this N-HASP)	6.91

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Radiological Hazard Controls

As a result of the radiological hazards discussed above, several engineering controls were designed into the system to contain and confine the material, and to handle the material indirectly via specialized equipment. **TABLE 8-23** lists the engineering controls designed into the project to help minimize the exposure potential and help maintain radiation exposures ALARA.

NOTE: The Radiological Control Requirements in Table 8-23 do not comprise the complete list of relevant controls for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable radiological controls, see RM-0020, *Radiological Controls Requirements Manual* [Ref. 51].

TABLE 8-23: RADIOLOGICAL HAZARD CONTROLS

Engineering Controls	
1	Project ventilation is designed to maintain incoming airflow from Silo 3 and the Process Building negative with respect to atmospheric pressure. Silo 3 and the Process Building have 10,000 CFM of building ventilation, which can assist in the control of airborne radioactivity in the event of leakage. Building ventilation is pulled through a HEPA filter by an exhaust fan and discharged via the 125-foot monitored stack. Both the HEPA assembly and fan are redundant to provide for continuous operation during maintenance and filter changes. The system is set up with pick-up points throughout the building to provide good air changes to eliminate or minimize the build-up of airborne radioactivity. The exhaust stack provides for dispersal of trace radon and any particulates not collected elsewhere within the process ventilation.
2	The Vacuum Wand Management System (VWMS) limits personnel exposures to bulk amounts of waste.
3	Excavation is done remotely. The excavator also includes features such as self-lubricating, camera usage, and interchangeable attachments. Maintenance and inspections are still required.
4	Video cameras provide viewing for the remote excavator. Other cameras will be used to allow for remote viewing of personnel and operations. Cameras will help to reduce the number of individuals and the time required inside the Silo 3 Project work areas.
5	Hoods and enclosures minimize airborne contamination. The Excavator Room hood is positioned near the silo wall opening to capture dust generated during silo wall intrusion.
6	The vacuum wand uses a containment system. The retrieval bin uses a hood to minimize generation of airborne material at the source during mechanical retrieval. The primary and secondary rotary feeders are enclosed and act as airlocks between the relatively-high vacuum of the collector and the ambient pressure of the Feed Conveyor. The Inclined Conveyor is contained within an enclosure.

TABLE 8-23: RADIOLOGICAL HAZARD CONTROLS	
7	Enclosed conveyors contain powders during material movement.
8	Thick PVC bag liners deter radon diffusion and provide containment of silo waste so that completed packages will meet the off-site waste acceptance criteria (WAC).
9	The packaging "bag-out" system controls contamination by providing a heat seal that allows the PVC liner to be severed from the packaging station.
10	Air locks between the Packaging Station Area and the Cargo Bay minimize the spread of contamination.
11	The Silos Project has temporary shielding available, (e.g., lead blankets). However, it is not anticipated that shielding will receive widespread use due to the generally low overall radiation levels that are expected.
12	Particulate air sampling and radon monitoring will be conducted in selected areas in the facility. In addition, Continuous Air Monitors (CAMs) will be used for early indication of elevated particulate airborne radioactivity.
Administrative Controls	
1	Bag-out procedures will be used for the removal of filters from the redundant Process HEPA filter banks (i.e., the stack filters), the Process Vent System, and the building ventilation system to minimize the potential for spread of contamination and generation of airborne radioactivity.
2	Access Controls/Postings/Labeling (see relevant sections in this table)
3	RWPs/Updated Radiological Surveys will be used for: • entry into any radiological area. • breaching of any process line, tank, vessel, or enclosure containing radioactive material that may become loose or airborne during work activities. • any work within the Controlled Area on contaminated or potentially-contaminated equipment where safety precautions are not adequately discussed in Radiological Control-approved technical work documents. • digging or disturbing soil in a Soil Contamination area. • breaking the barrier of a Fixed Contamination Area.
4	Area Radiation/Contamination Monitoring: As part of the Radiological Controls Program, Radiological Control Technicians (RCTs) monitor radiation levels and surface contamination. The Silo 3 Project Radiological Engineer, in conjunction with other safety professionals, determines the required PPE, thermoluminescent dosimeters (TLDs), and any other special radiological precautions. These requirements are controlled and specified on a RWP for each task.

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TABLE 8-23: RADIOLOGICAL HAZARD CONTROLS	
5	Area Air Monitoring: Occupational air monitoring for radionuclides will be performed in accordance with RM-0020 [Ref. 51] and the project-specific Occupational Air Monitoring Plan.
6	An ALARA Analysis was completed for Preventative Maintenance Tasks (see Appendix D of this N-HASP).
7	Airborne Radioactivity Areas: If sustained average radon concentrations and airborne particulate levels exceed 10 percent of the DAC, an Airborne Radioactivity Area will be established and appropriate respiratory protection equipment will be established, as prescribed in the RWP for the area/task. Air sampling and/or radon monitoring will continue, as necessary, to determine the extent and duration of the Airborne Radioactivity Area. Airborne Radioactivity areas no longer exceeding 10 percent of the DAC will be down-posted.
8	Completed waste packages will be surveyed before they are placed in the Sea/Lands to determine if there is surface contamination.
Radiological Access Controls: Access to Controlled Areas	
1	Unescorted access to Silos Project Controlled Areas or Radiological Areas requires a minimum of Radiological Worker training.
2	All workers shall be briefed on the contents of each RWP or Safe Work Plan. Workers shall sign an acknowledgment form to signify their understanding of RWP or Safe Work Plan requirements.
3	At the access control point (access point from the Uncontrolled Area to the Controlled Area), workers shall scan their bar code into the access control computer, which will verify that their training and bioassay requirements are current. If the access control computer system is inoperable, training may be verified by visual inspection of the worker's Occasional or General Site Worker's Card.
4	Access into the Silo 3 facility is primarily through the Silo 3 Control Point Trailer. However, the primary location for TLD storage and for bar-coding into the Silo 3 area is Trailer 92. Another TLD storage area and bar-code location is Trailer T-28H.
5	If personnel are assigned TLDs, they shall obtain them before reaching the Controlled Area.
6	If personnel are assigned TLDs, the TLDs must be worn while workers are in the Controlled Area

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TABLE 8-23: RADIOLOGICAL HAZARD CONTROLS	
7	TLDs shall be worn on the outside of the workers' clothing (non-PPE), facing forward, between their waist and shoulders.
8	Visitors may be allowed to enter the Controlled Area upon approval of Radiological Control with a properly trained and cognizant escort.
9	If a worker's training or bioassay is insufficient or out-of-date, access to the controlled area without an escort will be denied.
10	When exiting a Category I Controlled Area, workers shall perform whole body monitoring, (preferably with a personal contamination monitor [PCM]), and monitor personal items with a hand-held frisker.
Radiological Access Controls: Access to Contamination Area	
1	Workers shall sign the appropriate RWP for entry into a contaminated work area.
2	Workers shall obtain the prescribed PPE clothing and respiratory protection equipment, enter their badge number and the respirator serial number into the access control computer, show evidence of being respirator-fit, go to the dressing area, and don the prescribed PPE.
3	When wearing protective clothing so that no skin is exposed (i.e., full anti-Cs and a respirator), the worker's TLD must be worn underneath the protective clothing.
4	When protective clothing requirements allow skin to be exposed (e.g., no respirator), the TLD must be worn on the outside of the anti-Cs.
5	Before entering the Contamination Area, workers shall contact an RCT for assignment of personal air samplers and airflow testing of the powered air-purifying respirators (PAPRs) (if worn). The following conditions apply to persons wearing personal air samplers: • When changing work areas, workers must sign in on the appropriate RWP and verify they are wearing PPE in compliance with the RWP for the new area. If the worker must change PPE before moving to the new job area, the worker must exit the Contamination Area and go through the appropriate steps for re-entry, wearing the correct PPE for the new area. The worker will be assigned a different personal air sampler. • Personal entry into Contamination Areas must be through the established control point.

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TABLE 8-23: RADIOLOGICAL HAZARD CONTROLS	
Exiting Contamination Areas	
1	Whenever their protective clothing is compromised, or when non-water-resistant anti-Cs get wet, or sweat has penetrated protective clothing, workers shall always leave a Contamination Area and doff anti-Cs at the appropriate control point.
2	Workers shall sign out on the RWP upon exiting through the access control point.
3	To exit a High Contamination Area inside the Silo 3 facility, the potentially-contaminated outer layer of PPE will be doffed at the High Contamination Area exit (control point). The workers will then perform (at a minimum) hand and foot monitoring with the instrumentation provided by the RCT. Workers must ensure that, when performing monitoring with hand-held alpha friskers, the proper detector distance and frisk rate are used. The proper distance is within one-fourth inch. The proper frisk rate is less than two inches-per-second. The specific monitoring protocol will be determined by the Radiological Engineer and stated on the RWP. If contamination is detected at any control point, the worker will be required to notify an RCT for a response. All equipment and materials to be removed from the Contamination Areas must be surveyed and released by an RCT.
4	After workers exit the Silo 3 facility and doff anti-Cs, whole-body monitoring will be performed in the Silo 3 Control Point Trailer, or other location designated by the RWP, before they proceed to a different work area or leave the Controlled Area.
5	Access to Radiological Areas is controlled by Radiological Control. Workers requiring access to Radiological Areas receive a briefing from an RCT on the area radiological hazards (e.g., contamination levels) and the precautionary measures taken to ensure worker safety (e.g., PPE requirements).
Silo 3 Process Building Radiological Posting	
1	The Silo 3 Process Building will be controlled as a Radiological Area. The specific posting will vary as building conditions change based on activities to be performed. The initial anticipated postings for the Silo 3 Process Building are Airborne Radioactivity Area, Contamination Area, and RWP Required for Entry. If maintenance is to be performed and system breaches are required, the area will be up-posted to a High Contamination Area and a temporary control point will be established (location to be determined by the Radiological Engineer).

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TABLE 8-23: RADIOLOGICAL HAZARD CONTROLS

General Radiological Rules	
1	Eating, drinking, smoking, chewing tobacco or gum, dipping tobacco, and applying make-up are permitted only in areas designated by Radiological Control. Not withstanding the following medical exceptions, at no time are the above activities permitted within Contaminated Areas, High Contamination Areas, or Airborne Radioactivity Areas: • Silos Project personnel receiving medical treatment with radio-pharmaceuticals will be restricted from entering Controlled Areas until the radio-pharmaceutical has cleared sufficiently from his/her system so that frisking with a PCM at the control point does not trigger the alarm. Silos Project personnel who have received treatment with radio-pharmaceuticals must report to Fluor Fernald Medical immediately upon returning to work. • Silos Project personnel who are pregnant may "Declare Pregnancy" per 10 CFR 835, *Occupational Radiation Protection* [Ref. 52]. The pregnant person should report to Fluor Fernald Medical, where she will be informed of the risks related to her pregnancy as a result of working at the Silos Project.

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8.22 Chemical Hazards

Potential general occupational chemical hazards include:

- Corrosive materials coming in contact with the skin
- Inhalation of chemical materials

Fluor Fernald S&H personnel are responsible for providing chemical protection support through the use of general area air monitoring, personal sampling, and prescribing PPE. Activities with the potential for chemical exposure of personnel will be governed by work permits, procedures, or task-specific plans, which will also prescribe the level and type of protection to be afforded personnel.

Silo 3 Waste Profile

Twenty-two metals have been identified in the chemical composition of the Silo 3 waste. Analyses performed for the *Remedial Investigation Report for Operable Unit 4* [Ref. 7], and later core samples taken by the project, indicate that the material contains up to 15 percent sulfate and has undergone calcination in temperatures up to 820°C (1,500°F). At this temperature, elements are chemically bonded with their sulfate and oxide compounds. If the sulfate is not stable, it will convert into oxide and sulfur dioxide (a gas). Any volatile organic compounds (VOC) present would have completely decomposed during calcination.

Silo 3 elemental concentrations (mg/kg) are shown in **TABLE 8-24**. These values come from the OU4 Remedial Investigation Report. The concentrations are converted into potentially-releasable inventory (PRI) for comparison to thresholds. The PRI assumes 3,925 tons of Silo 3 material and an estimated damage ratio of 5.5%, which is material release determined for the earthquake silo failure in the Silo 3 ASR [Ref. 16].

Silo 3 waste material contains no compounds listed in 29 CFR 1910.119 [Ref. 31]. Thirteen chemical compounds may be present in inventories exceeding the Reportable Quantities (RQ) values in 40 CFR 302.4 [Ref. 53]

Five compounds exceed Threshold Planning Quantity (TPQ) values established in 40 CFR 355 [Ref. 54] vanadium pentoxide, arsenic trioxide, cadmium oxide, mercuric oxide, and thallium sulfate. Since the preliminary hazard categorization would be driven to HC-3 based on size of inventory alone, the concentrations of arsenic trioxide and vanadium pentoxide are assessed in the accident analyses.

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TABLE 8-24: INVENTORY OF INORGANIC CHEMICALS IN SILO 3 MATERIAL

Inorganic Chemical	Concen-tration[a] (mg/kg)	Total Elemental Mass[b] (kg)	Potentially Releasable Inventory[c] (kg)	Table 40 CFR 302.4			40 CFR 355	
				RQ[d] (kg)	Applicable Chemical Compound[e]	Exceed RQ	TPQ[d] (kg)	Exceed TPQ
Aluminum	29,500	105,120	5,782	2,270	Aluminum sulfate	Yes	n.l.	
Arsenic	7,270	25,906	1,425	0.454	Arsenic trioxide	Yes	45.4	Yes
Barium	57	203	11	Not listed			n.l.	
Beryllium	9.2	33	2	4.54	Beryllium powder	Yes	n.l.	
Cadmium	343	1,222	67	0.454	Cadmium oxide	Yes	45.4	Yes
Calcium	57,500	204,896	11,269	Not listed			n.l.	
Chromium	823	2933	161	Not listed			n.l.	
Cobalt	6,280	22,378	1,231	Not listed			n.l.	
Copper	7,360	26,227	1,442	4.54	Copper sulfate	Yes	n.l.	
Iron	113,000	402,664	22,147	454	Ferric sulfate	Yes	n.l.	
Lead	6,800	24,231	1,333	4.54	Lead sulfate	Yes	n.l.	
Magnesium	120,000	427,608	23,518	Not listed			n.l.	
Manganese	13,200	47,037	2,587	Not listed			n.l.	
Mercury	1,740	6,200	341	4.54	Mercuric sulfate	Yes	n.l.	
				0.454	Mercuric oxide	Yes	227	Yes
Nickel	9,890	35,242	1,938	45.4	Nickel sulfate	Yes	n.l.	
Potassium	79,200	282,221	15,522	Not listed			n.l.	
Selenium	902	3,214	177	4.54	Selenium dioxide	Yes	n.l.	
Silver	831	2,96s	163	Not listed			n.l.	
Sodium	92,100	328,189	18,050	Not listed			n.l.	
Thallium	163	581	32	45.4	Thallium oxide or sulfate	Yes	45.4	Yes
Vanadium	10,900	38,841	2,136	454	Vanadium pentoxide	No	45.4	Yes
Zinc	849	3025	166	454	Zinc sulfate	No	n.l.	

[a]The 95th percentile concentrations are taken from WSRC-TR-2000-00523, Appendix 3 [Ref. 55].

[b]Total Elemental Mass (kg) = Concentration (mg/kg) x 3,925 tons material x 908 kg/ton x kg/10^6mg

[c]Potentially Releasable Inventory (kg) = Total Elemental Mass x Damage Ratio of 5.5%

[d]RQ is taken from Table 40 CFR 302.4 (Final RQ); TPQ taken from 40 CFR 355, Appendix A

[e]Sulfate or oxide compound assumed based on process chemistry (beryllium powder assumed here for conservatism)

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TABLE 8-25 provides the Effective Concentration Limits (ECLs) and hazard rankings for all Silo 3 waste Constituents of Potential Concern (CPCs).

TABLE 8-25: SILO 3 MATERIAL EFFECTIVE CONCENTRATION LIMITS AND HAZARD RANKINGS

Constituent Of Potential Concern (CPC)	Effective Concentration Limit (ECL) (mg/m^3) [1]	Hazard Ranking[2]
Th-230	5E-02	1
Ac-227	3E-01	2
Th-232	6E-01	3
Pa-231	8E-01	4
Arsenic	3E+00	5
Th-228	5E+00	6
Beryllium	7E+00	7
Cobalt	7E+00	8
U-238	1E+01	9
U-234	1E+01	10
Uranium (toxicity)	1E+01	11
Vanadium	1E+01	12
Lead	2E+01	13
Pb-210	2E+01	14
Nickel	2E+01	15
Chromium	3E+01	16
Manganese	4E+01	17
Cadmium	5E+01	18
Calcium	6E+01	19
Ra-226	8E+01	20
Iron	1E+02	21
Aluminum	1E+02	22
Magnesium	1E+02	23
U-235	2E+02	24
Copper	3E+02	25
Silver	6E+02	26
Selenium	9E+02	27
Ra-228	1E+03	28
Thallium	2E+03	29
Barium	2E+03	30
Ra-224	2E+03	31
Mercury	1E+04	32
Zinc	2E+04	33

[1] ECLs are from Table 4 of the *Silo 3 Material Airborne Control Limit Calculation* [Ref. 56].
[2] The ranking is 1 to 33 (most severe inhalation hazard to least severe inhalation hazard)

Top Five Chemical Constituents of Concern

As shown in **TABLE 8-25**, the top five chemical constituents of concern in the Silo 3 material are arsenic, beryllium, cobalt, lead, and chromium (ranked as the 5th, 7th, 8th, 13th, and 16th most severe inhalation hazards, respectively, in the *Silo 3 Material Airborne Control Limit Calculation* [Ref. 56]).

Note: The 1st through 5th severe inhalation hazards in Table 8-25 (i.e., Th-230, Ac-227, Th-232, Pa-231) are radiological constituents. Their controls are discussed in Section 8.21.

- Arsenic has been shown to cause skin and lung cancer. It may cause reproduction damage by harming a developing fetus. Contact with the skin can cause irritation, itching, burning, thickening, and color changes. High exposure can cause nausea, vomiting, poor appetite, and muscle cramps. Long-term exposure can cause the formation of an ulcer or hole in the bone dividing the inner nose. High or repeated exposure can cause a 'pins and needles' sensation, burning numbness, and weakness of arms and legs. Repeated exposure can damage the liver and cause stomach problems.

- Beryllium has been shown to cause cancer. Exposure to beryllium may develop into chronic beryllium disease. Permanent scars may develop in the lungs. Symptoms including fatigue, shortness of breath, weight loss, and poor appetite may occur. Beryllium can irritate the nose, throat, and lungs. Bronchitis and/or pneumonia may occur after high exposure to beryllium. Contact with broken skin can cause ulcers and/or lumps to develop. Eye contact can cause irritation, itching, or burning.

- Cobalt may irritate the skin, eyes, nose, and throat. Cobalt may cause coughing and shortness of breath. Higher exposures can cause a build-up of fluid in the lungs called pulmonary edema. Cobalt can cause a skin allergy, with skin rash and itching. It can also cause an asthma-like allergy. If this allergy develops, then future exposures to cobalt can cause shortness of breath, wheezing, coughing, and/or chest tightness. Cobalt can affect the heart, thyroid, and kidneys. Repeated exposure to cobalt dust can cause scarring of the lungs and can be disabling or even fatal. Cobalt may decrease fertility in males.

- Lead can cause headaches, irritability, reduced memory, disturbed sleep, and mood and personality changes. Repeated exposure can lead to lead poisoning. Symptoms include a metallic taste in the mouth, poor appetite, weight loss, colic, upset stomach, nausea, vomiting, and muscle cramps. High or repeated exposure can result in nerve damage, a 'pins and needles' sensation and poor arm and leg coordination. There can be muscle and joint pains and high blood pressure. Lead can cause kidney and brain damage. Lead can damage blood cells, which can lead to anemia. It can take years for the human body to get rid of excess lead. Lead can irritate the eyes, nose, and throat. Lead has been shown to damage animal fetuses, and thus, may also affect human fetuses. Lead may also decrease fertility in men and women.

- Chromium may cause skin and lung allergies. If allergies develop, even low exposures can cause skin rashes, coughing, wheezing or shortness of breath. Exposure to chromium fumes can cause Metal Fume Fever, a flu-like illness involving a metallic taste in the mouth, fever, chills, aches, chest tightness, and cough. This flu-like illness usually lasts for 1-2 days.

Controls specific to the above chemicals are listed in **TABLE 8-26**.

Silo 3 Waste Conditioning Chemicals

The predominant hazardous chemical involved with Silo 3 operations is the ferrous sulfate solution used as an additive in the waste conditioning process (the major Silo 3 hazard is Th-230, a radiological hazard [Section 8.18]). Silo 3 materials will be conditioned with the following chemicals:

- Sodium lignosulfonate (47–weight percent). A polymeric organic binder that will reduce dispersion. The solution is a lignin waste product of pulp and paper processing. Sodium lignosulfonate is not listed in 40 CFR 355 or 40 CFR 302.4. The solution (REAX SN Solution) has a pH of 9. It may cause skin irritation, but animal tests indicate the material is not a primary skin irritant. There is no established exposure criteria for the solution, but breathing mists may irritate the respiratory system. The Cargo Container Bay inventory is estimated to be approximately 300 gallons. Thirty gallons will be used per day.

- Ferrous sulfate (13-16.3% ferrous sulfate, less than 6% sulfuric acid). An agent for reducing chromium VI to chromium III, which is more amenable to bonding agents [Ref. 57]. The ferrous sulfate solution has a pH <1. It can damage the skin, eyes, and other mucous membranes. Ferrous sulfate is not listed in 40 CFR 355; however, the sulfuric acid component in the ferrous sulfate has an exposure limit of 1 mg/m^3 (ACGIH TLV). Therefore, any monitoring results will be compared against that sulfuric acid exposure criterion. With a low pH and irritating fumes, ferrous sulfate must be stored in a cool, dry, ventilated area to reduce the generation of sulfuric acid vapors. A 4,500-gallon storage tank is located in the Cargo Container Bay; 340 gallons will typically be present in the wastewater tank area. This inventory would exceed the 40 CFR 302.4 RQ of 1,000 lb.

Chemical Hazard Controls

TABLE 8-26 lists the hazard controls designed into the project to help minimize the potential for chemical exposure.

NOTE: The SPRs in Table 8-26 do not comprise the complete list of relevant SPRs for this hazard topic. The items below have been identified as key elements for the Silo 3 Project. For a complete list of applicable SPRs, see the designated SPR section in RM-0021, *Safety Performance Requirements Manual.*

TABLE 8-26: CHEMICAL HAZARD CONTROLS (SPR 2-2, 12-11)	
General Controls	
1	Appropriate PPE will vary based on the location of the employee and the task being performed. PPE requirements will be identified in the work permit and/or procedures.
2	PPE may be upgraded with the appropriate Safety and Health approval authority.
3	If there is a potential to be splashed by a chemical, a faceshield and/or goggles or a full-face respirator will be required to be worn.
4	The Silo 3 facility will be equipped with video cameras to allow for remote viewing of personnel and equipment. This should help to reduce the number of individuals inside the Silo 3 facility and their time inside.
5	Permanent eyewashes are located in the Silo 3 facility. However, if there is a potential for contact with an acidic chemical and the nearest permanent eyewash is more than 100 feet away or it will take more than 10 seconds to reach the eyewash, then a portable eyewash will be located close to the work area.
6	Routine preventative maintenance and inspections will be conducted on all eyewashes.
7	Unescorted access to Silos Project Controlled Areas or Radiological Areas requires a minimum of OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) training.
8	All on-site personnel are required to comply with applicable Fluor Fernald Work Permits, approved work plans, and operational procedures.
9	All workers are briefed on the contents of each work permit, work plan, or operational procedure.

TABLE 8-26: CHEMICAL HAZARD CONTROLS (SPR 2-2, 12-11)	
10	When exiting a Category I Controlled Area, workers shall perform whole body monitoring, preferably with a PCM, and monitor personal material with a hand-held frisker. This procedure should identify any chemical contamination as well as any radiological contamination.
11	Workers shall obtain the prescribed PPE clothing and respiratory protection equipment, enter their badge number and the respirator serial number into the access control computer, show evidence of being respirator-fit, go to the dressing area, and don the prescribed PPE.
12	Workers shall always leave a Contamination Area and doff anti-Cs at the appropriate control point whenever their protective clothing is compromised or when non-water-resistant anti-Cs get wet or workers sweat through their protective clothing. This procedure will prevent contact with, or the spread of, chemical contamination.
13	Eating, drinking, smoking, chewing tobacco or gum, dipping tobacco, and applying makeup are permitted only in areas designated by Fluor Fernald Radiological Control. Except for approved medical exceptions, at no time are these activities permitted within Contaminated Areas, High Contamination Areas, or Airborne Radioactivity Areas. This practice will prevent the ingestion of chemical materials.
14	The design of the Waste Additive System area includes spill control and a flush system.
Arsenic, Beryllium, Cobalt, Lead, and Chromium Controls	
1	The following chemical-specific controls shall be followed in addition to the General Controls listed above.
2	Areas where arsenic, beryllium, cobalt, lead, and chromium are handled will be regulated.
3	Operations involving arsenic, beryllium, cobalt, lead, and chromium will comply with the following controls: • Operations will be enclosed as much as possible. • Exhaust ventilation will be used. • Respirators shall also be worn, as necessary, to ensure that personnel are not exposed to airborne levels that exceed exposure criteria (see Item #4 below). • Personnel handling these constituents shall wear protective gloves and clothing. • If there is skin contact, the area shall be washed. • If vacuuming these materials, a HEPA vacuum shall be used. • Eating, drinking, and smoking shall be prohibited in areas where these constituents are handled.

TABLE 8-26: CHEMICAL HAZARD CONTROLS (SPR 2-2, 12-11)	
4	Exposure to arsenic, beryllium, cobalt, lead, and chromium will be routinely evaluated by collecting personal air samples. Concentrations equaling or exceeding the action levels below will trigger the specified follow-up actions: • Arsenic = 5 micrograms per cubic meter. Follow-up actions per OSHA regulations. • Beryllium = 0.2 micrograms per cubic meter. Although the Silo 3 material does not meet the definition of beryllium found in 10 CFR 850, *Chronic Beryllium Disease Prevention Program* [Ref. 58], protective actions contained in this regulation will be considered as best management practices. • Cobalt = 10 micrograms per cubic meter. Follow-up actions to reduce the generation of cobalt airborne concentrations (e.g., adding ventilation, using wet methods, etc.). • Lead = 30 micrograms per cubic meter. Follow-up actions per OSHA regulations. • Chromium = 0.5 milligrams per cubic meter. Follow-up actions to reduce the generation of chromium airborne concentrations (e.g., adding ventilation, using wet methods, etc.).

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9.0 HAZARDS CONTROL MATRIX

A hazards assessment was performed for the tasks assigned to the Fluor maintenance and operations personnel associated with Silo 3 operations (see Section 7.0). The Hazards Control Matrix in **TABLE 9-1** is the method of documenting this assessment. It identifies the tasks to be performed in conjunction with their hazards (as discussed in Section 8.0), and their controls/ mitigators. This matrix forms the basis for employee briefings prior to working on the Silo 3 Project.

TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 1: **Truck transport of empty containers and containerized additive materials**	Chemical: Exhaust vapors	• Truck loading/unloading area adequately ventilated to prevented build-up of exhaust vapors • Industrial Hygiene monitoring performed in accordance with site requirements • Trucks not to remain idling for extended periods • Exhaust hoses used, if needed	FCP Work Permit S&H Procedures
	Heavy equipment	• Reflective materials to be worn by ground personnel • Communication to be maintained between truck driver and ground-person when truck in motion • Only qualified drivers permitted to enter and operate within facilities (CDL) • Ground persons not to walk in front of or behind moving trucks • Trucks are not to be left with engines running and unattended • Proper steps to be taken to prevent truck movement during loading operations • Truck drivers to obey site speed limits	Standard Operating Procedure (SOP) SPRs

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 1 (cont.): Truck transport of empty containers and containerized additive materials	Noise	• Hearing Protection to be worn in posted areas	FCP Work Permit S&H Procedures
	Slips, trips, and falls: Slippery surfaces	• Fluids dripping/leaking from trucks absorbed and removed • Liquids collecting on floors to be absorbed and removed	SOP SPRs
	Pinch/crushing points	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Workers will wear proper PPE	SOP Standing Orders FCP Work Permit Pre-job Briefing
	Housekeeping	• Maintain work areas and personnel access-ways free of obstructions and debris	SPR
Task 2: Receipt of Silo 3 bulk chemicals	Chemical	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures • Industrial Hygiene monitoring, as needed • Workers to wear prescribed PPE • Spill control	FCP Work Permit S&H Procedures MSDS Vendor procedures

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 2 (cont.): Receipt of Silo 3 bulk chemicals	Heavy equipment	• Reflective materials to be worn by ground personnel • Communication to be maintained between truck driver and ground-person when truck in motion • Only qualified drivers permitted to enter and operate within facilities (CDL) • Ground persons not to walk in front of or behind moving trucks • Trucks are not to be left with engines running and unattended • Proper steps to be taken to prevent truck movement during loading operations • Truck drivers to obey site speed limits	SOP SPRs
	Hazardous energy: Static electricity	• Equipment properly grounded prior to chemical delivery	Vendor procedures
	Pinch/crushing points	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Workers will wear proper PPE	SOP Standing Orders FCP Work Permit Pre-job Briefing
	Housekeeping	• Maintain work areas and personnel access-ways free of obstructions and debris	SPR
Task 3: Manipulation of the Pneumatic Retrieval System (PRS) vacuum wand and hose	Illumination	• Work area lighting levels optimal for performing the activity • Industrial Hygiene lighting surveys performed to ensure compliance	HFE SOP Standing Orders S&H Procedures

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 3 (cont.): Manipulation of the Pneumatic Retrieval System (PRS) vacuum wand and hose	Falls	• Fall protection system silo 3 dome	SOP SPRs FCP Work Permit
	Hoisting and rigging: Operating hoist over each manway to assist vacuum wand/hose handling	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures	SOP Pre-job Briefing
	Biological	• On-site personnel are instructed to use discretion and avoid all contact with wild animals. • If insects present a problem, insect sprays will be used to remove them. • Workers will be instructed on how to recognize poisonous plants and to avoid contact with them. When found, these hazards will be removed.	SPR

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 3 (cont.): Manipulation of the Pneumatic Retrieval System (PRS) vacuum wand and hose	Radiological: Airborne radioactivity, contamination, radiation	• Enclosed System to minimize the generation of airborne radioactivity and control the spread of contamination. • Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures • Workers will qualify as 40-hr HAZWOPER/Rad Worker • Workers will use good radiological work practices to prevent the spread of radioactive material and use containments when practical • Protective clothing and equipment will be used as prescribed by Radiological Controls • Work area contamination levels will be kept to a minimum • RCTs will perform contamination surveys to determine work area control levels • RCT oversight • Workers will doff potentially contaminated PPE per posted instructions • Vacuum wand sections to be decontaminated, as needed, when removed from silo penetration	FF RWP ALARA Analysis HPP SOP Pre-job Briefing
	Ergonomics: Lifting/holding/ manipulating wand for extended periods	• Workers will be trained to perform tasks safely • Work durations will be administratively controlled/limited via worker rotation • Mechanical devices (jig) to be used to minimize moment on lower back	HFE SOP Standing Orders Pre-job briefings

TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX			
Task	**Hazard**	**Mitigators/Controls**	**Permits/ Guid. Docs**
Task 3 (cont.): Manipulation of the Pneumatic Retrieval System (PRS) vacuum wand and hose	Heat stress Cold stress	• Implementation of the FCP cold/heat stress programs	Pre-job Briefing S&H Procedures SPRs
	Housekeeping	• Maintain work areas and personnel access-ways free of obstructions and debris	SPR
Task 4: Maneuvering of the Mechanical Retrieval System (MRS) remote control vehicle	Illumination	• Work area lighting levels optimal for performing remote operation of excavator • Industrial Hygiene lighting surveys performed to ensure compliance	HFE SOP Standing Orders S&H Procedures
	Radiological: Airborne radioactivity, contamination, radiation	• Remote Operations minimize radiological exposures to the worker • Excavator-mounted misting system can be used to suppress dust during excavation • Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures • Workers will qualify as 40-hr HAZWOPER/Rad Worker • Protective clothing and equipment will be used as prescribed by Radiological Controls • Work area contamination levels will be kept to a minimum • RCTs will perform contamination surveys to determine work area control levels • RCT oversight	FF RWP ALARA Analysis HPP SOP Pre-job Briefing

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX			
Task	**Hazard**	**Mitigators/Controls**	**Permits/ Guid. Docs**
Task 4 (cont.): Maneuvering of the Mechanical Retrieval System (MRS) remote control vehicle	Noise	• Wear hearing protection if required by area posting	Pre-job Briefing S&H Procedures
	Ergonomics: Carpal tunnel syndrome	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures	HFE
	Hazardous energy: Electrical	• Cable mgmt system (take-up reel)	Vendor procedures
	Housekeeping	• Maintain work areas and personnel access-ways free of obstructions and debris	SPR
Task 5: Conditioning and packaging of retrieved waste	Chemical: Acid vapors/splash during chemical addition	• Industrial Hygiene monitoring of work area • Chemical addition components working within design parameters • Workers performing tasks as trained	S&H Procedures SOPs
	Illumination	• Work area lighting levels optimal for performing the activity • Industrial Hygiene lighting surveys performed to ensure compliance	HFE SOP Standing Orders S&H Procedures

TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX			
Task	**Hazard**	**Mitigators/Controls**	**Permits/ Guid. Docs**
Task 5 (cont.): Conditioning and packaging of retrieved waste	Radiological: Airborne radioactivity, contamination, radiation	• Most of the activity is performed remotely to minimize radiological exposures to the worker • A thick liner is used for the packaging to minimize radon emanation and the potential for breaching the package during filling and handling • Heat seal for containment during bag separation • Liner seals to mixer chute using remotely inflatable boots to maintain containment. • Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures • Workers will qualify as 40-hr HAZWOPER/Rad Worker • Workers will use good radiological work practices to prevent the spread of radioactive material and use containments when practical • Protective clothing and equipment will be used as prescribed by Radiological Controls • Work area contamination levels will be kept to a minimum • RCTs will perform contamination surveys to determine work area control levels • RCT oversight • Workers will doff potentially contaminated PPE per posted instructions	FF RWP ALARA Analysis HPP SOP Pre-job Briefing

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 5 (cont.): Conditioning and packaging of retrieved waste	Ergonomics: Overhead reaching	• Work durations will be administratively controlled/limited via worker rotation • Workers will be trained to perform tasks safely	HFE SOPs Standing Orders Pre-job Briefing
	Pinch/crushing points	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Workers will wear proper PPE • Workers will not place hands, head or feet between lid and container, container and conveyor, or container and container. • Workers to be briefed on the hazards of their work area prior to initiating packaging activities	SOP Standing Orders FCP Work Permit Pre-job Briefing
	Head impact: Falling objects	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Workers are never to position their bodies under a load • Only Qualified personnel will operate the hoist • Head protection will be worn by personnel when the potential for falling objects or head injuries due to impact exist.	SOP Standing Orders FCP Work Permit Pre-job Briefing
	Ergonomics: Lifting (waste package liners)	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures	SPR 2-5 SOP Pre-job Briefing

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX			
Task	**Hazard**	**Mitigators/Controls**	**Permits/ Guid. Docs**
Task 5 (cont.): Conditioning and packaging of retrieved waste	Waste package heat sealer/bag cutter	• Workers will be trained to perform tasks safely	Vendor procedures Pre-job Briefing
	Hoisting and rigging: Lifting full bags	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures	SOP Pre-job Briefing
	Hand and power tools: Strapping down load	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures	SOP Vendor procedures
	Housekeeping	• Maintain work areas and personnel access-ways free of obstructions and debris	SPR
Task 6: Loading of containerized material	Head impact: Falling objects	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Workers are never to position their bodies under a load • Only Qualified personnel will operate the hoist • Head protection will be worn by personnel when the potential for falling objects or head injuries due to impact exist.	SOP Standing Orders FCP Work Permit Pre-job Briefing

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 6 (cont.): Loading of containerized material	Heavy equipment	• Reflective materials to be worn by ground personnel • Communication to be maintained between truck driver and ground-person when truck in motion • Only qualified drivers permitted to enter and operate within facilities (CDL) • Ground persons not to walk in front of or behind moving trucks • Trucks are not to be left with engines running and unattended • Proper steps to be taken to prevent truck movement during loading operations • Truck drivers to obey site speed limits	SOP SPRs
	Hoisting and rigging: Removing cargo lid; lifting packages into Sea/Land; replacing lid	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Only Qualified personnel will operate the hoist	SOP Pre-job Briefing
	Ladders and climbing: Removing the rigging from packages in the Sea/Land	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Workers are never to position their bodies under a load • Only Qualified personnel will operate the hoist	SOP Pre-job Briefing

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX			
Task	**Hazard**	**Mitigators/Controls**	**Permits/ Guid. Docs**
Task 6 (cont.): Loading of containerized material	Pinch/crushing points	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Workers will wear proper PPE • Workers will not place hands, head or feet between lid and container, container and conveyor, or container and container. • Workers to be briefed on the hazards of their work area prior to initiating loading activities	SOP Standing Orders FCP Work Permit Pre-job Briefing
	Illumination	• Work area lighting levels optimal for performing the activity • Industrial Hygiene lighting surveys performed to ensure compliance	HFE SOP Standing Orders S&H Procedures

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 6 (cont.): Loading of containerized material	Radiological: Airborne radioactivity, contamination, radiation	• Use of a conveyor system, rigging, and fork trucks to minimize handling • Radiological survey to minimize the potential for the spread of contamination • Placement of several packages in a single Sea/Land to minimize labeling and other transportation handling requirements (e.g., labeling/stenciling) • Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures • Workers will qualify as 40-hr HAZWOPER/Rad Worker • Protective clothing and equipment will be used if prescribed by Radiological Controls • RCTs will perform area contamination surveys to determine work area control levels • Completed packages will be surveyed for surface contamination before loading • Air locks between the Packaging Station Area and the Cargo Bay minimize the spread of contamination • RCT oversight	FF RWP ALARA Analysis HPP SOP Pre-job Briefing

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 6 (cont.): Loading of containerized material	Chemical: Exhaust vapors	• Fork truck loading/unloading area adequately ventilated to prevented build-up of exhaust vapors • Industrial Hygiene monitoring performed in accordance with site requirements • Fork trucks not to remain idling for extended periods • Exhaust hoses used, if needed	FCP Work Permit S&H Procedures
Task 7: On-site Transportation of Containerized Waste Materials	Heavy equipment	• Operators must obey all FCP posted speed limits • Operators must obey all FCP traffic safety rules	SPR 7 - 3 Qualified Operators
	Radiological: Airborne radioactivity, contamination, radiation	• Loaded radiological surveys of completed shipments • Placement of packages in a Sea/Land container • Staging of completed shipments and use of placarding/ Radiological postings • Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures • Workers will qualify as 40-hr HAZWOPER/Rad Worker if necessary • RCT oversight	FF RWP ALARA Analysis HPP SOP Pre-job Briefing
	Housekeeping	• Maintain work areas and personnel access-ways free of obstructions and debris	SPR

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 8: Maintenance of the Pneumatic Retrieval System (PRS), Air Handling Systems, and Process Vent System	Radiological: Airborne radioactivity, contamination, radiation	• Workers will use good radiological work practices to prevent the spread of radioactive material and use containments/HEPA ventilation when practical • As necessary, decontamination prior to performing maintenance • Capable of using bag-out process for removal of HEPA-ULPA (ultra-low penetrating air) filters and pre-filters, and cartridges and bags	FF RWP ALARA Analysis HPP SOP Pre-job Briefing
		• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures • Workers will qualify as 40-hr HAZWOPER/Rad Worker • Protective clothing and equipment will be used as prescribed by Radiological Controls • Work area contamination levels will be kept to a minimum • RCTs will perform contamination surveys to determine work area control levels • RCT oversight • Workers will doff potentially contaminated PPE per posted instructions	

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 8 (cont.): Maintenance of the Pneumatic Retrieval System (PRS), Air Handling Systems, and Process Vent System	Confined spaces	• Confined Space Entry procedures • Confined Space Training • Proper labeling of Confined Spaces	SOP Pre-job Briefing FCP Work Permit Confined Space Entry Permit
	Hazardous energy: Electrical shock/ inadvertent equipment start-up	• Energy isolation will be performed per site procedures • Only trained personnel will perform work on locked-out/tagged-out equipment	Energy Isolation Plan (EIP)/SOP
	Chemical	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures • Workers will qualify as 40-hr HAZWOPERs • Industrial Hygiene monitoring, as needed • Workers to wear prescribed PPE • Follow the directions outlined in the MSDS for handling cleaners, lubricants, etc. • Supervision must ensure that workers have been briefed, as necessary, on MSDS's	FCP Work Permit S&H Procedures MSDS
	Illumination	• Work area lighting levels optimal for performing the activity • Industrial Hygiene lighting surveys performed to ensure compliance	HFE SOP Standing Orders S&H Procedures

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 8 (cont.): Maintenance of the Pneumatic Retrieval System (PRS), Air Handling Systems, and Process Vent System	Flammable material	• Workers will be trained in fire protection and prevention.	SOP SPR
	Compressed gas	• Workers will be trained in the safe use of compressed gas cylinders.	SPR
	Hand and power tools	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures	SOP Vendor procedures
	Pinch/crushing points	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Workers will wear proper PPE	SOP Standing Orders FCP Work Permit Pre-job Briefing
	Head impact	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Head protection will be worn by personnel when the potential for falling objects or head injuries due to impact exist.	FCP Work Permit SOP Pre-job briefing
	Housekeeping	• Maintain work areas and personnel access-ways free of obstructions and debris	SPR

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 9: Maintenance of motorized vehicles (including the MRS)	Hazardous energy: Electrical shock/ inadvertent equipment start-up	• Energy isolation will be performed per site procedures • Only trained personnel will perform work on locked-out/tagged-out equipment • Cable-mgmt system (take-up reel)	EIP/SOP
	Hot surfaces	• Equipment cooled down prior to performing work • Proper use of PPE • Only qualified personnel to perform work	SOP Pre-job Briefing
	Flammable material	• Workers will be trained in fire protection and prevention.	SOP SPR
	Compressed gas	• Workers will be trained in the safe use of compressed gas cylinders.	SPR
	Pinch/crushing points	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Workers will wear proper PPE	SOP Standing Orders FCP Work Permit Pre-job Briefing
	Illumination	• Work area lighting levels optimal for performing the activity • Industrial Hygiene lighting surveys performed to ensure compliance	HFE SOP Standing Orders S&H Procedures

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 9 (cont.): **Maintenance of motorized vehicles (including the MRS)**	For MRS: Radiological (airborne radioactivity, contamination, radiation)	• Workers will use good radiological work practices to prevent the spread of radioactive material and use containments/HEPA ventilation when practical • As necessary, decontamination prior to performing maintenance • Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures • Workers will qualify as 40-hr HAZWOPER/Rad Worker • Protective clothing and equipment will be used as prescribed by Radiological Controls • Work area contamination levels will be kept to a minimum • RCTs will perform contamination surveys to determine work area control levels • RCT oversight • Workers will doff potentially contaminated PPE per posted instructions	FF RWP ALARA Analysis HPP SOP Pre-job Briefing
	Chemical	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures • Workers will qualify as 40-hr HAZWOPER • Industrial Hygiene monitoring, as needed • Workers to wear prescribed PPE • Follow the directions outlined in the MSDS for handling cleaners, lubricants, etc. • Supervision must ensure that workers have been briefed, as necessary, on MSDSs	FCP Work Permit S&H Procedures MSDS

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 9 (cont.): Maintenance of motorized vehicles (including the MRS)	Hand and power tools	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures	SOP Vendor procedures
	Head impact	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Head protection will be worn by personnel when the potential for falling objects or head injuries due to impact exist.	FCP Work Permit SOP Pre-job briefing
	Housekeeping	• Maintain work areas and personnel access-ways free of obstructions and debris	SPR
Task 10: Maintenance of conveyors, feeders, and packagers	Hazardous Energy: Electrical shock/ inadvertent equipment start-up	• Energy isolation will be performed per site procedures • Only trained personnel will perform work on locked-out/tagged-out equipment	EIP/SOP
	Flammable material	• Workers will be trained in fire protection and prevention.	SOP SPR
	Compressed gas	• Workers will be trained in the safe use of compressed gas cylinders.	SPR
	Elevated work surfaces	• Fall protection system used by workers	SOP SPRs FCP Work Permit
	Hand and power tools	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures	SOP Vendor procedures

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX			
Task	**Hazard**	**Mitigators/Controls**	**Permits/ Guid. Docs**
Task 10 (cont.): Maintenance of conveyors, feeders, and packagers	Pinch/crushing points	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Workers will wear proper PPE	SOP Standing Orders FCP Work Permit Pre-job Briefing
	Confined spaces: Entering the pit to work on the feed bin screws and/or incline conveyor	• Confined Space Entry procedures • Confined Space Training • Proper labeling of Confined Spaces	SOP Pre-job Briefing FCP Work Permit Confined Space Entry Permit
	Illumination	• Work area lighting levels optimal for performing the activity • Industrial Hygiene lighting surveys performed to ensure compliance	HFE SOP Standing Orders S&H Procedures

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX			
Task	**Hazard**	**Mitigators/Controls**	**Permits/ Guid. Docs**
Task 10 (cont.): Maintenance of conveyors, feeders, and packagers	Radiological: Airborne radioactivity, contamination, radiation	• Workers will use good radiological work practices to prevent the spread of radioactive material and use containments/HEPA ventilation when practical • As necessary, decontamination prior to performing maintenance • Use of HEPA ventilation to minimize airborne radioactivity • Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures • Workers will qualify as 40-hr HAZWOPER/Rad Worker • Protective clothing and equipment will be used as prescribed by Radiological Controls • Work area contamination levels will be kept to a minimum • RCTs will perform contamination surveys to determine work area control levels • RCT oversight • Workers will doff potentially contaminated PPE per posted instructions	FF RWP ALARA Analysis HPP SOP Pre-job Briefing

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 10 (cont.): Maintenance of conveyors, feeders, and packagers	Chemical	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures • Workers will qualify as 40-hr HAZWOPER • Industrial Hygiene monitoring, as needed • Workers to wear prescribed PPE • Follow the directions outlined in the MSDS for handling cleaners, lubricants, etc. • Supervision must ensure that workers have been briefed, as necessary, on MSDSs	FCP Work Permit S&H Procedures MSDS
	Confined space	• Confined Space Entry procedures • Confined Space Training • Proper labeling of Confined Spaces	SOP Pre-job Briefing FCP Work Permit Confined Space Entry Permit
	Heat stress	• Controlled stay times • Implementation of Heat Stress Program	SOPs SPR 12-10 Pre-job Briefing
	Head impact	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Head protection will be worn by personnel when the potential for falling objects or head injuries due to impact exist.	FCP Work Permit SOP Pre-job briefing

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 10 (cont.): Maintenance of conveyors, feeders, and packagers	Housekeeping	• Maintain work areas and personnel access-ways free of obstructions and debris	SPR
Task 11: Maintenance of cranes	Hazardous energy: Electrical shock/ inadvertent equipment start-up	• Energy isolation will be performed per site procedures • Only trained personnel will perform work on locked-out/tagged-out equipment	EIP/SOP
	Flammable material	• Workers will be trained in fire protection and prevention.	SOP SPR
	Compressed gas	• Workers will be trained in the safe use of compressed gas cylinders.	SPR
	Elevated work surfaces	• Fall protection system used by workers	SOP SPRs FCP Work Permit
	Pinch/crushing points	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Workers will wear proper PPE	SOP Standing Orders FCP Work Permit Pre-job Briefing
	Head impact	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Head protection will be worn by personnel when the potential for falling objects or head injuries due to impact exist.	FCP Work Permit SOP Pre-job briefing

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 11 (cont.): Maintenance of cranes	Illumination	• Work area lighting levels optimal for performing the activity • Industrial Hygiene lighting surveys performed to ensure compliance	HFE SOP Standing Orders S&H Procedures
	Housekeeping	• Maintain work areas and personnel access-ways free of obstructions and debris	SPR
Task 12: Maintenance of Waste Additive System and Wastewater System	Confined spaces	• Confined Space Entry procedures • Confined Space Training • Proper labeling of Confined Spaces	SOP Pre-job Briefing FCP Work Permit Confined Space Entry Permit

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 12 (cont.): Maintenance of Waste Additive System and Wastewater System	Waste Water System: Radiological (airborne radioactivity, contamination, radiation)	• Flushing of system prior to working on system • Use of HEPA ventilation to minimize airborne radioactivity • Workers will use good radiological work practices to prevent the spread of radioactive material and use containments/HEPA ventilation when practical • As necessary, decontamination prior to performing maintenance • Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures • Workers will qualify as 40-hr HAZWOPER/Rad Worker • Protective clothing and equipment will be used as prescribed by Radiological Controls • Work area contamination levels will be kept to a minimum • RCTs will perform contamination surveys to determine work area control levels • RCT oversight • Workers will doff potentially contaminated PPE per posted instructions	FF RWP ALARA Analysis HPP SOP Pre-job Briefing

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 12 (cont.): Maintenance of Waste Additive System and Wastewater System	Chemical	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures • Workers will qualify as 40-hr HAZWOPER • Industrial Hygiene monitoring, as needed • Workers to wear prescribed PPE • Follow the directions outlined in the MSDS for handling cleaners, lubricants, etc. • Supervision must ensure that workers have been briefed, as necessary, on MSDSs	FCP Work Permit S&H Procedures MSDS
	Hazardous energy: Electrical shock/ inadvertent equipment start-up	• Energy isolation will be performed per site procedures • Only trained personnel will perform work on locked-out/tagged-out equipment	EIP/SOP
	Flammable material	• Workers will be trained in fire protection and prevention.	SOP SPR
	Compressed gas	• Workers will be trained in the safe use of compressed gas cylinders.	SPR
	Hand and power tools	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures	SOP Vendor procedures
	Pinch/crushing points	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Workers will wear proper PPE	SOP Standing Orders FCP Work Permit Pre-job Briefing

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 12 (cont.): Maintenance of Waste Additive System and Wastewater System	Head impact	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Head protection will be worn by personnel when the potential for falling objects or head injuries due to impact exist.	FCP Work Permit SOP Pre-job briefing
	Illumination	• Work area lighting levels optimal for performing the activity • Industrial Hygiene lighting surveys performed to ensure compliance	HFE SOP Standing Orders S&H Procedures
	Housekeeping	• Maintain work areas and personnel access-ways free of obstructions and debris	SPR
Task 13: Maintenance of Plant/Breathing Air System	Hazardous energy: Electrical shock/ inadvertent equipment start-up	• Energy isolation will be performed per site procedures • Only trained personnel will perform work on locked-out/tagged-out equipment	EIP/SOP
	Flammable material	• Workers will be trained in fire protection and prevention.	SOP SPR
	Compressed gas	• Workers will be trained in the safe use of compressed gas cylinders.	SPR
	Pinch/crushing points	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Workers will wear proper PPE	SOP Standing Orders FCP Work Permit Pre-job Briefing

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 13 (cont.): Maintenance of Plant/Breathing Air System	Head impact	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Head protection will be worn by personnel when the potential for falling objects or head injuries due to impact exist.	FCP Work Permit SOP Pre-job briefing
	Illumination	• Work area lighting levels optimal for performing the activity • Industrial Hygiene lighting surveys performed to ensure compliance	HFE SOP Standing Orders S&H Procedures
	Housekeeping	• Maintain work areas and personnel access-ways free of obstructions and debris	SPR
Task 14: Shift-by-shift surveillance of Silo 3	Noise	• Wear hearing protection if required by area posting	Pre-job Briefing S&H Procedures

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 14 (cont.): Shift-by-shift surveillance of Silo 3	Radiological: Airborne radioactivity, contamination, radiation	• Use of remote cameras and windows • Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures • Workers will qualify as 40-hr HAZWOPER/Rad Worker • Protective clothing and equipment will be used as prescribed by Radiological Controls • Work area contamination levels will be kept to a minimum • RCTs will perform contamination surveys to determine work area control levels • RCT oversight • Workers will doff potentially contaminated PPE per posted instructions	FF RWP ALARA Analysis HPP SOP Pre-job Briefing
	Chemical	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with procedures • Workers will qualify as 40-hr HAZWOPER • Industrial Hygiene monitoring, as needed • Workers to wear prescribed PPE • Follow the directions outlined in the MSDS for handling cleaners, lubricants, etc. • Supervision must ensure that workers have been briefed, as necessary, on MSDSs	FCP Work Permit S&H Procedures MSDS

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX 4997

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 14 (cont.): Shift-by-shift surveillance of Silo 3	Slips, trips, and falls	• Good housekeeping practices will be followed by all personnel • Area lighting will be adequate for the type of work to be performed • If possible, avoid walking on uneven surfaces • Observe work area tripping hazards when coming to and leaving the area • Carefully place feet on stairs when ascending or descending stairway. • Always use handrails when ascending or descending stairway • Always maintain 3-points of contact when ascending/descending stairways	Briefings Walk-throughs Engineering design
	Heat stress Cold stress	• Implementation of the FCP cold/heat stress programs	Pre-job Briefing S&H Procedures SPRs
	Housekeeping	• Maintain work areas and personnel access-ways free of obstructions and debris	SPR
	Ladders and climbing	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures	SPRs

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX 4997

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 14 (cont.): Shift-by-shift surveillance of Silo 3	Head impact	• Workers will be trained to perform tasks safely • Workers will perform tasks in accordance with standard operating procedures • Head protection will be worn by personnel when the potential for falling objects or head injuries due to impact exist.	SPR
	Biological	• On-site personnel are instructed to use discretion and avoid all contact with wild animals. • If insects present a problem, insect sprays will be used to remove them. • Workers will be instructed on how to recognize poisonous plants and to avoid contact with them. When found, these hazards will be removed.	SPR
	Environmental	• In the event of adverse weather conditions, the Fluor Fernald S&H Representative will determine if operations may continue without the potential for injury to personnel.	SPR
	Illumination	• Work area lighting levels optimal for performing remote operation of excavator • Industrial Hygiene lighting surveys performed to ensure compliance	HFE SOP Standing Orders S&H Procedures

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TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX			4997
Task	**Hazard**	**Mitigators/Controls**	**Permits/ Guid. Docs**
15. Cutting a Hole in the Silo 3 Wall Structure	See the Silos Construction HASP	Hole cutting is a construction activity performed by construction labor. The associated hazards and their controls/mitigators are addressed in Silos Construction HASP [Ref. 38]). The Silo 4 mock access demonstration was performed during the construction of the retrieval facility. However, Silo 3 wall access will occur after the operations phase has begun because the plan calls for pneumatic retrieval of material behind the intended wall opening. Therefore, there will be a short window of time when operations (authorized by this N-HASP) and construction work will overlap.	See the Silos Const. HASP

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10.0 SYSTEM SAFETY REQUIREMENTS

System Safety Requirements are used to ensure project activities are maintained within the current safety envelope. The System Safety Requirements may be Safety Basis Requirements (SBRs) or Process Requirements (PRs), depending on the relative risk associated with each requirement. The following definitions apply:

- **SBRs** – A limitation for a facility, operation, or activity which is directly associated with its analyzed safety envelope and current hazard categorization or classification. Some examples of SBRs include:

  - In nuclear facilities with a SAR or a Hazard Analysis Report (HAR), the SBRs may be termed TSRs and are subject to 10 CFR 830 Subpart B.

  - Inventory threshold limits and/or dose limits established in a safety basis document. Each nuclear facility Basis for Interim Operations (BIO) states threshold limits.

  - Limitations on material types, characteristics, and unique properties, such as, pyrophoricity, corrosiveness, toxicity, reactivity, flammability, etc., as specified in the analysis.

  - Nuclear criticality safety requirements related to the direct prevention of a criticality, i.e., maintaining compliance with the double contingency principle is an SBR.

- **PRs** – PRs are developed and implemented to help ensure that SBRs are not exceeded or otherwise violated. Both SBRs and PRs establish requirements that the project must implement to ensure adequate defense-in-depth.

Silo 3 Retrieval and Disposition has been determined to qualify as a RAD Facility based on the analyses discussed in Appendix B, *Hazard Category Calculation*. Although Silo 3 Retrieval and Disposition qualifies as nuclear HC-3 based on inventory, it qualifies as RAD based on analytical consequences. Per DOE-STD-1120-98, *Integration of Environment, Safety and Health into Facility Disposition Activities* [Ref. 5], a RAD categorization/classification based on analytical consequences requires DOE approval. To provide defense-in-depth, Section 10.2 specifies System Safety.

10.1 Violation of System Safety Requirements

The requirements established by the FCP Safety Programs are relied upon to ensure that Silo 3 operations are conducted safely. Several support programs, such as the QA Program and the CONOPS Program, are relied upon to ensure that the elements of the FCP Safety Program are met. The maintenance of each of the safety programs is addressed within the associated program requirements manuals. In general, violations of FCP Safety Program requirements are addressed using QA-0001, *Fluor Fernald Nonconformance Identification and Tracking System* [Ref. 59]. The remaining discussion within this section establishes the actions to be taken following a violation of the specific requirements (i.e., SBRs and PRs).

Both SBRs and PRs establish requirements which ensure adequate defense-in-depth. Violation of an SBR or PR is subject to the requirements of SH-1006, *Event Investigation and Reporting* [Ref. 60], because a violation has a potential to degrade the Safety Basis. In the case of PRs, the requirement shall be evaluated to determine the impact to the defined SBR(s). In all cases, discovery of a violation results in appropriate notifications and an evaluation of impacts to the Safety Basis.

NOTE: Because the silos themselves are HC-3 facilities, when a potential SBR/PR violation could affect the Silos, the potential violation will be evaluated using the Safety Analysis Evaluation Process in Addendum 2 of PL-3049, *Implementation Plan for SARs and TSRs at the FEMP* [Ref. 45]. SBR/PR violations that affect the Silos are subject to the USQ process per NS-0002, *Unreviewed Safety Question (USQ) Determination and Safety Evaluation System* (USQD/SE System) [Ref. 44]. See also Section 10.3, Silos Project TSR.

Overview of the Potential Violation Response

A Silo 3 system safety SBR or PR violation occurs when there is a noncompliance with the requirement(s) listed in Section 10.2, Table 10.1. If there is a deviation from a system safety SBR or PR, activities will be placed in a safe configuration and the Assistant Emergency Duty Officer (AEDO) contacted. No further actions shall be taken until N&SS has evaluated the deviation to determine whether the project is outside the project safety envelope.

Following notification of a potential violation, project management may determine to temporarily limit the affected activities until the evaluation is completed. This limitation is defined as the "standby" mode of operations and allows time to adequately evaluate the impact of violating the requirements and to initiate corrective actions. A standby operating mode does not constitute a facility shutdown resulting from operations outside the approved Safety Basis and will not automatically require re-start authority per QA-0021, *Administration and Conduct of Standard Startup Review (SSR) Activities* [Ref. 61], to resume operations.

Once activities have been halted, N&SS personnel shall make a determination if operations have been conducted outside the Safety Basis. Operations determined to be outside the Safety Basis require a formal facility shutdown, corrective action, and restart approval. DOE-FCP has delegated to Fluor Fernald the approval authority for safety documentation and the startup and restart of Radiological and Other Industrial Facilities at the FCP [Ref. 62]. If the violation results in exceeding the delegated authority granted by DOE-FCP (e.g., hazard category greater than RAD), then the USQD/SE process shall be initiated.

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10.2 Silo 3 System Safety Requirements

The matrix in **TABLE 10-1** has been developed to identify Silo 3 System Safety Requirements, reference the origin of the requirements, and identify the method(s) of control and implementing document(s), as appropriate. These System Safety Requirements are provided for Defense-in-Depth. Table 10-1 is the requirements matrix pursuant to the DOE-approved *Decision Basis Document Implementation of 10 CFR 830 Safe Harbor Requirements for the Silos Projects,* 40000-RP-0034 [Ref. 1]. Table 10.1 identifies the requirements of the written site safety and health program and project specific requirements that relate to system safety and are relied upon for maintaining the safety envelope.

As identified in Appendix G, *Silo 3 Accident Analysis*, there are no safety class or safety-significant components associated with the Silo 3 Retrieval and Disposition Project. This is based on the fact that Silo 3-initiated accident scenarios do not yield consequences that would exceed on-site dose limits, nor was any mitigation credit taken for these systems, structures, and components in the consequence analysis. However, SBRs and PRs were developed around some components to provide defense-in-depth.

TABLE 10-1: SILO 3 SYSTEM SAFETY REQUIREMENTS

SBR, PR	Requirement	Basis/Source	Implementation
PR-1	When retrieval and packaging activities are ongoing, maintain the capability to measure Silo 3 stack concentrations of both radon and particulates, ensuring that concentrations remain within established operational parameters.	Public and Worker Protection, Environmental Protection Agency (EPA) Required	• I-Tab • 40000-PL-012, *Silos Engineering Project Execution Plan* (i.e. Silos Design Change Notice) • Operations procedures • Routine calibration and maintenance • Routine inspections • Engineering design
PR-2	Maintain the gross weight of each Sea/Land below 42,000 pounds (each shipment must meet DOT weight limits). The number of individual packages per container can vary.	Protect Hazard Categorization	• Operations procedures • Routine inspections • Engineering design • Routine calibration and maintenance
PR-3	Individual IP-2 bulk bags shall not exceed 7000 lbs. gross weight.	EBA-4 (App. G) Test Report for IP-2 Container Testing [Ref. 63]	Operating procedures

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10.3 Silos Project Technical Safety Requirement (TSR)

Technical Safety Requirements (TSRs) are the limits, controls, and related requirements necessary for the safe operation of a nuclear facility and, as appropriate for the work and the hazards identified in the documented safety analysis for the facility, includes management controls, use and application provisions, and design features, as well as a basis appendix. TSRs are subject to 10 CFR 830, Subpart B [Ref. 6].

The Silos Project has one TSR (see **TABLE 10-2**). There are no TSRs in support of the Silo 3 Retrieval and Disposition Project. However, planned Silo 3 operations and activities will be conducted within the umbrella of the Silos safety basis.

When a proposed activity could violate the Silos TSR (or potentially affect some other aspect of the Silos safety basis), the activity will be evaluated using the Safety Analysis Evaluation Process in Addendum 2 of PL-3049, *Implementation Plan for SARs and TSRs at the FEMP* [Ref. 45]. SBR/PR violations that affect the Silos are subject to the Unreviewed Safety Question (USQ) process per NS-0002, *Unreviewed Safety Question (USQ) Determination and Safety Evaluation System* (USQD/SE System) [Ref. 44].

Note: The current TSR below allows for a 700-pound live load on the silo domes. FCP has proposed an increase in this limit to 2000 pounds and is currently awaiting DOE approval. A report on increasing the allowable load limit for silo domes was prepared by an independent structural consultant specializing in concrete silos. The report concluded that the load limit of 2000 pounds proposed in Revision 2 of the TSR is justifiable [Ref. 27].

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TABLE 10-2: SILOS PROJECT TECHNICAL SAFETY REQUIREMENT (TSR)			
TSR	**Requirement**	**Basis/Source**	**Implementation**
TSR-1	There are two LCOs to protect silo dome integrity: LCO-1: No live load greater than 700 pounds, including up to three persons, other than snow, on the dome and/or dome cover. For details on further limiting conditions on loads, equipment operation, and enlargement of access ports, see 40000-H&S-0001, the OU4 TSR document [Ref. 64]. LCO-2: Approved critical lift plans shall be required. All lifting which has the potential to breach silo integrity shall be approved by Fluor Fernald. For details, see the OU4 TSR document.	Worker and co-located worker protection (AWR PHAR App. G, EBA-1)	• Silo Dome Access Permit • Critical Lift Plans • Silos Design Change Notice procedure

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11.0 TRAINING REQUIREMENTS

The *Silos Project Training and Qualification Program (TQP) Description*, TQP-067, [Ref. 65] establishes the training and qualification requirements for Silos personnel. The program's objectives are to:

- ensure that workers understand the potential hazards they may encounter.
- ensure that workers possess the knowledge and skills necessary to perform their work with minimal risk to their health and safety.
- ensure that workers are aware of the safety requirements, including the purpose and limitations of safety equipment.
- ensure that workers can safely avoid or escape from emergencies.

The program ensures that workers meet the minimum requirements of 29 CFR 1910.120, DOE Order 5480.20A [Ref. 66] (applicability as described in RM-0043, *FEMP Training Implementation Matrix* [Ref. 67], and other relevant regulations, as applicable.

Health and Safety Training

Workers will receive the appropriate training based on their scope of work. Workers performing activities which fall under 29 CFR 1910.120 [Ref. 68] will receive a required number of hours of initial and annual-refresher health and safety training for hazardous waste site operations. In addition to the initial health and safety training, workers will receive one to three days of directly-supervised field experience.

All personnel performing work under 29 CFR 1910.120 are required to be trained per RM-0055, *FEMP Access* [Ref. 69], in one of the following categories:

- Occasional Site Worker
- General Site Worker

Workers whose work scope does not require hazardous waste site operations training will receive a level of training that is specific to the type of activities to be performed and the hazards to be encountered. Personnel may not participate in field activities until they have been appropriately trained.

Job and Safety Briefings (all hazards)

Before commencement of field activities, all personnel performing fieldwork will participate in a briefing that will specifically address the activities, procedures, monitoring, and equipment used in the work. The briefing will include a description of the work to be accomplished, known hazards (all types), administrative controls, and PPE requirements. This briefing will also allow field workers to receive clarification of anything they do not understand and to confirm their responsibilities regarding safety and operations for their particular activity.

Project personnel will attend periodic safety briefings/meetings. Briefings will be conducted at the start of the day and at the start of any new task to assist site personnel in safely conducting their work. The briefings will include information on new operations to be conducted, changes in work practices, changes in the project's environmental conditions, and periodic reinforcement of previously-discussed topics. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify safety-related performance deficiencies during daily activities or as a result of safety inspections. The meetings will also be an opportunity for safety personnel to periodically update the crews on monitoring results. Before starting any new activity, an analysis of hazards will be performed and used to inform workers of the potential hazards. There will be an emphasis on particular hazards involved with each job. For example, radiological, chemical, and electrical hazards may be emphasized if pertinent for the operational work that is scheduled to be performed. Written documentation of the briefings and attendance sheets will be maintained as part of the project safety files.

Hazard Communication (chemical hazards)

Hazard communication training will be provided per the OSHA 29 CFR 1910.1200 [Ref. 70] requirements. The training shall provide workers with information on chemicals used on the Silos Project and their potential hazards. The training will be incorporated in formal instruction and/or pre-job briefings. MSDSs, labeling, and other forms of warnings will be used in conjunction with the training to foster worker awareness.

Classes of Silos Personnel and their Training and Qualification Requirements

Management qualifies personnel for a position based on the individual's education, experience, training, and performance. The term "qualification" has a different meaning for each position and may be executed in different ways. There are four primary classes of personnel associated with the Silos Project:

- Fluor Fernald, Inc., Employees: Position descriptions list the applicable selection criteria, including the education and experience requirements, for these Fluor Fernald Employees. TQP-067, *Silos Projects Training and Qualification Program Description* [Ref. 65], identifies training requirements. TQP-067 may identify additional training and requirements, for some personnel, by referring to other Training and Qualification Program Descriptions. The applicable Description will identify the method used to qualify an individual for each position. Methods range from formal qualification to being considered qualified by meeting the hiring criteria.

- Staff Augmentation Personnel: The applicable position requisition and justification documents identify the selection criteria for Staff Augmentation Personnel. TQP-067 identifies training requirements. TQP-067 may identify additional training and requirements, for some personnel, by referring to other Training and Qualification Program Descriptions. The applicable Description will identify the method used to qualify an individual for each position. Methods range from formal qualification to being considered qualified by meeting the hiring criteria.

- Construction/Maintenance Subcontract: Each subcontract identifies the personnel selection criteria (if applicable). The criteria may include education and experience requirements. The subcontract identifies the training requirements for Subcontract Personnel. These requirements are based on the hazards of the work. If qualification is necessary, the subcontract will identify who should be qualified and what qualification method should be used.

- Support Personnel Assigned for Tasks: Support Personnel will support the project periodically for short periods to provide distinct services. Those personnel shall be selected, trained, and qualified per the applicable Training and Qualification Program Description(s) for the services they provide. The supervisor who assigns the individual to work with the Silos Project must ensure that the individual is current in the applicable training requirements identified in RM-0055, *FEMP Access*, [Ref. 69] and all applicable work permits. Personnel will be briefed on the N-HASP and the Construction Safety HASP, if applicable. Personnel shall receive the applicable Pre-Job and RWP briefings, as required. Prior to the start of work, Silos Project Management will ensure that personnel have been trained as specified in the work permits.

Silos Vendors and Visitors

Silos vendors and visitors will not have unescorted access to the Silos Project site. Vendors and visitors will be briefed per this N-HASP commensurate with their planned activities.

12.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Fluor Fernald provides PPE to the Fluor work force in order to protect them from the various hazards present in the work place. **TABLE 12-1** lists most of the PPE issued to workers at the Silos. Other types of PPE may be required and issued for certain tasks. Levels of protection are subject to change based on air monitoring data, radiological data, and other types of work-area monitoring data. For more information on what PPE to use for a work activity, consult the current RWP, Work Permits, Work Plans, and procedures. RCTs and Fluor Fernald S&H Representatives will provide guidance when needed.

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TABLE 12-1: PERSONAL PROTECTIVE EQUIPMENT (PPE)		
Type of Protection	**PPE Name**	**PPE Use**
Respiratory Protection (See Fluor Fernald Respiratory Protection Program [Ref. 71])	Air Purifying Respirator (APR)	For potential airborne contamination, provides a protection factor of 50 (see Note 1)
	Powered Air Purifying Respirator (PAPR) (full-face, tightly-sealed)	For potential airborne contamination, provides a protection factor of 50 for chemical and 1000 for some radionuclides (see Notes 1 and 2)
	Self Contained Breathing Apparatus (SCBA)	For potential airborne contamination, provides a protection factor of 10,000
	Air Line Respirator	For potential airborne contamination, provides a protection factor of 1000
Eye Protection	Safety Glasses with side shields [American national Standards Institute (ANSI) Z-87 approved]	Required for site access and all site activities
	Face shield	Where splash hazard exists
	Cutting goggles (or equivalent cutting shield for use with respiratory protection)	For torch cutting operations.
	Welding Helmet (or equivalent welding shield for use with respiratory protection)	For welding operations

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TABLE 12-1: PERSONAL PROTECTIVE EQUIPMENT (PPE)

Type of Protection	PPE Name	PPE Use
Hand Protection	Nitrile gloves Leather Palm Gloves Long Leather Gloves (Gauntlets)	Ferrous sulfate Concrete work Sharp edges
Head Protection	Hard Hat (ANSI Z-89 approved)	Required where posted
Foot Protection	Steel-toed boots	Required for all site activities
	Latex overboots	For protection against contamination
	Rubber overshoes	For secure footing in contamination area
	Polyethylene booties	Inner liners. Do not use as outer foot ware.
	Cloth Anti-C Booties	Inner liners. Do not use as outer foot ware.
Skin Contact Protection	Cloth Anti C Coveralls with Hood	For contamination protection
	Tyvek Coveralls with Hood	For contamination protection
	Poly-Coated (Yellow) Tyvek with Hood	For splash protection
	Saranex Coated Tyvek with hood	For heavier splash protection and acid splash
	PVC Coveralls (or overalls with jacket)	For use with acid(s) and caustic solutions
Hearing Protection (See Fluor Fernald Hearing Protection Program [Ref. 72])	Ear Plugs	Use for noises greater that 85 dB (do not exceed rating)
	Ear Muffs (head phones)	For use in conjunction with ear plugs (see Note 3)

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TABLE 12-1: PERSONAL PROTECTIVE EQUIPMENT (PPE)		
Type of Protection	**PPE Name**	**PPE Use**
Fall Protection (See Fluor Fernald Fall Protection Program [Ref. 73])	5-point body harness and lanyard	For use where installed fall protection (i.e., railings) is inadequate
	Beam strap	To create a secure tie-off point at a secure location such as a steel beam.

Note 1: In order to be effective, the cartridge used must be able to filter, absorb, or adsorb the contaminant of concern. Consult RWP, Permits, Plans, MSDS(s), and/or with S&H Representative for more information.

Note 2: PAPRs provide a protection factor of 1000 for some radionuclides (i.e., particulates, which would include Thorium-230). Consult the RWP or Radiological Control for more information.

Note 3: Headphones have a lower noise-reduction rating than earplugs, plus wearing hoods and other anti-contamination clothing can further reduce their effective noise rating.

13.0 MEDICAL SURVEILLANCE

Per 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response*, all personnel assigned to an FCP project and performing actual tasks are required to participate in the Fluor Fernald medical monitoring program.

Medical approval must be received prior to performing work. If an outside medical resource is used to provide any portion of the monitoring program, the individual must receive prior written authorization from Fluor Fernald, which has final approval authority for external medical monitoring programs. Fluor Fernald will provide a list of pre-approved outside medical resources upon request. Fluor Fernald Medical Services will provide minimum requirement protocols for their employees. Medical documentation showing that personnel meet minimum requirements shall be submitted in a sealed envelope marked "SENSITIVE" to the Fluor Fernald Medical Director, Mail Stop 30, with a copy of the transmittal sheet to FCP Document Control.

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General Programs

Workers identified as hazardous waste site workers will be required to undergo medical examinations. Supervisors should make employees available for such examinations.

Special medical (health hazard) monitoring requirements as prescribed by 29 CFR 1910, *Occupational Safety and Health Standards*; 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response*; other federal, state, or local statutes; and specific site HASPs, may be fulfilled by sources outside of Fluor Fernald (e.g., lead and associated tests). Documentation (e.g., copies of medical examinations, laboratory tests, biologic monitoring reports) shall be provided to the Fluor Fernald Medical Director, as specified above. Biological monitoring requirements will be based on the hazardous chemical identified through monitoring.

No food or drink shall be consumed after 11PM prior to scheduled medical pre-assignment monitoring.

Workers shall report any open wounds prior to entry into a Controlled Area. Workers with wounds that cannot be covered are restricted from working in Radiological Areas.

Use of Prescription Medicine

- Non-prescription medicine shall not be taken into Controlled Areas with the single exception of Glucose Tablets which may be taken by diabetics. Employees needing Glucose Tablets shall register with the Fluor Fernald Medical Department.

- Prescription medicine will only be recognized as legitimate for on-site use after the employee to whom the medicine is prescribed registers the medicine with the Fluor Fernald Medical Department.

- In the event of an emergency, an employee may take prescription medicine on the spot, regardless of the area in which he or she is standing. If medicine has been taken under these conditions, the employee should contact Fluor Fernald to determine what action, if any, will be required of the employee in regard to dosimetry.

Employees receiving medical treatment with radio-pharmaceuticals will be restricted from entering Controlled Areas until such time as the radio-pharmaceutical has cleared sufficiently from his/her system so that frisking with a PCM at the control point does not trigger the alarms. Employees receiving such treatment shall report to Fluor Fernald Medical Services beforehand so appropriate precautions can be taken. Employees who have received treatment with radio-pharmaceuticals shall report to Medical immediately upon returning to work.

Pregnant employees should report to Fluor Fernald Medical. The employee will be informed of risks related to her pregnancy as a result of working on the Contract. The employee may "Declare Pregnancy" per 10 CFR 835 [Ref. 52]. If declared, Fluor Fernald will ensure that the employee's TLD is read monthly (as opposed to quarterly). Fluor Fernald's administrative control limit is 50 mrem/month or 400 mrem/gestation period.

Medical Services 4997

The project N-HASP, Work Plans, Work Permits, and RWPs contain information on project-specific hazards to which workers may be exposed.

The Fluor Fernald Medical Department has the following Medical Monitoring Programs in place for workers with potential exposures (including all of the laboratory, x-ray, and other testing ordinarily included in the Biologic Monitoring Program):

- Asbestos Worker
- Hazardous Waste Worker (including radiation)
- Lead Worker (and other heavy metals)
- Hearing Conservation

Some workers are required by regulation to be entered into a long-term Health Surveillance Process Program. Other standards of care/practice in Industrial Hygiene, Occupational Medicine, or Health Physics may also dictate special testing or programs for some workers. Air sampling for various Silo 3 constituents (e.g., beryllium) may identify additional medical monitoring if airborne concentrations indicate high airborne levels.

The Fluor Fernald Medical Director will be the final authority to determine the fitness of any worker or his/her suitability to perform work and be exposed to any of the various hazards at the FCP.

14.0 MONITORING

NOTE: This discussion excludes radiological contamination monitoring, which is discussed in Appendix H, *Health Physics Plan*.

A comprehensive air sampling program is essential for evaluating the hazards of work situations with the potential for worker exposure to hazardous substances. In many instances, air sampling data can also provide the basis for development and evaluation of control procedures, and can indicate whether or not operational changes are necessary to provide adequate protection of affected personnel. Air sampling data will be used to define airborne concentrations so that, if necessary, timely additional engineering or administrative controls can be implemented, and to verify that appropriate PPE has been assigned.

Air-contaminant exposures may be created: (1) during the removal of materials from Silo 3; (2) when Silo 3 materials are loaded into containers; (3) when loading containers for transport; and (4) when maintenance activities are performed on Silo 3 equipment. Air-contaminant exposure monitoring will be performed when there is a potential for exposure at or above ½ the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values-Time Weighted Average (TLV-TWA) [Ref. 74] or OSHA Permissible Exposure Level-Time Weighted Average (PEL-TWA) (action level) [Ref. 75], whichever is most restrictive. Personal sampling shall be conducted on the personnel involved in the task with emphasis on those employees with the greatest risk of exposure. Samples will be collected in the workers' breathing zone.

The Silos Project follows established air monitoring requirements as prescribed in the Fluor Fernald site procedures, the National Institute of Occupational Safety and Health (NIOSH) Analytical Methods, and the OSHA and ACGIH Exposure Criteria. Proper implementation of these requirements is necessary to assess the levels of hazardous contaminants in the atmosphere of the working environment.

The approach used is an integrated one that uses real-time air monitoring equipment in conjunction with personal and general area air sampling:

- Real-time Instruments can give immediate data on the levels of contaminants (without specifying which contaminants are being monitored), volatile chemicals, oxygen, and carbon monoxide. Additional qualitative and quantitative information on specific chemicals can be obtained through the use of colormetric (Draeger™) tubes, but they have limited accuracy. However, sulfuric acid Draeger™ tubes may be used since real-time instruments are not available for this contaminant.

- Personal and General Area air sampling can give more specific and accurate data on the levels of individual components of the atmosphere. However, the samples must be sent to a lab for analysis and the results are not immediately known. See Section 8.19 for further discussion of personal air sampling and the chemicals of concern.

TABLE 14-1 lists the various types of real-time air monitoring equipment used at the Silos, the associated action levels along with the response action(s), the various PELs and TLVs and the response actions if the PELs or TLVs are exceeded. The response to a detection by a colormetric (Draeger) tube will vary based on the chemical. Ordinarily, the use of a colormetric tube will be integrated with another real-time method such as a Photo Ionization Detector (PID).

TABLE 14-1: REAL-TIME IH AIR MONITORING EQUIPMENT, ACTION LEVELS, AND RESPONSES

Monitor	Action Level	Action to be taken	PEL or TLV	Response
Oxygen	Greater than 23.5% or less than 19.5%	• Evacuate area • Investigate • Upgrade to SCBA or supplied air protection respirator for re-entry	NA	NA
Combustible Gas Indicator (CGI)	$\geq$ 10 %	• Immediately stop all hot work activity • Evacuate area • Investigate	NA	NA
Carbon Monoxide	$\geq$ 12.5 PPM	• Investigate source and mitigate • Ventilate area	25 PPM	• Evacuate area • Ventilate area

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TABLE 14-1: REAL-TIME IH AIR MONITORING EQUIPMENT, ACTION LEVELS, AND RESPONSES

Monitor	Action Level	Action to be taken	PEL or TLV	Response
Photo Ionization Detector (PID)	≥ 10 PPM	• Investigate source and mitigate	PEL or TLV	At a minimum, wear chemical cartridge respirator
Colormetric (Draeger) tubes	≥ ½ PEL	Various. Typically: • Investigate source and mitigate	PEL	Various. Typically: • Evacuate area • Upgrade level of protection, as appropriate

Noise monitoring and illumination-level surveys may also be performed during Silo 3 maintenance and operations activities. Noise monitoring will be conducted per OSHA 29 CFR 1910 [Ref. 75]. Workers utilizing equipment capable of generating hazardous noise levels and/or working in areas with potential hazardous noise levels will be evaluated to determine exposure levels and the necessary controls. Also, areas with suspected high noise levels shall be evaluated to identify high noise sources and to aid in determining engineering and administrative controls.

Illumination surveys will be performed and illumination levels will be maintained per 29 CFR 1910 [Ref. 75] and Illuminating Engineering Society of North America (IES) guidelines [Ref. 76]. Supplemental lighting sufficient to meet the regulatory guidelines shall be provided, as necessary.

Data Quality Assurance

All instruments (air, noise, heat/cold, and illumination) shall be calibrated as specified by the manufacturer. Duplicate readings may be taken to confirm individual instrument response. Also, all instruments will be maintained in good working order as specified by the manufacturer. Air-sampling pumps used to collect worker-exposure samples shall be calibrated before and after sample collection. Calibrations shall be accomplished using a primary standard calibration system. Results of the calibrations shall be included on air-sampling data sheets. Calibration of noise-monitoring equipment will be performed per manufacturers' guidelines. Results of the calibrations shall be included on noise-survey data sheets.

Data Review

S&H personnel shall review the analytical results to evaluate the potential for worker exposure, upgrade/downgrade of protection limits, and changes in sampling/monitoring strategy. Reports and correspondence will be generated per procedure 602-5024, *Industrial Hygiene Air Sampling Program* [Ref. 77].

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Laboratory Analysis

Chemical analysis of samples collected for assessment of employee exposures shall be performed only by analytical laboratories accredited by the American Industrial Hygiene Association. The laboratory analysis will include field blanks, as required by the individual method or laboratory. Duplicate samples or splits with other laboratories may be used during the project. The laboratory shall also be a successful participant in the Proficiency Analytical Test (PAT) program for the category of material they are analyzing.

15.0 DECONTAMINATION PLAN

The Silos Project is a hazardous waste remediation project. Any person working in an area where the potential for exposure to project contaminants exists will only be allowed access after providing evidence of proper training and proper medical documentation.

During the conduct of Silo 3 activities, various work areas will be established. Entrances to, and perimeters of, Radiological Areas will be defined by yellow snow fencing and/or yellow-and-magenta rope. All radiological areas will be identified by signs having the standard radiation symbol (the tri-foil) on a yellow background and inserts describing the reason for the boundary and the controls necessary for entry.

Personnel Decontamination

Any circumstance that could have resulted in an intake of radioactive materials by inhalation, ingestion, absorption, or injection shall be immediately reported to a supervisor. The supervisor shall immediately report the circumstance of possible radioactive materials intake to an RCT for evaluation. Radiological Control/Medical will determine further actions.

If radioactive contamination is detected on the skin or clothing, contact an RCT immediately. When performing personnel contamination monitoring with automated instrumentation such as a PCM or a Hand and Foot Monitor (HFM), all alarms must be reported to an RCT for an evaluation before proceeding from the area. When performing manual personnel surveys with portable instruments (friskers), detection of a net count rate exceeding Fluor Fernald limits specified in the RWP should alert personnel of possible contamination.

Depending on the nature, location, and extent of the personnel contamination, Radiological Control may direct the contaminated personnel to initiate a bioassay analysis to assess a potential internal radiation dose from possible inhalation, ingestion, absorption, or injection of radioactive materials.

Decontamination of radiological and some chemical contaminants may be required during the conduct of Silo 3 operations. This will be accomplished by the use of or a combination of HEPA-filtered vacuum units, wet-wiping techniques, approved detergents or soaps, or the use of sealants or fixatives when immediate decontamination is not feasible or practical. Decontamination areas will be established for personnel decontamination and equipment decontamination.

Any circumstance that could have resulted in an intake of radioactive materials by inhalation, ingestion, absorption, or injection shall be immediately reported to a supervisor. The supervisor shall immediately report the circumstance of possible radioactive materials intake to an RCT for evaluation. Radiological Control/Medical will determine further actions.

In the unlikely case of body contact with an acid or caustic agent, non-permeable PPE should be doffed with extreme caution to prevent contact with the skin. Contaminated inner clothing shall be removed. The affected body area shall be washed thoroughly (15 minutes minimum) in a safety shower or eye bubbler in the case of a splash into the eye(s). Involved personnel shall report immediately to their supervisor and Medical.

In many cases, chemical contamination can be removed by physical means involving rinsing, wiping off, or vacuuming. Additional efforts to decontaminate may include the use of mild soap and/or soft-bristle brushes. Efforts shall be made to prevent loose chemical contamination from entering body openings and to prevent breaking the skin barrier. If the skin barrier is removed or breached during decontamination, medical assistance will be sought. Sensitive areas such as eyes, body cavities, or wounds are more difficult to decontaminate and will be dealt with by Medical.

If immediate medical treatment is required to save a life, decontamination will be delayed until the victim is stabilized.

Equipment Decontamination

If equipment becomes contaminated during a Silo 3 operation or maintenance activity, Radiological Control personnel will establish an area to perform the necessary decontamination. The area configuration will be based on the actual size of the equipment, levels of contamination, dispersability of the contamination, and the methods for performing the decontamination.

For chemical decontamination, efforts will be made to avoid coming into contact with the contaminated equipment. Standing or walking through pools of liquid will be discouraged. Objects may be encapsulated with plastic sheeting or other material to prevent contact with contaminated items. Physical removal methods for chemical contamination may include using water with a mild soap, vacuuming, scraping, brushing, and wiping. Surfactants, such as detergents, may be used to augment physical cleaning methods by reducing adhesion forces between chemical contaminants and the surface being cleaned, and by preventing redeposit of the contaminants.

16.0 EMERGENCY RESPONSE PLAN

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The Silos Emergency Plan has been developed to cover extraordinary conditions that might occur at the Silos and is to be used in conjunction with Fluor Fernald Site Emergency Action Plan.

Silos project personnel have the responsibility to be aware of the actions required of them under all site emergency procedures. However, there are two emergency procedures that require particular emphasis:

- EM-0020, *Building Emergency Procedure* [Ref. 78]
- EM-0030, *Silos Area Emergency Procedure* [Ref. 79]

EM-0020 provides details for standard emergencies (e.g., Fire, Severe Weather, Bomb Threat). EM-0030 provides detail for actions to be taken in the event of a potential significant release of radon from Silos 1 or 2.

Reporting

TABLE 16-1 lists the emergency numbers that shall be used to report emergencies at the Silos:

TABLE 16-1: FCP EMERGENCY NUMBERS

EMERGENCY RESOURCE	FCP PHONE EXT.	NON-FCP PHONE/CELL	RADIO
Ambulance	911	513-648-6511	Control
Hospital	911	513-648-6511	Control
Fire	911	513-648-6511	Control
Security	911	513-648-6511	Control
Emergency Response	911	513-648-6511	Control
Assistant Emergency Duty Officer (AEDO)	4749 4444	513-648-4749 513-648-4444	202/Control

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Site Notification Procedures

All emergencies shall be reported to the Fluor Fernald Communication Center to ensure rapid response. Whenever personnel are working, a means to report emergencies shall be available at all work locations. This may be accomplished by one or more of the following methods:

- Dial 911 on any site phone
- Dial 513-648-6511 on cell phones or any non-FCP phone
- Activate any fire alarm station
- Radio to Control

Any injury, no matter how minor, shall be reported to FCP Medical Department for evaluation or treatment. The injured party shall be accompanied by the supervisor in charge or his designee. The Silos S&H Representative shall be notified as soon as possible after the injury/accident has occurred.

Personnel will be notified of emergency or abnormal conditions by the plant-wide alarm system and radio announcements. Announcements follow the sounding of the site alarm horn signal. Emergencies may also be announced by fire-alarm pull stations, which are programmed to alarm locally and at the Emergency Operations Center.

What to Report

The following are examples of emergencies that justify calling and reporting:

- Serious Injury
- Injury Complicated by Contamination
- Hazardous Waste or Hazardous Substance Emergency
- Radiation/Contamination Release
- Chemical Splash (Eye and Skin)
- Chemical Spill
- Any Fire
- Property Damage
- Adverse Weather Conditions
- Unusual Occurrences
- Loss of Containment
- Loss of Utilities

When an emergency or abnormal condition is observed, personnel shall contact the Communications Center at extension 911 or via radio (Control). Stay on the phone line until the dispatcher hangs up. The following information must be given to the Communications Center Operator:

- Name
- Badge Number
- Location of emergency
- Nature of emergency

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- Number of personnel with injuries
- Unusual conditions (odors, symptoms, vapors, smoke)
- Current status of the emergency

Evacuation Routes

Should a situation require an emergency evacuation of the work areas, all equipment should be shut off (if possible) and left in place. Personnel should immediately proceed to primary Rally Point 4 (on the west side of the 30/45 parking lot). The back-up rally point is Rally Point 6 (near the west water tower).

Emergency Response

FCP Emergency Services will handle all emergencies. Any request for emergency help should be requested by telephone (911) or on any FCP radio frequency by calling Control.

Medical Emergencies

The FCP Medical Facility (located at Trailer T-195) is staffed and equipped to handle most types of medical emergencies. The Medical facility is staffed with Emergency Medical Technicians (EMT) and is equipped with an ambulance to transport injured personnel to the nearest off-site hospital should extended or specialized medical treatment be necessary. During the off-shifts, Emergency Response Team (ERT) personnel may direct serious medical emergencies to a local hospital emergency room.

Fire Emergencies

All work sites shall maintain effective communication to summon fire-fighting assistance. Access to work areas shall be maintained at all times to permit fire trucks and fire-fighting crews to safely approach the fire emergency.

Only trained personnel shall attempt to operate any fire-fighting equipment and only when the fire is clearly within the capability of the fire-fighting equipment.

The FCP ERT will also respond to all on-site fire emergencies. For any fire at the FCP, call 911.

Explosion Emergencies

When an explosion has occurred, the following actions are to be taken:

1. Activate the closest fire alarm, if possible. If a fire alarm is not available, notify other employees by an alternate method (call the Control Room, x 5492).

2. Evacuate the work area.

3. Proceed to the appointed rally point. 4997

   NOTE: The primary rally point is Rally Point 4 (on the west side of the 30/45 parking lot). The back-up rally point is Rally Point 6 (near the west water tower).

4. If qualified, render first-aid to any injured personnel.

5. Instruct all persons in transit to avoid the work area and surrounding area.

6. Contact Control by radio or by phone (911).

7. Call for medical assistance, if necessary.

8. Report to your supervisor for accountability.

Chemical Emergencies

Splashes

Flush the affected area for 15 minutes and report to Medical Services. Remember to always follow the MSDS guideline.

Personal Contamination (Chemical)

When contaminated with a corrosive or caustic material, flush the affected area with clean water for 15 minutes. Report to Medical Services. The injured party shall be accompanied by the supervisor in charge or his designee. The Silos S&H Representative shall be notified as soon as possible after the injury/accident has occurred.

All instances of personal chemical contamination shall be reported to Silos S&H Representative and the AEDO.

Any situation which could have resulted in the inhalation, ingestion, or absorption of a hazardous material shall immediately be reported to supervision and the Silos S&H Representative and the AEDO, who will report the circumstances to Medical Services. The involved personnel shall be directed by the AEDO or Supervision as to when and where to report for medical evaluation, completion of an Incident Investigation Report, and submission of bioassay samples (e.g., blood, urine).

Radiological Emergencies

Radiological Releases

For all radiological releases, the release area shall be evacuated. The Supervisor in charge, AEDO, RCTs, and a Silos S&H Representative shall be notified of the release.

If a silo dome failure occurs on one of the domes, all work shall be stopped in the Silos area, and the actions of EM-0030, *Silos Area Emergency Procedure* [Ref. 79], shall be followed.

Hazardous Waste/Substance Emergencies

Uncontrolled Hazardous Waste or Hazardous Substance Release

Under 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response,* an emergency exists when a site experiences an occurrence that results in, or is likely to result in, an uncontrolled hazardous waste or hazardous substance release, causing a potential health or safety hazard that cannot be mitigated by personnel in the immediate work area where the release occurs. In the case of an emergency, trained responders from the Fluor Fernald Emergency Response Organization will be relied upon for response.

Silos Project personnel will assist Fluor Fernald Emergency Response by providing detailed information regarding the emergency and any technical input needed to ensure the safety of the responders, the public, and the environment.

Incidental Release of Hazardous Substances

Under 29 CFR 1910.120 (a) (3), responses to incidental releases of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area, or by maintenance personnel, are not considered to be emergency responses within the scope of HAZWOPER. Responses to releases of hazardous substances where a potential health or safety hazard (i.e., fire, explosion, or chemical exposure) does not exist are considered to be non-emergency responses.

Management will ensure that only qualified personnel, trained in incidental release clean-up under the Hazard Communication Standard, will respond to incidental releases. These personnel are not considered emergency responders.

Spill Response

In order to prevent the spread of contamination from spills of hazardous chemicals, Fluor Fernald has provided the following controls for the Silos. In most instances, spills should be cleaned up quickly before they become larger or contaminate larger areas. Large spills should only be handled with the assistance of the FCP Emergency Response Team.

- Engineering Spill Controls: Secondary containment will be provided for any acid and caustic storage tanks determined to be necessary. Fuel cells are double-walled for containment of leaks. Floor areas are sloped to allow spilled materials to be collected in containment sumps.

- Administrative Spill Controls: Spill control kits will be placed in strategic areas. Specific spill-response steps are provided in the appropriate Fluor Fernald procedures. Only personnel trained in performing spill response should attempt to implement these procedures.

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General Spill Guidelines

The following guidelines are provided as basic information on spill response. These guidelines would apply to any spill potentials envisioned for the Silo 3 Project. Consult the applicable procedure, MSDS, or Work Plan for detailed spill response guidelines:

1. Before the task begins, review and be familiar with the MSDS or appropriate document for the chemical to be used.

2. Before the task begins, note the location(s) of the nearest spill kit(s) and ensure they are adequately stocked.

3. In the event of a spill, remove personnel from the area, as appropriate.

4. Contact your supervisor.

5. If the spill is large enough, it may require the assistance of the FCP Emergency Response Team. The supervisor shall contact them.

6. Barricade the spill area by the use of caution tape or another appropriate method.

7. Before entering the spill area, assure that the appropriate air monitoring has been performed.

8. Before entering the spill area, upgrade the level of protection, as necessary.

9. Prevent the spill from spreading any further by containing it with absorbent "socks," pads, or any compatible material.

10. Clean the spill by moving from the less-contaminated areas to the more-contaminated areas.

11. After cleaning the area, ensure that the area is safe for entry by use of air monitoring or other appropriate method before removing the barricade.

12. After cleaning the area, contain and dispose of the spilled material and PPE appropriately.

Post-Emergency Response

Post-emergency response is defined under HAZWOPER as that portion of an emergency response performed after the immediate threat of a release has been stabilized or eliminated and cleanup of the site has begun. Making this distinction is critical because, among other things, different training requirements and different exposure levels may apply depending on the phase of response. If post-emergency response is performed by personnel who were part of initial emergency response, it is considered to be part of the initial response and not post-emergency response.

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Weather Limitations/Adverse Conditions

Any outside work will be suspended if warnings for high winds, lightning, or tornadoes are sounded. Any operations utilizing cranes or personnel working on elevated steel will be suspended if wind velocity reaches 25 mph.

Personnel will assemble in the Maintenance Facility [formerly the Vitrification Pilot Plant (VitPP)] when severe weather approaches and/or signaled to do so via the Emergency Message System.

17.0 OCCURRENCE REPORTING

DOE's Occurrence Reporting Program provides timely notification to the DOE Complex of events that could adversely affect: public or DOE worker health and safety, the environment, national security, DOE's safeguards and security interests, functioning of DOE facilities, or the Department's reputation. DOE analyzes aggregate occurrence information for generic implications and operational improvements. The Program and its data system, the ORPS, are described in DOE Order 232.1A [Ref. 80] and its associated manual, DOE Manual 232.1-1A [Ref. 81].

DOE Order 232.1A arranges occurrences into ten groups that relate to DOE operations. These ten groupings are used solely for ease of reference and do not represent program requirements. The categories of occurrences are designed to be generic. The ten groups of categorized occurrences are:

1. Facility Condition
2. Environmental
3. Personnel Safety
4. Personnel Radiation Protection
5. Safeguards and Security
6. Transportation
7. Value Basis Reporting
8. Facility Status
9. Nuclear Explosive Safety (not applicable at the FCP)
10. Cross-Category Items

Implementation of ORPS at the FCP is performed by the Occurrence Reporting Team (ORT) of the Safety & Health Department, SH&Q Division, per SH-0028, *Occurrence Reporting* [Ref. 42] and SH-1006, *Event Investigation and Reporting* [Ref. 60].

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18.0 MAINTENANCE MANAGEMENT

The Fluor Fernald *Maintenance Implementation Plan (MIP)*, PL-3080, constitutes an agreement among the DOE Ohio Field Office, DOE-FCP, FCP (formerly the FEMP), and Fluor Fernald, Inc., on the implementation of the requirements of DOE Order 4330.4B, *Maintenance Management Program* [Ref. 82]. The MIP defines the programs and procedures in place to address the elements of the order at the FCP. The seven guiding principles and five core functions of Integrated Safety Management are incorporated in maintenance planning and execution.

The MIP addresses implementation of programmatic requirements and provides a listing of implementing documents and procedures. A graded approach, consistent with DOE Order 4330.4B guidance for nonreactor nuclear facilities, is used to define the depth of detail required, and magnitude of resources expended for, Fluor Fernald maintenance management elements commensurate with each element's relative importance to safety, environmental protection and compliance, safeguards and security, property preservation, fulfillment of the programmatic mission, and/or other facility-specific requirements. The Fluor Fernald maintenance management program policy states that all DOE property must be maintained in a manner which promotes operational safety, worker health, environmental protection and compliance, property preservation, and cost-effectiveness while meeting the programmatic mission. Structures, systems, and components that are important to safe operation will be subject to a maintenance program in order to meet or exceed their design requirements throughout their life.

A master equipment list of structures, systems, and components identified for tracking at the FCP is maintained in a computerized maintenance management database called the TabWare System. This listing has been graded in accordance with site engineering procedure ED-12-4015, *Performance Grading* [Ref. 83], which provides guidance for applying a performance grade to all components on the equipment list. The performance grade then establishes the basis for applying a graded approach to the level of review and documentation necessary for implementing maintenance and safety requirements. The TabWare System is the management system used to plan, schedule, track, store, review, and analyze data for work requests/orders.

The Silos Project will follow the MIP and MT-0003, *FEMP Work Request/Order Procedure* [Ref. 84], for the conduct of maintenance. The Silos Operations and Maintenance Group will provide oversight, first-line supervision, and utilize FAT&LC personnel to perform maintenance activities. The maintenance organization will use maintenance reference guides to provide a systematic approach in analyzing maintenance requirements for planning, scheduling, coordination, and overseeing the completion of maintenance activities for the project. The Silos Project will develop preventive maintenance and standard repair maintenance procedures that will be incorporated in the TabWare System. In addition, the project will establish a spare parts list and inventory and will be responsible for the performance of required calibrations.

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19.0 QUALITY ASSURANCE PROGRAM

Fluor Fernald's *Quality Assurance Program (QAP),* RM-0012 [Ref. 85], is based on the appropriate criteria and requirements specified in 10 CFR Part 830 Subpart A, *Quality Assurance Requirements* [Ref. 86]. This QAP, approved by DOE Letter DOE-0359-03 [Ref. 87] dated May 5, 2003, establishes quality assurance requirements for the conduct of activities, including items or services, that affect or may affect nuclear safety of DOE nuclear facilities. The QAP establishes the QA requirements for Fluor Fernald and all other contractor and subcontractor organizations performing work at the FCP. The QAP identifies and describes the integral elements of the QA activities that apply to the broad spectrum of work performed at the FCP.

The QAP, along with its associated policies and procedures, establishes a system for achieving or exceeding the required quality levels for FCP activities. Where, and to the extent that, activities must be controlled and performed in specific manners or steps, procedures and work instructions will be used with a level of specificity appropriate to the importance or hazard of the activity. Personnel will be trained to these procedures and instructions and will be expected to follow them exactly. In the event that personnel believe that procedural compliance is unwise or unsafe, they will stop work at a position of process safety and stability and resolve the concerns with appropriate supervision. Procedural changes will then be made, as appropriate, to continue work.

Major Silos work activities include remedial actions, construction, decontamination and decommissioning, program management, and support activities. Project planning, design, and execution are performed in compliance with applicable QA and safety and health regulations, and Fluor Fernald, Inc. policies and procedures using a balanced approach. Silos Quality Assurance management coordinates independent QA assessments and QC inspections and surveillances including review and approval of document submittals and Title III inspection of construction activities. QA personnel are certified/qualified/trained to perform assigned activities, as required.

A special QA program plan has been developed for the Silos Project. The *Quality Assurance Job Specific Plan for the Silos Project*, 40000-QA-0001 [Ref. 88], describes the programs and procedures needed to achieve and verify quality for the Silos Project. These programs and procedures implement the applicable broad requirements of the QAP and define specific implementation strategy, tailored to achieve and verify quality in design, construction, closure, monitoring, and documentation.

For record purposes, the basic requirements of DOE Order 414.1A, *Quality Assurance* [Ref. 89], and 10 CFR Part 830 Subpart A are identical. 10 CFR Part 830 Subpart A is intended to supersede the existing requirements in DOE Order 414.1A. Approved management programs based on DOE Order 414.1A will meet the requirements of 10 CFR Part 830 Subpart A.

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