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EFFECTIVE DATE	PCN NO.	REV. NO.	DESCRIPTION
Approved 07-12-04	1	1	(18) Section A-2.1, *Silo 3 Facility*, to add information on the ISA; (19) Section A-2.3, *Description of the Silo 3 Project*, to clarify the loading process and discuss reject packages; (20) Table A.4-1, to add containers and forklifts to Item 2f, and to add Items 6j and 12b to hazards; (21) Section A-5.1, *Analysis of Final IHA Table*, to add "by natural phenomena" to "Breach of a DOT package"; (22) Section B-1.0, *Introduction*, to change "storage" to "staging"; (23) Section B-1.2, *Segmentation*, to clarify that cargo containers can be stored in other areas besides the ISA; (24) Section B-1.3, *Bounding Accidents*, to discuss NPH; (25) Table B.1-1, Item C1, to add NPH to bounding hazards; (26) Section B-3.1, Preliminary Hazard Categorization, to update the Process Building inventory; (27) Section B-3.2.1, *Material at Risk*, to clarify MAR; (28) Appendix D, *Executive Summary*, to update dose data; (29) Section D-5.4.1, *Operations*, to clarify personnel involved in operations; (30) Appendix D, to add new Section D-5.4.3, *Inspection of Packaged Material Staged for Transportation*; (31) Table D.5-1, to add entry for "secure, inspect, stage, and load cargo containers," and to add related dose data; (32) Section E-4.0, *References*, to transfer ownership of Jacobs calculation 40430-CA-0003 to Fluor Fernald and update to Rev. 3 (which reflects more recent headspace radon concentrations), and to add new calc 40430-CA-0027, and to add new analysis SD-2089; (33) Section G-2.1, *Basic Calculation Method for Solids Release*, to add parameters for high wind event; (30) Table G.2-1, to add high wind event; (34) Section G-3.0, Accident Analyses, to add new EBA-6 and EBA-7; (35) Appendix G to add new Section G-3.6, *EBA-6: ISO Falls* and G-3.7, *EBA-7: ISO Penetrated*; (36) Tables G.4-1 and 4-2 to add EBA-6 and –7; (37) Appendix G to add Attachment 6 to include spreadsheet for EBA-6, and to add Attachment 7 to include spreadsheets for EBA-7; (38) Section H-7.2, *Entering the Silo 3 Project Area*, to state that the Project Area includes the interim staging areas; (39) end of Volume 2 to add DOE SER.

EFFECTIVE DATE	PCN NO.	REV. NO.	DESCRIPTION
3/03/05	1	1	Changes to: (1) Section 1.3.3, *Silo 3 History*, to update events for 2004 and 2005; (2) Section 1.4.3, *Silo 3 Material Retrieval and Packaging Activities*, under *Container Filling and Sampling*, to describe the new waste sampling process at the Fill Stations; and under *Filled Container Management and Preliminary Staging*, to describe sorting of soft-sided containers on the ISA to assemble an eight-bag ISO that meets shipping reqs.; (3) Section 1.6, *Silo 3 Project Organization*, to update roles and responsibilities; (4) Section 6.0, *Management of Change*, to delete maintenance alterations as a reason for completing an SBIS (covered by DCN process); (5) Section 8.21, *Radiological Hazards*, under *External Radiation*, to update collect dose values; (6) Section 16.0, *Emergency Response Plan*, to clarify proper radio channel for contacting the Silo 3 Control Room; and under *Evacuation Routes*, to update the primary and back-up Silo 3 rally points; (7) Table A.3-4, *Matrix of Tasks/Subtasks vs. Hazards for Silo 3 Facility*, to add breach of sample container to Item 14e; (8) Table A.4-1, *Final Hazard Assessment for the Silo 3 Project*, to add breach of sample container to Item 14e; (9) Section F-5.3, *Protective Signaling System*, under *Smoke Detection System*, to delete linear beam detectors and to clarify the actions of the Fire Alarm Control Panel (FACP) upon activation by a detector; (10) Appendix D, *ALARA Analysis*, under *Executive Summary*, to delete reference to Radiation Zone Drawings, and to update collective dose values; (11) D-5.1, *Duration of Silo 3 Project Tasks*, to update schedule; (12) delete Section D-5.3, *Changing Radiological Conditions* and renumber successive subsections; (13) renumbered Section D-5.3, *External Radiation Exposure*, to delete reference to Radiation Zone Drawings; (14) renumbered Section D-5.3.1, *Operations*, to add estimated dose rates for IP-2 package sampling, and for package handling via fork-truck; (15) renumbered Section D-5.3.3, *Inspection of Packaged Material Staged for Transportation*, to delete reference to Radiation Zone Drawings; (16) Table D.5-1, *ALARA and Exposure Analysis Matrix*, to add Sampling item and values; to add package staging item and values; to update Operations Subtotal collective dose; and to update Overall Total collective dose; (17) D-6.0, *References*, to delete reference for Radiation Zone Drawings.

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.

Final *Record of Decision* [ROD] *Amendment for Operable Unit 4 Silo 3 Remediation Action* [Ref. 20] prepared by Fluor Fernald. The ROD was reviewed by DOE and approved by USEPA and OEPA in August, 2003.

This Silo 3 Retrieval & Disposition N-HASP developed. Approved in February, 2004, this N-HASP is 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).

2004: Silo 3 Readiness successfully completed. Project placed on "cold standby" due to lack of off-site disposal site.

2005: Off-site disposal site contract awarded to Envirocare in Utah. Preparations for waste shipments commence.

PCN1

1.4 Silo 3 Process Description

The Silo 3 Retrieval and Disposition Project consists of the major activities shown below. The scope of this Silo 3 N-HASP covers Operation and Maintenance (i.e., Material Removal and Packaging) and On-site Transportation and Staging. For a breakdown of Silo 3 Project work authorization flowdown, see Section 2.0. For a discussion of the Silo 3 Project safety basis (and a view of how it fits into the overall Silos Project safety basis), see Section 5.0.

- STORAGE AND MAINTENANCE (IN SITU)
- CONSTRUCTION
- OPERATION AND MAINTENANCE
  - Material Removal
    - Pneumatic Retrieval
    - Mechanical Retrieval
  - Packaging
    - Waste Conditioning
    - Container Filling
    - Filled Container Management
- ON-SITE TRANSPORTATION AND STAGING
- DECONTAMINATION
- DEMOLITION

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 Silo Project 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

PCN1

Container Filling and Sampling

For both PRS- and MRS-retrieved waste, the final package is a tested and approved DOT (Department of Transportation) 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". The containers were certified IP-2 via testing per 49 CFR Part 173 [Ref. 26] and Part 178 [Ref. 27].

The test container was filled with 7,000 pounds (minimum) of surrogate material similar in characteristics to Silo 3 material. Two tests were performed using: (1) a surrogate similar to conditioned Silo 3 material; and (2) a surrogate similar to untreated Silo 3 material. Each test article underwent a series of tests, including a Free Drop Test, a Stacking Test, and a Vibration Test. Both test articles completed the test series, demonstrating no loss of material during or after testing. No splits, tears, rips, or damage were observed after testing.

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 a camera in the area to allow remote viewing of bagging operations.

Material will be dropped through the fill chutes into the PVC liner. Once material flow into the container has been started, an aqueous conditioning solution will be sprayed on the material as it passes through the chute. After the container is full, a small slit will be made in upper region of the container spout. A tube sampler will be manually inserted into the spout to collect a predetermined material volume which will be extracted and placed in a sample jar (the sample will be analyzed at a Silos Project lab outside the Silo 3 facility). The sample slit will then be taped closed (per procedure) so that a slight vacuum can be pulled on the liner to facilitate an RF-sealing and liner perforation process. This proceduralized process makes an upper seal, a perforation, and two lower seals to ensure that none of the powdered waste is released to the adjacent work area (from either the liner or the residual liner spout once the container is disconnected from the chute). PCN1

After liner sealing, the lower part of the liner neck will be detached from the chute by tearing at the perforation. The container assembly, (container and loading frame) will move away from the fill chute to be closed, surveyed, and labeled. The trimmed-off and sealed upper part of the liner neck will be retained by the fill chute and blown into the next liner bag to be filled. In the event of failure of the RF seal, the liner may be closed using the alternate method approved during container tests [Ref. 65], or an Engineering-approved alternative.

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 addressed by vibrating the package to lower the level of material. There is a capability (a port) to vacuum excess material if needed. Vacuum activity would make use of containment (plastic bagging), a work plan, and a Radiation Work Permit (RWP).

PCN1

Filled Container Management and Preliminary Staging

After a soft-sided container is filled and the PVC liner is sealed, the container assembly is moved to the Package Staging Conveyor where swipe sampling and surveys of the container assembly are performed. If no contamination is found, the container is then transported through an airlock to the Cargo Container Bay, where it is closed and placed on a shipping pallet. The containers are surveyed to meet shipping requirements and staged for labeling inside the Cargo Bay. Equipment and material, including containers of Silo 3 material, will be released from the Silo 3 facility when the exterior of the item meets DOT surface contamination limits. Therefore, it is planned that shipping activities will take place in a Controlled Area.

A labeled soft-sided container will be loaded by forklift into an International Standards Organization (ISO) container on the Interim Staging Area [ISA] (i.e., Silo 3 Pad). Due to anticipated radioactivity variability between soft-sided containers, these bags will undergo preliminary staging on the ISA. This entails placing four bags in an ISO (an ISO can hold up to eight bags). This allows bags to be retrieved from different staged ISOs to create a shipping ISO with eight bags that, as a unit, will meet shipping requirements. Once loaded, ISOs will be handled in one of the following manners: (1) one ISO each will be loaded onto a truck trailer on the ISA using a heavy forklift, and staged for shipment off-site; or (2) the loaded ISO will be moved by heavy forklift to a staging area for shipment off-site. Video cameras allow for remote viewing of the process and personnel. PCN1

If an IP-2 container is rejected because it does not pass the QC check, it can be repaired per an Engineering and Rad-approved process, or the shipping/packaging supervisor can have the package placed in the Excavator Service Room where its contents can later be recycled to a Packaging Station via the Excavator Bin.

On-site Transportation and Staging

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. Silo 3 waste material will be transported to an off-site disposal facility by truck. IP-2 containers of Silo 3 material may need to be moved, by forklift, on a pallet to other areas of the site for various activities such as assay.

Prior to shipping, trucks will be staged. Staging consists of container management, which includes completion of shipping paperwork for waste disposition. Containers meet DOT requirements for shipping and will be handled in accordance with DOT shipping requirements. Between 15 and 20 trucks will leave the site weekly. This is similar to other off-site shipment schedules prior to this project.

Because there may be delays in shipping, plans are being developed and evaluated to stage ISOs on site beyond the time period needed to complete shipping paperwork. If the entire Silo 3 contents need to be staged, as many as 273 ISOs (each containing 7 or 8 filled IP-2 containers) could be staged on site.

Staging is assumed to be in an outdoor location. Maximum duration for staging will be administratively controlled as six months. In addition to the ISA pad, staging areas include, but are not limited to, the former site of Silo 4 (now demolished), the area south of Silo 1, the silos lay-down area along the entry road, and various other on-site areas. All areas where Silo 3 material will be loaded and staged pending the completion of shipment will be within the site fence and provided with appropriate levels of security and lighting. FCP Security monitors site access by using stationary posts and walking/driving/perimeter patrols on a 24-hour basis.

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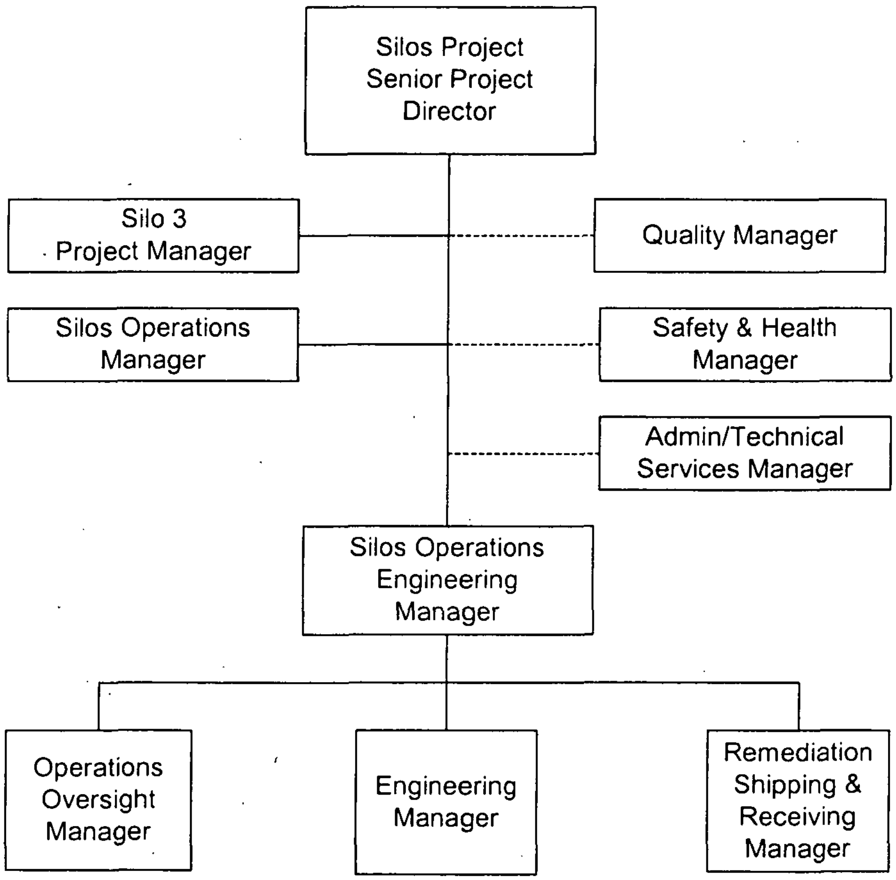
1.6 Silo 3 Project Organization

The Silos Project has organized a team with the extensive technical and administrative experience necessary for remediating Silo 3, and for remediating Silos 1 & 2 (which entails RCS [Phase 1], AWR [Phase 2], and WT&P [Phase 3]). 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. PCN1

FIGURE 1-8: SILO 3 PROJECT ORGANIZATION CHART PCN1



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 the Executive Account Approval Manager for all Silos Project accounts and the staffing manager for the Silos Project. 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.

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, construction support, 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 Cost Account Manager (CAM) authority for the Silo 3 Project. PCN1

Silos Safety and Health (S&H) Manager

The Safety and Health Manager (S&H) is matrixed to the Silos Project from the Safety, Health and Quality (SH&Q) Division. The S&H Manager reports to the Silos SPD is responsible 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.

- 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.

- 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 Operations Engineering Manager (OEM)

The Silos Operations Engineering Manager (OEM) reports to the Silos SPD and is responsible for the implementation of all engineering, operations oversight, training, shipping and receiving, and analytical support associated with the implementation of the Silos Project. OEM responsibilities include:

- ensuring that all engineering for the Silos Project is conducted in accordance with sitewide and project-specific engineering procedures and plans.
- implementing an appropriate design and configuration control program for the Silos Project.
- implementing a Title III design program in a manner consistent with engineering and configuration control plans and procedures, and integrated with construction and start-up activities.
- providing CAD and document control services for maintaining configuration and design control.
- ensuring that adequate trained resources are available for the safe start-up, operation, and maintenance of the Silo Project systems.
- investigating operational events to ensure that effective corrective actions are implemented and lessons learned are incorporated into work planning.
- implementing a Readiness Program aimed at ensuring that all aspects of work control, training, resource allocation, and configuration control are in place prior to declaring readiness to operate.
- implementing an off-site shipping program consistent with site requirements, site lessons learned, NTS waste acceptance requirements, and DOT shipping requirements.
- providing waste characterization and shipping of sitewide and silos waste.

PCN1

Silos Engineering Manager (EM)

The Silos Engineering Manager (EM) reports to the Silos Operations Engineering Manager and 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. PCN1

Silos Operations Manager (OM)

The Silos Operations Manager (OM) reports to the Silos SPD and is responsible for the operation of the Silo Project remedial systems for Silos 1 & 2 and Silo 3. OM responsibilities include:

- developing a system of work authorization and control, including administrative plans, procedures, standing orders, and work instructions for the safe and efficient execution of the project work scope in accordance with sitewide procedures, DOE orders, and pertinent core principals of Conduct of Operations (CONOPs).
- overseeing operations and acting promptly to resolve issues and identify necessary facility, equipment, resource, training, or procedural changes to ensure that operations are safe and efficient and project objectives are attained.
- being a visible and vocal advocate for the safe execution of work in accordance with the guiding principles and core values of Integrated Safety Management (ISM). PCN1

DELETIONS

Silos Operations Oversight Manager (OOM)

The Silos Operations Oversight Manager (OOM) reports to the Silos Operations Engineering 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 OOM 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 OOM 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 Quality Manager (QM)

The Quality Manager (QM) is matrixed to the Silos SPD for coordination of all quality functional areas within the division. The QM is also responsible to the Quality Control (QC) Manager and is responsible for performing 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 PCN1 document and coordinate Silo 3 Project QA/QC activities, including supervision of the Quality Engineers matrixed to the Silos Project. The QM is also responsible for quality control/quality assurance 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.

DELETION

Silos Administration/Technical Services Manager (ATSM)

The Administration/Technical Services Manager (ATSM) reports to the Silos SPD and is responsible for oversight of project control activities, including baseline development, cost estimating, and performance measurement, as well as oversight of all project administrative requirements, including personnel training, space management, records management, and resource planning. The ATSM integrates the resource needs of all functional areas within the project and works with other Fluor Fernald divisions and site support contracting mechanisms to ensure that properly trained and quality personnel are available for project execution. PCN1

DELETION

Silos Shipping and Receiving Manager (SRM)

The Silos Shipping and Receiving Manager (SRM) reports to the Silos Operations Engineering Manager and is responsible for receiving bulk materials, consumables, trailers, and empty containers. The SRM is also responsible for characterization of waste scheduled for shipment, and for container loading and shipping.

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.

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.

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. 42], and SH-0028, *Occurrence Reporting* [Ref. 43].

- 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

NOTE: With the approval of this Silo 3 N-HASP, Silo 3 personnel will no longer use the Silos Project Safety Basis Impact Screen (SBIS) for Silo 3 Project change issues. For Silo 3 changes, personnel will use the Silo 3 SBIS documented in this section. Changes to approved Silo 3 operating procedures, and approval of new Silo 3 operating procedures, must go through the review process specified in the site document control procedure, MS-2001. The Silos Project SBIS is still valid for Silos change issues outside the scope of any approved Silos N-HASP.

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). Upon Silo 3 N-HASP approval, 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; and (3) for changes to PCN1 this N-HASP. 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. 44].

Because the silos themselves are HC-3 facilities, when proposed changes have the potential to affect silo containment as described in the Technical Safety Requirements (TSR) document [Ref. 66], do NOT use the Silo 3 SBIS form. Instead, a USQ Determination/Safety Evaluation must be completed by a System Safety Analyst per NS-0002, *Unreviewed Safety Question (USQ) Determination and Safety Evaluation System* [Ref. 45].

A System Safety Analyst [SSA] must approve 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 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. 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.

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.

Software Management of Change

The Silo 3 Project uses the process outlined in MS-1040, *Software Quality Assurance* [Ref. 46], to classify, develop, verify, and validate software that may have an impact on nuclear safety. This process applies to software currently in use, proposed for use as well as software that is purchased, developed in-house, licensed from a commercial vendor for customized use, obtained from another site, or developed or customized by a vendor or subcontractor.

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 (for maintenance involving system breaches, the area will be up-posted to a High Contamination Area).

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 significant external 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 will be monitored. **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.

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	0.4 at 7 ft. 4.0 at 1 ft.

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)	7.076
Primary Maintenance & Inspection (6 months)	0.660
Inspection of Interim Staging Area (ISA) or other staging area	0.120
TOTAL OPERATIONS AND MAINTENANCE (this N-HASP)	7.856

PCN1

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

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. 82]
- EM-0030, *Silos Area Emergency Procedure* [Ref. 83]

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.

<u>Reporting</u>

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	Silo 3 Control Room via Channel 10
Hospital	911	513-648-6511	Silo 3 Control Room via Channel 10
Fire	911	513-648-6511	Silo 3 Control Room via Channel 10
Security	911	513-648-6511	Silo 3 Control Room via Channel 10
Emergency Response	911	513-648-6511	Silo 3 Control Room via Channel 10
Assistant Emergency Duty Officer (AEDO)	4749 4444	513-648-4749 513-648-4444	202/ Silo 3 Room Control Room via Channel 10

PCN1

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 Silo 3 Control Room via Channel 10 PCN1

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
- Atypical Events
- 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 (Silo 3 Control Room via Channel 10). Stay on the phone line until the dispatcher hangs up. The following information must be given to the Communications Center Operator: PCN1

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

- 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. Silo 3 personnel should immediately proceed to primary Rally Point 10 at pole WP 148 located northwest of the Silo 4 pad area (NW corner of the Silos Loop Road (Rally Point 10 also serves as an alternate for AWR and WT&P personnel). The Silo 3 back-up assembly area is located at Rally Point 4 (on the west side of the 30/45 parking lot). PCN1

Emergency Response

FCP Emergency Services will handle all emergencies. Any request for emergency help should be requested by telephone (911) or by radio (Silo 3 Control Room via Channel 10).

Medical Emergencies

For a medical emergency at the FCP, call 911 (by site phone) or 513-648-6511 (by cell or non-site phone) or by FCP radio (Silo 3 Control Room via Channel 10). The FCP Communications Center will contact the off-site Subcontracted Response Team regarding the emergency. The Subcontracted Response Team will initially treat the individual at the scene and then transport him/her to a local hospital emergency room. PCN1

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 Subcontracted Response Forces will respond to all on-site fire emergencies. For any fire at the FCP, call 911 (by site phone) or 513-648-6511 (by cell or non-site phone) or by FCP radio (Silo 3 Control Room via Channel 10).

Explosion Emergencies

When an explosion has occurred, the following actions are to be taken: PCN1

1. Activate the closest fire alarm, if possible. If a fire alarm is not available, notify other employees by an alternate method (radio Supervisor or Silo 3 Control Room via Channel 10).

2. Evacuate the work area.

3. Proceed to the appointed rally point.

   NOTE: The primary rally point is Rally Point 10 at pole WP 148 located northwest of the Silo 4 pad area (NW corner of the Silos Loop Road. The back-up assembly area is located at Rally Point 4 (on the west side of the 30/45 parking lot). PCN1

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 Silo 3 Control Room by radio (Channel 10) or by phone (911). PCN1

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, the AEDO, Silos Project management, and the RCS Control Room.

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, Silos Project management, a Silos S&H Representative, and the RCS Control Room 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. 83], 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 Subcontracted Emergency Response Services.

- 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.

TABLE A.3-4: MATRIX OF TASKS/SUBTASKS VS. HAZARDS FOR SILO 3 FACILITY

HAZARD TYPE	ID Number	STORAGE, S&M	CONSTRUCTION	OPERATION AND MAINTENANCE			DEMOBILIZATION
				Material Retrieval	Process Building Operations	ISA Operations	
Potential/Kinetic Energy							
Drop crane load	2a		X			X	X
Personnel fall from heights	2b	X	X	X	X		X
Drop tools/equipment	2c	X	X	X	X	X	X
Crane load swing	2d		X			X	X
Structural failure of silo due to degraded condition and excessive load	2e	X	X	X	X	X	X
Vehicle crash into facility	2f	X	X	X	X	X	X
Chemical Energy							
Fire/explosion from fuels	3a		X			X	X
Electrical Energy							
Overhead lines	5a		X				X
Utility connection/disconnection	5b		X				X
Hand tools/maintenance	5c	X	X	X	X	X	X
Human Capability and Hazards							
Inadequate lighting	6a	X	X	X	X	X	X
Slips, trips, and falls	6b	X	X	X	X	X	X
Pinch points	6c	X	X	X	X	X	X
Noise	6d	X	X	X	X	X	X
Heat/cold stress	6e	X	X	X	X	X	X
Human error due to clutter	6f	X	X	X	X	X	X
Human error due to equipment layout, human factors, ergonomics	6g			X	X		
Human error due to remote camera failure	6h			X	X		

TABLE A.3-4: MATRIX OF TASKS/SUBTASKS VS. HAZARDS FOR SILO 3 FACILITY

HAZARD TYPE	ID Number	STORAGE, S&M	CONSTRUCTION	OPERATION AND MAINTENANCE			DEMOBILIZATION
				Material Retrieval	Process Building Operations	ISA Operations	
Human Capability and Hazards (cont.)							
Human error due to schedule pressure, communications failure, complicated tasks	6i	X	X	X	X	X	X
Mechanical Energy							
Hand and power tools, rotating/conveying machinery	11a		X	X	X		X
Natural Phenomena							
Lightning, wind, tornado, earthquake	12a	X	X	X	X	X	X
Radiation							
Exposure from Silo 3 material	14a	X	X	X	X	X	X
Hose rupture during pneumatic retrieval	14b			X			
Silo wall failure due to wall cutting operations	14c		X	X			
Spill material from conveyor failure	14d			X	X		
Breach of material storage bag or sample container	14e				X	X	
Breach of DOT package - ISA	14f					X	
Dust collector failure	14g			X	X		
Silo collapse from pressure differential	14h			X			
Toxicants							
Concrete burns, paints, chemicals, silica, fuel, oil	16a		X	X	X	X	X
Spill of ferrous sulfate	16b				X		
Chemicals-such as lead and beryllium	16c		X	X	X	X	X
Exhaust from forklift-CO	16d				X	X	

PCN1

TABLE A.4-1: FINAL HAZARD ASSESSMENT FOR THE SILO 3 PROJECT

ID No.	Hazard Type	Initiating Event	Consequence (Unmitigated)	SIH * Yes/No	Frequency	Severity	Significant Hazard	Comments, Mitigators, Controls, Actions, and/or Justification
14d	Radiation exposure	Spill material due to a conveyor failure	Potential to exceed dose limits	N	Anticipated	Low	Yes	Approved procedures, training, process and equipment design, structure over work area.
14e	Radiation exposure	Breach of material storage bag or sample container	Potential to exceed dose limits	N	Anticipated	Low	Yes	Approved procedures, training, process and equipment design, structure over work area.
14f	Radiation exposure	Breach of a DOT package in ISA or other staging area	Potential to exceed dose limits	N	Anticipated	Low	Yes	DOT approved package. Approved procedures, training, process and equipment design.
14g	Radiation exposure	Dust collector failure	Potential to exceed dose limits	N	Anticipated	Low	Yes	Approved procedures, training, process and equipment design.
14h	Radiation exposure	Silo collapse due to pressure differential during headspace venting, preliminary pneumatic retrieval, and equipment installation, or routine pneumatic retrieval	Potential to exceed dose limits	N	Pressure issues Anticipated	Low	Yes	General: Approved procedures, operator training, process and equipment design, and structure over silo. Preliminary Pneumatic Retrieval: OWI. Routine Pneumatic Retrieval: silo pressurization is mitigated by the maximum achievable pressure, which is within failure limits, and by the relief valves. Depressurization requires multiple failures and could result in a pressure differential exceeding failure limits.

PCN1

5910

TABLE A.4-1: FINAL HAZARD ASSESSMENT FOR THE SILO 3 PROJECT

ID No.	Hazard Type	Initiating Event	Consequence (Unmitigated)	SIH * Yes/No	Frequency	Severity	Significant Hazard	Comments, Mitigators, Controls, Actions, and/or Justification
16a	Exposure to toxic materials	Use of concrete, paints, chemicals, fuel, oil, silica	Skin irritation, respiratory system damage, or other physical effects	Y	-	-	SIH	Use appropriate PPE, MSDS.
16b	Exposure to toxic materials	Spill of ferrous sulfate	Skin irritation, respiratory system damage, or other physical effects	N	Anticipated	Low	Yes	Approved procedures, training, equipment design, use appropriate PPE.
16c	Exposure to chemicals such as lead and beryllium	Spill or release of Silo 3 material.	Personnel injury	Y			SIH	Use appropriate PPE, approved procedures, equipment design.
16d	Exposure to exhaust from forklift-CO	Poor work practice	Personnel injury	Y			SIH	Maintain forklifts properly, approved procedures
17a	Exposure to poison ivy, snake bites, insect stings	Work outdoors	Personnel injury	Y	-	-	SIH	PPE, repellants. Removal of potential hazards (snakes, ivy, etc.)
21a	Exposure to welding operations	Welding and torch cutting	Eye injury, burns, respiratory, fire	Y	-	-	SIH	Training, qualified welders, PPE, fire watch
21b	Confined space	Const., maint., ops, inspections requiring confined space entry	Asphyxiation, injury, or death	Y	-	-	SIH	Training, PPE, ventilation, retrieval and rescue provisions

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EXECUTIVE SUMMARY

This appendix reflects the results of extensive analyses to minimize dose while optimizing the design and operation of the Silo 3 facility. The purpose of this analysis is to assure that the Silo 3 Project tasks have been designed and specified in a manner that will keep worker and co-located worker radiation doses ALARA. Silo 3 is a phased project consisting of construction, waste retrieval, and finally decommissioning of the retrieval facilities. This analysis does not address the radiation exposure associated with construction or decommissioning.

Each task where significant radiation exposure is expected has been described and analyzed to determine or estimate the number of workers involved, whether personal protective equipment and clothing is required, the time required to complete the task, the total number of times the task will be performed (frequency) during the Silo 3 Project, and the total person-hours of exposure in areas with radiation dose rates above background. PCN1

DELETION

The dose rate estimates were made on the basis of the Silo 3 final design. Collective dose estimates were calculated for each task based on the current data, and these estimates were summed for operations, maintenance, and other routine tasks. However, whenever there was uncertainty in estimates, assumptions were made that would conservatively overestimate the radiation doses. Finally, the total collective dose estimate or the collective dose budget for the Silo 3 Project was calculated to be approximately 7.856 person-rem. The results of this ALARA analysis can be summarized as follows: PCN1

- The collective operations dose during the entire retrieval and packaging evolution is conservatively estimated to be 7.076 person-rem.
- The collective maintenance dose during the retrieval and packaging evolution is conservatively estimated to be 0.66 person-rem.
- The collective inspection dose during on-site staging of packaged International Standards Organization (ISO) containers is conservatively estimated to be 0.120 person-rem.

Because the estimated total collective dose for the Silo 3 Project exceeds 2 person-rem, the ALARA trigger level used at Fernald, a formal ALARA Committee Review will be required. Furthermore, this analysis shows that expected radiation doses are large enough that engineering and operational controls will be needed to keep radiation doses to workers ALARA.

The scope of this ALARA Analysis is focused on support of the development of the final design. The analysis includes equipment installation and other operations and maintenance functions generated as the design matured. Details of the latest design have been incorporated as much as possible into this ALARA Analysis. Further detail required to clearly define operation and maintenance of equipment is generally contained in vendor's operating and maintenance manuals, which are not yet available. Thus, conservative assumptions about the frequency, duration, and complexity of operations and maintenance have been made and used in this analysis. As the construction proceeds and vendor manuals become available, this ALARA Analysis will be further refined to more clearly define operations and maintenance functions and/or to further reduce the degree of conservatism in the assumptions.

D-1.0 INTRODUCTION

The As Low As Reasonably Achievable (ALARA) Analysis addresses radiological controls for the operational, and facility shutdown phases of the Silo 3 Project. The purpose of this analysis is to ensure that the Silo 3 Project tasks have been designed and specified in a manner that will keep project workers and collocated worker radiation doses ALARA. Alternatives for dose reduction were assessed and optimum controls were selected.

D-1.1 Scope

The scope of this ALARA Analysis is limited to the Silo 3 Project area within Operable Unit (OU) 4. The radiation protection requirements discussed herein, however, apply to all operations at the Fernald Closure Project (FCP). The scope of existing or expected radiological conditions is also limited to occupational exposures of Silo 3 Project workers and collocated workers to ionizing radiation. Environmental releases of radon and any radiation exposure to the off-site population will be addressed in an ALARA Evaluation [Ref. 1]. This Occupational ALARA Analysis addresses radiation protection measures required for equipment, engineering design, packaging and staging of Silo 3 Project material.

Each task has been described and analyzed to determine or estimate the number of workers involved, the require personal protection equipment (PPE), the time required to complete the task, and the total number of person-hours of exposure in areas with radiation dose rates above background levels. The radiation dose rates in each of these areas were estimated and incorporated by reference in this ALARA Analysis. Refinements to the dose rate estimates will be based on the final design information, when available. From these data, collective dose estimates were calculated for each task, and these estimates were summed for operation, maintenance and inspection, and other routine tasks. Finally, the total collective dose estimate or the collective dose budget for the project was calculated.

D-1.2 Background Information

FCP, formerly known as the Feed Materials Production Center (FMPC), processed three basic classes of materials:

- Pitchblende ores as they were mined and shipped to the FMPC
- Uranium ore concentrates that had already been refined to some degree at the mill site
- Uranium process residues generated from FMPC metal production operations.

maintenance task to determine the number of workers necessary, whether they will be wearing PPE, the time required for the task, and the frequency of the task. However, detailed operations and maintenance manuals that would provide these data are not yet available from the manufacturers of each piece of equipment. Therefore, the data provided in this ALARA analysis are based on conservative estimates and general knowledge of comparable operations and equipment. The potential dose rates are conservative estimates based on the shielding calculations, including self-shielding and geometry considerations.

The collective dose estimates in TABLE D.5-1 have been summed to give a projection of the Silo 3 Project total collective dose. An assessment of these projected collective doses gives the relative impact of each task and suggests the level of analysis necessary to ensure that the collective and individual doses are maintained ALARA.

The ALARA Committee, made up of a variety of specialists from operations, maintenance, health physics, industrial hygiene, and industrial safety, critically reviews this analysis. Committee comments are reviewed and responses developed and incorporated to create a well-established starting point for initiation of physical work.

ALARA analysis is a continuous process that is repeated whenever additional data become available that enable refinements in estimates and calculations. As the project proceeds and operations and maintenance manuals are received, specific procedures will be developed that will better define tasks to be conducted in radiological areas. This additional information will be used to refine individual and collective dose estimates and generally reduce the degree of conservatism in the ALARA Analysis.

D-5.0 SILO 3 FACILITY ALARA ANALYSIS RESULTS

This section presents results of the ALARA analyses. Each task of the waste retrieval and packaging that involves significant radiation exposure has been reviewed and analyzed to calculate collective doses with an emphasis on those that pertain to the final design. These analyses are estimates for ALARA purposes.

D-5.1 Duration of Silo 3 Project Tasks

The duration of the Silo 3 Project operation tasks was determined from the Silo 3 current baseline schedule. Construction of the Silo 3 waste retrieval and packaging facility began in the fall of 2002 and operations are scheduled in 2005. PCN1

The process for the removal and packaging of Silo 3 waste is subdivided into the following three divisions:

- Pneumatic retrieval of Silo 3 waste by a vacuum wand inserted through a manway in the Silo 3 dome,

- Mechanical retrieval of waste through the side of the silo and material handling of the captured solids to a packaging area where it is placed in bags, and

- Bagged waste is containerized and staged in shipping containers for final transport to an off-site disposal facility.

A plan view of the retrieval/package building first floor, Figure D.1-2, shows the process equipment layout.

D-5.2 Internal Exposure to Radon and Other Radionuclides

Headspace radon and radon generated during mechanical processing of the retrieved, dry waste will be collected in exhaust hoods and ventilated to the atmosphere by the Silo 3 exhaust stack. Calculations of the atmospheric release and dispersion of radon from the exhaust stack show that doses to potential off-site recipients would be negligible [Ref. 10].

Very few project operations will be conducted in airborne radioactive areas where the radon concentrations will exceed 10 percent of the DAC and require respiratory protection. In these cases, the selection and use of respiratory protection equipment will be designed to prevent internal exposure to radon and its decay products. Fixed radon monitors installed in the Process Building and the Excavator Service Room will be supplemented with portable working level monitors to monitor radon and daughter product concentrations (see Appendix H).

In all cases where workers are exposed to Silo 3 material, they will be required by RWP to wear full PPE and respirators to prevent skin contamination and inhalation of airborne radioactive material. Thus, the probability of project workers being internally contaminated is low. Nevertheless, all project radiological workers will participate in the FCP bioassay program as required.

Radiological Control Technicians will also measure radon concentrations and determine the requirements for respiratory protection for any planning to access areas. The objective of monitoring and respiratory protection is to prevent exposures to radon concentrations in excess of 10 percent of a DAC and to ensure that internal exposures to radon concentrations less than 10 percent of a DAC are maintained ALARA.

DELETION

PCN1

D-5.3 External Radiation Exposure

The individual and collective dose estimates are detailed in this section. The collective dose estimates in TABLE D.5-1 have been summed to give a projection of the total collective dose for major project phases (i.e., operation and maintenance). Assessment of these projected collective doses gives the relative impact of each task and suggests the level of analysis necessary to ensure that the collective and individual doses are maintained ALARA. These estimates will also provide input to the development of project ALARA goals. The dose rate estimates were determined from calculations, existing survey data, and qualitative approximations. During operations, actual doses will be compared to estimated doses to analyze trends and measure performance against ALARA goals. Actual dose data will be used to refine dose estimates and make adjustments where necessary.

The scope of this ALARA Analysis is focused on the retrieval and packaging of the Silo 3 material. Further detail required to clearly define operation and maintenance of equipment is generally contained in vendor's operating and maintenance manuals, which are not yet available. Thus, conservative assumptions about the frequency, duration, and complexity of operations and maintenance have been made by the design engineers and used in this analysis. As vendor manuals become available, this ALARA Analysis will be further refined to more clearly define operations and maintenance functions and/or to further reduce the degree of conservatism in the assumptions.

The number of workers involved in the Silo 3 Project tasks is generally limited to only those workers who actually enter radiological areas to perform work. The "buddy system" of using two workers on a task will be used only when absolutely necessary for safety or efficiency. Supervisors, engineers, trainers, and trainees are not expected to be exposed to the same radiation levels as the primary workers. Furthermore, the estimated exposure times for workers performing radiological work are limited to the actual time spent in radiation areas. It is assumed that workers will perform efficiently and minimize the time spent in these areas because of their skills and training and because the tasks will have been practiced on "cold" systems.

The remainder of this section is focused on external radiation exposures to the Silo 3 Project workers. Radiation doses estimated in this section are taken from Calculation 40430-CA-0016 [Ref. 11]. DELETION. Radiation exposures to workers will be controlled by means of RWPs, including stay-time limits and local temporary shielding requirements. Actual radiation exposures to workers will be measured by dosimeters, and dosimetry records will be analyzed to ensure that worker exposures are maintained ALARA. PCN1

D-5.3.1 Operations

The Silo 3 Project will operate for several months performing material retrieval, treatment, and packaging. The pneumatic retrieval system and the mechanical retrieval system each have a material removal design capacity of 10 yd^3 per hour and a normal operating capacity of 6 yd^3 per hour. Therefore, the entire 5,100 yd^3 material removal could be accomplished in 510 hours at design capacity or 850 hours at normal operating capacity. The exposure durations used in this analysis conservatively assume 1000 operating hours to account for the retrieval operations and routine support activities. This is segmented into 300 operating hours for pneumatic retrieval and 700 operating hours for mechanical retrieval. The schedule duration is assumed to be 6 months, with the understanding that while not operating, the personnel will not always be located in areas with dose rates above background levels. Although a decision may be made by Operations to perform more pneumatic retrieval and less mechanical retrieval, the impact on total collective dose would be small.

The Pneumatic Retrieval System uses a vacuum wand (i.e., vacuum wand management system) to remove the Silo 3 material via five man-ways on the top of the silo dome. This system will operate for approximately 300 hours. Two operators will be on the dome at any given time, at an approximate dose rate of 1.9 mrem/hr, and will rotate out with a relief crew. The "off-duty" crew will spend the off hours in the Operations Support Trailer (dose rate of 0.1 mrem/hr). A pneumatic retrieval collector will collect and separate the air-entrained waste. The pneumatic retrieval discharge feeder and the primary and secondary rotary feeders will then move the waste material to the Container Management System.

The Mechanical Retrieval System uses a remotely operated mechanical excavator to remove the silo material through an opening in the side of the silo wall. Once sufficient material has been pneumatically removed from behind the wall opening, the silo wall is cut and wall sections are removed to allow excavator access. The 15 ft wide by 20 ft high section is removed in sections with a diamond wire saw. The wall removal operation was estimated to require 4 personnel a duration of 170 hours at an average dose rate of 0.8 mrem/hr. This average dose rate is based on the time durations with the wall in place and with sections removed. Approximately 95 percent of the effort will be performed with the wall in place (i.e., 0.5 mrem/hr). Approximately 5 percent of the effort will be performed with the wall sections removed (5 mrem/hr).

The Mechanical Retrieval System will be operated for approximately 700 hours. Two operators will operate the excavator remotely, observing the operations via a viewing window adjacent to the Excavator Room. The excavator operators will be exposed to a dose rate of 0.4 mrem/hr, which is based on approximately 5 to 6 cubic yards of material in the excavator room at any given time, and at a distance of approximately 15 ft. The calculated dose rate from a bag was used as guidance in estimating the dose rate to these operators. The "off-duty" relief crew will spend off hours in the Operations Support Trailer. A retrieval bin will receive the waste from the excavator and the retrieval bin discharge feeder located beneath the retrieval bin will move the waste material to the inclined conveyor. The inclined conveyor will transport the waste material upwards to a transfer conveyor, which will in turn move the waste to the Container Management System.

The container management system will require 2 packaging room operators to operate conveyors and the packaging equipment. The packaging room operators will be exposed to an average dose rate of 0.4 mrem/hr, assuming an average distance of 7 ft from each bag. In addition, 4 container bay operators and 1 QA/QC inspector are expected to be required to finalize the securing of the IP-2 package and perform visual inspections. The cargo container operators and QA/QC inspector will be exposed at approximately 1.8 mrem/hr for 50 percent of the time, based on a distance of 2 ft from a full cargo container, and 0.4 mrem/hr for 50 percent of the time, based on a distance of 7 ft from a bag. One-quarter hour per bag is assumed for securing, inspection and handling. Additional operators can be utilized to rotate personnel. In addition, localized shielding could be provided on the forklift to reduce the dose rate to the operator. PCN1

After the IP-2 package is filled, the 2 operators will perform a sampling evolution, extracting a small quantity of material from the package. This operation is expected to require 5 minutes with a dose rate of 0.4 mrem/hr.

While awaiting analytical results, it is anticipated that 1 operator will handle each package through use of a fork-truck approximately three times. Each handling is expected to require 5 minutes with a dose rate of 0.4 mrem/hr. PCN1

Vendors will deliver approximately 270 empty containers, at 0.5 hours per container, in a dose rate of approximately 0.08 mrem/hr. These same containers will be picked up by a driver, at 0.5 hours per container, in a dose rate of approximately 0.1 mrem/hr. Approximately 25 chemical deliveries are estimated, at 1 hour per delivery, in a dose rate of approximately 0.08 mrem/hr.

An RCT will perform routine surveys of the facility and will support work activities. The routine surveys are expected to consist of 2 hours daily in areas at 0.4 mrem/hr, and 2 hours daily in areas at 2 mrem/hr. Operations support activities are estimated to require 2 hours daily in areas at 1 mrem/hr. The remainder of the RCTs time will be in the operations support trailer. The duration of RCT support is 6 months or 132 days.

D-5.3.2 Maintenance and Inspection

PCN1

The Silo 3 Project process equipment generally consists of specialized waste removal equipment (pneumatic and mechanical), process piping, waste material packaging system, pumps, valves, conveyor systems, process parameter and equipment sensors, air compressors, air filtration systems, miscellaneous electrical switchgear, and fire and radiological monitoring equipment and systems. The frequency and type of maintenance required for this equipment vary, but the maintenance is typically performed monthly and generally consists of the inspection and replacement (as necessary) of seals, impellers, packing, motors, limit switches, bearings, sensors/ transmitters, filters, etc. Maintenance activities also include regularly scheduled equipment testing including limit switches, transmitters, sensors, and alarm setpoints. The durations of the maintenance activities ranged from 1 to 10 hours a month and required 1-2 workers for each maintenance activity. Each equipment item was reviewed to determine maintenance requirements, location of equipment items, and radiation exposure rates at specific maintenance locations. The period of operation was also considered in the descriptions that follow.

The Silo 3 Project is comprised of several major systems: the Pneumatic Retrieval System, the Mechanical Retrieval System, the Container Management System, the Additive System, the Wastewater System, the Process Vent System, the plant/breathing air system, and the HVAC system. Each of these components includes equipment that may require preventative maintenance, and these requirements are considered in the following paragraphs.

Maintenance on the vacuum wand will require two workers in PPE approximately 10 hours a month. The vacuum wand will be pulled off the silo dome for any maintenance. The Pneumatic Retrieval Collector, the discharge feeder, and the rotary feeders will each require two workers approximately 5 hours a month. The exposure rate during maintenance on the vacuum wand system will be 0.1 mrem/hr and for the rest of the equipment will be approximately 0.4 mrem/hr.

Maintenance on the retrieval bin and feeder will each require two personnel in PPE approximately 1 and 2 hours a month, respectively. The exposure rate at each of these pieces of equipment will be approximately 3 mrem/hr. Maintenance on the bottom portion of the inclined conveyor will require 2 personnel in PPE approximately 2.5 hr a month. The dose rate in this area will be approximately 1.0 mrem. Maintenance on the transfer conveyor will require two personnel in PPE approximately 5 hr a month. The exposure rate in this area will be approximately 0.4-2 mrem/hr and average 1 mrem/hr. Maintenance on the mechanical excavator will require two personnel in PPE approximately 10 hours once during mechanical retrieval. The mechanical excavator will be pulled into the Excavator Service Room for maintenance, where the exposure rate will be approximately 1.0 mrem/hr. The rollup doors in the Excavator Service Room will require two personnel in PPE approximately 0.5 hr each door a month.

The Container Management System receives the waste material from either the pneumatic retrieval system or the mechanical retrieval system and packages, weighs, and samples the waste prior to loading the packaged wastes (3 yd^3 bags) into cargo containers. This system is located in the Packaging Area and the Cargo Container Bay. Maintenance on the upper portion of the inclined conveyor and the feed conveyor and associated feed discharge valves requires two personnel in PPE approximately 2.5 hr a month, 5 hr a month, and 1 hr a month, respectively. The exposure rate in this area will be approximately 0.4-2.0 mrem/hr and average 1.0 mrem/hr. Maintenance on each package loading stands will require two personnel approximately 5 hr a month, where the exposure rate is 0.2 mrem/hr. Maintenance on the remainder of the conveyors will each require two personnel approximately 0.5 hr a month, at 0.1 mrem/hr. Maintenance on the bridge crane, forklift, loading crane, will each require two personnel approximately 1 hr a month, at 0.1 mrem/hr. Maintenance of the rollup doors will require 2 workers approximately 2 hours per month, at 0.1 mrem/hr.

The Process Vent System collects and filters air contaminated with radon and metal oxide dust from various process points in the waste retrieval and packaging facility. The air collection registers are located throughout the building to reduce the potential for the spread of contamination in areas where metal oxides are exposed to atmosphere (i.e., mechanical excavation retrieval bin, the excavator room, and the packaging stations).

Maintenance on the retrieval bin and excavator room registers will each require one person in PPE approximately 1 hr a month. The exposure rate at these registers will be approximately 3.0 mrem/hr. Maintenance on the process vent dust collectors and the fines collection bins will require two personnel in PPE approximately 1 hr a month and 2 hr a month, respectively. The exposure rate at these pieces of equipment will be approximately 2 mrem/hr. Maintenance on the packaging station registers will require one person in PPE approximately 1 hr a month. The exposure rate at the packaging station registers will be approximately 1.0 mrem/hr. Maintenance on the Process Vent System HEPA prefilters and exhaust fans located south of the Excavator Room will require two personnel approximately 1.5 hrs a month for the prefilters and 2 hr a month for each fan, respectively. The exposure rate at this equipment will be approximately 2.0 mrem/hr at the filters and 0.4 mrem/hr at the fans.

The Wastewater System receives wastewater from the Excavator Room and Excavator Service Room resulting from equipment wash down or excessive misting. The system also receives water from the Additive System sump pump and the Wastewater System sump pump, which is located in the diked area surrounding the Wastewater Tank. Maintenance on the wastewater tank agitator and the wastewater tank pump will each require two personnel approximately 2 hr a month. The exposure rate will be 0.1 mrem/hr. Maintenance on the Wastewater Tank sump pump will require two personnel approximately 1 hr a month, and exposure rate in the area will be 0.1 mrem/hr. Maintenance on the Excavator Room and Excavator Service Room sump pumps requires two personnel in PPE approximately 1 hr a month. The exposure rate for the excavator room will be approximately 3 mrem/hr and for the excavator service room, 0.1 mrem/hr.

The Waste Additive System adds two liquid reagents to the waste material as it is added to the waste bags to reduce fugitive emissions and condition the waste. Reagent totes are delivered and stored in the Cargo Container Bay along with associated metering pumps and a sump pump. The ferrous sulfate tank and pump receive ferrous sulfate from a tanker truck parked outside. The reagents are pumped to an additive tank and additive charge tanks located in the Storage Area. Two metering pumps in this room pump the reagents into the waste material as it is added to the waste bags. Each piece of equipment requires one person approximately 1 hr a month to maintain, and the exposure rate in the area of this equipment is 0.1 mrem/hr.

Air for the HVAC System is supplied via three air conditioning units adjacent to the Wastewater Tank room. Two building filtration exhaust fans are located adjacent to the Excavator Room. In addition, there is a Cargo Container Bay air handling unit, three Cargo Container Bay exhaust fans, and two Wastewater Tank exhaust fans. Two ultra-low penetrating air (ULPA)/HEPA filters are located on the roof of the Excavator Room. General maintenance will require two personnel for each of the units (i.e., 1 hr a month for each of the exhaust fans; 2 hours per month for the air handling unit, and 2 hr a month for each of the air conditioning units). The workers will not require PPE, and the exposure rate in the area will be 0.1 mrem/hr. Maintenance on the ULPA/HEPA exhaust prefilters will require two personnel in PPE 1 hr/month and the exposure rate will be 0.4 mrem/hr.

Electrical switchgear in the Electrical Building provides power to the facility. Maintenance for the electrical switchgear requires two workers without PPE approximately 1 hour a month. The exposure rate in this area will be 0.1 mrem/hr.

Electrical and mechanical equipment used for monitoring and alarming radiological (e.g., radon monitors, continuous air monitors,) and fire parameters will require two workers approximately 4 hours a month. These workers will require PPE approximately 50 percent of the time. Exposure rates will be 0.1 mrem/hr.

D-5.3.3 Inspection of Packaged Material Staged For Transportation

PCN1

Individual cargo containers (ISOs), loaded with seven or eight IP-2 packages may be temporarily staged on site prior to final off-site transportation. Staging of packaged material in this manner is expected to result in weekly inspections required for environmental compliance purposes.

Dose rate analysis and evaluation of potential radon concentrations resulting from this staging configuration was performed in Calculation 40430-CA-0027 [Ref. 12]. Based on this analysis, the area immediately surrounding the staging array will be posted as a Radiation Area and will require a Radiological Work Permit for entry. This area will also be monitored for radon working level concentrations and controlled in accordance with protocols specified in Appendix H, *Health Physics Plan*. PCN1

Exposure rates between two containers spaced 2-3 feet apart are on the order of 14 mrem/hr. A single worker is assumed to perform the inspection once per week requiring approximately 20 minutes (.33 hr) per inspection, for the six-month staging period. Waste Management has a system for tracking packages/ISOs during staging.

TABLE D.5-1: ALARA AND EXPOSURE ANALYSIS MATRIX

Silo 3 Project Operations	No. of Workers (1)	PPE Req'd (2)	Time Duration (hr) (3)	Frequency of Tasks (4)	Person-Hours(5)	Dose Rate(6) (mrem/hr)	Collective Dose(7) (person-rem)	Notes/ Location
FACILITY OPERATIONS								
Pneumatic Retrieval Operations:								
Pneumatic removal wand operator control from top of dome	2	Yes	300	1	600	1.9	1.14	Top of Silo Room 3
Operations support trailer activities	2	No	300	1	600	0.1	0.06	Support trailer
Mechanical Retrieval Operations:								
Perform Wall Cutting Operation	4	Yes	170	1	680	0.8	0.544	Silo 3
Mechanical excavator operations	2	No	700	1	1,400	0.4	0.56	Room 2
Operations support trailer activities	2	No	700	1	1,400	0.1	0.14	Support trailer
Packaging Room Operations								
Bag out, inspection, swipes, installation, weighing, post-fill swipes, labeling (1885 bags)	2	Yes	0.5	1,885	1,885	0.4	0.754	Room 4
Sampling (1885 bags)	2	Yes	.083	1,885	301.6	0.4	0.121	Room 4
Cargo Container Bay Operations								
Secure, inspect, and load cargo containers (4 Ops and 1 QA/QC)	5	No	0.25	1,885	2,356	1.1 average	2.592	Room 11
Staging of packages while awaiting analytical results (3 times/package)	1	No	.083	5655 (3x1,885)	469.4	0.4	.188	Room 11 / pad

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TABLE D.5-1: ALARA AND EXPOSURE ANALYSIS MATRIX

Silo 3 Project Operations	No. of Workers (1)	PPE Req'd (2)	Time Duration (hr) (3)	Frequency of Tasks (4)	Person-Hours(5)	Dose Rate(6) (mrem/hr)	Collective Dose(7) (person-rem)	Notes/ Location
Truck Drivers								
Transport 270 empty containers	1	No	0.5	270	135	0.08	0.011	East of Room 7
Pickup 270 full containers	1	No	0.5	270	135	0.1	0.014	
Deliver waste additives (25 deliveries)	1	No	1	25	25	0.08	0.002	East of Room 7
Radcon Technician (6 months or 132 days)								
Health physics surveys	1	No	2	132	264	0.4	0.1056	Room 4
Health physics surveys	1	No	2	132	264	2	0.528	Room 11
Area Surveys operation support	1	No	2	132	264	1	0.264	Various
Operations support trailer activities	1	No	4	132	528	0.1	0.0528	Support trailer
OPERATIONS SUBTOTAL							**7.076**	
MAINTENANCE/INSPECTION								
Pneumatic Retrieval System (2 months)								
Maintain vacuum wand management system	2	Yes	10	2	40	0.1	0.004	
Maintain pneumatic retrieval collector	2	Yes	5	2	20	0.4	0.008	Room 4

PCN1

TABLE D.5-1: ALARA AND EXPOSURE ANALYSIS MATRIX

Silo 3 Project Operations	No. of Workers (1)	PPE Req'd (2)	Time Duration (hr) (3)	Frequency of Tasks (4)	Person-Hours(5)	Dose Rate(6) (mrem/hr)	Collective Dose(7) (person-rem)	Notes/ Location
Maintain pneumatic retrieval collector discharge feeder	2	No	5	2	20	0.4	0.008	
Maintain primary rotary feeder	2	No	5	2	20	0.4	0.008	
Maintain secondary rotary feeder	2	No	5	2	20	0.4	0.008	
Mechanical Retrieval System (4 months)								
Maintain retrieval bin	2	Yes	1	4	8	3	0.024	Room 9
Maintain retrieval bin discharge feeder	2	Yes	2	4	16	3	0.048	Room 9
Maintain inclined conveyor	2	Yes	2.5	4	20	1	0.02	Room 9
Maintain/inspect excavator tools	2	Yes	1	4	8	1	0.008	Room 9
Maintain transfer conveyor	2	Yes	5	4	40	1	0.04	Room 4
Maintain excavator	2	Yes	10	1	20	1	0.02	Room 8
Maintain excavator service room rollup doors (2)	2	Yes	1	4	8	1	0.008	Room 8
Packaging/Loading System (6 months)								
Maintain inclined conveyor	2	Yes	2.5	6	30	1	0.03	Room 4
Maintain feed conveyor	2	Yes	5	6	60	1	0.06	Room 4
Maintain feed conveyor discharge valves	2	Yes	1	6	12	1	0.012	Room 4
Maintain loading stands (2)	2	No	10	6	120	0.2	0.024	Room 4
Maintain intermediate packaging conveyors (2)	2	No	1	6	12	0.1	0.0012	Room 4

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TABLE D.5-1: ALARA AND EXPOSURE ANALYSIS MATRIX								
Silo 3 Project Operations	**No. of Workers** [1]	**PPE Req'd** [2]	**Time Duration (hr)** [3]	**Frequency of Tasks** [4]	**Person-Hours**[5]	**Dose Rate**[6] **(mrem/hr)**	**Collective Dose**[7] **(person-rem)**	**Notes/ Location**
Maintain packaging staging conveyors (2)	2	No	1	6	12	0.1	0.0012	Room 4
Maintain airlock conveyors (2)	2	No	1	6	12	0.1	0.0012	
Maintain off-loading conveyors (2)	2	No	1	6	12	0.1	0.0012	Room 7
Maintain bridge crane	2	No	1	6	12	0.1	0.0012	Room 11
Maintain heavy-duty forklift	2	No	1	6	12	0.1	0.0012	Room 11
Maintain loading crane	2	No	1	6	12	0.1	0.0012	Room 11
Maintain airlock rollup doors (4)	2	No	2	6	24	0.1	0.0024	Room 7
Process Vent System (PVS)								
Maintain retrieval bin register	1	Yes	1	6	6	3	0.018	Silo opening
Maintain excavator room register	1	Yes	1	6	6	3	0.018	Room 8
Maintain process vent dust collectors (2)	2	No	2	6	24	2	0.048	Room 4
Maintain fines collection bins (2)	2	No	4	6	48	2	0.096	Room 4
Maintain packaging station exhaust registers (2)	1	No	1	6	6	1	0.006	Room 4
Maintain PVS HEPA filters (2)	2	Yes	1.5	6	18	2	0.036	Adjacent to Room 9
Maintain PVS exhaust fans (2)	2	No	4	6	48	0.4	0.0192	Adjacent to Room 9
Wastewater System								
Maintain wastewater tank agitator	2	No	2	6	24	0.1	0.0024	Room 6

TABLE D.5-1: ALARA AND EXPOSURE ANALYSIS MATRIX								
Silo 3 Project Operations	**No. of Workers** (1)	**PPE Req'd** (2)	**Time Duration (hr)** (3)	**Frequency of Tasks** (4)	**Person-Hours**[5]	**Dose Rate**[6] **(mrem/hr)**	**Collective Dose**[7] **(person-rem)**	**Notes/ Location**
Maintain wastewater pump	2	Yes	2	6	24	0.1	0.0024	Room 6
Maintain wastewater tank area sump pump	2	Yes	1	6	12	0.1	0.0012	Room 6
Maintain excavator room sump pump	2	Yes	1	6	12	3	0.036	Room 9
Maintain excavator service room sump pump	2	Yes	1	6	12	0.1	0.0012	Room 8
Waste Additive System								
Maintain Waste additive metering pumps	1	No	2	6	12	0.1	0.0012	Room 11
Maintain waste additive sump pump	1	No	1	6	6	0.1	0.0006	Room11
Maintain wastewater additive tank	1	No	1	6	6	0.1	0.0006	Room 5
Maintain waste additive change tanks	1	No	2	6	12	0.1	0.0012	Room 5
Maintain waste additive change tank metering pumps	1	No	2	6	12	0.1	0.0012	Room 5
HVAC System								
Maintain cargo container bay exhaust fans	2	No	3	6	36	0.1	0.0036	Cargo bay roof
Maintain cargo container bay air handling unit	2	No	2	6	24	0.1	0.0024	Adjacent to cargo bay
Maintain packaged air circulation units	2	No	6	6	72	0.1	0.0072	Adjacent to Room 8
Maintain building filtration exhaust fans	2	No	2	6	24	0.1	0.0024	Room 8 roof

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TABLE D.5-1: ALARA AND EXPOSURE ANALYSIS MATRIX

Silo 3 Project Operations	No. of Workers (1)	PPE Req'd (2)	Time Duration (hr) (3)	Frequency of Tasks (4)	Person-Hours(5)	Dose Rate(6) (mrem/hr)	Collective Dose(7) (person-rem)	Notes/ Location
Wastewater tank area exhaust fan	2	No	2	6	24	0.1	0.0024	Room 6
Maintain ULPA/HEPA exhaust filters	2	Yes	1	6	12	0.4	0.0048	Room 8 roof
Electrical Building								
Maintain miscellaneous electrical switchgear	2	No	1	6	12	0.1	0.0012	
Radiological/Fire Monitoring Equipment								
Maintain miscellaneous fire protection and radiological protection equipment	2	Yes	4	6	48	0.1	0.0048	
M/I SUBTOTAL							**0.66**	
Inspection of Packaged Material Staged For Transportation								
Inspection activities	1	No	.33	26	8.58	14	0.120	
OVERALL TOTAL							**7.856**	

PCN1

Notes:
(1) No. of Workers = number of workers that will actually receive radiation exposure during the task
(2 PPE Required = personal protective equipment required, typically two pairs of coveralls, shoe covers, gloves, hood, and respirator
(3) Time Duration = the actual exposure time in the radiation field

(4) Frequency = the number of times the task must be performed during the entire duration of the Silo 3 Project

(5) Person-Hours = the collective exposure time in the radiation field

(6) Dose Rate = the estimated whole body dose rate (mrem/hr) at the location where the task is to be performed

(7) Collective Dose = the product of Person-Hours and Dose Rate in units of person-rem

(8) Based on expected average dose rate where PPE will be doffed

(9) Based on expected average dose rate where PPE will be doffed

D-6.0 REFERENCES

1. 40000-RAD-0001, Rev. 1, *Operable Unit 4 (OU4) Silos Project ALARA Evaluation*, Fluor Daniel Fernald, March 28, 1998

2. 10 CFR 835, Section 835.1002 (c), *Occupational Radiation Protection, Facility Design and Modifications*, Title 10 Code of Federal Regulations Part 835; DOE; November, 1998

3. DOE Order 420.1, *Facility Safety*, Section 4.1, *Nuclear and Explosives Safety Design Criteria*, U.S. Department of Energy; Change 2: October 24, 1996

4. 40430-DC-001, *Design Basis and Requirements Document for the Silo 3 Project*, Fluor Fernald; February, 2002

5. FEMP-04RI-6, *Remedial Investigation Report for Operable Unit 4, Final, Volume 1 of 3*, Fernald Environmental Management Project; November, 1993

6. SD-2008, *Technical Basis for Internal Dosimetry at the FEMP*, Fluor Daniel Fernald; April, 1997

7. SD-2089, Rev. 0, *Radiological Considerations for the Controlled Release of the Silo 3 Radon Laden Headspace*, Fluor Fernald, June 9, 2004

8. RP-0020, *Radiation Work Permitting and Authorization*, Fluor Fernald

9. RM-0020, Rev. 1, *Radiological Control Requirements Manual*, Fluor Fernald; June, 2003

10. 40430-CA-019, *Radioactive Particulate and Radon-222 Stack Release Considerations for the Silo 3 Remedial Action Project*, Jacobs Engineering Group; December, 2002

11. 40430-CA-0016, *Silo 3 Area Dose Rate Calculation*, Jacobs Engineering Group; August, 2003

12. 40430-CA-0027, *Silo-3 Packaged Material Staging Area Dose Rate and Radon Concentration Calculations*, Fluor Fernald; June, 2004

- Chemical and Toxic Hazards: Two chemicals will be used in the process, ferrous sulfate and sodium lignosulfonate. Both chemicals will be supplied as aqueous solutions and will remain in solution (in an even more diluted form) during use. Ferrous sulfate is not combustible, and sodium lignosulfonate will only burn if dried out. With the detection/alarm systems provided, none of the fire scenarios should involve the release of hazardous or toxic chemicals.

F-4.6 Fire Protection Water Run-Off

Water for fire fighting would only be used in the non-contaminated areas of the facility. Therefore, this should not create a contaminated water run-off problem greater than normal storm water run-off, since no breach of contaminated areas would occur.

F-4.7 Natural Hazards (Earthquake, Flood, and Wind)

Wind is the only natural hazard that could exacerbate a fire by allowing a fire to propagate between the trailer and the Process Building (Section F-6.4, MPFL). Earthquake and flood potentials do not affect the fire risks.

F-5.0 FIRE PROTECTION

F-5.1 Water Supply

An adequate fire-protection water supply is available from the FCP site (Section F-1.4). Fires in areas that cannot be handled with portable fire extinguishers will be suppressed manually by the subcontracted fire department. The Silo 3 Civil Utility Plan, Drawing No. 94-X-3900-G-01299 [Ref. 10], outlines the site plan and the fire hydrant locations.

F-5.2 Fire Suppression

The Implementation Guide for DOE Orders 420.1 and 440.1 (paragraph 9.7) [Ref. 20] states that DOE has an obligation to provide protection for its facilities so that a fire will not result in an unacceptable program delay or property loss. Consequently, DOE considers any facility in excess of 5,000 ft^2 in ground floor area and any facility with a maximum possible fire loss (MPFL) of $1 million ($10 million approved at FCP via DOE memorandum, DOE-0320-99 [Ref. 21], J. Craig to G.L. Denver, January 22, 1999, *Change in Maximum Possible Loss Criteria at the Fernald Environmental Management Project*) as warranting protection by an automatic fire suppression system. The packaging area of the Silo 3 Process Building has a ground floor area of 5,700 ft^2 and Occupancy Classification of Group F-2 (Low Hazard). Group F-2 Occupancies do not require that an automatic sprinkler system be provided. On Feb. 1, 2000, a DOE memorandum provided FCP with a fire suppression system exemption [Ref. 22]. A fire detection and alarm system has been installed throughout the Silo 3 facility to assure occupant notification of emergencies. Fire extinguishers are provided throughout the Silo 3 facility. They are located external to the

fire hazard areas and near access ways so that incipient fires can be extinguished.
DELETION

Fire suppression for the trailer emphasizes manual fire fighting. Normally-occupied areas have been provided with fire detection and alarm systems to assure prompt notification of emergencies to both occupants and to subcontracted emergency response. Portable fire extinguishers have been provided in accordance with NFPA 10, *Standard for Portable Fire Extinguishers* [Ref. 23]. Because of the lack of continuity of combustibles and the provisions of the fire detection system (see Section F-5.3), credible fires will be incipient in nature and can be suppressed using portable extinguishers. Because of the limited size and low or moderate hazard use, no automatic sprinkler protection is required. A trailer fire that is not controlled with portable extinguishers will require hose lines operated by the subcontracted fire department. The water supply distribution system to the Silo 3 area is a dead end run hydrant. This dead end run hydrant is within 290 ft of the supply tie-in point. There are parts of the Silo 3 Project that exceed the suggested maximum hose run distance of 300 ft distance from a hydrant, as specified in DOE STD 1066-99, Section 6.2.5 [Ref. 1]. However, water pressure and hose diameter are sufficient to provide adequate protection. The parts of the facility that fall outside this suggested hydrant support area are the Operations Support and Change Trailer, and the north and northwest sides of the Silo 3 Enclosure.

F-5.3 Protective Signaling System

Fire Detection

The Silo 3 Process Facility has been provided with fire detection and alarm systems to assure prompt notification of fire emergencies to both building occupants and emergency responders.

Detectors have been installed in accordance with NFPA 72, *National Fire Alarm Code* [Ref. 24], and are connected to the Silo 3 Process Building Fire Alarm Control Panel.

Fire Alarm System

The fire alarm system has a central Fire Alarm Control Panel in the Silo 3 Process Building. A fire or trouble alarm will be sent to the Savannah River Facility Communication Center, which will relay the alarm to the FCP site. Manual pull boxes have been installed in accordance with NFPA 72 and the IBC. Notification devices consist of horns and strobes and are installed in all areas in accordance with NFPA 72.

Smoke Detection System

Industrial-grade duct smoke detectors powered by 24V with battery back-up have been installed in the facility. Photoelectric spot type smoke detectors have been installed in the Cargo Container Bay, Packaging Area, Storage Area, Waste Water Area, Electrical Building, Operations Support and Change Trailer, Corridors, Air Locks, supply air plenums for the air conditioning units and the Cargo Container Bay Air Handling Unit. Each device PCN1 is wired to the central Fire Alarm Control Panel (FACP). Upon activation, the FACP activates Silo 3 Project fire alarm horns/strobes, sends a fire alarm message to the Savannah River Facility Communication Center via telephone outlets, and send applicable output signals to the Silo 3 Process Control System. The Silo 3 Project also has numerous voice-message speakers that are connected to the site Emergency/Evacuation message system. PCN1

Heat Detection System

Combination rate-of-rise/fixed temperature type heat detectors have been installed above potentially dusty areas (i.e., rubber belt conveyors, within the air handling system, and in the Excavator Room). Each heat detector has a discrete address, will sound a general alarm, and automatically notify the communication center when activated.

F-5.4 Fire Department Response

Fire pre-plans have been developed for each fire area to outline the fire-fighting strategies and precautions required for the Silo 3 Process Facility. These pre-plans have been developed and reviewed with the Crosby Township Fire Department. Selected Silo 3 Process Facility project employees will receive incipient fire training regarding portable extinguishers and the alarm system.

F-6.0 FACILITIES, EQUIPMENT, AND PROGRAM PRESERVATION

F-6.1 Essential Safety Class Systems

No systems are considered essential safety class systems for this project as determined per the Silo 3 accident analysis in Appendix G of this N-HASP.

F-6.2 Vital and Critical Program

Vital Program Impact

A fire in the Process Building would be local and involve only one piece of equipment due to the lack of combustibles and their separation. As a result, recovery would not be more damaging to cost and schedule than other events such as the failure of containment (and the spread of contamination) or equipment failure. Areas where there are combustibles are areas where there is usual occupancy so that personnel would likely be available to mitigate the incipient fire immediately. In addition, the fire detection devices and alarms provided in these areas would alert others to help minimize damage and downtime.

Primary Equipment

All components involved with the retrieval, conveyance, and packaging of silo material are primary equipment. The fire detection system reduces the significance of a fire involving any of these components.

F-6.3 High-Value Equipment

The following values were obtained from estimates and procurements to date:

- Inclined conveyor: $125,000
- Packaging system bag loaders: $400,000
- Package heat sealers: $320,000
- Excavator: $450,000
- Pneumatic Retrieval - Vacuum Blower Skid: $100,000
- Pneumatic Retrieval Collector: $120,000
- Pneumatic Retrieval Cartridge Filter: $65,000
- Motor control centers: $125,000
- 480-volt feeder: $81,000
- Control System: $200,000
- Continuous emissions monitor: $90,000
- Personnel contamination monitors: $90,000
- Tennelec counting systems: $90,000
- Process Vent System Collectors: $90,000
- HVAC: $275,000
- Trailer: $135,000
- Tanks: $90,000

F-6.4 Facility Fire Loss Potential

The maximum credible fire loss (MCFL) and MPFL potential in each fire area includes the cost of property loss, recovery, cleanup, and replacement.

Maximum Credible Fire Loss

- Fire Area 1 – Process, Excavator, and Cargo Container Buildings, and Silo 3 Enclosure: The MCFL is a fire in the packaging area of the Process Building that would result in damage to one of the two Container Management and Packaging Systems. The