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INSTRUCTIONS:
NEW PCN FOR SILO 3 NHASP

Document No	Rev	Status	Title of Document	Comments
40430-PL-0010	1PCN8	APPROVED	SILO 3 RETREIVAL AND DISPOSITION NUCLEAR HEATH AND SAFETY PLAN	ATT: RAYER, DIANA L Project: 40430

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EFFECTIVE DATE	PCN NO.	REV. NO.	DESCRIPTION 6079
03-23-05	2	1	Changes to: (1) Section 1.4.3, *Silo 3 Material Retrieval and Packaging Activities*, to describe the in-line automatic samplers installed above Packaging Stations A and B; (2) Section 10.4, *Derivation of Safety Basis Requirements*, to make text consistent with PR-3; (3) Appendix B, under *Executive Summary*, and Sections B-3.2.3 and B-3.3, to change facility designation from Radiological to Less Than Nuclear; (4) Section, B-4.0, *Final Hazard Category*, to clarify purpose of Appendix G, and to change facility designation from Radiological to Less Than Nuclear; (5) Appendix F (FHA), on Pages 8, 16, 18, and 21, to remove the word "DELETION" left over from a previous PCN; (6) Appendix G, *Accident Analysis*, under Section G-2.3, *Common Assumptions*, to explain the calculated bulk density of 73 lb/ft^3 used in EBA-4; (7) Section G-3.4, *EBA-4: Breach of Full Package*, to discuss the calculated bulk density of 73 lb/ft^3; (8) Table G.3-4, *Breach of a Full Package Scenario Results*, to provide new dose values; (9) Section G-3.7, *EBA-7: ISO Penetrated*, to clarify ISO staging; (10) Table G.4-1, *Dose for Comparison to Emergency Guideline*, to provide new dose values for EBA-4; (11) Table G.4-2, *Dose for Comparison to Emergency Guideline Using Conservative Assumptions*, to provide new dose values for EBA-4; (12) App. G, Att. 4, *EBA-4 Spreadsheet*, *EBA-4 Solids Release*, to provide new dose values based on calculated bulk density of 73 lb/ft^3.
04-15-05	3	1	Changes to: (1) Section 1.4.3, *Silo 3 Material Retrieval and Packaging Activities*, under *Preliminary Pneumatic Retrieval and Equipment Installation*, to make past tense and to delete references to vacuum wand boots; and under *Routine Pneumatic Retrieval*, to delete discussions of vacuum wand boots; (2) Table 10-1, *Silo 3 System Safety Requirements*, to delete PR-4 regarding the flexible boots on the vacuum wands per DCN 40430-JEG-277 and DCN 40430-JEG-278; (3) Section 10.4, *Derivation of Safety Basis Requirements and Process Requirements*, to explain deletion of PR-4.

EFFECTIVE DATE	PCN NO.	REV. NO.	DESCRIPTION
05-24-05	4	1	Change to: (1) Section 16.0, *Emergency Response Plan*, to reflect replacement of landline phones with cell phones, elimination of the Communications Center, and clarification of Silos Project rally points; (2) Appendix F, *Fire Hazards Analysis*, to reflect replacement of land line phones with cell phones, and the replacement of the Savannah Communications Center monitoring system with local Protected Premises alarms.
07-07-05	5	1	Change to: (1) Section 10.3, *Silos Project Technical Safety Requirement (TSR)*, to specify new maximum values for area live loads and concentrated live loads; (2) Section 16.0 *Emergency Response Plan*, to change location of Rally Point 10; (3) Section 20, *References*, to update reference information for the OU4 TSR document.
08-31-05	6	1	Change to: (1) Section 1.4.3, Silo 3 *Material Retrieval and Packaging Activities*, to clarify that remote retrieval may require personnel entry into the Silo.
09/22/05	7	1	Change to (1) Section 7.0 *Hazards Assessment* to add Task 17, "Personnel Entry into Silo for excavator maintenance, ramp installation, material retrieval, etc", (2) Section 9.0 *Hazards Control Matrix* Table 9-1, to revise Task 15 "Cutting a Hole in the Silo 3 Wall Structure" to reflect current documentation (3) Section 9.0 *Hazards Control Matrix* Table 9-1, to add hazards from new Task 17. (4) Appendix A Section A-1.1, *Scope*, to clarify that Appendix A does not address wall cutting and personnel entry, these hazards are addressed in the OWI and in Section 9.
12-07-05	8	1	Change to (1) Sections 1.4, 1.4.1, 1.4.3, to add manual direct loading to descriptions, (2) Section 7.0 *Hazards Assessment* to add Task 18, "Direct Manual Loading Tasks (material retrieval and movement, bag placement, sampling, surveying)", (3) Section 9.0 *Hazards Control Matrix* Table 9-1, to add hazards from new Task 18, (4) Section 10.2, Table 10-1, *Silo 3 System Safety Requirements*, added PR-9 requiring HVAC and PVS for direct loading, (5) Appendix A, Table A.3-4 *Matrix of Tasks*, and Table A.4-1 *Final Hazard Assessment* to address Task 18, (6) Appendix D, added Section D-5.4 and Table 5-2 to address Direct Manual Loading, (7) Appendix F, (8) Appendix G, Section G-2.0 *Accident Analysis Methods* to discuss direct manual loading potential accidents, (9) Appendix H, Sections H-2.0 *General Description* and H-5.1 *Engineering Controls*, to add manual direct loading and delete obsolete portions.

6079

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
    - Manual Direct Loading
  - * Packaging
    - Waste Conditioning
    - Container Filling
    - Filled Container Management
    - Manual Direct Loading
- ON-SITE TRANSPORTATION AND STAGING
- DECONTAMINATION
- DEMOLITION

PCN8

PCN8

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

1.4.1 Basic Silo 3 Operation

To understand the Silo 3 radiological hazards, one must first understand the basic Silo 3 retrieval and disposition operation (see the flow diagram in **FIGURE 1-1**). Waste retrieval is accomplished by pneumatic retrieval and mechanical retrieval (the material was originally transferred into Silo 3 pneumatically). Some material handling and packaging equipment is shared by both systems. The silo itself is enclosed in a fabric structure, which provides protection from the elements to personnel operating the pneumatic retrieval system. Before Silo 3 is accessed for waste retrieval, radon concentrations in the silo headspace will be reduced by venting through the Silo 3 stack.

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

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

From a design point of view, the PRS and MRS are redundant systems. Either system has the capacity for retrieving the entire store of Silo 3 waste material. Current plans call for the PRS to be used prior to, and in conjunction with, the MRS. If the material consistency in the bottom layers of Silo 3 is not compatible with pneumatic retrieval or transport by conveyor, a manual direct loading method may be employed. This direct method will bypass the existing packaging stations and perform all packaging in the excavator room and maintenance bay. PCN8

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

After a soft-sided container is filled, the inner PVC liner is sealed by radio frequency, perforated, and detached from the fill chute at the perforation. The container 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 to the Cargo Container Bay, through an airlock, where it is closed and placed on a shipping pallet. The soft-sided containers are surveyed to meet shipping requirements and staged for labeling inside the Cargo Bay. A labeled soft-sided container will be loaded by forklift into an International Standards Organization (ISO) container on

the Interim Staging Area (ISA). An ISO can hold up to 8 soft-sided containers. 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.

1.4.2 Cutting a Hole in Silo 3 for Mechanical Retrieval

Note: Hole cutting is a construction activity performed by construction labor and authorized by the PHAR. The Silo 4 mock access demonstration was performed during the construction of the retrieval facility. However, Silo 3 wall access will occur after the operations phase has begun because the plan calls for pneumatic retrieval of material behind the intended wall opening. Safety Basis Requirement 1 (Section 10) specifies a deliberate process for proceeding with the wall cutting. Therefore, there will be a short window of time when operations (authorized by this N-HASP) and construction work (authorized by the Silo 3 PHAR [Ref. 14]) will overlap.

Successfully cutting an opening in the Silo 3 wall large enough for mechanical retrieval may be critical to successful project operations if pneumatic retrieval cannot transport the most compacted waste. The project committed to a demonstration of the work steps for cutting such an opening. This demonstration (conducted on now-demolished Silo 4) was designed to verify engineering calculations, support detail vendor design, integrate multiple field activities, analyze observations, and generate lessons learned for subsequent documentation.

Design and preliminary strategies were developed through early collaboration with consultants, engineers, equipment vendors, and construction representatives, including supervisors and craftsmen. An independent structural consultant, considered an expert in reinforced concrete tank design, supported the detailed design. The project bulk powder consultant conducted modeling studies to predict material flow during scenarios that varied by material height at the time of cutting. The overall retrieval approach is documented in 40430-PL-0002, *Access and Retrieval Strategy for the Silo 3 Project* [Ref. 21]. The results of the Silo 4 demonstration are documented in 40430-RP-0028, *Silo 4 Mock-up Demonstration* [Ref. 22]. The following two subsections provide an overview of those results.

Mock Access on Silo 4

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

A 20ft H x 15ft W opening is required for retrieving material with a remote-operated excavator. The access strategy calls for the intended wall opening to be cut into a grid pattern with a track-mounted wall saw. The outside surface of the silo wall was originally reinforced with post-

temporary blanket for covering the manway was used to minimize airborne contamination. While maintaining ventilation on Silo 3 via the PVS, the center manway was opened, pulling air into the manway. The PRS was then started to remove enough material to allow the installation of the Camera and Lighting Assembly into the center manway (approximately eight feet below the manway flange).

While continuing to maintain ventilation on the silo via the PVS, each of the remaining five (5) manways was opened one at a time. Once the manway cover was removed, enough material was again removed to allow airflow to the center manway. This level was determined using the center manway camera. Once this level was achieved, a Manway Vacuum Wand Management System was installed on the manway. This continued until all five Manway Vacuum Wand Systems were installed. PCN3

Routine Pneumatic Retrieval

Note: Prior to installation, the design of the pneumatic retrieval components will be evaluated against, and conform to, the Technical Safety Requirement (TSR) specified in Section 10.3. The pneumatic retrieval strategy has a demonstration plan [Ref. 25] for vacuum wand retrieval and will separately document the results.

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

At each vacuum wand (and associated manway), an enclosure is provided with passive air supply (inlet) and process vent (outlet) hose connections. DELETION PCN3

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

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

DELETION. There is a pressure transmitter on the silo dome to provide an alarm if the silo pressure becomes greater than 3 inches WC vacuum. The pneumatic system also has a low-pressure switch on the blower inlet that will open a blower inlet relief valve, and a low-flow switch to shut down the blower in the event of a plug in the pneumatic system or the passive air supply. PCN3

The PRS is contained in a steel beam/metal-sided building (the Process Building) adjacent to the silo. The PRS provides pneumatic, vacuum flow using rotary blowers. From the VWMS, the material/air stream enters the PRS baghouse collector, where material is separated from the air stream and fed by a screw conveyor and rotary airlock to the packaging screw conveyor. The air

stream from the PRS baghouse collector passes through a cartridge filter, a high-efficiency particulate air (HEPA)/ ultra-low penetrating air (ULPA) filter, and rotary blower and is discharged via the Silo 3 exhaust stack. Material collected by the cartridge filter is fed by the same screw conveyor and rotary airlocks to the packaging screw conveyor.

Pneumatic retrieval will be performed to the extent practicable (i.e., as long as material can be safely and effectively removed by vacuum). Personnel entry into the silo, to facilitate placement of the vacuum wand may take place during mechanical retrieval. Of significant importance is the use of the VWMS/PRS for removal of material from behind the silo wall, at the proposed access location, to permit safe wall opening for mechanical retrieval. The VWMS/PRS can be used prior to the MRS and in conjunction with it. PCN8

Mechanical Retrieval

The Mechanical Retrieval System (MRS) is housed in a robust concrete structure (Excavator Building) attached to the silo structure. When free-flowing material has been removed from the silo to expose the inside of the silo wall, and pneumatic retrieval is no longer practical, an opening will be cut into the exposed silo wall to enable the use of a mechanical excavator (see Section 1.4.2). Compacted material remaining behind the wall will not prevent initiation of wall removal.

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

The excavator can reach into the silo and loosen compacted material for vacuuming. Video cameras to allow for remote viewing. The excavator may also be used to manipulate the VWMS wand/hose to facilitate pneumatic retrieval. The remotely-operated excavator will enter the silo and dig into the waste pile. Removed material will be pneumatically retrieved, or placed in a below-grade bin in the Excavator Room and then moved to the two packaging stations via four conveyors. Three of the conveyors are screw-type, and one is a pocketed sidewall belt conveyor. The last of the screw-type conveyors is common to the PRS. Controlled personnel entry into the silo may be required to facilitate retrieval or perform non-routine maintenance. PCN6

Waste Conditioning

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

Container Filling and Sampling

PCN1

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

In-line dry material samplers have been installed underneath the screw feeders for the two drop chutes above Packaging Station A and B. Each sampler includes a PLC controller for setting sampler timers and counters. The sampler will collect numerous grab samples in a 125-ml plastic sample jar. When material flow is verified, the operator will initiate the sampling cycle. The sampler will then perform a number of grab samples, as programmed, with a set time delay between samples. When the sampler has completed the sampling routine, the operator will unscrew the sample jar, place a lid on it, and attach a new jar for the next sampling event. The sample will be handled and analyzed in a manner similar to samples taken from the Silo 3 waste packages. PCN2

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. PCN1

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).

Filled Container Management and Preliminary Staging PCN1

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.

Manual Direct Loading

If material consistency in the bottom layers of Silo 3 is found to contain high moisture or is too compacted for processing through the existing retrieval systems, an alternative approach consisting of bulk retrieval and direct loadout may be employed. This work would be performed with a manned, enclosed cab, diesel powered front-end loader, retrieving material from inside the silo and loading it into containers in the excavator room. PCN8

The filled containers will be moved into the excavator maintenance room for closure of the two inner liners, and decontamination of the container and loading frame. The container, still in the loading frame, will be transported through the Direct Loadout Connector Building into the Cargo Bay. There the container will be lifted out of the frame using the bridge crane, the outer layer sealed, and the package placed on a skid. All movements of containers and frames in the Excavator Building and in the Direct Loadout Connector Building will be accomplished through use of a battery powered forktruck. No liquid additives will be added to the material unless required for dust control.

The containers and frames to be used will be the same 96 cubic foot, double layer, coated woven polypropylene soft-sided packages, with two 6-mil poly liners rather than the 30-mil PVC inner liner. The change in the liner thickness does not prevent the package from meeting the requirements for an IP-2 container. There is a small inventory of bags that are not IP-2 rated. If any of these non IP-2 bags are used, or if any of the approved IP-2 containers fail to meet specs after loading/sealing, then the shipping ISO will be a certified IP-2 rated container.

During material loading into the containers, one operator will be inside the front-end loader; otherwise the excavator room will be unoccupied. To minimize airborne contamination, loading will occur in a ventilated containment enclosure. Approximately three other operators will be in PPE stationed inside the excavator maintenance room for immediate entry into the excavator room or silo, if needed. The outer roll-up door may be positioned slightly opened, or other means may be employed, to maximize airflow velocity into the maintenance bay. This action will take place prior to opening the inner roll-up door. The empty soft-sided container inside a loading frame will be moved into a ventilated Filling Station inside the Excavator Room using the electric fork truck. Once inside the Filling Station, the rear doors on the Filling Station will be closed and the inner roll-up door will be closed.

After the container is filled, the inner roll-up door will be opened, the Filling Station doors will be opened and an operator will perform gross cleanup of the frame. The container will be moved out of the Filling Station to the full container preparation area in the Excavator Service Room and another empty container placed into the Filling Station. Once in the full container preparation area, a sample will be obtained and the two inner liners will be closed, followed by final decontamination of the container and frame.

The containers will then be lifted out of the frame, RCT's will perform a swipe and dose rate survey, and the containers will be placed in the sealand package for shipment. The sealand package will then be closed, surveyed, and staged for shipment.

PCN8

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.

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

Description of Activity/Design Change:

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

IF the proposed change could involve silo containment as described in the Technical Safety Requirements (TSR) document (see N-HASP Section 10.3), **THEN** a USQD/safety evaluation must be completed per NS-0002 (Unreviewed Safety Question [USQ] Determination).

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

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

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

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

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

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

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

S-F-5889
Rev. 1: 06/24/04

7.0 HAZARDS ASSESSMENT

The hazards assessment associated with this N-HASP will focus on the activities necessary to support operations and maintenance of Silo 3. To date, sixteen Silo 3 operations tasks have been identified for routine performance by Fluor Fernald maintenance and operations personnel, and one by construction personnel (#15):

NOTE: Hazards associated with these tasks may initiate accidents are addressed in Appendices A, B, and G. PCN7

1. Truck transport of empty containers and containerized additive materials
2. Receipt of Silo 3 bulk chemicals
3. Manipulation of the Pneumatic Retrieval System (PRS) vacuum wand and hose
4. Maneuvering of the Mechanical Retrieval System (MRS) remote control vehicle
5. Conditioning and packaging of retrieved waste
6. Loading of containerized material
7. On-site transportation of containerized waste materials
8. Maintenance of the Pneumatic Retrieval System (PRS), Air Handling Systems, and Process Vent System
9. Maintenance of motorized vehicles
10. Maintenance of conveyors, feeders, and packagers
11. Maintenance of cranes
12. Maintenance of Waste Additive System and Wastewater System
13. Maintenance of Plant/Breathing Air System
14. Shift-by-shift surveillance of Silo 3
15. Cutting a hole in the Silo 3 wall structure (Note: This is Construction work) PCN7
16. Headspace venting, preliminary pneumatic retrieval, and equipment installation
17. Personnel entry into silo for excavator maintenance, ramp installation, material retrieval, etc
18. Direct Manual Loading PCN8

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

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

TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs

Task 17 (cont): Personnel Entry into Silo for excavator maintenance, ramp installation, material retrieval, etc	Confined spaces	• Confined Space Entry procedures
		• Confined Space Training
		• Proper labeling of Confined Spaces
		• Silo will be considered confined space until testing determines otherwise
		  • 2 man rule
		  • Retrieval harness required
			SOP
			
			FCP Work Permit
			
			Confined Space Entry Permit

	Heat stress	• Implementation of the FCP cold/heat stress programs	S&H Procedures SPRs FCP Work Permit
	Radiological: Airborne radioactivity, contamination, radiation	• Use of remote cameras • Workers will perform tasks in accordance with procedures • Workers will qualify as 40-hr HAZWOPER/Rad Worker • Protective clothing and equipment will be used as prescribed by Radiological Controls • Work area contamination levels will be kept to a minimum • RCTs will perform contamination surveys to determine work area control levels • RCT oversight • Workers will doff potentially contaminated PPE per posted instructions • Personnel instructed not to approach areas inside the silo where material is adhered to the wall at heights greater than 4 ft	FF RWP ALARA Analysis HPP SOP

PCN7

TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 17 (cont): Personnel Entry into Silo for excavator maintenance, ramp installation, material retrieval, etc	Chemical	• Workers will perform tasks in accordance with procedures • Workers will qualify as 40-hr HAZWOPER • Industrial Hygiene monitoring, as needed • Workers to wear prescribed PPE • Follow the directions outlined in the MSDS for handling lockdown spray, plumber's stop, etc.	FCP Work Permit S&H Procedures MSDS
Task 18: Direct Manual loading tasks (material retrieval and movement, bag placement, sampling, surveying)	Slips, trips and falls	• Good housekeeping practices will be followed by all personnel • Area lighting will be adequate for the type of work to be performed • If possible, avoid walking on uneven surfaces • Observe work area tripping hazards when coming to and leaving the area • Fall protection • Dome access prohibited during manual loading	SOP SPRs FCP Work Permit
	Noise	• Workers will be trained in accordance with SPR reqs. • Wear hearing protection if required by area posting	SPR S&H Procedures
	Housekeeping	• Maintain work areas and personnel access-ways free of obstructions and debris	SPR
	Illumination	• Work area lighting levels optimal for performing the activity • Spotters employed when needed	SOP S&H Procedures
	Pinch/Crush points	• Workers will wear proper PPE • Guards on tools where possible	FCP Work Permit

PCN7

PCN8

TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 18 (cont): Direct Manual loading tasks (material retrieval and movement, bag placement, sampling, surveying)	Confined space	• Confined Space Entry procedures • Confined Space Training • Proper labeling of Confined Spaces • Silo will be considered confined space until testing determines otherwise • 2 man rule	SOP FCP Work Permit Confined Space Entry Permit
	Ergonomics-lifting, manipulating, surveying	• Work durations will be administratively controlled/limited via worker rotation • Mechanical devices to be used to minimize lifting when possible	SOP FCP Work Permit
	Head impact	• Head protection will be worn by personnel when the potential for falling objects or head injuries due to impact exist.	SPR FCP Work Permit
	Hand and Power tools, survey instruments	• Workers will perform tasks in accordance with procedures/instructions • Guards on tools where possible • Ground fault interrupters	FCP Work Permit
	Hazardous Energy: electrical shock, inadvertent equipment start-up, compressed air	• Energy isolation will be performed per site procedures • Only trained personnel will perform work on locked out/tagged-out equipment • Work planning to address workers in vicinity of motorized vehicles	EIP/SOP FCP Work Permit SPR 2-11
	Hoisting and rigging: Lifting full bags	• Workers will be trained in accordance with SPR reqs. • Workers will perform tasks in accordance with standard operating procedures	SOP SPR
	Flammable material	• Workers will perform tasks in accordance with SPR. • Combustible loading evaluated.	SOP SPR

PCN8

TABLE 9-1: SILO 3 HAZARDS CONTROL MATRIX

Task	Hazard	Mitigators/Controls	Permits/ Guid. Docs
Task 18 (cont): Direct Manual loading tasks (material retrieval and movement, bag placement, sampling, surveying)	Heavy equipment	• Operators must obey all FCP posted speed limits • Operators must obey all FCP traffic safety rules	SPR 7 - 3 Qualified Operators
	Heat and cold stress	• Implementation of the FCP cold/heat stress programs	SPRs
	Radiological: airborne radioactivity, contamination, radiation	• Use of remote cameras • Workers will perform tasks in accordance with procedures • Workers will qualify as 40-hr HAZWOPER/Rad Worker • Protective clothing and equipment will be used as prescribed by Radiological Controls • Work area contamination levels will be kept to a minimum • RCTs will perform contamination surveys to determine work area control levels • RCT oversight • Workers will doff potentially contaminated PPE per posted instructions • Personnel instructed not to approach areas inside the silo where material is adhered to the wall at heights greater than 4 ft	FF RWP ALARA Analysis HPP SOP
	Chemical	• Workers will perform tasks in accordance with procedures • Workers will qualify as 40-hr HAZWOPER • Industrial Hygiene monitoring, as needed • Workers to wear prescribed PPE • Follow the directions outlined in the MSDSs.	FCP Work Permit S&H Procedures MSDS

10.2 Silo 3 System Safety Requirements

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

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

TABLE 10-1: SILO 3 SYSTEM SAFETY REQUIREMENTS

SBR, PR	Requirement	Basis/Source	Implementation
SBR-1	Wall cutting activity, for mechanical retrieval, must be authorized by updated documentation, including but not limited to an Unreviewed Safety Question Determination (USQD) and Operations Work Instructions.	Although consequences are analyzed in this document as EBA-2 (see Appendix G), the wall cutting activity is authorized in the Silo 3 PHAR [Ref. 14] and the work will be done by Construction.	• NS-0002 • Management assessment
PR-1	The Silo 3 stack monitoring capability will be maintained within defined operability parameters, with established action level thresholds and operating limits. Operating data from the particulate filtering system (i.e., pressure differential) can be relied upon during maintenance events on the stacks samplers.	Public and Worker Protection, Environmental Protection Agency (EPA) Required	• 40000-PL-012, *Silos Engineering Project Execution Plan* (i.e. Silos Design Change Notice) • Operations procedures • Routine calibration and maintenance • Routine inspections • Engineering design

TABLE 10-1: SILO 3 SYSTEM SAFETY REQUIREMENTS

SBR, PR	Requirement	Basis/Source	Implementation
PR-2	Individual IP-2 bulk bags shall not exceed 7000 lbs. gross weight.	EBA-4 (App. G) Test Report for IP-2 Container Testing [Ref. 65]	• Operations procedures • Routine inspections • Engineering design • Routine calibration and maintenance
PR-3	Verify that IP-2 bulk bags/packages are sealed per the IP-2 Container Closure Instructions [Ref. 66] before transfer outside of the Cargo Bay area. If a package is rejected because it cannot be sealed, it may be relocated outside the Cargo Bay area, but only one reject package may be moved at a time.	Shipping requirement EBA-4 (App. G) Test Report for IP-2 Container Testing [Ref. 65] Engineer Evaluation of IP-2 Containers [Rev. 67]	• Operations procedures • Routine inspections • Engineering design • Routine calibration and maintenance
~~PR-4~~	DELETED (SEE DISCUSSION IN SECTION 10.4, *DERIVATION OF SAFETY BASIS REQUIREMENTS AND PROCESS REQUIREMENTS*)	DELETED	DELETED
PR-5	During pneumatic retrieval operations, a vacuum relief valve must be installed on Silo 3, set to −3.0 inches of water, with alarm indication. NOTE: Does not apply to Preliminary Pneumatic Retrieval and Equipment Installation.	Dome Failure, protect Silo Dome TSR	• I-TAB • Routine inspections • Engineering design • Routine calibration and maintenance
PR-6	Preliminary Pneumatic Retrieval and Equipment Installation will be performed per the OWI package as reviewed and approved by an SSA.	Consequences bounded by EBAs in Appendix G. Public and Worker Protection, Containment	• OWI
PR-7	No more than 8 sealed, soft- sided containers may be staged in the ISA or other staging area without being in an ISO.	EBA-6, EBA-7 (App. G) Public and Worker Protection, Containment	• Administrative control
PR-8	ISOs containing Silo 3 materials shall not be stacked more than two high.	EBA-6, EBA-7 (App. G) Public and Worker Protection, Containment	• Administrative control
PR-9	The HVAC and PVS must be operational during direct manual loading.	Public and Worker Protection, Containment	• Administrative control

PCN3

PCN8

Identification of the required SBRs and PRs was completed by a team of Silos personnel representing Operations, Quality Assurance, Engineering, Project Safety, and Nuclear and System Safety. Although none resulted in significant radiological consequences, each of the seven EBAs described in Appendix G, as well as Environmental and Operational ALARA details, were considered for potential requirements to protect the Hazard Categorization.

Examination of EBA-1 (hose rupture) did not result in any single component or administrative control that required special protection, as the equipment was of rigorous design and construction, and detection of any spill resulting from hose rupture would be immediate in the occupied facility. Examination of EBA-2 (silo failure due to wall cutting) resulted in SBR-1, to ensure that the work plan for cutting into the Silo 3 wall was documented and implemented with the proper rigor. Examination of EBA-3 (material spill from conveyor) also did not result in any single component or administrative control that required special protection. As was the case for EBA-1, the equipment was of rigorous design and construction, and detection of any spill resulting from conveyor failure would be immediate in the occupied facility.

EBA-4 (package failure during transport to pallet) was examined and two PRs were developed for this scenario. Both PR-2 (gross weight at or below 7000 pounds) and PR-3 (bag are sealed before transfer to ISA) describe maintaining the bags within the parameters tested for DOT compliance. EBA-5 (filter system failure during retrieval) was examined but did not result in any single component or administrative control that required special protection. This was due to the fact that an abrupt pressure change resulting in filter failure had multiple levels of prevention, and consequences were limited by the immediate loss of ability to pneumatically retrieve. PCN2

PRs 1, 4, 5, and 6 were developed to protect parameters outside the EBA scenarios. PR-1 requires capability to measure stack concentration, to meet an environmental release requirement for radon. PR-4 was deleted with PCN3 of this N-HASP. PR-4 required a visual inspection of the fabric boot that sealed the Silo to the pneumatic retrieval system. Initial vacuum wand operation demonstrated that process ventilation at the manway ventilation ring provides adequate airborne containment without use of the boot. Retrieval is less difficult without the boot because operators can directly see the operation. The potential for significant negative pressure within the silo is essentially eliminated without the boot. PR numbering is being maintained to minimize negative impact on referencing procedures. PR-5 protects the TSR for the Silo dome, as it requires the vacuum relief valve to be set properly to prevent underpressurization of the silo that could cause dome collapse. PR-6 is an administrative control that requires review of an Operation Work Instruction (OWI) package for preliminary pneumatic retrieval and equipment installation. PCN3

EBAs 6 and 7 were added when staging of material in the ISA was better defined in the scope of the N-HASP. Two PRs were developed for defense-in-depth of material staging. PR-7 limits sealed bags not contained in an ISO to eight, and PR-8 limits the stacking of the ISOs to two high.

PR-9 was added to ensure that ventilation was available to control airborne contamination during direct manual loading of material. PCN8

11.0 TRAINING REQUIREMENTS

The *Silos Project Training and Qualification Program (TQP) Description*, TQP-067, [Ref. 69] establishes the training and qualification requirements for Silos personnel. The program's objectives are to:

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

The program ensures that workers meet the minimum requirements of 29 CFR 1910.120, DOE Order 5480.20A [Ref. 70] (applicability as described in RM-0043, *FEMP Training Implementation Matrix* [Ref. 71], and other relevant regulations, as applicable.

Health and Safety Training

Workers will receive the appropriate training based on their scope of work. Workers performing activities which fall under 29 CFR 1910.120 [Ref. 72] will receive a required number of hours of initial and annual-refresher health and safety training for hazardous waste site operations. In addition to the initial health and safety training, workers will receive one to three days of directly-supervised field experience.

All personnel performing work under 29 CFR 1910.120 are required to be trained per RM-0055, *FEMP Access* [Ref. 73], in one of the following categories:

- Occasional Site Worker
- General Site Worker

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

Job and Safety Briefings (all hazards)

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

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/equipment	2f	X	X	X	X	X	X
Chemical Energy							
Fire/explosion from fuels	3a		X	X		X	X
Electrical Energy							
Overhead lines	5a		X				X
Utility or battery connection/disconnection	5b		X	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		

PCN8

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	X	
Breach of DOT package - ISA	14f			X		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	X	

PCNs1, 8

PCN8

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	
Biohazards							
Poison ivy, snakes, bees and insects	17a		X			X	X
Industrial Hazards							
Welding and burning	21a		X				X
Confined space entries	21b		X	X			X
Traffic–trucks, heavy equipment, people	21c		X	X		X	X

PCN8

Note: The final integrated hazard analysis ID numbers designate specific hazards that are addressed in TABLE A..4-1.

A-4.0 FINAL HAZARD ASSESSMENT TABLE

The hazard selection criteria for the final integrated hazard analysis table have an emphasis on radiological hazards because of the nature of the waste materials. The criteria include:

- worker exposure to physical, chemical, or radiological hazards while performing the identified task or subtask
- spread of radioactive contamination because of inadequate administrative controls
- release of toxic or radiological materials to the atmosphere, ground, or groundwater because of catastrophic failure of an SSC
- health and safety hazards to workers during general construction
- standard industrial hygiene and safety hazards in an industrial facility

The final integrated hazard analysis table, **TABLE A.4-1** is organized as described in SECTION A-3.1 for each task and subtask. The hazard types are the applicable hazards taken from *Hazard Analysis Report for Operable Unit 4 (OU4)*, Appendix B [Ref. 17].

This information was then used to identify safety hazards that require special attention and/or additional analysis. TABLE A.3-2 contains the criteria for significant hazards as defined in NS-0005, *Initiating, Reviewing, and Approving DOE-Approved SBDs* [Ref. 2]. TABLE A.3-3 provides the consequence classifications employed for this final integrated hazard analysis. These consequence classifications were selected for inclusion in the final integrated hazard analysis tables under the heading of "severity."

The frequency and severity of the unmitigated hazard consequence are listed in the final integrated hazard analysis table. If the intersection of the hazard consequence and the hazard frequency falls within the cross-hatched area of TABLE A.3-2, the hazard is designated as a significant hazard and the column is marked "Yes." If the intersection is outside the cross-hatched area, the hazard is not designated a significant hazard and the column is marked "No." Standard industrial hazards are marked "SIH."

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
2a	Drop crane load during construction, container handling, or demobilization	Crane lifts	Personnel injury, equipment damage	Y	-	-	SIH	Qualified riggers and equipment operators. Inspect rigging. Uses approved procedures. Appropriate approval for critical lifts. A dropped load over the silo is addressed in ID No. 2e. A spilled container is addressed in ID No. 14f.
2b	Crane load swing	Crane lifts	Personnel injury, equipment or facility damage	Y	-	-	SIH	Qualified riggers and equipment operators. Inspect rigging. Uses approved procedures. Appropriate approval for critical lifts.
2c	Drop tools/ equipment	Working at heights	Personnel injury	Y	-	-	SIH	Hard hats, safety nets or tie off of tools as necessary.
2d	Personnel fall	Working at heights	Personnel injury or fatality	Y	-	-	SIH	Fall protection when working at heights >6 ft, personnel training, PPE, barriers.
2e	Structural failure of silo due to degraded structural condition	Drop load, excessive load, or earthquake	Release of radioactivity	N	Anticipated	Moderate	Yes	Based on the uncertainty in the structural integrity, the life expectancy cannot be determined. Therefore, failure is anticipated. Consequence analysis performed in the PHAR [Ref. 9]
2f	Vehicle crash into facility or containers	Vehicle/forklift traffic in immediate area	Release of radioactivity	N	Anticipated	Very Low	No	Work sequencing, traffic control, and training.

PCN8

6079

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
3a	Fire	Fuel storage and use, or ignition source	Damage to equipment and facilities. Personnel burns and injury.	Y	-	-	SIH	Storage and refueling in accordance with NFPA. Minimize combustibles. Fire protection program.
3a	Fire/explosion	Propane explosion around packaged material	Release of radioactivity	N	Incredible	Low	No	LEL for propane cannot be achieved in area. Storage in accordance with NFPA.
5a	Electric shock	Strike overhead power lines with equipment	Electrocution, burns, shock	Y	-	-	SIH	Maintain minimum distance per OSHA.
5b	Electric shock	Install or disconnect electric power, battery	Electrocution, burns, shock	Y	-	-	SIH	Qualified electrical workers, lockout/tagout program, proper tools, use approved procedures
5c	Electric shock	Use of hand tools, maintenance	Electrocution, burns, shock, or fatality	Y	-	-	SIH	Qualified electrical workers, lockout/tagout program, proper tools, use ground fault interrupters
6a	Impaired vision	Inadequate lighting	Personnel injury	Y	-	-	SIH	Human factors review of facility design, provide adequate temporary lighting, per OSHA, for construction and D&D.
6b	Slips and trips	Icy surface, uneven working surface, poor housekeeping	Personnel injury	Y	-	-	SIH	Housekeeping to minimize clutter and ice, sturdy work shoes, design reviews to ensure adequate surfaces.

PCN8

PCN8

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

6079

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, work planning
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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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
21c	Traffic	Material delivery, transport, construction, demolition, manual direct retrieval	Personnel injury, equipment damage	Y	-	-	SIH	Observe speed limits; establish/maintain appropriate traffic patterns, traffic control devices, warning equipment, and backup warning devices, work planning

PCN8

*SIH = standard industrial hazards, Y = yes, N = no
CFR = *Code of Federal Regulations*
D&D = decontamination and decommissioning
MSDS = Material Safety Data Sheets
NFPA = National Fire Protection Association
OSHA = Occupational Safety and Health Administration
PPE = personal protective equipment
RWP = radiological work permit
TLD = thermoluminescent dosimeter

6079

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TABLE OF CONTENTS

Executive Summary 7

D-1.0 Introduction 8

D-1.1 Scope 8
D-1.2 Background Information 8
D-1.3 Process Description 9

D-2.0 General Requirements 13

D-2.1 Design Criteria 14
D-2.1.1 External Exposure and Shielding Criteria 15
D-2.1.2 Control of Airborne Radioactive Materials 15
D-2.1.3 Design Development 16
D-2.2 Radiation Protection 17

D-3.0 Existing Radiological Conditions 18

D-3.1 Silo 3 Material 18
D-3.2 Radon 20

D-4.0 ALARA Analysis and Review Processes 21

D-4.1 ALARA Review Criteria 22
D-4.2 ALARA Committee Review 22

D-5.0 Silo 3 Facility ALARA Analysis Results 23

D-5.1 Duration of Silo 3 Project Tasks 23
D-5.2 Internal Exposure to Radon and Other Radionuclides 24
D-5.3 External Radiation Exposure 24
D-5.3.1 Operations 25
D-5.3.2 Maintenance and Inspection 27
D-5.3.3 Inspection of Packaged Material Staged For Transportation 30
D-5.4 Direct Load-out Operations 30

D-6.0 References 39

LIST OF FIGURES

D.1-1. SILO 3 PROCESS FLOW DIAGRAM 11
D.1-2. SILO 3 PROCESS BUILDING LAYOUT 12

LIST OF TABLES

D.2-1: ALARA FEATURES 14
D.2-2: SILO 3 APPLICATION OF ALARA FEATURES 15

D.3-1: SILO 3 MATERIAL-SPECIFIC ACTIVITY 19
D.3-2: SILO 3 RELATIVE DOSE FRACTIONS 20
D.3-3: SILO 3 RADON INVENTORIES AND EMISSIONS 21

D.5-1 and 5-2: ALARA AND EXPOSURE ANALYSIS MATRICES 31

PCN8

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 construction or decommissioning. PCN8

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

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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. DELETION PCN1

By November 2005 (due to high moisture content or compaction of the material) pneumatic and mechanical retrieval was no longer effective, and the project (in December 2005) established another loading process, as described in section D-5.4. Prior to this transition nearly 1,500 IP-2 packages had been produced from an initial estimate of 1,88! An initial collective dose estimate was made for 7,856 person-mrem. At the transition time Silo 3 has accumulated approximately 5,300 of the estimated 7.856 person-mrem. This revision to Appendix D includes the current 5,300 person-mrem, and a new dose estimate of 3,190 person-mrem for the remaining 400 packages, resulting in a new collective dose estimate of 8,490 person-mrem (net increase 634 person-mrem). The principal change to this document is the addition of section D-5.4. PCN8

Because the estimated total collective dose for the Silo 3 Project exceeded 2 person-rem, the ALARA trigger level used at Fernald, a formal ALARA Committee Review was 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.

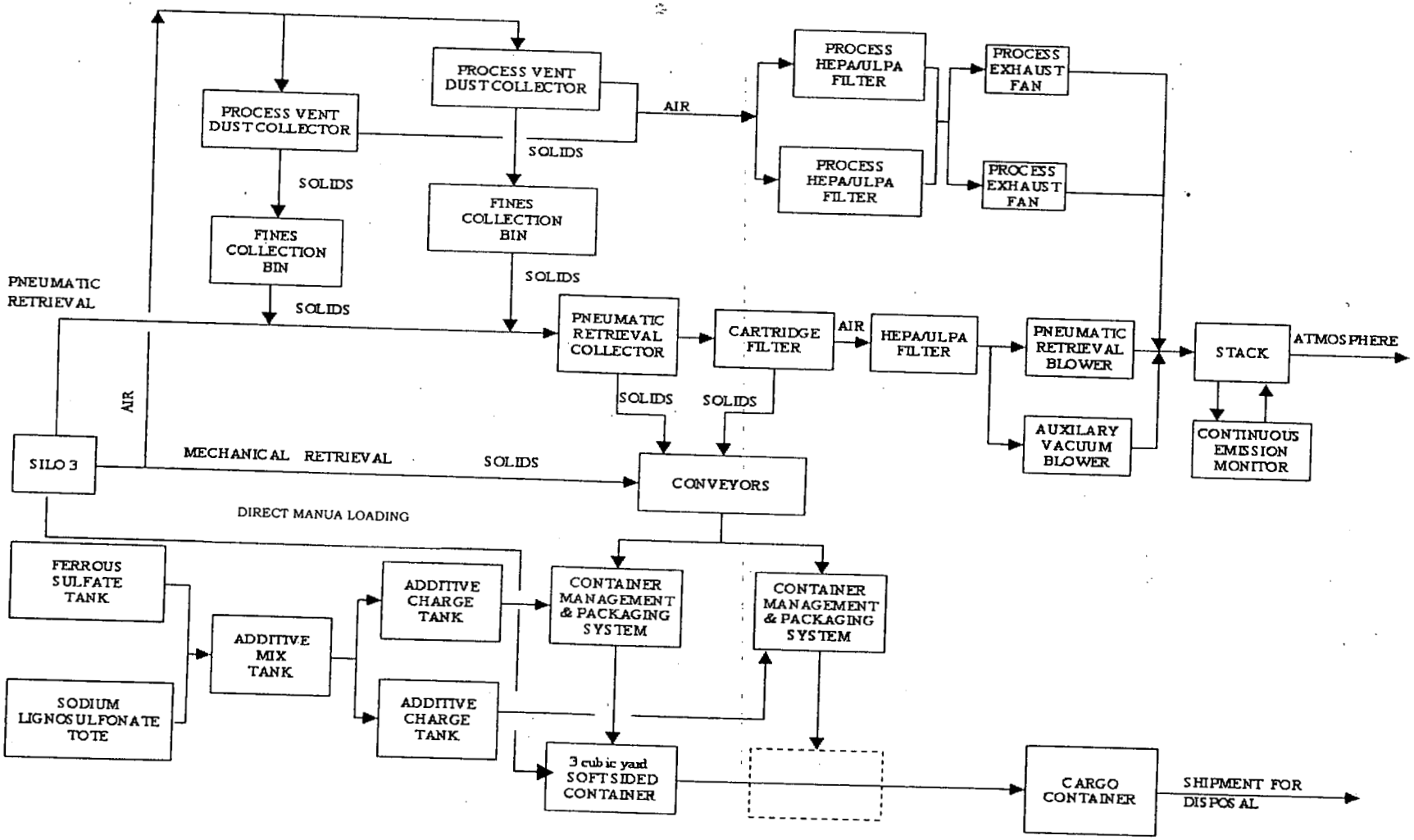

FIGURE D.1-1. SILO 3 PROCESS FLOW DIAGRAM

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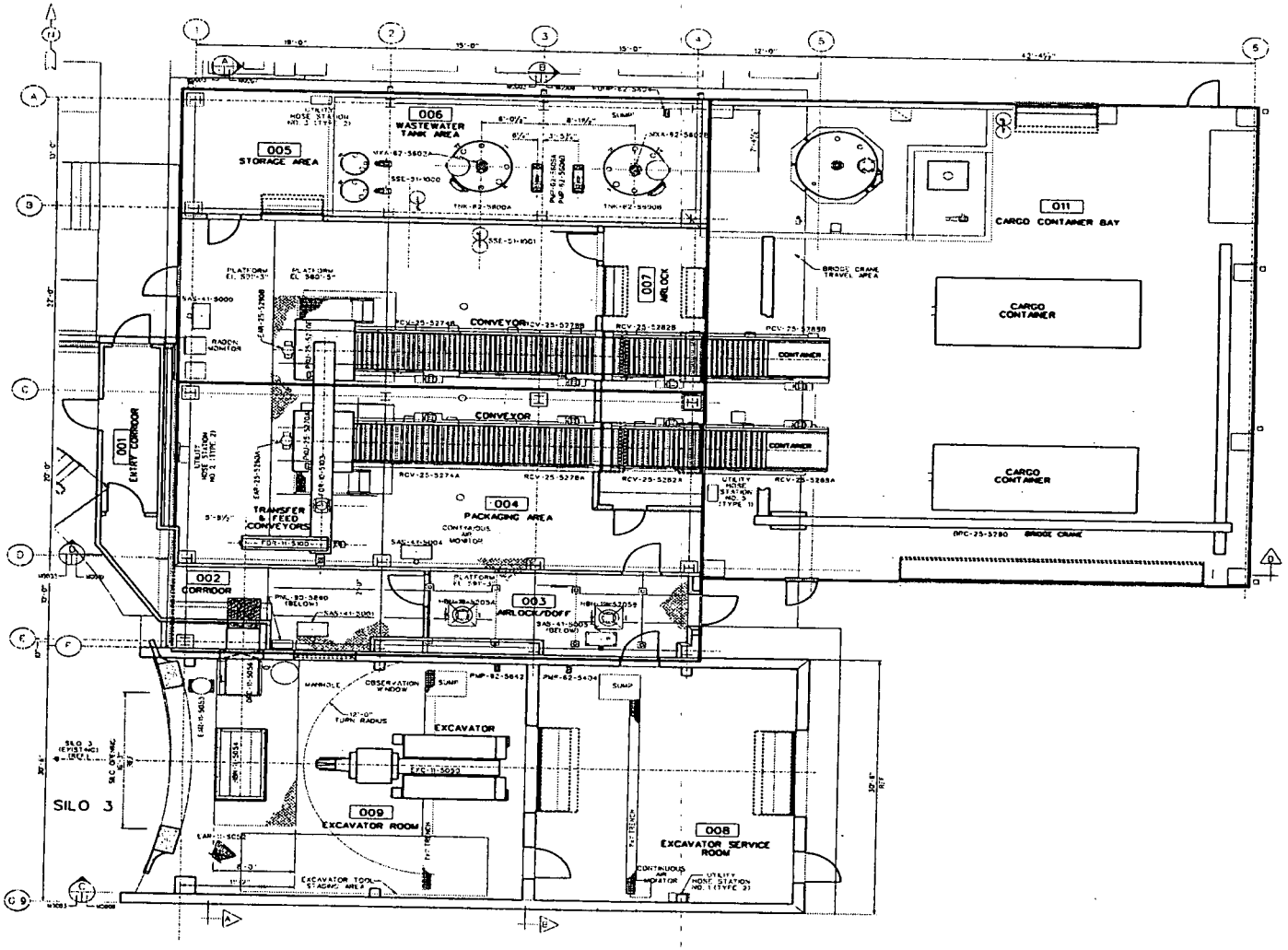

FIGURE D.1-2. SILO 3 PROCESS BUILDING LAYOUT

TABLE D.2-2: SILO 3 APPLICATION OF ALARA FEATURES (Numbers refer to ALARA features listed in TABLE D.2-1)			
Exposure Route	**System**		
	Pneumatic Retrieval	**Mechanical Retrieval**	**Packaging and Container Management**
External	19, 14, 21	15, 14, 21	14, 21
Surface contamination	4, 5, 7, 9, 10, 18, 21	4, 5, 6, 7, 8, 9, 11, 12, 18, 21	9, 10, 18, 20, 21
Airborne contamination	2, 3, 4, 5, 6, 7, 9, 10, 18	3, 4, 5, 6, 7, 8, 9, 11, 12, 18, 21	3, 4, 5, 9, 10, 18, 20, 21
Environmental release (particulate)	2, 3, 16, 17, 18, 21	3, 16, 17, 18, 21	13, 16, 17, 18, 21
Environmental release (radon)	16, 17	16, 17	3, 16, 17
Environmental release (water)		21	

D-2.1.1 External Exposure and Shielding Criteria

The criteria for the Silo 3 Project design will be in accordance with the requirements of 10 CFR 835.1002(c), *Facility Design and Modifications* [Ref. 2]. Specifically, the design objective for controlling personnel exposure from external sources of radiation in areas of continuous occupancy (2,000 hours per year) shall be to maintain dose rates below an average of 0.5 mrem per hour and as far below this limit as is reasonably achievable. Therefore, the continuous occupancy design objective for the gamma radiation exposure rate is established at 0.5 mR/hour. Areas with exposure rates in excess of the 0.4 mR/hour objective are intended to be controlled through administrative and work improvement processes, ensuring personnel exposures are minimized. The Silos 3 Project has adopted a more restrictive dose objective of 0.4 mR/hour to allow for an offset of the expected annual dose from airborne radon. An exposure rate of 0.4 mR/hour is assumed equivalent to a dose rate of 0.4 mrem/hour.

D-2.1.2 Control of Airborne Radioactive Materials

The criteria for new facility design shall be in accordance with the requirements of 10 CFR 835.1002(b), *Facility Design and Modifications* [Ref. 2]. Specifically, the design objective of confinement and ventilation for the control of airborne radioactive material shall be, under normal conditions, to avoid releases to the workplace atmosphere and in any situation, to control the inhalation of such material by workers to levels that are ALARA. Confinement and ventilation shall normally be used.

The design has been reviewed to ensure that concentrations of radioactive materials, especially radon, in occupied areas during normal operating conditions are ALARA. The airborne concentrations are not expected to exceed 10 percent of the derived air concentration (DAC) listed in 10 CFR 835, Appendix A. Therefore, respirators would not

normally be required. DELETED

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Design features have been incorporated to prevent the buildup and spread of contamination. Surfaces from which radioactive material can be resuspended are minimized (e.g., scaffolding, open rafters, hanging light fixtures, cable runs). The ventilation system and facility layout design will ensure that:

- Appropriate pressure differential exists between the areas of high contamination and the outside to prevent the spread of contamination. It is required that the isolation area (work area) have a pressure difference of 0.1 to 0.5 in. water gauge relative to its adjacent area.

- The potentially contaminated airflow is directed away from the worker's breathing zone and is designed to minimize resuspension of contamination. Room air may be recirculated if adequate HEPA filtration and monitoring are provided. Recirculation from an area of higher contamination to an area of lower contamination is prohibited.

- The capture velocity of a hood, hose, or plenum used to capture and redirect suspended contamination is equal to or greater than 150 ft/minute as measured at the source.

- Potentially radioactive particulate effluent discharges are minimized by using HEPA/ULPA filtration. The discharge from ventilation systems is directed away from potential sources of contamination to prevent resuspension.

- The facility layout includes a series of barriers enclosing the various zones that are classified according to the potential level of contamination. The number of barriers depends upon the sources of contamination, the confinement efficiency of each barrier, and the number and types of penetrations. The process equipment provides primary confinement; secondary confinement is provided by the enclosure containment. The ventilation system will be designed to assist the physical barriers within the facility in maintaining zone confinement.

D-2.1.3 Design Development

The Silo 3 Project Radiological Engineering Group reviews and ensures that radiological control requirements are incorporated during the facility design. The normal design process involves the following major steps, each of which requires an appropriate level of radiological review, input, and concurrence:

- functional design criteria,
- preconceptual design,
- conceptual design,
- preliminary design [preliminary hazard analysis report or safety assessment],
- final design [final hazard analysis report or safety assessment],
- documented technical safety requirements, and
- operational readiness assessment or review.

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

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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.

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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*.

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.

D-5.4 Direct Load-out Operations

The purpose of this section is to describe the radiological conditions, engineering controls and associated dose estimates projected for final waste removal and disposition activities. In late November 2005, effective pneumatic and mechanical retrieval was completed and the project transitioned into a final direct retrieval and load-out phase.

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Facility modifications are being made to facilitate operational movements of equipment, packages, and personnel while containing potential airborne concentrations and implementing contamination control measures. Facility airflow design changes are also being made with the HVAC system, which will now pull approximately 8,000 cfm through the silo northwest manway. Other manways have been secured with temporary structural covers.

The material transfer will involve one operator inside a front-end loader placing the material into a container staged inside a containment structure with dedicated ventilation, otherwise the excavator room will be unoccupied. Additional workers will be staged in the

excavator maintenance area dressed in the same level of PPE.

The outer roll-up door will be positioned slightly opened to maximize airflow velocity into the maintenance bay prior to opening of the inner roll-up door. The inner roll-up door will be opened for placement and/or removal of the container and frame from the containment structure, through use of an electric fork-truck. After moving the containers into, or out of, the excavator room containment structure, the inner roll-up door will be closed with the outer roll-up door positioned to ensure an inbound airflow.

The filled containers will be partially closed prior to movement into the excavator maintenance room for full closure of the inner and outer package. A material grab sample will be gathered for isotopic analysis in the excavator or maintenance room based on best contamination control practices decided upon after the start of operations. The container and frame will be moved out of the maintenance area, through an adjoining fabricated structure connecting it to the cargo load-out area. Once in the cargo load-out area, the container will be lifted from the frame with an overhead crane, inspected, weighed and have a radiological survey performed before placement in a shipping container. All movements of containers and frames will be accomplished through use of an electric forktruck. Empty frames will then be prepped with a new container arrangement and the above process will be repeated.

For the PRS, MRS and direct load-out, the end product is an IP-2-approved, soft-sided container or bulk bag containing a plastic bag filled with Silo 3 material. 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.

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The collective dose estimates in TABLE D.5-2 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.

During direct load-out multiple work groups will be performing activities under differing radiological conditions. This section is intended to provide a description of the activities, number of personnel involved, personal protective equipment used and resulting personnel exposure. Direct load-out operations are expected to result in production of approximately 350-400 final IPII containers. For the purposes of this evaluation the dose projections will be based on 400.

One operator inside the Silo and Excavator area collecting the material and loading into the container. Production is estimated at 1 hr/container. The worker will be in anti-c's with a Powered Air Purifying Respirator. External dose: (assuming 25% at 7 mrem inside the silo and 75% at < 1mrem)

Effective external dose averaged at (1.75 mrem/hr)x(400 hrs) = **700 mrem**

Internal particulate exposure = (100 hrs inside the silo)x(750 DAC(max) / 1000 PF) = 75 DAC-hrs at approx. 1.2 mrem CEDE/DAC hr = **90.0 mrem CEDE**

2 workers inside the excavator maintenance room and entering the excavator room preparing and/or closing empty and filled IPII containers. Contact time is estimated at .25 hrs per package. The workers will be in anti-c's with a Powered Air Purifying Respirator.

Effective external dose averaged at (3 mrem/hr at 1')x(400 containers)x(.25 hrs/container)x(2 workers) = **600 mrem**

Internal particulate exposure = **no projected internal exposure considering PF of 1000**

1 RCT supporting operations, performing area monitoring and surveying IPII containers. The RCT will be in anti-c's with a Powered Air Purifying Respirator.

Effective external dose averaged at (3 mrem/hr at 1') x (400 containers)x(.25 hrs/container)x(1 RCT) = **300 mrem**

Internal exposure = **no projected internal exposure considering PF of 1000**

5 workers and supervisors, unloading filled containers from their frames, performing final securing of the package, weighing and loading them into shipping containers. The workers will be in anti-c's with a Powered Air Purifying Respirator.

Effective external dose averaged at (3 mrem/hr at 1')x(400 containers)x(.25 hrs/container)x(5 workers) = **1,500 mrem**

Internal particulate exposure = **no projected internal exposure considering PF of 1000**

Estimated Total Effective Dose Equivalent for load-out operations = **3,190 mrem**

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(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

6079

TABLE D.5-2: ALARA AND EXPOSURE ANALYSIS FOR DIRECT LOADOUT 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
Material pick up and transfer (External Dose)	1	Yes	1	400	400	1.75	0.700	Silo 3 and Excavator Rm
Material pick up and transfer (Internal Dose)	1	Yes	0.25	400	100	0.90	0.090	Silo 3 and Excavator Rm
Container prep and closure	2	Yes	0.25	400	200	3.0	0.600	Excavator and Maint. Rm.
RCT Support	1	Yes	0.25	400	100	3.0	0.300	Excavator and Maint. Rm.
Container movement Loading and unloading	5	Yes	0.25	400	500	3.0	1.5	Excavator and Maint. Rm.
DIRECT LOADOUT SUBTOTAL							3.190	

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

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6079

D-6.0 REFERENCES

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

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

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EXECUTIVE SUMMARY

The purpose of this accident analysis is to determine if any safety-class structures, systems, and components or technical safety requirements are needed for protection of the public. The analysis quantifies the consequences of potential hazards associated with the activities supporting the Silo 3 project and compares the consequences to U.S. Department of Energy (DOE) Evaluation Guidelines.

Analysis of seven accident scenarios produced the radiological dose estimates for collocated workers and off-site populations. The nearest off-site point on the Fernald Environmental Management Project site boundary is approximately 350 m west of the silos. The maximally exposed off-site individual is assumed to be located 350 m downwind of the accident location. The committed effective dose equivalents are estimated in this appendix for individuals located at 30, 100, and 350 m from the point of the release. The values at 350 m are compared to the Evaluation Guidelines (EGs) established by DOE-STD-3009-94, Appendix A [Ref. 1].

The conclusion that can be drawn from the analyses is that none of the accident scenarios analyzed yield consequences that would require "safety-class" controls per DOE-STD-3009-94, Appendix A.

G-1.0 INTRODUCTION

The purpose of this Accident Analysis is to support the final hazard categorization and to determine if any safety-class structures, systems, and components (SSC) or technical safety requirements are needed for protection of the public. Safety-class SSCs will not normally be associated with Hazard Category 2 or 3 facilities due to their limited potential for offsite impact. The analysis quantifies the consequences of potential hazards associated with the retrieval and packaging of the material in Silo 3 including construction and operation of the processing areas and staging of retrieved material. The bounding accidents for the Silo 3 project are fully analyzed and reported in this document for comparison to the DOE-STD-3009-94, Appendix A [Ref. 1] Evaluation Guideline (EG). Safety-class SSCs are required for consequences exceeding an EG of 25 rem total effective dose equivalent to a maximally exposed off-site individual (MOI).

Safety-significant SSCs are those important to defense in depth or onsite worker safety. Although EGs are not used for designating safety-significant SSCs, the onsite impacts are determined in this analysis.

Within this analysis, consequences are determined for:

- workers at 30 m, which represents the distance for determining the dose threshold criteria of DOE Hazard Category (HC) 3 facilities.
- workers at 100 m, which represents the distance for determining the dose threshold criteria of DOE HC-2 facilities.
- The public at 350 m, which is the distance to the MOI. This distance corresponds to the nearest site boundary. The MOI distance is used for comparison with off-site EG.

The scope of the analysis is focused on the accidents most likely to be encountered during the operation, and maintenance of the Silo 3 retrieval and disposition project.

G-2.0 ACCIDENT ANALYSIS METHODS

This section presents the results and major assumptions for the analysis of seven evaluation basis accident (EBA) scenarios associated with the facility. As determined by the hazard category calculations in APPENDIX B, the Silo 3 activities constitute, at most, a "radiological" facility, and accident analyses are not essential. However, these analyses are presented to 1) demonstrate that consequences of accidents would not result in significant localized consequences, and 2) help in determining defense-in-depth controls. The accident scenarios considered are:

- EBA-1: Hose rupture during pneumatic retrieval
- EBA-2: Silo wall containment failure during cutting an opening in the silo wall
- EBA-3: Spill of material from a conveyor failure
- EBA-4: Breach of full soft-sided package
- EBA-5: Failure of the collectors/filters in the pneumatic retrieval system
- EBA-6: ISO Falls
- EBA-7: ISO Penetrated

The locations of scenarios are described in SECTION G-3.0.

Addition of the manual direct loading option Section 1.4.3 was evaluated for potential new accidents. Because all of the mechanisms for release were simply variations of a material spill, it was concluded that the existing 7 EBAs were bounding for any postulated scenarios resulting from manual direct loading.

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H-1.0 INTRODUCTION

This Health Physics Plan (HPP) describes the radiological controls specifically planned for the Silo 3 Retrieval and Disposition Project. It documents the radiological protection program elements and radiological hazards/controls specific to Silo 3 Operations. This HPP also meets the requirements stated in RM-0020 [Ref. 1] for an Occupational ALARA (As Low As Reasonably Achievable) Plan. The following elements are discussed in this document:

- General description of the Silo 3 Project
- Radiological hazards unique to the Silo 3 Project
- Engineering, administrative controls, and personal protective equipment (PPE) to mitigate radiological hazards
- Conduct of radiological work
- ALARA objectives

H-2.0 GENERAL DESCRIPTION OF THE SILO 3 PROJECT

A process flow diagram, **FIGURE H.2-1**, is provided to help describe the Silo 3 waste retrieval and packaging process. For a facility layout, see the 11x17 foldout, **FIGURE 1-4**, in the main body of the N-HASP.

The Silo 3 remediation process consists of two basic parts: waste retrieval and packaging. Retrieval is accomplished in two ways: pneumatic and mechanical. The pneumatic retrieval system is contained in a steel beam/metal-sided building adjacent to the silo. The mechanical retrieval system is housed in an adjacent robust concrete structure. Some material handling and packaging equipment is shared by the two systems.

Prior to pneumatically retrieving material from Silo 3, radon concentrations in the Silo 3 headspace will be reduced by venting the headspace through the Silo 3 stack. Silo 3 is enclosed in a fabric structure, which provides protection from the elements for personnel operating the pneumatic retrieval system (PRS). Initially, waste material will be removed from the top of the silo using a vacuum wand through the existing silo dome man-ways. The entrained material will be transported to a pneumatic retrieval collector. The retrieval collector will collect and separate the air-entrained waste. The air is further treated by a baghouse in series with a cartridge filter to collect any material remaining airborne. Finally, the air is treated with a high-efficiency particulate air (HEPA) and ultra-low penetrating air (ULPA) filter to reduce the amount of particulate material prior to the air being released to the atmosphere.

The material in the retrieval collector is sent via screw conveyors and rotary feeders to one of two packaging stations, where the waste will be dropped into a lined, soft-sided container. The polypropylene bag is a sturdy, flexible container which meets the transportation requirements for an IP-2 package. The poly-vinyl chloride (PVC) liner will be filled using a "bag-out" procedure to ensure that none of the powdered waste is released to the adjacent work area.

The Silo 3 material will be conditioned by the addition of an aqueous solution to reduce dispersibility and metals mobility. The solution of ferrous sulfate, sodium lignosulfonate, and water will be sprayed onto the material in the fill chutes of the packaging stations. Each of the two Package Loading Stands is a semi-automated system with loading spouts, loading stands, thumper tables, weighing scales, and motorized roller conveyors for transporting the filled bags away from the station. Labeled bags are transported to the Cargo Container Bay where they are transferred into cargo containers using a bridge crane.

When the PRS has removed sufficient material from the silo to expose the inside of the silo wall, the mechanical retrieval system (MRS) phase will commence to retrieve the remaining waste. An opening will be cut into the exposed wall of the silo to enable the use of a mechanical excavator. Using a remotely-operated excavator, material will be removed from the silo and placed in a below-grade bin in the Excavator Room. The material will be moved from there to the packaging stations by four conveyors. Three of the conveyors are screw-type, and one is a pocketed side-wall belt conveyor. This conveyor has a mating belt that covers the material during transfer. The last of the screw-type conveyors is common to the pneumatic retrieval system. The conveyers feed the material to the adjacent Process Building.

For both the PRS and MRS, the end product is an IP-2-approved, soft-sided container or bulk bag containing a heat-sealed PVC liner full of Silo 3 material. The packages will be surveyed as appropriate, decontaminated if necessary, and transferred to a Sea/Land container. When the shipping container is full, it will be removed and staged for final shipment off-site.

In late November 2005, effective pneumatic and mechanical retrieval was completed and the project transitioned into a direct manual load-out phase. Modifications were made to facilitate movements of equipment, packages, and personnel while controlling airborne concentrations contamination.

The material transfer involves one operator inside a front-end loader placing the material into soft-sided bags staged inside a containment structure, with dedicated ventilation. The bags will be partially closed, then moved into the excavator maintenance room for full closure and sampling/surveying, followed by placement into shipping containers.

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In all cases where workers are exposed to Silo 3 material, they will be required by 6079 Radiation Work Permit (RWP) to wear full PPE and respirators to prevent skin contamination and inhalation of airborne radioactive material.

Radiological Control Technicians (RCTs) will also measure radon and radioactive airborne particulate concentrations, and determine the requirements for respiratory protection for any plan to access areas. The objective of monitoring and respiratory protection is to prevent exposures to radon concentrations and airborne particulates in excess of 10 percent of their respective DACs, and to ensure that internal exposures to radon and airborne particulates are maintained ALARA.

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When workers breach systems and there is potential to be exposed to contamination from Silo 3 materials, they will be required (by RWP) to wear full PPE and respiratory protection. Thus, the probability of any worker uptake is very low.

Silo 3 radiological workers will participate in the Fernald Closure Project (FCP) bioassay program, as required. Adequate precautions will be taken to maintain internal exposure to workers ALARA.

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H-5.0 ENGINEERING AND ADMINISTRATIVE CONTROLS

H-5.1 Engineering Controls

Management is committed to reducing radiation exposures by applying the ALARA process in the design, construction, operation, maintenance, and demobilization phases of the project. Examples of engineering controls that help maintain work activities ALARA include:

- Silo Enclosure: The use of a silo enclosure protects workers from the weather, thus allowing retrieval activities to be completed in a more timely fashion.

- Vacuum Wand Management System: The use of the Vacuum Wands for waste retrieval limits personnel exposures to bulk amounts of waste by reducing exposure time and increasing the distance from the source of the exposed worker.

- Remote Excavator: The remote excavator and cameras allows the operator to be removed from the exposure source while performing waste retrieval activities. Using an automated remote excavator that is self-greasing, and has interchangeable work attachments, further removes the operator from the exposure source.

- Excavator Room Misting System: Once the excavator is in full operation, a water-misting system may be employed for one or both of the following functions:

  - Dust suppression: During mechanical retrieval, the Silo 3 contents will be disturbed. Dusting in the Excavator Room may result (the excavator will be operated in a manner to minimize dusting).

  - Stabilization of working face: As piles of Silo 3 material are created and "groomed," water misting may be used as a safe working practice to help establish a stable face.

  Water is supplied to the system from a water tank located on the excavator. Tests have shown that the Silo 3 material has a tremendous capacity to absorb moisture before it becomes deliquescent. Because the misting system will be used infrequently and the water introduced is a small fraction of the absorbent capacity of the material, it is expected that the moisture addition would have no deleterious effect on the material handling process.

- Video Cameras: Besides providing viewing for the remote excavator, cameras will also be used by the PRS operators as they remove waste via the silo man-ways. Additional cameras can be employed for remote viewing of personnel and operations to further reduce worker exposures. The use of cameras will help reduce the number of individuals needed to perform work in areas of radiological exposure and the time needed inside the project exposure areas.

Closed-circuit television (CCTV) cameras will be provided at the following locations:

- Silo 3 (selected ports)
- Excavator Room
- Excavator

- Shielding: The project has temporary shielding available (e.g., lead blankets). However, it is not anticipated that shielding will receive widespread use due to the generally low overall radiation levels that are anticipated.

- Ventilation: Silo 3 Project ventilation is designed to maintain the incoming air flow from the silo and waste packaging building negative with respect to atmospheric pressure. The silo and waste packaging buildings have 10,000 cubic-feet-per-minute (CFM) of building ventilation, which can assist in the control of airborne radioactivity in the event of leakage. Building ventilation is pulled through a HEPA filter by an exhaust fan and discharged via the 150-foot monitored stack. Both the HEPA assembly and fan are redundant to provide for continuous operation during maintenance or filter changes.

  The system has various pick-up points throughout the building to provide good air changes to eliminate or minimize the build-up of airborne radioactivity. The exhaust stack provides for dispersal of trace radon and particulates not collected elsewhere.

  There are several engineering controls used in the Silo 3 Project to help keep radiological exposures from contamination to the workers and environment ALARA:

  - Surfaces from which radioactive material can be re-suspended are minimized (e.g., scaffolding, open rafters, hanging light fixtures, cable runs).

  - Appropriate pressure differential exists between the areas of high contamination and the outside to prevent the spread of contamination.

  - Potentially-contaminated airflow is directed away from the worker's breathing zone and is designed to minimize re-suspension of contamination. Room air may be re-circulated if adequate HEPA filtration and monitoring are provided. Re-circulation from an area of higher contamination to an area of lower contamination is prohibited.

  - The capture velocity of a hood, hose, or plenum used to capture and redirect suspended contamination is equal to or greater than 150 ft/minute, as measured at the source.

  - Potentially-radioactive particulate effluent discharges are minimized by using HEPA/ULPA filtration. The discharge from ventilation systems is directed away from potential sources of contamination to prevent re-suspension.

- The facility layout includes a series of barriers enclosing various zones that are classified according to their potential level of contamination. The number of barriers depends upon the sources of contamination, the confinement efficiency of each barrier, and the number and types of penetrations. The process equipment provides primary confinement; secondary confinement is provided by the enclosure containment. The ventilation system will be designed to assist the physical barriers in maintaining zone confinement.

- Hoods and Enclosures: Hoods and enclosures minimize airborne contamination. The Excavator Room Hood is positioned near the silo wall opening to capture saw cuttings and Silo 3 dust generated during silo wall intrusion. The vacuum wand uses a containment system. The retrieval bin uses a hood to minimize generation of airborne material at the source during mechanical retrieval. The primary and secondary rotary feeders are enclosed and act as airlocks between the relatively-high vacuum of the collector and the ambient pressure of the Feed Conveyor. The Inclined Conveyor is contained within an enclosure. A ventilated enclosure is used during direct loading. PCN8

- Enclosed Conveyors: Enclosed conveyors act to contain powders during material movement.

- PVC liner: An inner liner is placed inside the soft-sided container in the loading frame. This thick PVC liner delays radon diffusion and provides containment for the Silo 3 waste residues. The liner is attached to the Package Loading Stand loading spout. An inflation blower on the Package Loading Station unit is used to expand the inner liner allowing it to conform the container internal silhouette. After this step, the container is ready for filling.

- Packaging bag-out system: Upon reaching the target fill quantity the system sends a signal to stop feeding. Alarms are included to alert operations personnel when a target weight in the container is reached. A camera is included as a safety feature. After the container is filled, a de-aerator removes air and fugitive dust, and thereby, molds the inner liner to the materials. Finally, a Radio Frequency (RF) sealer heat-seals and cuts the neck of the inner liner between containment attachment devices to leave a cover over the loading spout for contamination control. This heat seal controls contamination during separation of the bag from the packaging station.

H-5.2 Administrative Controls

The following administrative controls were developed to minimize radiation exposure for the Silo 3 Project:

- Bag-out procedures for the removal of filters from ventilation systems (i.e., the stack filters)

- Access Controls/Postings/Labeling

The Occupational Air Monitoring Plan contains the following information: — 6079

- Likely sources of airborne radioactivity
- Engineering and administrative controls to control the airborne radioactivity
- Proposed boundary configuration
- General description of air monitoring equipment to be used
- Description of air monitoring in occupied areas adjacent to the airborne areas
- Methods of bioassay evaluation to be implemented
- Contingency to be employed if air monitoring results are above expected values

H-6.3 Internal Dosimetry

Internal radiation monitoring is required for all radiation workers potentially exposed to surface or airborne radioactive contamination that could result in 100 mrem Committed Effective Does Equivalent (CEDE) from intakes of all radionuclides from occupational sources (excluding radon, thoron, and their short-lived progeny), or if any organ or tissue dose equivalent could exceed 5 rem CEDE.

Internal dose assessments are performed as necessary to determine significant intakes of radioactive material. Internal radiation monitoring at the FCP is accomplished by performing in vitro bioassay measurements and airborne radioactivity sampling. Radiological Control defines the internal radiation monitoring program for all FCP personnel.

In circumstances where bioassay data are not available or appropriate, air sampling results may be used to estimate internal exposure. Dose assessments from exposure to radon and its decay products will generally be based on air sampling results and exposure or access times recorded on applicable RWP's.

H-6.4 Environmental Radon Monitoring

Fluor Fernald Environmental Monitoring currently maintains many continuous radon monitors both on site and at locations off site. There are several radon monitors that run continuously, 24 hours a day, 7 days a week, in the Silos Project area. Using wireless data transmission and a Local Area Network connection, data is transmitted from the monitors to individuals at various locations, including the Communications Center, so that increases in environmental radon concentrations from on-site projects are identified in a timely manner.

The continuous monitoring project is supplemented by approximately 50 alpha track-etch radon detectors around the K-65 fenceline, selected locations on site, and at several off-site locations.

H-6.5 Contamination Control

The Silo 3 facility will be posted and controlled as a Contamination Area due to the low contamination limit for Th-230 of 20 dpm/100cm^2. Due to the project engineering controls, elevated contamination levels are only expected in a few areas. The areas where the highest contamination levels are expected are: (1) in the Excavator Room; (2) in the Excavator Service Room when performing excavator maintenance; and (3) whenever a system is breached for maintenance.

An airlock/doffing area is provided for personnel when exiting the excavator service area to allow doffing of outer layers of PPE and performing personnel monitoring. This will support the effort to keep contamination/airborne radioactivity levels ALARA in the remainder of the facility. When performing a breach of a system with potential 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. Potentially-contaminated outer layers of PPE will be doffed at the exit from High Contamination Areas. When exiting the, Contamination Area, personnel will undergo a contamination survey through use of a personal contamination monitor (PCM) located at the access control point trailer. In the case of the PCM being inoperable, whole-body frisking will be performed.

Routine cleaning of the facility will be performed as necessary to keep contamination levels ALARA, to prevent adverse effects on air sampling results, and to prevent the gradual spread of material to areas of lower contamination.

H-6.6 Airborne Radioactivity Areas

Initially, the entire Silo 3 facility will be posted as an Airborne Radioactivity Area and respiratory protection will be required until adequate documentation has been gathered to prove that the design and controls for the facility are adequate. However, the majority of the operational facility will likely always be an Airborne Radioactivity Area.

Particulate air sampling and radon monitoring will be conducted throughout the facility. DELETED. The project-specific Occupational Air Monitoring Plan (see SECTION H-6.2) will discuss the project's occupational radiological air monitoring in detail.

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H-9.0 RESPONSIBILITIES

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H-9.1 Personnel Responsibilities

Silos Project Director: Overall responsibility to implement the requirements of this plan and corrective actions, as necessary.

Operations Manager: Ensures that operations personnel implement the requirements contained within this HPP. Interfaces with Silos Project Radiological Control Lead regarding design changes and radiological issues.

Silos Project Radiological Controls Lead: Ensures that Radiological Control personnel assigned to the Silos Project are implementing required monitoring specified in this HPP. Interfaces with the Operations Manager on radiological issues encountered during operations. Provides guidance to Project Management for corrective actions. Ensures that doses on the Silos Project are maintained ALARA.

DELETED Reviews radiological data generated by radiological monitoring to identify trends and compare them against the limits in this HPP. Makes recommendations to the DELETED Operations Manager on monitoring program or operations changes. Notifies the DELETED Project Management if contamination and airborne radioactivity limits are exceeded. Develops RWPs required for Silo 3 Project tasks and continues to monitor Silo 3 Project tasks to detect any changes that would require RWP revisions. PCN8

Radiological Control Technician Supervisor: Interfaces daily with Silos Project Operations Supervisors regarding radiological issues. Ensures that monitoring is being conducted in accordance with this HPP. Coordinates RCT coverage to ensure that qualified RCTs are available to support operations and maintenance activities.

Operations Supervisors: Interfaces with Silos Project Radiological Control on radiological issues identified through radiological and other monitoring conducted according to this HPP.

H-9.2 Radiological Incidents and Reporting

All radiological incidents or abnormal events shall be immediately reported to the Silo 3 Project Radiological Engineer and Project Management. Further reporting will be required beyond these individuals as required by site procedures. Examples include, but are not limited to, skin or personal clothing contamination, situations where radioactive material uptake is suspected, and situations where contamination is spread from a radiological controlled area to the Controlled Area.

The Silo 3 Project Radiological Engineer will facilitate the documentation and proper notification of the event or condition, as required by site procedures, and ensure that corrective actions are taken, as necessary.

As required, Radiological Deficiency Reports (RDRs) will be written to document radiological deficiencies. Examples include, but are not limited to, poor performance of radiological control practices, violations of procedures or policies, and personnel contamination. The responsible supervisor will be responsible for correcting deficiencies and providing a written response summarizing action(s) taken and/or planned to prevent recurrences.

H-10.0 RCT RADIOLOGICAL COVERAGE REQUIREMENTS

Daily RCT duties will include:

- Job coverage
- Instrument operability checks
- Routine contamination verification surveys
- RWP briefings, acknowledgement forms, and daily sign-in sheets
- Issuance of respirators, lapel air samplers, direct-reading dosimeters, radon dosimeters, and other special dosimetry, as necessary.
- Air sample collection
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- Periodic radon working-level tracking and downloading of files
- PCM alarm response
- Equipment and material monitoring for release
- Paperwork associated with all the above

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Additionally, RCT coverage will be provided as deemed appropriate by the Silos Project Radiological Engineer and as prescribed on the RWP. Full RCT coverage is likely for activities involving breaching of contaminated systems. The RCT will perform frequent and timely surveys to ensure detection and characterization of contamination, if present. An RCT will periodically monitor radon working levels in the Silo 3 dome and waste packaging areas when personnel are inside. The Silo dome and waste packaging areas will be outfitted with remote cameras that can be viewed in the Control Room. The remote cameras will be used when appropriate to reduce personnel exposures.

H-11.0 PERSONAL PROTECTIVE EQUIPMENT

Initial start-up of the PRS and the packaging of Silo 3 waste will require the use of anti-C PPE and respiratory protection. After it has been confirmed that retrieval and packaging activities will not result in radioactive airborne concentrations that exceed DAC limits, the use of respiratory PPE requirements will be discontinued. Anti-contamination (anti-C) clothing will continue to be used and respiratory PPE will again be employed when airborne radioactive material concentrations are >10% DAC.