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EFFECTIVE DATE	PCN NO.	REV. NO.	DESCRIPTION
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.
12/21/05	9	1	Change to (1) Section 1.4.3, to clarify manual direct loading
02/03/06	10	1	Change to (1) Section 1.4.3, to address new IP-2 containers, (2) Table 10.1 PR-2 to reflect new IP-2 containers, (3) Section 10.4, *Derivation of Safety Basis Requirements and Process Requirements*, to reflect new IP-2 containers
3/1/06	11	1	Change to Section 1.4.3 and Appendix D Section 5.4 to modify manual direct loading

Container Filling and Sampling

For both PRS- and MRS-retrieved waste, the final package is a tested and approved DOT (Department of Transportation) IP-2-compliant (Industrial Package Type 2) soft-sided, sturdy-but-flexible, polypropylene bulk bag containing a sealed poly-vinyl choride (PVC) liner. The bulk bag measures 72" x 48" x 48". The containers were certified IP-2 via testing per 49 CFR Part 173 [Ref. 26] and Part 178 [Ref. 27]. PCN1

The test container was filled with 7,000 pounds of surrogate material similar in characteristics to Silo 3 material. Two tests were performed using: (1) a surrogate similar to conditioned material; and (2) a surrogate similar to untreated material. Tests performed included 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. Late in the project, alternate bags were procured that were tested at less than 7,000 pounds, and the operating procedures were revised accordingly. PCN10

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 he 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 ailure of the RF seal, the liner may be closed using the alternate method approved during container ests [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, or with the excavator, retrieving material from inside the silo and loading it into containers in the excavator room. PCN8&11

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 or in the excavator room, controlling the excavator; 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.

PCN8&11

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.

Various combinations for material retrieval will be utilized as needed. For example, the Bobcat Loader may be used in a fashion similar to the excavator, to transfer material to the conveyor system for loading by the original packaging station. Manual manipulation of the pneumatic retrieval vacuum wand by an operator may take place inside the silo.

PCN 9

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.

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
DELETION

The dose rate estimates were made on the basis of the Silo 3 final design. Collective dose estimates were calculated for each task based on the current data, and these estimates were summed for operations, maintenance, and other routine tasks. However, whenever there was uncertainty in estimates, assumptions were made that would conservatively overestimate the radiation doses. DELETION PCN1

By March 2006 (due to high moisture content or compaction of the material) pneumatic and mechanical retrieval was no longer effective, and the project established another loading process, as described in section D-5.4. Prior to this transition approximately 2,200 IP-2 packages had been produced. (Initial estimates were based on 1,885 packages.) An initial collective dose estimate was made for 7,856 person-mrem. At the transition time, Silo 3 has accumulated approximately 6,400 of the estimated 7.856 person-mrem. This revision to Appendix D includes the current 6,400 person-mrem, and a new dose estimate of 2,100 person-mrem for the remaining 100 packages, resulting in a new collective dose estimate of 8,500 person-mrem. The principal change to this document is the addition of section D-5.4. PCN8&11

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.

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

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

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

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

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

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

D-5.3.3 Inspection of Packaged Material Staged For Transportation

PCN1

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

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

PCN1

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

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 early March 2006, effective pneumatic and mechanical retrieval was completed and the project transitioned into a final direct retrieval and load-out phase.

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.

PCN8&11

The material transfer will involve one operator inside the excavator room, operating the excavator, placing the material into a container staged outside the silo in the excavator room.

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 with the inner roll-up door positioned to ensure airflow into the excavator room. After moving the containers into, or out of the excavator room, the inner roll-up door will be closed with the outer roll-up door positioned to ensure an inbound airflow. PCN11

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 a 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. PCN8

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 50-100 final IPII containers. For the purposes of this evaluation the dose projections will be based on 100. PCN11

One operator inside the excavator room loading material into the container via the excavator. Production is estimated at 1 hr/container. The worker will be in anti-c's with a Powered Air Purifying Respirator. External dose: (assuming 100% at 5 mrem)

Effective external dose averaged at (5 mrem/hr)x(100 hrs) = 500 mrem

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

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 .5 hrs per package. The workers will be in anti-c's with a Powered Air Purifying Respirator.

Effective external dose averaged at (4 mrem/hr at 1')x(100 containers)x(.5 hrs/container)x(2 workers) = 4**00 mrem**

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

1 RCT 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 (4 mrem/hr at 1') x (100 containers)x(.5 hrs/container)x(1 RCT) = 2**00 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 (4 mrem/hr at 1')x(100 containers)x(.5 hrs/container)x(5 workers) = 10**00 mrem**

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

Estimated Total Effective Dose Equivalent for load-out operations = 2,100 **mrem**

PCN8&11

(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

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	100	100	5.0	0.500	Silo 3 and Excavator Rm
Container prep and closure	2	Yes	0.5	100	100	4.0	0.400	Excavator and Maint. Rm.
RCT Support	1	Yes	0.5	100	50	4.0	0.200	Excavator and Maint. Rm.
Container movement Loading and unloading	5	Yes	0.5	100	125	4.0	1.000	Excavator and Maint. Rm.
DIRECT LOADOUT SUBTOTAL							2.100	

PCN8&11

Notes:

1. No. of Workers = number of workers that will actually receive radiation exposure during the task
2. PPE Required = personal protective equipment required, typically two pairs of coveralls, shoe covers, gloves, hood, and respirator
3. Time Duration = the actual exposure time in the radiation field
4. Frequency = the number of times the task must be performed during the entire duration of the Silo 3 Project
5. Person-Hours = the collective exposure time in the radiation field
6. Dose Rate = the estimated whole body dose rate (mrem/hr) at the location where the task is to be performed
7. Collective Dose = the product of Person-Hours and Dose Rate in units of person-rem
8. Based on expected average dose rate where PPE will be doffed
9. Based on expected average dose rate where PPE will be doffed

D-6.0 REFERENCES

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

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

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

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

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

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

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

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

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

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

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

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

13. SD-2083, *Air Sampling Plan for the Silo 3 Waste Removal and Disposition Operations-Final Operations ALARA Analysis*, Fluor Fernald, March 2006.