FLUOR FERNALD
SILOS PROJECT

APPENDIX H
SILO 3 RETRIEVAL AND DISPOSITION PROJECT HEALTH PHYSICS PLAN

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ACRONYMS AND ABBREVIATIONS

ACL	administrative control level
ALARA	as low as reasonably achievable
Anti-C	anti-contamination
CAM	Continuous Air Monitor
CCTV	Closed-circuit television
CFM	Cubic feet per minute
CFR	Code of Federal Regulations
CEDE	committed effective dose equivalent
cm^2	square centimeters
DAC	derived air concentration
DOE	U.S. Department of Energy
dpm	disintegrations per minute
FCP	Fernald Closure Project
HEPA	high-efficiency particulate air
HPP	Health Physics Plan
µCi/mL	microcuries per milliliter
MRS	Mechanical Retrieval System
mrem	millirem
PCM	personal contamination monitor
PF	protection factor
PPE	personal protective equipment
PRS	Pneumatic Retrieval System
RCT	Radiological Control Technician
RD	Removal and Disposal
RDR	Radiological Deficiency Reports
RF	Radio frequency
RWP	Radiation Work Permit
SILO 3	Silo 3 Retrieval and Disposition Project
TEDE	total effective dose equivalent
TLD	thermoluminescent dosimeter
ULPA	ultra low penetrating air

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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

2.0 GENERAL DESCRIPTION OF THE SILO 3 PROJECT

A process flow diagram, **FIGURE H-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.

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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.

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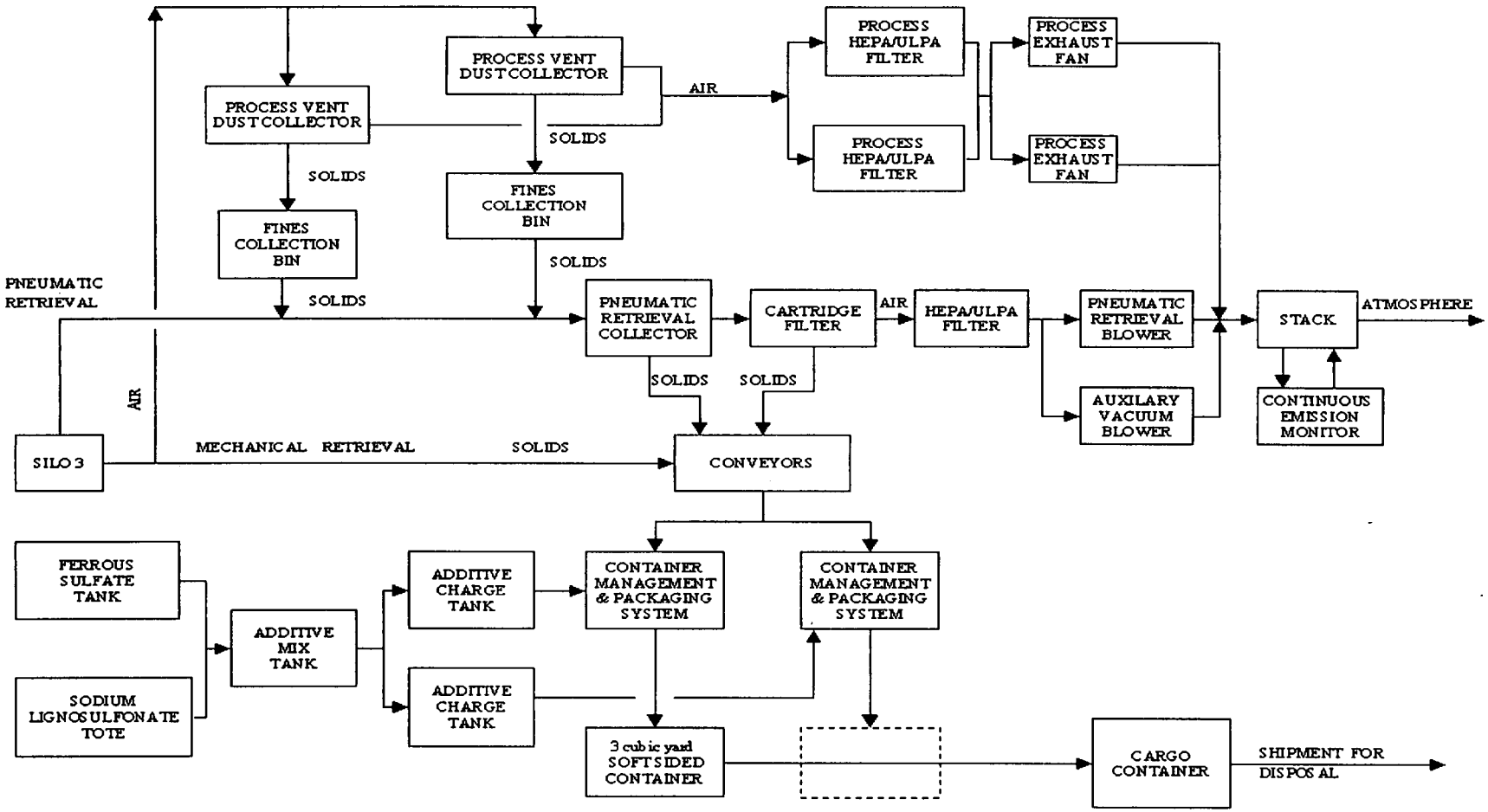
FIGURE H-1 - Silo 3 Operations Process Flow Diagram



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3.0 PRIMARY RADIOLOGICAL HAZARDS FOR SILO 3 WASTE

Silo 3 contains 5,100 yd^3 of calcined by-product material from uranium ore processing. Constituent radionuclides include:

Ac-227, Ac-228, Bi-210, Bi-211, Bi-212, Bi-214, Fr-223, Pb-210, Pb-211, Pb-212, Pb-214, Po-210, Po-212, Po-214, Po-215, Po-216, Po-218, Pa-231, Pa-234, Pa-234m, Ra-223, Ra-224, Ra-226, Ra-228, Tl-207, Tl-208, Th-227, Th-228, Th-230, Th-231, Th-232, Th-234, U-234, U-235/236, U-238, Rn-219, Rn-220, and Rn-222.

More than 80 percent of the relative dose fraction from an uptake of Silo 3 material into the body would result from Th-230. Therefore, survey techniques, contamination controls, and airborne radioactivity controls will be based on those limits set for Th-230.

Silo 3 material does not exhibit a high whole-body penetrating gamma exposure hazard. However, bulk handling of the material will result in chronic exposures to low-level radiation from the waste. In terms of radiation exposure potential for the occupational worker, the major concern is an intake of Th-230. There is also a potential for internal exposure from radon daughters. As a result of these hazards, engineering controls were designed into the system to contain and confine the material, and to handle the material indirectly via specialized equipment. Section 5.0 lists the engineering controls designed to help minimize the exposure potential and help maintain radiation exposures ALARA.

3.1 Radioisotopes of Concern

The most limiting radioisotopes for Silo 3 operations shall be determined and applied as the radioisotopes of concern for radiological control purposes. This determination was based on sampling data and calculations. The radioisotopes of concern for the Silo 3 Project are:

- Thorium-230: Contamination Control/Unrestricted Releases
- Thorium-230/Radon-222: Airborne Radioactivity Controls
- Uranium-238: Digging/Disturbing Soil

3.2 Potential Exposures to Contamination/Airborne Radioactivity

Contamination in the Silo 3 Project during waste removal operations is expected to be contained internally within the Silo 3 containment structure and buildings. Since Th-230 has a very low contamination limit for posting [20 disintegrations per minute (dpm)/100 square centimeters (cm^2)], the Silo 3 facility will be posted and controlled as a High Contamination and/or Contamination Area. However, the facility is designed to minimize the amount of contamination in work areas. Areas such as the Packaging Room, Cargo Bay Loading Area, Vacuum Retrieval Area, and the Remote Excavator Area are designed to implement an operating philosophy based on ALARA principles, through isolation, containment and ventilation.

Some areas and/or operations where higher levels of contamination are expected include, the Excavator Room, the Excavator Service Room, and whenever a system is breached for maintenance. Engineering and administrative controls are to be used in these areas to minimize the spread of contamination, and consequently, the generation of airborne radioactive material.

3.3 Potential Exposures to Radiation Exposure

TABLE H-1 shows the anticipated radiation dose rates for the major work areas.

TABLE H-1: DOSE RATES AT VARIOUS OPERATOR STATIONS

Location	Expected Dose Rate millirem (mrem)/hr
On top of dome performing pneumatic retrieval using vacuum wand	1.9
Remote Operator Station adjacent to the Excavator Room	0.4
Packaging Room	0.4
Cargo Bay Area w/ full container in area	2

4.0 ESTIMATED RADIOLOGICAL EXPOSURES

4.1 External Exposures

An estimate of the collective dose from the activities and the required support for Silo 3 has been prepared and is contained in ALARA Analysis, Appendix D of the N-HASP.

4.2 Internal Exposures

Headspace radon, as well as radon and thorium particulates generated during mechanical processing of the retrieved dry waste, will be collected in exhaust hoods, filtered, and ventilated to the atmosphere via the Silo 3 exhaust stack. Calculations of the atmospheric release and dispersion from the exhaust stack show that doses to potential off-site recipients will be negligible (see Appendix E).

It is anticipated that few project operations will be conducted in areas where the airborne concentrations may exceed 10 percent of the Derived Air Concentration (DAC). and require respiratory protection [Ref. 2]. In these cases, the selection and use of respiratory protection equipment will be designed to prevent internal exposure.

In all cases where workers are exposed to Silo 3 material, they will be required by 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.

Internal exposures are not anticipated in the Silo 3 Project. Airborne hazards may exist when maintenance is performed or if there is a system breach. In all cases, 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.

Continuous Air Monitors (CAMs) are used for the routine assessment of the potential for internal personnel exposure resulting from upset conditions. Two CAMs measure the concentration of particulate alpha-emitting radionuclides to warn against the leakage of the powdery Silo 3 material from the process equipment (the primary contaminant of concern being Th-230) and a third CAM monitors radon-222 levels. CAMs are used to measure airborne concentrations for comparison with the DAC for Th-230 of 3E-12 microcuries per milliliter (μCi/mL). The CAMs are positioned inside the Packaging Area and Excavator Service Rooms. The radon CAM is positioned inside the Packaging Area next to one of the particulate CAMs.

Readings from the CAMs and the radon monitor are available locally and in the Control Point. The alpha CAMs will have alarm setpoints established at 50% of the lowest protection factor for the assigned respiratory protection. Alarm indications will be given at the instrument area and at the RCT Control Point. In the case of an alpha CAM alarm, material processing or work will be temporarily suspended in the affected area, and personnel will make a controlled exit after equipment/systems are placed in a safe configuration. Radiological Control will evaluate the condition and work will resume after the concentrations have receded below the alarm setpoints or the condition is determined to have been a result of equipment problems that have been resolved.

5.0 ENGINEERING AND ADMINISTRATIVE CONTROLS 5005

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: 5005

- 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.

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- 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.

- 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.

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

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- RWPs/Updated Radiological Surveys for:
  - Entry into any radiological area
  - Breaching any process line, tank, vessel, or enclosure containing radioactive material that may become loose or airborne during work activities
  - Any work within the Controlled Area on contaminated or potentially contaminated equipment where safety precautions are not adequately discussed in technical work documents approved by Fluor Fernald Radiological Control
  - Digging or disturbing soil in a Soil Contamination area
  - Breaking the barrier of a Fixed Contamination Area
- Area Radiation/Contamination Monitoring: As part of the FCP's Radiological Controls Program, RCTs monitor radiation levels and surface contamination. The Silo 3 Project Radiological Engineer, in conjunction with other safety professionals, determines the required PPE, thermoluminescent dosimeters (TLDs), and any other special radiological precautions. These requirements are controlled and specified on a RWP for each task.
- Area Air Monitoring: Occupational air monitoring for radionuclides will be performed per RM-0020 and a project-specific Occupational Air Monitoring Plan that will be completed before project start-up.
- An ALARA Analysis has been completed for Preventative Maintenance Tasks (see Appendix D)
- Airborne Radioactivity Areas: If sustained average radon concentrations and airborne particulate levels exceed 10 percent of their DAC, an Airborne Radioactivity Area will be established and appropriate respiratory protection equipment will be required, as prescribed in the RWP for the area/task. Air sampling and/or radon monitoring will continue as necessary to determine the extent and duration of the Airborne Radioactivity Area. Airborne Radioactivity areas no longer exceeding 10 percent of the DAC will be down-posted.

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6.0 CONDUCT OF RADIOLOGICAL WORK

The conduct of radiological work is managed by the Fluor Fernald RWP program. The RWP program is used to designate the specific radiological controls, precautions, surveillance, and/or instructions to personnel. Training requirements, PPE, exposure limitations, dosimeter requirements, steps to minimize the spread of contamination, steps to limit radiation exposure to adjacent personnel, and provisions for augmented monitoring and surveillance are all specified by Radiological Control on the RWP. In addition, the RWP system provides a means to trend job exposures by inclusion of an area log and dose record sheet. Team members performing radiological work are required to read, understand, sign, and abide by the requirements prescribed on the RWP.

Radiological monitoring is performed in the Silo 3 Project areas to assess changes in radiological conditions, assess release levels of radon and particulates, prevent the spread of radioactive contamination, and limit personnel exposure. Radiological monitoring for the project will be performed in the following ways: personnel contamination monitoring, area radiation and contamination monitoring, air sampling (boundary, general area, and breathing zone), and radiobioassay if necessary.

6.1 Radiological Work Permits

RWPs will be generated by the cognizant Radiological Engineer. Work will not begin until the appropriate RWP is in place. The RWP informs workers of area radiological conditions, work controls, PPE, and entry/exit requirements.

Workers shall be briefed by a Supervisor or RCT on the contents of each RWP under which the workers shall perform work, and the conditions of the work area. Workers shall sign the acknowledgment sheet one time (per revision to the RWP) to indicate an understanding of the RWP requirements.

Workers shall manually or electronically sign in on the RWP applicable to the work they are to perform before entering the work areas, and shall sign out upon exiting these areas.

6.2 Area Air Monitoring

Area air samples are collected to monitor trends of airborne radioactive particulate levels and radon working levels, and to ensure compliance with good work practices. Occupational air monitoring for radionuclides and radon will be performed per RM-0020 and a project-specific Occupational Air Monitoring Plan that will be completed before project start-up.

The Occupational Air Monitoring Plan contains the following information:

- Likely sources of airborne radioactivity
- Engineering and administrative controls to control the airborne radioactivity
- Proposed boundary configuration

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- 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

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.

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.

6.5 Contamination Control

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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.

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 Excavator Room will likely always be an Airborne Radioactivity Area.

Particulate air sampling and radon monitoring will be conducted throughout the facility. In addition, CAMs will be used to provide early indication in the event of elevated particulate airborne radioactivity. The project-specific Occupational Air Monitoring Plan (see Section 6.2) will discuss the project's occupational radiological air monitoring in detail.

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7.0 PERSONNEL ENTRY AND EXIT PROTOCOLS

7.1 Entering/Exiting the Silos Project Controlled Area

The main access into the Controlled Area for the Silos Project is primarily through Trailer 92. This is the primary location for TLD storage and for bar-coding into the area. A secondary TLD storage and badge-in location is at T-28H near the project entrance.

Workers shall obtain their TLD before reaching the Controlled Area. TLDs must be worn while the worker is in the Controlled Area and must be stored on the assigned storage rack when not in the Controlled Area. TLDs shall be worn on the outside of the worker's clothing (non-PPE), facing forward, between their waist and shoulders. Visitors may be allowed to enter the Controlled Area with a properly trained and cognizant escort upon approval of Radiological Control.

Prior to entering the Controlled Area, workers shall scan their badges or manually enter their bar-code number into the access control computer, which will verify that their training and bioassay requirements are current. If the access control computer system is inoperable, training may be verified by visual inspection of the worker's qualification card.

If a worker's training or bioassay information is insufficient or out-of-date, access to the Controlled Area is denied.

Upon leaving the Controlled Area, workers shall place their TLD in the appropriate slot in the TLD storage rack (slots shall be labeled with badge numbers) and bar-code out of the area.

7.2 Entering the Silo 3 Project Area

The Silo 3 Project area will be controlled as a Radiological Area. The specific posting will vary as conditions change within the project area based upon the activities to be performed. Initial anticipated postings for operations of the Silo 3 Project will include: Contamination Area, Radiation Area, Airborne Radioactivity Area, and RWP Required for Entry.

Entries will be made only by trained Radiological Workers or as required by the job-specific RWPs. Most entry points will be supported by at least one FCP RCT. The Contamination Areas will be established so that the area is minimized. Provisions will be made for a step-off pad and an area for doffing contaminated PPE. Herculite, plastic, and glove bags may be used to help prevent the spread of contamination.

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7.3 Access to a Radiological Area

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Access to a Radiological Area requires the following:

- Workers shall sign the appropriate RWP for entry and obtain and don the prescribed PPE clothing and respiratory protection equipment.
- If a worker's training or bioassay is insufficient or out-of-date, their access shall be denied.
- When wearing protective clothing so that no skin is exposed (e.g., full anti-Cs and a respirator), the worker's TLD must be worn underneath the protective clothing. When protective clothing requirements allow skin to be exposed (e.g., no respirator), the TLD must be worn on the outside of the anti-Cs.
- Before entering a Radiological Area, workers shall contact an RCT for assignment of a personal air sampler and airflow testing of the powered air-purifying respirators (if worn).

7.4 Exiting the Silo 3 Control Point

Personnel and material monitoring is required when exiting the Silo 3 Control Point. Workers shall perform whole-body monitoring, preferably with a PCM. RCTs will collect any special monitoring equipment (e.g., breathing zone air samplers) at the control point exit.

Personnel and material monitoring is required when exiting the Silo 3 Control Point. Upon entering the control point trailer, the worker will return all assigned personal monitoring equipment, place material in a staging area for the RCT to monitor, doff PPE and place it in the appropriate receptacles, and proceed to the whole-body monitors. Whole-body monitoring should be performed with a PCM. However, whole-body alpha frisking is acceptable when PCMs are unavailable.. If contamination is detected, a Silo 3 Project RCT shall be contacted for assistance and evaluation of the alarming zones. If contamination is not detected, personnel will then sign out of the RWP.

Workers must recognize, and allow additional time for, monitoring when exiting thorium Contamination Areas due to the low contamination limits and difficulties in detecting low levels of alpha contamination. If contamination in excess of the values specified for the Silo 3 Project Surface Contamination Limits is found, personnel shall stay in the area and notify a Silo 3 Project RCT.

Some work in or near the facility may require isolated areas to be up-posted to "Contamination" or "High Contamination" areas. These areas will require added controls such as additional PPE for entry, then doffing of the additional outer PPE and local exit monitoring. If contamination is detected while trying to exit a local Contamination Area or High Contamination Area, the worker must contact a Silo 3 Project RCT for assistance. If

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no contamination is detected, the worker shall proceed directly to the main Silo 3 Control Point (as specified by the RWP) to conduct a whole-body survey with a PCM.

All material exiting Th-230 Contamination Areas shall be surveyed by an RCT. Personal items, tools, lapel samplers, and other equipment may only be surveyed out of a Contamination Area by an RCT. Workers requiring items of this nature to be removed from the Contamination Area shall give the RCT notice in advance. Workers may not remove items from a Contamination Area or radiological buffer area without specific permission from Silo 3 Project Rad Control personnel.

Workers shall always leave a Contamination Area and doff anti-Cs at the appropriate control point whenever their protective clothing is compromised, when non-water-resistant anti-Cs get wet, or when workers sweat through their protective clothing.

Workers shall sign out on the RWP upon exiting through the access control point.

High Contamination Areas will be posted in the Excavator Room, the Excavator Service Room when excavator maintenance is performed, and whenever a system is breached for maintenance. The exit to the High Contamination Area will require equipment for monitoring personnel, personal items, or equipment as well as receptacles for collection of PPE doffed upon exiting the area.

8.0 RADIOLOGICAL LIMITS AND RESPIRATORY PROTECTION

8.1 Personnel/Equipment Monitoring Limits

Equipment monitoring for release out of a Contamination or Controlled Area from the Silo 3 Project must be surveyed for loose contamination and fixed plus removable contamination. The limits are < 20 dpm/100 cm^2 (alpha) removable contamination and 500 dpm/100 cm^2 (alpha) fixed plus removable contamination. For free release, the limits are < 20 dpm/100 cm^2 (alpha) removable and 100 dpm/100 cm^2 (alpha) fixed plus removable.

Personnel exiting Contamination Areas or High Contamination Areas for the Silo 3 Control Point shall be surveyed using instrumentation capable of detecting 500 dpm/100 cm^2 alpha, which is the personnel contamination monitoring threshold for Th-230.

Generally, personnel monitoring at the Silo 3 Control Point Trailer will be performed using automated whole-body monitors. However, if these monitors are not operable, out-of-service hand-held monitoring equipment will be provided.

If a personnel monitoring instrument alarms, then the worker shall notify the RCT. The RCT will investigate to determine if there is long-lived contamination on the worker's clothing or skin (e.g., radium, thorium, uranium). If this is confirmed, the RCT will proceed as prescribed by procedure for personal decontamination.

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8.2 Airborne Radioactivity Limits

Airborne Radioactivity Areas shall be posted around locations that exceed, or are likely to exceed, the DAC values for the applicable radioisotope(s), or areas where a person could receive 12 DAC-hrs in a week without respiratory protection. Engineering and/or administrative controls shall be implemented for these areas to control the impact on personnel and other project areas. The DAC values that apply to the Silo 3 Project are:

- Th-230 effective DAC: 3×10^{-12} µCi/mL
- Rn-222 daughters: 0.33 Working-levels

The protection factors (PFs) that apply to the Silo 3 Project are:

- 1,000 for atmosphere supplying, airline, hood, continuous flow
- 1,000 for powered, air-purifying respirators
- 50 for full-face, air-purifying respirators
- 1 for no respirator or half-mask respirators

8.3 External Radiation Limits

Radiological administrative control levels (ACLs) will be used by the Silo 3 Project to keep exposures ALARA. RM-0020 establishes an annual facility ACL of 1,000 mrem total effective dose equivalent (TEDE) to an individual in a year.

Workers shall be restricted from working in radiologically-controlled areas if total (external and internal) exposures, in any one calendar year, nears 1,000 mrem TEDE without the prior approval of the Fluor Fernald President.

An investigation shall be initiated by Fluor Fernald when a worker reaches 80 percent of the ACL. The investigation will determine whether the worker requires limitations on work in a radiological area to ensure that the annual limit (1,000 mrem TEDE) is not exceeded.

9.0 RESPONSIBILITIES

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.

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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.

Radiological Engineer: Reviews radiological data generated by radiological monitoring to identify trends and compare them against the limits in this HPP. Makes recommendations to the Silos Project Radiological Controls Lead and Operations Manager on monitoring program or operations changes. Notifies the Silos Project Radiological Controls Lead and 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.

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.

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.

10.0 RCT RADIOLOGICAL COVERAGE REQUIREMENTS

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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
- CAM alarm response and source check
- Periodic radon working-level tracking and downloading of files
- PCM alarm response
- Equipment and material monitoring for release
- Paperwork associated with all the above

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.

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.

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12.0 PERSONNEL/EQUIPMENT RADIOLOGICAL CONTAMINATION MONITORING

Personnel may be exposed to contamination during routine pneumatic retrieval of Silo 3 waste, repackaging, and maintenance activities. RCTs will perform routine monitoring for contamination to assess radiological conditions and post the areas as appropriate. When a Contamination Area is established within the Silo 3 Project, a control point will be established where anti-contamination clothing can be doffed and personnel will perform contamination monitoring. The RWP and area radiological postings will specify the exact requirements for monitoring.

All equipment and materials to be removed from Contamination Areas must be surveyed and released by an RCT.

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13.0 REFERENCES

1. RM-0020, *Radiological Control Requirements Manual*, Fluor Fernald

2. 10 CFR 835, *Occupational Radiation Protection*, Title 10, Code of Federal Regulations, Part 835, Appendix A, *Derived Air Concentrations*; DOE

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