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REMEDIAL ACTION WORK PLAN

FOR

RADON CONTROL SYSTEM (RCS) PHASE 1 OPERATION

REVISION 3

SEPTEMBER 2002

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

40710-PL-0005

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1 INTRODUCTION

1.1 Purpose / Scope of RCS Phase 1 Operation

The Radon Control System (RCS) is designed to provide Best Available Technology (BAT) control of particulate radionuclide and radon emissions from Silos 1 and 2 and from facilities related to the Silos 1 and 2 Accelerated Waste Retrieval (AWR) Project.

The purpose of Phase 1 operation of the RCS is to reduce radon concentrations in the headspaces of Silos 1 and 2 during construction activities above the Silo domes, prior to the initiation of Silo waste retrieval. During Phase 1, the RCS will be operated as required to maintain the radiation field on the surface of the domes of Silos 1 and 2 below 10 mrem/hour during Phase 1 construction. Construction activities dependent upon RCS Phase 1 operation include construction of the waste retrieval superstructure, removal of the plywood covers over the centers of the domes, penetration of the Silo 1 and 2 domes, and installation of the risers for connection of Silos 1 and 2 to the waste retrieval equipment enclosures. The specific criteria for operation of the RCS during Phase 1 are described in Section 3.

1.2 Description of RCS Phase 1 Design

The design, operation, and control of the RCS are specified in detail in the Silos 1 and 2 Accelerated Waste Retrieval Remedial Design (RD) Package. The process flow and emission control equipment for the RCS are depicted in detail on Process Flow Diagram (PFD) drawings, Process Description (40710-RP-0015), and Process Control Summary (40710-RP-0020) documentation included in the RD Package.

The RCS process employs air conditioning, dehumidification, carbon adsorption, and HEPA filtration to minimize emissions of radon and other contaminants. The RCS System is designed to ultimately provide ventilation and air emission control for the following sources:

- Silo 1 and Silo 2
- Silo Waste Retrieval System
- Transfer Tank Area (TTA) Tanks
- TTA Waste Retrieval System, and
- Final Remediation Facility (outside the scope of the AWR Project)

RCS Phase 1 process is designed to treat air ventilated from the headspace in Silos 1 and 2 for radon removal. The purpose of this treatment is to reduce headspace radon concentrations, and thereby radiation exposure rates above the silo domes, to allow construction activities in the immediate vicinity of the domes. The primary treatment of the air involves the adsorption of radon in the active carbon adsorption beds.

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The RCS process flow for Phase 1 operation starts with the vacuuming of up to 1,000 cfm of air from Silos 1 and 2 headspace. During Phase 1, temporary flexible hoses will be routed over the silo berm to connect the Silo 1 and 2 headspaces to the RCS. This air is transferred through one of the redundant roughing filters for particulate removal and then to one of the redundant Desiccant Dryer Systems. In the Desiccant Dryer System the air is cooled and dehumidified to enhance the dynamic adsorption capacity of the activated carbon. The air is then transferred to the Carbon Bed System to remove radon. From the Carbon Beds the air is passed through one of the redundant HEPA filters to one of the redundant recycle/exhaust blowers, which is the mechanism used to move the air through the RCS system. Finally the treated air is either returned to the silos or, as necessary to maintain negative headspace pressure, discharged through the exhaust stack. The treated air returned to the silos is used for "sweep ventilation" purposes.

The RCS will operate in this mode to reduce radon concentration levels inside the silo headspaces to levels that will allow safe access for work activities in the silo area. The design flowrate for the ducting system for the ventilation of Silos 1 and 2 is based upon withdrawing up to 500 cfm from each silo during Phase 1 operations. To the extent practical, the system will be operated in a 'recycle' mode where the majority of the air withdrawn from the Silo and circulated through the RCS, is discharged back into the Silo. The airflow discharged to the environment through the exhaust stack will be minimized to the amount necessary to maintain negative pressure (e.g., during dome penetration and riser installation) and to provide effective operation and control of the system.

The RCS design also includes the flexibility to reduce flow from one silo in order to increase the amount of air exhausted from the other silo in service. This capability may be used during silo penetration and riser installation. During initial penetration of the dome of one of the silos, the flows will be adjusted as necessary, and some flow will be exhausted from the stack, to assure the necessary negative pressure is maintained in the silo being penetrated.

Phase 1 operation of the RCS will be established prior to accomplishing initial penetration of the Silo domes. During penetration and modification of the manways, the RCS will be operated to maintain negative pressure in the headspace and assure airflow into the silo through the manways. In this manner, potential emissions to the environment will be directed through the RCS for treatment.

2 RCS PHASE I PRE-OPERATIONAL ACTIVITIES

Construction turnover of the RCS processing equipment will occur after the verification of construction completion and the testing of distinct Construction Turnover Packages. These turnover packages will consist of facilities, systems, and components that are required for the operation of the RCS Phase 1 System. Verification of construction completion will include physical examination to certify that the facilities and associated equipment have been installed per the design documents. As described in Sections 2.1 and 2.2, the testing of the RSC Phase 1 System will be conducted in two phases.

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2.1 Construction Acceptance Testing (CAT)

Systems and components (e.g., piping, vessels, ductwork, valves, electrical switchboards and wiring, equipment and instruments) in Construction Turnover Packages will be inspected and tested as required. Typical CAT inspections and testing for individual components/subsystems includes hydrostatic testing, continuity and megger testing, valve stroking, motor rotation, and instrument calibration. CAT requirements are listed on Turnover Package Checklists that will be used to document completion of all CAT activities.

Following satisfactory completion of CAT and verification of acceptable CAT results, submittals, and documentation, there will be a conditional acceptance turnover of systems from Construction to Operations for startup testing.

2.2 Pre-Operational Testing

Pre-operational testing will be conducted in two phases, Post Maintenance Performance Testing (PMPT) and System Operability Testing (SOT) that will include total system integrated testing.

2.2.1 Post Maintenance Performance Testing (PMPT)

PMPT will ensure that all appropriate pre-operational preventive maintenance has been performed on the equipment. This will include verification of oiling, greasing, belt tightness, instrument tests, loop checks, and calibrations. The results of PMPT will be documented including verification of CAT results where applicable.

PMPT will be performed by Fluor Fernald maintenance craft personnel under the supervision of the Project Operations and Maintenance staff with assistance from Construction and equipment vendors as required.

2.2.2 System Operability Testing (SOT)

After completion of the PMPT Packages, a system SOT will be performed. SOT involves the comprehensive operation of the RCS Phase 1 systems to assess operational performance and the operation of automatic controls and alarms. This testing will include four separate SOTs: The first three SOTs, Building HVAC, Emergency/Backup systems, and Primary Systems Cold Functional Test, will be performed prior to the operational readiness process. These tests will be conducted with the RCS connected to a test plenum to simulate the Silos headspace. The final SOT, the primary Systems Hot Functional Test, will be the first activity following the completion of the readiness process and the initiation of RCS Phase 1 operations.

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The Operations and Maintenance Startup Group will be responsible for conduct of all four SOTs. Operations and Maintenance personnel will conduct the testing under the technical direction of the Startup Group.

2.3 Operational Readiness

During the conduct of and following the completion of pre-operational testing, the AWR Project will complete final preparations for operations. The project will ensure that readiness is established in the areas of personnel (training, proficiency, numbers, support elements, etc.), equipment (safety and process systems operational), and programs (safety basis implementation, operational formality, maintenance, ISM, quality, etc.). Prior to completion of these preparations the project will complete a self-assessment to determine that all necessary prerequisites are completed and that the project is in a condition of readiness to start RCS Phase 1 operations.

Following a certification that the project is ready to operate, independent operational readiness assessments will be performed by Fluor Fernald and by the Department of Energy (DOE). The purpose of these assessments will be to determine that the project is in a state of readiness to safely conduct operations in accordance with the safety basis and that management control programs are in place to ensure safe operations can be sustained. The startup approval authority for the startup of operations will be the Ohio Field Office Acting Manager.

The structured and independent Fluor Fernald operational readiness assessment will be a Standard Startup Review (SSR) conducted in accordance with site procedures. This performance-based assessment will include a field assessment; the conduct of interviews with personnel, including management, to evaluate their readiness to conduct operations; and the verification that necessary, approved, requirements documentation is in place and that procedures, personnel, equipment, and systems support the approved requirements.

The DOE will perform an independent Readiness Assessment (RA) in parallel with the Fluor Fernald SSR. The DOE will tailor this assessment based on the complexity and hazards associated with the RCS Phase 1 operations. As Phase 1 operations will be conducted by startup engineers and selected operations personnel, the focus will be verification of training and qualification of workers and new procedures, and the understanding of hardware configuration and operation. The DOE will also assess the adequacy and effectiveness of the Fluor Fernald SSR.

Following satisfactory completion of the SSR and RA including resolution of any pre-start findings and approved corrective action plan for any post start findings, the Ohio Field Office Acting Manager will grant authorization to start RCS Phase 1 operations.

2.4 Initiation of RCS Phase 1 Operation

The initial activity following the initiation of Phase 1 operation of the RCS will be to conduct the RCS Primary Hot Functional SOT. As described in Section 2.2, this SOT will verify operation of the equipment, controls, and instrumentation of the RCS during the initial drawdown of the Silo 1 and Silo 2 headspaces. The Primary Hot Functional SOT will verify the performance of the pressure control system, the measurement and evaluation of overall system performance, and the conduct of baseline radiation surveys. System parameters developed from hot testing will be utilized to develop final operating procedures.

The RCS will remove Radon laden air from Silos 1 and 2, treat the air to remove the Radon, and return the majority of the air to the Silos while discharging through the stack a volume roughly equal to system in-leakage. Both Silos will be maintained at a slight negative pressure to atmosphere.

This test, in conjunction with the RCS Primary Cold Functional SOT, will demonstrate that the RCS System performs acceptably and will support AWR Project RCS Phase 1 operations.

Following completion of the RCS Primary Hot Functional SOT, final operating procedures will be developed and the qualification of additional supervisors and chemical operators will be completed. Following the completion of the Primary Hot Functional SOT, Phase 1 operation will continue as required by the criteria outlined in Section 3. Operations prior to completion of final operating procedures and additional qualifications will be performed, if required, in accordance with the RCS Primary Hot Functional SOT.

3 Criteria for RCS Phase 1 Operation

Phase I operations of the RCS will significantly reduce radon concentration in the headspace of Silos 1 and 2. The result will be a reduction of radiation levels directly above and in the immediate vicinity of Silos 1 and 2. This reduction in radiation levels will be most beneficial for activities over the top of the silos, the top of the silo berm, and near the silo handrails. However, short-term activities in these areas are not likely to warrant operation of the RCS.

RCS Phase I operations will be intermittent, with operation initiated as needed to maintain the radiation field on the surface of the domes of Silos 1 and 2 below 10mrem/hour during Phase 1 construction. The decision to operate the RCS will be based upon the As Low As Reasonable Achievable (ALARA) concept and will be made utilizing the criteria described in this section.

There are many factors that will determine if operation of the RCS is warranted for ALARA purposes. The need to operate the RCS will be based upon task analyses and estimation of the potential radiation exposure. Activities to be performed within the Silos Exclusion Zone have already been or will be evaluated as part of the FEMP ALARA process.

The following are situations where intermittent operation of the RCS is warranted:

1) Silo 1 & 2 maintenance/construction that will involve moderate or significant job duration and exposure potential within the immediate area of Silo 1 and/or Silo 2.
   Examples include:
   - Installation/construction of waste retrieval superstructure/modules
   - Removal of the silo plywood covers
   - Installation/construction of bridges over-top of silos
   - Installation of new risers for equipment modules

2) Occupational radon concentrations in the general construction area in excess of 0.03 working levels averaged over one week due to leakage from Silo 1 or 2.
   The general construction area is defined for the purposes of this document to be the construction area located outside the Silo 1 ands 2 exclusion area fence. If radon concentrations were to become elevated, operation of the RCS would lower radon concentration within the silo's headspace such that emissions from the silos would be negligible to the general construction area. The area within the K-65 exclusion area fence is already controlled to prevent unauthorized access through a fence, radiological postings, and administrative controls such as radiological work permits.

3) Silos Breech or Partial Dome Collapse
   The purpose for operation of the RCS for a silo breech would be to minimize the exposure to the public and occupational worker from the release of radon from the silo headspace. Examples include:
   - Dropped Load on the Silos causing a dome breach
   - Discovery of a crack or other breech to either Silo1 or 2

Job location, silo headspace concentration, job duration, and buildup rate of the radon within the silo headspace will dictate if the RCS will run continuously during performance of a task or if the RCS will operate periodically. This decision will be made by the Silos Project Management with direct input from Silos Project Radiological Engineering.

4 Control of RCS Phase 1 Operation

The philosophy for control of RCS Phase 1 operation focuses upon controlling two key process parameters: system operating pressure and radon emissions.
Details concerning process controls for the RCS, including descriptions of instrumentation and control equipment, setpoints, alarms and alarm responses, is provided in the Remedial Design Package for the Silos 1 and 2 Accelerated Waste Retrieval Project. Details are provided in the following components of the RD Package:

- Process Description Document for the Accelerated Waste Retrieval Project, 40710-RP-0015
- Process Control Summary for the Accelerated Waste Retrieval Project, 40710-RP-0020

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- Environmental Control Plan for the Accelerated Waste Retrieval Project, 40710-PL-0007
- Appendix A, Process Flow diagrams

The RCS Process has been designed so that its operation can be monitored and controlled remotely through the use a Programmable Logic Controller (PLC) / Human-Machine Interface (HMI) computer.

The PLC programming is designed to:

- Automatically monitor and control the unit operations within the RCS operating equipment to ensure correct operating conditions are maintained,

- Automatically switch between redundant process trains when operational, maintenance, or mechanical problems occur,

- Initiate carbon bed isolation and/or recirculation mode upon detection of an out-of-parameter radon level from radon monitoring instrumentation,

- Enunciate warning status alarms to inform operational personnel that conditions exist within acceptable design parameters, but outside desired operating conditions, and

- Enunciate emergency status alarms and automatically initiate system shutdown if conditions exist that are outside design parameters (e.g. unrelieved high-pressure in silos)

Upon loss of primary power, the start-up sequence for the emergency generator will automatically be initiated. Approximately two minutes will be required for the startup sequence to be completed and the back-up generator to be supplying power to the RCS equipment. The Programmable Logic Controller (PLC) and the RCS controls are powered by an Uninterruptible Power Supply (UPS) with a battery backup. Process control and monitoring, including the stack monitoring system, and the dampers used to control silo headspace pressure, will remain in uninterrupted operation during transfer of main power to the emergency generator.

When power is lost, the exhaust/recirculation fans providing flow from the Silo 1 and 2 Headspaces through the RCS will cease operation; it will take approximately one minute for the fan to ramp down. The PLC will automatically close the Silo Supply Dampers, and open the Silo Exhaust Dampers. This will result in an "exhaust only' mode, directing flow through the RCS to the exhaust stack to prevent positive headspace pressure during ramp-down of the fans. In the absence of ventilation from the exhaust fans, the only source of emissions to the atmosphere during the absence of power would be passive diffusion from the silo headspaces. Since initial RCS Phase 1 operation will result in rapid reduction in headspace radon concentrations, the emission impact of the 1-2 minute lack of power will be minimal.

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Once the emergency generator is online, the automatic restart sequence will be initiated to resume operation of the fans. The PLC will automatically notify designated on-call operations and maintenance personnel that a main power outage and transfer to backup power has occurred. Monitoring data will be available to quantify the emissions during transfer of power to the emergency generator.

4.1 Environmental Control

The methods and controls used to minimize the environmental impacts resulting from RCS Phase 1 operations are documented in detail in the Environmental Control Plan for the AWR Project, contained in Section 5 of the Remedial Design Package. The following detailed information is documented in detail in the Remedial Design Package:

- Applicable or Relative and Appropriate Requirements (ARAR) Compliance Matrix
- Radon Control System Performance Calculations
- Storm Water Drainage Plan
- Waste Handling Work Plan
- Silos Projects Environmental Monitoring Plan

4.1.1 Air Emissions Control

To meet the requirements of air emission ARARs, the RCS is designed to provide Best Available Technology (BAT) control, as defined by Ohio Revised Code (ORC) Section 3704.01(F), for radionuclide particulate and radon emissions.

The stack receives the treated RCS ventilation stream from sources associated with the AWR Project and from the building exhaust for the RCS Building. The stack is a 150-foot tapered carbon steel stack that is approximately 6 feet 4 inches wide at the base and tapers to approximately 3 feet at the top.

The stack is equipped with continuous sampling of the stack exhaust for particulate radionuclides in compliance with Title 40 of the Code of Federal Regulations (CFR), Part 61, Subpart H. In addition, the stack exhaust is continuously monitored for radon. The monitor consists of a probe assembly and a sampling and monitoring rack which are inserted in the stack at an elevation of approximately 61 feet, which corresponds to roughly eight stack diameters downstream of the last flow disturbance in the stack. The probe assembly measures stack flow and sends a signal to the sample rack flow controller. The sample rack flow controller controls the sampling pump in order to match the flow rate in the sample nozzle with that in the stack. The sample rack also includes an instrument for measuring the radiation from the sample collected on a filter paper. The air stream flows through the filter paper and is directed through a continuous radon monitor that measures the concentration of radon in the stack effluent

Monitoring data is continuously collected and analyzed by a local computer, and concurrently sent to the control room for display and recordkeeping. Alarm circuits are available to alert the AWR Control Room operator if an out-of-specification condition exists in the stack. In the event that an out-of-parameter condition is detected, an alarm is enunciated and appropriate action is automatically initiated, such as switching the HEPA filters being used, recirculating the process flow to the silos, reducing the airflow in the RCS, or shutting down the RCS. Operating controls for the entire system are included in the AWR Control Room. These controls are presented in greater detail in the RD Package.

Detailed analysis of radon emissions during Phase 1 operation of the RCS is documented in the Radon Control System Performance Calculations included in the RD Package.

To ensure that applicable offsite emission limits (annual average 0.5 pCi/l radon above background; 10 mrem/year offsite EDE excluding radon) and onsite worker protection standards are not exceeded, setpoints have been calculated to initiate corrective actions, and if necessary, shutdown of the RCS, well before the most limiting criterion is reached. These setpoints will be fine-tuned during initial RCS Phase 1 operation.

Data from the continuous stack monitors, as well as data from ambient air monitors, will be used to demonstrate that emissions from the AWR operations are within specified criteria. For example, the radon emissions measured by the continuous radon monitor in the RCS stack will be used to calculate the resulting radon concentration at offsite receptors to demonstrate that the 0.5pCi/l annual average above background criterion has been met. These modeled values will be compared to ambient concentrations measured at fence-line air monitors to provide validation of the modeling results. Verification of compliance with the 0.5pCi/l criterion is addressed in detain in the Silos Projects Environmental Monitoring Plan (40000-PL-0010), which is included in the AWR Project Remedial Design Package.

As described in detail in the AWR Project RD Package, enhancements have been implemented to the existing site monitoring program to address air, direct radiation, and project wastewater (i.e., slurry wastewater and decontamination wastewater) monitoring for the AWR Project. These enhancements have been designed to focus on monitoring Silos 1 and 2 headspaces, environmental radon levels in the vicinity of the silos, as well as radon levels at the site fenceline.

Data from selected radon monitors will be accessible via a secure Internet address. The data will include the date and time of the most recent transmission, location, and latest radon concentration. This data will be sent from the monitoring instrumentation without review or validation. Data review and validation will be conducted in a manner consistent with the current methods used under the IEMP Fluor Fernald Inc. radon monitoring program.

4.1.2 Wastewater Control

Criteria for transfer of wastewater from AWR operations to the Advanced Wastewater Treatment (AWWT) facility are identified in Table 1. Wastewater generated from RCS Phase 1 operation will be limited to liquid condensed from the gas steam generated at the RCS. This condensate will be transferred to one of two 3000-gallon shielded hold-up tanks, and held up for up to 20 days to allow radon to decay to levels acceptable for transfer. After the radon has decayed to an acceptable level, the condensate will be

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sampled to assure that it meets the criteria for transfer to the Advanced Wastewater Treatment (AWWT) facility and pumped to the AWWT.

In addition to the criteria identified in Table 1, no listed or characteristic hazardous waste, nor wastewater containing concentrations of RCRA metals (e.g., lead) above the RCRA toxicity characteristic (TC) limits, may be discharged to the AWWT without appropriate pretreatment.

4.1.3 Secondary Waste Management

Potential secondary waste streams resulting from RCS Phase 1 operation will consist of filter elements and miscellaneous waste streams, such as PPE, generated during operation and maintenance activities. The management of secondary waste is described in detail in the Waste Handling Work Plan included in the RD Package for the AWR Project. All secondary waste will be segregated, characterized, packaged, and dispositioned in accordance with site procedures. Based upon the Final Design, a Project Waste Identification and Disposition (PWID) Report will be prepared in accordance with procedure EW-1021, *Preparation of the Project Waste Identification and Disposition (PWID) Report.* The PWID will document the anticipated waste streams, generation rates, and Fluor Fernald-approved disposition for secondary waste resulting from AWR operations. As waste is generated, the volumes of each waste stream will be tracked against the PWID, and the PWID will be updated.

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1 TABLE 1

CRITERIA FOR AWR LIQUID DISCHARGE TO AWWT

RADIONUCLIDE PARAMETER	DISCHARGE LIMIT (pCi/L)
Actinium-227 (^{227}Ac)	10
Lead-210 (^{210}Pb)	30
Polonium-210 (^{210}Po)	80
Protactinium-231 (^{231}Pa)	10
Radium-226 (^{226}Ra)	100
Radium-228 (^{228}Ra)	100
Thorium-228 (^{228}Th)	400
Thorium-230 (^{230}Th)	300
Thorium 232 (^{232}Th)	5 ppm
Uranium-234 (^{234}U)	
Uranium-234/236 ($^{235/236}$U)	5 ppm
Uranium-238 (^{238}U)	
MAXIMUM FLOW	5 gpm (7,200 gpd)
TOTAL SUSPENDED SOLIDS (TSS)	1,000 ppm

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5. MILESTONES

The following milestones have been identified for implementation of the activities described in this RA Work Plan:

ACTIVITY	MILESTONE
Initiation of Radon Control System (RCS) Phase 1 Operation	November 1, 2002[1]
Submit draft Remedial Action Work Plan for Waste Retrieval Operation to U.S. EPA.	August 2, 2003[2]

[1]Milestone established by 9/27/01 Revised Silos 1 and 2 Accelerated Waste Retrieval Project Remedial Design/Remedial Action Schedule, approved by U.S. EPA 10/26/01

[2]Milestone proposed by DOE letter DOE-0513-02, dated 5/31/02, approved by USEPA 7/26/02