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COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT FMPC RESPONSE TO ITEM B OF CERCLA SECTION - FFCA FEDERAL FACILITIES COMPLIANCE AGREEMENT

08/17/86

WMCO
62
REPORT

FMPC

Comprehensive Environmental Response, Compensation and Liability Act

FMPC Response to Item B of CERCLA Section - FFCA

FEDERAL FACILITIES COMPLIANCE AGREEMENT

30 Day Deliverable

August 17, 1986

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RESPONSE TO ITEM B OF COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT (CERCLA) SECTION
FEDERAL FACILITIES COMPLIANCE AGREEMENT

30 Day Deliverable

August 17, 1986

EXECUTIVE SUMMARY

This report describes an interim control plan and implementation schedule, developed as part of the Federal Facilities Compliance Agreement (FFCA), to address initial remedial measures concerning the K-65 silos and the thorium compounds storage structures. Remedial measures include: control of radioactive emissions, including radon gas and decay products emissions; interim control to ensure the structural integrity of the containment structures; radon and decay products monitoring program for the fence line and off-site environs; and measures to be undertaken in the event of an unplanned release to the environment.

To control emissions from the K-65 silos various control measures are being considered and evaluated at FMPC. Options under consideration include the following: a gas containment bag, water column absorption, solid media adsorption and compressed tank storage. Actions to control emissions from the thorium compound structures include installation of filtering devices, and repackaging and/or over-packing of the thorium compounds suitable for long term storage.

Remedial measures to insure the structural integrity of the K-65 silos include the installation of center dome covers (completed February 1, 1986) and a fluid applied roofing system (in progress). Remedial measures recommended by Camargo Associates are in progress to ensure the structural integrity of the silo that contain thorium compounds. Other structures that contain thorium compounds have not been found to have structural deficiencies at this time.

The radon and decay product monitoring program consists of a network of monitors surrounding the K-65 silos, at various locations along the site boundary, and at different site specific locations.

The site wide emergency procedure for an unplanned radioactive release from the K-65 silos and the thorium compound storage structures is included within this report. The actions of this plan are intended to protect the health and safety of on-site and off-site personnel, limit or reduce any possible damage to the environment, and contain and recover any released radioactive material.

K-65 SILOS

115

TABLE OF CONTENTS

Page

1.0 SUMMARY 1

2.0 INTRODUCTION 1

3.0 BACKGROUND 2

4.0 INTERIM CONTROL OF RADIOACTIVE EMISSIONS FROM THE K-65 SILOS 2

4.1 Discussion of Remedial Actions in Progress 2
4.2 Discussion of Radon Concentration in the K-65 Silos 3
4.3 Discussion of Thermal Expansion of the Gases Within K-65 Domes . . 4
4.4 Discussion of Feasibility Study for Controlling Radon Emission from the K-65 Silos 4
4.5 Recommendations Based on Conceptual Designs 5

5.0 INTERIM CONTROLS TO ENSURE STRUCTURAL INTEGRITY OF THE K-65 SILOS . . . 6

5.1 Summary of the Approach 6
5.2 Initial Silo Analysis Phase Discussion 6
5.3 Summary of Field Investigation 9
5.4 Final Silo Analysis Phase Discussion 9
5.5 Discussion of Results 11
5.6 Recommendations and Conclusions from CAL Analysis 14
5.7 Analysis Verification 14
5.8 Implementation of CAL Recommendations 15

6.0 RADON MONITORING PROGRAM 15

6.1 Introduction 15
6.2 Proposed Program 16
6.3 Status and Implementation Schedule 17

7.0 EMERGENCY PROCEDURES FOR UNPLANNED RADIOACTIVE RELEASE 17

7.1 Purpose 17
7.2 Background 17
7.3 Definitions 17
7.4 Emergency Response Level Classification Guideline 18
7.5 General Considerations 24
7.6 Emergency Actions 24
7.7 Decontamination 25

8.0 PLANNED IMPLEMENTATION SCHEDULE FOR INITIAL CONTROLS OF K-65 STORAGE SILOS 25

5

115

TABLES

		Page
Table 1	PLANNED IMPLEMENTATION SCHEDULE FOR INITIAL CONTROLS OF K-65 STORAGE SILOS	26

6

115

1.0 SUMMARY

The following interim control measures have been developed to address initial remedial measures for the K-65 silos. As part of the remedial measures, interim control of radioactive emissions, including radon gas and radon decay product emissions from the K-65 silos, has been evaluated at the FMPC. Under consideration in the feasibility study for controlling radon emission from the K-65 silos are the following: a gas containment bag, water column absorption, solid media adsorption and compressed tank storage. Due to both the commercial unavailability of radon control systems and the lack of field data concerning pressure and temperature fluctuations inside the K-65 silos, detailed design for control of radon emission from the K-65 silos is not currently available. Upon completion of the K-65 weatherproofing project and with the knowledge of the actual temperature and pressure fluctuations inside the silos, criteria will be developed to be used in the final, detailed design of a radon emission control system for the K-65 silos.

Remedial measures involving interim controls to insure structural integrity of the two K-65 silos until final disposition of the radium - bearing residues are currently underway at the FMPC. To insure the structural integrity of the K-65 silos, WMCO has completed the installation of center dome covers on both silos as of February 1, 1986, and is approximately 65% finished with an applied fluid roofing system for the balance of the domes.

A radon and radon flux measurement program was initiated at the FMPC in September 30, 1984 by Monsanto-Mound to gain quantitative data on radon release from the K-65 silos and its impact on the environs. Monsanto-Mound set up a radon monitoring network which consisted of a series of monitors surrounding the K-65 silos at the fence line immediately around the tanks, and at successively increasing distances from the tanks. To date, all monitors have shown readings which are well within the guideline values set by the DOE.

An emergency procedure is provided herein which outlines actions that are to be taken in the event of a radioactive material release at the K-65 silos. The actions are intended to protect the health and safety of on-site and off-site personnel, limit or reduce any possible damage to the environment, and contain and recover any released radioactive material.

2.0 INTRODUCTION

A plan and implementation schedule for the following initial remedial measures: have been prepared: 1) interim control of radioactive emissions, including radon gas and radon decay produce emissions from the K-65 silos; 2) interim controls to ensure the structural integrity of the two K-65 silos; 3) a radon and radon decay product monitoring program for the fence line and off-site environs; 4) measures to be undertaken in the event of unplanned releases from the K-65 silos to the environment.

The interim measures and controls are necessary until final disposition plans can be developed. Currently underway is the planning for a Characterization Investigation Study (CIS) of the K-65 silos which will be part of the larger RI/FS for the FMPC site.

3.0 BACKGROUND

The two K-65 silos, located on the west side of the Fernald site, were constructed in 1955. The silos are used for storage of radium bearing residues, a by-product of uranium ore processing. The silos are of cylindrical concrete construction, 80 feet in diameter and approximately 27 feet high. The silo domes were originally designed to be 4 inches thick at the center tapering to 8 inches at the dome-wall edge.

The walls were post-tensioned reinforced with 0.162 inch diameter wire stressed to 140,000 pounds per square inch (PSI) (with assumed 30% loss, for a design stress of 100,000 PSI). These post-tensioning wires were covered by a 3/4 inch thick gunite coating. The minimum 28-day compressive strength used was 4500 PSI for the dome and walls and 3000 PSI for the floor and footing. The maximum allowable soil pressure was 4000 pounds per square foot (PSF).

The silos were designed to be loaded with the metal oxides in slurry form at a maximum rate of 8000 gallons per day. The radioactive residues were allowed to settle and the water was decanted, leaving a sludge with a density of 100 pounds per cubic foot (PCF) and angle of repose of 0 degrees. The maximum allowable height of solid material was 23 feet and the water level was limited to a maximum height of 25 feet.

In 1963, the silos were showing signs of exterior surface deterioration. Large areas of spalling occurred in the exterior surface gunite coating, particularly on the north silo, leaving post-tensioning wires exposed to weather. Subsequently, patches of the wires became severely corroded and broken. Various options were investigated as remedial actions for the silos. Repairs began in 1964 by first chipping away all loose gunite material and then patching the surface with 3/4 inch coat of cement mortar. After the gunite was repaired and a waterproofing sealant was applied to the external silo walls, an earth embankment was built to the top of the wall on a one and one-half to one (1-1/2:1) slope (horizonal:vertical). The earthen embankment was to provide relief from tensile stress within the walls by counterbalancing the load from the internal contents, since the broken wires were not replaced. A soil was chosen with roughly the same density (125 PCF) as the contents of the silos (100 PCF). Two additional purposes of the embankment were to provide weather protection and to reduce the radon emission from the silos.

In subsequent years problems with soil erosion on the silo embankment were frequent. The eroded areas were repaired, but with heavy rains the problem reoccurred. In 1983, the embankment was enlarged to achieve a 3:1 slope. No further evidence of large scale erosion has occurred.

4.0 INTERIM CONTROL OF RADIOACTIVE EMISSIONS FROM THE K-65 SILOS

4.1 Discussion of Remedial Actions in Progress

4.1.1 Temperature and Pressure Monitoring System

In order to assess the anticipated temperature and pressure fluctuations within the K-65 storage silos, a project has been initiated to install a measuring system on the silos. To accomplish the temperature and pressure monitoring, an instrumented flange

assembly will be installed on top of the silo domes. The flange assembly will provide four temperature measurements and a differential pressure measurement for each silo. The temperature and pressure data for both silos will be monitored on a continuous strip chart recorder. Receipt of the necessary equipment is scheduled for 8/18/86. After the equipment is received, a work plan is in place so that installation can begin immediately. It has been estimated that two weeks will be required for installation.

4.1.2 Applied Fluid Roofing Membrane

The installation of an applied fluid roofing membrane (weatherproofing) on the K-65 silo domes has been initiated. It is anticipated that installation of the membrane will provide the following benefits: 1) the membrane will prevent water from seeping into the silo dome cracks thus limiting further deterioration of the domes; and 2) the membrane will help inhibit the escape of radon gas and radon daughter products to the environment. The membrane installation was approximately 65% completed when halted in late April due to increased radiological concerns stemming from application of the membrane. An action plan has been prepared to continue the work; it has been estimated that the work can be completed within eight weeks after approval of the plan.

4.2 Discussion of Radon Concentration in the K-65 Silos

Inherent in the criteria for final design of a radon emission control system for the K-65 silos is the determination of the radon concentration within the silos.

In order to accurately predict the radon gas concentrations, it would first be necessary to thoroughly sample the residues contained within the K-65 silos as planned in the Characterization Investigation Survey (CIS). An interim estimate of radon gas concentration was obtained using the following assumptions:

1. The concrete dome thickness and density are equal for the two tanks.

2. The height of the residues is identical in the two tanks.

3. The distribution of the radium and radon daughters within the two tanks are identical.

4. The density of the residues (and therefore the self shielding) is identical between two tanks.

5. Radon is completely contained inside the silos and no diffusion occurs through the concrete dome.

6. The Rn-222 is assumed to be in secular equilibrium with the Ra-226 (i.e. 816 curies of Ra-226 have formed 816 curies of Rn-222 in each silo).

Based upon the listed assumptions, the average exposure rate measurements

taken for the tank domes, and the total reported activity of the tanks, it is estimated that each silo contains 794 curies of Rn-222 entrained in the tails and that 22 curies or 3.5×10^{-5} Ci/l are contained within the air space inside the dome above the residue.

4.3 Discussion of Thermal Expansion of the Gases Within K-65 Domes

In order to properly design a radon emission control system, the thermal expansion of the gases within the K-65 silo domes must be determined as this dictates the volumed air to be treated. The necessary data for the thermal expansion of the gases will be obtained from the proposed K-65 silo temperature and pressure monitoring system. Due to thermal expansion, the gases within the K-65 domes expand and contract daily. As expansion occurs, the additional air volume escapes from the silo causing a greater Rn-222 release than would occur by diffusion alone. For example, it has been determined that for a temperature increase of 10°F, the volume of air in a silo would increase from 26,770 ft^3 to 27,393 ft^3, an increase of 623 ft^3 or 2.3%. Therefore, it can be estimated that 2.3% of the radon in the air in the silo, or 0.5 Ci per silo, is released due to a temperature increase of 10°F in the air in the silo.

4.4 Discussion of Feasibility Study for Controlling Radon Emission from the K-65 Silos

4.4.1 Gas Containment Bag

The majority of radon gas and radon decay product emissions from the K-65 silos is due to the gases within the silo domes. As discussed in Section 4.3, as the temperature inside the silo dome increases, the volume of the gases also increases. Therefore, if the additional volume of gas due to thermal expansion from the K-65 silos were to be vented into a containment bag, it is expected that the gas would return to the silos from the containment bag upon cooling. The containment bag would literally breath with the expansion and contraction of gases within the K-65 silo domes. The containment bag would be hung in an adjacent empty silo and vent lines from the K-65 silos would lead into the containment bag. Thus, the containment bag would be protected from the environment, and the empty silo would provide an additional precaution in the unlikely event that the containment bag would rupture.

4.4.2 Water Column Absorption

Water column absorption is used in many applications to control the emission of gaseous pollutants by allowing the effluent gas to interface the water and be absorbed by the water. The success of the water column absorption is dependent upon the solubility of radon gas in water as compared to the other gases present. It is predicted that the radon gas is indeed soluble enough in water to enable the control of its emission from the K-65 silos. The water column system would consist of a vent line leading into a continuously moving water column. The replenishment of the water column is necessary so that the water does not become saturated with the gases. The water would then need to be held in a tank until the radon activity had decayed to an acceptable level. After radon decay, the water would be

degassified and the remaining nonradioactive gases would be vented to the atmosphere. The degassified water would then be recirculated into the water column to absorb vented gases from the K-65 silos.

The water column absorption system could be effectively used to control radon emissions. However, due to the nature of the systems, extensive design work and monitoring would be required to ensure its success.

4.4.3 Solid Media Adsorption

Solid Media Adsorption is a separation process that has been effectively used to remove gaseous components preferentially from a flow stream. This process could be used in addition to the controlled venting option as discussed in Section 4.4.1. The system would trap the radon decay products in the HEPA filter (Section 4.4.1) and remove the radon gas by adsorption onto the surface of the adsorbing medium. The success of this system depends on the ability of the medium (such as activated carbon) to remove the radon gas from the vented gases. The Solid Media Adsorption System would require extensive design work and constant monitoring to ensure its success.

4.4.4 Compressed Tank Storage

A compressed tank storage system for control of radioactive emissions from the K-65 silos involves compressing the vented gas from the silos into a separate storage tank(s). A vent line would run from the K-65 silos to a compressor which would remove any excess pressure (above atmospheric) from the K-65 silos and would pump the gas into a holding tank. The vented gas would be held in the tank until it decayed to an environmentally safe level and then vented to the atmosphere through a HEPA filter. After decay and venting, the tank would again be ready to accept excess gas from the K-65 silos.

The compressed tank storage system is similar to the containment bag system discussed in Section 4.4.2 and would require a moderate amount of design work and monitoring.

4.5 Recommendations Based on Conceptual Designs

Based upon findings to date, the following will be vigorously pursued:

1. Completion of the installation of the applied fluid roofing system. The neoprene membrane is expected to effect temperature and pressure fluctuations within the silos and therefore effect the gas volume expansion and contraction within the silos.

2. Completion of the installation of the temperature and pressure monitoring system for the K-65 silos. The data that will be obtained from the monitoring system is necessary to properly design a radon emission control system.

3. Continuation of work on the radon emission control system by performing conceptual design work based on the options discussed in Sections 4.4.1 through 4.4.5. As additional information is

obtained from the CIS and the temperature and pressure monitoring system, a final design for controlling radon emissions will be developed and presented to the U. S. EPA, Ohio EPA, and Ohio Department of Health.

5.0 INTERIM CONTROLS TO ENSURE STRUCTURAL INTEGRITY OF THE K-65 SILOS

Essential to the final disposition of the K-65 silo residues disposal studies is a through testing and analysis of the two K-65 storage silos to determine their structural stability and to identify any potential structural problem areas that will require remedial action.

Camargo Associates, Limited (CAL) in association with Muenow and Associates and Soil & Materials Engineers, Inc., has provided for the inspection, testing, and evaluation of the two K-65 storage silos.

In addition to performing a testing and analysis evaluation of the silos, it was necessary to determine the allowable stresses (dynamic and static) that may be applied to each of the silos without causing failure or significant damage.

5.1 Summary of the Approach

FMPC supplied CAL with copies of the original silo design drawings. CAL was also given the maintenance file on the K-65 storage silos, containing available historical documents on remedial and maintenance actions on the silos.

The silo investigation consisted of three phases. The first phase was a computer analysis of the storage silos depicting the original "designed" condition of the silos based on the drawings supplied by FMPC. Only static loads were considered for this phase.

The second phase consisted of field work on and around the silos. This portion was divided into three areas. These were; the soil exploration study; the "Echo Pulse" system testing of the silo dome, wall and base slab; and the "Ground-Radar Survey" of the earth embankment surrounding the K-65 silos.

The third phase was a detailed computer analysis of the K-65 silos utilizing the results of the field work. Both static and probable dynamic loadings were considered during this phase.

5.2 Initial Silo Analysis Phase Discussion

The initial phase of the silo investigation was a computer analysis of the silo to be used as a tool to guide the field investigation. The original silo design was analyzed through a finite element computer program so that any critical points in the design of the silos could be given a more detailed investigation during the field investigation portion of the project. The finite element program, used in the initial analysis as well as the static analyses in the final analysis, is a capability of the Micas Computer System produced by the Rand Corporation in Dallas, Texas. The program was run on a Wang 2200 minicomputer.

There were two different finite element model types analyzed. One was an axisymmetric model, while the other was a three-dimensional shell subdivided into its three principle components, i. e., the arched dome roof titled 568DOME, the wall titled 568WALL, and the base slab titled 568SLAB. All models used the initial design of the K-65 silos as their respective design criteria. In this way, the actual history of the loading of these silos could be modeled.

The axisymmetric model titled 568TANK3 uses a two-dimensional model in the X-Y global coordinate system and rotates it 360 degrees about the Y axis, forming a shell of revolution. All components of the model are rotated, including nodes, elements and loads.

The individual shell models were used as a back-up to the axisymmetric model. The axisymmetric model was a complete system therefore, the effect of the joints is analyzed in whole by the computer. When they are separated into individual components, the continuity of the connections are lost. The continuity can be estimated through the use of springs. The spring constraints were generated by applying a unit load to each reaction component and determining the amount of translation or rotation generated. Once the springs were applied, the results could be compared to the axisymmetric model.

Both K-65 silos are of cylindrical concrete construction, using normal weight concrete (150 PCF) with a 28-day compressive strength of 4500 PSI. A Young's Modulus of Elasticity of 3.82×10^6 PSI, Poissons Ratio of 0.2, and a thermal coefficient of 5.5×10^{-6} in/in^{o}F were the resulting properties used in the analysis.

The connections of the dome-to-wall and wall-to-base slab were modeled as originally designed. The wall is anchored to the base slab by #4 dowels (0.5" diameter) at 12 inches O. D. (on center). The dowels and a 7 inch x 2 inch deep shear ledge provide translational support, but the joint is free to rotate. This condition is effectively modeled as a hinge. The axisymmetric computer model connects the wall to the base slab at a single node producing the hinged condition. The dome-to-wall connection is more rigid with #4 dowels at 12 inch O.C. at both the inside and outside face of the dome. This is modeled on the computer as a fixed condition, with the transition from wall to dome occurring over three nodes and eight elements.

The loads on the silo model were dead load (DL), live load (LL), contents (C), and the earth embankment (E). The dead load consisted of the self-weight of the concrete and the compressive hoop force of the post-tensioned wires. The concrete is normal weight (150 PCF) and was modeled as a gravity load on every element in the model. The post-tensioning wires were modeled as inward acting loads on the outside face of the walls. These loads were based on the number of wires per 8 inches of wall height and it was assumed that every wire was stressed fully to its design stress of 100,000 PSI.

The live load on the model was a 20 PSF snow load over the dome surface.

The contents of the K-65 silos are modeled based on the following assumptions derived from the historical data supplied to CAL:

115

1. The material was placed in the silo as a slurry, therefore, the angle of repose was taken as zero degrees.

2. The unit weight of the material was 100 PCF.

3. The contents over time have not shrunk back from the walls.

The contents were loaded at a maximum rate of 8000 gallons per day. However, for this load case the maximum possible loading was used. This was set at a maximum height of 23 feet above the floor slab for solids and 25 feet for water.

The embankment load was applied to the full height of the silos' walls and its density was taken as 125 PSF. The soil characteristics were assumed to be granular enough to prevent shrinkage away from the wall. A lateral pressure coefficient of 0.4 was used. This results in a silo wall lateral soil load at any point that is 40 percent of the total soil weight above the point.

The load combinations applied to the model paralleled the actual loading of the two K-65 silos. The first combination analyzed was DL (dead weight of structure) alone, resembling the as-built condition of the silo. Next the snow load was applied to the empty silo (DL + 20 PSF snow load (LL)). Then the silo was filled to its capacity (DL + Contents Properities (C)). Lastly, the embankment was built around the filled silos (DL + C + Soil Properities (E)).

The extreme events such as earthquake, tornado, and additional earth fill over the dome were left for the final analysis phase.

Results of the initial phase did not indicate any areas in the dome that were abnormal, therefore, no additional areas in the dome were investigated. Results of the analysis showed that the membrane stresses were very low and that all elements were in compression.

The results of the analysis of the silo walls under dead load plus contents showed that the elements in the bottom half of the silo were in tension. Normally, the post-tensioned wires would keep the concrete constantly under compression under the various load cases.

The initial phase analysis utilized the design stress value in the wires per the original drawings. The wires were initially stressed to a higher level, but the difference accounts for loss of pre-stressing force due to such factors as creep in concrete and steel, anchorage transfer loss, and initial deformation of the concrete. The stresses generated through the analysis indicate that the same wires were being stressed beyond the design stress value, therefore causing additional deformation of the wires and some cracking of the concrete since concrete in tension (modulus of rupture) has approximately 10% of its compressive strength capacity.

Results for the base slab show low stress levels, with the top of the slab in compression and the bottom in tension, indicating bending in the base slab. The backup analysis was a flat plate model, (568SLAB) which was then analyzed by a design post processor to check the amount of steel

14

reinforcement required. The results showed that the reinforcing steel provided in the original design was adequate.

5.3 Summary of Field Investigation

From August 19 to September 13, 1985, the field investigation of the K-65 silos was performed by personnel from Soil & Material Engineers, Inc. (S&ME), and Muenow and Associates, Inc. (M&A), under the supervision of CAL. The purpose of these tests was the determination of the existing condition of the silos. This information was necessary for assuring that the third phase computer model reflected the current K-65 silos site conditions.

The field studies performed fall under two categories. First was the test necessary to determine the subsurface soil conditions around the silos. The second was the nondestructive tests needed to determine the physical condition of the silos.

S&ME performed standard analytical tests on samples recovered from test borings to determine the soil index and engineering properties of the soil. These tests included natural moisture content, Atterberg Limits, grain size analysis, dry density and unconsolidated and undrained one-point triaxial compressive strength.

S&ME also measured the dynamic properties of the subgrade using crosshole seismic techniques. These dynamic soil properties were used in the generation of a synthetic earthquake for the final model.

M&A used subsurface ground radar to analyze the K-65 silos berm embankment. Ground radar utilities reflected radio waves to determine the uniformity of the soil, locate and measure the size of voids, and locate and measure the size of any moisture concentrations and/or associated riverlets. This information can be used as an aid in determining if any leakage from the silos had occurred.

M&A also performed pulse-echo nondestructive testing on the silos for the purpose of determining concrete quality. The pulse echo technique uses reflected sound waves to locate and determine any changes in the concrete. From this data, the following information can be determined:

1. Compressive strength of the concrete.

2. Thickness of the dome and walls.

3. Percentage of reinforcement remaining in the dome and walls.

4. Condition of the remaining reinforcement.

5. Condition of the foundation directly under the wall.

5.4 Final Silo Analysis Phase Discussion

The final phase of the silo analysis focused on the silos in their present condition. Information obtained from the field investigations was utilized to model the silos in their present state. From this analysis, the

structural integrity of the silos could be determined based on normal loading patterns as well as extreme cases such as earthquake and tornado.

There were two different types of axisymmetric finite element models analyzed during this phase. The first was a static model using a triangular element type. This model is similar to the one described in Section 5.2. The following information, taken from the M&A report was used to model the actual physical characteristics of both the north and south silos:

1. Actual dome thicknesses and concrete compressive strengths.

2. Actual wall thicknesses and concrete compressive strengths.

3. Percentage of post-tensioned wires remaining in the walls.

The M&A report showed general thinning of the silo domes with sharply undulating interior surfaces. Associated with the thinner dome sections was concrete that was cracked and exhibiting various stages of deterioration. Widely varying silo characteristics cannot be modeled axisymmetrically, because any small inconsistency (i.e., a hole) will be revolved 360 degrees about the Y axis. This would, if it were a hole, form a discontinuity in the silo structure at the location of the hole. To avoid this, average values were computed for various wall heights and dome radial points. The following trends were observed from M&A's report:

1. The silo dome thickness and general concrete quality deteriorated progressively, moving radially from the dome-wall edge to the dome top.

2. The silo wall thickness, concrete quality, and remaining percentage of horizontal preload wires have deteriorated progressively, moving from wall top to bottom.

3. The silo base slab could not be measured by the techniques used in the field investigation. Therefore, the slab was modeled as it was originally designed.

Load combinations applied to the final model for analysis were:

1. DL

2. DL + LL

3. DL + LL + CONT. (C)

4. DL + LL - EMBANKMENT (E)

5. DL + LL + C + E

6. DL + [FILL (F) + E (REV.)] + C

7. DL + TORNADO PRESSURE (TP) + CONT (C) + EMBANKMENT (E)

8. DL + TORNADO SUCTION (TS) + CONT (C) + EMBANKMENT (E)

9. DL + C

Where DL = Dead weight of structure

LL = 20 PSF snow load

C = Contents Properties: = 100 PCF, Angle of Respose = 0 degree

E = Soil Properties: = 130 PCF, Ka = 0.5 (value from S&ME report, Appendix D)

Fill (F) = 3 ft. soil cover over dome: = 390 PCF

E (Rev.) = E + surcharge produced by extra 3 ft. of soil

TP = 401 PSF acting downward on exposed dome surface

TS = 432 PSF acting upward on exposed dome surface

The second axisymmetric model analyzed was a dynamic model using the ASHSD2 program. ASHSD2 is a finite element computer program written by Sukumar Gosh and Edward Wilson in 1969 at the University of California, Berkley. The program was designed to be used for the dynamic stress analysis of axisymmetric structures under arbitrary loading. The current version was modified and improved by C. J. Lin of United Engineers & Contractors, Inc. in 1975. The program may be used to analyze axisymmetric structures subjected to arbitrary axisymmetric or non-axisymmetric loadings. The axisymmetric continuum may be idealized either as a shell of revolution or as an axisymmetric solid or a combination of both. This program will therefore enable one to evaluate the dynamic response of soil-structure system. The program will also perform a time history analysis (i.e., a step-by-step integration through the time domain).

The dynamic model was run using the same silo model data as the static model and the dynamic stresses developed would be added to the static loads to obtain the following load combination:

10. DL + LL + C + E + Dynamic

The dynamic properties were taken from S&ME report.

5.5 Discussion of Results

The final phase of the report addresses the structural condition of the silos and the recommended allowable loads the silos could support at the time the report was issued.

The following finite element programs were used as the computer models of the north and south K-65 silos. The north silo model is labeled "568TANK7" and the south silo model is labeled "568TANK8." Both of the above models are based on the axisymmetric technique. The above models were used for the static load cases as well as the tornado pressure and suction loadings.

The time-history earthquake loadings were modeled on an axisymmetric shell program called "ASHSD2."

5.5.1 Static Results - Dome

The dome of the silos were the most critical part of the entire silo structure system. Under the static loads, as they existed at the time of the report, Load Combination 5, the maximum X or hoop stress is 41 PSI tension near the center, and 190 PSI compression near the edges.

Another area that would limit the capacity of the dome would be its buckling stability or the ability to withstand the compressive loads without bending out of plane. Since the domes have thinned down, and the Modulus of Elasticity has also reduced, (concrete quality), the critical buckling load will also be reduced. The critical buckling load of the domes would be approximately 284 PSF for the existing concrete outside of the critical area. Using a safety factor of 4, the allowable load would be 71 PSF. This value would be valid for the 3 inch thick area of both domes.

Inside the critical 20 foot diameter area, the buckling load of the domes would be approximately 104 PSF for the existing concrete. Using a safety factor of 4, the allowable load would be 26 PSF. This is based on a 2 inch thick area of the concrete. As is readily evident, the allowable buckling load is nearly the same as the dead weight of the dome itself (25 PSF for a 2 inch thick dome).

Results indicated that the portion of the dome outside the center 20 foot diameter area was not capable of supporting much more than its own self weight and snow load. This amounts to 38 PSF for the slab and snow load at 20 PSF for a total of 58 PSF. Since the buckling load capacity of the 3 inch slab is 71 PSF, this leaves a net of 13 PSF. Ignoring the center 20 foot section, the total additional load that could be supported by the 3 inch (and greater thickness) dome area is 11,000 pounds. Since the center 20 foot diameter portion is only rated at a load equal to its own dead weight, and since the critical buckling load of the dome would be greatly affected by irregularities in the concrete surface, it was recommended that all additional live loads should be kept off that area.

Based on the computer Load Combination 6, which is for the 3 feet of earth cover over the dome (390 PSF), the stress is 1,000 PSI tension near the center and 300 PSI tension near the edge. Based on the low buckling capacity, the additional earth load should not be considered.

5.5.2 Combined Static and Dynamic Results - Dome

Based on the results of the analysis, the domes are not stiff enough to resist movement. Therefore, the domes will move along with the ground motions induced by the synthetic earthquake. There are very little additional stresses induced (2 PSI) into the concrete domes from the "defined" synthetic earthquake.

5.5.3 Static Results - Wall

The static load combinations indicated the following:

1. Under dead load, contents, and earth embankment, Load Combination 5, the stress levels indicate that the wall is under compression and as such, is in a stable condition. The maximum stress is 515 PSI compression. This case represents the present state of the silo.

2. Under dead load and contents, Load Combination 9, the stress levels indicate that the silo would be in a dangerous state with stress in the remaining post-tensioning wires at 114,000 PSI. This case would depict the removal of the earth berm with the contents of the silos left in place. The design stress in the wires was 100,000 PSI and the above value of 114, 000 PSI would be above the original design limits.

3. Under dead load, live load, and embankment, Load Combination 4, the stress levels are 1,200 PSI compression. This combination would represent the removal of the silo contents without removal of the earth berm. Because of the magnitude of the stresses, this combination should not be utilized.

4. Therefore, based on Load Combinations 4 and 9, the removal of the contents and/or embankment should both be accomplished simultaneously. This case would represent Load Combination 1.

5.5.4 Combined Static and Dynamic Results - Wall and Base Slab

Under the dynamic loading, two areas are in the greatest amount of stress. These locations are at the dome-wall intersection, Node 121, and at the base of the wall (approximately) 1'-0" above the footing, Node 50.

At the dome-wall intersection, the combined element stresses show the wall is in compression or just slightly into tension. The tension value is less than the modulus of rupture, and therefore will not introduce additional cracking. At the base of the wall, the stress levels even under combined static and dynamic loads would indicate that cracking and load redistribution would occur. Since the wall is surrounded on either side by the soil or the silo contents, the wall cannot collapse. Therefore, the wall would still function as a containment for a dry material. The combined results show that the slab experiences enough tension to crack the concrete during the dynamic loading. The result of this cracking would be to redistribute the loads since:

1. The slab is surrounded by soil and the silo contents and a collapse could not occur.

2. The program calculates the stress in the direction of the

applied load. Therefore, additional stress can be taken at other points along the wall outside of maximum point shown.

5.6 Recommendations and Conclusions from CAL Analysis

In conclusion, the analysis indicated the following:

1. The base slab and walls at that time were structurally stable under the existing static loads being applied to them and should continue to be so for approximately 5 to 10 years.

2. If either the contents of the silos or the silo embankment were to be removed, they must be removed simultaneously or failure of the walls or base slab could result.

3. The center 20 foot diameter portion of the dome top is structurally unsound for a load greater than the existing static dead load and no life expectancy was assigned to it.

4. The application of a three foot thick earth fill load on the dome or the application of tornado suction or pressure loads, would cause a structural failure of the dome.

5. The application of the "defined" synthetic earthquake would induce some additional cracking in the base slab and at the base of the silo wall, but the silo would still be in a serviceable condition. The dome would be unaffected, and should simply move with the ground motions.

6. If a cover is chosen to cover the center portion of each silo dome, the weight should be as light as possible and in no case should it be greater than that allowed by the buckling capacity of the dome (approximately 11,000 pounds).

5.7 Analysis Verification

The original CAL report, including calculations, analysis and methods used, was reviewed by a registered professional engineer on the CAL staff who was not originally associated with this project.

Another finite element program was run using the same type of elements (membrane stress only, no bending) as used in the original work. This program was "SAP IV" which is "A Structural Analysis Program For Static and Dynamic Response of Linear Systems" by Bathe, Wilson and Peterson 1973, Revised, from Earthquake Engineering Research Center.

Results of the verification confirmed the condition and findings of the silo. The following references were used during the investigation:

ACI-318-83 - "Building Code Requirements for Reinforced Concrete."

ACI SP-28 - Concrete Thin Shells

ACI SP-67 - Concrete Shell Buckling

Design of Prestressed Concrete Structure T. Y. Lin & Ned H. Burns - 3rd Edition - Wiley.

Theory of Prestressed Concrete by Michael Chi & Frank A. Biberstein. 1963 Prentice-Hall, Inc.

Thin Shell Concrete Structures by Billington. 1965 McGraw-Hill.

Finite Element Computer Programs
MICAS - Produced by the Rand Group, Dallas, Texas

ASHSD2 - "Dynamic Stress Analysis of Axi-Symmetric Structures Under Arbitrary Loading" by Ghosh & Wilson - Revised 1975 - Earthquake Engineering Research Center.

5.8 Implementation of CAL Recommendations

In order to assure the structural integrity of the K-65 storage silos, two actions were initiated as a result of the Camargo investigation. The actions included the installation of a cover over the center portion of the silo domes and an applied fluid roofing system for the rest of the dome.

5.8.1 Dome

A temporary dome, 30 feet in diameter, was designed and installed to span across the weakened portion of the concrete domes. The cover is self supporting and sits on a rolled plate steel skirt. The 30 foot diameter cover is composed of structural steel members which supports 3/4 inch plywood sheeting. An EPDM membrane will be glued to the plywood. The dome cover increases the stresses in the existing concrete, but all stresses are still within acceptable limits. The dome cover was installed so that containment of the silos contents will be maintained in the event of a center silo dome collapse. This work was completed on January, 1986.

5.8.2 Applied Fluid Roofing System

The installation of an applied fluid neoprene membrane was initiated to cover the existing concrete dome outside the dome cover on the K-65 silos. The neoprene membrane is designed to prevent water from seeping into the silo dome cracks; thus, limiting further deterioration. It is postulated that the membrane will also inhibit the escape of radon gas and radon daughter products to the environment. This work is currently on hold (see 4.1.2).

6.0 RADON MONITORING PROGRAM

6.1 Introduction

A radon monitoring program has been implemented for the fence line and off-site environs. The program monitors radon-222 to determine the radiation exposures to humans from both radon and its decay products. The maximum radiation exposures from those sources in the environs occur inside homes and other buildings where the radon has diffused or otherwise entered the

structures. The radon then forms its decay products which can build up to concentrations that can induce radiation exposures to the respiratory tract of humans living and working inside the building. Decay products formed outside the buildings are dispersed in the environs to the point that the radiation exposure from that source are small compared to the exposures from radon decay products formed inside the buildings. Likewise the radiation exposures from radon itself, both inside and outside buildings, is small compared to the exposures from radon decay products formed inside the buildings.

6.2 Proposed Program

To determine the maximum potential radiation exposures to humans, radon concentrations are monitored at the fence line and off-site environs and will be converted to potential indoor radiation exposures using the conventional EPA conversion factor of 0.5 (pCi radon-222 per liter x 0.005 = WL).

Radon-222 is monitored with track-etch detectors which consist of alpha sensitive plastic detectors mounted inside inverted cups covered by a hydrophobic microporous filter to prevent radon decay products from entering the cup and being detected. The radon-222 diffuses through the filter. The detector inside each cup is sensitive to alpha particles from radon and its decay products. The alpha particles penetrate the plastic detector leaving tracks which are subsequently etched to produce visible tracks in the plastic. The number of alpha tracks counted per unit area is proportional to the average radon concentrations. The advantages of the track-etch monitoring technique over other radon monitoring techniques are that the monitoring is completely passive, no electrical or mechanical components are involved, and the monitoring is easy to conduct. Once the detectors are exposed, the vendor of the detectors etches the plastic, visually reads the number of tracks per unit area, and reports the measured concentrations.

Track etch detectors are a widely-accepted method for obtaining accurate measurements of radon concentrations. Measurement standard deviations are generally in the range of 20% for typical environmental concentrations. Results are usually obtained within four weeks from submission of the detectors to the vendor for processing.

The monitoring of radon and radon decay products is conducted over quarterly time periods to produce a time-integrated measurements that is free of the short-term variations in concentrations that are characteristic of both radon and its decay products. The quarterly monitoring interval provides accuracy for the monitoring method yet guards against loss of detectors and data when longer time periods are used.

The monitoring locations are selected to characterize radon concentrations and potential exposures to humans at the site boundaries, at two schools, at a local business, and at two residences. The residences serve as background monitoring locations which are in the same meteorological wind patterns as is the site but far enough from the site so as not to be affected by radon emitted from the site. Specific monitoring locations, their distance from the center of the FMPC site, and the direction from the center of the FMPC site are presented below:

Location Number	Type of Site	Distance in LCM From Center of FMPC	Direction
1	Site Boundary	1.0	N
2	Site Boundary	1.3	NE
3	Site Boundary	0.7	E
4	Site Boundary	1.3	SSE
5	Site Boundary	1.1	SSE
6	Site Boundary	0.9	W
7	Site Boundary	1.3	NW
8	Elda School in Ross	4.6	ENE
9	Crosby Township School	3.6	SW
10	Business - Fernald	2.5	S
11	Residence	7.9	W
12	Residence	5.0	ENE

6.3 Status and Implementation Schedule

Radon-222 monitoring at the fence line and off-site environs was implemented in 1980. The program is currently in progress.

7.0 EMERGENCY PROCEDURES FOR UNPLANNED RADIOACTIVE RELEASE

7.1 Purpose

The purpose of this procedure is to outline actions that are to be taken in the event of a radioactive material release at the K-65 silos. These actions are intended to protect the health and safety of on-site and off-site personnel, limit or reduce any possible damage to the environment and contain and recover any released radioactive material. This procedure is considered preliminary until such time as the counties emergency plan is formally implemented.

7.2 Background

A radioactive release of material in the form of dust and/or gas could occur f the K-65 silos were damaged. The damage could result from natural or accidental causes.

7.3 Definitions

7.3.1 Minor Release (Unusual Event)

A minor release is one in which the effects of the release do not require the evacuation of a designated area and can be controlled or contained by the local work force. Assistance may be provided by other internal support groups.

7.3.2 Intermediate Release (Unusual Event, Possible Alert)

An intermediate release is one in which an entire area or building could be affected but adjacent areas would not. Releases would not affect off-site areas.

115

7.3.3 Major Release (Site Emergency, Possible General Emergency)

A release will be considered major if it affects areas or buildings beyond the one in which it originally occurred, or if there is the possibility of off-site areas being affected.

7.3.4 Emergency Director

President, WMCO, has overall authority for all emergency activities.

7.3.5 Emergency Duty Officer (EDO)

WMCO representative having management authority and responsibility for directing emergency operations. The EDO reports directly to the Emergency Director.

7.3.6 Emergency Operations Center Management Staff (EOCMS)

The EOCMS will consist of the designated management staff members who are responsible for re-establishing executive direction of the FMPC during the period of emergency. The EOCMS will consist of:

a. President, WMCO (Emergency Director)

b. Off Duty Emergency Duty Officers

c. Vice President & Manager of Community & Environmental Affairs (Public Information Officer)

d. FMPC DOE Site Manager

7.3.7 Emergency Support Staff

The Emergency Support Staff consists of designated personnel who advise the Emergency Duty Officer and Emergency Operations Center Management Staff at the FMPC during periods of emergency.

7.4 Emergency Response Level Classification Guideline

The FMPC Communication Center will be notified by the person in charge of the incident. This may be the supervisor of the area or the Emergency Brigade Chief. The Emergency Brigade Chief will be in charge of all emergency responses. The Emergency Brigade Chief is the Fire & Safety Inspector on duty.

NOTE: The Emergency Duty Officer will be contacted by the Communications Center immediately upon classification of the emergency. The following guidelines are to be followed by the Emergency Duty Officer after the emergency has been classified.

7.4.1 Unusual Event

Will not normally constitute an emergency but indicates a potential reduction of safety within the FMPC.

24

115

- There is no potential for significant off-site releases of toxic or radioactive materials.
- Activation of off-site response organizations is not expected.
- Response actions will be limited to on-site areas only.
- Response to the Communications Center is optional.

7.4.1.1 Notification Required

1. Oak Ridge Emergency Operations Center (EOC) (within hour)
2. President, Operating Contractor or alternate
3. DOE-FMPC Site Office Manager
4. Manager, Community and Environmental Affairs, Operating Contractor or alternate
5. Hamilton County and Butler County Civil Defense Offices

7.4.1.2 Department of Energy Notifications

The Department of Energy representatives will make the following notifications:

- Ohio Disaster Services Agency
- Southwestern Ohio Air Pollution Control Agency
- Congressional Offices for Districts One (1) and Eight (8)

7.4.1.3 Courtesy Notifications

Courtesy notifications will be coordinated by Manager, Community & Environmental Affairs or his representative. These will usually include but are not limited to:

- Ross, Morgan & Crosby Township Trustees
- Ross, & Southwest Local School Districts

7.4.2 Alert

An event is in progress or has occurred which involves an actual or potential substantial reduction of the level of safety at the FMPC.

Limited off-site releases of radioactive material may occur. For toxic materials off-site releases are expected to exceed permissible limits.

The purpose of this response level is to assure that on-site and off-site emergency response personnel are advised and available for activation if the incident becomes more serious.

Response to the Communications Center is mandatory.

7.4.2.1 Notification Required

1. EOC Management Staff

2. Oak Ridge Emergency Operations Center

3. Butler County Sheriff's Department

4. Hamilton County Communications Center

7.4.2.2 Department of Energy Notifications

The Department of Energy representatives will make the following notifications:

- Ohio Disaster Services Agency

- Southwest Ohio Air Pollution Control Agency

- Congressional Offices for Districts

7.4.2.3 Notes

When notifications are made to the Sheriff's Department and Communications Center they should be told we are at the Alert level, emergency response groups should be placed on stand-by, more information will be supplied as soon as possible, and no off-site releases have taken place at this time.

7.4.3 Site Emergency

An event is in progress or has occurred which involves an actual or likely major failure of a facility function needed for the protection of on-site personnel, the public health and safety and the environment. Off-site releases have the potential to exceed permissible limits.

The purpose of this response level is to assure the emergency operations center is in operation, the emergency support staff is in place, and monitoring teams are dispatched and other personnel necessary to mitigate the incident are available.

Current information should be available on a routine basis for off-site officials and organizations.

Response to the Communications Center is mandatory.

7.4.3.1 Notification Required

115

1. EOC Management Staff

2. Oak Ridge Emergency Operations Center (immediate)

3. Butler County Sheriff Department (immediate)

4. Hamilton County Communications Center (immediate)

5 EOC personnel will complete all other notifications.

7.4.3.2 Department of Energy Notification

The Department Energy representatives will make the following notifications:

- Ohio Disaster Services Agency

- Southwestern Ohio Air Pollution Control Agency

- Congressional Offices for Districts One (1) and Eight (8)

7.4.3.3 Actions

If not already done:

- Activate the Emergency Support Staff

7.4.3.4 Suggested Checkpoints

- Offer assistance to Civil Defense to prepare a EBS (Emergency Broadcast System) statement.

- This statement should prepare the general population for some type of response, e.g., sheltering, evacuation.

- Assure that emergency personnel have been issued dosimetry devices (Health Physics).

- Limit traffic into emergency area. Road blocks into plant may be necessary. (Security or off-site police agencies).

- Assure adequate medical treatment is available, if needed.

- Discuss problem with county officials. They will order protective actions for the public.

- Keep open lines of communication between Oak Ridge Emergency Operations Center (Communications Officer).

- Offer any available FMPC assistance to off-site groups (Security, Health Physics, etc.).

27

- Get support and advice from the EOC Management Staff and Emergency Support Staff.

- Keep in contact with the on-scene command post (Emergency Brigade Chief).

- Increase or decrease the level of the emergency as circumstances indicate.

7.4.4 General Emergency

An event is in progress or has occurred which involves an actual or imminent substantial reduction of a facility safety system. Off-site releases are expected to exceed permissible limits.

The purpose of this response level is to initiate pre-determined protective measures for on-site personnel, the public health, safety and the environment. Continuous assessment of the emergency condition and the exchange of such information between on-site and off-site organizations shall also be implemented.

A declaration of a General Emergency will initiate activation of DOE wide resources.

Response to the Communications Center is mandatory.

7.4.4.1 Notification Required

1. EOC Management Staff

2. Oak Ridge Emergency Operations Center (immediate)

3. Butler County Sheriff Department (immediate)

4. Hamilton County Communications Center (immediate)

5. EOC personnel will complete all other notifications

7.4.4.2 Department of Energy Notifications

The Department of Energy representatives will make the following notificatins:

- Ohio Disaster Services Agency

- Southwestern Ohio Air Pollution Control Agency

- Congressional Offices for Districts One (1) and Eight (8)

7.4.4.3 Actions - If Not Already Done

- Activate the Emergency Support Staff

Check with the Emergency Brigade Chief to confirm:

- what is the problem
- status of incident (what is going on)
- that necessary plants and areas have been evacuated
- that personnel are accounted for
- that personnel are in a safe zone
- what type of assistance is needed

7.4.4.4 Suggested Checkpoints

- Offer assistance to Civil Defense to prepare a EBS (Emergency Broadcast System) statement.
- This statement should prepare the general population for some type of response, e.g. shelter, evacuation.
- Assure that emergency personnel have been issued dosimetry devices - (Health Physics).
- Limit traffic into emergency area. Road blocks into plant may be necessary. (Security or off-site police agencies).
- Assure adequate medical treatment is available, if needed.
- Discuss problem with county officials. They will order protective actions for the public we recommend.
- Keep open lines of communication between FMPC and Oak Ridge Emergency Operations Center (Communications Officer).
- Offer any available FMPC assistance to off-site groups (Security, Health Physics).
- Get support and advice from the EOC Management Staff and Emergency Support Staff.
- Keep in contact with the on the scene command post (Emergency Brigade Chief).
- Increase or decrease the level of the emergency as circumstances indicate.
- Is there an off-site problem.

7.5 General Considerations

7.5.1 Indications of a Release May Include the Following:

a. Visible blowing dust originating from the silo or storage areas.

b. Activation of installed alarms.

c. Visual confirmation that a storage silo has sustained structural damage or containers of material are open or damaged.

7.5.2 If a radioactive material release occurs, any involved personnel should be sent to Medical for routine urine sampling and any other required medical treatment.

7.6 Emergency Actions

7.6.1 Reporting a Release

7.6.1.1 Emergency Conditions Can Be Reported By:

- Dialing telephone extension 6511
- pulling a manual fire alarm
- using a two-way radio
- the activation of fixed radiation detection alarms

7.6.2 Response To Intermediate Or Major Radioactive Material Releases

7.6.2.1 The Emergency Brigade Chief, after having been notified of a major radioactive release, will initiate the following plan:

- Assure all personnel have been evacuated from the area and are accounted for.
- If immediate off-site action is required, advise the Communications Center to contact the Butler County Sheriff's Office and/or the Hamilton County Communications Center.
- Have the Communications Center notify the Emergency Duty Officer.
- After personnel have been outfitted with appropriate safety equipment, start appropriate actions to contain the release. In the event of the collapse of a dome, a tarp may be temporarily placed over the opening to prevent further dispersion of the material.
- Attempt to prevent dispersion of all material.

- Survey surrounding areas to determine extent of contamination.

- Determine what personal safety equipment is required for re-entry.

- Permit only the minimum number of people necessary to deal with the spill/leak into the contaminated area.

7.6.2.2 The Emergency Duty Officer will assure that the following items have been addressed:

- escalate or downgrade the emergency as is necessary

- sufficient technical support is available to determine extent of contamination

- all conditions and methods are reviewed prior to decontamination to assure a safe clean-up.

7.7 Decontamination

Clean up, recovery and decontamination are essential steps in completing the response to a radioactive material release.

7.7.1 Preserve and identify the physical evidence associated with the release for documentation and evaluation purposes.

7.7.2 Consult with the Emergency Duty Officer before initial decontamination to assure that reviews by the appropriate sections have been completed and all health and safety aspects have been considered.

7.7.3 Determine the proper type of personal safety equipment required for the decontamination effort.

7.7.4 If material can be reclaimed, shovel or vacuum the material, mop the affected area, and store the recovered radioactive material in a critically safe container.

7.7.5 After suspected areas have been decontaminated, remonitor the area to assure decontamination has been completed.

7.7.6 Keep recovered material separated so the amount of uranium recovered can be determined.

8.0 PLANNED IMPLEMENTATION SCHEDULE FOR INITIAL CONTROLS OF INITIAL CONTROLS OF K-65 STORAGE SILOS

A schedule has been developed to provide for initial controls for the K-65 silos and is presented in Table 1.

TABLE 1

PLANNED IMPLEMENTATION SCHEDULE FOR INITIAL CONTROLS OF K-65 STORAGE SILOS*

RADON EMISSION CONTROL:	
Temperature & Pressure Monitoring System	Installation of K-65 Temperature and Pressure Monitoring System will be completed within 15 days after receipt of equipment, scheduled for 8/18/86.
Feasibility Study	Scheduled for completion August 29, 1986.
Conceptual Design	Estimated schedule for completion is 90 days after Temperature and Pressure Monitoring System data is obtained and analyzed.
Final Design	Estimated schedule is 90 days after conceptual design is finished.
Procurement	Estimated at 120 days.
Installation of Control System	Dependent upon approval of final design and delivery of equipment.
STRUCTURAL INTEGRITY CONTROLS:	
Applied Fluid Roofing Membrane (Weatherproofing)	Completion of weatherproofing project scheduled for 60 days after approval of continuation Action Plan.
Silo Dome Covers	Completed February 1, 1986.

TABLE 1

PLANNED IMPLEMENTATION SCHEDULE FOR INITIAL CONTROLS OF K-65 STORAGE SILOS*

MONITORING PROGRAM:	
Radon Monitoring Program	Monitoring program in place. Program to continue.
EMERGENCY PROCEDURES:	
Emergency Procedures	Emergency procedures completed.

*ALL SCHEDULING IS DEPENDENT UPON APPROVAL OF DESIGN AND FUNDING.

THORIUM STORAGE STRUCTURES

115

TABLE OF CONTENTS

		Page
1.0	SUMMARY	1
2.0	INTRODUCTION	1
3.0	BACKGROUND	1
	3.1 Quantity and Density of Stored Material	2
	3.2 Structural Analyses	3
	3.3 Structural Remediation	4
	3.4 Thorim Removal from Silo	4
	3.5 Thorium Removal from Bins	5
	3.6 Storage of Removed Material	5
4.0	INTERIM CONTROLS FOR RADIOACTIVE EMISSIONS FROM THORIUM STRUCTURES	7
5.0	INTERIM CONTROLS TO ENSURE THE STRUCTURAL INTEGRITY OF THE THORIUM STRUCTURES	8
6.0	RADON MONITORING PROGRAM	9
	6.1 Introduction	9
	6.2 Proposed Program	9
7.0	EMERGENCY PLAN FOR UNPLANNED RADIOACTIVE RELEASE	10
	7.1 Purpose	10
	7.2 Backgroud	10
	7.3 Definitions	11
	7.4 Emergency Response Level Classification Guideline	12
	7.5 General Considerations	17
	7.6 Emergency Actions	17
	7.7 Decontamination	18
8.0	PLANNED IMPLEMENTATION SCHEDULES FOR THE THORIUM COMPOUNDS STORAGE STRUCTURES	19

35

115

TABLES

		Page
Table 1	THORIUM COMPOUNDS FROM PLANT 8 SILO AND BINS AT FMPC	20
Table 2	REPACKAGING OF THORIUM WAREHOUSE MATERIALS AND THEIR LONG-TERM STORAGE	21

36

115

1.0 SUMMARY

This report proposes a plan and implementation schedule for the interim control of radioactive emissions including radon gas and decay daughters from the thorium compounds storage structures. Interim controls to ensure the structural integrity of the thorium compounds storage structures are also described as are the monitoring program and emergency procedures.

Filtering devices will be installed on the Plant 8 silo and bins to control radon (thoron) releases. These actions will reduce these decay product emissions from the stored thorium and thorium products. The next step is to redrum and/or overpack the existing stored thorium compounds into containers suitable for long-term storage. Included in this effort will be the removal of the bulk materials from the silo and bins, repackaging of the material, and storage of the material in environmentally acceptable long-term storage facilities. Finally, with the completion of structural modifications to the Plant 8 silo, all necessary structural remediation for thorium storage structures will be complete.

2.0 INTRODUCTION

A task team has been organized to concentrate on the necessary planning and engineering to expedite the repackaging and/or overpacking of existing stored drums of Thorium and Thorium compounds, and to expedite the design of the system to remove and package the Thorium Oxide materials stored in the bins and silo at Plant 8. The program outlined in this report represents not only the interim, but also the long-term program for the storage of this material at FMPC.

3.0 BACKGROUND

On June 9, 1986, a Thorium Silo Remediation/Thorium Materials Disposition task force was convened at the FMPC. The charter of the task force was to provide an evaluation of alternatives and to recommend a plan of action for structural reinforcement of the Plant 8 silo and bins and the removal and disposition of the thorium compounds stored inside.

The Plant 8 silo was constructed in approximately 1962 as part of the enriched feed preparation and Winlo process. The Plant 8 bins were constructed in approximately 1952 for use as raw ore storage. These storage vessels were used in various production processes until they were decommissioned in the early 1970's. In approximately 1972, the decision was made to use the vessels as an interim storage facility for thorium compounds. Plant records show that a variety of thorium compounds were then placed in the vessels.

In 1985, Lockwood Greene Engineers performed a conceptual design for a number of FMPC facilities. Included in this effort was the development of a conceptual design for a thorium handling system to remove the materials from the Plant 8 storage vessels. As part of the design process, Lockwood Greene performed a preliminary structural analysis of the storage vessels.

Conclusions provided in a preliminary letter report issued by Lockwood Greene in February, 1986, indicated that the silo and bins might be vulnerable to failure from high winds or a seismic event. In addition, the analysis showed that dependent on the product load, the silo was in an overloaded condition

37

from the dead and live loads alone. The final report included a preliminary structural analysis of the bins. This analysis concluded that a number of the structural stiffeners on the bin were overstressed by the assumed product load. This report did not include an analysis of the bins for wind or seismic loads. However, all of the Lockwood Greene analyses were based on assumed product loads. Investigation by FMPC personnel could not verify or dispute the accuracy of the assumed loads.

The Task Force was assembled June 9, 1986 to investigate the possible overstressed conditions in the silo and bins used to store thorium oxide in Plant 8. Overstressed conditions were identified in the following areas:

Silo:

- Bottom cone-to-cylinder junction
- Tank shell-to-column connections
- Tank columns

Bins:

- Bins-to-hoppers junction
- Stiffeners on upper hopper
- Plate below bin-to-hopper junction

The analysis of the bins did not include the building members which support the bins.

The Lockwood Greene report recommended several methods for alleviating the possible overstressed conditions. These included the construction of a concrete support structure for the silo and additional stiffeners on the bins.

3.1 Quantity and Density of Stored Material

There exists an uncertainty about the quantity and density of materials in the tanks. The Lockwood Greene analysis had first assumed that the silo was two-thirds full of material weighing 383 lbs. per cubic foot. Subsequent calculations on the silo were conducted using a density of 163 lbs. per cubic foot. The calculations on the bins assumed the bins to be within six feet being full with material weighing 180 lbs. per cubic foot.

To help resolve the questions relative to quantity and density level measurements, grab samples were taken on June 11, 1986 of the material stored in each storage container.

The results of the grab samples were as follows:

RESULTS OF SAMPLES TAKEN ON JUNE 12, 1986

TANK	VOLUME (FT^3)	TAP DENSITY (pcf)	ESTIMATED WEIGHT(tons)
Silo	2913	237	345
Small Bin	1991	63	68
Large Bin	3126	54	85

The samples were taken from the top material in the tanks. The tap density was the maximum expected density for these materials. These results were used for the preliminary independent structural evaluations.

To obtain additional information on the density of the materials at various elevations inside the tanks, Muenow Associates was contracted to perform ultrasonic measurements. The measurements were taken on June 19, 1986. The results indicated that a density variation exists within both the silo and storage bins. The variation in the density from the top to the bottom of the stored material could vary by a factor of 2.5 to 3. This being the case, the total weight may be higher than that determined from the sample analysis. These densities were used in the final independent structural evaluations and the design of structure remediations.

3.2 Structural Analyses

The Lockwood Greene report was independently reviewed,and the conclusion of this review was that the analyses were conservative. Factoring the Lockwood Greene results using the latest information on densities and quantities, the bins met all allowable limits. The building structure, however, was not analyzed. The silo exceeded allowable limits in certain areas,but was not in danger of imminent collapse under content weight, wind loads or ANSI standard seismic loads.

In addition, an independent computer analysis of the silo and storage bins was conducted by Camargo Associates, Limited. The analysis was completed on June 20, 1986 using the information on the density of the material from the ultrasonic measurements. The results were as follows:

- The stresses in the storage bins were well within the allowable stress and no structural remediation was considered necessary.
- The stresses in the silo could exceed the allowable limits under conditions of high wind, earthquake and unloading. The primary areas of concern were the cylinder-to-cone junction and the columns.
- Interim structural measures should be taken before modifying the silo to remove the stored material.

3.3 Structural Remediation

The most recent structural analysis performed by Camargo Associates based on the latest information on the density and quantity of the thorium oxide in the storage bins indicates that structural remediation of the bins is not required. Removal can, therefore, be deferred until this facility is decommissioned. A more refined analysis of seismic events is recommended to confirm this conclusion. Funds may be saved by going ahead with the removal of material from the bins at this time since the procedures will be similar to those used on removal of material from the silo. This will save mobilization and supporting engineering costs.

The most recent structural analysis based on the latest information on the density and quantity of the thorium oxide in the storage silo

indicated that interim remedial measures should be undertaken as soon as possible to reinforce the silo to withstand wind, seismic and unloading loads. The structural analysis indicated that the remedial measures should include the installation of a reinforcing ring at the junction of the cylinder-to-cone, additional cross bracing on the silo support columns, and selective reinforcement of the column flanges. The structural remediation program proposed by Lockwood Greene was not recommended because of questionable effectiveness, complexity, and inherent risk.

Based on the information on the density, quantity and level of materials gathered by the Task Force and the final independent structural evaluations performed by Camargo Associates, Limited, Camargo was contracted to prepare construction drawings and material specifications for the Plant 8 storage silo. The remediation was to include installation of a reinforcing ring of the junction of the cylinder-to-cone, additional cross bracing on the silo support columns, and selective reinforcement of the column flanges, plus any required modification of the silo foundation.

Preliminary drawings and the notice to proceed with advanced procurement of structural steel members required for the remediation were transmitted to Rust Engineering on June 25, 1986. A kickoff meeting with representatives from WMCO and Rust was held on July 2, 1986 and Rust was given verbal approval to begin construction work on the structural remediation project for the silo.

Structural steel remediation of the silo is expected to be completed by August 15, 1986. Modification of the silo foundation is expected to be completed by August 31, 1986.

3.4 Thorium Removal from Silo

The preferred method for removing the thorium oxide from the silo will be to use the existing shutoff valve and the existing rotary valve on the silo. This will require the repair or replacement of the rotary valve which is cracked and inoperative. This will allow the thorium oxide to be removed in a controlled manner with positive control of fugitive emissions.

If the shutoff valve cannot be closed with the present rotary valve in place, thus allowing for the repair or replacement of the rotary valve, it will not be possible to use the existing equipment. The preferred alternative for the removal of the thorium oxide will be to then install an alternative feed system which is described as follows:

1. Weld a specially designed saddle to lower cone.

2. Attach a four inch horizontal pipe with an inverted tee outlet to the saddle.

3. Use a four inch cutterhead to penetrate the tank and remove the cutout. The natural angle of repose of the material and the length of the horizontal pipe will prevent the flow of the contents from the silo.

115

4. Insert and thread a flexible spring type Flexicon feeder into the horizontal pipe.

5. Install a drive for the Flexicon feeder.

6. Mobilize the thorium oxide as required using vibrators on the sides of the hopper or use augers inserted into the cone from the top of the silo.

7. Operate the feeder to fill drums or other containers in a controlled manner with minimal operator exposure.

8. Once the silo has been emptied to the level of the feeder penetration, remove the remainder of the contents through the existing stop valve.

The technique will be demonstrated and qualified using mockups prior to actual implementation.

The second alternative would be to remove the material from the top of the silo. Removal of materials from the top of the silo will require the use or remote and/or robotic equipment. The technique will be demonstrated and qualified using mockups prior to acutal implementations.

3.5 Thorium Removal From Bins

The thorim oxide in the bins is currently held in place by the two metering screw feeders at the outlet of the slide valves. The slide valves are currently open, and it is questionable whether they could be closed.

The preferred plan for the removal of the thorium oxide from the storage bins is the activation of the two screw feeders and the large screw conveyor. The drums containing the thorium oxide will be transferred to the lower level using the existing freight elevator. Alternatively, a chute will be constructed to fill drums or large containers at ground level. The material will be mobilized using vibrators and if this is not successful, augers will be inserted into the hoppers from the top of the storage bins.

If the screw feeders cannot be activated, alternative approaches will be considered.

3.6 Storage of Removed Material

The thorium oxide removed from the silo and the storage bins must be stored until a decision is made as to whether this material is a resource or a waste. Pending this decision, the material must be handled and packaged to meet longterm, but retrievable storage conditions.

On-site storage of the thorium oxide containers in existing buildings is the preferred alternative. This space would be created by the removal and disposal of waste material already scheduled for disposal.

On-site material storage in modular concrete storage modules is being pursued if storage space in existing buildings cannot be made available.

41

115

Concrete containers will provide the required shielding and the durability required for relatively long-term outdoor storage.

The choice of container will be dependent upon the storage option selected (i.e. buildings versus concrete storage modules). Steel drums will provide the most economical method of packaging if existing buildings are used. Large containers may be more economical if concrete storage modules are used.

The long-term storage of Thorium and Thorium bearing compounds must focus on two problems. The first problem is to repackage existing Thorium materials in a configuration more suitable for long-term, on-site storage. Questions to be answered before proceeding include:

1. Selection of a suitable overpack

   Present technology utilizes steel, concrete and fiberglass reinforced containers. Each selection offers many advantages. Each have potential drawbacks. In the next few weeks the Thorium Disposition Task Team will be choosing the proposed method, preparing procedures, training personnel, acquiring equipment and building facilities for the repackaging effort.

2. Selection of long-term storage facilities

   Again, several options exist. The three being considered are:

   a. A subsurface earthen covered monitored pad utilizing concrete containers. The subsurface facility with earthen cover has the advantage of providing long-term shielding of the gamma radiation emitted by the Thorium materials.

   b. A surface controlled and monitored pad using concrete containers with future earthen cover. This is perhaps the simplest approach. However, both this option and option (a) present some difficulty in controlling Radon (Thoron) emissions. To pursue either a or b further requires a means of controlling the Radon (Thoron) emissions.

   c. An on-grade warehouse placed on a monitored pad with the option of berming the building with earth for shielding. This option allows long-term storage utilizing already available steel overpacks while at the same time, providing a means for collecting and removing Radon (Thoron) gas and its daughters from the storage environment.

The final selection will be based on which choice best meets all storage, Health Physics and Environmental considerations for the long-term storage of these materials at the FMPC. The above program/problem solution will be accomplished using WMCO personnel supplemented as needed by WTSD and W - Hittman.

The second problem to be addressed will be the removal and packaging of the bulk Thorium bearing material from the Plant 8 silo and bins and transport to long-term storage. The design criteria effort for his task has already been assigned. The task team has established a schedule for the accomplishment and

42

execution of the design. The task team's role for this effort will be to expedite the subcontractor effort, fast track the necessary reviews and approvals, and expedite any construction effort that results. The effort between now and October 1, 1986 will be to specify the core sample requirements for the silo and bins and begin preliminary engineering work. It has been determined that the most expeditious method for packaging the silo and bin material will be to prepare a performance specification and seek a Turn-key contract from one of several waste management vendors to remove and package the material. It is expected that preparation of the specification can be accomplished by December 1, 1986.

To adequately engineer the removal specification, sampling of the silos and bins must be accomplished. To ensure that correct sampling is done, a specification for sampling is being prepared. Completion of this effort is planned by December 1, 1986.

Worker health and safety will be foremost in the development of equipment and procedures. The design of all packaging facilities will provide for a dust-free environment and the application of time-distance-shielding criteria to control radiation exposures ALARA. Such things as glove-boxes, shielding, and remotely operable handling equipment will be considered in the designs. Ventilation systems that control Radon (Thoron) and its daughters will also be used. An independent ALARA review of the entire thorium project will be performed early in the effort.

4.0 INTERIM CONTROLS FOR RADIOACTIVE EMISSIONS FROM THE THORIUM STRUCTURES

The thorium storage silo and bins at Plant 8 are metal structures that presently are vented to the atmosphere. The vessels therefore are free to emit any gaseous decay products from the contained thorium compounds. The plan over the next year is to remove the compounds from the silo and bins, pack the thorium materials in acceptable long-term storage containers, and retain the materials in environmentally acceptable storage at the FMPC.

Another major aspect of the thorium storage is the redrumming and/or overpacking of existing thorium materials now stored in FMPC warehouses. Redrumming and/or overpacking of the existing materials (approximately 13,000 barrels) will be accomplished because of deterioration caused by exposure to weather that has occured over the several years of storage. Total containment of dust producing operations will be used to reduce worker exposure. Time - Distance - Shielding criteria will be designed into the redrumming stations as well as special filtered ventilation.

Both of these major efforts will not result in thorium being packaged until 1987. As such, it is considered prudent to take some action to reduce radon (thoron) emissions from the silo and bins at Plant 8. The interim plan under review proposes to use HEPA filters and activated charcoal filters to remove radon gas and radon decay products from the Plant 8 silo and bins. In the case of the silo, the tank manway covers will be sealed and filters installed on the tank vents such that any gas expelled from the tank will be filtered. Care will be taken in sizing the filters such that significant tank backpressures will be avoided. Redundant filters will be installed to allow for filter replacement on a periodic basis. Close monitoring of filter performance will be performed to ensure adequate radon control.

115

For the bins, it will be necessary to use a blower on the bins that will exhaust through HEPA and charcoal filters. The blower will be required since bin construction will prohibit sealing them to the point that all gaseous releases can be controlled through one vent point. By using a blower taking suction on the bins, a slight negative pressure can be maintained to ensure that radon can leave the bins only through the blower. Again, redundant systems will be installed to allow filter changes to take place without total system loss.

In addition to these interim controls, other controls may be necessary for the thorium storage warehouses. If radon (thoron) measurements now being taken in the vicinity of the warehouses indicate the need, actions similar to those described above will be taken.

5.0 INTERIM CONTROLS TO ENSURE THE STRUCTURAL INTEGRITY OF THE THORIUM STRUCTURES

The final structural analysis performed by Camargo Associates, Limited, based on the information on the density, quantity and level of thorium oxide materials in the Plant 8 storage bins indicated that structural remediation of the bins is not required. The analysis indicates that the weight of the material stored in the bins is less than the design product weight. It was recommended by the Task Force that a further structural analysis should be conducted to verify the structural stability of the Plant 8 supportive building members if the materials are not to be removed in the near future. This is needed because the original building may not have been analyzed and designed for seismic conditions when they were designed in the early 1950's.

The final structural analysis based on the information on the density, quantity and level of thorium oxide materials in the Plant 8 storage silo indicated that interim remedial measures, to ensure the structural and unloading loads, should be taken as soon as possible. The structural analysis indicated that, based on the final assumed thorium density and quantity, remedial measures should include the installation of a reinforcing ring at the cylinder-to-cone connection, additional cross bracing on the silo support columns, and selective reinforcement of the column flanges.

Camargo Associates, Limited was contracted to prepare construction drawings and material specifications for the recommended structural remedial actions for the Plant 8 storage silo. Preliminary drawings and the notice to proceed with advanced procurement of structural steel members required for the remediation was transmitted to Rust Engineering on June 25, 1986. Rust immediately did a materials take-off cost estimate, and placed material orders for the remediation project.

On July 2, 1986, a kickoff meeting for the silo remediation was held with Rust Engineering and WMCO representatives to outline the course of actions for the structural remediation. At the kickoff meeting Rust Engineering was given verbal approval to begin construction work.

In addition to the reinforcing ring at the cylinder-to-cone connection, additional cross bracing on the silo support columns, and selective reinforcement of the column flanges, additional work on the silo foundation is being done to meet building codes for seismic loading in this area. Work on the foundation will begin as soon as the structural steel remediation work is completed.

44

The structural steel remediation of the silo is expected to be completed by August 15, 1986. This will include all work recommended by the Task Force and verified by the Camargo Associates, Limited analysis. Modification of the silo foundation will begin on August 18, 1986, and is expected to be completed by August 31, 1986.

6.0 RADON MONITORING PROGRAM

6.1 Introduction

A radon monitoring program has been implemented for the fence line and off-site environs. The program monitors radon-222 to determine the radiation exposures to humans from both radon and its decay products. The maximum radiation exposures from those sources in the environs occur inside homes and other buildings where the radon has diffused or otherwise entered the structures. The radon then forms its decay products which can build up to concentrations that can induce radiation exposures to the respiratory tract of humans living and working inside the building. Decay products formed outside the buildings are dispersed in the environs to the point that the radiation exposure from that source are small compared to the exposures from radon decay products formed inside the buildings. Likewise the radiation exposues from radon itself, both inside and outside buildings is small compared to the exposures from radon decay products formed inside the buildings.

6.2 Proposed Program

To determine the maximum potential radiation exposures to humans, radon concentrations are monitored at the fence line and off-site environs and will be converted to potential indoor radiation exposures using the conventional EPA conversion factor of 0.5 (pCi radon-222 per liter x 0.005 = WL).

Radon-222 is monitored with track-etch detectors which consist of alpha sensitive plastic detectors mounted inside inverted cups covered by a hydrophobic microporous filter to prevent radon decay products from entering the cup and being detected. The radon-222 diffuses through the filter. The detector inside each cut is sensitive to alpha particles from radon and its decay products. The alpha particles penetrate the plastic detector leaving tracks which are subsequently etched to produce visible tracks in the plastic. The number of alpha tracks counted per unit area is proportional to the average radon concentrations. The advantages of the track-etch monitoring technique over other radon monitoring techniques are that the monitoring is completely passive, no electrical or mechanical components are involved, and the monitoring is easy to conduct. Once the detectors are exposed, the vendor of the detectors etches the plastic, visually reads the number of tracks per unit area, and reports the measured concentrations.

The monitoring of radon and radon decay products is conducted over quarterly time periods to produce a time-integrated measurements that is free of the short-term variations in concentrations that are characteristic of both radon and its decay products. The quarterly monitoring interval provides accuracy for the monitoring method yet guards against loss of detectors and data when longer time periods are used.

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The monitoring locations are selected to characterize radon concentrations and potential exposures to humans at the site boundaries, at two schools, at a local business, and at two residences. The residences serve as background monitoring locations which are in the same meteorological wind patterns as is the site but far enough from the site so as not to be affected by radon emitted from the site. Specific monitoring locations, their distance from the center of the FMPC site, and the direction from the center of the FMPC site are presented below:

Location Number	Type of Site	Distance in LCM From Center of FMPC	Direction
1	Site Boundary	1.0	N
2	Site Boundary	1.3	NE
3	Site Boundary	0.7	E
4	Site Boundary	1.3	SSE
5	Site Boundary	1.1	SSE
6	Site Boundary	0.9	W
7	Site Boundary	1.3	NW
8	Elda School in Ross	4.6	ENE
9	Crosby Township School	3.6	SW
10	Business - Fernald	2.5	S
11	Residence	7.9	W
12	Residence	5.0	ENE

6.3 Status and Implementation Schedule

Radon-222 monitoring at the fence line and off-site environs was implemented in 1980. The program is currently in progress.

7.0 EMERGENCY PROCEDURES FOR UNPLANNED RADIOACTIVE RELEASE

7.1 Purpose

The purpose of this procedure is to outline actions that are to be taken in the event of a radioactive material release at the thorium storage areas. These actions are intended to protect the health and safety of on-site and off-site personnel, limit or reduce any possible damage to the environment and contain and recover any released radioactive material. This procedure is considered preliminary until such time as the counties emergency plan is formally implemented.

7.2 Background

A radioactive release of material in the form of dust and/or gas could occur if the thorium storage facilities were damaged. The damage could result from natural or accidental causes.

115

7.3 Definitions

7.3.1 Minor Release (Unusual Event)

A minor release is one in which the effects of the release do not require the evacuation of a designated area and can be controlled or contained by the local work force. Assistance may be provided by other internal support groups.

7.3.2 Intermediate Release (Unusual Event, Possible Alert)

An intermediate release is one in which an entire area or building could be affected but adjacent areas would not. Releases would not affect off-site areas.

7.3.3 Major Release (Site Emergency, Possible General Emergency)

A release will be considered major if it affects areas or buildings beyond the one in which it originally occurred, or if there is the possibility of off-site areas being affected.

7.3.4 Emergency Director

President, WMCO, has overall authority for all emergency activities.

7.3.5 Emergency Duty Officer (EDO)

WMCO representative having management authority and responsibility for directing emergency operations. The EDO reports directly to the Emergency Director.

7.3.6 Emergency Operations Center Management Staff (EOCMS)

The EOCMS will consist of the designated management staff members who are responsible for re-establishing executive direction of the FMPC during the period of emergency. The EOCMS will consist of:

a. President, WMCO (Emergency Director)

b. Off Duty Emergency Duty Officers

c. Vice President & Manager of Community & Environmental Affairs (Public Information Officer)

d. FMPC DOE Site Manager

7.3.7 Emergency Support Staff

The Emergency Support Staff consists of designated personnel who advise the Emergency Duty Officer and Emergency Operations Center Management Staff at the FMPC during periods of emergency.

47

7.4 Emergency Response Level Classification Guideline

The FMPC Communication Center will be notified by the person in charge of the incident. This may be the supervisor of the area or the Emergency Brigade Chief. The Emergency Brigade Chief will be in charge of all emergency responses. The Emergency Brigade Chief is the Fire & Safety Inspector on duty.

NOTE: The Emergency Duty Officer will be contacted by the Communications Center immediately upon classification of the emergency. The following guidelines are to be followed by the Emergency Duty Officer after the emergency has been classified.

7.4.1 Unusual Event

Will not normally constitute an emergency but indicates a potential reduction of safety within the FMPC.

- There is no potential for significant off-site releases of toxic or radioactive materials.
- Activation of off-site response organizations is not expected.
- Response actions will be limited to on-site areas only.
- Response to the Communications Center is optional.

7.4.1.1 Notification Required

1. Oak Ridge Emergency Operations Center (EOC) (within hour)
2. President, Operating Contractor or alternate
3. DOE-FMPC Site Office Manager
4. Manager, Community and Environmental Affairs, Operating Contractor or alternate
5. Hamilton County and Butler County Civil Defense Offices

7.4.1.2 Department of Energy Notifications

The Department of Energy representatives will make the following notifications:

- Ohio Disaster Services Agency
- Southwestern Ohio Air Pollution Control Agency
- Congressional Offices for Districts One (1) and Eight (8)

7.4.1.3 Courtesy Notifications

Courtesy notifications will be coordinated by Manager, Community & Environmental Affairs or his representative. These will usually include but are not limited to:

- Ross, Morgan & Crosby Township Trustees

- Ross, & Southwest Local School Districts

7.4.2 Alert

An event is in progress or has occurred which involves an actual or potential substantial reduction of the level of safety at the FMPC.

Limited off-site releases of radioactive material may occur. For toxic materials off-site releases are expected to exceed permissible limits.

The purpose of this response level is to assure that on-site and off-site emergency response personnel are advised and available for activation if the incident becomes more serious.

Response to the Communications Center is mandatory.

7.4.2.1 Notification Required

1. EOC Management Staff

2. Oak Ridge Emergency Operations Center

3. Butler County Sheriff's Department

4. Hamilton County Communications Center

7.4.2.2 Department of Energy Notifications

The Department of Energy representatives will make the following notifications:

- Ohio Disaster Services Agency

- Southwest Ohio Air Pollution Control Agency

- Congressional Offices for Districts

7.4.2.3 Notes

When notifications are made to the Sheriff's Department and Communications Center they should be told we are at the Alert level, emergency response groups should be placed on stand-by, more information will be supplied as soon as possible, and no off-site releases have taken place at this time.

115

7.4.3 Site Emergency

An event is in progress or has occurred which involves an actual or likely major failure of a facility function needed for the protection of on-site personnel, the public health and safety and the environment. Off-site releases have the potential to exceed permissible limits.

The purpose of this response level is to assure the emergency operations center is in operation, the emergency support staff is in place, and monitoring teams are dispatched and other personnel necessary to mitigate the incident are available.

Current information should be available on a routine basis for off-site officials and organizations.

Response to the Communications Center is mandatory.

7.4.3.1 Notification Required

1. EOC Management Staff
2. Oak Ridge Emergency Operations Center (immediate)
3. Butler County Sheriff Department (immediate)
4. Hamilton County Communications Center (immediate)
5. EOC personnel will complete all other notifications.

7.4.3.2 Department of Energy Notification

The Department Energy representatives will make the following notifications:

- Ohio Disaster Services Agency
- Southwestern Ohio Air Pollution Control Agency
- Congressional Offices for Districts One (1) and Eight (8)

7.4.3.3 Actions

If not already done:

- Activate the Emergency Support Staff

7.4.3.4 Suggested Checkpoints

- Offer assistance to Civil Defense to prepare a EBS (Emergency Broadcast System) statement.
- This statement should prepare the general population for some type of response, e.g., sheltering, evacuation.

115

- Assure that emergency personnel have been issued dosimetry devices (Health Physics).

- Limit traffic into emergency area. Road blocks into plant may be necessary. (Security or off-site police agencies).

- Assure adequate medical treatment is available, if needed.

- Discuss problem with county officials. They will order protective actions for the public.

- Keep open lines of communication between Oak Ridge Emergency Operations Center (Communications Officer).

- Offer any available FMPC assistance to off-site groups (Security, Health Physics, etc.).

- Get support and advice from the EOC Management Staff and Emergency Support Staff.

- Keep in contact with the on-scene command post (Emergency Brigade Chief).

- Increase or decrease the level of the emergency as circumstances indicate.

7.4.4 General Emergency

An event is in progress or has occurred which involves an actual or imminent substantial reduction of a facility safety system. Off-site releases are expected to exceed permissible limits.

The purpose of this response level is to initiate pre-determined protective measures for on-site personnel, the public health, safety and the environment. Continuous assessment of the emergency condition and the exchange of such information between on-site and off-site organizations shall also be implemented.

A declaration of a General Emergency will initiate activation of DOE wide resources.

Response to the Communications Center is mandatory.

7.4.4.1 Notification Required

1. EOC Management Staff

2. Oak Ridge Emergency Operations Center (immediate)

3. Butler County Sheriff Department (immediate)

51

115

4. Hamilton County Communications Center (immediate)

5. EOC personnel will complete all other notifications

7.4.4.2 Department of Energy Notifications

The Department of Energy representatives will make the following notificatins:

- Ohio Disaster Services Agency
- Southwestern Ohio Air Pollution Control Agency
- Congressional Offices for Districts One (1) and Eight (8)

7.4.4.3 Actions - If Not Already Done

- Activate the Emergency Support Staff

Check with the Emergency Brigade Chief to confirm:

- what is the problem
- status of incident (what is going on)
- that necessary plants and areas have been evacuated
- that personnel are accounted for
- that personnel are in a safe zone
- what type of assistance is needed

7.4.4.4 Suggested Checkpoints

- Offer assistance to Civil Defense to prepare a EBS (Emergency Broadcast System) statement.
- This statement should prepare the general population for some type of response, e.g. shelter, evacuation.
- Assure that emergency personnel have been issued dosimetry devices - (Health Physics).
- Limit traffic into emergency area. Road blocks into plant may be necessary. (Security or off-site police agencies).
- Assure adequate medical treatment is available, if needed.
- Discuss problem with county officials. They will order protective actions for the public we recommend.

52

- Keep open lines of communication between FMPC and Oak Ridge Emergency Operations Center (Communications Officer).

- Offer any available FMPC assistance to off-site groups (Security, Health Physics).

- Get support and advice from the EOC Management Staff and Emergency Support Staff.

- Keep in contact with the on the scene command post (Emergency Brigade Chief).

- Increase or decrease the level of the emergency as circumstances indicate.

- Is there an off-site problem.

7.5 General Considerations

7.5.1 Indications of a Release May Include the Following:

a. Visible blowing dust originating from the silo or storage areas.

b. Activation of installed alarms.

c. Visual confirmation that a storage silo has sustained structural damage or containers of material are open or damaged.

7.5.2 If a radioactive material release occurs, any involved personnel should be sent to Medical for routine urine sampling and any other required medical treatment.

7.6 Emergency Actions

7.6.1 Reporting a Release

7.6.1.1 Emergency Conditions Can Be Reported By:

- Dialing telephone extension 6511

- pulling a manual fire alarm

- using a two-way radio

- the activation of fixed radiation detection alarms

7.6.2 Response To Intermediate Or Major Radioactive Material Releases

7.6.2.1 The Emergency Brigade Chief, after having been notified of a major radioactive release, will initiate the following plan:

- Assure all personnel have been evacuated from the area and are accounted for.

- If immediate off-site action is required, advise the Communications Center to contact the Butler County Sheriff's Office and/or the Hamilton County Communications Center.

- Have the Communications Center notify the Emergency Duty Officer.

- After personnel have been outfitted with appropriate safety equipment, start appropriate actions to contain the release. In the event of the collapse of a dome, a tarp may be temporarily placed over the opening to prevent further dispersion of the material.

- Attempt to prevent dispersion of all material.

- Survey surrounding areas to determine extent of contamination.

- Determine what personal safety equipment is required for re-entry.

- Permit only the minimum number of people necessary to deal with the spill/leak into the contaminated area.

7.6.2.2 The Emergency Duty Officer will assure that the following items have been addressed:

- escalate or downgrade the emergency as is necessary

- sufficient technical support is available to determine extent of contamination

- all conditions and methods are reviewed prior to decontamination to assure a safe clean-up.

7.7 Decontamination

Clean up, recovery and decontamination are essential steps in completing the response to a radioactive material release.

7.7.1 Preserve and identify the physical evidence associated with the release for documentation and evaluation purposes.

7.7.2 Consult with the Emergency Duty Officer before initial decontamination to assure that reviews by the appropriate sections have been completed and all health and safety aspects have been considered.

7.7.3 Determine the proper type of personal safety equipment required for the decontamination effort.

115

7.7.4 If material can be reclaimed, shovel or vacuum the material, mop the affected area, and store the recovered radioactive material in a critically safe container.

7.7.5 After suspected areas have been decontaminated, remonitor the area to assure decontamination has been completed.

7.7.6 Keep recovered material separated so the amount of uranium recovered can be determined.

8.0 PLANNED IMPLEMENTATION SCHEDULED FOR THE THORIUM COMPOUNDS STORAGE STRUCTURES

8.1 Interim Structural Remediation of the Plant 8 Thorium Silo

Preliminary drawings, prepared by Camargo Associates, Limited, and the notice to proceed with advanced procurement of structural steel members required for the structural steel members required for the thorium silo remediation were transmitted to Rust Engineering on June 25, 1986. A project kickoff meeting, and verbal approval for Rust to Proceed with construction, was held on July 2, 1986.

Structural steel remediation work on the silo began July 7, 1986 and is expected to be completed on August 15, 1986. Modification of the silo foundation was begun on August 13, 1986 and is expected to be completed by August 31, 1986.

8.2 Schedule for the Removal of Thorium Compounds from the Plant 8 Silo and Bins

Table 1 shows the proposed schedule for the removal and packaging of the Plant 8 silo and bins materials.

8.3 Schedule for the Repackaging of Thorium Warehouse Materials and their Long-term Storage

Table 2, Repackaging of Thorium Warehouse Materials and Their Long-Sterm Storage, shows the proposed schedule for the repackaging and storage of the FMPC warehouse thorium materials.

55

115

TABLE 1

THORIUM COMPOUNDS FROM PLANT 8 SILO AND BINS AT FMPC

ITEM	DATE
1. Start specification preparation	8/8/86
~~2. Silo and Bin Sampling~~	
1. AMK issue silo/bin sampling specification	8/1/86
2. Review/approval	8/22/86
3. Obtain contactor bids	9/19/86 *
4. Evaluate bids and award contact	10/3/86 *
5. Contractor mobilize and take samples	10/31/86 *
6. Analysis of samples and final report	11/28/86 *
3. AMK issue client review spec. (without sampling info.)	11/3/86
4. Review/approval	11/24/86
5. Obtain contractor bids	12/22/86
6. Evaluate bids and award contract	1/5/87 **
7. Contractor mobilization	1/19/87
8. Contractor install removal equipment, commence material removal and packaging	2/16/87
9. Estimated completion of packaging	8/17/87 **

* Items that may be expedited and done early if either DOE contractor performing sampling at FMPC can be used (i.e. R. Weston for K-65 and pit sampling or the RI/FS contractor for FFCA support).

** Assumes effort will proceed uninterrupted through holiday shutdown or plant summer shutdown.

56

115

TABLE 2

REPACKAGING OF THORIUM WAREHOUSE MATERIALS AND THEIR LONG-TERM STORAGE

	Item	Date
1.	Set-up Task Team, outline repackaging/storage work plan and schedule.	August, 1986
2.	Complete historicial data evaluation, drum location identification.	September, 1986
3.	Complete Task 1 work: radiation survey and inspection/sampling program; evaluation of storage facilities and storage containers; evaluation of handling and repackaging equipment; evaluation of Standard Operating Procedures; evaluation of ES&H requirements; preparation of repackaging plan and schedule; preparation of ADM, PMP, HS Risk Analysis, and Emergency Procedures; preparation of training program; preparation of storage facilities design.	October, 1986
4.	Prepare and issue Task 1 Report.	October, 1986
5.	Review/approval.	November, 1986
6.	Begin Task 2 work.	November, 1986
7.	Complete Task 2 work: purchase and delivery of special equipment, tools, containers, etc.; installation of special equipment; completion of personnel training programs; perform FMPC ORR.	February, 1987
8.	Prepare and issue Task 2 Report.	February, 1987
9.	Review/approval.	March, 1987
10.	Begin Task 3 work.	March, 1987
11.	Complete Task 3 work: perform DOE/ORO review; conduct "dry runs" on processes and equipment.	March, 1987
12.	Prepare and issue Task 3 Report.	April, 1987
13.	Review/approval.	April, 1987
14.	Begin Task 4 work.	April, 1987

57

115

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1. Set-up Task Team, outline repackaging/storage work plan and schedule.	August, 1986
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9. Review/approval.	March, 1987
10. Begin Task 3 work.	March, 1987
11. Complete Task 3 work: perform DOE/ORO review; conduct "dry runs" on processes and equipment.	March, 1987
12. Prepare and issue Task 3 Report.	April, 1987
13. Review/approval.	April, 1987
14. Begin Task 4 work.	April, 1987

57

115

Item	Date
15. Complete Task 4 work: thorium handling and repackaging operations; material identification; recordkeeping; completion of repackaging shakedown.	May, 1987
16. Prepare and issue Final Report.	May, 1987
17. Review/approval.	May, 1987
18. Operations begins repackaging effort.	May, 1987
19. Completion of repackaging effort.	December, 1987

58

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115

FEED MATERIALS PRODUCTION CENTER
RESPONSE TO ITEM 2.C OF COMPREHENSIVE
ENVIRONMENTAL RESPONSE, COMPENSATION AND
LIABILITY ACT (CERCLA) SECTION
FEDERAL FACILITIES COMPLIANCE AGREEMENT

115

Westinghouse
Materials Company
of Ohio

PO Box 398704
Cincinnati, Ohio 45239

(513) 738 6200

WMCO:EH(RC):86-0357

August 22, 1986

Mr. James A. Reafsnyder
Site Manager
U. S. Department of Energy
P. O. Box 398705
Cincinnati, Ohio 45239

SUBJECT: 45 DAY DELIVERABLES - FEDERAL FACILITIES COMPLIANCE AGREEMENT

Dear Mr. Reafsnyder:

Accompanying this letter are 25 copies of the 45-day submittals for the Federal Facilities Compliance Agreement (FFCA). These submittals complete the response for the CERCLA Seciton 2.C of the FFCA.

Very truly yours,

Howard D. Christiansen

L. C. Bogar
Vice-President & Manager
Environment, Safety & Health

DJL:kss

cc: M. B. Boswell
G. E. Butterworth, III
P. I. Campisi
L. C. Dolan
D. J. Loudin
R. E. Watts
W. A. Weinreich

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40

115

FEED MATERIALS PRODUCTION CENTER

RESPONSE TO ITEM 2.C OF COMPREHENSIVE

ENVIRONMENTAL RESPONSE, COMPENSATION AND

LIABILITY ACT (CERCLA) SECTION

FEDERAL FACILITIES COMPLIANCE AGREEMENT

45 Day Deliverable

September 1, 1986

61

115

FEED MATERIALS PRODUCTION CENTER
RESPONSE TO ITEM 2.C OF COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT (CERCLA) SECTION FEDERAL FACILITIES COMPLIANCE AGREEMENT

The Statement of Work (SOW) Task 7b for the Remedial Investigation deals with laboratory certification. This SOW Task 7b requires that the contactor laboratory pass a laboratory performance audit prior to performing any task after Task 1 of the SOW, if a certified CLP (Contract Laboratory Program) laboratory is not used. The two contractor laboratories to be used for the site-wide remedial investigations are U. S. Environmental Protection Agency (US EPA) CLP laboratories. These laboratories and their CLP number are listed below:

IT Analytical Services (ITAS)
5815 Middlebrook Pike
Knoxville, TN 37921

US EPA-CLP Contract Number: 68-01-7025
(IT-Knoxville)

Roy F. Weston, Inc.
Weston Analytical Lab, Inc.
256 Welsh Pool Road
Lionville, PA 19353

US EPA-CLP Number: 38009

If any other laboratories are to be used for organic or inorganic analyses, the laboratories selected will be certified CLP laboratories. Both the DOE and U.S. EPA will be informed if a new laboratory is to be used. This notification will be made prior to using the new laboratory. Should a proposed laboratory not be a certified CLP laboratory, the contractor will be required to pass a laboratory performance audit and receive DOE and U.S. EPA approval to performing any analyses in support of the remedial investigation.

62