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# REMOVAL SITE EVALUATION K-65 SILOS

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# REMOVAL SITE EVALUATION

## K-65 SILOS

FEED MATERIALS PRODUCTION CENTER
U.S. DEPARTMENT OF ENERGY

## Introduction

The K-65 silos were constructed at the FMPC in 1951 for the dewatering and storing of radium bearing residues formed as by products of uranium ore processing. Uranium-rich ore called pitchblende, imported from the Belgian Congo and Australia, was treated with nitric acid to dissolve the uranium for extraction from the ore. The radium bearing residues were separated using a precoat rotary vacuum filter, reslurried, neutralized with lime, and pumped into the silos where the solids settled. The liquids were decanted out of the silos and pumped to a treatment facility on-site. The silos received waste residues primarily between 1952 and 1958. The sources included slurry from the FMPC; 25,000 drums from a plant in St. Louis, Missouri; and 6,000 drums from a DOE storage site in Niagara Falls, New York which had been previously stored at the St. Louis plant. The silos now contain approximately 9700 tons of residual solids which include approximately 3000 curies of radium. The radium bearing residues emit radiation in the form of high energy gamma rays and radon gas.

## Source Term

Most of the radon that is generated in the K-65 residues are contained within the silos. Currently, approximately 12 curies of radon are released to the head space of each silo per day. Radon in the head space will build up until an equilibrium concentration is reached. The time required to obtain this equilibrium concentration is dependent on two factors: radioactive decay of the radon (half-life is 3.84 days), and the head space ventilation rate (due to diffusion through intact concrete and leakage through cracks, both of which are affected by the daily heating cycle). Once the equilibrium condition has been reached, the head space radon concentration will be affected only by changes in the ventilation rate. The concentration of radon in the head space has been measured to be as high as $3 \times 10^7$ pCi/liter. Using the concentration and the volume of the head space of each silo, it has been calculated that approximately 33 curies of radon-222 exist in the head space of each silo (see Attachment 1), based on measured concentrations of radon.

Two independent studies have been completed on the structural integrity of the silos (Camargo, 1986 and Bechtel, 1990). These two structural analyses concluded that the silos had lost over half of their design strength and that no life expectancy could be predicted for the silo domes.

The result of silo dome failure would be an immediate release of radon gas from the head space of the silos to the environment. There is also the potential for the K-65 residues to become airborne under tornado loading conditions.

## Evaluation of the Magnitude of the Potential Threat

The potential threat posed by the K-65 Silos is structural failure of the silos and the resultant release of radon gas and radioactive particulate to the environment.

If the silos were to fail, the radon contained in the head space of each silo (approximately 33 curies) would be instantaneously released to the environment. Under certain atmospheric conditions, this emission would result in radon concentrations in excess of the DOE Guideline for radon (100 pCi/l at any given point, or annual concentrations of 30 pCi/l for on-site and 3 pCi/l for off-site). Collapse of either dome would result not only in loss of containment, but would expose the residue surface. The resulting radon flux would exceed the National Emissions Standards for Hazardous Air Pollutants (NESHAP), 40 CFR 61, Subpart Q (20 $pCi/m^2/sec$).

## Assessment of the Need for Removal Action

Consistent with 40 CFR 300.65 and the National Contingency Plan, 40 CFR 300.415, the lead agency (DOE) shall determine the appropriateness of a removal action. The factors to be considered in this determination are listed in 40 CFR 300.65 (b)(2) and the proposed NCP, 40 CFR 300.415 (b)(2). Of the eight factors listed, the following apply to the K-65 Silos:

40 CFR 300.65 (b)(2)(i) - Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants.

40 CFR 300.65 (b)(2)(iii) - Hazardous substances or pollutants or contaminants in drums, barrels, tanks, or other bulk storage containers, that may pose a threat of release.

40 CFR 300.65 (b)(2)(v) - Weather conditions that may cause hazardous substances or pollutants to migrate or be released.

The factors listed above apply to the K-65 Silos due to the potential for structural failure of the silos and the resultant release of radon gas and radioactive particulate to the environment.

The potential structural failure of the K-65 Silos and the resultant contamination of the environment and exposure to the public are factors supporting the need for a removal action.

If left unattended, the structural integrity of the K-65 silos would continue to degrade. The potential for structural failure would increase thus increasing the potential for radon release to the environment.

**Appropriateness of a Response**

It has been determined that a response is appropriate, due to the current potential of the K-65 silos to fail structurally and thus release radon and radioactive particulate to the environment. A removal action to mitigate the possibility of radon and radioactive particulate release to the environment should be undertaken.

If a planning period of less than six months exists prior to initiation of a response, DOE will prepare an Action Memorandum. The Action Memorandum will describe the selected response and supporting documentation for the decision.

If it is determined that there is a planning period greater than six months before a response is initiated, DOE will prepare an Engineering Evaluation/Cost Analysis (EE/CA) Approval Memorandum. This memorandum is to be used to document the threat to public health and environment. It will also serve as a decision document for the Administrative Record file.

## Attachment 1

The radium source term has been evaluated using the measured concentrations of radon inside the K-65 silos. Since the measured concentrations of radon-222 inside the south (silo 1) and north (silo 2) silos are 3 x 10(7) pCi/liter and 2.5 x 10(7) pCi/liter respectively, curie content within the silo is calculated as follows:

The volume of the north silo: $V = \pi r^2 h$

where h = effective height of silo head space
r = radius of silo

and h = 7.5 feet r = 40 feet

$V = \pi(40^2)\ (7.5) = 38000$ ft.

The volume of the south silo:

where h = 9.5 feet r = 40 feet

$V = \pi(40^2)\ (9.5) = 48000$ ft.

The radon-222 content of the north silo is then:

$38000\ ft^3 \times 28.3\ l/ft^3 \times 3x10^7\ pCi/l \times 1\ Ci/1x10^{12}\ pCi$

= <u>32.3 Ci</u>

The radon-222 curie content of the south silo is:

$48000\ ft^3 \times 28.3\ l/ft^3 \times 2.5x10^7\ pCi/l \times 1\ Ci/1x10^{12}\ pCi$

= <u>34.0 Ci</u>