

White Paper Supplement to Radon Emissions from Feed Materials Production Center K-65 Silos

Rev. 0

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DISCUSSION

NIOSH wrote this supplement to address a specific issue raised in SCA-2010b. The issue is that the thermal expansion release model postulated by RAC may not account for all ventilation releases during the period 1979-1987. SCA postulates the Venturi effect of wind on the silo domes would contribute additional radon releases, beyond what is accounted for by the thermal expansion approach. SCA-2010b also points out that RAC-1995b discussed a ventilation release term in addition to the thermal expansion term, but ultimately did not include such a term.

For the sake of discussion, we will suppose that there was a non-trivial Venturi effect release for the years 1979-1987. The magnitude of the Venturi effect release is assumed to be equal to the thermal expansion release because Table P-6 of RAC-1993 indicates that the modeled radon releases under-predicted measured concentrations for a set of radon samplers by roughly a factor of 2 (model prediction averaged 0.44 of measured values).

Next we'll consider what effect this increased ventilation release would have on the calculated amount of radon that diffused into the headspace from the K-65 residues. The effective removal rate of radon from the silo headspaces, λ_{eff} , is the sum of the removal rates for ventilation and diffusion and the radon decay constant. From the RAC-1995b estimate of release, those values are:

$$\lambda_{\text{ven}} = 0.0297 \text{ d}^{-1}$$

$$\lambda_{\text{diff}} = 0.00477 \text{ d}^{-1}$$

$$\lambda_{\text{Rn}} = 0.1813 \text{ d}^{-1}$$

Therefore,

$$\lambda_{\text{eff}} = 0.21577$$

A Venturi effect release equal to the thermal expansion release would mean that λ_{ven} would be 0.0594 d^{-1} and λ_{eff} would be 0.24547 d^{-1} . This represents a 13.8% increase in total removal rate, and therefore a 13.8% increase in the diffusion of radon from the K-65 residues into the headspace. This value is still far below the diffusion rate that would be necessary to support the release estimates in SCA-2008.

REFERENCES

RAC-1993, “The Fernald Dosimetry Reconstruction Project, Task 4, Environmental Pathways – Models and Validation,” Killough, G.G., et. al., March 1993 (SRDB Ref ID 075602).

RAC-1995b, “The Fernald Dosimetry Reconstruction Project, Task 5, Review of Historic Data and Assessments for the FMPC,” Shleien, B., et. al., March 1995 (SRDB Ref ID 038043).

SCA-2010b, “A Second White Paper Addressing Enhanced Radon Releases from the K-65 Silos at the Fernald Site,” Behling, U. H., April 2010.