Department of Energy

Ohio Field Office
Fernald Closure Project
175 Tri-County Parkway
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DOE-0159-06

Mr. James A. Saric, Remedial Project Manager
United States Environmental Protection Agency
Region V-SRF-5J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Mr. Thomas Schneider, Project Manager
Ohio Environmental Protection Agency
Southwest District Office
401 East Fifth Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

REQUEST FOR REDUCING THE RADON IN-GROWTH PERIOD ASSOCIATED WITH RADIUM-226 QUANTIFICATION BY GAMMA SPECTROMETRY

The purpose of this letter is to request a decrease in the in-growth period for radon-222 prior to the analysis of soil samples by gamma spectroscopy. Historical data collected on hundreds of soil samples at the Fernald Closure Project indicates radon is retained in the soil matrix during preparation of the sample for analysis (attachment). This condition allows an accurate determination of radium-226 activity after a radon-222 in-growth period of 7 days, and the intent of this request is to use the 7-day in-growth period to calculate radium-226 concentrations for the remaining certification samples. The 7-day in-growth period will be reliable if the soil preparation procedure remains the same and the soil matrix is not significantly different. The soil preparation procedure will not be changed for the remainder of the soil certification effort. However, there is a potential for the soil matrix in the non-certified areas to differ from certified areas, and the non-certified areas will be investigated to determine if the soil samples exhibit the same radon retention capacity as previous certification samples. This approach was discussed during the June 27, 2005 Weekly Conference Call with the U.S. Environmental Protection Agency and Ohio Environmental Protection Agency.

Soil samples will be collected immediately from areas within the remaining non-certified areas (e.g., area associated with the Silos 1, 2 and 3 treatment facilities, Area 4B Part II, the 1st Street corridor and the radium stockpile area) and analyzed for radium-226 using the existing protocol that measures the activity of radon-222 progeny after an in-growth period of both 7 and 21 days. Approximately ten samples will be collected in each of the noted areas under an insignificant variance to the Area 3B, 4B and 5 Excavation Control Project Specific Plan. Results from this investigation will be compared to the data in Attachment I to determine if the fraction of retained

radon-222 in soil from the non-certified areas is similar to the historical data. New data collected from this investigation are expected to fall along the regression line displayed in Attachment I and result in no significant change to the regression statistics and calculated residuals (i.e., r and r^2 greater than 0.95 and residuals within plus/minus 5 percent). If the statistical criteria are not met, a 14-day in-growth period will be proposed to quantitate the radium-226 activity.

With the same soil preparation procedure and fully characterized soil matrix as proposed, Fluor Fernald, Inc. believes the proposed 7-day in-growth period will expedite the reporting of laboratory results while maintaining all laboratory Quality Control and Sitewide Comprehensive Environmental Response, Compensation and Liability Act Quality Assurance Project Plan (SCQ) requirements for the remaining certification efforts at Fernald. If you have questions or require additional information, please contact Jyh-Dong Chiou (513) 368-8038 or Rich Abitz (513) 300-8670.

Sincerely,

Johnny W. Reising
Director

Attachment

cc:
J. Desormeau, DOE-OH/FCP
G. Jablonowski, USEPA-V, SRF-5J
M. Cullerton, Tetra Tech
M. Shupe, HSI GeoTrans
S. Helmer, ODH
J. Chiou, Fluor Fernald, Inc./MS88
F. Johnston, Fluor Fernald, Inc./MS12
C. Murphy, Fluor Fernald, Inc./MS1
AR Coordinator, Fluor Fernald, Inc./MS6

ATTACHMENT I
BASIS FOR REDUCTION OF INGROWTH PERIOD FOR RADON-222 WHEN QUANTIFYING RADIUM-226 ACTIVITY IN SOIL VIA GAMMA SPECTROSCOPY

Radium-226 activity in soil samples is quantified via gamma spectroscopy by detecting the gamma rays emitted from lead-214 (27 minute half-life) and bismuth-214 (19.9 minute half-life), both progeny of radon-222 (3.8 day half life), which in turn is the daughter of radium-226. To achieve an accurate analysis of the radium-226 activity, radon and its progeny must be in secular equilibrium with the parent isotope. Secular equilibrium occurs when the activity ratio of the daughter to the parent is approximately one. As radon-222 is a noble gas, secular equilibrium is achieved by placing the dried and homogenized soil sample in a sealed canister to contain the emanation and prevent loss of the radon gas. When the initial radon-222 activity in a sample is zero, it takes less than 6 half-lives, or about 21 days, for the radon-222 activity to achieve 98 percent of the radium-226 activity (note that the short half-lives of the radon-222 progeny ensure that they will be in secular equilibrium with radon-222 in less than 3 hours). Therefore, the daughter in-growth period required to reach secular equilibrium with radium-226 is a function of the initial radon-222 activity.

The initial radon-222 activity is close to zero in water samples that are air-purged prior to being sealed for the in-growth period. However, initial radon-222 levels are never zero in soil samples, as radon gas is trapped in the mineral lattice of the grains and adsorbed to the surface of the grains. The amount of retained radon-222 is dependent on the soil type and sample preparation, and it commonly exceeds 50 percent of the radium-226 activity (Florida Institute of Phosphate Research, 1991; Health Physics Society, 2002).

Comparison of 7- and 21-day gamma spectroscopy results for 1699 soil samples collected at the Fernald site over the past three months indicate approximately 92 percent of the 21-day in-growth activity is achieved after 7 days. Based on the in-growth equation for radon-222 (Figure 1), the Fernald soil samples retain about 70 percent of the radon-222 that is required for achieving secular equilibrium with radium-226, indicating that equilibrium can be established in 14 days for Fernald soil samples, rather than 21 days. This information can be used to set a maximum in-growth period of 14 days.

However, the 7-day results are well correlated with the 21-day results and further reduction of the in-growth period is possible if one derives a good regression equation that utilizes the 7-day in-growth results to calculate the equilibrium activity. A subset of the data (N = 48) was selected to focus on results that exceed the radium-226 FRL of 1.7 pCi/g. Figure 2 indicates the correlation is excellent ($r = 0.98$ and $r^2 = 0.97$) and, when the residual percentage [100*(predicted 21day – observed 21day)/observed 21day] is calculated for each observation, the average residual percentage is 1.1. This states that the 7-day regression equation will generally overestimate the 21-day result by about 1.1 percent of the true value. This is within the acceptable accuracy uncertainty (± 10 %) for measurement of laboratory standards.

Additionally, the standard emanation procedure for radium-226 (HASL Procedure E-Ra-03-01; AEC, 1972) uses the same logic described above. In this procedure, radium is isolated from the medium by precipitation with barium sulfate and the sample is sealed for 7 days. As can be seen on Figure 1, radon-222 achieves approximately 70 percent of its equilibrium value after 7 days, and the measured value after 7 days is extrapolated to 21 days using the in-growth curve to

calculate the radium-226 activity in the sample. For example, if the emanation procedure returns a result for radon-222 of 2 pCi/g after 7 days, the equilibrium value is calculated as 2.86 pCi/g of radium-226 (i.e., 2/0.7 = x/1; where x is the equilibrium value).

In conclusion, the proposed in-growth period of 7 days for Fernald soil samples and the regression equation will yield accurate results (±10 %) relative to results reported after 21 days of in-growth. This is consistent with empirical data collected on 1699 samples and the emanation procedure for radium-226. Additionally, there is no variance required for the Fernald Sitewide CERCLA Quality Assurance Plan (SCQ; DOE 2003), because Section 9.2 of the SCQ states that "The FEMP has adopted the approach of utilizing performance-based methods for radiochemical analysis." That is, any analytical method or procedure that meets the performance objectives in Appendix G of the SCQ can be used to quantitate radionulcides.

REFERENCES

Atomic Energy Commission, 1972, HASL Procedures Manual, Health and Safety Laboratory, USAEC, New York.

Department of Energy, 2003, Fernald Sitewide CERCLA Quality Assurance Plan, Revision 3, Fernald Area Office, Cincinnati, Ohio.

Florida Institute of Phosphate Research, 1991, Investigations of Radon and Radon Daughters in Surficial Aquifers of Florida, No. 05-032-093, Bartow, Florida.

Health Physics Society, 2002, Ask the Experts, Category Radon, Question #1992, Answer posted on May 22, 2002.

FIGURE 1
In-growth curve for radon-222

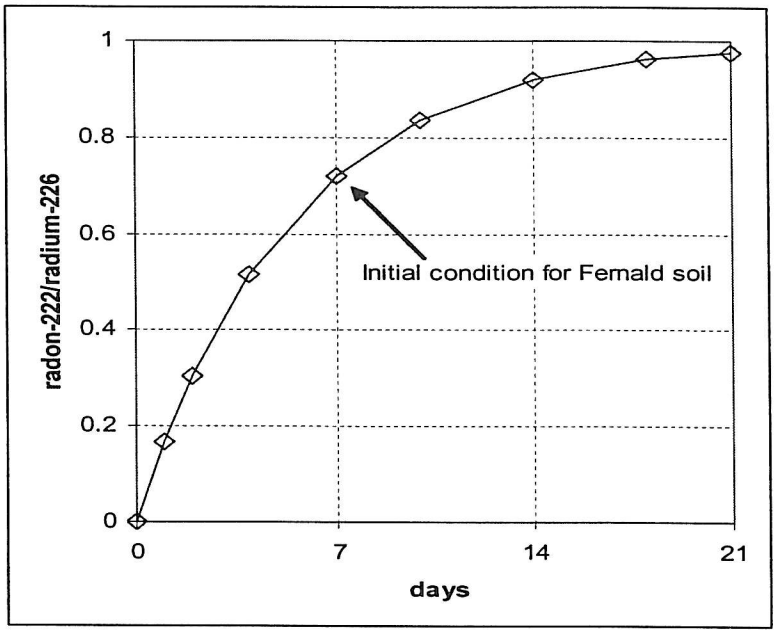

FIGURE 2
Regression analysis of 7- and 21-day gamma spectroscopy results for radium-226