



UNITED STATES  
NUCLEAR REGULATORY COMMISSION

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December 27, 2000

Mr. Tim Knapp  
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P.O. Box 1608  
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Boyertown, PA 19512

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION REGARDING THE CABOT-  
REVERE SITE DECOMMISSIONING PLAN AND RADIOLOGICAL  
ASSESSMENT

Dear Mr. Knapp:

This letter is in response to your November 17, 1997, Decommissioning Plan (DP) and Radiological Assessment (RA) for the Cabot Revere, Pennsylvania, site. In the proposed DP, Cabot proposes to remove the Revere Site from Cabot license SMC-1562 in accordance with 10 CFR Part 20, subpart E. In the DP and RA, Cabot proposes that the site be released for unrestricted use (§20.1402).

As part of NRC staff's review, we also considered the findings and conclusions in Sandia National Laboratory's "Preliminary Assessment of the Cabot Corporation Revere Slag Pile Site," which you received in November of this year.

NRC staff has determined that additional information is necessary to complete its review of Cabot's DP and RA. Additional information is required in two general areas (dose assessment and site characterization). Staff findings, summarized below, are described in the attachment to this letter:

**Dose Assessment:**

- 1) Staff considers that there is insufficient justification for treating the warehouse/loading dock as an unaffected area in the DP and RA. Further justification should be provided, or the warehouse/loading dock area should be included in the evaluation.
- 2) As discussed in previous NRC letters to Cabot (June 25, 1996, and March 12, 1997), staff believes that the dose assessment analysis cannot take credit for an undisturbed soil cover under unrestricted use conditions.

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- 3) Staff considers that the agricultural dose pathways should be included in the assessment, perhaps using a total available uranium calculation to assess the potential dose. Alternatively, a stronger justification could be provided for excluding this dose pathway.
- 4) Staff considers that the dose modeling should be done using the most recent RESRAD code (version 6.0), to incorporate recent changes which may affect the calculated results for the Revere site.
- 5) Staff has questions about the assumptions (e.g., homogenized or concentration gradient geometry, consistency with other exposure pathway calculations) made in using measured gamma exposure readings to determine gamma dose, in lieu of the RESRAD calculated gamma dose.

**Site Characterization and Environmental Assessment:**

- 6) Staff questions the instrumentation calibration methods for the gamma exposure rate data used in the RA. The calibration information is necessary to validate the exposure rate data.
- 7) Staff questions the methods and data used in the total activity calculation, as well as the assumptions about the fraction of material that is contaminated slag. Cabot should provide additional justification for the source term calculation, or provide a justified alternate source term calculation.
- 8) Staff requests Cabot provide any additional information as it relates to historical and cultural site reviews, and endangered species evaluations at the Revere site.

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NRC suggests a technical meeting or teleconference as soon as possible to clarify our informational requirements for you and your contractor. Please contact the NRC Project Manager, Ted Smith, at (301) 415-6721, to set up a meeting date and agenda.

Sincerely,



Larry W. Camper, Chief  
Decommissioning Branch  
Division of Waste Management  
Office of Nuclear Material Safety  
and Safeguards

Docket No.: 40-9027  
License No.: SMC-1562

Attachment:  
NRC Staff's Findings on Additional Information  
Needed for the Cabot Revere Decommissioning Plan

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## **NRC Staff's Findings on Additional Information Needed for the Cabot Revere Decommissioning Plan**

### **Additional Information Needed to Support Dose Assessment**

- 1) The presence of radioactive slag under the former warehouse/loading dock area cannot be ruled out based upon the site characterization completed to date. Given that part of the area is paved and part is beneath a structure, gamma surveys performed on the site are considered inconclusive. Therefore, a basis for classifying this as an unaffected area needs to be provided, or the warehouse/loading dock area should be included in the evaluation.
- 2) Staff does not believe that it is appropriate to assume that a soil cover will be applied to the site (over the slag) and permanently maintained without active maintenance. If a cover were applied, some degradation of the cover would occur over time (e.g., by erosion or by potential future site occupants). Thus, the assumption of an undisturbed soil cover will require some form of restrictions on the land use. Given the significance of this assumption on the calculated dose, Cabot needs to: (1) eliminate the assumption of a soil cover from the dose assessment; or (2) better justify the assumption that soil would be applied and include expected degradation scenarios in the dose assessment.
- 3) Staff does not agree that a sufficient basis for excluding the agricultural pathway has been provided. First, it is not clear why Cabot believes that it is reasonable to assume that someone would apply topsoil over the site to grow grass, but would not apply topsoil to maintain a small garden. Second, it seems reasonable that some of the debris and rubble may degrade over 1000 years, such that some soil is created. Consequently, the current absence of soil does not constitute a sufficient basis for eliminating the plant-ingestion pathway entirely. (Staff does believe that it is unlikely that the contaminated areas would be used to grow commodity items such as grains or livestock, so it would be reasonable to eliminate such commodity production from consideration and instead focus on a small garden scenario.) Staff's own assessment shows that inclusion of the plant-ingestion pathway has a significant effect on the calculated dose. Therefore, Cabot should either provide a stronger basis for eliminating the plant-ingestion pathway or should include it in the assessment.

The staff assessment looking at the effects of including the plant-ingestion pathway is based upon using the same model inputs as used by Cabot, with and without the soil cover, and inclusion of the plant-ingestion pathway. A key assumption in such an analysis is the environmental availability of the uranium (U-238 progeny are the prime contributors to the calculated dose). Because incorporation of uranium in food involves uptake of uranium by plants from an aqueous solution, the plant ingestion pathway assumes that the uranium is soluble. NUREG/CR-6232 (Amonette et al., 1994) suggest that doses for both soil ingestion and plant ingestion should be calculated on the basis of the total available uranium instead of total uranium. Because the total available uranium has been determined to be only a small fraction of the total uranium within the slag, the resulting doses should be only a fraction of the calculated dose based upon the total uranium. Therefore, Cabot may want to consider using the total available uranium in assessing potential doses from any ingestion pathways.

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- 4) Given that the latest version of the RESRAD code (i.e., version 6.0) is readily available for downloading from the Internet, Cabot should use the latest version of the code for conducting any additional analyses in support of demonstrating compliance with the license termination rule. Several changes in recent updates of the code could specifically affect the calculated results for the Cabot-Revere site. These changes include: (1) incorporation of a new area factor model for inhalation, (2) changes in the default mass loading factor, and (3) incorporation of a time integration routine for calculating doses.
  - 5) In the radiological assessment, Cabot states that use of the measured gamma readings (as opposed to calculating them with RESRAD) results in estimated external doses that are roughly a factor of three lower. Given that the doses calculated by RESRAD assumes uniform contamination, this difference between measured and calculated exposure rates would suggest that either: (1) the estimated concentrations used in the analysis are too high, or (2) most of the radioactive material is in the subsurface. As part of their characterization, Cabot dug a number of pits and trenches on-site, but Cabot does not have a reliable estimate of average subsurface concentrations. The assumption of homogenized contaminated media assumed in the RESRAD calculation would appear to be consistent with the modeling assumptions used by Cabot for the analyzing the other exposure pathways. Further, there is no reason to believe that the contaminated media will not be disturbed (i.e., homogenized) at some time in the future. To support the use of the gamma measurement readings to estimate external doses, Cabot should clarify the assumptions of the analysis; that is, whether or not a concentration gradient is assumed. If the primary radioactive material is assumed to occur in the subsurface, Cabot should explain why it is appropriate to assume that these conditions will be maintained throughout the assessment period without land-use restrictions. Further, Cabot should explain how this assumption (i.e., contamination being primarily subsurface) is consistent with the approach used to analyze doses for the other exposure pathways (i.e., contamination assumed homogeneous). As an alternative to supporting the use of the gamma measurement readings, Cabot could use RESRAD to calculate doses from external gamma radiation. To meet the dose criterion, this use of RESRAD may necessitate reassessing the source term concentrations.

#### **Additional Information Needed to Support Site Characterization**

- 6) In the radiological assessment, the gamma exposure rate measurements used by Cabot for estimating the external dose were obtained from the 1994 Radiological Characterization Survey Report (Enserch Environmental Corporation). Section 5.1 of that characterization report briefly describes the exposure rate measurement methods, indicating, in part, that measurements were made with a calibrated sodium iodide scintillator and portable ratemeter/scalar. However, the report does not describe the calibration of the instrument. Sodium iodide detectors are known to have a significantly energy-dependent response, so proper calibration to the energies and geometries encountered in the field measurements is important. Based on staff's assessment, the external exposure pathway is important to overall calculated dose (especially for the situation where application of cover topsoil cannot be assumed). To support the use of the gamma exposure rate measurements to estimate external doses, Cabot should provide additional information on the calibration methods used for the exposure rate measurements. Such information is needed to support Cabot's conclusion that the measurements are representative of the exposure rates from residual radioactivity at the Revere site. (See also Item 5.)

- 7) The source term concentrations (of U, Th, and progeny) are critical to the calculated doses. The average concentrations used in the dose modeling are not sufficiently supported. In Table 2-1 of the radiological assessment, the measured total activity of U plus Th is given as 272 pCi/g, based on results from a single sample, with the analysis results provided in Appendix A of the radiological assessment. From the same analysis results, the concentrations of all the U-238 series progeny are not consistent with each other, and are not consistent with the measured concentration of U-235 (if an assumption of the typical abundances in natural uranium is made). Thus, many different estimates of total uranium concentration in this slag sample can be made, some of which are almost three times as great as the value selected by Cabot.

It is also unclear to the staff why the source term is based on results from only this single piece of slag. Additional samples of contaminated slag/soil have been found in previous surveys. In their 1993 confirmatory survey report, ORISE identified a slag sample with elevated concentrations and significantly more Th than U, in contrast to the U to Th ratio of the single sample evaluated in Cabot's radiological assessment. In the 1994 Radiological Characterization Survey Report (Enserch Environmental Corporation), more than ten samples showed significantly elevated U and Th concentrations, with up to 1300 pCi/g total U. Based on the different results from the previous survey and on different possible interpretations of the one sample analyzed for the radiological assessment, the value of 272 pCi/g as the typical or average total U plus Th concentration in the contaminated slag has not been sufficiently justified.

The average concentrations (of U, Th, and progeny) used by Cabot in its dose modeling also rely on assumptions about the fraction of the debris and rubble that is contaminated slag. The fraction's value is only stated as an assumption, and no justification has been provided in the radiological assessment. If Cabot intends to use the average U and Th concentrations for dose modeling as described in the radiological assessment, Cabot should provide additional justification for the radionuclide concentrations in the contaminated slag and for all assumptions that support the calculation of the average concentrations used for the dose modeling source term. As an alternative, Cabot may wish to base source term concentrations on a bounding estimate of the inventory of U and Th at the site, similar to the approach taken by Sandia National Laboratory, in its recent assessment. If such a bounding-estimate approach is taken, Cabot should provide justification for all assumptions and parameters.

#### **Additional Information Needed to Support Environmental Assessment**

- 8) The Decommissioning Plan discusses site history, but does not discuss site historical and cultural resources, or an evaluation of endangered species on the site. Cabot should provide any available additional information in these areas, to be considered during completion of the environmental assessment of the Cabot Revere site proposal.

Specifically, Cabot should provide any additional information and documentation on: (1) historical and cultural resources at the site (e.g., site surveys, consultations, lists of properties eligible for the National Register), (2) details of any discussions with the Pennsylvania Historic Commission (State Historical Preservation Officer), (3) endangered and threatened species at the site (e.g., site surveys, lists of endangered and threatened species), and (4) details of any discussions with Pennsylvania Department of Conservation and Natural Resources and/or the U.S. National Fish and Wildlife Service.