CABOT

November 21, 2002

Mr. Larry Camper
Chief, Decommissioning Branch
Office of Nuclear Materials Safety and Safeguards
U.S. Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, MD 20852-2738

Subject: Characterization and Exposure Scenarios for the Reading Slag Pile Site; License No SMC-1562

Dear Mr. Camper:

At a public meeting at Nuclear Regulatory Commission (NRC) headquarters on September 23, 2002, Cabot Corporation (Cabot) committed to submit additional documentation relevant to the characterization of the Reading slag pile. In addition, Cabot also stated that it would provide its comments on the Health Consultation report prepared by the Agency for Toxic Substances and Disease Registry dated July 23, 2002 (ATSDR report). Cabot is submitting such information in two parts. This letter and the attached report, which includes referenced documents, provides comments on the Johns Hopkins University report titled: Characterization of Radioactive Slags, Draft Progress Report: 2000. (draft JHU report). Cabot's comments on the ATSDR report have been submitted directly to ASTDR. A copy of the comments provided to ATSDR is included.

Cabot has previously submitted detailed site characterization and dose assessment information that has been the subject of a detailed critical review by NRC for the past 7 years. The Reading Slag Pile site has been adequately and appropriately characterized and NRC approved both the Site Characterization Work Plan in 1995 and the Site Characterization Report in 1996. In its June 2002 Draft Environmental Assessment and Safety Evaluation Report, NRC concluded that the dose assessment meets both the dose limitation and ALARA requirements of the License Termination Rule. The September 23 meeting focused on questions that have arisen regarding the adequacy of site characterization and exposure scenarios. Those questions were based primarily on statements in the above-mentioned reports and two Sandia National Laboratories reports. A careful review of these documents and the additional documents provided by Cabot demonstrates that they do not provide a valid basis for questioning the previously docketed site characterization and dose assessment information.

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A May 2, 2002 letter from the Pennsylvania Department of Environmental Protection (PADEP) to NRC expressed concern regarding the adequacy of the slag pile characterization. The PADEP concerns appear to be based in part on erroneous statements in the draft JHU report. The intent of this letter and attachment is to correct the errors contained in the draft JHU report that led to the PADEP concerns so that the license termination process can proceed.

Draft Johns Hopkins University Report

The draft JHU Report makes a number of statements that are incorrect. As a result of these errors, the draft JHU Report grossly overestimates the amount of Th and U in the slag pile and makes unjustified criticisms of the site characterization methodology.

The draft JHU Report applies an incorrect source material concentration of 2 % to both tin and waste slag and grossly overestimates the quantity of source material in a large volume of material reportedly shipped from Baltimore to the Site. We are providing a number of period documents that indicate the inventory of source material in the pile is on the order of 2 to 2.5 tons, not 153 tons as reported in the draft JHU report. These documents indicate the following:

- Approximately 600 tons of waste slag was deposited on the slag pile. The concentration of Th/U in the waste slag from the Reading process was approximately 0.2 % to 0.4 %. NES and John Hopkins own data confirmed the concentrations of Th/U in the waste slag. This equates to approximately 1.8 tons Th/U.

- 580 tons of decontamination debris and soil that was placed on the pile from the 1977-1978 decommissioning effort had an average of 0.51 pCi/g Th and 0.35 pCi/g U based on analysis of 293 representative samples. This equates to approximately 0.0016 tons Th/U.

- The concentration of Th/U in tin slag was approximately 0.1 % to 0.3 %. Unused tin slag present at the Reading facility after the operation was terminated in 1969 was shipped to Baltimore for consolidation with the tin slag stored there.

- The over 28,000 tons of unused tin slag stored at Baltimore was eventually shipped to Europe.

- A substantial effort was undertaken to decontaminate the Baltimore shipyard after the unused tin slag was transferred to Europe. The tin slag was relatively fine grain material and a significant volume of soil/sand/slag material was removed from the site in order to meet the decontamination criteria of 0.05% Th applied to the site. The material that was shipped to the Reading Site from Baltimore would have consisted

of sand, soil and tin slag from decommissioning activities at that site. Recollection of workers was that tin slag constituted about 5% of the volume. This recollection is confirmed by analyses of sand samples collected during the characterization effort, which indicated that the material contained approximately 2 pCi/g to 3 pCi/g total Th/U (essentially the same as the background concentration at the Site). If 5700 tons of soil/sand/slag material was shipped to the site, this equates to approximately 0.6 tons Th/U.

The draft JHU Report also questioned whether the split-spoon sampling used for site characterization obtained representative samples, because some of the waste slag was in the form of large vitreous blocks. This concern is not valid because the vast majority of the slag pile consists of small particles, and the split spoon method also could obtain representative samples of the large blocks of waste slag.

The bulk of the material in the slag pile was contaminated with tin slag, which consisted of sand sized grains. Only the waste slag from the Reading process contained some larger pieces of vitreous slag, and the waste slag constituted only a small part (less than 4%) of the total slag volume. Both NES and John Hopkins located and analyzed some of the larger pieces of vitreous slag during their sampling efforts. The results of these analyses are consistent with the concentrations of Th/U in waste slag reported in historical documents indicating that representative samples of the waste slag were collected.

The results of the site characterizations are confirmed by the result of calculations based on a review of the history. The average activity in the slag pile of 75 pCi/g Th/U (45 pCi/g Th) was based on analysis of a significant number of samples collected from the pile. The characterization included 60 samples from six borings that extended through the entire vertical profile of the pile and penetrated all previous deposition depths. All materials reported to have been placed on the pile were encountered (slag, sand, concrete, soil, and other non-radiological materials such as wood). The expected activity based on inventory records and volume of the pile is approximately 47 pCi/g, which is consistent with and confirms the activity based on characterization data of 45 pCi/g.

ATSDR Report

The ATSDR report is important to the license termination proceeding for several reasons:

- It concludes that radionuclide concentrations in the Reading slag pile constitute a public health concern by way of the inhalation pathway.

- It concludes that the site may not be suitable for license termination with release for unrestricted use, as proposed by Cabot.

- It recommends consideration of additional site characterization.
- It recommends more detailed dose assessment using realistic exposure scenarios for the site.

The ATSDR report, dated July 23, 2002, makes reference to the May 2, 2002 letter from PADEP to NRC, and notes PADEP concerns about site characterization and exposure scenario issues. However, the report reflects no consideration or awareness of the NRC response, dated June 20, 2002, of subsequent correspondence, or of a substantial body of slag pile characterization and dose assessment information developed as part of the license termination process.

As explained in detail in the attached documentation, Cabot's review of the ATSDR finds the conclusions and recommendations noted above unfounded. The conclusion that radionuclide concentrations in soil constitute a public health concern is simply unsupported by any analysis in the report. The conclusion that the site may not be suitable for license termination with release for unrestricted use may stem in part from the first faulty conclusion, but also appears to be dependent upon the report's estimates of direct radiation dose, which are based on highly unrealistic exposure assumptions.

The ATSDR approach to dose assessment can be characterized as a screening approach. Specific uses of the site and site-specific constraints on such uses are not considered explicitly. Clearly conservative values for important parameter values, such as the duration of thousands of hours per year for occupation of the slag pile, are simply adopted without evaluation of reasonableness. Plausible exposure scenarios, including narrative descriptions of site uses mutually consistent with the adopted exposure assumptions, on one hand, and constraints imposed by site conditions, on the other hand, are simply not considered or developed. Such a simplistic approach is entirely justified when it can demonstrate that dose limits are met, as is the case with ATSDR's dose limits for public health concern, as applied to direct radiation. However, when a highly simplistic and conservative approach indicates that dose limits might be exceeded, as is the case when dose estimates for some of the ATSDR's exposure scenarios are compared to the license termination dose limit (a lower limit than the public health limit), the analysis must be supplemented with more realistic analysis, or must be considered inconclusive. (It should be noted that correction of an ATSDR mathematical error in the calculation of dose for the exposure scenario it characterizes as most realistic, shifts the dose estimate from a value slightly higher than the license termination dose limit to a value substantially lower than the dose limit.)

In its recommendation for more realistic dose assessment, ATSDR appears to realize the limitations in its dose assessment as applied to license termination. In making that recommendation, however, ATSDR reflects no consideration or awareness of more realistic dose assessments that have been performed by both Cabot and NRC.

The basis for ATSDR's recommendation for additional site characterization is unclear. It may stem from noted PADEP concerns, discussed above in connection with the JHU report. But the ATSDR report reflects no consideration or awareness of the extensive slag pile characterization that has already been performed.

Sandia Reports

In its two letters to NRC, PADEP expresses concerns about the suitability of exposure scenarios assumed by both Cabot and NRC for purposes of estimating doses for comparison to license termination dose limits. PADEP recommends scenarios similar to those developed and evaluated in the two Sandia reports noted above. The work described in these reports was performed for the NRC as part of the NRC's dose assessment effort. However, the Sandia report scenarios leading to the dose estimates exceeding license termination criteria, were not adopted by NRC staff in its assessment, and appropriately so.

Cabot has not prepared a separate document containing detailed comments on the Sandia reports, but the most important results of Cabot's review can be stated briefly and are provided below. In summary, Sandia, in the development of its exposure scenarios, did not properly consider either the regulatory context or the physical context of the radioactive material at the site

The regulatory context is that the radiological criteria for license termination were developed to be applied against results of realistic estimates of potential dose to the "average member of a critical group." The critical group is the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for the most likely exposure scenario based on prudently conservative exposure assumptions. This critical group approach has been adopted by regulation by the NRC as the basis for license termination dose assessments. It is consistent with long-standing International Commission on Radiation Protection (ICRP) practice of defining and using a critical group when assessing individual public dose from low levels of radioactivity, has been adopted in EPA's Federal Radiation Protection Guidance, and is consistent with the recommendations of the National Academy of Sciences on the Yucca Mountain Standards. In adopting the critical group approach by regulation, NRC explicitly rejected other approaches, including the "reasonably maximally exposed (RME) individual" and other approaches based on individuals. Estimating dose to the average member of the critical group was considered sufficiently conservative while limiting boundless speculation on possible future individual behavior.

The physical context of the radioactive material at the site is an important consideration in constraining the kinds of exposure scenarios that might be considered realistic for the site. The important aspects of the physical context of this material are as follows:

1. The concentration of source radioactive material in the slag itself is within about one order of magnitude of the threshold concentration below which it would not be regulated by NRC at all.

2. The slag is physically and chemically very stable.

3. The slag bearing radioactive material is mixed, not uniformly, but considerably, in a larger volume of debris, such that the average concentration in this material is roughly one order of magnitude less than in the slag itself, and the total volume is about 180,000 cubic feet.

4. This volume of slag and debris containing radioactive material represents a small, discrete segment of a much larger volume (about 3,000,000 cubic feet) of mixed non-radiological slag and industrial debris of various kinds.

5. The debris volume containing the radioactive material of interest is distributed, as an identifiable part of a substantial portion of the non-radiological debris, primarily along the surface of a stable but steep slope and a thin band along the edge of the horizontal top of the slope.

6. The slope and the areas at the top and bottom have been used for heavy industrial applications (e.g., oil refining, etc.) for over a century.

7. Well-developed plans for the use of the site in the foreseeable future of the site are being implemented. They recognize past use of the site and limit potential future uses of the site.

8. Given the large, stable, and clearly identifiable debris deposit, the long term future use of the site is not likely to differ from the expected near-term future use of the site.

9. Given the physical conditions, future excavation at the site must be considered highly unlikely. Even if it occurred, it would not likely leave the radioactive material in a more hazardous state than its current and expected near-term future state, and would most likely not result in doses greater than those estimated for short-duration incidental exposures evaluated in the Cabot Radiological Assessment.

All of these factors constitute constraints on the potential for natural migration or physical disturbance of the material, on the future uses by people of the area containing radioactive materials, on the pathways by which people using the area might be exposed to radiation, and, ultimately on the exposure scenarios used to evaluate dose for comparison to the license termination limit. Consideration of these constraints should make it readily apparent that exposure scenarios warranting evaluation in this case are limited to those involving only

short-duration, incidental exposure to average concentrations of radioactive materials (*i.e.*, average concentrations to which a person walking around on the site might be exposed).

The Sandia exposure scenarios that result in doses exceeding license termination criteria involve habitation of housing or occupational facilities assumed to be constructed on the site, either on-grade in the narrow band at the top edge of the slope (a mobile home perched at the top edge of the slope is offered as a possibility), or within a partial excavation on the slope. These scenarios are characterized as possible without consideration of the likelihood of the sequence of events necessary for the construction and habitation of such facilities—*e.g.*, the implicit assumption that construction of facilities on a foundation of industrial debris, a condition that would be readily apparent very early in the process, would proceed to completion. These scenarios and others, some of which are hardly plausible, let alone likely, ignore the regulatory and physical contexts described above and the constraints on the development of realistic exposure scenarios that derive from them.

Attached you will find detailed comments on the issues in the draft JHU report, additional documentation relevant to site characterization and a copy of Cabot's comments on the ATSDR report. The factual information provided herein demonstrates that the characterization results and dose assessment conclusions are correct and consistent with NRC requirements.

Cabot hopes that NRC and JHU will evaluate the attached comments, review all the available information for the Site and make the appropriate corrections before issuing the final draft NUREG for technical review. Please do not hesitate to contact me at 978-670-6970 should you have any question or wish to discuss this matter.

Sincerely,

Wayne M. Reiber
Manager, Environment Assessment & Remediation

Attachment

Cc: Scott Moore, USNRC
Theodore Smith, USNRC
George Pangburn, USNRC, Region I
David Allard, PADEP *(without attachment)*
Richard Janati, PADEP *(without attachment)*
Robert Maiers, PADEP
Adam Mukerji, City of Reading Redevelopment Authority *(without attachment)*