



November 21, 2002

Max M. Howie, Jr.
Chief, Program Evaluation, Records, and Information Services Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry
Atlanta, GA 30333

Subject: ATSDR Health Consultation (Exposure Investigation), American Chain and Cable Cabot Corporation (a/k/a American Chain and Cable); Reading, Berks County, Pennsylvania; July 18, 2002

Dear Mr. Howie,

I am writing in regards to the Agency for Toxic Substances and Disease Registry ("ATSDR") Health Consultation and Exposure Investigation Report for the above referenced site dated July 18, 2002. ATSDR attempted to evaluate the impact on the public's health resulting from the potential exposure to radiological material at the American Chain and Cable location. ATSDR's evaluation, however, did not review a number of important studies that are available for this site, misinterpreted the findings of other studies that were reviewed, and contained a number of errors. The attached letter report provides ATSDR with detailed comments on the Health Consultation report. While we recognize that there is no public comment process associated with the release of Health Consultation reports, we feel it is appropriate and necessary that ATSDR consider all relevant information, develop a correct understanding of the site and rely on accurate analysis in developing an assessment of this site.

ATSDR based its conclusions and recommendations presented in its Health Consultation and Exposure Investigation on 1993 and 1995 confirmatory surveys, recent radiation exposure readings performed by ATSDR Region III staff and EPA during a visit to the site in March 2002 and its current exposure investigation. Notably absent are several key documents that would have provided substantial additional information regarding the site history and radiological and physical characteristics and, most importantly, the extensive, critically reviewed, dose assessment performed in accordance with established practices for assessing potential exposure to the public.

Despite the extensive body of dose assessment work performed for this site, ATSDR performed its own cursory screening-type analysis using overly conservative exposure assumptions and concluded that "gamma radiation

exposure rates associated with the slag pile are not at a level of public health concern". This conclusion is based on the results of ASTDR's most plausible exposure scenario (Scenario 2) which suggest potential annual exposure was about 32 mrem/yr, a level less than the ATSDR's Minimum Risk Level (MRL) of 100 mrem/yr. While ASTDR's conclusion is correct, there is an error in ASTDR's dose calculation. The corrected value is 9.2 mrem/yr. This value based on a screening-type analysis using overly conservative assumptions is also well below the Nuclear Regulatory Commission's ("NRC") promulgated 25 mrem/year standard applicable for comparison to a detailed dose assessment using site-specific information and reasonable assumptions. The NRC standard was specifically "established to provide sufficient and ample margin of safety for protection of public health and safety."

Further on in its conclusion, ATSDR asserts that there are elevated concentrations of thorium above background at the site, that thorium has a low threshold for inhalation risk and therefore, "considers the contamination in the soils to be a public health concern". ASTDR presents no quantitative or qualitative basis for this conclusion, relying simply on the presence of "elevated concentrations" of thorium in soil above background as the basis for this conclusion. This is not a valid conclusion, as the simple presence of a constituent at an "elevated" concentration above background does not indicate that it presents a public health concern. This principle is well established in the regulatory, scientific and public health arenas.

ATSDR did not consult the extensive body of assessment work that has been performed for the site. These assessments include a site specific dose assessment performed by ST Environmental Professionals (STEP) that has been the subject of careful and critical review by NRC and its consultant, Sandia National Laboratories, over the past few years. These assessments indicated that total dose from the site was low and that the inhalation pathway did not contribute significantly to the total dose.

These assessments are critically important in a public health evaluation. These assessments evaluated the potential public exposures from this site by evaluating potential exposure to the "average member of critical group" which is the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for the most likely exposure scenario. These assessments are based on prudently conservative exposure assumptions. This average member of the critical group approach has been adopted by the NRC as the basis for dose assessments, is consistent with 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 approach adopted by the National Academy of Science. It is sufficiently conservative while limiting boundless speculation on possible future exposure scenarios. In its Toxicological

Profile on Ionizing Radiation, ATSDR clearly acknowledges and recognizes that the above entities are the authoritative bodies with regard to recommendations and standard development regarding public health.

Attached you will find detailed comments on the above referenced report. Cabot hopes that ATSDR will evaluate these comments, review all the available information for the site and make the appropriate corrections to its July 23, 2002 Health Consultation report. 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

Cc: L. Camper, USNRC
S. Moore, NUNRC
T. Smith, USNRC
G. Pangburn, USNRC, Region I
D. Allard, PADEP
R. Janati, PADEP
R. Maiers, PADEP
Adam Mukerji, City of Reading Redevelopment Authority

COMMENTS ON ATSDR REPORT

November 21, 2002

Following are Cabot Corporation comments on the Agency for Toxic Substances and Disease Registry (ATSDR) report, "Health Consultation (Exposure Investigation), American Chain and Cable Cabot Corporation (a/k/a American Chain and Cable), Reading, Berks County, Pennsylvania," dated July 18, 2002.

Comments are grouped below in five areas:

1. ATSDR review of available information,
2. Errors and Misunderstandings,
3. Measurements,
4. Dose assessment scenarios and results, and
5. Conclusions and recommendations.

1. ATSDR REVIEW OF AVAILABLE INFORMATION

ATSDR did not consider in its evaluation a number of important studies and reports that are critical to a health assessment. These studies and reports provide substantial additional knowledge regarding the radiological and physical characteristics of the site and, most importantly, a detailed, critically reviewed, dose assessment performed in accordance with established practices for assessing potential exposure to the public. These studies conclude that residual radioactivity at the site will not result in a dose exceeding applicable requirements considered protective of public health based on prudently conservative exposures scenarios.

- 1a. The ATSDR report states that their recommendations were based on the 1993 and 1995 confirmatory surveys, recent radiation exposure readings performed in March 2002 by ATSDR and EPA, and current radiation exposure readings. Other sources of site information listed in their reference section include the 1994 NES Decommissioning Plan for the main processing and surrounding area, two letters from the NRC to Cabot (1994 and 1995), a May 2, 2002 letter from PADEP to the NRC, and their internal transmittals of information. Notably absent are several key documents that would have provided substantial additional knowledge regarding the site history and radiological and physical characteristics. The most significant documents apparently omitted from the ATSDR review include:

- Final Decommissioning Project Report for the Main Processing Building and Surrounding Area, NES, Inc., May, 1995.
- NRC Letter to Cabot confirming release of the building and surrounding areas for unrestricted use, August 18, 1995.
- Characterization Report for the Reading Slag Pile, NES, April 22, 1996. That report was accepted and approved by the NRC.
- Hydrologic and Geologic Assessment for the Reading, Pennsylvania Slag Pile Site, STEP, 1997.
- Report on Topographic and Radiological Surveys, Reading Slag Pile Slope, STEP, 1999.
- Radiological Assessment for Reading Slag Pile Site, Rev. 1, STEP, 2000.
- Decommissioning Plan for Reading Slag Pile Site, Rev. 1, STEP, 2000.
- NRC Letter to the PADEP, dated June 2002, responding to the PADEP May 2, 2002 letter.

These documents provide a detailed and concise characterization of the site conditions, site history, and an extensive dose assessment evaluation performed in accordance with an established approach that is conservative and protective of the public and that has been critically reviewed. ATSDR's issues concerning dose assessment and the relevance of the air pathway are thoroughly addressed and resolved in these documents. These studies conclude that the air exposure pathway is not a significant exposure pathway and that residual radioactivity at the site will not result in a dose exceeding applicable requirements considered protective of public health based on prudently conservative exposures scenarios.

- 1b. Dose assessments are critically important in a public health evaluation. Particularly important are the ways in which site-specific considerations are accommodated in the dose assessment and the ways in which variable human behaviors and characteristics are considered in the dose assessment. Simply put, radiation dose is evaluated for an exposure scenario involving reasonably expected use of the site, given site conditions that constrain such use.

The whole point of expressing radiological limits in terms radiation dose (as opposed to radionuclide concentrations in environmental media, for example) is to allow regulators to take site-specific information into account in relating environmental concentrations to dose. Site-specific information was carefully considered in designing the dose assessments performed in support of license termination, and such consideration is fully documented.

2. ERRORS AND MISUNDERSTANDINGS

The ATSDR report contains a number of errors. It is also clear ATSDR does not correctly understand a number of important factual considerations. These errors and misunderstandings lead ATSDR to erroneous and inappropriate conclusions in its evaluation of the potential public health concerns associated with the site.

- 2a. Scenario 2 is defined by ATSDR as follows: "For this scenario, the individual would be exposed to the average dose 1 hour per day on both the pile and the and at the lower fence for 200 days per year." The ATSDR estimated annual dose for this scenario is 32 mrem/year. We have assumed ATSDR means 1 hour at each location per day which is the more conservative interpretation. Using the stated exposure times of 200 hours/year on the pile and 200 hours/year at the lower fence line, the average ATSDR dose rate measurements at those locations (corrected for background) of 25.4 urem/hour and 20.8 urem/hour, the calculated annual dose would be 9,240 urem/year or 9.2 mrem/year. An annual dose of 9.2 mrem/year is well below all guidance and regulatory limits referenced in the ATSDR report. The approach used by ATSDR was not appropriate for determining a dose for comparison to the 25 mrem/year decommissioning standard for unrestricted release. However, even using a screening approach and overly conservative exposure assumptions, the calculated dose is still well below the 25 mrem/year regulatory standard.

Based on review of their calculations, it appears that ATSDR used the maximum measured dose rates for their Scenario 2 dose-rate calculations, not the average as they stated.

- 2b. Errors in the ATSDR report resulted in overestimates of the dose. Table II in the ATSDR report lists the measured dose rates with a footnote indicating that they are not corrected for background. Table III lists the dose rates used in the Monte Carlo simulations with a footnote that the values are corrected for background. Although the minimum values are set to zero (i.e. corrected for background), all but one of the remaining values listed are the same as those listed in table II. The one exception is the highest dose value listed for the pile in Table II (115) which is greater than the maximum dose value for the pile listed in Table II. The uncorrected values appear to have been used in the Monte Carlo simulation (The average and 50 percentile results are higher than the respective average uncorrected values in Table III multiplied by the average daily exposure times listed in Table III for 200 days per year).
- 2c. In describing the area of the lower fenced area (or lower pile), ATSDR indicates that it is near a jogging trail (p.2), near the river (p.3, 4, 5, and 6), and that slag

has migrated past the fence (p. 3). These statements do not give an accurate impression of the distance relationships important in assessing potential dose. For clarification, the fenced area is over 50 feet from the jogging trail and they are separated by an active rail line and a steep berm next to the trail. Historical exposure rate measurements along the jogging trail are representative of background. The river is further away from the pile, over 100 feet, and at a substantially lower elevation.

ATSDR may have incorrectly interpreted the location of slag outside the fence as indicating movement due to a lack of understanding of the site history and characterization efforts. When first placed, some of the slag mixed with sand/soil/debris extended into the River Road ROW in one location (north west of the concrete block foundation at the base of the slope. It appears that at some subsequent time prior to 1997, grading activities in the River Road ROW distributed the toe of the slag pile laterally. The STEP 1999 topographic and radiological surveys of the River Road area confirmed that the radiological material in the ROW was restricted to a thin (less than 1.5 foot thick) layer underlain by non-radiological material. As presented in the RA, the radiological material in the ROW was included in the evaluation.

The slag is not migrating through the fence. The fence was installed in 1999 and was placed as close to the railroad as was allowable under applicable regulations¹. A small portion of the radiological slag was located inside the 12 foot limit and could not be enclosed by the fence.

- 2d. ATSDR states on page 8 of its report that it was "unable to verify if any remediation occurred" between the 1993 and 1995 ORISE confirmatory surveys. ATSDR points out the existence of mature trees on the slag pile and no evidence of excavation on the slag pile as indication that no remediation occurred. It is clear that ATSDR does not understand a critically important fact that the site consists of two separate and distinct areas—the slag pile and the buildings and surround areas. The building and exterior areas surrounding the building were subject to prior remedial action and decommissioning activities and were the focus of the 1993 and 1995 confirmatory surveys by NRC consultant, ORISE. Both the 1993 and 1995 ORISE surveys make it clear that the slag pile was specifically excluded from the study area. Remediation conducted between the 1993 and 1995 confirmatory surveys is described briefly in the 1995 ORISE report and is described in detail in the Final Decommissioning Project Report for the Main Processing Building and Surrounding Area cited above. Since the remediation between 1993 and 1995 and the ORSIE confirmatory surveys for these areas explicitly excluded the slag pile, ATSDR should not expect to find signs of excavation and other remedial action on the pile nor should they make any conclusions regarding the pile based on the 1993 and 1995 surveys.

¹ Conrail, Letter from J. N. Ahonen (Conrail) to Steffan R. Helbig (STEP), April 13, 1999.

2e. The ATSDR report also suggests on pages 2 and 3 that the 1995 confirmatory survey was suspect because the 1995 soil sampling locations did not correspond with the locations of elevated exposure rate measurements identified in the 1993 survey. The ATSDR report reflects no awareness of remedial action performed between the 1993 and 1995 surveys and reflects no awareness of any 1995 confirmatory measurements other than the ten soil samples mentioned in its report. The remediation between 1993 and 1995 focused on the areas identified in the 1993 survey. The 1995 confirmatory survey report states that, with respect to exterior areas (soils and paved areas) intended for release, screening measurement consisted of a 100% surface scan of affected areas and a 75% surface scan of unaffected areas using gamma radiation detectors and count-rate meters. This measurement method is at least as suitable as exposure rate measurement. Locations with results elevated above background were flagged for further analysis. As stated in the report, soil samples were then collected in areas where surface scan results were elevated above background and at some randomly selected locations. Analyses of those samples indicated that the residual concentrations of Th and U were not elevated above release criteria.

2f. ATSDR states:

“The ATSDR exposure investigation did not collect soil samples to estimate the extent of contamination within the slag pile. However, based on the review of available information, ATSDR considers the contamination in the soils to be a public health concern. ATSDR bases this conclusion on the results of the 1993 and 1995 confirmatory surveys. These surveys seem to be contradictory with respect to detected concentrations of contaminants as consistent with our measurements of hot spots.”

ATSDR is basing this conclusion on the results of the 1993 and 1995 confirmatory surveys. The confirmatory surveys dealt only with the buildings and adjacent outside areas and specifically excluded the slag pile. Therefore, they are irrelevant to assessing the dose associated with the slag pile. The last sentence of this paragraph is very confusing and would require clarification to understand the intent of this statement.

The 1993 confirmatory survey did indicate that where exposure rates were elevated, soil concentrations were elevated. Following remediation, the 1995 confirmatory survey did not find a correlation between readings elevated above background and soil concentrations above release criteria. ATSDR did not measure soil concentrations. ATSDR apparently assumed, based on the ORISE observations, that elevated direct dose measurements correspond to elevated soil concentrations. This assumption is generally correct. However, ATSDR provides no quantitative analysis to demonstrate that elevated concentrations above background do indeed lead to significant doses. Pointing to an elevated

concentration in soil and a low concentration limit in air does not constitute adequate analysis. As is the standard of practice for evaluating the potential risk posed by a specific concentration of constituents in soil, only through a detailed analysis of the pathways, receptors, and exposure mode can the corresponding dose be calculated. The RA includes such an analysis, and concludes that inhalation dose to an excavation worker on the site would be low, even if dusty conditions are assumed.

- 2g. The ATSDR discussion of NRC decommissioning regulations and guidance on page 8 appears to be confused, as does the related discussion on pages 2 and 3 of exposure rates measured near the "site perimeter," which presumably refers to the slag pile perimeter. ATSDR appears not to recognize that the new dose limit of 25 millirem per year supplants rather than supplements the earlier NRC Branch Technical Position discussed on page 8. Furthermore, the discussion appears not to recognize the licensing status of the slag pile. The buildings and much of the land on the site were released for unrestricted use under the Branch Technical Position criteria of 10 pCi/g in effect at the time. The slag pile, however, currently remains under license, which is presently in the process of being terminated under the new license termination regulation and dose limit criteria of 25 mrem/yr for unrestricted release.²

3. MEASUREMENTS

A report presenting and evaluating data should contain sufficient detail to allow for third party critical review and evaluation. The ATSDR report does not do this. It is recognized that ATSDR Health Consultation reports are not subject to a public comment process. However, this report is being used by authorities to form regulatory positions without the benefit of critical review regarding the facts presented, the data collected and the appropriateness of the evaluation.

- 3a. ATSDR apparently measured radiation exposure rates in two visits to the site, one in March, 2002, and the other at a later, unspecified time. Although the results of these measurements are described in statistical terms, there is no indication of the number of measurements, the time of various measurements, or the areal distribution of measurements. A sketch, perhaps using Figure 1-2 from the Cabot Reading RA (Radiological Assessment for the Reading Slag Pile, ST Environmental Professionals, Inc., Revision 1, March, 2000) or an equivalent, marked to show what levels were measured when and approximately where on the site, should have been included.

² ATSDR also appears not to recognize that the new dose limit of 25 millirem per year is a regulatory requirement and not a "guideline" as indicated in Table VI.

- 3b. The description of the measurement methodology is not complete. The report indicates at page 4 that at least some measurements were made at ground level, but there is no indication of the height of other measurements. Measurements made in for dose assessment and in support of license termination are generally made at a level of about 1 meter above the ground, because exposure rates in the vicinity of the trunk of the body are the most appropriate for use in dose estimation. Measurements made at ground level are highly sensitive to highly localized variability in concentrations of radioactive materials in soil. Because of the high degree of localization, these variabilities are only rarely important in assessment of dose to a site occupant. However, reliance on ground-level measurements that are highly sensitive to them can result in overestimates of the variability, maximum level, and, to some extent, even the average of exposure rates one meter above the ground.

Based on a comparison of statistics of ATSDR and NES measurements reported in the Site Characterization Report ("Characterization Report for the Reading Slag Pile," Revision 1, NES, Ind./IES, Danbury, Connecticut, April, 1996), NES mean exposure rates for the pile (the entire pile) and lower fence line area are about 60-65% of the ATSDR mean exposure rates. The NES standard deviations (sample standard deviations) are actually somewhat higher than the ATSDR values. The locations where the measurements were made are probably not entirely comparable and the ATSDR readings were collected during a severe drought when soil moisture levels were low. Therefore, the differences between ATSDR and NES measurement results are apparently not substantial.

- 3c. ATSDR lists three background exposure rates for the site in Table I, averaging 5.6 $\mu\text{R/hr}$. This is considerably lower than all previously reported background rates that have ranged from approximately 7 to 11 $\mu\text{R/hr}$. A lower background would lead to higher calculated net direct dose values.
- 3d. The ATSDR report states that measurements were made using a sodium iodide scintillation detector coupled to a spectrometer. ATSDR claims that its results agree with results from other surveys, but no comparison data are provided in the report. A table of results and a map showing the locations of the measurements would have allowed for a comparison of their data. A description of the instrument calibration procedure would also have been helpful.
- 3e. Clarification of the description of measurements made on the pile would have been helpful. The report indicates that some measurements were made "at the top of the slag pile and [on] lower portions of the pile." It is not clear whether these measurements were made on the slope or on approximately horizontal surfaces at the top and bottom of the slope.

It is not clear if measurements were made in the middle part of the slope. The absence of measurements from the middle part of the slope suggests that this

region was not readily accessible, which could be of some interest in exposure scenario definition.

4. DOSE ASSESSMENT SCENARIOS AND RESULTS

ATSDR's screening assessment did not consult the extensive body of assessment work that has been performed for this site over the past 5 years. These detailed assessments evaluated the potential public exposures from this site by evaluating potential exposure to the "average member of critical group" which 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.

- 4a. The dose assessments performed as part of the decommissioning process evaluated the potential public exposures from this site by evaluating potential exposure to the "average member of a critical group" which 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, 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 its Toxicological Profile on Ionizing Radiation, ATSDR clearly acknowledges and recognizes that the above entities are the authoritative bodies for public health recommendations and standard development related to ionizing radiation.

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 ATSDR approach to dose assessment can be characterized as a screening approach. Specific uses of the site and site-specific constraints are not considered explicitly. Clearly conservative values for important parameter values, such as the duration of exposure on the slag pile, are simply adopted without explanation. Plausible exposure scenarios, 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 developed. Such a simplistic approach is entirely justified when it can demonstrate that dose limits are met. If it cannot, however, the analysis must be supplemented with more

realistic analysis, or must be considered inconclusive. Even where the screening approach is used successfully, it should be carefully described as such, and the reader should be warned that the approach understates margins between estimated doses and dose limits.

- 4b. ATSDR properly notes the importance of the selection of an appropriate use scenario for dose evaluation at this site. ATSDR properly notes the large variability in exposure rate measurements, the localized nature of the highest measurements, and the possible lack of realism in assuming substantial exposure times to the highest levels.

The area containing the radiological slag occupies only approximately 160 linear feet along an embankment that is approximately 1,000 feet long (see Topographic Plan contained in the Report on Topographic and Radiological Surveys, Reading Slag Pile Slope, STEP, 1999). The physical setting along the top, bottom and slope of the embankment is quite uniform for over 700 feet of the section that contains the slag pile. In any scenario other than residential, there is no reason to expect a person would preferentially walk exclusively on the particular section of the embankment containing the slag pile. Therefore, the correct approach would be to use $\frac{1}{4}$ of a reasonable estimate of occupancy time on the entire embankment as representing the occupancy time on the portion of the slag pile containing radioactive material.

The ATSDR occupancy times of 2,000 hours per year for Scenario 1 and 400 hours for Scenario 2 imply that a person spends 8,000 hours per year (nearly 22 hours per day) on and next to the embankment under Scenario 1 and 1,600 hours per year for scenario 2. Both of these occupancy times are considered unrealistically high, given site characteristics.

It should also be noted that non-radiological slag and debris unrelated to the licensee's activities have been deposited at the American Chain and Cable site for over 100 years. The non-radiological material extends from the buildings to the embankment and comprises a volume of approximately 3,000,000 ft³ (more than 15 times the volume of the radiological slag). This condition severely constrains future use of the site as a whole and the small portion containing radioactive material.

- 4c. To estimate maximum dose, ATSDR developed a scenario (Scenario 1) that assumed exposure on the pile at the maximum measured exposure rate (108 μ R/h) for 1,600 hours per year and exposure in the lower fence area at the maximum exposure rate (54 μ R/h) for 400 hours per year. ATSDR calculated an annual dose of 195 millirem per year for this scenario.

The selection of very conservative assumptions may be useful if properly identified as such, when calculations using such assumptions demonstrate

compliance with applicable limits. However, both the exposure time and the exposure rates are excessively high in this case, even for a maximum dose estimate. ATSDR recognized that this "maximum estimate" does not provide useful information since ATSDR did not use the results for this scenario in judging compliance with any limits or guidelines. It is unclear why it was included.

Reasonable exposure scenario assumptions are especially important for dose estimates intended for comparison to the NRC license termination limit for unrestricted use. That dose limit applies to the average member of the "critical group," i.e., the people that may be exposed due to the residual radioactive material at the site. Since the "average" member is the test, the estimate is intended to be realistic. A scenario in which people occupy the slag pile for many hundreds of hours per year (leaving aside thousands of hours per year at one or the other of only two locations) is inconceivable in this case, given the setting of the material.

- 4d. ATSDR also evaluated what it described as a "more realistic" and "most plausible" scenario, Scenario 2, involving an individual with access to the site. ATSDR assumed exposure "to the average dose rate 1 hour per day on both the pile and at the lower fence for 200 days per year." It is not clearly stated whether this is intended to mean 1 hour per day in each area (400 hours per year total exposure) or 0.5 hour per day in each area (200 hours per year total). This scenario is approximately equivalent to the "trespasser" scenarios evaluated in the Radiological Assessment (RA), although no active barriers to assess were assumed for the RA scenario.

The stated use by ATSDR of the average exposure rate incorporates an implicit assumption of "averaging by walking around." That is, a person whose use of the site involves walking around on it in more or less random fashion would receive an annual dose much more closely related to the average measured exposure rate than the maximum. This kind of use of the site to be the only kind that can be expected realistically. Basing the dose estimate on average exposure is rate realistic.

ATSDR reports an annual dose of 32 millirem per year for this scenario. This estimate appears to have been incorrectly calculated using the maximum exposure rate values, not average values as stated. The correct value (assuming a total of 400 hours per year) is 9.2 mrem/year. Information in Table VI, a comparison of ATSDR findings against various dose guidelines and limits, indicates that ATSDR calculated doses exceed the NRC "guideline" of 25 millirem per year. However, the corrected value for Scenario 2, the only ATSDR scenario remotely approaching NRC provisions for realistic assessment, is below all the limits listed in Table VI.

It is interesting to note that the correct calculated dose of 9.2 mrem/yr for ATSDR's Scenario 2, presented as the more realistic scenario, was essentially equal to the results of the sensitivity scenarios presented in the March 2000 Radiological Assessment, which looked at trespassers and worker exposures under eroded slope conditions. The maximum annual dose predicted from these scenarios ranged between 10 and 11 mrem/year. Like screening analyses, sensitivity analyses are extremely conservative scenarios developed to "bound" dose assessments. They are extremely conservative and implausible for site conditions but remotely conceivable. ATSDR recommendation in the report that more detailed dose assessment be performed using realistic exposure scenario for this site indicates that ATSDR's scenario 2 followed this principle. Again, this recommendation by ATSDR appears to have been made without knowledge of the extensive body dose assessment work that has been performed at this site over the past 5 years.

The corrected ATSDR calculated dose of 9.2 mrem/yr is significantly less than the applicable guidance of 100 mrem/yr. The highest reasonable dose presented in the DA of 4.4 mrem/yr was also significantly less than the applicable standard of 25 mrem/yr for release without restriction. The agreement between the appropriate conclusions drawn from both methods of analysis provides confirmation of each approach for its intended use. It is an important clarification that the ATSDR conclusion that the slag pile posed a threat was based on comparison to a guidance that was not appropriate for the method of analysis used.

- 4e. ATSDR also included a probabilistic assessment composed of many simulation cycles, each of which assumed exposure for a selected number of hours per year at a selected exposure rate on the slope and exposure for a selected number of hours per year at a selected exposure rate in the lower fence area. For any given simulation cycle, the exposure rate for the pile and the exposure rate for the lower fence area were probabilistically selected from the two distributions of exposure rate measurements and the exposure time for the pile and the exposure time for the lower fence area were probabilistically selected from the assumed occupation time distributions for those areas. The means of the occupation time distributions were 1,600 hours per year for exposure on the slag pile and 400 hours per year for the lower fence area.³ These mean exposure time values were equivalent to the exposure times for Scenario 1. The ranges of the occupation time distributions were 200-2400 hours per year for the pile and 100-800 hours per year for the lower fence area.

The mean of the doses calculated in all of the simulation cycles was 64 millirem per year. This result is quite close to the dose that can be calculated

³ These time values are derived from average hours per day from Table III and an exposure of 200 days per year, as noted in the note to Table IV. For clarity, that note should appear beneath Table III.

deterministically using mean exposure times and mean exposure rates, 60 millirem per year.⁴ Percentile rankings for estimated doses were also calculated and tabulated, and demonstrate that the calculated dose distribution, while broad, falls nearly entirely below 100 millirem per year. As noted previously, it is not clear whether ATSDR used the values listed in Table II which are not corrected for background as stated or the corrected values for their Monte Carlo simulation. Therefore, all the reported Monte Carlo results may have overestimated the dose.

Probabilistic dose evaluations are acceptable under NRC guidance for license termination (NUREG-1727) and are appropriate for evaluating this site if properly applied. By that guidance, the mean dose from the simulation cycles would be compared against the license termination dose limit. However, the distributions of occupation times assumed by ATSDR are far too high to be considered realistic for estimating dose for license termination purposes. Simulation cycles with the upper time limits correspond to exposure of 4,000 hours per year, about half-time. As stated above, it is not plausible that, after license termination, people will occupy the slag pile for many hundreds of hours per year (leaving aside thousands of hours per year at one or the other of only two locations).

ATSDR's assumptions in this scenario clearly overestimate the potential dose to the average member of the critical group at the site. Nevertheless, Table VI shows that the mean doses calculated by ATSDR do not exceed ATSDR, EPA, or NRC limits characterized by ATSDR as "health limits," all of which are listed as 100 millirem per year.

5. ATSDR CONCLUSIONS AND RECOMMENDATIONS

- 5a. ATSDR correctly concludes that gamma radiation exposure rates associated with the site are not at a level of public health concern despite the issues presented in the above section. Their conclusion is supported by the site data and conservative analyses.
- 5b. The ATSDR conclusion that contamination in the soils is a public health concern is not correct and is not supported by the site data and detailed analyses or by ATSDR's data and analyses (as corrected). ATSDR correctly identifies evidence of elevated concentrations of radionuclides in surface soils on the slag pile. ATSDR also correctly points out that the NRC limit for the concentration of thorium in air is low. However, because ATSDR does not assess potential airborne concentrations or doses from inhalation, ATSDR has no basis for reaching its conclusion.

⁴ ATSDR also analyzed a variant of this scenario in which exposure rates greater than 30 μ R/h were not used. The mean of the resulting dose distribution was 36 millirem per year. It is not clear if the dose rate measurements used were corrected for background.

The Radiological Assessment does include the inhalation pathway in its dose assessment scenarios, one of which includes excavation. Those analyses found that inhalation dose is small in comparison to ground dose. That finding is independent of exposure time and average concentration of radioactive material in soil, even when concentration averaging is limited to a radius of a few meters or so. Given that ATSDR has found that gamma radiation levels are not at a level of public health concern, one can conclude that potential concentrations of thorium in air are also not at a level of public health concern.

- 5c. The ATSDR states that the ATSDR Minimum Risk Level (MRL) of 100 millirem per year would be exceeded only if a member of the public using the site were to "1) locate the most radioactive area of the pile and 2) stay in that exact location for an entire year to approach the MRL." This conclusion conflicts with the results for Scenario 1, 195 millirem per year from 2,000 hours per year exposure at maximum exposure rates. Nevertheless, the exposure time that would be required to exceed the ATSDR MRL would be far higher that could be reasonably expected for the average member of the critical group, given the setting of the radioactive material.
- 5d. ATSDR recommends a more detailed dose assessment be performed. Based on the body of the report and its list of references, it is apparent that the ATSDR did not review the detailed dose assessment work performed by Cabot and described in the RA. The ATSDR report also does not reflect awareness of NRC work on this effort as well as described in its June 20 2002 response to the May 2, 2002 PADEP letter mentioned on page 3 of the ATSDR report. Since such a detailed assessment has already been performed, there is no reason to take further action on this ATSDR recommendation apparently unaware of the extensive body of dose assessment work that has been done over the past several years. Both Cabot and the NRC staff have performed such assessment as an essential and routine part of the NRC license termination process.⁵
- 5e. ATSDR also recommends further characterization of the slag pile, but provides no basis for its recommendation. The ATSDR concern appears to be derived primarily from similar concerns expressed in the May 2, 2002 letter from PADEP to the NRC. The PADEP letter was mentioned on page 3 of the ATSDR report and cited in the reference list.⁶ The PADEP concerns in turn, appear to arise from an uncritical acceptance by PADEP of erroneous information in an internal NRC draft report prepared for the NRC by a researcher at the John Hopkins University. Cabot is separately providing to the NRC additional documentation related to quantification of radioactive material in the slag pile, which confirms the results

⁵ The ATSDR report reflects no ATSDR awareness of Cabot work on this effort, described in reports cited above, or NRC work on this effort, described in its June 20, 2002 response to the May 2, 2002 PADEP letter mentioned on page 3 of the ATSDR report.

⁶ (Letter dated May 2, 2002 from David J. Allard, Director, Bureau of Radiation Protection, Pennsylvania Department of Environmental Protection to Larry Camper, US Nuclear Regulatory Commission).

of the site characterization and otherwise seeks to correct the record. This separate submittal shows that no further site characterization is necessary.

- 5f. ATSDR also recommends that a public meeting be held in the City of Reading to educate the public to the hazards and risks associated with radiation exposure. While public education is always desirable, the RA and site characterization show that potential for exposure to radioactive materials at the Reading slag pile site does not present a significant risk to the public. It is anticipated that the NRC license will be terminated and the site released for unrestricted use. Such release can only be based on an NRC conclusion that the dose limit, 25 millirem per year, will not be exceeded by the critical group in the public. That limit is a very protective of public health (a factor of four below the ATSDR Minimum Risk Level). Consequently, whatever the merits of this ATSDR recommendation, it should not be tied to decommissioning this site.