ENVIRONMENTAL ASSESSMENT OF SITE DECOMMISSIONING PLAN FOR THE CABOT READING SLAG PILE SITE IN READING, PENNSYLVANIA
[DOCKET No. 40-9027]

1.0 Introduction

1.1 Background

The U.S. Nuclear Regulatory Commission (NRC) approved the possession of slag (i.e. ore smelting residues) at the Reading, Pennsylvania, location under NRC Source Material License SMC-1562 held by Cabot Corporation (Cabot). Slag materials from metal processing activities performed in the late 1960s were deposited on a preexisting slag pile. The process used tantalum in low-grade ores by heating a mixture of iron ore, tantalum ore, and coke in an electric arc furnace. The ores contained naturally occurring uranium and thorium in concentrations defined as "source material" by the NRC. The agency regulated the possession and handling of these materials under an NRC license. The tantalum alloyed with the iron, leaving slag residues in which the naturally occurring thorium and uranium remained. The slag residues from processing operations were placed on a preexisting nonradiological slag disposal area on an embankment at the southern end of the property. In 1976, the site received sand mixed with tin slag (which was the tantalum production source material for Reading operations) from cleanup of the Canton Yards in Baltimore. In 1977–1978, the site received debris from the decontamination of facilities owned by one of Cabot's predecessors (Kawecki Berylco Industries) in Baltimore. The total volume of industrial debris, radiological slag, nonradiological slag, and cover soil is estimated to be 5,000 cubic meters (m^3) (180,000 cubic feet (ft^3)).

In late 1995, Cabot initiated a comprehensive site characterization at the Reading slag pile site. The radiological survey included a site characterization, determination of slag leach rates, surface gamma measurements, radiological analysis of surface and subsurface samples, determination of the weathering rate of the slag, and analysis of the slag pile stability. Radiological slag was identified at two topographically distinct areas - on an embankment (slag pile area) and within the River Road right-of-way (ROW).

Since 1998, Cabot has been engaged in developing an acceptable decommissioning plan (DP) for the Cabot Reading site seeking unrestricted release of the site under Subpart E, "Radiological Criteria for License Termination," of Title 10, Part 20, "Standards for Protection Against Radiation," of the *Code of Federal Regulations* (10 CFR Part 20). On March 21, 2003, NRC staff requested additional information from Cabot in three areas. Cabot responded to the request with Revision 3 of its proposed DP and radiological assessment (RA) on June 14, 2005. This revision incorporated the addition of an erosion barrier on the site. The proposed erosion barrier will be utilized to mitigate the potential for future erosion at the site, and was not considered as shielding in Cabot's dose analysis. After further discussions with NRC staff, Cabot issued Revision 4 to its proposed DP and RA on August 21, 2006. Revision 4 also includes a erosion barrier on the slag slope, with more design analysis.

The NRC staff prepared this environmental assessment (EA) in evaluation of Cabot's August 2006 DP and RA submission. Approval of this plan and supporting documents would result in a revision to the license to authorize the licensee to commence decommissioning activities as

described in the DP. The primary decommissioning activity is devegetating the slope and placement of a riprap cover to control erosion. Upon successful completion of decommissioning activities, Cabot's license, SMC-1562, would be eligible for termination.

1.2 The Proposed Action

Cabot requested approval of its DP, which would allow it to conduct decommissioning activities at the site and to subsequently terminate its source materials license for the Reading slag pile site in Reading, Pennsylvania. In its DP, Cabot proposed to place a riprap erosion cover on the slope and provided analysis to demonstrate that the site will be acceptable for license termination under unrestricted release. Based on this EA, the NRC finds, for the reasons discussed below, that there are no significant environmental impacts from the proposed action.

1.3 Purpose and Need for the Proposed Action

The purpose of this action is to decommission an NRC-licensed site and terminate the source material license, where source material is no longer used, for unrestricted release. This action is required by 10 CFR 40.42, "Expiration and Termination of Licenses and Decommissioning of Sites and Separate Buildings or Outdoor Areas."

2.0 Facility Description/Operating History

2.1 Site Locale and Physical Description

The Cabot site is located in Reading, Berks County, Pennsylvania, east of the Schuylkill River. Between the slag pile area and the Schuylkill River, there are an undeveloped extension of the River Road ROW, a Norfolk Southern (Norfolk) railroad ROW, and remnants of the former Schuylkill Canal. Another Norfolk Southern ROW is located approximately 46 meters (150 feet) northwest of the slag pile. Buttonwood Street is located approximately 183 meters (600 feet) to the southeast of the pile. Slag materials from metal processing activities performed in the late 1960s were deposited on the preexisting slag pile. Topographical survey information was used to estimate the dimension of the radiological slag at the site. The cross-sectional area is approximately 103 square meters (m^2) (1125 square feet (ft^2)). The estimated volume of the slag pile and the slag in the River Road ROW is approximately 5007 m^3 (180,000 ft^3). The top of the slag pile is a level area that is approximately 49 meters (160 feet) long and extends back a maximum of 5 meters (15 feet) from the top edge of the slag pile. The slag pile stability was evaluated using standard geotechnical engineering practices. Based on the model results and observations that the slope has been stable for approximately 30 years since the material was placed, licensee consulted experts have concluded that the slope is stable. Its elevation is approximately that of a much larger contiguous level area upon which industrial facilities were formerly located.

2.2 Facility Operating History

In October 1967, Kawecki Chemical Company, a predecessor to Cabot, obtained Source Material License SMC-1562 from the U.S. Atomic Energy Commission (predecessor of the NRC), which allowed the company to process tin slag containing trace amounts of natural

uranium and thorium at their Reading location. The process was designed to increase the percentage of tantalum in low-grade ores by heating a mixture of iron ore, tantalum ore, and coke in an electric arc furnace. The tantalum alloyed with the iron, leaving a slag in which the naturally occurring thorium and uranium remained. The slag residues from processing operations were placed on a preexisting nonradiological slag disposal area on an embankment at the southern end of the property.

Currently, no licensed materials are used at the industrial property, which constitutes the site. Other than the slag pile area and the River Road ROW area, all areas where licensed material was handled have been decontaminated and released under the Site Decommissioning Management Plan cleanup criteria for unrestricted use. Because the licensee does not own the property, the staff has defined the area encompassing the radiological slag as the "site" for the purposes of discussion in this EA.

Currently, Cabot holds Source Material License SMC-1562 allowing the company to possess the slag material produced by Kawecki Chemical Company in the early 1960s.

3.0 Affected Environment

The site is a 2/3-acre slope embankment, comprised of industrial debris and a soil cover. Industrial slags have been placed on this site since approximately 1904. The overall slope is about 30 degrees, but some portions are as steep as 40 to 45 degrees. The nonradiological slag starts about 6 meters (20 feet) below the surface at the top of the embankment and extends to about 12 meters (40 feet). The total volume of industrial debris, radiological slag, nonradiological slag, and cover soil is estimated to be 5000 m^3 (180,000 ft^3).

The ground water in the vicinity of the site is not used for drinking water or industrial process water. The Reading-area public water supply is Lake Ontelaunee, a tributary to the Schuylkill River. Based on ground water sampling in 1998 and 1999, as well as periodic monitoring, radionuclide concentrations from leachates are below Environmental Protection Agency (EPA) drinking water standards. The uranium and thorium in the slag are bound in perovskite, calzartite, and pyrochlore mineral phases. Perovskite and calzartite are in the group of phases that make up Synroc, a manmade material formulated to encapsulate nuclear waste components for long-term isolation with minimal leaching potential. The structure of pyrochlore, while not a Synroc phase, also leads to low leachability of radionuclides. Independent leach testing of the Reading slag confirmed this low-leaching behavior, which indicates that potential contaminants are bound in either very insoluble or refractory mineral phases. Nonradiological contaminants have not been identified in the Cabot slag. The August 21, 2006, RA summarizes the results of Cabot's leach testing, which Cabot provided in a letter to the NRC dated September 12, 1996, and the NRC approved in letter to Cabot dated October 25, 1996. NUREG/CR-6632, "Solubility and Leaching of Radionuclides in Site Decommissioning Management Plan Slags," issued February 2002, and NUREG-1703, "Characterization of Radioactive Slags," issued October 2004, contain additional information on characterization, leaching, and solubility of NRC licensee slags in Pennsylvania.

3.1 Radiological Status of Uranium/Thorium Contaminated Slag

Cabot determined the radionuclides of interest for the dose assessment using operational history and the site characterization data. The radionuclides considered are naturally occurring uranium (U-238, U-234, and U-235), naturally occurring thorium (Th-232 and Th-228), and their radioactive progeny. The radioactive materials at concentrations distinguishable from background concentrations are primarily confined to slag from the processing of ores with small concentrations of naturally occurring uranium, thorium, and progeny nuclides. The slag, which retained the radioactive constituents, was deposited on the slag pile. The average measured thorium concentration in undiluted slag 0.31 weight percent and derived average uranium concentration of 0.13 weight percent.

3.2 Radiological Status of Soils

Based on the site characterization data (NES, April 1996) and visual observations, Cabot reports that the surface soils consist of mixed fill materials (i.e., primarily nonradiological slag mixed with construction debris, a small volume of radiological slag, and soil). The average net activity concentration in the slag/soil/debris mix is approximately 75 picocuries per gram (pCi/g) of combined thorium (Th-232 and Th-228) and uranium (U-238 and U-234). This estimate is based on the average measured concentration from the surface to a depth of 5 meters (16 feet). Average net uranium and thorium concentrations in soil near the surface (to a depth of 0.6 meter (2 feet) or less) are somewhat lower. The average net activity concentration in surface soil samples in the slope face is approximately 25 pCi/g total combined thorium and uranium, of which approximately 5 pCi/g is U-238 and 7.5 pCi/g is Th-232. These estimates are based on the results of surface soil measurements.

3.3 Radiological Status of Surface Water and Ground Water

Cabot's basis for excluding the ground water pathway includes the fact that (1) measured radionuclide concentrations in leachate from the slag are below drinking water standards, (2) the subsequent leachate will represent a small fraction of a water supply well, and (3) there is insufficient yield down gradient of the slag to support a well.

4.0 Proposed Action

The proposed action would add an erosion barrier to the slope and establish the site for unrestricted release. The slope would be cleared, covered with a durable riprap on a gravel filter bed. The rock size and thickness of the cover will vary over the sloped area. The thickness will vary from 1 to 4.5 feet thick and be made from rock varying from 6 inches to 18 inches in diameter. Placement of the riprap will begin at the bottom of the slope and work upwards. Hydraulic excavators will perform the initial placement. Above that, a small crane with clamshell bucket will be used to about halfway up the slope. The crane will relocate to the top of the slope, until placement again reaches the range of hydraulic excavators. The riprap will be placed by hand. The rocks will come from Dyer Quarry, located approximately 7 miles southeast of the site. In total, the licensee estimates that about 3,675 cubic yards of rock, weighing almost 6,000 tons, will be placed on the site. This is roughly estimated to be about 200 truck loads of riprap rock.

The downhill side of the slope is a wide railroad easement, which was at one time wide enough for multiple parallel rail lines. The current rail line is a single spur used occasionally for siding. The uphill side of the slope is unused open land, awaiting redevelopment by the City of Reading.

4.1 Alternative 1: No Action

The no-action alternative would not modify NRC Source Material License SMC-1562, and the contaminated slag pile on the site would remain as it currently is. Cabot would remain under NRC license as a complex site. Failure to pursue decommissioning of the site would not be consistent with 10 CFR 40.42. The purpose of the Decommissioning Timeliness Rule is to reduce the potential risk to the public and environment that may result from delayed decommissioning of inactive facilities and sites. Specific concerns addressed by the Decommissioning Timeliness Rule include the potential risk of safety practices becoming lax because of the attrition of key personnel and the lack of management interest at facilities after operations cease, as well as the potential for bankruptcy, corporate takeover, or other unforeseen changes in a company's financial status that may complicate or delay decommissioning.

The no-action alternative would also be counter to established NRC environmental regulations, policy, and practice. Therefore, this alternative is not reasonable, and therefore this EA does not address it further.

4.2 Alternative 2: Further Remediation of the Site

The licensee examined the possibility of conducting further remediation of the Site. However, after conducting a cost-benefit analysis, the licensee concluded that the cost of the proposed remediation exceeds the value of the dose expected to be saved, that the as-low-as-reasonably-achievable (ALARA) condition has been met, and that no further dose reduction is necessary.

NRC staff performed an independent ALARA analysis and concluded that shipping contaminated soil, slag and debris to a low-level waste burial facility is unlikely to be cost effective for this site which is undergoing unrestricted release, largely because of the high costs of waste disposal. Therefore, further evaluation is unnecessary, and this EA does not address this alternative further.

4.3 Alternative 3: No Erosion Barrier

The licensee initially proposed this option in previous versions of its DP. However, in response to NRC staff questions about uncertainties in the dose modeling analysis because of the possible effects of erosion on the embankment, Cabot added an erosion barrier to its plans.

5.0 Radiation Protection Program

During installation of the riprap cover, Cabot will control and monitor radiation exposures to workers and the public by exercising project managerial control and by establishing a radiation

protection program. While the program will be site specific, it will draw upon resources from the radiation safety program at Cabot's nearby facility in Boyertown, Pennsylvania. Chapter 6 of Addendum 1 to the DP describes the Reading site radiation safety program.

6.0 Evaluation of Proposed Action's Environmental Impacts

6.1 Licensee's Proposed Action

6.1.1 Radiological Impacts to Workers and the Public

Cabot developed 12 separate land use scenarios for the slag pile area and the River Road ROW. It analyzed three scenarios for the slag pile and two scenarios for the River Road ROW. In addition, Cabot developed seven alternate scenarios that it considered less likely to occur but still plausible.

The property containing the slag pile site has been used for industrial purposes for at least 100 years. As part of its process for urban redevelopment, The City of Reading Redevelopment Authority has also designated the site for industrial and commercial use. Cabot explained that the location, size, and physical arrangement of the slag material and its setting on an industrial property preclude resident and resident-farmer exposure scenarios. Therefore, Cabot developed and evaluated the following three compliance scenarios for the slag pile area:

- a worker placing riprap on the slope (WRR-P)
- a trespasser on riprap after license termination (TRR)
- a worker on top of the slope and on riprap after license termination (WRR)

For the first scenario, the worker would be placing riprap on the slope, which would also include clearing of the area. The worker is assumed to work full time on the slope for the duration of the job, which is 1 month. This results in an occupation time of 160 hours per year (h/yr). For the second scenario, Cabot assumed that a trespasser walks on the slope covered with riprap 3 hours per week, 6 months per year. The third scenario assumes that a worker spends part of his work day in a facility located on the flat surface at the top of the slag pile and a portion of his work time in activities involving walking on the slope of the slag pile. The worker is assumed to spend 200 h/yr (10 percent of his total annual work time) on the site in the area where radioactive materials of interest are located. Of these 200 hours, Cabot assumed that the worker spends 20 h/yr on the slope and 180 h/yr in a small structure on top of the pile.

To evaluate the sensitivity of the scenarios, Cabot developed and evaluated three groups of alternate scenarios, which it considered less likely to occur but still plausible. The first set of alternate scenarios represents a worker and a trespasser, in the absence of the riprap cover. This set, which is intended to assess the dose in the event of erosion from the riprap cover, includes the following:

- a trespasser on the slope in its current condition (TC)
- a worker on the slope in its current condition (WC)

The second set relates to limited excavation into the riprap covered slag pile. This set consists of the following:

- a worker conducting limited excavation (e.g., laying pipe or cable) on the riprap-covered slope (WRR-LE)

- a trespasser on the covered slope after limited excavation (TRR-ALE)

- a worker on top of the covered slope after limited excavation (WRR-ALE)

The third set of alternate scenarios relates to major excavation in which the entire area containing the slag is excavated and relocated to an unspecified and uncontrolled surface location. This set of scenarios includes the following:

- a worker conducting major excavation (W-ME)

- a worker on debris material that was removed to another surface location following major excavation (W-AME)

Cabot developed two types of exposure scenarios for the purposes of analyzing the River Road ROW area. Cabot considered the following scenarios sufficiently realistic to be compliance scenarios:

- a person who walks along the ROW (RWWLK)
- a worker on the ROW during excavation (RWWRK)

The walker is assumed to be exposed to radiation from slag radionuclides in soils along the ROW during walks (5 minutes per day, 200 days per year). The second scenario is for a worker exposed 40 h/yr along the ROW during the excavation of soils bearing concentrations of slag radionuclides.

For each of these scenarios (compliance and alternate scenarios), Cabot included in its assessment the pathways of direct exposure to external radiation from contaminated media, inhalation of airborne radionuclides, and ingestion of contaminated soil.

The slag pile has an estimated overall slope that ranges from 30 to 45 degrees; therefore, very limited activity is expected to occur on the side slope of the pile. However, a structure could be built on the adjacent property because the area adjacent to the slag pile is level and much larger. Therefore, the scenarios involving a worker are warranted. The critical group, scenario, and exposure pathways used in the assessment are considered to be appropriate given the configuration of the contaminated area along with the planned uses for the site. NRC staff found Cabot's dose scenarios to be acceptable.

Cabot's basis for excluding the ground water pathway includes the fact that (1) measured radionuclide concentrations in leachate from the slag are below drinking water standards, (2) the subsequent leachate will represent a small fraction of a water supply well, and (3) there is insufficient yield down gradient of the slag to support a well. Consistent with guidance in

NUREG-1757, the NRC staff finds excluding the ground water pathway to be acceptable based on the insufficient well yield.

Cabot analyzed annual doses at 0, 1, and 10 years after license termination. The analysis used the peak calculated annual dose to compare against NRC criteria for unrestricted use. The peak dose was calculated to occur at year zero. Dose modeling calculations were run for each scenario to determine the maximum dose to the average member of the critical group. Tables 1 and 2 provide the results of Cabot's analysis for each of the 12 scenarios. The maximum dose calculated for the five compliance scenarios is 0.037 millisievert per year (mSv/yr (3.7 millirem per year (mrem/yr)), which results from the worker placing riprap (WRR-P). For the seven alternate scenarios, the maximum dose is 0.048 mSv/yr (4.8 mrem/yr), which results from a worker conducting limited excavation (WRR-LE).

Table 1 Licensee's Dose for Compliance Scenarios

Scenario	Dose* (mrem/yr)
WRR-P	3.7
TRR	0.02
WRR	0.78
RWWLK	0.33
RWWRK	0.93

*To convert mrem/yr to mSv/yr, multiply by 0.01

Table 2 Licensee's Dose for Alternate Scenarios

Scenario	Dose* (mrem/yr)
TC	1.4
WC	1.2
WRR-LE	4.8
TRR-ALE	1.6
WRR-ALE	1.2
W-ME	0.92
W-AME	2.4

*To convert mrem/yr to mSv/yr, multiply by 0.01

The NRC staff recognized that there was uncertainty in Cabot's input values for the source concentration and outdoor exposure time for certain scenarios. Because dose is expected to

be most sensitive to the source concentration and outdoor exposure time parameters, the staff focused its review on these parameters.

The NRC staff analyzed Cabot's source term estimate and determined that the total thorium at the site could be five times the Cabot estimate of 2.19 tons. The uncertainty in the source term is expected to have the largest effect for the scenarios that relate to major excavation. Therefore, for the W-ME and W-AME scenarios, the NRC staff ran the RESRAD code with a source concentration of 1,165 becquerels per kilogram (Bq/kg) (31.5 pCi/g) (i.e., five times 233 Bq/kg (6.3 pCi/g)).

As discussed below, NRC staff's assessment of the W-ME scenario resulted in a dose of 0.24 mSv/yr (24 mrem/yr) to a hypothetical site worker, which is below the 0.25 mSv/yr (25 mrem/yr) dose limit of 10 CFR 20 Subpart E.

The NRC staff evaluated Cabot's erosion cover design and determined that the erosion protection design is adequate to provide reasonable assurance of protection for 1000 years against erosion and flooding.

In addition, the staff found that there was uncertainty in Cabot's input values for exposure time. The staff focused its review on the W-ME, W-AME, and WRR-LE scenarios because these scenarios showed a higher level of sensitivity to the exposure time parameter. To support its exposure time value for the W-ME scenario, Cabot compared its value of 160 h/yr to the Means construction and cost data value of 855 man-hours (see references). Cabot explained that a time of 855 man-hours would require an impractically long excavation period of 5.3 months. Cabot found that an excavation timeframe of 1 month could be achieved with multiple shifts or multiple crew members per day. However, there is no certainty that this type of excavation would span only 1 month, and Cabot provided no basis for assuming this 1-month timeframe. Therefore, the NRC staff used an exposure time of 855 h/yr for its independent analysis.

The Means construction data for the W-AME scenario indicated a time value of 356 man-hours for unloading and placement activities and 889 man-hours for spreading the load. The NRC staff determined that a timeframe of 800 hours would provide a more conservative value. The assumption of 800 hours involves one worker for unloading and placement and the same worker conducting half of the load spreading activities (i.e., 356 h + 1/2 (889 h) = 800 h). The staff did not analyze this scenario at 800 hours because its independent review of the W-ME scenario should bound the W-AME scenario.

Cabot used a value of 10 h/yr for the WRR-LE scenario. Although this value is slightly lower than the Means construction data value of 11.5 hours, the staff's analysis showed that this scenario would require an exposure time of more than 50 h/yr to exceed the 0.25 mSv/yr (25 mrem/yr) dose limit of 10 CFR 20 Subpart E .

Cabot did not provide a basis for the selection of a 20-h/yr exposure time for the WRR scenario. However, the staff's independent analysis of the W-ME scenario provides an exposure time of 855 h/yr and a source concentration of 1170 Bq/kg (31.5 pCi/g), which results in a bounding scenario for each of the licensee's scenarios, with the exception of the WRR-LE scenario. Thus, the worker scenario in during a major excavation bounds the pubic exposure scenarios,

and all other worker scenarios, except for a worker in limited excavation (WRR-LE), which is considered separately above. Therefore, the staff's analysis of the W-ME scenario also addresses the uncertainty of the occupation time for the WRR scenario provided by Cabot. The staff's assessment of the W-ME scenario resulted in a dose of 0.24 mSv/yr (24 mrem/yr), which is below the 0.25 mSv/yr (25 mrem/yr) dose limit of 10 CFR 20 Subpart E, and bounds Cabot's dose analysis for doses to the public. The licensee's three compliance scenarios doses to the general public were less than 0.01mSv/yr (1 mrem/yr), and the two alternate scenarios doses were less than 0.02 mSv/yr (2 mrem/yr).

6.1.2 Nonradiological Environmental Impacts

Cabot did not identify any water sources other than the Schuylkill River in the immediate vicinity of the site. As would be expected for granular fill material, the surface of the site and adjacent areas appear well drained. The Norfolk ROW and the River Road ROW are within the flood plain of the Schuylkill River. The majority of the slag pile, which ranges in elevation from approximately elevation 210 feet mean sea level (MSL) to 260 feet MSL, is above the 100-year and the maximum reported flood level.

Berks County has a temperate, humid, and maritime climate. The average annual precipitation is approximately 40 inches. Bedrock beneath the site is mapped as Richland Formation, which is from the Cambrian Period. Between the base of the embankment and the Schuylkill River, the geology is mapped as Quaternary-age alluvium. The ground water down gradient from the slag is restricted to a shallow, thin (no more than several feet thick), and short (80 feet to 200 feet long) flow zone between the slag and the river. The zone has insufficient yields to support even a marginal domestic or industrial supply well.

The ground water is not expected to be contaminated because the leach rate of the slag is so low. To confirm this conclusion, ground water samples were collected on two occasions from a well installed in the River Road ROW directly down gradient from the slope and within the ROW area. The results of that sampling and analysis indicate that the ground water quality meets the National Primary Drinking Water Standards for radionuclides.

No endangered animal or plant species have been identified on the site. Clearing the site would likely include removal of other rubbish and debris currently present on the embankment, generally improving the overall condition of the area.

The truck shipments of riprap rock from the Dyer Quarry and the use of hydraulic excavators and cranes to move rock onto the slope will impact the local area during the installation of the erosion barrier. However, given the current state of disuse and the distance from the nearest neighbor, the impacts are expected to be minimal. The truck shipments will occur over several weeks, since the rock must be placed by hand. Therefore, impacts to local traffic should be small and of limited duration.

6.1.3 Cumulative Impacts

The site has been used for industrial purposes for more than 100 years. The site is part of a much larger embankment of nonradiological slag, which is not uncommon in the State of

Pennsylvania. The addition of a cover of long-lasting natural rock on top of the slag would serve to slightly reduce any nonradiological impacts from that portion of the slag embankment.

The expected future use of this site is two-fold, based on the City of Reading's (the current property owner's) development plans. The sloped portion of the site would be left undisturbed, as the maintenance of the slope maximizes the size and utility of commercially usable space at the top of the slope. The city currently plans to extend River Road through the ROW to allow access to adjacent lands for other commercial development projects already underway.

Therefore, there are no foreseeable cumulative impacts due to past, present, or reasonably foreseeable future actions from the proposed action.

6.2 Alternative 3: No Erosion Barrier

The licensee previously considered this option but dropped it after the NRC staff asked Cabot to provide more analysis of the dose impacts that could result. Radiologically, the NRC staff considers it likely that doses would increase somewhat if erosion were not prevented. Nonradiological impacts would be somewhat more mixed. Trees and scrub brush would be allowed to remain on site. However, so would other existing debris. Furthermore, clearing and additional development of the area will likely end trash dumping, which has occurred in the recent past. Cumulative impacts would be similar to the proposed alternative, except no potential mitigation of nonradiological impacts from slag and debris would occur because of an erosion barrier.

7.0 Agencies and Individuals Consulted

7.1 U.S. Fish and Wildlife Service

The NRC contacted the U.S. Fish and Wildlife Service to determine the potential impacts of the proposed action on threatened and endangered species near the Site. By letter dated February 27, 2006 (ADAMS Accession No. ML060730519), the U.S. Fish and Wildlife Service informed the NRC that the proposed action would have no impact on threatened and endangered species.

7.2 Pennsylvania State Historic Preservation Officer

In a March 6, 2007, letter (ADAMS Accession No. ML070430115), the NRC contacted the State Historical Preservation Officer (SHPO) to confirm the NRC staff's preliminary conclusion that the proposed action would have no effects on historic properties. In an April 10, 2007, letter (ADAMS Accession No. ML071240260), the SHPO indicated that while there is a high probability of prehistoric and historic archaeological resources in the project area, the proposed action should have no effect on such resources. The SHPO further requested the NRC to contact the SHPO if any historic or archaeological properties are identified on the project site.

The NRC staff subsequently identified a building ruin in the project area that could be considered an historic property. On June 6, 2007, the NRC staff provided the SHPO a detailed analysis of the building ruin, including recent photos, and map overlays using excerpts from

1933 fire insurance maps, site plots, and georeferenced digital orthographic photographs and City Redevelopment Authority drawings. The overlays indicated the building ruin to be a 1933-era concrete block building used for storage, with no significant historic value. By letter of July 25, 2007 (ADAMS Accession No. ML072220371), the SHPO concurred with the findings of the NRC staff.

7.3 Pennsylvania Department of Environmental Protection

On March 28, 2007, the NRC staff provided the Pennsylvania Department of Environmental Protection (PADEP) a draft copy of this EA for comment (ADAMS Accession No. ML070880408). On April 24, 2007, PADEP provided 21 comments reiterating its concerns regarding the site, but did not comment directly on any of the draft EA text responded (ADAMS Accession No. ML071240261). Addendum 1 to this EA contains the PADEP comments, and the NRC's responses to them.

8.0 Conclusion

As discussed above, the NRC finds that there are no significant environmental impacts from the proposed action.

9.0 REFERENCES

Means, *Heavy Construction Cost Data,* R.S. Means Co. 20th Annual Edition, 2006.

NES Inc., "Characterization Report for the Reading Slag Pile," Cabot Corporation, Boyertown, Pennsylvania, April 1996.

NRC, "Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for License Termination of NRC-Licensed Nuclear Facilities," U.S. Nuclear Regulatory Commission, Washington, DC*,* NUREG-1496, July 1997.

NRC, "Probabilistic Modules for the RESRAD and RESRAD-BUILD Computer Codes-User Guide," U.S. Nuclear Regulatory Commission, Washington, DC*,* NUREG/CR-6692, November 2000.

NRC, "Probabilistic Dose Analysis Using Parameter Distributions Developed for RESRAD and RESRAD-BUILD Codes," U.S. Nuclear Regulatory Commission, Washington, DC*,* NUREG/CR-6676, July 2000.

NRC, "Disposal or On-Site Storage of Residual Thorium or Uranium from Past Operations," U.S. Nuclear Regulatory Commission, Washington, DC, SECY-81-576, October 1981.

NRC, "Radiological Criteria for License Termination; Final Rule," U.S. Nuclear Regulatory Commission, Washington, DC, July 1997, 10 CFR 20 Subpart E.

ST Environmental Professionals (STEP), "Radiological Assessment for Reading Slag Pile Site—Revision 4," Cabot Corporation, Boyertown, Pennsylvania, August 2006.

STEP, "Decommissioning Plan for Reading Slag Pile Site—Revision 4," Cabot Corporation, Boyertown, Pennsylvania, August 2006.

STEP, "Addendum 1 to Decommissioning Plan for Reading Slag Pile Site, Revision 4," Cabot Corporation, Boyertown, Pennsylvania, August 2006.

Addendum 1

PADEP Previously Documented Concerns and NRC Staff Responses

Source Term Used by Cabot To Assess Doses May Be Underestimated:

PADEP Comment 1.: Bases for the two largest and most significant values for "Total Th tons" listed in Table 2 [of Cabot Corporation Comment Report on the Johns Hopkins Draft Progress Report and Related Issues, dated November 21, 2002] are based on employee recollections (i.e., a handwritten note, and a 1979 letter from consultant—AHP) rather than data from formal reports or actual samples.

PADEP Comment 5.: Calculating the quantity of Thorium in the slag pile resulting from disposal of the sand and Sn slag using the conservative value of 0.7% (i.e., assuming no dilution) yields a quantity of 7.28 tons vs. the 0.104 tons reported in Table 2. If the dilution value is presumed correct, the quantity would be 0.36 tons.

PADEP Comment 10.: Cabot references the photo of slag being dumped onto the slope in [Page 7 of Cabot Corporation Comment Report on the Johns Hopkins Draft Progress Report and Related Issues], apparently for the purpose of estimating the ultimate thickness (and hence volume) of the slag layer. This photo first appeared as Figure 6 of AHP report #1 dated May 1967. This report is an attachment to the October 1967 application for license renewal that indicated that full operation had not yet been achieved at that time. It is reasonable to assume that a great deal of additional slag would be produced and deposited during full operation and therefore the slag layer would be a great deal thicker than may be indicated in the photo.

PADEP Comment 11.: Despite the information and uncertainties presented above, Cabot claims in Table 2 that only 2.19 tons of Thorium were disposed of at the Reading site.

NRC Staff Response:

The data uncertainties referenced in the above PADEP comments are among the reasons why the NRC staff performed an independent dose analysis. In doing so, the NRC staff used a larger source term than Cabot did in its dose analysis. The NRC's bounding dose modeling source term conservatively assumed 9 tons of licensed material, thus using a source term of five times the licensee's estimate (as referenced in Section 6 of the EA). As explained further below, the NRC staff dose modeling source term calculation assumes that all of the tin slag not on the export ship manifests is located at the Reading slag dump, to account for any tin slag not accounted for in export ship manifests.

The two largest contributors to the table are the waste slag, and the tin slag and sand mix from decontamination of the railroad storage area in Baltimore, Maryland.

References to the waste slag content appear in several documents, including the May 3, 1979, report from Applied Health Physics (AHP), which served as the licensee's contractor during its 2 years of operations. (ADAMS Accession No. 8005130397). The NRC reviewed the data from the May 3, 1979, report during agency inspections in 1980 (ADAMS Accession

No. 8203240516). The inspection concluded, “The inspector found that the licensee’s surveys, as documented in Applied Health Physics letter dated May 3, 1979 accurately reflects the condition of the plant facilities and slag dump.” Furthermore, NUREG-1027, “Environmental Impact Appraisal for Renewal of Source Material License SMB-920,” issued November 1983, page 1-3, further describes the quantity of waste slag at the Reading site, stating the following:

> About 544,000 kg (600 tons) of waste slag was dumped, either molten or as furnace “skulls” over the embankment during the two years of operation by KBI. The solidified slag is a black, glass-like, insoluble material containing about 0.16% natural thorium and 0.04% natural uranium.

This would equate to approximately 1 ton of thorium. As noted by PADEP, in Cabot’s Table 2, the licensee assumed 0.3 percent natural uranium to derive a source term estimate of 1.8 tons of thorium.

Additionally, in July 1976, approximately 30,000 tons of tin slag at the Baltimore site was exported to Holland via Germany. Detailed records show 25,476 tons of tin slag were loaded and shipped to Holland. From August 1976 to July 1977, Kawecki Berylco Industries (KBI) conducted decontamination at its Baltimore site. During this time, 286 truck shipments were made from Baltimore to Reading. AHP logs describe the loading conditions for the truck shipments, as summarized below.

During slag movement in preparation for the September 1976 bulk shipment, slag was again placed or dumped on unpaved areas at the rail yard. Large quantities of tin slag were left in the Canton railroad yard mainline area. During loading, heavy rains in this low-lying area resulted in the wheels of the loaders digging in and mixing tin slag with soil to a depth of 2 to 3 feet.

During loading operations that took place September 18–19, 1976, port stevedores bulldozed areas of the pier that contained piles of residual tin slag, resulting in extensive contamination of the entire pier area. Radiation surveys conducted on September 21, 1976, revealed that large amounts of tin slag had spread into low-lying areas and possibly deeper into the ground.

On October 25, 1976, two inches of additional rainfall caused heavy damage to the pier area that still needed decontamination.

On October 27, 1976, the State of Maryland conducted surveys of the pier and mainline areas of the rail yard. AHP indicated that the State of Maryland used very sensitive detection equipment, which “surpasse[d] anything that [was] commercially available.” The State rejected the area where a truckload of tin slag had been inadvertently dumped during loading on September 14, 1976, and an area where tin slag residue had been scrapped to the far end of the pier. AHP noted that the thoroughness of the State’s inspection was such that this likely included tin slag residue from the initial unloading back in the 1960s. The pier required extensive decontamination through the removal of surface soils. AHP estimated a waste volume of hundreds of tons.

By November 14, 1976, 114 truckloads of waste source materials had been moved from the Canton rail yard to Boyertown and Reading. As of November 30, 1976, 2447 tons of material

had been removed. AHP estimated that about 10–20 loads remained to be sent to Pennsylvania.

There is a significant discrepancy between the number of additional shipments estimated by AHP, which would total 114+20 or about 134 shipments, versus the 286 shipments reported. The difference of 152 shipments is likely indicative of the radiological content of the later phases of the cleanup operations, especially in consideration of the conditions and events ongoing at the Baltimore location described above. Nevertheless, the NRC staff assumed a source term of five times the licensee's estimate to account for any tin slag not accounted for in export ship manifests.

Regarding the thickness of the slag layer at the Reading site, the NRC staff did not use the photograph (referenced in PADEP Comment 11) as a basis for estimating its thickness.

PADEP Comment 2.: Cabot's value of 0.01 for wt % Thorium for 1977–78 Sand and Sn Slag appears to be low. This sand and Sn slag was trucked to the site from Baltimore, Maryland. Page 10 [of Health Physics Report of the Radiological Safety Aspects Associated with KBI Tin Slags Stored at the Canton Railroad Yards, Applied Health Physics, Inc., dated December 3, 1976] states that "KBI's tin slag contains 0.7% thorium." Even if one accepts Cabot's questionable assumption of a 20:1 dilution (based on a handwritten note on 1991 inspection report) this equates to 0.035%.

NRC Staff Response 2: As indicated above, the NRC's independent dose assessment did not use Cabot's value, but the NRC's source term accounted for the contaminated tin slag.

PADEP Comment 3.: AHP's 12/3/76 report, Page 7 indicates that an "extremely large quantity of tin slag" remained in Baltimore after the MIS Holthav was loaded. Based on the referenced photos (fig. 27 & 28) it appears that the vast majority of this material could have been moved without the unavoidable dilution with soil as claimed by employee recollection.

[The report] also states on Page 11 that "It is fortunate that KBI has a licensed waste disposal ground...otherwise it would be necessary to ship hundreds of tons of material to...Barnwell, South Carolina" (the location of a licensed radioactive waste disposal facility). If the material was truly as diluted as Cabot now claims (i.e., 0.01% Thorium), it seems quite unlikely that KBI would have gone to the expense of trucking it to Reading for disposal. Rather they could have disposed of it locally in the Baltimore area.

NRC Staff Response 3.: The NRC staff analysis did not use the relative concentrations and number of shipments from Baltimore and Reading. Further, the NRC staff notes that it is highly unlikely that local disposal near Baltimore would have been cost-effective as compared to using KBI's own State-permitted disposal site.

PADEP Comment 4.: If the original concentration of the tin slags was 0.7% as stated in [AHP's 12/3/1976 report] then dilution with soil by a factor of 20:1 would have resulted in a concentration of 0.035%. This is below the concentration at which it would be classified as "source material" (i.e., 0.05%). Even at 0.035% it seems unlikely that it would have been trucked to Reading since, at that concentration, it could have been released without restrictions.

The fact that it was transported to and disposed of at Reading indicates that it was between the 0.7% undiluted value and the 0.05% source material limit, not the 0.01% value used in Table 2 [of Cabot Corporation Comment Report on the Johns Hopkins Draft Progress Report and Related Issues, dated November 21, 2002] nor the 20:1 dilution value of 0.035%.

NRC Staff Response 4.: The NRC staff notes that page 1 of AHP's 12/3/1976 report actually reports thorium concentrations ranging from 0.1 to 0.7 percent. The first license for the imported tin slag was for 17,000 tons containing 0.11 percent thorium oxide. (ML072250442). Additionally, on page 16 of Health Physics Report #2 for the Kawecki Chemical Company, prepared by Applied Health Physics, Inc., dated February 6, 1968, a more detailed analysis of tin slags shows tests were made from 14 samples, in 3 batches with 23 analysis. These results showed thorium concentrations in tin slag of 0.15 to 0.37 weight percent.

Further, the licensee reported concentration values for waste slag in its November 21, 2002, supplement. (ML072410570). Their tabulated results of historical slag testing show 39 test results for thorium concentration averaging 0.3066 weight percent thorium, with a maximum of 0.455 weight percent thorium. NRC notes that this testing is the concentration of the slag after licensee processing, which concentrated the thorium into a smaller volume slag.

The fact that the waste was transported and disposed of at Reading indicates that the licensee owned its own burial site and had no need to pay disposal fees at another location. It is unclear to the NRC staff how the licensee's use of an in-house disposal facility would provide detailed radiological concentration data. As previously discussed, the NRC staff analysis did not use the relative concentrations and number of shipments from Baltimore and Reading.

PADEP Comment 6.: Page 12 [of AHP's 12/3/1976 report], 1st paragraph indicates that 2447 tons of waste source material were removed by November 30, 1976. Some was salvaged for reprocessing at Boyertown and some was buried at Reading. No data has ever been presented to indicate how much material went to each location. This same paragraph states that "each truckload has been sampled so that an approximation of the total amount of source material can be determined." No sample analysis results were presented to support material concentration estimates used.

NRC Staff Response 6.: As indicated above, the NRC's analysis did not use this information. The NRC assumed that all tin slag not manifested for export was sent to the Reading slag pile disposal area. However, it is highly likely that any of these shipments that were undiluted tin slag, would have been sent to Boyertown for processing, instead of to Reading for disposal.

PADEP Comment 7.: [In AHP's February 6, 1968 Health Physics Report #2 for the Kawecki Chemical Company], page 3 states that the A.E.C. license covers possession of up to 0.3% Thorium in 60,000,000 lbs of slag. This equates to approximately 90 tons of Thorium in raw materials. This page also cites a "formal request to the A.E.C. for an exemption...to permit burial of approximately nine million pounds of slag containing 1% or less thorium." This equals up to 45 tons of Thorium.

NRC Staff Response 7.: The 60 million pounds of tin slag is the 30,000 tons of tin slag imported, most of which never got farther in the United States than the Canton railroad yard in

Baltimore, as more than 25,000 tons were exported from there in July 1976. The NRC agrees that the Atomic Energy Commission (AEC) license covered the tin slag material at the licensee's various locations over the course of the license, including Reading, Revere, Boyertown, and Baltimore.

PADEP Comment 8.: The Pennsylvania Department of Health Permit for Burial of Radioactive Materials (an attachment to a letter from AHP to NRC dated May3, 1979) allows "disposal by burial in soil of approximately 105 tons of natural thorium and uranium contained in slag residue..."

NRC Staff Response 8.: The NRC agrees that it appears Cabot had plans for the tin slag operations to expand beyond the current inventory of material, but PADEP does not explain why this would now be relevant.

PADEP Comment 9.: [Kawecki Chemical Company's Application Renewal for Source Material License #SMB-920, dated October 4, 1967,], Att. #2 "Smelting Operation" indicates that 32,000 pounds of slag would be produced "Per 24 hour Day." Cabot asserts (based on a handwritten note dated January 23, 1991) that a total of only 600 tons of slag was disposed on the pile. If this figure is correct it would indicate that the plant operated for less than 38 production days during the 2-year operation of the plant.

NRC Staff Response 9.: The handwritten note to which PADEP refers discusses the dilution of tin slag in debris shipped from Baltimore to Reading during decontamination of the rail yard, as discussed in Staff responses above. The note does not discuss the 600 tons of processed slag. Other records indicate that initial processing of slag at Reading began in April 1967 and ran for 7 months. Operations took place 18 hours per week for the first 6 months. The Pennsylvania Department of Health suspended operations sometime before November 10, 1967. On March 18, 1968, the State of Pennsylvania granted the licensee a permit for the disposal of radioactive waste. On December 1, 1968, the AEC amended license SMB-920 to allow disposal of tin slag residues at the Reading site under Title 10, Section 20.302, of the *Code of Federal Regulations* (10 CFR 20.302). Operations ceased in May 1969, after 25 months. At least 7 of the 25 months were for operational testing and the plant was shut down for several more months during that period. It is clear from this history that the licensee's process did not work as planned.

Additionally, the bulk of the stock material was exported in the 1970's from Baltimore, Maryland. A Kawecki Chemical Company Summary, dated March 15, 1974 and titled Amine Extraction–Eastern Tin Slag, notes that the inventory of tin slags at Baltimore as reported on March 15, 1974, well after operations had ceased in Reading, was approximately 28,000 tons. Given that the original license of March 17, 1967, authorized only 30,000 tons, only about 2,000 tons would have been available for processing at Reading. The NRC staff dose analysis assumed the equivalent of five times the 600-ton licensee estimate, or roughly 3000 tons of tin slag.

Potential Use of Radioactive Waste as Site Fill Material:

PADEP Comment 12.: AHP letter to Kawecki dated May 3, 1968, indicates that Kawecki may have considered using (and possibly used) sludge containing 3000 pCi/g as fill for the plant site.

NRC Staff Response 12: In an AHP letter to NRC dated May 3, 1979, AHP stated that no sludge disposal occurred at the Reading site. AHP's Health Physics Report #2 for the Kawecki Chemical Company, dated February 6, 1968, indicates initial testing of waste filtrate at the site with thorium concentrations around 0.1 weight percent. Cabot included this material in its source term estimate, described in Table 2 (of Cabot Corporation Comment Report on the Johns Hopkins Draft Progress Report and Related Issues, dated November 21, 2002) as filter cake.

Slag Is Nonhomogenous and Consists of Large Pieces that Cabot's Characterization Did Not Include:

PADEP Comment 13.: Cabot claims in its letter to Camper dated 1/21/02) that the "slag bearing radioactive material is mixed, not uniformly, but considerably, in a larger volume of debris...." Contrast this with the "Representative Cross Section, Reading Slag Pile" (Att. A, Figure 1 of Cabot's Comment Report on the Johns Hopkins Draft Progress Report and Related Issues, dated November 21, 2002) which shows a distinct layer for waste slag.

NRC Staff Response 13: NRC's bounding analysis referenced above conservatively assumed the slag is concentrated in a layer. Cabot's site characterization data (Characterization Report for the Reading Slag Pile, Revision 1, NES, Inc., dated April 22,1996) indicates radiological material dispersed through 16 to 20 feet of several core bores. Cabot's DP includes a cross section diagram (inserted at the NRC staff's request), and the Staff found it to be a conservative conceptual model for the Staff's bounding dose modeling calculations.

PADEP Comment 14. : Cabot's October 1967 application for A.E.C. license renewal, supplemental information section, Page 3, Item 9.B. indicates that it was Kawecki's intent (and possibly their practice) to pour the molten slag from their operation "over the side of the slag dump where it will cool to form a black glassy mass containing most of the source material." This is supported by an AHP letter to NRC dated May 3, 1979, stating that "KBI waste slag was often dumped while still molten...." The presence and effect of large solidified masses of slag deposited down the slope are not addressed in Cabot's characterization nor in their radiological assessment.

PADEP Comment 15.: Cabot's October 1967 license renewal application also states on Page 14, 4th paragraph that "waste slag contains 0.2 to 0.29 percent thorium in the form of a black glass-like material which is broken into large pieces." Despite this information, Cabot claims(Cabot letter to Camper dated 11/21/02) that "the vast majority of the slag pile consists of small particles...."

NRC Staff Response 14 and 15: The NRC staff finds that these Cabot practices, of which PADEP takes issue with were considered by Cabot, as reflected in their conceptual model

referenced above. NRC staff notes that Cabot's dose scenarios involving limited excavation utilized a highly concentrated slag layer, which is counter to PADEP's above assertions.

The Number and Location of Test Borings Was Not Adequate To Provide a Representative Characterization of the Slag Pile:

PADEP Comment 16.: Cabot has not demonstrated that the limited number (17) and location of test borings meets the objective of ensuring that sufficient representative locations have been sampled. As stated in both NUREG/CR-5849 and MARSSIM, meeting this objective requires a statistically based plan for selecting measurement and sampling locations. Furthermore, NUREG/CR-5849 states that if there is unusual localized contamination, the survey should be supplemented with sampling in the areas of suspected localized contamination. Based on this guidance, the large blocks of slag that are reported to be a concentrated source should have been specifically investigated.

NRC Staff Response 16: NRC staff agrees that the site characterization report contains considerable uncertainty. However, NUREG/CR-5849 and MARSSIM are guidance documents for performing statistical surveys, which is one method that maybe used to demonstrate a site meets the decommissioning criteria. As discussed in NUREG 1757, *Consolidated NMSS Decommissioning Guidance*, Volume 2, Chapter 2.1, a risk-informed regulatory approach can also be used to reduce unnecessary conservatism in purely determinist approaches. Demonstration of compliance is accomplished through dose modeling, which can utilize detailed characterization, or rely upon risk-informed bounding estimates of the source term. NRC analysis relied upon a bounding estimate for the source term at the Reading site, similar to the analysis performed for the Cabot Revere site. (NRC letter ML020860370).

Further, In a March 21, 2003 request for additional information to the licensee (ML030800566), NRC stated:

> NRC staff considers that there is significant uncertainty in the sampling method's ability to obtain representative samples from large blocks of slag buried in an unconsolidated pile of sand, gravel and other fill material. Previous responses to this question did not reflect the fact that much of the contaminated waste slag appears to be in large blocks, which have been identified in historical site file photographs, excavated during slag characterization work, and observed during a recent site visit.

The letter went on to state:

> NRC staff notes this uncertainty could be addressed in a number of different ways, especially since the radiological constituency of the slag itself is well documented. For example, the licensee could assume a conservatively thick layer of slag to develop a source term for the slag layer, or perhaps conduct noninvasive surveys to identify the depth and thickness of the slag layer. If physical sampling of the material is necessary, test pit trenching could be performed. The licensee should ensure that any additional characterization is performed to refine the source term consistent with the expected eroded condition of the pile, and appropriate concentration averaging...

NRC staff considers that the radiological content of the slag blocks to be well documented, so additional sampling is not necessary. Cabot assumed a 4.2 foot layer of pure slag in it's excavation scenarios, and addressed erosion concerns by addition of a riprap barrier. NRC staff's independent analysis considered a source term five times Cabot's estimate, as discussed above.

Sampling by Split-Spoon Method Is Inappropriate for Sampling Slag:

PADEP Comment 17.: Split-spoon techniques are intended for non-consolidated material (e.g., soil), not "black glass-like material which is broken into large pieces" (see Page 14 of Health Physics Report # 1, attached to Kawecki Chemical Company's Application Renewal for Source Material License #SMB-920, dated October 4, 1967). The inappropriateness of the split-spoon technique for sampling the large pieces of slag that are known to exist in the pile is indicated in Cabot's response to NRC question 12.d. [on the Characterization Report for the Reading Slag Pile, Revision 1, dated April 22,1996].

NRC Staff Response 17.: While not completely effective, split-spoon sampling is utilized in unconsolidated, aggregated material when other means are not available. NRC staff agree that additional characterization could have been utilized to further refine Cabot's source term estimate. However, the licensee utilized both characterization data and documented site operational history to develop a source term estimate. As discussed above, NRC staff's independent analysis used a bounding source term five times the Cabot estimate due in part to concerns about uncertainty of the site characterization, including concerns about sampling methods.

PADEP Comment 18.: Cabot asserts in [Cabot Corporation Comment Report on the Johns Hopkins Draft Progress Report and Related Issues, dated November 21, 2002], Page 9 that "there is good reason to believe the split-spoon would penetrate and sample any large blocks of waste slag that were encountered. The fact that the slag was reportedly broken up by dropping an iron ball onto it indicates that it is possible to drill and sample it. The split-spoon technique uses a 140-pound hammer dropped 30 inches to drive a 2-inch diameter hollow tube. The impact force per unit area is likely similar to the force per unit area as of the dropped ball used to break the slag." Cabot provides no calculations to support this assertion.

NRC Staff Response 18.: NRC staff agrees that Cabot did not provide supporting calculations. However, the staff's bounding source term estimate did not rely solely on site characterization data, but on slag analysis, site operational history and license history (discussed in Staff Responses above). The staff's analysis is sufficiently conservative to accommodate the lack of calculations noted by PADEP.

PADEP Comment 19.: In [the Staff's letter to Cabot] dated 6/20/2002, NRC clearly opposes Cabot's current position that the split-spoon sampling obtained representative samples of the slag blocks, viz. "We [NRC] agree that split-spoon techniques used for subsurface characterization would be unable to sample the larger blocks of radioactive slag." In addition, (the letter from AHP to NRC dated 5/3/1979 [states that the] "usual practice of core sampling the dump is impractical if not impossible. The dumpsite is actually an embankment with a treacherous 70 degree slope that precludes core drilling which would be meaningless anyway

since most of the source materials consist of large skulls and fragments having high density and extreme hardness. Furthermore, the distribution of source materials is by no means homogeneous."

NRC Staff Response 19.: NRC staff agrees that it had sampling concerns. The slope (actually only thirty degrees, as described in Cabot's DP) is why more complete characterization data could not be obtained at the time of the 1996 site characterization.

Dose from Slag Pile Underestimated:

PADEP Comment 20.: [AHP's Health Physics Report #2 for the Kawecki Chemical Company, dated February 6, 1968, at] Page 15, section II.A. 1.(c). 1, and AHP's Health Physics Report #1, Page 14, 2 d paragraph, indicate that the existing exposure rate of the slag dump in 1967-68 was 1.0 to 1.5 mr/hr.

[Cabot's Hand written notes on bottom of copy of an 1980 inspection report, stamped January 23, 1991] states that "measurements taken at the slag dump indicate a maximum radiation reading of 0.2 mr/hr on contact with the ground." These readings are lower than the readings from 1967–68. This is likely due the shielding effect of the 580 tons of soil and debris from the plant and 500 tons of crushed rock and soil placed on the slag pile during decontamination of the plant.

If excavated, individual pieces of slag would produce significant exposure rates (e.g. 100's of microR/hr). See [AHP's Health Physics Report #2 for the Kawecki Chemical Company, dated February 6, 1968], at Page 15, and Health Physics Report #1, Page 14 [attached to Kawecki Chemical Company's Application Renewal for Source Material License #SMB-920, dated October 4, 1967]. This is confirmed by measurements taken at the site on exposed large pieces of slag by Decommissioning Section staff (and confirmed by Cabot).

These values may give a good indication of the dose rates that could be expected in an eroded or excavated slag pile scenario. Despite this information, Cabot scenarios that assume an eroded slag pile appear to use an external dose rate of 0.055 mrem/hr or (e.g., [ST Environmental Professionals' Radiological Assessment for Reading Slag Pile Site, Revision 1, dated March 2000] –Case BT, Trespasser-eroded pile: external dose of 10 mrem in 180 hours).

NRC Staff Response 20.: The licensee's March 2000 radiological assessment (RA) to which PADEP refers is not part of the basis for taking the proposed action. The RA version being relied upon is revision 4, dated August 2006, and is available at (ML062360159). In it, Cabot considered seven alternate scenarios for dose modeling calculations, five of which specifically included various levels of excavation. (Refer to the Alternate Scenarios on page 3-15 for more details). In summary, several excavation scenarios were developed in considerations of various mixes of pure slag with soil, not on existing exposure rates. NRC's independent dose analysis also considered excavation alternatives, based on radiologic concentrations of slag, rather than the site characterization bore hole data or existing exposure rates. All results demonstrated compliance with 10 CFR 20 Subpart E radiological criteria for unrestricted use.

Cabot Does Not Consider All (or Discounts) Plausible Land Use Scenarios:

PADEP Comment 21.: In Cabot's letter to [the Staff] dated 11/21/02, Item 9 states that future excavation is "highly unlikely" despite the existence of a right-of-way for River Road through the slag pile. Within the past 3 to 4 years, interest has been expressed in extending River Road (see Letter from John R. Morahan, St. Joseph Medical Center, to Theodore Smith, NRC, dated May 12, 2001.). Additionally Cabot states that, if the pile were excavated, "it would most likely not result in doses greater than those estimated for short-duration incidental exposures evaluated in the Cabot Radiological Assessment."[Revision 1 of the RA]. [These doses] appear to indicate an external dose rate on the eroded slope of approximately 0.055 mrem/h (e.g., Case BT: external dose of 10 mrem in 180 hours). This is contrasted by exposure rate readings of 1 to 1.5 mR/hr taken on the slag pile by AHP during the period of April through September 1967 [Kawecki Chemical Company's Application Renewal for Source Material License #SMB-920, dated October 4, 1967]. This was early in Kawecki's operational period, so it is safe to assume that additional radioactive slag was subsequently deposited. These readings were taken prior to any soil cover being placed on the pile. The conditions during the 1967 AHP survey could be considered a bounding condition for exposure rate from an eroded slag pile.

NRC Staff Response 21.: City of Reading developers are well aware of the slag pile, and there are no plans for excavation in the slag area during current development projects. NRC staff participated with PADEP representatives in communication exchanges with these developers.

Further, as stated above, Revision 1 of the RA is an outdated version of the licensee's RA. A scenario based on the 1967 AHP survey conditions is considered implausible, since the slag is covered by many feet of soil, rock and sand, some of which would be mixed with the slag during an excavation. Various mixes of pure slag and soil are considered in the five excavation alternate scenarios discussed in revision 4 of the licensee's RA. NRC staff notes that, as discussed in Kawecki Chemical Company's Application Renewal for Source Material License #SMB-920, dated October 4, 1967, utilizing the 1967 conditions would not reflect thorium decay in equilibrium.