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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of)	
)	
SHIELDALLOY METALLURGICAL CORP.)	Docket No. 40-7102
)	
)	
(Licensing Amendment Request for)	
Decommissioning the Newfield,)	
New Jersey Facility))	

**NEW JERSEY DEPARTMENT OF ENVIRONMENTAL
PROTECTION'S REPLY TO THE ANSWER OF SHIELDALLOY**

Shieldalloy argues in its answer that NJDEP is not entitled to a hearing on Shieldalloy's Decommissioning Plan ("DP") on any of its contentions. Shieldalloy bases this argument largely on disputing the expert reports submitted by NJDEP. Because Shieldalloy disputes the evidence provided by NJDEP, Shieldalloy has demonstrated that genuine issues of material fact are in dispute which require a hearing pursuant to 10 C.F.R. §2.309(f)(1)(vi).

CONTENTION 1

Shieldalloy argues that NJDEP's assertion that radionuclides will easily infiltrate the relatively thin layer of soil (the vadose zone) and enter the underlying groundwater is irrelevant. Sa¹ pages 13-14. However, NJDEP presented an expert report which states that the relatively thin vadose zone, combined with the hydraulic conductivity of the native vadose zone material and the absence of an engineered liner system beneath the waste, are not favorable for the long-term protection of groundwater. Malusis Report² page 4. These characteristics demonstrate that the proposed DP would not be protective of public health and would exceed the License Termination Rule's ("LTR") radiation dose limits through groundwater pathways.

Shieldalloy also argues that this contention should be rejected because it does not raise any genuine issues of fact that are in dispute. Sa pages 14-17. However, Shieldalloy's disagreement with NJDEP's petition and expert reports, which assert that the DP underestimates the saturated hydraulic conductivity of the vadose zone and the ability of the vadose zone and saturated zone soils to provide attenuation, Malusis Report page 4, demonstrate that there exists genuine issues of factual dispute

¹"Sa" refers to Shieldalloy's answer to NJDEP's Request for a Hearing.

²"Malusis Report" refers to the report submitted by Michael Masluis, Ph.D. with NJDEP's Request for a Hearing.

that require a hearing. See 10 C.F.R. §2.309(f)(1)(vi).

Shieldalloy also disagrees with NJDEP's experts on the issue of whether consideration of the groundwater should have been excluded from the DP. Compare Sa page 16 with Gaffigan Dec.³ ¶ 18. Shieldalloy also argues that the groundwater modeling conducted in the supplement to the DP showed no significant radiological impact. Sa page 16. However, NJDEP's experts showed that this modeling was lacking on the basis that the RESRAD run used by SMC in Appendix D was not provided, there was insufficient data submitted in order to properly evaluate the MODFLOW results, and there is no reasonable justification provided as to why a well could not be placed on the edge of the contaminated zone. Spayd Report page 3; Goodman Report page 22. This disagreement demonstrates more genuine issues of fact in dispute that require a hearing. See 10 C.F.R. §2.309(f)(1)(vi).

In response to Contentions 1, 2, and 3, Shieldalloy argues that the LLRWPA does not actually require the permanent isolation of radioactive materials. However, NJDEP does argue that the LLRWPA requires the permanent isolation of the radioactive waste, which requires the rejection of the DP because rain water will infiltrate the cap and cause radionuclide contamination to the groundwater. As such, a material issue of law is in dispute which requires a hearing. See 10 C.F.R. §2.309(f)(1)(vi).

³"Gaffigan Dec." refers to the Declaration of Donna Gaffigan which was submitted with NJDEP's Request for a Hearing.

CONTENTION 2

Shieldalloy argues that NJDEP's assertion that more leaching tests should have been performed is speculative. Sa page 19. However, Shieldalloy failed to conduct more than three TCLP tests of the slag (and only two TCLP tests were conducted on the baghouse dust). NJDEP has provided an expert opinion demonstrating that based on the large volume of radioactive materials and the different types of materials, including slag, baghouse dust, and building materials, more leaching tests should have been conducted to ensure that the DP accurately estimates the leaching characteristics of the radioactive waste. Malusis Report page 6.

Shieldalloy argues that it is irrelevant that the TCLP test did not sufficiently allow the leaching process to reach completion based on the fact that the TCLP test results were not used for dose modeling. Sa page 22. However, NJDEP presented expert opinions that TCLP testing that allows the leaching process to reach completion is required to accurately represent long-term leaching behavior. Malusis Report page 6.

Shieldalloy acknowledges that TCLP tests conducted by Shieldalloy showed high volumes of radium in leachate. Sa page 21. However, Shieldalloy argues that radium leaching is irrelevant since it was not used for dose assessment purposes. The DP at page 78 states that the results of the leaching tests were used as the input parameters to the RESRAD code. In fact, the DP at page 27

states that "the physical form of the slag in the Storage Yard slag (glass-like rock) does not permit the radioactive elements to leach out into the regional water supply or local wetlands. Leachability and distribution coefficient studies performed on samples of the slag support this conclusion." Also, the K_d used in Appendix D (Table 1) for Radium-226 is not the RESRAD default, but as explained in the text (Appendix D at page 4) "The distribution coefficient (K_d) value for Ra-226 is a site-specific value measured for the residual radioactive materials which is not necessarily representative of the K_d value for the aquifer materials". Therefore, it appears from the text of the DP and Appendix D that the results of the leaching tests are indeed relevant to the analyses and conclusions in the DP. Since SMC used the leach results in the DP, Shieldalloy's assertion in its answer that they are irrelevant must be rejected.

Shieldalloy challenges the NJDEP's assertion that the uranium concentration in water samples demonstrate concentrations that are above those reported by the USGS. Sa pages 22-23. Shieldalloy cites Figure 13 on page 42 of USGS Report 92-4144⁴ as evidence that there is significant variation in the Newfield area. Sa page 23 n.13. Shieldalloy chose a data point that was about 4 miles to the northeast of the slag pile of 0.35 ug/L. There are

⁴ Kozinski, J., Szabo, Z., Zapecza, O.S, and Barringer, T.H. *Natural Radioactivity in, and inorganic Chemistry of, ground water in the Kirkwood-Cohansey Aquifer System, Southern New Jersey, 1983-89*. US Geological Survey Water-Resources Investigations Report 92-4144, West Trenton, NJ. 1995.

closer data points to the Newfield site on Figure 13 which range from <0.01 to 0.14 ug/L of total uranium. Table 4 on page 31 lists the 90th percentile uranium concentrations for various geologic configurations (no Bridgeton Formation, with and without agriculture, and the Bridgeton Formation with and without agriculture). The range of the 90th percentile concentrations is 0.02-0.18 ug/L of uranium. This compares to 8.3 ug/L in Shieldalloy's well SC-11S and 16 ug/L in Shieldalloy's well SC-13S. These levels also exceeds the concentration cited by Shieldalloy in Figure 13. Thus, uranium concentrations in the groundwater at the western edge of the disposal area are well above background.

CONTENTION 3

Shieldalloy admits that the proposed cap will allow rainwater infiltration but argues that the radionuclides will not adversely impact groundwater. Sa pages 23-24. However, NJDEP has submitted expert reports which demonstrate that groundwater infiltration of radionuclides will adversely impact groundwater. Goodman Report page 11. Because a material issue of fact is in dispute, a hearing is required. See 10 C.F.R. §2.309(f)(1)(vi).

Shieldalloy attempts to justify a groundwater release as allowed by 10 C.F.R. Part 20 Appendix B. Sa page 24 n.16. However, NRC effluent release limits under 10 C.F.R. § 20.1302 do not apply to decommissioned sites, but to operating facilities. Compare 10

C.F.R. § 20.1302 (setting forth how "[e]ach licensee shall conduct operations") with 10 C.F.R. § 20.1401(a) (stating that the scope of Subpart E applies to decommissioned facilities). Indeed the allowed release limits in Appendix B would not meet the dose criterion of the LTR (50 mrem/y vs. 25 mrem/y)

Shieldalloy raises other objections to the assertions made by NJDEP and supported by NJDEP's experts. Sa pages 27-34. However, these disputes with the expert report submitted by NJDEP demonstrate that material issues of fact are in dispute which require a hearing pursuant to 10 C.F.R. §2.309(f)(1)(vi).

Shieldalloy argues there is one point of agreement, that Native American Mounds demonstrate erosionional stability. Sa page 33. However, NJDEP raised the Native American Mounds to demonstrate that erosional instability is likely. Goodman Report page 2. Because humans have intervned in the Native American Mounds, thereby causing erosional instability, future human intervention to the proposed cap will also be likely and will thereby cause erosion instability. Id. Therefore, a material issue of fact is also in dispute here which requires a hearing pursuant to 10 C.F.R. §2.309(f)(1)(vi).

CONTENTION 4

Shieldalloy argues that this contention is outside the scope of this preceding because the final status surveys are

conducted after the DP is approved. Sa pages 34-37. However, NJDEP's Contention 4 is within the scope of this proceeding because the NRC's evaluation criteria for decommissioning plans includes sufficiently characterizing the site. NUREG-1757 Vol.1 rev. 2 pages 16-22 through 16-29. NJDEP is asserting that Shieldalloy's characterization of the site, which has been incorporated into the final status survey design, is inadequate. The DP states that "[a] comprehensive site-wide survey for the presence of radioactivity at the Newfield facility was conducted in 1991." DP § 14.1.1. Because these results are presented and relied upon in Chapter 4 of the DP, and because NJDEP has found a number of specific problems with the facility's survey, NJDEP should be entitled to a hearing on this contention.

The DP is required to sufficiently characterize the site. NUREG-1757 Vol.1 rev.2 pages 16-22 through 16-29. If the site is not properly characterized, then classification of survey units may be underestimated. Since classification determines the size of the survey unit, NUREG-1575, Rev. 1 page 4-15, and the percentage of scanning, NUREG-1575, Rev. 1 p.2-32, misclassification could result in releasing a survey unit when it does not meet the release criteria. "If a survey unit is classified incorrectly, the potential for making decision errors increases." NUREG-1575, Rev. 1 page 2-28. This can happen because the lower the classification, the larger the survey unit, the larger the distance between sample

locations, and the less comprehensive the scan. NUREG-1575, Rev. 1 pages 4-15 and 2-32. Since Shieldalloy states that the site has been fully characterized (DP § 14.1.1), and since Shieldalloy has classified its survey units based on the inadequate characterization (DP at Figure 18.11), the Department still considers this a valid contention.

NJDEP contends that Shieldalloy's characterization was inadequate. Specific problems with the characterization data are presented in Exhibit M to NJDEP's Request for a Hearing. Specific problems with the water data are presented in Goodman's Report at page 17. In the regulations at that time, in 40 C.F.R. § 141.26(a)(1)(i), it recommends that States require radium-228 analyses when the gross alpha particle activity exceeds 2 pCi/L in localities where radium-228 may be present in drinking water. Therefore, since there is a source of Ra-228 (slag pile), in order to determine if the MCL for total radium was exceeded, Shieldalloy should have followed this protocol and analyzed for Ra-228 as well as Ra-226.

Specific problems with Shieldalloy's site characterization data are illustrated in Appendix 19.6 of the DP. There, over 150 results are presented in a table. This table is taken directly from the IT report, Assessment of Environmental Radiological Conditions at the Newfield Facility, 1992. This is the report that Shieldalloy relies on for the characterization of

the site. Yet the table and report omit supporting information that is required to validate the results, including the uncertainty, the accompanying laboratory data, the minimum detectable activities, and any indication whether the samples were sealed and held for 21 days. Goodman Report § 4.

Shieldalloy argues that NJDEP's multiplying out the assumptions of the quantity of radioactive material to argue that the entire site should be characterized is speculative and that the radioactive concentration being above New Jersey's cleanup standards is irrelevant. Sa page 44, n.23. However, NJDEP is simply asserting that Shieldalloy needs to adequately characterize the site. When considering the concentration of the radionuclides in the fill slag and the fact that Shieldalloy admits that the location of the fill slag has not been determined, DP page 30 n.69, one must conclude that Shieldalloy has not adequately characterized the site. Goodman Report pages 3-5. As stated above, adequate site characterization is required for a proper final status survey design. Since Shieldalloy states that the site has been fully characterized (DP § 14.1.1), and since Shieldalloy has classified its survey units based on the inadequate characterization (DP at Figure 18.11), the Department still considers this a valid contention.

These deficiencies in Shieldalloy's characterization of the site demonstrate that genuine issues of facts are in dispute

that requires a hearing pursuant to 10 C.F.R. §2.309(f)(1)(vi).

CONTENTION 5

Shieldalloy argues that groundwater contamination is not required to be considered by the DP because currently there are no drinking water wells within the restricted area of the Shieldalloy facility and drinking water is currently provided by a publicly owned water system. Sa page 46. However, there is no reason to believe in the next thousand, million, or billion years that the waste will remain a radioactive hazard that wells will not be used in the vicinity of the facility for drinking water. Shieldalloy also argues that groundwater is not considered because it is currently contaminated by non-radioactive contaminants from Shieldalloy's past operations. Sa page 46. However, this argument ignores the fact that Shieldalloy signed a Consent Order requiring it to conduct groundwater remediation for these non-radioactive contaminants. Gaffigan Dec. ¶ 17. Groundwater remediation has been ongoing for a number of years and will continue until these contaminants are removed from the groundwater. Id. When the groundwater remediation is completed, restrictions on the water's use for potable purposes will be lifted.

Shieldalloy argues that it conducted site-specific groundwater modeling, on which NJDEP did not comment. Sa page 47. However, NJDEP did not comment on the modeling because there was

insufficient information on which to evaluate it. The RESRAD run was not included in Appendix D of the Supplement nor in revised Appendix 19.5⁵.

Shieldalloy argues that farming encroachment to the property boundary is not likely due to anticipated land use factors and need not be considered. Sa page 48. However, 10 C.F.R. § 20.1403(e) requires residual radioactivity to be reduced "so that if the institutional controls were no longer in effect, there is reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group is as low as reasonably achievable and would not exceed" under certain specified limits. (Emphasis added). "Critical group" means the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances." 10 C.F.R. § 20.1003. A future resident farmer conducting activities in the vicinity of Shieldalloy's facility is not only an "applicable circumstance" in this case, it is a likely circumstance based on the fact that Shieldalloy's waste will remain a radioactive hazard for billions of years. Goodman Dec. ¶ 2. It is self-evident that over the course of a billion years, many land use scenarios in this area are

⁵ Note that when Shieldalloy provided a hard copy of the Supplement to the DP to the State, it did not include the revised Appendix 19.5. It was only after the Request for a Hearing was submitted that these revised runs were discovered on the website. However, there are no revised Microshield runs as indicated in the title of revised Appendix 19.5. Pages 203 -217 are blank.

possible, including a resident farmer. Furthermore, farms are currently located within a one-mile radius of the Shieldalloy facility. DP Appendix 19.9 Environmental Report § 3.1. In fact, a farm field is currently located less than 500 feet from Shieldalloy's slag pile. (Aerial photograph from www.maps.yahoo.com released April 2006, attached as Exhibit A). Shieldalloy failed to give any reasonable justification as to why the resident farmer scenario should be excluded except to reference a deed notice and unspecified "land use factors". (DP at pages 39-40). Since a deed notice is considered an institutional control, it must be assumed to fail under 10 C.F.R. § 20.1403(e).

Shieldalloy argues that a suburban resident scenario on the Newfield plant site is not reasonable and therefore need not be considered. Sa page 49. However, a resident currently lives 100 feet from the property. DP rev. 1 § 1.2. It is reasonable that residents may live at the site in the future.

Shieldalloy challenges NJDEP's modeling on the basis that it fails to identify the bases for selecting the changed parameters. The NJDEP Dose modeling summary report (Attachment 2 referenced in Goodman Report at page 11) was inadvertently omitted from the Request for Hearing package. It is attached hereto as Exhibit C. In order to be consistent with the RESRAD runs performed by Shieldalloy, the NJDEP used the only run that included all the drinking water parameters and distribution coefficients,

newfield 3004008.RAD, which Shieldalloy termed the Recreational Hunter scenario. Although the drinking water parameters were included in this run, the drinking water pathway was turned off, so the resultant dose from drinking water was not calculated by Shieldalloy. The Goodman run includes only the inhalation, drinking water, and soil ingestion pathways. The scenario is a resident with a drinking water well at the edge of the contaminated zone. The parameters that were changed were justified in the Malusis and Spayd reports. The source term used was the concentration of the slag since mixing of vitreous slag with baghouse dust would not decrease the concentration of the slag.

Shieldalloy asserts that inclusion of all of the photon-emitting progeny in the analysis of external exposure, assuming all are in equilibrium with their parent, would result in only a marginal increase in the exposure rate. Sa page 53. No explanation is offered, however, as to how this estimate was obtained, so it should be disregarded for lack of support. USEC, CLI-06-10, 63 NRC at 472. The NJDEP Microshield run with all progeny accounted for is included here as Exhibit D. As can be seen, the dose rate is higher than Shieldalloy's modeling.

Shieldalloy argues that the lateral and vertical extent of contamination will be characterized during the final status survey. Sa page 54. However, the DP is required to sufficiently characterize the site. NUREG-1757 Vol.1 rev.2 pages 16-22 through

16-29. If the site is not properly characterized, then classification of survey units may be underestimated. Since classification determines the size of the survey unit, NUREG-1575, Rev. 1 page 4-15, and the percentage of scanning, NUREG-1575, Rev. 1 p.2-32, misclassification could result in releasing a survey unit when it does not meet the release criteria. "If a survey unit is classified incorrectly, the potential for making decision errors increases." NUREG-1575, Rev. 1 page 2-28. This can happen because the lower the classification, the larger the survey unit, the larger the distance between sample locations, and the less comprehensive the scan. NUREG-1575, Rev. 1 pages 4-15 and 2-32.

Shieldalloy argues that assuming weighted averages of the concentrations of material in the storage yard is appropriate if the materials are uncovered because a person attempting to excavate the barrier would come in contact with a mixture of those materials. Sa pages 54-55. However, using weighted averages of the concentrations of material in the storage yard would make sense if the material were capable of being blended together. Goodman Report page 5. The concentration in the vitreous slag will not change even if other, less concentrated material is placed near it. Id. If the slag were uncovered, it is reasonable to assume that the receptor would be exposed to the slag concentration, not a weighted average. Id. Thus, the Derived Source Term should not be assumed in any of the exposure scenarios. Id. Page 22.

Shieldalloy's answer to this contention verifies that there are genuine issues of fact in dispute that requires a hearing pursuant to 10 C.F.R. §2.309(f)(1)(vi).

Contention 6

Shieldalloy argues that this contention should be rejected on the basis that NJDEP is challenging a regulation. Sa pages 57-61. However, NJDEP is not challenging this regulation. Rather, NJDEP is asserting that the intent of 10 C.F.R. § 20.1401(d) is to require modeling for longer than 1000 years for long lived nuclides. Furthermore, the AEA and LLRWPA also require longer modeling for long-lived nuclides.

62 Fed. Reg. 39058, 39083 (Response F.7.3) clearly states that the 1000-year modeling requirement does not apply to long-lived nuclides. Specifically, the provision states that "[u]nlike analyses of situations where large quantities of long-lived radioactive material may be involved . . . in the analysis for decommissioning, where the consequences of exposure to residual radioactivity at levels near background are small and peak doses for radionuclides of interest in decommissioning occur within 1000 years, long term modeling thousands of years into the future of doses that are near background may be virtually meaningless." 62 Fed. Reg. at 39083 (Response F.7.3) (emphasis added).

In the Shieldalloy case, the DP proposes to dispose of

radioactive waste containing long-lived nuclides. This waste contains thorium-232, which has a half-life of over 14 billion years, and uranium-238, which has a half-life of over 4 billion years. Goodman Dec. ¶ 2. Also, the DP is proposing an on-site disposal of large quantities of the waste--approximately 65,000 m³ of slag. Furthermore, modeling performed by the NJDEP indicates a TEDE of 1,718 mrem per year at 800 years, Goodman Report page 11, which exceed the permissible limits set forth in the License Termination Rule, 10 C.F.R. § 20.1403(e). The DP claims that the greatest dose occurs after 1000 years. DP rev. 1a § 5.5.7. Thus, the intent of 10 C.F.R. § 20.1401(d) was to require modeling for greater than 1000 years in a case such as this where there is a large quantity of long-lived nuclides and where the future doses are well above background levels. Shieldalloy's differing interpretation of 10 C.F.R. § 20.1401(d), the AEA, and the LLRWPA demonstrates that a genuine issue of law is in dispute that requires a hearing. See 10 C.F.R. §2.309(f)(1)(vi).

CONTENTION 7

Shieldalloy argues that the DP conducts a sufficient ALARA and net environmental harm analysis. Sa page 62. NJDEP found a number of deficiencies with these analyses and points them

out in its hearing request. Goodman Report pages. 11-16. Because Shieldalloy disagrees with these deficiencies, Sa pages. 63-67, genuine issues of material fact are clearly at issue which require a hearing pursuant to 10 C.F.R. § 2.309(f) (1) (vi).

Shieldalloy argues that its ALARA analysis properly considers and quantifies the collective dose averted. Sa page 64, n.32. However, footnote 32 of Shieldalloy's answer states that the collective dose averted is a comparative value of doses received by workers. However, this ALARA analysis was not performed correctly in that the benefit from the averted dose was not determined. Goodman Report page 12. The collective averted dose is the dose to the future population who drinks contaminated water and receives doses from exposed slag beneath a breached engineered barrier, not the dose incurred by workers who remove the pile, or a comparative dose between remedial options. According to NUREG 1757 vol. 2 page N-4, "the collective averted dose should be based on the same exposure scenarios used for the compliance calculations", not the dose incurred from performing the remedial action.

Again, NJDEP raises genuine and relevant issues in this contention that requires a hearing. See 10 C.F.R. § 2.309(f) (1) (vi).

CONTENTION 8

Shieldalloy argues that this contention should be rejected because the DP sufficiently considered inflation in determining the required financial assurance. Sa pages 67-69. Shieldalloy argues the DP takes into account inflation by assuming the trust fund will have a real rate of return--the rate of return after subtracting inflation-of 1%. Sa page 67. However, the DP failed to consider inflation when estimating the annual costs involved to maintain the cap. The DP also failed to consider inflation when providing for the contractor's profit. NJDEP's financial expert, John Burke, supports these assertions. Burke Dec. ¶¶ 3, 5.

The DP also failed to provide any financial assurance in case the cap needs to be reconstructed in the future. Id. ¶¶ 3, 4. It is self-evident that over the course of thousands, millions, or billions of years that either natural or human induced forces would damage the cap to such an extent that will require the its complete reconstruction.

The DP also failed to provide any financial assurance for groundwater monitoring. Shieldalloy assumes that financial assurance would not be required to remediate groundwater contamination based on its own groundwater modeling. Sa page 68. However, discussed above under Contention 5, NJDEP's groundwater modeling does show contamination to the groundwater. NJDEP's RESRAD

modeling shows that radium will leach into the groundwater starting at about 450 years, using Shieldalloy's parameters, with a hypothetical drinking water well at the edge of the contaminated zone. Goodman Report page 18. The DP fails to provide any financial assurance to remedy the radium leaching or to remediate the groundwater. Id.

Another reason for the inadequate financial assurance is that the DP assumes a real rate of return of 1% on the financial assurance over the entire 1000 years. However, there is general agreement that a rate of return should not be assumed over the long-term. See, e.g., Neill, H. And Neill, R. Perspectives on Radioactive Waste Disposal: A Consideration of Economic Efficiency and Intergenerational Equity pages 6, 8 (WM'03 Conference, February 23-27, 2003), attached at Exhibit B. The attached article recommends that no discount rate be used after 300 years. Id.

NJDEP has thus "[p]rovided a concise statement of the alleged facts [and] expert opinions" which support this contention. See 10 C.F.R. § 2.309(f)(1)(v). NJDEP has provided more than the "minimal factual and legal foundation in support of [its] contention." Duke Energy Corp., 49 NRC at 334.

CONTENTION 9

Shieldalloy argues there is no factual dispute concerning the DP's assumptions regarding site use restrictions. Sa page 72.

Specifically, the DP states three sets of restrictions: (A) current restrictions due to current natural resource restoration, (B) potential residential use restrictions due to chemically contaminated soil, and (C) the approximate proximity to the Pinelands National Reserve. Sa page 70. Shieldalloy argues that DEP did not dispute that these restrictions exist. Sa page 70. The DP suggests that these restrictions would limit future land use at the facility and NJDEP does dispute that these land use restrictions would limit future land uses. Specifically, NJDEP asserts that restrictions due to natural resource restoration requirements would eventually fail at some point during the billions of years that the Shieldalloy waste will remain a radioactive hazard. Goodman Report page 7. NJDEP further asserts that chemical contamination in the soil is currently being remediated under CERCLA and may be remediated to allow residential housing. Gaffigan Dec. ¶ 9. Furthermore, because the Shieldalloy facility is not located in the Pinelands National Reserve, it is not subject to Pinelands restrictions. These factual disputes demonstrate that a hearing is required pursuant to 10 C.F.R. § 2.309(f)(1)(vi).

Shieldalloy argues that it is speculative to believe that New Jersey would require remediation of its site to unrestricted use standards. Sa page 71. However, New Jersey law encourages remediating sites to unrestricted use. N.J.S.A. 58:10B-1.1

("unrestricted remedies for contaminated sites are preferable and the State must adopt policies that encourage their use"). Therefore, Shieldalloy should assume that the site will be remediated to unrestricted use standards and residents will live at the unrestricted released portions of the site. Goodman Report page 6.

CONTENTION 10

Shieldalloy presents a list of statements from this Contention of NJDEP's Hearing Request which it disagrees with. Such disagreement is sufficient to demonstrate material issues of fact in dispute, which requires a hearing under 10 C.F.R. § 2.309(f) (1) (vi).

CONTENTION 11

Shieldalloy argues that residual radioactivity in the surface water and sediment of the Hudson Branch Creek was sufficiently characterized based on 1991 results. Sa page 78. However, NJDEP has presented expert reports which present sufficient support that the site was not sufficiently characterized based on the 1991 sampling to determine the full extent of contamination in the surface water and sediments. Goodman Report page 17; Gaffigan Dec. ¶19. The 1991 data is not valid, as

detailed above in Contention 4. Goodman Report § 4.

Shieldalloy argues that there is no requirement for full characterization of the Hudson Branch Creek water and sediments. Sa page 80. However, full characterization is required for the Hudson Branch water and sediments as discussed above in Contention 4. NUREG-1757 Vol.1 rev.2 pages 16-22 through 16-29.

These disagreements are sufficient to demonstrate material issues of fact in dispute, which require a hearing under 10 C.F.R. § 2.309(f)(1)(vi).

CONTENTION 12

Shieldalloy argues that this contention impermissibly attacks 10 C.F.R. § 20.1403. Sa pages 81-84. However, as discussed below for Contention 15, NJDEP does not attack this regulation since the regulation actually prohibits use of the LTC license in this case.

Shieldalloy argues that the LLRWPA is not applicable to this case and therefore does not prevent the use of the LTC license. Sa page 84. However, the LLRWPA states that "[e]ach State shall be responsible for providing, either by itself or in cooperation with other States, for the disposal of--(A) low-level radioactive waste generated within the State." 42 U.S.C. § 2021c(a)(1). The term "disposal" is defined as "the permanent isolation of low-level radioactive waste pursuant to the

requirements established by the Nuclear Regulatory Commission under applicable laws." 42 U.S.C. § 2021b(7). Thus, the LLRWPA applies to the low-level radioactive waste at Shieldalloy's facility.

Shieldalloy also argues that NJDEP failed to support its argument that the LTC license conflicts with the AEA. Sa page 85. However, NJDEP's Hearing Request cited the declaration of Jennifer Goodman which stated that Shieldalloy's waste will remain a radiological hazard for billions of years. Goodman Dec. ¶ 2. It is self-evident that neither Shieldalloy nor a private third party trustee can be expected to endure for billions of years to enforce the LTC license. Therefore, the LTC license violates the LLRWPA by failing to isolate the radioactive waste and the AEA by failing to protect the public health and safety.

Shieldalloy's answer demonstrates there is a genuine dispute of law as to whether the LTC license conflicts with the LLRWPA and AEA. The dispute therefore requires a hearing. See 10 C.F.R. § 2.309(f)(1)(vi).

CONTENTION 13

Shieldalloy argues that NJDEP overlooked the language of 10 C.F.R. § 20.1003, which allows a facility to be decommissioned as long as residual radioactivity is at a level that permits release and termination of the license. Sa pages 85-89. However, NJDEP's Hearing Request acknowledges this language and argues that

the DP violates the LTR because residual radioactivity would not be reduced to a level that would permit release and termination of the license. As discussed above, it is self-evident that neither a private LTC licensee or a third party trustee will endure to enforce the institutional controls for the billions of years that the Shieldalloy waste remains a radiological hazard. Also, NJDEP's modeling indicates a TEDE of 1,718 mrem per year at year 800, Goodman Report page 11, which exceeds the limits required by the LTR, 10 C.F.R. § 20.1403(e). Therefore, residual radioactivity would not be reduced to a level that would permit release and termination of the license as required by 10 C.F.R. § 20.1003.

CONTENTION 14

Shieldalloy argues that it sufficiently elicited public opinion on the issues it was required to elicit under 10 C.F.R. § 20.1403(d). See pages 90-92. However, NJDEP's Petition for a Hearing explained that the SSAB members needed better information concerning the characterization of the slag and baghouse dust and the engineering design of the engineered cap. Gaffigan Dec. ¶ 5. There were many problems with the DP's characterization, including the fact that soil samples were sporadic and the EPA protocol for further analysis of water samples was not followed properly. Goodman Report page 1. The laboratory data was either not present, or had problems, like not meeting the required minimum detectable

activities (MDA). Id. Information regarding the engineering design was inadequate because the hydraulic conductivity of the native vadose zone material was a gross underestimate. Malusis Report page 4. No sorption tests were performed to verify that the underlying soil formations exhibit adsorption capacity for the contaminants of concern. Id. Despite the DP's assigning a sorption value to the underlying soil formations that is equal to the waste material itself, the nature of the underlying soils consisting primarily of sand, gravel, and little to trace silt means that the vadose zone and saturated zone materials are largely inert (i.e., do not participate in ion exchange reactions) and may provide little, if any, attenuation of inorganic contaminants (both radioactive and non-radioactive species) that leach from the waste mass. Id. Shieldalloy did not conduct adequate tests to evaluate the leachability of waste materials. Id. Pages 5-6. The SSAB was told about the recent leachability tests that were performed which they claimed demonstrated that the slag would not leach. The data was never provided until after the last SSAB meeting when the DP was submitted in October, 2005. Likewise, the dose modeling was not provided until after the last SSAB meeting when it was submitted in Rev. 1. This modeling was proven to be inadequate since the NRC rejected Rev. 1 of the DP. The SSAB never had an ALARA analysis until after the last SSAB meeting. SMC relied on the analysis done at the Cambridge, Ohio facility and cost estimates for disposal of

\$102-\$112 million, which were not accurate. See Exhibit A submitted with NJDEP's Hearing Request (Energy Solution's offer to transport, clean up and dispose of Shieldalloy's radioactive hazardous waste).

There was no information regarding the hydraulic performance of the cover. Id. page 7. At the time of the last SSAB meeting, a geomembrane was part of the engineered barrier design. While Shieldalloy now states that the geomembrane will not be utilized, the DP nevertheless relied on the geomembrane in developing its runoff coefficient. See DP rev. 1a page 73.

Had this information been provided to the SSAB, the SSAB could have provided better advice on whether the proposed institutional controls would assure that an average member of the public would not incur a radiation dose in excess of 25 millirem Total Effective Dose Equivalent ("TEDE"); whether the \$5 million financial assurance would be adequate to enable an independent third party to assume responsibility for control and maintenance of the site; and whether the proposed engineering design of the barrier was adequate. Gaffigan Dec. ¶¶ 5-6.

Shieldalloy also asserts that NJDEP's argument, that the DP failed to account for the strong public opposition to the plan, is lacking because the DP included transcripts or summaries of all four SSAB meetings and the DP attached letters from New Jersey officials expressing opposition to the DP. Sa pages 95-96. However, these attachments to the DP do not adequately "incorporate public

advice" into the DP as required by 10 C.F.R. § 20.1403(d). Incorporating public advice means using the public advice to affect the actual decommissioning activities that will take place. In this case, Shieldalloy's proposed decommissioning activities were not influenced at all by public advice.

Shieldalloy argues that it adequately addressed public opposition in the DP. Sa page 96. However, the SSAB advised that onsite disposal would be an undue burden on the community, but this was not incorporated into the DP. In fact, in their ALARA analysis, Shieldalloy actually contradicts the SSAB's advise by stating that aesthetic improvements associated with the engineered barrier could result in an increase in future land use value. DP rev. 1 page 89. The SSAB advised that institutional and engineering controls would not last for the duration of the radiological hazard, but this was not incorporated into the DP. The SSAB questioned how Shieldalloy would keep radioactivity from entering the groundwater and Shieldalloy responded that a geomembrane would be an integral part of the engineered barrier design, DP page 166, yet the geomembrane was later omitted from the DP, June 30, 2006 transmittal letter accompanying revision 1a of the DP, Page 7. The NJDEP believes that the DP should state, under section 16.5.4, that the SSAB was unanimously opposed to the LTC license option. NJDEP should not be required to propose a sufficient DP for Shieldalloy. However, because of the strong and universal public opposition to onsite

disposal, the DP should have proposed offsite disposal of the radioactive waste to an appropriate disposal facility.

To sum up, Shieldalloy failed to fully inform the SSAB of important data and details and thus deprived the SSAB of the opportunity for meaningful input into the DP which is now before the NRC for review. In addition, even the positions which the SSAB did have opportunity to express were not meaningfully incorporated in development of the DP.

CONTENTION 15

Shieldalloy argues that the LTC license is consistent with the License Termination Rule ("LTR") and that NJDEP fails to present any legal authority otherwise. Sa pages 97-98. However, the LTR's regulatory history states that for those cases involving long-lived nuclides, "[m]ore stringent institutional controls will be required in these situations, such as legally enforceable deed restrictions and/or controls backed up by State and local government control or ownership, engineered barriers, and Federal ownership, as appropriate." 62 Fed. Reg. at 39,070 (emphasis added). It is self-evident that the state, local or Federal government are the most likely entities to endure for the billions of years that the Shieldalloy waste will remain a radiological hazard. It is self-evident that a private LTC licensee or third party trustee will not endure to enforce the LTC license for

billions of years. Thus, this regulatory history actually supports NJDEP's argument that the LTC license conflicts with the LTR for long-lived nuclides.

Shieldalloy's answer demonstrates there is a genuine dispute of law as to whether the LTC license conflicts with the LTR. The dispute therefore requires a hearing. See 10 C.F.R. § 2.309(f)(1)(vi).

CONTENTION 16

Shieldalloy argues that the target of this contention is NUREG-1757 and not the DP. Sa page 99. However, the target of this contention is against the DP since the DP is seeking a LTC license for its long-lived nuclides. Issuing a LTC license in this case would violate NRC policy and thus be arbitrary and capricious. See Citizens Awareness Network v. NRC, 59 F.3d 284, 291 (1st Cir. 1995). NJDEP provided adequate support that issuance of the LTC license in this case is arbitrary and capricious based on NRC SECY documents on the Declaration of Jennifer Goodman, ¶ 5. Since SMC asserts throughout its answer that it is lawful for NRC to issue an LTC license, a genuine issue of law is in dispute that requires a hearing. See 10 C.F.R. § 2.309(f)(1)(vi).

CONTENTION 17

Shieldalloy argues this contention is not admissible and should be addressed through a rulemaking. Sa pages 103-104. However, since the AEA requires rules or regulations before NRC can issue the LTC license, NRC should accept this contention and stay the licensing proceeding/DP review until it acts on NJDEP's pending Petition for Rulemaking.

Selection of Hearing Procedures

This matter involves a request for approval of a decommissioning plan and issuance of the first long term control license by the NRC, plus establishment of the first permanent nuclear waste disposal site of its kind. The contentions advanced by NJDEP and the responses thereto by NRC Staff and particularly by Shieldalloy demonstrate that this is a matter involving numerous technical and factual disputes. The contentions and Shieldalloy's response demonstrate that the decommissioning plan submitted is confused, confusing and contradictory. Discovery in the form of interrogatories and depositions will be necessary to determine the basis and rationale for numerous aspects of the decommissioning plan. The scope of the proceeding will be governed by the contentions submitted and granted. This will prevent the proceeding from being unduly protracted. Discovery will ensure

that the opportunity for a hearing is meaningful, fair and produces an adequate record which supports agency decision making on matters related to the NRC's responsibilities for protecting public health and safety and the environment. CLI-98-12, 48 NRC 18 (July 28, 1998). Under the circumstances of this matter, the hearing procedures set forth in Subpart G, 10 C.F.R. 2.700, can and should be utilized.

CONCLUSION

In light of the preceding, the NJDEP respectfully requests NRC to grant a hearing regarding on the DP because Shieldalloy's proposed decommissioning will not protect the public health and safety and the LTC license sought by Shieldalloy will violate the law. A hearing should be granted because a genuine dispute exists regarding these issues.

Respectfully submitted,

STUART RABNER
ATTORNEY GENERAL OF NEW JERSEY

Dated: 2/27/07

By: Andrew D Reese

ANDREW D. REESE
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Exhibit A



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Exhibit B

**PERSPECTIVES ON RADIOACTIVE WASTE DISPOSAL: A CONSIDERATION OF
ECONOMIC EFFICIENCY AND INTERGENERATIONAL EQUITY**

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ABSTRACT

There are both internal and external pressures on the U.S. Department of Energy to reduce the estimated costs of isolating radioactive waste, \$19 billion for transuranic waste at Waste Isolation Pilot Plant (WIPP) and \$57 billion for high level waste at Yucca Mountain. The question arises whether economic analyses would add to the decision-making process to reduce costs yet maintain the same level of radiological protection. This paper examines the advantages and disadvantages of using cost-benefit analysis (CBA), a tool used to measure economic efficiency as an input for these decisions. Using a comparative research approach, we find that CBA analyses appear particularly applicable where the benefits and costs are in the near term. These findings can help policymakers become more informed on funding decisions and to develop public confidence in the merits of the program for waste disposal.

INTRODUCTION

The estimated costs of isolating unwanted long-lived radioactive residues through deep geologic disposal range from \$19 billion for transuranic waste at WIPP in New Mexico(i) to an excess of

\$57 billion for high level waste at the Yucca Mountain Project in Nevada. (ii) There are both internal and external pressures on the U.S. Department of Energy to reduce these high costs (iii, iv) yet maintain public confidence in each project. In high profile environmental projects such as these, policymakers are often conflicted between efforts to promote economic efficiency and efforts to promote public health for both present and future generations.

How useful are cost-benefit analyses for the formation of public policy decisions regarding nuclear waste disposal? Can policymakers assure the same level of radiological protection to both present and future generations utilizing cost-benefit analyses for comparisons? This paper examines the advantages and disadvantages of using cost-benefit analysis (CBA), a tool used to measure economic efficiency as an input in the decision-making process. We consider when CBA is an appropriate input in the decision making process and when other criteria such as intergenerational equity is more appropriate. This paper employs a comparative research approach (v) to examine the efficacy of CBA for public policy decisions on the disposal of nuclear waste.

This paper focuses on dynamic economic efficiency requirements and implications of using a positive discount rate to examine dollar values over short-term versus long-term time horizons. **The remainder of the paper is organized as follows. The next section presents background information on cost-benefit analysis, nuclear waste disposal, dynamic efficiency requirements, and inter-generational equity issues. The following section provides an example where a substantive cost-benefit analysis might have helped decision makers. A discussion of these follows. The final section contains concluding remarks.**

BACKGROUND

In evaluating the merits of any proposed endeavor, one generally compares the advantages to the disadvantages to see if it is worth pursuing. Analysts use CBA to quantify the benefits and costs of an endeavor. To do this, both need to be expressed in comparable monetary units and that the comparison be made at the same point in time. When comparing several options, efficiency requires the option where the net benefits are maximized. The implication of using efficiency as an input in regulatory decisions means that resources are being used optimally, a foundation of economic theory.

Critics often cite ethical and moral concerns in using CBA to evaluate regulations with public health and environmental dimensions.(vi) Other critics point to incomplete CBAs as evidence that that the technique is flawed.(vii) Others point to the seemingly impossible task of placing meaningful dollar values on reduced risks to present and future generations. Finally, critics point to the practice of discounting as problematic when comparing present costs and future benefits.

To address these and other criticisms of CBA, a group of economists developed eight principles

(viii) to guide evaluation of environmental, health and safety regulation. First, compare favorable and unfavorable effects and recognize uncertainties. Second, government agencies should not be precluded from using benefit-cost analysis when developing regulations or setting regulatory priorities. Third, require benefit-cost analysis for major regulatory decisions. Fourth, in regulatory decisions where costs are greater than benefits, recognize that factors other than economic efficiency such as equity within and across generations may be an important factor. Fifth, report best estimates of benefits and costs but care should be taken to assure that quantitative factors do not dominate important qualitative factors in decision-making. Sixth, subject CBA to external reviews. Seventh, create a standard format for presenting results (ix) and finally consider distributional consequences on subgroups of the population. Some principles are clearly administrative (principles 2, 3, 6, and 7) while others are evaluative (principles 1, 4, 5 and 8). The key concepts to gather from this list to be examined further in this paper are time horizon, intergenerational equity, and uncertainty. These principles can be used to examine projects such as the disposal of high level waste (HLW) and transuranic (TRU) waste where many of the benefits will be realized by future generations. The rest of this section is organized as follows: (A) history of CBA, (B) advantages and disadvantages of nuclear waste disposal, (C) use of ionizing radiation to dispose of nuclear waste, (D) dynamic economic efficiency, (E) intergenerational equity, (F) uncertainties, and (G) summary of advantages and disadvantages of CBA.

History of CBA for Environmental Decision Making

Quantifying costs and benefits for radiation protection is not new. The 1977 report by the International Committee on Radiation Protection (x) recommended the use of cost-benefit analyses in determining the acceptability of any operation involving exposure to radiation.

However, there are differences in the legal and administrative bases for economic comparisons using CBA. (xi, xii) When Congress passed various environmental protection laws, specific direction was provided to EPA on the use of CBA. Some Acts such as the Toxic Substances Control Act (TSCA) and the revision of the Safe Drinking Water Act require forms of CBA. Other environmental Acts such as the 1990 amendments to the Clean Air Act, Clean Water Act and Resource Conservation and Recovery Act require EPA to use "maximum achievable control technology." Strong requirements such as these preclude the use of CBA. (xiii) Both Acts dealing with transuranic and high level waste disposal are silent on whether to use CBA.

All Presidents since Carter have issued Executive Orders requiring some form of CBA. (xiv) Both President Reagan and President Clinton issued Executive Orders to federal agencies to do regulatory impact analyses. (xv, xvi)

Background on Nuclear Waste Disposal

Table I summarizes the advantages and disadvantages to present and future generations. The current generation is bearing the costs of the disposal of high level waste (HLW) and transuranic (TRU) waste now since this generation is also the beneficiary of operations that produced the waste; namely electricity from commercial power plants and national security from the deterrent of nuclear weapons. The EPA Standards for TRU waste disposal (xvii) and HLW (xviii) limit radioactive releases for 10,000 years in order to limit adverse health effects of latent cancer fatalities during that period. Local near-term benefits for both TRU and HLW are economic. Costs include small health risks currently and the avoidance of major long-term health risks. We present our results with respect to the relationship between nuclear waste disposal, CBA and intergenerational equity issues below.

Table I: Summary of Major Costs and Benefits of TRU and HLW Disposal

	Costs of Disposal	Benefits of Disposal
Present Generation	To be paid now	Electricity from nuclear power(HLW)
Present Generation	To be paid now	Nuclear weapons deterrence (TRU)
Long-Term Future Generations	Small number of calculated health effects	Prevention of large number of health effects from HLW and TRU

Using ionizing radiation to dispose of nuclear waste

USDOE devotes significant resources to limit the release of long-lived ionizing radiation sources containing mixed fission products and actinides through deep geologic disposal to prevent ionizing radiation exposure to present and future generations.

There are both short term and long term aspects of disposal. Short term considerations include worker and public safety issues. This section considers ionizing radiation sources used in nuclear waste disposal. The extent that ionizing radiation sources are routinely used to aid in the safe disposal of ionizing radioactive waste is generally not recognized. The benefits of these applications used routinely at WIPP are believed to outweigh the risks. We believe the following seven examples of the beneficial use of ionizing radiation should be quantified for both TRU and HLW and the results published to show the merits of these applications. Note that these applications generally entail only 1×10^{11} Becquerel (Bq) (a few curies) in contrast to the 3×10^{17} Bq (7.5 million Curie) WIPP operational inventory or the 5×10^{20} Bq, (10 billion Curie) Yucca Mountain Project inventory.

1. Site characterization

To determine the characteristics of a potential underground site, gamma ray sources are lowered in a borehole and the extent of absorption or Compton scattering provides information on the soil composition. Similarly, neutron sources (produced by Americium-241 alpha particles reacting with Beryllium-9) provide information on any hydrogenous material present by the scattering distribution.

2. Quantity of radioactivity in the drums containing waste

The scattering of neutrons passed through the drums of TRU waste determines the identity and measures the quantity of actinides. This non-invasive procedure does not require the vented drums to be opened, thus avoiding unnecessary radiation worker exposure.

3. Presence of prohibited items in drum

Radiography (X-Ray) helps identify RCRA banned items of pressurized containers in the drums of waste and this non-invasive procedure also avoids the need to open the drums for inspection.

4. Shipping container integrity

The TRUPACT pressure vessels undergo radiography to determine the efficacy of the welds. (xix)

5. Radiation detection instrumentation

Survey meters, such as ionization chambers and Geiger Muller counters, use the principle of ionization to measure the presence of radiation. Radioactive alpha, beta, and gamma sources are routinely used in the various WIPP Laboratories such as EEG's to calibrate equipment such as proportional counters. Biological uptake studies use Carbon-14 and Tritium.

6. Tracer Studies

While tracer studies have not been used at WIPP, the observed migration of cesium-137 from underground weapons testing at the Nevada Test Site provides empirical knowledge on the travel behavior of that fission product for breach and leach calculations.

7. Worker health

Diagnostic radiology (X-Ray), such as chest X-rays, mammography, and CT scans, is used to detect tissue abnormalities.

Non-ionizing radiation applications include lasers in the mine to insure proper alignment in drilling tunnels and ultrasound has been investigated to measure thickness of drums. It also illustrates that ionizing radiation from radioactive waste disposal is not unique. Quantifying advantages and disadvantages of each of these applications helps develop public confidence that

our actions are appropriate.

Dynamic Efficiency: Time Horizon and Discount Rate

There are many different relevant time horizons for the disposal of nuclear waste. Some of these time horizons involve current generations while others involve hundreds of future generations.

These alternative time horizons (t) in nuclear waste disposal require use of a discount rate to conduct a CBA. The discount rate (r) enables economists to compare future values (FV) of dollars with present values (PV). Two formulas (a) discrete formula where

$$PV = FV (1 + r)^{-t} \quad (\text{Eq. 1})$$

and (b) continuous formula where

$$PV = FV e^{-rt} \quad (\text{Eq. 2})$$

As t becomes very large, the results of both equations approach zero. A positive discount rate greater than 0 is based on the following two assumptions of impatience and productivity of capital. Table II summarizes the relationship between alternative discount rates and time horizons using the continuous formula. The shaded area of Table II represents present values of less than 1% (or 1.00 E-02) of the future value.

Table II shows that for a discount rate equal to 5% or more and a time horizon of 100 years or more leads to a present value of 0. Thus any benefit cost analysis comparing present costs with benefits to future generations of more than 100 years will never pass a cost-benefit test. What is the appropriate discount rate to use for WIPP and Yucca Mountain? This is a subject of great debate with respect to the type of project, public versus private and the desire to emphasize risk reduction benefits to future generations.

Intergenerational Equity

In 1999, Resources for the Future (RFF) published papers by 20 eminent economists convened at a forum sponsored by RFF and the Electrical Power Research Institute (EPRI) to address the issue whether cost benefit analyses of long-term projects should be discounted, what the rate should be, or whether it is even appropriate to use CBA at all in decision-making for the disposal of high level wastes.(xx) The overall view, published by RFF concluded that some form of discounting was appropriate, albeit with limitations, and the rate should be positive.

Weitzman(xx) recommended a stepwise sliding scale in which the rate should be 3 to 4% for the first 25 years, 2% for the next 50 years, 1% for the following 225 years and then drop to zero

Table II: Present Value of \$1 in Future Assuming Different Time Horizons (t) and Discount Rates (r)

Time Horizon		Alternative Discount Rates (r)													
Years (t)	0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%		
1	\$1	\$ 9.90E-01	\$ 9.80E-01	\$ 9.70E-01	\$ 9.61E-01	\$ 9.51E-01	\$ 9.42E-01	\$ 9.32E-01	\$ 9.23E-01	\$ 9.14E-01	\$ 9.05E-01	\$ 8.96E-01	\$ 8.87E-01		
10	1	9.05E-01	8.19E-01	7.41E-01	6.70E-01	6.07E-01	5.49E-01	4.97E-01	4.49E-01	4.07E-01	3.68E-01	3.33E-01	3.01E-01		
20	1	8.19E-01	6.70E-01	5.49E-01	4.49E-01	3.68E-01	3.01E-01	2.47E-01	2.02E-01	1.65E-01	1.35E-01	1.11E-01	9.07E-02		
30	1	7.41E-01	5.49E-01	4.07E-01	3.01E-01	2.23E-01	1.65E-01	1.22E-01	9.07E-02	6.72E-02	4.98E-02	3.69E-02	2.73E-02		
40	1	6.70E-01	4.49E-01	3.01E-01	2.02E-01	1.35E-01	9.07E-02	6.08E-02	4.08E-02	2.73E-02	1.83E-02	1.23E-02	8.23E-03		
50	1	6.07E-01	3.68E-01	2.23E-01	1.35E-01	8.21E-02	4.98E-02	3.02E-02	1.83E-02	1.11E-02	6.74E-03	4.29E-03	2.73E-03		
60	1	5.49E-01	3.01E-01	1.65E-01	9.07E-02	4.98E-02	2.73E-02	1.50E-02	8.23E-03	4.52E-03	2.21E-03	1.06E-03	4.57E-04		
70	1	4.97E-01	2.47E-01	1.22E-01	6.08E-02	3.02E-02	1.50E-02	7.45E-03	3.74E-03	1.84E-03	8.14E-04	3.57E-04	1.42E-04		
80	1	4.49E-01	2.02E-01	9.07E-02	4.08E-02	1.83E-02	8.23E-03	3.74E-03	1.84E-03	8.14E-04	3.57E-04	1.42E-04	5.27E-05		
90	1	4.07E-01	1.65E-01	6.72E-02	2.73E-02	1.11E-02	4.52E-03	1.84E-03	7.45E-04	2.94E-04	1.12E-04	4.02E-05	1.31E-05		
100	1	3.68E-01	1.35E-01	4.98E-02	1.83E-02	6.74E-03	2.48E-03	9.42E-04	3.65E-04	1.26E-04	4.24E-05	1.37E-05	3.71E-06		
200	1	1.35E-01	1.83E-02	2.48E-03	6.65E-04	1.52E-04	3.14E-05	6.32E-06	1.13E-06	1.62E-07	2.06E-08	2.72E-09	3.28E-10		
300	1	4.98E-02	2.48E-03	1.26E-04	6.14E-05	1.06E-05	1.52E-06	2.38E-07	3.72E-08	5.68E-09	8.36E-10	1.26E-10	1.82E-11		
400	1	1.83E-02	6.35E-04	2.01E-05	4.41E-06	7.06E-07	1.06E-07	1.69E-08	2.57E-09	3.94E-10	5.91E-11	8.73E-12	1.31E-12		
500	1	6.74E-03	1.64E-04	3.93E-06	8.06E-07	1.29E-07	1.93E-08	2.86E-09	4.25E-10	6.38E-11	9.38E-12	1.39E-12	2.06E-13		
600	1	2.48E-03	6.14E-05	1.52E-06	3.74E-07	9.36E-08	2.32E-08	5.75E-09	1.43E-09	3.33E-10	6.76E-11	1.27E-11	1.88E-12		
700	1	9.42E-04	3.32E-07	7.58E-10	1.69E-11	3.31E-12	5.75E-13	9.24E-14	1.47E-14	2.36E-15	3.98E-16	6.63E-17	1.03E-17		
800	1	3.35E-04	1.13E-07	2.78E-11	1.27E-14	2.25E-18	1.43E-21	2.78E-25	1.60E-28	5.38E-32	1.80E-35	6.05E-39	2.03E-42		
900	1	1.23E-04	1.52E-08	1.88E-12	2.32E-16	2.86E-20	3.53E-24	4.36E-28	5.38E-32	6.64E-36	8.19E-40	1.01E-43	1.25E-47		
1000	1	4.54E-05	2.06E-09	9.36E-14	4.25E-18	1.93E-22	8.76E-27	3.98E-31	1.80E-35	8.19E-40	3.72E-44	1.69E-48	7.67E-53		
10000	1	3.72E-14	1.38E-17	5.15E-18	1.92E-174	7.12E-216	2.65E-261	9.86E-305	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		

after 300 years. Cropper and Laibson (xxii) recommended hyperbolic discounting which leads to a lower annual discount rate in the distant future. Lind (xxiii) notes that the use of discount rates does not provide a complete basis for decision making or for determining what is an optimal policy. The majority of the participants had similar reservations.

Public health officials and environmentalists often disagree with the emphasis economists place on the present as opposed to future values to generations far in the future. So how do we provide assurance that the residual long-term intergenerational risks of health effects are reasonable and equitable? Basically, try to design repositories so as to limit the predicted long-term detriment to future generations to be comparable to allowable radiation doses considered to be acceptable to society today. Hence the issue of selecting an appropriate method to calculate today's value of benefits over a 10,000 year period has, in effect, been sidestepped.

Uncertainties

Developments in science may continue to change the values of benefits in the future. For example, will the allowable annual exposure of 15 millirem (mrem) be an acceptable criterion over the long term future? During atmospheric weapons testing at the Nevada Test Site in 1957, the AEC guide for off-site radiation exposure to any person was 3.9 Roentgen per test series which was essentially the same standard used in previous Nevada test series. (xxiv) The total exposure to any person should not exceed 3.9 Roentgen. This is approximately equal to 3900 mrem. We now consider 15 mrem per year to the reasonably maximally exposed individual to be acceptable for waste disposal in the area adjacent to the Nevada Test Site for the next 10,000 years. (xxv)

Summary of CBA

Table III reports the advantages and disadvantages of CBA. The punchline is that the CBA appears to be useful as an input for short term projects but not long term.

Table III: Advantages and Disadvantages of CBA

Advantages	Disadvantages
Use economic efficiency as an input in decision-making process	Economic efficiency does not include equity (either present and/or future). Difficult to include values for future generations, a significant part of the equity standard.
Monetary values understandable to general public	Seemingly straightforward CBA results on the surface require complex and potentially controversial assumptions based on science, resource requirements of the present generation, and resource requirements of future generations.
Useful as an input in short term analyses	The longer the time horizon, the greater the uncertainties

EXAMPLE

An example where either CBA or cost comparisons might have helped in a decision-making process was the decision to ship TRU waste by truck. DOE announced its decision to transport TRU waste to WIPP initially by truck while reserving the option to use commercial rail transportation in the future. (xxvi) One of the primary factors they based this decision on was dedicated trains are more expensive than trucks. While dedicated rail is significantly more expensive than trucks, shipments could be made by regular rail which is one-third the cost of truck.

While examining the advantages and disadvantages of both truck and rail, Neill and Neill (xxvii) estimate a \$600 million savings for using rail at Hanford and INEEL for both CH and RH TRU waste. These findings were examined by the National Academy of Sciences who made a similar recommendation to reevaluate the use of rail for WIPP. (xxviii) Clearly a more rigorous analysis of both the benefits and costs subject to external review before a decision is final might have saved tax payers significant resources.

DISCUSSION

This section discusses the implications of our findings. First, CBA does not appear to be appropriate for all stages of nuclear waste disposal. Given the relative short time horizons where one can make meaningful comparisons between present costs and future benefits, one cannot use CBA when deciding whether or not to build a repository. Given Table II, any time horizon

greater than 50 years will not pass a benefit-cost test. Obviously a time horizon of 50 years is significantly less than the 10,000 year standard for both TRU and HLW.

Second, seemingly straightforward CBA results on the surface require careful examination by external reviewers. Oftentimes the assumptions may not capture important complexities in science, politics and needs of present and future generations.

Finally, the longer the time horizon, the greater the uncertainty. The needs of future generations are not clear. We face tradeoffs between benefits of preventing harm (reducing risks) to future generation and alternative uses of resources today. What will make future generations better off, preventing harm or increasing consumption (nuclear power and nuclear deterrence)? From an economic perspective, current consumption levels build the infrastructure of today and tomorrow (better schools, highways, standard of living etc.). From a public health and intergenerational equity perspective, we owe it to future generations to properly manage our unwanted radioactive residuals.

CONCLUSION

We find that CBA appears particularly applicable where the benefits and costs are in the near term. An inventory of ionizing radiation sources used to help in the disposal of ionizing radiation waste is presented. We find cost benefit analyses applied to long term horizons are problematic and require careful consideration of intergenerational equity issues. These findings can help policymakers become more informed on funding decisions and to develop public confidence in the merits of the program for waste disposal. Along these findings we recommend the following:

1. USDOE should perform CBA analyses on the RCRA requirements for the non-radiological characterization of Mixed TRU waste to determine whether the benefits exceed the costs.
2. USDOE should publish CBA on the various ionizing radiation sources used to insure the safe disposal of ionizing radioactive waste at both WIPP and Yucca Mountain.

The challenges of conducting CBA for intermediate term projects are formidable, but such quantification can contribute substantially to providing a firmer basis for justification to policymakers for funding those projects that are in the national interest and help develop public confidence. While this generation has a moral responsibility to properly manage our unwanted radioactive residuals, it is important to try to calculate the net worth of our actions. These analyses require consideration of not only economic issues, but require consideration of technical, social, logistical, and political issues as well.

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Exhibit C

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary ...	2
Site-Specific Parameter Summary	5
Summary of Pathway Selections	10
Contaminated Zone and Total Dose Summary	11
Total Dose Components	
Time = 0.000E+00	13
Time = 1.000E+00	14
Time = 1.000E+01	15
Time = 3.000E+01	16
Time = 1.000E+02	17
Time = 1.000E+03	18
Time = 1.000E+04	19
Time = 1.000E+05	20
Dose/Source Ratios Summed Over All Pathways	21
Single Radionuclide Soil Guidelines	22
Dose Per Nuclide Summed Over All Pathways	23
Soil Concentration Per Nuclide	24

Dose Conversion Factor (and Related) Parameter Summary
 File: FGR 13 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(2)
B-1	Pb-210+D	2.320E-02	2.320E-02	DCF2(3)
B-1	Ra-226+D	8.600E-03	8.600E-03	DCF2(4)
B-1	Ra-228+D	5.080E-03	5.080E-03	DCF2(5)
B-1	Th-228+D	3.450E-01	3.450E-01	DCF2(6)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(7)
B-1	Th-232	1.640E+00	1.640E+00	DCF2(8)
B-1	U-234	1.320E-01	1.320E-01	DCF2(9)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(10)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(11)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(2)
D-1	Pb-210+D	7.270E-03	7.270E-03	DCF3(3)
D-1	Ra-226+D	1.330E-03	1.330E-03	DCF3(4)
D-1	Ra-228+D	1.440E-03	1.440E-03	DCF3(5)
D-1	Th-228+D	8.080E-04	8.080E-04	DCF3(6)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(7)
D-1	Th-232	2.730E-03	2.730E-03	DCF3(8)
D-1	U-234	2.830E-04	2.830E-04	DCF3(9)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(10)
D-1	U-238+D	2.690E-04	2.690E-04	DCF3(11)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(2,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(3,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(3,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(3,3)
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,3)
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(5,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,3)
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(6,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)
D-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
 File: FGR 13 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(7,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(7,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(7,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(8,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(8,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(8,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(9,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(9,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(9,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(10,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(10,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(10,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(11,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(11,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(11,3)
D-5				
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(2,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(2,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(4,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(4,2)
D-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(5,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(5,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(6,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(6,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(7,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(7,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(8,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(8,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(9,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(10,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(10,2)
D-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(11,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(11,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.823E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.800E+00	2.000E+00	---	THICKO
R011	Length parallel to aquifer flow (m)	1.350E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.000E+02	2.500E+01	---	BRDL
R011	Time since placement of material (yr)	4.300E+01	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	1.000E+01	3.000E+00	---	T(3)
R011	Times for calculations (yr)	3.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.000E+02	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+03	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+04	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+05	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Ac-227	1.600E+01	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Pa-231	3.590E+02	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Pb-210	3.590E+02	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Ra-226	3.590E+02	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Ra-228	3.590E+02	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Th-228	3.590E+02	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): Th-230	3.590E+02	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): Th-232	3.590E+02	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): U-234	3.590E+02	0.000E+00	---	S1(9)
R012	Initial principal radionuclide (pCi/g): U-235	1.600E+01	0.000E+00	---	S1(10)
R012	Initial principal radionuclide (pCi/g): U-238	3.590E+02	0.000E+00	---	S1(11)
R012	Concentration in groundwater (pCi/L): Ac-227	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Pa-231	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Pb-210	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Ra-228	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Th-228	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): Th-230	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(9)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(10)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(11)
R013	Cover depth (m)	1.000E+00	0.000E+00	---	COVERO
R013	Density of cover material (g/cm**3)	1.900E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	2.800E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	4.650E-05	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.000E+03	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	2.880E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	4.250E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	6.250E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.050E+00	1.000E+00	---	PRECIP

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R013	Irrigation (m/yr)	0.000E+00	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.600E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.520E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	2.200E+04	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	2.880E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	2.500E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.650E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+04	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Ac-227				
R016	Contaminated zone (cm**3/g)	2.400E+03	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.549E-05	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Pa-231				
R016	Contaminated zone (cm**3/g)	2.700E+03	5.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.376E-05	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.714E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	5.300E+01	7.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.003E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Ra-228				
R016	Contaminated zone (cm**3/g)	5.300E+01	7.000E+01	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.003E-04	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Th-228				
R016	Contaminated zone (cm**3/g)	5.201E+04	6.000E+04	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.146E-07	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for Th-230				
R016	Contaminated zone (cm**3/g)	5.201E+04	6.000E+04	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.146E-07	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for Th-232				
R016	Contaminated zone (cm**3/g)	5.201E+04	6.000E+04	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.146E-07	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	7.036E+04	5.000E+01	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.283E-07	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	7.036E+04	5.000E+01	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.283E-07	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	7.036E+04	5.000E+01	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.283E-07	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	3.000E-05	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	not used	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	not used	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	1.800E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	not used	8.894E+01	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm ³)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	1	---	---	LYMAX
TITL	Maximum number of integration points for risk	1	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	suppressed
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Exhibit D

Page : 1
DOS File : SMC_INF.MS5
Run Date : February 26, 2007
Run Time : 2:15:15 PM
Duration : 00:00:00

File Ref: SMC
Date: 2/26/07
By: E. Truskowski
Checked: J. Goodman

Case Title: shield alloyCase 1
Description: 3, 20 and 100 ft from 6 ft infinite slab
Geometry: 16 - Infinite Slab



Source Dimensions
Thickness 100.0 cm 3 ft 3.4 in

Dose Points
#.1 X 130.48 cm 4 ft 3.4 in
Y 0 cm 0.0 in
Z 0 cm 0.0 in

Shields			
Shield Name	Dimension	Material	Density
Source	Infinite	Concrete	2.8
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	$\mu\text{Ci/cm}^3$	Bq/cm ³
Ac-227	1.0000e-005	3.7000e-001
Ac-228	1.0000e-003	3.7000e+001
Bi-210	1.0000e-003	3.7000e+001
Bi-211	1.0000e-005	3.7000e-001
Bi-212	1.0000e-003	3.7000e+001
Bi-214	1.0000e-003	3.7000e+001
Fr-223	1.4000e-005	5.1800e-001
Pa-231	1.0000e-005	3.7000e-001
Pa-234	1.3000e-006	4.8100e-002
Pa-234m	1.0000e-003	3.7000e+001
Pb-210	1.0000e-003	3.7000e+001
Pb-211	2.8000e-006	1.0360e-001
Pb-212	1.0000e-003	3.7000e+001
Pb-214	1.0000e-003	3.7000e+001
Po-210	1.0000e-003	3.7000e+001
Po-211	1.0000e-003	3.7000e+001
Po-212	6.4000e-004	2.3680e+001
Po-214	1.0000e-003	3.7000e+001
Po-215	1.0000e-005	3.7000e-001
Po-216	1.0000e-003	3.7000e+001

<u>Nuclide</u>	<u>μCi/cm³</u>	<u>Bq/cm³</u>
Po-218	1.0000e-003	3.7000e+001
Ra-223	1.0000e-005	3.7000e-001
Ra-224	1.0000e-003	3.7000e+001
Ra-226	1.0000e-003	3.7000e+001
Ra-228	1.0000e-003	3.7000e+001
Rn-219	1.0000e-005	3.7000e-001
Rn-220	1.0000e-003	3.7000e+001
Rn-222	1.0000e-003	3.7000e+001
Th-227	9.8600e-004	3.6482e+001
Th-228	1.0000e-003	3.7000e+001
Th-230	1.0000e-003	3.7000e+001
Th-231	1.0000e-005	3.7000e-001
Th-232	1.0000e-003	3.7000e+001
Th-234	1.0000e-003	3.7000e+001
Tl-207	9.9700e-004	3.6889e+001
Tl-208	3.6000e-004	1.3320e+001
U-234	1.0000e-003	3.7000e+001
U-235	1.0000e-005	3.7000e-001
U-238	1.0000e-003	3.7000e+001

Buildup
 The material reference is : Air Gap

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Results</u>			
		<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	8.300e-04	2.235e-07	2.539e-07	1.917e-08	2.178e-08
0.02	7.820e-02	7.092e-05	9.752e-05	2.457e-06	3.378e-06
0.03	1.251e-01	5.525e-04	1.303e-03	5.476e-06	1.291e-05
0.04	4.628e-01	5.558e-03	2.020e-02	2.458e-05	8.936e-05
0.05	5.258e+00	1.236e-01	7.633e-01	3.293e-04	2.033e-03
0.06	1.933e+00	7.269e-02	6.613e-01	1.444e-04	1.314e-03
0.08	2.691e+01	1.857e+00	2.199e+01	2.939e-03	3.480e-02
0.1	6.281e+00	6.382e-01	8.006e+00	9.764e-04	1.225e-02
0.15	1.749e+00	3.257e-01	3.616e+00	5.364e-04	5.954e-03
0.2	3.004e+01	8.362e+00	7.142e+01	1.476e-02	1.261e-01
0.3	2.449e+01	1.195e+01	8.305e+01	2.266e-02	1.575e-01
0.4	1.516e+01	1.107e+01	6.096e+01	2.157e-02	1.188e-01
0.5	5.811e+00	5.826e+00	2.743e+01	1.144e-02	5.385e-02
0.6	2.984e+01	3.888e+01	1.566e+02	7.589e-02	3.056e-01
0.8	1.569e+01	3.111e+01	1.046e+02	5.917e-02	1.990e-01
1.0	3.352e+01	9.255e+01	2.691e+02	1.706e-01	4.960e-01
1.5	1.201e+01	6.124e+01	1.406e+02	1.030e-01	2.365e-01

Page : 3
DOS File : SMC_INF.MS5
Run Date : February 26, 2007
Run Time : 2:15:15 PM
Duration : 00:00:00

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
2.0	1.002e+01	7.908e+01	1.609e+02	1.223e-01	2.487e-01
3.0	1.329e+01	1.935e+02	3.445e+02	2.625e-01	4.674e-01
TOTALS:	2.327e+02	5.366e+02	1.454e+03	8.689e-01	2.466e+00



JON S. CORZINE
Governor

State of New Jersey
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STUART RABNER
Attorney General

ROBERT J. GILSON
Director

February 27, 2007

Re: NJDEP's Reply to the Response of the NRC Staff and
NJDEP's Reply to the Answer of Shieldalloy
Docket No. 40-7102

To Attached Service List:

This office represents the New Jersey Department of Environmental Protection ("NJDEP"), which previously filed a Petition for a Hearing on the Shieldalloy Metallurgical Corporation (License No. SMB-743) Decommissioning Plan. Enclosed for filing, please find copies of NJDEP's Reply to the Response of the NRC Staff and NJDEP's Reply to the Answer of Shieldalloy.

Thank you for your attention in this matter.

Sincerely yours,

STUART RABNER
ATTORNEY GENERAL OF NEW JERSEY

By: Andrew D. Reese

Andrew D. Reese
Deputy Attorney General

Encl.

