From: "Bill Kennedy" <kennedy@moellerinc.com>
To: "'Jennifer Opila'" <jennifer.opila@state.co.us>
Date: 8/10/05 9:39AM
Subject: RE: CHDT Dose to Nearby Residents

Jennifer

Sorry it has taken me this long to provide responses to your questions on the potential dose to nearby residents. My responses are provided in the word file attached. Please let me know if you have any other comments, questions, or concerns.

Bill.

-----Original Message-----
From: Jennifer Opila [mailto:jennifer.opila@state.co.us]
Sent: Friday, July 22, 2005 11:48 AM
To: kennedy@moellerinc.com
Cc: Steve Tarlton; Tom Pentecost
Subject: CHDT Dose to Nearby Residents

Bill,
One of the requirements for issuance of the radioactive materials license for Clean Harbors Deer Trail is that the applicant demonstrates with reasonable assurance that the general population will be protected from any release to the environment that would result in an annual dose greater than 25 mrem to any organ. (RH 14.11.3 and RH 14.19). The modeling for doses to nearby residents are provided in your response dated May 24, 2005. I have the following questions:

1. Does the NCRP 123 model provided in response 3 include doses to nearby residents from radon during operations? With only 6 inches of clean cover going over the waste after disposal, will there be a problem with radon emissions during operations?

2. The modeling provided shows that whole body doses would be less than 25 mrem/year, but it does not address the organ dose. Can you provide me with some documentation that would bridge the modeling you have given me to an organ dose of less than 25 mRem/year for the isotopes you are planning on taking?

Please feel free to give me a call if you need clarification on my questions.

Thank you,

Jennifer T. Opila, Health Physicist
Radiation Management Unit
Hazardous Materials and Waste Management Division
Colorado Department of Public Health and Environment
303-692-3403

CC: "'Steve Tarlton'" <steve.tarlton@state.co.us>, "'Tom Pentecost'" <tom.pentecost@state.co.us>

RESPONSE TO EMAIL COMMENTS FROM JENNIFER OPILA
Comments Provided July 22, 2005

Background: One of the requirements for issuance of the radioactive materials license for Clean Harbors Deer Trail is that the applicant demonstrates with reasonable assurance that the general population will be protected from any release to the environment that would result in an annual dose greater than 25 mrem to any organ. (RH 14.11.3 and RH 14.19). The modeling for doses to nearby residents are provided in your response dated May 24, 2005. I have the following questions:

Question 1. Does the NCRP 123 model provided in response 3 include doses to nearby residents from radon during operations? With only 6 inches of clean cover going over the waste after disposal, will there be a problem with radon emissions during operations?

In a previous response to comments (dated May 24, 2005), for Comment 6 we provided an analysis of the capability of the cap to mitigate radon emissions for the post closure period. The response relied on a conservative RESRAD analysis to determine the maximum dose to an individual standing over the closed site with a 1 m cap over the waste. In response to this question, the RESRAD analysis was modified to consider only 0.1 m of cover soil. The resulting dose was about 75 mrem/yr. The best estimate evaluation would consider an average waste concentration of 20% of the values shown, resulting in about 15 mrem/yr individual doses. A dispersion factor of 0.001 is applied to account for the air concentration at the location of the nearest resident. The resulting best estimate dose is about 0.015 mrem/y, which is well within the public dose limit of 25 mrem/y for facility operations.

Following the RESRAD analysis, consideration was given to the first of five elements of Criterion 6 in 6 CCR 1007-1, Part 18 for uranium and thorium waste processing and disposal:

The first criterion requires limitation of the radon releases to be less than 20 pCi per square meter per second. Using the RESRAD inhalation dose result for ^{222}Ra, the effective air concentration is estimated by dividing the reported inhalation dose by the inhalation dose conversion factor, to get the pCi inhaled in a year, then dividing this result by the amount of air inhaled in a year. This calculation is as follows:

$$[(75\ mrem/yr)/(8.6E\text{-}3\ mrem/pCi)] / (5{,}256\ m^3 per\ yr) = 1.6\ pCi/m^3$$

Dividing this air concentration by the wind speed (i.e., 2 m/s) yields the release rate as 0.83 pCi per square meter second. This result is less than the release rate criterion of 20 pCi per square meter second, and indicates that the release rate condition will likely be met.

Question 2. The modeling provided shows that whole body doses would be less than 25 mrem/year, but it does not address the organ dose. Can you provide me with some documentation that would bridge the modeling you have given me to an organ dose of less than 25 mRem/year for the isotopes you are planning on taking?

The NCRP 123 models report only the total effective dose equivalent - TEDE (i.e., the committed effective dose equivalent from inhalation and ingestion, plus the dose equivalent from external exposure). The TEDE is derived using a different dosimetry system (i.e., ICRP 26/30) than was used as the basis of the original NRC 10 CFR Part 61 (i.e., ICRP 2); thus direct comparisons are somewhat difficult to make since radionuclide contributions to organ dose for both inhalation and ingestion must be evaluated. The NRC usually accepts the TEDE at 25 mrem/yr to show compliance since it urges the use of consistent dosimetry following the latest revisions to 10 CFR 20. However, a best estimate of organ doses can be made using information from ICRP 26/30 for inhalation and ingestion for the "critical" organs associated with the radionuclides identified in Table 1 of our response to Comment 3 of the Department's April 20, 2005 Request for Information. Critical organs are those that receive the highest dose (thus, all other organs receive less than the critical organs). For the radionuclides in the assessment, the critical organ for most heavy metal radionuclides is bone surface. For completeness, we also considered red bone marrow, kidneys, and lungs (for the limiting solubility class for each radionuclide). For this estimate, the best-estimate individual radiation dose as described in response to Comment 3 of the Department's April 20, 2005 Request for Information is used. The best estimate is found by accounting only for wind effects on exposed (uncovered) waste for 2,000 hr/yr (rather than 8,760 hr/yr) and assuming waste concentrations are on average 20% of the maximum concentrations in the waste acceptance criteria. The best estimate of the TEDE is less than 1.0 mrem/yr, or about 0.38 mrem/yr. Using information from ICRP 26/30, the estimated organ doses are provided in the table below. Note that the limiting organ is bone surface, with a dose of 24 mrem/yr. This "best estimate" it is still considered bounding since it assumes that all of the waste received is radioactive waste, for 2,000 hr/yr of operations, with no down time (because of wind, snow, or rain), or no time spent handling other RCRA waste.

Radionuclide	TEDE	Red Bone Marrow	Bone Surface	Kidney	Lung
^{238}U+D	7.1E-02	3.2E-01	5.7E+00	2.4E+00	7.5E-01
^{234}U+D	3.8E-02	1.0E-01	1.6E+00	6.8E-01	8.6E-01
^{232}Th+D	5.2E-02	2.3E-01	1.9E+00	2.1E-02	2.4E-01
^{230}Th+D	5.8E-02	3.0E-01	2.4E+00	9.0E-04	6.3E-01
^{226}Ra+D	1.1E-01	3.8E-01	6.2E+00	1.8E-01	2.3E-01
^{210}Pb	3.8E-02	2.9E-01	6.0E+00	7.3E-01	2.1E-04
^{40}K	5.3E-03	1.1E-02	1.3E-02	1.1E-02	1.1E-02
Total	3.8E-01	1.6E+00	2.4E+01	4.0E+00	2.7E+00