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YUCCA MOUNTAIN – REQUEST FOR ADDITIONAL INFORMATION – VOLUME 2, CHAPTER 2.1.1.5, SET 1 (DEPARTMENT OF ENERGY'S SAFETY ANALYSIS REPORT SECTION 1.8) – Consequence Analyses

Reference: Ltr, Jacobs to Williams, dtd 07/22/09, "Yucca Mountain - Request For Additional Information – Volume 2, Chapter 2.1.1.5, Sets 1 & 2 (Department of Energy's Safety Analysis Report Section 1.8)"

The purpose of this letter is to transmit the U.S. Department of Energy (DOE) response to Request for Additional Information (RAI) number 8, identified in the above-referenced letter. The response and one DOE document cited in the response are provided as separate enclosures. DOE previously submitted its responses to RAI numbers 5 and 7 on August 21, 2009, RAI numbers 1, 2, and 6 on October 1, 2009, RAI number 3 on October 8, 2009, and RAI number 4 on October 15, 2009. This submittal completes DOE's responses on Set 1 of the Consequence Analysis RAIs.

A DOE reference, not previously submitted to NRC, is provided on an optical storage media (OSM) as Enclosure 2. Additionally, an OSM, provided as Enclosure 3, contains electronic attachments associated with the reference. The electronic attachments on the OSM are data files provided in their native file format, consistent with Sections 2.2 and 2.17 of the NRC guidance on electronic submissions. They are required by NRC staff in their native format to evaluate DOE's responses. The electronic attachments are not intended to be placed on or accessed through ADAMS and will be made available to the public, upon request.

There are no commitments in the enclosed RAI response. If you have any questions regarding this letter, please contact me at (202) 586-9620, or by email to jeff.williams@rw.doe.gov.

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OTM: SEG-0049

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Enclosures (3):
1. Response to RAI Volume 2, Chapter 2.1.1.5, Set 1, Number 8
2. Optical Storage Media – DVD containing one reference
3. Optical Storage Media – DVD containing electronic reference attachment

cc w/enclosure 1:
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EIE Document Components:
[186474]_000-00C-MGR0-05400-000-00A.pdf 2,276 KB

RAI Volume 2, Chapter 2.1.1.5, First Set, Number 8:

> Provide technical basis for the conversion factors used for radiation worker doses due to different throughput assumptions and direct radiation source terms. BSC (2008al, Table 3) presents annual maximum and nominal worker doses at individual facilities from normal operations. For example, in SAR Table 1.8-25, DOE reports an operator dose of 1.3 rem in the Receipt Facility as the maximum individual annual worker dose from operations in any surface or subsurface facility. However, in BSC 2008b, Section 7, DOE reports 4.5 rem as the estimated annual dose to an individual operator in the Receipt Facility.

1. RESPONSE

The *GROA Worker Dose Calculation* (BSC 2008a) provides a compilation of potential worker doses from all sources in the geologic repository operations area. The dose calculation (BSC 2008a, Table 3) provides two sets of annual worker dose estimates from facility normal operations, labeled as "maximum" and "nominal" individual worker doses. The "maximum" worker dose of 4.5 rem per year for the Receipt Facility (RF) (BSC 2008a, Table 3) is from *Receipt Facility Worker Dose Assessment* (BSC 2008b, Section 7). The "nominal" worker dose of 1.3 rem per year in Table 3 (BSC 2008a) is derived from the "maximum" worker dose of 4.5 rem per year adjusted by two scaling factors. The first scaling factor is used to adjust the throughput of the RF to be consistent with a processing rate of 210 casks/year, corresponding to the maximum repository annual rate of receipt. The second scaling factor is used to adjust the transportation cask external radiation dose rate to be consistent with the dose rate based on a design basis source term. Similar scaling factor calculations were used for the other surface facilities.

The "maximum" worker doses in Table 3 (BSC 2008a) are based on estimated maximum waste form processing capabilities of each individual facility and maximum source terms for dose rate estimates, as described in the response to RAI 2.2.1.1.5-006. The sum of these individual facility processing capability estimates is 1,055 casks/year, of which 273 casks/year pass through the RF. This sum is double the entire repository maximum annual rate of receipt (i.e., full operating capacity) described in SAR Section 1.2.1.1.2, which is equivalent to approximately 500 casks/year, of which 210 casks/year pass through the RF. Therefore, facility "maximum" worker dose estimates reflect worker doses greater than those for the repository at full operating capability with the repository maximum annual rates of receipt.

A throughput scaling factor for RF is used to adjust the "maximum" worker dose of 4.5 rem. The scaling factor is the ratio of the waste processing rate of 273 casks/year to a processing rate of 210 casks/year, corresponding to the maximum repository annual rates of receipt. The throughput scaling factor is 1.3 (273/210).

A second scaling factor adjusts the cask external radiation dose rates due to lower expected radiation source terms. This scaling factor adjusts the "maximum" worker doses for the expectation that over a year period, transportation casks received at the RF will realistically contain a mix of commercial spent nuclear fuel (SNF) assembly burnups and cooling times with

radiation source terms on average lower than the source terms allowed by the transportation cask licensed designs. Consequently, the annual average dose rates from transportation casks are expected to be lower than the regulatory limit allowed for transport. The dose rate scaling factor is estimated to be 2.7 based on a comparison of calculated radial surface dose rates at 1 m from a 21-PWR waste package containing commercial SNF with a maximum source term (80 GWd/MTU and 5 years decay) to a waste package containing commercial SNF with a design basis source term (60 GWd/MTU and 10 years decay). The radial surface at 1 m is axially divided into nine segments and dose rates compared for each segment. The range of scaling factors (i.e., ratios of calculated maximum to design basis dose rates) for the nine segments of the waste package model is represented by a value of 2.7 (plus or minus 10%).

Because worker doses primarily involve transportation cask activities rather than waste package activities and the average SNF source terms are expected to be lower than both the maximum and design basis source terms, a subsequent calculation substantiates that the value of 2.7 is conservative for transportation cask application with average SNF characteristics. The calculation is based on a comparison of dose rates in both axial and radial directions from a conceptual transportation cask carrying a transportation, aging, and disposal canister loaded with either commercial pressurized water reactor SNF design basis or average (48 GWd/MTU and 25 years decay) source terms (BSC 2008c). The design basis source term covers a minimum of 95% of the existing and projected fuel inventory. The average source term represents the average characteristics of the entire existing and projected fuel inventory. Scaling factors based on dose rates from design basis and average SNF source terms are representative of the existing distribution of commercial SNF assembly burnups and cooling times. All of the calculated axial and radial dose rate scaling factors determined from the design basis SNF and average SNF dose rates are greater than 4.8 (BSC 2008c, Tables 31, 32, and 33). Therefore, the selected dose rate scaling factor of 2.7 is conservative.

Application of the two scaling factors, 1.3 and 2.7, to the "maximum" annual worker dose of 4.5 rem for an operator in the RF results in an annual worker dose of 1.3 rem (4.5 /[1.3 × 2.7]). The 1.3 rem value is reported in the dose calculation (BSC 2008a, Table 3) in the column labeled "Nominal Individual Worker Dose" and reported in SAR Table 1.8-25. This worker dose estimate reflects the condition of the entire repository at full operating capability, as stated in SAR Section 1.2.1.1.2.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

BSC (Bechtel SAIC Company) 2008a. *GROA Worker Dose Calculation.* 000-PSA-MGR0-01400-000-00C. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20080327.0010.

BSC 2008b. *Receipt Facility Worker Dose Assessment*. 200-00C-RF00-00100-000-00B. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20080331.0003.

BSC 2008c. *Dose Reduction Factors Between Different Source Terms in a Cask*. 000-00C-MGR0-05400-000-00A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20081210.0012.