UNC RESPONSES TO NRC GROUP 1 RAI CLARIFICATION COMMENTS

RAI 6.3-3: Items 2 and 3 of this RAI and Response

NRC staff seek clarification because there appears to be a misunderstanding of the appropriate means and methods to determine CDE or TODE. Specifically, item 2 calls out the most restrictive NALI dose conversion factor for Th-230(W) being 7.99E+06 mrem/uCi which is a dose conversion factor for bone while the nat U and Ra-226 dcf's are for the lung. Item 3 calls out that the dose to the lung appears to be the most restrictive organ dose but will not include the contribution from Th-230. Stantec provided a reason for excluding Th-230 when determining lung dose that does not make logical sense as the reasoning would likely apply to all radionuclides in ore being inhaled and not just Th-230.

Staff's review of the non-stochastic dcf's for the most insoluble class of radionuclides in ore found that the bone surface may marginally exceed the lung (by ~5%) for most affected organ when considering only the long-lived radionuclides (i.e., nat U, Th-230, Ra-226, Pb-210, and Po-210). However, as noted in RG 8.7, Section 2.4, it is not necessary to calculate the TODE if CEDE is <1 rem and DDE is <5 rem. As such, Stantec may wish to review the organ dose determination method to see if calculating dose to lung vs bone surface would be appropriate and note that it is unlikely determining the TODE would be necessary assuming exposures are generally less than 1 rem CEDE.

NRC staff note that RG 8.34 contains guidance on calculating organ dose. However, given the approach being taken in Attachment L-1, Section 5.2, staff consider there are at least two ways Stantec could account for organ dose from the radionuclides in ore. The 1st being that Stantec could utilize the most conservative organ dose conversion factors in FGR 11 for each radionuclide and class of material and sum the resulting dose to get a conservative estimate of the most exposed organ. The 2nd being that Stantec could first identify the most affected organ then utilize the appropriate dose conversion factors for that organ and eventually sum the dose from each contributing radionuclide. To correctly include organ dose on any report to the individual or NRC and avoid human error, Stantec should revise Attachment L-1, Section 5.2, to reflect the use of the appropriate dose conversion factor and values/methods. Staff further note that any dose determination likely should include Th-230, Pb-210, Po-210, and "short lived" Rn daughter contributions, if significant.

Response:

> ***RAI 6.3-3, Item 2:*** *Section 5.2 of Attachment L-1 will be revised. First to state consistent with RG 8.7, if the CEDE is >1 rem (1000 mrem) and the DDE is less than 5 rem (5000 mrem), the CDE for the maximally exposed organ will be calculated to determine the TODE. Second, the most conservative organ dose conversion factors in Federal Guidance Report (FGR) 11 for each radionuclide, which are for bone surface Class D, as listed below, will be used for calculating CDE:*
>
> *U-238: 3.64E+04 mrem/µCi Ra-226: 2.81E+04 mrem/µCi*
> *U-234: 4.03E+04 mrem/µCi Pb-210: 2.02E+05 mrem/µCi*
> *Th-230: 7.99E+06 mrem/µCi Po-210: 1.49E+03 mrem/µCi*
>
> *The resulting CDE from each radionuclide will be summed to get a conservative estimate of the bone surface, which is the most exposed organ.*

RAI 6.3-3, Item 3: *As indicated in the response to Item 2 above, Th-230 will be included in the dose calculations. Section 5.2 of Attachment L-1 will be revised by removing the text that states that Th-230 is not included in the dose calculation.*

P.S. Staff recommend Stantec verify the inhalation rate (IR) given in section 5.2 for calculating dose from inhalation. ICRP 23 reference man inhalation rate is 20 L/min (1.2 m^3/hr or 1.2 E+6 mL/hr…check units).

Response:

The typo for the inhalation rate (IR) in Section 5.2 of Attachment L-1 will be revised to read 1.2E+06 ml/hr

RAI6.3-5: Inclusion of Pb-210 in Section 5.8.

Staff seek clarification as to why Pb-210 is not included in the list of radionuclides in Section 5.8 and Q.4.1.2 when the RAI response says it would be.

Response:

Pb-210 was not included in the list of radionuclides because internal radiation dose from inhalation is generally from alpha radiation emitters, while Pb-210 is a beta emitter. Po-210, an alpha emitter and a decay product of Pb-210, is included in the list of radionuclides, which would have accounted for internal radiation dose, specifically the committed dose from Pb-210. Nevertheless, Po-210 in the list of radionuclides in Section 5.8 of the Attachment L-1 will be replaced by Pb-210. The Pb-210 concentration will be determined based on the alpha activity of Po-210.

Also, for Section Q.4.1.2, now that Stantec includes Po-210 in its list of alpha emitters, it should consider revision of this section to state that Th-230 is now 20% of the total alpha activity or remove the statement as it does not pertain to the derived action limit.

Response:

Section Q.4.1.2 will be revised to state that Th-230 is 20% of the total alpha activity.

RAI 6.3-7/6.3-9: Revision/correction of MDC equations

Staff seek clarification as to why the MDC equation in RPP SOP-2 and attachment Q.2, pg 4, has parentheticals around the term 2.71 + 3.29.

Response:

The RPP SOP-2 and Attachment Q.2 will be revised to remove parentheticals around the term 2.71 + 3.29 in the MDC equation.

Also, clarify the use of the "FA" term vs the "FE" term in the equations.

The term Filter Absorption (FA) is for the correction of alpha radiation attenuation during counting due to air particulates embedded in deeper pores of glass fiber filters. The term Filter Efficiency (FE) is for the air particulate collection efficiency of the type of filter paper, which may be provided by the filter paper producer.

RAI 6.3-11: Release of Equipment and Material

Staff seek clarification why Stantec would not refer to the 1987 guidelines for decommissioning which are also referred to in license condition 11 of SUA-1475 instead of limits in RG 8.30, Table 2. Doing so would both avoid confusion as to the applicability of the limits cited and clarify the need to assess long lived radionuclides and exposure rates separately as noted in the footnotes of the 1987 guidelines. For ore, staff consider it to be necessary to address all the long lived radionuclides listed in the 1987 guidelines separately when applying the limits.

Example for determining a gross alpha "average" limit (assuming gross alpha measurement only where the Po-210 alpha, further assumed to be in secular equilibrium with other long lived alpha emitting radionuclides in the decay chain, has a limit consistent with Th-232 limits [see Table 1 of Draft ANSI N13.12]). The gross alpha measurement is assumed to originate equally from alphas emitted from U-238, U-234, Th-230, Ra-226, and Po-210. Limits are listed for all but Po-210 in the guidelines.

$$\text{Avg Limit} = \frac{1}{\left(\frac{0.4}{U_{nat}\ limit}+\frac{0.2}{Th{-}230\ limit}+\frac{0.2}{Ra{-}226\ limit}+\frac{0.2}{Po{-}210\ limit}\right)}$$

$$\text{Avg Limit} = \frac{1}{\left(\frac{0.4}{5000}+\frac{0.2}{100}+\frac{0.2}{100}+\frac{0.2}{1000}\right)} = \text{approx. 234 dpm/100 cm}^2\text{ Gross alpha}$$

Response:

The equipment and material release contamination levels for uranium recovery facilities established in Table 2 of the RG 8.30 are taken from the 1987 guidelines for decommissioning (NRC, 1987), as noted in the RG 8.30 footnote. The surface contamination release levels specified in RG 8.30 and the 1987 guidelines for decommissioning are for uranium and its daughters (U-nat, U-235, U-238, and associated decay products), which address all long-lived daughters, including daughters from ore. Thus, the levels specified in Attachment L-1, which match the RG 8.30 levels, are appropriate, and calculating a gross contamination limit from individual radionuclides is not necessary. The equipment and material release surface contamination levels specified in Table 2 of RG 8.30 are for uranium recovery facilities and are used at uranium mill sites, including the NECR mill site (SUA-1475), as approved by the USNRC. The health physics surveys at the NECR mill site, which includes equipment release surveys for unrestricted use, have been inspected by USNRC.

UNC will use the gross alpha surface contamination levels specified in Attachment L-1 for release of equipment and material impacted by uranium mine waste. However, if surface contamination on any equipment or material is impacted by 11e.(2) licensed material (uranium mill tailings), gross surface contamination levels for alpha and beta-gamma will apply independently for the release of equipment and material as indicated by the footnote of Table 1 of the 1987 guidelines for decommissioning. Section 7.0 of Attachment L-1 will be revised to indicate that surveys for gross alpha and gross beta-gamma contamination will be performed independently for compliance with release survey limits for any equipment or material impacted by tailings material.