SC&A TALKING POINTS ON THE SEC PETITION EVALAUTION REPORT FOR THE BAKER BROTHERS SITE IN TOLEDO, OH (SEC-00204)

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On February 18, 2013, SC&A was asked to read the Special Exposure Cohort (SEC) Petition Evaluation Report (PER) for the Baker Brothers site in Toledo, Ohio, and be prepared to discuss any concerns we might have at the TBD-6000 meeting scheduled for February 21, 2013. The following talking points are provided to help facilitate that discussion. These talking points should not be interpreted as findings.

(1) The Baker Brothers facility performed AWE operations in the very early years (1943 and 1944) of the MED program. The activities primarily involved machining uranium rods for use as reactor fuel at Hanford. The Baker Brothers facility was one of the first AWE facilities and apparently encountered many of the first unanticipated radiation protection challenges associated with handling uranium, including many uranium fires. Because of the trial and error nature of this early AWE work, the lack of bioassay data, the very limited air sampling data, and the fires, NIOSH recommended an SEC for all workers at the facility from June 1, 1943, to December 31, 1944. This is the time period when AWE work was performed. The SEC was recommended because of the inability to reconstruct internal exposures to uranium during the AWE operations period. We concur with this recommendation for the reasons cited in the PER.

(2) NIOSH believes that external exposures can be reconstructed with sufficient accuracy during the AWE period, because bounding but plausible assumptions can be made regarding the external radiation field in the vicinity of the uranium metal, including penetrating and non-penetrating radiation. SC&A concurs with this conclusion. However, we have some concerns regarding the assumptions used with respect to exposure durations and skin exposures that might have occurred from the direct deposition of uranium particles on exposed skin (e.g., face and neck).

(3) The SEC does not include workers whose exposure potential was less than 250 days, presumably because NIOSH has judged that there was no potential for short-term exposures comparable to those associated with a criticality accident (as defined in the Act). Some discussion is needed regarding the indoor uranium fires and the potential for very high intakes of uranium over a short time period due to the fires.

(4) Given that an SEC was recommended for the operations period, the PER focuses on the residual period and the FUSRAP cleanup period, i.e., January 1, 1945, to December 31, 1996. Therefore, the following talking points address potential issues associated with the approach NIOSH has adopted for reconstructing external and internal exposures during this extended time period.

(5) Contamination survey and air sampling data were first collected during the residual period in the 1980s, which apparently was the beginning of site characterization activities under the FUSRAP program. In addition, considerable data, including bioassay data, were collected during the actual FUSRAP remediation, which took place in the 1990s. It would appear that sufficient data are available to reconstruct doses beginning sometime in the 1980s. However, we have some questions regarding some of the assumptions and approaches identified in the PER to reconstruct external and internal exposures during the approximate 40-year period beginning January 1, 1945.

(6) NIOSH explains that the basic approach used to reconstruct doses beginning January 1, 1945, and up to the FUSRAP time period in the 1980s is to make use of the guidance provided in TBD-6000, ORAUT-OTIB-0070, and OCAS-TIB-009. We agree that these guidance documents are useful in addressing exposures during the residual periods at AWE facilities, especially when there is limited or no dosimetry or bioassay data or data characterizing the radiation fields and levels of surface and airborne contamination. However, TBD-6000 and OTIB-0070 provide an array of lookup tables and protocols that require a degree of judgment regarding how the guidelines will be applied to particular situations. In the following talking points, we would like to point out some of the critical assumptions and strategies used in the PER that we believe require discussion.

(7) The single most important starting assumption used to reconstruct the external and internal exposures during the residual period is that the airborne dust loading at the end of the operations period was 5,480 dpm/m^3, and that the surface contamination at the beginning of the residual period was the amount of uranium that would accumulate on surfaces from the deposition of this airborne activity over a 30-day period. In essence, the surface contamination level beginning in January 1, 1945, is derived in the PER as follows:

$$5{,}480 \text{ dpm/m}^3 \times 0.00075 \text{ m/sec} \times 30 \text{ days} \times 24 \text{ hrs/day} \times 3{,}600 \text{ sec/hr} = 1{,}065{,}312 \text{ dpm/m}^2 \text{ gross alpha (see page 36 of the PER)}$$

There are reasons why this is a good starting point for these calculations, but there are also some questions regarding this value and these assumptions that need to be explored. The value of 5,480 dpm/m^3 comes from Table 7.5 of TBD-6000, which in turn comes from Harris and Kingsley (1959[1]). This value is the geometric mean (GM) of <u>2 DWA values</u> (5,000 and 6,000 dpm/m^3) reported in Harris and Kingsley for an unspecified number of facilities and unspecified number of measurements that were made at a time of very limited ventilation for centerless grinding operations. What does all this mean as applied to the Baker Brothers facility? On the favorable side, centerless grinding operations are clearly a type of machining operation that was associated with the highest uranium dust levels. For example, inspection of Table 7.5 of TBD-6000 reveal that the GMs of DWAs for lathing operations, the types of operations that took place at the Baker Brothers facility, ranged from 67 to 245 dpm/m^3 (GM, DWA). From this perspective, the value chosen by NIOSH for the starting point for this calculation might be conservative

[1] Harris, W.B. and I. Kingsley 1959. *The Industrial Hygiene of Uranium Fabrication.* American Medical Association Archives of Industrial Health, May 1959, Vol. 19, pp. 540-565; SRDB Ref ID: 15779

by a factor of more than 20. However, there are a number of possible issues that need to be explored. The values in Table 7.5 of TBD-6000 are DWAs, which means that they reflects the daily time-weighted average exposures experienced by a worker, not the average airborne dust loading in the room, which is the parameter of interest when deriving the buildup of residual radioactivity on surfaces. It is our sense that, notwithstanding this issue, the use of the centerless grinding DWA is likely a bounding value for the average airborne dust loading at the Baker Brothers facility toward the end of its AWE operations. For perspective, the highest airborne concentration from the limited samples reported for Baker was 456 dpm/m^3. Based on discussion in the PER, the process was under better control in 1944 when the sample was taken.

(8) The story gets more complicated because of the numerous fires that occurred at the facility in 1943. Keep in mind that we are interested in the amount of surface contamination at the beginning of the residual period on January 1, 1945, and that NIOSH derived this value using the above-described dust loading, and that deposition occurred for a 30-day period (as prescribed in TBD-6000) without any removal activity just prior to the termination of AWE activities. Unless there was cleanup after every fire, the buildup of surface activity during operations might have been well in excess of the value derived in the PER as the starting point for this calculation. Without some evidence of cleanup after each fire, there is little reason to believe that there is any relationship between the airborne dust loadings reported in TBD-6000 (and by Harris and Kingsley) and the airborne dust loading used in the PER for the Baker Brothers facility.

(9) Given that there was cleanup after each fire, and we accept that 5,480 dpm/m^3 is a plausible bounding uranium dust loading for the types of operations that took place at the Baker Brothers facility, the assumption that deposition took place for a 30-day period seems rather arbitrary. It might be more appropriate to assume that the last fire occurred in 1943 (we might be able to confirm that this is, in fact, the case), and that dust accumulation occurred over the last year of AWE operations (i.e., 1944). Such an assumption might increase the derived dust loading on surfaces at the beginning of the residual period by about a factor of 10.

(10) An alternative approach to deriving the dust loading on surfaces at the beginning of the residual period is to make use of Table 6.4 of TBD-6000. Table 6.4 provides an array of values of the annual exposures due to surface contamination at AWE facilities for different time periods (beginning with “up to 12/31/1950”), for different processes (such as “machining”), and for different job categories (such as “operator”). Values for non-penetrating exposures (mR/yr) and beta exposures (mrad/yr) are provided. These values can be used to back-calculate the uranium surface contamination levels associated with these radiation fields, which might serve as a more appropriate basis for the contamination levels at the Baker Brothers facility at the beginning of the residual period on January 1, 1945. Of course, this strategy has the same limitation as the airborne dust loading assumption because of the “fires” issue.

(11) Given that we can settle on a reasonably bounding surface contamination level for the beginning of the residual period, two questions need to be discussed; the resuspension factor of 1E-6/m and the natural attenuation factor of 0.164/yr used in the PER to derive

both the external and internal exposures as a function of time during the residual period. The natural attenuation factor of 0.164/yr corresponds to a value of 0.00045/day. You might recall that OTIB-0070 adopted a natural attenuation factor of 0.00067/day, and that the Procedures Review Subcommittee concurred with the value. Hence, we concur with this natural attenuation factor. However, we believe that there is a need for some discussion of the resuspension factor of 1E-6/m, which is the subject of the next talking point.

(12) If there is evidence of cleanup immediately following the termination of AWE operations, we believe that the assumed surface contamination levels, as described above, and a resuspension factor of 1E-6/m are certainly bounding assumptions. However, without cleanup, 1E-6/m might not be adequately bounding, at least for the early years of the residual period. As you might recall, one of the topics discussed as part of the review of OTIB-0070 is the fact that the resuspension factor and the natural attenuation rate are coupled. If there is a high resuspension factor (e.g., 1E-5 or 1E-4/m), the rate at which the residual uranium would decline might be rapid. For a worker present for the entire residual period, that worker would be assigned a higher dose if a low resuspension rate (e.g. 1E-6/m) and low natural attenuation rate (e.g. 0.00067/day) were used, as compared to a high resuspension factor and high natural attenuation rate. The converse is likely the case for a worker that might have been present during only a few years at the beginning of the residual period. Perhaps this issue is best addressed on a case-by-case basis.

(13) We note that the PER assumes an ingestion intake for 1945 of 1.5E06 pCi (p. 36). The equivalent inhalation intake is 1.38 E04 pCi (4.8pCi/m^3 × 1.2 m^3/hr × 2,400hr/yr). Unless there are extraordinary circumstances, inhalation intakes should be substantially greater than ingestion intakes. We believe that the problem lies in selecting 5,480 dpm/m^3 for the dust concentration used to derive ingestion during the residual period.

(14) In Section 7.3.4.1 of the PER, NIOSH cites Table 6-1 in TBD-6000 as the source for photon exposures and states in Table 7-3 of the PER, for example, that the photon dose for 1945 is 2,500 mr/yr. The problem is that Table 6-1 reports photon doses (mrem/hr) and no adjustment is made for this in developing Table 7-3 of the PER. This difference can have a significant impact on dose conversion factors used for particular organ doses.

(15) In the same section, NIOSH states that, "Non-penetrating skin doses can be derived from radiation survey data found in the 1989 radiological survey of the Baker Brothers site." The reason for adopting this approach rather than using the data in Table 6-4 of TBD-6000 should be discussed.

(16) In Section 7.3.4.2, NIOSH presents an approach to calculate external doses during the residual period. NIOSH should explain why this approach is preferable to using the initial surface concentration, the dose conversion factors in Table 3-10 of TBD-6000, and the value of lambda (Equation 1) to provide the external doses for each year of the residual period.