MEMO

TO: TBD-6000 Work Group

FROM: Bill Thurber and John Mauro, SC&A

DATE: October 14, 2013

SUBJECT: Response to Comments Regarding Time to Reach Equilibrium for the Buildup of Uranium on Surfaces

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The purpose of the recent SC&A white paper (SC&A 2013) provided to the TBD-6000 Work Group was to ascertain whether or not the use of a 30-day settling period to achieve equilibrium between dust settling and removal was supported by the data in Adley et al. 1952. The equilibrium settling time was calculated using the equation:

Settling time = Surface contamination ÷ airborne concentration ÷ settling velocity

The surface contamination was measured at the Hanford Melt Plant on plates exposed in various areas of the plant for 117 or 158 days. The air concentrations were averages of measurements taken over extended periods throughout the plant. The settling velocity was obtained based on the theoretical terminal settling velocity for 5 µm AMAD spherical particles (0.00075 m/s) and adjusting the value for particle shape and slip of the particles between air molecules. The adjusted settling velocity was 0.00052 m/s. Since the Melt Plant operated only one shift per day, the airborne concentrations were adjusted downward to reflect that fact. It should be emphasized that the initial purpose of these calculations was not to determine whether the TBD-6000 default settling value was a conservative construct in dose reconstruction, but rather to determine the best values from the Adley data. SC&A's calculations showed that there was considerable variability in the calculated equilibrium settling times in various areas of the Melt Plant, as shown in Table 1.

Table 1. Recalculation of Equilibrium Settling Times Based on Average Adjusted Air Concentrations

Location	Days to Equilibrium
Furnace Room – Winter	55.4
Furnace Room – Spring	166.1
Burnout Room – Winter	88.0
Saw Room – Winter	118.6
Saw Room – Spring	67.8
Main Bay – Winter	15.7
Main Bay – Spring	17.4

Within the large main bay area of the plant, equilibrium was achieved in 16–17 days. In more confined areas, times as high as 166 days were required to reach equilibrium.

Given this range of calculated equilibrium times, it is useful to consider how this information might affect dose reconstruction. For example, if the dose reconstructor was advised to use a

default assumption that deposition occurred 24 hours per day, 7 days per week, then the effective air concentrations would be increased by a factor of 3.14 (24/10.7 × 7/5). Correspondingly, the days to equilibrium in Table 1 would be reduced by that factor. Under that scenario, use of a 30-day settling time would be appropriate and sometimes conservative for most of the examples in Table 1. However, even with such a default assumption regarding the settling hours per week, some of the areas in the Melt Plant would still have required more than 30 days to reach equilibrium. For example, if one averaged the winter and spring values for the furnace room, the time to reach equilibrium would be 35 days using the default deposition time assumption. Similarly, the time to reach equilibrium in the saw room would be 33 days. However, use of a default value for the terminal settling velocity of 0.00075 m/s would further decrease these settling times by a factor of 1.4 (0.00052/0.00075). With these corrections, all of the Adley results could be explained with equilibrium settling times of less than 30 days.

If the dose reconstructor is required to assume that deposition is continuous for 30 days to calculate the amount settled on a surface and to use a default value for the terminal settling velocity of 0.00075 m/s, then based on the information presented here, the amount deposited will not be understated.

Reference

Adley, F.E., W.E. Gill, and R.H. Scott, 1952. *Study of Atmospheric Contamination in the Melt Plant Building*, USAEC report HW-233352 (Rev.). Hanford Works, Richland, Washington. April 4, 1952.

SC&A 2013. *Comments on the NIOSH White Paper, "TBD 6000 Review by SC&A, Determination of Settling Time,"* Draft White Paper, Rev. 0. SC&A, Inc., Vienna, Virginia. October 7, 2013.