TO: Advisory Board on Radiation and Worker Health Work Group on TBD-6000
FROM: Robert Anigstein and John Mauro, SC&A
SUBJECT: Reply to NIOSH Response to SC&A Memo
DATE: June 11, 2012

Reply to NIOSH Response to SC&A Memo Dated May 30, 2012

Background

On May 30, 2012, we prepared a memo (Anigstein and Mauro 2012) updating our previous reviews of the NIOSH assessment of internal doses at GSI. On June 8, 2012, Allen (2012) issued a response to our memo. The present memo presents our reply to Allen's report.

Intakes During Uranium Handling Operations

After reviewing Allen's (2012) report, we concur that the uranium intakes during uranium handling operations that are listed in Appendix BB (Allen and Glover 2007) are consistent with the scenario described in the text of that document. We agree that the uranium intakes during uranium handling operations are consistent with the annual hours assigned by Allen and Glover to such operations, the assumption that the operators were exposed during only one-half of these hours, the default breathing rate of 1.2 m^3/h of workers engaged in light activity, and an airborne activity concentration of 198 dpm/m^3. We also agree that the NIOSH calculation of the exposure duration of workers during the uranium handling operations is consistent with the assumed duration of settling of the airborne dust, used to calculate the areal activity concentrations on contaminated surfaces.

Duration of Uranium Handling Operations

Although the calculations of this scenario are mathematically correct, we do not agree with the underlying assumptions. As we stated earlier:

> [T]here are different accounts of the uranium radiography procedures from former betatron operators, including accounts of brief "corner shots," presumably to determine the amount of defective metal in the casting that needed to be sawed off, as well as shots of "betatron slices." Evidence was also found for the radiography of relatively thin ingots produced at Weldon Spring, which would have required shorter radiographic exposures and would thus have led to a higher fraction of time spent by operators in the shooting room, in the proximity of the uranium. (Anigstein and Mauro 2012)

Furthermore, uranium was handled during its transportation to the betatron building, being transferred from a truck or rail car to the internal electric railway within the GSI foundry, creating the opportunity for the generation of additional dust. It is not clear that such handling

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would have been included in the hours of radiography covered by the purchase orders. Such handling operations, however, would be offset by the time consumed by the radiographic exposures. In the interest of a bounding calculation, we recommend that the entire time allotted to radiography of uranium in the Mallinckrodt purchase orders be used in calculating both the intakes during uranium handling operations and the accumulation of uranium dust on contaminated surfaces. This would have the effect of doubling the intakes of uranium, which would yield a plausible and claimant-favorable result.

We previously noted that the earliest Mallinckrodt purchase order, covering the period March 1, 1958–June 30, 1958, estimated a cost of $500/mo at an hourly rate of $16. This implies an expenditure of 31.25 h/mo, or 375 h/y. We believe that, in the absence of other documentation of the early period of AEC operations at GSI, these annual hours of uranium radiography should be assigned to the period January 1,1953–June 30, 1958 (Anigstein and Mauro 2012). Allen (2012) cited an invoice from General Steel Castings (GCC), as the company was then known, originally submitted to Mallinckrodt in February 1958, in the amount of $48 (Brownfield 1958b), and concluded that this implies a lower level of expenditure prior to the above-mentioned purchase order. We note that this invoice refers to a period during which GSI was not under contract to Mallinckrodt, since it states that

> We are submitting the attached invoice and requisition for payment without a purchase order because the requirement was completed prior to our receipt of the requisition.
>
> Based on the cost of a previous contract, this price is fair and equitable and should be paid as received. (Brownfield 1958a)

Apparently, GCC did the work to fulfill a request from Mallinckrodt prior to the receipt of a formal purchase order, presumably the one issued on March 6, 1958, covering the period of March–June. There is no basis for assuming that the earlier purchase orders, of which no records have been found, were for a smaller expenditure of effort. The purchase orders show that the level of effort was reduced from 31.25 h/mo in the March–June period to 28.125 h/mo in July–October. One could just as easily argue that the level of effort in the March–June period was lower than in the previous periods. The most reasonable and claimant-favorable assumption would be to assign a duration of uranium handling activities 31.25 h/mo or 375 h/y to the period January 1,1953–June 30, 1958.

Resuspension Factor

We have consistently questioned the use of a resuspension factor (RF) of 1×10^{-6} m^{-1} for freshly deposited activity in the intervals between uranium handling operations during the period of AEC operations, and during the residual period. In both cases, the resuspension would be from surfaces which include areas subjected to pedestrian and vehicular traffic and could be one or more orders of magnitude higher than the assumed value. Allen (2012) responded that this "issue was transferred from the TBD-6000 review to the procedures work group because they were reviewing the issue as part of the OTIB-70 review." However, we note that the newly

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revised OTIB-70 (Sharfi 2012), issued on March 5, 2012, states: "In cases, where the contaminated area is still involved in active operations, a site-by-site analysis of the appropriateness of the 1×10^{-6} m^{-1} resuspension factor should be done." At the most recent meeting of the procedures work group, on April 11, 2012, Mr. Sharfi stated that the OTIB constituted a guidance document for the use of the RF of 1×10^{-6} m^{-1}. SC&A was tasked at that meeting with looking at the revised version to make sure that the work group's findings were incorporated as stated. Assuming, as it now appears likely, that this issue is in the process of being closed by the procedures work group, it becomes the responsibility of each site profile review team to insure that the proper value of RF is used in the exposure assessments. Thus, this issue needs to be confronted on a site-specific basis.

Chu (2012) adopted an RF value of 5×10^{-5} m^{-1} for assessing intakes of chemically stable metal tritides at the Mound Laboratory during the period following the end of tritide operations. This was the median RF value presented by Beyler et al. in NUREG/CR-5512, vol. 3, as cited by Sharfi (2012). We believe that 5×10^{-5} m^{-1} is a plausible bounding value to apply during the the intervals between uranium handling operations, as well as during the residual period. As we stated earlier (Anigstein and Mauro 2012), NIOSH may choose to avail itself of the exponential interpolation described by Sharfi (2012, section 4.1.4) to model the surficial contamination levels during the residual period.

GSI Annual Work Hours

We note that Allen (2012) stated that all new GSI exposure assessments would be based on 3,250 work-hours per year. Thus, the annual work hours are no longer an issue.

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