

BATTELLE-TBD-6000 Appendix BB General Steel Industries
Response to SC&A memo dated May 30, 2012
Updated Review of Occupational Internal dose at GSI
Prepared by Dave Allen, DCAS
June 8, 2012

Background

On May 21, 2012, SC&A was asked to provide a review of NIOSH's position on the reconstruction of doses during the residual contamination period at GSI. The review, which was issued on May 30, 2012, was found by NIOSH to contain some minor misinterpretations of the methodology contained in Appendix BB. This white paper is intended to describe the methodology in Appendix BB and to respond to SC&A's comments on that methodology.

Intakes during uranium handling Operations

Appendix BB indicates that the values in Tables 7.8 and 7.9 of TBD 6000 were used to estimate intakes during uranium handling operations. These values, however, were prorated to the time operators were working with uranium. In their review, SC&A assumed that the value of 651 pCi per calendar day was based on a 2000 hour work year. However, the intake of 651 pCi per calendar day for slug production was for a period in which 2200 hr per work year was assumed. The appropriate Table 7.8 value for a 2000 hour work year would be 591 pCi per calendar day. Also, SC&A assumed that NIOSH used the entire uranium work time for inhalation. NIOSH, however, assumed operators were only exposed while in the shooting room between shots and not exposed when in the control room far from the uranium. The Appendix assumed 30 minutes to set up a shot, 30 minutes to take down a shot and 60 minutes to x-ray the uranium. Thus the operators were assumed to be in the vicinity of the uranium half the time.

The actual calculations in the Appendix started with the airborne concentration of 198 dpm/m³ that was used to derive the values in Table 7.8 of TBD-6000. This resulted in the calculated daily intake averaged over the calendar year of:

$198 \text{ dpm/m}^3 \times 1.2 \text{ m}^3/\text{hr} \times 337.5 \text{ hr/yr} \times .5 \text{ (fraction of time in vicinity of uranium)} / 365 \text{ days} \times 1.01 = 110.95 \text{ dpm/calendar day}$. The factor of 1.01 was used to account for the generation of fission products as described in the appendix and the 337.5 hrs/yr varied from year to year.

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Intakes between operations

For the intakes between operations, contamination levels were calculated using the settling rate from TBD-6000. It was assumed to settle for the entire period of uranium handling for a given year. Since the actual handling of the uranium metal (moving by crane or other means, placing and removing film, marking for shots, etc.) is the only force to suspend uranium corrosion products into the air, the estimate assumed that the airborne activity was only present when people were handling the uranium. While it is realized that the airborne contamination is not instantly reduced to zero when the workers leave the area, it is also recognized that it does not build up to a maximum instantly upon the worker's return. Assuming the maximum air concentration existed the entire time the workers were in the area is a reasonable average.

The largest number of annual uranium work hours used in the Appendix was 437.5. This occurred between 7/1/1961 and 6/30/1962. The surface contamination level calculated from that value (1170 dpm/100 cm²) was used from that point on throughout the residual period.

Intakes were assumed to occur the entire time uranium was not being handled over a 2400 hour work year. Thus, the intakes during the residual period resulted in 2400 hours per year of exposure from 1170 dpm/100 cm² surface contamination.

Uranium work times

Appendix BB discussed the purchase orders available for the uranium work and the basis for the amount of uranium work. The appendix indicated that, through June 30, 1961, the work was generally limited to \$450 per month. SC&A points out that the first purchase order was for \$500 per month and that value should be used for the period prior to the existence of purchase orders. However, while most of the purchase orders covered an entire fiscal year (July 1 through June 30 at that time), that first purchase order covered only 4 months (March 1, 1958 through June 30, 1958). It was extended through October 31, 1958 but with a limit of \$450 per month.

In February 1958, the month before the first purchase order, GSI sent an invoice to Mallinckrodt requesting a payment of \$48. Two letters (Attachment A and Attachment B) indicate that the work was done without a purchase order. Given the timing of this invoice, along with the unusual start date of the first purchase order, it appears the uranium work was started, or restarted in February of 1958 and only \$48 of work was performed in February.

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Even if a \$500 monthly purchase order limit was reached in each month between March and June of 1958, if one averages in the \$48 expenditure in February, the 5 month average is below the \$450 per month limit generally listed in purchase orders after that. Therefore, the appendix assumed the uranium work occurred at a rate of \$450 per month in the beginning.

Response to SC&A Review:

SC&A summarized their observations in bullet form on page 4 of their review memo. The NIOSH responses to those observations are below:

1st bullet – failure to convert dpm to pCi

As discussed above, the observation resulted from a misunderstanding of how the intakes were estimated.

2nd bullet – inappropriate resuspension factor of $1 \times 10^{-6} \text{ m}^{-1}$

This issue has been raised in a number of site profile reviews including the SC&A review of TBD-6000. The 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. There has been general agreement that a value exists but disagreement on what that value should be. Therefore, this observation should be considered a TBD issue. NIOSH recommends that this issue be transferred to the procedures working group.

3rd bullet – uranium assumed to deposit only when workers were in the shooting room

NIOSH agrees this is what was done. NIOSH, however, disagrees that the time spent x-raying the uranium should be included. The issue is discussed briefly in the earlier section labeled “Intakes between operations”.

4th bullet – uranium handling time 1/1/1953 to 6/30/1958 should be based on first purchase order

NIOSH disagrees. The basis for our position is discussed in the earlier section labeled “Uranium work times”.

5th bullet – External exposures during the residual period should be based on 3250 hours per year

NIOSH agrees. The next revision of the TBD will be based on 3250 hours per work year. This will also affect the intake values between uranium operations and in the residual period.

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References

DCAS 2011, "Site Profiles for Atomic Weapons Employers that Worked Uranium Metals", Battelle-TBD-6000, Rev. 1

OCAS 2007, "Site Profiles for Atomic Weapons Employers That Worked Uranium and Thorium Metals – Appendix BB: General Steel Industries," Battelle-TBD-6000, Appendix BB, Rev. 0

SCA 2012, "Update Review of Occupational Internal Dose at GSI", (May 30, 2012)

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Attachment A

MALLINCKRODT CHEMICAL WORKS
URANIUM DIVISION
WELDON SPRING

February 21, 1958

COPY

TO: Mr. J. P. O'Haire
FROM: C. M. Brownfield
SUBJECT: General Steel Castings Corporation Invoice #M-216

Reg M-1196-D

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.

C. M. Brownfield
Manager of Purchasing

OMB
/a

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Attachment B

July 10, 1958

TO: Mr. J. P. O'Maire
FROM: C. M. Brownfield
SUBJECT: GENERAL STEEL CASTINGS INVOICE # M-216

We are submitting the attached invoice and requisition for payment without a purchase order in that 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.

General Steel Casting Requisition # M-1196 \$48.00

C.M. Brownfield,
Manager of Purchasing

CMB/RDD/a

*this was posted Feb '58, but ltr
never went through. Post again as of this date (1/1)
+ file w/pcrik*

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