MEMO

TO: Subcommittee on Dose Reconstruction
FROM: Harry Chmelynski, SC&A
DATE: February 26, 2013
SUBJECT: Questions/Status of Bridgeport Brass Findings

This memorandum is in response to the questions raised during the most recent Subcommittee on Dose Reconstruction meeting held on February 4, 2013, concerning the history and current status of Findings 2 and 4 for external exposures at the Bridgeport Brass facilities. Finding 2 deals with the issue of building a coworker model by sampling from pooled data, and Finding 4 deals with the issue referred to as "leave-one-out" as a means of evaluating the significance of data outliers on the development of a coworker model. These findings originally were reported by SC&A in our limited review of the Bridgeport Brass exposure matrix (SC&A 2008) provided in ORAUT-TKBS-0030, *An Exposure Matrix for Bridgeport Brass: Havens Laboratory and Adrian Plant*, Rev. 0 (ORAUT 2005). As explained in this memorandum, the previous considerations of these findings appear now to be moot, as NIOSH has recently issued a revised version of ORAUT-TKBS-0030 (ORAUT 2013) based on a new methodology for deriving coworker models. However, the new methodology is part of an active review of an overarching protocol (see below) for developing coworker models. The implications are that, although Finding 2 is now moot, it is still of concern as an overarching issue. However, SC&A recommends that Finding 4 be closed, because it is no longer an issue in light of the new approach being used to develop coworker models that does not involve pooled data.

Previous discussions concerning these findings were held during a Subcommittee meeting in 2009, where NIOSH submitted a response to each finding. In response to these discussions, SC&A prepared a white paper titled, *SC&A Follow-Up to NIOSH's Responses to Bridgeport Brass Site Profile Review Findings* (SC&A 2009). These issues again were raised as the subject of discussion during the February 4, 2013, Subcommittee meeting.

During the February 4, 2013, meeting, the Subcommittee was informed that NIOSH recently published Rev. 1 of ORAUT-TKBS-0030 (ORAUT 2013). SC&A has not yet been tasked with reviewing this revised document, but was directed by the Subcommittee to review the revised exposure matrix to the extent needed to address the two open findings. The revised exposure matrix appears to use an approach that is similar to the one proposed in SC&A 2009. In this approach, annualized doses are estimated for each worker (as opposed to using pooled data), and the distribution of annualized individual worker exposures is used to derive a lognormal distribution for the coworker model. This general approach to coworker models known as "one person, one statistic (OPOS)," has been adopted by NIOSH in ORAUT-RPRT-0053, *Analysis of Stratified Coworker Datasets* (ORAUT 2011a). This document is currently under review by SC&A. One difference between the OPOS approach used in ORAUT 2013 and the approach recommended by SC&A in 2009 is the treatment of non-detects.

The numerical results are shown in Table 4-1 of ORAUT-TKBS-0030, Rev. 1, but only the following brief description is provided as to the calculations that were done.

> *To estimate doses for periods when dosimetry data are unavailable, the approach described in ORAUT-OTIB-0020, Use of Coworker Dosimetry Data for External Dose Assignment (ORAUT 2011a) was used.* ***The cycle data was*** [sic] ***converted to annual for all workers.*** *For totals based on less than 1 year of cycle data, the partial year doses were prorated to an annual dose. Cycled data below the LOD/2 were treated as missed dose. The 50th and 95th percentiles are in Table 4-1 below.* [Emphasis added.]

The brief text above suggests that the OPOS approach was used in the revised Bridgeport Brass exposure matrix. The reference the text refers to is given as ORAUT-OTIB-0020, Rev. 2 (ORAUT 2011a). Rev. 2 was actually issued in 2008 (ORAUT 2008) and this publication was superseded by ORAUT-OTIB-0020, *Use of Coworker Dosimetry Data for External Dose Assignment*, Rev. 3 (ORAUT 2011b). The previous version of ORAUT-OTIB-0020 (Rev. 2) contained an example of a procedure that was once used at K-25. This example was removed in Rev. 3. Otherwise, the reports are very similar.

It should be noted that Rev. 3 is a 4-page document containing no details pertaining to the calculations described in the quote above. To correct this deficiency, SC&A requests that NIOSH provide spreadsheets and a detailed description of the data analyses conducted for ORAUT-TKBS-0030, Rev. 1. An analysis of these materials will begin after SC&A is tasked with the review of Rev. 1.

The final results presented in Table 4-1 of OTIB-0020, Rev. 1, for Adrian are compared in Table 1 with the original SC&A 2008, the NIOSH 2005 results, and the SC&A 2009 results. The new NIOSH lognormal distributions using the OPOS approach are similar to the annualized dose distribution found by SC&A in 2009, as indicated by similarity of the estimates for the lognormal parameters μ and σ. The ORAUT 2013 95th percentile estimate for Adrian Lab is higher than the SC&A 2009 estimate for annualized gamma exposure and exceeds all previous estimates. The ORAUT 2013 95th percentile estimate is also higher than the SC&A 2009 estimate for annualized beta exposure, but does not exceed the SC&A 2008 estimate based on the bounding assumption of 100% correlation.

Table 1. Comparison of Adrian Dose Estimates from ORAUT 2005 and ORAUT 2013 with SC&A 2005 and 2009

GAMMA					
Lognormal Parameter	**NIOSH 2013 Results (OPOS)**	**SC&A 2009 Annualized Dose**	**NIOSH 2005 Simulation (no correlation)**	**SC&A 2008 Simulation (100% correlation)**	**Units**
μ (mu)	6.39	5.75	1.45	1.45	
σ (sigma)	0.44	0.43	1.31	1.31	
GSD	1.55	1.53	3.70	3.70	
GM (Median)	596	314	4.27	111	mrem
95th Percentile	**1,221**	634	452	955	mrem

Table 1. Comparison of Adrian Dose Estimates from ORAUT 2005 and ORAUT 2013 with SC&A 2005 and 2009

BETA					
Lognormal Parameter	**NIOSH 2013 Results (OPOS)**	**SC&A 2009 Annualized Dose**	**NIOSH 2005 Simulation (no correlation)**	**SC&A 2008 Simulation (100% correlation)**	**Units**
μ (mu)	7.31	6.50	3.44	3.44	
σ (sigma)	0.83	0.94	1.34	1.34	
GSD	2.29	2.56	3.83	3.83	
GM (Median)	1,495	666	1,817	811	mrem
95th Percentile	**5,832**	3,118	3,558	7,386	mrem

Bold: 95th percentile estimates recommended for Adrian in Table 4-1, ORAUT-TKBS-0030, Rev. 1 (ORAUT 2013).

Based on a preliminary examination of the results presented in Table 1, SC&A would conclude that the current NIOSH model adequately represents the annualized external dose to the 95th percentile worker. A final conclusion cannot be reached until a review of the OTIB-0020, Rev. 1, calculations for Adrian and Havens is completed.

REFERENCES:

ORAUT 2005. *An Exposure Matrix for Bridgeport Brass: Havens Laboratory and Adrian Plant*, ORAUT-TKBS-0030, Rev. 0. Oak Ridge Associated Universities Team, Cincinnati, Ohio. September 2005.

ORAUT 2008. *Use of Coworker Dosimetry Data for External Dose Assignment*, ORAUT-OTIB-0020, Rev. 2. Oak Ridge Associated Universities Team, Cincinnati, Ohio. 2008.

ORAUT 2011a. *Analysis of Stratified Coworker Datasets*, ORAUT-RPRT-0053, Rev. 0. Oak Ridge Associated Universities Team, Cincinnati, Ohio. October 2011.

ORAUT 2011b. *Use of Coworker Dosimetry Data for External Dose Assignment*, ORAUT-OTIB-0020, Rev. 3. Oak Ridge Associated Universities Team, Cincinnati, Ohio. November 2011.

ORAUT 2013. *An Exposure Matrix for Bridgeport Brass: Havens Laboratory and Adrian Plant*, ORAUT-TKBS-0030, Rev. 1. Oak Ridge Associated Universities Team, Cincinnati, Ohio. January 2013.

SC&A 2008. *Review of the Bridgeport Brass Technical Basis Document (Havens Laboratory and Adrian Plant).* Attachment 1 to the 8th Set of Dose Reconstruction Audit Reports, S. Cohen & Associates, Vienna, Virginia. May 2008.

SC&A 2009. *SC&A Follow-Up to NIOSH's Responses to Bridgeport Brass Site Profile Review Findings*, S. Cohen & Associates, Vienna, Virginia. April 2009.