

**Responses to Sanford Cohen & Associates
Review of Battelle -TBD-6000
Appendix BB
(*General Steel Industries, Rev. 1*)**

Response Paper

**National Institute for Occupational Safety and Health
Division of Compensation Analysis and Support**

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GENERAL

This document contains responses to the findings in Sanford Cohen & Associates' December 10, 2014, memo that provided review comments on NIOSH's revision 1 to *Appendix BB of TBD-6000*, General Steel Industries. The memo also contains a number of editorial comments and suggestions that were not summarized in the findings and are not addressed in this document. DCAS intends to address each editorial comment and suggestion when Appendix BB is revised to incorporate our responses the findings.

FINDING #1. Neutron Dose Rates

SC&A commented that the effective neutron dose was calculated while OCAS-IG-001 does not contain dose conversion factors for this dose.

NIOSH Response: The values in Appendix BB match the numbers agreed to during an exchange of files between SC&A and NIOSH prior to the drafting of the appendix revision. Both SC&A and DCAS neglected to realize at the time that calculating effective dose was not appropriate. DCAS will revise the calculations to use either ambient dose equivalent or deep dose equivalent conversions.

FINDING #2. Beta Skin Dose

SC&A commented that their calculation of beta dose is different than DCAS.

NIOSH Response: DCAS and SC&A exchanged files and reconciled differences late in 2013 prior to the drafting of the revision to Appendix BB. Appendix BB contains those values. Even though not included in the text of the summary for this finding, SC&A acknowledges in the body of this memo that they originally neglected to account for the one meter beta dose so it was calculated and added to the total dose as part of their review. This explains the difference between the Appendix BB and SC&A's recalculated values.

DCAS intends to correct this in the next revision to Appendix BB. However, the original calculations assumed the steel was irradiated for 30 continuous hours. DCAS intends to adjust the initial dose rate to account for the intermittent irradiation as described in a white paper that recalculates the layout man's beta dose. DCAS also intends to assume the steel was irradiated long enough to reach an equilibrium activity.

FINDING #3. No Dedicated Radiography Facility in No. 6 Building Prior to 1955

SC&A indicated there is evidence that the radiography facility in the 6 building may not have been constructed until 1955. This would affect the basis for the mode dose of the triangular distribution for the radium radiographer dose through 1955.

NIOSH Response: DCAS agrees with SC&A however, a slight correction is necessary. The calculations used by SC&A in their review report assumed the 15 seconds to place or retrieve the source was part of the exposure time. In the previous calculation, the time placing and retrieving the source was in additional to the exposure time. In keeping with that interpretation, the new calculated dose would be 11.34 R/y rather than 11.28 R/y. DCAS intends to use the 11.34 value.

FINDING #4. Maximum of Triangular Distribution of Photon Exposures for 1961 Should be 12 R/y

SC&A commented that the relevant revision to 10CFR20 was effective 1/1/1961 so the upper limit to the radium radiographer dose should be 12 R/y in 1961 not 15 R/y.

NIOSH Response: DCAS agrees. The error will be corrected in the next revision to Appendix BB.

FINDING #5. Combined Exposures to ²²⁶Ra and Betatron Operations during 1952-1962

SC&A commented that since radium radiography only occurred 30% of the time, the radiographers should be assigned betatron operator dose the remaining 70% of the time.

NIOSH Response: This is clearly a change from what had already been discussed and resolved. The 30% value that SC&A cites is actually the amount of time the radium source is exposed. The process of performing radiography requires a number of other steps, including marking the casting, moving the source to and from the location, placing the film, removing the film, developing the film, determining the duration of the shot, etc.

In the betatron building, it was assumed it took 15 minutes between shots on the same casting. It was further assumed the castings were often marked up prior to entering the betatron building. That was the job of the layout man for large castings but there is no indication a separate person was used for the smaller castings that would be radiographed using radium or cobalt sources. Therefore, it would not be unreasonable to double the time between shots to 30 minutes. Ten

shots per shift times 30 minutes per shot equals 5 hours of work per shift. Adding the 2.4 hours of shooting time to that accounts for the majority of the shift.

FINDING #6. Beta Skin Dose to Layout Man

SC&A comments that the Appendix BB beta dose to the layout man is significantly lower than those calculated by SC&A

NIOSH Response: This dose requires detailed discussion and is therefore the subject of a separate white paper that will be issued at the same time as these responses.

FINDING #7. Uranium Inhalation from Metal Handling in 1966

SC&A points out the inhalation intake for the first six months of 1966 is half the value it should be.

NIOSH Response: DCAS agrees. The intake was inadvertently averaged over the full year instead of 6 months. The error will be corrected in the next revision to Appendix BB.

FINDING #8. Ingestion Intakes Not Consistent with OCAS-TIB-009

SC&A points out that the ingestion intakes are significantly higher than they should be.

NIOSH Response: DCAS agrees. OCAS-TIB-009 is intended to apply to continuous operations and no adjustment was made for intermittent uranium work at GSI. DCAS agrees this would be more appropriate to use the average airborne activity for the year. However, DCAS suggests using the average annual airborne activity for the highest year, rather than changing the ingestion rate based on the amount of uranium work for a particular year. The ingestion rate is related to the surface contamination present and that value does not start at zero each year. Thus, contamination from a previous year can affect the ingestion rate in a following year. Since the highest year ingestion rate would be the first years, DCAS intends to revise the appendix to use that ingestion rate (calculated in the SC&A memo and verified by DCAS) for all years. This would also be the ingestion rate for the first year of the residual period.

FINDING #9. Ingestion Intakes during Residual Period

SC&A points out the ingestion rate in the first year of the residual period is incorrect.

NIOSH Response: DCAS agrees. The inhalation rate for the last operational year was inadvertently used as the ingestion rate for the first year of the residual period. Thus, the value should have been 15.44 dpm/day rather than the 15.88 dpm/day used in the Appendix. As stated in our response to Finding 8, DCAS intends to use the ingestion rate for the highest operational year for the beginning of the residual period in the next revision to Appendix BB.