



Memorandum

To: Blockson Chemical Work Group
From: Thomas P. Tomes
Subject: NIOSH Response on Open TBD Issues
Date: 3/9/2018

SC&A provided a review of the NIOSH Evaluation Report (ER) for petition SEC-00225, which covered the residual contamination period at Blockson Chemical Company, Joliet, Illinois. That review resulted in five findings (SC&A, 2016a). Three of the five findings were discussed by the Blockson Chemical Work Group (Work Group) and closed during the June 28, 2016, meeting (ABRWH, 2016a). Two of the findings, numbers 1 and 3, were discussed and considered to be Technical Basis Document (TBD) issues that needed further discussion (ABRWH, 2016b, pp. 90-91).

This memorandum is a follow-up report to the Work Group from discussion during the June 28, 2016, meeting and the previous responses to the Work Group (NIOSH, 2016; SC&A, 2016b). This document discusses the two open TBD issues, provides the results of an additional assessment, and recommends both TBD Findings be closed and no changes be made to the Blockson TBD.

SC&A Finding 1

The approach used to assign external exposures to workers at Blockson, though reasonable, is not consistent with the method used to assign external exposures at Simonds Saw and Steel, nor is it consistent with reported working hours characterized in claimant CATI reports.

SC&A Finding 3

Beta dose associated with residual contamination in Building 55 should be included in the site profile.

FINDING 1 DISCUSSION

Finding 1 consisted of two issues. The first issue was the treatment of the residual contamination period external dose rate, and the second issue was the number of hours used to calculate annual dose.

Finding 1, Issue 1 Discussion

SC&A disagreed with the use of the “full distribution” of dose in the TBD, in which the annual dose was applied in IREP as a lognormal distribution. They suggested that NIOSH should use an approach consistent with the methods used in the Simonds Saw and Steel TBD.

In the Simonds TBD, the residual external doses were based on applying the upper 95th percentile dose-rate as a constant dose rate to which workers were exposed for a finite number (2500) of work hours.

NIOSH’s previous response to Finding 1, Issue 1, was that the exposure characteristics of Blockson and Simonds are different. The Simonds external dose data indicated an elevated dose rate throughout the general work area, making the upper 95th percentile dose rate appropriate for estimating annual dose. However, the dose-rate characterization data for Blockson shows that most of the work area dose rates were below the reported Building 55 “background rate” of 20-30 uR/hour, although a handful of measurements showed isolated spots with higher dose rates. In the Blockson TBD, NIOSH assumed an exposure for 2000 hours at the upper end of the reported building background of 0.030 mR/hour, or 60 mR/year. This dose includes natural background radiation and elevated building “background” radiation from Blockson’s commercial phosphate operations, in addition to the fraction that is attributable to AEC residual contamination. To allow for a higher dose that potentially could have been received at some isolated spots, NIOSH applied the dose as a median value of a lognormal distribution with a geometric standard deviation of 3.2, which is based on the upper 95th percentile of the dose rate distribution being equal to exposure for 2000 hours at the maximum observed dose rate of 0.2 mR/hour.

Finding 1, Issue 1 was discussed by NIOSH, SC&A, and the Work Group during the June 28, 2016 meeting. It was agreed that assigning the full distribution of the dose-rate data is appropriate for Blockson because continuous exposure at the upper 95th percentile rate was not considered plausible (ABRWH, 2016a, pp 13-26).

Finding 1, Issue 2 Discussion

The second part of finding 1 concerns the number of work hours NIOSH assumed for calculation of annual dose from the dose-rate distribution (discussed above). SC&A commented that NIOSH assumed 2000 hours in a work year, although workers in CATI interviews indicated overtime work occurred at the facility. A work-year of 2500 hours was suggested.

As the described method above indicates, the TBD distribution varies the dose-rate, but not the hours. Although a constant 2000 hours was used in the TBD distribution, the applied uncertainty allows for a much higher annual dose, higher than would be obtained by using the full distribution of dose rate data for 2500 hours. This will be shown below.

There was lack of clarity on what the dose-rate distribution used in the Blockson TBD represents. Since it is a modeled dose distribution based on the assumptions stated above, it is not a true statistical distribution derived from all the observed dose-rate data. Therefore, additional calculations were needed to determine if dose assigned from the TBD distribution is favorable and plausible compared to the full distribution of measured dose rates for an exposure of 2500 hours/year.

Evaluation of Residual Period Dose-Rate Data

The Formerly Utilized Sites Remedial Action Program (FUSRAP) performed characterization surveys of Blockson Building 55 in 1978, which was the location of uranium extraction work (DOE, 1983). Seven of the 70 reported dose-rate measurements, measured at one meter above surface, were reported to be above the building “background”. The reported background dose rate in Building 55 was 0.02 to 0.03 mR/hour. The background was based on the end window G-M tube instrument reading at one meter above the floor. Based on measured natural background rates for the area, the higher Building 55 “background” is presumed to be elevated ambient radiation from phosphate plant activities including contribution from residual contamination from materials processed for the AEC from 1951-1960. There are no means to differentiate the dose rate from AEC residual contamination from dose rates resulting from phosphates used in Blockson’s on-going commercial operations at the time of the survey.

Natural background rates for the Blockson plant area have been published. The Illinois State Geological Survey reported a mean natural gamma radiation dose rate of 42 mrad/year in the northeast part of Illinois in the area that includes Joliet (Gilkeson, 1987). That equates to a natural background dose-rate of 0.0048 mrad/hour. A 1996 radiation survey at the Blockson site reported natural “background photon radiation readings of between 3-6 μ rem/hr”, or 0.003-0.006 mrem/hour (Olin, 2007, p. 15). For this evaluation of the Blockson Building 55 dose-rate data, NIOSH subtracted a natural background of 0.0048 from the reported dose rate measurements.

The 70 reported dose-rate values were analyzed using regression on order statistical methods and an assumed lognormal distribution. Probability was assigned to all 70 values, but only the 7 values above building background were used to fit a line through the data to determine lognormal distribution parameters. The annual doses at various quantiles were calculated from the derived distribution and assumed 2500 hour exposure, as shown in the second column of the table below. They are compared to the quantiles calculated from the residual annual dose distribution used in the TBD, which are provided in the third column of the table below. The upper 95th percentile dose, and all other quantiles, is higher using the TBD distribution as compared to the full distribution of the Blockson dose rate data.

Comparison of Annual Doses

Quantile	Data Annual Dose, mR	TBD Annual Dose, mR
5	0.70	8.9
10	1.3	14
15	1.9	18
20	2.6	23
25	3.4	27
30	4.3	33
35	5.4	38
40	6.6	45
45	8.2	52
50	10	60
55	12	69
60	15	81
70	23	110
75	30	131
80	39	160
85	53	200
90	79	266
95	143	406

Although the residual doses in the Blockson TBD were derived in a manner that is different than was done for other sites, NIOSH considers the TBD doses to be favorable and plausible. Additionally, the central tendency of the TBD dose distribution is likely more representative of exposure to workers in the building, given a 2500 hour work-year and the fact that the dose contribution from commercial phosphate operations cannot be reliably differentiated from dose from residual AEC contamination.

FINDING 3 DISCUSSION

Finding 3 was discussed by the Work Group on June 28, 2016 (ABRWH 2016a, pp. 42-53). The issue of concern was that the Blockson TBD assigns residual photon dose but no residual beta dose, which is applicable to some tissues such as the skin. NIOSH and SC&A discussed the FUSRAP survey data used by NIOSH to derive external dose. After some discussion it was agreed that the dose-rate measurements included dose from both gamma and beta radiation, with no means to quantify the beta or gamma dose fractions of the total dose measurements. The

doses were considered reasonable and favorable for all tissues. Therefore, the Work Group concluded that finding 2 on beta dose could be closed. It is noted that the beta dose issue was resolved at the Work Group meeting, but the actual dose value remained an open issue pending resolution of finding 1.

There was also discussion that the assessment of the beta dose should have been documented by NIOSH in the ER or TBD, and it was identified as a future action. However, it should be noted that the Blockson ER for SEC 225, Section 7.3.3, pages 30-31, specifically discusses the beta-gamma dose-rate measurement issue and the readings. That fact was overlooked in the discussion of finding 3. NIOSH considers that discussion and the Work Group discussion sufficient to close Finding 3.

REFERENCES

ABRWH (Advisory Board on Radiation and Worker Health), 2016a, ABRWH Blockson Chemical Work Group discussion, transcripts of the June 28, 2016 meeting.

<https://www.cdc.gov/niosh/ocas/pdfs/abrwh/2016/wgtr062816.pdf>

ABRWH (Advisory Board on Radiation and Worker Health), 2016b, ABRWH discussion on Blockson SEC petition 00225, transcripts of the 112th meeting of the Advisory Board on Radiation and Worker Health, pp. 82-118, August 9, 2016.

<https://www.cdc.gov/niosh/ocas/pdfs/abrwh/2016/tr080916.pdf>

DOE (U. S. Department of Energy), 1983, *Radiological Survey of Chemicals Group, Olin Corporation (formerly Blockson Chemical Company), Joliet, Illinois, March 27–November 28, 1978*, DOE/EV-0005/35, ANL-OHS/HP-83-103, Formerly Utilized Sites Remedial Action Program (FUSRAP), SRDB Ref ID 23615.

Gilkeson, 1987, Robert H. Gilkeson, et al., *Natural Background Radiation in the Proposed Illinois SSC Siting Area*, Illinois Department of Energy and Natural Resources, State Geological Survey Division, June. <https://www.ideals.illinois.edu/handle/2142/88811>

NIOSH (National Institute for Occupational Safety and Health), 2016, *NIOSH Response to SC&A Findings on SEC-00225, Blockson Chemical Company Residual Contamination Period*, National Institute for Occupational Safety and Health, Cincinnati, Ohio, May 23.

<https://www.cdc.gov/niosh/ocas/pdfs/dps/dc-bccsec225-052316.pdf>

Olin, 2007, Surveys and radiological data of the former Blockson Chemical Company site, provided to ORAU, SRDB Ref ID 30623.

SC&A (Sanford Cohen and Associates), 2016a, *Draft Review of Blockson Chemical Company Residual Period SEC-00225*, SCA-TR-2016-SEC003, Revision No. 1, SC&A, Inc., Vienna, Virginia, June 3, SRDB Ref ID 161258.

SC&A (Sanford Cohen and Associates), 2016b, *SC&A Responses to NIOSH Response to SC&A Findings on SEC-00225 Blockson Chemical Company Residual Contamination*, memorandum, SC&A, Inc., Vienna, Virginia, June 15. <https://www.cdc.gov/niosh/ocas/pdfs/abrwh/scarpts/sca-blocksec225-061516.pdf>