Memorandum

To: Work Group on Metals and Controls Corp.
From: SC&A, Inc.
Date: December 30, 2019
Subject: Review of NIOSH "Metals and Controls Corp. SEC-00236 Petitioner Concerns"

Background

On June 18, 2019, the National Institute for Occupational Safety and Health (NIOSH) completed a paper (NIOSH, 2019b), prepared in response to concerns raised by the petitioner for Special Exposure Cohort (SEC) Petition SEC-00236, which addressed the residual period at the Metals and Controls Corp. (M&C) in Attleboro, MA: from January 1, 1968, through March 21, 1997. SC&A received the response paper on July 10, 2019, and was tasked with reviewing the paper at that time.

Review of NIOSH Response Paper

The issues addressed by NIOSH (2019b) were communicated by the petitioner in the form of an expanded and edited transcript of oral testimony presented by this petitioner on December 13, 2018, at the 126th Meeting of the Advisory Board on Radiation and Worker Health (ABRWH, Board) in Redondo Beach, CA. The authors excerpted all but two pages of the petitioner's report, which was in the form of a continuous narrative in paragraph form. They divided the original text into nine "Petitioner Concerns." They first presented the excerpt or excerpts that, in their judgment, constituted each concern, then presented their response to the given issue. The excerpts began with a passage from the petitioner's email transmitting the document to NIOSH. The present review summarizes each of the concerns identified by NIOSH. We then comment on NIOSH's response and/or present an alternative or supplementary response that presents our insights into the issues. Our aim is to present the reader with an expanded perspective on the issues raised by the petitioner whenever we found such a perspective to be appropriate.

Petitioner Concern 1

The petitioner questioned if NIOSH can reconstruct doses to M&C maintenance workers with sufficient accuracy because (1) the source term characterization is incomplete, (2) there is incomplete knowledge of worker exposures to the source term, (3) the worker exposures were not monitored, and (4) there is no worker population that can be used as a surrogate to evaluate exposures to the M&C workers.

NIOSH (2019b) responded that doses to maintenance workers can be bounded by using survey data prior to decontamination and decommissioning (D&D), as described in two earlier reports: (NIOSH 2018, 2019a). SC&A (2018) reviewed the first of these reports. We concluded

> that doses to M&C workers during the residual period, including workers involved in maintenance and repurposing activities, can be reconstructed in a scientifically sound and claimant-favorable manner by using upper-end values of the contamination levels measured during the 1980s and 1990s, along with appropriately conservative assumptions regarding airborne dust loadings and exposure durations. (SC&A, 2018, p. 18)

To reiterate, SC&A found that NIOSH (2018) presented data that can form the basis of estimating doses to M&C workers during the residual period. Although we have proposed some modifications to the proposed NIOSH methodology, these constitute site profile rather than SEC issues.

Anigstein (2019) reviewed NIOSH (2019a) and found

> that NIOSH has developed a plausible approach to modeling worker exposures at M&C to residual ^{232}Th contamination and to work activities related to welding. We disagree with some the parameters and assumptions which NIOSH used to implement its approach. However, we believe that these issues can be resolved. These therefore constitute site profile rather than SEC issues. (Anigstein, 2019, p. 7)

Based on these findings, SC&A concludes that the two earlier reports cited by NIOSH (2019b) can provide a basis for assigning scientifically sound and claimant-favorable bounding doses that M&C workers might have received during the residual period.

Petitioner Concern 2

The petitioner noted that "the 1996 drain characterization survey in the interiors of Bldg. 10 and Bldg. 4 . . . only analyzed the sediment and soil samples . . . for isotopic uranium. Therefore, we can never know for sure what the thorium concentrations might have been" (quoted by NIOSH, 2019b, p. 4). SC&A's review of Petitioner Concern 1, above, concluded that NIOSH has enough information to estimate worker exposures to residual thorium-232 (^{232}Th) contamination.

Petitioner Concern 3

The petitioner observed that,

> by the time the drain survey was conducted in 1995, there had been close to 30 years of disturbances of the drain lines during the residual period – they were snaked numerous times, and some of the most plugged sections had been removed entirely. Therefore, there is no guarantee that the levels we documented [in the drain survey] represent the maximum levels ever present [and to which the M&C maintenance workers would have been exposed]. (Quoted by NIOSH, 2019b, p. 5)

NIOSH (2018) addressed this concern by adopting the 95th percentile value of the pipe contamination data, rather than the geometric mean, as the basis of exposures of M&C maintenance workers. SC&A (2018) concurred with this strategy.

Petitioner Concern 4

The petitioner stated, "the gross alpha screening analysis methodology that we used for the 1994-1995 comprehensive characterization surveys [for the majority of subsurface soils other than the drain survey area] was biased low at concentrations above the 30 pCi/gm cleanup standard" (quoted by NIOSH, 2019b, p. 5).

We have identified two documents containing survey data from the 1994–1995 timeframe: CPS (1995, n.d.). Based on internal evidence (i.e., a communication from a land surveyor, dated March 28, 1995, presenting the coordinates of the Building 5 grid system), SC&A believes that the second document was also issued in 1995. However, we will retain the designation "n.d." for consistency with prior SC&A and NIOSH reports. Although this fragmentary file lacks a title page, "Texas Instruments" is mentioned in the text, and references to drawings include the acronym "CPS"; we thus agree with NIOSH (2019b) that this document was most likely prepared by Creative Pollution Solutions, Inc. (CPS). This conclusion is further buttressed by a statement by CPS (1995): "The affected area surveys spanned an area in excess of 63,000 m^2 exclusive of the Materials Recovery Area which will be addressed within a separate report." CPS (n.d.), which presents data on the "Metals Recovery Area," is most likely part of that report.

CPS (n.d., PDF p. 3) stated:

> For the grid cells where systematic sub-surface soil sampling was conducted, the grid cell averages were calculated using simple arithmetic averaging of the sub-surface soil sample data within each grid at each depth. The *highest* calculated grid cell average (from each depth) was recorded as the grid cell average and is presented in Drawing CPS-TI-0105G included within this appendix. (Emphasis added)

The use of systematic sampling indicates a lack of bias in selecting the sampling locations. SC&A reviewed the results of subsurface soil sampling in the Metals Recovery Area tabulated in CPS (n.d., "Appendix D-1") and noted that soil samples were collected at 82 grid cells evenly spaced at 30-ft intervals in the N-S and E-W compass directions. Each grid cell contained up to 16 sample locations. Samples were collected at various depths at each location: at 1-ft depth intervals up to 4 ft, then 2-ft intervals up to 10 ft. A varying number of depths were sampled at the various locations, starting with the 0–1 ft depth at all locations.

A cursory inspection of the results showed many soil samples exceeding 100 picocuries per gram (pCi/g) total uranium, with a maximum of 1,148 pCi/g. Thus, there does not appear to have been any systematic effort to exclude samples >30 pCi/g. An average total uranium activity concentration was calculated for each depth in each grid cell, based on all samples at the given depth in that cell, and the highest average for all the depths was recorded as the average for that cell. This indicates that, if anything, the results were biased in favor of high activity concentrations.

CPS (1995, p. 3) described radiological surveys of open land areas of the M&C site: "Grid patterns selected for this survey were standardized to 10 meter by 10 meter grids designated by distance from a convenient bench mark along compass directions." Furthermore,

> subsurface soil samples were also obtained throughout the affected area. The use of systematic subsurface soil samples provided greater sensitivity than surface surveys since activity deposited at depth would not be readily identified by surface scans or static measurements due to shielding from overburden (if present) and self-shielding provided by the soils. Subsurface soil samples were obtained using split spoon sampling methods. The number of split spoon samples was established as 5 per grid cell, one at each comer and one in the center of the grid. (CPS, 1995, p. 3)

Again, such a systematic sampling scheme does not indicate any bias in the survey methods.

These open land areas were divided into six survey locations. The report states that data from each of these locations are presented in Appendices A–F. However, only Appendices A and B are furnished as part of the Site Research Database (SRDB) document. Consequently, we will confine the discussion to the locations corresponding to the following: the stockade area and railroad spur, and the Building 10 perimeter and Building 10 alleged zirconium burning area.

According to CPS (1995, p. 5):

> The walkover survey performed within the Stockade Area indicated a few isolated elevated readings in the northeast side of the area and the northwest portion of the site near the Railroad Spur. Surface soil samples were not obtained in this case since much of the area was covered with asphalt and the systematic subsurface soil sampling was used to identify soil contamination for these areas.
>
> Of the 700 subsurface soil samples, 68 were identified as exceeding 30 pCi g^{-1} total uranium . . . Within the 107 grid cells sampled, 44 grid cells had all samples below the criteria, whereas the remaining 63 grid cells had samples in excess of the criteria.

A cursory examination of the tabulated data shows a maximum concentration of 3,000 pCi/g total uranium. Again, we did not observe any indication of bias against samples >30 pCi/g.

The Building 10 perimeter area encompasses the alleged zirconium burning area. According to CPS (1995, p. 6):

> The walkover survey performed in this area indicated no areas in excess of 1.5 times nominal background. Static measurements performed in this area were also all less than 1.5 times nominal background levels.
>
> Of the 1300 subsurface soil samples obtained, only 5 samples indicated activity concentrations in excess of the criteria. These samples had concentrations of [32–172 pCi g^{-1}].

SC&A again did not observe any indication of bias against samples >30 pCi/g.

Our review of the 1994–1995 survey methodology and results likewise did not find any evidence of bias against samples >30 pCi/g. We thus agree with NIOSH (2019b, p. 7), which had "not identified a bias that would affect the conservativeness of our exposure model."

Petitioner Concern 5

The petitioner cited remarks made by Josie Beach, Chair of the M&C work group, at the 126th Meeting of the ABRWH on December 13, 2018, referring, in the petitioner's words, to contaminated soil and other debris "removed during the 1992-1996 decommissioning activities from a site that had ostensibly been released for unrestricted use" (quoted by NIOSH, 2019b, p. 7). The petitioner stated that this residual contamination exposed "M&C maintenance workers . . . to unknown and unknowable levels of exposure." In fact, the activity concentrations of uranium in these materials were not unknown: they were characterized by the surveys performed prior to their removal, as documented by Sowell (1985) and CPS (1992, 1995, n.d.). In its response, NIOSH (2019b, p. 8) explained that the additional cleanup was due to "the changing release criteria and the subsequent use of more comprehensive investigative methods." NIOSH further stated,

> the additional contamination identified using updated methods, including sections of the concrete floor and subsurface material, was previously inaccessible, and, as such, did not present a significant exposure hazard. It is important to note that although M&C, using updated techniques, was able to find contamination throughout the site after the NRC initially released Building 10, NIOSH incorporated these additional contamination data (e.g., Burial Area and Building 10 subsurface data) into its exposure models.

We believe that the foregoing discussion fully responds to the petitioner's concern.

Petitioner Concern 6

The petitioner stated that,

> concerning the incomplete knowledge of the nature, frequency, and duration of jobs performed; the degree of confidence that the NIOSH and SC&A technical experts place in the one-month duration estimate for all intrusive activities, both subsurface and in overhead areas, seems overly confident, to say the least. (Quoted by NIOSH, 2019b, p. 8)

The one-month annual duration of subsurface work that was previously agreed upon by NIOSH and SC&A was based on the worker interviews conducted jointly by SC&A, NIOSH, and Oak Ridge Associated Universities Team personnel in Mansfield, MA, on October 24–26, 2017. According to NIOSH (2019b), the NIOSH exposure assessments increased the duration of these tasks to two months per year, and "NIOSH assumes that the same person does all of the work associated with the highest concentrations of airborne contaminants" (NIOSH, 2019b, p. 9). In our opinion, the exact duration of the various exposure scenarios is not a determining factor in

NIOSH's ability to assess exposures, as long as NIOSH can arrive at a bounding, plausible estimate, which we believe to be the case.

Petitioner Concern 7

According to the petitioner:

> As previously stated, there is a complete absence of any measurements or monitoring of the workers who are the subject of this petition. NIOSH has relied on measurement and monitoring data for several surrogate populations that include the health & safety monitoring of radiation workers at the end of the operational period ca. 1968; the health physics monitoring data for the D&D (decommissioning project) workers ca. the 1990s; and the Mound Canal project dust loading measurements ca. 1997. I would suggest, however, that these populations are not comparable to the typical M&C maintenance worker in the class covered by this petition. The surrogate classes [proposed by NIOSH] do not adequately characterize the maximum radiation dose to any member of the class covered by this petition. (Quoted by NIOSH, 2019b, p. 9)

NIOSH (2019b, pp. 10–11) responded that

> NIOSH analyzed M&C maintenance work including use of personal protection equipment (PPE) and safety/health protocols, and we modeled associated exposures using plausible circumstances and without taking credit for any PPE or exposure limiting procedures.
>
> . . . NIOSH created additional exposure models (e.g. subsurface) to address worker contact with sediments and to allow for longer exposure occupancy durations. In addition, NIOSH used maximizing assumptions (e.g. 10^{-3} and 10^{-4} resuspension factors) to address work scenarios that involved work with accumulated dust (e.g. overhead area and welding).
>
> NIOSH recognizes there is some uncertainty when trying to bound doses to a class of workers that performed multiple and diverse tasks during an extended period. For this reason, NIOSH applied the use of the 95^{th} percentile radioactivity levels in its models to accommodate any uncertainty associated with work process assumptions. It is worth mentioning again here that NIOSH assumes the same person does all of the work associated with the highest concentrations of airborne contaminants, which provides additional conservatism to the exposure models.

This petitioner concern reiterates some of the same issues raised in Petitioner Concerns 1 and 2: uncertainty about the source term and the exposure scenarios, lack of monitoring during the residual period, and lack of a comparable surrogate population of workers. As stated in our response to these previous concerns, which is reinforced by the additional discussion in the NIOSH response cited above, SC&A again concludes that NIOSH is able to construct plausible, bounding scenarios to assess the exposures of M&C workers during the residual period.

Petitioner Concern 8

The petitioner cited

> a letter to Ms. Josie Beach, dated November 20, 2018, [[in which[1]]] Congressman Joseph Kennedy . . . acknowledged the uncertainty "among members of the work group as to how to evaluate the extent of the radiation these workers were exposed to in order to ascertain their eligibility for compensation." But Congressman Kennedy goes further by stating: "It is my hope that the workgroup takes a broader view and considers the cases of these workers in their final determination."
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> . . . The measurement and monitoring data from the 1960s, 1980s and the 1990s for radiation workers and D&D workers, [on which NIOSH has relied for their dose reconstruction modeling], are not suitable to estimate the bounding dose for the class of M&C maintenance workers. (Quoted by NIOSH, 2019b, p. 11)

NIOSH (2019b, p. 11) responded:

> In the SEC-00236 ER, NIOSH created a model to bound doses to the majority of M&C workers, i.e. those that performed production and support tasks. After NIOSH presented the ER to the Board on August 24, 2017, the petitioner raised a concern about the adequacy of the ER in addressing maintenance work. The petitioner stated that he "took great care to define the class of workers under evaluation in this petition as precisely and as *narrowly* as possible to coincide with workers for whom there is a high degree of confidence that they received elevated exposures to residual radioactive contamination" . . . In response to this concern, NIOSH obtained additional information and developed models in subsequent white papers that bound doses to workers that performed more invasive tasks as identified by the petitioner.
>
> In addition, the methods for the reconstruction of doses during periods of residual contamination have been established, documented, and accepted for use at numerous AWE sites with operations similar to those at M&C. . . For maintenance activities that were unique at M&C, NIOSH used monitoring data from measurements obtained before D&D along with maximizing assumptions to create bounding exposure models.

As stated in the discussion of Petitioner Concern 1 in the present review, SC&A reviewed NIOSH (2018, 2019a) and found that the authors presented data and methods that constitute a sound basis for assessing worker exposures, including those of workers engaged in maintenance and remediation during the residual period at M&C.

[1] The petitioner used brackets to indicate text that he added to his original presentation to the ABRWH. To avoid ambiguity, text inserted by the present reviewer in an excerpt from the petitioner, as quoted by NIOSH (2019b), is indicated by double brackets (i.e., "[[]]").

Petitioner Concern 9

NIOSH (2019b) separated two contiguous excerpts from the petitioner's report and labeled each of them "Petitioner Concern 9." We will discuss the two excerpts and the NIOSH response to each, in sequence.

The first excerpt cites concerns expressed by an M&C health physicist that NIOSH was using "measurement and monitoring data collected for D&D workers during the 1990s decommissioning project . . . as a surrogate for the types of exposures received by M&C Maintenance Workers during the residual period for estimating a bounding dose" (quoted by NIOSH, 2019b, p. 12). NIOSH (2019b, p. 12) responded that "NIOSH only used the D&D exposure data for its comparative value and not for dose reconstruction modeling." SC&A reviewed the NIOSH models described by NIOSH (2018, 2019a) and confirmed that these models did not incorporate data on exposures of D&D workers who performed their duties under health physics supervision.

In the second excerpt, the petitioner again cited the M&C health physicist who claimed that members of the ABRWH stated "that it is virtually impossible to identify every conceivable exposure scenario that the M&C maintenance workers were exposed to" (quoted by NIOSH, 2019b, p. 12). Based on our review of the transcript of the December 13, 2018, Board meeting, SC&A found that the petitioner misstated the Board members' opinion: While commenting on the complexity of site operations during the residual period, the members withheld judgment as to the feasibility of dose modeling.

NIOSH (2019b) responded by saying that NIOSH would expand its exposure models to account for the worst-case scenarios. SC&A believes that, contrary to the petitioner's implied assertion, NIOSH does not need to analyze and model every task performed by every worker during the almost 30-year-long residual period. It is sufficient to identify the tasks that, based on the prevalent source term and exposure duration, results in the highest probability of causation for a given claimant. The working conditions and site characteristics of M&C have been amply documented by survey reports and other references, as well as information presented by former M&C workers during 3 days of interviews in Mansfield, MA, on October 24–26, 2017. NIOSH has indicated that it will utilize this information in performing dose reconstructions for M&C claimants. We anticipate that NIOSH will augment the does reconstructions with any additional information based on the workers' experience and recollections that is furnished by claimants. Such information may be obtained in the course of the computer-assisted telephone interviews of claimants and from claim forms and other papers submitted by claimants.

Conclusions

The petitioner has presented a thoughtful discussion of the concerns of former M&C workers, including the petitioner, over the radiation exposures at M&C during the residual period. We believe that these concerns can be alleviated by the methodology that NIOSH has already developed and plans to continue refining to further address the petitioner's concerns. Although SC&A has raised some specific issues over the detailed parameters that NIOSH has proposed for its exposure assessments, these differences do not affect NIOSH's ability to perform these assessments.

References

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