



SC&A Review of SEC-00188 Evaluation Report Addendum 2 for Sandia National Laboratories – Albuquerque

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SC&A review of SEC-00188 ER Addendum 2

◆ **External Dose:**

- No issues that preclude dose reconstruction with sufficient accuracy.
- Questions remain on the application of dosimetry data to reconstruct exposures to severe radiation gradients encountered at the Sandia Pulse Reactor (SPR). *[1 observation]*

- ## ◆ **Internal Dose:**
- Weight of evidence supports feasibility of dose reconstruction with sufficient accuracy for 1997–2011. However, SC&A unable to verify completeness of breathing zone (BZ) monitoring results due to lack of available records from which the total number of workers monitored via BZ, or the total number of BZ samples issued and processed, could be tabulated. *[1 finding, 6 observations]*

SC&A conclusions 1 & 2: ER Addendum 2

1. Is weight of evidence sufficient for feasible external and internal dose assessment?

Answer: Yes. But for external dose assessment, questions remain about reconstructing severe radiation gradients at SPR and how NIOSH will apply available data. For internal dose assessment, unable to verify fully the completeness of BZ monitoring results; other clarifications requested.

2. Was implementation of 10 CFR Part 835 requirements for internal exposure monitoring adequate to support 100 mrem committed effective dose equivalent (CEDE) annual monitoring requirement as bounding value in co-exposure model?

Answer: Yes. Program implementation documented by end of 1996.

SC&A conclusions 3 & 4: ER Addendum 2

3. Any limitations or uncertainties related to SNL-A reliance on personnel air sampling results as indicators for assignment of 100 mrem CEDE dose?

Answer: Weight of evidence supports this assignment, with limitations of available BZ monitoring records mitigated by conservatism of NIOSH approach.

4. Is there evidence that security guards at SNL-A were potentially exposed to unmonitored intakes in excess of 100 mrem CEDE per year?

Answer: SC&A concludes that it is unlikely that security guards would have received an intake at or in excess of this annual dose.

Finding 1: Direct evaluation of record completeness is not possible

- ◆ **SC&A:** Unable to locate references, such as periodic health physics reports, that tabulate the total number of workers monitored via BZ nor the total number of BZ samples issued and processed. Thus, a direct evaluation of the completeness of captured BZ results is not currently feasible.
- ◆ **NIOSH response:**
 - NIOSH (2021) agrees that the dataset of raw field-monitoring data sheets is incomplete.
 - NIOSH notes that for 1997–2002 there were 965 sample entries in DAC-hr tracking logs and a dataset of 3,741 raw BZ samples available for comparison.
 - Evaluation indicates that 952 (or 98.7%) of samples found in DAC-hr logbooks were also located in NIOSH’s available dataset for evaluation.
 - NIOSH conclusion: Dosimetrically significant BZ samples were included in the dataset.

SC&A reply and recommended status

- ◆ SC&A reiterates that the conclusion reached in its Addendum 2 ER review was that a bounding dose reconstruction approach for unmonitored workers or partially monitored workers is likely feasible based on the weight of available evidence (SC&A, 2020, p. 7).
- ◆ SC&A concurs with the NIOSH response about potential biases based on a comparison with DAC-hr tracking reports (1997–2002 only, 63 of 173 applicable months).
- ◆ Nonetheless, the determination of acceptable levels of incompleteness in a feasibility context is ultimately a subjective judgment that should be discussed by the work group.
- ◆ Therefore, SC&A recommends this finding remain in progress pending work group discussion.

Observation 1: Duplicate samples and total breathing zone samples

SC&A identified 151 duplicate samples analyzed for 2002 in Addendum 2 of the petition evaluation report (ER) (NIOSH, 2019). These samples should not be included in reported BZ totals and should be removed from any exposure estimates. Furthermore, when reporting the total number of BZ samples, the distinct measurements (gross alpha, gross beta, low-energy beta, and tritium) should not be counted as separate and distinct BZ samples.

Observation 1: NIOSH response

For duplicate samples:

- ◆ NIOSH (2021) confirmed the presence of 148 usable samples that were duplicates.
- ◆ NIOSH removed the duplicate entries, repeated the original analysis, and found little to no impact on results.
- ◆ To be expected due to the large number of zero or negative results that require imputation.

For total breathing zone samples:

- ◆ More appropriate comparison would be to the actual number of BZ component measurements (alpha, beta/gamma, and tritium).
- ◆ Reiterated that analyzing the BZ data by alpha, beta, and tritium samples separately is appropriate and claimant favorable.
- ◆ Dose from alpha was orders of magnitude larger than the other components (beta/gamma, low-energy beta, and tritium).

Observation 1: SC&A reply and recommended status (observed duplicate samples)

- ◆ SC&A and NIOSH agree that there were duplicate BZ results inadvertently entered and analyzed for 2002.
- ◆ NIOSH has appropriately reanalyzed the data, and it had little to no effect on calculated results.
- ◆ Although NIOSH indicated that it could not find duplicate entries for other years identified in table 1 of SC&A (2020), resolving these few discrepancies observed by SC&A would have no effect on the resulting analysis and proposed methods for dose reconstruction.
- ◆ Therefore, SC&A recommends the part of observation 1 concerning duplicate samples be closed.

Observation 1: SC&A reply and recommended status (total reported BZ samples)

- ◆ SC&A's comparison was to table 6-1e, "Available Breathing Zone Air Monitoring Results: 1997-2011," in section 6 of the SEC ER (NIOSH, 2019).
- ◆ NIOSH's 2021 response states on page 7: "the tabulation for Section 6 (i.e., Table 6-1e) is related to the number of line items of data available to NIOSH – with each line item potentially containing more than one result type."
- ◆ SC&A understands where the discrepancies between the NIOSH SEC ER tabulation and SC&A's own analysis arise.
 - However, SC&A believes that this characterization of the data is misleading and overstates the actual amount of available data.
 - SC&A recommends further discussion with the work group and potentially revising the SEC ER.
- ◆ SC&A agrees with the final aspect of NIOSH's (2021) response, which defends separating BZ results by radiation type for the purpose of evaluating the magnitude of exposures. (SC&A never has questioned this.)

Observation 2: Temporal variation indicates incomplete dataset

- ◆ **SC&A:** Observed temporal variation in number of captured BZ samples suggests available dataset does not represent a complete set of monitoring records for affected worker population. Therefore, any conclusions about exposure potential reflected in captured BZ samples are likely based on incomplete data.
- ◆ **NIOSH response:**
 - Agrees that the BZ dataset is not complete.
 - Believes the dataset is likely biased high (all data transmitted to the internal dosimetry group for DAC-hr tracking purposes are included).
- ◆ **SC&A reply and recommended status:** SC&A and NIOSH agree. SC&A recommends that observation 2 be subsumed under finding 1 discussions.

Observation 3: Use of WebDose to establish completeness and bounding dose estimate

- ◆ **SC&A:** Comparison of BZ entries in WebDose to captured hardcopy records demonstrates that WebDose does not represent a complete data source reflecting who was monitored via BZ at SNL-A. Therefore, the use of WebDose to support the 100 mrem dose threshold may not be appropriate.
- ◆ **NIOSH response:**
 - Concurrs with SC&A observation that WebDose dataset does not contain entries for all collected BZ samples.
 - Notes that WebDose entries represent a complete assessment of most highly exposed worker population.
 - Constitutes an additional piece of evidence that a bounding dose reconstruction methodology is feasible.

Observation 3: SC&A reply and recommended status

- ◆ SC&A reviewed the WebDose database against available DAC-hr logbooks and agrees with NIOSH's conclusion that 100% of those logbook entries are contained in WebDose.
- ◆ Provides weight of evidence that the available dataset contains the dosimetrically significant BZ results (and is potentially biased high).
- ◆ SC&A recommends that observation 3 be subsumed under finding 1 discussions.

Observation 4: Distribution of breathing zone samples among individual workers

- ◆ **SC&A:** Substantial portion of available BZ samples per year are often assigned to just a few individuals. Approximately 8% of total BZ samples were associated with just a single individual, though over 195 monitored individuals were identified. Nearly 80% of identified individual workers in a given year had 20 BZ samples or fewer.
- ◆ **NIOSH:** Concurs with this observation and believes that it does not affect the conclusion that a bounding dose reconstruction methodology is feasible. This methodology using 100 mrem per year of internal dose for unmonitored or partially monitored workers is claimant favorable and appropriate
- ◆ **SC&A reply and recommended status:** Recommend work group closure.

Observation 5: Workers frequently monitored by BZ also participated in bioassay program

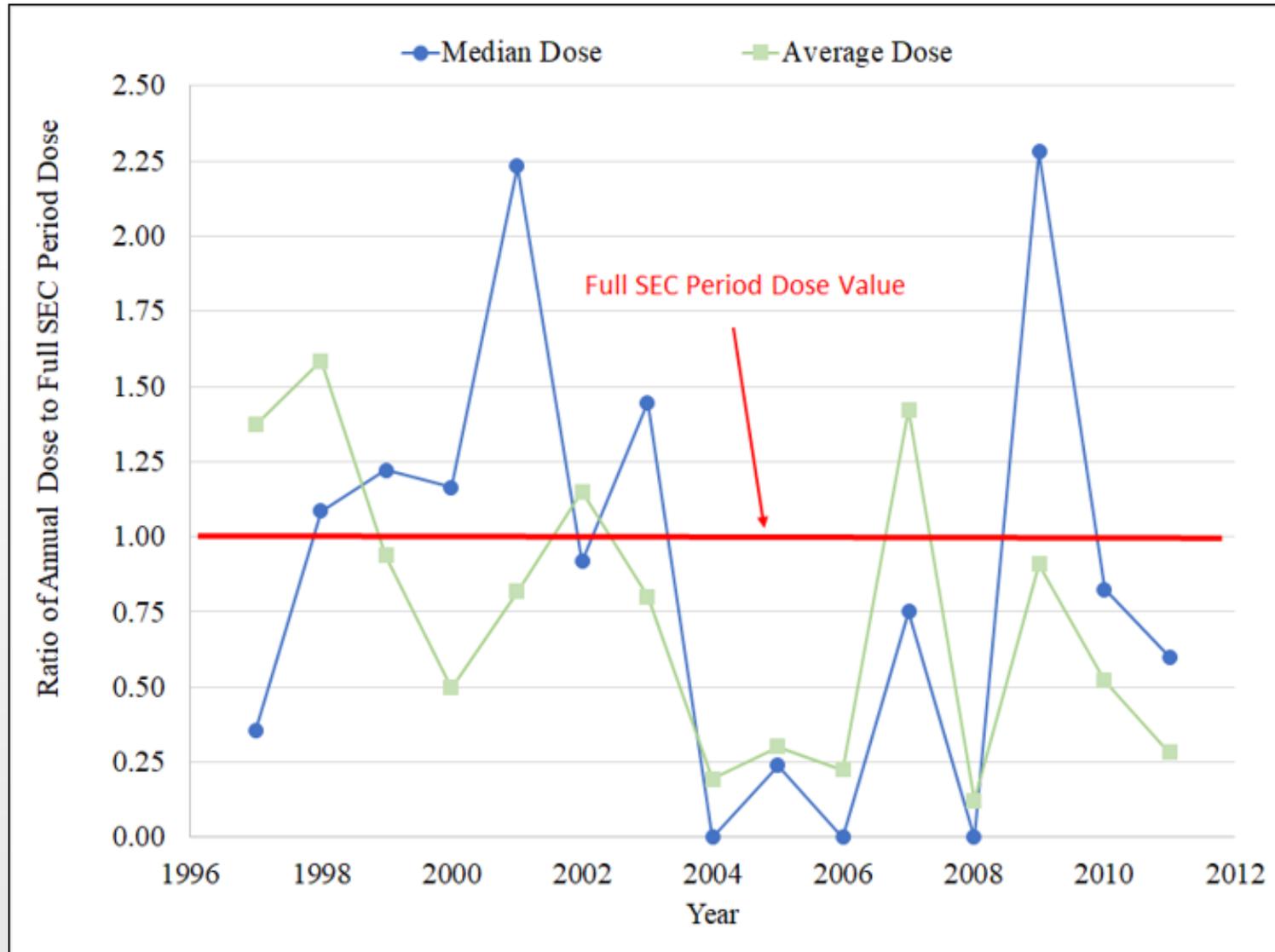
- ◆ **SC&A:** 79 of 194 identified individuals in the captured BZ records also participated in the non-tritium bioassay program during evaluated SEC period. This includes identified workers with the highest number of BZ results per year and 11 workers with the highest number of BZ results over the entire period. Therefore, evidence suggests that workers who were most often monitored via BZ were also often monitored via non-tritium bioassay. (SC&A, 2020, p. 25)
- ◆ **NIOSH response:** Concurs with SC&A's observation and reaffirms its conclusion that the captured set of raw BZ monitoring records were among those with the highest potential for internal exposure.
- ◆ **SC&A reply and suggested status:** Recommend work group closure.

Observation 6: Fluctuations in exposure potential by year and work area

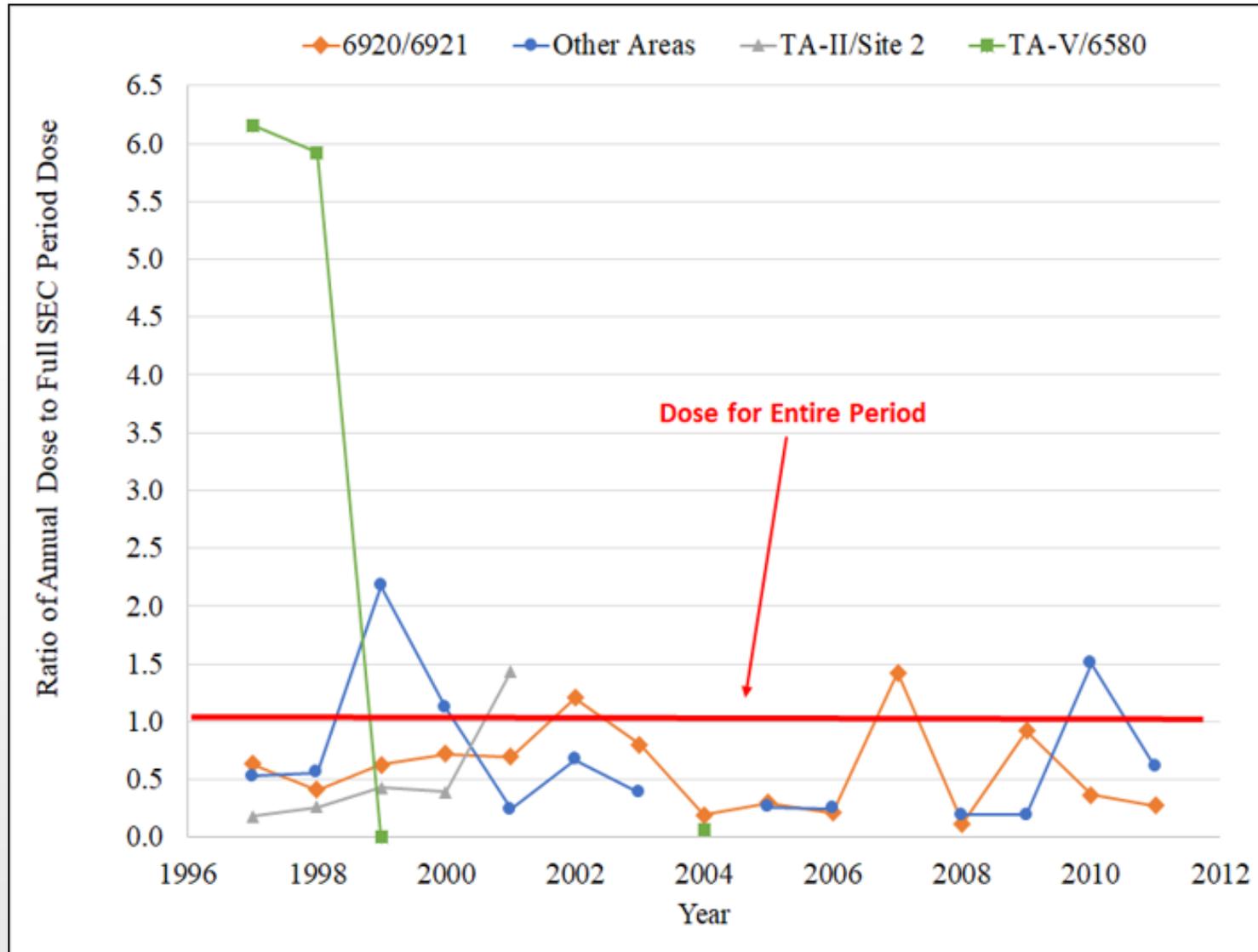
◆ SC&A:

- SC&A's analysis of relative exposure potential demonstrates that noteworthy fluctuations in exposure potential can exist by year and by work area.
- SC&A does not believe these fluctuations necessarily obviate the use of 100 mrem as a maximizing dose assignment to unmonitored workers, as several significantly conservative assumptions were included in the dose estimates. (SC&A, 2020, pp. 35–36)

Observation 6: Fluctuations by year



Observation 6: Fluctuations by area



Observation 6: Mitigating factors

- ◆ Pu-239 was assumed for nearly all (i.e., greater than 99%) dose calculations, though lower derived air concentration (DAC) value radionuclides were applicable in several specific scenarios (e.g., depleted uranium or mixed fission products).
- ◆ Respiratory protection was never considered in the dose estimates, though consideration of such protection factors would lower the dose anywhere by a factor of 40 (standard air purifying respirator) to 10,000 (supplied-air bubble suit). Respiratory protection was used in over two-thirds of the available BZ events when transuranic material was identified as the contaminant of interest.
- ◆ The number of probable exposure events per year was likely much less than 200 (SC&A, 2020, p. 23), which was calculated by NIOSH to result in 100 mrem at approximately 0.5 mrem per event.
- ◆ Observed individuals with the most frequent number of BZ events were also included in the non-tritium bioassay program.

Observation 6: NIOSH response and SC&A recommendation

- ◆ **NIOSH:** NIOSH concurs with the observation and does not believe these fluctuations obviate the use of 100 mrem as a maximizing dose assignment to unmonitored workers.
- ◆ **SC&A reply and recommended status:**
 - Based on these mitigating factors, SC&A (2020, 2021) concluded that dose assessment using incomplete BZ data is sufficiently conservative to allow the conclusion that a bounding internal dose estimate of 100 mrem on an annual basis is appropriate for unmonitored or partially monitored workers.
 - Recommend work group closure.

Observation 7: Sandia Pulse Reactor radiation gradient dose

- ◆ **SC&A:** Issue of exposure to severe radiation gradients would not be applicable to personnel working outside the immediate area of the bottom of SPR reactor vessel. However, potential exposures to maintenance and operating personnel while performing close-up work on SPR has not been sufficiently addressed and resolved.
- ◆ **NIOSH:** Finds that further research is needed for dose assignments for SPR workers. NIOSH intends to conduct additional review and research to determine the need for adjustment to recorded dosimetry doses. NIOSH will revise the external dose section of the SNL-A site profile to reflect any necessary changes to external dose assignment to SPR workers when using recorded dosimetry results.
- ◆ **SC&A reply and suggested status:** SC&A concurs with NIOSH's plan to (1) conduct additional review and research and (2) document dosimetry practices in an update to the external dose section of the SNL-A site profile.

Summary of SC&A recommendations:

Finding 1, observations 1–3

- ◆ **Finding 1:** Recommend some additional work group discussion to clarify issues remaining about data completeness.
- ◆ **Observation 1:**
 - First part of observation about inclusion of duplicate samples should be closed.
 - Recommend further discussion of the second part of the observation about the contents of table 6-1e, “Available Breathing Zone Air Monitoring Results: 1997-2011,” in the NIOSH SEC ER.
- ◆ **Observation 2:** Temporal issues should be subsumed under finding 1 discussion of data completeness.
- ◆ **Observation 3:** Use of WebDose as evidence of data bias should be subsumed under finding 1 discussion of data completeness.

Summary of SC&A recommendations: Observations 4–6

- ◆ **Observation 4:** SC&A and NIOSH agree that the number of observed BZ samples per worker per year does not adversely impact the feasibility of dose reconstruction. Recommend closure.
- ◆ **Observation 5:** SC&A and NIOSH agree that the workers most often sampled by BZ also participated in the non-tritium bioassay program. Recommend closure.
- ◆ **Observation 6:** Despite temporal and location variation in exposure potential, SC&A believes the proposed dose reconstruction methodology is feasible and bounding based on three mitigating factors:
 1. Conservative choice of contaminant for analysis (Pu-239)
 2. No consideration of respiratory protection
 3. Probable number of exposure events per year

Summary of SC&A recommendations: Observation 7 and summary conclusion

- ◆ **Observation 7:** NIOSH will address the SPR radiation gradient dose in the next revision of the SNL-A site profile.
- ◆ **Summary Conclusion:** Assuming these followup activities are addressed, SC&A does not have any remaining concerns about the Addendum 2 ER and its conclusion that a bounding dose reconstruction method is feasible, sufficiently accurate, and claimant favorable for SNL-A during the evaluated period (January 1, 1997–May 21, 2011).

References

National Institute for Occupational Safety and Health. (2019). *SEC petition evaluation report Petition SEC-00188, Addendum 2 (1997–2011) (rev. 0)*. <https://www.cdc.gov/niosh/ocas/pdfs/sec/sandianm/snlnmer-188-a2-508.pdf>

National Institute for Occupational Safety and Health. (2021). *NIOSH response to SC&A's review of SEC-00188 Sandia ER Addendum 2* [Response paper]. <https://www.cdc.gov/niosh/ocas/pdfs/dps/dc-snlsec188erad2-508.pdf>

SC&A, Inc. (2020). *Review of SEC petition evaluation report: Petition SEC-00188, Addendum 2 (1977–2011), for Sandia National Laboratories – Albuquerque (SCA-TR-2020-SEC004, rev. 0)*. <https://www.cdc.gov/niosh/ocas/pdfs/abrwh/scarpts/sca-sec188erad2-508.pdf>

SC&A, Inc. (2021). *Reply to NIOSH's response to SC&A's review of the Sandia National Laboratories – Albuquerque SEC-00188 Addendum 2 evaluation report (SCA-TR-2021-SEC006, rev. 0)*.