

 **Memorandum**

To: Subcommittee for Procedure Reviews
From: SC&A, Inc.
Date: July 19, 2022
Subject: Exposure from the Radon Calibration Chamber at the Grand Junction Facilities

SC&A's August 17, 2021, review of ORAUT-TKBS-0060, revision 00, issued May 18, 2018 (NIOSH, 2018), for the Grand Junction Facilities (GJF) identified observation 3, "Potential radon calibration chamber exposure." This observation was discussed at the February 15, 2022, meeting of the Subcommittee for Procedure Reviews (SCPR), with the resulting action item that the National Institute for Occupational Safety and Health (NIOSH) would provide relevant documents for SC&A to review.

Document Reviews

SC&A reviewed the five documents related to the GJF radon calibration chamber (RCC) provided by NIOSH in May 2022. In summary, these documents comprise a few snapshots in time of personnel monitoring and results. The following is a brief outline of the contents of the five documents (all pages refer to PDF page numbers).

Site Research Database (SRDB) 160585 (Geotech, 1991a) addresses radon dose for Geotech personnel who operated the RCC for the years [REDACTED] by using the log entries of stay time and chamber radon concentration measurement (assuming 50 percent equilibrium and 1 rem annual effective dose equivalent (AEDE) per working level month (WLM)). Any individual event dose <1 millirem (mrem) was entered as zero, and any total dose <10 mrem was entered as zero; all resulting doses for the 2-year period [REDACTED] for [REDACTED] workers were entered as zeros.

SRDB 100192 (Geotech, 1991b) is a summary of SRDB #160585 for 1990 for reporting purposes.

SRDB 166851 (NIOSH, 2017) is a NIOSH interview with a senior health physicist in March 2017 about health physics monitoring in general. This individual began work at GJF in [REDACTED]. The following list summarizes some relevant information about the RCC from the interview:

- Page 6: The RCC is mentioned as an airborne radioactivity area.

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- Page 9: One door will lock at >30 picocuries per liter (pCi/l), and both doors lock at >100 pCi/l.
- Page 12: The radon concentration value multiplied by the stay time was used to derive dose, as detailed in Geotech (1995), page 9.
- Page 13: [REDACTED] RCC workers were monitored in [REDACTED] per Geotech (1995).

SRDB 093732 (DOE, 1985) is the RCC operating manual of January 1985. The exposure chamber was a steel cylinder approximately 11 feet in diameter by 9 feet in height. It was constructed by the Bendix Field Engineering Corporation for the U.S. Department of Energy (DOE) at the GJF. Radon concentrations of 1 to 1,000 pCi/l were available inside the chamber. The following list summarizes some relevant information about exposure at the RCC:

- Page 25: The radon generator contained 5 millicuries of radium-226 on iron-hydroxide.
- Pages 27 and 31: Air monitoring consisted of five live-time radon detectors (three inside the chamber and two outside the chamber) and four live-time radon decay product real-time detectors (three inside the chamber and one outside the chamber). The air monitoring results were recorded on an HP-1000 computer.
- Page 41: Records of important conditions (such as air radon concentrations, stay time, and use of respirator and filters) were recorded in the log if the chamber was entered when concentrations were >30 pCi/l.
- Page 42: No entry into the chamber was allowed at radon concentrations >100 pCi/l because both doors were automatically locked (the only entry was with a special bypass key).
- Pages 50–51: The exposure rate was a maximum of 100 milliroentgen per hour (mR/h) at 6 inches from the radium-226 source and <1.1 mR/h outside RCC chamber.

SRDB 098093 (Geotech, 1995) is an internal memorandum summarizing the individual doses and WLM values for [REDACTED] employees who entered the RCC periodically during [REDACTED]. Appendix A provides the internal dose assessment calculations, and attachments A.1 through A.6 provide a detailed list of the calculated intakes in WLM and the committed effective dose equivalent and lung dose for the year [REDACTED] for each of the [REDACTED] employees. Attachment A.7 contains the radon chamber entry log sheets for [REDACTED].

SC&A analyzed the internal dose assessment methodology and the equations used in the calculations and found them to be correct and applicable. SC&A analyzed the calculated intakes in WLM and the committed effective dose equivalent and lung dose in attachments A.1 through A.7 for the year [REDACTED] (using the stay times and measured radon concentrations from the log entries in attachment A.7) for the [REDACTED] employees and found them correct.

The largest recorded acute equilibrium-equivalent radon concentration for [REDACTED] was 22 pCi/l. The largest annual committed effective dose equivalent dose for [REDACTED] for any of the [REDACTED]

employees who entered the RCC was 3 mrem. The largest derived WLM from the log entry information for [REDACTED] for any of the [REDACTED] employee was 0.0022 WLM. The maximum recorded number of RCC entries made by an individual in [REDACTED] was [REDACTED].

What this Information Indicates

1. The RCC was likely operated during the period 1985–1994 but could have been operated during other years also.
2. There was control of who could be present and who operated the RCC. Operating and entry information was recorded in logs.
3. There were real-time radon monitors with results recorded on a computer.
4. Internal radon doses for the period [REDACTED] were all <10 mrem total for each of the 10 RCC workers for the 2-year period, assuming <1 mrem for any given measurement and <10 mrem for any worker's total dose as stated in Geotech (1991a).
5. The largest annual committed effective dose equivalent dose in [REDACTED] for any of the [REDACTED] employees who entered the RCC was 3 mrem, and the largest derived WLM from the log entry information was 0.0022 WLM.
6. Exposure was controlled and personnel limited.

What Is Still Uncertain

The following information was not provided in the five documents reviewed in this memorandum:

1. exact years the RCC was operational (the RCC manual was dated 1985, and Building 32 was remediated in 1999–2000)
2. what the intakes and doses were during operational years other than 1989, 1990, and 1994
3. the number of chamber entries that one individual could make per year (the maximum recorded for an individual in [REDACTED] was [REDACTED] entries)

Summary

The question raised by observation 3 was: Does the 5.7 pCi/l used from Building 30 bound the exposures at the RCC? All information provided by NIOSH to date indicates the following:

1. According to table 5-7 in ORAUT-TKBS-0060 for 1975–1998, 5.7 pCi/l radon at 50 percent equilibrium equals 2.85E-2 working levels, which equals 0.340 WLM/year. At 1 rem AEDE/WLM (Geotech, 1991a, p. 3), this would result in a dose of 340 mrem/year. Additionally, thoron dose is assigned per table 5-7 of ORAUT-TKBS-0060.

2. A dose of 340 mrem/year bounds individual events of <1 mrem, and 340 mrem/year also bounds a maximum total <10 mrem, which is indicated by a zero being assigned for the total dose for the period [REDACTED].
3. A dose of 340 mrem/year bounds a maximum of 3 mrem recorded for [REDACTED], and 0.340 WLM/year bounds the maximum derived value of 0.0022 WLM for [REDACTED].
4. Currently, radon dose information for the period outside the years of [REDACTED] [REDACTED] has not been made available.
5. Indications are that (a) the RCC was a controlled facility with monitoring in place and (b) 5.7 pCi/l would bound exposures, but those conclusions are somewhat subjective outside of the years [REDACTED].

References

Geotech, Inc. (1991a). *Assessment of internal dose for Geotech workers occupationally exposed due to radon chamber entries during 1990*. SRDB Ref. ID 160585

Geotech, Inc. (1991b, February 20). *Internal dose assessment due to radon chamber entries during 1990* [Internal memorandum]. SRDB Ref. ID 100192

Geotech, Inc. (1995, February 28). *Internal radiation doses* [Internal memorandum]. SRDB Ref. ID 098093

National Institute for Occupational Safety and Health. (2017). Documented communication with [REDACTED], March 16 & 29, 1917. SRDB Ref. ID 166851

National Institute for Occupational Safety and Health. (2018). *Site profile for Grand Junction Facilities* (ORAUT-TKBS-0060, rev. 00). <https://www.cdc.gov/niosh/ocas/pdfs/tbd/gjf-r0-508.pdf>

SC&A, Inc. (2021). *SC&A's review of ORAUT-TKBS-0060, revision 00, "Site profile for Grand Junction Facilities"* (SCA-TR-2021-PR001, rev. 0). <https://www.cdc.gov/niosh/ocas/pdfs/abrwh/scarpts/sca-gjfsp-r0-508.pdf>

U.S. Department of Energy, Technical Measurements Center. (1985). *Operating manual for the radon-daughter chamber* (GJ/TMC-18, UC-70A). SRDB Ref. ID 093732