




# AFRL-SA-WP-TR-2024-0002

# Missile Community Cancer Study, Round 2 Radon Results for Malmstrom, F.E. Warren, and Minot Air Force Base

**Lt Col Scott M. Boyd**
**Occupational & Environmental Health Department**

**Report Date**
**2 February 2024**



**Date of Determination: 2 February 2024**
**Air Force Research Laboratory 711th Human Performance Wing**
**U.S. Air Force School of Aerospace Medicine**
**Occupational & Env. Health 2510 Fifth St., Bldg. 840**
**Wright-Patterson AFB, OH 45433-7913**

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SCOTT M. BOYD, Lt Col, USAF, BSC
Chief Consulting Executive, Occupational & Environmental Health Department

RENTES.JOANNA.LYNNE.1012419585 Digitally signed by RENTES.JOANNA.LYNNE.1012419585 Date: 2024.02.02 17:17:52 -05'00'

JOANNA L. RENTES, Col, USAF, BSC
Chair, Occupational & Environmental Health Department

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Capt Leigh M. Durden, Occupational and Environmental Health Department

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Air Force Research Laboratory, 711th Human Performance Wing
U.S. Air Force School of Aerospace Medicine, Occupational & Env. Health Dept
2510 Fifth St., Bldg. 840
Wright-Patterson AFB, OH 45433-7913

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Air Force Research Laboratory, 711th Human Performance Wing
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2510 Fifth St., Bldg. 840
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**13. SUPPLEMENTARY NOTES**

**14. ABSTRACT**
At the request of the Air Force Global Strike Commander (AFGSC/CC), the United States Air Force School of Aerospace Medicine (USAFSAM) Defense Centers for Public Health-Dayton Occupational and Environmental Health Department (DCPH-D/OE) performed an environmental health survey for all forty-five Missile Alert Facilities (MAFs) at Malmstrom AFB, Montana; F.E. Warren AFB, Wyoming; and Minot AFB, North Dakota. The purpose of this environmental health survey was to assess elevated cancer concerns within the Air Force missile community by characterizing and documenting potential exposures to environmental hazards in the MAFs. Round 2 sampling occurred from 8 September 2023 to 11 January 2024 and built upon the Round 1 environmental health survey which occurred from 8 June 2023 to 3 October 2023. Round 2 was executed as part of a three-round surveillance effort to determine seasonal variations associated with potential environmental hazards at MAF locations. Round 2 repeated area air sampling, direct reading instrument (DRI) air monitoring, swipe sampling in Missile Procedures Trainers, drinking water sampling, and soil sampling which were conducted in Round 1. The purpose of this memo is to augment previous Round 2 interim reports by conveying Round 2 radon results analyzed by DCPH-D/OE.

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|---|---|
| Capt Leigh Durden | (937) 938-3297 |



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**DEFENSE HEALTH AGENCY**
DEFENSE CENTER FOR PUBLIC HEALTH - DAYTON
2510 5TH STREET, BUILDING 840
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433-7951

Public Health

2 February 2024

MEMORANDUM FOR: AFGSC/SGPB
ATTN: Lt Col Raymond Mak

FROM: DCPH-D/OE
2510 Fifth Street, Building 840
WPAFB OH 45433-7913

SUBJECT: Consultative Letter, AFRL-SA-WP-TR-2024-0002, Missileer Cancer Study, Malmstrom, F.E. Warren, and Minot Air Force Base (AFB) Round 2 Radon Results

References: (a) Keith J. Westpfahl, Stepanie A. Ohms, Jesse M. Ford, Michael J. Anderson, and David M. Flint, *Bioenvironmental Engineering Guidebook for Radon Management* (OH: Air Force Research Laboratory, 2021), p20 & 27.

(b) Agency for Toxic Substances and Disease Registry, *Radon - ToxFAQs* (GA: ATSDR, 2012).

(c) Crystalyn E. Brown, *U.S. Air Force School of Aerospace Medicine Laboratory Sampling and Analysis Guide* (OH: Air Force Research Laboratory, 2016), p90.

(d) Environmental Protection Agency, *Health Risk of Radon*. (Washington, D.C.: EPA, 2023).

(e) Rad Elec, Inc., *Frequently Asked Questions: E-PERMs*. (MD, 2023).

(f) AFMAN 48-148, 20 July 2020, *Ionizing Radiation Protection*.

## 1. INTRODUCTION

At the request of the Air Force Global Strike Commander (AFGSC/CC), the United States Air Force School of Aerospace Medicine (USAFSAM) Defense Centers for Public Health-Dayton Occupational and Environmental Health Department (DCPH-D/OE) performed an environmental health survey for all forty-five Missile Alert Facilities (MAFs) at Malmstrom AFB, Montana; F.E. Warren AFB, Wyoming; and Minot AFB, North Dakota. The purpose of this environmental health survey was to assess elevated cancer concerns within the Air Force missile community by characterizing and documenting potential exposures to environmental hazards in the MAFs. Round 2 sampling occurred from 8 September 2023 to 11 January 2024 and built upon the Round 1 environmental health survey which occurred from 8 June 2023 to 3 October 2023. Round 2 was executed as part of a three-round surveillance effort to determine

seasonal variations associated with potential environmental hazards at MAF locations. Round 2 repeated area air sampling, direct reading instrument (DRI) air monitoring, swipe sampling in Missile Procedures Trainers, drinking water sampling, and soil sampling which were conducted in Round 1. The purpose of this memo is to augment previous Round 2 interim reports by conveying Round 2 radon results analyzed by DCPH-D/OE.

A. Installation Personnel:

(1) Malmstrom AFB:

(a) Maj Brian Shuler, 341st Operational Medical Readiness Squadron (OMRS) Bioenvironmental Engineering Flight Commander

(b) TSgt Darryl Adams, 341st OMRS Bioenvironmental Engineering Flight Chief

(2) F.E. Warren AFB:

(a) Capt Ariel Serrano, 90th OMRS Bioenvironmental Engineering Flight Commander

(b) SSgt Joseph Bahr, 90th OMRS Bioenvironmental Engineering Flight Chief

(3) Minot AFB:

(a) Maj Douglas Schneekloth, 5th OMRS Bioenvironmental Engineering Officer in Charge

(b) SSgt Jesse Ford, 5th OMRS Bioenvironmental Engineering Flight Chief

B. Equipment Used:

(1) Electret Passive Environmental Radon/Radiation Monitor (E-PERM) Electret Ion Chamber

(2) E-PERM Electret Reader

## 2. BACKGROUND

Following a March 2023 site visit to address cancer concerns in the missileer community, DCPH-D/OE performed the first and second rounds of environmental sampling at all MAFs at Malmstrom AFB, F.E. Warren AFB, and Minot AFB. The sampling plan targeted carcinogens which could potentially affect MAF personnel through dermal, ingestion, and inhalation exposure pathways. Radon sampling for all MAFs and occurred for 91 and 107 days depending on base and MAF. Radon sampling at Malmstrom AFB MAFs occurred from 27 September 2023 to 11 January 2024. Radon sampling at F.E. Warren from 8 September 2023 to 15 December 2023. Radon sampling at Minot AFB occurred from 11 September 2023 to 14 December 2023. Since all sampling durations were greater than 90 days, they meet Federal and Air Force guidelines for long-term sampling (Westpfahl et al, 2021). Variances in sampling duration occurred between the three bases due to scheduling availability for each base Bioenvironmental Engineering Flight.

When activated, the MAF is manned under two operational tempos. Malmstrom and Minot AFBs man the MAFs for twenty-four hours per day, seven days per week, three hundred sixty-

five days a year with rotating crews. Each crew works in the MAF seven straight days at the MAF followed by two weeks in non-MAF locations. F.E. Warren AFB mans the MAFs for twenty-four hours per day, seven days per week, three hundred sixty-five days a year with rotating crews. Each crew works in the MAF for twenty-four hours followed by forty-eight hours in non-MAF locations. Under both tempos, MAFs are occupied for 2,920 hours each year in the Topside Facility Manager Bedroom, Topside Common Area, Topside Security Forces Room, and Launch Control Center (LCC). For the non-continuously occupied location sampled (Hallway to/from LCC), an occupancy of 243 hours each year was applied under the conservative calculation that MAF occupants will occupy the hallway outside of the LCC for five minutes each hour.

## 3. HEALTH HAZARD SUMMARY

Radon is a naturally occurring, radioactive gas that is odorless, colorless, and tasteless (Agency for Toxic Substances and Disease Registry, 2012). Radon is constantly produced in soil and building materials where uranium exists (Brown, 2016). Because the gas is inert and has a 3.8-day half-life, radon can diffuse through the soil, where it enters the atmosphere or groundwater (Ibid, 2016). Radon in the atmosphere decays into particulate daughter products that adhere to dust particles. Per the EPA, radon is the second leading cause of lung cancer in the United States (EPA, 2023).

## 4. METHODOLOGY & ANALYSIS

The E-PERM Electret Ion Chamber measures radon concentrations by quantifying the reduction of voltage over a known time (Rad Elec Inc, 2023). Radon concentrations, measured in picocuries per liter (pCi/L), are converted to radon exposures (Working Level Months in a year) through a calculation which incorporates the radon concentration measured by the instrument at the location and the applicable occupancy (hours per year).

Seven E-PERM Electret Ion Chambers in an S Chamber Long-Term (SLT) electret configuration were placed in each MAF. SLT configurations enable thirty to one hundred and twenty days of sampling with a minimum detection limit of 0.2 picocuries per liter (pCi/L). Sample locations within each MAF include one electret placed in the:

A. Topside Facility Manager Bedroom
B. Topside Common Area
C. Topside Security Forces Room
D. LCC
E. Hallway to/from LCC

One blank and one duplicate electret were also placed in the LCC. The blank and duplicate are used to ensure quality assurance/quality control (QA/QC). They validate sample results are trustworthy, precise, and unbiased (Westpfahl et al., 2021). Upon completion of the scheduled sampling duration, installation Bioenvironmental Engineering Flight personnel transported the E-PERM Electret Ion Chambers Topside, conducted a radon reading via the E-PERM Electret

Reader, recorded the results on the E-PERM Calculation Spreadsheet, and returned the E-PERM Electret Reader to its designated location for Round 3 radon sampling. Installation Bioenvironmental Engineering then submitted the E-PERM Calculation Spreadsheet to DCPH-D/OE for final QA/QC. DCPH-D/OE compared the results documented in the E-PERM Calculation Spreadsheet to limits referenced in paragraph 7 of AFMAN 48-148, *Ionizing Radiation Protection*, which direct:

A. Annual exposure limit to radon is four Working Level Months in a year (4 WLM/yr)

B. Facility mitigation will begin at exposures greater than 0.8 WLM/yr

## 5. RESULTS & DISCUSSION

All radon measurements across all forty-five MAFs were below the annual exposure limit and the facility mitigation levels in Chapter 7 of AFMAN 48-148. Therefore, no facility modifications or mitigation to limit radon exposure are recommended. The highest radon levels measured at each installation are:

A. Malmstrom AFB at MAF Charlie-01 (Topside Facility Manager Bedroom), 0.71 WLM/yr

B. F.E. Warren AFB at MAF India-01 (Topside Facility Manager Bedroom), 0.21 WLM/yr

C. Minot AFB at MAF Charlie-01 (Topside Facility Manager Bedroom), 0.18 WLM/yr

## 6. CONCLUSIONS

The results presented in this report are a part of a multi-faceted study to characterize the environment where the missileer community works. Three sampling events will occur over a year to determine if seasonal variations exist. This report is the culmination of Round 2 radon sampling. Round 3 radon sampling for this project is currently underway. All other Round 3 environmental surveillance (air, water, soil sampling) will begin in Spring 2024. If you have any questions, comments, or concerns, please contact Capt Leigh Durden at 937-938-3297 or by e-mail at leigh.durden@us.af.mil.

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Date: 2024.02.02 18:00:54 -05'00'

SCOTT M. BOYD, Lt Col, USAF, BSC
Chief Consulting Executive

3 Attachments
1. Round 2 Radon Results for Malmstrom AFB from 27 September 2023 to 11 January 2024
2. Round 2 Radon Results for F.E. Warren AFB from 8 September 2023 to 15 December 2023
3. Round 2 Radon Results for Minot AFB from 11 September 2023 to 14 December 2023

**Attachment 1: Round 2 Radon Results for Malmstrom AFB from 27 September 2023 to 11 January 2024**

| MAF | Location | Start Date | End Date | Total Days Exposed | Bldg Occupancy (hrs/yr) | Radon in Air (pCi/L) | Radon in Air (WLM/yr) |
|---|---|---|---|---|---|---|---|
| A-01 | FM Bedroom | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 1.3 | 0.09 |
| A-01 | Topside Common Area | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 1.8 | 0.12 |
| A-01 | Security Forces Room | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 1.4 | 0.10 |
| A-01 | Hallway to/from LCC | 28-Sep-23 | 9-Jan-24 | 104 | 243 | 1.8 | 0.01 |
| A-01 | LCC | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 1.8 | 0.12 |
| B-01 | FM Bedroom | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 1.0 | 0.07 |
| B-01 | Topside Common Area | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 1.0 | 0.07 |
| B-01 | Security Forces Room | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 0.1 | 0.01 |
| B-01 | Hallway to/from LCC | 28-Sep-23 | 9-Jan-24 | 104 | 243 | 1.7 | 0.01 |
| B-01 | LCC | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 2.1 | 0.14 |
| C-01 | FM Bedroom | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 10.4 | 0.71 |
| C-01 | Topside Common Area | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 1.1 | 0.08 |
| C-01 | Security Forces Room | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 1.2 | 0.08 |
| C-01 | Hallway to/from LCC | 28-Sep-23 | 9-Jan-24 | 104 | 243 | 1.8 | 0.01 |
| C-01 | LCC | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 0.5 | 0.03 |
| D-01 | FM Bedroom | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 0.8 | 0.05 |
| D-01 | Topside Common Area | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 0.4 | 0.03 |
| D-01 | Security Forces Room | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 0.5 | 0.03 |
| D-01 | Hallway to/from LCC | 28-Sep-23 | 9-Jan-24 | 104 | 243 | 0.7 | 0.00 |
| D-01 | LCC | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 0.6 | 0.04 |
| E-01 | FM Bedroom | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 1.9 | 0.13 |
| E-01 | Topside Common Area | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 0.5 | 0.03 |
| E-01 | Security Forces Room | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 1.1 | 0.08 |
| E-01 | Hallway to/from LCC | 28-Sep-23 | 9-Jan-24 | 104 | 243 | 1.9 | 0.01 |
| E-01 | LCC | 28-Sep-23 | 9-Jan-24 | 104 | 2920 | 1.2 | 0.08 |
| F-01 | FM Bedroom | 3-Oct-23 | 11-Jan-24 | 101 | 2920 | 0.4 | 0.03 |
| F-01 | Topside Common Area | 3-Oct-23 | 11-Jan-24 | 101 | 2920 | 0.6 | 0.04 |
| F-01 | Security Forces Room | 3-Oct-23 | 11-Jan-24 | 101 | 2920 | 0.5 | 0.03 |
| F-01 | Hallway to/from LCC | 3-Oct-23 | 11-Jan-24 | 101 | 243 | 1.2 | 0.01 |
| F-01 | LCC | 3-Oct-23 | 11-Jan-24 | 101 | 2920 | 1.0 | 0.07 |

**Attachment 1: Round 2 Radon Results for Malmstrom AFB from 27 September 2023 to 11 January 2024**

| MAF | Location | Start Date | End Date | Total Days Exposed | Bldg Occupancy (hrs/yr) | Radon in Air (pCi/L) | Radon in Air (WLM/yr) |
|---|---|---|---|---|---|---|---|
| G-01 | FM Bedroom | 3-Oct-23 | 11-Jan-24 | 101 | 2920 | 0.6 | 0.04 |
| G-01 | Topside Common Area | 3-Oct-23 | 11-Jan-24 | 101 | 2920 | 0.8 | 0.05 |
| G-01 | Security Forces Room | 3-Oct-23 | 11-Jan-24 | 101 | 2920 | 1.1 | 0.08 |
| G-01 | Hallway to/from LCC | 3-Oct-23 | 11-Jan-24 | 101 | 243 | 1.3 | 0.01 |
| G-01 | LCC | 3-Oct-23 | 11-Jan-24 | 101 | 2920 | 1.0 | 0.07 |
| H-01 | FM Bedroom | 27-Sep-23 | 11-Jan-24 | 107 | 2920 | 0.3 | 0.02 |
| H-01 | Topside Common Area | 27-Sep-23 | 11-Jan-24 | 107 | 2920 | 0.3 | 0.02 |
| H-01 | Security Forces Room | 27-Sep-23 | 11-Jan-24 | 107 | 2920 | 0.2 | 0.01 |
| H-01 | Hallway to/from LCC | 27-Sep-23 | 11-Jan-24 | 107 | 243 | 0.5 | 0.00 |
| H-01 | LCC | 27-Sep-23 | 11-Jan-24 | 107 | 2920 | 0.0 | 0.00 |
| I-01* | FM Bedroom | 3-Oct-23 | 11-Jan-24 | 101 | 2920 | 2.5 | 0.17 |
| I-01* | Topside Common Area | 3-Oct-23 | 11-Jan-24 | 101 | 2920 | 1.2 | 0.08 |
| I-01* | Security Forces Room | 3-Oct-23 | 11-Jan-24 | 101 | 2920 | 0.6 | 0.04 |
| I-01* | Hallway to/from LCC | 3-Oct-23 | 11-Jan-24 | 101 | 243 | 1.9 | 0.01 |
| I-01* | LCC | 3-Oct-23 | 11-Jan-24 | 101 | 2920 | 2.4 | 0.16 |
| J-01 | FM Bedroom | 3-Oct-23 | 11-Jan-24 | 101 | 2920 | 2.8 | 0.19 |
| J-01 | Topside Common Area | 3-Oct-23 | 11-Jan-24 | 101 | 2920 | 1.1 | 0.08 |
| J-01 | Security Forces Room | 3-Oct-23 | 11-Jan-24 | 101 | 2920 | 0.8 | 0.05 |
| J-01 | Hallway to/from LCC | 3-Oct-23 | 11-Jan-24 | 101 | 243 | 2.2 | 0.01 |
| J-01 | LCC | 3-Oct-23 | 11-Jan-24 | 101 | 2920 | 0.9 | 0.06 |
| K-01 | FM Bedroom | 29-Sep-23 | 8-Jan-24 | 102 | 2920 | 1.5 | 0.10 |
| K-01 | Topside Common Area | 29-Sep-23 | 8-Jan-24 | 102 | 2920 | 1.1 | 0.08 |
| K-01 | Security Forces Room | 29-Sep-23 | 8-Jan-24 | 102 | 2920 | 1.0 | 0.07 |
| K-01 | Hallway to/from LCC | 29-Sep-23 | 8-Jan-24 | 102 | 243 | 1.9 | 0.01 |
| K-01 | LCC | 29-Sep-23 | 8-Jan-24 | 102 | 2920 | 2.8 | 0.19 |
| L-01 | FM Bedroom | 29-Sep-23 | 8-Jan-24 | 101 | 2920 | 1.3 | 0.09 |
| L-01 | Topside Common Area | 29-Sep-23 | 8-Jan-24 | 101 | 2920 | 1.0 | 0.07 |
| L-01 | Security Forces Room | 29-Sep-23 | 8-Jan-24 | 101 | 2920 | 0.0 | 0.00 |
| L-01 | Hallway to/from LCC | 29-Sep-23 | 8-Jan-24 | 101 | 243 | 1.4 | 0.01 |
| L-01 | LCC | 29-Sep-23 | 8-Jan-24 | 101 | 2920 | 0.4 | 0.03 |

* Results do not represent operational conditions considering MAF was inactivated during Round 2 radon sampling AND encountered periodic/un-periodic forced, fresh air ventilation to facilitate health hazard protection in support of Polychlorinated Biphenyl remediation.

**Attachment 1: Round 2 Radon Results for Malmstrom AFB from 27 September 2023 to 11 January 2024**

| MAF | Location | Start Date | End Date | Total Days Exposed | Bldg Occupancy (hrs/yr) | Radon in Air (pCi/L) | Radon in Air (WLM/yr) |
|---|---|---|---|---|---|---|---|
| M-01 | FM Bedroom | 29-Sep-23 | 8-Jan-24 | 101 | 2920 | 0.7 | 0.05 |
| M-01 | Topside Common Area | 29-Sep-23 | 8-Jan-24 | 101 | 2920 | 0.7 | 0.05 |
| M-01 | Security Forces Room | 29-Sep-23 | 8-Jan-24 | 101 | 2920 | 1.4 | 0.10 |
| M-01 | Hallway to/from LCC | 29-Sep-23 | 8-Jan-24 | 101 | 243 | 1.7 | 0.01 |
| M-01 | LCC | 29-Sep-23 | 8-Jan-24 | 101 | 2920 | 0.8 | 0.05 |
| N-01 | FM Bedroom | 29-Sep-23 | 8-Jan-24 | 101 | 2920 | 1.3 | 0.09 |
| N-01 | Topside Common Area | 29-Sep-23 | 8-Jan-24 | 101 | 2920 | 0.4 | 0.03 |
| N-01 | Security Forces Room | 29-Sep-23 | 8-Jan-24 | 101 | 2920 | 0.8 | 0.05 |
| N-01 | Hallway to/from LCC | 29-Sep-23 | 8-Jan-24 | 101 | 243 | 2.0 | 0.01 |
| N-01 | LCC | 29-Sep-23 | 8-Jan-24 | 101 | 2920 | 3.0 | 0.21 |
| O-01 | FM Bedroom | 29-Sep-23 | 8-Jan-24 | 101 | 2920 | 1.1 | 0.08 |
| O-01 | Topside Common Area | 29-Sep-23 | 8-Jan-24 | 101 | 2920 | 1.2 | 0.08 |
| O-01 | Security Forces Room | 29-Sep-23 | 8-Jan-24 | 101 | 2920 | 1.3 | 0.09 |
| O-01 | Hallway to/from LCC | 29-Sep-23 | 8-Jan-24 | 101 | 243 | 1.2 | 0.01 |
| O-01 | LCC | 29-Sep-23 | 8-Jan-24 | 101 | 2920 | 0.6 | 0.04 |

**Attachment 2: Round 2 Radon Results for F.E. Warren AFB from 8 September 2023 to 15 December 2023**

| MAF | Location | Start Date | End Date | Total Days Exposed | Bldg Occupancy (hrs/yr) | Radon in Air (pCi/L) | Radon in Air (WLM/yr) |
|---|---|---|---|---|---|---|---|
| A-01 | FM Bedroom | 8-Sep-23 | 15-Dec-23 | 99 | 2920 | 1.2 | 0.08 |
| A-01 | Topside Common Area | 8-Sep-23 | 15-Dec-23 | 99 | 2920 | 1.0 | 0.07 |
| A-01 | Security Forces Room | 8-Sep-23 | 15-Dec-23 | 99 | 2920 | 0.8 | 0.05 |
| A-01 | Hallway to/from LCC | 8-Sep-23 | 15-Dec-23 | 99 | 243 | 1.3 | 0.01 |
| A-01 | LCC | 8-Sep-23 | 15-Dec-23 | 99 | 2920 | 0.0 | 0.00 |
| B-01 | FM Bedroom | 8-Sep-23 | 11-Dec-23 | 95 | 2920 | 0.8 | 0.05 |
| B-01 | Topside Common Area | 8-Sep-23 | 11-Dec-23 | 95 | 2920 | 2.3 | 0.16 |
| B-01 | Security Forces Room | 8-Sep-23 | 11-Dec-23 | 95 | 2920 | 1.0 | 0.07 |
| B-01 | Hallway to/from LCC | 8-Sep-23 | 11-Dec-23 | 95 | 243 | 1.5 | 0.01 |
| B-01 | LCC | 8-Sep-23 | 11-Dec-23 | 95 | 2920 | 0.9 | 0.06 |
| C-01 | FM Bedroom | 8-Sep-23 | 11-Dec-23 | 95 | 2920 | 1.7 | 0.12 |
| C-01 | Topside Common Area | 8-Sep-23 | 11-Dec-23 | 95 | 2920 | 1.1 | 0.08 |
| C-01 | Security Forces Room | 8-Sep-23 | 11-Dec-23 | 95 | 2920 | 0.6 | 0.04 |
| C-01 | Hallway to/from LCC | 8-Sep-23 | 11-Dec-23 | 95 | 243 | 0.4 | 0.00 |
| C-01 | LCC | 8-Sep-23 | 11-Dec-23 | 95 | 2920 | 1.0 | 0.07 |
| D-01 | FM Bedroom | 8-Sep-23 | 11-Dec-23 | 95 | 2920 | 0.9 | 0.06 |
| D-01 | Topside Common Area | 8-Sep-23 | 11-Dec-23 | 95 | 2920 | 1.5 | 0.10 |
| D-01 | Security Forces Room | 8-Sep-23 | 11-Dec-23 | 95 | 2920 | 1.3 | 0.09 |
| D-01 | Hallway to/from LCC | 8-Sep-23 | 11-Dec-23 | 95 | 243 | 1.8 | 0.01 |
| D-01 | LCC | 8-Sep-23 | 11-Dec-23 | 95 | 2920 | 1.0 | 0.07 |
| E-01 | FM Bedroom | 8-Sep-23 | 15-Dec-23 | 99 | 2920 | 1.4 | 0.10 |
| E-01 | Topside Common Area | 8-Sep-23 | 15-Dec-23 | 99 | 2920 | 1.3 | 0.09 |
| E-01 | Security Forces Room | 8-Sep-23 | 15-Dec-23 | 99 | 2920 | 0.9 | 0.06 |
| E-01 | Hallway to/from LCC | 8-Sep-23 | 15-Dec-23 | 99 | 243 | 1.1 | 0.01 |
| E-01 | LCC | 8-Sep-23 | 15-Dec-23 | 99 | 2920 | 0.5 | 0.03 |
| F-01 | FM Bedroom | 8-Sep-23 | 13-Dec-23 | 97 | 2920 | 1.8 | 0.12 |
| F-01 | Topside Common Area | 8-Sep-23 | 13-Dec-23 | 97 | 2920 | 1.7 | 0.12 |
| F-01 | Security Forces Room | 8-Sep-23 | 13-Dec-23 | 97 | 2920 | 1.1 | 0.08 |
| F-01 | Hallway to/from LCC | 8-Sep-23 | 13-Dec-23 | 97 | 243 | 2.0 | 0.01 |
| F-01 | LCC | 8-Sep-23 | 13-Dec-23 | 97 | 2920 | 0.3 | 0.02 |

**Attachment 2: Round 2 Radon Results for F.E. Warren AFB from 8 September 2023 to 15 December 2023**

| MAF | Location | Start Date | End Date | Total Days Exposed | Bldg Occupancy (hrs/yr) | Radon in Air (pCi/L) | Radon in Air (WLM/yr) |
|---|---|---|---|---|---|---|---|
| G-01 | FM Bedroom | 13-Sep-23 | 14-Dec-23 | 93 | 2920 | 1.8 | 0.12 |
| G-01 | Topside Common Area | 13-Sep-23 | 14-Dec-23 | 93 | 2920 | 1.7 | 0.12 |
| G-01 | Security Forces Room | 13-Sep-23 | 14-Dec-23 | 93 | 2920 | 1.1 | 0.08 |
| G-01 | Hallway to/from LCC | 13-Sep-23 | 14-Dec-23 | 93 | 243 | 2.0 | 0.01 |
| G-01 | LCC | 13-Sep-23 | 14-Dec-23 | 93 | 2920 | 0.3 | 0.02 |
| H-01 | FM Bedroom | 13-Sep-23 | 14-Dec-23 | 93 | 2920 | 0.5 | 0.03 |
| H-01 | Topside Common Area | 13-Sep-23 | 14-Dec-23 | 93 | 2920 | 1.5 | 0.10 |
| H-01 | Security Forces Room | 13-Sep-23 | 14-Dec-23 | 93 | 2920 | 1.3 | 0.09 |
| H-01 | Hallway to/from LCC | 13-Sep-23 | 14-Dec-23 | 93 | 243 | 1.9 | 0.01 |
| H-01 | LCC | 13-Sep-23 | 14-Dec-23 | 93 | 2920 | 0.7 | 0.05 |
| I-01 | FM Bedroom | 15-Sep-23 | 15-Dec-23 | 92 | 2920 | 3.0 | 0.21 |
| I-01 | Topside Common Area | 15-Sep-23 | 15-Dec-23 | 92 | 2920 | 1.2 | 0.08 |
| I-01 | Security Forces Room | 15-Sep-23 | 15-Dec-23 | 92 | 2920 | 1.1 | 0.08 |
| I-01 | Hallway to/from LCC | 15-Sep-23 | 15-Dec-23 | 92 | 243 | 1.2 | 0.01 |
| I-01 | LCC | 15-Sep-23 | 15-Dec-23 | 92 | 2920 | 0.5 | 0.03 |
| J-01 | FM Bedroom | 13-Sep-23 | 13-Dec-23 | 92 | 2920 | 1.3 | 0.09 |
| J-01 | Topside Common Area | 13-Sep-23 | 13-Dec-23 | 92 | 2920 | 1.5 | 0.10 |
| J-01 | Security Forces Room | 13-Sep-23 | 13-Dec-23 | 92 | 2920 | 1.1 | 0.08 |
| J-01 | Hallway to/from LCC | 13-Sep-23 | 13-Dec-23 | 92 | 243 | 0.6 | 0.00 |
| J-01 | LCC | 13-Sep-23 | 13-Dec-23 | 92 | 2920 | 0.3 | 0.20 |
| K-01 | FM Bedroom | 13-Sep-23 | 14-Dec-23 | 93 | 2920 | 1.5 | 0.10 |
| K-01 | Topside Common Area | 13-Sep-23 | 14-Dec-23 | 93 | 2920 | 1.6 | 0.11 |
| K-01 | Security Forces Room | 13-Sep-23 | 14-Dec-23 | 93 | 2920 | 1.0 | 0.07 |
| K-01 | Hallway to/from LCC | 13-Sep-23 | 14-Dec-23 | 93 | 243 | 1.6 | 0.01 |
| K-01 | LCC | 13-Sep-23 | 14-Dec-23 | 93 | 2920 | 0.2 | 0.01 |
| L-01 | FM Bedroom | 12-Sep-23 | 13-Dec-23 | 93 | 2920 | 1.6 | 0.11 |
| L-01 | Topside Common Area | 12-Sep-23 | 13-Dec-23 | 93 | 2920 | 0.8 | 0.05 |
| L-01 | Security Forces Room | 12-Sep-23 | 13-Dec-23 | 93 | 2920 | 1.1 | 0.08 |
| L-01 | Hallway to/from LCC | 12-Sep-23 | 13-Dec-23 | 93 | 243 | 1.0 | 0.01 |
| L-01 | LCC | 12-Sep-23 | 13-Dec-23 | 93 | 2920 | 0.7 | 0.05 |

**Attachment 2: Round 2 Radon Results for F.E. Warren AFB from 8 September 2023 to 15 December 2023**

| MAF | Location | Start Date | End Date | Total Days Exposed | Bldg Occupancy (hrs/yr) | Radon in Air (pCi/L) | Radon in Air (WLM/yr) |
|---|---|---|---|---|---|---|---|
| M-01 | FM Bedroom | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 1.5 | 0.10 |
| M-01 | Topside Common Area | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 1.2 | 0.08 |
| M-01 | Security Forces Room | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 1.5 | 0.10 |
| M-01 | Hallway to/from LCC | 12-Sep-23 | 12-Dec-23 | 92 | 243 | 1.4 | 0.01 |
| M-01 | LCC | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 0.5 | 0.03 |
| N-01 | FM Bedroom | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 0.7 | 0.05 |
| N-01 | Topside Common Area | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 1.3 | 0.09 |
| N-01 | Security Forces Room | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 1.2 | 0.08 |
| N-01 | Hallway to/from LCC | 12-Sep-23 | 12-Dec-23 | 92 | 243 | 0.8 | 0.00 |
| N-01 | LCC | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 0.9 | 0.06 |
| O-01 | FM Bedroom | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 0.7 | 0.05 |
| O-01 | Topside Common Area | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 1.3 | 0.09 |
| O-01 | Security Forces Room | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 0.7 | 0.05 |
| O-01 | Hallway to/from LCC | 12-Sep-23 | 12-Dec-23 | 92 | 243 | 1.1 | 0.01 |
| O-01 | LCC | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 1.3 | 0.09 |

**Attachment 3: Round 2 Radon Results for Minot AFB from 11 September 2023 to 14 December 2023**

| MAF | Location | Start Date | End Date | Total Days Exposed | Bldg Occupancy (hrs/yr) | Radon in Air (pCi/L) | Radon in Air (WLM/yr) |
|---|---|---|---|---|---|---|---|
| A-01 | FM Bedroom | 11-Sep-23 | 11-Dec-23 | 93 | 2920 | 1.0 | 0.07 |
| A-01 | Topside Common Area | 11-Sep-23 | 11-Dec-23 | 93 | 2920 | 0.9 | 0.06 |
| A-01 | Security Forces Room | 11-Sep-23 | 11-Dec-23 | 93 | 2920 | 0.9 | 0.06 |
| A-01 | Hallway to/from LCC | 11-Sep-23 | 11-Dec-23 | 93 | 243 | 0.9 | 0.01 |
| A-01 | LCC | 11-Sep-23 | 11-Dec-23 | 93 | 2920 | 0.4 | 0.03 |
| B-01 | FM Bedroom | 11-Sep-23 | 11-Dec-23 | 93 | 2920 | 1.8 | 0.12 |
| B-01 | Topside Common Area | 11-Sep-23 | 11-Dec-23 | 93 | 2920 | 0.4 | 0.03 |
| B-01 | Security Forces Room | 11-Sep-23 | 11-Dec-23 | 93 | 2920 | 0.9 | 0.06 |
| B-01 | Hallway to/from LCC | 11-Sep-23 | 11-Dec-23 | 93 | 243 | 0.8 | 0.00 |
| B-01 | LCC | 11-Sep-23 | 11-Dec-23 | 93 | 2920 | 0.7 | 0.05 |
| C-01 | FM Bedroom | 11-Sep-23 | 11-Dec-23 | 93 | 2920 | 2.6 | 0.18 |
| C-01 | Topside Common Area | 11-Sep-23 | 11-Dec-23 | 93 | 2920 | 1.7 | 0.12 |
| C-01 | Security Forces Room | 11-Sep-23 | 11-Dec-23 | 93 | 2920 | 1.3 | 0.09 |
| C-01 | Hallway to/from LCC | 11-Sep-23 | 11-Dec-23 | 93 | 243 | 1.0 | 0.01 |
| C-01 | LCC | 11-Sep-23 | 11-Dec-23 | 93 | 2920 | 1.4 | 0.10 |
| D-01 | FM Bedroom | 13-Sep-23 | 13-Dec-23 | 92 | 2920 | 1.4 | 0.10 |
| D-01 | Topside Common Area | 13-Sep-23 | 13-Dec-23 | 92 | 2920 | 1.3 | 0.09 |
| D-01 | Security Forces Room | 13-Sep-23 | 13-Dec-23 | 92 | 2920 | 1.3 | 0.09 |
| D-01 | Hallway to/from LCC | 13-Sep-23 | 13-Dec-23 | 92 | 243 | 1.1 | 0.01 |
| D-01 | LCC | 13-Sep-23 | 13-Dec-23 | 92 | 2920 | 0.9 | 0.06 |
| E-01 | FM Bedroom | 11-Sep-23 | 13-Dec-23 | 94 | 2920 | 1.0 | 0.07 |
| E-01 | Topside Common Area | 11-Sep-23 | 13-Dec-23 | 94 | 2920 | 1.5 | 0.10 |
| E-01 | Security Forces Room | 11-Sep-23 | 13-Dec-23 | 94 | 2920 | 0.9 | 0.06 |
| E-01 | Hallway to/from LCC | 11-Sep-23 | 13-Dec-23 | 94 | 243 | 1.2 | 0.01 |
| E-01 | LCC | 11-Sep-23 | 13-Dec-23 | 94 | 2920 | 1.0 | 0.07 |
| F-01 | FM Bedroom | 13-Sep-23 | 13-Dec-23 | 92 | 2920 | 1.7 | 0.12 |
| F-01 | Topside Common Area | 13-Sep-23 | 13-Dec-23 | 92 | 2920 | 0.2 | 0.01 |
| F-01 | Security Forces Room | 13-Sep-23 | 13-Dec-23 | 92 | 2920 | 0.6 | 0.04 |
| F-01 | Hallway to/from LCC | 13-Sep-23 | 13-Dec-23 | 92 | 243 | 1.0 | 0.01 |
| F-01 | LCC | 13-Sep-23 | 13-Dec-23 | 92 | 2920 | 0.7 | 0.05 |

**Attachment 3: Round 2 Radon Results for Minot AFB from 11 September 2023 to 14 December 2023**

| MAF | Location | Start Date | End Date | Total Days Exposed | Bldg Occupancy (hrs/yr) | Radon in Air (pCi/L) | Radon in Air (WLM/yr) |
|---|---|---|---|---|---|---|---|
| G-01 | FM Bedroom | 13-Sep-23 | 13-Dec-23 | 92 | 2920 | 1.3 | 0.09 |
| G-01 | Topside Common Area | 13-Sep-23 | 13-Dec-23 | 92 | 2920 | 1.3 | 0.09 |
| G-01 | Security Forces Room | 13-Sep-23 | 13-Dec-23 | 92 | 2920 | 1.0 | 0.07 |
| G-01 | Hallway to/from LCC | 13-Sep-23 | 13-Dec-23 | 92 | 243 | 1.3 | 0.01 |
| G-01 | LCC | 13-Sep-23 | 13-Dec-23 | 92 | 2920 | 0.2 | 0.01 |
| H-01 | FM Bedroom | 13-Sep-23 | 12-Dec-23 | 91 | 2920 | 1.1 | 0.08 |
| H-01 | Topside Common Area | 13-Sep-23 | 12-Dec-23 | 91 | 2920 | 0.7 | 0.05 |
| H-01 | Security Forces Room | 13-Sep-23 | 12-Dec-23 | 91 | 2920 | 0.7 | 0.05 |
| H-01 | Hallway to/from LCC | 13-Sep-23 | 12-Dec-23 | 91 | 243 | 0.3 | 0.00 |
| H-01 | LCC | 13-Sep-23 | 12-Dec-23 | 91 | 2920 | 0.3 | 0.02 |
| I-01 | FM Bedroom | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 0.3 | 0.02 |
| I-01 | Topside Common Area | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 0.6 | 0.04 |
| I-01 | Security Forces Room | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 0.7 | 0.05 |
| I-01 | Hallway to/from LCC | 12-Sep-23 | 12-Dec-23 | 92 | 243 | 1.0 | 0.01 |
| I-01 | LCC | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 1.5 | 0.10 |
| J-01 | FM Bedroom | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 0.8 | 0.05 |
| J-01 | Topside Common Area | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 0.6 | 0.04 |
| J-01 | Security Forces Room | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 1.4 | 0.10 |
| J-01 | Hallway to/from LCC | 12-Sep-23 | 12-Dec-23 | 92 | 243 | 0.8 | 0.00 |
| J-01 | LCC | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 0.8 | 0.05 |
| K-01 | FM Bedroom | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 0.3 | 0.02 |
| K-01 | Topside Common Area | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 0.0 | 0.00 |
| K-01 | Security Forces Room | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 1.3 | 0.09 |
| K-01 | Hallway to/from LCC | 12-Sep-23 | 12-Dec-23 | 92 | 243 | 0.8 | 0.00 |
| K-01 | LCC | 12-Sep-23 | 12-Dec-23 | 92 | 2920 | 0.3 | 0.02 |
| L-01 | FM Bedroom | 12-Sep-23 | 14-Dec-23 | 94 | 2920 | 1.7 | 0.12 |
| L-01 | Topside Common Area | 12-Sep-23 | 14-Dec-23 | 94 | 2920 | 0.0 | 0.00 |
| L-01 | Security Forces Room | 12-Sep-23 | 14-Dec-23 | 94 | 2920 | 0.0 | 0.00 |
| L-01 | Hallway to/from LCC | 12-Sep-23 | 14-Dec-23 | 94 | 243 | 0.8 | 0.00 |
| L-01 | LCC | 12-Sep-23 | 14-Dec-23 | 94 | 2920 | 0.5 | 0.03 |

**Attachment 3: Round 2 Radon Results for Minot AFB from 11 September 2023 to 14 December 2023**

| MAF | Location | Start Date | End Date | Total Days Exposed | Bldg Occupancy (hrs/yr) | Radon in Air (pCi/L) | Radon in Air (WLM/yr) |
|---|---|---|---|---|---|---|---|
| M-01 | FM Bedroom | 14-Sep-23 | 14-Dec-23 | 92 | 2920 | 1.1 | 0.08 |
| M-01 | Topside Common Area | 14-Sep-23 | 14-Dec-23 | 92 | 2920 | 1.9 | 0.13 |
| M-01 | Security Forces Room | 14-Sep-23 | 14-Dec-23 | 92 | 2920 | 1.5 | 0.10 |
| M-01 | Hallway to/from LCC | 14-Sep-23 | 14-Dec-23 | 92 | 243 | 1.3 | 0.01 |
| M-01 | LCC | 14-Sep-23 | 14-Dec-23 | 92 | 2920 | 1.1 | 0.08 |
| N-01 | FM Bedroom | 14-Sep-23 | 14-Dec-23 | 92 | 2920 | 1.8 | 0.12 |
| N-01 | Topside Common Area | 14-Sep-23 | 14-Dec-23 | 92 | 2920 | 1.9 | 0.13 |
| N-01 | Security Forces Room | 14-Sep-23 | 14-Dec-23 | 92 | 2920 | 1.1 | 0.08 |
| N-01 | Hallway to/from LCC | 14-Sep-23 | 14-Dec-23 | 92 | 243 | 2.1 | 0.01 |
| N-01 | LCC | 14-Sep-23 | 14-Dec-23 | 92 | 2920 | 1.5 | 0.10 |
| O-01 | FM Bedroom | 14-Sep-23 | 14-Dec-23 | 92 | 2920 | 1.7 | 0.12 |
| O-01 | Topside Common Area | 14-Sep-23 | 14-Dec-23 | 92 | 2920 | 1.8 | 0.12 |
| O-01 | Security Forces Room | 14-Sep-23 | 14-Dec-23 | 92 | 2920 | 2.2 | 0.15 |
| O-01 | Hallway to/from LCC | 14-Sep-23 | 14-Dec-23 | 92 | 243 | 1.6 | 0.01 |
| O-01 | LCC | 14-Sep-23 | 14-Dec-23 | 92 | 2920 | 1.3 | 0.09 |