



**AFRL-SA-WP-TR-2024-0007**

# **Missile Community Cancer Study, Radon Results for Vandenberg Space Force Base**



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

**Report Date  
12 June 2024**



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

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# REPORT DOCUMENTATION PAGE

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<b>13. SUPPLEMENTARY NOTES</b>					
<b>14. ABSTRACT</b> 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 (EH) survey for the 377th Test and Evaluation Group (TEG) and 532nd Training Squadron (TRS) at Vandenberg Space Force Base (VSFB), California. The purpose of this EH survey was to characterize potential exposures among the 377th TEG and 532nd TRS personnel, cadre, and students. This survey occurred from 13 February to 15 May 2024 and reinforced ongoing EH assessments occurring at Malmstrom, F.E. Warren and Minot Air Force Bases (AFBs). The purpose of this memo is to augment the VSFB consultative memorandum dated 18 April 2024 by conveying radon results analyzed by DCPH-D/OE.					
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Public Health

**DEFENSE HEALTH AGENCY**  
DEFENSE CENTER FOR PUBLIC HEALTH - DAYTON  
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12 June 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-2024-0007, Missileer Cancer Study, Vandenberg Space Force Base 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) United States Environmental Protection Agency, *A Citizen's Guide to Radon*. (Washington, D.C.: USEPA, 2012)

(e) United States Environmental Protection Agency, *Health Risk of Radon*. (Washington, D.C.: USEPA, 2023).

(f) Rad Elec, Inc., *E-PERM System User's Manual*. (MD: Rad Elec Inc., 2024).

(g) Steiff, L. *Support Consultant, Rad Elec, Inc.* (MD: Rad Elec, Inc. 2024)

(h) 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 (EH) survey for the 377th Test and Evaluation Group (TEG) and 532nd Training Squadron (TRS) at Vandenberg Space Force Base (VSFB), California. The purpose of this EH survey was to characterize potential exposures among the 377th TEG and 532nd TRS personnel, cadre, and students. This survey occurred from 13 February to 15 May 2024 and reinforced ongoing EH assessments occurring at Malmstrom, F.E. Warren and Minot Air Force Bases (AFBs). The purpose of this memo is to augment the VSFB consultative memorandum dated 18 April 2024 by conveying radon results analyzed by DCPH-D/OE.

- A. DCPH-D/OE personnel executing the OEH survey:
  - (1) Capt Leigh Durden, Environmental Health Consultant
  - (2) SSgt Jose Chavez-Reyes, Occupational & Environmental Health Technician
  
- B. Vandenberg SFB personnel supporting the EH survey:
  - (1) Lt Col Luke Stover, 377th TEG Deputy Commander
  - (2) Lt Col Frank Scopa, 532nd TRS Commander
  - (3) Maj Carlos Juarez, 377th TEG Executive Officer
  - (4) Capt Brian Thompson, 30th Operational Medical Readiness Squadron (OMRS) Bioenvironmental Engineering Flight Commander
  - (5) Capt Caleb Seibert, 532nd TRS Maintenance Training Flight Commander
  - (6) Capt Austin Van Hoesen, 576th Flight Test Squadron (FLTS) Director of Operations
  - (7) MSgt Nicholas Flowers, 377th TEG Maintenance Operations Flight Chief
  - (8) MSgt Charles Martin, 532nd TRS Maintenance Training Flight Chief
  - (9) SrA Angel De Jesus Perez, 30th OMRS Bioenvironmental Engineering Technician
  
- C. Equipment Used:
  - (1) Electret Passive Environmental Radon/Radiation Monitor (E-PERM) Electret Ion Chamber
  - (2) E-PERM Electret Reader

## **2. BACKGROUND**

The sampling plan targeted carcinogens which could potentially affect 532nd TRS and 377th TEG personnel through dermal, ingestion, and inhalation exposure pathways. Radon sampling for all the Launch Facilities (LFs) occurred for 15 days while radon sampling for the Missile Alert Facilities (MAFs) occurred for 91 days. MAF sampling durations were greater than 90 days and met Federal and Air Force guidelines for long-term sampling (Westpfahl et al, 2021). Short-term radon surveys occurred in the LFs to avoid impacts the scheduled tests launches which occur three-to-four times per year. Per the United States Environmental Protection Agency (USEPA), short-term tests occur from two to 90-days (USEPA, 2012) are a viable option in situations where quick test results are preferred or required.

## **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 USEPA, radon is the second leading cause of lung cancer in the United States (USEPA, 2023).

#### 4. METHODOLOGY & ANALYSIS

The survey was completed using the E-PERM electret ion chamber system from Rad Elec, Inc. These electrets are charged Teflon disks that produce an electrostatic field. Radon gas passively enters the chambers and emits alpha particles that ionize the air molecules. These ions are then collected by the electret, causing a reduction of its surface charge. Radon measurements were determined by comparing the ending voltage measurement against the initial voltage measurement, then calculating the voltage loss. Background gamma radiation readings, measured with the Victoreen 451P, and elevation influence radon levels. These parameters are utilized when validating radon measurements.

Sample locations include:

- A. MAF-01A consisting of one blank, one duplicate, and two sample electrets
- B. MAF-01E consisting of one blank, one duplicate, and two sample electrets
- C. LF-08 consisting of one blank, one duplicate, and one sample electret
- D. LF-09 consisting of one blank, one duplicate, and one sample electret

For MAF 01A and MAF-01E, the E-PERM devices were configured in an S Chamber Long-Term (SLT) electret configuration. 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) (E-PERM, 2024).

For LF-08 and LF-09, an S Chamber Short-Term (SST) electret configuration was used. SST configurations enable two to seven days of sampling with a minimum detection limit of 0.2 pCi/L (IBID, 2024). Although SSTs are typically used for two-to-seven-day exposure periods, extending the exposure period increases the quality of characterization as long as the final voltage remains above zero (Stieff, 2024).

One blank and one duplicate electret were also placed in the sample locations. The blanks and duplicates are used to ensure quality assurance/quality control (QA/QC) by validating sample results are trustworthy, precise, and unbiased (Westpfahl et al., 2021). 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. FACILITY OCCUPANCY

A. MAF-01E (377th TEG): MAF-01E is a decommissioned MAF used for tours, events, and distinguished visitors spectating test launches. Maximum occupancy for MAF-01E accounts for 56 hours per year.

B. LF-09 (377th TEG): Maintenance operations occur in LF-09 for 840 hours per year.

C. MAF-01A (532nd TRS): Test operators perform MAF startup, checkouts, cleaning, tours, currency evaluations, and operational directives. When on alert, Missile Combat Crews perform 130 hours per year consisting of ten alerts each for twelve hours with an additional five hours of training.

D. LF-08 (532nd TRS): Under the most robust curriculum, student training occurs 20 days per month for eight hours each day with a potential for one instructor to be present during all training sessions. Under this tempo, the occupancy for LF-08 is calculated to be 1,920 hours a year.

## 6. RESULTS & DISCUSSION

All radon measurements were below the annual exposure limit of four working level months per year (4 WLM/yr) and the facility mitigation levels of 0.8 WLM/yr dictated by paragraphs 7.1.2 and 7.1.3 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. 377th TEG:

- (1) MAF-01E, 0.01 WLM/yr
- (2) LF-09, 0.01 WLM/yr

B. 532nd TRS

- (1) MAF-01A, 0.01 WLM/yr
- (2) LF-08, 0.17 WLM/yr

## 7. CONCLUSIONS

Radon levels measured in MAF-01A, MAF-01E, LF-08, and LF-09 comply with health and safety limits mandated by Air Force policy. 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](mailto:leigh.durden@us.af.mil).

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

Attachment: Radon Results for Vandenberg SFB from 13 February to 15 May 2024

**Attachment 1: Radon Results for Vandenberg SFB from 13 February to 15 May 2024**

<b>Unit</b>	<b>Facility</b>	<b>Location</b>	<b>Start Date</b>	<b>End Date</b>	<b>Total Days Exposed</b>	<b>Bldg Occupancy (hrs/yr)</b>	<b>Radon in Air (pCi/L)</b>	<b>Radon in Air (WLM/yr)</b>
377th TEG	MAF-01E	Topside Common Area	14-Feb-24	15-May-24	91	56	5.2	0.01
	LF-09	Inside LF	13-Feb-24	28-Feb-24	15	840	0.7	0.01
532nd TRS	MAF-01A	Topside Common Area	14-Feb-24	15-May-24	91	130	2.2	0.01
	LF-08	Inside LF	13-Feb-24	28-Feb-24	15	1920	3.7	0.17