

ANG and FAA Radar Maintenance: Radiation Safety, Exposure Records and Questions About Health Monitoring

Public comment to the U.S. Department of Health and Human Services (HHS), Office of the Assistant Secretary for Health (OASH)

Request for Information on Electromagnetic Fields and Radiofrequency Radiation | Docket
HHS-OASH-2026-0397

Why I am bringing this to HHS

I am a retired Federal Aviation Administration (FAA) Air Traffic Systems Specialist who maintained radar equipment. My Illinois Air National Guard (ANG) work ran from 1981-1989 and included weapons-control and electronic-systems maintenance on F-4 aircraft and workshop equipment. My FAA employment ran from 1990-2017. That history includes military service and civilian Guard technician employment, distinct from my subsequent FAA civilian employment. My work involved servicing the equipment used to track aircraft, including work performed while transmitters were operating. My medical history includes primary hyperparathyroidism, a disorder of the glands that control blood calcium, and parathyroid surgery. I am seeking FAA accountability for implementing its radiation-safety requirements and meaningful occupational-health protection for current and retired Air Traffic Systems Specialists (ATSS).

The problem I ask HHS to examine is whether written radiation-safety requirements resulted in effective protection during actual maintenance work, and what records demonstrate how those requirements were implemented. FAA's own rules recognized potential radiation hazards, required assessments of employee tasks and work environments, assigned medical-review responsibilities, and required records to survive long after employment ended. I have not obtained a complete set of task-specific radiation assessments, exposure estimates and medical-monitoring decisions for my FAA employment. The records requests described below remain partly unanswered. I do not recall ever receiving medical surveillance related to radiation exposure during my FAA employment. I would like to understand how the Occupational Medical Surveillance Program applied to my radar-maintenance duties and how the need for such surveillance was determined.

This matters to HHS's inquiry because research can overlook workers whose exposure history is insufficiently documented or whose illness was recognized after retirement. If records are missing, researchers and doctors may be unable to connect a worker's actual tasks with measurements, protective measures or medical follow-up. That lack of evidence must not be treated as evidence that there was no exposure or no health risk.

I ask HHS to examine both ANG and FAA radar-maintenance experience: determine what protections reached the people doing the work, locate and make accessible the evidence needed to evaluate their exposure, and develop appropriate long-term health follow-up. Each organization should account for its own requirements, workplace assessments and medical-review responsibilities.

Considerable attention was devoted to radiation safety in military technical manuals and FAA orders. Yet, decades later, technicians are providing comments to HHS about occupational exposure and unanswered health questions. The issue is whether those written safeguards translated into protection during actual maintenance work, and whether the resulting records can explain what exposures occurred and what

medical monitoring or follow-up was warranted. Written requirements alone do not answer those questions.

Who the workers are and what their jobs involve

Air Traffic Systems Specialists (ATSS) are technicians who maintain the equipment supporting air traffic operations. Air Traffic Control Specialists (ATCS) are controllers who direct aircraft traffic. The distinction matters: controllers rely on systems that technicians keep operating, but their work conditions and occupational hazards differ.

My FAA work included airport surveillance radar, which tracks aircraft near airports, and companion beacon equipment that interrogates aircraft transponders to obtain identification and other flight information. The equipment names in my account—ASR-8 and ATCBI-3/5—identify particular radar and beacon systems. Klystrons are high-power electronic tubes used in radar transmitters. A pulse-forming network supplies the electrical pulses used to operate a transmitter. These details matter because a measurement taken during ordinary operation may not describe a technician's position and conditions during servicing.

“my work experience was often immersed in rf radiation near fields of vhf and uhf communications transmitters, airport surveillance radar transmitters, and air traffic control beacon interrogator transmitters operating simultaneously.”

Exposure assessments must account for the combined RF environment created by simultaneous VHF/UHF communications, airport surveillance radar and air traffic control beacon interrogator operation, including the technician's near-field working position. HHS should examine whether the assessments represented the relevant frequencies, antenna locations, operating configurations and task durations. Assess indoor maintenance conditions in the building nearest the emitters, including possible reflections and standing waves. Establish their significance through building and equipment information and measurements; external antenna calculations alone do not resolve indoor exposure.

My maintenance experience included the following:

“I spent hours tuning ASR klystrons and ATCBI-3/5 transmitter cavities while the equipment was energized. My recurring work also included klystron replacement, work on the ASR-8 klystron oil section, and troubleshooting the pulse-forming network (PFN), which supplied electrical pulses to the transmitter.

“I recall at least two ASR-8 PFN troubleshooting episodes in which the shielding was replaced with a plexiglass cover so I could observe arcing after oil refill and re-energization.

“I believe suspected X-ray exposure recurred during this energized maintenance and tuning. I ask whether X-rays from the high-voltage tubes could have reached my work position, including during work with shielding replaced by plexiglass. I do not recall personal radiation monitoring for these tasks.”

My further statements are: “I was not trained to measure X-rays” and “we did not have such equipment anyway.” I depended on the employer's qualified personnel to assess radiation hazards that I could not see or measure myself. FAA's survey records are needed to identify which maintenance tasks and equipment conditions were assessed, and what the results showed.

The maintenance account above concerns my FAA civilian employment. The following account concerns my Illinois ANG work.

My ANG maintenance experience and the Air Force safety framework

My Illinois ANG work involved F-4C/D radar and electronic systems on the flightline, in a hangar calibration area, in the avionics repair/mockup building and in the electronic countermeasures (ECM) shop. The AN/AWM-27/27F maintenance workbench allowed aircraft radar units to be operated for troubleshooting and alignment. My recorded work account includes these statements:

“I removed covers or protective shields, further disassembled the units, and energized them for troubleshooting and alignment. This placed me close to exposed high-voltage power-supply and modulator circuitry, including the discharge thyatron and magnetron.”

“I also performed operational checks and troubleshooting on the AN/ALQ-119 in the workshop, approximately 1987-1989. I recall that it contained three traveling-wave tubes (TWTs) requiring high voltage to operate.”

The Navy's NAVSHIPS 0900-005-8000, Technical Manual for Radio-Frequency Radiation Hazards, First Revision, approved July 1, 1971, identifies the AN/APQ-109 as presenting a personnel hazard during fixed-beam operation. Table 1-1, printed page 1-4, gives the following entry: [23]

Radar	Fixed beam: personnel hazard	Distance	Moving beam	Maximum seconds per 30 seconds inside fixed-beam hazard distance
AN/APQ-109	YES	60 feet	-	0

The table lists a fixed-beam hazard distance of 60 feet and a maximum exposure time of zero seconds per 30-second interval inside that distance. Section 1-2, printed page 1-2, describes the minimum safe distances and exposure times as worst-case values that do not account for transmitter-to-antenna system losses and may be modified by a qualified equipment-specific survey. Table notes 1 and 3, printed page 1-7, identify the historical 10 mW/cm² continuous-exposure basis and the method for calculating permitted intermittent exposure. The moving-beam dash means the radar does not normally operate in that mode; it is not a finding of no hazard. [23]

This is equipment-specific recognition of an RF hazard. The listed distance concerns the antenna's main beam. I ask HHS and the Air Force/ANG to examine whether the protections used during aircraft checks and workshop troubleshooting accounted for the actual antenna configuration, technician position and energized maintenance conditions. Possible equipment-generated X-rays require their own assessment.

These are maintenance conditions that an exposure assessment must represent: energized equipment, close working positions, open units and the actual protective configuration. Both RF emissions and possible equipment-generated X-rays require assessment, so that an aircraft's normal operating configuration is not used as a substitute for evaluating bench troubleshooting.

The actual Air Force occupational standard, AFOSH Standard 161-9, applies to Air Force personnel, both military and civilian, and addresses RF radiation from communications systems, radar equipment and other sources. The reproduced cover, contents and printed pages 1-7 follow the FAA requirements in the supporting exhibits. They contain the historical policy, responsibilities, maintenance-facility assessment and medical-review provisions discussed below. [14,15]

The verified October 10, 1978 edition of AFOSH Standard 161-9, 'Exposure to Radiofrequency Radiation,' predates my ANG work. It establishes the historical radiation-protection framework: [15]

- RF and associated X-ray hazards: paragraphs A1–A3(a), printed page 1, cover potentially exposed Air Force military and civilian personnel and address both RF and associated X-ray hazards. Paragraphs A4(b)(2)(a) and A4(b)(2)(d)(3)–(4), pages 1–2, address technical-order precautions, specialized X-ray instruments and RF/X-ray survey capability.
- Medical and technical responsibility: paragraphs A4(d)–(f), pages 2–3, assign the base medical service, Bioenvironmental Engineering and environmental medicine responsibilities for hazard evaluation, surveys, incident investigation and required medical follow-up. Paragraph A4(c)(4), page 2, requires commanders to notify Bioenvironmental Engineering of new operations or equipment changes capable of changing the hazard.
- Recurring attention to maintenance: paragraphs C4(c)(4)(a)–(b) and C4(e)(3), page 5, recognize the particular exposure potential of repair, maintenance and test facilities and require quarterly visits/checks, with more frequent visits when indicated. These provisions distinguish recurring workplace review from a one-time equipment survey; they do not prescribe an instrument measurement at every quarterly visit.
- Reassessment and durable evidence: paragraphs C4(c), page 4, C4(d) and C5, page 5, address initial survey reports retained permanently by Bioenvironmental Engineering, equipment changes that may require resurvey, and narrative inventory/survey reports. Paragraph C6(a), page 5, calls for permanent incident-investigation records and expressly connects exposure records with long-term epidemiological and clinical follow-up.

Edition dates matter. AFOSH Standard 48-9, issued August 1, 1997, identifies its predecessor with the statement: “Supersedes AFOSH Standard 161-9, 12 February 1987.” The 1997 text is not a rule governing my earlier ANG work, and the 1978 paragraph citations above are not represented as unchanged throughout that work. I ask the Air Force and ANG to identify the editions, supplements and technical instructions in force during the relevant maintenance years and produce the assessments and medical-review records showing their implementation. [16]

The 1978 standard's medical provisions also identify the issue HHS should investigate. Paragraph C7(a), page 7, did not call for routine pre-employment or post-employment examinations for RF-exposed personnel. Paragraphs C6(g) and C7(b), page 7, instead provided for medical consultation and possible long-term follow-up after confirmed or likely overexposure. A process dependent on recognition of an exposure incident may not identify every worker needing evaluation, particularly when maintenance exposure is insufficiently documented or illness becomes recognizable much later. HHS should evaluate whether that approach leaves gaps and the need for longitudinal health research, including endocrine outcomes, rather than limiting review to already documented incidents. [15]

The ANG and FAA histories must remain identifiable in the research. An aircraft-avionics repair bench and an FAA radar site are different workplaces. Their assessments, responsible offices and medical decisions should be evaluated separately, while retaining the worker's complete occupational history. HHS should coordinate with the Department of Defense, Department of the Air Force and ANG as well as DOT and FAA to examine these parallel protection and recordkeeping questions.

Why radiofrequency radiation and possible X-rays both matter

Radiofrequency (RF) radiation is the non-ionizing electromagnetic energy used by radar and communications transmitters. X-rays are ionizing radiation and represent a different possible exposure pathway. FAA's radar-survey procedures addressed both RF conditions and possible X-rays from high-voltage tubes inside equipment cabinets. [2]

The same equipment can therefore require separate questions: what RF energy reached a technician's work position, and did high-voltage equipment produce X-rays that could reach that position? Answering one question does not answer the other. Both pathways should receive their own assessment, including when evidence concerning one remains incomplete.

The assessment must describe the work as performed: whether the transmitter was energized, where the technician stood, how long the task lasted, what cabinet access or shielding changes were involved, and whether components or operating conditions had changed. A general equipment specification or an antenna calculation cannot by itself establish a worker's exposure during those tasks. When measurements are unavailable, exposure reconstruction means using historical equipment, task and operating information to estimate possible exposure, with the uncertainty clearly stated.

Which FAA orders applied during my employment—and which are current

FAA Order 3900.19B, 'FAA Occupational Safety and Health Program,' issued April 29, 1999, included radiation-safety requirements in chapter 14. Chapter 14, 'Radiation Safety Program,' required assessment of potentially exposed employees' tasks and work environments. These requirements were already in place during my FAA employment, years before the separate Air Traffic Organization radiation order JO 3900.68 took effect on July 20, 2016. Chapter 14 of Order 3900.19B assigned responsibilities for assessment, training, records and medical review. [1]

Order 3900.19B consolidated earlier safety and occupational-health orders. Its chapter 1 cancellation list identifies Order 3900.6A, Occupational Safety Program for Airway Facilities Personnel, dated January 21, 1972; Order 3910.2A, Occupational Health Programs, dated January 5, 1973; Order 3900.19A, Occupational Safety and Health, dated July 20, 1982; and Order 3910.3A, Radiation Health Hazards and Protection, dated October 19, 1983. Paragraph 5(e) states that the radiation policies were updated and incorporated into chapter 14. These documented predecessors show that the framework did not begin in 1999; the cancellation list does not establish the first issuance date of the original unlettered Order 3900.19. FAA should identify the governing provisions for each period of my employment. [1]

The central requirement was not simply to test a facility once. Paragraph 1410(b)(4)(b)–(c), page 14-8, required documented annual assessments of employee tasks and work environments, identification of new operations or modifications, measurements when needed, and preservation of assessment results. Paragraph 1410(b)(3)(d), page 14-7, addressed nonroutine-task review. In practical terms, FAA needed a documented basis for deciding whether earlier measurements still represented the work being done and whether changed conditions required additional measurement.

Other provisions complete the chain: paragraph 1406(d)–(g), page 14-5, addresses assessment, training and source/configuration information; paragraph 1406(i)–(k), pages 14-5–14-6, addresses repositories, retention and incident investigation; paragraph 1410(c)(1)–(4), page 14-9, assigns Aviation Medicine functions; and paragraph 1410(f)(6)–(7), page 14-10, addresses employee exposure records and access. The medical functions matter because measuring radiation and evaluating a worker's need for medical

review are different responsibilities.

FAA Order 6050.32B, 'Spectrum Management Regulations and Procedures Manual,' issued November 17, 2005, supplies additional requirements for evaluating radiation from FAA equipment. Chapter 16 assigns definitive measurements to the Frequency Management Office, the FAA office responsible for that technical work (paragraph 1601, page 215). It addresses investigation of suspected hazards (paragraph 1609(f), page 219), distinguishes measurement from medical/industrial-hygiene evaluation, and requires report distribution regardless of measured level (paragraph 1610(f)–(g), page 220). Industrial hygiene is the assessment and control of workplace exposures. Figure 16-2, page 225, includes ASR-8, and paragraph 1611(b)(6)–(7), page 221, addresses possible tube-generated X-rays in cabinet surveys. [2]

FAA Figure 16-2: Radar power densities and calculated antenna distances

FAA Order 6050.32B, Figure 16-2, original printed page 225. The complete source page, including both ASR-8 entries and the distance-calculation footnote, is reproduced below. [2]

11/17/05

Chapter 16 - continued

6050.32B

FIGURE 16-2. RADARS USED BY FAA WITH POWER DENSITIES >MPE

Radar Type	Transmitter Power Peak MW	Average W	Nominal Frequency MHz	MPE mW/cm ²	Distance# Ft
AN/FPS-20	2.0	4319	1300	4.3	315
AN/FPS-60 (simplex)	2.0	4319	1300	4.3	315
AN/FPS-60 (duplex)	2.0	8638	1300	4.3	630
AN/FPS-6/90	2.8	2040	2800	9.3	264
ASDE	0.0045	3	15,950	10.0	*
ASR-4,-5,-6.	0.425	403	2800	9.3	29
ASR-7 (AN/GPN12)	0.5	475	2800	9.3	37
ASR-8 (AN/GPN-20/27) (Simplex)	1.4	875	2800	9.3	92
ASR-8 (AN/GPN-20/27) (Duplex)	1.4	1750	2800	9.3	172
ASR-9	1.237	1430	2800	9.3	205
ASR-11	.0229	324	2840	9.5	90
ARSR-1,-2	5.0	3595	1315	4.4	295
ARSR-3 (simplex)	4.6	3140	1315	4.4	230
ARSR-3 (duplex)	4.6	6280	1315	4.4	460
ARSR-4	0.93	558	1315	4.4	260
NEXRAD (WSR-88)	1.0	2000	2850	9.5	172
TDWR	0.31	550	5625	10.0	354
* MPE not exceeded.					
# Calculated distance from antenna to point on main beam axis where power density equals the MPE.					

Page 225

Figure 16-2, reproduced here in full, lists ASR-8 simplex and duplex configurations. Its distance footnote identifies calculated distances on the antenna's main beam axis where power density equals the maximum permissible exposure (MPE). These are antenna-beam calculations, not measurements at a technician's maintenance position. [2] FAA Order 6340.28, 'Procedures for Conducting Radiation Hazard Surveys and Radiation Safety Training,' dated February 3, 2006, applied to the air-route surveillance radar and FPS radar systems specified in that order. ASR-8 airport surveillance radar is not one of those specified systems. The survey deadlines in Order 6340.28 therefore cannot be asserted as ASR-8 requirements solely on the basis of that order. The ASR-8 provisions discussed here are instead identified in Order 6050.32B and the task-assessment requirements in Order 3900.19B. [1–3]

The historical orders above establish requirements that must be examined for the years in which I performed the work. They should not be confused with FAA's current orders:

- 2016 Air Traffic Organization order: JO 3900.68, 'Air Traffic Organization Radiation Safety Program,' took effect July 20, 2016. The Air Traffic Organization (ATO) is FAA's organization responsible for air traffic services and the supporting technical operations. JO 3900.68 applied to ATO employees whose duties could expose them to ionizing or non-ionizing radiation and cancelled Order 6340.28. The 2016 order did not create the earlier assessment and recordkeeping duties cited above. [11]

- Current ATO radiation order: FAA lists JO 3900.68A, 'Air Traffic Organization (ATO) Radiation Safety Program (RSP),' issued November 24, 2025, as active. It replaced JO 3900.68 on that date. FAA's public catalog restricts the full replacement text to the FAA network; its detailed requirements therefore cannot be described here from the catalog alone. I ask FAA to provide the applicable provisions and explain what changed. [12]

- Current agency-wide safety policy: FAA lists Order 3900.19D, issued February 14, 2024, as active. It followed Order 3900.19C, which replaced the historical Order 3900.19B. The annual-assessment and 30-year-retention citations in this comment are to the 1999 Order 3900.19B, the cited paragraph numbers belong to that historical order. [13]

Replacing an order does not answer whether FAA carried out its requirements when those requirements governed the work. The historical compliance question and the adequacy of today's technician protection are separate questions.

I ask HHS to coordinate with the Department of Transportation (DOT) and FAA to determine how these responsibilities were carried out for technicians. FAA should identify the annual assessments, the basis for decisions about further measurements and medical follow-up, and the records supporting those decisions. For technician work before April 1999, FAA should identify the earlier orders and field instructions that governed radiation assessments and worker protection, and produce records showing how those requirements were implemented.

Germany formally investigated the radar-maintenance pathway

Germany provides a concrete precedent for taking this occupational pathway seriously. Its Ministry of Defence appointed the Radar Commission to examine historical workplace conditions and radiation risks. The Commission's July 2, 2003 executive summary, section 3.1, pages 2–3, expressly recognizes that operation, maintenance and repair of radar equipment can involve both ionizing and high-frequency radiation. It identifies unwanted X-rays emitted by electronic tubes as the principal ionizing source discussed for this pathway. [22]

The Commission also addresses the evidence problem directly. For its earliest exposure phase, it found the information insufficient for reliable retrospective X-ray exposure assessment and warned that later or current measurements generally could not be applied to earlier conditions when the influencing factors could no longer be reconstructed. That is directly relevant to deciding whether a later survey can represent years of earlier maintenance. [22]

A. Schirmer's 2006 paper, 'Emission of Parasitic X-Rays from Military Radar Transmitters and Exposure of Personnel: Towards a Retrospective Assessment,' describes Germany's technical investigation of high-voltage vacuum tubes and reconstruction of maintenance workplaces. Section 4.1 considers close contact and energized open-cabinet work; technicians' interviews and work records helped establish task durations. Section 4.2 evaluates different body positions and equipment histories. The paper treats dose as equipment- and task-specific, rather than assigning every radar worker the same exposure. [21]

Germany's formal investigation demonstrates that the equipment-generated X-ray pathway is a recognized occupational question requiring evidence. I ask HHS to coordinate a comparably explicit U.S. review of FAA and ANG maintenance conditions, historical records and long-term health follow-up. Written U.S. safety requirements should lead to a demonstrated investigation and an identifiable protection process for the people who performed the work.

Assessment must come before a decision that monitoring is unnecessary

A radiation survey measures or evaluates a hazard. A personal dosimeter measures an individual's accumulated ionizing-radiation dose. For this comment, an occupational-health program means a process that connects a worker's tasks and exposure assessments with decisions about health monitoring, medical evaluation, referral and follow-up, including access to historical records after retirement. These functions are related, but one cannot substitute for the others.

The Occupational Safety and Health Administration (OSHA) ionizing-radiation standard, 29 CFR 1910.1096(d)(1), requires surveys necessary to evaluate radiation hazards. Here, 'survey' means an assessment of radiation conditions, including measurements when appropriate; it does not mean a questionnaire. Paragraph (d)(2)(i) requires individual monitoring for employees entering restricted areas who receive or are likely to receive doses above 25 percent of the applicable quarterly occupational dose limits during a calendar quarter. [4] The words "likely to receive" make prospective evaluation of the relevant work conditions important when determining whether individual monitoring is required.

This is an ionizing-radiation rule, not an RF dosimetry requirement. The broader point is the sequence of decisions. An employer must evaluate the relevant hazard and work conditions to justify its monitoring decision. A later absence of personal dose records cannot substitute for that initial evaluation or for reassessment as work changes.

Employees can report equipment changes, unsafe conditions and symptoms. They cannot be expected to identify invisible emissions by sight or produce measurements they were neither trained nor equipped to take. FAA should show how employee reporting was connected to qualified assessment, communication of results and medical review.

Why records must remain available for employment plus 30 years

FAA Order 3900.19B, paragraph 1406(j), page 14-6, required radiation-survey data, employee exposure records and related health or medical evaluations to be retained for the duration of employment plus 30 years. Paragraph 1410(f)(6), page 14-10, also required retention of employee measurements and calculated exposure estimates; paragraph 1410(f)(7) required informing employees how to obtain their records. [1]

The practical reason for long retention is that occupational disease may develop or become recognizable decades after exposure, including after retirement. A worker and physician may then need the old surveys, task descriptions and medical evaluations to investigate the illness. OSHA's records-access rule expressly identifies detection, treatment and prevention of occupational disease as its purpose. [9] Long retention preserves the evidence for that later work; it does not itself guarantee that medical follow-up occurred.

Retirement therefore does not end the employer's responsibility to preserve and make accessible the required evidence. FAA should identify the records, their custodians, and any authorized transfer or disposition. An agency reorganization should not leave a former worker unable to determine which office holds the evidence needed for medical evaluation.

What remains unresolved in my records requests

Obtaining the evidence has itself become a burden. Through FOIA, I have requested RF surveys, equipment configurations, technical manuals, radiation-safety training and occupational-health records. I have pursued multiple requests, follow-ups and an appeal, yet the records needed to evaluate my maintenance conditions are not readily available to me. I ask HHS to address this practical barrier: retention requirements must be accompanied by an effective way for current and retired workers to obtain their records. Where records cannot be located, agencies should explain the searches, transfers and documented disposition. Delayed or unavailable evidence impedes medical evaluation and research.

Through the Freedom of Information Act (FOIA), the federal process for requesting agency records, I have requested radiation surveys, equipment and maintenance information, radiation-safety training materials, exposure estimates, and records explaining monitoring and medical-surveillance decisions.

The records sought through FOIA include radiation-safety course materials and revisions, radiation-protection records, and employee occupational-health records. FAA responses available through October 10, 2026 include no-records results from particular offices and records requests that remain in processing.

I have spent several months trying to obtain FAA course FAA60004341, Radiation Safety Awareness for Technical Operations Personnel, and its revision history. My June 22, 2026 request sought the course content I completed in 2012, including the instructional material, assessments, references and records of revisions, so I could understand what radiation hazards and health effects the training addressed.

FAA's August 5 response reported that its Environmental, Occupational Safety & Health Services Group located no records responsive to that request. The same response stated that the course was reviewed regularly, with updates completed in 2018 and 2023, and described the course as a temporary record subject to five-year retention. It did not provide either updated course package or explain how I could obtain those versions. Identifying revisions without providing their content left me unable to determine what changed or what safety information the revised training contained.

I appealed the no-records determination and continued requesting surviving course versions, revision histories and existing disposition records. An October 6 follow-up specifically requested the later course packages and routing to the responsible course custodian. The materials available to me have not supplied the requested course content or a complete explanation of its disposition. A statement about a retention schedule does not establish when particular course materials were actually disposed of, or whether revised or successor materials remain available.

This experience illustrates the practical records-access problem: a retired technician seeking to understand the safety training provided during employment can face months of requests while the course content remains unavailable to the requester. I ask FAA to provide surviving course materials and revision records, identify the responsible custodian, and explain the documented disposition of any versions that cannot be located. HHS should consider how access to historical and revised safety information affects occupational-health evaluation and research.

These responses have not supplied a complete assessment and health-monitoring history. A no-records response from one office does not resolve the location of records in other FAA offices. FAA should identify the responsible custodians, complete coordinated searches, and explain what the available records show about recurring maintenance conditions and decisions on monitoring and medical follow-up.

HHS should examine how this uncertainty affects research. Unavailable exposure records should be identified as an uncertainty, rather than used to classify a worker as unexposed. Agencies responsible for workplace assessments should help locate or reconstruct the evidence needed for research and medical review. Workers with incomplete exposure histories should remain eligible for appropriate study and evaluation.

My illness and why delayed recognition matters

Earlier recognition and follow-up of abnormal findings may create opportunities for diagnosis and treatment. I ask HHS to evaluate whether occupational-health processes connect such findings with appropriate medical evaluation and review of continuing workplace exposures.

My medical history includes primary hyperparathyroidism (PHPT), parathyroidectomy—surgery to remove a parathyroid gland—and pathology compatible with parathyroid adenoma. An adenoma is a benign tumor. The parathyroid glands regulate blood calcium through parathyroid hormone (PTH); overactivity can raise blood calcium. These glands are distinct from the thyroid, despite the similar names. [10]

My history includes years of calcium concerns, documented elevated calcium and parathyroid hormone, endocrine evaluation and surgery. It illustrates why occupational-health review needs access to records over time rather than ending when employment ends.

The Department of Veterans Affairs (VA) lists parathyroid adenoma as a radiogenic disease under 38 CFR 3.311(b)(2)(xix). “Radiogenic” means that the disease may be induced by ionizing radiation. The classification concerns ionizing radiation; the RF question requires separate research. This recognition supports including parathyroid disease in the evaluation of potential occupational radiation effects. [5]

My experience illustrates why exposure assessments and long-term health monitoring matter. Workers and their physicians need access to the evidence required to investigate potentially delayed occupational illness. HHS should examine whether FAA's assessment, recordkeeping and medical-review processes met that need.

A published study of adults who received cervical-spine X-ray treatment for benign conditions reported intervals of 2–34 years from exposure to parathyroid-adenoma diagnosis, with a median of 26 years. [6] Those therapeutic exposures differ from radar-maintenance exposures; the reported intervals illustrate a long-latency research issue, rather than an estimate of technician dose or individual latency. They illustrate why a disease investigation may need evidence from decades earlier. This study concerns X-rays; the RF question requires its own evidence.

Research must include endocrine outcomes and incomplete exposure histories

The endocrine system includes glands that produce hormones. HHS's evaluation of RF research should address specific endocrine outcomes rather than treating all hormone findings as interchangeable. A 2019 systematic review of mobile-phone-related thyroid studies reported varied findings, including nonsignificant findings, and called for further research. [7] HHS should evaluate each measured hormone and each diagnosed disease separately. Findings about thyroid function from mobile-phone studies cannot be treated as findings about parathyroid disease in radar-maintenance workers.

Thyroid hormones are not parathyroid hormone. Consumer-phone exposure, animal experiments and occupational radar servicing also represent different exposure conditions. HHS should assess the quality and relevance of studies separately, identify gaps in parathyroid and calcium-regulation research, and include well-designed studies that found no statistically significant effect, as well as studies reporting changes.

Workers can know how to maintain a transmitter without knowing the emissions at their position or whether symptoms years later warrant an occupational evaluation. Radiation is invisible. A worker cannot report a measured dose without access to measurements relevant to the work performed. A study limited to reported exposure incidents may therefore overlook workers whose hazards were not recognized or whose disease appeared after retirement.

Long-term studies should include retired technicians and workers who never filed complaints. They should distinguish a documented decision that follow-up was unnecessary from cases where the available records do not establish whether a decision or referral occurred. An incomplete monitoring history should not be interpreted as a finding of no illness. With consent and privacy protections, exposure histories and medical records should be reviewed together, using comparison groups whose exposure differs in a defined way, while considering age, medical history and other possible causes of the conditions being studied.

Combined exposure and calcium-signaling mechanisms deserve investigation

Assessing RF and possible equipment-generated X-rays separately is necessary, but it should not end the inquiry. I ask HHS to investigate whether simultaneous or sequential ionizing and non-ionizing exposures can interact, including a possible synergistic effect greater than the expected combined effects of each exposure alone. Research should compare each exposure separately with the combined condition and test the interaction, including the effects of exposure sequence, timing, frequency, modulation, dose and maintenance configuration.

There is experimental evidence that makes this a legitimate research question. Cao and colleagues reported that 900-MHz microwave pre-exposure enhanced gamma-ray effects in SHG44 tumor cells, including reduced proliferation, increased apoptosis and reactive oxygen species. They described a synergistic effect. This was a cell experiment, not a demonstration of endocrine disease in maintenance workers. [18] Manti

and colleagues reported a small increase in chromosomal exchanges per cell under one RF/X-ray condition, without an increase in the proportion of aberrant cells. [19] Stronati and colleagues found no modification of X-ray effects under their tested RF conditions. [20] HHS should evaluate the entire pattern of findings and its dependence on experimental conditions, then test occupationally relevant exposure combinations. Neither universal synergy nor universal absence of interaction should be assumed from these experiments.

Dr. Martin L. Pall's work on voltage-gated calcium channels (VGCCs) deserves explicit scientific consideration. His 2013 review proposed VGCC activation as a mechanism for certain non-thermal EMF effects, drawing on experiments in which calcium-channel blockers reduced reported responses. He described downstream calcium/calmodulin, nitric-oxide and oxidative-stress pathways. [17] HHS should critically evaluate the underlying experiments, seek independent replication, and test whether the proposed pathway operates under the frequencies, pulse patterns and exposure conditions encountered in radar and communications maintenance. The research agenda should include a reasoned evaluation of this proposed mechanism and identify the evidence needed to test it.

Intracellular calcium signaling and elevated serum calcium are different biological measures. Pall's proposed pathway should therefore be investigated with measures of cellular calcium handling and relevant tissue function, alongside clinical endocrine outcomes, rather than treating a blood calcium value as a measurement of VGCC activity.

The outcome set should extend beyond thyroid hormones and parathyroid disease. I ask HHS to include diabetes, insulin resistance, glucose regulation, pancreatic endocrine function and gastric or other gastrointestinal symptoms and diagnosed disorders where biologically justified. Studies should distinguish hormone secretion from tissue responsiveness and distinguish nonspecific symptoms from confirmed diagnoses. Their occurrence in the general population does not, by itself, exclude an occupational contribution or aggravation. Researchers should test incidence, severity and progression against appropriate comparison groups and account for established risk factors.

Technician health monitoring and public safety

FAA Order 3930.3B, 'Air Traffic Control Specialist Health Program,' issued July 20, 2012, governed the controller program during the later years of my employment. Order 3930.3C, issued June 17, 2019, replaced Order 3930.3B; FAA currently lists 3930.3C, including Change 1, as active. Both orders expressly connect controller health with consistent performance, accurate judgment and public safety. [8] In my technician work, I do not recall ever receiving medical surveillance related to radiation exposure.

Appendix A reproduces selected original pages from FAA Order 3900.19B covering medical-surveillance scope and selection, radiation-safety training, annual task assessments, medical interpretation and employee records. These historical requirements explain the process whose implementation I seek to understand. They do not, by themselves, establish my individual exposure or a requirement for routine medical examinations for every radar technician.

FAA Order 3900.19B, chapter 12, established an Occupational Medical Surveillance Program (OMSP), with a scope tied to occupational hazards for which OSHA required medical surveillance and provision for additional monitoring where those requirements were absent. [1] I recall there was a Safety and Environmental Compliance Manager (SECM), but I do not recall concerns about radiation being communicated to me. I ask FAA to explain how the OMSP and radiation-safety program were implemented for radar technicians, what radiation hazards were evaluated, how assessment results were communicated

to workers, and what decisions were made about medical referral and follow-up.

The question is whether the written requirements produced effective protection in practice: assessments representing technicians' actual maintenance conditions, communication of results, documented decisions about medical monitoring, and referrals and follow-up when warranted. FAA should provide the records showing how that process operated for current and retired radar technicians, including access to historical records. The existence of a written program does not resolve whether there was a health-monitoring gap in practice.

FAA's orders identify the radiation-safety and occupational medical-surveillance framework. I ask FAA to explain how those requirements were applied to radar technicians, including my maintenance duties, and to provide the assessment records, decisions about medical surveillance, and records of any referrals or follow-up. Where surveillance was determined unnecessary, I ask for the documented basis for that decision.

Controller medical qualification and technician exposure surveillance serve different purposes. I am asking for a technician program based on radar-maintenance hazards, rather than proposing that technicians receive the controller medical-qualification examinations. I ask FAA to identify and document the process used to protect radar technicians: documented exposure assessment, communication of results, medical referral when warranted, and follow-up through retirement.

Unrecognized occupational illness can affect staffing, absence, retention and replacement-training costs. Technicians maintain radar and communications systems on which air traffic operations depend. HHS and FAA should therefore evaluate the connection between technician health protection, maintenance reliability and the safety of the flying public. I ask HHS and FAA to assess these workforce and public-safety implications.

Workers need a meaningful path to evaluate health conditions that may emerge years after occupational exposure. That requires accessible exposure records, appropriate medical evaluation, and clear guidance for current and retired workers. I ask HHS to consider how federal agencies can coordinate these functions so that unanswered exposure and health questions do not remain solely the worker's burden.

What I ask HHS to do

I ask HHS to coordinate with FAA, DOT, the Department of Defense, Department of the Air Force, ANG and occupational-health agencies, including the National Institute for Occupational Safety and Health (NIOSH), on the following actions:

1. Determine whether the agencies carried out their requirements. Compare FAA and applicable Air Force/ANG radiation-safety duties with the assessments, training, monitoring decisions and medical follow-up actually provided to maintenance personnel. Identify the historical editions governing each period and include the evidence supporting decisions that no additional protection was needed.
2. Locate, preserve and make accessible the evidence. Identify surveys, equipment configurations, maintenance conditions, exposure estimates and medical-review records; trace custody across reorganizations; and make required employee records accessible throughout their retention period.
3. Evaluate maintenance exposure. Develop methods that represent simultaneous VHF/UHF communications, radar and beacon transmitter operation; near-field working positions; aircraft-radar and ECM bench troubleshooting; energized servicing; changed shielding; and repeated tasks. Assess RF and possible X-rays separately, account for coexistence, and state uncertainty when reconstructing historical

exposure.

4. Study long-term health and combined-exposure mechanisms. Include endocrine, metabolic and gastrointestinal outcomes; evaluate Pall's proposed VGCC pathway and possible RF/ionizing-radiation interaction with independent replication and occupationally relevant conditions. Include retired workers and workers who never reported an incident. Follow exposure and health over time rather than ending observation when employment ends.
5. Identify and strengthen the technician occupational-health process. Specify which tasks and exposures trigger assessment or medical referral, how workers receive results, what follow-up occurs, and which office remains responsible when FAA reorganizes.
6. Address worker and public-safety consequences. Evaluate how technician illness, staffing losses and any identified gaps in occupational-health protection may affect maintenance reliability, government costs and the flying public.
7. Work with Congress to address the military-civilian compensation divide for occupational radiation illness. VA permits postservice disability claims without a filing deadline; FECA generally requires filing within three years, with special rules for latent disability. Workers with both military and federal civilian exposure histories therefore face different compensation rules for the same diagnosed illness, including when it is recognized years after exposure. Establish a coordinated pathway for evaluating and compensating occupational harm, allowing related claims to proceed in parallel with shared exposure and medical evidence and clear guidance on eligibility and benefit coordination. [24,25]

FAA and Air Force recognition of maintenance hazards is the starting point. HHS should help determine whether the required assessment, recordkeeping and health-review process protected the people doing the work—and what improvements are needed where the review identifies incomplete evidence or gaps in protection.

References

- [1] FAA Order 3900.19B, FAA Occupational Safety and Health Program, April 29, 1999, chapters 12 and 14, cited paragraphs/pages; chapter 1 paragraphs 3 and 5(e), predecessor orders and consolidation; chapter 1 ¶¶14(a)-(b), pp.1-11–1-12 distinguishes supervisor and employee responsibilities. https://www.faa.gov/documentLibrary/media/order/occ_safety/media/FINAL3900.pdf
- [2] FAA Order 6050.32B, Spectrum Management Regulations and Procedures Manual, November 17, 2005, chapter 16, cited paragraphs/pages. https://www.faa.gov/documentLibrary/media/Order/6050.32B_with_Changes_1_2_3.pdf
- [3] FAA Order 6340.28, Procedures for Conducting Radiation Hazard Surveys and Radiation Safety Training, February 3, 2006, ¶¶1,2,4 and7. <https://www.faa.gov/documentLibrary/media/Order/6340.28.pdf>
- [4] 29 CFR 1910.1096(d)(1),(d)(2)(i); current OSHA provision on hazard surveys and individual monitoring. <https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1096>
- [5] 38 CFR 3.311(b)(2), specifically(b)(2)(xix), parathyroid adenoma and the regulation's definition of radiogenic disease. <https://www.law.cornell.edu/cfr/text/38/3.311>
- [6] "Increased incidence of parathyroid adenomas following X-ray treatment of benign diseases in the cervical spine in adult patients," PMID 12460322. <https://pubmed.ncbi.nlm.nih.gov/12460322/>

- [7] Fatahi Asl et al., 2019, “The possible global hazard of cell phone radiation on thyroid cells and hormones: a systematic review of evidences,” PMID 31062236. Systematic review of thyroid-related research; not a study establishing parathyroid causation. <https://pubmed.ncbi.nlm.nih.gov/31062236/>
- [8] FAA Order 3930.3B, Air Traffic Control Specialist Health Program, July 20, 2012: https://www.faa.gov/documentLibrary/media/Order/FAA_Order_3930.3B.pdf ; current Order 3930.3C, June 17, 2019, including Change 1, FAA status and program description: https://www.faa.gov/regulations_policies/orders_notices/index.cfm/go/document.information/documentID/1036090
- [9] 29 CFR 1910.1020(a), purpose of access to exposure and medical records. OSHA distinguishes its general medical-record and exposure-record retention periods in(d)(1)(i)–(ii); the employment-plus-30-year statement above quotes the FAA directive's own requirement. <https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1020>
- [10] National Institute of Diabetes and Digestive and Kidney Diseases, “Primary Hyperparathyroidism,” explanation of parathyroid function, PHPT and adenoma. <https://www.niddk.nih.gov/health-information/endocrine-diseases/primary-hyperparathyroidism>
- [11] FAA Order JO 3900.68, Air Traffic Organization Radiation Safety Program, effective July 20, 2016, chapter 1, paragraphs 1-2 and 1-4: https://www.faa.gov/documentLibrary/media/Order/JO_3900.68.pdf ; FAA cancellation record: https://www.faa.gov/regulations_policies/orders_notices/index.cfm/go/document.information/documentID/1029091
- [12] FAA public catalog, JO 3900.68A, issued November 24, 2025; active status and FAA-network-only access: https://www.faa.gov/regulations_policies/orders_notices/index.cfm/go/document.information/documentID/1044760
- [13] FAA active-order catalog, Order 3900.19D, February 14, 2024: https://www.faa.gov/regulations_policies/orders_notices/index.cfm/go/document.list/?appliedFacets=%7B%22subjectclass%22%3A%223900%22%7D&statusID=2 ; Order 3900.19C replacement history: https://www.faa.gov/regulations_policies/orders_notices/index.cfm/go/document.information/documentID/1035114
- [14] Department of the Air Force, AFOSH Standard 161-9, Exposure to Radiofrequency Radiation, October 10, 1978, cover, contents and printed pages 1-7 reproduced in the supporting exhibits. Paragraphs A1-A2 address application and scope. The cover supersedes AFR 161-42, November 1975. Archived original scan contains handwritten annotations. Source: the Zory Glaser archive, as linked in reference 15.
- [15] Department of the Air Force, AFOSH Standard 161-9, Exposure to Radiofrequency Radiation, October 10, 1978, paragraphs and printed pages specified above. Historical Air Force primary document, reproduced in the Zory Glaser archive: <https://zoryglaser.com/wp-content/uploads/2020/05/AFOSH-STANDARD-161-9-OCCUPATIONAL-HEALTH-EXPOSURE-TO-RADIOFREQUENCY-RADIATION.pdf>
- [16] Department of the Air Force, AFOSH Standard 48-9, Radio Frequency Radiation (RFR) Safety Program, August 1, 1997, cover: supersedes AFOSH Standard 161-9, February 12, 1987. Cited for the edition history, not as a requirement during the earlier ANG work. Reproduced primary document: <https://studylib.net/doc/18800404/afoshstd48-9>

- [17] Pall ML. Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects. *Journal of Cellular and Molecular Medicine*. 2013;17:958–965. doi:10.1111/jcmm.12088. Mechanistic review; proposed pathway requiring evaluation under relevant occupational conditions. <https://pubmed.ncbi.nlm.nih.gov/23802593/>
- [18] Cao Y et al. 900-MHz microwave radiation enhances gamma-ray adverse effects on SHG44 cells. *Journal of Toxicology and Environmental Health, Part A*. 2009;72:727–732. doi:10.1080/15287390902841466. Experimental tumor-cell study. <https://pubmed.ncbi.nlm.nih.gov/19492235/>
- [19] Manti L et al. Effects of modulated microwave radiation at cellular telephone frequency (1.95 GHz) on X-ray-induced chromosome aberrations in human lymphocytes in vitro. *Radiation Research*. 2008;169:575–583. doi:10.1667/RR1044.1. Experimental lymphocyte study. <https://pubmed.ncbi.nlm.nih.gov/18439037/>
- [20] Stronati L et al. 935 MHz cellular phone radiation. An in vitro study of genotoxicity in human lymphocytes. *International Journal of Radiation Biology*. 2006. PMID 16782651. Experimental lymphocyte study reporting no modification of the measured X-ray effects. <https://pubmed.ncbi.nlm.nih.gov/16782651/>
- [21] Schirmer A. Emission of Parasitic X-Rays from Military Radar Transmitters and Exposure of Personnel: Towards a Retrospective Assessment. Second European IRPA Congress on Radiation Protection, 2006, sections 2 and 4, PDF pages 3–5 and 11–12. Bundeswehr technical investigation; conference paper. <https://www.osti.gov/etdeweb/servlets/purl/20992895>
- [22] German Radar Commission. Radar Commission Report — Executive Summary. July 2, 2003, sections 1 and 3.1, pages 1–3. Official English-language summary archived from the German Federal Office for Radiation Protection. https://archiv.bge.de/archiv/www.endlager-konrad.de/SharedDocs/Downloads/BfS/EN/expert-info/ion/radar-summaryb1dd.pdf?__blob=publicationFile&v=1
- [23] Department of the Navy, Naval Ship Engineering Center. NAVSHIPS 0900-005-8000, Technical Manual for Radio-Frequency Radiation Hazards, First Revision, approved July 1, 1971. Section 1-2, printed page 1-2; Table 1-1, AN/APQ-109 entry, printed page 1-4; table notes 1, 3 and 4, printed page 1-7. Relevant table entry and explanatory conditions are reproduced above.
- [24] Department of Veterans Affairs, Types of Disability Claims and When to File, postservice claims: no filing time limit. <https://www.va.gov/disability/how-to-file-claim/when-to-file/>
- [25] Federal Employees' Compensation Act, 5 U.S.C. 8122(a)-(b), filing deadlines and latent disability; 5 U.S.C. 8116(a), coordination with VA benefits. <https://www.dol.gov/agencies/owcp/FECA/regs/statutes/feca>

Appendix A: FAA medical-surveillance and radiation-safety requirements

Selected original pages from FAA Order 3900.19B, April 29, 1999. Source pages retain their original headings, dates and printed page numbers. [1]

Medical-surveillance framework - printed pages 12-1 and 12-2: paragraphs 1200-1203 identify the program, scope and goals; paragraph 1205 addresses hazard investigation, employee selection, tailored evaluations and medical-record access.

Radiation-safety training and records - printed pages 14-5 and 14-6: paragraph 1406 addresses training, assessment, safety information, repositories, retention and incident review.

Annual assessments and worker information - printed page 14-8: paragraph 1410(b)(4) addresses documented annual task/workplace assessments, measurements if needed, archived results, training and information resources.

Medical review and employee access - printed pages 14-9 and 14-10: paragraph 1410(c) addresses medical interpretation and surveillance recommendations; paragraph 1410(f)(6)-(7) addresses exposure-record retention and employee access.

These are historical requirements cited for the relevant FAA work period. Medical-surveillance decisions depend on the applicable hazard, exposure information and program criteria. The excerpt does not establish that every radar technician required routine examinations or that any individual requirement was or was not carried out.

The Air Force source guide and original AFOSH Standard 161-9 pages follow these FAA source pages. The guide explains their relevance and the historical edition limits.

CHAPTER 12. OCCUPATIONAL MEDICAL SURVEILLANCE PROGRAM

1200. GENERAL. Where the Occupational Safety and Health Administration (OSHA) requires the implementation of medical surveillance of FAA employees, the FAA shall conduct medical surveillance. This chapter establishes the elements of an FAA Occupational Medical Surveillance Program (OMSP), which includes requirements for medical surveillance and industrial hygiene surveillance in FAA workplaces and organizational responsibilities.

1201. BACKGROUND. A relatively small proportion of OSHA regulations include medical surveillance requirements. FAA is committed to identifying the OSHA regulations that apply to its workplaces or work tasks and to provide the requisite employee medical physicals. FAA may also provide additional medical monitoring where OSHA medical surveillance requirements are absent.

1202. GOALS AND OBJECTIVES. The goal of the OMSP is to safeguard employees' health by anticipating and identifying physiological changes in employees related to workplace exposures so that preventive measures can be taken, as well as identifying occupationally induced diseases prior to incapacitating illness.

1203. SCOPE. This chapter applies to all FAA employees whose work duties and/or work environments may expose them to certain occupational hazards that OSHA has identified as requiring medical surveillance. Not included in this program are medical examination requirements for certification of pilots and medical clearance of air traffic controllers. These certification requirements are covered in other organizations' orders and policies.

1204. DEFINITIONS.

a. Allied safety officer. An allied safety officer is an FAA employee who has been assigned full-time or collateral duty safety and health responsibilities, not including the Regional or Center Program Manager for Environment and Safety, Regional or Center Occupational Safety and Health Manager, or FAA headquarters safety and health staff. Examples include Safety and Environmental Compliance Managers (SECM), designated facility safety officers, and safety committee members.

b. American Industrial Hygiene Association (AIHA). The American Industrial Hygiene Association (AIHA) is a membership organization for industrial hygienists. AIHA manages an accreditation program designed for laboratories involved in analyzing samples for the purpose of evaluating workplace exposures.

c. Industrial hygiene surveillance. Industrial hygiene surveillance is performed by a qualified safety and health professional and includes evaluation of employee work practices and work environments with emphasis on identifying occupational health hazards, as required by OSHA regulations and FAA policy.

d. Job hazard analysis. Job hazard analysis is a tool for identifying safety and health hazards associated with specific job tasks. The analysis includes a review of job tasks and of workplace environments as possible contributors to health and safety hazards.

e. Medical surveillance. Medical surveillance is performed under the supervision of a qualified physician and includes periodic medical screening and/or medical monitoring of FAA employees as required by OSHA regulations and FAA policy.

f. National Institutes for Occupational Safety and Health (NIOSH). The National Institutes for Occupational Safety and Health (NIOSH) is a Federal agency under the Department of Health and Human Services. The agency conducts research on health and safety concerns and develops analytical methods for the analysis of air samples collected for determination of employee exposure.

g. Occupational hazard. An occupational hazard is any combination of environmental and/or human factors that can cause sickness, impaired health, or significant discomfort in workers. Examples may include chemicals in solid, liquid, or vapor form; physical agents like noise, ionizing and non-ionizing radiation, temperature and pressure extremes, and vibration; biological hazards like bloodborne pathogens; and ergonomic hazards.

1205. KEY PROGRAM ELEMENTS. FAA shall:

a. Investigate health hazards affecting FAA employees and determine which employees shall be included in or removed from the agency's medical surveillance program as required by OSHA regulations. OSHA standards may require the employer to provide medical surveillance for anticipated excessive exposure to occupational hazards without requiring prior exposure monitoring (e.g., 29 CFR 1910.120). Examples of occupational hazards for which OSHA requires medical surveillance are provided in Figure 12-1, Examples of OSHA Regulations That Include Medical Surveillance Requirements.

b. Ensure that medical evaluations are tailored to specific groups of employees and their exposures and that medical testing is supervised by a qualified physician.

c. Provide the required medical examinations and furnish results to appropriate recipients in a coordinated, timely manner.

d. Maintain a secure, confidential repository of all employee medical records and ensure that employees have access to their records as needed for personal medical care.

e. Review the medical surveillance program and update it based upon changes in regulations, consultation with site management and employees, exposure data, and medical monitoring test results.

1206. NATIONAL OCCUPATIONAL MEDICINE SURVEILLANCE PROGRAM OVERSIGHT TEAM (NOMSPOT).

a. Purpose. NOMSPOT shall provide a mechanism for consultation, technical assistance, quality assurance, and as a central point of contact for FAA region or center medical surveillance issues.

b. Membership. Core membership will include representatives from the Office of Aviation Medicine (AAM), Airway Facilities Service (AAF), and the Office of Environment and Energy (AEE). Names of contact persons will be announced at the national OSHECCOM committee meetings. Non-member participants at meetings may include FAA region or center safety and health professionals and bargaining unit representatives.

c. Frequency. Meetings will be held as needed to resolve medical surveillance-related issues and occur as teleconferences, videoconferences, or as panels at mutually agreed-upon locations.

d. Initiation of Request for Review. The initiator of a request to review a medical surveillance-related issue must send to AEE a memorandum describing the nature of the concern. AEE will notify sender of arrival of memorandum within 5 work days of receipt.

e. Resolution of Issue. Every effort will be made to handle medical surveillance-related issues expeditiously. Issues having little or no budgetary impact may be handled within 30 work days; otherwise, they may require a longer review.

1406. KEY RADIATION SAFETY PROGRAM ELEMENTS. FAA shall:

- a.** Adopt the most current ACGIH (1998 or as applicable) occupational exposure safety guidelines for physical agents, specifically the sections identified as Ionizing Radiation; Lasers; and Nonionizing Radiation and Fields. Also adopt the most current ANSI/IEEE C95.1 recommended RF radiation exposure safety standards for uncontrolled environments as “action levels” (see 1405a and 1407b(1) for definition). *(Note: ACGIH 1998 TLVs and BEIs and ANSI/IEEE C95.1-1991 shall serve as the baseline for 1998, the year of this chapter's initial issue.)*
- b.** Ensure that timely and specific implementation guidance of the RSP is developed and issued by the responsible FAA organizations. (See paragraph 1410.)
- c.** Ensure that appropriate radiation safety training materials are developed in a timely manner, in coordination with current and documented RSP guidance and safety information; and that responsible FAA staff (e.g., safety and health managers and allied safety officers, appropriate spectrum engineering, and technical maintenance and operations staff) receive appropriate initial and continuing training needed to prevent, evaluate, measure, control, and mitigate potential radiation exposure hazards in the FAA workplace.
- d.** Ensure that baseline radiation surveys, commissioning, modifications, and other radiation safety assessments are conducted as needed, or as requested, in a timely manner. The goal is to document, evaluate, control, and mark, by posted warnings or restricted access to, areas where employee exposures could exceed recommended exposure limits from a single source or multiple radiation sources. (Baseline surveys of ELF/EMF and static magnetic and electric fields will be performed only on an as-needed basis.)
- e.** Ensure that no FAA employee shall handle, maintain, test, and operate radiation emitting components, or perform duties in areas where there is a potential radiation hazard, without first being made aware of the radiation hazard potential, and receiving information or appropriate training in radiation hazards prevention and control appropriate to his/her job tasks. The employee shall be made aware of radiation potential hazards identification, safe work procedures, and strategies for preventing, controlling, and mitigating unnecessary or excessive personnel exposures.
- f.** Ensure that informative reading materials on potential radiation hazards shall be maintained by Washington headquarters, regions, centers, and field offices, and shall be made available to concerned employees on request.
- g.** Ensure that all existing radiation and high fields sources are inventoried, and that measured radiation emission levels are archived by facility type, source type, configuration, location, and date. Where employee exposures to these sources have been measured (i.e., dosimetry), the appropriate employee job classification numbers and job task descriptions shall also be archived.
- h.** Ensure that specifications for and acceptance testing of new equipment, subsystems, and systems to be developed or acquired under the NAS Facilities Modernization and/or as part of the NAS System Architecture complies with applicable radiation safety standards and guidelines.
- i.** Maintain a centralized RSP resource file and data base to include: work area radiation hazard measurements and estimates of radiation hazard by type, radiation survey data at typical facilities, and for representative sources, employee exposure and source(s) of exposure; also, results of baseline and periodic employee workplace radiation surveys and hazard assessments, and results of both scheduled or planned and on-request or unplanned investigations.

j. Ensure that all radiation emissions survey data and employees' exposure records and related health or medical evaluations shall be maintained for the duration of employment plus 30 years in accordance with 29 CFR 1910.1020, *Access to employee exposure and medical records*.

k. Investigate and document all alleged workplace exposure incidents and levels that exceed the adopted exposure criteria, and recommend prevention and mitigation strategies; or medical treatment and/or inclusion in a medical surveillance program, if recommended by AAM.

l. Require that all commercially acquired FAA equipment that are unintentional radiation sources (such as microwave ovens, computer, communication, and display devices, physical security screening equipment), have evidence of manufacturer or supplier compliance with applicable FCC or FDA/CDRH radiation safety standards.

1407. NIR EMPLOYEE EXPOSURE CRITERIA. Following is a brief overview of the criteria for the different radiation frequency bands. Consult the appropriate current version of the TLV booklet and/or ANSI/IEEE C95.1 for the actual criteria.

a. SRF limits for electromagnetic radiation with frequencies (f) below 30 kHz, including ELF/EMF power frequencies and harmonics ($f < 300$ Hz). These TLV's include both electric and magnetic fields down to static ($f = 0$) electric and magnetic fields. Special warnings and more stringent TLV's are noted for workers wearing electronic implants, such as pacemakers, susceptible to electromagnetic interference (EMI) from NIR sources.

b. RF radiation with $30 \text{ kHz} < f < 300 \text{ MHz}$ and MW radiation with $300 \text{ MHz} < f < 300 \text{ GHz}$. These TLV's are identical to the controlled environment electric and magnetic fields, or equivalent power density limits, in ANSI/IEEE C95.1-1991, "*Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*," and are applicable only to experienced, trained personnel, such as radar and/or environmental technicians, certain members of the Academy, safety professionals and allied safety officers, and other cognizant individuals. The ACGIH also adopted the C95.1-1991 controlled environment limits on RF-induced and contact (shock and RF burn limits) for whole body and partial body currents and on pulsed, multi-frequency or multiple-source radiation that requires summation, as well as spatial and time averaging to ensure exposure safety.

(1) Action Levels. MPE's for uncontrolled environments shown in ANSI/IEEE C95.1-1991 are applicable to most FAA workplaces, and shall be used as *action levels* for implementing this chapter and program guidance to control employee exposure to RF and MW radiation.

(2) Representative baseline surveys shall be conducted in accordance with program guidance to identify controlled and uncontrolled environments, and to demonstrate that *action levels* are not exceeded.

c. Laser safety. ACGIH-98 adopts appropriate technical standards for safe use of lasers in the workplace, as a function of wavelength, power, beam crossection, exposure type (both pulsed and continuous wave, CW), duration of exposure, and body crossection exposed (ocular or skin).

1408. IONIZING RADIATION EMPLOYEE EXPOSURE CRITERIA. The ACGIH 1998 TLV's for ionizing radiation include specific occupational exposure safety guidelines to limit exposures to ionizing radiation, including particulates (e.g., inhaled radon) and electromagnetic (e.g., x-rays from radars and VDTs). These guidelines are based on the most recent guidance from the National Council for Radiation Protection and Measurements (NCRP) and the International Commission on Radiological Protection (ICRP). The ACGIH also endorses the ALARA (as low as reasonably achievable) principle for minimizing workplace exposures. Special radiological protection guidance is given to minimizing exposures for declared pregnant employees, so as to limit the *in utero* dose. The existing OSHA standard for ionizing radiation, 29 CFR 1910.97, is outdated and does not specifically protect pregnant workers; however, the standard's program elements (e.g., labeling, warning signs, personal monitoring in special cases, reporting, and recordkeeping) shall be followed in this chapter.

(f) Assist in development of required radiation assessment audits.

(g) Assist AEE upon request as co-liaison with Federal worker protection and environmental safety and health regulatory agencies (OSHA, NIOSH, FDA/CDRH, FCC, EPA) and with other professional radiation health societies (ACGIH, ANSI/IEEE, NCRP), whose missions are to develop standards and guidelines to protect workers from radiation hazards.

(4) Coordinate with appropriate organizations as required to secure their support for RSP implementation. Specifically:

(a) Coordinate with AAM when seeking additional health or medical interpretation of any radiation measurement data.

(b) Ensure that annual field safety assessments of employee work tasks and/or work environments are conducted to identify employees for inclusion in the RSP; to identify new operations or modifications to the workspace environment that may increase the potential for radiation exposure hazard; and ensure that these assessments are supported by radiation emission and/or exposure measurements, if needed. All assessments shall be documented.

(c) Ensure all radiation exposure records are maintained in accordance with 29 CFR 1910.1020, *Access to Employee Exposure and Medical Records*. All radiation exposure hazard assessments shall be documented and archived.

(d) Provide technical assistance to the regions and the two centers for radiation hazard prevention, control, and/or mitigation strategies upon request or as needed.

(e) Implement initial and periodic radiation hazard evaluation training; and document all such training and maintain training records for a minimum of 3 years for the following employee groups:

i. Safety and health professionals and staff, who must perform baseline and periodic workplace radiation hazard assessments.

ii. Employees who must perform work tasks or work in environments where potential exists for exposure above adopted TLV's.

iii. Spectrum engineering staff in the performance of occupational radiation hazard measurements and evaluations of compliance with FAA adopted standards.

(f) Collect or develop and provide informational resources on radiation safety to concerned employees upon request.

(g) Provide technical assistance as appropriate to appropriate AF organizations to ensure that the employee safety paragraphs in radar maintenance orders (6000-series) and related publications are revised to include this chapter, and that safety information is available, current, and sufficient to the needs of the users.

(h) Provide Regional Frequency Management Offices (FMO) and the Mike Monroney Aeronautical Center and the William J. Hughes Technical Center counterparts with equipment and/or technical support required for emissions measurement and exposure assessment and for identification of uncontrolled and controlled environments.

(i) Maintain and annually update the radiation measurement equipment inventory and ensure that equipment calibrations are maintained in accordance with manufacturer recommendations.

(j) Periodically update Order 6050.32, Spectrum Management Regulations and Procedures Manual, and/or other written procedures consistent with this RSP policy, and update FMO training materials to ensure compliance with current standards.

(k) Maintain a centralized Spectrum Engineering data base or management information system of official records to log and track representative hazard measurements data. The repository should include baseline and periodic radiation hazard measurements for representative radiation sources and facilities, calculated estimates of exposure for representative employee classifications and/or job tasks, and data arising from all planned or unplanned investigations relating to possible potentially hazardous radiation exposures.

c. **AAM** shall:

(1) Provide medical interpretation of radiation exposure estimates for FAA employees upon request by the RPO and consult with outside specialists deemed appropriate to evaluate measurements collected by AAF.

(2) Develop written guidance for the regional flight surgeons related to employee radiation exposures and provide a copy to AEE and AAF for review prior to distribution.

(3) Maintain medical records of employees with documented exposure to radiation above the adopted FAA radiation exposure standards, and ensure accessibility to employees in accordance with 29 CFR 1910.1020, *Access to Employee Exposure and Medical Records*.

(4) Recommend an appropriate medical surveillance strategy when an employee has received an accidental or routine radiation exposure in excess of the adopted TLV's.

d. **ARA** shall:

(1) Coordinate with AAF early in the planning and design phase of prototype equipment that may generate radiation in excess of the adopted MPE's, as established for uncontrolled areas in ANSI/IEEE C95.1-1991.

(2) Ensure that all designs, acquisition, and acceptance testing plans are reviewed by the RPO for potential radiation hazards. This review shall be documented.

(3) Ensure that manufacturers and suppliers of FAA-purchased equipment containing radiation sources provide appropriate radiation source identification, emissions data, and potential hazard warning labels that demonstrate compliance with RSP standards and guidelines.

(4) Develop written procedures for review and evaluation of potential radiation hazards during planning, siting, acquisitions, construction, maintenance, modifications, upgrades or modernization, and all other phases of life-cycle management for real property (i.e., environmental assessment reviews). The procedures (and subsequent revisions) shall be reviewed by AEE and AAF prior to distribution.

(5) Provide to the RPO radiation safety information for new FAA equipment, systems, and facilities as needed to ensure compliance with the RSP and AAF guidance.

(6) Ensure, with technical assistance from AAF, that emerging or planned NAS systems and components or modifications to existing systems are evaluated for possible radiation and fields hazards in all phases of acquisition and life-cycle management.

e. **AHR** shall assist as necessary to ensure that the RSP policy is addressed in employee programs and policies, with special attention to employee categories identified as having potential for exposure to radiation. Examples of programs include Workers' Compensation claims for workers alleging excessive exposure to radiation; siting and construction of child care centers (see Figure 14-2, Evaluation of Potential Radio-Frequency (RF) Radiation Hazard at Planned and Existing Child Care Centers); and affirmative action programs for pregnant women or workers with pacemakers or other medical implants.

f. Regional Airway Facilities Division (AXX-400), Environmental, Safety, and Emergency Management Division (AMP-100), and Facilities Services and Engineering Division (ACT-600) shall:

(1) Implement the RSP in their region or center in accordance with this chapter and written guidance provided by AAF.

(2) Ensure that the request for resources for implementation of the RSP is addressed in the budgetary review process.

(3) Ensure that regional (or center) employees have clear procedures for requesting assistance in the identification of and resolution of concerns of potential and alleged radiation hazards.

(4) Ensure that all appropriate FAA personnel potentially exposed to radiation above adopted TLV's are informed and/or trained in safe work practices and radiation exposure prevention, and that such training is documented.

(5) Ensure that the Regional Occupational Safety and Health Manager (ROSHM) and/or allied safety officers and/or the FMO's receive training and adequate resources needed to identify, measure, evaluate, control, and mitigate radiation hazard risks in the workplace, and that the training is documented.

(6) Ensure that records of employee radiation exposure measurements, including calculated estimates of exposure, are maintained for each employee for the duration of employment plus 30 years. If these records are archived at a storage facility, ensure that they are properly catalogued and readily accessible.

(7) Inform employees that records are available to them and on how they can obtain such records, in accordance with 29 CFR 1910.1020, *Access to Employee Exposure and Medical Records*.

g. All FAA managers shall assist wherever possible in the identification of FAA employees whose job tasks or work environments expose them to radiation hazards, or who are at special risk (e.g., pregnant employees or those with medical electronic implants). Contact the FAA region, center, or Washington headquarters safety office or a local safety and health professional/allied safety officer for assistance in the evaluation of workplace radiation hazards.

Air Force requirements: AFOSH Standard 161-9

Exposure to Radiofrequency Radiation, October 10, 1978. The original cover, contents and printed pages 1-7 follow this guide. The archived scan retains its handwritten annotations. [14,15]

Printed pages 1-2: application to military and civilian Air Force personnel; RF and associated X-ray protection; responsibilities for surveys, hazard information, exposure reporting and medical evaluation.

Printed pages 3-5: exposure limits and base program; maintenance and test facilities; quarterly visits; survey reports; investigation and permanent documentation of suspected or actual overexposures.

Printed pages 6-7: warning-sign illustration, exposure reconstruction, medical consultation and follow-up. Paragraph C7(a) states that routine pre- or post-employment medical examinations are not indicated for personnel occupationally exposed to RF. Paragraph C7(b) provides for physician review and clinically indicated examination after confirmed or likely overexposure.

This edition predates my 1981-1989 ANG work. AFOSH Standard 48-9, August 1, 1997, identifies a February 12, 1987 edition of Standard 161-9 as its predecessor. The complete 1987 text has not been recovered for this comment; the 1978 provisions are not represented as unchanged throughout my ANG work. I ask the Air Force and ANG to identify the governing editions and provide implementation records. [16]

10 October 1978

//
Occupational Health/
EXPOSURE TO RADIOFREQUENCY RADIATION
"

A. APPLICATION AND SCOPE	Page
1. Application	1
2. Scope	1
3. Policy	1
4. Responsibilities	1
B. TERMS EXPLAINED	
1. Average Power	3
2. Permissible Exposure Level (PEL)	3
3. Power Density	3
4. Radiofrequency (RF) Radiation	3
5. Cardiac Pacemaker Risk Distance	3
6. A Glossary of Technical Terms	3
C. REQUIREMENTS	
1. Permissible Exposure Levels (FELs)	3
2. Protective Clothing	3
3. Radiofrequency Hazard Warning Signs	3
4. Base Program	4
5. Reports	5
6. Medical Investigation of Incidents and Accidents	5
7. Medical Examinations	7
8. Cardiac Pacemaker Interference	8
9. Background Information	8
D. REFERENCES	8
Tables	
1. Permissible Exposure Levels (PEL) for Personnel	3
Appendix	
I. Glossary	9
II. RF Introduction and Biological Effects	13
III. Calculations and Equations	21
IV. Evaluation of Radiofrequency Radiation Hazards	26
V. Guide for Surveying Microwave Oven	32
Figures	
1. Radiofrequency Radiation Hazard Warning Symbol (AF Forms 737 and 747)	6
2. Electric and Magnetic Fields	14
3. The Electromagnetic Spectrum	15
4. Power Density Versus Distance	20
5. Permissible Exposure Versus Exposure Time	24
6. PEL, Duty Factor and E-Field Relationship	25

→ Supersedes AFR 161-42, November 1975.

OPR: SGPA

No of Printed Pages: 35

Distribution: F

A. APPLICATION AND SCOPE

1. Application. This standard applies to all Air Force military and civilian personnel (including foreign nationals) working at Air Force facilities within the CONUS and overseas whose duties require that they work in areas where exposure to radiofrequency (RF) radiation may occur. It also addresses the protection of nonoccupationally exposed personnel (general public) from RF radiation produced by Air Force-owned or -operated sources.

2. Scope. A program is established in this standard to prevent possible harmful effects to personnel resulting from exposure to radiofrequency (RF) radiation in the frequency range from 10 kiloHertz (KHz) to 300 gigaHertz (GHz). It applies to all radiations, within this frequency range, originating from communication systems, radar equipment, and other possible sources of RF radiation such as are used for radionavigation, industrial, scientific, and commercial purposes. This standard is not intended to apply to the exposure of patients by the medical services during diagnostic or therapeutic procedures.

3. Policy. Air Force Policy is to:

a. Assure, to the maximum practicable extent, the elimination of RF radiation and associated X-ray hazards to personnel from electronic equipment before it becomes operational, and develop personnel protection procedures for those hazards which cannot be eliminated by engineering design.

b. Not permit exposure of personnel to RF radiation levels exceeding the permissible exposure levels specified herein.

c. Consider RF radiation as a personnel hazard and as a source of interference to medical prosthetic devices when plans, mission changes, or relocation of existing activities are reviewed by the Environmental Protection Committee (AFR 19-1).

d. Assure that all available capabilities for measurement surveys are fully exploited and not duplicated except where essential to a cost-effective program.

4. Responsibilities:

a. HQ USAF:

(1) Air Staff. All Air Staff elements will ensure their activities are conducted in a manner consistent with the spirit and intent of this standard and with AFR 19-1 as it considers RF radiation as a potential hazard.

(2) The Surgeon General. The Air Force Medical Service Center, Director of Professional Services (AFMSC/SGP) acting for the Surgeon General.

(a) Establishes RF radiation personnel expo-

sure standards and criteria.

(b) Provides professional advice and guidance applicable to RF radiation exposure control and biomedical research programs.

(c) Establishes adequate monitoring programs to ensure compliance with this standard and applicable Federal laws.

(3) DCS/Research Development and Acquisition

(a) Plans, programs, and budgets for research and development relating to the biological effects of RF radiation exposure.

(b) Ensures that appropriate consideration is given to personnel RF radiation exposure potential and control techniques throughout the RDT&E cycle.

b. Major Commands:

(1) Each Major Command:

(a) Assures that operation and maintenance activities implement measures to prevent personnel exposure to RF radiation in excess of limits prescribed in this standard.

(b) Consults AFSC for guidance and assistance in resolving RF radiation personnel hazards.

(c) Consults AFCS to determine what measurement capabilities they can provide.

(2) AFLC, AFCS, AFSC and USAFE fulfill the following additional responsibilities:

(a) HQ AFLC. Assures that technical orders, handbooks, and similar publications contain those health precautions and procedures needed to prevent the exposure of USAF personnel to RF and associated X-ray radiation levels in excess of applicable limits.

(b) HQ AFCS:

1. Provides expert consultation on RF measurement techniques and, when directed by HQ USAF or upon request from a major command measurement survey services according to AFR 100-6, to include a site RFR hazard report.

2. Sends to AFMSC/SGPA Brooks AFB TX 78235, USAF OEHL, Brooks AFB TX 78235; and the Surgeon of the responsible major command, copies of reports on RF measurement surveys and consultations conducted at USAF installations.

(c) HQ AFSC:

1. Establishes, incorporates, and issues specifications and standards for research, development, and production of electronic equipment to assure that RF and associated X-ray radiation hazards to personnel are identified. Provides data and tech-

nical guidance to using commands and AFLC on RF and X-ray radiation hazards collected during equipment development and acquisition.

2. Conducts biomedical research requisite to establishing RF radiation personnel exposure limits.

3. Recommends to the Surgeon General, USAF, RF radiation personnel exposure limits.

(d) USAF Occupational and Environmental Health Laboratory and USAFE/SGP:

1. Maintain information on, and use consistent methods and techniques for, measuring and evaluating RF radiation levels of biological significance.

2. Maintains specialized measuring equipment necessary to monitor RF radiation emission, both for laboratory use and for loan to properly trained base bioenvironmental engineering personnel.

3. Maintains specialized X-ray radiation measuring equipment necessary to monitor X-rays emitted by electronic equipment.

4. When directed by AFMSC/SGPA or when requested by a major command according to AFR 161-17, conducts RF and X-ray radiation surveys at military installations; provides consultation necessary to determine the effectiveness of operating procedures designed to prevent hazardous exposure of personnel to RF and X-ray radiation emitted by the electronic equipment surveyed.

5. Sends AFMSC/SGPA an information copy of reports, studies, and other information relating to RF and X-ray radiation personnel hazard evaluations.

6. Maintains a repository on operational characteristics of RF emitters and suspected RF overexposure investigations (USAF OEHL only).

7. Acts as initial point of contact and lead agency for field inquiries or requests for Bioeffects (see paragraph A3b(2)(e)) and suspected overexposure consultations. Refers such requests to the appropriate USAFSAM division along with technical information (emitter characteristics, field measurements, etc.) required. Arranges for direct communication between the field and USAFSAM when appropriate (see paragraphs C.6.f., C.7.b) and accomplishes necessary AMD internal coordination prior to referral (USAF OEHL only).

(e) USAF School of Aerospace Medicine (USAFSAM). The USAFSAM, Brooks AFB TX 78235, provides bioeffects consultations, including ophthalmologic examination and medical prosthetic device interference evaluations and provides direct

consultation to field agencies upon referral from the USAF OEHL.

c. Commanders:

(1) Assure that users of electronic equipment that produces potentially hazardous levels of RF radiation implement procedures to protect personnel from the hazard.

(2) Ensure that all personnel working in areas having equipment capable of producing hazardous levels of RF radiation are familiar with the sources and types of radiation, operating procedures, and any precautions which have been recommended in radiation hazard survey reports.

(3) Permanently post areas containing biologically hazardous levels of RF radiation as recommended by the Bioenvironmental Engineer (BEE).

(4) Notify the BEE of each new operation, change in equipment, or equipment modification that could potentially cause hazardous RF radiation exposure conditions.

(5) Immediately notify the Director of Base Medical Services (DBMS) of any suspected personnel overexposure to RF radiation and assist the DBMS in evaluation of the incident and preparation of the investigation report.

d. Director of Base Medical Services (DBMS):

(1) Implements and conducts a medical program at base level designed to evaluate personnel RF radiation hazards and conducts medical examinations as required by this standard.

(2) Initiates an evaluation by the BEE of suspected overexposures and ensures the preparation of reports thereon for submission in accordance with paragraph C7 of this standard.

e. Bioenvironmental Engineering Service:

(1) Provides, or requests from OEHL or AFCS as appropriate (see paragraphs 4b(2)(b)1 and 4b(2)(d)4) consultations and surveys when notified of new operations, equipment changes, or equipment modifications which may alter the biological significance of the RF radiation environment, and on a periodic basis as prescribed by this standard. Provides results of these evaluations to the base OPR for RF electro-explosive devices and fuel hazards if appropriate.

(2) Identifies all areas where RF radiation levels exceed USAF personnel permissible exposure levels and advises the commander, consistent with the policies stated herein, on the need for permanently posting such areas. Recommends engineering controls if appropriate.

(3) Advises commanders on standard operating

procedures for the control of RF radiation personnel hazards.

(4) Evaluates suspected overexposures and prepares reports thereon for submission in accordance with paragraph C7 of this standard.

f. Environmental Medicine:

(1) Conducts physical examinations as required by this standard.

(2) Ensures that medical followup examinations specified by USAFSAM for persons identified as having been overexposed to RF radiation are accomplished; when such individuals are transferred, notifies the gaining medical facility that medical followup is required.

B. TERMS EXPLAINED

1. **Average Power.** The time average rate of energy transfer.

$$P_{avg} = \frac{1}{t_2 - t_1} \int_{t_1}^{t_2} P dt \quad \text{Where } P \text{ is the peak power as a function of time (t)}$$

2. **Permissible Exposure Level (PEL).** That exposure level expressed in power density to which an individual may be exposed which, in light of present medical knowledge, will not cause detectable bodily injury under the conditions of exposure.

3. **Power Density.** The power per unit area. It is normally expressed in milliWatts per square centimeter (mW/sq cm).

4. **Radiofrequency (RF) Radiation.** For purposes of this standard, electromagnetic radiation at frequencies between 10 KHz and 300 GHz.

5. **Cardiac Pacemaker Risk Distance.** The distance in meters beyond which cardiac pacemakers are not likely to miss more than 10 beats per minute.

6. A glossary of technical terms is provided as Appendix I to this standard.

C. REQUIREMENTS

1. Permissible Exposure Levels (PELs):

a. The biological effects of radiofrequency (RF) radiation on man depend on the frequency of the incident radiation field, the size and shape of the individual and the individual's ability to dissipate the absorbed energy via normal biological response. The PELs listed in table 1 are based on current knowledge of radiofrequency radiation effects.

b. Continuous personnel exposures shall not exceed an average power density of 10 mW/sq cm for frequencies between 10 MHz and 300 GHz, inclusive, or 50 mW/sq cm for frequencies between 10

KHz and 10 MHz. In any 6-minute period, the product of the power density times the exposure time shall not exceed 3600 mW-sec/sq cm for frequencies between 10 MHz and 300 GHz inclusive, or 18000 mW-sec/sq cm for frequencies between 10 KHz and 10 MHz. As long as the RF radiation levels do not exceed the respective PELs in any 6-minute period, personnel exposures can continue for an indefinite time. It is permissible to allow any personnel exposure that satisfies one of the two criteria given above, and in table 1. Unnecessary exposures are to be avoided. Exposures, when required, should be maintained as low as practical and in no case will exceed the PEL.

c. When evaluating RF radiation levels for comparison with PELs expressed in mW-sec/sq cm, extreme care must be taken in the selection of the 6-minute period on which calculations will be based. The period selected must be representative of the expected personnel exposure potential.

(d) Refer to Appendix III for example calculations.

2. **Protective Clothing.** RF protective garments will not be worn by individuals working in RF radiation fields without specific approval of AFMCS/SGPA.

3. Radiofrequency Hazard Warning Signs:

a. AF Forms 737 and 747, Warning RF Radiation Hazard, are the official AF Radio frequency Radiation Warning Signs. These signs are consistent with the occupational Health and Safety Administration Regulations Part 29 CFR 1910.97. These signs may be reproduced in any size required (see figure 1).

b. RF warning signs are required at any location where access to power density levels in excess of the PEL is probable. It is not probable to generalize regarding appropriate locations for or appropriate size of the sign as each installation must be evaluated on an individual basis.

Table 1. Permissible Exposure Levels (PEL) For Personnel.

For Frequencies between 10 KHz and < 10 MHz	For Frequencies between 10 MHz and 300 GHz Inclusive
50 mW/sq cm (For continuous exposures) OR	10 mW/sq cm (For continuous exposures) OR
18,000 mW-sec/sq cm (In any 6-minute period)	3600 mW-sec/sq cm (In any 6-minute period)

NOTE: All exposures shall be limited to a maximum (peak) E-Field of 100 KV/m

c. Ordinarily the Base Bioenvironmental Engineer (BEE) or persons considered qualified by the BEE will make the determination as to where and what size signs are required at a given facility. This determination will be made in conjunction with an appropriate representative of the organization responsible for the facility. It is the responsibility of the operating organization to procure and install the signs.

d. Do not post warning signs around microwave ovens.

e. Warning signs will not be posted at access routes to RF sources because of interference potential to medical prosthetic devices (pacemakers). See paragraph 8 of this Standard.

4. Base Program. Each base will organize and implement an RF personnel protection program under the general supervision of the Bioenvironmental Engineering Service acting for the DBMS. While each base program will have certain unique features, all should include the five fundamental aspects described in detail below:

a. Inventory:

(1) The inventory should include all RF emitters on or controlled by a given base, regardless of location. (For example, communications, navigational aid, traffic surveillance, meteorology, metrology, air borne systems, and medical devices.)

(2) For each emitter, the following information is necessary:

(a) Nomenclature and organization responsible for its use.

(b) Function of the emitter.

(c) Frequency or frequencies, antenna gain, maximum power generated, CW or pulsed, pulse repetition frequency and pulse width.

(d) Physical location of the emitter and building number where applicable. (A site plan or base map can be used to identify the location of all emitters.)

(e) Where multiple identical emitters are involved such as aircraft avionics systems, it is sufficient for the purposes of this inventory to maintain the characteristics of the emitters, and state where they are used and maintained. A serial number inventory and evaluation of each single emitter is not required. Representative numbers of emitters should be evaluated.

(f) Some data items or association of a specific system with a particular aircraft or application may be classified. Treat such data accordingly. Inventories should be maintained unclassified to the

maximum extent possible, with specific references to where required data are available.

b. Categorization. Upon inventory completion, a detailed categorization of each emitter must be made in order to identify those units which present a potential or actual problem. In many cases, after the emitter is categorized, it will be obvious that it is nonhazardous and requires no further attention. Two major categories are suggested:

(1) **Hazardous or Potentially Hazardous Emitters.** Determine which emitters are potentially capable of producing radiation levels in excess of the PEL. This determination should be made on the basis of applicable publications and, if needed, mathematical calculations or consultation with the appropriate activities. All systems in this category require an initial survey and periodic checks and surveys when appropriate.

(2) **Nonhazardous Emitters.** All other units in the inventory should be included in this category and no further action is required.

(3) It is realized that base personnel may not have sufficient information to categorize equipment according to hazard; therefore, if inventory lists are sent to the USAF OEHL, this service will be provided.

c. Survey. Once the emitter is properly categorized, those that require a survey will be obvious. Each such emitter must be completely surveyed once and an appropriate report prepared and permanently maintained by the Bioenvironmental Engineering Service. On a yearly basis, each emitter that has been surveyed should be checked to ensure signs are current and operating procedures adequately followed. Special cases:

(1) Microwave ovens in public or organizational service must be surveyed at least annually, using the instructions in appendix V. Record survey data on Public Health Service (PHS) Form 2536 (FD), Microwave Oven Field Test Record. Forward copies of Form 2536 (FD) within 10 days after the survey is performed in accordance with appendix V. The standard for microwave oven leakage has been established by the BRH, for ovens manufactured after October 1971, to be no more than 5 mW/sq cm during the lifetime of the oven when measured 5 cm from any surface. Any oven, regardless of their manufacture date, exceeding this limit will be repaired or removed from service. The primary purpose of this survey is protection of personnel and assurance of proper oven maintenance, not enforcement of compliance by manufacturers with ERH standards. Access to ovens for a compliance evaluation by FDA regions should be provided if requested.

(2) Diathermy units will be surveyed as available field survey instrumentation allows to identify operator hazards, if any, and appropriate guidance to prevent operator exposure in excess of the applicable PEL will be posted on or near the diathermy unit.

(3) Airborne Equipment. Once an emitter has been adequately surveyed, periodic checks on procedures and personnel discipline are more important than resurveying the equipment, provided no changes or modifications in the equipment are made.

(4) Repair, maintenance, test facilities:

(a) These facilities have a significant potential for overexposure of personnel because of the great variety of tasks assigned, the proximity of personnel to the equipment, and operational pressures attending the need for rapid repair of equipment.

(b) Visits to these facilities must be made once per quarter. More frequent visits may be indicated based on the established hazard potential.

d. Review of Inventory Additions or Changes.

The inventory of RF radiation sources of any base is a dynamic list, and perhaps the most important portion of any base program is for medical personnel to keep abreast of these changes. Equipment is constantly being modified or upgraded, and each such change may give cause for a complete resurvey. One of the greatest opportunities for overexposure of personnel is during repair, maintenance, and equipment change programs. Medical personnel will maintain a close working relationship with all base units responsible for operation and repair of RF-emitting equipment. All modifications and additions of emitters will be coordinated with the base BEE to ensure procedural safety and categorization action. Further, prior to construction, new facilities on a base must be evaluated in light of their proximity to RF emitters and any potential hazard fully analyzed.

e. Periodic Checks and/or Resurveys:

(1) Annually. Microwave ovens.

(2) Every year. Ground-base RF emitters.

(3) Quarterly—maintenance shops, repair and test facilities, and flightline activities.

5. Reports. A narrative report must be prepared by the Bioenvironmental Engineer Service on all inventories and surveys of RF emitters except microwave ovens. Maintenance and distribution of the reports will be made according to AFR 161-33, paragraph 4-9. PHS form 2536 (FD) provides adequate documentation for oven surveys. The following is a

suggested list of information to be included in the report:

a. Name, location, and telephone number of responsible organization.

b. Primary responsible individuals contacted.

c. Location of RF device.

d. Nomenclature, manufacturer, model number, and serial number of RF device.

e. RF device operating parameters: frequency, antenna gain, pulse repetition frequency, operation time per 24 hours, etc.

f. Functional category: food processing, radar, communications, navigational aid, traffic surveillance, meteorology, metrology, medical, other (specify).

g. Hazard classification: hazardous or non-hazardous.

h. Survey information: survey meter type, serial number, probe serial number, last calibration data, survey data including PEL isodose contour plot superimposed on plane view of the installation.

i. Safety control procedures: written and adequate SOP; signs, warning lights, and barriers adequate; personnel aware of RF hazards; dummy loads used.

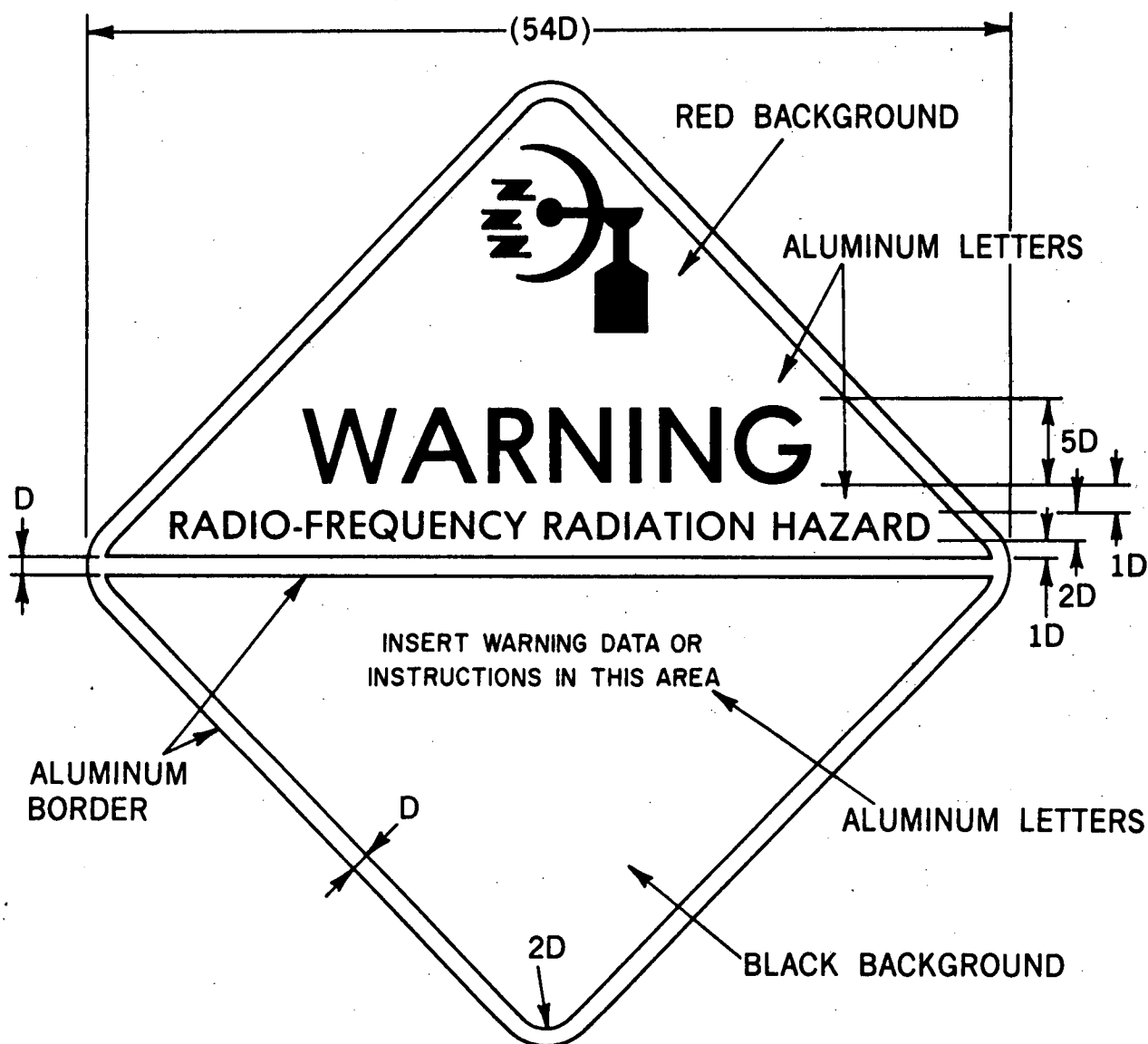
j. Name of surveyor.

6. Medical Investigation of Incidents and Accidents:

a. It is essential that every suspected or actual overexposure to RF radiation be thoroughly investigated and evidence of injury or absence of injury thoroughly documented. Of near equal importance is the need for the findings of each investigation to be collected in a single case report for retention as a permanent record of the event. Exposure records are essential for long-term epidemiological and clinical followup studies which may be conducted by the medical service and for medicolegal purposes.

b. Whenever a suspected overexposure to RF radiation occurs, the local Director of Base Medical Services must initiate an investigation of the event. The organization responsible for the equipment at the time of the event, or any individual having knowledge of the event, is required to report the event to the base medical service.

c. Personnel who may have been overexposed should be evaluated as prescribed by paragraph 7b of this standard. The evaluation should be made at the nearest USAF medical facility as soon as practical after the event. In all cases, a detailed history



1. Place handling and mounting instructions on reverse side.
2. D - Scaling unit.
3. Lettering: Ratio of letter height to thickness of letter lines.

Upper triangle:	5 to 1	Large
	6 to 1	Medium
Lower triangle:	4 to 1	Small
	6 to 1	Medium
4. Symbol is square, triangles are right-angle isosceles.

Figure 1. Radiofrequency Radiation Hazard Warning Symbol (AF Forms 737 and 747.)

of the event must be recorded in the individual(s) AF Form 2100 series, Treatment Record, on AF Form 190, Toxicological Exposure Incident/Occupational Illness Report.

d. Upon notification of a suspected overexposure, the Base/Attending Bioenvironmental Engineer will immediately go to the organization responsible for the equipment at the time of the event, and determine:

- (1) Type of RF emitter and nomenclature.
- (2) Organization responsible for operation of the unit.
- (3) Frequency being emitted at time of overexposure.
- (4) Mode of operation—pulsed versus continuous wave.
- (5) Peak power and average power at time of event.
- (6) Gain and sweep characteristics of antenna.
- (7) Beam width, azimuth, and elevation.

e. The engineer will then call the USAF OEHL to advise them of the suspected overexposure and obtain consultation as required. During duty hours contact OEHL/CC, AUTOVON 240-2001, after duty hours contact the Brooks AFB Command Post through the Brooks AFB operator and ask for the USAF OEHL duty officer.

f. Upon completion of the medical and equipment evaluations, it is essential that the event be reconstructed if possible and measurements made to determine the exposure to the individual(s). These measurements should be accomplished with the individual(s) present (if possible), so that the exact conditions of the exposure can be duplicated. Care must be taken to ensure that the equipment used to measure exposure is appropriate for the task and calibrated (calibration statement and details to be included in report) and that individuals making these measurements are not exposed in excess of the PELs.

g. If after investigation of the accident, measurements and other factors indicate that the individual(s) exposure dose exceeded the PELs provided in table 1, the BEE will contact the USAF OEHL who will arrange for appropriate consultation with USAFSAM (see paragraph A4b(2)(d)7). The following considerations will be addressed during the consult:

- (1) Need for long term followup examination/evaluation.
- (2) Need for a more comprehensive evaluation

than that performed under paragraph C.7.b of this standard.

(3) Arrangements for performing the evaluation if it is required.

(4) Consultations provided by USAFSAM will include a statement that followup medical examinations are or are not required; what such examinations are to consist of; whether the followup is to be done locally or at USAFSAM; and the frequency at which examinations are to be made.

h. Within 30 days after the suspected or actual exposure investigation has been completed, the responsible medical organization will forward a narrative report to the MAJCOM Surgeons Office (SGP) on AF Form 190, Toxicological Exposure Incident/Occupational Illness Report containing at least the following information:

- (1) Date, time, place of event.
- (2) Name, organization, address, and AUTOVON number of investigating officer.
- (3) Narrative description of exactly what happened.
- (4) Copy of medical evaluation.
- (5) Copy of equipment evaluation.
- (6) Exposure estimates, as determined during the reconstruction of the event; also list instruments used for measurements and calibration data.
- (7) Copy of any consultation reports such as may have been prepared by USAFSAM.

i. In addition to major command requirements, one copy will be forwarded to each of the following: USAF OEHL Brooks AFB TX 78235 for retention in an accident/incident investigation data repository; AFMSC/SGPA, USAFAM/RZP, Brooks AFB, TX 78235. One copy will also be placed in the individuals medical record (AF Form 2100 series).

7. Medical Examinations.

a. Routine, pre or post employment medical examinations are not indicated for personnel occupationally exposed to RF radiation.

b. In the event of confirmed or likely instance of an overexposure to an individual, a physician will review the individual's medical history and perform such examination as is indicated by clinical symptoms. Other studies may be performed as deemed appropriate by the examining medical officer after consultation with USAFSAM. Such consultation will be arranged by the USAF OEHL (See paragraph A4b(2)(d)7). If detailed studies/examinations are indicated, USAFSAM will arrange with