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PERSONNEL IONIZING RADIATION DOSIMETRY

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This manual implements Air Force Policy Directive (AFPD) 48-1, *Aerospace & Operational Medicine Enterprise* and Air Force Manual (AFMAN) 48-148, *Ionizing Radiation Protection*. It establishes and describes the Department of the Air Force (DAF) personnel ionizing radiation dosimetry program. This instruction applies to all DAF personnel including uniformed members of the Regular Air Force, Air Force Reserve, and Air National Guard. The requirements in this manual do not apply to government contractors, or government contractor-hired subcontractor employees, except as otherwise specified in the applicable government contract. This manual requires the collection and/or maintenance of information protected by the Privacy Act of 1974 authorized by Title 10 United States Code (U.S.C.), Section 9013, *Secretary of the Air Force*, and DoD Manual (DoDM) 6025.18, *Implementation of the Health Insurance Portability and Accountability Act (HIPAA) Privacy Rule in DoD Health Care Programs*. The applicable system of records notice (SORN) F044 AF SG O, *United States Air Force Master Radiation Exposure Registry* is available at: **http://dpclo.defense.gov/Privacy/SORNs.aspx**. The authority to collect and or maintain the records prescribed in this publication is Department of Defense Instruction (DoDI) 6055.08, *Occupational Ionizing Radiation Protection Program*. Ensure all records created as a result of processes prescribed in this publication are maintained in accordance with Air Force Instruction (AFI) 33-322, *Records Management and Information Governance Program*, and disposed of in accordance with the Air Force Records Disposition Schedule located in the Air Force Records Information Management System. Refer recommended changes and questions about this publication to the office of primary responsibility (OPR) using the AF Form 847, *Recommendation for Change of Publication*; route AF Forms 847 from the field through the appropriate chain of command. This publication may be supplemented at any level,

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SUMMARY OF CHANGES

This document now reflects administrative doses will only be assigned at request of the installation. The term thermoluminescent dosimeter was replaced by dosimeter throughout the document to account for new technologies. Minor administrative changes were made as necessary throughout the document.

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Chapter 1

INTRODUCTION

1.1. Overview. The personnel ionizing radiation dosimetry program provides a standard process for monitoring DAF personnel who are subject to occupational exposure to radiation. This manual provides detailed guidance for the program to include overarching responsibilities, procedures for managing an installation level dosimetry program, a description of Air Force (AF) dosimeters, procedures for monitoring under various circumstances, and instruction regarding the AF's Master Radiation Exposure Registry (MRER).

1.2. Purpose. The purpose of the dosimetry program is to ensure personnel who are subject to occupational exposure to ionizing radiation are monitored in accordance with DoDI 6055.08. The 711th Human Performance Wing (711 HPW) maintains permanently all dosimetry program monitoring results in the AF MRER.

1.3. Program Eligibility. Personnel eligible to participate in this program include:

1.3.1. Military and civilian DAF, Air Force Reserve and Air National Guard occupational radiation workers. These individuals are designated for dosimetry monitoring by the installation radiation safety officer (IRSO). The DAF may provide contractor personnel dosimetry services if the contract states these services will be provided.

1.3.2. Military and civilian occupational radiation workers of other Department of Defense (DoD) agencies. The AF MRER may store all personnel-monitoring results for workers of other DoD agencies consistent with the terms of applicable agreements between USAF School of Aerospace Medicine (USAFSAM) and the radiation dosimetry centers of those other DoD Services or agencies.

1.3.3. Occupational radiation workers employed by federal, state, or local government agencies outside DoD. These individuals may receive personnel monitoring from USAFSAM on a fee-for-services basis if permitted by and consistent with the terms of agreements between USAFSAM and their agency radiation safety office.

1.3.4. Government contractors, or government contractor-hired subcontractor employees only if specified in the applicable government contract. **Note:** Government contractors remain expressly responsible for providing adequate radiation dosimetry protection for their employees as required by applicable Occupational Safety and Health Administration, Nuclear Regulatory Commission (NRC), state regulations, as well as NRC and state-issued permits. The AF, consistent with AFMAN 40-201, *Radioactive Materials Management*, and AFMAN 48-148 policy implementation, is authorized to share ionizing radiation data with government contractors to assist them in meeting their contractual and regulatory obligations to their employees.

1.4. Overview of Routine Operations.

1.4.1. Management and enrollment. The dosimetry program is operated at the base level by the IRSO and may be assisted by a designated dosimetry program monitor. The dosimetry program monitor is usually a bioenvironmental engineering technician (AF Specialty Code 4B0X1) or an IRSO qualified civilian employee. The IRSO identifies personnel to be

monitored and the frequency of the monitoring. While some personnel receive dosimetry at the assessment of the IRSO, others must receive dosimetry. See AFMAN 48-148, AFMAN 40-201, and AFI 91-108, *Air Force Nuclear Weapons Intrinsic Radiation and 91(B) Radioactive Material Safety Program*.

1.4.2. Monitoring areas and installation codes. The IRSO assigns workers into similar exposure groups, which are known as "areas", and designates a letter to denote this group of collective workers. The IRSO provides this information to USAFSAM. Each installation is assigned a unique code used to identify that base in all dosimetry program records. Installation radiation safety program management personnel register individuals into the program using their base's code.

1.4.3. Dosimetry issuance, exchange, and reporting. USAFSAM separates each base dosimeter issue into the designated monitoring areas and issues dosimeters for the monitoring to meet the monitoring frequency requirements specified by the IRSO. At the end of the monitoring period, the dosimetry monitor retrieves issued dosimeters and returns them to USAFSAM for processing. The dosimetry monitor issues new dosimeters as needed for continued monitoring, usually at the same time as retrieval. After processing, USAFSAM forwards dose equivalent reports to the IRSO. The IRSO confirms that values reported are appropriate for the individual and the monitoring period; and uses the data to manage the installation-level radiation safety program. This cycle is repeated until the IRSO removes the individuals from the program, cancels monitoring for that area, or the individual leaves the work area through a permanent change of station, permanent change of assignment, separation, or retirement.

1.5. Non-routine Operations. In general, the processes and procedures in this manual are used for all radiation related contingencies, emergencies, and weapons of mass destruction response actions. Use of electronic personal dosimeters (EPDs) is incorporated in installation response plans.

Chapter 2

ROLES AND RESPONSIBILITIES

2.1. The Air Force Surgeon General (AF/SG). Provides guidance for operating the dosimetry program and ensures the program complies with federal rules and regulations, DoD, DAF, and AF policy, emergency response requirements, military deployment requirements and accepted scientific practice.

2.2. The Commander, Air Force Materiel Command (AFMC/CC). Implements the dosimetry program through the command surgeon (AFMC/SG).

2.3. The Commander, 711th Human Performance Wing (711 HPW/CC). Provides and maintains the facilities and personnel to conduct external dosimetry, bioassay analyses, and internal dose calculations.

2.4. The Commander, USAF School of Aerospace Medicine (USAFSAM) shall:

2.4.1. Establish and maintain accreditation for the dosimetry program through the National Voluntary Laboratory Accreditation Program administered by the National Institute of Standards and Technology in the following categories at a minimum **(T-0)**:

2.4.1.1. Whole Body Dosimeters. Must be able to process low and high-energy photons (protection and accident ranges), beta particles, and mixtures in accordance with performance test categories I-IV of American National Standards Institute (ANSI)/Health Physics Society (HPS) N13.11-2009, *Personnel Dosimetry Performance-Criteria for Testing*. **(T-1).**

2.4.1.2. Extremity Dosimeters. Must be able to process low and high-energy photons, beta particles in accordance with performance test categories IIB, IIIB, and IVBB of ANSI/HPS N13.32-2008, *Performance Testing of Extremity Dosimeters*. **(T-1).**

2.4.1.3. Whole Body Neutron Dosimeters. Must be able to process low and high-energy photons and neutrons in accordance with performance test categories II and V of ANSI/HPS N13.11-2009. **(T-1).**

2.4.2. Establish and maintain a program for indirect radiobioassay (in-vitro) in accordance with ANSI/HPS N13.30-2011, *Performance Criteria for Radiobioassay*. **(T-1).** Establish and maintain comprehensive radioanalytical capability necessary to assess potential internal deposition of radioactive material. **(T-1).** Ensure bioassay analysis, dose assessment, and entry of dose of record into MRER. **(T-1).**

2.4.3. Provide, process and analyze National Voluntary Laboratory Accreditation Program accredited dosimeters and EPDs for external monitoring of personnel identified by the IRSO meeting the criteria in AFMAN 48-148. **(T-1).**

2.4.4. Prepare and provide reports, listings or other necessary documentation to ensure the IRSO has information necessary to effectively administer the installation-level program. **(T-1).**

2.4.5. Provide 24-hour per day on-call technical and consultative assistance, via the Environmental, Safety, and Occupational Health (ESOH) service center, to the IRSO, or

other individuals, as appropriate, on internal and external radiation dosimetry and program operations. **(T-3).**

2.4.6. Ensure the MRER incorporates all internal and external dosimetry results. **(T-0).**

2.4.7. Brief the AF Radioisotope Committee quarterly on dosimetry data pertaining to permitted radioactive material on program status and statistical trends for the previous quarter. **(T-1).** Provide a briefing to the AF Radioisotope Committee at the 2nd quarter meeting which details program status and historical trend analysis covering the previous five calendar years. **(T-1).**

2.4.8. Brief the AF Radiation Safety Committee semi-annually on all dosimetry data, program status, and statistical trends for the previous half of the calendar year. **(T-1).** Provide a briefing to the AF Radiation Safety Committee at the 2nd semi-annual meeting which details program status and historical trend analysis covering the previous five calendar years. **(T-1).**

2.4.9. Permanently maintain records of all dosimetry, internal and external, for individuals entered into the dosimetry program database, currently the MRER, when available. **(T-0).** Records will also include negative and positive results of bioassays, administrative dose assignments (including copies of documents supporting dose assignments and historical information for veterans), and supplementary occupational dose equivalent information (e.g., dosimetry information resulting from off-duty employment). **(T-1).**

2.4.10. Ensure recordings of non-occupational radiation doses are differentiated from occupational radiation doses via database codes and/or fields. **(T-1).**

2.4.11. Refer radon issues and inquiries to the appropriate OPR as outlined in AFMAN 48-148. **(T-3).**

2.4.12. Provide notice to base IRSO whenever changes to procedures, algorithms, or analytical methods result in changes to baseline results or impact data quality. **(T-2).**

2.4.13. Provide monitoring support for U-2 flight operations:

2.4.13.1. Provide calibrated Mark N2 EPDs to all required IRSOs on a quarterly basis. **(T-1).**

2.4.13.2. Ensure that the demographical information for each pilot is correctly captured, and dose of all Mark N2 EPDs are read and assigned. **(T-1).**

2.4.13.3. Ensure that all dose records are entered into the MRER in accordance with established and accredited procedures (or from other AF Radiation Safety Committee-approved dose calculation methods). **(T-1).**

2.5. The Medical Treatment Facility Commander/Director (or equivalent) shall:

2.5.1. Ensure medical evaluation and appropriate testing for a potential radiation overexposure. **(T-1).**

2.5.2. Ensure declared-pregnant individuals in potential occupational radiation exposure environments are referred to the IRSO for enrollment in the dosimetry program on a monthly monitoring frequency. **(T-1).**

2.5.3. Ensure dosimetry records and bioassay results are entered into the individual participant's medical record. **(T-1). Note**: Effective 1 October 2018, the Director of the Defense Health Agency is responsible for the administration of medical treatment facilities, in accordance with Title 10 United States Code **Section 1073C**, *Administration of Defense Health Agency and Military Medical Treatment Facilities*. All personnel should consult the medical treatment facility commander or director for related guidance.

2.6. The IRSO shall:

2.6.1. Conduct the dosimetry program at base level per AFMAN 48-148. **(T-1). Note**: In some cases program management may be assigned to other offices and individuals depending on the organizational structure and the availability of suitable radiation expertise. **(T-1).**

2.6.2. Determine whether individuals meet one of the eligibilities outlined in **Paragraph 1.3** **(T-1).**

2.6.3. Determine the type of external monitoring required (e.g., body, head, extremity, beta, gamma, neutron), the length of the monitoring period, and the type and scope of any bioassay procedures (e.g., urine sampling, fecal sampling). **(T-1).**

2.6.4. Request records of an individual's prior occupational radiation dose in accordance with Title 10, Code of Federal Regulations (CFR), Part 20, *Standards for Protection Against Radiation*, at the time an individual registers in the dosimetry program. **(T-1).** If the individual's records are unattainable via request, the IRSO shall obtain them in another manner prescribed by 10 CFR Part 20. **(T-0).**

2.6.5. Upon referral from Public Health for declared-pregnant individuals:

2.6.5.1. Conduct workplace evaluation and exposure assessment. **(T-1).**

2.6.5.2. Notify Public Health of the scope of the radiation hazard and any recommended duty restrictions. **(T-1).**

2.6.5.3. Enroll declared-pregnant individuals into the dosimetry program and place on a monthly monitoring schedule. **(T-1).**

2.6.6. Brief personnel enrolling in the dosimetry program on the following (per USAFSAM guidance):

2.6.6.1. Proper wear and storage of dosimeters. **(T-1).**

2.6.6.2. Procedures for collecting any required bioassay samples. **(T-1).**

2.6.6.3. Hazards associated with ionizing radiation and methods to keep their exposure as low as is reasonably achievable (ALARA). **(T-1).**

2.6.6.4. Additional briefing requirements for female radiation workers:

2.6.6.4.1. Hazards associated with exposure to ionizing radiation during pregnancy. **(T-1).**

2.6.6.4.2. Their responsibility to report to Public Health as soon as possible following confirmation of pregnancy. **(T-1).**

2.6.7. Ensure personnel are informed of the requirement to provide IRSO copies of results of any monitoring (e.g., dosimetry device or bioassay) performed by organizations other than USAFSAM. **(T-1).** The IRSO will forward copies to USAFSAM. **(T-1).**

2.6.8. Establish a program for monitoring visitors. **(T-1).**

2.6.9. Report and investigate abnormal exposures and overexposures in accordance with **Chapter 8** and **Chapter 9** of this manual. **(T-1).**

2.6.10. Request priority processing from USAFSAM for dosimeters issued to pregnant individuals or used in planned special exposures. **(T-1).**

2.6.11. Maintain and review forms and listings received from USAFSAM to ensure accuracy and completeness and promptly notify USAFSAM of any required changes. **(T-1).**

2.6.12. Provide and review a copy of USAFSAM Form 1527-1, *Annual Occupational Dose Record.*, to each person upon demand and as otherwise required by DoDI 6055.08 **(T-0).**; ensure all other monitored personnel also receive a copy of USAFSAM Form 1527-1. **(T-1).**

2.6.13. Serve as the OPR for all contingency EPDs on the installation. **(T-3).** Will collect and ensure that all contingency EPDs are submitted to USAFSAM for annual performance verification. **(T-1).** The IRSO will maintain all EPD readers on the installation. **(T-3).**

2.6.14. Ensure first responders are knowledgeable of dose guidance in AFMAN 48-148. **(T-3).**

2.6.15. Notify USAFSAM of each U-2 pilot attached to IRSO's installation who requires quarterly monitoring utilizing a Mark N2 EPD and provide dosimetry support. **(T-1).**

2.6.16. Review all records associated with the dosimetry program and report any corrections to USAFSAM via the Radiation Dosimetry Web (**https://hpws.afrl.af.mil/dhp/OE/RADDOS/**), or via written correspondence when the Radiation Dosimetry Web is unavailable. **(T-1). Note**: Correction of individual dose data in the MRER will only be made upon receipt of written request signed by the individual or after the IRSO submits the request using the secure website. **(T-1).**

2.6.17. Approve dosimeter storage locations and maintain the installation's control badge(s) in an appropriate location. **(T-3).**

2.6.18. Appoint a dosimetry program monitor, if desired, for administrative tasks only. **(T-3).**

2.6.19. Establish an investigation action level for each monitoring area in accordance with AFMAN 48-148. **(T-1).** Conduct these investigations internally to manage potential adverse trends. **(T-1). Note**: Such an investigation generally includes a review of the circumstances associated with the apparently elevated internal or external personnel dose equivalent, assessment of the consequences and mitigation or prevention of such a personnel dose equivalent of similar magnitude in the future. The IRSO may use abnormal exposure investigation outlined in **Chapter 8** as a guide. An investigation action level is generally set at 10% of the monitoring period's limit, but is at the discretion of the IRSO and/or Radiation Safety Committee as applicable.

2.6.20. Ensure issued dosimeters are returned to USAFSAM within ten duty days after the end of each monitoring period. **(T-2).**

2.7. The Public Health Office. Prepares pregnancy profiles based upon physician recommendations and IRSO occupational and environmental health risk assessment (including radiation exposures).

2.8. The Physiological Support Squadron for U-2 monitoring shall:

2.8.1. Coordinate with IRSO on dosimetry requirements. **(T-1).**

2.8.2. Ensure the EPD Mark N2 assigned to a given pilot is powered "ON" and that the battery is viable prior to placing the device within the cockpit for each sortie. **(T-2).**

2.8.3. Secure the EPD Mark N2 within the cockpit in a manner that will not impair flight operations nor pose a health and safety risk to the pilot. **(T-2).** The EPD Mark N2 does NOT have to be affixed/secured to the pilot.

2.8.4. Be responsible for post sortie removal of the EPD Mark N2 from its storage location within the cockpit and for turning the unit "OFF." **(T-2). Note**: This includes removing the battery if an alkaline AA was used.

2.9. The Unit Commander, with Individuals in the Dosimetry Program, shall:

2.9.1. Ensure implementation of all requirements in this manual. **(T-1).**

2.9.2. Ensure engineering and/or administrative controls are in place and used to limit all personnel exposures to below established limits and are ALARA. **(T-1).**

2.10. The Supervisor of Individuals in the Dosimetry Program shall:

2.10.1. Ensure engineering and/or administrative controls are in place and used to limit all personnel exposures to below established limits and are ALARA. **(T-1).**

2.10.2. Ensure dosimeters are properly worn and handled, and secured when not in use. **(T-1).**

2.10.3. Refer newly assigned personnel and visitors who will enter into an area requiring dosimetry to the IRSO for entry into the dosimetry program prior to starting work involving occupational exposure to ionizing radiation. **(T-1).**

2.10.4. As notified, refer pregnant military personnel and declared-pregnant civilian personnel to Public Health for establishment of a pregnancy profile, which includes any work restrictions, and to the IRSO for placement into the monthly monitoring program. **(T-1).**

2.10.5. Review the current Radiation Dosimetry Laboratory (RDL) Listing 1499-1, *Occupational Dose Record for a Monitoring Period*, and associated IRSO comments and take necessary action to address errors or possible adverse trends. **(T-1).**

2.10.6. Maintain RDL Listing 1499-1 and provide dosimetry results to personnel upon request. **(T-3). Note**: Supervisor should maintain forms until the IRSO has distributed the USAFSAM Form 1527-1.

2.10.7. Cooperate in the assessment of assigned administrative doses due to lost, stolen, destroyed, or otherwise unaccountable personnel dosimeters. **(T-1).**

2.11. The Individual Participants in the Dosimetry Program shall:

2.11.1. Follow engineering and/or administrative controls to limit all personnel exposures below established limits and ensure all personnel exposures are ALARA. **(T-1).**

2.11.2. Provide the IRSO with all relevant personal dosimetry information. **(T-1).** Such information includes, but is not limited to, listing current or prior history of occupational radiation exposure.

2.11.3. Review dosimetry results (provided by supervisor/IRSO) promptly upon receipt and report any errors noted to the IRSO. **(T-1).** Provide any corrections in writing to USAFSAM, through the installation IRSO. **(T-1).**

2.11.4. Comply with any requirements for bioassay sample collection. **(T-1).**

2.11.5. Cooperate in the assessment of assigned administrative doses due to lost, stolen, destroyed, or otherwise unaccounted for personnel dosimeters. **(T-1).**

2.11.6. Notification of Pregnancy:

2.11.6.1. Military members will notify their workplace supervisor or primary care manager upon becoming aware of the pregnancy**. (T-1).**

2.11.6.2. Non-military individuals may voluntarily notify their workplace supervisor or primary care manager of pregnancy to ensure the safety of the fetus. **Note**: A non-military member's decision to declare a pregnancy is entirely voluntary. It is the fundamental responsibility of the pregnant non-military individual to decide when and if to formally declare the pregnancy via a signed letter. If not already enrolled in a monitoring program, the declared pregnant non-military individual may request to be enrolled in the dosimetry program.

2.11.7. Properly use issued dosimeters per instructions provided by the IRSO and in this manual. **(T-1).** Disciplinary action may result for anyone who willfully engages in deliberate exposure, destruction, contamination, falsification or tampering with dosimeters, bioassay samples, or records of dosimetry results.

Chapter 3

PROCEDURES FOR AIR FORCE DOSIMETERS

3.1. Air Force Dosimeters. All monitored personnel must wear USAF School of Aerospace Medicine (USAFSAM) approved and calibrated dosimeters. **(T-1).**

3.2. Electronic Personal Dosimeter (EPD) Use for Contingency Operations. As part of the dosimetry program, USAFSAM maintains a stockpile of EPDs that can be provided to support a surge in demand during a radiological response operation.

3.2.1. The IRSO will determine the number of personnel that must be monitored utilizing EPDs during a radiological response operation. **(T-1).**

3.2.2. The IRSO must determine whether personnel monitoring can be accomplished with the available EPD inventory. **(T-1).**

3.2.3. The IRSO will determine the minimum number of EPDs required to augment the available inventory based on the number of personnel to be monitored, the monitoring period/frequency, and currently available EPD inventory. **(T-1).**

3.2.4. The IRSO will submit, with a courtesy copy to IRSO's respective major command (MAJCOM) bioenvironmental engineering, an official request for additional EPDs to the ESOH service center including the EPD analysis. **(T-3).**

3.2.5. The ESOH service center technician will relay the request to the AF radiation dosimetry program director or the dosimetry laboratory technical director for processing. **(T-3).** The dosimetry lab will adjudicate all requests within 24 hours of notification and send EPDs as quickly as possible. **(T-3).**

3.2.6. The AF Personnel Ionizing Radiation Dosimetry Program will provide a means for the return shipment of the devices once the operation is complete. **(T-3).**

3.3. Electronic Personal Dosimeter (EPD) and Dose of Record. EPDs read for dose at the installation level may be included within the AF Master Radiation Exposure Registry (MRER) and be covered by the AF's accreditation from the National Voluntary Laboratory Accreditation Program, providing the following are met:

3.3.1. The EPD must have a valid performance verification conducted by the AF Radiation Dosimetry Laboratory. **(T-0).**

3.3.2. The EPD is "read" and "zeroed" prior to being issued to another individual.

3.3.3. The IRSO or designee must complete and sign the Electronic Personal Dosimeter Dose Processing Worksheet (EPDDPW) and submit same to the AF Personnel Ionizing Radiation Dosimetry Program. **(T-3). Note**: This form is not meant to replace the procedure established for assigned doses. If an IRSO wishes to assign a dose to monitored personnel utilizing dose information from an EPD those may still be submitted through the Radiation Dosimetry Web application.

3.3.4. The EPDDPW is an interactive Adobe Acrobat form that allows the IRSO or designee to complete and digitally sign the document from an AF computer. The customer clicks on each field to provide the required information. All fields outlined in red are mandatory. An

IRSO signature is required on each form. Failure to provide signed forms to the AF dosimetry laboratory may prevent/delay processing of the doses into the MRER. Contact USAFSAM ESOH service center for a copy of the EPDDPW.

Chapter 4

CONDUCTING AN INSTALLATION-LEVEL DOSIMETRY PROGRAM

4.1. Monitoring Criteria. Eligible persons, as described in **Paragraph 1.3** of this manual, are enrolled in the dosimetry program based on criteria and requirements outlined in AFMAN 48-148. In addition, personnel may be monitored if the IRSO determines that any of the following apply:

4.1.1. The type of radiation to which the individual could be exposed is detectable by personnel monitoring equipment.

4.1.2. Provision of monitoring services would be helpful in demonstrating compliance with ALARA.

4.1.3. Monitoring is desirable to evaluate potential exposure conditions to allay concern.

4.2. Monitoring Period.

4.2.1. Most personnel enrolled in the dosimetry program have dosimeters that are exchanged quarterly. Factors necessitating more frequent exchange, e.g., monthly exchange, might include prior exposure history of the unit for individuals performing similar duties, prior exposure history of the individual beginning work as an occupational radiation worker, the potential for accumulating radiation doses at a high or irregular rate, training of individuals, etc. The appropriate exchange frequency for personnel dosimeters is determined by the IRSO.

4.2.2. Normal Exchange Frequency.

4.2.2.1. Most occupational radiation exposure circumstances encountered within the AF can be adequately monitored by using dosimeters exchanged on a quarterly basis.

4.2.2.2. Monitoring at shorter frequencies (e.g., monthly) may be appropriate under special circumstances, as detailed below:

4.2.2.2.1. Occupational radiation workers who have declared their pregnancy (see definition of declared pregnant individuals for clarification) will be monitored monthly (see **Chapter 6**). **(T-1).**

4.2.2.2.2. Certain operations having an exceptionally high radiation exposure potential; e.g., greater than 12.5 milliSievert (mSv) [1.25 Roentgen Equivalent Man (rem)] per quarter may necessitate a monthly exchange frequency.

4.3. Determining Prior Occupational Dose.

4.3.1. In accordance with AFMAN 48-148 and 10 CFR Part 20, individuals enrolled in personnel monitoring programs should provide information regarding their current and past history of occupational radiation exposure at the time of enrollment.

4.3.2. For each individual who is likely to receive, in a year, an occupational dose requiring monitoring, the IRSO shall:

4.3.2.1. Request the records of the occupational internal and external radiation dose that the individual received during the current year. **(T-1).**

4.3.2.2. Attempt to obtain the records of cumulative occupational radiation dose. **(T-1).**

4.3.3. In complying with the requirements of **Paragraph 4.3.2**, the IRSO may:

4.3.3.1. Accept, as a record of the occupational dose that the individual received during the current year, a written signed statement from the individual, or from the individual's most recent employer for work involving radiation exposure, that discloses the nature and amount of any occupational dose the individual may have received during the current year or

4.3.3.2. Accept, as a record of the cumulative radiation dose, an up-to-date USAFSAM Form 1527-2, *Cumulative Occupational Dose History,* obtained from USAFSAM if the individual certifies by signature that the USAFSAM Form 1527-2 contains the complete radiation exposure history records or

4.3.3.3. Accept, as a record of the cumulative radiation dose, an up-to-date Nuclear Regulatory Commission (NRC) Form 4, *Cumulative Occupational Dose History*, or equivalent, signed by the individual and countersigned by an appropriate official (along with office/title of responsibility: radiation safety officer (RSO), supervisor, contract monitor, etc.) of the most recent employer for work involving radiation exposure, or the individual's current employer; and

4.3.3.4. Obtain reports of the individual's dose equivalents from the most recent former employer for work involving radiation exposure or the individual's current employer by telephone, electronic media, or letter. Written verification of dose data will be requested if the authenticity of the transmitted report cannot be established. **(T-0).**

4.3.4. The IRSO, as required by this chapter, shall take into account an individual's prior exposure history and ensure any additional occupational radiation exposure received as a result of AF or concurrent off-duty employment (moonlighting) operations does not exceed allowable occupational exposure limits as specified in DoDI 6055.08. **(T-0).** Individuals, whose prior exposure history exceeds allowable occupational exposure limits for the current calendar year either as a result of AF or concurrent off-duty employment moonlighting activities, will be immediately removed from all duties involving occupational radiation exposure. **(T-0).** Continued exposure monitoring is not thereafter required.

4.3.5. If the IRSO is unable to obtain a complete record of an individual's current and previously accumulated occupational doses, when establishing administrative controls for the calendar current year, the IRSO shall assume:

4.3.5.1. That the allowable dose limit for the individual is reduced by 12.5 mSv (1.25 rem) for each quarter records were unavailable and the individual was engaged in activities that could have resulted in occupational radiation exposure; **(T-0)** and

4.3.5.2. That the individual is not available for planned special exposures. **(T-0).**

4.4. Exposures Incurred during Secondary Employment.

4.4.1. AF occupationally exposed individuals, monitored under the dosimetry program, are prohibited from exceeding the dose limits specified in DoDI 6055.08 and AFMAN 48-148, regardless of the source of exposure. Because of this, it is necessary to consider the radiation exposure an individual may receive from employment outside the AF. **Note**: DAF occupational radiation workers may not wear their AF-issued dosimeters while moonlighting.

4.4.2. NRC Form 4, *Cumulative Occupational Dose History*. Upon initial entry or re-entry in the dosimetry program, radiation workers are required to provide radiation exposure histories (NRC Form 4 or equivalent per 10 CFR Part 20) from previous employers prior to beginning work. **(T-1).** This includes, but is not limited to, individuals who may have studied at civilian or military institutions for advanced degrees. The NRC Form 4 or its equivalent is used to record radiation exposures from previous employers outside of the DAF. This request is normally initiated by the IRSO with the individual signing a statement allowing the release of Privacy Act information. In accordance with AFMAN 48-148 all dose equivalent histories of previous employment outside the DAF must be forwarded to USAFSAM for inclusion in the MRER. **(T-1).**

4.4.3. NRC Form 5, *Occupational Dose Record for a Monitoring Period*. All DAFemployees involved in off-duty employment and registered in the dosimetry program are required to provide current radiation exposure summaries. The NRC Form 5, or its equivalent, is used to record radiation exposures to DAF personnel who have off-duty employment involving radiation exposures, and are provided dosimeters by an institution other than the AF. In accordance with AFMAN 48-148, the individual must furnish dose equivalent information from off-duty employment at least quarterly to the local IRSO. **(T-1).** The IRSO must forward this information to USAFSAM for entry into the MRER. **(T-1).**

4.5. Personnel Monitoring for Exposure to Radiation from an External Agency.

4.5.1. All persons monitored by the AF through USAFSAM, or working for the AF but monitored by another agency, must be registered in the dosimetry program. **(T-1).**

4.5.2. USAFSAM sends dosimeters to the IRSO or medical organization conducting the dosimetry program. Electronic RDL Listing 1523, *Dosimetry Assignment Data*, containing information on all registered individuals is automatically generated and available via the Radiation Dosimetry Web.

4.5.3. At the end of each monitoring period, the IRSO exchanges the dosimeters and ships the old dosimeters to USAFSAM.

4.5.4. USAFSAM processes all dosimeters and the IRSO, using the Radiation Dosimetry Web, retrieves a RDL Listing 1499-1 with the individual exposures for the monitoring period. For more information on the Radiation Dosimetry Web, please contact USAFSAM.

4.5.4.1. The IRSO reviews the RDL Listing 1499-1 and distributes a copy to the supervisor of the monitored individuals.

4.5.4.2. The IRSO evaluates any administrative doses assigned by USAFSAM on the RDL Listing 1499-1 due to lost or damaged dosimeters, to determine the most likely dose received by the individual for the given monitoring period.

4.5.5. Annual Reports. Annually, USAFSAM provides the IRSO, via the Radiation Dosimetry Web, with an AF Form 1527-1 for each individual entered in the dosimetry program for the previous calendar year. The IRSO provides these forms to each individual in the dosimetry program upon demand or as otherwise required by 10 CFR Part 19, *Notices, Instructions and Reports to workers; Inspection and Investigations*, within 30 days of receipt; **(T-0)** the IRSO ensures all other monitored personnel also receive this form within 30 days of receipt. **(T-1).**

4.6. Personnel Monitoring for Exposure to Radiation from Internally Deposited Radioactive Materials.

4.6.1. Introduction. Internal dosimetry is "…the science of assessing the amount and distribution of radionuclides in the body, and calculating resulting radiation doses to internal organs or tissues over specific time periods" (ANSI/HPS N13.39-2001, *Design of Internal Dosimetry Programs*). The intent of this section is to provide guidelines for achieving the minimum levels of acceptable performance in evaluating the internal radiation doses that may be received by radiation workers from intakes of radionuclides. Bioassay is a means to determine the dose from internally deposited radioactive materials and is generally used by the DAF instead of whole body counting.

4.6.2. IRSO/permit radiation safety officer (PRSO) will ensure monitoring is performed for any individual who is likely to internalize through a completed exposure pathway (primarily inhalation or ingestion), without regard to protective controls, more than 2% the annual limit on intake in a calendar year. **(T-1).** Bioenvironmental engineering and biomedical laboratory personnel will maintain radiobioassay sampling and internal dosimetry plans on file for units with the monitored individuals. **(T-2).** The conditions requiring bioassay, as well as the methods and maximum intervals discussed below, are designed to ensure that an annual intake exceeding this amount can be quantified.

4.6.3. Recommend IRSO/PRSO ensure routine bioassay (sampling on a regular interval) for continuous operations involving unsealed radioactive material, and when individuals involved are likely to exceed 2% of the annual limit on intake as a result of inhalation, ingestion, injection, or absorption of radioactive materials. This ensures documentation of exposure concomitant with intake of radioactive material and confirms that exposure controls are functioning.

4.6.3.1. IRSO/PRSO will ensure baseline individual bioassays are collected upon beginning of employment or before beginning work with radioactive materials. **(T-1).** When submitting the sample to the laboratory, IRSO/PRSO will request analysis for the nuclide(s) to which the individual may be exposed. **(T-2). Note**: Baseline sample collections should be limited to those individuals working with radioactive materials (e.g., radium-226 and depleted uranium) that are a part of normal dietary intake and likely to be detectable by standard laboratory methods.

4.6.3.2. Bioassay frequency. The maximum time that may elapse between periodic samples is a critical component to ensuring detection of the intake. The bioassay frequency for a specific nuclide is determined by the desired level of detection, metabolic characteristics of the radioactive material, and the analytical method used. IRSOs and PRSOs implementing bioassay programs shall contact USAFSAM at 1-888-232-ESOH (3764), DSN 798-3764, 937-938-3764, or email **esoh.service.center@us.af.mil**, to discuss frequency, sampling strategy, and possible termination of sampling. **(T-1).**

4.6.4. IRSO/PRSO should use special bioassay to quantify radionuclide intakes when individuals involved in a planned project are likely to exceed 2% of the annual limit on intake as a result of inhalation, ingestion, injection, or absorption of radioactive materials. Special bioassay monitoring consists of pre-event and post-event samples:

4.6.4.1. Pre-event assay. An assay sample should be conducted as close as possible to the start date of the event that has the potential to result in an intake. When submitting the sample to the laboratory, IRSO/PRSO will request analysis for the nuclide(s) to which the individual may be exposed during the event. **(T-2).**

4.6.4.2. Post-event assay. To determine the exposure associated with the project, collect another bioassay sample during the project (process details and laboratory detection limits influence adequate sampling strategy) and/or after work is completed. Consultation with USAFSAM prior to the project can be key to the success of the risk assessment. Monitored personnel, in conjunction with the IRSO and PRSO, shall make every effort to ensure that sampling and submission occur within the appropriate interval. **(T-2).**

4.6.5. RSO Concurrence. The USAFSAM internal dose assessment summary will contain a statement of concurrence for either the IRSO or PRSO to sign. **(T-2).**

4.6.5.1. If the dose assessment is tied to a permitted operation, the PRSO will indicate concurrence by signing/dating the dose assessment summary sheet (located at the ESOH service center website (**https://hpws.afrl.af.mil/dhp/OE/ESOHSC/**) and returning it to the IRSO to route to USAFSAM. **(T-2).** If the dose is not from a permitted operation, the IRSO will indicate concurrence by signing/dating the summary and returning it to USAFSAM. **(T-2).**

4.6.5.2. Complete requirements of **Paragraph 4.6.5** within 10 working days of receipt, or RSO non-concurrence with the reported dose, will result in USAFSAM elevating the summary to the AF Radiation Safety Committee for resolution. **(T-3).**

4.7. The Radiation Dosimetry Web.

4.7.1. The Radiation Dosimetry Web (RDW) is a secure website, hosted and managed by 711 HPW, which enables administration of the dosimetry program by the IRSO, the dosimetry monitor and selected alternate personnel. The following common dosimetry related tasks are accomplished through this system:

4.7.1.1. Base Information Change Request. Used to change information about the base: mailing address or delivery address, new IRSO (or alternate where applicable), new dosimetry monitor, new telephone or fax number, status of dosimetry program (active, inactive), etc.

4.7.1.2. Personnel Information Change Request. Used to add a person to the program, delete (deactivate) a person in the program, or request a change, e.g., new area, different dosimeters.

4.7.1.3. Declaration of Pregnant Radiation Worker. Self-explanatory (module of the Personnel Information Change Request).

4.7.1.4. Administrative Dose Change. Used to change the dose reported by a dosimeter or to change a dose that was assigned as a result of an unreturned dosimeter.

4.7.1.5. Special Requests. Used to order additional whole body, neutron, and extremity dosimeters, hangers, clips, etc.

4.7.1.6. Request for USAFSAM Form 1527-2. For radiation workers assigned to the base or location. If the radiation worker is not currently assigned to the base/location, or if the

worker was assigned within the last 5 days, IRSO is not be able to generate an USAFSAM Form 1527-2 by using this service. This service is available interactively.

4.7.1.7. Routine Dosimetry Reports (RDL Listing 1499-1 and RDL Listing 1499-2, *Summary Occupational Dose Record, Year to Date*). These will be transmitted via the Radiation Dosimetry Web. **(T-3).** Reports will be in portable digital format and will be available for viewing and printing only. **(T-3).** Authorized users will receive email notification that a dose report is ready for viewing and printing. **(T-3).**

4.7.2. Annual Dose Reports (USAFSAM Form 1527-1). These reports also will be sent as described in **Paragraph 4.7.1.7** **(T-1).**

4.7.3. The RDL Listing 1523 is an electronic form available through the RDW. USAFSAM does not accept printed listings containing requested changes. The installation radiation safety officer (IRSO)/dosimetry program monitor must submit all changes via the RDW for timely processing and data integrity. **(T-2).** Contact USAFSAM for technical issues.

4.7.4. RDW access is sought by requestor registering with own common access card on the Human Performance Wing Support (HPWS) gateway at **https://hpws.afrl.af.mil**. After registration is complete, an authorized user with access to the RDW, such as a radiation safety officer or dosimetry monitor, submits a "Base Information Change" in the RDW to identify the user's new role. Once the Base Information Change has been processed and approved in the RDW, the user have will access to the RDW.

Chapter 5

LOST, DAMAGED, OR NOT RECEIVED DOSIMETER PROCEDURES

5.1. On occasion, dosimeters may be lost, temporarily misplaced or damaged.

5.1.1. The IRSO should explain the occurrence of lost or damaged dosimeters at the end of monitoring period, and assign an appropriate dose equivalent for the monitoring period using the HPWS/RDW Administrative Dose Change module. If the HPWS/RDW Administrative Dose Change module is not available, then the dose assignments may be made via a memorandum for record.

5.1.2. It is the IRSO's responsibility to return dosimeters back to USAFSAM within ten duty days upon completion of the monitoring period. **(T-2).** The IRSO must assign an appropriate dose equivalent, and report the dose equivalent to USAFSAM within 30 days. **(T-2). Note**: Dosimeters are used to measure the radiation exposure to AF personnel; therefore, all necessary steps should be taken to ensure security and accountability of these devices.

5.2. Determining the Administrative Dose for Lost or Damaged Dosimeters. The following steps should be used in assigning an administrative dose:

5.2.1. The IRSO reviews radiation exposure records of the monitored individual and coworkers for the previous twelve months.

5.2.2. The first level supervisor prepares a statement of the worker's duties during the monitoring period and the worker signs the statement indicating concurrence.

5.2.3. The IRSO reviews the summary of duties and previous radiation exposures for the work area and assigns the best estimate of the dose equivalent using one of the following methods:

5.2.3.1. Occupancy or workload information and radiation dose levels at the radiation source operator location.

5.2.3.2. Data supplied by a supplemental dosimeter.

5.2.3.3. Average of the individual's previous occupational dose for the preceding 6 to 12 months if conditions prevailed similar to those during the period for which the dose is being estimated.

5.2.3.4. Recorded doses accrued by coworkers performing similar duties under similar circumstances.

5.2.3.5. Established doses for specific unit, duty position, and mission (e.g., using intrinsic radiation data).

5.2.4. The IRSO must report the assigned doses to USAFSAM by using the administrative dose change module of the HPWS/RDW application (preferred method) or report the assigned doses to USAFSAM by memorandum for record only if the HPWS/RDW is unavailable. **(T-1).** If reporting via memorandum for record, the report must include:

5.2.4.1. The assigned dose equivalent and any explanation on how that value was determined. **(T-1).**

5.2.4.2. The dosimeter number, type of dosimeter and monitoring period. **(T-2).**

5.2.4.3. The full name and full social security number of the individual. **(T-2).**

5.2.4.4. The signed statement of concurrence. **(T-1).** If an individual does not sign a statement of concurrence, the IRSO must note the reason. **(T-1).** In the event a member chooses not to concur with the assigned dose, the individual will provide written comments to the IRSO in a reasonable time frame stating the rationale for non-concurrence. **(T-1).** Copies of this report should be appropriately filed and/or a scanned copy should be included in the Occupational Health Management Information System. USAFSAM also will maintain a copy after the dose has been entered into the MRER as an assigned dose. **(T-1).**

5.3. Dosimeters Not Received By USAFSAM. The dosimetry program monitor and the IRSO must attempt to locate the dosimeter. **(T-2).** If found, the dosimeter must be forwarded to USAFSAM with a note indicating that the dosimeter was not returned to USAFSAM within 10 duty days following the monitoring period. **(T-1).** If not found, follow the steps in the previous paragraph to assign the appropriate dose equivalent. **(T-1).** If no response is received by USAFSAM within 30 calendar days after the end of the monitoring period, a list of individuals who have not received a RSO assigned dose may be sent to the MAJCOM Bioenvironmental Engineer and Air Force Medical Readiness Agency's Bioenvironmental Engineering Branch (AFMRA/SG3PB) for corrective actions.

Chapter 6

RADIATION MONITORING FOR DECLARED PREGNANT INDIVIDUALS

6.1. Fetal Dose Limits. AFMAN 48-148 prohibits occupationally exposed personnel from exceeding dose limits. The dose limits to an unborn fetus for declared pregnant individuals is 5 mSv (500 millirem (mrem)) during the gestation period, with a recommendation not to exceed 0.5 mSv (50 mrem) per month. **(T-0).** At all times the exposure levels should be ALARA. Therefore, IRSO will ensure all declared pregnant individuals are monitored monthly throughout their gestation period. **(T-1).** USAFSAM supports this requirement by providing monthly badges, priority processing, and priority notification of dosimetry results for declared pregnant individuals. When not being worn, individuals must properly store dosimeter. **(T-1).** This ensures the dosimeter will be exchanged at the proper frequency and that the device is properly analyzed.

6.2. Installation Radiation Safety Officer.

6.2.1. Evaluates exposure potential for declared pregnant individuals **(T-0)** and advises the attending physicians accordingly. **(T-1).**

6.2.2. Prescribes protective measures, including enrollment in the dosimetry program. Arranges placement on a monthly dosimetry exchange cycle and verifies priority processing of dosimetry by USAFSAM to ensure compliance. **(T-0).**

6.2.3. Makes appropriate recommendation(s) regarding reassignment to a non-radiation work environment. Recommends work restrictions necessary to ensure adequate protection of the embryo/fetus. Alternative duties for radiation protection purposes are without loss of all normal benefits. Declared pregnant individuals are normally recommended to be removed from radiation related duties under the following circumstances:

6.2.3.1. Past monitoring (internal and/or external) indicates the worker will receive a whole body total effective dose equivalent of greater than 1 mSv (100 mrem) over the gestation period, or the potential for receiving this dose is unacceptably high.

6.2.3.2. Work directly involving unsealed radionuclides unless authorized in writing by AFMRA/SG3PB.

6.2.4. Notifies USAFSAM of declared pregnant individuals requiring monthly monitoring and priority reporting of results. **(T-1).**

6.2.4.1. This notification should be done by using the RDW secure website.

6.2.4.2. If notification via the website is not possible, it should be made by email/fax. Email/fax reporting must include the individual's name, the installation, work area, and whether or not the worker had any past history of external or internal radiation exposure. **(T-2).** All considerations must be made to ensure compliance with the Privacy Act of 1974 and the Health Insurance Portability and Accountability Act. **(T-0).**

Chapter 7

NON-ROUTINE DOSIMETRY

7.1. Radiation Workers on Extended Temporary Duty (TDY).

7.1.1. TDY for periods of 90 days or less.

7.1.1.1. Individuals going TDY for 90 days or less will take their dosimeter and a designated transit control dosimeter with them. **(T-1).** The accompanying control dosimeter must be assigned and issued via RDW from spare dosimeters provided to the home base. **(T-2). Note**: When traveling, personnel must carry dosimeter and control badges onto aircraft and not place them in checked baggage which may be subject to x-ray radiation. **(T-3).** In addition, personnel must remove from carry-on baggage at the airport security screening checkpoints and request non-x-ray inspection of dosimeter and the control badge to avoid x-ray exposure. **(T-2).**

7.1.1.2. Upon return from TDY, the individual will ensure the dosimeter and transit control are turned in for processing at the next exchange interval. **(T-2).**

7.1.2. TDY for Periods Exceeding 90 Days.

7.1.2.1. TDY/Deployed Locations Having an Established Dosimetry Program. While TDY to a location with an established dosimetry program, individuals will obtain necessary dosimetry at the TDY location. **(T-1).** If dosimetry support is provided by other than USAFSAM, the individual is responsible for ensuring copies of these dosimetry results are provided to USAFSAM for inclusion in the MRER. **(T-1).**

7.1.2.2. TDY/Within the Continental United States Locations Not Having an Established Dosimetry Program. Individuals on TDY for periods greater than 90 days to locations without an established dosimetry program will receive dosimetry support from their sponsoring organization for the duration of the TDY. **(T-1).** Support includes providing dosimetry controls and ensuring exchanges are made in a timely fashion. Gaining organizations anticipating ongoing requirements of this nature are encouraged to establish their own dosimetry programs.

7.1.2.3. TDY/Outside the Continental United States Locations Not Having an Established Dosimetry Program. Individuals on TDY for periods greater than 90 days to locations without an established dosimetry program will receive dosimetry support from the nearest location with an established dosimetry program; establish these procedures before the member departs TDY for locations outside of the continental United States. **(T-1).** USAFSAM will provide additional dosimetry support to the location providing the support to these individuals. **(T-1).**

7.1.3. In no instances will an IRSO allow an individual to keep a dosimeter for periods longer than four months. **(T-1).**

7.2. Non-AF Individuals Occupationally Exposed to Ionizing Radiation From DAF Operations and DAF Individuals Monitored by Sister Services.

7.2.1. Individuals employed by other military services or other federal agencies may on occasion be occupationally exposed to ionizing radiation while working under AF

jurisdiction (e.g., cooperative staffing of military medical treatment facilities, joint operations, etc). Individuals having a primary employer other than the AF who are occupationally exposed while under AF jurisdiction (i.e., while working with radiation sources or devices subject to licensing, permitting, or control of the AF) shall be enrolled in the dosimetry program, which utilizes AF-provided personnel monitoring. **(T-1).**

7.2.2. USAFSAM will maintain dosimetry results, for individuals in circumstances of this section, within the MRER. **(T-1).**

7.2.3. In addition, dosimetry results for these individuals will be reported to the individual's primary employer using procedures established between USAFSAM and the counterpart organization in the other federal agency. **(T-1).**

7.2.4. USAFSAM will establish procedures to routinely request and obtain dosimetry results from the US Army and US Navy personnel dosimetry centers on any AF personnel who have received personnel dosimetry services from those centers **(T-3)** and will incorporate those results into the MRER as doses obtained outside the AF **(T-1).**

7.3. Visitors (or Occasionally-Exposed Individuals).

7.3.1. The IRSO may authorize visitors to enter a radiation area or high radiation area in accordance with AFMAN 48-148. IRSO shall ensure visitors are afforded personnel monitoring devices when entering defined "radiation areas" or "high radiation areas," or who are likely to incur a deep dose equivalent in excess of 0.1 mSv (10 mrem). **(T-1).** The IRSO may consult with USAFSAM regarding dosimeter selection if necessary. The decision to provide either an EPD or dosimeter for entry into controlled areas should be based on the anticipated exposure potential during a single visit and the anticipated number of visits by an individual in a year. In no case shall a member of the public visiting controlled areas be permitted to receive a dose that exceeds 1 mSv in a year (100 mrem in a year), as limited by DoDI 6055.08 **(T-0).** If EPDs are issued, the dosimeters must have been performance verified within the last year. **(T-1).** In addition, a log of all direct reading dosimeter readings must be maintained by the workplace supervisor. **(T-1).** This log must include the following:

7.3.1.1. The date, time, and purpose of the visit. **(T-1).**

7.3.1.2. The visitor's printed name, social security number, business address, sex, and phone number. **(T-1).**

7.3.1.3. The dosimeter's serial number and calibration date. **(T-1).**

7.3.1.4. The dosimeter reading before and after the visit. **(T-1).**

7.3.1.5. The dosimeter's net exposure reading and net exposure time. **(T-1).**

7.3.1.6. The license/permit information if applicable. **(T-1).**

7.3.2. The IRSO shall review all visitor dosimeter logs quarterly. **(T-1).**

7.3.3. The IRSO shall ensure USAFSAM is provided a copy of all positive or greater than zero log readings for entry into the MRER within 10 calendar days of the end of the quarterly monitoring period. **(T-2).**

7.3.4. Visitors shall not enter areas where unsealed radioactive materials are used and the use of respiratory protection is necessary to maintain exposures of visitors below 1 mSv (100 mrem) total effective dose equivalent. **(T-1).**

7.4. Special Survey Dosimeters.

7.4.1. The IRSO may request special survey dosimeters (e.g., dosimeters used for area surveys, localized exposure determinations, conducting an exposure investigation) from USAFSAM using the Radiation Dosimetry Web.

7.4.2. If a customer monitors the same location every monitoring cycle, the customer may request USAFSAM generated social security numbers and permanently assign special survey dosimeters, in the same manner dosimeters are assigned to personnel.

7.4.3. IRSO shall ensure dosimeters routinely provided by USAFSAM for personnel wear are not used for special surveys unless authorized by USAFSAM. **(T-2).**

7.5. Planned Special Exposures (per 10 CFR Part 20).

7.5.1. Installation personnel will not permit any planned special exposures unless prior written approval is granted by the AF Radioisotope Committee. **(T-1).** AFMRA/SG3PB only will coordinate planned special exposures requests to the AF Radioisotope Committee that comply with 10 CFR Part 20 . **(T-1).** Requests for planned special exposures will be signed by the installation commander. **(T-0).** These requests shall include:

7.5.1.1. Justification and purpose for the planned special exposure. **(T-0).**

7.5.1.2. Radiological work plan to include precautions to be taken to keep exposures received ALARA. **(T-1).**

7.5.1.3. Name, social security number, and cumulative record of lifetime radiation exposure history (NRC Form 4 or equivalent) for each individual involved. **(T-1).**

7.5.2. Following approval notification by AFMRA/SG3PB, the IRSO notifies USAFSAM of the planned special exposure and provides the individual's name, social security number, work area, and expected date of the planned exposure. **(T-1).**

7.5.3. Upon being notified by the IRSO, USAFSAM:

7.5.3.1. Ensures individuals are entered into the dosimetry program. **(T-1).**

7.5.3.2. Provides dosimeters specifically for use during the planned special exposure. **(T-1).**

7.5.3.3. Provides USAFSAM Form 1527-2 for each individual before and after the planned special exposure. **(T-1).**

7.5.3.4. Provides priority processing of planned special exposure dosimeters and bioassay samples. USAFSAM provides consolidated external and internal results via email/fax to the IRSO, along with a new USAFSAM Form 1527-2. **(T-1).**

7.5.4. The IRSO provides these results to all individuals involved in the planned special exposure within 30 calendar days of determining the dose. **(T-0).**

Chapter 8

ABNORMAL EXPOSURES

8.1. Abnormal Exposures. Any dosimeter and/or bioassay result exceeding any of the values in **Table 8.1** represent an "abnormal exposure."

Table 8.1. Abnormal Exposure Criteria.

The More Restrictive Of	Value	
	Monthly Dosimeter	Quarterly Dosimeter
Total Effective Dose Equivalent	>4.17 mSv (0.417 rem)	> 12.5 mSv (1.25 rem)
Deep dose equivalent to pregnant radiation worker	> 0.5 mSv (0.05 rem)	N/A
Sum of deep dose equivalent and committed dose equivalent to any individual organ or tissue other than the lens of the eye	> 41.7 mSv (4.17 rem)	> 125 mSv (12.5 rem)
Eye dose equivalent	> 12.5 mSv (1.25 rem)	> 37.5 mSv (3.75 rem)
Shallow dose equivalent to skin or extremity	> 41.7 mSv (4.17 rem)	> 125 mSv (12.5 rem)
Internal deposition of any radionuclide	>10% of ALI	>25% of ALI

8.2. Abnormal Exposure Suspected by Base. Any dosimeter suspected of receiving an abnormal exposure will be forwarded to USAFSAM together with a control dosimeter and an identifying letter detailing the circumstances involved in the suspected exposure. **(T-1).** USAFSAM will provide further instructions. **(T-1).**

8.3. Abnormal Exposure Observed by USAFSAM Upon Processing a Dosimeter. The installation radiation safety officer (IRSO) is to conduct an investigation into the abnormal exposure and submit a written report within 30 calendar days on the findings of the investigation, in accordance with AFMAN 48-148. An advance copy and finalized reports must be sent to AFMRA/SG3PB, USAFSAM, and the MAJCOM/SGPB. **(T-1).**

8.4. Notification of Abnormal Exposures. USAFSAM notifies the installation IRSO by telephone within 72 hours of apparent abnormal exposures, then follows up with an official memorandum via email/fax. **(T-1).** The memorandum:

8.4.1. Identifies the dosimeter and/or bioassay sample number. **(T-1).**

8.4.2. Includes the name, dosimetry area, and occupational code of the individual involved. **(T-1).**

8.4.3. Gives a dose equivalent estimate based on the dosimeter results, bioassay concentrations, or both. **(T-1).**

8.4.4. Provides instructions to accomplish the required investigation and report, in accordance with AFMAN 48-148. **(T-1).**

8.5. Exception. For external AF customers (e.g., Coast Guard or Defense Health Agency personnel), USAFSAM will provide an abnormal exposure notification; however investigation, adjudication, etc., will follow external agency's process. **(T-1).** USAFSAM will only update the MRER record of an external customer with a written request. **(T-1).**

8.6. Investigation. The IRSO must initiate a formal investigation for abnormal exposures to ensure personnel that AFMRA/SG3PB, MAJCOM/SGPB, and USAFSAM are aware of any actual abnormal occupational exposure and take corrective actions as necessary to avoid exceeding annual occupational limits. **(T-1).** If during the course of a formal investigation the IRSO suspects any criminal misconduct, IRSO should pause the formal investigation and consult the servicing legal office for guidance on how to proceed. The formal investigation should contain the following:

8.6.1. Circumstances surrounding the abnormal exposure.

8.6.2. The validity of the dose received.

8.6.3. The portion of the body exposed.

8.6.4. Any corrective actions required preventing recurrence.

8.7. Written Report. The IRSO submits a written report on the findings of the investigation to AFMRA/SG3PB, MAJCOM Bioenvironmental Engineering, and USAFSAM within 30 calendar days of being notified about the possible abnormal exposure. **(T-1).** USAFSAM will evaluate the written report and requests any necessary additional information from the IRSO to fully document the dose received and adjudicates with MAJCOM/IRSO as necessary. **(T-1).** The report could potentially be used for medical and legal purposes; therefore, it should be comprehensive. The IRSO shall submit a report to include:

8.7.1. Name, social security number, occupational code, and AF specialty code of the individual involved. **(T-1).**

8.7.2. Description of circumstances surrounding the abnormal exposure. **(T-1).**

8.7.3. Estimates of each individual's dose equivalent to include a detailed discussion of how this value was determined. **(T-1).**

8.7.4. If it is determined that the individual's dosimeter was inadvertently exposed to radiation while not being worn, the following information needs to be determined to assist in estimating the appropriate dose to be assigned for this monitoring period:

8.7.4.1. During the monitoring period, did the individual's activities differ from normal activities or those of fellow workers during the same monitoring period? If so, in what way did they differ (e.g., did the workload increase or decrease significantly)? **(T-1).**

8.7.4.2. Was the individual involved in any activities, which might have caused the dosimeter to indicate a higher or lower dose than normal? **(T-1).**

8.7.4.3. If the individual wore pocket dosimeters, what was the indicated exposure during the monitoring period? **(T-1).**

8.7.4.4. What is the individual's past dose history? **(T-1).**

8.7.4.5. What dose did the individual receive during normal periods of work? **(T-1).**

8.7.5. Any available evidence used in concluding the investigation. **(T-1).**

8.7.6. Any corrective actions taken to prevent recurrence. **(T-1).** Appropriate corrective actions might include: Instructing on the proper wear and uses of the dosimeter, ensuring the adequacy of the radiation protection program, surveying and correcting faulty equipment, moving the dosimeter storage area to an area free of radiation sources, etc.

8.7.7. Statement signed by the individual involved either supporting or contesting the investigation report. **(T-1).**

8.7.8. Results of any medical examinations (if appropriate). **(T-1).**

8.8. Termination of Investigation.

8.8.1. USAFSAM will provide analysis and recommendations to AFMRA/SG3PB. **(T-1).**

8.8.2. AFMRA/SG3PB evaluates the reports of abnormal exposures and either approves termination of the incident or requests additional information. Following termination, USAFSAM updates the MRER. **(T-1).**

8.8.3. Upon notification by USAFSAM that the MRER has been updated, the IRSO shall acquire an USAFSAM Form 1527-2 for the individual in question or request one from USAFSAM and distribute to member if required by 10 CFR Part 19. **(T-0).** The IRSO ensures the individual is given a copy of the revised USAFSAM Form 1527-2 in other cases. **(T-3).**

Chapter 9

POTENTIAL OVEREXPOSURES

9.1. General. Any dosimeter and/or bioassay result that exceeds the applicable dose limits, in accordance with DoDI 6055.08, shall be considered to represent a "potential overexposure." **(T-0).**

9.2. Potential Overexposure Identified by Base.

9.2.1. An IRSO who is notified by an individual, or suspects a potential overexposure may have occurred, shall immediately notify USAFSAM, the MAJCOM/SGPB and AFMRA/SG3PB by telephone and follows up with a letter via email explaining the circumstances. **(T-1).** This includes, but is not limited to, potential overexposures as a result of radiological or nuclear accidents or incidents, both in-garrison and deployed.

9.2.2. USAFSAM provides priority processing for all external dosimetry and bioassay samples collected in overexposure investigations and immediately reports the approved results to the IRSO by telephone and email. **(T-1).**

9.2.3. Written Report. The IRSO provides a written report of the investigation findings (see **Pargraph 8.6** on investigations) through the MAJCOM/SGPB to USAFSAM for archival within seven (7) calendar days of being notified of the potential over exposure. **(T-1).** IRSO also provides copies of this report to AFMRA/SG3PB and the individual. **(T-1).**

9.2.3.1. Contents of the report shall include all information required in **Paragraph 8.7.1** through **Paragraph 8.7.8** **(T-1).**

9.2.3.2. The written report shall also include a description of the root cause of the exposure. **(T-1).** When analyzing the root cause, a wide range of factors should be considered. Such factors might include deliberate exposure, exposure as a patient during diagnostic or therapeutic radiation, improper action on the part of the individual, inadequate protective measures, faulty operation of equipment, or use of the dosimeter for other than personnel monitoring, among others.

9.3. Removal from Duties. Individuals identified as potentially overexposed will be removed from duties involving radiation exposure, pending completion of the final investigation report. **(T-1).** This removal from duty is not to be considered adverse personnel action. If the final investigation report concludes the individual received an overexposure, AFMRA/SG3PB concurrence must be obtained before the exposed individual is allowed to return to radiation related duties. **(T-1).**

9.4. Potential Overexposure Identified by USAFSAM.

9.4.1. Notification.

9.4.1.1. When a dosimeter or bioassay indicates an overexposure may have occurred, USAFSAM shall immediately notify the IRSO by telephone and follows up with an encrypted email/fax letter within two (2) hours, and provides copies of this letter notification to AFMRA/SG3PB. **(T-1).** USAFSAM shall immediately provide an encrypted email/fax instructions for investigation and report. **(T-1).**

9.4.1.2. Following telephone notification by USAFSAM, the IRSO shall immediately contact the PRSO (if applicable) and unit commander, and request the individual be removed from all duties involving potential radiation exposure until an investigation of the incident can be completed. **(T-1).** The IRSO also notifies the Military Treatment Facility commander/director who, in turn, notifies the installation commander, as appropriate. **(T-1).** Notification should also be made to the appropriate MAJCOM/SGPB.

9.4.2. The IRSO shall investigates suspected overexposures. **(T-1).** An overexposure may represent a potentially or overtly injurious dose of ionizing radiation. These investigations demand swift action, more detailed reporting procedures, possible medical follow-up and comprehensive documentation. If during the course of an investigation the IRSO suspects any criminal misconduct, the IRSO should pause the investigation and consult the servicing legal office for guidance on how to proceed.

9.4.3. The IRSO shall provide a written report per **Paragraph 9.2.3** **(T-1).**

9.5. Exception. For external AF customers (e.g., Coast Guard or Defense Health Agency personnel), USAFSAM will provide an overexposure notification; however investigation, adjudication, etc., will follow external agency's process. **(T-1).** USAFSAM will only update the MRER record of an external customer with a written request. **(T-1).**

9.6. Termination of Investigation.

9.6.1. USAFSAM will review reports involving doses considered potential or true overexposure, and provide analysis and recommendations to the AF Radiation Safety Committee. **(T-1).**

9.6.2. The AF Radiation Safety Committee evaluates the reports of potential overexposures and either approves termination of the incident or requests additional information. Following termination, USAFSAM updates the MRER. **(T-1).**

9.6.3. Upon notification by USAFSAM that the MRER has been updated, the IRSO shall acquire an USAFSAM Form 1527-2 for the individual in question or request one from USAFSAM and distribute to member if required by 10 CFR Part 19 **(T-0).** The IRSO ensures the individual is given a copy of the revised USAFSAM Form 1527-2 in other cases **(T-3).**

Chapter 10

WEIGHTED EFFECTIVE DOSE EQUIVALENT WHEN SHIELDED PROTECTIVE APRON IS WORN

10.1. Overview. In some occupational environments the radiation dose to personnel is non-uniform, with relatively high doses to the head, neck, and extremities, with lower doses to the trunk and other regions protected by shielding. The weighted effective dose equivalent is a special calculation protocol that provides a more realistic estimate of the effective dose received by individuals working in these work environments.

10.2. Applicable Population. Occupational radiation workers certified by the IRSO as working exclusively with radiation sources not subject to regulation of the NRC, and wearing both a whole body badge beneath shielded protective clothing and a collar badge worn outside the shielded protective clothing.

10.3. Applicability Criteria.

10.3.1. Weighting effective dose equivalent is only applied if all of the following conditions are met:

10.3.1.1. During the monitoring period, the individual works only with machine produced radiation sources. **(T-1).**

10.3.1.2. During the monitoring period, the individual never works with radiation sources regulated by the NRC, radioactive material permitted under the AF Radioisotope Committee, radioactive materials permitted by Headquarters AF Safety Center, or exposures from intrinsic radiation from nuclear weapons. **(T-2).**

10.3.1.3. During the monitoring period, the individual is not enrolled in the pregnant radiation worker-monitoring program. **(T-2).**

10.3.1.4. The whole body badge is worn on the front of the body, below the neck and above the waist, underneath the lead apron. **(T-2).**

10.3.1.5. The collar badge is worn on the front of the body, at collar or neck level, outside the lead apron. **(T-2).**

10.3.1.6. Placement of the two badges is not interchanged during the monitoring period. **(T-2).**

10.3.2. If any of the above conditions are not met, USAFSAM will use the highest dose recorded for any dosimeter during that monitoring period as the dose of record. **(T-2).**

Chapter 11

FORMS, LISTINGS, RECORDS AND REPORTS

11.1. AF Master Radiation Exposure Registry (MRER). The MRER provides a centralized, permanent record of exposure for all personnel currently and previously registered in the dosimetry program (See **Chapter 12** for a detailed description of the MRER). The information contained in the MRER serves as the source for the generation of dose equivalent reports to be included in an individual's medical records. The MRER is medical information and contains Privacy Act information that must be protected in accordance with AFI 33-332, *Air Force Privacy and Civil Liberties Program*. **(T-0).** All records of exposure to ionizing radiation (e.g., USAFSAM Form 1527-1) are to be maintained in accordance with this manual, the requirements of 10 CFR Part 20, 10 CFR Part 19, DoDI 6055.8, AFMAN 48-148 and ANSI/HPS N13.6-2010, *Practice for Occupational Radiation Exposure Records Systems*. **(T-0).**

11.2. RDL Listing 1523, *Dosimetry Assignment Data*. Serves as a shipping list of dosimeters provided to a base for a specified monitoring period. It is automatically prepared based on information provided to USAFSAM by the IRSO for individuals and areas.

11.3. RDL Listing 1499-1, Occupational Dose Record for a Monitoring Period. This listing serves as a summary report for USAFSAM issued dosimetry. The automated record shows the results for all individuals assigned to a given base code and area.

11.4. RDL Listing 1499-2, *Summary Occupational Dose Record, Year to Date*. This listing is prepared for each dosimetry account by area and indicates the dose received by each individual monitored under the dosimetry program from the beginning of the calendar year to the date of the report. The date the form is prepared appears at the top of the form. All results are printed in rem unless indicated otherwise. A dash indicates the particular category is not applicable for the monitored individual.

11.5. USAFSAM Form 1527-1, *Annual Occupational Dose Record*. This form is used in place of certain reports as required by NRC licensees, Occupational Safety and Health Administration, and state regulations. It contains annual occupational exposure data similar to the NRC Form 5 and other equivalent forms. **(T-2).**

11.5.1. Certification: The bottom of each USAFSAM Form 1527-1 includes spaces for the dated signatures of the IRSO and the monitored individual.

11.5.2. The monitored individual will be provided with a copy of the signed USAFSAM Form 1527-1, a copy will be placed in the individual’s health record (if available) and a copy retained in the files of the IRSO. **(T-1).**

11.5.3. The IRSO upon receiving the USAFSAM Form 1527-1 from USAFSAM shall compare the USAFSAM Form 1527-1 reported results against the RDL Listing 1499 (all versions) results and investigate any discrepancies. **(T-2).** If no discrepancies are identified then the RDL Listing 1499 documents may be destroyed appropriately.

11.5.4. The IRSO makes at least two attempts either in person, via email, or other means, to provide a copy of the USAFSAM Form 1527-1 to each monitored individual and establishes a system (e.g., logbook, annotation on retained copy) to document each individual’s receipt of the form or attempted delivery. As a minimum, documentation should include the date

provided, individual's name and signature verifying receipt, and initials or signature of the IRSO or designee providing the form. The IRSO shall retain the USAFSAM Form 1527-1 for a period of five (5) years. **(T-1).** For individuals who have moved from the installation (e.g., permanent change of station, retirement, separation), one attempt will be made to send their USAFSAM Form 1527-1 to their last known forwarding address. **(T-2).** If the IRSO can confirm that the individual completed a permanent change of station and was monitored by the dosimetry program for the remainder of the year covered by the USAFSAM Form 1527-1 at the gaining installation, then an attempt to provide a copy is not required. The monitored individual will receive the information on the USAFSAM Form 1527-1 that will be provided by the gaining IRSO. **(T-2).**

11.6. USAFSAM Form 1527-2, *Cumulative Occupational Dose History*. This form is similar to USAFSAM Form 1527-1 except that it includes all information in the MRER related to the lifetime occupational radiation exposure history for an individual, including off-duty employment and other sources of exposure external to AF practices. Using the Radiation Dosimetry Web secure website, the IRSO can generate this form.

11.7. The Defense Occupational and Environmental Health Readiness System (DOEHRS) Sample Submission Form. The IRSO uses this form to submit bioassay samples to USAFSAM for analysis. The IRSO prepares the Sample Submission Form before submitting samples to USAFSAM for analysis, forwards the original copy to USAFSAM with the bioassay sample, and maintains a copy until results (i.e., updated 1527-1) are received from USAFSAM. (Only if DOEHRS is unavailable one may use AF Form 2753, *Radiological Sampling Form*, found at the ESOH service center website and AF ePubs.) For sample submission questions, contact USAFSAM customer service. For general DOEHRS assistance, contact the DOEHRS support office at **esoh.service.center@us.af.mil**.

11.8. NRC Form 4. The IRSO makes a reasonable effort to collect previous dosimetry histories for individuals having either past or present non-DAF employment. DAF personnel moonlighting in jobs where they are monitored for radiation exposure make arrangements to routinely (e.g., based on monitoring period, but no less than quarterly) provide these results to the IRSO. The IRSO ensures these results are forwarded to USAFSAM for incorporation into the MRER. The individual bears ultimate responsibility for ensuring any non-AF dosimetry results become part of the MRER.

Chapter 12

THE AF MASTER RADIATION EXPOSURE REGISTRY

12.1. Overview. In accordance with 10 CFR Parts 19 and 20, the DAF is required to maintain permanent dosimetry records for all personnel entered into the dosimetry program. The MRER is a computer database registry maintained by 711 HPW. The MRER houses historical records of dose equivalent data for all persons presently or formerly registered in the program. Depending on the age of the data, some internal dosimetry sample results may not be in the MRER, but are instead maintained by 711 HPW. 711 HPW is the sole custodian of the MRER. The MRER also will provide an individual's historical dose due to military operations not considered in the monitored individual's occupational exposure history. **(T-1).**

12.2. Forms and Reports Generated from Data in the MRER.

12.2.1. USAFSAM FORM 1527-1, *Annual Occupational Dose Record.*

12.2.2. USAFSAM FORM 1527-2, *Cumulative Occupational Dose History*.

12.3. Requests for Radiation Exposure History (USAFSAM Form 1527-2).

12.3.1. Required Information. The IRSO can generate this report using the Radiation Dosimetry Web. Additionally, the IRSO, monitored individual, and other authorized organizations can request in writing by contacting: USAFSAM/RDL; 2510 Fifth Street; Wright-Patterson AFB, OH 45433. The IRSO shall not release this report to another authorized organization without a written request **(T-1)** that includes:

12.3.1.1. The individual's name showing the last name, first name, and middle initial.

12.3.1.2. The individual's social security number.

12.3.1.3. The individual's date of birth by day, month, year.

12.3.1.4. The approximate dates the individual was monitored by the AF. **(T-3).** If the individual entered the service before 1 Jul 62, the location and dates of assignment and the previous AF Serial (Service) number assigned must also be provided. **(T-3).**

12.3.2. Authorization for Release. The form is prepared by USAFSAM upon written request of the individual, the IRSO, or a third party (such as a post-AF employer, the Department of Veterans Affairs, etc.). In all cases a signed release statement from the individual whose history is requested must accompany the request. **(T-1).**

DOROTHOY A. HOGG
Lieutenant General, USAF, NC
Surgeon General

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

AFPD 40-2, *Radioactive Materials (Non-Nuclear Weapons)*, 19 June 2019

AFPD 48-1, *Aerospace & Operational Medicine Enterprise*, 7 June 2019

AFI 33-322, *Records Management and Information Governance Program*, 23 March 2020

AFI 33-332, *Air Force Privacy and Civil Liberties Program*, 10 March 2020

AFI 91-108, *Air Force Nuclear Weapons Intrinsic Radiation and 91(B) Radioactive Material Safety Program*, 14 May 2020

AFMAN 40-201, *Radioactive Materials (RAM) Management*, 29 March 2019

AFMAN 48-148, *Ionizing Radiation Protection*, 20 July 2020

ANSI/HPS N13.6-2010, *Practice for Occupational Radiation Exposure Records Systems*, January 2010

ANSI/HPS N13.11-2009, *Personnel Dosimetry Performance—Criteria for Testing*, January 2009 ANSI/HPS N13.30-2011, *Performance Criteria for Radiobioassay*, January 2011

ANSI/HPS N13.32-2008, *Performance Testing of Extremity Dosimeters*, January 2008

ANSI/HPS N13.39-2001, *Design of Internal Dosimetry Programs*, January 2011

DAFI 33-360, *Publications and Forms Management*, 1 December 2015

DoDI 6055.08, *Occupational Ionizing Radiation Protection Program*, 15 December 2009

DoDM 6025.18, *Implementation of the Health Insurance Portability and Accountability Act (HIPAA) Privacy Rule in DoD Health Care Programs*, 13 March 2019

PL 109-58, *Energy Policy Act of 2005*

10 CFR Part 19, *Notices, Instructions and Reports to workers; Inspection and Investigations*

10 CFR Part 20, *Standards for Protection Against Radiation*

10 USC § 1073C, *Administration of Defense Health Agency and Military Medical Treatment Facilities*

10 USC § 9013, *Secretary of the Air Force*

Adopted Forms

The Defense Occupational and Environmental Health Readiness System (DOEHRS), *Sample Submission Form*

AF Form 847, *Recommendation for Change of Publication*

AF Form 2753, *Radiological Sampling Form*

NRC Form 4, *Cumulative Occupational Dose History*

NRC Form 5, *Occupational Dose Record for a Monitoring Period*

RDL Listing 1523, *Dosimetry Assignment Data*

RDL Listing 1499-1, *Occupational Dose Record for a Monitoring Period*

RDL Listing 1499-2, *Summary Occupational Dose Record, Year to Date*

USAFSAM Form 1527-1, *Annual Occupational Dose Record*

USAFSAM Form 1527-2, *Cumulative Occupational Dose History*

Abbreviations and Acronyms

711 HPW—711th Human Performance Wing

AF—Air Force

AFI—Air Force Instruction

AFMAN—Air Force Manual

AFMC/CC—Commander, Headquarters Air Force Materiel Command

AFMC/SG—Command Surgeon, Air Force Materiel Command

AFMC—Air Force Materiel Command

AFPD—Air Force Policy Directive

AFMRA/SG3PB—Air Force Medical Readiness Agency's Bioenvironmental Engineering Branch

ALARA—As Low As is Reasonably Achievable

ANSI—American National Standards Institute

CFR—Code of Federal Regulations

cm—centimeter (length)

cm2—square centimeter (area)

DAF—Department of the Air Force

DAFI—Department of the Air Force Instruction

DoD—Department of Defense

DoDI—Department of Defense Instruction

DoDM—Department of Defense Manual

DOEHRS—Defense Occupational and Environmental Health Readiness System

DT—Absorbed Dose in Tissue

EPD—Electronic Personal Dosimeter

EPDDPW—Electronic Personal Dosimeter Dose Processing Worksheet

ESOH—Environmental, Safety, and Occupational Health

HD—Deep Dose Equivalent

HE—Effective Dose Equivalent

HPS—Health Physics Society

HT—Dose Equivalent

IRSO—Installation Radiation Safety Officer

MAJCOM—Major Command

mg—milligram

mrem—milliRoentgen Equivalent Man

MRER—Master Radiation Exposure Registry

mSv—milliSievert

NRC—Nuclear Regulatory Commission

OPR—Office of Primary Responsibility

PRSO—Permit Radiation Safety Officer

rad—radiation absorbed dose

RAM—Radioactive Material

RDL—Radiation Dosimetry Laboratory

RDW—Radiation Dosimetry Web

REM—Roentgen Equivalent Man

RSO—Radiation Safety Officer

SNM—Special Nuclear Material

TDY—Temporary Duty

USAF—United States Air Force

USAFSAM—United States Air Force School of Aerospace Medicine

WT—Weighting Factors

Terms

Absorbed Dose—The energy imparted by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the rad and the Gray (Gy); (1 rad = 0.01 Gy).

Administrative Dose (administratively assigned dose)—A value assigned in a dose report in cases where a dosimeter is not returned for processing at the end of the wear period, is damaged, or cannot be evaluated due to other factors.

Air Force Radiation Safety Committee—The body responsible for providing oversight of sources of radiation not covered by AFMAN 40-201 or AFI 91-108 to ensure they are operated in accordance with federal, AF and host nation requirements. It is also responsible for the development and execution of the AF's radiation protection program for both practices and interventions.

As Low As is Reasonably Achievable (ALARA)—The act of making every reasonable effort to maintain exposures to radiation as far below established dose limits as is practical and consistent with the purpose for which the licensed activity is undertaken. ALARA takes into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

Annual Limit on Intake—The derived limit for the amount of radioactive material taken into the body of an adult (individual 18 or more years of age) worker by inhalation or ingestion in a year. Annual limit on intake is the smallest value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 50 mSv (5 rem) or a committed dose equivalent (HT) of 500 mSv (50 rem) to any individual organ or tissue. (Annual limit on intake values for intake by ingestion and by inhalation of selected radionuclides are given in Table 1, Columns 1 and 2, of appendix B to Secs. 20.1001- 20.2401, 10 CFR Part 20).

Background Radiation—Radiation from cosmic sources, naturally occurring radioactive materials. Includes radon (except as a decay product of source or special nuclear material) and global fallout as it exists in the environment from the testing of nuclear explosive devices. The term "background radiation" does not include radiation from source, byproduct, or special nuclear materials regulated by the NRC.

Bioassay (radiobioassay)—The determination of kinds, quantities or concentrations, and in some cases, the locations of radioactive material in the human body, whether by direct measurement (in vivo bioassay) or by indirect analysis and evaluation of materials excreted or removed from the human body (in vitro bioassay).

Byproduct Material—Any radioactive material (except source or special nuclear material (SNM)) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or using source or SNM. The definition of byproduct material has changed with the Energy Policy Act of 2005 to include some forms of naturally occurring or accelerator produced radioactive material (reference AFPD 40-2, *Radioactive Materials (Non-Nuclear Weapons)*).

Committed Dose Equivalent ($H_{T,50}$)—The dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

Committed Effective Dose Equivalent ($H_{E,50}$)—The whole body dose equivalent obtained by adding the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent ($H_{E,50}$) these organs or tissues, where $H_{T,50}$ is the committed (organ) dose equivalent to an individual organ from a current uptake, that will be delivered over the 50 years following the uptake. Committed effective dose equivalent applies specifically to the dosimetry of internally deposited radionuclides.

Control Dosimeter—A dosimeter that measures the background radiation accumulated during the transit and storage of personnel dosimeters.

Declared Pregnant Individuals—All pregnant AF military occupational radiation workers. Also AF civilian occupational radiation workers who have voluntarily informed their workplace supervisor or primary care manager, in writing, of their pregnancy and the estimated date of

conception. The declaration remains in effect until the declared pregnant woman withdraws the declaration in writing or is no longer pregnant.

Deep Dose Equivalent (HD)—The dose assigned to personnel from external whole-body exposure, it is the dose equivalent at a tissue depth of one cm (1000 mg/cm^2) which is expressed in units of rem or Sievert (Sv).

Dose (radiation dose)—A generic term that includes absorbed dose, dose equivalent (H_T), effective dose equivalent (H_E), committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent.

Dose Equivalent (H_T)—The product of the absorbed dose in tissue (D_T) and the quality factor (Q), and all other necessary modifying factors at the location of interest where $H_T = D_T*Q$. The units of dose equivalent are the rem and Sievert (Sv). (0.01 Sv = 1 rem). The dose equivalent in Sv is equal to the absorbed dose in Gray multiplied by the Q; 1 Sv = 100 rem. Its purpose is to have a single unit, regardless of the type of radiation, describing the radiation effect on man. See also Deep Dose Equivalent, Eye Dose Equivalent, and Shallow-Dose Equivalent.

Dosimeter—A device that detects and measures accumulated ionizing radiation dose received by occupationally-exposed individuals.

Effective Dose Equivalent (H_E)—The sum of the products of the dose equivalent to the organ or tissue (H_T) and the weighting factors (W_T) applicable to each of the body organs or tissues that are irradiated ($H_E = W_T*H_T$).

Embryo/fetus—The developing human organism from conception until the time of birth.

Exposure—Being exposed to ionizing radiation or to radioactive material.

External Dose—The portion of the dose equivalent received from radiation sources outside the body.

Extremity—The hand, elbow, arm below the elbow, foot, knee, or leg below the knee.

Extremity Dose Equivalent—The external dose equivalent to the extremities assessed at a tissue depth of 7 millimeters (7 mg/cm^2). This limit, set by 10 CFR Part 20 as the allowable dose to the skin of the whole body or the skin of the extremities, is 50 rem (0.5 Sv) in a year.

Extremity Dosimeter—A monitoring device used to determine the dose equivalent delivered to the extremities of the body. USAFSAM currently uses only the ring dosimeter (sometimes called a "finger ring") for extremity monitoring.

Eye Dose Equivalent—The external dose equivalent assessed at a tissue depth of 0.3 centimeters (300 mg/cm^2). This total value must not exceed 37.5 mSv (3.75 rem) per quarter or 150 mSv (15 rem) in one year.

Gray (Gy)—Unit of absorbed dose that is equivalent to 100 rad.

Head Dose Equivalent—The external dose equivalent to the head assessed at a tissue depth of 10 millimeters (1000 mg/cm^2). This total value must not exceed 12.5 mSv (1.25 rem) per quarter. 10 CFR Part 20 limits this to 50 mSv (5 rem) in one year and with a maximum of 30 mSv (3 rem) in any quarter.

High Radiation Area—An area accessible to individuals in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in

excess of 1 mSv (0.1 rem) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

Installation Radiation Safety Officer (IRSO)—An individual, normally a health physicist, bioenvironmental engineer, Department of the Air Force civilian, or a qualified bioenvironmental engineering craftsman designated in writing by the installation commander to manage the radiation safety program for the installation or using activity.

Intake—The act of taking radioactive material into the body by inhalation, absorption through the skin, injection, ingestion, or through wounds.

Internal Dose—That portion of the dose equivalent received from radioactive material taken into the body.

Intrinsic Radiation—Ionizing radiation emitted through the weapon surface or directly from exposed components of nuclear weapons.

Investigation Action Level—(1) A dose equivalent value or radionuclide intake activity set by the installation RSO that requires further investigation when exceeded. A 10% default value is recommended for all dose types (e.g., 1.25 mSv (125 mrem) for whole body quarterly badges, 3.75 mSv (375 mrem) for lens of eye quarterly badges, 12.5 mSv (1250 mrem) for extremity quarterly badges, 0.25 mSv (25 mrem) for pregnant women monthly badges), however, at the IRSO discretion, levels can be tailored to each using section's historical dosimetry data in order to promptly identify and correct adverse trends. (2) The committed effective dose equivalent from radioactive material ingested, inhaled, or otherwise taken into the human body or dose equivalent from an external radiation source to which the worker is occupationally exposed which justifies further investigation.

Ionizing Radiation—Any electromagnetic or particulate radiation capable of producing ions, directly or indirectly in its passage through matter. Ionizing radiation includes gamma rays, x-rays, alpha particles, beta particles, neutrons, protons and other particles and electromagnetic waves capable of producing ions.

Lens Dose Equivalent (HE)—The dose equivalent to the lens of the eye from external exposure of the lens of the eye to some ionizing radiation source. It is measured at an eye lens tissue depth of 0.3 cm (300 mg/cm^2).

License—A license issued under the regulations in Parts 30 through 36, 39, 40, 50, 60, 61, 70, or 72 of Title 10, Code of Federal Regulations.

Licensed Material—Source material, special nuclear material, or byproduct material received, possessed, used, transferred or disposed of under a general or specific license issued by the Nuclear Regulatory Commission.

Licensee—The holder of a license.

Limits (dose limits)—The permissible upper bounds of radiation doses.

Mark N2—A specific model of an electronic personal dosimeter used by the AF that is sensitive to gamma radiation, x-rays, and neutrons.

Master Radiation Exposure Registry (MRER)—The AF's sole permanent record keeping registry of occupational ionizing radiation exposures for all personnel (past and present) enrolled in the dosimetry program.

Monitoring (radiation monitoring, radiation protection monitoring)—The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses.

Moonlighting—Off-duty employment; in this manual, it refers to off-duty employment where individual is occupationally exposed to radiation.

National Voluntary Laboratory Accreditation Program—A program administered by the National Institute of Standards and Technology for the accreditation of ionizing radiation dosimetry processing laboratories.

Neutron Dosimeter—A monitoring device that has special filtration to enable it to distinguish between fast and thermal neutrons.

Occasionally-Exposed Individual—An individual whose work is not normally performed in a restricted area and whose duties do not normally involve exposure to ionizing radiation or radioactive material. Such individuals may, however, have reason to enter a restricted area in the performance of their duties. Examples are messengers, deliverymen, and maintenance workers.

Occupational Dose—The dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to radiation and/or radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person. Occupational dose does not include doses received from background radiation, from any medical administration the individual has received, from exposure to patients administered radioactive material and released in accordance with applicable regulations, from voluntary participation in medical research programs, or as a member of the public.

Occupational Exposure—Routine exposure of Department of Defense (DoD) personnel to radiation associated with DoD operations during performance of their official duties. Occupational exposure does not include exposures from natural background radiation or those as a patient of practitioners of the healing arts.

Overexposure (quarterly or annual)—Any accumulated or one-time ionizing radiation exposure exceeding the limits mandated by DoDI 6055.08.

Permit—A written authorization to possess and use radiation sources issued by AFMRA/SG3PB under the provisions of the NRC Air Force Master Material License.

Quarter—A period of time equal to one-fourth of the year observed by the licensee. (approximately 13 consecutive weeks), providing that the beginning of the first quarter in a year coincides with the starting date of the year and that no day is omitted or duplicated in consecutive quarters.

Radiation Absorbed Dose or Rad—A conventional unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs/gram or 0.01 joule/kilogram (0.01 Gray).

Radiation (ionizing radiation)—Alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation, as used in 10 CFR Part 20, does not include non-ionizing radiation, such as radio waves, microwaves, or visible, infrared, or ultraviolet light.

Radiation Area—An area accessible to individuals in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 mSv) in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

Radiation Monitoring—Evaluating or measuring radiation levels and amounts or concentrations of radionuclides in air, water, or other materials to evaluate potential exposures and doses to personnel.

Radiation Sources—Radioactive material, equipment, or devices which spontaneously generate or are capable of generating ionizing radiation. Examples include nuclear reactors, medical and dental radiographic and fluoroscopic x-ray systems, particle generators and accelerators, certain electromagnetic generators operating at electrical potentials that result in the production of x-rays, x-ray diffraction, industrial radiographic and spectrographic equipment, electron microscopes, electron-beam welding, melting, and cutting equipment, nuclear moisture or density gauges, byproduct, source, and special nuclear materials, natural or accelerator-produced radioactive materials, materials containing induced or deposited radioactivity and radioactive commodities.

Radiological Response Operation—Any incident or accident that poses a radiological threat to military personnel, ranging from exposure to depleted uranium munitions, to the hazards posed by a potential terrorist use of improvised nuclear devices, radiological dispersion devices, or an accident or incident in the nuclear stockpile. Additionally, historical commercial nuclear power plant incidents indicate that accidents and/or malevolent use of radioactive material from civilian sources is possible and may have direct impact on AF installations.

Radionuclide—An unstable isotope of an element that decays or disintegrates spontaneously, thereby emitting radiation. It is characterized by its atomic number (Z), mass number (A) and nuclear energy state.

Roentgen Equivalent Man (rem)—The conventional unit of any of the quantities expressed as dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rad multiplied by the quality factor Q [(1 rem = 0.01 Sievert) and (1 rem = 1,000 millirem)].

Respiratory Protection—An apparatus, such as a respirator, used to reduce the individual's intake of airborne radioactive materials.

Restricted Area—An area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation sources and radioactive materials. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

Shallow—**Dose Equivalent (Hs)**—The external exposure of the skin or an extremity which is taken as the dose equivalent at a tissue depth of 0.007 cm (7 mg cm^2—the average depth of the germinal cell layer) averaged over an area of 1 cm^2.

Source Material—(1) Uranium or thorium, or any combination of uranium or thorium in any physical or chemical form; or (2) ores that contain by weight one-twentieth of 1 percent (0.05 percent), or more, of uranium, thorium, or any combination of uranium and thorium. Source material does not include special nuclear material.

Special Nuclear Material (SNM)—Plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope 235; any other material that the NRC determines to be SNM and any material artificially enriched by the foregoing. SNM does not include source material.

Sievert (Sv)—The international unit of any of the quantities expressed as dose equivalent. The dose equivalent in Sievert is equal to the absorbed dose in Gray multiplied by appropriate radiation weighting factors, wR (1 Sv = 100 rem). One milliSievert (mSv) is 0.001 Sv [0.1 rem or 100 mrem].

Survey—An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

Total Effective Dose Equivalent—The sum of the deep dose equivalent (H_D) (for external exposures) and the committed effective dose equivalent (for internal exposures) expressed in units of either rem or Sv. This is labeled as "All Source Total Effective Dose Equivalent" on RDL Listing 1499-1 and RDL Listing 1499-2.

Total Organ Dose Equivalent—The sum of the deep dose equivalent and the committed dose equivalent expressed in units of rem or Sv for the maximally exposed organ.

Visitor—A person who does not normally work in an AF controlled radiation area, but who may be authorized to enter the area by the IRSO providing suitable dosimetry and/or protective equipment is available.

Whole Body—For purposes of external exposure, the head, trunk (including male gonads), arms above the elbow, or legs above the knee.

Year—The period of time beginning in January used to determine compliance with NRC dose limits. The licensee may change the starting date of the year used to determine compliance by the licensee, provided that the change is made at the beginning of the year and that no day is omitted or duplicated in consecutive years.