

DEPARTMENT OF THE ARMY
 HEADQUARTERS, U.S. ARMY MEDICAL DEPARTMENT CENTER
 AND SCHOOL AND FORT SAM HOUSTON
 Fort Sam Houston, Texas 78234-6142

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 No. 40-1

Medical Services
RADIATION SAFETY PROGRAM

1. **HISTORY.** This issue publishes a revision of this publication. Because the publication has been extensively revised, the changed portions have not been highlighted.

2. **PURPOSE.** This memorandum outlines responsibilities and procedures for the control of potential health hazards resulting from the procurement, possession, use, storage, and transportation of radioactive material, equipment capable of producing ionizing radiation, and equipment capable of producing potentially hazardous levels of non-ionizing radiation within the U.S. Army Medical Department Center and School (AMEDDC&S) and Fort Sam Houston (FSH). While it is recognized that there may be other hazards associated with radioactive materials and radiation-producing devices (e.g., chemicals, high voltage, etc.), this memorandum does not address such hazards. The intent of the program outlined in this memorandum is to keep radiation exposure to personnel and members of the general public As Low As Reasonably Achievable (ALARA).

3. **REFERENCES.**

- a Code of Federal Regulations, Title 10 - Energy,
- b Code of Federal Regulations, Title 29 - Labor,
- c Army Regulation 11-9, The Army Radiation Safety Program, 28 May 1999.
- d Army Regulation 40-5, Preventive Medicine, 15 Oct 90.
- e. Department of the Army Pamphlet 40-18, Personnel Dosimetry Guidance and Dose Recording Procedures for Personnel Occupationally Exposed to Ionizing Radiation, 30 June 1995.
- f. Technical Bulletin (Medical) 521, Management and Control of Diagnostic X-Ray, Therapeutic X-Ray, and Gamma-Beam Equipment, June 1981.
- g. Technical Bulletin (Medical) 523, Control of Hazards to Health from Microwave and Radio Frequency Radiation and Ultrasound, July 1980.
- h. Technical Bulletin (Medical) 524, Control of Hazards to Health from Laser Radiation, June 1985.
- i. Technical Bulletin (Medical) 525, Control of Hazards to Health from Ionizing Radiation Used by the Army Medical Department, March 1988.
- j. U.S. Army Medical Command Regulation 40-42, U.S. Army Medical Command Radiation Safety Program, 20 March 2002.
- k. Fort Sam Houston Memorandum 385-11, Radiation Protection Program, 18 May 1998.

*This memorandum supersedes AMEDDC&S Memo 40-1, 27 April 1992

1. Brooke Army Medical Center Memorandum 40-72, Ionizing Radiation Protection Program, 1 July 1999.

m. Memorandum of Agreement Between the U.S. Army Medical Department Center and School and Brooke Army Medical Center, Authorization for Use of Radioactive Materials, 22 June 2001.

4 EXPLANATION OF ABBREVIATIONS AND TERMS

a. 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).

b. Authorized Clinician. Physician, dentist, or other healthcare professional legally authorized to write prescriptions for patients under their care.

c. Committed Dose Equivalent. The dose equivalent to organs or tissue of reference that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

d. Contamination. Radioactive material in any area where it is not desirable and particularly in those areas where its presence could be harmful.

e. Controlled Area. A clearly defined area, posted with "Radioactive Material," "Radiation Area," or "High Radiation Area" signs, in which the exposure of personnel to radiation is under the supervision of an individual charged to enforce radiation protection practices. A controlled area may require monitoring devices and/or measurements to control access, occupancy, or working conditions for radiation protection purposes.

f. Deep Dose Equivalent. Applies to external whole-body exposure and is the dose equivalent at a tissue depth of 1 centimeter (1000 mg cm^{-2}).

g. Dose Equivalent. The product of absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest in tissue. The units of dose equivalent are the rem and sievert (Sv).

h. Effective Dose (same as effective dose equivalent). The sum of the products of the dose equivalent to the organ or tissue and the weighing factors applicable to each of the body organs or tissues that are irradiated. The units of dose equivalent are the rem and Sv.

i. Electron Volt (eV). A unit of energy equal to 1.6×10^{-19} joule (the kinetic energy gained by an electron accelerated through one volt of potential difference).

j. High Radiation Area. An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

k. Ionizing Radiation Producing Device. Any device that produces charged subatomic particles and ionized atoms with kinetic energies greater than 12.4 eV (enough energy to remove electrons from atoms), electromagnetic radiation with photon energies greater than 12.4 eV, and all free neutrons and other uncharged atomic and subatomic particles (except neutrinos and antineutrinos).

l. Limited Occupancy Area (Radiofrequency Radiation). Any accessible area in which the incident power density of the radiation is in excess of 10 milliwatts/cm², but not more than 50 milliwatts/cm².

m. Microwave Protection Standard. The microwave protection standard is defined as 10 milliwatts/cm² for continuous exposure based on average radiation output. Microwave radiation at 10 milliwatts/cm² has not caused detectable bodily harm/injury to a person at any time during their lifetime.

n. Non-Ionizing Radiation. Electromagnetic radiation with photon energies less than 12.4 eV.

o. Occasionally Exposed Individual. An individual whose work is not normally performed in a controlled area and whose duties do not normally involve exposure to radiation; however, the individual may have reason to enter a controlled area in the performance of duties (messenger, delivery person, maintenance worker, etc.). The exposure to radiation shall not be in excess of that allowed to any individual in the population at large.

p. Occupationally Exposed Individual (synonym: Radiation Worker). An individual whose work is performed in a controlled area and whose duties may involve exposure to radiation in excess of 10 percent of the quarterly basic occupational exposure standard (see Table 1).

q. Personnel Dosimetry Custodian. The person designated, in writing, by the Radiation Safety Officer (RSO) that is responsible for managing the personnel dosimetry program.

r. Radiation Accident. An unforeseen occurrence, either actual or suspected, involving exposure or contamination of humans and the environment by ionizing or non-ionizing radiation, over a short period of time, from seconds to several days. Chronic occupational or long-term exposure is not considered accidental.

s. 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 centimeters from the radiation source or from any surface that the radiation penetrates.

t. Radiation Facilities. Rooms or areas that have been approved by the RSO for the safe use and operation of radiation-producing devices or material; or rooms or areas approved by the RSO for radioactive materials not governed by the Nuclear Regulatory Commission (NRC); or rooms or areas approved by the Brooke Army Medical Center (BAMC) Radiation Control Committee for radioactive materials governed by the NRC.

u. Radiation Incident. Any unplanned occurrence involving the possession, use, storage, or transfer of radioactive material or radiation-producing equipment as a result of fire, spill, loss of control, etc., and which has the potential to overexpose personnel to the radiation.

v. Radiation Safety Officer (same as radiation protection officer). An individual designated by the Commander, AMEDDC&S, to provide consultation and advice on the degree of hazard associated with radiation and on the effectiveness of measures to control this hazard. The RSO is technically qualified by virtue of education, training, or professional experience to competently manage the Radiation Safety Program (RSP) for which he/she will be responsible. The term RSO is not intended to denote commissioned status. Alternate Radiation Safety Officers (ARSOs) may be designated to assist the RSO and are under the staff supervision of the RSO for implementation of the RSP.

w. Radiation Source. Materials, equipment, or devices that emit or are capable of generating ionizing or non-ionizing radiation.

x. Radiation Survey. Evaluation of potential radiation hazards in and around a facility. Surveys can include a physical survey of the arrangement

and use of the radiation-producing equipment, a review of applicable safety standing operating procedures (SOPs), measurements of ambient exposure rates, and measurements of radioactive contamination.

y Radiation Worker See Occupationally Exposed Individual

z. Radioactive Material Area. Any area in which radioactive material is present in levels exceeding the limits specified in Title 10, Code of Federal Regulation, Part 1020 (10 CFR 1020), Appendix C.

aa. Restricted Area. Any area designated by the RSO where specific access controls are required and precautionary measures are taken for the purpose of protecting individuals from exposure to ionizing radiation or radioactive material.

bb. Sealed Source. A radioactive material source that is encapsulated to contain radioactive material and prevent the spread of radioactive contamination.

cc. Shallow Dose Equivalent. Applies to the external exposure of the skin or an extremity and is taken as the dose equivalent at a tissue depth of 0.007 centimeter (7 mg cm^{-2}) averaged over an area of 1 square centimeter.

dd. Total Effective Dose Equivalent. The sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

5. APPLICABILITY

a This memorandum applies to all elements of the AMEDDC&S & FSH.

b. The definitions and limitations are based on peacetime standards for occupational exposure of personnel to ionizing and non-ionizing radiation and may not be applicable in a tactical or combat zone environment.

6. RESPONSIBILITIES

a. The Commander, AMEDDC&S, is responsible to ensure that adequate measures are established for the control of health hazards from potentially hazardous radiation sources within this command. The Commander shall appoint an RSO in writing, in accordance with Army Regulation (AR) 11-9, to implement the RSP. One or more ARSOs may also be appointed to assume the duties of the RSO during his/her absence.

b The RSO shall:

(1) Advise the Commander and personnel within the organization on the degree of hazard associated with the use of ionizing and non-ionizing radiation sources and the effectiveness of measures established to control such hazards.

(2) Ensure all commitments made by the AMEDDC&S in the BAMC Memorandum of Agreement (MOA) are met.

(3) Maintain a radiation permit from BAMC for the use of radioactive materials.

(4) Serve as a member of the BAMC Radiation Control Committee.

(5) Make initial and periodic surveys of areas where radiation sources or devices are used and stored and to ensure that users are complying with the various rules and regulations established for radiation protection.

(6) Ensure that leak testing of radiation sources is accomplished in accordance with appropriate directives.

(7) Maintain required records, reports, inventories, and registries relative to the licensing and control of ionizing or non-ionizing radiation sources.

(8) Compile an inventory, to include specific location of ionizing radiation sources that is reviewed and updated at least every 6 months.

(9) Implement the AMEDDC&S RSP to ensure compliance with all applicable regulations and the BAMC MOA.

(10) Maintain the Personnel Dosimetry Program

(11) Designate a Personnel Dosimetry Custodian in accordance with Department of the Army (DA) Pamphlet 40-18.

(12) Provide an annual radioactive materials inventory to the Fort Sam Houston Installation RSO.

(13) Provide initial and annual radiation safety training to all radiation workers assigned to the AMEDDC&S.

(14) Provide declared pregnant workers with appropriate counseling and take other precautionary measures to protect the unborn child and mother as deemed appropriate.

(15) Provide safety warning signs.

c. Chiefs (supervisors) of all elements possessing radiation sources or radiation-producing devices shall:

(1) Comply with all applicable federal, Department of Defense/DA, state, and local regulations pertaining to the safe use of radiation.

(2) Ensure that radiation sources under their control are used only by appropriately trained personnel.

(3) Develop, supervise, and enforce radiation safety procedures.

(4) Write SOPs on radiation safety for sources of radiation under their control. The SOPs must be staffed with the AMEDDC&S RSO prior to final publication.

(5) Ensure approved SOPs are posted in or near the working areas where there are sources of radiation.

(6) Review SOPs annually and update as necessary.

(7) Ensure personnel, who operate ionizing radiation-producing devices, handle radioactive material, or are otherwise occupationally exposed to radiation receive annual radiation safety training. This instruction will include appropriate information regarding:

(a) Nature of hazard.

(b) Rules, regulations, and procedures necessary for the safe use of radiation.

(c) Proper use of protective equipment

(d) Proper use of radiation detection equipment and personal monitoring devices or dosimeters.

(e) Procedures to be followed when an incident occurs or in the event of an emergency involving a radiation source.

(8) Forward records of radiation protection training to the RSO. Records of training will include the type of training, the date of training, name of the instructor, and printed names, social security numbers, and signatures of the attendees.

(9) Ensure that permanent party radiation workers newly assigned to the activity, in process with the RSO, receive initial radiation safety training, and apply for dosimetry if applicable, before assuming duties that entail occupational exposure to ionizing radiation.

(10) Notify the RSO 30 days prior to the departure of a permanently assigned radiation worker.

(11) Provide an updated listing of radiation workers to the RSO

(12) Inform the RSO upon receiving any source of ionizing radiation (including radiation-producing devices) or significant source of non-ionizing radiation (i.e., lasers or radiofrequency generators that have the potential to cause harm to the users or general public-laser pointers and microwave ovens generally do not fall into this category).

d. Radiation workers shall:

(1) Take necessary measures to protect themselves and others from unnecessary exposure to radiation, including complying with this memorandum and other applicable regulations and SOPs.

(2) Wear personal monitoring devices in accordance with prescribed directives and instructions of the RSO.

(3) Report any incident involving radioactive materials or radiation-producing devices immediately to their supervisor and the RSO.

(4) Report any work to the RSO which is outside normal duty hours ("moonlighting") that involves occupational radiation exposure. Provide the RSO with exposure records not later than 60 days after receiving them, or 120 days after termination of employment, whichever is earlier.

(5) The worker may, but is not required to, declare pregnancy to the RSO for the purposes of limiting radiation exposure to the developing fetus. It is recommended that the worker notify the RSO as soon as possible, so that appropriate counseling and any other precautions deemed prudent may be initiated.

7. CONTROL PROCEDURES

a Requirements for controlled areas

(1) Restricted Area. A restricted area will be under the supervision of an individual, authorized by the RSO in writing, to use sources of radiation in that area and will be responsible for the safety of the workers in that area.

(2) Radiation Area. Each radiation area shall be conspicuously posted with a sign bearing the radiation caution symbol and the words:

CAUTION
RADIATION AREA

(3) High Radiation Area

(a) A high radiation area shall not be established without the approval of the RSO except in an emergency.

(b) Each high radiation area established for more than 30 days shall be equipped with control devices in accordance with 10 CFR 1020.203 or 10 CFR 29 1919.96.

(c) Each high radiation area shall be conspicuously posted with a sign bearing the radiation caution symbol and the words:

CAUTION
HIGH RADIATION AREA

(4) Radioactive Material Area

(a) Each area or room and principal container in which radioactive material is stored or used shall be conspicuously posted with a sign bearing the radiation caution symbol and the words:

CAUTION
RADIOACTIVE MATERIAL AREA

(b) Containers with samples, working solutions, laboratory standards, check sources, etc., must be labeled, segregated, or otherwise identified in such a manner that personnel in the area recognize that radioactive material is present in that container. Radioactive marking tape may be used for this purpose. The label should include the radionuclide, activity, and date/time that the activity was determined.

b Posting of Signs

(1) Areas in which radioactive materials, exceeding the license exempt limits established in 10 CFR 1020, are used or stored shall be conspicuously posted with "Caution Radioactive Materials" signs and labeled in accordance with the provisions of 10 CFR 1020.

(2) For diagnostic x-ray facilities, radiation area signs shall be posted in each accessible area wherein a person could receive a dose equivalent in excess of five mrem, in any 1 hour, to a major portion of the whole body. "High Radiation Area" warning signs shall be posted where a person could receive 100 mrem in any 1 hour. Exceptions are permitted based upon guidance in Technical Bulletin, Medical (TB MED) 521 and with the approval of the RSO.

(3) Cardiac pacemaker warning signs must be placed near entrances of rooms in which microwave or radiofrequency radiation-producing devices are operating in accordance with TB MED 523. The posting of warning signs for microwave ovens is not required.

c. Radioactive materials (to include military standard sources).

(1) Radioactive material or equipment capable of producing radiation shall be used in accordance with the rules, regulations, and the conditions of any specific NRC licenses, certificates, or DA authorizations. Requests for an authorization to use radioactive materials or amendments to existing authorizations will be submitted to the RSO. Authorization to use radioactive materials governed by the NRC requires the approval of the BAMC Radiation Control Committee.

(2) Departments within the AMEDDC&S will notify the RSO when supplies or equipment containing radioactive materials are received at the AMEDDC&S. The RSO will ensure monitoring of incoming shipments and verify the receiver is an authorized user before the materials are consigned to the user.

(3) Sealed radiation sources which require leak testing will be tested, and the results recorded by the RSO at the prescribed frequency in accordance with BAMC Memo 40-72 and the BAMC MOA.

(4) The RSO will collect and dispose of radioactive waste through the BAMC Health Physics Service in accordance with AR 11-9 and 10 CFR 1020.

d Ionizing radiation-producing devices

(1) A registry of ionizing radiation-producing devices will be maintained by the RSO in accordance with TB MED 521. Input to this registry will be provided by the user activity whenever a change occurs and during the semiannual review.

(2) A radiation protection survey shall be conducted on all new or modified ionizing radiation facilities. Surveys of existing installations shall be done on request or at the discretion of the RSO to ascertain that the equipment, structural shielding, and operating procedures are in accordance with pertinent directives, standards, and guides.

(3) The RSO shall perform surveys of x-ray producing devices in accordance with TB MED 521.

(a) No person shall be exposed, as a patient, to the primary beam of an x-ray producing device solely for training purposes. Training can be conducted in conjunction with diagnostic procedures prescribed by an authorized clinician, provided that the system is authorized for human use.

(b) The control panel of x-ray systems not approved for human use will be labeled "CAUTION: Produces X-Rays, Not Authorized for Human Use." Under no circumstances will a person be exposed, as a patient, to the radiation of a system not authorized for human use.

(c) Individuals performing radiation surveys to approve x-ray systems for human use will label the system's control panel with the required resurvey date on a label reading "CAUTION: Produces X-Rays, Authorized for Human Use Until <date>." X-Ray systems authorized for human use may be used for diagnostic procedures when directed by an authorized clinician.

(d) X-ray simulators or their rooms will be labeled or posted to indicate that they are training devices only that do not produce x-rays.

(e) The entrance to rooms containing fixed x-ray systems, or rooms in which portable x-ray systems are in use, will be posted with a sign reading: "Caution, X-Rays."

e. Non-ionizing radiation sources. The supervisor responsible for a non-ionizing radiation source shall comply with all responsibilities outlined in paragraph 6c of this memorandum.

8. RADIATION PROTECTION STANDARDS

a. Occupational ionizing radiation dose limits, and ionizing radiation dose limits for individual members of the public, are described in Table 1

Table 1. Army Personnel Ionizing Radiation Exposure Standards

Category	Maximum ²
Member of the general public.	100 mrem (1 mSv) (TEDE) in calendar year ³ .
Fetus/embryo of occupationally exposed declared pregnant woman.	500 mrem (5 mSv) (DDE of mother + ED due to radionuclides in fetus/embryo) for entire pregnancy.
Occupational exposure of adults.	5 rem (0.05 Sv) (TEDE) in calendar year.
Lens of the eye.	15 rem (0.15 Sv) (EDE) in calendar year.
Individual organ.	50 rem (0.5 Sv) (DDE + CDE) in calendar year.
Skin or extremity.	50 rem (0.5 Sv) (SDE) in calendar year.
Occupational exposure of minors.	10% of limits for adults.

¹ From 10 CFR 1020. Refer to 10 CFR 1020 for detailed standards.

² Abbreviations: TEDE = total effective dose equivalent; DDE = deep dose equivalent; ED = effective dose; EDE = effective dose equivalent; CDE = committed dose equivalent; SDE = shallow dose equivalent.

³ OSHA standard for occupational exposure of adults and for the lens of the eye is 1¼ rem in calendar quarter. OSHA standard for skin of whole body is 7½ rem in calendar quarter. OSHA standard for hands and forearms; feet and ankles is 18¼ rem in calendar quarter.

⁴ The dose in any unrestricted area from external sources, exclusive of the dose contributions from patients administered radioactive material and released in accordance with applicable regulations, will not exceed 2 mrem (0.02 mSv) in any one hour.

b. Every effort will be made to maintain radiation exposures ALARA. Positive efforts will be carried out to fulfill this objective.

c. Investigation levels (ILs), established in order to monitor individual occupational external radiation exposures, are set forth in Table 2.

Table 2. Investigation Levels

Investigation Levels (ILs)				
Type of Exposure	Monthly ILs (rem)		Quarterly ILs (rem)	
	Level 1	Level 2	Level 1	Level 2
Total effective dose equivalent.	0.042	0.125	0.125	0.375
-----	0.417	1.250	1.250	3.750
-----		0.375	0.375	1.125
Shallow dose to skin or extremity.	0.417	1	-----	3.750

(1) The following are ILs for occupational external radiation exposure which, when exceeded, will initiate review or investigation by the RSO. These ILs apply to the exposure of individual radiation workers on either a monthly basis or a quarterly basis depending on the workers respective dosimetry exchange cycle.

(2) The RSO will review the personnel dosimetry records at least once per calendar quarter. The following actions will be taken at the ILs stated in Table 2.

(a) Except when deemed appropriate by the RSO, no further action will be taken in those cases where an individual's exposure is less than IL-1 values in Table 2.

(b) Personnel dose equal to or greater than IL-1 but less than IL-2. The RSO will review the dose of each worker whose quarterly dose equals or exceeds IL-1. The affected worker and his supervisor will review workload and practices to determine how to maintain exposures ALARA. The RSO will maintain documentation of this review. No action related specifically to the dose is required unless deemed appropriate by the RSO.

(c) Personnel dose equal to or greater than IL-2. The RSO will investigate in a timely manner the cause(s) of all personnel exposures equaling or exceeding IL-2 and, if warranted, take corrective action. A report of the investigation and corrective actions taken, if any, will be submitted to the Dean, Academy of Health Sciences. If the exposure to NRC-licensed materials caused the dose, the investigation will be performed jointly with the BAMC RPO, and the results reported to the BAMC Radiation Control Committee.

9. PERSONNEL DOSIMETRY

a. Dosimetry requirements are determined by the RSO in accordance with DA PAM 40-18.

b The Personnel Dosimetry Custodian will

- (1) Issue dosimetry to all radiation workers, as directed by the RSO
- (2) Collect all dosimetry at the end of the designated wearing period and exchange them for new ones.
- (3) Issue annual dosimetry reports to permanently assigned radiation workers, through the worker's supervisor.
- (4) Discontinue dosimetry on radiation workers when they terminate employment at the AMEDDC&S.
- (5) Provide dosimetry reports to exposed individuals or other authorized individuals on request.

c. Dosimeter Exchange Cycles. The basic dosimeter exchange cycle is quarterly. Selected groups or individual workers deemed at higher risk of routine or accidental exposure may participate in a monthly exchange cycle at the discretion of the RSO.

d. U.S. Army Medical Department Center and School-issued personnel dosimeters will not be worn at facilities other than the AMEDDC&S, except as authorized by the RSO.

e. Radiation workers shall not wear personnel dosimetry devices while undergoing medical or dental diagnostic or therapeutic treatment with ionizing radiation.

f. Personnel permanently assigned to the AMEDDC&S, beginning or ending dosimetry service at the AMEDDC&S, shall report to the RSO's office during normal duty hours with their medical records for processing.

10. ORDERING AND RECEIVING RADIOACTIVE MATERIAL.

a General.

- (1) The RSO has oversight responsibility for all radioactive material at the AMEDDC&S to include movement into, storage within, and movement out of the facility.
- (2) Questions concerning procurement, receipt, transfer, and shipment of radioactive material shall be directed to the RSO.

b. Procurement and receipt of radioactive material. No radioactive materials for use under the BAMC NRC license shall be procured or received without the prior approval of the BAMC RSO. Procurement and receipt of radioactive material must also be approved by the RSO, AMEDDC&S. All radioactive materials will be received by the BAMC Health Physics Service and transferred to the AMEDDC&S.

c. Storage. Radioactive materials shall only be stored in areas designated in writing by the RSO. The written designation, and other appropriate documents, shall be posted in the storage area.

11. RADIATION SURVEYS.

a Responsibilities

(1) A formal radiation survey will be performed by the RSO, or his representative, in each radioactive materials use and storage location on at least a quarterly basis. All surveys will be reviewed by the RSO.

(2) A formal survey of all ionizing radiation-producing devices will be conducted by the RSO, or his representative, upon installation or relocation of the device. Periodic surveys will be conducted on at least a biennial basis thereafter.

(a) Human use machines will be tested in accordance with all the appropriate requirements listed in TB MED 521.

(b) All non-human use equipment will be surveyed in accordance with a locally prepared SOP to ensure the safety and health of operators and the general public, and will at least include measurements of x-ray tube leakage and scatter radiation.

(3) The RSO will ensure necessary monitoring, surveys, and evaluations are accomplished as necessary to ensure that unwarranted radiological hazards are not present and exposures are maintained ALARA.

b Area (ambient dose rate) surveys

(1) An area survey shall be conducted with calibrated instrumentation:

(a) at the end of the training day whenever unsealed sources are used in the laboratory, and

(b) on a quarterly basis in designated radioactive materials storage areas

(2) The RSO shall establish action levels prior to the conduct of an area survey

(3) Immediately notify the RSO if any action levels are exceeded

c. Removable contamination surveys

(1) Any laboratory area, where unsealed radioactive material is used, will be surveyed at the end of the training day by taking wipe or smear samples of the work area to check for removable contamination.

(2) The wipe sample assay procedure should be capable of detecting the presence of the removable contamination limits specified in Table 3.

Table 3.^a Surface Radioactivity Values in dpm/100 cm²

Nuclide	Removable ^{b, c}	Total (Fixed + Removable ^{b, d})
^{nat} U, ²³⁵ U, ²³⁸ U, and associated decay products	1,000	5,000
Transuranics, ²²⁶ Ra, ²²⁸ Ra, ²³⁰ Th, ²²⁸ Th, ²³¹ Pa, ²²⁷ Ac, ¹²⁵ I, ¹²⁹ I	20	500
^{nat} Th, ²³² Th, ⁹⁰ Sr, ²²³ Ra, ²²⁴ Ra, ²³² U, ¹²⁶ I, ¹³¹ I, ¹³³ I	200	1,000
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except ⁹⁰ Sr and others noted above ^e	1,000	5,000
Tritium and tritiated compounds ^f	10,000	NA

^a This table is extracted from 10 CFR 835, appendix D. The values in this table apply to radioactive contamination deposited on, but not incorporated into, the interior of, the contaminated item. Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, apply the limits established for alpha- and beta-gamma-emitting nuclides independently.

^b As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

^c The amount of removable radioactive material per 100 cm² of surface area should be determined by swiping the area with dry filter or soft absorbent paper, applying moderate pressure, and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. (Note: The use of dry material may not be appropriate for tritium.) When removable contamination on objects of surface area less than 100 cm² is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. Except for transuranics and ²²⁸Ra, ²²⁷Ac, ²²⁸Th, ²³⁰Th, ²³¹Pa and alpha emitters, it is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination. The levels may be averaged over one square meter provided the maximum surface activity in any area of 100 cm² is less than three times the value specified. For purposes of averaging, any square meter of surface shall be considered to be above the activity guide G if: (1) From measurements of a representative number

n of sections, it is determined that $\frac{1}{n} \sum_{i=1}^n S_i \cdot c$, where S_i is the dpm/100 cm²

determined from measurement of section i ; or (2) it is determined that the sum of the activity of all isolated spots or particles in any 100 cm² area exceeds 3G.

^d This category of radionuclides includes mixed fission products, including the ⁹⁰Sr which is present in them. It does not apply to ⁹⁰Sr that has been separated from the other fission products or mixtures where the ⁹⁰Sr has been enriched.

^e Tritium contamination may diffuse into the volume or matrix of materials. Evaluation of surface contamination shall consider the extent to which such contamination may migrate to the surface in order to ensure the surface radioactivity value provided in this table is not exceeded. Once this contamination migrates to the surface, it may be removable, not fixed; therefore a "Total" value does not apply.

(3) In the absence of other regulatory or advisory guidance, a surface is contaminated if either the removable or total radioactivity is above the levels in Table 3.

(a) If a surface cannot be promptly decontaminated to levels below those in Table 3, it shall be controlled, marked, designated, and/or posted in accordance with guidance from the RSO.

(b) Always reduce radioactive contamination to levels ALARA

(4) Immediately notify the RSO if contamination exceeding the limits listed in Table 3 are found.

d. Survey of Radiation Safety Equipment. Fluoroscopic evaluation of all lead (Pb) aprons and gloves by the RSO, or his representative, will occur on at least an annual basis. This safety check will ensure that the Pb is intact and providing intended protection to the wearer. All safety equipment that is determined to be unsafe or defective will be removed from service.

Records.

(1) The RSO shall maintain a record of dose rate and contamination survey results. It will include the following information:

(a) The date, area surveyed, survey equipment used, and date of survey equipment calibration.

(b) The name of the person who conducted the survey.

(c) A priority action level established by the RSO

(d) A drawing of the areas surveyed annotated with removable contamination and dose rate action levels which have been established by the RSO.

(e) Measured dose rates in mR/hr or the contamination levels in dpm/100 cm².

(f) Actions taken in the case of excessive dose rates or contamination and follow-up survey information.

(2) The RSO will review and initial the record at least quarterly and more promptly in those cases in which action levels were exceeded.

(3) File numbers designated in AR 11-9 will be used for RSO records.

12. LEAK TESTING OF SEALED SOURCES.

a. Criteria for leak testing. Each sealed source shall be tested for leakage or contamination prior to use or transfer to another license and at least semiannually except for those sealed sources which individually meet any of the following criteria:

(1) Has a radionuclide with a half-life of less than 30 days

(2) The radioactive source is present solely in a gaseous form, such as Krypton-85 contained in MX-7338 sealed sources.

(3) The sealed source contains 100 microcuries or less of a beta and/or gamma emitting radionuclide in non-gaseous form or 10 microcuries or less of an alpha-emitting radionuclide in non-gaseous form.

(4) The sealed sources are not being used and are being kept in storage by the RSO

b. The RSO is responsible for the performance, analyses, and posting of records for leak tests of sealed radioactive sources. The RSO will submit a written leak test report to the BAMC Health Physics Service in accordance with the Authorized User Permit.

13. CALIBRATION OF RADIATION DETECTION/SURVEY INSTRUMENTS.

a. The AMEDDC&S routinely sends a dedicated radioactive check source with radiation detection, identification and computation (RADIAC) instruments when such instruments are sent to the calibration center.

(1) Once such a RADIAC instrument is returned from the calibration center, its radiation detection probe is placed directly on top of, and centered on, the check source dedicated to that instrument. The apparent RADIAC instrument exposure rate, due to evaluating the instrument's response to the check source dedicated to the particular instrument, is annotated onto

a self-adhesive label that is then affixed to the side of the instrument housing. The date and initials of the Health Physics individual performing this check source test is also written on the label. Also, this information is annotated in the logbook with additional information.

(2) Radiation survey instruments shall be evaluated with the dedicated check source prior to the use of the instrument. This quality control procedure verifies the proper response of the instrument.

b Calibration Frequency

(1) Survey instruments used for health and safety purposes will be calibrated at least annually or upon repair.

(2) Survey instruments used strictly for student training purposes will be calibrated in accordance with DA regulations.

14. RADIOLOGICAL EMERGENCIES

a. General. With all the complicating factors that may develop during a radiation incident, it is not feasible to establish rules or procedures to cover all situations. In any radiation incident, the primary concern must always be the protection of personnel from radiation injury. In any accident or incident involving radioactive material, a secondary concern is the confinement of contamination to the immediate area so that further exposure of personnel will be limited.

b. Fire Control. To reduce the possibility of fire or other major disasters, rooms where radioactive materials are stored or handled should be as fireproof as possible.

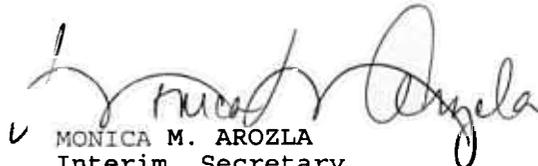
c. Any accident or incident involving a radiation source shall be reported immediately to the supervisor, the senior officer in the department, the RSO, and the AMEDDC&S Safety Officer.

15. MEDICAL EXAMINATIONS. Medical examinations of radiation workers shall be performed in accordance with AR 11-9 at the nearest health care facility when deemed appropriate by the RSO or local medical officer.

(MCCS-HP)

FOR THE COMMANDER

OFFICIAL:


MONICA M. AROZLA
Interim, Secretary
of the General Staff

Thomas E. Bailey
THOMAS E. BAILEY
LTC, FA
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