BY ORDER OF THE COMMANDER
460TH AIR BASE WING

460TH AIR BASE WING INSTRUCTION 40-201

17 APRIL 2003

Medical Command

RADIATION (IONIZING) SAFETY PROGRAM

COMPLIANCE WITH THIS PUBLICATION IS MANDATORY

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This instruction implements and reflects 10 CFR Part 20, *Standards for Protection Against Radiation,* and 10 CFR Part 19, *Notices, Instructions and Reports to Workers: Inspection and Investigations,* published by the US Nuclear Regulatory Commission (USNRC). This instruction describes the responsibilities of all personnel involved with the control and use of radioactive material (RAM) and radiation-producing devices (RPD). It also describes necessary procedures for the implementation of an effective radiation safety program at Buckley Air Force Base (BAFB). This instruction applies only to ionizing radiation sources. Nonionizing radiation sources, such as lasers and microwave emitters, are not covered by this instruction. Governing directives for the radiation safety program are DoDI 6055.8, *Occupational Radiation Protection Program*, Air Force Policy Directive (AFPF) 40-2, *Radioactive Materials (Non-Nuclear Weapons),* Air Force Instruction (AFI) 40-201, *Managing Radioactive Materials in the USAF*, and AFI 48-125, *The USAF Personnel Dosimetry Program.* See **Attachment 1** for a glossary of references and supporting information.

Maintain and dispose of records created as a result of prescribed processes in accordance with Air Force Manual (AFMAN) 37-139, *Records Disposition Schedule* (will convert to AFMAN 33-322, Volume 4). Comply with AF Instruction (AFI) 33-332, *Air Force Privacy Act Program*, for documents containing: "Privacy Act Information". For "Official Use Only" information comply with Department of Defense Regulation (DoD) 5400.7-R/AFSUP, *DoD Freedom of Information Act Program*, **Chapter 4.**

1. Responsibilities.

1.1. The Commander, 460th Air Base Wing, Buckley Air Force Base (BAFB), listed hereafter as the Installation Commander:

1.1.1. Ensure all base personnel comply with this instruction. This includes military personnel, civilian employees, tenants, contractor personnel and visitors.

1.1.2. Ensure all base activities comply with applicable federal and USAF directives covering the usage of radiation-producing equipment, the permitting, procurement, storage, handling, accountability for and disposal of RAMs and the reporting of incidents or accidents to the appropriate authorities.

1.1.3. Appoint the BAFB Radiation Safety Officer (BAFB RSO), in writing—mandated by AFI 40-201, *Managing Radioactive Materials in the USAF*.

1.1.4. Conduct a base-wide radiation safety program through the Bioenvironmental Engineering Office (460 MDS/SGPB) under the direction of the BAFB Radiation Safety Officer (BAFB RSO).

1.1.5. Certify, in writing, that BAFB is committed to the successful implementation of an as low as reasonably achievable (ALARA) program.

1.2. **The BAFB Radiation Safety Officer.**

1.2.1. Direct, for the Installation Commander, the overall conduct of the BAFB radiation safety program whose primary goal is to maintain radiation exposures to personnel ALARA. The BAFB RSO is the individual designated by the Installation Commander to investigate, evaluate, initiate corrective action and report on defects or noncompliance items relating to substantial safety hazards involving RAMs or RPDs.

1.2.2. Enforce all federal, Air Force, state and base rules and instructions relating to radiation safety.

1.2.3. Terminate any operation which, in the opinion of the BAFB RSO, poses a substantial radiation safety hazard to personnel or the environment. A report of such actions will be made immediately to the Installation Commander.

1.2.4. Ensure that personnel and area monitoring are accomplished as required by applicable rules and instructions.

1.2.5. Supervise, as a Disaster Control Group member, emergency radiation safety operations in the event of accidents/incidents involving RAMs or RPDs.

1.2.6. Review plans for facilities to be used for RAMs or RPDs which could require shielding.

1.2.7. Provide preliminary hazard evaluations for proposed uses of RAMs or RPDs.

1.2.8. Ensure that the receipt, shipment and transfer of RAMs are properly monitored and identified.

1.2.9. Maintain all necessary records of the BAFB radiation safety program, USAF RAM permits, BAFB RAM/RPD permits, including documentation in support of USAF and federal instructions, licenses and permits.

1.2.10. Identify to the individual users and their supervisors the protective equipment and facilities necessary for the safe conduct of projects and programs involving the use of radiation.

1.2.11. Provide a personnel dosimetry program for employees involved in ionizing radiation projects.

1.2.12. Manage the environmental surveillance program relative to radiation safety and ensure compliance with applicable federal, Air Force, state and BAFB instructions and directives dealing with protection of the public and the environment from unwarranted radiation exposures.

1.2.13. Manage and control the radioactive waste disposal program which ensures proper packaging, storage, transport and disposal of radioactive waste by BAFB organizations.

1.2.14. Manage the issuance of BAFB RAM/RPD permits to organizations requiring authorization to use RAMs and radiation-producing equipment.

1.2.15. Monitor the radiation safety training program for permit RSOs, supervisors, radiation monitors, users of RAMs and RPDs and emergency response team members. Radiation safety training provided by others, such as public health, permit RSOs or supervisors, will be approved by the BAFB RSO.

1.2.16. Manage the BAFB RAM and RPD inventory.

1.2.17. Provide emergency response capabilities in the event of accidents involving contamination of personnel or the environment or exposure of personnel to RAMs or RPDs

1.2.18. Provide expert consultation, advice, assistance and direction on the hazards associated with radiation and the methods to control these hazards as well as response to emergency incidents or accidents involving RAM or radiation-producing equipment.

1.2.19. Manage an inventory of calibrated radiation monitoring equipment which permits routine radiological surveillance as well as immediate response to emergency situations.

1.2.20. Establish the required frequency of area surveys.

1.3. **Commanders of organizations, which use RAMs or RPDs.**

1.3.1. Designate an individual to act as the single focal point for the organization on radiation safety matters.

1.3.2. Ensure qualified radiological monitors are designated, in writing to the BAFB RSO, for each functional area authorized to possess and use RAMs or RPDs.

1.3.3. Assure the timely reporting of accidents or incidents involving RAMs or RPDs to the BAFB RSO according to AFI 91-204, *Safety Investigations and Reports*.

1.4. **Permit RSOs or commander-designated individual.**

1.4.1. Advise the BAFB RSO of the proposed uses of RAMs or RPDs by individuals within the organization and advising the BAFB RSO of any matters affecting the radiation safety program of the organization.

1.4.2. Coordinate radiation survey or hazard evaluation activities with the BAFB RSO.

1.4.3. Perform those radiation safety duties at the organizational level that are commensurate with training and experience.

1.4.4. Assure the timely reporting of accidents or incidents involving RAMs or RPDs to the BAFB RSO and organizational commanders and according to AFI 91-204.

1.4.5. Assist in the investigation of incidents or accidents relating to the use of RAMs or RPDs.

1.4.6. Ensure that radiation areas and locations where RAM are stored and used are properly posted.

1.4.7. Perform or arrange with the BAFB RSO, radiation safety training for newly assigned employees, students or workers who may be occupationally exposed to ionizing radiation and likely to receive greater than 100 millirem (mrem) in a year.

1.4.8. Coordinate with the BAFB RSO before initiating any project including procurement, use, storage and/or disposal of RAMs or devices, or any changes in working conditions or activities which could affect the radiation safety program. All coordination will be accomplished prior to initiation of the project.

1.4.9. Submit to the BAFB RSO for review any new or revised operating instructions (OI), standard operating procedures (SOP) or unit instructions impacting on the radiation safety program prior to implementation.

1.4.10. Ensure all users are familiar with radiation safety OIs, radiation safety procedures and the BAFB ALARA program.

1.4.11. Ensure personal radiation monitoring devices, when required, are issued and worn correctly by all users.

1.4.12. Advising the BAFB RSO, in writing, of any proposed changes to the RAM inventory, any proposed acquisition of new RPDs or any proposed generation of radioactive waste. Such notice will be submitted with sufficient lead time to permit adequate review and comment.

1.5. **Each individual using RAMs or RPDs.**

1.5.1. Learn and implement the rules of radiation safety as described in applicable federal, Air Force and BAFB instructions as well as in organizational OIs.

1.5.2. Wear personal monitoring devices if directed by supervisors and the BAFB RSO.

1.5.3. Wear appropriate protective clothing and equipment as prescribed by supervisors and the BAFB RSO.

1.5.4. Become familiar with the ALARA program which is dedicated to maintaining exposure to ionizing radiation ALARA.

1.5.5. Report incidents/accidents and hazardous conditions immediately to supervisor or the BAFB RSO if appropriate.

1.5.6. Assist the supervisor or the BAFB RSO, as directed, to control the site of an accident/incident.

1.5.7. Inform their supervisor of any changes in equipment, procedures or other factors involving RAMs or RPDs which may alter the radiation safety practices or radiation levels in unrestricted areas.

2. Permits For the Possession and Use of RAMs and RPDs.

2.1. The USAF has been issued a master materials license by the USNRC. This license authorizes the USAF Radioisotope Committee (RIC), located at Brooks City-Base in San Antonio Texas, to grant

USAF RAM permits to Air Force organizations for possession and use of byproduct, source and special nuclear materials, normally controlled by the USNRC.

2.2. In addition, the USAF RIC has reserved the authority to grant USAF RAM permits for the possession and use of RAMs not under the jurisdiction of the USNRC. Examples of these materials are radium and accelerator-produced radionuclides.

2.3. BAFB tenant organizations must have been issued a permit by the USNRC or DoD component empowered by the USNRC authorizing the possession and use of RAMs of diverse types, forms and quantities.

2.4. Organizations located at BAFB and contractors performing work at BAFB must obtain a USNRC or Agreement State License and/or USAF or Navy RAM permit, and BAFB RAM/RPD permit in order to possess or use RAMs or RPDs:

2.4.1. RAM includes any item that emits radiation without external power. Examples are byproduct, source and special nuclear material as defined in the Code of Federal Regulations (CFR), Title 10, Parts 30, 40 and 70. Also included are accelerator-produced materials such as cobalt-57 as well as naturally-occurring radioisotopes such as radium. Excluded from the requirement for a permit are any items commonly available to the general public and not requiring a license. These items do not require a permit if used for their intended purpose. Any unusual activities involving these sources, such as attempting to remove the RAM from the item or accumulating large quantities of these items for storage may require a permit. Although there are no administrative controls over these items, they may require controlled disposal. If there is any doubt as to the requirement for a permit or the proper method of disposal, contact the BAFB RSO for guidance.

2.4.2. An RPD is any piece of equipment that emits ionizing radiation, regardless of intent, when energized by an external power source. Examples include medical and industrial x-ray machines, x-ray diffraction and fluorescence units, scanning and transmission electron microscopes and particle accelerators. In general, any device that accelerates electrons or other atomic particles with a potential difference of 10,000 volts or greater and produces x-ray radiation, either intentionally or unintentionally, may require a BAFB RPD permit. Some exceptions are television monitors, cathode ray tubes (CRT) and video display terminals (VDT) which are manufactured under the strict requirements of Title 21 Code of Federal Regulations 1020.10, *Performance Standards for Ionizing Radiation Emitting Products*. If there is any doubt as to the requirement for a permit, contact the BAFB RSO for guidance.

2.5. Requests for USAF RAM or BAFB RAM/RPD permits must be submitted in writing to the BAFB RSO (460 MDS/SPGB). Applications for either new permits, renewals of old permits or amendments to existing permits are reviewed by the BAFB RSO who may either (a) reject the application, (b) return it for additional clarification, (c) refer it to the USAF RIC for review, or (d) issue a permit. Once approved, organizations are required to comply with the statements made in their application as well as any additional conditions imposed by the BAFB RSO and listed as a condition of the permit itself. Any changes in the activities or personnel specified in the permit must be accompanied by the submission of an application for amendment of the permit. Applications for amendments will be submitted in the same manner as the original permit or renewal application except that only those items being changed need be addressed.

2.6. A BAFB RAM/RPD permit authorizes the possession and use of RAMs or RPDs on Buckley AFB only. Operations conducted under the conditions of the permit must be documented to ensure compliance with the BAFB ALARA program.

3. Contractors.

3.1. Contractors who perform services involving the use of RAM under the auspices of their own USNRC or Agreement State License shall be required to provide a copy of that license to the BAFB RSO well in advance of operations being conducted at BAFB. For contractors licensed by an Agreement State, in addition to a copy of the license, a completed copy of USNRC Form 241, **Report of Proposed Activities in Non-Agreement States**, must be submitted to the BAFB RSO. The BAFB RSO will review the license to ensure that the material and activities are authorized. The contractor will be required to comply with all applicable sections of this instruction as it applies to safe use of RAM and the reporting of incidents or accidents to the BAFB RSO. The BAFB RSO will be notified when the operation is terminated.

3.2. Contractors who perform services involving the use of RAM under the auspices of a USAF RAM permit issued to BAFB will comply with all requirements specified in this instruction.

3.3. Contractors who will be using RPDs will be required to obtain a BAFB RPD permit from the BAFB RSO as would any BAFB organization.

3.4. No contractor will allow contractor owned radioactive material to remain at Buckley AFB. All radioactive items belonging to the contractor must remain with the contractor.

4. Designation of Areas.

4.1. The following definitions are extracted from 10 CFR 20.1003:

4.1.1. “Restricted area” means any area, access to which is limited for the purpose of protecting individuals against undue risks from exposure to radiation and RAMs.

4.1.2. “Radiation area” means an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

4.1.3. “High radiation area” means an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.1 rem in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

4.2. The limits in the above definitions are specified in terms of "rem in one hour" not "rem per hour (rem/hr)." The difference between these two expressions is significant. If the limit was expressed as 0.005 rem/hr, then any measurement with a survey meter above 0.005 rem/hr would classify the location as a radiation area. However, when expressed as 0.005 rem in 1 hour, a measurement of 0.01 rem/hr could still be classified as a nonradiation area if the occupancy were limited to no more than 30 minutes each hour or if the radiation field were present for no more than 30 minutes each hour. Such might be the case for an x-ray operation. Therefore, the classification of a radiation area must also consider the occupancy of the area and the duration of the radiation exposure.

5. Exposure Limits.

5.1. Personnel who work with RAMs or RPDs may be exposed to radiation during the course of their employment. The goal of the radiation safety program at BAFB is to maintain all radiation exposures ALARA. However, it may be impossible to completely eliminate all radiation exposure. As a result, it is important to understand the procedures used to monitor for radiation exposure and also the significance of a radiation dose obtained during routine work activities.

5.2. Federal regulations (10 CFR 20) specify the maximum permissible dose limits for radiation workers, workers who are under 18 years of age, nonradiation workers (i.e., members of the general public) and embryo/fetus.

Table 1. Radiation Workers.

In Any Calendar Year	Radiation Workers	Workers Under 18
Whole Body (TEDE)	5 rem	0.5 rem
Lens of eye	15 rem	1.5 rem
Skin or extremities	50 rem	5 rem

NOTE: The whole body means, for purpose of external exposure, head, trunk (including male gonads), arms above the elbow or legs above the knee. TEDE means "total effective dose equivalent."

Table 2. Members of the Public.

One Year	**100 millirem**
In Any One Hour	**2 millirem**

Table 3. Embryo/Fetus.

Entire Pregnancy	**500 millirem**
Monthly	**50 millirem**

5.2.1. If integrated radiation levels could exceed these limits, the area must be restricted.

5.3. Occupational Exposure of Pregnant Employees:

5.3.1. Each female who may be occupationally exposed to ionizing radiation will be informed by the BAFB RSO of the risks to the unborn.

5.3.2. A woman must voluntarily declare her pregnancy in writing, to include the estimated date of conception, for the radiation exposure limits of the embryo/fetus to be applied.

5.3.3. The BAFB RSO may limit specific duties of a declared pregnant female who is occupationally exposed to radiation and who in the opinion of the BAFB RSO may receive a whole body exposure greater than 50 millirems per year, either in the course of routine duties or as a result of a credible accident involving the RAM or RPDs. The BAFB RSO's evaluation will include consideration of the workplace and the source of radiation, the individual's past history of exposure to radiation as documented by personal dosimetry records, current radiation measurements applicable to her specific tasks, current exposure histories of coworkers and likely exposures which would be incurred in the event of a credible accident.

5.3.4. If the RSO determines it is unlikely that the declared pregnant female would receive a total exposure during the term of the pregnancy (including the period preceding the confirmation of the pregnancy) in excess of 500 millirems, she may continue in her radiation-related duties. However,

if the individual is not already on the Air Force personnel dosimetry program, she will be enrolled for the duration of her pregnancy. Arrangements will be made with the AF Center for Radiation Dosimetry (311th HSW AFIERA/SDRD) at Brooks City-Base to receive, in addition to the laboratory's routine written report, telephone notification of the individual's dosimetry results as soon as each dosimeter is processed by the laboratory. Should exposure results indicate a trend which, if continued, could result in exceeding the 500 millirem limit, a re-evaluation will be made as to whether she should continue her radiation duties, be restricted from certain high risk duties or be removed entirely from occupational exposure.

5.3.5. Special consideration must be made when a declared pregnant worker's radiation duties involve the operation of high output sources or the use of unsealed RAMs. Pregnant workers will not continue in duties involving these sources without the concurrence of HQ AFMOA. When a pregnancy is suspected and reported to the immediate supervisor, women working with such sources or materials will receive a prompt evaluation by the BAFB RSO (within 5 workdays after receipt of the consult request) and, if warranted, actions such as restrictions or removal may be taken even prior to confirmation of the pregnancy.

6. Dosimetry.

6.1. Individuals who routinely work with or in the vicinity of sources of ionizing radiation may be designated as radiation workers by the BAFB RSO after an evaluation of the potential hazards. Radiation workers are issued radiation dosimeters which are exchanged either monthly or quarterly depending on whether the work environment has been determined by the BAFB RSO to pose a normal or low risk of radiation exposure. In certain circumstances, radiation workers may also be issued self-reading pocket dosimeters in addition to standard radiation dosimeters to permit immediate evaluation of a potentially hazardous radiation environment.

6.2. Air Force radiation dosimeters will only be issued to military or civilian government employees or contractors working with government owned and operated radiation sources. Contractors using contractor owned and operated radiation sources will be required to provide dosimeters to their own personnel.

6.3. The BAFB RSO and staff.

6.3.1. Determine whether radiation monitoring is required.

6.3.2. Determine the frequency of radiation monitoring.

6.3.3. Issue and exchange radiation dosimeters.

6.4. It is the responsibility of the supervisor of a newly assigned worker to request radiation monitoring for that individual. Monitoring will be required if the worker will be located in an area designated by the BAFB RSO as a potential radiation hazard area or if, because of the assigned duties, the individual can be classified as a radiation worker.

6.5. Each individual to be monitored will be provided with a radiation safety briefing to include an explanation concerning proper wear and storage of the dosimeter and the right to review the dosimetry results each month or quarter.

6.6. The supervisor will reinforce this information by introducing the dosimeter monitor who will indicate the dosimeter storage location and describe the procedures for requesting a review of the dosimetry results maintained by the supervisor.

6.7. The supervisor will not permit anyone to enter a radiation area or work with RAMs or RPDs unless that individual has been designated a radiation worker, been properly briefed and been issued a dosimeter, if appropriate. In those rare instances where it is essential for visitors to enter restricted radiation areas for brief periods and may receive greater than 100 mrem, the supervisor will ensure that each visitor is provided with a self reading pocket dosimeter or other radiation monitoring device. IAW AFI 48-125, *The US Air Force Personnel Dosimetry Program*, participants enrolled in the Personnel Dosimetry Program will provide the BAFB RSO with all relevant personnel dosimetry information along with the following information:

6.7.1. Name.

6.7.2. Dosimeter Serial Number.

6.7.3. Initial and final dose readings (if direct reading).

6.7.4. Date, time and duration of visit.

6.7.5. If at all possible, prior coordination with the BAFB RSO concerning visitor access to restricted radiation areas should be accomplished.

6.8. Monthly or quarterly, as applicable, a report of the exposures recorded on the dosimeters is published (Armstrong Lab Listing 1499). This report is sent to the BAFB RSO who reviews the results to determine if the exposures recorded are in compliance with the ALARA program. After review of the report, the BAFB RSO forwards a copy to the supervisors of the personnel monitored. These results are available to radiation workers for review.

6.9. There are several types of dosimeters which may be issued and specific rules governing proper wear of dosimeters:

6.9.1. Thermoluminescent dosimeter (TLD) badges are issued to monitor personnel for radiation exposure. There are three types of badges and depending on the type of radiation work performed, one, two or possibly all three will be issued to a single individual. The first type is called a whole body badge. As indicated by its name, it is designed to measure the radiation exposure to the entire body. Obviously, no badge which is approximately 1 by 2 inches can measure the radiation exposure to the whole body. However, the badge should be worn at the location of highest expected whole body radiation dose. The whole body badge is typically worn somewhere between the waist and the shoulders (i.e., waistband, collar or shirt pocket). In this location, the badge will provide a measure of the radiation exposure to the internal organs and the gonads. If, as is generally the case, the individual normally faces the radiation source, the badge should be worn on the front. However, if in some unusual instance, the radiation source is routinely behind the individual, the badge may be worn on the back. Since this badge is designed to provide a measure of the radiation exposure to the whole body, it should always be worn so as to be exposed to the same radiation environment as the body.

6.9.2. The second type of badge is called the collar badge worn on the shirt collar. It is designed to provide a representative sample of the radiation exposure to the critical organs above the shoulders, i.e., the thyroid in the neck and the lens of the eye. When a protective shield such as a lead apron is worn, the collar badge is placed outside the protective shield not under it. Results recorded on a collar badge are often reported as a "head" dose.

6.9.3. The third type of badge is called an extremity badge or finger badge. It is worn like a ring on a finger of the hand which is most likely to be exposed to the radiation. If the source of radia-

tion is typically held in the hand, the ring should be worn with the top portion turned around facing the palm and the radiation. However, if the radiation originates from a remote source such as an x-ray diffraction unit and the hand is likely to be exposed from the back, the ring should be worn in the usual manner.

6.9.4. If dosimeters are issued and irrespective of how many other dosimeters are assigned, a whole body dosimeter is always worn by a radiation worker. Any other badges issued are worn in addition to the whole body badge--never in place of it. The reason is, simply stated, that the collar and finger badges measure radiation exposure only to specific organs of the body whereas the whole body badge measures the radiation exposure to the most critical organs.

6.9.5. All radiation badges should be worn while working in a designated radiation area. The badges should be put on before beginning work and removed after leaving the radiation area. When not being worn, the badges must be stored on a rack or board of some kind in a radiation-free environment along with a control badge. This location is normally called a "control board." The control badge always remains on the control board. The control badge's purpose is to measure the background radiation level in the storage area so that the background radiation level can be subtracted from the measured values on the personal badges. Badges must never be taken home or stored in any other location such as desk drawers or lab coats. Badges should also never be worn when undergoing medical radiation procedures such as diagnostic x-ray or dental examinations, nuclear medicine evaluations or radiation therapy treatments. Badges will provide an accurate measure of the radiation to which an individual is exposed only if they are worn and stored properly. If a badge is lost or damaged an investigation will be performed by the BAFB RSO to estimate the exposure actually received during that monitoring period. The individual to whom the badge was issued will be required to sign a statement explaining the circumstances of the loss or damage.

6.9.6. In addition to routinely issued radiation monitoring badges, some activities in which there is a higher risk of a large exposure also require the use of self-reading pocket dosimeters. Unlike TLDs which record the exposure but must be sent to the AF Center for Radiation Dosimetry at Brooks City-Base for processing, resulting in a delay of several weeks before the results are obtained, pocket dosimeters are designed to be evaluated immediately. Although traditionally not as accurate as TLDs, self-reading pocket dosimeters do provide an instant indication as to whether an exposure has occurred. For this reason, self-reading pocket dosimeters are issued to visitors that are likely to receive greater than 100 mrem in a year so that it can be determined if an exposure has occurred before the visitor is lost to follow-up.

6.9.7. If anyone suspects that a dosimeter has been exposed either deliberately or unintentionally to radiation irrespective of whether it was being worn at the time or not, the supervisor and the BAFB RSO will be notified immediately. The dosimeter will be collected and shipped to the AF Center for Radiation Dosimetry at Brooks AFB for processing. If there is some evidence (such as survey meter readings or self-reading pocket dosimeter results) that an individual was, in fact, overexposed, the BAFB RSO will be notified immediately and may require that the individual be removed from duties involving exposure to radiation pending the results of an investigation.

6.10. In addition to federally imposed dose limits, the USNRC has also recommended the adoption of investigation levels for radiation workers. These levels are not legal limits. They are values arbitrarily set at 10 percent of the federally mandated limits to assist radiation safety program monitors to comply with the ALARA concept by anticipating potential difficulties and initiating corrective actions.

Therefore, investigations will be accomplished in a timely manner by the BAFB RSO for doses received by individuals in excess of the established ALARA levels. The investigation shall consider each such exposure in comparison with those of others performing similar tasks.

Table 4. Investigative Levels.

Per Monitoring Period	Radiation Workers
Whole Body (TEDE)	125 millirem
Lens of Eye	375 millirem
Skin or Extremeties	1250 millirem

NOTE: The whole body means, for purpose of external exposure, head, trunk (including male gonads), arms above the elbow or legs above the knee.

7. ALARA.

7.1. The ALARA concept was developed in response to scientific evidence which suggests that no level of radiation exposure is entirely risk-free. It is a policy which states that although there are acceptable, conservative levels of radiation exposure specified by federal regulations which offer a low risk of adverse health effects compared to the other hazards of life and occupation, it is prudent to make every effort to reduce exposures to the lowest levels reasonably achievable, thereby lowering the health risk associated with that exposure. In fact, individual and cumulative radiation exposures must be maintained as close to zero as possible given the type of activities involved, the state of technology, the risk to the individuals exposed and the benefit to society from the activity being accomplished. The guidance contained in this instruction provides the basis for conducting an effective ALARA program.

7.2. The publications listed below provide in-depth guidance which describes the philosophy behind the ALARA concept:

7.2.1. USNRC Regulatory Guide 8.10, *Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Reasonably Achievabl*e.

7.2.2. USNRC Regulatory Guide 8.18, *Information Relevant to Ensuring That Occupational Radiation Exposures at Medical Institutions Will Be As Low As Reasonably Achievable.*

7.2.3. USNRC Regulatory Guide 10.8, *Guide for the Preparation of Applications for Medical Pro-grams*, Appendix 0, *Model Program for Maintaining Occupational Radiation Exposures at Medical Institutions ALARA.*

7.2.4. USNRC NUREG-0267, *Principles and Practices for Keeping Occupational Radiation Exposures at Medical Institutions As Low As Reasonably Achievable.*

7.2.5. NCRP Report 105, *Radiation Protection for Medical and Allied Health Personne*l.

7.2.6. NCRP Report 59, *Operational Radiation Safety Program.*

7.2.7. AFMSC/SGPA policy guidance dated 17 Oct 84, *Implementation of the ALARA Concept in the Air Force Radiation Protection Program.*

7.3. The radiation safety program at BAFB is managed by the BAFB RSO for the Installation Commander. BAFB is committed to the concept of ALARA. The ALARA commitment is summarized below:

7.3.1. BAFB RSO:

7.3.1.1. Review the qualifications of each applicant for a BAFB RAM/RPD permit to ensure that the applicant will be able to take appropriate measures to maintain exposures ALARA.

7.3.1.2. Perform semiannual reviews of the radiation safety programs.

7.3.1.3. Perform a quarterly review of radiation exposure records and records of radiation surveys and present the results to the Aerospace Medicine Council through the Occupational Health Working Group.

7.3.1.4. Ensure users, workers and ancillary personnel are provided briefings describing the ALARA program at least annually.

7.3.1.5. Encourage users to submit suggestions for improving health physics practices and increasing the effectiveness of the ALARA program and will evaluate those suggestions with the goal of implementing as many of them as are considered acceptable and reasonable.

7.3.1.6. Investigate all deviations from ALARA and direct changes when appropriate.

7.3.2. Users:

7.3.2.1. Provide the BAFB RSO with information concerning newly proposed uses of RAMs or RPDs with sufficient lead time to permit the RSO to adequately evaluate the proposal. Alternate approaches will be considered in the interest of ALARA.

7.3.2.2. Explain the ALARA concept to individuals supervised by them, ensure that they understand the concept and are adequately trained for the task required and document the training.

7.3.3. Radiation Workers:

7.3.3.1. Be instructed annually in the ALARA concept and its applicability to work practices and conditions.

7.3.3.2. Be advised of available recourses if they feel that the ALARA concept is not being implemented.

8. Training.

8.1. Personnel requiring training in radiation safety commensurate with their duties may include:

8.1.1. Users.

8.1.2. Supervisors.

8.1.3. Radiation monitors.

8.1.4. Permit RSOs.

8.1.5. Emergency response teams.

8.1.6. Special inspection groups (SIG).

8.1.7. Ancillary personnel (such as housekeeping) who may perform duties in areas where RAMS or RPDs are used.

8.2. Training will be provided to individuals who in the course of their duties are likely to receive in a year an occupational dose in excess of 100 millirems:

8.2.1. Before the individual is permitted to assume duties with or in the vicinity of radiation sources.

8.2.2. Annually during a refresher training course.

8.2.3. When there is a significant change in duties or radiation safety requirements.

8.3. Training will be provided by**:**

8.3.1. The permit RSO, with the assistance of the BAFB RSO, according to the above schedule.

8.3.2. The Bioenvironmental Engineering Section during annual occupational safety briefings to workers. The contents of these briefings as they relate to radiation safety will be approved by the BAFB RSO.

8.4. Training sessions will include but are not limited to the following:

8.4.1. Applicable regulations and permit conditions.

8.4.2. Areas where radiation sources are used or stored.

8.4.3. Potential hazards from the radiation sources.

8.4.4. Appropriate radiation safety procedures.

8.4.5. Work rules pertaining to radiation sources.

8.4.6. Employee obligation to report unsafe conditions or practices.

8.4.7. Initial response procedures to radiation emergencies.

8.4.8. Employee right to be informed of occupational radiation exposure results.

8.4.9. Location where pertinent regulations and documents are available for review.

8.5. All radiation safety training will be documented and copies maintained by BAFB RSO or permit RSO, as appropriate.

9. Ordering and Receiving Radiation Sources.

9.1. No one may order or receive RAMs or RPDs without first obtaining a USAF RAM permit and a BAFB RAM/RPD permit for possession and use of the material or device.

9.2. Individuals or organizations who are issued a valid USAF RAM, USN RAM or a BAFB RAM/RPD permit may order RAMs or RPDs authorized by their permit. When placing orders, the following actions will be accomplished:

9.2.1. The order must be forwarded to the BAFB RSO through the permit RSO prior to submission to procurement.

9.2.2. If an order is to be verbal (i.e., placed by phone or directly to a visiting supplier) the BAFB RSO must be notified immediately by phone of the intent to order and this will be followed within five workdays by a written notification to the BAFB RSO.

9.2.3. The BAFB RSO will review the order to ensure it does not exceed the USAF RAM or BAFB RAM/RPD permit authorization, will file a copy of the request with the permit and forward the original to procurement or provide verbal authorization for immediate action.

9.2.4. The purchase order request will specify that the BAFB RSO will be contacted at 303-677-6384 during normal duty hours on receipt of the item at any location on BAFB. If the package contains RAM and appears to be damaged or leaking, the BAFB RSO will be notified immediately through the BAFB Fire Department.

9.2.5. On notification that the item has arrived at BAFB, the BAFB RSO will either inspect and monitor the package or merely request notification when the package is delivered to the user. Only the BAFB RSO or the user shall open the package. The action taken will depend on the hazard associated with the particular item and the condition of the package.

9.2.6. After the package is opened by the user and the contents examined, the BAFB RSO will be notified immediately if there is either a discrepancy between the items ordered and received or if the items appear damaged. If all items are as ordered and in acceptable condition, notification will be in writing to permit updating of the master BAFB inventory (copies of shipping documents should be included).

9.3. Special precautions must be taken by the permitter when receiving and opening packages which contain RAM:

9.3.1. Visually inspect the package and, if damaged, notify the BAFB RSO immediately.

9.3.2. Measure the exposure rate at the package surface and, if greater than expected, contact the BAFB RSO.

9.3.3. Wear gloves if the package contains liquids and is to be opened.

9.3.4. Verify the contents with the packing slip.

9.3.5. Examine the integrity of the final source container.

9.3.6. If anything unusual is encountered contact the BAFB RSO.

9.4. As specified in 10CFR20.1906, packages containing in excess of certain specified quantities of RAM must be monitored for external radiation and contamination within 3 hours after receipt during working hours and within 3 hours from the beginning of the next working day if it is received after working hours.

10. RAM Work Procedures.

10.1. Although each work environment will necessitate individual work practices, the following procedures will be incorporated in all RAM work procedures:

10.1.1. Wear laboratory coats or other protective clothing at all times where unsealed RAMs are used.

10.1.2. Wear disposable gloves at all times while handling unsealed RAMs.

10.1.3. Before leaving restricted areas where unsealed RAM is used, monitor hands and clothing for contamination with an appropriately sensitive survey meter.

10.1.4. Areas in which unsealed RAMs are stored or used will be posted with AFTO Form 9D, **Radiation Hazard No Smoking, Eating or Drinking in This Area**. In addition, cosmetics will not be applied in those areas and exposed portions of the body such as the face should not be touched.

10.1.5. Do not store food, drink or personal effects in areas where RAMs are stored or used.

10.1.6. If issued, wear personnel monitoring devices at all times while in areas where RAMs are used or stored.

10.1.7. Dispose of radioactive waste only in designated, labeled and properly shielded containers.

10.1.8. Do not pipette radioactive liquids by mouth.

10.1.9. Wash hands before eating, drinking, smoking or leaving work area. Discard contaminated protective equipment such as rubber gloves and boots into segregated radioactive waste disposal containers.

10.1.10. Individuals with open wounds will not work with RAM without proper protection.

10.1.11. Items will not be placed in ordinary trash or flushed down non-approved drains unless they are first checked for radioactivity with an appropriately sensitive survey meter.

10.1.12. In areas where unsealed RAMs are used, monitor surfaces after each use.

11. Leak Testing of RAM.

11.1. Sealed sources of RAM are leak tested at intervals specified in the USAF RAM permits. Current requirements are:

11.1.1. Beta and gamma sources in excess of 100 microcuries - every 6 months.

11.1.2. Alpha sources in excess of 10 microcuries - every 3 months.

11.2. Leak testing will be accomplished by the permit RSO, BAFB RSO or staff for analysis by BAFB RSO or other that is licensed/permitted to perform the analysis.

11.3. Results will be maintained by the BAFB RSO and a copy forwarded to the user along with an interpretation of the results and any actions required.

11.4. If contamination is detected in excess of acceptable limits (usually 0.005 microcurie), the source will be secured in an isolated area until arrangements can be made for the BAFB RSO and staff to supervise decontamination of the item or packaging for shipment either to the supplier or an approved radioactive waste disposal site.

12. Radioactive Waste.

12.1. **Responsibility.** Organizations possessing a valid RAM permit may generate radioactive waste during the course of their operations. Each organization will assume full responsibility for collection, packaging, storage and disposal of radioactive waste generated. If accomplished properly, the potential for contamination of the environment or subjecting personnel to unnecessary radiation risk, will be eliminated. Each organization will provide a secure, isolated area for temporary storage of its own waste, on-site, near the location where it is generated. Each site will be approved by the BAFB RSO. If a holder of a USAF RAM permit, waste will not be stored for more than 2 years without specific approval by the USAF RIC. When a container is filled and ready for disposal or has been in storage

for 2 years, the BAFB RSO will be notified in writing. The BAFB RSO will make arrangements for pickup of the waste by a disposal contractor authorized by USAF Radioactive Waste Program Office. Contracts for pickup and disposal of radioactive waste will NOT be made by the generator.

12.2. **Management of Radioactive Waste.** To ensure safe handling of radioactive waste, the following guidance is provided. Any proposed deviations from this guidance must be submitted in writing to the BAFB RSO and approval must be obtained prior to implementation of the alternative procedures.

12.2.1. Generation of Waste. The primary goal of all users is to minimize the accumulation of radioactive waste to those items which cannot be disposed of in any other manner. One suggestion is to avoid combining radioactive and nonradioactive waste such as paper products and ordinary laboratory waste. This will reduce volume and cost and facilitate final disposal. However, in the interest of reducing nonessential waste, care should be exercised not to inadvertently dispose of radioactive waste without regard to proper disposal procedures. Guidance may be obtained from the BAFB RSO. In general, most radioactive waste is generated in one of two ways:

12.2.1.1. Routinely, such as in a research laboratory.

12.2.1.2. Infrequently, such as when a device used for many years is no longer required. In this case, the BAFB RSO should be contacted as soon as the item is identified as excess and the BAFB RSO will provide specific directives for the proper management of the item. If the item is small, radiologically stable and presents no unusual hazard, the BAFB RSO may elect to assume responsibility for the item, consolidating it with other similar items for more efficient disposal. If this is the case, the BAFB RSO may store the items in a secure location until enough have accumulated to fill a shipping container.

12.3. **Segregation.** An important aspect of proper waste disposal is segregation of waste (i.e., separation of different types). Segregation may involve separating.

12.3.1. High activity from low activity radionuclides. An example is separation of sources which are less than one millicurie from sources which are greater than or equal to one millicurie (one millicurie arbitrarily selected).

12.3.2. Long half-life from short half-life radionuclides. An example is separation of sources which have half-lives less than 120 days from those which have half-lives greater than or equal to 120 days. Short half-life material may be decayed in storage and disposed of as nonradioactive waste if approved by the BAFB RSO in writing.

12.3.3. Different categories of material. An example is separation of alpha emitting transuranics such as plutonium and americium from gamma emitting byproduct material such as cobalt and cesium.

12.3.4. Commercial radioactive waste disposal facilities typically have extremely conservative segregation and disposal criteria. Proper segregation will eliminate the possibility of having to reopen the container and separate the contents at some later date possibly subjecting personnel to unnecessary radiation or chemical exposure. If there are any doubts as to the segregation procedures required, contact the BAFB RSO.

12.4. **Drums.** Radioactive waste will only be collected in new or recently refurbished 30 or 55 gallon drums; size of the drum will be dependent on the rate at which waste material is accumulated. A drum should be chosen which can be filled in one year or less. The selected drum whether new or refurbished must show no extensive signs of weathering or mishandling (i.e., no rust or dents) and must

have no openings other than the top lid (i.e., no bung holes, even if sealed). The gasket on the lid of the drum must be neoprene and no moisture is permitted inside the drum. The NSN for an acceptable 30-gallon drum is 8110-00-866-1728 while the NSN for an acceptable 55-gallon drum is 8110-00-082-2626. If there are any doubts as to the acceptability of a drum, contact the BAFB RSO.

12.5. **Liners.** The drums used for radioactive waste shall have two transparent plastic liners or one 8mm liner installed. The liners will be at least 4 mils thick and be appropriate in size for the drum used. They will be of sufficient length so that the top of each liner can be twisted into a tail long enough to be folded over onto itself and the inverted "U"-shaped end secured with duct tape. If there are any doubts as to the acceptability of the plastic liners, contact the BAFB RSO.

12.5.1. Solids. If only solid waste is generated, the two plastic liners described above will be placed one inside the other directly inside the drum. Each liner will be sealed individually resulting in a double encapsulation.

12.5.2. Liquids. Liquids are not normally acceptable for radioactive waste disposal. Some liquids may be disposed of through the sanitary sewer, however, the requirements of paragraph **12.8.** must be satisfied.

12.6. **Inner Containers.** As items are deposited in the radioactive waste drum, it is recommended that smaller transparent plastic containers be used to hold routine quantities of waste generated. For example, the waste generated each day during an experiment may be placed in a separate plastic container and sealed or the waste from each experiment (perhaps spanning several days) may be collected in a single plastic container and sealed. This procedure would permit a more detailed inventory of the drum contents prior to final sealing if there were any questions regarding the contents. Each smaller container could be removed and inspected without requiring the individual to sort through the actual waste which may pose a chemical/biological hazard, as well as radiological hazard.

12.7. **Final Closure.** When a drum is full and ready for disposal, the BAFB RSO will be notified in writing. The BAFB RSO or representative will visually inspect the drum and will initial the inventory sheets to indicate that proper procedures were followed. Current USAF policy requires a certified radioactive waste disposal broker may verify the contents and packaging before the container may be shipped. Since items packaged in the drum will not normally be removed for a detailed inventory, the BAFB RSO will not assume responsibility for problems arising as a result of incorrect inventories. If any problems do arise regarding the contents of the drums, it will be the responsibility of the organization generating the waste to resolve those problems with guidance from qualified radiation safety or radioactive waste disposal personnel.

12.8. **Disposal to Sanitary Sewer.** Liquid radioactive waste may be disposed of through the sanitary sewer only if authorization is granted by the BAFB RSO. The BAFB RSO will review the types and amounts of material proposed for disposal and the procedures and will verify that such disposal is authorized and does not exceed the maximum permissible quantities established in 10CFR20.2003 or those identified in the Buckley AFB wastewater discharge permit. If such disposal is deemed acceptable, the BAFB RSO will designate and label a drain approved for liquid radioactive waste and only this drain will be used. Material will be flushed with a continuous stream of water (not a trickle) for the time indicated by BAFB RSO.

12.9. **DIS.** DIS may be authorized for all radioactive waste with half-lives less than 120 days. It is encouraged for all radioactive waste with half-lives of 30 days or less. DIS is a procedure in which radioactive waste is placed in a storage container such as a drum and allowed to remain undisturbed

for at least 10 half-lives. The material must be stable and must be maintained in a secure location where it will not be disturbed during the storage interval which could extend up to 120 days under specifically authorized circumstances. Typically, storage will not exceed 300 days. After the 10 half-lives have elapsed, the remaining activity will be approximately one thousandth of the original activity but it must still be monitored by the BAFB RSO using an appropriately sensitive survey meter to ensure that no radiation above background is detectable. For DIS to be most effective, radioactive waste must be segregated according to half-life. Ideally, each container would contain only radionuclides with the same half-life. However, more realistically, the radioactive waste should be segregated into several categories according to half-life, such as, 1-15 days, 16-30 days, 31-45 days, 46-65 days and 66-120 days.

12.10. **Specific Waste.** The USNRC has authorized the disposal of some small quantities of radioactive waste as normal waste. This exemption applies only to carbon-14 (C-14) and hydrogen-3 (H-3) also known as tritium. Specifically, 10CFR20.2005, states that C-14 and H-3 may be disposed of without regard to radioactivity, if the amount is less than or equal to 0.05 microcurie per gram of medium used for liquid scintillation counting or per gram of animal tissue averaged over the weight of the entire animal. This exemption does not eliminate the requirement to dispose of the scintillation fluid and carcasses according to applicable chemical and biological waste disposal instructions. In addition, the instruction requires records of the amount disposed be maintained to ensure compliance.

12.11. **Records.** Every item must be inventoried that is placed into a waste disposal drum, flushed down an approved drain, incinerated or allowed to DIS, must be recorded. An inventory will be maintained by the generator for each drum and drain. If inner containers are used they should be numbered consecutively and the inventory should indicate into which inner container each item of waste was placed. When a drum is ready to be sealed for disposal or DIS, the BAFB RSO must be informed in writing and three copies of the inventory form will be made. One copy of the inventory remains with the user, a second is sent to the BAFB RSO. For drain disposal, the third copy should be posted near the drain. For a drum, the third is affixed to the drum with a minimum amount of tape (not glue) to permit subsequent removal. This is necessary since only certain shipping/disposal labels are permitted on the drum when it is sent to the waste burial site.

13. Posting Requirements.

13.1. Except as specified in paragraph **13.2.** of this section, copies of this instruction, 10CFR, applicable USAF permit, permit conditions, documents referenced in the permit and NRC Form-3, **Notice to Employees**, will be posted in at least one conspicuous location within each work area where activities involving the use of RAMs are conducted.

13.2. If posting of a document specified in paragraph **13.1.** is not practical with the exception of NRC Form 3, a notice may be posted which describes the document and states where it may be reviewed. Copies of the references listed in this instruction and other pertinent documents concerning the use of RAMs are maintained by the BAFB RSO in building 600. The notice shall state that the documents are available for review during normal duty hours.

13.3. The AL Listing 1499 lists each individual's radiation exposure record. This form is provided to supervisors at the end of each monitoring period and should also be made available for employee review.

14. Emergency Procedures.

14.1. **Emergency Situations.** Potential radiation hazards may include:

14.1.1. Spills of RAM. A spill is not limited to liquids. Release of RAM from its container irrespective of the form of the material is considered a spill. The material may be in powdered form, liquid, gas or a solid mass. Spills pose a hazard because of the potential for: (1) contamination of the environment, (2) contamination of the skin of personnel, (3) ingestion or inhalation of RAM and (4) production of a high radiation field which may result in a radiation dose exceeding permissible limits even if the individual does not become externally contaminated. A spill may result from a simple incident such as the dropping of a container or it may result from a more serious event such as a fire or explosion.

14.1.2. Production of a radiation field by an x-ray machine, irradiator, accelerator or RAM (even if the material is completely contained). An x-ray machine, radioisotope irradiator or accelerator may be emitting radiation when it is supposed to be off, such as; when a switch or circuit malfunctions and the unit does not shut down when switched off or it may be emitting radiation into an area where it is not expected, such as; when an accelerator beam is deflected into the wrong experimental area. In these instances, individuals may be exposed to high radiation fields possibly without their knowledge.

14.2. **Response Procedures:**

14.2.1. Differences in response to the two situations described above include:

14.2.1.1. For spills, the material must be confined to prevent further contamination and individuals/environment may require decontamination.

14.2.1.2. For radiation fields, individuals must be removed from the radiation field or the radiation source must be interrupted (e.g., turning off the x-ray machine or shielding the irradiator source).

14.2.1.3. For both cases, the primary concern is first, the protection of individuals in the vicinity including emergency response personnel and second, the protection of the environment. Life saving activities always take priority over other considerations. In fact relatively large personnel exposures may be permitted for life saving procedures. This, however, is a one time permissible exposure which can never be repeated. Essential first aid always takes precedence over decontamination.

15. Reporting Requirements.

15.1. **Mishaps, Incidents and Accidents.** Any abnormal occurrence involving RAM or RPD shall be reported by the using organization to the BAFB RSO immediately after the abnormal occurrence becomes known. Based on the severity of the occurrence, as specified in AFI 91-204 and AFI 40-201, the BAFB RSO shall notify the following:

15.1.1. 460 SG/SE.

15.1.2. HQ AFMOA/SGOR.

15.1.3. HW USAF/SGOE.

15.1.4. Other interested organizations with jurisdiction such as US Environmental Protection Agency, Food and Drug Administration.

16. Notice of Violation or Hazard:

16.1. Any worker or representative of workers who believes that a violation of USNRC or USAF instructions or permit conditions has occurred, or that any defect in facilities or equipment exists which may pose a hazard to personnel or the environment shall report such conditions to:

16.1.1. The immediate supervisor, permit RSO, branch or division chief or department chairperson.

16.1.2. The BAFB RSO.

16.2. Initial reports may be submitted verbally; however, a written report will be submitted within 5 workdays for proper documentation (AF Form 457, **USAF Hazard Report**, may be used).

JAMES A. SANDS, Colonel, USAF
Commander

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

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

AFI 40-201, *Managing Radioactive Materials in the USAF*

AFI 48-125, *The USAF Personnel Dosimetry Program*

AFI 91-204, *Safety Investigations and Reports*

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

10 CFR Part 19, *Notices, Instructions and Reports to Workers: Inspection and Investigations*

10 CFR Part 30, *Rules of General Applicability to Domestic Licensing of Byproduct Material*

10 CFR Part 40, *Domestic Licensing of Source Material*

10 CFR Part 70, *Domestic Licensing of Special Nuclear Material*

USNRC Regulatory Guide 8.10, *Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Reasonably Achievable*

USNRC Regulatory Guide 8.18, *Information Relevant to Ensuring That Occupational Radiation Exposures at Medical Institutions Will Be As Low As Reasonably Achievable*

DODI 6055.8, *Occupational Radiation Protection Program*

Abbreviations and Acronyms

ALARA—As Low As Reasonably Achievable

NRC—Nuclear Regulatory Committee

RAM—Radioactive Material

RIC—Radioisotope Committee

RPD—Radiation Producing Devices

Terms

Radioactive Material (RAM)—Any non-exempt quantity of radioactive material or a device that produces ionizing radiation.

Radiation Producing Devices—Any device that produces ionizing radiation.

Radiation Area—Area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

Restricted Area—Area, access to which is limited for the purpose of protecting individuals against undue risks from exposure to radiation and RAMs.

High Radiation Area—Area, accessible to individuals, in which radiation levels could result in an

individual receiving a dose equivalent in excess of 0.1 rem in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.