HEADQUARTERS
US ARMY COMMUNICATIONS AND ELECTRONICS
MATERIEL READINESS COMMAND
FORT MONMOUTH, NEW JERSEY 07703

CERCOM Supplement 1
to AMCR 385-25

26 February 1980

Safety

RADIATION PROTECTION

Issue of further supplements to this regulation by CERCOM subordinate elements is prohibited, unless specifically approved by Commander, CERCOM, ATTN: DRSEL-SF.

AMCR 385-25, 12 August 1968, is supplemented as follows:

Page 2, paragraph 2, Scope. Add the following:

This supplement applies to directorates, offices and activities of the US Army Communications and Electronics Materiel Readiness Command (CERCOM), US Army Communications Research and Development Command (CORADCOM), US Army Electronics Research and Development Command (ERADCOM), US Army Medical Department Activity (MEDDAC) and all other tenant activities located at Fort Monmouth concerned with the use of radioactive material and/or radiation producing devices.

Page 2, paragraph 3b, General. Add the following:

National Council on Radiation Protection and Measurements (NCRP) reports may also be referred to for supplemental information.

Page 3, paragraph 5, Policy. Add subparagraph g after subparagraph f.

g. Limited and special application of this supplement relative to organizations in possession of US Nuclear Regulatory Commission (NRC) licenses and/or Department of the Army (DA) authorizations and having an independent radiation protection program is contained in appendix C.

Page 3. Add paragraph 6-1 after paragraph 6.

6-1 Responsibilities of CERCOM. a. The Chief, Safety Office (DRSEL-SF) will:

(1) Be the CERCOM staff contact for all radiation safety matters.

(2) Designate an Installation Radiological Protection Officer (RPO) and alternate to perform the tasks outlined in paragraph 6c(2) of the basic regulation, and provide radiation safety support to the Commanding Officer, Headquarters and Installation Support Activity (HISA).

*This supplement supersedes ECOMR 385-9, 17 August 1973 including all changes.

Page 4, paragraph 6b, Radiation control committee. Add subparagraph (4) after subparagraph (3):

(4) The Fort Monmouth Ionizing Radiation Control Committee (IRCC) organization is delineated in appendix D.

Page 7, paragraph 6. Add subparagraph f after subparagraph e.

f. The Chief, Supply Services Branch, Industrial Operations Division, HISA, CERCOM, will insure prompt notification to the installation RPO of shipment or receipt of radioactive materials. Exclusive use vehicles transporting the received radioactive materials will only be released by the installation RPO or his designated representative as required by Title 49, Code of Federal Regulations, Part 173.397.

Page 18, paragraph 17c(1). Add the following:

The installation RPO or his designated representative will be contacted for this purpose.

Page 22, paragraph 21. Add subparagraph e after subparagraph d.

e. The Chief, Safety Office, CERCOM, will be informed of discharges of radioactive effluents at Fort Monmouth.

Page 47. Add appendices C and D after appendix B.

HEADQUARTERS
UNITED STATES ARMY MATERIEL COMMAND
WASHINGTON, D.C. 20315

10 February 1969

AMC REGULATION
No. 385-25
CHANGE 1

SAFETY

RADIATION PROTECTION

AMCR 385-25, 12 August 1968, is changed as follows:

a. Paragraph 5f is added:

"f. The AMC Surgeon (AMCPT-H) provides medical guidance for the protection of health of personnel in use of radiation sources."

b. Make the following changes:

(1) Paragraphs 5d, sixth line; 6b(3), sixth line; 12b, fourth line; 21d, third line; 30d(1)(j), fifth line; and 31, sixth line. Change "AMCAD-S" to "AMCSF."

(2) Paragraph 5e, first line. Change "Division" to "Office."

(3) Page 48, top of page. Change "(AMCAD-S)" to "(AMCSF)."

FOR THE COMMANDER:

OFFICIAL:

CLARENCE J. LANG
Major General, USA
Chief of Staff

WM. A. GREGORY
Colonel, GS
Chief, Administrative Office

DISTRIBUTION:
A and B

HEADQUARTERS
UNITED STATES ARMY MATERIEL COMMAND
WASHINGTON, D.C. 20315

AMC REGULATION
No. 385-25

12 August 1968

SAFETY

RADIATION PROTECTION

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1. Purpose. This regulation establishes U.S. Army Materiel Command (AMC) ionizing radiation protection standards.

2. Scope. This regulation applies to all AMC elements procuring, receiving, storing, shipping, using, transporting, maintaining, or disposing of ionizing radiation-producing materials and/or equipment. This regulation does not apply to nuclear weapons, nuclear reactor systems, or spent fuel from nuclear reactors, nor does it apply to LASER or microwave radiation.

3. General. This regulation supplements AMCR 385-224 and is to be used in conjunction with AMCR 385-224.

a. Waivers of radiation safety requirements of this regulation are the same as those set forth in AMCR 385-224.

b. National Bureau of Standards handbooks on radiation protection shall be used as AMC standards in planning of facilities and local procedures except where such publications conflict with the requirements of this regulation in which case this regulation shall apply.

c. The terms shall, will, or must indicate mandatory requirements. The term may or should is advisory.

4. Definitions. See appendix A.

5. Policy. a. Prior to the use of sources of ionizing radiation in any program or project, and prior to the incorporation of a source of ionizing radiation into an item of supply (issue items), the cost effectiveness and safety of such use must be weighed against the use of alternate methods or materials to achieve project or program goals. The radiological hazards shall be investigated and written guidance prepared before supply items containing sources of ionizing radiation are issued for field use. (The word "radiation" will be used in this regulation for "ionizing radiation.")

b. Without proper controls, radiation can be hazardous to health and property. Consequently, proposals to obtain, use, store, transport, maintain, or dispose of items which are, or contain, sources of ionizing

radiation will be carefully evaluated to assure that all resulting exposures to radiation will be kept to a minimum.

c. Adequate procedures, facilities, equipment, and trained personnel will be provided to assure the safe use of materials or equipment capable of producing radiation. Failure to meet this requirement will result in cessation of operations or delay in start-up.

d. Commanders of separate activities tenanted upon an installation will be guided by the installation radiation protection standards. Local radiation protection standards will not be less restrictive than those standards established by Federal, Army, or AMC regulations. Should a separate activity's mission be hampered or restricted by the installation requirements, and the difficulty cannot be resolved at local level, the problem will be forwarded to the Commanding General, AMC, ATTN: ~~AMCAD-S~~ AMCSF.

e. Headquarters, AMC Safety ~~Division~~ Office, developes and directs the AMC Radiation Protection (health physics) Program.

6. Responsibilities. a. Installations and activities. Commanders of installations and activities that procure, receive, store, ship, use, transport, maintain, or dispose of sources of radiation will:

(1) Establish a formal, written radiation safety program.

(2) Appoint a radiation control committee.

(3) Appoint a qualified individual as radiological protection officer (AR 40-14) and an alternate to provide continuity of operations.

(4) Assure compliance with Federal, State, and local regulations.

b. Radiation control committee. The committee will consist of the commander or his designated representative, the radiological protection officer, medical officer (where the establishment has a medical facility), the safety director, and other persons who are knowledgeable in the safe use of radiation, as are deemed necessary.

f. The AMC Surgeon (AMCPT-H) provides medical guidance for the protection of health of personnel in use of radiation sources.

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AUTOVON 8-227-2796

(1) Responsibilities of this committee will include:

(a) Recommending to the commander policies on the safe use, handling, storage, transport, receipt, shipment, and disposal of sources of radiation.

(b) Reviewing the radiation safety aspects of proposals for the procurement and use of sources of radiation, the modification of existing radiological operations and operating procedures, and providing recommendations to the commander for appropriate action.

(c) Reviewing applications for Atomic Energy Commission (AEC) licenses or Department of the Army authorizations.

(d) Reviewing and approving the qualifications of users of radiation.

(e) Reviewing reports of radiation accidents and incidents to determine the cause and recommending appropriate action to the commander.

(2) The radiation control committee should not exercise the functions of a clinical committee on radioisotopes in a medical facility, or of a reactor safeguards committee. However, handling, receiving, shipping, storage, transport, or disposal of radioisotopes beyond the control of the immediate medical or reactor staff is subject to the review of the radiation control committee.

(3) The committee membership will be kept up-to-date Training and experience résumés for each member of the committee will be kept on file by the radiological protection officer. In those cases where the committee membership list and résumés are on file at the AEC, the AEC will be advised of membership changes by letter forwarded through the Commanding General, AMC, ATTN: ~~AMCAD-S~~ AMCSF (See AMCR 385-9.)

c. Radiological protection officer (RPO). The training and experience of the radiological protection officer and his alternate must be commensurate with the type and hazard of the radiation source(s) for which they will be responsible. As a minimum, the formal training of the radiological protection officer and his alternate will be successful completion of the U.S. Public Health Service Occupational Radiation Protection Course or equivalent. Organizationally, he should

be in a position wherein he can effectively advise the commander and the radiation workers on matters of radiation safety.

(1) In cases involving more than 100 millicuries of unsealed sources and more than 10 curies of sealed sources, the radiological protection officer should be an individual other than a radiation user.

(2) Responsibilities of the radiological protection officer will include:

(a) Providing the commander, radiation control committee, and radiation users with advice and assistance on all matters pertaining to radiation safety. (Advice includes instructing and training of workers and visitors in the safe use of protective equipment and procedures.)

(b) Implementing the radiation protection safety program.

(c) Reviewing radiological operations to determine compliance with regulations and approved procedures.

(d) Maintaining an accurate record of the inventory of sources of radiation possessed by the installation or activity in accordance with AR 700-52. The record for each item should include: Federal stock number and nomenclature, manufacturer's model number, description and serial number, the isotope, source radioactivity and date radioactivity was determined, chemical and physical form, whether sealed or unsealed, date received, and using organization and location.

(e) Maintaining radiation protection records.

(f) Performing radiation surveys and leak tests, or causing such surveys and tests to be performed. The accuracy of tests and surveys if performed by others remains the responsibility of the radiological protection officer.

(g) Evaluating the hazard potential and adequacy of protective measures for existing and proposed operations.

(h) Reviewing standing operating procedures (SOP's) for operations involving sources of radiation prior to review by the radiation control committee.

(i) Investigating radiation accidents and incidents.

(j) Reporting the findings of investigations (para 30) in accordance with AMCR 385-3.

(k) Assuring that radiation detection instruments are properly calibrated and are available to radiation workers.

(l) Monitoring incidents wherein unusual levels of radiation or contamination are suspected.

(m) Prior to being relieved of his duties, the radiological protection officer will take the following action with regard to radioactive materials and equipment for which he is responsible:

1. Secure all material and equipment in such a manner as to preclude use or removal during the period for which there is no radiological protection officer appointed; or

2. Turn over to a properly qualified and authorized individual, all materials and records for which he is responsible. Such an authorized individual will have the qualifications and training required of a radiological protection officer.

d. Supervisors of radiation workers or radiological projects will be responsible for:

(1) Maintaining a current inventory of all sources of radiation for which they are responsible.

(2) Knowing the exact location of all sources of radiation for which they are responsible.

(3) Posting appropriate warning signs and notices.

(4) Assuring that their personnel have received adequate instruction and experience prior to using or being exposed to radiation.

(5) Controlling contamination.

(6) Assuring sources are secured against unauthorized use.

(7) Controlling personnel exposures.

(8) Preparing, prior to the start of any operation involving radioactive material or possible exposure to radiation, an adequate SOP for review by the Radiological Protection Officer and the Radiation Control Committee prior to final approval in accordance with paragraph 1625, AMCR 385-224. The SOP will contain, as a minimum, responsibilities, maximum permissible levels of radiation in the areas concerned, storage of sources, procedures regarding dosimetry, decontamination, and emergencies. (This SOP is mandatory for operations in which there is a reasonable probability of exposure beyond established limits.)

(9) Enforcing SOP's, rules, and special precautions.

(10) Reporting to the radiological protection officer, any accident, unusual incident, personnel injury, however slight, suspected overexposure, and/or suspected internal exposure, as soon as possible after occurrence.

(11) Prior to being relieved of his duties, each radiation supervisor will take the following action with regard to all radioactive materials and equipment for which he is responsible:

(a) Secure all material and equipment in such a manner as to preclude use or removal while not under the immediate supervision of a qualified and authorized individual; or

(b) Turn over to a properly qualified and authorized individual, all materials and equipment for which he is responsible. Such an individual will have the qualifications and training required for the safe handling of the materials involved.

e. Radiation workers will be responsible for:

(1) Knowing and following SOP's, rules, and special instructions.

(2) Using safety equipment properly.

(3) Reporting to the supervisor any accident; unusual incident; personal injury, however slight; suspected overexposure and/or suspected internal exposure; as soon as possible after the occurrence.

7. AEC licenses and Department of the Army authorizations. AMCR 385-9 furnishes guidance for installations and activities for obtaining AEC licenses and Department of the Army (DA) authorizations required by AR 700-52.

8. Local control of radioactive material. a. Activity and installation commanders will establish internal procedures to control the procurement, receipt, shipping, transport, use, maintenance, storage, and/or disposal of the following radiation sources:

(1) Radioactive solids in excess of 1 microcurie or with a specific radioactivity exceeding 0.002 microcuries per gram or emitting a dose rate of 0.1 millirad/hr at contact.

(2) AEC-controlled materials in excess of the quantities listed in Title 10, Code of Federal Regulations, Section 31.100.

(3) Machines which produce radiation; e.g., X-ray devices, accelerators, electron microscopes, etc.

(4) Radioactive gases or liquids of concentrations in excess of the values listed in Table II, Appendix B, Title 10, Code of Federal Regulations, Part 20. (See para 19 and 20 for disposal and release requirements.)

(5) Items activated in nuclear reactors (including Army reactors), by accelerators or by nuclear weapons.

b. Activity or installation approval of proposed procurement, receipt, use, transport, storage, maintenance, and/or disposal of radioactive material will be based upon the following considerations:

(1) Organizational element responsible for the proposed operation.

(2) Purpose for which the materials will be used, including the desired initiation date and estimated duration of the project.

(3) Materials desired, including:

(a) Isotopes and maximum activities to be used and possessed at any one time.

(b) Whether sealed or unsealed.

(c) Chemical and physical form.

(4) Qualifications and experience of persons who will directly supervise the operation and of the Radiological Protection Officer.

(5) Qualifications and experience of persons who will use or handle the material.

(6) Locations where sources will be used or stored (building number, room, and/or area number).

(7) Radiac instrumentation available to support the operation.

(8) Adequacy of facilities and equipment, storage containers, exhaust hoods, handling equipment, and protective equipment available.

(9) Adequacy of operational procedures, including procedures to be followed for collection and disposal of contaminated waste materials.

(10) Adequacy of radiation protection procedures to include safeguards to preclude emergencies, and actions to be taken should an emergency occur.

(11) Estimated exposure of operational and nearby non-operational personnel.

(12) Authority and conditions established in the AEC license or DA authorization issued to the installation or activity.

c. Activity or installation approval for programs involving machines which produce radiation will be based on the following information:

(1) Type of device.

(a) Function.

(b) Manufacturer and model number.

(c) Radiation output.

(d) Anticipated workload (hours/month).

(e) Whether fixed or mobile operation is anticipated.

(f) Whether single or multiposition exposure head is to be used.

(g) Pulse duration and anticipated workload.

(h) Target.

(i) Calibration procedure and frequency.

(j) For accelerators, the curie level of the target, the mode of operation (positive or negative), energy of accelerator particles, the procedures for exchange of targets, and the available ventilation will also be considered.

(2) Safeguards.

(a) Shielding.

(b) Interlock provisions and console locations.

(c) Estimated exposure based on seven consecutive day operations modified by the planned workload. (Exposures of operational and nonoperational personnel must be considered.)

(d) Occupied locations nearby.

(e) Boundaries of restricted area.

(3) Training and experience of operators.

d. Approval of the commander should be withheld until the radiation control committee has determined that:

(1) The proposed operation complies with regulations, current standards, and conditions contained in applicable licenses and/or DA authorizations.

(2) The operation will not present undue personnel exposure damage to property.

(3) Personnel are adequately trained.

(4) Facilities, equipment, locations, and procedures are adequate to assure safe operation.

(5) Necessary conditions and controls are provided.

9. Radioactive material. a. Unsealed radioactive material should not be used where sealed sources can perform the desired function. Unsealed radioactive material may result in the contamination of personnel and equipment if not properly handled.

b. The least hazardous chemical and physical form should be selected.

c. Storage or use of eating, drinking, chewing, smoking, and cosmetic materials will be prohibited in the immediate areas containing radioactive materials.

d. Radioactive solutions will not be pipetted by mouth.

e. Disposable paper towels and handkerchiefs will be provided workers in areas containing unsealed radioactive materials. Properly marked receptacles will be provided for the disposal of such materials.

f. Operations and facilities involving radioactive materials should be planned to limit the spread of radioactive material.

(1) Work areas will be designated, marked, and monitored.

(2) Movement of personnel and unsealed radioactive material will be minimized.

g. Ventilating systems will be designed so as to preclude the spread of radioactive materials.

h. In the case of sealed sources, the capsule enclosing the radioactive material and the physical form of the radioisotope will be chosen to minimize the possibility of dispersion, inhalation, and ingestion of the material. The capsule and container should be resistant to fire and corrosion.

i. Operations using remote-control devices to control sealed sources of radiation should be designed to prevent leakage or rupture of the source capsules; to provide a positive means of containment of contamination in case of leakage, rupture or other damage to the capsule; a positive means of control of the sources from "safe" to "exposed" position; and an interlock, visual or audible alarm system to prevent entry of personnel into the radiation field while the sources are in the "exposed" position. Compressed gas systems are considered to be the least likely type of system to meet these requirements.

j. TB MED 232 provides guidance concerning storage and maintenance of self-luminous devices.

10. Safe handling of radioactive materials. Additional guidance on the safe handling of radioactive materials is available in National Bureau of Standards Handbook 92.

11. Other sources of radiation. a. Guidance for design of facilities and preparation of operating procedures for other sources of radiation, such as X-ray units, accelerators, and electron microscopes, can be found in National Bureau of Standards Handbooks 50, 55, 63, 66, 76, and 97, or replacement documents, available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

b. Hazards associated with the high voltage, secondary beam, scattered radiation and activated material must also be considered. Ventilation, interlock provisions, shielding design, remote control, and handling procedures are essential considerations.

c. Prior to operation, X-ray, accelerator, and similar facilities should be surveyed by a competent individual for radiological safety hazards in construction and operation. The services of the U.S. Army Environmental Hygiene Agency are available for these surveys (AMCR 385-7). In order to avoid modification of or delay in operation of these facilities, the construction plans should be reviewed by a competent person.

12. Personnel exposure. The radiation exposure standards contained in this section are applicable to all personnel. Exposures incurred during examination or treatment for medical or dental purposes are not to be included in calculations for compliance with this section. However, medical exposures should be considered in the programing occupational exposures.

a. Exposure of personnel will not exceed the following values:

(1) Personnel 19 years of age and over who are occupationally exposed to radiation:

(a) Accumulated dose to the whole body, head and trunk, active blood-forming organs, gonads, or lens of the eye will not exceed:

1. 3 rem in any calendar quarter, or

2. 5(N-18) rem total lifetime dose where N equals the present age in years.

(b) Accumulated dose to the skin of the whole body or the thyroid will not exceed 7½ rem in any calendar quarter or 30 rem in any calendar year.

(c) Accumulated dose of radiation to the hands and forearms and to the feet and ankles will not exceed 18 3/4 rem in any calendar quarter or 75 rem in any calendar year.

(2) Members of the general public, personnel not occupationally exposed, and persons who are less than 19 years of age will not be exposed in any calendar quarter in excess of 0.125 rem or in excess of 0.500 rem in any calendar year. Pregnant women will not be exposed to ionizing radiation for other than medical reasons (AR 40-5). At the first indication of pregnancy, women should notify their supervisor.

b. Before permitting any individual to receive an exposure in excess of the limits in a(1) above, the installation or activity will forward a request through channels, to the Commanding General, AMC, ATTN: ~~AMCAD-S~~ AMCSF, for review and coordination. In addition to the information required in Title 10, Code of Federal Regulations, Section 20.102, the proposal must contain complete justification and describe the means for assuring that the higher levels requested will not be exceeded.

c. Personnel exposure will be kept as low as practicable. The necessity for exposure must be weighed against the benefits expected.

d. When an individual has received exposure in excess of the amount established for a calendar quarter, he shall be removed from duties involving exposures to radiation until subsequent exposure limitations are established through consultation with competent medical authority. When an individual has received exposure in excess of that established for a calendar year, he shall be removed from duties involving further exposure until his exposure records have been evaluated by Headquarters, AMC, and subsequent exposure limitations are established. When an individual has received an accumulated dose of radiation in excess of 5(N-18) rem, he shall be removed from duties involving occupational exposure to ionizing radiation until his exposure record has been evaluated by The Surgeon General; Headquarters, DA, and subsequent exposure limitations are established.

e. Radiation workers may be exposed to the limits established in a(1) above, when warranted. However, personnel exposure will be kept as low as practical. The necessity of exposure must be weighed against the benefits expected. Should an individual receive exposure in excess of the limits listed below, the circumstances involved will be recorded in the radiation protection records and the affected individual's DD Form 1141.

(1) 0.3 rem in any seven consecutive days, or

(2) 1.0 rem in any calendar month.

f. Should an individual be exposed to external radiation as well as internal radiation, his total exposure must be considered and recorded. For example, should an individual's thyroid receive eight rem in a calendar quarter as a result of a radioiodine spill, that exposure should be added to his whole body exposure to determine the total dose received by the thyroid.

g. Additional guidance concerning maximum permissible concentration and control of internal radiation hazards are contained in Title 10, Code of Federal Regulation, Part 20, and National Bureau of Standards Handbook 69.

13. Medical examinations. a. Radiation workers should be given a preemployment examination which includes medical history, radiation exposure history, physical examination, and a complete blood count. Personnel who are to be occupationally exposed to neutrons will be given a slit-lamp test prior to exposure. If radiation workers are to be exposed to unsealed radiation sources, appropriate bio-assay should be taken to establish base lines.

b. Any abnormalities will be recorded and carefully considered prior to exposure or continued exposure.

c. If a similar examination has been conducted within the past 6 months, those portions of the examination need not be repeated for which results are entered in the individual's record.

d. Visitors and personnel on temporary duty for less than 30 days do not require a medical examination provided they will not be exposed to radiation in excess of the levels established in paragraph 12a(1), or to radioactive concentration in excess of those given in Title 10, Code of Federal Regulations, Part 20, Appendix B, Table II.

14. Periodic medical examinations. a. Radiation workers should be given a medical examination at least once every 3 years. Dependent upon the work involved, the medical officer may desire to repeat the examination more frequently.

b. Upon termination of the occupational exposure, the individual should be given a medical examination.

c. In the event of an overexposure, a medical examination may be necessary.

15. Training and experience of personnel. a. Personnel, including visitors, who will be exposed to radiation and/or radioactive materials will be informed of the following information prior to exposure:

(1) The presence of radiation or radioactive material.

(2) Health hazards associated with exposure to such materials and/or radiation.

(3) Procedures and precautions to minimize exposures.

(4) Applicable provisions of AEC licenses, DA authorizations, regulations, and standing operating procedures.

(5) Emergency procedures.

(6) Right to receive a report of his exposure incurred.

(7) Proper use of protective equipment and clothing.

b. Radiation workers will receive the instruction in a above. In addition they will be instructed in the following areas:

(1) Maximum exposure and contamination levels.

(2) Safe methods of performing work. (The use of protective equipment and the operational steps involved will be demonstrated.)

(3) Procedures to minimize contamination and to secure sources of radiation from unauthorized use.

c. Before an individual uses or supervises the use of sources of radiation, the radiation control committee should determine that his training and experience are sufficient to enable him to deal safely with materials involved.

d. An individual whose training and experience is not adequate will be required to work under the direct supervision of a person known to be qualified until such time that the individual can demonstrate his ability on the job. In the event such training is not available locally, inquiry should be made into the possibility of the employee receiving the required training and experience at another AMC installation or activity.

e. Emergency and security personnel will be trained and equipped to cope with radiological hazards that may be encountered in the performance of their duties. Training will be sufficient to enable such personnel to function without waiting for the guidance of the radiological protection officer, or other individuals not part of their immediate group. Such persons will be informed of the existence of situations that might become hazardous during special or unusual circumstances.

f. A record of training will be recorded on DA Form 750 (Record of Training) and placed in each employee's official personnel folder.

16. Personnel dosimetry. a. Dosimetry requirements contained in this paragraph are not applicable to persons exposed while being examined or treated for medical or dental purposes.

b. Knowledge of the radiation exposure received by personnel is necessary to prevent future overexposure and possible injury. The Army film badge packet described in SB 11-206 will be used as the primary device to officially determine personnel exposure.

c. Film badges will be worn by each individual who is likely to be exposed to radiation or radioactive materials. This requirement applies to visitors as well as installation or activity personnel.

d. Pocket chambers or self-reading pocket dosimeters may be used to supplement the film badge dosimeter. Such devices are useful when worn in areas in which an individual is likely to receive five or more millirem in 1 hour. In areas in which an individual is likely to receive 100 millirem or more of radiation in 1 hour, personnel will wear self-reading pocket dosimeters in addition to the film badge.

e. The type of film badge (range and type of radiation detected), the part of the body upon which the badge is to be worn (lapel, belt, wrist, hand, etc.) and the need for additional dosimetric devices must be determined by taking into account the type of radiation exposures to be experienced.

f. In the event of failure or loss of dosimetric devices, personnel exposure will be calculated or estimated from past exposure histories, results of radiation survey, the exposures of other personnel under similar circumstances, breath sampling, bio-assay techniques, and whole body counting and scanning.

g. AMC personnel who may be exposed to radiation at non-Army sites will wear film badges obtained from the radiological protection officer of their home installation/activity. On-site film badges may be worn in addition to the Army badges, but not as substitutes for the Army badges. AMC personnel who may be exposed to radiation while on travel status will furnish the radiological protection officer with a copy of any reports of exposure received for inclusion in the DD Form 1141 (Record of Occupational Exposure to Ionizing Radiation) and the appropriate radiation protection records. In the event differences between the reading of on-site film badges and Army film badges cannot be resolved, the Army reading will be recorded in the individual's health record.

h. Procedures will be established for the centralized issue and control of dosimetric devices:

(1) Personnel will be instructed not to tamper with dosimetric devices, either physically, or by causing them to indicate readings that are not indicative of the personnel exposure.

(2) Facilities will be provided for the storage of dosimetric devices when the devices are not being worn. These storage facilities should be located so that the dosimeters will not be exposed to radiation, or excesses of heat or light. Each film badge dosimeter storage facility will be equipped with a control badge, in accordance with SB 11-206.

(3) Because of the possibility of being lost, or forgotten or the possibility of recording a faulty exposure, dosimetric devices must be stored in a designated receptacle when not being worn.

(4) Personnel on TDY will store their badges in such a manner that they will not be exposed to radiation when not being worn. However, personnel on TDY will wear film badges whenever they are exposed to radiation, whether or not during normal duty hours.

17. Radiation surveys. Surveys should be made under representative conditions. The following describes certain types of radiation surveys.

a. Initial surveys. An initial survey will be made by the radiological protection officer of sites and areas where sources of radiation will be used and/or stored before an operation involving radiation is initiated or operational changes are approved, or upon installation of a device which produces ionizing radiation.

b. Routine surveys.

(1) Surveys of each area in which sources of radiation are used and/or stored shall be performed by or under the direction of the radiological protection officer at least once each month. The radiation hazards incident to the production, use, release, disposal, or presence of radioactive materials or other sources of radiation will be evaluated. Such an evaluation includes a physical survey of the location of materials and equipment, measurements of levels of radiation and/or concentrations of radioactive material in and around the site. Conditions of stable storage may be exempted from monthly surveys at the discretion of the local radiation control committee. However, the intervals of surveys of storage areas will not exceed 3 months.

(2) The area survey will be performed using suitable instruments, and, when appropriate, smear and air sampling techniques. Work habits of personnel should be observed to obtain data regarding additional sites to be monitored or areas of improvement for the operational procedures. Locations of the monitoring points with the results, statement of the hazard, and any recommendations as to decontamination, shielding, procedural changes, etc., will be recorded and filed.

c. In addition to the surveys in a and b above, special surveys are required in the event of the following occurrences:

(1) Shipment or receipt of radioactive materials. Packages and the unloaded vehicles must be surveyed.

(2) Termination of a project involving radioactive materials. A survey is required to determine that no contamination exists and that sources of radiation are properly stored or have been disposed of properly.

(3) Unplanned events. Loss of control, spill, overexposure, or any unplanned event which could adversely or did adversely affect the safety of the operation must be monitored. Control must be re-established to prevent the hazard from increasing.

(4) Hazardous operations. Particularly hazardous operations, such as decontamination, encapsulation, or smelting of radioactive materials, as authorized by AEC license or DA authorization, must be continually monitored.

d. All places, equipment, persons, and animals suspected or known to have been in contact with radioactive material will be monitored for contamination. Personnel must be monitored before eating, smoking, chewing, drinking, or leaving the area in which radioactive materials are located.

e. Environmental monitoring. Environmental monitoring will be performed whenever radiological operations are such that they might have an adverse impact upon the surrounding environment. Ideally, such monitoring should be done prior to the inception of radiological operations at an installation and periodically thereafter. The results of such environmental monitoring should be used to determine the need to modify controls and/or operations.

18. Radiation warning signs. a. Areas, buildings, inclosures, packages, and containers will be conspicuously posted with radiation warning signs as required by AR 385-30; AR 55-55; Title 10 of the Code of Federal Regulations, Part 20; and Title 49 of the Code of Federal Regulations.

b. Additional instructional or precautionary information may be posted as desired, but not substituted for the signs required in a above.

19. Construction of radiation facilities. a. Selection of a radiation facility site will include consideration of the following factors:

(1) Impact of surrounding operations upon the proposed facility:

(a) Radiation background.

(b) Effluents from nearby operations.

(c) Fire and explosive hazard.

(d) Capability of controlling access.

(e) Possibility of expanding the facility or of using larger sources.

(2) Impact of proposed facility upon operations in surrounding areas and in areas downwind and downstream of the proposed site:

(a) Increased radiation background.

(b) Effect of effluent discharge.

(c) Impact of most severe plausible radiation incident.

(3) Possibility of flood or land movement.

(4) Waste disposal. A separate piping system may be desirable for the disposal of liquid waste.

b. A radiation facility should be a single story structure without a basement, and of noncombustible construction. Floors, walls, surfaces, and equipment should be nonporous and easy to clean. Fire fighting in radiation controlled areas presents problems that must be considered before any installation of fire fighting devices. While the containment and extinguishment of fires is desirable, the installation of fire fighting devices must be such that will not result in the contamination of drainage systems due to runoff; that will not result in the spread of contamination; or increase the hazard to personnel. In many instances, "fog" and "foam" type devices meet these requirements. Where practical, an automatic fire alarm system, reporting directly to the fire department, should be installed.

c. Ventilation systems must be planned carefully:

(1) Recirculation of air should not be permitted within buildings containing radioactive materials.

(2) Air intakes will be located to prevent the entrance of radioactive effluent from the same or nearby buildings into the ventilation system.

(3) Air flow will be from nonactive to "hot" areas, through filters, to the discharge. "Hot" areas should be maintained at a negative pressure to reduce the spread of contamination. Blowers should be positioned downstream from the filter so that the air is sucked rather than pushed through the filter.

(4) Hoods will be interlocked or designed to prevent reverse flow when all of the hoods are not operating at the same time. The airflow rate through openings of the hood should be at least 100 linear feet per minute. (See NBS Handbook No. 92.)

(5) Hoods, dry boxes, and traps are useful laboratory tools for minimizing contamination. Dry boxes may not be used for storing or handling radioactive materials involving explosives or flammable solvents unless designed to function as operational shields for the quantities of explosives or flammables involved.

d. Buildings in which unsealed radioactive materials are handled should be equipped with shower and monitoring facilities. Two separate locker rooms separated by a wash and shower room should be provided. The one locker room is for storage of the worker's street clothing; the other, for his work clothing.

20. Operational safety procedures. a. High radiation areas should be interlocked to halt the irradiation upon the entry of personnel to the area, or otherwise to alert workers of the entry of personnel into the area during irradiation. The alarm system should be of a fail-safe design of such type that in case of primary alarm circuit failure the secondary alarm circuit is set off. High radiation areas that exist for more than 30 days will be equipped with automatic alarms and devices as required by Title 10, Code of Federal Regulations, Part 20. In high radiation areas that exist for less than 30 days, appropriate protective measures, such as close supervision to prevent unauthorized entry and exposure, will be taken.

b. Work areas will be designated and marked. Radiation levels should be measured, and marked where practical.

c. Process control devices, such as thickness gages and moisture gages, involving radioactive sources, will be designed to protect the source(s) against mechanical damage and to limit the exposure of operators and maintenance personnel to limits established for the general public. The device will be conspicuously and permanently marked with a radiation warning sign.

d. Each AMC installation or activity having radiation counting facilities should perform surveys for smearable contamination on outdoor surfaces.

(1) Levels of radiation sufficiently high to be significant may result from various sources, such as poor radioactive waste disposal practices, radiation incidents, and nuclear weapons testing.

(2) If significant levels of radioactive material are deposited out of doors, this contamination, if not detected, can be tracked into "clean" areas and sensitive "low level" laboratories.

e. Emergency exits, passageways, and doorways must be planned to enable safe movement of personnel in the event of an emergency.

f. "Hot" drains and tanks should be planned on the assumption that they will leak and will require maintenance. Unless criticality requirements prohibit, "hot" drains should empty into hold up tanks in order that samples can be analyzed to effect proper disposal.

g. Whenever a high radiation area is not mechanically secured to prevent unauthorized entry, a guard will be posted.

h. Secure, centralized storage facilities will be provided for radioactive materials not required in the immediate work areas.

i. Before initiation of an operation or modifying an operation involving radiation, the operating and emergency procedures should be practiced using a dummy source or other non-radioactive material.

j. Explosives, propellants, and excessive flammables will be excluded from areas in which radioactive materials are used or stored unless specifically approved in a DA authorization or AEC license.

k. Personnel with open skin wounds will not be permitted to work with unsealed radioactive material without an adequate waterproof covering on the wound and the approval of the medical officer.

l. Containers of radioactive liquids should be provided with secondary containment.

m. Except in an emergency, anti-contamination equipment and clothing will be worn in radiation controlled areas only.

n. Each item of equipment being released from a "hot" area to a "clean" area will be monitored, and decontaminated if necessary, and certified by the monitor to have contamination levels below those listed in table 1.

o. Maintenance that must be performed in a radiation controlled area will be cleared with the radiological protection officer and area supervisor prior to initiation.

p. Sealed sources will be leak tested within 5 days after receipt; at least once every 6 months (alpha sources every 3 months); prior to shipments; suspect sources will be withheld from use until leak tested; and after any suspected or actual damage. Unless required otherwise by Army directives, sealed sources containing less than 10 microcuries of activity or containing only natural uranium, natural thorium, or depleted uranium need not be tested. Leak test results will be recorded in terms of microcuries.

q. The quantity of radioactive material stored within a working area should be limited to the smallest reasonable quantity consistent with operational requirements.

r. Anti-contamination clothing and equipment will be prescribed by the radiological protection officer and will be marked in accordance with TM 3-261.

21. Disposal. a. Unwanted radioactive materials will be disposed of in accordance with AR 755-15 (Disposal of Unwanted Radioactive Material).

b. Radioactive material will not be buried on any AMC installation.

c. Disposal of radioactive effluents (liquids or gases) into unrestricted areas will be in accordance with Title 10, Code of Federal Regulations, Sections 20.106 and 20.303, provided local governments do not prohibit such disposal. Compliance with concentration levels established in Appendix B, Title 10, Code of Federal Regulations, Part 20, will be determined by averaging concentrations on a monthly basis instead of an annual basis. The total quantity of radioactive effluents discharged at any installation will not exceed the amount authorized a single licensee under Title 10, Code of Federal Regulations, Part 20. At installations where more than one licensee desires to discharge radioactive effluents, the commander will apportion the amounts to be authorized each licensee.

d. Radioactive materials will not be burned or incinerated except as specifically authorized by prior approval of Headquarters, AMC ~~(AMCAD-S)~~ AMCSF.

22. Contamination levels. Maximum permissible contamination levels and indicated actions are contained in tables 1, 2, and 3 below. The following notes and definitions will apply to the use of tables 1, 2, and 3:

a. "None" shall be defined as the amount of activity which, in the same counting time, gives a count which is not different from the

background count. (See National Bureau of Standards Handbook No. 80, Section 2.5.3, para 2.)

b. No allowance shall be made for particle size or for the use of protective clothing or equipment for determining whether an individual is exposed to radioactive concentrations in excess of the levels specified in this regulation.

c. Items which cannot be decontaminated will be marked and tagged to indicate their condition, and will be removed from use pending further decontamination or disposal.

d. Contamination should be kept at a minimum at all times. The publication of maximum permissible contamination levels should not be used as a license for unwarranted relaxation of controls.

e. Abbreviations used in tables 1, 2, and 3 have the following meaning:

dpm = disintegration per minute

cm^2 = square centimeter

MPC = Maximum Permissible Concentration. See Title 10, Code of Federal Regulations, Part 20, and National Bureau of Standards Handbook 69 for Maximum Permissible Concentrations of Radionuclides in Air.

Table 1. Maximum permissible contamination on inanimate objects.

Item and Corrective Action	Fixed (F) or Removable (R)	CONTAMINATION LEVEL			
		Alpha		Beta-Gamma	
		dpm/100 cm^2 Instrument	dpm/100 cm^2 Smear	mrad/hr at 1 in.	dpm/100 cm^2
1. Personal clothing, including shoes. Replace, decontaminate or store for decay, if above:	F	200		0.2	
	R		None		None
2. Protective clothing, incl. shoes.					
a. General. Should be replaced or decontaminated, if above:	F	1,000		0.5	
	R		200		1,000
b. Laundry. Do not release to public laundry, if above:	F	200		0.4	
	R		50		200
c. Respirators	F	200		0.06	
	R		None		None
3. Laboratories and work areas:					
a. Uncontrolled areas. Require controls and posting or decontaminate, if above:	F	200		0.25	
	R		30		100
b. Controlled areas. Decontaminate, or if impossible, fix with periodic check on fixation, if above:	F	1,000		2.0	
	R		200		1,000
4. Vehicles:					
a. Use in controlled areas. Decontaminate or if impossible, fix, if above:	F	1,000		2.0	
	R		300		1,000
b. Use in uncontrolled areas. Decontaminate, if above:	F	500		0.4	
	R		30		500
5. Tools, equipment and containers. Prior to non-radioactive use, decon if above:	F	200		0.25	
	R		50		100
6. Shipping containers, outside surfaces, decon if above:	F	500		0.25	
	R		None		None

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Table 2. Airborne contamination levels.

Required respiratory protection	Alpha Concentration	Beta Concentration
[1]Half face mask with filter or canister respirator.	1 MPC	1 MPC
Supplied air or self-contained air supply with full face mask.	5 MPC	10 MPC

[1]For operations under the control of an AEC license, specific approval of the AEC must be obtained before making any allowance for use of respiratory equipment.

Table 3. Maximum permissible personnel contamination.

Area and action	Alpha or Beta-Gamma
1. Skin. Contact medical officer if contaminated on face or over major area of the body. Continue decontamination, if above:	Any detectable level above background.
2. Hands. Continue decontamination, if above:	Any detectable level above background.

23. Personnel decontamination. a. Thorough washing with non-abrasive soap and lukewarm water is the best general method of decontamination of the hands and other parts of the body regardless of the contaminant. If the contaminant is localized, it is often more practical to mask off the affected area and cleanse with swabs, rather than risk the danger of spreading the contaminant by general washing. Organic solvents must be avoided as decontamination agents because they may increase the probability of the radioactive materials entering the body through skin absorption. Special attention must be given to the areas between the fingers and around the nails. The outer edges of the hands are readily contaminated and often neglected in the washing.

b. After repeated washings, the skin may tend to chap. To avoid this, apply lanolin or hand cream and then continue to wash. If repeated washing with soap and water is unsuccessful in decontamination, the individual should be referred to the local medical officer for application of the more drastic chemical decontamination procedures listed in the National Bureau of Standards Handbook No. 48.

c. If it is suspected that any person, by inhalation, ingestion, or by any other manner, has introduced radioactive materials into his body, the local medical officer will be notified immediately so that medical procedures can be initiated to facilitate the elimination of such material. Contamination over a large area of his body or his face will be the basis for suspecting that the person is internally contaminated.

d. In the event an individual is contaminated on a large portion of his body, the following decontamination procedure is recommended:

(1) Place the individual under a lukewarm shower.

(2) Using a mild toilet soap, individual will cover his entire body with lather.

(3) While still covered with lather, the individual will step out of the shower. An assistant will then cover the individual with a heavy coat of mild soap flakes. (The purpose of the lather is to cause the soap flakes to adhere to the person.)

(4) Using his hands, the contaminated individual will rub the soap flakes on his body into a paste.

(5) Individual will then return to shower and attempt to rinse off the soap by starting at the top and working his way down. (Note. It will be necessary for the individual to rub body surfaces with his hands while rinsing, in order to remove soap paste.) Soap paste will remain in

those areas that have not been thoroughly rinsed. Although a soft cloth may be used, a brush may not. Particular attention should be given the hairy portions of the body.

(6) When the individual has rinsed himself to the point that he no longer feels slimy and while still under the shower, he will be examined by an assistant for traces of soap. The presence of soap will indicate which areas of the body have not been decontaminated.

(7) After removing all traces of soap, the individual will leave the shower and dry himself.

(8) After drying off, the individual will be monitored. If the individual is still contaminated, procedures outlined above will be repeated.

d. In all cases of personnel contamination, the radiological protection officer will be consulted.

e. All water used in the washing and rinsing described above will be contaminated and its disposal should be conditioned by this fact.

24. Equipment and area decontamination. a. General methods.

(1) Care must be taken during the decontamination process to avoid further spread of the contaminant which can be accomplished by:

(a) Always taking precautions to contain the contamination by the use of monitoring, protective clothing, and shoe covers.

(b) Always working from the areas of least contamination toward the area(s) of the heaviest contamination.

(c) Using a minimum amount of decontamination liquids and being aware that the runoff solutions, mops, rags, and brushes will all be contaminated.

(2) The methods listed below should be tried in the following sequence:

(a) Damp mopping. The area is wiped with a damp rag. The wiping surface of the rag is changed repeatedly to minimize spreading of the contaminant.

(b) Water and detergent. The area is wetted with a minimum amount of detergent solution. The area is then wiped dry with absorbent gauze or cloth.

(c) Steam cleaning.

(d) Cleaning with solvents other than water.

(e) Surface removal by use of chemicals, abrasives, sand blasting, grinding, etc.

(3) Vacuum cleaners. Only vacuum cleaners which are equipped with absolute filters and which have been tested for filtration efficiency may be used. The filtration efficiency will be tested after each replacement of the filter and each time contents are emptied.

b. Specific methods. If the above methods (a above) do not work, the following specific methods may be tried:

(1) Metals.

(a) Remove any oil from the surface with organic solvents.

(b) Soak in a solution of citric acid prepared by addition of one pound of citric acid to one gallon of water.

(c) Soak in a solution of diluted hydrochloric acid prepared by carefully adding one part of commercial grade concentrated hydrochloric acid to four parts of water. Hydrochloric acid should not be used on stainless steel because of the etching which will take place and destroy the smooth surface of the metal.

(d) Use metal polish.

(2) Plastics. Clean with ammonium citrate, dilute acids, or organic solvents (of a type not injurious to the plastics).

(3) Glass and porcelain. Clean with detergent solution. If this method fails, soak in concentrated nitric acid or chromic acid cleaning solution.

(4) Painted surfaces. Use paint remover, or, in cases where surfaces were coated with a strippable paint, peel the paint from surface.

(5) Rubber, including respirators and gas masks. Wash with detergent and water or with a warm 20 per cent (by weight) water solution of sodium citrate.

c. Decontamination of clothing.

(1) Determine extent of contamination using an AN/PDR-27, or equivalent, with the beta shield removed, and with the AN/PDR-60, or equivalent.

(2) Wash in special laundry facility (home type or other washer and dryer kept in the facility for washing "hot" clothing only). Use the following steps:

(a) Soak overnight in water solution of laundry detergent.

(b) Drain.

(c) Wash for full cycle with hot water and laundry detergent.

(d) Rinse, dry and remonitor.

(3) Water utilized for washing, rinsing or soaking contaminated clothing will be contaminated as a result of such usage and its disposal should be conditioned by this fact. Laundry equipment may become contaminated also.

d. Monitoring technique. Check crevices and inside corners of areas, tools, and equipment. Special attention should be given to oily and greasy surfaces such as those on automotive equipment.

25. Storage of radioactive materials. a. Areas will be set aside for the secure storage of radioactive materials. These areas will be used to store only radioactive materials. The storage area will be free from the danger of flooding and outside the danger radius of flammables or explosives. Physical security standards for storing radioactive materials are contained in appendix A, AMCR 190-3.

b. Each storage and shipping container will be marked as required by AR 55-55 and AR 385-30, whether or not the radioactive material is under the license control of the AEC. Laboratory containers such as flasks and test tubes need not be marked as long as the user is continuously present.

c. Radioisotopes will not be stored in glass containers unless secondary containment is provided.

d. Radioisotopes should not be transferred from one storage container to another within the storage area. A system will be provided to control and record the "check in" and "check out" and monitoring of radioactive materials.

e. Storage areas will be adequately ventilated as determined by the RPO if gaseous sources are being stored.

f. All sources and containers will be labeled. The areas will be monitored periodically to assure adequate shielding and to detect any contamination.

g. Dose rates of a shipping container should not exceed 200 mrem/hr at the surface nor 10 mrem/hr at 3 feet from any surface of the container.

h. Operating officials will keep a current record of all stored radioactive material, and a copy of this record will be forwarded to the RPO. The RPO will conduct a physical inventory every 6 months.

26. On-post transportation of radioactive materials. Within an installation, it is usually not convenient to package and transport radioactive materials in the manner required for off-post shipments. However, the following precautions will be observed:

a. In loading the vehicles:

(1) Keep within the weight limitations.

(2) Limit or arrange cargo to keep radiation levels, to which personnel (including the driver) will be exposed during transportation, as low as possible. Maximum permissible dose rate in occupied areas of the vehicle will depend upon the time required to transport the material. The driver will wear a film badge and will not be exposed to ionizing radiation in excess of the limits indicated in paragraph 12a.

(3) Keep the containers away from the cab of the vehicle.

b. Do not haul loose radioactive materials. Tail gates should be closed to minimize the chance of cargo loss.

c. Containers should be sturdily constructed, sealed air-tight, and be free of removable contamination. Each container must have a completed DA Label 15 (Caution: Radioactive Materials) unless specifically exempt by military specification M-19590C.

d. The route used should be planned to avoid areas in which explosives are stored or handled and in which there is heavy traffic or personnel activity. The fire department, guard force, and safety director should be informed of the exact route and time of movement in sufficient time to allow implementation of any special protective measures required.

e. A suitable vehicle should be used. Vehicles that are difficult to decontaminate, and privately-owned automobiles should not be used.

f. Unless emergency personnel (guard force and fire department) have demonstrated a capability to cope with a radiological emergency, a technically trained person should accompany the movement to be able to advise in the event of an emergency.

27. Off-post transportation of radioactive materials. a. Radioactive material will be transported in accordance with AR 55-55 and applicable Federal and State regulations.

b. Radioactive material should not be forwarded through the U.S. mail channels except in an emergency. Should transmission by mail be necessary, shipment will comply with Part 125.24, U.S. Postal Manual, and will be registered.

c. Containers should be secured by blocking or tie down, when appropriate.

d. Materials shipped will be properly addressed to insure delivery to the proper installation and section within the installation.

e. Personnel who will transport and/or escort radioactive shipments will be briefed as to potential hazards, methods to minimize hazards and emergency procedures. In addition to the briefing, personnel engaged to transport the radioactive material will be given a completed DD Form 836 (Special Instructions for Motor Vehicle Drivers) supplemented with written emergency procedures. Written information will be provided as to the means for obtaining assistance of radiological emergency teams off-post.

f. Consignees will be notified in advance of impending shipments in order that consignees may assure that they have the capability to receive and handle the materials being shipped.

28. On-site command of emergency during transportation. The ranking person accompanying the shipment will take immediate steps to clear the area and request assistance. He retains command at the accident site pending the arrival of the commander of the nearest military installation or his representative. The designated Army area representative assumes responsibility upon his arrival.

29. Radiac instrumentation. a. Sufficient radiac instruments will be available to properly support the use of radiation sources. The instruments will be capable of detecting the types and levels of radiation involved and any possible resulting contamination.

b. Personnel monitoring devices will be immediately available in areas in which radioactive materials are handled.

c. All instruments used for radiation protection will be calibrated at least every 3 months, and after each maintenance or battery change. More frequent calibration will be necessary for instruments which receive heavy use. Dosimeters need to be calibrated only at 6-month intervals. Dose rate instruments used to determine time of stay and exposure estimates should be calibrated at a minimum of two points on each instrument scale. The instruments will be labeled with DA Label 80 (U.S. Army Calibration System) to show the date of the last calibration, source or method used for calibration, and the initials of the calibrator.

d. Faulty instruments will be tagged with DA Form 2417 (Unserviceable Test Instrument or Standard) to prevent their being used before having been repaired.

e. Each instrument used for radiation protection should be provided with a check source or test sample.

f. Pocket dosimeters should be calibrated every 6 months. At the time of calibration, the correction factor for the dosimeter should be determined. Dosimeters which leak more than 5 percent of full scale after 24 hours in a radiation free area or which have an error of more than 10 percent should be repaired. Dosimeters should be calibrated by exposing them to known sources of an energy level comparable to that which the dosimeter will be exposed during use. Each dosimeter will bear a label showing the correction factor and the date of calibration. The correction factor is determined by dividing the actual level of radiation by the indicated level.

g. Dosimeters are used to give the wearer an estimate of his exposure while receiving the dose, in order that he may limit himself to permissible levels. Disagreement between dosimeter and film badge measurements is to be expected. The film badge reading will be used as the official dose for record purposes unless the badge is proven to have recorded an incorrect exposure.

h. Instrumentation must be selected based on the type and level of radioactive material and/or radiation to be encountered. In high radiation areas, it is desirable to have a high-range survey meter in addition to a low-range meter, in order to cover the range of dose rates likely to be encountered.

i. If funds permit, duplicate radiation protection instruments should be available. The duplicate instruments will avoid the necessity of shutting down a radiological operation until an instrument can be repaired or replaced.

30. Emergency procedures. a. In view of the complicating factors that may arise in an emergency, it is impossible to establish simple rules of procedure to cover all situations of a radiation emergency. However, in any emergency, the primary concern must always be the protection of personnel from radiation hazards. Confinement of the contamination to the immediate environment of the accident should be a secondary concern. Copies of the investigation report, relative to exposures received by the personnel involved, will be given to each individual involved in that emergency.

b. Emergencies will probably be of the following types:

(1) Spill of radioactive material.

(2) Explosion.

(3) Fire.

(4) Overexposure.

(5) Injury to personnel.

(6) Loss of radioactive source.

(7) Vehicular accident involving radioactive material.

c. The medical officer of each AMC element having radiation sources shall establish written medical procedures for radiation casualties.

d. Emergency procedures will be preplanned and rehearsed at least once each year. In the event of an emergency, the following action will be taken:

(1) Spills or uncontrolled spread of contamination.

(a) Notify all persons not involved with the spill to vacate the area at once.

(b) If the spill is liquid and the hands and clothing are protected, right the container and take steps to contain the spillage.

(c) If the spill is on the skin, flush thoroughly.

(d) If the spill is on the clothing, discard outer or protective clothing at once.

(e) Notify the local radiological protection officer.

(f) Decontaminate personnel.

(g) Decontaminate the area.

(h) Monitor all persons involved in the spill and cleaning operation to determine adequacy of decontamination.

(i) Permit no person to resume work in the area until an area survey is made and the area is cleared by the radiological protection officer.

(j) Prepare a complete history of the incident and decontamination operation related thereto for the facility or area records. The history will include a statement of the corrective actions taken to prevent a recurrence. Forward within 2 weeks of the accident, an information copy to the Commanding General, AMC, ATTN: ~~AMCAD-S~~ AMCSF.

(2) Accidents involving radioactive dusts, mists, fumes, organic vapors, and gases.

(a) Notify all personnel not directly involved with the incident to vacate the area immediately.

(b) Hold breath, and switch off any air circulating devices; e.g., fans, air conditioners, blowers, etc.

(c) Vacate the area to a predesignated region, and allow no person to leave until monitored.

(d) Close and seal all entrances into the area and post conspicuous warning signs or guards to prevent doors from being opened accidentally.

(e) Notify the RPO.

(f) Immediately report all known or suspected inhalations of radioactive materials to the local RPO and the medical officer.

(g) Evaluate the hazards and the safety devices required for safe re-entry and apply the "two man rule."

(h) Determine cause of contamination and rectify the condition.

(i) Decontaminate the area.

(j) Perform an area survey (including air sampling) of the area before resuming normal operations.

(k) Monitor all persons suspected of contamination.

(l) Prepare a complete history of the accident and subsequent activity related thereto for the facility records. Forward, within 2 weeks of the incident, an information copy to the Commanding General, AMC, ATTN: AMCAD-S.

(3) Injuries to personnel involving radiation.

(a) Wash minor wounds immediately under running water while spreading the edges of the wound.

(b) Contaminated personnel who are injured. In any radiological accident involving injured personnel, the local medical officer will be notified immediately. Unless an emergency medical reason requires that the injured person be removed immediately, the injured person will not be transported until a litter or ambulance is available. If, however, other emergencies exist (e.g., fire or possible explosion), good common judgment should be used. Moving of the patient may become imperative.

(c) Personnel with minor wounds will be monitored and decontaminated, if necessary, before leaving the radiation facility. If the wounds are of a serious nature, the injured individual will be wrapped in a blanket to prevent the further spread of contamination, and immediately be removed to the nearest medical facility. Persons accompanying the individual will warn the medical personnel that there is a possibility that the injured is contaminated.

(d) Report all radiation accidents (overexposure, wounds, ingestion, inhalation) to the personnel involved, to the medical officer, and to the RPO.

(e) Permit no person involved in radiation injury to return to work without the approval of the attending physician and the RPO.

(f) Prepare a complete history of the accident and subsequent activity related thereto for the radiation facility records. The history will include a statement of the corrective actions taken to prevent a recurrence. Forward, within 2 weeks of the occurrence, an information copy to the Commanding General, AMC, ATTN: AMCAD-S.

(4) Fires and other major emergencies.

(a) Notify all persons not directly involved with the incident who are in the area.

(b) Notify the fire department and other emergency personnel.

(c) Attempt extinguishment of fires using readily available first-aid type extinguishers if a radiation hazard is not immediately present. Efforts should be made to prevent water or fire fighting chemical from coming in contact with the radiation source. Attempt to control runoff, preventing it from entering sewers or drainage systems until it has been monitored.

(d) Notify the RPO.

(e) The RPO will advise and assist the emergency personnel.

(f) Following the emergency, monitor the area and determine the protective devices necessary for safe decontamination.

(g) Decontaminate.

(h) Monitor all persons who were in the emergency area and those who were involved in combating the emergency.

(i) Monitor downwind, delineate all contaminated areas, and restrict access as necessary.

31. Additional requirements. The above reporting requirements are in addition to the requirements of AR 385-40; AMCR 385-2; AMCR 385-3; and in addition to Title 10, Code of Federal Regulations, Sections 20.401, .402 and .403, when AEC-licensed material is involved. Information copies of reports to the AEC will be forwarded (AMCR 385-9) immediately, through channels, to the Commanding General, AMC, ATTN: ~~AMCAD-S~~, AMCSF.

32. Key emergency personnel. Key emergency personnel, such as Provost Marshal, Fire Chief, Medical Officer, and Safety Officer will be kept currently informed of the receipt, storage, use, disposal, or transfer of radiation sources and will be sufficiently trained and equipped to cope with radiological emergencies independent of the presence of the RPO.

33. Records. Records will be maintained to document all aspects of the radiation protection effort. Included are:

a. Licenses, authorizations, and supporting applications.

b. Receipts, transfers and shipment records, notification of movement, and instructions to drivers.

c. Inventory and leak test records.

d. Instrument and source calibration records and certificates.

e. Utilization logs and radiation work permits.

f. Radiation survey records which include description of each use, operation or work performed; radiation levels and personnel exposure rates encountered; airborne and smearable contamination detected; hazards and corrective action, estimated personnel exposure; and disposition of radiation sources.

g. Environmental monitoring records.

h. Waste disposal records

i. Records of training, plans of instruction, experience and certification of radiation workers.

j. Standing operating procedures.

k. Records of special studies, investigations.

l. Copies of reports originated and received.

m. Inspection reports and related papers.

n. Radiation analysis files.

o. Minutes of committee meetings.

p. Directives and interpretation of regulations.

q. Personnel occupational exposure records. AR 40-14 requires the custodian of the medical records to prepare and maintain DD Form 1141 for each person occupationally exposed to ionizing radiation. For administrative control purposes, it is recommended that the Radiological Protection Officer maintain forms AEC-4 and AEC-5 also, where AEC licenses are involved. These forms are available at the U.S. Atomic Energy Commission, Division of Materials Licensing, Washington, D.C. 20545, and may be reproduced locally.

Appendix A

GLOSSARY OF RADIATION SAFETY TERMS

APPROVAL. Official certification of compliance with the provisions of this regulation and with instructions and directives as issued by Headquarters, AMC, or with those of other approving agencies specifically referred to in this regulation.

BACKGROUND RADIATION. Radiation arising from radioactive material other than the one directly under consideration. Background radiation due to cosmic rays and natural radioactivity is always present. There may also be background radiation due to the presence of radioactive substances in other parts of the building, in the building material itself, etc.

CONTAMINATION (RADIOACTIVE). Deposition of radioactive material in any place where it is not desired, and particularly in any place where its presence can be harmful. The harm may be in invalidating an experiment or a procedure, or in actually being a source of danger to persons.

CURIE. A unit of activity defined as the quantity of any radioactive nuclide in which the number of disintegrations per second is 3.700×10^{10}

- millicurie - One-thousandth of a curie (3.700×10^{7} disintegrations per second).

- microcurie - One-millionth of a curie (3.700×10^{4} disintegrations per second).

DOSE.

1. Absorbed Dose. When ionizing radiation passes through matter, some of its energy is imparted to the matter. The amount absorbed per unit mass of irradiated material at the place of interest is called the absorbed dose and is measured in rads, where

1 rad = 100 erg/gm = 1/100 joule/kg.

The rad unit is applicable to any type of ionizing radiation, but in reporting dose, the type, as well as irradiated material (for instance, tissue), and the place of interest must be specified. Without the above three factors, a statement of absorbed dose received is incomplete and probably useless, since the same dose of different kinds of radiation, even delivered to the same place, can produce entirely different effects.

2. Exposure Dose. See EXPOSURE.

3. Biological Dose. The radiation dose absorbed in biological material. It is measured in rems.

DOSE EQUIVALENT. The term "RBE" dose has been used in the past in both radiobiology and radiation safety. It is now recommended that the term RBE be used in radiobiology only and that another term be used for purposes of radiation safety. The linear-energy-transfer factor is multiplied by the absorbed dose, D_a, to obtain a quantity that expresses on a common scale the irradiation received by persons exposed to all ionizing radiations. The name recommended for the linear-energy-transfer-dependent factor is quality factor, QF. Other factors must also be considered for the purposes of radiation safety. A distribution factor, DF, is used to express the modification of the biological effect of radiation due to a nonuniform distribution of isotopes in the body. The distribution factor, like the quality factor, also affects the absorbed dose when radiation safety is being considered. It is recommended by the International Commission on Radiological Units and Measurements that the final calculated dose received by an individual after the absorbed dose is modified by the above-mentioned factors, plus any other factors that may effect the incoming radiation, be called the dose equivalent, DE. If the only apparent modifying factors are QF and DF, then:

$$DE = D_a\ (QF)\ (DF).$$

If other factors must be considered and are defined, then:

$$DE = D_a\ (QF)(DF).....$$

where the dots take into account the product of these other factors. The unit of dose equivalent, DE is the rem. The unit of absorbed dose, D_a, is the rad. (Compare definitions of Rem and Rad.) Although the above definition of dose equivalent does not cover a number of theoretical aspects (in particular the physical dimensions of some of the quantities) it fulfills the immediate requirement for an unequivocal specification of a scale that may be used for numerical expression in radiation safety.

EXPOSURE. The term "Exposure Dose" is obsolete. Exposure is a term adopted by the International Commission on Radiological Units and Measurements in 1962 to replace the term "exposure dose" introduced in their 1956 report. The quantity is used for X- and gamma radiation. Exposure is the measure at a certain place of radiation which has the ability to produce ionization. The unit of exposure is the roentgen, R, where 1R equals 2.58×10^{-4} coulombs/kilogram. The definition thus corresponds to the terms roentgen dose and air dose.

EXPOSURE, OCCUPATIONAL. Exposure to ionizing radiation that is incurred as a result of an individual's employment or duties which are in support of facilities which use materials or machinery capable of producing ionizing radiation. Exposure of an individual to ionizing radiation for medical or dental diagnosis or therapy shall not be deemed as occupational exposure.

FAIL-SAFE. A design characteristic of the hardware, component or system which, in the event of a malfunction, will not result in a degradation of safety.

FILM BADGE. A pack of appropriate photographic film and filters used to determine radiation exposure.

HAZARD, RADIATION. See RADIATION HAZARD.

INTLRLOCK. A device, usually electrical and/or mechanical in nature, to prevent activation of a control until a preliminary condition has been met or to prevent hazardous operations. Its purpose usually is safety of personnel or equipment. For example, it may be used to warn responsible personnel of an unsafe condition or unauthorized entry of personnel.

IONIZING RADIATION. See RADIATION.

LEAK TEST. A determination of the integrity of a sealed source encapsulation by detection of leakage or escape of radioactive contamination.

NUCLEAR REACTOR SYSTEM. Any equipment or device, except a nuclear weapon, capable of neutron multiplication through fission of special nuclear material. This definition includes nuclear reactors and subcritical assemblies of special nuclear material and the supporting equipment or device (if any) associated with them.

RAD. The rad is defined as the unit of absorbed dose of any nuclear (or ionizing) radiation which is accompanied by the liberation of 100 ergs of energy per gram of absorbing material. Or, one rad is approximately equal to absorbed dose delivered when soft tissue is exposed to one roentgen of medium voltage X-radiation. The rad is to be used solely with absorbed dose.

1 rad = 100 erg/gram = 1/100 joule/kg.

RADIATION. Energy propagated through space. As used in this regulation, the term refers to two kinds of ionizing radiation:

1. Electromagnetic waves (X-rays, gamma rays), and

2. Corpuscular emissions from radioactive substances or other sources (alpha and beta particles, etc.). Ionizing radiation is any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter.

RADIATION CONTROLLED AREAS. Any area, whose access or occupancy is controlled for the purpose of protection of individuals from exposure to ionizing radiation and radioactive materials.

RADIATION CONTROL COMMITTEE. A group of persons appointed by the commander to advise him on policy and actions necessary to ensure safety of personnel and property from hazards of radiation. Synonymous with "Isotope Committee," "Radiological Health and Safety Committee," "Radiation Protection Committee," and other similar titles of committees with the same purpose.

RADIATION HAZARD. A condition under which persons might receive radiation in excess of the applicable maximum permissible dose, or where radiation damage might be caused to materials or personnel.

RADIATION SOURCES. Materials, equipment or devices which generate or are capable of generating ionizing radiation, including: (1) naturally occurring radioactive materials, (2) by-product materials, (3) source materials, (4) special nuclear materials, (5) fission products, (6) materials containing induced or deposited radioactivity, (7) nuclear reactors, (8) radiographic and fluoroscopic equipment, (9) particle generators and accelerators, and (10) radio frequency generators such as klystrons and magnetrons which produce X-rays.

RADIATION WORKER. Any person occupationally exposed to ionizing radiation and/or radioactive materials. (Job descriptions of radiation workers should reflect that the individual is potentially exposed to ionizing radiation.)

RADIOACTIVE MATERIAL. Any substance which undergoes spontaneous disintegration in which energy is liberated, generally resulting in the formation of new nuclides (a species of atom characterized by the constitution of its nucleus). The process is accompanied by the emission of one or more types of ionizing radiation. Included are materials possessing artificial, induced and natural radioactivity.

1. By-product materials. Any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to radiation incident to the process of producing or utilizing special nuclear material.

2. Source material. Uranium or thorium or a combination thereof, in any physical or chemical form or ores which contain by weight, one-twentieth of one per cent (0.05 per cent) or more of uranium, thorium or any combination thereof. Source material does not include special nuclear material.

3. Special nuclear material. Plutonium, uranium 233, uranium enriched in the isotope 233 or in the isotope 233, or any other material which the U. S. Atomic Energy Commission pursuant to the provisions of section 51 of the Atomic Energy Act of 1954, 42 USC section 2071, determines to be

special nuclear materials, but does not include source material; or any material artifically enriched by any of the foregoing but does not include source material.

4. Naturally occurring radioactive material. Substances which are radioactive in the natural state, such as radium and thorium and their decay products, except those defined as source and special nuclear material.

RADIOLOGICAL PROTECTION OFFICER. An individual designated by the commander to provide consultation and on the degree of hazards associated with ionizing radiation and the effectiveness of measures to control these hazards. This individual shall be technically qualified by virtue of education, military training, and/or professional experience to assure a capability commensurate with the assignment. The term "Radiological Protection Officer" is a functional title and is not intended to denote a commissioned status or job classification within the Armed Forces.

RBE. (Relative Biological Effectiveness.) The RBE of a given radiation is defined as the ratio of the absorbed dose in rads of gamma radiation (of a specific energy) to the absorbed dose in rads of the given radiation having the same biological effect. (See Dose Equivalent.)

REM (Roentgen Equivalent Mammal). One rem is the quantity of ionizing radiation of any type which, when absorbed by man or other mammal produces a physiological effect equivalent to that produced by the absorption of one roentgen of X-ray or gamma radiation. Dose in rems equals RBE times dose in rads. The rem provides an indication of the extent of biological injury (of a given type) that would result from the absorption of nuclear radiation. Thus, the rem is a dose unit of biological effect, whereas the rad is a unit of absorbed energy dose, and the roentgen (for X-ray and gamma rays only) is one of exposure. The rem can also be defined as the unit of dose equivalent. The dose equivalent is numerically equal to the dose in rads, multiplied by the appropriate modifying factors.

ROENTGEN. The quantity of gamma or X-radiation which will give rise to the formation of 2.08×10^9 ion pairs per cubic centimeter of dry air, STP ($0^{\circ}C$, 1 atm). This is equivalent to the release of 87.7 ergs of energy when one gram of dry air under STP conditions is exposed to one roentgen of radiation. The roentgen is to be used solely as the unit for exposure.

$1\ R = 2.58 \times 10^{-4}$ coulombs/kg.

SEALED SOURCE. Radioactive material that is encased in and is to be used in a container in a manner to prevent leakage or escape of the radioactive material.

UNSEALED SOURCE. A discrete amount of radioactive material that is not encapsulated in a container to prevent leakage or escape of the radioactive material.

USER. The activity, section, division or other organizational unit which has been assigned responsibility for the use, handling, operation or storage of radiation sources.

Appendix B

RECOMMENDED DOCUMENTS FOR A REFERENCE LIBRARY

1. Army regulations. AR's 40-4, 40-5, 40-14, 40-37, 40-501, 55-55, 55-355, 385-10, 385-12, 385-30, 385-32, 385-40, 385-80, 700-25, 700-52, 700-63, 700-64, and 755-15.

2. AMC regulations. AMCR's 190-3, 385-1, 385-3, 385-7, 385-9, 385-13, and 385-15.

3. Field manual. FM 3-15.

4. Table of allowances. TA 50-914.

5. Supply bulletin. SB 11-206.

6. Technical bulletins. TB's CML 52, CML 53, CML 63, 3-6665-200-12, 3-6665-201-12, 3-6665-202-12, 3-6665-203-12, 3-6665-204-12, MED 62, MED 223, MED 232, MED 249, SIG 226-8, SIG 226-9, TC 7, and 5-6600-227-15/1.

7. Technical manuals. TM's 3-220, 3-260, 3-261, 3-6665-214-15, 11-5514, 11-5514A, 11-5543, 11-6665-204-12, 11-6665-206-12, 11-6665-208-15, 11-6665-209-15, 11-6665-216-15, 11-6665-221-15, 11-6665-224-15, 38-250, 38-750, 39-20-3, 39-20-6, 39-35-15, 39-N-11.

8. Military standards and specifications.[1]

a.	MIL-STD-129	Marking for Shipment and Storage.
b.	MIL-M-3935A	Markers, Self-Luminous.
c.	MIL-C-10436	Compasses, Lensatic, Luminous Dial.
d.	MIL-M-19590	Marking of Commodities and Containers to Indicate Radioactive Material.
e.	MIL-STD-450	Radiation Hazard Symbol Contaminated Areas.

9. Miscellaneous. a. DOD 4160.21-M, Defense Disposal Manual.

b. Title 10, Code of Federal Regulations. Atomic Energy.[2]

c. Title 14, Part 49 of Code of Federal Regulations.[2]

d. Title 46, Part 146 of Code of Federal Regulations.[2]

e. Title 49, Parts 171 through 178 of Code of Federal Regulations.[2 3]

f. U.S. Postal Manual, Chapter 1, Sections 124.24 and 125.24.[4]

1 2 3 4 See footnotes on page 47.

g. Radiological Health Handbook, U.S. Department of Health, Education and Welfare.[4]

10. U.S. Department of Commerce, National Bureau of Standards Handbooks.

48 - Control and Removal of Radioactive Contamination in Laboratories.

49 - Recommendations for Waste Disposal of Phosphorus 32 and Iodine 131 for Medical Users.

51 - Radiological Monitoring Methods and Instruments.

53 - Recommendations for the Disposal for Carbon-14.

55 - Protection Against Betatron-Synchrotron Radiations up to 100 Million Electron Volts.

57 - Photographic Dosimetry of X- and Gamma Rays.

58 - Radioactive Waste Disposal in the Ocean.

59 - Permissible Dose for External Sources of Ionizing Radiation.

63 - Protection Against Neutron Radiation up to 30 Million Electron Volts.

65 - Safe Handling of Bodies Containing Radioactive Isotopes.

66 - Safe Design and Use of Industrial Beta-Ray Sources.

69 - Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure.

72 - Measurement of Neutron Flux and Spectra for Physical and Biological Applications.

73 - Protection Against Radiation from Sealed Gamma Sources.

75 - Measurement of Absorbed Doses of Neutrons and of Mixtures of Neutrons and Gamma Rays.

76 - Medical X-ray Protection up to 3 Million Volts.

78 - Report of International Commission on Radiological Units. and Measurements

80 - A Manual of Radioactivity Procedures.

[4]See footnotes on page 47.

84 - Radiation Quantities and Units (ICRU Report 10a).

85 - Physical Aspects of Irradiation (ICRU Report 10b).

86 - Radioactivity (ICRU Report 10c).

87 - Clinical Dosimetry (ICRU Report 10d).

88 - Radiobiological Dosimetry (ICRU Report 10e).

89 - Methods of Evaluating Radiological Equipment and Materials (ICRU Report 10f).

92 - Safe Handling of Radioactive Materials.

93 - Safety Standard for Non-Medical X-ray and Sealed Gamma Ray Sources: Part I. General.

11. Federal Radiation Council Reports[4]

No. 1 - Background Material for the Development of Radiation Protection Standards.

No. 2 - Background Material for the Development of Radiation Protection Standards.

12. International Atomic Energy Agency Regulations[5]

Safety Series No. 1 - Safe Handling of Radioisotopes.

Safety Series No. 2 - Safe Handling of Radioisotopes: Health Physics Addendum.

Safety Series No. 3 - Safe Handling of Radioisotopes: Medical Addendum.

Safety Series No. 4 - Safe Operation of Critical Assemblies and Research Reactors.

Safety Series No. 6 - Regulations for the Safe Transport of Radioactive Materials.

Safety Series No. 7 - Regulations for the Safe Transport of Radioactive Materials. Notes on Certain Aspects of the Regulations.

Safety Series No. 8 - The Use of Film Badges for Personnel Monitoring.

[4] [5]See footnotes on page 47.

Safety Series No. 9 - Basic Safety Standards for Radiation Protection.

Review Series No. 12 - The Packaging, Transport and Related Handling of Radioactive Materials.

Review Series No. 18 - Processing of Radioactive Wastes.

13. National Fire Protection Association Publications[6]

Fire Protection Handbook, 12th Edition, 1962.

National Fire Codes -
Pamphlet 801, Laboratories Handling Radioactive Material, 1955.
Pamphlet 802, Nuclear Reactors, 1960.

14. USA Standards Institute Publications[7]

ASA N6.1 - Safety Standard for Operations with Fissionable Materials Outside Reactors, 1964.

ASA N5.2 - Design Guide for a Radioisotope Laboratory (Type B), 1963.

[1]Military standards and specifications are available from the Commanding Officer, U.S. Naval Supply Depot (NSD 103), 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

[2]Copies of the Code of Federal Regulations are normally available from the Post Judge Advocate. Copies can be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.

[3]The Interstate Commerce Commission regulations are also published as "Agent TC George's Tariff No. 19", available from the Bureau of Explosives of the American Association of Railroads, 30 Vesey Street, New York, New York. Installation Transportation Officers usually have copies of George's Tariff No. 19.

[4]Available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.

[5]Available from National Agency for International Publications, Inc., 801 Third Avenue, New York, New York 10022

[6]Available from National Fire Protection Association, 60 Batterymarch Street, Boston, Massachusetts 02110.

[7]Available from USA Standards Institute, 70 East 45th Street, New York, New York 10017.

AMCR 385-25

~~(AMCAD-S)~~ (AMCSF)

FOR THE COMMANDER:

OFFICIAL:

CLARENCE J. LANG
Major General, USA
Chief of Staff

WM. A. GREGORY
Colonel, GS
Chief, Administrative Office

DISTRIBUTION:
A and B

* U.S. GOVERNMENT PRINTING OFFICE : 1968 316-870 (355)

Appendix C

REQUIREMENTS OF ORGANIZATIONS HAVING RADIATION PROTECTION OFFICERS AND RADIATION PROTECTION PROGRAMS

The application of this supplement is limited to the following:

a. To coordinate the radiation protection programs, the RPO or designated representative of each organization radiation protection committee will serve as a member of the Fort Monmouth IRCC.

b. All organizations will furnish copies of their NRC licenses and DA authorizations, including all supporting documentation associated with these licenses and authorizations, to the IRCC.

c. All organizations will furnish a radioisotope inventory report semi-annually to the IRCC. The Chief, Safety Office, CERCOM, will be notified of any change in inventory to include off-post shipments, disposals and transfers to other activities at Fort Monmouth.

d. Each organization RPO will submit a copy of all results of inspections and surveys conducted by higher authorities to each member of the Fort Monmouth IRCC.

e. The installation RPO is responsible for radiation protection concerning shipments of radioactive material while such shipments are in the physical custody of the Chief, Supply Services Branch, Industrial Operations Division, HISA. Shipments on and off Fort Monmouth will be in accordance with paragraph 26 and 27, AMCR 385-25. All organizations will advise the installation RPO of all outgoing shipments.

Appendix D

IONIZING RADIATION CONTROL COMMITTEE (IRCC)

1. Organization: The IRCC will be appointed on appropriate orders of the Commanding General, CERCOM, and will consist of the following members:

a. Installation RPO, Chairman.

b. Health Physicist, ERADCOM, Member, or designated representative.

c. Systems Safety Engineer, Safety Office, CORADCOM, Member.

d. RPO, MEDDAC, Member.

e. Environmental Engineer, Environmental and Energy Control Office, HISA, Member.

f. Representative of the 54th Ordnance Detachment, Explosive Ordnance Disposal, Member.

g. Science Advisor, Office of the Scientific Advisor, ERADCOM, Member.

h. Representative of the Commanding General, CERCOM, Member.

2. Functions: The IRCC will:

a. Serve in an advisory capacity to, and act as, the authoritative body for the Commanding General, CERCOM, on matters pertaining to ionizing radiation, coordinating with organizations and activities assigned, detached or located at Fort Monmouth.

b. Formulate rules and regulations relating to the use of ionizing radiation sources and equipment.

c. Review reports of radiological accidents and incidents, and of violations of appropriate regulations, recommending any required corrective action.

d. Review and authenticate NRC License, DA Authorization and DA Permit applications.

3. Responsibilities: a. The Chairman of the IRCC will:

(1) Call and preside at meetings of the IRCC.

(2) On majority vote of the IRCC, approve proposals, authenticate applications and correspondence on behalf of the IRCC.

b. Members or alternates will:

(1) Attend IRCC meetings.

Appendix D--Continued

(2) Review reports of IRCC officers, NRC License/DA Authorization applications, and requests involving ironizing radiation sources, as required.

(3) Review accident and incident reports and provide corrective action recommendations.

(DRSEL-SF)

FOR THE COMMANDER:

OFFICIAL:

LOUIS A. REINKEN, Jr.
Colonel, GS
Chief of Staff

CAMILLE JASTRZENSKI
1LT, AGC
Adjutant

DISTRIBUTION:
M and T plus

Chief, Safety Officer 50
Cdr, DARCOM, ATTN: DRCSF-P 1

DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL	SUBJECT
DRDEL-SS-FM-H	Radiation Protection, Combined Directive

TO All Elements of
TSA
CSTAL
ETDL
EWL

FROM Cmdr TSA
Cmdr CSTAL
Dir ETDL
Dir EWL

DATE 1 Jul 80

CMT 1
Mr. Potter/jlc/65292

1. POLICY.

a. It is the policy of the Commander/Directors that radiation sources be used in a fashion which will protect personnel from unwarranted radiation exposure and will maintain radiation exposures at a level as low as reasonably achievable.

b. Radiation sources will be used with the understanding that their procurement and utilization shall be in accordance with Radiation Safety Procedures (copy attached). Any questions concerning the interpretation of procedures will be brought to the attention of the Radiological Protection Officer (RPO) for assistance and guidance.

2. DISCUSSION.

a. These procedures apply to all addressee organizational units and individuals who procure, possess, use, store, transfer, or dispose of radiation sources, i.e., radioactiv material with an activity of one microcurie or greater, and ionizing radiation producing devices.

b. Responsibilities and procedures governing the radiation protection program are described in the inclosure.

3. REFERENCES.

a. Code of Federal Regulations, Title 10.

b. AR 40-14.

c. AR 385-11.

d. DARCOM-R 385-25.

e. DARCOM-R 385-29.

J. G. MIKULA
COL, SC
Commander TSA

V. J. KUBLIN
Acting Dir
CSTAL

for MAX ADLER
Acting Dir
EWL

CLARE THORNTON
Dir, ETDL

S. F. DANKO
Deputy Director, US Army Electronics Technology and Devices Lab

RADIOLOGICAL SAFETY PROCEDURES

RESPONSIBILITIES AND PROCEDURES GOVERNING THE RADIATION PROTECTION PROGRAM ARE DESCRIBED HEREIN. ANY QUESTIONS CONCERNING THE INTERPRETATION OF PROCEDURES SHOULD BE BROUGHT TO THE ATTENTION OF THE RADIOLOGICAL PROTECTION OFFICER (RPO), TELEPHONE EXTENSION 65292.

CONTENTS

CHAPTER 1

Responsibilities

1. The Chief, ERADCOM Safety Office is responsible for establishing an effective Radiation Protection Program in coordination with laboratory directors. For this purpose he will appoint a Radiation Protection Officer to assist him and act in an advisory capacity and coordinate safety policies and procedures among various users of radiation sources.

2. The Radiation Protection Officer is responsible for:

a. Staff supervision of the Radiation Protection Program including authority to order temporary suspension of hazardous operations.

b. Advising the Commander TSA and Laboratory Directors on the degree of hazards associated with ionizing radiation and the effectiveness of measures to control these hazards.

c. Performing inspections to insure compliance with provisions of NRC licenses and applicable Army regulations.

d. Maintaining the inventory of radiation sources and radioactive materials, including both materials licensed by NRC and those requiring DA authority.

e. Coordinating purchases of radioactive material to assure compliance with NRC licenses or DA authority.

f. Representing ERADCOM on the Ionizing Radiation Control Committee.

g. Coordinating submittal of applications for renewal or amendment of NRC licenses and DA authorization and for issuing permits to use radiation sources.

h. Maintaining a library of current regulations pertinent to the Radiation Protection Program which will be furnished on request to persons covered by this regulation.

3. The Industrial Safety Officer is responsible for providing assistance and advice on general safety matters in relation to the radiological safety programs.

4. The Chief, Logistics Management Division, TSA, is responsible for assuring that all purchases for items containing radioactive material, X-rays, lasers, or other radiation sources have been cleared through the Radiation Protection Officer.

5. The Chief, Logistics Management Division, TSA, is also responsible for prompt notification of the Radiation Protection Officer when radiation sources are received. Items will be picked up by the user after check by the Radiation Protection Officer.

6. Supervisors in areas where radiation sources are used are responsible for:

a. Insuring that permits are obtained before any work with radiation sources begins.

b. Insuring that the purchase or use of radiation sources are coordinated with the Radiation Protection Officer.

c. Insuring that all requisitions or contracts requiring radioactive material or other sources of radiation are clearly marked as "documents for procurement of radiation sources" and that these requisitions are coordinated with the Radiation Protection Officer.

d. Providing training of new employees in the safe handling of radiation sources.

7. Workers in areas where radiation sources are used are responsible for strict compliance with procedures approved for the specific application. These procedures and limitations will be contained in the application for a local permit.

8. Any person who notices a situation where an ionizing radiation safety hazard might exist will report that situation to the Radiological Protection Officer, Mr. Stanley Potter, telephone 65292, or his alternate, SP 5, Norman Pratt, at the same number. In the event that these persons cannot be contacted the report will be made to Dr Walter McAfee, telephone 54131.

CHAPTER 2

Definitions

Accelerator	A device for imparting kinetic energy to charged particles, such as electrons, protons, deterons and helium ions.
Airborne radioactive material	Any Radioactive material dispersed in the air in the form of dusts, fumes, mists, vapors of gases.
Bioassay	The determination of kinds, amounts or concentrations, and locations of radioactive materials in the human body, whether by in vivo counting (whole-body counting, selection organ counting, etc.) or by analysis and evaluation of materials excreted or removed from the human body.
Byproduct materials	Any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the process of producing or utilizing special nuclear material.
Contamination (Radioactive)	Deposition of radioactive material in any place where it is not desired, and particularly in any place where its presence can be harmful. The harm may be in invalidating an experiment or a procedure, or in actually being a source of danger to persons.
Controlled area	A defined area in which the exposure of personnel to ionizing radiation is under the supervision of an individual in charge or radiation protection.
Decay, Radioactive	The disintegration of the nucleus of an unstable nuclide by the spontaneous emission of charged particles and/or photons.

Decontamination Factor	The ratio of the amount of undesired radioactive material initially present to the amount remaining after a suitable processing step has been completed. A factor referring to the reduction of the gross measurable radioactivity.
Dose (Dosage)	The radiation delivered to a specified area or volume or to the whole body. The dose may be specified in air, or the skin, or at some depth below the surface, but no statement of dose is complete without specification of location.
Dose Equivalent (DE)	This is the product of absorbed dose (D), quality factor (QF), and other factors needed to achieve the common exposure scale referred to under the definition of Quality Factor. It is commonly expressed in rems.
Dose Rate	Radiation dose delivered per unit time.
Dosimeter	An instrument used to detect and measure an accumulated dose of radiation.
Dpm	Disintegrations per minute.
Gamma Ray	Electromagnetic radiation emitted by a nucleus as a result of a transition between two nuclear energy levels. Gamma rays have high energies with correspondingly short wavelengths and their ability to penetrate matter is high.
Health Physics	A term in common use for that branch or radiological science dealing with the protection of personnel from harmful effects of ionizing radiation.
High radiation area	Any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose equivalent in excess of 100 millirem.

Ionizing Radiation	Any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter.
Ionizing Radiation Producing Devices	Electronic devices which are capable of generating ionizing radiation such as x-ray machines, linear accelerators, cyclotrons, radio frequency generators which use klystrons, magnetrons, or other tubes which produce x-rays, and electron microscopes.
Istope	One or more nuclides having the same atomic number but a different mass. Istopes of a substance have almost identical chemical properties.
Monitoring	Periodic or continuous determination of the amount of ionizing radiation or radioactive contamination present in any occupied region or location.
MPC	Maximum permissible concentration(s).
mRad	Millirad
mRem	Millirem
Neutron	An elementary uncharged nuclear particle which has a mass equal to that of a hydrogen atom.
Photon	A quantity of electromagnetic energy whose value in ergs is the product of its frequency in hertz and Planck's constant.
Planck's Constant (h)	A natural constant of proportionality relating the frequency of a quantum of energy to the total energy of the quantum. $h=6.624 \times 10^{-34}$ joules-sec.
Positron	A particle equal in mass to the electron and having an equal but positive charge.

Quality Factor (QF)	This is the linear-energy-transfer-dependent factor by which absorbed doses are to be multiplied to obtain, for purposes of radiation protection, a quantity that expresses on a common scale for all ionizing radiations, the effectiveness of the absorbed dose.
Radiation	Energy propagated through space. As used in this regulation, the term refers to two kinds of ionizing radiation: 1. Electromagnetic waves (x-rays, gamma rays) and 2. Corpuscular emissions from radioactive substances or other sources (alpha and beta particles and neutrons). Ionizing radiation is any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter.
Radiation Absorbed Dose (Rad)	The amount of dose imparted to matter by ionizing radiation per unit mass of irradiated material. The unit of absorbed dose, the Rad, is equivalent to 10^{-5} Joules/gm.
Radiation Area	Any area accessible to personnel in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose equivalent in excess of 2 millirem or in any five consecutive days a dose equivalent in excess of 100 millirem.
Radiation Hazard	A condition under which persons might receive radiation in excess of the applicable maximum permissible dose, or where radiation damage might be caused to materials or personnel.
Radiation Sources	Materials or devices which generate or are capable of generating ionizing radiation, including naturally occurring radioactive material, by-product materials, source materials, special nuclear materials, fission products, materials containing induced or deposited radioactivity, radiographic and fluoroscopic equipment, particle generators and accelerators, and

	electronic equipment which utilizes kystrons, magnetrons, or other electron tubes which produce x-rays.
Radiation Work Permit	A locally developed form which is completed prior to the start of any work that is to be performed in a controlled area and describes the potential radiation hazards and a given job.
Radioactivity	Process whereby certain nuclides undergo spontaneous disintegration, liberating energy through the emission of alpha or beta particles or gamma photons or a combination of these.
Radiological Survey	Evaluation of the radiation hazard incident to the production, use, or existence of radioactive materials or other sources or radiation under a specific set of conditions.
Radiological Protection Officer (RPO)	An individual designated by the commander to provide consultation and advice on the degree of hazards associated with radiation and the effectiveness of measures to control these hazards. In addition, he is tasked with the supervision of the Radiation Protection Program. This individual will be technically qualified by virtue of education, training, and professional experience, to assure a capability commensurate with the assignment. (The term "Radiological Protection Officer" is not intended to denote a commissioned status.)
Restricted area	Any area to which access is controlled for purposes of protection of individuals from exposure to radiation and radioactive materials.

Roentgen	The quantity of X or gamma radiation such that the associated corpuscular emission per 0.001293 gram of air (1cc of dry air at standard conditions) produces, in air, ions carrying one electrostatic unit or quantity of electricity of either sign. This is the radiological unit of exposure.
Roentgen Equivalent Man (REM)	This is the unit of dose equivalent (DE) and is commonly referred to as the roentgen equivalent mammal.
Special Work Permit	A permit to assure that no work will commence in areas where radiation is greater than 20 mrem/hr until each job has been properly evaluated from a radiological standpoint and has been approved by Health Physics personnel.
User	An individual assigned to an activity, section, division, or other organizational unit which has been deletated the responsibility for the use, operation, or storage of radiation sources.
X-ray	Penetrating electromagnetic radiation having wavelengths shorter than those of visible light. X-rays are similar to gamma rays, but originating in the extra-nuclear origin.

CHAPTER 3

EXPOSURE GUIDES

1. Regulations. Requirements as set forth in Title 10, Parts 19 and 20, Code of Federal Regulations, and AR 40-14 for the Control of Occupational Exposure to Ionizing Radiation, will be followed. Recommendations in the National Bureau of Standards Handbooks on Radiation will be used in addition.

2. Exposure of individuals in controlled areas. a. A controlled area is any area in which the exposure of personnel to radiation or radioactive materials is under the supervision of a radiation protection officer. Every effort will be made to maintain radiation doses as low as possible. Avoid all unnecessary exposure to ionizing radiation. Radiation protection standards for the control of occupational exposures to ionizing radiations include the following:

(1) The accumulated dose or radiation to the whole body, head and trunk, active blood-forming organs, gonads, or lens of the eye shall not exceed:

(a) 1.25 rem in any calendar quarter, nor

(b) 5 rem in any one calendar year, nor

(c) 5(N-18) rem total lifetime dose, where N equals the present age in years.

(2) The accumulated dose of radiation to the skin of the whole body, forearms, or the cornea of the eye shall not exceed:

(a) 7.5 rem in any calendar quarter, nor

(b) 30 rem in any calendar year.

(3) The accumulated dose or radiation to the hands and wrists or the feet and ankles shall not exceed:

(a) 18.75 rem in any calendar quarter, nor

(b) 75 rem in any calendar year.

(4) All radiation exposure will be maintained as low as reasonably achievable.

b. Personnel not occupationally exposed, and persons who are less than 19 years of age will not be exposed in any calendar quarter in excess of 0.125 rem or in excess of 0.50 rem in any calendar year. Pregnant women will not be exposed to occupational doses of ionizing radiation. When a female employee becomes aware of her pregnancy, she will request that her duties be changed to eliminate all occupational exposure to ionizing radiation.

c. Occupational exposure to radioactive concentrations in air or water may not exceed the limits set forth in Title 10, Part 20 of the Code of Federal Regulations.

3. Exposure of individuals in uncontrolled areas. Radioactive materials and other sources of ionizing radiation will not be possessed, used, or transferred in such a manner as to create in any uncontrolled area radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of 0.5 rem in one calendar year.

4. Limits for contamination. When hands, body surfaces, clothing or shoes become unavoidably contaminated, steps will be taken as soon as possible to remove loose contamination. Decontaminate hands and body surfaces until no detectable activity above background is observed. Some degree of fixed contamination in certain cases cannot be avoided and the following maximum limits are recommended for personal clothing and shoes (see Chapter 6, Para 6n):

Alpha activity - 200 disintegrations per minute per 100 square centimeters of area.

Beta-gamma activity - 0.2 millirad per hour at one centimeter.

5. Concentrations of radioactive contamination surfaces. a. Loose contamination on exposed surfaces such as bench tops and floors will be removed as soon as possible. Small amounts of fixed contamination will be unavoidable at times, but the degree of such contamination should be kept as low as practicable. Maximum limits of fixed contamination of 1000 dpm per 100 cm^2 of alpha and 2 mrad/hr at 1 cm of beta-gamma are recommended for controlled areas. Amounts of contamination in excess of the above limits will not be permitted to remain on exposed surfaces without approval of the RPO. Higher levels of contamination may be permitted for restricted surfaces, that is in areas where entry or access is controlled by procedures or special work instructions. The same standards of contamination control shall apply to tools and equipment. In all cases, signs and controls for contaminated surfaces, areas, or euqipment will be instituted to the extend necessary to prevent the occurrence of a health hazard or the spread of contamination. In no case will the levels result in exposure to individuals in excess of the established limits. Any material or equipment so contaminated will be properly labeled with a contamination tag giving:

(1) Type and level or radiation (mrad/hr) at a specified distance.

(2) Extent of contamination on surfaces.

b. No contaminated equipment or material may be removed from any area without prior notification and approval of the RPO. Any equipment or material to be maintained or handled in a clear area must be decontaminated according to the requirements set forth in Chapter 6, paragraph 6, Table 1.

6. Radiation protection controls governing beta-gamma exposure. The following limits will be observed:

a. No individual without a special work permit will be permitted to work in a radiation controlled area where exposure levels are greater than 20 mrem/hr.

b. Any radiation area where exposure levels are greater than 100 mrem/hr shall be classified as a high-radiation area. An accurate exposure record will be maintained for each individual required to work in a high-radiation area. Based on pencil dosimeter reading, the record will contain the total cumulative exposure of the individual during the life of the special work permit.

c. The time during which any individual is exposed will be controlled so that exposure limits will not be exceeded. Exposure at all times will be kept as low as reasonable achievable.

7. Radiation protection controls governing alpha exposure. External exposure to alpha radiation is negligible, since the range of the alpha particles is less than the thickness of the layer of dead skin. Fume hoods will be used in conjunction with the long-lived alpha-emitting substances or other substances presenting a similar health hazard. In handling an unsealed alpha source, gloves or forceps afford adequate protection. Sealed alpha-neutron sources must be carefully handled to protect the integrity of the seal and prevent the spread of contamination. The prime hazard to consider is personnel contamination and the danger of ingestion or inhalation of airborne contamination. Fume hoods should have an absolute filter. The linear flow rate should be at least 150 ft/min. Airborne contamination levels will be determined as set forth in Chapter 6, paragraph 6.

CHAPTER 5

Procuring, Shipping and Receiving of Radiation Sources

1. Procurement. All requisitions or contracts for items that contain radioactive materials will be coordinated with the Radiation Protection Officer. Each request for radiation sources will include a covering DF stating the need for the material and citing the local radiation permit where the sources will be used. Procurement of radioactive materials will not be initiated until proper coverage under a NRC license or DA authorization is issued.

2. Shipping.

a. The user (person originating the shipment) is responsible for the proper packaging and labeling of radioactive materials for shipping. The user will initiate DA Form 2791-R which will then be completed by the Radiation Protection Officer.

b. The user will provide the Radiation Protection Officer with a copy of the NRC License or DA authorization of the person who will receive the radioactive material.

3. Receiving.

a. The Radiation Protection Officer will check all radioactive material when it arrives. He will complete all necessary shipping paperwork, then notify the user to pick up the radioactive material. Radioactive materials will only be transported in privately owned vehicles in emergency cases, and only with specific approval of the RPO.

b. Upon receipt of radioactive material, the Radiation Protection Officer will perform a leak test, when required, and notify the user of the results of the leak test.

CHAPTER 4

Radiological Permits

1. Local permits for the use of radiation sources are required. Applications for permission to use or store radioactive materials or sources of ionizing radiation will be submitted to the Radiation Protection Officer, DRDEL-SS-FM-H.

2. Radioactive sources. Local permits for the use of radioactive materials will be issued only when an approved NRC license or DA authorization is available. Contractors will be issued a local permit based on an approved DA permit.

3. Application for local permits. The local permit must be obtained before procurement of the particular item(s). Each organization desiring to use a radiation source will apply for a permit. Application will be on DF addressed to Radiation Protection Officer, DRDEL-SS-FM-H, and will include the following information:

a. Organization.

b. User personnel and qualifications (include training and experience).

c. Type or radiation source.

d. Physical form of the radioactive material.

e. Number of sources required.

f. Quantity of radioactive material or power of radiation source(s).

g. Planned use of radiation source.

h. Radiation protection equipment.

i. Facilities where radiation source will be used.

j. Radiation protection program (SOP).

Special Work Permit

An application for a special work permit must be submitted to the RPO before working in any area with radiation levels greater than 20 mrem/hr when authorization has not been otherwise obtained (included in local permit).

Radiation Work Permit (RWP)

Upon request from radiation area supervisors, a radiation work permit will be issued by health physics personnel for work when unusual working conditions are required as prescribed by the RPO.

CHAPTER 6

Prevention of Radiation Hazards

1. Method. a. This chapter contains information on the prevention of radiation hazards and special precautions necessary to safely work with radioactive materials. The three methods of radiation hazard prevention are: Mechanical and chemical, medical, and monitoring. All personnel required to work in radiation hazard areas will be informed as to the function and use of each method.

b. Some methods of radiation hazard prevention involve the proper use of fire extinguishers, roping off and posting of areas, permanent and portable shielding, and the use of area-monitoring instrumentation.

c. Another method of radiation hazard prevention includes the protection of personnel by wearing some of all of the following items, depending on the type of work: Disposable clothing, coveralls, plastic aprons, gloves, plastic shoe covers, and/or boots.

d. Decontamination materials include such things as; the chemicals used to decontaminate personnel and laboratory equipment, waste containers, swabs or Kemwipes, and paper - both absorptive and non-absorptive.

e. Prevention of radiation hazards is effected by the establishment of restricted areas, time limits for stay in danger zones, and the requirements to comply with exposure limits and other rules.

2. Procedures. a. Mechanical and chemical. (1) Film badge service will be initiated or discontinued by request to the RPO. An adequate supply of film badges will always be available for immediate use. Staff members who escort visitors to radiation areas are responsible for signing badges in and out for their visitors.

(2) Each person assigned a film badge will wear only the particular badge number assigned to him. Under no circumstances will badges be exchanged with another person. Film packs should never be removed from the badge or tampered with in any way.

(3) Personnel working in radiation areas must wear badges at all times while they are in such areas. These badges may be worn comfortably on the belt line or chest but they must never be covered by any other clothing or carried in pockets.

(4) All film badges will be kept in the assigned badge rack at the end of the work period. They will not be taken out of the building unless the outside specific duty or travel will be associated with an exposure to radiation.

(5) Film badges will be collected for exchange of film each month on the day specified on the assigned badge rack.

(6) Pocket dosimeters will be recharged as required. Additional pocket dosimeters will be maintained for visitors or persons whose routine does not require a permanently assigned film badge. These dosimeters will be signed for in a log, the dose will be recorded, and a notation will be made that the person wearing it was a visitor.

(7) All persons entering radiation areas will wear a dosimeter or a film badge. People who are unfamiliar with the facility will be accompanied by responsible personnel acquainted with the facility. All persons entering a high radiation area will wear a film badge and a dosimeter.

(8) Fire extinguishers will be placed in conspicuous places in radiation areas and clearly marked. They will be periodically checked and maintained by the Area Fire Captain. Any extinguisher that is used will not be returned to its rack but will be reported to the Fire Captain as soon as possible. All personnel will familiarize themselves with the location and use of these extinguishers throughout the building so that in the event of an emergency they will be brought into use as soon as possible.

(9) Radiation signs and tags are posted for the safety of every employee and must be respected. The Radiological Protection Officer will post and remove radiation warning signs. When radiation levels exceed permissible levels, the area will be posted with appropriate signs. These signs will indicate the nature of the radiation and/or contamination, the date of posting, the radiation level at a specified distance, and any other appropriate data.

b. Medical. (1) Each person working with radiation will be required to undergo a complete medical examination at the start of employment and at one-year intervals thereafter. This initial examination will include a complete medical history and physical examination. The history will include a notation of previous work with ionizing radiation. A copy of each medical record will be kept on file by the preventative-medicine facility. The entering examination will include a complete blood count, urinalysis, and a chest x-ray.

(2) Special checkups will be made at any time as determined necessary by the Radiation Protection Officer and/or Preventive Medicine Officer.

c. Monitoring. (1) Personnel monitoring will be accomplished by the use of film badges and dosimeters with resulting data recorded. Special monitoring due to exposure or contamination may be required. Cases of overexposure or contamination may require a special medical checkup.

(2) If an individual receives a dose of ionizing radiation in an amount exceeding 1.25 rem per calendar quarter, he will be removed from duties involving occupational exposure to ionizing radiation until subsequent exposure limitations are established in consultation with competent medical authority. Should an individual receive an accumulated dose of ionizing radiation in excess of 5(N-18) rem, he will be removed from duties involving occupational exposure to ionizing radiation until his exposure record has been evaluated by the Surgeon General of the Army and subsequent exposure limitations are established as necessary.

(3) The frequency of area monitoring will depend upon the radiation levels of the usual work in the area, the frequency of the use of the area and other conditions specific for each area. The radiation area supervisor will assure radiation levels are determined prior to working in a radiation control area, on a daily basis.

(4) The general radiation background in the area will be first recorded. Successive readings in representative work areas will be taken and noted. If any locations are noted where the dose rate is greater than the maximum permissible, the area will be posted immediately. Where additional shielding will correct the situation, this will be done as soon as possible.

(5) The RPO will ensure that each radiation facility is surveyed at least monthly. As each area is surveyed, a check will be made to detect any existing or potential hazard and to rectify it.

(6) Special surveys will be made by the RPO at any time upon specific request of an individual or before unrestricted entry is permitted to a previously contaminated area.

(7) Sufficient instrumentation is available to the RPO to properly support all special radiation surveys. All instrumentation used for radiation protection will be calibrated at least every three (3) months, and after each maintenance or battery change. Dosimeters will be calibrated at least every six (6) months.

3. Periodic checkups. a. From time to time, inspections will be made to insure that personnel are complying with procedures in radiation areas. Periodic checks will also insure that any modifications to the basic operating procedures are being followed correctly so as to minimize radiation hazards.

b. Constant inspections are necessary to avoid a dulled alertness on the part of personnel. It cannot be overemphasized that while working with radiation can be safe, mistakes may be very dangerous and possibly fatal. The checkups are for the safety of personnel.

c. The efficiency of all warning devices will be determined at intervals not greater than one month; this is in addition to the complete maintenance check which will be made at any time on all locks, etc. If at any time there is a failure in any remote monitors, work will be halted immediately and the approval of the Radiation Protection Officer Will be required before normal operating procedure is resumed.

4. Access to radiation areas. a. Access to areas where there is a potential radiation hazard will be limited to minimum personnel required to safely, efficiently, and most readily carry out the required procedures. All persons entering an area classified as a Radiation Control Area or a High Radiation Area must wear a film Badge. A pocket dosimeter may also be required in certain areas. All visitors to radiation areas are required to be accompanied by personnel assigned to the area. A "visitor" is considered to anyone not directly connected with the work being conducted. All visitors must be advised of the potential hazards prior to being allowed into a radiation area.

b. Anyone discovering an area of hazardous radiation will evacuate the area and call the RPO who will accurately survey the area and post it. Only the RPO has the authority to remove any signs once they are posted.

5. Radiation hazard signs. These signs are in the form of labels, tags, and signs for posting areas and equipment and identifying radiation areas and items which may be radioactive or contaminated. They incorporate the standard magenta and yellow color, the three bladed radiation symbol, and appropriate working, such as "Caution," "Danger", "Contamination", "Radiation Area", and "High Radiation Area." Where such signs and tags are used, additional information may be added to them by the RPO to further identify the nature of the hazard. The information will contain the nature of the substance causing the hazard, its dose rate at a specified distance, the date, and other pertinent information.

6. Decontamination and waste disposal. a. In order to prevent the possibility of contamination, the following regulations will be observed:

(1) There will be no smoking, drinking, or eating in radiation control areas.

(2) In cases of skin contamination, no eating, smoking or application of cosmetics will be permitted until all removable radioactivity has been taken from the skin and the person is released by the RPO.

(3) Organic solvents, highly alkaline soaps, or abrasives should not be used for decontamination at any time, since they increase the possibility of skin injury and serious contamination. Levels of radiation beyond which areas are considered to be contaminated radiation areas are outlined in Chapter 3. Any incident or accident which causes an area to be contaminated must be reported immediately to the RPO. The use of any decontaminates other than mild soap and water should only be done under the supervision of medical personnel.

b. The RPO will be responsible for establishing procedures controlling the spread of contamination. These procedures will include emergency ventilation control, controlled step-off areas, controlled passageways, personnel monitoring, decontamination procedures, etc.

c. All persons selected by the RPO to work on monitoring and decontamination will be equipped with protective clothing, suitable gloves and other equipment required by the level of work.

d. In the event of airborne contamination the RPO will determine through the use of fixed or portable air sampling monitors the extent of the contamination. The RPO will specify the maximum levels for personnel access to airborne contamination areas. These limits will not exceed:

For Personnel Wearing	Alpha Concentrations	Beta Concentrations
No respiratory protection	1 MPC*	1 MPC*
M-17 full face respirator	5 MPC*	10 MPC*
Supplied air or self-contained air supply with full face mask	50 MPC*	50 MPC*

*Maximum permissible concentration

e. When there is a possibility of contamination or radiation hazard, all ducts and vents leading from the building, whether they are for water, air, gas, or electrical conduit, will be marked so that maintenance or repairmen will be aware of the potential hazard. Where these tags exist, the RPO will be notified to survey the area before any work is started. If the need for shielding is indicated by monitoring procedures, the supervisor or the project leader will provide the shields before work in this area can resume.

f. Personnel decontamination methods depend upon the nature of the contaminating material and the size of contaminated skin area. No detectable contamination level above background is allowed to remain on hands or skin after decontamination. The following procedures will be used immediately:

(1) First notify the RPO. All materials needed for decontamination will be furnished by the RPO and will be located where they will be most convenient for use.

(2) Thorough washing with soap and water and rinsing with large quantities of water is the best general decontamination method for the hands and other parts of the body, regardless of the nature of the radioactive contaminant. If, however, the contamination is well localized,

it is recommended that the area be cleaned immediately with small swabs and later, if necessary, by a general washing. Spread of contamination to other skin areas is thus avoided.

g. If the contamination is widespread, a general washing or shower should be taken and other more specific measures outlined below should be followed under medical supervision and the RPO.

(1) For general washing: Wash the hands for two to three minutes in tepid water using a mild soap, with special attention to finger folds, outer edges of the hands and fingernails. Rinse thoroughly and repeat a maximum of four times. If the required degree of decontamination is not reached, proceed with step (2),

(2) Using a soft brush, wash and rinse contaminated areas three times in eight minutes of which no less than six minutes are spent in scrubbing. Use pressure light enough not to abrade the skin. Rinse thoroughly and monitor. If the desired level is not reached after several trials, chemical decontamination may be attempted as outlined in step (3).

(3) Apply a paste of titanium dioxide liberally and work it in over the contaminated areas for a minimum of two minutes. Use water sparingly, only enough to keep the paste moist. Rinse with warm water and follow with soap, brush and water, being extremely cautious to remove all paste about the nails. Monitor. Repeat process if necessary. If three successive trials fail to remove all contamination to the prescribed level, follow step (4). Note: Do not use near face or other body openings.

(4) Daub over the contaminated area a saturated solution of potassium permanganate for not more than two minutes. Wash with soap and water and rinse. Next, apply a solution of sodium bisulfite to remove the dark permanganate stain. The procedure may be repeated but since the permanganate is caustic to the skin, care should be taken to follow the prescribed times closely. Hand cream should be used as a final step to prevent chapping. Note: Do not use near face or other body openings.

h. Persons with cuts or wounds will not be permitted to work in a contaminated area or radioisotope laboratory unless specific approval is obtained from the RPO. Any wounds, cuts or abrasions received while working with, in, or near radioactive materials should be flushed with water immediately. Any such accidents should be referred to the RPO immediately so that specific measures can be taken.

i. The RPO will assist in and monitor the decontamination of materials and equipment. He will supervise the disposal or radioactive waste and other work connected with radiation hazards.

j. In the event of contaminated clothing, the contaminated articles will be removed immediately. Skin areas underneath the clothing will be cleansed as soon as possible and the contaminated clothing placed in plastic bag so that it may be properly laundered and recovered.

k. In order to prevent the gross contamination of laundered items, two separate laundry systems are employed. All contaminated laundry generated in radiation areas is laundered in a specially equipped laundry.

l. Contaminated materials will be disposed of in suitable dry radioactive waste or liquid radioactive waste containers. At no time should dry radioactive and liquid radioactive wastes be mixed. Containers for radioactive waste containers will be stored in the radioactive storage vault.

m. The RPO will aid in the problem of evaluating contaminated equipment. If it is not practical to decontaminate the equipment, it will be handled as dry radioactive waste. In some cases, it may be possible to store such equipment for future use when radiation levels have decayed to acceptable levels. Equipment properly marked and shielded will be stored in the radiation storage vault.

n. The following methods can be used to decontaminate equipment; the decision as to the actual and most practical method will be determined by the RPO.

(1) Equipment may be washed with a hot, strong detergent solution, rinsed, and procedure repeated until the desired decontamination is reached. Chemicals that may be used include chromic acid, nitric acid, ammonium citrate, trisodium phosphate, and ammonium bifluoride. In selecting decontamination materials, the nature of the surface and extend of contamination must be considered. For all practical purposes, decontamination effectiveness of a solution is considered complete at the end of the second repetition of any one process. If the desired level is not reached at this time, other methods should be considered.

(2) Before any decontaminated equipment or articles can be moved or transported to a "clear area" the RPO will determine the extent of contamination of the particular item. Limits of contamination for items to be admitted to a clear area on the basis of 100 cm^2 area are as follows:

Loose contamination detectable by smear

Alpha (DPM)	50
Beta-Gamma (DPM)	100

Maximum fixed contamination

Alpha (DPM)	200
Beta-Gamma (m Rad/hr)	0.25

In the case of area contamination, the method of decontamination will depend upon the nature of the surface. These methods are vacuuming, physical removal of surfaces, covering of short-lived materials with impervious materials, detergents, and chemicals. When practical, areas which are contaminated will be isolated until radioactive decay permits safe entry.

o. All areas which are contaminated by accidents or spills will be evacuated immediately. If certain safety precautions can be instituted (such as placing absorbent paper on a spill to prevent spread of the contaminant) without endangering one's safety before leaving, it should be done. The RPO will monitor the contaminated area and determine the most practical methods of decontamination.