NRC Form 313 I (12-81) 10 CFR 30

U.S. NUCLEAR REGULATORY COMMISSION

APPLICATION FOR BYPRODUCT MATERIAL LICENSE
INDUSTRIAL

See attached instructions for details.

Completed applications are filed in duplicate with the Division of Fuel Cycle and Material Safety, Office of Nuclear Material Safety, and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555 or applications may be filed in person at the Commission's office at 1717 H Street, NW, Washington, D. C. or 7915 Eastern Avenue, Silver Spring, Maryland.

1. APPLICATION FOR: *(Check and/or complete as appropriate)*

	a. NEW LICENSE
	b. AMENDMENT TO: LICENSE NUMBER
X	c. RENEWAL OF: LICENSE NUMBER 19-00294-19

2. APPLICANT'S NAME *(Institution, firm, person, etc.)*
Commander, US Army Aberdeen Proving Ground
Aberdeen Proving Ground, MD 21005

TELEPHONE NUMBER: AREA CODE – NUMBER EXTENSION
301/278-4006

3. NAME AND TITLE OF PERSON TO BE CONTACTED REGARDING THIS APPLICATION
BENJAMIN F. CASOLE, III Health Physicist

TELEPHONE NUMBER: AREA CODE – NUMBER EXTENSION
301-278-4756/4757

4. APPLICANT'S MAILING ADDRESS *(Include Zip Code)*
(Address to which NRC correspondence, notices, bulletins, etc., should be sent.)
Commander, US Army Aberdeen Proving Ground
ATTN: STEAP-SA
Aberdeen Proving Ground, MD 21005

5. STREET ADDRESS WHERE LICENSED MATERIAL WILL BE USED *(Include Zip Code)*
Aberdeen Proving Ground, MD 21005
and locations described in Supplements C and J

(IF MORE SPACE IS NEEDED FOR ANY ITEM, USE ADDITIONAL PROPERLY KEYED PAGES.)

6. INDIVIDUAL(S) WHO WILL USE OR DIRECTLY SUPERVISE THE USE OF LICENSED MATERIAL
(See Items 16 and 17 for required training and experience of each individual named below)

FULL NAME	TITLE
a. Benjamin Francis Casole, III and	Health Physicist/APG Radiation Protection Offcr
b. individuals approved to use or supervise	
c. use, by the APG Radiation Protection Committee	

7. RADIATION PROTECTION OFFICER
Benjamin F. Casole, III
Robert A. Aaserude, Alternate
Denver C. Miser, Alternate

Attach a resume of person's training and experience as outlined in Items 16 and 17 and describe his responsibilities under Item 15.
See Supplement B

8. LICENSED MATERIAL

LINE NO.	A ELEMENT AND MASS NUMBER	B CHEMICAL AND/OR PHYSICAL FORM	C NAME OF MANUFACTURER AND MODEL NUMBER *(If Sealed Source)*	D MAXIMUM NUMBER OF MILLICURIES AND/OR SEALED SOURCES AND MAXIMUM ACTIVITY PER SOURCE WHICH WILL BE POSSESSED AT ANY ONE TIME
(1)	See Supplements E and F			
(2)				
(3)				
(4)				

	E DESCRIBE USE OF LICENSED MATERIAL
(1)	Research and development as defined in Part 30.4(g), 10 CFR 30 "Rules of General Applicability to Licensing of Byproduct Material"
(2)	
(3)	
(4)	

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9. STORAGE OF SEALED SOURCES

LINE NO.	CONTAINER AND/OR DEVICE IN WHICH EACH SEALED SOURCE WILL BE STORED OR USED. A.	NAME OF MANUFACTURER B.	MODEL NUMBER C.
(1)	See Supplement I		
(2)			
(3)			
(4)			

10. RADIATION DETECTION INSTRUMENTS

LINE NO.	TYPE OF INSTRUMENT A	MANUFACTURER'S NAME B	MODEL NUMBER C	NUMBER AVAILABLE D	RADIATION DETECTED (alpha, beta, gamma, neutron) E	SENSITIVITY RANGE (milliroentgens/hour or counts/minute) F
(1)	See Supplement G					
(2)						
(3)						
(4)						

11. CALIBRATION OF INSTRUMENTS LISTED IN ITEM 10

☒ a. CALIBRATED BY SERVICE COMPANY

NAME, ADDRESS, AND FREQUENCY

US Army MICOM
Internal Calibration and Repair Center
APG, MD. 21010

☐ b. CALIBRATED BY APPLICANT

Attach a separate sheet describing method, frequency and standards used for calibrating instruments.

12. PERSONNEL MONITORING DEVICES

TYPE (Check and/or complete as appropriate.) A	SUPPLIER (Service Company) B	EXCHANGE FREQUENCY C
☒ (1) FILM BADGE	US Army Ionizing Radiation Dosimetry Center Lexington, KY 40511	XX MONTHLY
☐ (2) THERMOLUMINESCENCE DOSIMETER (TLD)		☐ QUARTERLY
☐ (3) OTHER (Specify): _____		☐ OTHER (Specify):

13. FACILITIES AND EQUIPMENT (Check were appropriate and attach annotated sketch(es) and description(s).

☒ a. LABORATORY FACILITIES, PLANT FACILITIES, FUME HOODS (Include filtration, if any), ETC.
☒ b. STORAGE FACILITIES, CONTAINERS, SPECIAL SHIELDING (fixed and/or temporary), ETC.
☒ c. REMOTE HANDLING TOOLS OR EQUIPMENT, ETC.
☒ d. RESPIRATORY PROTECTIVE EQUIPMENT, ETC. See Supplements D and I

14. WASTE DISPOSAL

a. NAME OF COMMERCIAL WASTE DISPOSAL SERVICE EMPLOYED

None

b. IF COMMERCIAL WASTE DISPOSAL SERVICE IS NOT EMPLOYED, SUBMIT A DETAILED DESCRIPTION OF METHODS WHICH WILL BE USED FOR DISPOSING OF RADIOACTIVE WASTES AND ESTIMATES OF THE TYPE AND AMOUNT OF ACTIVITY INVOLVED. IF THE APPLICATION IS FOR SEALED SOURCES AND DEVICES AND THEY WILL BE RETURNED TO THE MANUFACTURER, SO STATE.

IAW Army Regulation 385-11; APG Regulation 385-3

INFORMATION REQUIRED FOR ITEMS 15, 16 AND 17

Describe in detail the information required for Items 15, 16 and 17. Begin each item on a separate page and key to the application as follows:

15. RADIATION PROTECTION PROGRAM. Describe the radiation protection program as appropriate for the material to be used including the duties and responsibilities of the Radiation Protection Officer, control measures, bioassay procedures *(if needed)*, day-to-day general safety instruction to be followed, etc. If the application is for sealed source's also submit leak testing procedures, or if leak testing will be performed using a leak test kit, specify manufacturer and model number of the leak test kit. See Suppl A

16. FORMAL TRAINING IN RADIATION SAFETY. Attach a resume for each individual named in Items 6 and 7. Describe individual's formal training in the following areas where applicable. Include the name of person or institution providing the training, duration of training, when training was received, etc. See Suppl B

    a. Principles and practices of radiation protection.

    b. Radioactivity measurement standardization and monitoring techniques and instruments.

    c. Mathematics and calculations basic to the use and measurement of radioactivity.

    d. Biological effects of radiation.

17. EXPERIENCE. Attach a resume for each individual named in Items 6 and 7. Describe individual's work experience with radiation, including where experience was obtained. Work experience or on-the-job training should be commensurate with the proposed use. Include list of radioisotopes and maximum activity of each used. See Suppl B

18. CERTIFICATE

(This item must be completed by applicant)

The applicant and any official executing this certificate on behalf of the applicant named in Item 2, certify that this application is prepared in conformity with Title 10, Code of Federal Regulations, Part 30, and that all information contained herein, including any supplements attached hereto, is true and correct to the best of our knowledge and belief.

WARNING.—18 U.S.C., Section 1001; Act of June 25, 1948; 62 Stat. 749; makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

a. LICENSE FEE REQUIRED *(See Section 170.31, 10 CFR 170)* No fee required per 10 CFR 170.11(a)(5)	b. CERTIFYING OFFICIAL *(Signature)* Martin W. Walsh Jr.
	c. NAME *(Type or print)* MARTIN W. WALSH, JR., COL, CE,
(1) LICENSE FEE CATEGORY: Not Applicable	d. TITLE Commander, USA Aberdeen Proving Ground
(2) LICENSE FEE ENCLOSED: $ None	e. DATE

SUPPLEMENT A *

SUBJECT: Regulation and Procedures for Radiation Protection

2. Contents:

Annex 1: APG Regulation 385-3, Radiation Protection, dated 11 February 1981 and forms used at APG.

Annex 2: Emergency Room SOP 38 - Management of Radiation Casualties in the Emergency Room. KAHC SOP 40-279 - Management of Casualties Secondary to Ionizing Radiation.

Annex 3: Procedures for Receiving and Opening Packages Containing Radioactive Material and Leak Test Procedure.

* In accordance with Regulatory Guide 10.5, these documents may be revised by updating in conformance with Federal and Army Regulation and may be made without prior notification to NRC staff as approved by the Radiation Protection Committee and the Radiation Protection Officer.

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DEPARTMENT OF THE ARMY
US ARMY ABERDEEN PROVING GROUND
Aberdeen Proving Ground, Maryland 21005

APG Regulation
No. 385-3

11 February 1981

Safety
RADIATION PROTECTION

The term "he" (and its derivatives) when used in this regulation represents both the male and female genders; exceptions will be noted.

*Supersedes APGR 385-3, dated 11 September 1979

CHAPTER 1

GENERAL

1-1. PURPOSE.

a. To prescribe command policies and delineate responsibilities regarding special requirements for administering ionizing radiation protection standards.

b. To establish standards and furnish technical guidance to promote radiation safety in the evaluation of radioactive items associated with the testing of materials or operation of apparatus which produces ionizing radiation at APG.

c. To provide procedures for the control of potential personnel hazards from ionizing radiation sources.

d. To implement the APG Radiation Protection Program.

1-2. SCOPE. This regulation is applicable to all DOD organizations, other governmental agencies, civilian contractors, and visitors, whether tenant or transient at APG, using, operating, and/or possessing equipment or devices capable of producing potentially hazardous ionizing radiation. This regulation, however, in no way obligates the US Government for any liability to contractor personnel at APG for any adverse health effects arising from radiation sources.

1-3. DEFINITIONS. See appendix B.

1-4. GENERAL.

a. Ionizing Radiation. Any level of ionizing radiation is potentially harmful to body tissue; thus, any exposure should be minimized to a level as low as is reasonably achievable. Any intentional exposure will be evaluated in light of the risk/benefits derived therefrom.

b. Sources of Ionizing Radiation.

(1) X-ray equipment used for medical or industrial purposes is a potential source of ionizing radiation exposure. Protection of personnel can best be afforded by proper design, installation, shielding, and operating techniques.

(2) Radioisotopes, such as Depleted Uranium, Tritium, and Promethium, are used for or in support of research, development, test, and evaluation. Protection can be achieved by time, distance, and shielding.

(3) Particle accelerators, such as the linear accelerator, are used in nondestructive testing. Ionizing radiation is produced by such equipment in the form of x-rays. Proper design, installation, shielding, and operating procedures are essential to protect operating personnel.

(4) Electronic equipment such as electron microscopes, cathode ray tubes, magnetrons, klystrons, and thryratron tubes operating at high voltages can produce x-rays. Proper installation, shielding, and operating procedures are essential to protect operating personnel.

(5) Nuclear reactors used for electrical power and/or research generate various types of ionizing radiation, such as neutrons, gamma rays, and beta particles. Due to the high neutron fluxes and fission products, special measures must be taken to insure safe conditions for reactor personnel, visitors, and the local community.

1-5. RESPONSIBILITIES.

a. Commander, APG, and tenant commanders/directors will:

(1) Develop and implement a Radiation Protection Program (RPP) IAW applicable directives and regulations.

(2) Appoint, on orders, a principal and alternate Radiation Protection Officer IAW AR 40-14 and AR 385-11.

(3) Appoint, on orders, a Radiation Protection Committee IAW AR 40-14 and 385-11.

b. Chief, Safety Office, APG, will:

(1) Staff supervise all safety activities for the Commander, APG.

(2) Recommend to the Commander a qualified health physicist to staff and supervise the APG RPP.

(3) Review and concur in standing operating procedures (SOP's) for hazardous operations within APG Command and maintain a copy of all approved SOP's.

(4) Provide a member to the APG Radiation Protection Committee (RPC).

c. Chiefs of tenant activity safety offices will carry out their responsibilities as specified in chapters 15, 16, and Appendix A of this regulation.

d. The APG Radiation Protection Officer will, for the Commander, APG:

(1) Exercise staff supervision over the APG RPP and management of Nuclear Regulatory Commission (NRC) licenses and DA authorizations for the APG Command.

(2) Report directly to the Commander, APG, in situations where prompt command action is required to prevent a radiation accident or incident.

(3) Serve as chairperson of the APG RPC and perform the following duties:

(a) Call and preside at quarterly and/or special meetings.

(b) Represent the committee on matters pertaining to the use, transfer, and storage of radioactive material.

(4) Provide technical advice and assistance on matters pertaining to radiation safety.

(5) Review radiological operations within APG Command for compliance with regulations, approved procedures, NRC licenses, and DA radiation authorizations (DARA).

(6) Maintain formal radioisotope inventory records for APG in accordance with AR 385-11. Obtain radioisotope inventories from tenant organizations and provide copies to appropriate APG activities.

(7) Maintain radiation protection records IAW AR 340-18-6.

(8) Ensure qualified personnel perform radiation surveys, monitoring, and leak tests.

(9) Act as the Contracting Officer's Representative (COR) for augmentation contracts funded by APG Command involving the monitoring associated with depleted uranium testing.

(10) Evaluate the hazard potential and adequacy of protective measures for existing and proposed test and evaluation (T&E) programs as well as existing or proposed Radiological (Health Physics) Monitoring and Environmental Radiological Monitoring Augmentation contracts.

(11) Review radiological permit (RP) applications and SOP's in T&E programs involving sources of radiation subject to testing or included as ancillary material not subject to testing prior to review by the RPC.

(12) Investigate accidents and/or incidents involving radiation and report the findings in accordance with AR 385-40.

(13) Provide assistance to Quality Assurance Office, APG, in radiation detection instrument calibration matters and review appropriateness of instrumentation used by RP holders.

(14) Coordinate and prepare applications for NRC licenses and DA authorizations for RPC review, approval, and submission.

(15) Ensure that radioactive material movements, shipments, and receipt functions are IAW AR 385-11, 10 CFR 20, 49 CFR 173, and the guidance contained in TM 55-315.

(16) Assure the maintenance of command NRC license and DARA limits through the isotope inventory process and prepare and submit the Annual Source Material Inventory Statement to Department of Energy (DOE) as required by 10 CFR 40.64(b).

(17) Assure that the Army Pulse Radiation Division, Materiel Testing Directorate (MTD), APG, radioactive sources are leak tested and that leak testing is performed IAW the RPP.

(18) Provide health physics orientations IAW 10 CFR 19.12 for radiation workers; review and assist in the administration of protective services training given IAW NFPA 801 and the APG Disaster Control Plan.

(19) Present a health physics orientation on an annual basis to APG Command radiation workers engaged in the testing of depleted uranium penetrators and on a case-by-case basis to visitors at the test area.

(20) Provide radiation monitoring training to appropriate personnel.

(21) Provide centralized issue, collection, control, and submission for processing of photo dosimetry film.

(22) Prepare a Report of Recorded Whole Body Exposure for and as specified by the NRC.

(23) Advise radiological permit holders and radioactive commodity users of radioactive waste disposal procedures.

(24) Coordinate with appropriate medical activity personnel in the event of suspected internal or external overexposure.

(25) Provide emergency health physics assistance IAW the APG Disaster Control Plan.

(26) Coordinate with other activities in matters of mutual radiation protection concerns.

(27) Provide technical assistance to APG activities preparing requests for radiological permits and associated SOP's.

(28) Coordinate with Logistics Directorate, APG, on matters concerning radioactive waste disposal.

(29) Monitor the RPP's of tenant activities by:

(a) Reviewing the NRC licenses and DA authorization submissions.

(b) Reviewing the evaluations of tenant activities' RPP's by higher headquarters and other agencies.

(c) Performing field evaluations, as required.

(30) Provide a copy of the radioisotope inventory to Protective Services.

e. The Health Physicist assigned to the Army Pulse Radiation Division (APRD), MTD, APG, will:

(1) Prepare and inspect radioactive shipments for the staff and contractors at the APRD. When applicable, furnish the Transportation Officer written report of survey. The report will contain consignor and consignee NRC or state license numbers. A copy will be part of the shipping records and a copy will be sent to the APG RPO.

(2) Perform required inventories and leak tests for all APRD sources.

(3) Control and prepare all radioactive waste generated at the APRD for disposal as directed by AR 385-11 and/or other applicable regulations.

(4) Insure that the storage and use of radioactive materials in Bldg 860 and 861 are IAW the applicable RP.

(5) Provide health physics training for the APRD personnel.

(6) Collect, submit, and analyze data for the APRD Environmental Monitoring Program and initiate subsequent reports to DARCOM.

(7) Conduct special radiation hazard studies of the APRD facilities.

(8) Issue and record the assignment of film badges to the APRD staff and visitors.

(9) Perform routine radiation surveys for the APRD users and perform decontamination as required.

(10) Be a member of the APG RPC and the Reactor Test Planning Committee.

(11) Provide input to and review license application drafts for the APRD.

(12) Provide health physics assistance to APG as required.

f. The APG RPC will:

(1) Consist of the following members and their alternates:

(a) Chairperson (the APG Health Physicist).

(b) Representative from each using activity.

(c) Radiation safety supervisors (as designated).

(d) Medical officer.

(e) Environmental Quality Coordinator (EQC), Facilities Engineering Directorate, APG.

(f) Labor union representative (as designated).

(g) Health physicist at tenant organizations having an RPP (non-voting).

(h) Other persons as deemed necessary.

(2) Recommend to the Commander, policies on the safe use, handling, storage, transport, receipt, shipment, and disposal of sources of radiation.

(3) Review the radiation safety aspects of proposals for the procurement and use of sources of radiation, modifications to existing radiological operations, radiological permit applications, and operating procedures.

(4) Review applications for all NRC licenses and DARA submitted by APG and/or tenant activities; monitor programs, as necessary, to insure compliance with applicable regulations; and assure that radiological operations and activities of tenant agencies do not endanger personnel, facilities, or the environment for which the Commander, APG, is responsible. Review may be performed by the RPO and the EQC for the committee. Reviews will normally be completed in 15 working days.

(5) Review and approve the qualifications of APG Command radiological permittees and users of radioactive devices.

(6) Review reports of accidents and incidents involving radiation to determine the cause, and recommend appropriate action to the Commander, APG.

(7) Meet at least quarterly and/or as called by the chairperson. Minutes of the meeting will be maintained IAW AR 340-18-6. At least three committee members shall constitute a quorum empowered to act for the full committee. These members will be the chairperson or alternate, the APRD staff member or the nondestructive test branch member, and a safety office staff member or the environmental management member.

g. Tenant activities radiation protection officers and radiation protection committees will carry out their responsibilities as specified in chapters 15 and 16 of this regulation as appropriate.

h. Commanders, directors, or heads of APG Command activities engaged in tests or operations involving ionizing radiation will:

(1) Insure that personnel involved in ionizing radiation operations are aware of the hazards involved and follow required safety procedures as specified in the RP.

(2) Notify the RPO of the termination of assignment of any worker listed on an RP as soon as termination occurs. The notification should include:

(a) Name.

(b) Social Security number (SSN) (for identification purposes only).

(c) The RP number.

(d) Status of worker (military, civilian, or contractor).

(3) Return to the Safety Office (ATTN: STEAP-SA) all film badges within one week of the end of the wearing period, and account for any missing badges.

(4) Submit for approval to the chairperson, APG RPC, RP applications and SOP's for the possession or use of ionizing radiation device(s). SOP's will be prepared in accordance with the format in APGR 310-1.

(5) Insure that the requirements of pertinent regulations and procedures are satisfied prior to the final acceptance of radiation producing equipment.

(6) Insure that projects, not initially subject to this regulation but changed to include ionizing radiation devices, are revised to meet the requirements in chapter 14.

(7) Coordinate the approval of procurement of ionizing radiation producing material or devices with the RPC in accordance with chapter 14.

i. Radiation safety supervisors will:

(1) Be responsible for the overall operations involved in the radiation project and the action of radiation workers as specified in the RP.

(2) Insure that personnel identified as radiation workers are scheduled for and obtain medical examinations as specified in chapter 5.

(3) When informed of termination notices for radiation workers:

(a) Transfer inventory of an accountability for radioactive material for which the employee is responsible to another approved radiation worker.

(b) Arrange for a termination medical examination.

(c) Notify the RPO.

(d) Assure turn-in of personnel dosimetry devices.

(e) Prevent further radiation exposure to the employee.

j. Radiation workers will:

(1) Know and follow appropriate RP's, SOP's, rules, and special instructions pertaining to ionizing radiation.

(2) Wear the appropriate dosimetry device(s) and promptly report, in writing, circumstances incident to loss of a dosimetry device to the RPC.

(3) Report for periodic medical examinations.

(4) Follow prescribed safety procedures for the handling and use of radiation sources.

(5) Report immediately to their supervisors any accident, however slight, involving a radiation source. This especially includes suspected overexposure to radiation sources.

k. Commander, Kirk US Army Health Clinic (KUSAHC), will:

(1) Provide medical examinations to all APG radiation workers. See chapter 5.

(2) Maintain medical records to include radiation exposure records (DD Form 1141, Record of Occupational Exposure to Ionizing Radiation) for APG Command radiation workers.

(3) Provide emergency medical care for all personnel, Federal or contractor, who are injured due to overexposures to ionizing radiation.

(4) Record on DD Form 1141 the exposure for APG Command personnel in the film badge program and for post visitor film badge users.

1-6. PROCEDURES.

a. Specific procedures pertaining to the administration of the APG RPP are contained in the chapters of this regulation.

b. Range control procedures are contained in APGR 385-1.

c. Procedures for the use of protective clothing and equipment are contained in AR 385-32 and APGR 385-2.

1-7. REFERENCES. See appendix C.

CHAPTER 2

LICENSES AND/OR AUTHORIZATIONS FOR RADIOACTIVE MATERIAL

2-1. PURPOSE. This chapter prescribes procedures for obtaining NRC licenses and DA authorization for possession and use of sources of ionizing radiation.

2-2. SCOPE. This chapter applies to APG Command elements.

2-3. GENERAL.

a. NRC Licenses. The control of by-product materials, source materials, and special nuclear materials is vested in the US Nuclear Regulatory Commission. No persons will manufacture, produce, transfer, receive, acquire, own, possess, use, import, or export such material, except by authority of a license pursuant to Title 10, Code of Federal Regulations (CFR). This requirement does not apply to the procurement or use of radioactive materials utilized in nuclear weapons, Section 91b Nuclear Reactors, or to operations of the Defense Nuclear Agency. The Nuclear Regulatory Commission's special nuclear material regulations (Title 10, CFR, Part 70) do not necessarily apply to the Department of Defense (DOD) in that the DOD may receive, possess, and use special nuclear materials in accordance with Section 91b of the Atomic Energy Act of 1954. Detailed instructions for the preparation and submission of license applications are in DARCOM/AMC Regulation (AMCR) 385-9 and TECOM Regulation 385-9.

b. DA Authorization. The Department of the Army controls all radioactive material which is in excess of one microcurie. Authorizations to possess radioactive material are issued by DARCOM. Requests will be prepared by the requesting range user in accordance with AR 385-11 and DARCOM/AMCR 385-9 and submitted for review by the APG RPC.

c. Electron Tubes Containing Radioactive Material. Electron tubes containing radioactive material require no license or approval for procurement.

2-4. PROCEDURES.

a. DA Radiation Authorizations (DARA) and Permits for Radioactive Materials at APG.

(1) APG has broadscope NRC licenses and DARA for the use, transfer, and possession of radioactive by-product material, source material, and special nuclear material.

(2) Radioactive material users requiring quantities greater than those specified in the NRC licenses and DARA will present a request for application for amendment through command channels for NRC licenses or DARA. (See AR 385-11 and DARCOM/AMCR 385-9 for preparation of NRC Form 313 (Application for By-product Material) or NRC Form 2 (Application for Source Material) and DA Form 3337 (Application for Department of the Army Radioactive Material Authorization or Permit)). DARA are usually granted for a three-year period. Applications and renewals will be submitted at least 60 days prior to the expiration date of the current DARA.

b. DA Permits for Use, Storage, Possession, and Disposal of Radioactive Sealed Sources by Non-Army Agencies (Including Civilian Contractors) at APG. IAW 385-11, concurrence of the Commander, APG, is required to obtain a DA permit.

(1) Agencies having an NRC license permitting use or storage of radioactive sources at unspecified DA installations and who plan to use those sources at APG will send six copies of a completed DA Form 3337 to Commander, US Army Aberdeen Proving Ground, ATTN: STEAP-SA, Aberdeen Proving Ground, MD 21005 at least 60 days prior to the date of intended use of radioactive sources at APG. The APG RPO will review the application prior to its submission to the APG RPC for review and approval. Upon committee approval, a letter of concurrence will be prepared for the Commander's signature. The Commander will send five copies of the DA Form 3337 through Commander, US Army Test and Evaluation Command, ATTN: DRSTE-ST, to Commander, DARCOM, ATTN: DRCSF-P, for approval.

(2) Renewal for DA permits will be requested in the same manner as the original application. Renewal will be submitted at least 45 days prior to the expiration date of the original permit.

(3) Temporary use or storage (less than 15 consecutive days) does not require a DA permit if the Commander determines that adequate safety exists. The Commander may approve temporary use and storage of radioactive sealed sources by users who have a current NRC or Agreement State license. The user will submit a written request to the Commander, US Army

Aberdeen Proving Ground, ATTN: STEAP-SA, Aberdeen Proving Ground, MD 21005, 30 days prior to the intended use, giving the following information:

(a) Use and storage information and use location.

(b) Applicable license number and expiration date certification.

(c) Operating procedure summary.

(d) Radioactive source, element and atomic number, and quantity in curies.

(e) Estimated length of stay at APG.

(f) A statement that the APG RPO will be notified when the radioactive sources leave APG.

The APG RPO will review the request prior to submission to the RPC for review and approval. Upon RPC approval, a letter of approval will be prepared for the Commander's signature. A copy of the request and the Commander's approval letter will be sent through channels to Commander, DARCOM, ATTN: DRCSF-P, within three days of the approval.

c. Disposal of Radioactive Materials. Procedures for disposal of radioactive materials are contained in AR 385-11 and in chapter 12 of this regulation.

CHAPTER 3

PERSONNEL DOSIMETRY

3-1. PURPOSE. This chapter prescribes responsibilities and procedures for personnel dosimetry at APG.

3-2. SCOPE. This chapter applies to APG Command elements.

3-3. GENERAL.

a. An appropriate personnel monitoring device will be used to monitor the exposure of each individual who is occupationally exposed to sources of ionizing radiation or those who periodically enter a controlled area (occasionally exposed individual) and are likely to receive an accumulated dose equivalent of radiation in excess of 10 percent of the applicable quarterly basic radiation protection standard. Exemptions to using film badges are authorized only by the Surgeon General, DA.

b. All persons involved with APG ionizing radiation projects will wear an APG film badge whether or not they also wear a film badge provided by a service other than APG.

c. AR 40-14 outlines the general requirements for recording exposure to ionizing radiation. See also paragraph 3-7 of this chapter.

d. Internal dose assessments will be made whenever there are significant bioassay results.

3-4. RESPONSIBILITIES. The APG RPO is responsible for the supervision of the personnel dosimetry service at APG. Chiefs of activities having projects involving ionizing radiation will enforce dosimetry requirements for personnel under their supervision.

3-5. TYPES OF DOSIMETERS.

a. The following personnel dosimetry devices are authorized for use at this installation:

(1) Film badge for x-ray, gamma rays, and beta particles.

(2) Neutron film badge.

(3) Pocket ion chamber (nonself-reading).

(4) Pocket dosimeter (self-reading).

(5) Thermoluminescent dosimeter (TLD).

b. Film badges, including neutron badges and wrist badges will be used to obtain a permanent record of the radiation dose to which an individual is exposed. This exposure record will be maintained permanently in each individual's medical record (DD Form 1141). Film badges will normally be worn clipped to the clothing in such a manner as to record whole body exposure. Wrist badges will be used to monitor the dose to hands. Pocket ion chambers and pocket dosimeters permit the individuals to check their accumulated doses on a daily basis. TLD's will only be used to supplement the dosimetry program.

c. Bioassay will be performed IAW para 5-35, AR 40-5, by monitoring individuals for possible internal depositions of radioactive substances.

3-6. PROCEDURES. The procedures for applying dosimetric devices are as follows:

a. Film Badges and TLD's.

(1) General Precautions.

(a) Persons who tamper with dosimetry devices will be subject to disciplinary action.

(b) Films should not be exposed to excessive heat or moisture; e.g., direct sunlight, heaters, immersion in liquids, etc.

(c) Films will not be left in a location where they may be exposed to excessive radiation.

(d) Film badges permanently assigned to an individual will be worn by that individual during all work with ionizing radiation or in a radiation area.

(e) Film badges will not be taken home. A rack or similar arrangement for storage of film badges and other dosimeter devices during nonduty hours will be provided by each facility whose personnel have been issued film badges. This storage rack will be placed in a cool, dry location not above normal background radiation. A control film badge will be maintained at this location throughout the wearing period for that type badge.

(f) Film badges and other dosimeters will be worn on the outermost garment in a location on the body to best indicate the maximum amount of whole body radiation received. Where beta radiation is present, the beta-gamma badge will be worn as close to the eyes as practicable.

(g) The individual will wear only the film badges or dosimeters which have been assigned to him. If the badge has been lost or misplaced, the RPO will be notified at once and a replacement badge will be issued.

(h) Any violation of these procedures will be reported to the appropriate supervisor who will notify the RPO. Flagrant violation of any of the above subparagraphs (a) thru (g) will result in administrative action against the individual.

(2) How to Obtain Badges.

(a) DD Form 1952 (Film Badge Application and Record of Occupational Radiation Exposure). The responsible supervisor will, prior to using a radiation source, request a film badge for each individual who may be potentially exposed. Request will be made on DD Form 1952 (2 copies) to the APG RPO, ATTN: STEAP-SA. A carbon copy will be sent to KUSAHC by the APG RPO.

(b) The APG RPO will notify the radiation safety supervisor to pick up the film badges prior to the beginning of the wearing period.

(c) At the end of the wearing period, the radiation safety supervisor will return the exposed film to the RPO and pick up the next period's film.

(d) The RPO will forward the film packets and three completed copies of DA Form 3484 (Photodosimetry Report) to the Lexington Bluegrass Army Depot for processing.

(e) In the event of an overexposure, the Lexington Bluegrass Army Depot will notify the APG RPO telephonically or by electrical message. Otherwise, the film evaluation report will be received by the APG RPO through normal mail service.

(f) If an individual has received an overexposure, the APG RPO will notify the individual's supervisor immediately. The individual will be removed from radiation exposure, if required, until KUSAHC determines that the resumption of duties will not adversely affect the individual's health. (See AR 40-14.)

(3) Upon termination of work on an RP, the film badge will be turned in, with the date of termination, to the RPO.

b. Pocket Dosimeters and Pocket Chambers.

(1) Since pocket dosimeters and pocket ion chambers permit daily evaluation of radiation exposure, they are used to supplement the film badge. Pocket dosimeters or chambers will be used in any area in which the exposure rate is likely to exceed 20 mR/hr. Two dosimeters or pocket chambers should be worn as they are subject to leakage and accidental discharge.

(2) Pocket dosimeters and pocket chambers will be charged as required and read at least once a day by the supervisor or a qualified person designated by him. An approved RP will be maintained. If an overexposure (suspected or actual) occurs, the individual's film badge will be delivered immediately to the Safety Office, APG. The badge will be forwarded by mail to the Lexington Bluegrass Depot for evaluation and verification of pocket dosimeter readings. Only exposures evaluated from the film badges will be recorded on DD Form 1141 (see para 3-7b below), unless an accident should occur to the film badge. In such a case, the pocket dosimetry record will be used as a working guide by the RPO in estimating the radiation dose received by the individual.

c. An evaluation of internal dosage may be determined by various combinations of the following methods: (1) urinalysis, (2) nose wipes, (3) fecal analysis, (4) sputum analysis, (5) blood analysis, (6) breath analysis, or (7) whole body counting.

3-7. PERSONNEL MONITORING RECORDS. AR 40-14 prescribes the requirements for recording non-combat radiation exposures.

a. The APG RPO will insure that exposure records are recorded on each individual's DD Form 1141, as outlined in AR 40-14.

b. The Commander, KUSAHC, is responsible for maintaining individual DD Forms 1141 for APG radiation workers upon notification of assignment by the organization.

c. DD Form 1141 will be initiated for each radiation worker when first occupationally exposed to ionizing radiation. If the person exposed is not a radiation worker, his exposure dose will be forwarded to KUSAHC for inclusion in his medical records.

d. DD Form 1141 will be part of the medical record.

CHAPTER 4

EXPOSURE OF INDIVIDUALS TO RADIATION

4-1. PURPOSE. This chapter prescribes radiation protection standards.

4-2. SCOPE. This chapter applies to all APG Command personnel.

4-3. GENERAL.

a. The health physics philosophy at APG is to accomplish a given task with the least possible radiation exposure to personnel (ALARA).

b. Radiation exposure may be categorized as internal or external.

c. The population is divided into two groups for determining the permissible exposures:

(1) Occupationally exposed individuals or radiation workers are persons who work in a controlled area and whose duties might involve exposure to radiation.

(2) The general population includes those who are not occupationally exposed to radiation and those occasionally exposed individuals who are not radiation workers but may have reason to enter a restricted area in the performance of their duties.

4-4. RADIATION PROTECTION STANDARDS.

a. External radiation protection standards are contained in para 6, AR 40-14; 10 CFR 20; and 29 CFR 1910.96 as applicable. This regulation is further restricted by the following APG limitations:

(1) In an emergency situation, these limits may be exceeded to save human life (100 rem) or rescue valuable equipment (25 rem) provided the decision is made by a responsible person in consultation with an APG health physicist, time permitting.

(2) The current accumulative occupational dose records will be kept by the medical health records custodian on DD Form 1141.

(3) Previous occupational radiation exposure records will be forwarded to the medical records custodian for incorporation into the individual's DD Form 1141.

b. Control of personnel internal doses will be achieved by limiting the body burden of radioisotopes. This will be accomplished by control of the average concentrations of radioactive materials in the air, water, and food taken into the body. In particular, the limitations of Title 10, CFR, Part 20.103 will be complied with in the possession, use, and transfer of licensed radioactive materials. NCRP Report No. 22 will be used as a guide for those radionuclides not controlled by NRC.

CHAPTER 5

MEDICAL EXAMINATION POLICIES FOR IONIZING RADIATION WORKERS

5-1. PURPOSE. This chapter prescribes medical examination policies for ionizing radiation workers.

5-2. SCOPE. This chapter applies to all personnel classified as radiation workers within the APG Command.

5-3. GENERAL. Radiation workers at Aberdeen Proving Ground are divided into three categories according to the type of hazard to which they are exposed as defined below. Assignment to categories will be by the APG RPO upon the recommendation of the individual's supervisor.

a. Personnel exposed to external radiation hazard. Potential exposure to x- or gamma radiation, sealed gamma sources, etc.

b. Reactor workers and personnel exposed to neutron hazard. This group includes reactor staff members, health physics personnel, and experimenters who frequently work around the reactor.

c. Personnel exposed to an internal radiation hazard. Persons who are routinely in proximity to unsealed radioactive material and, therefore, potentially subject to inhalation, ingestion, or absorption of this material into their bodies.

5-4. MEDICAL EXAMINATIONS. Supervisors of radiation workers will schedule appropriate medical examinations:

a. Initial radiation worker medical examination. This examination will be performed prior to an individual's assignment as a radiation worker. (See para 5a, AR 40-14.)

b. Periodic examination. This examination will be performed at least every three years or more frequently as specified by medical authorities (AR 40-14).

c. Termination examination. This examination will be performed upon termination of assignment to a position which classified the employee as a radiation worker.

5-5. SCOPE OF EXAMINATIONS. Required examinations will be performed according to the type of radiation hazard to which the individual will be exposed and IAW the provisions of AR 40-5, AR 40-14, and other applicable medical regulations. (See para 3-5c, chapter 3.)

CHAPTER 6

SPECIAL AND UNIQUE SOURCE MATERIAL (DEPLETED URANIUM) PROPERTIES AND CONTROLS

6-1. PURPOSE. This chapter describes the properties of depleted uranium and the controls to be exercised by command personnel when working with the material.

6-2. SCOPE. This chapter applies to the APG Command.

6-3. TERMINOLOGY. Depleted uranium is referred to as U (depleted), DU, D-38, or Tuballoy. The material is contained in projectiles as an alloy of uranium.

6-4. USES. U (depleted) is used in projectiles and shielding, and as a simulator for special nuclear material devices or design items.

6-5. SOURCE MATERIAL PROCESS. Natural uranium is about 99.3 percent ^{238}U, 0.7 percent ^{235}U with a trace quantity of ^{234}U. The uranium is subjected to a separation process to obtain the fissionable ^{235}U isotope. The resulting ^{238}U is now depleted and contains about 0.2 percent ^{235}U and may be considered to be all ^{238}U. Generally most DU material is an alloy of U (depleted) and another metal.

6-6. RADIOACTIVITY.

a. General properties of DU. Natural uranium is radioactive, as is DU. Uranium isotopes are mildly radioactive and have a relatively low specific activity. DU emits alpha, beta, and gamma radiation. Sheathing or encasing the material with metal attenuates the alpha and beta. Workers will be informed of hazards and precautions as required by Title 10, Code of Federal Regulation, Part 19. See chapter 14.

b. Selected Information Relevant to DU. For purposes of comparison, the following table lists some specific activity data, demonstrating the relatively low activity values for ^{238}U and ^{235}U as compared with other isotopes.

Isotope	Specific Activity (MicroCurie/gram)
^{238}U	0.36
^{235}U	2.1
^{226}Ra	1.0×10^{6}
^{60}Co	1.1×10^{9}

Although low in specific activity, DU is radioactive source material and with its daughters emits the following:

Radiation	Range in Air	Stopped By
Gamma Rays	more than 30 meters	2-5 cm of steel*
Beta Particles	up to 6 meters	a thin sheet of metal
Alpha Particles	about 2 cm	skin or a sheet of paper

* The range and penetrating ability of gamma rays depends on the energy level. Practically all DU gammas have low energies. The figures given above are considered adequate for APG operations involving DU. Emissions from a slug of DU are complex, due to bremsstrahlung, self absorption and to the formation of decay products, called daughters, each of which decays with the apparent

activity of the parent, DU. In theory, the refining and separation processes separate the ^{238}U from its daughters; however, radioactive decay immediately starts the daughters forming again. The following table shows the decay scheme:

Progeny	Radiosotope	Emissions	Half Life*
Parent	^{238}U	Alpha, Gamma **	4.5×10^{9} years
Daughter	^{234}Th	Beta, Gamma	24 days
Daughter	^{234}Pa	Beta, Gamma	1.2 minutes
Daughter	^{234}U	(See Below) ***	2.5×10^{5} years

* The time required for a radioactive substance to lose 50 percent of its activity by decay.

** This gamma is of low energy and occurs about one-fifth as often as the alpha.

*** Because of the long half-life of ^{234}U and the small amount that will be built up, we may consider the process ended here for our purposes.

c. Maximum Permissible Concentrations (MPC) for occupationally exposed personnel (10 CFR 20, appendix B, table 1) are:

	In Air	In Water
^{238}U Soluble (S)	7×10^{-11} microCuries/cm^3	1×10^{-3} microCuries/ml
^{238}U Insoluble (I)	1×10^{-10} microCuries/cm^3	1×10^{-3} microCuries/ml

d. Surface dose rates for DU. An infinite thickness of DU is about 5mm. Infinite thickness is that thickness of material such that any further increase in the thickness will cause no further change in the count rate. The surface dose rate is 200 mRad/hr. The handling time required to give a 1.5 rem/week exposure is 7.5 hr/week for bare hands and 15 hr/week for hands with 1mm leather gloves. APG utilizes 7.5 hr/week as a limit (1.5 rem/week x 50 weeks = 75 rem per year, the limit for hands and feet). (Reference Los Alamos Handbook of Radiation Monitoring (LA4400).)

e. Guide for the Calculation of Atmospheric Concentration Derived from a Removable Contamination Swipe Survey and the Determination of Safety Action Levels to Protect Personnel.

(1) Removable surface contamination may give rise to ingestion of the contaminant through transfer to the mouth or skin or resuspension of the contaminate and then inhaling it. Maximum limits for surface contamination cannot be fixed as are the limits of concentration of radionuclides in air and water. It is useful to compute a number that may serve as a guide in the evaluation of hazard to workers from surface contamination and to assist in deciding whether or not to require the initiation of protective measures for workers should contamination be present. Inhalation is considered the most serious route of exposure on a per-unit quantity basis. Removable contamination is usually limited by the inhalation hazard which may occur from resuspension of the contaminant. The quantitive relationship between the removable contamination and consequent atmospheric concentration above the contaminated surface due to stirring up the surface is called the resuspension factor, f_r, and is defined by

$$f_r = \frac{\text{atmospheric concentration } \mu Ci/cm^3}{\text{surface concentration } \mu Ci/cm^2}$$

(2) Values for the resuspension factor vary from about 10^{-4} to 10^{-8}. A value for f_r of 10^{-6} is reasonable for the purpose of estimating hazard from surface contamination on target material and fixtures within the target enclosure.

(3) An estimate of the maximum removable surface contamination level allowed before taking safety measures to protect personnel against airborne contamination is calculated as follows for all compounds of U-238 where the atmospheric concentration is the maximum permissible concentration as described in paragraph 4c of this chapter:

Encl 2

activity of the parent, DU. In theory, the refining and separation processes separate the ^{238}U from its daughters; however, radioactive decay immediately starts the daughters forming again. The following table shows the decay scheme:

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Daughter	^{234}Th	Beta, Gamma	24 days
Daughter	^{234}Pa	Beta, Gamma	1.2 minutes
Daughter	^{234}U	(See Below) ***	2.7×10^{5} years

* The time required for a radioactive substance to lose 50 percent of its activity by decay.

** This gamma is of low energy and occurs about one-fifth as often as the alpha.

*** Because of the long half-life of ^{234}U and the small amount that will be built up, we may consider the process ended here for our purposes.

c. Maximum Permissible Concentrations (MPC) for occupationally exposed personnel (10 CFR 20, appendix B, table 1) are:

	In Air	In Water
^{238}U Soluble (S)	7×10^{-11} microCuries/cm^3	1×10^{-3} microCuries/ml
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d. Surface dose rates for DU. An infinite thickness of DU is about 5mm. Infinite thickness is that thickness of material such that any further increase in the thickness will cause no further change in the count rate. The surface dose rate is 200 mRad/hr. The handling time required to give a 1.5 rem/week exposure is 7.5 hr/week for bare hands and 15 hr/week for hands with 1mm leather gloves. APG utilizes 7.5 hr/week as a limit (1.5 rem/week x 50 weeks = 75 rem per year, the limit for hands and feet). (Reference Los Alamos Handbook of Radiation Monitoring (LA4400).)

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$$f_r = \frac{\text{atmospheric concentration } \mu Ci/cm^3}{\text{surface concentration } \mu Ci/cm^2}$$

(2) Values for the resuspension factor vary from about 10^{-4} to 10^{-8}. A value for f_r of 10^{-6} is reasonable for the purpose of estimating hazard from surface contamination on target material and fixtures within the target enclosure.

(3) An estimate of the maximum removable surface contamination level allowed before taking safety measures to protect personnel against airborne contamination is calculated as follows for all compounds of U-238 where the atmospheric concentration is the maximum permissible concentration as described in paragraph 4c of this chapter:

$$\text{surface concentration } (\mu Ci/cm^2) = \frac{\text{atmospheric concentration } (\mu Ci/cm^2)}{f_r\ (cm^{-1})}$$

$$= \frac{7 \times 10^{-11}\ \mu Ci/cm^3}{10^{-6}\ cm^{-1}}$$

$$= 7 \times 10^{-5}\ \mu Ci/cm^2$$

This concentration equates to approximately 15,600 disintegrations per minute (dpm). Since the limits (5000 dpm alpha) for contamination control contained in table 4-3, AR 385-11, are far below this 15,600 dpm level, the hazard from resuspension should be minimal. (Reference: Introduction to Health Physics, Cember, Pergamon Press 1969.)

f. Potential Inhalation Exposure to Occupational Workers During Target Plate Changing. Assuming that no respirators are worn, no filtered air exhaust system existed, dust became airborne on plate alternation, dose assessment calculations below can be made. Air samplings performed after plate alternation indicated an average alpha activity of 1.5×10^{-5} µCi of DU for a 5-minute sampling period (3582 liters of air). An average worker would inhale about 20 liters of air per minute; thus, in 5 minutes his inhalation exposure to DU dust would be:

$$\frac{20 \text{ liters/min} \times 5 \text{ min}}{3582 \text{ liters}} \times (1.5 \times 10^{-5}\ \mu Ci) = 4.2 \times 10^{-7}\ \mu Ci$$

The dose to the lungs from inhaling 1 gram of DU dust is 17.12 rems. (Calculated from equation contained in Report of (ICRP) Committee II on permissable dose for internal radiation (1959).) Therefore, the individual would receive a lung dose of:

$$\frac{17.12 \text{ Rems}}{\text{gm of DU}} \times \frac{1 \text{ gm DU}}{0.36\ \mu Ci} \times (4.2 \times 10^{-7}\ \mu Ci) = 2.0 \times 10^{-5} \text{ Rem}$$

If an individual were to regularly change plates for 5 years (based on a 5-year experience of 1480 rounds), the 5-year dose assessment would be:

$$1480 \text{ rds} \times (2.0 \times 10^{-5} \text{ Rem/rd}) = 30 \text{ millirem.}$$

f. Miscellaneous Properties.

(1) DU emits alpha particles at the rate of one alpha disintegration per minute per microgram and releases 4.2 MeV of energy in 60 percent of the emissions (LA4400).

(2) A thick slab of DU gives about 800 alpha counts/min per cm^2 with 2 pi geometry (LA4400).

(3) Contact dose rates for a 0.25 inch cylindrical DU rod with:

(a) Eberline PACISA Alpha meter are 800-1000 counts/min.

(b) Eberline E520 Geiger Counter are 10-11 mRem/hr beta, and about 0.4 mRem/hr gamma.

6-7. RESPONSIBILITIES OF THE ON-SITE HEALTH PHYSICS MONITOR. The health physics monitor (contractor personnel) at the depleted uranium hard target test site will report to the Contracting Officer's Representative (COR) (the RPO) or alternate and submit reports in accordance with local supplied procedures. He will be responsible for:

a. Controlling access to the controlled area by maintaining an entry/exit log.

b. Performing area and personnel monitoring.

c. Performing routine health physics instrument and swipe surveys of the controlled area and adjacent structures, personnel facilities, and the environmental sampling as appropriate to support the Environmental Radiological Monitoring Program. See chapter 7.

d. Providing breathing zone and/or spot air samplings at the target area, and providing personnel dose assessment from the results.

e. Conducting surveys of material and equipment exiting the controlled area and recommending its decontamination method if required. Insure that contamination limits are IAW table 4-3, AR 385-11.

f. Providing annual orientation and training to test personnel, and on a case-by-case basis to transient/visitor personnel.

g. Maintaining and documenting a source material inventory of recovered scrap at the test site.

h. Operating supplemental (Government-owned) monitoring equipment.

i. Performing appropriate health physics monitoring commensurate with good health physics practice.

j. Assuring that the responsible personnel observe and conform to the requirements of the RP in addition to those listed in paragraph 6-7.

6-8. RESPONSIBILITIES OF TEST PERSONNEL. Test personnel will be responsible for, but are not limited to, the requirements listed below for any RP involving depleted uranium work.

a. Posting.

(1) A room or area will be posted "CAUTION RADIOACTIVE MATERIAL" if 30Kg (66 lb) or more material is stored or used. Reference 10 CFR 20.203(e)(2).

(2) A container will be labeled "CAUTION RADIOACTIVE MATERIAL" if 3 Kg (6.6 lb) or more of material is contained therein. Reference 10 CFR 20.203(f)(3)(ii). (For shipments refer to AR 385-11 and DOT regulations.)

(3) A room or area will be posted "CAUTION RADIATION AREA" if the dose rate is in excess of 2 mRem/h. (Reference AR 385-30.)

(4) A controlled access test area enclosed with an exclusion fence not meeting the requirements established in paragraph 6-8a(1)(2) or (3) may be posted with warning signs demonstrated in AR 385-30.

b. Personnel Restrictions. Impact of the projectile on plate produces dust to which DU particles may be attached. Personnel are not permitted in the impact area enclosure at the time of impact. To avoid inhalation or ingestion, personnel will:

(1) Wait until the HEPA filtered air evaculation system has reduced the DU air concentration to less than 10 percent of the appropriate 10 CFR 20, appendix B, table 1 limit. A water washdown of fixtures to remove dust and particles will be performed when contamination levels exceed those in AR 385-11. Wash water drains to a baffled holding tank.

(2) Not eat, drink, smoke, or chew in any radiologically controlled area.

(3) Wear protective clothing as prescribed by the RP or by the RPO.

(4) Have available an approved respirator mask which will be issued to the individual (APGR 385-2).

(5) Suspend firing when monitoring devices indicate an abnormal condition.

(6) Monitor themselves with the RADIAC instrument provided after the removal of protective clothing but prior to leaving the test area. Decontamination limits are specified in table 4-3, AR 385-11.

(7) Monitor material, equipment, and tools used in the impact area prior to removal.

(8) Perform maintenance and repair only after appropriate radiological surveys have been performed, and will observe good industrial hygiene practices when work is in progress.

(9) Exert every reasonable effort to remove dirt, dust, and fragments from associated fixtures in the impact area, and will enforce good personal hygiene practices as a means to protect personnel from ingesting uranium.

c. Visitors/transients to the test area will:

(1) Observe the entry requirements.

(2) Wear protective clothing and devices as follows:

(a) Visitor/transient - less than one day. Shoe cover only - do not handle metal, fragments, or plate. Film dosimetry is not required.

(b) Visitor/transient - one day or more, but less than 30 days. Lab or shop coat, shoe covers, and gloves if material in the target area must be handled. Film dosimetry is not required.

(c) Visitor/transient - 30 days or more. Same as operating personnel.

d. Dosimetry and Monitoring. External exposure is primarily skin dose due to beta with a fractional whole body gamma contribution. Operating personnel will:

(1) Wear film badges in the impact area.

(2) Obtain estimate dose rate using the assigned RADIAC instrument.

(3) Wear leather gloves when handling bare DU, plate, or items in the impact area which may contain deposited DU.

(4) Not handle bare assembly DU more than 7.5 hours per week when wearing leather gloves. (See paragraph 6-6d above.)

(5) Not enter the enclosure until authorized by the onsite health physicist or test director.

e. Plate Butt and Impact Area Facilities.

(1) The air-evacuated enclosure will be provided to contain scattering of DU and to trap debris and particulates resulting from impact on targets. Debris will be collected and stored in a metal waste container and held for disposal action IAW AR 385-11.

(2) When the requirement for this type of testing no longer exists, the plate butts, impact area, and contiguous affected areas will be restored for unrestricted use in accordance with NRC Guidelines for Decontamination of Facilities Prior to Release for Unrestricted Use or Termination of Licenses for By-product, Source, or Special Nuclear Material and NBS HB 48.

f. Exemptions for Non-Fragmenting Mode Firing into Unexploded Ordnance (UXO) Impact Areas (In Excess of 1000m Down Range).

(1) In instances where projectiles are fired in a non-fragmenting mode, the measures stipulated in paragraphs 6-7 b, c, and d need not be observed unless otherwise directed by the RPO.

(2) DU recovered from UXO area will be made under procedures established for range clearing operations and will be accomplished as a part of those operations.

g. Operating Areas.

(1) All APG test ranges are restricted (security) to the general public. Security ID badges are required for access and additional clearances may be required for entry into specific range test areas.

(2) DU impact areas are limited to those areas which are remote from the public areas of the post. While all impact areas may be considered suitable for impacting DU projectiles, the number of impact areas will be limited to those which are presently in use or have been used in the past. New operating areas will not be used unless military exigency exists, and then only after consideration of environmental imperatives and approval of the APG RPC.

(3) The line of fire will be established so as to contain DU projectiles within the impact area and to minimize the possibility of impact in riparian or littoral areas or waters adjacent to APG.

(4) Applicable procedural portions of this regulation are to be included in the operating element's SOP. Modification and updating of the SOP will be permitted based on results of new information from studies, but only upon approval of the RPC and the RPO.

CHAPTER 7

SPECIAL AND UNIQUE SOURCE MATERIAL (DEPLETED URANIUM)
ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM

7-1. PURPOSE. This chapter establishes criteria for environmental radiological monitoring (ERM) for test-firing of depleted uranium (DU) kinetic energy penetrators at Aberdeen Proving Ground (APG).

7-2. SCOPE. This plan applies to all activities having requirements to test-fire DU penetrators at APG.

7-3. DEFINITION OF ENVIRONMENTAL RADIOLOGICAL MONITORING (ERM). An assessment of the impact of test-firing DU penetrators on the environment by sampling and analyzing various media (soil sediment, water, vegetation, aquatic organisms and air) and observing appropriate trends and changes to insure that the limits, as stated in 10 CFR 20, and NRC License SUB-834, are not exceeded.

7-4. OBJECTIVES.

a. To develop a plan for environmental radiological monitoring.

(1) To develop action levels.

(2) To analyze Environmental Transport Pathways and Dose Assessment Predictions.

(3) To establish sample sites.

(4) To establish sampling procedures.

(5) To match the sampling effort with the actual threat.

b. This program will attempt to reassure the public and governmental organizations that the enclosure will adequately contain aerosolized DU. If initial judgement of none or limited release is verified, the program will be restructured.

7-5. RESPONSIBILITIES.

a. Commander, APG, will establish an Environmental Radiological Monitoring (ERM) Program to support any DU testing activities. This ERM Program will be coordinated with the APG Radiation Protection Committee.

b. The APG Radiation Protection Officer (RPO) will:

(1) Insure that the sampling procedures stated in the current contract and the local SOP are carefully adhered to by the contractor for the ERM Program.

(2) Be briefed by the contractor at least once a month on the ERM Program and report the results to the APG RPC.

(3) Assure contractor performance by review of data summary report and independent audit actions.

c. The APG Radiation Protection Committee (RPC) will:

(1) Make final decisions concerning the performance or adequacy of ERM and evaluate the ERM reports, observing appropriate trends and changes to insure that the limits as stated in 10 CFR 20, and NRC License SUB 834, are not exceeded.

(2) Be authorized to make changes or deviations in the ERM Program for purposes of program enhancement.

d. The APG Environmental Quality Coordinator will provide, upon request, an escort from the APG Environmental Quality Office to assure that ERM sampling procedures are followed and that the samples for the ERM Program are obtained from the designated locations.

e. The ERM contractor will:

(1) Conduct the Environmental Radiological Monitoring Program according to the requirements of the ERM contract and the procedures as outlined in ERM SOP 385-3. Also, have a

quality assurance program commensurate with the guidance contained in USNRC Regulatory Guide 4.15, and every six months provide one split sample of soil, sediment, water and vegetation to the COR for duplicate analysis.

(2) Provide documentation by means of the Technical Report-Study Service Contract NSA A5029, DD Form 1164, exhibited in the contract to include a Quality Assurance (QA) data summary report as illustrated in section C USNRC Regulatory Guide 4.15., quarterly to the COR (RPO) 30 days after completion at sample analysis.

(3) Be prohibited from releasing to any person or agency, other than the sponsoring activity, any interim, draft, or final report, or information pertaining thereto, until report approval or official review had been obtained from the APG RPO and RPC.

(4) Promptly notify the COR of APG if sample analysis shows significance.

7-6. GENERAL. Detailed procedures (SOP 385-3) are available from the Safety Office.

CHAPTER 8

X-RAY FACILITIES

8-1. PURPOSE. This chapter prescribes protective measures to be taken to reduce unnecessary exposures to x-rays.

8-2. SCOPE. This chapter applies to APG Command elements which use x-rays for industrial radiography.

8-3. PROCEDURES.

a. New x-ray facilities will not be installed without prior approval of the RPO. Requests for approval of proposed x-ray facilities or significant alterations to existing facilities will be submitted to Chief, Safety Office, ATTN: Chairperson, RPC, and will contain the following information:

(1) Location (building number).

(2) Proposed facility drawings, showing wall thickness, construction material, etc.

(3) Tube voltage and current.

(4) Projected workload; i.e., number of exposures per week and exposure duration.

(5) Number and type of people potentially exposed to the x-rays.

(6) Interim operating procedures.

(7) Any further information deemed necessary by the APG RPO.

b. The RPC will review the proposal. If approved, the plans and specifications will be sent to higher headquarters for review and approval if required by DARCOM/AMCR 385-100.

c. Only after command approval (and DARCOM approval if required) may construction or alterations begin.

8-4. PROTECTION.

a. All radiation workers will wear personnel monitoring devices (appendix B).

b. Operating supervisors are responsible for notifying the RPO of the completion of the new facility and for requesting that a health hazard evaluation be made IAW TECOM Supplement 1 to AR 40-5. The new facility will not be operated until completion of the survey.

c. Radiation surveys will be performed by the operator holding the RP. Surveys of permanent industrial facilities should be performed on the initial activation of that facility anytime there is a change or modification of X-ray producing equipment, and semiannually. Radiation surveys of remote nonpermanent field operations will be performed at the beginning of each new field setup.

d. Operations will not be conducted if radiological safety devices are nonfunctioning.

e. Supervisors will insure that personnel do not receive x-radiation in excess of the applicable standards (appendix C). If there is reason to believe that a person has received more than the allowable dose equivalent, the RPO will be notified immediately.

f. An approved RP and SOP covering all phases of the operation will be posted in a conspicuous location. Supervisors will insure that personnel comply with RP and applicable regulations.

8-5. SUMMARY. As it is impossible to establish a single set of criteria for the design and operation of all x-ray facilities, it is necessary for each supervisor involved in x-ray operations to keep the APG RPO informed and up-to-date concerning those facilities and operations.

CHAPTER 9

INITIAL RECEIPT OF RADIOACTIVE MATERIALS

9-1. PURPOSE. This chapter outlines procedures for receiving and opening packages containing radioactive materials.

9-2. SCOPE. This chapter applies to the initial receipt of radioactive materials by APG Command elements. Supplemental procedures for the receipt of DU are contained in APGR 710-3.

9-3. PROCEDURES.

a. Radioactive Material Receipt.

(1) The APG RPO or his designee will maintain supervisory control for monitoring radioactive material packages.

(2) Movement Services Division, Logistics Directorate, APG, will notify the APG RPO of the receipt of radioactive material packages and deliver these materials to the proper consignee.

(3) Responsible investigators designated on RP's will receive packages unopened in their use area. Receipt of ammunition containing radioactive material is exempt from this provision, see APGR 710-3.

(4) Responsible investigators will contact the APG RPO or his designee when packages are to be opened. The RPO or his designee will:

(a) Monitor for removable contamination, following the procedure in paragraph 4b below.

(b) Complete a receipt (radioactive material receipt document).

b. Radioactive Material Package Monitoring.

(1) Upon the receipt of a package of radioactive material, the APG RPO or his designee, will monitor the external surfaces of the package for radioactive contamination caused by leakage of the radioactive contents. The following packages are exempt:

(a) Packages containing no more than the exempt quantity specified in the table in this paragraph.

(b) Packages containing radioactive material as gases or in special form.

(c) Packages containing radioactive material in other than liquid form and not exceeding the Type A quantity limit specified in the table in this paragraph.

(d) Packages containing only radionuclides with half-lives of less than 30 days and a total quantity of no more than 100 millicuries.

TABLE OF EXEMPT AND TYPE A QUANTITIES[1]

Transport Group[2]	Exempt Quantity Limit (in millicuries	Type A Quantity Limit (in curies)
I	0.01	0.001
II	0.1	0.050
III	1	3
IV	1	20
V	1	20
VI	1	1000
VII	25,000	1000
Special Form	1	20

[1]Table from 10 CFR 20.205

[2]The transport group for each radionuclide is specified in appendix C, 10 CFR 71 and paragraph 4f, TM 55-315.

(2) The monitoring of packages will be performed as soon as practical after receipt, but no later than 3 hours after the package is received if during normal duty hours, or within 18 hours if received after normal duty hours.

(a) Packages containing exempt quantities will be monitored with a beta-gamma survey instrument to establish any special handling requirements.

(b) The exterior surface of packages containing material in excess of the exempt or type A quantities will be wiped with an absorbent smear which will then be analyzed and counted for removable activity.

(c) All sealed sources will be wiped with an absorbent smear which will then be analyzed and counted for removable activity.

9-4. ACTION LEVELS.

a. If removable radioactive contamination in excess of 0.005 microcuries (11,100 disintegrations per minute) per 100 square centimeters of package surface is found on the external surfaces of the package, it will be considered contaminated and the ATC RPO will hold materials and packaging for decontamination or disposal in accordance with AR 385-11. If twice the above level of contamination is found, see 10 CFR 20.205(b)(2).

b. If removable radioactive contamination in excess of 0.005 microcuries (11,100 disintegrations per minute) per 100 square centimeters is found on the external surface of a sealed source, the RPO will immediately withdraw the sealed source from use and will have it decontaminated and repaired or disposed of in accordance with AR 385-11.

c. Packages or containers of radioactive materials or devices containing sealed sources, which at one foot from the surface have exposure rates greater than 1 mR/hr, will be placed in the user's radioactive materials storage area. For items exceeding type A quantities, see 10 CFR 20.205(c).

d. Commodity items will be handled IAW TB 43-0116.

e. Luminous devices will be handled IAW TB 700-3.

f. Electron tubes will be handled IAW TB 43-0122.

(2) The monitoring of packages will be performed as soon as practical after receipt, but no later than 3 hours after the package is received if during normal duty hours, or within 18 hours if received after normal duty hours.

(a) Packages containing exempt quantities will be monitored with a beta-gamma survey instrument to establish any special handling requirements.

(b) The exterior surface of packages containing material in excess of the exempt or type A quantities will be wiped with an absorbent smear which will then be analyzed and counted for removable activity.

(c) All sealed sources will be wiped with an absorbent smear which will then be analyzed and counted for removable activity.

9-4. ACTION LEVELS.

a. If removable radioactive contamination in excess of 0.005 microcuries (11,100 disintegrations per minute) per 100 square centimeters of package surface is found on the external surfaces of the package, it will be considered contaminated and the APG RPO will hold materials and packaging for decontamination or disposal in accordance with AR 385-11. If twice the above level of contamination is found, see 10 CFR 20.205(b)(2).

b. If removable radioactive contamination in excess of 0.005 microcuries (11,100 disintegrations per minute) per 100 square centimeters is found on the external surface of a sealed source, the RPO will immediately withdraw the sealed source from use and will have it decontaminated and repaired or disposed of in accordance with AR 385-11.

c. Packages or containers of radioactive materials or devices containing sealed sources, which at one foot from the surface have exposure rates greater than 2 mR/hr will be placed in the user's radioactive materials storage area. For items exceeding type A quantities, see 10 CFR 20.205(c).

d. Commodity items will be handled IAW TB 43-0116.

e. Luminous devices will be handled IAW TB 700-3.

f. Electron tubes will be handled IAW TB 43-0122.

CHAPTER 10

OTHER RADIATION HAZARDS

10-1. PURPOSE. This chapter identifies hazards originating from sources other than radioactive material.

10-2. SCOPE. This chapter provides information for APG Command personnel.

10-3. GENERAL.

a. Many devices produce unwanted radiation, usually x-rays, as an inherent by-product. These devices may include high voltage rectifying tubes and power supplies, klystrons and other RF tubes, television tubes, oscilloscopes, electron microscopes, and other devices utilizing high voltages. In these devices, fast moving electrons from a cathode are decelerated by an anode or target and bremsstrahlung (x-rays) radiation produced. The higher the voltage applied, the more penetrating are the x-rays produced.

b. Other types of radiation, such as visible light, infra-red radiation, and RF radiation, may also be encountered around the above devices and may be hazardous.

10-4. SPECIFIC DEVICES THAT INHERENTLY PRODUCE IONIZING RADIATION.

a. Potential sources of x-rays at APG are klystrons and other RF tubes. These devices could conceivably produce radiation levels up to 6R/hr on unshielded tubes. At some radar and microwave installations it is necessary to shield these tubes specifically to reduce the potential x-radiation hazard.

b. High Voltage Rectifying Tubes. During the useful part of the voltage wave, x-rays are generated at the anode of the tubes; but normally the voltage across the tube is less than 1 kV, and the rays are too soft to penetrate the glass envelope of the tube. If the tube filament current is too low, the voltage drop across the tube is increased and results in the production of more penetrating radiation. During the suppressed part of the wave when the voltage across the valve is high, penetrating rays may be produced due to cold emission of gas in the tube. Therefore, it may be necessary to provide shielding around the valves unless they are oil-immersed or located in infrequently occupied areas.

c. Cathode-Ray Oscilloscopes. Again, the hazard depends upon the voltage and current of the tube, as well as the attenuation afforded by the tube wall. Measurements have shown detectable levels of radiation at the normal position of the observer's eye.

d. Electron Microscopes. Some of the earlier types of instruments had considerable radiation leakage at the primary viewing ports because the windows were made of ordinary glass. Present models use leaded glass ports and generally provide a high degree of radiation safety under normal operation. However, if the current is dropped, the resultant increase in voltage may cause significant levels of leakage radiation.

e. Others. Bremsstrahlung may be a hazard in any operation using high voltages. X-rays are produced when a stream of high-speed electrons strike a target and are suddenly stopped or deflected by atoms within the target material.

CHAPTER 11

LEAK TESTING

11-1. PURPOSE. This chapter outlines procedures for leak testing sealed or plated sources licensed by the NRC or by Department of Army authorizations to Aberdeen Proving Ground.

11-2. SCOPE. This chapter applies to APG Command.

11-3. RESPONSIBILITIES. The APG RPO or his alternate will maintain supervisory control over the leak-testing of sealed or plated sources for the APG Command.

11-4. PROCEDURES.

a. Sealed sources will be leak-tested as required by para 2-7c, AR 385-11.

b. Results of leak tests will be recorded in a leak test log. Radiation safety supervisors will be informed of any positive results.

c. Leaking sources will be removed from use and be subjected to repair or disposal in accordance with AR 385-11.

d. Leak-testing will be accomplished as follows:

(1) The swipe disc will be rubbed over the physical surfaces of the source. If the source is permanently or semipermanently housed in a device, the area of the device most likely to be contaminated in the event of a source leak will be wiped.

(2) Before being placed in counting equipment, the swipe will be checked with an appropriate survey meter to determine if detectable levels of contamination are present. (A meter reading exceeding 0.25 mrem/h beta-gamma or 300 cpm alpha will be considered evidence of a leaking source.)

(3) If a swipe shows activity less than noted in paragraph 11-4d(2), it will be placed in counting equipment for analysis. An analysis revealing contamination of 0.005 microcuries or greater will be considered evidence of a leaking source.

e. Plated sources will be tested as follows:

(1) A swipe will be made of the storage container and of the areas where an alpha source exceeding 0.1 microcurie of activity is used; or

(2) A swipe will be made of the external surfaces of the source mount, other than the radioactive surface of the source, with a swipe disc.

(3) Procedures contained in paragraphs 11-4c, 11-4d(2), and 11-4d(3) will apply.

f. Periodic leak tests shall be performed at intervals not to exceed three months for sealed or plated plutonium sources. The periodic leak test does not apply to sealed sources that are stored and not being used. These sources shall be tested for leakage prior to any use or transfer.

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11-3. RESPONSIBILITIES. The APG RPO or his alternate will maintain supervisory control over the leak-testing of sealed or plated sources for the APG Command.

11-4. PROCEDURES.

a. Sealed sources will be leak-tested as required by para 3-5, AR 385-11.

b. Results of leak tests will be recorded in a leak test log. Radiation safety supervisors will be informed of any positive results.

c. Leaking sources will be removed from use and be subjected to repair or disposal in accordance with AR 385-11.

d. Leak-testing will be accomplished as follows:

(1) The swipe disc will be rubbed over the physical surface of the source. If the source is permanently or semipermanently housed in a device, the area of the device most likely to be contaminated in the event of a source leak will be wiped.

(2) Before being placed in counting equipment, the swipe will be checked with an appropriate survey meter to determine if detectable levels of contamination are present. (A meter reading exceeding 0.25 mrem/h beta-gamma or 300 cpm alpha will be considered evidence of a leaking source.)

(3) If a swipe shows activity less than noted in paragraph 11-4d(2), it will be placed in counting equipment for analysis. An analysis revealing contamination of 0.005 microcuries or greater will be considered evidence of a leaking source.

e. Plated sources will be tested as follows:

(1) A swipe will be made of the storage container and of the areas where an alpha source exceeding 0.1 microcurie of activity is used; or

(2) A swipe will be made of the external surfaces of the source mount, other than the radioactive surface of the source, with a swipe disc.

(3) Procedures contained in paragraphs 11-4c, 11-4d(2), and 11-4d(3) will apply.

f. Periodic leak tests shall be performed at intervals not to exceed three months for sealed or plated plutonium sources. The periodic leak test does not apply to sealed sources that are stored and not being used. These sources shall be tested for leakage prior to any use or transfer.

CHAPTER 12

DISPOSAL OF RADIOACTIVE MATERIAL

12-1. PURPOSE. This chapter prescribes procedures to be followed when:

a. Commodity items containing radioactive material become unserviceable or surplus.

b. Low specific activity (LSA) radioactive waste material generated during testing is to be disposed of.

12-2. SCOPE. This chapter applies to APG Command elements.

12-3. GENERAL. Material is not considered radioactive if the specific activity is less than 0.002 microcurie/gm, or the total activity is less than 0.1 microcurie; or a maximum surface dose rate is less than 0.1 mR/hr. Irradiated material is not considered radioactive if the maximum surface dose rate is less than 0.1 mR/hr gross gamma and spreadable contamination is less than 100 disintegrations per 100 cm^2.

12-4. RESPONSIBILITIES.

a. The radiological permit holder is responsible for initiating turn-in action of the radioactive material.

b. The Logistics Directorate, APG, is responsible for storage pending shipment, final packaging, requesting shipping instructions, and shipment to an authorized disposal site.

c. The APG Radiation Protection Officer is responsible for staff supervision and management to include:

(1) Approval of interim storage sites.

(2) Providing advice on packaging, labeling, and other pertinent NRC regulations.

12-5. PROCEDURES.

a. Commodity Items Under NRC Control.

(1) The Radiological Permit Holder will request turn-in through normal supply channels. A copy of this request will be sent to the RPO. The request shall contain the following information:

(a) Nomenclature.

(b) Physical description to include physical state, quantity, number of items, number of shipping containers, and exterior dimensions and weight of packaged shipping container.

(c) Chemical and radioisotope description to include hazardous chemicals, solvents, and radioisotopes present.

(d) Level(s) of radioactivity of each isotope: microcuries of activity of each isotope; and intensity readings (mR/hr) at the surface and at one meter from the surface of the container or package.

(e) Applicable security considerations.

(2) Generators of LSA radioactive waste will deliver the items to be disposed of to a designated site as directed by the Logistics Directorate.

(3) The Logistics Directorate will request disposition instructions from the NICP and Commander, USAARRCOM, ATTN: DRSAR-MAD-AC. The request will contain the same information prescribed in paragraph 12-5a(1). A copy of the request will be sent to the RPO.

(4) Upon receipt of instructions, disposition will be accomplished within the time frame specified in the instructions.

b. LSA Radioactive Waste.

(1) All radioactive waste will be handled in such a manner as to preclude the spread of contamination and to minimize exposure to workers and to the general public. Transfer of

waste to uncontaminated areas will not be accomplished unless material is in a container adequate to preclude the spread of the radioactive material. It is essential that wooden boxes be caulked, that barrels utilize proper seals, and that secondary containment methods be incorporated. All liquid waste must be solidified prior to disposal. Once containerized, the containers themselves must be stored to preclude deterioration of the container and possible leakage. Long term outdoor storage is not permitted. The storage site must be approved by the RPO.

(2) Radioactive waste materials will not be stored outside of designated radiation areas. A storage area will be posted: CAUTION RADIATION AREA, if the dose rate is in excess of 2 mRem/hour (reference AR 385-30). Storage containers will be labeled as required in 10 CFR 20.203(f) and chapter 6, this regulation for DU.

(3) All reasonable actions must be taken to minimize the volume of radioactive waste generated within APG. This is necessary to reduce container transportation and disposal costs as well as to minimize the amount of radioactive wastes being received at authorized waste-disposal sites in the United States.

(4) Radioactive waste will be shipped at regular intervals with these intervals being based upon volume and operational considerations.

(5) The RP holder will request turn-in as described in paragraph 12-5a(1) whenever test site storage space is exhausted or further outdoor storage is inadvisable based on potential package deterioration.

(6) The Logistics Directorate will pick up the material to be disposed of and store at approved storage site.

(7) When sufficient volume for cost effective shipment is accumulated, the Logistics Directorate will request shipping instructions from Commander, USAARRCOM, ATTN: DRSAR-MAD-AC. The request will contain the same information as prescribed in paragraph 12-5a(1). A copy of the request will be sent to the RPO.

(8) Upon receipt of instructions, disposition will be accomplished within the time frame specified in the instructions.

c. Items not under NRC control requiring disposal will be disposed of IAW AR 385-11.

d. Radioactive Electron Tubes. This will not be allowed to accumulate to any degree and will be disposed of in accordance with TB 43-0122.

CHAPTER 13

ACCIDENTS

13-1. PURPOSE. This chapter prescribes procedures to be followed in the event of radiological accidents to include spills, loss of control, fire and explosions, and overexposures.

13-2. SCOPE. This chapter applies to APG Command and tenant activities on this installation.

13-3. GENERAL. Due to the inherent responsibility of the installation commander for the safety of all personnel working, living or visiting on the installation, all radiological accidents will immediately be reported to the Commander, APG, ATTN: STEAP-SA.

13-4. PROCEDURES.

a. Radiation Spills or Loss of Control.

(1) The following will apply to any radiation spill or loss of control at any facility or area at APG:

(a) Evacuate all personnel to a known area of safety and close all entrances into the hazard area to prevent entry.

(b) Close all portals and turn off ventilation and air exhaust systems if airborne radioactive contamination is known or suspected in the form of dusts, mists, or gases.

(c) Contact the appropriate RPO immediately and, if so directed or when the RPO cannot be contacted, activate the emergency response system by dialing "17" in accordance with criteria established in the appropriate annex of the APG Disaster Control Plan.

(d) Keep all personnel known or suspected of being contaminated with radioactive material confined to one area to prevent further spread of the contamination.

(2) The APG RPO will notify the RPC of any accident involving radioactive materials.

(3) If required, the RPC or designee will investigate the cause of the accident and recommend precautions to be taken to prevent a recurrence of such an accident.

(4) KUSAHC will report the accident to the Surgeon General, Department of the Army, if required (see subpara (5) below).

(5) The Chief, Safety Office, APG, will report the accident to the Commander, APG, and other applicable authorities.

b. Fires or Explosions Involving Radioactive Material. When a fire or explosion occurs involving radioactive materials, or in which materials are suspected of being involved, the procedures outlined in paragraph 13-4a above will be followed. This paragraph is not applicable to fire in enclosures incident to testing of DU projectiles.

c. Overexposure of Personnel to Ionizing Radiation.

(1) The appropriate RPO will be notified immediately of any known or suspected external exposure in excess of the limits of chapter 4 of this regulation. All such reports will be immediately investigated by the RPO to determine whether there was an actual overexposure. The individual involved will be taken to KUSAHC for such examinations and treatment as prescribed by medical personnel.

(2) Internal Exposure.

(a) For the purpose of this regulation, any known ingestion, inhalation, or absorption of radioactive materials will be treated as an emergency poisoning case. In all such cases, the KUSAHC will be notified and will investigate the incident at once. Radiological first aid will be administered as necessary (see para 13-4d below). KUSAHC will be informed of any radiological first aid treatment which has been administered.

(b) In all cases of internal exposure, arrangements for a bioassay will be made at the discretion of a medical officer to determine the body burden of radioactive material received. Upon evaluation of the incident, KUSAHC will inform the RPC of its findings with respect to the exposure.

(3) Clinical Management of Overexposure. KUSAHC will be responsible for the clinical arrangement and disposition of all cases of suspected overexposure to ionizing radiation. The RPC will provide consultation or information at the request of medical personnel.

(4) Recommended Procedure for Personnel Decontamination.

(a) The chief objective of personnel decontamination is to remove the radioactivity from the body as quickly and safely as possible. First, remove all contaminated clothing and monitor the body to locate specifically all contaminated skin area. If the contamination is confined to a small area (e.g., the hands or forearms), decontamination may be performed in the local use area.

(b) Wash contaminated areas thoroughly with soap and cold water. DO NOT USE ORGANIC SOLVENTS OR ABRASIVES. Dry skin completely before monitoring. If contamination remains, repeat process. KUSAHC will be consulted if personnel contamination involves the head area, if wounds are present, or if internal contamination is suspected.

d. Radiological First Aid. The following radiological first aid procedures will be used prior to the arrival of medical personnel for the types of exposures listed below. The measures described in this paragraph in no way alleviate the requirements of notification of KUSAHC.

(1) Ingestion. Individuals accidentally swallowing radioactive material of any type will be considered as poison victims. It is of prime importance to obtain immediate medical attention for the victim. Until direct medical supervision has been obtained, do not induce vomiting.

(2) Inhalation. It is suggested that material in the nostrils be removed by the use of cotton-tipped applicators. Gargling with water (CAUTION: DO NOT SWALLOW) is also recommended. The nasal passages may be irrigated by sniffing of isotonic (0.85%) salt solution to remove particles. Irrigation of the nasal passages will be done under medical supervision. Treatment to remove radioactive material from the remainder of the respiratory tract will be performed only under the direct supervision of a qualified physician. All decontaminating materials will be saved for monitoring and proper disposal.

(3) Cuts and Punctures. Individuals who receive cuts or abrasions from items which are contaminated with radioactive material will wash the wound immediately under a strong jet of water.

(4) Skin Contamination. Decontaminate as directed in para 13-4c(4) above.

13-5. RADIOLOGICAL ACCIDENT REPORTS.

a. APG RPO Accident Reports (see AR 385-40). In all instances of fire, explosion, theft, spill, loss of control, personnel overexposure, or any other accident involving radioactive materials, the APG RPO will be notified as required by this regulation. The RPO will then notify proper authorities as prescribed in AR 385-40 and 10 CFR 20 (20.402, 20.403, and 20.405).

b. Personnel Overexposures. In all cases of overexposure to ionizing radiation, a written report will be hand-carried to the APG RPO (in addition to the immediate notification to the RPO) within 24 hours of the accident. This report will be prepared by the officer or supervisor in charge when the accident occurred and will contain the following:

(1) The name and location of the organization where the overexposure occurred.

(2) The name of each individual who received an overexposure.

(3) The source of the ionizing radiation and, if radioisotopes are involved, the element, chemical and physical forms, and the activity level.

(4) A brief summary of how the overexposure occurred.

(5) Corrective steps which will be taken to prevent a recurrence of the accident.

(6) A signed statement from each individual who received an overexposure, relating his actions prior to, during, and after the overexposure. One copy of this statement will be retained in the files of the RPO. Another copy will be forwarded to the medical record custodian for filing.

13-6. APRD ACTIVITIES. In the event of radiological accident/incident at the APRD, annex D of the APG Disaster Control Plan will apply and take precedence over any provisions of this chapter.

CHAPTER 14

ADMINISTRATIVE CONTROLS, PROCEDURES, AND TRAINING

14-1. PURPOSE. This chapter establishes the administrative controls, procedures, and training requirements applicable to the possession, use, storage, and transfer of ionizing radiation producing materials and equipment on Aberdeen Proving Ground.

14-2. SCOPE. This chapter applies to the APG Command.

14-3. GENERAL. Work with radiation material or devices will require an RP. An RP is written authorization from the RPC permitting an individual to possess, use, store, or transfer ionizing radiation producing materials and equipment in accordance with the terms and conditions of the RP. Personnel frequenting a controlled area are required by Army and NRC regulations to be informed of the existence of radiation hazards and in the applicable radiation protection procedures.

14-4. RESPONSIBILITIES.

a. The APG RPO will coordinate and administer the Radiation Protection Training Program at APG.

b. Supervisors are responsible for scheduling, with the APG RPO, radiation protection training of all personnel under their jurisdiction including:

(1) Initial training.

(2) On-the-job training.

(3) Required updating of information, procedures, and techniques necessary for personnel safety.

14-5. PROCEDURES.

a. Requests to use radioactive material or equipment at APG will be submitted on EAP Form 1114 (Radiological Permit Application) (4 copies) through the applicable division chief to the chairperson, RPC. A copy of the pertinent SOP will be attached.

b. The applicant will submit his training and experience with radioisotopes or other radiation sources on EAP Form 1115 (Radiological Permit Application Supplement) (2 copies). The applicant must have adequate training and experience with the subject or similar radioactive material to enable the applicant to use it safely. In those cases where training and experience are inadequate, as judged by the RPC, the application will be disapproved until adequate training or experience has been obtained or an adequately trained individual is assigned to the project. DD Form 1952 (Application for Film Badge Service and Record of Occupational Exposure) should be submitted concurrently.

c. Upon approval of the Radiological Permit Application by the RPC, the chairperson will issue a Radiological Permit (EAP Form 1113) (4 copies) and a Notice to Employees (NRC Form 3) which will be posted conspicuously at the entrance to the work area.

d. Designated Radioactive Material Inventory Officers (RMIO) will submit four copies of a radioisotope inventory to the RPO annually IAW AR 385-11. The commander will select and appoint an individual, in writing, to perform an annual physical inventory of radioactive material. A RMIO will be nominated by the division/branch chief. The name of the individual will be sent to Commander, APG, ATTN: STEAP-SA. Submission date of the annual inventory will be as of 30 September; EAP Form 1118 (Radioisotope Inventory) will be used. A computer printout containing the information required by AR 385-11 is authorized for those elements having access to a computer.

e. Request and approval for the procurement of radiation producing material will be forwarded to the RPO on Disposition Form (DA Form 2496). The RPO will enter the NRC license or DA authorization number and its expiration date. The RPC will review the request, enter its action, and return the request to the requestor.

f. The radiation safety supervisor (RSS) or test directors (TD) designated on the RP will be responsible for the performance of health physics swipe, instrument and personnel monitoring as delineated in the applicable RP and SOP. They shall record and document surveys on Radiation Survey Report (EAP Form 1117) and submit the report with any swipe or filter

samples to the RPO or designated representative. Results of the survey will be recorded on the Radiation Survey Report. Radiation levels exceeding the limits established in AR 385-11, table 4-3, will be reported to the RSS/TD for recommended corrective action. Completed reports will be retained by the RPO. TECOM Pamphlets 385-1 and 385-2 may be used as survey and monitoring guides.

g. Radioactive material or items which originate from or are used in a radiation controlled area will require a radiation survey and Health Physics Clearance Label (EAP Form 1004) prior to turn-in to Logistics Directorate.

h. Summary of Administrative Control Documents.

(1) Radiological Permit Application (EAP Form 1114).

(2) Radiological Permit Application Supplement (EAP Form 1115).

(3) Radiological Permit (EAP Form 1113).

(4) Pertinent SOP.

(5) Radioisotope Inventory (EAP Form 1118).

(6) Disposition Form, DA Form 2496 (Request and Approval for Radioactive Material Procurement).

(7) Application for Film Badge Service and Record of Occupational Exposure (DD Form 1952).

(8) Radiation Survey Report (EAP Form 1117).

(9) Health Physics Clearance Label (EAP Label 1004).

i. Orientation and Training.

(1) Health physics orientation will be given by the APG RPO, or designated representative, to personnel prior to their working in or frequenting radiation areas at APG. This orientation will cover as a minimum:

(a) The hazards associated with radioactive materials and other sources of ionizing radiation.

(b) The precautions or procedures to minimize radiation exposure and control radioactive contamination.

(c) The applicable Federal regulations and provisions of NRC licenses and DA authorizations applying to use of ionizing radiation producing material or equipment.

(d) The rights of employees to request reports of their exposure to ionizing radiation under the provisions of 10 CFR 19.

(e) The provisions of the APG RPP and applicable emergency procedures.

(2) The APG RPO will submit a record of training to the appropriate personnel division for inclusion in each employee's official personnel folder.

j. On-The-Job Training. Supervisors will conduct on-the-job training of sufficient content and duration to insure that all personnel under their supervision know how to safely perform their work. As a minimum the immediate supervisor will:

(1) Explain the hazards associated with the job the employee is to perform, the corresponding safe practices to be followed, and the standing operating and emergency procedures written for hazardous operations.

(2) Explain the steps required to perform the job and the equipment to be used (including radiation safety equipment).

(3) Where possible, demonstrate how the operations are performed.

(4) Allow employee to practice the steps and constructively criticize the employee's performance.

(5) Periodically spot check employee's safety practices during job performance.

(6) Allow employees to perform unfamiliar operations with material that is not radioactive before attempting the same operation involving materials with ionizing radiation.

(7) Periodically bring employee's training up-to-date on the latest developments concerning relevant information, procedures, changes, and safety techniques.

(8) Submit a record of training to the appropriate personnel division for inclusion in each employee's official personnel folder.

k. Designation of Radiation Safety Supervisors.

(1) APG branch chiefs will designate an RSS on each Radiological Permit Application which will be submitted through the division chief, to the chairperson, RPC. The RSS is the individual in the organization who has overall responsibility for the radiation project and radiation workers. The training and experience of the proposed RSS will be listed on the supplement sheet (EAP Form 1115). An RSS previously approved by the chairperson, RPC, is exempt from these requirements.

(2) The qualifications of the proposed RSS will be reviewed by the chairperson, RPC, to insure that the designated RSS:

(a) Has appropriate knowledge in radiation and/or equivalent experience.

(b) Occupies a supervisory position.

(c) Has completed a health physics orientation within the quarter he is designated as an RSS, or has previously received an orientation as a responsible investigator/test director.

(d) Has passed the radiation type physical examination meeting the requirements of KUSAHC.

(e) Has completed a health physics oral examination given by the RPO or the RPO's authorized representative.

(f) Has at least one month on-the-job training in handling radioisotopes (certified by an approved RSS).

(3) The RPO or designated respresentative will determine the applicant's knowledge in radiation commensurate with the degree of exposure/involvement as follows:

(a) NRC and DA posting and labeling requirements.

(b) Leak test procedures, if applicable.

(c) Applicable written operating procedures.

(d) Emergency procedures.

(e) Applicable sections of this regulation.

(f) Fundamentals of radiation protection.

(g) Operation and use of appropriate survey instrumentation.

(h) Radioisotope procurement, storage, transfer, and disposal procedures.

(i) Personnel monitoring requirements.

(j) Characteristics of radioisotopes to be used.

(k) Other information pertinent to the operation the employee will perform.

(4) Applicants meeting the above requirements will be recommended to the RPC for designation as RSS. Those individuals who fail to meet the requirements must have additional training.

l. Designation of Responsible Investigator/Test Director. APG branch chiefs will designate a responsible investigator/test director on each Radiological Permit Application which will be submitted through the division chief, to the chairperson, RPC. The responsible investigator/test director will perform specific testing tasks under the RP. This individual may also serve as the RSS. The training and experience of the proposed responsible investigator/test director will be listed on the Supplement Sheet. The qualifications of the proposed responsible investigator/test director will be reviewed by the chairperson, RPC, to insure that the designated individual:

(1) Has appropriate knowledge in radiation or equivalent experience.

(2) Has completed a health physics orientation within the quarter he is designated as a responsible investigator/test director, or received an orientation as a radiation worker.

(3) Has passed the radiation-type physical examination meeting the requirements of KUSAHC.

(4) Has at least one month on-the-job training in handling radioisotopes in the form and range of activity levels for which applying and has read and understood pertinent written operating and emergency procedures for the appropriate test program.

(5) Has completed a health physics oral examination given by the RPO or authorized respresentative.

m. Designation of Radiation Workers.

(1) Operating divisions will list proposed radiation workers on the Radiological Permit Application. A radiation worker is any individual authorized by RP to perform work with ionizing radiation producing materials and/or equipment.

(2) Responsible branch chiefs will insure that radiation workers:

(a) Have completed a health physics orientation.

(b) Have passed a radiation-type physical examination meeting the requirements of KUSAHC.

(c) Have satisfactorily completed on-the-job training covering appropriate written operating and emergency procedures (certified by RSS).

CHAPTER 15

APPLICABILITY TO TENANT ORGANIZATIONS

15-1. PURPOSE. This chapter describes the applicability of APGR 385-3 to tenant organizations at Aberdeen Proving Ground.

15-2. GENERAL. Since tenants of APG may have independent radiation protection programs and may themselves be licensees of the NRC, the applicability of this regulation to tenant organizations is limited by the respective intraservice support agreement.

15-3. TENANT RESPONSIBILITIES. Specific tenant responsibilities include the following:

a. The RPO, or alternate, of each tenant radiation protection committee will serve as a nonvoting member of the other committees in order to coordinate the tenant and APG radiation protection programs.

b. Prior to submission for approval, tenant organizations will furnish for review copies of their NRC license and DA authorizations to Commander, APG, ATTN: Installation Health Physicist (STEAP-SA). Applications for all NRC licenses and DA authorizations will be provided to the APG RPC in accordance with paragraph 1-5f(4), chapter 1 of this regulation.

c. Tenant organizations will furnish four copies of their radioisotope inventory report annually to the Installation Health Physicist/RPO when there is any change in inventory.

d. Disposal of radioactive material will be in accordance with AR 385-11. The Commander, APG, will be informed of the quantities of all discharges of radioactive effluents at APG.

e. The Installation Health Physicist/RPO is responsible for radiation protection concerning shipments of radioactive material while such shipments are in the physical custody of the Logistics Directorate, APG. Shipments on and off post will be in accordance with AR 385-11. Tenant organizations will be authorized to monitor incoming and outgoing shipments consistent with the requirements of current regulations and their respective radiation protection programs and in coordination with Movement Services Division, Logistics Directorate, APG. The Installation Health Physicist/RPO shall be advised of inbound shipments IAW Chapter 9 of this regulation.

f. Radioactive commodity items or other items which were used in radiation controlled areas will require a Health Physics Clearance prior to turn-in and acceptance by the appropriate division of the Logistics Directorate, APG.

g. Tenant activities will provide to the APG RPO access to their radiation areas in a timely manner.

h. Deficiencies in tenant RPP's which may impact upon the responsibilities of the Commander, APG, require prompt notification of the APG RPO.

CHAPTER 16

IMPLEMENTATION TITLE 10 CFR PART 21

16-1. PURPOSE. To prescribe procedures for implementation of Title 10, CFR, Part 21.

16-2. SCOPE. This chapter applies to APG Command elements.

16-3. DEFINITIONS. For the purposes of this regulation, the following definitions apply to the APG Command:

a. Defect. A departure from the technical requirements of an item or component which could result in creation of a substantial safety hazard involving NRC licensed material.

b. Responsible Officer. For matters pertaining to Title 10, CFR, Part 21, the Commander, APG, is the responsible officer.

c. Substantial Safety Hazard. Loss of safety function to the extent that there is a major reduction in the degree of protection provided to public health and safety for any facility or activity licensed by NRC.

16-4. GENERAL. Title 10, CFR, Part 21, requires the reporting to the NRC of defects or noncompliance which could result in a substantial safety hazard from NRC licensed material. The Federal regulation provides for a $5,000 per day penalty for failure to report up to a maximum of $25,000 penalty.

16-5. PROCEDURES. In conformance with DARCOM letter, DRCSF-P, 4 December 1979, subject: Implementation of Part 21, Title 10, Code of Federal Regulations, the following procedures are established:

a. Any individual who discovers a defect or becomes aware of a condition of noncompliance involving NRC licensed material will immediately notify his immediate supervisor or, in the supervisor's absence, his next higher supervisor.

b. The supervisor receiving the notification of a defect, deviation, or condition of noncompliance will immediately provide the following information to the APG RPO.

(1) Name, organization, and phone number of the individual who made the initial report.

(2) The nature of the defect, deviation, or condition of noncompliance.

(3) The date and time the defect, deviation, or noncomplaince was identified.

(4) The nature of the operation being conducted at the time the defect, deviation, or noncompliance was identified.

(5) Any action taken to correct the defect, deviation, or assure compliance.

(6) Any suspected or actual exposure of personnel to excess levels of radiation.

c. The APG RPO will request any additional information felt necessary and will provide the responsible officer with all data needed for conduct of an analysis of the potential for a substantial safety hazard and submission of a report in accordance with Title 10, CFR, Part 21. A report will be submitted, by means other than written, within two days of the determination that Title 10, CFR, Part 21 applies, to the Regional Office of Inspection and Enforcement, listed in Appendix, Title 10, CFR, Part 20. A follow-up written report shall be submitted within five days to the regional office; information copies shall be forwarded to HQDA, DAPE-HRS and HQ, DARCOM, DRCSF-P.

d. The responsible officer will conduct an analysis of the facts provided and, based upon his conclusions, will report to the NRC those incidents found covered by Title 10, CFR, Part 21, in the format prescribed and within the time limits defined in Title 10, CFR, Part 21.

e. Each individual or entity subject to Title 10, CFR, Part 21, shall assure that each procurement document for a facility, or a basic component as defined in Title 10, CFR, Part 21, issued by him, her, or it, when applicable, that the provisions of Title 10, CFR, Part 21, apply. See Title 10, CFR, Part 21-31.

f. Excerpt of Section 206, Energy Reorganization Act of 1974 and the foregoing procedure will be posted with the applicable RP. Title 10, CFR, Part 21, may be examined at the Safety Office.

TENANT ORGANIZATION RADIATION PROTECTION PROGRAM

AEHA, BRL, and CSL Radiation Protection Programs are maintained on file in the Safety Office, APG.

ABBREVIATIONS AND DEFINITIONS

SECTION 1

Abbreviations used in the regulation.

1. AEHA - Army Environmental Hygiene Agency.
2. ALARA - As Low As Reasonably Achievable.
3. APG - Aberdeen Proving Ground.
4. APRD - Army Pulse Radiation Division.
5. CFR - Code of Federal Regulations.
6. COR - Contracting Officer's Representative.
7. cm - Centimeter.
8. Ci - Curie.
9. DNA - Defense Nuclear Agency.
10. DOE - Department of Energy.
11. DOT - Department of Transportation.
12. EPA - Environmental Protection Agency.
13. ERM - Environmental Radiological Monitoring.
14. eV - electron Volt.
15. esu - electrostatic unit.
16. FAA - Federal Aviation Agency.
17. GM - Geiger Mueller.
18. gms - grams.
19. ICC - Interstate Commerce Commission.
20. k - kilo (1000).
21. kV - Kilvolt.
22. m - milli (1/1000).
23. M - Mega (1,000,000).
24. KUSAHC - Kirk United States Army Health Clinic.
25. NBS - National Bureau of Standards.
26. NFPA - National Fire Protection Association.
27. NRC - Nuclear Regulatory Commission.
28. rem - roentgen equivalent man.
29. RP - Radiological Permit.
30. RPC - Radiation Protection Committee.
31. RPG - Radiation Protection Guide.

32. RPO - Radiation Protection Officer.

33. RPP - Radiation Protection Program.

34. RSS - Radiation Safety Supervisor.

35. RI/TD - Responsible Investigator/Test Director.

36. SOP - Standing Operating Procedure.

37. USPHS - United States Public Health Service.

38. u - micro (1/1,000,000).

SECTION 2

Definitions.

1. As Low As Reasonably Achievable. Maintaining radiation exposures and releases of radioactive materials in effluents to unrestricted areas as low as is reasonably achievable taking into account the state of technology, and the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to the utilization of atomic energy in the public interest.

2. Bremsstrahlung. Secondary photon radiation produced by the deceleration of charged particles. Braking radiation.

3. By-Product Material. Any radioactive material (except special nuclear material) yielded in or made radioactive by exposures to the radiation incident to the process of producing or utilizing special nuclear material.

4. Control Film. Film packets used to compute correlation factors for incidental exposure to radiation or emulsion deterioration which may occur in transit or storage. Control films are stored in an area where only background radiation is present and are not worn by personnel.

5. Controlled (Restricted) Area. Any area where access or occupancy is controlled for the purpose of protection of individuals from exposure to ionizing radiation and radioactive materials. The controlled area for test-firing DU could be from the target site out to a radius of 260 meters as defined in AR 385-30.

6. Curie. The special unit of activity. One curie equals 3.7×10^{10} nuclear transformations per second.

7. Dose. A general term denoting the quantity of radiation or energy absorbed. For special purposes, it must be appropriately qualified. If unqualified, it refers to absorbed dose. (Absorbed Dose: The energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest. The unit of absorbed dose is the rad. One rad equals 0.01 Joule/kilogram).

8. Dose Equivalent. The product of absorbed dose, quality factor, and other necessary modifying factors necessary to obtain an evaluation of the effects of radiation received by exposed persons so that the different characteristics of the exposure are taken into account.

9. Dose Rate. Absorbed dose delivered per unit time.

10. Dosimeter. Instrument to detect and measure accumulated radiation exposure.

11. Dosimetry. Determination of radiation dose.

12. Electron Volt. The unit of energy equivalent to the energy gained by an electron in passing through a potential difference of one volt (Abbreviated: eV, 1 eV = 1.6×10^{-12} erg).

13. Film Badge. A film packet in a holder which normally includes a means of attaching the badge to the wearer's clothing and is used as a personnel dosimetric device.

14. Half Life. ($T_{\frac{1}{2}}$). The time required for half the atoms of a sample of a given radionuclide to decay.

15. High Radiation Area. A radiation area in which a major portion of the body could receive a dose equivalent in excess of 100 millirem in any one hour.

16. Ionizing Radiation. Any radiation, electromagnetic or particulate, capable of producing ion pairs, directly or indirectly, in its passage through matter. This includes, among others, the following:

a. Alpha Particle. A charged particle having the same mass and charge as a helium nucleus; i.e., 2 protons and 2 neutrons, which is emitted from the nucleus of an atom.

b. Beta Particle. A charged particle with the same mass and charge as an electron and which is emitted from the nucleus of an atom.

c. Neutron. A particle having one mass unit and zero charge, released in fission processes and by bombarding certain nuclei with alpha particles, high energy protons, or high energy electromagnetic radiation. Neutrons are unstable and disintegrated by beta emission.

d. Positron. A particle having the mass of an electron and unit positive charge, ejected from the nucleus.

e. Proton. A particle having one mass unit and unit positive charge.

f. X-rays. Penetrating electromagnetic radiation whose wavelengths are shorter than those of visible light. They are usually produced by bombarding a metallic target with fast electrons in a high vacuum. In nuclear reactions, it is customary to refer to photons originating in the nucleus as gamma rays, and those originating in the extranuclear part of the atom as x-rays.

g. Gamma Rays. Short wavelength electromagnetic radiation of nuclear origin (range of energy from 10 KeV to 9 MeV emitted from the nucleus).

17. Licensed Material. Source material, special nuclear material or by-product material, which is received, possessed, transferred, or used under a general or specific license issued by the NRC.

18. Licensee. The holder of a general or specific license issued by the NRC under the provisions of Title 10, Code of Federal Regulations, Part 30, 40, or 70.

19. Personnel Monitoring Equipment. Devices designed to be worn or carried by an individual for the purpose of measuring radiation received by him. Examples of personnel monitoring equipment include film badges, pocket chambers, pocket dosimeters, and film rings.

20. Quality Factor. A multiplier correcting for linear energy transfer dependence of biological effect when absorbed doses are modified to a common scale for all ionizing radiations.

21. Rad. The unit of radiation absorbed dose (0.01 Joule/kilogram, 100 ergs/gram, in any medium).

22. Radiation. An energy transport mechanism.

a. Annihilation Radiation. Photons produced when an electron and a positron unite and cease to exist. The annihilation of a positron-electron pair results in the production of two photons, each of 0.51 MeV energy.

b. Background Radiation. Radiation arising from radioactive material other than that directly under consideration. Background radiation due to cosmic rays and material 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.

c. Characteristic (Discrete) Radiation. Radiation originating from the atom after removal of an electron or excitation of the nucleus. The wavelength of the emitted radiation is specific depending only on the nuclide and particular energy levels involved.

d. External Radiation. Radiation from a source outside the body.

e. Internal Radiation. Radiation from a source within the body as a result of disposition of radionuclides in body tissue.

f. Ionizing Radiation. Any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter.

g. Leakage (Direct) Radiation. All radiation coming from the source housing except the useful beam.

h. Primary Radiation. The useful beam of an x-ray tube.

i. Scattered Radiation. Radiation which during its passage through a substance has been deviated in direction. It may be modified by a decrease in energy.

j. Secondary Radiation. Radiation resulting from absorption of other radiation in matter. It may be either electromagnetic or particulate.

k. Stray Radiation. The sum of leakage and scatter radiation.

23. 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 5 consecutive days a dose equivalent in excess of 100 millirem.

24. Radiation Generating Device. Materials, equipment, or devices which generate or are capable of generating ionizing radiation, including (1) naturally occurring radioactive material, (2) by-product materials, (3) source materials, (4) special nuclear materials, (5) nuclear reactors, (6) radiographic and fluoroscopic equipment, (7) particle generators and accelerators, and (8) radio frequency generators such as klystrons and magnetrons which produce x-rays.

25. Radiation Overexposure. An exposure which exceeds those levels stated in AR 40-14.

26. Radiation Protection Guide (RPG). The radiation dose equivalent, which should not be exceeded without careful consideration of the reason for doing so.

27. Radioactive Material. Any material, solid, liquid, or gas which spontaneously emits ionizing radiation. For the purpose of this regulation, material is not considered radioactive if its specific activity is less than 0.002 μCi/gm, or its total activity is less than 0.1 Ci, or its maximum surface dose rate is less than 0.1 mR/hr; material activated by irradiation is not considered radioactive if maximum surface dose rate is less than 0.1 mR/hr gross gamma and spreadable contamination is less than 100 disintegrations per minute per 100 cm^2.

28. Radiographer. Any person who performs or who personally supervises radiographic operations.

29. Radiographer's Assistant. Any person, who under the personal supervision of a radiographer, uses radiographic exposure devices, sealed sources, or related handling tools for radiography.

30. Radiographic Exposure Device. Any instrument which may be operated for the purpose of making a radiographic exposure.

31. Radiography. The making of shadow images on photographic emulsion by the action of ionizing radiation. The image is the result of the defferential attenuation of the radiation in its passage through the object being radiographed. Includes industrial and medical uses.

32. Rem. The special unit of dose equivalent numerically equal to the absorbed dose in rads multiplied by the quality factor and any other necessary modifying factors.

33. Roentgen (R). The special unit of exposure where 1R = 2.58×10^{-4} coulombs per kilogram of air.

34. Sealed Source. Any radioactive material that is encased in a container designed to prevent leakage or escape of the radioactive material or any of its daughter products.

35. Source Material.

a. Uranium or thorium, or any combination thereof, in any physical or chemical form.

b. Ores which contain by weight one-twentieth of one percent (0.0005) or more of (1) uranium, (2) thorium, or (3) any combination thereof. Source material does not include special nuclear material.

c. Depleted uranium in the U-235 isotope.

36. Special Nuclear Material.

a. Plutonium, uranium 233, uranium enriched with isotope 233, or with isotope 235, and any other material which the NRC determines to be special nuclear material, but does not include source material.

b. Any material artificially enriched with any of the foregoing, but does not include source material.

37. Source Container. A device in which sources are transported or stored.

38. Survey. An evaluation of the radiation hazards incidental to the production, use, or presence of radioactive materials or other sources of radiation under a specific set of conditions. Such an evaluation customarily includes a physical survey of the location of materials and measurements of the dose rate of radiation that may be involved.

39. Wearing Period. The length of time during which a film packet is worn by the individual being monitored.

40. X-Ray Area. Any area where x-radiation hazards exist.

REFERENCES

1. AR 40-5 w/TECOM Supplement.
2. AR 40-13.
3. AR 40-14.
4. AR 40-66.
5. AR 55-38.
6. AR 340-18-6.
7. AR 385-10.
8. AR 385-11.
9. AR 385-30.
10. AR 385-32.
11. AR 385-40 w/DARCOM Supplement.
12. AR 385-80.
13. AR 700-64.
14. DARCOM/AMCR 385-9.
15. DARCOM/AMCR 385-25.
16. DARCOM/AMCR 385-30.
17. DARCOM/AMCR 385-100.
18. TECR 385-9.
19. TECR 385-25.
20. APGR 310-1.
21. APGR 385-1.
22. APGR 385-2.
23. TECOM Pam 385-1.
24. TECOM Pam 385-2.
25. NBS Handbook 48.
26. NBS Handbook 54.
27. NBS Handbook 59.
28. NBS Handbook 63.
29. NBS Handbook 66.
30. NBS Handbook 73.
31. NBS Handbook 80.
32. NBS Handbook 92.
33. NCRP Reports.
34. NFPA 801 (NFC Vol 16).

35. SB 11-206.

36. TB MED 62.

37. TB MED 223.

38. TB MED 232.

39. Title 9, CFR.

40. Title 10, CFR.

41. Title 14, CFR.

42. Title 29, CFR.

43. Title 46, CFR.

44. Title 49, CFR.

45. APGR 710-3.

46. APG Disaster Control Plan.

47. TB 43-0116.

48. TB 43-0122.

49. TB 43-0197.

50. TB 700-3.

51. TB 750-249.

52. TM 55-315.

53. FM 3-15.

11 February 1981

APGR 385-3

(STEAP-SA)

FOR THE COMMANDER:

PHILIP W. BRISTOL
MAJ, AGC
Adjutant

OFFICIAL:

William H. Monks
WILLIAM H. MONKS
Admin Officer

DISTRIBUTION:

X - 120 Safety Office, APG
10 Materiel Testing Dir, APG
2 Facilities Engrg Dir, APG
2 Quality Assurance Ofc, APG
4 Logistics Dir, APG
2 Troop Command, APG
1 Ballistic Research Lab
1 USA Tech Escort Unit
1 USA Environmental Hygiene Agcy
1 Chemical Systems Lab
1 USA Ordnance Center & School
1 USA Human Engrg Lab
1 Kirk USA Health Clinic
1 149th Ord Det (EOD)
1 11th MI Bn
11 Surety Div, PT&FMD, APG
1 Mil Spt Div, MTD, APG
5 Mail & Dir Svcs, Adj Ofc, APG
2 Admin Svcs Div, Adj Ofc, APG
2 TECOM, ATTN: DRSTE-PP & DRSTE-SG-A

DEPARTMENT OF THE ARMY
Kirk US Army Health Clinic
US Army Medical Department Activity
Aberdeen Proving Ground, Maryland 21005

Emergency Room
SOP No. 38

28 August 1979

Management of Radiation Casualties in the Emergency Room

1. Purpose: To provide the procedure to be followed in the event a notification is given that a Radiation Alert exists.

2. Notification: Persons to be notified when a radiation casualty is anticapted are as follows:

During Normal Duty Hours	After Normal Duty Hours
Commander, KUSAHC	AOD
Chief, Nursing Service	Nursing Supervisor on Call
	NCOIC, Emergency Room

3. Procedure: In the event a notification is given that a Radiation Alert exists, the following procedures are to be followed:

a. When requested, an ambulance will be dispatched for the patient. Radiation Film Badges, (in Radiation Locker kept in Emergency Room ambulance entrance), will be worn by all personnel going to the area. All film badges will be signed out on the form provided in the radiation locker. All windows in the ambulance are to be kept closed and the ventilation system turned off. Upon approaching the area, the ambulance will stop at building 860, where the necessary protective clothing and equipment will be issued (coveralls, boots, gloves, caps, protective mask, and two additional film badges).

b. An internal map of the Pulse Radiation Facility will be provided, pin-pointing the exact location of the injured person or persons. The first gate will be opened and the ambulance will proceed through. The second gate may or may not be open. If not, the ambulance attendant (with protective mask in place) will open the gate for the ambulance to pass through, than reboard the ambulance. The gate will be left open so as not to interfere with leaving the site.

c. Inasmuch as is practical, the decontamination procedure will have begun by the team at the reator site. Personnel at the site will also provide a large plastic sheet with which to drape the patient and/or the ambulance to prevent excess contamination of both the ambulance and personnel in the vehicle as much as possible.

d. A Health Physicist is to be notified by the agency that experiences the accident, and he will accompany the patient to the hospital and remain present until the patient and all equipment have been decontaminated. He will also make arrangements for the disposal of all contaminated waste.

Encl 1

e. In anticipation, before the arrival of the patient, remove all extra equipment which may not be needed out of the Emergency Room reception area (chairs, litters, crash box, linen hamper, ambulance closet, etc.). In addition, the emergency cart, stools, IV poles, dressing table, all but one kick bucket, etc., are to be removed from the Emergency Room. From outside the Emergency Room ambulance entrance, the galvanized can marked "radioactive waste" is brought in to the Emergency Room. Any equipment which might be needed is removed from the cabinets and then all cabinets are closed securely. Remaining table and the floor are covered with sheets or a large plastic drape. The door leading to the ER desk is sealed off with masking tape from the inside. A long strip of tape is placed on the outside across the door at eye level marked "SEALDED OFF". The air conditioner outlet which surrounds the ceiling light and the outlet vent to the left of the Emergency Room door are also sealed off with a large plastic bag and masking tape.

f. All medical personnel coming in contact with the patient or in the patient area will don protective clothing as well as wear film badges. With the exception of gloves, all protective clothing (gown, face mask, hair cover, shoe cover) are located in the clothing isolation pack. This isolation pack and gloves are maintained in the Radiation Locker.

g. There is to be one medical person to stand outside the ER ambulance entrance for the purpose of obtaining any equipment which might be needed for treatment of the patient.

h. Decontaminate the patient by wiping off all exposed areas with soap and moist sponges. Save all the sponges in a plastic bag. Save the water in a plastic bag in a pail. Remove all the patient's clothing and wash down again. Pay particular attention to ears, fingernails, and areas of the body where hair is present. Do not go from a dirty to a clean area (the area covered by the patient's clothing should be a relatively clean area). Be sure to save all discarded waste in the radioactive waste can.

i. In the event that the patient's medical condition is such that routine decontamination would be hazardous to the patient's life, it may be dispensed with until the immediate medical emergency is met and the patient is considered by the physician to be out of danger.

j. All water, urine, emesis, suction residue, linen, etc., will be saved in covered containers (plastic bags, sealed off) for testing and disposal by the Health Physicist.

k. The patient will be monitored by the Health Physicist prior to discharge from the Emergency Room.

l. All equipment will be wiped down with A-33 by Emergency Room personnel and monitored by the Health Physicist. After monitoring and clearance by the physicist, the room will be ready for use again.

28 August 1979

m. Following decontamination, the patient may be treated according to medical indications. No further precautions are necessary.

n. Anyone coming in contact with a radiation casualty must wear protective clothing (gown, shoe covers, face mask, gloves, hair cover) and a film badge. Make a note of the badge number of each individual. Badges must be turned into X-Ray for monitoring after patient and equipment are decontaminated.

o. The area is to be sealed off with tape after the patient and all required personnel (kept at a minimum - corpsman, doctor, patient, Health Physicist, and nurse, if necessary) have entered the area. No one is to enter or leave the area until cleared by the Health Physicist.

SANDRA K. McLEOD
MAJ, AMC
Chief Nurse

ADDENDUM TO EMERGENCY ROOM SOP NO. 38, MANAGEMENT OF RADIATION CASUALTIES IN THE EMERGENCY ROOM

1. Emergency Medical Team (EMT) members consist of all members of the Ambulance Section and Emergency Room staff. The EMT physician is always the military POD. The entire staff functions as the EMT in the following manner:

a. Day Shift

CPS
NCOIC, ER
Ambulance Driver #1 (EMT-A)
ER - Enlisted #1
Ambulance Driver #2 (EMT-A)
ER - Enlisted #2

b. Evening Shift

Military POD is called in
3 Ambulance Drivers (EMT-A)
3 Enlisted Medics
1 Nurse
Head Nurse, ER is called in

c. Night Shift

Military POD is called in
Head Nurse, ER is called in
1 Ambulance Driver (EMT-A)
1 Enlisted Medic
1 Nurse

2. All team members go through inservice education on a regular basis.

SANDRA K. MILFORD
MAJ, ANC
Chief Nurse

DEPARTMENT OF THE ARMY
KIRK US ARMY HEALTH CLINIC
US ARMY MEDICAL DEPARTMENT ACTIVITY
FORT GEORGE G. MEADE, MARYLAND 20755

KAHC SOP
No. 40-279

3 November 1978

Management of Casualties Secondary to Ionizing Radiation

1. Purpose: To provide guidance and instructions to be followed in the management of occupational radiological casualties.

2. References: AR 40-13; AR 385-30; AR 755-15; TM 8-215.

3. Applicability: All personnel of KAHC, APG.

4. General: Individuals may be victims of accidents involving exposure to ionizing radiation (leaks, spills, x-ray room overexposures) either singly or in combination with other injuries.

5. Responsibilities:

a. Chief, Emergency Medical Services will insure that:

(1) Personnel will be selected to form an emergency medical team to respond to such accidents (the same team will be used to respond to other types of accidents regardless of cause).

(2) Equipment and supplies will be established and ready to be used if such an accident occurs.

(3) The team so selected is familiar with their duties and the equipment they will use.

(4) Notify the following individuals as soon as he is well informed of the medical aspect of the accident.

(a) KAHC Commander.

(b) Clinic Administrator.

(c) Chief, Preventive Medicine Division.

(d) Chief, Occupational Health Service.

(5) Dispatch the emergency teams in ambulances as necessary to cope with the surviving casualties. A 91B/91C and medical officer (if available) will accompany the vehicle. The vehicle will stop at the roadblock and be issued protective clothing should this be deemed necessary by the senior person in charge at the site of the accident.

17604

b. Person receiving the alert will record the time the alert was received and will obtain and record the following information from the notifier:

(1) Name of the notifier.

(2) Nature of the accident -- injury, leak, spill, etc.

(3) Location of accident -- building number.

(4) Phone at the accident area.

(5) Estimated number of surviving injured.

(6) Estimated nature of injury. (radiation -- how many rem; burns, crush, wounds, fractures, etc.).

(7) Exact place for emergency medical team to report.

(8) Name and rank of OIC at the site of accident.

(9) The time of the accident.

(10) When this information has been recorded, it will be given to the Chief, Emergency Medical Services in person or by telephone (extension 3474/4671) or to the POD during off-duty hours.

c. Supervisor/Charge Nurse, Emergency Room, will:

(1) Ready the health clinic Emergency Room for receipt of patients.

(2) Seal ventilation and exhaust ducts in the Emergency Room.

(3) Assemble linen sheets with which to wrap decontaminated patients.

(4) Provide leak proof plastic bags with which to collect patient's clothing.

(5) Assemble Nursing Service personnel ready to handle the expected patients.

(6) Assemble necessary materials for decontaminating patients.

d. Decontamination Procedures:

(1) Decontamination at the site of injury. If at all possible, decontamination of the radiological casualty will be completed at the scene of injury by the Health Physics facility staff decontaminating team. The medical officer dispatched to the scene of injury can determine the necessity for immediate evacuation to the Emergency Room. No contaminated

patient will be brought to KAHC unless his/her injuries are such that delay of evacuation for the purpose of decontamination would be life-threatening. No contaminated patient will be brought into the KAHC without the verbal consent of the Clinic Commander, or the OIC in the Commander's absence.

(2) Hospital Decontamination:

(a) If the contaminated patient must be moved to the Clinic immediately, he/she should be placed on paper or linen sheets before transferral to the ambulance.

(b) Upon arrival at the Emergency Room, the installation Health Physicist will be notified at extension 4756/4757 during duty hours and 4500, Staff Duty Officer, APG, after duty hours, weekends and holidays.

(c) Ventilation and exhaust ducts in the Emergency Room will be sealed before the casualty is admitted. When these precautions are taken, the casualty should be moved directly from the ambulance to the Emergency Room. Paper or linen sheets should be used to isolate the patient and any contaminated articles from the medical staff and equipment.

(d) Emergency Room personnel will don protective gowns, masks, caps, shoe covers, rubber gloves, and film badges stored in the Emergency Room.

(e) The patient's clothing and personal articles will be removed and secured in leak proof plastic containers or bags.

(f) A preliminary radiological survey will be conducted by the Health Physicist to determine the extent and degree of contamination of the patient.

(g) After the necessary examinations and life-saving procedures are completed, decontamination should begin:

1. Start on the area showing the greatest contamination. Avoid spread of contamination to the eyes, ears, nose, mouth or clean areas of the body.

2. Use individual buckets of water, liquid soap, and scrub brushes. The scrub is similar to the surgical preparation. Do not scrub the skin to the point it becomes thin or reddened. The patient should be monitored by the Health Physicist after each complete scrub. If scrubbing does not remove the contamination after several applications, special purpose reagents should be secured from the Radiological Decontamination Kit stored in the Emergency Room. All waste water, soap, and excrement must be saved in sealed plastic bags for survey and disposal in accordance with AR 755-15 and AR 385-30.

3. Special Body Areas:

a. Hair: Wash thoroughly with surgical soap and water. Eyes, ears, nose and mouth should be protected. If contamination remains after 3 washings, cut the hair and proceed as in (g)2 above.

b. Eyes, mouth or open wounds: Flush the area copiously with sterile distilled water or saline until the contamination is removed.

c. Nose: Clean the nasal membranes with wet cotton swabs. The nose should be blown frequently. Deeper contamination can be removed by nasal irrigation, preferably performed by an otolaryngologist.

d. Finger nails: Nails should be clipped and scrubbed as outlined in (g)2 above.

e. Ingestion: Emesis or gastric lavage should be performed according to the conscious state of the patient.

(h) When the Health Physicist declares the patient decontaminated, he/she may be treated in the clinic or transported to a hospital without further radiological precautions.

(i) The following studies should be obtained as a baseline:

1. CBC.

2. Twenty-four hour urine collection for radiation count. This can be submitted to the Occupational Health Service for shipment to the US Army Environmental Hygiene Agency, APG-EA.

(j) All medical personnel involved with the treatment of the radiological casualty and permanent equipment in the Emergency Room will be monitored by the health physicist. The health physicist must certify that the emergency facility is free of contamination prior to its being opened for regular use. Medical Maintenance and Preventive Medicine will provide assistance as required.

(k) The attending physician will make appropriate entries of the estimated level of contamination in the patient's permanent health record. Any required entry in the patient's DD Form 1141 will be done by the monitoring health physicist.

(l) The NCOIC of the Emergency Room will be responsible to insure that all film badges are issued to, and collected from, all clinic personnel who come in contact with the patient or other contaminated areas or equipment.

(m) Upon receipt of the Photodosimetry Report (EA Form 3484), appropriate entries will be made in the individual's DD Form 1141.

(n) If further information or assistance in managing the radiological casualty is required from a higher command, the attending physician or Commander, KUSAHC, can contact the Radiological Emergency Medical Team, Walter Reed Army Medical Center, Washington, DC, AUTOVON 291-5104/5107.

FOR THE COMMANDER:

THOMAS E. O'DELL
MAJ, MSC
Clinic Administrator

DISTRIBUTION:

CEHC
USA Health Clinic - EA
Nursing Service
Emergency Medical Services
ER
PWRTMED
Clinical Spt Br

SAFETY OFFICE
US ARMY ABERDEEN PROVING GROUND
Aberdeen Proving Ground, Maryland 21005

STANDING OPERATING PROCEDURE
NO. 385-6 *

29 March 1984

Procedures for Receiving and Opening Packages Containing Radioactive Materials

1. PURPOSE. To outline procedures for receiving and opening packages containing radioactive materials.

2. REFERENCES.

a. APGR 385-3.

b. Title 10, Code of Federal Regulations, Part 20 and 71.

c. Title 49, Code of Federal Regulations, Parts 170-189.

d. AR 385-40.

e. AR 385-11.

f. TM 55-315.

3. RADIOACTIVE MATERIAL RECEIPT.

a. The Radiation Protection Officer (RPO) or his designee will maintain supervisory control for monitoring radioactive material packages. Supply Receiving will notify the RPO of receipt of radioactive material packages.

b. Responsible Investigators designated on Radiological Permits will receive packages unopened in their use area.

c. Responsible Investigators will contact the RPO or his designee when packages are to be opened. The RPO or his designee will:

*Supersedes SOP No. 386-6 dtd 23 February 1977.

(1) Monitor for removable contamination following the procedures in paragraph 4.

(2) Fill out DA Form 2971-R, Radioactive Materials Movement.

4. RADIOACTIVE MATERIAL PACKAGE MONITORING.

a. Upon the receive of a package of radioactive material, the RPO or his designee shall monitor the external surfaces of the package for radioactive contamination caused by leakage of the radioactive contents. The following packages are exempt:

(1) Packages containing no more than the exempt quantity specified in the table in this paragraph;

(2) Packages containing radioactive material as gases or in special form;

(3) Packages containing radioactive material in other than liquid form and not exceeding the Type A quantity limit specified in the table in this paragraph; and

(4) Packages containing only radionuclides with half-lives of less than 30 days and a total quantity of no more than 100 millicuries.

Table of Exempt and Type A Quantities[1]

Transport Group[2]	Exempt Quantity Limit (in millicuries)	Type A Quantity Limit (in Curies)
I	0.01	0.001
II	0.1	0.050
III	1	3
IV	1	20
V	1	20
VI	1	1000
VII	25,000	1000
Special Form	1	20

[1] Table from 10 CFR 20.205 (ref b)

[2] The transport group for each radionuclide is specified in Appendix C, 10 CFR 71, and paragraph 4f, TM 55-315 (ref b and f).

b. The monitoring of packages shall be performed as soon as practical after receipt, but no later than three hours after the package is received, if during normal duty hours, or eighteen hours if received after normal working hours.

(1) Packages containing exempt quantities will be monitored with a beta-gamma survey instrument to establish any special handling requirements.

(2) The exterior surface of packages containing material in excess of the exempt or Type A quantities will be wiped with an absorbent smear, which will be analyzed and counted for removable activity.

(3) All sealed sources will be wiped with an absorbent smear which will be analyzed and counted for removable activity.

5. ACTION LEVELS.

a. If removable radioactive contamination in excess of 0.005 microcuries (11,100 disintegrations per minute) per 100 square centimeters of package surface is found on the external surfaces of the package, it will be considered contaminated and the RPO will hold materials and packaging for decontamination or disposal in accordance with AR 385-11 (ref e). If 2 times above value, see 10 CFR 20.205 (b)(2).

b. If removable radioactive contamination in excess of 0.005 microcuries (11,100 disintegrations per minute) per 100 square centimeters is found on the external surfaces of a sealed source, the RPO shall immediately withdraw the sealed source from use and shall cause it to be decontaminated and repaired or disposed of in accordance with AR 385-11.

c. Packages or containers of radioactive materials or devices containing sealed sources, which at one foot from the surface have expcsure rates greater than 2 mR/hr, will be placed in user's Radioactive Materials Storage Area. For items exceeding Type "A" quantities, see 10 CFR 20.205(c)(1)(2).

BENJAMIN F. CASOLE, III
Health Physicist

SAFETY OFFICE
US ARMY ABERDEEN PROVING GROUND
Aberdeen Proving Ground, MD 21005

STANDING OPERATING PROCEDURE 29 March 1984
NC. 385-8 *

Leak Test Procedure

1. Purpose: Outline procedures for leak testing sealed or plated sources.

2. References:

a. APGR 385-3.

b. NRC Licenses.

c. Department of Army Authorizations.

3. Responsibilities: The Health Physicist or his designated alternate will maintain supervisory control of leak testing of sealed sources licensed by the Nuclear Regulatory Commission or by Department of Army Authorizations to Aberdeen Proving Ground.

4. Procedures:

a. Sealed sources will be leak tested as required by Chapter 11 of reference a.

b. Results of leak tests will be recorded in the Leak Test Log. Radiation protection supervisors will be informed of any positive results.

c. Leak testing will be accomplished as follows:

(1) The swipe disc will be rubbed over the physical surface of the source. If the source is permanently or semi-permanently housed in a device, the area of the device most likely to be contaminated in the event of a source leak will be wiped.

(2) Before being placed in counting equipment, the swipe will be checked with an appropriate survey meter to determine if detectable levels of contamination are present. (Meter reading exceeding 0.25 mrem/h beta gamma or 300 cpm alpha will be considered evidence of a leaking source.)

(3) If a swipe shows activity less than noted in paragraph 9-4, it shall be placed in counting equipment for analysis.

*Supersedes SOP No. 385-8 dtd 11 Mar 76

(4) If analysis reveals contamination of 0.005 microcuries or greater, the sources shall be withdrawn from use and action taken as directed by the Health Physicist. Leaking sources will be removed from use and be subjected to repair or disposal in accordance with AR 385-3.

d. Plated sources will be tested as follows:

(1) By swiping of the storage container and area where the alpha source exceeding 0.1 microcuries of activity is used; or

(2) By swiping the external surfaces of the source mount, other than the radioactive surface of the source, with a swipe disc.

(3) Procedures contained in paragraph c(2), (3), and (4) will be observed.

e. Periodic leak tests shall be performed at intervals not to exceed three months for sealed plutonium sources and not to exceed three months for plated plutonium sources. The periodic leak test does not apply to sealed sources that are stored and not being used. These sources shall be tested for leakage prior to any use of transfer.

BENJAMIN F. CASOLE, III
Health Physicist

RADIATION PROTECTION FORMS USED AT APG

FORM NUMBER	FORM TITLE
NRC-3	Notice to Employees
DD 1141	Record of Occupational Exposure to Ionizing Radiation
EAP-1113	Radiological Permit
EAP-1114	Radiological Permit Application
EAP-1115	Radiological Permit Application Supplement
EAP-1117	Radiation Survey Report
EAP-1118	Radioisotope Inventory
DA 1952	Film Badge Application & Record of Exposure
EAP Label 1004	Health Physics Clearance
DA 2791	Radioactive Materials Movement Shipment/Receipt
DA 3161	Request for Issue or Turn In
DD 836	Special Instructions for Drivers

NOTICE TO EMPLOYEES

The U.S. Nuclear Regulatory Commission (NRC) regulations and legislation (Part 20) has established standards for your protection against radiation hazards from radioactive material under license issued by the NRC. Part 19 has established certain provisions for the options of workers engaged in NRC licensed activities. Parts 30, 40, 50, and other parts containing provisions related to employee protection.

POSTING REQUIREMENTS Copies of this notice must be posted in a sufficient number of places in every establishment where activities licensed by the NRC are conducted, to permit employees to observe a copy on the way to or from their place of employment.

YOUR EMPLOYER'S RESPONSIBILITY

Your employer is required to—

1. Apply these NRC regulations and the conditions of his NRC license to all work under the license.
2. Post or otherwise make available to you a copy of the NRC regulations, licenses, and operating procedures which apply to work you are engaged in, and explain their provisions to you.
3. Post Notices of Violation involving radiological working conditions, proposed imposition of civil penalties and orders.
4. Refrain from discriminatory acts against employees who provide information to NRC.

YOUR RESPONSIBILITY AS A WORKER

You should familiarize yourself with those provisions of the NRC regulations, and the operating procedures which apply to the work you are engaged in. You should observe their provisions for your own protection and protection of your co-workers.

WHAT IS COVERED BY THESE NRC REGULATIONS

1. Limits on exposure to radiation and radioactive material in restricted and unrestricted areas.
2. Measures to be taken after accidental exposure.
3. Personnel monitoring, surveys and equipment.
4. Caution signs, labels, and safety interlock equipment.
5. Exposure records and reports.
6. Options for workers regarding NRC inspections.
7. Identifies "protected activities" that employees may engage in.
8. Prohibits discrimination against employees who engage in these protected activities.
9. Identifies the Department of Labor as a source of relief in the event of discrimination; and
10. Related matters.

REPORTS ON YOUR RADIATION EXPOSURE HISTORY

1. The NRC regulations require that your employer give you a written report if you receive an exposure in excess of any applicable limit as set forth in the regulations or in the license. The basic limits for exposure to employees are set forth in Section 20.101, 20.103, and 20.104 of the Part 20 regulations. These Sections specify limits on exposure to radiation and exposure to concentrations of radioactive material in air.
2. If you work where personnel monitoring is required pursuant to Section 20.202:
   (a) your employer must give you a written report of your radiation exposures upon the termination of your employment, if you request it, and
   (b) your employer must advise you annually of your exposure to radiation, if you request it.

INSPECTIONS

All activities under the license are subject to inspection by representatives of the NRC. In addition, any worker or representative of workers who believes that there is a violation of the Atomic Energy Act of 1954, the regulations issued thereunder, or the terms of the employer's license with regard to radiological working conditions in which the worker is engaged, may request an inspection by sending a notice of the alleged violation to the appropriate United States Nuclear Regulatory Commission Regional Office (shown on map below). The request must set forth the specific grounds for the notice, and must be signed by the worker or the representative of the workers. During inspections, NRC inspectors may confer privately with workers, and any worker may bring to the attention of the inspectors any past or present condition which he believes contributed to or caused any violation as described above.

EMPLOYEE PROTECTION

If an employee believes that discrimination has occurred due to engaging in the "protected activities" said employees may, within 30 days of the discriminatory act, file a complaint with the Department of Labor, Employment Standards Administration, Wage and Hour Division. The Department of Labor shall conduct an investigation and shall, where discrimination has occurred, issue an order providing relief to the employee if relief is not provided by other means of settlement.

PROTECTION OF INSPECTORS

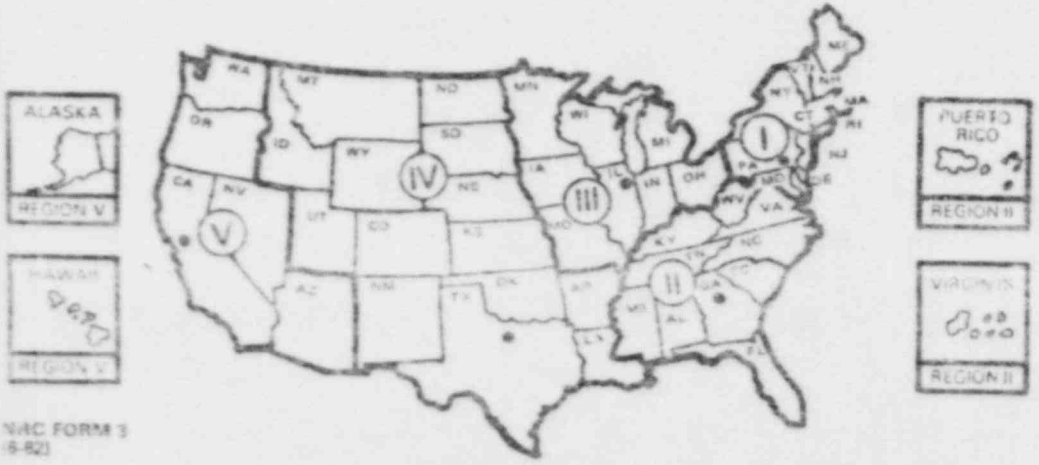
The amended Atomic Energy Act, section 235, provides criminal penalties against any individual who kills, forcibly assaults, resists, opposes, impedes, intimidates or interferes with any person who performs any inspections which (1) are related to any activity or facility licensed by the Commission, and (2) are carried out to satisfy requirements under the Atomic Energy Act or under any other Federal law covering the safety of licensed facilities or the safety of radioactive materials. The acts described above are criminal not only if taken against inspection personnel who are engaged in the performance of such inspection duties, but also if taken against inspection personnel on account of such duties.

SABOTAGE OF NUCLEAR FACILITIES OR FUEL

The amended Atomic Energy Act, section 236, provides criminal penalties against any individual who intentionally and willfully destroys or causes physical damage, or attempts to do so, to any production, utilization, or waste storage facility licensed under the act, or any nuclear fuel or spent fuel regardless of location.

UNITED STATES NUCLEAR REGULATORY COMMISSION REGIONAL OFFICE LOCATIONS

A representative of the Nuclear Regulatory Commission can be contacted at the following addresses and telephone numbers. The Regional Office will accept collect telephone calls from employees who wish to register complaints or concerns about radiological working conditions or other matters regarding compliance with Commission rules and regulations.



Regional Offices

REGION	ADDRESS	TELEPHONE
I	U.S. Nuclear Regulatory Commission Region I 631 Park Avenue King of Prussia, PA 19406	215 337-5000
II	U.S. Nuclear Regulatory Commission Region II 101 Marietta St., N.W., Suite 3100 Atlanta, GA 30303	404 221-4503
III	U.S. Nuclear Regulatory Commission Region III 799 Roosevelt Road Glen Ellyn, IL 60137	312 932-2500
IV	U.S. Nuclear Regulatory Commission Region IV 611 Ryan Plaza Drive, Suite 1000 Arlington, TX 76012	817 465-8100
V	U.S. Nuclear Regulatory Commission Region V 1450 Maria Lane, Suite 210 Walnut Creek, CA 94596	415 943-3700

NRC FORM 3
(8-82)

RECORD OF OCCUPATIONAL EXPOSURE TO IONIZING RADIATION

FOR INSTRUCTIONS, SEE REVERSE OF SHEET.

1. IDENTIFICATION NUMBER	2. NAME (*Last, first, middle initial*)	3. SOCIAL SECURITY NUMBER	4. RANK/RATE TITLE OF POSITION	5. DATE OF BIRTH (*Day, month, year*)

PLACE WHERE EXPOSURE OCCURRED	PERIOD OF EXPOSURE		DOSE THIS PERIOD (rem) 1. Method of monitoring is presumed to be film badge reading unless otherwise specified under item 16, "REMARKS."				ACCUMULATED DOSE (rem)		INITIAL
ACTIVITY	FROM (*Day-Mo-Yr*)	TO (*Day-Mo-Yr*)	SKIN DOSE (*Soft*)	GAMMA AND X-RAY	NEUTRON	TOTAL THIS PERIOD	TOTAL LIFETIME	PERMISSIBLE LIFETIME 5(N-18)	PERSON MAKING ENTRY
6	7	8	9	10	11	12	13	14	15

16. REMARKS (*Continue on additional sheet if necessary*)

TO BE RETAINED PERMANENTLY IN INDIVIDUAL'S MEDICAL RECORD

DD FORM 1 MAY 67 1141 PREVIOUS EDITIONS ARE OBSOLETE.

RADIOLOGICAL PERMIT NO ORIGINAL AMENDMENT RENEWAL	DATE OF ISSUE	DATE OF EXPIRATION

1. THRU: TO:	2. FROM
3. RESPONSIBLE INVESTIGATOR	4. AREA RADIATION PROTECTION OFFICER or RADIATION PROTECTION SUPERVISOR

5. RADIOISOTOPE(S) AND/OR OTHER SOURCES OF IONIZING RADIATION

	ELEMENT AND MASS NUMBER	CHEMICAL FORM	PHYSICAL FORM	POSSESSION LIMIT (CURIES)

6. LOCATION(S)

7. AUTHORIZED USE (S)

8. SPECIAL CONDITIONS

APPROVED	
AUTHENTICATED: TITLE:	CHAIRMAN, RADIATION PROTECTION COMMITTEE

EAP Form 1113, 12 Apr 73 (APG Suppl 1 to AMCR 385-25)

RADIOLOGICAL PERMIT APPLICATION

DATE _____

CHECK ONE
☐ INITIAL PERMIT APPLICATION
☐ APPLICATION FOR AMENDMENT TO PERMIT NO. _____
☐ APPLICATION FOR RENEWAL OF PERMIT NO. _____

(Use supplemental sheets if necessary)

1. TO:	2. ORGANIZATION APPLYING FOR PERMIT:
RADIOLOGICAL PERMIT SUPPLEMENT (EAP Form 1115) MUST BE FILED WITH THE HEALTH PHYSICS OFFICE FOR INDIVIDUALS NAMED IN 3 AND 4 BELOW.	
3. RESPONSIBLE INVESTIGATOR NAME _____ SIGNATURE	4. RADIATION PROTECTION SUPERVISOR NAME _____ SIGNATURE

5. RADIOISOTOPE (S) AND/OR OTHER SOURCES OF IONIZING RADIATION DESIRED

ELEMENT AND MASS NUMBER	CHEMICAL FORM	PHYSICAL FORM	POSSESSION LIMIT DESIRED (CURIES)

6. OPERATIONAL PERSONNEL

7. LOCATIONS WHERE SOURCE (S) OF IONIZING RADIATION WILL BE

	BLDG	ROOM OR AREA
A. USED		
B. STORED		

EAP Form 1114R, 1 JAN 83
(Previous editions will be used until exhausted) (APGR 385-3)

8. DESCRIBE PROCEDURE (S) IN WHICH RADIOISOTOPE (S) AND/OR OTHER SOURCES OF IONIZING RADIATION WILL BE USED.
INCLUDE HEALTH PHYSICS PRECAUTIONS TO BE TAKEN.
ATTACH COPIES OF PERTINENT SOP AND EMERGENCY SOP TO BE POSTED.

9. RADIATION DETECTION INSTRUMENT AVAILABLE,

	TYPE OF INSTRUMENT	NUMBER ON HAND	RADIATION DETECTED	FULL RANGE	USE E.G., MONITORING SURVEYING	CALIBRATION	
						FREQUENCY	SOURCE

10. DESCRIBE LABORATORY FACILITIES AND EQUIPMENT, STORAGE CONTAINERS, SHIELDING, FUME HOODS, AND PROTECTIVE CLOTHING.

11. SIGNATURE OF DIRECTOR OR DIVISION CHIEF.

RADIOLOGICAL PERMIT APPLICATION SUPPLEMENT

NAME: _____

(Last) (First) (Middle)

TENANT ACTIVITIES WILL SUBMIT THRU INTERNAL CHANNELS.

LIST BELOW YOUR TRAINING AND EXPERIENCE WITH RADIOISOTOPES AND OTHER SOURCES OF IONIZING RADIATION (use supplemental sheets if necessary)

1. TRAINING (To be completed by Responsible Investigator, Radiation Protection Supervisor)

WHERE TRAINED	DURATION OF TRAINING	ON THE JOB (Circle answer)	FORMAL COURSE (Circle answer)
a. Principles and practice of radiation protection.		Yes No	Yes No
b. Radioactivity measurement standardization and monitoring techniques and instruments.		Yes No	Yes No
c. Mathematics and calculations basic to the use and measurement of radioactivity.		Yes No	Yes No
d. Biological effects of radiation.		Yes No	Yes No

2. EXPERIENCE

ISOTOPE OR OTHER SOURCE	MAXIMUM AMT OR DESCRIPTION OF SOURCE	LOCATION	DURATION	TYPE OF USE

EAP Form 1115R, 1 Feb 81 (APGR 385-3)
(Previous editions will be used until exhausted.)

RADIATION SURVEY REPORT

No. _____

TO:	FROM:	DATE:

a. Type of Survey: Routine_____ Special_____ Date Performed _____

b. Location _____ Bldg. No. _____ Room_____

c. Instrument(s) used: Make & Model _____ Serial No._____

d. Summary of Results:

(1) Airborne Activity - beta/gamma _____ µCi/cc Alpha _____ µCi/cc

(2) Removable Contamination exceeds established limits -Yes_____ No _____

(3) External radiation levels exceed established limits - Yes_____ No_____

(4) Notification of Contamination - Date _____ Time_____

(5) Survey performed by _____

APPROVED _____
Radiation Protection Officer

CHECK LIST

1. Materials and equipment labeled to indicate hazard: Yes _____ No_____
2. Radioactive materials secured against unauthorized removal: Yes_____ No_____
3. Working surfaces covered to prevent contamination: Yes_____ No_____
4. Materials stored in a manner to prevent spills: Yes _____ No_____
5. Radiation workers wearing proper dosimetry and protective clothing: Yes _____ No _____
6. Properly calibrated and operable radiac survey instruments available and being used: Yes _____ No_____
7. Handling Technique proper: Yes _____ No_____
8. Proper Ventilation: Yes _____ No_____
9. Copies of SOP's and Radiological Permits available: Yes _____ No_____
10. Personnel familiar with contents of above items: Yes _____ No_____
11. Exposure records of radiation workers reviewed: Yes _____ No_____
12. Remarks:

EAP Form 1117R, 1 Feb 81 (Previous editions will be used until exhausted.)

SKETCH OR DESCRIPTION OF AREA SURVEYED

COUNTING DATA

Instrument(s) used: Make _____
Model No. _____
Serial No. _____

ACTIVITY (DPM)

Sample No.	Type of Count	Counting Time	Alpha	Beta Gamma

ACTIVITY (DPM)

Sample No.	Type of Count	Counting Time	Alpha	Bet Gamma

_____
Name of Person Performing Count

RADIOISOTOPE INVENTORY

ABERDEEN PROVING GROUND, MARYLAND

PERSON PERFORMING INVENTORY

Date of Inventory: _____

ORGANIZATION: _____ Signature: _____

Sheet _____ of _____

_____ Name: _____

Authority	Isotope	Original Amount (Date)	Present Amount (Date)	Serial Number	Rad Level Surface or 30cm-mr/hr	S, L, or G	L T	Physical Location	Receipt/ Transfer/ or Disposal	Remarks, FSN, etc.

EAP Form 1118, 1 Jul 82 Edition of 12 Apr 73 is Obsolete (APGR 385-3) (Over for Instructions)

RADIOISOTOPE INVENTORY FORM - INSTRUCTIONS

USE OF FORM:

This form is to be used both for the annual radioisotope inventory (a complete listing of all radioisotopes held) and for all changes in inventory which occur between annual inventories (only affected items need be listed). In each case, four (4) copies will be sent to the Chairman, Radiation Protection Committee.

GENERAL INSTRUCTIONS:

List together alphabetically by chemical symbol all sources held under a given authority (all sources of a set may be listed together without regard to this instruction). Leave one blank space between sources listed under different authority.

SPECIFIC INSTRUCTIONS BY COLUMN HEADING:

1. Authority - Identify specific authority under which source was obtained (identify USNRC licenses by number, e.g., 19-00294-19 and DA Authorization 19-01-02).

2. Isotope - Chemical symbol and mass number.

3. Original amount and date received by organization and present activity.

4. Serial Number - SN of source or equipment.

5. Radiation level in mRem/hr at surface or 30 cm.

6. S, L, or G - Physical state - S for solid, L for liquid, or G for gas.

7. L T - If leak test is required, indicate with an "X."

8. Physical Location - Normal storage location.

9. Receipt, Transfer, or Disposal.

10. Remarks.

Amounts will be given in appropriate units, i.e., uCi, mCi, or Ci for byproduct material and kilograms, grams, or milligrams for special nuclear material and source material. The unit may be indicated under the column heading or with each entry.

Leak test information for commodity items may be obtained for commodity items from the manager. Commodity source in excess of 10 microCuries are controlled by report surveillance leak testing.

Any NRC licensed source is exempt from the leak test at APG command when the source contains 100 microCuries or less of beta and/or gamma emitters or 10 microCuries or less of alpha emitter. Except for alpha sources, periodic leak test is not required for sources that are stored and not being used. These excepted sources shall be leak tested prior to use or transfer.

DOSIMETER APPLICATION AND RECORD OF OCCUPATIONAL RADIATION EXPOSURE

Print legibly or type all information requested. See Privacy Act Statement on reverse.

1. FULL NAME *(Last, First, Middle)*	2. DATE OF BIRTH *(YYMMDD)*	3. SOCIAL SECURITY NO.

4. DUTY SECTION *(Dept., Ward, Unit, etc.)*	5. JOB TITLE	6. DUTY PHONE

7. PAY GRADE		8. HAVE YOU WORN A DOSIMETER ISSUED BY THIS COMMAND IN THE PAST	9. DATE OF RADIATION PHYSICAL *(YYMMDD)*
CIVILIAN	MILITARY	☐ YES ☐ NO	

10. DUTY STATUS	IF TRANSIENT SHOW MAILING ADDRESS *(street address, city, state, zip code)* OF LOCATION OF HEALTH RECORDS
☐ PERMANENT ☐ TRANSIENT 6 WEEKS OR LESS	

EXPOSURE INFORMATION *(ITEMS 11 THROUGH 20 FOR HEALTH PHYSICS USE ONLY)*

11. CLASSIFICATION OF EXPOSURE
☐ EXTERNAL ☐ NEUTRON ☐ INTERNAL

12. BADGES REQUIRED	13. TLD REQUIRED
☐ WRIST ☐ WHOLE-BODY ☐ NEUTRON	☐ WRIST ☐ WHOLE-BODY ☐ FINGER

14. BIOASSAYS REQUIRED

WHOLE-BODY COUNT	THYROID UPTAKE	URINALYSIS	FREQUENCY
☐ YES ☐ NO	☐ YES ☐ NO	☐ a ☐ β ☐ β-γ	☐ QUARTERLY ☐ MONTHLY ☐ ANNUALLY

GIVE DATES FOR ITEMS 15 THROUGH 20 (YYMMDD)

15. DOSIMETER(S) ISSUED	16. DD FORM(S) 1141 INITIATED	17. DOSIMETER(S) DISCONTINUED

18. LAST DOSIMETER(S) RETURNED	19. LOCATOR CARD TO HEALTH RECORD	20. DD FORM(S) 1141 TO MEDICAL RECORDS

OCCUPATIONAL EXPOSURE HISTORY

NOTE: This section only applies to the individual who has worked with radiation-producing devices or radioisotopes in a permanent status. List only those employers for whom you worked with radiation.

NAME OF EMPLOYER	ADDRESS *(street address, city, state, zip code)*	FROM		TO		*Do not write in this space*
		YR	MO	YR	MO	
	TOTAL EXPOSURE DATA					

REMARKS

PRIVACY ACT STATEMENT
DATA REQUIRED BY THE PRIVACY ACT OF 1974
(5 USC 552a)

1. TITLE OF FORM: Dosimeter Application and Record of Occupational Radiation Exposure.

2. PRESCRIBING DIRECTIVE: AR 40-14 and DLAR 4145.24.

3. AUTHORITY: 5 USC 301-Departmental Regulation; 10 USC 1071, Medical and Dental Care, Purposes; 42 USC 2073, 2093, 2095, 2111, 2133, 2134, 2201(b), and 2201(o). The authority for soliciting the social security number is 10 CFR 20; 44 USC 3101-Record Management by Agency Heads, General Duties.

4. PRINCIPAL PURPOSE(S): To establish qualification of personnel monitoring and document previous exposure history. The information is used in the evaluation of risk of exposure to ionizing radiation or radioactive materials. The data permits meaningful comparison of both current (short-term) and long-term exposure to ionizing radiation or radioactive material. Data on your exposure to ionizing radiation or radioactive materials is available to you upon request.

5. ROUTINE USES: The information may be used to provide data to other Federal agencies, academic institutions, and non-governmental agencies, such as the National Council on Radiation Protection and Measurement and the National Research Council, involved in monitoring/evaluating exposures of individuals to ionizing radiation or radioactive materials who are employed as radiation workers on a permanent or temporary basis and exposure received by monitored visitors. The information may also be disclosed to appropriate authorities in the event the information indicates a violation or potential violation of law and in the course of an administrative or judicial proceeding.

6. MANDATORY OR VOLUNTARY DISCLOSURE AND EFFECT ON INDIVIDUAL NOT PROVIDING INFORMATION: It is voluntary that you furnish the requested information, including social security number; however, the installation or activity must maintain a completed DD Form 1141 on each individual occupationally exposed to ionizing radiation or radioactive material as required by 10 CFR 20, 29 CFR 1910.96 and AR 40-14/DLAR 4145.24. If information is not furnished, individual may not become a radiation worker. The social security number is used to assure that the Army/Agency has accurate identifier not subject to the coincidence of similar names or birthdates among the large number of persons on whom exposure data is maintained.

STATEMENT

Under the provisions of 10 CFR 19.13, 29 CFR 1910.96 and the Privacy Act of 1974, I hereby authorize the release of, and request that all of my radiation exposure records be furnished appropriate authorities in accordance with the "Routine Uses" portion of the above Privacy Act Statement. As a radiation worker, I have been provided instructions in radiation protection as required by 10 CFR 19.12 and 29 CFR 1910.96. As a female radiation worker, I have been informed of the biological affects and the risks from ionizing radiation on the embro-fetus and received a copy of NRC (Nuclear Regulatory Commission) Guide 8.13. I will contact my supervisor or the radiation protection officer if I have any questions. I hereby certify that the exposure history listed on the obverse is correct and complete, to the best of my knowledge and belief. I have read and understand the above Privacy Act Statement.

_____ _____
Date (YYMMDD) Signature of Applicant

HEALTH PHYSICS CLEARANCE

DATE_____

I certify that this item is free of radioactive contamination.

_____

Signature

EAP Label 1004, 1 Nov 75
(APG Suppl 1 to AMCR 385-25)

RADIOACTIVE MATERIALS MOVEMENT

☐ SHIPMENT ☐ RECEIPT

For use of this form, see AR 55-55; the proponent agency is Office of the Deputy Chief of Staff for Logistics.

(See instructions on reverse.)

DETAILS OF SHIPMENT

1. TO: *(Include ZIP Code)*	2. FROM: *(Include ZIP Code)*

3. SHIPMENT NUMBER	4. SECURITY CLASSIFICATION	5. MODE OF SHIPMENT *(i.e., Railway Express)*

6. COMMODITY DESCRIPTION			7. RADIOACTIVITY		
CONTAINERS a	NUMBER OF ITEMS b	NOMENCLATURE c	QUANTITY, ISOTOPE AND FORM d	d. LEVEL AT SURFACE	d. LEVEL AT ONE METER

SHIPMENT

THE ABOVE DESCRIBED ARTICLES ARE PROPERLY CLASSIFIED, PACKAGED, MARKED, AND LABELED. THE ARTICLES ARE IN PROPER CONDITION FOR TRANSPORTATION AND THE SPREADABLE ACTIVITY AND DOSE RATES ARE WITHIN THE SPECIFIED LIMITS, AS PRESCRIBED BY APPLICABLE REGULATIONS OF THE DEPARTMENT OF TRANSPORTATION AND DEPARTMENT OF THE ARMY.

8. REMARKS

9. SPECIAL PRECAUTIONS

10. SIGNATURE OF RADIATION PROTECTION OFFICER *(Shipping Organization)*		DATE
11. SIGNATURE OF TRANSPORTATION OFFICER *(Shipping Organization)*	GRADE AND TITLE	DATE
12. ORGANIZATION		

DA FORM 2791-R, 1 Oct 70 REPLACES DA FORM 2791, 1 JUN 64, WHICH IS OBSOLETE.

REQUEST FOR ISSUE OR TURN—IN

(DA PAM 710-2-1)

	ISSUE / TURN-IN	SHEET NO 1	NO SHEETS	3. REQUEST NO	4. VOUCHER NO
1. SEND TO:	5. DATE MATERIEL REQUIRED	6. DODAAC	7. PRIORITY	8. ACCOUNTING/FUNDING DATA	
2. REQUEST FROM:	9. END ITEM IDENT	9a. NAME/MANUFACTURER	9b. MODEL	9c. SERIAL NO	

* CODE — ISSUE: *I—Initial; R—Replacement* — TURN—IN: *FWT—Fair Wear And Tear; RS—Report of Survey; EX—Excess; SC—Stmt of Charges*

10. PUBLICATION	11. JOB ORDER NO

12. ITEM NO *a*	STOCK NO *b*	ITEM DESCRIPTION *c*	UNIT OF ISSUE *d*	QUANTITY *e*	CODE* *f*	SUPPLY ACTION *g*	UNIT PRICE *h*	TOTAL COST *i*	*j* POSTED DATE	*j* POSTED BY
								SHEET TOTAL		GRAND TOTAL

13. ISSUE/TURN-IN "QUANTITY" COLM IS REQUESTED	DATE	BY	14. ISSUE QTY IN "SUPPLY ACTION" COLUMN	DATE	BY	15. REC QTY IN "SUPPLY ACTION" COLUMN	DATE	BY

FORM

PREVIOUS DA FORM [illegible] WILL BE USED UNTIL SUPPLY IS EXHAUSTED

SPECIAL INSTRUCTIONS FOR MOTOR VEHICLE DRIVERS

DATE

TO: *(Carrier's Name and Trailer Number)*

FROM: *(Installation Issuing Instructions)*

BILL OF LADING NUMBER

THIS TRUCK IS LOADED WITH *(Commodity description)*

TYPE PLACARDS REQUIRED

IN CASE OF FIRE

1. If any part of the vehicle outside of actual contents catches fire, take vehicle to a clear or uninhabited area, if practicable, and/or attempt to put fire out immediately with hand extinguishers or other available means. If practicable, ask someone to notify the fire department. Call to the attention of fire or police personnel at the scene of the fire the information on this form.
2. Fires may be fought until the flames reach the cargo, at which time firemen and other personnel should be withdrawn to a safe distance, as noted in 5 and 6 below.
3. If in convoy, other trucks proceed to safe distance.
4. Water may be used on this cargo ☐ Yes ☐ No *(See Other Specific Precautions or Instructions below)*

Firemen should not approach closer than _____ feet* from the fire when the fire has reached the cargo. *(See Other Specific Precautions or Instructions below)*

6. Public should not approach closer than _____ feet* from fire.
7. As soon as practical, notify the nearest military installation.

IN CASE OF ACCIDENT

1. Set brake and block vehicle to prevent movement.
2. Post flags by day, and red electric lanterns or reflectors by night, warning traffic approaching from each direction.
3. Call for ambulance, if necessary.
4. Notify nearest police.
5. Notify nearest military installation if cargo is damaged.

ADDITIONAL NOTIFICATION REQUIRED *(By phone or wire as soon as possible)*

IN CASE OF BREAKDOWN

1. Do not attempt to tow loaded vehicle.
2. Post flags by day and red electric lanterns by night, warning traffic from each direction.

GENERAL PRECAUTIONS

1. While operating over public roads, keep at least 300 feet from trucks loaded with explosives or other dangerous articles; a greater minimum distance must be maintained if required by state or municipal regulations.
2. Protect the public from the hazards of the cargo.
3. Do not allow smoking or use of matches or lighters in or near the vehicle.
4. Obey all state and local traffic regulations.
5. Do not exceed posted speed limits.
6. Stop at all railroad crossings.
7. Use designated routes. Whenever possible, avoid congested residential or business areas.
8. Do not permit unauthorized persons to ride on vehicles.
9. At other than carrier rest stops or interchange points, select safe parking space at stopping locations designated by the carrier. Vehicles carrying explosives should not group together at these stopping locations.

OTHER SPECIFIC PRECAUTIONS OR INSTRUCTIONS

These instructions must be transferred to each subsequent driver for turn-in at final destination. If more than 3 drivers are involved, the additional signatures should be made on an extra sheet and attached hereto.

SIGNATURE OF SHIPPER REPRESENTATIVE

SIGNATURE OF FIRST DRIVER

SIGNATURE OF SECOND DRIVER

SIGNATURE OF THIRD DRIVER

* *The distances shown are minimum; greater distances should be used whenever possible.*

DD FORM 1 MAY 71 836 REPLACES EDITION OF 1 JUN 65, WHICH MAY BE USED.

SUPPLEMENT B

SUBJECT: US Army Aberdeen Proving Ground Radiation Protection Committee and Resumes

1. Reference: NRC Form 313, items 7, 16, and 17.

2. Contents:

Annex 1: Radiation Protection Committee Members.

Annex 2: Resumes of Radiation Protection Committee Members.

DEPARTMENT OF THE ARMY
U S ARMY ABERDEEN PROVING GROUND
ABERDEEN PROVING GROUND, MARYLAND 21005

REPLY TO
ATTENTION OF

5 MAY 1983

STEAP-AD

SUBJECT: Appointment of the Radiation Protection Officer and Alternates

SEE DISTRIBUTION

1. Effective this date, the personnel listed at Encl 1 are appointed as Radiation Protection Officer and Alternate.

a. Authority: AR 40-14 and AR 385-11.

b. Purpose: In compliance with Title 10, Code of Federal Regulations, Part 33; DARCOM-R 385-25; AR 40-14; and AR 385-11.

c. Period: Indefinite.

d. Special Instructions: None.

2. Letter, STEAP-AD, dated 13 August 1982, SAB, is rescinded.

FOR THE COMMANDER:

William H. Monks

WILLIAM H. MONKS
Assistant Adjutant

1 Encl
as

DISTRIBUTION:

2 Ea Indiv
5 Civillian Personnel Office
45 Radiation Protection Officer, APG Safety Office

RADIATION PROTECTION OFFICER AND ALTERNATES

CASOLE, Benjamin F. III Health Physicist APG Safety Office
(Radiation Protection Officer)

AASERUDE, Robert A. Health Physicist APG Safety Office
(APRD) (Alternate Radiation Protection Officer)

MISER, Denver C. Health Physicist APG Safety Office
(Alternate Radiation Protection Officer)

Encl 1

RADIATION PROTECTION COMMITTEE

CASOLE, Benjamin F., III Health Physicist APG Safety Office
(Chairman/ Radiation Protection Officer)

MISER, Denver C. Health Physicist APG Safety Office (Member) (APRD)

HERUD, Craig Materials Engineer Mat Test Dir (Member)

FINFERA, James Mechanical Engineer Mat Test Dir (Member)

SEARS, Timothy W. Mechanical Engineer Mat Test Dir (Member)

FRAILER, Ronald L. Physicist Mat Test Dir (Alternate Member)

RUFF, Kenneth I. Mechanical Engineer Tech Mat Test Dir (Member)

ESMOND, William G. Medical Officer Occup Hlth Clinic (Member)

KLUCK, David L. MAJ MSC Prev Med (Member)

AASERUDE, Robert Health Physicist APG Safety Office (APRD)
(1st Vice Chairman/Alternate Radiation Protection Officer, Member)

YOCKEY, Hubert P. Supr Nuclear Engr PhD APRD (Member)

ONDEK, Joseph Environmental Tech DEH (Member)

SCARBOROUGH, Thomas C. Fire Chief DEH (Member)

(Tenant Organization Members - Non-Voting)

MARKLAND, Richard A. Health Physicist USA Ballistic Research Laboratory (Radiation Protection Officer)

EDWARDS, Phillip M. Health Physicist Chemical Research & Development Center (Radiation Protection Officer)

GRAY, Jerry 1LT Med Service Corps USA Environmental Hygiene Agency (Radiation Protection Officer)

FIELD, Grace L. USA Ordnance Center & School (Radiation Protection Officer)

Encl 1

DEPARTMENT OF THE ARMY
U S ARMY ABERDEEN PROVING GROUND
ABERDEEN PROVING GROUND, MARYLAND 21005

REPLY TO ATTENTION OF

STEAP-AD

2 0 MAR 1984

SUBJECT: Duty Appointment (Appointment of the Radiation Protection Committee)

SEE DISTRIBUTION

Reference letter, STEAP-AD, dated 21 Feb 84, is amended as follows:

a. DELETE: Mr. James Finfera, Mechanical Engineer, Mat Test Dir (Member).

b. EFFECTIVE DATE: 28 March 1984.

FOR THE COMMANDER:

Glendell Wilson

GLENDELL WILSON
CPT, AG
Adjutant

DISTRIBUTION:

2 Ea Indiv
1 Cdr, USARHA
5 Civ Pers Ofc
45 Rad Prot Ofcr, APG Safety Ofc

DEPARTMENT OF THE ARMY
U S ARMY ABERDEEN PROVING GROUND
ABERDEEN PROVING GROUND, MARYLAND 21005

REPLY TO
ATTENTION OF

STEAP-AD

21 FEB 1984

SUBJECT: Duty Appointment (Appointment of the Radiation Protection Committee)

SEE DISTRIBUTION

1. Effective this date the personnel listed at Enclosure 1 are appointed as the Radiation Protection Committee.

a. Authority: AR 40-14, AR 358-11, and DARCOM-R 385-25.

b. Purpose: In compliance with Title 10, Code of Federal Regulations, Part 33; DARCOM-R 385-25; AR 40-14; and AR 385-11.

c. Period: Indefinite.

d. Special Instructions: None.

2. Letter, STEAP-AD, 5 May 1983, SAB, is rescinded.

FOT THE COMMANDER:

Glendell Wilson

GLENDELL WILSON
CPT, AG
Adjutant

1 Encl
as

DISTRIBUTION:

2 Ea Indiv
1 Cdr, USAEHA
5 Civ Pers Ofc
45 Rad Prot Ofcr, APG Safety Ofc

RADIOLOGICAL PERMIT APPLICATION SUPPLEMENT

NAME: CASOLE, III (Last) BENJAMIN (First) FRANCIS (Middle)

TENANT ACTIVITIES WILL SUBMIT THRU INTERNAL CHANNELS.

Health Physicist, APG Safety Office
BS, 1974, The Pennsylvania State University

LIST BELOW YOUR TRAINING AND EXPERIENCE WITH RADIOISOTOPES AND OTHER SOURCES OF IONIZING RADIATION (use supplemental sheets if necessary)

1. TRAINING (To be completed by Responsible Investigator, Radiation Protection Supervisor)

	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB (Circle answer)	FORMAL COURSE (Circle answer)
a. Principles and practice of radiation protection.	USAEHA and APG Harvard Sch of Pub Hlth ORAU	8 years 40 hours 30 hours	(Yes) No Yes (No) Yes (No)	Yes (No) (Yes) No (Yes) No
b. Radioactivity measurement standardization and monitoring techniques and instruments.	USAEHA and APG ORAU USAEHA	8 years 80 hours 30 hours	(Yes) No Yes (No) Yes (No)	Yes (No) (Yes) No (Yes) No
c. Mathematics and calculations basic to the use and measurement of radioactivity.	USAEHA and APG ORAU USAEHA	8 years 80 hours 30 hours	(Yes) No Yes (No) Yes (No)	Yes (No) (Yes) No (Yes) No
d. Biological effects of radiation.	USAEHA and APG Harvard Sch of Pub Hlth	8 years 40 hours	(Yes) No Yes (No)	Yes (No) (Yes) No

2. EXPERIENCE

ISOTOPE OR OTHER SOURCE	MAXIMUM AMT OR DESCRIPTION OF SOURCE	LOCATION	DURATION	TYPE OF USE
Radium-226	Microcurie Amt	USAEHA/RICD/RAB	7 years	lab procedures
Radium-228	Microcurie Amt	USAEHA/RICD/RAB	7 years	lab procedures
Actinium-228	Microcurie Amt	USAEHA/RICD/RAB	7 years	lab procedures
Thorium-232	Microcurie Amt	USAEHA/RICD/RAB	7 years	lab procedures
Strontium-90	Microcurie Amt	USAEHA/RICD/RAB	7 years	lab procedures
Nickel-63	Microcurie Amt	USAEHA/RICD/RAB	7 years	lab procedures
Promethium-147	Microcurie Amt	USAEHA/RICD/RAB	7 years	lab procedures
Plutonium-239	Microcurie Amt	USAEHA/RICD/RAB	7 years	lab procedures
Uranium-238	Microcurie Amt	USAEHA/RICD/RAB	7 years	lab procedures
Carbon-14	Microcurie Amt	USAEHA/RICD/RAB	7 years	lab procedures
Cesium -137	Microcurie Amt	USAEHA/RICD/RAB	7 years	lab procedures
Cobalt-60	Microcurie Amt	USAEHA/RICD/RAB	7 years	lab procedures

RADIOLOGICAL PERMIT APPLICATION SUPPLEMENT

NAME: CASOLE, III (Last) BENJAMIN (First) FRANCIS (Middle)

TENANT ACTIVITIES WILL SUBMIT THRU INTERNAL CHANNELS.

LIST BELOW YOUR TRAINING AND EXPERIENCE WITH RADIOISOTOPES AND OTHER SOURCES OF IONIZING RADIATION (use supplemental sheets if necessary)

1. TRAINING (To be completed by Responsible Investigator, Radiation Protection Supervisor)

SEE PAGE 1 WHERE TRAINED	DURATION OF TRAINING	ON THE JOB (Circle answer)	FORMAL COURSE (Circle answer)
a. Principles and practice of radiation protection.		Yes No	Yes No
b. Radioactivity measurement standardization and monitoring techniques and instruments.		Yes No	Yes No
c. Mathematics and calculations basic to the use and measurement of radioactivity.		Yes No	Yes No
d. Biological effects of radiation.		Yes No	Yes No

2. EXPERIENCE (CONTINUED)

ISOTOPE OR OTHER SOURCE	MAXIMUM AMT OR DESCRIPTION OF SOURCE	LOCATION	DURATION	TYPE OF USE
Tritium	curie amts	USAEHA/RICB/RAB	7 years	lab procedures
Tritium	curie amts	USAAPG	1 year	rad surveys
Uranium-238	curie amts	USAAPG	1 year	surveys & operations
X-Ray Producing Equip	4 MeV	USAAPG	1 year	rad surveys
Cesium-137	curie amts	USAAPG	1 year	rad surveys
Plutonium-239	millicurie amts	USAAPG	1 year	rad surveys
Co-60	10,000 Ci	USAAPG	1 year	irradiator leak test
CF-252	19 micrograms	USAAPG	1 year	Neutron Source
U-235	Curie Amts.	USAAPG	1 year	Reactor Fuel
Th-230	Microcurie Amts	USAAPG	1 year	Radiation Surveys
Pm-147	Microcurie Amts	USAAPG	1 year	Radiation Surveys
Kr-85	Microcurie Amts	USAAPG	1 year	Radiation Surveys

Encl 3

RADIOLOGICAL PERMIT APPLICATION SUPPLEMENT

NAME: RUFF (Last) Kenneth (First) I. (Middle)

TENANT ACTIVITIES WILL SUBMIT THRU INTERNAL CHANNELS.

LIST BELOW YOUR TRAINING AND EXPERIENCE WITH RADIOISOTOPES AND OTHER SOURCES OF IONIZING RADIATION (use supplemental sheets if necessary)

1. TRAINING (To be completed by Responsible Investigator, Radiation Protection Supervisor)

	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB (Circle answer)	FORMAL COURSE (Circle answer)
a. Principles and practice of radiation protection.	APG, MD HP Orientation	5 years 20 hours	(Yes) No	(Yes) No
b. Radioactivity measurement standardization and monitoring techniques and instruments.	APG, MD HP Orientation	5 years 20 hours	(Yes) No	(Yes) No
c. Mathematics and calculations basic to the use and measurement of radioactivity.	APG, MD	1 year	(Yes) No	Yes No
d. Biological effects of radiation.	HP Orientation, APG	20 hours	Yes No	(Yes) No

2. EXPERIENCE Test Director - Artillery Ammunition

ISOTOPE OR OTHER SOURCE	MAXIMUM AMT OR DESCRIPTION OF SOURCE	LOCATION	DURATION	TYPE OF USE
DU	Metal Total up to 5,000 kg	Materiel Testing Directorate, APG, MD	5 years	Testing of Military Items

EAP Form 1115R, 1 Feb 81 (APGR 385-3)
(Previous editions will be used until exhausted.)

RADIOLOGICAL PERMIT APPLICATION SUPPLEMENT

NAME: SEARS, (Last) TIMOTHY (First) WILLIAM (Middle)

Nuclear Power School, Bainbridge, MD
Nuclear Power, Phototype, West Milton, NY
Basic Radiological Health, Ft McCilleen (Schedule for 1981)

LIST BELOW YOUR TRAINING AND EXPERIENCE WITH RADIOISOTOPES AND OTHER SOURCES OF IONIZING RADIATION (use supplemental sheets if necessary)

1. TRAINING (To be completed by Responsible Investigator, Radiation Protection Supervisor)

	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB (Circle answer)	FORMAL COURSE (Circle answer)
a. Principles and practice of radiation protection.	West Milton, NY	3 wks	[Yes] No 2 wk	[Yes] No 1 wk
b. Radioactivity measurement standardization and monitoring techniques and instruments.	West Milton, NY	3 wks	[Yes] No 2 wk	[Yes] No 1 wk
c. Mathematics and calculations basic to the use and measurement of radioactivity.	West Milton, NY	3 wks	[Yes] No 2 wk	[Yes] No 1 wk
d. Biological effects of radiation	West Milton, NY	1 wk	Yes No 2 wk	[Yes] No 1 wk

2. EXPERIENCE

ISOTOPE OR OTHER SOURCE	MAXIMUM AMT OR DESCRIPTION OF SOURCE	LOCATION	DURATION	TYPE OF USE
CO-60	Reactor	SSN 603	6 yrs	
		S1C Prototype		

NAVPERS 1221/1, Apr 73

RADIOLOGICAL PERMIT APPLICATION SUPPLEMENT

NAME: HERUD, CRAIG (NMN)
(Last) (First) (Middle)

School Attended: Newark College of Engineering, Newark, NJ

LIST BELOW YOUR TRAINING AND EXPERIENCE WITH RADIOISOTOPES AND OTHER SOURCES OF IONIZING RADIATION (use supplemental sheets if necessary)

1. TRAINING (To be completed by Responsible Investigator, Radiation Protection Supervisor) 21 Oct

	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB (Circle answer)	FORMAL COURSE (Circle answer)
a. Principles and practice of radiation protection.		4 hrs 21 Oct 80	Yes No	[Yes] No
b. Radioactivity measurement standardization and monitoring techniques and instruments.		4 hrs 21 Oct 80	Yes No	[Yes] No
c. Mathematics and calculations basic to the use and measurement of radioactivity.		4 hrs 21 Oct 80	Yes No	[Yes] No
d. Biological effects of radiation.		4 hrs 21 Oct 80	Yes No	[Yes] No

2. EXPERIENCE

ISOTOPE OR OTHER SOURCE	MAXIMUM AMT OR DESCRIPTION OF SOURCE	LOCATION	DURATION	TYPE OF USE
Depleted Uranium		APG, MD	1976 - Pres	Armor Piercing Projectiles
Radium Beryllium	13.3 mCi	APG, MD	1980 - Pres	Moisture/Density Meters
Tritium		APG, MD	1976 - Pres	Self Illuminated Equipment

NAVMAT Form 1115, 24 Apr 73

RADIOLOGICAL PERMIT APPLICATION SUPPLEMENT

NAME: Ondek (Last) Joseph (First) Paul Jr. (Middle)

Environmental Quality Group APG
Attended A.B.C. School, while in USMC
Aerology Course NATTU Lakehurst, NJ

LIST BELOW YOUR TRAINING AND EXPERIENCE WITH RADIOISOTOPES AND OTHER SOURCES OF IONIZING RADIATION (use supplemental sheets if necessary)

I. TRAINING (To be completed by Responsible Investigator, Radiation Protection Supervisor)

	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB (Circle answer)		FORMAL COURSE (Circle answer)	
a. Principles and practice of radiation protection.			Yes	No	Yes	No
b. Radioactivity measurement standardization and monitoring techniques and instruments.			Yes	No	Yes	No
c. Mathematics and calculations basic to the use and measurement of radioactivity.	College up through Calculus		(Yes)	No	(Yes)	No
d. Biological effects of radiation	Environmental Management ALMC Fort Lee, VA	Part of 7-week course	(Yes)	No	(Yes)	No

II. EXPERIENCE

ISOTOPE OR OTHER SOURCE	MAXIMUM AMT OR DESCRIPTION OF SOURCE	LOCATION	DURATION	TYPE OF USE

AP Form 1115, 1 Apr 73 (AFR Suppl 1 to AFCR 385-22)

19 2919 See 1949

RADIOLOGICAL PERSONNEL TRAINING AND EXPERIENCE RESUME'
(AFCR 385-8)

WOOD, WILLIAM O., M.D.
(last, First, Middle)

LICENSE RADIATION PERMIT NUMBER	APPLICANTS PLEASE LEAVE BLANK
EA RADIATION PROTECTION OFFICER	RESPONSIBLE INVESTIGATOR

T BELOW YOUR TRAINING AND EXPERIENCE WITH RADIOISOTOPES AND OTHER SOURCES OF IONIZING DIATION (Use supplemental sheets if necessary)

TRAINING

Principles and practices of radiation protection
Radioactivity measurement standardization and monitoring techniques & instruments
Mathematics and calculations basic to the use and measurement of radioactivity
Biological effects of radiation

E	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
	SEE ATTACHED RESUME			

EXPERIENCE

ISOTOPE OTHER TYPE	MAXIMUM AMOUNT OR DESCRIPTION OF SOURCE	LOCATION	DURATION	TYPE OF USE
	SEE ATTACHED RESUME			

Form 2752-(6), OS Dept 63

DEPARTMENT OF THE ARMY
WALTER REED MEDICAL CENTER
ADDRESS: [illegible] 20012
TELEPHONE: [illegible]

29 September 1972

CURRICULUM VITAE: RADIOLOGICAL SURVEY PROGRAMS

[illegible] of University of Maryland School of Medicine, June 1951. [illegible] clinical instruction in radiation physics and the physiological effects of radiation and the interpretation of x-rays and the use of [illegible].

[illegible] and interpreted x-rays while working as an Intern at Lutheran Hospital of Maryland Inc., Baltimore, Md., July 1951 to June 1952.

[illegible] experience in the use of radio isotopes in clinical practice was gained as a Fellow in Medicine at the University of Maryland School of Medicine Hospital in Baltimore, Md. July 1952 to June 1953.

Further training in radiation health physics and x-ray interpretation was gained during Residency training in Medicine at Mercy Hospital in Baltimore, Md. July 1953 to June 1955.

Initiated and directed the research projects as an Assistant Professor at the University of Maryland School of Medicine:

A. In 1965, partially completed at the Walter Reed Army Institute for Research, Washington, D. C. on a proposed new method of protecting animals from lethal x-radiation injury.

B. In 1969, an evaluation of a new radio isotope method of evaluating artificial kidney membrane dialysis in a new type of radio isotopes cell.

Have had periodic conferences with Physicians in the Cobalt Therapy [illegible] University of Maryland Hospital regarding the treatment of patients with radiation for various types of malignant disease.

Have had periodic conferences with Physicians in the radio isotope [illegible] of University of Maryland Hospital, Baltimore, Maryland, St. Joseph's Hospital, Towson, Maryland, and Lutheran Hospital, Baltimore, Maryland, regarding plans for, and interpretation of, radio isotope tests of thyroid, [illegible], liver, and kidney function over a period of 20 years.

Experience in the clinical interpretation of patient x-rays from 1949 to the present time.

Inventor of a new x-ray ray presentation method outlined in a [illegible] published in the Journal of the American Medical Association, 25 [illegible] 1971, Volume 218, Page 990, entitled "Three Dimensional X-ray Device".

William D. Edwards, M.D.

RADIOLOGICAL PERMIT APPLICATION SUPPLEMENT

NAME: KLUCK, DAVID LeROY
(Last) (First) (Middle)

School Attended: University of Minnesota Degree: Master of Public Health

TENANT ACTIVITIES WILL SUBMIT THRU INTERNAL CHANNELS.

LIST BELOW YOUR TRAINING AND EXPERIENCE WITH RADIOISOTOPES AND OTHER SOURCES OF IONIZING RADIATION (use supplemental sheets if necessary)

1. TRAINING (To be completed by Responsible Investigator, Radiation Protection Supervisor)

	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB (Circle answer)	FORMAL COURSE (Circle answer)
a. Principles and practices of radiation protection	AHS, Ft Sam Houston, TX	1 month	Yes (No)	(Yes) No
b. Radioactivity measurement standardization and monitoring techniques and instruments.	"	"	Yes (No)	(Yes) No
c. Mathematics and calculations basic to the use and measurement of radioactivity	"	"	Yes (No)	(Yes) No
d. Biological effects of radiation	"	"	Yes (No)	(Yes) No

2. EXPERIENCE Not Applicable

ISOTOPE OR OTHER SOURCE	MAXIMUM AMT OR DESCRIPTION OF SOURCE	LOCATION	DURATION	TYPE OF USE

DAP Form 1115R, 1 Feb 81 (APGR 385-3)
(Previous editions will be used until exhausted.)

April 1983

RADIOLOGICAL TRAINING

DENVER C. MISER
Health Physicist, Army Pulse Radiation Division

Type of Training	Where Trained	Duration	On The Job	Formal Course
Principles and Practice of Radiation Protection	Public Health Service Schools US Army Schools	17 weeks	Yes	Yes
Radioactivity Measurements, Instrumentation	Public Health Service Schools US Army Schools	17 weeks	No	Yes
Dosimetry and Calculations	Johns Hopkins Univ W. Virginia Univ	1 year	No	Yes
Biological Effects of Radiation	Public Health Service Schools US Army Schools	17 weeks	No	Yes

Experience:

From November 1962 to March 1972 Mr. Miser served as a Health Physics Technician with the U.S. Army Nuclear Defense Laboratory providing Health Physics and Radiac Calibration services to all USA NDL Divisions. From March 1972 to present Mr. Miser has been serving as the Health Physics Operator and staff Health Physicist at the Army Pulse Radiation Division (APRD) Reactor Facility.

Additional Training and Experience:

Educational:

1) Chemical Laboratory Specialist School, Ft. McClellan, ALA.

2) Basic Radiological Health and Occupational Radiological Health, Public Health Service School, Rockville, MD.

3) Nuclear Emergency Team Operations, US Army School, Sandia Base, N.M.

4) In Place Filter Testing Workshop, Harvard University School of Public Health, Boston, MASS.

5) Advanced Radiological Health Course, University of Texas Health Science Center, San Antonio, Texas.

RADIOLOGICAL TRAINING OF ROBERT A. AASERUDE

Type of Training	Where Trained	Duration	On the Job	Formal Course
Principles and Practice of Radiation Protection	Oregon State University	1 year	No	Yes
	Health Physics Office, BRL	2 years	Yes	No
	Reactor Facility	15 years	Yes	No
Radioactivity Measurements	Oregon State University	1 year	No	Yes
	Health Physics Office, BRL	2 years	Yes	No
	Reactor Facility	15 years	Yes	No
Mathematics and Calculations	Oregon State University	1 year	No	Yes
	Health Physics Office, BRL	2 years	Yes	No
	Reactor Facility	15 years	Yes	No
Radiological Effects of Radiation	Oregon State University	1 year	No	Yes

March 1984

ADDITIONAL TRAINING AND EXPERIENCE OF ROBERT A. AASERUDE

PERIOD: 1969 - 1984

1. Educational: Rockwell HP Course (2 weeks)
   Laser and Microwave (2 weeks) AEHA
   Harvard School of Public Health - Occupational and Environmental Radiation Protection (1 week)

2. Job Assignments:

   a. Chief, Health Physicist

   b. Reactor Health Physicist

   c. Radiological Prctection Officer

   d. Radioactive Materials Inventory Control Officer

   e. Chairman, Radiation Protection Committee

   f. Member, Proposal Evaluation Board to perform technical evaluation for environmental radiological monitoring and health physics programs.

   g. Special Nuclear Material Custodian

   h. Alternate Radiological Accident/Incident Control Officer

3. Use of Ionizing Radiation: (See attached sheet)

4. Publications Related to Radiation Safety:

   a. Reactor Health Physics Manual

   b. Special Safety Analysis Report for Criticality Alarm System

   c. Environmental Radiological Monitoring Plan

5. Awards: DA Suggestion Award for more effective usage of Liquid Nitrogen resources

March 1984

RADIOLOGICAL EXPERIENCE OF ROBERT A. AASERUDE

Isotope	Max. Amt of Source	Where Experience was Gained	Duration	Type of Use
H-3	1 curie	Ballistic Research Laboratories	2 years	Accelerator Targets Leak Test
Sr-90	1 Ci	"	1 year	Leak Test
Cs-137	9 Ci	"	2 years	Calibration Source
Pm-147	25 mCi	"	1 year	Leak Test
Ra-226	200 mCi	"	1 year	Calibration Source
U-238	100 pounds	"	2 years	Health Physics Surveys
PU-239	5 Ci	"	2 years	Fission Foils, Neutron Source
Am-241	16 µCi	"	1 year	Leak Test
CF-252	19 micro-grams	Reactor Facility	4 years	Neutron Source
Co-60	10,000 Ci	"	15 years	Irradiator Leak Test
BA-133	Small Amounts	"	15 years	Check Source
CD-109	"	"	15 years	"
Co-57	"	"	15 years	"
Mn-54	"	"	15 years	"
Np-237	"	"	15 years	"
Na-22	"	"	15 years	"
Th-230	"	"	15 years	"
U-235	Large Amounts	"	15 years	Reactor Fuel

Mr. Aaserude has a B.S. degree in Physics received in 1963 from Oregon State University and a M.S. degree in Radiological Physics received from Oregon State University in 1965. From August 1966 to July 1969, Mr. Aaserude served as the Radiological Safety Officer for the US Army Ballistic Research Laboratories and Chief, Health Physics Office with overall responsibility for the radiological health and safety program at the laboratories including staff supervision over the APRD (reactor) operation, the BRL Radiation Laboratory and the handling of all radioactive isotopes and other sources of ionizing radiation. From July 1969 to present, Mr. Aaserude has been serving as the Reactor Health Physicist at the Army Pulse Radiation Division (APRD) Reactor, Aberdeen Proving Ground, Maryland.

17604

RADIOLOGICAL TRAINING OF HUBERT P. YOCKEY

8. Type of Training	Where Trained	Duration	On the Job	Formal Course
a. Principles & Practice of Radiation Protection	U of Cal Radiation Laboratory Oak Ridge National Laboratory	1939-1943 1948-1950 1952-1959	Yes	No
b. Radioactivity Measurements, etc.	U of Cal	1939-1943 1948-1950	Yes	Yes
	ORNL	1952-1959	Yes	No
c. Mathematics & Calculations	U of Cal	1939-1943 1948-1950	Yes	Yes
	ORNL	1952-1959	Yes	No
d. Biological Effects of Radiation	U of Cal	1939-1943 1949-1950	No	No
	ORNL	1952-1959	No	No

9. Experience:

Isotope	Max Amt	Where Experience was Gained	Duration	Type of Use

Used U.S. Nuclear GR-9 Co-60 irradiator at Hughes Research Laboratories. Approximately 700 curies from June 1962 - October 1962.

Dr. Yockey received his PhD from the University of California in 1942 in Physics, has worked with 37 inch and 60 inch cyclotrons in 1939-1943; 1948-1950, and Assistant Director of Health Physics Division, Oak Ridge National Laboratories from 1952-1959. Certified Health Physicist 1 Dec 60.

ADDITIONAL TRAINING AND EXPERIENCE OF HUBERT P. YOCKEY

PERIOD: June 1969 - Present

- Educational: None
- Job Assignments:
  a. Chief, Army Pulse Radiation Division, MTD
  b. Chief, Reactor Branch, Vulnerability Laboratory, BRL
  c. Member, Radiation Protection Committee
- Use of Ionizing Radiation: Supervisor of BRL Pulse Radiation Facility
  Supervisor of MTD Pulse Radiation Facility
- Publications Related to Safe Use of Ionizing Radiation: None
- Awards: None

SUPPLEMENT C

SUBJECT: Locations Where Byproduct Material May Be Used

1. Reference: NRC Form 313, item 5.

2. Contents:

Locations Where Byproduct Material May Be Used.

RADIOLOGICAL PERMIT APPLICATION SUPPLEMENT

NAME: FRAILER, (Last) RONALD (First) LEE (Middle)

EDUCATION SCHOOL: Johns Hopkins University
DEGREE: MS in Physics

LIST BELOW YOUR TRAINING AND EXPERIENCE WITH RADIOISOTOPES AND OTHER SOURCES OF IONIZING RADIATION (use supplemental sheets if necessary)

1. TRAINING (To be completed by Responsible Investigator, Radiation Protection Supervisor)

	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB (Circle answer)	FORMAL COURSE (Circle answer)
a. Principles and practice of radiation protection.	Public Health Service, HEW Rockville, MD	2 wks	Yes (No)	(Yes) No
Radioactivity measurement standardization and monitoring techniques and instruments.	Public Health Service, HEW Rockville, MD	2 wks	Yes (No)	(Yes) No
Mathematics and calculations basic to the use and measurement of radioactivity.	Public Health Service, HEW Rockville, MD	2 wks	Yes (No)	(Yes) No
a. Biological effects of radiation	Public Health Service, HEW Rockville, MD	2 wks	Yes (No)	(Yes) No

2. EXPERIENCE

ISOTOPE OR OTHER SOURCE	MAXIMUM AMT OR DESCRIPTION OF SOURCE	LOCATION	DURATION	TYPE OF USE
Ir 192	100 curies	APG-EA	5/68 - 9/75	Radiography

BAP Form 1115, 12 Apr 73

LOCATIONS WHERE BYPRODUCT MATERIAL MAY BE USED

Material may be used at Aberdeen Proving Ground and at temporary job sites anywhere in the United States and OCONUS by APG personnel as approved by the APG Radiation Protection Committee. The job site will include those of the Department of Defense, the Nuclear Regulatory Commission, Department of Energy, NASA, and/or contractor locations where common interest or use items are of interest.

Use of sealed sources in demonstrations for Executive, Legislative, and Defense Department personnel will be subject for review by the Radiation Protection Committee. Demonstration for civic and educational groups, if performed, will be under the control of the Radiation Protection Committee.

Coordination with the host or visited activity and the APG Radiation Protection Committee approval will be obtained for off-post use.

SUPPLEMENT D

SUBJECT: Facilities and Equipment; Protective Clothing and Equipment.

1. Reference: NRC Form 313, item 13.

2. Contents:

Facilities and Equipment Summary;
Bldg 860 and 861 Drawings, and APGR 385-2,
Safety - Protective Clothing and Equipment*

*May be revised without prior notification, see summary paragraph 4 underlined.

FACILITIES AND EQUIPMENT

1. Facilities:

a. Hoods and Glove or Dry Boxes: Radiological Permits will require that certain operations involving unsealed radioisotopes be performed in hoods or dry boxes. NBS Handbook 92 will serve as a guide dependent on isotope, quantity, and operation.

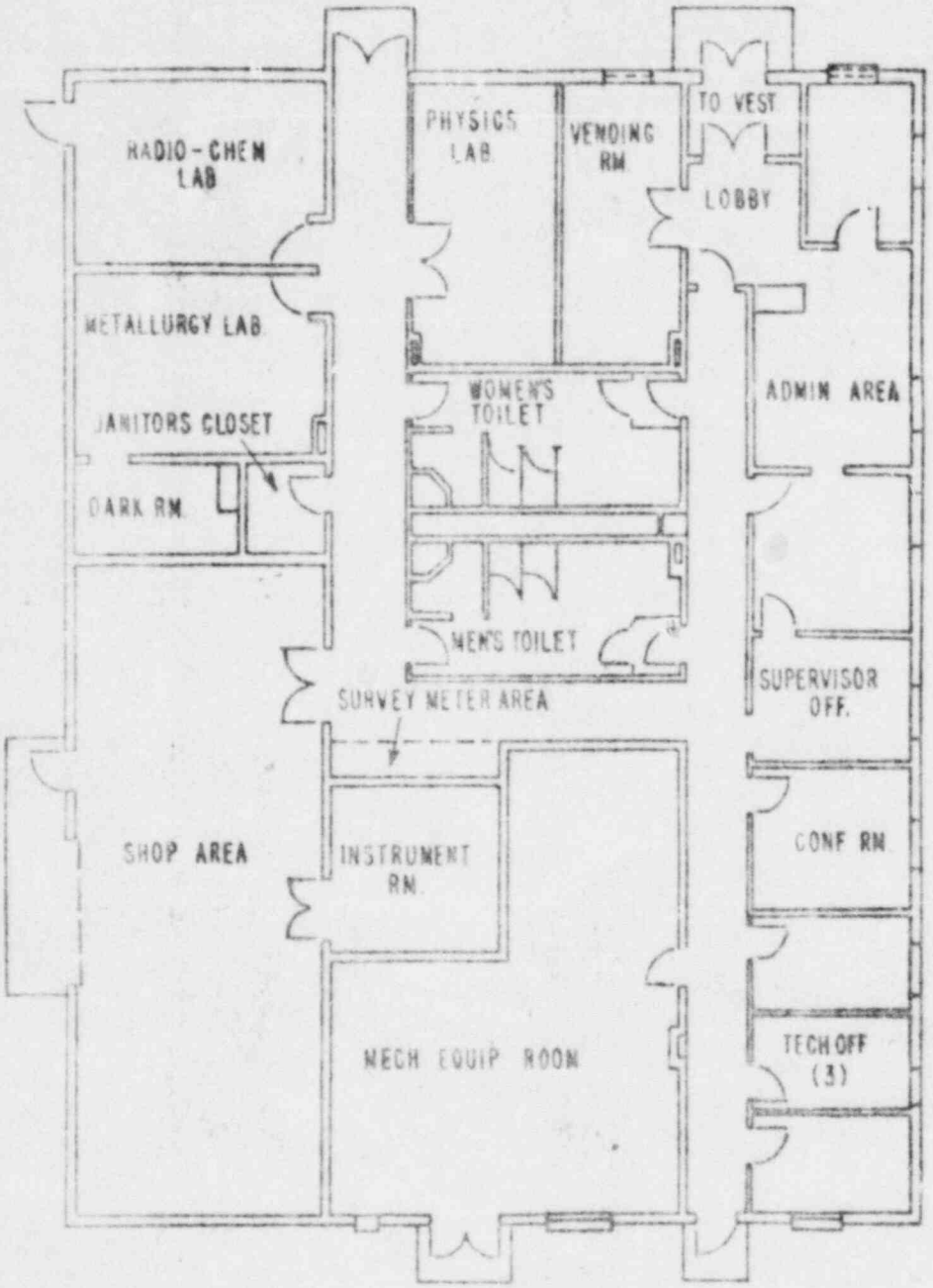
b. Shielding: Temporary or permanent shielding will be employed to prevent excessive exposure when time and distance factors alone would not be adequate. Shielding will also be used whenever feasible to minimize exposure. Sealed sources in commodities or test items will not be removed from the device without prior written approval of the Radiation Protection Committee.

2. Handling and Viewing Equipment: Tongs, forceps, and slave manipulators, and mirrors, telescopes, or closed circuit television will be used as necessary to reduce exposure to whole body and hands.

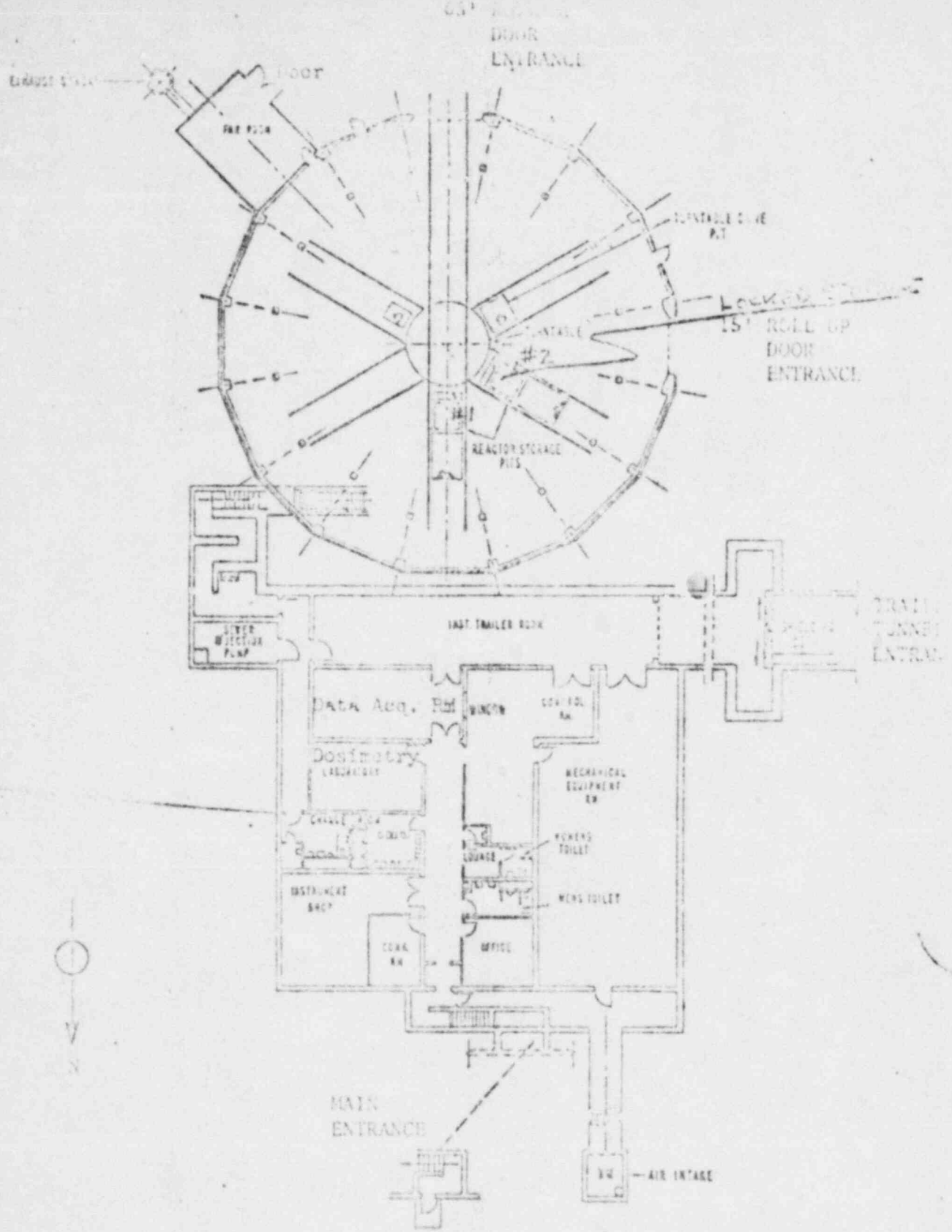
3. Storage: NBS Handbook 92 will serve as a guide for determining storage facility requirements. Radioisotope storage shall be secured against unauthorized removal. Radiological Permits will state authorized storage or use and storage locations. Commodities will be stored as required by publications promulgated by Commodity Managers. Radioactive items in excess of needs will beheld and disposition will be made in accordance with AR 385-11.

4. Protective Clothing and Equipment: Appropriate protective items will conform to the requirements contained in the attached APGR 385-3, where applicable, for respiratory protection and items required by the Radiological Permit. This regulation may be revised without prior notification of the NRC staff when new or better protective devices are recommended, such as revision by NIOSH and the Army Surgeon General for respiratory protection.

5. Facilities: The Army Pulse Radiation facility has facilities in the form of laboratory, storage, and instrumentation availability should they be required. These are described in BML 19-00294-23 and SNM 1649. Drawings of the APRF facilities are included on pages 2 and 3 of this supplement.



BUILDING 860 -3 PLAN OF THE LABORATORY BUILDING



BUILDING 861 PLAN OF THE CONTROL AND REACTOR BUILDINGS

0394-11

SUPPLEMENT E

SUBJECT: List of Byproduct Material

1. Reference: NRC Form 313, item 8.

2. Contents:

List of Byproduct Material, A thru N

17504

BYPRODUCT MATERIAL NRC FORM 313, ITEM 8
SOURCES A THROUGH N

8a Byproduct Material	8b Chemical/ Physical Form	8c Manufacturer & Model No.	8d Possession Limit
a. Any byproduct material with Atomic Nos 1-52, inclusive and 54-83, inclusive.	Any	---	Not to exceed 200 millicuries per radionuclide and 2 curies total.
b. Any byproduct material with Atomic Nos. 1-52, inclusive and 54-83, inclusive.	Any	---	Not to exceed 200 millicuries per radionuclide and 2 curies total except for the following foils, plated sources, or sealed sources: Cesium 137 - 1 source of 100 millicuries and 1 source of 120 curies. "Hydrogen 3 - 17 foils of 3 curies each. Sealed sources not to exceed 50 curies per device and 15,000 curies total. Nickel 63 - not to exceed 15 millicuries per foil or source. Krypton 85 - not to exceed 500 millicuries per source and 5.3 curies total. Promethium 147 - not to exceed 500 millicuries per source and 10 curies total.
c. Hydrogen-3	Sealed Light Sources, Gaseous	---	15,000 curies total contained in sources not to exceed 50 curies each.

Supplement F

8a Byproduct Material	8b Chemical/ Physical Form	8c Manufacturer & Model No.	8d Possession Limit
d. Hydrogen-3	Sealed light sources Hydrogen-3 in solid form	---	20 curies contained in sources not to exceed 500 millicuries each.
e. Hydrogen-3	Foils of Scandium or Titanium Tritide	USRC Model LAB 508-3 or LAB 508-2 or equal as in Army M43E1 Detector	50 curies in sources of not more than 3 curies each.
f. Promethium-147	Sealed light sources	---	10 curies contained in sources of not more than 500 millicuries each.
g. Krypton-85	Sealed gas sources	US Radium or equal	300 millicuries. Three sources not to exceed 100 millicuries each.
h. Krypton-85	Sealed light sources	---	5 curies contained in sources not to exceed 500 millicuries each.
i. Nickel-63	Plated metal sources	New England Nuclear or equal	Not to exceed 15 millicuries each.
j. Neptunium-237	Solid metal foils. Any, for neutron spectral measurements	MOLCHEM NCFNp237	5 millicuries in sources not to exceed 0.3 millicuries each.
k. Cesium-137	Sealed,low-level calibration source	EON Corp or equal	One source not to exceed 100 millicuries.
l. Cesium-137	Sealed, high-level calibration source	ANC Corp, MDL 1206 BM 6005, or equal	One source not to exceed 120 curies.

8a	8b	8c	8d
Byproduct Material	Chemical/ Physical Form	Manufacturer & Model No.	Possession Limit
m. Californium-252	$(CF\text{-}OH)_2 - SO_4$ solid sintered in Al, double encapsulated stainless steel.	Savannah River, Mdl series 100	One source not to exceed 4×10^7 n/s
n. Americium-241	Solid metalic foil encapsulated between a gold-palladium foil and a silver backing	Amersham Corp Model AMM1001 or equivalent	20 millicuries total in sources not to exceed 250 microcuries each.

SUPPLEMENT F

SUBJECT: Purpose for Which Byproduct Material Will Be Used

1. Reference: NRC Form 313, item 8.

2. Contents:

Summary: Purpose for Which Byproduct Material Will Be Used.

SUMMARY OF PURPOSE FOR WHICH
BYPRODUCT MATERIAL WILL BE USED

Byproduct	Purpose
A	Research, development, test & evaluation, training, demonstrations for Executive and/or Legislative Branch and foreign VIPs, DOD personnel and civic groups; as reference, calibration and check sources; sources contained in as components in equipment and instrumentation.
B	Storage of excess or unwanted radioactive material pending disposal.
C thru N	Activators in self-luminous light sources and light sources in military equipment, such as fire control systems, sights, level vials, and instruments; absorbed material in ionization sources contained in detectors, density/depth meters, chromatograph instruments; and other similar devices; calibration sources for instrumentation and neutron spectrometers. Devices will be used, tested, and evaluated for military application and in testing of military material in various stages of development and/or the improved version of the item as determined by test and evaluation.

SUPPLEMENT G

SUBJECT: List of Radiation Detection Instruments

1. Reference NRC Form 313, item 10.

2. Contents:

List of Radiation Detection Instruments

NOTE: Additional instrumentation listed in BML 19-00294-23 and SNM 1649 are also available.

Instruments may be replaced when obsolete or unrepairable with a similar item and added to with new programs or reduced with the completion of tests. We request an exemption from the amendment process under this license should such be the case. The Radiological Permit Process reviewed by the APG Radiation Protection Committee and the Radiation Protection Officer, imposes conditions which include proper and adequate instrumentation during the conduct of testing.

SUPPLEMENT G

RADIATION DETECTION INSTRUMENTS

	Type	No.	Rad. Detected	Sensitivity Range	Window	Use
1.	GM Counter Eberline EC-4	1	Beta		Less than 2mg/cm^2	Measuring
2.	Scint. Counter Eberline SAC4	1	Alpha		N/A	Measuring
3.	Liquid Scint. Counter, Beckmen Beta Mate II	1	Beta		N/A	Measuring
4.	Eberline PACISA	2	Alpha	0-2x10^{6}cpm	1.5mg/cm^2	Survey
5.	B-A GM Meter	1	Beta/ Gamma	0-100mR/hr	30mg/cm^2	Monitoring
6.	AN/PDR27 GM Meter	2	Beta/ Gamma	0-500mR/hr	0.005 mica	Monitoring
7.	Victoreen Meter Model 440	4	Beta/ Gamma X-ray	0-300mR/hr	Ion Chamber	Survey
8.	Prima Mdl 202	2	X & Gamma	NonSaturating Chirper	N/A	Pers Monitoring
9.	Eberline Radiation Monitor RM-19	1	Beta/ Gamma	Approx 1200 c/m/uR/h 137 Cs field 0-500K c/m	30mg/cm^2	Monitoring
10.	Eberline Air Monitoring System AMS 2	1	Beta/ Gamma	0-50 K c/m	1.4 - 2.0 mg/cm^2	Air Particle Monitoring
11.	Pers Dosimeters IM 9E or equal	72 of which 14 used for Equip Maint	X & Gamma	0-200mr	N/A	Pers Monitoring & Equipment
12.	Eberline RADTAD RT1A	2	X & Gamma	NonSaturating Chirper	N/A	Pers Monitoring
13.	RAD ALERT Fly Int	1	X & Gamma	NonSaturating Chirper	N/A	Pers Monitoring
14.	AN/PDR27R GM Meter	2	Beta	0-500mr/hr	0.005 mica	Monitoring

Supplement G
Radiation Detection Instruments (Con't)

	Type	No.	Rad. Detected	Sensitivity Range	Window	Use
15.	Victoreen Ion Chamber Model 592B	1	Gamma	0-1000mr/hr	550mg/cm^2	Monitoring
16.	Eberline GM Meter E400	1	Beta, Gamma	0-200mr/hr	30mg/cm^2	Monitoring
17.	Eberline GM Meter E 520	2	Beta, Gamma	0-2KmR/hr	30mg/cm^2	Monitoring
18.	Dosimeter Charger Victoreen 2000A or Equal	5	N/A	N/A	N/A	Dosimetry
19.	Lardsverd L5I or equal	3	X + Gamma	0 - 5 RAD	N/A	Equipment Maintenance

Also available are those instruments belonging to the APRF (Reactor) as listed in SNM 1649 and TML 19-00294-23.

SUPPLEMENT H

SUBJECT: Summary of Instrument Calibration

1. Reference NRC Form 313, item 11.

2. Contents:

Summary of Instrument Calibration

CALIBRATION

1. The calibration of radiation detection instruments is performed by the Internal Calibration & Repair Center (ICRC), US Army Missile Command, Aberdeen Proving Ground, MD 21005, in accordance with the Army Calibration Program. Instruments are recalled for calibration through the use of a computer print out. The frequency of calibration for radiation protection instruments does not exceed 90 days. Sources used are those of the ICRC. The ICRC is covered by an NRC BML.

2. Dosimeters (self-reading) are submitted to the ICRC for inspection and certification. Calibration frequency is 180 days.

3. Services and frequency for TMDE & Radiac Calibration/Repair is in accordance with AR 710-2, AR 725-1, AR 750-25, TB 750-25, TB 43-180, and TB 38-370.

SUPPLEMENT I

SUBJECT: Radioactive Material Storage

1. Reference NRC Form 313, item 9.

2. Contents:

Summary of Radioactive Material Storage Locations

RADIOACTIVE MATERIAL STORAGE

1. General radioactive material storage will be in either of two above ground type magazines. Security is maintained by a plate steel locked magazine door. The buildings are unoccupied, masonry and brick construction, located within a fenced and guarded access industrial area which is restricted to the public. No electrical or other utilities are available to these buildings and no flammable materials were used in the structures.

2. Building M 466 dimensions are 16 x 10 feet. This building is used for storage of excess or unwanted radioactive or commodity items containing radioactive components and sources pending disposition or turn-in.

3. Building M 376 is 8 x 8 feet and is used for storage of sources when they are not in use and for excess items pending disposition.

Supplement J

SUBJECT: Method of Controlling Off-Post Use of Sealed Light Sources and Ionizing Sources

1. Reference: NRC form 313, Item 5

2. Contents:

Annex 1 Summary, Method of Controlling Off-Post Use of Radioactive Sealed Light Sources and Devices Using Radioactive Sources as Components for Detection Purposes

Annex 2 Radiological Safety Primer
TECOM Pamphlet 385-1

SUMMARY, METHOD OF CONTROLLING OFF-POST USE OF RADIOACTIVE SEALED LIGHT SOURCES AND DEVICES USING RADIOACTIVE SOURCES AS COMPONENTS FOR DETECTION

1. Source description:

a. Self-luminous devices containing ^{3}H, ^{147}Pm, or ^{85}Kr, and a phosphor will be used to illuminate various components of military equipment, example: Fire Control System, etc.

b. Ionizing sources containing ^{3}H on foils such as Scandium or Titanium Tritide, ^{241}Am foils encapsulated in a foil matrix of gold-palladium face and silver backing or ^{63}Ni as plated foil with in a cylindrical fixture and/or ^{63}Ni plated, rectangular foil in a gold matrix contained in an internal component, are to be used as components in detection devices such as the Army M43E1 detector, Chemical Agent Monitor, Automated Chemical Agent detector and alarm or similar military device.

2. These devices are to be tested by the US Army Test and Evaluation Command (TECOM) only at DOD installations or activities. Military hardware, as approved by the Radiation Protection Committee (APG RPC), containing sources used for display purposes will be under supervisory control of a qualified escort and is to be exempt from the requirements of this supplement. Prior to submission of devices to the testing elements, the proponent agency will comply with the safety and health requirements contained in current Army and TECOM regulations.

3. Agencies such as, HEADQUARTERS TECOM, and TECOM subordinate commands test these devices infrequently so that it is impractical to cause them to apply for an NRC License or retain a permanently assigned Radiation Protection Officer (RPO). Because of the extended duration of some of these tests, the nature of the sources used, and quantity, the assignment of a RPO to these test areas on extended temporary duty for the entire testing period would be economically unfeasible and inefficient. For example, some devices containing sources will remain untouched, exposed to tropical, arctic, or arid environment for extended time periods to examine environmental effects on the equipment.

4. The alternate approach is to dispatch a Health Physicist to the test site during the initial and the closing period of testing. The Health Physicist will provide on-the-job training to a designated on-site Radiation Safety Supervisor and an alternate who would supervise radiation safety. The Health Physicist will be available, on call, in the event of an emergency of other condition which may require his presence or advice. An on-site inspection by the Health Physicist during the test may also be performed when determined to be necessary by the APG RPC. Travel and per diem costs would be paid from test project funds.

5. Method of accomplishing the above:

a. All requests for Off-Post support will be channeled directly to the Chairman, APG RPC at the APG Safety Office; and the RPC will act on each request on a case-by-case basis.

Supplement J
Annex 1

b. The Aberdeen Proving Ground Radiation Protection Committee will review and approve a Radiation Safety Supervisor and an alternate from each activity scheduled for testing devices under TECCM Auspices. The individual and his alternate will receive on-the-job training supervised by an experienced APG RPC assigned RPO, HP, or HPT.

c. The on-site Radiation Safety Supervisor and his alternate will be responsible for performing the duties outlined in Section XV and XVI of the Radiological Safety Primer, TECCM Pamphlet 385-1, Annex 2, of this Supplement as appropriate.

d. On-the-job training will be as follows:

(1) An APG RPC assigned RPO, HP or HPT will give a radiological safety presentation to test participants prior to testing. Instruction will include:

(a) Purpose of using radioactive materials in the test program and the need to document the fact that a hazard does or dose not exist.

(b) History of radioactivity.

(c) Type of radiation emissions.

(d) Characteristics, alpha, beta, and gamma radiation.

(e) Natural radioactive background.

(f) Radiation dose units.

(g) Quantities of radioactivity.

(h) External hazards.

(i) Internal hazards.

(j) Control of radiation dose - time, distance and shielding.

(k) Radiation detection instruments and monitoring devices.

(l) Survey, swipe and leak test requirements.

(m) Personnel monitoring, washing of hands, etc.

(n) Emergency procedures, accidents, leakage, fire, explosions.

(o) Corrective actions to prevent spread of radioactive materials in the event of emergency situations.

(p) NRC and Army radiation safety regulations.

(q) Description of each item of equipment utilizing radioactive material, assesment of probable hazard and required protective measures.

(r) Demonstration of the presence of radiation. (Use audio on the instrument)

(s) Summary - question and answer session.

(2) The HP will supervise the local Radiation Safety Supervisor and his alternate in the performance of duties outlined in Sections XV and XVI of Annex 2 of this Supplement. This supervision will continue until such time that the local Radiation Safety Supervisor and his alternate are deemed competent to supervise Radiation Safety portion test operations involving devices containing illuminating or ionizing sources. The HP will submit the names of the Radiation Safety Supervisor and his alternate to the Chairman, APG Radiation Protection Committee, for review and approval. Near the end of the test period, the HP will visit the test area (e.g. prior to test termination) for the purpose of providing further administrative instruction, advice in evaluation test results, and returning borrowed test equipment.

RECORD OF ENVIRONMENTAL CONSIDERATION

Title: Byproduct Material License 19-00294-19

Description of Proposed Action: (Brief description (if not obvious from title)).

Renewal of License

Anticipated Date and/or Duration of Proposed Action: (month/year of expected action)

June 1984

It has been determined that the action (choose one)

a. Is adequately covered in the existing EA _____ EIA _____ EIS _____ entitled _____ and dated _____.

b. Qualified for Catagorical Exclusion # A-11 Appendix 2, AR 200-2.

c. Is exempt from NEPA requirements under the provision of (cite superseding law).

SIGNED: _____
(office responsible for proposed action)

DATE: _____

CONCURRENCE: Joseph P. Dudek
Environmental Management Office

DATE: 28 March 84

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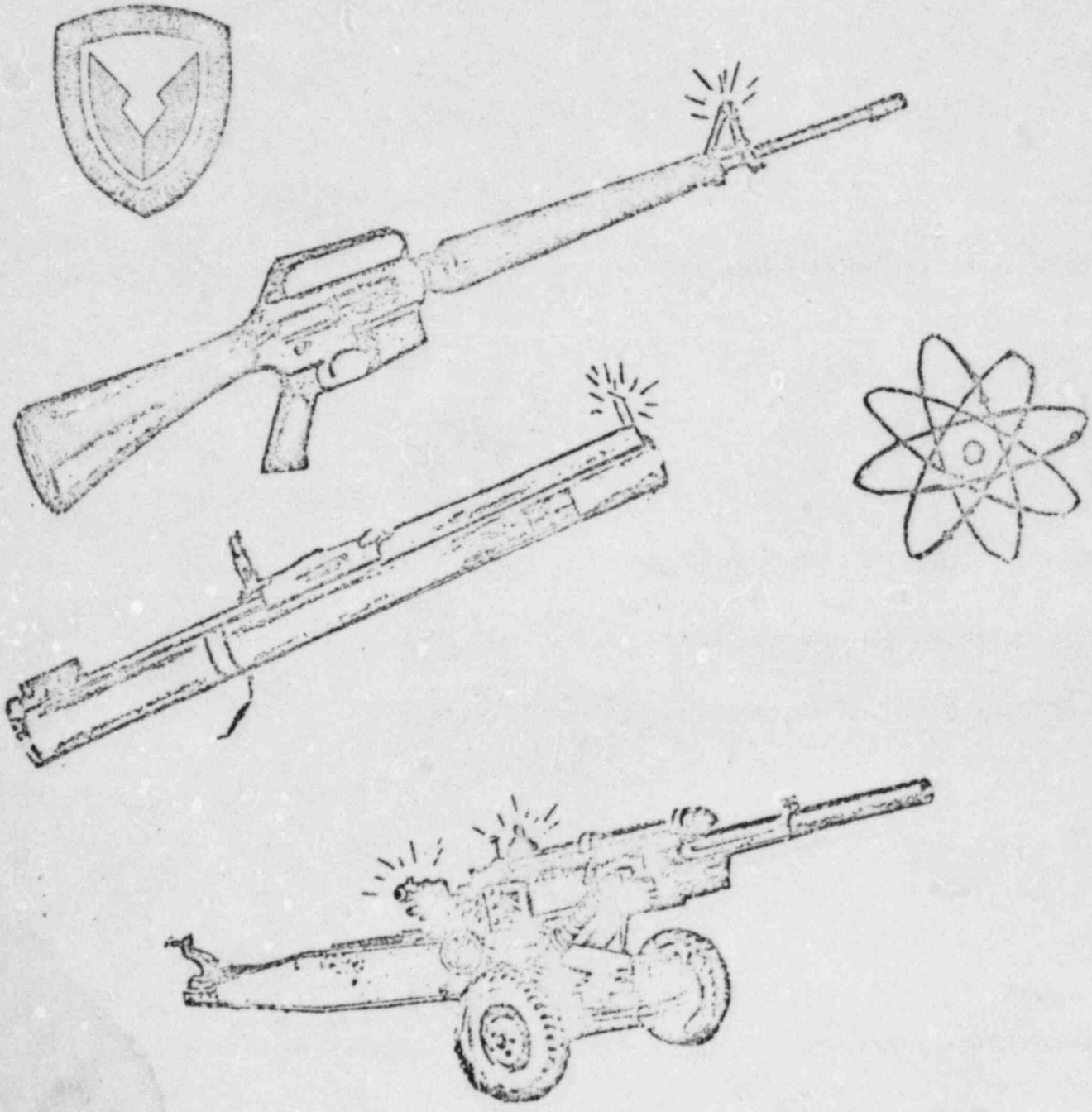
Encl 2

RADIOLOGICAL SAFETY PRIMER



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TECOM PAMPHLET
NUMBER 385-1

OCTOBER 1971

Army 2

HEADQUARTERS
US ARMY TEST AND EVALUATION COMMAND
Aberdeen Proving Ground, Maryland 21005

TECOM PAMPHLET
NO. 385-1

25 October 1971

SAFETY

RADIOLOGICAL SAFETY PRIMER

This pamphlet is a general primer for non-radiation workers or for individuals who are working with radioactivity for the first time, and who, therefore, need an understanding of the rudiments of radioactivity. Further, the adoption of the basic protection techniques outlined in this pamphlet can assist in limiting exposures to ionizing radiation. Sections XIV - XVII present specific information related to the testing of luminous night vision devices. These sections provide base-line guidance for activities, such as test boards, that do not have radiological programs.

FOR THE COMMANDER:

S. W. KOSTER
Brigadier General, USA
Chief of Staff

OFFICIAL:

PAUL E. LYON
Chief
Admin Mgt Office

DISTRIBUTION:
B1

Section I

GENERAL

1. Introduction.

a. The increase in the use of radiation sources and radiation emitting devices by the Army has resulted in a proportional increase in the number of personnel handling this material. Although Army scientific personnel are competent to control the hazards associated with the above, problems arise when troops work with or test such material. A particular need exists for troops and other inexperienced persons to understand radiation hazards. They must know how to reduce hazards and yet perform their jobs with maximum efficiency.

b. The Army uses many types of radiation sources. Some are used as "tools" in research, development, test and evaluation in providing the combat soldier with weapons, vehicles, and equipment. These "tools" range from nuclear reactors to thickness gages. The US Army Test and Evaluation Command uses many types of radiation sources in testing Army material.

c. Radiation sources are used also in items of supply furnished the soldier. Most of these are components containing radioactive material which serve to provide a light source.

d. For many years radium was used and some items containing radium are still in the supply system. The Army now prohibits use of radium except when a substitute is not available. A number of other types of radioactive materials are used as substitutes for radium; e.g.,

Promethium (Pm-147), Tritium (H-3), or Krypton (Kr-85). Items containing radium are being withdrawn from the supply system as substitutes are developed.

2. Objectives. Experience has proven that persons who are properly informed of radiation hazards are not careless nor fearful, but cautious in handling material which produces radiation hazards. To this end, reading and understanding this primer should serve as a stimulus for inexperienced persons with the objectives that they will be better informed, more alert, and more competent in working with radiation hazards. Additional objectives are:

a. To supplement radiological safety guidance provided in US Atomic Energy Commission regulations (Title 10, Code of Federal Regulations) and publications of Department of Defense, Department of the Army, US Army Materiel Command, and US Army Test and Evaluation Command (TECOM).

b. To aid in planning and conducting tests.

Section II

TECOM RADIATION POLICIES

3. Policies. TECOM installations/activities use radioactive sources and radiation emitting devices to aid in accomplishing assigned test missions. Their usage will always be tempered with the understanding that the procurement and use of radiation sources must be in accordance with written procedures which, like Atomic Energy Commission's regulations, are not subject to interpretations by users. In this

* Refer to page 46.

respect, any question on interpretation will be brought to the attention of the local Health Physicist or Radiation Protection Officer for assistance and guidance.

a. All radiation exposures will be kept as low as possible and in any event lower than maximum permissible levels.

b. Applicable radiation safety regulations will be enforced. Any assistance required will be requested from the Health Physicist, Headquarters, TECOM.

c. The Radiation Protection Program will be directed so that supervisors are assisted and guided in discharging their responsibilities and ensuring that all personnel are provided with the best possible protection for their health and safety.

d. Training in radiation safety will be provided to the maximum extent practicable.

e. Local laboratories and Radiological Safety Procedures will be inspected monthly by the local Health Physicist or the Radiation Protection Officer.

f. Each procurement of radiac instruments, devices rated above 25 kV which produce ionizing radiation; or any amount of radioactivity to include general licensed sources, naturally occurring sources, reactor or accelerator produced sources, source material, special nuclear material, or by-product material, must be approved prior to procurement action by the local Radiation Protection Committee or the Radiation Protection Officer, if no such committee exists.

g. All radiological safety entries in any record book, form, etc., will be made in ink or type, dated and initialled by the person making the entry.

h. All contacts with post and off-post personnel concerning the radiological safety program will be channeled through the local Health Physicist or Radiation Protection Officer.

i. Radioactive waste discharges into the sewerage and concentrations in effluents to restricted areas will not exceed the limits prescribed in 10 CFR 20. Radioactive material will not be buried, dumped on the ground, nor burned unless authorized by the AEC and Headquarters, AMC.

j. Installations/activities that are scheduled for an AEC radiological inspection or inspection by any other agency, will notify Commanding General, TECOM, ATTN: AMSTE-ST, of the inspection dates. A copy of any inspection findings will be forwarded to the above address.

k. AEC or AEC-state licensed radioactivity will be transferred only to those persons or activities who are licensed by the AEC or AEC-states to possess and use radioactivity. In the absence of directions from this headquarters, licensed radioactivity will not be shipped until a copy of the recipient's license is received verifying that they are authorized to receive the particular radionuclide in the amount shipped and perform the intended use, testing, research, etc., for which the item was shipped.

Section III

DISCOVERY AND UNDERSTANDING

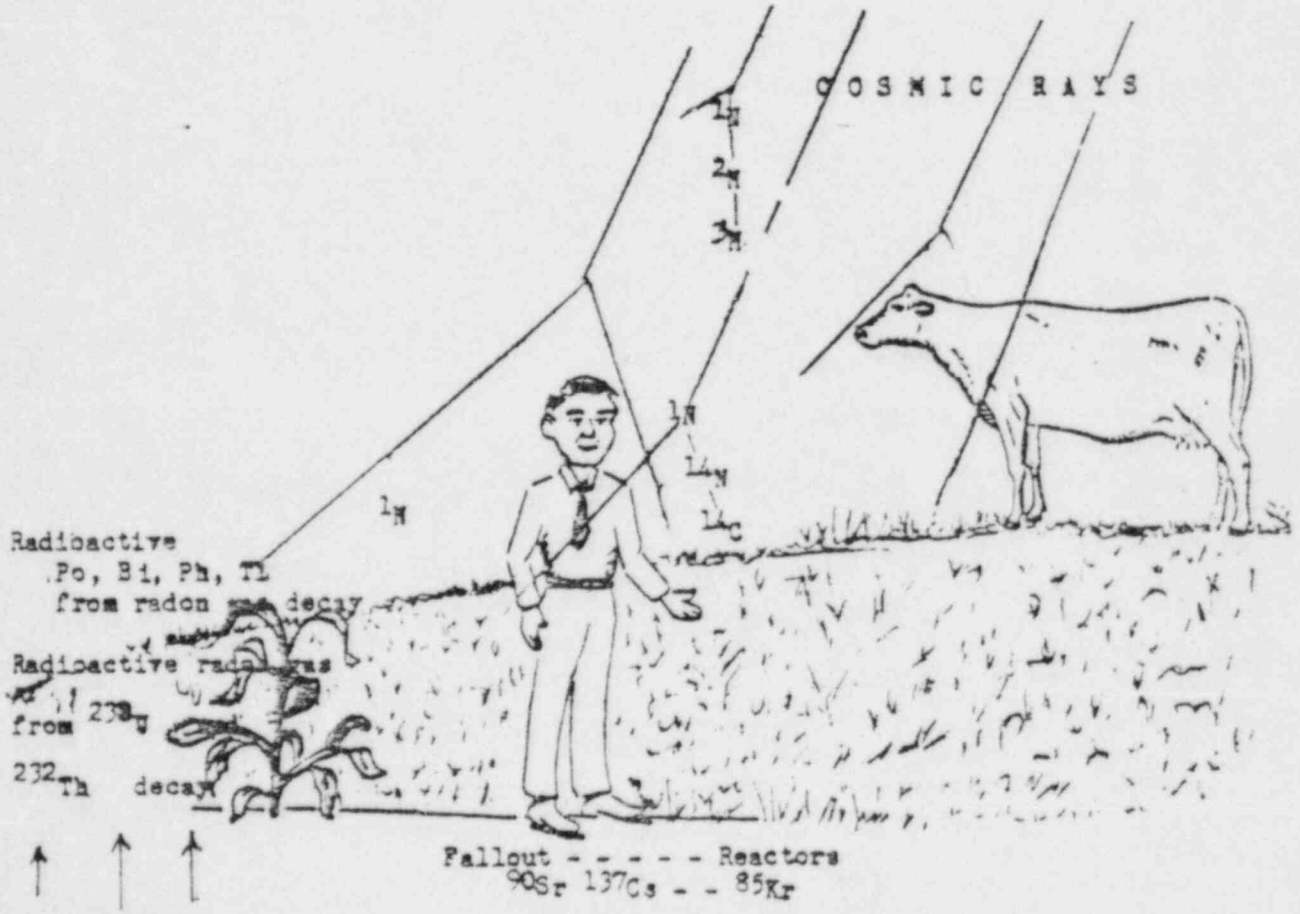
4. Discovery.

a. *Radioactivity was discovered by Professor Bequerel of France in 1896. Professor Bequerel was conducting a study to determine why a piece of uranium rock placed on photographic film, after being placed in sunlight, would when developed result in a dark outline of the rock on the film. At first he thought that the rock was absorbing sunshine and later was releasing this energy to the film. One day he placed the rock on the film without first exposing the rock to sunshine. He was amazed to discover that something other than sunlight energy was being released by the rock. His later experiments and the work of others established the fact that the uranium rock was spontaneously emitting small invisible rays or particles: one positively charged, one negatively charged and one with no charge. These were named alpha particles, beta particles and gamma rays.

* The property of certain atoms to spontaneously emit alpha or beta particles, gamma or X-rays or of undergoing spontaneous fission.

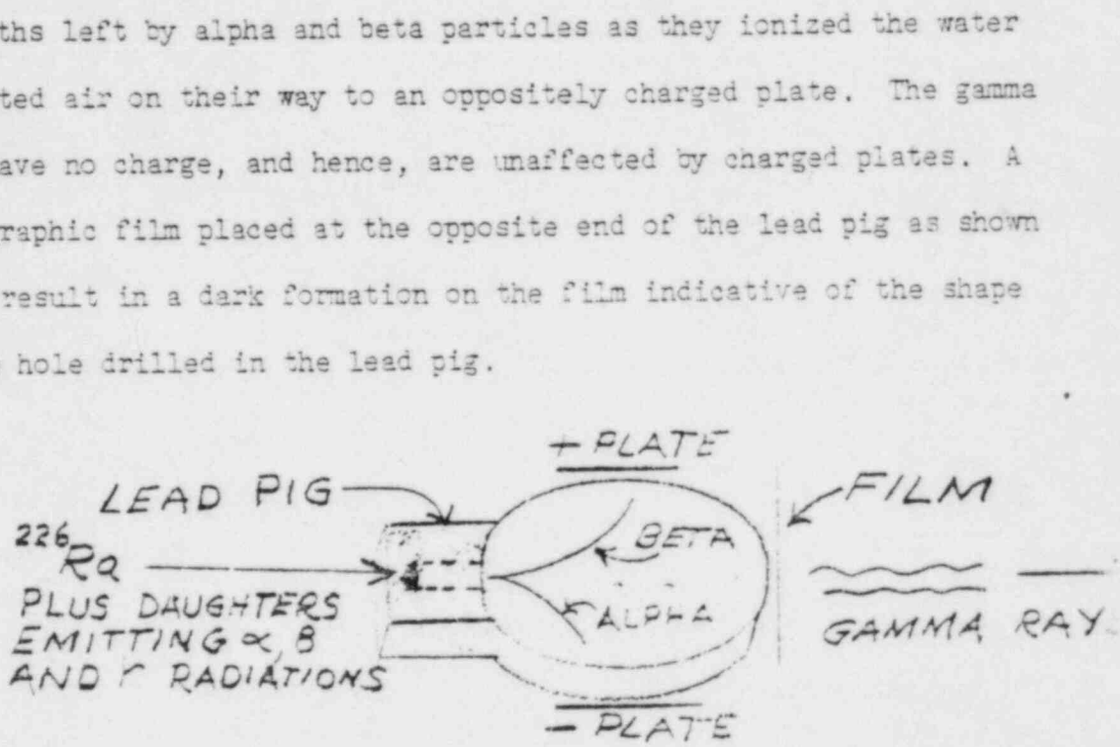
b. Radioactivity is nothing new. We have been eating, drinking, and breathing radioactive materials all of our lives. Also, we are constantly bombarded by cosmic rays from space and from gamma rays emitted from the ground and from practically every material near to us or with which we come in contact. As a result of living in this radioactive environment, our bodies and the food we eat (animals and plants) are radioactive.

* Primary sources of man's radioactive environment



* Referred to as background radiation

5. Wilson Cloud Chamber. A device known as the Wilson Cloud Chamber (see figure below) later provided visual observations of the paths left by alpha and beta particles as they ionized the water saturated air on their way to an oppositely charged plate. The gamma rays have no charge, and hence, are unaffected by charged plates. A photographic film placed at the opposite end of the lead pig as shown would result in a dark formation on the film indicative of the shape of the hole drilled in the lead pig.



6. Other contributions. Lord Rutherford made many significant contributions which lead to a better understanding of the atom. A few of these were: his collection of alpha particles from radon gas which had passed through an ultra thin-walled glass tube and his identification of the transformation of these alpha particles into helium gas by means of spectroscopy. This experiment identified an alpha particle as the nucleus of a helium atom. His studies of alpha scattering led to many basic postulates, among which was the substantiation that an atom was not a solid entity but was mostly occupied by space with electrons orbiting around a relatively small, positively charged nucleus. His studies of the transmutations of light

17504

elements by alpha bombardment are shown below in the alpha bombardment of beryllium to form carbon and a neutron. The neutron part of this bombardment action was not understood until the existence of the neutron was proven by Sir Lawrence Chadwick, 1932.

Basic data

UNIT	SYMBOL	CHARGE	RELATIVE MASS	RANGE IN AIR	VELOCITY
Gamma Ray	γ	0	0	* hundreds of yards	C
Beta particle	β	-1	.000549	* 30 feet	.9C
Alpha particle	α	+2	4.00270	2-3 inches	.1C
Neutron	n	0	1.008986	* hundreds of yards	.1C
Proton	p	+1	1.007594	** 25 inches	.1C

* ranges vary greatly with energy
** alpha bombardment protons
C = speed of light

$^{4}_{2}He$ ... the 2 in the subscript ($_{2}He$) refers to the number of protons in the nucleus, the 4 in the superscript (^{4}He) refers to the combined total of protons and neutrons in the nucleus.

Basic reaction

$^{4}_{2}He$ (Alpha Particle) + 2 Electrons = $^{4}_{2}He$ (Helium)

$^{4}_{2}He$ (Alpha Particle) + $^{9}_{4}Be$ (Beryllium) = $^{12}_{6}C$ (Carbon) + $^{1}_{0}N$ (Neutron)

Note: The alpha beryllium combination used by Lord Rutherford and other early pioneers is one of the current standard means used to produce neutrons.

Section IV

COMMON RADIATION TERMS

7. Dose terms.

a. Roentgen (R). An amount of radiation exposure, in air, from X-ray or gamma radiation. Once roentgen had a simple definition, still approximately correct, as the amount of radiation one would receive from one gram of radium if the person were to remain one meter away from the radium for one hour. Now, roentgen is defined as that quantity of X or gamma radiation such that the associated corpuscular emission per .001293 gram of air, (1 cc of air* S.T.P.), produces in air ions (2.08 x 10^9 ions pairs) carrying one electrostatic unit of quantity of electricity of either sign.

b. Milliroentgen (mR). $\frac{1}{1000}$ of a roentgen.

c. Rad. An absorbed dose, or the energy imparted to material, by ionizing radiation per unit mass of material. One rad is equal to the absorption by an type of ionizing radiation of 100 ergs per gram.

d. Millirad (mrad). $\frac{1}{1000}$ of a rad.

e. Roentgen equivalent man (rem). A unit of biological dose equal to the dose in rads multiplied by appropriate modifying factors.

Radiation	Dose equivalent
X-Ray, Gamma or Beta.....	1
Proton, Alpha or fast Neutron	10
Slow Neutron	5

* Standard Temperature and Pressure

f. Millirem (mrem). $\frac{1}{1000}$ of a rem.

8. Dose rate terms.

a. Roentgen/hr (R/hr). The rate at which radiation is emitted as measured at a particular point, usually by a portable instrument such as a Geiger-Muelleror ion chamber meter. Note: Most R/hr or mR/hr instrument readings are approximately equal to rad/hr, mrad/hr, rem/hr or mrem/hr.

mr/hr: $\frac{1}{1000}$ of R/hr

rad/hr: Rate at which an absorbed dose is being received per unit mass.

mrad/hr: $\frac{1}{1000}$ of rad/hr

rem/hr: Dose in rads/hr x appropriate modifying factor

mrem/hr: $\frac{1}{1000}$ of rem/hr

Quantitative terms

b. Curie (Ci). That quantity of a radioactive nuclide disintegrating at a rate of 3.7×10^{10} atoms per second (DPS) or 2.2×10^{12} disintegrations per minute (DPM).

c. Millicurie (mCi). $\frac{1}{1000}$ of a curie, 3.7×10^{7} DPS or 2.2×10^{9} DPM.

d. Microcurie (uCi). One millionth of a curie, 3.7×10^{4} DPS or 2.2×10^{6} DPM.

e. Micro-microcurie (uuCi). One millionth of a microcurie, 3.7×10^{-2} DPS or 2.22 DPM.

f. Picocurie (pCi). Same as uuCi.

Energy terms

g. Electron volt (eV). A unit of energy equivalent to the amount of energy gained by an electron in passing through a potential difference of one volt.

h. KeV. One thousand electron volts.

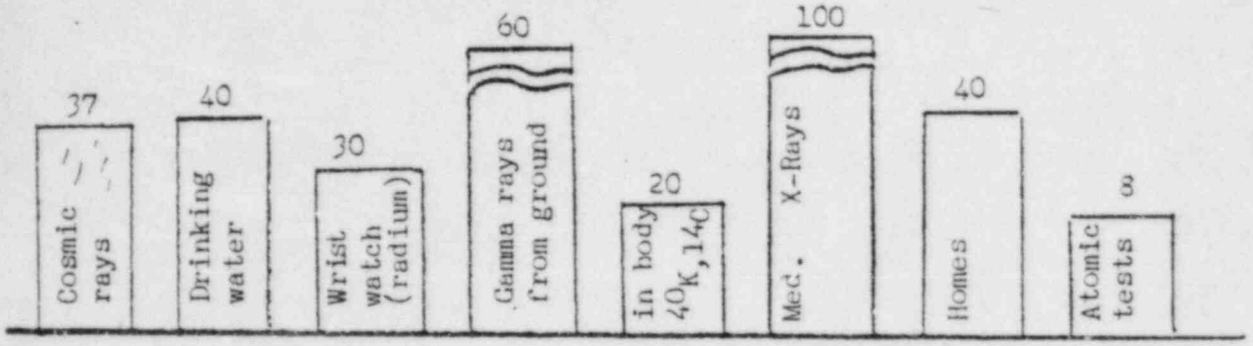
i. MeV. One million electron volts.

Section V

RADIATION DOSAGES

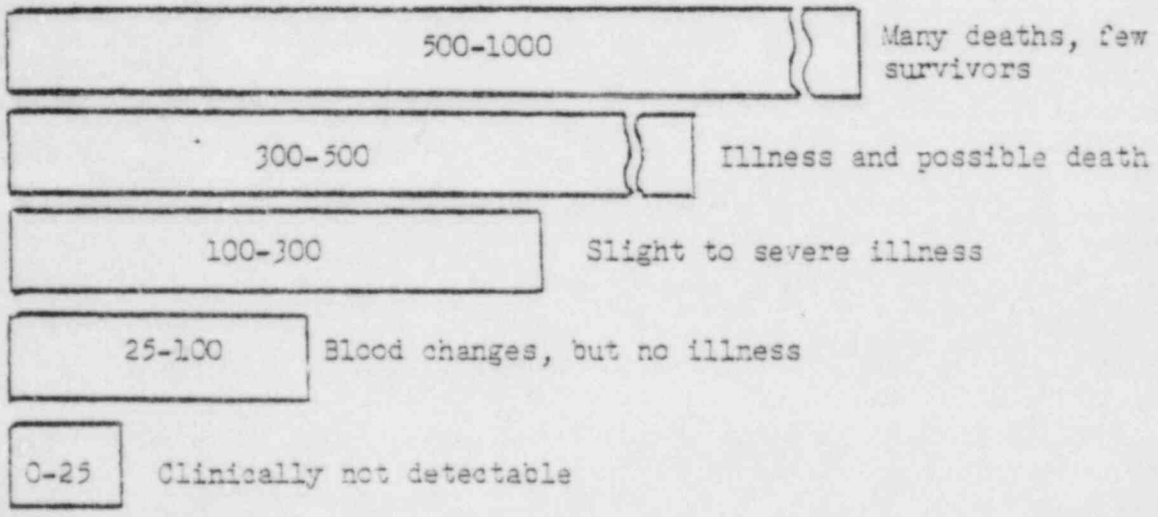
9. Average dosage. The chart below will give a rough approximation of the radiation dosage received each year as a result of just being alive. The chart will prove useful in relating any exposure received while working or visiting a radiation area; for example, one might receive 10-20 mrem and then by comparing the yearly dose of over 300 mrem received naturally, realize that this dosage is relatively insignificant. Although 10-20 mrem is relatively a small dose, the basic philosophy of working with radiation is always to limit the amount of radiation received to the lowest possible amount. The radiation amounts in the chart can be off by a factor of 10 in some cases; for example, a full mouth X-ray or fluoroscope would easily exceed this factor of 10. Likewise, if you drink water from a well where high radium soil content exists or live in high mountainous country where cosmic rays are more intense, the factor of 10 would be exceeded. If you live in a brick house, you can double the amount shown; if your house is cement, you can triple it.

Sources of Radiation Dosage to Man Per Year in mrem/yr



10. Acute dosage.

a. Effects of acute radiation exposure (in rems, 24 hour exposure)



The chart above correlates the occupational dosage of 3 rem/qtr and non-occupational dosage of 0.5 rem/year with the large dosages required to effect illness.

b. Dosage is a product of dose rate x time. It can be compared to your automobile speedometer; for example, if you were to travel at a speed of 30 MPH for two hours, you would travel a distance of 60 miles. Likewise, if you were in a radiation area where the dose rate was 30 mR/hr and you remained in such area for two hours, then the dose received would be 30 x 2 or 60 mR, equal to 60 mrem. The dose rate in the example above

would be read directly from your radiation detection instrument. In summary:

Dosage = Dose rate x time

Time of stay in rad area = $\frac{\text{Allowable dosage}}{\text{Dose rate}}$

11. Allowable Dosage.

a. Radiation effects in regard to time versus dosage is similar to the effect of sunshine on a person. A large amount of sunshine received in a short period, even one day, can be very damaging. Conversely, the same amount received in shorter time increments over a much longer period would not be damaging. Radiation received in a 24-hour period is more damaging to the body than the same amount of radiation received in small increments over a much longer period (chronic radiation).

Allowable radiation dosage

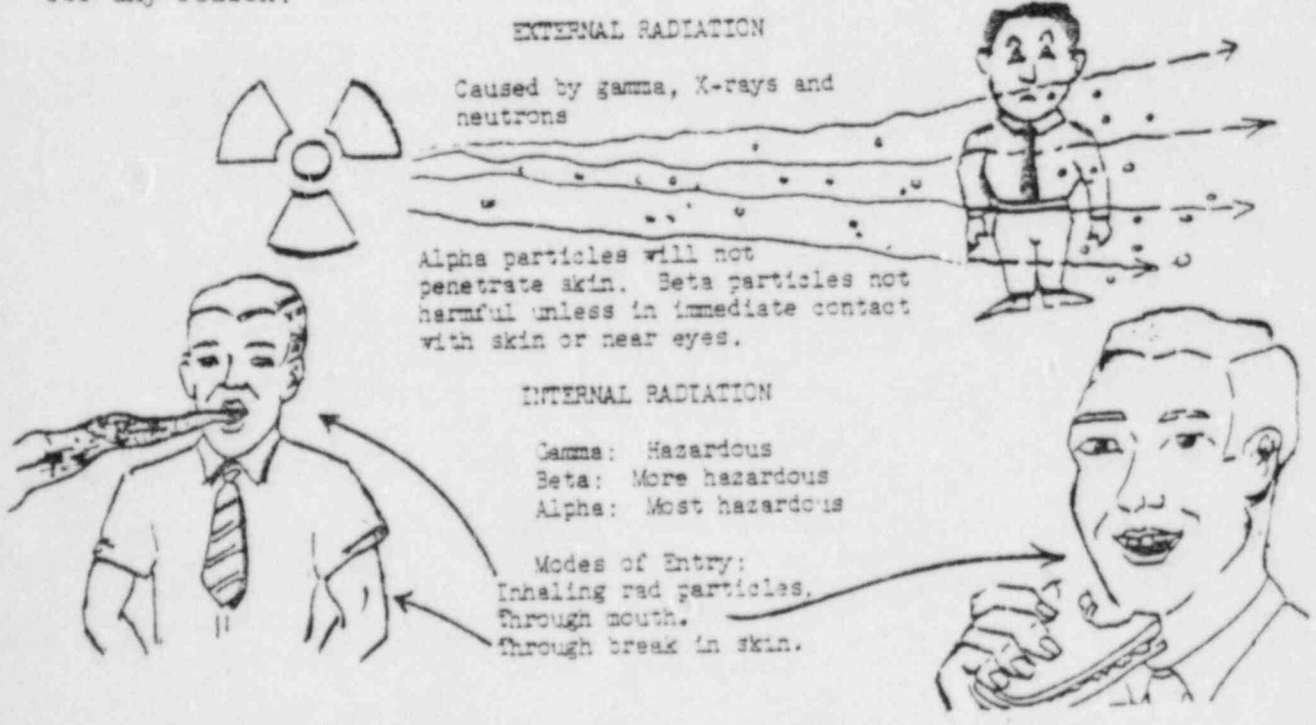
Radiation workers	3 rems/qtr* or 300 mrem/week
Non-radiation workers	500 mrem/year

* Yearly limitations for radiation workers are further controlled by age factors using the formula 5(N-18) where N = age at last birthday. From the above chart, a person 20 years old could receive 5 (20-18) = 10 rems exposure without harm in one year. However, the above formula is limited to 12 rems of exposure per year. Example: a person 50 years of age could receive only 12 rems in one year.

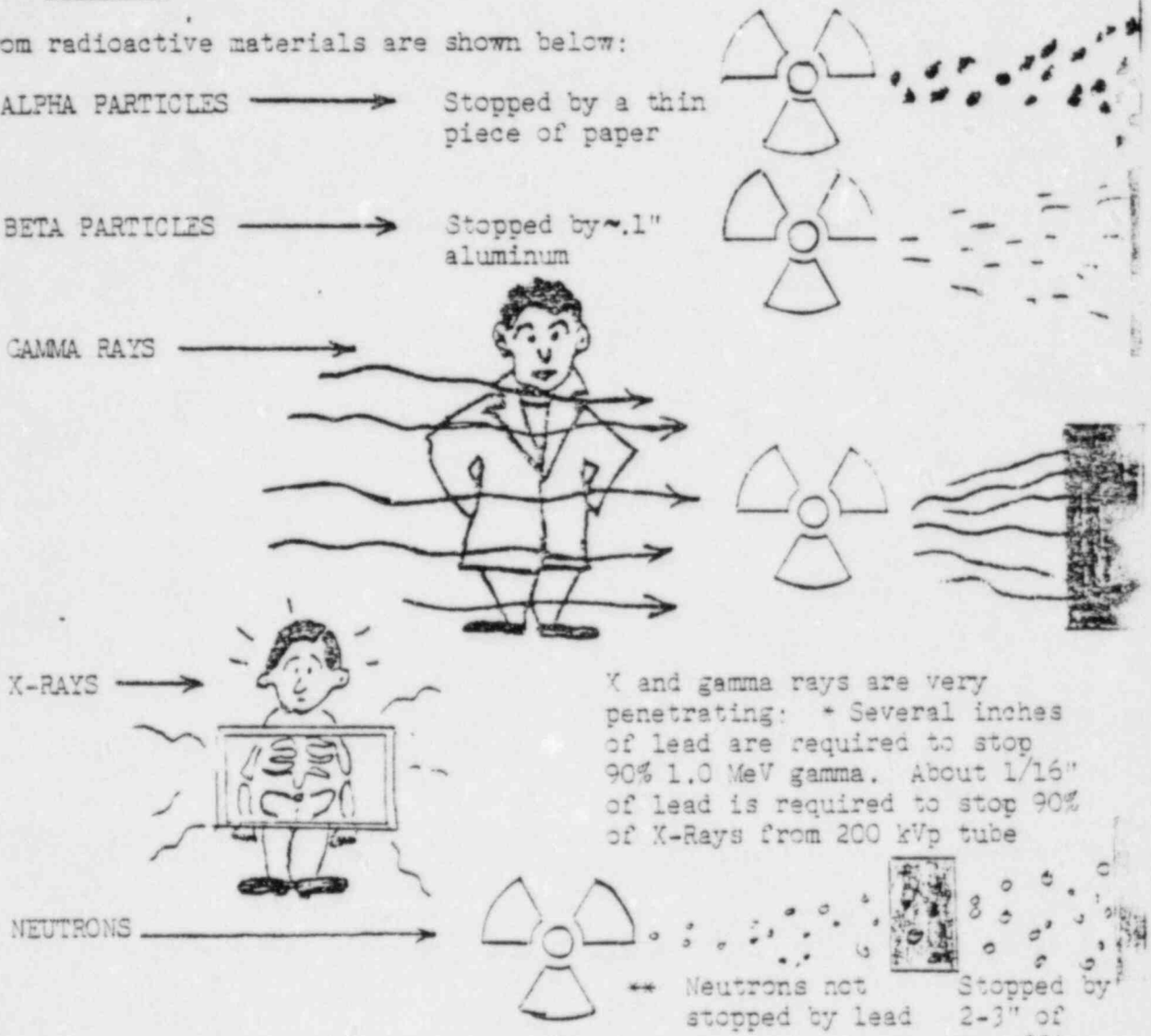
Section VI

EXPOSURE TO RADIATION

12. Causes. Cells are made of atoms. Radiation can ionize these atoms which make up body cells thus causing the body cells to die or become ineffective. This ionization can be caused by external radiation; that is, by radiation which is capable of penetrating our bodies (example: X-rays). This ionization can also be caused by internal radiation; e.g., breathing radioactive contaminated air or eating radioactive contaminated food or permitting radioactive material to enter body through a break in the skin. To minimize the internal radiation hazard, the most important actions each person is responsible for are to assure that hands, face, and clothing are monitored before leaving a radiation area; then to wash hands, (and face is necessary) with soap and water before eating, smoking, drinking, or leaving the work area, for any reason.



13. Examples. Examples of the penetrating power of radiation from radioactive materials are shown below:



* The thickness of materials required to stop gamma, X-rays and neutrons vary greatly with their respective energies; high energy gamma, X-rays and neutrons require greater thicknesses to slow down or stop their penetrating radiations.

** Many non-radioactive materials bombarded by neutrons will become radioactive (induced radiation or absorption of neutrons).

Section VII

RADIUM, THE TROUBLEMAKER

14. Reputation. Radium has a poor reputation because, at first, users either did not understand or pay attention to the internal and external hazards incident to handling radium.

15. Facts. Important facts about radium follow:

a. Radium is one of the most damaging radioactive elements which can be introduced (internal hazard) into the body. Radium is a bone-seeker, and the limit to which the bones can burden themselves is 1/10 millionth of a gram, approximately 0.1 microcurie, 0.1 uCi.

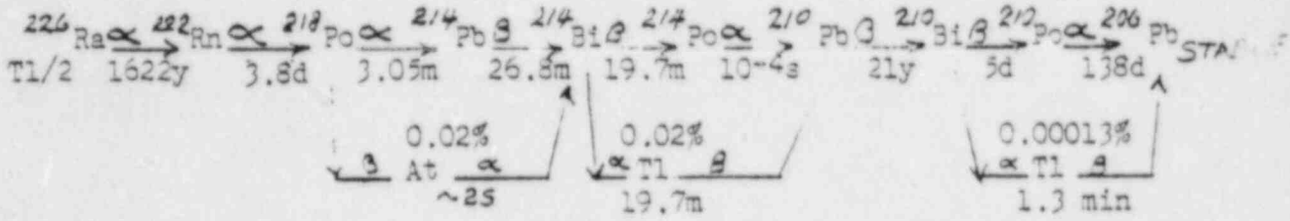
b. Strong gamma rays are emitted from radium, thus creating an external hazard to persons who are in close proximity to devices containing radium.

c. Radium finds its greatest use in exciting a phosphor such as zinc sulphide and thereby creating illumination for night vision in many devices (example, the hands of dial numbers of a wristwatch). Unfortunately, the strong alpha bombardment degrades most of the zinc sulphide causing a greatly reduced light output in several years and also causes the zinc sulphide paste to flake-off. These actions can result in the faulty conclusion that no or little radium is in a device because no or little luminescence exists.

d. Radium decays by alpha emission into radon gas, radon then decays successively into the daughter products shown below: (Note: T1/2 is the half life or the time required for one-half of a given number of atoms to change into another element by emitting (primary modes of decay) an alpha (α) particle or beta (β) particle,

usually accompanied by the simultaneous emission of one or more gamma rays.

Emission:



It should be noted that each atom, or given amount of radium, results in 8 radioactive daughters before changing into stable lead - 206.

Note: The above figure ignores insignificant contribution due to branching decay of Po-218, Bi-214 and Bi-210.

16. - Radon gas. a. The real trouble maker, radon gas, creates the following problem:

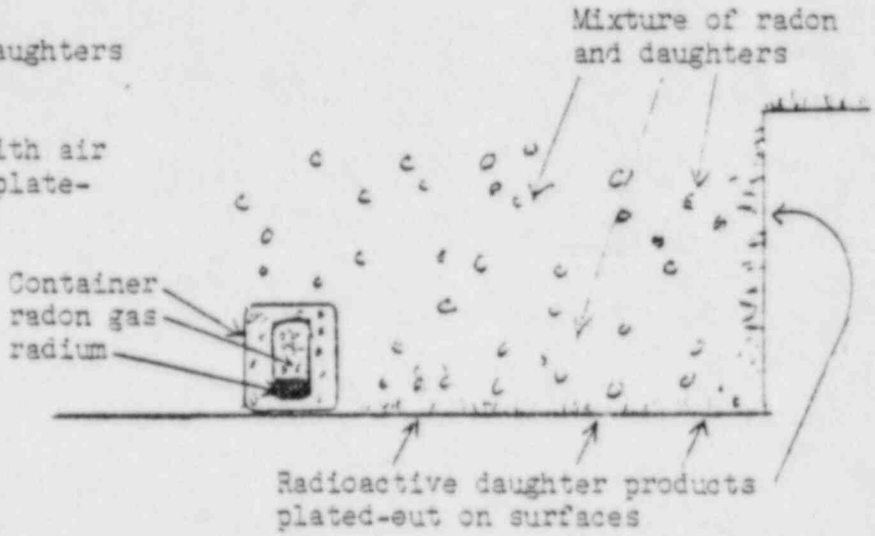
(1) The gas is capable of diffusing through thin metals and readily passes through plastic. Each atom of radon gas which escapes creates five times the amount of radioactivity in a period of less than one day (decay action then continues at a very negligible rate due to 21 year half life of Pb-210) which, because the four radioactive daughters are solids, results in contamination (plating-out) on walls, floors, and other surfaces. Because radon gas leakage from luminous markers was ignored, an entire warehouse was contaminated and had to be disposed of as radioactive waste.

(2) The radon gas plus helium gas from alpha disintegrations, plus any trapped water, creates a pressure build-up which can rupture a container.

Diffusion of Radon gas:

Sequence:

1. Radium decays into radon gas
2. Some of the radon escapes from container
3. Radon decays into daughters (solids)
4. Daughters combine with air particulates which plate-out on all surfaces



b. Summary.

(1) Devices containing small microcurie levels of radium pose no problem; however, when many such devices are grouped together for storage, etc., the total amount could create conditions of external and internal hazards.

(2) Devices containing radium should be stored in a well-ventilated area; e.g., an open shed.

(3) Compared to air, radon is a heavy gas which will concentrate in low ground areas.

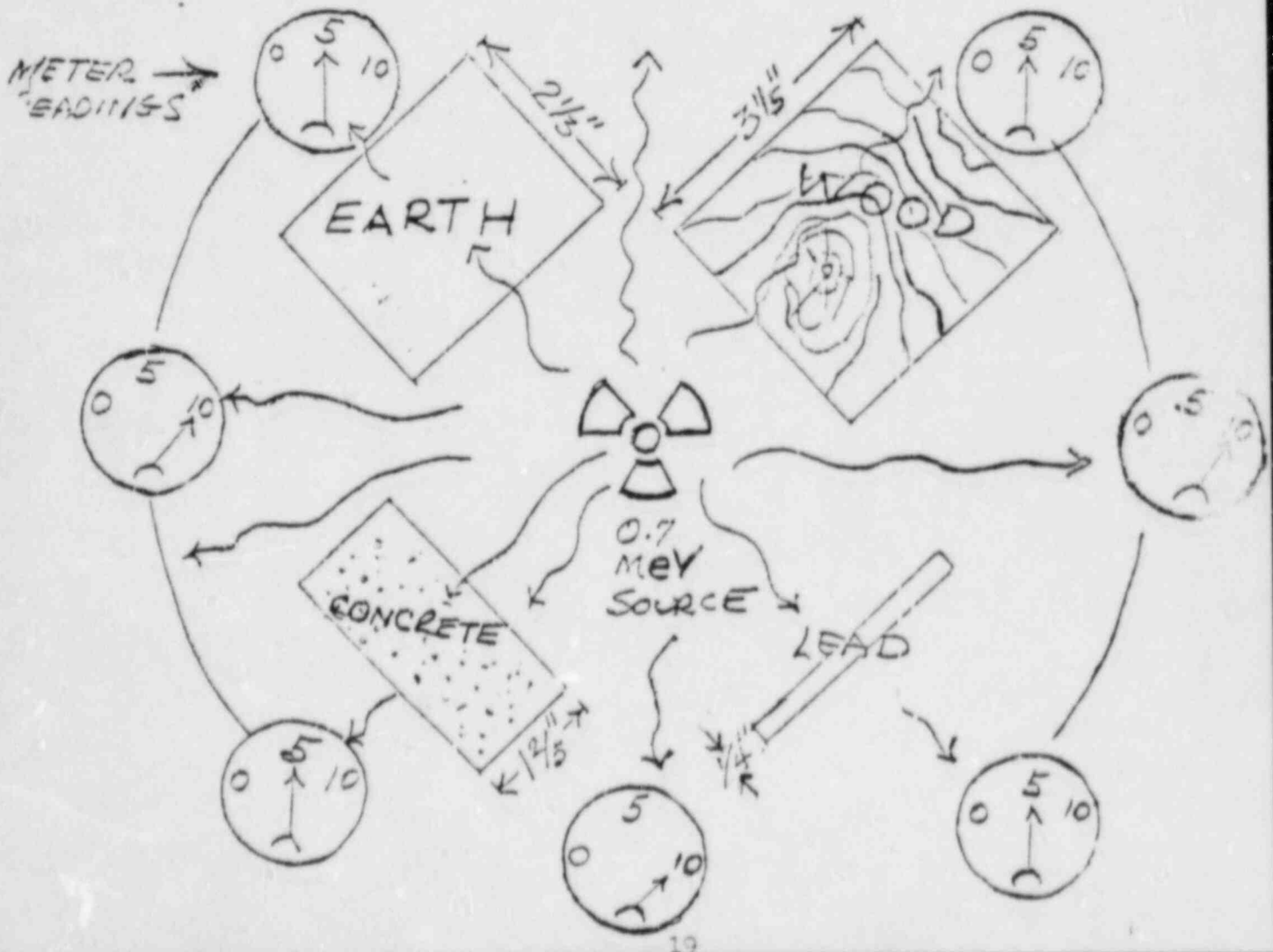
(4) Radium luminous devices which do not luminesce still contain radium and daughter products.

Section VIII

ATTENUATION

17. Half-thickness. The attenuation of X-ray and gamma radiation is often defined as the half thickness of any material which will decrease the amount of radiation emerging from such material by one-half its original amount. The amount of material to reduce radiation intensities to one-half is dependent on a number of factors, among which are the energies of the photons involved. Larger half thicknesses are required to stop the higher energy photons.

RELATIVE HALF THICKNESSES OF VARIOUS MATERIALS



18. Attenuation of radiation by distance. a. Radiation from a point source decreases in intensity as does light; that is, inversely as the distance squared or expressed mathematically: $I_1 (D_1)^2 = I_2 (D_2)^2$ .... where I_1 is the radiation intensity (dose rate) at distance D_1 and I_2 is the radiation intensity at distance D_2. The inverse square law for reduction of radiation intensity applies for point sources of X, gamma, and neutron radiation. X-ray tubes act sufficiently like point sources so that calculations by this law are valid. Gamma ray sources whose dimensions are small in comparison to the distances involved (approximately 1 - 10 ratio) may also be considered point sources as can capsule neutron sources. Observation of the formula above reveals that doubling the distance from the source decreases the intensity by a factor of four; increasing the distance by a factor of ten would decrease the intensity by $\frac{1}{100}$.

Sample problem: The dose rate reading at one foot was 256 mR/hr. At what distance will the dose rate be only 4 mR/hr?

Solution: $256 (1)^2 = 4 (D_2)^2$, $(D_2)^2 = 64$, $D = 8$ ft

b. When working near a line source, a long pipe irradiating gamma or a group of radioactive supplies placed in a row or any such elongated geometry, the intensity of radiation will decrease (when moving in a direction that is perpendicular to such elongation)* linearly. For example, if the dose rate from a line source was 50 mR/hr measured 10 feet from such source, what will the dose rate be at 20 feet from this source?

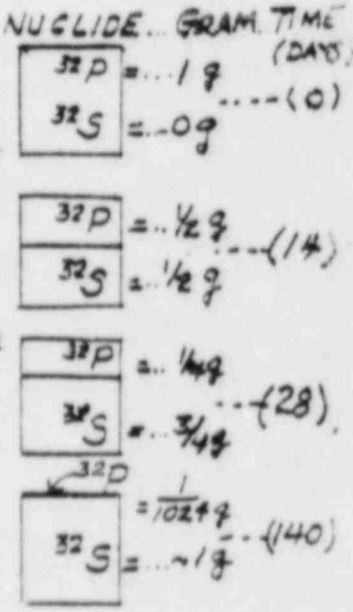
Answer: $\frac{10}{20} \times 50 =$ 25 mR/hr.

* A rough approximation.

19. Half life. a. Radioactivity decays at a fixed rate. No known physical or chemical action can change this fixed rate. The basic equation for computing the amount of radioactivity remaining after decay to a stable element is shown by the equation below:

$A_t = A_o\, e^{-\frac{.693t}{T1/2}}$ Where A_t = amount remaining, A_o = initial amount
e = base of natural logs, T1/2 = half life of nuclide
t = elapsed time

To illustrate this decay, assume that we have one gram of radioactive phosporous (^{32}P T1/2 = approximately 14 days) represented by the block appearing on the right. After 14 days only one/half gram of the phosphorous would remain, the other one-half would have changed into sulfur. After another 14 days, only one-fourth gram of phosphorous would remain. This steady rate of decay would continue until after a total elapsed time of 140 days, 10 half-lives, only $\sim \frac{1}{1000}$ of the original phosphorous would remain, all the remaining part of the gram would now be changed into sulfur. Rules of thumb for calculating decay of one radionuclide into another are: after 3.33 half lives $\frac{1}{10}$ remains, after 6.66 half lives $\frac{1}{100}$ remains, after 9.99 half lives only $\frac{1}{1000}$ of the original amount will remain (multiples of 3.33 produce the above.)



b. In the above example, the phosphorous is a beta emitter, and all beta emitting nuclides react as if one of their neutrons had given off an electron and then changed into a proton. This net change results in the transmutation of beta emitters into the next higher element which has one proton more than the original beta emitter.

Section IX

RADIATION DETECTION DEVICES

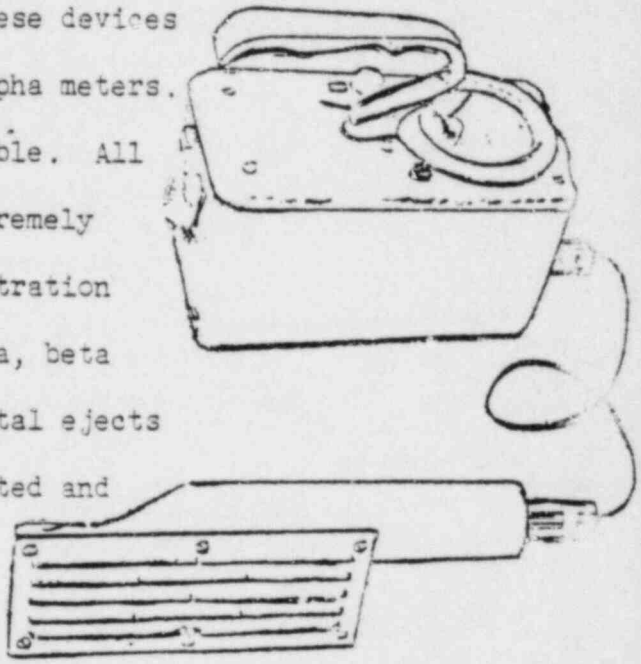
20. Protective measures. One might ask: "How can persons working with radiation be protected from radioactive materials which emit particles and rays smaller than an atom and which are invisible, noiseless, odorless, and unresponsive to the sense of touch or feeling?" There is a twofold answer to this question. First, a variety of instruments and devices respond to the ionization effects of radiation; second, there are rules, procedures, and license permits issued and supervised by the Atomic Energy Commission and Department of the Army which allow only select persons to work with radioactive devices. These directives prescribe how instruments and devices will be used to protect personnel.

21. Common Detection Devices.

a. Film badge. This device is worn on the person usually on or near the breast pocket or at or above the waistline. Inside the badge is a piece of film which is covered with paper to exclude light. As X-ray, beta (see drawing), gamma or neutrons (a special badge is used for neutrons) pass through the badge, this film becomes ionized and turns dark. The degree of darkness on the film indicates the amount of radiation received. It is interesting to reflect on the fact that photographic film which had a leading role in the accidental discovery of radioactivity is today an accurate, reliable, and the accepted legal record of a person's

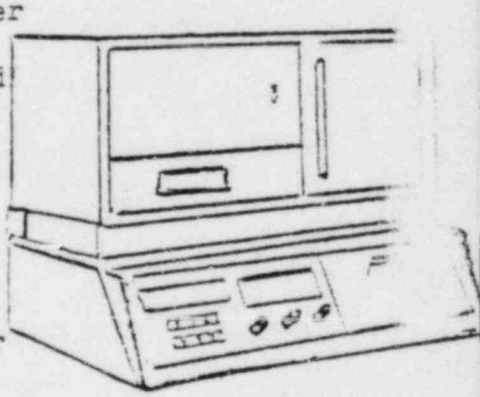
exposure to radiation.

b. Scintillation sensing devices. These devices find their most popular use as portable alpha meters. Gamma and beta instruments are also available. All these devices operate by utilizing the extremely small amount of light produced by the penetration and ionization of various crystals by alpha, beta and gamma. The light produced in the crystal ejects photo electrons which are in turn accelerated and multiplied by a photomultiplier tube.



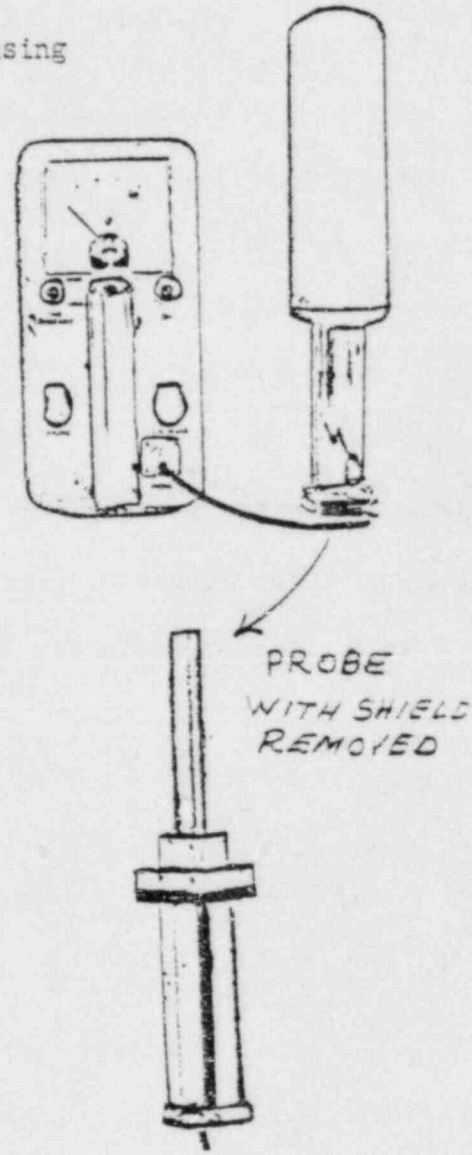
These multiplied electrons produce a corresponding pulse which, with other pulses, are read as disintegrations per minute per unit area. In the laboratory, these sensing devices are fed into sophisticated counters and oscilliscopes (gamma spectrometers) which are capable of measuring and identifying one or more isotopes by their respective energies (light signals) dissipated inside the crystal.

c. Laboratory counters. Extremely minute amounts of radioactivity in liquids or solids, collected on paper (swipes) or in liquids or air filter paper are placed immediately adjacent to a sensing device which is located inside a lead jacket (lead pig), to reduce background radiation. The ionization produced in the sensing device is transmitted to a scaler-counter

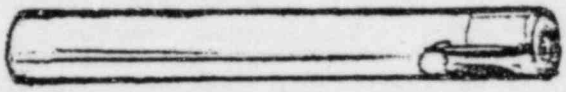


as pulses which are translated as counts per minute on a register, light system, or print-out system.

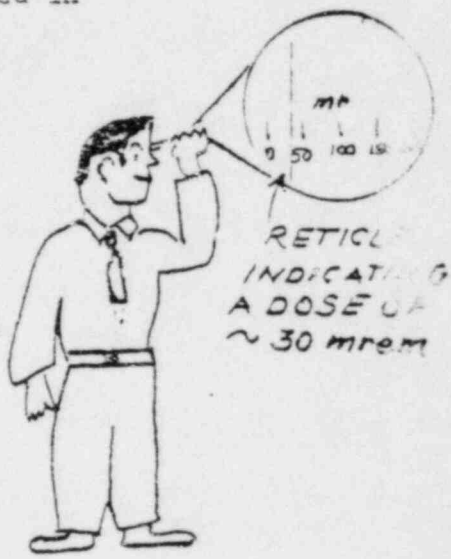
d. Neutron detection meters. These meters, both portable and fixed, detect and measure fast and slow neutrons. A common capture detector device is shown on the right. The boron in BF_3 gas, inside the sensing head, captures slow neutrons and gives rise to the formation of Li and α particles producing ionization which is translated to counts per minute or neutrons/sec/cm^2. For fast neutron detection, the cadmium in the shield captures slow neutrons and the fast neutrons are moderated in passing through an inside layer of paraffin to slow neutrons which then react with the BF_3 as described above. By removing the shield, the probe then measures slow neutrons only. Other fission devices exist such as U-235 and U-238, lined detectors for slow and fast neutrons; however, both produce radioactive fission products. These fission products are a source of gamma rays which gradually increase with increased neutron exposure and cause unwanted gamma dosages with subsequent use.



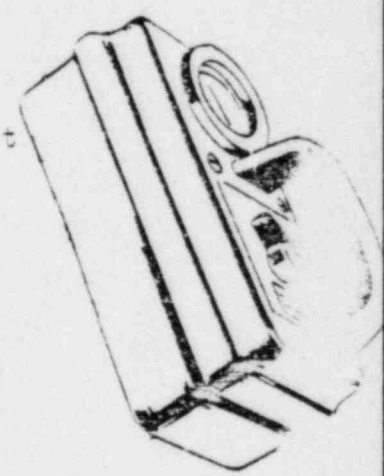
e. Pocket dosimeters. These devices are worn on or near the breast pocket of individuals to measure gamma and X-ray dosage.



A fully charged dosimeter will register zero when viewed in the direction of strong light (see drawing). As gamma and X-ray pass through the dosimeter air chamber, such air becomes ionized and causes the charge inside the air chamber to neutralize which in turn causes a hair-line indicator to drift across a scale, usually marked in 0-200 mR dosage. While in a radiation area, the wearer should occasionally look through the dosimeter to check the amount of radiation he has received up to that moment. Note: Pocket dosimeters are energy dependent and most dosimeters do not accurately measure radiation below 50 KeV. All personnel will wear self-reading pocket dosimeters in addition to film badges in areas where individuals could receive 100 mrem in one hour.



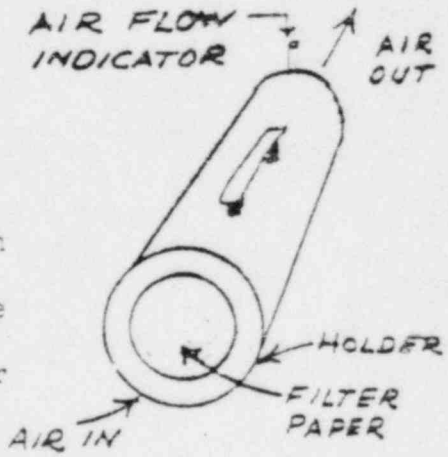
f. Ionization chamber meters. Most of these meters detect and measure gamma and X-ray; however, special types exist having ultra-thin windows and shields which can detect and measure alpha and beta. These meters have ranges in fractions of mR/hr readings up to high R/hr readings. They are energy dependent, and the user should consult manufacturer's specifications for range of energy response.



Ionization chamber meters are primarily used to survey the amount of radiation found at various distances from X-ray and gamma sources.

g. Geiger-Mueller meters. These instruments operate at higher voltages than ionization chambers and have the inherent ability of creating a large pulse response from a single ionizing event. This sensitivity enables the Geiger-Meter to detect small quantities of radioactive materials. Accordingly, this meter is used to detect radioactivity on personnel, equipment, in laboratories (as shown) and to verify the completeness of decontamination operations. These meters usually have a metal covering over the sensing device which permits only gamma detection and measurement when closed, and beta detection and gamma detection and measurement when open. Geiger-Mueller instruments operate over low mR/hr ranges, and many have the undesirable characteristics of becoming saturated in high R/hr areas and thereby giving false readings in these areas.

h. Air sampling devices. These devices are similar in operation to a vacuum machine. Air is drawn through an orifice at a measured rate; radioactive substances in air is filtered through a piece of special paper. After operation of the machine, the radioactivity deposited on the paper is counted on a laboratory-counting instrument



which relates the amount of radioactivity in the air per unit volume of air. Air sampling devices assure that the air breathed by radiation workers does not exceed the maximum permissible concentrations of radioactivity in air specified by AEC regulations.

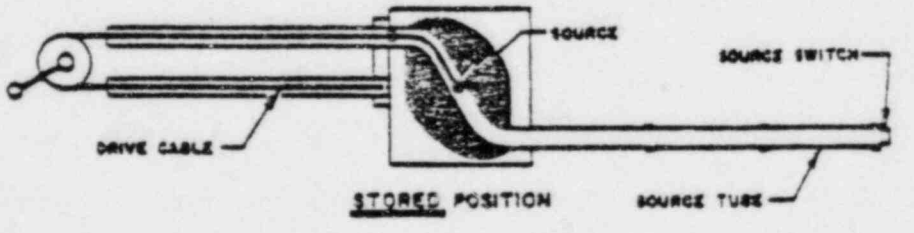
Section X

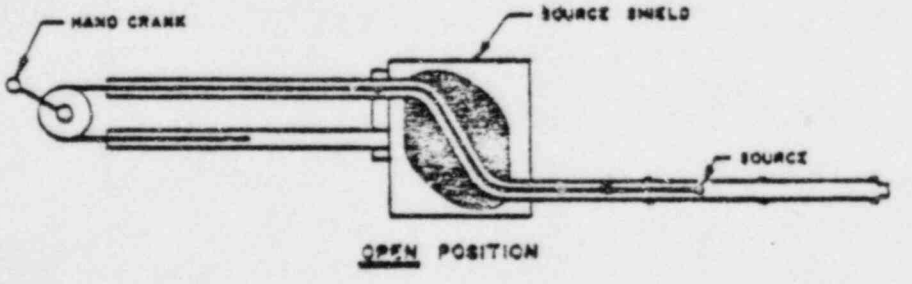
RADIOGRAPHIC SOURCES (Gamma Ray Projectors)

22. Radiography. a. X-rays and the gamma rays, emitted from radioactive sources such as Co-60 and Ir-192, have proven valuable in finding defects in castings, gears, pipe, shells and other metal objects. Using radioactivity to discover flaws in metal by causing an image of the metal to appear on film is defined as radiography.

b. Radioactive sources have the advantage of being portable, i.e., used in the field and generally being capable of penetrating considerable thicknesses (approximately 5") of metal.

c. The basic operation of a radiographic source is to cause a sealed radioactive source to be driven, usually by means of a hand-driven cable, to an exposed position as shown in the drawings below:





Unfortunately, these devices are responsible for a disproportionate number of overexposures. A few simple "do's" and "don'ts" as listed, if followed by operators, will greatly reduce overexposures.

(1) Do read and comply with manufacturer's operational instructions.

(2) Don't try to correct a stuck source or other hazardous situation by yourself. Call the supervisor, and together plan a safe, positive method of correcting the situation.

(3) Don't handle the source with bare hands or place your body in the immediate vicinity of the exposed source. At or near contact, most sources are in the 1000's of rems/hours levels; exposure for just minutes to this high level of radiation can cause serious injury.

(4) Do look beyond the wall or other blind spot, and check to be sure that bystanders will not be exposed to your radiographic source.

(5) Do check source location with survey meter to assure that source is "all the way home" in shield.

Section XI

DECONTAMINATION

23. Definition. Decontamination is the removal of undesirable amounts of radioactive materials which may be harmful to the health and safety of personnel or to the validity of experiments or tests.

24. Contamination. Contamination is generated as the result of spills, explosion or burning material which contains radioisotopes, grinding, welding, machining, or sanding of radioactive solids, evaporation,

aeration or spilling of radioactive liquids; in general, the unwanted transfer of radioactive materials from places where they should be to places where they should not be.

25. Radioactive contamination. Radioactive contamination is unique from other types of contamination in that radioactivity can exist in amounts that can be harmful and yet be invisible. Because they are hazardous in extremely small quantities and yet invisible, they can spread throughout a laboratory without anyone being aware of the fact that he is carelessly causing this transfer. One policy that must be adopted and rigidly enforced is that after working with radiation all persons must insist that they be monitored; further, working areas must be monitored after working with radiation.

26. Transfer. Radioactivity cannot be destroyed by chemical or physical means. It can only be moved from one place to a more desirable place by means such as dissolving or wiping up the scum, grease, or dirt on the equipment in which the radioactive contamination is lodged, or by dissolving the radioactive isotope with an acid or other chemical which would dissolve the stable non-radioactive isotope in the same element.

Note: All elements behave alike chemically whether they are or are not radioactive; for example, stable lead and radioactive lead are two isotopes of lead; i.e., they are the same chemically and physically. Radioactive contamination can also be physically removed by sanding, planing, or scraping off things such as paint in which it is embedded.

27. Decontamination techniques. a. Spills and other radioactive losses must be decontaminated (sometimes picked up, wiped up, or vacuumed by using an absolute filter) as soon as practicable. Otherwise, the contamination has a greater probability of spreading. Always work from the edges toward the center of a contaminated area and remember that all equipment, solutions, rags and water run-offs are contaminated and are to be treated accordingly. Always work upwind of a contaminated area and always work from the top to the bottom of a contaminated area.

b. All persons working with contamination will wear anticontamination clothing (overalls, booties, gloves, cap or hood and if an aerosol hazard exists, a full protective mask will be worn).

c. Personnel decontamination.

(1) Skin cuts. Radionuclides entering a cut will be flushed immediately with copious amounts of water being careful not to wash other contamination from upper parts of the cut area into the cut. A doctor will then dress and care for the wound.

(2) Skin decontamination. First, specific hot spots on the skin should be located and wetted with liberal amounts of soap and water. The area will then be washed thoroughly with a brush having very soft bristles, only for about one or two minutes. Then, the skin area should be monitored to measure the efficiency of decontamination, and the scrubbing continued for approximately three minutes. If any signs of radioactivity remain, or the skin is becoming red or breaking out in rashes, then the person should be assisted by a doctor.

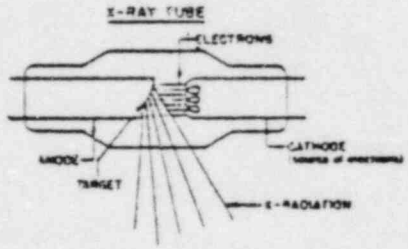
(3) Hair. Hair is best decontaminated by using a mild detergent. Particular care should be taken to prevent suds and water from entering the eyes, ears, nose or mouth. Several washes and rinses should be applied before drying the hair.

(4) Planning. All of the above actions must be pre-planned before actual operations commence.

Section XII

X-RAYS

28. Discovery. X-rays were discovered in 1895 by Herr Conrad Roentgen. X-rays are generated when fast moving electrons strike any target. These electrons are generated when a filament (cathode) is heated to incandescense. The electrons emitted from the filament are then accelerated through an air evacuated tube and varying potentials $\sim$ 100 kV and much higher voltages, and strike a target (anode). The electrons are stopped in the target which then becomes the source of X-rays.



29. Similarity to gamma rays. a. These rays are similar to gamma rays in that they blacken film and ionize gas mediums. Consequently, their dose and dose rate can be measured by standard Army film badge,

pocket dosimeter, and ionization chamber instrument. The Army film badge can measure X-rays down to approximately 10 keV and above; pocket dosimeters can respond to rays as low as 50 keV; ion chambers vary in accordance with manufacturer's specifications. X-rays are like gamma rays in their effect on the body and other materials. The primary difference is that gamma rays originate from the nucleus of the atom and X-rays are generated by changes in electrons which surround the atom and by electron deceleration.

b. Specifically, two different types of X-ray spectra exist; a continuous spectrum and a sharp line spectrum. The continuous spectrum results when the electrons are decelerated in the target by the coulomb field of force of the nuclei of the target atoms. This radiation is called Bremsstrahlung or braking rays. The sharp line spectrum is produced by the energy changes which take place as a result of the rearrangement of the electrons in the various electronic levels of the atom following the transfer of energy to the atom by the impinging electron.

c. X-rays entering materials are attenuated and re-emitted as scattered and secondary X-rays. This property of X-rays must be located and measured by operators to reduce exposure. Scattered rays are rays which have collided with atoms of the absorbing material causing a change in direction. Most of this scattering is in a forward direction; part is at right angles to the forward direction, and a small fraction is emitted in a backward direction. Secondary X-rays are caused by

original X-rays reacting with, or ejecting, orbital electrons and the subsequent filling of these orbits by electrons with the emission of an X-ray characteristic of the absorbing material. Secondary X-rays are emitted equally in all directions.

30. X-Ray Precautions.

a. Always wear film badge and pocket dosimeter.

b. Never make any adjustments in the cone or filter or other parts of the unit unless you are extremely familiar with machine and associated hazards.

c. Any change in the instrument or placing new type of material in the path of the primary beam will necessitate a new survey. Surveys will always include those areas occupied by personnel on the other side of walls, ceilings, or floors.

d. New units will be surveyed before using. Note: The Army Environmental Hygiene Agency (AEHA) is available, upon request through Commanding General, TECOM, ATTN: AMSTE-ST, for assistance in surveying X-ray and other operations that present radiation hazards.

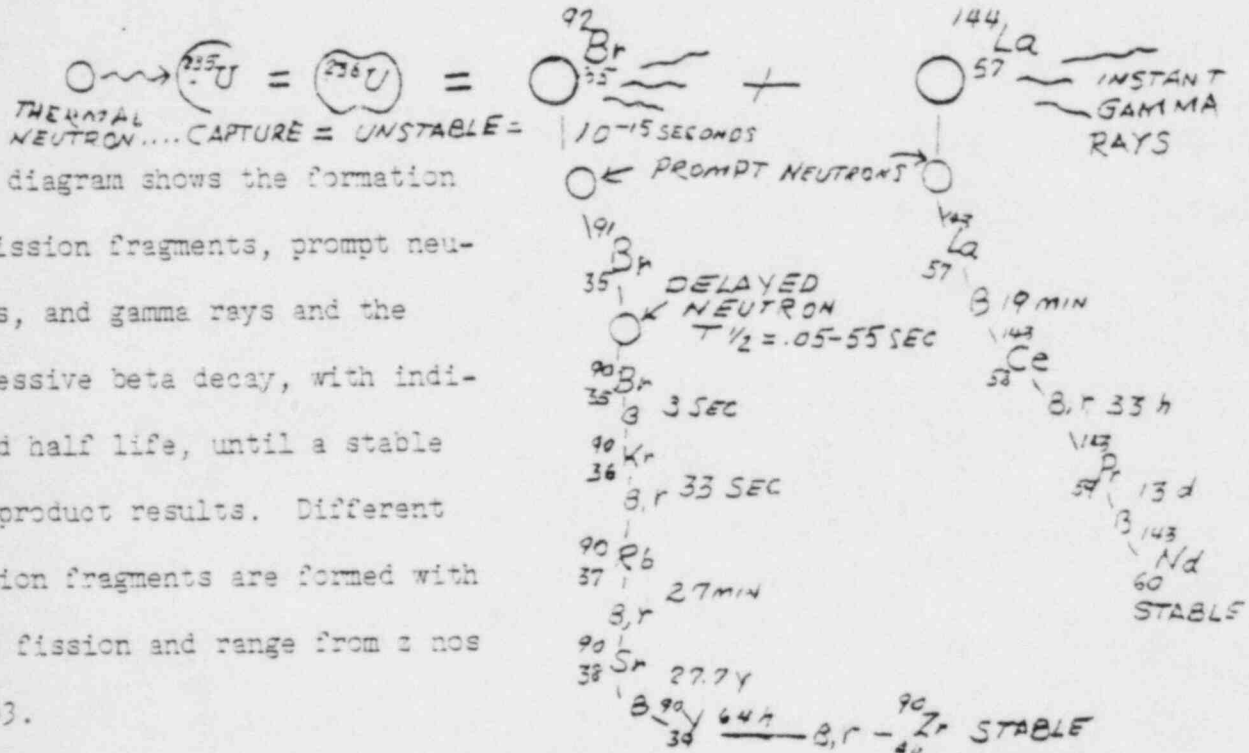
Section XIII

NEUTRONS AND FISSION

31. Neutrons. Neutrons, because of neutral charges are very effective in penetrating the positively charged nuclei of atoms and thereby producing nuclear transformations. The early pioneers could bombard only the light elements with alpha particles because of the strong coulombic repulsions involved with the higher z elements. However, with the advent

in 1932 of the neutron, scientists were capable of bombarding the higher elements and causing nuclear transmutations (changing one element into another element).

32. Fission. a. Enrico Fermi was bombarding uranium with neutrons in the hope of creating transuranic elements; that is, elements with an atomic number greater than 92, and accidentally produced fission. It was later shown that 235U was primarily responsible for this fission as shown below. Note: Natural uranium contains .7% 235 and .006% 234 (both fissionable).



This diagram shows the formation of fission fragments, prompt neutrons, and gamma rays and the successive beta decay, with indicated half life, until a stable end-product results. Different fission fragments are formed with each fission and range from z nos 30-63.

b. At the instant when fission fragment is formed, each fragment has a neutron/proton (nz) ratio of about 1.6. These fragments have an excess number of neutrons because the range of n/z ratio for stable elements is about 1.3 - 1.5. Hence, the unstable fragments go to a stable ratio by emitting neutrons and beta decay. For each fission

event, 2.47 ± .03 neutrons are emitted. Of this amount approximately .755% are delayed neutrons with half-lives of .05-55.6 seconds. These delayed neutrons play a vital role in the sustained operations of a nuclear reactor.

c. The primary source of energy from each fission event for conversion to usable power comes from the large fission fragments which ionize the medium through which they travel. Another source of energy usable for power is the residual decay product, the beta and accompanying gamma decay. The total distribution of fission energy is shown below:

Kinetic energy of fission fragments	162 MeV
Beta decay energy	5
Gamma decay energy	5
*Anti-neutrino energy	11
Energy of fission neutrons	6
Instantaneous gamma-ray energy	6
Total	195 MeV

Research reactors, such as the White Sands Missile Range (WSMR) reactor, serve primarily as a source of neutrons and gamma rays; that is, different materials can be placed near the reactor and studies made of the neutron and gamma effects on such materials (target materials).

*Anti-neutrinos are very small particles which share a spectrum of energy distributions with each beta emission. They are not a health hazard.

33. Other sources. a. Neutrons are also produced when light elements for example, beryllium,are bombarded with alpha particles. An intimate mixture of plutonium, polonium, or radium mixed with beryllium is commonly used to produce neutrons.

b. Another source of neutrons is the accelerator. A typical method is to use a tritium target and accelerate a deuteron (one proton plus one neutron, stripped of its electron) into the target to produce neutrons.

Section XIV

H-3, Pm-147 and Kr-85

34. Tritium, H-3; promethium Pm-147, and krypton, Kr-85 when mixed with a phosphor such as zinc sulphide. ZnS, are being used widely throughout the Department of Defense as luminous night sights; i.e., for night time illumination of weapons, instruments, and other equipment. Although these radionuclides are considered less hazardous than radium, they are hazardous. The relative index of safety and other facts bearing on safe handling are provided below:

35. Tritium (H-3). a. H-3 found in luminous devices is usually in paint form; i.e., tritium compounds mixed with ZnS and a binder or in gaseous form; i.e., tritium gas contained in a sealed glass tube coated on the inside with ZnS and a binder. Of these two forms, H-3 in gas form contained in sealed glass is the safer one, because minimal leakage exists. H-3 in paint form readily leaks through plastic and other enclosures.

b. H-3 encapsulated in glass is in the elemental gas form. This gas readily combines with water in the air to form tritium oxide. Tritium oxide is completely absorbed in the lungs and readily absorbed through the skin. Breakage of H-3 gas capsules in the open would not, in most cases, be hazardous to personnel. However, tritium gas capsules broken inside of a building, particularly one containing a re-circulating air conditioner, would cause many, many contamination and exposure problems. Needless to say, tritium glass capsules, subject to breakage should be used only in a ventilated hood possessing a 100 linear feet/min air flow or used only outdoors.

c. H-3 is only an internal hazard. No gamma or Bremsstrahlung radiation hazard exists.

d. H-3 is readily absorbed by water, grease, scum, and other hydrogenous compounds.

e. Loose H-3 contamination is usually measured by swiping a 100 cm^2 area, about the size of the palm of your hand, with a metrecel filter and counting the swipe in a liquid scintillation counting system. H-3 can also be counted in an internal gas flow system. However, most laboratories will not permit this action since it results in contamination of the system.

f. Because of the weak 18 keV beta maximum, H-3 cannot be counted with instruments possessing a membrane filter over its sensing probe; e.g., CM meters, cutie pies, etc.

36. Promethium, Pm-147. a. Pm-147 is used only in a solid form mixed with ZnS and a binder. It is commonly encased in clear plastic such as mylar or silicone. The beta radiation, 247 keV, usually does not pass through the plastic. This beta radiation causes Bremsstrahlung radiation $\sim$ 90 keV which is noted below:
Breakage of Pm-147 sources, would in some cases, result in particulate contamination which can be detected with portable instruments, example: GM instruments possessing thin windows. A window thickness of less than 2mg/cm^2 is required to detect small amounts of loose Pm-147 on hands, body and clothing.

b. As indicated above, Pm-147 is an internal hazard, and also, under most conditions, a negligible external hazard. The radiation levels fall off rapidly with distance; e.g., at 6" from a 3mCi level source and at 12" from a 500 mCi source the radiation is in the low mR/hr levels.

c. Pm-147 is readily absorbed by grease and scum. Loose Pm-147 contamination levels are measured by swiping a 100 cm^2 area with a paper or cloth swipe and counting same in a laboratory counting system. A rough determination can be made of contaminated levels by first placing the swipe immediately adjacent to the open end of a GM probe, less than 2mg/cm^2 window. Any response would indicate a gross amount of radioactivity.

37. Krypton, Kr-85. a. Kr-85 is used only in gas form encapsulated in a glass capsule coated with ZnS. Kr-85 is a noble gas and

accordingly, the problems of contamination, body uptake, leak testing, and swiping are minimal. Kr-85 does emit a strong gamma ray. Lead is positioned around most Kr-85 sources in order to lessen this gamma radiation hazard. Kr-85 is readily detected with portable meters. If a glass source containing gas is broken, the luminosity will be reduced greatly. If a source containing solid H-3 or Pm-147 breaks, there will usually be a negligible change in luminosity. Luminous night sights can be considered as equivalent to small batteries which will last for three-to-six years before requiring replacing. Additionally, these devices operate in all temperature extremes and do not require bulbs or wiring.

Specific Data

	H-3	Pm-147	Kr-85
Half life	12.2 years	~ 2.7 years	~ 10 years
Beta energy (max)	18 keV	247 keV	670 keV
External radiation	None	Bremsstrahlung	Gamma
Natural form	Gas - (also mixed chemically to form solids)	Solid	Gas

Section XV

HANDLING AND TESTING RADIOACTIVE MATERIAL

38. Instructions. The following instructions in this section and Section XVI represent base-line instructions for all activities such as test boards or other activities who do not possess an AEC license or radiation protection officers but instead rely on assistance from

other agencies to test radioactive (usually luminous) devices. The above activities will not deviate from the listed requirements unless authorized by the TECOM Safety Office.

a. All test personnel will receive a one-two hour orientation on radiological safety before testing.

b. All test personnel working directly with or handling radioactive equipment will wear film badges. Note: It may be necessary to wear a film badge for only one week to verify the fact that no external hazard exists.

c. If any radioactive source or other device should break or indicate gross leakage, i.e., loss of luminosity, then a urine sample will be taken no sooner than four hours after the discovery or as soon thereafter as possible. The TECOM Safety Office will be notified immediately of any such occurrence. Bottles will be mailed after each group collection to the US Army Environmental Hygiene Agency, ATTN: Radiochemistry Division, Edgewood Arsenal, Maryland 21010.

d. The sources or the exterior surfaces immediately adjacent to sources, will be swiped before test and at the end of each test day. Swipes will be counted locally or mailed on a daily basis to the address above.

e. Any swipe test taken from instruments, or from personnel, that indicates a level above background, when measured with an open GM probe (window thickness must be less than 2 mg/cm^2), will be the criterion for stopping further testing. Testing will be resumed only when it is

determined by AEC licensed user personnel that the personnel (or instrument) are decontaminated, or when the instrument is replaced.

f. Those portions of the radioactive equipment that seal-in radioactive sources will not be opened, nor will any of the radioactive sources be modified or handled in any way except when such handling is under the direct control of the licensee or persons named by the Headquarters, TECOM Health Physicist.

g. All test personnel working directly with radioactivity will have their hands and bodies monitored with the open probes of a GM instrument. All test personnel will also wash their hands after each test and before eating. Washing hands with soap and water is an absolute requirement.

h. All equipment containing radioactivity will be stored in a locked container(s). Container(s) will be located in a ventilated hood or other ventilated area such as an open shed or a secured, fenced-in area, or other areas approved by the Headquarters, TECOM, Health Physicist.

i. Local fire department and security personnel will be informed of the types and amounts of radioactivity on hand and instructed about action to be taken in the event of a fire or other emergency.

j. Radioactive material will not be loaned, shipped, or handled by non-test personnel unless authorized by the licensee or this headquarters.

Section XVI

STANDING OPERATING PROCEDURES FOR RAD TECHNICIANS

39. Procedures. The following procedures are provided for Rad

technician: Note: These procedures were taken from a past test involving radioactive luminous sights. Because most future tests involving radioactivity by test boards will also include similar luminous devices, these duties, with minor modifications, will be followed in all such future tests.

a. Take 20-minute background in morning.

b. Swipe each luminous device after each test.

c. Swipe hands of all personnel handling luminous devices after each day of testing.

d. *If source should break, or screening of swipes by portable GM meter indicates background is exceeded, then all hands, face, shoes, and clothing of affected personnel will be swiped. Any person who has detectable contamination on face or on clothing will shower himself.

e. *Contaminated personnel will be decontaminated until no detectable radiation exists on personnel.

f. Check meter response to check source daily.

g. Dispose of broken devices only in a Rad-waste yard (per TECOM instructions).

h. All test personnel will have their hands monitored by meter and will wash their hands after tests and before messing.

i. *Any swipe which measures 220 DPM will cause device to be withdrawn from further testing.

j. Record swipe data on survey forms provided.

k. Mail film badges and LBAD Form 352 (3 copies) to Commanding Officer, Lexington-Bluegrass Army Depot, Lexington, Kentucky 40507, ATTN: Maintenance Directorate, Chief, Nucleonics Branch.

l. Call Headquarters, TECOM, Safety Office Health Physicist, Aberdeen Proving Ground, Maryland, telephone extension 3677 or 2170, if any problems arise or any of the asterisked conditions exist.

m. If any luminous device should break or indicate gross leakage; i.e., loss of luminosity, then a 24-hour urine sample will be taken to start with the first urine voidance occurring four hours after exposure. Urine voidance collection will continue for a 24-hour period with each individual collecting all his urine voidances in bottles marked with his name. Bottles will be mailed after the 24-hour collection period to the US Army Environmental Hygiene Agency, ATTN: Rad Chem Div., Edgewood Arsenal, Maryland 21010.

40. Other information. Additional guidance is provided below:

a. Contamination levels are listed in Table I, page 24, AMC Regulation 385-25.

b. Counting instructions (for counting BKG $\sim$ 25 CPM).

Devices and Personnel. One-minute count for screening background levels.

Devices. Ten-minute recount for swipes which are above mean background.

Personnel. Preset to 200 counts (recount) for personnel swipes which are above mean background.

Note: 220 DPM will require withdrawal of device from further testing.

c. A background swipe will be taken from hood of vehicle, or from other similar surface area, during each test day.

d. If radioactive luminous source is lost in the field, a 110-volt generator will be taken to the field to power an ultra-violet lamp. The ultra-violet (plus extension cord) will be utilized to locate the lost source.

e. At least once a week, an ultra-violet survey will be made of the storage area to locate any flaking loss (small pieces of phosphor).

Section XVII

LIMITING EXPOSURE TO INDIVIDUAL

41. Safety Measures. The actions below have, or will be, taken by higher headquarters to insure the safety of each individual who works with or near radiological material.

a. Publish rules, regulations, and technical publications.

b. Provide experienced, on-call personnel to assist in advising or assisting anyone with any radiation problem.

c. A radiological safety committee exists which reviews and approves all operations involving radiation (local level).

d. Provide protective anti-c clothing, masks and other handling, shielding, and ventilating equipment.

e. Provide film badges, pocket dosimeters, portable and fixed instrumentation for measuring radiation.

f. Provide periodic medical examinations to personnel working with radiation.

g. Post radiation and other warning signs in all areas requiring same.

42. Individual responsibility. Precautions which each individual who works with radioactivity must take to assure his own safety are listed below:

a. Read, understand and comply with all instructional material and regulations.

b. Wear your film badge and pocket dosimeter. Read your pocket dosimeter as required. Know your cumulative dosage. Notify your supervisor when your weekly dosage approaches 100 mrem.

c. Don't remain in radiation longer than necessary. Keep maximum practical distance from radiation. Use shielding materials when practical.

d. Safeguard radioactive materials in your charge so that other personnel will not be unnecessarily exposed.

e. Notify your supervisor of:

(1) Damage or improper functioning of safety equipment, e.g., torn anti-c clothing, protective masks, damaged air filteration systems, defective instruments or rad-handling equipment.

(2) Any stuck or inoperative source system. Note: Do not attempt to correct dangerous systems yourself. Notify your supervisor and together plan a safe technique or course of action to correct any deficiency.

(3) Any wound you have received before, or while working, such

as a break in the skin, or any other incident where radioactive material may have entered a person's body.

(4) Any spill of radioactive material or liquid. Always initiate action to clean up or remove any contamination your job has caused.

f. Always monitor your hands, feet, head and clothing, and immediate working area after work with radioactive material.

43. Supervisor's responsibility. a. Assure that each individual assigned to work with radioactive materials is informed of hazards and is properly trained.

b. Remove (or limit) personnel from further radiation exposure when his dosage approaches prescribed limits or his attitude or past work practices are such that he is a hazard to himself and others.

c. Request assistance from higher headquarters or AEHA for resolving difficult problems.

Section XVIII

EXAMPLES OF TECOM TESTING OF RADIATION SOURCES

44. The following are examples of TECOM testing of radiation sources:

a. Luminous Night Sight Devices. Those devices containing radioactivity which provide night-time illumination of devices contained in military equipment are tested for military application and hazards to using troops.

b. Tagging. Short lived radioactivity such as Ta-182, Sc-46 are placed in the fused area of ammunition. Radiation emanations then aid in locating spent fuses and duds.

c. Calibration of Instruments. Radiac instruments are checked against ability to measure accurately certain types and amounts of radiation.

d. Tracer Studies. A small amount of radioactive substance or element is placed in a piece of equipment or testing medium. After testing, extremely small quantities of tracer residue can be detected with sensitive radiological detection instruments.

e. Radiography. Gamma rays from radioactive sources or X-rays from X-ray devices pass through materials and outline the defects inside the materials on photographic film.

f. Radiation Effects. Study of radiation induced chemical and physical changes in materials.

g. Dosimetry. Study of absorbed dose in materials.

h. Shielding. Study of the attenuation of gamma rays and neutron particles through various materials.

i. X-ray. Study of materials in flight, break up of materials due to explosives or other forces.

j. Gages. Determine thickness, content and density of materials.

k. Reference standards. Known amounts of radioactivity are used to determine the efficiency of laboratory instruments in counting a particular radionuclide.

l. Check sources. Small amounts of radioactivity placed in a wand or similar device is held near an instrument's sensing probe to determine if an instrument will respond to radioactivity.

m. Other tests. TECOM testing also encompasses many other diversified test projects involving missiles, accelerators and fast burst reactor studies.

Section XIX

MISCELLANEOUS INFORMATION

45. Alphabetical List of the Elements. (see Appendix A).

46. Densities of Common Metals in gm/cc. (see Appendix B).

47. Calculated Gamma Radiation Levels, at one meter for one curie. (see Appendix C).

48. Transmission of Ra-226, Co-60 and Cs-137. (see Appendix D).

49. Decay Chart for Common Radionuclides. (see Appendix E).

50. Proper Use of Radioactive Sources in an Instrument (see Appendix F).

APPENDIX A

ALPHABETICAL LIST OF THE ELEMENTS

At. No.	Name of Element	Sym.	At. Wt.	At. No.	Name of Element	Sym.	At. Wt.	At. No.	Name of Element	Sym.	At. Wt.
89	Actinium	Ac	227	79	Gold	Au	196.967	59	Praseodymium	Pr	140.907
13	Aluminum	Al	26.9815	72	Hafnium	Hf	178.49	61	Promethium	Pm	145*
95	Americium	Am	243*	2	Helium	He	4.0026	91	Protactinium	Pa	231*
51	Antimony	Sb	121.75	67	Holmium	Ho	164.930	88	Radium	Ra	226*
18	Argon	Ar	39.948	1	Hydrogen	H	1.00797	86	Radon	Rn	222*
33	Arsenic	As	74.9216	49	Indium	In	114.82	75	Rhenium	Re	186.2
85	Astatine	At	210*	53	Iodine	I	126.9044	45	Rhodium	Rh	102.905
56	Barium	Ba	137.34	77	Iridium	Ir	192.2	37	Rubidium	Rb	85.47
97	Berkelium	Bk	247*	26	Iron	Fe	55.847	44	Ruthenium	Ru	101.07
4	Beryllium	Be	9.0122	36	Krypton	Kr	83.80	62	Samarium	Sm	150.35
83	Bismuth	Bi	208.980	57	Lanthanum	La	138.91	21	Scandium	Sc	44.956
5	Boron	B	10.811	103	Lawrencium	Lw	257*	34	Selenium	Se	78.96
35	Bromine	Br	79.909	82	Lead	Pb	207.19	14	Silicon	Si	28.086
48	Cadmium	Cd	112.40	3	Lithium	Li	6.939	47	Silver	Ag	107.870
20	Calcium	Ca	40.08	71	Lutetium	Lu	174.97	11	Sodium	Na	22.996
98	Californium	Cf	251*	12	Magnesium	Mg	24.312	38	Strontium	Sr	87.62
6	Carbon	C	12.01115	25	Manganese	Mn	54.9380	16	Sulfur	S	32.064
58	Cerium	Ce	140.12	101	Mendelevium	Md	256*	73	Tantalum	Ta	180.948
55	Cesium	Cs	132.905	80	Mercury	Hg	200.59	43	Technetium	Tc	99*
17	Chlorine	Cl	35.453	42	Molybdenum	Mo	95.94	52	Tellurium	Te	127.60
24	Chromium	Cr	51.996	60	Neodymium	Nd	144.24	65	Terbium	Tb	158.924
27	Cobalt	Co	58.9332	10	Neon	Ne	20.183	81	Thallium	Tl	204.37
29	Copper	Cu	63.54	93	Neptunium	Np	237*	90	Thorium	Th	232.038
96	Curium	Cm	247*	28	Nickel	Ni	58.71	69	Thulium	Tm	168.934
66	Dysprosium	Dy	162.50	41	Niobium	Nb	92.906	50	Tin	Sn	118.69
99	Einsteinium	E	254*	7	Nitrogen	N	14.0067	22	Titanium	Ti	47.90
68	Erbium	Er	167.26	102	Nobelium	No	253*	74	Tungsten	W	183.85
63	Europium	Eu	151.96	76	Osmium	Os	190.2	92	Uranium	U	238.03
100	Fermium	Fm	253*	8	Oxygen	O	15.9994	23	Vanadium	V	50.942
9	Fluorine	F	18.9984	46	Palladium	Pd	106.4	54	Xenon	Xe	131.30
87	Francium	Fr	223*	15	Phosphorus	P	30.9738	70	Ytterbium	Yb	173.04
64	Gadolinium	Gd	157.25	78	Platinum	Pt	195.09	39	Yttrium	Y	88.905
31	Gallium	Ga	69.72	94	Plutonium	Pu	244*	30	Zinc	Zn	65.37
32	Germanium	Ge	72.59	84	Polonium	Po	209*	40	Zirconium	Zr	91.22
19	Potassium	K	39.102								

*Mass number of the most stable isotope.

Atomic weights are based on C^{12} taken as 12.0000.

APPENDIX B

DENSITIES OF COMMON METALS in gm/cc

Aluminum	Al	2.699	Phosphorus	P	2.34
Beryllum	Be	1.84	Platinum	Pt	21.37
Bismuth	Bi	9.781	Potassium	K	0.87
Cadmium	Cd	8.648	Silver	Ag	10.492
Calcium	Ca	1.54	Sodium	Na	0.9712
Cesium	Cs	1.873	Strontium	Sr	2.50-58
Chromium	Cr	6.92	Sulfur	S	2.0-1
Cobalt	Co	8.71	Tantalum	Ta	16.6
Copper	Cu	8.92	Thallium	Tl	11.86
Gold	Au	18.88	Thorium	Th	11.3
Iridium	Ir	22.42	Tin (white)	Sn	7.29
Iron	Fe	7.85-88	Tin (gray)	Sn	5.8
Lead	Pb	11.342	Titanium	Ti	4.5
Magnesium	Mg	1.741	Uranium	U	18.7
Manganese	Mn	7.42	Tungsten (Wolfram)	W	18.6-19.1
Mercury (L)	Hg	13.546	Zinc	Zn	6.92
Molybdenum	Mo	10.2	Zirconium	Zr	6.44
Nickel	Ni	8.60-90			

~ DENSITIES OF COMMON MATERIALS IN gm/cc

Glass	2.5	Lucite	1.2
Paper	0.8	Rubber	1.2
Paraffin	0.9	Wood	0.4 - 1.0

APPENDIX C

CALCULATED GAMMA RADIATION LEVELS, AT ONE METER FOR ONE CURIE

Isotope	T1/2	R/hr @ one meter
Na-22	2.6y	1.20
Sc-46	83 9d	1.09
Mn-54	303d	0.49
Fe-59	45.6d	0.59
Co-57	270d	0.09
Co-60	5.26y	1.32
Zn-65	245d	0.27
Kr-85	10.76y	0.004
Cs-137	30.0y	0.33
Ta-182	115.1d	0.68
Ir-192	74.2d	0.48
Au-198	2.7d	0.23
Ra-226	1622y	0.825

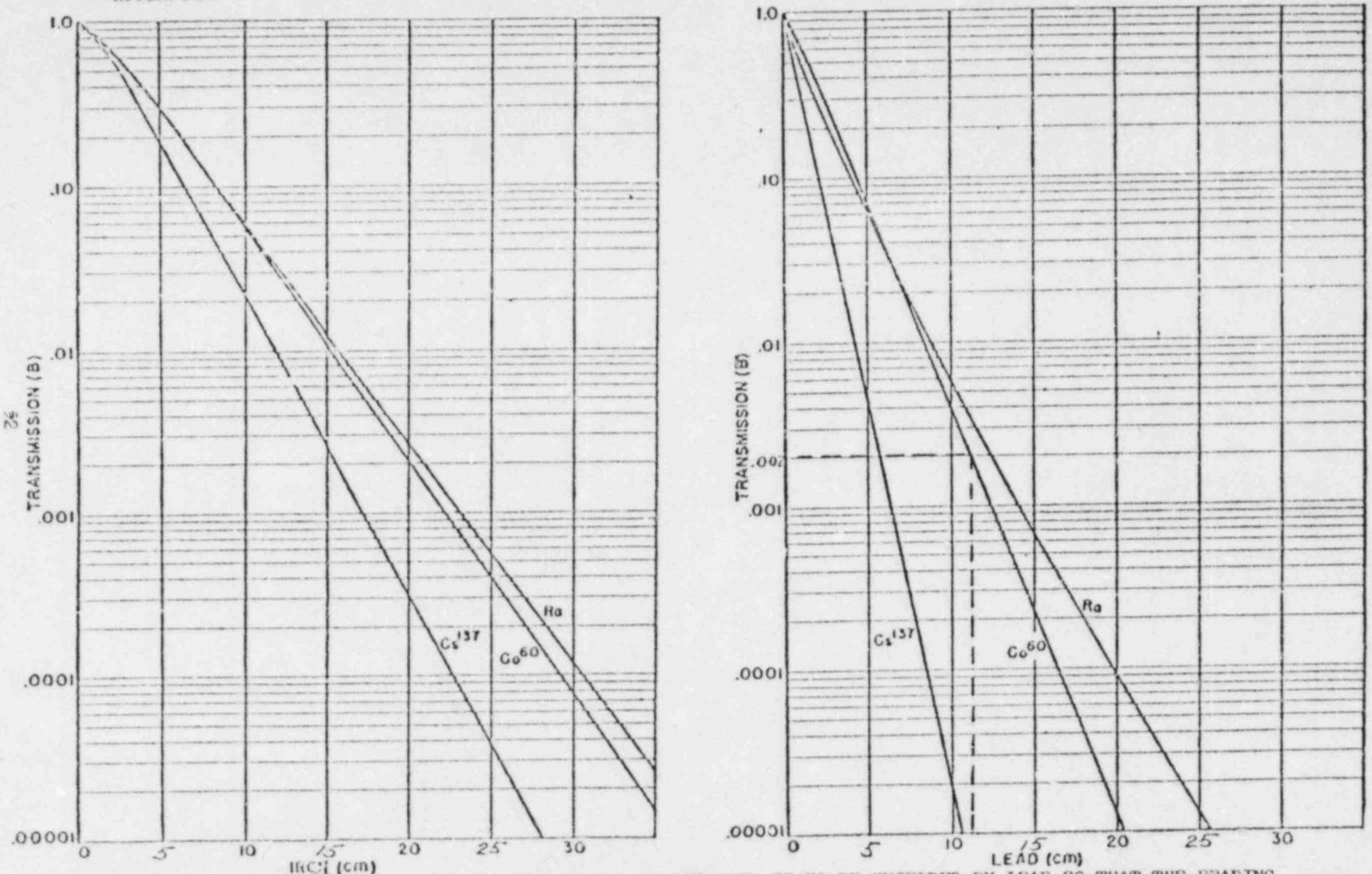
TECOM PAMPHLET
NO. 385-1

(FROM NBS HANDBOOK 54)

25 October 1971

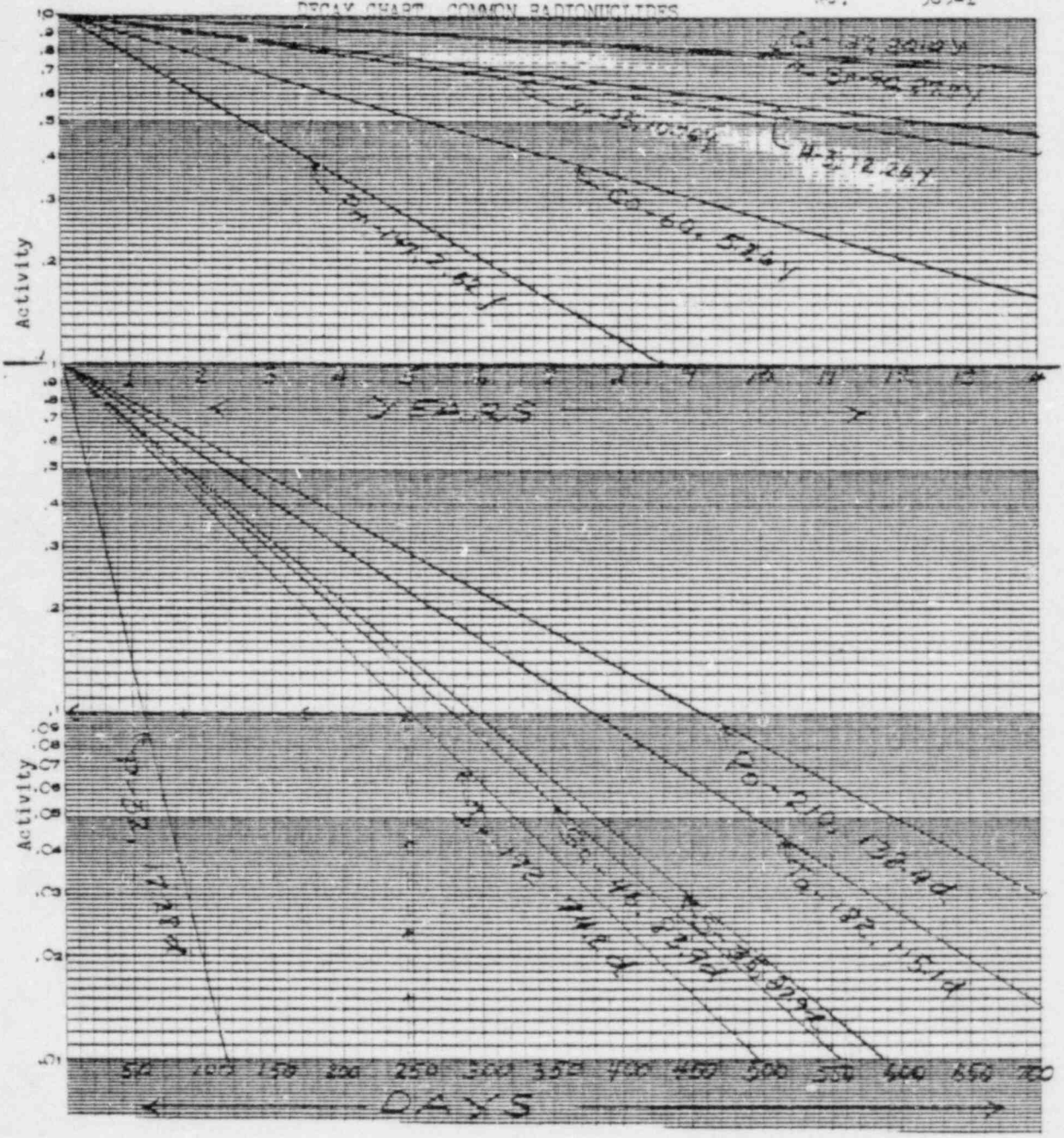
APPENDIX D

TRANSMISSION OF RADIUM, COBALT-60 AND CESIUM-137 GAMMA RAYS (INCLUDES BUILDUP)



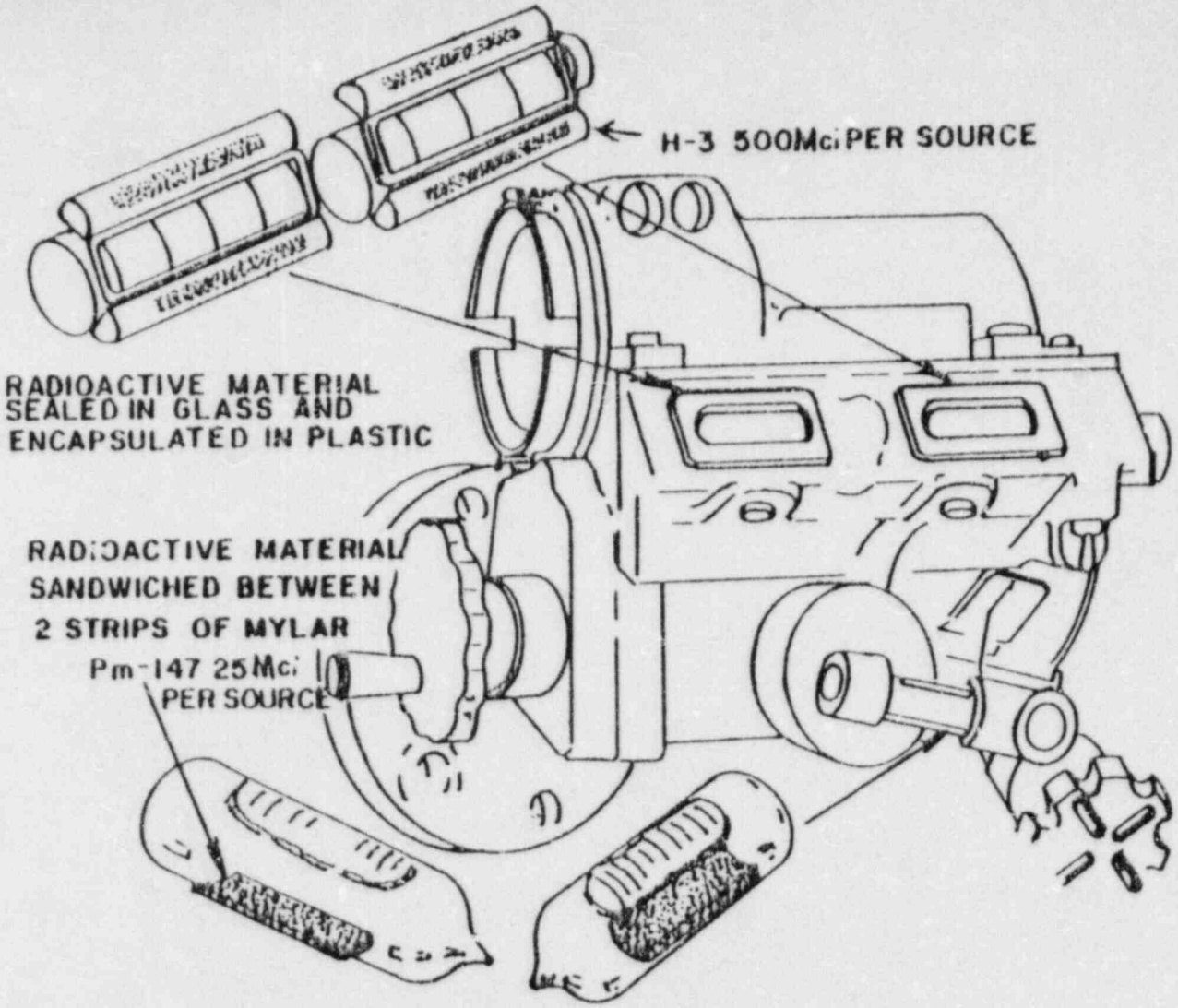
SAMPLE PROBLEM: A Co^{60} SOURCE READING 5000 mR/hr AT ONE YARD IS TO BE SHIELDED BY LEAD SO THAT THE READING AT ONE YARD IS REDUCED TO 10 mR/hr OR THAT THE TRANSMISSION ATTENUATION FACTOR (B) IS $\frac{10}{5000}$ OR .002. THE .002 TRANSMISSION VALUE WILL GIVE A VALUE, AS SHOWN, OF APPROXIMATELY 11+ cm OF LEAD.

DECAY CHART, COMMON RADIONUCLIDES



Example of Chart Use:

If a 50 Ci source of Ir-192 has decayed for a period of 248 days, how much activity remains? Solution: Enter chart at 248 days to Ir-192 line, go left and read that 0.1 of activity or 5 Ci remains.



M14E1 ELEVATION QUADRANT (M102 Howitzer)

The above use of H-3 and Pm-147 illustrates proper use of radioactivity; e.g., H-3 is used, because of its "Zero" radiation, in an area where eyes are in intimate contact and Pm-147 is used to spread illumination. The above resulted in a better job of illumination than batteries and bulbs.