APPENDIX (continued)

FORM NRC-313 I (1-79) 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)*
Broad Scope, Type A

	a. NEW LICENSE
X	b. AMENDMENT TO LICENSE NUMBER 05-00046-13
	c. RENEWAL OF LICENSE NUMBER

2. APPLICANT'S NAME *(Institution, firm, person, etc.)*
Department of the Army
FAMC, Aurora, CO 80045
TELEPHONE NUMBER: AREA CODE – NUMBER EXTENSION
(303) 361-8311

3. NAME OF PERSON TO BE CONTACTED REGARDING THIS APPLICATION
CPT Randall J. Hill
TELEPHONE NUMBER: AREA CODE – NUMBER EXTENSION
(303) 361-3826/3916

4. APPLICANT'S MAILING ADDRESS *(Include Zip Code)*
SAME AS ITEM #2

5. STREET ADDRESS WHERE LICENSED MATERIAL WILL BE USED *(Include Zip Code)*
SAME AS ITEM #2

(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.	USERS WILL BE APPROVED BY THE FAMC RADIATION CONTROL COMMITTEE	
b.	SEE TAB A	
c.		

7. RADIATION PROTECTION OFFICER
Officer appointed by the FAMC Radiation Control Committee (SEE TAB A)

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

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)	Any Byproduct Material w/Atomic 1-83, Inclusive	ANY	NOT APPLICABLE	500 Millicurie qf ea not to exceed 25 Ci
(2)	Iodine - 125	ANY	NOT APPLICABLE	1000 Millicuries
(3)	Iodine - 131	ANY	NOT APPLICABLE	2000 Millicuries
(4)	Krypton - 85	ANY	NOT APPLICABLE	5000 Millicuries

CONT. ON NEXT PAGE

DESCRIBE USE OF LICENSED MATERIAL
E

(1) Request Byproduct Material License of Broad Scope, Human Use, Type A. Byproduct
(2) Material will be used for medical research, clinical diagnosis, therapy, and re-
(3) search and development, as defined under the provisions of Section 30.4(k), (q)
(4) 30.32, 30.32(a) [illegible] Code of Federal Regulations.

FORM

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147 pp

05-00046-13 RDR

NRC-11

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U.S. NUCLEAR REGULATORY COMMISSION

APPLICATION FOR BYPRODUCT MATERIAL LICENSE
INDUSTRIAL

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

Broad Scope, Type A

	a. NEW LICENSE
X	b. AMENDMENT TO LICENSE NUMBER 05-00046-13
	c. RENEWAL OF LICENSE NUMBER

2. APPLICANT'S NAME *(Institution, firm, person, etc.)*

SAME AS PAGE 1

TELEPHONE NUMBER: AREA CODE - NUMBER EXTENSION

3. NAME OF PERSON TO BE CONTACTED REGARDING THIS APPLICATION

TELEPHONE NUMBER: AREA CODE - NUMBER EXTENSION

4. APPLICANT'S MAILING ADDRESS *(Include Zip Code)*

SAME AS PAGE 1

5. STREET ADDRESS WHERE LICENSED MATERIAL WILL BE USED *(Include Zip Code)*

(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.	SAME AS PAGE 1	
b.		
c.		

7. RADIATION PROTECTION OFFICER — *Attach a resume of person's training and experience as outlined in Items 16 and 17 and describe his responsibilities under Item 15.*

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) 5	Xenon - 133	ANY FORM	NOT APPLICABLE	5000 Millicuries
(2) 6	Hydrogen - 3	ANY FORM	NOT APPLICABLE	5000 Millicuries
(3) 7	Molybdenum - 99	ANY FORM	NOT APPLICABLE	5000 Millicuries
(4) 8	Technetium - 99m	ANY FORM	NOT APPLICABLE	5000 Millicuries
	CONT. ON NEXT PAGE			

DESCRIBE USE OF LICENSED MATERIAL
E

(1)	SAME AS PAGE 1
(2)	
(3)	
(4)	

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U.S. NUCLEAR REGULATORY COMMISSION

APPLICATION FOR BYPRODUCT MATERIAL LICENSE
INDUSTRIAL

See attached instructions for details.

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

Broad Scope, Type A

	a. NEW LICENSE
	b. AMENDMENT TO LICENSE NUMBER
X	05-00046-13
	c. RENEWAL OF LICENSE NUMBER

2. APPLICANT'S NAME *(Institution, firm, person, etc.)*

SAME AS PAGE 1

TELEPHONE NUMBER: AREA CODE – NUMBER EXTENSION

3. NAME OF PERSON TO BE CONTACTED REGARDING THIS APPLICATION

TELEPHONE NUMBER: AREA CODE – NUMBER EXTENSION

4. APPLICANT'S MAILING ADDRESS *(Include Zip Code)*

SAME AS PAGE 1

5. STREET ADDRESS WHERE LICENSED MATERIAL WILL BE USED *(Include Zip Code)*

(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.	SAME AS PAGE 1	
b.		
c.		

7. RADIATION PROTECTION OFFICER — *Attach a resume of person's training and experience as outlined in Items 16 and 17 and describe his responsibilities under Item 15.*

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)9	Cesium - 137	ANY	NOT APPLICALBE	1500 Millicuries
(2)0	Strontium - 90	SEALED-TRACER LAB	MODEL NO. RA-1	20 Millicuries
(3)1	Strontium - 90	SEALED - 3M	Model No. 691A	100 Millicuries
(4)2	Cesium - 137	SEALED CELLS & NEEDLES - NOT TO EXCEED NEEDLE (23mg RADIUM EQUIVALENT) TO A TOTAL OF 900 mCi (238mg		60 Millicuries
	CONT. ON NEXT PAGE			

	E DESCRIBE USE OF LICENSED MATERIAL
(1)	SAME AS PAGE 1
(2)	
(3)	
(4)	

FORM NRC-313 I (1-79)

FORM NRC-313 I (1-79)
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. 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)*
Broad Scope, Type A

- a. NEW LICENSE
- b. AMENDMENT TO LICENSE NUMBER — X 05-00046-13
- c. RENEWAL OF LICENSE NUMBER

2. APPLICANT'S NAME *(Institution, firm, person, etc.)*
SAME AS PAGE 1
TELEPHONE NUMBER: AREA CODE – NUMBER EXTENSION

3. NAME OF PERSON TO BE CONTACTED REGARDING THIS APPLICATION
TELEPHONE NUMBER: AREA CODE – NUMBER EXTENSION

4. APPLICANT'S MAILING ADDRESS *(Include Zip Code)*
SAME AS PAGE 1

5. STREET ADDRESS WHERE LICENSED MATERIAL WILL BE USED *(Include Zip Code)*

(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	SAME AS PAGE 1	
b		
c.		

7. RADIATION PROTECTION OFFICER — *Attach a resume of person's training and experience as outlined in Items 16 and 17 and describe his responsibilities under Item 15.*

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)	13 Group VI 10 CFR 35.100	ANY SEALED SOURCE		2000 Millicuries To
(2)				
(3)				
(4)				

	E. DESCRIBE USE OF LICENSED MATERIAL
(1)	SAME AS PAGE 1
(2)	
(3)	
(4)	

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)	NOT APPLICALBE		
(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 TAB "B"					
(2)						
(3)						
(4)						

11. CALIBRATION OF INSTRUMENTS LISTED IN ITEM 10

☐ a. CALIBRATED BY SERVICE COMPANY

NAME, ADDRESS, AND FREQUENCY QUARTERLY
Dept of the Army
Sacramento Army Depot ATTN: DRSMI-MCA-SA
Sacramento, CA 95813

☐ b. CALIBRATED BY APPLICANT

Attach a separate sheet describing method, frequency and standard 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 ☒ (2) THERMOLUMINESCENCE DOSIMETER (TLD) ☐ (3) OTHER (Specify):	US Army Ionizing Radiation Dosimetry Center ATTN: DRSMI-MCI-DCS Lexington, KY 40511	☒ MONTHLY ☐ QUARTERLY ☐ 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.

14. WASTE DISPOSAL

a. NAME OF COMMERCIAL WASTE DISPOSAL SERVICE EMPLOYED

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 STAT

FORM NRC 313 I (1-79)

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.

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 tr g, duration of training, when training was received, etc.

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.

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)*	b. CERTIFYING OFFICIAL *(Signature)* JIMMIE L. CRAFT
	c. NAME *(Type or print)* BG PHILIP K. RUSSELL, M.D.
(1) LICENSE FEE CATEGORY	d. TITLE Commander Fitzsimons Army Medical Center
(2) LICENSE FEE ENCLOSED $	e. DATE 6 February 1984

FORM NRC-313 I (1 79)

ANNEX A

APPENDIX 8

RADIATION CONTROL COMMITTEE

1. Purpose. The Radiation Control Committee is established to direct and control the procurement, storage, use and disposal of all radioisotopes and byproducts within the parameters of US Nuclear Regulatory Commission Licenses and DA Authorizations.

2. Composition.

a. Deputy Commander - Chairperson.

b. Chief, Department of Radiology.

c. Chief, Department of Medicine.

d. Chief, Department of Surgery.

e. Chief, Nuclear Medicine.

f. Chief, Department of Pathology.

g. Chief, Department of Clinical Investigation.

h. Deputy for Preventive Medicine Activities.

*i. Representative of the Department of Nursing.

j. Radiation Protection Officer.

*k. Chief, Directorate of Industrial Operations.

l. Chief, Radiation Therapy.

m. Chief, Department of Cardiology.

n. Chief, Medical Physicist.

o. Nuclear Pharmacy Officer.

*p. Secretary/Recorder.

3. References:

a. AR 40-14, Control and Recording Procedures for Occupational Exposure to Ionizing Radiation.

*Non Voting Members

b. AR 40-37, Radioisotope License Program (Human Use).

c. AR 700-52, Licensing and Control of Sources of Ionizing Radiation.

d. FAMC Reg 40-604, Radiation Safety.

e. Accreditation Manual for Hospitals (JCAH).

f. NRC Regulations Guide 10-8, Preparation of Medical License Application.

4. Objectives.

a. Review and grant permission for, or disapproval of, the use of byproduct material from the standpoint of radiological health and safety.

b. Certify individual users for each type of procedure with each individual radioisotope and insure that a copy of such certification is placed in the user's personnel and credentials records.

c. Maintain current records of training of approved users.

d. Collect and maintain data for reports required by the above references.

e. Be familiar with all pertinent NRC regulations, the terms of the license, and information submitted in support of the request for the license and its amendments.

f. Establish a program to ensure that all individuals whose duties may require them to work in the vicinity of radioactive material (e.g., nursing, security and housekeeping personnel) are properly instructed as required by Section 19.12, of CFR Part 19.

g. Review and approve all requests for use of radioactive material within the institution.

h. Prescribe special conditions that will be required during a proposed use of radioactive material such as requirements for bioassays, physical examination of users and special monitoring procedures.

i. Review the entire radiation safety program at least annually to determine that all activities are being conducted safely and in accordance with NRC regulations and the conditions of the license. The review shall include an examination of all records, reports from the radiation protection officer, results of NRC inspection, written safety procedures and management control system.

j. Recommend remedial action to correct any deficiencies identified in the radiation safety program.

k. Ensure that the byproduct material license is amended, when necessary,

prior to any changes in facilities, equipment, policies, procedures, and personnel.

5. Meetings. The Radiation Control Committee (Radioisotope Committee) will meet quarterly at the call of the Chairperson.

6. Quorum. Will consist of 3/4 (three-fourths) of the voting members.

7. Administration. Minutes of all meetings will be recorded, authenticated by the Chairperson and submitted to the Executive Committee. The original copy will be maintained in the office of record and the file copy will be retained for file in the office of the Adjutant General for one year, then retired to inactive files. Certifications of principal users of radioactive materials will be forwarded to the Chairperson of the Credentials Committee and to Military Personnel Division.

FORM NRC 313M SUPPLEMENT A
(8-78)

U.S. NUCLEAR REGULATORY COMMISSION

TRAINING AND EXPERIENCE
AUTHORIZED USER OR RADIATION SAFETY OFFICER

1. NAME OF AUTHORIZED USER OR RADIATION SAFETY OFFICER: HILL, Randall J., CPT

2. STATE OR TERRITORY IN WHICH LICENSED TO PRACTICE MEDICINE: NA

3. CERTIFICATION

SPECIALTY BOARD (A)	CATEGORY (B)	MONTH AND YEAR CERTIFIED (C)
R.T. B.S.-Radiologic Technology M.S.-Radiological Sciences	Registry No. 045818	1964

4. TRAINING RECEIVED IN BASIC RADIOISOTOPE HANDLING TECHNIQUES

FIELD OF TRAINING (A)	LOCATION AND DATE(S) OF TRAINING (B)	TYPE AND LENGTH OF TRAINING: LECTURE & LABORATORY COURSES (Hours) (C)	TYPE AND LENGTH OF TRAINING: SUPERVISED LABORATORY EXPERIENCE (Hours) (D)
a. RADIATION PHYSICS AND INSTRUMENTATION	University of Nebraska University of Cincinnati Interservice Nuclear Weapons School	221	16 yrs OJT
b. RADIATION PROTECTION	University of Nebraska University of Cincinnati Interservice Nuclear Weapons School	140	16 yrs OJT
c. MATHEMATICS PERTAINING TO THE USE AND MEASUREMENT OF RADIOACTIVITY	University of Nebraska University of Cincinnati	90	16 yrs OJT
d. RADIATION BIOLOGY	University of Cincinnati Armed Forces Radiobiology Institute	310	16 yrs OJT
e. RADIOPHARMACEUTICAL CHEMISTRY	University of Nebraska University of Cincinnati	30	16 yrs OJT

5. EXPERIENCE WITH RADIATION. (Actual use of Radioisotopes or Equivalent Experience)

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION OF EXPERIENCE	TYPE OF USE
99 Tc 75 SE 125 I 131 I 51 Cr 67 Ga 60 Co		St Francis Hosp Sch of Radiologic Technology Univ of Nebraska College of Medicine Univ of Cincinnati College of Medicine Childrens Hospital Natl Medical Center	1964-1982	Clinical

TRAINING AND EXPERIENCE
AUTHORIZED USER OR RADIATION SAFETY OFFICER

HILL, Sandra J., CPT

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION OF EXPERIENCE	TYPE OF USE
99m Tc		USA MEDDAC, Ft. Knox, KY	1984-1987	Clinical
75 Se				
125 I				
131 I		FAMC		
51 Cr				
67 Ga				
60 Co				
57 Co				
32 P				
14 C				
226 Ra				
201 TL				

PRINCIPLE USERS

NRC Form 313M has been submitted for the individuals listed below under Group Specific Byproduct Material License #05-00046-13, issued 6 March 1979.

Norman O. Aarestad, MD
Nicholas C. Bethlenfalvay, MD
Peter W. Blue, MD
Nasser Ghaed, MD
Fred D. Hofeldt, MD
John H. Jackson, MD
Gerald S. Kidd, MD
Harold S. Nelson, MD
David L. Richardson, MD
John R. Russell, MD

John W. Harbell, PhD
Thomas P. O'Barr, PhD
Samuel R. Wetherill, III, Nuclear Pharmacist
Michael D. Williams, PhD
Roger S. Whitaker, PhD

RADIATION PROTECTION EQUIPMENT

INSTRUMENT	MODEL NUMBER	ALPHA	BETA	GAMMA or X-RAY
Eberline	E-120			
Eberline	E-120			
Eberline	E-120			
Eberline	E-120			
Eberline	E-120			
Eberline	E-120		X	X
Eberline	E-120			
Eberline	E-120			
Eberline	E-120			
Eberline	E-120			
Eberline	E-120			
Eberline	E-120			
Eberline	PRS-1			
Eberline	PRS-1			
Eberline	PRS-1		X	X
Eberline	PRS-1			
Eberline	PRS-1			
Victoreen	440		X	X
Victoreen	470A			
Victoreen	470A		X	X
Victoreen	470A			
Victoreen	490			
Victoreen	490			X
Picker	600081			X
Victoreen	495			X
Victoreen	555			X

INSTRUMENT	MODEL NUMBER	ALPHA	BETA	GAMMA or X-RAY
Victoreen	660-1			X
Victoreen	666			X
Baird Atomic	904517			X
MDH	1015			X
MDH	2195			X
Eberline	PAC4G3			
Eberline	PAC4G3	X		
Radiacmeter	IM-174/PD			X
Radiacmeter	IM-174/PD			
Dosimeters (6)	CDV-742			
Dosimeters (6)	CDV-742			
Dosimeters (6)	CDV-742			X
Dosimeters (6)	CDV-742			
Dosimeters (6)	CDV-742			
Dosimeters (6)	CDV-742			
Dosimeters (5)	IM-9E/PD			
Dosimeters (5)	IM-9E/PD			
Dosimeters (5)	IM-9E/PD			X
Dosimeters (5)	IM-9E/PD			
Dosimeters (5)	IM-9E/PD			

INSTRUMENT	MODEL NUMBER	ALPHA	BETA	GAMMA or X-RAY
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			X
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			
Dosimeters (25)	IM-93A/UD			
Packard Prias	APGD			X
Packard Prias	BPLD		X	
Nuclear Data	ND66		X	X
Beckman	Gamma 8000			X
Beckman	LS8100		X	

TAB B

8538/

INSTRUMENT	MODEL NUMBER	ALPHA	BETA	GAMMA or X-RAY
Packard Tri-Carb	3002			X
Packard Auto-Gamma Tri-Carb	5260			X
Packard Tri-Carb	3330		X	
Packard Tri-Carb	4640		X	

Calibration - Survey Instruments

1. Readings with a reference check source will be taken before and after use as described in Appendix D of Regulatory Guide 10.8.

2. Calibration will be done by Metrology Division, Sacramento Army Depot, Sacramento, Ca. (NRC License No's SNM507 and 04-04279-01) in accordance with Army Regulation 40-37.

3. AR 40-37 currently prescribes the following schedules for calibration:

USE	CALIBRATION SCHEDULE
Used directly in survey and monitoring	Every 3 months and after servicing/ repair
Pocket chambers and personnel dosimeters	Every 6 months
Used to measure exposure, dose or dose rate during therapy	Annually and after servicing/repair

APPENDIX A

ROLE OF FAMC HEALTH PHYSICS

1. PURPOSE. To identify the major areas of responsibilities of the individual filling the position of FAMC Radiation Protection Officer (RPO).

2. RESPONSIBILITIES OF THE RADIATION PROTECTION OFFICER. The function and responsibilities of Health Physics may be found in the FAMC Organization and Function Manual (FAMC Reg 10-1) and AR 40-37.

a. Functions as the Radiation Protection Officer (RPO) for FAMC.

b. Acts as principal advisor to the Commander, FAMC.

c. Directs all radiation safety activities at FAMC.

d. Serves as principal FAMC staff officer for control of radioactive material and machine sources of ionizing radiation.

e. Acts as executive agent for the USNRC license and DA authorization for the possession, storage, and use of radioactive material at FAMC.

f. Provides advice and assistance to activities using radioactive material or machine produced ionizing radiation on matters of radiation safety.

g. Conducts and administers education and training programs in the use of radioactive material and ionizing radiation producing devices.

h. Performs certain technical support missions, including:

(1) Periodic radiation protection surveys (see Appendix O).

(2) Administration of the photodosimetry and bioassay programs (see Appendix E, F).

(3) Provides radiation control including:

(a) Maintaining inventory of radioactive material and machines which produce x-ray, laser, microwave, ultrasound and radio frequency diathermy radiation at FAMC.

(b) Insuring compliance with USNRC license and DA authorization.

(c) Rendering required administrative reports.

(d) Keeping necessary and required records to insure compliance with Federal law and regulations.

(e) Supervises the monitoring of incoming shipments of radioactive material to avoid contamination of the user's facilities and to insure compliance with Federal packaging, labeling, and shipping requirements.

(f) Receives, processes, and ships radioactive waste generated at FAMC.

(g) Aids in shipping radioactive material from FAMC in compliance with Federal and Department of the Army regulations.

(4) Directs calibration of portable survey instruments used at FAMC.

(5) Provides full-range Health Physics consultation support for all users of ionizing radiation sources and devices at FAMC.

(6) Develops and tailors individual radiation protection programs to insure that adequate radiation protection standards will be met.

(7) Assists radiation workers in avoiding unwarranted exposure to radiation through close and continuous support.

APPENDIX B

AUTHORIZATION TO USE RADIOACTIVE MATERIAL

1. PURPOSE. The purpose of this Appendix is to describe the administrative policies and procedures relating to the use of radioactive material.

2. GENERAL. Fitzsimons Army Medical Center has been issued a USNRC license and a Department of the Army (DA) authorization to permit the receipt, possession, storage, use, transfer, and disposal of radioactive material. No individual may be licensed by the NRC to use radioisotopes; the institution is licensed. Accordingly, the possession and use of radioactive materials by individuals within FAMC is permitted only when specifically authorized by the Radiation Control Committee (RCC).

3. EXPLANATION OF TERMS.

a. US Nuclear Regulatory Commission License. A license issued to FAMC which permits the receipt, possession, storage, utilization, transfer, and disposal of certain radioactive material and is subject to specific conditions.

b. Department of the Army Authorization. An authorization issued by Department of the Army to FAMC which permits the receipt, possession, storage, utilization, transfer, and disposal of naturally occurring and accelerator produced radioactive material at FAMC.

c. Radioisotope Authorization. An authorization issued by the RCC to an individual within the authority of the USNRC license and DA authorization held by FAMC to receive, possess, store, use, transfer, and dispose of radioactive material. FAMC radioisotope authorizations are subject to the conditions of the USNRC license, the Code of Federal Regulations, Department of Army Regulations, and this Radiation Safety Regulation.

d. Human Use. Human use of radioactive materials refers to the internal or external administration of radioactive materials or radiation therefrom to human beings.

e. Nonhuman Use of radioactive materials refers to those applications in which radioactive material is not applied or injected into human beings. In vitro studies of human tissues are included in this category providing none of the product material is to be administered to humans.

f. Principal User is an individual who, by virtue of his training and

experience with radioactive material, has been authorized by the RCC to possess and use radioactive material for a given purpose. A Principal User bears the responsibility for the safe handling of the material and for proper precautionary measures to protect himself and others from unwarranted exposure to radiation. He may dictate such rules, procedures, or other restrictions as he deems necessary to effect the proper handling of the radioactive material. He is directly responsible to the RCC.

g. Co-worker is an individual who possesses adequate training and experience with comparable radioactive material or equipment to qualify him as a Principal User. A Co-worker performs such duties under the authorization of the Principal User as directed. A Co-worker is responsible to the Principal User for safe and proper handling of radioactive materials. In the absence of the Principal User, a Co-worker may assume the responsibilities of Principal User.

h. Trainee is an individual who does not possess adequate training and experience to be authorized as a Principal User himself. He is assigned to this category so that he may obtain the necessary experience under the direct supervision of the Principal User and Co-workers. It is the aim of the Trainee to obtain suitable training and experience to become qualified as a Principal User or Co-worker.

i. Technician is an individual who, under the supervision of the Principal User or Co-worker, performs certain routine duties involving the use of radioactive material. He does not possess suitable training and experience to be classified as a Principal User or Co-worker, and is not undergoing such training as would qualify him to attain that status. Technicians must be trained in the safe handling of radioactive material, contamination control, and precautionary measures which may be taken to protect themselves and others from unwarranted exposure to radiation..

j. Health Physics is a profession devoted to the protection of man and his environment from unwarranted radiation exposure (i.e., radiation protection).

4. PROCEDURES FOR INITIALLY OBTAINING RADIATION CONTROL COMMITTEE AUTHORIZATION TO USE RADIOACTIVE MATERIAL.

a. The Principal User prepares in final form FAMC Request for Authorization to Use Radioactive Material (One copy; see Section 1B to this Appendix). Appropriate instructions are included in the form and assistance in its preparation will be furnished by the Health Physics Office upon request.

b. If the contemplated use is not listed in the Appendix to AR 40-37, or if the contemplated dosage range exceeds the range shown in that Appendix, the Principal User must submit a protocol for nonroutine medical use of radioactive material. Detailed information will be provided from Health Physics upon request (see Section 2B to this Appendix). Patient dose calculations and literature reprints should accompany the protocol.

c. If the contamplated use involves the use of human volunteers, the pro-

visions of AR 70-25 and AR 40-37 (Use of Volunteers as Subject of research; Licensing and Control of Radioactive Materials for Medical Purposes) apply. It is the responsibility of the Principal User to obtain the required approval, through Command channels, from the Office of the Surgeon General. A copy of this approval will be forwarded with the request. If the approval has not been obtained, a copy of the request for approval will be submitted.

d. Health Physics personnel will conduct an initial survey (pp. 3 and 4, Section 1B of this Appendix) of the contemplated laboratory facility to evaluate potential occupational radiation hazards.

e. All documentation will be forwarded to the RPO who will verify the presence of all documents, attach additional documents as needed, and insure that procedure, radioisotope and activity requested may be allowed within the limitations of the USNRC license and the DA authorization issued to FAMC. If conditions are required to insure the above, they will be developed, discussed with the requester, and appropriate changes made to the request.

f. Copies of documentation will then be distributed to members of the RCC for review prior to the committee meeting. Questions or comments concerning the request may be resolved prior to the meeting by discussing them with the requester or the Radiation Protection Officer (RPO), as appropriate. During the committee meeting the procedure requested and qualifications of the workers will be evaluated to insure adequate training and experience in the safe handling of radioisotopes. In the case of human uses involving non-routine medical uses of radioisotopes, the protocol will be evaluated from a professional standpoint to determine the medical acceptability of the procedure.

g. Following approval the authorization will be recorded, a number assigned, and distribution effected.

5. AMENDMENT OF RADIOISOTOPE AUTHORIZATIONS TO USE RADIOACTIVE MATERIAL. If at any time the applicant desires to deviate from the procedure, the radioisotope, or the specified investigation as described on the approved authorization, he shall request an amendment to his authorization by submitting Section 2B of this Appendix, describing the proposed changes to his radioisotope authorization, through the RPO to the RCC. Amendments will be formally reviewed by the RCC.

6. REVIEW AND RENEWAL OF AUTHORIZATIONS. Current authorizations will be reviewed at least annually and at other times as deemed appropriate by the RPO. After review authorizations are renewed, discontinued, or revised in accordance with current requirements, users will submit a Section 3B of this Appendix for annual review and state procedural or personnel changes.

7. SECTIONS.

a. Section 1B, Request for Authorization to Use Radioactive Material.

b. Section 2B, Nonroutine Medical Uses of Radioactive Material.

SECTION 1B

REQUEST FOR AUTHORIZATION TO USE RADIOACTIVE MATERIAL (FOR USE OF THIS FORM, SEE FAMC REG 40-604)	DATE

THRU: Radiation Protection Officer Health Physics Office Fitzsimons Army Medical Center TO: Radiation Control Committee Fitzsimons Army Medical Center	FROM: (Principal User and Organization)

List all Co-Workers and respective organizations

Radionuclides and maximum curiage of each which may be possessed at any one time

☐ UNSEALED SOURCE
☐ SEALED SOURCE

Areas of radioactive material use	USE ☐ HUMAN ☐ NON-HUMAN
Location of radioactive material storage	

Description of Use (Use reverse and additional sheets where necessary; list reference and show dose calculations where applicable, method of wash disposal, counting or assay procedures.)

I Acknowledge my Responsibilities as Principal User	Administrative Approval:
(Signature of Principal User)	(Signature of Chief of Dept, Svc/Div)

FAMC RADIATION CONTROL COMMITTEE APPROVAL

Approved:	Approved:	Authorization No.
		Review Date

FAMC

SECTION 1B

INSTRUCTIONS

1. New Users.

a. Human Use.

(1) Be familiar with responsibilities of Principal Users.

(2) Complete pages 1, 5, 6, and 7.

(3) Forward pages 3 and 4 with the rest of the forms to the Health Physics Office at least two weeks prior to the meeting of the Radiation Control Committee (RCC).

(4) Co-workers must complete pages 5, 6, and 7 and forward with principal user's request.

b. Nonhuman Use.

(1) Be familiar with responsibilities of Principal Users.

(2) Complete pages 1 and 5.

(3) Forward pages 2 and 3 with the rest of the forms to the Health Physics Office at least two weeks prior to the meeting of the RCC.

(4) Co-workers must complete page 5 and forward with principal user's request.

2. Annual Reviews.

a. Be familiar with responsibilities of Principal Users.

b. Complete page 1 indicating any changes under Description of Use or, if no changes, writing "Annual review, no changes."

c. Forward pages 3 and 4 with the rest of the forms to the Health Physics Office at least two weeks prior to the meeting of the RCC.

d. Submit an updated curriculum vitae (CV) with packet reflecting any changes.

3. All users and co-workers must submit a curriculum vitae with packet.

SECTION 1B

RADIATION SAFETY EVALUATION FOR USE OF RADIOACTIVE MATERIAL

A radiation safety evaluation will be conducted by the Health Physics office prior to
a. Approval of a new radioactive material authorization.
b. Annual review of an authorization.
c. A change in a current authorization such as isotopes, quantities, rooms, protocols, etc.

(Completed by Principal User)

1. General Information:

a. Authorization Number _____

b. Principal User _____ Number of Techs & Co-Workers _____

c. Phone Number _____

2. Radioactive Materials Authorized:

Isotope	Total Quantity Authorized	One Time Use Quantity	Physical Form	Chemical Form

If more space is needed, attach additional sheets.

(Completed by Radiation Protection Officer)

3. Authorized Use Area: Room Number(s) _____

a. Work Benches
- Absorbent paper..... Y N NA
- Radioactive material labeling..... Y N NA

b. Waste Receptacles..... Y N NA
- Solid waste..... Y N NA
- Liquid waste..... Y N NA

c. Authorized Sink Disposal..... Y N NA
- Disposal log..... Y N NA

d. Fume Hood Required..... Y N NA
- Air flow check..... Y N NA

e. Signs Y N NA
- Room entrance..... Y N NA
- Storage area..... Y N NA
- Waste..... Y N NA

f. Shielding..... Y N NA

SECTION 1B

4. Personnel Safety Requirements:

   a. Gloves..... Y N NA
   b. Lab coats..... Y N NA
   c. Shoe covers..... Y N NA
   d. Eye protection..... Y N NA
   e. Syringe shields..... Y N NA
   f. Other_____

5. Instrumentation and Personnel Monitoring:

   a. Dosimetry..... Y N NA
      Whole body _____ Wrist _____ Collar _____ Ring TLD _____
   b. Room monitor..... Y N NA Type _____
   c. Survey instrument..... Y N NA Type _____
   d. Air samples..... Y N NA
   e. Bioassays..... Y N NA Type _____
      How often? _____
   f. Dose rate surveys..... Y N NA
      How often? _____ By _____
   g. Contamination surveys..... Y N NA
      How often? _____ By _____

6. Health Physics Comments:

7. ALARA: Based on this evaluation, maximum individual exposures should not exceed _____ millirem per month. An investigational exposure limit of _____ milirem will be used by the Health Physics office to maintain exposures ALARA.

Evaluation conducted by _____ Date _____

Signature _____

SECTION 1B

Form NRC-313M-SUPPLEMENT A (8-78) U.S. NUCLEAR REGULATORY COMMISSION

TRAINING AND EXPERIENCE
AUTHORIZED USER OR RADIATION SAFETY OFFICER

1. NAME OF AUTHORIZED USER OR RADIATION SAFETY OFFICER	2. STATE OR TERRITORY IN WHICH LICENSED TO PRACTICE MEDICINE

3. CERTIFICATION

SPECIALTY BOARD A	CATEGORY B	MONTH AND YEAR CERTIFIED C

4. TRAINING RECEIVED IN BASIC RADIOISOTOPE HANDLING TECHNIQUES

FIELD OF TRAINING A	LOCATION AND DATE(S) OF TRAINING B	TYPE AND LENGTH OF TRAINING	
		LECTURE/ LABORATORY COURSES (HOURS) C	SUPERVISED LABORAYORY EXPERIENCE (HOURS) D
a. RADIATION PHYSICS AND INSTRUMENTATION			
b. RADIATION PROTECTION			
c. MATHEMATICS PERTAINING TO THE USE AND MEASUREMENT OF RADIOACTIVITY			
d. RADIATION BIOLOGY			
e. RADIOPHARMACEUTICAL CHEMISTRY			

5. EXPERIENCE WITH RADIATION. (Actual use of Radioisotopes or Equivalent Experience

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION OF EXPERIENCE	TYPE OF USE

FORM NRC-313M Supplement A (8-78)

SECTION 1B

Form NRC-313M-SUPPLEMENT B
(8-78)

U.S. NUCLEAR REGULATORY COMMISSION

PRECEPTOR STATEMENT

Supplement B must be completed by the applicant physician's preceptor. If more than one preceptor is necessary to document experience, obtain a separate statement from each.

1. APPLICANT PHYSICIAN'S NAME AND ADDRESS

FULL NAME

STREET ADDRESS

CITY | STATE | ZIP CODE

KEY TO COLUMN C

PERSONAL PARTICIPATION SHOULD CONSIST OF:

1. Supervised examination of patients to determine the suitability for radioisotope diagnosis and/or treatment and recommendation for prescribed dosage.
2. Collaboration in dose calibration and actual administration of dose to the patient including calculation of the radiation dose, related measurements and plotting of data.
3. Adequate period of training to enable physician to manage radioactive patients and follow patients through diagnosis and/or course of treatment.

2. CLINICAL TRAINING AND EXPERIENCE OF ABOVE NAMED PHYSICIAN

ISOTOPE A	CONDITIONS DIAGNOSED OR TREATED B	NUMBER OF CASES INVOLVING PERSONAL PARTICIPATION C	COMMENTS (Additional info or comments may be submitted) D
I-131 or I-125	DIAGNOSIS OF THYROID FUNCTION		
	DETERMINATION OF BLOOD AND BLOOD PLASMA VOLUME		
	LIVER FUNCTION STUDIES		
	FAT ABSORPTION STUDIES		
	KIDNEY FUNCTION STUDIES		
	IN VITRO STUDIES		
OTHER			
I-125	DETECTION OF THROMBOSIS		
I-131	THYROID IMAGING		
P-32	EYE TUMOR LOCALIZATION		
Se-75	PANCREAS IMAGING		
Yb-169	CISTERNOGRAPHY		
Xe-133	BLOOD FLOW STUDIES AND PULMONARY FUNCTION STUDIES		
OTHER			
Tc-99m	BRAIN IMAGING		
	CARDIAC IMAGING		
	THYROID IMAGING		
	SALIVARY GLAD IMAGING		
	BLOOD POOL IMAGING		
	PLACENTA LOCALIZATION		
	LIVER AND SPLEEN IMAGING		
	LUNG IMAGING		
	BONE IMAGING		

FORM NRC-313M-Supplement B
(8-78)

SECTION 1B

PRECEPTOR STATEMENT (CONTINUED)

2. CLINICAL TRAINING AND EXPERIENCE OF ABOVE NAMED PHYSICIAN (CONTINUED)

ISOTOPE A	CONDITIONS DIAGNOSED OR TREATED B	NUMBER OF CASES INVOLVING PERSONAL PARTICIPATION C	COMMENTS (Additional info or comments may be sub) D
P-32 (SOLUBLE)	TREATMENT OF POLYCYTHEMIA VERA, LEUKEMIA, AND BONE METASTASES		
P-32 (COLLOIDAL)	INTRACAVITARY TREATMENT		
I-131	TREATMENT OF THYROID CARCINOMA		
	TREATMENT OF HYPERTHYROIDISM		
Au-198	INTRACAVITARY TREATMENT		
Co-60 or Cs-137	INTERSTITIAL TREATMENT		
	INTRACAVITARY TREATMENT		
I-125 or Ir-192	INTERSTITIAL TREATMENT		
Co-60 or Cs-137	TELETHERAPY TREATMENT		
Sr-90	TREATMENT OF EYE DISEASE		
	RADIOPHARMACEUTICAL PREPARATION		
Mo-99/ Tc-99m	GENERATOR		
Sn-113/ In-113m	GENERATOR		
Tc-99m	REAGENT KITS		
OTHER			

3. DATES AND TOTAL NUMBER OF HOURS RECEIVED IN CLINICAL RADIOISOTOPE TRAINING

4. THE TRAINING AND EXPERIENCE INDICATED ABOVE WAS OBTAINED UNDER THE SUPERVISION OF:

a. NAME OF SUPERVISOR

b. NAME OF INSTITUTION

c. MAILING ADDRESS

d. CITY

5. MATERIALS LICENSE NUMBER(S)

6. PRECEPTOR'S SIGNATURE

7. PRECEPTOR'S NAME (PLEASE PRINT)

8. DATE

FORM NRC-313M-Supplement B
(8-78)

SECTION 1B

GENERAL PROVISIONS
FOR AUTHORIZED USE OF RADIOACTIVE MATERIAL AT
FITZSIMONS ARMY MEDICAL CENTER

PRINCIPAL USERS FOR FAMC RADIOACTIVE MATERIAL AUTHORIZATIONS ARE RESPONSIBLE FOR COMPLIANCE WITH THE FOLLOWING PROVISIONS:

1. Maintaining occupational, occasional and environmental ionizing radiation exposures as low as reasonably achievable (ALARA). Current investigational levels under our ALARA Program are:

	Investigational Levels (mrems per calendar quarter)	
	Level I	Level II
a. Whole body; head & trunk; active blood-forming organs; lens of eyes; or gonads	125	375
b. Hands & forearms; feet & ankles	1875	5625

Additional limits are listed in Appendix D, FAMC Reg 40-604.

2. Obtaining and using proper personnel dosimetry devices in accordance with Appendix E, FAMC Reg 40-604, Personnel Monitoring.

3. Complying with the provisions of Appendix C, Section 1C, FAMC Reg 40-604, Recommended Rules of Laboratory Safety for Radiation Workers.

4. Maintaining an inventory of radioactive materials in accordance with AR 40-61.

5. Posting of appropriate radiation warning signs and labels and the removal of warning signs and labels when no longer required.

6. Instructing co-workers, technicians and trainees concerning the safe handling and usage of the radioactive materials listed in this authorization and concerning their responsibilities and rights as occupational radiation workers.

7. Insuring the proper disposal of radioactive materials in accordance with Appendix M, FAMC Reg 40-604, Radioactive Waste, and such other provisions specified in this authorization.

8. Notifying the Health Physics Office promptly of any changes in the use, location, or possession of radioisotopes from the terms of this authorization.

9. Storing of radioactive materials such that they are secured from unauthor-

ozed removal from the place of storage. Materials kept in an unrestricted area must be under the constant surveillance and the immediate control of the principal user or other authorized user.

10. Complying with applicable provisions of Appendix J, FAMC Reg 40-604, Receipt, Transfer and Shipment of Radioactive Material and, in particular, insuring that all NRC licensed or DA authorized radioactive materials entering Fitzsimons Army Medical Center or its support activities have either been processed through the Health Physics Office or have been documented by the Health Physics Office as having been received.

11. Insuring that NRC licensed or DA authorized radioactive materials are not transferred to unauthorized users or outside of FAMC or its supported activities.

12. In the event of an emergency situation, accomplishing the emergency procedures outlined in Appendix M, FAMC Reg 40-604, Radiological Emergencies.

13. Complying with the applicable provisions of Appendix Q, FAMC Reg 40-604, Health Physics Aspects of Patient Care.

SECTION 2B

NONROUTINE MEDICAL USES OF RADIOACTIVE MATERIAL AUTHORIZATION TO USE RADIATION SOURCES

1. Experimental and nonroutine medical uses of byproduct materials include all human uses not specified in the Appendix to AR 40-37. Such uses may be classified into one of two phases of development:

a. Clinical Research applies to a new use of radioactive material in humans. Little or nothing is known about the procedure and little or nothing has been published on the subject. The basis for proceeding with the new use in humans is derived from knowledge obtained from animal studies. This phase of development includes the initial introduction into humans and initial trials on a limited number of patients.

b. Clinical Evaluation applies to the planned testing of a new diagnostic or therapeutic procedure in an appropriate series of control and diseased humans. The procedure and results of clinical research will ordinarily have been reported in the literature or at meetings. If adequate information has not been published, the applicant should have spent sufficient time with those who developed the test to be thoroughly familiar with the details.

2. The clinical research phase of experimental or nonroutine medical use of radioactive material is normally limited to physicians under the supervision of an individual physician with broad experience in clinical evaluation and the use of radioisotopes and under the guidance of the RCC representing a number of disciplines. Adequate resources to conduct the trials shall be available.

3. The clinical evaluation phase of experimental or nonroutine medical use of radioactive material is normally limited to physicians under the supervision of an individual physician with broad experience in clinical evaluation and the use of radioisotopes and under the guidance of the RCC representing a number of disciplines. Adequate resources to conduct the trials shall be available.

4. Applications for experimental or nonroutine uses of radioactive material in humans are reviewed by the RCC. Applications should be supported by a research protocol which includes:

a. Title of study.

b. The purpose for conducting the study. Indicate whether or not the study is to be clinical research or clinical evaluation and explain why.

c. The plan of investigation is sufficient detail to permit a critical evaluation of the methods for conducting the experiments and the controls established.

d. A statement as to whether or not any planned complementary drug or radioisotope administration is contemplated in conjunction with the study.

e. A statement about the expected fate of the isotope administered and, if the procedure is for therapy, a statement about the expected effects.

f. If the application is for clinical research, an outline of related work conducted by the applicant or others in laboratory animals and in humans, including data on location, effective half-life, and radiation dosage. If no work has been conducted in animals, explain why. Pertinent references and a brief abstract prepared by the applicant of published or unpublished material should be submitted. (The brochure of a commercial supplier is not a satisfactory authority for this purpose.)

g. If the application is for clinical evaluation, pertient references and a brief abstract prepared by the applicant of published or unpublished material, including information on localization, effective half-life, and radiation dosage should be submitted. (The brochure of a commercial supplier is not a satisfactory authority for this purpose.)

h. If volunteers are to be used as human subjects of research, the provisions of AR 70-25 and AR 40-37 apply. The applicant must include the written consent of Office of The Surgeon General secured in accordance with these regulations.

i. If investigational drugs are to be used clinically in the project on human subjects, the provisions of AR 40-37 apply, and the applicant must include the written approval of the Army Investigational Drug Review Board obtained in accordance with that regulation. Investigational drugs are defined as: "A new drug, not yet approved by the Commissioner of Food and Drugs, Department of Health and Human Services for general use by the public as a safe and efficacious drug, and that is proposed for clinical study under Department of Army auspices after adequate preclinical information has been obtained."

j. A description of human subjects to be studied:

(1) Persons without manifest disease - number, method of selection, age range.

(2) Persons with manifest disease - number, nature of pathology, method of selection, age range.

(3) Pregnant women will ordinarily be excluded from any test not involving the condition of the pregnancy itself. Specify whether or not pregnant women will be tested and if so, explain why.

(4) Persons under the age of 18 years will ordinarily be excluded from any test involving radiation exposures. Specify whether or not persons under 18 years of age will be tested and if so, explain why.

APPENDIX C

RESPONSIBILITIES OF PRINCIPAL USERS OF RADIOACTIVE MATERIALS

1. PURPOSE. The purpose of this APPENDIX is to delineate the responsibilities and authority of a Principal User of radioactive material.

2. EXPLANATION OF TERMS.

a. Principal User. See definition, Appendix B to this regulation.

b. Co-worker. See definition, Appencix B to this regulation.

c. Trainee. See definition, Appendix B to this regulation.

d. Technician. See definition, Appendix B to this regulation.

3. RESPONSIBILITIES.

a. Become thoroughly familiar with the contents of this regulation prior to the use of radiation sources.

b. Obtain and use radiation sources only as authorized by this regulation.

c. Take adequate precautionary measures to protect himself and others from unwarranted exposure to radiation.

d. Seek advice and assistance from the RPO when in doubt concerning the safety of an operation.

e. Prescribe rules, procedures, SOPs, or protocols for the use of radioactive materials under his control to insure their proper and safe use. These will be made available to any radiation worker in that area and will be furnished to the Health Physics Office upon request. (See Section IC to this Appendix for a list of minimum radiation laboratory safety rules.)

f. Insure that all personnel working under his authorization or in his area of responsibility are familiar with the specific practices to be followed or avoided in the interest of radiological safety. Health Physics will assist in providing instruction in radiation safety upon request.

g. Preclude the misuse of radioisotopes and radiation producing devices by unstable or irresponsible personnel who might endanger themselves or others

h. Insure that all rules, procedures, and practices of radiological safety are rigorously followed in the work area.

i. Seek the assistance of the appropriate supervisors if assistance in obtaining cooperation and compliance is needed. Although Health Physics is available to provide necessary technical advice on matters of radiological safety, enforcement of regulations and rules is basically the responsibility of the immediate supervisor. All disputes should be resolved at the lowest possible level.

j. The Principal User will promptly report to the RPO all known or suspected overexposures to radiation. The overexposed individual shall cooperate in any and all attempts to evaluate his radiation exposure.

k. Maintain a current inventory of the quantity of radioactive material on hand to be readily available to the RPO upon request. The inventory will include the radionuclide(s), activity, and date of that activity.

l. Provide information and assistance to Health Physics personnel which is necessary for the completion of adequate radiation protection surveys. Where recommended by NRC Reg Guide 8.23, the Principal User is required to perform daily radiation surveys of his activity.

m. The Principal User is directly responsible to the RCC for violations of this regulation by personnel working under his authorization. The RPO will report all cases of this nature to the Committee whenever appropriate corrective actions are not initiated by the Principal User or when violations are repeated or flagrant. The Principal User will be invited to the meeting at which the matter is discussed.

n. Additional specific responsibilities are described in:

(1) Appendix D, para 3
(2) Appendix G, para 1
(3) Appendix J, para 4b
(4) Appendix K, para 1c
(5) Appendix M, para 2b, 2c
(6) Appendix O, para 2b
(7) Appendix S, para 2b
(8) Appendix V, para 3

SECTION 1C

MINIMUM RULES OF LABORATORY SAFETY FOR RADIATION WORKERS
RESPONSIBILITIES OF PRINCIPAL USERS OF RADIOACTIVE MATERIAL

1. No eating, drinking, smoking or applying cosmetics in any area where radioisotopes are stored or used.

2. Do not bring food or drink into areas where radioisotopes are used or stored, even if it is to be eaten elsewhere.

3. Do not store food (lunch bags, soft drinks, etc.) in cabinets, refrigerators, etc., which are used or have been used for radioactive material.

4. Do not use laboratory glassware or equipment for the preparation or consumption of food or drink.

5. Wear protective gloves, aprons, laboratory coats, etc., whenever there is a possibility of contaminating oneself.

6. Protect all breaks in the skin with waterproof material (e.g., rubber gloves) whenever handling radioactive materials.

7. Wash hands thoroughly, including under fingernails, with mild soap and water and a soft brush after handling any radioisotope; monitor hands with a suitable detector before going about any other work and whenever leaving the laboratory for meals, coffee breaks, etc., and especially before eating, drinking, smoking or applying cosmetics.

8. Never wash hands with solvent materials; use mild soap and water and a soft brush if needed.

9. Eliminate all sharp objects (e.g., broken glassware) from areas where radioactive materials are used.

10. Wear film badges (if issued) at all times during duty hours, except for medical and dental appointments.

11. When leaving the work area for the day or for medical or dental appointment, leave film badge in a controlled, low background area where it will not be exposed to radiation. Do not take the film badge home.

12. Do not tamper with film badges. Protect them from damage (i.e., mechanical, heat, moisture, chemical stresses).

13. Mark all radiologically contaminated or potentially contaminated containers and equipment clearly with radioactive marking tape.

14. At the conclusion of each run of the experiment using radioactive material, decontaminate areas, change absorbent paper, clean up equipment, etc., to avoid buildup of contamination.

15. Do not wear lab coats which were worn during the use of radioactive material for other work or outside the lab. Contamination on the coat may be spread, absorbed or ingested if care is not taken.

16. Never pipet by mouth, not even water. Bad habits, once formed, are not easily broken.

17. Report all known or suspected exposures, contamination, spills, inhalations, ingestions, absorptions, or injections of radioactive materials IMMEDIATELY to Health Physics, Ext. 3826, and to your immediate supervisor. No punitive action will be taken against individuals who are accidentally exposed to radiation, for the accident, or for prompt reporting.

18. Dispose of radioactive waste only in the receptacles provided. Do not mix radioactive and nonradioactive waste.

19. If a radioactive waste sink is available, follow the posted instructions for use. Be sure to complete the logbook entry.

20. Keep work areas where radioactive materials are used free from unnecessary materials and equipment.

21. Where practical, use absorbent paper to limit the spread of contamination.

22. Use common sense.

23. Do not handle telephone, reports, etc., with contaminated hands or while using protective gloves.

24. Keep fingernails short and clean.

25. Personnel working with radioactive materials will report IMMEDIATELY to the appropriate superior and to the Health Physics Section any cuts or skin abrasions occurring during the working hours.

26. The following procedures are followed in the event of a wound incurred while working with radioactive materials:

a. Wash the injured area at once with running water. Time is important; even a few seconds may make a considerable difference.

b. Notify the appropriate superior and the Health Physics Office, Ext 3826.

c. Self-treatment or antiseptics shall not be employed until the wound has been checked by a medical officer.

APPENDIX D

CONTROL MEASURES AND PROTECTION STANDARDS FOR RADIATION EXPOSURE

1. REFERENCES.

a. Title 10, Code of Federal Regulations, Part 20, U.S. Nuclear Regulatory Commission Rules and Regulations.

b. Ar 40-14, Control and Recording Procedures for Occupational Exposure to Ionizing Radiation.

c. NCRP Report No. 39, Basic Radiation Protection Criteria.

d. NUREG 0267, Principles and Practices for Keeping Occupational Radiation Exposures At Medical Institutions As Low As Reasonably Achievable.

2. APPLICABILITY. The definitions and limitations stated in this Appendix are peacetime standards for occupational exposure of personnel to ionizing radiation. Occupational exposure to ionizing radiation is that exposure incurred as a result of an individual's employment or duty. No portion of this Appendix shall be interpreted as limiting the intentional exposure of an individual to radiation for the purpose of medical diagnosis or medical therapy of that individual.

3. DEFINITIONS AND REQUIREMENTS FOR CONTROLLED AREAS. A controlled area is a defined area in which the occupational exposure of personnel to radiation is under the supervision of the Radiation Protection Officer (RPO).

a. Restricted Area.

(1) Definition: Any area designated by the RPO to which access will be limited and in which precautionary measures are taken for the purpose of protecting individuals from exposure to ionizing radiation or radoactive materials.

(2) Requirement: A controlled area will be under the supervision of an individual authorized by the Radiation Control Committee (RCC) to use sources of radiation in that area.

b. Radiation Area.

(1) Definition: Any area accessible to personnel in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose equivalent in excess of 2 millirem, or in any five consecutive days a dose equivalent in excess of 100 milirem.

(2) Requirement: Each radiation area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION
RADIATION AREA

c. High Radiation Area.

(1) Definition: 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 of dose equivalent in excess of 100 millirem.

(2) Requirements:

(a) A high radiation area shall not be established without the approval of the RPO or his representative except in any emergency.

(b) Each high radiation area established for more than 30 days shall be equipped with control devices in accordance with 10 CFR 20.203 and 29 CFR 1919.96.

(c) Except in an emergency, no individual shall enter a high radiation area until the area has been monitored by Health Physics and approval for his entry has been given by Health Physics.

(d) No individual shall enter or remain in a high radiation area unless personnel are immediately available in the vicinity to render assistance.

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

CAUTION
HIGH RADIATION AREA

d. Airborne Radiation Area.

(1) Definition: Any room, enclosure, or operating area in which airborne radioactive materials exist in concentrations in excess of amounts specified in Appendix B, Table 1, Column 1, Title 10, Code of Federal Regulations, Part 20, or any room, enclosure, or operating area in which airborne radioactive material exists in concentrations which, averaged over the number of hours in any week during which individuals are in the area, exceed 25 percent of the amounts specified in the above referenced Code of Federal Regulations.

(2) Requirements:

(a) An airborne radioactivity area shall not be established without approval of the RPO or his representative except in an emergency.

(b) The RPO shall direct the use of respiratory protective devices, ventilation control measures, and other appropriate actions with airborne radioactivity areas.

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

CAUTION
AIRBORNE RADIOACTIVITY AREA

e. Areas Where Radioactive Material is Present.

(1) The provisions of this paragraph apply to materials which have been procured and are useful because of their radioactive component.

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

CAUTION
RADIOACTIVE MATERIAL

(3) Samples, working solutions, laboratory standards, check sources, etc., must be labeled, segregated, or otherwise identified in such a manner that all personnel in the area recognize that radioactive material is present in the object. Radioactive marking tape may be used for this purpose. The label should include the specific nuclide, activity, date (or time) of that activity, name (or initials) of individual responsible for the radioactive material. However, beakers, flasks, test tubes, and other laboratory containers used transiently (within one working day) in laboratory procedures are exempt from labeling requirements, provided the area in which the material is used is adequately labeled with signs or tapes.

f. Contaminated Areas.

(1) Definition: Any area, including work areas, which are contaminated with radioactive material to levels in excess of values published in Section 1S to Appendix S of this regulation (Contamination Control and Decontamination Operations).

(2) All areas designated as "Contaminated Areas" will always be regarded as heavily contaminated and must be surveyed by Health Physics following use and decontamination in order to be considered free of contamination.

g. Special Areas of Concern.

(1) At the discretion of the RPO, dose rates may be posted for information purposes at any point.

(2) Specially designated sinks, approved by the RPO, through which radioactive material may be discharged into the sanitary sewer system shall be conspicuously posted with the radiation caution symbol and the words:

CAUTION
RADIOACTIVE MATERIAL DISPOSAL SINK

A log will be maintained listing the date, type, and amount (in mCi) of liquid waste dumped.

(3) All laboratory receptacles for radioactive waste shall be conspicuously posted with the radiation caution symbol and the words:

CAUTION
RADIOACTIVE WASTE

4. RADIATION PROTECTION STANDARDS. Every effort will be made to maintain the radiation dose equivalent as far below the following radiation protection standards as practicable. Positive efforts will be carried out to fulfill this objective, and determination of necessity will be weighed against the benefits to be expected. (See Table, page D-8).

a. Basic radiation protection standards adopted for the control of occupational exposures to ionizing radiation include (subject to change by Federal regulations):

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

(a) 1.25 rem in any calendar quarter, nor

(b) 5 rem in any one (1) calendar year.

(2) The accumulated dose equivalent of radiation to the skin of the whole body (other than hands and forearms); cornea of the eye; and bone will not exceed:

(a) 7.50 rem in any calendar quarter, nor

(b) 30 rem in any one (1) calendar year.

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

(a) 18.75 rem in any calendar quarter, nor

(b) 75 rem in any one (1) calendar year.

(4) The accumulated dose of radiation to the forearms will not exceed:

(a) 10 rem in any calendar quarter, nor

(b) 30 rem in any one (1) calendar year.

(5) The accumulated dose equivalent or radiation to the thyroid; other organs; tissues; and organ systems will not exceed:

(a) 5 rem in any calendar quarter, nor

(b) 15 rem in any 1 calendar year.

(6) Individual(s) under 18 years of age, females known to be pregnant, and occasionally exposed individual(s) will not be exposed to a whole body dose equivalent of more than:

(a) 2 Millirem in any 1 hour, nor

(b) 100 millrem in any 7 consecutive days, nor

(c) 500 millirem in any 1 calendar year, nor

(d) more than 10 percent of the values in (2), (3), (4), and (5) above, for other areas of the body .

(7) Individuals over 18 years of age but who have not yet reached their 19th birthday may be occupationally exposed to ionizing radiation provided that they do not exceed 1.25 rem dose equivalent to the whole body in any calendar quarter, nor 3 rem in the 12 consecutive months prior to their 19th birthday.

(8) Women of reproductive capacity should be occupationally exposed only under conditions where the dose equivalent to the abdomen will not exceed:

(a) 170 millirem in any calendar quarter, nor

(b) 500 millirem in any 9 month period.

(9) Females known to be pregnant should not be occupationally exposed to ionizing radiation more than 4a (6) (a) and (b), and 4a (8) above. It is the responsibility of the female employee to advise her employer of the fact that she is pregnant.

b. Radiation protection standards adopted for the control of planned occupational exposures to ionizing radiation under emergency situations include:

(1) Life Saving:

(a) The accumulated dose equivalent of radiation to the whole body should not exceed 100 rem.

(b) The accumulated total dose equivalent of radiation to the hands and forearms should not exceed 300 rem.

(2) Less Urgent:

(a) The accumulated dose equivalent of radiation to the whole body should not exceed 25 rem.

(b) The accumulated total dose equivalent of radiation to the hands and forearms should not exceed 100 rem.

c. Radiation protection standards adopted for the control of non-occupational exposures to ionizing radiation include limiting the use of sources of ionizing radiation such that the accumulated dose equivalent of radiation to the whole body for an individual in the general population (exclusive of natural background and medical and dental exposures) will not exceed 0.5 rem in any 1 calendar year.

d. Alternate radiation protection standards, less restrictive than those prescribed in 4a above, may be used in special circumstances when approved by the Surgeon General of the military department concerned.

(1) Proposals for the use of alternate standards will contain complete justification and will describe the procedures by which the alternate standards will be implemented.

(2) Alternate radiation protection standards will not be considered for individuals under 19 years of age, females known to be pregnant, occasionally exposed individuals, women of reproductive capacity or nonoccupational exposure to ionizing radiation.

e. When dosimetry indicates that an individual may have received greater than 40 millirem per month whole body exposure; exposure to unusual concentrations of airborne radioactive material; or the individual believes he may have been exposed to excessive ionizing radiation, the RPO will direct an investigation of the circumstances of the exposure. A written report of the investigation will be prepared and maintained by the RPO.

f. When it is determined that ar individual may have received a dose of ionizing radiation in excess of the limits stated in para 4 above, or has been exposed to airborne concentrations of radioactive material in excess of 25 percent of the amounts specified in Appendix B, Table 1, Column 1, 10 CFR 20, when averaged over the number of hours in any week, a report of the findings will be made to the RCC for recommendation for corrective action will be prepared by the RPO and submitted through US Army Health Services Command, ATTN: HSPA-P, Fort Sam Houston, TX 78234, to the Surgeon General and the USNRC in compliance with pertinent directives.

g. The exemption of medical exposure from consideration relative to permissible exposure limits of this Appendix apply only to the patient. All other personnel such as physicians and technicians administering exposures are subject to the permissible exposure limits listed above.

5. ACCIDENTAL EXPOSURE TO IONIZING RADIATION. The specific procedures and responsibilities relating to the accidental exposure of personnel to known

or suspected overexposures are delineated in Appendix V to this regulation.

a. Internal Exposure. All persons who are known or suspected to have been internally exposed to quantities of radioactive material in excess of the amounts specified in Appendix V of this regulation shall be reported to the RPO.

b. External Exposure. All persons who are known or suspected to have been externally exposed to radiation levels in excess of those listed in para 4 above shall be reported IMMEDIATELY to the RPO.

6. DEFINITIONS. The chart on page D-9 includes a list of the currently used radiation units.

TABLE - Occupational Exposure Limits

Accumulated Dose Equivalent of Radiation to:	Not to Exceed: Rems per calendar quarter	Not to Exceed: Rems per calendar year
Whole Body; Head & Trunk; Active Blood-forming Organs; Gonads; Lens of Eye	1.25	5
Skin of the Whole Body; Cornea of the Eye; and Bone	7.50	30
Hands & Wrists; Feet & Ankles	18.75	75
Forearms	10	30
Thyroid; Organs; Tissued; Organ Systems	5	15
Individuals Over 18 Years of Age, but Not Yet 19 Years - Whole Body	1.25	3

Unit	Quantity Of Which It is a Measure	Definition	Major Use
CURIE (Ci)	Activity	Quantity of a radionuclide in which 3.7×10^{10} nuclear transformations occur per sec. Historically, the number of transformations per sec of a 1 gm sample of Ra-226.	Describes rate at which a radionuclide decays. 1 Ci = 3.7×10^{10} DPM. = 2.22×10^{12} DPM.
ROTENTGEN (R)	Exposure	Quantity of X or γ radiation that produces ionization in air equal to 2.08×10^{9} on pairs per cubic centimeter of air at STP. 2.58×10^{4} Coulomb/kilogram 1 e.s.u. of charge/cc 1 e.s.u. of charge/0.001293 gm	Measure of intensity of radiation fields. Tells nothing about the amount of energy absorbed or the biological injury that might occur.
RAD (rad)	Absorbed Dose	Quantity of any type of ionizing radiation which deposits 100 ergs of energy per gram of absorber material.	Describes the energy that is imparted to the material being irradiated. Puts all types of radiations on an absorbed energy equivalent basis. Not fully descriptive of the biological injury that might be caused
REM (rem)	Dose Equivalent	Dose in rads x RBE or Dose in rads x QF The 2 expressions for determing dose equivalents in rem are used to distinguish radiobiology experiments and radiation protection. The use of Relative Biological Effectiveness (RBE) in calculating dose equivalent in rem is reserved for radiation biology experiments where the specific biological effect is stated. The use of Quality Factor (QF) is reserved for use in radiation protection.	A unit that establishes equivalence on a biological effect basis (RBE). Compares the biological effect to Cobalt-60 gamma rays.

APPENDIX E

PERSONNEL MONITORING

1. PURPOSE. The purpose of the personnel monitoring program is to:

a. Quantitatively estimate the magnitude of the exposure of individuals to sources of ionizing radiation.

b. Detect hazardous conditions relating to ionizing radiation exposure not found during radiation protection surveys.

2. SELECTION OF PARTICIPANTS. Personnel selected for personnel monitoring will include:

a. Individuals who are likely to receive an accumulated exposure in excess of 10 percent of the applicable quarterly basic radiation protection standard. (See Appendix D to these regulations.)

EXAMPLE: Radiation protection standards are based on a 50-week year. Therefore, to be occupationally exposed, one must potentially receive 100 mR per week whole body.

$$5R \text{ per year} = 5000 \text{ mR}$$

$$\frac{5000 \text{ mR}}{50 \text{ wks}} = 100 \text{ mR per wk}$$

b. Other individuals selected by the RPO.

3. DEVICES AND METHODS FOR PERSONNEL MONITORING.

a. A film badge is the primary dosimetric device for personnel monitoring in the Army. It consists of a packet of radiosensitive photographic film in a plastic holder. The RPO will determine which person(s) will be issued which type(s) of dosimeter using the guidelines in AR 40-14. The following types of film badges are available:

(1) Whole body badge. Sensitive to beta, x-ray, and gamma radiation and worn to measure the exposure received by the whole body.

(2) Wrist badge. Same as the whole body badge except that it is provided with a wrist band so that it can be used to measure the dose to the wrist. Further, anyone who is issued an extremity personnel dosimeter

will also be issued a whole body badge.

(3) Collar or neck badge. Same as the whole body badge except that it is used to monitor exposure to the head and neck area.

b. Thermoluminescent dosimeters are useful for dose measurements where other devices are to cumbersome or are otherwise unsuitable.

c. Bioassay methods may be employed in some cases to assess the quantity of certain radioisotopes which are present within the body. Available techniques include: Selective organ scanning.

4. GENERAL GUIDELINES.

a. Each person, except those being exposed to a radiation source for medical purposes, who occupies a controlled area for more than one day will wear a film badge unless specifically exempted by the RPO

b. Film badges will not be used for any purpose other than personnel monitoring without the approval of the RPO.

c. Only those film badges issued from the Health Physics Office shall be acceptable in meeting the requirements of this paragraph for persons coming under the scope of this regulation.

d. Film badges shall not be worn by personnel when occupationally exposed at other facilities. When military or civilian personnel are exposed to ionizing radiation at an installation outside the jurisdiction of FAMC, they shall insure that the required exposure information is furnished to the RPO at least quarterly.

e. Other dosimetric devices and methods may be employed to supplement the film badge under certain circumstances. The RPO will designate those individuals authorized to substitute another device or method for the film badge based upon the occupational hazards to which they are exposed.

f. Film badges should be stored in controlled, low dose rate areas when not being worn by the individual. The area should not be exposed to heat greater than normal room temperature, normal humidity, or unusual chemical exposure.

g. Film badges used for personnel dosimetry shall not be worn during medical and dental x-ray exposures or when the individual is to receive a radioisotope treatment. Clearance will be obtained from the RPO before wearing the film badge after completion of radioisotope treatment procedures.

h. Film badges will not be worn off duty.

i. The film badge will not be intentionally exposed, tampered with, or damaged.

j. Whenever a film badge is thought to have been lost, damaged, accidentally exposed, tec., the RPO will be promptly notified. A replacement badge will be issued immediately.

k. The whole body badge should be worn on the torso between the neck and the waist.

l. The whole body film badge will be worn under the lead apron and the wrist badge under the lead glove when these protective items are worn.

m. The wrist badge will be worn on the side of the wrist facing the radiation source.

n. Film badges should never be carried in the pocket, subjected to mechanical stress, chemical fumes, heat, humidity, or direct sunlight since these can damage the film and give false results.

o. Film badges will be worn only by the individual to whom they are issued.

p. Collar or neck badges will be worn on the outside of the lead apron.

5. ADMINISTRATION.

a. Applicants for film badge service will appear in person with his Health Record at the Health Physics Office to complete a DD Form 1952.

b. Personnel on permanent personnel monitoring service will be subject to medical examinations in accordance with Appendix F to this regulation.

c. Health Physics will exchange film badges and send the film packets along with photodosimetry reports to Lexington-Blue Grass Army Depot for monthly development and exposure evaluation.

d. Records of exposures will be maintained as follows:

(1) Lexington-Blue Grass Army Depot maintains permanent records of all exposure readings and returns the Photodosimetry Report to the RPO.

(2) The RPO maintains DD Form 1141 (Record of Occupational Exposure to Ionizing Radiation) for all military and civilian personnel assigned or attached to FAMC who are participants in the FAMC personnel monitoring program in accordance with AR 40-14.

(3) When an individual's DD Form 1141 is maintained by the RPO, a copy of FAMC Form 1519 (DD Form 1141 Locator) will be placed on the out side of the Health Record by the custodian of the individual's medical record.

(4) When clearing Post, personnel who were occupationally exposed will bring their medical records to the Health Physics Office for proper

posting of DD 1141 prior to final clearance being granted.

(5) The RPO will forward the photodosimetry reports of Radiation Workers to the appropriate custodian of the medical record of each monitored individual at intervals not to exceed a calendar quarter. Reports of zero exposure will not be furnished to monitored visitors, unless requested by the visitor or the custodian of his exposure record.

(6) The "Record of Occupational Exposure to Ionizing Radiation" and records of bioassay results shall be made available to the individual or his superiors upon request to the RPO.

(7) The results of bioassay, whole body radioactivity measurements, or estimation of internal exposure to persons registered in the personnel monitoring program shall be sent to the RPO who is responsible for posting data to the DD Form 1141 and other dosimetry files.

e. Personnel monitoring will be discontinued when an individual departs or is assigned duties which, in the opinion of the RPO, do not warrant continuation.

6. INVESTIGATIONS.

a. Health Physics personnel will inquire into all excessive, unusual, or unanticipated exposure results.

b. Exposures in excess of ALARA standards will be investigated by the RPO and a written report will be prepared.

APPENDIX F

MEDICAL SURVEILLANCE OF RADIATION WORKERS

1. GENERAL. The low exposures at FAMC and the limited potential for exposure to radiation workers obviates the need for extraordinary medical surveillance. At the exposure levels experienced at FAMC (generally lower than limits set for the general population), no clinical effects to radiation exposure can be expected. Under certain circumstances (e.g., an exposure investigation), the RPO may require medical evaluation specific to radiation exposure.

2. PURPOSE. It is the purpose of this regulation to promulgate the medical evaluation procedures for radiation workers at FAMC based upon applicable regulations, guidelines, and the professional opinion of the RPO and the Radiation Control Committee (RCC).

3. RESPONSIBILITIES.

a. The RCC is responsible for providing guidance and rendering professional opinions regarding suitable medical evaluation procedures for radiation workers at FAMC.

b. The RPO is responsible for monitoring working conditions which could result in the accidental ingestion, inhalation, injection, or absorption of radioisotopes by workers and taking action to reduce such hazards.

c. The Preventive Medicine Officer is responsible for:

(1) Coordinating medical examination requirements (pre-employment, medical surveillance, etc.) for personnel exposed to ionizing or nonionizing radiation with the supervisors of the activity involved. Requirements for these examinations will be based on guidance from the RCC, the RPO, and the US Army Environmental Hygiene Agency.

(2) Evaluating the results of examinations and recording these in the individual's medical record.

(3) Ordering appropriate examinations for possible overexposures to ionizing or nonionizing radiation based on recommendations from the RCC or other qualified specialists.

4. MEDICAL EVALUATIONS.

a. Initial Examination. Pre-placement/pre-employment medical examinations are required. For workers exposed to radiation hazards, this examination should consist of a review of prior occupational exposure and a description of any unusual exposure to radiation resulting from previous occupations, accidents, or diagnostic procedures. Any therapeutic exposure will be listed by the dosage and the areas treated. This information in diagnostic and therapeutic radiation will be recorded as a portion of the history, but will not be entered on DD Form 1141 (Record of Occupational Exposure to Ionizing Radiation). The family and personal medical history will note the presence or absence of cancer, blood dyscrasias, thyroid disease, history of recurrent abortion, congenital malformation, or any other inheritable conditions which may be associated with exposure to radiation.

b. Periodic Examinations. Radiation workers should receive periodic medical examinations at intervals not to exceed three years.

c. Termination Examinations. Termination examinations will not ordinarily be conducted. The RPO may, after reviewing the individual's DD 1141 at the time of outprocessing, request a termination examination of the individual by the Preventive Medicine Officer.

d. Special Cases. If the RPO identifies areas of particular hazard from radioisotopes, especially areas of potential internal hazard from radioisotopes, he will take appropriate action to minimize the hazard and will advise the Preventive Medicine Officer of the hazard. The RPO, seeking whatever consultation he deems necessary, will direct the appropriate additional bioassays or selective organ scans which might be of medical benefit in the evaluation of suspected exposure of the individual. He will insure that such studies are conducted and that the results are evaluated by well-trained professional personnel.

e. Consultation. Professional advice in the area of radiation exposure is available from Chief, Ophthalmology; Chief, Radiology; Chief, Nuclear Medicine; or Chief, Radiation Therapy. Any physician engaged in the evaluation of radiation workers may seek the advice of any of these individuals to assist in such evaluations.

f. Reports. Abnormal medical findings discovered during medical examinations of radiation workers will be IMMEDIATELY reported to the RCC for appropriate action. The RPO (Ext. 3826) will coordinate such reporting.

5. REFERENCES. AR 40-5, Health and Environment.

APPENDIX G

PREGNANCY SURVEILLANCE PROGRAM

1. Female radiation workers are subject to the pregnancy surveillance program. It is the responsibility of both the individual and her supervisor to notify the Radiation Protection Officer (RPO) immediately upon learning of a confirmed pregnancy.

2. The RPO will survey the working environment and the worker's radiation exposure history to determine the advisability of her continuing work in that area for the duration of her pregnancy.

3. The RPO will brief the pregnant employee concerning radiation risks to the embryo-fetus (Section 2 to Appendix G). The RPO will consider the worker's past exposure history and her working environment during this briefing. The primary objective is to advise the worker on the risks involved in continuing to work in the area. A counseling statement (Section 1) will be completed regardless of her choice.

a. If the worker has a fear that the type of work she is doing will be hazardous to her fetus, she can resign (civilian employee), or may request discharge because of pregnancy (military). If she would prefer to be retained in the service, she should request reclassification.

b. If the worker is to continue working in the area, an additional briefing by the RPO, covering precautions she can utilize to insure that her exposure is kept as low as practicable, should be given prior to allowing her to continue working with radiation.

4. The RPO will make specific recommendations to the appropriate personnel branch for a change in working environment during pregnancy when it is considered desirable from the radiological health standpoint.

5. Section 1G, Statement of Pregnancy.
Section 2G, Possible Health Risks to Children of Women Who Are Exposed to Radiation During Pregnancy.

SECTION 1-G

STATEMENT

I ACKNOWLEDGE HAVING READ U.S. NRC REGULATORY GUIDE 8.13 CONCERNING POSSIBLE PRENATAL RADIATION EXPOSURE AND HAVING BEEN COUNSELED BY THE RADIATION PROTECTION OFFICER (RPO) CONCERNING MY PAST EXPOSURE HISTORY AND POTENTIAL FOR EXPOSURE DURING MY PREGNANCY.

After having considered all the information presented and having had the opportunity to ask questions concerning possible risks, I have decided to (initial appropriate section):

a. I will resign because of my pregnancy since I do not prefer to do radiation type work. (Civilian Employee)

b. I will request discharge from the Army because of pregnancy under applicable regulations.

c. I would like to be re-classified into an MOS for which I am qualified.

d. Remain in my present position. The RPO has pointed out methods whereby I can reduce my exposure to even lower levels.

PRINTED NAME_____

SIGNATURE_____ DATE_____

FAMC Reg 40-604

STATEMENT

I ACKNOWLEDGE HAVING READ U.S. NRC REGULATORY GUIDE 8.13 CONCERNING POSSIBLE PRENATAL RADIATION EXPOSURE AND HAVING BEEN COUNSELED BY THE RADIATION PROTECTION OFFICER (RPO) CONCERNING MY PAST EXPOSURE HISTORY AND POTENTIAL FOR EXPOSURE DURING MY PREGNANCY.

After having considered all the information presented and having had the opportunity to ask questions concerning possible risks, I have decided to (initial appropriate section):

a. I will resign because of my pregnancy since I do not prefer to do radiation type work. (civilian employee)

b. I will request discharge from the Army because of pregnancy under applicable regulations.

c. I would like to be re-classified into an MOS for which I am qualified.

d. Remain in my present position. The RPO has pointed out methods whereby I can reduce my exposure to even lower levels.

PRINTED NAME _____

SIGNATURE _____ DATE _____

U.S. NUCLEAR REGULATORY COMMISSION

APPENDIX TO REGULATORY GUIDE 8.13

POSSIBLE HEALTH RISKS TO CHILDREN OF WOMEN WHO ARE EXPOSED TO RADIATION DURING PREGNANCY

Some recent studies have shown that the risk of leukemia and other cancers in children increases if the mother is exposed to a significant amount of radiation during pregnancy. According to a report by the National Academy of Sciences, the incidence of leukemia among children from birth to 10 years of age in the United States could rise from 3.7 cases in 10,000 children to 5.6 cases in 10,000 children if the children were exposed to 1 rem of radiation before birth (a "rem" is a measure of radiation). The Academy has also estimated that an equal number of other types of cancers could result from this level of radiation. Although other scientific studies have shown a much smaller effect from radiation, the Nuclear Regulatory Commission wants women employees of its licensees to be aware of any possible risk so that the women can take steps they think appropriate to protect their offspring.

As an employee of a Nuclear Regulatory Commission licensee, you may be exposed to more radiation than the general public. However, the Nuclear Regulatory Commission has established a basic exposure limit for all occupationally exposed adults of 1.25 rems per calendar quarter, or 5 rems per year. No clinical evidence of harm would be expected in an adult working within these levels for a lifetime. Because the risks of undesirable effects may be greater for young people, individuals under 18 years of age are permitted to be exposed to only 10 percent of the adult occupational limits. (This lower limit is also applied to members of the general public.)

The scientific organization called the National Council on Radiation Protection and Measurements has recommended that because unborn babies may be more sensitive to radiation than adults, their radiation dose as a result of occupational exposure of the mother should not exceed 0.5 rem. Other scientific groups, including the International Commission on Radiation Protection, have also stressed the need to keep radiation doses to unborn children as low as is reasonably achievable.

All Nuclear Regulatory Commission licensees are now required* to inform all individuals who work in a restricted area of the health protection problems associated with radiation exposure. This instruction would in many cases include information on the possible risks to unborn babies. The regulations also state** that licensees should keep radiation exposures as low as is reasonably achievable. According to the National Council on Radiation Protection and Measurements, vigorous efforts should be made to keep the radiation exposure of an embryo or fetus at the very lowest practicable level during the entire period of pregnancy.

Thus it is the responsibility of your employer to take all practicable steps to reduce your radiation exposure. Then it is your responsibility to decide whether the exposure you are receiving is sufficiently low to protect your unborn child. The advice of your employer's health physicist or radiation protection officer should be obtained to determine whether radiation levels in your working areas are high enough that a baby could receive 0.5 rem or more before birth. If so, the alternatives that you might want to consider are:

(a) If you are now pregnant or expect to be soon, you could decide not to accept or continue assignments in these areas.

(b) You could reduce your exposure, where possible, by decreasing the amount of time you spend in the radiation area, increasing your distance from the radiation source, and using shielding.

(c) If you do become pregnant, you could ask your employer to reassign you to areas involving less exposure to radiation. If this is not possible, you might consider

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* By Title 10, Part 19 of the Code of Federal Regulations.

**In Title 10, Part 20.

leaving your job. If you decide to take such steps, do so without delay. The unborn child is most sensitive to radiation during the first three months of your pregnancy.

(d) You could delay having children until you are no longer working in an area where the radiation dose to your unborn baby could exceed 0.5 rem.

You may also, of course, choose to:

(e) Continue working in the higher radiation areas, but with full awareness that you are doing so at some small increased risk for your unborn child.

The following facts should be noted to help you make a decision:

1. The first three months of pregnancy are the most important, so you should make your decision quickly.

2. In most cases of occupational exposure, the actual dose received by the unborn baby is less than the dose received by the mother because some of the dose is absorbed by the mother's body.

3. At the present occupational exposure limit, the actual risk to the unborn baby is small, but experts disagree on the exact amount of risk.

4. There is no need to be concerned about sterility or loss of your ability to bear children. The radiation dose required to produce such effects is more than 100 times larger than the Nuclear Regulatory Commission's dose limits for adults.

5. Even if you work in an area where you receive only 0.5 rem per three-month period, in nine months you could receive 1.5 rems, and the unborn baby could receive more than 0.5 rem, the full-term limit suggested by the NCRP. Therefore, if you decide to restrict your unborn baby's exposure as recommended by the NCRP, be aware that the 0.5 rem limit to the unborn baby applies to the full nine-month pregnancy.

The remainder of this document contains a brief explanation of radiation and its effects on humans. As you will see, some radiation is present everywhere and the levels of radiation most employees of Nuclear Regulatory Commission licensees receive are not much larger than these natural levels. Because the radiation levels in the facility where you will be working are required by law to be kept quite low, there is not considered to be a significant health risk to individual adult employees.

Discussion of Radiation

The amount of radiation an individual receives called the "dose" and is measured in "rems." The average individual in the United States accumulates a dose of one rem from natural sources every 12 years. The dose from natural radiation is higher in some states, such as Colorado, Wyoming, and South Dakota, primarily because of cosmic radiation. There the average individual gets one rem every 8 years.

Natural background radiation levels are also much higher in certain local areas. A dose of one rem may be received in some areas on the beach at Guarapari, Brazil, in only about 9 days, and some people in Kerala, India, get a dose of one rem every 3 months.

Many people receive additional radiation for medical reasons. In 1970, an estimated 212 million X-ray examinations were performed in the United States. The estimated average surface skin dose from one radiographic chest X-ray is 0.027 rem. The estimated average surface skin dose per abdominal X-ray is 0.62 rem.*

Radiation can also be received from natural sources such as rock or brick structures, from consumer products such as television and glow-in-the-dark watches, and from air travel. The possible annual dose from working 8 hours a day near a granite wall at the Redcap Stand in Grand Central Station, New York City, is 0.[illegible] rem, and the average annual dose in the United States from TV, consumer products, and air travel is 0.002[illegible] rem.

Radiation, like many things, can be harmful. A large dose to the whole body (such as 600 rems in one day) would probably cause death in about 30 days, but such large doses result only from rare accidents. Control of exposure to radiation is based on the assumption that any exposure, no matter how small, involves some risk. The occupational exposure limits are set so low, however, that medical evidence gathered over the past 50 years indicates no clinically observable injuries to individuals due to radiation exposures when the established radiation limits are not exceeded. This was true even for exposures received under the early occupational exposure limits, which were many times higher than the present limits. Thus the risk to individuals at the occupational exposure levels is considered to be very low. However, it is impossible to say that the risk is zero. To decrease the risk still further, licensees are expected to keep actual exposures as far below the limits as is reasonably achievable.

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* "Pre-Release Report. X-Ray Exposure Study (XES) Revised Estimates of 1964 and 197[illegible] Genetically Significant Dose," February 4, 1975. U.S. Department of Health, Education and Welfare, Public Health Service, Federal Drug Administration, Bureau of Radiological Health.

The current exposure limits for people working with radiation have been developed and carefully reviewed by nationally and internationally recognized groups of scientists. It must be remembered, however, that these limits are for adults. Special consideration is appropriate when the individual being exposed is, or may be, an expectant mother, because the exposure of an unborn child may also be involved.

Prenatal Irradiation

The prediction that an unborn child would be more sensitive to radiation than an adult is supported by observations for relatively large doses. Large doses delivered before birth alter both physical development and behavior in experimentally exposed animals. A report of the National Academy of Sciences states that short-term doses in the range of 10 to 20 rems cause subtle changes in the nerve cells of unborn and infant rats. The report also states, however, that no radiation induced changes in development have been demonstrated to result in experimental animals from doses up to about 1 rem per day extended over a large part of the period before birth.

The National Academy of Sciences also noted that doses of 25 to 50 rems to a pregnant human may cause growth disturbances in her offspring. Such doses substantially exceed, of course, the maximum permissible occupational exposure limits.

Concern about prenatal exposure (i.e., exposure of a child while in its mother's uterus) at the permissible occupational levels is primarily based on the possibility that cancer (especially leukemia) may develop during the first 10 years of the child's life. Several studies have been performed to evaluate this risk. One study involved the follow-up of 77,000 children exposed to radiation before birth (because of diagnostic abdominal X-rays made for medical purposes during their mother's pregnancy). Another study involved the follow-up of 20,000 such children. In addition, 1292 children who received prenatal exposure during the bombing of Hiroshima and Nagasaki were studied. Although contradictory results have been obtained, most of the evidence suggests a relationship between prenatal exposure and an increased risk of childhood cancer.

Summary

Occupational exposures to radiation are being kept low. However, qualified scientists have recommended that the radiation dose to an embryo or fetus as a result of occupational exposure of the expectant mother should not exceed 0.5 rem because of possible increased risk of childhood leukemia and cancer. Since this 0.5 rem is lower than the dose generally permitted to adult workers, women may want to take special actions to avoid receiving higher exposures, just as they might stop smoking during pregnancy or might climb stairs more carefully to reduce possible risks to their unborn children.

Bibliography

1. Donald G. Pizzarello and Richard L. Witcofski, *Basic Radiation Biology*, Philadelphia: Lea and Febiger, 1967.

2. National Academy of Sciences – National Research Council, *The Effects on Populations of Exposure to Low Levels of Ionizing Radiation*, Washington, D.C., November 1972.

3. National Council on Radiation Protection and Measurements, *Basic Radiation Protection Criteria*, NRCP Report No. 39, Washington, D.C., January 15, 1971.

4. United Nations, *Ionizing Radiation: Levels and Effects*, 2 vol., Reports of the United Nations Scientific Committee on the Effects of Atomic Radiation, Report No. A/8725, United Nations, New York, 1972.

5. U.S. Atomic Energy Commission, Division of Technical Information, Understanding the Atom Series:

   Atoms, Nature and Man

   The Genetic Effects of Radiation

   The Natural Radiation Environment

   Your Body and Radiation

APPENDIX H

TRAINING AND EXPERIENCE OF RADIOISOTOPE USERS AND X-RAY WORKERS

1. PURPOSE. The purpose of this Appendix is to establish the standards of training for all personnel who work with radioisotopes and x-ray at FAMC

2. GENERAL. The standards of training of personnel working with radioisotopes and x-ray at FAMC have been established by the Radiation Control Committee (RCC). The training outlined below, or its equivalent, is considered prerequisite for individuals who work in categories described. Exception to these requirements may be granted on an individual basis by, and at the discretion of, the RCC.

3. DEFINITIONS.

a. Human Use - See definition, Appendix B to this regulation.

b. Nonhuman Use - See definition, Appendix B to this regulation.

c. Principal User - See definition, Appendix B to this regulation.

d. Co-worker - See definition, Appendix B to this regulation.

e. Trainee - See definition, Appendix B to this regulation.

f. Technician - See definition, Appendix B to this regulation.

g. Health Physics - See definition, Appendix B to this regulation.

4. COURSE OF INSTRUCTION.

a. Safe Use and Handling of Radioisotopes. This course of instruction is designed to be given to all principal users,co-workers and trainees who have not received equivalent training. A working knowledge is provided of the principles and practices of radiation protection, the biological effects of radiation, basic terminology, mathematics and calculations used in measurement of radioactivity, nuclear instrumentation, personnel monitoring devices and techniques, NRC and DA regulations governing radiation protection, dose calculations, shielding determinations, and laboratory and experimental design. This course will be conducted at a military installation and/or a university.

b. Nuclear Pharmacy Orientation Course. Instruction conducted by the nuclear pharmacist is designed primarily for pharmacists, pharmacy technicians and pharmacy students, and is open to both military and civilian personnel. Experience is obtained with radioisotope uptake, dose calculations, laboratory and experimental design, formulation of laboratory rules and safe working practices, nuclear imaging techniques and instrument operation, and radioimmunoassay principles and procedures.

c. Physics and Instrumentation in Radiology and Nuclear Medicine. This course of instruction is primarily to prepare radiology residents to take their RAPHEX examinations. Subject matter includes such areas as atomic structure, x-ray production, spectra and characteristics, circuits and components, radioactive modes of decay, interactions of decay products with matter, shielding, radiation protection and measurement, and individual components. The professor of medical physics conducts this course with assistance from Department of Radiology, Nuclear Medicine Service, Radiation Therapy Service, and Health Physics Section.

d. ALARA Training. Specific training in risks, location, and use of radioactive materials or radiation producing devices at FAMC in accordance with the ALARA program. Classes will be presented to target groups on an annual basis by the Health Physics staff.

5. TRAINING AND EXPERIENCE REQUIRED OF INDIVIDUALS.

a. All Principal Users, Co-workers and Trainees working with radioisotopes will have received the Safe Use and Handling of Radioisotopes Course or its equivalent.

b. All individuals operating x-ray machines will receive instruction in x-ray protection or its equivalent.

c. Technicians working with radioisotopes will receive the Safe Use and Handling of Radioisotopes Course or its equivalent, along with specialized instruction as required by their supervisors or the Principal Users under whose authorization they work.

d. Principal Users, Co-workers, and Trainees (nonhuman use) will receive the Safe Use and Handling of Radioisotopes Course or its equivalent, along with specialized instruction (as required).

e. Principal Users, Co-workers, and Trainees (humand use) will receive the following, or their equivalent:

(1) Safe Use and Handling of Radioisotopes Course.

(2) Clinical practical experience in the specific studies for which they are being trained, to include any specialized instruction which is applicable to the instrumentation used in the determinations for which they are being trained.

f. Residents and interns receive only familiarization instruction in

the use of radioisotopes and are exempted from the provisions of this Appendix. The training received does not qualify them for independent use of radioisotopes.

g. All occupational workers and nonoccupational workers frequenting radiation use areas will receive annual ALARA training.

6. QUALIFICATION AND CERTIFICATION.

a. Personnel may become qualified in the use of radioisotopes through the receipt of training at FAMC or through constructive credit granted by the RCC for previous training and experience which parallels the comparable FAMC training.

b. Certification of satisfactory completion of appropriate training which is conducted under the auspices of Health Physics Section will be made by that organization.

c. In the case of physicians, evidence of satisfactory completion of the clinical practical experience will be provided to Health Physics Section by the Principal User under whom the experience is obtained.

d. Records of training and experience of radioisotope workers will be maintained by Health Physics Section.

e. Upon the completion of the blocks of instruction, appropriate Department of Army Certificates of Training will be issued, appropriate entries will be made in personnel records, and the Health Physics Section training log annotated.

7. REFERENCES.

a. APPENDIX A, USNRC Regulatory Guide 10.8 - Guide for the Preparation of Applications for Medical Programs.

b. 10 CFR 30 - Rules of General Applicability to Licensing of Byproduct Material, Rules and Regulations of the US Nuclear Regulatory Commission.

c. TB MED 521 - Management and Control of Diagnostic X-ray, Therapeutic X-Ray, and Gamma-Beam Equipment Having Energies Up To 10 Million Electron Volts.

d. NUREG-0267 - Principles and Practices for Keeping Occupational Radiation Exposures at Medical Institutions As Low As Reasonably Achievable.

APPENDIX I

REFERENCES

The following listed references are general in nature and pertain to this regulation as a whole; additional references which are more specific are cited in the APPENDIXES.

AR 40-5	Health and Environment
AR 40-7	Use of Investigational Drugs in Humans and the Use of Schedule I Controlled Drug Substances
AR 40-13	Radiological Emergency Medical Teams (REMT)
AR 40-14	Control and Recording Procedures for Occupational Exposure to Ionizing Radiation
AR 40-37	Licensing and Control of Radioactive Materials for Medical Purposes
AR 50-5	Nuclear Surety
AR 55-355	Military Traffic Management Regulation
AR 70-25	Use of Volunteers as Subjects of Research
AR 200-1	Environmental Protection and Enhancement
AR 385-11	Ionizing Radiation Protection
AR 700-64	Radioactive Commodities in the DOD Supply Systems
AR 725-1	Special Authorization and Procedures for Issues, Sales, and Loans
SB 11-206	Film Badge Supply and Services (Photodosimetry) Technical Radiation
TB MED 521	Management and Control of Diagnostic X-Ray, Therapeutic X-Ray, and Gamma-Beam Equipment Having Energies Up To 10 Million Electron Volts
TB MED 223	Respiratory Protection Program

TB MED 522	Control of Health Hazards From Radioactive Material Used in Self-Luminous Devices
TB 43-0116	Identification of Radioactive Items in the Army Supply System
TM 3-261	Handling and Disposal of Unwanted Radioactive Material
TM 55-315	Transportability Guidance for Safe Transport of Radioactive Materials
Title 10	Code of Federal Regulations - Rules and Regulations of the USNRC
Title 21	Code of Federal Regulations - Regulations for the Administration and Enforcement of the Radiation Control for Health and Safety Act of 1968 (21 CFR Subchapter J)
Title 49	Code of Federal Regulations - Rules and Regulations of the DOT

APPENDIX J

RECEIPT, TRANSFER AND SHIPMENT OF RADIOACTIVE MATERIAL

1. PURPOSE. The purpose of this Appendix is to familiarize Principal Users and other personnel with the Health Physics aspects of radioactive material procurement, receipt, transfer, and shipment.

2. DEFINITIONS. For the purpose of this Appendix the following definitions apply:

a. Radioactive Material. Any material which undergoes spontaneous nuclear disintegration with emission of corpuscular or electromagnetic radiations. Radioactive material includes naturally occurring isotopes, special nuclear material, byproduct material, accelerator produced isotopes, source material, and items contaminated with radioactive material.

b. Radioactive Commodity. An item of US Government property to which a Federal Stock Number (FSN) has been assigned, composed in whole, or in part, of radioactive material.

c. US Nuclear Regulatory Commission License. See definition, para 3a, Appendix B to this regulation.

d. Department of the Army Authorization. See definition, para 3b, Appendix B to this regulation.

e. FAMC Radioisotope Authorization. See definition, para 3c, Appendix B to this regulation.

3. GENERAL.

a. The RPO has supervisory responsibility for all radioactive material at FAMC to include movement into, storage within, and movement out of the facility.

b. Questions concerning procurement, receipt, transfer, and shipment should be directed to the RPO (Ext. 3826).

4. PROCUREMENT OF RADIOACTIVE MATERIAL.

a. General.

(1) A Principal User may procure for use at FAMC only those radioisotopes currently authorized for his use by the RCC, subject to the limitations of his authorization.

(2) The maximum quantity which may be ordered at any one time is limited by the maximum activity of that radioisotope which the user is authorized to possess unless arrangements have been made with the RPO for any deviation.

b. Principal Users.

(1) The RPO will assign maximum isotope possession limits to each Principal User or using activity. It is the responsibility of each Principal User or using activity to maintain current records indicating possession limits of each authorized isotope. Under no circumstances will the maximum possession limits be exceeded for a specific isotope without prior notification of the RPO.

(2) The Principal User shall submit a complete purchase request and commitment through his supply channels for the procurement of all radioactive materials. In addition, a copy of the Principal User or using activity authorization to use Radioactive Material shall accompany the request and commitment. Radioactive materials will not be purchased without a valid authorization to use Radioactive materials.

(3) The Principal User will request that the vendor ship all radioactive packages (except those specifically exempt by the RPO) to the following address:

(a) Health Physics Section (Duty Hours Delivery Only)
ATTN: (Using Activity)
Fitzsimons Army Medical Center
Aurora, Colorado 80045

(b) Any item requiring special handling or pick-up by Health Physics, must be coordinated with the RPO.

(4) Quantities of Radioactive material exempted from shipment monitoring.

(a) Certain shipments of radioactive materials are exempted from the monitoring procedures required by paragraph 20.205, Title 10, Code of Federal Regulations, Part 20

(b) The following shipments are not required to be monitored for radioactive contamination and excessive radioactive exposure rates.

- Packages containing no more than the exempt quantities shown in the table in paragraph (c) below.

- Packages containing no more than 10 mCi of radioactive material consisting solely of H-3, C-14, S-35, or I-125.

- Packages containing only radioactive material as gases or in special form.

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

(c) TABLE OF EXEMPT AND TYPE A QUANTITIES

Transport Group*	Exempt Quantity Limit (In Millicuries)	Type A Quantity Limit (In Curies)
I	0.01	0.001
II	0.1	0.050
III	1.0	3
IV	1.0	20
V	1.0	20
VI	1.0	1000
VII	25,000.0	1000

*A Table of Radioactive Material Transport Groups is set forth in Appendix L (Appendix C, 10 CFR 71).

(d) Packages containing exempt quantities of radioactive materials will be shipped directly to the Principal User or using activity.

5. RECEIPT OF RADIOACTIVE MATERIAL.

a. Upon receipt of all incoming shipments of radioactive material, the following procedure will be followed:

(1) The shipping container and packing material will be inspected for damage and monitored for contamination IAW 10 CFR.

(2) The labeling of the package, the packing slip, and other documents will be inspected, and the exposure rate on contact and at one meter from the container will be recorded.

(3) Logbooks and records remain as controlled items by Health Physics

Service and are subject to review at any time. Logbooks maintained outside of the Health Physics Office will be made available to the Health Physics Office upon request.

(4) Each package containing quantities of radioactive material in excess of the "Type A Quantities" specified in APPENDIX to ANNEX J, shall be monitored by the receiving service within three (3) hours after it is received if received during normal duty hours, or within eighteen (18) hours after it is received, if received during non-duty hours. If radiation levels found on the external surface of the package are in excess of 200 millirem per hour, or at three (3) feet from the external surface of the package are in excess of 10 millirem per hour, the Health Physics Office shall IMMEDIATELY be notified. The final delivering carrier and the Nuclear Regulatory Commission Inspection and Enforcement Office for Region IV, Ph: (817) 960-8182 will be notified by the RPO.

b. If shipments are found to be contaminated in excess of levels specified in 10 CFR 20.205, the RPO will be notified and he will perform appropriate notifications.

c. Under no circumstances will an incoming shipment of radioactive material be refused when delivered.

d. The external inspection does not constitute an assay or an evaluation of the pharmaceutical quality of the radionuclide.

e. Health Physics Section in para 3 operate during normal FAMC duty hours. After duty hours, radioactive material will be received by the AOD and stored within a lead lined safe as outlined within the AOD instructions.

6. TRANSFER OF RADIOACTIVE MATERIAL.

a. Transfer of radioactive material within FAMC shall be accomplished only between persons authorized to use those radioisotopes by the RCC.

b. Transfer of radioactive material between Principal Users at FAMC and other activities or agencies outside the jurisdiction of FAMC (VA Hospital, etc.) shall be coordinated with the RPO. Health Physics must have proof in writing that the recipient is licensed or authorized to possess the radioactive material by the USNRC or other authority before the transfer can be accomplished.

c. The RPO will be notified before transfer of all adapted or experimental items of equipment containing radioactive material that are to be returned to a vendor for repair, replacement, and/or disposal.

7. SHIPMENT OF RADIOACTIVE MATERIAL.

a. Health Physics Section will certify all outgoing shipments identified as containing radioactive material.

b. The Principal User shall coordinate with Logistics, Transportation, and the Comptroller in the preparation of all appropriate shipping documents to include obtaining a fund cite for transportation costs.

c. The RPO or his representative will insure that the container is properly identified, described, packaged, and labeled in accordance with existing regulations.

8. REFERENCES.

a. Title 10, Code of Federal Regulations, Rules and Regulations of the US Nuclear Regulatory Commission.

b. Title 49, Code of Federal Regulations, Rules and Regulations of the Department of Transportation.

APPENDIX K

FAMC Reg 40-34 (Radiation Protection)

ACCOUNTABILITY AND INVENTORY OF RADIOACTIVE MATERIAL AND MACHINES WHICH PRODUCE IONIZING RADIATION

1. RESPONSIBILITIES.

a. The Radiation Protection Officer (RPO) is responsible for the physical inventory and accountability for all radioactive material and ionizing radiation producing devices in accordance with AR 700-52 and AR 40-61.

b. The RPO is responsible for insuring that the total inventory of any radioisotope on hand at any one time does not exceed the possession limitations imposed for that isotope by the USNRC license or DA authorization, as appropriate.

c. Each Principal User is responsible for the control, security, and inventory of all radioactive material in his possession at all times. He will insure that the maximum quantity which he has on hand at any one time does not exceed the possession limit stated in his radioisotope authorization. Quantities in excess of his possession limits will be returned to the Health Physics Office for storage until needed.

2. PROCEDURES.

a. Inventory records will be updated on a quarterly basis at FAMC.

b. Inventory of on-hand radioisotopes and radioactive waste is the responsibility of the Principal User. The Principal User will forward the inventory to the RPO on a quarterly basis for consolidation.

c. Machines and devices which produce ionizing radiation, laser, and microwave radiation will be registered with the RPO who will maintain a registry in accordance with AR 385-11. This registry will be updated as needed and verified semiannually.

APPENDIX I.

TRANSPORTATION OF RADIOACTIVE MATERIALS

1. PURPOSE. To prescribe general guidelines for the transportation of radioactive material within and from FAMC and to implement the provisions of AR 55-55 and 49 CFR 171-178.

2. RESPONSIBILITIES.

a. The Directorate of Industrial Operations, FAMC, is responsible for providing the means by which radioactive materials are transported.

b. The Radiation Protection Officer (RPO) is responsible for:

(1) Controlling all radioactive material at FAMC to include location, transfer, and transportation.

(2) Insuring that packaging meets standards of 49 CFR 173.24 and other pertinent directives.

(3) Insuring that all packaging and accessories which have previously been used for shipments of radioactive materials and are being shipped empty conform to 49 CFR 173.29 and other pertinent directives.

(4) Verifying that removable radioactive contamination does not exceed the limits specified in 49 CFR 173.397.

(5) Assigning Transport Group classifications and the Transport Index to shipments of radioactive materials in accordance with 49 CFR 173.390 and 173.389(i).

(6) Verifying labeling of packages of radioactive materials in the manner prescribed in 49 CFR 173.399, 173.402, and 173.414 and other pertinent directives.

(7) Advising on the preparation of shipping documents for shipment of radioactive material as required.

(8) Releasing shipments to carriers after verifying that the vehicle intended for transport is suitable, in a proper state of repair, placarded in accordance with 49 CFR 177.823(a)(1), and free from any obvious condition which could reasonably impair the safe transport of the cargo. Vehicles not meeting these tests will be immediately reported to the Transportation Officer.

(9) Surveying military vehicles which have been used to transport radioactive materials for dose rate at any accessible surface and removeable radioactive surface contamination in accordance with 49 CFR 177.843 and 173.397 and other pertinent directives.

3. POLICIES.

a. All shipments and transportation requirements for radioactive material will be coordinated with the RPO and the Directorate of Insustrial Operations.

b. Vehicles transporting radioactive materials will comply with 49 CFR.

c. Passenger-carrying vehicles, including POV and motor vehicles which carry passengers for hire, will NOT be used to transport radioactive mamaterials unless there is no other practicable means of transportation available and, then, only with the expressed consent of the RPO and the Directorate of Industrial Operations. When passenger-carrying vehicles are authorized for use in transporting radioactive materials, the requirements in para 3b above will be met (49 CFR 177.870).

d. The U.S. Mail and Parcel Post will not be used for shipment of radioactive material except in case of emergency, or for the movement of radioisotopes which meet the requirements specified in 39 CFR 125.2 and para 5a(4), TM 55-315. All such shipments must be coordinated with the RPO (para 3-13b, AR 55-55).

APPENDIX C-TRANSPORT GROUPING OF RADIONUCLIDES

Element*	Radionuclide***	Group
Actinium (89)	Ac 227	I
	Ac 228	I
Americium (95)	Am 241	I
	Am 243	I
Antimony (51)	Sb 122	IV
	Sb 124	III
	Sb 125	III
Argon (18)	Ar 37	VI
	Ar 41	II
	Ar 41 (uncompressed)**	V
Arsenic (33)	As 73	IV
	As 74	IV
	As 76	IV
	As 77	IV
Astatine (85)	At 211	III
Barium (56)	Ba 131	IV
	Ba 133	II
	Ba 140	III
Berkelium (97)	Bk 249	I
Beryllium (4)	Be 7	IV
Bismuth (83)	Bi 206	IV
	Bi 207	III
	Bi 210	II
	Bi 212	III
Bromine (35)	Br 82	IV
Cadmium (48)	Cd 109	IV
	Cd 115 m	III
	Cd 115	IV
Calcium (20)	Ca 45	IV
	Ca 47	IV
Californium (98)	Cf 249	I
	Cf 250	I
	Cf 252	I
Carbon (6)	C 14	IV
Cerium (58)	Ce 141	IV
	Ce 143	IV
	Ce 144	III
Cesium (55)	Cs 131	IV
	Cs 134 m	III
	Cs 134	III
	Cs 135	IV
	Cs 136	IV
	Cs 137	III
Chlorine (17)	Cl 36	III
	Cl 38	IV
Chromium (24)	Cr 51	IV
Cobalt (27)	Co 56	III
	Co 57	IV
	Co 58m	IV
	Co 58	IV
	Co 60	III
Copper (29)	Cu 64	IV
Curium (96)	Cm 242	I
	Cm 243	I
	Cm 244	I
	Cm 245	I
	Cm 246	I
Dysprosium (66)	Dy 154	III
	Dy 165	IV
	Dy 166	IV
Erbium (68)	Er 169	IV
	Er 171	IV
Europium (63)	Eu 150	III
	Eu 152m	IV
	Eu 152	III
	Eu 154	II
	Eu 155	IV
Fluorine (9)	F 18	IV
Gadolinium (64)	Gd 153	IV
	Gd 159	IV
Gallium (31)	Ga 67	III
	Ga 72	IV
Germanium (32)	Ge 71	IV
Gold (79)	Au 193	III
	Au 194	III
	Au 195	III
	Au 196	IV
	Au 198	IV
	Au 199	IV
Hafnium (72)	Hf 181	IV
Holmium (67)	Ho 166	IV
Hydrogen (1)	H 3 (see tritium)	
Indium (49)	In 113 m	IV
	In 114 m	III
	In 115 m	IV
	In 115	IV
Iodine (53)	I 124	III
	I 125	III
	I 126	III
	I 129	III
	I 131	III
	I 132	IV
	I 133	III
	I 134	IV
	I 135	IV
Iridium (77)	Ir 190	IV
	Ir 192	III
	Ir 194	IV
Iron (26)	Fe 55	IV
	Fe 59	IV
Krypton (36)	Kr 85 m	III
	Kr 85 m (uncompressed)**	V
	Kr 85	III
	Kr 85 (uncompressed)**	VI
	Kr 87	II
	Kr 87 (uncompressed)**	V

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See footnotes at end of table.

APPENDIX C - TRANSPORT GROUPING OF RADIONUCLIDES - Continued

Element*	Radionuclide***	Group
Lanthanum (57)	La 140	IV
Lead (82)	Pb 203	IV
	Pb 210	II
	Pb 212	II
Lutecium (71)	Lu 172	III
	Lu 177	IV
Magnesium (12)	Mg 28	III
Manganese (25)	Mn 52	IV
	Mn 54	IV
	Mn 56	IV
Mercury (80)	Hg 197 m	IV
	Hg 197	IV
	Hg 203	IV
Mixed fission products MFP		II
Molybdenum (42)	Mo 99	IV
Neodynium (60)	Nd 147	IV
	Nd 149	IV
Neptunium (93)	Np 237	I
	Np 239	I
Nickel (28)	Ni 56	III
	Ni 59	IV
	Ni 63	IV
	Ni 65	IV
Niobium (41)	Nb 93 m	IV
	Nb 95	IV
	Nb 97	IV
Osmium (76)	Os 185	IV
	Os 191 m	IV
	Os 191	IV
	Os 193	IV
Palladium (46)	Pd 103	IV
	Pd 109	IV
Phosphorus (15)	P 32	IV
Platinum (78)	Pt 191	IV
	Pt 193	IV
	Pt 193 m	IV
	Pt 197 m	IV
	Pt 197	IV
Plutonium (94)	Pu 238 (F)	I
	Pu 239 (F)	I
	Pu 240	I
	Pu 241 (F)	I
	Pu 242	I
Polonium (84)	Po 210	I
Potassium (19)	K 42	IV
	K 43	III
Praseodymium (59)	Pr 142	IV
	Pr 143	IV
Promethium (61)	Pm 147	IV
	Pm 149	IV
Protactinium (91)	Pa 230	I
	Pa 231	I
	Pa 233	II

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APPENDIX C - TRANSPORT GROUPING OF RADIONUCLIDES - Continued

Element*	Radionuclide***	Group
Radium (88)	Ra 223	II
	Ra 224	II
	Ra 226	I
	Ra 228	I
Radon (86)	Rn 220	IV
	Rn 222	II
Rhenium (75)	Re 183	IV
	Re 186	IV
	Re 187	IV
	Re 188	IV
	Re Natural	IV
Rhodium (45)	Rh 103 m	IV
	Rh 105	IV
Rubidium (37)	Rb 86	IV
	Rb 87	IV
	Rb Natural	IV
Ruthenium (44)	Ru 97	IV
	Ru 103	IV
	Ru 105	IV
	Ru 106	III
Samarium (62)	Sm 145	III
	Sm 147	III
	Sm 151	IV
	Sm 153	IV
Scandium (21)	Sc 46	III
	Sc 47	IV
	Sc 48	IV
Selenium (34)	Se 75	IV
Silicon (14)	Si 31	IV
Silver (47)	Ag 105	IV
	Ag 110 m	III
	Ag 111	IV
Sodium (11)	Na 22	III
	Na 24	IV
Strontium (38)	Sr 85 m	IV
	Sr 85	IV
	Sr 89	III
	Sr 90	II
	Sr 91	III
	Sr 92	IV
Sulphur (16)	S 35	IV
Tantalum (73)	Ta 182	III
Technetium (43)	Tc 96 m	IV
	Tc 96	IV
	Tc 97 m	IV
	Tc 97	IV
	Tc 99 m	IV
	Tc 99	IV
Tellurium (52)	Te 125 m	IV
	Te 127 m	IV
	Te 127	IV
	Te 129 m	III
	Te 129	IV
	Te 131 m	III
	Te 132	IV

See footnotes at end of table.

APPENDIX C—TRANSPORT GROUPING OF RADIONUCLIDES—Continued

Element*	Radionuclide***	Group
Terbium (65)	Tb 160	III
Thallium (81)	Tl 200	IV
	Tl 201	IV
	Tl 202	IV
	Tl 204	III
Thorium (90)	Th 227	II
	Th 228	I
	Th 230	I
	Th 231	I
	Th 232	III
	Th 234	II
	Th Natural	III
Thulium (69)	Tm 168	III
	Tm 170	III
	Tm 171	IV
Tin (50)	Sn 113	IV
	Sn 117 m	III
	Sn 121	III
	Sn 125	IV
Tritium (1)	H 3	IV
	H 3 (as a gas, as luminous paint, or adsorbed on solid material)	VII
Tungsten (74)	W 181	IV
	W 185	IV
	W 187	IV
Uranium (92)	U 230	II
	U 232	I
	U 233 (F)	II
	U 234	II
	U 235 (F)	III
	U 236	II
	U 238	III
	U Natural	III
	U Enriched (F)	III
	U Depleted	III
Vanadium (23)	V 48	IV
	V 49	III
Xenon (54)	Xe 125	III
	Xe 131 m	III
	Xe 131 m (uncompressed)**	V
	Xe 133	III
	Xe 133 (uncompressed)**	VI
	Xe 135	II
	Xe 135 (uncompressed)**	V
Ytterbium (70)	Yb 175	IV
Yttrium (39)	Y 88	III
	Y 90	IV
	Y 91 m	III
	Y 91	III
	Y 92	IV
	Y 93	IV
Zinc (30)	Zn 65	IV
	Zn 69 m	IV
	Zn 69	IV
Zirconium (40)	Zr 93	IV
	Zr 95	III
	Zr 97	IV

*Atomic number shown in parentheses.

**Uncompressed means at a pressure not exceeding one atmosphere.

***Atomic weight shown after the radionuclide symbol.

m—Metastable state.

(F)—Fissile material.

APPENDIX M

RADIOACTIVE WASTE

1. PURPOSE. To prescribe the policies and procedures to be followed in the management of radioactive waste at FAMC in order to insure compliance with pertinent laws and regulations.

2. RESPONSIBILITIES.

a. The Radiation Protection Officer (RPO) is responsible for the management and control of radioactive waste to include effluents released to the unrestricted environment.

b. Principal Users are responsible for segregation, packaging and delivery of radioactive wastes generated under their control to the areas designated by the RPO.

c. Individual users are responsible for:

(1) Keeping the inventory of radioactive waste in their possession to a practical minimum.

(2) Providing containers for their radioactive waste.

(3) Properly identifying the contents of their waste to include radioisotope, approximate activity, date, and authorization number in the manner prescribed by the RPO.

(4) Defacing radioactive material/transportation labels prior to discarding empty, nonradioactive containers as routine waste.

3. POLICIES AND PROCEDURES.

a. Radioactive waste is unwanted radioactive material or unwanted material contaminated with radioisotopes.

b. Radioactive waste will be classified and segregated prior to disposal depending upon the types and quantities of radionuclides used.

c. Procedures to be followed by users of radioactive material include:

(1) Limit the nonradioactive waste which is intermixed with the radioactive waste to a practical minimum.

(2) Solid waste should be placed in plastic bags or a receptacle lined with a plastic bag. The bag when filled and ready for removal will be taped closed. If plastic bags are used for radioactive waste containing tritium, they will be placed inside a Kraft paper bag.

(3) Liquid waste that is retained for disposal should be collected in plastic bottles or sealed cans to diminish the breakage hazard. However, liquid waste that will chemically react with plastic and liquid waste containing tritium should be placed in glass bottles. All bottle caps should be taped when presented for disposal.

(4) All radioactive waste containers shall be properly marked with the radiation caution symbol and the words "Caution - Radioactive Waste" and/or "Caution - Radioactive Material".

(5) Radioactive waste will be controlled by the user to prevent unauthorized disposal.

(6) Animal carcasses will be packed in two plastic bags of suitable size and strength and kept frozen until properly disposed of.

d. Disposal of radioactive waste.

(1) Radioactive waste will be collected and disposed of by the user in accordance with instructions received from the RPO.

(2) Excreta from patients undergoing medical diagnosis or therapy may be disposed of in the usual manner.

(3) Individual users may be permitted to dispose of radioactive waste via laboratory sinks into the sanitary sewage system after coordinating use procedures with the RPO.

(4) Ultimate disposal of radioactive waste will be accomplished by the RPO in accordance with AR 385-11 and other pertinent directives.

APPENDIX N

LEAK TESTING SEALED SOURCES

1. PURPOSE. To delineate responsibilities for leak testing of sealed sources of radioactive material at FAMC.

2. DEFINITIONS.

a. Sealed sources, for the purpose of this Appendix, are those which meet all of the following criteria:

(1) Radioactive material other than tritium.

(2) Half-life greater than thirty (30) days.

(3) In any physical form other than gas.

(4) In a quantity which is greater than 100 microcuries of beta and/or gamma emitting material or greater than 10 microcuries of alpha emitting material.

(5) Inclosed in, and is intended to be used in, a container of durable (not fragile) material in a manner intended to prevent contact with and leakage or escape of the radioactive material or any of its daughter products under conditions of use and wear for which it was designed.

b. Leak Test. A nondestructive test in which a wipe is taken from the surface of the sealed source or from the surfaces of the device in which the sealed source is permanently or semi-permanently mounted or stored on which one might expert contamination to accumulate. Leak tests may be taken by any of a variety of techniques depending on the source, the radioisotope, the method of analysis, the mounting, etc.

3. RESPONSIBILITY. The Radiation Protection Officer (RPO) is responsible for performance, analysis, and posting of records of all leak tests performed at FAMC to satisfy the requirements of AR 385-11, USNRC license conditions, and DA authorization for the use of radioisotopes.

4. CRITERIA FOR LEAK TESTING.

a. Leak tests, when required, will be performed on beta-gamma emitting sources at intervals not to exceed six months, and each source of alpha emiting radioisotope will be tested at intervals not to exceed three months.

b. If a source requiring leak testing is supplied with a certificate

from the vendor indicating that a leak test has been made within six months (three months for alpha emitting sources), the source need not be re-tested until six months (three months for alpha emitting sources) from the date of the last test and may be issued for immediate use.

c. If no documentary evidence is available to substantiate that a given source has been leak tested within six months (three months for alpha emitting sources), the source will not be issued until it has been leak tested and the results evaluated.

d. The leak test instruments shall be capable of detecting the presence of 0.005 microcuries (11,100 DPM) of radioactive material on the test sample.

e. Sealed sources will be considered contaminated if a leak test removed 0.005 microcuries (11,100 DPM) of radioactive material.

f. All sealed sources found to be contaminated will be immediately withdrawn from use by the RPO who will determine whether or not the source is leaking. If it is leaking, he shall direct that it be resealed or disposed of. He shall also render any required reports.

g. The RPO shall be notified prior to fabrication of a sealed source so that the required leak testing may be accomplished.

APPENDIX O

SURVEY OF WORKING AREAS

1. PURPOSE. The purpose of this Appendix is to delineate the responsibilities for survey of working areas where radioactive materials are used.

2. RESPONSIBILITIES.

a. Health Physics personnel will perform a formal radiation protection survey in each area of FAMC where radioactive material is located IAW Table 1, NRC Reg Guide 8.23, Radiation Surveys at Medical Institutions, and will notify the Principal User when removable contamination levels exceed 2½ times background.

b. Each Principal User is responsible for radiological safety within his work area. He will insure necessary monitoring, surveys and evaluations are accomplished as routine procedures when necessary to insure that unwarranted radiological hazards are not present. The Radiation Protection Officer (RPO) will, upon request, advise on appropriate procedures, and in some instances, provide necessary survey instrumentation. The Principal User is responsible for cleaning contaminated areas at the direction of the RPO.

3. AREAS OF INTEREST. Radiological protection surveys will include evaluations of the following areas, as appropriate:

a. Surface contamination, both removable and fixed.

b. Dose rate measurements.

c. Airborne radiological hazard, both particulate and gaseous.

d. Ventilation, including fume hoods.

e. Storage areas for radioactive materials.

f. Radioactive waste management, including radioactive waste disposal sinks.

g. Radiation safety and contamination control aspects of the working environment and experimental procedures.

h. The familiarity of personnel with radiological safety and emergency procedures.

APPENDIX Q

HEALTH PHYSICS ASPECTS OF PATIENT CARE

1. RESPONSIBILITIES.

a. The Radiation Protection Officer (RPO), FAMC, is responsible for providing full-range Health Physics support throughout FAMC.

b. The Commander, FAMC, provides such guidelines as are necessary to insure adequate protection for medical treatment personnel involved in patient care who are occupationally exposed to ionizing radiation.

2. SPECIFIC REQUIREMENTS.

a. Individuals who are occupationally exposed to radiation from radioisotopes or x-ray producing devices will wear film badges unless specifically exempted therefrom by the RPO.

b. Personnel, equipment, linen and facilities will be monitored for radioactive contamination following any procedure in which the possibility of contamination exists.

c. Dressings, etc., destined for disposal will be monitored and disposed of as radioactive waste when warranted.

d. Health Physics personnel will not impede patient care, but are expected to make recommendations to minimize the accumulated dose to medical personnel and patients who are not being treated with radiation.

e. Patients will not be discharged from the hospital with more than 30 mCi of radioactive material remaining in the body. The specific requirements of the FAMC NRC license are given in para 7, section 5 to this APPENDIX.

f. Guidance on various areas of patient care are described below:

(1) Nursing Instructions (Sealed Sources) (see Section 1Q to this APPENDIX).

(2) Nursing Instructions (Radiopharmaceuticals) (see Section 2Q to this APPENDIX).

(3) Death - Health Physics Procedures (see Section 3Q to this APPENDIX).

(4) Health Physics Aspects of Surgery and Autopsy (see Section 4Q to this APPENDIX).

(5) Health Physics Aspects in the Therapeutic Administration of Radioactive Material (see Section 5Q to this APPENDIX).

g. Bed bath given by the nurse should be omitted while the sources are in place.

h. A television set, telephone, books, or other items for the patient's entertainment may be provided for the patient.

i. Perineal care is not given during gynecologic treatment; the perineal pad may be changed when necessary, unless orders to the contrary have been written.

j. Special handling of the food tray is not required.

k. Surgical dressings and bandages used to cover the area of needle insertion may be changed only by the attending physician and MAY NOT BE DISCARDED until directed by the radiation oncologist. Dressings should be kept in a basin until checked by the radiation oncologist or member of the Health Physics Section. Special orders will be written for oral hygiene for patients with oral implants.

l. No special precautions are needed for sputum, urine, vomitus, stools, dishes, instruments, or utensils unless specifically ordered.

m. These patients must stay in bed unless orders to the contrary are written.

n. Visitors will be limited to those 18 years of age or over, unless other instructions are noted on the precaution sheet in the patient's chart.

o. Visitors shall sit behind the designated (2 mR/hr) line and should remain no longer than one hour per visit.

p. No nurse, visitor, or attendant who is pregnant should be permitted in the room of a patient while brachytherapy sources are implanted in the patient. Female visitors should be asked whether or not they are pregnant.

q. Emergency procedures.

(1) If an implanted source becomes loose or separated from the patient, or

(2) If the patient dies, or

(3) If the patient requires emergency surger, IMMEDIATELY CALL Radiation Therapy Service (Ext. 3045), or the Health Physics Section (Ext. 3826).

q. The Radiation Protection Officer will:

(1) See that the bed is placed to minimize exposure to adjacent areas.

(2) Establish safe distance line as necessary (usually 5 mR/h).

(3) Determine exposure rate at surface, 30 cm, 1 meter, and 2 meters as necessary.

(4) Advise the patient of potential hazards to visitors.

r. At the conclusion of treatment call the Health Physics Service and request that the patient and room be surveyed to be sure all radioactive sources have been removed. Do not release linen until after the survey.

SECTION 10

NURSING INSTRUCTIONS, (SEALED SOURCES)
HEALTH PHYSICS ASPECTS OF PATIENT CARE

1. PURPOSE. The purpose of this APPENDIX is to familiarize the nursing staff with their responsibilities to the patient and themselves in the prevention of unnecessary exposure to radiation.

2. GENERAL.

a. This type of radioactive source ("sealed source") is encapsulated in a metal tube which is then sealed. It is intended to be removed after a specified treatment period. Once this source has been removed from the patient, there is no longer a source of radiation in the patient. Normally, there is no contamination on the linen, utensils, etc. Examples of this type of sealed source include Cs-137, Ra-226, I-125 and Ir-192.

b. If any of the following should occur, immediately notify the Health Physics Office (Ext. 3826) AND the physician who administered the radioactive material:

(1) Major surgery.

(2) Transfer of the patient.

(3) Death of the patient.

3. SPECIFIC GUIDANCE.

a. Whenever possible, place the patient in a private room with the bed near the outside wall of the room. When it is necessary, two radiation therapy patients may be placed in the same room. A non-radiation therapy patient should not be in the same room with a radiation therapy patient. If private rooms are not available, the Radiation Protection Officer must be contacted to assist in establishing bed location.

b. Special restrictions may be noted on the precaution sheet in the patient's chart. Nurses should read these instructions before administering to the patient. Call the Radiation Therapy Service if you have any questions about the care of these patients.

c. Nurses should spend only the minimum necessary time near a patient for routine nursing care and must obtain and wear a film badge.

d. Consistent with adequate care for the patient, carry out only minimal nursing procedures close to the patient. If the patient's clinical status requires constant observation, rotate personnel required to perform adequate nursing care in order to minimize exposure to personnel. The patient's bed should be approached, within the 5 mR/hr line, only when required by nursing duties.

e. When a nurse receives an assignment to a therapy patient, a film badge must be obtained from the Health Physics Section (Bldg. 404) prior to providing nursing care to the patient. The badge shall be worn only by the nurse to whom it is issued and shall not be exchanged between nurses.

f. Pregnant nurses should not be assigned to the personal care of these patients.

g. Never touch needles, capsules or containers holding brachytherapy sources. If a source becomes dislodged, use long forceps and put it in the corner of the room or in the shielded container provided; contact the Radiation Therapy Service (Ext. 3045) or the Health Physics Section (Ext. 3826) at once. After normal duty hours ask the AOD to obtain Health Physics assistance.

SECTION 2Q

NURSING INSTRUCTIONS, (RADIOPHARMACEUTICALS) (HEALTH PHYSICS ASPECTS OF PATIENT CARE)

1. PURPOSE. The purpose of this Section is to fam-liarize the nursing staff with their responsibility to the patient and themselves in the prevention of unnecessary exposure to radiation.

2. GENERAL.

a. This type of radioactive source ("non-sealed source") is usually administered in liquid form and, therefore, is classified as a nonsealed source. Though some low energy sealed sources are used, the source material will remain in the patient until it decays by half-life and/or is excreted; therefore, contamination of linen, etc., is possible. Examples of thse types of sources include: Liquids - I-131, P-32; unsealed - I-125.

b. Immediately notify the Health Physics Office (Ext. 3826) AND the physician who administered the radioactive material if any of the following-ing occur:

(1) Major surgery.

(2) Transfer of the patient.

(3) Death of the patient.

3. SPECIFIC GUIDANCE.

a. Nurses should spend only that amount of time near the patient required for ordinary nursing care. Special restrictions may be noted on the precaution sheet in the patient's chart. Nurses should read these instructions before administering to the patients. Call the Nuclear Medicine Service (Ext. 8646) if you have any questions about the care of these patients.

b. Whenever possible, place the patient in a private room with the bed near the outside wall of the room. When necessary, two radiation therapy patients may be placed in the same room. A non-radiation therapy patient should not be in the same room with a radiation therapy patient.

c. Consistent with adequate care for the patient, carry out only minimal nursing procedures close to the patient. If the patient's clinical status requires constant observation, rotate personnel required to perform

adequate nursing care in order to minimize exposure to personnel. The patient's bed should be approached only when required by nursing duties, i.e., remain beyond 5 mR/hr line when possible.

d. Wear YOUR film badge when entering the area. DO NOT use the film badge of another employee. Film badges may be obtained by calling the Radiation Protection Officer (Ext. 3826).

e. Personnel are not to remain in the room unless engaged in a specific activity. Custodial, utility, ma;ntenance, and food service personnel should not enter the room unless they receive permission and instructions from the ward nurse.

f. A television set, telephone, and books may be provided the patient.

g. The food tray will be prepared entirely with disposable components. The tray will be disposed of as waste within the patient's room. Uneaten food WILL NOT be given to other patients or staff members.

h. Visitors will be limited to those 18 years of age or over, unless other instructions are noted on the precaution sheet in the patient's chart. Visits will be limited to one hour.

i. Patients must remain in bed while visitors are in the room and visitors will remain behind the radiation warning tape.

j. Radioactive patients are to be confined to their rooms except for special medical or nursing purposes approved by the Nuclear Medicine Service.

k. No nurse, visitor, or attendant who is pregnant should be permitted in the room of a patient who has received a therapeutic amount of radioactivity until the patient no longer presents a radiation hazard. Female visitors should be asked whether or not they are pregnant.

l. Attending personnel must wear rubber or disposable plastic gloves when handling ruinals, bedpans, emesis basins or other containers having any material obtained from the body of the patient. Wash gloves before removing and then wash hands. The gloves must be left in the patient's room in the designated waste container. These gloves need not be sterile or surgical in type. Disposable booties will also be utilized in the room and disposed of on the way out.

m. Disposable items will be used in the care of these patients whenever possible. These items should be placed in the designated waste container. Contact the Health Physics Section for proper disposal of the contents of the designated waste container.

n. All clothes and bed linens used by the patient should be placed in the laundry bag provided and left in the patient's room to be checked by a member of the Health Physics Section.

o. All nondisposable items should be placed in a plastic bag and left in the patient's room to be checked by a member of the Health Physics Section.

p. Surgical dressings should be changed only as directed by the physician. Gold-198 leaking from a puncture wound will stain the dressings dark red or purple. Such dressings should not be discarded but should be collected in plastic bags and turned over the Nuclear Medicine Service. Handle these dressings only with tongs or tweezers. Wear disposable gloves.

q. For Iodine-131 Patients:

(1) Disposable plates, cups, and eating utensils will be used by patients who are treated with Iodine-131.

(2) Vomiting within 24 hours after oral administration, urinary incontinence, or excessive sweating within the first 48 hours may result in contamination of linen and/or floor. In any such situations or if radioactive urine and/or feces is spilled during collection, call the Health Physics Section (Ext. 3826). Meanwhile, handle all contaminated material with disposable gloves and avoid spreading contamination.

(3) Feces and urine need not be routinely saved, unless ordered on the chart. The same toilet should be used by the patient al all times, and it should be well flushed (3 times).

r. Utmost precautions must be taken to see that no urine or vomitus is spilled on the floor or the bed. If any part of the patient's room is suspected to be contamiated, notify the Health Physics Section.

s. If a nurse, attendant, or anyone else knows or suspects that his skin, clothing, or shoes is contaminated, notify the Health Physics Section IMMEDIATELY. This person should remain in the patient's room and not walk about the hospital. If the hands become contaminated, wash IMMEDIATELY with soap and water.

t. If a therapy patient should need emergency surgery or should die, notify the Health Physics Section IMMEDIATELY.

u. When the patient is discharged, the Health Physics Section will survey the room for contamination before it is used by another patient.

SECTION 3Q

DEATH - HEALTH PHYSICS ASPECTS OF PATIENT CARE

1. APPLICABILITY. This Section applies to the management of remains of patients who have been undergoing radiation therapy with radioactive implants or unsealed radioisotopes. If the residual quantity within the body is less than 5 mCi (check with the attending physician or the RPO), the body will be handled without regard for the presence of the radioactive material.

2. RADIOACTIVE IMPLANTS. When the patient has been treated with a radioactive implant, the procedure outlined below will be followed:

a. Notify the radiotherapist who administered the implant. The implant will be removed before the remains are taken to the morgue.

b. Notify the Radiation Protection Officer (RPO) (Ext. 3826) and request special instructions in management and transportation of the remains and return of the room to general use.

c. After the radioactive implant has been removed from the body, the remains may be handled in the routine manner.

d. If the radioactive implant cannot be removed from the body (e.g., radon seeds, gold seeds, etc.), process the remains as outlined in para 4 below.

3. UNSEALED RADIOISOTOPES. When the patient has been receiving radiation therapy using unsealed radioactive material (radioisotopes), the procedure outlined below will be followed:

a. Notify the physician who administered the radioactive material.

b. Notify the RPO (Ext. 3826). Health Physics Section personnel will report to the ward to assist in:

(1) Radiation safety considerations in management of the remains.

(2) Radiation safety considerations in transportation of the remains to the morgue.

(3) Survey of the room, personal effects, linen, etc.

(4) Removal of any radioactive waste or items for disposal or de-

contamination, as appropriate.

(5) Removal of protective markings and signs from the patient's room.

4. ADMINISTRATIVE REQUIREMENTS. To insure the rpompt identification of radioactive remains and to facilitate the minimizing of radiation exposure of the staff, the following administrative procedures will be followed:

a. The "CUATION - RADIOACTIVE MATERIALS" label affixed to the outside of the chart will remain in place until all radioactive material is removed from the body.

b. A tag bearing the radiation warning symbol and the words: "CAUTION - RADIOACTIVE MATERIALS. This patient's body contains a significant quantity of radioactive material as specified in Chapter 3, NCRP Report No. 37," will be attached to the body in the same manner as the tag contained in the mortuary pack by attending medical personnel.

c. A similar tag or label will be attached to the outside of the shroud by the attending medical personnel.

d. If the body contains residual quantities of radioactive material, the RPO or his representative will complete and sign one of the following statements in accordance with APPENDIX V, NCRP Report No. 37. This statement will be attached to the death certificate for transmittal to the funeral director by the Registrar, FAMC.

(1) REPORT ON RADIOACTIVITY.

TO: Funeral Director

FROM: Radiation Protectior Officer
Fitzsimons Army Medical Center
Aurora, Colorado 80045

This body contains no significant amount of radioactive material. No special precautions are required if only standard embalming procedures are employed.

Radiation Protection Officer
Fitzsimons Army Medical Center
Date: _____

(2) REPORT ON RADIOACTIVITY.

TO: Funeral Director

FROM: Radiation Protection Officer
Fitzsimons Army Medical Center
Aurora, Colorado 80045

This body contains a significant amount of radioactive material. The following special precautions are recommended:

_____

_____

_____

Radiation Protection Officer
Fitzsimons Army Medical Center
Date: _____

5. REFERENCES. NCRP Report No. 37, Precautions in the Management of Patients Who Have Received Therapeutic Amounts of Radionuclides.

SECTION 4Q

HEALTH PHYSICS ASPECTS OF SURGERY AND AUTOPSY
HEALTH PHYSICS ASPECTS OF PATIENT CARE

1. GENERAL.

a. The Radiation Protection Officer (RPO) will provide guidance to surgery and autopsy on patients whose bodies contain radioisotopes.

b. The principal guidance for surgeons, pathologists, and funeral directors on this subject is contained in NCRP Report No. 37, a copy of which will be provided by the Health Physics Office upon request.

c. Health Physics support and/or advice regarding radiation protection during surgery or autopsy may be obtained by calling:

Duty hours:	Ext. 3826/3916
After duty hours:	Call the Administrative Officer of the Day (AOD) for telephone numbers for Radiological Emergency personnel.

2. SPECIAL REQUIREMENTS.

a. Prior to the surgery (autopsy) the physician who administered the radioactive material should meet with the assigned surgeon (Pathologist) and the RPO. The probable residual quantity of radioactive material within the body will be evaluated. The health physics aspects of the surgery (autopsy) procedure will be estimated.

b. If the anticipated exposure to the surgeon (prosector) and his assistants is considered to be prohibitive, it may be necessary to delay the procedure to allow for decay of the radioactive material in the body or rotate the personnel performing the procedure to preclude overexposure.

c. Personnel engaged in and supporting surgery (autopsy) will wear film badges if the patient contains radioisotopes, unless exempted by the RPO.

d. Personnel, equipment, linen, and facilities will be monitored for radioactive contamination following the procedure when the possibility of contamination exists.

e. Tissues, dressings, etc., destined for disposal will be monitored and disposed of as radioactive waste when warranted.

f. Health Physics personnel will not impede procedures, but are expected to make recommendations to minimize the accumulated dose to the surgeon (pathologist) and other members of the team.

g. Autopsy.

(1) At the completion of the autopsy, the physician who administered the radioactive material will inform the RPO of the probable residual quantity of radioactive material within the body based on the body fluids, tissues, and organs which were removed.

(2) The RPO will execute the statement on the radiation hazard for delivery to the funeral director based on information gained during autopsy.

SECTION 5Q

HEALTH PHYSICS ASPECTS IN THE THERAPEUTIC ADMINISTRATION OF RADIOACTIVE MATERIAL HEALTH PHYSICS ASPECTS OF PATIENT CARE

1. PURPOSE. The purpose of this Section is to specify the duties of Health Physics personnel in the prevention of unwarranted exposure to nursing personnel, visitors, and those who occupy areas adjacent to the patient being treated.

2. NOTIFICATION OF THERAPEUTIC ADMINISTRATION.

a. Sealed Sources. The radiotherapist will notify the Health Physics Office when he schedules a patient for a sealed source implant. The type and quantity of sealed sources, the applicator to be used and its loading arrangement, the patient's name, date of use, and ward number will be recorded.

b. Non-sealed Sources. The Nuclear Medicine Clinic will notify the Health Physics Office by telephone of the proposed schedule for the administration of the radioactive material.

c. Notification of Ward Nurse.

(1) The physician scheduling a patient for radiation therapy will notify the appropriate ward nurse of the proposed administration of radioactive material.

(2) Health Physics personnel will obtain from the nurse the names and social security numbers of those persons who will be caring for the therapy patient and will issue film badges to any personnel not assigned a film badge. A copy of Section 1Q or 2Q to APPENDIX Q will be furnished to the ward as appropriate.

3. PREPARATION OF THE RADIOACTIVE MATERIAL.

a. Sealed Sources. Health Physics personnel should insure that the radiation therapy technicians divide the workload between them in order to keep their exposure to a minimum.

b. Non-sealed Source. Health Physics personnel have no specific duties that relate to the preparation of non-sealed sources.

4. SEALED SOURCE ADMINISTRATION.

a. The radiotherapist is responsible for the safe handling of the radioactive material from the time it leaves radiation therapy until he returns it.

b. The Radiation Protection Officer (RPO) (Ext. 3826) will provide assistance as required.

5. NON-SEALED SOURCE ADMINISTRATION.

a. The physician treating the patient is responsible for insuring safe delivery of the radioactive material to the ward, and for obtaining sufficient absorbent paper and other protective equipment as indicated by the type of radioactive material.

b. Health Physics personnel will normally be in attendance during therapeutic administration of unsealed radioactive material.

c. Health Physics personnel will:

(1) Ascertain that the protective materials are used in the manner that provides maximum protection of medical personnel.

(2) Remain available during the administration for monitoring assistance.

d. Following administration Health Physics personnel will:

(1) Monitor the administering staff and their equipment.

(2) Insure that radioactive laundry and waste containers are in the patient's room and are properly labeled.

(3) Instruct the patient in procedures for preventing the spread of contamination, employing a manner which will obtain the desired results without alarming the patient.

6. PATIENT CARE ON THE WARD.

a. When the therapeutic application is performed at a location other than the patient's room, Health Physics personnelwill go to the ward as soon as practicable after the patient arrives.

b. The Health Physics personnel will:

(1) Ascertain that the patient's bed is placed in a position that will reduce any unnecessary exposure of adjacent areas.

(2) Mark on the floor a "safe distance" line (not greater than 2 mR/hr).

(3) Advise the patient of the potential hazard to visitors who spend too much time in the room. He will take care not to alarm the patient and will emphasize that the treatment has been prescribed for the patient and not the visitors.

(4) Prepare an information packet to be posted near the doorway to the patient's room. This packet will consist of:

(a) A visitor's sign-in and sing-out sheet.

(b) A copy of "Nursing Instructions (Sealed Sources)" or "Nursing Instructions (Radiopharmaceuticals)."

(c) A "CAUTION - RADIOACTIVE MATERIALS" sign.

(5) Execute a radiation survey record.

(6) Return to the ward at least once each day to insure that personnel are maintaining good health physics practices.

c. Removal of protective markings.

(1) If the patient was treated with a sealed source, the Health Physics restrictions (signs, etc.) will be removed after the source has been removed.

(2) If the patient was treated with a non-sealed source of radioactive material, all Health Physics restrictions will remain in effect until the exposure rate at 1 meter indicates a "no restriction" level of activity as defined by Table 4, NCRP Report No. 37.

(a) The administering physician, as well as the ward nurse, should be notified when Health Physics restrictions are removed.

(b) Radioactively contaminated laundry and waste will be removed from the patient's room and the room will be monitored before it is released for normal occupancy.

7. DISCHARGE OF THERAPY PATIENTS.

a. Patients receiving radiotherapy with non-sealed Iodine-131 shall remain hospitalized until the residual activity in the body is 30 milli-curies or less. Release of patients with greater activity than 8 mCi of Iodine-131 will be approved by the health physicist and the physician treating the patient. Factors to consider in the 8-30 mCi range include:

(1) Age of persons in household.

(2) Probability of and length of contact with children and adults of childbearing age.

(3) Advise the patient of the potential hazard to visitors who spend too much time in the room. He will take care not to alarm the patient and will emphasize that the treatment has been prescribed for the patient and not the visitors.

(4) Prepare an information packet to be posted near the doorway to the patient's room. This packet will consist of:

(a) A visitor's sign-in and sing-out sheet.

(b) A copy of "Nursing Instructions (Sealed Sources)" or "Nursing Instructions (Radiopharmaceuticals)."

(c) A "CAUTION - RADIOACTIVE MATERIALS" sign.

(5) Execute a radiation survey record.

(6) Return to the ward at least once each day to insure that personnel are maintaining good health physics practices.

c. Removal of protective markings.

(1) If the patient was treated with a sealed source, the Health Physics restrictions (signs, etc.) will be removed after the source has been removed.

(2) If the patient was treated with a non-sealed source of radioactive material, all Health Physics restrictions will remain in effect until the exposure rate at 1 meter indicates a "no restriction" level of activity as defined by Table 4, NCRP Report No. 37.

(a) The administering physician, as well as the ward nurse, should be notified when Health Physics restrictions are removed.

(b) Radioactively contaminated laundry and waste will be removed from the patient's room and the room will be monitored before it is released for normal occupancy.

7. DISCHARGE OF THERAPY PATIENTS.

a. Patients receiving radiotherapy with non-sealed Iodine-131 shall remain hospitalized until the residual activity in the body is 30 milli-curies or less. Release of patients with greater activity than 8 mCi of Iodine-131 will be approved by the health physicist and the physician treating the patient. Factors to consider in the 8-30 mCi range include:

(1) Age of persons in household.

(2) Probability of and length of contact with children and adults of childbearing age.

b. Patients containing radioactive implants, except Iodine-125 and Gold-198 seeds, shall remain hospitalized until the implant is removed.

c. Normally, radiation therapy patients will remain hospitalized until the residual activity in the body is 30 millicuries or less, regardless of isotope.

d. Clearances for discharge of the patient may be obtained from the therapist who administered the material. He will coordinate with the health physicist.

e. If the patient is returning to a home where there are young children, an evaluation of the dose to them may be appropriate in determining the discharge date (see NCRP Report No. 37).

f. In no event will a patient be discharged if there is sufficient radioactive material remaining in the dody to warrant posting of the patient's room with the radiation warning symbol.

g. In an endeavor to keep population and genetic dose "as low as reasonably achievable" (ALARA), the material in Tables 4 and 5 and para 4.1.2(d) of NCRP Report No. 37 will be reviewed by the physician and the RPO prior to release of any therapy patient.

APPENDIX R

MANAGEMENT OF RADIATION CASUALTIES

1. PURPOSE.

a. To delineate the responsibilities and describe the procedures for management of radioactive and radioactively contaminated casualties.

b. To prescribe control measures to limit the radiation exposure to staff treating the radioactive or radioactively contaminated casualty.

c. To prescribe control measures to limit the spread of radioactive contamination through FAMC resulting from handling a radioactive or radioactively contaminated casualty.

d. To provide guidance in the management of radioactive or radioactively contaminated casualties.

2. APPLICABILITY. This Appendix is applicable to all individuals and activities at FAMC in the handling of radioactive or radioactively contaminated casualties.

3. DEFINITIONS.

a. A radioactive patient is a patient who is radioactive because of internal deposition of radioactive material or neutron activation of body tissues. If improperly managed, such a casualty could irradiate medical personnel or contaminate personnel, equipment and facilities.

b. A radioactively contaminated patient is an individual who has external contamination on his clothing or body. After removal of radioactive contamination, the individual presents no radiation hazard.

4. GENERAL GUIDANCE.

a. Radioactive patients and contaminated patients will receive all necessary medical care and treatment at the earliest practicable time.

b. Radiation fields and radioactive contamination will not deter medical personnel in efforts to save life or limb, although slightly different techniques may be employed (e.g., rotating medical personnel to minimize exposure of any one individual, etc.).

c. Radioactively contaminated patients will be decontaminated at the earliest opportunity consistent with their medical needs.

d. Every effort will be made to minimize radiation exposure and the spread of contamination during medical treatment.

e. The Radiation Protection Officer (RPO) will provide a representative to advise on exposure and contamination control at the site of patient treatment. This representative will not impede patient care, but is expected to make recommendations to minimize personnel exposure and avoid the loss of resources due to radioactive contamination.

f. At the earliest possible time consistent with the medical needs of the patient, the attending physician will allow decontamination to begin. Decontamination will be undertaken by paramedical personnel under the direction and guidance of a Health Physics representative.

g. All contaminated clothing, equipment and waste materials will be retained by the Health Physics representative.

h. Contaminated valuables will be accounted for by using the DA Form 3696 (Patient's Deposit Record) in the conventional manner. These valuables will be retained by the Health Physics representative who will account for them, and will undertake to decontaminate them as soon as the situation permits so that they may be returned to the hospital treasurer or the patient. Valuables and personal property of the patient will not be disposed of as contaminated waste without the written consent of the patient.

5. RESPONSIBILITIES.

a. The senior medical officer (or senior individual, in the absence of a medical officer) present at the scene of an accident is responsible to:

(1) Apply first aid to the patient (radiation casualty).

(2) Evaluate the injury of the patient to determine if immediate evacuation is required.

(3) Evaluate the contamination of the patient, if practicable.

(4) Decontaminate the patient before evacuation if the condition of the patient permits, and if such decontamination can be performed without aggravating the injuries.

(5) Employ contamination control measures.

(6) Arrange, undertake, or direct evacuation of the casualty to the Emergency Room, FAMC, by the most practical means.

(7) Notify the Emergency Room (Ext. 3774) AND the Health Physics Office (Ext. 3826) that a radiation casualty is being evacuated to the Emergency Room.

b. The attending surgeon shall:

(1) Notify Health Physics (Ext. 3826) that a potentially radioactive or radioactively contaminated casualty is enroute and request support.

(2) Undertake treatment of the casualty emphasing life-saving measures only until the Health Physics team arrives.

(3) Contamination control measures which are appropriate for an emergency room are quite similar to isolation techniques employed with a highly contagious patient. The movement of the patient throughout the hospital should be minimized until decontamination procedures can be undertaken or contamination control measures implemented (e.g., have x-rays taken in the Emergency Room, etc.).

(4) Exposure control measures under emergency room conditions are essentially as follows:

(a) Employ the minimum number of medical personnel necessary to evaluate and treat the patient.

(b) Limit the time individuals spend in the proximity of the casualty to the minimum consistent with his needs.

(c) Keep all nonessential personnel as far away from the patient as practicable.

(d) If the patient is highly radioactive or contaminated, rotate or replace staff personnel frequently to limit individual exposure. Keep a record of all personnel who attended the patient including the length of time they were near the patient.

c. The Radiation Protection Officer (RPO), FAMC, is responsible to:

(1) Provide advice and radiation protection equipment to support the care of radioactive or contaminated casualties.

(2) Provide exposure control and monitoring of staff personnel attending the casualty.

(3) Direct decontamination of the casualty at the earliest time consistent with medical needs of the patient.

(4) Direct contamination control measures to limit the spread of contamination throughout the hospital.

(5) Survey the hospital areas for radioactive contamination.

(6) Advise on decontamination of hospital areas as early as possible following treatment of the casualty.

(7) Notify the Chairman of the Radiation Control Committee of the radioactive or radioactively contaminated casualty and, if necessary, assemble appropriate members of the Committee for appropriate recommendations regarding the medical management of the casualty and parameters to be examined on a suspected or actual overexposure.

(8) Notify the Public Affairs Officer (Ext. 3192) promptly of the incident and provide updated information periodically.

(9) Make appropriate reports to the Surgeon General, the Nuclear Regulatory Commission, and other agencies in accordance with pertinent directives.

(10) Make a prompt investigation of the incident.

(11) Prepare and submit necessary reports of the incident.

(12) Issue specific guidance for the management of a radioactive or radioactively contaminated patient to minimize exposure of the staff or the spread of contamination depending on the prevailing situation. Such guidance will be developed on the scene by the Health Physics representative. The recommendations of this representative should be heeded whenever possible, since radioactive contamination can necessitate very costly decontamination operations and result in the loss of facilities for many days.

6. REFERENCE. NCRP Report No. 37, Precautions in the Management of Patients Who Have Received Therapeutic Amounts of Radionuclides.

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APPENDIX S

CONTAMINATION CONTROL AND DECONTAMINATION PROCEDURES

1. PURPOSE. To delineate responsibilities relating to contamination control and decontamination procedures at FAMC.

2. RESPONSIBILITIES.

a. The Radiation Protection Officer (RPO) is responsible for control of radioactive contamination and supervision of decontamination procedures.

b. Each Principal User is responsible for assisting the RPO in the accomplishment of his mission by:

(1) Controlling contamination within his area of responsibility.

(2) Reporting all spills, releases, accidents, incidents, or unusual occurrences involving radioactive material promptly, so that contamination control may be initiated.

(3) Providing the resources for decontamination operations.

c. The individual who causes contamination to occur performs the decontamination required. The RPO will provide advice and guidance relative to decontamination.

3. The contamination limits prescribed by Department of the Army are shown in Section 1S (Permissible Levels of Radioactive Contamination) to this Appendix.

4. GENERAL. Air or water that contains radioactive material in excess of concentrations specified in Section 2S (taken from Appendix B, Table II, 10 CFR 20) shall be considered to be contaminated and shall be controlled and disposed of in accordance with the instructions of the RPO.

5. Methods of controlling contamination which may be employed to minimize the spread of radioactive contamination include:

a. Use of personal protective clothing and devices such as rubber or plastic gloves, laboratory coats, shoe covers, head covers, face masks, respirators, etc.

b. Providing and frequently using an exposure rate meter capable of detecting and monitoring contamination from the radioisotope(s) in use.

c. Using separate, specially marked radioactive waste containers.

d. Limiting traffic and occupancy of work areas where radioactive materials are in use.

e. Designing and enforcing work flow and procedures to minimize transfers and manipulations of radioactive material.

f. Conducting procedures which generate radioactive aerosols, dusts, or gaseous products in fume hoods, glove boxes, or other suitable closed systems.

g. Designating and posting of contaminated and potentially contaminated areas during procedures which are likely to produce contamination. (Anyone can post radiation contaminated areas; however, only the RPO can remove signs indicating contaminated areas.)

h. Covering working surfaces with polyethylene and absorbent disposable material.

i. Using trays capable of containing a total spill of liquid radioactive material under experiments of this type.

j. Using double containers for vessels of radioactive materials which are easily upset (e.g., volumetric flasks).

k. Using polyethylene bags to contain waste and to line waste containers. If tritium is used the polyethylene should be replaced by or contained in Kraft paper bags, since tritium easily penetrates polyethylene and is retarded by paper.

l. Avoiding the use of house vacuum liners with radioactive materials.

m. Rigorously posting cabinets, refrigerators, ovens, etc., where radioactive material is used so that all personnel will be advised of its presence. When the item is not used exclusively for radioactive material, the radioactive material should be separated from the other contents and conspicuously posted.

n. Establishing control points outside contaminated areas where personnel will monitor themselves for contamination with a suitable instrument before leaving the area.

o. Promptly cleaning up and monitoring all spills of radioactive material.

6. Decontamination methods are many and varied. The RPO will supervise and advise on decontamination procedures.

a. Personnel Decontamination.

(1) Individuals with contaminated clothing should remove their clothing at the earliest opportunity.

(2) Decontamination of the skin should be attempted promptly after discovery of contamination. The skin should be washed thoroughly and repeatedly with a mild soap or detergent worked into a good lather with a soft brush. Care should be taken not to abrade the skin.

(3) Special decontamination of individuals beyond that described above will be under the supervision of the RPO.

b. Surface decontamination will be undertaken only by personnel who are wearing protective gloves and, in some cases, protective clothing. Material used in decontamination will be disposed of as radioactive waste in accordance with instructions received from the RPO.

7. HANDLING OF CONTAMINATED LAUNDRY. Contaminated clothing and bedding will be collected by Health Physics personnel at the site of the contamination and taken for decontamination or disposal.

SECTION IS

CONTAMINATION CONTROL AND DECONTAMINATION OPERATIONS

PERMISSIBLE LEVELS OF RADIOACTIVE CONTAMINATION

Contamination items and indications for action	CONTAMINATION LEVEL					Method of Detection
	FIXED REMOVABLE	ALPHA		BETA-GAMMA		
		DPM per 100 cm^2	DPM per 100 cm^2	mr/hr @ 1 in.	DPM per 100 cm^2	
1. Clothing, including shoes						
a. Personal. Should be replaced, decontaminated or stored for decay if above.	F R	200	None	0.2	None	Probe **Smear
b. Anticontamination						
(1) General. Should be replaced and/or decontaminated if above.	F R	1000	200	0.2	1000	Probe **Smear
(2) Laundry. Should not be released to public laundry if above	F R	200	50	0.2	200	Probe **Smear
(3) Respirators. Should be decontaminated after use if above.	F R	200	None	*1.0	None	Probe **Smear
2. Containers. Prior to nonradiation use, should be decontaminated if above.	F R	200	None	0.2	100	Probe **Smear

SECTION 1S

CONTAMINATION CONTROL AND DECONTAMINATION OPERATIONS

PERMISSIBLE LEVELES OF RADIOACTIVE CONTAMINATION

Contamination Items and Indications for Action	CONTAMINATION LEVEL						Method of Detection
	FIXED REMOVABLE	ALPHA		BETA-GAMMA			
		DPM per 100 cm2	DPM per 100 cm2	mr/hr @ 1 in.	DPM per 100 cm2		
3. Laboratories and Work Areas							
a. Noncontrolled areas. Require controls and posting or decontamination if above.	F	200		0.2			Probe
	R		20		100		**Smear
b. Controlled Areas							
(1) Hoods	F	1000		2.0			Probe
	R		200		2000		**Smear
(2) Glove Boxes	F	5000		2.5			Probe
	R		1000		5000		**Smear
(3) Workbench Surface	F	1000		0.5			Probe
	R		200		1000		**Smear
4. Skin							
a. Body. Continue decontamination if above.	F	200		0.06			Probe
	R		None		None		**Smear
b. Hands. Continue decontamination if above.	F	400		0.1			Probe
	R		None		None		**Smear

SECTION 1S

CONTAMINATION CONTROL AND DECONTAMINATION OPERATIONS

PERMISSIBLE LEVELS OF RADIOACTIVE CONTAMINATION

Contamination Items and Indications for Action	CONTAMINATION LEVEL						Method of Detection
	FIXED REMOVABLE	ALPHA		BETA-GAMMA			
		DPM per 100 cm^2	DPM per 100 cm^2	mr/hr @ 1 in.	DPM per 100 cm^2		
5. Vehicles/Radioactive Containers							
a. Used in controlled area. Should be decontaminated if above.	F R	&	2200&	2.0	22000		Probe **Smear
b. Used in noncontrolled area. Should be decontaminated if above.	F R	&	220	0.5	2200		Probe **Smear
6. Equipment							
a. Used in controlled area. Should be decontaminated if above.	F R	5000	1000	2.0	10,000		Probe **Smear
b. Used in noncontrolled area. Should be decontaminated if above.	F R	500	100	0.2	1,000		Probe **Smear

* At contact w[illegible] any surface of the mask.

** Smear analyzed with a calibrated instrument.

& Based on 49 CRF 173.397 or Graziano's Tariff.

REF: Appendix G, AR 40-37 - 7 Jan 77.

APPENDIX B

Concentrations in Air and Water Above Natural Background

(See footnotes on page 20-18)

Element (atomic number)	Isotope [1]	†	Table I Column 1 Air (μCi/ml)	Table I Column 2 Water (μCi/ml)	Table II Column 1 Air (μCi/ml)	Table II Column 2 Water (μCi/ml)
Actinium (89)	Ac 227	S	2×10^{-12}	6×10^{-3}	8×10^{-14}	2×10^{-4}
		I	3×10^{-11}	9×10^{-3}	9×10^{-12}	3×10^{-4}
	Ac 228	S	8×10^{-8}	3×10^{-3}	3×10^{-9}	9×10^{-5}
		I	2×10^{-8}	3×10^{-3}	6×10^{-10}	9×10^{-5}
Americium (95)	Am 241	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		* I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	Am 242m	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		I	3×10^{-10}	3×10^{-3}	9×10^{-12}	9×10^{-5}
	Am 242	S	4×10^{-8}	4×10^{-3}	1×10^{-9}	1×10^{-4}
		I	5×10^{-8}	4×10^{-3}	2×10^{-9}	1×10^{-4}
	Am 243	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	Am 244	S	4×10^{-8}	1×10^{-3}	1×10^{-9}	5×10^{-5}
		I	2×10^{-8}	1×10^{-3}	8×10^{-10}	5×10^{-5}
Antimony (51)	Sb 122	S	2×10^{-7}	8×10^{-4}	6×10^{-9}	3×10^{-5}
		I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
	Sb 124	S	2×10^{-7}	7×10^{-4}	5×10^{-9}	2×10^{-5}
		I	2×10^{-8}	7×10^{-4}	7×10^{-10}	2×10^{-5}
	Sb 125	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	3×10^{-8}	3×10^{-3}	9×10^{-10}	1×10^{-4}
Argon (18)	A 37	Sub[2]	6×10^{-3}		1×10^{-6}	
	A 41	Sub	2×10^{-6}		4×10^{-8}	
Arsenic (33)	As 73	S	2×10^{-6}	5×10^{-3}	7×10^{-8}	5×10^{-4}
		I	4×10^{-7}	1×10^{-2}	1×10^{-8}	5×10^{-4}
	As 74	S	3×10^{-7}	2×10^{-3}	1×10^{-8}	5×10^{-5}
		I	1×10^{-7}	2×10^{-3}	4×10^{-9}	5×10^{-5}
	As 76	S	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
		I	1×10^{-7}	6×10^{-4}	3×10^{-9}	2×10^{-5}
	As 77	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
Astatine (85)	At 211	S	7×10^{-9}	5×10^{-3}	2×10^{-10}	2×10^{-4}
		I	3×10^{-8}	2×10^{-3}	1×10^{-9}	7×10^{-5}
Barium (56)	Ba 131	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
		I	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-4}
	Ba 140	S	1×10^{-7}	8×10^{-4}	4×10^{-9}	3×10^{-5}
		I	4×10^{-8}	7×10^{-4}	1×10^{-9}	2×10^{-5}
Berkelium (97)	Bk 249	S	9×10^{-10}	2×10^{-2}	3×10^{-11}	6×10^{-4}
		I	1×10^{-7}	2×10^{-2}	4×10^{-9}	6×10^{-4}
	Bk 250	S	1×10^{-7}	6×10^{-3}	5×10^{-9}	2×10^{-4}
		I	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}
Beryllium (4)	Be 7	S	6×10^{-6}	5×10^{-2}	2×10^{-7}	2×10^{-3}
		I	1×10^{-6}	5×10^{-2}	4×10^{-8}	2×10^{-3}
Bismuth (83)	Bi 206	S	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
		I	1×10^{-7}	1×10^{-3}	5×10^{-9}	4×10^{-5}
	Bi 207	S	2×10^{-7}	2×10^{-3}	6×10^{-9}	6×10^{-5}
		I	1×10^{-8}	2×10^{-3}	5×10^{-10}	6×10^{-5}
	Bi 210	S	6×10^{-9}	1×10^{-3}	2×10^{-10}	4×10^{-5}
		I	6×10^{-9}	1×10^{-3}	2×10^{-10}	4×10^{-5}
	Bi 212	S	1×10^{-7}	1×10^{-3}	3×10^{-9}	4×10^{-4}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-4}

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APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

(See footnotes on page 20-18)

Element (atomic number)	Isotope [1]	†	Table I Column 1 Air (μCi/ml)	Table I Column 2 Water (μCi/ml)	Table II Column 1 Air (μCi/ml)	Table II Column 2 Water (μCi/ml)
Bromine (35)	Br 82	S	1×10^{-6}	8×10^{-3}	4×10^{-8}	3×10^{-4}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
Cadmium (48)	Cd 109	S	5×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
		I	7×10^{-8}	5×10^{-3}	3×10^{-9}	2×10^{-4}
	Cd 115m	S	4×10^{-8}	7×10^{-4}	1×10^{-9}	3×10^{-5}
		I	4×10^{-8}	7×10^{-4}	1×10^{-9}	3×10^{-5}
	Cd 115	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	3×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
Calcium (20)	Ca 45	S	3×10^{-8}	3×10^{-4}	1×10^{-9}	9×10^{-6}
		I	1×10^{-7}	5×10^{-3}	4×10^{-9}	2×10^{-4}
	Ca 47	S	2×10^{-7}	1×10^{-3}	6×10^{-9}	5×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	3×10^{-5}
Californium (98)	Cf 249	S	2×10^{-12}	1×10^{-4}	5×10^{-14}	4×10^{-6}
		I	1×10^{-10}	7×10^{-4}	3×10^{-12}	2×10^{-5}
	Cf 250	S	5×10^{-12}	4×10^{-4}	2×10^{-13}	1×10^{-5}
		I	1×10^{-10}	7×10^{-4}	3×10^{-12}	3×10^{-5}
	Cf 251	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	4×10^{-6}
		I	1×10^{-10}	8×10^{-4}	3×10^{-12}	3×10^{-5}
	Cf 252	* S	6×10^{-12}	2×10^{-4}	2×10^{-13}	7×10^{-6}
		* I	3×10^{-11}	2×10^{-4}	1×10^{-12}	7×10^{-6}
	Cf 253	S	8×10^{-10}	4×10^{-3}	3×10^{-11}	1×10^{-4}
		I	8×10^{-10}	4×10^{-3}	3×10^{-11}	1×10^{-4}
	Cf 254	S	5×10^{-12}	4×10^{-4}	2×10^{-13}	1×10^{-5}
		I	5×10^{-12}	4×10^{-4}	2×10^{-13}	1×10^{-5}
Carbon (6)	C 14 (CO_2)	S	4×10^{-6}	2×10^{-3}	1×10^{-7}	8×10^{-5}
		Sub	5×10^{-7}		1×10^{-8}	
Cerium (58)	Ce 141	S	4×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
		I	2×10^{-7}	3×10^{-3}	5×10^{-9}	9×10^{-5}
	Ce 143	S	3×10^{-7}	1×10^{-3}	9×10^{-9}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}
	Ce 144	S	1×10^{-8}	3×10^{-4}	3×10^{-10}	1×10^{-5}
		I	6×10^{-9}	3×10^{-4}	2×10^{-10}	1×10^{-5}
Cesium (55)	Cs 131	S	1×10^{-5}	7×10^{-2}	4×10^{-7}	2×10^{-3}
		I	3×10^{-6}	3×10^{-2}	1×10^{-7}	9×10^{-4}
	Cs 134m	S	4×10^{-5}	2×10^{-1}	1×10^{-6}	6×10^{-3}
		I	6×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-3}
	Cs 134	S	4×10^{-8}	2×10^{-4}	1×10^{-9}	9×10^{-6}
		I	1×10^{-8}	1×10^{-3}	4×10^{-10}	4×10^{-5}
	Cs 135	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	9×10^{-8}	7×10^{-3}	3×10^{-9}	2×10^{-4}
	Cs 136	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	9×10^{-5}
		I	2×10^{-7}	2×10^{-3}	6×10^{-9}	6×10^{-5}
	Cs 137	S	6×10^{-8}	4×10^{-4}	2×10^{-9}	2×10^{-5}
		I	1×10^{-7}	1×10^{-3}	5×10^{-10}	4×10^{-5}
Chlorine (17)	Cl 36	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
		I	2×10^{-6}	2×10^{-3}	8×10^{-10}	6×10^{-5}
	Cl 38	S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}
		I	2×10^{-6}	1×10^{-2}	7×10^{-8}	4×10^{-4}
Chromium (24)	Cr 51	S	1×10^{-5}	5×10^{-2}	4×10^{-7}	2×10^{-3}
		I	2×10^{-6}	5×10^{-2}	8×10^{-8}	2×10^{-3}

APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

(See footnotes on page 20-18)

Element (atomic number)	Isotope		Table I Column 1 Air (μCi/ml)	Table I Column 2 Water (μCi/ml)	Table II Column 1 Air (μCi/ml)	Table II Column 2 Water (μCi/ml)
Cobalt (27)	Co 57	S	3×10^{-6}	2×10^{-3}	1×10^{-7}	5×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
	Co 58m	S	2×10^{-5}	8×10^{-2}	6×10^{-7}	3×10^{-3}
		I	9×10^{-6}	6×10^{-2}	3×10^{-7}	2×10^{-3}
	Co 58	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	5×10^{-6}	3×10^{-3}	2×10^{-7}	9×10^{-5}
	Co 60	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	5×10^{-5}
		I	9×10^{-6}	1×10^{-3}	3×10^{-7}	3×10^{-5}
Copper (29)	Cu 64	S	2×10^{-6}	1×10^{-2}	7×10^{-8}	3×10^{-4}
		I	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}
Curium (96)	Cm 242	S	1×10^{-10}	7×10^{-6}	4×10^{-12}	2×10^{-3}
		* I	2×10^{-10}	7×10^{-6}	6×10^{-12}	2×10^{-3}
	Cm 243	S	6×10^{-12}	1×10^{-6}	2×10^{-13}	5×10^{-6}
		I	1×10^{-10}	7×10^{-6}	3×10^{-12}	2×10^{-3}
	Cm 244	S	9×10^{-12}	2×10^{-6}	3×10^{-13}	7×10^{-6}
		I	1×10^{-10}	8×10^{-6}	3×10^{-12}	3×10^{-3}
	Cm 245	S	5×10^{-12}	1×10^{-6}	2×10^{-13}	4×10^{-6}
		I	1×10^{-10}	8×10^{-6}	4×10^{-12}	3×10^{-3}
	Cm 246	S	5×10^{-12}	1×10^{-6}	2×10^{-13}	4×10^{-6}
		I	1×10^{-10}	8×10^{-6}	4×10^{-12}	3×10^{-3}
	Cm 247	S	5×10^{-12}	1×10^{-6}	2×10^{-13}	4×10^{-6}
		I	1×10^{-10}	8×10^{-6}	4×10^{-12}	3×10^{-3}
	Cm 248	S	6×10^{-13}	1×10^{-6}	2×10^{-14}	4×10^{-7}
		I	1×10^{-11}	4×10^{-6}	4×10^{-13}	1×10^{-6}
	Cm 249	S	1×10^{-6}	6×10^{-3}	4×10^{-7}	2×10^{-3}
		I	1×10^{-6}	6×10^{-3}	4×10^{-7}	2×10^{-3}
Dysprosium (66)	Dy 165	S	3×10^{-6}	1×10^{-3}	9×10^{-8}	4×10^{-5}
		I	2×10^{-6}	1×10^{-3}	7×10^{-8}	4×10^{-5}
	Dy 166	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}
Einsteinium (99)	Es 253	S	8×10^{-10}	7×10^{-6}	3×10^{-11}	2×10^{-3}
		I	6×10^{-10}	7×10^{-6}	2×10^{-11}	2×10^{-3}
	Es 254m	S	5×10^{-8}	5×10^{-6}	2×10^{-9}	2×10^{-3}
		I	6×10^{-8}	5×10^{-6}	2×10^{-9}	2×10^{-3}
	Es 254	S	2×10^{-11}	4×10^{-6}	6×10^{-13}	1×10^{-6}
		I	1×10^{-10}	4×10^{-6}	4×10^{-12}	1×10^{-3}
	Es 255	S	5×10^{-10}	8×10^{-6}	2×10^{-11}	3×10^{-3}
		I	4×10^{-10}	8×10^{-6}	1×10^{-11}	3×10^{-3}
Erbium (68)	Er 169	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
		I	4×10^{-7}	3×10^{-3}	1×10^{-8}	9×10^{-5}
	Er 171	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Europium (63)	Eu 152	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	(T/2 = 9.2 hrs)	I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	Eu 152	S	1×10^{-6}	2×10^{-3}	4×10^{-10}	8×10^{-5}
	(T/2 = 13 yrs)	I	2×10^{-6}	2×10^{-3}	6×10^{-10}	8×10^{-5}
	Eu 154	S	4×10^{-9}	6×10^{-6}	1×10^{-10}	2×10^{-3}
		I	7×10^{-9}	6×10^{-6}	2×10^{-10}	2×10^{-3}
	Eu 155	S	9×10^{-8}	6×10^{-3}	3×10^{-9}	2×10^{-4}
		I	7×10^{-8}	6×10^{-3}	3×10^{-9}	2×10^{-4}

APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

(See footnotes on page 20-18)

Element (atomic number)	Isotope		Table I Column 1 Air (μCi/ml)	Table I Column 2 Water (μCi/ml)	Table II Column 1 Air (μCi/ml)	Table II Column 2 Water (μCi/ml)
Fermium (100)	Fm 254	S	6×10^{-5}	4×10^{-2}	2×10^{-6}	1×10^{-3}
		I	7×10^{-6}	4×10^{-2}	2×10^{-7}	1×10^{-3}
	Fm 255	S	2×10^{-6}	1×10^{-2}	6×10^{-8}	3×10^{-4}
		I	1×10^{-6}	1×10^{-2}	4×10^{-8}	3×10^{-4}
	Fm 256	S	3×10^{-6}	3×10^{-2}	1×10^{-7}	9×10^{-4}
		I	2×10^{-6}	3×10^{-2}	6×10^{-8}	9×10^{-4}
Fluorine (9)	F 18	S	5×10^{-6}	2×10^{-3}	2×10^{-7}	8×10^{-5}
		I	3×10^{-6}	1×10^{-3}	9×10^{-8}	5×10^{-5}
Gadolinium (64)	Gd 153	S	2×10^{-7}	6×10^{-4}	8×10^{-9}	2×10^{-5}
		I	9×10^{-8}	6×10^{-4}	3×10^{-9}	2×10^{-5}
	Gd 159	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
Gallium (31)	Ga 72	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
Germanium (32)	Ge 71	S	1×10^{-5}	5×10^{-2}	4×10^{-7}	2×10^{-3}
		I	6×10^{-6}	5×10^{-2}	2×10^{-7}	2×10^{-3}
Gold (79)	Au 196	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
		I	6×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-4}
	Au 198	S	3×10^{-7}	2×10^{-3}	1×10^{-8}	5×10^{-5}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	5×10^{-5}
	Au 199	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
		I	8×10^{-7}	4×10^{-3}	3×10^{-8}	2×10^{-4}
Hafnium (72)	Hf 181	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
Holmium (67)	Ho 166	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}
		I	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-5}
Hydrogen (1)	H3	S	5×10^{-6}	3×10^{-3}	2×10^{-7}	1×10^{-4}
		I	5×10^{-6}	3×10^{-3}	2×10^{-7}	1×10^{-4}
		Sub	2×10^{-6}		4×10^{-8}	
Indium (49)	In 113m	S	8×10^{-6}	4×10^{-3}	3×10^{-7}	1×10^{-4}
		I	7×10^{-6}	4×10^{-3}	2×10^{-7}	1×10^{-4}
	In 114m	S	1×10^{-7}	5×10^{-5}	4×10^{-9}	2×10^{-6}
		I	2×10^{-6}	5×10^{-5}	7×10^{-10}	2×10^{-6}
	In 115m	S	2×10^{-6}	1×10^{-3}	8×10^{-8}	4×10^{-5}
		I	2×10^{-6}	1×10^{-3}	6×10^{-8}	4×10^{-5}
	In 115	S	2×10^{-7}	3×10^{-3}	9×10^{-9}	9×10^{-5}
		I	3×10^{-6}	3×10^{-3}	1×10^{-8}	9×10^{-5}
Iodine (53)	I 125	S	5×10^{-9}	4×10^{-6}	8×10^{-11}	2×10^{-7}
		I	2×10^{-7}	6×10^{-3}	6×10^{-9}	2×10^{-4}
	I 126	S	8×10^{-9}	5×10^{-6}	9×10^{-11}	3×10^{-7}
		I	3×10^{-7}	3×10^{-3}	1×10^{-8}	9×10^{-5}
	I 129	S	2×10^{-9}	1×10^{-6}	2×10^{-11}	6×10^{-8}
		I	7×10^{-8}	6×10^{-4}	2×10^{-9}	2×10^{-5}
	I 131	S	9×10^{-9}	6×10^{-6}	1×10^{-10}	3×10^{-7}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	I 132	S	2×10^{-7}	2×10^{-3}	3×10^{-9}	8×10^{-5}
		I	9×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	I 133	S	3×10^{-8}	2×10^{-5}	4×10^{-10}	1×10^{-6}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}
	I 134	S	5×10^{-7}	4×10^{-3}	6×10^{-9}	2×10^{-4}

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APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

(See footnotes on page 20-18)

Element (atomic number)	Isotope †		Table I Column 1 Air (μCi/ml)	Table I Column 2 Water (μCi/ml)	Table II Column 1 Air (μCi/ml)	Table II Column 2 Water (μCi/ml)
Iodine (53)	I 124	I	3×10^{-8}	2×10^{-3}	1×10^{-7}	6×10^{-8}
	I 125	S	1×10^{-7}	7×10^{-4}	1×10^{-6}	4×10^{-8}
		I	4×10^{-7}	2×10^{-3}	1×10^{-6}	7×10^{-8}
	I 126	S	1×10^{-8}	6×10^{-4}	4×10^{-8}	2×10^{-8}
		I	4×10^{-7}	5×10^{-3}	1×10^{-6}	2×10^{-8}
	I 129	S	1×10^{-7}	1×10^{-3}	4×10^{-8}	4×10^{-8}
		I	3×10^{-8}	1×10^{-3}	9×10^{-10}	4×10^{-8}
	I 131	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	3×10^{-8}
		I	2×10^{-7}	9×10^{-4}	5×10^{-9}	3×10^{-8}
	I 132	S	9×10^{-7}	2×10^{-3}	3×10^{-8}	8×10^{-8}
		I	1×10^{-6}	7×10^{-3}	3×10^{-8}	2×10^{-8}
	I 133	S	1×10^{-7}	2×10^{-3}	5×10^{-9}	6×10^{-8}
		I	5×10^{-8}	2×10^{-3}	2×10^{-8}	5×10^{-8}
	I 134	S	6×10^{-6}		1×10^{-7}	
		I	1×10^{-8}		3×10^{-7}	
	I 135	S	1×10^{-6}		2×10^{-8}	
		I	1×10^{-6}		2×10^{-8}	
Iridium (77)	Ir 190	S	2×10^{-7}	7×10^{-4}	5×10^{-9}	2×10^{-8}
		I	1×10^{-7}	7×10^{-4}	4×10^{-9}	4×10^{-8}
	Ir 192	S	3×10^{-8}	1×10^{-3}	6×10^{-9}	4×10^{-8}
		I	4×10^{-8}	4×10^{-4}	1×10^{-8}	1×10^{-7}
	Ir 194	S	3×10^{-8}	1×10^{-3}	8×10^{-9}	3×10^{-8}
		I	2×10^{-7}	9×10^{-4}	5×10^{-9}	3×10^{-8}
Iron (26)	Fe 55	S	9×10^{-7}	2×10^{-3}	3×10^{-8}	8×10^{-8}
		I	1×10^{-6}	7×10^{-3}	3×10^{-8}	2×10^{-8}
	Fe 59	S	1×10^{-7}	2×10^{-3}	5×10^{-9}	6×10^{-8}
		I	5×10^{-8}	2×10^{-3}	2×10^{-8}	5×10^{-8}
Krypton (36)	Kr 85m	Sub	6×10^{-6}		1×10^{-7}	
	Kr 85	Sub	1×10^{-5}		3×10^{-7}	
	Kr 87	Sub	1×10^{-6}		2×10^{-8}	
	Kr 88	Sub	1×10^{-6}		2×10^{-8}	
Lanthanum (57)	La 140	S	2×10^{-7}	7×10^{-4}	5×10^{-9}	2×10^{-8}
		I	1×10^{-7}	7×10^{-4}	4×10^{-8}	2×10^{-8}
Lead (82)	Pb 203	S	3×10^{-6}	1×10^{-2}	9×10^{-9}	4×10^{-8}
		I	2×10^{-6}	1×10^{-2}	6×10^{-8}	4×10^{-8}
	Pb 210	S	1×10^{-10}	4×10^{-4}	4×10^{-12}	1×10^{-7}
		I	2×10^{-10}	5×10^{-3}	8×10^{-12}	2×10^{-8}
	Pb 212	S	2×10^{-8}	6×10^{-4}	6×10^{-10}	2×10^{-8}
		I	2×10^{-8}	5×10^{-4}	7×10^{-10}	2×10^{-7}
Lutetium (71)	Lu 177	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-8}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-8}
Manganese (25)	Mn 52	S	2×10^{-7}	1×10^{-3}	7×10^{-9}	3×10^{-8}
		I	1×10^{-7}	9×10^{-4}	5×10^{-9}	3×10^{-8}
	Mn 54	S	4×10^{-7}	4×10^{-3}	1×10^{-8}	1×10^{-8}
		I	4×10^{-8}	3×10^{-3}	1×10^{-8}	1×10^{-8}
	Mn 56	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-8}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-8}
Mercury (80)	Hg 197m	S	7×10^{-7}	6×10^{-3}	3×10^{-8}	2×10^{-8}
		I	8×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-8}
	Hg 197	S	1×10^{-6}	9×10^{-3}	4×10^{-8}	3×10^{-8}
		I	3×10^{-6}	1×10^{-2}	9×10^{-8}	5×10^{-8}
	Hg 203	S	7×10^{-8}	5×10^{-4}	2×10^{-9}	2×10^{-8}
		I	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-8}
Molybdenum (42)	Mo 99	S	7×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-8}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-8}
Neodymium (60)	Nd 144	S	8×10^{-11}	2×10^{-3}	3×10^{-12}	7×10^{-8}
		I	3×10^{-10}	2×10^{-3}	1×10^{-11}	8×10^{-8}
	Nd 147	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-8}
		I	2×10^{-7}	2×10^{-3}	8×10^{-9}	6×10^{-8}
	Nd 149	S	2×10^{-6}	8×10^{-3}	6×10^{-8}	3×10^{-8}
		I	1×10^{-6}	8×10^{-3}	5×10^{-8}	3×10^{-8}

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APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

(See footnotes on page 20-15)

Element (atomic number)	Isotope †		Table I Column 1 Air (μCi/ml)	Table I Column 2 Water (μCi/ml)	Table II Column 1 Air (μCi/ml)	Table II Column 2 Water (μCi/ml)
Neptunium (93)	Np 237	S	4×10^{-12}	9×10^{-3}	1×10^{-12}	3×10^{-8}
		I	1×10^{-12}	9×10^{-4}	4×10^{-12}	3×10^{-8}
	Np 239	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-7}
		I	7×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-7}
Nickel (28)	Ni 59	S	3×10^{-7}	6×10^{-3}	2×10^{-8}	2×10^{-8}
		I	8×10^{-7}	6×10^{-3}	3×10^{-8}	2×10^{-8}
	Ni 63	S	6×10^{-8}	8×10^{-4}	2×10^{-9}	3×10^{-8}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-8}
	Ni 65	S	9×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-7}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-7}
Niobium (Columbium) (41)	Nb 93m	S	1×10^{-7}	1×10^{-2}	4×10^{-9}	4×10^{-8}
		I	2×10^{-6}	1×10^{-2}	5×10^{-9}	4×10^{-8}
	Nb 95	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-7}
		I	1×10^{-7}	3×10^{-3}	3×10^{-8}	1×10^{-7}
	Nb 97	S	6×10^{-6}	3×10^{-2}	2×10^{-7}	9×10^{-8}
		I	5×10^{-6}	3×10^{-2}	2×10^{-7}	9×10^{-8}
Osmium (76)	Os 185	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-8}
		I	5×10^{-8}	2×10^{-3}	2×10^{-8}	7×10^{-8}
	Os 191m	S	2×10^{-5}	7×10^{-2}	6×10^{-7}	3×10^{-7}
		I	9×10^{-6}	7×10^{-2}	3×10^{-7}	2×10^{-7}
	Os 191	S	1×10^{-6}	5×10^{-2}	4×10^{-8}	2×10^{-8}
		I	4×10^{-7}	5×10^{-2}	1×10^{-8}	2×10^{-8}
	Os 193	S	4×10^{-7}	2×10^{-2}	1×10^{-8}	6×10^{-8}
		I	3×10^{-7}	2×10^{-2}	9×10^{-9}	5×10^{-8}
Palladium (46)	Pd 103	S	1×10^{-6}	1×10^{-2}	5×10^{-8}	3×10^{-8}
		I	7×10^{-7}	8×10^{-3}	3×10^{-8}	3×10^{-8}
	Pd 109	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-8}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-8}
Phosphorus (15)	P 32	S	7×10^{-8}	5×10^{-4}	2×10^{-9}	2×10^{-8}
		I	8×10^{-8}	7×10^{-4}	3×10^{-8}	2×10^{-8}
Platinum (78)	Pt 191	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-7}
		I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-7}
	Pt 193m	S	7×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-7}
		I	5×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-7}
	Pt 197	S	1×10^{-6}	3×10^{-2}	4×10^{-8}	2×10^{-8}
		I	3×10^{-7}	3×10^{-2}	1×10^{-8}	2×10^{-8}
	Pt 197m	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-8}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-8}
Plutonium (94)	Pu 238	S	2×10^{-12}	1×10^{-2}	7×10^{-14}	5×10^{-8}
		I	3×10^{-11}	8×10^{-3}	1×10^{-12}	3×10^{-8}
	Pu 239	S	2×10^{-12}	1×10^{-2}	6×10^{-14}	5×10^{-8}
		I	4×10^{-11}	8×10^{-3}	1×10^{-12}	3×10^{-8}
	Pu 240	S	2×10^{-12}	1×10^{-2}	6×10^{-14}	5×10^{-8}
		I	4×10^{-11}	8×10^{-3}	1×10^{-12}	3×10^{-8}
	Pu 241	S	9×10^{-10}	7×10^{-2}	3×10^{-12}	2×10^{-7}
		I	4×10^{-8}	4×10^{-2}	1×10^{-9}	1×10^{-7}

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Concentrations in Air and Water Above Natural Background—Continued

(See footnotes on page 20-18)

Element (atomic number)	Isotope [1]	†	Table I Column 1 Air (μCi/ml)	Table I Column 2 Water (μCi/ml)	Table II Column 1 Air (μCi/ml)	Table II Column 2 Water (μCi/ml)
Plutonium (94)	Pu 242	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	5×10^{-6}
		I	4×10^{-11}	9×10^{-4}	1×10^{-12}	3×10^{-5}
	Pu 243	S	2×10^{-6}	1×10^{-2}	6×10^{-8}	3×10^{-4}
		I	2×10^{-6}	1×10^{-2}	8×10^{-8}	3×10^{-4}
	Pu 244	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	4×10^{-6}
		I	3×10^{-11}	3×10^{-4}	1×10^{-12}	1×10^{-5}
Polonium (84)	Po 210	S	5×10^{-10}	2×10^{-5}	2×10^{-11}	7×10^{-7}
		I	2×10^{-10}	8×10^{-4}	7×10^{-12}	3×10^{-5}
Potassium (19)	K 42	S	2×10^{-6}	9×10^{-3}	7×10^{-8}	3×10^{-4}
		I	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
Praseodymium (59)	Pr 142	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}
		I	2×10^{-7}	9×10^{-4}	5×10^{-9}	3×10^{-5}
	Pr 143	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	5×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	5×10^{-5}
Promethium (61)	Pm 147	S	6×10^{-8}	6×10^{-3}	2×10^{-9}	2×10^{-4}
		I	1×10^{-7}	6×10^{-3}	3×10^{-9}	2×10^{-4}
	Pm 149	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
Protoactinium (91)	Pa 230	S	2×10^{-9}	7×10^{-3}	6×10^{-11}	2×10^{-4}
		I	8×10^{-10}	7×10^{-3}	3×10^{-11}	2×10^{-4}
	Pa 231	S	1×10^{-12}	3×10^{-5}	4×10^{-14}	9×10^{-7}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	2×10^{-5}
	Pa 233	S	6×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-4}
		I	2×10^{-7}	3×10^{-3}	6×10^{-9}	1×10^{-4}
Radium (88)	Ra 223	S	2×10^{-9}	2×10^{-5}	6×10^{-11}	7×10^{-7}
		I	2×10^{-10}	1×10^{-4}	8×10^{-12}	4×10^{-6}
	Ra 224	S	5×10^{-9}	7×10^{-5}	2×10^{-10}	2×10^{-6}
		I	7×10^{-10}	2×10^{-4}	2×10^{-11}	5×10^{-6}
	Ra 226	S	3×10^{-11}	4×10^{-7}	3×10^{-12}	3×10^{-8}
		I	5×10^{-11}	9×10^{-4}	2×10^{-12}	3×10^{-5}
	Ra 228	S	7×10^{-11}	8×10^{-7}	2×10^{-12}	3×10^{-8}
		I	4×10^{-11}	7×10^{-4}	1×10^{-12}	3×10^{-5}
Radon (86)	Rn 220	S	3×10^{-7}		1×10^{-8}	
	Rn 222 [3] ...		... 3×10^{-8}		3×10^{-9}	
Rhenium (75)	Re 183	S	3×10^{-6}	2×10^{-2}	9×10^{-8}	6×10^{-4}
		I	2×10^{-7}	8×10^{-3}	5×10^{-9}	3×10^{-4}
	Re 186	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	5×10^{-5}
	Re 187	S	9×10^{-6}	7×10^{-2}	3×10^{-7}	3×10^{-3}
		I	5×10^{-7}	4×10^{-2}	2×10^{-8}	2×10^{-3}
	Re 188	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-5}
Rhodium (45)	Rh 103m	S	8×10^{-5}	4×10^{-1}	3×10^{-6}	1×10^{-2}
		I	6×10^{-5}	3×10^{-1}	2×10^{-6}	1×10^{-2}
	Rh 105	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Rubidium (37)	Rb 86	S	3×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
		I	7×10^{-8}	7×10^{-4}	2×10^{-9}	2×10^{-5}
	Rb 87	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	7×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}

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APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

(See footnotes on page 20-18)

Element (atomic number)	Isotope [1]	†	Table I Column 1 Air (μCi/ml)	Table I Column 2 Water (μCi/ml)	Table II Column 1 Air (μCi/ml)	Table II Column 2 Water (μCi/ml)
Ruthenium (44)	Ru 97	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}
		I	2×10^{-6}	1×10^{-2}	6×10^{-8}	3×10^{-4}
	Ru 103	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}
		I	8×10^{-8}	2×10^{-3}	3×10^{-9}	8×10^{-5}
	Ru 105	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
	Ru 106	S	8×10^{-8}	4×10^{-4}	3×10^{-9}	1×10^{-5}
		I	6×10^{-9}	3×10^{-4}	2×10^{-10}	1×10^{-5}
Samarium (62)	Sm 147	S	7×10^{-11}	2×10^{-3}	2×10^{-12}	6×10^{-5}
		I	3×10^{-10}	2×10^{-3}	9×10^{-12}	7×10^{-5}
	Sm 151	S	6×10^{-8}	1×10^{-2}	2×10^{-9}	4×10^{-4}
		I	1×10^{-7}	1×10^{-2}	5×10^{-9}	4×10^{-4}
	Sm 153	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
Scandium (21)	Sc 46	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
		I	2×10^{-8}	1×10^{-3}	8×10^{-10}	4×10^{-5}
	Sc 47	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
	Sc 48	S	2×10^{-7}	8×10^{-4}	6×10^{-9}	3×10^{-5}
		I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
Selenium (34)	Se 75	S	1×10^{-6}	9×10^{-3}	4×10^{-8}	3×10^{-4}
		I	1×10^{-7}	8×10^{-3}	4×10^{-9}	3×10^{-4}
Silicon (14)	Si 31	S	6×10^{-6}	3×10^{-2}	2×10^{-7}	9×10^{-4}
		I	1×10^{-6}	6×10^{-3}	3×10^{-8}	2×10^{-4}
Silver (47)	Ag 105	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	8×10^{-8}	3×10^{-3}	3×10^{-9}	1×10^{-4}
	Ag 110m	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}
		I	1×10^{-8}	9×10^{-4}	3×10^{-10}	3×10^{-5}
	Ag 111	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
Sodium (11)	Na 22	S	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
		I	9×10^{-9}	9×10^{-4}	3×10^{-10}	3×10^{-5}
	Na 24	S	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}
		I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
Strontium (38)	Sr 85m	S	4×10^{-5}	2×10^{-1}	1×10^{-6}	7×10^{-3}
		I	3×10^{-5}	2×10^{-1}	1×10^{-6}	7×10^{-3}
	Sr 85	S	2×10^{-7}	3×10^{-3}	8×10^{-9}	1×10^{-4}
		I	1×10^{-7}	5×10^{-3}	4×10^{-9}	2×10^{-4}
	Sr 89	S	3×10^{-8}	3×10^{-4}	3×10^{-10}	3×10^{-6}
		I	4×10^{-8}	8×10^{-4}	1×10^{-9}	3×10^{-5}
	Sr 90	S	1×10^{-9}	1×10^{-5}	3×10^{-11}	3×10^{-7}
		I	5×10^{-9}	1×10^{-3}	2×10^{-10}	4×10^{-5}
	Sr 91	S	4×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
		I	3×10^{-7}	1×10^{-3}	9×10^{-9}	5×10^{-5}
	Sr 92	S	4×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
Sulfur (16)	S 35	S	3×10^{-7}	2×10^{-3}	9×10^{-9}	6×10^{-5}
		I	3×10^{-7}	8×10^{-3}	9×10^{-9}	3×10^{-4}
Tantalum (73)	Ta 182	S	4×10^{-8}	1×10^{-3}	1×10^{-9}	4×10^{-5}
		I	2×10^{-8}	1×10^{-3}	7×10^{-10}	4×10^{-5}

APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

(See footnotes on page 20-18)

Element (atomic number)	Isotope [1]		Table I Column 1 Air † (μCi/ml)	Table I Column 2 Water (μCi/ml)	Table II Column 1 Air (μCi/ml)	Table II Column 2 Water (μCi/ml)
Technetium (43)	Tc 96m	S	8×10^{-3}	4×10^{-3}	3×10^{-6}	1×10^{-3}
		I	3×10^{-3}	3×10^{-3}	1×10^{-6}	1×10^{-3}
	Tc 96	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	5×10^{-4}
	Tc 97m	S	2×10^{-6}	1×10^{-3}	8×10^{-8}	4×10^{-4}
		I	2×10^{-7}	5×10^{-3}	5×10^{-9}	2×10^{-4}
	Tc 97	S	1×10^{-5}	5×10^{-3}	4×10^{-7}	2×10^{-3}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-4}
	Tc 99m	S	4×10^{-5}	2×10^{-3}	1×10^{-6}	6×10^{-3}
		I	1×10^{-5}	8×10^{-3}	5×10^{-7}	3×10^{-3}
	Tc 99	S	2×10^{-6}	1×10^{-2}	7×10^{-8}	3×10^{-4}
		I	6×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
Tellurium (52)	Te 125m	S	4×10^{-7}	3×10^{-3}	1×10^{-8}	2×10^{-4}
		I	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
	Te 127m	S	1×10^{-7}	2×10^{-3}	5×10^{-9}	6×10^{-5}
		I	4×10^{-6}	2×10^{-3}	1×10^{-7}	5×10^{-5}
	Te 127	S	2×10^{-6}	8×10^{-3}	6×10^{-8}	3×10^{-4}
		I	9×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	Te 129m	S	8×10^{-8}	1×10^{-3}	3×10^{-9}	3×10^{-5}
		I	3×10^{-8}	6×10^{-4}	1×10^{-9}	2×10^{-5}
	Te 129	S	5×10^{-6}	2×10^{-2}	2×10^{-7}	8×10^{-4}
		I	4×10^{-6}	2×10^{-2}	1×10^{-7}	8×10^{-4}
	Te 131m	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
	Te 132	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}
		I	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
Terbium (65)	Tb 160	S	1×10^{-7}	1×10^{-3}	3×10^{-9}	4×10^{-5}
		I	3×10^{-8}	1×10^{-3}	1×10^{-9}	4×10^{-5}
Thallium (81)	Tl 200	S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}
		I	1×10^{-6}	7×10^{-3}	4×10^{-8}	2×10^{-4}
	Tl 201	S	2×10^{-6}	9×10^{-3}	7×10^{-8}	3×10^{-4}
		I	9×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	Tl 202	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	2×10^{-7}	2×10^{-3}	8×10^{-9}	7×10^{-5}
	Tl 204	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	3×10^{-8}	2×10^{-3}	9×10^{-10}	6×10^{-5}
Thorium (90)	Th 227	S	3×10^{-10}	5×10^{-6}	1×10^{-11}	2×10^{-7}
		I	2×10^{-10}	5×10^{-6}	6×10^{-12}	2×10^{-7}
	Th 228	S	9×10^{-13}	2×10^{-6}	3×10^{-13}	7×10^{-8}
		I	6×10^{-13}	4×10^{-6}	2×10^{-13}	1×10^{-7}
	Th 230	S	2×10^{-12}	5×10^{-5}	8×10^{-14}	2×10^{-6}
		I	1×10^{-11}	9×10^{-4}	3×10^{-13}	3×10^{-5}
	Th 231	S	1×10^{-6}	7×10^{-3}	5×10^{-8}	2×10^{-4}
		I	1×10^{-6}	7×10^{-3}	4×10^{-8}	2×10^{-4}
	Th 232	S	3×10^{-11}	5×10^{-5}	1×10^{-13}	2×10^{-6}
		I	3×10^{-12}	1×10^{-5}	1×10^{-13}	4×10^{-6}
	Th natural	S	6×10^{-12}	6×10^{-5}	2×10^{-12}	2×10^{-6}
		I	6×10^{-11}	6×10^{-4}	2×10^{-12}	2×10^{-5}
Thorium (90)	Th 234	S	6×10^{-9}	5×10^{-4}	2×10^{-7}	2×10^{-3}
		I	3×10^{-9}	5×10^{-4}	1×10^{-7}	2×10^{-3}
Thulium (69)	Tm 170	S	4×10^{-8}	1×10^{-3}	1×10^{-9}	5×10^{-5}
		I	3×10^{-8}	1×10^{-3}	1×10^{-9}	5×10^{-5}
	Tm 171	S	1×10^{-7}	1×10^{-2}	4×10^{-9}	5×10^{-4}
		I	2×10^{-7}	1×10^{-2}	8×10^{-9}	5×10^{-4}
Tin (50)	Sn 113	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	9×10^{-5}
		I	5×10^{-6}	2×10^{-3}	2×10^{-8}	8×10^{-5}
	Sn 125	S	1×10^{-7}	5×10^{-4}	4×10^{-9}	2×10^{-5}
		I	8×10^{-8}	5×10^{-4}	3×10^{-9}	2×10^{-5}
Tungsten (Wolfram) (74)	W 181	S	2×10^{-6}	1×10^{-3}	8×10^{-8}	4×10^{-5}
		I	1×10^{-7}	1×10^{-3}	4×10^{-9}	3×10^{-5}
	W 185	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	1×10^{-6}	3×10^{-3}	4×10^{-8}	1×10^{-4}
	W 187	S	4×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
Uranium (92)	U 230	S	3×10^{-10}	1×10^{-3}	1×10^{-11}	5×10^{-5}
		I	1×10^{-10}	1×10^{-3}	4×10^{-12}	5×10^{-5}
	U 232	S	1×10^{-10}	8×10^{-4}	3×10^{-12}	3×10^{-5}
		I	3×10^{-9}	8×10^{-4}	9×10^{-12}	3×10^{-5}
	U 233	S	5×10^{-10}	9×10^{-4}	2×10^{-11}	3×10^{-5}
		I	1×10^{-10}	9×10^{-4}	4×10^{-12}	3×10^{-5}
**	U 234	S[4]	6×10^{-10}	9×10^{-4}	2×10^{-11}	3×10^{-5}
		I	1×10^{-10}	9×10^{-4}	4×10^{-12}	3×10^{-5}
**	U 235	S[4]	5×10^{-10}	8×10^{-4}	2×10^{-11}	3×10^{-5}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	U 236	S	6×10^{-10}	1×10^{-3}	2×10^{-11}	4×10^{-5}
		I	1×10^{-10}	1×10^{-3}	4×10^{-12}	4×10^{-5}
**	U 238	S[4]	7×10^{-10}	1×10^{-3}	2×10^{-11}	4×10^{-5}
		I	1×10^{-10}	1×10^{-3}	5×10^{-12}	4×10^{-5}
	U 240	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	3×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	3×10^{-5}
**	U-natural	S[4]	1×10^{-10}	1×10^{-3}	5×10^{-12}	3×10^{-5}
		I	1×10^{-10}	1×10^{-3}	6×10^{-12}	3×10^{-5}
Vanadium (23)	V 48	S	2×10^{-7}	9×10^{-4}	8×10^{-9}	3×10^{-5}
Xenon (54)	Xe 131m	Sub	6×10^{-6}	8×10^{-4}	2×10^{-7}	3×10^{-5}
	Xe 133	Sub	2×10^{-6}		4×10^{-7}	
	Xe 133m	Sub	1×10^{-6}		3×10^{-7}	
	Xe 135	Sub	1×10^{-6}		3×10^{-7}	
Ytterbium (70)	Yb 175	S	4×10^{-7}		1×10^{-7}	
Yttrium (39)	Y 90	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
	Y 91m	S	1×10^{-7}	6×10^{-3}	4×10^{-9}	2×10^{-4}
		I	1×10^{-7}	6×10^{-3}	3×10^{-9}	2×10^{-4}
	Y 91	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	3×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	3×10^{-5}
	Y 92	S	4×10^{-8}	8×10^{-4}	1×10^{-9}	3×10^{-5}
		I	3×10^{-8}	8×10^{-4}	1×10^{-9}	3×10^{-5}
	Y 93	S	4×10^{-8}	2×10^{-3}	1×10^{-9}	6×10^{-5}
		I	3×10^{-8}	2×10^{-3}	1×10^{-9}	6×10^{-5}
			2×10^{-7}	8×10^{-4}	6×10^{-9}	3×10^{-5}
			1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}

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APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

Element (atomic number)	Isotope [1]		Table I Column 1 Air (μCi/ml)	Table I Column 2 Water (μCi/ml)	Table II Column 1 Air (μCi/ml)	Table II Column 2 Water (μCi/ml)
Zinc (30)	Zn 65	S	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
		I	6×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
	Zn 69m	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	Zn 69	S	7×10^{-6}	5×10^{-2}	2×10^{-7}	2×10^{-3}
		I	9×10^{-6}	5×10^{-2}	3×10^{-7}	2×10^{-3}
Zirconium (40)	Zr 93	S	1×10^{-7}	2×10^{-2}	4×10^{-9}	8×10^{-4}
		I	3×10^{-7}	2×10^{-2}	1×10^{-8}	8×10^{-4}
	Zr 95	S	1×10^{-7}	2×10^{-3}	4×10^{-9}	6×10^{-5}
		I	3×10^{-8}	2×10^{-3}	1×10^{-9}	6×10^{-5}
	Zr 97	S	1×10^{-7}	5×10^{-4}	4×10^{-9}	2×10^{-5}
		I	9×10^{-8}	5×10^{-4}	3×10^{-9}	2×10^{-5}
Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life less than 2 hours.		Sub	1×10^{-6}		3×10^{-8}	
Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life greater than 2 hours.			3×10^{-9}	9×10^{-5}	1×10^{-10}	3×10^{-6}
Any single radionuclide not listed above, which decays by alpha emission or spontaneous fission.			6×10^{-13}	4×10^{-7}	2×10^{-14}	3×10^{-8}

[3] These radon concentrations are appropriate for protection from radon-222 combined with its short-lived daughters. Alternatively, the value in Table I may be replaced by one-third (⅓) "working level." (A "working level" is defined as any combination of short-lived radon-222 daughters, polonium-218, lead-214, bismuth-214 and polonium-214, in one liter of air, without regard to the degree of equilibrium, that will result in the ultimate emission of 1.3 x 10 MeV of alpha particle energy.) The Table II value may be replaced by one-thirtieth (1/30) of a "working level." The limit on radon-222 concentrations in restricted areas may be based on an annual average.

40 FR 50704

‡4 For soluble mixtures of U-238, U-234 and U-235 in air chemical toxicity may be the limiting factor. If the percent by weight (enrichment) of U-235 is less than 5, the concentration value for a 40-hour workweek, Table I, is 0.2 milligrams uranium per cubic meter of air average. For any enrichment, the product of the average concentration and time of exposure during a 40-hour workweek shall not exceed 8×10^{-3} SA μCi-hr/ml, where SA is the specific activity of the uranium inhaled. The concentration value for Table II is 0.007 milligrams uranium per cubic meter of air. The specific activity for natural uranium is 6.77×10^{-7} curies per gram U. The specific activity for other mixtures of U-238, U-235 and U-234, if not known, shall be:

$SA = 3.6 \times 10^{-7}$ curies/gram U   U-depleted
$SA = (0.4 + 0.38 E + 0.0034 E^2) 10^{-6}$ $E \geq 0.72$

where E is the percentage by weight of U-235 expressed as percent.

39 FR 23990

*Amended 37 FR 23319.
**Amended 39 FR 23990; footnote redesignated 40 FR 50704.
***Amended 40 FR 50704.
†Amended 38 FR 29314.
‡Amended 39 FR 25463; redesignated 40 FR 50704.

NOTE TO APPENDIX B

Note: In any case where there is a mixture in air or water of more than one radionuclide, the limiting values for purposes of this Appendix should be determined as follows:

1. If the identity and concentration of each radionuclide in the mixture are known, the limiting values should be derived as follows: Determine, for each radionuclide in the mixture, the ratio between the quantity present in the mixture and the limit otherwise established in Appendix B for the specific radionuclide when not in a mixture. The sum of such ratios for all the radionuclides in the mixture may not exceed "1" (i.e., "unity").

Example: If radionuclides A, B, and C are present in concentrations C_A, C_B, and C_C, and if the applicable MPC's are MPC_A, and MPC_B, and MPC_C respectively, then the concentrations shall be limited so that the following relationship exists:

$$\frac{C_A}{MPC_A}+\frac{C_B}{MPC_B}+\frac{C_C}{MPC_C}\leq 1$$

2. If either the identity or the concentration of any radionuclide in the mixture is not known, the limiting values for purposes of Appendix B shall be:

a. For purposes of Table I, Col. 1—6×10^{-14} μCi/ml

b. For purposes of Table I, Col. 2—4×10^{-7} μCi/ml

c. For purposes of Table II, Col. 1—2×10^{-12} μCi/ml

d. For purposes of Table II, Col. 2—3×10^{-6} μCi/ml

3. If any of the conditions specified below are met, the corresponding values specified below may be used in lieu of those specified in paragraph 2 above.

a. If the identity of each radionuclide in the mixture is known but the concentration of one or more of the radionuclides in the mixture is not known, the concentration limit for the mixture is the limit specified in Appendix "B" for the radionuclide in the mixture having the lowest concentration limit; or

b. If the identity of each radionuclide in the mixture is not known, but it is known that certain radionuclides specified in Appendix "B" are not present in the mixture, the concentration limit for the mixture is the lowest concentration limit specified in Appendix "B" for any radionuclide which is not known to be absent from the mixture; or

a. Element (atomic number) and isotope	Table I		Table II	
	Column 1 Air (μCi/ml)	Column 2 Water (μCi/ml)	Column 1 Air (μCi/ml)	Column 2 Water (μCi/ml)
If it is known that Sr 90, I 125, I 126, I 129, I 131, (I 133, table II only), Pb 210, Po 210, At 211, Ra 223, Ra 224, Ra 226, Ac 227, Ra 228, Th 230, Pa 231, Th 232, Th-nat, Cm 248, Cf 254, and Fm 256 are not present	.....	9×10^{-9}	.....	3×10^{-6}
If it is known that Sr 90, I 125, I 126, I 129, (I 131, I 133, table II only), Pb 210, Po 210, Ra 223, Ra 226, Ra 228, Pa 231, Th-nat, Cm 248, Cf 254, and Fm 256 are not present	.....	6×10^{-8}	.....	2×10^{-5}
If it is known that Sr 90, I 129, (I 125, I 126, I 131, table II only), Pb 210, Ra 226, Ra 228, Cm 248, and Cf 254 are not present	.....	2×10^{-8}	.....	6×10^{-7}
If it is known that (I 129, table II only), Ra 226, and Ra 228 are not present	.....	3×10^{-8}	.....	1×10^{-7}
If it is known that alpha-emitters and Sr 90, I 129, Pb 210, Ac 227, Ra 228, Pa 230, Pu 241, and Bk 249 are not present	3×10^{-12}	.....	1×10^{-10}	.....
If it is known that alpha-emitters and Pb 210, Ac 227, Ra 228, and Pu 241 are not present	3×10^{-12}	.....	1×10^{-10}	.....
If it is known that alpha-emitters and Ac 227 are not present	3×10^{-12}	.....	1×10^{-10}	.....
If it is known that Ac 227, Th 230, Pa 231, Pu 238, Pu 239, Pu 240, Pu 242, Pu 244, Cm 248, Cf 249 and Cf 251 are not present	3×10^{-13}	.....	1×10^{-11}	.....

4. If a mixture of radionuclides consists of uranium and its daughters in ore dust prior to chemical separation of the uranium from the ore, the values specified below may be used for uranium and its daughters through radium-226, instead of those from paragraphs 1, 2, or 3 above.

a. For purposes of Table I, Col. 1—1×10^{-11} μCi/ml gross alpha activity; or 5×10^{-11} μCi/ml natural uranium; or 75 micrograms per cubic meter of air natural uranium.

b. For purposes of Table II, Col. 1—3×10^{-12} μCi/ml gross alpha activity; or 2×10^{-11} μCi/ml natural uranium; or 8 micrograms per cubic meter of air natural uranium.

5. For purposes of this Note, a radionuclide may be considered as not present in a mixture if (a) the ratio of the concentration of that radionuclide in the mixture (C_A) to the concentration limit for that radionuclide specified in Table II of Appendix B (MPC_A) does not exceed 1/10 (i.e., $\frac{C_A}{MPC_A}\leq\frac{1}{10}$) and (b) the sum of such ratios for all the radionuclides considered as not present in the mixture does not exceed 1/4 (i.e., $\frac{C_A}{MPC_A}+\frac{C_B}{MPC_B}+\ldots\ldots\leq\frac{1}{4}$).

APPENDIX C

Material	Microcuries
Americium-241	.01
Antimony-122	100
Antimony-124	10
Antimony-125	10
Arsenic-73	100
Arsenic-74	10
Arsenic-76	10
Arsenic-77	100
Barium-131	10
Barium-133	10
Barium-140	10
Bismuth-210	1
Bromine-82	10
Cadmium-109	10
Cadmium-115m	10
Cadmium-115	100
Calcium-45	10
Calcium-47	10
Carbon-14	100
Cerium-141	100
Cerium-143	100
Cerium-144	1
Cesium-131	1,000
Cesium-134m	100
Cesium-134	1
Cesium-135	10
Cesium-136	10
Cesium-137	10
Chlorine-36	10
Chlorine-38	10
Chromium-51	1,000
Cobalt-58m	10
Cobalt-58	10
Cobalt-60	1
Copper-64	100
Dysprosium-165	10
Dysprosium-166	100
Erbium-169	100
Erbium-171	100
Europium-152 9.2 h	100
Europium-152 13 yr	1
Europium-154	1
Europium-155	10
Fluorine-18	1,000
Gadolinium-153	10
Gadolinium-159	100
Gallium-72	10
Germanium-71	100
Gold-198	100
Gold-199	100
Hafnium-181	10
Holmium-166	100
Hydrogen-3	1,000
Indium-113m	100
Indium-114m	10
Indium-115m	100
Indium-115	10
Iodine-125	1
Iodine-126	1
Iodine-129	0.1
Iodine-131	1
Iodine-132	10
Iodine-133	1
Iodine-134	10
Iodine-135	10
Iridium-192	10
Iridium-194	100
Iron-55	100
Iron-59	10
Krypton-85	100
Krypton-87	10
Lanthanum-140	10
Lutetium-177	100
Manganese-52	10
Manganese-54	10
Manganese-56	10
Mercury-197m	100
Mercury-197	100
Mercury-203	10
Molybdenum-99	100
Neodymium-147	100
Neodymium-149	100
Nickel-59	100
Nickel-63	10
Nickel-65	100
Niobium-93m	10
Niobium-95	10
Niobium-97	10
Osmium-185	10
Osmium-191m[1]	100
Osmium-191	100
Osmium-193	100
Palladium-103	100
Palladium-109	100
Phosphorus-32	10
Platinum-191	100
Platinum-193m	100
Platinum-193	100
Platinum-197m	100
Platinum-197	100
Plutonium-239	.01
Polonium-210	0.1
Potassium-42	10
Praseodymium-142	100
Praseodymium-143	100
Promethium-147	10
Promethium-149	10
Radium-226	.01
Rhenium-186	100
Rhenium-188	100
Rhodium-103m	100
Rhodium-105	100
Rubidium-86	10
Rubidium-87	10
Ruthenium-97	100
Ruthenium-103	10
Ruthenium-105	10
Ruthenium-106	1
Samarium-151	10
Samarium-153	100
Scandium-46	10
Scandium-47	100
Scandium-48	10
Selenium-75	10
Silicon-31	100
Silver-105	10
Silver-110m	1
Silver-111	100
Sodium-24	10
Strontium-85	10
Strontium-89	1
Strontium-90	0.1
Strontium-91	10
Strontium-92	10
Sulphur-35	100
Tantalum-182	10
Technetium-96	10
Technetium-97m	100
Technetium-97	100
Technetium-99m	100
Technetium-99	10
Tellurium-125m	10
Tellurium-127m	10
Tellurium-127	100
Tellurium-129m	10
Tellurium-129	100
Tellurium-131m	10
Tellurium-132	10
Terbium-160	10
Thallium-200	100
Thallium-201	100
Thallium-202	100
Thallium-204	10
** Thorium (natural)[1]	100
Thulium-170	10
Thulium-171	10
Tin-113	10
Tin-125	10
Tungsten-181	10
Tungsten-185	10
Tungsten-187	100
** Uranium (natural)[2]	100
Uranium-233	.01
Uranium-234 Uranium-235	.01
Vanadium-48	10
Xenon-131m	1,000
Xenon-133	100
Xenon-135	100
Ytterbium-175	100
Yttrium-90	10
Yttrium-91	10
Yttrium-92	100
Yttrium-93	100
Zinc-65	10
Zinc-69m	100
Zinc-69	1,000
Zirconium-93	10
Zirconium-95	10
Zirconium-97	10
Any alpha emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition	.01
Any radionuclide other than alpha emitting radionuclides, not listed above or mixtures of beta emitters of unknown composition	1

35 FR 6425

35 FR 6425

45 FR 71761

Note.—For purposes of § 20.303, when there is involved a combination of isotopes in known amounts, the limit for the combination should be derived as follows. Determine, for each isotope in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific isotope when not in combination. The sum of such ratios for all the isotopes in the combination may not exceed "1" (i.e., "unity").

[1] Based on alpha disintegration rate of Th-232, Th-230 and their daughter products.

[2] Based on alpha disintegration rate of U-238, U-234, and U-235.

* Amended 36 FR 16898.

** Amended 39 FR 23990.

APPENDIX T

HEALTH PHYSICS ASPECTS OF FIRE FIGHTING

1. PURPOSE. To prescribe general measures to be followed to minimize radiological hazards associated with fire protection.

2. FIRE PREVENTION.

a. Whenever possible, flammable materials will not be stored with radioactive materials. When flammable materials must be stored in conjunction with radioactive materials, the manner of storage will be coordinated with the Fire Inspector's Office (Ext. 8667) to insure that the fire hazard is minimized.

b. Every effort will be made by the user to eliminate fire hazards within his area of responsibility.

c. During routine inspections by fire prevention personnel, the location of radioactive material will be made known to the inspector. The "CAUTION - RADIOACTIVE MATERIALS" warning which is to be posted on containers and rooms in accordance with instructions contained in Appendix D to this regulation will assist in meeting this requirement.

3. FIRE FIGHTING. Whenever firemen respond to a call in an area posted "CAUTION - RADIOACTIVE MATERIALS," the following protective measures will be employed to minimize radiological hazards:

a. The Radiation Protection Officer (RPO), Ext . 3826, will be notified of a fire in a posted area.

b. Health Physics personnel will provide radiation detection equipment and make necessary dose rate measurements. If possible, radiation measurements will be completed prior to the arrival of fire department personnel.

c. Personnel assigned to the area in which the fire occurred should remain in the nearby area to provide current information concerning the location and activity of radiation sources.

d. Firemen should wear self-contained breathing apparatus and protective coat and boots if it does not unduly interfere with their mission. If any area may require the use of self-contained breathing apparatus to fight a fire, each entrance to that area will be clearly posted.

e. Personnel will stay in the area the shortest period of time necessary to accomplish the fire-fighting mission. Firemen will avoid unnecessary contact with equipment, opening of containers, or handling of debris.

f. Personnel who have entered the area will remain in the vicinity until surveyed and released by Health Physics personnel. This measure is prescribed to avoid unnecessary spread of radioactive contamination. In the event of personal injury, the provisions of Appendix V to this regulation will be followed in lieu of this provision.

4. SPECIAL CONSIDERATIONS.

a. During fire fighting in areas where large radioactive sources are located, every effort will be made to cool the source with a stream of water if the heat of the fire might cause the lead shielding to melt. When the lead shielding mets, it may escape or change shape in such a way that a serious radiation hazard could result.

b. Health Physics personnel will conduct classes for the fire department regarding the use of radiological survey instruments, radiological hazards associated with fire protection, and current locations of radioactive materials.

APPENDIX V

RADIOLOGICAL EMERGENCIES

1. PURPOSE.

a. The primary purpose of this Appendix is to insure that an individual who is known or suspected to have been involved in a radiation accident and/or incident that could have resulted in an internal and/or external exposure to ionizing radiation receives proper medical care, and that the possible radiation exposure is evaluated.

b. A secondary purpose of this Appendix is to insure that the source of the accidental radiation exposure is contained, so that further exposure of personnel will be controlled.

2. GENERAL GUIDANCE.

a. It is assumed that radioactive material will be handled by qualified persons and in accordance with existing regulations and policies. It is expected that this Appendix will be interpreted by those persons in the light of their knowledge of the relative radiotoxicity of the various radioactive materials (radionuclides) in their possession.

b. A radiation accident may be defined as an unforeseen occurrence, either actual or suspected, involving exposure or contamination of humans and the environment by ionizing radition. The accident will be considered as occurring over a short period of time, from seconds up to several days. Chronic occupational or other long-term exposure will not be considered.

c. There are two ways in which humans can be exposed to ionizing radiation:

(1) External. The source of ionizing radiation may be outside of the body so that the radiation strikes the individual and is absorbed, depending upon its physical characteristics. Radiation from x-ray generators, particle accelerators, sealed sources of radionuclides and reactors are examples of this type. The radiation may be beta, gamma, or neutrons. Alpha emitters present no significant external hazard. Particle accelerators may produce other particles such as deuterons, mesons, etc. All persons who are known or suspected to have been externally exposed to an acute dose (within a twenty-four hour period) in excess of:

(a) Whole body, head and trunk, active blood-forming organs,

gonads or lens of the eye -- 3 rem.

(b) Skin of the whole body and thyroid -- 10 rem.

(c) Hands and forearms, feet and ankles -- 30 rem.

shall be reported immediately to the Radiation Protection Officer (RPO), FAMC (Ext 3826).

(2) Internal. The source of ionizing radiation may gain entrance into the human body by inhalation, ingestion, injection or absorption through the intact or injured body surface. Radionuclides may also be formed within the body following exposure to an external source of neutrons. All persons who are known or suspected to have been internally exposed to activities of radioactive material in excess of 1/10 of the amounts specified in Appendix C, 10 CFR 20 (see Section 1 to this Appendix) shall be reported to the RPO, FAMC.

d. There should be no undue delay in the evacuation of the victim to the treatment facility, but there is seldom a need for unusual haste.

3. In the event of an emergency the most senior knowledgeable individual present will assume control of the situation and direct activities until relieved by proper authority. The exact actions and sequence of actions to be taken will be determined by the nature of the emergency. The following actions are typical responses to emergency situations. (The sequence of these actions is highly variable.):

a. Dismiss nonessential personnel.

b. Limit or eliminate the condition if undue hazard to personnel does not result. For example:

(1) Return sources to shielded containers.

(2) Place absorbent material on spills.

(3) Turn off ventilation.

(4) Extinguish flames, heaters, etc.

(5) Turn off equipment.

c. Evacuate ALL personnel from the area.

d. Make certain that all personnel have left the area.

e. Restrict access to the area.

4. Health Physics personnel will respond to all radiological emergencies and will:

a. Provide technical advice as necessary.

b. Arrange for additional resources (personnel, supplies, and equipment).

c. Supervise the reduction of radiological hazards.

d. Monitor the persons who were in the vicinity of the accident if there is a reasonable probability that they may have been exposed and/or contaminated.

e. Take action to prevent further contamination of personnel and equipment.

f. Make and/or coordinate all appropriate follow-up measures, reports, investigations, etc.

5. The Commander, FAMC, will develop procedures to:

a. Insure the proper evaluation and treatment of patients who may have been accidentally exposed to ionizing radiation.

b. Assure effective control of radiation contamination and radiation exposure to personnel.

c. The RPO will provide direct support of patient care activities involving contaminated and/or radioactive patients to minimize occupational radiation exposure to medical personnel.

APPENDIX C

35 FR 6425

Material	Microcuries
Americium-241	.01
Antimony-122	100
Antimony-124	10
Antimony-125	10
Arsenic-73	100
Arsenic-74	10
Arsenic-76	10
Arsenic-77	100
Barium-131	10
*Barium-133	10
Barium-140	10
Bismuth-210	1
Bromine-82	10
Cadmium-109	10
Cadmium-115m	10
Cadmium-115	100
Calcium-45	10
Calcium-47	10
Carbon-14	100
Cerium-141	100
Cerium-143	100
Cerium-144	1
Cesium-131	1,000
Cesium-134m	100
Cesium-134	1
Cesium-135	10
Cesium-136	10
Cesium-137	10
Chlorine-36	10
Chlorine-38	10
Chromium-51	1,000
Cobalt-58m	10
Cobalt-58	10
Cobalt-60	1
Copper-64	100
Dreprosium-165	10
Dysprosium-166	100
Erbium-169	100
Erbium-171	100
Europium-152 9.2 h	100
Europium-152 13 yr	1
Europium-154	1
Europium-155	10
Fluorine-18	1,000
Gadolinium-153	10
Gadolinium-159	100
Gallium-72	10
Germanium-71	100
Gold-198	100
Gold-199	100
Hafnium-181	10
Holmium-166	100
Hydrogen-3	1,000
Indium-113m	100
Indium-114m	10
Indium-115m	100
Indium-115	10
Iodine-125	1
Iodine-126	1
Iodine-129	0.1
Iodine-131	1
Iodine-132	10
Iodine-133	1
Iodine-134	10
Iodine-135	10
Iridium-192	10
Iridium-194	100
Iron-55	100
Iron-59	10
Krypton-85	100
Krypton-87	10
Lanthanum-140	10
Lutetium-177	100
Manganese-52	10
Manganese-54	10
Manganese-56	10
Mercury-197m	100
Mercury-197	100
Mercury-203	10
Molybdenum-99	100
Neodymium-147	100
Neodymium-149	100
Nickel-59	100
Nickel-63	10
Nickel-65	100
Niobium-93m	10
Niobium-95	10
Niobium-97	10
Osmium-185	10

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Material	Microcuries
Osmium-191m*	100
Osmium-191	100
Osmium-193	100
Palladium-103	100
Palladium-109	100
Phosphorus-32	10
Platinum-191	100
Platinum-193m	100
Platinum-193	100
Platinum-197m	100
Platinum-197	100
Plutonium-239	.01
Polonium-210	0.1
Potassium-42	10
Praseodymium-142	100
Praseodymium-143	100
Promethium-147	10
Promethium-149	10
Radium-226	.01
Rhenium-186	100
Rhenium-188	100
Rhodium-103m	100
Rhodium-105	100
Rubidium-86	10
Rubidium-87	10
Ruthenium-97	100
Ruthenium-103	10
Ruthenium-105	10
Ruthenium-106	1
Samarium-151	10
Samarium-153	100
Scandium-46	10
Scandium-47	100
Scandium-48	10
Selenium-75	10
Silicon-31	100
Silver-105	10
Silver-110m	1
Silver-111	100
Sodium-24	10
Strontium-85	10
Strontium-89	1
Strontium-90	0.1
Strontium-91	10
Strontium-92	10
Sulphur-35	100
Tantalum-182	10
Technetium-96	10
Technetium-97m	100
Technetium-97	100
Technetium-99m	100
Technetium-99	10
Tellurium-125m	10
Tellurium-127m	10
Tellurium-127	100
Tellurium-129m	10
Tellurium-129	100
Tellurium-131m	10
Tellurium-132	10
Terbium-160	10
Thallium-200	100
Thallium-201	100
Thallium-202	100
Thallium-204	10
**Thorium (natural)[1]	100
Thulium-170	10
Thulium-171	10
Tin-113	10
Tin-125	10
Tungsten-181	10
Tungsten-185	10
Tungsten-187	100
**Uranium (natural)[2]	100
Uranium-233	.01
Uranium-234 Uranium-235	.01
Vanadium-48	10
Xenon-131m	1,000
Xenon-133	100
Xenon-135	100
Ytterbium-175	100
Yttrium-90	10
Yttrium-91	10
Yttrium-92	100
Yttrium-93	100
Zinc-65	10
Zinc-69m	100
Zinc-69	1,000
Zirconium-93	10
Zirconium-95	10
Zirconium-97	10

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Any alpha emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition 0.1

Any radionuclide other than alpha emitting radionuclides, not listed above or mixtures of beta emitters of unknown composition... 1

45 FR 71761

Note.—For purposes of § 20.303, where there is involved a combination of isotopes known amounts, the limit for the combinati should be derived as follows. Determine, fo each isotope in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific isotope when no in combination. The sum of such ratios for the isotopes in the combination may not exceed "1" (i.e., "unity").

[1] Based on alpha disintegration rate Th-232, Th-230 and their daughter produc

[2] Based on alpha disintegration rate U-238, U-234, and U-235.

* Amended 36 FR 16898.

** Amended 39 FR 23990.

ANNEX F A-5

DAILY QC Mo-99 ASSAY

1. Example:

Date	Generator Lot #	Elution Total mCi	Total uCi Mo-99	Break-through (Decimal)	Initials
29 Jan 79	290179N2	1240	2.9	.002	ER

2. The decimal breakthrough and total uCi of Mo-99 present are calculated as shown in Annex.

3. Standards of allowable Mo-99:

   a. Not more than 0.15uCi per mCi of Tc-99m.

ANNEX F A-6

DOSE CALIBRATOR DAILY LOG

1. Example:

Date	Activity of Standard	Calibrator Reading	Variation	Isotope	Initials
22 Mar 82	2.72	2.70	0.073	^{57}Co	GJD

DAILY MONITORING LOG

1. Example:

Date	Sink	Hot Sink	Floor	Dose Calib.	Inj. Table	Counter	Bkg.	Int.
22 Mar 82	Bkg.	Bkg.	Bkg.	Bkg.	Bkg.	Bkg.	<0.04	GJD

2. The headings refer to the following areas:

a. Sink; the sink counter and floor along the north wall of the nuclear pharmacy.

b. Hot sink; the sink counter and floor along the east wall of the nuclear pharmacy. This includes the chemistry exhaust hood.

c. Floor; the floor of the nuclear pharmacy.

d. Dose Calibrator; the dose calibrators, counter and floor along the west wall of the nuclear pharmacy.

e. Inj. Table; the area where freight is received inside the pharmacy. Also included are the well counter area and the area where injections are made, in the injection room.

f. Counter; Counters of the nuclear pharmacy.

g. Bkg; this will include the bkg. (background) reading.

h. Int.; the initials of the person performing the survey.

3. The Chief, Nuclear Pharmacy will be notified of any abnormal readings and actions taken will be recorded in this log (See Annex E).

ANNEX F A-9

HOT SINK DISPOSAL RECORD

1. Example:

Date	uCi Dumped	Isotope	Chemical Form	Initials
5 Jan 79	11	125-I	T3 & T4	ER

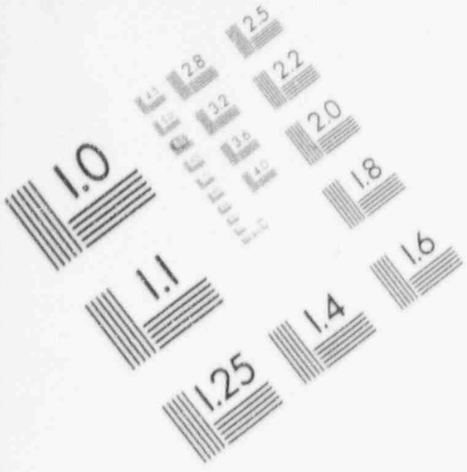
2. See Annex A for disposal procedures.

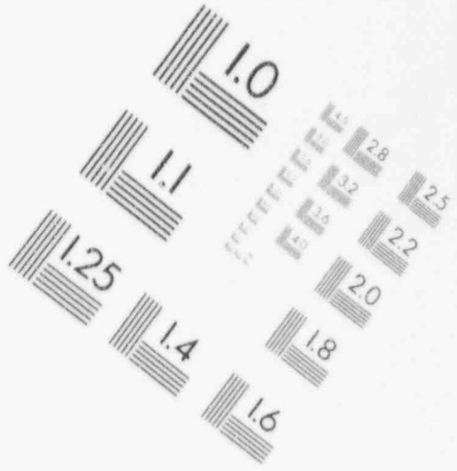
Tc-99m RADIOPHARMACEUTICAL COLOR CODES

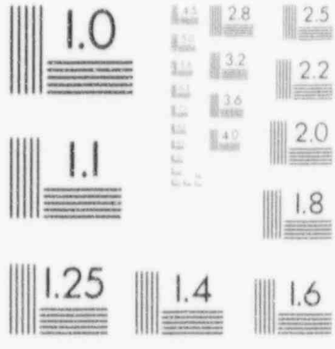
Radiopharmaceutical	Color Code
$^{99m}TcO_4$	Black
Sulfur Colloid	Orange
MDP	Red
DTPA	Yellow
Gluco	White
MAA	Yellow/Black
PYRO	Red/Black
PIPIDA	Green
Hepatolite	Green

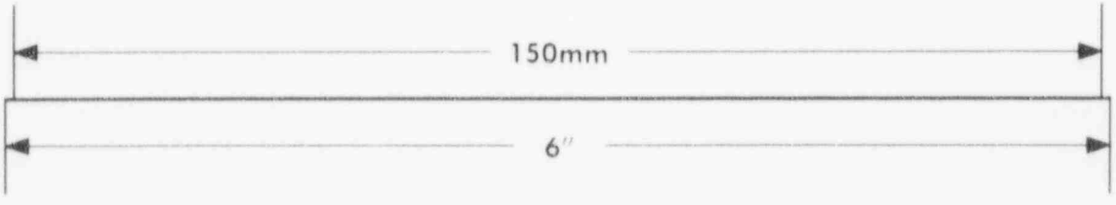
2

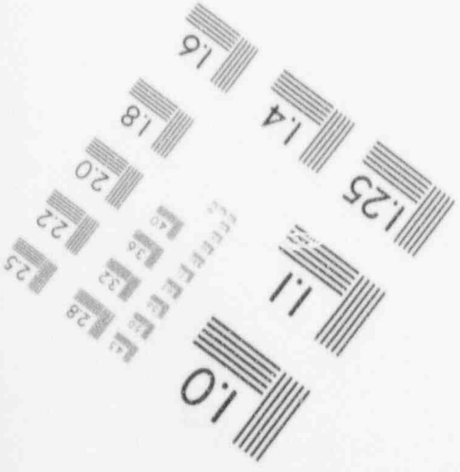
IMAGE EVALUATION TEST TARGET (MT-3)

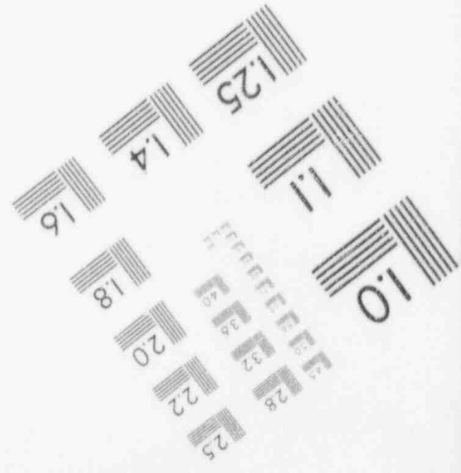












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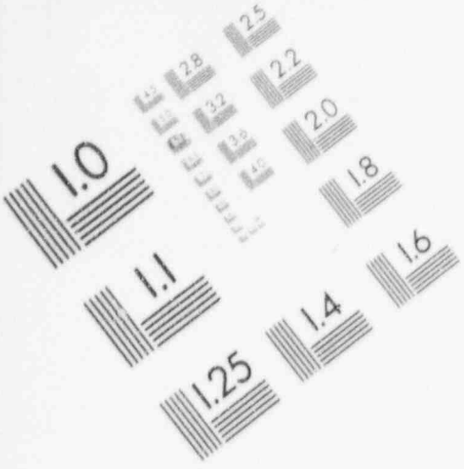
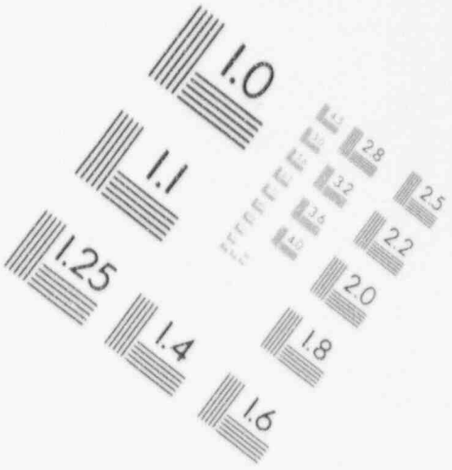
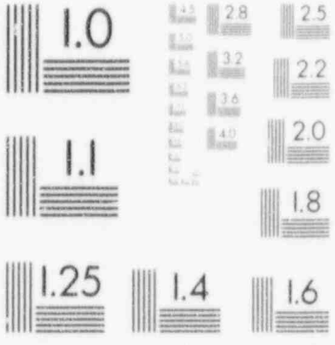
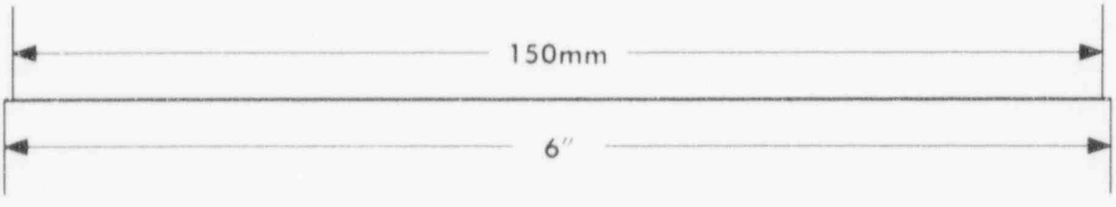
2

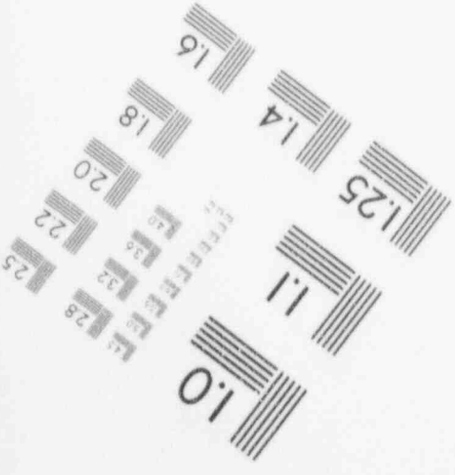
IMAGE EVALUATION TEST TARGET (MT-3)

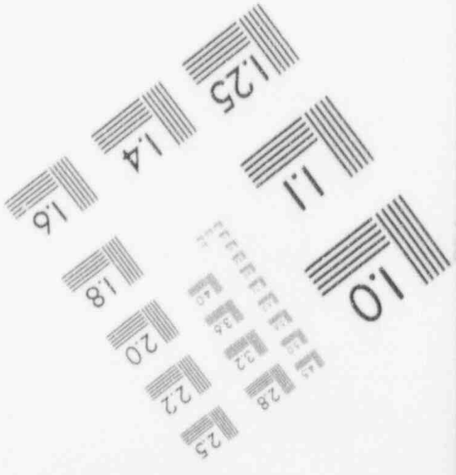












PHOTOGRAPHIC SCIENCES CORPORATION
770 BASKET ROAD
P.O. BOX 338
WEBSTER, NEW YORK 14580
(716) 265-1600

ANNEX G

(NRC REGULATORY REQUIREMENTS)

1. DOSE CALIBRATOR METHOD (CRC-30):

a. Place the eluent into the Mo-99 shield and record activity (ensure dose calibrator set for Mo-99).

b. Assay the same eluent for total Tc-99m activity without shield and record activity (ensure dose calibrator set for Tc-99m).

c. Divide the uCi of Mo-99 recorded in step a. by the total mCi of Tc-99m in step b.

d. Record this value. The maximum allowable breakthrough is 0.15uCi/mCi of Tc-99m. (See Annex F, A-5).

FACILITIES AND EQUIPMENT

1. The following areas are represented:

   a. Radioactive Waste Lab - Bldg 603

   b. Radioactive Waste Storage Area - Bldg 616

   c. Radiation Therapy - Bldg 500

   d. Nuclear Pharmacy - Bldg 511

   e. Nuclear Medicine Service - Bldg 511

   f. Clinical Pathology RIA Lab - Bldg 511

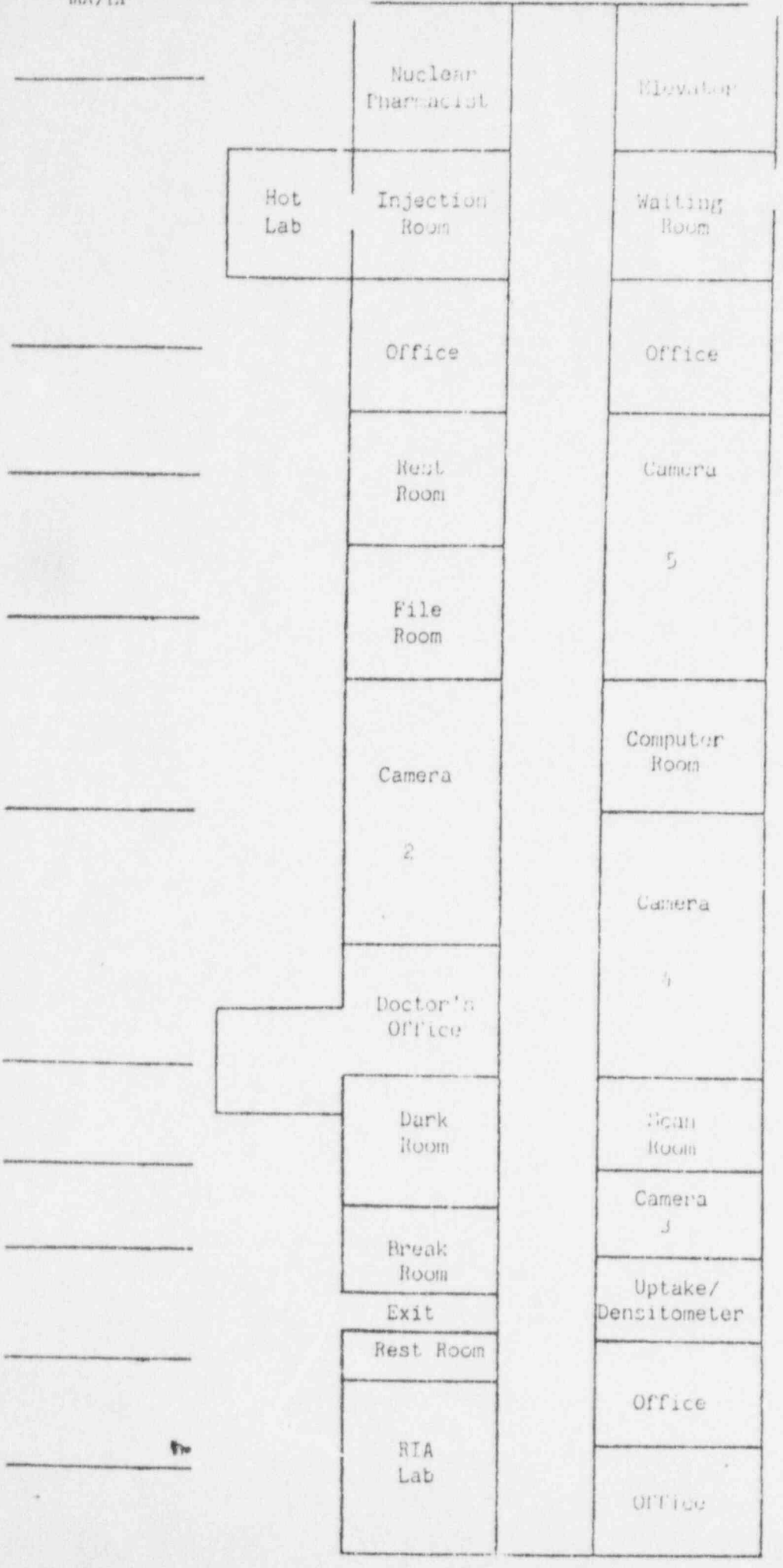
   g. Clinical Investigation - Bldg 600

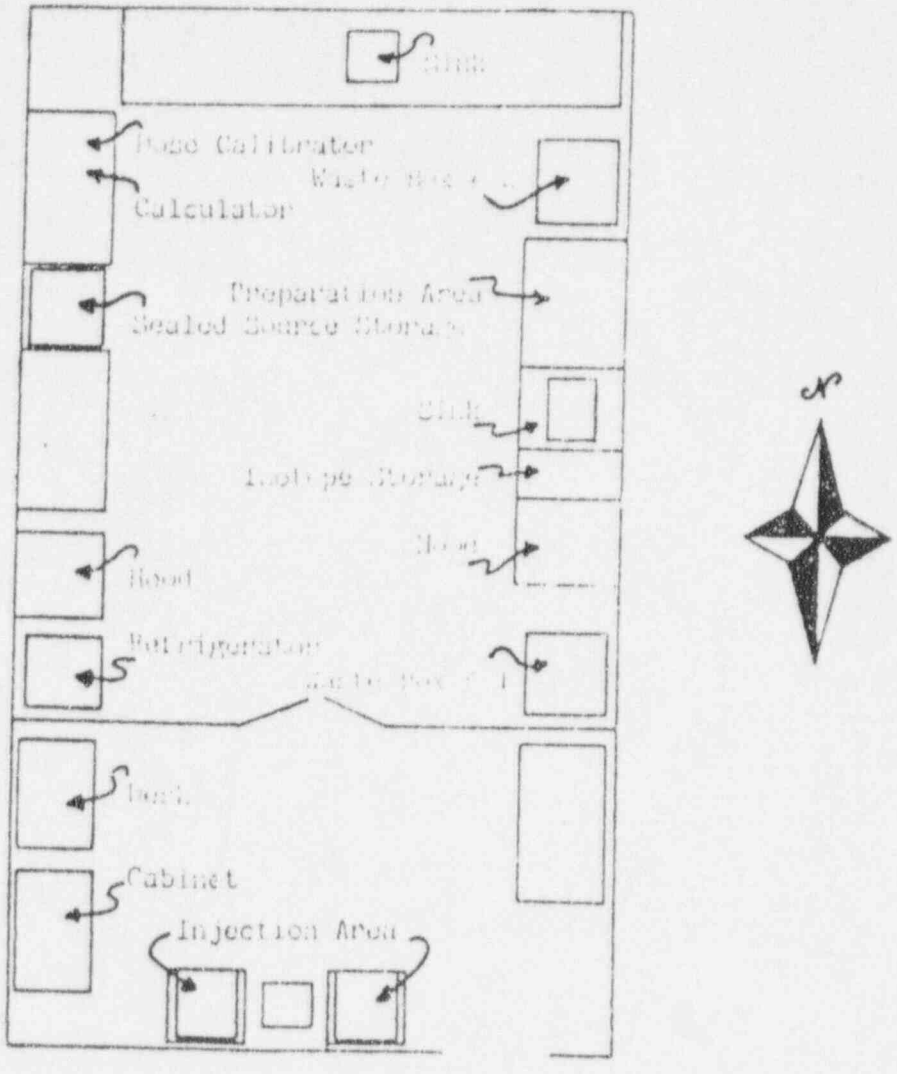
2. In accordance with the conditions of the license and Army Regulation 40-37, the FAMC Radiation Control Committee will be empowered to grant approval of additional facilities and equipment for uses of radioactive material. The Committee will act only after the Radiation Protection Officer has made a thorough survey of the proposed facility and provided the Committee with a documented recommendation.

mR/hr

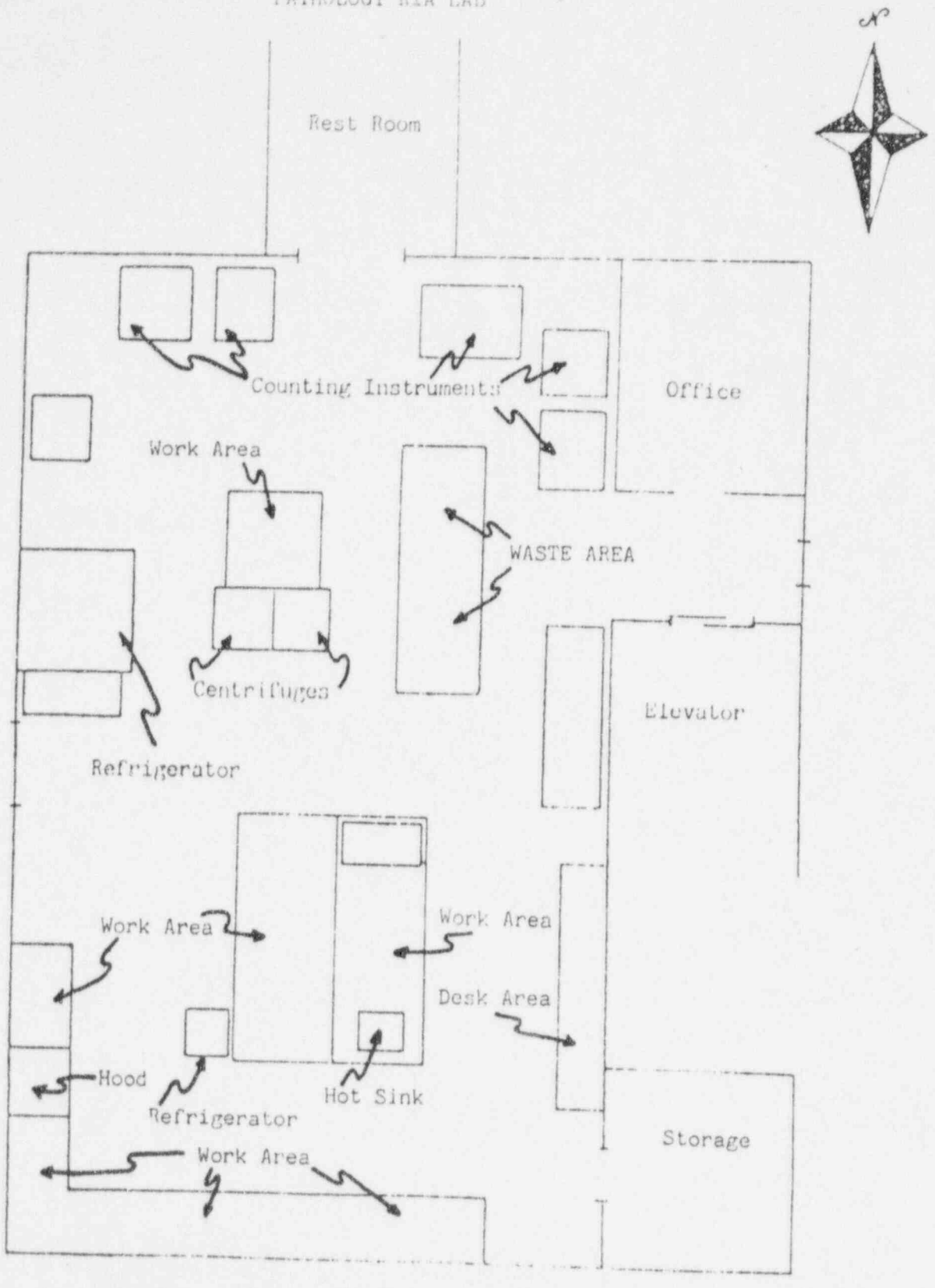
NUCLEAR MEDICINE SERVICE

mR/hr

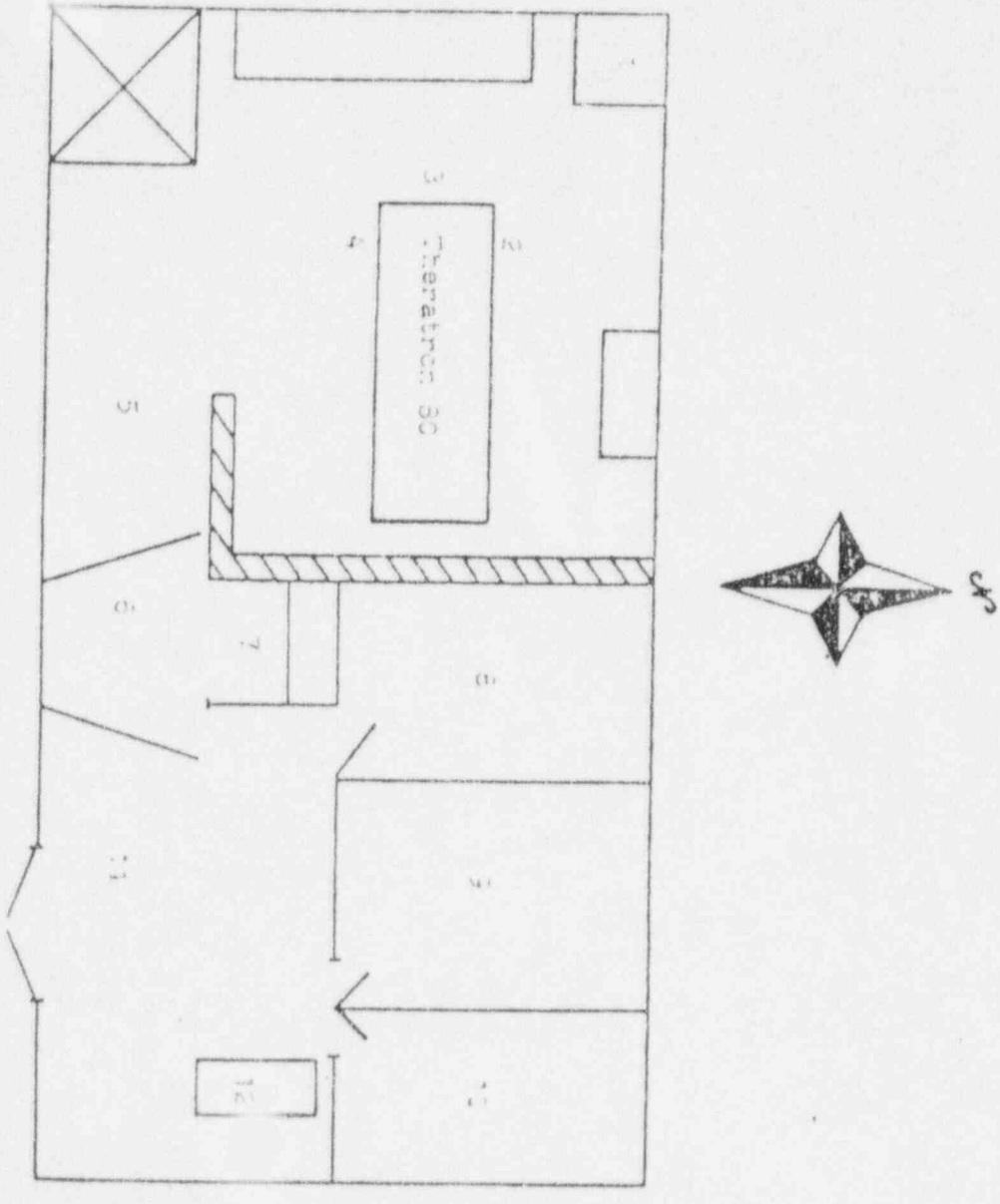


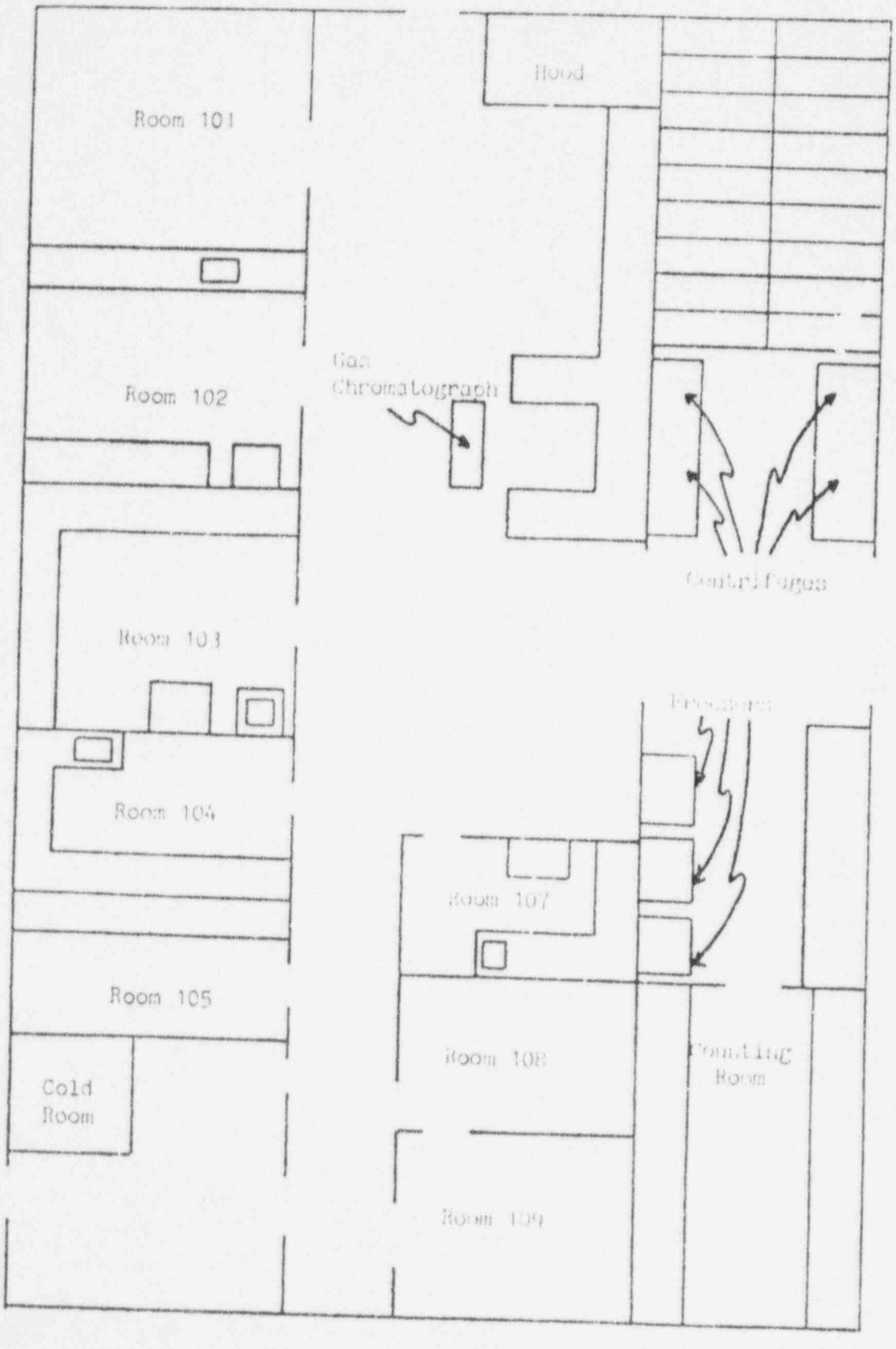

Sink
Dose Calibrator
Calculator
Preparation Area
Sealed Source Storage
Sink
Hood
Refrigerator
Bench
Cabinet
Injection Area
N

PATHOLOGY RIA LAB - 511

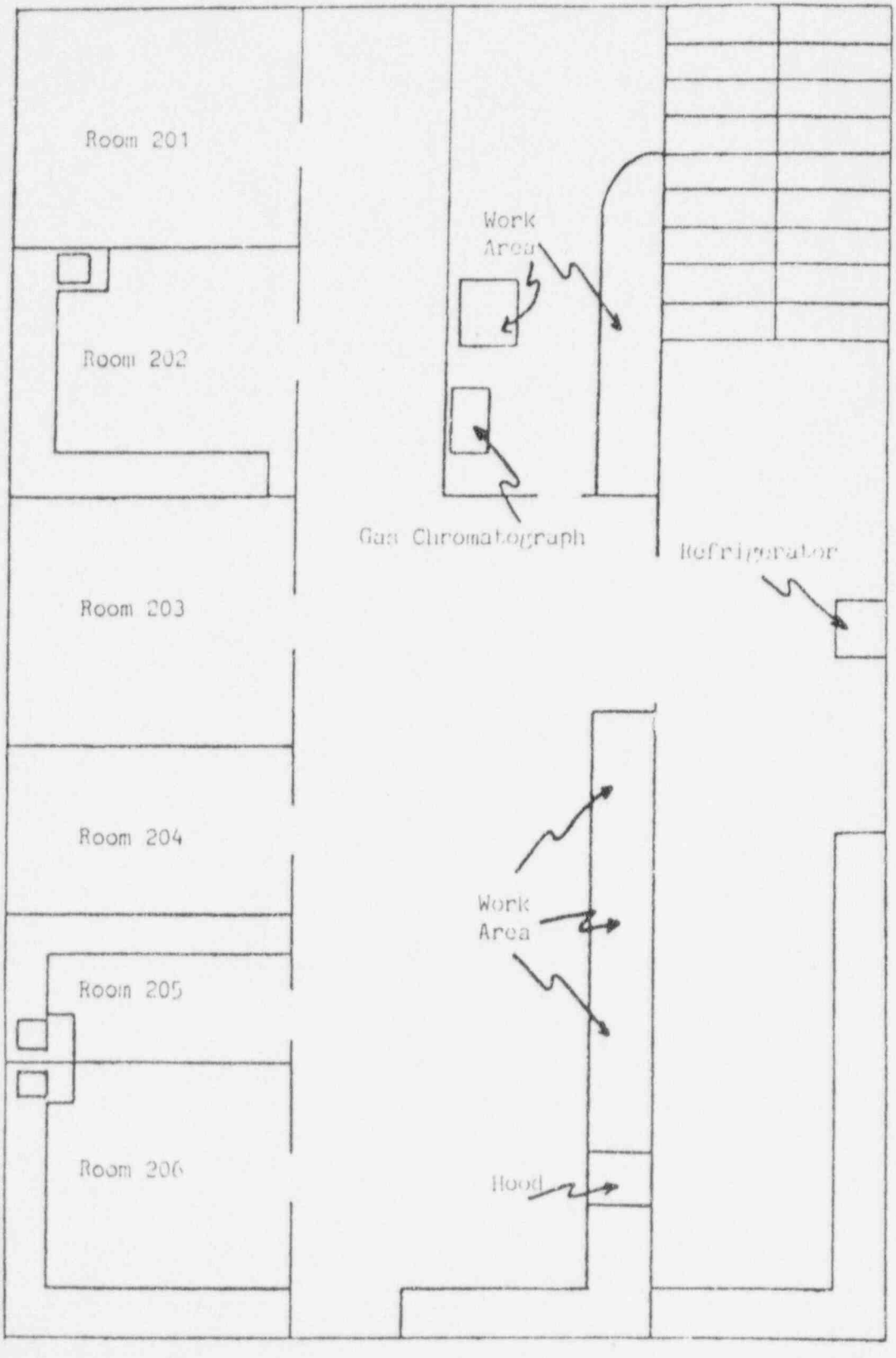


RADIATION THERAPY
BASEMENT-BLDG 500

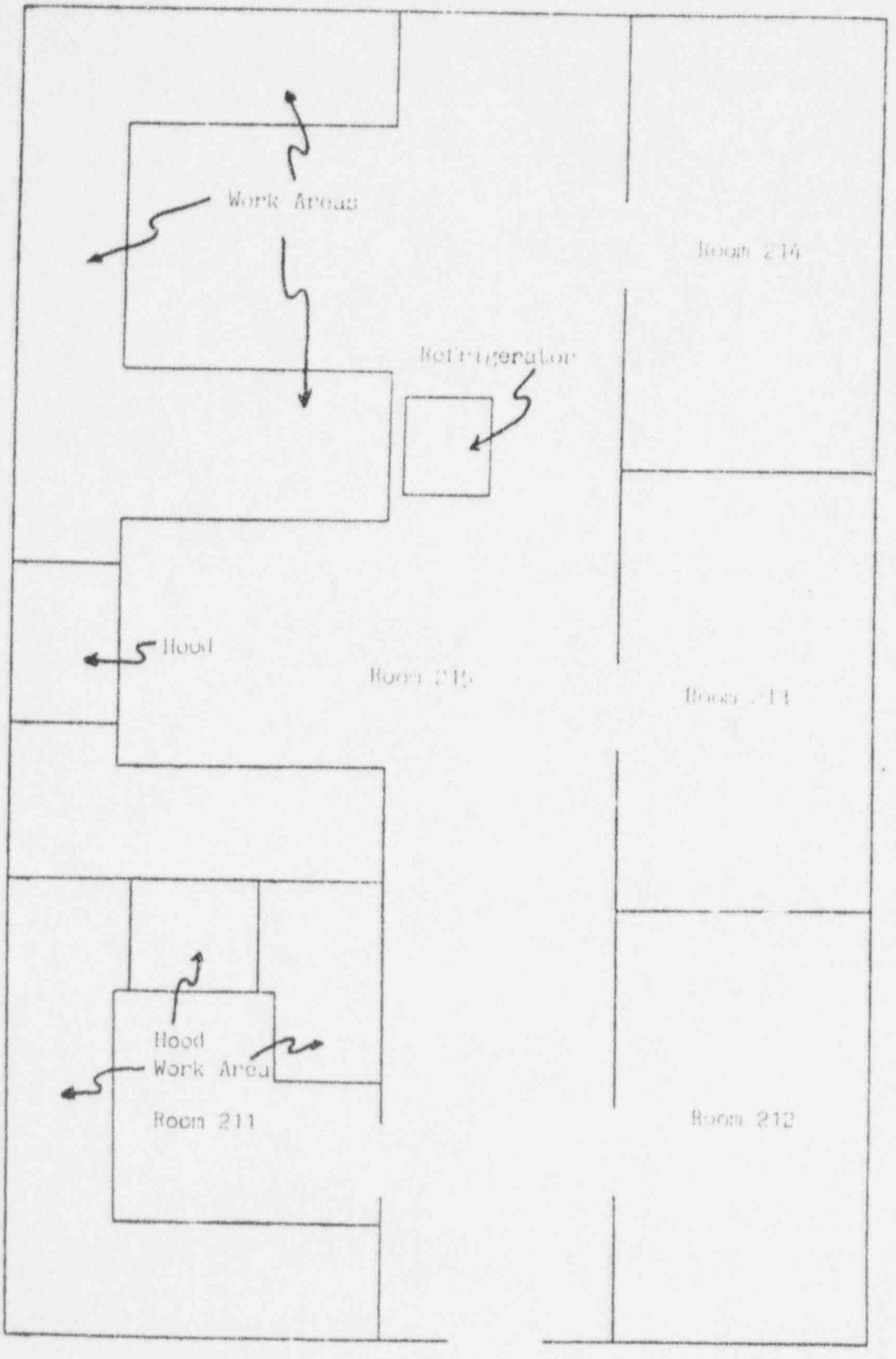


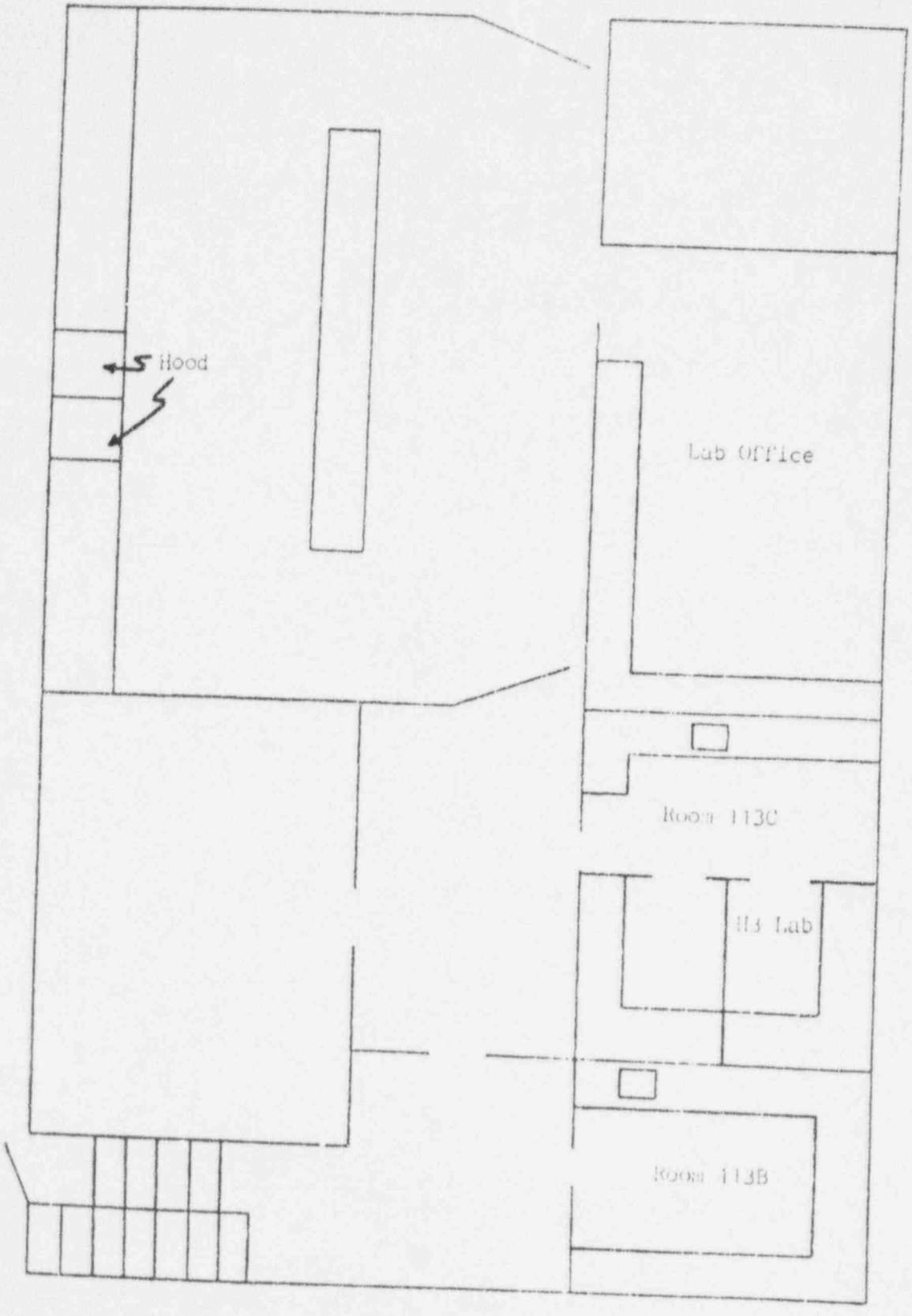

Room 101
Hood
Gas
Chromatograph
Room 102
Centrifuges
Room 103
Freezers
Room 104
Room 107
Room 105
Room 108
Counting
Room
Cold
Room
Room 109

CLINICAL INVESTIGATION, BLDG 600, 2nd

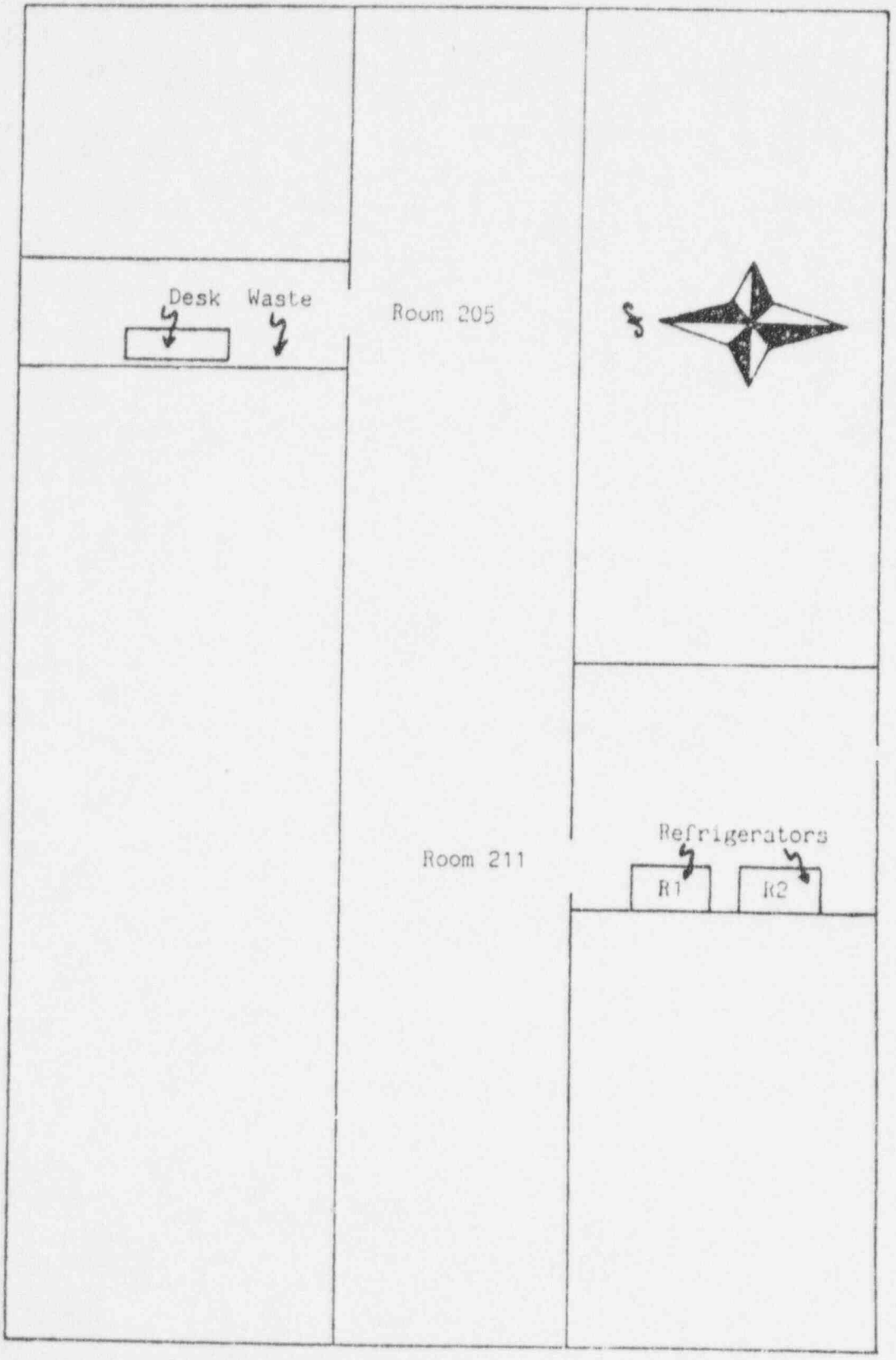


CLINICAL INVESTIGATION, BLDG 600, 2nd, Wing

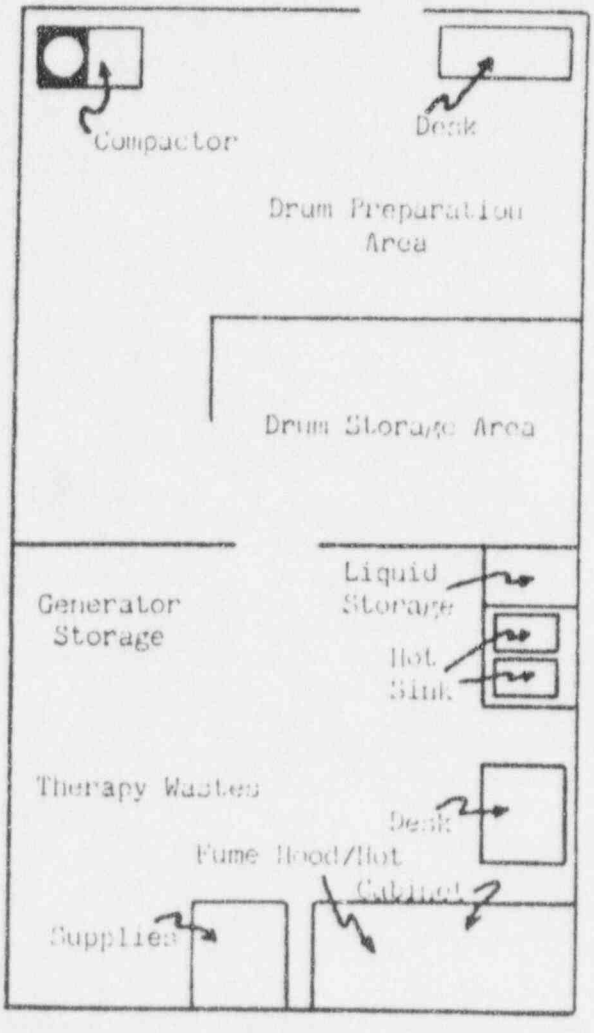



Hood
Lab Office
Room 113C
H3 Lab
Room 113B

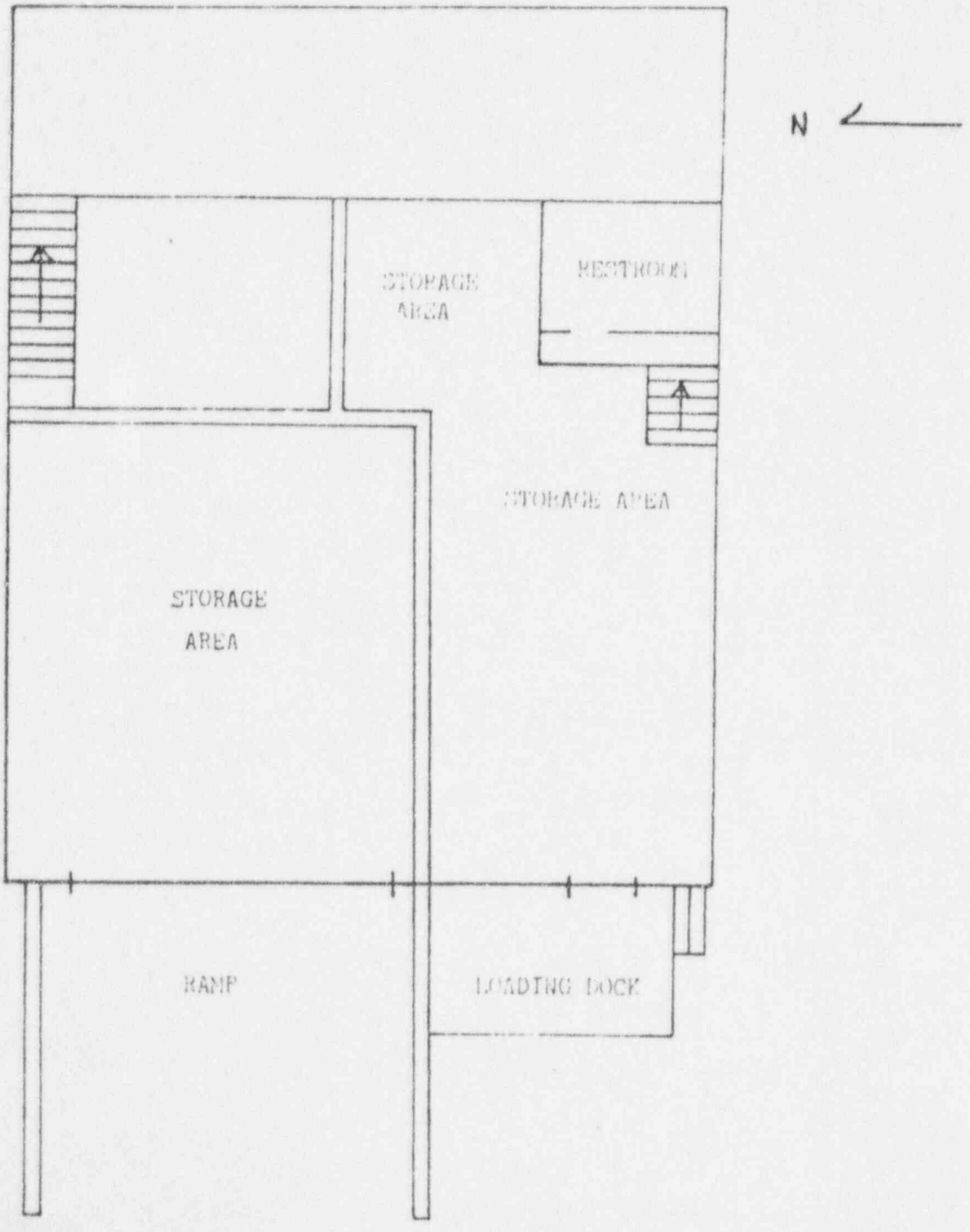
CLINICAL INVESTIGATION SERVICE, BLDG 601, 2ND, East



WASTE LAB, BLDG 603



WASTE STORAGE FACILITY, BLDG 615



AOD/NCOD INSTRUCTIONS

RECEIVING RADIOACTIVE PACKAGES DURING NON-DUTY HOURS

Step 1 - Under no circumstances will the AOD refuse delivery of radioactive packages addressed to FAMC.

Step 2 - Identification of Radioactive Packages

Visually inspect all packages for a Department of Transportation (DOT) radioactive material warning label I, II, III, etc. (See Fig. 1)

Step 3 - Visually inspect all radioactive packages for damage or leakage.

NOTE: IF DAMAGED OR LEAKING IMMEDIATELY NOTIFY ONE OF THE PERSONS LISTED ON THE ROSTER FOR RADIOLOGICAL EMERGENCIES AND INSTRUCT THE CARRIER (DELIVERY PERSON) NOT TO LEAVE.

Step 4 - Place all radioactive packages within the lead lined safe located within the Adjutant's office and temporarily post a Radiation Area sign on the entrance door to the lead lined safe.

If the above procedures are followed, there is no danger to duty personnel. Most radioactive packages are small and contain little radioactivity. Adherence to instructions is extremely important to protect the health of patients, staff and general public. The AOD is not justified in demanding immediate response from the Health Physics Section unless the AOD has reasons to suspect that a package is damaged or leaking.

The radioisotope generator for Nuclear Medicine is a large and heavy package that arrives every weekend, late on Saturday or early Sunday. This package does not require refrigeration.

Under 10CFR; Part 20.205 and AR 40-37 it is required that radioactive packages received after duty hours, holidays and weekends be monitored within (18) eighteen hours. Personnel of the Health Physics Section will monitor radioactive packages.

Under no circumstance will non-radioactive packages, food, property, etc., be stored within the lead lined safe.

FIGURE 1

WARNINGS: Department of Transportation Warning Labels

LABEL I

LABEL II

LABEL III

18398

DEPARTMENT OF THE ARMY
FITZSIMONS ARMY MEDICAL CENTER
AURORA, CO 80045

FAMC Regulation
Number 40-604

30 July 1983

MEDICAL SERVICES
RADIATION SAFETY

1. Purpose

a. Implement the applicable laws, regulations, conditions and restrictions under which radioactive materials and X-Ray producing devices are used within Fitzsimons Army Medical Center (FAMC).

b. Promulgate the rules, direction, and guidance of the Radiation Control Committee in the proper and safe handling of radioactive material and equipment which produce ionizing radiation.

c. Control the production, procurement, receipt, storage, use, repair, transfer, and disposal of radioactive material and equipment which produce ionizing radiation.

d. Prescribe the radiation protection program for FAMC and keep personnel exposures to ionizing radiation as low as reasonably achievable.

2. Scope

These regulations apply to all activities and organizations using radioactive material and/or equipment which produce ionizing radiation at FAMC. It also applies to all personnel and activities assigned or attached to FAMC.

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*This regulation supersedes FAMC Reg 40-604, 26 September 1977

3. Organization of Regulation:

To facilitate the use and understanding of this regulation, the contents have been divided into separate appendixes, each concerned with a specific topic.

4. Definitions

As used in this regulation, the following definitions apply:

a. Shall, will infer a standard, condition, or procedure which must be met if one is to be in compliance with punitive Federal regulations.

b. Should, may, is recommended infer a standard, condition, or procedure from which one may deviate for good and sufficient reason without violating a punitive regulation. A decision to deviate from accepted procedures in this regulation warrants careful consideration by the principal user or other responsible individuals in a supervisory capacity.

5. Responsibilities

a. The Commander of Fitzsimons Army Medical Center is responsible for the provisions of this regulation.

b. The Radiation Protection Officer (RPO), FAMC, is the principal staff officer responsible for the implementation of this regulation. Temporary minor exceptions to specfic provisions of this regulation may be granted on an individual basis by the RPO providing such exceptions do not jeopardize radiological safety, violate Federal law, the conditions of the NRC license, or the provisions of the DA authorization to use radioactive materials.

REFERENCES

The following listed references are general in nature and pertain to this regulation as a whole; additional references which are more specific are cited in the appendixes.

AR 40-5	Health and Environment
AR 40-7	Use of Investigative Drugs in Humans and the Use of Schedule 1 Controlled Drug Substances
AR 40-13	Radiological Emergency Medical Teams (REMT)
AR 40-14	Control and Recording Procedures for Occupational Exposure to Ionizing Radiation
AR 40-37	Licensing and Control of Radioactive Material for Medical Purposes
AR 50-5	Nuclear Surety
AR 55-355	Military Traffic Management Regulation
AR 70-25	Use of Volunteers as Subjects of Research
AR 200-1	Environmental Protection and Enhancement
AR 385-11	Ionizing Radiation Protection
AR 700-64	Radioactive Commodities in the DOD Supply Systems
AR 725-1	Special Authorization and Procedures for Issues, Sales, and Loans
SB 11-206	Film Badge Supply and Services (Photodosimetry) Technical Radiation
TB Med 521	Management and Control of Diagnostic X-Ray, Therapeutic X-Ray, and Gamma-Beam Equipment Having Energies up to 10 Million Electron Volts
TB Med 223	Respiratory Protection Program
TB Med 522	Control of Health Hazards from Radioactive Material Used in Self-Luminous Devices
TB 43-0116	Identification of Radioactive Items in the Army Supply System
TM 3-261	Handling and Disposal of Unwanted Radioactive Material
TB 43-180	Calibration Requirements for the Maintenance of Army Material

REFERENCES CONT.

TM 55-315 Transportability Guidance for Safe Transport of Radioactive Materials

Title 10 Code of Federal Regulation - Rules and Regulations of the NRC

Title 21 Code of Federal Regulation - Regulations for the Administration and Enforcement of the Radiation Control for Health and Safety Act of 1968 (21CFR Subchapter J)

Title 49 Code of Federal Regulations - Rules and Regulations of the DOT

US Nuclear Regulatory Guides

(1) Number 8.9, Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program

(2) Number 8.13, Instruction Concerning Prenatal Radiation Exposure

(3) Number 8.20, Applications of Bioassay for I-125 and I-131

(4) Number 8.23, Radiation Safety Surveys at Medical Institution

(5) Number 8.26, Applications of Bioassay for Fission and Activation Products

(6) Number 10.5, Application for Type A Licenses of Broad Scope

(7) Number 10.8, Guide for the Preparation of Application for Medical Programs.

National Council on Radiation Protection and Measurements (NCRP) Reports

(1) Number 37, Precaution in the Management of Patients who Have Received Therapeutic Amounts of Radionuclides

(2) Number 40, Protection Against Radiation from Brachytherapy Sources