ITEM # 4

FROM: Princeton University
Princeton, New Jersey 08540

TO: AEC- Layfield

CLASSIF.: U

POST OFFICE

REG. NO:

DESCRIPTION: (Must Be Unclassified)

Ltr. 12-3-68 and trans......

ENCLOSURES:

Master Revision Sheet

Radiation Safety Guide

REMARKS:
Distribution:
1-Compliance (Region)
1-PDR

DATE OF DOCUMENT: 12-3-68

DATE RECEIVED: 12-5-68

NO.: 5171

LTR.: x

MEMO:

REPORT:

OTHER: x

ORIG.: 1

CC:

OTHER: 4

ACTION NECESSARY ☐

NO ACTION NECESSARY ☐

CONCURRENCE ☐

COMMENT ☐

DATE ANSWERED:

BY:

FILE CODE: 70-391 & 40-5259

REFERRED TO	DATE	RECEIVED BY	DATE
Nussbaumer w/file cy & folder	12/6		
		DO NOT REMOVE	
		ACKNOWLEDGED	

Information in this record was deleted in accordance with the Freedom of Information Act, exemptions
FOIA- 2001-0139

U.S. ATOMIC ENERGY COMMISSION MAIL CONTROL FORM FORM AEC-326S (8-60)

U.S. GOVERNMENT PRINTING OFFICE: 1968-296-615

36

PRINCETON UNIVERSITY
HEALTH PHYSICS OFFICE
JAMES FORRESTAL CAMPUS
PRINCETON, NEW JERSEY 08540
(609) 452-5294

Regulatory Suppl File Cy.

December 3, 1968

Mr. Robert L. Layfield
Source & Special Nuclear Materials Branch
Division of Materials Licensing
United States Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Layfield:

Be advised that we have recently ammended our University Radiation Safety Guide. According to our records, we sent you a total of three copies of the Guide under our Source Materials License and one copy to Mr. Don Harmon in connection with our Special Nuclear Materials License.

Enclosed you will find four sets of ammended pages and instruction sheets. We would appreciate your making the proper distribution of these revision sets.

We now refer to the Guide as the "Third Edition as ammended on October 15 and November 15, 1968". Thank you very much for your consideration in this matter.

Very truly yours,

J C Faust

Jack C. Faust
Director
University Health Physics Group

JCF:lcj
Enclosures

cc: File 9.2 & 9.3

ACKNOWLEDGED

ZC-38/440-525

12-3-68

MASTER REVISION SHEET

This is a permanent record of all revisions which have occurred in the University Radiation Safety Guide. All pages in the University Radiation Safety Guide are dated September 15, 1967, with the exception of the following which are dated as indicated:

PAGE NO.	VALID PAGE DATE	PAGE NO.	VALID PAGE DATE
Title Page	October 15, 1968	XVII.1	October 15, 1968
ii, iii, iv	" " "	XIX.1	" " "
III.2	" " "	A.1	" " "
VIII.1	" " "	B.3, 4, 5, 6	" " "
X.3	" " "	C.5	" " "
XI.1, 2	" " "	D.1	" " "
XII.2	" " "	E.1, 2	" " "
XIII.1	" " "	F.3	" " "
XV.1	" " "	H.1, 2, 3, 4	" " "
XVI.1	" " "	J.1	" " "
i	November 15, 1968	J.2	November 15, 1968
IV.2	" " "		

PRINCETON UNIVERSITY

Radiation Safety Committee

a sub-committee of

University Research Board

RADIATION SAFETY GUIDE

RULES & REGULATIONS

edited by

Jack C. Faust, Director
University Health Physics Group

First Edition June, 1962
Second Edition June, 1965
Third Edition September, 1967
ammended
October 15, 1968

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

Appendices

to the University Research Board. Prior approval of both the United States Atomic Energy Commission and the State of New Jersey must be also secured in the form of additional licenses.

H. "Limited Possessor"

one who has been issued a Limited Possession Number but who does not hold an Authorization Number.

I. "Radiation Area"

means any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body may receive in any one hour a dose in excess of five millirems or in any five consecutive days a dose in excess of 100 millirems.

J. "Radioactive Material Area"

any room or area in which there are present radioactive materials in such quantities that a "Caution Radioactive Material" label is required in accordance with Section VIII of this Guide.

K. "Responsible Investigator"

refers to the individual who is immediately responsible for the conduct of a research project involving the use of a "Source of Radiation". This implies one who holds an Authorization or Machine Number and a faculty or research position and previous experience with "Sources of Radiation".

L. "Restricted Area"

means any area, access to which is controlled by the University for purposes of protection of individuals from exposure to radiation and radioactive material.

NOTE: "Restricted Area" includes all "Radiation Areas", "Radioactive Material Areas" and certain other areas which may be so defined by the University Radiation Safety Committee.

M. "Sealed Source"

means any radioactive source material encased in a capsule designed to prevent leakage or escape of the radioactive material and which is to be used unopened.

N. "Sources of Radiation"

refers to radioisotopes, radioactivated materials (irradiation or by exchange processes), radiation producing machines, and generally licensed quantities and devices.

E. Revocation

The Committee has the right to revoke any authorization granted by it if, in its opinion, sufficient justification exists for such action.

F. Purchase Requisitions

Purchase requisitions for "Sources of Radiation" will not be processed by the Purchasing Department unless previously approved by the "Health Physics Officer". When internal processing of the requisition with the Department or Laboratory has been completed, the purchase requisition (blue copy) is sent to the Purchasing Department or the Health Physics Office. The second alternative saves time.

Purchase requisitions must be annoted with the appropriate number and bear the signature of the authorized "User". A "User" may designate an alternate to act in his absence for short and specified periods of time. This is done by sending written notification to the "Health Physics Officer" indicating the alternate's name, the inclusive dates of his appointment, and a specific statement authorizing the indicated individual to sign purchase requisitions and various reports in the "User's" absence.

G. Loans and Transferals

Loans and transferals of radioisotopes are permitted only to persons holding the appropriate Authorization or Limited Possession Numbers. The Health Physics Office must be notified of transferals. Off-campus transferals must have prior approval of both the Princeton Health Physics Group and the receiving organization.

H. Amendments

Any change in the use of the "Source of Radiation" from that described in the application shall be discussed with the "Health Physics Officer". Significant changes, such as an increase in isotope needed, use of any open source as opposed to a "sealed source", use of dry powders instead of a less hazardous form, etc., require an amendment approved by the University Radiation Safety Committee. Amendments providing approval for less significant changes may be granted by the "Health Physics Officer".

VIII. POSTING, LABELING, TAGGING AND SIGNALING REQUIREMENTS

A. Posting Requirements

Each laboratory or group of laboratories using "Sources of Radiation" must have posted or otherwise available the following:

1. "10 CFR 20" as amended
2. 10 CFR 30 and 33 as amended
3. Princeton University Radiation Safety Guide
4. Laboratories where Source Material is used - 10 CFR 40 and AEC License SUD #381
5. Laboratories where Special Nuclear Materials are used - 10 CFR 70 and AEC License SNM #356
6. AEC Broad License #29-5185-24 as amended
7. AEC Form #3, "Notice to Employees" (must be posted). Contract areas must also post AEC Form #9, "Notice to Employees".
8. Laboratories where materials licensed by the State of New Jersey are present:
   a. New Jersey Radiation Protection Code as amended
   b. Rh-D 14, "Notice to Employees" (must be posted)
   c. New Jersey Broad License #80066
9. H. P. Form #12 , "Emergency Procedures" and "Health Physics Officer's Phone Number" (must be posted)
10. H. P. Form #31, "Emergency Phone Numbers and Instructions" or internal facsimile.

It is further required that all personnel working with radioactive material and/or radiation, or frequenting a "Restricted Area" be familiarized with the provisions of these regulations.

J. Airborne Radioactivity Restrictions

Persons who work in or frequent "Airborne Radioactivity Areas" may be required to obtain routine bioassays. No person should enter a room or area where it is known or suspected that the permissible concentrations for airborne radioactivity is exceeded except in cases of serious emergency. No operation is to be planned and performed that might cause radioactivity to become airborne in excess of permissible levels. Such work can be done if every person present is provided with protective equipment and the required prior approval of the Atomic Energy Commission or the State of New Jersey has been obtained for the entire operation. A routine air sampling program may be required in areas where an airborne hazard might exist.

K. Pipetting

Pipetting of radioactive solutions by mouth is prohibited.

L. Dust or Finely Divided Materials

All work with volatile or dust-forming radioactive materials shall be confined to hoods or glove boxes, preferably the latter.

M. Dummy Runs

Extensive radiochemical work should not be performed with hazardous materials until the procedure has been tested by means of a "dummy" run. "Extensive radiochemical work" shall signify one or more chemical reactions involving radioactive substances and/or the transfer of radioactive substances from one vessel to another four or more times. However, it shall not include such physical processes as source preparation by evaporation.

N. Working Surfaces

No radiochemical operation shall be performed directly on unsuitable laboratory table tops. All such work must be done on smooth surface (stainless steel or enameled trays) or on an absorbent paper. The floor should be of such construction that it is easily decontaminated or replaced.

O. Opening of Shipments

Radioisotopes received in shipment must be opened in a properly equipped laboratory and only by the authorized "User or some one properly trained and authorized by the User". All instances of damaged, contaminated or improperly packaged radioactive materials shall be reported to the "Health Physics Officer" immediately.

P. Special Equipment

In cases where exceptional hazards may exist, special safety equipment and precautions may be required as determined by consultation with the "Health Physics Officer". These would include such items as specialized shielding, clothing, and monitoring apparatus, etc.

XI. SEALED SOURCES AND LEAK TESTS

A. Initial Test

1. Each "Sealed Source", as defined in Section III, obtained from another organization shall be tested for contamination and/or leakage, prior to use, in the absence of a certificate indicating that a test has been made within the last six months unless:

   a. they contain only tritium

   b. if the isotope contained has a half-life of less than 30 days

   c. if the activity consists entirely of a gas.

2. All "Sealed Sources" fabricated by University personnel shall be inspected and tested for constructional defects, contamination and leakage immediately after fabrication. If the test reveals any constructional defects or 0.005 μCi or greater of contamination, the source must be repaired and/or decontaminated and retested before use.

B. Periodic Leak Test

1. Each "Sealed Source" shall be tested for contamination and/or leakage at intervals not exceeding six months, except that sources designed for the purpose of emitting alpha particles shall be tested at intervals not exceeding three months unless exempted below.

2. "Sealed Sources" are exempt from the required <u>periodic</u> leak test if:

   a. they contain only tritium

   b. the half-life of the contents is less than 30 days

   c. they contain less than ten times the activity listed in column B of Appendix C

   d. the activity consists entirely of a gas.

3. Transuranium Plated Sources are <u>not</u> exempted from any of these tests.

C. Transuranium Plated Sources

1. Each Transuranium plated source shall be tested for leakage at intervals not to exceed three months.

D. Leakage Defined

If any of the required tests indicated the presence of 0.005 μc or more of transferable radioactivity, the source is considered leaking or contaminated and shall immediately be withdrawn from service and be either decontaminated and/or repaired and retested, or disposed of as radioactive waste or returned to the supplier as appropriate.

E. Filing of Report

In the event a source is determined to be contaminated and/or leaking, a report must be filed within five days with the Atomic Energy Commission and the State of New Jersey indicating the test results, the equipment used and the corrective action taken.

F. Performance of Test

The Health Physics Group shall provide the required leak test for all University "sealed Sources", maintain the required records, suggest corrective actions where indicated, and file the necessary reports. To implement this service all "Users" shall:

1. inform the "Health Physics Officer" in writing of the receipt or manufacture of a new source, or prior to the disposal of an old source

2. provide the Health Physics Office with a copy of the test certificate received with purchased "Sealed Sources"

3. recall sources on loan to a central point, and generally assist in locating all sources when the scheduled tests are to be performed.

G. Restriction

Sources obtained as "Sealed Sources" shall not be opened.

1. Daily disposals by individuals be limited to less than the amount specified in column A of Appendix C, provided the "User" provides sufficient local dilution to insure compliance with the daily concentration limits set forth in Table I of Appendix B. A record of such disposals shall be kept and reported to the Health Physics Office.

2. In order to insure compliance with the monthly average concentration limit, and the yearly total limit (1 Curie), the Health Physics Office will compute and record the concentrations and totals each month. The input data, including negative reports, shall be provided by each "User" generating such waste on H.P. Form #11. The report shall include a record of all disposals to the sanitary sewer for the calendar month. It is due on the eighth of the following month.

3. No radioactive material may be placed in the sanitary sewer unless it is readily soluble or dispersible in water.

C. There are no facilities at the University for incineration or burial of radioactive wastes.

XIII. TRANSPORTATION AND SHIPMENT OF RADIOACTIVE MATERIALS

A. Requirements

Radioisotopes transported to or from destinations outside the University or transferred from one campus to another shall be packaged and transported in accordance with all pertinent regulations. See Appendix F for details. In addition:

1. A University employee preparing a radioactive substance for shipment shall have the responsibility to insure full compliance with pertinent regulations with respect to packaging, marking, and labeling of the container.

2. A University employee who is to transport radioactive material prepared for shipment by an individual or agency not associated with the University shall have the responsibility to acquaint himself with regulations relating to transportation of the material in question and to satisfy himself that the conditions of packaging and transport comply with those regulations.

3. In the case of transportation by private automobile, the radioactive material shall be in the charge of an individual occupationally engaged in work with radioisotopes. The package shall be placed in the trunk of the automobile, if possible; otherwise, it shall be placed at least two feet from the nearest occupant. It shall be suitably marked with the name and university address of the owner, a notice that the contents might be dangerous if removed, and that the owner and/or the University Health Physics Office should be notified if the package is found. Provide phone numbers. If it is necessary to leave radioactive materials in an unattended car, the package shall be locked in the car, preferably in the trunk.

4. An individual who transports radioisotopes of such type and quantity that the dose rate at one meter from the container exceeds two mrem/hr at one meter shall wear a film badge.

XV. EMERGENCY PROCEDURES

A. Emergency Assistance

Assistance for any emergency, including one involving radiation, at the University is obtained by simply dialing 3131 and providing the information requested. To insure immediate Health Physics Group assistance, call the Health Physics Office at 5294. Also notify the "User".

B. Radiation Emergency - "Spill"

In the event of the escape of a radioactive substance from its normal confines (spill, evaporation, vaporization, combustion, escape of a gas, liquid, solid, etc.) in an amount which is known to exceed or may exceed ten (10) times the quantities listed in column A, Appendix C, the "Health Physics Officer" shall be notified promptly as above. Pending his arrival, take the following steps:

1. Where Airborne Contamination (from evaporation, vaporization, explosion, combustion, formation of a smoke, dust, spray, escape of a gas, etc.) may have occurred:

   a. Evacuate the laboratory immediately.

   b. Shut all doors to the laboratory. Shut down the air conditioning.

   c. Post a guard to insure that no one re-enters the laboratory and to keep the general area clear of spectators.

   d. Assemble all persons who were in the laboratory at the time of the accident. The place of assembly should be near the contaminated area in order to reduce the spread of contamination about the building.

   e. Monitor assembled personnel if an instrument is available, to determine whether contamination of the skin or clothing exists. If such contamination is found, proceed as follows:

      1. Remove all contaminated clothing.

      2. Flush contaminated cuts with cold running water.

XVI. PROCUREMENT OR EXPANSION OF RADIATION PRODUCING EQUIPMENT AND MACHINES

A. Committee Approval

Before any member of the University community obtains or alters any radiation producing machine so as to affect a significant increase in its radiation output (such as by purchase or construction of new equipment or by installation, reactivation or expansion of existing equipment), he has an obligation to make known his intentions to the University Radiation Safety Committee at the earliest opportunity so that the Committee may discharge its responsibility for radiation safety. See Appendix H for details.

B. Registration

Every radiation producing machine must be registered with the State of New Jersey within 15 days of its initial installation. This applies to any machine which results in the existence of a radiation field equal to or greater than 5 mrem/hr. at 5 cm from any accessible point -- even if the radiation is incidental to its purpose. The New Jersey Department of Health must also be notified when a radiation producing machine is deactivated, sold or disposed of. Registration of new equipment and cancellation of registration is performed by the Health Physics Office.

C. Labeling Requirement

All such equipment must be labeled on the control panel to remind the operator of the fact that when it is in operation, ionizing radiation is produced.

D. Unintentional Production of Radiation

Much modern electronic gear is capable of producing radiation; usually X-rays as a by-product of its operation. Any questions relative to this and the above should be directed to the "Health Physics Officer".

XVII. FINANCIAL CONSIDERATIONS

A. Distribution of Health Physics Group Costs

The normal operating costs incurred by the Health Physics Group are distributed at Quarterly internals among those persons and groups using "Sources of Radiation", according to the procedure detailed in Appendix J.

1. In brief, the assessment is based on the "Annual Analysis of Health Physics Group Costs" prepared in September by the Director of the Health Physics Group. This analysis determines the fraction of Health Physics Group Costs attributable to each Department. Some Departments further fractionate their share among the various "Users" within the Department.

2. Upon receipt of the quarterly statement, the "Health Physics Officer" prepares the "Quarterly Distribution of Charges" for the Controller's Office. This is based on the Departmental fraction determined in the "Annual Analysis" and any additional information relative to sub-fractionation is provided by the Department. This distribution lists each Department, or "User" if sub-fractionation is desired, the appropriate fraction for each and account numbers against which the charges are to be assessed.

3. The fraction provided is used twice by the Controller's Office; once for equipment and materials and once for salaries and benefits. Specific overheads are charged on the salaries and benefits portion, according to the terms of the various contracts and grants.

B. Prior Financial Planning

Persons planning to use "Sources of Radiation" in their research are advised to give consideration to the financial aspects of such an undertaking. Such considerations should include the costs of monitoring equipment which might be needed (portable GM monitors, air-sampling equipment, survey meters, signs, labels, etc.) as well as the quarterly assessments arising from Health Physics Group costs. Funds should be requested in the proposed budget or in the grant application.

XIX. MISCELLANEOUS

A. Maintenance Work

Departments in which "Sources of Radiation" are used shall insure that University maintenance personnel are informed of the fact and that they are advised to consult with the "User" and/or "Health Physics Officers" before commencing work. Maintenance work in or around restricted areas such as filter changes on fume hoods used in radiation work, plumbing repairs on sinks, janitorial services in cleaning up spills, etc., should be done only after such consultation with, and in some cases, under the direct supervision of Health Physics personnel.

B. Insurance

Since any significant change in the radiation hazards existing in a Department will result in a change in the insurance premium and/or the coverage requirements, department officials should insure that the specific information is communicated to the "Health Physics Officer".

APPENDIX A

THE RADIATION SAFETY COMMITTEE (AS OF JULY 1, 1968)

NAME	PHONE NUMBER
Mr. Jack C. Faust, Health Physics Secretary of The Committee James Forrestal Campus	Office: 452-5294 Home : [redacted]
Mr. L. R. Hyde, Biology A-1 Moffett Laboratory	Office: 452-3840 Home : [redacted]
Prof. A. J. Kelly, Aerospace and Mechanical Sciences Guggenheim Laboratory	Office: 452-5179 Home : [redacted]
Prof. M. D. Kostin, Chemical Engineering A325 Engineering Quadrangle	Office: 452-4586 Home : [redacted]
Mr. Charles Kulick, Geology 18 Guyot Hall	Office: 452-4143 Home : [redacted]
Dr. W. B. Mather, Health Services McCosh Infirmary	Office: 452-3141 Home : [redacted]
Prof. J. C. Maxwell, Geology Chairman of The Committee I-57 Guyot Hall	Office: 452-4100 Home : [redacted]
Prof. E. A. Phillips, Physics 130 Palmer Laboratory	Office: 452-4376 Home : [redacted]
Mr. R. A. Rossi, Research Administration 508 New South Building	Office: 452-3110 Home : [redacted]
Mr. W. Schimmerling, Accelerator A215 Accelerator	Office: 452-5542 Home : [redacted]
Dr. R. M. Sinclair, Plasma Physics & Dept. of Astrophysical Sciences C230 Plasma Physics C	Office: 452-5835 Home : [redacted]
Prof. T. D. Thomas, Nuclear Chemistry (1st. Semester) A12 Chemical Sciences Building	Office: 452-5917 Home : [redacted]
Prof. R. A. Naumann, Nuclear Chemistry (2nd. Semester) A14 Chemical Sciences Building	Office: 452-5288 Home : [redacted]
Prof. R. V. Wolfenden, Chemistry 61 Frick Chemistry Laboratory	Office: 452-3946 Home : [redacted]

HEALTH PHYSICS OFFICERS

Mr. Jack C. Faust, Director University Health Physics Group James Forrestal Campus	Office: 452-5294 Home : [redacted]
Mr. Edward D. Scalsky University Health Physicist James Forrestal Campus	Office: 452-5294 Home : [redacted]

Portions withheld - Ex. 6

October 15, 1968

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—continued

[See notes at end of appendix]

Element (atomic number)	Isotope [1]		Table I Column 1 Air (μc/ml)	Table I Column 2 Water (μc/ml)	Table II Column 1 Air (μc/ml)	Table II Column 2 Water (μc/ml)
Plutonium (94)	Pu 240	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	5×10^{-6}
		I	4×10^{-11}	8×10^{-4}	1×10^{-12}	3×10^{-5}
	Pu 241	S	9×10^{-11}	7×10^{-3}	3×10^{-12}	2×10^{-4}
		I	4×10^{-8}	4×10^{-2}	1×10^{-9}	1×10^{-3}
	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)	K42	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}	....
		I				
	Rn 222	S	1×10^{-7}	....	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}
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}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—continued

[See notes at end of appendix]

Element (atomic number)	Isotope [1]		Table I Column 1 Air (μc/ml)	Table I Column 2 Water (μc/ml)	Table II Column 1 Air (μc/ml)	Table II Column 2 Water (μc/ml)
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}
Technetium (43)	Tc 96m	S	8×10^{-5}	4×10^{-1}	3×10^{-6}	1×10^{-2}
		I	3×10^{-5}	3×10^{-1}	1×10^{-6}	1×10^{-2}
	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^{-5}
	Tc 97m	S	2×10^{-6}	1×10^{-2}	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^{-2}	4×10^{-7}	2×10^{-3}
		I	3×10^{-7}	2×10^{-2}	1×10^{-8}	8×10^{-4}
	Tc 99m	S	4×10^{-5}	2×10^{-1}	1×10^{-6}	6×10^{-3}
		I	1×10^{-5}	8×10^{-2}	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}	5×10^{-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^{-8}	2×10^{-3}	1×10^{-9}	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}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—continued

[See notes at end of appendix]

Element (atomic number)	Isotope [1]		Table I Column 1 Air (μc/ml)	Table I Column 2 Water (μc/ml)	Table II Column 1 Air (μc/ml)	Table II Column 2 Water (μc/ml)
Thorium (90)	Th 228	S	9×10^{-12}	2×10^{-4}	3×10^{-13}	7×10^{-6}
		I	6×10^{-12}	4×10^{-4}	2×10^{-13}	10^{-5}
	Th 230	S	2×10^{-12}	5×10^{-5}	8×10^{-14}	2×10^{-6}
		I	10^{-11}	9×10^{-4}	3×10^{-13}	3×10^{-5}
	Th 232	S	3×10^{-11}	5×10^{-5}	10^{-12}	2×10^{-6}
		I	3×10^{-11}	10^{-3}	10^{-12}	4×10^{-5}
	Th natural	S	3×10^{-11}	3×10^{-5}	10^{-12}	10^{-6}
		I	3×10^{-11}	3×10^{-4}	10^{-12}	10^{-5}
	Th 234	S	6×10^{-8}	5×10^{-4}	2×10^{-9}	2×10^{-5}
		I	3×10^{-8}	5×10^{-4}	10^{-9}	2×10^{-5}
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^{-8}	2×10^{-3}	2×10^{-9}	8×10^{-5}
	Sn 125	S	1×10^{-7}	5×10^{-4}	1×10^{-8}	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^{-2}	8×10^{-8}	4×10^{-4}
		I	1×10^{-7}	1×10^{-2}	4×10^{-9}	3×10^{-4}
	W 185	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	1×10^{-7}	3×10^{-3}	1×10^{-9}	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^{-4}	1×10^{-11}	5×10^{-6}
		I	1×10^{-10}	1×10^{-4}	4×10^{-12}	5×10^{-6}
	U 232	S	1×10^{-10}	8×10^{-4}	3×10^{-12}	3×10^{-5}
		I	3×10^{-11}	8×10^{-4}	9×10^{-13}	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	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	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}	3×10^{-5}
		I	1×10^{-10}	1×10^{-3}	4×10^{-12}	3×10^{-5}
	U 238	S	7×10^{-11}	1×10^{-3}	3×10^{-12}	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	7×10^{-11}	5×10^{-4}	3×10^{-12}	2×10^{-5}
		I	6×10^{-11}	5×10^{-4}	2×10^{-12}	2×10^{-5}
Vanadium (23)	V 48	S	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-5}
		I	6×10^{-8}	8×10^{-4}	2×10^{-9}	3×10^{-5}
Xenon (54)	Xe 131m	Sub	2×10^{-5}	....	4×10^{-7}	....
	Xe 133	Sub	1×10^{-5}	....	3×10^{-7}	....
*	Xe 133m	Sub	1×10^{-5}	....	3×10^{-7}	....
	Xe 135	Sub	4×10^{-6}	....	1×10^{-7}	....
Ytterbium (70)	Yb 175	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}
Yttrium (39)	Y 90	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}
	Y 91m	S	2×10^{-5}	1×10^{-1}	8×10^{-7}	3×10^{-3}
		I	2×10^{-5}	1×10^{-1}	6×10^{-7}	3×10^{-3}
	Y 91	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 92	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	Y 93	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}
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}

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND

[See notes at end of appendix]

Element (atomic number)	Isotope [1]		Table I Column 1 Air (μc/ml)	Table I Column 2 Water (μc/ml)	Table II Column 1 Air (μc/ml)	Table II Column 2 Water (μc/ml)
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}

☆ [1] Soluble (S); Insoluble (I).
[2] "Sub" means that values given are for submersion in a semispherical infinite cloud of airborne material.

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^{-13}
b. For purposes of Table I, Col. 2—4×10^{-7}
c. For purposes of Table II, Col. 1—2×10^{-14}
d. For purposes of Table II, Col. 2—3×10^{-8}

26 FR 11046

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

30 FR 15801

c. Element (atomic number) and isotope	Table I Column 1 Air (μc/ml)	Table I Column 2 Water (μc/ml)	Table II Column 1 Air (μc/ml)	Table II Column 2 Water (μc/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^{-5}	----------	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^{-5}	----------	2×10^{-6}
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^{-6}	----------	6×10^{-7}
If it is known that (I 129, table II only), Ra 226, and Ra 228 are not present	----------	3×10^{-6}	----------	1×10^{-7}
☆☆ If it is known that alpha-emitters and Sr 90, I 129, Pb 210, Ac 227, Ra 228, Pa 230, Pu 240, and Bk 240 are not present	3×10^{-9}	----------	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^{-10}	----------	1×10^{-11}	----------
If it is known that alpha-emitters and Ac 227 are not present	3×10^{-11}	----------	1×10^{-12}	----------
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^{-12}	----------	1×10^{-13}	----------

25 FR 13952

4. If the mixture of radionuclides consists of uranium and its daughter products in ore dust prior to chemical processing of the uranium ore, the values specified below may be used in lieu of those determined in accordance with paragraph 1 above or those specified in paragraphs 2 and 3 above.

a. For purposes of Table I, Col. 1—1×10^{-10} μc/ml gross alpha activity; or 2.5×10^{-11} μc/ml natural uranium; or 75 micrograms per cubic meter of air natural uranium.

b. For purposes of Table II, Col. 1—3×10^{-12} μc/ml gross alpha activity; or 8×10^{-13} μc/ml natural uranium; or 3 micrograms per cubic meter of air natural uranium.

26 FR 11046

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 ¼ i.e.

$$\frac{C_A}{MPC_A}+\frac{C_B}{MPC_B}+\cdots\cdots\leq\frac{1}{4}).$$

*Revised 30 FR 15801
**ERRATUM: This line should read: "210, Ac 227, Ra 228, Pa 230, Pu 241, and Bk 249 are not"

APPENDIX C

Material	Micro-curies
Ag^{105}	1
Ag^{111}	10
As^{76}, As^{77}	10
Au^{198}	10
Au^{199}	10
$Ba^{140}+La^{140}$	1
Be^{7}	50
C^{14}	50
Ca^{45}	10
$Cd^{109}+Ag^{109}$	10
$Ce^{144}+Pr^{144}$	1
Cl^{36}	1
Co^{60}	1
Cr^{51}	50
$Cs^{137}+Ba^{137}$	1
Cu^{64}	50
Eu^{154}	1
F^{18}	50
Fe^{55}	50
Fe^{59}	1
Ga^{72}	10
Ge^{71}	50
H^{3}(HTO or $H^{3}{}_{2}O$)	250
I^{131}	10
In^{114}	1
Ir^{192}	10
K^{42}	10
La^{140}	10
Mn^{52}	1
Mn^{56}	50
Mo^{99}	10
Na^{22}	10
Na^{24}	10
Nb^{95}	10
Ni^{59}	1
Ni^{63}	1
P^{32}	10
$Pd^{103}+Rh^{103}$	50
Pd^{109}	10
Pm^{147}	10
Po^{210}	0.1
Pr^{143}	10
Pu^{239}	1
Ra^{226}	0.1
Rb^{86}	10
Re^{186}	10
Rh^{105}	10
$Ru^{106}+Rh^{106}$	1
S^{35}	50
Sb^{124}	1
Sc^{46}	1
Sm^{153}	10
Sn^{113}	10
Sr^{89}	1
$Sr^{90}+Y^{90}$	0.1
Ta^{182}	10
Tc^{96}	1
Tc^{99}	1
Te^{127}	10
Te^{129}	1
Th (natural)	50
Tl^{204}	50
Tritium. See H^{3}	250
U (natural)	50
U^{233}	1
$U^{234}-U^{235}$	50
V^{48}	1
W^{185}	10
Y^{90}	1
Y^{91}	1
Zn^{65}	10
Unidentified radioactive materials or any of the above in unknown mixtures	0.1

NOTE: For purposes of §§ 20.203 and 20.304, where 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").

EXAMPLE: For purposes of § 20.304, if a particular batch contains 2,000 μc of Au^{198} and 25,000 μc of C^{14}, it may also include not more than 3,000 μc of I^{131}. This limit was determined as follows:

$$\frac{2{,}000\ \mu c\ Au^{198}}{10{,}000\ \mu c}+\frac{25{,}000\ \mu c\ C^{14}}{50{,}000\ \mu c}+\frac{3{,}000\ \mu c\ I^{131}}{10{,}000\ \mu c}=1$$

The denominator in each of the above ratios was obtained by multiplying the figure in the table by 1,000 as provided in § 20.304.

APPENDIX D

UNITED STATES ATOMIC ENERGY COMMISSION

COMPLIANCE OFFICES

Region		
I		
Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.		
II		
Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Panama Canal Zone, Puerto Rico, South Carolina, Tennessee, Virginia, Virgin Islands, and West Virginia.		
III		
Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri ,Ohio, and Wisconsin.		
IV		
Colorado, Idaho, Kansas, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, and Wyoming.		
V		
Alaska, Arizona, California, Hawaii, Nevada, Oregon, Washington and U.S. territories and possessions in the Pacific.		

Address	Telephone	
	Daytime	Nights and holidays
Region I, Division of Compliance, USAEC, 970 Broad St., Newark, N.J. 07102.	201-645-3960	212-989-1000
Region II, Division of Compliance, USAEC, Suite 818, 230 Peachtree St. NW., Atlanta, Ga. 30303.	404-526-4537	404-526-4537
Region III, Division of Compliance, USAEC, 799 Roosevelt Road, Glen Ellyn, Ill. 60137.	312-858-2660	312-858-2660
Region IV, Division of Compliance, USAEC, 10395 West Colfax Ave., Denver, Colo. 80215.	303-297-4211	303-237-5095
Region V, Division of Compliance, USAEC, 2111 Bancroft Way, Berkeley, Calif. 94704.	415-841-5121 Ext. 651.	415-841-9244

33 FR 5212

NOTE: The record keeping and reporting requirements contained in this part have been approved by the Bureau of the Budget in accordance with the Federal Reports Act of 1942.

Appendix C from 25 FR 10914.

Appendix D from 27 FR 10826.

The denominator in each of the above ratios was obtained by multiplying figures in the table by 100 as indicated in Appendix H.

Note 3: For purposes of Section VIII where 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 (in the table) 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").

EXAMPLE: If a particular room contains open sources of 125 uc of S-35 and 250 uc of C-14, it must then be posted if more than 25 uc of P-32 is obtained. This limit was determined as follows:

$$\frac{125 \text{ uCi } S^{35}}{500 \text{ uCi}} + \frac{250 \text{ uCi } C^{14}}{500 \text{ uCi}} + \frac{25 \text{ uCi } P^{32}}{100 \text{ uCi}} = 1$$

The denominator in each of the above ratios was obtained by multiplying the figure in the table by ten as provided in Section VIII.

APPENDIX D

Maximum Permissible Exposures (Occupational)

1. External Exposure

The maximum permissible dose (MPD) as established by "10 CFR 20" and the New Jersey Radiation Protection Code is as follows:

	Rem Per Calender Year	Rem Per Calender Quarter	Cumulative Life Total Rem
Whole Body Exposure; head and trunk; active blood-forming organs; lens of eyes, or gonads	5	1-1/4	< 5 (N - 18) where N is age at last birthday
Hands and forearms; feet and ankles	75	18-3/4	
Skin of whole body	30	7-1/2	

2. Internal Exposure

Internal occupational exposures are limited by establishing controls over the concentration of airborne radioactive materials. The limits are specified in Table I, Appendix B. The limits set forth in Appendix B are based on a 40 hour week and an adjustment shall be made in the concentration limits if the number of exposure hours is either greater or less than 40 in any seven consecutive days.

3. Minors

The permissible exposure limits for minors, persons under 18 years of age, are as follows:

a. Exposure limits for external radiation are limited to 10 percent or less of the limits specified in paragraph 1 above.

b. Exposure limits to airborne concentrations are those specified in Table II, Appendix B. The concentration may be averaged over periods not greater than one week.

c. Exposure limits for pregnant women are determined by consideration of the exposure to the unborn child.

4. "Unrestricted Areas"

Radiation levels in excess of the following are not permitted in "Unrestricted Areas":

a. radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of two millirems in any one hour or

APPENDIX E

Useful Health Physics Forms

1. General

Convenient forms for the required records and reports should be obtained from the Health Physics Office. The forms are indexed as Health Physics Forms and numbered in the lower left hand corner. If your supply is outdated or exhausted, please call 5294.

2. Required Forms for the "Departmental Representative"

The "Departmental Representative" or his assistant should have the following forms:

Form Number	Date	Title or Description
H. P. #1	7/68	Personnel Data and Exposure History
H. P. #2	10/67	Letter requesting Previous Exposure Records
H. P. #4	7/68	Statement of Training
H. P. #12	8/68	Accident Procedure In Case Of A Radioisotope Spill
H. P. #18a	7/68	Direct Instructions for Forms 1 & 2
H. P. #20	8/68	Application for Authorization for an Isotope
H. P. #20a	7/68	Supplemental Information
H. P. #20b	1/68	Application for Limited Possession No.
H. P. #30	8/68	Application for Authorization for an Irradiation
H. P. #36	6/67	Application for Authorization Number for Radiation Producing Machine
H. P. #37a	1/68	General Licensed Devices and Equipment (10 CFR 31)
H. P. #37b		In preparation
H. P. #37c	8/68	Transportation of Radioactive Materials

3. "Users" should have the following forms:

Form Number	Date	Title or Description
H. P. #5	4/68	Monthly Radioisotope Inventory
H. P. #6	4/68	Radioisotope Inventory Log
H. P. #11	12/67	Monthly Radioactive Waste Disposal Report
H. P. #12	8/68	Accident Procedure and Emergency Phone Numbers
H. P. #31	2/66	Emergency Directory and Instructions
H. P. #34	3/68	Radioactive Waste Record (Financial)

5. Other Agencies

Agencies involved in the regulation of transportation of radioactive materials include:

a. Federal Aviation Agency

b. United States Coast Guard

c. Civil Aeronautics Board

d. New Jersey State Department of Health

e. New York State Department of Labor

f. Port of New York Authority

g. Department of Health New York City

h. New York Thruway Authority

i. New Jersey Thruway Authority

j. Triborough Bridge and Tunnel Authority

k. New Jersey Highway Authority

l. Interstate Commerce Commission.

m. Department of Transportation

APPENDIX H

Approval Procedure - Explanation and Instructions

1. Authorization Numbers

   a. Only persons immediately responsible for the conduct of a research project may apply for an Authorization Number. The applicant must hold a faculty or research position and have had previous experience with "Sources of Radiation" similar to those requested.

   b. The amount of radioactivity and the scope of work permitted is, in general, limited only by the terms and conditions of the relevant University License.

   c. Authorization Numbers are valid for two years.

   d. There are two types of Authorization Numbers; on for Isotopes and one for Irradiations. They are distinguished as follows:

      (1) An Isotope Authorization Number authorizes possession and use of the requested amount of a specific isotope (and daughters) in accordance with the statements and representations made in the application. Isotopes are generally acquired by purchase or loan, usually from a commercial supplier.

      (2) An Irradiation Authorization Number authorizes irradiation of a sample in an accelerator, reactor, etc. and subsequent possession and use of the product radioactivities in accordance with the statements and representations made in the application. Several types of irradiations are recognized as explained in paragraph 4 below.

2. Limited Possession Numbers

   a. A Limited Possession Number is essentially a restricted or limited Authorization Number. It differs from an Authorization Number in the following ways:

      (1) The applicant does not have to qualify as a "Responsible Investigator" and less emphasis is placed on previous experience with "Sources of Radiation". Accordingly, the scope of work permitted is more restricted.

      (2) The total amount of radioactivity permitted a "Limited Possessor" is limited to 100 times the amount listed in the appropriate column (A or B) of Appendix C of a single isotope or the equivalent prorated quantity of several as illustrated in the footnote to Appendix C.

(3) Limited Possession Numbers are valid for up to one year.

(4) Limited Possession Numbers are issued at the discretion of the "Health Physics Officer" without complete Committee review. The "Health Physics Officer" may require that an application be submitted to the entire Committee as an application for an Authorization Number. The Committee is informed of all Limited Possession Numbers issued.

b. Limited Possession Numbers are issued to authorized possession of "Generally Licensed Devices" such as fire detector heads, spark gaps, thickness gauges, etc. which contain radioactive materials. All General Licenses have certain requirements.

3. Machine Numbers

a. A Machine Number authorizes possession and use of radiation producing machinery such as X-ray machines, accelerators, reactors and other equipment which emits radiation, whether or not such emission is intended. Questions of interpretation shall be referred to the "Health Physics Officer".

b. The qualifications of the applicant, the scope of work permitted and the period of validity are similar to that permitted under an Authorization Number as explained above.

4. Types of Irradiation and Authorization Requirements

a. An "offsite" irradiation is one performed for Princeton University personnel at off-campus facilities not owned or operated by Princeton University and where the resulting radioactivity, however small or purified, is to be brought on campus. Any person desiring these must obtain an Irradiation Authorization or Limited Possession Number. Examples of offsite facilities are the Industrial Reactor Laboratory and the Brookhaven National Laboratory.

b. An "onsite-external" irradiation is one performed at Princeton University facilities, such as the Princeton-Pennsylvania Accelerator or the Palmer Cyclotron, for ultimate use by personnel at offsite locations. Persons desiring these must either find a sponsor who has or will obtain the appropriate Irradiation Authorization or Limited Possession Number or he may file an application with the Princeton University Radiation Safety Committee through the University Health Physics Office for an "Authorization Number". The following conditions regarding such irradiations have been established by the New Jersey State Department of Health.

(1) The person desiring the irradiation must demonstrate to the "Health Physics Officer's" satisfaction that he and his organization are duly authorized to possess and use the requested materials under the provisions of an Atomic Energy Commission or State Licenses as appropriate.

(2) The applicant and the individual responsible for the transportation phase of the material will be interviewed by the "Health Physics Officer" to insure that they are aware of, and agree to comply with, all relevant laws and regulations.

(3) The "Health Physics Officer" is responsible for reporting the transfer on the next monthly radioisotope inventory and State Report, indicating the amount of activity, and the date of transfer, the recipient, and the address or organization.

c. An "Intramural" irradiation is one performed at University facilities for or by University personnel. Persons desiring these must obtain an Irradiation Authorization or Limited Possession Number.

d. An "In-house" irradiation is a special class of an "Intramural" irradiation which meets the following additional criteria:

(1) it is performed for or by an individual associated on a full-time basis with the Princeton University facility at which the irradiation is done, and

(2) all of the subsequent use of the radioactive material will take place within the facility in which it was produced and

(3) no transportation over University and/or public roadways and/or streets is involved, and <u>either</u>

(4) the total activity produced and present at the end of the irradiation is less than 20 millicuries at the time of the first manipulation, <u>or</u>

(5) it is not performed for the specific purpose of radionuclide production i.e., target irradiations for the purpose of producing secondary particle beams, incidential irradiation of machine components and shielding, etc.

"In-house" irradiations are arranged at the discretion of the "User" authorized to operate the radiation producing machine. This individual has assumed the responsibility of meeting the obligations of radiation safety. He may request Health Physics

Group and University Radiation Safety Committee review of the proposed irradiation; however, no Authorization Number is issued. The responsiblility for safety and the final decision remain with the "User".

5. How to apply for an Authorization or Limited Possession Number

   a. Applicant obtains the necessary Health Physics Forms and discussess his proposal with his "Departmental Representative". Forms are also available from the Health Physics Office upon request.

   b. Use H. P. Form #20 for an Isotope and Health Physics Form #30 for an Irradiation, and follow the instructions on the form.

   c. Do not use obsolete forms. See Appendix E for latest edition date. Please do not use blue ink when completing the application as it does not Xerox well.

   d. Indicate whether this application is for an Authorization Number or a Limited Possession Number in the upper left hand corner of the form. In making this decision, the following will be helpful:

      (1) If the applicant qualifies as a "Responsible Investigator", he may apply for either type of number.

      (2) If the applicant does not qualify as a "Responsible Investigator", he must apply for a Limited Possession Number.

      (3) If the amount desired exceeds 100 times the amount listed in the appropriate column (A or B) of Appendix C of a single isotope or the equivalent prorated quantity of several, the applicant must apply for an Authorization Number provided, of course, he meets the qualifications. If he does not qualify and his needs exceed the above, he must then arrange to work under the supervision of a "Responsible Investigator" who is or will become properly authorized.

      (4) Other cases should be referred to the "Health Physics Officer".

   e. The applicant should consult the "Health Physics Officer" to discuss the proposal and for assistance in completing the application. This is a necessity for an applicant filing his first application at Princeton University.

   f. The completed application must be approved and signed by the "Departmental Representative". It is then forwarded to the Health Physics Office.

APPENDIX J

Distribution of Health Physics Group Costs

The following is the procedure used for distributing the costs of the University Health Physics Group. This procedure was approved by the University Radiation Safety Committee on April 8, 1968, and subsequently approved by the University Research Board on May 20, 1968.

1. An "Annual Analysis of Health Physics Group Costs" is prepared in September by the Director of the University Health Physics Group. This determines the fraction of the costs attributable to each Department.

2. The analysis is prepared as follows:

   a. The costs of routine program or contracted services such as, film badges, waste disposal, Slit-Lamp examinations, routine bioassays, etc., are determined and the percentage attributable to each Department tabulated.

   b. An estimate of the percentage of the Health Physics Group effort clearly attributable to each Department is tabulated. This is based mainly on past experience but is modified to compensate for any predictable and significant shifts in Health Physics Group effort due to planned initiation of new research programs involving "Sources of Radiation".

   c. The items described in paragraph 'a' and 'b' above are totaled and tabulated for each Department. These accounts for about 65% of the Health Physics Group Costs.

   d. The remaining 35% is tabulated as "Other". This include the costs of the routine services for very small "Users" and the Health Physics Group, the effort of the Health Physics Group not clearly attributable to anyone Department and the cost of supplies, materials, telephones and other miscellaneous items needed for the functioning of the group. "Other" is then distributed proportionately as per the percentages derived in paragraph 'c' above.

3. The results tabulated in the "Annual Analysis" are used to distribute the Health Physics Group Costs in accordance with the following procedures:

   a. The basic distribution unit is the Department or Laboratory. Each is assessed in accordance with the percentages tabulated above. The Departmental Representative provides the Health Physics Group with the needed Account Numbers.

b. A Department or Laboratory wishing to further fractionate its assessment does so by providing the "Health Physics Officer", via its Departmental Representative, with the following information: name of individual to be assessed, his account number, and the sub-fraction of the Departmental assessment to be applied in his case. The technique by which the sub-fraction is decided upon is an internal Departmental matter.

c. Using the input data thus provided, the Health Physics Office does all the calculations, and provides the Controller and all interested parties with the "Quarterly Distribution of Charges". The assessment is made each quarter at the request of the Controller's Office.

d. The "Annual Analysis of Health Physics Group Costs" is prepared on the basis of the previous fiscal year and is submitted for Committee review and approval at the fall meeting of the University Radiation Safety Committee. After approval, this distribution is used for the current fiscal year without modification unless a significant change in the Health Physics Group effort occurs which would clearly indicate the need for reassessment.

e. A Department or Laboratory which utilizes Health Physics Group services to such an extent that the total described in paragraph 2c (above) is equal to or greater than one tenth of one percent of the Health Physics Group "effort" is entered as a separate Department in the "Annual Analysis of Health Physics Group Costs". This Department would then be invited to appoint a representative to the University Radiation Safety Committee. Costs amounting to less than 0.10% are included in "Other".

f. Any large or extraordinary costs such as those resulting from an accident or spill and requiring bioassays, whole body counts, major clean up activities, etc., will be charged directly to the individual "User" via an interdepartmental invoice. Such costs will not appear on the "Annual Analysis of Health Physics Group Costs" since they might seriously affect the distribution and their inclusion would unnecessarily imply an expected recurrance the following year.