THE AMERICAN UNIVERSITY
WASHINGTON, D.C.

MS 16
KI

April 4, 1985

John D. Kinneman, Chief
Nuclear Section A
United States Nuclear Regulation
Commission, Region I
Division of Radiation Safety
and Safeguards
631 Park Avenue
King of Prussia, PA 19406

Dear Dr. Kinneman: Expired

This is in reference to your letter of February 5, 1985 requesting additional information prior to renewal of License Number 08-08371-02. This request was in response to our renewal application which was sent to NRC on October 29, 1984. Your letter indicated that it was not received in King of Prussia until November 7, 1985, and I do want to follow up on that at this time. When I spoke with you following the receipt of your letter, you did indicate that the date received had been misread. It was received on November 2, 1984. In addition, I feel I need to clarify the fact the renewal application was sent to the Washington address (noted on the instructions or envelope). Therefore, we do not feel that our request should be treated as a new license request. However, as you noted by telephone, the same questions apply.

The following narrative responds to the five pages of questions; i.e., 18 questions and their subparts. Even though we were somewhat overwhelmed when we received your letter and request, the exercise of going through the questions has provided us an opportunity to reevaluate and improve some of our procedures.

1. Specify the particular nuclides which will be used by each individual named in item 6 of your application.

- Professor Romeo Segnan - Sn 19

  Professor Robert Chinnis - C^{14}, Tritium

  Professor Ann Hagan - H^3

  Professor Nina Roscher - C^{14}

  Professor Albert Cheh - P^{32}, C^{14}, H^3

2. A list of the manufacturer, model number, and quantity for all sealed sources. Specifically, this information was not provided for the thorium-228 and barium-133 sealed sources.

- The thorium-228 was removed from the premises of The American University on February 22, 1984, by Southwest Nuclear Corporation and transported to burial site number 1151, Richland, Washington. All from Nuclear Chicago , purchased in 1960s:

  Barium-133 - Hurst Hall

  (1) Model Sk1-5
  Solid .05 uci

  (2) Model Sk1-16
  Quantity .5 uci

  (3) Model SK1-15
  .05 uci

  (4) Model SK1-6
  .5 uci

  Barium 133 solid samples (4) - Hurst Hall 4:

  1. Model SK1- 5 0.05 Microcurice

  2. Model SK1-16 0.50 Microcurice

  3. Model SK1-15 0.05 Microcurice

  4. Model SK1- 6 0.50 Microcurice

3. Describe special precautions to be used while handling sealed sources.

- Please see license application (point number 15) and the "Good Laboratory Practices" section in Radioactive Materials: Policies and Procedures (attached). These will be augmented with the following:

  Personnel handling sealed sources will:

  - o Wear monitoring badge
  - o Wear gloves
  - o Use tongs
  - o Use lead shielding whenever appropriate

4. Describe your method for determining the radiation dose to the extremities of personnel handling sealed sources.

- The hands of personnel using sealed sources will be routinely surveyed with survey meters. If there is a spill or any suspicion of radioactive contamination, feet will also be surveyed using survey meter.

5. Describe the areas where sealed sources will be stored, including (a) placement and thickness of shielding, and (b) proximity of the storage area to unrestricted areas.

- All radioactive materials are now housed in two locations; Room 4, McKinley; Room 4, Hurst. The room in which the sealed sources are housed is at least six feet from any unrestricted areas; these areas are separated by a 1.5' concrete wall. In addition, these sealed sources are stored in laboratory lead shielded containers located in a cabinet. The lead shielding is at least 2" in thickness.

6. Describe the training which will be provided to laboratory personnel or students who are involved in or associated with the use of radioactive materials. The description should include the form of training (e.g., formal course work, lectures), the duration of training, the subject matter included, and the means of determining the proficiency of each person handling radioactive materials. The training program should be of sufficient scope to ensure that all personnel using radioactive materials receive proper instruction in accordance with 19.12 of 10 CFR Part 19 and are knowledgeable in those radiation safety procedure safety procedures and techniques pertinent to their respective duties.

- All laboratory personnel and/or students who are involved in or associated with the use of radioactive materials are required to have training. Professors who use radioactive materials in their teaching or laboratories and students who assist them are required to take the course offered at the National Institutes of Health. The subject matter for the "Radiation Safety in the Laboratory," session includes the NIH Radiation Safety Guide, Norman Figerio's, Your Body and Radiation, and Exposure Control and Bioeffects. In order to receive certification from the NIH training, one must pass the examination given at the end of the session.

  Students who use radioactive materials as part of their classes or laboratories will be instructed by supervisors in good laboratory practices (see the manual and, in addition, NIH provided materials listed above will be used). Strict adherence to these laboratory practices is expected. All students are required to study Part 19 of the regulations.

  For cleaning and safety/security personnel, TAU has sent procedures to offices supervising these employees and, in each of the two locations housing radioactive materials, copies of the emergency procedures are available and appropriate posters are on display.

7. Submit a copy of general instructions to be followed by laboratory personnel or students while working with radioactive materials. These instructions should:

a. Outline control procedures for obtaining permission to use radioactive materials at the institution. Give limitations on the quantity to be handled per student or allowed per experiment.

- See copy of the "Laboratory Safety Practices (Top of page 9)." Quantity will not exceed limits so noted in license.

b Explain what laboratory apparel to wear and what safety equipment to use (e.g., use of laboratory coats, gloves, and remote pipetting devices).

- See "Laboratory Safety Practices", page 9.

c. Prescribe limitations and conditions on handling liquid or loose (unencapsulated or dispersible) radioactive materials and what laboratory equipment to use in working with them. For example, explain when materials and operations should be confined to radio chemical fume hoods or glove boxes and explain what shieding or remote handling equipment is to be used when hard beta-or-gamma-emitting materials are handled.

- See "Policies and Procedures Manual."

d. Instruct the user about movement of materials between rooms, halls, or in corridors, if applicable.

- Usage of radioactive materials is limited to Hurst 4 and McKinley 4. There is no movement between rooms, in halls, or in cooridors.

e. Explain requirements for storage of materials and labeling of containers and how areas will be identified where radioactive materials are used. Explain where and how contaminated articles and glassware are to be handled and stored.

- All areas and containers are identified by signs and labels as per NRC regulations.

  Radioactive storage containers are used for this purpose.

f. Specify personnel monitoring devices to be used, where to obtain them, and instructions given on their proper usage.

- The American University uses p.m.d. issued by Proxtronics of College Park, MD. Professors give instructions on their proper use as per guidelines from the NIH course.

8. Specify the window thickness in mg/cm^2 and type of each radiation detection instrument. The type of use would normally be monitoring, surveying, assaying or measuring.

- The window thickness is 1.4 to 2.0 mg^2. The instruments are used for monitoring and surveying.

9. The name, address and license number of the firm contracted to perform calibration of radiation detection equipment should be specified along with frequency of calibration. The applicant should contact the firm that will perform the calibrations to determine if information concerning calibration procedures has been filed with the Commission. If this information concerning calibreation procedures has not been filed, it should be obtained and submitted.

- The firm which performs calibration of TAUs radiation detection equipment every six months is:

  Radiation Services Organization
  5204 Minnick Road
  Laurel, MD 20707
  (301) 953-2482

  Information concerning calibration procedures has been filed with N.R.C. In fact, that is where we secured Radiation Services Organization's name. R.S.O. possesses license number MD-33-01-01.

10. Describe your routine area survey program, including th type and frequency of surveys, the areas to be surveyed, the instrumentation or technique to be used and the levels of contamination that you consider to be acceptable, and provisions for preserving recrods of such surveys. For an institution using the types and quantities of materials listed on your present license, it is recommended that a brief contamination survey be conducted at the end of each experiment, and a comprehensive survey performed once monthly.

- The radiation safety officer assistant (a graduate student who is majoring in physics and who has successfully completed the NIH course) is responsible for routine area surveys.

The Radiation Safety Office Assistant's duties are (1) to keep radioactive dosiometry records, (2) make periodic contamination tests and (3) change monthly film badge monitors. Records are kept in files of the RSO assistant.

The areas surveyed are Hurst Hall Rooms 15 & 4 and McKinley Building Room 4.

The maximum permissable dose of contamination are the following in Rems.

Whole body	.040/month	.125/quater	.500/year
Skin of whole body	.250/month	.750/quater	3/year
Extremity	.625/month	1.875/quater	7.5/year

11. Submit a description of the duties and responsibilities of your radiation protection officer, Dr. Romeo Segnan, under your license. The typical duties of a radiation protection officer would be:

    a. To ensure that the use of radioactive material is by or under the direct supervision of individuals specifically listed on your license.

    b. to ensure that all users (where appropriate) wear personnel monitoring equipment when using radioactive materials.

    c. To ensure that radioactive materials are properly secured against unauthorized removal at all times when not in use.

    d. To perform routine inspections of all laboratories using or storing radioactive materials.

    e. To ensure that the terms and conditions of your license are met, and that all required records are maintained.

    - The American University's Radiation Protection Officer's duties are to perform or supervise activities stated in a, b, c, d, & e. In addition, see the "Manual of Policies and Procedures,". pp. 45 and 46.

12. Submit a copy of the emergency procedures to be followed in case of spills or other types of accidents involving radioactive materials. It is recommended that such procedures contain:

    - For minor spills, please see "Policies and Procedures Manual, pp. 5-7.

a. Instructions to be followed during minor spills. For minor spills, please see "Policies and Procedures Manual", pp. 5-7.

b. Instructions to be followed during major spills.

- (Procedures for major spills are also in the "Policies & Procedures Manual," however, are generally not applicable at TAU.)

c. Your radiation protection officer's name, his office telephone number, and a telephone number to be used during off-duty hours.

- Professor Romeo Segnan
Department of Physics
McKinley Building
The American University
4400 Massachusetts Aveune, N.W.
Washington, D.C. 20016

Office - (202) 885-2750 or 2745
Home - (202) 244-2070

13. Submit a complete, comprehensive description of your procedures for disposal of radioactive wastes. You should include procedures for collecting wastes at individual investigators' laboratories and final disposal procudures and any special instructions given to housekeeping personnel.

- The American University uses Radiation Services Organization, 5204 Minnick Road, Laurel, MD 20707, to dispose of waste from radioactive materials. TAU has gone through licensing procedures with the State of Washington for the disposal of waste and have Site Use Permit 1151, valid until 12/31/85.

Use of radioactive materials takes place in only two rooms on The American University campus, Room 4, Hurst and Room 4, McKinley. Waste is confined to those areas and collection of all waste is in radioactive waste containers. Housekeeping personnel are instructed as to the location of containers containing radioactive waste and are instructed not to handle the containers. In addition, they have been given procedures to follow in case a spill occurs when they are in the rooms of if a spill has occurred prior to their occupancy of the room. (See "Policies and Procedures Manual.")

14. Cobalt-57, produced in a cyclotron, and radium-226, a naturally occurring isotope are not byproduct materials are defined in Section 30.4(d) of Title 10, Code of Federal Regualtions, Part 30, and are not subject to licensing by the NRC. Therefore, you may procure and

use them without reference in your byproduct material license.

You should contact District of Columbia regulatory authorities to determine the licensing or registration requirements for use of these radionuclides.

- We are in the process of contacting the District of Columbia.

15. If radioactive materials are to be used with animals, please submit:

    a. A description of the animals' housing facilities.

    b. A copy of instructions provided to animal caretakers for handling of animals, animal waste carcasses, and cleaning and decontamination of animal cages.

- Radioactive materials are not used with animals at the present time.

16. Describe your bioassay program for individuals using millicurie quantities of tritium. You should include the type of bioassays (thyroid count, urine count, whole body count, etc.), the criteria and frequency for performing bioassays, and the type of action taken when positive results are obtained. For your assistance, we are enclosing a tritium bioassay guide that contain criteria for performing bioassays that we find acceptable.

- Please see manual. In addition we will abide by the tritium bioassay guide which you have sent, if we use tritium in any experiment, currently we do not.

17. Describe your procedures for complying with Section 20.1(c), Section 20.103, and Section 20.106 of 10 CFR part 20, for procedures such as tritium labeling experiments that may release volatile or gaseous radioactive materials to restricted and unrestricted areas. You should include a description of the type of surveys (e.g., environmental or breathing zone), frequency of surveys, and the individuals who will perform the surveys (e.g., radiation safety officer or investigator), equipment to be used, and the procedures for evaluating the results.

- As previously described, all such materials are kept in two rooms only. Hoods are used for ventilation; areas are surveyed at regular intervals when experiments are in progress. Smears and analyses are performed with the liquid scintillation counter. No radioactivity is disposed of in effluents.

  However, it is important to note that at this time no such experiments are being carried out or contemplated.

18. In support of your request for 75 millicuries of phosphorus-32, you should develop and submit special safety instructions to be provided to individuals using millicurie quantities of P-32. We recommend that your procedures include, but not be limited to, the following:

    a. The use of low density shielding (e.g., plexiglass) in order to keep Bremsstrahlung radiation at a minimum.

    b. A mandatory radiation survey and wipe test procedures after each use.

    c. The use of finger extremity monitors for procedures that involve 1 millicuries or more.

    d. The use of dry run prior to the performce of unfamiliar procedures in order to preclude unexpected complications. In addition, it is recommended that the radiation protection officer be present during new procedures.

    e. The use of eye protection for procedures that involve 10 millicuries or more.

TAU will abide by these procedures.

Sincerely,

Barbara K. Gordon

Dr. Barbara Gordon
Executive Coordinator
Protection Radiation
Committee

THE AMERICAN UNIVERSITY
WASHINGTON, D.C.

RADIOACTIVE MATERIALS

POLICIES AND PROCEDURES

INCLUDING

EMERGENCY PROCEDURES

Radiation Protection Committee

TABLE OF CONTENTS

THE AMERICAN UNIVERSITY

RADIATION PROTECTION COMMITTEE

MEMBERS

THE AMERICAN UNIVERSITY
RADIATION PROTECTION COMMITTEE

*Professor Romeo Segnan, Chairperson and Radiation Protection Officer
Department of Physics, McKinley 102, Ext. 2745 or 2750

*Nina M. Roscher, Vice Provost for Academic Affairs, President's Building,
Ext. 2124

*Albert Cheh, Assistant Professor, Department of Chemistry, Beeghly,
Ext. 1768, 1772

*Robert Chinnis, Associate Professor, Department of Biology, Hurst,
Ext. 2184, 2192

Stanley M. Matelski, Director, Research, Grants, and Contract Services,
Certifying Official for Licensing of Radioactive Isotopes, Hamilton,
Ext. 3442

Barbara J. A. Gordon, Executive Coordinator, Radiation Protection Committee,
Hamilton, Ext. 3446, 3442

Diana Woody, Assistant Radiation Protection Officer, Department of Physics,
McKinley, Ext. 2761

*Voting members of the Committee: appointed by Provost Greenberg

EMERGENCY PROCEDURES

RADIATION PROTECTION COMMITTEE
THE AMERICAN UNIVERSITY

EMERGENCY PROCEDURES FOR RADIOACTIVE MATERIALS

ATTENTION: CLEANING PERSONNEL

RADIOACTIVE MATERIALS ARE LOCATED IN ROOM 4 HURST AND ROOM 4 MCKINLEY

In case of an emergency involving any of the radioactive materials located in Room 4 Hurst or Room 4 McKinley, please follow these procedures:

1. Notify the Security Office immediately on x 2525.

2. Request that security immediately notify the Radiation Protection Officer, Professor Romeo Segnan (office x 2745 or 2750, home 244-2070) or the Assistant Radiation Protection Officer, Diana Woody (office x 2761).

3. Clear the area. Notify all persons not involved in the spill to vacate the area.

4. Security and/or the Radiation Protection Officer will assume the responsibility for further action.

RADIATION PROTECTION COMMITTEE

THE AMERICAN UNIVERSITY

EMERGENCY PROCEDURES FOR RADIOACTIVE MATERIALS

ATTENTION: SAFETY AND SECURITY

Re: RADIOACTIVE MATERIALS LOACTED IN ROOM 4 HURST AND ROOM 4 McKINLEY

In case of emergency involving and of the radioactive materials located in either of the above rooms, please follow these procedures:

1. Notify the Radiation Protection Officer, Professor Romeo Segnan, Physics Department. McKinley 102, x 2750 or 2745 (office), 244-2070 (home), or the Assistant Radiation Protection Officer, Diana Woody (x 2761).

2. Clear the area - Notify all persons not involved in the spill to vacate the room.

3. Prevent the spread - Cover the spill with absorbent pads or paper, but do not attempt to clean it up. Confine the movement of all personnel potentially contaminated to prevent the spread. You will find spill or emergency kits in both Hurst 4 and McKinley 4. These will contain absorbent pads or paper.

4. If the Radiation Protection Officer has not arrived, close the room and lock the door(s) to prevent entry.

5. Watch for contamination. Contaminated clothing should be removed and stored for further evaluation by the Radiation Protection Officer. If there have been any spills on the skin, flush thoroughly and then wash with mild soap and lukewarm water.

6. Report, in writing, incident to the Radiation Protection Officer, Professor Romeo Segnan, Physics Department, McKinley 102.

RADIATION PROTECTION COMMITTEE

THE AMERICAN UNIVERSITY

EMERGENCY PROCEDURES

FOR RADIOACTIVE MATERIALS

Based on material in Appendix H, N.R.C. Regulatory Guide 10.8

MINOR SPILLS:

1. NOTIFY:
   - Notify persons in the area that a spill has occurred.
   - Notify Security on x 2525
   - Notify the Radiation Protection Officer, Professor Romeo Segnan (office) x 2750 or 2745; (home) 244-2070

2. PREVENT THE SPREAD: Cover the spill with absorbent paper.

3. CLEAN UP: Use disposable gloves and remote handling tongs. Carefully fold the absorbent paper and pad. Insert into a plastic bag and dispose of in the radioactive waste container. Include all other contaminated materials such as disposable gloves.

4. SURVEY: With a G.M. Survey Meter, check the area around the spill, your hands and clothing for contamination.

5. REPORT: Report, in writing, incident to the Radiation Protection Officer, Professor Segran.

MAJOR SPILLS

1. CLEAR THE AREA: Notify all persons not involved in the spill to vacate the room.

2. PREVENT THE SPREAD: Cover the spill with absorbent pads, but do not attempt to clean it up. Confine the movement of all personnel potentially contaminated to prevent the spread.

3. SHIELD THE SOURCE: If possible, the spill should be shielded, but only if it can be done without further contamination or without significantly increasing your radiation exposure.

4. CLOSE THE ROOM: Leave the room and lock the door(s) to prevent entry.

5. CALL FOR HELP. Notify the Radiation Protection Officer immediately.

6. PERSONNEL DECONTAMINATION: Contaminated clothing should be removed and stored for further evaluation by the Radiation Safety Officer. If the spill is on the skin, flush thoroughly and then wash with mild soap and lukewarm water.

RADIATION SAFETY OFFICER: Professor Romeo Segnan

OFFICE PHONE: 885-2750 or 2745

HOME PHONE: 244-2070

ASSISTANT RADIATION SAFETY OFFICER: Diana Woody

OFFICE PHONE: 885-2761

Please Note:
Use of radioactive materials at The American University is strictly limited to persons whose names appear on the NRC license (08-08371-02) or who are under the supervision of those so named. Persons so named on the NRC license have undergone updated training on "Radiation Safety in the Laboratory" or a comparable seminar.

GOOD LABORATORY PRACTICES

REMINDER OF GOOD RADIOISOTOPE LABORATORY SAFETY PRACTICES

Use of radioisotope materials at The American University is strictly limited to persons whose names appear on the NRC license (08-08371-02) or who are under the supervision of those so named. Persons so named on the NRC license have undergone updated training on "Radiation Safety in the Laboratory" or a comparable seminar.

1. Never pipette by mouth.
2. No smoking, eating, or cosmetics are permitted in the work area.
3. Gloves and laboratory coat are required when using radioisotopes.
4. Prescribed personnel monitors must be worn.
5. Hands, shoes and clothing should be frequently monitored.
6. Work with radioactive materials in an approved hood or glove box, unless the safety of working on an open bench can be demonstrated.
7. Radioisotope work should be conducted in an impervious tray or pan, lined with absorbent paper.
8. Utilize shielding and distance whenever possible.
9. Dispose of liquid and solid radioactive waste in the approved containers provided.
10. Refrigerators containing isotopes shall not be used for storing food.
11. Monitor radioisotope work areas at least once daily for contamination and make notation of this survey in laboratory records.
12. Thoroughly wash hands after manipulating isotopes, before eating or smoking, and on completion or work.
13. Maintain records of receipt, use, transfer and disposal of radioactive materials.
14. Report accidental inhalation, ingestion, injury or spills to your supervisor and the Radiation Safety Office.
15. Review pertinent safety practices frequently, especially before using a new radionuclide.
16. Assure compliance with NIH Radiation Safety Guide and Title 10, Code of Federal Regulations, Part 20.
17. Wear personnel monitoring devices at all times.
18. Confine radioactive solutions in covered containers plainly identified and labelled with name of compound, radionuclide, date, activity, and radiation level if applicable.
19. Always transport radioactive material in shielded containers.

THE AMERICAN UNIVERSITY RADIATION PROTECTION OFFICER IS PROFESSOR ROMEO SEGNAN. If you have any questions or need assistance, he may be contacted by calling Extension 2750 or 2745 (office) or 244-2070 (home).

NUCLEAR REGULATORY COMMISSION

RULES AND REGULATIONS

PART 20

PART 20

STANDARDS FOR PROTECTION AGAINST RADIATION

PART 20—STANDARDS FOR PROTECTION AGAINST RADIATION

GENERAL PROVISIONS

Sec.
20.1 Purpose.
20.2 Scope.
20.3 Definitions.
20.4 Units of radiation dose.
20.5 Units of radioactivity.
20.6 Interpretations.
20.7 Communications.

PERMISSIBLE DOSES, LEVELS AND CONCENTRATIONS

20.101 Radiation dose standards for individuals in restricted areas.
20.102 Determination of prior dose.
20.103 Exposure of individuals to concentrations of radioactive materials in air in restricted areas.
20.104 Exposure of minors.
20.105 Permissible levels of radiation in unrestricted areas.
20.106 Radioactivity in effluents to unrestricted areas.
20.107 Medical diagnosis and therapy.
20.108 Orders requiring furnishing of bioassay services.

PRECAUTIONARY PROCEDURES

20.201 Surveys.
20.202 Personnel monitoring.
20.203 Caution signs, labels, signals and controls.
20.204 Same; exceptions.
20.205 Procedures for picking up, receiving, and opening packages.
20.206 Instruction of personnel.
20.207 Storage and control of licensed materials in unrestricted areas.

WASTE DISPOSAL

20.301 General requirement.
20.302 Method for obtaining approval of proposed disposal procedures.
20.303 Disposal by release into sanitary sewerage systems.
20.305 Treatment or disposal by incineration.
20.306 Disposal of specific wastes.
20.311 Transfer for disposal and manifests.

RECORDS, REPORTS, AND NOTIFICATION

20.401 Records of surveys, radiation monitoring, and disposal.
20.402 Reports of theft or loss of licensed material.

Sec.
20.403 Notifications of incidents.
20.404 [Reserved]
20.405 Reports of overexposures and excessive levels and concentrations.
20.406 [Reserved]
20.407 Personnel monitoring reports.
20.408 Reports of personnel monitoring on termination of employment or work.
20.409 Notifications and reports to individuals.

EXCEPTIONS AND ADDITIONAL REQUIREMENTS

20.501 Applications for exemptions.
20.502 Additional requirements.

ENFORCEMENT

20.601 Violations.

APPENDIX A—[Reserved]
APPENDIX B—CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND
APPENDIX C
APPENDIX D—UNITED STATES NUCLEAR REGULATORY COMMISSION, INSPECTION AND ENFORCEMENT REGIONAL OFFICES

Authority: Secs. 53, 63, 65, 81, 103, 104, 161, 68 Stat. 930, 933, 935, 936, 937, 948, as amended, (42 U.S.C. 2073, 2093, 2095, 2111, 2133, 2134, 2201); secs. 201, as amended, 202, 206, Pub. L. 93-438, 88 Stat. 1242, 1244, 1246, Pub. L. 94-79, 89 Stat. 413 (42 U.S.C. 5841, 5842, 5846).

For the purposes of sec. 223, 68 Stat. 958, as amended, (42 U.S.C. 2273), §§ 20.101, 20.102, 20.103(a) (b), and (f), 20.104 (a) and (b), 20.105(b), 20.106(a), 20.201, 20.202(a), 20.206, 20.207, 20.301, 20.303, 20.304 and 20.305 are issued under sec. 161b, 68 Stat. 948, as amended, (42 U.S.C. 2201(b)); and §§ 20.102, 20.103(a), 20.401–20.407, 20.408(b) and 20.420 are issued under sec. 161o, 68 Stat. 950, as amended, (42 U.S.C. 2201(o)).

GENERAL PROVISIONS

§ 20.1 Purpose.

(a) The regulations in this part establish standards for protection against radiation hazards arising out of activities under licenses issued by the Nuclear Regulatory Commission and are issued pursuant to the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974.

(b) The use of radioactive material or other sources of radiation not licensed by the Commission is not subject to the regulations in this part. However, it is the purpose of the regulations in this part to control the possession, use, and transfer of licensed material by any licensee in such a manner that the total dose to an individual (including exposures to licensed and unlicensed radioactive material and to other unlicensed sources of radiation, whether in the possession of the licensee or any other person, but not including exposures to radiation from natural background sources or medical diagnosis and therapy) does not exceed the standards of radiation protection prescribed in the regulations in this part.

(c) In accordance with recommendations of the Federal Radiation Council, approved by the President, persons engaged in activities under licenses issued by the Nuclear Regulatory Commission pursuant to the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974 should, in addition to complying with the requirements set forth in this part, make every reasonable effort to maintain radiation exposures, and releases of radioactive materials in effluents to unrestricted areas, as low as is reasonably achievable. The term "as low as is reasonably achievable" means as low as is reasonably achievable taking into account the state of technology, and the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to the utilization of atomic energy in the public interest.

§ 20.2 Scope.

The regulations in this part apply to all persons who receive, possess, use, or transfer material licensed pursuant to the regulations in Parts 30 through 35,40,60,61,70,or72 of this chapter, including persons licensed to operate a production or utilization facility pursuant to Part 50 of this chapter and persons licensed to possess power reactor spent fuel in an independent spent fuel storage installation (ISFSI) purusant to Part 72 of this chapter.

§ 20.3

§ 20.3 Definitions.

(a) As used in this part:

(1) "Act" means the Atomic Energy Act of 1954 (68 Stat. 919) including any amendments thereto.

(2) "Airborne radioactive material" means any radioactive material dispersed in the air in the form of dusts, fumes, mists, vapors, or gases.

(3) "Byproduct material" means any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material.

(4) "Calendar quarter" means not less than 12 consecutive weeks nor more than 14 consecutive weeks. The first calendar quarter of each year shall begin in January and subsequent calendar quarters shall be such that no day is included in more than one calendar quarter or omitted from inclusion within a calendar quarter. No licensee shall change the method observed by him of determining calendar quarters except at the beginning of a calendar year.

40 FR 8774
41 FR 51446
40 FR 8774
40 FR 42387
40 FR 50487
34 FR 23333

(3) A dose of 0.1 rad due to neutrons or high energy protons.

(4) A dose of 0.05 rad due to particles heavier than protons and with sufficient energy to reach the lens of the eye. If it is more convenient to measure the neutron flux, or equivalent, than to determine the neutron dose in rads, as provided in paragraph (c)(3) of this section, one rem of neutron radiation may, for purposes of the regulations in this part, be assumed to be equivalent to 14 million neutrons per square centimeter incident upon the body; or, if there exists sufficient information to estimate with reasonable accuracy the approximate distribution in energy of the neutrons, the incident number of neutrons per square centimeter equivalent to one rem may be estimated from the following table:

[35 F.R. 15914]

NEUTRON FLUX DOSE EQUIVALENTS

Neutron energy (Mev)	Number of neutrons per square centimeter equivalent to a dose of 1 rem (neutrons/cm²)	Average flux to deliver 100 millirem in 40 hours (neutrons cm⁻² sec⁻¹)
Thermal	970 × 10⁶	670
0.0001	720 × 10⁶	500
0.005	820 × 10⁶	570
0.02	400 × 10⁶	280
0.1	120 × 10⁶	80
0.5	43 × 10⁶	30
1.0	26 × 10⁶	18
2.5	29 × 10⁶	20
5.0	26 × 10⁶	18
7.5	24 × 10⁶	17
10	24 × 10⁶	17
10 to 30	14 × 10⁶	10

(d) For determining exposures to X or gamma rays up to 3 Mev, the dose limits specified in §§ 20.101 to 20.104, inclusive, may be assumed to be equivalent to the "air dose". For the purpose of this part "air dose" means that the dose is measured by a properly calibrated appropriate instrument in air at or near the body surface in the region of highest dosage rate.

[39 F.R. 30314]

§ 20.5 Units of radioactivity.

(a) Radioactivity is commonly, and for purposes of the regulations in this part shall be, measured in terms of disintegrations per unit time or in curies. One curie = 3.7×10^{10} disintegrations per second (dps) = 2.2×10^{12} disintegrations per minute (dpm). Commonly used submultiples of the curie are the millicurie and the microcurie:

(1) One millicurie (mCi) = 0.001 curie (Ci) = 3.7×10^{7} dps.

(2) One microcurie (μCi) = 0.000001 curie = 3.7×10^{4} dps.

(b) [Deleted 40 FR 50704.]

(c) [Deleted 39 FR 23990.]

§ 20.6 Interpretations.

Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

[25 F.R. 10914]

§ 20.7 Communications.

Except where otherwise specified in this part, all communications and reports concerning the regulations in this part should be addressed to the Executive Director for Operations, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555. Communications, reports, and applications may be delivered in person at the Commission's offices at 1717 H Street NW., Washington, D.C.; or at 7920 Norfolk Avenue, Bethesda, Maryland.

[40 F.R. 8374]

PERMISSIBLE DOSES, LEVELS, AND CONCENTRATIONS

§ 20.101 Radiation dose standards for individuals in restricted areas.

(a) In accordance with the provisions of § 20.102(a), and except as provided in paragraph (b) of this section, no licensee shall possess, use, or transfer licensed material in such a manner as to cause any individual in a restricted area to receive in any period of one calendar quarter from radioactive material and other sources of radiation a total occupational dose in excess of the standards specified in the following table:

[36 F.R. 1466]

[25 F.R. 10914]

REMS PER CALENDAR QUARTER

1. Whole body, head and trunk, active blood-forming organs, lens of eyes, or gonads	1¼
2. Hands and forearms, feet and ankles	18¾
3. Skin of whole body	7½

(b) A licensee may permit an individual in a restricted area to receive a total occupational dose to the whole body greater than that permitted under paragraph (a) of this section, provided:

[41 F.R. 12135]

(1) During any calendar quarter the total occupational dose to the whole body shall not exceed 3 rems; and

(2) The dose to the whole body, when added to the accumulated occupational dose to the whole body, shall not exceed 5 (N-18) rems where "N" equals the individual's age in years at his last birthday; and

[25 F.R. 10914]

(3) The licensee has determined the individual's accumulated occupational dose to the whole body on Form NRC-4, or on a clear and legible record containing all the information required in that form, and has otherwise complied with the requirements of § 20.102. As used in paragraph (b), "Dose to the whole body" shall be deemed to include any dose to the whole body, gonads, active blood-forming organs, head and trunk, or lens of eye.

§ 20.102 Determination of prior dose.

(a) Each licensee shall require any individual, prior to first entry of the individual into the licensee's restricted area during each employment or work assignment under such circumstances that the individual will receive or is likely to receive in any period of one calendar quarter an occupational dose in excess of 25 percent of the applicable standards specified in § 20.101(a) and § 20.104(a), to disclose in a written, signed statement, either: (1) That the individual had no prior occupational dose during the current calendar quarter, or (2) the nature and amount of any occupational dose which the individual may have received during that specifically identified current calendar quarter from sources of radiation possessed or controlled by other persons. Each licensee shall maintain records of such statements until the Commission authorizes their disposition.

[41 F.R. 12137]

(b) Before permitting, pursuant to § 20.101(b), any individual in a restricted area to receive an occupational radiation dose in excess of the standards specified in § 20.101(a), each licensee shall:

[25 F.R. 10914]

(1) Obtain a certificate on Form NRC-4, or on a clear and legible record containing all the information required in that form, signed by the individual showing each period of time after the individual attained the age of 18 in which the individual received an occupational dose of radiation; and

(2) Calculate on Form NRC-4 in accordance with the instructions appearing therein, or on a clear and legible record containing all the information required in that form, the previously accumulated occupational dose received by the individual and the additional dose allowed for that individual under § 20.101(b).

(c)(1) In the preparation of Form NRC-4, or a clear and legible record containing all the information required in that form, the licensee shall make a reasonable effort to obtain reports of the individual's previously accumulated occupational dose. For each period for which the licensee obtains

(1) The licensee selects respiratory protective equipment that provides a protection factor greater than the multiple by which peak concentrations of airborne radioactive materials in the working area are expected to exceed the values specified in Appendix B, Table I, Column 1 of this part. The equipment so selected shall be used so that the average concentration of radioactive material in the air that is inhaled during any period of uninterrupted use in an airborne radioactivity area, on any day, by any individual using the equipment, does not exceed the values specified in Appendix B, Table I, Column 1 of this part. For the purposes of this paragraph, the concentration of radioactive material in the air that is inhaled when respirators are worn may be estimated by dividing the ambient concentration in air by the protection factor specified in Appendix A of this part. If the exposure is later found to be greater than estimated, the corrected value shall be used; if the exposure is later found to be less than estimated, the corrected value may be used.

(2) The licensee maintains and implements a respiratory protection program that includes, as a minimum: air sampling sufficient to identify the hazard, permit proper equipment selection and estimate exposures; surveys and bioassays as appropriate to evaluate actual exposures; written procedures regarding selection, fitting, and maintenance of respirators, and testing of respirators for operability immediately prior to each use; written procedures regarding supervision and training of personnel and issuance records; and determination by a physician prior to initial use of respirators, and at least every 12 months thereafter, that the individual user is physically able to use the respiratory protective equipment.

(3) A written policy statement on respirator usage shall be issued covering such things as: use of practicable engineering controls instead of respirators; routine, nonroutine, and emergency use of respirators; and periods of respirator use and relief from respirator use. The licensee shall advise each respirator user that the user may leave the area at any time for relief from respirator use in the event of equipment malfunction, physical or psychological distress, procedural or communication failure, significant deterioration of operating conditions, or any other condition that might require such relief.

(4) The licensee uses equipment within limitations for type and mode of use and provides proper visual, communication, and other special capabilities (such as adequate skin protection) when needed.

(d) Unless otherwise authorized by the Commission, the licensee shall not assign protection factors in excess of those specified in Appendix A of this part in selecting and using respiratory protective equipment. The Commission may authorize a licensee to use higher protection factors on receipt of an application (1) describing the situation for which a need exists for higher protection factors, and (2) demonstrating that the respiratory protective equipment will provide these higher protection factors under the proposed conditions of use.

(e) Where equipment of a particular type has not been tested and certified, or had certification extended, by NIOSH/MSHA, or where there is no existing schedule for test and certification of certain equipment, the licensee shall not make allowance for this equipment without specific authorization by the Commission. An application for this authorization must include a demonstration by testing, or on the basis of reliable test information, that the material and performance characteristics of the equipment are capable of providing the proposed degree of protection under anticipated conditions of use.

(f) Only equipment that has been specifically certified or had certification extended for emergency use by NIOSH/MSHA shall be used as emergency devices.

(g) The licensee shall notify, in writing, the Director of the appropriate Nuclear Regulatory Commission Inspection and Enforcement Regional Office listed in Appendix D at least 30 days before the date that respiratory protective equipment is first used under the provisions of this section.

§ 20.104 Exposure of minors.

(a) No licensee shall possess, use, or transfer licensed material in such a manner as to cause any individual within a restricted area who is under 18 years of age, to receive in any period of one calendar quarter from radioactive material and other sources of radiation in the licensee's possession a dose in excess of 10 percent of the limits specified in the table in paragraph (a) of § 20.101.

(b) No licensee shall possess, use or transfer licensed material in such a manner as to cause any individual within a restricted area, who is under 18 years of age to be exposed to airborne radioactive material possessed by the licensee in an average concentration in excess of the limits specified in Appendix B, Table II of this part. For purposes of this paragraph, concentrations may be averaged over periods not greater than a week.

(c) The provisions of §§ 20.103(b)(2) and 20.103(c) shall apply to exposures subject to paragraph (b) of this section except that the references in §§ 20.103(b)(2) and 20.103(c) to Appendix B, Table I, Column 1 shall be deemed to be references to Appendix B, Table II, Column 1.

§ 20.105 Permissible levels of radiation in unrestricted areas.

(a) There may be included in any application for a license or for amendment of a license proposed limits upon levels of radiation in unrestricted areas resulting from the applicant's possession or use of radioactive material and other sources of radiation. Such applications should include information as to anticipated average radiation levels and anticipated occupancy times for each unrestricted area involved. The Commission will approve the proposed limits if the applicant demonstrates that the proposed limits are not likely to cause any individual to receive a dose to the whole body in any period of one calendar year in excess of 0.5 rem.

(b) Except as authorized by the Commission pursuant to paragraph (a) of this section, no licensee shall possess, use or transfer licensed material in such a manner as to create in any unrestricted area from radioactive material and other sources of radiation in his possession:

(1) 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

(2) Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of 100 millirems in any seven consecutive days.

(c) In addition to other requirements of this part, licensees engaged in uranium fuel cycle operations subject to the provisions of 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations," shall comply with that part.

§ 20.106 Radioactivity in effluents to unrestricted areas.

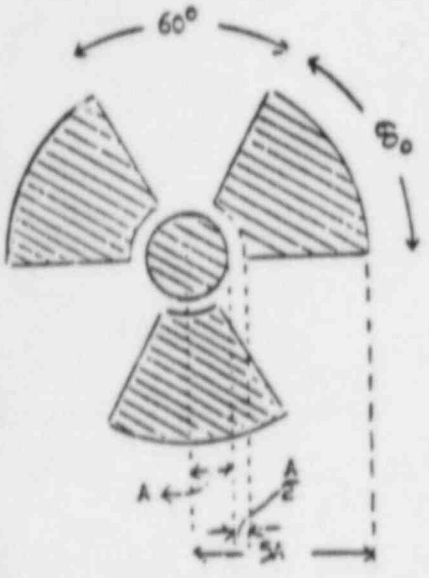
(a) A licensee shall not possess, use, or transfer licensed material so as to release to an unrestricted area radioactive material in concentrations which exceed the limits specified in Appendix B, Table II of this part, except as authorized pursuant to § 20.302 or paragraph (b) of this section. For purposes of this section concentrations may be averaged over a period not greater than one year.

§ 20.203 Caution signs, labels, signals and controls.

(a) *General.* (1) Except as otherwise authorized by the Commission, symbols prescribed by this section shall use the conventional radiation caution colors (magenta or purple on yellow background). The symbol prescribed by this section is the conventional three-bladed design:

RADIATION SYMBOL

1. Cross-hatched area is to be magenta or purple.
2. Background is to be yellow.



35 FR 5033

(2) In addition to the contents of signs and labels prescribed in this section, licensees may provide on or near such signs and labels any additional information which may be appropriate in aiding individuals to minimize exposure to radiation or to radioactive material.

(b) *Radiation areas.* Each radiation area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION [1]

RADIATION AREA

(c) *High radiation areas.* (1) Each high radiation area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION [1]

HIGH RADIATION AREA

[1] Or "Danger".

(2) Each entrance or access point to a high radiation area shall be:

(i) Equipped with a control device which shall cause the level of radiation to be reduced below that at which an individual might receive a dose of 100 millirems in 1 hour upon entry into the area; or

(ii) Equipped with a control device which shall energize a conspicuous visible or audible alarm signal in such a manner that the individual entering the high radiation area and the licensee or a supervisor of the activity are made aware of the entry; or

(iii) Maintained locked except during periods when access to the area is required, with positive control over each individual entry.

35 FR 5033

(3) The controls required by paragraph (c)(2) of this section shall be established in such a way that no individual will be prevented from leaving a high radiation area.

(4) In the case of a high radiation area established for a period of 30 days or less, direct surveillance to prevent unauthorized entry may be substituted for the controls required by paragraph (c)(2) of this section.

(5) Any licensee, or applicant for a license, may apply to the Commission for approval of methods not included in paragraphs (c)(2) and (4) of this section for controlling access to high radiation areas. The Commission will approve the proposed alternatives if the licensee or applicant demonstrates that the alternative methods of control will prevent unauthorized entry into a high radiation area, and that the requirement of paragraph (c)(3) of this section is met.

42 FR 6536

(6) Each area in which there may exist radiation levels in excess of 500 rems in one hour at one meter from a sealed radio-active source [1] that is used to irradiate materials shall: [2]

42 FR 7167

(i) Have each entrance or access point equipped with entry control devices which shall function automatically to prevent any individual from inadvertently entering the area when such radiation levels exist; permit deliberate entry into the area only after a control device is actuated that shall cause the radiation level within the area from the sealed source, to be reduced below that at which it would be possible for an individual to receive a dose in excess of 100 mrem in one hour, and prevent operation of the source if the source would produce radiation levels in the area that could result in a dose to an individual in excess of 100 mrem in one hour. The entry control devices required by this paragraph (c)(6) shall be established in such a way that no individual will be prevented from leaving the area.

42 FR 64619

(ii) Be equipped with additional control devices such that upon failure of the entry control devices to function as required by paragraph (c)(6)(i) of this section the radiation level within the area, from the sealed source, shall be reduced below that at which it would be possible for an individual to receive a dose in excess of 100 mrem in one hour, and visible and audible alarm signals shall be generated to make an individual attempting to enter the area aware of the hazard and the licensee or at least one other individual, who is familiar with the activity and prepared to render or summon assistance, aware of such failure of the entry control devices.

(iii) Be equipped with control devices such that upon failure or removal of physical radiation barriers other than the source's shielded storage container the radiation level from the source shall be reduced below that at which it would be possible for an individual to receive a dose in excess of 100 mrem in one hour, and visible and audible alarm signals shall be generated to make potentially affected individuals aware of the hazard and the licensee or at least one other individual, who is familiar with the activity and prepared to render or summon assistance, aware of the failure or removal of the physical barrier. When the shield for the stored source is a liquid, means shall be provided to monitor the integrity of the shield and to signal, automatically, loss of adequate shielding. Physical radiation barriers that com-

[1] This paragraph (c)(6) does not apply to radioactive sources that are used in teletherapy, in radiography, or in completely self-shielded irradiators in which the source is both stored and operated within the same shielding radiation barrier and, in the designed configuration of the irradiator, is always physically inaccessible to any individual and cannot create high levels of radiation in an area that is accessible to any individual. This paragraph (c)(6) also does not apply to sources from which the radiation is incidental to some other use nor to nuclear reactor generated radiation other than radiation from byproduct, source, or special nuclear materials that are used in sealed sources in non-self-shielded irradiators.

[2] These requirements apply after Mar. 14, 1978. Each person licensed to conduct activities to which this paragraph (c)(6) applies and who is not in compliance with the provisions of this paragraph on Mar. 14, 1978, shall file with the Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, on or before June 14, 1978, information describing in detail the actions taken or to be taken to achieve compliance with this paragraph by Dec. 14, 1978, and may continue activities in conformance with present license conditions and the provisions of the previously effective § 20.203 until such compliance is achieved. For such persons compliance must be achieved not later than Dec. 14, 1978.

(4) Each licensee shall, prior to disposal of an empty uncontaminated container to unrestricted areas, remove or deface the radioactive material label or otherwise clearly indicate that the container no longer contains radioactive materials. [43 FR 1271]

§ 20.204 Same: exceptions. [35 FR 15984]

Notwithstanding the provisions of § 20.203,

(a) A room or area is not required to be posted with a caution sign because of the presence of a sealed source provided the radiation level twelve inches from the surface of the source container or housing does not exceed five millirem per hour.

(b) Rooms or other areas in hospitals are not required to be posted with caution signs, and control of entrance or access thereto pursuant to § 20.203(c) is not required, because of the presence of patients containing byproduct material provided that there are personnel in attendance who will take the precautions necessary to prevent the exposure of any individual to radiation or radioactive material in excess of the limits established in the regulations in this part. [36 FR 5033]

(c) Caution signs are not required to be posted at areas or rooms containing radioactive materials for periods of less than eight hours provided that (1) the materials are constantly attended during such periods by an individual who shall take the precautions necessary to prevent the exposure of any individual to radiation or radioactive materials in excess of the limits established in the regulations in this part and, (2) such area or room is subject to the licensee's control. [35 FR 15984]

(d) A room or other area is not required to be posted with a caution sign, and control is not required for each entrance or access point to a room or other area which is a high radiation area solely because of the presence of radioactive materials prepared for transport and packaged and labeled in accordance with regulations of the Department of Transportation. [36 FR 5033]

§ 20.205 Procedures for picking up, receiving and opening packages. [39 FR 17972]

(a)(1) Each licensee who expects to receive a package containing quantities of radioactive material in excess of the Type A quantities specified in paragraph (b) of this section shall:

(i) If the package is to be delivered to the licensee's facility by the carrier, make arrangements to receive the package when it is offered for delivery by the carrier; or

(ii) If the package is to be picked up by the licensee at the carrier's terminal, make arrangements to receive notification from the carrier of the arrival of the package, at the time of arrival.

(2) Each licensee who picks up a package of radioactive material from a carrier's terminal shall pick up the package expeditiously upon receipt of notification from the carrier of its arrival.

(b)(1) Each licensee, upon receipt of a package of radioactive material, shall monitor the external surfaces of the package for radioactive contamination caused by leakage of the radioactive contents, except:

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

(ii) Packages containing no more than 10 millicuries of radioactive material consisting solely of tritium, carbon-14, sulfur-35, or iodine-125;

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

(iv) Packages containing only radioactive material in other than liquid form (including Mo-99/Tc-99m generators) and not exceeding the Type A quantity limit specified in the table in this paragraph; and

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

The monitoring shall be performed as soon as practicable after receipt, but no later than three hours after the package is received at the licensee's facility if received during the licensee's normal working hours, or eighteen hours if received after normal working hours. [39 FR 17972]

(2) If removable radioactive contamination in excess of 0.01 microcuries (22,000 disintegrations per minute) per 100 square centimeters of package surface is found on the external surfaces of the package, the licensee shall immediately notify[1] the final delivering carrier and, by telephone and telegraph, mailgram or facsimile, the appropriate Nuclear Regulatory Commission Inspection and Enforcement Regional Office shown in Appendix D of this part. [41 FR 16445]

[1]For example, containers in locations such as water-filled canals, storage vaults, or hot cells.

TABLE OF EXEMPT AND TYPE A QUANTITIES

Transport group[1]	Exempt quantity, curies or microcuries	Type A quantity, curies or curies
I	0.1	0.001
II	0.1	0.05
III	1	3
IV	1	20
V	1	20
VI	1	1000
VII	25,000	1000
Special Form	1	20

[1]The definitions of "transport group" and "special form" are specified in § 71.4 of this chapter.

[1]The reporting requirements in § 20.205 have been approved by OMB under number B-180225 (R0054).

(c)(1) Each licensee, upon receipt of a package containing quantities of radioactive material in excess of the Type A quantities specified in paragraph (b) of this section, other than those transported by exclusive use vehicle, shall monitor the radiation levels external to the package. The package shall be monitored as soon as practicable after receipt, but no later than three hours after the package is received at the licensee's facility if received during the licensee's normal working hours, or 18 hours if received after normal working hours.

(2) If radiation levels are found on the external surface of the package in excess of 200 millirem per hour, or at three feet from the external surface of the package in excess of 10 millirem per hour,

the licensee shall immediately notify by telephone and telegraph, mailgram, or facsimile, the director of the appropriate NRC Regional Office listed in Appendix D, and the final delivering carrier. [39 FR 17972; 41 FR 16445]

(d) Each licensee shall establish and maintain procedures for safely opening packages in which licensed material is received, and shall assure that such procedures are followed and that due consideration is given to special instructions for the type of package being opened. [39 FR 17972]

§ 20.206 Instruction of personnel. [47 FR 22320]

Instructions required for individuals working in, or frequenting any portion, of a restricted area are specified in § 19.12 of this chapter.

§ 20.207 Storage and control of licensed materials in unrestricted areas. [40 FR 23679]

(a) Licensed materials stored in an unrestricted area shall be secured from unauthorized removal from the place of storage.

(b) Licensed materials in an unrestricted area and not in storage shall be

Environmental Protection Agency regulations or requirements of the receiver, provided all the required information is included. Copies of manifests required by this section may be legible carbon copies or legible photocopies.

(c) Each manifest must include a certification by the waste generator that the transported materials are properly classified, described, packaged, marked, and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation and the Commission. An authorized representative of the waste generator shall sign and date the manifest.

(d) Any generating licensee who transfers radioactive waste to a land disposal facility or a licensed waste collector shall comply with the requirements in paragraphs (d)(1) through (8) of this section. Any generating licensee who transfers waste to a licensed waste processor who treats or repackages waste shall comply with the requirements of paragraphs (d)(4) through (8) of this section. A licensee shall:

(1) Prepare all wastes so that the waste is classified according to § 61.55 and meets the waste characteristics requirements in § 61.56 of this chapter;

(2) Label each package of waste to identify whether it is Class A waste, Class B waste, or Class C waste, in accordance with § 61.55 of this chapter;

(3) Conduct a quality control program to assure compliance with §§ 61.55 and 61.56 of this chapter; the program must include management evaluation of audits;

(4) Prepare shipping manifests to meet the requirements of §§ 30.311 (b) and (c) of this part;

(5) Forward a copy of the manifest to the intended recipient, at the time of shipment; or, deliver to a collector at the time the waste is collected, obtaining acknowledgement of receipt in the form of a signed copy of the manifest or equivalent documentation from the collector;

(6) Include one copy of the manifest with the shipment;

(7) Retain a copy of the manifest and documentation of acknowledgement of receipt as the record of transfer of licensed material as required by Parts 30, 40, and 70 of this chapter; and,

(8) For any shipments or any part of a shipment for which acknowledgement of receipt has not been received within the times set forth in this section, conduct an investigation in accordance with paragraph (h) of this section.

(e) Any waste collector licensee who handles only prepackaged waste shall:

(1) Acknowledge receipt of the waste from the generator within one week of receipt by returning a signed copy of the manifest or equivalent documentation;

(2) Prepare a new manifest to reflect consolidated shipments; the new manifest shall serve as a listing or index for the detailed generator manifests. Copies of the generator manifests shall be a part of the new manifest. The waste collector may prepare a new manifest without attaching the generator manifests, provided the new manifest contains for each package the information specified in paragraph (b) of this section. The collector licensee shall certify that nothing has been done to the waste which would invalidate the generator's certification;

(3) Forward a copy of the new manifest to the land disposal facility operator at the time of shipment;

(4) Include the new manifest with the shipment to the disposal site;

(5) Retain a copy of the manifest and documentation of acknowledgement of receipt as the record of transfer of licensed material as required by Parts 30, 40, and 70 of this chapter, and retain information from generator manifests until disposition is authorized by the Commission; and,

(6) For any shipments or any part of a shipment for which acknowledgement of receipt is not received within the times set forth in this section, conduct an investigation in accordance with paragraph (h) of this section.

(f) Any licensed waste processor who treats or repackages wastes shall:

(1) Acknowledge receipt of the waste from the generator within one week of receipt by returning a signed copy of the manifest or equivalent documentation;

(2) Prepare a new manifest that meets the requirements of paragraphs (b) and (c) of this section. Preparation of the new manifest reflects that the processor is responsible for the waste;

(3) Prepare all wastes so that the waste is classified according to § 61.55 and meets the waste characteristics requirements in § 61.56 of this chapter;

(4) Label each package of waste to identify whether it is Class A waste, Class B waste, or Class C waste, in accordance with §§ 61.56 and 61.57 of this chapter;

(5) Conduct a quality control program to assure compliance with §§ 61.55 and 61.56 of this chapter. The program shall include management evaluation of audits;

(6) Forward a copy of the new manifest to the disposal site operator or waste collector at the time of shipment, or deliver to a collector at the time the waste is collected, obtaining acknowledgement of receipt in the form of a signed copy of the manifest or equivalent documentation by the collector;

(7) Include the new manifest with the shipment;

(8) Retain copies of original manifests and new manifests and documentation of acknowledgement of receipt as the record of transfer of licensed material required by Parts 30, 40, and 70 of this chapter; and

(9) For any shipment or part of a shipment for which acknowledgement is not received within the times set forth in this section, conduct an investigation in accordance with paragraph (h) of this section.

(g) The land disposal facility operator shall:

(1) Acknowledge receipt of the waste within one week of receipt by returning a signed copy of the manifest or equivalent documentation to the shipper. The shipper to be notified is the licensee who last possessed the waste and transferred the waste to the operator. The returned copy of the manifest or equivalent documentation shall indicate any discrepancies between materials listed on the manifest and materials received;

(2) Maintain copies of all completed manifests or equivalent documentation until the Commission authorizes their disposition; and

(3) Notify the shipper (i.e., the generator, the collector, or processor) and the Director of the nearest Commission Regional Office listed in Appendix D of this part when any shipment or part of a shipment has not arrived within 60 days after the advance manifest was received.

(h) Any shipment or part of a shipment for which acknowledgement is not received within the times set forth in this section, must:

(1) Be investigated by the shipper if the shipper has not received notification of receipt within 20 days after transfer; and

(2) Be traced and reported. The investigation shall include tracing the shipment and filing a report with the nearest Commission Regional Office listed in Appendix D of this part. Each licensee who conducts a trace investigation shall file a written report with the nearest Commission's Regional office within 2 weeks of completion of the investigation.

(3) Records of disposal of licensed materials made pursuant to §§ 20.302, 20.303, removed § 20.304,[1] and Part 61 of this chapter are to be maintained until the Commission authorizes their disposition.

(4) Records which must be maintained pursuant to this part may be the original or a reproduced copy or microform if such reproduced copy or microform is duly authenticated by authorized personnel and the microform is capable of producing a clear and legible copy after storage for the period specified by Commission regulations.

(5) If there is a conflict between the Commission's regulations in this part, license condition, or technical specification, or other written Commission approval or authorization pertaining to the retention period for the same type of record, the retention period specified in the regulations in this part for such records shall apply unless the Commission pursuant to § 20.501, has granted a specific exemption from the record retention requirements specified in the regulations in this part.

§ 20.402 Reports of theft or loss of licensed material.

(a)(1) Each licensee shall report to the Commission, by telephone, immediately after it determines that a loss or theft of licensed material has occurred in such quantities and under such circumstances that it appears to the licensee that a substantial hazard may result to persons in unrestricted areas.

(2) Reports must be made as follows:

(i) Licensees having an installed Emergency Notification System shall make the reports to the NRC Operations Center in accordance with § 50.72 of this chapter.

(ii) All other licensees shall make reports to the Administrator of the appropriate NRC Regional Office listed in Appendix D of this part.

(b) Each licensee who makes a report under paragraph (a) of this section shall, withing 30 days after learning of the loss or theft, make a report in writing to the U.S. Nuclear Regulatory Commission, Document Control Desk, Washington, D.C. 20555, with a copy to the appropriate NRC Regional Office listed in Appendix D of this part. The report shall include the following information:

(1) A description of the licensed material involved, including kind, quantity, chemical, and physical form;

(2) A description of the circumstances under which the loss or theft occurred;

(3) A statement of disposition or probable disposition of the licensed material involved;

(4) Radiation exposures to individuals, circumstances under which the exposures occurred, and the extent of possible hazard to persons in unrestricted areas;

(5) Actions which have been taken, or will be taken, to recover the material; and

(6) Procedures or measures which have been or will be adopted to prevent a recurrence of the loss or theft of licensed material.

(c) Subsequent to filing the written report the licensee shall also report any substantive additional information on the loss or theft which becomes available to the licensee, within 30 days after he learns of such information.

(d) Any report filed with the Commission pursuant to this section shall be so prepared that names of individuals who may have received exposure to radiation are stated in a separate part of the report.

(e) For holders of an operating license for a nuclear power plant, the events included in paragraph (b) of this section must be reported in accordance with the procedures described in § 50.73 (b), (c), (d), (e), and (g) of this chapter and must include the information required in paragraph (b) of this section. Events reported in accordance with § 50.73 of this chapter need not be reported by a duplicate report under paragraph (b) of this section.

§ 20.403 Notifications of incidents.

(a) *Immediate notification.* Each licensee shall immediately report any events involving byproduct, source, or special nuclear material possessed by the licensee that may have caused or threatens to cause:

(1) Exposure of the whole body of any individual to 25 rems or more of radiation, exposure of the skin of the whole body of any individual of 150 rems or more or radiation, or exposure of the feet, ankles, hands or forearms of any individual to 375 rems or more of radiation; or

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 5,000 times the limits specified for such materials in Appendix B, Table II of this part; or

(3) A loss of one working week or more of the operation of any facilities affected; or

(4) Damage to property in excess of $200,000.

(b) *Twenty-four hour notification.* Each licensee shall within 24 hours of discovery of the event, report any event involving licensed material possessed by the licensee that may have caused or threatens to cause:

(1) Exposure of the whole body of any individual to 5 rems or more of radiation, exposure of the skin of the whole body of any individual to 30 rems or more of radiation, or exposure of the feet, ankles, hands, or forearms to 75 rems or more of radiation; or

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 500 times the limits specified for such materials in Appendix B, Table II of this part; or

(3) A loss of one day or more of the operation of any facilities affected; or

(4) Damage to property in excess of $2,000.

(c) Any report filed with the Commission pursuant to this section shall be prepared so that names of individuals who have received exposure to radiation will be stated in a separate part of the report.

(d) Reports made by licensees in response to the requirements of this section must be made as follows:

(1) Licensees that have an installed Emergency Notification System shall make the reports required by paragraphs (a) and (b) of this section to the NRC Operations Center in accordance with § 50.72 of this chapter.

(2) All other licensees shall make the reports required by paragraphs (a) and (b) of this section by telephone and by telegram, mailgram, or facsimile to the Administrator of the appropriate NRC Regional Office listed in Appendix D of this part.

§ 20.404 [Reserved]

§ 20.405 Reports of overexposures and excessive levels and concentrations.

(a)(1) In addition to any notification required by § 20.403 of this part, each licensee shall make a report in writing concerning any one of the following types of incidents within 30 days of its occurrence:

(i) Each exposure of an individual to radiation in excess of the applicable limits in §§ 20.101 or 20.104(a) of this part, or the license;

(ii) Each exposure of an individual to radioactive material in excess of the applicable limits in §§ 20.103(a)(1), 20.103(a)(2), or 20.104(b) of this part, or in the license;

Radionuclide[1]	Quantity in curies
Cesium-137	1
Cobalt-60	1
Gold-198	100
Iodine-131	1
Iridium-192	10
Krypton-85	1,000
Promethium-147	10
Technetium-99m	1,000

[1]The Commission may require as a license condition or by rule, regulation or order pursuant to § 20.502 reports from licensees who are licensed to use radionuclides not on this list, in quantities sufficient to cause comparable radiation levels.

(7) Receive radioactive waste from other persons for disposal under Part 61 of this chapter.

(b) When an individual terminates employment with a licensee described in paragraph (a) of this section, or an individual assigned to work in such a licensee's facility but not employed by the licensee, completes the work assignment in the licensee's facility, the licensee shall furnish to the Director of Management and Program Analysis, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, a report of the individual's exposures to radiation and radioactive material, incurred during the period of employment or work assignment in the licensee's facility, containing information recorded by the licensee pursuant to §§ 20.401(a) and 20.108. Such report shall be furnished within 30 days after the exposure of the individual has been determined by the licensee or 90 days after the date of termination of employment or work assignment, whichever is earlier.

[1]The Commission will evaluate the data obtained for 1978 and 1979 pursuant to this paragraph, and the benefits derived therefrom and may take action, including publication of notice of proposed rulemaking, to extend or otherwise modify this reporting requirement.

§ 20.409 Notifications and reports to individuals.

(a) Requirements for notifications and reports to individuals of exposure to radiation or radioactive material are specified in § 19.13 of this chapter.

(b) When a licensee is required pursuant to §§ 20.405 or 20.408 to report to the Commission any exposure of an individual to radiation or radioactive material, the licensee shall also notify the individual. Such notice shall be transmitted at a time not later than the transmittal to the Commission, and shall comply with the provisions of § 19.13(a) of this chapter.

Exceptions and Additional Requirements

§ 20.501 Applications for exemptions.

The Commission may, upon application by any licensee or upon its own initiative, grant such exemptions from the requirements of the regulations in this part as it determines are authorized by law and will not result in undue hazard to life or property.

§ 20.502 Additional requirements.

The Commission may, by rule, regulation, or order, impose upon any licensee such requirements, in addition to those established in the regulations in this part, as it deems appropriate or necessary to protect health or to minimize danger to life or property.

Enforcement

§ 20.601 Violations.

An injunction or other court order may be obtained prohibiting any violation of any provision of the Atomic Energy Act of 1954, as amended, or Title II of the Energy Reorganization Act of 1974, or any regulation or order issued thereunder. A court order may be obtained for the payment of a civil penalty imposed pursuant to section 234 of the Act for violation of section 53, 57, 62, 63, 81, 82, 101, 103, 104, 107, or 109 of the Act, or section 206 of the Energy Reorganization Act of 1974, or any rule, regulation, or order issued thereunder, or any term, condition, or limitation of any license issued thereunder, or for any violation for which a license may be revoked under section 186 of the Act. Any person who willfully violates any provision of the Act or any regulation or order issued thereunder may be guilty of a crime and, upon conviction, may be punished by fine or imprisonment or both, as provided by law.

Note: The reporting and record keeping requirements contained in this part have been approved by the General Accounting Office under B-180225 (R0043), (R0044), and (R0084).

25 F.R. 10914

APPENDIX B

Concentrations in Air and Water Above Natural Background

[See notes at end of appendix]

Element (atomic number)	Isotope [1]		Table I		Table II	
			Column 1	Column 2	Column 1	Column 2
		†	Air (μCi/ml)	Water (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)
Actinium (89)	Ac 227	S	2×10^{-12}	6×10^{-8}	8×10^{-14}	3×10^{-9}
		I	3×10^{-11}	9×10^{-8}	9×10^{-13}	3×10^{-9}
	Ac 228	S	8×10^{-9}	3×10^{-7}	3×10^{-9}	9×10^{-8}
		I	2×10^{-8}	3×10^{-7}	6×10^{-10}	9×10^{-8}
Americium (95)	Am 241	S	6×10^{-12}	1×10^{-8}	2×10^{-13}	4×10^{-9}
		● I	1×10^{-10}	8×10^{-8}	4×10^{-12}	2×10^{-8}
	Am 242m	S	6×10^{-12}	1×10^{-8}	2×10^{-13}	4×10^{-9}
		I	3×10^{-10}	3×10^{-7}	9×10^{-12}	9×10^{-8}
	Am 243	S	4×10^{-9}	4×10^{-7}	1×10^{-9}	1×10^{-7}
		I	5×10^{-9}	4×10^{-7}	2×10^{-9}	1×10^{-7}
	Am 243	S	6×10^{-12}	1×10^{-8}	2×10^{-13}	4×10^{-9}
		I	1×10^{-10}	8×10^{-8}	4×10^{-12}	3×10^{-8}
	Am 244	S	4×10^{-9}	1×10^{-7}	1×10^{-9}	5×10^{-8}
		I	2×10^{-7}	1×10^{-7}	8×10^{-9}	5×10^{-8}
Antimony (51)	Sb 122	S	2×10^{-7}	8×10^{-8}	6×10^{-9}	3×10^{-8}
		I	1×10^{-7}	8×10^{-8}	5×10^{-9}	3×10^{-8}
	Sb 124	S	2×10^{-7}	7×10^{-8}	5×10^{-9}	2×10^{-8}
		I	2×10^{-8}	7×10^{-8}	7×10^{-10}	2×10^{-8}
	Sb 125	S	3×10^{-7}	3×10^{-7}	2×10^{-8}	1×10^{-7}
		I	3×10^{-8}	3×10^{-7}	9×10^{-10}	1×10^{-7}
Argon (18)	A 37	Sub[2]	6×10^{-3}	..	1×10^{-6}	
	A 41	Sub	2×10^{-8}	..	4×10^{-9}	
Arsenic (33)	As 73	S	2×10^{-6}	1×10^{-7}	7×10^{-8}	5×10^{-8}
		I	4×10^{-7}	1×10^{-7}	1×10^{-8}	5×10^{-8}
	As 74	S	3×10^{-7}	2×10^{-7}	1×10^{-8}	5×10^{-8}
		I	1×10^{-7}	2×10^{-7}	4×10^{-9}	5×10^{-8}
	As 76	S	1×10^{-7}	6×10^{-8}	4×10^{-9}	2×10^{-8}
		I	1×10^{-7}	6×10^{-8}	3×10^{-9}	2×10^{-8}
	As 77	S	3×10^{-7}	2×10^{-7}	2×10^{-8}	8×10^{-8}
		I	4×10^{-7}	2×10^{-7}	1×10^{-8}	8×10^{-8}
Astatine (85)	At 211	S	7×10^{-9}	5×10^{-7}	3×10^{-10}	2×10^{-8}
		I	3×10^{-8}	2×10^{-7}	1×10^{-9}	7×10^{-8}
Barium (56)	Ba 131	S	1×10^{-6}	5×10^{-7}	4×10^{-8}	2×10^{-8}
		I	4×10^{-7}	5×10^{-7}	1×10^{-8}	2×10^{-8}
	Ba 140	S	1×10^{-7}	8×10^{-8}	4×10^{-9}	3×10^{-8}
		I	4×10^{-8}	7×10^{-8}	1×10^{-9}	3×10^{-8}
Berkelium (97)	Bk 249	S	9×10^{-10}	2×10^{-7}	3×10^{-11}	6×10^{-8}
		I	1×10^{-7}	2×10^{-7}	4×10^{-9}	6×10^{-8}
	Bk 250	S	1×10^{-7}	6×10^{-7}	5×10^{-9}	2×10^{-8}
		I	1×10^{-6}	6×10^{-7}	4×10^{-8}	2×10^{-8}
Beryllium (4)	Be 7	S	6×10^{-6}	5×10^{-7}	2×10^{-7}	2×10^{-8}
		I	1×10^{-6}	5×10^{-7}	4×10^{-8}	2×10^{-8}
Bismuth (83)	Bi 206	S	2×10^{-7}	1×10^{-7}	6×10^{-10}	4×10^{-8}
		I	1×10^{-7}	1×10^{-7}	5×10^{-9}	4×10^{-8}
	Bi 207	S	2×10^{-7}	2×10^{-7}	6×10^{-10}	6×10^{-8}
		I	1×10^{-6}	2×10^{-7}	5×10^{-10}	6×10^{-8}
	Bi 210	S	6×10^{-9}	1×10^{-7}	2×10^{-10}	4×10^{-8}
		I	6×10^{-9}	1×10^{-7}	2×10^{-10}	4×10^{-8}
	Bi 212	S	1×10^{-7}	1×10^{-7}	3×10^{-9}	5×10^{-8}
		I	2×10^{-7}	1×10^{-7}	7×10^{-9}	4×10^{-8}

25 FR 10914

APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

(See notes at end of appendix)

Element (atomic number)	Isotope [1]		Table I		Table II	
			Column 1	Column 2	Column 1	Column 2
		†	Air (μCi/ml)	Water (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)
Cobalt (27)	Co 57	S	3×10^{-6}	2×10^{-3}	1×10^{-7}	8×10^{-5}
		I	2×10^{-7}	1×10^{-7}	6×10^{-9}	4×10^{-6}
	Co 58m	S	2×10^{-5}	8×10^{-5}	6×10^{-7}	3×10^{-3}
		I	9×10^{-6}	6×10^{-5}	3×10^{-7}	2×10^{-3}
	Co 58	S	8×10^{-7}	4×10^{-5}	3×10^{-8}	1×10^{-3}
		I	8×10^{-9}	3×10^{-5}	3×10^{-9}	9×10^{-4}
	Co 60	S	3×10^{-7}	1×10^{-5}	1×10^{-8}	5×10^{-4}
		I	9×10^{-9}	1×10^{-5}	3×10^{-10}	3×10^{-4}
Copper (29)	Cu 64	S	2×10^{-6}	1×10^{-5}	7×10^{-8}	3×10^{-4}
		I	1×10^{-6}	6×10^{-5}	4×10^{-8}	2×10^{-3}
Curium (96)	Cm 242	S	1×10^{-10}	7×10^{-4}	4×10^{-12}	3×10^{-2}
		W	2×10^{-10}	7×10^{-4}	6×10^{-12}	2×10^{-2}
	Cm 243	S	6×10^{-11}	1×10^{-4}	2×10^{-12}	5×10^{-3}
		I	1×10^{-10}	7×10^{-4}	3×10^{-12}	2×10^{-2}
	Cm 244	S	9×10^{-11}	2×10^{-4}	3×10^{-12}	7×10^{-3}
		I	1×10^{-10}	8×10^{-4}	3×10^{-12}	3×10^{-2}
	Cm 245	S	3×10^{-11}	1×10^{-4}	2×10^{-12}	4×10^{-3}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-2}
	Cm 246	S	5×10^{-11}	1×10^{-4}	2×10^{-12}	4×10^{-3}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-2}
	Cm 247	S	3×10^{-11}	1×10^{-4}	2×10^{-12}	4×10^{-3}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-2}
	Cm 248	S	6×10^{-12}	1×10^{-5}	2×10^{-13}	4×10^{-4}
		I	1×10^{-11}	4×10^{-5}	4×10^{-13}	1×10^{-3}
	Cm 249	S	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-1}
		I	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-1}
Dysprosium (66)	Dy 165	S	3×10^{-6}	1×10^{-3}	9×10^{-8}	4×10^{-2}
		I	2×10^{-6}	1×10^{-3}	7×10^{-8}	4×10^{-2}
	Dy 166	S	3×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-2}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-2}
Einsteinium (99)	Es 253	S	8×10^{-10}	7×10^{-4}	3×10^{-11}	2×10^{-2}
		I	6×10^{-10}	7×10^{-4}	2×10^{-11}	2×10^{-2}
	Es 254m	S	2×10^{-7}	3×10^{-5}	2×10^{-9}	9×10^{-4}
		I	6×10^{-9}	3×10^{-5}	2×10^{-10}	9×10^{-4}
	Es 254	S	2×10^{-11}	4×10^{-5}	6×10^{-13}	1×10^{-3}
		I	1×10^{-10}	4×10^{-5}	4×10^{-12}	1×10^{-3}
	Es 255	S	5×10^{-10}	8×10^{-5}	2×10^{-11}	3×10^{-3}
		I	4×10^{-10}	8×10^{-5}	1×10^{-11}	3×10^{-3}
Erbium (68)	Er 169	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-2}
		I	4×10^{-7}	3×10^{-3}	1×10^{-8}	9×10^{-2}
	Er 171	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-2}
		I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-2}
Europium (63)	Eu 152 (T/2 = 9.2 hrs)	S	4×10^{-7}	3×10^{-3}	1×10^{-8}	6×10^{-2}
		I	3×10^{-7}	3×10^{-3}	1×10^{-8}	6×10^{-2}
	Eu 152 (T/2 = 13 yrs)	S	1×10^{-9}	3×10^{-3}	4×10^{-11}	8×10^{-2}
		I	2×10^{-9}	3×10^{-3}	6×10^{-11}	8×10^{-2}
	Eu 154	S	4×10^{-9}	6×10^{-4}	1×10^{-10}	3×10^{-2}
		I	7×10^{-9}	6×10^{-4}	2×10^{-10}	2×10^{-2}
	Eu 155	S	9×10^{-8}	6×10^{-3}	3×10^{-9}	2×10^{-1}
		I	7×10^{-8}	6×10^{-3}	3×10^{-9}	2×10^{-1}

APPENDIX B

Concentrations in Air and Water Above Natural Background — Continued

(See notes at end of appendix)

Element (atomic number)	Isotope [1]		Table I		Table II	
			Column 1	Column 2	Column 1	Column 2
		†	Air (μCi/ml)	Water (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)
Iodine (53)	I 134	I	3×10^{-6}	2×10^{-3}	1×10^{-7}	6×10^{-4}
	I 135	S	1×10^{-7}	7×10^{-4}	1×10^{-8}	4×10^{-4}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-3}
Iridium (77)	Ir 190	S	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-3}
		I	4×10^{-7}	3×10^{-3}	1×10^{-8}	2×10^{-3}
	Ir 192	S	1×10^{-7}	1×10^{-3}	4×10^{-8}	4×10^{-3}
		I	3×10^{-6}	1×10^{-3}	9×10^{-10}	4×10^{-3}
	Ir 194	S	2×10^{-7}	1×10^{-3}	8×10^{-8}	3×10^{-3}
		I	2×10^{-7}	9×10^{-4}	8×10^{-9}	3×10^{-3}
Iron (26)	Fe 55	S	9×10^{-7}	2×10^{-3}	3×10^{-8}	8×10^{-3}
		I	1×10^{-6}	7×10^{-4}	3×10^{-8}	2×10^{-3}
	Fe 59	S	1×10^{-7}	2×10^{-3}	5×10^{-9}	6×10^{-3}
		I	5×10^{-6}	2×10^{-3}	2×10^{-8}	8×10^{-3}
Krypton (36)	Kr 83m	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^{-3}
		I	1×10^{-7}	7×10^{-4}	4×10^{-9}	2×10^{-3}
Lead (82)	Pb 203	S	3×10^{-6}	1×10^{-3}	9×10^{-8}	4×10^{-3}
		I	2×10^{-6}	1×10^{-3}	6×10^{-8}	4×10^{-3}
	Pb 210	S	1×10^{-10}	4×10^{-6}	4×10^{-12}	1×10^{-3}
		I	2×10^{-10}	3×10^{-3}	8×10^{-12}	2×10^{-3}
	Pb 212	S	2×10^{-6}	6×10^{-4}	6×10^{-10}	2×10^{-3}
		I	2×10^{-6}	5×10^{-4}	7×10^{-10}	2×10^{-3}
Lutetium (71)	Lu 177	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-3}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-3}
Manganese (25)	Mn 52	S	2×10^{-7}	1×10^{-3}	7×10^{-9}	3×10^{-3}
		I	1×10^{-7}	9×10^{-4}	5×10^{-9}	3×10^{-3}
	Mn 54	S	4×10^{-7}	4×10^{-3}	1×10^{-8}	1×10^{-3}
		I	4×10^{-8}	3×10^{-3}	1×10^{-9}	1×10^{-3}
	Mn 56	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-3}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-3}
Mercury (80)	Hg 197m	S	7×10^{-7}	6×10^{-3}	3×10^{-8}	2×10^{-3}
		I	8×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-3}
	Hg 197	S	1×10^{-6}	9×10^{-3}	4×10^{-8}	3×10^{-3}
		I	3×10^{-6}	1×10^{-3}	9×10^{-8}	5×10^{-3}
	Hg 203	S	7×10^{-8}	5×10^{-4}	2×10^{-9}	2×10^{-3}
		I	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-3}
Molybdenum (42)	Mo 99	S	7×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-3}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-3}
Neodymium (60)	Nd 144	S	8×10^{-11}	2×10^{-3}	3×10^{-12}	7×10^{-3}
		I	3×10^{-10}	2×10^{-3}	1×10^{-11}	8×10^{-3}
	Nd 147	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-3}
		I	2×10^{-7}	2×10^{-3}	8×10^{-9}	6×10^{-3}
	Nd 149	S	3×10^{-6}	8×10^{-3}	6×10^{-8}	3×10^{-3}
		I	1×10^{-6}	8×10^{-3}	5×10^{-8}	3×10^{-3}

APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

(See notes at end of appendix)

Element (atomic number)	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)
Plutonium (94)	Pu 243	S	2×10^{-11}	1×10^{-4}	6×10^{-14}	3×10^{-7}
		I	4×10^{-11}	9×10^{-4}	1×10^{-13}	3×10^{-7}
	Pu 243	S	2×10^{-9}	1×10^{-3}	6×10^{-9}	3×10^{-6}
		I	2×10^{-9}	1×10^{-3}	8×10^{-9}	3×10^{-6}
	Pu 244	S	2×10^{-11}	1×10^{-4}	6×10^{-14}	4×10^{-7}
		I	3×10^{-11}	3×10^{-4}	1×10^{-13}	1×10^{-6}
Polonium (84)	Po 210	S	8×10^{-10}	2×10^{-3}	3×10^{-11}	7×10^{-6}
		I	2×10^{-9}	8×10^{-3}	7×10^{-11}	3×10^{-5}
Potassium (19)	K 42	S	2×10^{-7}	9×10^{-3}	7×10^{-9}	3×10^{-5}
		I	1×10^{-7}	6×10^{-3}	4×10^{-9}	2×10^{-5}
Praseodymium (59)	Pr 142	S	2×10^{-7}	9×10^{-3}	7×10^{-9}	3×10^{-5}
		I	2×10^{-7}	9×10^{-3}	8×10^{-9}	3×10^{-5}
	Pr 143	S	3×10^{-7}	1×10^{-2}	1×10^{-8}	5×10^{-5}
		I	2×10^{-7}	1×10^{-2}	6×10^{-9}	3×10^{-5}
Promethium (61)	Pm 147	S	6×10^{-9}	6×10^{-3}	2×10^{-9}	2×10^{-5}
		I	1×10^{-7}	6×10^{-3}	3×10^{-9}	2×10^{-5}
	Pm 149	S	3×10^{-7}	1×10^{-2}	1×10^{-8}	4×10^{-5}
		I	2×10^{-7}	1×10^{-2}	8×10^{-9}	4×10^{-5}
Protactinium (91)	Pa 230	S	2×10^{-9}	7×10^{-3}	6×10^{-11}	2×10^{-5}
		I	8×10^{-10}	7×10^{-3}	3×10^{-11}	2×10^{-5}
	Pa 231	S	1×10^{-12}	3×10^{-7}	4×10^{-14}	9×10^{-10}
		I	1×10^{-10}	8×10^{-6}	4×10^{-12}	2×10^{-8}
	Pa 233	S	6×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-5}
		I	2×10^{-7}	3×10^{-3}	6×10^{-9}	1×10^{-5}
Radium (88)	Ra 223	S	2×10^{-9}	3×10^{-3}	6×10^{-11}	7×10^{-6}
		I	2×10^{-10}	1×10^{-3}	8×10^{-12}	4×10^{-6}
	Ra 224	S	8×10^{-9}	7×10^{-3}	2×10^{-10}	2×10^{-5}
		I	7×10^{-10}	3×10^{-3}	2×10^{-11}	8×10^{-6}
	Ra 226	S	3×10^{-11}	4×10^{-7}	3×10^{-13}	3×10^{-9}
		I	5×10^{-11}	9×10^{-4}	2×10^{-13}	3×10^{-6}
	Ra 228	S	7×10^{-11}	8×10^{-7}	2×10^{-13}	3×10^{-9}
		I	4×10^{-11}	7×10^{-4}	1×10^{-13}	3×10^{-7}
Radon (86)	Rn 220	S	3×10^{-7}		1×10^{-9}	
	Rn 222	***	3×10^{-8}		3×10^{-9}	
Rhenium (75)	Re 183	S	3×10^{-6}	2×10^{-1}	9×10^{-9}	6×10^{-4}
		I	2×10^{-7}	8×10^{-3}	5×10^{-9}	3×10^{-5}
	Re 186	S	6×10^{-7}	3×10^{-3}	2×10^{-9}	9×10^{-6}
		I	3×10^{-7}	1×10^{-3}	8×10^{-10}	5×10^{-6}
	Re 187	S	9×10^{-6}	7×10^{-2}	3×10^{-7}	3×10^{-3}
		I	5×10^{-7}	4×10^{-3}	2×10^{-9}	2×10^{-5}
	Re 188	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-6}
		I	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-6}
Rhodium (45)	Rh 103m	S	8×10^{-3}	4×10^{-1}	3×10^{-7}	1×10^{-3}
		I	6×10^{-3}	3×10^{-1}	2×10^{-7}	1×10^{-3}
	Rh 105	S	8×10^{-7}	4×10^{-3}	3×10^{-9}	1×10^{-5}
		I	5×10^{-7}	3×10^{-3}	2×10^{-9}	1×10^{-5}
Rubidium (37)	Rb 86	S	3×10^{-7}	3×10^{-3}	1×10^{-8}	7×10^{-6}
		I	7×10^{-8}	7×10^{-4}	3×10^{-9}	2×10^{-6}
	Rb 87	S	8×10^{-7}	3×10^{-3}	3×10^{-9}	1×10^{-5}
		I	7×10^{-8}	8×10^{-4}	3×10^{-9}	3×10^{-6}

*** 3×10^{-8}

[75 FR 10004]

APPENDIX B

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 (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^{-4}	4×10^{-3}	3×10^{-6}	1×10^{-5}
		I	3×10^{-3}	2×10^{-3}	1×10^{-6}	1×10^{-5}
	Tc 96	S	6×10^{-7}	3×10^{-6}	2×10^{-9}	1×10^{-8}
		I	2×10^{-7}	1×10^{-6}	8×10^{-9}	3×10^{-8}
	Tc 97m	S	2×10^{-6}	1×10^{-5}	8×10^{-9}	4×10^{-8}
		I	2×10^{-7}	3×10^{-5}	8×10^{-9}	2×10^{-8}
	Tc 97	S	1×10^{-5}	6×10^{-5}	4×10^{-7}	2×10^{-7}
		I	3×10^{-7}	2×10^{-5}	1×10^{-8}	8×10^{-8}
	Tc 99m	S	4×10^{-5}	2×10^{-4}	1×10^{-6}	6×10^{-6}
		I	1×10^{-7}	6×10^{-5}	5×10^{-7}	3×10^{-6}
	Tc 99	S	2×10^{-6}	1×10^{-5}	7×10^{-8}	3×10^{-7}
		I	6×10^{-6}	5×10^{-5}	2×10^{-7}	2×10^{-6}
Tellurium (52)	Te 125m	S	4×10^{-7}	3×10^{-6}	1×10^{-8}	2×10^{-7}
		I	1×10^{-7}	3×10^{-6}	5×10^{-9}	1×10^{-7}
	Te 127m	S	1×10^{-7}	2×10^{-6}	3×10^{-9}	6×10^{-9}
		I	4×10^{-7}	2×10^{-6}	1×10^{-8}	5×10^{-9}
	Te 127	S	3×10^{-6}	8×10^{-6}	6×10^{-8}	3×10^{-7}
		I	9×10^{-7}	5×10^{-6}	3×10^{-8}	2×10^{-7}
	Te 129m	S	8×10^{-8}	1×10^{-6}	3×10^{-9}	3×10^{-8}
		I	3×10^{-7}	6×10^{-6}	1×10^{-8}	2×10^{-7}
	Te 129	S	3×10^{-6}	2×10^{-5}	2×10^{-7}	8×10^{-7}
		I	4×10^{-6}	2×10^{-5}	1×10^{-7}	8×10^{-7}
	Te 131m	S	4×10^{-7}	2×10^{-6}	1×10^{-8}	6×10^{-8}
		I	2×10^{-7}	1×10^{-6}	6×10^{-9}	4×10^{-8}
	Te 132	S	2×10^{-7}	9×10^{-7}	7×10^{-9}	3×10^{-8}
		I	1×10^{-7}	6×10^{-7}	4×10^{-9}	2×10^{-8}
Terbium (65)	Tb 160	S	1×10^{-7}	1×10^{-6}	3×10^{-9}	4×10^{-8}
		I	2×10^{-6}	1×10^{-6}	1×10^{-8}	4×10^{-8}
Thallium (81)	Tl 200	S	3×10^{-6}	1×10^{-5}	9×10^{-8}	4×10^{-7}
		I	1×10^{-6}	7×10^{-6}	4×10^{-8}	2×10^{-7}
	Tl 201	S	2×10^{-6}	9×10^{-6}	7×10^{-8}	3×10^{-7}
		I	9×10^{-7}	5×10^{-6}	3×10^{-8}	2×10^{-7}
	Tl 202	S	8×10^{-7}	4×10^{-6}	3×10^{-8}	1×10^{-7}
		I	2×10^{-7}	2×10^{-6}	8×10^{-9}	7×10^{-8}
	Tl 204	S	6×10^{-7}	3×10^{-6}	2×10^{-8}	1×10^{-7}
		I	3×10^{-6}	2×10^{-5}	9×10^{-8}	6×10^{-7}
Thorium (90)	* Th 227	S	2×10^{-10}	9×10^{-9}	1×10^{-11}	2×10^{-9}
		I	2×10^{-10}	5×10^{-9}	6×10^{-11}	2×10^{-9}
	Th 228	S	9×10^{-13}	2×10^{-9}	3×10^{-13}	7×10^{-13}
		I	6×10^{-13}	4×10^{-9}	2×10^{-13}	1×10^{-12}
	Th 230	S	2×10^{-12}	5×10^{-9}	8×10^{-13}	2×10^{-9}
		I	1×10^{-11}	9×10^{-9}	3×10^{-12}	3×10^{-9}
	* Th 231	S	1×10^{-6}	7×10^{-5}	5×10^{-8}	2×10^{-7}
		I	1×10^{-6}	7×10^{-5}	4×10^{-8}	2×10^{-7}
	Th 232	S	3×10^{-11}	5×10^{-9}	1×10^{-13}	2×10^{-9}
		I	3×10^{-11}	1×10^{-8}	1×10^{-12}	4×10^{-9}
	** Th natural	S	6×10^{-11}	6×10^{-9}	2×10^{-13}	2×10^{-9}
		I	6×10^{-11}	6×10^{-9}	2×10^{-13}	2×10^{-9}

25 F.R. 10914

APPENDIX B

Concentrations in Air and Water Above Natural Background—Continued

Element (atomic number)	Isotope [1]		Table I		Table II	
			Column 1	Column 2	Column 1	Column 2
			Air (μCi/ml)	Water (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)
Zinc (30)	Zn 65	S	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
		I	6×10^{-8}	3×10^{-3}	3×10^{-9}	2×10^{-4}
	Zn 69m	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
		I	2×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	Zn 69	S	7×10^{-6}	6×10^{-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}	3×10^{-3}	4×10^{-9}	8×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
	Zr 95	S	1×10^{-7}	2×10^{-3}	4×10^{-9}	6×10^{-5}
		I	3×10^{-8}	2×10^{-3}	1×10^{-8}	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^{-8}	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^{-7}	9×10^{-3}	1×10^{-8}	3×10^{-4}
Any single radionuclide not listed above, which decays by alpha emission or spontaneous fission.			6×10^{-12}	4×10^{-7}	2×10^{-13}	3×10^{-8}

[1] Solubility (S): insoluble (I).

[2] "Sub" means that values given are for submersion in a semi-infinite cloud of airborne material.

[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 1.3×10^5 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.

[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^{-9} 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:

$$SA = 3.6 \times 10^{-7} \text{ curies/gram U} \quad \text{U-depleted}$$
$$SA = (0.4 + 0.38\,E + 0.0034\,E^2)\,10^{-6} \quad E \le 5.7$$

where E is the percentage by weight of U-235 expressed as percent.

*Amended 37 FR 23319.
**Amended 39 FR 23990; footnote re designated 40 FR 50704.
***Amended 40 FR 50704.
†Amended 58 FR 29314.
‡Amended 39 FR 23461; redesignated 40 FR 50704.

APPENDIX C

Material	Microcuries
Americium-241	.01
Antimony-122	100
Antimony-124	10
Antimony-126	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

Material	Microcuries
Osmium-191m[1]	100
Osmium-191	100
Osmium-193	100
Palladium-109	100
Palladium-149	100
Phosphorus-32	10
Platinum-191	100
Platinum-193m	100
Platinum-197	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-105m	100
Rhodium-106	100
Rubidium-86	10
Rubidium-87	10
Ruthenium-97	100
Ruthenium-105	10
Ruthenium-106	10
Ruthenium-103	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-238	.01
Vanadium-48	10
Xenon-13[illegible]	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 radionuclides other than alpha emitting radionuclides, not listed above or mixtures of beta emitters of unknown composition... 1

Note.—For purposes of § 20.303, 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").

[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.

LICENSE APPLICATION

LICENSE

ATTACHMENT TO LICENSE 08-08371-02

RENEWAL APPLICATION

15. RADIATION PROTECTION PROGRAM

Procedures for Ordering and Receiving Radioactive Materials

By formal agreement with the AU Purchasing Office, all requisitions or purchase orders (P.O.) for radioactive materials are processed first through the department chairperson and then through the Radiation Protection Officer (R.P.O.) to ensure that the requested radioactive materials and quantities are authorized by NRC License 08-08371-02 and that user possession limits are not exceeded. In every purchase order for radioactive materials there must be an approved plan for the safe disposal of radioactive isotopes.

To ensure that this procedure is followed the AU Purchasing Agent will not sign or process a P.O. for radioactive materials without the signature of the AU Radiation Safety officer on the P.O. All orders for radioactive materials are then processed by the University Purchasing Office bearing the Radiation Protection Officer's signature, the AU License Number, and a xerox copy of the license is submitted to the supplier if one is not already on file with the supplier. Also on the purchase order is the statement that "The above requested materials are to be delivered only to the AU Purchasing Office and will be received only during the hours of business (8:00 a.m. - 5:30 p.m.), and that deliveries will not be received at any other time unless prior arrangements have been made." Also, AU P.O.'s do not give the user's name or office, but only the Purchasing Office for the delivery.

Upon receipt of a delivery of radioactive material, the Purchasing Office will telephone the Radiation Protection Office and the Radiation Protection office (RPO) personnel will immediately pick up the delivery and transfer it to the RPO (a secure and restricted area) to safeguard against unauthorized removal or opening.

If any packages containing radioactive material should arrive at the University during non-business hours of the Purchasing Office, Campus Security does not and will not receive deliveries.

Procedures for Opening and Examining Packages Containing Radioactive Material

All packages containing radioactive material received by the University are picked up by the Radiation Protection Office from the Purchasing Office. The Purchasing Office, upon receiving a package immediately phones the RPO for the package to be transferred to the RPO. If the package appears damaged or wet, the Purchasing Office will ask the carrier to remain at the

University until the Radiation Protection Officer can determine that neither he/she nor the delivery vehicle is contaminated. The package, after transfer to the RPO, will be examined and opened with the following procedure:

1. The exposure rate at three feet from the package surface will be measured and recorded. If the level is greater than 10 mR/hr. the procedure will be stopped and the Radiation Protection Officer notified.

2. The exposure rate at the package surface will be measured and recorded. If the level is greater than 200 mR/hr. the procedure will be stopped and the Radiation Protection Officer notified.

3. Gloves are worn to open all packages.

4. The outer package is opened (following manufacturer's directions, if supplied) and the packing slip is removed, the inner package is opened and verification is made that requisition, packing slips and labeled material agree as to contents. The labeled material is inspected to check integrity of shipment (for breakage of seals or vials, loss of liquid, discoloration of packing material). The radiation limit of the labeled material is also checked against the initial P.O. to make sure possession limits authorized and requested were delivered.

5. The external surface of the final source container is wiped with a moistened filter paper held with forceps, assayed and recorded.

6. The packing material and packages are monitored for contamination before discarding.

   a. If contaminated, they are treated as radioactive waste.

   b. If not contaminated, the radiation labels are obliterated or removed before being discarded in regular trash.

Cleaning Service and Security (Police and Fire) Considerations for Job Safety

All cleaning and security personnel have been notified of the location of radioactive materials. They are advised of procedures to follow in being in the area of the materials and in the event of any emergencies.

Management Control System in the Radiation Safety Area

The Radiation Protection Committee consists of the following persons appointed by Provost Milton Greenberg as of February 17, 1984:

Dr. Albert M. Cheh, Chemistry Department
Dr. Robert J. Chinnis, Biology Department
Dr. Romeo Segnan, Physics Department (Radiation Protection Officer)
Dr. Isaac Welt, Senate Research Committee
Mr. Stephen Gorney, University Safety Officer

Dr. Nina Roscher, Vice Provost for Academic Affairs, represents the University administration and Dr. Barbara Gordon/Research, Grants, and Contract Services, performs administrative functions. Mr. Stanley M. Matelski, Director/RGCS, is the Certifying Officer.

This Committee meets at least semi-annually to monitor the compliance of the University with N.R.C. regulations and licensing requirements.

Professor Romeo Segnan who has been the Radiation Protection Officer since April 15, 1984, coordinates the safe use of the licensed material specified in the license and will ensure compliance with the applicable parts of Title 10, Code of Federal Regulations.

In addition, there are periodic meetings with departmental chairpersons in whose departments radioactive materials are in use. These meetings serve to update them on the actions of the Radiation Safety Committee and to review procedures, such as those for the safe use, purchase and disposal of radioactive isotopes.

Inventory Procedures

The University has updated its inventory of all radioactive substances anywhere on the campus. This inventory has been sent to the appropriate persons and departments on campus, e.g., department chairpersons in affected departments, members of the Radiation Protection Committee, the campus safety office, the cleaning contractor, and the University telephone services manager. Updates, which reflect location changes, will be sent to the above personnel and departments as needed. The inventory, including updates, is located in the Office of Research, Grants, and Contract Services.

Notices

Multiple copies of Form NRC-3 with the name of the Radiation Protection Officer at The American University have been placed in all areas where there are radioactive isotopes. In addition, descriptions of the University licenses indicating where the actual licenses can be accessed have been developed and posted.

16. Formal Training in Radiation Safety

Each person whose name appears in 6/7 has either attended or will attend the National Institutes of Health "Radiation Safety in the Laboratory" one-day seminar or their longer term training. This training is described in further detail in The American University letter of August 9, 1984, addressed to Dr. John C. Glenn. The following persons have had recent training (1983/84): Romeo Segnan, University RPO, Robert Chinnis, Ann Hagan (long term training), Barbara Clarke. The following persons will attend the NIH seminar during the Fall Semester 1984: Albert Cheh (has had pertinent training at the University of Minnesota) and Nina Roscher.

17. Experience: Resumes attached.