RADIATION SAFETY

MANUAL

BOSTON BIOMEDICAL RESEARCH INSTITUTE

1985

Preamble

The Responsibilities of the Radioisotope User

Any BBRI staff members who have been licensed by the Institute may use radioisotopes and they may authorize others under their supervision to work with radioisotopes.

The user is privileged to have radioisotopes available to simplify his investigations. Because radioisotopes are a potential health hazard to society, the privilege of use carries the responsibility of care in use, exposure, storage and disposal. The rules pertaining to the use of radioisotopes at BBRI and the Research Farm are summarized in this manual. Users are urged to reread the sections covering safety (Sect. 5), recordkeeping (Forms 1, 2, Appendix 3), and waste disposal (Sect 5.9) periodically.

Commercial disposal is costly, so plan your experiments to minimize the bulk of contaminated waste, comply with the recommendations concerning radioisotope disposal, and put your waste down the sink or consign it to incineration whenever it is legally permissible.

NOTE: ^{32}P is one of the isotopes that CANNOT be incinerated.

TABLE OF CONTENTS

1. THE RADIOISOTOPES COMMITTEE

1.1 THE PURPOSE OF THE RADIOISOTOPES COMMITTEE

The Committee is to promote the best practices in safe handling and use of radioactive sources in all facilities of the Institute located at 20 Staniford Street, Boston, and at the Research Animal Farm, Townsend, Massachusetts, and to ensure compliance with governmental and NRC regulations. Its services are available to all users, Department Heads, and the Board of Trustees, and shall complement the radiation safety activities already existing within the Institute.

1.2 ORGANIZATION OF THE RADIOISOTOPES COMMITTEE

The Radioisotopes Committee consists of the Radiation Protection Officer, who serves as chairman, nominated by the Executive Director; and members representing each department of the Institute.

Meetings of the Committee shall be called by the Radiation Protection Officer at his own discretion, or by the Executive Director, or on petition of any member of the Committee, and shall occur not less than once per year. The Radiation Protection Officer shall conduct the interim business of the Committee.

1.3 THE RESPONSIBILITIES OF THE RADIOISOTOPES COMMITTEE ARE:

1.3.1 To review and approve or disapprove applications for the use within the Institution of radioisotopes, and to keep records of such actions.

1.3.2. To prescribe special conditions that may be necessary for the safe handling of radioisotopes including: additional training, the designation of limited areas of use, proper disposal methods, and the procedures to be followed after spills or other radiation accidents.

1.3.3 To receive and review periodic or urgent reports of the Radiation Protection Officer and of a representative of Harvard University Health Services regarding:

a. Results of area monitoring.

b. Personnel exposures as measured by suitable dosimeters.

c. Accidents in handling, storage, or use of radioisotopes.

d. Records of radioisotope procurement and disposal.

1.3.4 To recommend remedial action or suspension in the event of repeated violations if unsafe procedures are being used where an ionizing radiation hazard exists or government regulations are not being obeyed.

1.3.5 To advise regarding the health of personnel and to conduct or encourage educational programs* designed to prepare persons for the safe handling and use of radioactive sources, both for their safety and that of others.

1.3.6 To inform and advise the Department Heads on all matters relative to the safe use of radioisotopes.

1.3.7 To oversee the use of institutional counting and survey instruments.

*All personnel without previous training in the use of radioactive isotopes are required to attend a course in the fundamentals of such use given under the auspices of Harvard University.

1.4 THE RADIATION PROTECTION OFFICER

1.4.1 Authority. The Radiation Protection Officer (RPO) is the authorized representative of the Isotopes Committee regarding measures to implement radiation protection and control within the Institute. The RPO is assisted by the Harvard University Health Services who periodically survey the radiation areas.

1.4.2. Function. The duties of the RPO are to:

a. Provide consulting services on all aspects of radiation protection.

b. Maintain radiation exposures at the lowest possible level by the supervision or operation of an effective and appropriate radiation protection and control program.

c. Develop and maintain a procedure for keeping the personnel exposure and contamination records.

d. Indoctrinate personnel in the proper procedures to be used and the equipment necessary for the safe use of radioisotopes.

e. Provide assurance that the waste disposal program and the records associated with waste disposal are appropriate in accordance with regulations.

f. Supervise a continuous program of area and environmental radiation hazard analysis.

g. Ensure maintenance of records of radioisotope procurement and distribution within the Institute.

2.0 LICENSING AND REGISTRATION REGULATIONS

2.1. GOVERNMENT REGULATIONS

By-product material, which is material yielded in or made radioactive through nuclear reactions utilizing plutonium, uranium 233, or uranium 235, may be used only under specific or general licenses issued by the United States Nuclear Regulatory Commission. The regulations covering the procurement of licenses are published in Title 10, Chapter 1, Part 30 of the Federal Register. Copies of these regulations may be obtained from each Department office.

All licensees of the NRC are required to conform with standards for protection against radiation hazards established by the NRC. These standards are published in Title 10, Chapter 1, Part 20 of CFR. Copies of these standards are attached as Appendix 6.

All persons who "receive, possess, use or transfer radioactive materials or machines which emit or may emit ionizing radiation in the Commonwealth" are subject to rules and regulations issued by the Massachusetts Department of Public Health, except as exempted by the regulations. Copies of these regulations may be obtained by writing to the Department of Public Health, Division of Sanitary Engineering, State House, Boston, Massachusetts, or they may be examined in the Isotope Committee office.

2.2 BOSTON BIOMEDICAL RESEARCH INSTITUTE REGULATIONS

No person may use within, or bring into, the Institute any radioisotopes without approval by the RPO or his representatives.

Although a license is not required for the possession and use of isotopes in quantities less than those listed in Table I, the Radioisotope Committee must be informed prior to the time any such radioactivity (except for radioactivity contained in devices sold to the general public) is brought into the Institute.

2.3 RESPONSIBILITY OF LICENSED USERS

Those persons who have been licensed by the NRC to use radioisotopes are responsible for the safe use of radiation sources by individuals under their control.

The licensees are responsible for:

2.3.1 Compliance with the Boston Biomedical Research Institute Rules for the Safe Handling of Radioactive Materials (Sections 5 and 6 of this manual) and the relevant Federal Regulations (10-CFR-20, see Appendix 6).

2.3.2 Instruction of employees under their control in the use of safety devices and procedures.

2.3.3 Proper planning of an experiment or procedure, to assure that adequate safety precautions are taken.

2.3.4 Communication of pertinent information regarding employees to the RPO with respect of changes in operational procedures, new techniques, alterations in the physical plant or new operations which

might lead to increased personal exposures or contamination levels in the laboratory or the environs.

2.3.5 Direction of personnel under their control to comply with all recommendations to wear film badges, to survey their hands and clothing, to submit urine specimens, etc., which are designed to control and to reduce their total exposure.

2.3.6 Limitation of use of radioisotopes obtained under his license to those over whom he has supervision and to approved areas.

2.3.7 Maintenance of required current records of receipt, use, storage and disposal of radioisotopes.

2.4 RESPONSIBILITY OF THE INDIVIDUAL USER OF RADIOISOTOPES

Each person at Boston Biomedical Research Institute who has any contact of ionizing radiation has a responsibility to:

2.4.1 Keep his exposure to radiation at the lowest possible value and specifically below the maximum permissible exposure as stated in Section 5.

2.4.2 Wear the recommended radiation detectors for personnel, such as film badges and pocket ionization chambers.

2.4.3 Survey his hands, shoes, body and clothing for radioactivity and and record the results, and remove all loose contamination before leaving the laboratory.

2.4.4 Use all appropriate protective measures such as protective clothing, respiratory protection, remote pipetting devices, ventilated and shielded glove boxes and hoods.

2.4.5 Avoid smoking, drinking or eating in radioisotope laboratories.

2.4.6 Maintain good personal hygiene.

2.4.7 Check working areas daily, or after each radioisotope procedure.

2.4.8 Maintain good housekeeping practices in the laboratories.

2.4.9 Label radiation equipment and segregate radiation waste and equipment to avoid cross contamination.

2.4.10 Report immediately to the RPO the details of a spill or other accidents involving radioactivity.

2.4.11 Conduct decontamination procedures.

3.0 APPLICATION FOR A RADIOISOTOPES LICENSE

The following process should be followed in applying for a license to use radioactive materials:

3.1 Obtain from the Secretary of the Isotopes Committee a Boston Biomedical Research Institute Application Form, in triplicate (See Form 4)

3.2 Send to the Radiation Protection Officer the completed Application Form, in duplicate.

3.3 The application will be initially reviewed in detail by the Radiation Protection Officer. Final action will be taken by the full Radioisotopes Committee and the applicant will be notified.

4.0 PROCUREMENT OF RADIOACTIVE MATERIALS

The following procedures are followed for the purchase of any material having radioactivity great enough to require an NRC license.

4.1 PURCHASING

4.1.1 Who may order: any licensee, i.e., an investigator who is trained in handling radioisotope and is listed with the Harvard Environmental Health Service.

4.1.2 What may be ordered: any one or more of the following isotopes carried on our present license. The amount in parentheses is the total that the institute may have at any time (for all investigators).

Byproduct, source, and/or special nuclear matl.	Chemical and/or physical form	Max. amount BBRI may possess at any one time under our license
Carbon 14	any	40 millicuries
Phosphorus 32	any	20 millicuries
Sulfur 35	any	100 millicuries
Calcium 45	any	10 millicuries
Zinc 65	any	10 millicuries
Mercury 203	any	10 millicuries
Iodine 131	any	20 millicuries
Hydrogen 3	any	6 curies
Cadmium 115	any	10 millicuries
Iron 59	any	10 millicuries
Strontium 89	any	10 millicuries
Strontium 85	any	10 millicuries
Iodine 125	any	10 millicuries
Phosphorus 33	any	5 millicuries
Ruthenium 103	any	5 millicuries
Ruthenium 106	any	5 millicuries
Rubidium 86	any	5 millicuries
Gadolinium 153	any	5 millicuries
Terbium 160	any	10 millicuries
Chromium 51	any	5 millicuries
Cadmium 109	any	10 millicuries
Potassium 42	any	10 millicuries

4.1.3 How to Order: Complete a standard Purchase Order. It must be signed by the licensee and countersigned by the Chairman of the Radioisotope Committee or his designee on the pink and blue copies of the PO. This procedure ensures that each purchase is added to the inventory. The Accounting Department has been instructed not to pay an invoice if the PO is not countersigned. The countersigned PO should be returned to the user with Forms 1 (radioisotope receiving check list) and 2 (experimental check list).

4.1.4 When the isotope is received: Comply with the instructions on Form 1, sign it and retain it in your records. Store the shipment safely -- not near any food and not where radiation can be a health hazard.

4.1.5 How to Reorder: Send the PO to the Chairman of the Radioisotope Committee, together with a summary of the disposition of the previous order (Form 5). In this way the previous shipment can be deleted from the inventory. Any reorder before the last shipment is consumed should be explained.

The report of disposal on Form 5 should correspond to disposal records (Form 3).

4.2 PROCUREMENT BY OTHER THAN PURCHASING

If radioactive material is to be brought into the Institute under any conditions other than purchasing (i.e., purchased by another institution, or contained in specimens, etc. from another institution for a collaborative project), approval to bring that material into the Institute must follow the same procedures as those for purchasing radioactive materials. Please be certain that these isotopes are added to the inventory.

4.3 RECEPTION

All radioisotopes are received at the receiving area at 20 Staniford Street, and the porter must be notified as soon as possible. The porter will examine the package for evidence of leakage or physical damage. If no such evidence is found, the porter will deliver the package directly to the principal investigator. The principal investigator will immediately open the package to determine if any leakage has occurred and if the order has been filled and delivered correctly. The package will be kept in a designated hood while it is opened. The principal investigator will wear gloves while opening the package. The principal investigator will wipe the vial of isotope with a swab of filter paper and count the swab in an appropriate instrument to determine if any contamination has occurred on the outside of the vial. In addition, the package should be monitored at the surface and at one meter and the results recorded.

5.0 RULES FOR THE SAFE HANDLING OF RADIOACTIVE MATERIALS

5.1 CLASSIFICATION OF AREAS

5.1.1. Unrestricted Areas. An area is unrestricted and does not require control measures if:

a. an individual continually present in the area cannot receive more than 2 mrem in any one hr or 100 mrem in any seven consecu-

tive days to any portion of the body (for definition of rem, see appended NRC regs. p. 20.2); or

b. when an allowance is made for expected occupancy and time variations in dose-rate, no individual is likely to receive more than 500 mrem in a calendar year.

5.1.2. Restricted areas. All areas within the institute in which dose levels do not conform to the standard for unrestricted areas shall be restricted and under the control of the Radiation Protection Officer for radiation safety purposes. A sign carrying the words "Radiation Area - No Entrance to Unauthorized Personnel" shall be prominently displayed at the entrance to each restricted area, and the licensee responsible for work with radioisotopes in that area shall be responsible for controlling access to the area.

Both Federal and State regulations define restricted areas containing radiation which require special control measures as follows:

a. Radiation Area - Any area accessible to individuals in which there exists ionizing radiation at such levels that a major portion of the body of such individuals could receive an absorbed dose greater than 5 mrem in any one hr or 100 mrem in any five consecutive days.

b. High Radiation Area - Any area accessible to individuals in which there exists ionizing radiation at such levels that a major portion of the body could receive in any one hr an absorbed dose greater than 100 mrem.

5.2. MAXIMUM PERMISSIBLE DOSE LEVELS

5.2.1 In restricted areas, control must be such that no individual over 18 years of age (excluding patients) will receive in any one calendar quarter, a dose in excess of the following limits, except as specified in 5.2.2.

Whole body, head and trunk active blood-forming organs lens of eyes or gonads	1.25	rem
Hands, forearms, feet, ankles	18.75	rem
Skin of the whole body	7.5	rem

5.2.2 Doses to the whole body in excess of the above limits are permitted providing that during any calendar quarter the dose does not exceed 3 rem and that the cumulative dose does not exceed 5 rem/year. However, current ALARA recommendations (see Appendix 4) require the review of laboratory practices at considerably lower exposure levels than those listed in 5.2.1. Should the exposure of an individual exceed 10 percent of the above dose levels, the RPO will review the exposure and will report the results of his review at the first Isotope Committee meeting following the quarter when the exposure was recorded. If the exposure does not equal or exceed 30 percent of the

above levels, no action related specifically to the exposure is required unless deemed appropriate by the Committee. The Committee will, however, consider each such exposure in comparison with that of others performing similar tasks and will record the review in the Committee minutes. If the exposure of an individual should equal or exceed 30 percent of the above dose levels, the RPO will investigate in a timely manner the cause and, if warranted, take appropriate action.

5.2.3 The maximum whole body exposure of individuals under the age of 18 must be limited to 0.5 rem per calendar year; for pregnant women, limit exposure to 0.5 rem over 9 months with particular care in the first trimester.

5.2.4 All areas in the vicinity of the Institute, which may be irradiated by sources under the control of the Institute, shall meet the standards in 5.1.1. for unrestricted areas.

5.2.5 Contamination Levels. Radioactive contamination levels of air and water in restricted areas must be controlled such that the levels in μc/ml specified in 10 CFR 20 Appendix B, Table 1, are not exceeded.

5.3. PERSONNEL MONITORING

Personnel monitoring devices are required by law and records must be kept, if an individual receives or is liable to receive a dose in any calendar quarter in excess of 25 percent of the values in Section 5.2 (5 percent for individuals under 18).

Such monitoring will normally take the form of film badges worn on the chest or at the waist, and shall be mandatory in all areas requiring a "Radiation Area" sign. Where the hand dose may exceed 25 percent of the relevant limit in Appendix 1, ring or wrist film badges must be worn. Urinalyses (bio-assay service) are made when indicated for the evaluation of internally deposited radioactive materials, including H-3. The recommendations of the NRC (see Appendix 8) are that urinanlyses be done routinely whenever an individual works with amounts exceeding 100 mCi of HTO, 100 Ci of HT gas, or 10 mCi of H-3 labeled nucleotide precursors.

Where the nature of the radiation or the unusual level of the possible exposure dictates their choice, personnel dosimeters of the ionization type should be worn and readings recorded daily.

A guide concerning the advisability of wearing film badges is included as Appendix 1.

Special procedures are required for radioiodination experiments with I-125 or I-131 of high specific activity, since these can lead to the release of a large fraction of the iodine as a vapor. Any staff member contemplating radioiodinations involving more than 100 μCi of radioiodine should inform the Harvard Radiological Service who will make an appointment to send out technicians who will monitor both the air around the investigator and the effluent from the exhaust hood. It is the responsibility of each principal investigator to assure that these conditions are met before embarking on such experiments. It is the responsibility of each worker involved that if his experimental design is approved then the procedures which he follows each time are identical to those approved, most particularly with respect to use of the hood so that exposure of others in the laboratory is minimized. After each experiment with more than 100 μCi of radioiodine, the worker must be scanned

for the uptake of radioiodine in the thyroid under a program administered by the Harvard Radiological Service. The Chairman of the Radioisotope Committee will provide information concerning the schedule and location of the thyroid scanning service.

5.4 POSTING OF AREAS AND OTHER REQUIRED LABELS

Signs are required by law to denote areas or containers with levels of radiation or radioactivity specified in the following sections.

5.4.1. Caution Radiation Area - in areas accessible to personnel in which a major portion of the body could receive in any one hour a dose of 5 mrem or in any 5 consecutive days a dose in excess of 100 mrem.

A sign is NOT required on a room containing a sealed source if the radiation level 12" from the surface of the source container of housing does not exceed 5 mrem/hour.

5.4.2. Caution Radioactive Material - in areas in which radioactive material is used or stored in amounts exceeding those in Table II, Column I on containers in which radioactive material is transported, stored or used in amounts exceeding those in Table II, Column II (taken from Appendix C 10 CRF 20).

When containers are used for storage, the labels shall state the quantities and kinds of radioactive materials and the date of measurement and the responsible investigator.

A label is NOT required if the concentration of the material in the container does not exceed the maximum permissible concentration for occupationally-exposed individuals (10 CRF 20 Appendix B, Table 1, Column 2); or for laboratory containers, such as beakers, flasks and test tubes, used transiently in laboratory procedures, when the user is present.

5.4.3. Other signs are required for HIGH RADIATION AREAS (dose-rate greater than 100 mrem in an hour) with the above exceptions, and in AIRBORNE RADIOACTIVITY AREAS. The Radiation Protection Officer must be consulted regarding control measures in these areas.

5.5 SURVEYS

It is good practice to monitor all work areas as soon as possible after work with radioactive materials.

When unsealed quantities of activity exceeding 500 times those listed in Table 1 or 5mCi, whichever is lower, are used:

a. In a single procedure, a survey shall be made by the user immediately after the completion of the procedure and the results recorded.

b. In total during the week, a survey shall be made at the end of the week, and the results recorded.

In all other cases, surveys shall be made at least monthly and the results recorded.

5.6 HANDLING OF RADIOACTIVE MATERIALS

5.6.1. Before any work is undertaken with quantities of radioisotopes which may produce significant external or internal exposure, attention shall be given by the licensee to precautionary measures including the use of hoods, remote handling equipment, air monitoring. The Radiation Safety Officer may be consulted for recommendations on specific operations.

5.6.2. Work which may result in contamination of work areas shall be done over stainless steel trays or trays lined with heavy absorbent paper.

5.6.3. Personnel working in areas containing radioactive materials shall wash their hands thoroughly, using plenty of soap, before eating, smoking or leaving work. Those working with unsealed sources should monitor hands and shoes upon completing operations.

5.6.4 Eating, drinking, storing or preparation of food is forbidden in a laboratory or rooms where work with unsealed radioactive sources is taking place or where contamination may exist.

5.6.5. Smoking is not permitted in areas where work with unsealed radioactive sources is in progress or where contamination may exist. Under no circumstances should cigarettes, cigars or pipes be laid on tables or benches where radioactive work has been or is in progress.

5.6.6. Pipetting radioisotopes by mouth is prohibited.

5.6.7. Impervious gloves shall be worn whenever hand contamination is likely, and should be seriously considered whenever quantities requiring a radioactive materials area sign are being handled.

Impervious gloves shall always be worn when handling open vessels containing alpha emitters or Sr-90, or when handling equipment possibly contaminated with these materials.

Gloves should be cleaned, if practicable, before removal or disposal. They should be handled and stored to prevent contamination of the inside surface.

5.6.8. Laboratory coats shall be worn by all individuals handling radioactivity. In cases where millicurie amounts of activity are being handled and there is a likelihood of spillage and personal contamination, the laboratory coat should be removed before leaving the isotope laboratory and kept in the laboratory. It should be monitored for contamination before sending to the laundry.

5.6.9 Appropriate records should be kept of all experiments, minimally Form 2.

5.7 STORAGE

5.7.1. Radioisotopes requiring a "Radioactive Materials" label must be received and stored in areas under the control of the responsible user, or in a central storage area designated by the Isotopes Committee. A user leaving isotopes unsecured when no one is present may be subject to a fine.

CALL HARVARD UNIVERSITY, ENVIRONMENTAL HEALTH AND SAFETY, 495-2061, Mr. R. Johnson.

If a radiation source has been separated from its container, use tongs or other remote pick-up devide to return source to its container. Do not pick up in hands. Do not allow anyone to go near source.

If radioactive dust appears to have been released from the containers in the vehicle, clear as much of the area as necessary to prevent contact of individuals with the contamination.

Maintain a guard over the radiation (or contaminated) area until authorized radiation survey technicians from Environmental Health and Safety have surveyed the area and determined it to be free of contamination and that no radioactive sources have been released to the environment.

5.8.3 Transportation of radioisotopes purchased through the Institution must be carried out under the conditions established by the NRC under the terms of our license. It is the responsibility of the person wishing to transport isotopes to ensure compliance with these regulations and to ensure that those isotopes transported are removed from the Institution's inventory.

5.9. RADIOACTIVE WASTE DISPOSAL

5.9.1. Storage of Wastes

a. Each laboratory should maintain for temporary storage a metal waste can with a foot-operated lid, which must display a "Radioactive Materials" label in a prominent position. The use of a disposable liner is recommended in order to maintain the waste can free of contamination. Where there is a large turnover of waste, it is advantageous to maintain separate cans for combustible and noncombustible or reclaimable materials. Combustible wastes in the laboratory should be held to a minimum. A record must be made of the estimated activity of each specific isotope consigned to the sink and combustion. and a survey should be made and the results recorded.

b. High-level waste that contains short-lived radioactive material should be stored temporarily in a marked area in the licensee's laboratory to permit substantial decay before ultimate disposal. A survey should be made and recorded before disposal.

c. Liquid wastes should be stored in unbreakable containers, preferably in polyethylene bottles. There must be no possibility of a chemical reaction during storage that might cause an explosion or cause the release of radioactive gases or vapors. Liquids shall be neutralized before deposition in a waste container.

5.9.2. Liquid Disposal

a. Aqueous waste up to the daily limit prescribed in Column II, Table II, should not be stored but discarded down the nearest designated disposal sink (in each lab). If substantial amounts of radio-

5.7.2. The radioisotopes shall be stored in a container, shielded if necessary, such that the radiation at a distance of 1 ft from the container does not exceed 100 mrem/hour, i.e., the area may be classified as no more than a Radiation Area.

5.7.3. Containers must be properly labeled and area signs posted where necessary.

5.7.4. Suitable precautions shall be taken so that the probability of an explosion in the storage area which would cause the dispersion of radioactivity is very small.

5.8. TRANSPORTATION

5.8.1. On Institute premises:

a. Radioisotopes requiring a "Radioactive Materials" label must be enclosed in non-shatterable carrying cases or containers, preferably metallic, before being transported through corridors or between buildings.

b. Containers for the transportation of beta sources requiring a "Radioactive Materials" label must provide shielding thicker than the maximum range of the beta rays.

c. Gamma ray emitters shall be transported in closed containers, shielded if necessary, such that the dose-rate at one meter does not exceed 10 mrem per hour. (This rule follows the D.O.T. shipping regulations.)

5.8.2. Between 20 Staniford Street, Boston, and Research Farm in Townsend, Massachusetts.

a. Transportation of radioactive materials must be in accordance with appropriate packaging, labeling, and transportation requirements contained in the ICC regulations.

All vehicles will carry a radiation survey meter, tongs, and appropriate personnel dosimetric equipment.

b. Emergency procedures in case of an accident. These procedures are to be made available to the driver of any vehicle carrying radioactive materials in quantities requiring placarding of the car with "Radioactive Material" signs.

IF THE DRIVER OF THIS VEHICLE IS INJURED AND CANNOT PROVIDE INSTRUCTIONS, FIRST ATTEND TO ANY NECESSARY MEDICAL AND EMERGENCY FIRST AID TO INJURED PERSONNEL. PHONE MGH FOR EMERGENCY CARE, 726-2204. REPORT THE ACCIDENT AND THAT THE VEHICLE WAS CARRYING RADIOACTIVE MATERIALS.

KEEP ALL PERSONS NOT DIRECTLY CONCERNED WITH MEDICAL TREATMENT AWAY FROM THE VEHICLE.

activity are involved (>1 μCi) a record should be kept at the sink and on your Radioisotope Experiment Check List. Amounts over the daily limit can be discarded over several days.

b. Water-miscible organic waste (including Liquiscint and DMSO-based fluorography reagent) should be disposed of in the sink like aqueous waste. Whenever possible ^{32}P should be counted in Liquiscint so that it can be subsequently flushed away. Our license does not permit ^{32}P to be burned.

c. Organic waste (water immiscible) should be first counted to monitor the level of radioactivity. If this is less than 100 cpm per 10 ml, it may be disposed of as nonradioactive organic waste. If it contains higher levels of radioactivity (>100 cpm per 10 ml), and has a short half-life, allow it to decay in a safe place in your laboratory (dated and labeled with your name and the isotope) or if it is flammable, it should be burned. High level organic waste must be disposed of through Harvard services.

Used scintillation fluid is best disposed of by incineration without removal from the vials, as described below.

5.9.3 Solid disposal. Every effort should be made not to accumulate solid waste by adhering to the following guidelines:

a. Contaminated glassware must be taken to a disposal sink and washed to remove contamination, using agents such as "Count-Off" (NEN) if necessary, and then reused or discarded in the waste basket with regular trash. If items are being soaked for an extended period of time (not more than 4 days - further soaking is unproductive), they should NOT clutter the sink but be placed in the glass washroom's large sink out of the way of the glasswasher. (Anything placed in the washroom should be clearly labeled and the dishwasher should be informed of the presence of the contaminated items in the sink.) Glassware and noncombustibles that are irreversibly contaminated must be packaged tightly and safely (plastic bags through which broken glass may protrude are not safe), labeled with your name, the isotope, and the radioactivity (mR/hr) and disposed of commercially through the Harvard services.

b. Plastic scintillation vials containing scintillation fluid and ^{14}C, ^{3}H, ^{125}I or ^{35}S) should be packaged in cardboard donut boxes and taken to the incinerator room for burning, labeled with an estimate of the radioiisotope content. Vials should be disposed of in this manner on a regular basis and not be allowed to accumulate in the lab because they release highly toxic and flammable vapors of toluene or xylene. Store briefly in the lab under or in fume hoods. Glass scintillation vials are strongly discouraged. If used they are the PI's responsibility to clean and dispose of.

c. Combustible waste (paper, plastic tips, filter discs, etc.) should be divided into two categories.

Low level (no response with the Geiger counter) should be bagged and disposed of as nonradioactive in the regular trash at the end

of the experiment. We do not need to accumulate this low level waste.

High level (positive response with the Geiger counter or the result of a spill or accident) should be double-bagged and provided with a label indicating the type and amount of radioisotope. Material containing ^{3}H, ^{14}C, ^{35}S and ^{125}I (up to the daily limit) may be placed in the incinerator room for burning. Waste containing ^{32}P and ^{45}Ca and other isotopes should be stored in your laboratory and suitably screened until the level of radioactivity has declined below the disposal limit; or it must be disposed of by shipment and burial. It is the originators' responsibility to ensure that their waste is disposed of in a legal fashion.

d. Storage in the Hot Room (006). No radioactive material may be stored in room 006 without submitting form 6 to the Radioisotope Protection Officer and obtaining his approval. The Hot Room must not be used for storage of long-lived radioisotopes unless they are due for commercial disposal and unless they present a hazard from radiation. Therefore ^{3}H or ^{14}C must not be dumped there. Any such wastes awaiting commercial disposal must be held in the user's lab.The only material stored in the Hot Room for decay must be clearly identified with the name of the investigator, and the type of long-lived isotope of high level that can only be disposed of by commercial burial.

5.9.4. Incineration. Incineration is permitted only with a specific license from NRC (for current license see Appendix 2). All incinerations must be carried out in the incinerator in the basement. The incinerator operator must first receive approval to incinerate from the Chairman of the RadioIsotopes Committee, or the RPO. All radioactive material for incineration shall be labeled as to isotope, quantity, and date on which measured. In order to comply with the provisions of the NRC license, all persons involved will be monitored, and all persons concerned with the incineration and the ashes will be given specific instructions for the safe handling of the material.

5.9.5. Waste disposal, through Harvard University Environmental Health Services. Radioactive waste in amounts exceeding the sewer or incinerator disposal limits or material dissolved in flammable solvents may be transferred to Harvard University Environmental Health and Safety for disposal. It is important for this method of disposal to adhere strictly to the rules and regulations set by Harvard University. These procedures may change from time to time, and the current set of regulations is described in Appendix 6. In case of doubt, check with the Chairman of the Radioisotope Committee for current regulations. This is a costly means of disposal and the charge may be made against the user.

5.10. DESIGN OF NEW FACILITIES

The design of all facilities involving the use, handling or storage of radioactive materials shall be reviewed by the Radiation Protection Officer to assure the maintenance of adequate environmental protection.

6.0 ANIMALS CONTAINING RADIOACTIVE MATERIALS

6.1. Injections of radioactive materials in animals shall be carried out in stainless steel trays having absorbent materials in the bottom. Rubber surgical gloves shall be worn by the worker, for all levels of radioactivity requiring a Radioactive Materials sign.

6.2. All cages housing animals injected with radioactive material shall be clearly marked as follows:

a. Name of the radioisotope.

b. Amount of radioactive material injected per animal

c. Date of injection

d. Principal investigator's name

e. "Caution Radioactive Material" tape must be affixed to the cage.

6.3. Animals containing radioactive materials must be kept in cages apart from other animals.

6.4. All animal excreta which may contain radioactivity shall be collected and disposed of, if necessary, after storage. The disposal through the sewerage of excreta in a suitable form (i.e., not mixed with sawdust or wood shavings) is subject to the restriction on amounts imposed by 10 CFR 20 (see also Section 5.9.2 of this manual).

If the excreta show no significant activity above background when monitored by a survey meter appropriate to the radioisotope involved, they may be discarded with normal trash in a suitable container.

In all other cases, the excreta shall be labeled with the name of the isotope and the estimated amount of activity, and either incinerated (Sect. 5.9.4) or stored prior to shipment via a commercial disposal company, in accordance with the rules for disposal (Section 5.9.1).

6.5. The carcasses or dissected parts of injected animals shall be wrapped in absorbent material and placed in a watertight container so as to prevent dripping during transportation from one area to another.

6.6. Adequate ventilation and air cleaning must be provided in instances where animals are stored after an injection of radioactive materials that may be volatilized and dispersed in the room.

6.7. The rules laid down in 5.9.4 apply also to the incineration of carcasses and animal tissues.

6.8. Animals placed in a refrigerator prior to incineration or other disposal must be properly labeled.

7. EMERGENCY PLANS

7.1. SEALED SOURCE RUPTURE

If a disruption of a sealed source occurs, or if potentially hazardous quantities of radioactive dusts, mists, fumes, organic vapors or gases are introduced into the air, the following emergency measures should be taken immediately:

a. No immediate attempt should be made to clean up the spill.

b. All windows should be closed, fans and air conditioners should be shut off, and everyone should leave the room.

c. All doors should be closed and locked.

d. If powdered or gaseous sources are involved, the door and all other openings leading into the room should be sealed with wide masking tape or adhesive tape and heavy wrapping paper.

e. The spread of radioactive contamination can be diminished by restricting the movements of potentially contaminated persons to a local zone just outside the spill area until the extent of shoe and clothing contamination is ascertained.

f. Every person who might have been contaminated should be monitored for radioactivity, and, if contaminated, should remove his clothes and be decontaminated. If no means are available for monitoring, it should be assumed that the person is contaminated.

g. The Radiation Protection Officer should be called immediately. If necessary, outside consultants experienced in radiation hazards should be called in and their advice followed.

7.2. RADIOACTIVE LIQUID SPILLS

All spills of radioactive material must be cleaned up promptly. The responsibility for cleaning or for calling for experienced help rests on the individuals working in the area involved and responsible for the spill.

Under no circumstances should any untrained person attempt to examine or clean up a major spill of radioactive material. (The clean-up technique should be planned with the same care as is used in quantitative chemical analyses or in bacteriological handling of virulent organisms.) Fans or ventilation apparatus should not be turned on in an attempt to blow the isotope or its decay products away. Such a maneuver will only disseminate the radioactive material throughout the area. If the isotope is blown out of a building, air currents may carry the finely divided material into nearby windows or air-intake ducts. Proper precautions taken immediately will protect human life and reduce financial losses.

The Radiation Protection Officer shall be notified immediately of all accidents involving possible body contamination or ingestion of radioactivity by personnel, over-exposure to radiation, contamination of equipment, spread of contamination or difficulty in cleaning up contaminated areas. The RPO must be notified immediately in the event of loss of radioisotopes.

The following procedures will be followed:

7.2.1 Minor spills

a. Notify all persons in the room at once.

b. Permit only the minimum number of persons necessary to deal with the spill in the area.

c. Confine the spill immediately.

d. Don protective gloves and drop absorbent paper on the liquid spill.

e. Decontaminate, using a monitor to check the progress of the work.

f. Monitor all persons involved in the spill and the cleaning.

7.2.2. Major Spills

a. Notify all persons not involved in the spill to vacate the room at once, and notify the Radiation Protection Officer.

b. If hands are protected from contamination (i.e., gloves) right the container of the spilled liquid.

c. If the spill is on clothing, discard outer clothing at once.

d. Vacate the room.

e. Take immediate steps to decontaminate involved personnel.

f. A consultant experienced in radiation hazards should be called in and his advice followed.

7.2.3. NOTE: Special problems associated with the spillage of liquid sources are covered in NBS Handbook 48, pages 20 and 21.

8.0 THE ALARA CONCEPT

NRC directives require that licensees must demonstrate their commitment to maintaining all employee exposure to radiation as low as reasonably achievable (ALARA). The uses of radioisotopes at BBRI are diverse and are constantly changing; consequently, without day-to-day supervision, direct control is a practical impossibility. Therefore, the maintenance of minimal exposure must be the responsibility of the individual worker and the worker's supervisor, although the department representative of the Radioisotope Committee must at regular intervals review and examine the techniques and procedures in the laboratories in their department to ensure that control is maintained.

Adherence to the ALARA concept involves periodic formal reviews of the radiation safety program, the scheduling of briefings and educational sessions, and investigation of the causes of personnel exposure if it should exceed certain levels (see Section 5.2.2). The program for the achievement of radiation exposure ALARA is described in Appendix 4.

BBRI

RECORD KEEPING REQUIREMENTS

IN CONNECTION WITH RADIOISOTOPE USE

As a condition of our license for the use of radioisotopes, the following records must be maintained, kept on file, and available for inspection without prior notice.

Samples of the appropriate record forms are attached and may be photocopied for your use.

Form No.	Description	Person responsible for record maintenance	Location where record must be kept on file
1	Radioisotope Receiving Check List	Radioisotope user or licensee	Licensee's office
2	Radioisotope Experiment Check List	Radioisotope user	Radioisotope user's desk, to to transferred to licensee upon completion of experiments.
3	Radioactive Waste Disposal Record	Licensee	Licensee's office
	Film Badge Record	Harvard University Health Services	Health Services office (Radioisotope Chairman must be notified if exposure is observed.)
5	Request for reorder	Chairman, Radioisotope Committee	Chairman's office
	Radioisotope inventory	Chairman, Radioisotope Committee	Chairman's office
6	Permission for storage in 006	Chairman, Radioisotope Committee	Chairman's office

It is recommended that Disposal Records, Form 3, be summarized monthly.

TABLE I

QUANTITIES OF SOME RADIOACTIVE MATERIALS WHICH DO NOT REQUIRE AN N.R.C. LICENSE AND WHICH MAY BE DISPOSED IN THE SEWAGE SYSTEM PER DAY

Radionuclide		Unsealed Sources µc
Actinium	227	0.1
Americium	241	0.1
Antimony	124	10
Arsenic	73	100
	74	10
	76	10
	77	100
Astatine	211	0.1
Barium-Lanthanum	140	10
Bromine	82	10
Cadmium-	109	10
Calcium	45	10
	47	10
Carbon	14	100
Cerium-	144	1
Cesium	137	10
Chlorine	36	10
Chromium	51	1000
Cobalt	58	10
	60	1
Copper	64	100
Europium	154	1
Fluorine	18	1000
Gallium	72	10
Germanium	71	100
Gold	198	100
	199	100
Holmium	166	100
Hydrogen	3	1000
Indium	114	10
Iodine	131	1
	132	10
Iridium	192	10
Iron	55	100
	59	10
Krypton	85	100
Lanthanum	140	10
Lead	210	0.1
Lutecium	177	100
Manganese	52	10
	54	10
	56	10
Iodine	125	1

Radionuclide		Unsealed Sources µc
Molybdenum	99	100
Nickel	59	100
	63	10
Niobium	95	10
Palladium	103	100
Palladium	109	100
Phosphorus	32	10
Platinum	191	100
	193	100
Polonium	210	0.1
Potassium	42	10
Praseodymium	143	100
Prometheum	147	10
Rhenium	186	100
Rhodium	105	100
Rubidium	86	10
Ruthenium	103	10
Ruthenium-Rhodium	106	10
Samarium	151	10
	153	100
Scandium	46	10
	47	100
	48	10
Silver	105	10
	110	1
	111	100
Sodium	24	10
Strontium	89	1
Strontium-Yttrium	90	0.1
Sulfur	35	100
Tantalum	182	10
Technetium	96	10
	99	10
Tellurium	127	100
	129	100
Thallium	200	100
	201	100
	202	100
	204	10

Continued

TABLE I

Radionuclide		Unsealed Sources μc
Thulium-Ytterbioum	170	10
Tin	113	10
Tungsten	181	10
	185	10
Vanadium	48	10
Yttrium	90	10
Yttrium	91	10
Zinc	65	10
Zirconium-Niobium	95	10

This list is taken from Schedule B 10 CFR 30 of the U. S. NRC (1984) and Table I of the Rules and Regulations of the Commonwealth of Massachusetts, Department of Public Health. (1962). Where there is disagreement the lower quantity has been adopted.

NOTE: — No human use of radioactivity is permitted without an N.R.C. License.

TABLE II

QUANTITIES OF SOME RADIOACTIVE MATERIALS REQUIRING SIGNS

RADIOISOTOPE	Column I Minimum Quantity for Radioactive Material Sign in Room MICROCURIES	Column II Minimum Quantity for Radioactive Material Label on Container MICROCURIES
As-76	100	10
Au-198	1000	100
C-14	1000	100
Ca-45	100	10
Cl-36	100	10
Co-60	100	10
Cr-51	10000	1000
Cs-137	100	10
Cu-64	1000	100
F-18	10000	1000
Fe-55	1000	100
Fe-59	100	10
H-3 (HTO or H_2^3O)	10000	1000
I-131 or I-125	10	1
K-42	100	10
Na-24	100	10
P-32	100	10
Po-210	1	0.1
Ra-226	0.1	0.01
S-35	1000	100
Sc-46	100	10
Sr-89	10	1
Sr-90 + Y-90	1	0.1
Y-90	100	10
Zn-65	100	10
Unidentified	1	0.1
Tc-99	1000	100
Ni-63	100	10

This Table is based on Appendix C, 10 CFR 20, May 1970.

Form No. 1

BOSTON BIOMEDICAL RESEARCH INSTITUTE

RADIOISOTOPE RECEIVING: CHECK LIST

Check each "__ OK" block as you complete the item. This form should then be retained by the PI in his files.

NAME OF RECIPIENT:

DATE RECEIVED:

P.O. NUMBER:

ISOTOPE:

QUANTITY:

SUPPLIER:

1. The shipment will not be brought beyond the reception area if there is any sign of damage or leaking liquid.

2. When you receive the shipment you ordered, you must - if possible within three hours:

a. Put on plastic gloves and place the package in a vented hood. __ OK

b. Wipe test the outside of the package and count the paper in a scintillation counter. (Notify the Radioisotope Protection Service if more than 22,000 dpm per 100 sq. cm. surface wiped) __ OK

c. Verify quantity and contents of shipment against order __ OK

d. Measure radiation field (for α and β emitters) around shipping container. If more than 200 millirem/hr at the surface or 10 millirem/hr at 3 ft, notify shipper and Radiation Protection Officer __ OK

e. Open package and check for leakage, breaks or damage __ OK

f. Wipe test inner contents. Discard packing appropriately __ OK

3. If contamination, leakage or shortage is observed, notify vendor's Customer Service Department and Radiation Protection Officer by telephone.

SIGNATURE: _____

DATE: _____

FORM #2

Revised: 23 April 1980

BOSTON BIOMEDICAL RESEARCH INSTITUTE
Radioisotope Experiment Checklist

Records must be maintained of all experiments involving significant amounts of radioactivi >10 µCi). These records should be held on file and be available for inspection by members of the Radioisotope Committee or Federal Inspectors.

Any experiment with radio-iodine must be approved by the BBRI Radioisotope Committee. Any work with more than 5 mCi of ^{32}P or 10 mCi of ^{3}H or 100 µCi of iodine involves special procedures and must be reported to the Divisional Safety Officer.

The name of every radioisotope user must be listed with the Radioisotope Committee. Every woman who may be pregnant must be warned of the increased risk to the fetus and lower permissible radiation limits (10-CFR-19:12).

NAME OF AUTHORIZED AND QUALIFIED WORKER: _____

ISOTOPE: SUPPLIER:

STOCK QUANTITY: DATE RECEIVED:

DATE OF EXPERIMENT:						
PRODUCT USE: (e.g. in vitro experiment, animal experiment, chemical synthesis)						
QUANTITY TAKEN FOR USE:						
GLOVES USED? (Yes/No)						
GOOD USED? (Yes/No)						
HOT ROOM USED? (Yes/No)						
FILM BADGE USED? (Yes/No)						
SURVEY METER USED? (Yes/No) (Identify survey meter: _____)						
WASTE DISPOSAL:	LIQUID Amount Where					
	SOLID Amount Where					
	ANIMAL Amount Where					
FINAL WIPE TEST OF CLEANED WORK AREAS (counts/min or NDA)						
FINAL COUNT OF WORKER'S HANDS AND CLOTHES (counts/min or NDA)						

NOTES AND REMARKS:
(contamination, spills, etc.)

FORM 3

MONTHLY

Harvard Affiliate _____
Building Number _____
Room Number _____
Licensee's Name _____

WASTE DISPOSAL RECORD

LAB

Daily Limits for Radionuclide Disposal to Sink

^{45}CA	10	µCi	^{59}Fe	10	µCi
^{14}C	100	µCi	^{32}P	10	µCi
^{36}Cl	10	µCi	^{42}K	10	µCi
^{51}Cr	1000	µCi	^{24}Na	10	µCi
^{3}H	1000	µCi	^{86}Rb	100	µCi
^{125}I	1	µCi	^{35}S	100	µCi
^{131}I	1	µCi	^{65}Zn	10	µCi
^{55}Fe	100	µCi			

DATE	ISOTOPE	MICROCURIE	USER	METHOD OF DISPOSAL

Form 4

BOSTON BIOMEDICAL RESEARCH INSTITUTE
APPLICATION FOR AUTHORIZATION TO USE RADIOISOTOPES

Instructions: Send original and two signed copies to Chairman, Radioisotope Committee, BBRI. Upon approval, one copy will be returned to applicant.

1. Name _____ 3. Department _____

2. Position _____ 4. Address a _____
Extension _____

5. Locations where radioactive materials will be used _____

_____

6. Radioisotopes, Chemical and Physical form and maximum amounts that you will possess at any time.

7. Purpose for which radioactive material will be used. (Use extra sheets if necessary.)

8. Will you use designated fume hoods ____ the basement "hot" room (006)___

_____ _____
(date) (Signature of Applicant)

_____ _____

If this is your first application for authorization, submit a signed state- ment giving your training and experience in the use of radioisotopes, including (A) training in protection, dosimetry, and biological effects: (B) experience with specific radionuclides, including largest amounts of sealed and unsealed activities handled, places, dates, and types of work. If you propose to use isotopes or experimental procedures not covered in your current authorization, you are required to submit a new application.

THIS SECTION TO BE COMPLETED BY CHAIRMAN OF RADIOISOTOPE COMMITTEE

Investigated for Radioisotope Committee _____
Name Date

This application is approved subject to any conditions listed on the reverse side and provided that the use, storage and disposal of the radio- active material shall be in conformity with (A) the provisions of the Code of the Federal Regulations Title 10, Part 20, "Standard for Protection Against Radiation Hazards of Radioactive Materials," and (B) the regulations for the use of radioisotopes at BBRI.

_____ _____
Date FOR THE RADIOISITOPE COMMITTEE

FORM 5

REQUEST FOR RE-ORDER OF RADIOISOTOPES

The shipment of _____(radioisotope) in the form of _____ (chemical name) _____ (Purchase Order No.) was used and disposed of as follows:

1. Amount retained _____ in the form of _____.
2. Amount disposed of in sink _____ , Room:_____.
3. Other disposal and amount:_____ _____.
4. Amount decayed: _____.

Signature of P.I. _____

These data should summarize the reports on Forms 2 (Experiment Check List), and 3 (Monthly Disposal Record).

Form 6

PERMISSION TO STORE RADIOISOTOPES IN ROOM 006

To prevent Room 006 being made unusable due to irresponsible storage, users may place radioisotopes there no longer than two days, unless they are intended for commercial disposal and cannot be reasonably or safey held in the user's laboratory.

Licensee _____ requests permission to store

_____ μCi/mCi of _____ (radioisotope) in

Room 006 from _____ (date) until the next commercial

disposal.

Justification:

Physical form:

Grant to be charged for disposal costs:

The appropriate place for storage and the necessary screening will be decided in consultation with the RPO or Radioisotope Committee representative.

APPENDIX I.

GUIDES FOR THE USE OF FILM BADGES

Federal and State laws specify the wearing of personnel dosimeters for individuals entering restricted areas who receive or are likely to receive more than 5Δ of the maximum permissible doses. The total absorbed dose shall not exceed 5 rad in any twelve-month period. It is, however, recommended that radiation workers shouid wear dosimeters where it is likely that 10Δ of these limits may be exceeded; i.e., where the maximum permissible dose for members of the general public may be exceeded.

LOW ENERGY BETA EMITTERS

The beta rays from soft beta emitters such as C-14 and S-35 have insufficient range to affect film badges as normally packaged. By removal of some of the packaging material (maintaining the film cover at greater than 7 mg/cm), protection services may make the badge sensitive to these isotopes.

Beta rays from tritium will not affect film badges even when modified, and, therefore, individuals handling only tritium should not wear badges.

APPENDIX 2

INCINERATION PROCEDURES

Under present license, the Institute is permitted to dispose of organic compounds in solid form (paper, cloth, carcasses of animals) and in limited liquid form (scintillation fluid) containing sulfur-35, hydrogen-3, carbon-14, and iodine-125. The radioactivity in the material to be incinerated should not exceed the following limits.

Sulfur-35	5 μC/kg
Hydrogen-3	50 μC/kg
Carbon-14	50 μC/kg
Iodine-125	1 μC/kg

Based on the normal operation of the incinerator, the concentration in the gaseous effluent from the incineration of these concentrations of radioisotopes should not exceed the limits specified for air in Appendix B, Table II of 10 CRF 20, and the concentration of radioactive material appearing in the ash residue from incineration should not exceed the concentrations (in terms of microcuries per gram) specified for water in Appendix B, Table II, 10 CFR 20.

All material that can be incinerated under these limits must be properly packed in suitable containers, tagged to indicate the radioisotope type and amount, and the package delivered to the incinerator room in the basement (room 003) and placed on the floor inside the room in the area indicated.

UNDER NO CIRCUMSTANCES IS ANYONE EXCEPT THE ANIMAL FACILITIES SUPERVISOR TO PLACE ANYTHING IN THE INCINERATOR ITSELF!

Liquid scintillation fluid containing radioisotopes within the limits set above may be incinerated IN THE PLASTIC SCINTILLATION VIALS. Special cardboard boxes (3" x 5" x 8") must be used to pack these vials for incineration. The boxes are available from the Animal Facilities Supervisor.

The ash from the incinerator must be saved for assay according to NRC requirements.

Appendix 3

UNIVERSITY HEALTH SERVICES

Memorandum

DATE: February 6, 1980

To: Users of Radioactive Materials

FROM: Radiation Protection Office

Subject: REVISED WASTE DISPOSAL INSTRUCTIONS (2/1/80)

IMPORTANT: THE FOLLOWING WASTE DISPOSAL REGULATIONS WERE REVISED TO ENABLE COMPLIANCE WITH NEW WASTE DISPOSAL REQUIREMENTS AT THE HANFORD BURIAL GROUNDS. VIOLATION OF THESE REGULATIONS WILL RESULT IN REJECTION OF ANY FURTHER SHIPMENTS FROM HARVARD NOT ONLY AT HANFORD BUT AT THE OTHER WASTE DISPOSAL SITES AS WELL. WE MUST HAVE COMPLETE COOPERATION OF USERS IF WE ARE TO CONTINUE TO SHIP OUT RADIOACTIVE WASTE

Attached is a revised manifest to accompany all packages of radioactive waste. These are grouped into six categories (an additional category is assigned to animal carcasses). Packages in categories A,B,C and D can be shipped to Hanford. Packages in categories E and F can be handled locally at about 25 percent of the Hanford burial cost. All animal carcasses are in category G and must be handled separately, as in the past.

Each package of waste received by EH&S must be individually labelled and must fall into at least one of the seven categories listed on the manifest. Each package will be disposed of in the least expensive category in which it can be classified.

LABELLING MUST BE ACCURATE. Many packages labelled paper and plastic have been found to contain glass. These are handled, and billed as Dry Solids (category D), which has the greatest cost. Any package which cannot be placed in a category or is improperly labelled, will be returned to the user.

There are 12 Nuclear Regulatory Commission inspectors at the Hanford Burial site. They inspect drums, both outside and inside and will cite the most minor violations with disastrous consequences to the shipper. We must be equally strict if we are to be allowed to ship out waste. Following is a detailed description of the seven categories.

A. Liquid Scintillation Vials - Full or Empty.

This may include only liquid scintillation vials. Users must not include pipettes, microscope slides, syringes, gloves, bench pads, etc. These are not liquid scintillation vials.

B. Tubes and Vials.

This includes plastic and glass labware, excluding liquid scintillation vials, and each tightly capped item may contain up to 10 milliliters of liquid. Containers which are not tightly capped must not contain liquids. Paper waste or plastic gloves may not be included.

C. Bulk Liquids.*

This includes all liquids, except those contained in liquid scintillation vials. Containers holding up to 10 milliliters may be packaged in category B, or emptied and the contents shipped as Bulk Liquids. It is the only liquid category other than the liquid scintillation vial category that applies to liquids. Culture bottles, centrifuge tubes, test tubes, etc. must be emptied, the liquids shipped as bulk, and the containers shipped in categories D, E, or F.

D. Dry Solids.

This category is restricted to dry materials only. The regulations specify that they "do not contain any trace of liquids." For our purposes this means that all discernible volumes of liquid be removed by pouring and draining. The Hanford burial site was closed in October, 1979 because of improperly packaged liquids and the operators are particularly sensitive to any recurring violations. Any package labelled "paper and plastic" and found to contain glass will be shipped in category D if it complies with the requirements; otherwise it will be returned to user.

E. Paper, Plastic, and Cloth.

Containing ^{3}H, ^{14}C, ^{35}S, ^{51}Cr or isotopes with half lives less than 90 days except ^{131}I and ^{125}I. Must not include glass.

F. Paper, Plastics, and Cloth.

Containing ^{125}I or ^{131}I. Must not include glass.

G. Animal Carcasses.

These will be handled as in the past. It is essential that each package be labelled with isotope, amount, date and investigator's name. Animals must be packed in the most compact form possible, doubled bagged or boxed and labelled with a tag stating above information.

Any user having radioactive waste or any radioisotope which does not fall into one of the above categories please call EH&S, (495-2061) for disposal instructions.

* PLEASE NOTE: Bulk liquids must be delivered in non-breakable plastic containers (Nalgene, i.e.) and if brought to the storeroom on carts, must be placed in a restraining container (such as a box) to prevent toppling off the cart. Accidents have occurred several times within the past month as the result of improper containers being used.

WASTE DISPOSAL MANIFEST

1. Licensee:
2. Address (Bldg. and room)
3. Date Transferred to EH&S:

4. Category	Isotope and Activity	Group 3* Toxic	Volume (Office Use Only)
☐ A. Liquid Scintillation Vials. Must be tightly capped.			
☐ B. Tubes and vials.			
☐ C. Bulk Liquids			
☐ D. Dry glass, metal (except no liquid scintillation vials, even empty ones) See instructions for further explanation. May contain dry paper and plastics but is much cheaper to package these in categories E and F.			
☐ E. Paper, plastics, cloth containing ^{3}H, ^{14}C, ^{35}S, ^{51}Cr and isotopes with half lives less than 90 days except ^{125}I and ^{131}I.			
☐ F. Paper, plastics, cloth containing ^{125}I and ^{131}I.			
☐ G. Animal Carcasses.			

Each package of radioactive waste delivered to EH&S must be accompanied by the above manifest. Items in the manifest must be completed.

Items 1 through 3. Enter the name of the investigator who holds the license under which the material was purchased and used. Also fill out address and date transferred to EH&S completely.

Items A through G. Describe the waste by checking appropriate box.

Each package of waste delivered to EH&S must conform to at least one of the segregation categories listed on the manifest. Any package which does not fall into any of these categories will be returned to the user for repackaging.

* Containing substances which merit a "3" toxic hazard rating code according to Dangerous Properties of Industrial Materials, N. Irving Sax (" may cause death or perminent injury after very short exposure to small quantities")

Appendix 4

Model Program for Maintaining Occupational Radiation Exposures at Medical Institutions ALARA

_____
(Licensee's Name)

_____
(Date)

I. Management Commitment

a. We, the management of this (medical facility, hospital, etc.) are committed to the program described in this paper for keeping exposures (individual and collective) as low as reasonably achievable (ALARA). In accord with this commitment, we hereby describe an administrative organization for radiation safety and will develop the necessary written policy, procedures and instructions to foster the ALARA concept within our institution. The organization will include a Radiation Safety Committee (RSC)[1] and a Radiation Safety Officer (RSO).

b. We will perform a formal annual review of the radiation safety program including ALARA considerations. This shall include reviews of operating procedures and past exposure records, inspections, etc., and consultations with the radiation protection staff or outside consultants.

c. Modification to operating and maintenance procedures and to equipment and facilities will be made where they will reduce exposures unless the cost, in our judgement, is considered to be unjustified. We will be able to demonstrate, if necessary, that improvements have been sought, that modifications have been considered, and that they have been implemented where reasonable. Where modifications have been recommended but not implemented, we will be prepared to describe the reasons for not implementing them.

d. In addition to maintaining doses to individuals as far below the limits as is reasonably achievable, the sum of the doses received by all exposed individuals will also be maintained at the lowest practicable level. It would not be desirable, for example, to hold the highest doses to individuals to some fraction of the applicable limit if this involved exposing additional people and significantly increasing the sum of radiation doses received by all involved individuals.

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[1] Private practice physician licenses do not include a RSC.

II. Radiation Safety Committee (RSC)[2]

a. Review of Proposed Users and Uses

1. The RSC will thoroughly review the qualifications of each applicant with respect to the types and quantities of materials and uses for which he has applied to assure that the applicant will be able to take appropriate measures to maintain exposure ALARA.

2. When considering a new use of byproduct material, the RSC will review the efforts of the applicant to maintain exposure ALARA. The user should have systematized procedures to ensure ALARA, and shall have incorporated the use of special equipment such as syringe shields, rubber gloves, etc., in his proposed use.

3. The RSC will ensure that the user justifies his procedures and that dose will be ALARA (individual and collective).

b. Delegation of Authority

(The judicious delegation of RSC authority is essential to the enforcement of an ALARA program.)

1. The RSC will delegate authority to the RSO for enforcement of the ALARA concept.

2. The RSC will support the RSO in those instances where it is necessary for the RSO to assert his authority. Where the RSO has been overruled, the Committee will record the basis for its action in the minutes of the Committee's quarterly meeting.

c. Review of ALARA Program

1. The RSC will encourage all users to review current procedures and develop new procedures as appropriate to implement the ALARA concept.

2. The RSC will perform a quarterly review of occupational radiation exposure with particular attention to instances where Investigational Levels in Table I below are exceeded. The principal purpose of this review is to assess trends in occupational exposure as an index of the ALARA program quality and to decide if action is warranted when Investigational Levels are exceeded (see paragraph VI).[3]

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[2]The RSO on private practice physician licenses will assume the responsibilities of the RSC under Section II

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[3]The NRC has emphasized that the Investigational Levels in this program are not new dose limits but, as noted in ICRP Report 26, "Recommendations of the International Commission on Radiological Protection", serve as check points above which the results are considered sufficiently important to justify further investigations.

3. The RSC will evaluate our institution's overall efforts for maintaining exposures ALARA on an annual basis. This review will include the efforts of the RSO, authorized users, and workers as well as those of management.

III. Radiation Safety Officer (RSO)

a. Annual and Quarterly Review

1. Annual review of the Radiation Safety Program. The RSO will perform an annual review of the Radiation Safety Program for adherence to ALARA concepts. Reviews of specific procedures may be conducted on a more frequent basis.

2. Quarterly review of Occupational Exposures. The RSO will review at least quarterly the external radiation exposures of authorized users and workers to determine that their exposures are ALARA in accordance with the provisions of paragraph VI of this program.

3. Quarterly review of records of Radiation Level Surveys. The RSO will review radiation levels in unrestricted and restricted areas to determine that they were at ALARA levels during the previous quarter.

b. Education Responsibilities for an ALARA Program

1. The RSO will schedule briefings and educational sessions to inform workers of ALARA program efforts.

2. The RSO will assure that authorized users, workers and ancillary personnel who may be exposed to radiation will be instructed in the ALARA philosophy and informed that management, the RSC and the RSO are committed to implementing the ALARA concept.

c. Cooperative Efforts for Development of ALARA Procedures

Radiation workers will be given opportunities to participate in formulation of the procedures that they will be required to follow.

1. The RSO will be in close contact with all users and workers in order to develop ALARA procedures for working with radioactive materials.

2. The RSO will establish procedures for receiving and evaluating the suggestions of individual workers for improving health physics practices and encourage the use of those procedures.

d. Reviewing Instances of Deviation from Good ALARA Practices

The RSO will investigate all known instances of deviation from good ALARA practices; and, if possible, determine the causes. When the cause is known, the RSO will require changes in the program to maintain exposures ALARA.

IV. Authorized Users

a. New Procedures Involving Potential Radiation Exposures

1. The authorized user will consult with, and receive the approval of, the RSO and/or RSC during the planning stage before using radioactive materials for a new procedure.

2. The authorized user will evaluate all procedures before using radioactive materials to ensure that exposures will be kept ALARA. This may be enhanced through the application of trial runs.

b. Responsibility of the Authorized User to Those He Supervises

1. The authorized user will explain the ALARA concept and his commitment to maintain exposures ALARA to all of those he supervises.

2. The authorized user will ensure that those under his supervision who are subject to occupational radiation exposure are trained and educated in good health physics practices and in maintaining exposures ALARA.

V. Persons Who Receive Occupational Radiation Exposure

a. The worker will be instructed in the ALARA concept and its relationship to his working procedures and work conditions.

b. The worker will know what recourses are available if he feels that ALARA is not being promoted on the job.

VI. Establishment of Investigational Levels In Order to Monitor Individual Occupational External Radiation Exposures

This institution (or private practice) hereby establishes Investigational Levels for occupational external radiation exposure which, when exceeded, will initiate review or investigation by the Radiation Safety Committee and/or the Radiation Safety Officer. The Investigational Levels that we have adopted are listed in Table 1 below. These levels apply to the exposure of individual workers.

Table 1

		Investigational Levels - (mrems per calendar quarter)	
		LEVEL I	LEVEL II
1.	Whole body; head and trunk; active blood-forming organs; lens of eyes; or gonads	125	375
2.	Hands and forearms; feet and ankles	1875	5625
3.	Skin of whole body*	750	2250

* Not normally applicable to nuclear medicine operations except those using significant quantities of beta emitting isotopes.

The Radiation Safety Officer will review and record on Form NRC-5, Current Occupational External Radiation Exposures, or an equivalent form (e.g. dosimeter processor's report), results of personnel monitoring, not less than once in any calendar quarter, as is required by 10 CFR 20, §20.401. The following actions will be taken at the Investigational Levels as stated in Table 1:

a. Quarterly exposure of individuals to less than Investigational Level I.

Except when deemed appropriate by the RSO, no further action will be taken in those cases where an individual's exposure is less than Table I values for the Investigational Level I.

b. Personnel exposures equal to or greater than Investigational Level I, but less than Investigational Level II.

The RSO will review the exposure of each individual whose quarterly exposures equal or exceed Investigational Level I. He will report the results of his reviews at the first RSC meeting following the quarter when the exposure was recorded. If the exposure does not equal or exceed Investigational Level II, no action related specifically to the exposure is required unless deemed appropriate by the Committee. The Committee will, however, consider each such exposure in comparison with ~~those~~ that of others performing similar tasks as an index of ALARA program quality and will record the review in the Committee minutes.

c. Exposure equal to or greater than Investigational Level II.

The RSO will investigate in a timely manner the cause(s) of all personnel exposures equaling or exceeding Investigational Level II and, if warranted, take action. A report of the investigation, actions taken, if any, and a copy of the individual's Form NRC-5 or its equivalent will be presented to the RSC at the first RSC meeting following completion of the investigation. The details of these reports will be recorded in the Committee minutes. Committee minutes will be sent to the management of this institution for review. The minutes, containing details of the investigation, will be made available to NRC inspectors for review at the time of the next inspection.

d. Re-establishment of an individual occupational worker's Investigational Level II Above That Listed In Table I.

In cases where a worker's or a group of worker's exposures need to exceed Investigational Level II, a new, higher Investigational Level II may be established on the basis that it is consistent with good ALARA practices for that individual or group. Justification for a new Investigational Level II will be documented.

The Radiation Safety Committee will review the justification for, and will approve, all revisions of Investigational Levels II. In such cases, when the exposure equals or exceeds the newly established Investigational Level II, those actions listed in paragraph c above will be followed.

VII. Signature of Certifying Official[4]

I hereby certify that this institution (or private practice), has implemented the ALARA Program set forth above.

Peter F. Davison
Signature

PETER F. DAVISON
Name (print or type)

Executive Director.
Title

Institution (or Private Practice) Name and Address:

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[4] The individual who is authorized to make commitments for the administration of the institution (e.g., hospital administrator, etc.) or, in the case of a private practice, the licensed physician.

Appendix 5

GUIDELINES FOR BIOASSAY REQUIREMENTS FOR TRITIUM

Nuclear Regulatory Commission

Division of Fuel Cycle and Material Safety

October 19, 1977

AB/REA

BIOASSAY REQUIREMENTS FOR TRITIUM

I. Conditions Requiring Bioassay

A. Routine Bioassay is required when quantities processed by an individual at any one time, or total amount processed per month, exceed those for the respective forms of tritium as shown in the attached Table 1.

B. Above 0.1 of, but less than, the levels in Table 1, routine bioassay is required unless a written justification is submitted for not performing bioassays.

C. Except as stated in I.D. below, bioassay is not required for process quantities less than 0.1 of those in Table 1.

D. Special bioassay measurements should be performed to verify the effectiveness of respiratory protection devices and other protective clothing. If an individual wearing a respiratory protective device or protective clothing is subjected to a concentration of tritium in air (in any form) such that his or her intake with no protection would have exceeded that which would result from exposure for 40 hours per week for 13 weeks at uniform concentrations of tritium in air as specified in Appendix B, Table I, Column I, 10 CFR 20,* bioassays should be

*Multiplying the concentration given in Appendix B, 5×10^{-6} μCi/ml, by 6.3×10^{8} ml gives the corresponding quarterly intake of tritium by inhalation. This is assumed equal to the uptake of tritium (as HTO) by absorption through the skin unless the form of tritium in the air can be demonstrated to have lower uptakes. The total uptake, including skin absorption, would be assumed to be about 6.3 mCi, which delivers a dose commitment of about 1.25 rems to standard man.

performed to determine the resulting actual tritium intake. These special bioassay procedures should also be conducted, for personnel wearing respirators, if for any reason the average tritium concentration in air and the duration of exposure are unknown.

II. Who Should Participate

All workers involved in the processing of tritium, under conditions specified in I above, or sufficiently close that intake is possible, should participate.

III. What Types of Bioassays Should be Performed

A. Baseline (including Pre-employment, or Pre-operational Urinalysis, not more than one month prior to beginning work with tritium requiring bioassay under Section I above).

B. Routine Urinalysis

C. Post-operational. Within one month of last possible exposure to tritium.

D. Diagnostic. Within one week of any sample exceeding levels given as action points in Section V below. See V.A.2.(d).

IV. How Often

A. Initial Routine Samples

Within 48 hours following entry of an individual into an area where operations require bioassay according to Section I.A and

B above, and then every two weeks or more frequently thereafter as long as the individual is working with ^{3}H.

B. After 3 Months

The sampling frequency selected in accordance with Section IV.A above may be changed to quarterly if, after 3 months, the following 3 conditions are met:

(1) The average urinary tritium concentration from specimens obtained during the 3-month period does not exceed 3 μCi/l,

(2) Where measurements of the concentration of tritium in air are required as a condition of the license, the quarterly average concentration (μCi/ml) to which workers are exposed, multiplied by the factor 6.3×10^{8} ml, does not exceed 0.8 mCi, and

(3) The working conditions during the 3-month period, with respect to the potential for tritium exposure, are representative of working conditions during the period in which a quarterly urinalysis frequency is employed, and there is no reasonable expectation that the criteria given in (1) and (2) above will be exceeded.

V. Action Points and Corresponding Actions

A. Bi-Weekly or More Frequent Sampling

1. If urinary excretion rates exceed 5 μCi/liter, but are less

than 28 μCi/liter, the following course of action should be taken:

(a) a survey of the operations involved, including air and area monitoring, should be carried out to determine the cause(s) of exposure and evaluate potential for further larger exposures.

(b) Implement any reasonable corrective actions indicated in the survey that may lower the potential for further exposures.

(c) A repeat urine sample should be taken within one week of the previous sample and should be evaluated within a week after collection.

(d) Any evidence from (a) and (b) indicating that further work in the area might result in an employee receiving a dose commitment in excess of the limits established in §20.101 should serve as cause to remove the employee from work in this operation until the source of exposure is discovered and corrected.

2. If urinary excretion rates exceed 50 μCi/liter, the following course of action should be taken:

(a) Carry out all steps as in 1.(a) to (d) above.

(b) If the projected dose commitment exceeds 5 rems, report the incident to the NRC in accordance with §20.403 of 10 CFR Part 20.

(c) Refer the case to appropriate medical/health physics consultation for recommendations regarding therapeutic procedures that may be carried out to accelerate removal of tritium from the body and reduce the dose as low as reasonably achievable.

(d) Carry out repeated sampling (urine collections of at least 100 ml each) at approximately one-week intervals, at least until samples show an excretion rate less than 5 μCi/liter. If there is a possibility of long-term organic compartments of tritium that require evaluation, continue sampling as long as necessary to ensure that appreciable exposures to these other compartments do not go undetected.

B. Quarterly Sampling

Carry out actions at levels as indicated under A. above, and if the excretion rate continues to exceed 5 μCi/liter, also reinstitute biweekly (or more frequent) sampling for at least the next 6-month period, even when urinary excretion falls below 5 μCi/liter.

TYPES OF OPERATION	HTO FORM (& forms other than those on right-hand cols.)	HT or T_2 GAS IN SEALED PROCESS VESSELS	NUCLEOTIDE PRECURSORS	HTO MIXED WITH MORE THAN 10K_g OF INERT H_2O OR OTHER SUBSTANCES
PROCESSES IN OPEN ROOM OR BENCH, WITH POSSIBLE ESCAPE OF TRITIUM FROM PROCESS VESSELS	0.1 Ci	100 Ci	0.01 Ci	0.01 Ci/K_g
PROCESSES WITH POSSIBLE ESCAPE OF TRITIUM, CARRIED OUT WITHIN A FUME HOOD OF ADEQUATE DESIGN, FACE VELOCITY, AND PERFORMANCE RELIABILITY	1 Ci	1000 Ci	0.1 Ci	0.1 Ci/K_g
PROCESSES CARRIED OUT WITHIN GLOVEBOXES, ORDINARILY CLOSED, BUT WITH POSSIBLE RELEASE OF TRITIUM FROM PROCESS AND OCCASIONAL EXPOSURE TO CONTAMINATED BOX AND BOX LEAKAGE	10 Ci	10,000 Ci	1 Ci	1 Ci/K_g

Table 1

ACTIVITY LEVELS OR CONCENTRATIONS ABOVE WHICH BIOASSAY SHALL BE REQUIRED

Quantities present (< 10Kg) may be considered either the amount processed by an individual at any one time (when accidental intake is more likely), or the amount of activity entered into process (throughput) during any one month (when routine handling of repeated batches is the more likely source of exposure). Concentrations in the right-hand column may be used when activity in process is always diluted in more than 10K_g of other reagents, as in nuclear reactor coolant systems.

UNITED STATES NUCLEAR REGULATORY COMMISSION

RULES and REGULATIONS

TITLE 10, CHAPTER 1, CODE OF FEDERAL REGULATIONS—ENERGY

PART 19

NOTICES, INSTRUCTIONS, AND REPORTS TO WORKERS; INSPECTIONS

Sec.

Authority: Secs. 53, 63, 81, 103, 104, 161, 186, 68 Stat. 930, 933, 935, 936, 937, 948, 955, as amended, sec. 234, 83 Stat. 444, as amended (42 U.S.C. 2073, 2093, 2111, 2133, 2134, 2201, 2236, 2282); sec. 201, 88 Stat. 1242, as amended by Pub. L. 94-79, 89 Stat. 413 (42 U.S.C. 5841), Pub. L. 95-601, sec. 10, 92 Stat. 2951 (42 U.S.C. 5851).

For the purposes of sec. 223, 68 Stat. 958, as amended (42 U.S.C. 2273); §§ 19.11(a), (c), (d), and (e) and 19.12 are issued under sec. 161b, 68 Stat. 948, as amended (42 U.S.C. 2201(b)); and §§ 19.13 and 19.14(a) are issued under sec. 161o, 68 Stat. 950, as amended (42 U.S.C. 2201(o)).

40 FR 8774

§ 19.1 Purpose.

The regulations in this part establish requirements for notices, instructions, and reports by licensees to individuals participating in licensed activities, and options available to such individuals in connection with Commission inspections of licensees to ascertain compliance with the provisions of the Atomic Energy Act of 1954, as amended, Title II of the Energy Reorganization Act of 1974, and regulations, orders, and licenses thereunder regarding radiological working conditions.

47 FR 57446

§ 19.2 Scope.

The regulations in this part appy to all persons who receive, possess, use, or transfer material licensed by the Nuclear Regulatory Commission pursuant to the regulations in Parts 30 through 35,40,60,61,70 or 72 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) pursuant to Part 72 of this chapter.

38 FR 22217

§ 19.3 Definitions.

As used in this part:

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

(b) "Commission" means the United States Nuclear Regulatory Commission;

(c) "Worker" means an individual engaged in activities licensed by the Commission and controlled by a licensee, but does not include the licensee.

47 FR 57446

(d) "License" means a license issued under the regulations in Parts 30 through 35,40,60,61,70 or 72 of this chapter, including licenses to operate a production or utilization facility pursuant to Part 50 of this chapter and licenses to possess power reactor spent fuel in an independent spent fuel storage installation (ISFSI) pursuant to Part 72 of this chapter. "Licensee" means the holder of such a license.

38 FR 22217

(e) "Restricted area" means any area access to which is controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials. "Restricted area" shall not include any areas used as residential quarters, although a separate room or rooms in a residential building may be set apart as a restricted area.

§ 19.4 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.

40 FR 8774

§ 19.5 Communications.

Except where otherwise specified in this part, all communications and reports concerning the regulations in this part should be addressed to the Director, Office of Inspection and Enforcement, 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.

49 FR 19623

§ 19.8 Information collection requirements: OMB approval.

(a) The Nuclear Regulatory Commission has submitted the information collection requirements contained in this part to the Office of Management and Budget (OMB) for approval as required by the Paperwork Reduction Act of 1980 (44 U.S.C. 3501 et seq.). OMB has approved the information collection requirements contained in this part under control number 3150-0044.

49 FR 19623

(b) The approved information collection requirements contained in this part appear in § 19.13.

36 FR 22217

§ 19.11 Posting of notices to workers.

(a) Each licensee shall post current copies of the following documents: (1) The regulations in this part and in Part 20 of this chapter; (2) the license, license conditions, or documents incorporated into a license by reference, and amendments thereto; (3) the operating procedures applicable to licensed activities; (4) any notice of violation involving radiological working conditions, proposed imposition of civil penalty, or order issued pursuant to Subpart B of Part 2 of this chapter, and any response from the licensee.

(b) If posting of a document specified in paragraph (a) (1), (2) or (3) of this section is not practicable, the licensee may post a notice which describes the document and states where it may be examined.

47 FR 30452

(c) Each licensee and applicant shall post Form NRC-3, (Revision 6-82 or later) "Notice to Employees," as required by Parts 30, 40, 50, 60, 70, 72, and 150 of this chapter.

NOTE: Copies of Form NRC-3 may be obtained by writing to the Director of the appropriate U.S. Nuclear Regulatory Commission Inspection and Enforcement Regional Office listed in Appendix "D", Part 20 of this chapter, or the Director, Office of Inspection and Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

38 FR 22217

(d) Documents, notices, or forms posted pursuant to this section shall appear in a sufficient number of places to permit individuals engaged in licensed activities to observe them on the way to or from any particular licensed activity location to which the document applies, shall be conspicuous, and shall be replaced if defaced or altered.

(e) Commission documents posted pursuant to paragraph (a)(4) of this section shall be posted within 2 working days after receipt of the documents from the Commission; the licensee's response, if any, shall be posted within 2 working days after dispatch by the licensee. Such documents shall remain posted for a minimum of 5 working days or until action correcting the violation has been completed, whichever is later.

§ 19.12 Instructions to workers.

All individuals working in or frequenting any portion of a restricted area shall be kept informed of the storage, transfer, or use of radioactive materials or of radiation in such portions of the restricted area; shall be instructed in the health protection problems associated

with exposure to such radioactive materials or radiation, in precautions or procedures to minimize exposure, and in the purposes and functions of protective devices employed; shall be instructed in, and instructed to observe, to the extent within the worker's control, the applicable provisions of Commission regulations and licenses for the protection of personnel from exposures to radiation or radioactive materials occurring in such areas; shall be instructed of their responsibility to report promptly to the licensee any condition which may lead to or cause a violation of Commission regulations and licenses or unnecessary exposure to radiation or to radioactive material; shall be instructed in the appropriate response to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radiation or radioactive material; and shall be advised as to the radiation exposure reports which workers may request pursuant to § 19.13. The extent of these instructions shall be commensurate with potential radiological health protection problems in the restricted area.

§ 19.13 Notifications and reports to individuals.

(a) Radiation exposure data for an individual, and the results of any measurements, analyses, and calculations of radioactive material deposited or retained in the body of an individual, shall be reported to the individual as specified in this section. The information reported shall include data and results obtained pursuant to Commission regulations, orders or license conditions, as shown in records maintained by the licensee pursuant to Commission regulations. Each notification and report shall: be in writing; include appropriate identifying data such as the name of the licensee, the name of the individual, the individual's social security number; include the individual's exposure information; and contain the following statement:

This report is furnished to you under the provisions of the Nuclear Regulatory Commission regulation 10 CFR Part 19. You should preserve this report for further reference.

(b) At the request of any worker, each licensee shall advise such worker annually of the worker's exposure to radiation or radioactive material as shown in records maintained by the licensee pursuant to § 20.401(a) and (c).

(c) At the request of a worker formerly engaged in licensed activities controlled by the licensee, each licensee shall furnish to the worker a report of the worker's exposure to radiation or radioactive material. Such report shall be furnished within 30 days from the time the request is made, or within 30 days after the exposure of the individual has been determined by the licensee, whichever is later; shall cover, within the period of time specified in the request, each calendar quarter in which the worker's activities involved exposure to radiation from radioactive materials licensed by the Commission; and shall include the dates and locations of licensed activities in which the worker participated during this period.

(d) When a licensee is required pursuant to § 20.405 or § 20.408 of this chapter to report to the Commission any exposure of an individual to radiation or radioactive material the licensee shall also provide the individual a report on his exposure data included therein. Such report shall be transmitted at a time not later than the transmittal to the Commission.

(e) At the request of a worker who is terminating employment in a given calendar quarter with the licensee in work involving radiation dose, or of a worker who, while employed by another person, is terminating assignment to work involving radiation dose in the licensee's facility in that calendar quarter, each licensee shall provide to each such worker, or to the worker's designee, at termination, a written report regarding the radiation dose received by that worker from operations of the licensee during that specifically identified calendar quarter or fraction thereof, or provide a written estimate of that dose if the finally determined personnel monitoring results are not available at that time. Estimated doses shall be clearly indicated as such.

44 FR 32332

§ 19.14 Presence of representatives of licensees and workers during inspections.

(a) Each licensee shall afford to the Commission at all reasonable times opportunity to inspect materials, activities, facilities, premises, and records pursuant to the regulations in this chapter.

(b) During an inspection, Commission inspectors may consult privately with workers as specified in § 19.15. The licensee or licensee's representative may accompany Commission inspectors during other phases of an inspection.

(c) If, at the time of inspection, an individual has been authorized by the workers to represent them during Commission inspections, the licensee shall notify the inspectors of such authorization and shall give the workers' representative an opportunity to accompany the inspectors during the inspection of physical working conditions.

(d) Each workers' representative shall be routinely engaged in licensed activities under control of the licensee and shall have received instructions as specified in § 19.12.

(e) Different representatives of licensees and workers may accompany the inspectors during different phases of an inspection if there is no resulting interference with the conduct of the inspection. However, only one workers' representative at a time may accompany the inspectors.

(f) With the approval of the licensee and the workers' representative an individual who is not routinely engaged in licensed activities under control of the license, for example, a consultant to the licensee or to the workers' representative, shall be afforded the opportunity to accompany Commission inspectors during the inspection of physical working conditions.

(g) Notwithstanding the other provisions of this section, Commission inspectors are authorized to refuse to permit accompaniment by any individual who deliberately interferes with a fair and orderly inspection. With regard to areas containing information classified by an agency of the U.S. Government in the interest of national security, an individual who accompanies an inspector may have access to such information only if authorized to do so. With regard to any area containing proprietary information, the workers' representative for that area shall be an individual previously authorized by the licensee to enter that area.

§ 19.15 Consultation with workers during inspections.

(a) Commission inspectors may consult privately with workers concerning matters of occupational radiation protection and other matters related to applicable provisions of Commission regulations and licenses to the extent the inspectors deem necessary for the conduct of an effective and thorough inspection.

(b) During the course of an inspection any worker may bring privately to the attention of the inspectors, either orally or in writing, any past or present condition which he has reason to believe may have contributed to or caused any violation of the act, the regulations in this chapter, or license condition, or any unnecessary exposure of an individual to radiation from licensed radioactive material under the licensee's control. Any such notice in writing shall comply with the requirements of § 19.16(a).

(c) The provisions of paragraph (b) of this section shall not be interpreted as authorization to disregard instructions pursuant to § 19.12.

§ 19.16 Requests by workers for inspections.

(a) Any worker or representative of workers who believes that a violation of the Act, the regulations in this chapter, or license conditions exists or has occurred in license activities with regard to radiological working conditions in which the worker is engaged, may request an inspection by giving notice of the alleged violation to the Director of Inspection and Enforcement, to the Director of the appropriate Commission Regional Office, or to Commission inspectors. Any such notice shall be in writing, shall set forth the specific grounds for the notice, and shall be signed by the worker or representative of workers. A copy shall be provided the licensee by the Director of Inspection and Enforcement, Regional Office Director, or the inspector no later than at the time of inspection except that, upon the request of the worker giving such notice, his name and the name of individuals referred to therein shall not appear in such copy or on any record published, released, or made available by the Commission, except for good cause shown.

(b) If, upon receipt of such notice, the Director of Inspection and Enforcement or Regional Office Director determines that the complaint meets the requirements set forth in paragraph (a) of this section, and that there are reasonable grounds to believe that the alleged violation exists or has occurred, he shall cause an inspection to be made as soon as practicable, to determine if such alleged violation exists or has occurred. Inspections pur-

38 FR 22217

38 FR 22217

38 FR 22217

suant to this section need not be limited to matters referred to in the complaint.

§ 19.17 Inspections not warranted; informal review.

(a) If the Director of Inspection and Enforcement or of the appropriate Regional Office determines, with respect to a complaint under § 19.16, that an inspection is not warranted because there are no reasonable grounds to believe that a violation exists or has occurred, he shall notify the complainant in writing of such determination. The complainant may obtain review of such determination by submitting a written statement of position with the Executive Director for Operations, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, who will provide the licensee with a copy of such statement by certified mail, excluding, at the request of the complainant, the name of the complainant. The licensee may submit an opposing written statement of position with the Executive Director for Operations who will provide the complainant with a copy of such statement by certified mail. Upon the request of the complainant, the Executive Director for Operations or his designee may hold an informal conference in which the complainant and the licensee may orally present their views. An informal conference may also be held at the request of the licensee, but disclosure of the identity of the complainant will be made only following receipt of written authorization from the complainant. After considering all written and oral views presented, the Executive Director for Operations shall affirm, modify, or reverse the determination of the Director of Inspection and Enforcement or of the appropriate Regional Office and furnish the complainant and the licensee a written notification of his decision and the reason therefor.

(b) If the Director of Inspection and Enforcement or of the appropriate Regional Office determines that an inspection is not warranted because the requirements of § 19.16(a) have not been met, he shall notify the complainant in writing of such determination. Such determination shall be without prejudice to the filing of a new complaint meeting the requirements of § 19.16(a).

38 FR 22217

§ 19.20 Employee protection.

Employment discrimination by a licensee or a contractor or subcontractor of a licensee against an employee for engaging in protected activities under this part or Parts 30, 40, 50, 60, 70, 72, or 150 of this chapter is prohibited.

47 FR 30452

§ 19.30 Violations.

An injunction or other court order may be obtained prohibiting any violation of any provision of the Act or Title II of the Energy Reorganization Act of 1974, or any regulation or order issued thereunder.

40 FR 8774

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 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.

38 FR 22217

§ 19.31 Application 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.

§ 19.32 Discrimination prohibited.

No person shall on the ground of sex be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity licensed by the Nuclear Regulatory Commission. This provision will be enforced through agency provisions and rules similar to those already established, with respect to racial and other discrimination, under title VI of the Civil Rights Act of 1964. This remedy is not exclusive, however, and will not prejudice or cut off any other legal remedies available to a discriminatee.

40 FR 8774

PART 20 STANDARDS FOR PROTECTION AGAINST RADIATION

PART 20—STANDARDS FOR PROTECTION AGAINST RADIATION

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 20.409 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. [40 FR 8774]

(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. [14 FR 12352] [40 CFR 8774]

(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. [40 FR 58847]

§ 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) pursuant to Part 72 of this chapter. [47 FR 57446]

§ 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; [40 CFR 8774]

(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 42557]

(5) "Commission" means the Nuclear Regulatory Commission or its duly authorized representatives;

(6) "Government agency" means any executive department, commission, independent establishment, corporation, wholly or partly owned by the United States of America which is an instrumentality of the United States, or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the Government; (25 FR 10914)

(7) "Individual" means any human being;

(8) "Licensed material" means source material, special nuclear material, or by-product material received, possessed, used, or transferred under a general or specific license issued by the Commission pursuant to the regulations in this chapter;

(9) "License" means a license issued under the regulations in Parts 30 through 35,40,60,61,70 or 72 of this chapter. "Licensee" means the holder of such license; (47 FR 57446)

(10) "Occupational dose" includes exposure of an individual to radiation (i) in a restricted area; or (ii) in the course of employment in which the individual's duties involve exposure to radiation, provided, that "occupational dose" shall not be deemed to include any exposure of an individual to radiation for the purpose of medical diagnosis or medical therapy of such individual. (25 FR 10914)

(11) "Person" means: (i) Any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission or the Department (except that the Department shall be considered a person within the meaning of the regulations in this part to the extent that its facilities and activities are subject to the licensing and related regulatory authority of the Commission pursuant to section 202 of the Energy Reorganization Act of 1974 (88 Stat. 1244)), any State, any foreign government or nation or any political subdivision of any such government or nation, or other entity; and (ii) any legal successor, representative, agent, or agency of the foregoing. (40 FR 8774)

(12) "Radiation" means any or all of the following: alpha rays, beta rays, gamma rays, X-rays, neutrons, high-speed electrons, high-speed protons, and other atomic particles; but not sound or radio waves, or visible, infrared, or ultraviolet light; (25 FR 10914)

(13) "Radioactive material" includes any such material whether or not subject to licensing control by the Commission; (45 FR 14199)

(14) "Restricted area" means any area access to which is controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials. "Restricted area" shall not include any areas used as residental quarters, although a separate room or rooms in a residential building may be set apart as a restricted area; (25 FR 13952)

(15) "Source material" means: (i) Uranium or thorium, or any combination thereof, in any physical or chemical form; or (ii) ores which contain by weight one-twentieth of one percent (0.05%) or more of (a) uranium, (b) thorium or (c) any combination thereof. Source material does not include special nuclear material. (27 FR 5905)

(16) "Special nuclear material" means: (i) Plutonium, uranium 233, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Commission, pursuant to the provisions of section 51 of the act, determines to be special nuclear material, but does not include source material; or (ii) any material artificially enriched by any of the foregoing but does not include source material; (25 FR 10914)

(17) "Unrestricted area" means any area access to which is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials, and any area used for residential quarters. (25 FR 13952)

(18) "Department" means the Department of Energy established by the Department of Energy Organization Act (Pub. L. 95-91, 91 Stat. 565, 42 U.S.C. 7101 *et seq.*) to the extent that the Department, or its duly authorized representatives, exercises functions formerly vested in the U.S. Atomic Energy Commission, its Chairman, members, officers and components and transferred to the U.S. Energy Research and Development Administration and to the Administrator thereof pursuant to sections 104 (b), (c) and (d) of the Energy Reorganization Act of 1974 (Pub. L. 93-438, 88 Stat. 1233 at 1237, 42 U.S.C. 5814) and retransferred to the Secretary of Energy pursuant to section 301(a) of the Department of Energy Organization (Pub. L. 95-91, 91 Stat. 565 at 577, 42 U.S.C. 7151). (45 FR 14199)

(19) "Termination" means the end of employment with the licensee or, in the case of individuals not employed by the licensee, the end of a work assignment in the licensee's restricted areas in a given calendar quarter, without expectation or specific scheduling of reentry into the licensee's restricted areas during the remainder of that calendar quarter. (44 FR 32352)

(b) Definitions of certain other words and phrases as used in this part are set forth in other sections, including:

(1) "Airborne radioactivity area" defined in § 20.203;

(2) "Radiation area" and "high radiation area" defined in § 20.202;

(3) "Personnel monitoring equipment" defined in § 20.202;

(4) "Survey" defined in § 20.201;

(5) Units of measurement of dose (rad, rem) defined in § 20.4;

(6) Units of measurement of radioactivity defined in § 20.5.

§ 20.4 Units of radiation dose.

(a) "Dose," as used in this part, the quantity of radiation absorbed, p unit of mass, by the body or by any portion of the body. When the regulations in this part specify a dose during a period of time, the dose means the total quantity of radiation absorbed, per unit of mass, by the body or by any portion of the body during such period of time. Several different units of dose are in current use. Definitions of units as used in this part are set forth in paragraphs (b) and (c) of this section. (25 FR 10914)

(b) The rad, as used in this part, is a measure of the dose of any ionizing radiation to body tissues in terms of the energy absorbed per unit mass of the tissue. One rad is the dose corresponding to the absorption of 100 ergs per gram of tissue. (One millirad (mrad)=0.001 rad.)

(c) The rem, as used in this part, is a measure of the dose of any ionizing radiation to body tissues in terms of its estimated biological effect relative to a dose of one roentgen (r) of X-rays. (One millirem (mrem)=0.001 rem.) The relation of the rem to other dose units depends upon the biological effect under consideration and upo the conditions of irradiation. For t purpose of the regulations in this part, any of the following is considered t be equivalent to a dose of one rem:

(1) A dose of 1 r due to X- or gamma radiation;

(2) A dose of 1 rad due to X-, gamma, or beta radiation;

(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:

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 delivery 100 millirem in 40 hours (neutrons/cm² sec.)
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.

§ 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.

§ 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.

§ 20.8 Information collection requirements: OMB approval.

(a) The Nuclear Regulatory Commission has submitted the information collection requirements contained in this part to the Office of Management and Budget (OMB) for approval as required by the Paperwork Reduction Act of 1980 (44 U.S.C. 3501 et seq.). OMB has approved the information collection requirements contained in this part under control number 3150–0014.

(b) The approved information collection requirements contained in this part appear in §§ 20.102, 20.103, 20.105, 20.106, 20.203, 20.205, 20.302, 20.311, 20.401, 20.402, 20.403, 20.405, 20.407, 20.408, and 20.409.

(c) This part contains information collection requirements in addition to those approved under the control number specified in paragraph (a) of this section. These information collection requirements and the control numbers under which they are approved are as follows:

(1) In §§ 20.101 and 20.102, Form NRC–4 is approved under control number 3150–0005.

(2) In § 20.401, Form NRC–5 is approved under control number 3150–0006.

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:

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:

(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

(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.

(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 FR 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

such reports, the licensee shall use the dose shown in the report in preparing the form. In any case where a licensee is unable to obtain reports of the individual's occupational dose for a previous complete calendar quarter, it shall be assumed that the individual has received the occupational dose specified in whichever of the following columns apply:

Part of body	Column 1—Assumed exposure in rems for calendar quarters prior to Jan. 1, 1961	Column 2—Assumed exposure in rems for calendar quarters beginning on or after Jan. 1, 1961
Whole body, gonads, active blood-forming organs, head and trunk, lens of eye	3¾	1¼

(2) The licensee shall retain and preserve records used in preparing Form NRC-4 until the Commission authorizes their disposition.

If calculation of the individual's accumulated occupational dose for all periods prior to January 1, 1961 yields a result higher than the applicable accumulated dose value for the individual as of that date, as specified in paragraph (b) of § 20.101, the excess may be disregarded.

§ 20.103 Exposure of individuals to concentrations of radioactive materials in air in restricted areas.

(a)(1) No licensee shall possess, use, or transfer licensed material in such a manner as to permit any individual in a restricted area to inhale a quantity of radioactive material in any period of one calendar quarter greater than the quantity which would result from inhalation for 40 hours per week for 13 weeks at uniform concentrations of radioactive material in air specified in Appendix B, Table I, Column 1.[1][2][3] If the radioactive material is of such form that intake by absorption through the skin is likely, individual exposures to radioactive material shall be controlled so that the uptake of radioactive material by any organ from either inhalation or absorption or both routes of intake[4] in any calendar quarter does not exceed that which would result from inhaling such radioactive material for 40 hours per week for 13 weeks at uniform concentrations specified in Appendix B, Table I, Column 1.

(2) No licensee shall possess, use, or transfer mixtures of U-234, U-235, and U-238 in soluble form in such a manner as to permit any individual in a restricted area to inhale a quantity of such material in excess of the intake limits specified in Appendix B, Table I, Column 1 of this part. If such soluble uranium is of a form such that absorption through the skin is likely, individual exposures to such material shall be controlled so that the uptake of such material by any organ from either inhalation or absorption or both routes of intake[4] does not exceed that which would result from inhaling such material at the limits specified in Appendix B, Table I, Column 1 and footnote 4 thereto.

(3) For purposes of determining compliance with the requirements of this section the licensee shall use suitable measurements of concentrations of radioactive materials in air for detecting and evaluating airborne radioactivity in restricted areas and in addition, as appropriate, shall use measurements of radioactivity in the body, measurements of radioactivity excreted from the body, or any combination of such measurements as may be necessary for timely detection and assessment of individual intakes of radioactivity by exposed individuals. It is assumed that an individual inhales radioactive material at the airborne concentration in which he is present unless he uses respiratory protective equipment pursuant to paragraph (c) of this section. When assessment of a particular individual's intake of radioactive material is necessary, intakes less than those which would result from inhalation for 2 hours in any one day or for 10 hours in any one week at uniform concentrations specified in Appendix B, Table I, Column 1 need not be included in such assessment, provided that for any assessment in excess of these amounts the entire amount is included.

(b)(1) The licensee shall, as a precautionary procedure, use process or other engineering controls, to the extent practicable, to limit concentrations of radioactive materials in air to levels below those which delimit an airborne radioactivity area as defined in § 20.203(d)(1)(ii).

(2) When it is impracticable to apply process or other engineering controls to limit concentrations of radioactive material in air below those defined in § 20.203(d)(1)(ii), other precautionary procedures, such as increased surveillance, limitation of working times, or provision of respiratory protective equipment, shall be used to maintain intake of radioactive material by any individual within any period of seven consecutive days as far below that intake of radioactive material which would result from inhalation of such material for 40 hours at the uniform concentrations specified in Appendix B, Table 1, Column 1 as is reasonably achievable. Whenever the intake of radioactive material by any individual exceeds this 40-hour control measure, the licensee shall make such evaluations and take such actions as are necessary to assure against recurrence. The licensee shall maintain records of such occurrences, evaluations, and actions taken in a clear and readily identifiable form suitable for summary review and evaluation.

(c) When respiratory protective equipment is used to limit the inhalation of airborne radioactive material pursuant to paragraph (b)(2) of this section, the licensee shall use equipment that is certified or had certification extended by the National Institute for Occupational Safety and Health/Mine Safety and Health Administration (NIOSH/MSHA). The licensee may make allowance for this use of respiratory protective equipment in estimating exposures of individuals to this material provided that:

[1] Since the concentration specified for tritium oxide vapor assumes equal intakes by skin absorption and inhalation, the total intake permitted is twice that which would result from inhalation alone at the concentration specified for H 3 S in Appendix B, Table I, Column 1 for 40 hours per week for 13 weeks.

[2] For radon-222, the limiting quantity is that inhaled in a period of one calendar year. For radioactive materials designated "Sub" in the "Isotope" column of the table, the concentration value specified is based upon exposure to the material as an external radiation source. Individual exposures to these materials may be accounted for as part of the limitation on individual dose in § 20.101. These nuclides shall be subject to the precautionary procedures required by § 20.103(b)(1).

[3] Multiply the concentration values specified in Appendix B, Table I, Column 1, by 6.3×10^4 ml to obtain the quarterly quantity limit. Multiply the concentration value specified in Appendix B, Table I, Column 1, by 2.5×10^6 ml to obtain the annual quantity limit for Rn-222.

[4] Significant intake by ingestion or injection is presumed to occur only as a result of circumstances such as accident, inadvertence, poor procedure, or similar special conditions. Such intakes must be evaluated and accounted for by techniques and procedures as may be appropriate to the circumstances of the occurrence. Exposures so evaluated shall be included in determining whether the limitation on individual exposures in § 20.103(a)(1) has been exceeded.

[5] Regulatory guidance on assessment of individual intakes of radioactive material is given in Regulatory Guide 8.9, "Acceptable Concepts, Models, Equations and Assumptions for a Bioassay Program," single copies of which are available from the Office of Standards Development, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, upon written request.

47 FR 16162

(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.

47 FR 16162

(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.

25 FR 10914

(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.

41 FR 52302

(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.

25 FR 10914

(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.

46 FR 18525

(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.

29 FR 14434

(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.

(b) An application for a license or amendment may include proposed limits higher than those specified in paragraph (a) of this section. The Commission will approve the proposed limits if the applicant demonstrates:

(1) That the applicant has made a reasonable effort to minimize the radioactivity contained in effluents to unrestricted areas; and

(2) That it is not likely that radioactive material discharged in the effluent would result in the exposure of an individual to concentrations of radioactive material in air or water exceeding the limits specified in Appendix B, Table II of this part.

(c) An application for higher limits pursuant to paragraph (b) of this section shall include information demonstrating that the applicant has made a reasonable effort to minimize the radioactivity discharged in effluents to unrestricted areas, and shall include, as pertinent:

(1) Information as to flow rates, total volume of effluent, peak concentration of each radionuclide in the effluent, and concentration of each radionuclide in the effluent averaged over a period of one year at the point where the effluent leaves a stack, tube, pipe, or similar conduit;

(2) A description of the properties of the effluents, including:

(i) Chemical composition;

(ii) Physical characteristics, including suspended solids content in liquid effluents, and nature of gas or aerosol for air effluents;

(iii) The hydrogen ion concentrations (p^H) of liquid effluents; and

(iv) The size range of particulates in effluents released into air.

(3) A description of the anticipated human occupancy in the unrestricted area where the highest concentration of radioactive material from the effluent is expected, and, in the case of a river or stream, a description of water uses downstream from the point of release of the effluent.

(4) Information as to the highest concentration of each radionuclide in an unrestricted area, including anticipated concentrations averaged over a period of one year:

(i) In air at any point of human occupancy; or

(ii) In water at points of use downstream from the point of release of the effluent.

(5) The background concentration of radionuclides in the receiving river or stream prior to the release of liquid effluent.

(6) A description of the environmental monitoring equipment, including sensitivity of the system, and procedures and calculations to determine concentrations of radionuclides in the unrestricted area and possible reconcentrations of radionuclides.

(7) A description of the waste treatment facilities and procedures used to reduce the concentration of radionuclides in effluents prior to their release.

(d) For the purposes of this section the concentration limits in Appendix B, Table II of this part shall apply at the boundary of the restricted area. The concentration of radioactive material discharged through a stack, pipe or similar conduit may be determined with respect to the point where the material leaves the conduit. If the conduit discharges within the restricted area, the concentration at the boundary may be determined by applying appropriate factors for dilution, dispersion, or decay between the point of discharge and the boundary.

(e) In addition to limiting concentrations in effluent streams, the Commission may limit quantities of radioactive materials released in air or water during a specified period of time if it appears that the daily intake of radioactive material from air, water, or food by a suitable sample of an exposed population group, averaged over a period not exceeding one year, would otherwise exceed the daily intake resulting from continuous exposure to air or water containing one-third the concentration of radioactive materials specified in Appendix B, Table II of this part.

(f) The provisions of paragraphs (a) through (e) of this section do not apply to disposal of radioactive material into sanitary sewerage systems, which is governed by § 20.303.

(g) 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 Standard for Nuclear Power Operations," shall comply with that part.

§ 20.107 Medical diagnosis and therapy.

Nothing in the regulations in this part shall be interpreted as limiting the intentional exposure of patients to radiation for the purpose of medical diagnosis or medical therapy.

§ 20.108 Orders requiring furnishing of bio-assay services.

Where necessary or desirable in order to aid in determining the extent of an individual's exposure to concentrations of radioactive material, the Commission may incorporate appropriate provisions in any license, directing the licensee to make available to the individual appropriate bio-assay services and to furnish a copy of the reports of such services to the Commission.

Precautionary Procedures

§ 20.201 Surveys.

(a) As used in the regulations in this part, "survey" means an evaluation of the radiation hazards incident to the production, use, release, disposal, or presence of radioactive materials or other sources of radiation under a specific set of conditions. When appropriate, such evaluation includes a physical survey of the location of materials and equipment, and measurements of levels of radiation or concentrations of radioactive material present.

(b) Each licensee shall make or cause to be made such surveys as (1) may be necessary for the licensee to comply with the regulations in this part, and (2) are reasonable under the circumstances to evaluate the extent of radiation hazards that may be present.

§ 20.202 Personnel monitoring.

(a) Each licensee shall supply appropriate personnel monitoring equipment to, and shall require the use of such equipment by:

(1) Each individual who enters a restricted area under such circumstances that he receives, or is likely to receive, a dose in any calendar quarter in excess of 25 percent of the applicable value specified in paragraph (a) of § 20.101.

(2) Each individual under 18 years of age who enters a restricted area under such circumstances that he receives, or is likely to receive, a dose in any calendar quarter in excess of 5 percent of the applicable value specified in paragraph (a) of § 20.101.

(3) Each individual who enters a high radiation area.

(b) As used in this part,

(1) "Personnel monitoring equipment" means devices designed to be worn or carried by an individual for the purpose of measuring the dose received (e.g., film badges, pocket chambers, pocket dosimeters, film rings, etc.);

(2) "Radiation area" means any area, accessible to personnel, in which there exists radiation, originating in whole or in part within licensed material, at such levels that a major portion of the body could receive in any one hour a dose in excess of 5 millirem, or in any 5 consecutive days a dose in excess of 100 millirems;

(3) "High radiation area" means any area, accessible to personnel, in which there exists radiation originating in whole or in part within licensed material at such levels that a major portion of the body could receive in any one hour a dose in excess of 100 millirem.

29 FR 14434

46 FR 18525

25 FR 10914

46 FR 53647

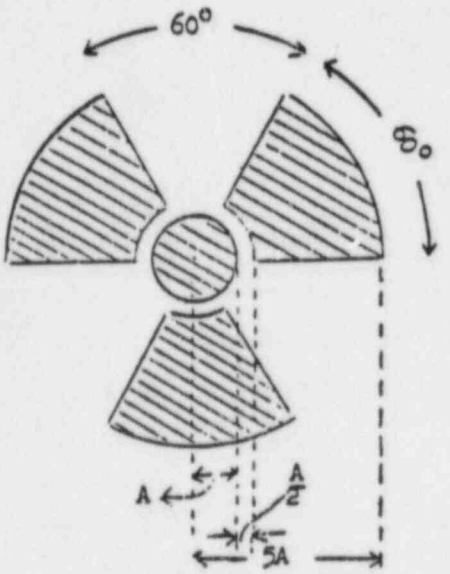
25 FR 10914

§ 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.

(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.

35 FR 5033

(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 64619

(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 [2] that is used to irradiate materials shall: [3]

43 FR 2167

(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-

[2] 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 shelding 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.

[3] 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 § 20.2034 until such compliance is achieved. For such persons compliance must be achieved not later than Dec. 14, 1978.

prise permenent structural components, such as walls, that have no credible probability of failure or removal in ordinary circumstances need not meet the requirements of this paragraph (c)(6)(iii).

(iv) Be equipped with devices that will automatically generate visible and audible alarm signals to alert personnel in the area before the source can be put into operation and in sufficient time for any individual in the area to operate a clearly identified control device which shall be installed in the area and which can prevent the source from being put into operation.

(v) Be controlled by use of such administrative procedure and such devices as are necessary to assure that the area is cleared of personnel prior to each use of the source preceding which use it might have been possible for an individual to have entered the area.

(vi) Be checked by a physical radiation measurement to assure that prior to the first individual's entry into the area after any use of the source, the radiation level from the source in the area is below that at which it would be possible for an individual to receive a dose in excess of 00 mrem in one hour.

(vii) Have entry control devices required in paragraph (c)(6)(i) of this section which have been tested for proper functioning prior to initial operation with such source of radiation on any day that operations are not uninterruptedly continued from the previous day or before resuming operations after any unintended interruption, and for which records are kept of the dates, times, and results of such tests of function. No operations other than those necessary to place the source in safe condition or to effect reparis on controls shall be conducted with such source unless control devices are functioning properly. The licensee shall submit an acceptable schedule for more complete periodic tests of the entry control and warning systems to be established and adhered to as a condition of the license.

(viii) Have those entry and exit portals that are used in transporting materials to and from the irradiation area, and that are not intended for use by individuals, controlled by such devices and administrative procedures as are necessary to physically protect and warn against inadvertent entry by any individual through such portals. Exit portals for processed materials shall be equipped to detect and signal the presence of loose radiation sources that are carried toward such an exit and to automatically prevent such loose sources from being carried out of the area.

(7) Licensees with, or applicants for, licenses for radiation sources that are within the purview of paragraph (c)(6) of this section, and that must be used in a variety of positions or in peculiar locations, such as open fields or forests, that make it impracticable to comply with certain requirements of paragraph (c)(6) of this section, such as those for the automatic control of radiation levels, may apply to the Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, for approval, prior to use of safety measures that are alternative to those specified in paragraph (c)(6) of this section, and that will provide at least an equivalent degree of personnel protection in the use of such sources. At least one of the alternative measures must include an entry-preventing interlock control based on a physical measurement of radiation that assures the absence of high radiation levels before an individual can gain access to an area where such sources are used.

(d) *Airborne radioactivity areas.* (1) As used in the regulations in this part "airborne radioactivity area" means (i) any room, enclosure, or operating area in which airborne radioactive materials composed wholly or partly of licensed material, exist in concentrations in excess of the amounts specified in Appendix B, Table I, Column 1 of this part; or (ii) any room, enclosure, or operating area in which airborne radioactive material composed wholly or partly of licensed material exists in concentrations which, averaged over the number of hours in any week during which individuals are in the area, exceed 25 percent of the amounts specified in Appendix B Table I, Column 1 of this part.

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

CAUTION [1]

AIRBORNE RADIOACTIVITY AREA

(e) *Additional requirements.* (1) Each area or room in which licensed material is used or stored and which contains any radioactive material (other than natural uranium or thorium) in an amount exceeding 10 times the quantity of such material specified in Appendix C of this part shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION [1]

RADIOACTIVE MATERIAL(S)

(2) Each area or room in which natural uranium or thorium is used or stored in any amount exceeding one hundred times the quantity specified in Appendix C of this part shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION [1]

RADIOACTIVE MATERIAL(S)

(f) *Containers.* (1) Except as provided in paragraph (f)(3) of this section, each container of licensed material shall bear a durable, clearly visible label identifying the radioactive contents.

(2) A label required pursuant to paragraph (f)(1) of this section shall bear the radiation caution symbol and the words "CAUTION, RADIOACTIVE MATERIAL" or "DANGER, RADIOACTIVE MATERIAL". It shall also provide sufficient information [2] to permit individuals handling or using the containers, or working in the vicinity thereof, to take precautions to avoid or minimize exposures.

(3) Notwithstanding the provisions of paragraph (f)(1) of this section labeling is not required:

(i) For containers that do not contain licensed materials in quantities greater than the applicable quantities listed in Appendix C of this part.

(ii) For containers containing only natural uranium or thorium in quantities no greater than 10 times the applicable quantities listed in Appendix C of this part.

(iii) For containers that do not contain licensed materials in concentrations greater than the applicable concentrations listed in Appendix B, Table I, Column 2, of this part.

(iv) For containers when they are attended by an individual who takes the precautions necessary to prevent the exposure of any individual to radiation or radioactive materials in excess of the limits established by the regulations in this part.

(v) For containers when they are in transport and packaged and labeled in accordance with regulations of the Department of Transportation.

(vi) For containers which are accessible [3] only to individuals authorized to handle or use them, or to work in the vicinity thereof, provided that the contents are identified to such individuals by a readily available written record.

(vii) For manufacturing or process equipment, such as nuclear reactors, reactor components, piping, and tanks.

[1] Or "Danger".

[2] As appropriate, the information will include radiation levels, kinds of material, estimate of activity, date for which activity is estimated, mass enrichment, etc.

42 FR 64619
43 FR 2167
42 FR 64619
25 FR 10914
43 FR 2167
25 FR 10914
31 FR 10514
31 FR 19546
31 FR 10514

(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 22171]

§ 20.204 Same: exceptions.

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. [25 FR 10914]

(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. [35 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. [25 FR 10914]

(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. [35 FR 5033]

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

§ 20.205 Procedures for picking up, receiving, and opening packages.

(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. [39 FR 17972]

(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 [41 FR 16445]

(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 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]

TABLE OF EXEMPT AND TYPE A QUANTITIES

Transport group [1]	Exempt quantity limit (in millicuries)	Type A quantity limit (in [redacted])
I	.01	0.001
II	0.1	0.050
III	1	3
IV	1	20
V	1	20
VI	1	1000
VII	25.000	1000
Special Form	1	20

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

[Footnote 1 removed 49 FR 19623]

(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. [39 FR 17972]

(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. [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.

Instructions required for individuals working in or frequenting any portion of a restricted area are specified in § 19.12 of this chapter. [38 FR 22220]

§ 20.207 Storage and control of licensed materials in unrestricted areas. [40 FR 26679]

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

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

tended under the constant surveillance and immediate control of the licensee.

Waste Disposal

§ 20.301 General requirement.

No licensee shall dispose of licensed material except:

(a) By transfer to an authorized recipient as provided in the regulations in Parts 30, 40, 60, 61, 70 or 72 of this chapter, whichever may be applicable; or

47 FR 57446

(b) As authorized under § 20.302 or Part 61 of this chapter; or

46 FR 16230

(c) As provided in § 20.303, applicable to the disposal of licensed material by release into sanitary sewerage systems, or in § 20.306 for disposal of specific wastes, or in § 20.106 (Radioactivity in effluents to unrestricted areas).

§ 20.302 Method for obtaining approval of proposed disposal procedures.

(a) Any licensee or applicant for a license may apply to the Commission for approval of proposed procedures to dispose of licensed material in a manner not otherwise authorized in the regulations in this chapter. Each application should include a description of the licensed material and any other radioactive material involved, including the quantities and kinds of such material and the levels of radioactivity involved, and the proposed manner and conditions of disposal. The application should also include an analysis and evaluation of pertinent information as to the nature of the environment, including topographical, geological, meteorological, and hydrological characteristics; usage of ground and surface waters in the general area; the nature and location of other potentially affected facilities; and procedures to be observed to minimize the risk of unexpected or hazardous exposures.

36 FR 23138

47 FR 57446

(b) The Commission will not approve any application for a license for disposal of licensed material at sea unless the applicant shows that sea disposal offers less harm to man or the environment than other practical alternative methods of disposal.

§ 20.303 Disposal by release into sanitary sewerage systems.

No licensee shall discharge licensed material into a sanitary sewerage system unless:

(a) It is readily soluble or dispersible in water; and

(b) The quantity of any licensed or other radioactive material released into the system by the licensee in any one day does not exceed the larger of paragraphs (b)(1) or (2) of this section.

(1) The quantity which, if diluted by the average daily quantity of sewage released into the sewer by the licensee, will result in an average concentration equal to the limits specified in Appendix B, Table I, Column 2 of this part; or

(2) Ten times the quantity of such material specified in Appendix C of this part; and

(c) The quantity of any licensed or other radioactive material released in any one month, if diluted by the average monthly quantity of water released by the licensee, will not result in an average concentration exceeding the limits specified in Appendix B, Table I, Column 2 of this part; and

25 FR 10914

(d) The gross quantity of licensed and other radioactive material, excluding hydrogen-3 and carbon-14, released into the sewerage system by the licensee does not exceed one curie per year. The quantities of hydrogen-3 and carbon-14 released into the sanitary sewerage system may not exceed 5 curies per year for hydrogen-3 and 1 curie per year for carbon-14. Excreta from individuals undergoing medical diagnosis or therapy with radioactive material shall be exempt from any limitations contained in this section.

46 FR 16230

§ 20.305 Treatment or disposal by incineration.

No licensee shall treat or dispose of licensed material by incineration, except for materials listed under § 20.306 or as specifically approved by the Commission pursuant to §§ 20.106(b) and 20.302.

§ 20.306 Disposal of specific wastes.

Any licensee may dispose of the following licensed material without regard to its radioactivity:

(a) 0.05 microcuries or less of hydrogen-3 or carbon-14, per gram of medium, used for liquid scintillation counting; and

(b) 0.05 microcuries or less of hydrogen-3 or carbon-14, per gram of animal tissue averaged over the weight of the entire animal; provided however, tissue may not be disposed of under this section in a manner that would permit its use either as food for humans or as animal feed.

46 FR 16230

(c) Nothing in this section, however, relieves the licensee of maintaining records showing the receipt, transfer and disposal of such byproduct material as specified in § 30.51 of this chapter; and

(d) Nothing in this section relieves the licensee from complying with other applicable Federal, State and local regulations governing any other toxic or hazardous property of these materials.

§ 20.311 Transfer for disposal and manifests.

(a) Purpose. The requirements of this section are designed to control transfers of radioactive waste intended for disposal at a land disposal facility and establish a manifest tracking system and supplement existing requirements concerning transfers and recordkeeping for such wastes. The reporting and recordkeeping requirements contained in this section have been approved by the Office of Management and Budget; OMB approval No. 3150-0014.

(b) Each shipment of radioactive waste to a licensed land disposal facility must be accompanied by a shipment manifest that contains the name, address, and telephone number of the person generating the waste. The manifest shall also include the name, address, and telephone number or the name and EPA hazardous waste identification number of the person transporting the waste to the land disposal facility. The manifest must also indicate as completely as practicable: a physical description of the waste; the volume; radionuclide identity and quantity; the total radioactivity; and the principal chemical form. The solidification agent must be specified. Waste containing more than 0.1% chelating agents by weight must be identified and the weight percentage of the chelating agent estimated. Wastes classified as Class A, Class B, or Class C in § 61.55 of this chapter must be clearly identified as such in the manifest. The total quantity of the radionuclides H-3, C-14, Tc-99 and I-129 must be shown. The manifest required by this paragraph may be shipping papers used to meet Department of Transportation or

47 FR 57446

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 §§ 20.311 (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 §§ 61.55 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.

47 FR 57446

47 FR 57446

47 FR 57446

[25 FR 10914]

§ 20.401 Records of surveys, radiation monitoring, and disposal.

(a) Each licensee shall maintain records showing the radiation exposures of all individuals for whom personnel monitoring is required under § 20.202 of the regulations in this part. Such records shall be kept on Form NRC-5, in accordance with the instructions contained in that form or on clear and legible records containing all the information required by Form NRC-5. The doses entered on the forms or records shall be for periods of time not exceeding one calendar quarter.

[47 FR 27446]

(b) Each licensee shall maintain records in the same units used in this part, showing the results of surveys required by § 20.201(b), monitoring required by §§ 20.205(b) and 20.205(c), and disposals made under §§ 20.302, 20.303, removed § 20.304,[1] and Part 61 of this chapter.

[41 FR 16300]

(c)(1) Records of individual exposure to radiation and to radioactive material which must be maintained pursuant to the provisions of paragraph (a) of this section and records of bioassays, including results of whole body counting examinations, made pursuant to § 20.108, shall be preserved until the Commission authorizes disposition.

(2) Records of the results of surveys and monitoring which must be maintained pursuant to paragraph (b) of this section shall be preserved for two years after completion of the survey except that the following records shall be maintained until the Commission authorizes their disposition: (i) Records of the results of surveys to determine compliance with § 20.103(a); (ii) in the absence of personnel monitoring data, records of the results of surveys to determine external radiation dose; and (iii) records of the results of surveys used to evaluate the release of radioactive effluents to the environment.

[47 FR 57446]

(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.

[41 FR 18300]

(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.

[48 FR 33850]

§ 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, within 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:

[34 FR 7500]

(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.

[34 FR 7500]

(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.

[48 FR 33850]

§ 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:

[27 FR 6905]

(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

[42 FR 43965]

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

[48 FR 33850]

(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:

[27 FR 6905]

(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

[42 FR 43965]

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

[28 FR 6822]

(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.

[48 FR 33850]

(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]

[48 FR 33850]

§ 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;

(iii) Levels of radiation or concentrations of radioactive material in a restricted area in excess of any other applicable limit in the license;

(iv) Any incident for which notification is required by § 20.403 of this part; or

(v) Levels of radiation or concentrations of radioactive material (whether or not involving excessive exposure of any individual) in an unrestricted area in excess of ten times any applicable limit set forth in this part or in the license.

(2) Each report required under paragraph (a)(1) of this section must describe the extent of exposure of individuals to radiation or to radioactive material, including:

(i) Estimates of each individual's exposure as required by paragraph (b) of this section;

(ii) Levels of radiation and concentrations of radioactive material involved;

(iii) The cause of the exposure, levels or concentrations; and

(iv) Corrective steps taken or planned to prevent a recurrence.

(b) Any report filed with the Commission pursuant to paragraph (a) of this section shall include for each individual exposed the name, social security number, and date of birth, and an estimate of the individual's exposure. The report shall be prepared so that this information is stated in a separate part of the report.

(c)(1) In addition to any notification required by § 20.403 of this part, each licensee shall make a report in writing of levels of radiation or releases of radioactive material in excess of limits specified by 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations," or in excess of license conditions related to compliance with 40 CFR Part 190.

(2) Each report submitted under paragraph (c)(1) of this section must describe:

(i) The extent of exposure of individuals to radiation or to radioactive material;

(ii) Levels of radiation and concentrations of radioactive material involved;

(iii) The cause of the exposure, levels, or concentrations; and

(iv) Corrective steps taken or planned to assure against a recurrence, including the schedule for achieving conformance with 40 CFR Part 190 and with associated license conditions.

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

(e) All other licensees who make reports under paragraphs (a) or (c) of this section shall, within 30 days after learning of the overexposure or excessive level or concentration, 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.

§ 20.406 [Reserved]

§ 20.407 Personnel monitoring reports.

Each person described in § 20.408 of this part shall, within the first quarter of each calendar year, submit to the Director, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555, the reports specified in paragraphs (a) and (b) of this section, covering the preceding calendar year.[1]

(a) A report of either (1) the total number of individuals for whom personnel monitoring was required under § 20.202(a) or § 34.33(a) of this chapter during the calendar year; or (2) the total number of individuals for whom personnel monitoring was provided during the calendar year: *Provided, however,* That such total includes at least the number of individuals required to be reported under paragraph (a)(1) of this section. The report shall indicate whether it is submitted in accordance with paragraph (a)(1) or (a)(2) of this section. If personnel monitoring was not required to be provided to any individual by the licensee under §§ 20.202(a) or 34.33(a) of this chapter during the calendar year, the licensee shall submit a negative report indicating that such personnel monitoring was not required.

(b) A statistical summary report of the personnel monitoring information recorded by the licensee for individuals for whom personnel monitoring was either required or provided, as described in paragraph (a) of this section, indicating the number of individuals whose total whole body exposure recorded during the previous calendar year was in each of the following estimated exposure ranges:

Estimated whole body exposure range (rems)[1]	Number of individuals in each range
No measurable exposure	
Measurable exposure less than 0.1	
0.1 to 0.25	
0.25 to 0.5	
0.5 to 0.75	
0.75 to 1	
1 to 2	
2 to 3	
3 to 4	
4 to 5	
5 to 6	
6 to 7	
7 to 8	
8 to 9	
9 to 10	
10 to 11	
11 to 12	
12+	

[1] Individual values exactly equal to the values separating exposure ranges shall be reported in the higher range.

The low exposure range data are required in order to obtain better information about the exposures actually recorded. This section does not require improved measurements.

§ 20.408 Reports of personnel monitoring on termination of employment or work.

(a) This section applies to each person licensed by the Commission to:

(1) Operate a nuclear reactor designed to produce electrical or heat energy pursuant to § 50.21(b) or § 50.22 of this chapter or a testing facility as defined in § 50.2(r) of this chapter;

(2) Possess or use byproduct material for purposes of radiography pursuant to Parts 30 and 34 of this chapter;

(3) Possess or use at any one time, for purposes of fuel processing, fabricating, or reprocessing, special nuclear material in a quantity exceeding 5,000 grams of contained uranium-235, uranium-233, or plutonium or any combination thereof pursuant to Part 70 of this chapter;

(4) Possess high-level radioactive waste at a geologic repository operations area pursuant to Part 60 of this chapter; or

(5) Possess spent fuel in an independent spent fuel storage installation (ISFSI) pursuant to Part 72 of this chapter; or

(6) Possess or use at any one time, for processing or manufacturing for distribution pursuant to Parts 30, 32, or 33 of this Chapter, byproduct material in quantities exceeding any one of the following quantities:

[1] A licensee whose license expires or terminates prior to, or on the last day of the calendar year, shall submit reports at the expiration or termination of the license, covering that part of the year during which the license was in effect.

43 FR 44827

Radionuclide [1]	Quantity in curies
Cesium-137	1
Cobalt-60	1
Gold-198	100
Iodine-131	1
Indium-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.

47 FR 57446

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

49 FR 24513

(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, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 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.

38 FR 22220

§ 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

25 FR 10914

§ 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

46 FR 8774

§ 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 removed 49 FR 19623]

APPENDIX A.—PROTECTION FACTORS FOR RESPIRATORS [a]

Description [b]	Modes [c]	Protection factors [d]		Tested and certified equipment—National Institute for Occupational Safety and Health/Mine Safety and Health Administration tests for permeability
		Particulates only	Particulates, gases and vapors [e]	
I. Air-purifying respirators [f]				
Facepiece, half-mask [g]	NP			
Facepiece, full	NP	10		30 CFR Part 11, Subpart K.
Facepiece, half-mask, full, or hood	PP	50		
		1,000		
II. Atmosphere-supplying respirators				
1. Air-line respirator:				
Facepiece, half-mask	CF		1,000	
Facepiece, half-mask	D		5	
Facepiece, full	CF		2,000	
Facepiece, full	D		5	30 CFR Part 11, Subpart J.
Facepiece, full	PD		2,000	
Hood	CF		(h)	
Suit	CF		(i)	(i)
2. Self-contained breathing apparatus (SCBA):				
Facepiece, full	D		50	
Facepiece, full	PD		[j] 10,000	30 CFR Part 11, Subpart H.
Facepiece, full	RD		50	
Facepiece, full	RP		[k] 5,000	
III. Combination respirator. Any combination of air-purifying and atmosphere-supplying respirators.			[l]	30 CFR Part 11, § 11.83(a).

[a] For use in the selection of respiratory protective devices to be used only where the contaminants have been identified and the concentrations (or possible concentrations) are known.

[b] Only for shaven faces and where nothing interferes with the seal of tight-fitting facepieces against the skin. (Hoods and suits are excepted.)

[c] The mode symbols are defined as follows: CF = continuous flow; D = demand; NP = negative pressure (i.e., negative phase during inhalation); PD = pressure demand (i.e., always positive pressure); PP = positive pressure; RD = demand, recirculating (closed circuit); RP = positive pressure, recirculating (closed circuit).

[d] The protection factor is a measure of the degree of protection afforded by a respirator, defined as the ratio of the concentration of airborne radioactive material outside the respiratory protective equipment to that inside the equipment (usually inside the facepiece) under conditions of use. It is applied to the ambient airborne concentration to estimate the concentrations inhaled by the wearer according to the following formula:

$$\text{Concentration inhaled} = \frac{\text{Ambient airborne concentration}}{\text{Protection factor}}$$

[e] The protection factors apply:

(a) Only for trained individuals wearing properly fitted respirators used and maintained under supervision in a well-planned respiratory protective program.

(b) For air-purifying respirators only when high efficiency particulate filters (above 99.97% removal efficiency by thermally generated 0.3 μm dioctyl phthalate (DOP) test) are used in atmospheres not deficient in oxygen and not containing radioactive gas or vapor respiratory hazards.

(c) No allowance is to be made for the use of sorbents against radioactive gases or vapors.

(d) For atmosphere-supplying respirators only when supplied with adequate respirable air. Respirable air shall be provided of the quality and quantity required in accordance with NIOSH/MSHA certification (described in 30 CFR Part 11). Oxygen and air lines shall not be used in the same apparatus.

[f] Excluding radioactive contaminants that present an absorption or submersion hazard. For tritium oxide, approximately one half of the intake occurs by absorption through the skin so that an overall protection factor of less than 2 is appropriate when atmosphere-supplying respirators are used to protect against tritium oxide. If the protection factor for a device is 5, the effective protection factor for tritium is about 1.4; for devices with protection factors of 10 the effective factor for tritium oxide is about 1.7; and for devices with protection factors of 100 or more the effective factor for tritium oxide is about 1.8. Air-purifying respirators are not suitable for protection against tritium oxide. See also footnote i concerning supplied-air suits.

[g] Canisters and cartridges shall not be used beyond service-life limitations.

[h] Under-chin type only. This type of respirator is not satisfactory for use where it might be possible (e.g., if an accident or emergency were to occur) for the ambient airborne concentration to reach instantaneous values greater than 10 times the pertinent values in Table 1, Column 1 of Appendix B of this part. This type of respirator is not suitable for protection against plutonium or other high-toxicity, massless. The mask shall be leaked for fit with irritant smoke, prior to use each time it is donned.

[i] Equipment shall be operated in a manner that ensures that proper air flow-rates are maintained. A protection factor of no more than 1000 may be used for tested-and-certified supplied-air hoods when a minimum air flow of 6 cubic feet per minute is maintained and calibrated airline pressure gauges or flow measuring devices are used. A protection factor of up to 2000 may be used for tested and certified hoods only when the air flow is maintained at the manufacturer's recommended maximum rate for the equipment, this rate is greater than 6 cubic feet per minute, and calibrated airline pressure gauges or flow measuring devices are used.

The design of the supplied-air hood or helmet (with a minimum flow of 6 cfm of air) may determine its overall efficiency and the protection it provides. For example, some hoods exploit contaminated air into the breathing zone when the wearer works with hands-over-head. This aspiration may be overcome if a short cape-like extension to the hood is worn under a coat or overalls. Other limitations specified by the approval agency shall be considered before using a hood in certain types of atmospheres, such as the design and its permeability to the contaminant under conditions of use.

[j] Appropriate protection factors shall be determined (see 20.103(e)), taking into account the design of the suit and its permeability to the contaminant under conditions of use. There shall be a standby rescue person equipped with self-contained breathing apparatus and communications equipment whenever supplied-air suits are used.

[k] No approved schedules are currently available for this equipment. Equipment shall be evaluated by testing or on the basis of reliable test information.

[l] This type of respirator may provide greater protection and be used as an emergency device in unknown concentrations for protection against inhalation hazards. External radiation hazards and other limitations to permitted exposure such as skin absorption shall be taken into account in these circumstances.

[m] Quantitative fit testing shall be performed on each individual and no more than 0.02% leakage is allowed with this type of apparatus. Perceptible outward leakage of gas from this or any positive pressure self-contained breathing apparatus is unacceptable because service life will be reduced substantially. Special training in the use of this type of apparatus shall be provided to the wearer (see footnote s).

[n] Protection factor for type and mode of operation as listed above.

47 FR 19511

Note 1.—Protection factors for respirators as may be approved by the U.S. Bureau of Mines/National Institute for Occupational Safety and Health (NIOSH) according to applicable approvals for respirators for type and mode of use to protect against airborne radionuclides, may be used to the extent that they do not exceed the protection factors listed in this table. The protection factors listed in this table may not be appropriate to circumstances where chemical or other respiratory hazards exist in addition to radiological hazards. The selection and use of respirators for these circumstances should take into account applicable approvals of the U.S. Bureau of Mines/NIOSH.

Note 2.—Radioactive contaminants for which the concentration values in Table 1, column 1, Appendix B of this part are based on internal dose due to inhalation may, in addition, present external exposure hazards at higher concentrations. Under these circumstances, limitations on occupancy may have to be governed by external dose limits.

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	
			Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)	Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)
Actinium (89)	Ac 227	S	2×10^{-12}	6×10^{-8}	8×10^{-14}	2×10^{-9}
		I	3×10^{-11}	9×10^{-8}	9×10^{-13}	3×10^{-9}
	Ac 228	S	8×10^{-9}	3×10^{-5}	3×10^{-9}	9×10^{-9}
		I	2×10^{-8}	3×10^{-5}	6×10^{-10}	9×10^{-9}
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}	3×10^{-9}
	Am 242m	S	6×10^{-12}	1×10^{-8}	2×10^{-13}	4×10^{-9}
		I	3×10^{-10}	3×10^{-5}	9×10^{-12}	9×10^{-9}
	Am 242	S	4×10^{-8}	4×10^{-5}	1×10^{-9}	1×10^{-8}
		I	5×10^{-8}	4×10^{-5}	2×10^{-9}	1×10^{-8}
	Am 243	S [2]	6×10^{-12}	1×10^{-8}	2×10^{-13}	4×10^{-9}
		I	1×10^{-10}	8×10^{-8}	4×10^{-12}	3×10^{-9}
	Am 244	S	4×10^{-8}	1×10^{-7}	1×10^{-9}	5×10^{-9}
		I	2×10^{-8}	1×10^{-7}	8×10^{-9}	5×10^{-9}
Antimony	Sb 122	S	2×10^{-7}	8×10^{-8}	6×10^{-9}	3×10^{-9}
		I	1×10^{-7}	8×10^{-8}	5×10^{-9}	3×10^{-9}
	Sb 124	S	2×10^{-7}	7×10^{-8}	5×10^{-9}	2×10^{-9}
		I	2×10^{-9}	7×10^{-8}	7×10^{-10}	2×10^{-9}
	Sb 125	S	5×10^{-7}	3×10^{-7}	2×10^{-9}	1×10^{-8}
		I	3×10^{-9}	3×10^{-7}	9×10^{-10}	1×10^{-8}
Argon (18)	A 37	Sub [3]	6×10^{-3}		1×10^{-4}	
	A 41	Sub	2×10^{-6}		4×10^{-8}	
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	5×10^{-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^{-8}	5×10^{-8}	2×10^{-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^{-7}
		I	4×10^{-7}	5×10^{-7}	1×10^{-8}	2×10^{-7}
	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}	2×10^{-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^{-8}	5×10^{-9}	2×10^{-8}
		I	1×10^{-6}	6×10^{-8}	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^{-9}	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^{-9}	6×10^{-8}
		I	1×10^{-6}	2×10^{-7}	5×10^{-10}	6×10^{-8}
	Bi 210	S	6×10^{-8}	1×10^{-7}	2×10^{-10}	4×10^{-8}
		I	6×10^{-8}	1×10^{-7}	2×10^{-10}	4×10^{-8}
	Bi 212	S	1×10^{-7}	1×10^{-7}	3×10^{-9}	4×10^{-8}
		I	2×10^{-7}	1×10^{-7}	7×10^{-9}	4×10^{-8}
Bromine (35)	Br 82	S	1×10^{-6}	8×10^{-8}	4×10^{-8}	3×10^{-8}
		I	2×10^{-7}	1×10^{-7}	6×10^{-9}	4×10^{-8}
Cadmium (48)	Cd 109	S [2]	5×10^{-8}	5×10^{-7}	2×10^{-9}	2×10^{-8}
		I	7×10^{-8}	5×10^{-8}	3×10^{-9}	2×10^{-8}
	Cd 115m	S	4×10^{-8}	7×10^{-8}	1×10^{-9}	3×10^{-8}
		I	4×10^{-8}	7×10^{-8}	1×10^{-9}	3×10^{-8}
	Cd 115	S	2×10^{-7}	1×10^{-7}	8×10^{-9}	3×10^{-8}
		I	2×10^{-7}	1×10^{-7}	6×10^{-9}	4×10^{-8}

38 FR 29314

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	
			Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)	Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)
Calcium (20)	Ca 45	S	3×10^{-8}	3×10^{-6}	1×10^{-9}	9×10^{-8}
		I	1×10^{-7}	5×10^{-8}	4×10^{-9}	2×10^{-7}
	Ca 47	S	2×10^{-7}	1×10^{-7}	6×10^{-9}	5×10^{-8}
		I	2×10^{-7}	1×10^{-7}	6×10^{-9}	3×10^{-8}
Californium (98)	Cf 249	S	2×10^{-12}	1×10^{-8}	5×10^{-14}	4×10^{-9}
		I	1×10^{-10}	7×10^{-8}	3×10^{-12}	2×10^{-9}
	Cf 250	S	5×10^{-12}	4×10^{-8}	2×10^{-13}	1×10^{-8}
		I	1×10^{-10}	7×10^{-8}	3×10^{-12}	3×10^{-9}
	Cf 251	S	2×10^{-12}	1×10^{-8}	6×10^{-14}	4×10^{-9}
		I	1×10^{-10}	8×10^{-8}	3×10^{-12}	3×10^{-9}
	Cf 252	S	6×10^{-12}	2×10^{-8}	2×10^{-13}	7×10^{-9}
		I	3×10^{-11}	2×10^{-8}	1×10^{-12}	7×10^{-9}
	Cf 253	S	8×10^{-10}	4×10^{-8}	3×10^{-11}	1×10^{-8}
		I	8×10^{-10}	4×10^{-8}	3×10^{-11}	1×10^{-8}
	Cf 254	S	5×10^{-12}	4×10^{-8}	2×10^{-13}	1×10^{-8}
		I	5×10^{-12}	4×10^{-8}	2×10^{-13}	1×10^{-8}
Carbon (6)	C 14	S	4×10^{-8}	2×10^{-6}	1×10^{-9}	8×10^{-8}
	(CO_2)	Sub	5×10^{-6}		1×10^{-6}	
Cerium (58)	Ce 141	S	4×10^{-7}	3×10^{-7}	2×10^{-8}	9×10^{-8}
		I	2×10^{-7}	3×10^{-7}	5×10^{-9}	9×10^{-8}
	Ce 143	S	3×10^{-7}	1×10^{-7}	9×10^{-9}	4×10^{-8}
		I	2×10^{-7}	1×10^{-7}	7×10^{-9}	4×10^{-8}
	Ce 144	S	1×10^{-8}	3×10^{-6}	3×10^{-10}	1×10^{-6}
		I	6×10^{-8}	3×10^{-6}	2×10^{-10}	1×10^{-6}
Cesium (55)	Cs 131	S	1×10^{-6}	7×10^{-7}	4×10^{-8}	2×10^{-7}
		I	3×10^{-6}	3×10^{-7}	1×10^{-7}	9×10^{-8}
	Cs 134m	S	4×10^{-6}	2×10^{-7}	1×10^{-6}	6×10^{-8}
		I	6×10^{-6}	3×10^{-7}	2×10^{-7}	1×10^{-7}
	Cs 134	S	4×10^{-8}	3×10^{-6}	1×10^{-8}	9×10^{-8}
		I	1×10^{-8}	1×10^{-7}	4×10^{-10}	4×10^{-8}
	Cs 135	S	5×10^{-7}	3×10^{-7}	2×10^{-8}	1×10^{-7}
		I	9×10^{-8}	7×10^{-7}	3×10^{-9}	2×10^{-7}
	Cs 136	S	4×10^{-7}	2×10^{-7}	1×10^{-8}	9×10^{-8}
		I	2×10^{-7}	2×10^{-7}	6×10^{-9}	6×10^{-8}
	Cs 137	S	6×10^{-8}	4×10^{-6}	2×10^{-8}	2×10^{-7}
		I	1×10^{-8}	1×10^{-7}	5×10^{-10}	4×10^{-8}
Chlorine (17)	Cl 36	S	4×10^{-7}	2×10^{-7}	1×10^{-8}	8×10^{-8}
		I	2×10^{-8}	2×10^{-7}	8×10^{-10}	6×10^{-8}
	Cl 38	S	3×10^{-6}	1×10^{-7}	9×10^{-8}	4×10^{-8}
		I	2×10^{-6}	1×10^{-7}	7×10^{-8}	4×10^{-8}
Chromium (24)	Cr 51	S	1×10^{-6}	5×10^{-7}	4×10^{-7}	2×10^{-6}
		I	2×10^{-6}	5×10^{-7}	8×10^{-8}	2×10^{-6}
Cobalt (27)	Co 57	S	3×10^{-6}	2×10^{-7}	1×10^{-7}	5×10^{-6}
		I	2×10^{-7}	1×10^{-7}	6×10^{-9}	4×10^{-8}
	Co 58m	S	2×10^{-6}	8×10^{-7}	6×10^{-7}	3×10^{-6}
		I	9×10^{-6}	6×10^{-7}	3×10^{-7}	2×10^{-6}
	Co 58	S	8×10^{-7}	4×10^{-7}	3×10^{-8}	1×10^{-6}
		I	5×10^{-6}	3×10^{-7}	2×10^{-8}	9×10^{-7}
	Co 60	S	3×10^{-7}	1×10^{-7}	1×10^{-8}	5×10^{-8}
		I	9×10^{-9}	1×10^{-7}	3×10^{-10}	3×10^{-8}
Copper (29)	Cu 64	S	2×10^{-6}	1×10^{-7}	7×10^{-9}	3×10^{-6}
		I	1×10^{-6}	6×10^{-7}	4×10^{-8}	2×10^{-6}
Curium (96)	Cm 242	S	1×10^{-10}	7×10^{-8}	4×10^{-12}	2×10^{-9}
		I	2×10^{-10}	7×10^{-8}	6×10^{-12}	2×10^{-9}
	Cm 243	S	6×10^{-12}	1×10^{-8}	2×10^{-13}	5×10^{-9}
		I	1×10^{-10}	7×10^{-8}	3×10^{-12}	2×10^{-9}
	Cm 244	S	9×10^{-12}	2×10^{-8}	3×10^{-13}	7×10^{-9}
		I	1×10^{-10}	8×10^{-8}	3×10^{-12}	3×10^{-9}
	Cm 245	S	5×10^{-12}	1×10^{-8}	2×10^{-13}	4×10^{-9}
		I	1×10^{-10}	8×10^{-8}	4×10^{-12}	3×10^{-9}
	Cm 246	S	5×10^{-12}	1×10^{-8}	2×10^{-13}	4×10^{-9}
		I	1×10^{-10}	8×10^{-8}	4×10^{-12}	3×10^{-9}
	Cm 247	S	5×10^{-12}	1×10^{-8}	2×10^{-13}	4×10^{-9}
		I	1×10^{-10}	6×10^{-8}	4×10^{-12}	2×10^{-9}
	Cm 248	S	6×10^{-13}	1×10^{-8}	2×10^{-14}	4×10^{-9}

38 FR 29314

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	
			Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)	Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)
		I	1×10^{-11}	4×10^{-5}	4×10^{-13}	1×10^{-6}
	Cm 249	S	1×10^{-4}	6×10^{-2}	4×10^{-7}	2×10^{-3}
		I	1×10^{-5}	6×10^{-3}	4×10^{-7}	2×10^{-3}
Dysprosium (66)	Dy 165	S	3×10^{-6}	1×10^{-3}	8×10^{-9}	4×10^{-4}
		I	2×10^{-6}	1×10^{-3}	7×10^{-9}	4×10^{-4}
	Dy 166	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-4}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-4}
Einsteinium (99)	Es 253	S	8×10^{-10}	7×10^{-6}	3×10^{-11}	2×10^{-6}
		I	6×10^{-10}	7×10^{-6}	2×10^{-11}	2×10^{-6}
	Es 254m	S	5×10^{-9}	5×10^{-6}	2×10^{-10}	2×10^{-6}
		I	6×10^{-9}	5×10^{-6}	2×10^{-10}	2×10^{-6}
	Es 254	S	2×10^{-11}	4×10^{-6}	6×10^{-13}	1×10^{-6}
		I	1×10^{-10}	4×10^{-6}	4×10^{-12}	1×10^{-6}
	Es 255	S	5×10^{-10}	8×10^{-6}	2×10^{-11}	3×10^{-6}
		I	4×10^{-10}	8×10^{-6}	1×10^{-11}	3×10^{-6}
Erbium (68)	Er 169	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-6}
		I	4×10^{-7}	3×10^{-3}	1×10^{-8}	9×10^{-6}
	Er 171	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-5}
		I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-5}
Europium (63)	Eu 152	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-6}
	(T/2 = 9.2 hrs)	S	2×10^{-6}	1×10^{-3}	6×10^{-8}	3×10^{-7}
	Eu 152	S	1×10^{-6}	2×10^{-3}	4×10^{-10}	8×10^{-6}
	(T/2 = 13 yrs)	I	2×10^{-6}	2×10^{-3}	6×10^{-10}	8×10^{-6}
	Eu 154	S	4×10^{-8}	6×10^{-4}	1×10^{-10}	2×10^{-6}
		I	7×10^{-8}	6×10^{-4}	2×10^{-10}	2×10^{-6}
	Eu 155	S	9×10^{-8}	6×10^{-3}	3×10^{-9}	2×10^{-4}
		I	7×10^{-8}	6×10^{-3}	3×10^{-9}	2×10^{-4}
Fermium (100)	Fm 254	S	6×10^{-6}	4×10^{-3}	2×10^{-9}	1×10^{-4}
		I	7×10^{-6}	4×10^{-3}	2×10^{-9}	1×10^{-4}
	Fm 255	S	2×10^{-6}	1×10^{-3}	6×10^{-10}	3×10^{-6}
		I	1×10^{-6}	1×10^{-3}	4×10^{-10}	3×10^{-6}
	Fm 256	S	3×10^{-9}	3×10^{-6}	1×10^{-10}	9×10^{-7}
		I	2×10^{-8}	3×10^{-6}	6×10^{-11}	9×10^{-7}
Fluorine (9)	F 18	S	5×10^{-6}	2×10^{-3}	2×10^{-9}	8×10^{-6}
		I	3×10^{-6}	1×10^{-3}	9×10^{-9}	5×10^{-6}
Gadolinium (64)	Gd 153	S	2×10^{-7}	6×10^{-4}	8×10^{-9}	2×10^{-6}
		I	9×10^{-6}	6×10^{-3}	3×10^{-8}	2×10^{-6}
	Gd 159	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-6}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-6}
Gallium (31)	Ga 72	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-6}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-6}
Germanium (32)	Ge 71	S	1×10^{-5}	5×10^{-3}	4×10^{-7}	2×10^{-3}
		I	6×10^{-6}	5×10^{-3}	2×10^{-7}	2×10^{-3}
Gold (79)	Au 196	S	1×10^{-6}	5×10^{-3}	4×10^{-9}	2×10^{-6}
		I	6×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-6}
	Au 198	S	3×10^{-7}	2×10^{-3}	1×10^{-8}	5×10^{-6}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	5×10^{-6}
	Au 199	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-6}
		I	8×10^{-7}	4×10^{-3}	3×10^{-8}	2×10^{-6}
Hafnium (72)	Hf 181	S	4×10^{-8}	2×10^{-3}	1×10^{-9}	7×10^{-6}
		I	7×10^{-8}	2×10^{-3}	3×10^{-9}	7×10^{-6}
Holmium (67)	Ho 166	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-6}
		I	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-6}
Hydrogen (1)	H3	S	5×10^{-6}	1×10^{-1}	2×10^{-7}	3×10^{-3}
		I	5×10^{-6}	1×10^{-1}	2×10^{-7}	3×10^{-3}
		Sub	2×10^{-7}		4×10^{-9}	
Indium (49)	In 113m	S	8×10^{-6}	4×10^{-3}	3×10^{-7}	1×10^{-3}
		I	7×10^{-6}	4×10^{-3}	2×10^{-7}	1×10^{-3}
	In 114m	S	1×10^{-7}	5×10^{-4}	4×10^{-9}	2×10^{-6}
		I	2×10^{-6}	5×10^{-4}	7×10^{-10}	2×10^{-6}
	In 115m	S	2×10^{-6}	10^{-3}	8×10^{-9}	4×10^{-6}
		I	2×10^{-6}	1×10^{-3}	6×10^{-9}	4×10^{-6}
	In 115	S	2×10^{-7}	3×10^{-3}	9×10^{-9}	9×10^{-6}
		I	3×10^{-6}	3×10^{-3}	1×10^{-8}	9×10^{-6}
Iodine (53)	I 125	S	5×10^{-6}	4×10^{-3}	8×10^{-11}	2×10^{-3}

38 FR 29314

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	
			Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)	Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)
		I	2×10^{-7}	8×10^{-3}	8×10^{-9}	2×10^{-6}
	I 126	S	8×10^{-8}	5×10^{-3}	9×10^{-11}	3×10^{-6}
		I	3×10^{-7}	3×10^{-3}	1×10^{-8}	9×10^{-6}
	I 129	S	2×10^{-8}	1×10^{-3}	2×10^{-11}	6×10^{-6}
		I	7×10^{-8}	6×10^{-3}	2×10^{-8}	2×10^{-6}
	I 131	S	9×10^{-8}	6×10^{-3}	1×10^{-10}	3×10^{-6}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-6}
	I 132	S	2×10^{-7}	2×10^{-3}	3×10^{-8}	8×10^{-6}
		I	9×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-6}
	I 133	S	3×10^{-8}	2×10^{-4}	4×10^{-10}	1×10^{-6}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-6}
	I 134	S	5×10^{-7}	4×10^{-3}	6×10^{-9}	2×10^{-6}
		I	3×10^{-6}	2×10^{-3}	1×10^{-7}	6×10^{-6}
	I 135	S	1×10^{-7}	7×10^{-4}	1×10^{-9}	4×10^{-6}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-6}
Indium (77)	Ir 190	S	1×10^{-6}	6×10^{-3}	4×10^{-9}	2×10^{-6}
		I	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-6}
	Ir 192	S	1×10^{-7}	1×10^{-3}	4×10^{-9}	4×10^{-6}
		I	3×10^{-8}	1×10^{-3}	9×10^{-10}	4×10^{-6}
	Ir 194	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	3×10^{-6}
		I	2×10^{-7}	9×10^{-4}	5×10^{-9}	3×10^{-6}
Iron (26)	Fe 55	S	9×10^{-7}	2×10^{-3}	3×10^{-8}	8×10^{-6}
		I	1×10^{-6}	7×10^{-3}	3×10^{-8}	2×10^{-5}
	Fe 59	S	1×10^{-7}	2×10^{-3}	5×10^{-9}	6×10^{-6}
		I	5×10^{-8}	2×10^{-3}	2×10^{-8}	5×10^{-6}
Krypton (36)	Kr 85m	Sub	6×10^{-6}		1×10^{-7}	
	Kr 85	Sub	1×10^{-5}		3×10^{-7}	
	Kr 87	Sub	1×10^{-6}		2×10^{-8}	
	Kr 88	Sub	1×10^{-6}		2×10^{-8}	
Lanthanum (57)	La 140	S	2×10^{-7}	7×10^{-4}	5×10^{-9}	2×10^{-6}
		I	1×10^{-7}	7×10^{-4}	4×10^{-9}	2×10^{-6}
Lead (82)	Pb 203	S	3×10^{-6}	1×10^{-3}	9×10^{-8}	4×10^{-6}
		I	2×10^{-6}	1×10^{-3}	6×10^{-8}	4×10^{-6}
	Pb 210	S	1×10^{-10}	4×10^{-6}	4×10^{-12}	1×10^{-7}
		I	2×10^{-10}	5×10^{-6}	8×10^{-12}	2×10^{-6}
	Pb 212	S	2×10^{-8}	6×10^{-4}	6×10^{-10}	2×10^{-6}
		I	2×10^{-8}	5×10^{-4}	7×10^{-10}	2×10^{-6}
Lutetium (71)	Lu 177	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Manganese (25)	Mn 52	S	2×10^{-7}	1×10^{-3}	7×10^{-9}	3×10^{-6}
		I	1×10^{-7}	9×10^{-4}	5×10^{-9}	3×10^{-6}
	Mn 54	S	4×10^{-7}	4×10^{-3}	1×10^{-8}	1×10^{-4}
		I	4×10^{-8}	3×10^{-3}	1×10^{-8}	1×10^{-4}
	Mn 56	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Mercury (80)	Hg 197m	S	7×10^{-7}	6×10^{-3}	3×10^{-8}	2×10^{-4}
		I	8×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	Hg 197	S	1×10^{-6}	9×10^{-3}	4×10^{-8}	3×10^{-6}
		I	3×10^{-6}	1×10^{-3}	9×10^{-8}	5×10^{-6}
	Hg 203	S	7×10^{-8}	5×10^{-4}	2×10^{-8}	2×10^{-6}
		I	1×10^{-7}	3×10^{-3}	4×10^{-8}	1×10^{-4}
Molybdenum (42)	Mo 99	S	7×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-6}
Neodymium (60)	Nd 144	S	8×10^{-11}	2×10^{-3}	3×10^{-12}	7×10^{-6}
		I	3×10^{-10}	2×10^{-3}	1×10^{-11}	8×10^{-6}
	Nd 147	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-6}
		I	2×10^{-7}	2×10^{-3}	8×10^{-9}	6×10^{-6}
	Nd 149	S	2×10^{-6}	8×10^{-3}	6×10^{-8}	3×10^{-6}
		I	1×10^{-6}	8×10^{-3}	5×10^{-8}	3×10^{-6}
Neptunium (93)	Np 237	S	4×10^{-12}	9×10^{-6}	1×10^{-13}	3×10^{-6}
		I	1×10^{-10}	9×10^{-6}	4×10^{-12}	3×10^{-6}
	Np 239	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	7×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-4}
Nickel (28)	Ni 59	S	5×10^{-7}	6×10^{-3}	2×10^{-8}	2×10^{-4}
		I	8×10^{-7}	6×10^{-3}	3×10^{-8}	2×10^{-4}

38 FR 29314

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	
			Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)	Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)
	Ni 63	S	6×10^{-8}	8×10^{-4}	2×10^{-6}	3×10^{-2}
		I	3×10^{-7}	2×10^{-3}	1×10^{-5}	7×10^{-4}
	Ni 65	S	9×10^{-7}	4×10^{-3}	3×10^{-5}	1×10^{-1}
		I	5×10^{-7}	3×10^{-3}	2×10^{-5}	1×10^{-1}
Niobium (Columbium) (41)	Nb 93m	S	1×10^{-7}	1×10^{-3}	4×10^{-7}	4×10^{-1}
		I	2×10^{-7}	1×10^{-3}	5×10^{-6}	4×10^{-1}
	Nb 95	S	5×10^{-7}	3×10^{-3}	2×10^{-5}	1×10^{-1}
		I	1×10^{-7}	3×10^{-3}	3×10^{-6}	1×10^{-1}
	Nb 97	S	6×10^{-6}	3×10^{-2}	2×10^{-4}	9×10^{-1}
		I	5×10^{-6}	3×10^{-2}	2×10^{-4}	9×10^{-1}
Osmium (76)	Os 185	S	5×10^{-7}	2×10^{-3}	2×10^{-6}	7×10^{-1}
		I	5×10^{-6}	2×10^{-2}	2×10^{-6}	7×10^{-1}
	Os 191m	S	2×10^{-5}	7×10^{-2}	6×10^{-4}	3×10^{-1}
		I	9×10^{-6}	7×10^{-2}	3×10^{-4}	2×10^{-1}
	Os 191	S	1×10^{-6}	5×10^{-3}	4×10^{-6}	2×10^{-1}
		I	4×10^{-7}	5×10^{-3}	1×10^{-5}	2×10^{-1}
	Os 193	S	4×10^{-7}	2×10^{-3}	1×10^{-5}	6×10^{-1}
		I	3×10^{-7}	2×10^{-3}	9×10^{-6}	5×10^{-1}
Palladium (46)	Pd 103	S	1×10^{-6}	1×10^{-3}	5×10^{-5}	3×10^{-1}
		I	7×10^{-7}	8×10^{-3}	3×10^{-5}	2×10^{-1}
	Pd 109	S	6×10^{-7}	3×10^{-3}	2×10^{-5}	9×10^{-1}
		I	4×10^{-7}	2×10^{-3}	1×10^{-5}	7×10^{-1}
Phosphorus (15)	P 32	S	7×10^{-8}	5×10^{-4}	2×10^{-6}	2×10^{-1}
		I	8×10^{-8}	7×10^{-4}	3×10^{-6}	2×10^{-1}
Platinum (78)	Pt 191	S	8×10^{-7}	4×10^{-3}	3×10^{-5}	1×10^{-1}
		I	6×10^{-7}	3×10^{-3}	2×10^{-5}	1×10^{-1}
	Pt 193m	S	7×10^{-6}	3×10^{-2}	2×10^{-4}	1×10^{-1}
		I	5×10^{-6}	3×10^{-2}	2×10^{-4}	1×10^{-1}
	Pt 193	S	1×10^{-6}	3×10^{-3}	4×10^{-5}	9×10^{-1}
		I	3×10^{-7}	5×10^{-3}	1×10^{-5}	2×10^{-1}
	Pt 197m	S	6×10^{-6}	3×10^{-2}	2×10^{-4}	1×10^{-1}
		I	5×10^{-6}	3×10^{-2}	2×10^{-4}	9×10^{-1}
	Pt 197	S	8×10^{-7}	4×10^{-3}	3×10^{-5}	1×10^{-1}
		I	6×10^{-7}	3×10^{-3}	2×10^{-5}	1×10^{-1}
Plutonium (94)	Pu 238	S	2×10^{-13}	1×10^{-4}	7×10^{-12}	5×10^{-4}
		I	3×10^{-11}	8×10^{-4}	1×10^{-12}	3×10^{-3}
	Pu 239	S	2×10^{-13}	1×10^{-4}	6×10^{-12}	5×10^{-4}
		I	4×10^{-11}	8×10^{-4}	1×10^{-12}	3×10^{-3}
	Pu 240	S	2×10^{-13}	1×10^{-4}	6×10^{-12}	5×10^{-4}
		I	4×10^{-11}	8×10^{-4}	1×10^{-12}	3×10^{-3}
	Pu 241	S	9×10^{-11}	7×10^{-3}	3×10^{-12}	2×10^{-2}
		I	4×10^{-9}	4×10^{-2}	1×10^{-10}	1×10^{-2}
	Pu 242	S	2×10^{-13}	1×10^{-4}	6×10^{-12}	5×10^{-4}
		I	4×10^{-11}	9×10^{-4}	1×10^{-12}	3×10^{-3}
	Pu 243	S	2×10^{-6}	1×10^{-2}	6×10^{-8}	3×10^{-1}
		I	2×10^{-6}	1×10^{-2}	8×10^{-8}	3×10^{-1}
	Pu 244	S	2×10^{-13}	1×10^{-4}	6×10^{-12}	4×10^{-4}
		I	3×10^{-11}	3×10^{-4}	1×10^{-12}	1×10^{-3}
Polonium (84)	Po 210	S	5×10^{-10}	2×10^{-5}	2×10^{-11}	7×10^{-2}
		I	2×10^{-10}	8×10^{-5}	7×10^{-12}	3×10^{-3}
Potassium (19)	K42	S	2×10^{-6}	9×10^{-3}	7×10^{-5}	3×10^{-1}
		I	1×10^{-7}	6×10^{-4}	4×10^{-6}	2×10^{-1}
Praseodymium (59)	Pr 142	S	2×10^{-7}	9×10^{-4}	7×10^{-6}	3×10^{-1}
		I	2×10^{-7}	9×10^{-4}	5×10^{-6}	3×10^{-1}
	Pr 143	S	3×10^{-7}	1×10^{-3}	1×10^{-5}	5×10^{-1}
		I	2×10^{-7}	1×10^{-3}	6×10^{-6}	5×10^{-1}
Promethium (61)	Pm 147	S	6×10^{-6}	6×10^{-3}	2×10^{-4}	2×10^{-1}
		I	1×10^{-7}	6×10^{-3}	3×10^{-6}	2×10^{-1}
	Pm 149	S	3×10^{-7}	1×10^{-3}	1×10^{-5}	4×10^{-1}
		I	2×10^{-7}	1×10^{-3}	8×10^{-6}	4×10^{-1}
Protoactinium (91)	Pa 230	S	2×10^{-8}	7×10^{-3}	6×10^{-11}	2×10^{-2}
		I	8×10^{-10}	7×10^{-3}	3×10^{-11}	2×10^{-2}
	Pa 231	S	1×10^{-12}	3×10^{-5}	4×10^{-14}	9×10^{-3}
		I	1×10^{-10}	8×10^{-5}	4×10^{-12}	2×10^{-2}
	Pa 233	S	6×10^{-7}	4×10^{-3}	2×10^{-5}	1×10^{-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	
			Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)	Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)
		I	2×10^{-7}	3×10^{-3}	6×10^{-6}	1×10^{-1}
Radium (88)	Ra 223	S	2×10^{-9}	2×10^{-4}	6×10^{-11}	7×10^{-3}
		I	2×10^{-10}	1×10^{-4}	8×10^{-12}	4×10^{-3}
	Ra 224	S	5×10^{-9}	7×10^{-3}	2×10^{-10}	2×10^{-2}
		I	7×10^{-10}	2×10^{-4}	2×10^{-11}	5×10^{-3}
	Ra 226	S	3×10^{-11}	4×10^{-3}	3×10^{-12}	3×10^{-2}
		I	5×10^{-11}	9×10^{-4}	2×10^{-12}	3×10^{-3}
	Ra 228	S	7×10^{-11}	8×10^{-3}	2×10^{-12}	3×10^{-2}
		I	4×10^{-11}	7×10^{-4}	1×10^{-12}	3×10^{-3}
Radon (86)	Rn 220	S	3×10^{-7}		1×10^{-9}	
	Rn 222 [3]		3×10^{-9}		3×10^{-9}	
Rhenium (75)	Re 183	S	3×10^{-6}	2×10^{-2}	9×10^{-8}	6×10^{-2}
		I	2×10^{-7}	8×10^{-3}	5×10^{-6}	3×10^{-2}
	Re 186	S	6×10^{-7}	3×10^{-3}	2×10^{-5}	9×10^{-2}
		I	2×10^{-7}	1×10^{-3}	8×10^{-6}	5×10^{-2}
	Re 187	S	9×10^{-6}	7×10^{-2}	3×10^{-4}	3×10^{-1}
		I	5×10^{-7}	4×10^{-3}	2×10^{-5}	2×10^{-1}
	Re 188	S	4×10^{-7}	2×10^{-3}	1×10^{-5}	6×10^{-1}
		I	2×10^{-7}	9×10^{-4}	6×10^{-6}	3×10^{-1}
Rhodium (45)	Rh 103m	S	8×10^{-6}	4×10^{-2}	3×10^{-4}	1×10^{-1}
		I	6×10^{-6}	3×10^{-2}	2×10^{-4}	1×10^{-1}
	Rh 105	S	8×10^{-7}	4×10^{-3}	3×10^{-5}	1×10^{-1}
		I	5×10^{-7}	3×10^{-3}	2×10^{-5}	1×10^{-1}
Rubidium (37)	Rb 86	S	3×10^{-7}	2×10^{-3}	1×10^{-5}	7×10^{-1}
		I	7×10^{-8}	7×10^{-4}	2×10^{-6}	2×10^{-1}
	Rb 87	S	5×10^{-7}	3×10^{-3}	2×10^{-5}	1×10^{-1}
		I	7×10^{-8}	5×10^{-4}	2×10^{-6}	2×10^{-1}
Ruthenium (44)	Ru 97	S	2×10^{-6}	1×10^{-2}	8×10^{-5}	4×10^{-1}
		I	2×10^{-6}	1×10^{-2}	6×10^{-5}	3×10^{-1}
	Ru 103	S	5×10^{-7}	2×10^{-3}	2×10^{-5}	8×10^{-1}
		I	8×10^{-7}	2×10^{-3}	3×10^{-5}	8×10^{-1}
	Ru 105	S	7×10^{-7}	3×10^{-3}	2×10^{-5}	1×10^{-1}
		I	5×10^{-7}	3×10^{-3}	2×10^{-5}	1×10^{-1}
	Ru 106	S	8×10^{-6}	4×10^{-2}	3×10^{-4}	1×10^{-1}
		I	6×10^{-6}	3×10^{-2}	2×10^{-4}	1×10^{-1}
Samarium (62)	Sm 147	S	7×10^{-11}	2×10^{-3}	2×10^{-12}	6×10^{-3}
		I	3×10^{-10}	2×10^{-3}	9×10^{-12}	7×10^{-3}
	Sm 151	S	6×10^{-6}	1×10^{-2}	2×10^{-4}	4×10^{-1}
		I	1×10^{-7}	1×10^{-3}	5×10^{-6}	4×10^{-1}
	Sm 153	S	5×10^{-7}	2×10^{-3}	2×10^{-5}	8×10^{-1}
		I	4×10^{-7}	2×10^{-3}	1×10^{-5}	8×10^{-1}
Scandium (21)	Sc 46	S	2×10^{-7}	1×10^{-3}	8×10^{-6}	4×10^{-1}
		I	2×10^{-6}	1×10^{-2}	8×10^{-5}	4×10^{-1}
	Sc 47	S	6×10^{-7}	3×10^{-3}	2×10^{-5}	9×10^{-1}
		I	5×10^{-7}	3×10^{-3}	2×10^{-5}	9×10^{-1}
	Sc 48	S	2×10^{-7}	8×10^{-4}	6×10^{-6}	3×10^{-1}
		I	1×10^{-7}	8×10^{-4}	5×10^{-6}	3×10^{-1}
Selenium 34)	Se 75	S	1×10^{-6}	9×10^{-3}	4×10^{-5}	3×10^{-1}
		I	1×10^{-7}	8×10^{-3}	4×10^{-6}	3×10^{-1}
Silicon (14)	Si 31	S	6×10^{-6}	3×10^{-2}	2×10^{-4}	9×10^{-1}
		I	1×10^{-5}	6×10^{-2}	3×10^{-5}	2×10^{-1}
Silver (47)	Ag 105	S	6×10^{-7}	3×10^{-3}	2×10^{-5}	1×10^{-1}
		I	8×10^{-6}	3×10^{-2}	3×10^{-5}	1×10^{-1}
	Ag 110m	S	2×10^{-7}	9×10^{-4}	7×10^{-6}	3×10^{-1}
		I	1×10^{-6}	9×10^{-4}	3×10^{-10}	3×10^{-1}
	Ag 111	S	3×10^{-7}	1×10^{-3}	1×10^{-5}	4×10^{-1}
		I	2×10^{-7}	1×10^{-3}	8×10^{-6}	4×10^{-1}
Sodium (11)	Na 22	S	2×10^{-7}	1×10^{-3}	6×10^{-6}	4×10^{-1}
		I	9×10^{-6}	9×10^{-4}	3×10^{-10}	3×10^{-1}
	Na 24	S	1×10^{-6}	6×10^{-3}	4×10^{-5}	2×10^{-1}
		I	1×10^{-7}	8×10^{-4}	5×10^{-6}	3×10^{-1}
Strontium (38)	Sr 85m	S	4×10^{-6}	2×10^{-2}	1×10^{-4}	7×10^{-1}
		I	3×10^{-6}	2×10^{-2}	1×10^{-4}	7×10^{-1}
	Sr 85	S	2×10^{-7}	3×10^{-3}	8×10^{-6}	1×10^{-1}
		I	1×10^{-7}	5×10^{-3}	4×10^{-6}	2×10^{-1}

38 FR 29314

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	
			Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)	Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)
	Sr 89	S	3×10^{-8}	3×10^{-6}	3×10^{-10}	3×10^{-8}
		I	4×10^{-8}	8×10^{-6}	1×10^{-9}	3×10^{-8}
	Sr 90	S	1×10^{-9}	1×10^{-7}	3×10^{-11}	3×10^{-9}
		I	5×10^{-8}	1×10^{-6}	2×10^{-10}	4×10^{-8}
	Sr 91	S	4×10^{-7}	2×10^{-6}	2×10^{-8}	7×10^{-8}
		I	3×10^{-7}	1×10^{-6}	9×10^{-9}	5×10^{-8}
	Sr 92	S	4×10^{-7}	2×10^{-6}	2×10^{-8}	7×10^{-8}
		I	3×10^{-7}	2×10^{-6}	1×10^{-8}	6×10^{-8}
Sulfur (16)	S 35	S	3×10^{-7}	2×10^{-6}	9×10^{-9}	6×10^{-8}
		I	3×10^{-7}	8×10^{-6}	9×10^{-9}	3×10^{-8}
Tantalum (73)	Ta 182	S	4×10^{-8}	1×10^{-6}	1×10^{-9}	4×10^{-8}
		I	2×10^{-8}	1×10^{-6}	7×10^{-10}	4×10^{-8}
Technetium (43)	Tc 95m	S	8×10^{-8}	4×10^{-7}	3×10^{-9}	1×10^{-8}
		I	3×10^{-8}	3×10^{-7}	1×10^{-9}	1×10^{-8}
	Tc 96	S	6×10^{-7}	3×10^{-6}	2×10^{-8}	1×10^{-7}
		I	2×10^{-7}	1×10^{-6}	8×10^{-9}	5×10^{-8}
	Tc 97m	S	2×10^{-6}	1×10^{-5}	8×10^{-8}	4×10^{-7}
		I	2×10^{-7}	5×10^{-6}	5×10^{-8}	2×10^{-7}
	Tc 97	S	1×10^{-6}	5×10^{-6}	4×10^{-7}	2×10^{-7}
		I	3×10^{-7}	2×10^{-6}	1×10^{-8}	8×10^{-8}
	Tc 99m	S	4×10^{-8}	2×10^{-7}	1×10^{-9}	6×10^{-8}
		I	1×10^{-6}	8×10^{-6}	5×10^{-7}	3×10^{-6}
	Tc 99	S	2×10^{-6}	1×10^{-5}	7×10^{-8}	3×10^{-7}
		I	6×10^{-8}	5×10^{-6}	2×10^{-8}	2×10^{-7}
Tellurium (52)	Te 125m	S	4×10^{-7}	5×10^{-6}	1×10^{-8}	2×10^{-7}
		I	1×10^{-7}	3×10^{-6}	4×10^{-9}	1×10^{-7}
	Te 127m	S	1×10^{-7}	2×10^{-6}	5×10^{-9}	6×10^{-8}
		I	4×10^{-8}	2×10^{-6}	1×10^{-9}	5×10^{-8}
	Te 127	S	2×10^{-6}	8×10^{-6}	6×10^{-8}	3×10^{-7}
		I	9×10^{-8}	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^{-8}	6×10^{-6}	1×10^{-9}	2×10^{-8}
	Te 129	S	5×10^{-6}	2×10^{-5}	2×10^{-7}	8×10^{-7}
		I	4×10^{-8}	2×10^{-6}	1×10^{-9}	8×10^{-8}
	Te 131m	S	4×10^{-7}	2×10^{-6}	1×10^{-8}	8×10^{-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^{-6}	4×10^{-8}	2×10^{-7}
Terbium (65)	Tb 160	S	1×10^{-7}	1×10^{-6}	3×10^{-9}	4×10^{-8}
		I	3×10^{-8}	1×10^{-6}	1×10^{-9}	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^{-10}	6×10^{-8}
Thorium (90)	Th 227	S	3×10^{-10}	5×10^{-8}	1×10^{-11}	2×10^{-9}
		I	2×10^{-10}	5×10^{-8}	6×10^{-12}	2×10^{-9}
	Th 228	S	9×10^{-12}	2×10^{-8}	3×10^{-13}	7×10^{-10}
		I	6×10^{-12}	4×10^{-8}	2×10^{-12}	10^{-9}
	Th 230	S	2×10^{-12}	5×10^{-8}	8×10^{-14}	2×10^{-9}
		I	10^{-11}	9×10^{-8}	3×10^{-12}	3×10^{-9}
	Th 231	S	1×10^{-6}	7×10^{-6}	5×10^{-8}	2×10^{-7}
		I	1×10^{-6}	7×10^{-6}	4×10^{-8}	2×10^{-7}
	Th 232	S	3×10^{-11}	5×10^{-8}	1×10^{-12}	2×10^{-9}
		I	3×10^{-11}	1×10^{-8}	1×10^{-12}	4×10^{-9}
	Th natural	S	6×10^{-11}	6×10^{-8}	2×10^{-12}	2×10^{-9}
		I	6×10^{-11}	6×10^{-8}	2×10^{-12}	2×10^{-9}
	Th 234	S	6×10^{-8}	5×10^{-6}	2×10^{-9}	2×10^{-7}
		I	3×10^{-8}	5×10^{-6}	1×10^{-9}	2×10^{-7}
Thulium (69)	Tm 170	S	4×10^{-8}	1×10^{-7}	1×10^{-9}	5×10^{-9}
		I	3×10^{-8}	1×10^{-7}	1×10^{-9}	5×10^{-9}
	Tm 171	S	1×10^{-7}	1×10^{-6}	4×10^{-9}	5×10^{-8}

40 FR 50704

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	
			Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)	Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)
		I	2×10^{-7}	1×10^{-5}	8×10^{-9}	5×10^{-8}
Tin (50)	Sn 113	S	4×10^{-7}	2×10^{-5}	1×10^{-8}	9×10^{-8}
		I	5×10^{-8}	2×10^{-5}	2×10^{-9}	8×10^{-8}
	Sn 125	S	1×10^{-7}	5×10^{-6}	4×10^{-9}	2×10^{-8}
		I	8×10^{-8}	5×10^{-6}	3×10^{-9}	2×10^{-8}
Tungsten (Wolfram) (74)	W 181	S	2×10^{-6}	1×10^{-5}	8×10^{-8}	4×10^{-7}
		I	1×10^{-7}	1×10^{-5}	4×10^{-9}	3×10^{-8}
	W 185	S	8×10^{-7}	4×10^{-5}	3×10^{-8}	1×10^{-7}
		I	1×10^{-7}	3×10^{-5}	4×10^{-9}	1×10^{-7}
	W 187	S	4×10^{-7}	2×10^{-5}	2×10^{-8}	7×10^{-8}
		I	3×10^{-7}	2×10^{-5}	1×10^{-8}	6×10^{-8}
Uranium (92)	U 230	S	3×10^{-10}	1×10^{-7}	1×10^{-11}	5×10^{-10}
		I	1×10^{-10}	1×10^{-7}	4×10^{-12}	5×10^{-10}
	U 232	S	1×10^{-10}	8×10^{-8}	3×10^{-12}	3×10^{-9}
		I	3×10^{-11}	8×10^{-8}	9×10^{-13}	3×10^{-9}
	U 233	S	5×10^{-10}	9×10^{-8}	2×10^{-11}	3×10^{-9}
		I	1×10^{-10}	9×10^{-8}	4×10^{-12}	3×10^{-9}
	U 234	S*	6×10^{-10}	9×10^{-8}	2×10^{-11}	3×10^{-9}
		I	1×10^{-10}	9×10^{-8}	4×10^{-12}	3×10^{-9}
	U 235	S*	5×10^{-10}	8×10^{-8}	2×10^{-11}	3×10^{-9}
		I	1×10^{-10}	8×10^{-8}	4×10^{-12}	3×10^{-9}
	U 236	S	6×10^{-10}	1×10^{-7}	2×10^{-11}	3×10^{-9}
		I	1×10^{-10}	1×10^{-7}	4×10^{-12}	3×10^{-9}
	U 238	S*	7×10^{-11}	1×10^{-7}	3×10^{-12}	4×10^{-9}
		I	1×10^{-10}	1×10^{-7}	5×10^{-12}	4×10^{-9}
	U 240	S	2×10^{-7}	1×10^{-5}	8×10^{-9}	3×10^{-8}
		I	2×10^{-7}	1×10^{-5}	6×10^{-9}	3×10^{-8}
	U-natural	S*	1×10^{-10}	1×10^{-7}	5×10^{-12}	3×10^{-9}
		I	1×10^{-10}	1×10^{-7}	5×10^{-12}	3×10^{-9}
Vanadium (23)	V 48	S	2×10^{-7}	9×10^{-6}	6×10^{-9}	3×10^{-8}
		I	6×10^{-8}	8×10^{-6}	2×10^{-9}	3×10^{-8}
Xenon (54)	Xe 131m	Sub	2×10^{-6}		4×10^{-7}	
	Xe 133	Sub	1×10^{-6}		3×10^{-7}	
	Xe 133m	Sub	1×10^{-6}		3×10^{-7}	
	Xe 135	Sub	4×10^{-6}		1×10^{-7}	
Ytterbium (70)	Yb 175	S	7×10^{-7}	3×10^{-6}	2×10^{-8}	1×10^{-7}
		I	6×10^{-7}	3×10^{-6}	2×10^{-9}	1×10^{-7}
Yttrium (39)	Y 90	S	1×10^{-7}	6×10^{-6}	4×10^{-9}	2×10^{-8}
		I	1×10^{-7}	6×10^{-6}	3×10^{-9}	2×10^{-8}
	Y 91m	S	2×10^{-6}	1×10^{-5}	8×10^{-7}	3×10^{-6}
		I	2×10^{-6}	1×10^{-5}	6×10^{-7}	3×10^{-6}
	Y 91	S	4×10^{-8}	8×10^{-6}	1×10^{-9}	3×10^{-8}
		I	3×10^{-8}	8×10^{-6}	1×10^{-9}	3×10^{-8}
	Y 92	S	4×10^{-7}	2×10^{-6}	1×10^{-8}	6×10^{-8}
		I	3×10^{-7}	2×10^{-6}	1×10^{-8}	6×10^{-8}
	Y 93	S	2×10^{-7}	8×10^{-6}	6×10^{-9}	3×10^{-8}
		I	1×10^{-7}	8×10^{-6}	5×10^{-9}	3×10^{-8}
Zinc (30)	Zn 65	S	1×10^{-7}	3×10^{-6}	4×10^{-9}	1×10^{-7}
		I	6×10^{-8}	5×10^{-6}	2×10^{-9}	2×10^{-7}
	Zn 69m	S	4×10^{-7}	2×10^{-6}	1×10^{-8}	7×10^{-8}
		I	3×10^{-7}	2×10^{-6}	1×10^{-8}	6×10^{-8}
	Zn 69	S	7×10^{-6}	5×10^{-5}	2×10^{-7}	2×10^{-6}
		I	9×10^{-8}	5×10^{-6}	3×10^{-7}	2×10^{-7}
Zirconium (40)	Zr 93	S	1×10^{-7}	2×10^{-6}	4×10^{-9}	8×10^{-8}
		I	3×10^{-7}	2×10^{-6}	1×10^{-8}	8×10^{-8}
	Zr 95	S	1×10^{-7}	2×10^{-6}	4×10^{-9}	6×10^{-8}
		I	3×10^{-8}	2×10^{-6}	1×10^{-9}	6×10^{-8}
	Zr 97	S	1×10^{-7}	5×10^{-6}	4×10^{-9}	2×10^{-8}
		I	9×10^{-8}	5×10^{-6}	3×10^{-8}	2×10^{-8}
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}	

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	
			Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)	Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)
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^{-8}	9×10^{-6}	1×10^{-10}	3×10^{-8}
Any single radionuclide not listed above, which decays by alpha emission or spontaneous fission			6×10^{-12}	4×10^{-7}	2×10^{-14}	3×10^{-8}

[1] Soluble (S), insoluble (I).

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

[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^{-3} SA μCi-hr/ml, where SA is the specific activity of the uranium inhaled. The concentration value for Table II is 0.007 milligrams uranium per cubic meter of air. The specific activity for natural uranium is $6.77 \cdot 10^{-7}$ curies per gram U. The specific activity for other mixtures of U-238, U-235 and U-234, if not known, shall be:

$SA = 3.6 \cdot 10^{-7}$ curies/gram U U-depleted

$SA = (0.4 + 0.38\,E + 0.0034\,E^2)\,10^{-6}$ E 0.72

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

NOTE: In any case where there is a mixture in air or water of more than one radionuclide, the limiting values for purposes of this Appendix should be determined as follows:

1. If the identity and concentration of each radionuclide in the mixture are known, the limiting values should be derived as follows. Determine, for each radionuclide in the mixture, the ratio between the quantity present in the mixture and the limit otherwise established in Appendix B for the specific radionuclide when not in a mixture. The sum of such ratios for all the radionuclides in the mixture may not exceed "1" (i.e., "unity").

EXAMPLE: If radionuclides A, B, and C are present in concentrations C_A, C_B, and C_C, and if the applicable MPC's, are MPC_A, and MPC_B, and MPC_C, respectively, then the concentrations shall be limited so that the following relationship exists:

$(C_A/MPC_A) + (C_B/MPC_B) + (C_C/MPC_C) \leq 1$

2. If either the identity or the concentration of any radionuclide in the mixture is not known, the limiting values for purposes of Appendix B shall be:

a. For purposes of Table I, Col. 1—6×10^{-12}
b. For purposes of Table I, Col. 2—4×10^{-7}
c. For purposes of Table II, Col. 1—2×10^{-14}
d. For purposes of Table II, Col. 2—3×10^{-8}

3. If any of the conditions specified below are met, the corresponding values specified below may be used in lieu of those specified in paragraph 2 above.

a. If the identity of each radionuclide in the mixture is known but the concentration of one or more of the radionuclides in the mixture is not known, the concentration limit for the mixture is the limit specified in Appendix "B" for the radionuclide in the mixture having the lowest concentration limit; or

b. If the identity of each radionuclide in the mixture is not known, but it is known that certain radionuclides specified in Appendix "B" are not present in the mixture, the concentration limit for the mixture is the lowest concentration limit specified in Appendix "B" for any radionuclide which is not known to be absent from the mixture; or

c. Element (atomic number) and isotope	Table I		Table II	
	Col. 1—Air ([3] μCi/ml)	Col. 2—Water (μCi/ml)	Col. 1—Air (μCi/ml)	Col. 2—Water (μCi/ml)
If it is known that Sr 90, I 125, I 126, I 129, I 131 (I 133, table II only), Pb 210, Po 210, At 211, Ra 223, Ra 224, Ra 226, Ac 227, Ra 228, Th 230, Pa 231, Th 232, Th-nat, Cm 248, Cf 254, and Fm 256 are not present		9×10^{-6}		3×10^{-8}
If it is known that Sr 90, I 125, I 126, I 129 (I 131, I 133, table II only), Pb 210, Po 210, Ra 223, Ra 226, Ra 228, Pa 231, Th-nat, Cm 248, Cf 254, and Fm 256 are not present		6×10^{-6}		2×10^{-8}
If it is known that Sr 90, I 129 (I 125, I 126, I 131, table II only), Pb 210, Ra 226, Ra 228, Cm 248, and Cf 254 are not present		2×10^{-6}		6×10^{-9}
If it is known that (I 129, table II only), Ra 226, and Ra 228 are not present		3×10^{-6}		1×10^{-7}
If it is known that alpha-emitters and Sr 90, I 129, Pb 210, Ac 227, Ra 228, Pa 230, Pu 241, and Bk 249 are not present	3×10^{-9}		1×10^{-10}	
If it is known that alpha-emitters and Pb 210, Ac 227, Ra 228, and Pu 241 are not present	3×10^{-10}		1×10^{-11}	
If it is known that alpha-emitters and Ac 227 are not present	3×10^{-11}		1×10^{-12}	
If it is known that Ac 227, Th 230, Pa 231, Pu 238, Pu 239, Pu 240, Pu 242, Pu 244, Cm 248, Cf 249 and Cf 251 are not present	3×10^{-12}		1×10^{-13}	

[a]

4. If a mixture of radionuclides consists of uranium and its daughters in ore dust prior to chemical separation of the uranium from the ore, the values specified below may be used for uranium and its daughters through radium-226, instead of those from paragraphs 1, 2, or 3 above.

a. For purposes of Table I, Col. 1—1×10^{-10} μCi/ml gross alpha activity; or 5×10^{-11} μCi/ml natural uranium or 75 micrograms per cubic meter of air natural uranium.

b. For purposes of Table II, Col. 1—3×10^{-12} μCi/ml gross alpha activity; 2×10^{-11} μCi/ml natural uranium; or 3 micrograms per cubic meter of air natural uranium.

5. For purposes of this note, a radionuclide may be considered as not present in a mixture if (a) the ratio of the concentration of that radionuclide in the mixture (C_A) to the concentration limit for that radionuclide specified in Table II of Appendix "B" (MPC_A) does not exceed 1/10 (i.e. $C_A/MPC_A \leq 1/10$) and (b) the sum of such ratios for all the radionuclides considered as not present in the mixture does not exceed ¼ (i.e. $(C_A/MPC_A + C_B/MPC_B \ldots + \leq ¼)$).

APPENDIX C

Material	Microcuries
Americium-241	.01
Antimony-122	100
Antimony-124	10
Antimony-125	10
Arsenic-73	100
Arsenic-74	10
Arsenic-76	10
Arsenic-77	100
Barium-131	10
Barium-133	10
Barium-140	10
Bismuth-210	1
Bromine-82	10
Cadmium-109	10
Cadmium-115m	10
Cadmium-115	100
Calcium-45	10
Calcium-47	10
Carbon-14	100
Cerium-141	100
Cerium-143	100
Cerium-144	1
Cesium-131	1,000
Cesium-134m	100
Cesium-134	1
Cesium-135	10
Cesium-136	10
Cesium-137	10
Chlorine-36	10
Chlorine-38	10
Chromium-51	1,000
Cobalt-58m	10
Cobalt-58	10
Cobalt-60	1
Copper-64	100
Dysprosium-165	10
Dysprosium-166	100

APPENDIX C—Continued

Material	Microcuries
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
Indium-192	10
Indium-194	100
Iron-55	100
Iron-59	10
Krypton-85	100
Krypton-87	10
Lanthanum-140	10
Lutetium-177	100
Manganese-52	10

40 FR 50704; 40 FR 50704; 30 FR 15801; 40 FR 50704; 39 FR 23990; 26 FR 11046; 36 FR 16898; 39 FR 23990; 25 FR 10914; 30 FR 15801; 26 FR 11046; 30 FR 15801

APPENDIX C—Continued

Material	Microcuries
Manganese-54	10
Manganese-56	10
Mercury-197m	100
Mercury-197	100
Mercury-203	10
Molybdenum-99	100
Neodymium-147	100
Neodymium-149	100
Nickel-59	100
Nickel-63	10
Nickel-65	100
Niobium-93m	10
Niobium-95	10
Niobium-97	10
Osmium-185	10
Osmium-191m	100
Osmium-191	100
Osmium-193	100
Palladium-103	100
Palladium-109	100
Phosphorus-32	10
Platinum-191	100
Platinum-193m	100
Platinum-193	100
Platinum-197m	100
Platinum-197	100
Plutonium-239	.01
Polonium-210	0.1
Potassium-42	10
Praseodymium-142	100
Praseodymium-143	100
Promethium-147	10
Promethium-149	10
Radium-226	.01
Rhenium-186	100
Rhenium-188	100
Rhodium-103m	100
Rhodium-105	100
Rubidium-86	10
Rubidium-87	10
Ruthenium-97	100
Ruthenium-103	10
Ruthenium-105	10
Ruthenium-106	1
Samarium-151	10
Samarium-153	100
Scandium-46	10
Scandium-47	100
Scandium-48	10
Selenium-75	10
Silicon-31	100
Silver-105	10
Silver-110m	1
Silver-111	100
Sodium-24	10
Strontium-85	10
Strontium-89	1
Strontium-90	0.1
Strontium-91	10
Strontium-92	10
Sulphur-35	100
Tantalum-182	10
Technetium-96	10
Technetium-97m	100
Technetium-97	100
Technetium-99m	100

36 FR 16898

APPENDIX C—Continued

Material	Microcuries
Technetium-99	10
Tellurium-125m	10
Tellurium-127m	10
Tellurium-127	100
Tellurium-129m	10
Tellurium-129	100
Tellurium-131m	10
Tellurium-132	10
Terbium-160	10
Thallium-200	100
Thallium-201	100
Thallium-202	100
Thallium-204	10
Thorium (natural)[1]	100
Thulium-170	10
Thulium-171	10
Tin-113	10
Tin-125	10
Tungsten-181	10
Tungsten-185	10
Tungsten-187	100
Uranium (natural)[2]	100
Uranium-233	.01
Uranium-234—Uranium-235	.01
Vanadium-48	10
Xenon-131m	1,000
Xenon-133	100
Xenon-135	100
Ytterbium-175	100
Yttrium-90	10
Yttrium-91	10
Yttrium-92	100
Yttrium-93	100
Zinc-65	10
Zinc-69m	100
Zinc-69	1,000
Zirconium-93	10
Zirconium-95	10
Zirconium-97	10
Any alpha emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition	.01
Any radionuclide other than alpha emitting radionuclides, not listed above or mixtures of beta emitters of unknown composition	.1

39 FR 23990

45 FR 71761

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.

APPENDIX D.—UNITED STATES NUCLEAR REGULATORY COMMISSION REGIONAL OFFICES

	Address	Telephone (24 hrs)
Region I: Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.	USNRC, 631 Park Ave., King of Prussia, PA 19406	(213) 337-5000, (FTS) 488-1000.
Region II: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, Puerto Rico, South Carolina, Tennessee, Virginia, Virgin Islands, and West Virginia.	USNRC, 101 Marietta Street, Suite 3100, Atlanta, GA 30303	(404) 221-4503, (FTS) 242-4503.
Region III: Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin.	USNRC, 799 Roosevelt Road, Glen Ellyn, IL 60137	(312) 932-2500, (FTS) 384-2500.
Region IV: Arkansas, Colorado, Idaho, Kansas, Louisiana, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, and Wyoming.	USNRC, 611 Ryan Plaza Drive, Suite 1000, Arlington, TX 76102	(817) 860-8100, (FTS) 728-8100.
Region IV Field Office	USNRC, Region IV Uranium Recovery Field Office, 730 Simms Street, P.O. Box 25325, Denver, CO 80225.	(303) 234-7232, (FTS) 234-7232.
Region V: Alaska, Arizona, California, Hawaii, Nevada, Oregon, Washington, and U.S. territories and possessions in the Pacific.	USNRC, 1450 Maria Lane, Suite 210, Walnut Creek, CA 94596	(415) 943-3700, (FTS) 463-3700.

PART 30

RULES OF GENERAL APPLICABILITY TO DOMESTIC LICENSING OF BYPRODUCT MATERIAL★★

GENERAL PROVISIONS

EXEMPTIONS

LICENSES

RECORDS, INSPECTIONS, TESTS, PROCEDURES, AND REPORTS†

ENFORCEMENT

SCHEDULES

Authority: Sections 81, 82, 161, 182, 183, 186, 68 Stat. 935, 948, 953, 954, 955, as amended, sec. 234, 83 Stat. 444, as amended (42 U.S.C. 2111, 2112, 2201, 2232, 2236, 2282); secs. 201, as amended, 202, 206, 88 Stat. 1242, as amended, 1244, 1246 (42 U.S.C. 5841, 5842, 5846).

Section 30.7 also issued under Pub. L. 95-601, sec. 10, 92 Stat. 2951 (42 U.S.C. 5851). Section 30.34(b) also issued under sec. 184, 68 Stat. 954, as amended (42 U.S.C. 2234). Section 30.61 also issued under sec. 187, 68 Stat. 955 (42 U.S.C. 2237).

For purposes of sec. 223, 68 Stat. 958, as amended (42 U.S.C. 2273); §§ 30.3, 30.34(b) and (c), 30.41 (a) and (c) and 30.53 are issued under sec. 161b, 68 Stat. 948, as amended (42 U.S.C. 2201(b)); and §§ 30.36, 30.51, 30.52, 30.55 and 30.56(b) and (c) are issued under sec. 161o, 68 Stat. 950, as amended (42 U.S.C. 2201(o)).

[48 FR 39036]

§ 30.1 Purpose and Scope.

This part prescribes rules applicable to all persons in the United States governing domestic licensing of byproduct material under the Atomic Energy Act of 1954, as amended (68 Stat. 919), and under Title II of the Energy Reorganization Act of 1974 (88 Stat. 1242), and exemptions from the domestic licensing requirements permitted by section 81 of the Act.

[43 FR 6915]

§ 30.2 Resolution of conflict.

The requirements of this part are in addition to, and not in substitution for, other requirements of this chapter. In any conflict between the requirements in this part and a specific requirement in another part of the regulations in this chapter, the specific requirement governs.

[30 FR 8185]

§ 30.3 Activities requiring license.

Except for persons exempt as provided in this part and Part 150 of this chapter, no person shall manufacture, produce, transfer, receive, acquire, own, possess, or use, byproduct material except as authorized in a specific or general license issued pursuant to the regulations in this chapter.

[43 FR 6915]

§ 30.4 Definitions.

As used in this part and Parts 31-35 of this chapter:

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

[36 FR 1466]

(a-1) "Department" and "Department of Energy" means the Department of Energy established by the Department of Energy Organization Act (Pub. L. 95-91, 91 Stat. 565, 42 U.S.C. 7101 *et seq.*) to the extent that the Department, or its duly authorized representatives, exercises functions formerly vested in the U.S. Atomic Energy Commission, its Chairman, members, officers and components and transferred to the U.S. Energy Research and Development Administration and to the Administrator thereof pursuant to sections 104 (b), (c) and (d) of the Energy Reorganization Act of 1974 (Pub. L. 93-438, 88 Stat. 1233 at 1237, 42 U.S.C. 5814) and retransferred to the Secretary of Energy pursuant to section 301(a) of the Department of Energy Organization Act (Pub. L. 95-91, 91 Stat. 565 at 577-578, 42 U.S.C. 7151).

[45 FR 14199]

(b) Terms defined in section 11 of the Act shall have the same meaning when used in the regulations in this part and Parts 31-35 to the extent such terms are not specifically defined in this part;

[43 FR 6915]

(c) "Agreement State" means any state with which the Atomic Energy Commission or the Nuclear Regulatory Commission has entered into an effective agreement under subsection 274b. of the Act. "Non-Agreement State" means any other State; 40 FR 8774 45 FR 14199

(d) "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;

(e) "Commission" means the Nuclear Regulatory Commission and its duly authorized representatives;

(f) "Curie" means that amount of radioactive material which disintegrates at the rate of 37 billion atoms per second;

(g) "Government agency" means any executive department, commission, independent establishment, corporation, wholly or partly owned by the United States of America which is an instrumentality of the United States, or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the Government; 30 FR 8185

(h) "Human use" means the internal or external administration of byproduct material, or the radiation therefrom, to human beings;

(i) "License" except where otherwise specified means a license for byproduct material issued pursuant to the regulations in this part and Parts 31-35 of this chapter; 41 FR 6915

(j)(1) "Microcurie" means that amount of radioactive material which disintegrates at the rate of 37 thousand atoms per second; 35 FR 1314

(2) "Millicurie" means that amount of radioactive material which disintegrates at the rate of 37 million atoms per second;

(k) "Person" means (1) any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission or the Department, except that the Department shall be considered a person within the meaning of the regulations in this part to the extent that its facilities and activities are subject to the licensing and related regulatory authority of the Commission pursuant to section 202 of the Energy Reorganization Act of 1974 (88 Stat. 1244),[5] any State or any political subdivision of or any political entity within a State, any foreign government or nation or any political subdivision of any such government or nation, or other entity; and (2) any legal successor, representative, agent, or agency of the foregoing; 45 FR 14199

(l) "Physician" means an individual licensed by a State or territory of the United States, the District of Columbia or the Commonwealth of Puerto Rico to dispense drugs in the practice of medicine;

(m) "Production facility" means production facility as defined in the regulations contained in Part 50 of this chapter; 30 FR 8185

(n) "Radiographer" means any individual who performs or who, in attendance at the site where the sealed source or sources are being used, personally supervises radiographic operations and who is responsible to the licensee for assuring compliance with the requirements of the Commission's regulations and the conditions of the license;

(o) "Radiographer's assistant" means any individual who, under the personal supervision of a radiographer, uses radiographic exposure devices, sealed sources or related handling tools, or radiation survey instruments in radiography; 36 FR 1466

(p) "Radiography" means the examination of the structure of materials by nondestructive methods, utilizing sealed sources of byproduct materials; 30 FR 8185

(q) "Research and development" means (1) theoretical analysis, exploration, or experimentation; or (2) the extension of investigative findings and theories of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of models, devices, equipment, materials and processes, "Research and development" as used in this part and Parts 31-35 does not include the internal or external administration of byproduct material, or the radiation therefrom, to human beings; 43 FR 6915

(r) "Sealed source" means any byproduct material that is encased in a capsule designed to prevent leakage or escape of the byproduct material;

(s) "Source material" means source material as defined in the regulations contained in Part 40 of this chapter; 30 FR 8185

(t) "Special nuclear material" means special nuclear material as defined in the regulations contained in Part 70 of this chapter;

(u) "United States", when used in a geographical sense, includes Puerto Rico and all territories and possessions of the United States;

(v) "Utilization facility" means a utilization facility as defined in the regulations contained in Part 50 of this chapter; 45 FR 18905

(w) "Commencement of construction" means any clearing of land, excavation, or other substantial action that would adversely affect the natural environment of a site but does not include changes desirable for the temporary use of the land for public recreational uses, necessary borings to determine site characteristics or other preconstruction monitoring to establish background information related to the suitability of a site or to the protection of environmental values. 37 FR 5745

(x) "Irretrievable well-logging source" means any sealed source containing licensed material that is pulled off or not connected to the wireline that suspends the source in the well and for which all reasonable effort at recovery has been expended. 48 FR 39036

§ 30.5 Interpretations.

Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part and Parts 31-35 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. 43 FR 6915

[5] The Department facilities and activities identified in section 202 are:

(1) Demonstration Liquid Metal Fast Breeder reactors when operated as part of the power generation facilities of an electric utility system, or when operated in any other manner for the purpose of demonstrating the suitability for commercial application of such a reactor.

(2) Other demonstration nuclear reactors, except those in existence on January 19, 1975, when operated as part of the power generation facilities of an electric utility system, or when operated in any other manner for the purpose of demonstrating the suitability for commercial application of such a reactor.

(3) Facilities used primarily for the receipt and storage of high-level radioactive wastes resulting from licensed activities.

(4) Retrievable Surface Storage Facilities and other facilities authorized for the express purpose of subsequent long-term storage of high-level radioactive waste generated by the Department, which are not used for, or are part of, research and development activities.

§ 30.6 Communications.

(a) Unless otherwise specified or covered under the regional licensing program as provided in paragraph (b) of this section, any communication or report concerning the regulations in Parts 30 through 35 of this chapter and any application filed under these regulations may be submitted to the Commission as follows:

(1) By mail addressed to: Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

(2) By delivery in person to the Commission's offices to the Director, Office of Nuclear Material Safety and Safeguards at:

(i) 1717 H Street, N.W., Washington, D.C.; or

(ii) 7915 Eastern Avenue, Willste Building, Silver Spring, Maryland.

46 FR 16030

(b) The Commission has delegated to the five Regional Administrators licensing authority for selected parts of its decentralized licensing program for nuclear materials as described in paragraph (b)(1) of this section. Any communication, report, or application covered under this licensing program must be submitted as specified in paragraph (b)(2) of this section.

(1) The delegated licensing program includes authority to issue, renew, amend, cancel, modify, suspend, or revoke licenses for nuclear materials issued pursuant to 10 CFR Parts 30 through 35, 40, and 70 to all persons (except Federal agencies) for academic, medical, and industrial uses, with the following exceptions:

(i) Activities in the fuel cycle and special nuclear material in quantities sufficient to constitute a critical mass in any room or area. This exception does not apply to license modifications relating to termination of special nuclear material licenses that authorize possession of larger quantities when the case is referred for action from NRC's headquarters to the Regional Administrators.

(ii) Health and safety design review of sealed sources and devices, and approval, for licensing purposes, of sealed sources and devices.

(iii) Processing of source material for extraction of metallic compounds (including Zirconium, Hafnium, Tantalum, Titanium, Niobium, etc.).

(iv) Distribution of products containing radioactive material to persons exempt pursuant to 10 CFR 32.11 through 32.26.

49 FR 19630

(2) *Submissions.* (i) *Region I.* With the exception of Federal facilities, the regional licensing program involves the following Region I non-Agreement States and the District of Columbia: Connecticut, Delaware, Maine, Massachusetts, New Jersey, Pennsylvania, and Vermont. All inquiries, communications, and applications for a new license or an amendment or renewal of an existing license specified in paragraph (b)(1) of this section must be sent to: U.S. Nuclear Regulatory Commission, Region I, Nuclear Material Section B, 631 Park Avenue, King of Prussia, Pennsylvania 19406.

46FR16030

46 FR 16030

(ii) *Region II.* With the exception of Federal facilities, the regional licensing program involves the following Region II non-Agreement States and territories: Virginia, West Virginia, Puerto Rico, and the Virgin Islands. All inquiries, communications, and applications for a new license or an amendment or renewal of an existing license specified in paragraph (b)(1) of this section must be sent to U.S. Nuclear Regulatory Commission, Region II, Material Radiation Protection Section, 101 Marietta Street, NW, Suite 2900, Atlanta, Georgia 30323.

49 FR 47823

(iii) *Region III.* With the exception of Federal facilities, the regional licensing program involves the following Region III non-Agreement States: Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin. All inquiries, communications, and applications for a new license or an amendment or renewal of an existing license specified in paragraph (b)(1) of this section must be sent to: U.S. Nuclear Regulatory Commission, Region III, Material Licensing Section, 799 Roosevelt Road, Glen Ellyn, Illinois 60137.

46 FR 16030

(iv) Region IV. With the exception of Federal facilities, the regional licensing program involves the following Region IV non-Agreement States: Montana, Oklahoma, South Dakota, and Wyoming. All inquiries, communications, and applications for a new license or an amendment or renewal of an existing license specified in paragraph (b)(1) of this section must be sent to: U.S. Nuclear Regulatory Commission, Region IV, Material Radiation Protection Section, 611 Ryan Plaza Drive, Suite 1000, Arlington, Texas 76011.

49 FR 19630

(v) *Region V.* With the exception of Federal facilities, the regional licensing program involves the following Region V non-Agreement States and a territory: Alaska, Hawaii, and Guam. All inquiries, communications, and applications for a new license or an amendment or renewal of an existing license specified in paragraph (b)(1) of this section must be sent to: U.S. Nuclear Regulatory Commission, Region V, Material Radiation Protection Section, 1450 Maria Lane, Suite 210, Walnut Creek, California 94596.

46 FR 16030

46FR16030

§ 30.7 Employee protection.

(a) Discrimination by a Commission licensee, an applicant for a Commission license, or a contractor or subcontractor of a Commission licensee or applicant against an employee for engaging in certain protected activities is prohibited. Discrimination includes discharge and other actions that relate to compensation, terms, conditions, and privileges of employment. The protected activities are established in section 210 of the Energy Reorganization Act of 1974, as amended, and in general are related to the administration or enforcement of a requirement imposed under the Atomic Energy Act or the Energy Reorganization Act.

(1) The protected activities include but are not limited to—

(i) Providing the Commission information about possible violations of requirements imposed under either of the above statutes;

(ii) Requesting the Commission to institute action against his or her employer for the administration or enforcement of these requirements; or

(iii) Testifying in any Commission proceeding.

47 FR 30452

(2) These activities are protected even if no formal proceeding is actually initiated as a result of the employee assistance or participation.

(3) This section has no application to any employee alleging discrimination prohibited by this section who, acting without direction from his or her employer (or the employer's agent), deliberately causes a violation of any requirement of the Energy Reorganization Act of 1974, as amended, or the Atomic Energy Act of 1954, as amended.

(b) Any employee who believes that he or she has been discharged or otherwise discriminated against by any person for engaging in the protected activities specified in paragraph (a)(1) of this section may seek a remedy for the discharge or discrimination through an administrative proceeding in the Department of Labor. The administrative proceeding must be initiated within 30 days after an alleged violation occurs by filing a complaint alleging the violation with the Department of Labor, Employment Standards Administration, Wage and Hour Division. The Department of Labor may order reinstatement, back pay, and compensatory damages.

(c) A violation of paragraph (a) of this section by a Commission licensee, an applicant for a Commission license, or a contractor or subcontractor of a

Commission licensee or applicant may be grounds for—

(1) Denial, revocation, or suspension of the license.

(2) Imposition of a civil penalty on the licensee or applicant.

(3) Other enforcement action.

(d) Actions taken by an employer, or others, which adversely affect an employee may be predicated upon nondiscriminatory grounds. The prohibition applies when the adverse action occurs because the employee has engaged in protected activities. An employee's engagement in protected activities does not automatically render him or her immune from discharge or discipline for legitimate reasons or from adverse action dictated by nonprohibited considerations.

(e) Each licensee and each applicant shall post Form NRC–3, "Notice to Employees," on its premises. Posting must be at locations sufficient to permit employees protected by this section to observe a copy on the way to or from their place of work. Premises must be posted not later than 30 days after an application is docketed and remain posted while the application is pending before the Commission, during the term of the license, and for 30 days following license termination.

47 FR 30452

Note.—Copies of Form NRC–3 may be obtained by writing to the the Regional Administrator of the appropriate U.S. Nuclear Regulatory Commission Regional Office listed in Appendix D, Part 20 of this chapter or the Director, Office of Inspection and Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

(f) The general licenses provided in Parts 31 and 35 of this chapter are exempt from paragraph (e) of this section.

§ 30.8 Information collection requirements: OMB approval.

(a) The Nuclear Regulatory Commission has submitted the information collection requirements contained in this part to the Office of Management and Budget (OMB) for approval as required by the Paperwork Reduction Act of 1980 (44 U.S.C. 3501 et seq). OMB has approved the information collection requirements contained in this part under control number 3150–0017.

(b) The approved information collection requirements contained in this part appear in §§ 30.15, 30.19, 30.20, 30.32, 30.34, 30.36, 30.37, 30.38, 30.51, 30.55, and 30.56.

(c) This part contains information collection requirements in addition to those approved under the control number specified in paragraph (a) of this section. These information collection requirements and the control numbers under which they are approved are as follows:

49 FR 19523

(1) In §§ 30.32, 30.37, and 30.38, Form NRC–313I is approved under control number 3150–0042.

(2) In §§ 30.32, 30.37, and 30.38, Form NRC–313T is approved under control number 3150–0081.

(3) In § 30.36, Form NRC–314 is approved under control number 3150–0028.

(4) In §§ 30.37 and 30.38, Form NRC–313M is approved under control number 3150–0041.

(5) In §§30.37 and 30.38, Form NRC–313R is approved under control number 3150–0023.

49 FR 19523

EXEMPTIONS

§ 30.11 Specific exemptions.

(a) The Commission may, upon application of any interested person or upon its own initiative, grant such exemptions from the requirements of the regulations in this part and Parts 31 through 35 of this chapter as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest. (43 FR 6915)

(b) [Deleted 45 FR 6553]

(c) The DOE is exempt from the requirements of this part to the extent that its activities are subject to the requirements of Part 60 of this chapter. (46 FR 1397)

(d) Except as specifically provided in Part 61 of this chapter, any licensee is exempt from the requirements of this part to the extent that its activities are subject to the requirements of Part 61 of this chapter. (47 FR 57446)

§ 30.12 Persons using byproduct material under certain Department of Energy and Nuclear Regulatory Commission contracts. (45 FR 14199)

Except to the extent that Department facilities or activities of the types subject to licensing pursuant to section 202 of the Energy Reorganization Act of 1974 are involved, any prime contractor of the Department is exempt from the requirements for a license set forth in sections 81 and 82 of the Act and from the regulations in this part to the extent that such contractor, under his prime contract with the Department manufactures, produces, transfers, receives, acquires, owns, possesses, or uses byproduct material for: (a) The performance of work for the Department at a United States Government-owned or controlled site, including the transportation of by-product material to or from such site and the performance of contract services during temporary interruptions of such transportation; (b) research in, or development, manufacture, storage, testing or transportation of, atomic weapons or components thereof; or (c) the use or operation of nuclear reactors or other nuclear devices in a United States Government-owned vehicle or vessel. In addition to the foregoing exemptions and subject to the requirement for licensing of Department facilities and activities pursuant to section 202 of the Energy Reorganization Act of 1974, any prime contractor or subcontractor of the Department or the Commission is exempt from the requirements for a license set forth in sections 81 and 82 of the Act and from the regulations in this part to the extent that such prime contractor or subcontractor manufacturers, produces, transfers, receives, acquires, owns, possesses, or uses byproduct material under his prime contract or subcontract when the Commission determines that the exemption of the prime contractor or subcontractor is authorized by law; and that, under the terms of the contract or subcontract, there is adequate assurance that the work thereunder can be accomplished without undue risk to the public health and safety. (45 FR 14199)

§ 30.13 Carriers. (43 FR 6915)

Common and contract carriers, freight forwarders, warehousemen, and the U.S. Postal Service are exempt from the regulations in this part and Parts 31 through 35 of this chapter and the requirements for a license set forth in section 81 of the Act to the extent that they transport or store byproduct material in the regular course of carriage for another or storage incident thereto.

§ 30.14 Exempt concentrations.

(a) Except as provided in paragraphs (c) and (d) of this section, any person is exempt from the requirements for a license set forth in section 81 of the Act and from the regulations in this part and Parts 31 through 35 of this chapter to the extent that such person receives, possesses, uses, transfers, owns or acquires products or materials containing byproduct material in concentrations not in excess of those listed in § 30.70.

(b) This section shall not be deemed to authorize the import of byproduct material or products containing byproduct material. (30 FR 8185)

(c) A manufacturer, processor, or producer of a product or material in an agreement State is exempt from the requirements for a license set forth in section 81 of the Act and from the regulations in this part and Parts 31, 32, 33, and 34 of this chapter to the extent that he transfers byproduct material contained in a product or material in concentrations not in excess of those specified in § 30.70 and introduced into the product or material by a licensee holding a specific license issued by an Agreement State, the Commission, or the Atomic Energy Commission expressly authorizing such introduction. This exemption does not apply to the transfer of byproduct material contained in any food, beverage, cosmetic, drug, or other commodity or product designed for ingestion or inhalation by, or application to, a human being. (43 FR 6915)

(d) No person may introduce byproduct material into a product or material knowing or having reason to believe that it will be transferred to persons exempt under this section or equivalent regulations of an Agreement State, except in accordance with a license issued pursuant to § 32.11 of this chapter or the general license provided in § 150.20 of this chapter. (30 FR 8185)

§ 30.15 Certain items containing byproduct material. (34 FR 19546)

(a) Except for persons who apply byproduct material to, or persons who incorporate byproduct material into, the following products, or persons who initially transfer for sale or distribution the following products containing byproduct material, any person is exempt from the requirements for a license set forth in section 81 of the Act and from the regulations in Parts 20 and 30 through 35 of this chapter to the extent that such person receives, possesses, uses, transfers, owns, or acquires the following products: (43 FR 6915)

(1) Timepieces or hands or dials containing not more than the following specified quantities of byproduct material and not exceeding the following specified levels of radiation:

(i) 25 millicuries of tritium per timepiece,

(ii) 5 millicuries of tritium per hand,

(iii) 15 millicuries of tritium per dial (bezels when used shall be considered as part of the dial),

(iv) 100 microcuries of promethium-147 per watch or 200 microcuries of promethium-147 per any other timepiece,

(v) 20 microcuries of promethium-147 per watch hand or 40 microcuries of promethium-147 per other timepiece hand,

(vi) 60 microcuries of promethium-147 per watch dial or 120 microcuries of promethium-147 per other timepiece dial (bezels when used shall be considered as part of the dial),

(vii) The levels of radiation from hands and dials containing promethium-147 will not exceed, when measured through 50 milligrams per square centimeter of absorber:

(*a*) For wrist watches, 0.1 millirad per hour at 10 centimeters from any surface,

(*b*) For pocket watches, 0.1 millirad per hour at 1 centimeter from any surface,

(*c*) For any other timepiece, 0.2 millirad per hour at 10 centimeters from any surface.

(2) Lock illuminators containing not more than 15 millicuries of tritium or not more than 2 millicuries of promethium-147 installed in automobile locks. The levels of radiation from each lock illuminator containing promethium-147 will not exceed 1 millirad per hour at 1 centimeter from any surface when measured through 50 milligrams per square centimeter of absorber.

(3) Balances of precision containing not more than 1 millicurie of tritium per balance or not more than 0.5 millicurie of tritium per balance part.

(4) Automobile shift quadrants containing not more than 25 millicuries of tritium.

(5) Marine compasses containing not more than 750 millicuries of tritium gas and other marine navigational instruments containing not more than 250 millicuries of tritium gas.

(6) Thermostat dials and pointers containing not more than 25 millicuries of tritium per thermostat.

(7) [Deleted 34 FR 6651.]

(8) Electron tubes: *Provided*, That each tube does not contain more than one of the following specified quantities of byproduct material:

(i) 150 millicuries of tritium per microwave receiver protector tube or 10 millicuries of tritium per any other electron tube;

(ii) 1 microcurie of cobalt-60;

(iii) 5 microcuries of nickel-63;

(iv) 30 microcuries of krypton-85;

(v) 5 microcuries of cesium-137;

(vi) 30 microcuries of promethium-147;

And provided further, That the levels of radiation from each electron tube containing byproduct material do not exceed 1 millirad per hour at 1 centimeter from any surface when measured through 7 milligrams per square centimeter of absorber.[3]

(9) Ionizing radiation measuring instruments containing, for purposes of internal calibration or standardization, one or more sources of byproduct material: *Provided*, That:

(i) Each source contains no more than one exempt quantity set forth in § 30.71, Schedule B, and

(ii) Each instrument contains no more than 10 exempt quantities. For purposes of this paragraph (a)(9), an instrument's source(s) may contain either one type or different types of radionuclides and an individual exempt quantity may be composed of fractional parts of one or more of the exempt quantities in § 30.71, Schedule B, provided that the sum of such fractions shall not exceed unity.

(iii) For purposes of this paragraph (a)(9), 0.05 microcurie of americium-241 is considered an exempt quantity under § 30.71, Schedule B.

(10) Spark gap irradiators containing not more than 1 microcurie of cobalt-60 per spark gap irradiator for use in electrically ignited fuel oil burners having a firing rate of at least 3 gallons per hour (11.4 liters per hour).

(b) Any person who desires to apply byproduct material to, or to incorporate byproduct material into, the products exempted in paragraph (a) of this section, or who desires to initially transfer for sale or distribution such products containing byproduct material, should apply for a specific license pursuant to § 32.14 of this chapter, which license states that the product may be distributed by the licensee to persons exempt from the regulations pursuant to paragraph (a) of this section.

§ 30.16 Resins containing scandium-46 and designed for sand-consolidation in oil wells.

Any person is exempt from the requirements for a license set forth in section 81 of the Act and from the regulations in Parts 20 and 30-35 of this chapter to the extent that such person receives, possesses, uses, transfers, owns, or acquires synthetic plastic resins containing scandium-46 which are designed for sand-consolidation in oil wells, and which have been manufactured or initially transferred for sale or distribution, in accordance with a specific license issued pursuant to § 32.17 of this chapter or equivalent regulations of an Agreement State. The exemption in this section does not authorize the manufacture or initial transfer for sale or distribution of any resins containing scandium-46.

§ 30.18 Exempt quantities.

(a) Except as provided in paragraphs (c) and (d) of this section, any person is exempt from the requirements for a license set forth in section 81 of the Act and from the regulations in Parts 30-34 of this chapter to the extent that such person receives, possesses, uses, transfers, owns, or acquires byproduct material in individual quantities each of which does not exceed the applicable quantity set forth in § 30.71, Schedule B.

[3] For purposes of this subparagraph "electron tubes" include spark gap tubes, power tubes, gas tubes including glow lamps, receiving tubes, microwave tubes, indicator tubes, pickup tubes, radiation detection tubes, and any other completely sealed tube that is designed to conduct or control electrical currents.

(b) Any person who possesses byproduct material received or acquired prior to September 25, 1971, under the general license then provided in § 31.4 of this chapter is exempt from the requirements for a license set forth in section 81 of the Act and from the regulations in Parts 30-34 of this chapter to the extent that such person possesses, uses, transfers, or owns such byproduct material. 36 FR 16898

(c) This section does not authorize for purposes of commercial distribution the production, packaging, repackaging, or transfer of byproduct material, or the incorporation of byproduct material into products intended for commercial distribution.

(d) No person may, for purposes of commercial distribution, transfer byproduct material in the individual quantities set forth in § 30.71 Schedule B, knowing or having reason to believe that such quantities of byproduct material will be transferred to persons exempt under this section or equivalent regulations of an Agreement State, except in accordance with a license issued under § 32.18 of this chapter, which license states that the byproduct material may be transferred by the licensee to persons exempt under this section or the equivalent regulations of an Agreement State. 43 FR 6915

§ 30.19 Self-luminous products containing tritium, krypton-85, or promethium-147.

(a) Except for persons who manufacture, process, produce, or initially transfer for sale or distribution self-luminous products containing tritium, krypton-85, or promethium-147, and except as provided in paragraph (c) of this section, any person is exempt from the requirements for a license set forth in section 81 of the Act and from the regulations in Parts 20 and 30-35 of this chapter to the extent that such person receives, possesses, uses, transfers, owns, or acquires tritium, krypton-85, or promethium-147 in self-luminous products manufactured, processed, produced, or initially transferred in accordance with a specific license issued pursuant to § 32.22 of this chapter, which license authorizes the initial transfer of the product for use under this section.

(b) Any person who desires to manufacture, process, or produce self-luminous products containing tritium, krypton-85, or promethium-147, or to transfer such products for use pursuant to paragraph (a) of this section, should apply for a license pursuant to § 32.22 of this chapter, which license states that the product may be transferred by the licensee to persons exempt from the regulations pursuant to paragraph (a) of this section or equivalent regulations of an Agreement State. 43 FR 6915

(c) The exemption in paragraph (a) of this section does not apply to tritium, krypton-85, or promethium-147 used in products primarily for frivolous purposes or in toys or adornments. 34 FR 9075

§ 30.20 Gas and aerosol detectors containing byproduct material.

(a) Except for persons who manufacture, process, produce, or initially transfer for sale or distribution gas and aerosol detectors containing byproduct material, any person is exempt from the requirements for a license set forth in section 81 of the Act and from the regulations in Parts 20 and 30-35 of this chapter to the extent that such person receives, possesses, uses, transfers, owns, or acquires byproduct material in gas and aerosol detectors designed to protect life or property from fires and airborne hazards, and manufactured, processed, produced, or initially transferred in accordance with a specific license issued pursuant to § 32.26 of this chapter, which license authorizes the initial transfer of the product for use under this section. 43 FR 6915

(b) Any person who desires to manufacture, process, or produce gas and aerosol detectors containing byproduct material, or to initially transfer such products for use pursuant to paragraph (a) of this section, should apply for a license pursuant to § 32.26 of this chapter, which license states that the product may be initially transferred by the licensee to persons exempt from the regulations pursuant to paragraph (a) of this section or equivalent regulations of an Agreement State.

LICENSES

§ 30.31 Types of licenses.

Licenses for byproduct material are of two types: General and specific. Specific licenses are issued to named persons upon applications filed pursuant to the regulations in this part and Parts 32-35. General licenses are effective without the filing of applications with the Commission or the issuance of licensing documents to particular persons. 43 FR 6915

§ 30.32 Application for specific licenses.

(a) A person may file an application in duplicate on NRC Form 313, "Application for Material License," in accordance with the instructions in § 30.6 of this chapter. Information contained in previous applications, statements or reports filed with the Commission or the Atomic Energy Commission may be incorporated by reference, provided that the reference is clear and specific. 49 FR 27923

(b) The Commission may at any time after the filing of the original application, and before the expiration of the license, require further statements in order to enable the Commission to determine whether the application should be granted or denied or whether a license, should be modified or revoked. 30 FR 8185

(c) Each application shall be signed by the applicant or licensee or a person duly authorized to act for and on his behalf.

(d) An application for license filed pursuant to the regulations in this part and Parts 32-35 will be considered also as an application for licenses authorizing other activities for which licenses are required by the Act, provided that the application specifies the additional activities for which licenses are requested and complies with regulations of the Commission as to applications for such licenses. 43 FR 6915

(e) Each application for a byproduct material license, other than a license exempted from Part 170 of this chapter, shall be accompanied by the fee prescribed in § 170.31 of this chapter. No fee will be required to accompany an application for renewal or amendment of a license, except as provided in § 170.31 of this chapter. [36 FR 145]

(f) An application for a license to receive and possess byproduct material for the conduct of any activity which the Commission has determined pursuant to Subpart A of Part 51 of this chapter will significantly affect the quality of the environment shall be filed at least 9 months prior to commencement of construction of the plant or facility in which the activity will be conducted and shall be accompanied by any Environmental Report required pursuant to Subpart A of Part 51 of this chapter. [49 FR 9352]

§ 30.33 General requirements for issuance of specific licenses.

(a) An application for a specific license will be approved if:

(1) The application is for a purpose authorized by the Act;

(2) The applicant's proposed equipment and facilities are adequate to protect health and minimize danger to life or property; [30 FR 8185]

(3) The applicant is qualified by training and experience to use the material for the purpose requested in such manner as to protect health and minimize danger to life or property;

(4) The applicant satisfies any special requirements contained in Parts 32-35; and [43 FR 6915]

(5) In the case of an application for a license to receive and possess byproduct material for the conduct of any activity which the Commission determines will significantly affect the quality of the environment, the Director of Nuclear Material Safety and Safeguards or his designee, before commencement of construction of the plant or facility in which the activity will be conducted, on the basis of information filed and evaluations made pursuant to Subpart A of Part 51 of this chapter, has concluded, after weighing the environmental, economic, technical, and other benefits against environmental costs and considering available alternatives, that the action called for is the issuance of the proposed license, with any appropriate conditions to protect environmental values. Commencement of construction prior to such conclusion shall be grounds for denial of a license to receive and possess byproduct material in such plant or facility. As used in this paragraph the term "commencement of construction" means any clearing of land, excavation, or other substantial action that would adversely affect the environment of a site. The term does not mean site exploration, necessary roads for site exploration, borings to determine foundation conditions, or other preconstruction monitoring or testing to establish background information related to the suitability of the site or the protection of environmental values. [49 FR 9352]

(b) Upon a determination that an application meets the requirements of the Act, and the regulations of the Commission, the Commission will issue a specific license authorizing the possession and use of byproduct material (Form NRC-374, "Byproduct Material License"). [30 FR 8185]

§ 30.34 Terms and conditions of licenses.

(a) Each license issued pursuant to the regulations in this part and the regulations in Parts 31-35 shall be subject to all the provisions of the Act, now or hereafter in effect, and to all valid rules, regulations and orders of the Commission.

(b) No license issued or granted pursuant to the regulations in this part and Parts 31-35, nor any right under a license shall be transferred, assigned or in any manner disposed of, either voluntarily or involuntarily, directly or indirectly, through transfer of control of any license to any person, unless the Commission shall, after securing full information, find that the transfer is in accordance with the provisions of the Act and shall give its consent in writing. [43 FR 6915]

(c) Each person licensed by the Commission pursuant to the regulations in this part and Parts 31-35 shall confine his possession and use of the byproduct material to the locations and purposes authorized in the license. Except as otherwise provided in the license, a license issued pursuant to the regulations in this part and Parts 31-35 of this chapter shall carry with it the right to receive, acquire, own, and possess, byproduct material. Preparation for shipment and transport of byproduct material shall be in accordance with the provisions of Part 71 of this chapter.

(d) Each license issued pursuant to the regulations in this part and Parts 31-35 shall be deemed to contain the provisions set forth in section 183b.-d., inclusive, of the Act, whether or not these provisions are expressly set forth in the license. [43 FR 6915]

(e) The Commission may incorporate, in any license issued pursuant to the regulations in this part and Parts 31-35, at the time of issuance, or thereafter by appropriate rule, regulation or order, such additional requirements and conditions with respect to the licensee's receipt, possession, use and transfer of byproduct material as it deems appropriate or necessary in order to:

(1) Promote the common defense and security;

(2) Protect health or to minimize danger to life or property;

(3) Protect restricted data;

(4) Require such reports and the keeping of such records, and to provide for such inspections of activities under the license as may be necessary or appropriate to effectuate the purposes of the Act and regulations thereunder. [30 FR 8185]

(f) [Reserved] [48 FR 32324]

(g) Each licensee preparing technetium-99m radiopharmaceuticals from molybdenum-99/technetium-99m generators shall test the generator eluates for molybdenum-99 breakthrough in accordance with § 35.14(b)(4) (i) thru (iv). [45 FR 41393]

§ 30.35 [Deleted 40 FR 8774.]

§ 30.36 Expiration and termination of licenses.

(a) Except as provided in § 30.37(b) and paragraph (d)(3) of this section, each specific license expires at the end of the day, in the month and year stated in the license.

(b) Each licensee shall notify the Commission immediately, in writing under § 30.6, and request termination of the license when the licensee decides to terminate all activities involving materials authorized under the license. This notification and request for [48 FR 32324]

termination of the license must include the reports and information specified in paragraphs (d)(1) (iv) and (v) of this section. The licensee is subject to the provisions of paragraphs (d) and (e) of this section, as applicable.

(c) No less than 30 days before the expiration date specified in a specific license, the licensee shall either—

(1) Submit an application for license renewal under § 30.37; or

(2) Notify the Commission, in writing under § 30.6, if the licensee decides not to renew the license.

(d)(1) If a licensee does not submit an application for license renewal under § 30.37, the licensee shall, on or before the expiration date specified in the license—

(i) Terminate use of byproduct material;

(ii) Remove radioactive contamination to the extent practicable;

(iii) Properly dispose of byproduct material;

(iv) Submit a completed form NRC–314; and

(v) Submit a radiation survey report to confirm the absence of radioactive materials or to establish the levels of residual radioactive contamination, unless the licensee demonstrates the absence of residual radioactive contamination in some other manner. The licensee shall, as appropriate— 48 FR 32324

(A) Report levels of radiation in units of microrads per hour of beta and gamma radiation at one centimeter and gamma radiation at one meter from surfaces and report levels of radioactivity in units of disintegrations per minute (or microcuries) per 100 square centimeters removable and fixed on surfaces, microcuries per milliliter in water, and picocuries per gram in contaminated solids such as soils or concrete; and

(B) Specify the survey instrument(s) used and certify that each instrument is properly calibrated and tested.

(2) If no residual radioactive contamination attributable to activities conducted under the license is detected, the licensee shall submit a certification that no detectable radioactive contamination was found. If the information submitted under this paragraph and paragraphs (d)(1) (iv) and (v) of this section is adequate, the Commission will notify the licensee in writing that the license is terminated.

(3)(i) If detectable levels of residual radioactive contamination attributable to activities conducted under the license are found, the license continues in effect beyond the expiration date, if necessary, with respect to possession of residual byproduct material present as contamination until the Commission notifies the licensee in writing that the license is terminated. During this time, the licensee is subject to the provisions of paragraph (e) of this section.

(ii) In addition to the information submitted under paragraphs (d)(1) (iv) and (v) of this section the licensee shall submit a plan for decontamination, if required, as regards residual radioactive contamination remaining at the time the license expires. 48 FR 32324

(e) Each licensee who possesses residual byproduct material under paragraph (d)(3) of this section, following the expiration date specified in the license shall—

(1) Limit actions involving byproduct material to those related to decontamination and other activities related to preparation for release for unrestricted use; and

(2) Continue to control entry to restricted areas until they are suitable for release for unrestricted use and the Commission notifies the licensee in writing that the license is terminated.

49 FR 19623

§ 30.37 Applications for renewal of licenses.

(a) Application for renewal of a specific license shall be filed on Form NRC–313 in accordance with § 30.32.

(b) In any case in which a licensee, not less than thirty (30) days prior to the expiration of his existing license, has filed an application in proper form for renewal or for a new license, such existing license shall not expire until the application has been finally determined by the Commission. [30 FR 8185]

§ 30.38 Applications for amendment of licenses. [49 FR 19623]

Applications for amendment of a license shall be filed on Form NRC-313 in accordance with § 30.32 and shall specify the respects in which the licensee desires its license to be amended and the grounds for the amendment.

§ 30.39 Commission action on applications to renew or amend. [43 FR 6915]

In considering an application by a licensee to renew or amend his license the Commission will apply the applicable criteria set forth in § 30.33 and Parts 32-35 of this chapter.

§ 30.41 Transfer of byproduct material. [38 FR 33968]

(a) No licensee shall transfer byproduct material except as authorized pursuant to this section.

(b) Except as otherwise provided in his license and subject to the provisions of paragraphs (c) and (d) of this section, any licensee may transfer byproduct material:

(1) To the Administration;

(2) To the agency in any Agreement State which regulates radioactive material pursuant to an agreement under section 274 of the Act; [40 FR 8774]

(3) To any person exempt from the licensing requirements of the Act and regulations in this part, to the extent permitted under such exemption;

(4) To any person in an Agreement State, subject to the jurisdiction of that State, who has been exempted from the licensing requirements and regulations of that State, to the extent permitted under such exemption; [38 FR 33968]

(5) To any person authorized to receive such byproduct material under terms of a specific license or a general license or their equivalents issued by the Atomic Energy Commission,, the Commission, or an Agreement State; or

(6) To a person abroad pursuant to an export license issued under Part 110 of this chapter; [43 FR 6915]

(7) As otherwise authorized by the Commission in writing.

(c) Before transferring byproduct material to a specific licensee of the Commission or an Agreement State or to a general licensee who is required to register with the Commission or with an Agreement State prior to receipt of the byproduct material, the licensee transferring the material shall verify that the transferee's license authorizes the receipt of the type, form, and quantity of byproduct material to be transferred.

(d) The following methods for the verification required by paragraph (c) of this section are acceptable:

(1) The transferor may have in his possession, and read, a current copy of the transferee's specific license or registration certificate;

(2) The transferor may have in his possession a written certification by the transferee that he is authorized by license or registration certificate to receive the type, form, and quantity of byproduct material to be transferred, specifying the license or registration certificate number, issuing agency and expiration date; [38 FR 33968]

(3) For emergency shipments the transferor may accept oral certification by the transferee that he is authorized by license or registration certificate to receive the type, form, and quantity of byproduct material to be transferred, specifying the license or registration certificate number, issuing agency and expiration date: *Provided*, That the oral certification is confirmed in writing within 10 days;

(4) The transferor may obtain other sources of information compiled by a reporting service from official records of the Commission or the licensing agency of an Agreement State as to the identity of licensees and the scope and expiration dates of licenses and registration; or

(5) When none of the methods of verification described in paragraphs (d)(1) to (4) of this section are readily available or when a transferor desires to verify that information received by one of such methods is correct or up-to-date, the transferor may obtain and record confirmation from the Commission or the licensing agency of an Agreement State that the transferee is licensed to receive the byproduct material.

RECORDS, INSPECTIONS, TESTS, AND REPORTS [46 FR 55085]

§ 30.51 Records. [43 FR 6915]

(a) Each person who receives byproduct material pursuant to a license issued pursuant to the regulations in this part and Parts 31-35 shall keep records showing the receipt, transfer, and disposal of such byproduct material.

(b) Records which are required by the regulations in this part and Parts 31-35 or by license condition shall be maintained for the period specified by the appropriate regulation or license condition. If a retention period is not otherwise specified by regulation or license condition, such records shall be maintained until the Commission authorizes their disposition.

(c)(1) Records of receipt of byproduct material which must be maintained pursuant to paragraph (a) of this section shall be maintained as long as the licensee retains possession of the byproduct material and for two years following transfer, or disposal of the byproduct material. (2) [Deleted 43 FR 6915.] (3) Records of transfer of byproduct material shall be maintained by the licensee who transferred the material for five years after such transfer. (4) Records of disposal of byproduct material shall be maintained in accordance with § 20.401 (c) of this chapter.

(d)(1) Records which must be maintained pursuant to this part and Parts 31-35 may be the original or a reproduced copy of 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.

(2) If there is a conflict between the Commission's regulations in this part and Parts 31-35, license condition, 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 and Parts 31-35 for such records shall apply unless the Commission, pursuant to § 30.11, has granted a specific exemption from the record retention requirements specified in the regulations in this part or Parts 31-35.

30 FR 8185

§ 30.52 Inspections.

(a) Each licensee shall afford to the Commission at all reasonable times opportunity to inspect byproduct material and the premises and facilities wherein byproduct material is used or stored.

(b) Each licensee shall make available to the Commission for inspection, upon reasonable notice, records kept by him pursuant to the regulations in this chapter.

43FR 6915

§ 30.53 Tests.

Each licensee shall perform, or permit the Commission to perform, such tests as the Commission deems appropriate or necessary for the administration of the regulations in this part and Parts 31 through 35 of this chapter, including tests of:

30 FR 8185

(a) Byproduct material;

(b) Facilities wherein byproduct material is utilized or stored;

(c) Radiation detection and monitoring instruments; and

(d) Other equipment and devices used in connection with the utilization or storage of byproduct material.

46 FR 55085

§ 30.55 Tritium reports.

(a) [Reserved]

49 FR 24705

➤ (b) [reserved]

43 FR 6915

(c) Except as specified in paragraph (d) of this section, each licensee who is authorized to possess tritium shall report promptly to the appropriate NRC Regional Office listed in Appendix D of Part 20 of this chapter by telephone and telegraph, mailgram, or facsimile any incident in which an attempt has been made or is believed to have been made to commit a theft or unlawful diversion of more than 10 curies of such material at any one time or more than 100 curies of such material in any one calendar year. The initial report shall be followed within a period of fifteen (15) days by a written report submitted to the appropriate NRC Regional Office which sets forth the details of the incident and its consequences. Copies of such written report shall be sent to the Director of Inspection and Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

43 FR 6915

37 FR 9207

Subsequent to the submission of the written report required by this paragraph, the licensee shall promptly inform the Office of Inspection and Enforcement by means of a written report of any substantive additional information, which becomes available to the licensee, concerning an attempted or apparent theft or unlawful diversion of tritium.

(d) The reports described in this section are not required for tritium possessed pursuant to a general license provided in Part 31 of this chapter or for tritium contained in spent fuel.

49 FR 24705

➤ (e) [reserved]

48 FR 39036

§ 30. 56 Well-logging operations using sealed sources.

(a) A licensee may perform well-logging operations with a sealed source only after the licensee executes a written agreement with the well owner or operator that, within thirty (30) days after a well-logging source has been classified as irretrievable, the following requirements will be implemented:

(1) Each irretrievable well-logging source must be immobilized and sealed in place with a cement plug.

(2) A whipstock or other deflection device must be set at some point in the well above the cement plug, unless the cement plug and source are not accessible to any subsequent drilling operations.

(3) A permanent identification plaque, constructed of long lasting material such as stainless steel, brass, bronze, or monel, must be mounted at the surface of the well, unless the mounting of the plaque is not practical. The plaque must contain:

(i) The word "CAUTION";

(ii) A radiation symbol (the color requirement need not be met);

(iii) The date the source was abandoned;

(iv) The name of the well owner or well operator;

(v) The well name and well identification number(s) or other designation;

(vi) An identification of the sealed source(s) by radionuclide and quantity of activity;

(vii) The depth of the source and depth to the top of the plug; and

(viii) An appropriate warning.

(b) When a well-logging source becomes irretrievable, the licensee shal

(1) Notify the Regional Administrator of the appropriate NRC Regional Office listed in Appendix D of Part 20 of this chapter of the circumstances of the loss by telephone; and

(2) Obtain approval to implement abandonment procedures.

(c) The licensee shall, within 30 days after a well-logging source has been classified as irretrievable, make a repor in writing to the appropriate NRC Regional Office listed in Appendix D of Part 20 of this chapter. The licensee shall send a copy of the report to each appropriate State agency that has authority over the particular well-drilling operation. The report must contain the following information:

(1) Date of occurrence.

(2) A description of the irretrievable well-logging source involved, including radionuclide, quantity, and chemical and physical form.

(3) Surface location and identification of well.

(4) Results of efforts to immobilize and seal the source in place.

(5) Depth of source.

(6) Depth of the top of the cement plug.

(7) Depth of the well.

(8) Any other information (e.g., warning statement) contained on the permanent identification plaque.

(9) Notifications made to State agencies.

(10) A brief description of the attempted recovery efforts.

(d) Any licensee or applicant for a license may apply to the Commission fo approval of proposed procedures to abandon an irretrievable well-logging source in a manner not otherwise authorized in paragraph (a) of this section.

ENFORCEMENT

43 FR 6915

§ 30.61 Modification and revocation of licenses.

(a) The terms and conditions of each license issued pursuant to the regulations in this part and Parts 31-35 shall be subject to amendment, revision or modification by reason of amendments to the Act, or by reason of rules, regulations and orders issued in accordance with the terms of the Act.

30 FR 8185

(b) Any license may be revoked, suspended or modified, in whole or in part, for any material false statement in the application or any statement of fact required under section 182 of the Act, or because of conditions revealed by such application or statement of fact or any report, record or inspection or other means which would warrant the Commission to refuse to grant a license on an original application, or for violation of, or failure to observe any of the terms and provisions of the Act or of any rule, regulation or order of the Commission.

(c) Except in cases of willfulness or those in which the public health, interest or safety requires otherwise, no license shall be modified, suspended or revoked unless, prior to the institution of proceedings therefor, facts or conduct which may warrent such action shall have been called to the attention of the licensee in writing and the licensee shall have been accorded an opportunity to demonstrate or achieve compliance with all lawful requirements.

40 FR 8774

§ 30.62 Right to cause the withholding or recall of byproduct materials.

30 FR 8185

The Commission may cause the withholding or recall of byproduct material from any licensee who is not equipped to observe or fails to observe such safety standards to protect health as may be established by the Commission, or who uses such materials in violation of law or regulation of the Commission, or in a manner other than as disclosed in the application therefor or approved by the Commission.

40 FR 8774

§ 30.63 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 sections 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.

SCHEDULES

§ 30.70 Schedule A—Exempt concentrations.

Element (atomic number)	Isotope	Column I Gas concentration μCi/ml[1]	Column II Liquid and solid concentration μCi/ml[2]
Antimony (51)	Sb 122	-----	3×10^{-4}
	Sb 124	-----	2×10^{-4}
	Sb 125	-----	1×10^{-3}
Argon (18)	A 37	1×10^{-3}	-----
	A 41	4×10^{-7}	-----
Arsenic (33)	As 73	-----	5×10^{-3}
	As 74	-----	5×10^{-4}
	As 76	-----	2×10^{-4}
	As 77	-----	8×10^{-4}
Barium (56)	Ba 131	-----	2×10^{-3}
	Ba 140	-----	3×10^{-4}
Beryllium (4)	Be 7	-----	2×10^{-2}
Bismuth (83)	Bi 206	-----	4×10^{-4}
Bromine (35)	Br 82	4×10^{-7}	3×10^{-3}
Cadmium (48)	Cd 109	-----	2×10^{-3}
	Cd 115m	-----	3×10^{-4}
	Cd 115	-----	3×10^{-4}
Calcium (20)	Ca 45	-----	9×10^{-5}
	Ca 47	-----	5×10^{-4}
Carbon (6)	C 14	1×10^{-6}	8×10^{-3}
Cerium (58)	Ce 141	-----	9×10^{-4}
	Ce 143	-----	4×10^{-4}
	Ce 144	-----	1×10^{-4}
Cesium (55)	Cs 131	-----	2×10^{-2}
	Cs 134m	-----	6×10^{-2}
	Cs 134	-----	9×10^{-5}
Chlorine (17)	Cl 38	9×10^{-7}	4×10^{-3}
Chromium (24)	Cr 51	-----	2×10^{-2}
Cobalt (27)	Co 57	-----	5×10^{-3}
	Co 58	-----	1×10^{-3}
	Co 60	-----	5×10^{-4}
Copper (29)	Cu 64	-----	3×10^{-3}
Dysprosium (66)	Dy 165	-----	4×10^{-3}
	Dy 166	-----	4×10^{-4}
Erbium (68)	Er 169	-----	9×10^{-4}
	Er 171	-----	1×10^{-3}
Europium (63)	Eu 152 (T/2=9.2 Hrs)	-----	6×10^{-4}
	Eu 155	-----	2×10^{-3}
Fluorine (9)	F 18	2×10^{-6}	8×10^{-3}
Gadolinium (64)	Gd 153	-----	2×10^{-3}
	Gd 159	-----	8×10^{-4}
Gallium (31)	Ga 72	-----	4×10^{-4}
Germanium (32)	Ge 71	-----	2×10^{-2}
Gold (79)	Au 196	-----	2×10^{-3}
	Au 198	-----	5×10^{-4}
	Au 199	-----	2×10^{-3}
Hafnium (72)	Hf 181	-----	7×10^{-4}
Hydrogen (1)	H 3	5×10^{-6}	3×10^{-2}
Indium (49)	In 113m	-----	1×10^{-2}
	In 114m	-----	2×10^{-4}
Iodine (53)	I 126	3×10^{-9}	2×10^{-5}
	I 131	3×10^{-9}	2×10^{-5}
	I 132	8×10^{-8}	6×10^{-4}
	I 133	1×10^{-8}	7×10^{-5}
	I 134	2×10^{-7}	1×10^{-3}
Iridium (77)	Ir 190	-----	2×10^{-3}
	Ir 192	-----	4×10^{-4}
	Ir 194	-----	3×10^{-4}
Iron (26)	Fe 55	-----	8×10^{-3}
	Fe 59	-----	6×10^{-4}
Krypton (36)	Kr 85m	1×10^{-6}	-----
	Kr 85	3×10^{-6}	-----
Lanthanum (57)	La 140	-----	2×10^{-4}
Lead (82)	Pb 203	-----	4×10^{-3}
Lutetium (71)	Lu 177	-----	1×10^{-3}
Manganese (25)	Mn 52	-----	3×10^{-4}
	Mn 54	-----	1×10^{-3}
	Mn 56	-----	1×10^{-3}
Mercury (80)	Hg 197m	-----	2×10^{-3}
	Hg 197	-----	3×10^{-3}
	Hg 203	-----	2×10^{-4}
Molybdenum (42)	Mo 99	-----	2×10^{-3}
Neodymium (60)	Nd 147	-----	6×10^{-4}
	Nd 149	-----	3×10^{-3}
Nickel (28)	Ni 65	-----	1×10^{-3}
Niobium (Columbium) (41)	Nb 95	-----	1×10^{-3}
	Nb 97	-----	9×10^{-3}
Osmium (76)	Os 185	-----	7×10^{-4}
	Os 191m	-----	3×10^{-2}
	Os 191	-----	2×10^{-3}
	Os 193	-----	6×10^{-4}
Palladium (46)	Pd 103	-----	3×10^{-3}
	Pd 109	-----	9×10^{-4}
Phosphorus (15)	P 32	-----	2×10^{-4}
Platinum (78)	Pt 191	-----	1×10^{-3}
	Pt 193m	-----	1×10^{-2}
	Pt 197m	-----	1×10^{-2}
	Pt 197	-----	1×10^{-3}
Potassium (19)	K 42	-----	3×10^{-3}
Praseodymium (59)	Pr 142	-----	3×10^{-4}
	Pr 143	-----	5×10^{-4}
Promethium (61)	Pm 147	-----	2×10^{-3}
	Pm 149	-----	4×10^{-4}
Rhenium (75)	Re 183	-----	6×10^{-3}
	Re 186	-----	9×10^{-4}
	Re 188	-----	6×10^{-4}

38 FR 29314

38 FR 29314

[1] Values are given only for those materials normally used as gases.

[2] μCi/gm for solids.

Element (atomic number)	Isotope	Column I Gas concentration μCi/ml[1]	Column II Liquid and solid concentration μCi/ml[2]
Rhodium (45)	Rh 103m	-----	$1X10^{-1}$
	Rh 105	-----	$1X10^{-3}$
Rubidium (37)	Rb 86	-----	$7X10^{-4}$
Ruthenium (44)	Ru 97	-----	$4X10^{-3}$
	Ru 103	-----	$8X10^{-4}$
	Ru 105	-----	$1X10^{-3}$
	Ru 106	-----	$1X10^{-4}$
Samarium (62)	Sm 153	-----	$8X10^{-4}$
Scandium (21)	Sc 46	-----	$4X10^{-4}$
	Sc 47	-----	$9X10^{-4}$
	Sc 48	-----	$3X10^{-4}$
Selenium (34)	Se 75	-----	$3X10^{-3}$
Silicon (14)	Si 31	-----	$9X10^{-3}$
Silver (47)	Ag 105	-----	$1X10^{-3}$
	Ag 110m	-----	$3X10^{-4}$
	Ag 111	-----	$4X10^{-4}$
Sodium (11)	Na 24	-----	$2X10^{-3}$
Strontium (38)	Sr 85	-----	$1X10^{-3}$
	Sr 89	-----	$1X10^{-4}$
	Sr 91	-----	$7X10^{-4}$
	Sr 92	-----	$7X10^{-4}$
Sulfur (16)	S 35	$9X10^{-8}$	$6X10^{-4}$
Tantalum (73)	Ta 182	-----	$4X10^{-4}$
Technetium (43)	Tc 96m	-----	$1X10^{-1}$
	Tc 96	-----	$1X10^{-3}$
Tellurium (52)	Te 125m	-----	$2X10^{-3}$
	Te 127m	-----	$6X10^{-4}$
	Te 127	-----	$3X10^{-3}$
	Te 129m	-----	$3X10^{-4}$
	Te 131m	-----	$6X10^{-4}$
	Te 132	-----	$3X10^{-4}$
Terbium (65)	Tb 160	-----	$4X10^{-4}$
Thallium (81)	Tl 200	-----	$4X10^{-3}$
	Tl 201	-----	$3X10^{-3}$
	Tl 202	-----	$1X10^{-3}$
	Tl 204	-----	$1X10^{-3}$
Thulium (69)	Tm 170	-----	$5X10^{-4}$
	Tm 171	-----	$5X10^{-3}$
Tin (50)	Sn 113	-----	$9X10^{-4}$
	Sn 125	-----	$2X10^{-4}$
Tungsten (Wolfram) (74)	W 181	-----	$4X10^{-3}$
	W 187	-----	$7X10^{-4}$
Vanadium (23)	V 48	-----	$3X10^{-4}$
Xenon (54)	Xe 131m	$4X10^{-6}$	-----
	Xe 133	$3X10^{-6}$	-----
	Xe 135	$1X10^{-6}$	-----
Ytterbium (70)	Yb 175	-----	$1X10^{-3}$
Yttrium (39)	Y 90	-----	$2X10^{-4}$
	Y 91m	-----	$3X10^{-2}$
	Y 91	-----	$3X10^{-4}$
	Y 92	-----	$6X10^{-4}$
	Y 93	-----	$3X10^{-4}$
Zinc (30)	Zn 65	-----	$1X10^{-3}$
	Zn 69m	-----	$7X10^{-4}$
	Zn 69	-----	$2X10^{-2}$
Zirconium (40)	Zr 95	-----	$6X10^{-4}$
	Zr 97	-----	$2X10^{-4}$
Beta and/or gamma emitting byproduct material not listed above with half-life less than 3 years.	----------	$1X10^{-10}$	$1X10^{-6}$

38 FR 29314

[1] Values are given only for those materials normally used as gases.

[2] μCi/gm for solids.

NOTE 1: Many radioisotopes disintegrate into isotopes which are also radioactive. In expressing the concentrations in Schedule A, the activity stated is that of the parent isotope and takes into account the daughters.

NOTE 2: For purposes of § 30.14 where there is involved a combination of isotopes, the limit for the combination should be derived as follows:

Determine for each isotope in the product the ratio between the concentration present in the product and the exempt concentration established in Schedule A for the specific isotope when not in combination. The sum of such ratios may not exceed "1" (i.e., unity).

Example:

$$\frac{\text{Concentration of Isotope A in Product 1}}{\text{Exempt concentration of Isotope A}} + \frac{\text{Concentration of Isotope B in Product}}{\text{Exempt concentration of Isotope B}} < 1$$

38 FR 29314

§ 30.71 Schedule B.

36 FR 16898

Byproduct material	*Microcuries*
Antimony 122 (Sb 122)	100
Antimony 124 (Sb 124)	10
Antimony 125 (Sb 125)	10
Arsenic 73 (As 73)	100
Arsenic 74 (As 74)	10
Arsenic 76 (As 76)	10
Arsenic 77 (As 77)	100
Barium 131 (Ba 131)	10
Barium 133 (Ba 133)	10
Barium 140 (Ba 140)	10
Bismuth 210 (Bi 210)	1
Bromine 82 (Br 82)	10
Cadmium 109 (Cd 109)	10
Cadmium 115m (Cd 115m)	10
Cadmium 115 (Cd 115)	100
Calcium 45 (Ca 45)	10
Calcium 47 (Ca 47)	10
Carbon 14 (C 14)	100
Cerium 141 (Ce 141)	100
Cerium 143 (Ce 143)	100
Cerium 144 (Ce 144)	1
Cesium 131 (Cs 131)	1,000

Byproduct material	Microcuries
Cesium 134m (Cs 134m)	100
Cesium 134 (Cs 134)	1
Cesium 135 (Cs 135)	10
Cesium 136 (Cs 136)	10
Cesium 137 (Cs 137)	10
Chlorine 36 (Cl 36)	10
Chlorine 38 (Cl 38)	10
Chromium 51 (Cr 51)	1,000
Cobalt 58m (Co 58m)	10
Cobalt 58 (Co 58)	10
Cobalt 60 (Co 60)	1
Copper 64 (Cu 64)	100
Dysprosium 165 (Dy 165)	10
Dysprosium 166 (Dy 166)	100
Erbium 169 (Er 169)	100
Erbium 171 (Er 171)	100
Europium 152 9.2h (Eu 152 9.2h)	100
Europium 152 13 yr (Eu 152 13 yr)	1
Europium 154 (Eu 154)	1
Europium 155 (Eu 155)	10
Fluorine 18 (F 18)	1,000
Gadolinium 153 (Gd 153)	10
Gadolinium 159 (Gd 159)	100
Gallium 72 (Ga 72)	10
Germanium 71 (Ge 71)	100
Gold 198 (Au 198)	100
Gold 199 (Au 199)	100
Hafnium 181 (Hf 181)	10
Holmium 166 (Ho 166)	100
Hydrogen 3 (H 3)	1,000
Indium 113m (In 113m)	100
Indium 114m (In 114m)	10
Indium 115m (In 115m)	100
Indium 115 (In 115)	10
Iodine 125 (I 125)	1
Iodine 126 (I 126)	1
Iodine 129 (I 129)	0.1
Iodine 131 (I 131)	1
Iodine 132 (I 132)	10
Iodine 133 (I 133)	1
Iodine 134 (I 134)	10
Iodine 135 (I 135)	10
Iridium 192 (Ir 192)	10
Iridium 194 (Ir 194)	100
Iron 55 (Fe 55)	100
Iron 59 (Fe 59)	10
Krypton 85 (Kr 85)	100
Krypton 87 (Kr 87)	10
Lanthanum 140 (La 140)	10
Lutetium 177 (Lu 177)	100
Manganese 52 (Mn 52)	10
Manganese 54 (Mn 54)	10
Manganese 56 (Mn 56)	10
Mercury 197m (Hg 197m)	100
Mercury 197 (Hg 197)	100
Mercury 203 (Hg 203)	10
Molybdenum 99 (Mo 99)	100
Neodymium 147 (Nd 147)	100
Neodymium 149 (Nd 149)	100
Nickel 59 (Ni 59)	100
Nickel 63 (Ni 63)	10
Nickel 65 (Ni 65)	100
Niobium 93m (Nb 93m)	10
Niobium 95 (Nb 95)	10
Niobium 97 (Nb 97)	10
Osmium 185 (Os 185)	10
Osmium 191m (Os 191m)	100
Osmium 191 (Os 191)	100
Osmium 193 (Os 193)	100
Palladium 103 (Pd 103)	100
Palladium 109 (Pd 109)	100
Phosphorous 32 (P 32)	10
Platinum 191 (Pt 191)	100
Platinum 193m (Pt 193m)	100
Platinum 193 (Pt 193)	100
Platinum 197m (Pt 197m)	100
Platinum 197 (Pt 197)	100
Polonium 210 (Po 210)	0.1
Potassium 42 (K 42)	10
Praseodymium 142 (Pr 142)	100
Praseodymium 143 (Pr 143)	100
Promethium 147 (Pm 147)	10
Promethium 149 (Pm 149)	10
Rhenium 186 (Re 186)	100
Rhenium 188 (Re 188)	100
Rhodium 103m (Rh 103m)	100
Rhodium 105 (Rh 105)	100
Rubidium 86 (Rb 86)	10
Rubidium 87 (Rb 87)	10
Ruthenium 97 (Ru 97)	100
Ruthenium 103 (Ru 103)	10
Ruthenium 105 (Ru 105)	10
Ruthenium 106 (Ru 106)	1
Samarium 151 (Sm 151)	10
Samarium 153 (Sm 153)	100
Scandium 46 (Sc 46)	10
Scandium 47 (Sc 47)	100
Scandium 48 (Sc 48)	10
Selenium 75 (Sc 75)	10
Silicon 31 (Si 31)	100
Silver 105 (Ag 105)	10
Silver 110m (Ag 110m)	1
Silver 111 (Ag 111)	100
Sodium 24 (Na 24)	10
Strontium 85 (Sr 85)	10
Strontium 89 (Sr 89)	1
Strontium 90 (Sr 90)	0.1
Strontium 91 (Sr 91)	10
Strontium 92 (Sr 92)	10
Sulfur 35 (S 35)	100
Tantalum 182 (Ta 182)	10
Technetium 96 (Tc 96)	10
Technetium 97m (Tc 97m)	100
Technetium 97 (Tc 97)	100
Technetium 99m (Tc 99m)	100
Technetium 99 (Tc 99)	10
Tellurium 125m (Te 125m)	10
Tellurium 127m (Te 127m)	10
Tellurium 127 (Te 127)	100
Tellurium 129m (Te 129m)	10
Tellurium 129 (Te 129)	100
Tellurium 131m (Te 131m)	10
Tellurium 132 (Te 132)	10
Terbium 160 (Tb 160)	10
Thallium 200 (Tl 200)	100
Thallium 201 (Tl 201)	100
Thallium 202 (Tl 202)	100
Thallium 204 (Tl 204)	10
Thulium 170 (Tm 170)	10
Thulium 171 (Tm 171)	10
Tin 113 (Sn 113)	10
Tin 125 (Sn 125)	10
Tungsten 181 (W 181)	10
Tungsten 185 (W 185)	10
Tungsten 187 (W 187)	100
Vanadium 48 (V 48)	10
Xenon 131m (Xe 131m)	1,000
Xenon 133 (Xe 133)	100
Xenon 135 (Xe 135)	100
Ytterbium 175 (Yb 175)	100
Yttrium 90 (Y 90)	10
Yttrium 91 (Y 91)	10
Yttrium 92 (Y 92)	100
Yttrium 93 (Y 93)	100
Zinc 65 (Zn 65)	10
Zinc 69m (Zn 69m)	100
Zinc 69 (Zn 69)	1,000
Zirconium 93 (Zr 93)	10
Zirconium 95 (Zr 95)	10
Zirconium 97 (Zr 97)	10
Any byproduct material not listed above other than alpha emitting byproduct material	0.1

[Note removed 49 FR 19623]